FEASIBILITY REPORT FOR EARLY-WINNER PROJECT CONCEPTS

Golden Gate National Recreation Area

Draft Technical Report

By

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GLOSSARY OF ABBREVIATIONS

AVL	Automatic Vehicle Location
Caltrans	California Department of Transportation
CCTV	Closed-circuit Television
CMS	Changeable Message Sign
DOT	Department of Transportation
DRI	Division of Research and Innovation
FCC	Federal Communications Commission
GGNRA	Golden Gate National Recreation Area
GGT	Golden Gate Transit
HAR	Highway Advisory Radio
ITS	Intelligent Transportation Systems
LOS	Level of Service
MOU	Memorandum of Understanding
MTC	Metropolitan Transportation Commission
NPS	National Park Service
PCMS	Portable Changeable Message Sign
ROW	Right-of-way
RWIS	Road Weather Information Systems
WASO	Washington Service Office (NPS)
WTI	Western Transportation Institute

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1. INTRODUCTION

Because of the economic benefit and transportation impacts associated with the state's national parks, California Department of Transportation (Caltrans) Division of Research and Innovation (DRI) funded a research study to examine how intelligent transportation systems (ITS) could be used to address mutual park and district transportation challenges. Phase 1 of this effort assessed the transportation needs and ITS solutions for the state's national parks by focusing on two demonstration parks, Golden Gate National Recreation Area and Sequoia and Kings Canyon National Parks. Caltrans DRI has funded a second phase of this project that includes, among other deliverables, the demonstration of early-winner projects in each park.

The purpose of this document is to develop a few early winner project ideas for Golden Gate National Recreation Area (GGNRA). This document is intended to inform key GGNRA and Caltrans stakeholders of the characteristics of each project, their advantages and disadvantages, to help them make a more educated decision about how to proceed with selecting early-winner projects. This document is intended only to be a starting point for discussions with GGNRA, Caltrans, and other stakeholders. The ideas in this document may need further consideration, research, and refinement prior to deployment if chosen.

Several candidate early-winner projects were identified as relatively low-cost ways of moving toward the long-term ITS vision for the park. These early winner projects were selected by revisiting the Phase 1 report (1) which included GGNRA's challenges and ITS themes. The challenges identified included:

- Roadway Congestion
- Inadequate Access
- Limited Parking
- Transit Coordination and Information
- Planning Data
- Traveler Information
- Work Zone/Event Coordination
- Emergency Response

The following ITS themes were identified in Phase 1 of the ITS Applications in California National Parks project based on the above needs:

- Roadway Congestion Forecasting
- Data Collection and Storage
- Parking Management and Information
- Parking Intercept
- Traveler Information
- Transit Trip Planner
- Major Emergency Response

The themes represented a long-term vision about how the park may pursue ITS. The themes and challenges were then used to identify ITS projects that could be done within the contract period and budget while still fitting with the needs and themes.

Aesthetic challenges and solutions are discussed further in this document. As national parks have a mission to "…preserve unimpaired the natural and cultural resources…" the number of transportation and tourism signs inside the park are limited. Those that do exist are generally either brown or green and hung on wooden posts. To enhance the beauty of the parks, the appearance of ITS and the manner in which it is deployed in national parks must also be taken into consideration[1].

National and regional ITS Architectural standards and plans are not addressed in this document; however, how selected projects conform to regional and national standards will be addressed in a separate document prepared for GGNRA and Caltrans. Although this document will not address a broad ITS vision or ITS strategy for GGNRA, one should be created into which the chosen early winner project will fit. For each project idea, the following items will be presented:

- A summary project description
- Related problems, objectives and themes from Phase 1 report (1)
- Required stakeholder involvement
- A rough operational concept of how the project would be used
- Anticipated benefits/results
- Estimated area costs of installation, operations and maintenance
- Approximate timetable for implementation and evaluation
- Potential measures of effectiveness and evaluation criteria
- Estimated cost/benefit or cost-effectiveness
- Outstanding issues (technical, operational, maintenance)
- Strengths and weaknesses

[1] More information on (aesthetic) planning and design concerns can be found on the Scenic America website at www.scenic.org/communitydesign/communitydesign.htm.

2. SHARED USE PORTABLE CMS AT US 101 AND STATE ROUTE 1 INTERCHANGE

2.1. Project Description

This project would involve the deployment of two portable changeable message signs (PCMS), as shown in Figure 1, on US 101 approaching the Manzanita interchange of US 101 and State Route 1. The PCMS could be used to help reduce congestion at the interchange and to alert motorists of parking availability at Muir Woods and Stinson Beach.

Figure 1: Picture of a PCMS

Source: American Signal Company

2.2. Relationship to Phase 1

2.2.1. Problems

Roadway Congestion. Roadway congestion occurs during high visitation times (e.g. summer weekends) at many locations throughout the recreation area, including US Route 101 north of Golden Gate Bridge and the State 1 Corridor, Conzelman Road, Rodeo Beach, Golden Gate Vista Point, the south end of Golden Gate Bridge, 19th Avenue/Park Presidio Boulevard, Stinson Beach, Crissy Field/Bay Street, and Muir Woods National Monument. Sausalito has expressed concern about the potential for additional traffic impacts when Fort Baker is redeveloped as part of NPS as Sausalito generates its own visitor traffic and congestion in that corridor.

Limited Parking. Overflow visitor parking is a challenge at several GGNRA locations, including Muir Woods, Stinson Beach, Conzelman Road, Rodeo Beach, Golden Gate Vista Point, Fort Mason and Fort Baker. At Muir Woods, for example, parking may back up one mile from the park entrance onto adjacent two-lane roadways that are not designed to support on-street parking. There is a lack of real-time information regarding parking availability and advance information about when crowded conditions might be expected. This is especially true for beaches like Stinson, dependent on weather conditions and overflowing during nice sunny summer weekends. There is also concern about employee parking as the Presidio continues to be developed.

Traveler Information. There is a need to provide visitors with information about parking, congestion, and transit availability prior to their visit, along with improved information about activities within the park as well as in surrounding areas. Ideally, this could be done with a predictive element to allow for better planning and management of visitor traffic. This traveler information needs to reach people in systems they will use while planning their trip or during their trip to enable them to make appropriate decisions.

Work Zone/Event Coordination. There is a need for better coordination between public agencies on work zones and construction, and providing information on actual versus planned

lane closures. In addition, there are often special events that significantly impact traffic levels on roadways providing access to park sites. In some cases, estimated traffic impacts of events are reported to some agencies but are not distributed to all affected agencies, or are not communicated effectively to the general public.

Emergency Response. The park and other responsible public agencies like the Golden Gate Bridge Highway and Transit District, must be sensitive to evacuation and emergency response needs on its lands. There will be a need to ensure rapid coordination and dispatch of appropriate resources to respond to large-scale emergencies, and to provide visitors and others with appropriate information to allow them to alter their travel behavior and visitation activities as needed.

2.2.2. Objectives

1.1.2 Provide visitors with appropriate information at major transportation decision points

1.1.3 Provide information to help visitors avoid congested locations and times

1.1.6 Provide information on parking availability to visitors

1.2.1 Improve the safety of vehicles at or approaching congested entrance stations

1.2.2 Improve the safety of vehicle travel on park roadways

1.2.3 Improve the safety of vehicle travel through work zones in the park

2.2.3. Themes

Parking Intercept. Even after a visitor has begun to drive to a park, it may be desirable to get them out of their vehicles because of congestion on roadways approaching park sites or at parking areas. This ITS theme would involve using information on current congestion and parking availability to provide information to locations where drivers could park and then take transit. Information could be provided using highway advisory radio or changeable message signs at decision points to direct drivers to parking lots where they could use transit. The parking lots would then have information on the availability and real-time arrival schedule of transit.

Traveler Information. This ITS theme involves collecting and distributing all information that would help visitors to enjoy their visitor experience to GGNRA, parklands and other key destinations in the Route 1 Corridor. It would provide a mix of static and dynamic information to assist them in planning their itinerary to and between select GGNRA sites, along with adjacent visitor attractions of interest. The information would include travel time (reflecting congestion and construction activities), weather and parking information for GGNRA sites. It would also include information on transit and non-auto alternatives. It would also provide links to more detailed information about GGNRA sites along with other attractions that may be of interest to visitors.

2.3. Stakeholders

- Caltrans District 4 TMC
- Golden Gate National Recreation Area
- California State Parks
- California Highway Patrol
- Marin County

2.4. Draft Operational Concept

The concept for this site would be to deploy two portable or semi-permanent changeable message signs (PCMS) on US 101, one northbound and one southbound, prior to the US 101 and State Route 1 interchange. A semi-permanent sign is a portable sign that has a concrete pad with fixed power and communications for the sign. This would allow the portable sign to always be placed at this location. These would be joint-use PCMS, therefore Caltrans District 4 would display messages according to their protocols and these would take priority over GGNRA messages according to FHWA standards. However, when Caltrans is not using the PCMS, the park and Caltrans will use these to provide advanced information to assist visitors' trip planning and decision-making. The messages that would benefit both Caltrans and the park include information on incidents, congestion, and evacuation. Both agencies would also benefit by using the PCMS to display messages such as Route 1 congestion and parking availability at Stinson Beach and Muir Woods. Operational guidelines can be created in a separate task agreement but it is recommended that Caltrans have responsibility over the signs' operation and that the park coordinate with Caltrans when a park-specific message is needed.

2.5. Anticipated Benefits

2.5.1. Caltrans District 4

Improved partnership with park may help in other transportation initiatives (transportation planning, regional air quality monitoring, etc.)

Improved coordination between agencies will assist in decreasing congestion on Route 1.

2.5.2. Golden Gate National Recreation Area

Increased utilization of PCMS may improve public perception of benefits of signs

Provide accurate, helpful information to visitors earlier that will help them choose an enjoyable visitor park experience

May reduce frustration of visitors, which would improve their experience, and may result in increased time enjoying a park site

Allow visitors to be more successful in their trip planning and may eventually improve travel times to park sites

2.5.3. Visitors

The benefits would depend on how GGNRA and Caltrans would use the PCMS. Table 1 lists some possible PCMS uses and the benefits that might be related.

Table 1: Potential Benefits of Shared-use CMS.

Example Use	Sample Message	Benefits
Warn of potential congestion at Muir Woods entrance	"PARK VISITORS / EXPECT QUEUES / AT ENTRANCE"	• Reduce potential incidents at entrance gate • Improve visitor satisfaction (better information) • Improve visitor/pedestrian safety
Inform visitors of shuttle alternatives	"MUIR WOODS / SHUTTLE / EXIT X"	• Enhance visitor convenience (less time)
Inform visitors of full parking lot	"PARKING LOT FULL / AT STINSON BEACH/ USE ALT PARKING/ AND SHUTTLE"	• Improve visitor satisfaction (better information)

2.6. Aesthetic Concerns

For aesthetic reasons, a permanent CMS deployed within Great Smoky Mountains National Park was encased in timbers and uses white lights rather than amber for displays, see Figure 2. As the PCMS under discussion for GGNRA will be used on Caltrans right-of-way (i.e. outside of park land), the aesthetics of this sign are not as big a priority. It should also be noted that Caltrans no longer specifies the typical orange sign due to the amount of lead in the paint and therefore the PCMS will be a more aesthetically pleasing white color.

Figure 2: Timber Framed CMS

Source: Great Smoky Mountain National Park

2.7. Information Amount and Uses

Most PCMS are three lines of eight characters (i.e. this equals one frame or phase). The PCMS should be visible from half a mile under both day and night conditions and the entire message should be readable at least twice at the posted speed limit. A message should be no longer than two phases or frames. With a two phase or frame message, the message should be a total of eight seconds or four second for each phase or frame (2). Therefore the amount of information that can be put on the PCMS is limited to 48 letters or characters.

According to Dudek, the types of applications that a PCMS can be used for include ():

- "Traffic management and diversion for the following events:
  - Incidents (e.g. crashes, stalled vehicles, vehicle fires, hazardous material spills)
  - Work zones
  - Special high volume traffic (e.g. weekend holiday traffic, recreational traffic)
  - Current special events (e.g. sport events, parades, state fairs, bicycle races)
  - Adverse road and weather conditions
  - Evacuations during major catastrophes (e.g. hurricanes, terrorist attacks)
- Warning of adverse conditions:
  - Adverse weather and environmental conditions (e.g. fog, rain, snow, dust, wind, smog)
  - Adverse road conditions (e.g. ice, snow, high water)
- Control at crossings:
  - Bridge control
  - Tunnel control
  - Mountain-pass control
  - International border crossing control
  - Highway/railroad crossing control
  - Highway/light rail transit crossing control
- Special-use lane and roadway control:
  - High occupancy vehicle lanes
  - Contra-flow lanes
  - Exclusive lanes
  - Reversible lanes
  - Mixed flow managed lanes
- Special applications:
  - Advance parking systems
  - Advance notice of events that may impact traffic operations (e.g. upcoming work zones, special events, etc)
  - Travel time information
  - AMBER (America's Missing: Broadcast Emergency Response) alert
  - Homeland security
  - Inter-modal information
  - Truck restrictions
  - Hazardous cargo
  - Support of highway advisory radio"

Current CMS uses in national parks include a PCMS within and operated by Great Smoky Mountain (GSM) National Park (three lines of twelve characters), and Caltrans allowance of national park messages to be displayed on their permanent CMS outside of Yosemite National Park and Sequoia and Kings Canyon (SEKI) National Parks. The messages that are currently used in these parks are shown in Table 2.

Table 2: Current National Park CMS Messages

Message[2]	Park
ACCIDENT / AHEAD 4 MILES / USE CAUTION	GSM (3)
BE PREPARED / TO STOP / AHEAD	GSM[3]
LITTLE RIVER / ROAD / CLOSED	GSM
CADES COVE / LOOP ROAD / CLOSED	GSM
ROAD / WORK / AHEAD	GSM
ONE LANE / CLOSURES / AHEAD	GSM
EXPECT / DELAYS	GSM
MOWERS / AHEAD / USE CAUTION	GSM
USE / CAUTION / AHEAD	GSM
YOSEMITE / ACCESS / LIMITED // DUE TO / OVER / CROWDING	Yosemite (4)
YOSEMITE / PARK / CLOSED // DUE / TO/ FLOODING	Yosemite
YOSEMITE / PARK / CLOSED // DUE TO / FOREST / FIRE	Yosemite
CONGESTED / TRAFFIC // X MILES / AHEAD / EXPECT DELAYS	SEKI (5)
CHAINS / REQUIRED / AHEAD	SEKI
CONGESTED / TRAFFIC / AHEAD // PREPARE / TO / STOP	SEKI
EXPECT / SLOW TRAFFIC / AHEAD	SEKI
ICY / ROAD / AHEAD // DRIVE / WITH / CAUTION	SEKI
ROADWORK AHEAD / EXPECT / DELAYS	SEKI
ROADWORK AHEAD / EXPECT / SLOW TRAFFIC	SEKI
ROADWORK / AHEAD // LEFT / LANE / CLOSED	SEKI
ROADWORK / AHEAD // RIGHT / LANE / CLOSED	SEKI
SLIPPERY / ROAD / AHEAD // DRIVE / WITH / CAUTION	SEKI
SLOW / TRAFFIC / AHEAD	SEKI
TRAFFIC / SUBJECT / TO DELAYS	SEKI
HEAVY TRAFFIC / IN / SEQUOIA PARK	SEKI
HEAVY TRAFFIC / IN / KINGS CANYON PARK	SEKI
CHAINS REQUIRED / FOR / PARK ENTRANCE	SEKI
EXPECT DELAYS / AT / PARK ENTRANCE	SEKI

2.8. Estimated Costs

2.8.1. Installation

Either a stand-alone portable changeable message sign or a semi-permanent changeable message sign is affordable. The average cost of a PCMS is about $23,500, with $1,600 annual operations

[2] / indicates a new line in the CMS message and // indicates a new phase or frame in the CMS message

[3] Great Smoky Mountains also has snow closure messages; however, we do not have the exact message and therefore they are not included in this list.

and maintenance costs (6). The approximate cost of a PCMS following Caltrans specifications is between $23,000 and $27,000 per PCMS. An extended maintenance/warranty contract (more than one year) is between $500 and $1,000 per sign per year. The cost to rent a PCMS in California is approximately $750 per week or $2,250 per month. The installation and site development cost for a semi-permanent CMS is anywhere from $500 to $1,000 assuming that cellular communications and solar power will be used (7).

Therefore, a purchased stand alone PCMS would cost approximately $23,500-28,000. The cost to purchase a semi-permanent PCMS would cost approximately $24,000-29,000. The cost to rent a PCMS is approximately $2,250 per month.

The estimated cost for putting together an operational protocol document to accompany the PCMS is $5,000. This would include facilitating meetings with key stakeholders, developing messages sets, and producing, circulating and revising agreements. The operational document would outline acceptable messages, how conditions at the park will be monitored, and what the criteria would be for contacting Caltrans TMC with a message request.

2.8.2. Operations and Maintenance

No operations and maintenance costs would be anticipated over the duration of Phase 2. Operations (i.e. staffing, utilities, communications) and maintenance (i.e. preventative and repair) costs of the signs would be borne by Caltrans District 4.

2.9. Schedule

See Table 3.

Table 3: Schedule for Shared-use PCMS.

Date	Tasks
Start	• Project kickoff
2 months after start	• Stakeholder discussions • Complete tentative agreements
3 months after start	• Develop message sets • Finalize agreements; start shared-use • Write RFP for CMS purchase
5 months after start	• Purchase and Install CMS

2.10. Measures of Effectiveness

Some potential measures to consider:

- Number of uses of PCMS by park versus Caltrans

- Visitor surveys – Do visitors notice information on PCMS? Do the PCMS help visitors in planning their trip to the park? Did visitors adjust their travel as a result of a PCMS message? Do visitors believe PCMS messages are accurate and current?

- Road volume counts and Level of Service (LOS) at intersections to determine counts on Route 1 during non-PCMS versus PCMS seasonal use.

- Stakeholder surveys – Do the agreements limit perceived value of PCMS to Caltrans District 4? Does the park use the PCMS? Do other public agencies see value? Do they request use?

- Accident reduction benefits for this project would be difficult if not impossible to demonstrate

- Benefits from information about road closures would depend on the number and nature of road closures, so may not provide much comparability

2.11. Estimated Cost/benefit or Cost-effectiveness

2.11.1. Cost-benefit

The question with a cost-benefit analysis is the relative value of benefits from the project to the cost associated. A favorable cost-benefit ratio does not establish this project as the best project, but it simply conveys that funding invested in the project would yield more than equivalent value in return.

Optimally, the primary benefit of this project would relate to decreases in congestion along Route 1 and improved visitor experience at park sites; however, the benefit of visitor satisfaction is difficult to quantify in economic terms. Does it mean additional visits to the park in the future? Does it mean additional spending on this visit to the park in the gateway communities? There may be benefits of reduced travel time to the park. For example, instead of finding out there was no parking after they had traveled all the way to Muir Woods from the interchange on US 101 and State Route 1, visitors could find out prior to the interchange and either head to a different park site or utilize an alternative shuttle during their present trip or in the future. It is unclear what the magnitude of these benefits would be; therefore, the cost-benefit would be difficult to calculate.

2.11.2. Cost-Effectiveness

Cost-effectiveness examines how efficiently or effectively this project provides the intended benefits relative to other solutions. Alternative methods for providing en-route visitor information include the following:

- **Addition of portable highway advisory radio (HAR) system at the same location.** The average installation cost of a park-grade HAR system is around $10,000, with $500 annual operations and maintenance cost. A radio system has the advantage that it can

provide more information than a PCMS. However, studies have shown that drivers show greater awareness of PCMS than HAR (8, 9). This may be due to PCMS being seen by everyone driving by and HAR requiring the motorist to tune in to the radio station. It may also be due to some HAR having poor broadcasting quality, decreasing driver willingness to try again. The survey completed in GGNRA also showed that visitors were more likely to use PCMS than HAR for obtaining information while en-route to the park (). An addition of a HAR system could complement a PCMS, but does not appear to be a suitable alternative to a PCMS.

- **Installation of a park-owned portable PCMS.** Rather than having portable or semi-permanent signs that are owned and operated by Caltrans, the PCMS could be owned and operated by the park. This option would still allow for shared-use PCMS, but would give the park more control over the sign messaging as well as a greater partnership with Caltrans and Marin County in attempting to alleviate congestion. It may require the park to relocate the PCMS as needed. Usage of right-of-way would require, at a minimum, a permitting agreement with Caltrans. The average cost of the PCMS would remain the same as previously discussed, but the PCMS would have greater flexibility regarding the location at which information is provided rather than the semi-permanent version. However, there may be issues with electricity and communications, as well as the PCMS needing to be transported from the site to the park, rather than left in place when semi-permanent.

2.12. Outstanding Issues (Technical, Operational, Maintenance)

2.12.1. Technical

There may be electrical or communications issues in this area. This would need to be discussed with Caltrans District 4, and should be part of a separate task agreement.

2.12.2. Operational

As the roadway that the PCMS would be installed on is owned and operated by Caltrans District 4, and there are benefits to the state to assist with traveler dissemination, their support is essential for success. Caltrans and GGNRA would jointly determine operational duties including storage of the sign during the off-season.

2.12.3. Maintenance

The shared-use PCMS agreement would need some maintenance over time, to ensure that it is consistent with Caltrans priorities and purposes and meets park needs. The maintenance and operational costs for the PCMS would need to be worked out between Caltrans District 4 and GGNRA.

2.13. Strengths and Weaknesses

2.13.1. Strengths

- This project could have positive public value with the local community.
- This project could provide significant advanced traveler information to visitors.
- The agreements could provide models transferable to other national parks.
- The agreements could provide models transferable to other Caltrans districts in California.
- The project would introduce new technology to park staff.
- The project would be relatively easy to implement and evaluate.

2.13.2. Weaknesses

- This project is a high-cost target of opportunity.
- It may be more beneficial for this area to have a permanent CMS, due to the high volume of traffic, congestion, and vehicle speeds on Route 1.
- Institutional issues regarding conflicting message priorities between stakeholders could be difficult to resolve.
- It will be difficult to quantify benefits on this project.
- It is unknown how visitors will react to the sign.

3. PARK-WIDE RADIO SYSTEM

3.1. Project Description

This project would look to install a park-wide radio system with potential locations to include Doyle Drive, Fort Mason, the Presidio, Lands End, US 101 at the north end of the Golden Gate Bridge to cover Fort Baker and the Marin Headlands, US 101 at the interchange of US 101 and State Route 1, Muir Woods, Mount Tamalpais State Park, and Stinson Beach. This would improve the en-route traveler information. This system could provide automated recording capabilities, which can provide more detailed, real-time information while reducing staffing requirements, and provide real-time indications to motorists of when information is available. This type of system would not limit the park due to other agencies' restrictions. The park would be able to use this system whenever it is needed, put any message they deem necessary on the system, and provide significantly more information than can be conveyed on a CMS[4].

3.2. Relationship to Phase 1

3.2.1. Problems

Roadway Congestion. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Limited Parking. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Coordination and Information. The dispersed lands associated with GGNRA may make it difficult for a visitor to access park lands without an automobile. The variety of transit services in the Bay Area, plus numerous other cultural, educational and recreational attractions in the area, provide an opportunity for coordinating transit service to improve the level of service and access to GGNRA lands. There is a need to improve information about transit service at park sites as well, to inform travelers of available transit options, their schedules, and their estimated arrival times.

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Work Zone/Event Coordination. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Emergency Response. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

[4] There is currently a highway advisory radio set-up on Mt. Tamalpais that is operated by the Marin County Office of Emergency Services. At this time, there is no joint use of this radio by GGNRA. There are also two Caltrans owned highway advisory radios on Highway 101, north Conte Madera and south of the Golden Gate Bridge.

3.2.2. Objectives

1.1.2 Provide visitors with appropriate information at major transportation decision points

1.1.3 Provide information to help visitors avoid congestion locations and times

1.1.4 Provide weather, road condition, and chain requirement information to visitors

1.1.5 Provide construction and work zone information to visitors

1.1.6 Provide information on parking availability to visitors

1.2.1 Improve the safety of vehicles at or approaching congested entrance stations

1.2.2 Improve the safety of vehicle travel on park roadways

1.2.4 Improve the safety of pedestrians approaching popular destinations

2.1.3 Promote information about non-automobile alternatives

3.2.3. Themes

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

3.3. Stakeholders

- Caltrans District 4
- Federal Communications Commission
- National Park Service Pacific West Regional Office
- Golden Gate National Recreation Area
- Marin County Office of Emergency Services
- California State Parks
- Marin County Department of Public Works and Planning
- Marin County communities

3.4. Draft Operational Concept

3.4.1. Concept

The first step in this process is to determine where the radio transmitters should be placed in order to reach the greatest number of visitors. As a first draft, it is recommended that transmitters be placed at Fort Mason, the Presidio, Lands End, US 101 after the Golden Gate Bridge to cover Fort Baker and the Marin Headlands, US 101 at the interchange of US 101 and State 1, Muir Woods, and Stinson Beach.

Transmitters, power, communications and static signs with flashing beacons (to alert visitors when a message is being broadcast) will then be deployed in these areas. The sign will read "Visitor Information / Tune to [1610/530] AM / When Flashing." The lights will be automatically activated whenever any message is placed on the HAR, and will be de-activated when the message is turned off. An alternative is to not install a flashing beacon and to have the system always broadcasting a message.

Two recording options would be available in this system. One option would have park staff record the message in their own voice, and have it transmitted onto the HAR. A second option would be to have park staff type the message, and voice annunciation software convert the text message into an audio recording suitable for broadcast.

An option to make messages consistent would be to have a real-time park database that would provide a wide variety of information that may be of note to visitors. Software could be developed that would select the most important information types for the given season (e.g. visibility), day of the week (e.g. construction information on weekdays, congestion information on weekends), and related to current conditions (e.g. road closures). The software could have a variety of standard message sets that could be combined with each other to form the overall broadcast message. This could then be used with either recording option. Park staff could be provided with this information to manually record it, although from an efficiency perspective it would be better to have this information posted automatically using voice annunciation software.

An operations guide should be adopted to provide guidance for the use of new technology. This guide would clearly spell out who is responsible for keeping messages current, what type of content should be recorded, when content should be updated, and similar questions. Certain types of information, such as road closures in the park, that are important enough to broadcast on all stations should be communicated through park staff via two-way radios or telephones; messages are then updated by the ranger responsible for each HAR location. Each message should also include a time stamp so visitors know when it was last updated.

3.5. Anticipated Benefits

3.5.1. Caltrans District 4

Many of these HAR would be located on Caltrans right-of-way (ROW) and therefore could be used to give general transportation information as well as park specific information and benefit Caltrans as well.

3.5.2. Golden Gate National Recreation Area

Provide better information to visitors earlier.

Helps promote lesser known park sites.

May reduce frustration of visitors, which would enhance visitor experience.

Enhance efficiency of staff utilization.

Reduce visitors' travel time by informing them of parking situations before they arrive at the site.

Possible increase in usage of transit and parking intercept sites (when implemented) due to more information provided to the visitors.

3.5.3. Visitors

Receive improved real-time information and more options.

3.6. Aesthetic Concerns

Highway advisory radio are commonly used in National Parks and therefore the aesthetics are not a huge concern.

Figure 3: Sequoia and Kings Canyon National Park Highway Advisory Radio Sign

3.7. Information Amount and Uses

Highway advisory radio messages are generally short enough for motorists to hear them twice, are played continuously, and are typically one minute long (10).

HAR location is restricted to, "the immediate vicinity of air, train, and bus transportation terminals, public parks and historical sites, bridges, tunnels, and any intersection of a Federal Interstate Highway with any other Interstate, Federal, State, or local highway." As mentioned in the FHWA guide, typical applications for HAR use include maintenance/construction zones, traffic advisories (e.g. accidents, lane blockages, etc), route diversion, special events (including parking control), weather advisory and visitor information (e.g. gas, food, and lodging) ().

Examples of current highway advisory radio uses can be seen in Table 4 for Yosemite National Park and Table 5, Table 6, Table 7, and Table 8 for Yellowstone National Park.

Table 4: Yosemite National Park Highway Advisory Radio Messages

MsgContent
ALL ROADS OPEN AND CLEAR-ALL HAR LOCATIONS->At this time, all roads to and from Yosemite Valley are open and clear. Lodging and camping opportunities within the Yosemite National Park may be limited , please confirm availability before entering the Park.
CAMPGROUNDS FULL IN VALLEY-MARIPOSA HAR->Campgrounds in Yosemite Valley are full. Other campgrounds within Yosemite National Park are normally full by noon. Lodging may be limited, please confirm
CAMPGROUNDS FULL IN VALLEY-ALL HAR LOCATIONS->Campgrounds in Yosemite Valley are full. Other campgrounds within Yosemite National Park are normally full by noon. Lodging may be limited, please confirm
LODGING FULL IN YOSEMITE VALLEY-MARIPOSA HAR->Lodging within the Park is full; please make other arrangements. Lodging and dining facilities are available in Mariposa, El Portal and Merced. If you do not have reservations in Yosemite, consider parking your car and riding the bus. Scheduled bus service is available
LODGING FULL IN YOSEMITE VALLEY-CHINESE CAMP HAR->Lodging within the Park is full; please make other arrangements. Lodging and dining facilities are available in Groveland, Coulterville, Jamestown ,and
LODGING FULL IN YOSEMITE VALLEY-OAKHURST HAR->Lodging within the Park is full; please make other arrangements. Lodging and dining facilities are available in Madera, Oakhurst, Bass Lake and Fish Camp.
LODGING FULL IN YOSEMITE VALLEY-LEE VINING HAR->Lodging within the Park is full; please make other arrangements. Lodging and dining facilities are available in Lee Vining, June Lake, Bridgeport, and Mammoth
140 OPEN-MARIPOSA HAR->Highway 140 to Yosemite Park is open.
120 OPEN-CHINESE CAMP HAR->Highway 120 to Yosemite Park is open.
41 OPEN-OAKHURST HAR->Highway 41 to Yosemite Park is open.
140 CLOSED-MARIPOSA HAR->Highway 140 to Yosemite Park is closed due to weather related road problems, call 209-372-0200 for updated information or check with the Mariposa Visitor Center.
120 CLOSED-CHINESE CAMP HAR ->Highway 120 to Yosemite Park is closed due to weather related road problems, call 209-372-0200 for updated information.
41 CLOSED-OAKHURST HAR->Highway 41 to Yosemite Park is closed due to weather related road problems, call 209-372-0200 for updated information or check with the Southern Yosemite Visitor's Bureau in Oakhurst.
140 CHAINS-MARIPOSA HAR->Chains are required on highway 140 near the Yosemite Park entrance.
120 CHAINS-CHINESE CAMP HAR->Chains are required on highway 120 near the Yosemite Park entrance.
41 CHAINS-OAKHURST HAR->Chains are required on highway 41 near the Yosemite Park entrance.
MARIPOSA GROVE RESTRICTION-ALL HAR LOCATIONS->Access to the Mariposa Grove of Giant Sequoias within Yosemite is restricted due to traffic congestion. Entry to the Grove is limited to free shuttle service from
YOSEMITE VALLEY RESTRICTED-ALL HAR LOCATIONS->Due to temporary heavy traffic congestion in the east end of Yosemite Valley, vehicles are being diverted to other Park locations. Some delays may be
PENDING YOSEMITE VALLEY RESTRICTION-ALL HAR LOCATIONS->Due to temporary heavy traffic congestion in the east end of Yosemite Valley, vehicles may be diverted to other Park locations. Some delays
CLOSING MESSAGE-MARIPOSA HAR->For more information stop at the Mariposa Tourist Information Center at the intersection of highway 140 North, highway 49 North, and Jones Street and access the Yosemite Area Traveler Information Kiosk. The phone number is 209-966-2456. This message will be updated as conditions
CLOSING MESSAGE-CHINESE CAMP HAR->For more information please call 1-800-446-1333. This message will be updated as conditions change.
CLOSING MESSAGE-OAKHURST HAR->For more information please call 209-683-4636 or stop at the Southern Yosemite Visitors Bureau on highway 41in Oakhurst and access the Yosemite Traveler Information Kiosk. This message will be updated as conditions change.
CLOSING MESSAGE-LEE VINING HAR->For more information stop at the Lee Vining Visitor Center and access the Yosemite Traveler Information Kiosk. This message will be updated as conditions change.
CARRY CHAINS-ALL HAR LOCATIONS->All vehicles are required to carry chains.
COMMERCIAL TRUCKING-ALL LOCATIONS->Commercial Trucking is prohibited on all routes through
TRAVELERS WISHING TO TRY A NEW VOLUNTARY TRANSIT OPTION IN THE MARIPOSA, MERCED, AND MONO COUNTY REGION CAN CHOOSE TO RIDE THE YOSEMITE AREA REGIONAL TRANSPORTATION SYSTEM. SERVICE BETWEEN LOCAL COMMUNITITES AND YOSEMITE NATIONAL PARK DAILY. WINTER
IF YOU PLAN TO LEAVE YOSEMITE PARK ON HWY 140 DUE TO ONGOING ROAD CONSTRUCTION THE ROAD WILL BE OPEN FROM 6:30 AM TO 10:30 PM DAILY INCLUDING WEEKENDS W/1 HOUR DELAY POSSIBLE DUR TO CONSTRUCTION ACTIVITES. THE ROAD WILL CLOSED NIGHTLY FROM 10:30 PM TO
YOSEMITE NATIONAL PARK HAS ISSUED A HIGH WIND WARNING FOR THE YOSEMITE VALLEY HIGH PROFILE VEHICLES SUCH AS CAMPERS AND MOTOTHOMES DRIVE WITH CAUTION

Table 5: Yellowstone National Park Spring 2002 HAR Message

Entrance Station Radio Message – All Entrances – Spring 2001

Welcome to Yellowstone National Park. The $20 entrance fee you will be charged admits you to both Yellowstone and Grand Teton National Parks for 7 days. If you already have an entrance receipt, please have it ready to show so you can get in without being charged again.

Ask entrance station personnel about other types of passes available for U.S. citizens 62 years of age and older, and for visitors with disabilities. You may also purchase annual entrance passes for Yellowstone and Grand Teton National Parks as well as the Golden Eagle Passport, which can be used nationwide.

You will be given a free copy of the official park newspaper. Please read it as soon as possible. It will help you plan your Yellowstone visit and contains important safety information. It is especially important for you to know what is open in the park at the time of your visit. Throughout the months of April and May, Yellowstone' s roads and facilities begin opening for the main summer season; typically, only a few basic services and facilities are open during much of the spring season. Opening dates are included in the park newspaper.

Roads will open according to the following schedule, weather permitting: the road from Mammoth Hot Springs to Madison to Old Faithful and the West Entrance to Old Faithful opens April 19; Norris to Canyon opens April 26; Canyon to Lake to East Entrance, and Tower Junction to Tower Fall opens May 3; Old Faithful to South Entrance and Lake to West Thumb opens May 10. The road between Canyon and Tower Fall may open on Memorial Holiday weekend, weather permitting. Finally, Beartooth Highway, beyond the park' s Northeast Entrance, opens Memorial Holiday weekend, weather permitting.

Construction may cause delays on the road between Madison Junction and Norris beginning in late May. Check the park newspaper for detailed information.

The fishing season in Yellowstone National Park begins on some park waters on the Saturday of Memorial Day weekend. Fishing in Yellowstone requires a permit, which may

Table 6: Yellowstone National Park Summer 2002 HAR Message

Entrance Station Radio Message – All Entrances – Summer 2002

Welcome to Yellowstone National Park. The $20 entrance fee you will be charged admits you to both Yellowstone and Grand Teton National Parks for 7 days. If you already have an entrance receipt, please have it ready to show so you can get in without being charged again.

Ask entrance station personnel about other types of passes available for U.S. citizens 62 years of age and older, and for visitors with disabilities. You may also purchase annual entrance passes for Yellowstone and Grand Teton National Parks as well as the the National Parks Pass and the Golden Eagle Pass, both of which can be used nationwide.

You will be given a free copy of the park newspaper. Please read it as soon as possible. It will help you plan your Yellowstone visit, contains important safety information, and features a schedule of ranger-led activities and programs. Over 3 million visitors travel through Yellowstone each year, mostly during the summer months. Campgrounds and lodging fill early, so stop at a visitor center, ranger station, or hotel or lodge office to find out more about overnight accommodations. Camping is allowed only in established campgrounds. It is illegal to camp in roadside pullouts, picnic areas, or parking lots, and there is no overflow camping area in the park.

Park roads are undergoing construction in several locations this summer. The road between Madison Junction and Norris Junction will be closed between the hours of 9:00pm and 9:00am. At other times, delays of up to 30 minutes or more may be possible. However, during the period surrounding the July 4th holiday, from 9:00 am July 2 to 9:00pm July 5, the road with be open, but delays are possible. Check the park newspaper for details and to locate this road on the map.

Table 7: Yellowstone National Park Fall 2002 HAR Message

Autumn 2002: Entrance Station 1610 Message

Welcome to Yellowstone National Park at a beautiful time of the year. This message contains vital trip planning information. In addition, please consult the park newspaper you receive at the entrance station as soon as possible for more details.

The $20.00 fee you pay as you enter buys a permit good for 7 days in both Yellowstone and Grand Teton National Parks. A range of fees for visitors travelling by means other than a private, noncommercial vehicle is explained at the entrance. A variety of annual passes are also available. For more information, check your newspaper, ask at the entrance, or inquire at visitor centers.

The road between Norris Junction and Madison Junction is undergoing major reconstruction. From September 3 through November 3, this road will be open from 6:00 am to 10:00 am and 6:00 pm to 10:00 pm *weekdays*, but closed to travel during other hours. On *weekends* this road will be open from 6:00 pm Friday to 10:00 am Monday, with 30 minute delays possible. Road construction may also cause delays of up to 30 minutes on Dunraven Pass between Canyon Village and Tower Junction, and in Hayden Valley between Canyon Village and Fishing Bridge Junction. Please note that Dunraven Pass closes for the season on Tuesday, October 15.

Snow storms may also cause temporary road restrictions or closures during the autumn months. Please check at visitor centers for current information.

All roads in Yellowstone close for the season at 8:00 am on Monday, November 4 except for the North Entrance to Cooke City road, which is the only road in the park open year round to automobile travel. If you are not familiar with Yellowstone's roads, please consult the map on the back of the park newspaper to verify locations and change your travel route, if necessary.

Lodging, camping, restaurant and other types of services and facilities are available on a limited basis this time of year. Page eleven of the newspaper contains a complete listing of closing dates for all services and facilities inside the park. Camping is permitted only in open campgrounds. It is illegal to camp in roadside pullouts, picnic areas, or parking lots.

Fishing in Yellowstone National Park requires a permit, which may be purchased at visitor centers and ranger stations. Fishing permits cost $10.00 for a ten day permit and $20.00 for a season permit. Anglers 12 to 15 years of age are required to possess a nonfee permit, and children 11 years and under may fish without a permit. You will receive a copy of park fishing regulations when you obtain your permit.

Yellowstone's world famous natural grandeur is fascinating to explore. Here, you meet nature on its terms, not yours. Wildlife are among the most famous of Yellowstone's wonders, but be aware that they are not tame! If an animal feels threatened because you get too close, it can easily injure you. Keep your distance around any of Yellowstone's animals, especially elk, bison, and bears.

Please stay on constructed walkways in the park's geyser basins. The ground can be thin and fragile – and right below may be boiling water!

A special note to hunters: Hunting is prohibited in Yellowstone National Park. All firearms must be cased and broken down before entering the park. In addition, park campgrounds may not be used as hunting base camps. Game taken legally outside the park may be transported through Yellowstone as long as the carcasses are covered. A permit for this must be obtained as you enter the park.

If you have an emergency, dial 911 from any telephone in Yellowstone.

If you missed part of this message, stay tuned. It will repeat.

Enjoy your visit to Yellowstone -- since 1872, part of our national heritage.

(KOF _____)

Table 8: Yellowstone National Park Winter 2002-2003 HAR Message

Winter 2002-2003: Entrance Station 1610 Message

Welcome to Yellowstone National Park. This message contains essential trip planning information. In addition, please consult the park newspaper which you receive at the entrance station as soon as possible for detailed information. You might also stop at the Albright Visitor Center, located 5 miles ahead at Mammoth Hot Springs, which is open 9:00 am to 5:00 pm daily.

The $20.00 fee you pay as you enter buys a permit good for 7 days in both Yellowstone and Grand Teton National Parks. A range of fees for visitors travelling by means other than a private, noncommercial vehicle is explained at the entrance. A variety of annual passes are also available. For more information, check your newspaper, ask at the entrance, or inquire at the visitor center.

Yellowstone's winter season runs from December 18 to mid-March. The only road open for year-round automobile travel extends 60 miles from Gardiner, Montana at Yellowstone's North Entrance, to just beyond the Northeast Entrance where it ends at the town of Cooke City, Montana. You must return to Gardiner to drive back to Interstate 90 and destinations beyond.

All other park roads are closed to wheeled vehicles but groomed for snowmobile or snowcoach travel. Lodging and meals are available inside Yellowstone at Mammoth Hot Springs and Old Faithful. Snowmobile fuel may be purchased at Mammoth Hot Springs, Old Faithful, Canyon and Fishing Bridge. Please consult your park newspaper for specific dates of operation and for locations of other winter facilities and services.

Winter is a time of great stress for wildlife. Please keep your distance! Approaching animals too closely can force them to run through deep snow, spending energy critical to their survival. Throughout the park, boardwalks and trails may be snow covered and icy. Please use common sense and extra care near canyons, waterfalls, thermal areas and overlooks.

Detailed information about winter safety is available in the park newspaper and at visitor centers and warming huts throughout the park.

If you missed any part of this message, please stay tuned. It will repeat.

KOF _____

3.8. Estimated Costs

3.8.1. Installation

A new 10-watt park-type installation including processor, antenna, transmitters, battery back up, cabinet, rack mounting, lighting, mounts, connectors, cables, and license fee would cost about $65,000 per site ().

Frequency studies are recommended prior to installation; these studies help the park to identify appropriate frequencies that are available and that are acceptable for the park to use. Including permit processing with the appropriate Federal agency, these studies would cost about $500 per site (11). The approval process for the permit could take 30 to 180 day and the Federal Communications Commission (FCC) fee is waived since GGNRA is a government agency (12).

Location studies – to pinpoint a tower location once the general area at which information should be presented has been identified by park staff – would cost about $2,500 each ().

The cost of a static sign with a flashing beacon is approximately $5,000 per site ().

Developing an operations guide for the HAR towers would cost about $5,000.

Therefore, a total cost per site is $73,000. With the budget for this project, one site could be deployed and an operations guide could be created. The recommended site for early deployment would be Doyle Drive or the north end of the Golden Gate Bridge.

Portable highway advisory radio are also available. Rental of portable HAR cost $3000 per month and purchasing portable HAR cost $38,000 ().

3.8.2. Operations and Maintenance

Estimated annual operations and maintenance expenses for the system are $600-1,000 per site. Estimated annual operations and maintenance costs of a flashing beacon HAR sign are $250 (6).

3.9. Schedule

See Table 9.

Table 9: Schedule for Park-wide Radio System.

Date	Tasks
Start	• Project kickoff
1 month after start	• Stakeholder discussions regarding message information • Develop concept of operations for how tower system should work (e.g. who has access, centralized vs. decentralized control) • Start request-for-information from vendors
2 months after start	• Complete request-for-information from vendors • Develop requirements for new radio towers • Identify potential locations for new radio towers • Develop message requirements for phase 1 (no centralized database)
5 months after start	• Start request-for-proposals for new towers with a couple of location options • Start request-for-bids for contractors for installation of new towers • Start contracting for sign installation • Select radio system vendor
7 months after start	• Select contractor; start tower installation • Develop message requirements for phase 2 (includes centralized database) requirements
8 months after start	• Testing of system
9 months after start	• System activated

3.10. Measures of Effectiveness

- Number of messages recorded by park indicates increased traveler information
- The number of hours of broadcast messages indicates increased traveler information
- Visitor surveys – do they use HAR? do they consider information real-time? do they respond to information? does HAR change how visitors get information? does HAR enhance visitor satisfaction/experience? if implemented at Fort Mason, does HAR help reduce delay and better manage event traffic?
- Park staff surveys – do they like the system? do they perceive time savings, and if so, how much? did the HAR help with event management at Fort Mason? did the HAR help with congestion/parking at Muir Woods and Stinson Beach?
- Measures based on specific information provided (for example, less overflow parking with similar visitation levels, improved utilization of transit)

3.11. Estimated Cost/benefit or Cost-effectiveness

3.11.1. Cost-Benefit

The system's primary benefit would be to provide more and better real-time information to visitors in more locations in the park and surrounding communities. It is unclear how the economic benefit of enhancing the visitor experience could be measured. There would be calculable benefits in reduced staffing requirements and maintenance costs. However, there may be additional system cost associated with database / radio system management.

3.11.2. Cost-Effectiveness

In terms of providing expanded geographic coverage of en-route visitor information, the following are potential alternatives.

- **Addition of permanent CMS.** The cost of a new CMS is substantial – up to $200,000 – and CMS are far more limited in the volume of content they can provide. However, as was described earlier, CMS tend to have greater motorist awareness than HAR.

- **Addition of portable CMS.** The cost of portable CMS is comparable to the cost of a new HAR installation. They have the benefit of location flexibility – a portable CMS can be moved to different locations depending upon current information needs. However, a portable CMS is very limited in terms of the amount of content that can be provided. Moreover, there may be limits on where they can be deployed based on power, communications and aesthetic considerations.

- **Use of portable HAR.** Highway advisory radio may also be deployed using portable installations. This offers a potential alternative to a permanent HAR, provided that portable stations can be integrated just as easily into the overall system. There are no special permitting requirements, and the range is reported to be comparable to permanent HAR. However, there is no special advantage to portable HAR unless the park anticipates regularly moving these systems (for example, a system could be devoted exclusively to in-park road construction work). Portable HAR typically rely on analog cellular or digital wireless communications, and operate primarily on solar power. Although this type of system may be useful for GGNRA as it can be moved to where it is needed based on construction, event management, and congestion, portable HAR cost more than twice as much as a traditional park HAR deployment (13).

Either the purchase of two permanent HAR or one portable HAR would be beneficial to GGNRA.

3.12. Outstanding Issues

3.12.1. Technical

How easy will it be to establish locations to install towers? How easy will it be to install towers within park boundaries?

How easy will it be to establish a database?

Is it worth deploying only two of the seven potential locations?

How easy will it be to install towers outside of park boundaries, on Caltrans right-of-way? In many parts of the country the DOT is resistant to allowing HAR signage or HAR towers within its right-of-way.

3.12.2. Operational

It is recommended that an operations and protocol guide be developed for each HAR, describing when messages should be provided, what types of messages are appropriate, how message content is to be collected, how message content should be developed, how frequently messages should be updated, who is responsible for updating messages, and similar questions. This will be especially critical as the park moves closer to real-time information, since apart from unified or automated messaging the potential exists for one tower's message to reflect less current information than the other.

Any HAR system could be operated by a current public agency (like Caltrans and Marin County), or piggy-backed off an existing system, optimally. This is standard procedure in other geographic locales.

Flashing beacons help to indicate that the radio system is actively broadcasting; however, there may be concern about how to install beacons in a park setting in an aesthetically acceptable manner.

Questions to resolve include:

- Will this system take more staff time then the perceived benefit as GGNRA does not currently have HAR?
- Would the transmitters be worthwhile if an automated recording system is deemed inappropriate for GGNRA?

3.12.3. Maintenance

GGNRA currently does not have a HAR system and therefore may not have someone capable of maintaining the system; nevertheless, maintenance of the systems should be minimal.

3.13. Strengths and Weaknesses

3.13.1. Strengths

- This would provide greater geographic coverage for park information, reaching more visitors with more detailed information, than would be possible using other information delivery methods.

- This would be the start to a system that could be expanded to cover significant portions of the park. By only deploying two systems at the beginning it would allow park staff to get used to the operations and maintenance of the system before deploying a park-wide system.

3.13.2. Weaknesses

- It may be difficult to build permanent tower infrastructure on park land, especially in a short time frame.

- System expansion, apart from automated capabilities, will require an investment of staff time to ensure message content is current.

- If messages are recorded manually, there will need to be some commitment of staff time to ensure that content is current. There would also need to be a commitment of staff to adhere to consistent operational policies.

- The efficiency benefits of this system will be marginal at best until automated messaging is fully implemented and accepted. This does not have to be completed, but should build upon other successful road condition HARs in California (e.g. Interstate 80). However, the current quality of automated messaging technology is probably not consistent with the intended park experience.

- The flashing beacon may be expensive to implement; conversely, without some indication that the broadcast information is current, there may be less usage of the radio system by visitors.

- The range on these systems, while predicted to be 3-5 miles, is not always reliable.

4. MUIR WOODS/STINSON BEACH CAMERAS

4.1. Project Description

The need for better information on parking and weather at both Stinson Beach and Muir Woods leads to the idea of installing remotely controlled (pan-tilt-zoom) closed circuit television (CCTV) cameras. Images from these cameras could be sent directly to the GGNRA webpage and Caltrans operation center and therefore would be accessible to all travelers and NPS and Caltrans staff.

4.2. Relationship to Phase 1

4.2.1. Problems

Limited Parking. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

4.2.2. Objectives

1.1.3 Provide information to help visitors avoid congestion locations and times

1.1.4 Provide weather, road condition, and chain requirement information to visitors

1.1.6 Provide information on parking availability to visitors

1.2.1 Improve the safety of vehicles at or approaching congested entrance stations

2.2.1 Reduce emissions of idling vehicles in parking areas

3.1.2 Monitor transportation operations and congested areas

3.4.1 Reduce congestion in and around parking areas

3.4.2 Reduce parking outside of designated parking areas

3.4.3 Improve management of existing parking facilities to optimize parking usage

4.2.3. Themes

Parking Management and Information. This ITS theme involves the fusion of real-time information about parking availability along with historical information about parking occupancy and turnover to estimate current and future parking availability at parking facilities throughout the park. Real-time information would be collected through automated systems that would

communicate the information to a central location. Parking availability information could be conveyed to visitors and other through travelers through a variety of means, including park rangers, visitor centers, kiosks, the Internet, and the regional 511 system. This information could also be communicated via changeable message signs to park and ride sites located away from the park, which could allow visitors to switch to transit.

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Major Emergency Response. This ITS theme would help park management and other public agencies to respond to catastrophic man-made or natural disasters. Its primary emphasis would be evacuation of visitors in a safe and efficient manner to ensure their safety while allowing emergency response activities to continue. This theme would also allow for communication between emergency responders and park police as needed to ensure a coordinated response between all regional parties.

4.3. Stakeholders

- Golden Gate National Recreation Area
- Caltrans District 4
- California Highway Patrol
- Marin County (including the Town of Stinson)
- California State Parks

4.4. Draft Operational Concept

Images collected from the web cameras would be posted on the GGNRA website and the regional Caltrans and ITS websites for use by both visitors and park staff alike. This will allow visitors in San Francisco to determine if the weather and parking situations at Stinson Beach and Muir Woods are worth driving out there. The images for park staff will allow them to know approximately how many parking spaces are left available at each site and allow them to distribute this information to visitors by other means.

The Stinson Beach camera could be positioned on State 1 on an overlook of the beach that would allow images to show part of the south parking lot and the weather on the beach. It is acceptable to only show the south lot because it is the last to fill-up, so when it is full no more parking is available. Park staff would control the camera, but Caltrans District 4 staff may use the camera on an exception basis. The addition of pan-tilt-zoom to this camera would allow the camera to be used for incident management and verification on State Route 1 by Caltrans District 4 staff. The multi-use nature of this camera provides additional incentive for Caltrans to support location of the camera on Caltrans ROW.

The Muir Woods camera can be positioned at the Annex Lot to show both local weather and parking availability. Similar to the south lot at Stinson, only the Annex Lot at Muir Woods needs to be shown because when it is full no more parking is available.

An alternate location for a camera is at the interchange of US Route 101 and State Highway 1. This camera could facilitate travelers' decision-making by identifying the extent of backup and congestion in a key access area for all parkland sites along State Route 1. Caltrans, GGNRA and Marin County would benefit from this real-time information.

4.5. Anticipated Benefits

4.5.1. Caltrans District 4

The camera could be used to improve incident response on State Route 1.

Anticipated changes in visitor trips during peak times will decrease congestion, improve level of service at intersections, and improve safety by reducing shoulder parking on State Highway 1.

4.5.2. Golden Gate National Recreation Area

The camera could help collect more accurate information on weather and parking at Stinson Beach and Muir Woods for dissemination over other means.

The camera could help to reduce delay and increase safety at the entrance gates and on roadways leading to Stinson Beach and Muir Woods.

The camera could help to reduce notification and response time for incidents on State Route 1.

Reductions in parking demand will improve resource protection.

4.5.3. Visitors

The camera could help to improve safety and travel times at entrance gates and roads leading to Muir Woods and Stinson Beach by providing visitors with real-time information.

The camera could provide better traveler information to visitors allowing them to make informed decisions prior to driving all the way to Stinson Beach and Muir Woods.

4.6. Aesthetic Concerns

There is an aesthetics concern with the cameras as in order to provide the range of vision needed the camera may need to be set on a very tall pole. Acadia National Park had similar aesthetic concerns when they installed a camera for parking lot monitoring. They were provided the choice of installing one tall pole and camera or several smaller poles and cameras. In the end, Acadia chose to install the tall pole and camera while specifying that the pole was more rustic looking (14) as shown in Figure 4.

Figure 4: Acadia National Park Camera Pole ()

Another aesthetic approach for the pole is to utilize the cellular communications approach which is to install concealed or stealth towers. There are several companies that specialize in wireless tower concealment. Concealment can be done through rooftops, flagpoles, bell towers, crosses, clock towers, road signs, silos, water towers, monopole towers, trees, and rocks. For the National Park purposes, the tree would be the optimal tower concealment (as shown in Figure 5) while the hollow rock would be optimal for communication equipment concealment (as shown in Figure 6). Note that these concealment options are more expensive than regular camera poles.

4.7. Estimated Costs

4.7.1. Installation

Caltrans Traffic Management Center Staff indicate that the cost of purchasing and installing a camera is approximately $80,000 (i.e. $30,000 for equipment and $50,000 for pole and installation) Note that the cost for a pole is using a standard camera pole and not a stealth pole (17).

4.7.2. Operations and Maintenance

Estimated operations and maintenance costs would be $3,800 per year per camera according to Caltrans District 4 records. Operations cost would consist of additional power and communications costs associated with the camera; these would need to be borne by the park. The most common maintenance need is preventative maintenance to clean the camera lens and inspect the cabling and cabinetry for corrosion. Problems may occur with communication between the camera and the operations center, depending upon the quality of power supply and environmental effects. Many solid-state devices, such as modems, routers and monitors, may be used in the image transmission and delivery process; these should need little maintenance.

4.8. Schedule

See Table 10.

Figure 5: Larson Camouflage Company Pine Tree in North Carolina (15 and 16)

Figure 6: Larson Camouflage Company Hollow Rock (and)

Table 10: Schedule for Muir Woods/Stinson Beach Cameras

Date	Tasks
Start	• Project kickoff • Identify power and communications availability at sites
1 month after start	• Identify who would control cameras and where images should go • Start request-for-information from vendors • Start obtaining agreements, permits to use ROW
3 months after start	• Complete request-for-information from vendors • Develop requirements for cameras • Start request-for-bids for contractors for purchase and installation of camera
5 months after start	• Evaluate request-for-bids and select contractor • Start camera installation • Develop test plan
7 months after start	• Complete camera installation • Testing of camera
8 months after start	• System activated

4.9. Measures of Effectiveness

Potential measures include:

- Reduced visitor delay at Stinson Beach and Muir Woods parking lot (average time savings, number of vehicles queued)
- Reductions in excess parking demand during peak periods
- Visitor surveys – Do visitors use the images on the Internet? Do the images help visitors in planning their trip to the park? Did visitors adjust their travel as a result of the camera image? Do visitors believe the camera images are accurate and current?
- Park staff surveys – how do they use the cameras images? do they hear anecdotal evidence of enhanced visitor satisfaction?
- Does Caltrans realize reductions in vehicle volumes and improvements in level of service on State Highways 101 and 1 during peak season?

4.10. Estimated Cost-Benefit and Cost-Effectiveness

4.10.1. Cost-Benefit

The primary benefit of this project would relate to both reductions in congestion on the roadway and improvements in visitor experience. The economic benefit of saved time and decreases in accidents between road shoulder and road traveler can be analyzed. However, the benefit of visitor satisfaction is difficult to quantify in economic terms. Does it mean additional visits to the park in the future? Does it mean additional spending on this visit to the park in the gateway communities? There may be benefits of reduced travel time to the park; for example, visitors can learn about weather at Stinson Beach before leaving and save time. The key question in estimating the economic benefit of this project is estimating value of time for recreational travel – the literature is unclear on this topic. It is unclear what the magnitude of these benefits would be; therefore, the cost-benefit would be difficult to calculate.

4.10.2. Cost-Effectiveness

This project is intended to improve traveler information about parking, congestion, and weather at Muir Woods, Stinson Beach, and the exit from US Route 101 onto State Route 1. Other alternatives that might be used are as follows.

- **Road Weather Information Systems (RWIS).** Instead of a camera that shows visitors the actual weather, an RWIS system could be used to collect data such as road surface conditions, wind speed, air temperature, visibility, precipitation accumulation, etc. The cost for this type of system would be approximately $25,000 per site (since the park would most likely want to include visibility sensors) with installation costing approximately $5,000 to 6,000 per site (18). Many DOTs have found, however, that the public is more favorable towards seeing the images on a camera instead of looking at raw weather data.

- **Parking Management System.** Rather than using a camera to determine approximate parking availability, a parking management system could be deployed that would give actual parking space numbers. An innovative low-cost system, using radio communications, pneumatic road tubes and battery power, has been deployed and tested at Gateway National Recreation Area by U.S. DOT Volpe National Transportation Systems Center. The cost for this system is $36,000 per location (19). This system was not wired into a permanent power infrastructure, and may have features incompatible with GGNRA.

- **Addition of highway advisory radio (HAR) system at the same location.** Instead of the camera images, the park could use HAR to convey information about parking and weather. The average installation cost of a park-grade HAR system is around $15,000, with $500 annual operations and maintenance cost. A radio system has the advantage that it can interpret how current conditions may impact the visitor's experience. However, HAR has lower utilization than other traveler information devices, while web cams are generally among the most popular features of a traveler information web page. There are

also significant concerns about how to provide current information on the HAR, especially as conditions change rapidly (for example, a parking lot filling up).

- **Installation of a park-owned portable CMS.** Instead of the camera images, the park could use CMS to convey information about parking and weather. A portable sign would permit the park to relocate the CMS as needed, based on parking availability and current weather. If the sign were located on Caltrans ROW, then this would require, at a minimum, a permitting agreement with Caltrans. The average cost of a portable CMS is about $23,500, with $1,600 annual operations and maintenance costs (). The portable CMS would have greater flexibility regarding the location at which information is provided than the semi-permanent. However, there may be issues with electricity and communications, as well as the CMS needing to be transported from the site to the park, rather than left in place when semi-permanent. There are also significant concerns about how to provide current information on the CMS, especially as conditions change rapidly (for example, a parking lot filling up).

It appears that the web camera represents the most cost-effective method of enhancing weather and parking traveler information and could also highlight the congestion at state highway intersections that provide park access (similar to how it is used in other locales).

4.11. Outstanding Issues

4.11.1. Technical

Can camera provide adequate resolution to be of use?

How effective would the camera location be during low-visibility weather (low clouds, fog, smog, etc.)?

Is there available power and communications for the cameras in the potential locations?

4.11.2. Operational

Planning the shared-use of these cameras with Caltrans District 4 to use them for incident verification as well as weather and parking information.

Creating a use agreement with the local television stations to allow them use of camera images. Caltrans probably has a draft that can be adjusted for park use.

Will the camera image be useful enough for parking information or would a parking management system be more beneficial?

Could cameras be located in an aesthetically acceptable way?

4.11.3. Maintenance

How will camera maintenance be performed? What time costs might be involved?

4.12. Strengths and Weaknesses

4.12.1. Strengths

- This is a low-cost target of opportunity that could help improve traveler information and reduce travel delay for visitors headed to Stinson Beach, Muir Woods, and along State Route 1.

- Web camera images of highways are very popular, and these would provide tangible benefits to visitors as well as the public agencies (Caltrans, NPS, CHP, etc) with jurisdictional responsibilities to address accidents and alleviate congestion. Consequently, this project may generate significant support for future ITS investment.

4.12.2. Weaknesses

- There is concern about the quality of images of pictures from a camera that is broadcasted several miles away at Stinson Beach. This is exacerbated by concerns about the level of possible visibility during foggy days.

- There is an aesthetics concern with the cameras. The rule of thumb is that the camera needs to be elevated one foot for every ten feet of sight distance. However, in order to provide the range of vision needed to cover the Annex Lot at Muir Woods, the camera may need to be set on a very tall pole.

5. NEXTBUS™/AVL FOR MUNI AND GGT

5.1. Project Description

Currently San Francisco Bay Area transit agencies are equipping their bus routes with automatic vehicle location systems (AVL) and the NextBus™ technology to track vehicles and provide real-time information about the arrival time of the next bus to transit users. The arrival time information will be displayed at the bus stop on changeable message signs, on the Internet, and on the 511 system. The two transit routes that serve GGNRA are scheduled to be in the last round of deployment of this system meaning that it could be two or more years before they are equipped with this system. This project would allow those two routes to be equipped within the next six months. This is beneficial because these routes have limited frequency of service, generally stopping at a bus stop once per hour. With AVL and NextBus™, transit users can determine whether or not they may have missed the bus or if it is running late. It is also a great technology because it lets people at the bus stop know how long they are going to need to wait and allows them to plan accordingly. For example, if it is raining they can go inside a store next door and get some coffee, and the system could tell them how many minutes they have before they need to return to the stop.

5.2. Relationship to Phase 1

5.2.1. Problems

Roadway Congestion. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Coordination and Information. See description under "Park-wide Radio System."

Limited Parking. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Planning Data. Data exists on visitation patterns for Marin national parklands, the Presidio and Alcatraz through the CTMP Headlands and water shuttle planning efforts. This data reveals point of origin, destination and trip combinations; however, it does not reveal specific neighborhoods and communities within counties. There is also a lack of data regarding visitor travel by non-motorized means, although there is limited ability to collect this data automatically.

5.2.2. Objectives

1.1.2 Provide visitors with appropriate information at major transportation decision points

1.1.3 Provide information to help visitors avoid congestion locations and times

1.1.6 Provide information on parking availability to visitors

1.1.7 Provide visitors with information at various park sites about transit arrivals and schedules

1.3.1 Improve access options for visitors without automobile access

1.3.2 Provide transit service that enables visitors to see attractions that may not have been possible because of unavailability of parking

1.4.1 Reduce the delay to visitors waiting in long lines at entrance stations

2.1.1 Increase usage of transit, pedestrian and bicycle modes for park access

2.1.2 Increase usage of alternative transportation systems within park

2.1.3 Promote information about non-automobile alternatives

3.5.1 Improve efficiency and level of service of transit operations within the park

3.5.2 Enhance the monitoring and coordination of various transit operations serving the park

5.2.3. Themes

Data Collection and Storage. ITS data may be collected and archived to serve a variety of planning purposes. For example, data on traffic volumes and speed may be stored along with weather information to develop correlations between weather conditions and traffic levels at various sites. Data on transit usage for routes serving the park may be useful in identifying trends in transit utilization that could result in improved transit service and efficiency. This theme would involve collecting and organizing all relevant data in a manner that is useful to local and regional National Park Service staff and others who would benefit from this information.

Parking Intercept. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Trip Planning. In conjunction with Bay Area transit agencies, this ITS theme would promote the coordination of transit schedule and vehicle location information to provide real-time information about transit service to various park sites. This feature would allow visitors to develop itineraries, and would allow visitors to factor in any special needs (e.g. bringing a bicycle) that may affect which services they can use. This would require transit providers to have accurate location information.

5.3. Stakeholders

- NextBus™
- San Francisco Municipal Rail (MUNI)

- Golden Gate Transit (GGT)
- Golden Gate National Recreation Area (GGNRA)
- Metropolitan Transportation Commission (MTC)
- Presidio Trust
- Private tour operators
- Caltrans District 4

5.4. Draft Operational Concept

This project would fund the early deployment of AVL and NextBus™ technology for MUNI Bus Route 76 and GGT Route 63. As deployment of this system is already under way on other MUNI routes, the only design decision that would need to be made is to decide which bus stops on these two routes should have changeable message signs displaying the information.

The integration of this information onto the transit websites and 511 should also go smoothly as it has been pilot tested with other city routes. The one other design requirement may be how to post this information on the GGNRA website.

Working together with these partners may leverage greatly needed improvements or expansions to these two bus routes.

5.5. Anticipated Benefits

5.5.1. Golden Gate National Recreation Area

Increase reliability of GGNRA's bus routes, possibly increasing ridership.

Providing real-time information for when to expect a crowd of people arriving on transit.

Providing better information for event management.

Reduce auto congestion at selected park sites.

5.5.2. Visitors

Increased awareness and reliability of the transit service to GGNRA.

Real-time information for making more informed decisions.

May reduce travel time and frustration of visitors.

5.6. Estimated Costs

5.6.1. Installation

The cost of purchasing and installing the MUNI Route 76 AVL systems would be $6,000 for the route, and $2,500 for each of the two buses that cover the route. The cost for installation of the changeable message sign is $2,500 per sign. The cost of purchasing and installing the GGT route 63 AVL systems would be $6,000 for the route and $2,500 for each of the four buses that cover this route. The cost for installation of the changeable message signs is $2,500 per sign (20).

The cost for both systems is $27,000 – $11,000 for MUNI Route 76 and $16,000 for GGT Route 63 – which does not include signs at $2,500 each and operations and maintenance costs. For discussion and planning purposes, a reasonable assumption would be that both MUNI Route 76 and GGT Route 63 would require signs at 4-6 stops each which would total 8-12 signs per route. Therefore, to outfit each route would likely cost an additional $20,000-30,000 each above the baseline costs listed above. So a fair total cost estimate for MUNI Route 76 would be $31,000-41,000 and for GGT Route 63 it would be $36,000-46,000. There may be additional cost requirements for integration of this information onto the GGNRA website.

5.6.2. Operations and Maintenance

Estimated operations and maintenance costs would be $70-90 per month per sign ongoing costs to NextBus™ for sign maintenance and operations and $70-90 per month per bus ongoing costs for bus tracking as the vendor does not provide the software to the customer. It is envisioned that this system, while benefiting GGNRA, would be turned over to MUNI and GGT and therefore they would be responsible for operations and maintenance costs.

5.7. Schedule

See Table 11.

Table 11: Schedule for NextBus™/AVL for MUNI and GGT

Date	Tasks
Start	• Project kickoff • Meet with partners who are already implementing the system
1 month after start	• Identify where the signs should be located
2 months after start	• Create requirements for integration on GGNRA website
3 months after start	• Procure system equipment (need lead time of 4-6 months depending on method of procurement) • Install system • Integrate with GGNRA website
9 months after start	• System activated

5.8. Measures of Effectiveness

- Increased ridership (number of transit users on route before and after implementation).
- Number of website hits on site with these two routes' information.
- Visitor surveys – Do they use the information on the Internet? Do they use the information at the bus stop? Does the information help them in planning their trip to the park? Did visitors adjust their travel as a result of the information? Do visitors believe the information is accurate and current? Are they more likely to ride transit now? Did having the correct information improve their visitor experience at the park? Do visitors believe it is better to have the information even though they may still have to wait on the bus?
- Increased visitation numbers by mode of arrival
- Staff survey

5.9. Estimated Cost-Benefit and Cost-Effectiveness

5.9.1. Cost-Benefit

The primary benefit of this project would relate to visitor experience; however, the benefit of visitor satisfaction is difficult to quantify in economic terms. Does it mean additional visits to the park in the future? Does it mean additional spending on this visit to the park in the gateway communities? The key question in estimating the economic benefit of this project is estimating value of time for recreational travel – it's not clear what the literature says about this. It is unclear what the magnitude of these benefits would be; therefore, the cost-benefit for this benefit would be difficult to calculate.

The other benefit would be increased ridership on the bus route. Part of this benefit could be measured by increased farebox revenue for these routes, although this may take a significant time to outweigh the cost. Another measurement of this benefit is reduced congestion on roadways and parking lots in the park based on increased ridership. This would also be hard to measure in the given time period for this study.

Also, there are environmental benefits, reduced burdens on staff, and the goodwill gained through agency partnerships.

5.9.2. Cost-Effectiveness

This project is intended to improve traveler information about transit in the GGNRA area. Other alternatives that might be used are as follows.

- **Collaboration with MTC to utilize the transit trip planner on the GGNRA website.** Rather than giving real-time information on the transit to the current users, GGNRA could try to market the system to non-users. As mentioned at the February 26, 2003 meeting for this project, approximately 40 people per trip are using these routes with only about 14 traveling to the park. By including the transit trip planner on the GGNRA website, this may better inform visitors that transit is an option for touring the park.

- **Improvements and expansion of the current routes.** Rather than improving the real-time information for the current routes, GGNRA could also help MUNI and GGT to expand and improve on the two current lines by adding more stops on the routes, making the route stop closer to Muir Woods, and increasing the frequency of the route (e.g. every 30 minutes instead of every hour). Although this would help both GGNRA and the visitors, the cost to do this is not a one-time cost. There would be significant operational costs to pay bus drivers, to potentially buy additional vehicles to accommodate more frequent service, and to redesign the bus route.

It appears that the AVL/NextBus^{TM} system along with collaborating with MTC to utilize the transit trip planner on the GGNRA website would be the most efficient and beneficial use of funds.

5.10. Outstanding Issues

5.10.1. Technical

Can the AVL information and transit trip planner be used on the GGNRA website based on NPS website guidelines?

5.10.2. Operational

Is there enough ridership on these lines to make the deployment cost effective?

Will MUNI, GGT, and MTC be willing to deploy the system on lines with less ridership and risk a public backlash that "their line with more riders should get the system first?"

Are MUNI, GGT, and MTC still testing the system and not willing to deploy a second round?

Is there an issue with using a sole-source vendor approach?

5.10.3. Maintenance

This should not be a problem as GGT, MUNI, and MTC should roll the costs of maintaining these two lines in with the others.

5.11. Strengths and Weaknesses

5.11.1. Strengths

- This is a relatively low-cost target of opportunity that could help improve traveler information and travel delay for GGNRA transit riders.
- The benefits of this system would be visible to visitors as the current system has already had a great deal of publicity, so it may generate significant support for future ITS investment.
- If marketed properly, this project may increase transit ridership to GGNRA and therefore reduce congestion on roadways and parking lots.
- Implementing this system may increase the ridership.

5.11.2. Weaknesses

- The application of this technology is dependent on an effective transit system for the parks.
- It is unclear if the current ridership is high enough to warrant this type of system.
- Using a sole-source approach to go with NextBus™ may introduce procurement problems, but using other vendors' technologies may introduce compatibility problems with MUNI's other routes.

6. RESERVATION SYSTEM FOR PARKING AT MUIR WOODS AND STINSON BEACH

6.1. Project Description

This project would allow GGNRA to manage parking at Stinson Beach and Muir Woods. A reservation system would be put into place so visitors would need to call in advance to schedule a parking space at one of these two very popular GGNRA locals. The requirement that visitors call in advance for a reservation should lessen the volume of visitors that decide spontaneously or with little advance planning to visit these park sites. On heavy visitation days many spontaneous visitors are unable to find parking as lots overflow. The reservation requirement would help manage the congestion and overflow parking at these two sites, improving visitor satisfaction and, at Muir Woods, pedestrian safety. It would also reinforce advance planning and guarantee parking space for those traveling from afar.

6.2. Relationship to Phase 1

6.2.1. Problems

Roadway Congestion. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Limited Parking. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Lack of Planning Data. See description under "NextBus™/AVL for MUNI and GGT."

Work Zone/Event Coordination. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

6.2.2. Objectives

1.1.3 Provide information to help visitors avoid congestion locations and times

1.1.6 Provide information on parking availability to visitors

1.2.1 Improve the safety of vehicles at or approaching congested entrance stations

1.2.4 Improve the safety of pedestrians approaching popular destinations

1.4.1 Reduce the delay to visitors waiting in long lines at entrance stations

1.4.3 Allow visitors to make reservations for experiencing certain park activities

2.2.1 Reduce emissions of idling vehicles in parking areas

2.2.2 Reduce emissions of idling vehicles at entrance gates

3.1.2 Monitor transportation operations and congested areas

3.1.3 Reduce congestion on park roadways

3.4.1 Reduce congestion in and around parking areas

3.4.2 Reduce parking outside of designated parking areas

3.4.3 Improve management of existing parking facilities to optimize parking usage

3.7.1 Manage adverse traffic impacts on local communities while preserving the economic benefits of visitor activity

6.2.3. Themes

Parking Management and Information. See description under "NextBus™/AVL for MUNI and GGT."

Data Collection and Storage. See description under "NextBus™/AVL for MUNI and GGT."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

6.3. Stakeholders

- Golden Gate National Recreation Area
- National Park Service Pacific West Region Office
- Rental Car Agencies
- MUNI
- GGT
- MTC
- Caltrans District 4
- Private tour operators
- Marin County

6.4. Draft Operational Concept

There are several ways this system could be accomplished. In all of the versions, the visitor would phone, mail, fax, or deliver in person their reservation form. This form would include their name, number of people, phone number and address where they can be reached, and license plate (if it is a rental car, they will need to phone this information in when they get the car).

The access to the site is where the options come in. One option is to have parking staff manually check the vehicles entering the site with those that are registered for the day. This may have the highest operational costs, but its greatest advantage is that it requires a live person, and that person can address reservation problems or mistakes immediately. All of the other options, except the sixth option, do not have do not have a built-in ability to address mechanical or information problems that would stop vehicles from proceeding orderly through the entrance point.

A second option is to have a license plate reader (with or without a gate) that can correlate license plates of cars entering with those that have reservations for the day. A camera would need to be set-up to record the license plates of those cars in violation.

A third option is to have a keypad with a security access number, such as those used on home security systems or in certain parking lot applications, and have this number change daily. People would be provided with this number only if they made a reservation for a given day. This way they can access the site. A license plate reader/camera would be helpful to verify that this system is being used correctly and not being taken advantage of by visitors with reservations passing the valid number on to visitors without reservations.

A fourth option is a barcode reader. Each visitor who makes a reservation would be sent a barcode as their confirmation. In the database, the barcode would be associated with a date. When the person tries to gain access to the parking lot, by showing the barcode on a piece of paper to an electronic barcode scanner, the gate will open only if the date and barcode correspond.

A fifth option is to have a gate on the entrance to the parking lots. The cars/people would have a FasTrak™ transponder (if supported by public agencies with roadway jurisdiction) or a bus pass to access the gate. The bus pass/transponder number would be provided with their form and programmed into the system for daily reservations. When a car with a correct number approaches the gate, it will open. In order to use this option, the park would need to partner with MTC, MUNI, GGT and Caltrans District 4 for use of transponder and bus passes. They will also need to partner with rental car agencies to have them equip cars with either a bus pass or a FasTrak™ tag.

The sixth option is to utilize a reservation display system whereby visitors with a valid reservation are sent a proof of reservation which they display on the dashboard of their vehicle. Visitors with reservations that were made too close to the actual date of visit would stop and pick their proof of reservation up at a visitor center. Visitors who attempt to park without a reservation would receive heavy fines from parking management staff who would enforce this program.

For all of these options, reservation forms would need to be created along with determining a realistic reservation program based on average length of stay at these sites, so that available parking is managed in real-time and visitors with valid reservations are always able to find an open parking space.

6.5. Anticipated Benefits

6.5.1. Golden Gate National Recreation Area

The park will be able to reduce overflow parking and control parking congestion, but still allow visitors to enter the site.

By essentially enforcing parking restrictions, this system could help to encourage the use of alternative modes to access park sites and encourage off-peak visitation.

6.5.2. Visitors

There will be less delay searching for a parking spot.

There will be less visitor frustration because visitors with reservations will have guaranteed access to a parking space.

6.6. Estimated Costs

6.6.1. Installation

The cost for the first option (staffed entrance station operation) has not been officially evaluated, but based on available NPS information it is estimated to require three full-time staff (8 hours days and 7 days a week). The current San Francisco Bay Area locality pay for a GS-5-1 position is $20,243 annually, so this option is likely to cost at least $65,000 annually not including ancillary costs above staffing.

The cost for option two would be $5,000 to 10,000 for the high speed camera; an estimated $10,000 to 15,000 for the parking management database and software; $2,000 to 11,500 for the hardware (low end for a PC installation and printer and high end if there is a central computer) (); and the price for a solar-powered gate is $950-2,000 (21).

The cost for option three would be $350 to 500 with an example type being the Linear 480 User AccessKey Garage Gate Or Door Digital Keypad by the Keyless Lock Store (22); a solar-powered gate at $950-2,000 (); and $2,000 to 11,500 for the hardware (low end for a PC installation and printer and high end if there is a central computer) (2).

The cost for the fourth option is $6,300 for a barcode reader, $1,000 for hardware, $250 for card readers, $3-5 a piece for barcodes (23), $950-2,000 for the solar gate (), and $2,000 to 11,500 for the hardware (low end for a PC installation and printer and high end if there is a central computer) (2).

The cost for option five (FasTrak™ pass) would be $2,000 to 5,000 for the electronic toll reader/parking tag reader; $5,000-10,000 for the high speed camera; an estimated $10,000 to 15,000 for the parking management database and software; $2,000 to 11,500 for the hardware (low end for a PC installation and printer and high end if there is a central computer) (); and the price for a solar-powered gate is $950-2,000 ().

The cost for the sixth option (reservation and display) would be approximately $2,500-11,000 for the hardware (low end PC installation and printer and high end if there is a central computer), plus staff costs for roving patrols by park rangers to ensure visitor compliance with the reservation program.

Please note that none of these prices include system installation costs.

6.6.2. Operations and Maintenance

The operation and maintenance costs for option two are $500-1,000 for the high speed camera, and $200-1,150 for the hardware.

The operation and maintenance costs for option five are $200-500 for the toll/parking tag reader, $500-1,000 for the high speed camera, and $200-1,150 for the hardware, and any additional staffing costs.

Maintenance costs for option 1, 3, 4, and 6 were not available.

6.7. Schedule

See Table 12.

Table 12: Schedule for Reservation System for Parking at Stinson Beach and Muir Woods

Date	Tasks
Start	• WASO project approval • Project kickoff • Meet with partners to discuss options
2 months after start	• Design system that was chosen at meeting
4 months after start	• Complete request for information from vendors • Create requirements for parking reservation system • Start request-for-bids for contractor for purchase and installation of system
7 months after start	• Evaluate request-for-bids and select contractor • Develop marketing and public awareness plan • Start installation
9 months after start	• Implement marketing and public awarness plan
11 months after start	• Develop test plan • Test system
12 months after start	• System activated

6.8. Measures of Effectiveness

- Reduced traffic volumes and improve LOS at key intersections during peak periods.
- Number of vehicles versus number of visitors to ensure that the reservation system reduced parking congestion, but did not limit visitor use to these sites. Collect before and after data.
- Number of overflow parked vehicles. Collect before and after to ensure that this number has decreased.
- Examine transit ridership on these routes to see if it has increased due to reservation system.
- Visitor surveys – do they feel that the new system is a benefit or a detriment? does it help them in planning their trip to the park? did they adjust their travel as a result of the information? do they believe the information is accurate and current? are they more likely to ride transit now? did having the correct information improve their visitor experience at the park?
- Park staff survey (including natural resources staff)– do they feel the new system is worthwhile? do they feel the new system is efficient? do they feel the new system is helping with parking management?
- Examine how many times the system had operational issues.
- Examine how many times people without reservations tried to enter/did enter the site? Were they caught and fined?
- Surveys/interviews with community and business groups.

6.9. Estimated Cost-Benefit and Cost-Effectiveness

6.9.1. Cost-Benefit

One of the primary benefits of this project would relate to visitor experience in accessing the park; however, as was stated earlier, the benefit of visitor satisfaction is difficult to quantify in economic terms. The project could reduce the environmental and safety impacts of overflow parking, which are important considerations but also difficult to put a value on.

Another benefit would be increased ridership on bus routes accessing park sites where effective transit access is provided now or in the future. Part of this benefit could be measured by increased farebox revenue for these routes,

The other measurement of this benefit is reduced congestion on roadways and parking lots in the park. This would be hard to measure in the given time period for this study.

6.9.2. Cost-Effectiveness

This project is intended to relieve parking congestion at selected sites in the GGNRA area. Other alternatives that might be used are as follows.

- **Improvements and expansion of the current transit routes.** Instead of a punitive or "stick" approach, the park could try a "carrot" approach, by working with MUNI and GGT to expand and improve on the two current lines by adding more stops on the routes, making the route stop closer to Muir Woods, and increasing service frequency. Although this would help both GGNRA and the visitors, the cost to do this is not a one-time cost. There would be significant operational costs to pay bus drivers, to potentially buy additional equipment to accommodate more frequent route turnover, and to redesign the bus route.

- **Parking management system.** Rather than using a reservation system, the parking could be setup first come first served as it is now and a parking management system could be put into place to better inform visitors of the real-time status of the parking lot. The parking management system could be deployed to give actual parking space numbers. This system has been deployed and tested at Gateway National Recreation Area by U.S. DOT Volpe National Transportation Systems Center. The cost for this system is $36,000 per location (). Such a system could successfully inventory current parking availability, and would reflect how long people actually stay at the park as opposed to an estimate. However, it also would require additional infrastructure (HAR, CMS) to provide real-time information to visitors who wish to drive their cars to park sites. This system would also probably be less effective than a well-publicized reservation-based system.

- **Expansion of parking areas.** In addition to costing significant amounts of money and requiring extensive time to obtain permits and construct, this approach would be inconsistent with park objectives.

It appears that the reservation system will provide GGNRA with a more effective system than the alternative options.

6.10. Outstanding Issues

6.10.1. Technical

Can the systems be setup to automatically compare reservation data with license plate or toll tag data?

Can the FasTrak™ and bus pass information be shared to be used at a GGNRA gate?

Is this feasible at an acceptable cost?

6.10.2. Operational

What is the best way to determine a typical length of stay for reservation scheduling?

How will the park deal with irate visitors that did not know there was a reservation system and drove all the way to the site before discovering this information?

Any of these systems may not be aesthetically pleasing enough for a park site.

Are existing parking lots designed in a way that could accommodate this type of technology (power, communications and footprint)?

6.10.3. Maintenance

This type of system has not been tried yet and therefore there is no way to know of any maintenance issues.

6.11. Strengths and Weaknesses

6.11.1. Strengths

- This is a medium-cost target of opportunity that could help improve parking management and information.
- This could improve pedestrian safety and reduce environmental degradation by mitigating overflow parking.
- This system could guarantee safe, available parking for visitors.
- If marketed properly, this project may increase transit ridership to GGNRA and therefore reduce congestion on roadways and parking lots.

6.11.2. Weaknesses

- This type of system has not been tried at these locations yet and therefore may have more technical issues at the beginning than the more proven technologies.
- This may be less appropriate for weather-dependent beach areas.
- This option requires advanced, broad, aggressive public information and marketing campaign to communicate to visitors (especially non-local ones) about the need to make reservations.
- The project would require significant institutional cooperation if it involves their jurisdictions, and it is not known whether Marin County, MUNI, GGT, MTC and the rental car agencies would want to partner on this project.

7. PARK INFORMATION DATABASE AND INTEGRATION WITH 511

7.1. Project Description

Improving information dissemination to park visitors requires both an infrastructure to get information out (i.e. kiosks, changeable message signs, Internet sites, highway advisory radio, telephone number), and accurate, real-time information. To get information out efficiently, the time required to collect, analyze and re-package data should be minimized. One effective way to do this is to develop a common database for all traveler information that may be useful to park visitors. The database can serve as a source of information for a variety of information outlets, and can provide capabilities for automation that can help to reduce the time park staff need to spend in collecting and analyzing data on a real-time basis.

7.2. Relationship to Phase 1

7.2.1. Problems

Roadway Congestion. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Inadequate Access. There is a desire to improve access to various park sites, including Crissy Field, Doyle Drive, various sites within Presidio, in addition to neighborhoods, museums, and other local attractions where automobile access is limited.

Limited Parking. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Coordination and Information. See description under "Park-wide Radio System."

Lack of Planning Data. See description under "NextBus™/AVL for MUNI and GGT."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Work Zone/Event Coordination. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Emergency Response. See description under "Park-wide Radio System."

7.2.2. Objectives

1.1.3 Provide information to help visitors avoid congestion locations and times

1.1.4 Provide weather, road condition, and chain requirement information to visitors

1.1.5 Provide construction and work zone information to visitors

1.1.6 Provide information on parking availability to visitors

1.1.7 Provide visitors with information at various park sites about transit arrivals and schedules

1.3.1 Improve access to options for visitors without automobiles

1.3.2 Provide transit service that enables visitors to see attractions that may not have been possible because on unavailability of parking

2.1.1 Increase usage of transit, pedestrian and bicycle modes for park access

2.1.2 Increase usage of alternative transportation systems within the park

2.1.3 Promote information about non-automobile alternatives

3.1.2 Monitor transportation operations and congested areas

3.1.3 Reduce congestion on park roadways

3.3.1 Enhance interagency coordination and communication regarding work zones and special events

3.3.2 Reduce the vehicle delay through work zones within the park

3.4.1 Reduce congestion in and around parking areas

3.4.3 Improve management of existing parking facilities to optimize parking usage

3.5.1 Improve efficiency and level of service of transit operations within the park

3.5.2 Enhance the monitoring and coordination of various transit operations within the park

3.6.1 Enhance the reliability, accuracy, and timeliness of visitation statistics

3.6.2 Collect additional statistics to help in transportation planning (e.g. distinguish between travelers and visitors, determine linked trips and trip patterns, count non-motorized travel)

3.7.1 Manage adverse traffic impacts on local communities while preserving the economic benefits of visitor activity

3.7.2 Promote sharing of information regarding visitor activities between the park and local communities

7.2.3. Themes

Roadway Congestion Forecasting. This ITS theme involves the utilization of information on current roadway conditions, along with archival information on "normal" traffic characteristics and the anticipated impacts of special events and construction, to access current and near-term

congestion levels. This information would assist park managers in preparing for congestion activity, and would help visitors to better plan their trips to park sites.

Data Collection and Storage. See description under "NextBus™/AVL for MUNI and GGT."

Parking Management and Information. See description under "NextBus™/AVL for MUNI and GGT."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Trip Planner. See description under "NextBus™/AVL for MUNI and GGT."

Major Emergency Response. See description under "Muir Woods/Stinson Beach Cameras."

7.3. Stakeholders

- County transportation authorities and transportation departments
- National Park Service Headquarters (as needed)
- Golden Gate National Recreation Area
- Other parties who own key data (National Weather Service? Caltrans District 4?)
- MTC

7.4. Draft Operational Concept

Park staff understand that providing accurate information to visitors on a real-time basis is integral to the quality of the visitor's experience at GGNRA. They have developed a good understanding of the types of information that visitors require, where they require it, and what are the consequences (both to themselves and park operations) if they fail to receive that information. Park staff are continually looking for ways to get new types of information to visitors. Unfortunately, information collection and dissemination has not been developed in a systematic fashion. There is little consistency in how information is collected and stored, which makes it difficult for the park to take full advantage of new information dissemination opportunities (for example, the Internet and automated telephone traveler information systems like 511).

The park information database fills in a gap by unifying data collection and storage throughout the park. The database would support all real-time information functions that park staff provides. Visibility conditions information can be provided by direct data feeds from Caltrans District 4 (with nearby RWIS sites) and National Weather Service. Transit schedule and arrival information for the transit system could be in the database. The database can also store real-time parking information to be provided as lots are instrumented with equipment to detect occupancy. For now, park rangers can use personal digital assistants using radio communications to transmit parking lot status information into the database. Software can provide automatic time-stamps as information is received so visitors can know how current the information is.

The database will provide the content for the park's two most popular information delivery media: the Internet and telephone information. Without a real-time database link, the park's web page needs manually updating by park staff based on current conditions, which is done as time permits; consequently, this information can become dated throughout the day. The database would allow the park's web site to have automated querying processes to collect the most current information regarding parking availability, visibility conditions, and congestion, along with schedules of interpretive activities. Currently, the park's telephone number is also updated manually; the database could be integrated with this to provide automated information via telephone as well.

Once the database is functional, database information could be integrated into 511, the national traveler information number. Although there is not enough money in the budget to create a database and integrate with the San Francisco Bay Area 511 system, it would be a very beneficial step for GGNRA. Currently the 511 menu structure in that area is: public transportation, traffic, bicycling, car pooling, van pooling, airports, etc. By either adding GGNRA or visitor attractions to this main menu and allowing GGNRA visitors to navigate and find transportation information strictly for GGNRA, they will know what options are is available to them when visiting park sites. Currently the 511 system in San Francisco is designed to appeal to local commuters; adding a GGNRA portion, which could provide information beneficial to both locals and visitors alike, would enhance its usefulness. Most American visitors will know about 511, as the majority of states are expected to deploy their 511 system by 2005. The need for the database prior to integration is that 511 systems are a real-time information source for travelers. This information must remain accurate; therefore, by building a database first, GGNRA will ensure that the information they are supplying to the 511 system will be accurate. For future information, the 511 system in San Francisco is run by MTC and their consultant is PB Farradyne. They are interested in talking about this type of partnership, but do not want to change their current system for at least four months do to currently expanding the system. They also mentioned that it would cost more than $50,000 to plan, design, and integrate the GGNRA database/information with 511 (24).

7.5. Anticipated Benefits

7.5.1. Golden Gate National Recreation Area

The database would provide a more efficient way of storing and transmitting data for visitor information purposes.

The database would provide a structure that would make it easier to disseminate real-time information in new ways.

The database would allow for tie-in to 511, the national traveler information number, which is the "face of ITS" to the public.

7.5.2. Visitors

The database would enhance the timeliness and quality of visitor information, resulting in an enhanced park visit.

7.6. Estimated Costs

7.6.1. Installation

The precise cost for database development and associated hardware will be impossible to determine until a detailed requirements analysis is developed. The requirements analysis would consist of meetings with park stakeholders who would provide information into the database or would need to query the database for visitor information needs and/or NPS reporting requirements. The estimated cost of conducting this requirements analysis would be $30,000. The results of the requirements analysis would be sufficiently detailed for the park to know how the database would be laid out and what types of information would be used by which stakeholders and in what formats. This would provide information suitable for in-house or contracted development of the software and hardware necessary.

The cost for integration of the database with the San Francisco 511 system is over $50,000 ().

7.6.2. Operations and Maintenance

No operations and maintenance costs are necessary for the initial requirements analysis. It is anticipated that another round of requirements analysis would need to be pursued once database design is underway, to ensure that new requirements will be addressed.

7.7. Schedule

See Table 13.

Table 13: Schedule for Park Information Database.

Date	Tasks
Start	• Project kickoff
1 month after start	• Survey park staff regarding current data availability, data needs
2 months after start	• With park staff, prioritize data needs • Develop draft data structure
3 months after start	• Develop computer/hardware architecture
4 months after start	• Develop phased implementation plan and protocols • Request information from database vendors on cost
8-12 months after start	• Integrate protocols and data into regional system

7.8. Measures of Effectiveness

The database, when complete, would not provide direct benefits to park visitors; however, the effects of the database should be measurable in several secondary measures:

- Increased usage of park telephone number
- Increased usage of park web site
- Visitor perceptions of park information sources – usefulness, timeliness, reliability, etc.
- Increased visitor satisfaction with park experience
- Anecdotal evidence regarding secondary effects of improved park information (e.g. more efficient utilization of parking lots, increased transit usage, etc.)
- Anecdotal evidence regarding secondary effects of satisfied visitors (e.g. increased park visitation, increased economic benefits to gateway communities, increased support of park foundation, etc.)

For park staff the benefits could be measured by:

- Increased accuracy of information for event management
- Increased accuracy of information for annual statistics being sent to NPS headquarters
- Increased efficiency when data is automatically input into database rather than manually

These benefits would be realized only on completion of the database, and not upon completion of a requirements analysis.

7.9. Estimated Cost-Benefit and Cost-Effectiveness

7.9.1. Cost-Benefit

It will be difficult to estimate benefits specifically related to improved information, since there may be other factors that would increase visitors' willingness to return to the park and/or spend more money on their visits.

Although still hard to measure by cost, the system will also show a benefit in more accurate annual statistics for NPS headquarters and for event/parking management.

Once this database is integrated into 511, the benefits should be shown through visitors' willingness to return to the park and/or spend more money on their visits, along with increased transit usage, and reduced staff time spent on traffic monitoring.

7.9.2. Cost-Effectiveness

This project focuses on re-structuring data collection and management to improve the timeliness and relevance of visitor information. Since this project encompasses the gamut of technology alternatives that may be used to this end, there are no technology alternatives. The other alternative to provide improved data management would be to increase staffing levels to support improved data collection and management; this is not a viable alternative.

7.10. Outstanding Issues

7.10.1. Technical

What computer and technology infrastructure – communications, networked terminals and servers, handheld devices, etc. – is available to support data collection, management and transmission?

What databases are currently in use by the park? How would this database need to integrate with those?

Are there other databases outside of GGNRA that would be affected by this database (for example, data needed to meet NPS headquarters requirements)?

When considering integration with 511, it must be ensured that the system meets requirements for San Francisco's current 511 vendor.

Staffing requirements for NPS to provide this and manage GGNRA interface.

7.10.2. Operational

How would the database be used, and by whom?

Are there information dissemination outlets (e.g. can the database feed 511, a HAR, the Internet, etc.) that can use the information generated by the database?

Perceptions at MTC and PB Farradyne about this information being strictly tourism information would need to be changed. Only park transportation related information would be requested for integration with 511 and this information would benefit locals alike as they are the majority of visitors to Stinson Beach on a crowded summer day.

7.10.3. Maintenance

Does the park have access to staff skill sets to support long-term operation, maintenance and upgrading of the database as available park data increases or visitor information needs evolve?

7.11. Strengths and Weaknesses

7.11.1. Strengths

- This project provides an important foundation piece to support a variety of visitor information outlets.
- Upon completion of the requirements analysis, the database can be developed in a phased fashion based on available resources.
- This project can help to guide and direct future investments in data collection equipment to ensure that park-related information is provided in a systems perspective.
- The database will increase park's accuracy and reliability of traveler information without requiring additional staff.
- As the database is integrated into 511, this system would have highly visible benefits to visitors and regional residents.
- 511 will be utilized by more people as it increases the amount of information it contains.

7.11.2. Weaknesses

- The current lack of automation in many data collection processes may mean that a significant hardware investment would be required for this project to be feasible.
- The requirements analysis alone will not provide an interesting product to the public, but is the place to start the process.
- This will have visitor benefits only once it can be tied in to improving the web site and the telephone number; therefore, there needs to be a commitment to funnel the database into those (and potentially other) information dissemination outlets.

8. EVENT MANAGEMENT AT FORT MASON AND CRISSY FIELD

8.1. Project Description

Many events take place at Fort Mason and Crissy Field in GGNRA. Improving event management for park visitors requires policies and procedures for park staff along with documenting lessons learned – both positive and negative – from past events. As the turnover of park volunteers occurs every summer, the chances of having a group of experienced staff assigned to an event are pretty minimal. This document would help to fill these gaps in experience and assure a more efficient event management.

8.2. Relationship to Phase 1

8.2.1. Problems

Roadway Congestion. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Inadequate Access. See description under "Park Information Database and Integration with 511."

Limited Parking. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Coordination and Information. See description under "Park-wide Radio System."

Lack of Planning Data. See description under "NextBus™/AVL for MUNI and GGT."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Work Zone/Event Coordination. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Emergency Response. See description under "Park-wide Radio System."

8.2.2. Objectives

1.1.2 Provide visitors with appropriate information at major transportation decision points

1.1.3 Provide information to help visitors avoid congestion locations and times

1.1.6 Provide information on parking availability to visitors

1.1.7 Provide visitors with information at various park sites about transit arrivals and schedules

1.2.1 Improve the safety of vehicles at or approaching congested entrance stations

1.2.2 Improve the safety of vehicle travel on park roadways

1.2.4 Improve the safety of pedestrians approaching popular destinations

1.4.1 Reduce the delay to visitors waiting in long lines at entrance stations

2.1.1 Increase usage of transit, pedestrian and bicycle modes for park access

2.1.2 Increase usage of alternative transportation systems within the park

2.1.3 Promote information about non-automobile alternatives

2.2.1 Reduce emissions of idling vehicle in parking areas

3.1.2 Monitor transportation operations and congested areas

3.1.3 Reduce congestion on park roadways

3.3.1 Enhance interagency coordination and communication regarding work zones and special events

3.3.3 Use archived data to help promote improved planning for the impacts of special events on the local transportation system

3.4.1 Reduce congestion in and around parking areas

3.4.2 Reduce parking outside of designated parking areas

3.4.3 Improve management of existing parking facilities to optimize parking usage

3.5.2 Enhance the monitoring and coordination of various transit operations within the park

3.7.2 Promote sharing of information regarding visitor activities between the park and local communities

8.2.3. Themes

Roadway Congestion Forecasting. See description under "Park Information Database and Integration with 511."

Data Collection and Storage. See description under "NextBus™/AVL for MUNI and GGT."

Parking Management and Information. See description under "NextBus™/AVL for MUNI and GGT."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Trip Planner. See description under "NextBus™/AVL for MUNI and GGT."

Major Emergency Response. See description under "Muir Woods/Stinson Beach Cameras."

8.3. Stakeholders

- Golden Gate National Recreation Area
- MTC
- MUNI
- GGT
- Caltrans District 4
- City of San Francisco
- Presidio Trust
- Fort Mason Center

8.4. Draft Operational Concept

Park staff understand that a visitor's time is valuable and therefore event management should be seamless and efficient to get visitors in and out of events in a timely manner. However, this is sometimes not possible, especially when the staff assigned these duties changes so often. In order to have a seamless event management protocol with the turnover in staff, a policies and procedures document should be created to help new staff.

To create this document, meetings with park staff, who have been involved in previous event management and have relevant experience, will need to take place. This document will then recommend different protocols and procedures based on the type of event and will include advanced technology alternatives for disseminating traveler information. One of the alternatives would then be tested and evaluated as part of this project.

8.5. Anticipated Benefits

8.5.1. Golden Gate National Recreation Area

The document would make current operations more efficient and may even reduce the number of staff required for events.

As event management is improved, it could reduce the impact of GGNRA traffic on surrounding neighborhoods, yet potentially increase the number of people who enjoy these events.

8.5.2. Visitors

The document would enhance the timeliness and quality of visitor information, resulting in an enhanced park visit.

8.6. Estimated Costs

8.6.1. Installation

The estimated cost of creating this document and evaluating one of the alternatives would be $30,000. This project would not contain purchasing of technological equipment.

8.6.2. Operations and Maintenance

No operations and maintenance costs are necessary for the initial document. It is anticipated that the document will need to be updated once all of the alternatives have been tested. This document should also be updated with the acquisition of new technology such as changeable message signs (e.g. every three years).

8.7. Schedule

See Table 14.

Table 14: Schedule for Event Management at Fort Mason and Crissy Field

Date	Tasks
Start	• Project kickoff
1 month after start	• Survey park event management staff on best practices, lessons learned, and what a "typical" event would be • With park staff, prioritize management needs
4 months after start	• Develop document with several management alternatives including advanced technology use
6 months after start	• Get stakeholder feedback on document • With park staff, determine which alternative should be evaluated
9 months after start	• Create evaluation plan
12 months after start	• Evaluate alternative picked and document results

8.8. Measures of Effectiveness

- Visitor surveys – do they feel that the event management improved their mobility? did the information provided help them in planning their trip to the event? did they adjust their travel as a result of the information? do they believe the information is accurate and current? are they more likely to ride transit after being provided with the event information? did having the correct information improve their visitor experience at the park? did they feel that the parking, arriving, and departing went more smoothly than normal?

- Park staff survey – do they feel the new event management options are worthwhile? Do they feel the new system is efficient? Do they feel the new system is helping with parking management? did they feel that the parking, arriving, and departing went more smoothly than normal? do they feel that the event management made the mobility easier?

- Increased usage of transit due to traveler information.

- Decreased delay in arriving and leaving the venue.

- No decrease in number of visitors/participants.

- Community/business group survey.

8.9. Estimated Cost-Benefit and Cost-Effectiveness

8.9.1. Cost-Benefit

It will be difficult to estimate benefits specifically related to improved information, since there may be other factors that would increase visitors' willingness to return to the park and/or spend more money on their visits.

8.9.2. Cost-Effectiveness

This project focuses on managing events by using a number of advanced technologies and non-technological strategies. Since this project could include a wide variety of technology alternatives that may be used to this end, there are no technology alternatives. The other alternative to provide improved event management would be to increase staffing levels to support improved traveler information and help with parking; this is not a viable alternative.

8.10. Outstanding Issues

8.10.1. Technical

As there will be no ITS elements purchased for this project, there should be no technical difficulties.

8.10.2. Operational

Are there some portable advanced technologies that can be borrowed form the city of San Francisco or Caltrans District 4 (e.g. portable CMS or portable HAR)? MOUs will need to be created.

Successful event management will require close coordination between the park and regional stakeholders (e.g. Marin County, the City of San Francisco), especially in developing best practices.

8.10.3. Maintenance

The only maintenance for this project is to ensure that new employees read it and to update the document every 2-3 years to include new best practices, lessons learned, and new technologies that are available for park use.

8.11. Strengths and Weaknesses

8.11.1. Strengths

- This project will increase efficiency of event management and increase visitor satisfaction.
- This project provides an important foundation piece to support a variety of visitor information outlets.
- This project can help to guide and direct future investments in data collection equipment/traveler information to ensure that event-related information is provided in a systems perspective.

8.11.2. Weaknesses

- The current lack of ITS (portable or not) in the park may mean that a significant hardware investment or a memorandum of understanding to borrow city or state equipment would be required for this project to be feasible.
- The document alone will not provide an interesting product to the public, but the testing/evaluation of one alternative will be visible.
- In order for this document to be useful, it will need to be read by new employees and updated every 2-3 years.

9. PEDESTRIAN/BICYCLE TRAIL PLAN FOR GGNRA

9.1. Project Description

With congestion being a factor in San Francisco in general and parking being a factor at most GGNRA sites, alternative transportation options need to be addressed. Based on an MTC survey done in 2001, 88 percent of respondents bike for recreation and the perceived constraints for biking in San Francisco include lack of bikeways (66 percent of respondents) (25). This project would identify needs for bike and pedestrian trails within and leading to GGNRA sites, and would deploy a test ITS application.

9.2. Relationship to Phase 1

9.2.1. Problems

Roadway Congestion. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Inadequate Access. See description under "Park Information Database and Integration with 511."

Limited Parking. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

Transit Coordination and Information. See description under "Park-wide Radio System."

Lack of Planning Data. See description under "NextBus™/AVL for MUNI and GGT."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

9.2.2. Objectives

1.2.4 Improve the safety of pedestrians approaching popular destinations

1.3.1 Improve access options for visitors without automobile access

2.1.1 Increase usage of transit, pedestrian and bicycle modes for park access

2.1.2 Increase usage of alternative transportation systems within the park

2.1.3 Promote information about non-automobile alternatives

9.2.3. Themes

Roadway Congestion Forecasting. See description under "Park Information Database and Integration with 511."

Data Collection and Storage. See description under "NextBus™/AVL for MUNI and GGT."

Parking Management and Information. See description under "NextBus™/AVL for MUNI and GGT."

Traveler Information. See description under "Shared Use Portable CMS At US 101 and State Route 1 Interchange."

9.3. Stakeholders

- Golden Gate National Recreation Area
- MTC
- Marin County and San Francisco County Bicycle Advocates and Groups
- City of San Francisco
- Marin County
- Caltrans District 4

9.4. Draft Operational Concept

Park staff want to encourage alternative transportation and bicycle/pedestrian use; therefore, this project is important to GGNRA. In order to make bicycling a viable access option for park sites, the trails in GGNRA must be safe and must provide an integrated network. This project would seek to examine all current bike/pedestrian trails and determine where the holes are (e.g. is it possible to travel between all GGNRA sites safely, do they all have separate trails, sidewalks, or bike lanes?).

This project would produce a document that would contain recommendations not only for improvements to trails, paths, sidewalks, and bike lanes to improve bicycle and pedestrian access within and mobility between sites, but also recommend ITS technologies that may be helpful in improving bike and pedestrian safety. Such ITS may include countdown pedestrian signal timers; lighted crosswalk systems; detection systems that would warn motorists of pedestrians/bicyclists on crosswalks, bridges, or tunnels; use of speed trailers to slow motorists down; and automated pedestrian/bicyclist counters to improve data collection.

This project would also seek to implement and evaluate one ITS technology.

9.5. Anticipated Benefits

9.5.1. Golden Gate National Recreation Area

The document would help plan for improving the current bike lane/path/trail system to help promote alternative transportation to and between GGNRA sites.

This document would also promote ITS alternatives for non-motorized information and safety.

9.5.2. Visitors

Visitors would be able to have a more robust non-auto alternative for park access.

Visitors would benefit from the one ITS deployment and evaluation by increasing pedestrian safety.

9.6. Estimated Costs

9.6.1. Installation

The estimated cost of creating this document and evaluating one of the alternatives would be $30,000. This project would not contain purchasing of one piece of technological equipment. The following are potential costs for equipment ():

- 4 countdown pedestrian signal timers: $325-450 per unit
- 1 lit crosswalk $27,500 – 42,000
- 1 pedestrian detection/counting system and flashing beacon sign
    - microwave (need at least 2 units per crosswalk) $600 per unit
    - infrared (need at least 2 units per crosswalk) $300-500 per unit
    - sign (assume HAR sign) $5,000
- 1 speed trailer for speed enforcement $3,700 – 5,000

9.6.2. Operations and Maintenance

No operations and maintenance costs are necessary for the initial document, although there will be significant costs in deploying the recommendations. Estimated operations and maintenance costs per equipment include ():

- 4 countdown pedestrian signal timers: not available
- 1 lit crosswalk $2,750 - 4,200

- 1 pedestrian detection/counting system and flashing beacon sign not available
- 1 speed trailer for speed enforcement not available

9.7. Schedule

See Table 15.

Table 15: Schedule for Pedestrian/Bicycle Trail Plan for GGNRA

Date	Tasks
Start	• Project kickoff
1 month after start	• Consider all current bike paths/trails/lanes to determine where there is a disconnect
6 months after start	• Survey cyclists/pedestrians and park staff on where they feel improvement is needed and prioritize them • Collect data on these areas
8 months after start	• Create document stating park needs and recommendations for infrastructure improvements and addition of ITS
9 months after start	• Have park choose a ITS technology for testing • Create evaluation plan
15 months after start	• Evaluate alternative picked and document results

9.8. Measures of Effectiveness

This will depend solely on which ITS technology is chosen. Possible measures include:

- Decreased speed where speed trailers or warning lights are deployed.
- Decreased pedestrian/vehicle accidents where lit crosswalks and warning lights are deployed.
- Increased accuracy in statistics where pedestrian counters are installed.

After deployment of recommendations:

- Increased usage of current pedestrian/bicycle trails.
- Increased usage of transit by bicyclists.
- Increased levels of pedestrians/bicyclists at park sites.

- Less car-related congestion.
- Fewer accidents/incidents at park "hot spots."
- Visitor survey – do they feel the improvements were necessary/positive? are they more likely to walk/bike to/at GGNRA now? do they feel safer due to the improvements? are the ITS measures helpful? are the ITS measures an eyesore?

9.9. Estimated Cost-Benefit and Cost-Effectiveness

9.9.1. Cost-Benefit

It will be difficult to estimate benefits specifically related to a written document. Benefits related to increased bicycle and pedestrian mode share include reduced parking congestion, reduced vehicular emissions, and enhanced air quality. The ITS improvement would likely be incremental in nature, so the specific nature of benefit will be difficulty to quantify.

9.9.2. Cost-Effectiveness

It will be difficult to estimate the cost effectiveness of these ITS alternatives, as there may be non-ITS alternatives that are more cost-effective and would also be a solution to the challenges. This project focuses on recommendations for improvements to pedestrian and bicycle lanes, trails, and paths, along with ITS alternatives. There are a variety of non-ITS solutions that may be applicable as well (for example, bicycle and pedestrian bridges, improved static signage, etc.).

9.10. Outstanding Issues

9.10.1. Technical

Which of the ITS alternatives will work better in the area, based on power, communications, and aesthetics?

Bicycle/pedestrian detection is a relatively untried ITS concept, so the level of accuracy and success is uncertain.

9.10.2. Operational

If this document is created, is there a champion to ensure that the recommendations get carried out?

9.10.3. Maintenance

The only maintenance for the document is to ensure that the recommendations are deployed. Maintenance for the ITS project would depend on the nature of the project selected.

9.11. Strengths and Weaknesses

9.11.1. Strengths

- This project may increase the use of bicycle and pedestrian modes to access park sites.
- This project will provide the park with an important foundation for implementing improvements to the bicycle and pedestrian trail system and ITS alternatives.
- This project can help to guide and direct future investments in pedestrian ITS equipment to ensure that it is provided in a systems perspective.

9.11.2. Weaknesses

- A similar document may already exist.
- If the document is created and there is no champion or money, it is not beneficial.

10. SELECTION OF EARLY-WINNER PROJECT

On January 6, 2004 project members from GGNRA, Caltrans District 4, Caltrans DRI, Central Federal Lands Highway Division, and MUNI had a teleconference to discuss the eight potential early-winner projects including:

- Shared Use Portable CMS At US 101 and State Route 1 Interchange,
- Park-wide Radio System,
- Muir Woods/Stinson Beach Cameras,
- NextBusTM/AVL for MUNI and GGT,
- Reservation System for Parking at Muir Woods and Stinson Beach,
- Park Information Database and Integration with 511,
- Event Management at Fort Mason and Crissy Field, and
- Pedestrian/Bicycle Trail Plan for GGNRA.

10.1. Early-winner Project Decision

To succeed, the early-winner project must have a clear positive impact and high visibility. The most valuable alternatives, according to the stakeholders, were the park information database interfacing with 511, CMS, and cameras. All of these options would improve traveler information to help visitors make more informed decisions. The preferred choice among stakeholders was the park information database which could be used with both CMS and 511; however, it was agreed that funding was inadequate for this option.

Within limited funding, GGNRA's priority was the CMS because of local community support, while Federal Lands and MUNI personnel thought that cameras should be the top priority as people are already using this technology. The final decision was that the park wants the CMS, but if they could work with Caltrans on using their current CMS, then they could purchase cameras and integrate the two.

As Caltrans does not have any spare portable CMS – most CMS in the district are contractor owned – the final decision was to purchase two portable CMS for GGNRA.

10.2. Changes Made to the Original Concept

Rather than choosing the original concept where Caltrans would own and operate the signs, it was decided that option three (see Section 2.11.2) would be chosen. Under this option, the two portable changeable message signs (not semi-permanent) will be owned, operated, and maintained by GGNRA. GGNRA will be responsible for displaying messages and will have full control over the CMS, although Caltrans can request a message be placed on the sign if needed. A memorandum of understating between GGNRA and Caltrans District 4 will be signed. All messages will be created by GGNRA, but must be approved by Caltrans. GGNRA will create a policies and procedures document, and will pay for all maintenance and phone charges for the signs.

Caltrans will be responsible for providing an encroachment permit for the PCMS use along Caltrans right of way, storage of the signs during the off season, transportation of the signs to the roadway/storage, and approval of the messages used by GGNRA.

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