VERP: Putting Principles into Practice in Yosemite National Park

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Introduction

THE MERCED RIVER RUNS THROUGH THE HEART OF YOSEMITE NATIONAL PARK. The river is a central feature of the Yosemite Valley, literally shaping it into the natural wonder for which the park was originally protected (Figure 1). The Merced was designated as a Wild and Scenic River in 1987. The Wild and Scenic Rivers Act (1968; 16 USC 1274d) outlines an overall objective for designated rivers that mirrors the dual mission found in the 1916 National Park Service Act:

> Each component of the national wild and scenic rivers system shall be administered in such manner as to protect and enhance the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values.

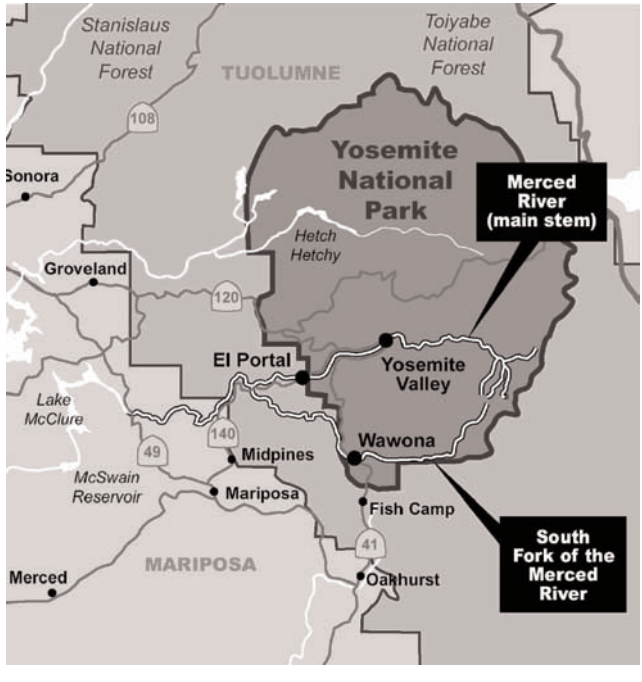

Figure 1. Yosemite National Park and the Merced River.

The Wild and Scenic Rivers Act stipulates that user capacity be addressed for each designated river, and defines it as "the quantity of recreation use which an area can sustain without adverse impact on the Outstandingly Remarkable Values and free-flowing character of the river area, the quality of recreation experience, and public health and safety."

In 2000, Yosemite National Park completed the Merced River Comprehensive Management Plan. Subsequent public criticism and ensuing legal action suggested that the park had not appropriately addressed user capacity in the plan. The park was ordered by the U.S Ninth District Court to re-address these concerns in a revised planning effort. Consequently, in February 2004 the park developed a User Capacity Management Program for the Merced Wild and Scenic River Corridor (Yosemite National Park 2004). This program commits to applying the Visitor Experience and Resource Protection (VERP) framework to address user capacity issues within the Merced River corridor.

The VERP framework was developed to address human use and associated carrying capacity issues in units of the national park system (Hof et al. 1995; NPS 1997). Development of the VERP framework has risen out of more than thirty years of research, planning, and management experience (Graefe et al. 1984; Hof and Lime 1997; Manning 1999). The framework was pilot-tested in Arches National Park, Utah, in the mid-1990s (Hof et al. 1994; Manning et al. 1995; NPS 1995). Since that time it has been applied to various other units of the national park system (Manning et al. 2005).

The application of VERP in Yosemite National Park represents one of the most recent, and perhaps complex, initiatives to date. This paper presents a case study describing the successes, challenges, and lessons learned from this effort. Emphasis is placed on the implementation elements of the framework: monitoring ecological and social conditions using indicators and standards to inform management action.

Methods

The VERP framework consists of nine elements encompassing both planning and management activities. Planning activities associated with applying the VERP framework to the Merced Wild and Scenic River included the formation of a core planning team, development of a public involvement strategy, definition of desired conditions, and application of prescriptive management zoning. Operational or management activities included the development of indicators and standards of quality, establishment of a monitoring program, continuation of public outreach efforts, and determination of alternative management action strategies.

Desired conditions were prescribed based on the Merced River's "outstandingly remarkable values" (ORVs). ORVs are defined by the Wild and Scenic Rivers Act as those characteristics that make the river worth protecting. In the management plan these characteristics are classified by the following categories: *scientific, scenic, recreational, biological, cultural, geologic,* and *hydrologic.*

Once desired conditions were developed, prescriptive management zoning was applied. This involved the geographic delineation and definition of appropriate types and levels of human use along the river corridor. Zones developed in the VERP process for the Merced River fall into three categories: (1) wilderness, (2) diverse

visitor experience, and (3) developed. (The Merced Wild and Scenic Comprehensive Management Plan and its accompanying environmental impact statement have a complete listing of management zones applied.)

Indicator variables were established to measure and monitor conditions within the river corridor and reflect the river's ORVs. Currently, a total of ten indicator variables are utilized, reflecting both social and ecological conditions in the river corridor (Table 1). Standards of quality were established for each indicator variable based on best professional practice and informed by available scientific research. Table 2 presents the preliminary standards for the indicator variables that were monitored in 2005.

Monitoring protocols for each indicator variable have been developed and compiled into a field monitoring guide. The field guide establishes monitoring methodology, monitoring locations, equipment requirements, and safety considerations. Each season during the first five years of the program represents iterations toward developing a rigorous management program. An annual report summarizing monitoring results, potential need for management actions, and program evaluation concludes each iteration.

Selected results

Examples of selected monitoring results are presented below. Complete field monitoring protocols and results from the 2004 and 2005 seasons are documented in the field monitoring guide and annual reports, respectively. These documents can be found on the park's website (www.nps.gov/yose/planning/ucmp.htm).

Length of social trails indicator. The length of social trails in meadows was monitored in 2004 and 2005. Maps were generated exhibiting the linear extent of social

Indicator variable	Method of measurement
Trail encounters	Number of encounters with other parties along trails in wilderness
People at one time (PAOT)	Number of people at one time (PAOT) along the river
Parking capacity	Occupied parking versus capacity at Camp 6 day use parking area
Facilities availability	Percentage of available picnic tables versus area capacity at selected sites
Wildlife exposure to human food	Percent compliance with food storage regulations
Number of social trails	Number of social trailheads originating from roadside pull-outs
Length of social trails	Length (m) of social trails through meadows
Riverbank erosion	Condition-class assessments of riverbank erosion accelerated or caused by human use
Ethnobotany	Extent/magnitude and usability of four plant species gathered by local tribal groups
Water quality	Total dissolved nitrogen, nitrate, total phosphorus, total dissolved phosphorus, fecal coliform or *E. coli* bacteria, and petroleum hydrocarbon content

Table 1. Indicator variables and methods of measurement used in 2005.

Indicator	Standard
Trail encounters	Zone 1A: No more than 1 encounter with another party per day, 80% of time Zone 1B: No more than 1 encounter with another party per four hour period, 80% of time
People at one time (PAOT)	No net increase from 2005 baseline of number of people in River Protection Overlay at selected sites along the river
Parking capacity	The number of instances (time) when designated parking is full (requiring alternative parking actions) will occur on no more than *X* days per year (season) and *X* hours on average/day (for visitors, transit buses, and commercial tour buses) (**NOTE: *X represents the number of days and number of hours respectively. The standard is yet to be determined***)
Facilities availability	Visitors are able to find an open table 70% of the time during peak hours—June through October—at outdoor concession food service areas and park day use picnic areas. Baseline to be established from data collected during 2005
Wildlife exposure to human food	95% or greater compliance with food storage regulations in selected campgrounds and parking areas
Number of social trails	No net increase in number of social trailheads from 2004 baseline No social trails for wetland features
Length of social trails	No net increase in length of social trails from 2004 baseline
Riverbank erosion	No net increase over 2005 baseline in linear extent of riverbank erosion that is accelerated or caused by human use; no riverbank erosion exceeds Condition Class 2
Ethnobotany	No alteration of characteristics of the traditional cultural resources that make them eligible for listing on the National Register of Historic Places.
Water quality	Anti-degradation for each segment, for fecal coliform (or *E. coli),* nutrients (total dissolved nitrogen, nitrate, total dissolved phosphorus, and total phosphorus), and petroleum hydrocarbons per sampling period Absolute minimum, all segments: State fecal coliform standard for recreational contact at all times

Table 2. Indicator standards of quality used in 2005.

trails in each meadow in Yosemite Valley. Figure 2 presents findings from El Capitan Meadow in 2004 and 2005.

The total length of social trails in El Capitan Meadow has increased from 5881.3 m in 2004 to 7132.5 m in 2005. This may be due to the wet conditions found in the meadows in 2005 resulting from an above-average snowfall during the winter. Such wet conditions may have contributed to a greater number of trails with a higher degree of impact per unit area. However, caution must be applied when interpreting these results because 2004 marked the first year of social trail monitoring in meadows and was conducted under

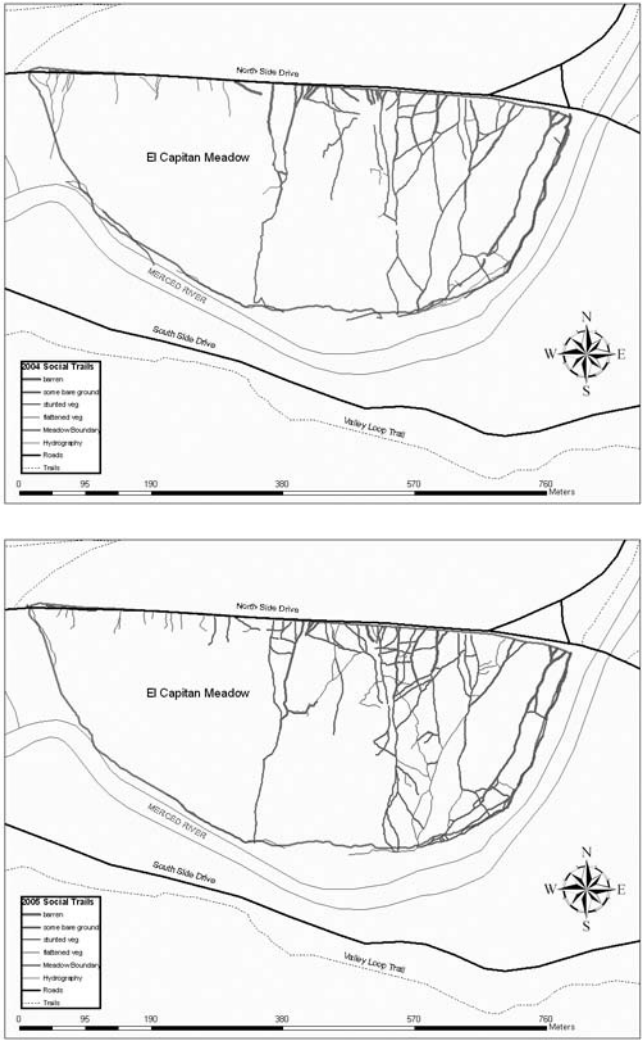

Figure 2. Social trails in El Capitan Meadow in 2004 (top) and 2005 (bottom).

significant time constraints. This may have caused some trails not to be documented in 2004, whereas a more thorough inventory may have been achieved in 2005.

Nevertheless, monitoring in El Capitan Meadow has provided a baseline or inventory suggesting that there are significant social trail impacts. These impacts are most likely due to several factors. Human activities in the meadow consist of river access, viewing climbers on El Capitan, picnicking, traditional activities, and others. This is also complicated by animal behavior in the meadow. Generally, deer and bear utilize human-made trails in the meadow and vice versa. Continued monitoring is necessary to distinguish between human and wildlife impacts and to further determine the overall extent of social trail impacts in El Capitan Meadow in order that appropriate management action can be taken to mitigate impacts.

Water quality indicator. Water quality sampling has been conducted monthly and

during storm events since July 2004. Samples taken from ten locations along the main stem and South Fork of the Merced are analyzed for nutrients such as total dissolved nitrogen and total phosphorous, petroleum hydrocarbons, and *E. coli* bacteria. During spring surface run-off periods, sampling is conducted on a weekly basis in order to document the potential concentration of water contaminants during such high-water events.

An example of data from the main stem of the Merced is shown in Figure 3, which can be interpreted as follows: the bottom and top of the box represent the 25th and 75th percentile values, respectively. The line within the box is the median, whiskers represent the 10th and 90th percentile values where sufficient data exists, and dots represent outlier values.

Overall, data analysis from 2004 shows all water contaminants to be well below California State standards, which have been established in accordance with the Clean Water Act. Rigorous water quality monitoring will continue for the next three years to establish baseline data from which standards may be reliably established.

Ethnobotany indicator. *Ethnobotany* refers to the mutual relationship between plants and traditional peoples (Cotton 1996). In 2005, a new ethnobotany indicator was pilot-tested that addresses American Indian plant gathering activities along the Merced River corridor. Various plant species found along the corridor are gathered and used by local American Indian groups for traditional practices. Many of these species are being affected by overall visitor use. Therefore, this indicator has

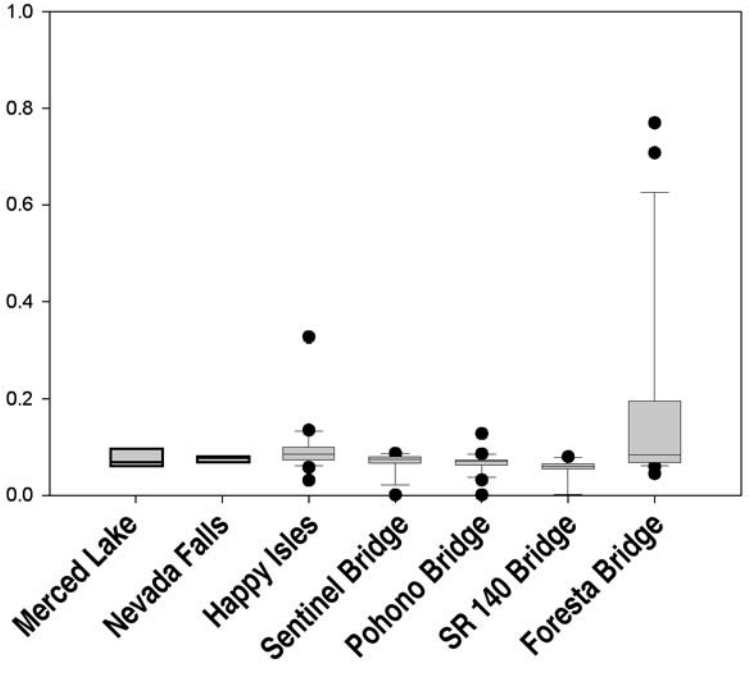

Figure 3. Box diagram of total dissolved nitrogen data from the main stem Merced River sampling stations, July 2004–August 2005. See text for explanation.

been developed in an attempt to protect both the natural resources and associated experiences important to local American Indian traditional practices.

Monitoring consisted of assessing the health and condition, both biologically and with respect to practitioner use, of four plant species traditionally gathered by local American Indian groups: bracken fern *(Pteridium aquilinum),* blue elderberry *(Sambucus mexicana)*, showy milkweed *(Asclepias speciosa)*, and redbud *(Cercis occidentalis)*. Biological parameters measured by park staff are given in Table 3.

A practitioner assessment protocol was also developed to determine the "usability" of selected plant populations for traditional activities (Figure 4). Practitioners assessed blue elderberry and redbud during the 2005 pilot season. Use criteria were determined in consultation with native practitioners and a usability scale was established (1 = "extremely poor," 10 = "optimal") for berries (blue elderberry), stems, and overall health. Results from field monitoring in 2005 will be used to establish baseline information, while more appropriate standards of quality have yet to be determined.

Species	Parameters	Measurement unit
Showy milkweed	1. Number of individuals (per plot)	Number
	2. Number of damaged individuals (per plot)	Number
	3. Distance to nearest social trail (per plot)	m (to 0.1 m)
	4. Presence of non-native species within 10 m (per plot)	Presence/absence, species (if present)
	5. Height (per individual)	cm
	6. Stem diameter (per individual)	mm
	7. Lifestage (per individual)	Vegetative (V) Flowering (Fl) Fruiting (Fr)
Bracken fern	1. Number of individuals (per plot)	Number
	2. Number of damaged individuals (per plot)	Number
	3. Distance to nearest social trail (per plot)	m (to 0.1 m)
	4. Presence of non-native species within 10 m (per plot)	Presence/absence, species (if present)
	5. Height (per individual)	cm
	6. Stem diameter (per individual)	mm
	7. Lifestage (per individual)	Fiddlehead (F) Immature (I) Mature (M)
Blue elderberry	1. Height	m (to 0.01 m)
	2. Breadth of crown	m (to 0.01 m)
	3. Non-native species within 10 m	Presence/absence, species (if present)
Redbud	1. Height	m (to 0.01 m)
	2. Breadth of crown	m (to 0.01 m)
	3. Non-native species within 10 m	Presence/absence, species (if present)

Table 3. Summary of biological parameters measured for each species.

Figure 4. American Indian tribal members and park staff developing practitioner assessment protocol.

Discussion

Park planning. VERP is defined as a planning and management framework (NPS 1997). Planning elements of the framework were originally intended to be incorporated into park general management planning (GMP) efforts (NPS 1997). However, the framework may also be applied outside of the GMP process (Hof and Lime 1997). In some park units, for example, VERP has been applied in conjunction with implementation-level planning efforts, such as wilderness management and other related plans. This disparity in applying VERP has left many professionals unclear about when and how to most effectively incorporate the framework into park planning.

In Yosemite, VERP has been applied in conjunction with wild and scenic river planning. As noted earlier, it was first applied to the Merced River and is now being applied to the Tuolumne River. These plans are considered on the scale and order of comprehensive or general management plans. Applying a VERP planning and management framework at this level ensures compliance with the provisions of the National Environmental Policy Act (NPS 1997).

Indicator variables. Various indictors have been tested in the Yosemite VERP program. It is important to note that several of the indicators originally tested in 2004 were replaced in 2005 with more salient or appropriate indicators. It was found that many of the indicators originally pilot-tested were more oriented to wilderness values and less suited to the frontcountry of Yosemite Valley. Therefore, new indicators, such as the availability of day-use facilities, health and condition of traditionally gathered plant resources, parking availability, and people at one time (PAOT) along the river, were developed. Our experience thus far suggests that different indicators work in different areas. That is to say, what applies in the backcountry may not necessarily be most suited for the frontcountry. This has been found to be true in other park units with a diversity of resources and visitor opportunities (Budruk and Manning, in press). Therefore, indicator development should proceed by selecting a diverse set of variables that most adequately reflects natural, cultural, and social conditions in particular areas of the park.

Standards of quality. Setting standards of quality for indicator variables continues to be an iterative learning process. At the outset we were unsure as to what might represent appropriate standards of quality for some indicator variables. Therefore, interim standards were established representing the desire to have no further impact. Initial data collection efforts then focused on obtaining baseline information on existing conditions from which to determine whether additional impact has occurred. For example, the standard for the length of social trails in meadows indicator was set at *no net increase in length of social trails from 2004 baseline*. However, monitoring in El Capitan Meadow in 2004 established a baseline condition that appeared already

unacceptable to resource management professionals. Therefore, measures to mitigate these impacts were initiated even before monitoring in 2005 showed that additional impact had occurred.

This example illustrates that standards of quality should represent desired, rather than existing conditions. As Laven and Manning (2005) caution, standards set at baseline or existing conditions may potentially lead to the perpetuation of unacceptable conditions. Nevertheless, our experience suggests that setting preliminary standards of quality is an integral part of the iterative learning process that characterizes the VERP framework. In the absence of published standards for a particular indicator, baseline conditions may represent a starting point that stimulates discussion, refinement, and research leading to more appropriate standards protective of desired conditions.

Public involvement and outreach. The developers of the VERP framework recognized the value and importance of public involvement in park planning and management decision-making to the extent possible. Element two of the framework calls for the development of a public involvement strategy. This strategy should consider not only how to best involve the public in VERP planning elements, but also in the implementation-level elements of the framework.

Yosemite has conducted quarterly meetings to provide the public with updates and information on the park's VERP monitoring program. Information is also found on the park's website and includes documents such as the VERP field monitoring guide, annual report, and fact sheets. Finally, public outreach has also included volunteer monitoring of indicator variables. In 2005, several local volunteers donated their time to monitor indicator variables. This has proven very effective for promoting continued public involvement in the monitoring program. Through such efforts, volunteers are able to see first-hand what goes into making informed management decisions. Often, volunteer monitors recognize, perhaps for the first time, the inherent trade-offs that must be made when attempting to balance resource protection and providing high-quality experiences in the park.

VERP programming and institutionalization. An important aspect of VERP involves the institutionalization of an ongoing program for the implementation-level elements of the framework: monitoring, reporting of results, and taking appropriate management action. Concerns have been voiced about these elements of the VERP framework. Hof and Lime (1997) suggest that the lack of funding sources and an institutional basis to implement VERP will result in the framework being only partially applied or not at all.

In Yosemite, fee demonstration money has been allocated to initiate the program. However, concerns remain as to long-term funding for the program. Grants, in the form of National Park Service-wide Comprehensive Calls and other funding sources, have been sought to complement park fiscal resources. However, these are neither reliable nor long-term funding sources.

Recently, Yosemite has made strides toward developing an institutional basis for its VERP program. In June 2005 a program coordinator was hired. This individual coordinates the efforts of various personnel across several administrative branches and divisions of the park. Collectively, this team of people is creating the necessary institutional and organizational structure to carry

out the operations of the framework on a continuing basis.

Informed management action. The last step in the VERP process is to feed monitoring results back into informed management action to mitigate unacceptable impacts. A handbook, *Maintaining the Quality of Park Resources and Visitor Experiences* (Anderson et al. 1998), has been produced; it is intended to provide insight into the range of potential management strategies that may be employed to mitigate impacts. However, this range of strategies is often constrained by the socioeconomic and political environment in which national park administration is couched. Legal challenges, funding deficiencies, and other factors can often hinder managers from taking timely and appropriate action. How to fully integrate VERP monitoring results into informed action may be a function of mitigating not only visitor impacts, but management constraints as well.

Conclusion

Yosemite has committed to applying the VERP framework as a means to address user capacity and associated human use impacts throughout the park. Initial application of the framework to the Merced Wild and Scenic River has been positive. Further application of VERP is expected to occur on an area-by-area, plan-by-plan basis. The next application will occur as part of the Tuolumne Wild and Scenic River plan and subsequently in the revision of the park's wilderness management plan. In this way, the VERP program in Yosemite will eventually be expanded park-wide, representing a full spectrum of resources and associated human experiences.

Implementation elements of VERP—monitoring, reporting results, and taking management action—will remain integral parts of an institutionalized and on-going program. Such efforts will need to be, to the extent possible, integrated into routine park operations. As one park professional has stated, "it needs to be a part of the way we do business." Thus, one might argue that the success of a park-wide VERP program is contingent upon it losing its distinctive identity as a process or framework in and of itself, and simply becoming a part of everyday business. Initial experience in applying VERP in Yosemite suggests that this may not only be a desired outcome, but a necessary one.

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