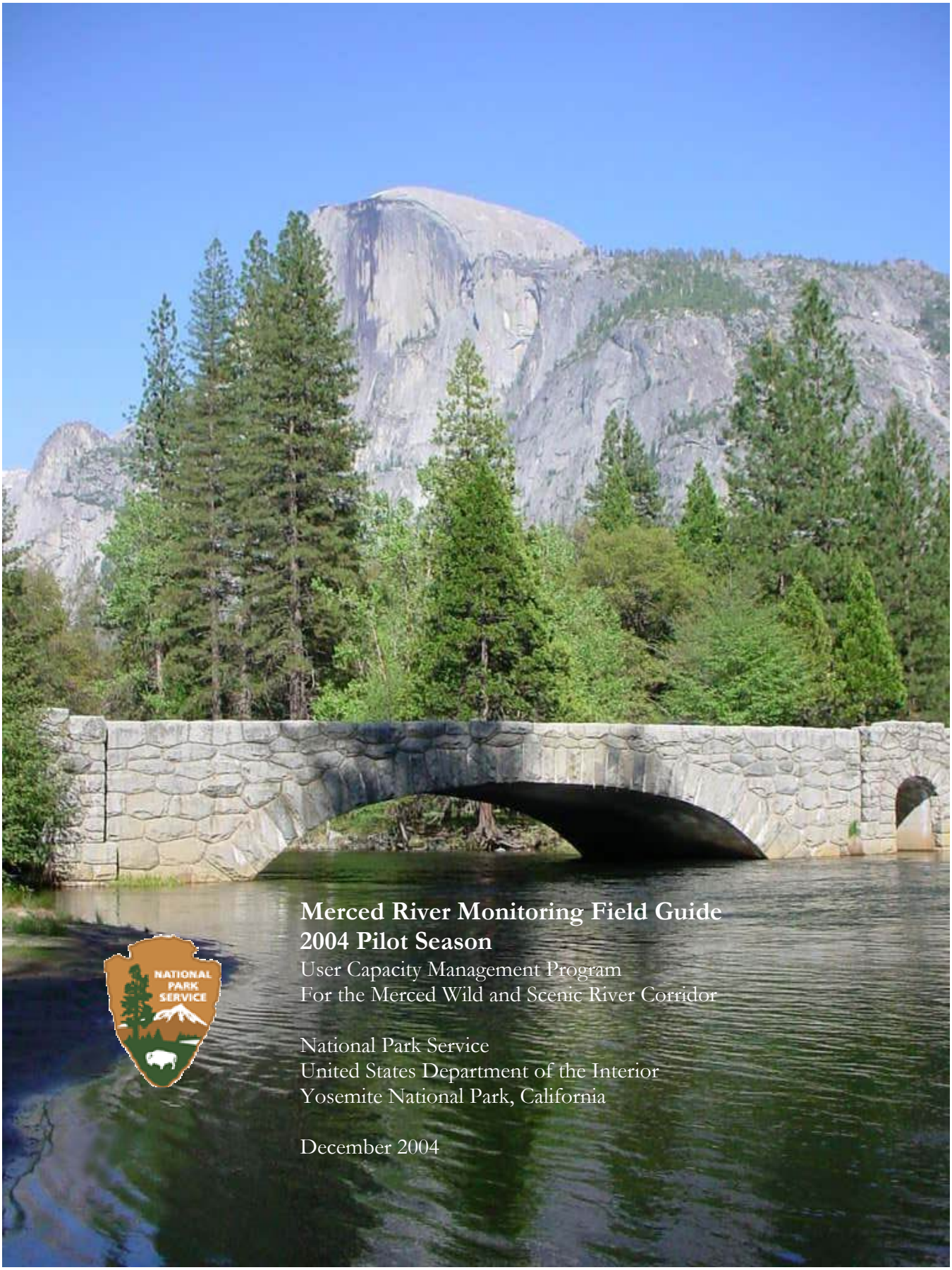

Merced River Monitoring Field Guide
2004 Pilot Season

User Capacity Management Program
For the Merced Wild and Scenic River Corridor

National Park Service
United States Department of the Interior
Yosemite National Park, California

December 2004

MERCED RIVER MONITORING FIELD GUIDE
2004 PILOT SEASON

USER CAPACITY MANAGEMENT PROGRAM
FOR THE MERCED WILD AND SCENIC RIVER CORRIDOR

NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

Yosemite National Park
California

December 2004

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A.0 INTRODUCTION

A.1 Background

The National Park Service (NPS)'s enabling legislation (the Organic Act of 1916) mandates park managers to protect and maintain the natural and scientific values of the park and to provide for public outdoor recreation (NPS 2000). These protection-visitor use dual mandates are applicable to all NPS units, including Yosemite National Park -- one of the most spectacular and visited national parks in the world. According to the Yosemite General Management Plan, there are two purposes for the park:

> "The first is preservation of the resources that contribute to Yosemite's uniqueness and attractiveness - its exquisite scenic beauty; outstanding wilderness values; a nearly full diversity of Sierra Nevada environments, including the very special sequoia groves; the awesome domes, valleys, polished granites, and other evidences of the geologic processes that formed the Sierra Nevada; historic resources, especially those relating to the beginnings of a national conservation ethic; and evidences of the Indians that lived on the land. The second purpose is to make the varied resources of Yosemite available to people for the individual enjoyment, education, and recreation, now and in the future." (YOSE 1980)

Yosemite National Park possesses an outstanding combination of natural and cultural resources, including sublime granite landforms, waterfalls and rich biological resources (NPS 1980). The Yosemite Valley and the Merced River Corridor within the park are major visitor destinations, attracting about 70% of all summer visitors (YOSE 2000). Paradoxically, the Merced River is central to the Valley's scenery and ecological processes. In 1987, Congress designated the Merced River a Wild and Scenic River to protect the river's free-flowing condition and protect and enhance its unique values for the benefit and enjoyment of present and future generations. Not surprisingly, the high intensity of visitation in this river corridor of high ecological value has posed some of the most significant management concerns, challenging park managers to develop effective and efficient management strategies for addressing important visitor use and impact issues. One of such issues is that of visitor carrying capacity or user capacity, which is often referred to as the appropriate type and amount of visitor use the park area can accommodate without compromising the park's management goals (YOSE 2004).

The Visitor Experience and Resource Protection (VERP) framework was developed to address the need of national parks for "identification of and implementation commitments for visitor carrying capacities for all areas of the unit" as mandated by the National Parks and Recreation Act of 1978 (P.L. 95-625). The amended Wild and Scenic Rivers Act also calls for a comprehensive management plan in which user capacities are addressed. The VERP process consists of nine steps, in which selecting resource and social indicators, establishing associated standards and developing monitoring protocols for these indicators are critical components (NPS 1997 and 2000). Since the early 1990s the VERP process has been initiated or implemented in a series of parks across the country. In Yosemite, the VERP process has been applied to develop plans for the future of Yosemite Valley and the Merced River Corridor (Manning et al. 2000, YOSE 2000, 2001 and 2004). It represents a significant effort of the park in tackling the visitor capacity issue through a systematic and adaptive management framework (NPS 1997). Through a deliberative process of VERP implementation ten indicators were selected and their associated standards established (YOSE 2004).

While the VERP framework has been implemented in different parks, very few of them have moved forward with the development and actual application of monitoring protocols for selected resource and social indicators (Leung et al. 2002, Monz and Leung 2003, Newman et al. 2001). In Yosemite's Merced River Corridor, effort is being put to address the monitoring need by developing this monitoring field guide that comprises sampling design, data collection procedures, data/statistical analysis methodology and annual reporting structure.

This project aims at providing scientific input on the development of monitoring protocols for the ten VERP indicators selected for the Merced River Corridor (YOSE 2004). This ½-mile wide, 81-mile long Corridor runs the length of the Main and South Forks of the Merced in Yosemite, from wilderness headwaters through the park to park and/or administrative area boundaries.

Management zoning for the Merced Wild and Scenic River corridor was established in the Merced Wild and Scenic River Comprehensive Management Plan. Management zones classify park areas and prescribe future desired resource conditions, visitor activities, and facilities. Management zones were established to protect and enhance the Outstandingly Remarkable Values within each zone. Zoning prescriptions address capacity by listing the typical activities and facilities allowed or not allowed in each zone. Management zones are illustrated in Figures 1, 2 and 3, which are reprinted from the *Merced Wild and Scenic River Comprehensive Management Plan*.

A.2 Indicators and Standards

The User Capacity Management Program describes ten selected indicators and specifies the zone(s) within the corridor for which each indicator and associated standard is applied (YOSE 2004). Indicators are measurable physical, social, or ecological variables that reflect the overall condition of a management zone. Standards are the minimum acceptable condition for each indicator variable. The *User Capacity Management Program for the Merced Wild and Scenic River Corridor* document can be referenced for more detailed information. The ten selected indicators and standards addressed in this field guide are:

- **Indicator—**Campsite Number
- **Standards:**

- **Zone 1A—**No net increase over baseline established during 3-5 year pilot phase.
- **Zone 1B—** No net increase over baseline established during 3-5 year pilot phase.

- **Indicator—**Campsite Condition
- **Standards:**

- **Zone 1A—** No net increase in campsite condition classes 3, 4 or 5 from established baseline.
- **Zone 1B—** No net increase in campsite condition classes 3, 4 or 5 from established baseline.

- **Indicator—**Number of Encounters with Other Parties
- **Standards:**

  - **Zone 1A—** No more than six encounters per day, 80 percent of the time.
  - **Zone 1B—** No more than six encounters per day, 80 percent of the time.

- **Indicator—**People at One Time at Selected Sites
- **Standards:**

  - **Zone 1C—**Not more than 20 people on a 50-meter section of the trail per day, 80 percent of the time.

- **Indicator—**Exposed Tree Roots in Wilderness Campsites
- **Standards:**

- **Zone 1D—**No more than 10% sampled trees with moderate or severe level of exposed tree roots.

- **Indicator—**Number of Social Trails
- **Standards:**

  - **Zone 2A—**No net increase in number from 2004 baseline for linear features. No social trails for wetland features.
  - **Zone 2A+—**No net increase in number from 2004 baseline.

- **Indicator—**Length of Social Trails in Meadows
- **Standards:**

  - **Zone 2B—**No net increase in total length of social trails when compared with baseline. Baseline established in 2004. Baseline will be updated as restoration actions are implemented and data is re-collected to reflect restoration effort.
  - **Zone 2C—**No net increase in total length of social trails when compared with baseline. Baseline established in 2004. Baseline will be updated as restoration actions are implemented and data is re-collected to reflect restoration effort.

- **Indicator—**River Bank Erosion that is Accelerated or Caused by Visitor Use
- **Standards:**

  - **Zone 2B—**No net increase over baseline in linear extent of river bank erosion that is accelerated or caused by visitor use; no river bank erosion that exceeds Condition Class 2.
  - **Zone 2C—**No net increase over baseline in linear extent of river bank erosion that is accelerated or caused by visitor use; no river bank erosion that exceeds Condition Class 2.

- **Indicator—**Exposed Tree Roots in Developed Campgrounds
- **Standards:**

  - **Zone 3A—**95 percent of campsites meet the no, slight, or moderate root exposure criteria as defined by inventory and monitoring guidelines (Marion, 1991)

- **Indicator—**Water Quality
- **Standards:**

  - **Zones 1D, 2A, 2C, 2D, 3A, 3B, and 3C—**Non-degradation from 5-year pilot monitoring. Non-exceedence of State requirement for recreational contact for fecal coliform.

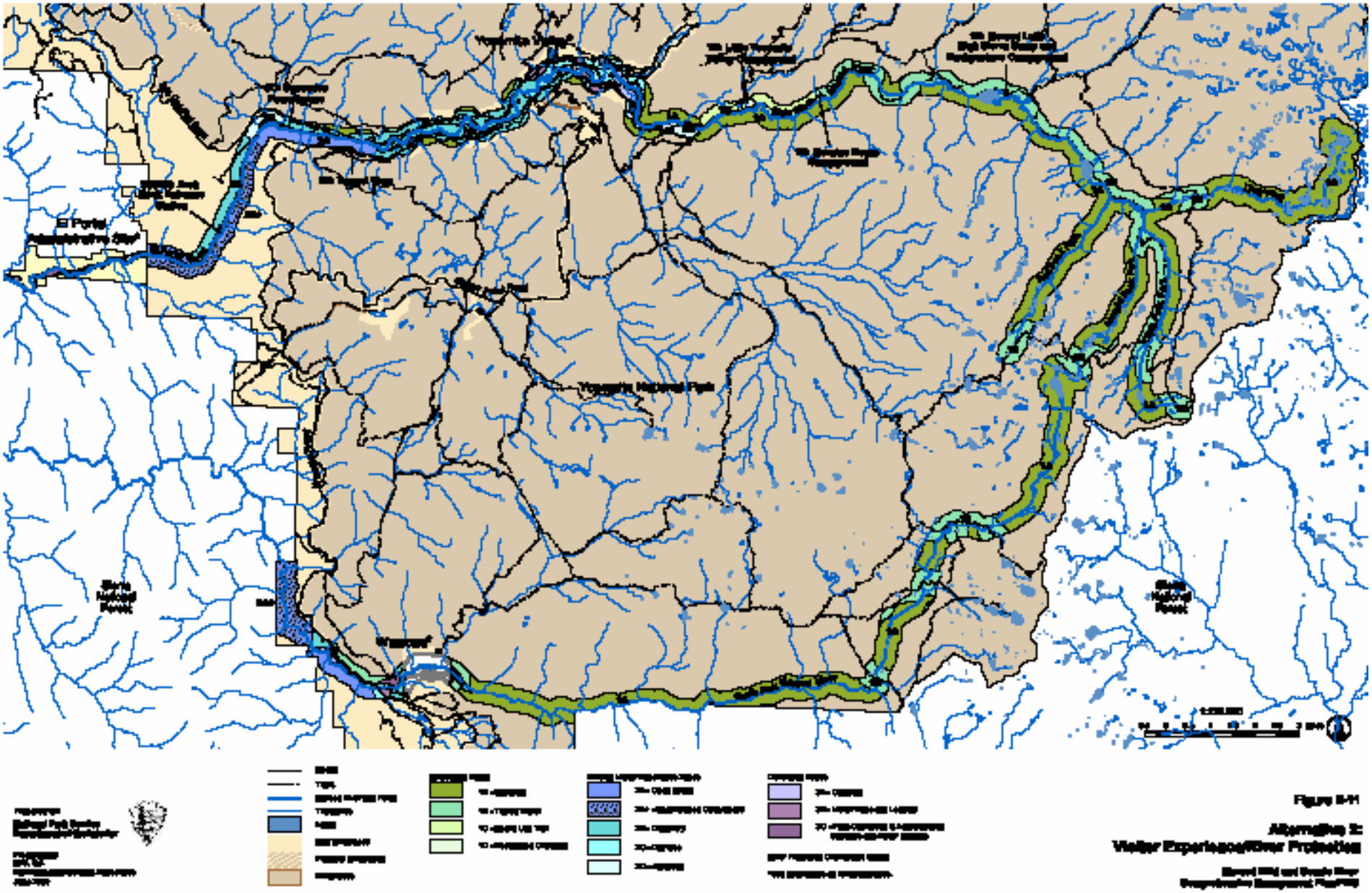


Figure 5-11

Alternative 3:
Visitor Experience/River Protection

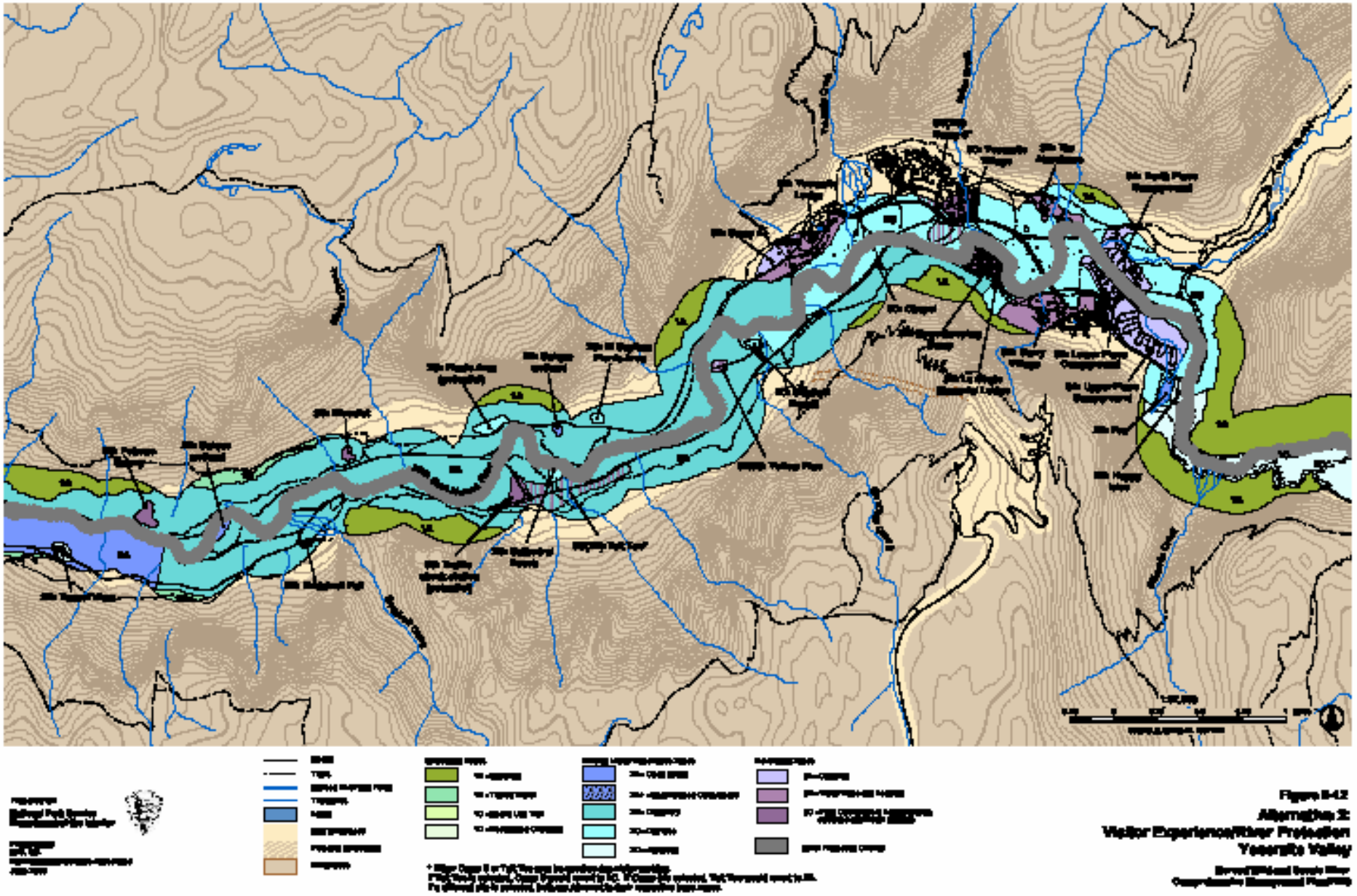


Figure 5-42
Alternative 2:
Visitor Experience/River Protection
Yosemite Valley

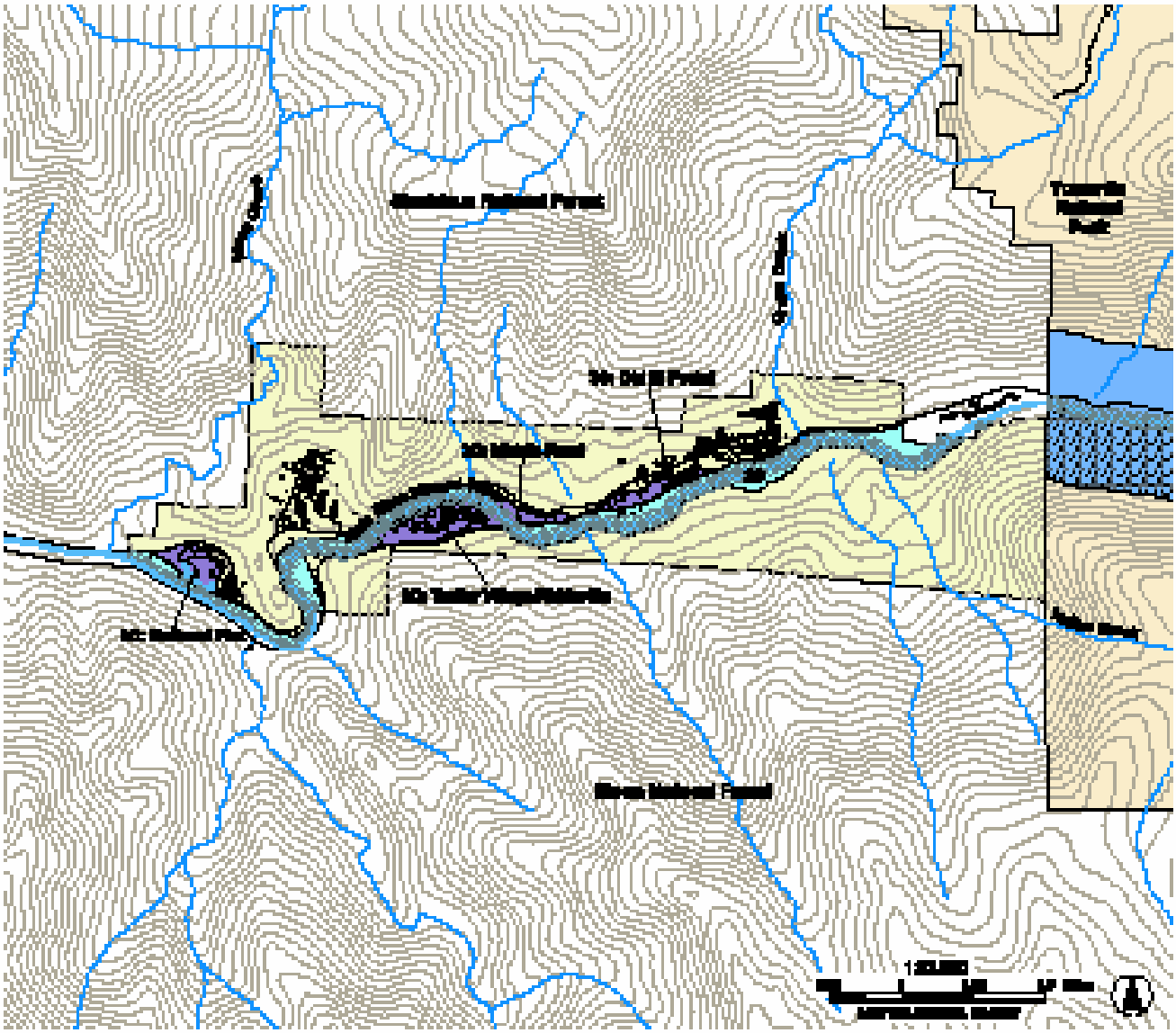


Figure II-13

Alternative 2:
Visitor Experience/River Protection
El Portal Administrative Site

Merced Wild and Scenic River
Comprehensive Management Plan/EIS

Prepared for:
National Park Service
Department of the Interior

Prepared by:
MIG, Inc.
Environmental Science Associates
June 2000

A.3 MONITORING PROTOCOLS AND SAMPLING

Monitoring resource and experiential conditions requires the development of monitoring protocols that allow NPS staff to collect data in order to understand current use, impact, and improvement trends. Creating a robust and accurate measurement strategy requires a good sampling plan. Sampling is a systematic approach to collecting data. A good sample will accurately represent estimates of population values. Watson et al (2000) outlined seven components of a good sampling strategy.

1. Bias in the sampling can be eliminated by randomization.
2. Probability sampling can be used to measure precision sample results.
3. Patterns and landscape characteristics of wilderness use do usually not allow for census measurements in a field season.
4. Good sampling strategies require fewer personnel hours.
5. Well designed sampling leads to higher accuracy in the data.
6. Flexibility is very important to managers challenged to multi-task and accomplish more work with fewer people.
7. Sampling should not burden visitors.

These sampling strategy components can be generalized to the indicators to be measured in the Merced River Corridor. However, we would like to add another component to this list. NPS staff pressed for time may not to be able to monitor as many times as they would like because of reduced budgets, fewer staff and other stochastic events such as weather, medical emergencies and unforeseen circumstances. In this case, NPS staff should know the standard error associated with the number of days or times that an indicator is measured. Generally, the higher the sample size, the lower the standard error. For several of the indicators, the standard error can be calculated to help NPS staff be informed about such conditions. All of these components of a good sampling strategy were incorporated into development of this field guide. Sampling strategies were developed for each indicator that will be efficient yet provide the data required to address whether any standard has been exceeded.

Although all of these considerations were incorporated into the development of this field guide, it is understood that it takes time to develop monitoring protocols that truly address changes in the natural or social environment. Recent research by United State Geological Survey and National Park Service staff concluded that long-term monitoring protocols take several years of field work and revisions to develop the level of confidence in the data for long-term monitoring (Oakley, et al, 2003).

This version of the field guide was prepared for use during the 2004 Pilot Season. The field guide will be revised/refined following the field season, and in subsequent years, as needed to improve monitoring methodology and procedures. This field guide is organized into the following sections.

Section A — Introduction. Provides background on the VERP and User Capacity Management Program and introduces the Indicators to be monitored in the 2004 Pilot Season.

Section B — Field Monitoring Protocols. Describes the field monitoring protocols to be completed for each Indicator for the 2004 Pilot Season.

Section C — Field Logistics. Describes field personnel responsibilities, typical work flow for monitoring activities, training for field personnel and debriefing activities.

Section D — Safety Plan. This section provides safety procedures for field personnel.

Section E — References. This section is the listing of background literature for development of this field guide.

Appendices — The appendices section includes background information on the development of campsite condition and campsite number sampling design. A glossary and a list of acronyms are also located in the appendices.

The results from the 2004 Pilot Season are presented in the *Merced River Monitoring Annual Report, 2004 Pilot Season*. That report is a separate document. The field monitoring results from the 2004 Pilot Season are analyzed and any changes proposed for field monitoring protocols for the 2005 Field Monitoring Season are discussed.

B.0 MERCED RIVER MONITORING FIELD GUIDE INDICATORS AND MONITORING PROTOCOLS

B.1 CAMPSITE NUMBER AND CAMPSITE CONDITION

B.1.1 Overview

This field protocol presents the procedures, data requirements, and field data collection sheets for conducting inventories of the number of campsites in backcountry and condition assessments of backcountry campsites. The User Capacity Program identified two zones that should be monitored to determine the quality of the resource and the effects of current management actions. Campsite Number and Campsite Condition were discussed separately in the User Capacity Management Program, however because the sampling sites for each indicator can be the same, it was determined that combining the two tasks would be more cost and time efficient. A more detailed description of these indicators is presented in the User Capacity Management Program on pages 45-48.

B.1.1.2 Zones:

- **Zone 1A: Untrailed**
- **Zone 1B: Trailed Travel**

B.1.1.3 Standards for Campsite Number:

- **Zone 1A Untrailed—**No net increase over baseline established during 3-5 year pilot phase.
- **Zone 1B Trailed Travel—**No net increase over baseline established during 3-5 year pilot phase.

B.1.1.4 Standards for Campsite Condition:

- **Zone 1A Untrailed—**No net increase in campsite condition classes 3, 4 or 5 from established baseline.
- **Zone 1B Trailed Travel—** No net increase in campsite condition classes 3, 4 or 5 from established baseline.

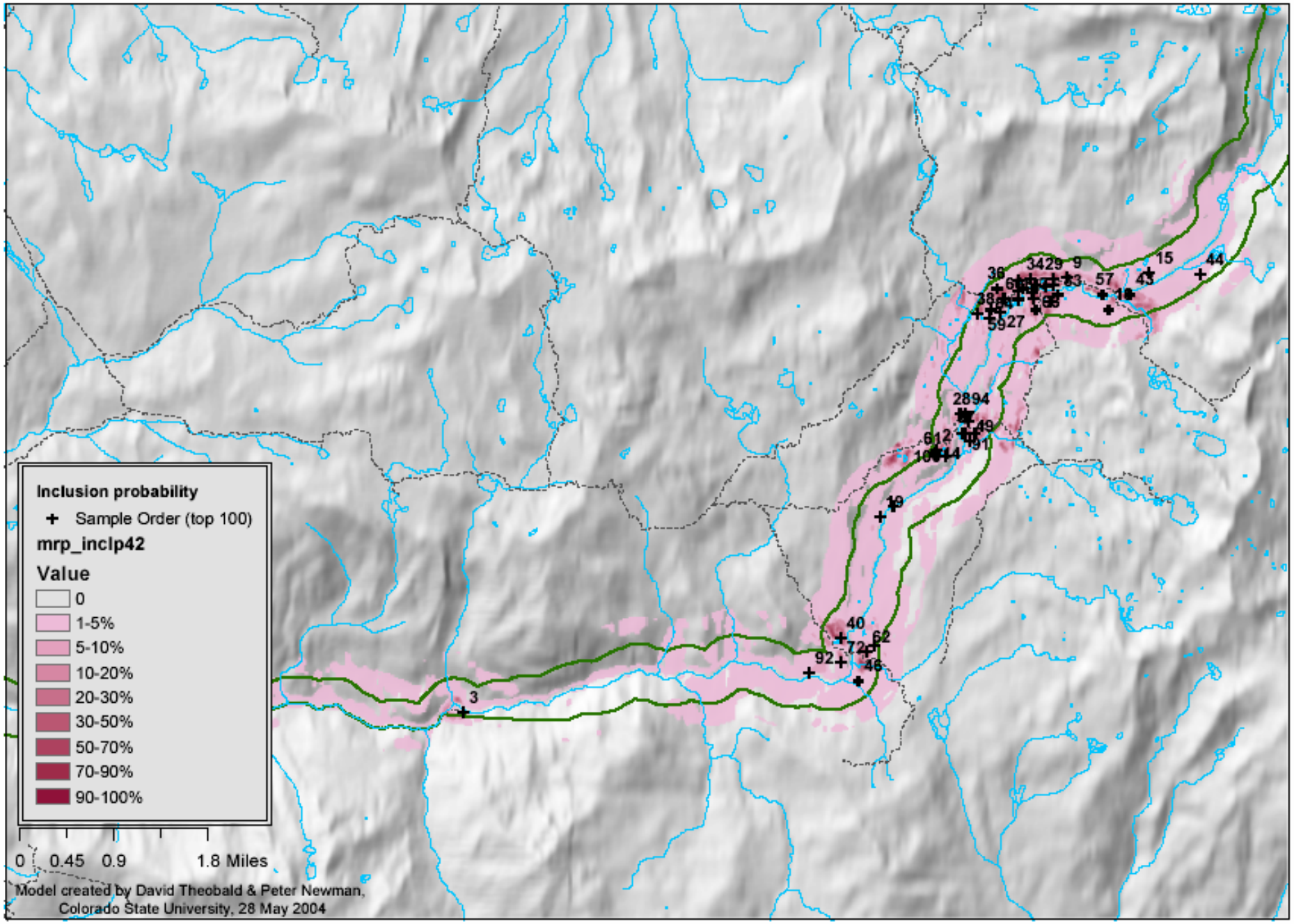
B.1.2 Sampling

The sampling plan for these indicators was developed through coordination with Yosemite wilderness management staff and development of a GIS model. The GIS model identified the most probable location for campsites along the Merced River and created a listing of sites to be monitored. Monitoring of these indicators will be conducted at the high priority sites. These are shown on Figure 4. A detailed explanation of the GIS model and sampling desing is provided in Appendix A.

B.1.3 Equipment and Supplies

- Map with location/directions to monitoring sites
- Compass
- GPS device
- Digital camera
- Topographic (field map) enlargements
- Clipboard and pencils
- Copy of Campsite Number and Campsite Condition Data Sheet Procedures on waterproof paper
- Copy of Campsite Number and Campsite Condition Data Sheets on waterproof paper

Sampling points



B.1.4 Quality Assurance

B.1.4.1 Training—Wilderness rangers with experience conducting campsite condition surveys will be responsible for training any NPS staff or volunteers without prior campsite condition monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Ability to navigate to target sites.
- Operate a GPS device.
- Make subjective determinations and make appropriate recordings of campground conditions.
- Field data entry into the Campsite Conditions database.

These skills will be verified through field training and assistance of qualified wilderness rangers.

B.1.5 Method of Performance

- Prior to beginning field work review Section C.0 - Field Logistics Protocols and Section D.0 - Safety Plan in this field guide.

- Prior to beginning fieldwork review baseline data and previous monitoring results.

- Refer to list of sites and map identifying sampling sites.

- Navigate to the assigned UTM coordinates

- Once you have arrived at the point, mark your center point with backpack or other instrument. See Figure 5 below.

- Inventory 1 (Center Point): Pace out 25 meters or approximately 75 feet or 30 paces. Search the 25 meter radius circle around the center point for campsites. Count and record the number of sites in the circle.

- For each campsite you find, determine the impact class using the impact level photos located in Figure 6 as your baseline. Note presence or absence of obsidian.

- Record data on data sheet

- Return GPS unit and data sheets to wilderness management office. Information on data sheets will be entered into the Campsite Number and Campsite Condition database. Photographs will be downloaded to a CD and stored in the Campsite Number and Campsite Condition administrative file. Field maps will be stored in the Campsite Number and Campsite Condition administrative file.

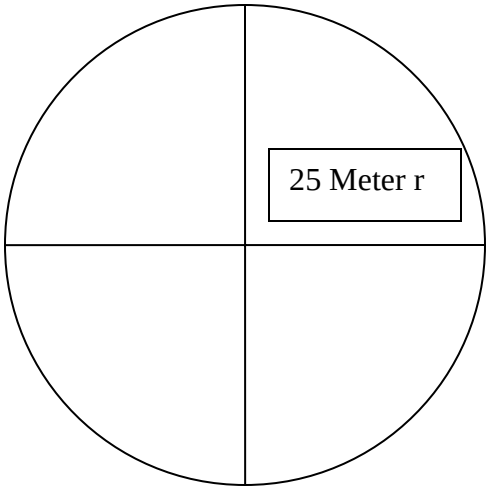


Figure 5. Schematic of sampling plan. The circle represents a 25 meter radius.

B.1.6 Campsite Number and Campsite Condition Data Sheet Procedures

B.1.6.1 Record Data:

- **Field Monitor(s):** Record name(s) of field monitors.
- **Date of Survey:** Day/Month/Year (August 8, 2004 = 08/08/04)
- **Number of campsites:** Record the number of campsites within 50 meter survey area.
- **Campsite Class:** Rate overall general appearance of campsite by the condition classes shown. Refer to photo examples of Campsite Class.

  Class 3—Trash, windbreaks, seats mostly moderate--fire ring mostly minimal to moderate; most vegetation cover lost and/or organic litter pulverized on much of the site, but humus and litter still present in all but a few areas. (Holmes Type B)

  Class 4—Trash, windbreaks, seats, fire rings, and paraphernalia mostly, moderate, some heavy; litter more or less absent, pulverized, ground into soil; bare soil widespread throughout primary use area; significant vegetation loss on non-primary use areas. (Holmes Type C)

  Class 5—Heavily developed campsite; litter cones and duff completely absent; bare soil extensive, vegetation loss extensive. (Holmes Type D)
- **Presence or absence of obsidian:** Record whether obsidian is present in each campsite.

B.1.7 Merced River Monitoring Field Guide Campsite Number and Campsite Condition Data Sheet

The Campsite Number and Campsite Condition Data Sheets are on the following pages.

Name:							Date:		
Site Order	UTM X Value	UTM Y Value	# of Campsites in 50 Meter Circle	# of Class 1	# of Class 2	# of Class 3	# of Class 4	# of Class 5	# of Sites Within 100' of Water
1	293873.6	4170955.1							
2	284663.6	4161175.1							
3	277403.6	4157155.1							
4	291263.6	4176385.1							
5	285893.6	4179985.1							
6	285923.6	4163515.1							
7	286163.6	4163515.1							
8	288773.6	4179295.1							
9	286673.6	4163845.1							
10	286343.6	4163695.1							
11	288443.6	4179265.1							
12	289043.6	4179055.1							
13	285683.6	4163515.1							
14	284663.6	4161085.1							
15	287933.6	4163905.1							
16	283703.6	4158175.1							
17	286193.6	4163725.1							
18	287303.6	4163335.1							
19	283793.6	4160155.1							
20	293333.6	4170205.1							
21	286133.6	4179775.1							
22	289973.6	4177855.1							
23	293903.6	4172575.1							
24	292973.6	4175395.1							
25	293063.6	4170145.1							

Site Order	UTM X Value	UTM Y Value	# of Campsites in 50 Meter Circle	# of Class 1	# of Class 2	# of Class 3	# of Class 4	# of Class 5	# of Sites Within 100' of Water
26	288923.6	4179235.1							
27	285653.6	4163305.1							
28	285023.6	4161745.1							
29	286463.6	4163815.1							
30	286643.6	4179445.1							
31	284003.6	4160335.1							
32	285503.6	4180015.1							
33	293813.6	4168285.1							
34	286103.6	4163815.1							
35	289343.6	4171165.1							
36	285593.6	4163665.1							
37	285263.6	4161445.1							
38	285293.6	4163275.1							
39	286283.6	4179775.1							
40	283193.6	4158295.1							
41	285923.6	4163785.1							
42	286553.6	4179595.1							
43	287633.6	4163575.1							
44	288713.6	4163875.1							
45	288623.6	4179415.1							
46	283463.6	4157635.1							
47	285473.6	4179925.1							
48	293063.6	4174195.1							
49	285173.6	4161325.1							
50	285923.6	4163485.1							
51	293063.6	4170295.1							

Site Order	UTM X Value	UTM Y Value	# of Campsites in 50 Meter Circle	# of Class 1	# of Class 2	# of Class 3	# of Class 4	# of Class 5	# of Sites Within 100' of Water
52	285143.6	4161625.1							
53	285623.6	4179925.1							
54	286463.6	4163725.1							
55	289043.6	4178605.1							
56	286553.6	4179565.1							
57	287213.6	4163575.1							
58	290783.6	4169695.1							
59	285503.6	4163335.1							
60	285713.6	4163515.1							
61	284633.6	4161145.1							
62	283583.6	4158085.1							
63	285263.6	4179865.1							
64	293933.6	4173025.1							
65	293543.6	4171105.1							
66	286193.6	4163335.1							
67	285533.6	4180105.1							
68	288143.6	4179355.1							
69	285863.6	4180015.1							
70	284483.6	4179445.1							
71	292763.6	4172575.1							
72	283193.6	4157935.1							
73	291173.6	4169935.1							
74	285053.6	4161445.1							
75	285683.6	4180225.1							
76	286133.6	4163605.1							
77	288743.6	4179235.1							

Site Order	UTM X Value	UTM Y Value	# of Campsites in 50 Meter Circle	# of Class 1	# of Class 2	# of Class 3	# of Class 4	# of Class 5	# of Sites Within 100' of Water
78	289013.6	4178635.1							
79	285983.6	4163665.1							
80	293183.6	4169875.1							
81	295073.6	4175665.1							
82	289013.6	4179025.1							
83	286523.6	4163575.1							
84	285473.6	4163215.1							
85	291953.6	4175725.1							
86	290873.6	4169755.1							
87	285653.6	4180135.1							
88	294053.6	4173715.1							
89	285353.6	4179985.1							
90	293663.6	4171525.1							
91	285113.6	4161445.1							
92	282713.6	4157755.1							
93	287963.6	4179415.1							
94	285113.6	4161745.1							
95	288323.6	4179385.1							
96	289073.6	4178545.1							
97	285923.6	4163635.1							
98	286403.6	4163455.1							
99	293963.6	4167925.1							
100	284813.6	4161085.1							
TOTAL # OF SITES									

Figure 6: Campsite Number and Campsite Condition
Campsite Class Photo Examples

Class 1	
Class 2	
Class 3	

Figure 6: Campsite Number and Campsite Condition
Campsite Class Photo Examples (Continued)

Class 4	
Class 5	

B.2 NUMBER OF ENCOUNTERS WITH OTHER PARTIES

B.2.1 Overview

This field protocol presents the procedures, data requirements and data collection procedures for the number of encounters Yosemite NP rangers or volunteers have with visitors on trails. The User Capacity Management Program identified two zones that should be monitored. A more detailed description of this indicator is presented on page 49 of the User Capacity Management Program.

B.2.1.1 Zones:

- **Zone 1A: Untrailed**
- **Zone 1B: Trailed Travel**

B.2.1.2 Standards:

- **Zone 1A: Untrailed—**No more than six encounters per day, 80 percent of the time.
- **Zone 1B: Trailed Travel—** No more than six encounters per day, 80 percent of the time.

B.2.2 Sampling

Sampling along trails in Zones 1A and 1B could occur during ranger/volunteer patrols as shown in the following schedule (Figure 7). The schedule in Figure 7 is a representative example and does not reflect the actual calendar for any particular year.

This data should be collected during both the morning and afternoon of weekdays and weekend days to ensure that the sample is accurate, and should be filed in morning and afternoon sections for weekdays, weekends, holidays and trail segment. Sampling should capture hikers in the vicinity of the High Sierra Camps. This schedule provides a total of 10 normal weekday samples and 2 holiday weekday samples, as well as 10 normal weekend samples and 2 holiday weekend samples. In this schedule, Monday – Thursday constitutes weekdays, while Friday – Sunday constitutes weekend days. An example of a sampling schedule can be seen in Figure 7. This scheme in Figure 7 is a representative example and does not reflect the actual calendar for any particular year.

Figure 7 – Example of a Sampling Schedule for Number of Encounters with other Parties

June						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
31 (May) Holiday Weekday Sample	1	2	3	4	5 Weekend Sample	6
7	8 Weekday Sample	9	10	11	12	13
14	15	16	17	18	19 Weekend Sample	20
21	22	23 Weekday Sample	24	25	26	27
28	29	30				

July						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
			1	2 Holiday Weekend Sample	3	4
5	6 Weekday Sample	7	8	9	10	11 Weekend Sample
12	13	14	15 Weekend Sample	16	17 Weekend Sample	18
19	20	21 Weekday Sample	22	23	24	25
26 Weekday Sample	27	28	29	30 Weekend Sample	31	

August						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
						1 Weekend Sample
2	3	4 Weekday Sample	5	6	7	8
9	10	11	12 Weekday Sample	13 Weekend Sample	14	15
16 Weekday Sample	17	18	19	20	21 Weekend Sample	22
23	24 Weekday Sample	25	26	27	28	29 Weekend Sample
30	31					

September						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
		1	2	3	4 Holiday Weekend Sample	5
6 Holiday Weekday Sample	7	8	9	10	11	12 Weekend Sample
13	14	15 Weekday Sample	16	17 Weekend Sample	18	19
20 End Data Collection	21	22	23	24	25	26
27	28	29	30			

B.2.3 Equipment and Supplies

- Pencils
- Watch
- Number of Encounters data sheet/index card

B.2.4 Quality Assurance

B.2.4.1 Training—Wilderness rangers with experience in recording encounters with parties will be responsible for training any NPS staff or volunteers without prior monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Adjust hiking speed to approximate the typical speed of a visitor. Typical hiking speed would be approximately 2 miles per hour.
- Make appropriate recordings of encounter data on ranger patrol card.
- Data entry into the Number of Encounters database.

These skills will be verified through field training and assistance of qualified wilderness rangers.

B.2.5 Method of Performance

- Prior to beginning field work review Section C.0 - Field Logistics Protocols and Section D.0 - Safety Plan in this field guide.

- An NPS staff member should hike in Zones 1A and 1B dressed in civilian clothing to blend with visitors. Civilian appearance is to ensure that visitors react as they would to another visitor, not a staff member, to prevent data contamination.

- Using the watch, NPS staff/volunteer should make sure that his or her pace does not exceed 2 miles per hour (approx. 1 minute per 50 meters), the average visitor hiking speed for a flat or low angle trail.

- Every time the staff member/volunteer enters a new trail segment, that information needs to be recorded on the data sheet/index card. Any encounters within that zone will then be recorded.

- During patrols in Zones 1A and 1B, NPS staff/volunteer will count and record the number of parties they encounter along that trail section. This can be recorded into a small notebook or on index cards while hiking.

- NPS staff/volunteers will only count parties that are close enough to establish verbal or eye contact. Parties camped close to the trail, that can be seen and talked to from the trail will count. Parties found by leaving the trail to specifically look for campers or to perform other administrative tasks will not count

- At the conclusion of the hike, the data should be transposed onto an Encounter Record Sheet, which should be filed until the end of the data collection period.

- Return data sheet/index cards to the wilderness management office and enter information in the Number of Encounters with other Parties database.

B.2.6 Number of Encounters with other Parties Data Sheet Procedures

When encounters with parties occur along a trail or are visible from the trail, record the following data:

- **Field Monitor Name(s):** Record field monitor name(s).

- **Date:** Day/Month/Year (August 8, 2004 = 08/08/04).

- **Start Time:** Record time entering trail segment.

- **End Time:** Record time leaving trail segment.

- **Segment:** Record the trail segment number.

- **Number of Parties:** Record the number of parties encountered.

B.2.7 Number of Encounters with Other Parties Field Data Sheet/Index Card

Name_____

Date	Segment	Start Time	End Time	# of Parties

Segments:

1B Zone		1A Zone	
Moraine-Echo	1	Red Peak Fork	5
Echo-MLRS	2	Merced Peak Fork	6
MLRS-Washburn	3	Lyell Fork	7
Washburn-Junction	4	South Fork	8

B.3 PEOPLE AT ONE TIME AT SELECTED SITES

B.3.1 Overview

This field protocol presents the procedures, data requirements and data collection procedures for surveying People At One Time at Selected Sites (PAOT) in a section of trail from Moraine Dome Campground to the top of Nevada Fall. Monitoring for this indicator will be facilitated by a Yosemite ranger or volunteer. The User Capacity Management Program focuses on one zone in the park to monitor for exceptionally high volumes of hikers. A more detailed description of this indicator is presented on page 51 in the User Capacity Management Program.

Zone:

- **Zone 1C: Heavy Use Trail**

Standard:

- **Zone 1C: Heavy Use Trail—**Not more than 20 people on a 50-meter section of the trail per day, 80 percent of the time.

B.3.2 Sampling

A 50 meter section of trail in Zone 1C will be sampled. Sampling for PAOT should cover mornings and afternoons for both weekdays and the weekends. Sampling should capture early and late day hikers to and from Half Dome. This schedule provides a total of 10 normal weekday samples and 2 holiday weekday samples, as well as 10 normal weekend samples and 2 holiday weekend samples. In this schedule, Monday – Thursday constitutes weekdays, while Friday – Sunday constitutes weekend days. Adherence to this schedule will generate the sample sizes for PAOT on a Zone 1C trail. Efforts should be made to sample early and late daily and seasonally. Depending on the resulting variance from the 2004 Pilot Season, it may be necessary to increase the sample size (see the discussion on confidence levels following Figure 8. Sample sizes are summarized in Table 1. An example of a sampling schedule can be seen in Figure 8. The schedule in Figure 8 is a representative example and does not reflect the actual calendar for any particular year.

Table 1
Sample Sizes for People At One Time

Type of Sample	*Sample Size*
Weekday Morning	300
Weekday Afternoon	300
Weekend Morning	360
Weekend Afternoon	360
Holiday Weekday Morning	60
Holiday Weekday Afternoon	60
Holiday Weekend Morning	60
Holiday Weekend Afternoon	60

Figure 8 – Example of a Sampling Schedule for People at One Time

June						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
31 (May) Holiday Weekday Sample	1	2	3	4	5 Weekend Sample	6
7	8 Weekday Sample	9	10	11	12	13
14	15	16	17	18	19 Weekend Sample	20
21	22	23 Weekday Sample	24	25	26	27
28	29	30				

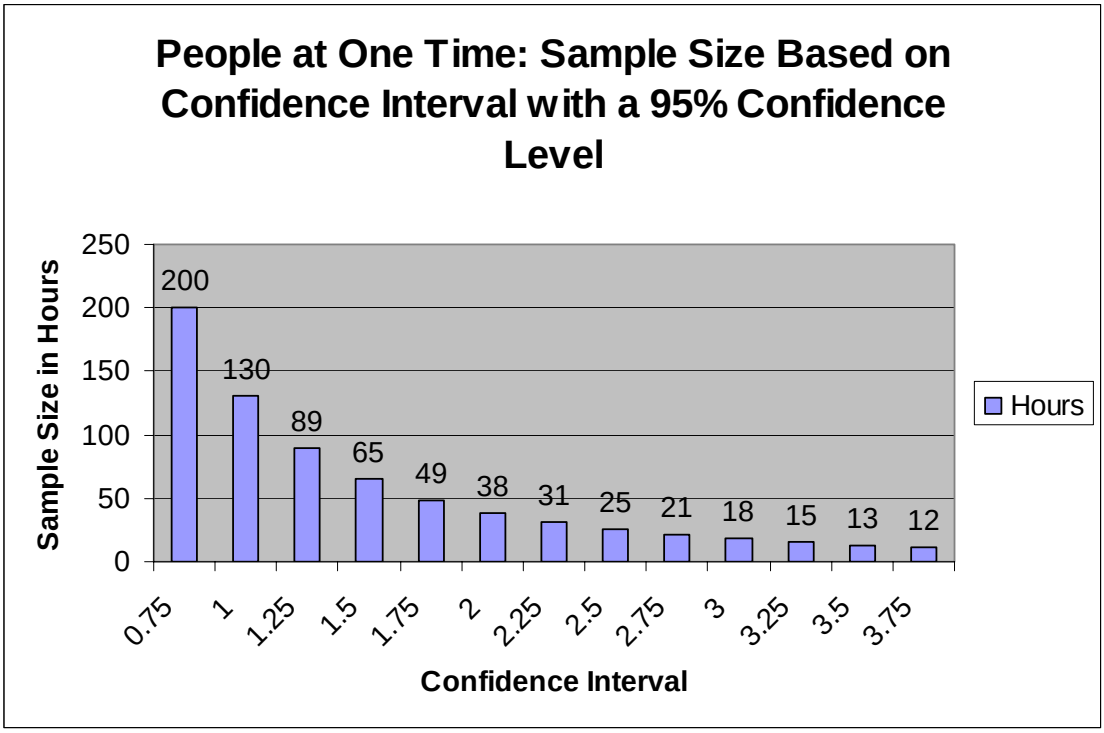
July						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
			1	2 Holiday Weekend Sample	3	4
5	6 Weekday Sample	7	8	9	10	11 Weekend Sample
12	13	14	15 Weekday Sample	16	17 Weekend Sample	18
19	20	21 Weekday Sample	22	23	24	25
26 Weekday Sample	27	28	29	30 Weekend Sample	31	

August						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
						1 Weekend Sample
2	3	4 Weekday Sample	5	6	7	8
9	10	11	12 Weekday Sample	13 Weekend Sample	14	15
16 Weekday Sample	17	18	19	20	21 Weekend Sample	22
23	24 Weekday Sample	25	26	27	28	29 Weekend Sample
30	31					
September						
Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
		1	2	3	4 Holiday Weekend Sample	5
6 Holiday Weekday Sample	7	8	9	10	11	12 Weekend Sample
13	14	15 Weekday Sample	16	17 Weekend Sample	18	19
20 End Data Collection	21	22	23	24	25	26
27	28	29	30			

NPS staff should determine the sample size that is feasible within a given field season and plan accordingly. The chart below illustrates confidence intervals based on a 95% confidence level. The **confidence interval** is the plus-or-minus figure that is often used in newspaper or television opinion poll results. For example, if a confidence interval of 5 is used and 60% percent of the sample results in an answer, then staff can be "95% sure" that if staff had asked the question of the entire relevant population, between 55% (60-5) and 65% (60+5) would have picked that answer.

The **confidence level** tells how sure staff can be in the results. It is expressed as a percentage and represents how often the true percentage of the population who would pick an answer lies within the confidence interval. The 95% confidence level means staff can be 95% certain; the 99% confidence level means staff can be 99% certain. Most researchers use the 95% confidence level.

When NPS staff put the confidence level and the confidence interval together, then one can say that they are 95% sure that the true percentage of the population is between 55% and 65%. If the average PAOT is 15 and the confidence interval is 2 then staff can be 95% sure the PAOT on that section of trail is between 13 (15-2) and 17 (15+2).



B.3.3 Equipment and Supplies

- Map with location/directions to monitoring site
- Clipboard/pencils
- Instructions for PAOT data sheet on waterproof paper
- Watch with second hand (plus a stopwatch?)
- PAOT data sheet on waterproof paper

B.3.4 Quality Assurance

B.3.4.1 Training—Wilderness rangers with experience in taking manual counts of visitors along trails will be responsible for training any NPS staff or volunteers without prior experience. Prior to installation of trail monitors, any NPS staff and volunteers without experience will be required to demonstrate the ability to:

- Accurately count the number of visitors along marked trail section.
- Enter data into the PAOT database.

These skills will be verified through field training and assistance of qualified wilderness rangers.

B.3.5 Method of Performance

- Prior to beginning field work review Section C.0 - Field Logistics Protocols and Section D.0 - Safety Plan in this field guide.
- Prior to beginning fieldwork review baseline/background data.
- Refer to map identifying sampling site.
- Consult photos or experienced sampler to locate natural viewscape markers.

- The NPS staff member will then station himself or herself in a position that permits vision of the complete viewscape and low visitor interaction levels. This is illustrated in Figure 9. The NPS staff member should be clothed in normal attire to prevent visitor delay in the viewscape due to personal interaction.

- The NPS staff member should record the amount of people visible in the viewscape at the beginning of each minute, every minute for an hour. For example, if four people are present in the viewscape at 12:01:00 pm, and another walks in at 12:01:03 pm, the staff member should record 4 in the PAOT field data sheet. Figure 10 illustrates a completed field data sheet.

- This data should be collected on weekdays and weekends, during the morning and afternoon. It is also important to note whether or not the day in question is a holiday.

- When sampling is completed return GPS unit and data sheets to Wilderness Management office. GPS unit will be given to GIS for download. Information on data sheets will be entered into the PAOT database.

Figure 9: Example of People at One Time viewscape

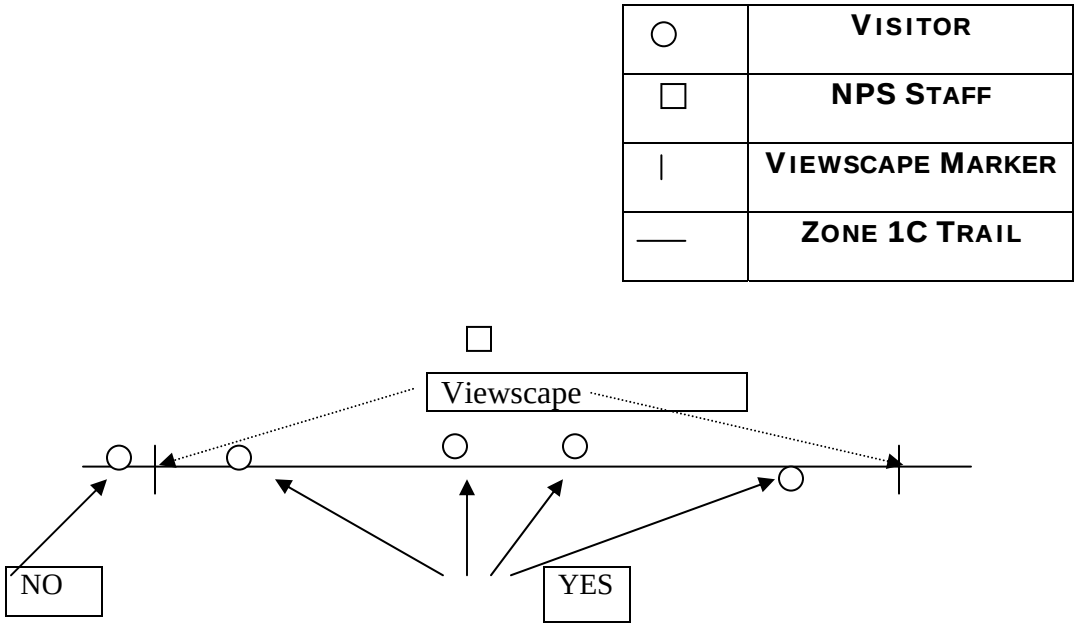


Figure 10 - Example of Table for Recording People at One Time

TIME:	# of People in Viewscape:	TIME:	# of People in Viewscape:
2:00 PM	0	2:30 PM	0
2:01 PM	2	2:31 PM	3
2:02 PM	4	2:32 PM	2
2:03 PM	5	2:33 PM	0
2:04 PM	6	2:34 PM	0
2:05 PM	1	2:35 PM	0
2:06 PM	3	2:36 PM	1
2:07 PM	0	2:37 PM	1
2:08 PM	0	2:38 PM	3
2:09 PM	0	2:39 PM	5
2:10 PM	1	2:40 PM	1
2:11 PM	2	2:41 PM	4
2:12 PM	0	2:42 PM	1
2:13 PM	3	2:43 PM	3
2:14 PM	4	2:44 PM	0
2:15 PM	1	2:45 PM	2
2:16 PM	0	2:46 PM	1
2:17 PM	3	2:47 PM	0
2:18 PM	6	2:48 PM	2
2:19 PM	2	2:49 PM	5
2:20 PM	6	2:50 PM	3
2:21 PM	2	2:51 PM	2
2:22 PM	0	2:52 PM	2
2:23 PM	1	2:53 PM	1
2:24 PM	0	2:54 PM	0
2:25 PM	0	2:55 PM	0
2:26 PM	0	2:56 PM	5
2:27 PM	0	2:57 PM	1
2:28 PM	0	2:58 PM	2
2:29 PM	2	2:59 PM	5

B.3.6 People at One Time Data Sheet Procedures

B.3.6.1 Record the following data:

- **Field Monitor Name(s):** Record field monitor name(s).
- **Trail segment:** Record the trail segment where the monitoring was conducted.
- **Date:** Day/Month/Year (August 8, 2004 = 08/08/04).
- **Day of Week:** Record the day that the monitoring occurred.
- **Holiday:** Record whether or not the monitoring occurred on a holiday.
- **UTM:** Record the GPS coordinates for both viewscape markers.
- **Time:** The time will be recorded each minute during an hour-long monitoring session.
- **Number of People:** Record the number of people observed in the viewscape for that minute.

B.3.7 Merced River Monitoring Field Guide People at One Time Field Data Sheet

Field Monitors: ____

Trail Segment: _______________ Date: _________________

Day of Week: ______________________ Holiday (Y or N): ______

UTM 1: _____________________ UTM 2: _____________________

TIME:	# of People in Viewscape:	TIME:	# of People in Viewscape:

B.4 EXPOSED TREE ROOTS IN WILDERNESS CAMPSITES

B.4.1 Overview

This field protocol presents the procedures, data requirements and data collection procedures for surveying exposed tree roots. The User Capacity Management Program focuses on one zone in the park to monitor for soil erosion caused by human or stock use. The field monitoring will be conducted at the Little Yosemite Valley (LYV) Campground. A more detailed description of this indicator is presented on page 53 in the User Capacity Management Program.

B.4.1.1 Zone:

- **Zone 1D: Designated Overnight**

B.4.1.2 Standard:

- **Zone 1D: Designated Overnight—**No more than 10% sampled trees with moderate or severe level of exposed tree roots.

B.4.2 Sampling

This indicator will be monitored in 1D Zone (LYV).

Monitoring should occur during the late summer or early Fall (i.e., near or right after the peak use season). A representative sample of trees from the campground can be monitored every 1-2 years depending on the available labor and resources. This monitoring effort may be performed by park staff during regular patrol duties or by volunteers with sufficient training.

B.4.3 Equipment and Supplies

- Map with location/directions to monitoring sites.
- Compass
- GPS device
- Tape measure
- Digital camera
- Topographic map enlargements of monitoring sites
- Parachute cord or equivalent tool (150 -200 m)
- Nails or similar anchoring devices
- Clipboard/pencils
- Instructions for tree root exposure data sheet on waterproof paper
- Tree root exposure data sheet on waterproof paper

B.4.4 Quality Assurance

B.4.4.1 Training—Wilderness rangers with experience conducting sampling for tree root exposure will be responsible for training any NPS staff or volunteers without prior tree root exposure monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Navigate to monitoring sites.
- Operate a GPS device.

- Make visual determinations and make appropriate recordings of tree root exposure conditions.
- Enter data into the Exposed Tree Root database.

These skills will be verified through field training and assistance of qualified wilderness rangers or volunteers.

B.4.5 Method of Performance

- Prior to beginning field work review Section C.0 - Field Logistics and Section D.0 - Safety Plan of this field guide.

- Prior to beginning fieldwork review baseline data and previous survey results.

- The *Northwest* corner of the composter structure located at the western end of the campground is to be used as the *Principal Reference Point* (NW), which should be documented using GPS and a photograph. (See diagram on next page)

- Three west-east (i.e., 90^{o} orientation) line transects are established. The northern transect starts at the NW (i.e., composter) and extends through the campground to the eastern edge of the campground. A parachute cord and nails can be used to set up the transect physically. The tree or permanent feature (e.g., boulder) at the eastern edge *closest* to the transect is selected as a reference point (NE). This point should be photographed and mapped using GPS. (See diagram on next page)

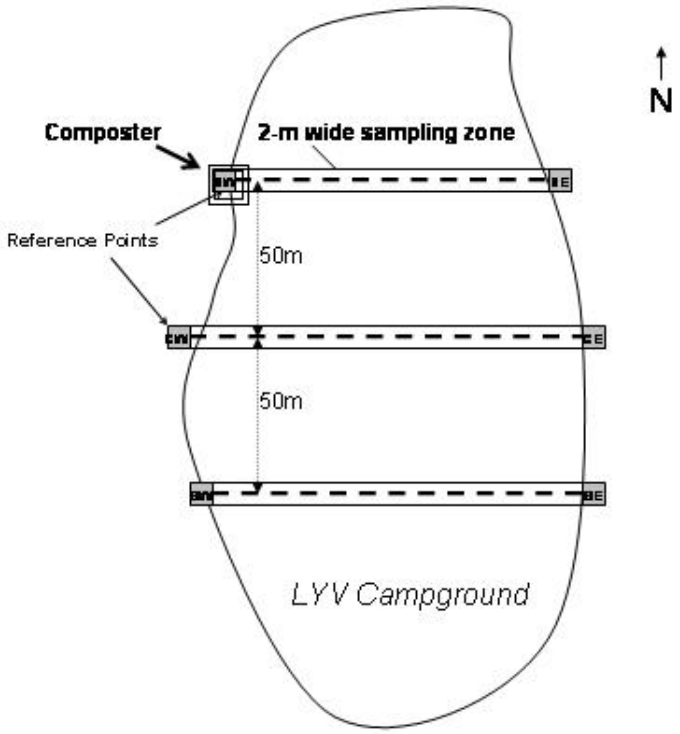
- The other two transects (i.e., the central and southern transects) are set up so that they start at the western edge of campground and run parallel to and are *50 meters* and *100 meters* from the northern transect, respectively. The tree or permanent feature at the western edge close to each transect is selected as a reference point (CW, SW). Similarly, the tree or permanent feature at the western edge close to each transect is selected as a reference point (CE, SE). A parachute cord and nails can be used to set up each transect physically. These four reference points should be photographed and mapped using GPS. (See diagram on next page)

- Live trees (>1 in. diameter at 4.5 ft.) are assessed within a 2-m sampling zone along each transect (i.e., 1 m on either side). All trees that *entirely or partly* fall within the sampling zone should be assessed.

- Tally each tree to one of the root exposure rating classes described below based on the Marion (1991) rating system. Where obvious, assess trees with roots exposed by natural causes (e.g., stream/river flooding) as None/Slight:
  - *None/Slight* - No or slight root exposure such as is typical in adjacent offsite areas.
  - *Moderate* - Top half of many major roots exposed more than one foot from base of tree.
  - *Severe* - Three-quarters or more of major roots exposed more than one foot from base of tree; soil erosion obvious

- Photos are used to enhance the consistency of assessment. Refer to the photo examples in Figure 11 to aid in making determination of Tree Root Exposure rating.

- Return GPS unit and data sheets to Wilderness Management office. GPS unit will be given to GIS for download after the first field visit. Information on data sheets will be entered into the Exposed Tree Roots (Little Yosemite Campground) database. Photographs will be downloaded to a CD and stored with the field map in the Exposed Tree Roots (LYV) administrative file.



B.4.6 Exposed Tree Roots (LYV) Data Sheet Procedures

B.4.6.1 Record Data:

- **Date of Survey:** Record Day/Month/Year (August 8, 2004 = 08/08/04)
- **Field Monitor(s):** Record the name(s) of field monitors.
- **Transect Number:** (N, C, or S)
- **UTM Coordinates:** Record coordinates of six reference points using a GPS device.
- **Tree Root Exposure Code:** Use Marion (1991)'s rating system to evaluate each tree within 1 m of each transect and assign its root exposure condition into none/slight, moderate or severe category.

B.4.7 Merced River Monitoring Field Guide Exposed Tree Roots (LYV) Field Data Sheet

Date: ____________________ Transect No. (N/C/S)**:** __________________
UTM: West Ref. Point ________________ **East Ref. Point** ______________
Field Monitors: ____

- Tally of trees in each condition rating:

None/Slight ____
____
____(Total:)

Moderate ____
____
____(Total:)

Severe ____
____
____(Total:)

Date: ____________________ Transect No. (N/C/S)**:** __________________
UTM: West Ref. Point ________________ **East Ref. Point** ______________
Field Monitors: ____

- Tally of trees in each condition rating:

None/Slight ____
____
____(Total:)

Moderate ____
____
____(Total:)

Severe ____
____
____(Total:)

Date: ____________________ Transect No. (N/C/S)**:** __________________
UTM: West Ref. Point ________________ **East Ref. Point** ______________
Field Monitors: ____

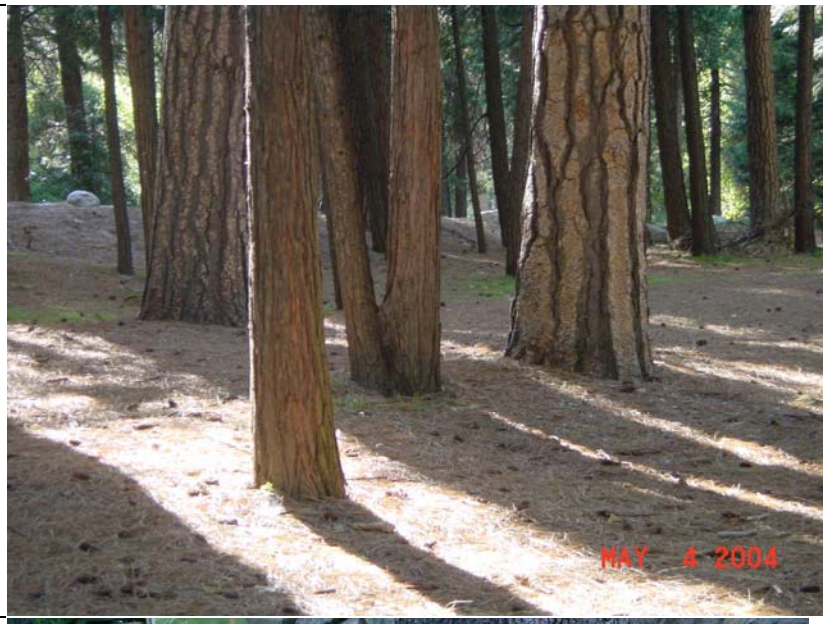
- Tally of trees in each condition rating:

None/Slight ____
____
____(Total:)

Moderate ____
____
____(Total:)

Severe ____
____
____(Total:)

Figure 11 Exposed Tree Roots (LYV Campground)
Tree Root Exposure Photo Examples

None / Slight	
Moderate	
Severe	

B.5 NUMBER OF SOCIAL TRAILS

B.5.1 Overview

This field protocol presents the procedures, data requirements, and data collection sheets for conducting inventories of the number of social trails. The User Capacity Management Program identified two zones that should be monitored to determine if visitors are impacting wetland areas and other Outstandingly Remarkable Values in along the Merced River corridor. The Standards presented in the User Capacity Management Program were based on 1990 data. After further evaluation it was determined that the 1990 data was not as rigorous as needed to conduct monitoring. The standards were revised to develop a more rigorous data set from which future monitoring efforts will be measured. A more detailed description of this indicator is presented in the User Capacity Management Program on pages 55 and 56.

B.5.1.1 Zones:

- **Zone 2A: Open Space**
- **Zone 2A+: Undeveloped Open Space**

B.5.1.2 Revised Standards:

- **Zone 2A: Open Space—**No net increase in number from 2004 baseline for linear features. No social trails for wetland features.
- **Zone 2A+: Undeveloped Open Space—**No net increase in number from 2004 baseline.

B.5.2 Sampling

The pilot study and field tally to establish the 2004 baseline will be conducted in late summer (August or September).

Digital orthophotos (DOQs) and GIS may be used to identify possible extent of social trails for logistical planning purposes (such as where are the priority areas for monitoring).

For routine monitoring social trail offshoot points can be tallied from parking lots (turnouts) along defined road corridors in Zones 2A and 2A+. Established sites will be monitored annually after baseline is established.

B.5.3 Equipment and Supplies

- Map with location/directions to target sites
- Compass
- GPS device
- Flagged wire pins
- Digital camera
- GIS map enlargements
- Clipboard/pencils
- Instructions for social trails data sheet on waterproof paper
- Social trails data sheet on waterproof paper

B.5.4 Quality Assurance

B.5.4.1 Training—Vegetation and Restoration Management staff with experience conducting natural resource impact surveys, including social trailing will be responsible for training any NPS staff or volunteers without prior monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Navigate to target sites.
- Operate a GPS device.
- Make subjective determinations and make appropriate recordings of social trail condition.
- Data entry into the Number of Social Trails database.

These skills will be verified through field training and assistance of qualified vegetation and restoration management staff.

B.5.5 Method of Performance

- Prior to beginning field work review Section C.0 - Field Logistics and Section D.0 - Safety Plan of this field guide.

- Prior to beginning fieldwork review baseline data and previous monitoring results.

- Refer to list of sites and/or map identifying sampling sites.

- Go to turnouts along roadside. Conduct a visual survey of any potential social trailheads beginning from turnout. If trailhead(s) exists, refer to map to see if it is indeed within specified zone or eventually leads into zone. Determine if trail receives enough usage to be included (e.g. was the trail used only once by one or two people or does it appear to receive somewhat consistent use?).

- GPS the turnout and assign a site designator:

  EPR= Parkline to Windy Point along El Portal Road;
  YV=Yosemite Valley Wetlands;
  MRS= Merced River Southside;
  WWR= Wawona Road;
  WW= Wawona proper.

  A site designator should be given to each pullout surveyed, even if it is determined that the pullout is not in the low use zone. For example, WWR1, WWR2, and WWR3 are the first three turnouts south of the Wawona Rd/Southside Drive intersection, yet are not in the surveyed zone, and therefore do not show up in our data. The first site recorded in this case, would be WWR4, as that is the first site within the zone showing social trails. GPS information should only recorded for pullouts within the surveyed zones.

- Place flags at beginning of social trails.

- Determine the condition class for the trails utilizing the photo examples in Figure 12 (when available) as a guide.

- Draw map of sight.

- Take digital photographs with Nikon Coolpix 4300. If possible, all social trail photographs should be taken from the same GPS photo point. If this is not possible, multiple GPS photo points could be used within the same turnout. Different photo points within the same turnout should be designated by placing A, B, C, etc… after the

respective turnout number. For example, the 4th turnout south of the Wawona Rd/Southside Drive intersection is labeled WWR4, however, 3 different photo points are needed to document the 4 different social trails in that turnout, and are thus labeled, WWR4A, WWR4B, and WWR4C. Pictures are not zoomed unless noted (max zoom) to be able to replicate.

- GPS photo point.
- Get UTM of photo point.
- Determine azimuth for each photo from the GPS photo point using Brunton Pocket Transit.
- Complete data sheet per instructions. Refer to Figure 12 (when available) in making determination of trail definition.
- Return GPS unit and data sheets to Vegetation and Restoration Management office. GPS unit will be downloaded. Information on data sheets will be entered into the Number of Social Trails database. Photographs will be downloaded to a CD and stored with the field maps in the Number of Social Trails administrative file.

B.5.6 Number of Social Trails Date Sheet Procedures

B.5.6.1 Record Data:

- **Site Designator:** Record unique site identifier
- **Name (VERP area):** Record the area of the site (El Portal Road, Merced River South, Wawona, Wawona Road, Bridalveil Meadow, Wosky Pond, Happy Isles Fen)
- **Date of Survey:** Day/Month/Year (August 8, 2004 = 08/08/04)
- **Field Monitor(s):** Record the name(s) of monitors
- **General Parking Location:** Record a more specific site location.
- **Photo Point UTM coordinates:** Record the coordinates from the GPS device.
- **Photo Point:** Record photo point number.
- **Photo Azimuth:** Record Photo Azimuth.
- **Photo Number:** Record photo number.
- **Condition Class:** Record condition class of trail. Utilize photo examples (Condition Class assessments were not conducted during the 2004 Pilot Season. They will be conducted during the 2005 Field Season).
- **Record Number of Trails:** XX
- **In Low Use Area:** Y or N
- **Map:** Draw map of location.

Number of Social Trails: _____

In Low Use Area?: _____

B.5.7 Merced River Monitoring Field Guide Number of Social Trails Field Data Sheet

Site Designator: _____ Date: _____

Name (VERP Area): _____

Field Monitors: _____

General Parking Location: _____

Photo Point UTM Easting: _____ Northing: _____

Photo Point	Photo / Trail Name	Photo Azimuth	Photo Number	Condition Class	Notes

MAP:

LEGEND:

X: Photo Point
XI:
XII:
XIII:
XIV:
XV:

Figure 12 Number of Social Trails
Photo Examples of Social Trail Condition Class (placeholder)

Social Trail: Flattened Vegetation

Social Trail: Stunted Vegetation

Social Trail: Some Bare Ground

Figure 12 Number of Social Trails (Continued)
Photo Examples of Social Trail (placeholder)

Social Trail: Barren

Barely Discernable Trail

B.6 LENGTH OF SOCIAL TRAILS IN MEADOWS

B.6.1 Overview

This field protocol presents the procedures, data requirements and data collection procedures for surveying the length of social trails in meadows in Yosemite Valley. The User Capacity Management Program identified two zones to be monitored. The meadows to be monitored in those zones are: Stoneman, Ahwahnee, Cooks, Sentinel, Woskey Pond, Leidig, El Capitan, and Bridalveil. The Standards presented in the User Capacity Management Program were based on 1990 data. It was decided that data on current conditions should be used as the basis for future monitoring. This methodology described will be used to determine current conditions and to monitor them in the future. The standards were revised to develop a more rigorous data set from which future monitoring efforts will be measured. A more detailed description of this indicator is presented in the User Capacity Management Program on pages 57 and 58. The goal is to—through restoration—reduce the total length of social trails in 8 meadows of Yosemite Valley (Stoneman, Ahwahnee, Cooks, Sentinel, Woskey Pond, Leidig, El Capitan, and Bridalveil). Restoration targets will be set through other documents and processes; monitoring protocol will remain the same, irrespective or restoration or restoration goals.

B.6.1.1 Zones:

- **Zone 2B: Discovery**
- **Zone 2C: Day Use**

B.6.1.2 Revised Standards:

- **Zone 2B: Discovery—**No net increase in total length of social trails when compared with baseline. Baseline established in 2004. Baseline will be updated as restoration actions are implemented and data is re-collected to reflect restoration effort.
- **Zone 2C: Day Use—**No net increase in total length of social trails when compared with baseline. Baseline established in 2004. Baseline will be updated as restoration actions are implemented and data is re-collected to reflect restoration effort.

B.6.2 Sampling

The pilot study and field tally to establish the 2004 baseline for all meadows will be conducted in late summer (August or September). A second year of baseline sampling will be conducted in 2005 to verify the methodology and baseline data.

Digital orthophotos (DOQs) and GIS data may be used to identify possible extent and length of social trails in all Yosemite Valley meadows for logistical planning purposes (such as where are the priority areas for monitoring).

After establishment of the indicator standard, restoration and monitoring efforts in these 8 meadows will be on a 3-5 year rotation.

B.6.3 Equipment and Supplies

- Compass
- GPS device
- PDA handheld device
- Flagged wire pins
- Measuring wheel
- Digital camera

- Digital orthophotos/GIS map enlargements
- Clipboard/pencils
- Instructions for Length of Social Trails data sheet on waterproof paper
- Length of Social Trails data sheet on waterproof paper

B.6.4 Quality Assurance

B.6.4.1 Training—Vegetation and Restoration Management staff with experience conducting length of social trail surveys will be responsible for training any NPS staff or volunteers without prior monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Ability to navigate to target sites at meadows.
- Operate a GPS device.
- Data entry into the Length of Social Trail database.

These skills will be verified through field training and assistance of qualified Vegetation and Restoration Management staff.

B.6.5 Method of Performance

- Prior to beginning field work review Section C.0 - Field Logistics Protocols and D.0 - Safety Plan in this field guide.

- Prior to beginning fieldwork review baseline data and previous monitoring results.

- Some monitoring of social trail length may be completed in association with surveying for the Number of Social Trails indicator. This needs to be coordinated with the Crew Leader and Supervisor.

- The meadows to be surveyed are Stoneman, Ahwahnee, Cooks, Sentinel, Woskey Pond, Leidig, El Capitan, and Bridalveil. The name of the meadow being monitored should entered into the data dictionary in the GPS unit.

  Social trail classifications should be entered into the GPS as line features. Identify which of the five different trail classifications should be applied to each section of social trail encountered:

  - Flattened vegetation
  - Stunted vegetation
  - Some bare ground
  - Barren (barren width in inches recorded)

- For trails identified as barely discernable, enter the location in the GPS unit as a point feature. The point location should be taken at the place where the barely discernable trail started or intersected with another trail. Make a determination on whether the trail was apparently caused by humans or apparently caused by wildlife.

- All trail classifications should be entered into the GPS unit with a line feature from beginning to end, or to where that trail became barely discernable, at which time, a point feature should be recorded. The exception to the above would be when a trail of any classification other than barely discernable continues for less than 50 feet; in that case, the trail should be noted and recorded as barely discernable.

- When encountering a disturbed area, indicating a high level of use and it is determined that the area is not necessarily a trail record a point feature in the middle of the disturbed area. Estimate the approximate square footage of the disturbed area.

- If a trail changes from one classification to another, the first line feature with the first classification should be stopped, and another line feature with the new classification started. If the new trail segment's classification extends for less than 50 feet, the change in classification should be disregarded, and the original line feature continued. Similarly, if a barren trail's width changes dramatically, a new line feature should be started with the new barren width recorded. Again, if a trail with a new barren width continues for less than 50 feet, the original line feature should be continued.

B.6.6 Data Sheet Procedures

B.6.5.1 Record Data (in Data Dictionary):

- **Field Monitor(s):** Record the name of the field monitor(s).

- **Meadow Name:** Record the name of the meadow being monitored.
  a. Bridalveil
  b. El Capitan
  c. Woskey Pond
  d. Leidig
  e. Sentinel
  f. Cooks
  g. Ahwahnee
  h. Stoneman

B.6.5.2 Social Trail (Line Segment):

- **Trail Segment Type**: Record condition class of trail:
  a. Flattened Vegetation
  b. Stunted Vegetation
  c. Some Bare Ground
  d. Barren
     - Barren attribute: Record width of barren ground in inches for trails in barren class.

- **Trail Identifier**: Record a unique value for each trail.

- **Date of Survey:** Record Day/Month/Year (August 8, 2004 = 08/08/04).

- **Time of Survey:** Record time of survey.

B.6.5.3 Barely Discernable Trail (Point Feature):

- **Source:** Record the apparent source of the trail.
  a. Apparently Wildlife
  b. Apparently Human

- **Date of Survey:** Record Day/Month/Year (August 8, 2004 = 08/08/04).

- **Time of Survey:** Record time of survey.

B.6.5.4 Disturbed Area (Point Feature):

- **Approximate size in square feet**: Record size of disturbed area.

- **Date of Survey:** Record Day/Month/Year (August 8, 2004 = 08/08/04).

- **Time of Survey:** Record time of survey.

B.6.6 Data Sheet Procedures (page 2)

B.6.5.5 Meadow Boundary (Polygon):

- **Meadow Name:** Record the name of the meadow being delineated.
  a. Bridalveil
  b. El Capitan
  c. Woskey Pond
  d. Leidig
  e. Sentinel
  f. Cooks
  g. Ahwahnee
  h. Stoneman

- **Date of Survey:** Record Day/Month/Year (August 8, 2004 = 08/08/04).

- **Time of Survey:** Record time of survey.

B.6.7 Merced River Monitoring Field Guide
Length of Social Trails Data Dictionary Input Fields

Feature 1: Social Trail (line)

- **Field 1A:** Meadow Name
  a. Bridalveil
  b. El Capitan
  c. Woskey Pond
  d. Leidig
  e. Sentinel
  f. Cooks
  g. Ahwahnee
  h. Stoneman

- **Field 1B:** Classification
  a. Flattened Vegetation
  b. Stunted Vegetation
  c. Some Bare Ground
  d. Barren
  e. Barren Attribute: Barren Width
- **Field 1C:** Trail Identifier—Unique Value for Each Trail
- **Field 1D:** Date
- **Field 1E:** Time
- **Field 1F:** Field Monitor's Name(s)

Feature 2: Barely Discernable Trail (Point)

- **Field 2A:** Source
  a. Apparently Wildlife
  b. Apparently Human
- **Field 2B:** Date
- **Field 2C:** Time
- **Field 2D:** Field Monitor's Name(s)

Feature 3: Disturbed Area (Point)

- **Field 3A:** Approximate Size in Square Feet
- **Field 3B:** Date
- **Field 3C:** Time
- **Field 3D:** Field Monitor's Name(s)

Feature 4: Meadow Boundary (Polygon)

- **Field 4A:** Meadow Name
  a. Bridalveil
  b. El Capitan
  c. Woskey Pond
  d. Leidig
  e. Sentinel
  f. Cooks
  g. Ahwahnee
  h. Stoneman
- **Field 4B:** Date
- **Field 4C:** Time
- **Field 4D:** Field Monitor's Name(s)

Figure 13 Length of Social Trails
Photo Examples of Social Trail Conditions

Social Trail: Flattened Vegetation




Social Trail: Stunted Vegetation



Social Trail: Some Bare Ground



Figure 13 Length of Social Trails (Continued)
Photo Examples of Social Trail Conditions

Social Trail: Barren


Barely Discernable Trail


B.7 RIVERBANK EROSION THAT IS ACCELERATED OR CAUSED BY VISITOR USE

B.7.1 Overview

This field guide presents the procedures, data requirements, and data collection sheets for conducting inventories and condition assessments of the banks of the Merced River. Erosion of the banks of the Merced River will be monitored because the conditions of riverbanks are an important indicator of potential impacts to Outstandingly Remarkable Values of the river corridor. A more detailed description of this indicator is presented in the User Capacity Management Program on pages 59 and 60.

B.7.1.1 Zones:

- **Zone 2B: Discovery**
- **Zone 2C: Day Use**

B.7.1.2 Standards:

- **Zone 2B: Discovery—**No net increase over baseline in linear extent of riverbank erosion that is accelerated or caused by visitor use; no riverbank erosion that exceeds Condition Class 2.
- **Zone 2C: Day Use—**No net increase over baseline in linear extent of riverbank erosion that is accelerated or caused by visitor use; no riverbank erosion that exceeds Condition Class 2.

B.7.2 Sampling

For the first year (the 2004 Pilot Season) inventory high use zones. In year two and beyond, sampling should be conducted using the following protocols. The river segment included in this indicator will be classified into high use and low use *sampling zones*. High use zones are characterized by their close proximity to bridges, parking lots/pull-offs, recreational areas such as lodges, campgrounds and picnic sites. Locate these zones on large-scale park maps; label them with two-digit codes starting from upstream. The letter digit represents the river side, and the second is a consecutive number. For example, 11 is the first high use zone from upstream on river left and 24 is the fourth high use zone on river right. Please note the length of each zone.

Within the high use zones at least 20 sampling locations are randomly located, with at least 3 sites selected from each zone. Within low use zones select another 10 sampling locations. Use a random number table to determine the sampling location as follows:

- Pick a 3-digit random number to determine the exact location (distance from upstream limit) within the selected sampling zone. For example, if a random number of 943 were chosen, the corresponding sampling plot would be located in 943 ft from the upstream limit of that zone. The approximate location of each sampling plot can be estimated using GIS and its 'Measure' tool (ArcView or ArcGIS).

B.7.3 Equipment and Supplies

- Map with location/directions to target sites
- Map identifying known archeological sites in proximity to target sites
- Compass
- GPS device
- PDA handheld device

- Tape measure
- Digital camera
- Center point stake (10”)
- Flagged wire pins
- Topographic map/aerial photograph enlargements
- Field Forms: Data sheet on waterproof paper and blank paper for map
- Clipboard/pencils
- Field guide instructions for riverbank erosion data sheet on waterproof paper

B.7.4 Quality Assurance

B.7.4.1 Training— Vegetation and Restoration Management staff with experience surveying and monitoring target sites along the Merced River will be responsible for training any NPS staff or volunteers without prior monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Ability to navigate to target sites.
- Operate a GPS device.
- Make subjective determinations and make appropriate recordings of riverbank erosion (tree root exposure, erosion features, and so on) conditions.
- Enter field data into the Riverbank Erosion database.

These skills will be verified through field training and assistance of qualified Vegetation and Restoration Management staff.

B.7.5 Method of Performance

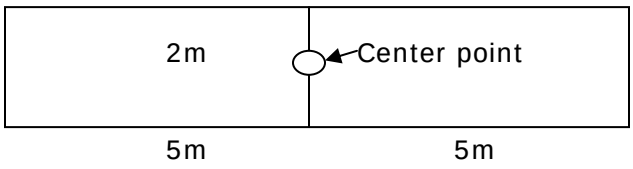
- Prior to beginning field work review Section C.0 - Field Logistics Protocols and Section D.0 - Safety Plan in this field guide.

- Prior to beginning fieldwork review baseline data and previous monitoring results.

- Refer to list of sites and/or map identifying sampling sites.

- Locate the center point of sampling location using GPS. Mark the center point with the center point stake. The long axis of the sampling plot will be parallel to the river.

- Once center point is located, extend 5 m on both sides to define a 10m x 2m rectangle sampling plot using measuring tape and marking flags.



- Record the exact GPS coordinates of the center point and label it with predefined location code (to be determined).

- Within each sampling plot the following data are collected:

- Environmental attributes (related to erosion potential due to fluvial actions and mass movements)

  Type/slope of river bank (undercut, steep, gentle) (defined by EPA 1997). Refer to photo examples in Figure 14 to aid in making determination of river bank classification.

Substrate type (sandy, cobble, rocky),
Visitor access (bridge-side, roadside, campground, day use site, river-side)

Condition Attributes— Record condition class rating (based on Morgan 1995). Refer to photo examples in Figure 16 (when available) to aid in making determination of attribute rating.

- Photograph site attributes. Mark all photo points and record azimuth on field map.
- Complete data sheet per instructions.
- Return GPS unit and data sheets to Vegetation and Restoration Management office. GPS unit will be given to GIS for download. Information on data sheets will be entered into the River Bank Erosion database. Photographs will be downloaded to a CD and stored with the field map in the River Bank Erosion administrative file.

B.7.6 River Bank Erosion Data Sheet Procedures

B.7.6.1 Record Data:

- **Site Designator:** (such as AB123)
- **Date of Survey:** Day/Month/Year (August 8, 2004 = 08/08/04)
- **Field Monitor(s):** Record name of field monitor(s)
- **UTM coordinates:** Record GPS coordinates
- **Type/Slope of Riverbank:**

  1 Undercut
  2 Steep
  3 Gentle

- **Substrate Type:**

  1 Sandy
  2 Cobble
  3 Rocky

- **Visitor Access:**

  1 Bridge-Side
  2 Roadside
  3 Campground
  4 Day Use Site
  5 River-side

- **Condition Attributes:**

  0 No exposure of tree roots; no erosion features*; vegetative ground cover on sampling plot is near identical to the surrounding areas

  1 No/slight exposure of tree roots; erosion features exist but barely distinguishable; less than 50% vegetative ground cover is lost as compared to the surrounding areas

  2 Slight/moderate exposure of tree roots; erosion features are dominated by visual evidence of sheet or splash erosion; Shallow rills may be present but to a very limited extent (<5%); vegetative ground cover lost between 50 and 90% as compared to the surrounding areas

  3 Moderate exposure of tree roots; erosion features occupy up to 25% of sampling plot; rills are common and up to 3 cm deep; less than 10% of vegetative ground cover remains as compared to the surrounding areas

  4 Moderate/severe exposure of tree roots; substantial presence (up to 50%) of erosion features within sampling plot; rills are very common and up to 8cm deep; gullies may be present but to limited extent (5%); bare soil only with no/very little vegetative ground cover

  5 Severe exposure of tree roots; widespread presence (>75%) of erosion features; gullies and rills over 8cm deep are common; bare soil only with no/very little vegetative ground cover

B.7.7 Merced River Monitoring Field Guide Riverbank Erosion Data Sheet

Site: _____ Date: _____

Field Monitors: _____ UTM: _____

Type/Slope of River bank (1, 2, 3): _____

Substrate Type (1, 2, 3): _____

Visitor Access (1, 2, 3, 4, 5): _____

Condition Attributes (0, 1, 2, 3, 4, 5): _____

Figure 14 River Bank Erosion - Type/Slope of River bank Photo Examples

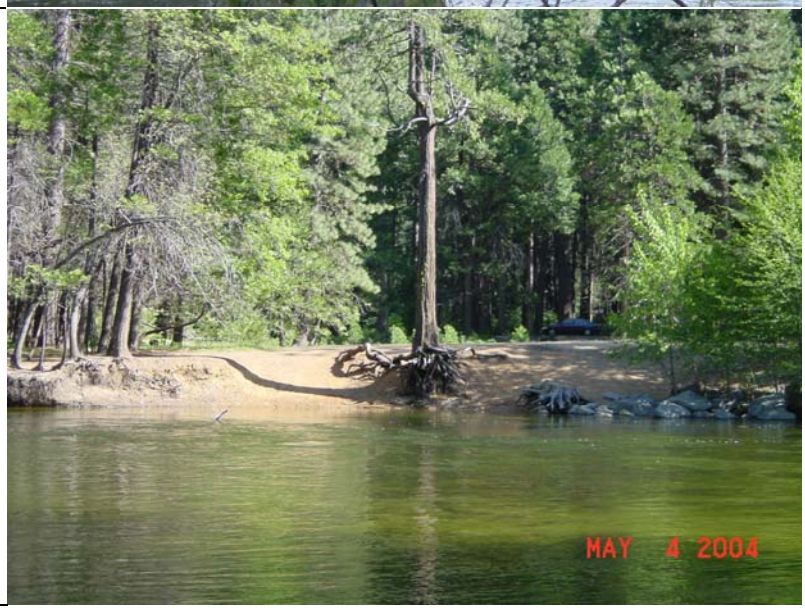
1) Undercut	
2) Steep	
3) Gentle	

Figure 15 River Bank Erosion - Tree Root Exposure Photo Examples

None / Slight	
Moderate	
Severe	

Figure 16 River Bank Erosion - Attribute Condition Photo Examples (placeholder)

To be added following the 2005 Field Season.

B.8 EXPOSED TREE ROOTS IN DEVELOPED CAMPGROUNDS

B.8.1 Overview

This field protocol presents the procedures, data requirements, and data collection sheets for conducting inventories of the number and condition of exposed tree roots in developed campgrounds. This indicator is being monitored because several Outstandingly Remarkable Values associated with the Merced River are directly impacted by soil erosion. A more detailed description of this indicator is presented on page 61 of the User Capacity Management Program.

B.8.1.1 Zones:

- **Zone 3A: Camping**

B.8.1.2 Standards:

- **Zone 3A: Camping—**95 percent of campsites meet the no, slight, or moderate root exposure criteria as defined by inventory and monitoring guidelines (Marion, 1991).

B.8.2 Sampling

This indicator will be monitored in 3A Zones, including Upper Pine, Lower Pine and North Pine Campgrounds.

Each campground consists of multiple campsites that are permanently marked with concrete numbered posts.

Use a list of campsite numbers to randomly select 10% of campsites for each campground. For example, if there are 100 campsites on a campground, 10 campsites would be selected using a random number table (e.g., #4, #11, #67, #88, etc.). Details on sampling for each campground are as follows:

- Lower Pines Campground
  - total number of campsites = 78.
  - 8 sites (10%) are randomly selected.
  - Campsites selected are 5, 12, 29, 43, 50, 63, 73 and 76.

- North Pines Campground
  - total number of campsites = 86.
  - 9 sites (10%) are randomly selected.
  - Due to the irregular numbering of this campground a set of consecutive serial numbers was generated for random sampling.
  - Campsite SERIAL NUMBERS selected are 7, 10, 22, 34, 52, 61, 64, 68 and 82.
  - ACTUAL campsites selected are 113, 118, 135, 213, 315, 401, 404, 503 and 525.

- Upper Pines Campground
  - total number of campsites = 240.
  - 24 sites (10%) are randomly selected.
  - Campsites selected are 11, 14, 17, 21, 24, 41, 42, 48, 52, 53, 55, 63, 91, 111, 146, 155, 161, 162, 184, 197, 209, 210, 217 and 220.

The campsite post on each selected site will be used as the origin from which root exposure assessments are made.

B.8.3 Equipment and Supplies

- Map with location/directions to target sites
- Compass
- GPS device
- Tape measure
- Digital camera
- Topographic map enlargements
- Clipboard/pencils
- Instructions for tree root exposure data sheet
- Tree toot exposure data sheet

B.8.4 Quality Assurance

B.8.4.1 Training—Vegetation and Restoration Management staff with experience conducting sampling for tree root exposure will be responsible for training any NPS staff or volunteers without prior tree root exposure monitoring experience. NPS staff and volunteers will be required to demonstrate the ability to:

- Navigate to target sites.
- Operate a GPS device.
- Take accurate compass readings.
- Make subjective determinations and make appropriate recordings of tree root exposure conditions.
- Enter data into the Exposed Tree Root database.

These skills will be verified through field training and assistance of qualified NPS staff or volunteers.

B.8.5 Method of Performance

- Prior to beginning field work review Section C.0 - Field Logistics Protocols and Section D.0 - Safety Plan in this field guide.

- Prior to beginning fieldwork review baseline data and previous monitoring results.

- Refer to list of sites and/or map identifying sampling sites.

- Starting at the campsite post, divide the space into four quadrants based on four cardinal directions (N, E, S, W). Within each quadrant identify sampling tree Sample tree must have a dbh of 6 inches or greater. closest to the campsite post for root exposure evaluation. Mark the distance (in meters) and direction (bearing in azimuth) to each observed tree for future re-measurements/comparison.

- At each selected tree (Marion, 1991) the species type will be documented, and 3-point root exposure rating system will be applied. Utilize the photo examples in Figure 17 Tree Root Exposure Photo Examples to aid in judgment of tree root exposure.

- Photograph site to show each observed tree. Mark all photo points and record azimuth on field map.

- Complete data sheet per instructions.

- Return GPS unit and data sheets to Vegetation and Restoration Management office. GPS unit will be downloaded. Information on data sheets will be entered into the Exposed Tree Root in Developed Campground database. Photographs will be downloaded to a CD and stored with the field map in the Exposed Tree Root in Developed Campgrounds administrative file.

B.8.6 Exposed Tree Roots in Developed Campground Date Sheet Procedures

B.8.6.1 Record Data:

- **Site Designator:** Record the Campsite Post Number
- **Date of Survey:** Day/Month/Year (August 8, 2004 = 08/08/04)
- **Field Monitor(s):** Record name of field monitor(s)
- **Distance of Tree from Campsite Post:** Record the distance (in meters) of the observed tree.
- **Direction of Tree from Campsite Post:** Record the direction (azimuth) of the observed tree.
- **Species of Tree:** Record the species of the observed tree.
- **Tree Root Exposure Code:** See Photo Examples in this Field Guide
- **Camera Photo Number:** Record the photo number.

Record tree root exposure as follows:

1 **None/Slight—**No or slight root exposure such as is typical in adjacent offsite areas.
3 **Moderate—**Top half of major roots exposed more than one foot from base of tree.
5 **Severe—**Three-quarters or more of major roots exposed more than one foot from base of tree; soil erosion obvious.

B.8.7 Merced River Monitoring Field Guide
Tree Root Exposure in Developed Campgrounds Field Data Sheet

Site Designator: _____ Date: _____

Field Monitors: _____

NE Quarter

Distance of Tree from Campsite Post: _____

Direction of Tree from Campsite Post: _____

Species of Tree: _____

Tree Root Exposure Code (1, 3, 5): _____

Photo Number: _____

SE Quarter

Distance of Tree from Campsite Post: _____

Species of Tree: _____

Direction of Tree from Campsite Post: _____

Tree Root Exposure Code (1, 3, 5): _____

Photo Number: _____

B.8.7 Merced River Monitoring Field Guide
Tree Root Exposure in Developed Campgrounds Field Data Sheet (page 2)

SW Quarter

Distance of Tree from Campsite Post: _____

Species of Tree: _____

Direction of Tree from Campsite Post: _____

Tree Root Exposure Code (1, 3, 5): _____

Photo Number: _____

NW Quarter

Distance of Tree from Campsite Post: _____

Species of Tree: _____

Direction of Tree from Campsite Post: _____

Tree Root Exposure Code (1, 3, 5): _____

Photo Number: _____

Figure 17 Exposed Tree Roots in Developed Campgrounds -Tree Root Exposure Photo Examples

1) None/Slight	
3) Moderate	
5) Severe	

B.9 WATER QUALITY

B.9.1 Overview

This protocol is intended to provide procedural guidance for water sampling associated with implementation of the Visitor Experience and Resource Protection portion of the Merced Wild and Scenic River Comprehensive Management Plan (CMP). The purpose of this guidance is to assure collection of high quality water data as well as organization of that data.

This document is organized into four sections:

- Sampling Protocol Overview
- Quality Assurance Project Plan (QAPP)
- Standard Operating Procedures (SOPs)
- Field Data Forms

B.9.2 Overview of the Sampling Protocol

This section outlines in brief the monitoring procedures and personnel responsibilities associated with this program. The Quality Assurance Project Plan (QAPP) in Section II describes in detail all aspects the monitoring plan. The branch manager of Physical Sciences and GIS will be responsible for administration and updating this plan. The plan identifies data and metadata reporting requirements, standard operating procedures, laboratory requirements, and procedures for data review and analysis.

Before sampling may begin, the project manager needs to identify and train technician staff, develop a sampling schedule, and assemble and maintain all sampling equipment. This person should also prepare an annual operating plan and budget. In addition, once sampling has begun, quality control data and procedures need to be reviewed frequently to assure that problems are corrected immediately. The project manager is also responsible for proper data and metadata storage and security.

Table 2 lists sampling locations, analytes to be sampled, and personnel responsible for sample collection and field measurements. In short, eight front-country (accessible by vehicle) sites will be sampled monthly, following summer and fall storm events, and weekly during the peak spring runoff period. An additional two backcountry sites will be sampled seasonally on a monthly basis. Each sampling event will take place over 1-2 days and require a minimum of 2 technicians to collect samples and deliver them to laboratory facilities in a timely manner. Sample collection at two backcountry sites will require one technician 2 days per event. Sampling will be coordinated with routine state-mandated water quality sampling conducted by Yosemite National Park Utilities staff to minimize duplication of effort. Sampling should also be coordinated with more comprehensive sampling conducted at Happy Isles by the USGS as part of the Hydrologic Benchmark program to provide a quality control check.

Nutrients (dissolved nitrogen species, total phosphorous and total dissolved phosphorous) will be sampled at all sites. Hydrocarbons will be sampled at three downstream locations only. Fecal coliform will be sampled at the eight front-country sites due to the short 6-hour hold time on these samples. All sampling and sample hold times will conform to published USGS and EPA procedures (see Water Sample Collection SOP). Storm and spring runoff sampling will be conducted at 5 sites only, to facilitate same day delivery of fecal coliform samples to laboratory facilities in Fresno, California.

At each sampling location, field measurements will also be recorded. These include water and air temperature, pH, specific conductivity, and dissolved oxygen. Where possible, river stage or discharge will also be recorded. Sampling will occur at the flow centroid if the river

is deemed to be well mixed as determined by conductivity measurements across the river cross-section. Otherwise, an equal width interval (EWI) composite sample will be collected.

Table 2
Sample Locations for Water Quality Monitoring

Sampling Location [Latitude, Longitude, Elevation, (NAD27 Datum)]	Sample—Collector	Sampling Schedule
Merced River at Merced Lake, below High Sierra Camp 37° 44' 17'' 119° 25' 07'' 7,200 ft	Total Nitrogen—Resources Total Phosphorus—Resources	Monthly between June 15 and October 15
Merced River at top of Nevada Falls (below Little Yosemite Valley 37° 43' 29'' 119° 31' 55'' 5,920 ft	Total Nitrogen—Resources Total Phosphorus—Resources	Monthly between June 15 and October 15
Merced River in Yosemite Valley at Happy Isles Gaging Station 37° 43' 54'' 119° 33' 28'' 4,016 ft	Fecal Coliform—Resources Total Nitrogen—Resources Total Phosphorus—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
Merced River in Yosemite Valley at Sentinel Bridge 37° 44' 36'' 119° 35' 20'' 3,950 ft	Fecal Coliform—Resources Total Nitrogen—Resources Total Phosphorus—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
Merced River in Yosemite Valley at Pohono Bridge 37° 43' 01'' 119° 39' 55'' 3,862 ft	Fecal Coliform—Resources Total Nitrogen—Resources Total Phosphorus—Resources Hydrocarbons—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
Merced River in El Portal at SR140 Bridge 37° 40' 17'' 119° 47' 33'' 1,825 ft	Fecal Coliform—Utilities Total Nitrogen—Resources Total Phosphorus—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
Merced River in El Portal at Foresta Bridge 37° 40' 10'' 119° 48' 58'' 1,640 ft	Fecal Coliform—Utilities Total Nitrogen—Resources Total Phosphorus—Resources Hydrocarbons—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
South Fork Merced River in Wawona at Swinging Bridge 37° 32' 19'' 119° 37' 11'' 4,180 ft	Fecal Coliform—Resources Total Nitrogen—Resources Total Phosphorus—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
South Fork Merced River in Wawona at South Fork Bridge 37° 32' 19'' 119° 39' 28'' 3,950 ft	Fecal Coliform—Resources Total Nitrogen—Resources Total Phosphorus—Resources Hydrocarbons—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)
South Fork Merced River in Wawona below Wawona campground 37° 33' 02'' 119° 37' 11'' 3,860 ft	Fecal Coliform—Resources Total Nitrogen—Resources Total Phosphorus—Resources	Monthly, weekly during snowmelt runoff, and during rainfall-generated high flows (e.g. summer thunderstorms)

Hydrocarbons and fecal coliform will be sampled as grab samples due to sampling requirements. Field splits and blanks will be prepared according the requirements for each analyte.

Field staff will properly store and ship water samples within 24 hours. All field forms, calibration forms, and chain of custody forms will be photo-copied and stored according to protocol. All equipment problems should be documented and addressed immediately.

B.9.3 Quality Assurance Project Plan

This quality assurance project plan identifies the goals and objectives of the Merced River Water Quality Monitoring Plan and outlines its functional components. The latter include responsibilities for the implementation of the plan, data quality objectives, instrument calibration procedures, sampling procedures, quality control procedures, and requirements for data organization, storage, and review.

B.9.3.1 Purpose of the Merced River Monitoring Plan

Human use has the potential to affect water quality. People swimming in the river or horse manure (at stables or on trails) can increase fecal coliform (i.e. bacteriological) levels, people bathing in the river with soap can increase phosphorus/phosphate (i.e. nutrients) levels, and surface water runoff from campgrounds and stables can affect both fecal coliform and nutrient levels. These activities, as well as hydrocarbon pollution associated with roads and other development, all may occur in Yosemite Valley.

The goal of this plan is to collect baseline water quality data along the Merced River corridor. Specific objectives are to sample backcountry sections of river downstream of heavy use areas and above and below heavy use areas in Yosemite Valley, El Portal, and Wawona. A final objective is to collect high quality data that is comparable to data collected in other parks and in the Sierran Region.

Water quality standards have been established by the State of California, in accordance with the Clean Water Act, for surface waters in the San Joaquin River Basin, which includes the Merced River. Similar standards that are much more restrictive for certain indicators such as fecal coliforms have been established for Lake Tahoe under the Clean Water Act's anti-degradation policy that mandates protection of waters with existing high quality (see Lahontan Region Basin Plan). The NPS currently monitors water quality above and below the treated water discharge points for the wastewater treatment plants in El Portal (monthly) and Wawona (weekly), to assure attainment with state standards and to carry out the requirements of the operating permits. In the event of a sewage spill or direct discharge of treated water to the river, the monitoring is more frequent (potentially daily).

Nutrient levels (total nitrogen, total phosphorus), fecal coliform, and total petroleum hydrocarbons are appropriate variables to monitor in surface waters because their levels can be tied to human contact with water and other human activities. Other variables such as total coliform, temperature, dissolved oxygen, and conductivity will vary with human use, but are not effective variables to monitor because it is difficult to link changes in their levels to human use (they are lagging indicators, affected by other factors).

B.9.3.2 Responsible Parties

Yosemite National Park, through the Division of Resource Management and Science will be responsible for the administration of this monitoring plan. Standard Operation Procedure A, Section IIIA, details the specific responsibilities involved.

B.9.3.3 Data Quality Objectives

High data quality will be achieved through proper training of field technicians (Standard Operation Procedure B, Section IIIB) and the following parameter measurement and completeness objectives (Tables 3 and 4).

Table 3
Parameter Measurement

Parameter	Method/ Range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Completeness
Temperature	Electronic Thermometer (-5 to 50)	o C	-5	0.01 o C	± 0.01 o C	± 0.15 o C	80%
Dissolved oxygen	Electronic meter/probe	mg/l	0.1	0.01 mg/l	± 0.01 mg/l	± 0.2 mg/l	80%
pH	pH meter	pH units	0	0.01 unit	+ 0.01 units	+ 0.2 units	80%
Conductivity	conductivity meter	µS/cm	1	1 µS/cm	± 0.5%	± 5%	80%

Table 4
Laboratory Parameters

Parameter	Method/Range	Units	Detection Limit	Reporting Limit	Completeness
Total Dissolved Nitrogen	USGS/NWQL 2754	mg/l	0.015	0.03	80%
Nitrate and Nitrite	USGS/NWQL 1979	mg/l	0.008	0.016	80%
Total Phosphorous	USGS/NWQL 2333	mg/l	0.002	0.004	80%
Total Dissolved Phosphorous	USGS/NWQL 2331	mg/l	0.002	0.004	80%
Fecal Coliform Bacteria	SM9221B	MPN/100 ml	2	2	80%
Total Petroleum Hydrocarbons	EPA Method 1664	mg/l	1 mg/l	2 mg/l	80%

B.9.3.3.1 Accuracy

Chemical and Physical Parameters—Accuracy describes how close the measurement is to its true value. Accuracy is the measurement of a sample of known concentration and comparing the known value against the measured value. The accuracy of field measurements will be checked by performing tests on standard check solutions as a part of calibration procedures. Standard calibration and check solutions will be purchased from commercial labs or the USGS Office of Water Quality. In addition, the accuracy of chemical measurements should be verified through use of blind audit samples. Check standards and audit samples should be in the mid-range of typical values for the Merced River.

Biological Parameters—Accuracy for bacteria will be determined by analyzing a positive control sample twice annually. A positive control is similar to a standard, except that a specific discreet value is not assigned to the bacterial concentrations in the sample. This is due to the fact that bacteria are alive and capable of mortality and reproduction. Instead of a specific value, an approximate target value of the bacterial concentration is assigned to the sample by the laboratory preparing the positive control sample. In general, these checks are performed as a part of a certified laboratory routine quality control.

Comparability—Comparability is the degree to which data can be compared directly to similar studies. Sample collection methods and field parameter measurements outlined in this protocol are derived from the USGS National Field Manual and the Surface Water Ambient Monitoring Program of the California State Water Resources Control Board. Laboratory analyses will be conducted by the USGS National Water Quality Laboratory or similar USGS approved contact laboratory or, at minimum, a National Environmental

Laboratory Accreditation Program (NELAP) approved laboratory. These measures should insure broad data comparability, particularly with National Park Service Inventory and Monitoring and Vital Signs Programs.

Before modifying these methods, or developing alternative or additional methods, technical advisors will evaluate and review the effects of the potential modification. It will be important to address their concerns about data quality before proceeding with the monitoring program.

Completeness—Completeness reflects the ratio of valid laboratory results to number of samples actually sampled. The goal is 80% sample validity. This ratio may be increased as this program matures.

B.9.3.3.2 Precision

Chemical and Physical Parameters—The precision objectives apply to duplicate and split samples taken as part of normal sampling and repeated field parameter measurements on the same sample. Precision describes how well repeated measurements agree. Duplicate or split samples prepared in the lab or field will comprise at least 5% of the samples or one set per sampling day (about 10%). Repeated field measurements on a single sample will be conducted once per sampling day.

Biological Parameters—Precision for bacterial parameters will be determined by having the same analyst complete the procedure for laboratory duplicates of the same sample. At a minimum this should be done once per day, or run duplicates on a minimum of 5% of the samples if there are over 20 samples run per day. The results of the duplicates should be within the confidence limits supplied by the manufacturer.

B.9.3.3.3 Representativeness

Representativeness describes how relevant the data are to the actual environmental condition. Problems can occur if:

- Samples are taken in a non-standard collection area such as downstream of a bridge
- Samples are not representative of the entire flow due sampling in a backwater area, or not properly assuring an integrated sample
- Samples are not analyzed or processed appropriately, causing conditions in the sample to change (e.g. water chemistry measurements are not taken immediately).

Representativeness will be ensured by processing the samples in accordance with SOP D, by following the established methods, and by obtaining approval of this document.

B.9.3.3.4 Method Detection Limit and Sensitivity

The Method Detection Limit (MDL) is the lowest possible concentration the instrument or equipment can detect. This is important to record because we can never determine that a pollutant was not present, only that we could not detect it. Sensitivity is the ability of the instrument to detect one concentration from the next. Detection Limits and Sensitivities are noted in Tables 2 and 3. Some labs use reporting limits in addition to the method detection limits. A reporting limit is typically 2-5 times the MDL.

B.9.3.4 Instrument Calibration

Instrument calibration procedures are outlined in Standard Operating Procedure C, Section III.C.

B.9.3.5 Sample Collection

Sample collection procedures are outlined in Standard Operating Procedure D, Section III.D. Table 1 shows the sample sites, sampling schedule, samples to be collected, and responsible personnel.

Monthly Sampling—Sample collection should be conducted during the first week of each month in coordination with the Utilities Branch state-mandated water quality sampling. The backcountry sites will require a minimum of two days for sampling. Sampling frequency may be reduced to once every two months during the winter months.

Snowmelt Runoff Sampling—Snowmelt runoff sampling should be conducted weekly once the average daily discharge at the USGS Happy Isles Gage reaches 500 cubic feet per second (cfs). Continue weekly sampling until the average daily discharge drops below 500 cfs.

Event Sampling—Collect at least one set of samples per precipitation event when the USGS Happy Isles Gage indicates at least a doubling of discharge following the onset of a rain event. In the case where a storm follows an extended dry period, one may wish to collect a sample prior to the point at which the discharge has doubled. During large storm events that last many days, 2 samples should be collected as the discharge increases.

B.9.3.6 Quality Control

Quality control procedures are outlined in Standard Operating Procedure E, Section III.E.

B.9.3.7 Equipment Maintenance

Schedules and Procedures for equipment maintenance are outlined in Standard Operating Procedure F, Section III.F.

B.9.3.8 Data Organization, Storage, and Review

Procedures for data organization and storage are outlined in Standard Operating Procedure G, Section III.G. Data quality should be reviewed quarterly. An annual review of data completeness should also be done in conjunction with a workshop or peer review of the data.

B.9.4 Standard Operating Procedures

B.9.4.1 Project Management Standard Operating Procedure

Management of this project will be conducted by the branch manager of Physical Sciences and GIS within the division of Resource Management and Science. Responsibilities are:

- Preparation of an annual implementation plan and budget
- Training of field personnel
- Purchase and maintenance of field equipment
- Review of data and procedures

- Maintenance of data, field forms, equipment repair and maintenance logs, and updating SOP's

Preparation of an Annual Implementation Plan and Budget:

The annual plan should include a sampling schedule, the laboratory(s) used, anticipated personnel needs and time. There should be a comprehensive list of equipment, repair or calibration needs, and a list of disposables such as calibration and check solutions. A budget should be included. If possible, there should also be a summary of the previous season's problems and possible solutions. This plan provides a record of data gathering activities.

As each new or returning technician enters on duty, they should receive comprehensive training on field and office water sampling procedures (Training SOP). The project manager should document this training for each technician for each season.

The project manager or a designated technician should be responsible for ordering new equipment and consumables, repairing or calibrating existing equipment (beyond routine actions), maintaining a supply of fresh buffers and calibration solutions, and maintaining a log of all equipment repairs.

Every couple of months, the project manager should review the laboratory data and the QC sample data in particular. This information coupled with discussions with field staff should be used to review or modify procedures to improve data quality.

All field data forms should be photo-copied and stored as office copies or archive copies. Office copies are photo-copies of the originals and are intended as an operational reference. Original data forms, chain-of-custody forms, and calibration forms should be stored as archives in a fire-safe location. Each instrument should have a log-book to document calibrations, repairs, and factory calibrations. As SOP's are modified, former SOP's should be archived with the dates that they were in effect.

B.9.4.2 Training Standard Operating Procedure

Each technician collecting water samples and field data associated with this project must have demonstrated the following:

- The ability to calibrate and operate conductivity, pH, and dissolved oxygen (DO) meters.
- Proper sample collection, preservation, and handling.
- A safety conscious approach to field work around rivers.
- Knowledge of proper documentation procedures.

These skills may be verified through assisting a qualified technician or by a means deemed satisfactory to the branch manager for Physical Sciences and GIS. This training should be documented at least once a year for each technician.

B.9.4.3 Instrument Calibration

Instrument calibration and checks should be conducted at least twice per day plus an additional check of the calibration following collection of the last sample. Calibration checks are intended to verify the calibration of the instrument. The following table specifies post calibration check error limits. If the instrument does not read within these limits, perform the calibration sequence again.

Post Calibration Check Error Limits:

Parameter	Value
Dissolved oxygen	± 0.5 mg/L, ± 6% saturation
pH	± 0.2 standard units
Specific conductance	± 5%
Temperature	± 0.2 °C, annual calibration check

Instruments to calibrate will be the multi-parameter probe for measuring temperature, pH, specific conductivity, and dissolved oxygen and the smaller packable unit for temperature and conductivity. Calibration procedures will vary by instrument but the following provides a general outline of the procedure and a form to record calibration results.

- **Temperature—**Conductivity, pH, and dissolved oxygen are all temperature compensated qualities and therefore it is critical that temperature be measured accurately. Temperature accuracy should be verified periodically via a side-by-side comparison with a NIST-traceable thermometer every 3 months during regular field measurements. Document the side by side measurements in the notes section on the calibration form.

  Both the multi-parameter probe and the NIST-traceable thermometer should be sent to the manufacturer once per year to verify or adjust calibration. All calibration certificates should be filed with field data for the period that the calibration was valid.

- **Specific Conductivity—**Calibration should be performed once per sampling day. The calibration should be checked once during the day and again after the last sample has been collected to insure the instrument has maintained its calibration.

  - If the probe has been in storage, soaking in deionized (DI) water may be necessary to ensure the probe is thoroughly wetted prior to use. Equilibrating the probe in DI water for 10 minutes is recommended. Consider immersing the probe in DI water in a clean durable container before heading to the field.
  - To calibrate the meter for specific conductivity, use a conductivity standard solution of around 1000 µS/cm. A single point calibration will be adequate.
  - Immerse the probe into the standard and agitate vertically to insure there are no air bubbles trapped. Allow time for the reading to stabilize.
  - Record the value of the calibration standard, the manufacturer and lot number, and the expiration date.
  - Rinse the probe with DI water, blot dry, and immerse in the check solution. This solution should be another conductivity standard around 700 µS/cm.
  - Record the manufacturer's value for the check solution, the solution temperature, the manufacturer and lot number, and the expiration date.
  - Record the measured value of the check solution. This is the Initial Calibration Check (ICC).
  - Record Continuing Calibration Checks (CCC) during the day and at the end of the day and record these values and times

- **pH—**Calibrate the pH meter before the start of sampling and when going to a different river, at least two times per day. In addition, the meter accuracy should be verified using a check standard close in value to the river water. A final check of the instrument should be done after the last sample is taken. All calibration and checks should be performed in the field due to the sensitivity of the pH probe.

  - Rinse electrode with DI water.
  - Calibrate and operate in temperature-compensation mode using pH = 4.00 and 7.00 buffer solutions. Record the value of each buffer standard, the manufacturer and lot number, and the expiration date.
  - Rinse the probe with DI water and blot the excess.

- Check using a buffered check solution of pH 5-6. Immerse the electrode into the solution and stir briefly.
- Record the manufacturer's value, the measured value (ICC or CCC), temperature, the manufacturer and lot number, and expiration date.
- Rinse the probe with DI water, blot dry, and make field measurement.

- **Dissolved Oxygen—**Clean the sonde and stirrer under running tap water to remove debris. Swab the DO membrane and pH probe with a cotton ball soaked in Alconox or methanol. This removes surface films that may cause the calibration to drift. Check the condition of the membrane. Ensure the membrane is intact; free of wrinkles, bubbles, and surface films; and not discolored below the membrane.

  - Fill the calibration cup with water to just below the O-ring, securing the DO membrane.
  - Carefully remove any water droplets from the membrane with a Kimwipe or soft towel.
  - Cap the calibration cup and allow to stabilize for about five minutes.
  - Select Calibrate, (%) Saturation, and then enter the correct barometric pressure (mm-Hg) and hit Enter.

- **Discharge Estimate—**

  - At Happy Isles and Pohono Bridge use the USGS gaged flows. Note the time of your site visit and find the discharge later via the USGS web-sites: Happy Isles: http://nwis.waterdata.usgs.gov/nwis/uv/?site_no=11264500&agency_cd=USGS and Pohono Bridge: http://nwis.waterdata.usgs.gov/nwis/uv/?site_no=11266500&agency_cd=USGS

  - At all other sites make a qualitative estimate using 1) <25% bank full, 2) 25-75% bank full, and 3) >75% bankfull. If there is a nearby staff gage record that reading as well (at Sentinel Bridge, for example).

B.9.4.4 Water Sample Collection Procedures

What follows is a detailed description of monthly sampling. Event sampling is much smaller in scope due to time restrictions. At the end of this section are two **Quick Guides** to sampling: 1) monthly and 2) event. Once the more detailed information is learned, one can simply take the quick guide to the field as a reference.

Before Going to the Field:

- Coordinate with the Utilities branch to collect samples on the same days they collect theirs. They will collect fecal coliform samples at the Foresta Bridge, the CA 140 Bridge, the South Fork Bridge in Wawona, and below the Wawona Campground. All other sampling will be conducted by Resource Management personnel.

- Confirm with the park water quality laboratory that they will be expecting to receive samples that day. Ideally, all sampling trips should be scheduled at least one month ahead of time.

- Calibrate and check pH, conductivity, and dissolved oxygen (DO) meters according to the Calibration SOP. Record this data on the Calibration/Check form and place in binder. Calibrating the conductivity meter once per sample day is sufficient. The pH and DO meters should be calibrated and checked at each sample site. However, due to time constraints, recalibrate at three of the sites (first, middle, and last samples). This procedure will be reviewed as sampling progresses to assure proper meter calibration.

- Gather bottle sets, gloves, collection device, meters, forms, cooler, and blue ice. Use at least one blue ice block per sample set to assure the samples remain at or below 4°C.

- Given that fecal coliform samples must be in the laboratory within 6 hours of collection, it may be advisable to have two people collecting samples: One to collect samples along the main stem of the Merced River and one to collect at locations on the South Fork of the Merced River. Otherwise, a second person as an assistant would certainly increase the efficiency of sample collection.

Sampling Technique Overview:

For each site, there should be a designated sampling location. The sample should be representative of the whole river at this location so collect the sample from water moving downstream, possibly in a location where the thalweg impacts the river's edge. A major assumption is that the river is well-mixed. This should be verified by measuring pH and conductivity at the left and right banks as well as the center of flow. These values should vary by no more than 5%. If this is not the case, one should consider an equal-width increment (EWI) or an equal-discharge increment (EDI) sampling procedure (NFM Chapter 9, Section 6.02).

In general, collect the samples before making field measurements to avoid contamination of the site. Also, when possible, collect samples starting at the most downstream location and working upstream to avoid contamination due to sampling activities. Wear a new set of gloves at each site. Sample upstream of bridges to avoid contamination from the bridge. For each grab sample, open the bottle or WhirlPak and plunge beneath the water surface about 1.0 feet and move the mouth upstream until the container is nearly full. If wading, collect the sample upstream of you. If water depth is less than 1.5 feet deep immerse the sample bottle of one third of the depth. Cap the bottle and label properly. Once the samples have been collected, place the pH, conductivity, temperature, and DO probes (or multi-probe) in the water to equilibrate. Process the samples (acidification, filtration, documentation as necessary) then take field readings. Note: samples may be collected as grab samples and processed in the lab.

Sample Processing Requirements:

Bottle Number	Analyte(s)	Collection Method	Container	Preservation
1	Dissolved Nitrogen and Phosphorous Species	Depth Integrated	125 ml brown plastic	Filter within 2-3 hours using 0.45 μm filter; chill to 4°C. Hold time = Ship as soon as possible
2	Total Phosphorous	Depth Integrated	125 ml clear plastic	Acidify with 1 ml 4.5 N H_2SO_4; chill to 4°C Hold time = 28 days
3	Fecal Coliform	Grab	WhirlPak	Chill to 4°C Hold time = 6 hours
4	Total Petroleum Hydrocarbons	Grab	Baked borosilicate glass 1000ml	Acidify with 2.5 ml 1:1 HCl to pH 2.5 to 1.5; chill to 4°C Hold time = 28 days

Specific Tasks at Each Sample Site:

A. Collect Fecal Coliform Sample
B. Collect QC Sample(s)
C. Collect Dissolved Nitrogen Sample
D. Collect Total Phosphorous Sample
E. Collect Total Petroleum Hydrocarbon Sample (at Pohono, Foresta, and South Fork Bridges only)
F. Collect Field Measurements

A. Fecal Coliform Sampling protocol (USGS National Field Manual for the Collection of Water-Quality Data (NFM), Chapter 7). Never pre-rinse the sample container. When submerging the sample container, take care to avoid contamination by surface scums. The surface film is enriched with particles and bacteria not representative of the water mass.

Fecal Coliform samples will always be collected as grab samples.

1. Establish a consistent sampling location at each site, preferably where there is a consistent downriver current and is deep enough to avoid collecting any sediment.
2. For each sample set, wear a new pair of latex gloves.
3. Open the Whirlpack™ container and collect a sample from about 1 foot beneath the surface moving the bag forward upstream until full. Always hold the mouth of the sample container upstream of the sampler, sampling apparatus, and any disturbed sediments. Avoid contact with the sediment. Squeeze out the top one inch of water from the bag and whirl the bag to seal. The sealed bag must retain at least 50 ml of sample but leave a small pocket of air. This airspace will help mix the sample when it is shaken just before making dilutions and membrane filtration.
4. Place sample immediately in cooler. Fill out sample form.

B. Quality Control Samples:

Field Replicate (Collect one replicate per sampling trip).

1. Collect two separate samples at one location. Rotate sites at which a replicate is collected.
2. Filter or acidify as appropriate (see D and E).

Field Equipment Blank (Collect one blank per trip).

1. Rinse sample bottle for the DH-81 or DH-95 with DI water 3 times. Fill with DI water. This is the 'blank' sample.
2. Rinse sample splitter with the 'blank' sample.
3. Split the sample and filter and acidify as appropriate (see D and E).

C. Total Dissolved Nitrogen Sampling Protocol (NFM, Chapter 5.2.1.A):

1. Collect depth-integrated sample at the flow centroid using a DH-81 sampler if wading and a DH-95 sampler if suspended from a bridge.
2. For each sample set, wear a new pair of latex gloves.
3. Collect sample in a 1-liter Nalgene bottle that had been rinsed 3 times with deionized (not distilled) water. Rinse the bottle 3 times with river water before collecting the sample.
4. Filter the sample using a 0.45 μm filter.
5. Place sample immediately in cooler. Fill out sample form.

D. Total Phosphorous Sampling Protocol (NFM, Chapter 5.2.1.A):

1. Collect depth-integrated sample at the flow centroid using a DH-81 sampler if wading and a DH-95 sampler if suspended from a bridge.
2. For each sample set, wear a new pair of latex gloves.
3. Collect sample in a 1-liter Nalgene bottle that had been rinsed 3 times with deionized (not distilled) water. Rinse the bottle 3 times with river water before collecting the sample.
4. Acidify the sample per directions from the laboratory.
5. Place sample immediately in cooler. Fill out sample form.

E. Hydrocarbon/Petroleum Sampling Protocol (NFM, Chapter 5.4.2):

1. Sample at the same location as the fecal coliform sample. This sample will always be collected as a grab sample.
2. For each sample set, wear a new pair of latex gloves.
3. Open the sample bottle not touching the opening. Do not pre-rinse bottle. Plunge the bottle into the river fully below the surface facing the opening upstream. Move the bottle slowly forward under the surface until nearly full. Leave a small amount of head space.
4. Acidify the sample per directions from the laboratory.
5. Place sample immediately in cooler. Fill out sample form.

F. Field Measurements:

Measure temperature (air and water), specific conductivity, pH, and dissolved oxygen (DO). In addition make an estimate of the discharge (NFM Chapter 6). Record all calibration information on calibration forms and place in notebook.

- **Temperature—**

  - Use a NIST certified electronic thermometer (or one whose accuracy has been verified by a laboratory NIST certified thermometer). Verification should be performed and documented quarterly.
  - Measure the temperature at 5-10 cm beneath the water surface, approximately the same location where the samples were collected.
  - Report the value to the nearest 0.2 °C.

- **Specific Conductivity—**

  - Calibrate at first sample site using temperature-compensation mode. Calibration solutions should be close to the same temperature as the river water. Calibrate first to a standard that is close to the river water value. Then perform a check of the probe by immersing it into different (though not radically different) calibration solution. Record this information on the appropriate form. This probe needs to be calibrated once per day of use. Conduct a final calibration check immediately following collection of the last sample of the day.
  - Immerse probe into the water at approximately the same location as where the samples were taken.
  - Once it has stabilized, record the raw conductivity and specific (temperature compensated) conductivity values to nearest tenth µS/cm.

- **pH—**

  - Calibrate the pH meter before the start of sampling and when going to a different river, at least two times per day. In addition, the meter accuracy should be verified using a check standard close in value to the river water. A final check of the instrument should be done after the last sample is taken. All calibration and checks should be performed in the field due to the sensitivity of the pH probe.
  - Calibrate and operate in temperature-compensation mode using pH = 4.00 and 7.00 buffer solutions. Check using a buffered solution of pH 5-6.
  - Immerse probe into the water at approximately the same location as where the samples were taken. Agitate the probe continuously.
  - Once it has stabilized, record value to the nearest tenth of a pH unit.

- **Dissolved Oxygen—**

  - Calibrate the meter at each sample location. Conduct a final calibration check immediately following collection of the last sample of the day.

- Immerse probe into the water at approximately the same location as where the samples were taken. Agitate the probe continuously.
- Once it has stabilized, record value to the nearest 0.1 mg/L.

Discharge Estimate—

- At Happy Isles and Pohono Bridge use the USGS gaged flows. Note the time of your site visit and find the discharge later via the USGS web-sites: Happy Isles: http://nwis.waterdata.usgs.gov/nwis/uv/?site_no=11264500&agency_cd=USGS and Pohono Bridge: http://nwis.waterdata.usgs.gov/nwis/uv/?site_no=11266500&agency_cd=USGS
- At all other sites make a qualitative estimate using 1) <25% bank full, 2) 25-75% bank full, and 3) >75% bankfull. If there is a nearby staff gage record that reading as well (at Sentinel Bridge, for example).

Quick Guide to VERP Water Quality Sampling (Normal Monthly Sampling):

Before Field Days (Monday or Tuesday):

1) Charge MiniSonde Controller (turn on to assure charging; don't turn off)
2) Print and copy on waterproof paper: field forms (12), chain of custody form (1), calibration forms (3), Sampling Log (1). All forms are at U:VERP/Water Quality Monitoring. Note that field forms have a back side with reference codes.
3) Assure you have 12 NWQL bottle sets (1 FCC, 1 WCA each), 3 1-L amber bottles (pre-acidified), and at least 6 Whirlpak bags. 1 set is for Merced Lake which Brian has probably already taken care of.
4) Fill 5-gal DI bottle at El Portal Waste Water Treatment Plant (call Dave Shackelton @ 379-1828)
5) Verify with Jim Allen (379-1039) that they are available to take samples to Fresno on Thursday. Verify with Jim Fredle at Wawona Waste Water Treatment Plant that they will be able to process the fecal coliform samples on Wednesday.

Day 1—South Fork Merced (First Wednesday of the Month):

Before going to the field:

1) Assemble 3 bottle sets, 3 Whirl_Pak bags, 1 TPH brown glass bottle. Place all in cooler with ample blue ice.
2) Clipboard with field forms, chain of custody form, calibration forms, and sample log form. Assure adequate supply of pH 7, pH 4, pH 5.00, 1000 uS/cm, and 750 uS/cm standards. Assure adequate filters, acid vials, gloves, Kimwipes etc.
3) Pack 2 large bins, DH-81, binoculars, Hydrolab with cord and controller.

In the field:

1) Calibrate the Hydrolab at the Wawona campground ampitheater (less dust). Calibrate pH (pH 7 and 4, check at pH 5.00), DO, and conductivity (1000 uS/cm and check at 750 uS/cm). **Record all information on calibration form.**
2) Measure pH, water and air temperatures, DO (mg/l), and conductivity at each site.
3) Collect centroid sample (1-L) (Sample Method = 30 on field form) about 100 yards downstream of campground at outlet of large pool. Cap sample bottle, label, and store for processing later. Collect one Whirlpak bacterial sample (no rinsing). Collect one TPH sample (no rinsing). The latter two can be collected near the stream edge. Read stage on river near golf course. **Fill out field form. No BSK chain of custody form is necessary for the fecal coliform samples as they will be processed by the Wawona Waste Water Treatment Plant. Record TPH sample on BSK Chain of Custody Form.**

4) Collect Remaining Samples as follows:

Site	NWQL Sample	Total Pet Sample	Fecal Coliform Sample	Measure Stage
Below Wawona Campground	1	1	1	Same as below.
South Fork Bridge	1	0	0 (1 if Wawona Waste Water Treatment Plant isn't collecting a sample that day)	Gage in river near golf course (use binoculars).
Swinging Bridge	1	0	1	Same as above.

5) **Fill out the Sampling Log Form as you go.**
6) Deliver WhirlPak Samples (Fecal Coliform) samples to Wawona Waste Water Plant.
7) Process NWQL Samples. (This can be done at the Wawona Waste Water Plant in the parking area.) Filter the sample for the FCC (125ml brown bottle). Acidify an unfiltered sample in the WCA (125ml clear bottle). Rinse bottles three times before filling. Label and chill immediately. **Change filters between samples. On the Field form check the following analyses: TDN, Nitrate, Total P, Total Dissolved P.**

Day 2—Main Stem Merced (First Thursday of the Month):

Before going into field:

1) One person needs to go to Nevada Falls. This person should calibrate handheld conductivity meter. **Record on calibration form**. Take one clean 1-L nalgene bottle. Go collect sample. Process back at lab.
2) Assemble 3 Whirl_Pak bags, 2 TPH brown glass bottles. **Place in small cooler with 1-L TPH sample collected in Wawona. (This way you have all samples for BSK analysis ready to go when you arrive at the El Portal Wastewater Treatment Plant.)** Prepare another cooler with blue ice in which to store 6 1-L bottles each in a zip-lock bag. You may want to prelabel these bottles for each site. One will be a replicate.
3) Clipboard with field forms, chain of custody form, calibration forms, and sample log form. Assure adequate supply of pH 7, pH 4, pH 5.00, 1000 uS/cm, and 750 uS/cm standards. Assure adequate filters, acid vials, gloves, Kimwipes etc.
4) Pack 2 large bins, DH-81, DH-95 and bridgeboard and reel, Hydrolab with cord and controller.

In the field:

1) Calibrate Multiprobe at Happy Isles. Calibrate pH (pH 7 and 4, check at pH 5.00), DO, and conductivity (1000 uS/cm and check at 750 uS/cm). **Record all information on calibration form.**
2) Measure pH, water and air temperatures, DO (mg/l), and conductivity at each site. **Fill out field form.**
3) Collect centroid sample (1-L) (Sample Method = 30 on field form) at each site using DH-81 or DH-95. Cap sample bottle, label, and store for processing later. Collect one Whirlpak bacterial sample (no rinsing). **Record bacterial samples on BSK Chain of Custody form. Record TPH samples on BSK Chain of Custody Form.**
4) Collect samples indicated in the following table. Collect samples in the order indicated. Following collection of the samples at Foresta Bridge, deliver BSK samples (3 TPH and 3 Fecal Coliform, and Chain of Custody Form) to Dave Shackelton at the El Portal Waste Water Treatment Plant.

Site	NWQL Sample	Total Pet Sample	Fecal Coliform Sample	Measure Stage
Happy Isles	1	0	1	Online or in field.
Sentinel Bridge	1	0	1	Use gage on bridge.

Site	NWQL Sample	Total Pet Sample	Fecal Coliform Sample	Measure Stage
Pohono Bridge	1	1	1	Online or in field.
Foresta Bridge	1	1	0	Wire weight gage on bridge.
SR140 Bridge	1	0	0	Use same value as Foresta.
SR140 Bridge Replicate	1	0	0	Use same value as Foresta.

5) **Fill out the Sampling Log Form as you go.**
6) **Before 11am:** Deliver WhirlPak Samples (Fecal Coliform) samples and all TPH samples to El Portal Waste Water Plant. Get a copy of the signed Chain of Custody. Make sure someone is there to receive the samples (Dave Shackelton 379-1828 or Jim Allen 379-1039).
7) Back at the lab, process NWQL Samples. Filter the sample for the FCC's (125ml brown bottle). Acidify an unfiltered sample in the WCA (125ml clear bottle). Rinse bottles three times before filling. Label and chill immediately. **Change filters between samples. On the Field form check the following analyses: TDN, Nitrate, Total P, Total Dissolved P.**
8) Process the replicate sample as above.
9) Process one blank sample (use DI water for 1 FCC and 1 WCA).
10) Check the multimeter using pH 5.00 solution. Check conductivity using 750 uS/cm solution. **Record these values and solution temperature on the Calibration Form.**
11) Recalibrate multimeter. No need to record.
12) Rinse Multimeter. Place a small amount of tap water in the calibration cup for storage. Unplug cord and cap conductors for protection.
13) Make copies of all field forms and calibration forms. Verify that each sample bag has the proper field form. Include Calibration forms in a separate plastic bag.
14) Store all equipment properly. Rinse all filtering equipment and bottles and allow to air dry before storage.
15) **Store samples over the weekend in the refrigerator. Ship on following Monday using overnight Fedex to Dave Clow (forms are in lab). Use plenty of blue ice.**

Quick Guide to VERP Water Quality Sampling
(Event or Snowmelt Runoff Sampling):

1. Weekday? Call Miyuki Fujita at BSK Labs (559) 497-2888 to tell her you are coming with 5 fecal coliform (3 x 5) samples and 3 total petroleum hydrocarbon samples. Tell her approximately what time you will arrive.

   Weekend? Don't collect fecal coliform samples.

2) Gather Bottles Sets, Forms, Two (2) Coolers, and Blue Ice:

   a. 7 WCA (clear 125ml bottles + acid)
   b. 7 FCC (brown 125ml bottles)
   c. 5 Whirlpak bags
   d. 3 amber glass bottles (total petroleum hydrocarbons) + 1 spare in case one is broken
   e. FORMS: 1 Chain of Custody BSK form, 1 Sample log form, 1 Calibration form, 7 field forms (all on waterproof paper)

3) Collect Field Items:

   a. Big Black Tuff box : orange vests, Fecal coliform Whirlpak tongs, towels, lifejacket, grab sample bottles with labels (6), ziplock bags, Whirlpak bags, gloves, Conductivity meter
   b. 2 coolers : one for NWQL samples, one for BSK samples

c. Clipboard – all forms, example forms, calibration instructions
d. Binoculars if you can find them – for the Wawona staff gage by the golf course

4) Calibrate meter – use simple Oakton meter for specific conductivity and temperature only. Calibrate with 1000 uS/cm solution or equivalent and check using 750 uS/cm solution or equivalent.

5) Sample Sequence:

a. Foresta Bridge—FC, TPH, FCC, and WCA
b. Pohono Bridge—FC, TPH, FCC, and WCA
c. Happy Isles Bridge—FC, FCC, and WCA
d. Wawona Campground—FC, TPH, FCC, and WCA
e. Swinging Bridge—FC, FCC, and WCA (collect 2 1-L bottles of river water, 1 sample and 1 replicate)

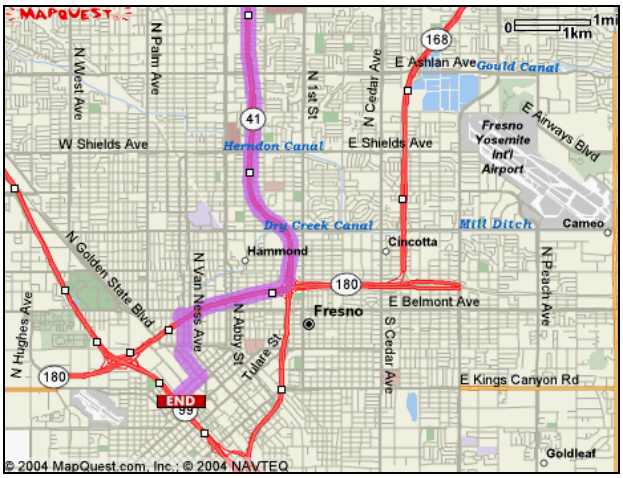
[FC = Fecal Coliform (Whirlpak), TPH = Total Petroleum Hydrocarbon (1L bottle), FCC = Filtered Chilled (125 ml brown), and WCA = Whole water acidified (125 ml clear)]

6) At Each Site:

a. Check river mixing; note stage **(try to collect sample at location in main current where it is safe to do so)**
b. Collect FC sample using Whirl Pak (no rinsing!)
c. Collect TPH using 1-L amber bottle—must be prepped with acid (no rinsing!)
d. Collect one liter of water in plastic bottle for FCC and WCA (rinse 3 times)
e. Label bottles with date, time, sample location
f. Measure temperature, conductivity
g. Finish field form(s)
g. Store samples in cooler

Immediately following collection of last sample at Swinging Bridge in Wawona, Drive to BSK labs in Fresno (see map). Complete Chain of custody form placing an 'X' under sample types collected for each location. In summary, you should have 5 fecal coliform samples and 3 TPH samples for delivery to BSK.

BSK Analytical Laboratories
1414 Stanislaus Street
Fresno, California 93706
Local: (559) 497-2888
Toll-Free: (800) 877-8310



7) Back at the Lab:

   a. Filter samples for FCC bottles
   b. Acidify sample for WCA bottles
   c. Label all bottles with site name, number, date, time
   d. Finish field form
   e. Process replicate sample as others, label as such, fill out separate field form, place sample in separate bag
   f. Process field equipment blank as others, label as such, fill out separate field form, place sample in separate bag
   g. Copy field forms
   h. Place original waterproof field forms with their respective samples
   i. Check calibration of the meter using 750 uS/cm solution or equivalent.
   j. Copy calibration form. Place a copy with the samples (in a separate bag). Mail with samples.
   k. Complete sample log form
   l. Refrigerate samples
   m. Place all copies of forms in the VERP Drawer at Brian's desk

8) Mail samples to Dave Clow as soon as possible. Send in a cooler with plenty of blue ice. If after 12:00 p.m. on Thursday, mail the following Monday so samples don't sit over the weekend.

Dave Clow
USGS/WRD
MS 415 Federal Center
Building 53
Denver, Colorado 80007
Telephone: 303.236.4882, Ext. 294

B.9.4.5 Quality Control

Quality control (QC) of field measurements and sample integrity are outlined in this section. In general, at least one set of QC samples and one set of duplicate field measurements should be taken per sampling trip (one per the eight front-country sites and two back-country sites). In addition, one field blank should be processed per sampling trip.

Sample Replicates (Once per Sampling Trip):

For nutrients (nitrogen species and total phosphorous) collect sample replicates at one site per sampling event. Processes both samples as normal, labeling one as the replicate sample.

For the coliform sample, a replicate will be prepared in the laboratory. This should be the same sample location as the split for the other analysis. Standard laboratory positive and negative tests should be reported for each sample batch.

For the Total Petroleum Hydrocarbon sample, the laboratory conducting the analysis will perform quality assurance.

Field Equipment Blanks (One per Trip):

Process one sample set using DI water in exactly the same way as a normal river water sample. Rinse a 1 L bottle with DI water three times. Fill with DI water. Fill the total phosphorous bottle from this 'sample' bottle. Acidify the sample and store as normal. Filter the 'sample' water into a dissolved nitrogen species bottle following normal filtration protocols. Store and label as normal.

Repeated Field Measurements (Once per Trip):

Repeat field measurements of temperature, pH, conductivity, and dissolved oxygen once per sampling trip. If taking measurements from a bridge, take the first set of readings as normal. Remove sensors from the water and rinse thoroughly with DI water and return to the same location as the first set of readings. Record these readings in the space provided on the field form.

Field Blanks:

None scheduled at this time.

External Audit Samples:

None scheduled at this time.

B.9.4.6 Equipment Maintenance

The following is a schedule and procedural guide to maintenance of water monitoring field equipment.

Daily (After Sampling):

- Buffers and Standards Solutions:
  - Store buffers and standards solutions according to manufacturer's directions. Some solutions may have to be refrigerated when not in use.
  - Check the expiration dates and order new solutions well in advance. Do not use expired solutions.
- Sample Bottles and Collection Devices
  - Rinse all sampling devices (bottles, caps, nozzles, filtering systems, and tubing) with DI water after each sampling day. Store in clean zip-lock bags or a clean dust-free container.
  - Inspect sampling bottles regularly for scratches or other damage. Do not use bottles that are excessively scratched as these may be difficult to clean.
  - Inspect the sampling ports of the DH-81 and DH-95 devices for scratches or damage. Order replacement parts if necessary.

Annually (January or February):

- Buffers, Standards Solutions, Other Chemicals:
  - Order sufficient buffer and standards solutions for the coming year. This includes pH 4.00, 7.00, and check solution, and Conductivity standard and check solutions.
  - Order sufficient acid and methanol.
- Sample Bottles and Collection Devices:
  - Inspect sampling bottles regularly for scratches or other damage. Do not use bottles that are excessively scratched as these may be difficult to clean.
  - Order new sample bottles if necessary.
  - Inspect the sampling ports of the DH-81 and DH-95 devices for scratches or damage. Order replacement parts if necessary.

Hydrolab MiniSonde 4a:

Follow this schedule for minimum maintenance. This schedule has been developed from the record of instrument performance and consultation with the manufacturer.

After Each Sampling Trip—These are important steps in preventive maintenance that are done each day the instrument is used.

- Post-calibrate the instrument before general cleaning and maintenance.
- Following post-calibration, rinse off the sensors and store them in tap water. Do not use
- distilled or deionized water for storage.
- Keep the water-tight rubber cable connectors well lubricated and dry on the inside. The best procedure is to store the instrument with all connectors separated and open to the air until dry.
- Check rubber cable connectors regularly to ensure that the mated surfaces are covered with a thin film of white silicone.
- As necessary, use some tissue paper to remove old traces of silicone and dirt and then reapply the silicone.

Before Calibrating—Clean off the sensors. Use a cotton pad and methanol. Cotton swabs or gauze pads are the only materials that will not scratch the soft glass of the pH probes. Paper, including lens paper, is not suitable.

Conductivity:

Every two months or once every 15 field trips:

- Clean the conductivity sensor with a Q-Tip soaked with methanol.

pH:

Every two months or once every 15 field trips:

- Wipe the pH probe with a Q-tip soaked in methanol.
- Replace the solution in the pH reference sleeve with a standard electrolyte (3.5 molar KCl saturated with silver chloride).
- Clean the plastic reference probe sleeve and fritted end piece inside and out with a Q-tip soaked in methanol.
- Rinse everything with deionized water before filling and reassembling.
- Always apply a thin layer of silicone to the O-rings.
- When replacing the sleeve, point the sensor down and push the sleeve up until it just covers the O-ring, then point the sensor up and continue to push the sleeve all the way to the base of the probe. This will purge air out of the sleeve and force electrolyte through the Teflon junction.
- Inspect the reference sleeve for air bubbles by observing the sensor while inverting the Sonde. If bubbles are present, repeat the filling procedure.
- Place the instrument sensor upright and fill the reference sleeve with solution until overflowing. As the Teflon junction is screwed in place observe electrolyte coming through.

Every 12 Months:

- Replace Teflon junctions on pH reference sleeve.
- Store spare junctions in a 2 to 5 molar (> 50,000 µmhos/cm) KCl solution.
- Inspect the O-ring at the bottom of the Teflon junction and at the base of the reference sleeve. Replace them if they appear flattened or have small nicks or cuts.

pH Trouble Shooting:

If pH still doesn't calibrate correctly, do the following:
Evaluate the condition of the Teflon junction on the terminal end of the pH reference sleeve. The sleeve should slide on easily with some force applied. If the sleeve is difficult to apply, then the junction may have become clogged. In contrast, if the sleeve slides on too easily with little resistance, the junction is too porous. In both instances the junction must be replaced.

If replacing the junction does not solve pH problems, then clean the probe by alternately soaking it in 0.1 N HCl (hydrochloric acid), and then in 0.1 N NaOH (sodium hydroxide) for five minutes in each solution. Use the small black caps that protect display unit terminals to isolate the probes for soaking with these solutions.

Safety Note—Wear safety glasses and gloves when working with the corrosive chemicals.

Batteries:

Every two months or once every 15 field trips:

- Review the calibration and replacement schedule for batteries.
- Recharge the 6-volt NiCad Gelcell batteries (nickel-cadmium or nickel-metal hydride) for 12 to 24 hours, regardless of the voltage displayed by the instrument. Ensure that NiCad batteries are recycled or disposed of properly. They should not be put in the regular trash.

Stirrer:

Every two months or once every 15 field trips:

- Remove the magnetic metal wheel from the stirrer post.
- Thoroughly clean all lubricant, dirt, and debris from the inside of the wheel and stirrer post with a paper towel and Q-tip.
- Reapply a very small amount of white silicone lubricant to the tip of the stirrer post.

Dissolved Oxygen:

Every six months or once every 15 field trips:

- Change the DO membrane and add fresh KCl solution.
- Invert the Sonde on a ring stand.
- Remove the guard, the O-ring, and the membrane. Shake out old electrolyte.
- Rinse DO cavity twice with deionized water and twice with DO electrolyte.
- Fill the cell with DO electrolyte and gently tap the side to release any trapped air bubbles.
- Replace the membrane and secure with the O-ring.
- Inspect the membrane for wrinkles or trapped air bubbles.

Whenever there is anything but a rapid and stable oxygen calibration, replace the membrane as a first step in troubleshooting. The new Teflon membrane is stretched during the replacement procedure. This affects the rate of diffusion for oxygen through the membrane to the internal sensing components. As the membrane relaxes, the rate of diffusion changes in an unpredictable manner. It is preferable to allow the membrane to relax overnight before calibrating. A minimum of 30 minutes must be allowed before the initial calibration.

If the gold cathode ring is discolored or tarnished, polish lightly with a lint free cloth or pencil eraser.

If the white ceramic post in the DO sensor is discolored (ages from white to gray to black):

- Clean with a 1:1 solution of household ammonia and deionized water.
- Remove the membrane from the sensor and pour out the electrolyte.
- Rinse with deionized water. Invert the Sonde on a ring stand and with a small eye dropper fill the cell with the ammonia solution until the white ceramic post is covered. Be careful not to get the solution on the gold anode ring. Have a moist towel close by when conducting this procedure so that the solution can be quickly wiped from the gold ring.
- Let stand for 10 minutes.
- Rinse twice with deionized water and refill according to the standard procedure described above.
- If it is necessary to use the DO probe before the new membrane has 12-hours to relax, carefully recalibrate the dissolved oxygen immediately before each set of measurements.

Sonde:

Every 12 months:

- Replace desiccant inside the display and Sonde units.

B.9.4.7 Data Organization and Storage

Each sampling trip will generate field forms, calibrations forms, and chain-of-custody forms. In addition, there will be lab analysis results. All this information must be stored in a convenient and secure manner.

Sample Site Files:

Each sample site will have its own folder that will contain site metadata and all field forms. Field forms will likely be required to accompany the samples to the laboratory. Therefore, make copies of each before sending samples.

File the following items in the sample site file:

- Copy of field form
- Copy of the instrument calibration form that corresponds to field measurements taken at that location
- Copy of the corresponding chain-of-custody file(s)
- Copy of laboratory analysis results

These files should be stored in a secure fire-proof location.

Instrument Calibration Notebook:

All instrument calibration sheets should be stored in a 3-ring binder that is stored in the lab.

Instruments Maintenance Notebook:

All notes regarding instruments maintenance should be stored in a 3-ring binder kept in the lab. This binder should be organized by instrument. Notes to be included are battery changes, maintenance performed in-house, and any manufacturer servicing of the devices.

Forms:

1) USGS Field Form
2) BSK Field Form
3) Calibration Form
4) Sample Log Form

Figure 18
USGS Field Form (Front)

AHRG Lab number (entered at login) _____

SITE INFO (Units (circle))

Site Code (see list) _____

Site Name (see list) _____

New site (y / n)? if yes, enter new site info below

DATE INFO

Collection date _____

Collection time _____

Field Filtered? _____

If no, date/time filtered

BULK PRECIPITATION DATA

Begin date _____

Begin time _____

Precip volume _____ L / ml

SNOWPACK OR LAKE DATA

Sampling depth _____ ft / in m / cm

NEW SITE INFO (complete only for new sites)

Latitude/Longitude _____

Elevation _____ ft / m

Datum, method (GPS, digitizer) _____

Accuracy _____ ft / m

County, State

FIELD DATA	Units (circle)
Sample Type (see list)	
If blank, note water lot#	
Sample Method (see list)	
Sampler type (see list)	
Staff gage	ft / in m / cm
Description	
Tape down	ft / in m / cm
Description	
Depth of water thru weir	ft / in m / cm
Inner gage	ft / in m / cm
Discharge	cfs / cms
Air temp.	°C / °F
Water temp.	°C / °F
Field S.C.	µS/cm
Field D.O.	mg/L
Susp. sediment collected?	y / n
If yes, volume filtered	L / ml

PERSONNEL

Sampling team _____

Team lead signature _____

Date signed

BOTTLES	# of each	**Preservation**	**Acid lot #**
250 ml FA		filter; acidify in lab (1 ml Ultrex HNO_3)	
250 ml RU		none	
250 ml FU		filter	
125 ml FCC		filter, chill	
60 ml FCC		filter, chill	
125 ml DOC		filter, chill	
15 ml vial (^{18}O)		none	
125 ml WCA		acidify in field (1 ml 5N H_2SO_4)	
Septums (dissolved gas)		none	
Mercury		acidify in field (5 ml Omnitrace HCl)	
1L or 2L RU (circle)		none	

ISOTOPES	Check		Check
^{18}O-water		Tritium	
$^{34}S/^{32}S$		$^{87}Sr/^{86}Sr$	
^{35}S		CFCs	
^{15}N-NO_3		^{18}O-NO_3	

ANALYSES

AHRG Lab	Check
ICP	
IC Anions	
IC Cations	
alkalinity, pH, SC	
DOC	
DON	
NWQL	
HBN (schedule 1671)	
TDN (lab code 2754)	
Total N (lab code 2756)	
Nitrate (lab code 1979)	
Ammonia (lab code 1980)	
ortho-P (lab code 1978)	
TDP (lab code 2331)	
Total P (lab code 2333)	
Other (specify lab codes below)	

NOTES _____

USGS Field Form (back)

Sample Type	Description
S	Streamwater
R	Springwater (eg., talus springs)
G	Groundwater (eg., wells)
B	Bulk precipitation
W	Wet-only precipitation
P	Snowpack
O	Lake Outflow
E	Lake Epilimnion
H	Lake Hypoliminion
F	Field Blank
K	Lab Blank

Sample Method	Description
M	Grab
E	EWI
A	Autosampler
R	Replicate
B	Blank
W	Weir
G	Gage
C	Composite
30	Centroid

Sampler Type
(surface water samples)
1L or 2L bottle
DH81
Autosampler
(precipitation samples)
Carboy
Funnel
Aerochem
Shovel/scoop

Site Info

Site Code	Site Name
HB259	Merced River below Merced Lake
HB201	Merced River above Nevada Falls
HB204	Merced River above Happy Isles Bridge
NP182	Merced River above Sentinel Bridge
HB317	Merced River above Pohono Bridge
NP183	Merced River above SR140 Bridge
NP184	Merced River above Foresta Bridge
NP185	S. Fork Merced River above Swinging Bridge
NP186	S. Fork Merced River above South Fork Bridge
NP187	S. Fork Merced River below Wawona Campground

Figure 19

BSK ANALYTICAL LABORATORIES

Laboratory Chain of Custody

BSK Submission: ______

1414 Stanislaus, Fresno CA 93706
(559) 497-2888, (800) 877-8310, FAX (559) 485-6935

Client: NPS-YOSE-RESOURCES	Report Attention: JIM ROCHE	Phone: (209) 379-1310
Address: Po. Box 577	PO:	FAX: (209) 379-1116
City, State, Zip: Yosemite, Ca. 95389	Copy to: jim_roche@nps.gov . joe_meyer@nps.gov	System #: N/A
Lab Use Only / Sampling Info	Sampled by: JIM ROCHE	Project: VERP

S#	T	#C	Date	Time		Comment or Station Code	Fecal coliform SM 9221B	EPA 1664 - Hydrocarbon Oil and Grease									Rush Priority (1-Day, 2-Day, 5-Day)
					Merced River above Happy Isles Bridge	HB204											
					Merced River above Sentinel Bridge	NP182											
					Merced River above Pohono Bridge	HB317											
					Merced River above SR140 Bridge	NP183											
					Merced River above Foresta Bridge	NP184											
					S. Fork Merced River above Swinging Bridge	NP185											
					S. Fork Merced River above South Fork Bridge	NP186											
					S. Fork Merced River below Wawona Campground	NP187											
					Perserved with ice												
					Run if hold time is exceeded												
					Email results to jim_roche@nps.gov												
					Email results to joe_meyer@nps.gov												

QC Report Type: Level [ ] **2** [ ] **3** [ ] **4** Formal COC Required: [ ] Additional Services authorized by: ______

Signature	Print Name	Company	Date	Time
Received / Reliquished by:	Jim Roche	National Park Service		
Received / Reliquished by:	Jim L. Allen	National Park Service		
Received / Reliquished by:				
Received / Reliquished by:				
Received / Reliquished by:				

Notice: Payment for services rendered as noted herein are due within 30 days from the invoice date. If not so paid, account balances are deemed deliquent. Deliquent balances are subject to monthly services/re-billing charges and interest calculated at 1.5% per month, 18% per annum. BSK & Associates shall be entitled to recover on deliquent accounts, costs of collections, including attorney's fees incurred prior to or in litigation whether concluded by judgment, settlement, compromise or otherwise. The person signing for the Client/Company expressly acknowledges that they are either the Client or authorized agent of the Company.

Payments Received with delivery Date ______ Amount ______ Ref # Initials

Figure 20
Yosemite Water Quality Monitoring Program
Instrument Calibration Form

Date: ____________________
Analysts: ____

pH

Hydrolab MiniSonde 4a s/n . . . . Sensor # or Other: _______________________________
Time ____________
First Level Calibration: ___________ / ______°C; Mfr/Lot# ______________Exp. Date____
Second Level Calibration: _________ / ______°C; Mfr/Lot# ______________Exp. Date___
Calibration Check Standard True: ___________; Mfr/Lot# ______________Exp. Date____
ICC (measured): ______/_____°C% Diff ___Cal accepted: ___________ ___Initials/date/time
CCC (measured): ______/_____°C% Diff ___ Cal accepted: __________ ___Initials/date/time
CCC (measured): ______/_____°C% Diff ___ Cal accepted: __________ ___Initials/date/time

Time ____________
First Level Calibration: ___________ / ______°C; Mfr/Lot# _____________Exp. Date_____
Second Level Calibration: _________ / ______°C; Mfr/Lot# _____________Exp. Date____
Calibration Check Standard True: ___________; Mfr/Lot# ______________ Exp. Date____
ICC (measured): ______/_____°C% Diff ___Cal accepted: _______________Initials/date/time
CCC (measured): ______/_____°C% Diff ___ Cal accepted: ______________Initials/date/time
CCC (measured): ______/_____°C% Diff ___ Cal accepted: ______________Initials/date/time

Conductivity

Hydrolab MiniSonde 4a s/n . . . . Sensor # or Other: _______________________________
Time ____________
First Level Calibration: _____µS/cm/ _____°C; Mfr/Lot# ____________Exp.Date_________
Calibration Check Standard True: _____µS/cm/ _____°C; Mfr/Lot# __________Exp.Date__
ICC (measured): ______________ % Diff. ________Cal accepted: ________ Initials/date/time
CCC (measured): ______________ % Diff ________ Cal accepted: _______ Initials/date/time
CCC (measured): ______________ % Diff ________ Cal accepted: _______ Initials/date/time

Dissolved Oxygen

Hydrolab MiniSonde 4a s/n . . . . Sensor # or Other: _______________________________
Calibrations:
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C
Time _______ Barometric Pressure _____________ (mm Hg) Temperature ___________°C

Notes:

Figure 21
Merced River Water Quality
Sampling Log

Site Name	Site Code	Date	Time	Samples Collected (Number)			
				FCC	WCA	1-L TPH	Fecal Coliform
Merced River Above Happy Isles Gaging Station	HB204						
Merced River Above Sentinel Bridge	NP182						
Merced River Above Pohono Bridge	HB317						
Merced River Above SR140 Bridge	NP183						
Merced River Foresta Bridge	NP184						
S. Fork Merced River Above Swinging Bridge	NP185						
S. Fork Merced River Above SR41 Bridge	NP186						
S. Fork Merced River Below Wawona C.G.	NP187						

FCC - Filtered, Chilled, Integrated
WCA - Unfiltered, Acidified,
Integrated
1-L TPH - Amber Glass Bottle, Acidified, Total Petroleum Hydrocarbons, Grab Sample
Fecal Coliform - 100ml Whirl Pak,
Grab Sample

Figure 22
Yosemite Water Quality Monitoring Program
Sample Site Information Form

Site Name: _____
Date: _____

Site Location: UTM _____ E _____N Datum NAD27 NAD83

Lat/Long _____ N _____ W

Site Elevation: _____ meters feet

USGS Site Number: _____

Other Relevant Site Numbers _____

Site Description:

Sketch Map:

C.0 FIELD LOGISTICS

C.1 OVERVIEW

The monitoring of User Capacity Indicators will be conducted by personnel from various park operations. Crew configuration and/or coordination activities and procedures may vary across park divisions and branches, but measurement and collection protocols are defined in the Field Guide. The following section describes field personnel responsibilities and activities, and describes typical work flow when assigned to monitoring work. Additionally, this section discusses training, and debriefing activities.

C.2. TRAINING

Field activities are preceded by training. Training activities will start with background on the indicator and standard. The primary objective of the training process is for field personnel to demonstrate proficiency in established, fixed, measurable protocols, and to insure ease of adherence to established guidelines. Training in data management responsibilities will acquaint personnel with data entry and transfer responsibilities.

Immediately following training, crews will visit practice/training plots or sites before formal field collection.

C.3 FIELD LOGISTICS

This field guide presents the procedures, data requirements, and data collection sheets for conducting inventories and condition assessments of the banks of the Merced River.

C.3.1 Monitoring/Sampling Responsibilities

Personnel will have responsibility for completion of one or more tasks as shown in Table 5. While task completion by Monitoring Crews may require more than one individual's effort, there will be one person assigned as Crew Leader; this person will assume full accountability. Some crew members may be trained in monitoring for several indicators or several tasks related to a separate indicator. Cross training is beneficial; it yields perspectives that improve the program processes and effectiveness.

C.3.2. Work Flow

Table 6 suggests a typical work flow for each monitoring program.

Table 5
Monitoring/Sampling Responsibilities

Indicator	Monitoring Completion Target Date	Monitoring/Crew Coordinator	Monitoring Crew Type*	Equipment Maintenance	Data Input and/or Transfer
Campsite Number	Wilderness Manager	Wilderness Manager	Wilderness Rangers	Wilderness Rangers	Sheets: Wilderness GPS: GIS
Campsite Condition	Wilderness Manager	Wilderness Manager	Wilderness Rangers	Wilderness Rangers	Sheets: Wildness GPS: GIS
Number of Encounters with other Parties	Wilderness Manager	Wilderness Manager	Wilderness Rangers	None	Sheets: Wilderness
People at one time at selected sites	Wilderness Manager	Wilderness Manager	LYV Camp Rangers	LYV Camp Rangers	Sheets: Wilderness
Exposed tree roots	Wilderness Manager	Wilderness Manager	LYV Camp Rangers	None	Sheets: Wilderness GPS: GIS
Number of Social Trails	Chief, Res. Mgmt & Science	Br. Chief, Veg. Mgmt./ Restor	Restoration staff	Restoration Crew	Sheets: Veg/Rest. GPS: Veg or GIS
Length of social trails in meadows	Chief, Res. Mgmt & Science	Br. Chief, Physical Science/GIS	Restoration staff	GIS Specialists	GIS Specialists
River bank erosion that is accelerated or caused by visitor use	Chief, Res. Mgmt & Science	Br. Chief, Veg. Mgmt./ Restoration	Restoration staff	Restoration Crew	Restoration Crew
Exposed tree roots in Yosemite Valley Campgrounds	Chief, Res. Mgmt & Science	Br. Chief, Veg. Mgmt./ Restoration	Restoration staff	Restoration Crew	Restoration Crew
Water Quality	Chief, Res. Mgmt & Science	Br. Chief, Physical Science/GIS	Physical Science staff	Physical Science staff	Physical Science Staff

*Includes Leader, who is responsible for crew assembly, transportation arrangements, and site activities.

Table 6
Work Flow for Monitoring Crews

INDICATOR	**Campsite Condition**	Logistical Prepara-tion	Establish or locate plot; GPS location	Walk site, establish boundaries; pin flag core, boundary and center point	Sketch map for core, boundary, center point and key features	Photo-graph site per guide	Complete data sheet per guide	Office: Data entry
	Campsite Number	Finish assessment of target campsite (see above).	Walk basin or area surrounding target site, generally within 200' of water	For each site encountered, rapid assessment of site development and vegetation damage	GPS the location of each site encountered	Office: Data entry		
	Number of Encounters with other Parties	Logistical preparation for patrol	Patrol	Document: trail segment; encounter date and time; (party size?)	Office: Data entry:			
	People at one time at selected sites	Logistical prepara-tion	Travel to site of trail counter	Connect data collector to trail monitor Download per instructions; confirm data	Disconnec t; Reset monitor (clear data).	Move to unit #2 and repeat	On office computer: Open Stat Pack; Connect Data Collector (by cable) to comport and download data.	
	Exposed tree roots	Logistical prepara-tion	Establish or relocate campsite to be monitoring	From campsite marker, record first tree from marker and root condition class, for each quarter, quarter point method, per guide	Office: Data entry			
	Number of Social Trails	Logistical prepara-tion	Drive or hike to parking site or activity area	Establish or relocate origin and terminus of transect, per guide. Pin flag each.	Record each trail intercept along transect. (GPS each??)	Office: Data entry		
	Length of social trails in meadows	Logistical preparation: GPS unit and copies of orthophotos.	Arrive at meadow; walk site, inventory and pin flag each trail origin	For each trail, assign identifier.	For each trail: GPS point of origin, nodes and terminus	Office: Download and data entry		
INDICATOR	**River bank erosion that is accelerated or caused by visitor use**	Logistical prepara-tion	Establish or relocate plot; GPS center point	Establish 2m x10m plot; pin flag boundaries, center point.	Document environment attributes, per guide.	Assess and document Condition Class, per guide.	Office: Data entry	
	Exposed tree roots in Yosemite Valley Campgrounds	Logistical prepara-tion	Establish or relocate transect; GPS point of origin.	Walk belt transec t	At each intercepted campsite marker, record root condition class, first tree, quarter point method, per guide.	Office: Data entry		
	Water Quality	Logistical preparati on; Gather materials (bottles, kit, blue ice, coolers, DI water, etc).	First site (down-stream site): Calibrate meter. Collect field "equipment blank" per guide.	First and all subsequent sites: Collect, preserve and store fecal coliform, nutrient and total petroleum hydrocarbon samples, per guide.	Take and record field measure-ments: Temp, pH, DO, and Conductivit y, discharge, per guide.	Com-plete field form and chain of custody form.	Final site of day: Final field calibra tion check of meter.	Mail sample s; clean and store equip-ment.	Data entry: field forms and lab results.

C.3.3 Monitoring Crew Responsibilities and Activities

The crew's daily field activities will be supervised by one member of the crew who will be designated by the field coordinator. The Crew Leader will supervise all field operations and, if necessary, resolve all discrepancies or issues at the site. The field Crew Leader has the responsibility of:

- Maintaining sampling schedule
- Assembling the field crew
- Transportation to the site(s)
- Ensuring adherence to sampling protocol
- Ensuring proper use of field equipment
- Maintaining site integrity (monitoring with care)
- Daily communications

C.3.3.1 Sampling Schedule

The initial sampling schedule will be coordinated by the Program Manager (Chief, Resource Management & Science, or Wilderness Manager), and may be delegated to the appropriate supervisor. The Program Manager will work with the Crew Leader to determine the most appropriate timeline and seasonal itinerary to meet program goals. The crew leader will be responsible for sampling quota (a certain number of sites, plots or samples within a period—including within the year—based on the sampling scheme for the particular indicator), while maintaining the quality of the measurements and samples, and following standard protocol. The Crew Leader must also be attentive to field crew morale and safety while planning a productive sampling schedule.

C.3.3.2 Assembly of the Field Crew

Each Crew Leader will determine the time and place for assembling the crew, and will review specific safety information and risks associated with the site and activities in question.

C.3.3.3 Transportation and Travel

Transportation may be assigned by the Crew Leader to another member of the crew.

Travel time must be considered. Wilderness travel times and the logistics of getting to a site are factors in scheduling. Living safely in a wilderness environment requires planning, preparedness and proper equipment. Water is generally available but a quart bottle with filter is required for travel in wilderness.

Access to trailheads must be considered. A vehicle is needed for trailheads, or arrangements must be made for pickups and drop-offs.

C.3.3.4 Sampling Site Locations and Plot Establishment

Sampling site locations will be identified for the monitoring crews as part of the Field Guide, OR, if not identified, the protocol for sample selection will be used by the Monitoring/Crew Coordinator to select and establish sampling site locations. Each Indicator section includes procedures for sampling site selection.

C.3.3.5 Ensuring Adherence to Sampling Protocols

The crew leader is expected to have a basic knowledge of all sampling procedures and be able to determine whether crew members are adhering to sampling protocols. It is suggested that all crew members attend all possible training sessions for tasks related to the monitoring program(s) in question, but the Crew Leader has the discretion to assign tasks to crew members with training in only the assigned tasks.

C.3.3.6 Ensuring Proper Use and Maintenance of Field Equipment

During orientation and training, each field crew member will be provided equipment and an inventory list for "Equipment and Supplies" needed to carry out a particular monitoring program (these are also listed in the Monitoring Guide, for each Indicator). If equipment is damaged during field activities, the item should be identified on the inventory list, and appropriate replacement or repair made, so that logistical packs remain intact. Crew members will inform the Crew Leader, who will inform the Monitoring Coordinator

Some field equipment will require special care (water quality meters and GPS units, for example) and proper use. The assigned crew member(s) must be familiar with the proper use of equipment and, if necessary, assist crew members if problems occur. Crew members will inform the Crew Leader if equipment is destroyed or in need of repair. The Crew Leader is responsible for addressing the equipment problem, or informing, in the case of equipment loss, the Monitoring Coordinator.

C.3.3.7 Maintaining Site Integrity

During sampling, flagging and/or pin flags will be placed around the site to mark various sampling points and site boundaries. All flagging must be removed after sampling has been completed. The Crew Leader will be responsible for maintaining site integrity and anonymity when sampling is completed and will direct all crew members to assist in these activities.

C.3.3.8 Daily Communications

During wilderness travel, daily communications should be scheduled, according to specifications of the Wilderness Manager. Communications should be maintained by radio and / or cell phone, routed through park dispatch.

Front country logistical communications are the responsibility of the Crew Leader, and will be coordinated during Crew Assembly Meetings.

C.3.4 Debriefing

Upon completion of field activities, crews will be given an opportunity to evaluate the field activities, measurement protocols, measurement protocols, the Field Guide, and logistics. Initially, crews will be given a "Debriefing Questionnaire" to complete prior to any formal debriefing meeting. The debriefing lends crews an opportunity to further present and discuss issues. The meetings will be held soon after field collection is finished in Late August or September.

D.0 SAFETY PLAN

D.1 Overview

Safety is a critical component of any field operation. Field personnel must be aware of potential safety hazards, follow all project safety protocol and equipment guidelines, and be prepared for emergency situations. This plan includes Job Safety Analyses for monitoring activities in wilderness and frontcountry areas.

(NOTE: For safety procedures to be effective, operations, field crews and supervisory personnel involved in VERP monitoring studies must read and fully understand them.)

D.2 Potential Field Hazards

Field personnel will encounter hazardous field operations about which they must be aware and informed concerning proper precautions. Some potential hazards discussed in this section are:

- Travel
- Weather extremes
- Terrain
- Insect pests, poisonous organisms, large animals
- Tree hazards
- Sampling

D.3 Travel

Vehicles should be well maintained to ensure safe travel. Clean windows and headlights frequently to reduce dirt and grime buildup. Wear seat belts at all times while the vehicle is in motion. Drivers must follow California state rules and regulations. Never use an unsafe vehicle. Make necessary repairs as soon as any unsafe condition develops. Store extra potable water in vehicles.

D.4 Defensive Driving

Defensive driving training and certification is strongly suggested and may be required at the direction of the Program Manager (Chief of Resources Management or the Wilderness Manager).

- Make sure driver is well-rested and alert.
- Insure any medication taken does not cause drowsiness.
- Limit daily travel and rotate driving responsibilities.
- All passengers must wear seat belts.
- No smoking is allowed in vehicles.
- No drinking and driving.

D.4.1 Accident Reporting—Drivers must report any accidents to their supervisors, and fill out a motor vehicle accident report.

D.5 Weather Extremes

The field crew leader should follow daily and weekly weather forecasts. Field crews should prepare for the summer weather conditions of heat, rain and snow with appropriate gear.

D.6 Terrain

Field crews will be exposed to dangerous terrain conditions, such as:

- Steep slopes
- Thick underbrush (thorns, roots, etc.)
- Loose rock conditions
- Wet, slippery ground
- Stream/marsh lands
- Deep water and proximity to fast water and waterfalls

Field wear should include weather-proof field boots with ankle support and slip-resistant (Vibram or similar material) soles. Long pants and shirts may be appropriate in some field settings, especially when there is a high potential for brush cuts and scrapes. Safety glasses are suggested to protect against eye injury in brush and when handling chemical materials. Hard hats may be appropriate in some situations (working in high slope areas with loose rock and/or past fire activity, for example).

D.7 Insect Pests, Poisonous Organisms, Large Animals

Field personnel may be exposed to insect pests and poisonous organisms. Such as:

- Mosquitoes
- Bees/Hornets
- Ticks (with the potential for exposure to Lyme Disease)
- Ants
- Poison Oak
- Snakes

The Crew Coordinator should complete a personnel and medical information form for all field crew personnel (Figure 23) before field sampling begins. Other people visiting the monitoring sites, such as managers, should also complete a medical information form before traveling to the field. Keep a copy on hand at the sampling site and distribute it to proper management personnel. This form lists crew members and their allergies to insect pests and medicines. Proper medicine should be available for any field crews with known allergic reactions to insects. Clothes covering the legs and arms can help protect against insect pests. Insect repellant should be available to field crew members. Snake bite kits should be available. In campgrounds and frontcountry parking areas, approach dogs with care. Poison oak areas should be handled by applying TecNu or a similar product; people with severe reaction should consider applications before going into the field.

D.8 Sampling and Sampling Equipment

Sampling can be hazardous if a person places undue strain upon himself or herself. If not used properly and with care, some sampling equipment can be hazardous. Take care in packing and transporting equipment in and out of the field. Use equipment according to instructions and routinely examine it for damage. Wear gloves as needed. Wear eye protection when working in heavy brush or handling chemical materials.

Each field crew should carry a first aid kit. It is strongly suggested that field personnel be certified in CPR and first aid; this may be made mandatory at the discretion of the program manager (Chief, Resources Management or Wilderness Manager).

D.9 Tree Hazards/Water Hazards

Trees can present hazards, including dead trees that remain upright or lean against other trees and dead limbs which remain in branches. Upon disturbance during travel to, from, or at a site, limbs and trees can fall. When traveling through the forest, be aware of hazards in the overstory. Consider hard hats for when working near fires and loose rocky slopes.

During spring runoff and storm events, the river can run deep and/or fast. Sampling and site monitoring should not expose monitoring crews to unnecessary risks. The areas above and below water falls can also be hazardous; avoid getting in the river above waterfalls, and when below, be aware of possible actions (dropping items, etc.) by visitors.

D.10 Training

During field training, review all the Job Hazard Analyses and all aspects of the Safety Plan. Crew leaders should conduct a 5-minute refresher safety training before beginning a new week's work. Field crew personal and medical information forms (Figure 23) should be completed prior to the training.

D.11 Documentation

The Field Crew Personal and Medical Information Form (Figure 23) should be completed before entering the field

D.12 Personal Protection and Safety Gear

The Job Hazard Analyses for VERP Monitoring activities identify required personal protection and safety gear.

D.13 Accident Reporting

If a field crew person is injured, notify the crew leader immediately. The crew leader will notify the crew coordinator immediately. The injured person, unless incapacitated, provides first aid treatment to himself or herself, and, if necessary, should be assisted to the nearest medical facility. The person and their supervisor will immediately complete Forms CA-1, CA-16, and any other forms needed to report the injury and document medical attention and treatment.

D.14 Job Hazard Analyses

The attached Job Hazard Analyses will be periodically reviewed. In the event of an accident or incident, lessons learned will be added to the Job Hazard Analyses and these will be communicated to crew members.

Figure 23 - *Personal and Medical Information Form*

PERSONAL AND MEDICAL INFORMATION FORM

NAME: _____

LOCAL ADDRESS:
PERMANENT ADDRESS:

LOCAL PHONE NUMBER:
PERMANENT PHONE NUMBER

NEXT OF KIN NAME:
ADDRESS:

PHONE NUMBER:

RELATIONSHIP TO YOU:

HEALTH CONCERNS TO BE AWARE OF (please include allergies, etc.):

DO YOU WEAR CONTACT LENSES? GLASSES?

*If you need to wear corrective lenses to do your job, please keep an extra pair with you at all times, as well as any precautionary needs.

D.15 Job Safety Analysis

Job / Activity—VERP Monitoring in Backcountry Areas
RAC—III/C
Date Revised—5-21-04

Table 7
Job Safety Analysis in Backcountry Areas

Principal Step	Potential Safety Concerns	Recommended Controls
1. Travel to survey area	A. Strain / sprains / falls B. Carrying heavy loads C. Dehydration / heat related injuries (sunstroke, heat exhaustion) D. Sunburn E. High Altitude Pulmonary Edema, High Altitude Cerebral Edema F. Acute Mountain Sickness G. Getting lost H. Blisters I. Medical emergencies J. Hazard trees K. Lightening strikes L. Physical fitness M. Specific allergies (e.g. bee sting) N. Animal encounters (e.g. bear, mountain lion) O. Walking on steep, loose talus P. Early season hiking—high water, snow fields Q. Carrying sharp tools R. Getting packs on and off S. Rock fall, natural & human induced. T. Slick trails, slopes due to gravel or wetness	♠ Conduct orientation with crew to find out medical histories, training, skill level, ensure everyone knows the plan. ♠ Review appropriate behavior for animal encounters. ♠ Review appropriate behavior during electrical storms. ♠ Ensure crew is aware of any specific allergies and proper treatment. ♠ Check out at start of trip, and check back in upon return, using designated point of contact. ♠ Proper & fitting boots, dry socks and pack. ♠ Careful placement of feet and hands. ♠ Stretch slowly before starting any strenuous activity. ♠ Scope and plan route. ♠ Everyone on crew gets map and compass. ♠ Pack sensibly with lighter gear. ♠ Lift pack with legs, not back. ♠ Drink plenty of water. ♠ Carry radio with spare batteries ♠ Carry first aid kit (sunblock, blister treatment, personal medications). ♠ Carry & use sunglasses. ♠ Ensure that crew knows where radio “dead zones” are. ♠ Be familiar with symptoms / treatments for altitude issues. ♠ Be aware of environment. ♠ On steep, loose talus slopes, space crew laterally so that one person is not above the other. If a rock starts rolling , loudly yell “rock” to warn others. If you encounter a loose rock, be sure to warn others.

Table 7
Job Safety Analysis in Backcountry Areas

Principal Step	Potential Safety Concerns	Recommended Controls
2. Conduct survey	A. Strain / sprains / falls B. Dehydration / heat related injuries C. Ticks / poison oak / rattlesnakes D. Getting lost / losing co-workers E. Tetanus F. Drowning during stream crossings G. Mosquitoes and other nuisance insects H. Hypothermia	♠ Proper & fitting boots and pack. ♠ Careful placement of feet. ♠ Scope and plan route. ♠ Drink plenty of water. ♠ Wear long, light-colored pants and do nightly tick checks. ♠ Use insect repellent. long clothes, net. ♠ Watch placement of hands and feet. ♠ Carry radio with spare batteries (know radio protocol) and first aid kit. ♠ Carry compass and map, and use them. ♠ Have tetanus updated. ♠ Loosen pack for stream crossing. ♠ Use tripod method or other accepted method of stream crossing. ♠ Avoid prolonged exposure to cold water.
3. Camp	A. Bear interaction B. Giardia C. Hypothermia D. Waste disposal E. Moving around in the dark F. Communication with park operations	♠ Proper food storage and camp maintenance ♠ Filter or boil all water ♠ Drink plenty of water, eat well. ♠ Be aware of symptoms/treatment for hypothermia. ♠ Avoid cotton, have proper layering clothing. ♠ Carry and use adequate shelter (tent, pad and bag). ♠ Carry radio and first aid kit. ♠ Designate latrine for large parties, protocol for others. ♠ Carry & use flashlight with extra batteries. ♠ Establish regular radio contact time, and ensure radio is functioning during that time.
4. Travel from survey area	Same as # 1	♠ Post field-work office \ contact check-in.

Safety Equipment to Be Used	Inspection Requirements	Training Requirements
♠ **DAYTRIP—**Appropriate boots, wool or synthetic socks, pack fit properly, clothes for layering, rain gear, water filter, head lamp, radio with extra batteries, first aid kit (including TecNu, tool for ticks). ♠ **OVERNIGHT TRIP—**Above plus, stove, sleeping bag, sleeping pad, and tent. ♠ **PPE—**Sunscreen, sunglasses, brimmed hat.	♠ Inspect water filter, stove, sleeping pad, tent, radio batteries, and boots.	♠ Maintain physical fitness. ♠ Stretch before and after hiking. ♠ Train with pack and other gear (compass). ♠ Basic first aid.

D.16 Job Safety Analysis

Job / Activity—Yosemite Valley and El Portal VERP Monitoring
RAC—III/C
Date Revised—5/21/04

Table 8
Job Safety Analysis Yosemite Valley and El Portal

Principal Step	Potential Safety Concerns	Recommended Controls
Travel to and from survey area	1. Review Sampling Location Map. 2. Working close to moving traffic.	♠ Have sampling plan maps. ♠ Step off of road surfaces, and walk on even surfaces where possible. If necessary to walk uphill of road, stop and retain solid footing while traffic passes.
Set up Monitoring Site	1. Sunburn 2. Dehydration / heat related injuries(sunstroke, heat exhaustion) 3. Focusing on the work at hand and not maintaining an awareness of surroundings, changing conditions. 4. Heavy pack due to equipment 5. Hammering rebar into ground 6. Hurrying at end of the day when fatigued. 7. Inattention facilitating contact with bears, snacks, insects. 8. Exposure to fast moving water during flood events. 9. Exposure to potentially hazardous materials, including chemicals. 10. Ticks/poison oak/rattlesnakes 11. Tetanus	♠ Protect yourself from the sun, wear a brimmed hat, use sunscreen, reapply as needed. ♠ Drink water regularly. ♠ Take breaks, observe surroundings, monitor co-staff to be sure of adequate hydration and food consumption. ♠ Be prepared for changes in weather—raingear, extra layer, emergency survival kit. ♠ Allow adequate time to hike out and drive. ♠ Divide up equipment so pack isn't too heavy. ♠ Protect eyes when hammering. ♠ Have good footing when taking water samples during high water events or spring runoff; select slack water areas where possible. ♠ Have MSDS sheets for any chemicals in use. ♠ Carry first aid kit and insect repellant. ♠ Update tetanus.

Safety Equipment to Be Used	Inspection Requirements	Training Requirements
♠ **DAYTRIP—**Appropriate boots, wool or synthetic socks, pack fit properly, clothes for layering, rain gear, water filter, head lamp, radio with extra batteries ♠ **PPE—**Sunscreen, sunglasses, brimmed hat	♠ Inspect gear to assure it is in good working condition.	♠ Maintain physical fitness. ♠ Stretch before and after hiking. ♠ Stop and soak feet, ankles knees in cold water on way down. ♠ First Aid, map and compass.

RAC

I	Death/Permanent Disability	A	Likely to Occur
II	Permanent Partial Disability	B	Probably Will Occur
III	Lost Day Mishap	C	Possible to Occur
IV	First Aid Only	D	Unlikely to Occur
		E	Improbable to Occur

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APPENDICES

MERCED RIVER MONITORING FIELD GUIDE
2004 PILOT SEASON

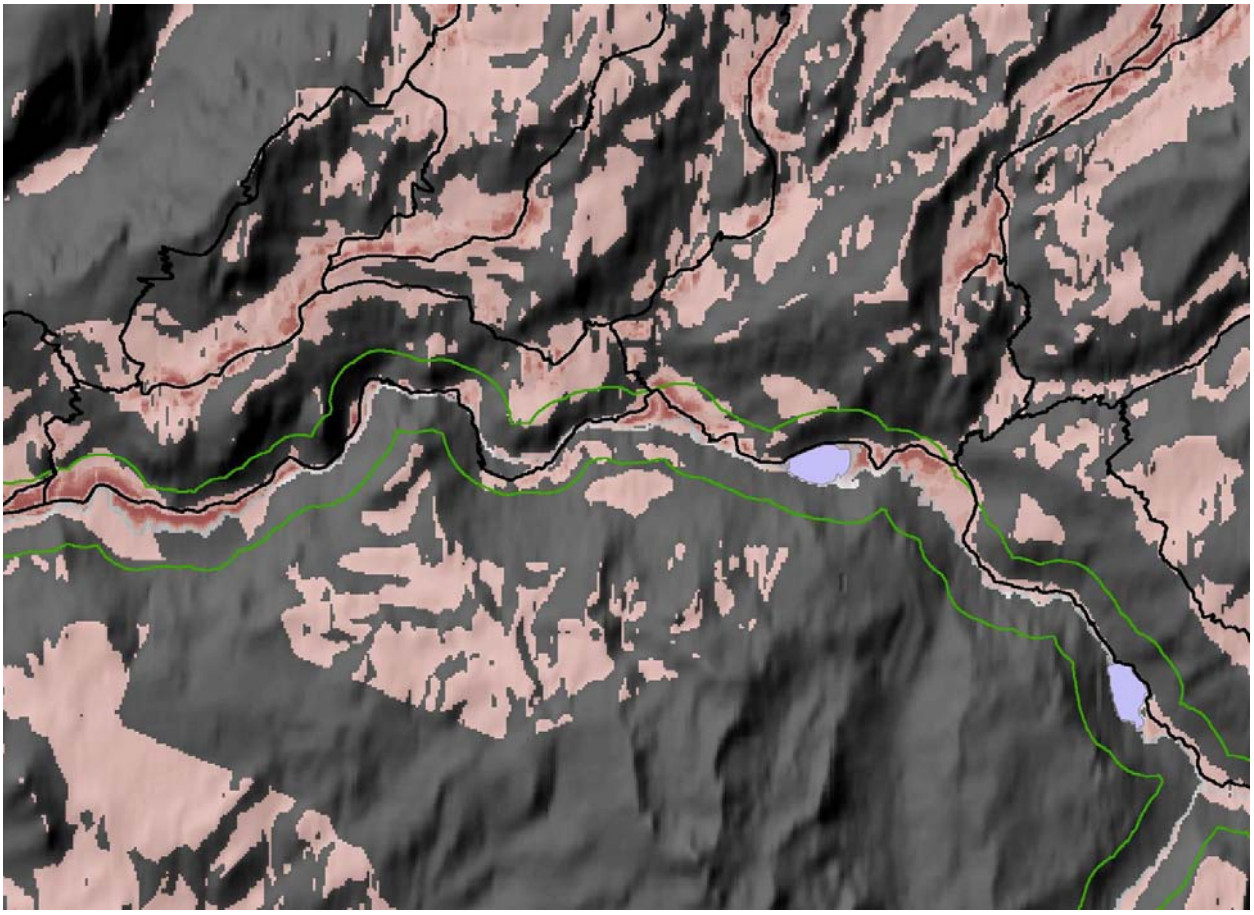
USER CAPACITY MANAGEMENT PROGRAM
FOR THE MERCED WILD AND SCENIC RIVER CORRIDOR

APPENDIX A

Notes on Yosemite valley sampling design
David Theobald
Peter Newman

15 May 2004

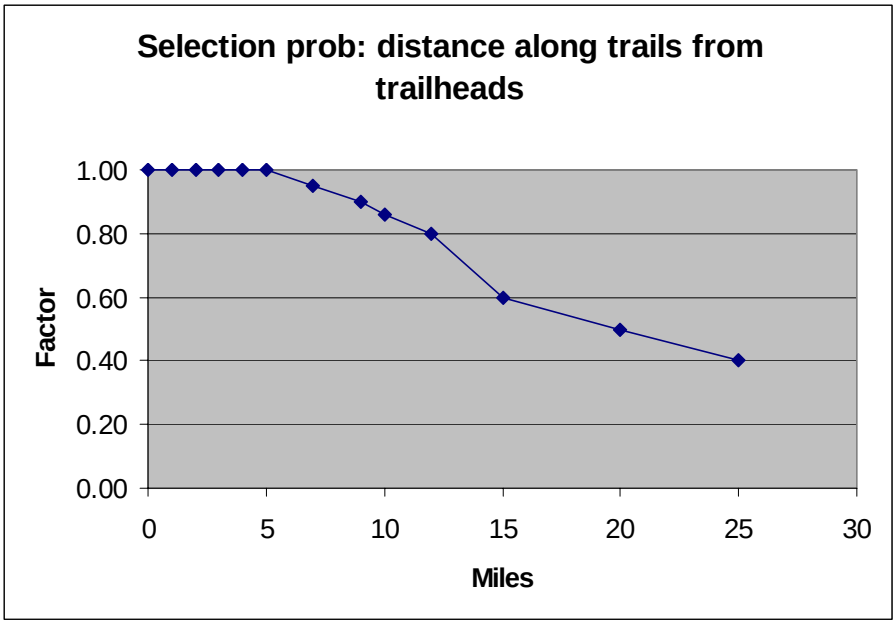
After consultation with Park staff, we felt 5 factors strongly influenced the likelihood of campsites along the Merced River corridor. For each of the factors, we developed spatially explicit maps that represented the spatial features (e.g., distance from trails). Based on those maps, we generated a function that relates the spatial location to the probability of having a campsite located there. We then combined (equal weighted) these five factors by multiplying their probability (0→1), to find an overall model of probability of campsite locations.[i] The map below shows dark areas as 0 and shades of red (light – low, deep red – high) showing the probability. This "surface" of probabilities is the main input to the sampling algorithm that depicts the inclusion probabilities, or the likelihood that a location will be sampled.



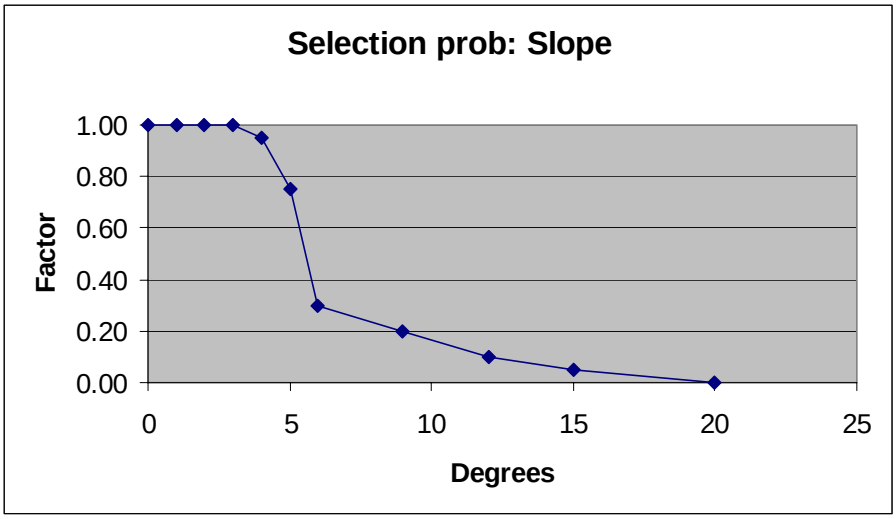
The five factors are as follows:

1. Distance along trails from trailhead

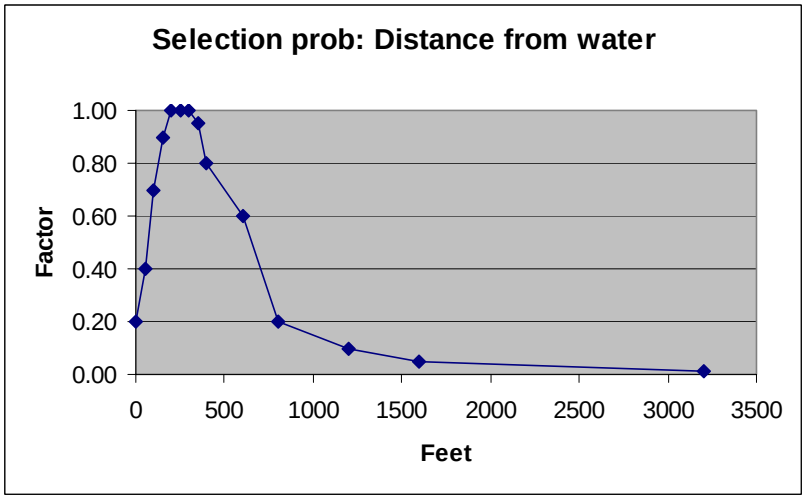
a. Three trailheads:
    i. Yosemite Valley
    ii. Coming in the north from Tualumne
    iii. Near Gravelly Ford from south
b. Convert distance to integer (divided by 10 as well, so units are tens of meters)
c. Allocation on the integer grid – assumes shortest distance access, but works ok in the MR corridor
d. Could make modifications to this to account for travel speed along trails (because of slope)
e. → rc_d4trailheads3.info ; → rcd4th3



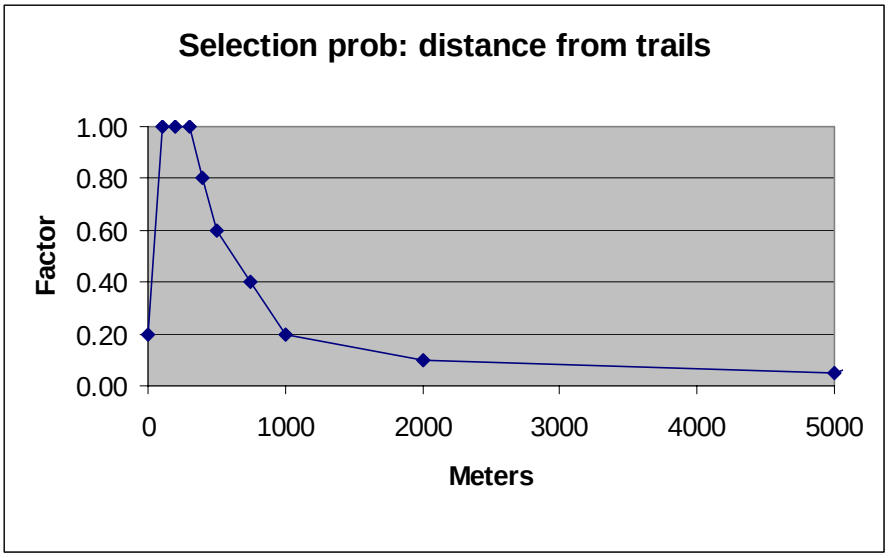
2. Slope
    a. Using 30 m DEM, find slope
    b. Roughly 6% drops off quickly, but recall that 30 m resolution (actually 90 m slope) is coarser scale that what people might make a decision on…
    c. → rcslope



3. Distance from water (perennial streams and lakes)
    a. Selected appropriate streams from hydrology:
        "DESC" IN ('dam', 'earthen dam', 'falls', 'indefinite shor', 'left bank', 'right bank', 'shoreline', 'shoreline/pond', 'stream')
    b. Computed Euclidean distance away



4. Distance offtrail from trails
    a. Assume that hikers cannot cross the mainstem and south fork of Merced River → Merced_river
    b. Create NOTMERCED by opposite
    c. Compute cost-distance using NOTMERCED (values of 1)… does not assume different weights → d4trails



5. No camping zones
    a. above timberline (~10,000') - find all areas below 3047.8 m
    b. And, above 2072.5 m (6800') above Yosemite Valley
    c. And, 4 miles east from Wowona trailhead (elevation 1650 m, mile 29.5)
    d. Raster Calculator:
    nocampz = con ([yose_ned] < 3047.8, con ($$rowmap > 900, con([yose_ned] > 1650, 1, 0), con([yose_ned] > 2072.5, 1, 0)), 0)

    Notes:
    We also considered, but decided not to include:
6. Lakes and wetlands areas – no camping (Merced Lake, Washburn Lake)
    a. created polygons of the big lakes
    b. heads-up digitizing wetland areas from DRG and hydrology (apparent limit lines)
7. Distance to big lakes (Merced Lake, Washburn Lake)
    a. created polygons of the big lakes
    b. EucDistance to create d4biglakes
8. Within ¼ buffer in MR plan… but don't constrain using this initially

Took the zones mrp_alt2, converted to GRID, then buffered them (allocation) by 400 m, just in case. The consequence is that we'll need to filter (using polygon intersection) the resulting points to find those that are within the MRP and within allowed camping zones…

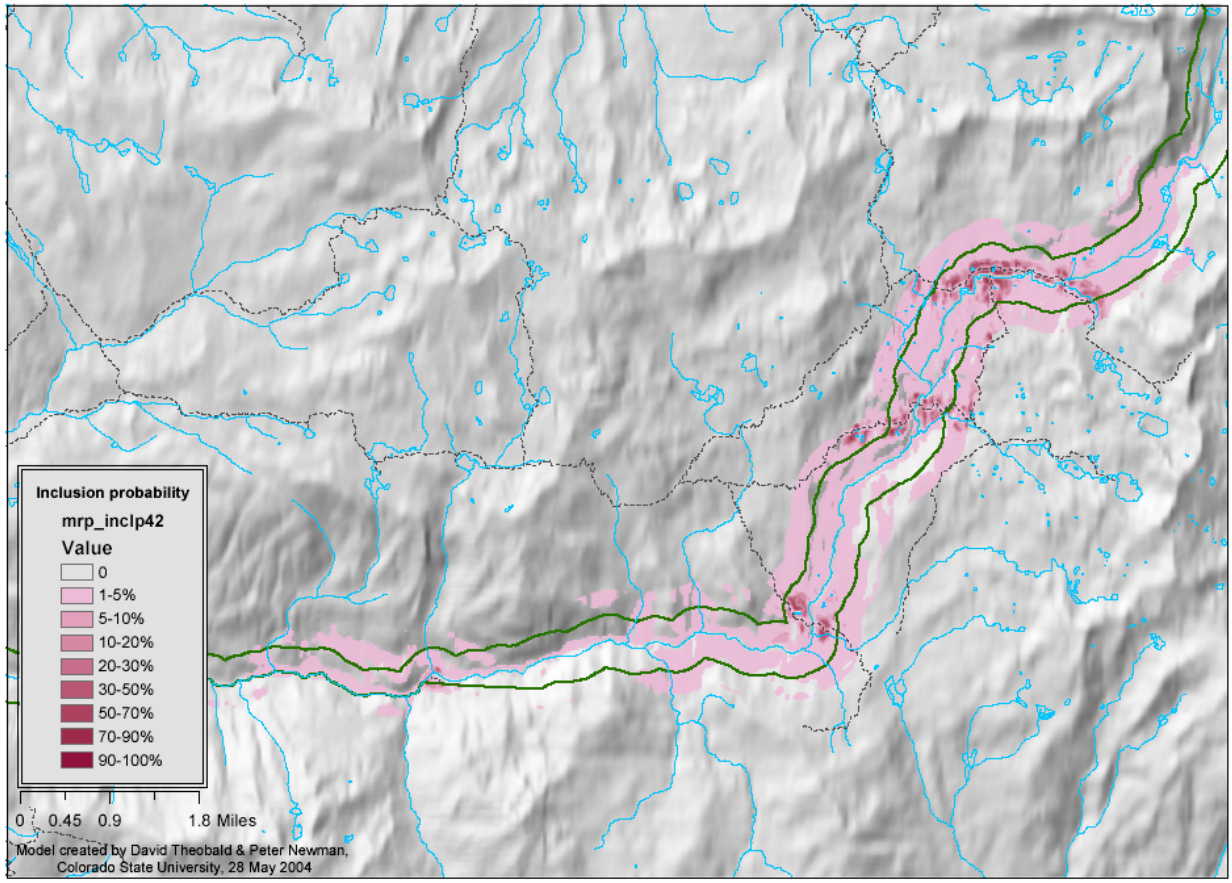
OVERALL MODEL
([rcslope] / 100.0) * ([rcd4trails] / 100.0) * ([rcd4th2] / 100.0) * ([rcd4water] / 100.0) * ([nocampz2] / 100.0) * (con (isnull([lakes_wetl]), 1, 0))

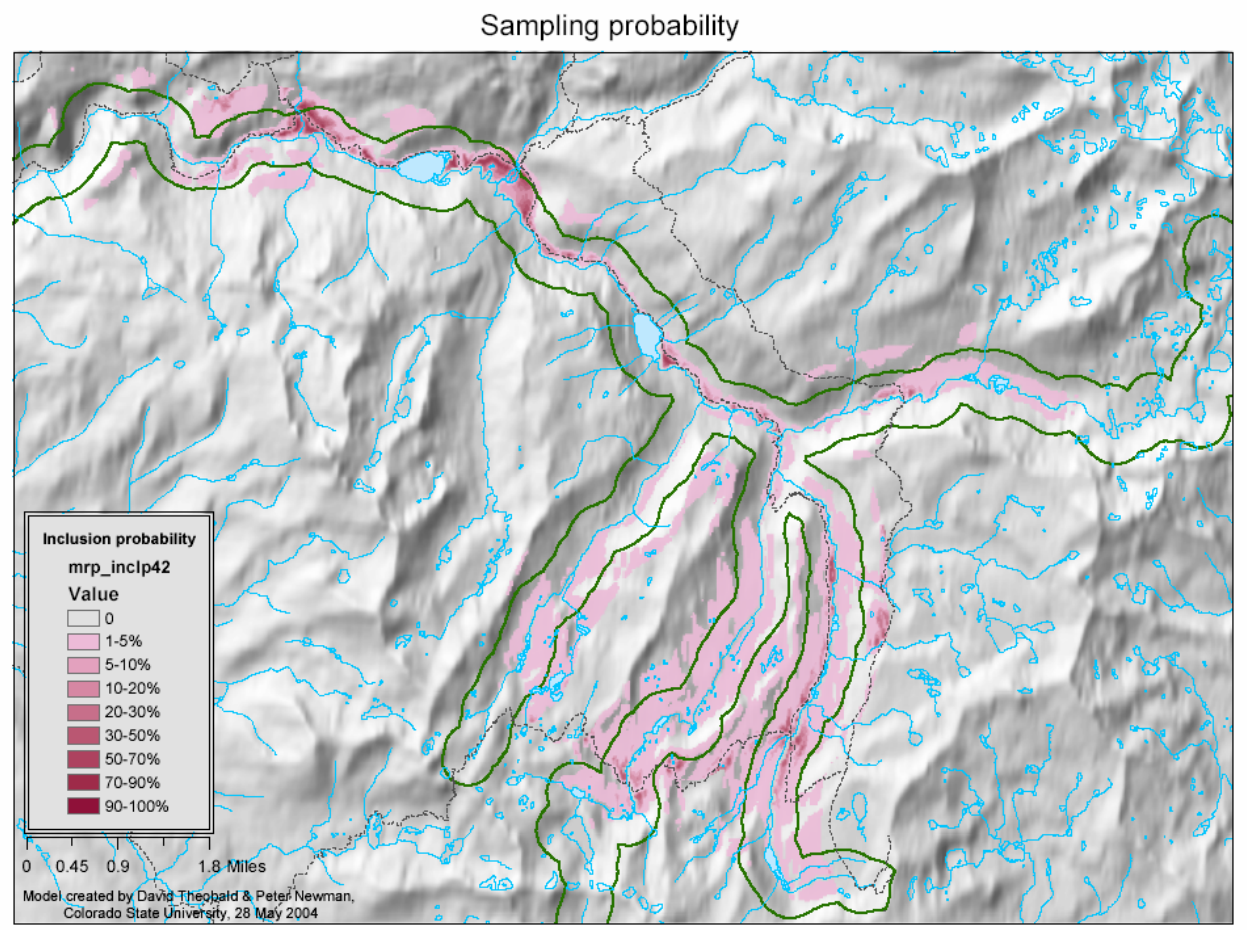
Try 2:

([rcslope] / 100.0) * ([rcd4trails] / 100.0) * ([rcd4th2] / 100.0) * ([rcd4water] / 100.0) * ([nocampz2]) * (con (isnull([lakes_wetl]), 1, 0))

Try 3:
([rcslope] / 100.0) * ([rcd4trails] / 100.0) * ([rcd4th3] / 100.0) * ([rcd4water] / 100.0) * ([nocampz2]) * (con (isnull([lakes_wetl]), 1, 0))

Sampling probability





[i] OVERALL MODEL ArcGIS code:
([rcslope] / 100.0) * ([rcd4trails] / 100.0) * ([rcd4th2] / 100.0) * ([rcd4water] / 100.0) * ([timberline2] / 100.0)

APPENDIX B

GLOSSARY

Azimuth: This is the direction of a celestial object, measured clockwise around the observer's horizon from north. So an object due north has an azimuth of 0°, one due east 90°, south 180° and west 270°. Azimuth and altitude are usually used together to give the direction of an object in the topocentric coordinate system.

Carrying Capacity: As it applies to parks, carrying capacity is the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions that complement the purpose of a park unit and its management objectives.

Geographic Information System (GIS): A computer system for capturing, storing, checking, integrating, manipulating, analysing and displaying data related to positions on the Earth's surface. Typically, a Geographical Information System (or Spatial Information System) is used for handling maps of one kind or another. These might be represented as several different layers where each layer holds data about a particular kind of feature. Each feature is linked to a position on the graphical image of a map.

Global Positioning System (GPS): The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or setup charges to use GPS.

Indicator: Indicators are specific, measurable physical, ecological, or social variables that reflect the overall condition of a management zone. Resource indicators measure visitor impacts on the biological, physical, and/or cultural resources of a park; social indicators measure visitor impacts on the park visitor experience.

Management zone (zone): A geographical area for which management directions or prescriptions have been developed to determine what can and cannot occur in terms of resource management, visitor use, access, facilities or development, and park operations.

Outstandingly Remarkable Values (ORVs): Those resources in the corridor of a Wild and Scenic River that are of special value and warrant protection. ORVs are the “scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values…that shall be protected for the benefit and enjoyment of present and future generations” (16 USC 1272).

River corridor: The area within the boundaries of a Wild and Scenic River (e.g., the Merced River corridor).

Standard: Standards define the minimum acceptable condition of each indicator variable. A standard does not define an intolerable condition.

User capacity: As it applies to parks, user capacity is the type and level of visitor use that can be accommodated while sustaining the desired resource and social conditions based on the purpose and objectives of a park unit.

Visitor experience: The perceptions, feelings, and reactions a park visitor has in relationship with the surrounding environment.

Visitor Experience Resource Protection (VERP): A process developed for the National Park Service to help manage the impacts of visitor use on the visitor experiences and resource conditions in national parks.

Wetland: Wetlands are defined by the U.S. Army Corps of Engineers (CFR, Section 328.3[b], 1986) as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wild and Scenic Rivers: Those rivers receiving special protection under the Wild and Scenic Rivers Act.

Wilderness: Those areas protected by the provisions of the 1964 Wilderness Act. These areas are characterized by a lack of human interference in natural processes.

Wilderness Impact Monitoring System (WIMS): An inventory process that monitors campsite and trail conditions in Yosemite National Park backcountry and wilderness.

ACRONYMS

C	Centigrade
CA	California
CCC	Continuing Calibration Check
CD	Compact Disc
cfs	cubic feet per second
cm	centimeter
CMP	Comprehensive Management Plan
DH-81	Standard USGS wading sediment / water sampling device
DH-95	Standard USGS suspended sediment / water sampling device
DO	Dissolved Oxygen
DI	Deionized Water
DOQs	Digital Orthophotos
EPA	Environmental Protection Agency
EDI	Equal Discharge Increment
EWI	Equal Width Interval
GIS	Geographic Information System
GPS	Global Positioning System
HCI	Hydrochloric Acid
Hg	Mercury
ICC	Initial Calibration Check
KCI	Potassium Chloride
L	Liter
mg/l	Milligram per Liter
ml	Milliliter

MDL	Method Detection Limit
mm	Millimeter
MPN	Most Probable Number
NAD27	North American Datum 27
NAD83	North American Datum 83
NELAP	National Environmental Laboratory Accreditation Program
NFM	National Field Manual
NIST	National Institute of Standards and Technology
NPS	National Park Service
PDA	Personal Data Assistant
pH	Potential Hydrogen
QAPP	Quality Assurance Project Plan
QC	Quality Control
SOP	Standard Operating Procedure
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
µS	Micro-Siemens (a measure of electrical conductivity)
µmhos	Micro-mhos (inverse of micro-ohms, a measure of electrical resistance)
VERP	Visitor Experience and Resource Protection
WIMS	Wilderness Impacts Monitoring System

APPENDIX C

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