



# United States Department of the Interior

NATIONAL PARK SERVICE

P.O. Box 577

Yosemite National Park, California 95389

JUN 4 1996

IN REPLY REFER TO:

L7617

To All Interested Parties:

The National Park Service (NPS) has completed an environmental assessment (EA) which proposes to implement natural and cultural resources restoration, improve interpretive facilities and improve visitor services at Mirror Lake in Yosemite National Park. The proposed action is intended to: 1) correct damages now occurring to natural resources by redirecting, removing and improving trails and paths; 2) restore degraded cultural resources by improving historical vistas and features, and 3) improve visitor services by providing site interpretation, orientation and wayfinding signs and displays, along with installation of vault toilets, benches and refuse/recycling receptacles.

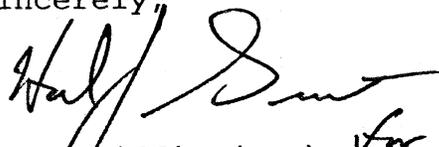
The 1980 Yosemite National Park General Management Plan provides no specific management directives for Mirror Lake. The proposed action, however, is consistent with the broad natural and cultural resources management objectives outlined in the 1980 GMP.

The Mirror Lake EA is enclosed for your review and comment. Public comments concerning the EA will be collected until July 1, 1996. Please send written comments to:

Superintendent  
Yosemite National Park  
P.O. Box 577  
Yosemite, CA 95389  
Attn.: Mirror Lake Project EA

The NPS encourages your participation in all Yosemite National Park planning activities. We look forward to hearing from you.

Sincerely,

  
B.J. Griffin (Ms.)  
Superintendent

Enclosure

# ENVIRONMENTAL ASSESSMENT

## MIRROR LAKE PROJECT



UNITED STATES DEPARTMENT OF INTERIOR  
NATIONAL PARK SERVICE  
YOSEMITE NATIONAL PARK  
May 1996

## **TABLE OF CONTENTS**

- I. PURPOSE AND NEED
  - A. Purpose and Need
  - B. Scope of the Proposed Action
  - C. Alternatives
    - 1. Alternative A - No Action
    - 2. Alternative B - Restore Natural Processes and Manage Mirror Lake as a Cultural Landscape
    - 3. Alternative C - Restore Natural Processes and Manage Mirror Lake as Wilderness
    - 4. Alternatives Considered and Rejected - Recreate the Manipulated Landscape
- II. DESCRIPTION OF THE EXISTING ENVIRONMENT
  - A. Physical Components
    - 1. Air and Climate
    - 2. Soils
    - 3. Geology
    - 4. Hydrology
    - 5. Land Use Suitability
    - 6. Water Quality
    - 7. Wetlands
  - B. Biotic Components
    - 1. Vegetation
    - 2. Wildlife
    - 3. Aquatic
  - C. Ecological Interrelationships
    - 1. Succession
    - 2. Food Relationships
    - 3. Community Relationships
  - D. Human Component/Cultural Resources
    - 1. Archeological Resources
    - 2. Human Cultural Processes/Ethnological Values
    - 3. Historical Resources

4. Socio-Cultural Interests

- a. Wilderness
- b. Cultural Values

III. ENVIRONMENTAL CONSEQUENCES OF PROPOSED ACTION AND ALTERNATIVES

A. Environmental Impacts

1. Alternative A- Anticipated Impacts

- a. Impacts to the Physical Environment
- b. Impacts to the Biotic Environment
- c. Impacts to the Cultural Resource
- d. Impacts on the Visitor Experience and Park Operations

2. Alternative B- Anticipated Impacts

- a. Impacts on the Physical Environment
- b. Impacts to the Biotic Environment
- c. Impacts on Cultural Resources
- d. Impacts on Visitor Experience and Park Operations
- e. Possible Mitigating or Enhancing Measures
- f. Recommendations for Mitigating and Enhancing Measures
- g. Residual Impacts

3. Alternative C- Anticipated Impacts

- a. Impacts on the Physical Environment
- b. Impacts on the Biotic Environment
- c. Impacts on the Cultural Resources
- d. Impacts on the Visitor Experience and Park operations

B. Impact Matrix by Alternative

IV. RECORD OF PERSONS, GROUPS, AND GOVERNMENTAL AGENCIES CONSULTED

V. PARTICIPATING STAFF

APPENDICES

REFERENCES

# I. PURPOSE AND NEED

## A. INTRODUCTION

The purpose of this proposed action is to restore, protect, and interpret a broad range of cultural and natural resources at Mirror Lake, Yosemite National Park, as well as improve visitor services at the site. This Environmental Assessment identifies and evaluates the proposed action and two alternatives, including No Action, for attaining this resource oriented goal. The proposed action was initiated by the National Park Service (NPS) and is governed by resource management objectives identified in the 1980 Final Environmental Impact Statement / General Management Plan (See Appendix B), which were further refined by an NPS interdisciplinary team in 1995. In the 1980 GMP there are no specific management directives for Mirror Lake.

Mirror Lake is located at the east end of Yosemite Valley in lower Tenaya Canyon at an elevation of approximately 4,000 feet. It is situated approximately one mile upstream from the confluence of Tenaya Creek and the Merced River. Immediately below the Northwest Face of Half Dome, the banks of Mirror Lake provide outstanding views of not only Half Dome, but of Mt. Watkins and several other prominent features in Yosemite Valley and Tenaya Canyon. Access to Mirror Lake is restricted to foot, stock and some bicycle traffic. Vehicle use is permitted for individuals with disabled placards, maintenance personnel, and emergency response staff. Regional and project area maps are located in Appendix A.

Depictions of Mirror Lake's landscape have been reproduced since the first photographers and artists entered Yosemite Valley. Early images created of this majestic scene have contributed substantially to the visual images that many people hold of the American west and of the Yosemite wilderness. For these reasons among others, Yosemite National Park aims to manage Mirror Lake to retain significant cultural features of the landscape remaining from the "pre-National Park" period which occurred between 1855 and 1917. Preservation of cultural elements would be balanced with current visitor service needs, and with the requirements of the natural biotic system.

Currently, extensive impacts to Mirror Lake threaten the integrity of the cultural and natural resources. These impacts also diminish the ability of the NPS to provide adequate interpretive and visitor services. Impacts effect four main areas:

Impacts to **natural resources** stem from the presence of redundant and unnecessary roads, trails, and parking lots. Severe soil compaction, habitat fragmentation, loss of wildlife habitat, and trampling of vegetation are widespread.

Impacts to **cultural resources** include degradation of the historic carriage road and changes in access and the obstruction of historic views.

The extensive cultural and historical resources available at Mirror Lake receive little **site interpretation**. Little information is available, and often is inaccurate.

**Visitor facilities** are obsolete and have over time fallen into disrepair.

## B. SCOPE OF THE PROPOSED ACTION

As mentioned, a plan to comprehensively improve natural resources, cultural resources, site interpretation, and visitor facilities is proposed for Mirror Lake. The proposal focuses on three major areas: 1) removing, restoring, consolidating, and improving roads and trails 2) improving interpretive facilities and wayfinding, and 3) improving visitor services.

1) Consolidation and restoration of the roads and trails would include:

- the removal and restoration of 450 feet of unnecessary asphalt road and stone retaining wall,
- the removal and restoration of the former upper parking lot and replacement of handicap parking for near the lower pond,
- the construction of a 600 foot all-access trail linking the proposed parking area, the upper pool, and the stone steps, and
- the repair of the historic carriage road and historic footbridge which would connect to the all-access trail.(See Appendix A: Maps)

2) Improvement of interpretive facilities would include:

- construction of an orientation display at the nearest shuttle bus stop,
- construction of a series of thematic interpretive panels (See Appendix F),
- the incorporation of viewing platforms and displays along the all-access trail, and
- improved signing and clarification at trail intersections.

3) Improvement of visitor services would include:

- the removal of railroad irons from the surface of the rock rubble dam to provide for the safety of visitors,
- the installation of two accessible vault toilets (at the lake road/lower carriage road intersection (See Appendix A:Maps)),
- the addition of benches and viewing areas,
- the addition of bicycle racks and garbage/recycling cans.

The proposed **action** would be carried out during the next three years. Specific elements proposed for 1996/97 include: 1) the installation of vault toilets adjacent to the road above the shuttle bus stop, 2) the construction of an accessible interpretive trail highlighting Mirror Lake's natural and cultural resources, 3) the removal unnecessary road segments and stone wall, 4) the repair of the surface of the historic carriage road, and 5) the revegetation of impacted areas. Revegetation is proposed to continue for up to three years or longer.

Previous National Environmental Policy Act compliance action (Categorical Exclusion # 95-01a) has been completed for restoration of some portions of the now abandoned upper

parking lot and picnic area, and the stock trail. Implementation of this previously approved action was begun in 1995.

## C. ALTERNATIVES CONSIDERED

### 1. ALTERNATIVE A: No Action.

Under the NO ACTION alternative management of Mirror Lake would remain unchanged, ongoing impacts to both cultural and natural resources would continue. Current unconsolidated road and trail patterns would continue. Inadequate interpretive and visitor services would remain as they are. Ongoing conditions include:

#### a. Roads and Trails

The presence of an unnecessary asphalt parking lot, access road, and retaining wall precluding the establishment and interaction of natural biotic communities; A redundancy of trails with an overlap of conflicting uses such as the presence of two stock/hiker trails, a stage road, a paved vehicle road, a pedestrian/bicyclist path and a historic ice house and sand harvesting road;

#### b. Interpretation and Wayfinding

Inaccurate wayfinding information and relict signs; A lack of natural and cultural resource interpretation;

#### c. Visitor Services

Habitat fragmentation, trampling of vegetation, soil compaction, loss of potential habitat for the federally protected willow flycatcher, and potential for water contamination; Access changed to a prominent historic viewpoint and obstruction of the historic view.

### 2. ALTERNATIVE B: Restore Natural Processes and Manage as a Cultural Landscape (PROPOSED ACTION)

Under Alternative B, the PROPOSED ACTION, there would be an enhancement of natural processes, cultural elements, visitor services, and interpretation. Restoring and protecting important cultural elements would be balanced with meeting visitor service needs and restoration of the natural systems. For these reasons, Yosemite National Park proposes to manage Mirror lake to retain significant cultural features of the landscape remaining from the "pre-National Park" period. Some cultural artifacts would remain while others that have conflicting use or demonstrated impact on the ecosystem would be removed (See Appendix A-Maps/Preferred Alternative). Modifications would occur in three areas, the roads and trails corridor, interpretation and wayfinding, and visitor services.

#### *Removing, restoring and improving roads and trails.*

The former upper parking lot and picnic area would be removed and restored to a natural state by removing asphalt, decompacting soil, adding mulch, and replanting and seeding with native plants.

The asphalt road between the upper parking lot and the lower pool would be removed. Approximately 450 linear feet of stone retaining wall would be removed. Slopes would be

restored to original conditions, adequate drainage controls would be provided, and disturbed soils revegetated. The topography of the upper parking lot and slope would be contoured utilizing the topographic details found in the 1928 design plan for the installation of the parking lot.

An all-access trail and restored historic carriage road would serve as the main approaches to Mirror Lake. The historic carriage road would be repaired between its junction with the Mirror Lake road (west of Iron Spring) and the road near the lower pool. Interpretive signing would direct pedestrian traffic towards the carriage road for use as an alternative to the lower paved road. The carriage road would extend toward its historic terminus and cross a footbridge to the Mirror Lake loop trail. The reconstruction of the small footbridge could incorporate the remaining foundations of the historic footbridge.

The new all-access interpretive trail, designed to meet *Universal Access Guidelines*, would connect the proposed handicap accessible parking area with the upper pool and the stone steps, and then return along the water's edge upstream from the dam. Trail surface will be predominantly decomposed granite. The trail and edging would be 10 feet wide with an overall length of 600 feet. Existing grade would be utilized wherever possible built to a grade of 5% or less. The all-access trail would connect with the old carriage road at the base of the existing stone steps.

A short segment of the trail would be extended to connect the historic carriage road terminus and the old bridge over to the Tenaya Canyon loop trail. This section of trail would not be built to "all-access" specifications, but would be graded as nearly as possible to universal access guidelines. Maintenance of the Mirror Lake loop trail would take place to repair erosion problems.

The stone staircase leading to the "historic view" would remain with minor engineering to meet current safety guidelines. Vegetation shall be removed in order to preserve selected historic vistas. Historic vistas are described in Appendix F.

Social trails located in fragile riparian vegetation would be removed and directed toward sites better able to accommodate trampling. Protective fencing and educational signs will be installed along trail as needed, to further restrict trampling.

A detailed description of the existing infrastructure and proposed changes may be found in APPENDIX D and E respectively.

### *Interpretation and Wayfinding*

Orientation to Tenaya Canyon would begin at the shuttle bus stop with a graphic overview of the area as well as an interpretive narrative. Interpretive display panels would be designed into the all-access trail and at the base of the stone staircase (see Appendix F). Additional interpretive panels may be considered for the "Y" intersection and the terminus of the all-access trail. The top of the stone staircase would be engineered into a gathering place to view the historic scene. Viewing platforms would be located adjacent to the dam site and another further upstream.

The series of interpretive display panels would discuss ecological processes and cultural history including geology, indigenous peoples, early attempts to manipulate Tenaya Creek's environment, dam construction and recreational use, ecosystem dynamics and hydraulics,

changes in vegetation and riparian habitat, historic vistas, and wildlife (including cautioning for mountain lion habitat).

Additional signs for wayfinding shall would be placed at confusing trail intersections including: the Tenaya Creek bridge trail to the south side of Tenaya Creek, the footbridge downstream of the lower pool and connecting the Canyon loop trail, and directions to the Snow Creek Trail.

#### *Visitor services*

Railroad irons would be removed from the surface of the rock rubble dam to provide for visitor safety.

A small handicap accessible parking area would be constructed adjacent to restrooms at the lower pool to accommodate 5 vehicles.

Two "all-access" vault toilets are proposed to be installed a short distance from the closest shuttle bus stop to Mirror Lake, at the intersection of the lower carriage road with the multiple use road.

Benches, viewing areas and interpretive displays would be provided.

Bicycle racks and refuse/recycling cans would be installed at the handicap accessible parking area.

The former upper parking lot and picnic tables would be removed from the upper parking lot.

### **3. ALTERNATIVE C - Restore Natural Processes and Manage as Wilderness**

Under Alternative C, natural processes would be restored and Mirror Lake would be managed similar to wilderness areas. All built elements of the landscape and most park infrastructure would be removed from the Mirror Lake area. This action would include removal of unnatural material in the dam. Toilets, parking lot, road materials, stone walls, and stone steps would be removed. Impacted soils and slopes would be restored and revegetated to nearly original conditions. The Mirror Lake loop trail would remain as access for hikers into the wilderness.

The removal of material in the rock rubble dam would alter the base level hydrological control in Tenaya Creek. This could result in a potential increase in hydraulic gradient, with the increased likelihood of local scouring and head-cutting of sediments now located above the dam. Slow lateral movement of the stream channel above the dam could also be expected to follow as a result of the increase in hydrologic gradient.

"All-access" usage would not be available, limiting access to Mirror Lake for those visitors who have mobility impairments.

Historic landscape elements including featured viewpoints and historic roads would be removed.

The intensity of visitor use in the area, in the absence of hardened trails, toilets and other site management tools, would have the potential to greatly impact soils and water quality.

Portions of Mirror Lake would have natural resource qualities improved. Fragmentation of vegetative cover would be reduced by the removal of the roads and parking lots. Increases in plant communities would increase habitat available to wildlife.

**4. ALTERNATIVE CONSIDERED AND REJECTED: Recreate  
The Manipulated Landscape**

This alternative would have re-enacted dredging and dam building at Mirror Lake, in an effort to enlarge the lake to the size generated by the initial construction of a rubble dam in the 1880s. Yosemite National Park enacted the decision to stop dredging sand from Mirror Lake in 1971. Natural Resource Management guidelines state that the NPS will manage natural resources to maintain, restore and perpetuate the integrity of the resource. A proposal to reinstitute the manipulation of the impounded waters and alter the hydrological processes and thereby contradict NPS guidelines.

## II. DESCRIPTION OF THE EXISTING ENVIRONMENT

### A. PHYSICAL COMPONENTS

#### 1. AIR AND CLIMATE

Mirror Lake is located within the Mountain Counties Air Basin of California (MCAB). The Clean Air Act and Amendments has designated the Yosemite National Park region of the MCAB as a Class I airshed. A Class I designation provides the air environment at Mirror Lake with the most stringent degree of air quality protection. All efforts must be made to prevent the significant deterioration of air quality. Air quality at Mirror lake is relatively unimpacted and, in general, considered to be excellent.

The climate of the Mirror Lake region of Yosemite National Park is typical of its setting in the Sierra Nevada and consists of distinct seasonal variations. Annual precipitation in Yosemite Valley is about 35 inches per year. At Mirror Lake, most precipitation is received in the form of winter snow and rain with occasional summer thunderstorms.

#### 2. SOILS

Soil types found in the Mirror Lake floodplain consists of El Capitan fine sandy loam with Miwok complex on the upland fringe. The El Capitan fine sandy loam is a coarse textured stream alluvium from granitic rocks and reworked lake sediments. The area has occasional flooding and is likely to be scoured and recharged with fresh sediments after periods of high flows. Colluvial (talus) slopes comprise the deposits found above the floodplain and near the upper parking lot. Stones and boulders over 10 inches in diameter predominate the gravel size fragments found in the upper portions of the project area (NRCS 1994).

#### 3. GEOLOGY

Beginning 25 million years ago (late Cenozoic) with the onset of uplift and tilt of the Sierra Nevada, the gradient of major streams steepened and river-channel incision was accelerated. Tenaya Canyon probably eroded along a complex joint system in the granite terrain. The evidence of this jointing would be concealed by stream deposits on the floor of the canyon. During the Tioga glaciation, between 30,000 to 60,000 years ago, Tuolumne ice flowed over a pass into the Tenaya Lake basin and down Tenaya Canyon to join the main Merced Glacier in Yosemite Valley. A medial moraine exists in the east end of Yosemite Valley where the Merced and Tenaya Glaciers once joined. The surrounding valley walls at Mirror Lake consist of Half Dome Granodiorite (Huber, 1989)

Talus and rockfall have contributed to constrictions in the Tenaya Creek channel and in the formation of natural backwater conditions (Wieczorek, 1992). Granitic sands have been deposited upstream from the dam site, forming large sandbars. The formation of these sandbars is noted in records as early as 1888. They are part of the fluvial cycle, eroding during years of above normal spring flooding and reforming in other years. There is only a one foot rise in elevation from the rock rubble dam to a point 500 feet up stream indicating a very low gradient fluvial system (Smillie - NPS, 1994).

There is some variation in the theories on the geologic forces that shaped Mirror Lake. Matthes (1930), in his interpretation of the geologic history of the Yosemite area, suggests the following explanation for the presence of the lake in this depositional environment. He

speculated that the historic lake was formed on the nearly level floor of fill material deposited in a glacially scoured lake basin following the retreat of a large glacier. Over time, the glacial lake filled with sediment, and formed a low gradient valley bottom meadow. In recent geologic time, a large rockfall deposited debris on the old lake bed and formed a long shallow impoundment, Mirror Lake. However, as noted by Matthes, it was evident even at the time of his investigation that the lake was rapidly filling-in with sediment.

N. King Huber's interpretation of Mirror Lake's formation is slightly different. Huber states that although glacier striations are evident near the base of Half Dome, the lake was created entirely by the rockfall event (Huber, 1989).

The lower pool is bounded on its downstream side by a steepening of gradient and narrowing of stream channel. This small or lower pool is more persistent at low flow than Mirror Lake's upper pool, but does dry up during protracted drought. The pool appears to be maintained by hydraulic scour induced by the presence of several extremely large rocks that have fallen into the channel just upstream of the channel constriction.

#### 4. HYDROLOGY

Hydrologically, Mirror Lake's name is somewhat misleading, since it is now recognized as a fluvial (riverine) element of Tenaya Creek (Inglis, Smillie- NPS, 1994). The name, however, does describe the visual appearance quite well. Basically, there are two predominant pools associated with Mirror Lake: there is the main "lake", or upper pool, that provides the large reflecting surface that has become famous, as well as a lower or smaller pool that is located immediately downstream.

Flash flooding has been documented in Tenaya Canyon following a rare and extremely intense rainstorms. Although infrequent, the volume of water moving through can be catastrophic. (N.P.S. Case Incident #771217)

A rock rubble dam was added to the rockfall between the upper and lower pools in 1882. It is estimated that this action increased the surface area of the upper pool by "six times" (Milestone 1978). The intent of the rubble dam was to preserve Mirror Lake and its reflective qualities. It was effective for a short time. The added rubble material influenced where the upper pool sediment deposition occurred, reduced the effect of hydraulic scour, and reduced water speed through the backwater. Within a few years following the placement of the additional dam material, a large sand bar formed upstream.

The formation of a sand bar led the Yosemite Commissioners to set the "restoration" of Mirror Lake as a top priority in 1888 (Biennial Report, cited Greene, 1987). "Restoration" recommendations outlined by the Yosemite Commissioners included dredging sand from the lake, building additional impoundments upstream of the dam to trap sediments, and adding to the height of the original rock rubble dam.

The Tenaya Creek watershed is naturally sand laden, as can be observed in stream channels in the upper watershed. As a result, the upper pool is dynamic and subject to rapid sedimentation. A cycle of dredging and channel obstruction began in 1889. For many years thereafter, park managers maintained water in Mirror Lake by adding rock rubble to the lake outlet and dredging aggraded sediments. The effectiveness of these actions was short-lived, however, due to subsequent and continual rapid deposition of sand. Dam enhancement and dredging stopped with the 1970 decision by park managers to allow natural hydrological processes to re-establish.

Sedimentation cycles now continue unabated. Recreating and maintaining the upper pool today would require intensive sediment removal similar to the dredging operations that took place from the late 1920's through 1971. Maintenance of a transitory feature by non-natural means is generally not appropriate in a natural national park. Aside from occasional "wash outs" following high flow events (like the one observed following the 1977 Tenaya Canyon flash flood, where several feet of the rubble dam height were removed (Milestone, 1978)), the rubble dam continues to function as the predominant hydrological control structure impacting Mirror Lake's upper pool. A 1994 NPS Water Resources Division hydrologic evaluation of the Mirror Lake basin documented some of the impacts of the rubble dam on the fluvial system of Tenaya Creek (see Appendix C).

## 5. LAND USE SUITABILITY

General land use plans have set the project area aside for recreation and landscape viewing. Though arguably suitable for other uses such as concessions, park operations, or wilderness, use has been determined for visitor recreational activity. The GMP designated Mirror Lake as a Natural Environment Subzone. Roads, picnicking areas, and trail-heads are permitted within this subzone, but development is minimal.

Environmental conditions within the project area have been considered in the proposed placement of the facilities and trails. It is recognized that areas such as the "beach area" adjacent to the lower pool, are in the floodplain, and additional sediment can be deposited during high flow events. However, the beach area has a low gradient and would be resilient to human foot traffic and suitable for the all-access interpretive trail. Vault toilets have been located at a higher elevation, out of the floodplain.

Mirror Lake's herbaceous vegetation in the riparian zone is vulnerable to impact from trampling. Furthermore, with repeated trampling, social trails develop rapidly and cause the sandy soils to lose their structure. These land suitability conditions restrict use in these sensitive areas.

The current upper parking lot and picnic area contains extensive impacts to soils. Portions of the talus slope have been removed for use during construction of the road and the wall. The adjacent talus slopes have narrow margins of slowly developing soils in crevices and catchment areas, and therefore should be avoided. Trail relocation to the perimeter between the steeper slope and the level area is an appropriate land use.

## 6. WATER QUALITY

Waters found in the Tenaya Creek watershed are generally considered to be near pristine and are largely undisturbed. The watershed is sediment laden when granitic sand is mobilized during spring runoff and periods of intense thunderstorms. Peak water runoff occurs from snow melt between April and June. It is not uncommon for the seasonal water discharge of Tenaya Creek to diminish substantially during mid-to-late summer months. There are periods when surface water is absent in the lower watershed except for isolated deep pools.

At Mirror Lake there appears to be frequent and observable deposition of human waste. The stock use on the Mirror Lake loop trail brings an intrusive volume of horse manure into areas adjacent to the stream. These situations create the potential to contaminate the surface and subsurface waters with fecal coliform and other infectious material.

## 7. WETLANDS

Wetlands in the Mirror Lake area consist of aquatic systems within the Tenaya Creek channel, and the riparian zone which occurs along the edges of Tenaya Creek and extends outward into the canopy or streamside vegetation. The specific project area described in this proposal does not include wetlands areas, except for the removal of railroad irons from the surface of the rubble dam for visitor safety.

### B. BIOTIC COMPONENTS

#### 1. VEGETATION

Mirror Lake and Tenaya Canyon supports a diverse range of vegetative species common to the many plant communities and ecotones of the area, ranging from woodland to riparian. There are no special status plants occurring in the project area. The northeastern section of the basin is characterized by a riparian/wetland area along Tenaya Creek, where the overstory is dominated by black cottonwood (*Populus trichocarpa*), big leaf maple (*Acer macrophyllum*), and white alder (*Alnus rhombifolia*). There is an understory of dogwood (*Cornus nuttallii*) and many water-tolerant species including sedges (*Carex spp.*), rushes (*Juncus sp.*), and horsetail (*Equisetum arvense*). Grasses occur in seasonally drier sites. In addition, many exotic species have become established, including the Himalayan blackberry (*Rubus discolor*) and bull thistle (*Cirsium vulgare*). The backwater areas upstream from the channel constriction ("Mirror Lake") contain an extensive sandbar community sparsely inhabited by various willows (*Salix spp.*) and black cottonwood with a seasonal herbaceous cover of silver wormwood (*Artemisia ludoviciana*), lupines (*Lupinus spp.*) and annual grasses.

As distance from water increases above this floodplain, the vegetation transitions into a slightly drier mixed-conifer forest dominated by an overstory of ponderosa pine (*Pinus ponderosa*), white fir (*Abies concolor*), incense-cedar (*Calocedrus decurrens*), douglas-fir (*Pseudotsuga menziesii*), with broad-leave trees of California bay-laurel (*Umbellularia californica*) and scattered California black oak (*Quercus kelloggii*). Shrubs are common, and are represented by chaparral coffeeberry (*Rhamnus californica*), greenleaf manzanita (*Arctostaphylos viscida*), and snowberry (*Symphoricarpos acutus*). The understory is lush during the spring, with wild ginger (*Asarum hartwegii*), ferns, native berries (*Ribes spp.*, *Rubus spp.*), and annual forbs and grasses. This is the vegetation zone that has received the greatest impact from past and present visitor use. There is evidence of tree cutting for vista clearing, hazard tree management, and firewood. Many areas have lost understory shrub and herbaceous layers by trampling and loss of soil structure.

The rockslide zones, where moisture and soils are more limiting, contain the sparsest vegetation community within the Mirror Lake area. An open-canopy overstory of interior live oak (*Quercus wislizeni*) and canyon live oak (*Quercus chrysolepis*) dominates, with scattered components of the mixed-conifer forest. The understory is made up of many native herbaceous species growing in small soil pockets including lupine (*Lupinus spp.*), popcorn-flower (*Plagiobothrys sp.*), woodland star (*Lithophragma spp.*), white yarrow (*Achillea lanulosa*), and gaping penstemon (*Keckiella breviflora*).

Iron Spring, located about 1/2 mile downstream of the lower pool, contains atypically high mineral concentrations and is inhabited by some unusual plant species for Yosemite Valley. These include Sierra laurel (*Leucothoe davisiae*), which is normally found in boggy areas at higher elevations.

## 2. WILDLIFE

The Mirror Lake area and Tenaya Canyon have populations of mammals including abundant deer (*Odocoileus hemionus*) and frequent observations of bobcat (*Lynx rufus*), black bear (*Ursus americanus*), gray fox (*Urocyon cinereoargenteus*), coyote (*Canis latrans*), and mountain lion (*Felis concolor*). Protected species documented in the area include the spotted bat (*Euderma maculatum*). This species and the western mastiff bat (*Eumops perotis*) have been observed feeding over the sandbar above the rock rubble dam. The cliffs and rocky crevices above Mirror Lake provide ideal breeding and roosting areas for both bat species.

Reptiles observed in the area include: the western fence lizard (*Sceloporus occidentalis*), one of the most common and adaptable reptiles in California, and the sagebrush lizard (*Sceloporus graciosus*), a common reptile with wide dispersal in rocky sunny areas from sea level up to 7,500 feet. Based upon habitat descriptions it is likely that the southern alligator lizard (*Gerrhonotus multicarinatus*) would also be widespread in shady areas within the project. Gilbert's skink (*Eumeces gilberti*) is another common but seldom observed lizard found in open areas within a wide variety of habitats (Abel, 1993).

The amphibian decline observed at higher elevations in the Sierra Nevada is also apparent at the lower elevations in Yosemite. All four species of native frogs and toads are declining, and the Yosemite Valley area has seen a reduction in western toads (*Bufo boreas*) (Drost & Fellers, 1994). However, there are no special status amphibian species such as the red-legged frog (*Rana aurora draytoni*) or foothill yellow-legged frog (*Rana boylei*) in the Mirror Lake area. Other protected amphibian species are not found at Mirror Lake's elevation.

Bird observations in Yosemite Valley for the yellow warbler (*Dendroica petechia brewsteri*), a state listed species which nests in willow thickets and riparian deciduous forests, suggest that the species would also be found in the Mirror Lake area. However, there are no recent recordings of this species at Mirror Lake. The federally listed endangered peregrine falcon (*Falco peregrinus anatum*) has nested on the rocky cliff areas below Half Dome and may feed in the area. Another pair of falcons nesting on the Rhombus Wall could feed in the Mirror Lake/Tenaya Canyon area. The last documented record in the Mirror Lake area for nesting willow flycatcher (*Empidonax traillii*) was in 1949. This species is listed as endangered by the state and would typically nest in riparian shrub communities, especially in willow thickets. Park staff have observed willow flycatchers in Yosemite. However, with the general degradation of riparian areas (stream bank erosion and the associated reduction in willow habitat), as well as the possible parasitism of nests by the brown headed cowbird, flycatcher sightings are infrequent. Tenaya Creek does provide willow habitat that has not been impacted as much as other riparian areas of Yosemite Valley and is suitable and available to the willow flycatcher.

## 3. AQUATIC

The indigenous fish present in Yosemite Valley prior to the first contact with Euro-Americans included rainbow trout (*Salmo gairdneri*) and the Sacramento sucker (*Catostomus occidentalis*). These species may have extended up to Mirror Lake although the surface waters of Tenaya Creek regularly dry up in the fall, and fish populations would follow cycles of elimination and replacement by migrants moving upstream from the Merced River. Four other native species were occasionally seen in the lower waters of the park. It is believed that fish were extirpated in waters above 4,000 feet by the Pleistocene glaciations.

Leo Marnell's Management Plan for Aquatic Resources (1971) examined the fish population in many Yosemite lakes and waterways. Mirror Lake was found to have both rainbow trout and brown trout (*Salmo trutta*) sustaining populations by natural reproduction.

The stocking of fish in the park began as early as 1878. Records for Mirror Lake and Tenaya Creek show attempts to establish a number of non-native species in the watershed including brook trout (*Salvelinus fontinalis*), cutthroat trout (*Salmon Clark*), grayling (*Thymallus anticus*) and brown trout. There is no current evidence that Tahoe suckers (*Catostomus tahoensis*) have emigrated downstream following an illegal introduction in Tenaya Lake. Although rainbow trout is listed as an indigenous fish the native strain of trout is believed lost through hybridization with hatchery stocks. Rainbow trout are not as extensive as non-native fish in the waters of Yosemite Valley. A number of altered habitat conditions in the Merced River appear to favor the non-native fish over the rainbow trout, including stream gradient, water temperature, substrate, cover complexity and habitat diversity.

### C. ECOLOGICAL INTERRELATIONSHIPS

#### 1. SUCCESSION

There are a number of river-related features in the Mirror Lake project area that are subject to the scour and deposition of sediments. The riparian shrub community is frequently interrupted by seasonal high flows and periodic drought conditions. Vegetation in this community responds quickly to disturbance as long as the soil conditions have not been compromised by compaction and other changes in the soil structure.

Revegetation of impacted areas would initially favor the establishment of incense-cedar (*Calocedrus decurrens*), pearly everlasting (*Anaphalis margaritacea*), buckwheat (*Eriogonum spp.*), lessingia (*Lessingia leptoclada*), lotus (*Lotus sp.*) and other grasses and forbs; followed by longer lived communities of Douglas-fir (*Pseudotsuga menziesii*), western raspberry (*Rubus leucodermis*), black oak (*Quercus kelloggii*), canyon live oak (*Quercus chrysolepis*), dragon sagewort (*Artemisia dracunculus*), and dogwood (*Cornus nuttallii*).

#### 2. FOOD RELATIONSHIPS

Insect populations associated with Mirror Lake's backwater provide a food source for a number of species. Birds rely on the riparian zone for nesting and foraging. A number of insectivorous birds are recorded for the area. There have been observations of morning and evening feeding by the spotted bat (*Euderma maculatum*) and the western mastiff bat (*Eumops perotis*).

Rainbow and brown trout have periodically established breeding populations in Mirror Lake and the lower pool. However, recent drought has impacted the distribution of these species in the project area. It would be expected that peregrine falcons nesting on adjacent cliffs would feed in the area as well. The talus slopes above the project provide habitat for both bobcat and mountain lions. Juveniles of both species have been observed moving through the area frequently enough to suggest that den sites and hunting territory encompass the project area.

#### 3. COMMUNITY RELATIONSHIPS

The interrelationships of the various components of the Mirror Lake ecosystem are many and complex. The driving external factors are regional climate, topography, parent material, and available organisms. The origin of the "lake" itself and the surrounding alluvial plain are products of geologic events and paleo climates producing an environment of rich, deep soils and

seasonally abundant moisture. In response to this environment, vegetation has established, creating suitable ecological niches for wildlife. All of these components interact with each other to form a viable and dynamic ecosystem.

Tenaya Creek and Mirror Lake provide aquatic environments for invertebrates and the fish that feed on them. The wet alluvial plain flourishes with grasses which, along with the fish, are food for the bears which den in the talus. Fires are also incorporated in the system and keep meadow edges from becoming invaded with conifers. On the dryer upland soils, forests are kept open by periodic fires, and habitats for numerous animals are maintained. Each component contributes to the sustainability of the larger ecosystem.

## **D. HUMAN COMPONENT/CULTURAL RESOURCES**

### **1. ARCHEOLOGICAL RESOURCES**

Documentation, mapping, and inventory of historic features and archeological sites in the lower Tenaya Creek drainage has been conducted by NPS staff. No Native American archaeological sites were found on the western edge of Mirror Lake. This is due to the alluvial formation of Mirror Lake by recent rock slide (Caputo, 1995), most likely obliterating traces of prehistoric human evidence. Tenaya Canyon and Mirror Lake were likely locations for seasonal encampments by indigenous peoples. The area would have provided access to game and basket making materials. Local vegetation consists of many traditionally used plant species, including black oak, blue oak, gooseberry, big leaf maple, dogwood, sedges, willows, silver wormwood, ponderosa pine, incense-cedar, California bay-laurel, greenleaf manzanita, elderberry and wild ginger. Archeological sites found in similar environment areas elsewhere in the park, suggest that the potential for buried prehistoric archeological remains is high (Caputo, 1995).

The extended winter snows in Tenaya Canyon would have made Mirror Lake less attractive for year-round residence, in contrast to other portions of Yosemite Valley. A map prepared by Lafayette H. Bunnell does not indicate any villages in the Mirror Lake area. The closest habitation noted by Bunnell was at Iron Spring. An 1878 color plate, "*Indian Life at Mirror Lake*", by Lady C. F. Gordon-Cummings portrays Ahwahneechee structures, umu'tca, on the west shore of Mirror Lake. Although no Indian village sites were identified, Gordon-Cummings work was reputed to be a fairly accurate portrayal (D. Robertson, 1984).

The historical archaeological features at Mirror Lake stem from early recreational use of the locale. Early Yosemite National Park (1920s) rockwork is abundant. Civilian Conservation Corps-era road and trail development is extensive. Historic records and archival resources are limited for this area of the park. Completion reports for early maintenance projects in the park mention some road and trail work in the area, and early Commissioner's Reports and early newspaper articles mention historic development of the area. Mirror Lake is noted as a sacred area on the 1942 Park Master Plan, however, the term sacred is not used in context and its exact meaning may never be discerned. Early oral histories, and some photographs demonstrate the construction of a cabin and ice house at the Lake. However, only archaeological remains of the ice house have been located. There is an intricate network of historic trails, roads, and rock features still in use today (Caputo, 1995).

Yosemite National Park prepared and submitted for Mirror Lake a nomination as a cultural landscape to the National Register. The Mirror Lake area was found to be not eligible (see Appendix I- Correspondance / Office of Historic Preservation). Prior to implementation of any

selected alternative the park will prepare the final documentation of compliance with Section 106 of the National Historic Preservation Act.

## 2. HUMAN CULTURAL PROCESS/ETHNOLOGICAL VALUES

The Mirror Lake area has been inventoried for Native American Traditional Cultural Properties and local Native American communities have been consulted. The cultural manipulation of the landscape by indigenous people would have included seasonal burning and selective removal and cultivation of plant materials to enhance wildlife habitat, food and medicinal plant harvest, and production of basket making materials (M. K. Anderson, 1993). The inaccessibility of Tenaya Canyon may have provided a refuge for indigenous peoples during periods of attack or conflict.

Mirror Lake (known as A-wai'-a in the Miwok language) figures prominently in the Miwok legend of Tis-se'-yak. Geographic features from the landscape are mentioned in the legend and the draining of the waters by Tis-se'-yak may refer to the episodic siltation of the basin during low water years (La Pena, et al, 1993).

C. Hart Merriam in his *Ethnographic Notes on California Indian Tribes* (1917) reports on a summer village situated at the extreme upper end of Yosemite Valley between the Merced River and Tenaya Creek and just below the mouth of Tenaya Canyon known as Hoo-ké-hahtch'-ke. cursory inspection of the Mirror Lake area by the park archeological staff did not identify any Native American village sites. Two smaller prehistoric sites were documented in Tenaya Canyon and outside the work area. Potential exists for additional Native American sites in the area, but the sites have been covered by alluvial sediments and rockfall (J. Caputo, 1995).

## 3. HISTORICAL RESOURCES

Captain William Howard constructed the first road from the Yosemite Valley loop road to Mirror Lake in the 1860's. His cabin was completed at the terminus of the carriage road by 1875. This toll road contributed to the accessibility of Mirror Lake by carriage, for the very first visitors in the area.

The "Lake House" was built on the shores of Mirror Lake by Leonidas Whorton and Peter Gordon in 1870. The opening of the Lake House for public lodging was featured in the *Mariposa Free Press* on June 3rd, 1870. In 1875, the Lake House was sold for delinquent taxes, Captain Howard leased the building and operated it as a saloon, constructing a dance pavilion over the lake (Historic Resource Study, L. Greene, 1987). Howard's cabin was destroyed for being unsightly by order of the commissioners in 1881. At least one and possibly two ice houses were erected at Mirror Lake by 1895, this enabled the first cold storage rooms at the *Stoneman House* and *Hutchings Hotel*.

The first mention of construction of the Mirror Lake dam is in 1883. However, it is possible that some manipulation of the backwater took place before the documented addition of "large blocks of granite, some of them weighing 10-15 tons each, from the adjacent banks at the narrowest neck of the channel of exit of Tenayah Creek" (pg. 117, J. Milestone, 1978). Anecdotal record cited that the surface of the lake was increased by 6 times following the 1880's construction. Photographs during the later part of the nineteenth century and early twentieth century suggest that the extensive waters and reflected vista of Mirror Lake may have been somewhat seasonal. Late summer and fall photographs show sandbars and peninsulas of land. In the Report to the Commissioner, 1885-86, the concern that the lake was filling with sediment led to the construction of another dam, a "retaining dam in a narrow rocky gorge above the lake" to catch

the silt. The Report in 1889 cited the restoration of Mirror Lake as a park priority it was "so covered with aquatic plants and shrubs due to the shoaling of the basin" (pg. 288, L. Greene, 1987). Dredging began that year.

Yosemite Nature Notes, in 1924, documented the extensive sandbar. The Gordon-Cummings' plate from 1878 also shows an island of land in the upper pool. Sand was routinely dredged out of the lake from the 1930's until 1971. Once dredging was stopped, the sandbar redeveloped sufficiently by 1977 to divide the pool in half (Milestone, 1978).

Stonework along the outboard edge of the road up to the parking lot was constructed by the National Park Service in 1928 (NPS, Yosemite Maintenance Completion Reports, 1929). This stonework is locally considered to be an attractive example of the craft. Portions of the stonewall and road were replaced following flood damage in 1937 and 1955 and variations in the stonework of the wall may be observed. Yosemite does possess other samples of stonework that are of exceptional quality and craftsmanship and warranted nomination to the National Register in 1987, these include the retaining walls of Arch Rock and Big Oak Flat Road (L. Greene, 1987).

The Mirror Lake site has historic archeological resources. Building foundations and artifacts remain from the primary historic periods including early carriage and equestrian trails, early roads, bridge abutments, building foundations, a natural dam with man made modifications, historic privy sites, tether rings for horses, two documented prehistoric sites, and potential for several other prehistoric sites. A chronology of historic events occurring at Mirror Lake may be found in Appendix G.

#### **4. SOCIO-CULTURAL INTERESTS**

##### **a. Wilderness**

Proposed restoration and trail construction activities would occur outside of designated wilderness. The wilderness boundary begins at the 4,200 foot contour line above Mirror Lake. This elevation is found at the upper edge of the Mirror Lake basin, a distance of approximately 500 feet northeast from the project area and, again, 100 feet away from the western edge of the project. Although the project does not take place within designated wilderness the area is valued by people for its views of adjacent wilderness. The proposed restoration work is intended to enhance interpretation and restore natural processes and vegetation and remove obsolete infrastructure. These actions should enhance the perception of wilderness values at Mirror Lake.

##### **b. Cultural Values**

Cultural considerations relevant to visitors coming to Yosemite in the late 1800s drew heavily upon the British romanticists. Yosemite during that period rapidly became one of the western destinations identified in travel guides of the times represented as possessing "perfect combinations of all the elements of the picturesque...without a rival in the world." Important values included: a romantic perception of nature, a high degree of social consciousness, popularity of resort life, and a national competitiveness for American scenery to achieve international recognition (Demars, 1991). Travel literature in the late 1800s used the vernacular of the European romanticists and characterized the Yosemite landscapes as sublime, a term which encompassed the picturesque, and increasingly referred to "wild" as a "direct expression of God Himself" (Demars, 1991).

The vista of Mt. Watkins and Half Dome reflected in the waters of Mirror Lake was reproduced by the first photographers and artists entering Yosemite. The images created of this majestic scene have contributed to the perception many people hold of the American west and the Yosemite wilderness (D. Robertson, 1984). Visitors to Yosemite Valley considered the early morning trip to Mirror Lake a "must" for the romantic tourist, where the elegant profile of Mt. Watkins achieved mirror-like reflection on the placid water (Demars, 1991).

Many of these values persist into the twentieth century. The interplay of mountains, water and reflected light continue to draw people to Mirror Lake as a gathering place. The "Easter sunrise service" was a widely attended event for many years and the granite block that served as the altar is still in place. Yosemite's research library carries photographic documentation of the Easter celebration dating from the early 1930's to mid-1960's.

The belief systems and learned values that shape the cultural values found in the Mirror Lake landscape have continued to evolve from the 1860's to current time. The aesthetic appreciation of wilderness is a more recent phenomenon and more physically demanding forms of recreation, such as backpacking and climbing, have increased in popularity (Demars, 1991). The Yosemite visitor's motivation for coming to the park is predominately to enjoy the "spectacular natural beauty" via sightseeing (Gramann 1992), and Mirror Lake is a frequently visited destination within the park.

### **III. ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND ALTERNATIVES**

#### **A. ENVIRONMENTAL IMPACTS**

##### **1. ALTERNATIVE A: NO ACTION.**

###### **a. Impacts on the Physical Environment**

There would be no adverse impacts on air quality.

There would be no change in current impacts on soils and hydrology.

There would be no additional impacts to wetlands. The existing dam has created a situation which would not have developed in the historic time frame. The natural constriction of the stream channel will always create a depositional site at Mirror Lake. The steepening of the stream's energy in the channel constriction below Mirror Lake may be increasing the effect of hydraulic scour in the lower pool. The influence of the dam may be accelerating the sedimentation rates in the backwater (increasing backwater effect) and reducing the occurrence of hydraulic scour in the upper pool. The deposition of the sandbar may be a cyclic and dynamic process and the retention of increased sediments by the dam has interrupted the deposition/scour cycle.

###### **b. Impacts on the Biotic Environment**

The presence of an unnecessary asphalt parking lot, access road, and retaining wall would continue to preclude the establishment and interaction of natural biotic communities.

Habitat fragmentation, trampling of vegetation, soil compaction, loss of potential habitat for the federally protected willow flycatcher, and potential for water contamination would continue.

The sandbar provides a less diverse wildlife habitat than the riparian shrub zone. The current sandbar, close to 400 feet in length, is more extensive than what was present prior to construction of the dam. This area may have supported more emergent wetland and riparian shrub vegetation prior to dam construction and creation of the sandbar.

Social trails that have been developing in the riparian vegetation would continue to have associated impacts of soil compaction and vegetation loss.

Wildlife habitat would remain unchanged with the impacts from the dam upon the backwater area reducing the cover of willow and emergent vegetation.

###### **c. Impacts on Cultural Resources**

Impacts on archeological and historical resources would continue. The archeological use of the area would not be interpreted on site with thematic panels. The historical view from the top of the stone staircase would continue to be obscured by vegetation. Artifacts of the historical period would remain in the landscape and although a part of the site experience they would continue to fall into disrepair. Access would remain changed to a prominent historic viewpoint with the historic view obstructed.

#### **d. Impacts on the Visitor Experience and Park Operations**

Runoff would still produce the expanse of reflective water historically photographed at "Mirror Lake". The lower pool may continue to look similar to its current appearance, maintained by a cycle of deposition and hydraulic scour.

Visitors with mobility impairment would continue to have a difficult time viewing the Mirror Lake area beyond the asphalt road.

The interpretive potential, with opportunities for education and inspiration, would not be developed for the visitor.

There would be no change in the visitor use patterns of the area. Redundant and unnecessary roads and trails would remain.

### **2. ALTERNATIVE B: Anticipated Impacts (PROPOSED ACTION).**

Under Alternative B, the PROPOSED ACTION, there would be a redesign of transportation corridors and improved interpretation of cultural elements and mitigation of impacts to natural processes. Impacted areas would be restored with native vegetation.

#### **a. Impacts on the Physical Environment**

There would be no permanent adverse impacts to air quality from this alternative, although machinery emissions and increased dust resulting from restoration activity would temporarily reduce air quality in the vicinity.

The removal of the former upper parking lot would change the existing landscape. Asphalt pieces would be removed and the soil will be decompacted using a variety of mechanical and manual methods. Soil disturbance to retrieve buried asphalt would occur to depths of up to 24 inches. The surface area of the former upper parking lot would be sculpted to create an uneven topography with large boulders from the surrounding talus slope. The soil will be amended with native mulch to improve the moisture retention capability. The road and adjoining stone wall would be removed above the lower pool. The slope would be restored to near original grade and the area revegetated.

The increased soil moisture, planting of locally salvaged vegetation and native seed, and manipulation of topography will contribute to the formation of micro-habitats and reduction of sheet water flow across the area. As the vegetation matures the existing gap in the forest canopy will be reduced.

Soils will be **disturbed** during the construction of the all-access interpretive trail. All-access trails have a **larger impact area** than a typical footpath. The impacted width of the trail would be approximately 10 feet. The surface material of permeable decomposed granite would not act as a barrier to the movement of soil moisture. Increased soil moisture, addition of vegetation, and manipulation of boulders will contribute to the formation of additional micro-habitats.

The installation of vault toilets requires an excavation of 5 cubic yards of material, at a depth of approximately 5 feet. The volume of human waste disposed of around the wooded area of the upper turn around lot would diminish.

The land use as a scenic vista would not change. Spring runoff would still produce the expanse of reflective water historically photographed at "Mirror Lake". The lower pool may continue to look similar to its current appearance, maintained by a cycle of deposition and hydraulic scour.

Potential visual impact of the parking area would be mitigated with screening vegetation.

The predominant approach to Mirror Lake would be identified. The addition of the interpretive trail would contribute to the length of time a visitor might spend in the project area.

The removal of the railroad irons from the Mirror Lake rock rubble dam could dislodge a minor amount of sediment. Manipulation of the irons would take place in the fall when water flow in Tenaya Creek is minimal to subsurface. Sediment dislodged would deposit in the lower pool add to the bed load carried during spring high energy flows. Peak spring seasonal runoff would still produce an expanse of reflective water at the upper pool. Soils in the backwater area would continue to be hydric. Monitoring sites have been established to document deposition patterns and changes in the stream channel above and below the dam.

#### **b. Impacts on the Biotic Environment**

Removing asphalt and fill material will expose native soils for revegetation. The reestablishment of vegetation will reduce the gap in vegetative cover. The species richness for forest interior birds would increase as corridors or gaps are reduced and forest continuity returned. Overall productivity of the area should increase. The removal of the road and regrading of the slope would take place between the upper parking lot and the lower pool. Following all restoration and revegetation, encroachment by exotic vegetation would be monitored and mitigated. Once vegetation was reestablished the habitat availability for wildlife would increase. Woodland nesting bird species would be less subject to predation from cowbirds and small mammals. Social trails that have been developing in the riparian zone will be closed off and revegetated. Informational signs and barriers will be installed, highlighting revegetation efforts.

The construction of the interpretive trail would result in the loss of some vegetation. The trail would be located around the perimeter of a wooded patch above the lower pool. Currently use trails exist in this area. The establishment of the all-access interpretive trail would allow foot traffic to be consolidated onto a hardened surface and revegetation carried out on the remaining social trails. Placing the trail around the edge of the wooded patch would leave a less fragmented central area.

Impacts on soil and vegetation would occur during construction. Soils on the upslope edge of the trail may have to be excavated to a depth of eight inches to level the trail. Some trees and herbaceous vegetation would be removed to make way for the trail. Plants will be salvaged from the impacted area prior to construction when possible. Replacement plantings would take place with younger aged trees and salvaged vegetation.

Human activity and noise associated with construction would disturb animals. Mobile animals intolerant of disturbance would temporarily abandon sites during restoration. Some less mobile animals and invertebrates, are expected to be lost during soil disturbing activities.

The only threatened and endangered species recorded for the area are the spotted bat and the western mastiff bat. These species roost in the cliffs of the canyon, away from construction

activities. Woodland nesting birds may be less subject to predation by small mammals and cowbirds when gaps and fragmentation of the forest canopy are reduced. The aquatic habitat will not be affected by the action.

### **c. Impacts on Cultural Resources**

Although no prehistoric habitation site has been identified in the project area, the potential exists to uncover prehistoric sites buried under alluvial deposits and rockfall. The closest recorded prehistoric site is out of the work area. Ground disturbing activities would be monitored for artifacts and evidence of early habitation. Indigenous uses by Native Americans of the area would be interpreted on site with thematic panels.

There would be impacts to some of the historical era artifacts. The road and stone retaining wall are proposed for removal between the lower pool and the upper parking lot. Portions of the original stonework dates from 1928. However, the roadcut obliterated a segment of the 1860's carriage road and left the carriage road divided by a steep slope. The removal of the road would allow the carriage road to be repaired over the length of the project area. This would provide an interpretive experience for visitors to walk a historic transportation corridor and approach Mirror Lake as visitors from the late 1800s might have.

Currently most water runoff from the road is channelled into a culvert with some water moving along the asphalt road. Removing the road and regrading the slope would open areas for revegetation and reducing the area under asphalt. Erosion control for the newly graded slope would include mulching with native materials and controlling upslope runoff, returning the tread to a pedestrian scale and increasing the habitat.

The carriage road is proposed for minor repairs with additional re-construction of the segment needed to connect the disjointed portions of the road. The upper portion would be adapted for current use as an all-access interpretive trail. The lower portion of the carriage road would have routine maintenance to improve the trail tread, but trail construction standards would not be "universal access". The transportation corridor from the late 1800s would be represented by the carriage road. The carriage terminus and metal rings would remain in their current condition and near the location where Captain Howard's 1875 cabin once stood.

Railroad irons would be removed from the dam, primarily for visitor safety. The rock rubble dam would be interpreted as a manipulation of the landscape during the early historic settlement of Yosemite Valley and for the beliefs that led the early residents to enhance and "bring order" to the landscape. The manipulation of the site by early park guardians and the National Park Service, evolved from these early beliefs.

Artifacts of the historic era that would remain in the landscape include: the stone steps, the sunrise service peninsula, foundation of the ice house, and other stonework along the carriage road. The presence and significance of these items would be included in the interpretive messages in the project area.

### **d. Impacts on Visitor Experience and Park Operations**

Visitors with mobility impairments would find the project area more widely accessible. All visitors would find more in-depth interpretive information about Mirror Lake. The new trail signing will prevent the confusing array of information currently encountered by the visitor.

Proposed construction activities include the installation of additional vault toilets adjacent to the lower part of the road near the shuttle bus stop and construction of five all-access parking spaces near the lower pool. Each vault toilet requires an excavation of five cubic yards of soil.

The construction of the all-access trail will generate noise and dust as granite materials will be worked on site. The timing of the trail construction portion is proposed for fall of 1996. Although there are fewer visitors in October and November some people will be inconvenienced by the noise and dust. Information advising visitors about conditions during work at Mirror Lake may help them to identify other sites in the valley or target their visit to Mirror Lake on weekends.

Signing would be improved to assist wayfinding and identify access to the Snow Creek Trail Head. This trail is the original grade of the carriage road and it's construction may date to the 1860's. The intersection of the old carriage road and the lake road is currently signed "Mirror Lake" and appears to have been an attempt to direct pedestrian traffic off of the paved road. This became an obsolete sign once the road closed to vehicular traffic and the majority of the pedestrians began to use the roadway. The current signing confuses visitors as they witness the majority of people using the road to reach Mirror Lake. With trail improvements and effective signing the carriage road could serve as the transportation corridor for pedestrian use.

**e. Possible Mitigation of Enhancing Measures.**

**IMPACT**

**MITIGATION**

**Physical Environment**

**Air Quality:** No permanent adverse impacts; temporary adverse impacts from dust and fumes of equipment.

Surface disturbing activities coupled with water sprinkling to reduce dust.

**Soil Disturbance:** Some soil would be disturbed by decompaction, grading, road removal, and trail construction.

Mitigate the soil disturbance and prevent erosion, apply native mulch and retainsoil profile. Provide for adequate surface drainage. Mulch restored slopes.

**Land Use:** The qualities of the scenic vista would not change and would improve with the restoration of the fluvial cycle. There would be temporary obstructions of the scene during construction.

Visitor information will be available to assist people in planning a visit to Mirror Lake during a time when construction is not in progress. Most of the use of heavy equipment will take place in fall and during weekdays. Provide temporary signs during restoration.

**Water/Wetlands:** Removing the railroad irons from the dam may disturb sediments.

Work on the dam will be done when surface flow is nonexistent. Monitoring will take place above and below the dam and the potential impacts of the sediment on the stream channel will be evaluated.

## **Biotic Environment**

**Vegetation:** Vegetation may be lost in the construction of the trail. No impacts to any federally listed, proposed, or sensitive plants will be affected.

Seed collection of native plants has already occurred. The locally gathered plant material will be propagated or reseeded to revegetate the newly restored areas. Plants will be salvaged from areas where loss is anticipated due to construction activities. Plant willow cuttings on eroding stream banks to facilitate the establishment of vegetation and soil loss.

**Wildlife:** Increased human activity and noise associated with construction may disturb some wildlife. Mobile animals may temporarily

Disturbances will be temporary and by scheduling the restoration work adjacent to the stream corridor for fall the species peak reproductive times will be avoided. In time the increased cover of vegetation will

### **f. Recommendations for Mitigating and Enhancing Measures**

Cross sections of Tenaya Creek have been surveyed above and below the project area. The dynamic hydrology of the Mirror Lake area will be better understood when the data are fully analyzed. In addition, the sediment load transport capacity of the Merced River is an important factor in understanding and evaluating the impact of displaced sediments from Mirror Lake. Estimates of the Merced's sediment transport capacity are provided in the report, Analysis of Bank Erosion on the Merced River, (Madej, Weaver, & Hagans, 1991). This report states that the volume of sediment transported by the Merced is much lower than its transport capacity. This may be characteristic of sediment transport in the glaciated granitic terrain of the Sierra Nevada, (Madej, et al). Analysis of sediments and stream channel will continue.

The measures proposed to mitigate the impacts associated with restoration and trail construction will be implemented. Yosemite National Park's Impact Mitigation Specialist will supervise the project.

The California Office of Historic Preservation reviewed the description of work outlined and expect no significant impacts to cultural resources and no mitigation was required (See Appendix I). Removal of the upper road and stone wall would take place only after full documentation.

### **g. Residual Impacts**

Visitors with severe mobility impairments would no longer be able to drive an automobile to the point overlooking the traditional view. Access would be provided as far as the lower pool by vehicle and then access would be on the "universal access" pathways.

The upper road and stonewall would be removed from the landscape. Lower portions of the stonewall at the lower pool would be retained as an active portion of the road and a sample of rockwork installed between 1928-1955.

### **3. ALTERNATIVE C: Anticipated Impacts**

#### **a. Impacts on the Physical Environment**

There would be no permanent adverse impacts to air quality from this alternative. Although machinery emissions and increased dust resulting from restoration activity would temporarily reduce air quality in the vicinity.

Soils would be disturbed but the area available for revegetation would be increased by the removal of asphalt and fill material from the parking lot and road. Native soil materials would be regraded to original slope. Imported fill materials would be removed from the area. Removal of the dam could accelerate hydraulic scour in the backwater area and reduce the extent of the sandbar. In time, the area would become less impacted by the footprint of infrastructure.

Human land use patterns would change. The priority for managing the area would be for its wilderness values. Access into Mirror Lake would be by foot and existing infrastructure would be removed.

The fluvial system would be similar to what existed prior to the construction of the dam. Initially head-cutting above the dam site would contribute to increased sediment load downstream. The impacts on the stream channel would be monitored both above and below the dam site. The removal of the upper 3-4 feet of rock from the dam could deposit sediments downstream at places where channel shifting and evulsion could occur. The soils in the backwater area would continue to be hydric but the duration of inundation could change. Following the removal of the road and parking lot the surface flow of water would not be channelled into drains. The removal of drains and restoration of the slopes would contribute to more soil moisture and a reduction in the gaps of vegetative cover.

Assuming the attraction of the area for visitors remains unchanged, with four million visitors arriving at Yosemite annually, Mirror Lake would continue to be among the most heavily most visited sites in the park. Removing the infrastructure would create a greater waste disposal problem than the current one. Potential exists for microbial contaminants to enter both surface and ground water.

#### **b. Impacts on the Biotic Environment**

See Alternative B. Impacts as a result of new construction would not occur.

Less disturbance of wildlife would occur from a lack of vehicle traffic.

#### **c. Impacts on Cultural Resources**

There would be no change in the impacts to archeological resources, the nearest recorded habitation site is out of the project area. Construction activities would be monitored for artifacts and evidence of early habitation.

The impact to the historical era artifacts would be widespread. The remnants of previous management actions in the project area span over 130 years. Actions taken during this earlier time period reflect the philosophy of European-Americans interaction with their environment and their willingness to manipulate, change and "create order" in the wilderness. Artifacts present in the landscape include metal rings at the carriage road terminus, the road base for the

carriage road, a stone foundation near the rock rubble dam, the rock rubble dam, trails, stone steps, the Easter sunrise worship peninsula, and the stonewall that forms the outboard edge of the road. The historic resources provide an educational and interpretive opportunity and have value in terms of the early settlement of the park, park management, and the contribution made by the Civilian Conservation Corps to Yosemite. The removal of all cultural elements and infrastructure within the project area would diminish the opportunities for interpretation and restrict the visitors perception of the area to the natural resources and exclude the human/landscape interaction layer.

**d. Impacts on Visitor Experience and Park Operations**

Visitors with mobility impairments would generally find the site inaccessible. Minimal on site interpretation would take place. The natural resource would (in time) appear restored from human impacts. Removing the relics of the historic time period would diminish the opportunities for education and interpretation. The traditional view would change with some vegetation growth obscuring the view. Water quality for human consumption could be contaminated by the disposal of untreated human waste in the area.

**B. IMPACT MATRIX BY ALTERNATIVE**

Alternatives	A No Action		B Restore Natural Processes and Manage as a Cultural Landscape		C Restore Natural Processes and Manage as Wilderness	
	Short	Long	Short	Long	Short	Long
Impact Duration						
Air Quality	0	0	-	0	-	+
Topography and Soils	0	0	-	+	-	+
Water and Wetlands	0	0	0	+	0	+
Begetation	0	0	0	+	0	+
Wildlife	0	0	-	+	-	+
Aquatic	0	0	-	+	-	+
Ecological Interrelationships	0	—	-	+	-	+
Cultural Resources	0	—	0	+	-	—
Socio-Cultural	0	-	0	+	-	-

Aesthetics and Visual Qualities	0	-	-	+	-	+
---------------------------------	---	---	---	---	---	---

**Symbols indicate the following:**

++ highly positive effect; + positive effect; 0 neutral effect; - negative effect; —highly negative effect

#### **IV. RECORDATION OF PERSONS, GROUPS, AND GOVERNMENTAL AGENCIES CONSULTED**

American Indian Council of Mariposa County, Incorporated

California Department of Parks and Recreation, Office of Historic Preservation

National Biological Service, Research Office, Jan W. van Wagtendonk, Ph.D.

National Park Service, Water Resources Division, Gary Smillie and Richard Inglis

Pacific Watershed Associates, Arcata, CA., Bill Weaver and Danny Hagans

## V. PARTICIPATING STAFF

### PREPARERS

#### Yosemite National Park, National Park Service

Elizabeth Waldow	Biological Technician
Lisa Acree	Biological Technician/vegetation
Sylvia Augustus	Historical Architect
Mark Butler	Phy. Sci. Specialist, Environmental Compliance Officer
Jane Caputo	Historical Archeologist
Jim Corless	Valley District Interpreter, Supervisor
Frank Dean	(formerly) Management Assistant
Bill Delaney	Chief, Branch of Professional Services
Chris English	Civil Engineer
Don Fox	Landscape Architect
Sue Fritzke	Plant Ecologist
Bob Fry	Valley District Interpreter
Jay Johnson	Forestry Crew Supervisor
Louise Johnson	Impact Mitigation Specialist
Jeff Kangas	Valley Utilities, Supervisor
Steve Kelly	Chief of Roads & Trails
Mary Kline	Valley District Interpreter
Laura Laird	Archeologist
Tim Ludington	Trails Supervisor
Kate McCurdy	Biological Technician/wildlife
Jerry Mitchell	Chief, Branch of Cultural Resources

Ron Parker (formerly) Concessions Specialist  
Jeff Samco Valley District Interpreter  
Henry Snyder Chief, Division of Resources Management  
Jim Snyder Historian  
Steve Thompson Wildlife Biologist

**Water Resources Division, Ft. Collins, National Park Service**

Richard R. Inglis Hydrologist  
Gary Smillie Hydrologist

**Yosemite Field Station, National Biological Service**

Jan W. van Wagtenonk Field Station Director

## **LIST OF APPENDICES**

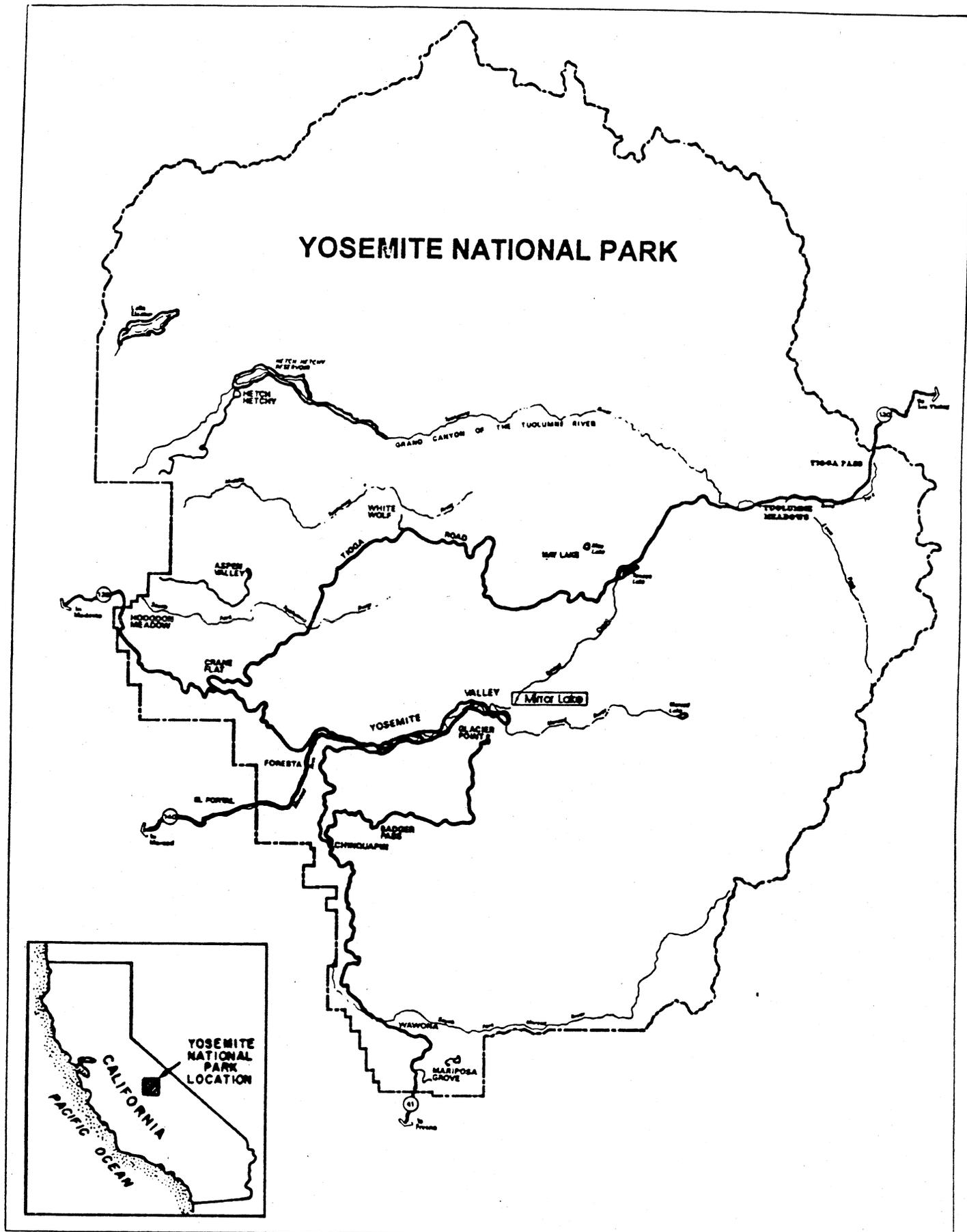
- APPENDIX A. Maps and Illustrations of the Mirror Lake Project Area**
- APPENDIX B. Influences On Planning and Management of Yosemite National Park as Stated In The General Management Plan/1980**
- APPENDIX C. Hydrologic Evaluation/Trip Report, 1994**
- APPENDIX D. Description of Existing Infrastructure**
- APPENDIX E. Description of Proposed Infrastructure**
- APPENDIX F. Interpretive Plan**
- APPENDIX G. Chronology of Historic Events Occurring At Mirror Lake**
- APPENDIX H. Plant Species List**
- APPENDIX I. California Department of Parks and Recreation Office Of Historic Preservation (Correspondence)**

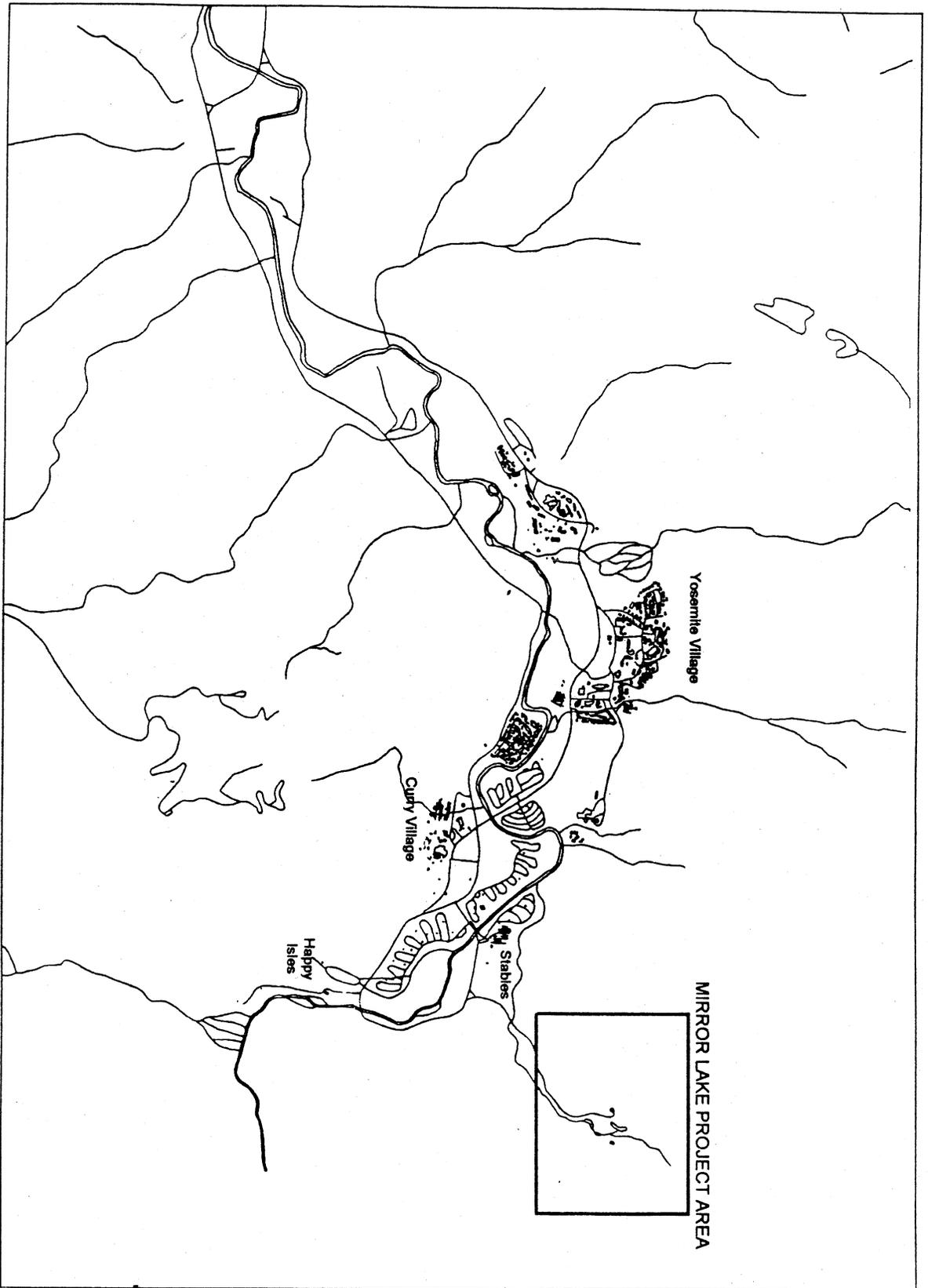


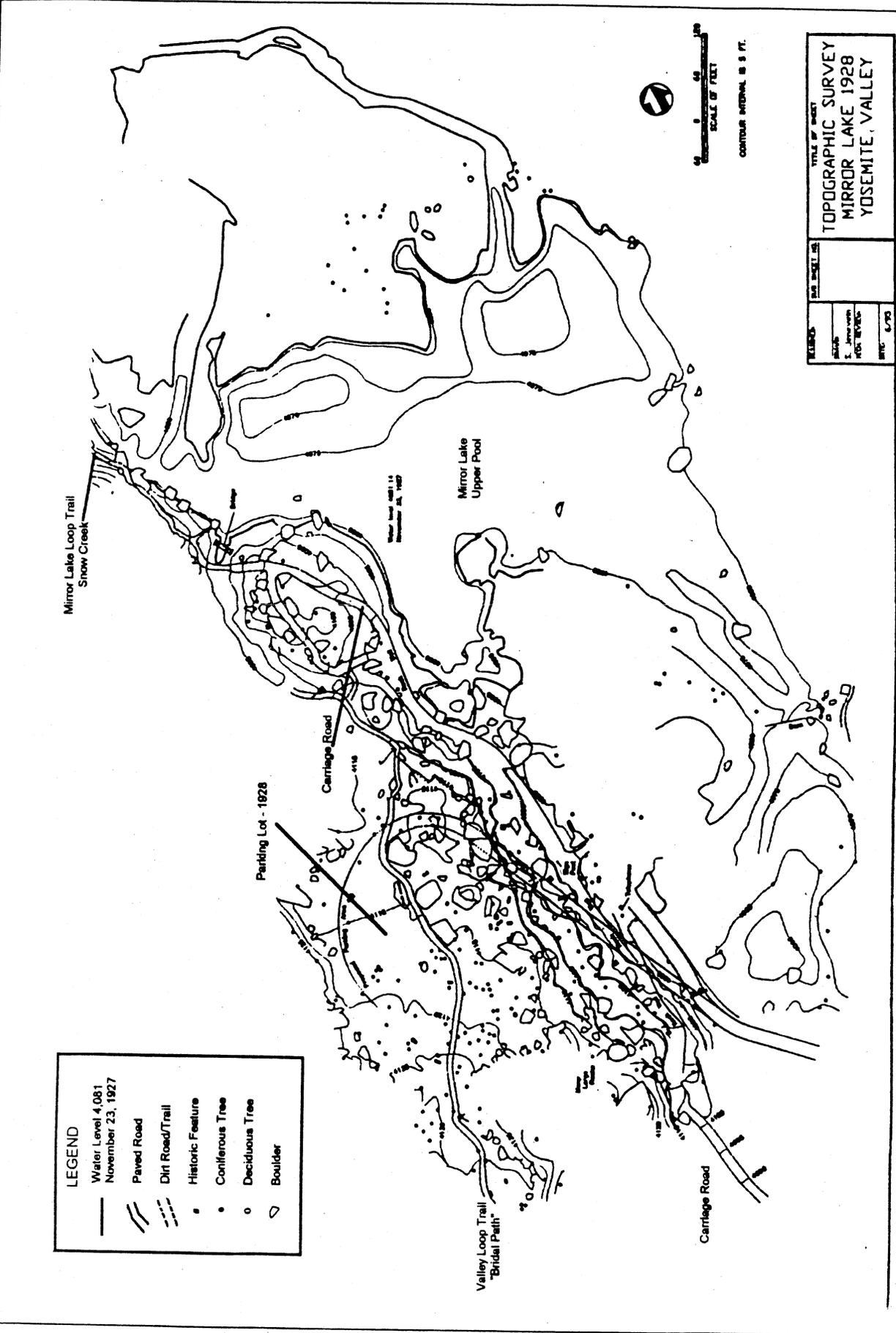
## **APPENDIX A. Maps And Illustrations Of The Mirror Lake Project Area**

1. Sheet 1: Regional map showing California, location of Yosemite National Park and location of Mirror Lake
2. Sheet 2: Yosemite Valley map showing the location of Mirror Lake
3. Sheet 3: 1928 site map of Mirror Lake, topographic data prior to the construction of the upper road and parking lot
4. Sheet 4: Site plan of the existing condition
5. Sheet 5: Site plan of the proposal

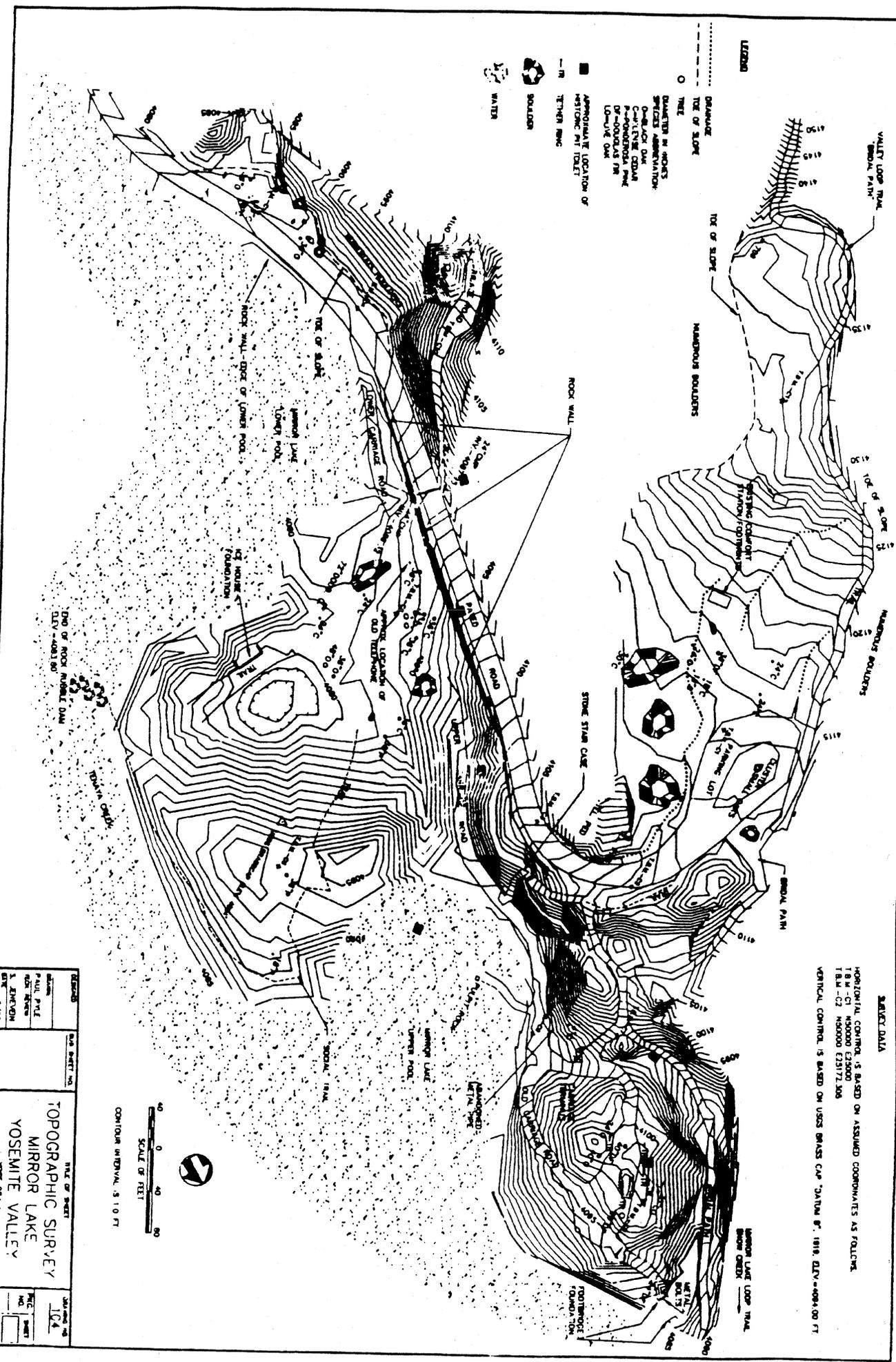




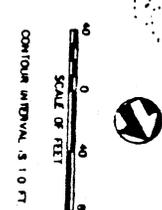




# Current Infrastructure



**SURVEY DATA**  
 HORIZONTAL CONTROL IS BASED ON ASSUMED COORDINATES AS FOLLOWS:  
 T.M. - C1 N50000 623000  
 T.M. - C2 N50000 623172.888  
 VERTICAL CONTROL IS BASED ON U.S.G.S. BRASS CAP "CATHAM" B. 1816. ELEV. 4094.00 FT



DESIGNED	DATE SHEET NO.	TITLE OF SHEET	DATE OF SHEET
DRAWN		TOPOGRAPHIC SURVEY	
PLANT FILE NO.		MIRROR LAKE	
EXTENSION		YOSEMITE VALLEY	
DATE		NO. 1	
		NO. 2	
		NO. 3	
		NO. 4	
		NO. 5	
		NO. 6	
		NO. 7	
		NO. 8	
		NO. 9	
		NO. 10	
		NO. 11	
		NO. 12	
		NO. 13	
		NO. 14	
		NO. 15	
		NO. 16	
		NO. 17	
		NO. 18	
		NO. 19	
		NO. 20	

# Preferred Alternative



**SURVEY DATA**

HORIZONTAL CONTROL IS BASED ON ASSUMED COORDINATES AS FOLLOWS:

T.B.M. - C1 N50000 E23000

T.B.M. - C2 N50000 E23172.305

VERTICAL CONTROL IS BASED ON USGS BRASS CAP "DATUM" B.F. 1819, ELEV. = 4984.00 FT.

DATE SHEET NO.	104
DATE	8/83
SCALE	1:10,000
PROJECT	MIRROR LAKE
DESIGNED BY	S. ZENEVICH
CHECKED BY	8/83
TITLE OF SHEET	TOPOGRAPHIC SURVEY
SHEET NO.	104
PROJECT NO.	YOSEMITE VALLEY
YOSEMITE VALLEY	YOSEMITE VALLEY
YOSEMITE VALLEY	YOSEMITE VALLEY



## **APPENDIX B. Guidelines For Planning and Management of Yosemite National Park as Stated in The Final Environmental Impact Statement / General Management Plan (GMP -1980)**

There are two purposes for Yosemite National 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 awesome domes, valleys, polished granites, and other evidences of the geologic processes that formed the Sierra Nevada; historic resource, 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 their individual enjoyment, education, and recreation now and in the future.

The GMP attempts to manage development so that "visitors can step into Yosemite and find nature uncluttered by piecemeal stumbling blocks of commercialism, machines and fragments of suburbia."

### **EXCERPTS FROM RESOURCES MANAGEMENT GMP GUIDELINES:**

Restore altered ecosystems as nearly as possible to conditions they would be in today had natural ecological processes not been disturbed.

Identify and perpetuate natural processes in park ecosystems.

Identify the major scenic resources and the places from which they are viewed.

Provide for the preservation or protection of existing scenic resources and viewing stations.

Provide for historic views through vista clearing.

Permit only those levels and types of use that are compatible with the preservation or protection of the scenic resources and with the quality of the viewing experiences.

Identify, evaluate, and determine the significance of cultural resources, encompassing buildings, structures, sites, and objects.

Provide for the preservation, restoration, or protection of these significant cultural resources.

Provide interpretive services that relate the natural and cultural significance of Yosemite to visitors with a broad diversity of interests.

### **PARK OPERATIONS GMP GUIDELINES**

Provide facilities and utility systems that conserve energy and comply with all applicable standards and codes.

Remove barriers that interfere with use of developed facilities by the handicapped and other special populations, and provide easy access for all visitors whenever feasible.

### **LAND MANAGEMENT ZONING GMP GUIDELINES**

The Mirror Lake project area is included within a subzone of the Natural Zone, the Natural Environment Subzone. Within this zone roads, picnicking areas, and trail-heads are permitted, but development will be minimal.

**APPENDIX C. Hydrologic Evaluation/trip Report. 1994**

February 7, 1995

L54(479)  
YOSE

Memorandum

To: Chief, Water Resources Division  
Through: Chief, Water Operations Branch  
From: Richard Inglis and Gary Smillie, Hydrologists, Water  
Operations Branch  
Subject: Trip Report for Travel to Yosemite National Park,  
September 26-30, 1994.

PURPOSE: The purpose of this trip was to provide advice regarding the potential impacts of the proposed removal of a rubble dam at Mirror Lake and evaluate proposals to maintain open meadowlands by hydrologic manipulations.

ITINERARY: We departed Fort Collins on September 26th and met with park staff Sept. 27th. After 3 days in the field, we returned to Fort Collins on Sept. 30th.

CONTACTS: Louise Johnson, YOSE  
Beth Waldow, YOSE  
Lisa Acree, YOSE  
Mark Butler, YOSE

DISCUSSION:

### Mirror Lake

#### Background

Mirror Lake is located in lower Tenaya Canyon about a mile upstream of the confluence of Tenaya Creek and the Merced River. There are two pools associated with Mirror Lake; the main lake that provides the large reflecting surface that has become famous and a small pool located immediately downstream. The Tenaya Creek watershed is naturally sand laden as we observed in stream channels in the upper watershed. As a result, the upper pool (here after referred to as Mirror Lake) is not a stable feature because it is subject to rapid sedimentation. Matthes (1930), in his interpretation of the geologic history of the Yosemite area, suggests the following explanation for the presence of the lake in this depositional environment. A lake formed in a depression left upon retreat of a large valley glacier. Over a period of time this lake filled-in with sediment and formed a low gradient valley bottom/meadow. In recent geologic time, a large rockfall deposited debris on the old lake bed and formed a long, shallow impoundment, Mirror Lake. However, as noted by Matthes, it was evident even at the time of

his investigation that the lake was filling-in rapidly with sediment and would quickly return to a meadow environment.

The lower pool is bounded on the downstream side by the terminal moraine as identified by Matthes (1930). This small pool is more persistent at low flow than Mirror Lake but was dry during our site visit at a time of protracted drought. The pool appears to be caused by erosion induced by the presence of several extremely large rocks that have fallen into the channel just upstream of the moraine. Unlike Mirror Lake, the lower pool appears to be self-maintaining due to the scouring ability of the river around these rocks.

For many years the Park Service maintained water in Mirror Lake by placing rock and debris at the outlet of the lake to impound water to a higher level and, also, occasionally, by dredging and removal of aggraded sediments from the lake bed. The effectiveness of these actions were short-lived, however, due to subsequent aggradation. These practices have since been stopped and as a result, the sedimentation process is progressing unabated. Park staff is presently considering removing some or all of the placed-material at the outlet of the lake. Returning to the original outlet elevation is appealing to the park but, as a minimum, removal of man-made debris within the elevated control is desired. Two questions arise if placed-material is removed; first, would an existing, lacustrine system somehow be degraded or changed to a fluvial/meadow environment, and second, would the release of stored sediment cause problems downstream to aquatic biota and/or park infrastructure or disrupt naturally functioning geomorphologic processes? We offer the following observations and recommendations.

#### Field Observations

Upon site inspection, we question whether Mirror Lake is now or at the time of European discovery was a true lake in the manner in which it functioned. This is an important point when considering future management options. During our site visit all flow in Tenaya Creek had ceased due to dry conditions and the "lake" was totally dry. No pool below channel grade was present such as is the case in a true lake setting. The lake bed is covered by coarse sand with many bars and fluvial features. There is little deposition of organic material, clay, or fine sand that would be indicative of a true lake formation. It appears that pooling of water is due to the substantial narrowing of the valley in the area of the rock avalanches. During high to moderate flows the constriction of flow area here causes a large backwater pool to form that is lake-like in appearance but disappears quickly as flow diminishes.

If Mirror Lake is not a true lacustrine system but rather a fluvial feature, several points can be made that are relevant to the questions posed above. First, any attempt to maintain a pool by increasing the elevation of the control will quickly become

ineffectual. As previously mentioned, this has been observed in the past. The elevation of the control (lake outlet), whether it is established through naturally occurring processes or by man, simply dictates the elevation at which a fluvial surface forms upstream. Therefore, increasing, decreasing, or not adjusting the elevation of the outlet all result in nearly the same effect just at a different elevation. This means that removal of material making up the outlet would not be predicted to have an impact on the morphology of Tenaya Canyon except to promote the development of a lower fluvial surface. Secondly, the option of dredging aggraded sediments on a continuing basis could be effective for maintaining the pool during periods of low flow. However, this option would need to be repeated frequently and is a questionable activity in a National Park.

With respect to the possibility of overloading downstream reaches with eroded sediment, we think there is some potential for this to occur. As mentioned above, the sedimentation process is nearly at completion for the present elevated control of Mirror Lake. Therefore, any reduction in base elevation will cause a headcut to run upstream followed by lateral erosion processes leading to an overall reduction in the elevation of the fluvial surface. The eroded material, primarily sand sized, will be transported downstream in a relatively high energy environment most likely as bed load. Slightly above the confluence with the Merced River, the gradient of Tenaya Creek reduces and energy to transport sediment diminishes. From this area and continuing downstream in the Merced River, the potential for aggradation is quite high. The transport rate for bed load in these lower reaches is not zero but, rather, less than the rate in the upstream reach so temporary storage of the sand is likely in Yosemite Valley. Whether or not the amount of aggradation could be sufficient to cause problems for infrastructure or natural channel processes is uncertain. The most likely location for problems stemming from aggradation is just above the confluence of Tenaya Creek and the Merced River. This area appears to be susceptible to deposition and, therefore, channel shifting and avulsion. Should the channel become dynamic as a result of increased sediment loading, several facilities, including a campground could be affected.

#### Conclusions and Recommendations

In our opinion, the park has made the correct decision to discontinue the maintenance of an open pool in Mirror Lake. Maintenance of a feature by non-natural means is not generally an appropriate activity in a natural national park, particularly when the actions are taken to maintain the existence of an unnatural or, at least, transitory geologic feature.

We recommend initially removing the top layer of boulders from the dam and extracting the man-made debris. This will bring the water surface elevation of the upper pool down a small amount. We expect a shallow layer of sand from the bed of the creek and upper lake to be transported downstream during the next few high water events.

The initial scour should be limited and taper out in the upstream direction. Initial sediment movement will be rapid but the effects should stabilize quickly. Deposition should be transitory in low gradient/low velocity areas downstream in Tenaya Creek and the Merced River.

To monitor the downstream effects of dam removal, cross sections should be selected at a few representative, low-gradient areas and surveyed pre-removal and, periodically, post-removal. Cross sections should also be surveyed at several locations within Mirror Lake. The approximate volume of material likely to be mobilized for a given change in base level could then be predicted and evaluated for potential impact to down stream reaches. Follow-up surveys through Mirror Lake should occur to document the amount and timing of actual erosion.

Following this strategy for removal and monitoring, the exotic material visible on the surface of the outlet will, at a minimum, be removed and a large risk for serious impacts downstream will not be incurred. Additionally, the information learned during this first phase of restoration can be used to determine whether or not it is advisable to remove more of the placed-material in the future.

## **APPENDIX D. Description of Existing Infrastructure**

### **POTABLE WATER SUPPLY SYSTEM**

No public drinking water is provided at Mirror Lake.

### **WASTE TREATMENT**

Toilets are located west of the lower parking lot.

### **ROADS AND TRAILS**

Roads and trails in the project area provide confusing access choices for visitors. The main access road is a double lane of asphalt paving, a continuation of the transportation pattern from the 1930's when most visitors approached by automobile. The parking lot at the lake was expanded, then reduced in size when energy conservation concern and the availability of the shuttle bus eliminated automobile access to Mirror Lake.

The entrance to the stone staircase is oriented to visitors approaching from the upper parking lot, most visitors now approach from south of the stairs and shortcut or jump over boulders to reach the staircase. The carriage road bed intersects the paved road near Iron Springs and a weather beaten, poorly aligned, wooden sign indicates that the carriage road is the route to Mirror Lake. The signing may date to the time when automobile traffic was heavy on the paved road and might have been an attempt to separate the pedestrian from the vehicular traffic. The majority of the visitors discern that the paved road provides access to Mirror Lake and provides an attractive stream side walk with the sensory experience of running water. A portion of the visitors select the carriage road to avoid being crowded and experience the woodland walk or they manage to see the sign and believe it's the direction to Mirror Lake. The old carriage road intersects the paved road again near the lower pool and crosses over to drop down towards the pool and then continues northerly to the bottom of the stonewall and the carriage terminus. The tread of the road is compacted soil, broken asphalt pieces and about ten feet in width.

The northside Valley Loop trail is used by the concession operated horse ride and connects at the upper parking lot with the Tenaya Canyon loop trail.

The loop trail from the stable to the parking lot is used primarily as a bridle path, possibly pedestrians avoid the trail because surface conditions are very dusty or muddy and horse waste is frequently encountered. The Tenaya Canyon loop trail continues northeast from the lake and around on the southeast side to return and intersect the lake road at a foot bridge downstream from the lower pool. The foot bridge is signed on the road side with a Mirror Lake directional. Pedestrians who follow the sign on the bridge find themselves on the southeast side of the Tenaya Canyon loop trail and opposite the historic vista at the stone steps. Visitors who arrive at the historic vista and interpretive sign at the top of the stone steps on occasion misinterpret the bold lettering on the sign and believe they have reached "DISAPPEARING LAKE". Visitors have walked the Tenaya Canyon loop trail in search of Mirror Lake.

### **MIRROR LAKE DAM**

## **APPENDIX E. Description of Proposed Infrastructure**

### **POTABLE WATER SUPPLY SYSTEM**

No public drinking water is proposed for Mirror Lake.

### **WASTE TREATMENT**

Two vault toilets are proposed for installation at the lake road and lower carriage road intersection. Excavation of 5 cubic yards of soil will be needed to install the vault toilets. The toilets will be handicap accessible and adjacent to the road.

### **TRANSPORTATION CORRIDOR**

The Mirror Lake road will be removed between the upper parking lot and the lower pool, a distance of approximately 450 feet. Non-native fill material would be removed from the project site. The stone wall will be removed between the carriage road intersection and the upper parking lot, an estimated 1,100 cubic yards of stone. The slopes will be recontoured and revegetated based on the original topographic maps from the 1928 construction of the parking lot. The upper parking lot will be removed and restored, the current diameter of the lot is 100 feet. Revegetation of the upper picnic area will extend 250 feet beyond the current parking lot. A smaller parking area will be developed adjacent to the lower pool and along the road edge, approximately 100 feet by 25 feet.

The carriage road bed between the intersection near Iron Springs and the intersection near the lower pool will be repaired and adapted to current pedestrian use. The two segments of the carriage road would be connected by the reconstruction of the portion destroyed during the 1928 road construction. The upper carriage road beyond the lake road would be part of the all-access interpretive trail. Signing will be removed and appropriate directional signs installed.

### **TRAILS AND INTERPRETIVE TRAILS**

Approximately 600 feet of all-access trail would be constructed between the lower pool and the upper pool to the base of the stone steps. The trail surface on the old carriage road would be repaired. The northside Valley Loop trail will be repaired as needed and vistas will be managed for their significant characteristics.

### **MIRROR LAKE DAM**

It is proposed that the railroad irons found in the upper portion of the dam be removed. Evaluate impacts to the stream channel above and below the dam site. The remaining "human placed" material in the dam may be removed in later years if it is determined that there is deleterious impact on the fluvial system.

### **VISITOR FACILITIES**

The four wooden picnic tables at the upper parking lot would be removed. Benches designed to be appropriate to the significant time period will be placed throughout the project area.

The dam is made up of large blocks of granite and underneath the dam's surface rock twenty foot lengths of railroad rails can be observed. Milestone's survey in 1977 measured the dam at over nine feet in height and seventy feet across. A flood in 1978 reduced the height of the dam and the height estimated in 1994 was five feet.

## **VISITOR FACILITIES**

There are four picnic tables provided at the west end of the upper parking lot. The tables are of wood construction and not designed for "all access" use.

There are two interpretive panels in the project area. One is located adjacent to the road and the lower pool. The second is located at the top of the stone steps and at the site of the traditional view. The second panel interprets the progression from lake to wetland meadow and is titled "Disappearing Lake".

There is a telephone located at the upper parking lot, towards the stone steps, that is provided to report emergencies. Mirror Lake is one of the four most visited locations within Yosemite and a number of visitors undertake the walk from the shuttle bus stop without water or the physical conditioning to complete the walk.

Bicycle racks are available part of the way up the hill and a sign requests that bicyclists on rented bikes leave them at the racks and not attempt to take them all the way to the view point. The intent of this signing was to prevent inexperienced bicyclists from losing control of the bike on the descent along the Mirror Lake road.

A series of interpretive panels will be developed and installed along an all-access trail. Themes will include: geology, indigenous peoples use of Mirror Lake, historic use and vista, construction activities, riparian habitat, wildlife, and Tenaya Canyon.

The interpretation of Tenaya Canyon/Mirror Lake will begin at the "Y" junction of the road with a orientation display containing a map of the project area, seasonal interpretive information, resource protection statement, and safety information.

The telephone will be relocated to the lower parking lot.

Bicycle racks will be installed near the lower parking lot.

Appropriate garbage/recycling cans will be installed at the lower parking lot.

## APPENDIX F. Interpretive Plan

### Excerpts from the Yosemite National Park General Management Plan/1980

The interpretive program is essential to the fulfillment of the Yosemite experience. The following goals for interpretation are intended to assist visitors in understanding, enjoying, and contributing to the preservation of the scenic, natural, and cultural resources of the park.

Orient visitors, provide personal assistance, and inform them about opportunities available in the park.

Provide interpretive services that relate the natural and cultural significance of Yosemite to visitors with a broad diversity of interests.

The natural and cultural significance of the park is reflected in the following park interpretive themes:

**Scenery** - the unique and spectacular visual attributes of Yosemite Domes, cliffs, meadows, forests, rivers, and waterfalls in Yosemite Valley. Towering peaks, ridges, deep canyons, lakes and streams, meadows, forests, and giant sequoia groves in the High Sierra surrounding the Valley.

**Biotic Systems and Geology** - the natural processes that modify the land, the life forms that occupy it and the processes and interrelationships that govern it.

The geologic land base and its origins, composition, processes, and present forms; its characteristics (attributes, tolerances, and capacities); and its geologic future.

Yosemite's life communities - plants and animals and the balance and interdependence of all life forms and processes; present and future endangered species.

**Wilderness/Conservation** - intangible and tangible values.

The human uses of wilderness - the human values of wilderness (societal, personal, spiritual, and physical); the scientific values of wilderness; the myriad forms of exploitation and their consequences; choices and alternatives.

The history of the wilderness idea and the conservation movement - early wilderness advocates (those instrumental in preserving Yosemite); the establishment and early administration of the park.

**Humans and Yosemite** - Different times, cultures, values, and human impacts on the landscape. Yosemite's indigenous people - the story of the cultures of Native Americans in Yosemite before and after European contact; their lives and settlements, their material and social culture, their values, their fate, and their future.

European people in Yosemite - their views, uses of resources and activities in Yosemite.

**Park Experience** - Enjoying the special attributes of Yosemite. The human need for physical and mental activities congruent with the park's primary purpose - activities that can be

appropriately enjoyed at Yosemite; programs for doing, thinking, dreaming, and being in relationship to Yosemite's resources.

**Provision for Special Populations** -Provisions will be made to ensure an enjoyable park experience by special populations, such as the physically disabled, the young, foreign visitors, and senior citizens. Developed facilities, the interpretive program, and the transportation system will be designed or modified to meet the requirements of all park visitors. An access plan for the disabled has been prepared and will be amended as needed to conform to applicable regulations. Special population groups will continue to be consulted in the development of park programs.

Proposed site specific thematic panels for the Mirror Lake project site include:

1. The orientation display panel would introduce the visitor to Tenaya Canyon and illustrate the trails in the project area. Information presented should include the "Wilderness" ethic, seasonal information and a strong safety message on the hazards inherent in mountain lion habitat, specifically indicating that children should be kept close to the supervising adults.

The orientation panel should be located near the "Y" intersection above the Tenaya Creek Bridge with the bicycle trail and the road.

2. Geologic origins of the canyon, moraine, lower pool. Fluvial systems operating on the backwater. Rockfall zone and channel constriction contribute to retention of waters at Mirror Lake. A description from the August 1923 issue of Yosemite Nature Notes describes Tenaya Canyon ... "The rock gardens of the Tenaya Gorge possess a wild magnificent beauty. The gorge is fifteen to thirty feet wide at the bottom with bare granite walls that rise 4,000 feet above the stream. The plants that one may observe on the terraces include: five fingered fern, false asphodel, yellow mimulus, pink spirea, grass of parnassus, and golden narthesium."

3. Cultural uses of the project area by early indigenous people would have included seasonal encampments. Burning, selective removal and cultivation of plant materials may have been carried out to enhance wildlife habitat, food and medicinal plant harvest, and production of basket making materials. The inaccessibility of Tenaya Canyon may have provided a refuge during periods of attack or conflict.

4. Historic era development of the project area included road construction, public lodging, a cabin, ice houses and facilities intended to enhance the visitors enjoyment of the area. Visitors arriving at the Mirror Lake area would have travelled by carriage upon Captain Howard's toll road for the cost of one dollar. People arriving in the spring and early summer would see the expanse of the lake reflecting Half Dome and Mt. Watkins.

Fine liquors and Havana cigars could be purchased at the Lake House. The lucky few spending the night at the public lodging could boat or dance under moonlight and reflected mountains on the dance floor built out over the water.

5. The construction of the dam at Mirror Lake is an example of the enhancement that the Yosemite Commissioners attempted. The expanse of the lake's reflection increased six fold following the 1882 construction of the dam and addition of many ton sized boulders. Within two years the rapid build up of the sand bar was recorded and the Yosemite Commissioners reported in 1884 that the "restoration of Mirror Lake was a park priority as it was so quickly filling with sand". By the mid-1880's the park managers began a cycle of dredging the lake. The removal of sand from Mirror Lake continued at irregular intervals until the increase of

automobile traffic into Yosemite in the 1930's. Then the removal of sand from the lake became an annual activity and served to provide sand for winter road de-icing. The National Park Service last dredged the upper pool in 1971.

6. Riverine ecology and a discussion of the hydrology of the backwater which forms Mirror Lake. Evolution of the park understanding of the dynamics that influence the system from the earlier interpretation of the succession of a lake to meadow to the current understanding of the fluvial cycle of hydraulic scour and sediment deposition. Interpret the wetland habitat, riparian vegetation and wildlife associations, (such as the endangered spotted bat and mastiff bat feeding over the wetland area).

7. Panels with early photographs and etchings of the scenic landscape that comprised Mirror Lake, 1860-1916. Narrative could include the influence the early artists had on the American view of the western wilderness and Yosemite.

## **APPENDIX G. Chronology of Historical Events Occurring at Mirror Lake**

- 1851 Trader James D. Savage and a small portion of the Mariposa battalion enter Yosemite Valley and eventually scout up the Tenaya Creek canyon beyond Mirror Lake.
- 1860s Captain William Howard builds a toll road to Mirror Lake.
- 1870 Construction completed for the Lake House, a frame building open for public lodging and providing "fine liqueurs and Havana cigars".
- 1875 Howard completed construction of his "shake shanty" cabin on the shores of Mirror Lake and near the terminus of the carriage road. Howard takes over the operations of the Lake House as a saloon and adds on a dance floor over the lake.
- 1881 Howard's cabin demolished by order of the Yosemite Commissioners for being unsightly.
- 1882 A dam is constructed across Mirror Lake's narrow outlet in an attempt to preserve the lake from filling in with sediment and vegetation. Anecdotal information suggest that surface of the lake was increased six times over the original.
- 1885 Information within the Report to the Commissioner states that the lake was filling in with sediment and a second dam was constructed "as a retaining dam in the narrow rocky gorge above the lake to catch the silt."
- 1889 Report to the Commissioner identifies the restoration of Mirror Lake as a park priority it was "so covered with aquatic plants and shrubs due to the shoaling of the basin". Dredging began that year.
- 1890 Yosemite Stage and Turnpike Company built a frame ice house at the lake. A second ice house was later built and these provided to the hotels of Yosemite Valley the first opportunity to refrigerate perishable food items.
- 1890-1930's
- The dredging of sand from the lake was performed at irregular intervals, as needed, to remove sediments.
- 1930s Increased automobile traffic into Yosemite led to annual harvesting of sand from Mirror Lake to de-ice winter roads. Periodically the Mirror Lake dam would be rebuilt after major floods would destroy it. Sluicing gates were installed to reduce sand deposition.
- 1971 The National Park Service ended the dredging of Mirror Lake.
- 1977 The sand bar is perceived as increasing rapidly and divides Mirror Lake in half.
- 1978 A flash flood removed several feet of rock from the top of the dam.

## APPENDIX H Plant Species List

### **Riparian/Wetland area**

black cottonwood (*Populus trichocarpa*)  
big leaf maple (*Acer macrophyllum*)  
white alder (*Alnus rhombifolia*)  
dogwood (*Cornus nuttallii*)  
sedges (*Cares spp.*)  
rushes (*Juncus spp.*)  
horsetail (*Equisetum arvense*)  
Himalayan blackberry (*Rubus discolor*) -Exotic  
bull thistle (*Cirsium vulgare*) - Exotic

### **Backwater area**

willow (*Salix spp.*)  
silver wormwood (*Artemesia ludoviciana*)  
lupines (*Lupinus spp.*)

### **Mixed-conifer forest**

ponderosa pine (*Pinus ponderosa*)  
white fir (*Abies concolor*)  
incense-cedar (*Calocedrus decurrens*)  
douglas-fir (*Pseudotsuga menziesii*)  
California bay-laurel (*Umbellularia californica*)  
California black oak (*Quercus kelloggii*)  
chaparral coffeeberry (*Rhamnus californica*)  
greenleaf manzanita (*Arctostaphylos viscida*)  
elderberry (*Sambucus melanocarpa*)

snowberry (*Symphoricarpos acutus*)  
wild ginger (*Asarum hartwegii*)  
bracken fern (*Pteridium aquilinum*)  
California polypody (*Polypodium californicum*)  
saxifrage (*Saxifraga* spp.)  
nemophila (*Nemophila heterohpylla*)  
white hawkweed (*Hieracium albiflorum*)  
rattlesnake plantain (*Goodyera olbongifolia*)  
trail plant (*Adenocaulon bicolor*)  
wood violet (*Viola* sp.)  
gooseberries (*Ribes* spp.)  
western raspberry (*Rubus leucodermis*)  
thimbleberry (*Rubus parviflorus*)  
California blackberry (*Rubus ursinus*)  
columbine (*Aquilegia formosa*)  
tiger lily (*Lillium* spp.)

**Rockslide zones**

interior live oak (*Quercus wislizeni*)  
canyon live oak (*Quercus chrysolepis*)  
brickell bush (*Brickella californica*)  
popcorn-flower (*Plagiobothrys* spp.)  
woodland star (*Lithophragma* spp.)  
white yarrow (*Achillea lanulosa*)  
gaping penstemon (*Keckiela breviflora*)  
mountain dandelion (*Agoseris* sp.)

**Iron Springs**

Sierra laurel (*Leucothoe davisiae*)

**APPENDIX I. California Department Of Parks And Recreation Office Of  
Historic Preservation (Correspondence)**

RECEIVED  
YOSEMITE

PETE WILSON, Governor

OFFICE OF HISTORIC PRESERVATION  
DEPARTMENT OF PARKS AND RECREATION  
P.O. BOX 942896  
SACRAMENTO 94296-0001  
(916) 653-6624  
FAX: (916) 653-9824

NATIONAL PARK  
MAILROOM

FEB 2

FEB 28 10 29 AM '96



Act	Inch	File
<input checked="" type="checkbox"/>		Supt.
<input checked="" type="checkbox"/>		Asst. Supt.
		Mgmt. Asst.
		Admin. Officer
		Resrch. Scientist
		Ch. Concessions
		Ch. Interpreter
		Ch. Maintenance
<input checked="" type="checkbox"/>		Ch. Recreation
		Ch. Visitor Pk.
		Safety
		Control Files
		REPLY DUE

NPS 9511102A

(916) 653-6624  
FAX (916) 653-9824

February 15, 1996

B.J. Griffin, Superintendent  
National Park Service  
U.S. Department of the Interior  
P.O. Box 557  
YOSEMITE NATIONAL PARK CA 95389

Re: Mirror Lake Restoration Project, Yosemite National Park,  
Mariposa County.

Dear Ms. Griffin:

Thank you for submitting to our office your copy of the Yosemite Valley Cultural Landscape Report, Vols. 1 and 2 (National Park Service, October 1994). The report was submitted as part of our continuing effort to establish the historic significance of Mirror Lake, Yosemite National Park, Mariposa County. The National Park Service (NPS) is currently considering an undertaking that would restore Mirror lake to its pre-1928 circulation pattern, vegetation, and ground contours.

Your previous inquiries to our office regarding the eligibility of Mirror Lake for inclusion on the National Register of Historic Places (NRHP) was addressed in part by our letter of January 5, 1996 in which we requested more information regarding the Lake's overall significance in the development of the Yosemite National Park as a recreational entity. We also requested further information on the role of Frederick Olmstead in the design changes for Mirror Lake's natural environment that contributed to greater access to and utilization of the Lake's recreational resources. The Yosemite Valley Cultural Landscape Report offers some information on these questions. However, we have concluded that the information in this report does not adequately support your determination that Mirror Lake and its surrounding area is individually eligibility for the NRHP under any of the criteria established by 36 CFR 60.4.

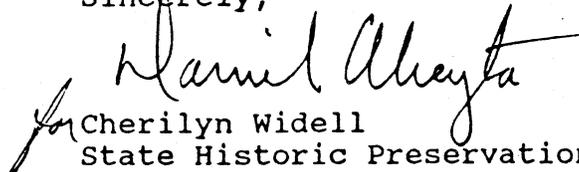
No conclusive evidence has been presented that ties the development of the Mirror Lake area to significant historic events, nor is the connection to Frederick Olmstead's role in the design of the Lake's natural features firmly established. The Yosemite Valley Landscape Report does make reference to various activities that occurred from 1928-1956 that sought to maintain the Lake's reflective qualities (dredging), and the road and

bridge infrastructure associated with the area's circulation patterns. These activities however are no more significant than other activities occurring throughout the park during the same time period. As alluded to in our January 5, 1996 letter, we would encourage you to pursue the possibility that Mirror Lake may be a contributing resource to a larger discontinuous district containing many of Yosemite's greatest natural wonders. Such a district would provide a better contextual reference point for determining Mirror Lake's historic significance within Yosemite National Park.

You were also seeking our comments on your determination of the effects the proposed project would have on Mirror Lake in accordance with 36 CFR 800, regulations implementing Section 106 of the National Historic Preservation Act. Our review of the submitted documentation leads us to concur with your determination that the proposed project will have no adverse effect on Mirror Lake or any other potential historic resources located in the project Area of Potential Effect (APE). We are encouraged to note that efforts are being made to restore much of the area's natural landscape to its pre-1928 appearances, and that interpretive displays of the area's cultural history and natural processes will be provided to the public.

Thank you again for seeking our comments on your project. If you have any questions, please contact staff historian Clarence Caesar at (916) 653-8902.

Sincerely,

  
for Cherilyn Widell  
State Historic Preservation Officer



## REFERENCES

Acree, Lisa Nemzer

The Plant Communities of Yosemite Valley - A Map and Descriptive Key. 1994. N.P.S. Technical Report NPS/WRU/NRTR-94-01.

Cooperative National Park Studies Unit

The University of California - Davis, California.

Anderson, M. K. and Blackburn, T. C.

Before the Wilderness: Environmental Management by Native Californians. 1993.

Augustus, Sylvia R. and J. Caputo

Nomination: National Register of Historic Places, 1995

OMB No. 1024-0018,

U.S.D.I., National Park Service

Barbour, Michael and Major, Jack

Terrestrial Vegetation of California. 1988. University of California, Davis

Caputo, Jane

Cultural Resources Survey Report for Mirror Lake, 1995

Yosemite National Park Report

Demars, Stanford E.

The Tourist in Yosemite, 1855-1985. 1991.

California Native Plant Society

Inventory of Rare and Endangered Vascular Plants of California.

Drost, Charles and Fellers, Gary

Decline of Frog Species in Yosemite. 1994. N.P.S. Report.

Greene, Linda Wedel, Yosemite National Park

Historic Resources Study. 1987

Gramann, James

Visitors, Alternative Futures, and Recreational Displacement at Yosemite National Park, Texas  
A&M University, 1992

Grinnell, Joseph and Storer, Tracy Irwin

Animal Life in the Yosemite. 1924

Heady, Harold and Ziegler, Robert

Vegetational Types in Relation to Soil in Yosemite Valley. 1964. N.P.S. Report. University  
of California.

Huber, N. King

The Geologic Story of Yosemite National Park. 1989

Yosemite Association

Inglis, Richard and Smillie, Gary

Hydrologic Evaluation of the Tenaya Creek Basin and Mirror Lake. 1994

N.P.S. Water Resources Division - Trip Report

La Pena, Frank, Craig D. Bates and Steven P. Medley

Legends of the Yosemite Miwok. 1993

Yosemite Association: Yosemite National Park

Marnell, Leo F.

Long-Range Management Plan for the Aquatic Resources of Yosemite. 1971

N.P.S. Report

Matthes, Francois E.

Geologic History of the Yosemite Valley. 1930. U.S. Geological Survey Professional Paper #  
160

Merriam, C. Hart

Ethnographic Notes on California Indian Tribes. 1917

- Milestone, James F.  
The Influence of Modern Man on the Stream System of Yosemite Valley. 1978. Graduate thesis, San Francisco State University
- Pierson, Elizabeth D.  
Bat Surveys at Yosemite Valley and the Hetch Hetchy Reservoir. 1993
- Robertson, David  
West of Eden. 1984
- State of California Department of Fish and Game  
California's Wildlife. Volume I -Amphibians and Reptiles, Volume II - Birds, Volume III - Mammals. 1988
- University of California, Division of Agricultural Sciences  
California Forest Soils. 1979
- U.S. Department of Agriculture, Soil Conservation Service  
Soil Survey of Yosemite National Park, "Interim Report". 1991
- U.S. Department of Interior, National Park Service  
Yosemite National Park: General Management Plan. 1980
- U.S. Department of Interior, National Park Service  
Yosemite National Park: Research Management Office Records  
Park's Sensitive Plant Species List, Wildlife Observation Records, Fish Checklists  
Yosemite National Park: Maintenance Office Records  
Annual Completion Reports (1928-1971)  
Analysis of Bank Erosion on the Merced River, Yosemite Valley, 1991
- Madej, Mary Ann and Weaver, William and Hagans, Danny
- U.S. Fish and Wildlife Service, Coastal California Fishery Resource Office  
Merced River Habitat Typing, Underwater Fish Observations, and Habitat Restoration Recommendations. 1991
- Kisanuki T. & Shaw, T.

Wieczorek, Gerald F., J. Snyder, C. Alger, and K. Isaacson

Rock falls in Yosemite Valley, California. 1992. U.S. Geological Survey

Report 92-387

Yosemite Nature Notes, 1923, 1924, 1930

Zinke, Paul, and Alexander, Earl

The Soil and Vegetation of Yosemite Valley. 1963. N.P.S. Report. University of California