Floodplain Modeling Report
Floodplain Mapping of the Merced River in Wawona and El Portal Yosemite National Park, California

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1.0 Introduction

This Floodplain Modeling Report details the methods and results used to delineate the 100-year and 500-year floodplains of two reaches of the Merced River in and near Yosemite National Park, Mariposa County, California. The El Portal Reach study limits extend from approximately 110 meters upstream of the El Portal General store (-119.781˚W 37.675˚N) to the Foresta Bridge (-119.817˚W 37.669˚N) (**Figure 1**). The Wawona reach, located on the South Fork of the Merced River, extends from the lower end of Section 35 (-119.658˚W 37.543˚N) to the lower end of the Wawona Campground (-119.687˚W 37.552˚N) (**Figure 2**). This flood study only includes the 1-, and 0.2-percent annual chance flood events based on peak discharge estimates from the hydrologic analysis.

This study is based on the best available information, including field survey of river cross sections and structures, site investigation, new hydrology developed specifically for this project, interviews with observers of recent flood events, and LiDAR-derived topographic data. The field survey was obtained by PBS&J staff during September and October of 2010. LiDAR data for the El Portal Reach (August, 2006) and Wawona reach (August, 2010) was gathered by the National Center for Airborne Laser Mapping (NCALM) at the University of Houston under a contract directly with the National Park Service.

2.0 Hydrology

Updates to floodplain mapping in the El Portal and Wawona areas of Yosemite National Park required that hydrologic analyses be completed for subject reaches of the Merced River (El Portal) and the South Fork Merced River (Wawona). The purpose of the analyses was to determine appropriate peak discharge values for the 1-percent annual chance (100-year) and 0.2-percent annual chance (500-year) flood events, to be used as input data in the hydraulic (HEC-RAS) models.

The El Portal study reach (**Figure 1**) extends from the public gas station at Old El Portal (upstream end) to the Foresta Road Bridge immediately west of the NPS maintenance facility (downstream end), a distance of about 3 river miles (4.8 kilometers). The Wawona study reach (**Figure 2**) extends from the lower end of Section 35 to the lower end of the Wawona Campground, a distance of about 3 river miles (4.8 kilometers).

Hydrologic analyses were performed following procedures recommended in Bulletin 17B of the Interagency Advisory Committee on Water Data (USGS, 1982). The PEAKFQ computer program (Flynn et. al., 2006) was used to complete flood-frequency analyses of existing stream gage data for both study reaches. PEAKFQ performs flood-frequency analysis based on the guidelines delineated in Bulletin 17B.

Figure 1. El Portal Study Reach

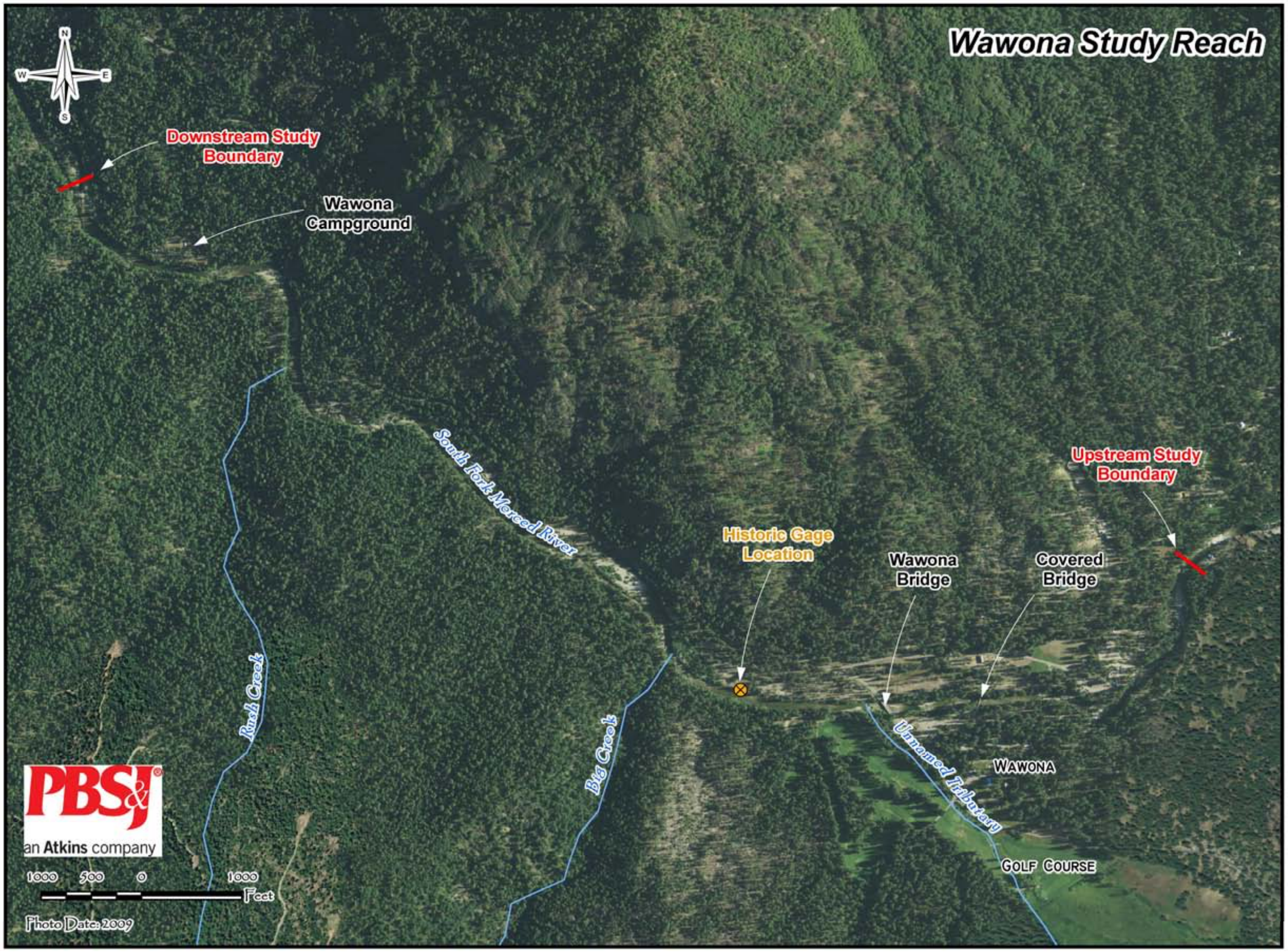

Figure 2. Wawona Study Reach

PEAKFQ uses the method of moments to fit the Pearson Type III distribution to the logarithms of annual flood peaks. The skew that is used may be a user-developed generalized skew for a region from the Bulletin 17B skew map, computed from the data, or weighted between the generalized skew and station skew computed from the data. For this study, skew values were taken from the Bulletin 17B skew map. Adjustments can also be made for high and low outliers and historic information.

2.1 Merced River – El Portal Area

There are no existing stream gages located within the El Portal study reach. The closest stream gages to the study reach are located approximately 8.5 (Pohono Bridge) and 17.5 (Happy Isles) river miles (13.7 and 28.2 kilometers) upstream of the El Portal reach. Both gages are maintained by the USGS and have long periods of record (Pohono Bridge – 93 years, Happy Isles – 94 years). Streamflow data for each of these gaged sites can be found at the respective USGS websites (USGS, #11266500 Pohono Bridge) and (USGS, #11264500 Happy Isles).

Two commonly used methods to determine streamflow values at an ungaged location include: 1) application of regression equations that relate flows to basin characteristics, and 2) use of a drainage area-ratio adjustment for existing flow data in the same drainage basin. Statewide flood frequency regression equations for California were last updated in 1977, and do not accurately account for extreme precipitation events that have occurred in the last 30 years (Charles Parrett, personal comm.). Updated regression equations to estimate flood frequency in California are currently being developed, however they are not available yet for public use (Parrett, personal comm.). Therefore, the drainage area-ratio method was used to determine flood flows for the El Portal reach.

The drainage area-ratio method (Parrett and Johnson, 2004) assumes that peak flows at the ungaged site are equivalent per unit area to the peak flows at the gaged site. The method is most effective at estimating peak flows for locations on the same stream or within the same drainage basin as the gaging station(s). The drainage area-ratio method should only be used when the ratio of drainage areas between the ungaged and gaged sites is within a range of 0.5 to 1.5, otherwise the results may not be reliable. The following equation is used to calculate flows at the ungaged site:

$Q_{T,u} = Q_{T,g} * (DA_u / DA_g)^{expT}$, where

$Q_{T,u}$ = T-year peak discharge at the ungaged site (e.g., for the 100-yr, or 1% annual chance flood, T = 100)
$Q_{T,g}$ = T-year peak discharge at the gaged site
DA_u = drainage area at the ungaged site
DA_g = drainage area at the gaged site, and
exp T = regression coefficient for a simple ordinary least squares (OLS) regression relating the log of T-year flood to the log of drainage area

Determination of values for the regression coefficient was completed using the equation above and applying discharge values and drainage area data at the Pohono and Happy Isles gages. **Appendix A** provides the flood frequency data from the Pohono and Happy Isles gages (via

PEAKFQ), as well as the drainage area-ratio calculations used to determine flood frequency values for the El Portal study reach. The resulting flow values to be used for the El Portal reach are provided in **Table 1**.

Table 1 - ***Hydrologic Analysis Results for Merced River at Foresta Road (El Portal Area).***

Annual Peak Discharge		
Recurrence Interval	**Cubic Meters/Second**	**Cubic Feet/Second**
2-Year	176.3	6226.0
5-Year	276.9	9778.6
10-Year	385	13596.1
25-Year	561.4	19825.7
50-Year	727.4	25687.9
100-Year	927.7	32761.4
200-Year	1169	41282.8
500-Year	1564.2	55239.2

2.2 South Fork Merced River – Wawona Area

There is currently no operating stream gage on the South Fork Merced River within the Wawona area. However, the USGS did operate a stream gage on the South Fork at Wawona between 1959 and 1975. In absence of other stream gage data, and lacking updated regression equations, it was decided to use the historic gage data. The PEAKFQ program was used to determine peak discharge values based on the historic gage record. In addition to the 16 year period of annual peak flows, an historic peak flow value from 1956 (15,000 cfs, 424.8 cms) was also included in the frequency analysis. **Appendix B** provides the output report from the PEAKFQ run. The resulting flow values to be used for the upper portion of the Wawona reach are provided in **Table 2**.

Table 2 - ***Hydrologic Analysis Results for South Fork Merced River (Wawona Area).***[1]

Annual Peak Discharge		
Recurrence Interval	**Cubic Meters/Second**	**Cubic Feet/Second**
2-Year	69.8	2465.0
5-Year	138.3	4884.0
10-Year	203.8	7197.1
25-Year	315.2	11131.2
50-Year	423.1	14941.6
100-Year	556.5	19652.6
200-Year	720.5	25444.2
500-Year	994.3	35113.4

[1] Flow values shown in this table are used ONLY for the upper portion of the Wawona reach.

Two tributaries, Big Creek and Rush Creek, enter the South Fork Merced River between the historic gage location and the lower limit of the study reach (**Figure 2**). Therefore, the flow values provided in **Table 2** do not capture flows entering the South Fork from these two tributaries. The WinTR-55 Small Watershed Hydrology computer model was utilized to develop flows for each of these tributaries. WinTR-55 is a single event rainfall-runoff model, applicable for use in determining peak discharges and total runoff volumes from watershed areas of 25 square miles (6,500 hectares) or less.

USGS topographic maps (1:24,000 scale) were used to delineate the contributing drainage areas for each tributary. The Big Creek drainage area was calculated at 30.75 $mi.^2$ (7,966 hectares) and the Rush Creek drainage was calculated at 5.80 $mi.^2$ (1,503 hectares). Given a maximum drainage area of 25 $mi.^2$ for input to the WinTR-55 model, the Big Creek drainage was modeled using an area of 25 $mi.^2$; calculated flow values were then increased based on a simple drainage area ratio (30.75 $mi.^2$/25 $mi.^2$ = 1.23). Application of a drainage area ratio was determined to be a reasonable means of estimating hydrology for Big Creek primarily because the time of concentration did not increase appreciably with the additional drainage area.

Runoff curve numbers (CN), which are used in the model to predict infiltration and runoff for a given precipitation amount (depth), were determined based on land use and vegetation types as well as the hydrologic soil group (A through D). **Appendix C** provides a summary of the input/output to the WinTR-55 model for each drainage area (Big Creek and Rush Creek), including precipitation depths for the modeled storm events, and hydrologic soil group classifications for the watershed areas.

Floodplain mapping within the Wawona area also included a short segment of an unnamed tributary that flows through the golf course and joins the mainstem South Fork Merced River just west of the Highway 41 Bridge. Flow values for this tributary were also developed using the WinTR-55 model. The contributing drainage area for the tributary reach was calculated to be 2,798 acres (1132.1 hectares). **Appendix C** provides a summary of the input/output to the WinTR-55 model including precipitation depths for the modeled storm event, and hydrologic soil group classifications for the drainage area.

Table 3 provides the flow values for the Big Creek and Rush Creek tributaries, as well as the unnamed tributary through the golf course. Flow values for the 500-year recurrence interval are extrapolated from the calculated flow values for each tributary.

Table 3 - ***Hydrologic Analysis Results for Big Creek, Rush Creek, and Unnamed Wawona Reach Tributary (Wawona area).***

Annual Peak Discharge						
	Big Creek[1]		Rush Creek		Unnamed Wawona Reach Tributary	
Recurrence Interval	CMS	CFS	CMS	CFS	CMS	CFS
2-Year	13.4	474.6	5.9	209.1	2.3	80.9
5-Year	50.9	1797.2	18.8	664.6	8.0	283.2
10-Year	73.1	2581.5	23.4	825.3	13.5	477.5
25-Year	125.3	4425.3	38.1	1344.1	24.0	846.8
50-Year	172.6	6096.7	52.3	1848.0	36.6	1293.9
100-Year	197.7	6982.1	57.6	2034.1	46.0	1623.1
500-Year[2]	276.0	9747.6	80.3	2837.2	64.1	2263.4

[1] Flows shown for Big Creek reflect application of a drainage area ratio multiplier (1.23).
[2] Flows shown for the 500-year recurrence interval represent extrapolated values.

3.0 Hydraulics

HEC-GeoRAS (United States Army Corps of Engineers (USACE), 2008) was used to initiate the hydraulic model setup for both study reaches. The water surface elevations that were used in the floodplain mapping were determined using HEC-RAS, Version 4.0.0 (USACE, 2008), a one-dimensional flow modeling program. Hydraulic model input data and parameters are discussed in the following paragraphs.

3.1 Channel Geometry - Field Survey

A PBS&J field crew collected field survey data used to create the channel geometry. The survey data was captured in UTM Zone 11N NAD 1983 and the vertical datum is based on NAVD 1988 elevations. Cross sections locations were selected by a PBS&J Geomorphologist in September 2010. A total of 35 cross sections were surveyed on the El Portal reach and 42 on the Wawona reach. All of the surveyed cross sections were used in the hydraulic analysis.

3.2 Overbank Geometry - Topographic Data

For the overbank geometry a Triangulated Integrated Network (TIN) was developed using topographic LiDAR data provided by NCALM at the University of Houston. The TIN accompanied with HEC-GeoRAS was used to extract cross sections, stream length, and overbank floodplain flow lengths.

3.3 Final HEC-RAS Cross Sections

Final HEC-RAS cross sections were created using the field survey data and the LiDAR topographic data. The field survey cross sections were created by exporting the field points along the cut line from AutoCAD (Autodesk, Inc. 2009) into Excel. The LiDAR cross sections were cut using HEC-GeoRAS in ArcGIS. The geometric data from HEC-GeoRAS was then directly imported into HEC-RAS for hydraulic modeling.

3.4 Flow Resistance or Roughness

Manning's *n* values for the HEC-RAS model were determined by field reconnaissance and engineering judgment. A PBS&J geomorphologist walked the channels of both reaches and estimated roughness values for every surveyed cross section. The HEC-RAS User's Manual (USACE, 2008), "Roughness Characteristics of Natural Channels" (Barnes 1967), and "Open Channel Hydraulics", (Chow 1959) provided tables of roughness coefficients for different surfaces. The investigation determined for the El Portal Reach that a value of 0.050 to 0.070 was acceptable for the overbank value and 0.049 to 0.055 was appropriate for the channel values along most of the project reach. The Wawona reach roughness values ranged from 0.060 to 0.075 for the overbank areas and 0.055 to 0.060 for the channel bed. A sensitivity analysis of varying Manning's *n* values was also completed to further ensure appropriate values were used (see **Section 3.8**).

3.5 Hydraulic Structures

There were four hydraulic structures modeled, two on the El Portal reach and two on the Wawona reach. All four structures are bridges. From downstream to upstream, the structures on the El Portal reach are Highway 140 Bridge (Sta.3174.88) and Foresta Bridge (Sta. 97.65). The Wawona reach structures include the Covered Bridge (Sta.3608.69) and the Wawona Bridge (Sta.3322.8). Survey crews captured structure geometry and this was used in combination with field notes and photographs to provide model inputs.

3.6 Boundary Conditions

The HEC-RAS models were executed under the assumption of subcritical flow. Normal depth was the chosen downstream boundary condition. Normal depth computations are based on energy slope which was approximated by channel slope of the downstream reach as determined from topographic data. Two calibration cross sections were placed downstream of the limit of the study to further ensure accuracy of the downstream boundary condition used for the model.

3.7 Ineffective Flow Areas

Ineffective flow areas are areas of the channel that contain water which is not actively conveyed. Ineffective flow areas were added to the model cross sections located just upstream and downstream of each hydraulic structure per the *HEC-RAS Hydraulic Reference Manual* (USACE, 2008). Ineffective flow areas were also added in overbank areas that are acting as storage, with no conveyance of flow.

3.8 Sensitivity Analysis

The El Portal reach of the Merced River has a high gradient and a coarse bed of boulders and cobbles. The flow resistance is very high in this type of channel. The flow depth in an open channel is directly proportional to the roughness; the greater the roughness, the greater the flow depth. It was difficult to estimate flow resistance through the El Portal reach and there was some uncertainty in the final values. To address this uncertainty and to increase our confidence in the model results we used a previous flood event to "check" or confirm our final roughness values. The flood event of 1997 was a 25 to 50 year event in the El Portal reach and provided a good opportunity to check model assumptions. During the 1997 event several NPS staff made observations of and photographed the flooding extent and water surface elevations relative to landmarks. The most useful of these observations was made at the Highway 140 Bridge (**Figure 1**). NPS staff reported in personal communications that the water surface elevation of the Merced River, several hours before the peak flow, was equal to the Highway 140 bridge deck and that floodwaters were just starting to crest the bridge. Several photographs confirmed these observations. To check the model we ran the estimated flood discharge from the 1997 event and compared the modeled water surface elevation to the observed and found that they were in good agreement. In addition to comparisons to known water surface elevations several model runs were completed with adjusted roughness values to determine how sensitive the water surface elevation was to different values. While the model did respond to changes in roughness values the change in water surface elevation was very small.

3.9 Areas of Interest

El Portal Reach, Gas Station Levee

For a short reach starting approximately 300 meters downstream of the El Portal General Store and running downstream for roughly 200 meters there is a stone levee between Highway 140 and the Merced River (**Figure 1**). The levee is constructed of loose rocks and ranges in height from 0.5 to 1.3 meters (**Photo 1**). The levee is porous, with large gaps between the stacked rocks and will not restrict floodwaters. For this reason the levee was removed from the model and adjacent ground elevations were used as model geometry inputs.

Photo 1 - *Gas Station Levee*

El Portal Reach, Trailer Court area – Split flow analysis overview

The El Portal hydraulic analysis determined that a split flow occurs directly upstream of the Highway 140 Bridge. Split flow occurs when two major flow directions are indentified. The Merced River and the split flow side channel required two separate HEC-RAS study reaches to accurately model the 1-percent annual chance flood event.

The water surface elevation on the upstream side of the Highway 140 Bridge overtops the left bank and flows west along Highway 140 during the 1-percent annual chance flood event. The flow along Highway 140 is initially contained in a borrow ditch. As the flow progresses to the west it eventually overtops Highway 140 and enters a field to the north. From this point, flood flows meander through low lying areas and run westerly back towards the Merced River Please refer to **(Figure 3).**

A lateral weir was inserted into the hydraulic model upstream of the Highway 140 Bridge to quantify the amount of water leaving the main Merced River and entering the side channel. The lateral weir is for modeling purposes only and is not a physical feature found on the landscape. It is a tool used to approximate the amount of flow that can leave a channel based on the height of water above the ground profile. A more detailed explanation of the lateral weir and its computations can be found in section **Split Flow Analysis - Lateral Weir (Sta. 32+08).**

Overall, the split flow reach is approximately 900 meters long and contains 26.78 cms (946 cfs) flood flow during the 1-percent annual chance event, around 3% of the total flow volume.

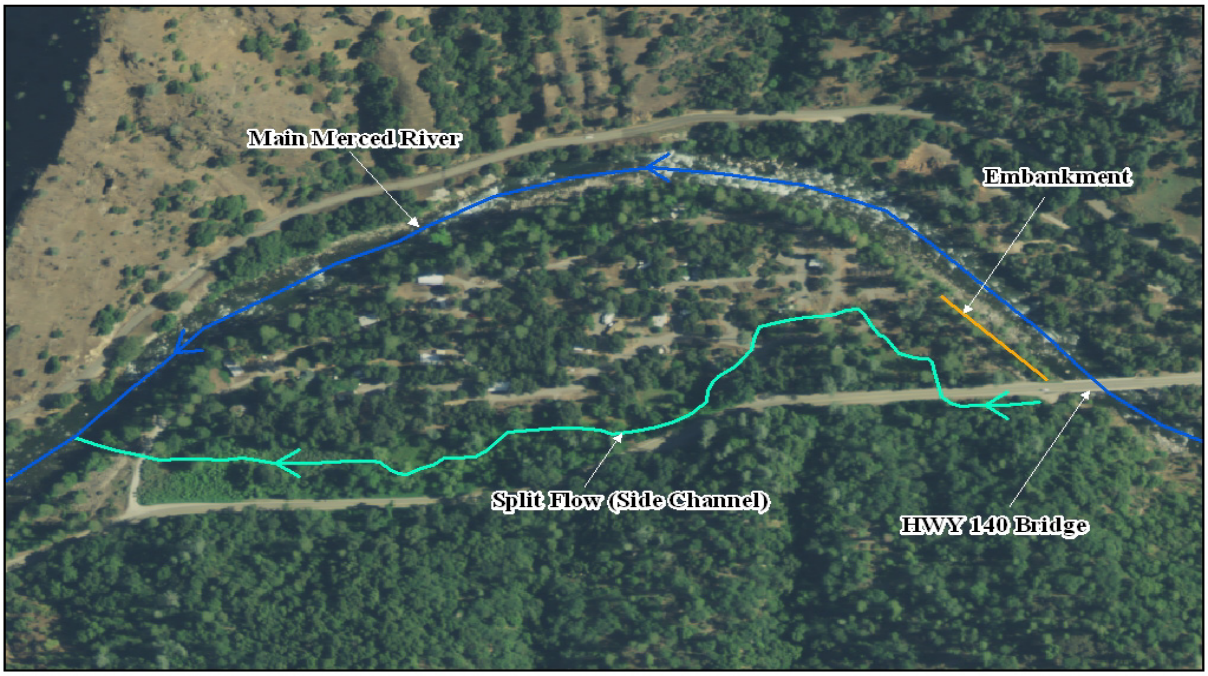

Figure 3 – Split flow path during the 1-percent Annual Chance Event

Split Flow Analysis - Lateral Weir (Sta. 32+08):

A lateral weir was used to quantify the amount of flow leaving the main Merced River and entering the side channel during the 1-percent annual chance flood event. Two bounding cross sections were used for the split flow analysis. These cross sections are Sta. 31+86 and Sta. 32+08. The lateral weir is placed between these two cross sections in HEC-RAS and the maximum left overbank elevation is used for the bounding weir elevation. Using available LiDAR data, the maximum river left overbank elevations were used as boundary conditions in the embankment editor for the lateral weir. The maximum left overbank elevations for Sta.31+86 and Sta. 32+08 are 559.73 m and 559.63 m, respectively. **Figure 4** is profile plot of river station 32+08, which illustrates the uncontained water overtopping the left bank.

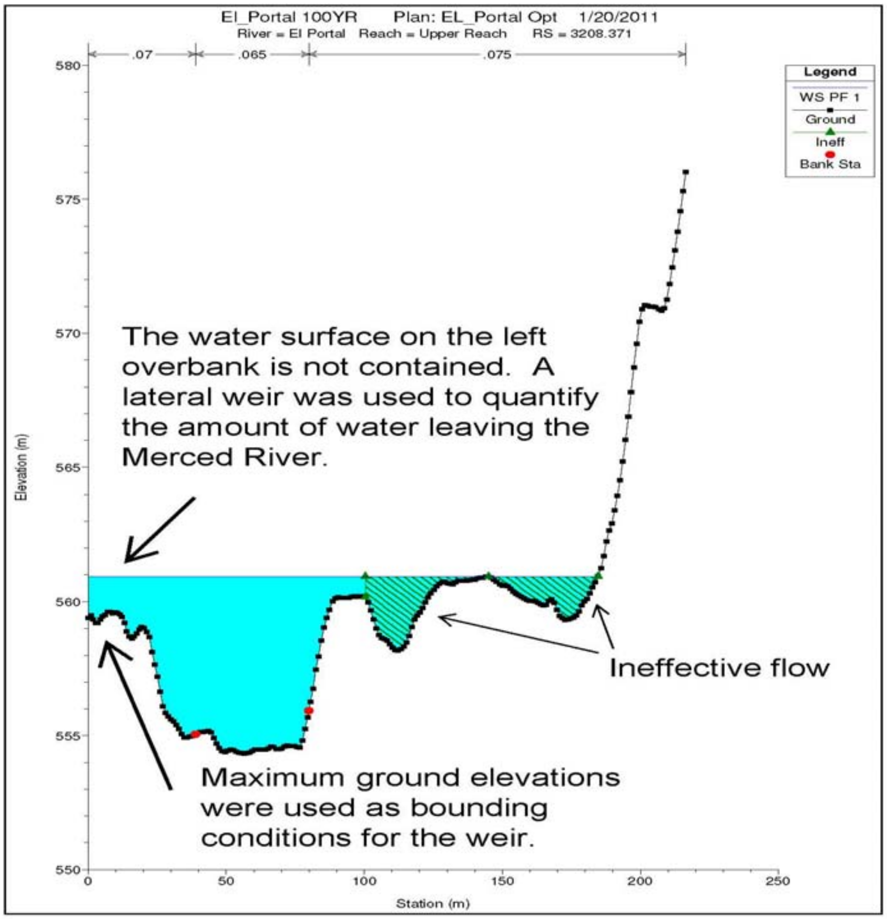

Figure 4 - HEC-RAS Profile Plot of Cross Section 32+08

In HEC-RAS, the lateral weir optimization uses a split flow algorithm to balance flows between two channels to solve a looped or diverging network. The lateral weir only activates when the water surface in the main Merced River overtops the left overbank. In HEC-RAS, the lateral weir extends from Sta. 31+86 to Sta. 32+08 and is graphically displayed on the left overbank in the geometric data editor. All hydraulic parameters associated with the lateral weir are set at HEC-RAS defaults.

The values in **Table 4** were obtained from the lateral structures output table in the El Portal hydraulic model. The values obtained from the lateral weir were used in the 1-percent annual chance hydraulic analysis.

Table 4: ***Lateral Weir Analysis Results for El Portal Hydraulic Analysis, Merced River.***

Flooding Source and Location	Peak Discharge 1% Annual Chance		Flow Direction	Flow Destination
	cms	cfs		
El Portal - Merced River - Lateral Weir Sta. 32+08	26.8	945.7	Q Leaving	Merced River split flow channel flowing west
Sta. 32+08 to Sta. 31+86	900.9	31815.7	Q Downstream	Merced River flow continues towards north under Hwy. 140 Bridge

Note: In the El Portal hydraulic model a lateral weir calculated the amount of flow leaving the main channel.
The lateral weir tolerance in the El Portal hydraulic model is set to .001 ft due to processing considerations. The final values calculated by the algorithm may be off by <1% of the total event flow. Due to the tolerance settings the Q leaving has been adjusted by 0.02 cms. This does not affect the overall outcome of the hydraulic analysis. Values in **Table 5** are carried out to the hundredths place for accuracy.

Split Flow Analysis – Cross Sections

LiDAR topographic data was used to create a Triangulated Irregular Network (TIN). A TIN is representative ground surface in which cross sections can be created using HEC-GeoRAS. Hec-GeoRAS is used to export cross sections from the TIN directly into HEC-RAS. In the model no interpolated cross sections are used. In the side channel, cross sections are spaced in 15 meter intervals. The 15 meter cross section interval is adequate at capturing topographic breaks and placement of the side channel stream centerline.

Split Flow Analysis – Ineffective flow

HEC-RAS allows the users to place ineffective flow throughout a cross section. When an area in a cross section is declared ineffective, that area is removed from the conveyance calculation and the general result is an increase in water surface elevation. In some cases, however, a substantial increase in velocity with a lower water surface elevation is observed. Placement of ineffective flow for the 1-percent annual chance split flow analysis is explained below.

1-percent annual chance split flow analysis. Ineffective flow was placed on the south side of Highway 140 and in areas that showed lacking hydraulic conveyance. Site photos, aerial imagery, and engineering judgment determined the placement of ineffective flow.

HEC-RAS Models: 1-percent vs. 0.2-percent annual chance

The hydraulic analysis of the El Portal reach determined that two separate hydraulic models would be needed to accurately model the 1-percent and 0.2-percent annual chance flood events (**Figures 5, and 6**). The 1-percent and 0.2-percent annual chance events are explained in greater detail below.

The hydraulic analysis for 1-percent annual chance flood event on the main Merced River determined that backwater is created on the upstream side of the Highway 140 Bridge. The backwater created by the bridge allows flow to leave the main channel and travel west along

Highway 140. A side channel HEC-RAS model was created to accurately model the flow leaving the main Merced River. A lateral weir, which is a tool in HEC-RAS, was used to quantify the amount of flow leaving the main channel. The separate hydraulic analysis for the side channel established that once flow leaves the main Merced River on the upstream side of the Highway 140 Bridge it becomes hydraulically isolated from the main channel. The isolation of flow is due to a large embankment on the downstream side of the Highway 140 Bridge (**Figure 1**). The embankment is approximately 100 meters long and located on the left bank of the Merced River. The intended use for the embankment was to keep flood flows from the main Merced River from entering the side channel. Although this was the intended idea, the embankment does not prevent flood waters that enter the side channel upstream of the Highway 140 Bridge.

The current configuration of the embankment does prevent additional flood waters from the Merced River to enter the side channel downstream of the bridge. If the embankment were to fail additional flow would be added to the side channel **(Figure 5).**

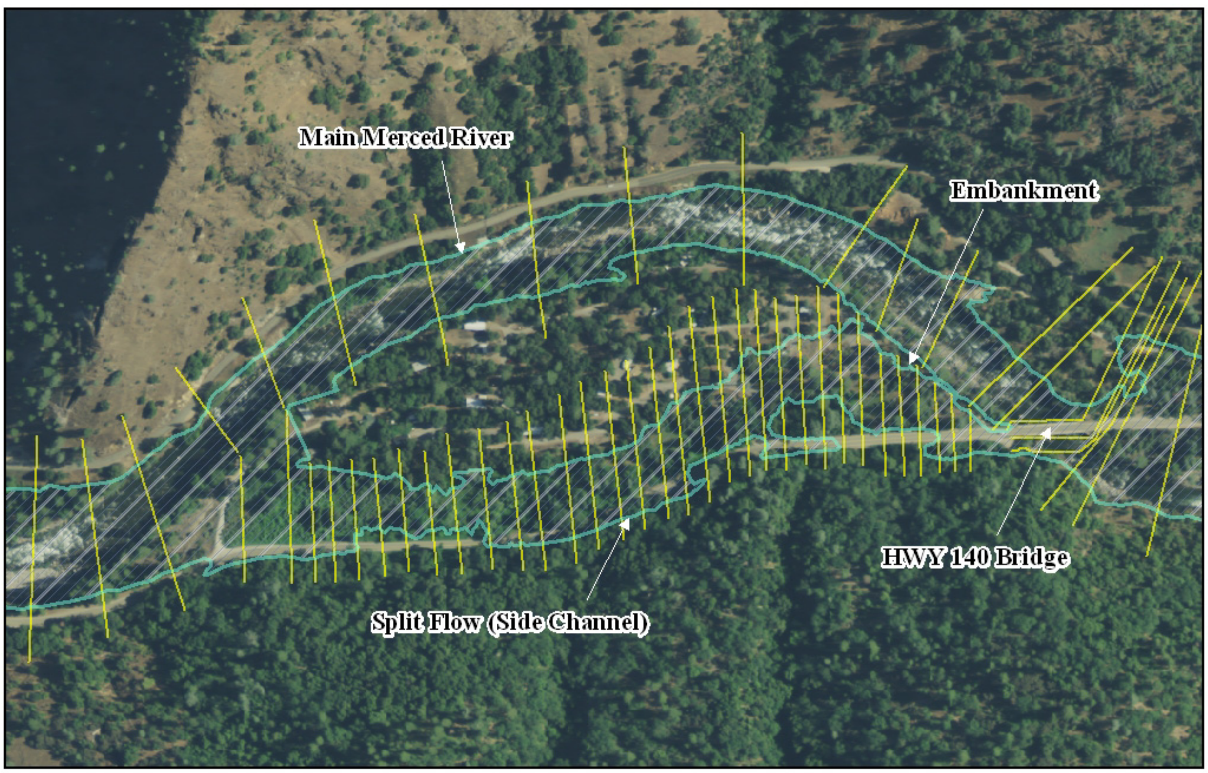

Figure 5 - Floodplain and Cross Sections during the 1-percent Annual Chance Flood Event.

The hydraulic analysis for the 0.2-percent annual chance flood event on the main Merced River determined that the river overtops both the left bank on the upstream side, and the embankment on the downstream side. Initial attempts in HEC-RAS at placing a lateral weir across such a large area were deemed inaccurate. Instead, cross sections in the main channel were extended to the south to capture the side channel. The channel bed elevations between the main channel and the side channel are different. The bed elevations in the side channel are higher. The higher bed elevations in the side channel create a perched stream. HEC-RAS conveyance calculations use channel slope, effective flow, roughness, etc. For modeling and conservative purposes ineffective flow was placed in the side channel. This assured that the main channel was filled to capacity and that the side channel did not take effective flow away from the main channel. The final HEC-RAS result is the most realistic flood situation between the two channels. The embankment on the downstream side of the Highway 140 Bridge has no effect on flooding (**Figure 6)**.

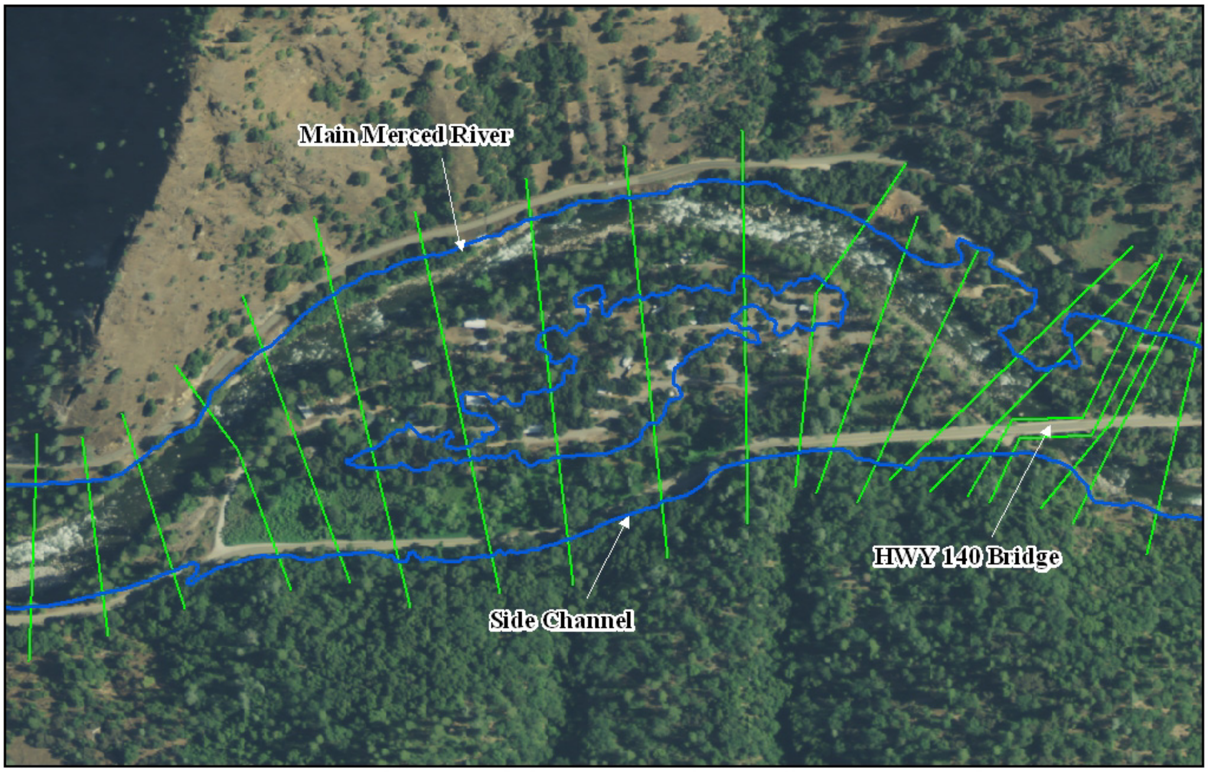

Figure 6 - Floodplain and Cross Sections during the 0.2-percent Annual Chance Flood Event

4.0 Floodplain Mapping

ArcMap (ESRI, 2009) software was used to create the floodplain maps. The base map for this document is an aerial photograph (USDA, 2009). The maps include the HEC-RAS cross section locations (with stationing), the 1 and 0.2-percent annual chance floodplain boundaries, hydraulic structures and major landmarks.

The detailed floodplain boundary on the map was plotted using LiDAR data and HEC-GeoRAS. Floodplain maps have been included with this report submittal as separate documents.

5.0 References

A list of the reference documents used in the development of this study follows:

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U.S. Geological Survey, National Water Information System: USGS 11267300 South Fork Merced River at Wawona, CA. http://waterdata.usgs.gov/ca/nwis/inventory/?site_no=11267300&agency_cd=USGS&amp

U.S. Geological Survey Peak Streamflow Gage Data: USGS 11264500 Merced River at Happy Isles Bridge near Yosemite, CA. http://nwis.waterdata.usgs.gov/ca/nwis/peak/?site_no=11264500&agency_cd=USGS

U.S. Geological Survey Peak Streamflow Gage Data: USGS 11266500 Merced River at Pohono Bridge near Yosemite, CA. http://nwis.waterdata.usgs.gov/ca/nwis/peak/?site_no=11266500&agency_cd=USGS

Appendix A

Flood Frequency Data

Pages A-2 and A-3 include modeled flood frequency data for the USGS stream gages at Happy Isles (Gage #11264500) and Pohono Bridge (Gage #11266500). The PEAKFQ program (USGS) was used to perform the flood-frequency analysis based on guidelines delineated in Bulletin 17B.

Resulting flow estimates for the 1.005-year (0.995 annual exceedance probability) to the 500-year (0.002 annual exceedance probability) flood events are shown in the second column of the model output data (under "Bull.17B Estimate"). Note is made that only the 100-year (0.01 annual exceedance probability) and 500-year (0.002 annual exceedance probability) flows were used for floodplain mapping purposes.

Page A-4 provides the calculations used to apply the drainage area ratio method to determine flood flows for the Merced River at Foresta Road based on the flood frequency data for the gaged site at Pohono Bridge. The boxed flow values shown at the bottom of page A-4 are the flow values used for the Merced River-El Portal Reach hydraulic model (these values are provided in Table 1 within the report text).

Station - 1126450 MERCED R A HAPPY ISL ES BRIDGE NR YOSEMITE CA

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1	3.4435	0.2158	0.415
BULL.17B ESTIMATE	0.0	1	3.4435	0.2158	0.36

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY ESTIMATE	95-PCT CONFIDENCE LIMITS ' FOR BULL. 17B ESTIMATES LOWER	UPPER
0.995	912.9	936.4	891.4	764.9	1054
0.99	997.8	1018	978.6	844.8	1144
0.95	1294	1305	1281	1128	1452
0.9	1502	1508	1491	1328	1667
0.8	1816	1815	1809	1634	1994
0.6667	2191	2183	2187	1996	2388
0.5	2695	2683	2695	2474	2933
0.4292	2946	2933	2948	2708	3211
0.2	4171	4163	4190	3803	4631
0.1	5333	5343	5383	4792	6051
0.04	7024	7082	7148	6179	8206
0.02	8454	8571	8671	7319	10090
0.01	10040	10230	10390	8556	12230
0.005	11800	12100	12340	9903	14670
0.002	14430	14910	15330	11880	18400

Station - 112665 00 MERCED R A POHONO B RIDGE NR YOSEMITE CA

ANNUAL FREQUENCY CURVE PARAME TERS -- LOG-PEARSON TYP III

	FLOOD	BASE	LOGARITHMIC		
	----------	------------	----------------------		---------
		EXCEEDANCE	STANDARD		
	DISCHARGE	PROBABILITY	MEAN	DEVIATION	SKEW
	----------	------------	------------------------		---------
SYSTEMATIC RECOR D	0.0	1	3.6806	0.2574	0.622
BULL.17B ESTIMAT E	0.0	1	3.6806	0.2574	0.511

ANNUAL FREQUE NCY CURVE - #NAME? AT SELECTED EXCEEDANCI PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CON FOR BULL. LOWER	FIDENCE LIMITS 17B ESTIMATES UPPER
0.995	1382	1468	1349.0	1129.0	1631
0.99	1512	1588	1482.0	1248.0	1770
0.95	1985	2029	1963.0	1688.0	2273
0.9	2334	2358	2316.0	2017.0	2642
0.8	2885	2884	2873.0	2541.0	3227
0.6667	3576	3550	3569.0	3195.0	3966
0.5	4558	4509	4558.0	4113.0	5044
0.4292	5068	5012	5072.0	4580.0	5618
0.2	7735	7690	7779.0	6926.0	8764
0.1	10510	10540	10630.0	9237.0	12230
0.04	14900	15190	15240.0	12750.0	18020
0.02	18920	19530	19560.0	15850.0	23520
0.01	23660	24770	24760.0	19420.0	30240
0.005	29250	31060	31060.0	23520.0	38390
0.002	38180	41370	41440.0	29920.0	51850

Merced River at Foresta Rd

USGS Regression Equations

Gage Transfer

$Q_{T,U}=Q_{T,G}(DA_U/DA_G)^{expT}$

$Q_{T,U}$=The T year flood at the ungaged site (cfs)

$Q_{T,G}$=The T year flood at the gaged site (cfs)

DA_U=Drainage area at the ungaged site (mi^2)

DA_G=Drainage area at the gaged site (mi^2)

^{expT}=regression coefficient deveopled using two USGS gauging station sites on the Merced River

Equation for Southwest Region

$Q_{2,U}=Q_{T,G}(DA_U/DA_G)^{0.947}$

$Q_{5,U}=Q_{T,G}(DA_U/DA_G)^{1.078}$

$Q_{10,U}=Q_{T,G}(DA_U/DA_G)^{1.184}$

$Q_{25,U}=Q_{T,G}(DA_U/DA_G)^{1.313}$

$Q_{50,U}=Q_{T,G}(DA_U/DA_G)^{1.406}$

$Q_{100,U}=Q_{T,G}(DA_U/DA_G)^{1.496}$

$Q_{200,U}=Q_{T,G}(DA_U/DA_G)^{1.584}$

$Q_{500,U}=Q_{T,G}(DA_U/DA_G)^{1.698}$

Region =	Merced Watershed Region, using Pohona USGS station and Happy Isles USGS station to determine expT	
DA_U=	399	mi^2
DA_G=	321	mi^2
DA_U/DA_G=	1.242991	Ratio should be between 0.5 and 1.5 otherwise this method is unreliable

Gaging Station	Station - 112665 Merced River NR Pohona Bridge	
$Q_{2,G}$=	5068	cfs
$Q_{5,G}$=	7735	cfs
$Q_{10,G}$=	10510	cfs
$Q_{25,G}$=	14900	cfs
$Q_{50,G}$=	18920	cfs
$Q_{100,G}$=	23660	cfs
$Q_{200,G}$=	29250	cfs
$Q_{500,G}$=	38180	cfs

$Q_{2,U}$=	6227	cfs
$Q_{5,U}$=	9779	cfs
$Q_{10,U}$=	13597	cfs
$Q_{25,U}$=	19825	cfs
$Q_{50,U}$=	25689	cfs
$Q_{100,U}$=	32760	cfs
$Q_{200,U}$=	41282	cfs
$Q_{500,U}$=	55239	cfs

$Q_{2,U}$=	176.3	m^3/s
$Q_{5,U}$=	276.9	m^3/s
$Q_{10,U}$=	385.0	m^3/s
$Q_{25,U}$=	561.4	m^3/s
$Q_{50,U}$=	727.4	m^3/s
$Q_{100,U}$=	927.7	m^3/s
$Q_{200,U}$=	1169.0	m^3/s
$Q_{500,U}$=	1564.2	m^3/s

Appendix B

Output Report from the PEAKFQ Run for Historic South Fork Merced River at Wawona (USGS) Stream Gage

Pages B-2 through B-4 include modeled flood frequency data for the historic USGS stream gage located on the South Fork of the Merced River near Wawona. The PEAKFQ program (USGS) was used to perform a flood-frequency analysis of the gage data based on guidelines delineated in Bulletin 17B.

Resulting flow estimates for the 1.005-year (0.995 annual exceedance probability) to the 500-year (0.002 annual exceedance probability) flood events are shown in the second column of the model output data (under "Bull.17B Estimate") on page B-3. Note is made that only the 100-year (0.01 annual exceedance probability) and 500-year (0.002 annual exceedance probability) flows were used for floodplain mapping purposes.

```
                              PEAKWAWONA.PRT.txt
1
  Program PeakFq          U. S. GEOLOGICAL SURVEY                 Seq.000.000
  Ver. 5.2               Annual peak flow frequency analysis      Run Date / Time
  11/01/2007             following Bulletin 17-B Guidelines       10/20/2010 11:41

                            --- PROCESSING OPTIONS ---

                         Plot option           = Graphics device
                         Basin char output     = None
                         Print option          = Yes
                         Debug print           = No
                         Input peaks listing = Long
                         Input peaks format   = WATSTORE peak file

                         Input files used:
                            peaks (ascii)   - C:\DOCUMENTS AND
SETTINGS\22474\DESKTOP\PEAKFQ_WAWONA\PEAKWAWONA.TXT
                            specifications - PKFQWPSF.TMP

                         Output file(s):
                            main - C:\DOCUMENTS AND
SETTINGS\22474\DESKTOP\PEAKFQ_WAWONA\PEAKWAWONA.PRT

1


  Program PeakFq          U. S. GEOLOGICAL SURVEY                 Seq.001.001
  Ver. 5.2               Annual peak flow frequency analysis      Run Date / Time
  11/01/2007             following Bulletin 17-B Guidelines       10/20/2010 11:41

                     Station - 11267300  SF MERCED R A WAWONA CA

                        I N P U T   D A T A   S U M M A R Y

                   Number of peaks in record              =        17
                   Peaks not used in analysis             =         0
                   Systematic peaks in analysis           =        16
                   Historic peaks in analysis             =         1
                   Years of historic record               =        25
                   Generalized skew                       =     0.131
                        Standard error                    =     0.550
                        Mean Square error                 =     0.303
                   Skew option                            =    WEIGHTED
                   Gage base discharge                    =       0.0
                   User supplied high outlier threshold =    --
                   User supplied low outlier criterion  =    --
                   Plotting position parameter            =      0.00


  *********  NOTICE -- Preliminary machine computations.          *********
  *********  User responsible for assessment and interpretation.  *********

    WCF134I-NO SYSTEMATIC PEAKS WERE BELOW GAGE BASE.                    0.0
    WCF165I-HIGH OUTLIERS AND HISTORIC PEAKS ABOVE HHBASE.  0  1     12031.4
    WCF195I-NO LOW OUTLIERS WERE DETECTED BELOW CRITERION.             378.8
1

  Program PeakFq          U. S. GEOLOGICAL SURVEY                 Seq.001.002
  Ver. 5.2               Annual peak flow frequency analysis      Run Date / Time
  11/01/2007             following Bulletin 17-B Guidelines       10/20/2010 11:41
                                     Page 1
```

PEAKWAWONA.PRT.txt

Station - 11267300 SF MERCED R A WAWONA CA

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	1.0000	3.3826	0.3062	0.506
BULL.17B ESTIMATE	0.0	1.0000	3.4143	0.3363	0.399

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	'EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9950	471.8	547.9	374.1	207.1	766.7
0.9900	539.0	610.1	446.3	248.8	854.8
0.9500	797.7	844.6	723.7	424.8	1185.0
0.9000	1001.0	1024.0	938.6	575.3	1440.0
0.8000	1339.0	1319.0	1293.0	841.3	1869.0
0.6667	1788.0	1704.0	1760.0	1207.0	2460.0
0.5000	2466.0	2274.0	2466.0	1756.0	3428.0
0.4292	2833.0	2580.0	2852.0	2044.0	3995.0
0.2000	4885.0	4265.0	5104.0	3508.0	7710.0
0.1000	7195.0	6134.0	7884.0	4955.0	12790.0
0.0400	11130.0	9288.0	13310.0	7162.0	23080.0
0.0200	14940.0	12330.0	19490.0	9120.0	34650.0
0.0100	19650.0	16070.0	28490.0	11380.0	50700.0
0.0050	25440.0	20660.0	41810.0	13990.0	72730.0
0.0020	35110.0	28340.0	70420.0	18070.0	114400.0

1

Program PeakFq — U. S. GEOLOGICAL SURVEY — Seq.001.003
Ver. 5.2 — Annual peak flow frequency analysis — Run Date / Time
11/01/2007 — following Bulletin 17-B Guidelines — 10/20/2010 11:41

Station - 11267300 SF MERCED R A WAWONA CA

I N P U T   D A T A   L I S T I N G

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
-1956	15000.0	H	1967	4670.0	
1959	1860.0		1968	1050.0	
1960	1470.0		1970	4030.0	
1961	800.0		1971	1760.0	
1962	2110.0		1972	2160.0	
1963	8590.0		1973	3230.0	
1964	1300.0		1974	2350.0	
1965	9030.0		1975	3800.0	
1966	1310.0				

Page 2

```
                         PEAKWAWONA.PRT.txt
      Explanation of peak discharge qualification codes

     PeakFQ      NWIS
      CODE       CODE     DEFINITION

        D          3      Dam failure, non-recurrent flow anomaly
        G          8      Discharge greater than stated value
        X         3+8     Both of the above
        L          4      Discharge less than stated value
        K        6 OR C   Known effect of regulation or urbanization
        H          7      Historic peak

        -   Minus-flagged discharge -- Not used in computation
               -8888.0 -- No discharge value given
        -   Minus-flagged water year -- Historic peak used in computation


1

  Program PeakFq          U. S. GEOLOGICAL SURVEY             Seq.001.004
  Ver. 5.2             Annual peak flow frequency analysis    Run Date / Time
  11/01/2007           following Bulletin 17-B Guidelines     10/20/2010 11:41

                   Station - 11267300  SF MERCED R A WAWONA CA


   EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

      WATER          RANKED         SYSTEMATIC       BULL.17B
       YEAR         DISCHARGE         RECORD         ESTIMATE

      -1956          15000.0            --            0.0385
       1965           9030.0          0.0588          0.0865
       1963           8590.0          0.1176          0.1442
       1967           4670.0          0.1765          0.2019
       1970           4030.0          0.2353          0.2596
       1975           3800.0          0.2941          0.3173
       1973           3230.0          0.3529          0.3750
       1974           2350.0          0.4118          0.4327
       1972           2160.0          0.4706          0.4904
       1962           2110.0          0.5294          0.5481
       1959           1860.0          0.5882          0.6058
       1971           1760.0          0.6471          0.6635
       1960           1470.0          0.7059          0.7212
       1966           1310.0          0.7647          0.7788
       1964           1300.0          0.8235          0.8365
       1968           1050.0          0.8824          0.8942
       1961            800.0          0.9412          0.9519
1


 End PeakFQ analysis.
   Stations processed :       1
   Number of errors   :       0
   Stations skipped   :       0
   Station years      :      17

Data records may have been ignored for the stations listed below.
(Card type must be Y, Z, N, H, I, 2, 3, 4,  or *.)
                                             Page 3
```

Appendix C

Summary of the Input/Output to the WinTR-55 Model for Big Creek, Rush Creek and Unnamed Wawona Tributary

This Appendix includes model output from the TR-55 model (NRCS) that was used to calculate flood flows for the Big Creek, Rush Creek, and unnamed Wawona drainages. The first section of the model output summarizes the drainage area, the averaged runoff coefficient (C) value, and the calculated Time of Concentration. This is followed by the rainfall depths for a 24-hour, Type II storm event for the 2-year through 100-year storm events. The peak flow is then provided for the 2-year through 100-year storm events.

Following the model output data, aerial photo maps of the drainage area are provided which show the NRCS soil maps according to hydrologic soil groups (A-D). Due to the size of the drainage area for Big Creek, the aerial photo maps showing the hydrologic soil groups are broken into three portions (western, central, and eastern). A description of the soil types follows the soil mapping.

WinTR-55 Current Data Description

--- Identification Data ---

```
User:      M. Rotar                                  Date:        1/21/2011
Project:   S Fk Merced floodplain mapping            Units:       Metric
SubTitle:  Big Creek hydrology                       Areal Units: Hectares
State:     California
County:    Mariposa
Filename:  C:\Documents and Settings\19795\Application Data\WinTR-55\Big Creek.w55
```

--- Sub-Area Data ---

Name	Description	Reach	Area(ha)	RCN	Tc
Big Creek	entire Big Creek drainageBig main		6475	41	10

Total area: 6475 (ha)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (mm)	5-Yr (mm)	10-Yr (mm)	25-Yr (mm)	50-Yr (mm)	100-Yr (mm)	1-Yr (mm)
132.1	190.5	215.9	266.7	304.8	325.1	.0

```
Storm Data Source:             User-provided custom storm data
Rainfall Distribution Type:    Type II
Dimensionless Unit Hydrograph: <standard>
```

M. Rotar

S Fk Merced floodplain mapping
Big Creek hydrology
Mariposa County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (mm)	5-Yr (mm)	10-Yr (mm)	25-Yr (mm)	50-Yr (mm)	100-Yr (mm)	1-Yr (mm)
132.1	190.5	215.9	266.7	304.8	325.1	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

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S Fk Merced floodplain mapping
Big Creek hydrology
Mariposa County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cms)	5-Yr (cms)	10-Yr (cms)	25-Yr (cms)	50-Yr (cms)	100-Yr (cms)
SUBAREAS						
Big Creek	10.95	41.44	59.43	102.04	140.68	161.19
REACHES						
Big main	10.95	41.44	59.43	102.04	140.68	161.19
Down	10.93	41.37	59.43	101.88	140.36	160.74
OUTLET	10.93	41.37	59.43	101.88	140.36	160.74

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Big Creek hydrology
Mariposa County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cms) (hr)	5-Yr (cms) (hr)	10-Yr (cms) (hr)	25-Yr (cms) (hr)	50-Yr (cms) (hr)	100-Yr (cms) (hr)
SUBAREAS						
Big Creek	10.95	41.44	59.43	102.04	140.68	161.19
	21.36	19.95	19.88	19.00	19.27	19.06
REACHES						
Big main	10.95	41.44	59.43	102.04	140.68	161.19
	21.36	19.95	19.88	19.00	19.27	19.06
Down	10.93	41.37	59.43	101.88	140.36	160.74
	23.26	21.21	20.51	20.26	19.91	20.33
OUTLET	10.93	41.37	59.43	101.88	140.36	160.74

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M. Rotar S Fk Merced floodplain mapping
Big Creek hydrology
Mariposa County, California

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ha)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
Big Creek	6475.00	10.000	41	Big main	entire Big Creek drainage

Total Area: 6475 (ha)

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S Fk Merced floodplain mapping
Big Creek hydrology
Mariposa County, California

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (m)	Routing Method
Big main	Outlet	24000	CHANNEL

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Big Creek hydrology
Mariposa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (m)	Slope (m/m)	Mannings's n	End Area (sq m)	Wetted Perimeter (m)	Velocity (m/sec)	Travel Time (hr)
Big Creek							
SHEET	30.00	0.1500	0.800				0.216
SHALLOW	30000.00	0.1000					5.359
CHANNEL	30000.00	0.0600	0.100	2.50	6.00	1.367	6.098
					Time of Concentration		10
							========

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S Fk Merced floodplain mapping
Big Creek hydrology
Mariposa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ha)	Curve Number
Big Creek	Woods	(fair)	A	2590	36
	Woods	(good)	D	323.75	77
	Pinyon - juniper	(good)	B	3561.25	41
	Total Area / Weighted Curve Number			6475	41

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S Fk Merced floodplain mapping
Big Creek hydrology
Mariposa County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (m)	Reach Manning's n	Friction Slope (m/m)	Bottom Width (m)	Side Slope
Big main	24000	0.1	0.05	5	2 :1

Reach Identifier	Stage (m)	Flow (cms)	End Area (sq m)	Top Width (m)	Friction Slope (m/m)
Big main	0.0	0.000	0	5	0.05
	0.2	0.713	0.8	5.6	
	0.3	2.303	1.7	6.2	
	0.6	7.846	3.8	7.4	
	1.5	41.573	12.2	11.1	
	3.1	167.460	33.9	17.2	
	6.1	764.971	104.9	29.4	

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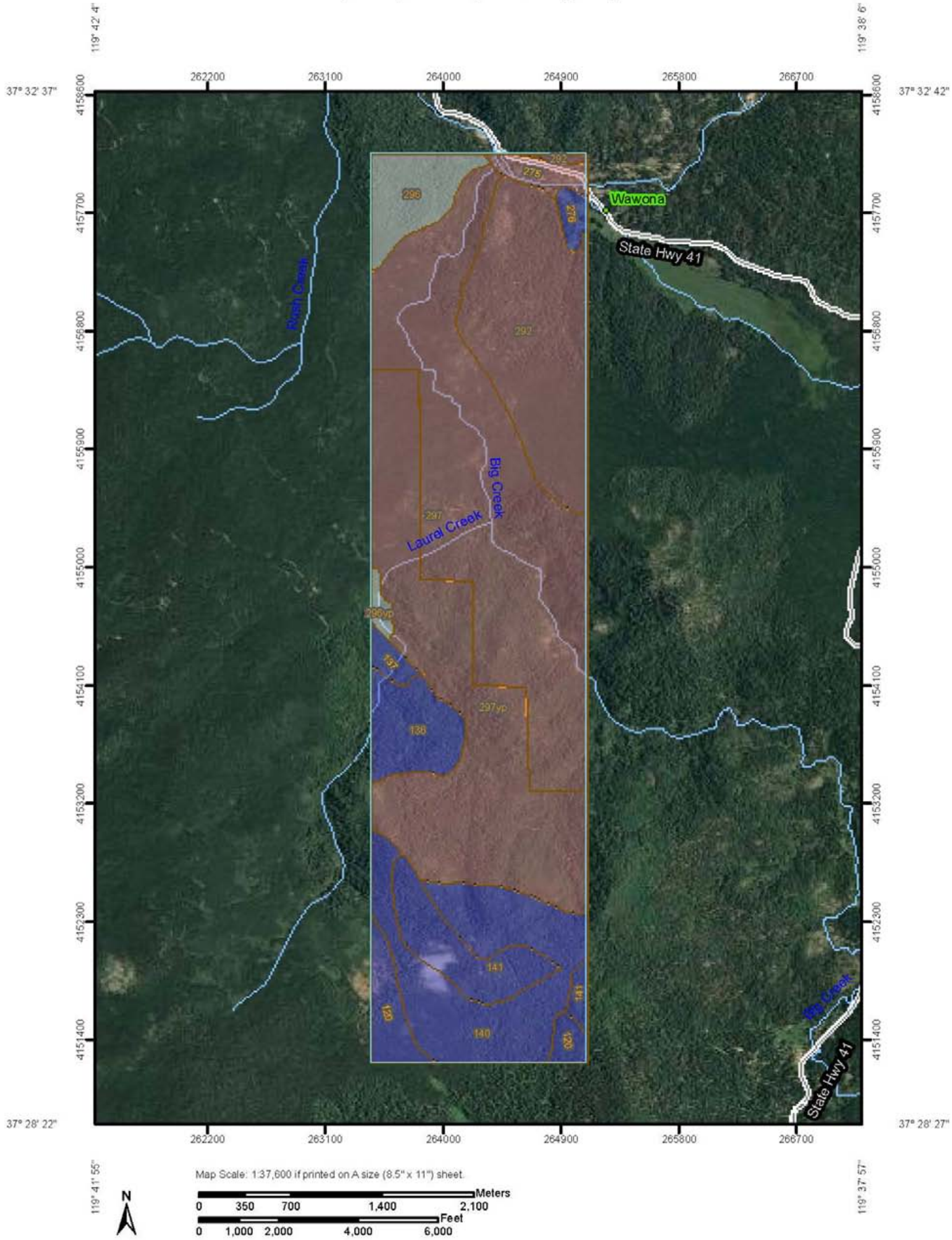
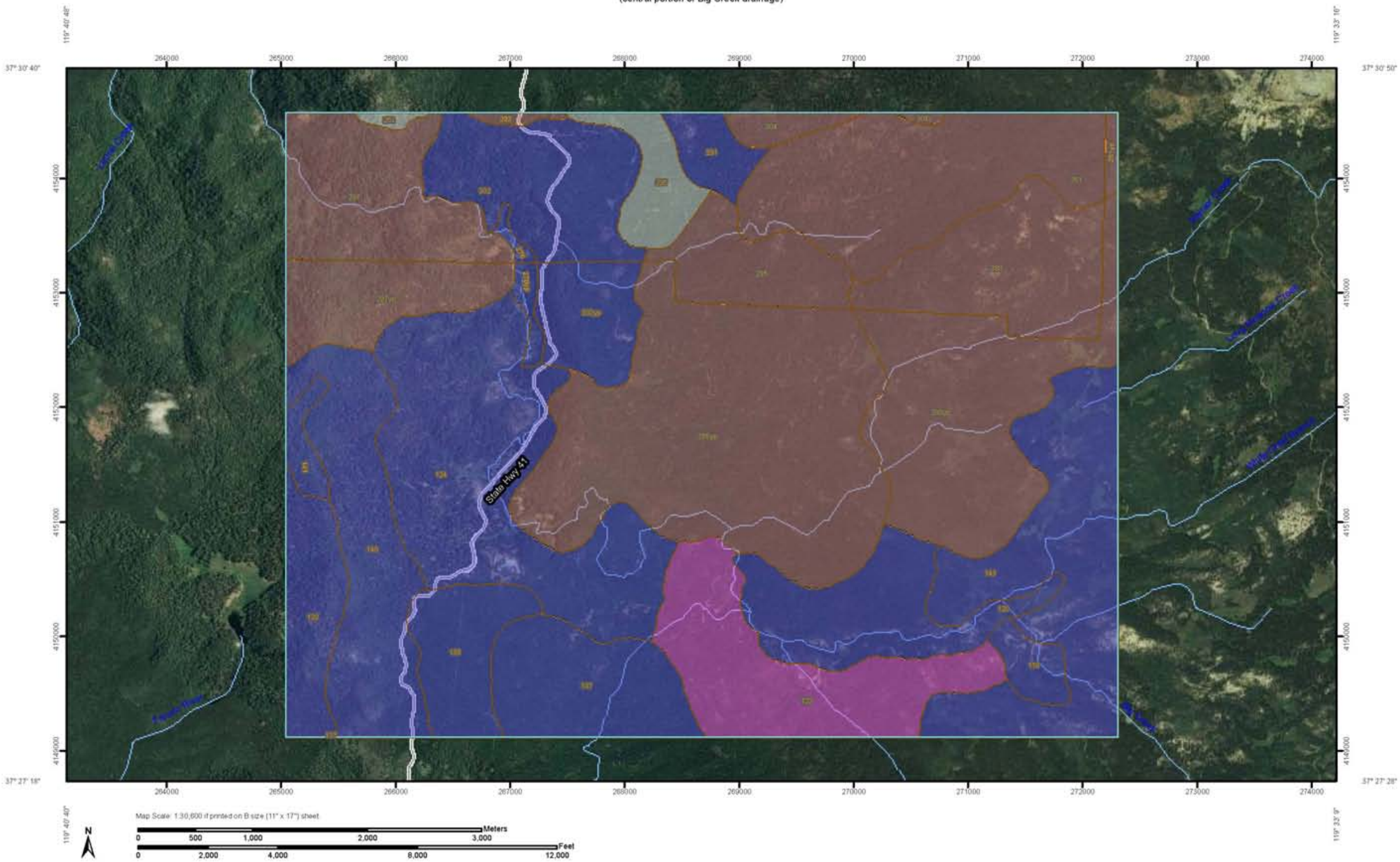
Hydrologic Soil Group—Sierra National Forest Area Parts of Fresno, California, and Yosemite National Park, California
(western portion of Big Creek drainage area)

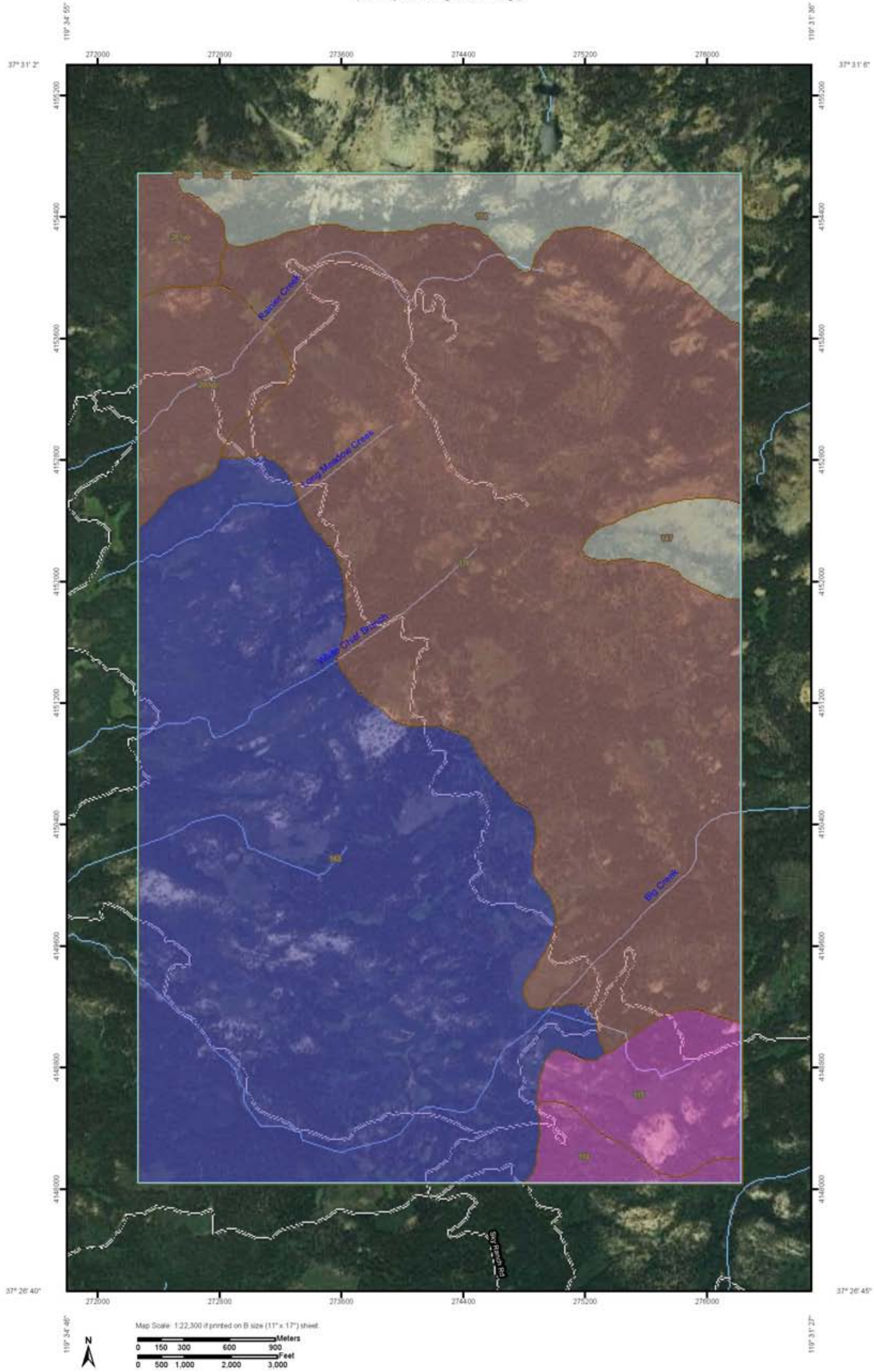


Hydrologic Soil Group—Sierra National Forest Area Parts of Fresno, California, and Yosemite National Park, California
(central portion of Big Creek drainage)



an Atkins company

Hydrologic Soil Group—Sierra National Forest Area Parts of Fresno, California
(eastern portion of Big Creek drainage)



an Atkins company

Hydrologic Soil Group–Sierra National Forest Area Parts of Fresno, California, and Yosemite National Park, California
(central portion of Big Creek drainage)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:30,600 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sierra National Forest Area Parts of Fresno, California
Survey Area Data: Version 6, Sep 1, 2009

Soil Survey Area: Yosemite National Park, California
Survey Area Data: Version 5, Jan 8, 2008

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 6/11/2005; 8/24/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Sierra National Forest Area Parts of Fresno, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
120	CHAIX FAMILY, DEEP, 5 TO 45 PERCENT SLOPES	B	83.4	3.0%
136	HOLLAND FAMILY, 5 TO 35 PERCENT SLOPES	B	113.8	4.0%
137	HOLLAND FAMILY, 35 TO 65 PERCENT SLOPES	B	21.0	0.7%
140	HOLLAND-CHAWANAKEE FAMILIES COMPLEX, 35 TO 65 PERCENT SLOPES	B	335.5	11.9%
141	HOLLAND-CHAWANAKEE FAMILES-ROCK OUTCROP COMPLEX, 15 TO 35 PERCENT SLOPES	B	138.7	4.9%
296yp	Ultic Palexeralfs-Humic Dystroxerepts complex, 10 to 35 percent slopes, mountain slopes, mesic		12.9	0.5%
297yp	Typic Xerorthents-Rock outcrop-Typic Xeropsamments complex, 15 to 45 percent slopes, mountain slopes, mesic	A	671.4	23.9%
Subtotals for Soil Survey Area			**1,376.8**	**49.0%**
Totals for Area of Interest			**2,812.4**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Yosemite National Park, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
275	Oxyaquic Dystroxerepts-Dystric Xerorthents-Vitrandic Xerorthents-Rubble land complex, stony, 0 to 20 percent slopes, mountain valleys, mesic	A	37.7	1.3%
276	Happyisles-Typic Dystroxerepts association, 0 to 15 percent slopes, mountain valley floors, mesic	B	21.5	0.8%
292	Humic Dystroxerepts-Typic Haploxerults complex, 5 to 35 percent slopes, mountain footslopes, landslides, mesic	A	418.4	14.9%
296	Ultic Palexeralfs-Humic Dystroxerepts complex, 10 to 35 percent slopes, mountain slopes, mesic		107.1	3.8%
297	Typic Xerorthents-Rock outcrop-Typic Xeropsamments complex, 15 to 45 percent slopes, mountain slopes, mesic	A	850.9	30.3%
Subtotals for Soil Survey Area			**1,435.6**	**51.0%**
Totals for Area of Interest			**2,812.4**	**100.0%**

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Sierra National Forest Area Parts of Fresno, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
118	CHAIX FAMILY, 5 TO 35 PERCENT SLOPES	B	77.6	0.8%
120	CHAIX FAMILY, DEEP, 5 TO 45 PERCENT SLOPES	B	647.7	6.6%
123	CHAIX-CHAWANAKEE FAMILIES-ROCK OUTCROP COMPLEX, 35 TO 65 PERCENT SLOPES	D	582.7	6.0%
124	CHAIX-HOLLAND FAMILIES COMPLEX, 15 TO 35 PERCENT SLOPES	B	998.3	10.2%
136	HOLLAND FAMILY, 5 TO 35 PERCENT SLOPES	B	245.9	2.5%
137	HOLLAND FAMILY, 35 TO 65 PERCENT SLOPES	B	382.8	3.9%
140	HOLLAND-CHAWANAKEE FAMILIES COMPLEX, 35 TO 65 PERCENT SLOPES	B	562.6	5.7%
141	HOLLAND-CHAWANAKEE FAMILES-ROCK OUTCROP COMPLEX, 15 TO 35 PERCENT SLOPES	B	55.8	0.6%
143	LEDFORD FAMILY-ENTIC XERUMBREPTS-ROCK OUTCROP ASSOCIATION, 10 TO 45 PERCENT SLOPES	B	769.2	7.9%
261yp	Dystric Xeropsamments-Typic Dystroxerepts-Badgerpass-Rock outcrop association, 5 to 35 percent slopes, mountain valleys, mountain slopes, frigid	A	21.4	0.2%
276yp	Happyisles-Typic Dystroxerepts association, 0 to 15 percent slopes, mountain valley floors, mesic	B	34.5	0.4%
280yp	Typic Dystroxerepts-Humic Dystroxerepts-Rock outcrop association, 15 to 45 percent slopes, mountain slopes, frigid	A	758.1	7.7%
285yp	Waterwheel-Humic Dystroxerepts complex, 15 to 45 percent slopes, mountain slopes, frigid	A	1,443.7	14.8%
297yp	Typic Xerorthents-Rock outcrop-Typic Xeropsamments complex, 15 to 45 percent slopes, mountain slopes, mesic	A	280.9	2.9%
302yp	Typic Haploxerults-Ultic Haploxeralfs complex, 0 to 30 percent slopes, mountain slopes, hummocky, mesic	B	210.1	2.1%
Subtotals for Soil Survey Area			**7,071.2**	**72.2%**
Totals for Area of Interest			**9,787.3**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Yosemite National Park, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
261	Dystric Xeropsamments-Typic Dystroxerepts-Badgerpass-Rock outcrop association, 5 to 35 percent slopes, mountain valleys, mountain slopes, frigid	A	729.2	7.5%
262	Humic Dystroxerepts-Dystric Xerorthents-Rock outcrop association, 30 to 70 percent slopes, mountain slopes, frigid		14.3	0.1%
276	Happyisles-Typic Dystroxerepts association, 0 to 15 percent slopes, mountain valley floors, mesic	B	15.8	0.2%
280	Typic Dystroxerepts-Humic Dystroxerepts-Rock outcrop association, 15 to 45 percent slopes, mountain slopes, frigid	A	466.1	4.8%
285	Waterwheel-Humic Dystroxerepts complex, 15 to 45 percent slopes, mountain slopes, frigid	A	255.2	2.6%
291	Ultic Haploxeralfs-Typic Dystroxerepts complex, 5 to 25 percent slopes, mountain footslopes, frigid	B	101.3	1.0%
292	Humic Dystroxerepts-Typic Haploxerults complex, 5 to 35 percent slopes, mountain footslopes, landslides, mesic	A	16.1	0.2%
295	Craneflat-Typic Dystroxerepts complex, 15 to 45 percent slopes, landslides, mountain slopes, frigid		149.4	1.5%
297	Typic Xerorthents-Rock outcrop-Typic Xeropsamments complex, 15 to 45 percent slopes, mountain slopes, mesic	A	459.6	4.7%
302	Typic Haploxerults-Ultic Haploxeralfs complex, 0 to 30 percent slopes, mountain slopes, hummocky, mesic	B	445.2	4.5%
304	Clarkslodge-Rock outcrop complex, 0 to 30 percent slopes, mountain slopes, metavolcanic, frigid/mesic	A	63.9	0.7%
Subtotals for Soil Survey Area			**2,716.2**	**27.8%**
Totals for Area of Interest			**9,787.3**	**100.0%**

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Sierra National Forest Area Parts of Fresno, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
114	CAGWIN FAMILY-LITHIC XEROPSAMMENTS-ROCK OUTCROP COMPLEX, 45 TO 65 PERCENT SLOPES	D	85.2	1.3%
115	CAGWIN FAMILY-ROCK OUTCROP COMPLEX, 15 TO 35 PERCENT SLOPES	D	241.4	3.7%
143	LEDFORD FAMILY-ENTIC XERUMBREPTS-ROCK OUTCROP ASSOCIATION, 10 TO 45 PERCENT SLOPES	B	2,467.6	38.0%
147	ROCK OUTCROP		107.9	1.7%
154	ROCK OUTCROP-RUBBLE LAND ASSOCIATION		412.0	6.3%
176	UMPA FAMILY, DEEP, 20 TO 60 PERCENT SLOPES	A	2,840.8	43.7%
261yp	Dystric Xeropsamments-Typic Dystroxerepts-Badgerpass-Rock outcrop association, 5 to 35 percent slopes, mountain valleys, mountain slopes, frigid	A	89.5	1.4%
280yp	Typic Dystroxerepts-Humic Dystroxerepts-Rock outcrop association, 15 to 45 percent slopes, mountain slopes, frigid	A	251.2	3.9%
293yp	Xeric Dystrocryepts-Marmotland association, 0 to 25 percent slopes, mountain slopes, summits, cryic	A	0.4	0.0%
Totals for Area of Interest			**6,496.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

WinTR-55 Current Data Description

--- Identification Data ---

```
User:     M. Rotar                              Date:         1/21/2011
Project:  S Fk Merced floodplain mapping        Units:        Metric
SubTitle: Rush Creek hydrology                  Areal Units: Hectares
State:    California
County:   Mariposa
Filename: C:\Documents and Settings\19795\Application Data\WinTR-55\Rush Creek.w55
```

--- Sub-Area Data ---

Name	Description	Reach	Area(ha)	RCN	Tc
Rush Creek	entire Rush Ck drainage	Rush main	1503.04	47	6.04

Total area: 1503.04 (ha)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (mm)	5-Yr (mm)	10-Yr (mm)	25-Yr (mm)	50-Yr (mm)	100-Yr (mm)	1-Yr (mm)
127.0	182.9	198.1	241.3	279.4	292.1	.0

```
Storm Data Source:             User-provided custom storm data
Rainfall Distribution Type:    Type II
Dimensionless Unit Hydrograph: <standard>
```

M. Rotar

S Fk Merced floodplain mapping
Rush Creek hydrology
Mariposa County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (mm)	5-Yr (mm)	10-Yr (mm)	25-Yr (mm)	50-Yr (mm)	100-Yr (mm)	1-Yr (mm)
127.0	182.9	198.1	241.3	279.4	292.1	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

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S Fk Merced floodplain mapping
Rush Creek hydrology
Mariposa County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cms)	5-Yr (cms)	10-Yr (cms)	25-Yr (cms)	50-Yr (cms)	100-Yr (cms)
SUBAREAS						
Rush Creek	5.93	18.83	23.39	38.12	52.47	57.78
REACHES						
Rush main	5.93	18.83	23.39	38.12	52.47	57.78
Down	5.92	18.82	23.39	38.12	52.43	57.69
OUTLET	5.92	18.82	23.39	38.12	52.43	57.69

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S Fk Merced floodplain mapping
Rush Creek hydrology
Mariposa County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cms) (hr)	5-Yr (cms) (hr)	10-Yr (cms) (hr)	25-Yr (cms) (hr)	50-Yr (cms) (hr)	100-Yr (cms) (hr)
SUBAREAS						
Rush Creek	5.93	18.83	23.39	38.12	52.47	57.78
	17.16	16.19	16.10	15.99	15.86	16.06
REACHES						
Rush main	5.93	18.83	23.39	38.12	52.47	57.78
	17.16	16.19	16.10	15.99	15.86	16.06
Down	5.92	18.82	23.39	38.12	52.43	57.69
	17.54	16.95	16.87	16.75	16.62	16.45
OUTLET	5.92	18.82	23.39	38.12	52.43	57.69

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S Fk Merced floodplain mapping
Rush Creek hydrology
Mariposa County, California

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ha)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
Rush Creek	1503.04	6.040	47	Rush main	entire Rush Ck drainage

Total Area: 1503.04 (ha)

```
M. Rotar               S Fk Merced floodplain mapping
                            Rush Creek hydrology
                        Mariposa County, California

                            Reach Summary Table


              Receiving     Reach        Routing
  Reach         Reach       Length       Method
Identifier    Identifier     (m)
----------------------------------------------------------------------

  Rush main      Outlet        8240       CHANNEL
```

M. Rotar — S Fk Merced floodplain mapping
Rush Creek hydrology
Mariposa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (m)	Slope (m/m)	Mannings's n	End Area (sq m)	Wetted Perimeter (m)	Velocity (m/sec)	Travel Time (hr)
Rush Creek							
SHEET	30.00	0.1500	0.800				0.220
SHALLOW	18000.00	0.1000					3.215
CHANNEL	7830.00	0.0500	0.120	1.50	5.00	0.835	2.605
					Time of Concentration		6.04

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S Fk Merced floodplain mapping
Rush Creek hydrology
Mariposa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ha)	Curve Number
Rush Creek	Woods	(good)	A	150.304	30
	Woods	(good)	D	300.608	77
	Pinyon - juniper	(good)	B	1052.128	41
	Total Area / Weighted Curve Number			1503.04	47
				=======	==

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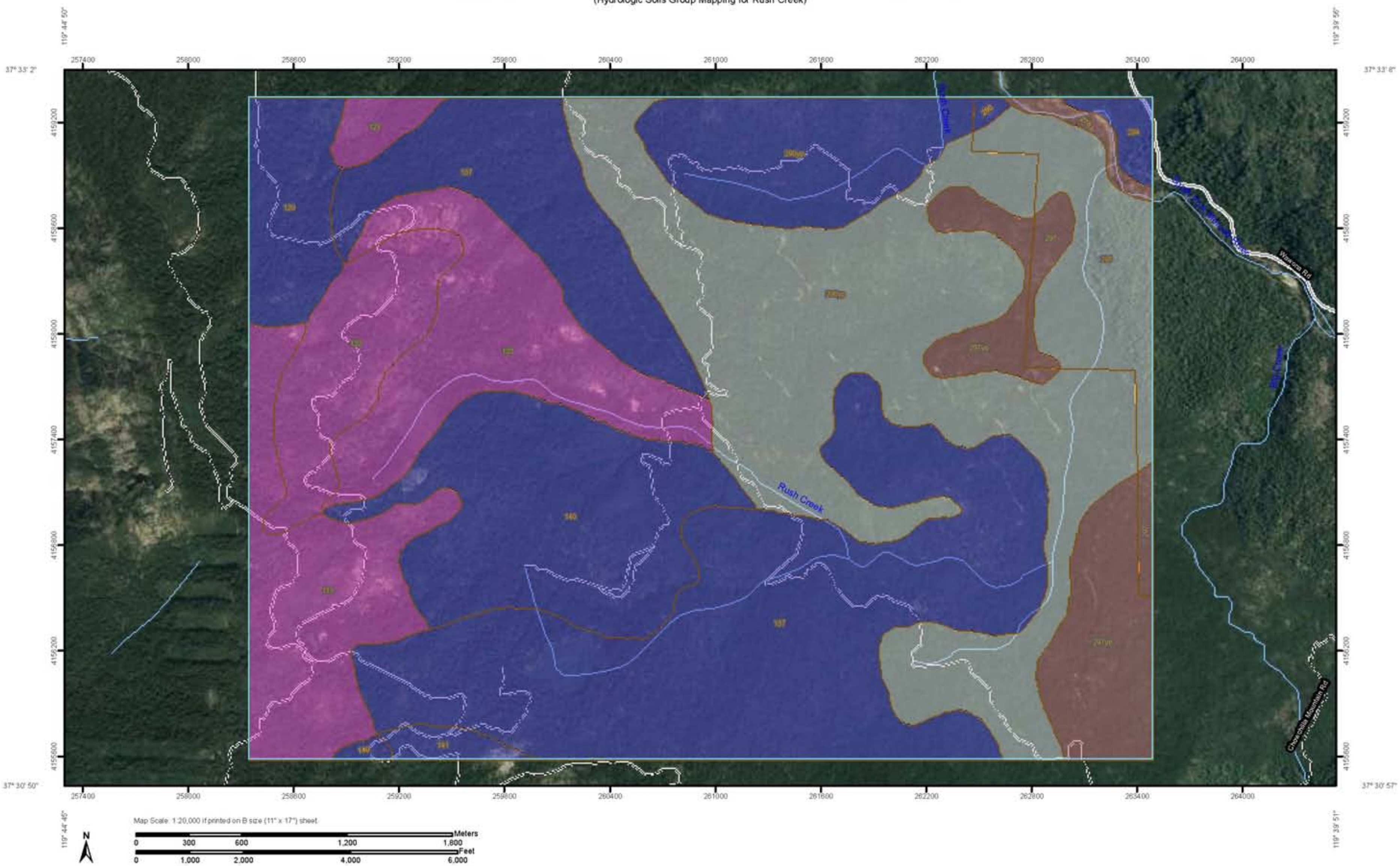
S Fk Merced floodplain mapping
Rush Creek hydrology
Mariposa County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (m)	Reach Manning's n	Friction Slope (m/m)	Bottom Width (m)	Side Slope
Rush main	8240	0.1	0.06	4	2 :1

Reach Identifier	Stage (m)	Flow (cms)	End Area (sq m)	Top Width (m)	Friction Slope (m/m)
Rush main	0.0	0.000	0	4	0.06
	0.2	0.627	0.6	4.6	
	0.3	2.038	1.4	5.2	
	0.6	7.039	3.2	6.4	
	1.5	38.717	10.7	10.1	
	3.1	162.604	30.8	16.2	
	6.1	774.446	98.8	28.4	

Hydrologic Soil Group—Sierra National Forest Area Parts of Fresno, California, and Yosemite National Park, California
(Hydrologic Soils Group Mapping for Rush Creek)



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Hydrologic Soil Group–Sierra National Forest Area Parts of Fresno, California, and Yosemite National Park, California
(Hydrologic Soils Group Mapping for Rush Creek)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:20,000 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sierra National Forest Area Parts of Fresno, California
Survey Area Data: Version 6, Sep 1, 2009

Soil Survey Area: Yosemite National Park, California
Survey Area Data: Version 5, Jan 8, 2008

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Date(s) aerial images were photographed: 8/24/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Sierra National Forest Area Parts of Fresno, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
113	CAGWIN FAMILY-LITHIC XEROPSAMMENTS-ROCK OUTCROP COMPLEX, 15 TO 45 PERCENT SLOPES	D	322.1	6.7%
120	CHAIX FAMILY, DEEP, 5 TO 45 PERCENT SLOPES	B	152.1	3.2%
122	CHAIX-CHAWANAKEE FAMILIES-ROCK OUTCROP COMPLEX, 15 TO 35 PERCENT SLOPES	D	207.5	4.3%
123	CHAIX-CHAWANAKEE FAMILIES-ROCK OUTCROP COMPLEX, 35 TO 65 PERCENT SLOPES	D	392.4	8.2%
137	HOLLAND FAMILY, 35 TO 65 PERCENT SLOPES	B	1,308.5	27.4%
140	HOLLAND-CHAWANAKEE FAMILIES COMPLEX, 35 TO 65 PERCENT SLOPES	B	485.1	10.2%
141	HOLLAND-CHAWANAKEE FAMILES-ROCK OUTCROP COMPLEX, 15 TO 35 PERCENT SLOPES	B	30.9	0.6%
290yp	Humic Dystroxerepts-Waterwheel-Typic Xerorthents-Ultic Haploxeralfs complex, 30 to 70 percent slopes, mountain slopes, mesic	B	269.2	5.6%
296yp	Ultic Palexeralfs-Humic Dystroxerepts complex, 10 to 35 percent slopes, mountain slopes, mesic		1,024.6	21.5%
297yp	Typic Xerorthents-Rock outcrop-Typic Xeropsamments complex, 15 to 45 percent slopes, mountain slopes, mesic	A	261.8	5.5%
Subtotals for Soil Survey Area			**4,454.2**	**93.3%**
Totals for Area of Interest			**4,773.7**	**100.0%**

Hydrologic Soil Group— Summary by Map Unit — Yosemite National Park, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
275	Oxyaquic Dystroxerepts-Dystric Xerorthents-Vitrandic Xerorthents-Rubble land complex, stony, 0 to 20 percent slopes, mountain valleys, mesic	A	23.3	0.5%
290	Humic Dystroxerepts-Tuolumne-Typic Xerorthents-Ultic Haploxeralfs complex, 30 to 70 percent slopes, mountain slopes, mesic	B	6.6	0.1%
294	Waterwheel-Typic Dystroxerepts complex, 30 to 70 percent slopes, landslides, mountain slopes, frigid	B	30.9	0.6%

Hydrologic Soil Group— Summary by Map Unit — Yosemite National Park, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
296	Ultic Palexeralfs-Humic Dystroxerepts complex, 10 to 35 percent slopes, mountain slopes, mesic		213.5	4.5%
297	Typic Xerorthents-Rock outcrop-Typic Xeropsamments complex, 15 to 45 percent slopes, mountain slopes, mesic	A	45.1	0.9%
Subtotals for Soil Survey Area			**319.4**	**6.7%**
Totals for Area of Interest			**4,773.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

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WinTR-55 Current Data Description

--- Identification Data ---

User: M. Rotar Date: 1/21/2011
Project: Merced River floodplain maps Units: Metric
SubTitle: Wawona Reach - golf course tributary Areal Units: Hectares
State: California
County: Mariposa
Filename: C:\Documents and Settings\19795\Application Data\WinTR-55\Wawona trib.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ha)	RCN	Tc
A	South Fork of tributary	Reach 1	191.42	42	1.922
B	Middle Fork of tributary	Reach 2	184.74	42	1.516
C	North Fork of tributary	Reach 3	413.49	42	7.833
D	golf course reach	Reach 4	342.46	49	3.032

Total area: 1132.11 (ha)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (mm)	5-Yr (mm)	10-Yr (mm)	25-Yr (mm)	50-Yr (mm)	100-Yr (mm)	1-Yr (mm)
114.3	152.4	177.8	215.9	254.0	279.4	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (mm)	5-Yr (mm)	10-Yr (mm)	25-Yr (mm)	50-Yr (mm)	100-Yr (mm)	1-Yr (mm)
114.3	152.4	177.8	215.9	254.0	279.4	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type II
Dimensionless Unit Hydrograph: <standard>

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M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period 2-Yr (cms)	5-Yr (cms)	10-Yr (cms)	25-Yr (cms)	50-Yr (cms)	100-Yr (cms)
SUBAREAS						
A	0.32	1.65	3.10	6.00	9.62	12.31
B	0.33	1.83	3.52	6.90	11.07	14.25
C	0.45	1.60	2.72	4.81	7.33	9.28
D	1.67	4.78	7.55	12.52	18.16	22.27
REACHES						
Reach 1	0.32	1.65	3.10	6.00	9.62	12.31
Down	0.32	1.65	3.10	6.00	9.59	12.30
Reach 2	0.33	1.83	3.52	6.90	11.07	14.25
Down	0.33	1.83	3.51	6.89	11.06	14.21
Reach 3	0.45	1.60	2.72	4.81	7.33	9.28
Down	0.45	1.60	2.71	4.81	7.33	9.28
Reach 4	2.30	8.04	13.52	24.01	36.67	46.02
Down	2.29	8.02	13.52	23.98	36.64	45.96
OUTLET	2.29	8.02	13.52	23.98	36.64	45.96

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M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cms) (hr)	5-Yr (cms) (hr)	10-Yr (cms) (hr)	25-Yr (cms) (hr)	50-Yr (cms) (hr)	100-Yr (cms) (hr)
SUBAREAS						
A	0.32	1.65	3.10	6.00	9.62	12.31
	14.25	13.52	13.33	13.22	13.26	13.26
B	0.33	1.83	3.52	6.90	11.07	14.25
	13.77	13.16	13.00	12.98	12.97	12.92
C	0.45	1.60	2.72	4.81	7.33	9.28
	19.86	18.75	18.18	17.57	17.38	17.63
D	1.67	4.78	7.55	12.52	18.16	22.27
	14.50	14.17	14.05	14.00	14.02	13.83
REACHES						
Reach 1	0.32	1.65	3.10	6.00	9.62	12.31
	14.25	13.52	13.33	13.22	13.26	13.26
Down	0.32	1.65	3.10	6.00	9.59	12.30
	14.38	13.89	13.69	13.58	13.50	13.50
Reach 2	0.33	1.83	3.52	6.90	11.07	14.25
	13.77	13.16	13.00	12.98	12.97	12.92
Down	0.33	1.83	3.51	6.89	11.06	14.21
	13.86	13.45	13.28	13.17	13.16	13.11
Reach 3	0.45	1.60	2.72	4.81	7.33	9.28
	19.86	18.75	18.18	17.57	17.38	17.63
Down	0.45	1.60	2.71	4.81	7.33	9.28
	20.85	19.24	18.68	18.07	17.87	18.12
Reach 4	2.30	8.04	13.52	24.01	36.67	46.02
	14.44	14.02	13.76	13.55	13.55	13.50
Down	2.29	8.02	13.52	23.98	36.64	45.96
	15.11	14.31	14.05	13.84	13.74	13.69
OUTLET	2.29	8.02	13.52	23.98	36.64	45.96

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M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ha)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
A	191.42	1.922	42	Reach 1	South Fork of tributary
B	184.74	1.516	42	Reach 2	Middle Fork of tributary
C	413.49	7.833	42	Reach 3	North Fork of tributary
D	342.46	3.032	49	Reach 4	golf course reach

Total Area: 1132.11 (ha)

M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (m)	Routing Method
Reach 1	Reach 4	3170	CHANNEL
Reach 2	Reach 4	2500	CHANNEL
Reach 3	Reach 4	5800	CHANNEL
Reach 4	Outlet	3600	CHANNEL

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M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (m)	Slope (m/m)	Mannings's n	End Area (sq m)	Wetted Perimeter (m)	Velocity (m/sec)	Travel Time (hr)
A							
SHEET	30.00	0.1500	0.800				0.232
SHALLOW	2400.00	0.1000					0.429
CHANNEL	3350.00	0.0600	0.120	1.00	4.60	0.738	1.261
				Time of Concentration			1.922
B							
SHEET	30.00	0.1429	0.800				0.236
SHALLOW	3200.00	0.1100					0.545
CHANNEL	2000.00	0.0630	0.120	1.00	4.60	0.756	0.735
				Time of Concentration			1.516
C							
SHEET	30.00	0.1000	0.800				0.273
SHALLOW	12000.00	0.0930					2.223
CHANNEL	16800.00	0.0585	0.100	1.00	4.60	0.874	5.337
				Time of Concentration			7.833
D							
SHEET	30.00	0.1000	0.400				0.157
SHALLOW	5600.00	0.0800					1.118
CHANNEL	4000.00	0.0150	0.070	1.00	4.60	0.632	1.757
				Time of Concentration			3.032

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M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ha)	Curve Number
A	Paved; open ditches (w/right-of-way)		B	.585	89
	Dirt (w/ right-of-way)		B	1.75	82
	Pinyon - juniper	(good)	B	189.085	41
	Total Area / Weighted Curve Number			191.42	42
B	Paved; open ditches (w/right-of-way)		B	2	89
	Dirt (w/ right-of-way)		B	.64	82
	Pinyon - juniper	(good)	B	182.1	41
	Total Area / Weighted Curve Number			184.74	42
C	Paved; open ditches (w/right-of-way)		B	4.06	89
	Dirt (w/ right-of-way)		B	.64	82
	Pinyon - juniper	(good)	B	408.79	41
	Total Area / Weighted Curve Number			413.49	42
D	Open space; grass cover > 75%	(good)	B	30	61
	Paved parking lots, roofs, driveways		B	.3	98
	Paved; open ditches (w/right-of-way)		B	3.1	89
	Dirt (w/ right-of-way)		B	9.02	82
	Meadow -cont. grass (non grazed)		B	90.5	58
	Pinyon - juniper	(good)	B	209.54	41
	Total Area / Weighted Curve Number			342.46	49

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M. Rotar

Merced River floodplain maps
Wawona Reach - golf course tributary
Mariposa County, California

Reach Channel Rating Details

Reach Identifier	Reach Length (m)	Reach Manning's n	Friction Slope (m/m)	Bottom Width (m)	Side Slope
Reach 1	3170	0.12	0.06	1	1.5 :1
Reach 2	2500	0.12	0.063	1	1.5 :1
Reach 3	5800	0.1	0.0585	1	1.5 :1
Reach 4	3600	0.07	0.015	1.5	1.5 :1

Reach Identifier	Stage (m)	Flow (cms)	End Area (sq m)	Top Width (m)	Friction Slope (m/m)
Reach 1	0.0	0.000	0	1	0.06
	0.2	0.135	0.2	1.5	
	0.3	0.465	0.4	1.9	
	0.6	1.810	1.2	2.8	
	1.5	12.697	5	5.6	
	3.1	65.079	17	10.2	
	6.1	363.495	61.9	19.3	
Reach 2	0.0	0.000	0	1	0.063
	0.2	0.138	0.2	1.5	
	0.3	0.476	0.4	1.9	
	0.6	1.855	1.2	2.8	
	1.5	13.011	5	5.6	
	3.1	66.686	17	10.2	
	6.1	372.471	61.9	19.3	
Reach 3	0.0	0.000	0	1	0.0585
	0.2	0.160	0.2	1.5	
	0.3	0.551	0.4	1.9	
	0.6	2.145	1.2	2.8	
	1.5	15.045	5	5.6	
	3.1	77.112	17	10.2	
	6.1	430.707	61.9	19.3	
Reach 4	0.0	0.000	0	1.5	0.015
	0.2	0.170	0.3	2	
	0.3	0.565	0.6	2.4	
	0.6	2.073	1.5	3.3	
	1.5	13.120	5.8	6.1	
	3.1	62.638	18.5	10.7	
	6.1	332.759	65	19.8	

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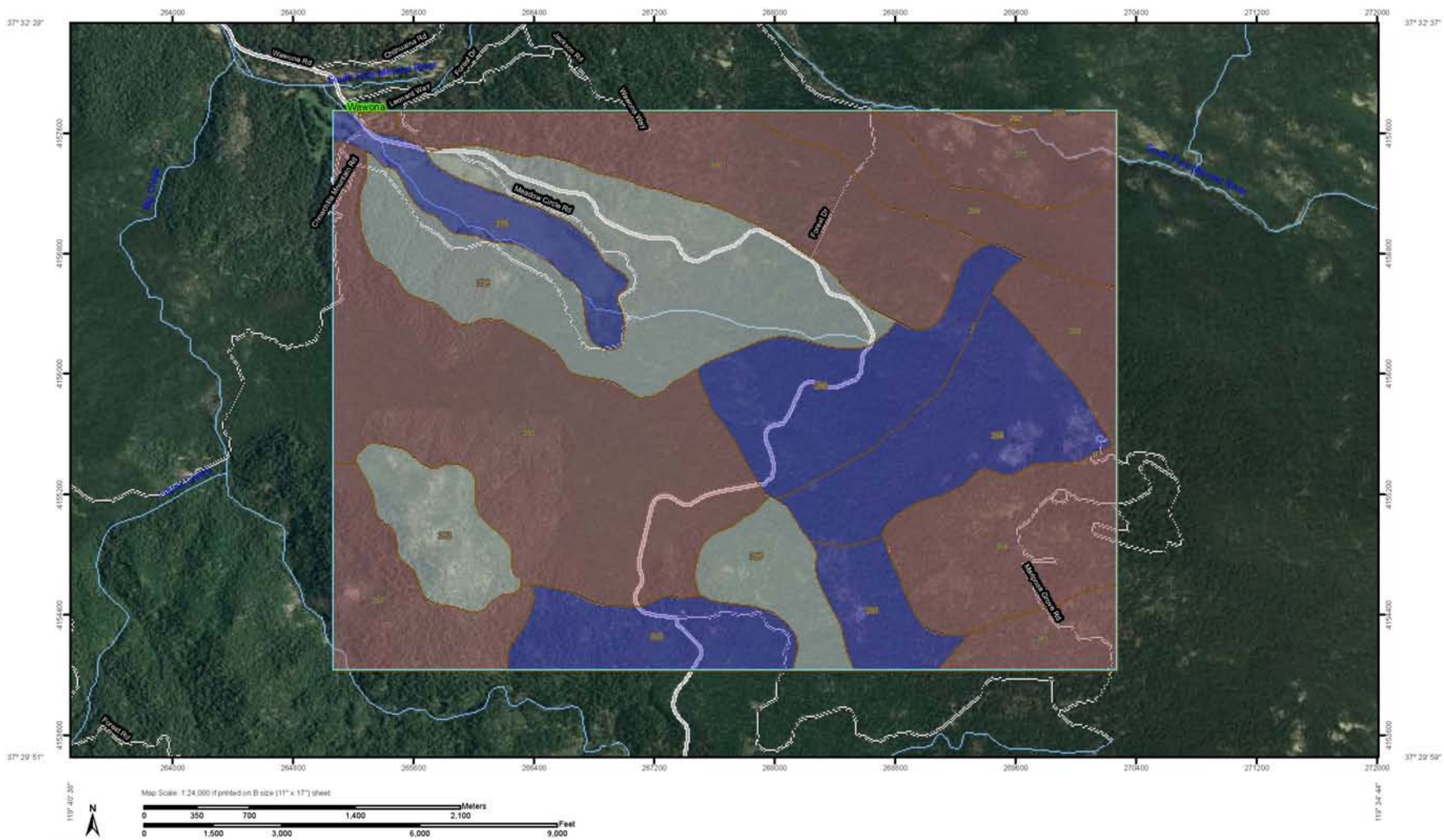
Hydrologic Soil Group—Yosemite National Park, California
(Wawona - "golf course" tributary to S. Fork Merced River)



USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

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Hydrologic Soil Group—Yosemite National Park, California
(Wawona - "golf course" tributary to S. Fork Merced River)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features
- Cities

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads

MAP INFORMATION

Map Scale: 1:24,000 if printed on B size (11" × 17") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 11N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Yosemite National Park, California
Survey Area Data: Version 5, Jan 8, 2008

Date(s) aerial images were photographed: 6/11/2005; 8/24/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Yosemite National Park, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
261	Dystric Xeropsamments-Typic Dystroxerepts-Badgerpass-Rock outcrop association, 5 to 35 percent slopes, mountain valleys, mountain slopes, frigid	A	107.8	2.3%
262	Humic Dystroxerepts-Dystric Xerorthents-Rock outcrop association, 30 to 70 percent slopes, mountain slopes, frigid		168.3	3.5%
275	Oxyaquic Dystroxerepts-Dystric Xerorthents-Vitrandic Xerorthents-Rubble land complex, stony, 0 to 20 percent slopes, mountain valleys, mesic	A	181.0	3.8%
276	Happyisles-Typic Dystroxerepts association, 0 to 15 percent slopes, mountain valley floors, mesic	B	164.0	3.4%
289	Waterwheel-Craneflat complex, 35 to 70 percent slopes, mountain slopes, frigid	A	122.1	2.6%
290	Humic Dystroxerepts-Tuolumne-Typic Xerorthents-Ultic Haploxeralfs complex, 30 to 70 percent slopes, mountain slopes, mesic	B	335.1	7.0%
291	Ultic Haploxeralfs-Typic Dystroxerepts complex, 5 to 25 percent slopes, mountain footslopes, frigid	B	122.4	2.6%
292	Humic Dystroxerepts-Typic Haploxerults complex, 5 to 35 percent slopes, mountain footslopes, landslides, mesic	A	910.9	19.1%
294	Waterwheel-Typic Dystroxerepts complex, 30 to 70 percent slopes, landslides, mountain slopes, frigid	B	342.2	7.2%
295	Craneflat-Typic Dystroxerepts complex, 15 to 45 percent slopes, landslides, mountain slopes, frigid		146.9	3.1%
296	Ultic Palexeralfs-Humic Dystroxerepts complex, 10 to 35 percent slopes, mountain slopes, mesic		694.3	14.6%
297	Typic Xerorthents-Rock outcrop-Typic Xeropsamments complex, 15 to 45 percent slopes, mountain slopes, mesic	A	226.4	4.7%
298	Tuolumne-Typic Dystroxerepts complex, 30 to 65 percent slopes, mountain slopes, landslides, mesic	B	1.7	0.0%
299	Humic Dystroxerepts-Ultic Haploxeralfs complex, 15 to 35 percent slopes, mountain slopes, moraines, mesic	A	221.9	4.7%
300	Typic Dystroxerepts-Ultic Haploxeralfs complex, 0 to 15 percent slopes, mountain slopes, moraines, mesic	A	482.0	10.1%

Hydrologic Soil Group— Summary by Map Unit — Yosemite National Park, California				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
302	Typic Haploxerults-Ultic Haploxeralfs complex, 0 to 30 percent slopes, mountain slopes, hummocky, mesic	B	207.7	4.4%
304	Clarkslodge-Rock outcrop complex, 0 to 30 percent slopes, mountain slopes, metavolcanic, frigid/mesic	A	334.2	7.0%
Totals for Area of Interest			**4,768.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower