



ROAD AND TRAIL MANAGEMENT PLAN

Marin County Parks

Marin County Open Space District



ROAD AND TRAIL MANAGEMENT PLAN

FINAL

Prepared for:

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Marin County Open Space District

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EXECUTIVE SUMMARY

Introduction

Marin County Parks, which includes the Marin County Open Space District (MCOSD), presents its first public inclusive, science-based, comprehensive plan to address the complex challenges of Marin County's Open Space District preserves' roads and trails – this *Road and Trail Management Plan* (RTMP) and companion *Tiered Programmatic Environmental Impact Report* (TPEIR) as required by the California Environmental Quality Act (CEQA). These documents were developed through a rigorous process that included 11 well attended public meetings and workshops, numerous additional meetings with small groups, consultation with other land management agencies, and studies never before undertaken to better understand existing visitor use, the natural resources, and existing physical system of roads and trails.

The Marin County Open Space District was created through a grassroots initiative and a vote of the people in 1972. Since then nearly 16,000 acres have been acquired creating 34 distinct preserves – vast tracts of marshland, forests, creeks, and rolling hills – that define the character and quality of life in Marin, promote health and wellness, clean our air and water, protect important natural habitats and ecosystem functions, and provide opportunities to recreate in the out-of-doors. As directed by the enabling ordinance and mission statement, the preserves are managed for both natural resource protection and “enjoyment”. They encompass some of the most ecologically sensitive resources and habitats in the bay area, and they are enjoyed by many thousands of county residents (called “visitors” for the vernacular of this *Road and Trail Management Plan*) and other visitors annually.

By design, the lands within the preserves were selected as community separators, now integrated into some of Marin's most dense settlements. They abut over 3,700 backyards. Access is via some 335 trailheads and “road-end” access points in the neighborhoods. They are Marin's backyards, treasured as daily destinations for local hikers, dog walkers, mountain bikers, equestrians, bird watchers, and those who want to be immersed in nature in their recreation pursuits, right in their own communities. Frequent use by people of diverse abilities, hundreds of access points, multiple modes of travel, different rates of speed inherent in those modes, the desire to accommodate people of diverse abilities, and potential impacts to the native vegetation and wildlife pose real management challenges.

The preserves include over 249¹ miles of unpaved roads and trails, few of which were formally planned or designed as a public access system. Most of them were originally built to be logging and ranch roads, fire and emergency access roads, utility access, and informal trails created from repeated use. Route selection was commonly based on ease of construction or finding

the shortest distance between two points. As a result they do not provide an optimum range of recreation experiences. Additionally, natural resource protection was only rarely considered. These facilities were never intended to support the level and types of year round recreational and other use they currently receive.

Since this *Road and Trail Management Plan* process commenced, a marked improvement in trail etiquette has been reported; nevertheless, there continues to be conflict among recreational users, safety concerns, high speed and extreme riding, unauthorized off-trail use, destructive trail building in fragile areas, ongoing problems of sedimentation into creeks, fire risk and fire fuel management needs, and the proliferation of invasive nonnative plants. Inappropriate use and poor system design has resulted in diminution of ecological integrity and safety concerns, which brought preserve management to a critical point in 2010, driving initiation of two planning processes. A separate *Vegetation and Biodiversity Management Plan* (VBMP) process sought to learn more about the natural resources of the preserves, especially the vegetation and its habitat value. This *Road and Trail Management Plan* process sought to improve recreation opportunities, resolve conflict, make trails safer, and protect the wondrous natural species and habitats of the MCOSD. Data from the *Vegetation and Biodiversity Management Plan* inform and provide a platform for additional data collected and analyzed for this *Road and Trail Management Plan*. Vegetation zones and habitat values are common to both.

This *Road and Trail Management Plan* does not prescribe lists of road and trail modification projects in specific locations. Rather it presents a framework and process for making decisions in an inclusive, trackable, transparent, and defensible process. It also presents a set of policies to which proposed projects must adhere. The challenge that will remain even when this *Road and Trail Management Plan* is adopted is instilling a sense of the “common good” and stewardship among visitors to the preserves. It is impossible to legislate those values with policies and laws. Success will rely on Marin’s organized advocacy groups, retailers, clubs, coaches, outfitters, volunteers, and individuals to practice and promote responsible behavior that respects and honors all visitors, and that protects Marin’s beautiful and diverse preserves.

Purpose and Goals of this Road and Trail Management Plan

Once adopted by the MCOSD Board of Directors, this *Road and Trail Management Plan* will guide the MCOSD efforts over the course of the next approximately 15 years.

The tools and processes described in the following chapters, and the use of robust physical and environmental data, will support achievement of this plans’ goals, which are to:

1. Establish and maintain a sustainable system of roads and trails that meet design and management standards.

2. Reduce the environmental impact of roads and trails on sensitive resources, habitats, riparian areas, native and special-status plant and animal species.
3. Improve the visitor experience and visitor safety for all users, including hikers, mountain bikers, and equestrians.

Elements and Implementation

Adoption of this *Road and Trail Management Plan*:

- Puts into effect a framework for science-based management developed through the collection and synthesis of large amounts of data describing the physical characteristics of the existing road and trail network, the related natural environment, and the social values related to visitor use of the roads and trails. These data provide a solid backbone for the application of transparent and collaborative decision making processes.
- Reaffirms many existing policies governing visitor use and safety, sets forth revised and updated policies governing visitor use and safety, and introduces new policies aimed at improving visitor experience and protecting the natural environment.
- Puts into practice collaborative and transparent decision making processes that will inform the designation of the official road and trail system in the course of the initial implementation and outreach period, and that will support the evaluation and selection of road and trail projects on an annual basis.
- Prescribes road and trail Design Standards and Best Management Practices (BMP) to guide how work is done in each and every project, management, and maintenance action.
- Sets a baseline from which the MCOSD can track continuous and measurable reductions in physical and environmental impacts associated with the road and trail network.

This *Road and Trail Management Plan* divides the system of 34 preserves into six regions that will be used to organize public outreach efforts and that will serve as planning units for designating the road and trail system and establishing a baseline of its impacts. Immediately following the adoption of this plan, the MCOSD will launch a public outreach and engagement process to designate the formal system of roads and trails that will be managed and maintained within each region going forward, and to solicit input on the specific road and trail projects that will improve and make incremental adjustments to this designated system over time.

The decision-making processes that will be used to designate the system and to evaluate project proposals are designed to be transparent and collaborative, and together constitute the core element of this plan. Inputs to these processes include adopted policies, the road and trail design guidelines incorporated into this document by reference, public feedback, and large

amounts of data that will be processed through a unique mathematical and geospatial modeling tool developed especially for this *Road and Trail Management Plan*.

The combined outputs of these processes will be:

- the future designated road and trail system depicted on a map; and
- a list of prioritized road and trail projects and actions (e.g., construction, major modification, decommissioning, restoration projects, and changes in use) that the MCOSD will draw from on an annual basis when formulating its proposed budgets and work plans.

The list of prioritized road and trail projects and actions will be updated on an annual basis as new proposals are evaluated and previously submitted proposals are reevaluated on the basis of new information. This *Road and Trail Management Plan* organizes the process to evaluate project proposals into six successive steps, beginning with the solicitation of proposals and culminating with the inclusion of successful project proposals into proposed annual budgets submitted by the MCOSD staff to the Board of Directors for approval. A key element of this evaluation is the requirement that annually budgeted projects show a projected reduction in the previous year's baseline score of environmental impacts within each of the six planning regions, and within all regions combined.

Neither the map nor the prioritized project list will be complete or final, as the initial designation of the system of roads and trails, and subsequent implementation of road and trail projects, will incrementally change the road and trail system over time. And as implementation continues, there will be measurable reductions in the physical and environmental impacts associated with roads and trails, improvements in the range of opportunities for visitors to experience the preserves, and improvements in visitor safety, compared to the existing conditions.

Achievement of these outcomes, which are measures of the success of this plan, relies upon the full engagement and participation of the MCOSD Board of Directors, the Parks and Open Space Commission, the MCOSD staff, and the public. Adoption of this plan is intended to instill shared values and a shared sense of purpose among visitors to the preserves. These values cannot be legislated with policy or regulation. Success will rely upon the Marin community to commit to practice and promote responsible behavior that respects and honors all visitors, and that protects the natural resources of the preserves.

Summary of Planning Process

Development of this plan began with the Project Initiation phase, which included:

- determining a need for the plan,
- determining the purpose and goals, and
- reviewing existing guidance (management plans, policies, laws, regulations).

This was followed by the Data Collection and Synthesis phase, which included:

- inventorying the location and assessing the condition of the existing roads and trails,
- collecting and synthesizing data about environmental conditions,
- surveying the types and levels of visitor use, and
- engaging a variety of technical experts.

And lastly, the Policy, Management, and Decision Making phase, which included:

- developing visitor use management zones based on environmental conditions and visitor interests and concerns,
- reviewing, updating, and creating policies related to visitor use and management,
- Identifying road and trail design standards and best management practices for use in all activities, and
- developing a formal decision-making process to solicit, evaluate and prioritize potential road and trail projects, and to designate the official road and trail system.

The MCOSD Board of Directors, the Parks and Open Space Commission, elected officials, community leaders, constituents, and subject matter experts have all contributed to the evolution of this plan. In the fall of 2010, the MCOSD began work on an inventory and assessment of the location and condition of the existing network of roads and trails. The completed inventory and assessment resulted in the creation of data layers in a Geographic Information System (GIS) that show the physical locations of roads and trails, the condition of each trail and trail segment, chronic problem areas, and thousands of Global Positioning System (GPS) located photo points. Through this effort, the MCOSD discovered the existence of many “social trails”, as well as many trails that were constructed without the authorization of the MCOSD. In the spring of 2011, the MCOSD undertook a visitor use census and survey at

key locations on a subset of preserves. While this effort was not comprehensive in nature, the work provided the MCOSD with both quantitative and qualitative data and information regarding visitor access; type and level of use; and social values, concerns, and desires. The MCOSD was also able to incorporate significant amounts of vegetation data that had been compiled as part of the development of the *Vegetation and Biodiversity Management Plan* to better understand the extent and condition of vegetation resources on the preserves. These three data collection efforts were critical to the development of this plan.

In addition, the MCOSD engaged the public at key stages of the planning process. Much was learned at the eleven public workshops, each of which were attended by at least 70-80 participants, where the focus was on presenting data and information, soliciting input and feedback, and bringing divergent interests together to resolve differences. In each case, staff and technical experts gained input and feedback on a range of topics, all critical to the development of this plan. Notices for all meetings and workshops were published in the newspaper and on the Marin County Parks website. The MCOSD also notified all adjacent property owners by mail, provided email notice to website subscribers, and provided email alerts when updates were made to the website. Additionally, the process was supported by multiyear in depth coverage by local media including the Pacific Sun and Marin Independent Journal. Organized constituencies, such as Marin County Bicycle Coalition, Marin Conservation League, Access 4 Bikes, and Marin Audubon Society partnered with the MCOSD to get out the word. The workshops focused on the following topics:

Public Information and Scoping

November 29, 2010, 6:30pm - 8:00pm, Margaret Todd Senior Center, Novato
November 30, 2010, 6:30pm - 8:00pm, Lagunitas School, San Geronimo
December 1, 2010, 6:30pm - 8:00pm, Mill Valley Community Center, Mill Valley
December 2, 2010, 6:30pm - 8:00pm, Marin County Civic Center, San Rafael

Notice of Preparation

February 15, 2011, 3:00pm - 7:30pm, Marin Center, San Rafael

History of Open Space and the MCOSD, Existing Plans and Guidance Documents

March 26, 2011, 9:00am - 3:00pm, Marin Health and Wellness Campus, San Rafael

Trends in Resource Protection, Carrying Capacity, Desired Resource Conditions, Range of Possible Visitor Uses

June 18, 2011, 8:30am - 12:30pm, Marin Health and Wellness Campus, San Rafael

Road and Trail Network and Inventory, Areas of Environmental Sensitivity, User Conflicts

October 29, 2011, 8:30am - 12:30pm, Marin Health and Wellness Campus, San Rafael

Road and Trail Assessment and Visitor Use Survey

March 31, 2012, 8:30am - 12:00pm, Marin Health and Wellness Campus, San Rafael

Visitor Use Management Zones, Visitor Use Policies, and California Environmental Quality Act Requirements

October 29, 2012, 6:00pm - 8:00pm, Marin Health and Wellness Campus, San Rafael

Implementing the RTMP: The Road and Trail Project Evaluation Tool

March 15, 2014, 9:30am-12:30pm, Marin Health and Wellness Campus, San Rafael

Review and Revision

The document was initially released as a *Preliminary Administrative Draft Road and Trail Management Plan* on October 29, 2012. The purpose of the release was to seek the review and studied input of stakeholders keenly involved in the two-year planning process. This informal step allowed the MCOSD to gain valuable input and feedback, listed in table ES.1, while still working to complete the environmental review process. While written comments were submitted and accepted, this was not a formal comment period, and as such, the MCOSD was not expected to draft official responses under CEQA to the more than 100 comment letters and emails received. However, given the many comments received related to Visitor Use Management Zones, Visitor Use Management Zone policies, and new Systemwide Policies, substantial revisions were made to reflect those comments.

A *Draft Road and Trail Management Plan* was then released on October 2, 2013, with its companion *Draft Tiered Programmatic Environmental Impact Report* (TPEIR), for a formal 90 day public comment period on the draft TPEIR. During the formal public comment period, a much greater number of comments were received on the *Draft Road and Trail Management Plan* than were received on the TPEIR. Most of the comments fell into four categories listed in the table below, and were for the most part directed towards chapters 4 and 5².

The extent and nature of the comments led the MCOSD to make significant revisions to this *Road and Trail Management Plan*. Partial drafts of these revisions were released to the public via hard copy and the MCOSD website in January and March 2014. The revisions were described by staff in the course of the regularly scheduled meetings of the Marin County Park and Open Space Commission and during one additional fully noticed public workshop.

The complete final *Road and Trail Management Plan* was released in the summer of 2014, with its companion *Recirculated Draft Tiered Programmatic Environmental Impact Report* (RTPEIR), for a formal 45 day public comment period on the Draft RTPEIR.

² Formal responses to the comments received during the 90 day public comment period can be found in the Response to Comments, an addendum to the Final Tiered Programmatic Environmental Impact Report.

On December 16, 2014, the Board of Directors of the Marin County Open Space District approved the RTMP with four modifications: (1) revise the third goal to state that one of the purposes of the plan is to improve visitor experience and safety “for all users, including hikers, mountain bikers, and equestrians; (2) revise the policy requirements for the Sensitive Resource Area to allow off leash dogs on fire roads; (3) remove references to mountain bikers in Policy SW-13; and (4) require the establishment of metrics and monitoring when implementing novel forms of trail designations.

Table ES.1 Public Input and Feedback to Draft RTMP

Public Input and Feedback	Changes Made in Response
Visitor Use Management Zones	
<ul style="list-style-type: none"> • Zones should be changed to allow visitors to be “immersed in nature.” • Zone specific policies should be revised. 	<ul style="list-style-type: none"> • Visitor Use Management Zones 1 and 2 were combined. • Policies specific to Visitor Use Management Zones were eliminated. The spirit and intent of those policies was embedded in the Systemwide Policies.
Visitor Use, Conflict and Safety	
<ul style="list-style-type: none"> • Some trails, particularly those near stables, should be established as horse only trails. • Impacts on wildlife should be analyzed. • Enforcement of regulations should be added as a policy. • Hikers should continue to be allowed on all trails. • Use should be grounded in stewardship. • Longer trails are needed to achieve safety. • Redundant trails should be used to separate different types of users. • More opportunities for mountain biking are needed. This may be achieved by more multiuse trails or designated use trails. • Plan should be clear that types of use may change over time. 	<ul style="list-style-type: none"> • Wildlife data is being collected and will be incorporated into decision making. • Novel tools to separate users in certain areas will be considered and implemented initially on a pilot basis, including time-separated, single-use, one-way, and uphill only trail designations. Revisions allow for the retention of some redundancy as an aid to separating users and reducing conflict. • Plan places greater emphasis on accountability of users and user groups.
Implementation	
<ul style="list-style-type: none"> • Plan is not a vision for the preserves, but a decision process directed towards a desirable future condition that needs to be more clearly defined. • Plan should emphasize that resource protection is the primary goal. • Plan should clearly describe Best Management Practices and standards for trail design and construction, including safety criteria. • Plan should include metrics for achieving safe trails. 	<ul style="list-style-type: none"> • Plan reaffirms mission of the MCOSD to balance protection of natural resources with public access and enjoyment. • Plan provides further description of decision making processes that will be used to designate formal road and trail system, and to select annual projects. • Selection of projects will be driven by need to reduce overall environmental impact and improve overall condition of natural resources within a region.
<ul style="list-style-type: none"> • The 2:1 and 1:1 metrics are arbitrary and unrealistic and should be changed. Linking the construction of trail(s) in one area to the decommissioning of trail(s) in other area is unacceptable. • Destruction of social trails is unacceptable. • Decommissioning is likely to result in environmental impacts, and closing of trails likely to result in their reopening. • There should be a ‘no net increase’ in trail mileage, footprint, and impacts. • Management should acknowledge needs of resident and migrating wildlife, not just threatened and endangered species. • The Plan should be clear that it cannot continue to meet future demand without restraint. 	<ul style="list-style-type: none"> • Road and Trail Design Standards and Best Management Practices will apply to all management actions. • The 2:1 and 1:1 metrics removed and replaced by a decision making model that relies on a more precise measure of impacts. • The data driven decision making model was improved to better assess potential environmental impact and/or benefit of proposed actions. • Social trails will be considered in regional assessment when making determinations regarding official road and trail system. • Additional policies regarding visitor safety were added. • Best Management Practices now include provisions requiring monitoring and protection of sensitive native plants and wildlife. • Efforts will continue to be made to engage the public, visitors, and preserve constituencies in long term implementation of plan to ensure success.
Public Process	
<ul style="list-style-type: none"> • There was inadequate public noticing. • There was insufficient community input. • All users not notified of the process. 	<ul style="list-style-type: none"> • Further description of public engagement process, plan development process, process to publicly notice meetings and broad media coverage was added. • Public and constituent engagement will be central to decision making processes, and implementation of selected projects.

1. PROJECT INITIATION

The Need for a Plan

Marin County Parks, which includes the Marin County Open Space District (MCOSD), presents its first public inclusive, science-based, comprehensive plan to address the complex challenges related to the MCOSD's roads and trails—this *Road and Trail Management Plan*, and companion *Tiered Programmatic Environmental Impact Report (TPEIR)* as required by the California Environmental Quality Act (CEQA). These documents were developed through a rigorous process that included 11 well-attended public meetings and workshops, numerous additional meetings with small groups, consultation with other land management agencies, and studies never before undertaken to better understand existing visitor use, the natural resources and existing physical system of roads and trails.

The MCOSD was created through a grassroots initiative and a vote of the people in 1972. Since then nearly 16,000 acres have been acquired in 34 distinct preserves—vast tracts of marshland, forests, creeks, and rolling hills—that define the character and quality of life in Marin, promote health and wellness, clean our air and water, protect important natural habitats and ecosystem functions, and provide opportunities to recreate in the out-of-doors. As directed by the enabling ordinance and mission statement, the preserves are managed for both natural resource protection and “enjoyment”. They encompass some of the most ecologically sensitive resources and habitats in the Bay Area, and they are enjoyed by many thousands of Marin County residents (called “visitors” for the vernacular of this *Road and Trail Management Plan*), and other visitors annually.

By design, the lands within the preserves were acquired as community separators, now integrated into some of Marin's most dense settlements. They abut over 3,700 backyards. Access is via some 335 trailheads and “road-end” access points in the neighborhoods. They are Marin's backyards, treasured as daily destinations for local hikers, dog walkers, mountain bikers, equestrians, bird watchers, and those who want to be immersed in nature in their recreational pursuits, right in their own communities. Frequent use by people of diverse abilities, hundreds of access points, multiple modes of travel, different rates of speed inherent in those modes, the desire to accommodate people of diverse abilities, and potential impacts to the native vegetation and wildlife pose real management challenges.

The preserves include over 249 miles of unpaved roads and trails, few of which were formally planned or designed as a public access system. Most of the roads were originally built to serve logging and ranching operations, and fire, emergency, and utility access; many informal trails were created from repeated use. Route selection was commonly based on ease of construction

or finding the shortest distance between two points. As a result they do not provide an optimum range of recreation experiences. Additionally, natural resource protection was only rarely considered. These facilities were never intended to support the level and types of year-round recreational and other use they currently receive.

Conflicts among visitors, safety concerns, high speed and extreme riding, unauthorized off-trail use, destructive trail building in fragile areas, sedimentation into creeks, fire risk and fire fuel management needs, and the proliferation of invasive nonnative plants. Inappropriate use and poor system design has resulted in diminution of ecological integrity and safety concerns, which brought preserve management to a critical point in 2010, driving initiation of two planning processes. A separate *Vegetation and Biodiversity Management Plan* process sought to learn more about the natural resources of the preserves, especially the vegetation and its habitat value. The process of this *Road and Trail Management Plan* sought to improve recreation opportunities, resolve conflict, improve the safety and sustainability of the roads and trails, and protect the wondrous natural species and habitats of the MCOSD. Data from the *Vegetation and Biodiversity Management Plan* inform and provide a platform for additional data collected and analyzed for this *Road and Trail Management Plan*. Vegetation management zones and habitat values are common to both.

During preparation of this *Road and Trail Management Plan*, visitors were surveyed, roads and trails were inventoried, and conditions assessed. Much was learned at eleven public workshops, each of which were attended by 70-80 participants. This *Road and Trail Management Plan* operates within the framework of local, state, and federal laws and policies. Then the mission of the MCOSD is overlain—to preserve, protect, and enrich the preserves while providing recreation opportunities.

This *Road and Trail Management Plan* does not prescribe lists of road and trail modification projects in specific locations. Rather it presents a framework and approach for making decisions in an inclusive, trackable, transparent, and defensible process. It also presents a set of policies and best management practices to which proposed projects must adhere. The challenge that will remain even when this *Road and Trail Management Plan* is adopted is instilling a sense of the “common good” and stewardship among visitors to the preserves. It is impossible to legislate those values with policies and laws. Success will rely on Marin’s organized advocacy groups, retailers, clubs, coaches, outfitters, volunteers, and individuals to practice and promote responsible behavior that respects and honors all visitors, and that protects Marin’s beautiful and diverse preserves.

Purpose and Goals of this Road and Trail Management Plan

As described in the MCOSD *Resource Management Plan Framework* (2008a), one of the

MCOSD's high-level goals is to protect, restore, and enhance natural resources that have been adversely affected by poor road and trail alignment or construction and by concentrated visitor use. To achieve this goal, one of the elements of the approved framework is the adoption of a road and trail management plan for the purposes of, among other things, reducing sedimentation from roads and trails in critical watersheds, preserving in-stream habitat for populations of rare and threatened or endangered fish species, and protecting water quality. According to the *Resource Management Plan Framework*, the proposed plan would be the MCOSD's "key vehicle for striking the appropriate balance between resource protection and public use, and provide guidance for sustainable maintenance of roads and trails." This *Road and Trail Management Plan* is intended to serve that purpose.

This plan has three primary goals:

- Establish and maintain a sustainable system of roads and trails that meet design and management standards.
- Reduce the environmental impact of roads and trails on sensitive resources, habitats, riparian areas, and special-status plant and animal species.
- Improve the visitor experience and visitor safety for all users, including hikers, mountain bikers, and equestrians.

These goals will be achieved by following the direction provided in this plan. First, a *framework for science-based management* has been developed through the collection and synthesis of large amounts of data describing the physical characteristics of the road and trail network, the related natural environment, and the social values related to the use of roads and trails. These data provide a scientific basis for this plan and will remain a powerful tool in support of future decision making.

Second, to better inform decisions about needed and appropriate access, *existing policies governing visitor use and other uses of the preserves* have been updated, and new policies have been added. The revised and new policies reflect the most current information about environmental conditions and about current types and amounts of visitor use.

Third, the plan includes a *decision-making process* developed to support trackable, systematic, and transparent decisions about which road and trail projects will be undertaken in the future. Such projects may involve the reconstruction, rerouting, or decommissioning of existing roads and trails, or the construction of new ones. The decision-making process will consider the physical and environmental conditions surrounding the road or trail. It will also consider the need for, and appropriateness of, the access that the road or trail would provide. The most sustainable and desirable projects will be considered in the MCOSD's annual budget development and work planning processes.

Finally, the plan will specify the *road and trail standards* and *best management practices* that will be incorporated into every project to minimize environmental impacts.

This *Road and Trail Management Plan* is comprehensive in its coverage. The policies, processes, and practices included in this plan will apply across all 34 open space preserves and direct all management related to roads and trails, from long-range goal setting to day-to-day work activities. This plan is expected to guide the management of roads and trails on the MCOSD preserves for the next 15 years.

Mission, Operation, and Accountability of the MCOSD

The MCOSD is a separate legal entity from the County of Marin and an independent special district operating pursuant to the *California Public Resources Code*. Its mission, as stated in the *Marin County Parks and Open Space Strategic Plan (2008)* is as follows:

We are dedicated to educating, inspiring, and engaging the people of Marin in the shared commitment of preserving, protecting, and enriching the natural beauty of Marin's parks and open spaces, and providing recreational opportunities for the enjoyment of all generations.

The MCOSD was formed with approval of a ballot initiative (Measure A) by Marin County voters in 1972. According to Marin County's official statements on the measure, the purpose of the district was to "acquire open space, park or recreation lands, or for the development, operation or maintenance of open space, park or recreation lands."

A five-member board of directors governs the MCOSD. A seven-member Parks and Open Space Commission advises the MCOSD Board of Directors on policy matters related to acquisition, development, funding, management, and operation of the MCOSD lands. A general manager oversees the day-to-day operations of the MCOSD. Through Marin county, the MCOSD employs some 38 full-time employees and approximately 18 seasonal employees (seasonal numbers fluctuate annually).

In 2012 the voters of Marin County adopted a second Measure A (Marin County Ordinance 3586). Under this measure, the MCOSD and Marin County Parks were directed to accomplish the following:

- Preserve the quality of life and maintain open space, parks, and farmland with money that cannot be taken by the state from Marin County.
- Protect streams, baylands, natural areas, and wildlife habitat.

- Manage vegetation to preserve biodiversity and reduce wildfire risk.
- Repair and replace deteriorating park facilities.
- Maintain and enhance walking, hiking, biking, and equestrian trails.

This measure, which enacted a one-quarter cent sales tax increase throughout Marin County, also required the formation of a citizens' oversight committee whose purpose is to verify that expenditures are consistent with Ordinance 3586 and oversee an annual audit.

This *Road and Trail Management Plan* is designed to be consistent with this hierarchy of responsibilities approved by the voters, emphasizing resource protection first, followed by road and trail system maintenance and improvement, and the maintenance and enhancement of recreation uses on the MCOSD lands.

The public oversight provisions of the most recent Measure A require the MCOSD to report to the public annually on the expenditures made of Measure A funds. The MCOSD intends to report on the implementation and success of this *Road and Trail Management Plan* as part of the required Measure A reporting. This report will be presented to the public, the Parks and Open Space Commission, and the MCOSD Board of Directors for the nine years that Measure A is in effect.

The primary measure of success and outcome in implementing this plan will be the cumulative reduction of biophysical impacts associated with the MCOSD's network of inventoried roads and trails. Details of how this will be accomplished are provided in chapter 5 and the appendix. Additional measures of success will be reported in three categories:

- effects on the environment
 - » length of roads and trails with identified wet or muddy segments that have been rerouted, stabilized, or decommissioned
 - » length of trails relocated or decommissioned within stream conservation areas, areas of sensitive vegetation or wildlife habitat, wetlands, or areas of other sensitive resources
 - » change in the amount or size of significant habitat areas previously impacted
 - » number of stream crossings eliminated or reconstructed
 - » length of roads and trails affected by unstable slopes or other geologic hazards that have been rerouted, stabilized, or decommissioned
 - » change in the volume of sediment generated from roads and trails
- physical changes to the road and trail network

- » change in designated road and trail mileage or area
- » length of new roads and trails constructed
- » length of roads and trails rated fair, fair-poor, or poor that have been reconstructed, stabilized, or decommissioned
- » length of fall line roads and trails that have been rerouted, stabilized, or decommissioned
- » length of steep (>15%) roads and trails that have been reconstructed, stabilized, or decommissioned
- » length of redundant roads and trails rerouted, repurposed, redesignated, or decommissioned
- effects on public use of roads and trails
 - » number of new connections created
 - » number of new trails created
 - » increased availability and/or variety of trail experiences
 - » observed changes in road and trail use by the public, including better compliance with regulations
 - » number and nature of reported user conflicts, violations, and incidents
 - » number and nature of complaints regarding parking within neighborhoods by open space preserve visitors
 - » increased respect among the wide variety of trail users from bird watchers to mountain bikers
 - » number and nature of complaints regarding actions of road and trail users by neighbors of open space preserves
 - » changes in allowed uses on existing trails
 - » level of volunteerism to maintain roads and trails

Existing Guidance

This *Road and Trail Management Plan* is consistent with federal and state laws and regulations (including the National Environmental Policy Act, the federal Endangered Species Act, the California Endangered Species Act, the California Environmental Quality Act, and section 5500 of the *California Public Resources Code*) and with applicable Marin County policies and plans (see table 1.1). All of the policies and standards in this plan are tiered off this more general guidance and interrelated into a comprehensive framework for the management of roads and trails across the MCOSD preserves.

In 2009 the MCOSD initiated its first ever *Vegetation and Biodiversity Management Plan* (VBMP), which seeks to guide the MCOSD in its efforts to identify, protect, and enhance native and special-status plants, plant communities, and habitats while managing vegetation to enhance safety. While the VBMP was underway, the MCOSD initiated this *Road and Trail Management Plan*. Both the VBMP and this *Road and Trail Management Plan* share data sources, and vegetation management zones.

This plan has also been influenced by the actions and policies of agencies whose lands are adjacent to or near MCOSD preserves, including the California Department of Parks and Recreation, the National Park Service, and the Marin Municipal Water District, and by fire agencies, including the Marin County Fire Department.

Table 1.1 Summary of Marin County Plans, Guidelines, and Policies Related to Road and Trail Management

Source	Guidance	
Marin Countywide Plan (2007)	Relevant Guiding Principles	
	1	A Preserved and Restored Natural Environment: Marin watersheds, natural habitats, wildlife corridors, and open space will be protected, restored, and enhanced.
	2	Collaboration and Partnerships: Marin public agencies, private organizations, and regional partners will reach across jurisdictional boundaries to collaboratively plan for and meet community needs.
	3	A Community Safe from Climate Change: Marin will be a leader in averting and adapting to all aspects of climate change.
	Pertinent Goals and Policies	
	BIO-1	Enhanced Native Habitat and Biodiversity: Effectively manage and enhance native habitat, maintain viable native plant and animal populations, and provide for improved biodiversity throughout the county.
	BIO-1.6	Control Spread of Invasive Exotic Plants: Work with landowners, landscapers, the MCOSD, nurseries, and the multi-agency Weed Management Area to remove and prevent the spread of highly invasive and noxious weeds.
	BIO-2	Protection of Sensitive Biological Resources: Require identification of sensitive biological resources and commitment to adequate protection and mitigation, and monitor development trends and resource preservation efforts.
	BIO-4	Riparian Conservation: Protect and, where possible, restore the natural structure and function of riparian systems.
	BIO-2.5	Restrict Disturbance in Sensitive Habitat During Nesting Season: Limit construction and other sources of potential disturbance in sensitive riparian corridors, wetlands, and baylands to protect bird nesting activities.
	BIO-2.6	Identify Opportunities for Safe Wildlife Movement: Ensure that existing stream channels and riparian corridors continue to provide for wildlife movement at roadway crossings, preferably through the use of bridges, or through over-sized culverts, while maintaining or restoring a natural channel bottom.
	BIO-4.7	Protect Riparian Vegetation: Retain riparian vegetation for stabilization of streambanks and floodplains, moderating water temperatures, trapping and filtering sediments and other water pollutants, providing wildlife habitat, and aesthetic reasons.
	BIO-4.15	Reduce Wet Weather Impacts: Ensure that development work adjacent to and potentially affecting stream conservation areas is not done during the wet weather or when water is flowing through streams, except for emergency repairs, and that disturbed soils are stabilized and replanted, and areas where woody vegetation has been removed are replaced with suitable species before the beginning of the rainy season.
	TRL-2.2	Respect the Rights of Private Landowners: Design and manage trails to avoid trespass and trail construction impacts on adjacent private land.
TRL-2.3	Ensure User Safety: Plan and maintain trails to protect the safety of trail users.	

Table 1.1 Summary of Marin County Plans, Guidelines, and Policies Related to Road and Trail Management

Source	Guidance	
	TRL-2.7	Ensure Sustainable Maintenance: Continue to ensure that trails are responsibly maintained.
	OS-1.1	Enhance Open Space Stewardship: Promote collaborative resource management among land management agencies. Monitor resource quality. Engage the public in the stewardship of open space resources.
Marin County Strategic Plan (2001)		<i>The Marin County Strategic Plan contains the basic framework for the mission statement, goals, and strategies for Marin County Open Space.</i>
Marin County Parks and Open Space Strategic Plan (2008)	Pertinent Goals	
	Goal-1	Protect and Restore Our Lands: Protect, restore, and preserve the natural systems of the lands held in trust for current and future generations.
	Goal-2	Grow and Link the County's Systems of Parks, Trails, and Protected Lands: Complete the county's system of parks, open space, and trails. Support the efforts of other agencies, organizations, and communities to fulfill their land preservation and system goals.
	Goal-3	Foster Discovery, Learning, and Stewardship: Engage the community by providing volunteer and educational experiences for people to discover, learn about, protect, and restore their parks and open spaces.
	Goal-5	Lead, Innovate, and Partner: Cultivate partnerships, explore new approaches, and adopt best practices and technologies.
	Pertinent Fire Policies	
	F-1	The MCOSD shall strive to reduce fire hazards on its lands in partnership with local fire agencies and communities, in recognition of the importance of wildfire prevention to every Marin County resident.
	F-2	The MCOSD shall strive to plan and conduct fire fuel reduction activities in a manner that protects natural resources.
	F-3	The MCOSD shall participate in countywide fire hazard reduction planning.
	F-4	The MCOSD shall assess fire hazard conditions when acquiring new lands and in land management planning.
	F-5	The MCOSD shall determine annual fire fuel reduction priorities on its lands, in consultation with Marin County's fire agencies.
	F-6	The MCOSD shall consider the use of prescribed burns, grazing, and other fire hazard reduction practices to reduce fire hazard and restore or maintain native ecosystems.
	F-7	The MCOSD shall encourage adjoining property owners to create defensible space surrounding homes and other improvements.
	F-8	The MCOSD shall strive to resolve issues of defensible space in cooperation with Marin County fire agencies, planning authorities, and communities.
	Pertinent Invasive Plant and Wildlife Policies	
	NN-1	The MCOSD shall strive to reduce populations of nonnative species for the benefit of native habitats and species.
	NN-2	The MCOSD should collaborate with public agencies, nongovernmental organizations, and landowners in regional and countywide planning to reduce populations of invasive species.
	NN-3	The MCOSD shall inventory populations of, establish control priorities for, and develop control strategies for nonnative species.
	NN-4	The MCOSD should minimize the unintentional introduction of nonnative species.
	NN-5	The MCOSD should support and participate in research concerning the control of nonnative species.
	NN-6	The MCOSD shall accommodate remnants of nonnative species when they contribute to historic and cultural landscapes.

Table 1.1 Summary of Marin County Plans, Guidelines, and Policies Related to Road and Trail Management

Source	Guidance
	Pertinent Special-Status Species Policies
	SS-1 The MCOSD shall protect and enhance the habitats of indigenous plants and animals. Those whose survival is threatened, endangered, or tenuous, or whose regional presence is rare, shall be given special protection. Such plants and animals shall be referenced in the following policies as special-status species.
	SS-2 The MCOSD should partner with public agencies, nongovernmental organizations, and landowners in regional and countywide efforts to inventory special-status species and to develop regional habitat conservation plans that protect special-status species, wildlife corridors, ecosystems, and biodiversity.
	SS-3 The MCOSD shall develop strategies to protect special-status species and their habitats, including strategies to resolve conflicts between public use of district lands and the protection of special-status species and their habitats.
	Pertinent Public Outreach Policies
	PO-1 The MCOSD shall conduct public outreach to inform Marin County residents and open space visitors of its mission, lands, resources, and programs; to enhance visitor appreciation and the educational value of open space; to encourage compliance with the MCOSD Code; and to promote good relations.
	PO-2 The MCOSD shall encourage public participation in its decision-making processes and, specifically, encourage the participation of neighborhoods and communities in discussions of issues affecting their interests.
	PO-3 The MCOSD shall direct its public outreach primarily to Marin County residents.
	PO-4 The MCOSD shall accommodate non-English-speaking visitors by providing outreach in multiple languages.
The MCOSD Resource Management Framework (September 2008)	This document was approved by the MCOSD Board of Directors and directs the development of plans to address road and trail management, vegetation management, management of geologic and cultural resources, and carbon management.
The MCOSD Policy Review Initiative (May 2005)	The MCOSD policies have provided general guidance for the development of this plan. Specific policies related to road and trail management and visitor use management have been reviewed and updated as part of this plan and are presented in chapter 4.
Guidelines for Protecting Aquatic Habitat and Salmon Fisheries for County Road Maintenance (FishNet 2004)	These guidelines were developed for and funded by the FishNet 4C counties, the California Department of Fish and Wildlife, the National Marine Fisheries Service, and the California Resources Agency in response to the listings of the Coho salmon (1996) and steelhead trout (1997) under the federal Endangered Species Act. The guidelines are designed for the Marin County Department of Public Works, Marin County Department of Parks, and the MCOSD to use when implementing road-related projects, and they include best management practices for protecting water quality, aquatic habitat, and salmonid fisheries.
Guidelines for non-federal recreational sites covered by the Americans with Disabilities Act (ADA), including access to new or altered trails, are under development through a rulemaking process. (United States Access Board, pending regulations for Outdoor Developed Areas, Section 1017)	The federal Americans with Disabilities Act of 1991 (ADA), as well as state laws, apply to a wide range of public accommodations and facilities, including roads and trails in park lands. As a general rule, public land management agencies address trail system planning – with its focus on natural resource protection – and accessibility as separate, though related, issues. This plan does not address road and trail accessibility for individuals with mobility and other impairments. This topic will be addressed in a separate planning document subsequent to approval of this <i>Road and Trail Management Plan</i> .

2. OVERVIEW: THE MCOSD PRESERVES AND THE ROAD AND TRAIL NETWORK

For planning purposes, the 34 MCOSD preserves are divided into six regions as listed below and as shown in figure 2.1. The regions are located in different areas of Marin County, have varying adjacent lands uses, and correspond roughly with biomes of the San Francisco Bay area:

Region 1: Baltimore Canyon, King Mountain, Blithedale Summit, Camino Alto, Horse Hill, Alto Bowl

Region 2: French Ranch, Maurice Thorne Memorial, Roy's Redwoods, Gary Giacomini, Loma Alta, White Hill, Cascade Canyon

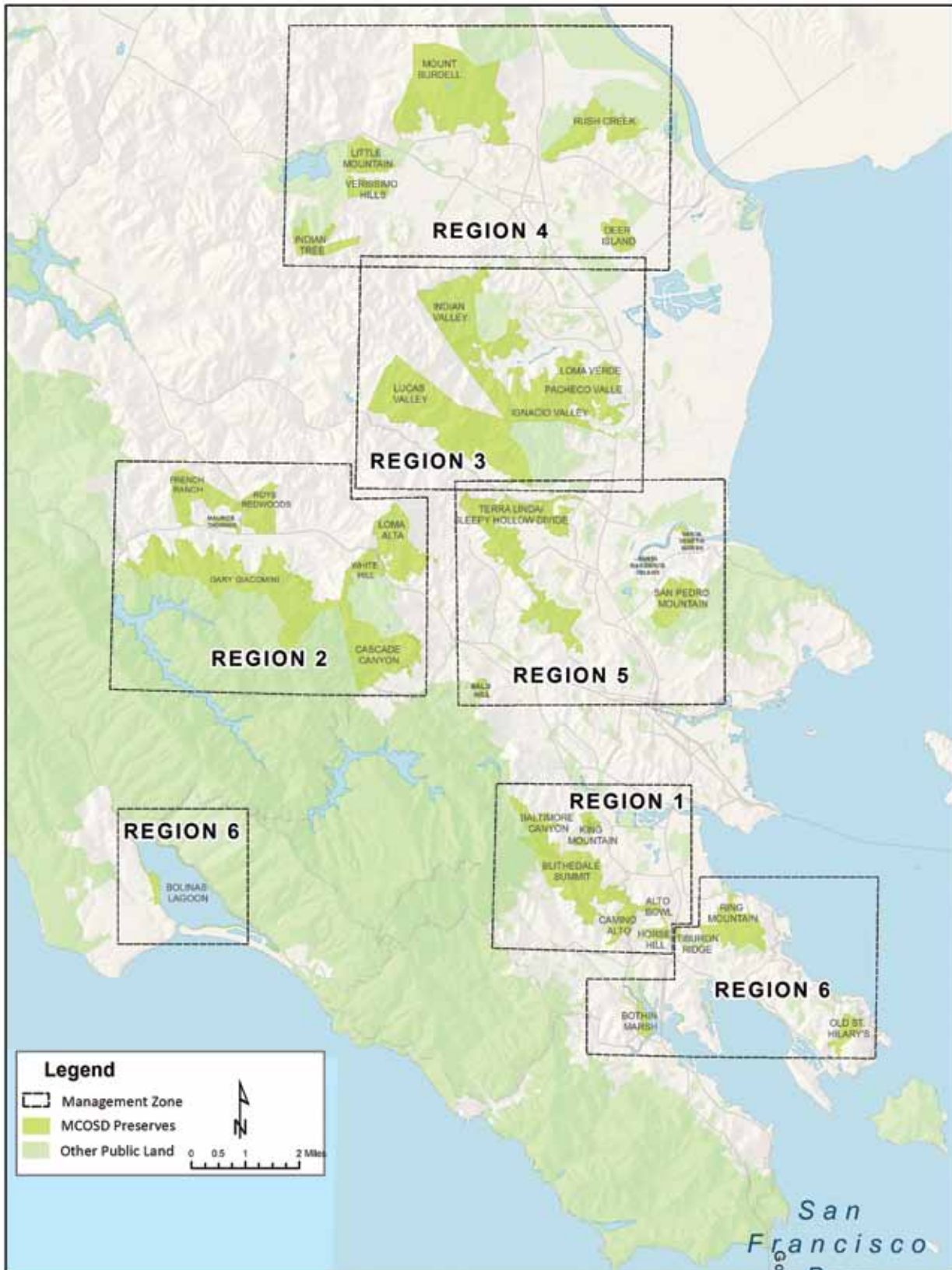
Region 3: Indian Valley, Lucas Valley, Loma Verde, Pacheco Valle, Ignacio Valley

Region 4: Mount Burdell, Rush Creek, Little Mountain, Verissimo Hills, Indian Tree, Deer Island

Region 5: Terra Linda/Sleepy Hollow Divide, Santa Margarita Island, Santa Venetia Marsh, San Pedro Mountain, Bald Hill

Region 6: Ring Mountain, Old Saint Hilary's, Bothin Marsh, Bolinas Lagoon, Tiburon Ridge

Figure 2.1 Preserves by Region



The 34 open space preserves owned and managed by the MCOSD range in size from 8 acres to more than 1,600 acres, and together total almost 16,000 acres scattered throughout central and eastern Marin County. Additionally the MCOSD holds conservation easements on approximately 3,000 acres of private lands.

Visitors and community members access the preserves through a network of unpaved roads and trails from more than 316 formal trailheads and a multitude of informal road based access points. The network of roads and trails lies primarily within the preserves, but the MCOSD also holds numerous public trail easements across private lands that link preserves to surrounding communities. The nearly 249 miles of unpaved roads and trails traversing the preserves represent roughly 44% of the estimated 640 miles of unpaved roads and trails, on public lands, in all of Marin County (Marin County 2007). Some of the numerous narrow trails used for recreation are well designed and laid out, but others evolved over time from informal use and are irregularly maintained by staff. Many are associated with resource protection concerns and were not intended to support the level of recreational use they currently receive.

Land uses surrounding the various preserves include private residences, other public conservation lands, agricultural lands, and some undeveloped land and commercial/mixed use. Many of the preserves are located adjacent to other large open space and recreational lands, including Golden Gate National Recreation Area and Point Reyes National Seashore (both managed by the National Park Service), various California state parks, lands managed by the Marin Municipal Water District and the North Marin Water District, and local city parks. These preserves provide important linkages in large blocks of habitat and recreational open space.

Many preserves also share boundaries with private land, including urban, suburban, and rural residences and ranches. Residential uses consist mainly of medium- to high-density development; however, a small percentage of residential use is “very rural” (*Marin Countywide Plan* categories of low density and hillside residential uses). Shared boundaries present both opportunities and constraints to county residents and to the MCOSD. Many residents value the aesthetic benefits of preserved open space near their homes and use the preserves regularly for recreation. Conversely, residents can be adversely affected by higher intensity recreational uses within preserves or by management actions undertaken by the MCOSD.

Region 1

Region 1 (see figure 2.2) is located in the southeastern portion of Marin County. This region consists of six open space preserves totaling approximately 1,197 acres. It includes Baltimore Canyon, King Mountain, Blithedale Summit, Camino Alto, Alto Bowl, and Horse Hill Preserves. The largest preserves are Blithedale Summit (640 acres), Baltimore Canyon (193 acres), and Camino Alto (170 acres). Region 1 contains approximately 34 miles of roads and trails.

This region is near Mount Tamalpais State Park, with the public lands of Golden Gate National Recreation Area to the west. Public lands and private residences within Homestead Valley are located to the south. Piper Park, U.S. Highway 101, and residential areas are located to the east. Hal Brown Park, the College of Marin, and residences are located to the north. Adjacent land uses within ¼ mile of the MCOSD roads and trails within region 1 include residential use (1,491 acres, or 66.5% of adjacent acreage), other open space (412 acres, or 18.3%), public or quasi-public use (286 acres, or 12.7%), and commercial/mixed uses (53 acres, or 2.3%).

Region 2

Region 2 (see figure 2.3) is located in the western portion of Marin County, near the town of Fairfax. This region consists of seven preserves totaling approximately 3,631 acres. It includes French Ranch, Maurice Thorner Memorial, Roy's Redwoods, Gary Giacomini, Loma Alta, White Hill, and Cascade Canyon Preserves. The Gary Giacomini Preserve is the largest preserve in this region (1,500 acres), followed by Loma Alta (509 acres), and Cascade Canyon (504 acres). Region 2 contains approximately 69 miles of roads and trails, the highest mileage of all the regions.

The Gary Giacomini and Cascade Canyon Preserves serve as gateways to lands of the Marin Municipal Water District. Samuel P. Taylor State Park is also located less than 1 mile west of Gary Giacomini Preserve. Other adjacent land uses include residences along Sir Francis Drake Boulevard. The Gary Giacomini Preserve is located to the south of Sir Francis Drake Boulevard, and the French Ranch, Maurice Thorner Memorial, and Roy's Redwoods Preserves are located north of this roadway. The Spirit Rock Meditation Center is located to the east of Roy's Redwoods Preserve. Camp Tamarancho, managed by the Marin Council of Boy Scouts of America, is situated directly north of Cascade Canyon Preserve. Large ranches and scattered residences are located east of the Loma Alta, White Hill, and Cascade Canyon Preserves. Adjacent land uses within ¼ mile of the MCOSD roads and trails within region 2 include public or quasi-public use (1,965 acres, or 39.5% of adjacent acreage), residential use (1,626 acres, or 32.7%), agricultural land (841 acres, or 16.9%), and commercial and mixed uses (426 acres, or 8.5%).

Region 3

Region 3 (see figure 2.4) is located in the middle of Marin County, west of the Ignacio and Marinwood communities. This region consists of five preserves totaling approximately 3,553 acres. It includes the Lucas Valley, Ignacio Valley, Indian Valley, Pacheco Valle, and Loma Verde Preserves. Lucas Valley is the largest preserve in this region (1,271 acres), followed by Ignacio Valley (901 acres) and Indian Valley (558 acres). Region 3 contains approximately 38 miles of roads and trails.

This region is surrounded by varying land uses, including large private ranches to the west of the region and between the Lucas Valley and Indian Valley Preserves. Lands managed by the Marinwood Community Service District are located to the east of the Lucas Valley Preserve and to the south of the Ignacio Valley and Pacheco Valle Preserves. Other land uses in the region include Indian Valley College, located to the northeast of the Indian Valley Preserve. Residences are located to the north of the Ignacio Valley, Pacheco Valle, and Loma Verde Preserves, and to the south of the Lucas Valley Preserve. Adjacent land uses within $\frac{1}{4}$ mile of the MCOSD roads and trails within region 3 include agricultural use (3,537 acres, or 40.2% of adjacent acreage), residential use (1,093 acres, or 28.2%), and public or quasi-public use (882 acres, or 22.7 %).

Region 4

Region 4 (see figure 2.5) is located toward the northern end of Marin County near the City of Novato. It is the northernmost of the six regions. The region consists of six preserves totaling approximately 2,874 acres. It includes the Mount Burdell, Little Mountain, Verissimo Hills, Indian Tree, Rush Creek, and Deer Island Preserves. Mount Burdell is the largest preserve in region 4 (1,627 acres), followed by Rush Creek (522 acres), Indian Tree (242 acres), and Little Mountain (214 acres). Region 4 contains 59 miles of roads and trails, the second highest mileage of any region.

Olompali State Historic Park is located to the north of Mount Burdell Preserve, and U.S. Highway 101 is located east of Mount Burdell Preserve. The Rush Creek Marsh and Petaluma Marsh Wildlife Refuges, managed by the California Department of Fish and Wildlife, are located north of the Rush Creek Preserve. The Deer Island Preserve is located southeast of the other preserves, and the Indian Tree Preserve is located to the southwest of the other preserves in the region. The Indian Valley Golf Club is situated west of the Little Mountain, Verissimo Hills, and Indian Tree Preserves. Adjacent land uses within $\frac{1}{4}$ mile of the MCOSD roads and trails within region 4 include public or quasi-public use (1,775 acres, or 42.5% of adjacent acreage), residential use (1,372 acres, or 32.8%), and agricultural lands (404 acres, or 9.7%). Region 4 is the only region where roads and trails are located near very rural residential lands (295 acres, or 7% of adjacent acreage within $\frac{1}{4}$ mile of the MCOSD roads and trails).

Region 5

Region 5 (see figure 2.6) is located north of the City of San Anselmo in the center of Marin County, east of region 2 and south of region 3. The region consists of five preserves totaling 1,602 acres, including Bald Hill, San Pedro Mountain, Terra Linda/Sleepy Hollow Divide, Santa Margarita Island, and Santa Venetia Marsh. The Terra Linda/Sleepy Hollow Divide Preserve is the largest in this region (1,172 acres), followed by San Pedro Mountain (358 acres) and Santa Venetia Marsh (33 acres). Region 5 contains 31 miles of roads and trails, the second lowest mileage of any region.

The Terra Linda/Sleepy Hollow Divide Preserve is located south of Lucas Valley Road and extends in a southerly direction to Sir Francis Drake Boulevard. Residential areas surround the Terra Linda/Sleepy Hollow Divide Preserve. The Bald Hill Preserve is located southwest of Terra Linda/Sleepy Hollow Divide and is also surrounded primarily by residences. The San Pedro Mountain Preserve is located just east of the Marin Civic Center, and is adjacent to Harry Barbier City Park and China Camp State Park to the east. Adjacent land uses within $\frac{1}{4}$ mile of the MCOSD roads and trails within region 5 include residential use (1,697 acres, or 66% of adjacent acreage), public or quasi-public use (790 acres, or 30.7%), and commercial and mixed use (71 acres, or 2.7%).

Region 6

Region 6 (see figure 2.7) is the southernmost of the six regions. The region includes remote preserves at the far southwestern and southeastern ends of the county along Bolinas Lagoon and near Richardson Bay and San Francisco Bay, as well as preserves located on the Tiburon Peninsula. The region consists of five preserves totaling 1,687 acres. It includes the Bolinas Lagoon, Bothin Marsh, Old Saint Hilary's, Ring Mountain, and Tiburon Ridge. (It also includes Strawberry Point and various water lots totaling about 550 acres, not included in the above total acreage for the region). Bolinas Lagoon is the largest preserve within region 6, at approximately 1,077 acres, most of which consists of coastal wetlands. Ring Mountain is the next largest (367 acres), followed by Old Saint Hilary's (122 acres). Most of the preserves in this region are near or along the San Francisco Bay or the Pacific Ocean. Region 6 contains only 18 miles of road and trails, the lowest mileage of any region.

Golden Gate National Recreation Area is located to the east of the Bolinas Lagoon Preserve. Ring Mountain Preserve is surrounded by residences and situated near the Corte Madera Ecological Reserve to the north. Adjacent land uses within $\frac{1}{4}$ mile of the MCOSD roads and trails within region 6 include residential use (961 acres, or 67.5 % of adjacent acreage), public and quasi-public use (335 acres, or 23.5%), and open space (86 acres, or 6%).

Table 2.1 identifies each preserve, the region within which the preserve is located, its acreage, and its history and setting (e.g., former owners and uses, land acquisitions, notable adjacent uses).

Table 2.1 Preserve Sizes and Settings

Preserve Name	Area (acres)	History and Setting
Region 1		
Alto Bowl	37.1	<ul style="list-style-type: none"> . Former dairy ranches (Tunnel Ranch and Alto Dairy) until 1940. . Parcels acquired in 1974, 1985, and 1990.
Baltimore Canyon	193.1	<ul style="list-style-type: none"> . Redwoods were logged in the mid-1800s, all in less than one decade. . West property boundary is shared with the Marin Municipal Water District.
Blithedale Summit	638.6	<ul style="list-style-type: none"> . Saved from development in 1970s. . Adjoins Marin Municipal Water District, state park, and national park lands, which together provide a linkage between the waters of San Francisco Bay and the Pacific Ocean.
Camino Alto	170.3	<ul style="list-style-type: none"> . Northridge acquisition from 1970s. Parcels purchased in 1974, 1976, 1977, 1978, 1989, 1991, 1992, and 2002. . Shares boundary with Marin Municipal Water District land to the west; abuts residential neighborhoods along its eastern margin; and is adjacent to the Mill Valley Golf Course to the west.
Horse Hill	50.2	<ul style="list-style-type: none"> . Purchased in 1995. . Horses have grazed Horse Hill for over 40 years. Privately owned horses (maximum of 14) are grazed on 60 acres, including land belonging to Mill Valley Meadows Homeowners' Association. . At least three prehistoric archeological sites identified. . Abuts Highway 101 to the east.
King Mountain	107.5	<ul style="list-style-type: none"> . Ranching in late 1800s. Goat grazing in early to mid-1900s. . Parcels acquired in 1988 and 1990.
REGION 1 TOTAL	1,196.8	
Region 2		
Cascade Canyon	504.4	<ul style="list-style-type: none"> . Grazing (Bottini Ranch) until 1914. . Hunting (Elliot Nature Preserve) from mid 1900s to 1970s. . Parcels purchased in 1974, 1976, 1978, 1987, 1994, and 1995. . Cascade Canyon bottomlands and Cascade Canyon fire trail are very heavily used. . Gateway to Marin Municipal Water District and other public lands.
French Ranch	402.6	<ul style="list-style-type: none"> . Purchased in 1977. . Previously combined with Indian Tree.
Gary Giacomini	1,499.83	<ul style="list-style-type: none"> . Parcels purchased from developers in 1991 and 1995. . Marin Municipal Water District shares the western boundary of the preserve; gateway to other public lands.
Loma Alta	508.5	<ul style="list-style-type: none"> . History of grazing. . Parcels acquired in 1988, 1989, and 1990.
Maurice Thorner Memorial	32.8	<ul style="list-style-type: none"> . Acquired in 1981. . Gold mining in late 1800s on slope south of the preserve.
Roy's Redwoods	293.0	<ul style="list-style-type: none"> . Select-cut logging, grazing in mid-1900s. . Purchased in 1978. . Golf course along southwestern boundary.
White Hill	390.0	<ul style="list-style-type: none"> . History of grazing, probably until the 1920s. . Purchased from Boy Scouts of America in 1994 and 1997 – 98. . North Shore Railroad built tunnel (now Bothin Tunnel) through ridge north from White Hill. . Shares western boundary with Marin Municipal Water District; gateway to other public lands.
REGION 2 TOTAL	3,631.2	

Table 2.1 Preserve Sizes and Settings

Preserve Name	Area (acres)	History and Setting
Region 3		
Ignacio Valley	900.84	<ul style="list-style-type: none"> . Purchased in 1975. . Adjacent to Loma Verde and Pacheco Valle Preserves.
Indian Valley	557.6	<ul style="list-style-type: none"> . Previously part of the Back Ranch. . First parcel purchased in 1975.
Loma Verde	319.6	<ul style="list-style-type: none"> . History of ranching. . Adjacent to Ignacio Valley and Pacheco Valle Preserves.
Lucas Valley	1,270.9	<ul style="list-style-type: none"> . History of ranching since 1860 (Lucas Valley Dairy). . Parcels acquired in 1975, 1986, 1989, 1990, and 1996. . Properties to the west are privately owned ranches. . County-owned parcels to the east are managed by the Lucas Valley Homeowners' Association.
Pacheco Valle	503.73	<ul style="list-style-type: none"> . Parcels acquired in 1975 and 1995. . Adjacent to Ignacio Valley and Loma Verde Open Space Preserves.
REGION 3 TOTAL	3,552.7	
Region 4		
Deer Island	153.5	<ul style="list-style-type: none"> . Island until late 19th century; diked and drained for pasture land. History of ranching since 1890. . Parcels acquired in 1978 and 1983 (9-acre grazing lease ended). . Property surrounded by parcels owned by Marin County Department of Public Works/ Flood Control, Novato Sanitary District, California Department of Fish and Wildlife, Marin Audubon Society.
Indian Tree	242.0	<ul style="list-style-type: none"> . Purchased in 1977. . Adjacent properties owned by Marin Agricultural Land Trust and North Marin Water District. . Road access is from Vineyard Road through North Marin Water District lands.
Little Mountain	214.1	<ul style="list-style-type: none"> . Previously part of E Ranch. . Purchased in 1995. . Adjacent residential community is essentially surrounded by the MCOSD lands. . North Marin Water District lands are adjacent on west boundary. . Slope instability issues on south face addressed shortly after property was acquired.
Mount Burdell	1,627.3	<ul style="list-style-type: none"> . Previously part of C Ranch. . Purchased in 1977. . California Department of Parks and Recreation owns Olompali property to the northeast. . Private dairies on northwest and western slopes. . Cattle have grazed here for many decades.
Rush Creek	522.1	<ul style="list-style-type: none"> . Chicken ranch in early 1900s. . Land acquired in late 1990s. . California Department of Fish and Wildlife owns adjacent properties.
Verissimo Hills	114.6	<ul style="list-style-type: none"> . Gift from Sanchez family in 1985. . Adjacent residential community is essentially surrounded by the MCOSD lands.
REGION 4 TOTAL	2,873.6	
Region 5		
Bald Hill	31.0	<ul style="list-style-type: none"> . Parcels acquired in 1994 and 1995. . Shares a boundary with Marin Municipal Water District land. . Summit is privately owned.
San Pedro Mountain	357.5	<ul style="list-style-type: none"> . Dairy ranching since mid-1850s. Nike Missile site established in 1954. . Parcels purchased in 1974 – 77. Additional parcel purchased in 1999. . Adjacent lands owned by City of San Rafael and California Department of Parks and Recreation. Adjacent to China Camp State Park.

Table 2.1 Preserve Sizes and Settings

Preserve Name	Area (acres)	History and Setting
Santa Margarita Island	8.8	<ul style="list-style-type: none"> . Land used for soil disposal after World War II. Dumping of dredging spoils in 1969 and 1987. Residents recall goats on the island in the 1940s and 1950s. The west side of the island burned in 1974. Landfill on the north end of island. . Purchased in 1974; marshland filled in and canals built. . Residents of Las Gallinas contributed to funding of this preserve.
Santa Venetia Marsh	32.8	<ul style="list-style-type: none"> . Purchased in 1978. Handwritten note: Land used for soil disposal; Santa Venetia Land Corp. sold land to Trust for Public Land in 1973; purchased in 1974.
Terra Linda/Sleepy Hollow Divide	1,171.8	<ul style="list-style-type: none"> . Numerous parcel acquisitions from 1972 through 1989. . Sheep grazing from 1981 – 87 for fuel reduction.
REGION 5 TOTAL	1,601.9	
Region 6		
Bolinas Lagoon	1,077.5	<ul style="list-style-type: none"> . Management turned over to the MCOSD in 1988 from Marin County Parks Department. . Audubon Canyon Ranch owns a portion of Kent Island. Adjacent properties owned by California Department of Parks and Recreation and National Park Service.
Bothin Marsh	105.9	<ul style="list-style-type: none"> . North and South Basins are essentially man-made marshes. . 1851 map shows tidal marshes extending to base of the hills. Dikes built in 1950s and 1960s; filling and building in 1970s. . Shell mound in North Basin. . Acquired in 1976. Pathway (old railroad right of way) acquired in 1981 through Rails-to-Trails Program.
Old Saint Hilary's	121.8	<ul style="list-style-type: none"> . Acquired parcels in 1993 and 1997. . The MCOSD owns adjacent Tiburon Uplands Nature Preserve.
Ring Mountain	367.2	<ul style="list-style-type: none"> . Earliest Miwok village dated to 370 BC. . Part of Reed Ranch for 130 years until 1965. Army installed guns on summit in 1950s, deactivated in 1960s. . The MCOSD took title to property in 1995; The Nature Conservancy retained a conservation easement. . Geologically diverse and unique; mineral lawsonite first discovered here in the 1890s. . Town of Tiburon owns several significant adjacent properties.
Tiburon Ridge	15.1	<ul style="list-style-type: none"> . Formerly Koch property. . Acquired in 1983. . The Northwestern Pacific Railroad once ran freight trains through a tunnel on Tiburon Ridge. The trail that delivered the first prisoners to Alcatraz Island ran through that tunnel.
REGION 6 TOTAL	1,687.1	
COUNTY TOTAL	14,543.2	

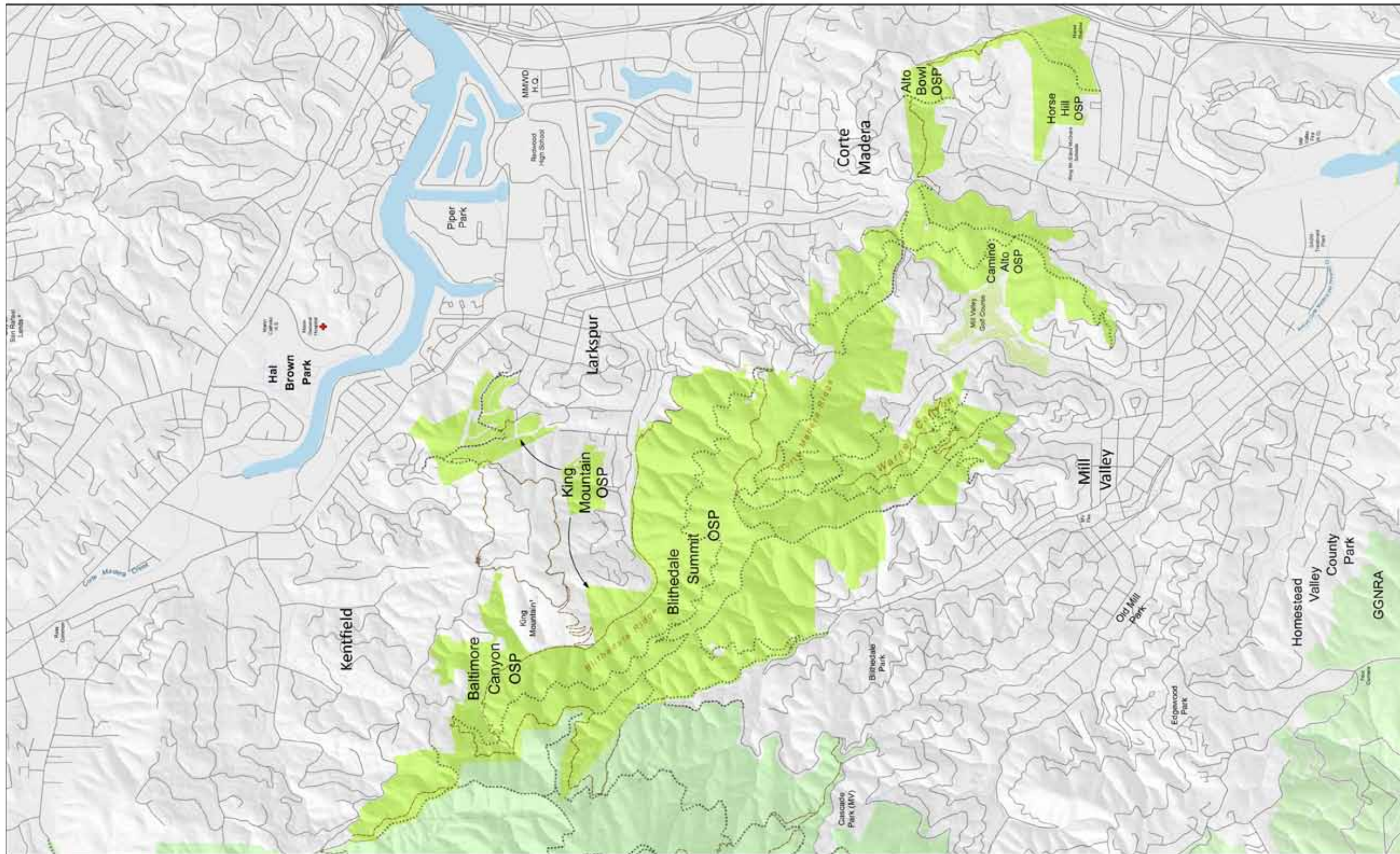


Figure 2.2
Preserves, Region 1

0 1,000 2,000 4,000 Feet
Data Source: MatchMap, USGS and MCOSD
Coordinate System: NAD 1983 StatePlane California III FIPS 8903 Feet
Projection: Lambert Conformal Conic



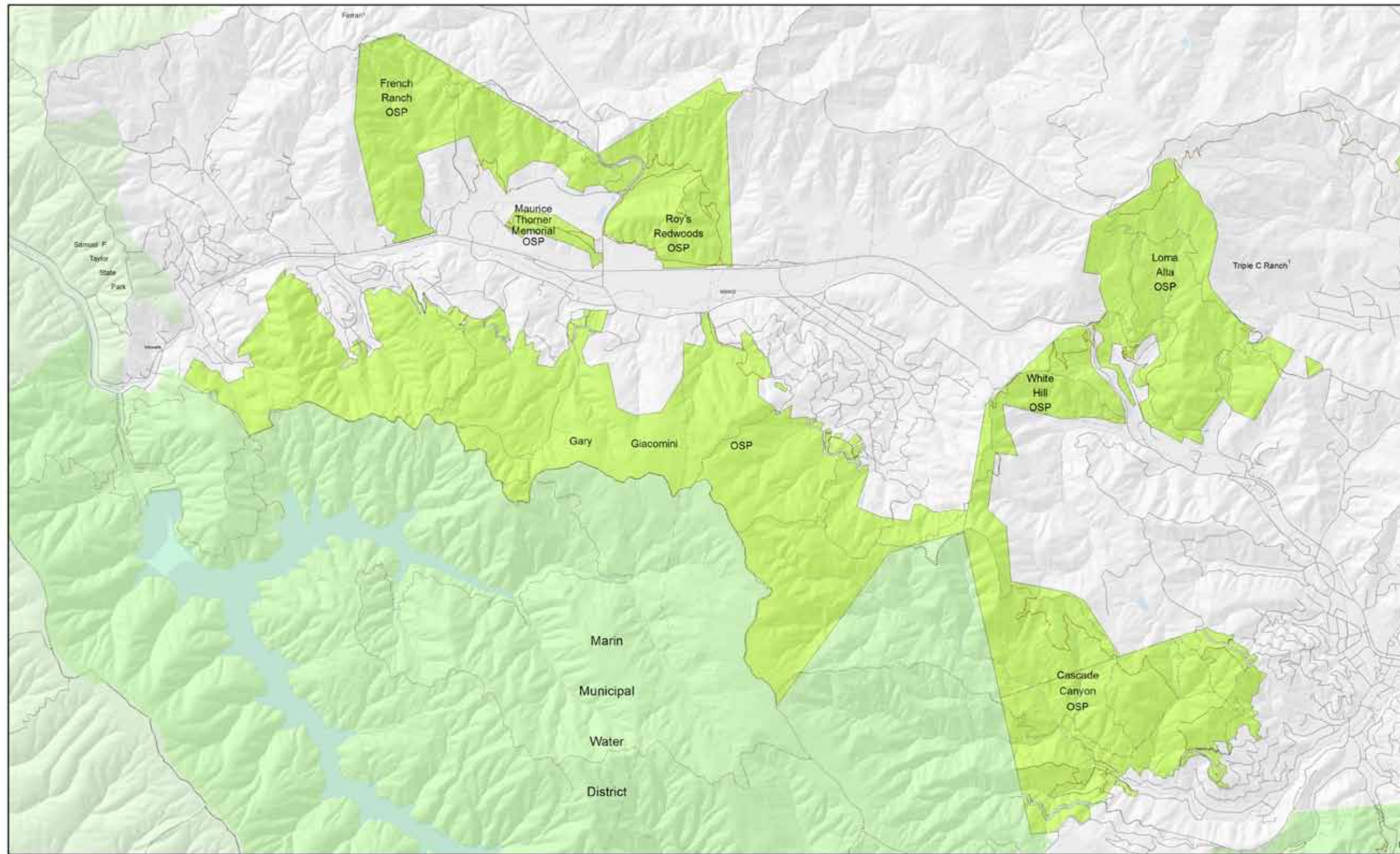


Figure 2.3
Preserves, Region 2

0 1,000 2,000 4,000 Feet
Data Sources: MapInfo, CIGIS and MCOSD
Coordinate System: NAD 1983 StatePlane California II FIPS 4011 Feet
Projection: Lambert Conformal Conic

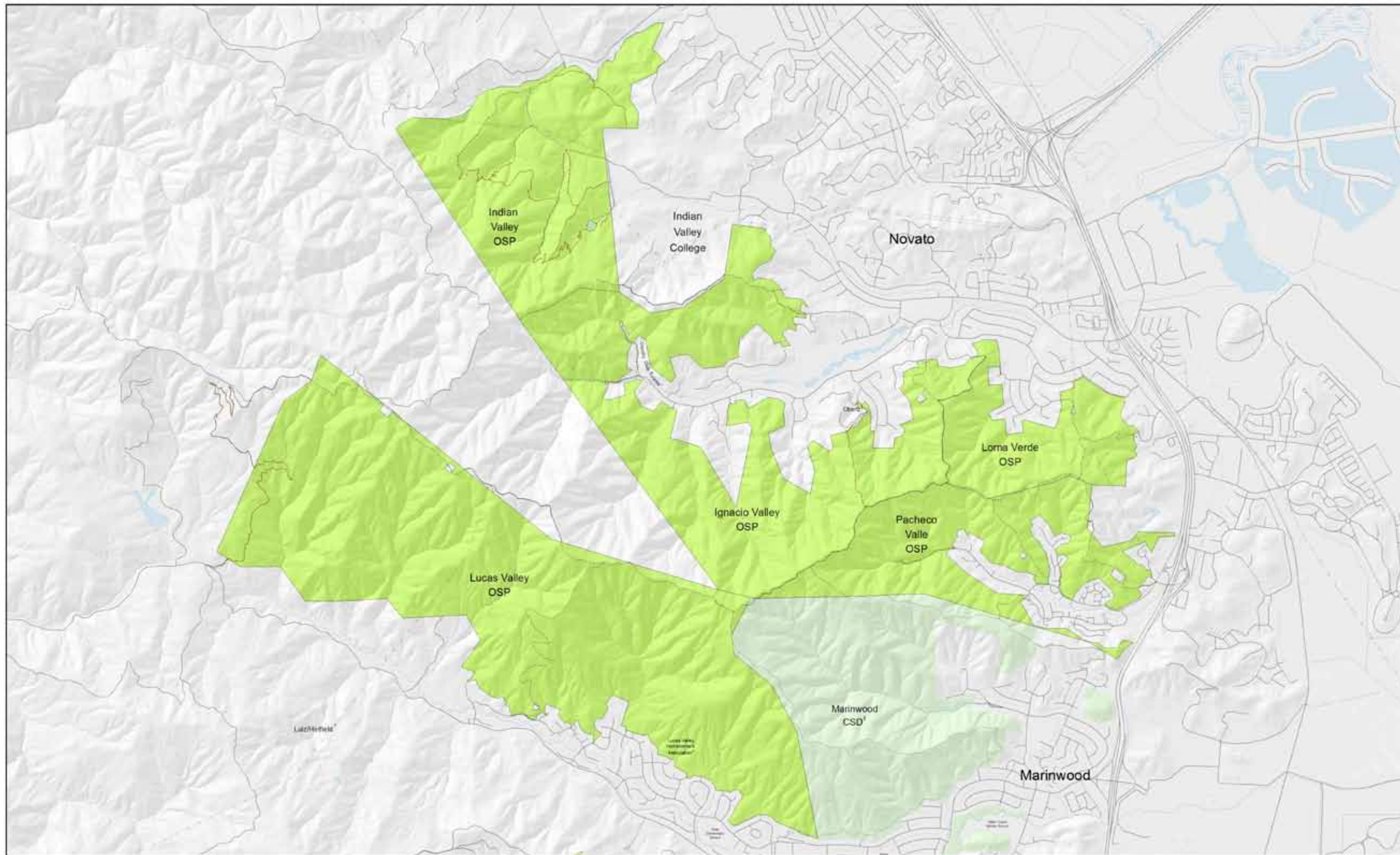


Figure 2.4
Preserves, Region 3

0 1,000 2,000 4,000 Feet
Data Sources: MapInfo, USGS and MCOSD
Coordinate System: NAD 1983 NorthCarolina 311209 9487 Feet
Projection: Lambert Conformal Conic

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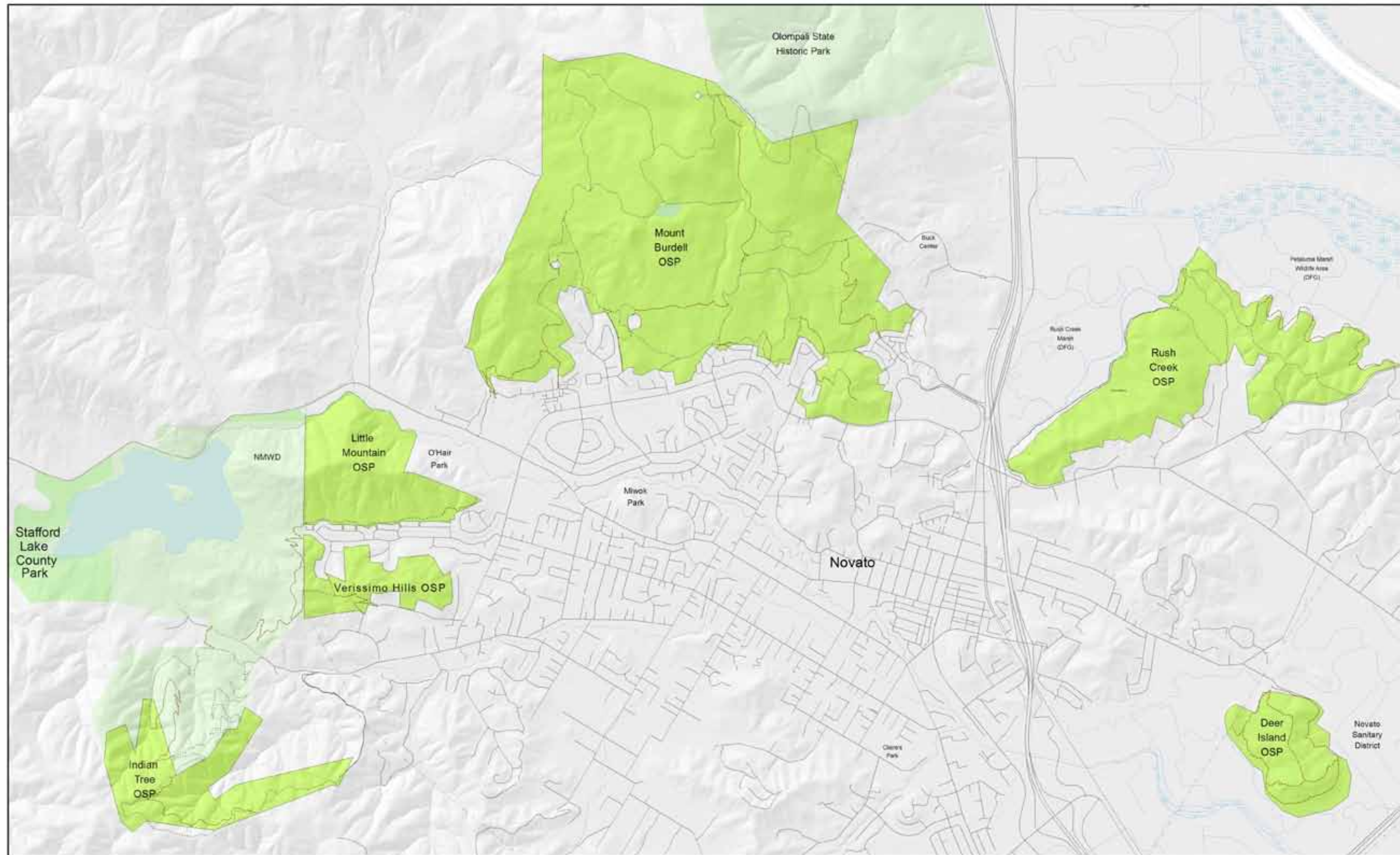


Figure 2.5
Preserves, Region 4

0 1,000 2,000 4,000 Feet
Data Sources: MapInfo, USGS, and MCOSD
Coordinate System: NAD 1983 StatePlane California III FIPS 9403 Feet
Projection: Lambert Conformal Conic

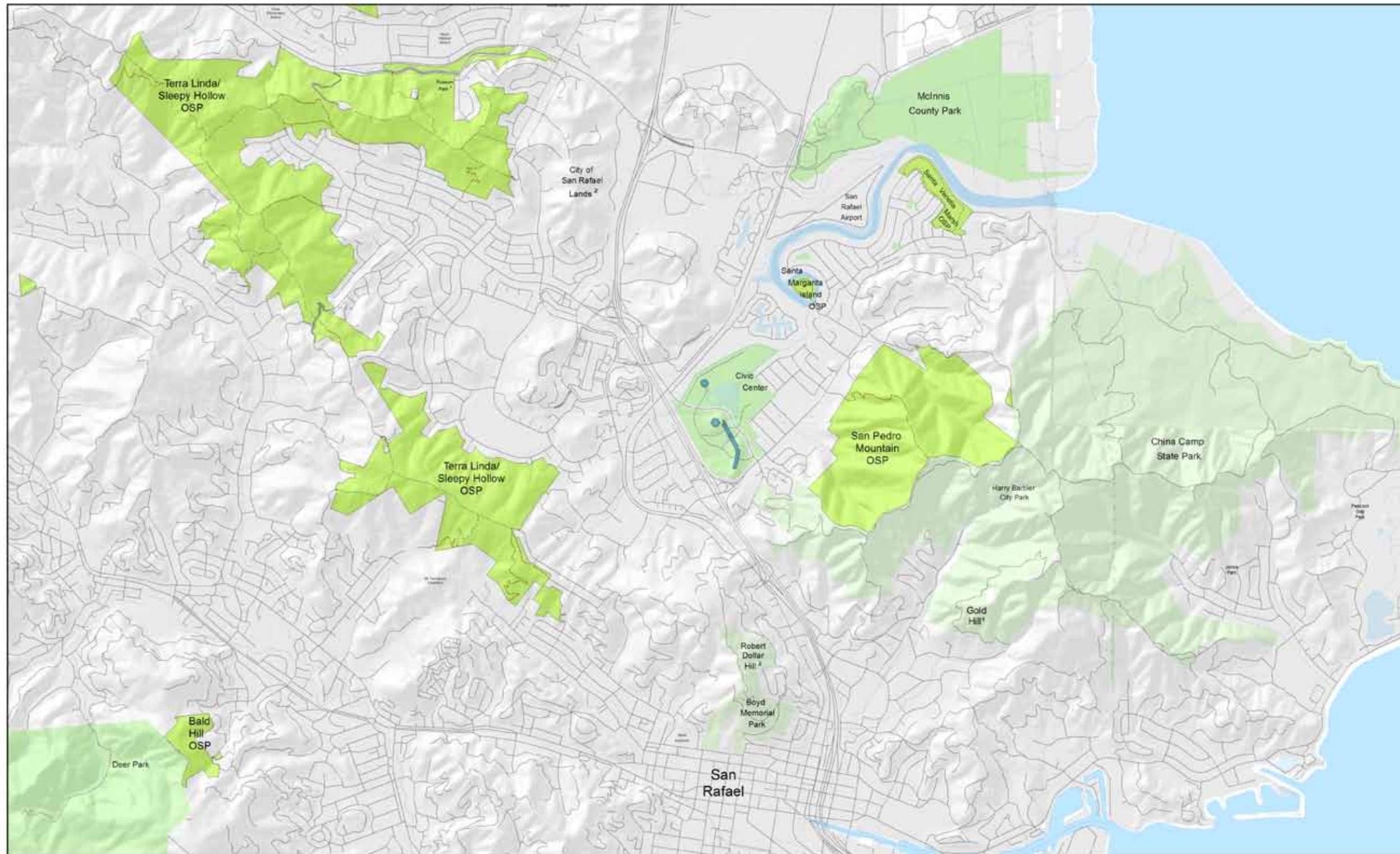


Figure 2.6
Preserves, Region 5

0 1,000 2,000 4,000 Feet
Data Sources: MapInfo, USGS and MCOSED
Coordinate System: NAD 1983 StatePlane California III FIPS 8903 Feet
Projection: Lambert Conformal Conic

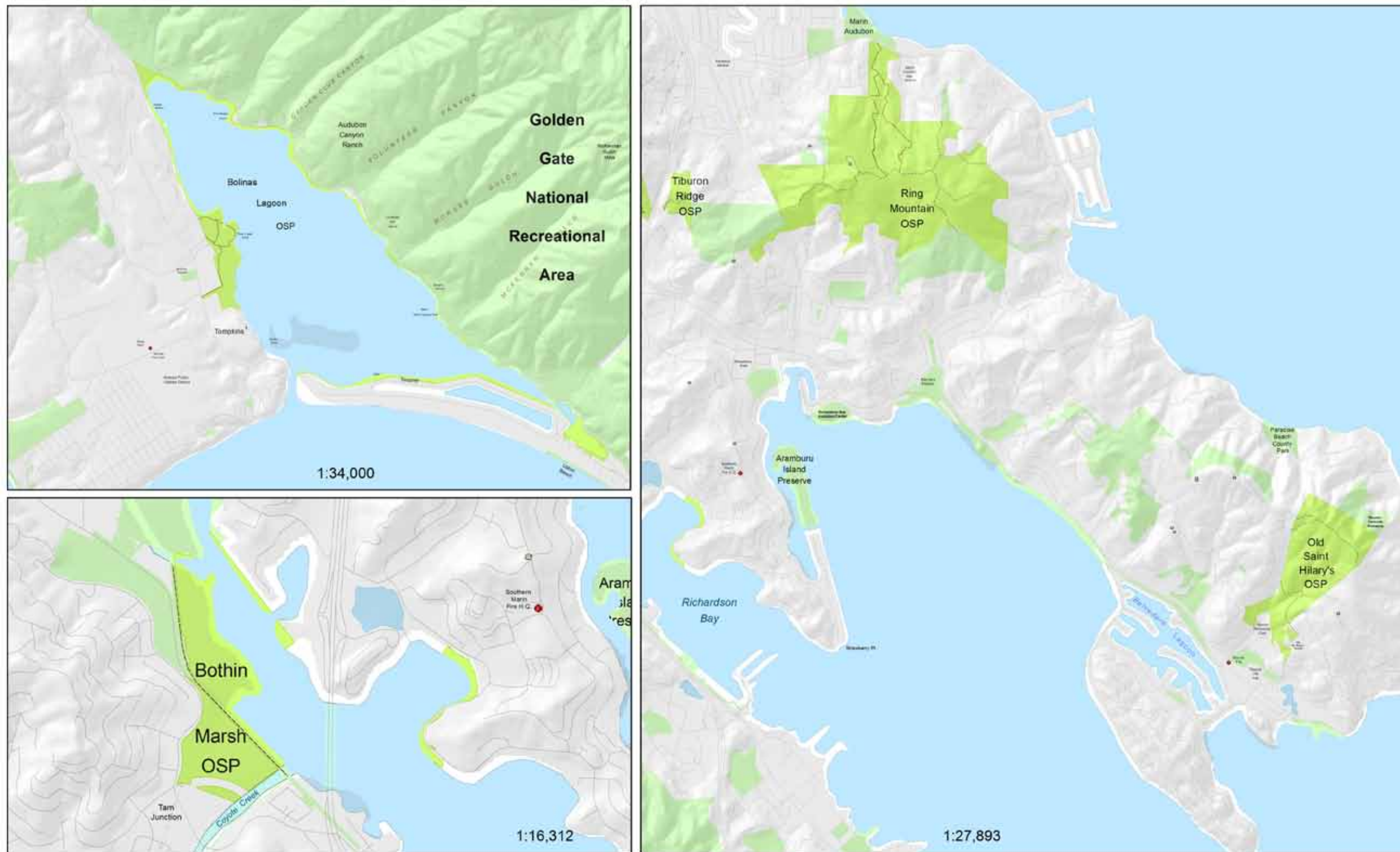


Figure 2.7
Preserves, Region 6

Data Source: MapInfo, USGS and MDCSD
Coordinate System: NAD 1983 StatePlane California III FIPS 8903 Feet
Projection: Lambert Conformal Conic



3. FRAMEWORK FOR SCIENCE-BASED MANAGEMENT

The MCOSD has developed a framework of integrated databases and GIS mapping layers to support road and trail decision making. It includes three kinds of data:

- extensive data about the physical characteristics of roads and trails
- environmental data and mapping of high-value habitats, hydrologic resources, soils, and geologic hazards
- social data about use of the preserves and visitors' interests and concerns

This information can be queried at various levels of detail to support decision making ranging from broad policies, to recommended actions for specific trails, to monitoring and evaluation of the effectiveness of management actions. The tables and figures in this chapter present a summary of the best available data, derived from many volumes of data developed for the thousands of acres of the MCOSD lands. The MCOSD will continue to collect information, and to expand and fill gaps in its databases in order to refine future road and trail management actions. For example, more in depth wildlife data collection was initiated in summer 2014.

Road and Trail Assessment

In 2010 the MCOSD contracted for an extensive assessment of the locations and the existing conditions of all the roads and trails on the MCOSD preserves, including both the formal alignments maintained by the district and the many informal alignments created by users. The resulting *Road and Trail Assessment* (MCOSD 2011d) provides detailed information about the condition of roads and trails and identifies known problem areas, such as wet areas and locations with erosion and drainage issues, steep grades, or rough tread.

Types of Data

The data included in the assessment are based primarily on a systematic and comprehensive field-based inventory of pertinent features identified at distinct points (point data) or along reaches (reach data) of roads or trails. (Reaches are linear segments of a road or trail with similar average characteristics, conditions, and constraints.)

Point Data

Point data record specific information at one or more spots within a road or trail segment. Point features include stream crossings, pertinent erosional features, utilities and facilities, road/trail structures, and photo points. They may also identify localized trail conditions that differ from the average condition of the trail segment. Only significant points, impacts, or obstacles were recorded, rather than every small variation within the trail segment. The categories of collected point data are summarized in table 3.1.

Table 3.1 Point Data Categories

Feature	Feature Description	Measured Values
Stream crossing	Watercourse crossing	Location, size, condition, and type of constructed facility at crossing
Cross drain	Features for draining the road/trail surface, including water bars, reverse grade dips, and ditch relief culverts	Location, size, and type of cross-drain feature
Structure	Feature other than stream crossings and cross drains used to support the road or trail	Location and type of constructed structure
Landslide	Natural or road related	Location, type, and volume of slope failure
Erosion	Significant erosional feature along alignment	Type of erosional feature
Facility	Road and trail improvement feature, including gates and signs	Location and type of improvement
Utilities	Utility features (water and power) along route. (May exclude some underground utilities that were not apparent in the field review.)	Location and type of utility infrastructure
Water feature	Springs, streams, swales, lagoons, wet areas	Location of water feature

Source: MCOSD 2011d.

Reach Data

Although reaches are defined to have similar characteristics, conditions, and constraints, because roads and trails are not uniform, the recorded data for each reach represents the average condition for that reach. Where substantial changes in characteristics and conditions occur, a new reach begins. Some attributes, notably grade, orientation, tread condition, and wetness can vary significantly in short distances; for these attributes additional information was gathered and recorded separately for subsegments within a reach, with all the subsegments then included in calculating the average condition for the reach. The categories of data collected for each reach are summarized in table 3.2.

Table 3.2 Reach Data Categories

Category	Description and Measured Values
Length	Road/trail distance (feet) from start to end of reach
Location	Predominant location of reach (e.g., ridgetop, ridgetop/fall line, fall line, cross-slope, valley bottom, mixed)
Width	Average width of constructed road/trail bed (the constructed width of the tread and not necessarily the useable width)
Surface material	Predominant tread surface material (e.g., paved, oil-screened, base rock/gravel, or native material)
Grade (reach)	Average road/trail grade per reach
Grade (subsegment)	Average grade per subsegment

Table 3.2 Reach Data Categories

Category	Description and Measured Values
Grade (maximum)	Maximum sustained trail grade per reach (sustained for 50 feet or more)
Trail orientation to the fall line (reach)	Average alignment of each reach of road/trail relative to the fall line
Trail orientation to the fall line (subsegment)	Fall line alignment of each subsegment
Level of use	Qualitative measure of the level of use based on observed tread wear
Drivability	Measure of whether the road/trail is passable by vehicle. (This information is useful for the MCOSD maintenance staff. It does not reflect the managed or accepted use.)
ADA access potential	Qualitative determination of whether the road/trail meets access criteria required under the Americans with Disabilities Act
Tread roughness (subsegment)	Qualitative and relative measure of tread roughness per subsegment
Wet/muddy (subsegment)	Seasonal wetness or muddiness along a subsegment
Maintenance	Level of maintenance or repair required to conform to typical trail standards

Source: MCOSD 2011d.

Overall Condition of Roads and Trails

The *Road and Trail Assessment* evaluated the following three categories of information regarding overall road and trail conditions:

- tread condition
- sustainability factors, primarily drainage condition, grade, fall line orientation, and required maintenance
- potential for resource impacts, primarily erosion into water bodies

Based on this assessment, each road and trail was placed in one of five classes, ranging from good to poor, as defined in table 3.3. Those ranked as good are fully functional and sustainable, with uniform tread, minimal erosion problems, and low resource impact. Those ranked as poor are not functional or sustainable over the long term. They include roads/trails where the tread has deteriorated and is in need of upgrades and those that are poorly aligned and/or excessively steep and at high risk for erosion with continued use. Some roads/trails that are in a location and/or configuration that puts them at risk for erosion, such as a steep fall line alignment in open grassland, may not currently show signs of erosion due to low use; however, these were still ranked as having either fair or poor condition, depending on the steepness of the fall line alignment or other factors that could cause the trail to become unsustainable over the long term if it experienced increased use.

Steep, wet, and/or rutted or otherwise degraded trails, and poorly designed trails, adversely affect the quality of visitor experiences by making travel difficult or unsafe or by diminishing visitors' perceptions of naturalness. Visitors seeking to circumvent muddy or badly eroded trail sections contribute to tread widening and the creation of parallel secondary treads, which

Table 3.3 Road and Trail Condition Classes

Category	Description
Good	Fully functional and sustainable with standard maintenance: Uniform stable tread, minimal problems, and low resource impact.
Good-Fair	Functional and sustainable with ongoing maintenance: Generally stable tread with low potential for resource impact; local minor problems may exist; minor upgrades may be required.
Fair	Marginally functional, with portions unsustainable without a high level of maintenance: Moderately drained with infrequent cross drains; tread in fair condition; rilling may be evident, but significant erosion problems are generally absent; portions in need of upgrades to repair damage or minimize resource impact.
Fair-Poor	Not functional, with portions unsustainable and possibly infeasible to upgrade: Deteriorated and in need of upgrades, and/or poorly aligned and/or excessively steep with a fall line orientation and at high risk for erosion with continued uses; typically moderately to poorly drained with infrequent cross drains; tread may be deeply rutted and rilled; high level of maintenance required to prevent offsite impacts.
Poor	Not functional or sustainable, possibly infeasible to upgrade: Deteriorated and/or at high risk for erosion; may present significant offsite impact.

Source: MCOSD 2011d.

expand vegetation loss and the aggregate area of trampling disturbance. When existing trail networks fail to provide visitors the access and experiences they desire, visitors frequently venture off trail to reach locations not accessible by formal trails. The informal trails created by visitors (sometimes referred to as social trails), the trails created by cattle and wildlife, and the trails constructed by various user groups without authorization from the MCOSD are usually not professionally designed, constructed, or maintained and can have substantially greater adverse effects on natural resources than do formal trails (Leung and Marion 1999; Marion et al. 2006). Informal trails can be linked to trail alignment parallel to the fall line (the natural downhill course, such as water would take), steep grades, multiple trails accessing the same destinations, and routes through fragile vegetation, soils, or sensitive wildlife habitats.

The undesirable effects of roads and trails can be both chronic and episodic. Chronic problems occur every year, and typically include surface flow running down roads and trails and washing sediments into creeks and reservoirs, or segments of trail tread seasonally becoming wet and muddy. Episodic problems occur infrequently and typically only during large storm events; these problems include slope failures and failures of culverts at stream crossings.

Table 3.4 indicates that open space preserves with a substantially higher-than-average percentage of good or good-fair roads and trails include Baltimore Canyon, King Mountain, Blithedale Summit, Gary Giacomini, Roy's Redwoods, Deer Island, Indian Tree, Santa Margarita Island, and Santa Venetia Marsh. Preserves with a substantially higher-than-average percentage of roads and trails within the fair-poor or poor classifications are Camino Alto, Horse Hill, French Ranch, Loma Alta, Indian Valley, Verissimo Hills, and Terra Linda/Sleepy Hollow Divide. Table 3.5 shows the percentage of roads and trails within each of the defined condition classes within each region. As shown in table 3.5, regions 1, 2, and 4 have a higher percentage of roads and trails within the good or good-fair classifications than the average for all regions. Conversely, regions 3 and 5 have a greater percentage of roads and trails within the fair-poor and poor classifications compared with the regional average.

Table 3.4 Percentage of Roads and Trails by Road Condition Class Compared to Systemwide Average

Preserve	Road Condition Class					
	Good	Good-Fair	Fair	Fair-Poor	Poor	Unknown
REGION 1						
Baltimore Canyon	higher	higher	lower	lower	lower	lower
King Mountain	lower	higher		lower	lower	lower
Blithedale Summit	lower	higher	lower			
Camino Alto	lower		higher		higher	lower
Alto Bowl	lower	lower	lower	lower	lower	higher
Horse Hill	lower		lower	higher		lower
REGION 2						
Cascade Canyon	lower				lower	lower
French Ranch	lower			higher	lower	lower
Gary Giacomini	higher			lower		
Loma Alta				higher	lower	
Maurice Thorner Memorial						higher
Roy's Redwoods	higher	lower	higher	lower	higher	lower
White Hill			lower		lower	
REGION 3						
Ignacio Valley		lower	higher			
Indian Valley					higher	lower
Loma Verde	lower	lower	higher		lower	lower
Lucas Valley	lower	lower		higher		
Pacheco Valle	lower		higher		lower	lower
REGION 4						
Deer Island	lower	higher	lower	lower	lower	lower
Indian Tree		higher	lower		lower	lower
Little Mountain	lower	lower	higher			lower
Mount Burdell						
Rush Creek					lower	lower
Verissimo Hills	lower			higher	lower	lower
REGION 5						
Bald Hill						
San Pedro Mountain	lower		higher			lower
Santa Margarita Island	lower	higher				lower
Santa Venetia Marsh	higher					lower
Terra Linda/Sleepy Hollow Divide					higher	
REGION 6						
Bolinas Lagoon						
Bothin Marsh						
Old Saint Hilary's						
Ring Mountain	lower					lower
Tiburon Ridge						

Notes: = favorable condition = neutral condition = unfavorable condition

Condition class with no notation = preserve has an average percentage of roads and trails in that condition class, or there are no roads or trails of that condition class within the preserve.

**Table 3.5 Summary of Road and Trail Conditions by Region
(miles and percentage of total miles within each classification)**

Region	Region Acreage	Road Condition Class						Total Miles	Density (miles/acre)
		Good	Good-Fair	Fair	Fair-Poor	Poor	Unknown		
Region 1	1196.8	4.75 13%	13.4 39%	6.2 18%	7.17 21%	2.54 7%	0.00 0%	34	0.02
Region 2	3631.2	12.59 18%	19 27%	13.8 20%	15.95 23%	4.44 6%	3.22 4%	69	0.01
Region 3	3552.7	2.82 7%	7.86 20%	11.59 30%	8 21%	4.2 11%	3.53 9%	38	0.01
Region 4	2873.6	2.85 4%	19.7 33%	13.19 22%	11.57 19%	1.35 2%	10.33 17%	59	0.01
Region 5	1601.91	4.6 14%	7.2 23%	7.5 24%	5.6 18%	3.7 11%	2.4 7%	31	0.01
Region 6	1687.1	1.58 8%	2.38 13%	5.75 31%	2.24 12%	1.05 5%	5 27%	18	0.01
Total System	14543.2	29.19 11%	69.54 27%	58.03 23%	50.53 20%	17.28 6%	24.48 9%	249	0.01

Source: Based on information developed by Best et. al. 2011.
Note: Not all column values sum to totals due to rounding.

Tread Condition

The tread condition category describes the current condition of the trail tread with respect to roughness, erosion, and obstacles. Trail tread is ranked as good to poor. Trails with good tread condition are typically smooth, without significant erosion, obstructions, or berms. Trails with poor tread condition have a highly irregular and uneven tread that is often gullied and eroded. On the MCOSD lands, tread condition is generally a function of erosion and gullyng, but uneven tread condition also may occur for other reasons, such as exposed bedrock. Tread condition provides a general measure of where erosion has occurred, but not the rate or timing of erosion. Figures 3.1 – 3.3 illustrate examples of different tread conditions. The tread condition of the roads and trails in each preserve is summarized in table 3.6, in terms of miles within each condition classification (poor to good).



Figure 3.1 An example of good tread condition.



Figure 3.2 An example of fair tread condition.



Figure 3.3 An example of poor tread condition.

Table 3.6 Road and Trail Tread Condition by Preserve (miles within each classification)

Preserve	Poor	Fair-Poor	Fair	Good-Fair	Good	Unknown	Totals
Region 1							
Baltimore Canyon	0.04	0.04	0.66	2.39	1.59	0.00	4.72
King Mountain	0	0.17	0.27	0.42	0.59	0.15	1.60
Blithedale Summit	0.14	1.42	3.51	4.52	3.80	0.00	13.39
Camino Alto	0.30	0.57	2.02	1.84	1.55	0	6.28
Alto Bowl	0	0.46	0.63	0.05	0	0	1.14
Horse Hill	0	0.74	0.48	0.58	0	0	1.80
Region 2							
Cascade Canyon	0	1.16	3.85	3.04	1.29	0	9.34
French Ranch	0	1.21	0.43	1.14	0.04	0	2.82
Gary Giacomini	1.56	1.66	4.89	3.61	7.78	0	19.50
Loma Alta	0	0.67	3.77	3.03	1.19	0.03	8.69
Maurice Thorner Memorial	0	0	0.11	0.12	0.63	0	0.86
Roy's Redwoods	0	1.38	1.26	0.18	1.30	0	4.12
White Hill	0	0.62	3.01	1.42	1.73	0.01	6.79
Region 3							
Ignacio Valley	0	0.48	1.60	3.67	0.99	0	6.74
Indian Valley	0.38	2.55	1.77	1.75	2.48	0	8.93
Loma Verde	0	0.40	1.57	0.92	0.35	0.04	3.28
Lucas Valley	0	1.22	2.81	4.97	0.97	0	9.97
Pacheco Valle	0	0.35	2.27	0.91	0.18	0	3.71
Region 4							
Deer Island	0	0	0	2.60	0.55	0	3.15
Indian Tree	0	0.55	0.62	2.24	0.00	0	3.41

Table 3.6 Road and Trail Tread Condition by Preserve (miles within each classification)

Preserve	Poor	Fair-Poor	Fair	Good-Fair	Good	Unknown	Totals
Little Mountain	0	0.32	0.77	0.32	1.14	0	2.55
Mount Burdell	0.50	0.51	8.24	10.82	3.99	0	24.06
Rush Creek	0	0.50	0.91	1.94	2.88	0	6.23
Verissimo Hills	0	0	0.27	0.38	0.51	0	1.16
Region 5							
Bald Hill	0	0	0.04	0.62	0	0	0.66
San Pedro Mountain	0.07	0	0.96	0	1.39	0.00	2.42
Santa Margarita Island	0	0	0	0.30	0	0	0.30
Santa Venetia Marsh	0	0	0	0	1.08	0	1.08
Terra Linda/Sleepy Hollow Divide	0.87	1.48	4.98	7.08	3.91	0.59	18.91
Region 6							
Bolinas Lagoon	0	0	0	1.33	0.09	0.00	1.42
Bothin Marsh	NA	NA	NA	NA	NA	NA	NA
Old Saint Hilary's	0	0.30	0.81	0.69	0.44	0	2.24
Ring Mountain	0	0.82	2.14	3.23	2.66	0.19	9.04
Tiburon Ridge	0	0.20	0.13	0	0	0	0.33

Note: Not all column values sum to totals due to rounding.
 Source: MCOSD 2011d, with figure updates by the MCOSD in 2013.

Factors Affecting Road and Trail Sustainability

In the context of this plan the term *sustainable* is used to describe a road or trail that can be maintained through standard practices for its designated use without causing off-site impacts. The following factors influence road and trail sustainability:

- trail design and location factors
 - » grade
 - » orientation to the fall line
 - » width
 - » protection of natural drainage patterns
- natural factors
 - » geology and soil type
 - » required stream crossings
- use factors
 - » type of use
 - » amount of use
- required maintenance

Trail Grade

The average trail grade is estimated by dividing the run (linear distance) by the rise (net change in elevation) (see figure 3.4). Numerous studies have documented a strong positive relationship between trail grade and degradation (Midpeninsula Open Space 2002, MCOSD 2010, IMBA 2001, Marion and Olive 2006, Parker 2004). The steeper the grade, the more likely it is to erode. The steepness of the roads and trails in each preserve is summarized in table 3.7 in terms of miles within each grade classification (gentle to steep). Steep gradient trails also impact recreational access, making the trail more difficult to travel and more difficult to use while maintaining control of a horse or bicycle.

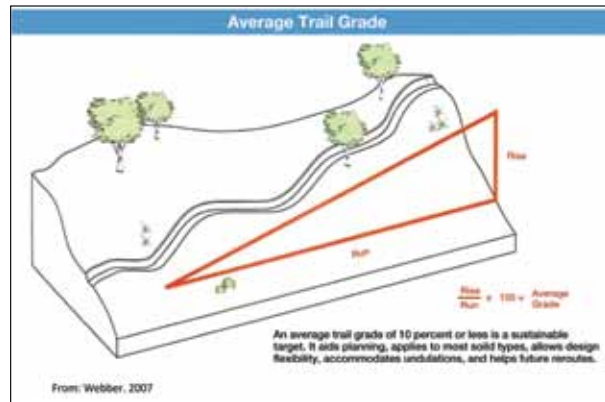


Figure 3.4 Average trail grade.

Most erosion problems tend to occur where the road or trail grade exceeds 15%. Grades steeper than 15% (see figure 3.5) are difficult to adequately drain, and as a result, runoff tends to concentrate down the road or trail for long distances (see figure 3.6).



Figure 3.5 Steep road and fall line trail. Both are difficult to drain and experience much greater erosional problems compared to lower gradient trails.



Figure 3.6 Erosion along steep (>15% grade) trail segment.

Trail Orientation to the Fall Line

Higher rates of erosion occur on fall line roads and trails (Midpeninsula Open Space 2002, MCOSD 2010, Marion and Olive 2006). Fall line routes drop directly down the hillside (see figure 3.7). They generally follow the same path that water flows, thereby channeling water down their length (see figures 3.8 – 3.11). These roads and trails are difficult, if not impossible, to drain properly and often experience ongoing erosion. Repeated grading of fall line alignments can result in shallow through-cuts (a lowering of the tread so that it becomes lower than the

Table 3.7 Road and Trail Grade by Preserve (miles within each classification)

Preserve	Gentle	Gentle - Moderate	Moderate	Moderate -Steep	Steep	Unknown	Totals
Region 1							
Baltimore Canyon	1.77	1.65	.23	0.89	0.17	0	4.71
King Mountain	0.37	0.13	0.57	0.43	0.1	0	1.60
Blithedale Summit	3.99	2.87	2.84	1.20	1.82	0.68	13.40
Camino Alto	1.66	1.28	1.98	0.92	0.43	0	6.27
Alto Bowl	0.38	0.63	0	0.13	0	0	1.14
Horse Hill	0.28	0.55	0.04	0.62	0.31	0	1.80
Region 2							
Cascade Canyon	1.82	2.28	1.81	2.79	0.65	0	9.35
French Ranch	0.33	0.86	0.63	0.23	0.79	0	2.84
Gary Giacomini	3.44	3.63	6.51	2.95	2.42	0.57	19.52
Loma Alta	2.79	2.20	0.37	2.23	1.07	0.03	8.69
Maurice Thorner Memorial	0	0	0.11	0	0	0.74	0.85
Roy's Redwoods	0.75	1.62	0.36	0.94	0.45	0	4.12
White Hill	2.16	1.93	0.26	1.33	1.1	0.01	6.79
Region 3							
Ignacio Valley	0.5	0.21	2.08	3.01	0.94	0	6.74
Indian Valley	3.3	1.39	0.86	1.47	1.91	0	8.93
Loma Verde	0.06	0.29	1.31	1.56	0.07	0	3.29
Lucas Valley	1.1	0.17	2.93	1.74	2.92	1.1	9.96
Pacheco Valle	0.19	0.38	1.87	1.15	0.12	0	3.71
Region 4							
Deer Island	1.92	0.13	0.79	0	0.31	0	3.15
Indian Tree	1.39	0.15	1.23	0.50	0.14	0	3.41
Little Mountain	1.33	0.95	0	0.002	0.27	0	2.55
Mount Burdell	7.16	8.29	2.44	4.07	1.67	0.43	24.06
Rush Creek	4.07	1.65	0.52	0	0	0	6.24
Verissimo Hills	0.52	0	0.49	0	0.15	0	1.16
Region 5							
Bald Hill	0	0	0	0.04	0.62	0	0.66
San Pedro Mountain	0	0	0.61	0.15	1.65	0	2.41
Santa Margarita Island	0.30	0	0	0	0	0	0.30
Santa Venetia Marsh	1.04	0	0	0.04	0	0	1.08
Terra Linda/Sleepy Hollow Divide	5.72	3.82	1.96	3.73	3.13	0.55	18.91
Region 6							
Bolinas Lagoon	1.41	0.01	0	0	0	0	1.42
Bothin Marsh	NA	NA	NA	NA	NA	NA	NA
Old Saint Hilary's	0.48	0.09	0.14	1.23	0.3	0	2.24
Ring Mountain	2.78	1.40	1.71	2.47	0.69	0	9.05
Tiburon Ridge	0	.13	0	0.05	0.15	0	0.33

Source: MCOSD 2011d, with figure updates by the MCOSD in 2013.

- Notes: Gentle: less than 10% of the reach length is steeper than 15% grade.
- Gentle-moderate: less than 25% of the reach length is steeper than 15% grade.
- Moderate: 25% to 50% of the reach length is steeper than 15% grade.
- Moderate-steep: 50% to 75% of the reach length is steeper than 15% grade.
- Steep: 50% to 100% of the reach length is steeper than 15% grade.

Not all column values sum to totals due to rounding.

surrounding ground level), which further capture runoff and confine flow, disrupting natural drainage patterns.

Fall line routes have been generally laid out to expedite the construction process, often by ranchers or loggers who infrequently used the road, or by recreational users looking for the shortest route. Many of the fall line routes inventoried within preserves are situated along ridge lines to avoid the need to switch back and forth across steep slopes below the ridge. Some of these roads and trails are problems; others are not.

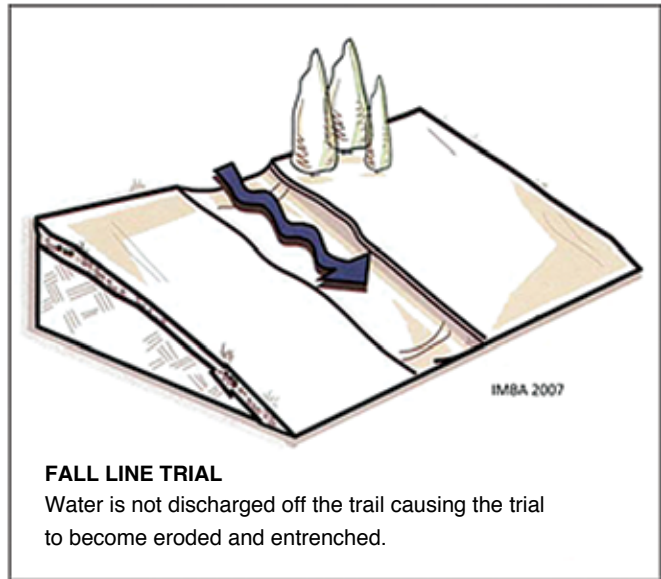


Figure 3.7 Fall line trail.



Figure 3.8 Erosion of fall line segment of a fire road. Notice that the lower portion of the road is in a through-cut.



Figure 3.9 Short fall line road segment in seasonally wet and muddy soils. Road segment drains into watercourse and is responsible for chronic fine-grained sediment delivery.



Figure 3.10 Example of steep fall line social trail.



Figure 3.11 Gullying on fall line narrow trail.

On steep trails with a fall line orientation, use patterns tend to result in trail widening (see figure 3.12). This results in greater ground disturbance and higher rates of erosion.



Figure 3.12 The lower Vogelsang Trail was widened as a result of visitor use. This steep fall line segment of trail drains to a watercourse at the base of the hillside.

Road or Trail Width

Road or trail width is a factor of sustainability, and also of sediment production. Roads have the potential to erode more than trails because of their greater width of disturbed area; and they can also be more difficult to drain where the alignment is steep. The types of drainage features that can be used are constrained by the need to accommodate vehicle use. Table 3.8 summarizes the widths of roads and trails in each preserve in terms of miles within each width classification (narrow to wide).

Table 3.8 Road and Trail Width by Preserve (miles within each classification)

Preserve	Narrow	Moderate	Wide	Totals
Region 1				
Baltimore Canyon	2.48	0.44	1.79	4.71
King Mountain	0.82	0	0.77	1.59
Blithedale Summit	3.91	3.10	6.39	13.40
Camino Alto	2.73	1.46	2.09	6.28
Alto Bowl	0.77	0	0.37	1.14
Horse Hill	1.20	0	0.59	1.79
Region 2				
Cascade Canyon	2.35	6.22	0.77	9.34
French Ranch	1.08	0.27	1.48	2.83
Gary Giacomini	6.37	7.08	6.06	19.51
Loma Alta	2.67	0.70	5.32	8.69
Maurice Thorner Memorial	0.86	0	0	0.86
Roy's Redwoods	2.85	1.27	0	4.12
White Hill	3.51	0.26	3.02	6.79
Region 3				
Ignacio Valley	4.07	0.40	2.27	6.74
Indian Valley	5.98	1.75	1.19	8.92
Loma Verde	1.07	0	2.23	3.30
Lucas Valley	3.32	2.04	4.60	9.96
Pacheco Valle	0.48	0	2.94	3.42

Table 3.8 Road and Trail Width by Preserve (miles within each classification)

Preserve	Narrow	Moderate	Wide	Totals
Region 4				
Deer Island	2.65	0.50	0	3.15
Indian Tree	2.21	0.15	1.04	3.40
Little Mountain	1.25	1.30	0	2.55
Mount Burdell	12.12	9.57	2.36	24.05
Rush Creek	3.10	3.02	0.12	6.24
Verissimo Hills	0.85	0.15	0.15	1.15
Region 5				
Bald Hill	0.67	0	0	0.67
San Pedro Mountain	2.34	0.07	0	2.41
Santa Margarita Island	0.30	0	0	0.30
Santa Venetia Marsh	0.04	1.04	0	1.08
Terra Linda/Sleepy Hollow Divide	9.16	3.68	6.07	18.91
Region 6				
Bolinas Lagoon	1.42	0	0	1.42
Bothin Marsh	0	0	0	0.00
Old Saint Hilary's	1.21	0.09	0.94	2.24
Ring Mountain	6.20	2.77	0.09	9.06
Tiburon Ridge	0.20	0.13	0	0.33

Source: MCOSD 2011d, with figure updates by the MCOSD in 2013.

Notes: Narrow = less than 4 feet; moderate = 4-10 feet; wide = greater than 10 feet.

Not all column values sum to totals due to rounding.

Drainage

One of the most important considerations for sustainable unpaved roads and trails is maintaining natural drainage patterns. Unpaved roads and trails should be designed and constructed to minimize the disturbance of natural drainage patterns. This avoids the concentration of runoff down the trail tread, which otherwise leads to erosion of the tread and sediment entering streams (Midpeninsula Open Space 2002, MCOSD 2010; Parker 2004; MCRCD 1994; Webber 2007).

The erosion caused by runoff down the trail tread of poorly drained trails can result in exposed rocks and plant roots, uneven tread surface, and locally muddy conditions. Erosion or instability of a hillside can also occur where runoff eventually spills over the road embankment. This appears to have been the case along the Luiz Fire Road, where several large gullies have developed on the grassy hillside from concentrated runoff, and on the Ponte Fire Road, where a large fill failure occurred (MCOSD 2010). Erosion can be self-perpetuating when treads erode below the surrounding soil level, forming a shallow through-cut and preventing the water from draining off the road or trail.

The most serious problems with drainage tend to occur in areas where the road or trail is steep, typically greater than 15% grade, or eroded (see figure 3.13). In these areas, constructing effective drainage dips² can be difficult, and therefore they are often undersized or installed at inadequate intervals. Such drains have a short life expectancy, since they tend to break down and/or infill easily with trail use. Various examples of well and poorly drained trails and roads are shown in figures 3.14 through 3.19.

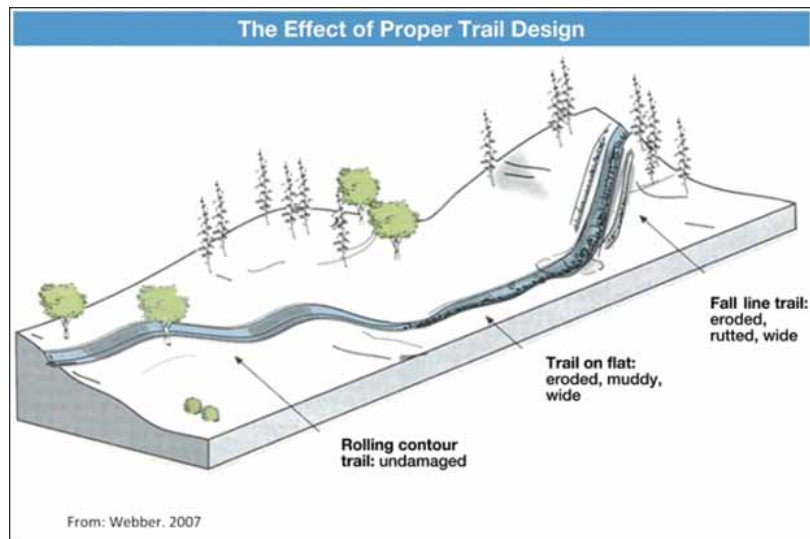


Figure 3.13 Factors affecting trail drainage.

The adequacy of drainage on roads and trails in each preserve is summarized in table 3.9 in terms of miles within each condition classification (poor to good). Roads and trails with good drainage have frequently spaced cross drains and do not show signs of concentrated runoff. Roads and trails with poor drainage have few effective cross drains, and significant concentrated runoff is evident or expected.

² Drainage dip: A short dip constructed in the road or trail that forces water off the tread and prevents runoff from concentrating. Drainage dips include rolling dips, reverse grade dips, and as a last option, water bars. Frequent dips are essential elements for sustainable trail design.



Figure 3.14 Reverse grade dips were integrated into this well-designed narrow trail.



Figure 3.15 Shallow gulying is evident along this wide trail. The lack of cross drains results in runoff being concentrated, resulting in the observed erosion.



Figure 3.16 A narrow trail without drainage dips. The lack of dips and compaction of the tread has caused the trail to become entrenched.



Figure 3.17 A deeply entrenched and poorly drained trail. Treatment of this trail will be difficult due to the steep grade and extensive entrenchment.



Figure 3.18 Erosion on rocked road attributed to lack of cross drains. Vehicular use of the road has resulted in shallow rutting along the wheel tracks.



Figure 3.19 Sediment from erosion of the road bed is deposited in a natural dip. Frequently placed drainage dips could have minimized this erosion.

Table 3.9 Adequacy of Road and Trail Drainage by Preserve (miles within each classification)

Preserve	Poor	Fair-Poor	Fair	Good-Fair	Good	Unknown	Totals
Region 1							
Baltimore Canyon	0.04	0.17	1.07	2.77	0.68	0	4.73
King Mountain	0	0.48	0.45	0.23	0.20	0.23	1.59
Blithedale Summit	0.84	2.29	5.60	4.14	0.23	0.29	13.39
Camino Alto	0.94	0.84	2.88	1.33	0.29	0	6.28
Alto Bowl	0	0.46	0.68	0	0	0	1.14
Horse Hill	0.31	0.15	1.34	0	0	0	1.80
Region 2							
Cascade Canyon	0.07	2.45	3.46	2.77	0.59	0	9.34
French Ranch	0	1.45	1.05	0.29	0.04	0	2.83
Gary Giacomini	2.96	3.83	6.88	1.78	4.06	0	19.51
Loma Alta	0.11	2.20	3.87	1.99	0.49	0.03	8.69
Maurice Thorner Memorial	0	0	0.11	0	0.74	0	0.85
Roy's Redwoods	1.77	0.58	1.76	0	0	0	4.11
White Hill	0	1.32	1.80	3.09	0.56	0.01	6.78
Region 3							
Ignacio Valley	0.35	3.00	1.81	1.42	0.15	0	6.73
Indian Valley	1.04	1.8	4.05	0	0.84	1.19	8.92
Loma Verde	0	2.48	0.60	0.17	0	0.05	3.30
Lucas Valley	0.99	3.54	4.30	0.80	0.33	0	9.96
Pacheco Valle	0.22	2.39	0.42	0.23	0.45	0	3.71
Region 4							
Deer Island	0	0.04	3.11	0	0	0	3.15
Indian Tree	0	0.64	0.20	1.66	0.90	0	3.40
Little Mountain	0	0.54	1.51	0.50	0	0	2.55
Mount Burdell	0	5.62	17.49	0.32	0.62	0	24.05
Rush Creek	1.12	0	4.22	0.78	0.12	0	6.24
Verissimo Hills	0	0.15	1.01	0	0	0	1.16
Region 5							
Bald Hill	0	0.04	0.59	0.04	0	0	0.67
San Pedro Mountain	0.40	0	0.61	0	0	1.40	2.41
Santa Margarita Island	0	0	0.30	0	0	0	0.30
Santa Venetia Marsh	0	0	1.08	0	0	0	1.08
Terra Linda/Sleepy Hollow Divide	3.97	2.14	8.30	2.53	1.51	0.43	18.88
Region 6							
Bolinas Lagoon	0	0	0.33	1.10	0	0	1.43
Bothin Marsh	0	0	0	0	0	0	0.00
Old Saint Hilary's	0.30	0.81	0.69	0.44	0	0	2.24
Ring Mountain	0.09	0.43	2.07	0	0.68	5.77	9.04
Tiburon Ridge	0.20	0.13	0	0	0	0	0.33

Source: MCOSD 2011d, with figure updates by the MCOSD in 2013.

Notes: Poor: Road/trail is poorly drained with few effective cross drains in place; significant concentrated runoff is evident or expected.

Fair-Poor: Road/trail is moderately to poorly drained with few cross drains in place; runoff is locally concentrated (or expected) for long distances; erosion of road/trail tread is typically evident; moderate to severe erosion is expected.

Fair: Road/trail is moderately drained with infrequent cross drains; concentrated runoff is locally evident or expected for short distances; minor tread erosion may be evident.

Fair-Good: Road/trail is well drained; cross drains may be infrequent, but concentrated runoff is not apparent.

Good: Road/trail is well drained with frequent cross drains; concentrated runoff is not evident.

Not all column values sum to totals due to rounding.

Soils

Road and trail stability is also influenced by the underlying soils—how easily they are compacted and eroded, and how stable they are on slopes. Soils within the preserves are predominantly loam to clay loam, which poses a severe to very severe erosion hazard for earthen roads and trails. According to field observations, the soils are moderately drained with high erosion potential. Erosion is most evident in areas where runoff has been concentrated. The breakdown of soil under heavy trail use often leads to accelerated erosion and trail rutting (MCOSD 2010).

Bank seeps and springs can cause soils to become chronically wet and muddy. This problem is exacerbated on low-gradient trails where water collects. Use of wet roads or trails can cause the surface to rut, resulting in the breakdown of the erosion-control structures and drainage dips. These problems may be compounded in soft clayey soils that do not dry out quickly. Additional damage can occur as the trail or roadbed is widened by users skirting the wet areas.

Chronic wet areas are potential sediment sources when they are located in or near a watercourse (see figure 3.20). When they are located away from drainages they may not be a sediment problem, but they may need to be repaired for access reasons. Other problems occur when relatively weak and soft clayey Franciscan mélange soil is encountered and/or where groundwater emerges towards the base of hillsides (see figure 3.21).

Many roads and trails are underlain at a shallow depth by relatively competent Franciscan sandstone and shale. When exposed in the road or trail bed, these earth materials are resistant to erosion; therefore, significant erosion problems are generally absent. The principal problems with shallow bedrock are twofold. First, the hard rock makes it difficult to install adequate drainage dips, and as a result dips are often infrequently spaced, allowing for runoff to become concentrated. While this may not result in much erosion of the road surface, it can result in



Figure 3.20 A wet segment of trail dropping into a small ephemeral stream. Trail erosion can be a source of fine-grained sediment.



Figure 3.21 Erosion of seasonally wet and relatively weak cohesionless soils.

problems where runoff is discharged off the road. The second problem is that bedrock, by nature, is often uneven and therefore when rock is exposed, the road and trail can be rough and uneven, which can impact the usability of the trail (see figure 3.22). Trails routed through serpentinite bedrock are particularly prone to this problem (see figures 3.23 and 3.24).

Use Level

For well-designed and constructed trails, post-construction trail impacts would be minimal in the absence of use. This is even the case for some poorly designed trails that are not heavily used, and are largely covered by vegetation, which limits the direct impact of rainfall and runoff. Some specific undesirable conditions, such as trail widening and the creation of parallel treads (trail braiding) or side trails, are related to user behavior. However, this user behavior is often caused by other poor trail conditions. For additional information regarding road and trail use, please refer to “Road and Trail Use,” below.



Figure 3.22 Competent shallow bedrock can minimize the amount of erosion, but at the same time can lead to an uneven road/trail surface.

Trail degradation is related to use intensity; however, trail design and other constraints are contributing factors. Leung and Marion (1996) found that the majority of post-construction changes occur with initial use or low levels of use, while degradation tends to diminish on a per-capita basis with increasing use, as users are occupying the already degraded area. Degradation on established trails is mostly a function of site durability and other use-related factors, such as type of use and user behavior.



Figure 3.23 Highly irregular tread surface with continuous obstacles. This narrow trail is routed through serpentinite bedrock.



Figure 3.24 Irregular tread surface on ridgetop fire road routed through serpentinite bedrock.

Table 3.10 shows the observed use levels on roads and trails within each preserve in terms of miles in each use level classification (abandoned to high).

Table 3.10 Observed Use Levels on Roads and Trails by Preserve (miles within each classification)

Preserve	Abandoned	Low	Moderate	High	Unknown	Totals
Region 1						
Baltimore Canyon	0	0.04	0.67	4.00	0	4.71
King Mountain	0	0.01	0	0.51	0	0.52
Blithedale Summit	0	1.59	3.45	7.21	0.35	12.6
Camino Alto	0.13	1.31	1.84	0	0	3.28
Alto Bowl	0	0	0.05	0	0.96	1.01
Horse Hill	0	1.03	0.39	0.25	0	1.67
Region 2						
Cascade Canyon	0	1.71	5.12	2.49	0	9.30
French Ranch	0	10.6	1.48	0.29	0	2.83
Gary Giacomini	0.70	1.03	4.68	11.32	1.64	19.37
Loma Alta	0	1.59	2.57	4.04	0.44	8.64
Maurice Thorner Memorial	0	0	0	0	0.83	0.83
Roy's Redwoods	0.04	1.03	0.85	1.91	0	3.83
White Hill	0.23	0.82	1.82	3.91	0.79	7.57
Region 3						
Ignacio Valley	0	1.74	0.93	0.98	0.71	4.36
Indian Valley	0	0.14	3.50	5.30	0	8.95
Loma Verde	0.28	0.66	0.96	1.05	0	2.95
Lucas Valley	0	2.51	0.71	5.07	1.18	9.45
Pacheco Valle	0	0.11	0.38	2.93	0	3.42
Region 4						
Deer Island	0	0.55	0.26	2.34	0	3.16
Indian Tree	0	0.33	1.53	1.55	0	3.41
Little Mountain	0	0.10	0.85	1.09	0	2.05
Mount Burdell	0.58	5.54	6.15	11.34	0.66	24.26
Rush Creek	0	0.11	3.38	2.38	0	5.87
Verissimo Hills	0	0.50	0.29	0.36	0	1.16
Region 5						
Bald Hill	0	0	0	0	0	0.00
San Pedro Mountain	0	0.80	1.62	0	0	2.42
Santa Margarita Island	0	0	0	0.30	0	0.30
Santa Venetia Marsh	0	0	1.08	0	0	1.08
Terra Linda/Sleepy Hollow Divide	0.09	3.01	7.40	6.35	1.54	18.39
Region 6						
Bolinas Lagoon	0	0	0	0	0	0.00
Bothin Marsh	0	0	0	0	0	0.00
Old Saint Hilary's	0	0	0	0	0	0.00
Ring Mountain	0.11	1.46	4.57	2.92	0	9.06
Tiburon Ridge	0	0	0	0	0	0.00

Source: Based on information in MCOSD. 2011d, with numbers updated by the MCOSD in 2013.

Notes: High = Notable wear of the trail tread; tread typically worn and nearly always exposed.

Low = Infrequent use with tread typically vegetated or covered in duff.

Not all column values sum to totals due to rounding.

Type of Use

Roads and trails on the MCOSD preserves receive a wide variety of uses, including patrol and maintenance vehicles, utility maintenance vehicles, and fire trucks, as well as mountain bikes, equestrians, and pedestrians. Type of use has also been shown to be a determinant of the type and extent of trail impacts (Marion and Olive 2006, Marion and Wimpey 2007, Wilson and Seney 1994). Roads with sustained vehicle use have been shown to have greater degradation than trails where vehicles are not used. The *Road and Trail Assessment* did not attempt to characterize or differentiate the impacts of different types of trail uses. It addressed only the observed conditions resulting from general trail use levels.

Required Maintenance

Ideally, roads and trails are located and designed to be very low maintenance, but many MCOSD roads and trails were not designed with this in mind. Maintenance practices include surface grading, construction and maintenance of drainage structures, and control of use patterns that affect the trail, such as cutting switchbacks. Trails were assessed qualitatively for the amount of maintenance required to conform to typical trail standards, and that information was included in the assessment of their overall condition (see table 3.3).

Road and Trail Redundancy

Systemwide 27% of the roads and trails in the preserves are redundant. Redundancy occurs when a preserve contains multiple similarly configured roads or trails within the same area that either parallel each other or lead to the same viewpoint or destination.

The lengths of redundant trails per region were calculated according to an updated and more recent dataset than that set forth in the *Road and Trail Assessment*. As set forth in table 3.11, the preserves having the highest percentage of redundant roads and trails occur in regions 5 and 6, although the highest mileage of such facilities occurs in region 2.

Table 3.11 Road and Trail Redundancy by Region

Region	Total Road/Trail Miles	Road and Trail Redundancy	
		Miles	% of total miles
Region 1	34	10	34%
Region 2	69	18	26%
Region 3	38	6	15%
Region 4	59	14	23%
Region 5	31	12	38%
Region 6	18	10	55%
Total	249	70	28%

Source: Based on queries from 2011 Marin County GIS Database.

The inventoried results imply there is ample opportunity for potentially decommissioning trails, particularly when one of the trails has an extremely low sustainability rating and great potential for aggravated erosion and/or sediment delivery. Removing or decommissioning redundant trails would help reduce road and trail maintenance costs and better meet environmental improvement goals.

Environmental Data

The complex geology and soils of Marin County combine with several microclimates to create a rich tapestry of unique vegetation communities, endemic plant species, and rare wildlife, interspersed with habitats common throughout coastal California. The MCOSD preserves protect a great diversity of these habitats, ranging from the San Francisco Bay salt marshes on the east of the Marin peninsula to valley oak rangelands on Mount Burdell. They also protect outstanding examples of northern California's natural vegetation communities, including oak-bay woodlands, savannas, grasslands, and wetlands.

Terrain within the preserves is varied, ranging from steep upland hills, characterized by V-shaped valleys located between narrow ridge crests, to low-gradient hills and marshes. Redwood forests above San Geronimo Valley funnel precipitation to salmon-bearing creeks, and the coastal wetlands of Bolinas Lagoon nurture fish, which in turn support shorebirds and migratory waterfowl. Each of the 34 preserves drains to unique stream, estuarine, or bay systems in one or more watersheds.

Several preserves are important links in regional habitat corridors. For example, Blithedale Summit and the southern complex of preserves adjoin Golden Gate National Recreation Area, Point Reyes National Seashore, Marin Municipal Water District lands, and California state parks to link habitats extending from the waters of San Francisco Bay to the Pacific Ocean. Mount Burdell and the northern complex of preserves link San Pablo Bay with conservation lands in west Marin and beyond. Figure 2.1 in chapter 2 shows the location of the MCOSD preserves with respect to other protected public lands within Marin County.

Biological Resources

The preserves are characterized as having high biodiversity (Howell et al. 2007; Howell 1986). The full taxonomic richness of the MCOSD lands is not well understood at this time, so many more species of wildlife, lichens, mosses, fungi, and insects are likely to occur than are currently known to occur on the MCOSD preserves. (More complete surveys conducted on Marin Municipal Water District lands have identified more than 900 species of vascular plants and at least 400 species of vertebrates [MMWD 2009]).

The MCOSD preserves contain forest, woodland, shrubland, grassland, wetland, and marsh habitats made up of 107 documented vegetation alliances and associations. Forested communities occur most frequently in the moister, north- and east-facing slopes and canyons throughout Marin County. California bay and oak woodlands are known throughout the Marin hills, while bishop pine, shore pine, and coast redwood forests line the canyons and coastal bluffs. These forests and woodlands contribute to riparian cover and cool streams for salmon and steelhead. Herbaceous communities are also common throughout the MCOSD preserves. Grasslands and coastal prairies composed of native bunch grasses and spring wildflowers blanket the hills and coastal terrace, while extensive salt marshes dominated by tules, cattails,

rushes, pickleweed, and salt grass buffer the shoreline of San Pablo Bay, Richardson Bay, and Bolinas Lagoon. Marsh ecosystems provide cover and forage for fishes, shorebirds, and migratory waterfowl, while providing essential water quality functions.

Special-status plant and wildlife species and sensitive plant communities are typically found clustered in areas with unusual geology, soils, aspects, elevations, or combinations of these attributes, conditions that have contributed to the evolution of these unique or rare species. For example, the portion of Mount Tamalpais that receives a marine influence (in the form of summer fog) contains maritime chaparral, a type of chaparral that is associated with several special-status plant species. Likewise, areas with serpentine soils support unique serpentine grasslands and serpentine chaparral. Both of these vegetation types are strongly correlated with special-status species that are tolerant of extreme soil conditions characterized by low levels of nutrients and high levels of heavy metals.

Marin County supports 171 rare plants, including 17 known from nowhere else in the world; 51 of these have been documented from the MCOSD lands (Calflora 2012, Howell et al. 2007). Marin western flax (*Hesperolinon congestum*), Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*), and Tiburon buckwheat (*Eriogonum luteolum* var. *caninum*) are serpentine endemics that are closely associated with Tiburon mariposa lily (*Calochortus tiburonensis*), a species known to occur only on serpentine grasslands in the Ring Mountain Preserve.

Diverse vegetation communities and open space contribute to high-quality wildlife habitat within the preserves. Eleven special-status wildlife species have been documented from the MCOSD lands. Northern spotted owls (*Strix occidentalis caurina*) are found within dense, old-growth forests, while shaded streams buffered from erosion by natural vegetation within preserves provide habitat for salmonids, such as steelhead (*Onchorhynchus mykiss irideus*) and chinook salmon (*Oncorhynchus tshawytscha*) (see “Hydrologic Resources,” below). Perennial wetlands and open waters provide breeding habitat for the endangered California red-legged frog (*Rana draytonii*), while California clapper rail (*Rallus longirostris obsoletus*), California black rail (*Laterallus jamaicensis*), and salt marsh harvest mouse (*Reithrodontomys raviventris halicoetes*) occupy marshes in Bolinas Lagoon and San Pablo Bay.

The vegetative richness of the MCOSD preserves supports a wide variety of species that depend on native habitat. Because of the habits and mobility of wildlife, the collection of wildlife data is difficult, time consuming, and costly. Consequently, with certain exceptions, there is insufficient scientific documentation regarding the presence of wildlife in the preserves on which to make well informed decisions regarding trail use. Much of the wildlife data possessed by the MCOSD is limited to particular special-status species, or anecdotal, meaning that it was not collected within the context of scientific research protocols. Given this circumstance, the MCOSD, like most land managers, must rely on data related to plant communities, including their areal extent, contiguity and proximity to each other, to infer whether a particular species may be present. Even then, the presence of a particular species within a plant community, or

a particular mix of plant communities, cannot be known with certainty until it is confirmed by observation and monitoring.

Vegetation Zoning

The MCOSD classified vegetation within the preserves into four management zones, based on the ecological and/or cultural importance of distinctive vegetation types, the condition of resources in particular locations, and the proximity of particular locations to urban or suburban areas. This process is described in great detail in the MCOSD's *Vegetation and Biodiversity Management Plan*. Most preserves contain more than one of the following four zones:

- legacy zone (vegetation types or species with highest biological value, often because they are unique or rare remnants of biological diversity)
- sustainable natural systems zone (vegetation types important to the ecological resiliency of natural systems, including wildlife corridors and refuge areas)
- natural landscape zone (typical native vegetation types with moderate amounts of human disturbance)
- highly disturbed zone (vegetation near developed areas, which receive high human use and disturbance)

Figures 3.25 to 3.30 show the distribution of these zones in each of the preserves by region. The potential for impacts associated with roads and trails is highest in the legacy zone and lowest in the highly disturbed zone.

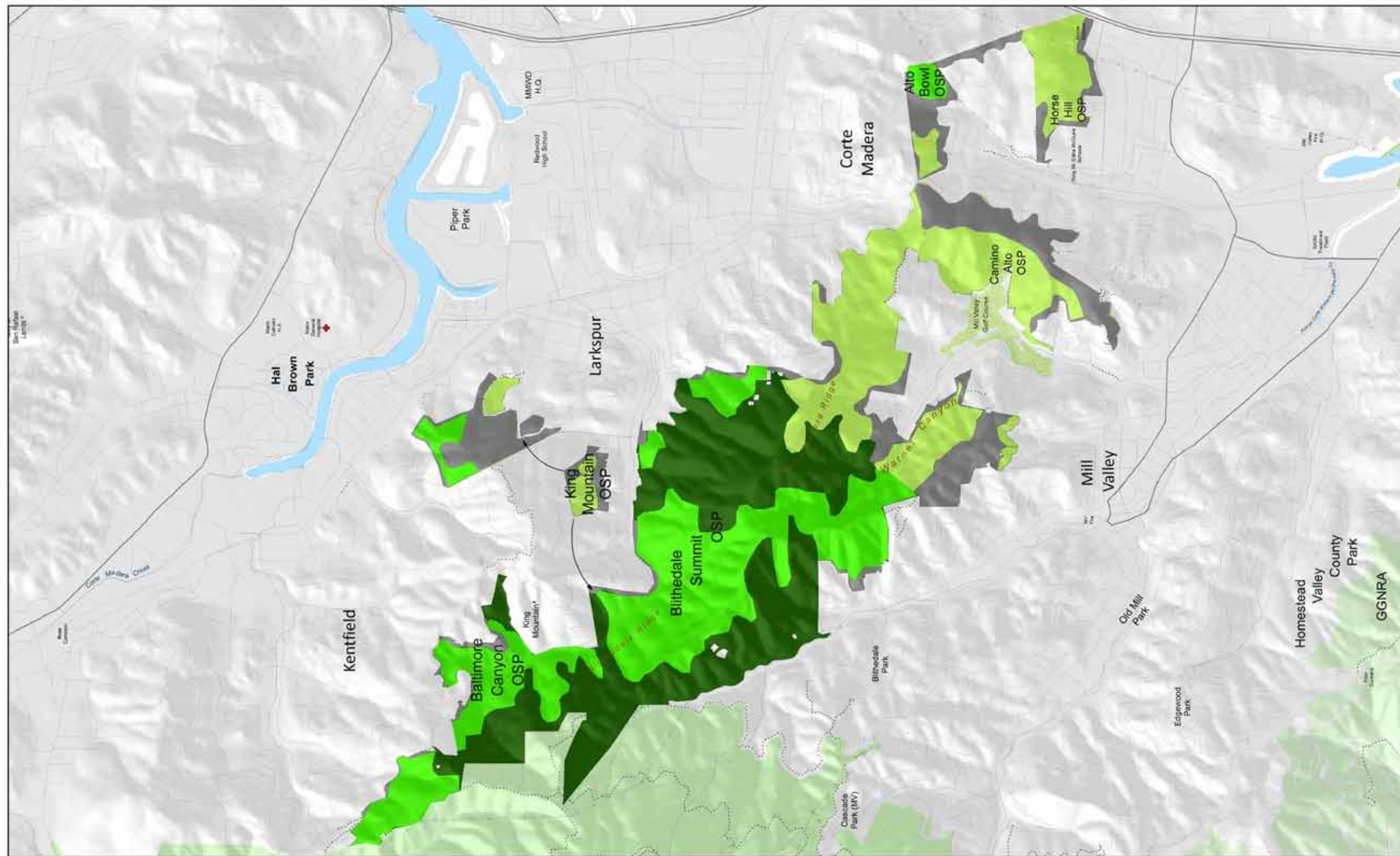


Figure 3.25
Vegetation Management
Zones
Region 1

0 1,000 2,500 4,000 Feet

Data Source: Microsoft, USGS and MCDOT
 Coordinate System: NAD 1983 StatePlane California II FIPS 6001 Feet
 Projection: Lambert Conformal Conic



- Legacy Zone
- Sustainable Natural Systems Zone
- Natural Landscape Zone
- Highly Disturbed Zone

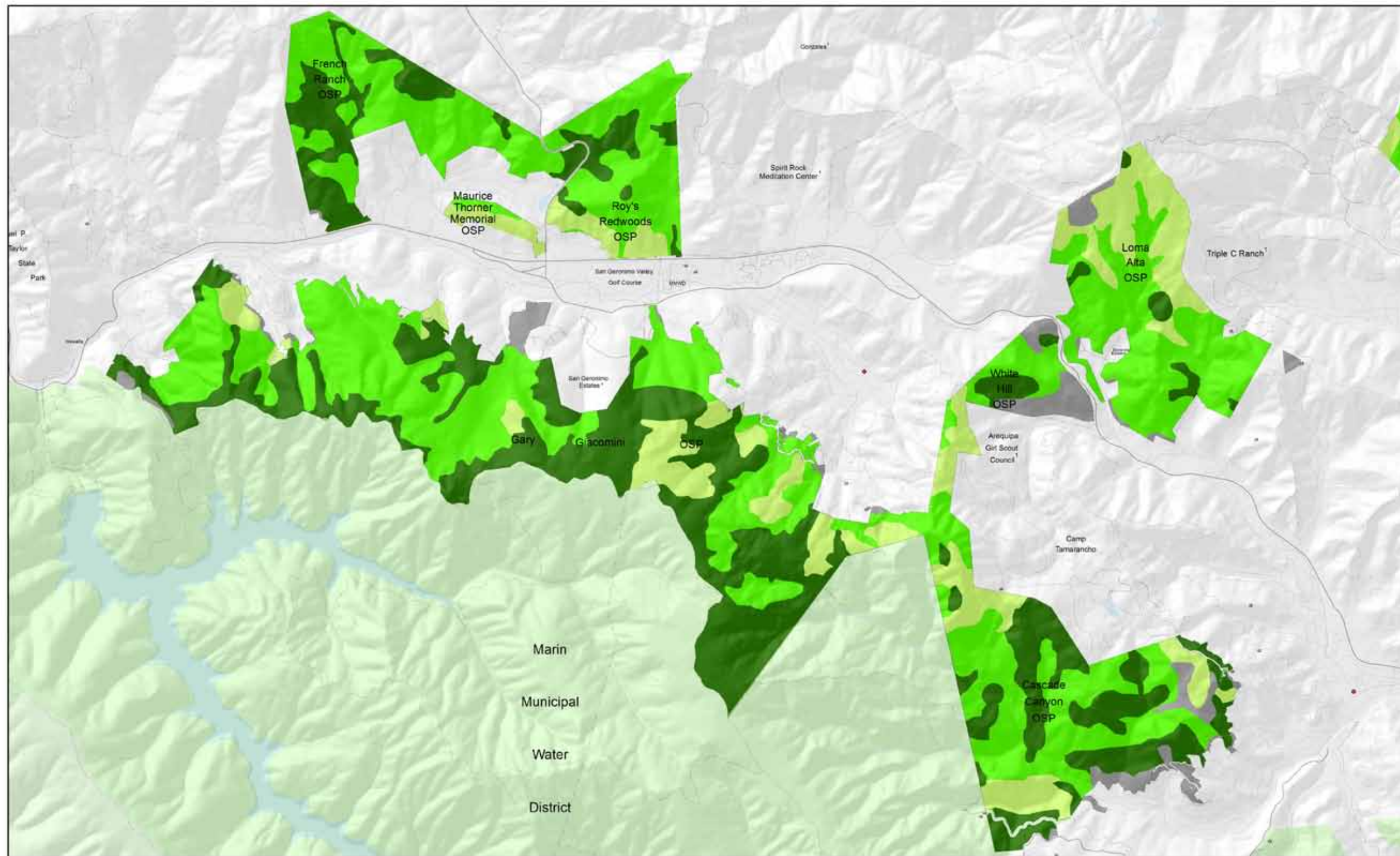


Figure 3.26
Vegetation Management
Zones
Region 2

0 1,000 2,000 4,000 Feet
 Data sources: MapInfo, USGS and NCEM
 Coordinate System: NAD 1983 StatePlane California III FIPS 6000 Feet
 Projection: Lambert Conformal Conic



- Legacy Zone
- Natural Landscape Zone
- Sustainable Natural Systems Zone
- Highly Disturbed Zone

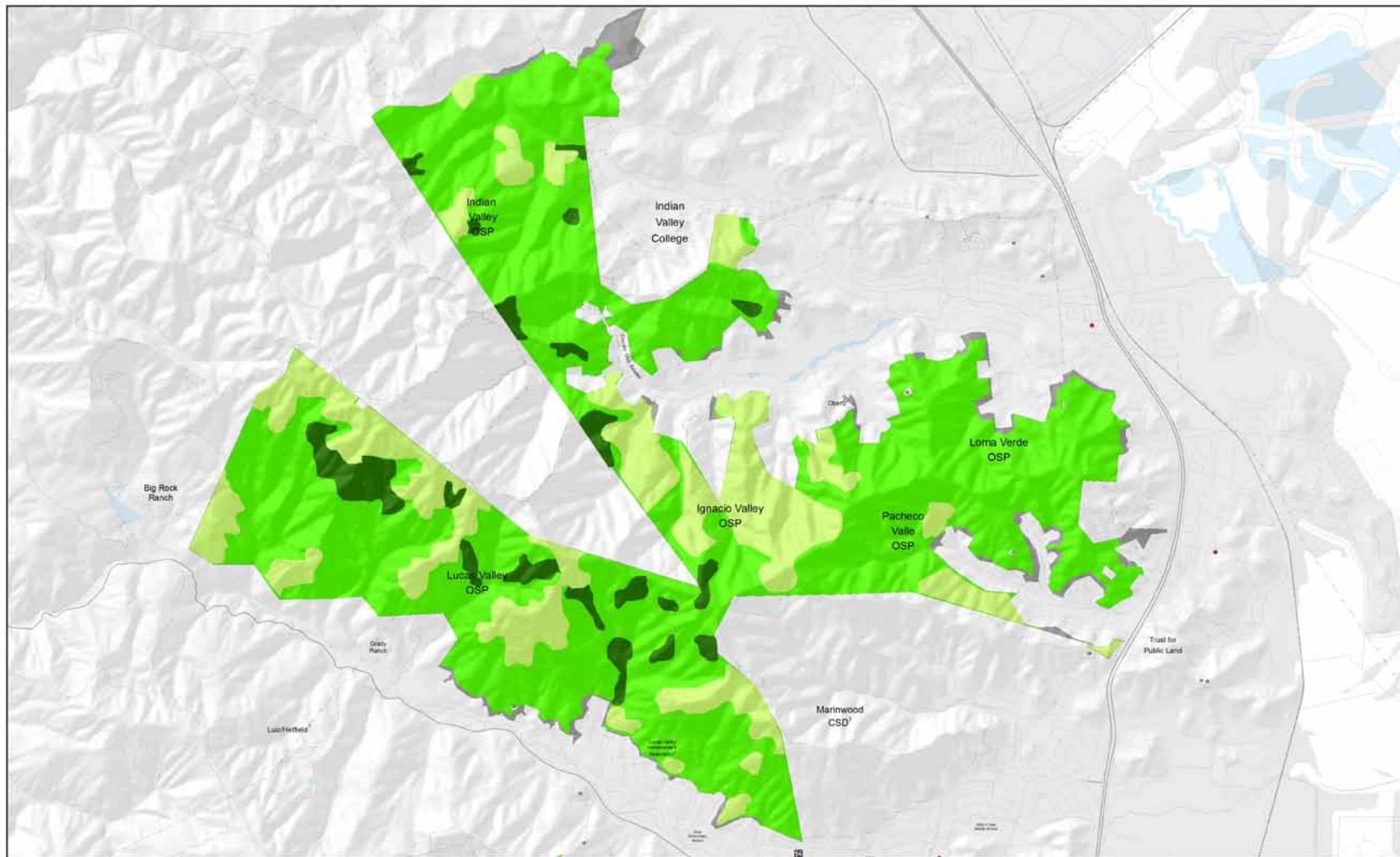


Figure 3.27
Vegetation Management
Zones
Region 3

0 1,000 2,000 4,000 Feet
 Data Sources: MapInfo, USGS and MDCWD
 Coordinate System: NAD 1983 StatePlane California 21181 9911 Feet
 Projection: Lambert Conformal Conic



- Legacy Zone
- Sustainable Natural Systems Zone
- Natural Landscape Zone
- Highly Disturbed Zone

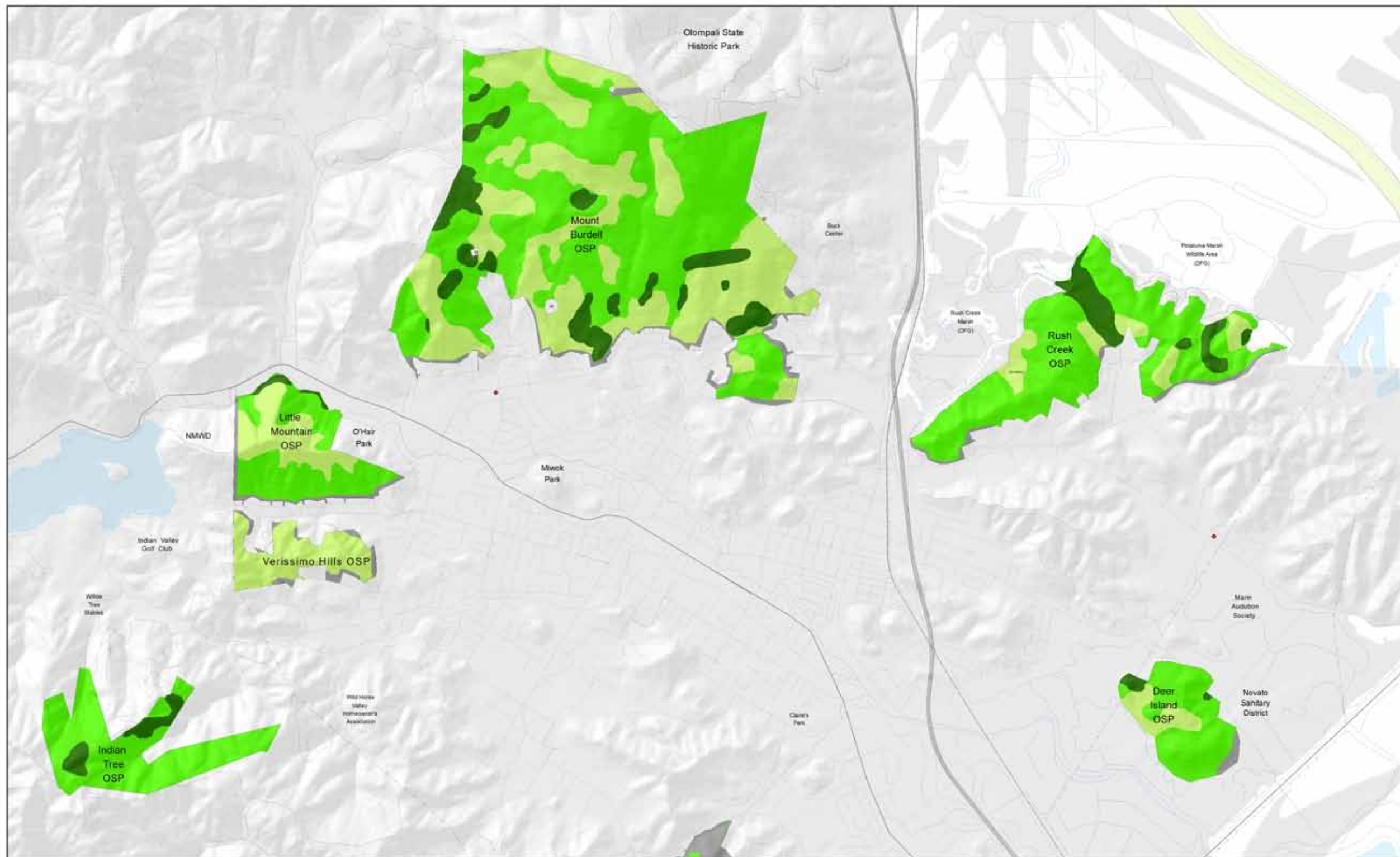


Figure 3.28
Vegetation Management
Zones
Region 4

0 1,000 2,000 4,000 Feet
 Data Sources: MapInfo, USGS and MDCGISD
 Coordinate System: NAD 1983 StatePlane California (FIPS 9801) Feet
 Projection: Lambert Conformal Conic

- Legacy Zone
- Natural Landscape Zone
- Sustainable Natural Systems Zone
- Highly Disturbed Zone

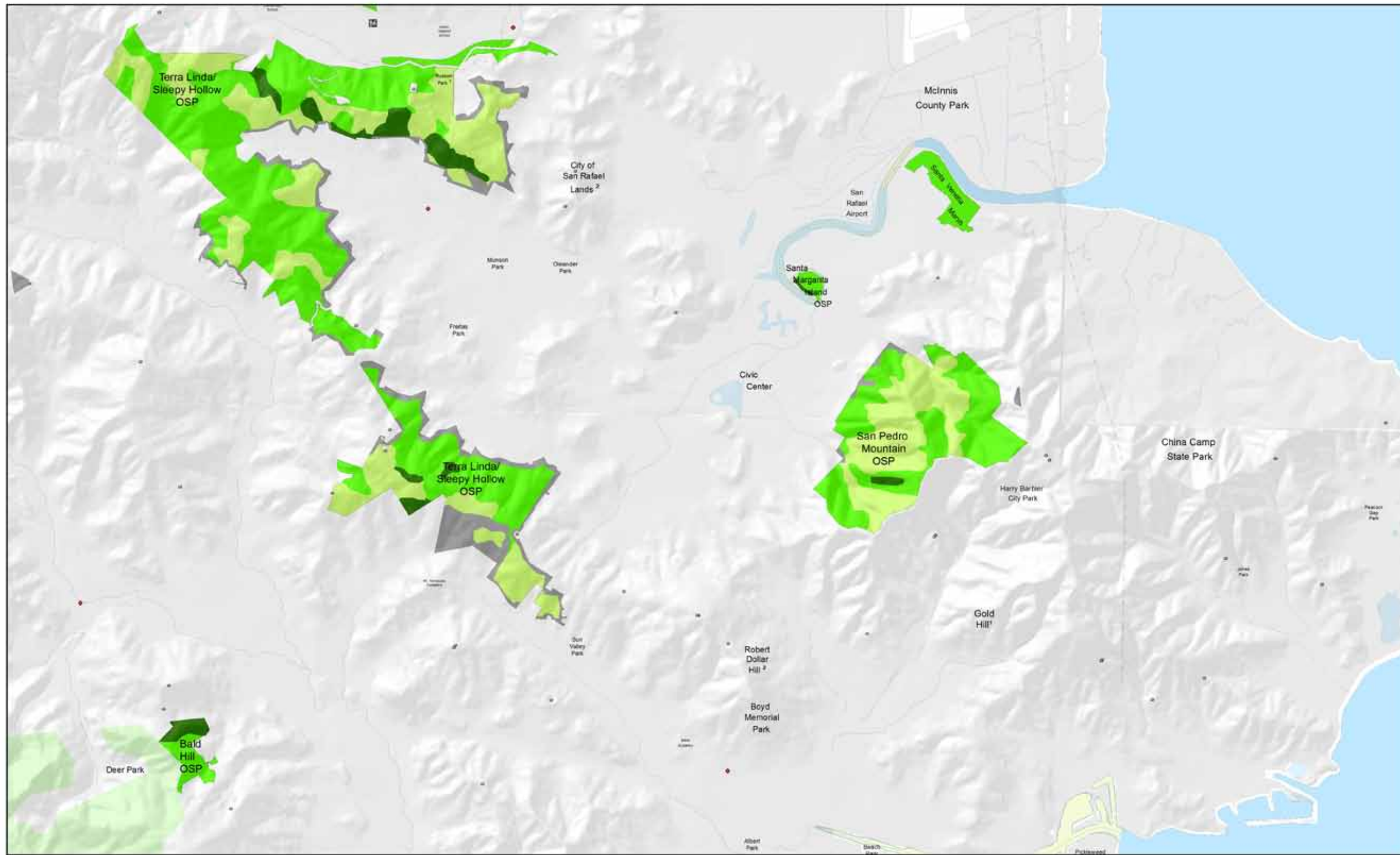


Figure 3.29
Vegetation Management
Zones
Region 5

0 1,000 2,000 4,000 Feet
 Data Sources: StreetMap, USGS and MCOSS
 Coordinate System: NAD 1983 StatePlane California III FIPS 9403 Feet
 Projection: Lambert Conformal Conic



- Legacy Zone
- Natural Landscape Zone
- Sustainable Natural Systems Zone
- Highly Disturbed Zone

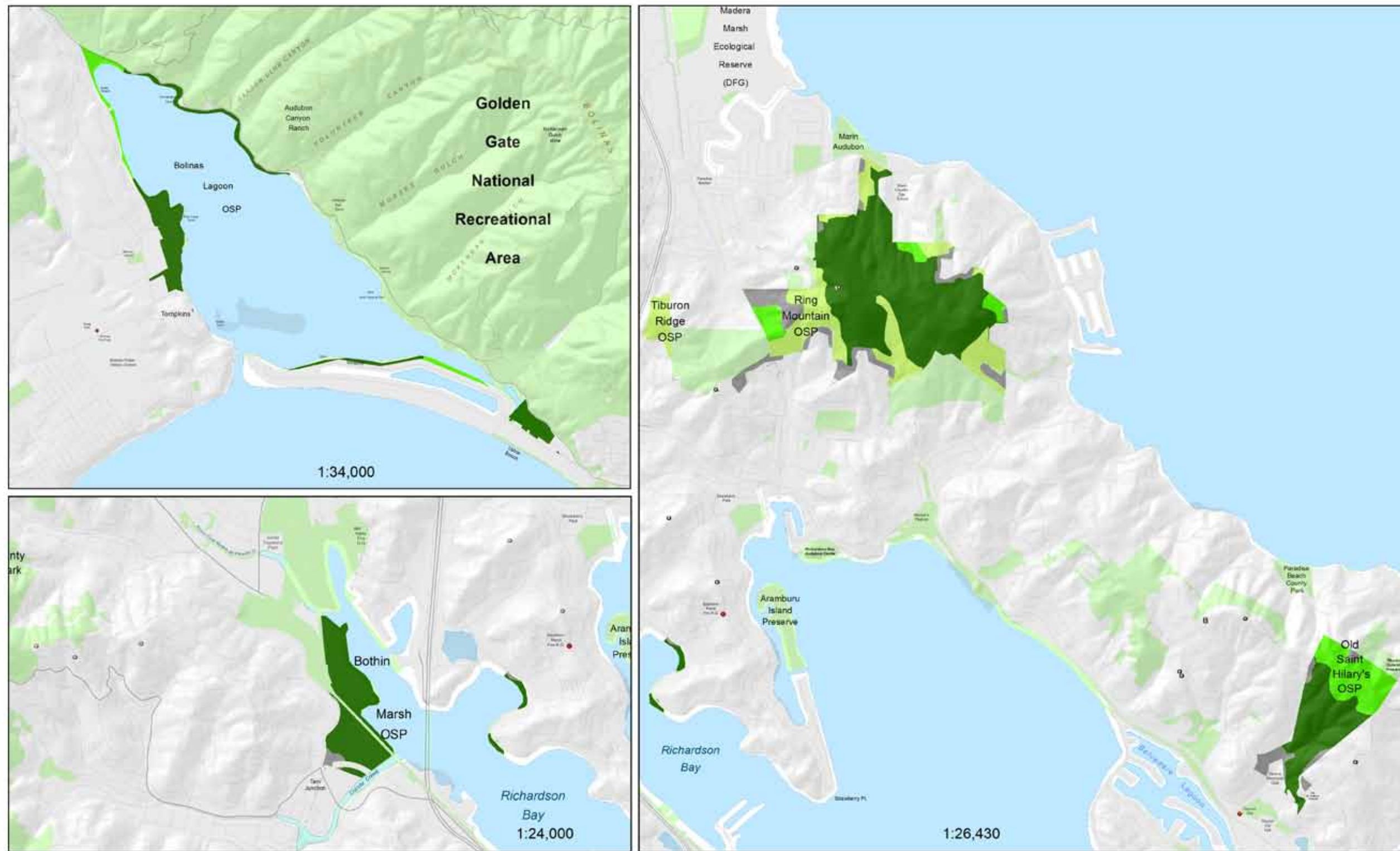


Figure 3.30
Vegetation Management
Zones
Region 6

Data Sources: Meridian, CIGIS and MCOSSD
 Coordinate System: NAD 1983 StatePlane California III FIPS 4601 Feet
 Projection: Lambert Conformal Conic



Hydrologic Resources

Many of the preserves drain to or encompass water bodies listed by the San Francisco Regional Water Quality Control Board as beneficial for water supply, critical habitat, or recreational use. In addition several of the preserves encompass or drain to small ephemeral, intermittent, and perennial creeks and streams and associated riparian and wetland habitat, which are also important resources for water quality, riparian and aquatic species, and recreation. The MCOSED aids in the protection of hydrologic features and water quality by providing for stormwater infiltration within the vegetated landscape, maintaining riparian corridor buffers, and negating any potential increases in runoff or pollutants that would coincide with development. Within this larger scope of protection, however, the construction and operation of roads and trails can affect water resources by introducing new sediment sources from construction disturbance, trail erosion, slope failures, or creek destabilization.

Figures 3.31 through 3.36 display “Features with Potential to Affect Water Quality” in regions 1-6. The specific features illustrated on these maps include the following:

- watershed boundary and name
- terrain topography
- wetlands and beneficial surface water bodies
- road and trail type and placement
- evidence of concentrated flow or gulying within trail network
- locations where drainage-crossing infrastructure (i.e., culverts, fords, or bridges) exists, and where it does not (i.e., an undesignated crossing).

Much of this information is also summarized in table 3.12.

Table 3.12 Summary of Hydrologic Conditions by Preserve

Preserve Name	Watershed(s)	Terrain	Wetlands/ Sensitive Water Bodies	Notable Potential for Impacts on Hydrologic Resources
Region 1				<ul style="list-style-type: none"> • 25 miles of trails with extensive gullyng • 110 undesignated stream crossings
Baltimore Canyon	Corte Madera (part of Ross Valley watershed)	Mostly steep canyon and ridgeline	<ul style="list-style-type: none"> • Larkspur Creek headwaters and numerous springs 	<ul style="list-style-type: none"> • Extensive gullyng occurs along Hoo Koo E Koo Trail and Indian Fire Road. • Hoo Koo E Koo and Southern Marin Line Trails cross Larkspur Creek, and the Dawn Falls Trail runs immediately adjacent to the creek, crossing some of its tributary drainages.
King Mountain	Corte Madera (part of Ross Valley watershed)	Steep		
Blithedale Summit	Corte Madera (part of Ross Valley watershed); and Arroyo Corte Madera del Presidio (part of Richardson Bay watershed)	Steep	<ul style="list-style-type: none"> • Larkspur Creek • Warner Canyon Creek • Arroyo Corte Madera del Presidio Creek 	<ul style="list-style-type: none"> • Active erosion and gullyng occurs along several trails, including those along Blithedale Ridge, Madera Ridge, the Middle Summit Fire Road, and Huckleberry Trail. • Stream crossings on Southern Marin and Corte Madera Trails. • Large portions of the Blithedale and Corte Madera Ridge fire roads are steeper than 15% grade, which often coincides with prominent gully formation.
Camino Alto	Corte Madera (part of Ross Valley watershed); and Arroyo Corte Madera del Presidio (part of Richardson Bay watershed)	Steep, mostly along a ridgeline	<ul style="list-style-type: none"> • Creeks and riparian woodlands 	<ul style="list-style-type: none"> • The preserve contains a high concentration of eroded and gullyng roads.
Alto Bowl	Arroyo Corte Madera del Presidio (part of Richardson Bay watershed)		<ul style="list-style-type: none"> • Sutton Manor Creek 	
Horse Hill	Arroyo Corte Madera del Presidio (part of Richardson Bay watershed)	Steep	<ul style="list-style-type: none"> • Three springs grazed by horses 	<ul style="list-style-type: none"> • Almost all the trails within the preserve show evidence of gullyng and erosion.
Region 2				<ul style="list-style-type: none"> • 48 miles of trails with extensive gullyng • 241 undesignated stream crossings
Cascade Canyon	San Anselmo Creek (part of Ross Valley watershed)	Steep	<ul style="list-style-type: none"> • Pine Mountain Creek • Cascade Falls Creek • Carey Camp Creek • Rush Creeks • Vernal pool • Numerous springs (including serpentine seep) 	<ul style="list-style-type: none"> • The High Water Trail, Canyon Trail, and Cascade Fire Road all cross San Anselmo Creek. • Numerous steep trails (>15%-25% grade) with gullyng. • Four slides in the area.
French Ranch	San Geronimo Creek (part of Tomales Bay watershed via Lagunitas Creek)	Steep	<ul style="list-style-type: none"> • Clear Creek 	<ul style="list-style-type: none"> • Sections of French Ranch Road along the fall line have extensive gullyng.
Gary Giacomini	San Geronimo Creek (part of Tomales Bay watershed via Lagunitas Creek); and San Anselmo Creek (part of Ross Valley watershed)		<ul style="list-style-type: none"> • San Geronimo Creek • Montezuma Creek • Candelerio Creek • Creamery Creek • Deer Camp Creek • Bates Canyon Creek • Woodacre Creek • Pine Mountain Creek 	<ul style="list-style-type: none"> • Several steep trails, including Manzanita, Juniper, Grange, and Conifer Ridge, have sections along the fall line and extensive gullyng. • Numerous stream crossings including several each along Sylvestris Fire Road, Contour Trail, the Candelerio Canyon Trail, and Lagunitas Trail.
Loma Alta	Fairfax Creek (part of Ross Valley watershed)		<ul style="list-style-type: none"> • Fairfax Creek • Seasonal wetlands 	<ul style="list-style-type: none"> • The majority of trails, including Hill Fire Road, Old Railroad Grade, and Gunshot Fire Road, exhibit extensive gullyng. • Four stream crossings occur within the preserve.

Table 3.12 Summary of Hydrologic Conditions by Preserve

Preserve Name	Watershed(s)	Terrain	Wetlands/ Sensitive Water Bodies	Notable Potential for Impacts on Hydrologic Resources
Maurice Thorne Memorial	San Geronimo Creek (part of Tomales Bay watershed via Lagunitas Creek)	Ridgeline		
Roy's Redwoods	San Geronimo Creek (part of Tomales Bay watershed via Lagunitas Creek)	Steep	<ul style="list-style-type: none"> Larsen Creek Spirit Rock Creek 	<ul style="list-style-type: none"> Gullyng on Roy's Loop Trail and the fire road trail on Dickson's Ridge.
White Hill	Fairfax Creek (part of Ross Valley watershed); and for a very small portion of the preserve: San Geronimo Creek (part of Tomales Bay watershed via Lagunitas Creek)	Ridgeline	<ul style="list-style-type: none"> Pine Mountain Creek Cascade Falls Creek Wet meadow (sedge-rush-wet meadow) 	<ul style="list-style-type: none"> The preserve contains some fall line trail sections and gullyng.
Region 3				<ul style="list-style-type: none"> 39 miles of trails with extensive gullyng 88 undesignated stream crossings
Ignacio Valley	Arroyo de San Jose (part of Novato Creek watershed)	Steep	<ul style="list-style-type: none"> Arroyo de San Jose Creek Two unnamed creeks 	<ul style="list-style-type: none"> Chicken Shack Fire Road on ridgeline has several steep portions with gullyng.
Indian Valley	Ignacio Creek (part of Novato Creek watershed)	Steep	<ul style="list-style-type: none"> Arroyo Avichi, South Fork One unnamed creek 	<ul style="list-style-type: none"> One stream crossing occurs on Waterfall Trail.
Loma Verde	Ignacio Creek (part of Novato Creek watershed)	Steep		The fire roads at Pebble Beach and Escondido have long reaches on the fall line and exhibit extensive gullyng.
Lucas Valley	Miller Creek	Steep	<ul style="list-style-type: none"> Miller Creek and several tributaries Pristine coastal prairie 	
Pacheco Valle	Pacheco Creek (part of Novato Creek watershed via Ignacio Creek)	Steep	<ul style="list-style-type: none"> Pacheco Creek 	<ul style="list-style-type: none"> Gullyng occurs along the ridgeline fire roads, including Chicken Shack, Little Cat, and Ponti.
Region 4				<ul style="list-style-type: none"> 40 miles of trails with extensive gullyng 70 undesignated stream crossings
Deer Island	Novato Creek watershed	Steep and gently sloped	<ul style="list-style-type: none"> Estuarine marsh habitats Novato Creek and Deer Island Channel Creek (outside preserve edges) 	<ul style="list-style-type: none"> Trails show evidence of concentrated flow, but no gullyng.
Indian Tree	Novato Creek watershed	Steep	<ul style="list-style-type: none"> Vineyard Creek and one unnamed creek 	
Little Mountain	Novato Creek watershed	Steep	<ul style="list-style-type: none"> Small vernal pool Novato Creek (along the preserve boundary) Undifferentiated marsh 	<ul style="list-style-type: none"> Evidence of gullyng on switchback trails between Willow Tree Stables and the ridgetop. Gullyng occurs along the Doe Hill Fire Road.
Mount Burdell	Novato Creek watershed; and eastern edge of preserve: Rush Creek watershed	Mostly steep	<ul style="list-style-type: none"> Two small, unnamed creeks Hidden Lake, one of Marin County's few vernal pools 	<ul style="list-style-type: none"> Large proportion of preserve trails exhibit erosion and gullyng.
Rush Creek	Rush Creek watershed	Steep and gently sloped	<ul style="list-style-type: none"> Rush Creek (along boundary) Seasonal wetlands (Cemetery Marsh) Wet meadow 	<ul style="list-style-type: none"> Minimal steep trail sections exist; however, evidence of gullyng occurs on Pinheiro Fire Road and the Rush Creek Trail.
Verissimo Hills	Novato Creek watershed	Steep		

Table 3.12 Summary of Hydrologic Conditions by Preserve

Preserve Name	Watershed(s)	Terrain	Wetlands/ Sensitive Water Bodies	Notable Potential for Impacts on Hydrologic Resources
Region 5				<ul style="list-style-type: none"> • 20 miles of trails with extensive gullyng • 33 undesignated stream crossings
Bald Hill	Sleepy Hollow Creek (part of Ross Valley watershed)	Steep		
San Pedro Mountain	Gallinas Creek watershed	Steep	<ul style="list-style-type: none"> • One unnamed creek 	The trail east of Woodoaks Trail has several ford crossings, and it follows a natural drainage; the trail to the west has one ford crossing on the unnamed creek.
Santa Margarita Island	Gallinas Creek watershed	Gently sloped	<ul style="list-style-type: none"> • South Fork of Gallinas Creek (around preserve boundary) • Riparian woodlands • Salt marsh • Brackish marsh • Seasonal wetlands 	<ul style="list-style-type: none"> • Erosion and gullyng occur on the trail that encircles the island.
Santa Venetia Marsh	Gallinas Creek watershed	Flat	<ul style="list-style-type: none"> • Wetland/marsh system 	
Terra Linda/Sleepy Hollow Divide	Eastern and largest portion: Gallinas Creek watershed; western portion: Sleepy Hollow Creek (part of Ross Valley watershed); southern tip: San Rafael watershed; and northern portion: Miller Creek watershed	Mostly ridgeline	<ul style="list-style-type: none"> • Miller Creek 	<ul style="list-style-type: none"> • Several short fall line trails with associated erosion and gullyng are interspersed throughout the preserve. • Two stream crossings occur, one on Miller Creek near Lucas Valley Road and one on the Sleepy Hollow Creek tributary.
Region 6				<ul style="list-style-type: none"> • 8 miles of trails with extensive gullyng • 23 undesignated stream crossings
Bolinas Lagoon	Bolinas Lagoon watershed	Mixture flat and steep areas	<ul style="list-style-type: none"> • Salt marsh (high, intermediate, low marsh) • Brackish marsh • Seasonal wetlands 	
Bothin Marsh	Richardson Bay watershed	Flat	<ul style="list-style-type: none"> • Salt marsh (high, intermediate, low marsh) • Brackish marsh • Seasonal wetlands 	
Old Saint Hilary's	Richardson Bay watershed	Mostly steep	<ul style="list-style-type: none"> • Two unnamed creeks 	
Ring Mountain	Northern portion: San Pablo Bay (part of Ross Valley watershed); and southern portion: West and East Creeks (part of Richardson Bay watershed)	Mostly steep	<ul style="list-style-type: none"> • East Creek • West Creek • Three other unnamed creeks 	<ul style="list-style-type: none"> • The extensive network of overlapping steep trails has a high concentration of gullyng. • Many ford crossings occur over drainages.
Tiburon Ridge	Richardson Bay watershed			

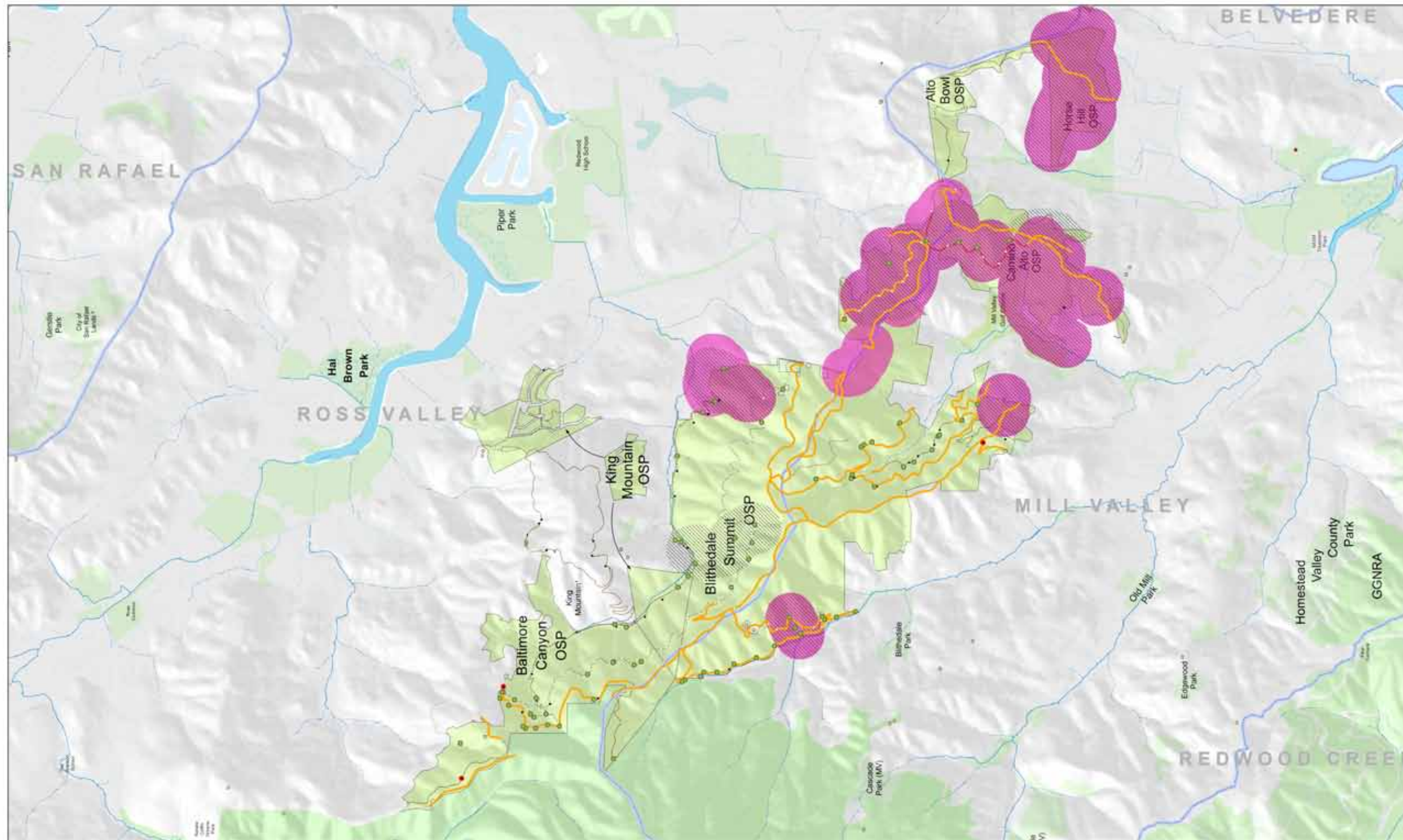
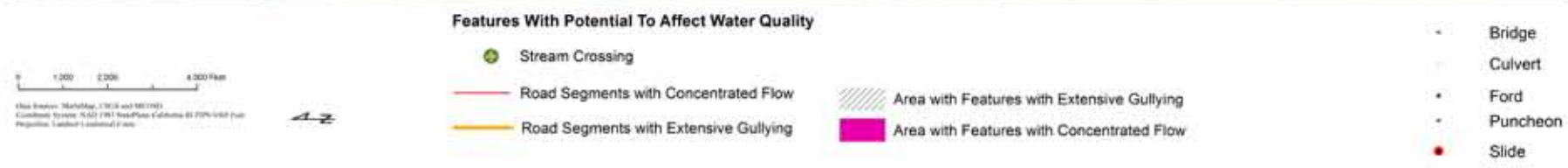


Figure 3.31
Features with
Potential to Affect
Water Quality
Region 1



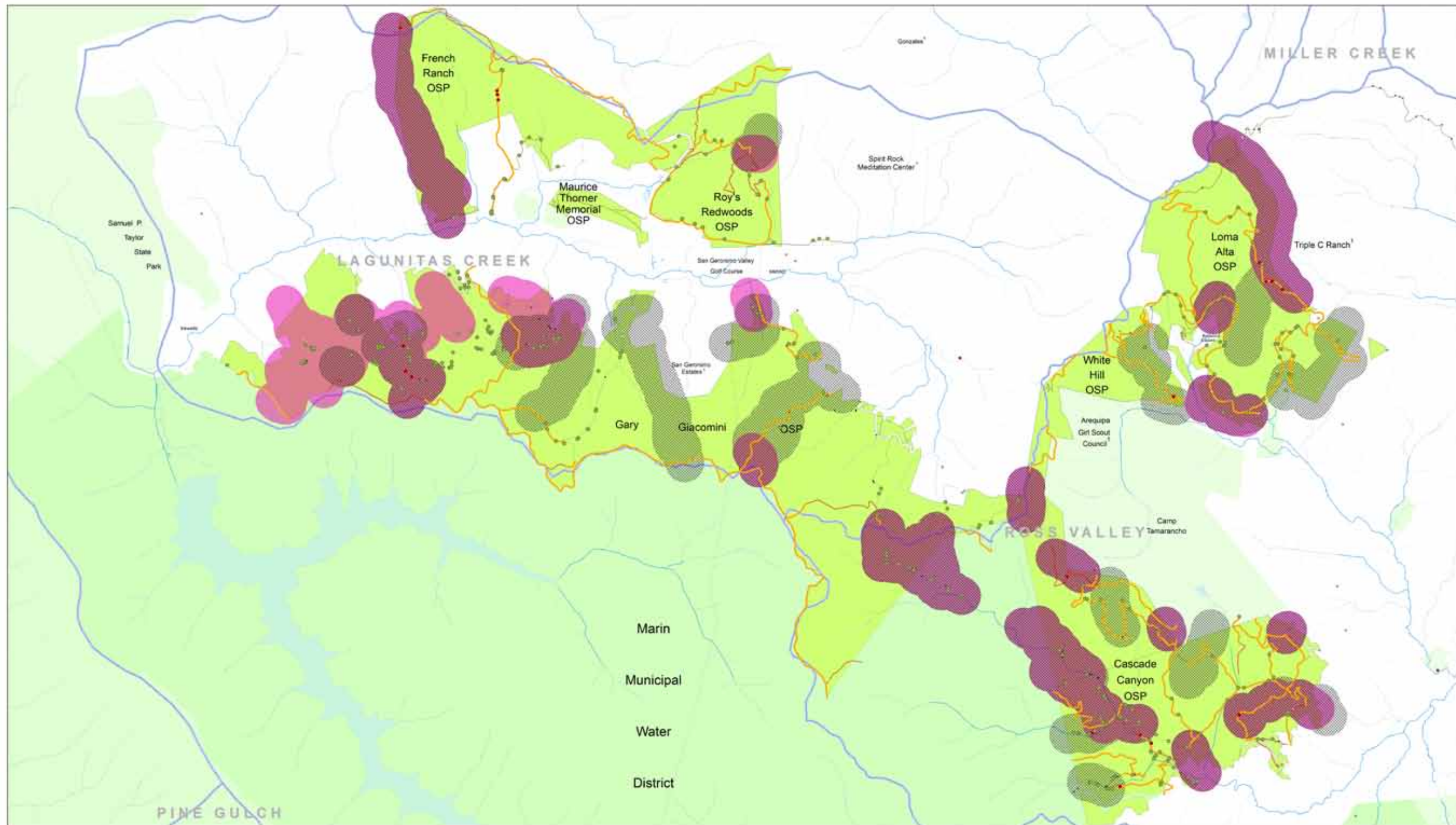


Figure 3.32
Features with
Potential to Affect
Water Quality
Region 2

0 1,000 2,000 4,000 Feet
 Title: Road and Trail Management Plan
 Date: 10/20/2015
 Author: [unreadable]
 Project: [unreadable]

- | | | |
|------------------|--|------------|
| Road Type | Features With Potential To Affect Water Quality | |
| — Paved Road | ● Stream Crossing | - Bridge |
| --- Unpaved Road | — Road Segments with Concentrated Flow | - Culvert |
| — Trail | — Road Segments with Extensive Gullying | - Ford |
| | | - Puncheon |
| | | ● Slide |

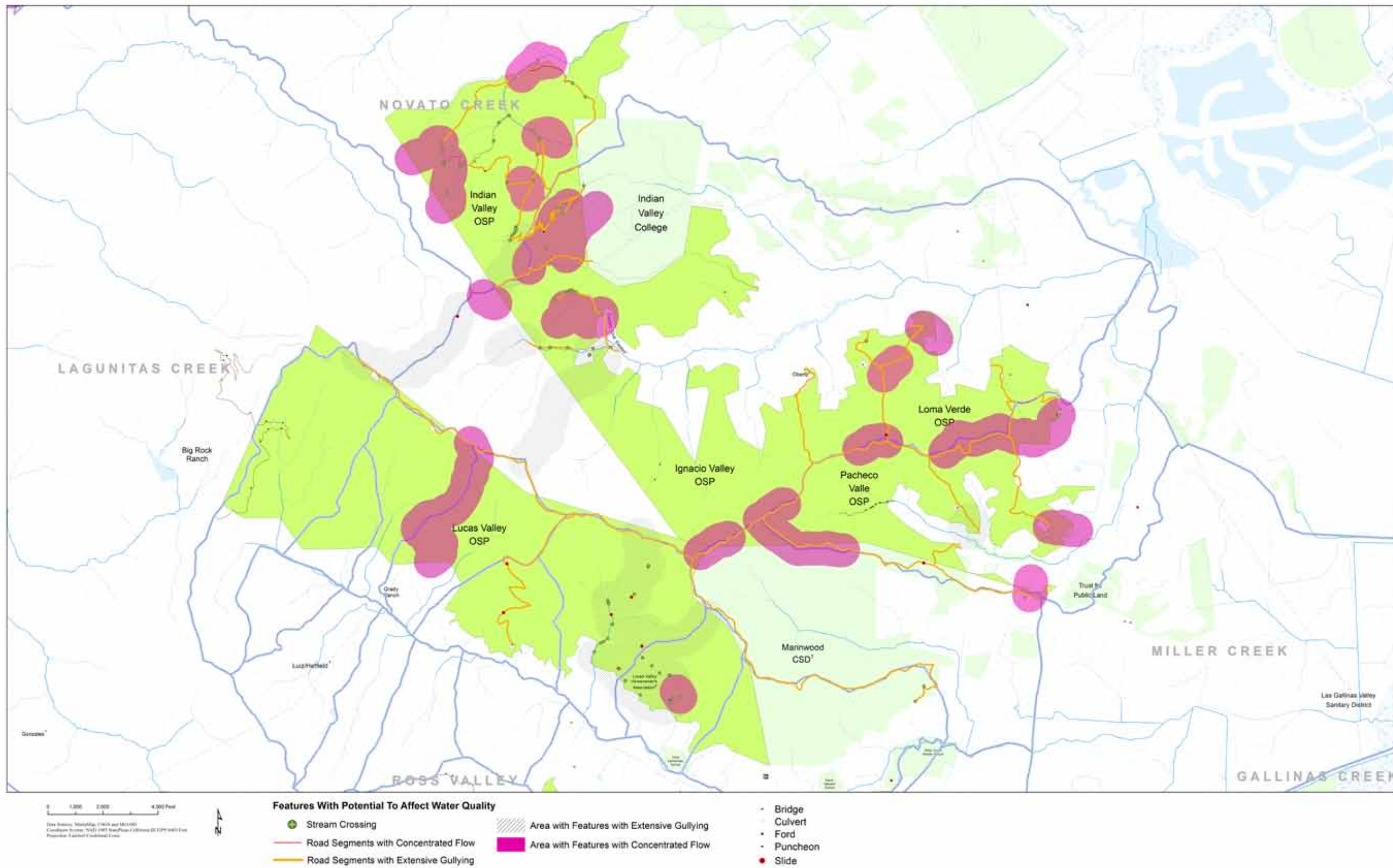


Figure 3.33
Features with
Potential to Affect
Water Quality
Region 3

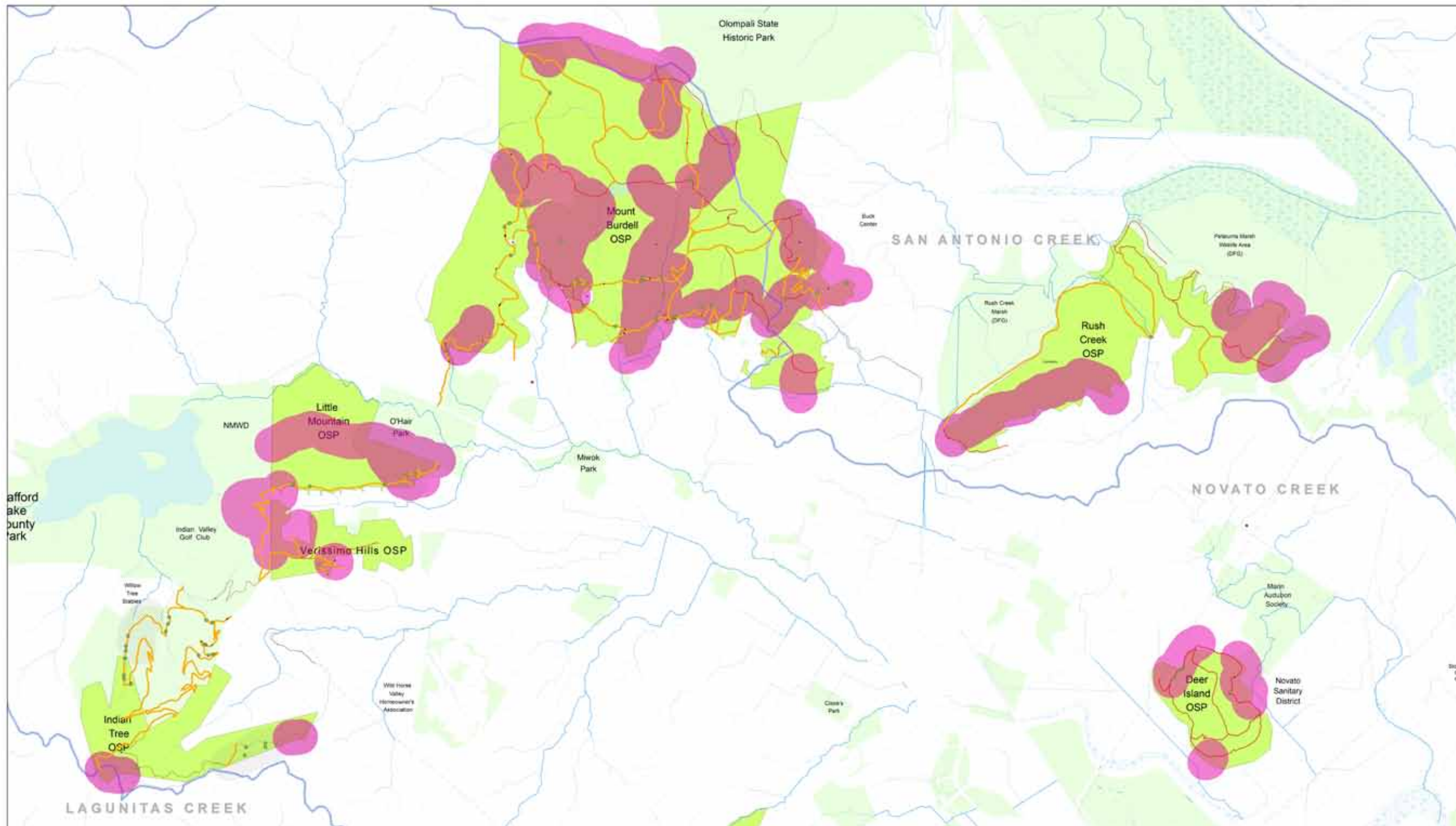


Figure 3.34
Features with
Potential to Affect
Water Quality
Region 4

Scale: 0 1,000 2,000 4,000 Feet
 Date: 10/15/2013
 Project: Marin County Open Space District / Draft / Road and Trail Management Plan

Features With Potential To Affect Water Quality

- Stream Crossing
- Road Segments with Concentrated Flow
- Road Segments with Extensive Gullying

- Area with Features with Extensive Gullying
- Area with Features with Concentrated Flow

- Bridge
- Culvert
- Ford
- Puncheon
- Slide

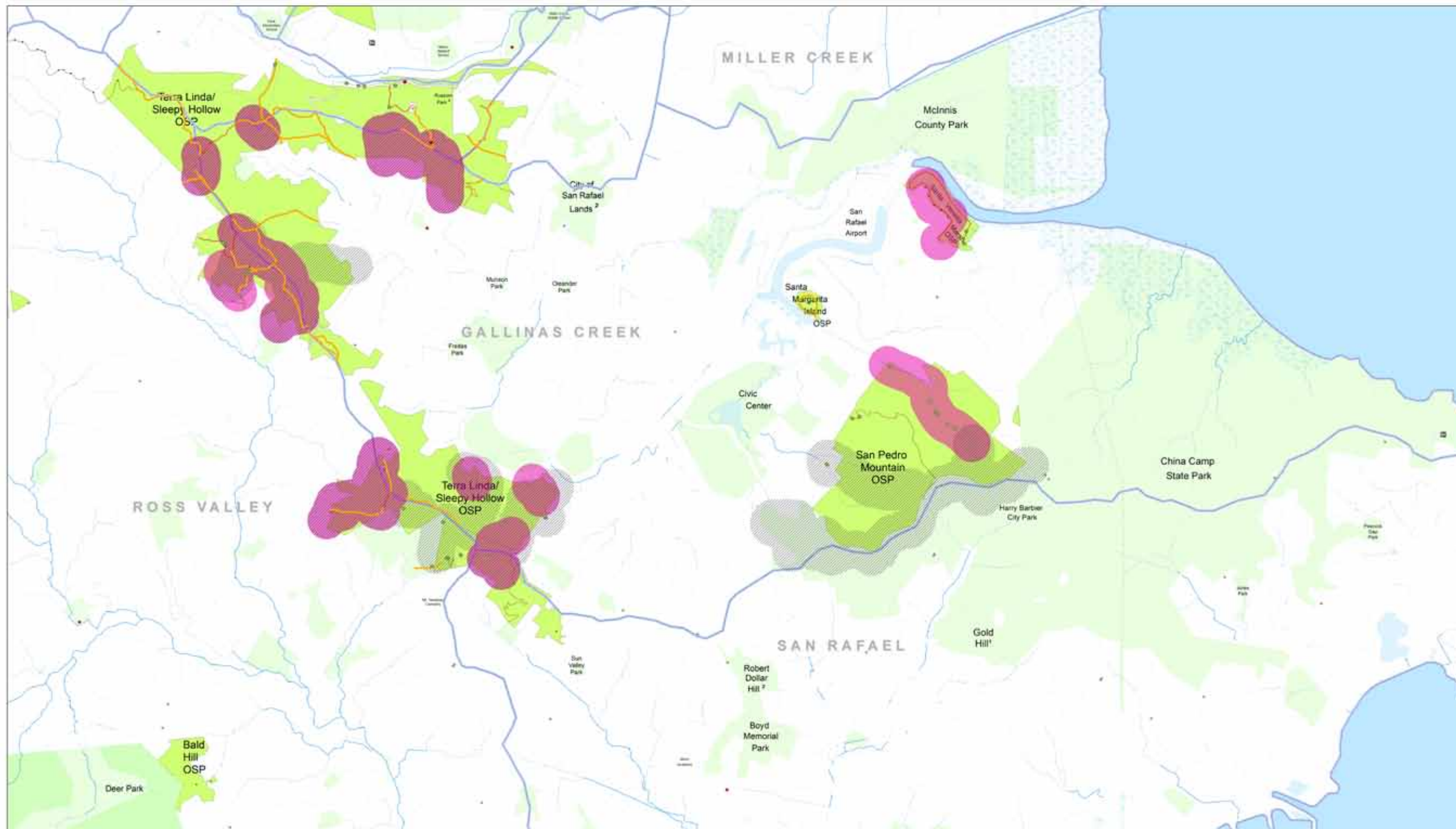


Figure 3.35
Features with
Potential to Affect
Water Quality
Region 5

0 1,000 2,000 4,000 Feet
 Date Revisions: 10/10/13 (1) and 10/12/13 (2)
 Database System: NAD 1983 StatePlane California North Zone
 Projection: EqualAreaConformal Conic

Features With Potential To Affect Water Quality

- Stream Crossing
- Road Segments with Concentrated Flow
- Road Segments with Extensive Gulying
- Area with Features with Extensive Gulying
- Area with Features with Concentrated Flow
- Bridge
- Culvert
- Ford
- Puncheon
- Slide

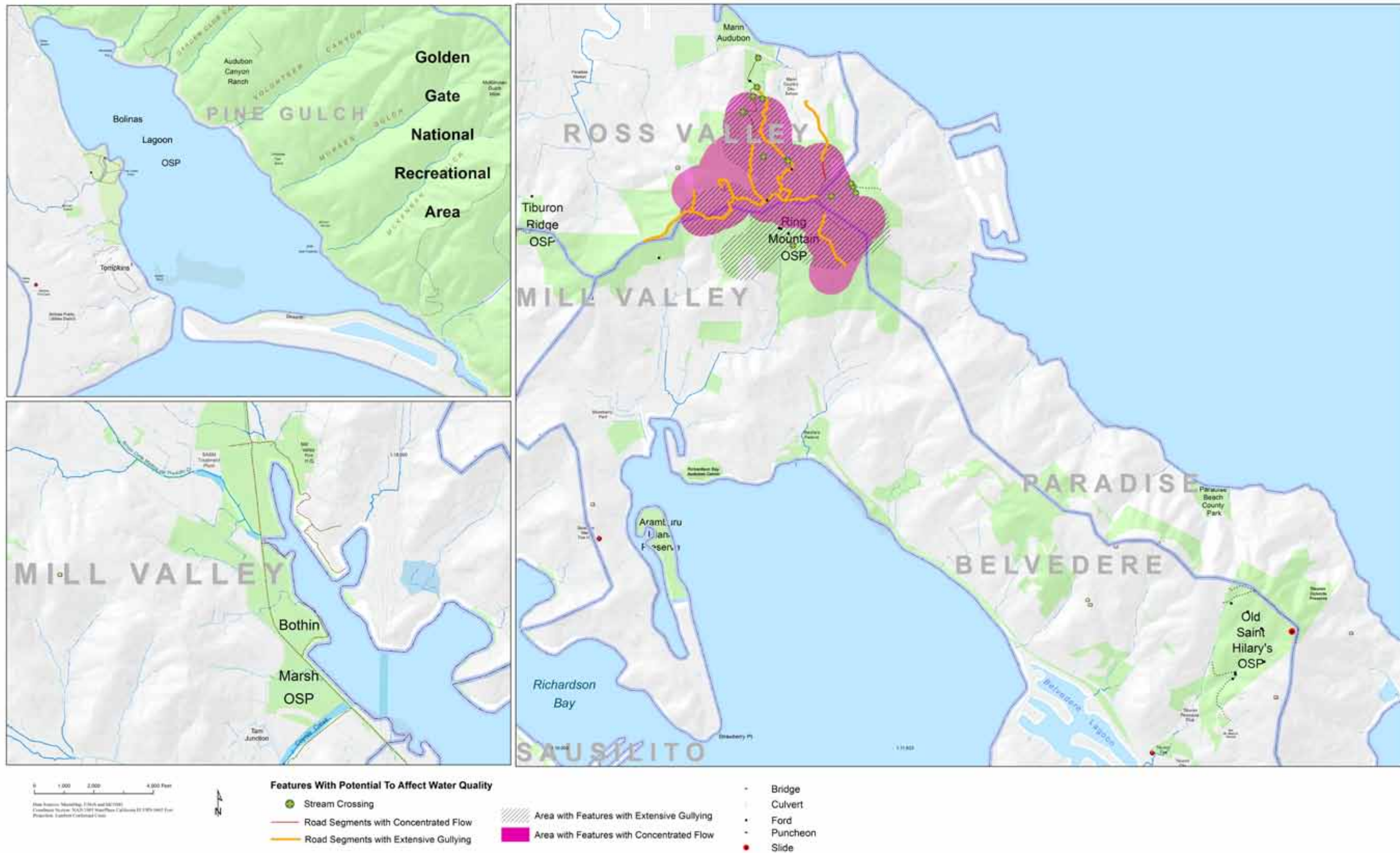


Figure 3.36
Features with
Potential to Affect
Water Quality
Region 6

Stream Crossings

Roads and trails in the MCOSED preserves frequently pass through steeply inclined landscapes with a number of steep canyon drainages and riparian creeks. Some stream crossings are improved with bridges, culverts, fords, or puncheons, but almost 500 unimproved crossings exist. Examples of these crossings are shown in figures 3.37 to 3.42. Failures of stream crossings can lead to accelerated erosion at crossing points, with potential increases in sediment loads to receiving water bodies. This makes crossing points a primary focus for upgrades.

Infrastructure in the form of culverts, fords, and bridges constructed to isolate or stabilize a drainage or creek from continued crossing by pedestrians, equestrians, bicyclists, and maintenance and fire crews can mitigate the potential for erosion of sediment, but if inadequately designed or undersized for the anticipated flows, they can cause further channel degradation and soil loss by eroding the bed and banks of streams. Improved crossings may need to be reassessed to ensure that 50-year design flows can be adequately conveyed without flooding or a sharp increase in velocities or shear stress.

If not designed properly, some stream crossings may also create impediments to fish passage. Figures 3.43 – 3.48 illustrate locations where features with the potential to adversely affect special-status fish species exist, including barriers to their upstream passage. Table 3.12 includes summary information on stream crossings specific to each preserve. Because special-status fish species are present in the Baltimore Canyon, Gary Giacomini, and Cascade Canyon Preserves, additional information about specific stream crossings in those preserves is included in the table.



Figure 3.37 Functional wood foot bridge.



Figure 3.38 Informal puncheon over a small ephemeral watercourse.



Figure 3.39 Stream crossing with culvert. Note the two smaller pipes, which were undersized and became plugged with sediment.



Figure 3.40 Recently installed plastic pipe. Outlet is "shotgunned," leading to erosion at the outfall.



Figure 3.41 Rock ford on unsurfaced road. Ford constructed using native rock to armor outer road edge.



Figure 3.42 Rock ford on road-width trail.

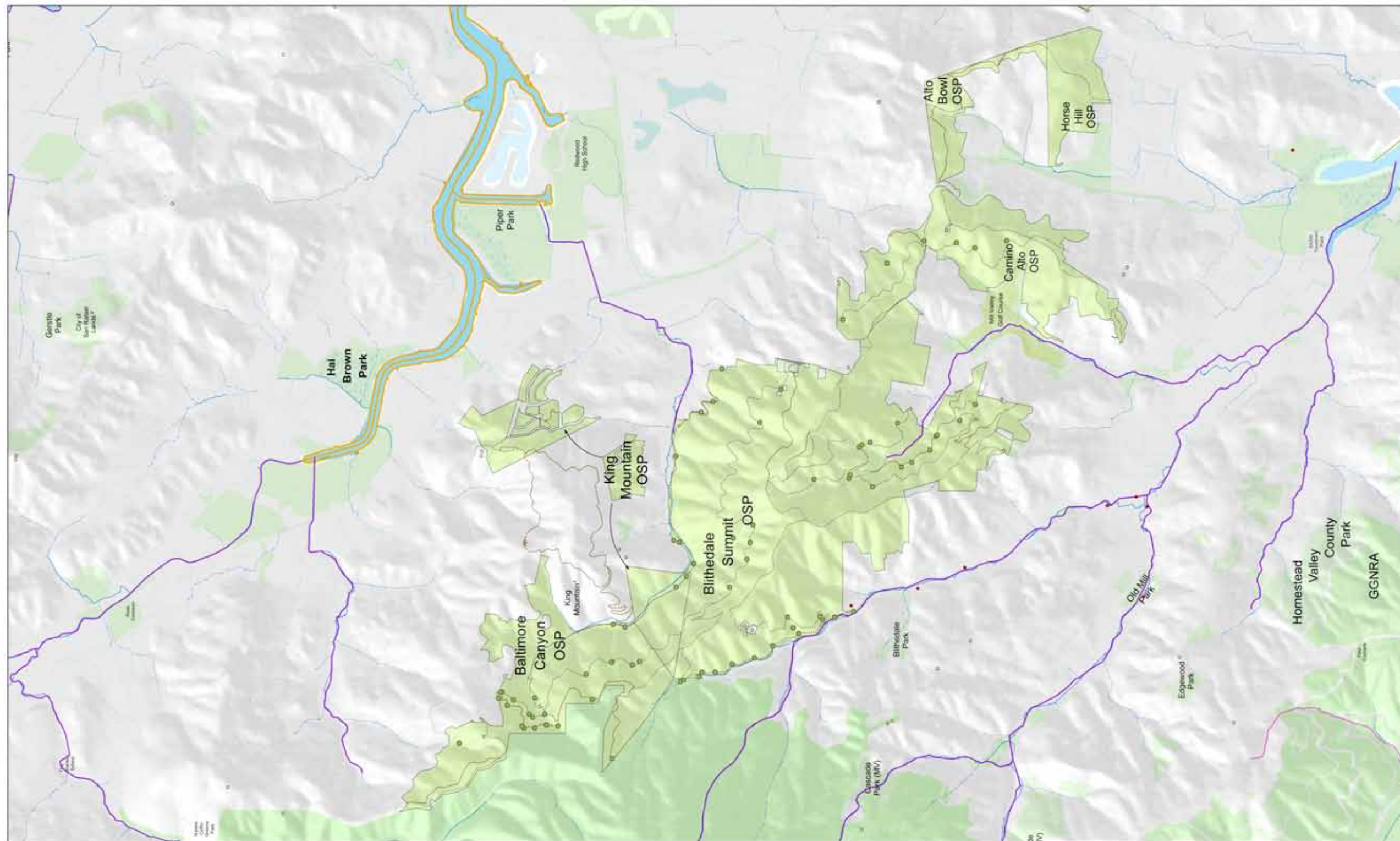


Figure 3.43
Features with Potential
to Affect Special-Status
Fish Species
Region 1



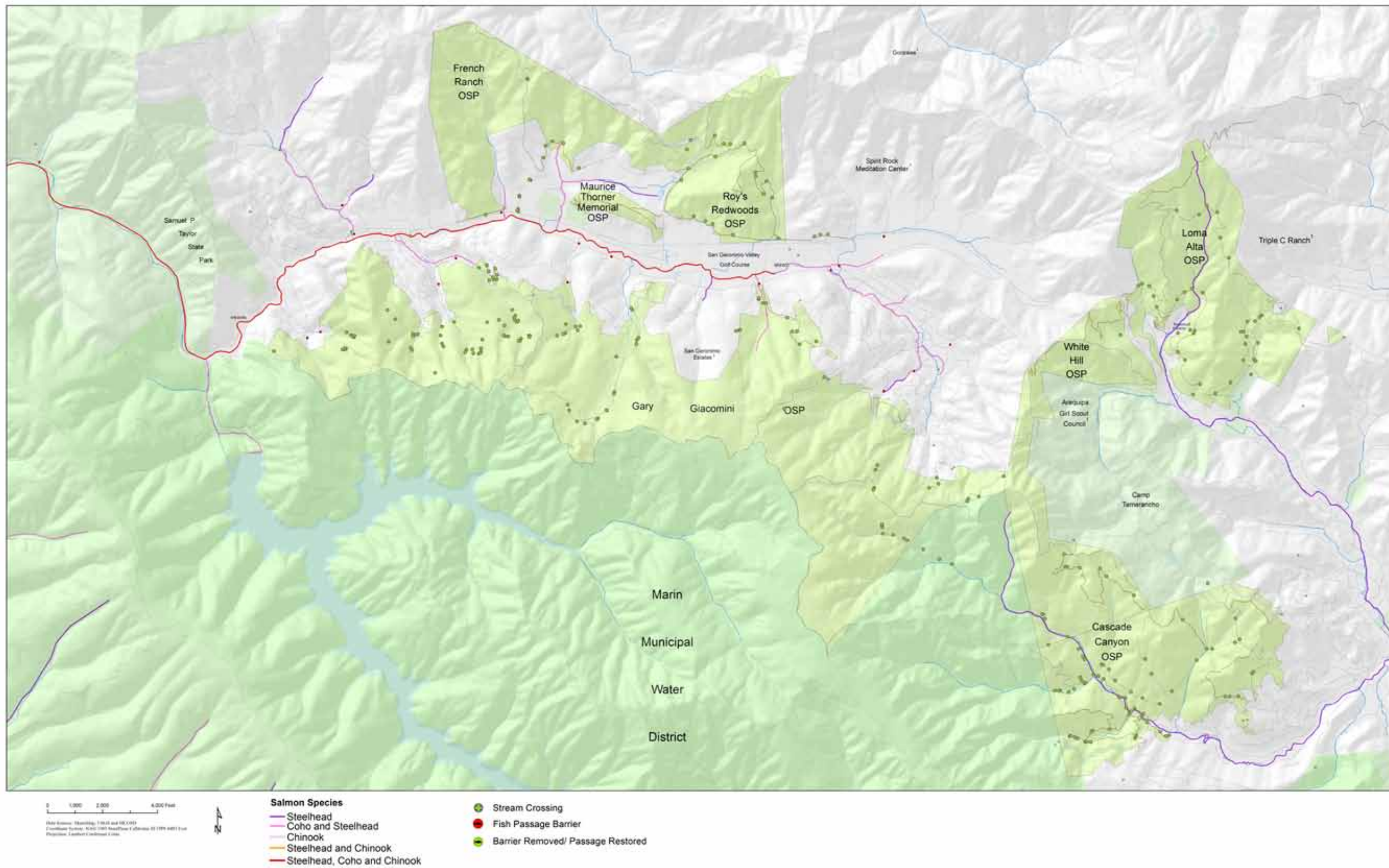


Figure 3.44
Features with Potential to Affect Special-Status Fish Species
Region 2

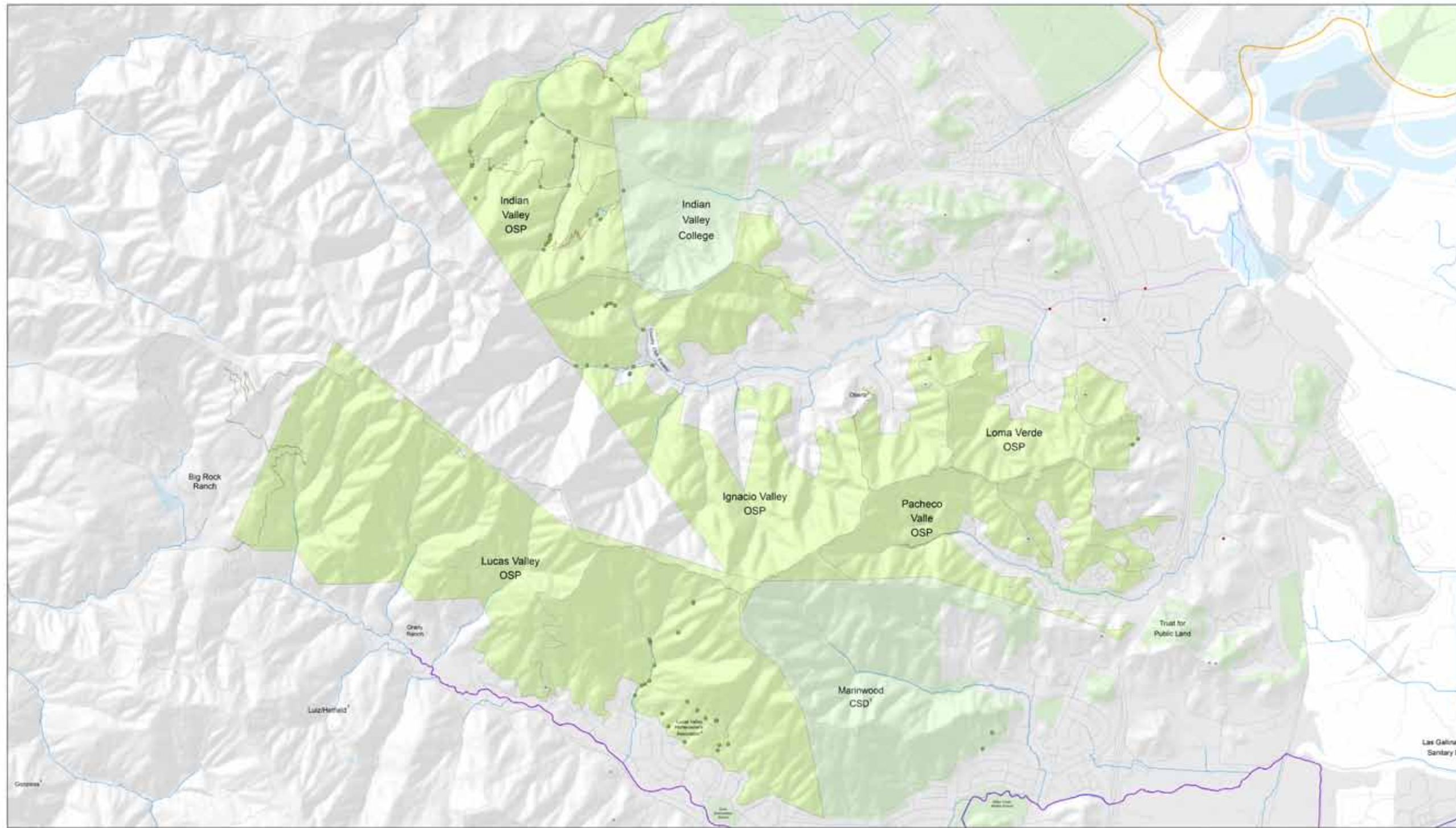


Figure 3.45
Features with Potential
to Affect Special-Status
Fish Species
Region 3

0 1,000 2,000 4,000 Feet
 Data Source: Microsoft, 1994 and 1995
 © Landmark Systems, 1992-1995 Road Plans California © 1995-2002 Esri
 Reproduced, Esri/MapInfo/California State



- Salmon Species**
- Steelhead
 - Coho and Steelhead
 - Chinook
 - Steelhead and Chinook
 - Steelhead, Coho and Chinook
- Stream Crossing
 - Fish Passage Barrier
 - Barrier Removed/ Passage Restored

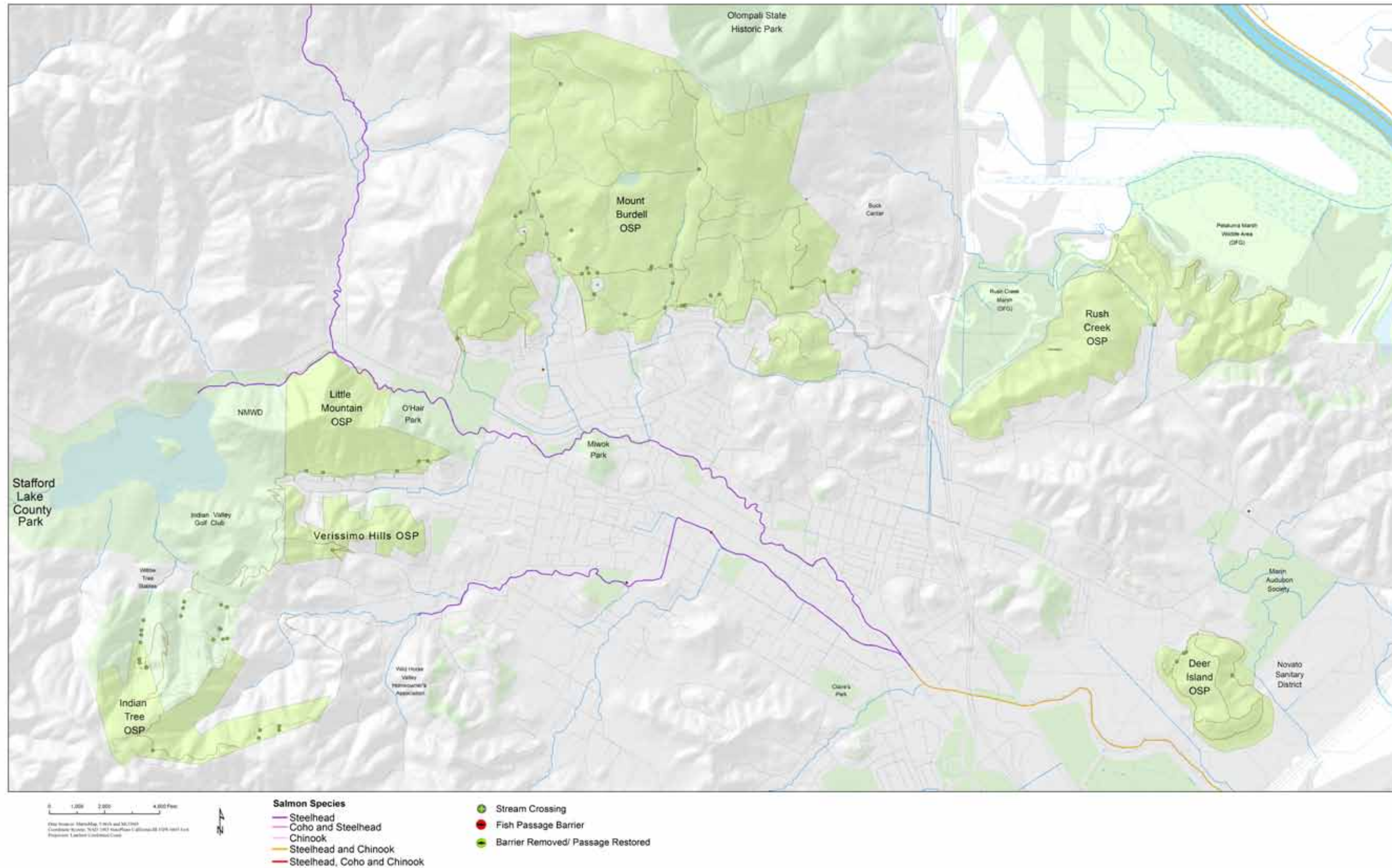


Figure 3.46
Features with Potential to Affect Special-Status Fish Species
Region 4

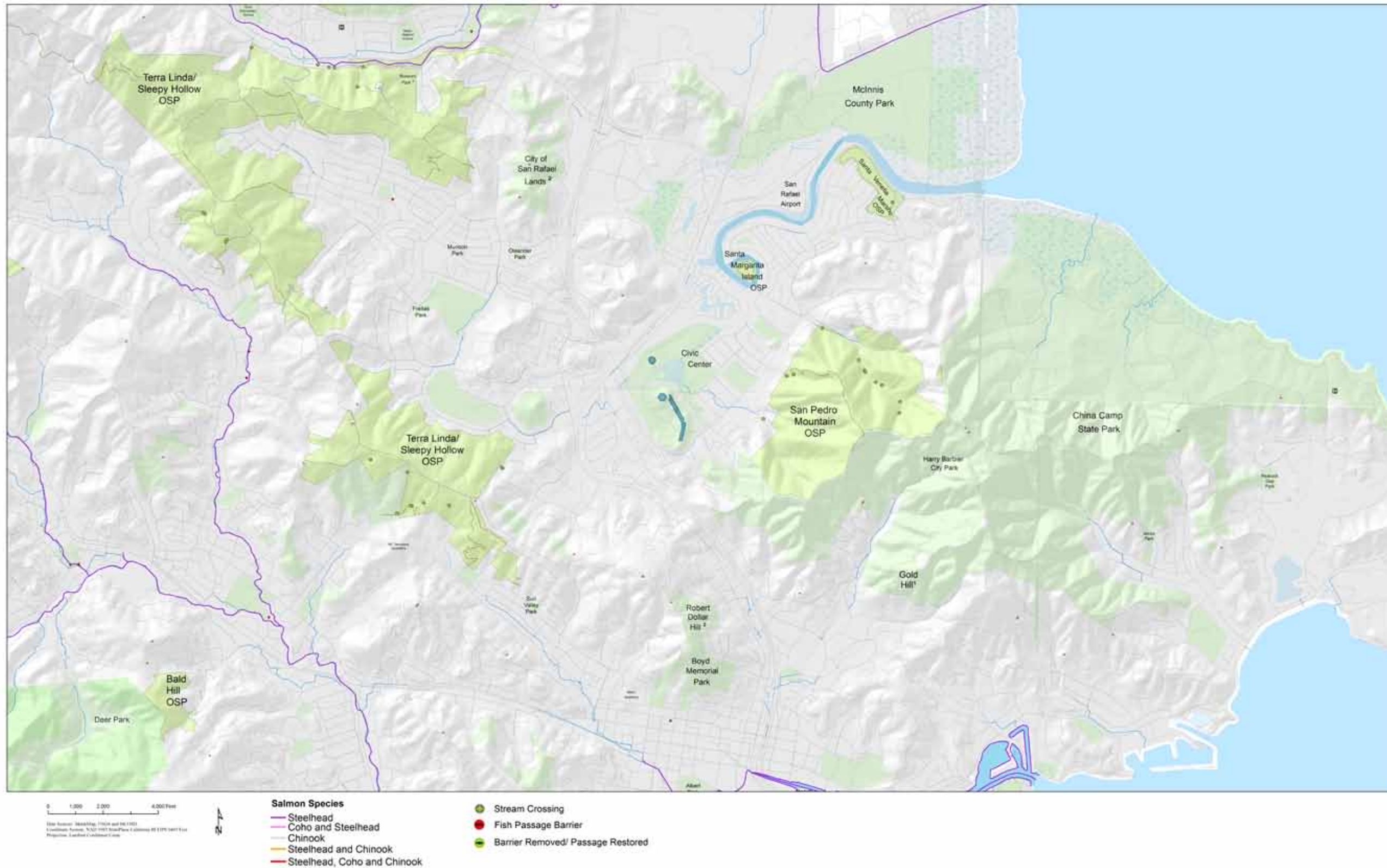


Figure 3.47
Features with Potential
to Affect Special-Status
Fish Species
Region 5

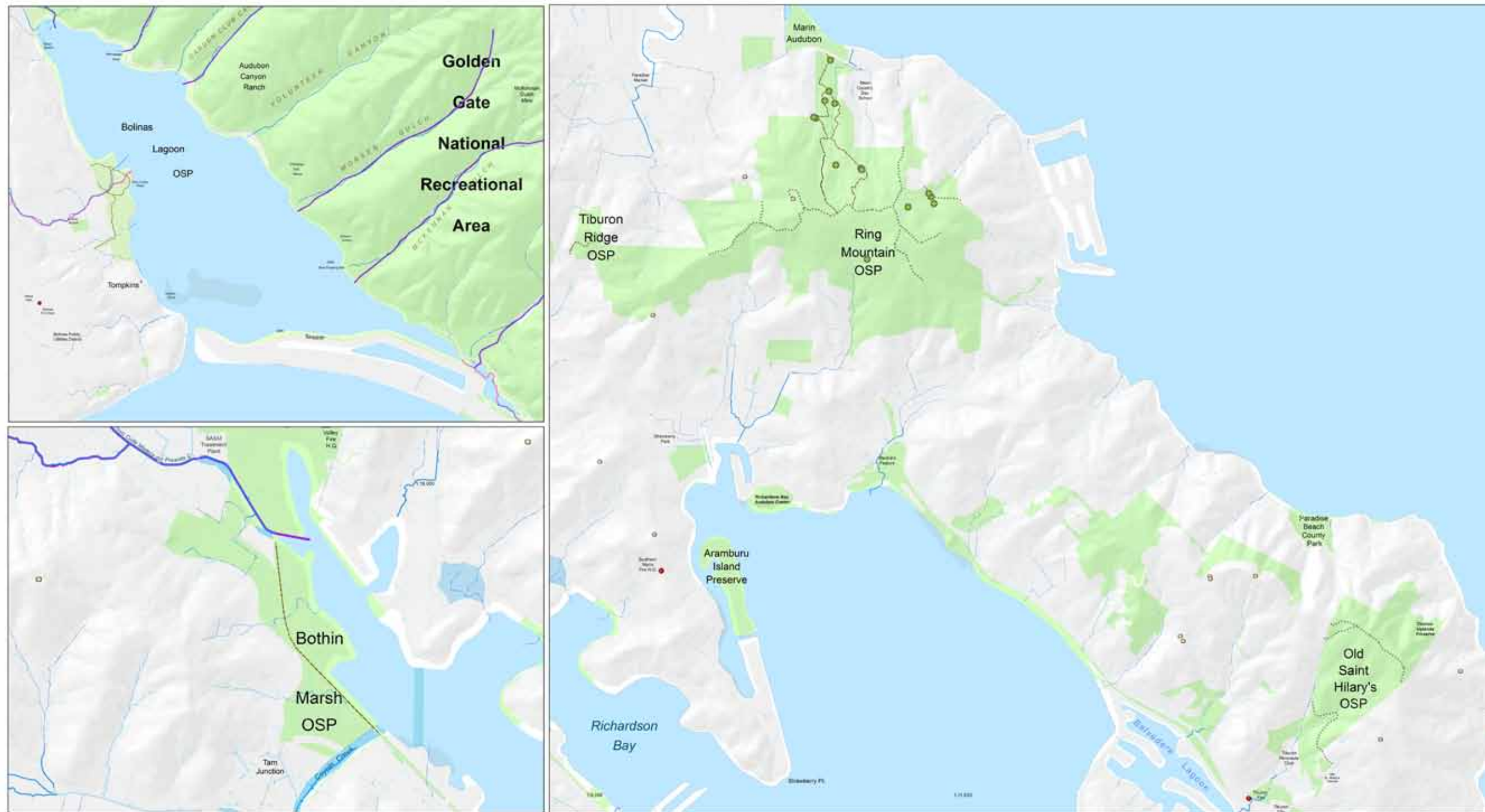


Figure 3.48
Features with Potential
to Affect Special-Status
Fish Species
Region 6

0 1,500 3,000 4,500 Feet
 Date Revised: March 2019
 File Number: M001009
 Project Number: 15-221-1001
 Project Name: Road and Trail Management Plan



- Salmon Species**
- Steelhead
 - Coho and Steelhead
 - Chinook
 - Steelhead and Chinook
 - Steelhead, Coho and Chinook

- Stream Crossing
- Fish Passage Barrier
- Barrier Removed/ Passage Restored

Flooding

Regional flooding is not a major concern for the majority of preserves, given that they are most often located in the upper elevations of the watersheds closer to the stream and drainage headwaters. Nonetheless, management and engineering attention still needs to be paid to the potential for localized flooding within these upper-elevation preserves caused by a flashy but sharp rise in peak flow during a large storm event. Within these higher-elevation or headwaters areas, road and trail managers need to ensure that drainage is not, or could not become, constricted by undersized, damaged, or poorly placed culverts, fords, or bridges that might result in flooding of the road or trail or overflow onto the adjacent slopes. Several of the preserves drain to creeks that wind tightly through neighborhoods and urban areas with 100-year flood zones that penetrate property lines and infrastructure downstream of the preserves. An example of this is Larkspur Creek, whose 100-year flood zone overlies the neighborhoods downstream of Blithedale Summit (FEMA 2009). Although the minimal amount of development associated with road and trail management and operation would not be expected to increase or decrease runoff volumes to areas downstream, the MCOSD staff needs to remain vigilant to this possibility.

Conversely, in the lower-elevation wetland and lagoon preserves, flooding is probable and often beneficial. Trail installation and operation in these preserves requires an understanding of potential impacts due to tidal fluctuations, groundwater influence, flooding, and anticipated future sea level rise (see figure 3.49). The following preserves are either partially or completely within the 100-year regulatory flood zone (FEMA 2009):

- Santa Margarita Island
- Santa Venetia Marsh
- Bothin Marsh
- Bolinas Lagoon

Figure 3.49 Sea Level Rise Inundation Areas



Source: San Francisco Bay Conservation and Development Commission, Shoreline Areas Potentially Exposed to Sea Level Rise: Central Bay North

Geologic Hazards

The main geologic hazards for the MCOSD preserves and trail infrastructure are landslides and other related slope-stability hazards, which might occur as a result of strong seismic shaking, or more commonly, during intense rainfall events that quickly saturate the soil. Landslides are the downward movement of materials such as rock, soil, or fill under the direct influence of gravity as a result of slope instability. Types of landslides include debris flows (the rapid downslope movement of a thick slurry composed of loose soil, rock, and organic material entrained with air and water) and debris avalanches (a more rapid or extreme debris flow).

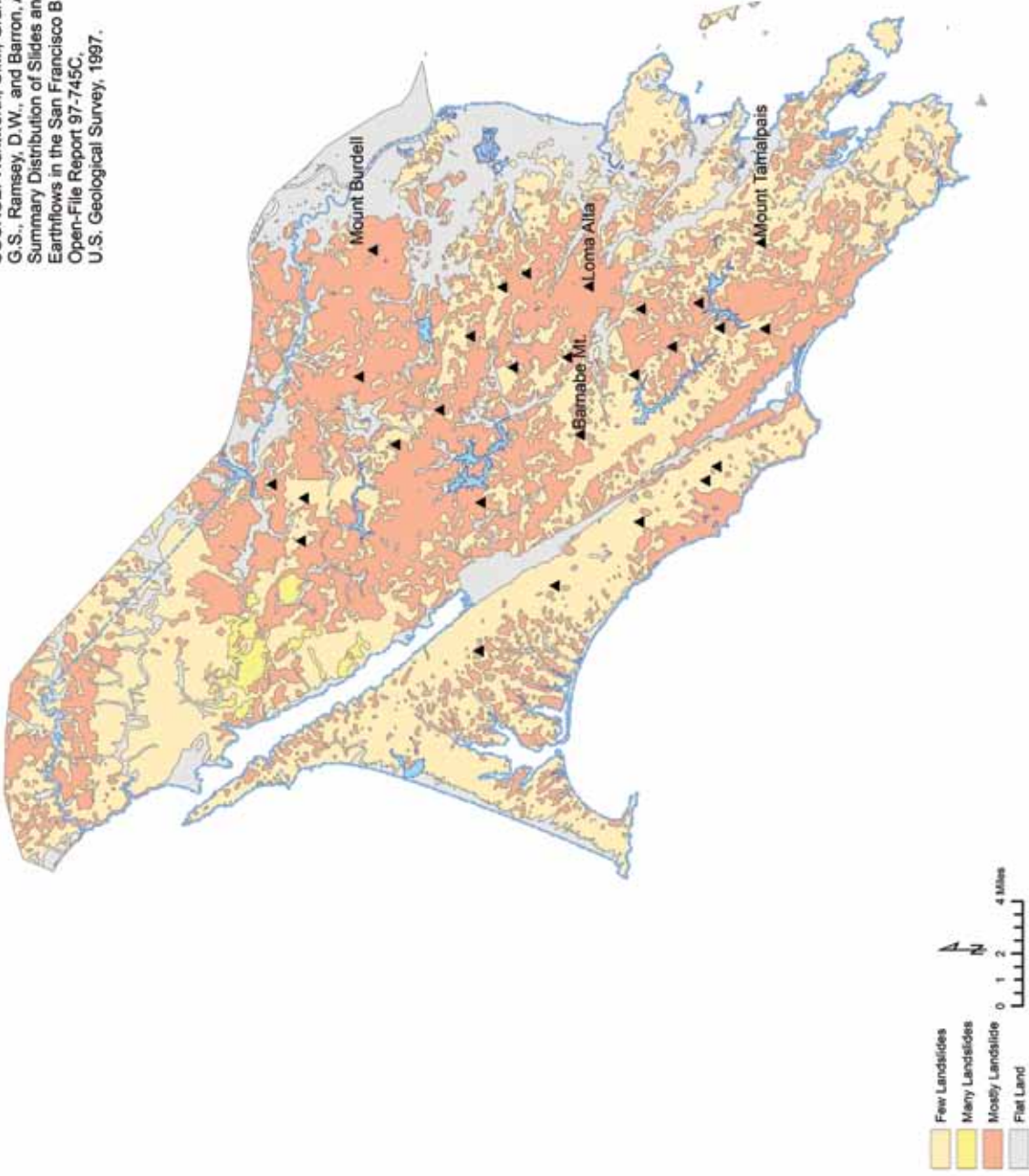
Landslides, particularly debris flows, have been widespread in Marin County during periods of heavy and intense rainfall. Figure 3.50 shows the extensive distribution of mapped slides throughout Marin County. More than 4,500 debris flows were mapped following the large January 1982 storm events; they displayed the following commonalities:

- steep slopes (80% of the slides occurred on slopes steeper than 27.5 degrees)
- granular soil mantle or granular soil mantle with both bedrock contacts and materials with permeability constraints
- closely associated with drainages
- associated with intense rainstorms

Several shallow landslides have occurred on the MCOSD preserves in recent years from high-intensity and long-duration storm events. The slides are more often found in areas where steep slopes are over-steepened due to bank erosion, or along ravines or swales where surface water and groundwater are concentrated. Some of the noted landslides were in areas where fill was placed on already steep slopes, where roadways concentrated storm runoff or where cuts were made to create flat building pads for homes in subdivisions adjacent to the preserves (MCOSD 2011d).

Figure 3.50 Summary Distribution of Landslides and Earthflows

SOURCE: Wentworth, C.M., Graham, S.E., Pike, Beukelman, G.S., Ramsey, D.W., and Barron, A.D., Summary Distribution of Slides and Earthflows in the San Francisco Bay Area Region, Open-File Report 97-745C, U.S. Geological Survey, 1997.



Road and Trail Use

Visitor Use

In fall 2011 the MCOSD contracted for a visitor use census and survey within selected preserves (MCOSD 2011b). The work was designed to capture a representative sample of visitors and their use of roads and trails within the 34 preserves. The objectives were to answer the following questions:

- Who is using the open space preserves (by visitor type and location)?
- When is use occurring (times and patterns of use)?
- What are visitor attitudes, preferences, and experiences?

The data collection methodology was developed to provide unbiased survey protocols and a statistically valid sample of visitors. Data collection included two components:

- a census of visitor use at 14 preserve locations (selected to be a representative sample of the 34 preserves and access points) over a series of up to three peak time periods (with a duration of two hours per period) to provide a reasonable picture of use activity throughout the week (see table 3.13)
- an intercept opinion survey at the same times and locations to determine visitor attitudes and interests

Table 3.13 Census and Survey Locations and Time Periods

	Preserve	Weekday Morning	Weekday Afternoon	Weekend Mid-Day
1	Baltimore Canyon	X	X	X
2	Blithedale Summit	X	X	X
3	Camino Alto	X	No data	X
4	Cascade Canyon	No data	X	X
6	Gary Giacomini	X	X	X
7	Indian Valley	X	X	X
8	Mount Burdell	X	X	X
9	Ring Mountain	X	X	X
10	Roy's Redwoods	X	X	X
11	Rush Creek	X	X	No data
12	San Pedro	X	X	X
13	Terra Linda/Sleepy Hollow Divide	X	X	X
14	White Hill	X	X	X

Source: MCOSD 2011b.

Visitors were categorized as bicyclists, pedestrians, equestrians, or those using motorized vehicles. For all categories, use was recorded as the number of visitors (for example, two people on a tandem bicycle were counted as two bicyclists; two people on a horse were counted as two equestrians). The number of dogs was also recorded to gain an understanding of use by visitors with dogs.

The summary results of the census and surveys are shown in table 3.14, followed by detailed results regarding topics most important to the development of road and trail management policies on the MCOSD preserves.

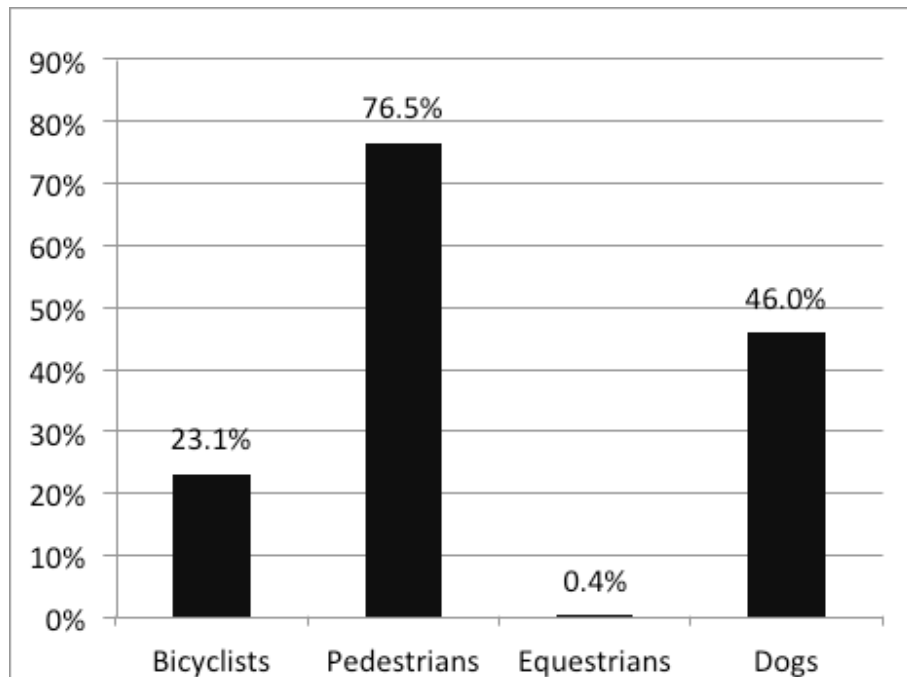
Table 3.14 Summary Results of Visitor Use Census and Survey

Summary of Census Findings	Summary of Survey Findings
Estimated overall preserve annual activity: <ul style="list-style-type: none"> • 2.8 to 3.8 million visitors 	Number of surveys: <ul style="list-style-type: none"> • 384
Mode of transportation to the preserve: <ul style="list-style-type: none"> • 76% of visitors were pedestrians • 46% of pedestrians walked with dogs • 23% of visitors were bicyclists • 0.4% of visitors were equestrians 	Mode of transportation to the preserve: <ul style="list-style-type: none"> • 69% arrived by driving alone or carpooling • 22% arrived by walking
Baltimore Canyon: <ul style="list-style-type: none"> • highest visitor activity • most dog activity 	Visitor origin: <ul style="list-style-type: none"> • 91% from Marin County • 2.4% from Sonoma County • 1.8% each from Alameda and San Francisco Counties
Blithedale Summit: <ul style="list-style-type: none"> • second most visitor activity • most bicycle activity 	Common concerns: <ul style="list-style-type: none"> • Dog and horse waste
Camino Alto: <ul style="list-style-type: none"> • third most visitor activity • second most dog activity 	Visitor experience: <ul style="list-style-type: none"> • 97% good to great trail conditions • 76% good to great maps and signs • 94% good to great interactions

Source: Data taken from MCOSD 2011b.

Figure 3.51 presents census results by visitor type. The following section presents a discussion of the census findings.

Figure 3.51 Visitor census results by visitor type



Source: MCOSD 2011b.

Regional Activity by Visitor Type

Bicyclists

Volunteers counted 321 bicyclists, which accounted for 23.1% of visitors. The locations with the most bicyclists and the respective counts averaged over all the sampled time periods are listed below:

- Blithedale Summit (35)
- Baltimore Canyon (12)

China Camp State Park³ had the highest percentage of bicyclists compared to other visitor types (77%). Of the locations where 100 or more visitors were counted, Terra Linda/Sleepy Hollow Divide had the lowest percentage of bicyclists (2%).

³At the time that the census and survey was conducted, the MCOSD was considering partnering to assist in management of China Camp State Park.

Pedestrians

Volunteers counted 1,063 pedestrians, which accounted for 76.5% of visitors. The locations with the most pedestrians and the respective counts averaged over all the sampled time periods are listed as follows:

- Baltimore Canyon (83)
- Camino Alto (71)
- Indian Valley (67)

Ring Mountain had the highest percentage of pedestrians compared to other visitor types (100%). Of the locations where 200 or more visitors were counted, Indian Valley had highest percentage of pedestrians (92%).

Equestrians

Volunteers counted five equestrians, which accounted for 0.4% of visitors. Volunteers counted two equestrians each at the Mount Burdell and Gary Giacomini Preserves, and one at Indian Valley.

The low equestrian activity may suggest equestrian peak activity times differ from pedestrians and bicyclists. Other possible reasons for the low activity may be that the count locations are not those used by equestrians or that there may be little equestrian activity systemwide.

Dogs

Volunteers counted 494 dogs. Approximately 46% of pedestrians walked with dogs. The locations with the most dogs and respective average counts are listed below:

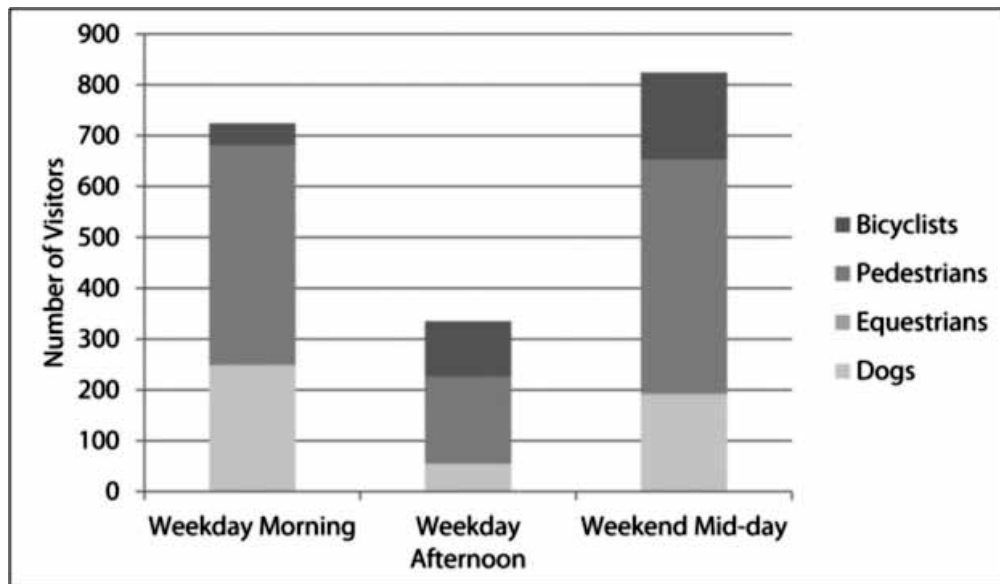
- Baltimore Canyon (165)
- Camino Alto (81)
- Indian Valley (76)

Baltimore Canyon had the highest percentage of pedestrians with dogs (67%) of locations where 10 or more dogs were counted.

Visitor Activity by Day of Week and Time of Day

Overall, the weekend mid-day count period had the highest visitor activity (633 visitors and 191 dogs) of all the sampled time periods. Volunteers counted the most of each visitor type on the weekend, while dog activity was highest during the weekday mornings. Figure 3.52 presents the number of visitors by time period.

Figure 3.52 Visitor census results showing numbers of visitors by time period



Source: MCOSD 2011b.

Visitor Origin, Preserve Access, and Travel and Activity within Preserves

Visitor Origin

- The overwhelming majority of visitors surveyed (91%) lived in Marin County.
- Of those that were from “out of the county,” the majority came from Sonoma County (37%).
- Most (75%) of the out-of-county visitors (25) came on the weekend.
- Roughly equal percentages of out-of-county visitors reported using the preserves during weekdays (47%) and weekends (53%), despite counts indicating higher weekend use.
- Most out-of-county visitors (49%) reported typically visiting in the morning.

Access Mode to Preserve

- Nearly half of visitors surveyed accessed the preserves by driving alone (48%), while about one-fifth carpooled (21%).
- Many visitors walked to the preserves (22%).

Travel in Preserve

- The overwhelming majority of visitors (82%) reported walking through a preserve.
- 17% reported bicycling through a preserve.
- 44% of visitors surveyed brought at least one dog into a preserve (slightly less than the census count of 46%).

The survey of travel mode resulted in slightly different percentages from the census count, during which 76% of visitors walked and 23% bicycled through the preserve.

Visit Purpose

- Exercise (93%)
- Recreation (49%)
- Experience nature (41%)
- Social (29%)

Visit Frequency to Marin County Parks

- Daily (47%)
- Weekly (39%)
- Monthly (9%)

Visitor Concerns and Comments

- Dog waste (16)
- Requests for more narrow trails (for mountain biking) (5)
- Concerns regarding bicyclists riding too fast, and poor interactions with bicyclists (6)
- Concerns about off-leash dogs (8)
- Appreciation for permitting off-leash dogs (9)
- Horse waste (8)

Visitor Experience

- The majority of visitors (97%) rated trail conditions as great or good.
- The majority of visitors (76%) thought the usability of maps and signs was great to good; however, 24% rated the maps and signs as fair to poor.
- The majority of visitors (94%) rated their interactions with other visitors as great or good.

Amount of Visitor Use

Based on actual weekday and weekend counts, a range of estimated weekly, monthly, and annual visits was calculated for the open space system as a whole. Table 3.15 presents the range of estimated weekly, monthly, and annual activity. The total estimated annual visitor use to the preserves is between 2.8 million and 3.8 million visitors.

Table 3.15 Estimated Visitor Use

Period	Estimated Visitor Use (Range)
Weekly	38,100 - 70,100
Monthly (September)	169,000 - 301,000
Annual	2,820,000 - 3,760,000

Source: MCOSD 2011b.

Emergency Access

Roads and trails serve various functions for preserve visitors, county residents, public agencies, and private companies. For preserve visitors and county residents, the roads and trails offer recreational access opportunities. For the MCOSD staff, the roads and trails provide access for patrol and enforcement, maintenance, resource protection and restoration, and other activities. For other agencies, such as the Marin County Fire Department and local fire agencies, the Marin Municipal Water District, and the North Marin Water District, and for private utilities, the roads provide emergency access in the event of wildland fire, and for maintenance of water tanks, antennae, and other infrastructure.

Fire Roads

More than half of the total road and trail mileage on the MCOSD lands, or 113 miles, consists of what are considered fire roads. This equates to approximately 19 miles of fire roads per region. Region 2 contains the most fire roads (38 miles), and region 6 contains the fewest fire roads (3 miles). Region 1 contains 18 miles, region 3 contains 19 miles, region 4 contains 21 miles, and region 5 contains 14 miles of fire roads.

Maintenance Roads & Utility Assets by Region

Existing development within the preserves includes public service and utility facilities and infrastructure that need regular maintenance and replacement. These include stormwater facilities, such as culverts and drainage features (e.g., water bars); water mains and hydrants; telecommunication towers; fences and gates; bridges; locks; signs; and parking areas. Pacific Gas and Electric (PG&E), AT&T, the Marin Municipal Water District, and the North Marin Water District operate and maintain facilities within the MCOSD preserves that require year-round access over preserve roads. The utility companies and districts in Marin County currently use the majority of the MCOSD roads, including all 113 miles of fire roads, although some access is restricted by the MCOSD. For example, the Marin Municipal Water District uses most of the roads within the Blithedale Summit Preserve to access water tanks and hydrants or to access watershed lands managed by the water district. Utility use within each of the regions is summarized below.

Region 1

The Marin Municipal Water District operates and maintains water mains that parallel 12.2 miles of roads. Along these roads, the water district operates and manages 167 water valves, three pump stations, and nine hydrants. It accesses approximately 18 miles of the MCOSD roads within region 1 to operate and maintain this water utility infrastructure. No road or trail within region 1 is used by any telecommunication service provider.

Region 2

Water mains, including 33 water valves, five corrosion test stations, and two hydrants, parallel 3 miles of roads within the MCOSD preserves. The Marin Municipal Water District accesses approximately 30 miles of the MCOSD roads within region 2 to operate and maintain this water utility infrastructure. PG&E uses approximately 38 miles of roads. Telecommunication service providers use approximately 4 miles of roads.

Region 3

The Marin Municipal Water District operates and maintains water mains that parallel 3 miles of roads on the MCOSD preserves, along with three water valves and one hydrant using a total of 1 mile of access roads. The North Marin Water District operates and maintains three water tanks and other assets requiring 1 mile of the MCOSD roads for access. PG&E uses approximately 19 miles of roads. Telecommunication service providers, including AT&T, Verizon, and American Tower, operate communication towers on Big Rock Ridge and use approximately 19 miles of the MCOSD roads for access.

Region 4

The North Marin Water District manages three water tanks and related infrastructure, using approximately 1 mile of the MCOSD roads for access. PG&E uses approximately 21 miles of

the MCOSD roads. Telecommunication service providers use approximately 5.5 miles of the MCOSD roads in the Mount Burdell Preserve.

Region 5

The Marin Municipal Water District manages water mains along 3.5 miles of the MCOSD roads, in addition to operating 28 water valves, 13 corrosion test stations, and four hydrants with access provided by an additional 2 miles of the MCOSD maintained roads. PG&E uses approximately 14 miles of the MCOSD roads.

Region 6

No utility service providers use any roads within this region.

4. ROAD AND TRAIL USE POLICIES AND MANAGEMENT

This chapter addresses visitor use of the MCOSD preserves and the roads and trails that support this use. It focuses on recreational use, establishing visitor use goals and management areas aimed at facilitating visitor enjoyment of a variety of desired recreational experiences, while minimizing impacts to sensitive resources and minimizing visitor conflicts. It also addresses special uses, including administrative use by other agencies and public utilities, and other permitted activities.

Visitor use of the road and trail system will occur within the framework of guiding principles, which have been developed as part of this plan, and by management policies, which are both internal and external to this plan. Most of the policies described in this chapter are from other plans previously adopted by the Marin County Board of Supervisors or the MCOSD Board of Directors; however, some revisions to these policies and some new policies have been developed as part of this plan, and are identified as such. Where federal, state, county, or MCOSD policies and policies specific to this plan overlap, or seem to contradict, by law, the more environmentally protective policies will apply.

Figure 4.1 Spectrum of Federal, State, and Marin County Direction Applicable to the Policies Included in this *Road and Trail Management Plan*

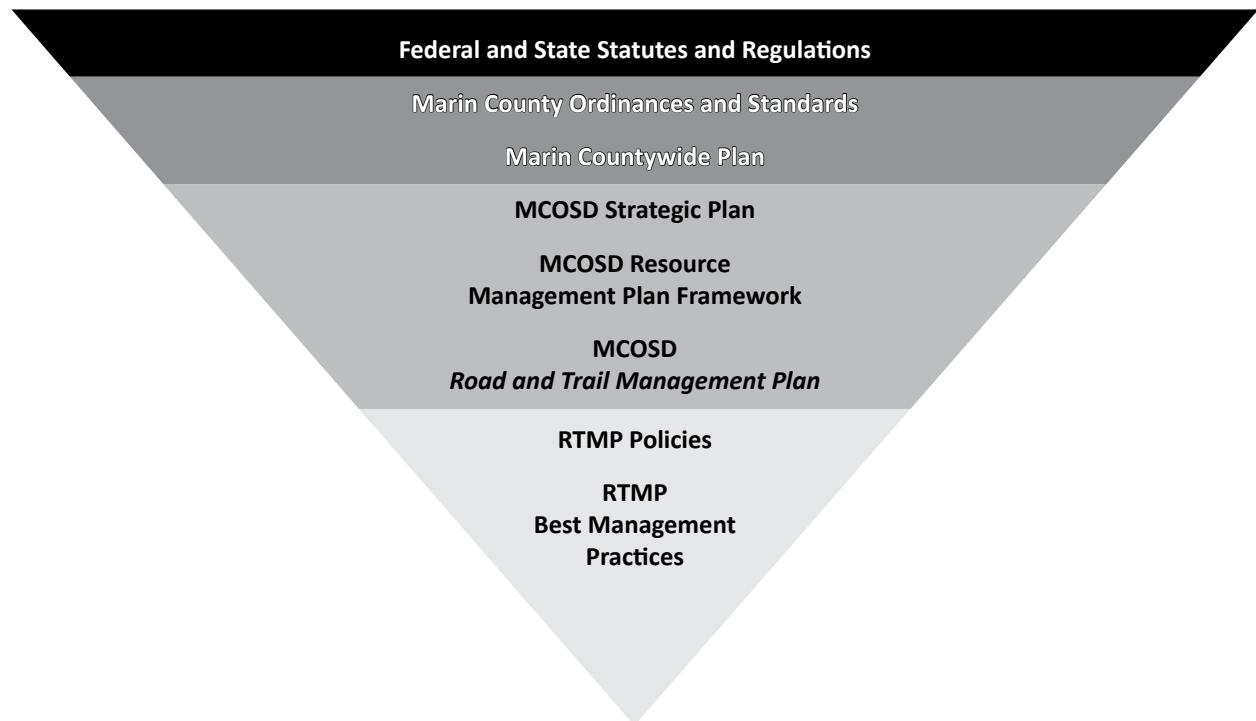


Figure 4.1 illustrates the general relationship between existing federal, state, and Marin County regulations and plans, and the more specific policies included in this *Road and Trail Management Plan* (RTMP).

Visitor Use Goals and Management Areas

Goals

Visitor use goals summarized from the 2011 Notice of Preparation for this *Road and Trail Management Plan* are as follows:

- Provide an appropriate range of desired experiences for visitors.
- Address visitor conflict issues.
- Minimize or avoid impacts to sensitive resources.

Management Areas

As a first step to achieving the visitor use goals, the MCOSD has developed three visitor use management areas as part of this *Road and Trail Management Plan*. Visitor use management

areas are commonly used in recreation planning (1) to acknowledge the importance of and manage for a range of resource conditions and visitor experiences within the system, and (2) to designate consistent resource protection and visitor experience conditions within portions of the planning area defined by common characteristics (e.g., vegetation type, habitat type, amount and types of use).

The three visitor use management areas developed for the preserves reflect the following concepts: an experience of being immersed in nature in largely intact, sensitive resource areas with encounters with few other visitors; an experience of being connected to nature in well protected resource areas, but with encounters with a greater number of visitors; and an experience of being in a highly managed and/or impacted area, with exposure to adjacent land uses and encounters with the greatest number of visitors. Each area is meant to support a different visitor experience characterized by environmental conditions, type of access, management of visitor use, and level of visitor use. Some of the policy guidance will depend upon the visitor use management area where the road or trail might be located (see the policies at the end of this chapter and the discussion of how consistency with policies is considered when recommending actions for roads and trails in chapter 5).

The development of the visitor use management areas was guided by the following Marin County and the MCOSD policies and information developed during preparation of this plan:

- the goals and policies regarding roads and trails from the *Marin Countywide Plan* and the MCOSD Policy Review Initiative
- the stated purposes of this plan and the goals for visitor use developed as part of this plan
- vegetation management zones established in the *Vegetation and Biodiversity Management Plan*
- results of the 2011 visitor use census and survey
- public interests and concerns expressed during the public workshops conducted during plan development
- requirements of federal and state laws

Goals and policies from Marin County and the MCOSD planning documents clearly demonstrate the importance of resource protection and stewardship, and that activities by the public or by public agencies must be undertaken only when adverse impacts to the natural environment can be avoided or mitigated to acceptable levels; that is to say that the natural attributes of the preserves take precedence over public use. This idea is also set forth in the ballot measure that established the MCOSD in 1972. The ideas of being immersed in nature or connected to nature are grounded in this guidance; however, they also reflect the comments gathered at the

public workshops conducted for this plan. While the visitor census and survey focused primarily on describing the existing visitor demographics and behavior (e.g., visitor origin, use type, trail use patterns), questions posed during the public workshops focused on visitors' desired experiences while on the MCOSSD preserves. Among the responses to the question, "What makes an enjoyable experience?" the most frequently mentioned responses pertained to nature, either "viewing nature" or "learning about nature." In response to the workshop question, "What kinds of qualities of experiences are you seeking?" the most common responses (in nearly equal proportions) were "exploration and discovery," "quiet and solitude," and "camaraderie." Comments gathered during public scoping meetings in fall 2010 and spring 2011 additionally indicated that visitors are also interested in having access to a greater variety of experiences (additional trails, more opportunities to create loop routes); being able to travel long distances; travelling to scenic vistas/viewing good scenery; being free from user conflicts; learning about and appreciating nature; testing outdoor skills; and getting exercise.

The preserves have also been divided into vegetation management areas as part of the *Vegetation and Biodiversity Management Plan*. The vegetation management areas are based on the inherent value and current condition of natural resources and their proximity to developed areas. While the visitor use management areas are based in part on environmental conditions, they do not prescribe management of natural resources. Instead, they prescribe the management of visitor use and associated development.

The three visitor use management areas

- Sensitive Resource Area
- Conservation Area
- Impacted Area

are described below.

1: Sensitive Resource Area

Desired Future Condition

Visitors perceive and experience a relatively undisturbed, minimally developed natural environment, with few encounters with others, opportunities for solitude, and wildlife viewing.

Management Emphasis

The Sensitive Resource Area is planned to accommodate only low to moderate visitor use. All existing types of uses are allowed (e.g., hiking, walking dogs, mountain biking, horseback riding). The opportunity to experience solitude and an undisturbed natural environment is highest in this area, while reduction of visitor impacts to plants and wildlife is maximized, compared to the other two visitor use management areas.

Locations

This area encompasses those parts of the preserves that are typically well buffered (i.e., surrounded) by other largely intact natural areas. Typical examples of lands in the Sensitive Resource Area include portions of Cascade Canyon Preserve and Gary Giacomini Preserve. This area encompasses 16% of all preserve lands (see figures 4.2 – 4.7).

2: Conservation Area**Desired Future Condition**

Visitors experience easy access to a primarily natural landscape and good views. Opportunities for solitude and wildlife viewing may be more frequent in proximity to the Sensitive Resource Areas; but encounters with other visitors may be frequent, and wildlife viewing may be compromised in proximate to Impacted Areas.

Management Emphasis

The Conservation Area is managed to accommodate moderate to high levels of visitor use (e.g., hiking, walking leashed dogs and off-leash dogs, mountain biking, and/or horseback riding) with minimal to moderate disturbance to plants and wildlife.

Locations

Conservation Areas encompass large natural areas, often linear in nature, and offer access into more remote places with good views. These areas are sometimes located along ridgelines. Typical examples of lands included in the Conservation Area include portions of Blithedale Summit Preserve and Baltimore Canyon Preserve, and Pacheco Valle Preserve and Loma Verde Preserve. The Conservation Area also includes preserves not well buffered from surrounding developed land uses and associated impacts. This area encompasses 73% of all preserve lands (see figures 4.2 – 4.7).

3: Impacted Area**Desired Future Condition**

Impacted Areas are easily accessed for recreation. The sights and sounds of others and the built environment are present. Visitors should expect frequent encounters with others and with staff, but not wildlife.

Management Emphasis

The Impacted Area is managed to accommodate high levels of visitor use, and to provide varied uses and experiences (e.g., hiking, dog walking, bicycling, and/or horseback riding). Use may be supported by improvements to enhance the visitor experience and protect resources.

Locations

Impacted Areas are located near preserve boundaries that are adjacent to homes, other developed areas, or near other private lands. Impacted Areas may also encompass large portions of preserves, depending on a preserve's boundary configuration and the type of adjacent land use. Typical examples of lands included in this area are portions of Terra Linda/Sleepy Hollow Divide Preserve. This area encompasses 11% of all preserve lands (see figures 4.2 – 4.7).

Guiding Principles for Managing Roads and Trails on the MCOSD Preserves

Guiding principles for making determinations regarding which roads and trails will ultimately be included in the MCOSD's designated road and trail system are identified below (see chapter 5 for a description of this process). Any road or trail that was included in the *Road and Trail Assessment* completed in November 2011 will be considered for inclusion in the designated road and trail system. Any unauthorized roads and trails that were constructed after November 2011, will not be considered for inclusion in the designated road and trail system. Social trails were not included in the *Road and Trail Assessment*, but are defined and recognized in table 4.1.

These guiding principles have been developed by staff and gleaned from road and trail management plans developed by other land management agencies in the San Francisco Bay area. The guiding principles provide a framework for the policies described in this chapter.

- The road and trail system will provide a fair, desirable, and appropriate range of recreation opportunities—and associated infrastructure—for visitors to enjoy the preserves.
- Impacts to the natural environment from the road and trail system will be avoided or mitigated to acceptable conditions under the California Environmental Quality Act and other applicable local, state, and federal environmental laws and regulations.
- Safety will be maintained and conflicts among visitors will be minimized.
- Foreseeable construction, maintenance, and enforcement responsibilities related to the road and trail system will be financially feasible.
- Designation of the road and trail system and subsequent management actions will occur through transparent and collaborative decision-making processes.
- Management actions will encourage respect for private property and adjacent property owners and land uses.

Figure 4.2 Visitor Use Management Areas, Region 1

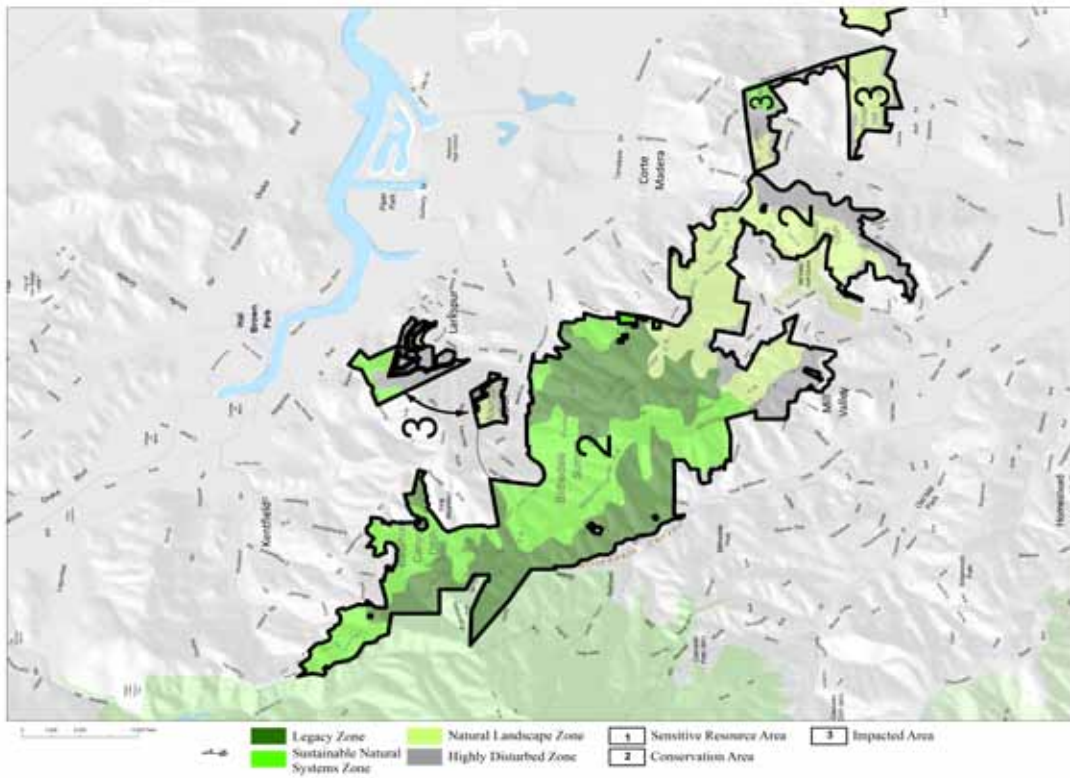


Figure 4.3 Visitor Use Management Areas, Region 2

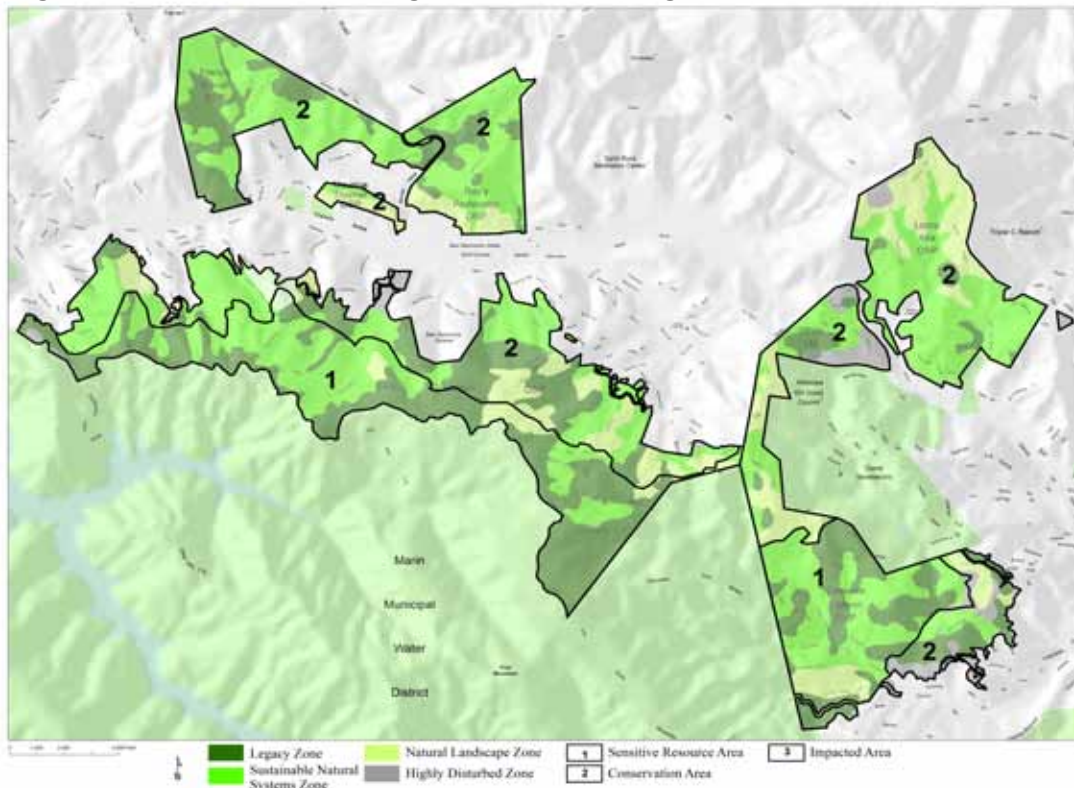


Figure 4.4 Visitor Use Management Areas, Region 3

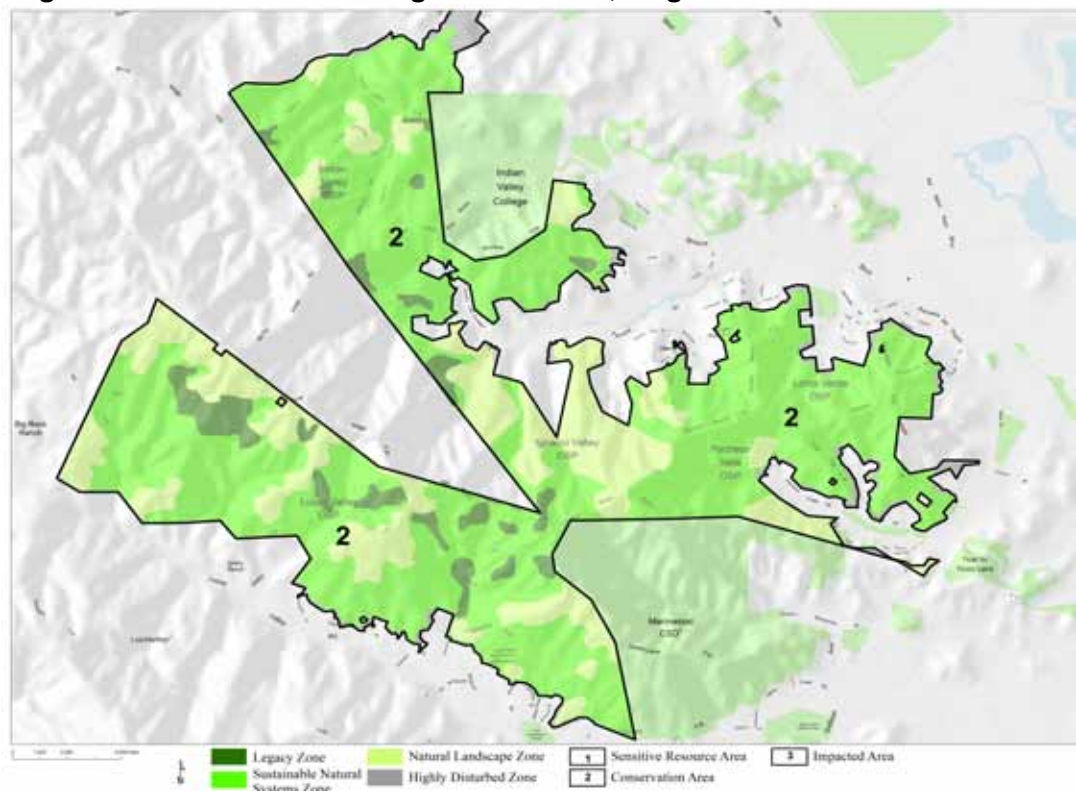


Figure 4.5 Visitor Use Management Areas, Region 4

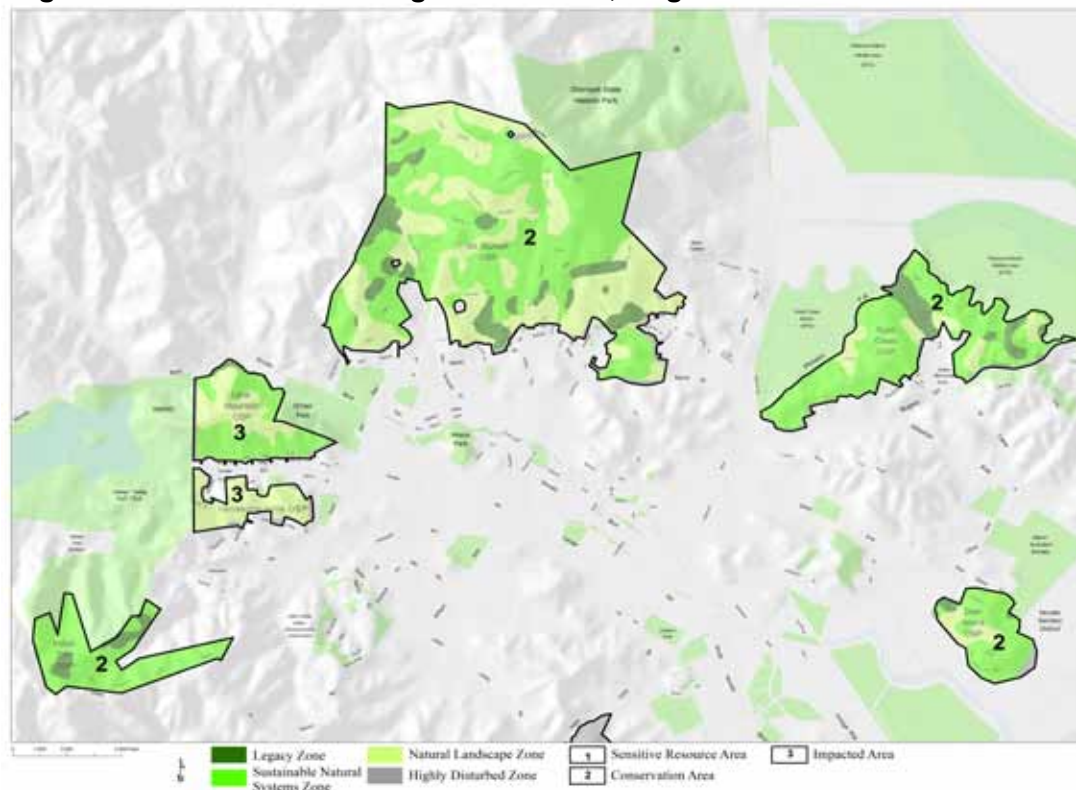


Figure 4.6 Visitor Use Management Areas, Region 5

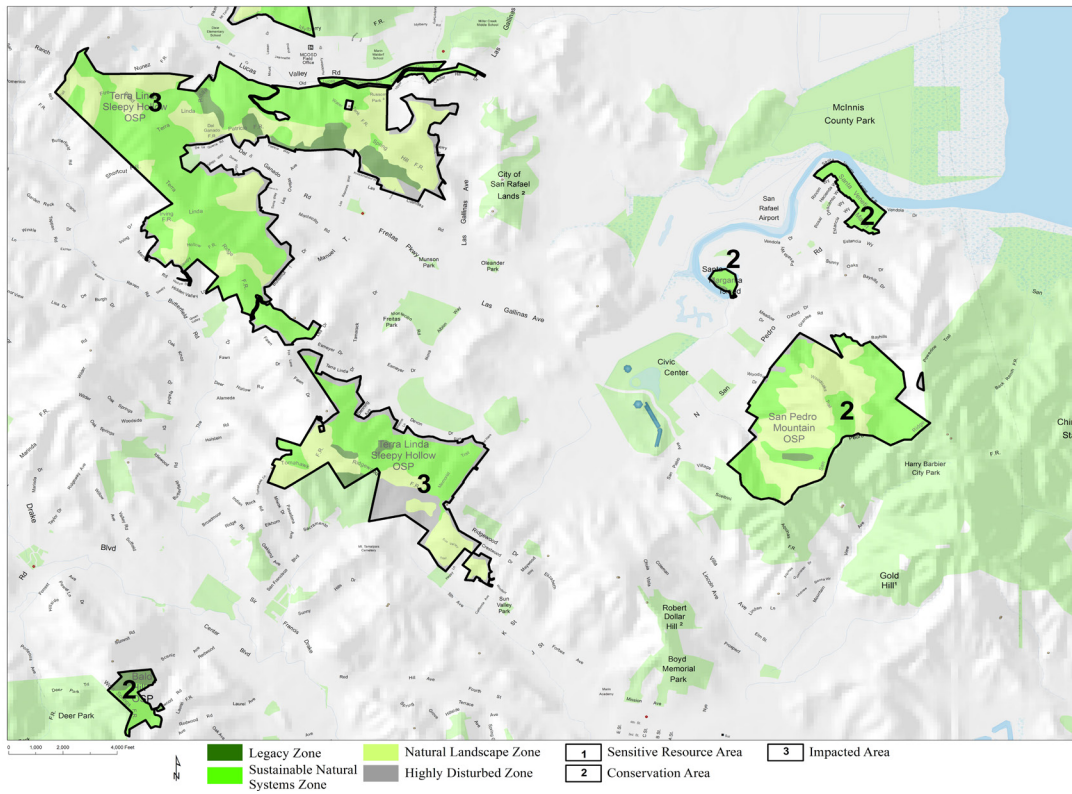
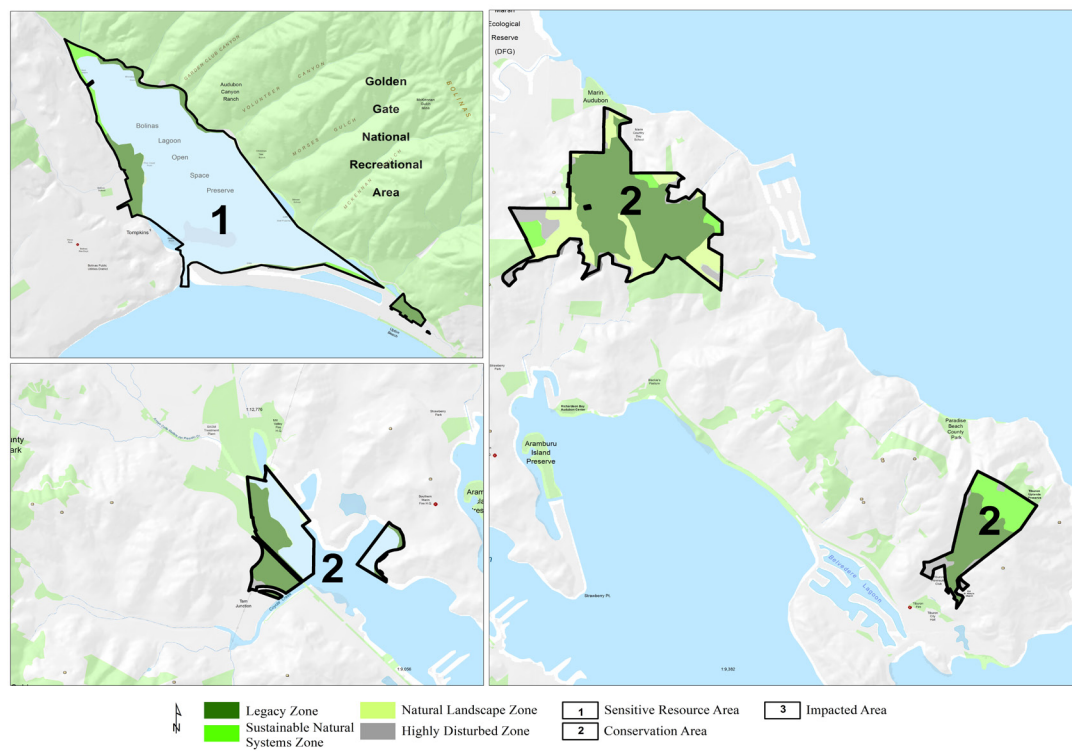


Figure 4.7 Visitor Use Management Areas, Region 6



Policies Directing the Management of Roads and Trails on the MCOSD Preserves

Most of the policies governing the development and use of roads and trails on the MCOSD preserves were excerpted from the 2007 *Marin Countywide Plan*, approved by the Marin County Board of Supervisors, or the MCOSD Policy Review Initiative, adopted by the MCOSD Board of Directors. A number of new policies, developed as part of this plan and identified as such below, emphasize the importance of natural resource protection and the necessary limitations on visitor uses to achieve visitor safety, harmony of users, and protection of natural resources within acceptable limits.

These policies will be applied across the system of preserves, and will address multiple interests and concerns, which can be categorized as follows:

1. Meet current and future demand for access to public lands by providing roads and trails for a variety of users.
2. Ensure a sustainable road and trail system.
3. Protect sensitive resources.
4. Minimize user conflicts.
5. Enhance road and trail connectivity and improve the range of opportunities for visitors to experience the preserves.
6. Provide limited parking in appropriate locations.
7. Provide appropriate trail-related infrastructure (accessible entry structures and signs, for example).
8. Coordinate with adjacent landowners and respect private property rights.
9. Maintain user safety.
10. Other (i.e., the lawful authority of the MCOSD to restrict recreational use or to allow special use under certain circumstances).

Table 4.1 lists all of the policies that will guide the designation, development, management, and use of the road and trail system within the MCOSD preserves. The policies are listed according to their source (the *Marin Countywide Plan*, the *MCOSD Policy Review Initiative*, or this *Road and Trail Management Plan*). The table also indicates which of the above interests and/or concerns (numbers 1 – 10) are addressed by each policy.

Table 4.1 Policies Governing the MCOSD Roads and Trails

	1. Public Access	2. Sustainability	3. Resource Protection	4. User Conflicts	5. Connectivity	6. Parking	7. Infrastructure	8. Adjacent Landowners	9. Safety	10. Other
Policies from the Marin Countywide Plan										
BIO-4.14: Reduce Road Impacts in Stream Conservation Areas (SCA). Locate new roads and road fill slopes outside SCAs, except at stream crossings, and consolidate new road crossings wherever possible to minimize disturbance in the SCA. Require spoil from road construction to be deposited outside the SCA, and take special care to stabilize soil surfaces.		X								
BIO-5.f: Control Public Access. Design public use areas to be clearly marked, to minimize possible conflicts between public and private uses, to provide continuous walkways from the nearest roads to the shoreline and along the shoreline, to be set back from any proposed structure, and to be buffered from wetlands. Restrict access to environmentally sensitive marshland and adjacent habitat, especially during spawning and nesting seasons.		X				X		X		
BIO-4.k: Locate Trails Appropriately. Situate trails at adequate distances from streams to protect riparian and aquatic habitat and wildlife corridors. Trails may occasionally diverge close to the top of the bank to provide visual access and opportunities for interpretive displays on the environmental sensitivity of creek habitats.		X								
GOAL TRL-1: Trail Network Preservation and Expansion. Preserve existing trail routes designated for public use on the Marin Countywide Trails Plan maps, and expand the public trail network for all user groups, where appropriate. Facilitate connections that can be used for safe routes to school and work.	X			X						
TRL-1.1: Protect the Existing Countywide Trail System. Maintain the existing countywide trail system and protect the public's right to access it.	X									
TRL-1.2: Expand the Countywide Trail System. Acquire additional trails to complete the proposed countywide trail system, providing access to or between public lands and enhancing public trail use opportunities for all user groups, including multi-use trails, as appropriate.	X			X						
TRL-1.4: Coordinate Trail Planning. Promote collaboration among public land management agencies, nongovernmental organizations, and private landowners to implement the Marin Countywide Trails Plan and regional trail systems.								X		
TRL-1.b: Designate Trails Consistent with Agency Missions. Determine public use of trails consistent with each agency's mission and policies.								X		
TRL-1.d: Establish Regional Trail Connections. Strive to complete regional trail systems in Marin County, including the Bay Area Ridge Trail, the San Francisco Bay Trail, and the California State Coastal Trail. The proposed alignment of the Coastal Trail will be considered through process to update Marin County Local Coastal Plan.					X					
TRL-1.e: Explore Funding for Trail Acquisition. Consider developing or supporting legislation to assist trail acquisition. Consider public and private funding sources, including private endowments and bequests.	X									
TRL-1.g: Evaluate Proposed Development for Trail Impacts. Review development proposals for consistency with the Marin Countywide Trails Plan or local community plans.	X		X					X		
TRL-2.1: Preserve the Environment. In locating trails, protect sensitive habitat and natural resources by avoiding those areas.			X							
TRL-2.2: Respect the Rights of Private Landowners. Design and manage trails to avoid trespass and trail construction impacts on adjacent private land.								X		
TRL-2.3: Ensure User Safety. Plan and maintain trails to protect the safety of trail users.										X

Table 4.1 Policies Governing the MCOSD Roads and Trails

	1. Public Access	2. Sustainability	3. Resource Protection	4. User Conflicts	5. Connectivity	6. Parking	7. Infrastructure	8. Adjacent Landowners	9. Safety	10. Other
TRL-2.5: Provide Access for Persons with Disabilities. Design and develop trails and trail programs to enhance accessibility by persons with disabilities.	X									
TRL-2.6: Provide Multiple Access Points. Design trails with multiple access points to maximize accessibility and minimize concentrating access.	X									
TRL-2.7: Ensure Sustainable Maintenance. Continue to ensure that trails are responsibly maintained.		X								
TRL-2.8: Provide Trail Information. Strive to provide information to users that facilitates visitor orientation, nature interpretation, code compliance, and trail etiquette. Develop a method for signing trails to assist users and emergency personnel.							X			
TRL-2.a: Locate Trails to Protect Habitat. Align or relocate trails to avoid impacting sensitive habitats such as wetlands and areas where endangered species are present. Avoid aligning trails along the boundaries of sensitive habitats.			X							
TRL-2.b: Design, Build, and Manage Trails in a Sustainable Manner. Incorporate design measures that protect vegetation, protect habitats, and minimize erosion.		X	X							
TRL-2.c: Eliminate Trail Redundancy. Identify, abandon, and restore redundant or otherwise unnecessary trails or trail segments.	X		X							
TRL-2.d: Protect Private Property. Design and locate trails to avoid trespassing and adverse impacts on adjacent private lands and sensitive land uses.								X		
TRL-2.e: Design Safe Trails. Design trails so that their surfaces, grades, cross gradients, sight distances, width, curve radii, vegetation clearance, and other specifications are consistent with anticipated uses.									X	
TRL-2.f: Acknowledge Historic Trail Users. When acquiring a property for public use, consider trail use that occurred prior to the public acquisition.	X									
TRL-2.g: Promote Harmony Among Trail Users. Provide educational information, and consider special programs and events to promote trail etiquette and cooperation among trail user groups. Encourage interagency collaboration on countywide standards for trail etiquette to promote harmony among trail user groups.				X						
TRL-2.h: Identify Access Opportunities for Persons with Disabilities. Review existing access opportunities for persons with disabilities. Identify and pursue new opportunities.	X									
TRL-2.k: Ensure Trail Maintenance. Encourage public agencies to develop trail maintenance plans and enter into cooperative trail maintenance agreements. Encourage volunteer trail stewardship programs.		X								
TRL-2.l: Ensure Trail Maintenance Funding. Strive to identify and secure consistent sources of funding for trail maintenance. Develop a program for funding that explores trail adoption, trail maintenance annuities, jurisdictional cooperation, and other sustainable methodology.		X								
TRL-2.m: Maintain Trails in a Sustainable Manner. Consider and implement as appropriate.		X								
TRL-2.n: Promote Interagency Cooperation. Encourage information sharing and cooperation among public agencies concerning sustainable trail maintenance.		X						X		

Table 4.1 Policies Governing the MCOSD Roads and Trails

	1. Public Access	2. Sustainability	3. Resource Protection	4. User Conflicts	5. Connectivity	6. Parking	7. Infrastructure	8. Adjacent Landowners	9. Safety	10. Other
TRL-2.p: Improve Code Compliance. Encourage trail managers to enforce codes, secure consistent funding for code enforcement, monitor the type and frequency of violations, and offer educational materials and programs to reduce code violations. Expand or create volunteer opportunities to monitor trail use.	X	X	X		X		X			
Policies from the MCOSD Policy Review Initiative										
Policy P1: The MCOSD will rely primarily on public rights-of-way to provide the parking capacity necessary to serve open space visitors arriving by motorized vehicle.						X				
Policy P2: The MCOSD will strive to provide multiple points of entry to open space, to maximize available parking capacity and to avoid concentrating access.					X					
Policy P3: The MCOSD will encourage open space visitors to walk, bicycle and carpool to open space.						X				
Policy P4: The MCOSD should partner with police and fire departments to enforce lawful parking at entrances to open space.					X					
Policy P5: The MCOSD may seek increased parking capacity on a case-by-case basis, including the development of parking facilities on the MCOSD lands where necessary for public safety, and where resource conditions permit.					X					
Policy T1a: The MCOSD will allow trail-based uses on open space, because the ability of the public to access and enjoy open space enhances the quality of life in Marin.	X									
Policy T1b: The MCOSD will permit use of fire protection roads by open space visitors on foot, on a bicycle, and with a saddle animal, but may limit any or all uses when appropriate.	X		X	X						
Policy T1c: The MCOSD will permit use of trails by visitors on foot and with a saddle animal, but may limit any or all uses when appropriate.	X		X	X						
Policy T1d: The MCOSD will permit bicycling on trails designated for their use, including (a) new trails that the MCOSD builds and designates for shared use and (b) existing trails on new lands, when compatible with natural resource protection and the safety of trail users. (Existing policy to be revised as stated below in Policy T1d.)										
Policy T1e: The MCOSD will prohibit trail use conduct and other trail use modes that compromise the protection of natural resources or the safety of open space visitors.			X					X		
Policy T1f: The MCOSD will discourage the use of trails that are not part of its system of maintained trails when use of such trails is inconsistent with natural resource protection.										
Policy T1g: The MCOSD will prohibit the use of motorized vehicles on open space, with authorized exceptions.										X
Policy T2a: The MCOSD will use best management practices in the design, construction, and maintenance of trails.	X									
Policy T2b: The MCOSD will strive to coordinate trail design and management with the owners and managers of adjoining lands.								X		
Policy T2c: The MCOSD will strive to provide information, including signs, to trail users that facilitate visitor orientation, nature interpretation, code compliance, and proper trail etiquette.							X			

Table 4.1 Policies Governing the MCOSD Roads and Trails

	1. Public Access	2. Sustainability	3. Resource Protection	4. User Conflicts	5. Connectivity	6. Parking	7. Infrastructure	8. Adjacent Landowners	9. Safety	10. Other
Policy VA2: The MCOSD may provide visitor amenities such as (a) informational displays and signs; (b) portable restrooms in areas where group use is seasonally frequent; (c) facilities for watering and tying equines; and (d) bicycle racks.							X			
Revisions to Existing Policies (adopted as part of this Road and Trail Management Plan)										
Policy T1d: The MCOSD will permit bicycling and saddle animals on trails designated and signed for their use, including (a) existing trails and new trails that the MCOSD builds and designates for shared use; and (b) existing trails on newly acquired lands, when compatible with natural resource protection and the safety of trail users.	X		X						X	
New Policies (adopted as part of this Road and Trail Management Plan)										
Policy SW.1: Application of this Road and Trail Management Plan Policies. The policies and requirements of this plan will apply within all open space preserves, and within any new preserves that may be established. These policies will also apply to existing and future trail easements unless they would conflict with the terms of the easement, in which case the easement will prevail.	X	X	X	X	X	X	X	X	X	X
Policy SW.2: System Roads and Trails. The MCOSD will, following adoption of this plan, designate a system of roads and trails, referred to as “system roads and trails”, in all existing and new open space preserves, through a collaborative public process. Those roads and trails eligible for consideration as part of the system must have been constructed as of November 2011. The MCOSD may improve, maintain, convert, or reroute system roads and trails according to the policies and requirements of this plan, as time and resources allow. Nonsystem roads and trails, defined as those roads and trails not designated as system roads and trails, may be decommissioned at any time, as time and resources allow.	X	X	X	X	X	X	X	X	X	X
Policy SW.3: Social Trails. For the purpose of this policy, social trails are defined as narrow pedestrian footpaths that a) were not constructed; and b) have not been improved, managed, or maintained. This definition extends to wildlife trails used occasionally by pedestrians. This plan recognizes that, for all practical purposes, social trails will continue to exist after the system of roads and trails has been designated. Social trails are not subject to closure or decommissioning unless a) their continued existence compromises public safety; b) results in unacceptable levels of erosion, or damage or disruption to plants and wildlife; c) their volume of use increases; and/or d) they are used by equestrians or bikers.	X	X	X						X	
Policy SW.4: Overall Reduction of Road, Trail, and Visitor Impacts. The designated system of roads and trails will have less overall impact to resources compared to the network of roads and trails existing as of November 2011. Impacts will be reduced by decommissioning nonsystem roads and trails, and by the improvement, conversion, or rerouting of system roads and trails. The MCOSD will maximize the reduction of road, trail, and visitor impacts in Sensitive Resource Areas, compared to Conservation Areas and Impacted Areas. Impacted Areas will exhibit the widest range of acceptable road, trail and visitor impacts.		X	X							
Policy SW.5: Policy on Pedestrian Activities. Pedestrians are encouraged to stay on system roads and trails.	X	X	X							
Policy SW.6: Prohibition on Off-Road or Off-Trail Equestrian Use. Horses and pack animals must stay on system roads and trails, except when watering or resting the animal. Off-trail riding is prohibited. Riding or possession of a horse or pack animal on nonsystem roads and trails is prohibited. Riding or possession of a horse or pack animal on social trails is prohibited.	X	X								

Table 4.1 Policies Governing the MCOSD Roads and Trails

	1. Public Access	2. Sustainability	3. Resource Protection	4. User Conflicts	5. Connectivity	6. Parking	7. Infrastructure	8. Adjacent Landowners	9. Safety	10. Other
Policy SW.7: Prohibition on Off-Road or Off-Trail Bicycle Use. Mountain bikers must stay on system roads and trails designated for bicycle use. Off-trail riding is prohibited. Riding or possession of a bicycle on nonsystem roads and trails is prohibited. Riding or possession of a bicycle on social trails is prohibited.	X									
Policy SW.8: Prohibition on Off-Road or Off-Trail Pedestrians with Dogs or Other Domestic Animals. Pedestrians with dogs and other domestic animals must stay on system roads and trails. Off-trail use by pedestrians with dogs and other domestic animals is prohibited. Use of nonsystem roads and trails, and social trails, by pedestrians with dogs and other domestic animals is prohibited.	X									
Policy SW.9: Prohibition of Dogs within Sensitive Water Resources. Dogs are not allowed to travel, run, walk, hunt, or bathe in streams or any sensitive water bodies, such as marshes, lakes, or ponds, within the preserves.			X							
Policy SW.10: Policy on Leash Only Preserves. Due to the occurrence of sensitive resources, dogs must be leashed on all roads and trails in those preserves currently designated as “leash only” (i.e., Cascade Canyon, Ring Mountain, and Rush Creek Preserves). The MCOSD may designate other “leash only” preserves in the future.			X							
Policy SW.11: Policy on Leash Requirements for Dogs. Dogs must be on leash (no more than 6 feet in length) a) in all designated “leash only” preserves; and b) on all trails. Dogs may be off leash, but under voice control, only on fire roads that are not within leash only preserves. The MCOSD will identify roads passing through leash only preserves with signs. Dogs under voice control must remain on the fire road.	X									
Policy SW.12: Road and Trail Connectivity. The MCOSD will strive to increase road and trail connectivity for all trail users. The MCOSD will strive to provide opportunities for short to medium distance loops and long-distance routes. The MCOSD may consider one-way, uphill-only, time separation, and single-use or priority-use trails to achieve these ends.	X				X					
Policy SW.13: Prohibition on Dangerous Activities. Activities that exceed the established speed limit, are reckless, or pose a danger to the user or to other road and trail users, are prohibited.	X								X	
Policy SW.14: Road and Trail Etiquette. All road and trail users will practice good etiquette at all times. Mountain bikers will always yield to both hikers and equestrians. Hikers will yield to equestrians. Mountain bikers must announce their presence by using a bell or calling out when overtaking other trail users.	X			X						
Policy SW.15: Expectation of Active Cooperation of All Road and Trail Users. Increased trail use opportunities must be coupled with cooperation among all trail users, and with the MCOSD, to promote lawful trail use, reduce violations, reduce impacts to natural resources, prevent displacement of any trail user types, minimize disturbance to existing neighbors, and avoid endangerment of other trail users.				X			X		X	
Policy SW.16: Prohibition of Uses. The MCOSD may prohibit certain trail uses or apply increased trail use restrictions within certain areas to enhance safety, minimize conflicts between trail users, and protect natural resources. Examples of areas where this policy may apply include, but are not limited to, those proximate to stables and those traditionally heavily traveled by equestrians, and in Sensitive Resource Areas.			X						X	
Policy SW.17: Displacement of Existing Trail Users. The MCOSD will strive to prevent displacement of equestrians and pedestrians when accommodating trail access and trail connections for mountain bikers. When considering the designation of existing trails as single-use or priority-use, the MCOSD will take care to maintain connectivity between destinations for user groups historically using those trails.	X				X					

Table 4.1 Policies Governing the MCOSED Roads and Trails

	1. Public Access	2. Sustainability	3. Resource Protection	4. User Conflicts	5. Connectivity	6. Parking	7. Infrastructure	8. Adjacent Landowners	9. Safety	10. Other
<p>Policy SW.18: Unauthorized Trail Construction and Maintenance. The MCOSED has no tolerance for unauthorized trail construction and unauthorized reopening of closed or decommissioned roads and trails. The MCOSED will prosecute such violations to the fullest extent of the law. The MCOSED will apply new deterrence methods, including rigorous investigation and increased penalties to stop such damaging and unlawful activities.</p>	X		X							
<p>Policy SW.19: Redundant Roads and Trails. Redundant roads or trails are defined as those that roughly parallel an existing route serving essentially the same purposes, uses, and user groups. Through designation of the road and trail system, the MCOSED will reduce the overall level of redundancy compared to baseline levels and when doing so will exclude from designation the road or trail segment or segments that have the highest overall maintenance costs and the worst profile of environmental impacts. The MCOSED may strategically retain some redundant roads and trails in the interest of separating user groups and avoiding user conflict. Redundant roads and trails that are not designated as system roads and trails will be decommissioned as time and resources allow. All decommissions of redundant fire road segments will be subject to consultation with Marin County Fire and the relevant local fire agencies.</p>	X	X	X							
<p>Policy SW.20: Conversion of System Roads to Trails. The MCOSED may convert system roads to trails to protect natural resources, enhance visitor experience and/or safety, or align maintenance costs with available funds. System roads encumbered by license, lease, or easement for nonrecreational purposes, and roads required for maintenance or emergency access, may not be converted to trails unless encumbrances are removed or roads are no longer necessary for maintenance or emergency use.</p>	X	X	X					X		X
<p>Policy SW.21: Roads or Trails Serving Nonrecreational Uses. Roads or trails subject to or encumbered by license, lease, or easement, for nonrecreational purposes, and those roads required for maintenance or emergency access, will become system roads and trails, unless encumbrances are removed or roads are no longer necessary for maintenance or emergency use.</p>							X	X		X
<p>Policy SW.22: Protect High-Value Vegetation Types. As a general policy, visitors will be directed away from areas of high-value vegetation types, as identified in the MCOSED's mapped Legacy Vegetation Management Zones and other more site specific biotic assessments undertaken or commissioned by the MCOSED, to prevent disturbance and adverse impact. This will be done through the appropriate placement of new and rerouted trails, by erecting fencing, or by installing educational signs that provide information about the resource values being protected.</p>			X							
<p>Policy SW.23: Identify High Value Biological Resources. Designation of the road and trail system and evaluation of road and trail project proposals will be based on best available data, including inventories of wildlife, and vegetation resources. The MCOSED will undertake site specific and programmatic efforts to extend and improve upon the biological data underlying its decision-making criteria. System designations, project design, and project implementation are subject to amendment on the basis of new information.</p>			X							
<p>Policy SW.24: Minimize Intrusions into Larger Contiguous Habitat Areas and Wildlife Corridors. In designating the system of roads and trails, the MCOSED will minimize their adverse effects on sensitive vegetation, as well as, habitat connectivity and migration corridors for all native species of wildlife.</p>			X							
<p>Policy SW.25: Helmet Requirement. Per California state law, bicycle riders less than 18 years old are required to wear a helmet when riding on the MCOSED roads and trails.</p>									X	
<p>Policy SW.26: Control or Restrict Access to Ignition Prevention Zones when Red-Flag Conditions Exist. Appropriate actions will be taken to minimize the risk of wildfire ignition when red-flag conditions exist. These actions may include prohibiting vehicle access, closing trails, or closing entire areas to all human activities until red-flag conditions expire. The public will be informed of the reasons why such actions are being taken, and areas will be patrolled to ensure compliance.</p>									X	

Table 4.1 Policies Governing the MCOSD Roads and Trails

	1. Public Access	2. Sustainability	3. Resource Protection	4. User Conflicts	5. Connectivity	6. Parking	7. Infrastructure	8. Adjacent Landowners	9. Safety	10. Other
Policy SW.27: Protect High-Value Cultural and Historic Resources by Rerouting or Confining Visitor Access. Areas of high-value cultural and historic resources will be protected from disturbance and adverse impact. This will be done through the appropriate placement of trails, by erecting barriers, or other methods to discourage access.	X		X				X			
Policy SW.28: Remove or Realign Roads and Trails Away from High-Value Cultural and Historic Resources. As a general policy, designated roads and trails will be rerouted away from high-value cultural and historic resources whenever possible and feasible. Areas where roads or trails are removed will be restored to natural conditions. The removal or realignment of roads will be done in consultation with Marin County Fire and other local fire agencies.	X		X				X			
Policy SW.29: Retrofit or Upgrade Construction Equipment. Work with the Bay Area Air Quality Management District to implement feasible actions from the 2010 Clean Air Plan MSM C-1 – Construction and Farming Equipment. Pursue funding to retrofit the existing construction equipment engines with diesel particulate filters or upgrade to equipment with electric, Tier III, or Tier IV off-road engines. Seek to rent construction equipment that meets these criteria, if available.										X
Policy SW.30: Permeable Paving. For any new parking areas and other large areas of potentially impermeable surfaces, use permeable paving or an equivalent for all paved areas to provide for the infiltration of rainfall.						X				
Policy SW.31: Floodplain Policy for New and Improved Roads and Trails. The MCOSD will review current Federal Emergency Management Agency Flood Insurance Rate Maps and other current flood maps to assess potential flood impacts to any proposed new or improved road, trail, or associated facilities located in the lower elevation bayland or coastal areas (i.e., Santa Margarita Island, Santa Venetia Marsh, Bothin Marsh, Rush Creek, Deer Island, and Bolinas Lagoon). In cases where a flood risk is identified, proposed facilities shall either be relocated outside of the flood prone area or designed and constructed in a manner to protect public safety and not increase base flood elevations. As part of public safety, the MCOSD shall also review the most current Tsunami Inundation Maps as part of the trail improvement planning efforts in those areas in order to identify areas that may require escape plans or proper notification.	X	X	X						X	
Policy T.1: Loop and Long Distance Trail Connections. When designating system roads and trails, the MCOSD will seek to maintain and/or develop new opportunities for loop and long-distance travel, when such opportunities do not conflict with resource protection or visitor safety.	X				X					
Policy T.2: Visitor Amenities. The MCOSD may provide or permit visitor amenities such as a) facilities to encourage the pickup and disposal of pet waste; b) watering opportunities for horses and other pack animals; c) potable water; and d) small bike repair stations.	X						X			
Policy T.3: Visitor Safety. The safety of all road and trail users depends in large part on visitor conduct. The MCOSD expects that all users will conduct themselves in a safe manner, to protect their own safety and the safety of other users. The MCOSD shall consider visitor safety in designating the road and trail system.				X					X	

Special Use Policies

In addition to providing public access for recreational uses, the MCOSD preserves also allows uses such as commercial dog walking, recreational events, and access for utility providers such as Verizon and PG&E. There is a need for a consistent and structured approach for the MCOSD to respond to requests for special uses. New policies to accomplish this are described below.

Policy SP-1: Lease/License/Other Form of Approval Required for Land Management or Utility Activities. Consistent with the MCOSD's Nonconforming Use Policy, all agencies and service providers requesting access to open space preserves will be required to obtain a lease, license, or other form of approval from the MCOSD describing the purpose and timing of their activities. The MCOSD may impose fees and conditions. Such conditions may include, but will not be limited to, the timing of the activity with respect to seasonal and weather concerns, the protection of natural resources, and the location of the activity. The MCOSD's Nonconforming Use Policy provides specific guidance for permitting use of open space by utilities, water districts, and other similar entities.

Policy SP-2: Permit Required for Organized Recreational Activities or Events. All private parties or public agencies requesting access to the MCOSD preserves for recreation-related or other special events will be required to complete and obtain a permit detailing the purpose and timing of their activities. The MCOSD may impose fees and conditions. Such conditions may include, but will not be limited to, the timing of the activity with respect to seasonal and weather concerns, the number of participants, the protection of natural resources, and the location of the activity. An administrative fee will be charged by the MCOSD for reviewing and granting any permits. Additional fees may be incurred by the applicant for administration and monitoring of the event by the MCOSD staff, or if compliance with the California Environmental Quality Act or any regulatory permit is required. The MCOSD insurance and indemnity requirements will also apply.

Policy SP-3: Prohibition on Unofficial, Nonsponsored Group Activities. Any unofficial, nonsponsored outdoor recreation event involving more than 15 participants is prohibited.

5. ROAD AND TRAIL DECISION-MAKING PROCESS

This chapter describes the decision-making process the MCOSD will use to determine the road and trail system it will designate, manage, and maintain. Existing roads and trails will be evaluated to determine whether they should be maintained in their current location and footprint, or be rerouted, reconstructed, or decommissioned and restored. Road and trail projects proposed by the public will be screened and evaluated to determine whether they should be implemented, thereby incrementally changing the MCOSD's road and trail system over time. The primary objectives of all *Road and Trail Management Plan* projects and the drivers of all decisions regarding project selection and prioritization are to:

- achieve continuous measurable reductions in physical and environmental impacts associated with the road and trail network, and
- enhance visitor experience and safety

The MCOSD annually receives many more requests to construct new trails; reconstruct existing trails; and decommission and restore others than it can either fund or undertake. A key guiding principle of this plan is that road and trail management projects will be the result of an objective and transparent decision-making process. Requisite to this principle is continuing public involvement, both in suggesting road and trail projects and by participating in the processes that lead to their prioritization and funding.

This plan documents the agreements between the MCOSD and the individuals, organizations, trail user groups, and public agencies that participated in its development to achieve the plan's three primary goals articulated in chapter 1. Indispensable elements of this plan, and central to these agreements, are two complementary road and trail decision-making processes, one conducted immediately after adoption of this plan, and the other conducted annually. The combined outputs of these processes will be:

- **the future designated road and trail system.** An initial public outreach process will identify changes and improvements to the existing road and trail network (roads and trails currently managed by the MCOSD, plus all other roads and trails identified in the *Road and Trail Assessment* [MCOSD 2011d]). This initial outreach process will yield a comprehensive, but not complete, picture of the designated road and trail system, and a list of prioritized road and trail improvement projects and actions, and

- **annual lists of prioritized road and trail construction, major modification, decommissioning, and restoration projects aligned with the designated system of roads and trails.** An annual six-step process will complete and refine the picture of the designated road and trail system, and result in its incremental implementation. New proposals not brought forth in the initial public outreach process will be considered in the annual process.

Both processes will be conducted in a transparent, and collaborative manner, subject to the laws, policies, and goals outlined in this plan.

Decisions regarding changes to the road and trail system start with the *Road and Trail Assessment*, which informs this plan. Existing roads or trails not included in the *Road and Trail Assessment* will not be considered for inclusion in the designated system, and will be decommissioned.

The remainder of this chapter will introduce the various categories of road and trail improvement projects emerging from this *Road and Trail Management Plan*, describe the initial outreach process, and describe the annual process to refine the designated system and identify priority road and trail improvement projects.

Project Categories

The types of road and trail projects and actions that the MCOSD plans, manages, and implements can be organized into two broad groups: those that compete in the annual project review, selection, and funding process described below, and those that do not. Both groups are summarized in table 5.1. Planned road and trail maintenance does not need to compete because it is an essential function and service of the MCOSD that must be performed. It consists of scores of multiple small stewardship projects and actions that take place on a daily basis and are typically, though not always, exempt from environmental review and permitting. With the exception of emergency actions, all road and trail projects in the non-competing group will still be evaluated using the same screening process applied to all *Road and Trail Management Plan* projects to insure compliance with existing goals and policies, and to confirm that such actions will not increase net environmental and physical impacts, reduce the quality of the visitor experience, or reduce visitor safety.

Table 5.1 Road and Trail Project Types

Project Type	Definition
Project Types that Compete in the Annual Project Review, Selection, and Funding Process	
Reconstruction	Actions taken to correct significant defects or to repair, replace, or restore major components of a road or trail that have been destroyed, damaged, or significantly deteriorated during the life of the facility. Reconstruction activities may include resurfacing, replacing, or restoring trail tread; installing new water bars and other drainage features; stabilizing a severely eroded hillside, and replacing a bridge. Reopening a trail or road that has not been maintained is also considered reconstruction.
Rerouting	Actions taken to change the alignment of a road or trail on any portion of its length.
Active Decommissioning	Actions taken to restore nonsystem roads or trails to a more natural and stabilized state. Active decommissioning involves full obliteration of the road or trail, including ripping the road bed, recontouring, revegetating, and restoring natural slopes.
Active Road to Trail Conversion	Actions taken to encourage the evolution of a road to a trail. Actions may include recontouring, revegetating, and restoring the unused portion of the former roadbed to a more natural condition.
New Construction	A project to build a new road or trail on previously undisturbed land, to connect previously unconnected points.
Projects Types That Need Not Compete in the Annual Project Review, Selection, and Funding Process	
Planned Maintenance	Planned maintenance refers to periodic upkeep that allows for the smooth and safe functioning of a road or trail. It includes grading, cleaning water bars and other drainage features, cleaning culverts, replacing or adding signs, and pruning trees and shrubs to allow access. Generally, planned maintenance is conducted only on trails that are in good or fair-good condition; trails in fair or worse condition generally require different actions other than planned maintenance. The difference between planned maintenance and day to day maintenance is a matter of scope. The area or linear feet of planned maintenance projects is larger and costs are greater than day to day maintenance. Planned maintenance projects must be prioritized in the overall district budget development process, and they must be evaluated by staff to determine whether environmental review and permits are required.
Passive Decommissioning	Passive decommissioning is defined as actions that result in a road or trail converting to a more natural state. Actions may include blocking entrance points, signing the road or trail as closed, or permitting vegetation to naturally encroach along the road or trail. Passive decommissioning activities are typically associated with other types of road and trail projects, and for this reason do not compete on their own in the annual project selection and prioritization process.
Passive Road to Trail Conversion	Passive conversion is the result of the deliberate evolution of a road to a trail. Actions may include allowing vegetation to naturally encroach into the unused portions of the former roadbed. Passive road to trail conversion activities are typically associated with other types of road and trail projects, and for this reason do not compete on their own in the annual project selection and prioritization process.
Other Management Actions not Requiring Construction	Management actions consist of those temporary or permanent activities necessary to implement the visitor use and environmental protection policies set forth in chapter 4 that would not involve any construction and are not already included in the description of passive decommissioning or passive road to trail conversion in the rows above. Management actions, as defined by this plan, may include changing the types of permitted recreational activities (i.e., pedestrian travel, equestrian use, or mountain biking) along a road or trail, establishing single-use, priority-use, one-way, uphill only, or time-separated uses for trails, implementing a bicycle licensing program, changing the access granted to other agencies for special administrative uses, and trail closures.
Emergency Actions	Road and trail work likely to qualify as emergency actions may include repairs to road and trail segments and related infrastructure, such as foot bridges or culverts, severely damaged by a natural disaster and impeding visitor use of the segment. Examples of natural disasters are wildland fire, flood, mudslide, or other natural disasters proclaimed by the governor in compliance with the California Emergency Management Act. Emergency actions could result in budget impacts that prevent initiation, progress on, or completion of road and trail projects approved for funding in an annual budget.

Initial Public Outreach

Shortly after adoption of this plan, staff of the MCOSD will initiate a 24 to 30 month process to identify projects and other changes to the existing road and trail network that, when implemented over time, will yield adjustments to the designated trail system. The initial outreach process will consist of a series of meetings focused on each of the regions identified in chapter 2, in the order listed below:

Region 1: Baltimore Canyon, King Mountain, Blithedale Summit, Camino Alto, Horse Hill, Alto Bowl

Region 2: French Ranch, Maurice Thorner Memorial, Roy's Redwoods, Gary Giacomini, Loma Alta, White Hill, Cascade Canyon

Region 3: Indian Valley, Lucas Valley, Loma Verde, Pacheco Valle, Ignacio Valley

Region 4: Mount Burdell, Rush Creek, Little Mountain, Verissimo Hills, Indian Tree, Deer Island

Region 5: Terra Linda/Sleepy Hollow Divide, Santa Margarita Island, Santa Venetia Marsh, San Pedro Mountain, Bald Hill

Region 6: Ring Mountain, Old Saint Hilary's, Bothin Marsh, Bolinas Lagoon, Tiburon Ridge

Preserves in each region share geographic proximity. Grouping the preserves also assures that road and trail decisions take into account watershed boundaries, proximity to other public lands and regional trails, and inter- and intra-preserve opportunities and constraints.

The meetings for each region will include time spent indoors at an initial workshop to review data and outputs of the road and trail evaluation tool, as well as field visits, where appropriate, to review and discuss opportunities and constraints. At this time, it is not possible to determine the number of meetings associated with each region, or to characterize the conduct of subsequent meetings.

At the initial workshop for each region, staff will:

- Present baseline information for the existing network of roads and trails. The baseline information consists of:
 - » mapped alignments of the existing system of roads and trails that the MCOSD currently manages, and all other roads and trails identified in the *Road and Trail Assessment*. (Trails will be shown as segments, as they are in the *Road and Trail Assessment*. A single road or trail may consist of one or more segments); and

- » a numeric coefficient associated with each trail segment that represents the biophysical impacts and social characteristics of that segment. To determine this coefficient, spatial and quantitative data, derived from the *Road and Trail Assessment*, will be collated and entered into a mathematical Road and Trail Evaluation Tool. A description of this tool can be found at the end of this chapter.
- Share public input relevant to that region that was collected in workshops conducted in 2010 and 2011.
- Solicit specific proposals for road and trail projects and management actions, including adjustments to the network of system roads and trails and changes in use. Following the initial workshop, staff will begin to evaluate project proposals according to steps 2 and 3 of the annual project review and selection process, described below.

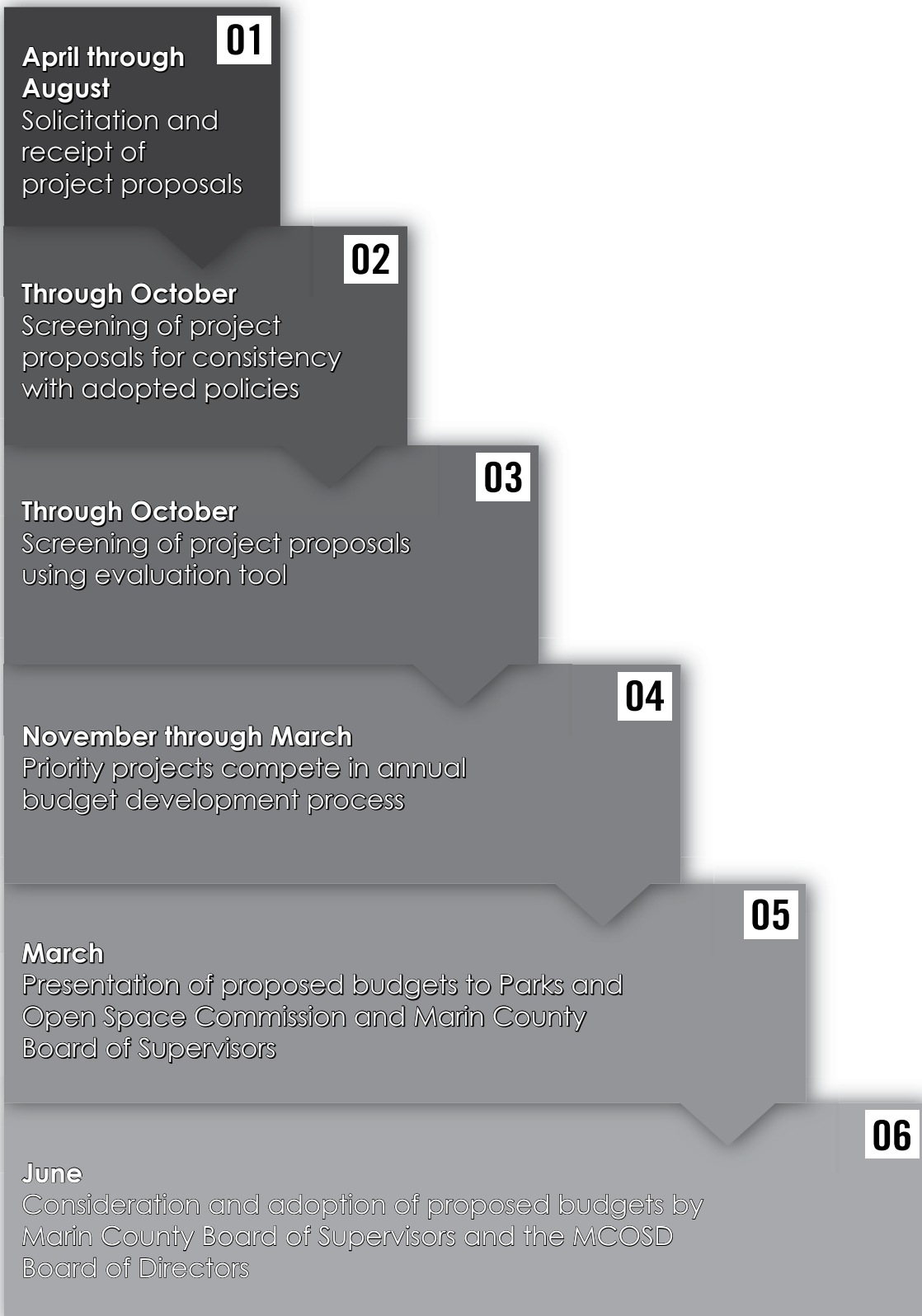
In subsequent meetings and updates, staff will share its evaluation of project proposals, including their respective coefficients, compare them to each other and to existing conditions, and work to identify the projects within each region that will reduce environmental impacts, improve the visitor experience, and/or improve visitor safety compared to existing conditions. Primary outputs of each meeting (or series of meetings) will be:

- a conceptual map of proposed road and trail projects, or other actions that will constitute adjustments to the designated trail system, and
- a prioritized list of road and trail projects aligned with the map.

As noted above, neither the map nor the prioritized project list will be complete or final. The designated system will continue to evolve and be refined in successive years, as new proposals for road and trail improvements (ones not considered in the initial outreach process) are put forth in an annual road and trail decision making process.

Figure 5.1 summarizes the annual decision-making process for road and trail project proposals.

Figure 5.1 Annual Decision-Making Process for Road and Trail Project Proposals



Development of Potential Road and Trail Projects

Process Used

The MCOSD staff will follow an annual six-step decision making process to develop potential road and trail projects.

Step 1: Solicit Road and Trail Project Proposals

The public will be encouraged to participate in an annual process of identifying potential projects that meet all relevant laws, policies, and primary *Road and Trail Management Plan* goals of progressively reducing physical and environmental impacts of system and non-system roads and trails while enhancing visitor experience and safety. Potential projects may involve maintenance, major modification (including decommissioning and restoration), new facilities, or management, as defined above.

It is anticipated that the first, and likely the second, annual project review and selection process will occur while the initial outreach and system designation process is still underway. Until the latter process is completed, only those projects emerging from planning units for which the initial outreach and system designation process has been undertaken will be considered in the annual project review and selection process.

The MCOSD will accept project proposals from the public at any time; however, projects will be formally reviewed once per year. The MCOSD will determine the information required in a project proposal, and will create a form to be completed by the project proponent. Proposals received from April through August will be evaluated and considered in the Marin County Parks annual budget development process that runs from November through March. Proposals received September through March will be considered in the next budget development cycle. For example, if a proposal is received in August 2016, it will be considered in the budget development process that begins in November 2016. If a proposal is received in September 2016, it will be considered in the budget development process that begins in November 2017.

New project proposals must be submitted on a form developed by the MCOSD. Staff will review all proposals for completeness, and will return incomplete proposals to project proponents. Depending on the number of project proposals received, the MCOSD may host meetings with all project proponents and/or meet with individual project proponents in an attempt to revise the nature or scope of their projects to the mutual satisfaction of each.

The evaluation of all proposals submitted by August each year will be completed by November, in time for high priority projects to be considered in the MCOSD's annual budget development process.

Step 2: Screen Project Proposals for Consistency with Policies

Steps 2 and 3 involve the progressive screening and evaluation of road and trail project proposals by Marin County Parks staff. Prioritized projects emerging from the initial outreach process will already have been screened for consistency with laws, policies, and goals, and evaluated for biophysical and social impacts. Such projects will skip steps 2 and 3, unless new information becomes available that affects their prioritization. All new projects not previously proposed in the initial outreach process or in previous annual project solicitations will proceed through steps 2 and 3.

Step 2 involves an initial screening of all submitted potential road and trail management projects to filter out those projects that would be inconsistent in their design, location, or any other factor with adopted MCOSED policies and goals, including the specific goals and policies adopted as part of this plan.

Step 3: Screen Project Proposals Using the Evaluation Tool, and Reprioritize All Projects

Proposals successfully emerging from step 2 will be evaluated using the same data-intensive model used in the initial outreach process to measure the baseline impact of existing road and trail segments. Those proposals that yield a net reduction, or no net increase, in a planning unit's baseline of biophysical impacts and that enhance visitor experience and safety will be integrated into a reprioritized list of road and trail projects. Proposals for projects that increase biophysical impacts will not be prioritized or will need to be amended and resubmitted. A single proposal may bundle two or more projects if doing so could reduce their combined overall impact compared to the baseline impact. For example, a proposal may combine the construction of a new trail with the decommissioning of an existing, poorly performing trail. Once integrated into the list, "proposals" become unfunded "projects."

The outputs of step 3 will be:

- new map of prioritized road and trail projects, and
- a newly prioritized list of unfunded road and trail improvements aligned with the map, which is equivalent to a multi-year road and trail work plan.

In a manner and at a time yet to be determined, but no later than October of each year, staff will inform the public of the outcome of step 3.

Step 4: Highest Priority Road and Trail Projects Compete in the MCOSED and Measure A Budget Development Processes

Step 4 is a process that is conducted internally, among Marin County Parks staff.

From November through March of each year, staff develops multiple budgets, including the budgets for the Open Space District and Measure A. These two budgets, together with available grants, are the sources of funding for MCOSD's road and trail projects. Each year, Marin County Parks staff evaluates scores of internally generated budget requests competing for Open Space District and Measure A funding. These budget requests originate from all department programs: natural resources, capital projects, volunteers, planning and acquisition, landscape architecture, parks and open space maintenance and operations, and environmental education. In this step, the highest priority road and trail projects (from the reprioritized list of road and trail projects) compete for funding against all other requests.

Because budget requests typically exceed available funds, Marin County Parks has developed a rigorous system to evaluate, score and rank competing requests. Staff determines whether requests are considered in the Open Space District budget or Measure A budget. Because of legal requirements, certain requests may not be eligible for Measure A funding. Some requests may be funded by either Measure A or the Open Space District, or both. The criteria used to evaluate requests for funding from the Open Space District are as follows:

- Project is a priority in a current adopted plan, or has been identified as a priority through this *Road and Trail Management Plan* process
- Engages volunteers or raises awareness of department's benefits, mission
- Removes and reduces threat to health and safety
- Legal mandate, such as accessibility
- Grant funding or other outside funding likely or committed
- Board priority
- Project is already underway and is a one-time, multi-year expenditure
- Generates revenues or leads to savings, efficiency

If a request competes in the Measure A budget development process, three additional criteria apply, in addition to the eight listed above:

- Engages underserved communities
- Contributes to community health and wellness
- Contributes to increasing visitor diversity

Competition is greater in the Measure A budget development process compared to the MCOSD budget development process because requests for county parks and landscape services are considered in addition to requests from the MCOSD. However, the amount of funding from Measure A far exceeds the amount from the Open Space District, after basic operating revenues are subtracted from anticipated annual revenues.

The output of each process, a draft budget, is reviewed by department managers, and then by the department's executive team. The latter team is responsible for making adjustments to each budget, and recommending the proposed Measure A budget to the Marin County Board of Supervisors, and recommending the proposed Open Space District budget to the MCOSD Board of Directors. Given the significance of this *Road and Trail Management Plan* and the public interest in it, it is anticipated that there will be strong support for successful road and trail projects emerging from step 4. The only certainty regarding future budgets is that the department's capacity to fund projects will be substantially reduced if Measure A is not renewed prior to its expiration.

The list of prioritized road and trail projects submitted in each year's draft budget will yield a net reduction in the combined index of environmental and physical impacts compared to the previous year's index, as measured at the planning unit level. As discussed in greater detail below, baseline impacts associated with certain land and easement acquisitions and with updated resource information will not be included in calculations of net reductions or increases to impacts. Not every region will have budgeted road and trail projects in every year. When advancing projects in Sensitive Resource Areas, as these are described in chapter 4, the MCOSD project staff will seek to maximize the reduction of physical and environmental impacts. This does not mean that decisions regarding projects in these areas will disregard considerations of fiscal responsibility or visitor experience and safety, but it does mean that considerations of net environmental impacts and sustainability will receive disproportionate weight in these decisions and that, measured on both an annual and cumulative basis, the reductions in physical and environmental impacts should be significantly greater for Sensitive Resource Areas as compared to other areas.

Step 5: Public Review of Proposed Annual Budgets, including Road and Trail Projects Recommended for Funding

The development of proposed budgets is largely completed by mid-March, when the public will get its first look at staff's proposed MCOSD and Measure A budgets, though they are still subject to change based on public input provided in this and the following step. In mid-March, or until such time that Marin County government budget procedures change, staff will present an overview of the proposed Measure A budget at public budget hearings conducted by the Marin County Board of Supervisors. It is also in mid-March when Marin County Parks staff reports on the department's proposed budgets to the Marin County Parks and Open Space Commission, and the commission solicits public input on the budget. The department's presentations in both instances will include a list of road and trail projects recommended for funding, along with a

description of any refinements to the system of designated roads and trails that would result from implementation of those projects.

Step 6: Adoption of Annual Budgets and Commencement of Work

The Marin County Board of Supervisors and the Board of Directors of the MCOSD typically adopt their respective budgets for the coming fiscal year at public meetings in mid to late June. This is the public's last opportunity to comment on proposed expenditures included in the budget. Expenditures for items such as road and trail projects are typically described in the staff reports accompanying the proposed budgets. Once the board adopts a budget, the MCOSD's work plan for the coming fiscal year, which is aligned with its budget, is finalized.

Construction work to improve the road and trail system must be preceded by planning, design, and the fulfillment of environmental review and permitting requirements. In many cases it is anticipated that these tasks can occur in the same fiscal year as the scheduled work to be completed. More complex projects may require additional environmental review and/or multiple permits, which could take up to a year to obtain. In this circumstance, staff would phase a project by budgeting its planning and design in one year, and its field work in the following year. The commencement of actual road and trail project implementation is dependent on a number of factors including grant availability, weather, and project mitigation and permitting requirements.

Notes Regarding the Processes

The above processes should be considered a general framework for the MCOSD's road and trail decision-making. Additional detail is intentionally left open to allow for refinement and adaptation within the transparent public process as needed and appropriate. Improvement of both processes will be incremental, and most is expected to occur over the course of the first two to three years after this *Road and Trail Management Plan* is adopted.

Novel forms of trail designation, including one-way, uphill-only, priority-use and time-separated use, will be initially implemented on a limited, pilot basis. Although certain of these methods may be successful elsewhere, the circumstances that contribute to such success may or may not exist in Marin County. The mission of an agency, the population density in the vicinity of the park or preserve access points, trail density, the size of the park or preserve, the mix of trail users, visitor compliance, and other factors all contribute to the success – or failure – of these methods. Trial use of such methods will be accompanied by the establishment of metrics to gauge their success or failure, and a period of monitoring.

The acquisition of land, or the acquisition of public trail easements over private or public land by the MCOSD lies outside of the scope of this *Road and Trail Management Plan*. Nevertheless, land and easements acquired by the MCOSD do commonly have road and trail facilities in place that predate this *Road and Trail Management Plan* and/or the MCOSD's efforts to acquire them.

For purposes of coordination and baseline accounting, the MCOSD will, following the acquisition of such land or easements, calculate the impacts of pre-existing roads and trails using the Road and Trail Evaluation Tool described in this chapter. The scores for these facilities will be added to the baseline index of the relevant region, and these additions will be reflected in the baseline reporting for the following budget year. Unlike new impacts associated with project work undertaken as part of this *Road and Trail Management Plan*, increases in baseline scores attributable to the acquisition of pre-existing facilities on land or easements newly acquired by the MCOSD do not require offsetting.

In this context, “pre-existing facilities” are defined as those road and trail improvements that a) existed at the time of the landowner’s acquisition of the property and known to the landowner or b) were constructed by, and/or constructed with the consent of the landowner as of the date of the first documented contact between the landowner or the landowner’s representative and the MCOSD, regarding the MCOSD’s acquisition of the property. Roads and trails constructed without a landowner’s knowledge or consent do not fall within the definition of pre-existing facilities.

Informed by direction from the board, by public input, and by fiscal and administrative constraints, the MCOSD will make a decision to formally designate all or a portion of such pre-existing facilities according to the policies set forth in this *Road and Trail Management Plan*. Those pre-existing facilities that are not made a part of the designated system of roads and trails will be decommissioned and restored as time and resources permit. Facilities that cannot be demonstrated to be pre-existing will be decommissioned before or as soon as practically possible following acquisition. The MCOSD’s actions regarding pre-existing unconstructed social trails will be consistent with policies contained in chapter 4.

This *Road and Trail Management Plan* will inform an Open Space Accessibility Plan for the preserves for individuals with mobility and other impairments. It is not within the scope of this plan to address road and trail access for individuals with mobility or other impairments. The MCOSD will develop a separate Open Space Accessibility Plan aligned with this *Road and Trail Management Plan*.

The Road and Trail Evaluation Tool

The MCOSD will use a mathematical model, the Road and Trail Evaluation Tool, to evaluate the following characteristics of existing roads and trails, and proposed road and trail projects:

- environmental (potential for natural and cultural resource impacts)
- physical (slope, orientation to the fall line, redundancy, and the existing physical conditions that affect sustainability)
- social (potential contribution to the visitor experience)

Environmental and physical criteria are related to the general sustainability of the road or trail within the context of the surrounding preserve. Scores for these two categories of criteria will be added together to yield the total “biophysical” impact of a road or trail segment, or collection of segments.

Social criteria are by their very nature more subjective, and it is virtually impossible to devise any single set of criteria that could comprehensively measure in a single number the utility and inherent worth of a road or trail for all potential users. The social criteria incorporated here measure basic features that are likely to be regarded as meaningful by many, if not most, preserve visitors: variability of the road or trail grade, distance of sight lines, diversity of the surrounding vegetation, opportunities for challenge and exercise, and connections to other roads or trails that provide opportunities for extending a trail experience into longer trips. Taken together and alone, these criteria tell us something useful, but they will not substitute for the feedback that the MCOSD receives directly from members of the public through the public process described in this chapter, or in the regular course of administering the system of preserves.

Figures 5.2 and 5.3 graphically summarize the Road and Trail Evaluation Tool.

Large amounts of spatial and quantitative data related to each criterion will be used to establish the numeric coefficients described in previous sections of this chapter. The data for many of the physical criteria will be derived from the *Road and Trail Assessment*. Other data, especially that related to the biological criteria, is sourced from resource assessments conducted over time by the MCOSD and from other Marin County sources. Data inputs for each criteria are summarized in table 5.2, along with the rationale for each item. The derived scores are based on the best available data and as data improves, for example as a result of wildlife and plant surveys, baselines and project rankings will change accordingly.

The inputs listed in table 5.2 are measured many different ways (linear miles, percent slope, feet in distance from a certain point, number of vegetation types) or simply judged qualitatively (good-poor, yes/no). In order to synthesize all these data into a meaningful, comparable scoring system, the raw measurements for each criterion are converted into a relative scale using the ModelBuilder program in ArcGIS. Additional information about how the individual criteria were measured and scored in the model is provided in the appendix.

Table 5.2 Inputs to the Road and Trail Evaluation Tool

Criterion	Rationale for Criterion	Applicability	
		New Road/Trail	Existing Road/Trail
Environmental Criteria			
Vegetation management zone	Vegetation management zones (MCOSD 2012) are proxies for the relative importance and level of intactness of the vegetation communities surrounding the road or trail. The greater the importance and intactness, the greater the potential for resource impacts associated with trail development and use. This criterion is partially double weighted for new road/trail facilities to limit new impacts to the most sensitive and intact vegetation management zones, in compliance with Policies SW.22 and SW.24.	X	X

Table 5.2 Inputs to the Road and Trail Evaluation Tool

Criterion	Rationale for Criterion	Applicability	
		New Road/Trail	Existing Road/Trail
Stream conservation areas	Marin County designates stream conservation areas to protect active channels, water quality, flood control functions, and fish and wildlife habitat values of and associated with streams. Development in these areas has a relatively high potential for resource impacts.	X	X
Stream crossings	Trails that cross directly over existing drainages and streams can lead to accelerated erosion at crossing points, thereby leading to potential increases in sediment loads to receiving local and downstream water bodies. Even improved crossings may have the potential for adverse effects if the 50-year design flow cannot be adequately conveyed without flooding or a sharp increase in velocities or shear stress.	X	X
Stream adjacency on special-status fish-bearing streams	Roads and trails running parallel and in close proximity to fish bearing streams may deliver sediment into the water course, which can adversely affect habitat. If not designed properly, some stream crossings may create impediments to fish passage and other spawning activities, as well as harmful sediment loading.	X	X
Northern spotted owl habitat	Northern spotted owls (<i>Strix occidentalis caurina</i>), federally listed as threatened, are found within dense, old-growth forests. Nesting habitat or nesting buffers have been identified in some preserves. Development in these areas has a high potential for impact. This criterion is double-weighted for both existing and new road/trail facilities to account for the extreme sensitivity of this resource and for the greater administrative and cost burden of projects that directly affect it.	X	X
Rare plant areas	Proximity to habitat of a threatened, endangered, or sensitive native species is an indicator of potential for resource impacts.	X	X
Rare wildlife areas	Proximity to habitat of a threatened, endangered, or sensitive native species is an indicator of potential for resource impacts.	X	X
Serpentine soils	Serpentine soils support unique serpentine grasslands and serpentine chaparral. Both of these vegetation types are strongly correlated with special-status species that are tolerant of extreme soil conditions. The degree of overlap of road or trail alignments with serpentine soils is an indicator of potential impacts on sensitive resources. This criterion is double weighted for both existing and new road/trail facilities to account for the extreme sensitivity of this resource and for the greater administrative and cost burden of projects that directly affect it.	X	X
Wetlands	Wetlands are present in many preserves, where they may provide critical habitat for special-status species. Development in these areas has a high potential for impact.	X	X
Noxious weeds	The presence of noxious weeds increases the potential for their spread as a result of road or trail management activities. This criterion is double weighted for new road/trail facilities to account for the fact that the risk of weed dispersion is greatest in the period of time during and just after construction.	X	X
Preserve trail density	The surface area occupied by roads and trails reduces the available habitat for plants and animals. By facilitating the movement of people and domestic animals into natural areas, the network of roads and trails in a given area also disrupts wildlife activity in that area in roughly direct proportion to its density.	X	X
Physical Criteria			
Hydrological slope	Hydrological slope is the percent of slope along the fall line at any given location along a road or trail. (The fall line is the steepest line drawn downhill at any given location, which is the path where water would flow in a natural environment.) Steeper hydrological slopes are a good predictor of higher design, construction and maintenance costs and greater long-term challenges to maintain natural drainage patterns. Hydrological slope is not measured for existing trails because other criteria provide many more direct measures of erosion and drainage condition for those facilities.	X	N/A
Trail gradient ¹ (as measured for existing trails)	Trail gradient is the actual (user-experienced) slope of the road or trail at any given location. Higher rates of erosion occur on roads and trails where the directional slope follows the fall line. These roads and trails are difficult, if not impossible, to drain properly and often experience ongoing erosion.	N/A	X
Trail gradient (as measured for proposed new trails)	Trail gradient is the actual (user-experienced) slope of the road or trail at any given location. Higher rates of erosion occur on roads and trails where the directional slope follows the fall line. These roads and trails are difficult, if not impossible, to drain properly and often experience	X	N/A

Table 5.2 Inputs to the Road and Trail Evaluation Tool

Criterion	Rationale for Criterion	Applicability	
		New Road/Trail	Existing Road/Trail
Number and condition of mapped "Problem Sites" ¹	Problem Sites were mapped in the <i>Road and Trail Assessment</i> (2011d) and correspond to features, such as poorly configured stream crossings, that present acute threats to trail maintenance, resource management, and/or visitor safety. Some road and trail segments contain more than one mapped Problem Site.	N/A	X
Trail width ¹	Road or trail width is a factor of sustainability, and also of sediment production. Roads have the potential to erode more than trails because of their greater width of disturbed area.	X	X
Drainage condition ¹	The maintenance of natural drainage patterns is one of the most important considerations for road or trail sustainability.	N/A	X
Tread condition ¹	Tread condition describes the current condition of the road/trail tread with respect to roughness, erosion, and obstacles. Tread condition provides a general measure of where erosion has occurred.	N/A	X
Wet/muddy conditions ¹	Seasonal wetness or muddiness may be an indication of poor drainage and may lead to tread widening as users seek to circumvent wet areas.	N/A	X
Maintenance requirements ¹	One of the objectives of this plan is to prioritize and direct maintenance staff and resources to the roads/trails where the cost/benefit ratio, in terms of effort and benefit, is positive. Trails requiring more than routine maintenance to remain in a good or fair-good condition are generally not considered sustainable without additional management.	N/A	X
Erosion impact ¹	Roads and trails built on highly erodible or expanding soils will require more frequent and more expensive maintenance. Fine grain sediment delivered to streams from erosive roads and trails is harmful to downstream infrastructure and aquatic habitat values for fish and other sensitive species.	N/A	X
Revised Universal Soil Loss Equation (RUSLE) erosion factor	Roads and trails built on highly erodible or expanding soils will require more frequent and more expensive maintenance and will deposit greater loads of harmful sediment into nearby waterbodies. The RUSLE erosion factor criterion is double weighted because it is an especially important proxy measure for several criteria that are measured individually for existing facilities (including erosion impact, maintenance requirements, drainage condition, etc.).	X	N/A
Amount of excavated soil volume	Soil excavated from bench cuts in the process of new trail construction disrupts downhill vegetation, creates an opportunity for the proliferation of invasive weeds, and can have detrimental impact on water quality and aquatic species.	X	N/A
Social Criteria			
Road/Trail length	Trail length is used to assess the opportunity to travel long distances, which is an idea that was raised several times during public scoping meetings.	X	X
Distance from development	This criterion was used as a proxy for opportunities to travel long distances. The greater the distance of a particular trail segment from development, the greater the opportunity to experience solitude.	X	X
Distance between trail intersections	The further a particular trail segment is from an intersection, the better the opportunity to experience fewer contacts with other visitors.	X	X
Terrain quality	Rolling terrain, with numerous changes in grade, offers a diverse physical and visual trail experience and is generally assumed to be preferable to either very flat or rugged terrain.	X	X
Connectivity to regional trail or road/trail on adjacent public land	Trail segments connecting to regional trails (Bay Area Ridge Trail and the Bay Trail) contribute to achieving regional goals for public access and trail-based recreation. These trails also often provide access to scenic vistas and opportunities to experience nature.	X	X
Connectivity to destination points or attractions	Attractions such as viewpoints, historical and cultural landmarks, and waterfalls enhance a trail experience and access to these features, as well as adjacent attractions on private lands, is frequently cited as desirable by all categories of trail users.	X	X
Vegetation community variety	Higher vegetation variety is associated with better opportunities for visitors to learn about and appreciate nature.	X	X

¹Data derived from MCOSD 2011d.

Figure 5.2 Example of some of the GIS datasets, overlain over the existing road and trail network, which would be used to evaluate biological, physical, and social characteristics of a road or trail. The GIS data would be used to inform a model, described in more detail in the appendix, which would guide decision making about road and trail projects.

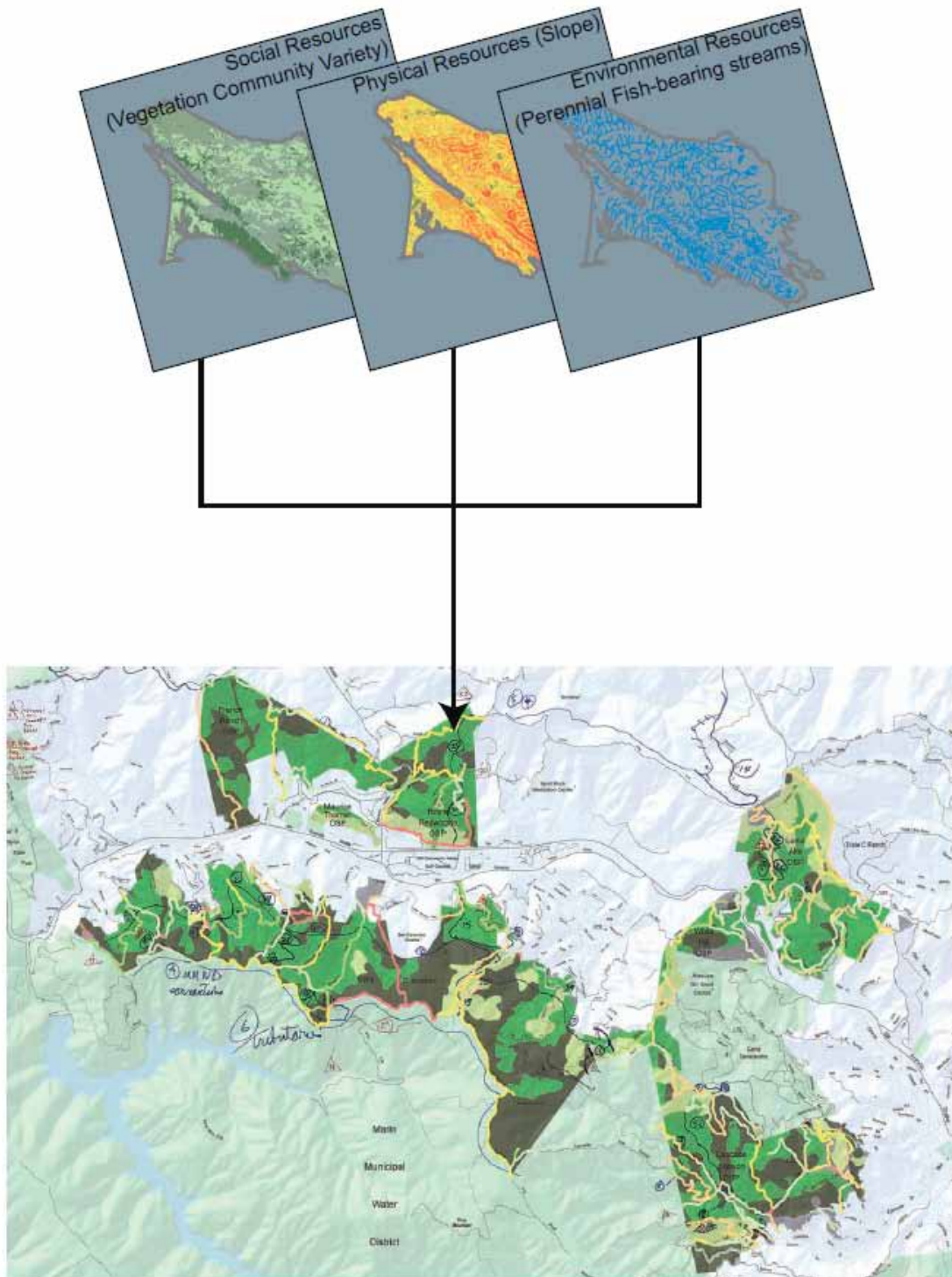
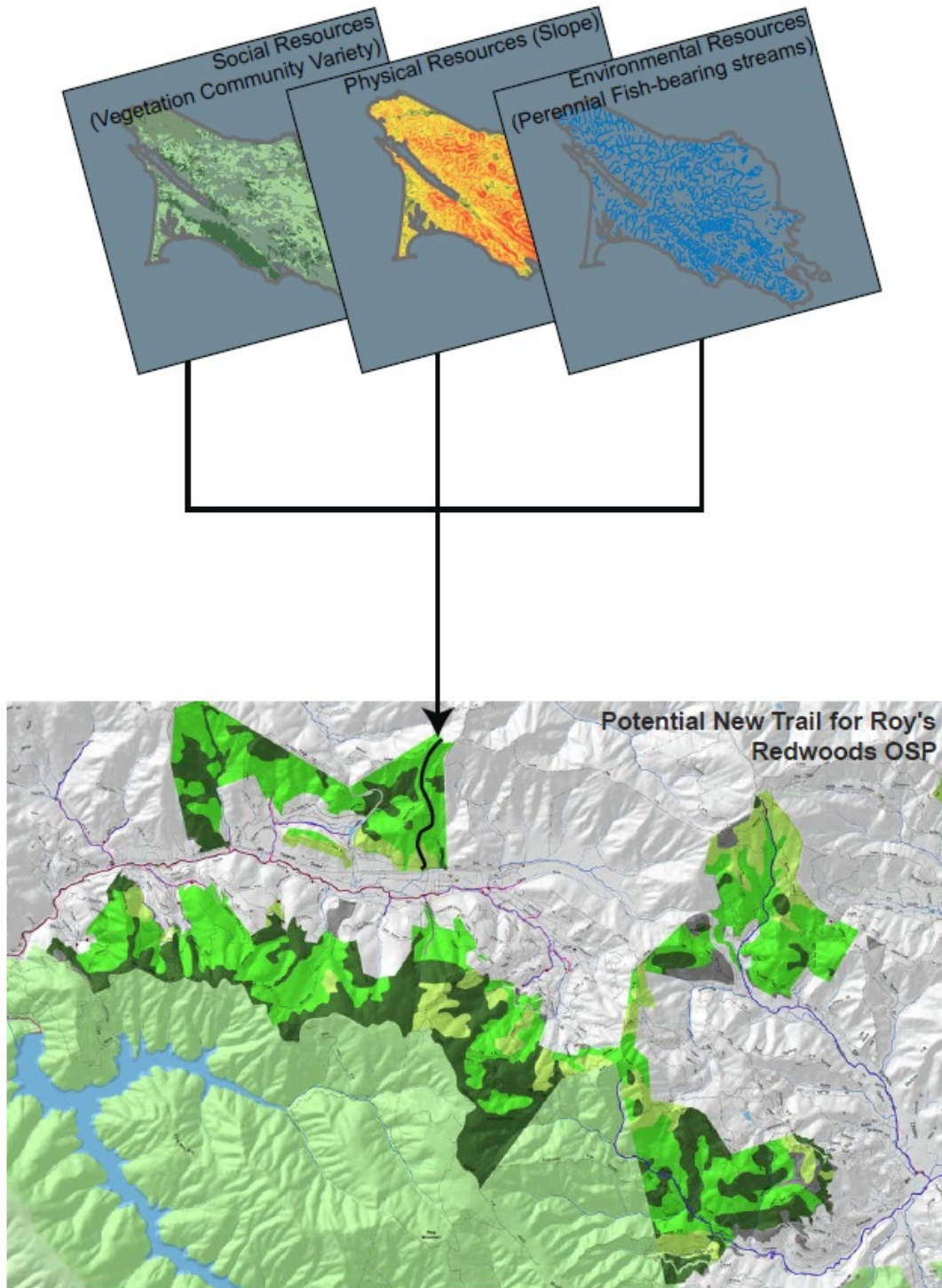


Figure 5.3 Example of some of the GIS datasets, overlain over a potential new trail alignment which would be used to evaluate biological, physical, and social characteristics of the road or trail. The GIS data would be used to inform a model, described in more detail in the appendix, which would guide decision making about road and trail projects.



6. ROAD AND TRAIL STANDARDS AND BEST MANAGEMENT PRACTICES

Road and Trail Standards

The MCOSD roads and trails will be constructed and maintained to meet the design and engineering standards specified in this section. Roads and trails that meet these standards and the associated design and engineering specifications can be expected to be sustainable with routine maintenance and to minimize resource impacts associated with the erosion of sediments into wetlands and water bodies. All work to achieve these standards will be conducted in conformance with the best management practices described in the second part of this chapter.

DESIGN AND ENGINEERING SPECIFICATIONS

The more detailed design and engineering specifications associated with the standards presented in this chapter may vary for individual projects based on site conditions and other factors and will be established by qualified professionals on a project-by-project basis. Examples of typical road and trail specifications adopted by the MCOSD for specific projects are found in the following publications:

- *County of Los Angeles Trail Manual*
(Los Angeles County Department of Parks and Recreation 2011)
- *Road and Trail Design Specifications*
(Midpeninsula Regional Open Space District 2013)
- *Handbook for Forest and Ranch Roads*
(Mendocino County Resources Conservation District 1994)
- *Trail Construction and Maintenance Notebook*
(U.S. Forest Service, San Dimas Technology and Development Center 2007)

Road and Trail Cross Sections

Proper drainage is critical to maintaining trails over the long term and preventing the onset of erosion and water quality impacts. To ensure proper drainage, roads and trails will have one of the following cross sections:

- outsloped (preferred method)
- insloped to ditch
- crowned to ditch

Outsloped is the preferred cross section, since it more readily reflects natural drainage patterns. In almost all cases an outsloped road will be paired with rolling dips or water bars. In some cases trail sections may be narrow enough or constructed of stair steps or switchbacks that negate the need for an insloped or outsloped cross section.

Dips and Water Bars

Rolling/reverse grade dips or water bars will be constructed to disperse flow and to minimize the potential for concentrated flow, which might otherwise cause rilling or gullying. Rolling dips are more durable and drivable than water bars and are therefore the preferred method.

Dip and bar spacing is dependent upon grade, soil type, and expected runoff volume. General guidance for spacing dips is as follows, although the specific engineering specification may differ, depending on site conditions and other factors:

- 2% - 3% grade = 200 to 300 feet
- 5% - 7% grade = 160 to 180 feet
- 8% - 10% grade = 140 to 150 feet

Gently sloped (less than 2% grade) or sloped trail and road sections that are short in length (less than 200 feet) do not necessarily require dips or bars.

Road or Trail Surface Treatment and Delineation

Heavy pedestrian, bicycle, and vehicle traffic can degrade an earthen trail or road over time, resulting in eroded sediment material becoming mobilized in stormwater runoff and wind. Heavily used trails, roads, or parking at trailheads may receive treatment, such as road aggregate, to minimize degradation.

Users veering off designated trails can lead to accelerated erosion at the margins. When this is a concern due to potential damage that may result to an adjacent sensitive resource, such as a wet meadow or special-status species, trail delineation measures such as the following will be applied:

- wood fencing (split rail, MCOSD compliant)
- vegetation barriers (e.g., thorny or medium to tall native vegetation)

- boulders (placed along the trail margin)
- signs (e.g., “sensitive resource—please stay on designated trail”)

Runoff Conveyances

Insloped and crowned roadways will incorporate conveyances such as the following to carry runoff to culverts:

- native grass- or rock-lined ditches
- vegetated swales
- subdrains

The materials selected to line the installations (e.g., vegetation, rock, gravel) will depend upon estimated peak flow velocities and infiltration requirements. If the road grade is slight and velocities are less than 4 feet per second, native grasses are appropriate in the ditch; if the road grade is steeper and velocities are likely to exceed 4 feet per second, then 4- to 6-inch rock is required. Subdrains can be installed adjacent and parallel to or within the road prism when there is a benefit to infiltrating surface water flows more quickly, such as in the case of reducing stagnant water sources as a vector control measure or when collecting drainage behind a retaining wall structure. In cases where there is ample space and the trail grade is very slight (<5%), a broader, shallower grassy or vegetated swale may be used to provide additional infiltration.

Ditch Relief Culverts and Outlets

Ditch relief culverts are necessary to drain an inside ditch at specified intervals to prevent excess velocities in the ditch or overflow onto the trail from the ditch. Relief culverts convey the flow under and across the trail or roadway to the outsloped area below. When a ditch relief or permanent culvert empties onto a steep slope, an extension of the piping may be warranted to prevent erosion at the outlet.

Energy dissipation is critical to preventing erosion at culvert outlets. An energy dissipater is to be combined with a ditch relief culvert and permanent culvert installations.

Conveyance Flow Attenuation

Existing inside ditches that exhibit erosion or rilling due to excess gradient or insufficiently spaced relief culverts will be repaired with measures to prevent erosion. Rock or log check dams will be installed to reduce the effective slope of the ditch, thereby attenuating flow velocities and reducing erosion. Temporary check dams may also be constructed of fiber rolls, staked straw bales, or gravel bags, but these should only be considered as interim measures to prevent erosion until a more permanent repair can be made.

Drainage, Wetland, or Stream Crossings

Proper cross drainage will be required when a trail or road crosses an existing drainage, wetland, or stream. Whether a pipe or open conveyance is chosen, adequately sizing and sloping the cross drainage to convey up to the 100-year design flow is critical to ensuring long-term functionality with minimal maintenance. Selection and design of each crossing installation will consider, at a minimum, the road or trail type, required vehicle use and load-bearing capacity, stream type, fish-passage requirements, and estimated flood flows. Project-specific engineering design and analysis will be conducted to ensure correct size, material, and placement before construction can begin.

If the drainage or stream is small and does not host any fish species, one of the following may be used to provide cross drainage:

- permanent culvert
- rock ford
- stream ford
- low puncheon (boardwalk)

When fish species are known to inhabit the stream or may end up populating the stream as part of future restoration efforts, one of the following may be used to provide cross drainage:

- embedded culvert
- open arch culvert
- bridge

Slope Stability

Steep slopes adjacent to trails and roadways can result in slumping or gullyng that can damage the road or trail and degrade water quality. The following measures are to be considered in stabilizing steep slopes adjacent to trails and roads:

- lay back the slope (modify to 2:1 or flatter) and vegetate
- rip rap a steep slope (1:1)
- retaining wall

Slopes that are sloped back to 2:1 or flatter and seeded may also require temporary erosion-control blanket installations to stabilize the hill slope while the vegetation matures. A retaining wall may only be applicable in special cases where a short vertical slope (around 3 to 5 feet) needs to be stabilized in a park area that includes some urban or residential interface.

Trails and roads that impinge upon stream riparian corridors often degrade streambanks either directly, from road construction, or indirectly, from road drainage that flows over the banks or from foot traffic by pedestrians who access the stream via social trails down the banks. Any restoration within the banks of streams or creeks has to be done with care and will almost always require prior authorization from various regulatory agencies including the California Department of Fish and Wildlife (streambed alteration agreement), the U.S. Army Corps of Engineers (404 permit), and the San Francisco Regional Water Quality Control Board (401 certification and national pollution discharge elimination system [NPDES] permit). Any repairs should be properly engineered and permitted before being implemented.

Biotechnical treatments are the preferred method over hardscape solutions, such as rip rap, when the designs are feasible under existing and forecasted site conditions. The following is a list of potential applications to stabilize creek banks:

- biotechnical treatments (preferred method), such as willow staking and pole planting
- lay back the slope (modify to 2:1 or flatter)
- seed and blanket
- brush mattress
- soil wraps
- wattles/fascines
- brush layering
- willow/blanket combination
- boulder or log weirs
- large woody debris revetment
- plantable rip rap
- retaining walls

Slopes associated with bridge crossings also require protection as follows:

- bridge bank armor

Additional measures for extremely vertical or unstable slopes, such as terracing, concrete retaining walls, soldier pile walls, or subsurface geogrid installations, will require full engineering design and analysis on a case-by-case basis.

Trail Buttressing

When a trail is built in steep terrain or on a steep cross slope, the following approaches will be implemented as necessary to maintain trail stability and prevent erosion:

- wood log retaining wall
- rock or log trail buttress
- wood trail steps

Catchment Basins

The following methods may be used to capture and infiltrate runoff from the MCOSD facilities, parking areas, or roadways. Method selection will be based on the site's available land area, soil type, groundwater level, and estimated volume of runoff to be collected. All the following options require engineering design prior to installation:

- dry basin
- wet basin
- infiltration trench
- subsurface infiltration gallery or drywell

Decommissioning Existing Roads or Trails

The end goal of road and trail decommissioning is to restore the area to more closely mimic its preexisting topographic and drainage conditions. Measures will include tilling and seeding, mulching, and/or installing fiber rolls along contour intervals in order to revegetate and stabilize the newly graded areas. Graded slopes are not to exceed 2:1 unless additional measures, such as rock rip rap, are incorporated to stabilize any steepened slopes.

Large woody debris and slash, when available, can be placed intermittently across and through the area to prevent pedestrian and/or vehicle traffic from accessing the restored site. Temporary fencing may also be used until the restored vegetation has matured and the area has reached a more stable condition.

When stream crossings, such as culverts or fords, are removed as part of trail decommissioning, grade control structures within the streambeds will likely be required to prevent incision and to maintain channel bed stability. These methods will require engineering design prior to installation and can be one of the following types:

- rock grade check
- log grade check
- boulder weirs

Best Management Practices

Consistent with the MCOSD *Strategic Plan* (2008) one of the goals of this *Road and Trail Management Plan* is to reduce the environmental impact of roads and trails on sensitive resources, habitats, riparian areas, and special-status plant and animal species. To achieve this goal, the Strategic Plan recommends best management practices to reduce sedimentation from roads and trails, to preserve in-stream habitat and protect populations of rare and threatened or endangered fish species, and to protect water quality.

As defined by this plan, a *best management practice* is a practice, or combination of practices, that has been determined to be most effective and practicable in preventing or reducing the amount of pollution generated, or the level of environmental harm created, from an activity to a level compatible with environmental goals and regulatory standards. Within the context of this definition, the MCOSD will adopt the best management practices described in this chapter to guide all future road and trail management actions and activities.

Prior to any road and trail management work, the MCOSD will secure all applicable authorizations and permits from federal and state resource agencies and Marin County. While many routine maintenance activities will not require special permits, some maintenance activities and new trail construction may. When required, this process will typically result in implementation of best management practices required by the resource agencies to protect natural and cultural resources, protect air and water quality, and reduce construction nuisance effects (e.g., dust and noise). These practices will supplement the practices adopted by the MCOSD. In the case of overlapping practices, the more protective practice will apply.

This plan provides a programmatic set of best management practices for all road and trail management activities that will be implemented as necessary and practicable. This programmatic set of practices can be drawn upon during the resource permitting process and can be supplemented by any additional practices required by the resource agencies. For projects not requiring permits or regulatory involvement, the best management practices presented in this chapter will be implemented as necessary and practicable to protect sensitive resources on the MCOSD and adjacent lands. The general and topically specific practices can be considered as standards to be followed and implemented as appropriate for any road and trail management action. For presentation, the practices have been divided into categories and placed into tables, as shown in the following list.

- General:
 - » Table 6.1 General Best Management Practices
- Biological resources:
 - » Table 6.2 Sensitive Natural Resources Best Management Practices
 - » Table 6.3 Special-Status Wildlife Best Management Practices

- » Table 6.4 Special-Status Plants Best Management Practices
- » Table 6.5 Invasive Plants Best Management Practices
- » Table 6.6 Construction Contracts Best Management Practices
- Cultural resources:
 - » Table 6.7 Cultural Resources Best Management Practices
- Water quality:
 - » Table 6.8 Water Quality Best Management Practices
- Geologic hazards:
 - » Table 6.9 Geologic Hazards Best Management Practices
- Air quality:
 - » Table 6.10 Air Quality Best Management Practices
- Noise:
 - » Table 6.11 Construction Noise Best Management Practices

The Best Management Practices (BMPs) listed in table 6.1 apply to all activities related to road and trail project activities. The Best Management Practices listed in tables 6.2 through 6.11 add more specificity to planning and implementation of road and trail project activities, including maintenance, management, and construction. If implemented, these BMPs will help to avoid and/or minimize impacts to all sensitive biological resources (i.e., special-status plant and wildlife species, sensitive vegetation, wetlands, and other native habitats), to reduce impacts related to soil disturbance, and erosion, and help limit the potential for spread of invasive plants from infested areas to non-infested areas. Each BMP is written to stand on its own and as a result, there is some unavoidable overlap and repetition between the BMPs.

Biological Resources

Many of the best management practices listed below stem from other existing documents adopted and approved by the Marin County Board of Supervisors and the MCOSD Board of Directors. They focus on protecting sensitive biological resources and habitat types. Properly implemented best management practices will allow road and trail management projects to avoid, minimize, and mitigate impacts to sensitive resources and habitats to the maximum extent possible. The following practices will be followed by the MCOSD, its representatives, and project contractors as applicable and appropriate.

Road and Trail Construction, General

Preconstruction Literature Reviews

Prior to any new road or trail construction activities, the MCOSD natural resource staff or a

representative will conduct a literature review to determine if any special-status species and habitats have the potential to occur in the construction project area.

The first source reviewed will be the MCOSD's extensive database of special-status plant and wildlife occurrences and sensitive habitats. This database is actively updated and maintained by the MCOSD natural resource staff and contains the most relevant data on sensitive resources on the MCOSD preserves.

In addition to the MCOSD database, other resources will be reviewed prior to work as necessary, including the following:

- U.S. Geological Survey topographic maps
- U.S. Fish and Wildlife Service National Wetlands Inventory maps
- Bay Area Aquatic Resource Inventory Database
- Aerial photographs
- California Department of Fish and Wildlife Natural Diversity Database records
- U.S. Fish and Wildlife Service quadrangle species lists
- California Native Plant Society inventory records
- University of California at Davis Information Center for the Environment Distribution Maps for Fishes in California
- National Marine Fisheries Service Distribution Maps for California Salmonid Species

Database searches for known occurrences of special-status species will focus on the vicinity of the project area. Biological communities present in the project location and surrounding areas will be classified based on existing plant community descriptions described in the *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Holland 1986). Biological communities will be classified as sensitive or nonsensitive as defined by the California Environmental Quality Act and other applicable laws and regulations.

Preconstruction Surveys

If it is determined that sensitive resources may occur in the project area, a qualified biologist from the MCOSD natural resource staff or an outside contractor will survey the area during the appropriate time window (e.g., season, time of day, flowering period) to determine the presence or absence of the sensitive resources identified. If sensitive resources are located, the appropriate resource agencies will be contacted and the necessary permits acquired.

Additionally, the programmatic best management practices will be implemented as applicable and appropriate.

Multi-year Wildlife Monitoring Program

To address gaps in the scientific documentation of wildlife in the preserves in a more systematic way than can be accomplished on the basis of preconstruction surveys alone, the MCOSD will, after adoption of this plan, design and implement a multi-year wildlife monitoring program with the goal of enhancing the protection of wildlife in the preserves through the collection, sharing, and analysis of wildlife data to be used in making refinements to the designated road and trail system and managing visitor use.

Construction Timing Windows

All construction activities will be timed to avoid impacts to sensitive resources. If nesting birds are present in the project area, construction will take place outside of the breeding season or after the young have fledged; or appropriate buffers will be established consistent with state and federal law. See table 6.3 for specific practices to protect special-status and nesting bird species located in the project area.

If any other special-status plant or animal species is present, construction will take place outside of the reproductive season. If migrating birds or other wildlife are present and/or using the project area as a migration corridor, construction activities will occur outside of this window, unless an alternative method for avoiding disturbance can be applied that is consistent with state and federal law. If construction activities must take place in or around a watercourse or water body, construction will take place during the dry season, when impacts on water quality and aquatic habitats will be minimized. See table 6.8 for specific practices to protect water quality.

Invasive plants in the project area will usually be treated prior to construction. However, if this is not feasible or treatments are ineffective, construction will be planned to occur when invasive plant species in and adjacent to the project area are not in seed. When plants are in seed, their populations can be distributed and inadvertently dispersed to new areas by construction personnel, equipment, and general activities. See table 6.5 for specific practices for working near invasive plant populations.

The MCOSD staff and contractors will work on a project-specific basis to determine appropriate construction timing windows.

Impact Area Planning

The MCOSD will plan all new facilities to avoid sensitive resources to the maximum extent possible and to minimize construction footprints. When feasible, construction impact zones (including staging areas and associated infrastructure to complete projects) will be confined to areas of existing disturbance, such as a current road or trail alignment. If sensitive resources are

present in the impact area or immediate surroundings, their locations (including an appropriate buffer) will be demarcated in the field, and personnel will be advised to avoid these areas. Project personnel will also be provided with maps showing sensitive resources in the project impact area that must be avoided. Workers will receive environmental sensitivity training prior to the commencement of project activities, as described below. If necessary, exclusion fencing will be installed to keep nearby special-status wildlife species from entering the area of impact.

Water Quality Protection and Erosion Control

Wetlands and other waters (e.g., streams, ponds, lakes) are sensitive communities that have the potential to support a diversity of life and provide other ecosystem services. Projects will be planned to avoid wetlands and water habitats to the maximum extent possible. The MCOSD will perform road and trail construction in a manner that controls and minimizes the potential for soil erosion and contribution of sedimentation to wetlands. All construction that must take place in or adjacent to wetlands and waters (e.g., stream crossings) will take place during the dry season. Sedimentation filtration barriers, stormwater pollution prevention plans, and other measures to protect water quality will be implemented as necessary for work in the vicinity of wetlands and waters. Specific water quality protection and erosion-control practices are listed in table 6.8.

Design Considerations

If a special-status species known to occur within the vicinity is dependent upon a vegetative community in the area of impact or the immediate surroundings, efforts will be made during project planning and design to maintain that habitat where possible. If actively breeding birds are known from the area, large tree and shrub vegetation in the immediate surroundings that could provide nesting and protective habitat will be preserved to the maximum extent possible.

Other design elements intended to protect special-status species or their habitats, or other sensitive resources, will be considered on a case-by-case basis. Specific wildlife design considerations are listed in table 6.3.

Worker Awareness Training and Construction Tailgate Meetings

A qualified biologist will conduct worker awareness training prior to any construction activities in areas with federal and state-protected sensitive resources. Training will educate workers about resource identification, avoidance measures, and necessary actions if a sensitive resource is encountered. All project personnel who will be involved with implementation activities should be present for these meetings so that all workers have a consistent understanding of sensitive resource issues. Potential invasive weed populations and the possibility for spread of invasive weeds will also be covered during these training meetings.

Worker awareness training will include the following:

- a photograph and description of each special-status species, sensitive resource, or invasive plant known from the project area

- a description of its ecology and habitat needs
- potentially confusing resources (e.g., similar species or habitats)
- an explanation of the measures being taken to avoid or reduce adverse impacts
- reporting and necessary actions if sensitive resources are encountered
- responsibility of the individual worker under the applicable environmental regulation

One tailgate meeting will be conducted on the construction site with all project personnel the day before work begins to reemphasize materials covered during the worker awareness training. The tailgate meeting will also be a good opportunity to cover any potential resource issues that might be encountered for specific project elements in more detail and reinforce resource issues for workers on the ground.

Resource-specific items to be covered during worker awareness training and tailgate meetings are listed in tables 6.1 through 6.4.

Additionally, an annual MCOSD agencywide road and trail maintenance worker education program will provide information about all the sensitive resources on the MCOSD preserves to the MCOSD road and trail management personnel.

Construction Monitoring

If federal or state-listed species are known to be present in the project area or immediate surroundings, a qualified biologist from the MCOSD natural resource staff or outside contractor will monitor construction activities to ensure impacts to sensitive resources will be avoided. If special-status wildlife species are present within the vicinity of the project area, a more involved monitoring program might be necessary to ensure that these species do not enter the project area. If a special-status species is observed by a worker or construction monitor, work will cease immediately and the appropriate resource regulatory agency will be contacted if necessary. A construction monitoring program will be developed for each project.

Noise Control

Equipment and vehicles will utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, and use of intake silencers, ducts, engine enclosures, and acoustically attenuating shields or shrouds) to prevent disturbance of nearby wildlife populations.

Preventing and Reducing Potential for Pollution

The MCOSD will ensure that actions are undertaken during road and trail management projects to prevent or reduce the potential for pollutants entering the MCOSD preserve system from management activities that could affect sensitive resources. Specific practices listed in table 6.8 will be implemented as needed to reduce the potential for pollution of water quality.

Controlling Food-Related Trash

Food-related trash can attract wildlife to construction sites, disrupting their normal behavior patterns. Food-related trash will be stored daily in closed containers and removed from the construction site daily.

Relocation of Special-Status Species

If special-status plant species are located in the project area and impacts to these species are unavoidable, plants and/or propagules will be relocated to suitable habitat off site prior to the commencement of construction activities. Alternatively, off-site mitigation for impacts could be considered. If special-status wildlife species are located on site, the appropriate resource agency will be contacted, and a qualified biologist possessing necessary permits will relocate individuals to suitable habitat off site, as necessary.

Invasive Weed Control

If invasive exotic weeds (identified on the California Invasive Plant Council Inventory of Invasive Plants) are located in the project area, they will be treated prior to the commencement of project activities to reduce the potential for their spread. Project design will avoid soil disturbance in heavily invaded areas to the maximum extent possible to reduce the potential for spread on and off site. Any imported soil, compost, gravel, stone aggregate, erosion-control materials, or other fill material of any kind will be certified weed-free.

Specific invasive weed control practices are provided in table 6.5.

Revegetation with Native Plant Species

Following the completion of construction elements or soil disturbance, disturbed areas will be revegetated with native plant species as necessary and practicable. Revegetation with annual grasses and forbs can provide rapid vegetative cover and initial soil stabilization. Planting or seeding with a combination of native annual and perennial grasses, forbs, shrubs, and trees can provide longer term and stronger erosion control, as well as more desirable visual cover. The end goal of revegetation will be a species composition and vegetative structure that integrates with the surrounding natural community, or a desired natural community, to the maximum extent possible.

Locally collected native plant materials from the project footprint and surrounding areas will be the preferred standard for revegetation efforts. Plant materials will be collected from within the same watershed or the MCOSD preserve if possible. The MCOSD will allow collection of no more than 5% of any native plant population to prevent overcollection of wild plant material sources. If sufficient local plant materials are not available for collection prior to project activities, geographically appropriate native plant materials will be purchased from a local nursery or seed supplier.

A project-specific revegetation plan will be developed by the MCOSD natural resource staff for projects as needed to guide revegetation efforts.

Mitigation

Any approved impacts to sensitive resources will be mitigated as required by resource agencies, on a project-specific basis.

Road and Trail Maintenance, General

The following list of best management practices is specific to road and trail maintenance. Previously described practices for road and trail construction (e.g., preconstruction literature reviews and surveys, noise control) will be implemented wherever applicable, in addition to the following maintenance-specific protective measures.

Inspections

During regular inspections, the MCOSD staff will check to ensure that road and trail features and associated infrastructure are well maintained and poses no threat to surrounding sensitive biological resources. Staff conducting inspections will record information pertaining to runoff and effects on water quality of nearby habitats, the spread of invasive exotic plants, and the status and quality of any known sensitive resources in the immediate vicinity that could be affected by road or trail use and/or maintenance. Staff will report any findings and make recommended corrective actions if appropriate.

Grading and Maintenance Windows

Grading will only occur during the dry months (generally May 15 to October 15), when associated erosion will be reduced to the maximum extent possible.

Culverts

Culverts will be inspected on a regular basis to ensure that they do not clog with sediment or debris. Blocked culverts may affect water quality, change the water course, increase erosion or sediment runoff, or affect wildlife. Any materials blocking culverts will be removed and disposed of outside the watercourse in an area not subject to erosion. If a significant blockage or sedimentation exists, the MCOSD will plan and implement corrective actions as necessary. Excavation of sediments within streams may require a maintenance permit from the U.S. Army Corps of Engineers, the California Department of Fish and Wildlife, and/or the San Francisco Water Quality Control Board.

Disposal of Materials

Any maintenance-related materials (including soils, debris, trash, or other materials that need to be removed as part of maintenance activities) will be disposed of at an appropriate site where materials could not impact sensitive resources. For example, grading-related excess soils or

removed debris will not be placed in or around a water body or wetland where the materials could be subject to erosion, thereby affecting water quality.

Road and Trail Decommissioning, General

The following list of best management practices is specific to road and trail decommissioning. Previously described practices for road and trail construction and maintenance (e.g., preconstruction literature reviews and surveys, noise control, work timing windows) will be implemented wherever applicable, in addition to the following protective measures specific to decommissioning. Any segments of roads or trails that have the potential to affect sensitive resources (e.g., water quality) will be treated immediately to ensure that impacts are avoided or minimized.

Simply closing a road or a trail is not sufficient to decommission it and protect sensitive resources. Instead, road and trail decommissioning will involve removing fill from the project area; removing creek crossings, bridges, and culverts; excavating unstable fill slopes; treating road and trail surfaces, shoulders, ditches, and embankments to prevent runoff and erosion; and revegetating any disturbed areas as necessary. These actions will eliminate the potential for runoff and erosion to enter wetlands and water habitats and will restore natural vegetative communities and habitats.

Removal of Stream Crossings

When removing a stream crossing, sediment filtration barriers will be placed around the extent of the construction area to prevent sediment from entering streams. All removed materials will be disposed of in an off-site location where they will not be subject to erosion. Slopes where infrastructure and fill were removed will be stabilized to prevent erosion. Work within streams may require regulatory agency permits. If the stream is not a perennial watercourse, the work will be done when the creek is dry.

Removal of Unstable Fill Slopes and Cut Banks

Any unstable fill slopes and cut banks that have the potential to erode and negatively affect water quality of nearby wetlands and waters will be removed entirely and graded to a stable contour. These areas will be revegetated with appropriate native species. Sediment filtration barriers will be deployed around the edges of unstable slopes as necessary to prevent erosion and runoff into wetlands and waters.

Reuse and Replanting of Excavated Trees and Shrubs

Where feasible, excavated trees and shrubs removed from unstable fill slopes and cut banks will be replanted on graded contours to restore the areas with native vegetation. These plants will represent the most locally appropriate materials for restoration and conform to the vegetation types of the surroundings.

Ripping and Recontouring Road and Trail Surfaces

Road and trail surfaces will be ripped and decompacted. Ripping surfaces provides a more suitable substrate for the recolonization or revegetation of native plant materials. Road and trail surfaces will be recontoured and sloped away from wetlands and water bodies to prevent the potential for erosion into these features. Any shoulders, ditches, or embankments will also be removed, and the area graded to a natural contour.

Invasive Plant Species

Decommissioned road and trail areas will be monitored for the presence of invasive plant species for two years following decommissioning to ensure no infestations develop. If invasive species are detected during this time, appropriate corrective actions will be taken. See table 6.3 for practices specific to managing invasive plants.

Table 6.1 General Best Management Practices

BMP ID	DESCRIPTION
General-1 Limit Work Area Footprints in Sensitive Resource Areas	Limit the size of construction-related road and trail management activities to the minimum size needed to meet project objectives. BMPs include: <ul style="list-style-type: none"> • Minimize project footprint. Minimize the size of the work area, including the project area, access roads, and staging areas. Wherever possible, use existing upland roads, trails, and other disturbed areas for project activities in order to reduce unnecessary disturbance, minimize soil and water erosion, and reduce overall project costs. • Reduce or relocate footprint during planning and design phase. Reduce the work area footprint in sensitive resource areas or move the work area to common natural communities and upland areas. Implement further refinements during site preparation and construction to further reduce impacts. • Minimize soil disturbance. Minimize soil disturbance to the greatest extent possible to reduce the potential for introducing or spreading invasive plants, to protect topsoil resources, and to reduce available habitat for the establishment of new invasive plants. • Mark project footprint near sensitive natural resources. Mark ingress/egress routes, staging areas, and sensitive resources to prevent inadvertent impacts to sensitive resources. • Restrict soil disturbance and import of nonnative soil or fill material. To reduce the potential for damage of native plants and/or introduction of invasive plants, the contractor will be required to minimize the footprint of soil disturbance to the minimum amount necessary to complete the contracted work. In particular, access roads, staging areas, and areas of temporary disturbance will be minimized in size. The contractor and its staff and subconsultants agree not to drive off-road or drive or park on native vegetation unless approved in advance by the MCOSD natural resource staff. The contractor agrees that if soil excavation is required, every attempt will be made to have a balanced cut and fill project that reuses all native soils onsite. No nonnative soil or fill material will be brought onsite, or used during the contractor's activities unless approved by the MCOSD natural resource staff.
General-2 Modify Construction-Related Vegetation Management Methods in and near Wetlands, Riparian Vegetation	Restrict construction-related vegetation management near wetlands in a manner that reduces the potential for sediment or pollutants to enter wetlands. Implement the following BMPs, as needed: <ul style="list-style-type: none"> • Establish a buffer of 100 feet from wetland and tidally influenced areas (i.e., from the ordinary high water mark of flowing or standing water in creeks, streams, or ponds). Avoid construction work within this buffer area. • If construction work in wetlands and riparian areas cannot be fully avoided, consult with the appropriate state and federal agencies to obtain permits. • Within the buffer, restrict routine vegetation management activities in creeks, streams, other waterways, and tidally influenced areas. Limit vegetation management work to least-harmful methods; restrict herbicides to those that are EPA-approved for use near water. Prohibit activities that disturb soil or could cause soil erosion or changes in water quality. • Within the buffer, limit work that may cause erosion to the low flow or low tide periods. Low flow months for local creeks are typically August to October. For tidal areas, work will not occur within 2 hours of high tide events at construction sites when high tide is greater than 6.5 feet measured at the Golden Gate Bridge, using corrections for areas near individual MCOSD preserves. Tide charts are available online from the National Oceanic and Atmospheric Agency/National Weather Service (http://www.wrh.noaa.gov/mtr/sunset.php).

Table 6.1 General Best Management Practices

BMP ID	DESCRIPTION
	<ul style="list-style-type: none"> • Within the buffer, minimize erosion and sedimentation; maintain erosion and sediment control devices during ground disturbing activities and until all disturbed soils have been stabilized. Measures include weed-free straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials must be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion control materials must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.) and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians. • Prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) to protect water quality for work in or near wetlands, ponds, seeps, creeks, tidal areas, or stream crossings.
General-3 Minimize Potential for Erosion	Conduct road and trail activities in a manner that controls and minimizes the potential for soil erosion and contribution of sediment to wetlands. Implement the following as needed: <ul style="list-style-type: none"> • To minimize erosion and sedimentation, maintain erosion and sediment control devices during ground disturbing activities and until all disturbed soils have been stabilized. Measures include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials must be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion control materials must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.) and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians. • Unless no feasible alternative is available, avoid using heavy equipment in areas with soils that are undisturbed, saturated, or subject to extensive compaction. Where staging of heavy equipment, vehicles, or stockpiles is unavoidable, limit and mark the allowable disturbance footprint with flagging or fencing. Following the end of work, scarify surface soils to retard runoff and promote rapid revegetation. • Immediately rehabilitate areas where project actions have disturbed soil. Require areas disturbed by equipment or vehicles to be rehabilitated as quickly as possible to prevent erosion, discourage the colonization of invasive plants, and address soil compaction. Techniques include decompacting and aerating soils, recontouring soils to natural topography, stabilizing soils via erosion control materials, revegetating areas with native plants, and removing and monitoring invasive plants.
General-4 Control Food-Related Trash	Food-related trash can attract wildlife to road and trail project sites. Store food-related trash in closed containers and remove from the project site daily
General-5 Modify Construction Methods Relating to Soil Disturbance, Restrict use of Offsite Soil, Aggregate, or Other Construction Materials	Conduct construction-related vegetation management in a manner that restricts the use of offsite materials that could introduce or spread invasive plants. Implement the following as needed: <ul style="list-style-type: none"> • Minimize soil disturbance. Minimize soil disturbance to the greatest extent possible to reduce the potential for introducing or spreading invasive plants, to protect topsoil resources, and to reduce available habitat for the establishment of new invasive plants. • Do not allow the introduction of incompatible fill. Use only clean, native soils and aggregate materials from projects within the preserve, or use fill that is purchased from a certified weed-free source, before allowing the importation of materials from outside the preserves. Fill materials should be approved by natural resource staff to ensure compatibility with future restoration/rehabilitation goals. • Segregate and treat soils and vegetation contaminated with invasive plant seeds and propagules. Treat, as appropriate, to prevent the spread of invasive plants. Treatment may include disposal onsite within already infested areas, chipping or pile burning and mulching to eliminate viable seeds, or disposal at an approved cogeneration plant or green waste facility. • Salvage, store, and reuse topsoil. Where activities disturb soil temporarily, require salvage of the top 6 to 12 inches of topsoil (to retain seeds, soil mycorrhizae, and fungi) from all excavation and disturbance areas. Require reapplication of the salvaged topsoil as a topdressing or topcoat over backfill, unless known to contain invasive plant seeds or propagules. • Establish dedicated areas for cleaning vehicles, inside and out, of soil or invasive plant seeds or plant parts before entering the MCOSD preserves, whenever moving equipment between areas within the preserves, and before leaving preserves. Within the wash areas, the tires and body of vehicles and equipment will be brushed off and/or hosed down. • Inspect construction equipment for soil or invasive seeds or plant parts. Require contractors to make equipment available for inspection before entering the MCOSD preserves, when moving between sites within the preserves, and before leaving preserves. • Develop a native seed mix for erosion control. Develop the seed mixture on a project-by-project basis based on the observed mixture of native and naturalized plants in and near the impact area. Where possible, ensure that seeds are collected locally (i.e., within the same watershed or preserve as the impact), or obtained from a reputable native plant nursery specializing in seed that is collected from local sources. • Maintain erosion and sediment control devices during ground disturbing activities and until all disturbed soils have been stabilized to help minimize erosion and sedimentation. Measures include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials must be certified as weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion control materials must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.) and not of plastic monofilaments or other materials that could entrap snakes or amphibians.

Table 6.1 General Best Management Practices

BMP ID	DESCRIPTION
	<ul style="list-style-type: none"> • Immediately rehabilitate areas where road and trail project activities have disturbed soil. Areas disturbed by equipment or vehicles should be rehabilitated as quickly as possible to prevent erosion, discourage the colonization of invasive plants, and address soil compaction. Techniques include decompacting and aerating soils, recontouring soils to natural topography, stabilizing soils via erosion control materials, revegetating areas with native plants, and removing and monitoring invasive plants.
General-6 Prevent or Reduce Potential for Pollution	<p>Ensure that actions are taken during ongoing road and trail project activities to prevent or reduce the potential for pollutants entering the MCOSD preserve. Implement the following as needed:</p> <ul style="list-style-type: none"> • Prohibit, or restrict equipment refueling, fluid leakage, equipment maintenance, and road surfacing activities near wetlands. Require placement of fuel storage and refueling sites in safe areas well away from wetlands. Safe areas include paved or cleared roadbeds, within contained areas such as lined truck beds, or other appropriate fuel containment sites. Inspect equipment and vehicles for hydraulic and oil leaks regularly. Do not allow leaking vehicles on the MCOSD preserves, and require the use of drip pans below equipment stored onsite. Require that vehicles and construction equipment are in good working condition, and that all necessary onsite servicing of equipment be conducted away from the wetlands. • Require all contractors to possess, and all vehicles to carry, emergency spill containment materials. Absorbent materials should be on hand at all times to absorb any minor leaks and spills.
General-7 Include Standard Procedures in Construction Contracts	<p>When using contractors to perform vegetation management, related to road and trail project activities, the MCOSD will include some or all of the following standard procedures in those contracts.</p> <p>The contractor will work with the MCOSD natural resource staff to determine the optimal timing of contracted work. Many timing restrictions relate to protecting special-status species. Other types of timing restrictions include timing to control invasive plants; timing to avoid migration, gestation, or flowering periods for special-status species; or timing work in wetlands to the dry season.</p> <ul style="list-style-type: none"> • Establish a buffer of 100 feet from wetland and tidally influenced areas (i.e., from the ordinary high water mark of flowing or standing water in creeks, streams, or ponds). Avoid construction work within this buffer area. <ul style="list-style-type: none"> » Within the buffer, limit work that may cause erosion to low flow periods. Low flow months for local creeks are typically August to October. For tidal areas, work will not occur within 2 hours of high tide events at construction sites when high tide is greater than 6.5 feet measured at the Golden Gate Bridge, using corrections for areas near individual MCOSD preserves. Tide charts are available online from the National Oceanic and Atmospheric Agency/National Weather Service (http://www.wrh.noaa.gov/mtr/sunset.php). » If construction work cannot be fully avoided in wetlands and riparian areas, consult with the appropriate state and federal agencies to obtain permits. » Require the contractor to prepare and implement a Stormwater Pollution Prevention Plan (SWPPP) to protect water quality for road and trail project work in or near wetlands, ponds, seeps, creeks, tidal areas, or stream crossings. <p>The contractor will work with the MCOSD natural resource staff to identify any priority invasive plants that occur near the project work area, including the project footprint, access roads, staging areas, and similar work areas. The contractor agrees to comply with requirements to reduce the spread or transport of priority invasive plants related to construction activities. Requirements may include some or all of the following:</p> <ul style="list-style-type: none"> » Conduct a training program for all field personnel involved with the proposed road and trail project prior to initiating project. The program will consist of a brief presentation by person's knowledgeable in the special-status species, sensitive resource, or invasive plants known from the project area. The program will include the following: a photograph and description of each special-status species, sensitive resource, or invasive plant known from the project area; a description of its ecology and habitat needs; an explanation of the measures being taken to avoid or reduce adverse impacts; and the workers' responsibility under the applicable environmental regulation. The worker training may be conducted in an informal manner (e.g., as part of a routine tailgate safety meeting). » Restrict work to periods when invasive plants are not in fruit or flower. » Establish dedicated area for cleaning vehicles, inside and out, of soil or invasive plant seeds or plant parts before entering the MCOSD preserves, whenever moving equipment between areas within the preserves, and before leaving preserves. Within the wash areas, the tires and body of equipment will be brushed off or hosed down. » Inspect construction equipment for soil or invasive seeds or plant parts. Require contractors to make equipment available for inspection before entering the MCOSD preserves, when moving between sites within the preserves, and before leaving preserves. » Dispose of green waste in a manner that does not spread invasive plants. Methods include onsite disposal in an already infested area; offsite disposal to a cogeneration plant or an approved green waste composting facility).

Table 6.1 General Best Management Practices

BMP ID	DESCRIPTION
	<p>Protect environmentally sensitive areas. The MCOSD natural resource staff will identify any Environmentally Sensitive Areas in or near the road and trail project area prior to the start of work. Environmentally Sensitive Areas may include: special-status plant or wildlife species or their habitats (e.g., woodrat nests, habitat for special-status plant and wildlife species, individuals or populations of listed special-status plant or wildlife species or locally rare species); wetlands including creeks streams and related riparian area; and sensitive vegetation types as described in this report. The MCOSD staff and contractors will fully avoid and protect such areas during habitat restoration work, or will help obtain and comply with necessary permits and regulatory requirements.</p> <ul style="list-style-type: none"> » Use locally collected plant materials for revegetation projects. Plant materials will be collected onsite at the MCOSD preserves or within the same watershed as the revegetation project. The contractor will work with the MCOSD to identify native plant nurseries that can collect and propagate seed and other plant materials from the local area. No use of commercial grassland mixtures for erosion control unless approved in advance by the MCOSD. The contractor will allow the MCOSD to inspect and approve all plant materials and seed prior to use onsite. » Protect special-status species habitat. For vegetation work in or near special-status species habitat, the contractor is required to comply with requirements of the MCOSD project permits to protect special-status species and their associated habitats before and during construction, and to cooperate with the MCOSD in implementing any state and federal permits and agreements for the project. The special-status species population plus a buffer should be designated as an "Environmentally Sensitive Area" using lath and flagging, pin flags, or temporary fencing (depending on resource sensitivity to work). The contractor will be required to avoid all designated Environmentally Sensitive Areas during construction. For any special-status species or their habitats that cannot be fully avoided, the contractor will work with the MCOSD to obtain and comply with federal and state Endangered Species Acts, the federal Migratory Bird Treaty Act, and the state Fish and Game Code permits and agreements. » Restrict soil disturbance, import of nonnative soil or fill material. To reduce the potential for damage of native plants and/or introduction of invasive plants, the contractor will be required to minimize the footprint of soil disturbance to the minimum amount necessary to complete the contracted work. In particular, minimize the footprint of access roads, staging areas, and areas of temporary disturbance. The contractor and its staff and subconsultants agree not to drive off-road or drive or park on native vegetation unless approved in advance by the MCOSD natural resource staff. The contractor agrees that if soil excavation is required, every attempt will be made to have a balanced cut and fill project that reuses all native soils onsite. Unless pre-approved by the MCOSD natural resource staff, there will be no use of nonnative soil or fill material during the contractor's activities. » To minimize erosion and sedimentation, maintain erosion and sediment control devices during ground disturbing activities and until all disturbed soils have been stabilized. Measures include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials will be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion control materials will be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.) and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians. <p>Other procedures:</p> <ul style="list-style-type: none"> • All entry gates to the project site not used for construction access will be locked at all times and gates used for construction access will be locked during non-construction hours. • All vehicles will carry a suitable fire extinguisher. • Immediately rehabilitate areas where project actions have disturbed soil. Require areas disturbed by equipment or vehicles to be rehabilitated as quickly as possible to prevent erosion, discourage the colonization of invasive plants, and address soil compaction. Techniques include decompacting and aerating soils, recontouring soils to natural topography, stabilizing soils via erosion control materials, revegetating areas with native plants, and removing and monitoring invasive plants. • Unless no feasible alternative is available, avoid using heavy equipment in areas with soils that are undisturbed, saturated, or subject to extensive compaction. Where staging of heavy equipment, vehicles, or stockpiles is unavoidable, limit and mark the allowable disturbance footprint with flagging or fencing. Following the end of work, scarify surface soils to retard runoff and promote rapid revegetation.
<p>General-8 Control Noise</p>	<p>To reduce daytime noise and potential disturbance to wildlife species, the MCOSD will require contractors to muffle or control noise from equipment through implementation of the following measures:</p> <ul style="list-style-type: none"> • Equipment and vehicles should utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, and use of intake silencers, ducts, engine enclosures and acoustically attenuating shields or shrouds, and installation of sound blanket around the project site.

Table 6.1 General Best Management Practices

BMP ID	DESCRIPTION
General-9 Conduct Worker Training	<p>The MCOSD will conduct a worker-training program for all field personnel involved with the proposed road and trail management project prior to initiating the project. The program will consist of a brief presentation by persons knowledgeable in the special-status species, sensitive resource, or invasive plants known from the project area. The worker training may be conducted in an informal manner (e.g., as part of a routine tailgate safety meeting). The program will include a photograph and description of each special-status species, sensitive resource, or invasive plant known from the project area; and a description of its ecology and habitat needs; an explanation of the measures being taken to avoid or reduce adverse impacts; and the workers' responsibility under the applicable environmental regulation(s).</p>
General-10 Road and Trail Inspections	<ul style="list-style-type: none"> • Regularly inspect road and trail features and associated infrastructure to ensure they are well maintained and posing no threat to surrounding sensitive and/or special-status natural resources. Staff will record information pertaining to the status of biophysical resources that could be affected by road or trail use, maintenance, or management activities. These inspections will monitor for the spread of invasive, exotic plants that could affect sensitive and/or special-status native plant or wildlife habitats and any other changes that could create negative impacts to known sensitive and/or special-status native plant or wildlife populations in the immediate vicinity. Staff will report any findings and make recommended corrective actions if appropriate.
General-11 Management of Sudden Oak Death	<p>To reduce and control the spread of Sudden Oak Death (SOD) within the MCOSD system, the following practices will be implemented.</p> <p>The MCOSD staff will educate visitors about preventing the spread of Sudden Oak Death (SOD).</p> <ul style="list-style-type: none"> • The MCOSD may use interpretive signs, brochures, ranger talks, and other online and print materials that explain the importance of preventing the spread of pathogens and use of preventative measures. • The education materials should explain that SOD occurs within the preserve; identify typical symptoms; explain that SOD can be spread by park users, especially during rainy and windy weather; and request that park visitors: <ul style="list-style-type: none"> » Use designated parking areas » Avoid transporting SOD on shoes, bicycles, and the feet of pet dogs and horses through the use of cleaners and disinfectants. <p>The MCOSD staff shall be trained about SOD host species and disease transmission pathways and, when undertaking road and trail construction and maintenance activities in areas of the preserves affected by SOD, shall implement the following measures.</p> <ul style="list-style-type: none"> • Clean equipment, boots, truck tires, and any other exposed material after working in forest and woodland habitats, with a 10% bleach solution or other disinfectant • Avoid pruning oaks or other affected trees in wet weather. • Avoid work in forest and woodlands during the wet season when spores are being produced and infections are starting. • Leave potentially infected downed trees on site instead of transporting the material to an uninfected area. • Remove potentially infected downed trees from the property only if it is the first infected tree to be detected in the area or if there is a high fire risk. • Dispose of infected materials at an approved and permitted dump facility within the 14-county infected quarantine zone. • If necessary to reduce safety or fire hazards or to address aesthetic or recreational impacts, cut, branch, chip, and/or split infected trees in areas where the material would be less likely to be transported to an uninfected location. • Purchasing nursery stock for restoration plantings at nurseries that follows current BMPs for preventing the spread of SOD (consult the California Oak Mortality Task Force, www.suddenoakdeath.org, for current standards). • Inspect all plant materials for symptoms of SOD before bringing any plants onto the property.

The Best Management Practices listed in table 6.2 below apply to all activities related to road and trail projects to be conducted near known or suspected locations of high-value natural resources, including special-status wildlife and plants and sensitive vegetation types. Implementation of these best management practices will reduce the potential for adverse effects on these resources during road and trail project activities, and ongoing road and trail maintenance activities. Each BMP is written to stand on its own. As a result, there is some unavoidable overlap and repetition between the BMPs.

Table 6.2 Sensitive Natural Resources Best Management Practices

BMP	Description
Sensitive Natural Resources-1 Modify Management Practices near Sensitive Natural Resources	For construction related activities requiring extensive ground disturbance in and near known sensitive biological resources, the MCOSD will assess the project or proposed action prior to the start of work to suggest modifications to standard procedures considered necessary to help ensure avoidance of impacts to special-status species and other sensitive biological resources. Actions that may be taken include one or more of the following: <ul style="list-style-type: none"> • Mark project footprint near sensitive natural resources. Mark ingress/egress routes, staging areas, and sensitive resources to prevent inadvertent impacts to sensitive resources. • Inspect ingress/egress routes, escort vehicles, and equipment onto the site if necessary to help prevent impacts on ground nesting and ground dwelling species. Work should be conducted during bird non-breeding season (published California Department of Fish and Wildlife non-breeding season dates are August 15-March 1, but should be adjusted to local conditions). • Maintain a 15 MPH speed limit in sensitive habitat areas. This will reduce the potential for mortality, dust impacts on vegetation and wildlife. For larger projects, water the roads for dust control near sensitive resources.

Table 6.3 Special-Status Wildlife Best Management Practices

BMP ID	Description
Special-Status Wildlife-1 Literature Reviews	Prior to all road and trail management activities, literature reviews will be conducted to determine if special-status wildlife-species or critical habitats exist within the project area. The first source reviewed will be the MCOSD's database of special-status wildlife occurrences and sensitive habitats. This database is actively updated and maintained by the MCOSD natural resource staff and contains the most relevant data on sensitive resources on MCOSD land. In addition to the MCOSD database, the following resources will be reviewed, as necessary, prior to work: <ul style="list-style-type: none"> • U.S. Geological Survey topographic maps • Aerial photographs • California Department of Fish and Wildlife Natural Diversity Database records • U.S. Fish and Wildlife Service quadrangle species lists • University of California at Davis Information Center for the Environment Distribution Maps for Fishes in California • National Marine Fisheries Service Distribution Maps for California Salmonid Species Database searches for known occurrences of special-status wildlife species will focus on the vicinity of the project area. Biological communities will be classified as sensitive or nonsensitive as defined by the California Environmental Quality Act and other applicable laws and regulations
Special-Status Wildlife-2 Preconstruction Surveys	If it is determined that special-status wildlife species may occur in a project area, a qualified biologist will survey the area during the appropriate time window to determine the presence or absence of the species. If the species is located, the MCOSD should conduct the activity to avoid impacts to the species. If avoidance is not possible, the appropriate resource agencies will be contacted to obtain guidance or the necessary permits.
Special-Status Wildlife-3 Seasonal Restrictions During Bird Nesting Season	The MCOSD will implement the following seasonal restrictions to protect nesting birds. If work will occur outside the nesting bird window of February 1 to August 31, surveys and avoidance measures will not be necessary for nesting birds. However, surveys for special-status species may still be necessary if they are present in the area. <ul style="list-style-type: none"> • Identify potential habitat for nesting birds and survey to determine if active nests are present before initiating road and trail management actions. Surveys will include the proposed road and trail management footprint, and a ¼ mile buffer area (for raptors) or a 150 foot buffer area (for other birds). Surveys will be conducted within 14 days of the start of active ground-disturbing activities.

Table 6.3 Special-Status Wildlife Best Management Practices

BMP ID	Description
	<ul style="list-style-type: none"> • If any active nests of protected bird species are found, prohibit brushing, mowing and tree removal activities at the nest site and within a buffer area until the young birds have fledged and left the site, and/or the nest has been abandoned. The buffer area will be 50-250 feet, or as determined through consultation with the California Department of Fish and Wildlife, pursuant to section 2081 of the California Fish and Game Code and the federal Migratory Bird Treaty Act. In general, a line-of-site buffer of at least 150 feet between the nest site and road and trail management activities is recommended. For raptors, buffer distances may be increased to 250 feet or more, depending on the visual distance from the nest to the road and trail management work area, and the sensitivity of the raptor species to road and trail management activities. In addition, a 5 MPH speed limit will be enforced in and near bird nesting habitats and other sensitive habitat areas. • If impacts to nesting birds cannot be avoided, contact the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife to obtain the necessary permits before initiating road and trail management activities.
<p>Special-Status Wildlife-4</p> <p>Avoidance and Protection of Northern Spotted Owl</p>	<p>Northern spotted owls have potential to occur on the MCOSD preserves. The MCOSD will undertake the following actions when construction-related road and trail management actions are planned to occur within or adjacent to potential northern spotted owl habitat:</p> <ul style="list-style-type: none"> • Identify potential habitat for the northern spotted owl and survey to determine if it is occupied or if active nests are present before initiating road and trail management activities. Surveys will include the proposed road and trail management footprint and a 150 foot buffer area. Surveys will be conducted within 14 days of the start of active ground-disturbing activities. • To the greatest extent possible, avoid occupied habitat completely during key northern spotted owl breeding and nesting season (March-September). • Mark occupied habitat with flagging or temporary fencing. • Avoid removal of trees with documented northern spotted owl nests. Removal of nest trees typically requires compensatory mitigation. • Establish a buffer of at least 100 feet around occupied habitats. Within the buffer area, select least harmful road and trail management activities. Within the buffer area, retain old-growth forest trees and forest canopy, and minimize removal of other vegetation to the fullest extent possible. • Avoid cutting native trees greater than 10 inches in diameter at breast height within occupied northern spotted owl habitat. • Conduct a worker training program for all field personnel involved with the proposed road and trail management project prior to project initiation. The program will consist of a brief presentation by persons knowledgeable about the northern spotted owl. The program will include the following: a photograph and description of the northern spotted owl, a description of its ecology and habitat needs, an explanation of the measures being taken to avoid or reduce adverse impacts, and the workers' responsibility under applicable environmental regulations. The worker training may be conducted in an informal manner (e.g., as part of a routine tailgate safety meeting). • If impacts cannot be avoided, contact the U.S. Fish and Wildlife Service and/or the California Department of Fish and Wildlife to obtain the necessary permits before initiating road and trail management activities. • Notify the U.S. Fish and Wildlife Service and/or the California Department of Fish and Wildlife within 24 hours of finding any injured northern spotted owl or any unanticipated damage to its habitat associated with the proposed action. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. Dead animals will be sealed in a plastic zip lock bag containing a piece of paper indicating the location, date, and time when it was found, and the name of the person who found it; the bag should be frozen in a freezer in a secure location. The MCOSD will contact the U.S. Fish and Wildlife Service within seven days to transfer any dead or injured specimens.
<p>Special-Status Wildlife-5</p> <p>Avoidance and Protection of Double-Crested Cormorant Nests and Heron and Egret Rookery Sites</p>	<p>There are several known or suspected double-crested cormorant, great blue heron, snowy egret, and black-crowned night heron rookery or nesting sites existing on the MCOSD preserves. These procedures are similar to those described in Special-Status Wildlife Protection-3 for seasonal restrictions during bird nesting season, but are more specific to these particular bird species and therefore supersede the more general practices for protecting all nesting birds. The MCOSD will undertake the following procedures when construction-related road and trail management is planned to occur within or adjacent to potential nesting or rookery sites for these species:</p> <ul style="list-style-type: none"> • Identify potential habitat for double-crested cormorant, heron, and egret nest and rookery sites and survey to determine if they are occupied or if nests are present before initiating road and trail management actions. Surveys will include the proposed road and trail management footprint and a 150-foot buffer area. Surveys will be conducted within 14 days of the start of active ground-disturbing activities. • To the greatest extent possible, avoid nests and rookery sites completely during key breeding and nesting periods. Activities in or near known sites will be limited during the known nesting seasons for each species, or until young have fully fledged. • Establish a buffer of at least 100 feet around rookery and nest sites. Within the buffer area, select least harmful road and trail management activities. Restrict activities within the buffer to those that will not disturb roosting or nesting behavior (e.g., noise and visual disturbances). • Mark occupied habitat with flagging or temporary fencing. • Prohibit the removal of known roost or nest trees. Restrict the removal of other mature riparian trees within the buffer zone.

Table 6.3 Special-Status Wildlife Best Management Practices

BMP ID	Description
	<ul style="list-style-type: none"> • Conduct a worker training program for all field personnel involved with the proposed road and trail management project prior to project initiation. The program will consist of a brief presentation by persons knowledgeable about the special-status species. The program will include the following: a photograph and description of the special-status species, a description of its ecology and habitat needs, an explanation of the measures being taken to avoid or reduce adverse impacts, and the workers' responsibility under applicable environmental regulations. The worker training may be conducted in an informal manner (e.g., as part of a routine tailgate safety meeting). • If impacts cannot be avoided during the nesting season (March 1 – August 31), contact the California Department of Fish and Wildlife to obtain the necessary permits before initiating road and trail management activities. • Notify the California Department of Fish and Wildlife within 24 hours of finding any injured special-status species or any unanticipated damage to its habitat associated with the proposed action. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. Dead animals will be sealed in a plastic zip lock bag containing a piece of paper indicating the location, date, and time when it was found, and the name of the person who found it; the bag should be frozen in a freezer in a secure location. The MCOSD will contact the California Department of Fish and Wildlife within seven days to transfer any dead or injured specimens. • Prohibit or restrict equipment refueling, fluid leakage, equipment maintenance, and road surfacing activities near wetlands. Fuel storage and refueling will occur in safe areas well away from wetlands; safe areas may include paved or cleared roadbeds and other contained areas, such as lined truck beds. Equipment and vehicles will be inspected regularly for hydraulic and oil leaks, and leaking vehicles will not be allowed on the MCOSD preserves. Drip pans will be placed underneath equipment stored on site. Vehicles and construction equipment will be maintained in good working condition, and any necessary on-site servicing of equipment will be conducted away from the wetlands. • Require all contractors to possess, and all vehicles to carry, emergency spill containment materials. Absorbent materials will be on hand at all times to absorb any minor leaks and spills.
<p>Special-Status Wildlife-6</p> <p>Avoidance and Protection of California Clapper Rail, California Black Rail, and Salt Marsh Harvest Mouse</p>	<p>The MCOSD preserves encompass some tidal areas that are known to support, or have the potential to support, California clapper rail, California black rail and salt-marsh harvest mouse. In areas where road and trail management activities are planned to occur within or adjacent to salt marsh or brackish marsh habitats, the MCOSD will first consult with the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife to determine locations where these species could potentially be affected. The MCOSD will obtain and comply with necessary permits for working in suitable habitat for these species, including, but not limited to the following types of protective actions to prevent harm to these species:</p> <ul style="list-style-type: none"> • To the greatest extent possible, avoid occupied California clapper rail and California black rail habitat completely during key breeding and nesting periods. Noise-generating activities, including operating heavy machinery in or near known California clapper or California black rail sites, will be avoided during the nesting season (March 1 – August 31). • During the California clapper rail and California black rail breeding season, identify potential habitat for California clapper rail and California black rail, and survey to determine if it is occupied before initiating road and trail management activities. Survey will include the proposed road and trail management footprint and a 150-foot buffer area around occupied habitat. Surveys will be conducted within 14 days of the start of active ground- disturbing activities. Occupied habitat will be marked with flagging or temporary fencing. • Assume presence of salt marsh harvest mouse in appropriate habitats, avoid impacting these areas, and establish a protective buffer. Because the U.S. Fish and Wildlife Service frequently does not allow trapping of the salt marsh harvest mouse to determine its presence, the MCOSD will assume presence in appropriate habitats and avoid disturbing them. If appropriate habitats are present, a 200-foot buffer will be established around the habitat. If work is required within the buffer, activities will be restricted within the buffer to those that will not disturb nesting behavior (e.g., through noise or visual disturbances), and vegetation will be removed by hand under the supervision of a qualified biologist to ensure no impacts to the salt marsh harvest mouse occur.
<p>Special-Status Wildlife-7</p> <p>Protection of Fish Habitats</p>	<p>If crossing a stream with the potential to support fish is part of a road or trail project, proper fish passage will be designed:</p> <ul style="list-style-type: none"> • Preference will be for a bridge instead of a culvert, and an open-arch culvert instead of a pipe culvert. A bridge that will not affect streamflow will be the preferred option. If a culvert is necessary, an open-arch design that does not affect the bed or flow of the stream will be preferred. If an open arch culvert is not possible, pipe culverts will be installed slightly below grade in an area perpendicular to the crossing where the existing streamflow is linear. Resting pools will be designed above and below culverts to allow fish to rest before and after having to pass through the culvert.
<p>Special-Status Wildlife-8</p> <p>Worker Awareness Training</p>	<ul style="list-style-type: none"> • Conduct worker awareness training. Worker training will include the following information: a photograph and description of each special-status species, sensitive, resource, or invasive plant known from the project area; a description of its ecology and habitat needs; potentially confusing resources (e.g., similar species or habitats); an explanation of the measures being taken to avoid or reduce adverse impacts; reporting and necessary actions if sensitive resources are encountered; and workers' responsibility under the applicable environmental regulation.

Table 6.3 Special-Status Wildlife Best Management Practices

BMP ID	Description
Special-Status Wildlife-9 Construction Monitoring	If federal- or state-listed wildlife species are known to be present in the project area or immediate surroundings, a qualified biologist will monitor construction activities to ensure impacts to species will be avoided. If listed wildlife species are present within the immediate vicinity of the project area, a more involved monitoring program might be necessary to ensure that these species do not enter the project area. If a listed species is observed by a worker or construction monitor, work will cease immediately and the appropriate resource regulatory agency will be contacted if necessary. A construction monitoring program will be developed for each project on a project-specific basis.
Special-Status Wildlife-10 Relocation of Special-Status Species	If federal- or state-listed wildlife species are located on site, the appropriate resource agency will be contacted, and a qualified biologist possessing any necessary permits will relocate individuals to suitable habitat off site as applicable.
Special-Status Wildlife-11 Noise Control	<ul style="list-style-type: none"> • Utilize the best available noise-control techniques when in proximity to occupied sensitive wildlife habitat. The best available noise-control techniques (e.g., improved mufflers, equipment redesign, and use of intake silencers, ducts, engine enclosures, and acoustically attenuating shields or shrouds) will minimize disturbance of nearby wildlife populations
Special-Status Wildlife Protection-12 Trash Control	<ul style="list-style-type: none"> • Store food-related trash in closed containers and remove it from the project site daily. Food-related trash can attract wildlife to construction sites, disrupting their normal behavior patterns.
Special-Status Wildlife-13 Road and Trail Inspections	<ul style="list-style-type: none"> • Regularly inspect road and trail features and associated infrastructure to ensure they are well maintained and posing no threat to surrounding special-status wildlife species. Staff will record information pertaining to the spread of invasive exotic plants that could affect wildlife habitats and to the status and quality of any known special-status wildlife species in the immediate vicinity that could be affected by road or trail use, maintenance, or management activities. Staff will report any findings to MCOSD natural resource staff and make recommended corrective actions if appropriate.

Table 6.4 Special-Status Plants Best Management Practices

BMP ID	Description
Special-Status Plants-1 Literature Reviews	<p>Prior to all management activities, literature reviews will be conducted to determine if special-status plant species, critical habitats, or sensitive communities exist within the project area. In addition to the MCOSD database, the following resources will be reviewed, as necessary, prior to work:</p> <ul style="list-style-type: none"> • U.S. Geological Survey topographic maps • U.S. Fish and Wildlife Service National Wetlands Inventory maps • Bay Area Aquatic Resource Inventory Database • Aerial photographs • California Department of Fish and Wildlife Natural Diversity Database records • U.S. Fish and Wildlife Service quadrangle species lists • California Native Plant Society inventory records <p>Database searches for known occurrences of special-status plant species will focus on the vicinity of the project area. Biological communities present in the project location and surrounding areas will be classified based on existing plant community descriptions described in the Preliminary Descriptions of the Terrestrial Natural Communities of California (Holland 1986). Biological communities will be classified as sensitive or nonsensitive as defined by the California Environmental Quality Act and other applicable laws and regulations.</p>
Special-Status Plants-2 Avoidance and Protection of Special-Status Plant Species near Road and Trail Management Projects	<p>The MCOSD will undertake the following actions when construction-related road and trail management is planned to occur within or adjacent to special-status plant populations:</p> <ul style="list-style-type: none"> • Identify potential special-status plant habitat and survey to determine if it is occupied before initiating road and trail management activities. Surveys will include the proposed road and trail management footprint and a 100-foot buffer area around the footprint if potential special-status plant habitat exists. Surveys will be conducted within 14 days of the start of active ground-disturbing activities. • To the greatest extent possible, avoid occupied special-status plant populations completely. • If full avoidance is not possible, restrict work to the period when special-status plants have flowered or set seed. • Establish a buffer of at least 100 feet around special-status plant populations. Within the buffer area, select the least harmful road and trail management activities. • Mark special-status plant populations with flagging or temporary fencing. • Prevent unnecessary vehicular and human intrusion into special-status plant species habitat from adjacent construction, maintenance, and decommissioning activities. Where necessary, reroute or sign and fence trails to avoid the special-status plant population.

Table 6.4 Special-Status Plants Best Management Practices

BMP ID	Description
	<ul style="list-style-type: none"> • Prohibit or restrict equipment refueling, fluid leakage, equipment maintenance, and road surfacing activities near special-status plant populations. Activities will be restricted within the buffer to those that will not disturb roosting or nesting behavior (e.g., through noise or visual disturbances). Fuel storage and refueling will occur in safe areas well away from wetlands; safe areas may include paved or cleared roadbeds and other contained areas, such as lined truck beds. Equipment and vehicles will be inspected regularly for hydraulic and oil leaks, and leaking vehicles will not be allowed on the MCOSD preserves. Drip pans will be placed underneath equipment stored on site. Vehicles and construction equipment will be maintained in good working condition, and any necessary on-site servicing of equipment will be conducted away from special-status plant populations. • To minimize downslope erosion and sedimentation near special-status plants, maintain erosion- and sediment-control devices during ground-disturbing activities and until all disturbed soils have been stabilized. Control devices include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials must be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion-control materials must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.) and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians. • Conduct a worker training program for all field personnel involved with the proposed road and trail management project prior to project initiation. The program will consist of a brief presentation by people knowledgeable about the special-status species. The program will include the following: a photograph and description of the special-status species, a description of its ecology and habitat needs, an explanation of the measures being taken to avoid or reduce adverse impacts, and the workers' responsibility under applicable environmental regulations. The worker training may be conducted in an informal manner (e.g., as part of a routine tailgate safety meeting). • If impacts cannot be avoided, contact the U.S. Fish and Wildlife Service and/or the California Department of Fish and Wildlife to obtain the necessary permits before initiating road and trail management activities. Permit conditions will likely require presence of a biological monitor, installation of exclusion fencing, surveys to relocate or avoid the species, and/or possibly timed or staged road and trail management activities that avoid the species or reduce potential for take or harm. • If a special-status plant species is detected during work activities, stop work immediately at that location and contact the U.S. Fish and Wildlife Service and/or the California Department of Fish and Wildlife within two working days. Work will not resume at that location until authorization is obtained from the appropriate agency (unless prior approval has already been granted). • Notify the U.S. Fish and Wildlife Service and/or the California Department of Fish and Wildlife within 24 hours of finding any damaged special-status plant species or any unanticipated damage to plant habitats associated with the proposed action. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. Dead plants should be sealed in a zip lock bag containing a piece of paper indicating the location, date, and time when it was found, and the name of the person who found it; the bag should be frozen in a freezer in a secure location. The MCOSD will contact the California Department of Fish and Wildlife or the U.S. Fish and Wildlife Service within two days and transmit the specimen in the appropriate manner. <p>If work occurs during the dry season and is greater than 100 feet from special-status plant species habitat, erosion control and water quality protection measures generally will not be necessary.</p>
Special-Status Plants-3 Ensure Proposed Actions are Consistent with Ongoing Special-Status Plant Management Programs	Some MCOSD preserves (e.g., Ring Mountain and Old Saint Hilary's) have ongoing special-status plant management and monitoring programs. In these locations the MCOSD will ensure that all new proposed road and trail management activities are consistent with the ongoing management of these sites: <ul style="list-style-type: none"> • Review existing management plans and analyze proposed actions for consistency against adopted procedures. • Ensure that new road and trail management projects do not interfere with ongoing management and maintenance activities.
Special-Status Plants-4 Earthwork near Special-Status Plant Populations	Many special-status plants are closely associated with specific soil types or geologic conditions (e.g., serpentine or ultramafic soils). To protect these species, the MCOSD will implement the following practices: <ul style="list-style-type: none"> • Use native soil in all MCOSD road and trail management projects in natural habitat areas. • Do not allow the introduction of incompatible fill near special-status plant populations. Fill will consist of clean, native soils and aggregate materials from other projects within the preserve if available, or it will be purchased from a certified weed-free source before allowing the importation of other materials from outside the preserves. Fill materials will be approved by natural resource staff to ensure compatibility with future restoration/rehabilitation goals. • Salvage, store, and reuse topsoil. Where activities disturb soil temporarily, the top 6 to 12 inches of topsoil will be salvaged to retain seeds, soil mycorrhizae, and fungi from the excavated or otherwise disturbed area. The salvaged topsoil will be reapplied as a topdressing or topcoat over backfill, unless it is known to contain invasive plant seeds or propagules.

Table 6.4 Special-Status Plants Best Management Practices

BMP ID	Description
Special-Status Plants-5 Erosion Potential near Special-Status Plants	<p>The MCOSD will seek to prevent erosion near special-status plants. To protect these species, the MCOSD will:</p> <ul style="list-style-type: none"> • Unless no feasible alternative is available, avoid using heavy equipment in areas with soils that are undisturbed, saturated, or subject to extensive compaction. Where staging of heavy equipment, vehicles, or stockpiles is unavoidable, the allowable disturbance footprint will be limited and marked with flagging or fencing. Following the end of work, surface soils will be scarified to retard runoff and promote rapid revegetation. • Maintain a 15 MPH speed limit in sensitive habitat areas. This will reduce the potential for dust impacts on vegetation. For larger projects, roads will be watered for dust control near sensitive resources. • Immediately rehabilitate areas where project actions have disturbed soil. Areas disturbed by equipment or vehicles will be rehabilitated as quickly as possible to prevent erosion, discourage the colonization of invasive plants, and address soil compaction. Techniques include decompacting and aerating soils, recontouring soils to natural topography, stabilizing soils via erosion-control materials, revegetating areas with native plants, and removing and monitoring invasive plants. • To minimize erosion and sedimentation, maintain erosion- and sediment-control devices to protect special-status plant populations during ground- disturbing activities and until all disturbed soils have been stabilized. Measures include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials must be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds, must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.), and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians. If work occurs during the dry season and is more than 100 feet from special- status plant populations, erosion-control and water quality protection measures will not be necessary.
Special-Status Plants-6 Introduction of Invasive and Nonnative Plants and Plant Material	<p>The MCOSD will prevent the introduction of invasive and other nonnative plant material into special-status plant habitats by implementing the following practices:</p> <ul style="list-style-type: none"> • To the extent feasible, use plant seeds, cuttings, and other propagules that are collected from the same area as the project site (usually the same watershed or preserve). Allow collection of no more than 5% of any native plant population to prevent over collecting of wild plant material sources. • To minimize erosion and sedimentation, maintain erosion- and sediment-control devices during ground-disturbing activities and until all disturbed soils have been stabilized. Measures include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Only weed-free materials will be used as erosion- and sediment control devices. Materials must be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion-control materials must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.) and not of plastic monofilaments or other materials that could entrap snakes or amphibians. • Do not allow the introduction of incompatible fill near special-status plant populations. Fill will consist of clean, native soils and aggregate materials from other projects within the preserve if available, or it will be purchased from a certified weed-free source before allowing the importation of other materials from outside the preserves. Fill materials will be approved by natural resource staff to ensure compatibility with future restoration/rehabilitation goals. • Segregate and treat soils and vegetation contaminated with invasive plant seeds and propagules. To prevent the spread of invasive plants, treatment of contaminated soils may include disposal on site within already infested areas, chipping or pile burning and mulching to eliminate viable seeds, or disposal at an approved cogeneration plant or green-waste facility. • Clean vehicles of contaminated soil, invasive plant seeds, or plant parts before entering the MCOSD preserves, whenever moving equipment between areas within the preserves, and before leaving the preserves. Vehicle-cleaning areas will be established for this purpose. Within the cleaning areas, tires and interior and exterior of vehicles and equipment will be brushed off or hosed down. • Inspect construction equipment for soil or invasive seeds or plant parts. Contractors will be required to make equipment available for inspection before entering the MCOSD preserves, when moving between sites within the preserves, and before leaving the preserves.
Special-Status Plants-7 Revegetation with Native, Geographically Appropriate Plant Species	<p>The MCOSD will revegetate areas where construction and ground disturbance has occurred, to promote a species composition and vegetative structure that integrates with the surrounding natural community, to the maximum extent possible. This will be accomplished by implementing the following:</p> <ul style="list-style-type: none"> • Revegetate with annual grasses and forbs. Use of annual grasses and forbs can provide rapid vegetative cover and initial soil stabilization, and erosion control, promote habitat for native species, and provide a more desirable visual cover. • Prepare a project-specific revegetation plan. The MCOSD natural resource staff will develop a revegetation plan for projects as needed. • Wherever possible use locally collected native plant materials from the project footprint and surrounding areas. If possible, plant materials should be collected from within the same watershed or preserve. The MCOSD will allow collection of no more than 5% of any native plant population to prevent overcollection of wild plant material sources. If sufficient local plant materials are not available for collection prior to project activities, geographically appropriate native plant materials will be purchased from a local nursery or seed supplier.

Table 6.4 Special-Status Plants Best Management Practices

BMP ID	Description
Special-Status Plants-8 Worker Awareness Training	The MCOSD will conduct a worker awareness training for all field personnel involved with proposed road and trail management activities prior to initiating the project. The program will include the following: <ul style="list-style-type: none"> • a photograph and description of each special-status species, sensitive resource, or invasive plant known from the project area • a description of its ecology and habitat needs • potentially confusing resources (e.g., similar species or habitats) • an explanation of the measures being taken to avoid or reduce adverse impacts • reporting and necessary actions if sensitive resources are encountered • workers' responsibility under the applicable environmental regulation
Special-Status Plants-9 Relocation of Special-Status Plants	If special-status species are located in the project area and impacts to these species are unavoidable, plants and/or propagules will be relocated to suitable habitat off site prior to the commencement of construction or management activities. Alternatively, off-site mitigation for impacts could be considered. If special-status wildlife species are located on site, the appropriate resource agency will be contacted, and a qualified biologist possessing any necessary permits will relocate individuals to suitable habitat off site as applicable.
Special-Status Plants-10 Road and Trail Inspections	<ul style="list-style-type: none"> • Regularly inspect road and trail features and associated infrastructure to ensure they are well maintained and posing no threat to surrounding special-status plant resources. Staff will record information pertaining to the spread of invasive, exotic plants that could affect special-status plant habitats and to the status and quality of any known special-status plant populations in the immediate vicinity that could be affected by road or trail use, maintenance, or management activities. Staff will report any findings and make recommended corrective actions if appropriate.
Special-Status Plants-11 Reuse and Replanting of Native Trees and Shrubs	<ul style="list-style-type: none"> • Where feasible, replant excavated trees and shrubs, removed from unstable fill slopes and cut banks, on graded contours to restore the areas with native vegetation and promote native plant habitat. These plants will represent the most locally appropriate materials for restoration and conform to the vegetation types of the surroundings.
Special-Status Plants-12 Ripping and Recontouring Roads	<ul style="list-style-type: none"> • Rip and decompact road and trail surfaces where appropriate. Ripping surfaces provides a more suitable substrate for recolonization or revegetation by native plant materials. Decommissioned road and trail surfaces will be recontoured and sloped away from wetlands and water bodies to prevent the potential for erosion into these features. Any shoulders, ditches, or embankments will also be removed, and the area graded to a natural contour.

Table 6.5 Invasive Plants Best Management Practices

BMP ID	Description
Invasive Plants-1 Compliance with Integrated Pest Management Ordinance	All herbicide use will be administered under Marin County's Integrated Pest Management (IPM) Ordinance, and work will only be conducted under the supervision of a certified pest control applicator. All herbicide use for vegetation management actions will be posted and reported consistent with the ordinance.
Invasive Plants-2 Herbicide Use near Sensitive Natural Resources	<ul style="list-style-type: none"> • Limit herbicide use within 100 feet of sensitive natural resources. Hand control, mechanical control, and cultural control will be used wherever possible to minimize the use of herbicides near sensitive resources.
Invasive Plants-3 Survey and Control of Invasive Plants in Project Footprint	<ul style="list-style-type: none"> • Before ground-disturbing activities begin, inventory and prioritize invasive plant infestations for treatment within the project footprint and along access routes. Controlling priority invasive plant infestations at least a year prior to the planned disturbance, if feasible, will minimize invasive plant seeds in the soil. • Where feasible, survey the road shoulders of access routes for invasive plant species and remove priority invasive plants that could be disturbed by passing vehicles. • Avoid establishing staging areas in areas dominated by invasive plants. If populations of priority invasive plants occur within or near staging areas, their perimeters will be flagged so that vehicle and foot traffic can avoid them. • Clean vehicles of contaminated soil, invasive plant seeds, or plant parts before entering the MCOSD preserves, whenever moving equipment between areas within the preserves, and before leaving the preserves. Vehicle-cleaning areas will be established for this purpose. Within the cleaning areas, tires and the insides and outsides of vehicles and equipment will be brushed off or hosed down. • Inspect construction equipment for soil or invasive seeds or plant parts. Contractors will be required to make equipment available for inspection before entering the MCOSD preserves, when moving between sites within the preserves, and before leaving the preserves.
Invasive Plants-4 Limited Soil Disturbance	Soil disturbance during road and trail projects will be minimized to reduce the potential for introduction or spread of invasive plant species, to protect topsoil resources and to reduce available habitat for new invasive plant species: <ul style="list-style-type: none"> • Plan all road and trail management activities to disturb as little area as possible.
Invasive Plants-5 Cleaning of Heavy Equipment, Maintenance Tools, and Fire Management Vehicles	The MCOSD will implement the following procedures when working in or near infested areas: <ul style="list-style-type: none"> • Clean vehicles of contaminated soil, invasive plant seeds, or plant parts before entering the MCOSD preserves, whenever moving equipment between areas within the preserves, and before leaving the preserves. Vehicle-cleaning areas will be established for this purpose. Within the cleaning areas, tires and the insides and outsides of vehicles and equipment will be brushed off or hosed down. • Inspect construction equipment for soil or invasive seeds or plant parts. Contractors will be required to make equipment available for inspection before entering the MCOSD preserves, when moving between sites within the preserves, and before leaving the preserves.
Invasive Plants-6 Reducing Potential for Establishment of Invasive Plants on Disturbed Soil Surfaces	To minimize the establishment of invasive species in disturbed soil areas, the MCOSD will implement one or more of the following actions: <ul style="list-style-type: none"> • To minimize erosion and sedimentation, maintain erosion- and sediment-control devices during ground-disturbing activities and until all disturbed soils have been stabilized. Control devices include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials must be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion-control materials must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles, etc.) and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians. • Do not allow the introduction of incompatible fill. Fill will consist of clean, native soils and aggregate materials from other projects within the preserve if available, or it will be purchased from a certified weed-free source before allowing the importation of other materials from outside the preserves. Fill materials will be approved by natural resource staff to ensure compatibility with future restoration/rehabilitation goals. • Segregate and treat soils and vegetation contaminated with invasive plant seeds and propagules. To prevent the spread of invasive plants, treatment of contaminated soils may include disposal on site within already infested areas, chipping or pile burning and mulching to eliminate viable seeds, or disposal at an approved cogeneration plant or green-waste facility.
Invasive Plant Management-7 Monitor and Control of Invasive Plants in Road and Trail Management Work Areas	<ul style="list-style-type: none"> • Periodically monitor areas subject to road and trail management activities for a minimum of three years following project completion for the presence of invasive plant species. If invasive plants threaten to become established or spread as a result of project activities, they will be treated in conformance with the Vegetation and Biodiversity Management Plan.

Table 6.5 Invasive Plants Best Management Practices

BMP ID	Description
Invasive Plant Management-8 Protection of Streambanks and Water Quality During Invasive Plant Removal	<ul style="list-style-type: none"> • Install approved erosion-control devices following the removal of invasive plants from streambanks to prevent sediment movement into watercourses and to protect bank stability. The MCOSD will obtain and comply with necessary wetland permits and integrated pest management procedures related to work in and near wetlands. Where appropriate, the MCOSD will also seek guidance from a fisheries biologist regarding the amount of material permissible to remove from stream corridors when controlling large patches of invasive plants, so as to prevent changes in water temperature and quality. If work occurs during the dry season near seasonally wet areas, erosion-control and water quality protection measures generally will not be necessary.
Invasive Plant Management-9 Road and Trail Inspections	<ul style="list-style-type: none"> • Regularly inspect road and trail features and associated infrastructure to ensure they are well maintained and posing no threat to surrounding sensitive biological resources. Inspectors will record information pertaining to invasive exotic plant populations and new infestations that may be threatening sensitive species and habitats. Inspectors will report any findings and make recommended corrective actions if appropriate.
Invasive Plant Management-10 Monitoring Decommissioned Areas	<ul style="list-style-type: none"> • Monitor areas of decommissioned roads and trails for the presence of invasive plant species for two years following decommissioning to ensure no infestations develop. If invasive species are detected at this time, corrective actions will be taken as appropriate.

Table 6.6 Construction Contracts Best Management Practices

BMP ID	Description
Construction Contracts -1 Standard Procedures in Construction Contracts	<p>When using contractors to perform road and trail management, the MCOSD will include some or all of the following standard procedures into construction contracts.</p> <p>Time of work. The contractor will work with the MCOSD natural resource staff to determine the optimal timing of contracted work. Many timing restrictions relate to avoiding migration, gestation, or flowering periods for special-status species. Other types of timing restrictions relate to avoiding the spread of invasive plants or scheduling work in wetlands during the dry season.</p> <p>Work in and near water bodies and wetlands. To protect water quality, the contractor will be required to prepare and implement a stormwater pollution prevention plan for road and trail management work in or near wetlands, ponds, seeps, creeks, tidal areas, or stream crossings. The following practices will be followed to protect these habitats:</p> <ul style="list-style-type: none"> • Avoid construction work within a buffer of 100 feet from the ordinary high-water mark of any water body, wetland, or tidally influenced area. If construction work cannot be fully avoided in water bodies, wetlands and riparian areas, the appropriate state and federal agencies will be consulted and permits obtained. • Within the buffer, restrict activities to the least-harmful methods. For example, herbicides will be restricted to those that are EPA-approved for use near water. Activities that disturb soil or could cause soil erosion or changes in water quality will be prohibited. • Within the buffer, limit work that may cause erosion to low-flow periods. Low-flow months for local creeks are typically August to October. For tidal areas, work will not occur within two hours of high-tide events at construction sites when high tide is greater than 6.5 feet as measured at the Golden Gate Bridge, using corrections for areas near individual MCOSD preserves. Tide charts are available online from the National Oceanic and Atmospheric Agency/National Weather Service (http://www.wrh.noaa.gov/mtr/sunset.php). <p>Work in and near invasive plant infestations. The contractor will work with the MCOSD natural resource staff to identify any priority invasive plants that occur near the project work area, including the project footprint, access roads, staging areas, and similar work areas. The contractor will agree to comply with requirements to reduce the spread or transport of priority invasive plants related to construction activities. Requirements may include some or all of the following:</p> <ul style="list-style-type: none"> • Conduct a training program for all field personnel involved with the proposed road and trail management project prior to initiating the project. The program will consist of a brief presentation by persons knowledgeable about the special-status species, sensitive resource, or invasive plants known from the project area. The program will include the following: a photograph and description of each special-status species, sensitive resource, or invasive plant known from the project area; a description of its ecology and habitat needs; an explanation of the measures being taken to avoid or reduce adverse impact; and the workers' responsibility under the applicable environmental regulation. The worker training may be conducted in an informal manner (e.g., as part of a routine tailgate safety meeting). • Restrict work to periods when invasive plants are not in fruit or flower. • Clean vehicles of contaminated soil, invasive plant seeds, or plant parts before entering the MCOSD preserves, whenever moving equipment between areas within the preserves, and before leaving the preserves. Vehicle-cleaning areas will be established for this purpose. Within the cleaning areas, tires and insides and outsides of vehicles and equipment will be brushed off or hosed down.

Table 6.6 Construction Contracts Best Management Practices

BMP ID	Description
	<ul style="list-style-type: none"> • Inspect construction equipment for soil or invasive seeds or plant parts. Contractors will be required to make equipment available for inspection before entering the MCOSD preserves, when moving between sites within the preserves, and before leaving the preserves. • Dispose of green waste in a manner that does not spread invasive plants. Disposal practices may include on-site disposal in an already infested area or off-site disposal in a cogeneration plant or an approved green-waste composting facility. <p>Work in environmentally sensitive areas. The MCOSD natural resource staff will identify any environmentally sensitive areas in or near construction projects prior to the start of the project. The following practices will be followed to protect these resources: Environmentally sensitive areas may include special-status plant or wildlife species or their habitats; wetlands; creeks, streams, and related riparian areas; and sensitive vegetation types as described in this report.</p> <ul style="list-style-type: none"> • Avoid work in environmentally sensitive areas. If work cannot be fully avoided, any applicable regulatory agencies will be consulted and the necessary permits obtained. • Use locally collected plant materials for revegetation projects. Whenever possible, locally collected native plant materials from the project footprint and surrounding area will be used for revegetation. Plant materials should be collected from within the same watershed or the MCOSD preserve if possible. The MCOSD will allow collection of no more than 5% of any native plant population to avoid overcollection of wild plant material sources. If sufficient local plant materials are not available for collection prior to project activities, geographically appropriate native plant materials will be purchased from a local nursery or seed supplier. The contractor will allow the MCOSD to inspect and approve all plant materials and seed prior to use on site. • Comply with requirements of the MCOSD project permits to protect special-status species and their associated habitats. For road and trail management work in or near special-status species habitat, the contractor is required to comply with requirements of the MCOSD project permits to protect special-status species and their associated habitats before and during construction, and to cooperate with the MCOSD in implementing any state and federal permits and agreements for the project. The special-status species population plus a buffer will be designated as an environmentally sensitive area using lath and flagging, pin flags, or temporary fencing (depending on resource sensitivity to work). The contractor will be required to avoid all designated environmentally sensitive areas during construction. For any special-status species or their habitats that cannot be fully avoided, the contractor will work with the MCOSD to obtain and comply with federal and state Endangered Species Acts, the federal Migratory Bird Treaty Act, and the California Fish and Game Code permits and agreements. • Restrict soil disturbance and import of nonnative soil or fill material. To reduce the potential for damage of native plants and/or introduction of invasive plants, the contractor will be required to minimize the footprint of soil disturbance to the minimum amount necessary to complete the contracted work. This includes the footprint of access roads, staging areas, and areas of temporary disturbance. The contractor and its staff and subcontractors will agree not to drive off road or drive or park on native vegetation unless approved in advance by the MCOSD natural resource staff. The contractor will agree that if soil excavation is required, every attempt will be made to have a balanced cut-and-fill project that reuses all native soils on site. Nonnative soil or fill material will not be used unless preapproved by the MCOSD natural resource staff. • To minimize erosion and sedimentation, maintain erosion- and sediment-control devices during ground-disturbing activities and until all disturbed soils have been stabilized. Control devices include rice straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials will be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion-control materials will be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles) and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians. <p>Other procedures:</p> <ul style="list-style-type: none"> • Keep all entry gates to the project site locked during nonconstruction hours, or locked at all times if not needed for construction access. • Equip all vehicles with a suitable fire extinguisher. • Immediately rehabilitate areas where project actions have disturbed soil. Areas disturbed by equipment or vehicles will be rehabilitated as quickly as possible to prevent erosion, discourage the colonization of invasive plants, and address soil compaction. Techniques include decompacting and aerating soils, recontouring soils to natural topography, stabilizing soils via erosion-control materials, revegetating areas with native plants, and removing and monitoring invasive plants.

Cultural Resources

Table 6.7 Cultural Resources Best Management Practices

BMP ID	Description
Cultural Resources-1 Historical and Archaeological Resource Mapping	Prior to constructing any project that would involve ground disturbance outside road or trail beds or other areas previously disturbed when constructing the road and trail system, the MCOSD staff will determine whether or not the project area is located within an area that is mapped as “historically or archaeologically sensitive” according to map 4-1 (Historical Resources) in the Marin Countywide Plan and/or identified as culturally sensitive on other confidential maps on file with the county that list prehistoric or archeological sites. If the project area is identified as sensitive on any of these maps, the site will be field surveyed by a state-qualified archeologist or an archeological consultant recommended by the Federated Indians of Graton Rancheria, who will make recommendations and develop proposals for any procedures deemed appropriate to further investigate and/or mitigate adverse impacts to those resources.
Cultural Resources-2 Consultation with Northwest Information Center	Prior to constructing any project that would involve ground disturbance outside road or trail beds or other areas previously disturbed when constructing the road and trail system, the MCOSD staff will contact the Northwest Information Center of the California Historical Resources Information System and request a records search of known historic and cultural resources within and adjacent to the proposed project area, and seek the determination of the information center coordinator regarding the potential for cultural resources on the site. Should the records request or the recommendation of the coordinator indicate the presence of sensitive resources, the site will be field surveyed by a state-qualified archeologist or archeological consultant recommended by the Federated Indians of Graton Rancheria, who will make recommendations and develop proposals for any procedures deemed appropriate to further investigate and/or mitigate adverse impacts to those resources.
Cultural Resources-3 Tribal Consultation	The following tribal consultations will be conducted prior to any new ground disturbance related to road or trail construction: <ul style="list-style-type: none"> • Send the road and trail project description information to the Native American Heritage Commission and request contact information for tribes with traditional lands or places located within the geographic areas affected by the proposed changes. • Contact each tribe identified by the commission in writing and provide them the opportunity to consult about the proposed project. • Organize a consultation with tribes that respond to the written notice within 90 days. • Refer proposals associated with proposed road and trail modifications to each tribe identified by the commission at least 45 days prior to the proposed action. • Provide notice of a public hearing at least 10 days in advance to tribes and any other persons who have requested that such notice be provided.
Cultural Resources-4 Alteration of Historic Structures	<ul style="list-style-type: none"> • Limit the modification of ranch structures or other historical features to maintain the aesthetic quality, historical setting, and rural character of the preserves.
Cultural Resources-5 Permanent Protection	<ul style="list-style-type: none"> • Where road and trail activities cannot avoid sensitive cultural resources, require modifications to the actions to incorporate the resource and include a resource protection plan for its maintenance and future protection.
Cultural Resources-6 Construction Discovery Protocol	<ul style="list-style-type: none"> • If cultural resources are discovered on a site during construction activities, halt all earthmoving activity in the area of impact until a qualified archeological consultant examines the findings, assesses their significance, and develops proposals for any procedures deemed appropriate to further investigate and/or mitigate adverse impacts to those resources.
Cultural Resources-7 Human Remains	<ul style="list-style-type: none"> • In the event that human skeletal remains are discovered, discontinue work in the area of the discovery and contact the County Coroner. If skeletal remains are found to be prehistoric Native American remains, the coroner will call the Native American Heritage Commission within 24 hours. The commission will identify the person(s) it believes to be the most likely descendant of the deceased Native American. The most likely descendant will be responsible for recommending the disposition and treatment of the remains. The most likely descendant may make recommendations to the landowner or the person responsible for the excavation/grading work for means of treating or disposing of the human remains and any associated grave goods as provided in section 5097.98 of the California Public Resources Code.
Cultural Resources-8 Community Awareness	<ul style="list-style-type: none"> • Increase public awareness of local history and archeology, and the need to protect cultural resources. This may be accomplished by highlighting cultural resources along a road or trail with interpretive signs and information kiosks, and/or by placing a historical marker along the road or trail segment to inform trail users about the importance of the site and/or event.

Water Quality

Table 6.8 Water Quality Best Management Practices

BMP ID	Description
<p>Water Quality-1</p> <p>Modifications to Road and Trail Management Actions to Protect Water Bodies, Wetlands, and Tidally Influenced Areas</p>	<p>Road and trail management activities will be restricted near wetlands and other waters to reduce the potential for sediment or pollutants to enter water bodies or wetlands. If work occurs during the dry season and is greater than 100 feet from creeks and wetlands, erosion control and water quality protection measures will not be necessary.</p> <ul style="list-style-type: none"> • If possible, avoid work around water bodies, wetlands, and tidally influenced areas, including a buffer area of 100 feet around these areas (i.e., as measured from the top bank of creeks, streams, or ponds). • If construction work in wetlands, riparian areas, or tidally influenced areas cannot be fully avoided, consult with the appropriate state and federal agencies. This consultation may result in wetland delineation, permit applications, and mitigation that meets Countywide Plan and other regulatory requirements. • Within the 100 foot buffer, limit construction activities. Limit activities to least-harmful methods; restrict herbicides to those that are EPA-approved for use near water. Prohibit activities that disturb soil or could cause soil erosion or changes in water quality. • Within the 100 foot buffer, limit work that might cause erosion to low-flow or low-tide periods. Low-flow months for local creeks are typically August to October. For tidal areas, work will not occur within two hours of high-tide events at construction sites when high tide is greater than 6.5 feet as measured at the Golden Gate Bridge, using corrections for areas near individual MCOSD preserves. Tide charts are available online from the National Oceanic and Atmospheric Agency/National Weather Service (http://www.wrh.noaa.gov/mtr/sunset.php). • Within the 100 foot buffer, minimize erosion and sedimentation by maintaining erosion- and sediment-control devices during ground-disturbing activities and until all disturbed soils have been stabilized. Control devices include weed-free straw, hydromulch, geofabrics, wattles, sediment traps, check dams, drainage swales, and sand bag dikes. Materials must be certified weed-free to prevent the introduction of wheat, barley, and other nonnative plant seeds. Erosion-control materials must be constructed of natural fibers (e.g., coconut fiber mats, burlap and rice straw wattles) and may not be constructed with plastic monofilaments or other materials that could entrap snakes or amphibians.
<p>Water Quality-2</p> <p>Temporary Erosion and Sediment Control</p>	<p>Temporary sediment-control practices will be implemented when new trail construction or existing trail improvements will result in greater than 1 acre of disturbance. Temporary practices may also be required when disturbance is less than 1 acre but close to a sensitive resource or has the potential to discharge a significant amount of sediments or pollutants to surface water. Several of the listed temporary practices can also be used as postconstruction stabilization measures: Information and standard details for temporary erosion-control BMPs can be found in the California Stormwater BMP Handbook – Construction (CASQA 2009).</p> <ul style="list-style-type: none"> • Install temporary fencing around staging areas and along limits of construction when work areas are immediately adjacent to sensitive resources. This will limit the disturbance footprint and help protect resources, including native vegetation, wetlands, and streams, during grading operations. • Install linear sediment barriers to slow and filter stormwater runoff from disturbed areas. Fiber or straw roll barriers can also be spaced along the contours of a disturbed area after construction to prevent concentrated flow and stabilize the area until there is sufficient vegetation coverage. • Apply one or more of the following to restore or protect areas disturbed by excavation or grading operations: <ul style="list-style-type: none"> » tilling (minimum 6 inch depth) and seeding » hydromulch and tackifier » planting » straw or wood mulch
	<ul style="list-style-type: none"> » coir (jute) netting » biodegradable erosion-control blankets » plastic sheeting (only as an interim protection during storm events when construction site is still active) <ul style="list-style-type: none"> • Cover soil and loose material stockpiles with weighted plastic sheeting when inactive or prior to storm events. Active and inactive material stockpiles will be encircled at all times with a linear sediment barrier. • Manage sediment when diverting streamflow. When constructing trail or road stream crossings, a temporary clear-water diversion may be required. The following options will be considered for isolating the work area and protecting resources when diverting streamflow via gravity-fed flexible pipe or active pumping around the work area: sand or gravel bag coffer dam enclosed in plastic sheeting, water-filled dam (e.g., Aquadam), sheet piling, and turbidity curtains. • Manage sediment during dewatering operations. The following options will be considered for applying or containing and treating sediment-laden water produced during dewatering operations: sprinkler system to open area (as long as there is no visible surface runoff), temporary constructed sediment basin or trap, rented sedimentation tank (e.g., Baker Tank).

Table 6.8 Water Quality Best Management Practices

BMP ID	Description																		
Water Quality-3 Erosion Control Measures	<ul style="list-style-type: none"> • Avoid the use of heavy equipment in areas with soils that are undisturbed, saturated, or subject to extensive compaction. • If no feasible alternative is available and staging of heavy equipment, vehicles, or stockpiles is unavoidable, limit the disturbance footprint and flag or mark the allowable disturbance area in the field. Following the end of work, newly disturbed soils will be scarified to retard runoff and promote rapid revegetation. • Immediately rehabilitate areas where project actions have disturbed soil. Require areas disturbed by equipment or vehicles to be rehabilitated as quickly as possible to prevent erosion, discourage the colonization of invasive plants, and address soil compaction. Techniques include decompacting and aerating soils, recontouring soils to natural topography, stabilizing soils via erosion-control materials, revegetating areas with native plants, and removing and monitoring invasive plants. • Leave the roots of target invasive trees and shrubs in place in areas with highly erosive soils or steep slopes. Stumps may be cut or ground down to the ground level. <p>If work occurs during the dry season and is greater than 100 feet from water bodies and wetlands, erosion control and water quality protection measures will not be necessary.</p>																		
Water Quality-4 Preventing or Reducing the Potential for Pollution	<ul style="list-style-type: none"> • Include spill prevention and clean-up in annual staff training sessions. • Properly use, store, and dispose of chemicals, fuels, and other toxic materials according to manufacturer's specifications and agency regulations. • Prohibit or restrict equipment refueling, fluid leakage, equipment maintenance, and road surfacing activities near wetlands. Fuel storage and refueling will occur in safe areas well away from wetlands; safe areas may include paved or cleared roadbeds and other contained areas, such as lined truck beds. Equipment and vehicles will be inspected regularly for hydraulic and oil leaks, and leaking vehicles will not be allowed on the MCOSD preserves. Drip pans will be placed underneath equipment stored on site. Vehicles and construction equipment will be maintained in good working condition, and any necessary on-site servicing of equipment will be conducted away from the wetlands. • Require all contractors to possess, and all vehicles to carry, emergency spill containment materials. Absorbent materials will be on hand at all times to absorb any minor leaks and spills. 																		
Water Quality-5 Road and Trail Inspections	<ul style="list-style-type: none"> • Inspect roads and trails for conditions that might adversely affect water quality or other resources. Road and trail maintenance staff will use road/trail inspection forms to facilitate complete and consistent data capture and reporting of the following conditions: <ul style="list-style-type: none"> » concentrated flows on roads and trails that cause erosion, rilling, or gullyng » runoff and effects to water quality of nearby habitats » the spread of invasive exotic plants near wetlands and waters » the status and quality of any known sensitive resources in the immediate vicinity that could be affected by road or trail use and/or maintenance <p>Staff will report any findings and make recommended corrective actions if appropriate.</p>																		
Water Quality-6 Grading Windows	<ul style="list-style-type: none"> • Restrict grading activity to the dry months (generally May 15 – October 15), when associated erosion will be reduced to the maximum extent possible. 																		
Water Quality-7 Culvert Inspection	<ul style="list-style-type: none"> • Inspect culverts on a regular basis. Inspections will ensure that culverts do not clog with sediment or debris. Blocked culverts may affect water quality, change the water course, increase erosion or sediment runoff, or affect wildlife. Any materials blocking culverts will be removed and disposed of outside of the watercourse in an area not subject to erosion. If a significant blockage or sedimentation exists, the MCOSD will plan and implement corrective actions as necessary. Excavation of sediments within streams may require a maintenance permit from the U.S. Army Corps of Engineers, the California Department of Fish and Wildlife, and/or the San Francisco Water Quality Control Board. 																		
Water Quality-8 Proper Disposal of Excess Materials	<ul style="list-style-type: none"> • Avoid resource impacts when disposing of materials. Any excess material related to new construction, maintenance, or decommissioning (including soils, debris, trash, or other materials that need to be removed as part of management activities) will be disposed of at an appropriate site where materials could not impact sensitive resources. For example, grading-related excess soils or removed debris will not be placed in or around a water body or wetland, where the materials could be subject to erosion that would affect water quality. 																		
Water Quality-9 Sidcasting Construction Material	<ul style="list-style-type: none"> • Avoid sidcasting, or at a minimum contain and remove sidcast material when it has the potential to reach surface waters. The following "rules of thumb" based on Fishnet 4C Guidelines (2007) will be used as guidance: <table border="1" style="margin-left: 20px; width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Slope gradient</th> <th style="text-align: left;">Distance to watercourse</th> <th style="text-align: left;">Sidcast rule</th> </tr> </thead> <tbody> <tr> <td>Any slope</td> <td>Will likely enter watercourse</td> <td>Not allowed</td> </tr> <tr> <td>≤20%</td> <td>≥150 feet</td> <td>Allowed</td> </tr> <tr> <td>≤50%</td> <td>≥300 feet</td> <td>Allowed</td> </tr> <tr> <td>> 50%</td> <td>Long vegetated slope</td> <td>Allowed</td> </tr> <tr> <td>>50%</td> <td>Shorter, sparsely vegetated slope</td> <td>Not allowed</td> </tr> </tbody> </table> 	Slope gradient	Distance to watercourse	Sidcast rule	Any slope	Will likely enter watercourse	Not allowed	≤20%	≥150 feet	Allowed	≤50%	≥300 feet	Allowed	> 50%	Long vegetated slope	Allowed	>50%	Shorter, sparsely vegetated slope	Not allowed
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Geologic Hazards

Table 6.9 Geologic Hazards Best Management Practices

BMP ID	Description
Geologic Hazards-1 Assessment and Requirements in Areas of Potential Geologic Hazard	Given the unique and potentially high risks associated with geologic hazards, general best management practices for these types of potential impacts are not appropriate. Instead, when new trails or trail improvements are proposed in preserve areas with a propensity for geologic instabilities, including slides or debris flows in the more elevated areas and subsidence or liquefaction in the low-lying areas, a site assessment will be conducted by a certified geologist or geotechnical engineer. If geologic hazards are confirmed in the area, the site assessment will propose adequate avoidance measures or engineering elements to ensure trail and infrastructure stability and maintained public safety.
Geologic Hazards-2 Construction in Areas of Slides and Debris Flows	<ul style="list-style-type: none"> • In areas of identified slide and debris flow hazards, locate and design new trails, drainage improvements, or irrigation so as not to alter the shape or stability, or change the drainage or groundwater conditions, of an existing slide area. Such alterations would potentially result in reactivation or further destabilization of the slope.
Geologic Hazards-3 Construction in Areas of Erodible and Expansive Soils	<ul style="list-style-type: none"> • Use avoidance tactics or engineered grading to mitigate adverse geologic conditions and potential hazards. Prior to final road or trail project design, consult with engineering geologists and/or geotechnical engineers to identify and implement mitigating road or trail designs for new facility locations or when improving existing facilities.
Geologic Hazards-4 Construction in Areas of Collapsible Soils	<ul style="list-style-type: none"> • In any of the lower elevation preserves (i.e., those near sea level) assess soil type and the potential for subsidence to determine optimum trail location and structural foundations necessary to avoid collapsible soils. In consultation with a certified geologist or geotechnical engineer, design roads and trails to avoid or reduce this potential hazard through optimizing location or by implementing appropriate engineering designs.

Air Quality

Table 6.10 Air Quality Best Management Practices

BMP ID	Description
Air Quality-1 Implement BAAQMD Measures	As part of the review process required under the California Environmental Quality Act, the MCOSD will use the current Bay Area Air Quality Management District guidelines to evaluate the significance of air quality impacts from road and trail management plans and projects, and to establish appropriate mitigation requirements.
Air Quality-2 Minimize Dust Control Emissions during Construction	<p>The MCOSD will require its staff or contractors to implement appropriate Bay Area Air Quality Management District control measures for emissions of dust during construction of all road and trail modifications and improvements.</p> <p>The following basic control measures cover routine operation and maintenance and day-to-day upkeep of roads and trails, minor road and trail reconstruction, and minor decommissioning activities, they also cover changes in use, the conversion of a road to a trail, or any proposed action that does not involve construction activities, but an increase or decrease in the level of activity:</p> <ul style="list-style-type: none"> • Water all active construction areas at least twice daily. • Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least 2 feet of freeboard (vertical space between the top surface of the material and the top of the hauling container). • Pave, apply water three times daily, or apply nontoxic soil stabilizers on all unpaved access roads, parking areas, and staging areas at construction sites. • Sweep daily (with water sweepers) all paved access roads, parking areas, and staging areas at construction sites. • Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets.
Air Quality-3 Enhanced Dust Control during Construction	<p>The following enhanced control measures cover major road and trail reconstruction, rerouting, and decommissioning activities, such as repairing, replacing, or restoring heavily used and wide road and trail segments; they also cover resurfacing, replacing, and restoring trailhead areas and installing new water quality and drainage features:</p> <ul style="list-style-type: none"> • Hydroseed or apply nontoxic soil stabilizers to inactive construction areas (previously graded areas inactive for ten days or more). • Enclose, cover, water twice daily, or apply nontoxic soil binders to exposed stockpiles (dirt, sand, etc.). • Limit traffic speeds on unpaved roads to 15 miles per hour. • Install sandbags or other erosion-control measures to prevent silt runoff to public roadways. • Replant vegetation in disturbed areas as quickly as possible.

Table 6.10 Air Quality Best Management Practices

BMP ID	Description
Air Quality-4 Dust Control during Construction in Sensitive Resource Areas	The MCOSD will require its staff or contractors to implement appropriate Bay Area Air Quality Management District optional control measures for emissions of dust during construction of all road and trail modifications and improvements that are large in area, located near sensitive resources, or which for any other reason may warrant additional emission reductions. The following measures cover rerouting road and trail alignments, significant decommissioning or restoration activities, and the construction of a new road and trail alignment on undisturbed land to connect previously unconnected points: <ul style="list-style-type: none"> • Install wheel washers for all exiting trucks, or wash off the tires or tracks of all trucks and equipment leaving the site. • Install wind breaks, or plant trees/vegetative wind breaks, at windward side(s) of construction areas. • Suspend excavation and grading activity when winds (instantaneous gusts) exceed 25 miles per hour. • Limit the area subject to excavation, grading, and other construction activity at any one time.

Noise

Table 6.11 Construction Noise Best Management Practices

BMP ID	Description
Noise-1 County Noise Ordinance Requirements	<ul style="list-style-type: none"> • For all maintenance and construction projects using powered or heavy equipment, implement the day and time restrictions for equipment operation and maintenance specified by Marin County Ordinance 3431, Construction Noise.
Noise-2 Noise Control during Construction within and adjacent to Sensitive Wildlife Populations	<ul style="list-style-type: none"> • Ensure that equipment and vehicles utilize the best available noise-control techniques (e.g., improved mufflers, equipment redesign, and use of intake silencers, ducts, engine enclosures and acoustically attenuating shields or shrouds) to prevent disturbance of nearby wildlife populations. • Except for emergency projects, prohibit nighttime operations or planned operations during breeding season in areas adjacent to sensitive wildlife populations.

APPENDIX

Further Description of the Criteria Based Tool and Modeling Examples

This appendix provides additional information about the modeling tool to be used to establish and monitor biophysical impact baselines and, during step 3 of the decision-making process, to rank specific road and trail management project proposals. The purpose of the model is to synthesize large amounts of data to evaluate the environmental and maintenance burden of the MCOSED's road and trail network and to support a systematic, transparent evaluation and comparison of potential projects. Two models have been developed: one for existing roads and trails and another for new roads or trails. Both models have been tested using the criteria and scoring conventions described in this appendix. The criteria and scoring conventions may be refined over time; however, all projects competing for annual funding in any year are to be evaluated against the same criteria and using the same scoring conventions.

Criteria Used to Evaluate Projects and Recommend Appropriate Actions

The criteria used to evaluate projects in the models are listed in chapter 5 (table 5.2), and are grouped into the following three categories.

Environmental Criteria

Environmental criteria capture the potential for an action to result in adverse impacts on natural resources. Roads and trails can have a number of undesirable effects on the natural environment. They can fragment habitat, provide opportunities for the influx or spread of invasive weeds, disrupt the behavior patterns of sensitive native wildlife, and create visual scars. In addition, the compaction of soils decreases soil porosity and water infiltration, which in turn increases muddiness, water runoff, and soil erosion. Erosion and instability can result in increased sediment discharge to nearby streams, adversely impacting water quality and fish habitat.

A higher score represents a greater potential for resource impacts. Roads and trails with high total scores generally have a significant potential for negative impacts to sensitive native plant and animal communities and for chronic sediment delivery to streams or water bodies during average large storm events. Roads and trails with low total scores generally have a low potential for harmful sediment delivery and a low potential for weed dispersion and disruption to sensitive native wildlife. Most of the criteria are scored on a uniform 0-5 scale. Two of the criteria, one

measuring proximity to known northern spotted owl nesting sites and the other measuring intersection with areas of serpentine soils (which are in turn associated with many rare, special-status plants), are double weighted. Double weighting these two criteria accounts for the special inherent value of these sensitive resources and acknowledges that projects that create new impacts to these areas are a significant administrative and financial burden, which merit extra deliberation before being undertaken.

Physical Criteria

Physical criteria most frequently relate to the sustainability of the road or trail in terms of its design, location, condition, and perceived level of use. Most of the criteria in this category measure conditions that correlate negatively with sustainability from a maintenance standpoint. A higher score indicates a less sustainable road or trail. Many are also secondary measures of the potential for a road or trail to negatively impact the environment. For instance, even when a road or trail is relatively isolated from sensitive waterbodies, the erosion of soils along the alignment exposes rocks and plant roots, leading to a progressive widening of devegetated areas and a corollary loss of native plant habitat. Muddy or very rough, unstable tread encourages users to leave the established path, which also leads to larger devegetated areas, and can facilitate the spread of noxious weeds. Additionally, many of these criteria provide useful secondary indicators of public safety hazards or other hindrances to a positive user experience. A very steep and/or incised trail is at best perceived as a nuisance and is often a threat to safety as well. A poorly engineered or maintained road can lead to localized washouts or, in areas with underlying geological instability, increased landslide hazards.

Many of the criteria related to physical attributes apply only to existing roads and trails as they reflect existing conditions. A few apply only to new proposed alignments, either because they use different sources of data to measure the same parameter as an equivalent criteria applied only to existing facilities, or because they measure an impact, such as the volume of soil excavated from new bench cuts, that is specific to new trail construction.

For any particular road or trail segment, the sum of scores for the environmental and physical criteria constitutes a measure of the total biophysical impact for that facility. The maximum possible biophysical score for an existing road or trail facility is 115 points. The maximum possible biophysical score for a proposed new facility is 105 points. As a practical matter, because the criteria cover a broad range of issue areas and physical parameters, scores for individual trail segments, even for relatively poorly performing trail segments, will generally be much lower than the total possible number. Results obtained during the MCOSD's development and testing of the model indicate that, for existing facilities, a score of 40-60 generally indicates poor performance. Sustainable existing facilities tend to carry scores in the range of 20-30. Newly constructed roads or trails will be designed to meet the standards and policies adopted in this plan to ensure long-term sustainability and therefore would be expected to score well on all or nearly all of the applicable criteria. Scores for segments can be summed to provide scores for trails, and regional baseline scores will be calculated by totaling all of the biophysical scores

for the network of road and trail segments in each of the six regions. The sum of the regional baseline scores represents the total baseline for the MCOSD's entire systemwide network of roads and trails at any given time.

Social Criteria

Several criteria were developed specifically in response to issues raised by stakeholders during scoping meetings and in the course of the visitor survey conducted in 2011 (MCOSD 2011b). Because the MCOSD GIS database does not include explicitly identified social criteria, several proxy criteria that could be measured using existing spatial data were adopted, based on research by Newman and others (2003), to represent visitors' desired experiences. Though these criteria are topically focused on issue areas of importance to users, it is surprisingly difficult to construct scoring conventions for most social criteria that accurately convey in simple numerical terms the "desirability" or "undesirability" of a particular trail experience for all users. For instance, "distance from development" is a theme that emerges frequently in survey responses and academic research on user experience. For many of those surveyed by the MCOSD during the road and trail management planning process, the desire was for access to immersive interactions with nature, relatively far from existing development. For those with constrained time or physical abilities, however, opportunities for diverse trail based recreation that are proximate to and easily accessed from developed areas are especially valuable. The same could be said of the criteria evaluating "terrain quality," which is a combined measure of ruggedness and steepness. Nearly everyone can agree that terrain is an important element of any trail experience, and very few users prefer a very steep or very rugged trail experience most of the time, but the mode of travel, motivation for engagement, and individual physical ability of the user combine in different ways to produce a wide range of specific preferences, from flat, to rolling, to sustained uphill grades that provide a significant physical challenge for virtually any user.

In recognition of this diversity, the scoring conventions for the social criteria eschew the 0-5 scheme used for most of the environmental and physical criteria. Instead, values for social criteria will be reported as easy to understand qualitative categorical values. For instance, the social criteria "trail length" has the following range of possible values:

- "< 0.2 mile"
- "0.2 – 0.5 mile"
- "> 0.5 – 0.9 mile"
- "> 0.9 – 1.5 miles"
- "> 1.5 – 2.7 miles"
- "> 2.7 miles"

Methods for Scoring the Evaluation Criteria

The conventions used for measuring and scoring criteria in the preliminary models are shown in table A.1. Like the criteria themselves, the conventions used for measuring and/or scoring them could be refined over time.

Table A.1 Conventions for Scoring Decision-Making Criteria

Criterion	Measurement	Classification / Score
Environmental Criteria		
Vegetation management zone	Zone(s) in which the project would be located. Scores for Legacy Zone and Sustainable Natural Systems Zone are double counted for proposed new trails.	<p>Zones are weighted as follows:</p> <p>For existing road/trail: 5.00 = Legacy Zone 3.30 = Sustainable Natural Systems Zone 1.67 = Natural Setting Zone 0.00 = Highly Disturbed Zone</p> <p>For proposed new road/trail: 10.0 = Legacy Zone 6.66 = Sustainable Natural Systems Zone 1.67 = Natural Setting Zone 0.00 = Highly Disturbed Zone</p> <p>Total score is the proportion of the total alignment occurring in each zone, multiplied by the weight assigned to each zone and rounded to the nearest integer. The highest possible score is 5 for existing trails or 10 for new trails (greatest potential for resource impact) and the lowest possible score is 0 (least potential for resource impact).</p>
Stream conservation areas	Area in acres that road/trail passes through a stream conservation area	<p>Scoring determined by Natural Breaks distribution of existing road/trails within a Stream Conservation Area (SCA):</p> <p>0 = Not in an SCA 1 = 0 – 0.13 acre within an SCA 2 = > 0.13 – 0.44 acre within an SCA 3 = > 0.44 – 0.99 acre within an SCA 4 = > 0.99 – 2.53 acres within an SCA 5 = > 2.53 acres within an SCA</p>
Stream crossings	Count of stream crossings	<p>0 = No stream crossings 1 = 1 stream crossing 2 = 2 stream crossings 3 = 3 stream crossings 4 = 4 stream crossings 5 = 5+ stream crossings</p>
Stream adjacency, fish-bearing streams for listed species (specifically steelhead, coho, or chinook)	Scoring based on a combination of whether road/trail is within fish-bearing stream watershed, length of road/trail intersection within fish-bearing stream 50' buffer zone, and whether there are any problem erosion sites within the trails intersection of the buffer zone.	<p>0 = Trail is not in the watershed of a fish bearing stream 1 = Trail is in the watershed of a fish bearing stream, but does not enter the 50' buffer 2 = 1'-100' of the trail is inside a 50' buffer zone; no intersection of trail is in fair-poor to poor condition or has indicators of erosivity (for new trails no intersection of trail has high RUSLE value > 682) 3 = 1'-100' of the trail is inside a 50' buffer zone; at least one intersection of trail is in fair-poor to poor condition or has indicators of erosivity (for new trails at least one intersection of trail has high RUSLE value > 682) 4 = >100' of the trail is inside a 50' buffer zone; no intersection of trail is in fair-poor to poor condition or has indicators of erosivity (for new trails no intersection of trail has high RUSLE value > 682) 5 = >100' of the trail is inside a 50' buffer zone; at least one intersection of trail is in fair-poor to poor condition or has indicators of erosivity (for new trails at least one intersection of trail has high RUSLE value > 682)</p>

Table A.1 Conventions for Scoring Decision-Making Criteria

Criterion	Measurement	Classification / Score
Northern spotted owl habitat	Total number of Intersection between road/trail segments and the concentric buffers established around nest location points (consistent with U.S. Fish and Wildlife Service guidance for determining impacts to nesting habitat). Zones based on buffer zones of 0 – 200', 200 – 750', and 750' – ¼ mile around nest sites.	Scoring based on number of intersections within buffer zones, each intersection is weighted twice: 0 = No intersections in owl buffer zones 2 = 1 intersection of owl buffer zone 4 = 2 intersection of owl buffer zones 6 = 3 intersection of owl buffer zones 8 = 4 intersection of owl buffer zones 10 = 5+ intersections of owl buffer zones
Rare plant areas	Area in acres that road/trail passes through habitat of rare, threatened or endangered plant species. Includes 50' buffer around point and polygon occurrences.	Scoring determined by Natural Breaks distribution of existing road/trails 0 = No intersection 1 = > 0 – 0.03 acre within rare plant habitat 2 = > 0.03 – 0.09 acre within rare plant habitat 3 = > 0.09 – 0.21 acre within rare plant habitat 4 = > 0.21 – 0.34 acre within rare plant habitat 5 = > 0.34 acre within rare plant habitat
Rare wildlife areas	Determined by number of intersections with areas confirmed to be actively utilized by threatened, endangered, or other sensitive native wildlife.	0 = No intersection 3 = Intersection with 1 rare wildlife point or polygon 5 = Intersections with more than 1 rare wildlife point or polygon.
Serpentine soils	Area in acres of intersection within mapped serpentine soils from NRCS SSURGO soils database.	Scoring determined by Natural Breaks distribution of existing road/trails. Scoring is double counted 0 = No intersection 2 = > 0 – 0.08 acre of alignment in serpentine soil 4 = > 0.08 – 0.27 acre of alignment in serpentine soil 6 = > 0.27 – 0.61 acre of alignment in serpentine soil 8 = > 0.61 – 1.25 acres of alignment in serpentine soil 10 = > 1.25 acres of alignment in serpentine soils
Wetlands	Area in acres of intersection within mapped wetlands as reported by the Bay Area Aquatic Resources Inventory (San Francisco Estuary Institute n.d.)	Scoring determined by Natural Breaks distribution of existing road/trails 0 = No wetlands crossed 1 = > 0 – 0.01 acre within wetland 2 = > 0.01 – 0.04 acre within wetland 3 = > 0.04 – 0.08 acre within wetland 4 = > 0.08 – 0.14 acre within wetland 5 = > 0.14 acre within wetland
Noxious weeds	Determined by percentage of trail within areas mapped in the MCOSD database as having noxious weed populations and Cal-IPC ranking of the species mapped. Scores for proposed new trails are double counted	0 = If no areas of noxious weeds are mapped within trail length or if entire trail is within mapped noxious weeds If > 0% and < 100% of trail is within noxious weeds then: 1 (2 for new trails) = Highest Cal-IPC ranking of weeds are "Limited" 3 (6 for new trails) = Highest Cal-IPC ranking of weeds are "Moderate" 5 (10 for new trails) = Highest Cal-IPC ranking of weeds are "High"
Preserve trail density	Determined by length (ft.) of road/trails per acre in each preserve. Road/trail will receive value from the preserve with the highest density it falls within. If a proposed new trail, then length of intersection will be added to the preserves density.	Scoring determined by Natural Breaks distribution of existing road/trails summarized per preserve 0 = 0 – 20'/acre of existing road/trail within preserve 1 = 21 – 46'/acre of existing road/trail within preserve 2 = 47 – 76'/acre of existing road/trail within preserve 3 = 77 – 105'/acre of existing road/trail within preserve 4 = 106 – 155'/acre of existing road/trail within preserve 5 = >155'/acre of existing road/trail within preserve

Table A.1 Conventions for Scoring Decision-Making Criteria

Criterion	Measurement	Classification / Score
Physical Criteria		
Hydrological slope (the slope along the fall line) – as measured for new proposed trails only	The average fall line slope over the entire trail	Scoring determined by Natural Breaks distribution of existing road/trails 0 = < 13.0% 1 = 13.0% to 20.3% average slope 2 = > 20.3% to 27.7% average slope 3 = > 27.7% to 36.6% average slope 4 = > 36.6% to 47.9% average slope 5 = > 47.9% average slope
Trail gradient (actual user-experienced slope of the road/trail) – as measured for existing trails only	Percentage of trail steeper than 15%	Scaling is based on the classifications in the Road and Trail Assessment (MCOSD 2011d). Total score is the average reach value over entire length of road/trail rounded to the nearest integer. 0.00 = Gentle (Less than 10% of the trail steeper than 15% grade) 1.25 = Gentle-moderate (More than 10% to less than 25% of the trail steeper than 15% grade) 2.50 = Moderate (25% to 50% of the trail steeper than 15% grade) 3.75 = Moderate-steep (More than 50% to 75% of the trail steeper than 15% grade) 5.00 = Steep (More than 75% to 100% of the trail steeper than 15% grade)
Trail gradient (actual user-experienced slope of the road/trail) – as measured for new proposed trails only	The average directional slope over the entire trail (due to a lack of site specific surveyed elevation data, this measurement is coarser than the method used for existing trails).	Scoring determined by Natural Breaks distribution of existing road/trails 0 = < 6.1% average slope 1 = 6.1% to 10.4% average slope 2 = > 10.4% to 14.9% average slope 3 = > 14.9% to 20.6% average slope 4 = > 20.6% to 29.0% average slope 5 = > 29.0% average slope
Width	Average width of constructed road/trail bed	0.0 = Narrow (2 to 4 feet wide) 2.5 = Moderate (More than 4 to 8 feet wide) 5.0 = Wide (More than 8 feet wide)
Drainage condition	Qualitative assessment of the size and spacing of cross drains (dips and ditch relief culverts), road shape, and evidence of concentrated road runoff	Scaling is based on the classifications in the Road and Trail Assessment (MCOSD 2011d). Total score is the average reach value over entire length of road/trail rounded to the nearest integer. 0.00 = Good (Road/trail is well drained with frequent cross drains; concentrated runoff is not evident.) 1.25 = Fair-good (Road/trail is well drained; cross drains may be infrequent, but concentrated runoff is not apparent.) 2.50 = Fair (Road/trail is moderately drained with infrequent cross drains; concentrated runoff is locally evident or expected for short distances; minor tread erosion may be evident.) 3.75 = Fair-poor (Road/trail is moderately to poorly drained with few cross drains in place; runoff is, or is expected to be, locally concentrated for long distances; erosion of road/trail tread is typically evident; moderate to severe erosion is expected.) 5.00 = Poor (Road/trail is poorly drained with few effective cross drains in place; significant concentrated runoff is evident or expected.)

Table A.1 Conventions for Scoring Decision-Making Criteria

Criterion	Measurement	Classification / Score
Tread condition	Qualitative assessment of tread roughness, erosion, and obstacles	Scaling is based on the classifications in the Road and Trail Assessment (MCOSD 2011d). Total score is the average reach value over entire length of road/trail rounded to the nearest integer. 0.00 = Good (typically smooth without erosion, obstructions, or berms) 1.25 = Good-fair 2.50 = Fair (minor to moderate roughness) 3.75 = Fair-poor 5.00 = Poor (highly irregular and uneven tread, often gullied and eroded)
Wet/muddy	Qualitative assessment of the amount of seasonal wetness or muddiness along a trail	Scaling is based on the classifications in the Road and Trail Assessment (MCOSD 2011d). Total score is the average reach value over entire length of road/trail rounded to the nearest integer. 0.00 = Low 1.25 = Low-moderate 2.50 = Moderate 3.75 = Moderate-high 5.00 = High
Maintenance	Level of maintenance or repair required to conform to typical trail standards	Scaling is based on the classifications in the Road and Trail Assessment (MCOSD 2011d). Total score is the average reach value over entire length of road/trail rounded to the nearest integer. 0.00 = Low (Monitor and maintain as required.) 1.67 = Moderate (Conduct standard maintenance every 2 to 5 years: Inspect and clean ditches and culverts, reinstall cross drains as needed.) 3.33 = High (Annually inspect, clean ditches and culverts, reinstall cross drains.) 5.00 = Extreme (Road is not sustainable for long-term use: Significant effort will be required to maintain; trail may need to be abandoned or require significant reroutes.)
Erosion impact	Calculated for existing trails only. Qualitative measure of the potential and magnitude for future erosion and its associated impact on aquatic systems. It assumes current level of use and maintenance.	Scaling is based on the classifications in the Road and Trail Assessment (MCOSD 2011d). Total score is the average reach value over entire length of road/trail rounded to the nearest integer. 0.00 = Low 1.25 = Low-moderate 2.50 = Moderate 3.75 = Moderate-high 5.00 = High
RUSLE Erosion	Calculated for proposed new trails only. Estimates rates of soil erosion caused by rainfall and associated overland flow. RUSLE calculation derived from $R*K*LS*C = A$: R = rainfall erosivity factor at watershed scale K = soil erodibility factor derived from soil texture and organic matter content LS = combination of slope length and gradient, accounts for both gradient of slope and the amount of water flow accumulation C = cover factor derived from vegetation mapping. Determined by canopy type, canopy percent cover, understory type, and understory percent cover. A = estimated average soil loss in tons per acre per year	RUSLE A value calculated at average for entire length of road/trail: 0 = 0 - 15 (low BMP value recommended by Marin County Stormwater Pollution Prevention Program) 2 = >15 - 75 (medium BMP value recommended by Marin County Stormwater Pollution Prevention Program) 4 = > 75 - 307 (natural breaks distribution of existing trails/roads for high BMP values) 6 = > 307 - 682 (natural breaks distribution of existing trails/roads for high BMP values) 8 = > 682 - 1,248 (natural breaks distribution of existing trails roads for high BMP values) 10 = > 1,248 (natural breaks distribution of existing trails/roads for high BMP values)

Table A.1 Conventions for Scoring Decision-Making Criteria

Criterion	Measurement	Classification / Score
Condition of Worst Drainage Problem Sites	Based on feature point data for worst drainage sites, as provided in the <i>Road and Trail Assessment</i> (MCOSD 2011d).	0 = no points fall within road/trail 1 = Good 2 = Good-Fair 3 = Fair 4 = Fair-Poor 5 = Poor
Condition of Worst Erosion Problem Sites	Based on feature point data for worst graded sites, as provided in the <i>Road and Trail Assessment</i> (MCOSD 2011d).	0 = no points fall within road/trail 1 = Low 3 = Medium 4 = Medium-High 5 = High
Number of Problem Sites	Based on feature point data for sites with drainage of "Fair-Poor" or "Poor" and/or erosion is "Medium-High" or "High," as provided in the <i>Road and Trail Assessment</i> (MCOSD 2011d)	0 = no points fall within road/trail 1 = 1 problem site is within road/trail 2 = 2 problem sites are within road/trail 3 = 3 problem sites are within road/trail 4 = 4 problem sites are within road/trail 5 = 5 or more problem sites are within road/trail
Amount of Excavated Soil Volume	Estimated amount of soil volume in cubic yards (CY) to be removed during construction of road/trail and benches.	0 = 100 or less CY 1 = > 100 – 200 CY 2 = > 200 – 300 CY 3 = > 300 – 400 CY 4 = >400 – 500 CY 5 = >500 CY
Social Criteria		
Trail length	Total trail length in miles	Qualitative values based on natural breaks for existing road/trails: < 0.2 mile 0.2 – 0.5 mile > 0.5 – 0.9 mile > 0.9 – 1.5 miles > 1.5 – 2.7 miles > 2.7 miles
Distance from development	The average distance to development in miles over the entire length of a trail	Qualitative values based on natural breaks for existing road/trails: < 0.08 mile average 0.08 – 0.17 mile average > 0.17 – 0.27 mile average > 0.27 – 0.40 mile average > 0.40 – 0.56 mile average > 0.56 mile average
Distance between trail intersections	Average length of all the individual segments of a trail (before they intersect with other trails or roads)	Qualitative values based on natural breaks for existing road/trails: < 0.08 mile average 0.08 – 0.20 mile average > 0.20 – 0.37 mile average > 0.37 – 0.61 mile average > 0.61 – 1.12 miles average > 1.12 miles average
Connectivity to regional trail or road/trail on adjacent public land	Qualitative assessment based on direct connection or distance from a junction with a regional trail or a junction with a legal road or trail on adjacent public lands	Direct connection 0.25 mile or less from connection > 0.25 – 0.5 mile from connection > 0.5 – 1.0 mile from connection > 1.0 – 2.5 miles from connection > 2.5 miles from connection
Connectivity to destination points or attractions	Measure of connectivity to an attraction on MCOSD preserves (for instance a prominent vista point) or a destination point at the exit of a preserve giving access to a nearby off-site attraction (for instance a stable or other private recreational amenity).	Direct connection 0.25 mile or less from connection > 0.25 – 0.5 mile from connection > 0.5 – 1.0 mile from connection > 1.0 – 2.5 miles from connection > 2.5 miles from connection

Table A.1 Conventions for Scoring Decision-Making Criteria

Criterion	Measurement	Classification / Score
Vegetation community variety	The total number of vegetation communities encountered along entire length of trail	Qualitative values based on natural breaks for existing road/trails: 1 to 2 communities 3 to 4 communities 5 to 7 communities 8 to 10 communities 11 to 15 communities 16 or more communities
Terrain quality	Two-factor approach based on overall directional slope (user experienced slope) and the amount of elevational variation along entire length of trail. Used natural breaks on existing roads/trails to derive slope values: < 12.4% = Low Grade 12.4% – 23.3% = Moderate Grade > 23.3 % = High Grade Used natural breaks on existing roads/trails to derive elevational variation values using the following equation: (Mean Elevation – Actual Elevation)/ Elevation Range. Range and mean values derived from a roaming 100' radius analysis extent. 0 – 0.095 = Flat Terrain >0.095 – 0.150 = Rolling Terrain >0.150 = Rugged Terrain	Range of qualitative values: “Low Grade, Flat Terrain” “Low Grade, Rolling Terrain” “Low Grade, Rugged Terrain” “Moderate Grade, Flat Terrain” “Moderate Grade, Rolling Terrain” “Moderate Grade, Rugged Terrain” “High Grade, Flat Terrain” “High Grade, Rolling Terrain” “High Grade, Rugged Terrain”

Examples of How the Tool Will be Applied and Interpreted

The following two examples demonstrate how the tool will be used to assess proposed trail projects in a before and after condition. Both examples are based on actual projects budgeted for completion in 2014-2015.

Example 1: Dawn Falls Trail Rehabilitation

This project seeks to reduce sediment discharges from the Dawn Falls Trail to creeks and improve visitor access and experience along almost two miles of trail spanning Baltimore Canyon, King Mountain, and Blithedale Summit Open Space Preserves. As illustrated in figure A.1, the project includes the reinforcement of three existing crossings with rock, a treatment also known as armoring, replacement of culverts at an additional site with an armored crossing, installation of three free-span bridges, installation of two puncheons, and various drainage upgrades (primarily grading, minor reroutes, and dips).

Figure A.1 Dawn Falls Trail Rehabilitation Project



The biophysical scores and social values for the Dawn Falls Trail rehabilitation project are reported in tables A.2 and A.3. High biophysical scores, indicating a resource-related issue of concern, are highlighted in red on table A.2. While the one environmental criteria with a high score, measuring the proximity of the trail facility to known northern spotted owl nesting sites, would remain unchanged in the after condition, four of the highest scoring physical criteria saw their scores reduced to zero, an indication that the project will lead to significant improvements in the drainage function of the trail, with corollary long term benefits for habitat values, water

quality, and user experience. In the aggregate, implementation of this project would cut the measure of biophysical impacts associated with this existing facility approximately in half and would reduce the total baseline score of biophysical impacts in Region 1 by 20 points.

The social values reported in table A.3 provide a transparent summary of the Dawn Falls Trail experience. At “1.5 miles to 2.7 miles,” the trail is relatively long by the standards of the MCOSD preserve system, though at an average of “less than 0.08 miles” from existing development it is highly suburban. The trail provides direct access along a relatively flat, gently sloped trail, to a notable attraction, in this case the namesake Dawn Falls, and is on average 0.25 mile to 0.5 mile from a trail connection with adjacent lands managed by Marin Municipal Water District (MMWD).

Table A.2 Dawn Falls Trail Rehabilitation Project Biophysical Scores

Criterion	Score	
	Before Treatment	After Treatment
Environmental Criteria		
Vegetation Management Zone Average	1.67	1.67
Stream Conservation Area Intersection	2	2
Stream Intersection	3	3
Fish Presence Adjacency	0	0
Nothorn Spotted Owl Habitat Zone Intersection	10	10
Rare Plant Area Intersection	0	0
Wildlife Area Intersection	0	0
Serpentine Soil Area Intersection	0	0
Wetland Area Intersection	0	0
Weed Area Intersection	3	3
Trail Density Average	1	1
Physical Criteria		
Trail Gradient	1.25	1.25
Worst Drainage Score	5	0
Worst Erosion Score	5	0
Number of Problem Sites	2	0
Erodibility (RUSLE Model)	N/A	N/A
Excavated Soil Volume	N/A	N/A
Drainage Condition	4	0
Wet/Mud Average	0	0
Trail Width	2.5	2.5
Tread Condition Average	4	0
Maintenance Average	1	1
Erosion Impact	0	0
Biophysical TOTALS Biological + Physical Combined	45.42	25.42

Table A.3 Dawn Falls Trail Rehabilitation Project Social Values

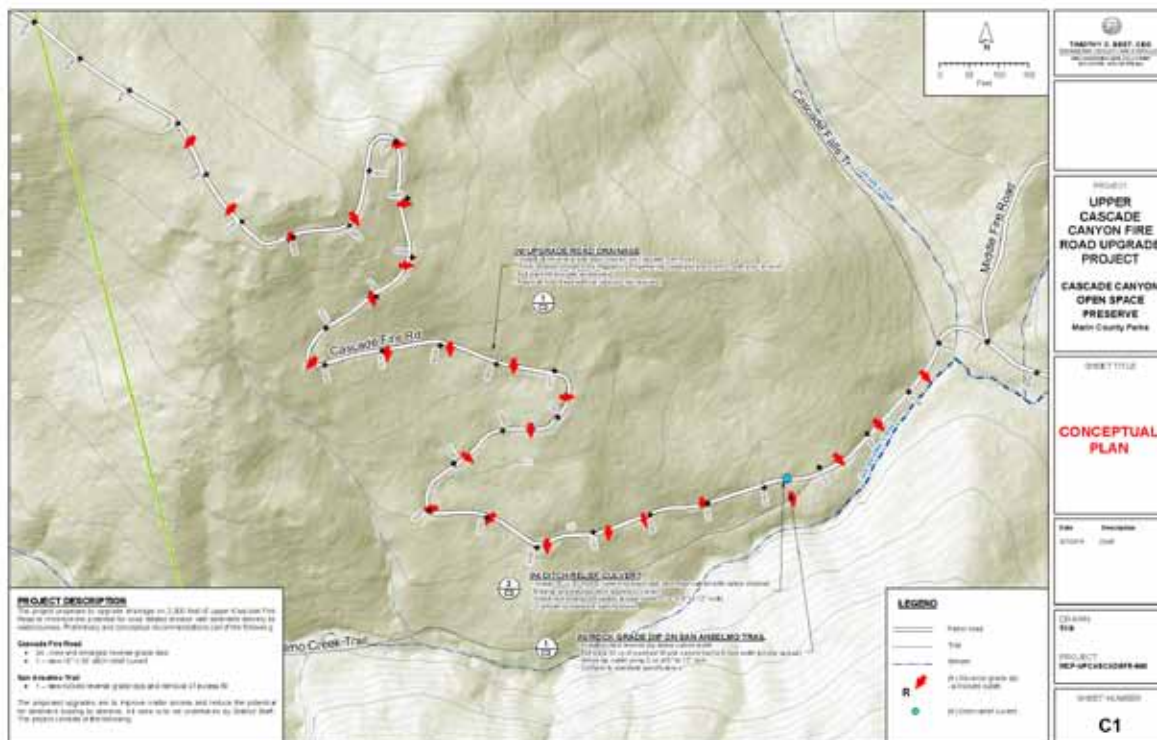
Criterion	Classification
Social Criteria	
Trail length	> 1.5 – 2.7 miles
Distance from Development	< 0.08 mile average
Distance Between Intersections	> 0.37 – 0.61 mile average
Connectivity to Regional Trails	> 0.25 – 0.5 mile from connection
Connectivity to Destination	Direct connection
Vegetation Community Variety	5 to 7 communities
Terrain Quality	Low Grade, Flat Terrain

Example 2: Cascade Fire Road Rehabilitation

This project located in the Cascade Canyon Open Space Preserve seeks to reduce sediment discharges from Cascade Fire Road into San Anselmo Creek, which provides spawning habitat for special-status steelhead, while improving visitor access and experience along a fire road that is also popular with hikers and mountain bikers. As illustrated in figure A.2, this project includes the installation of more than thirty rolling dips to break up the velocity of runoff water on the steeply pitched road and a ditch-relief culvert to divert and disperse the runoff before it reaches the creek.

The biophysical scores and social values for the Cascade Fire Road rehabilitation project are reported in tables A.4 and A.5. High biophysical scores, indicating a resource-related issue of concern, are highlighted in red on table A.4. While the one environmental criteria with a high score that measures the adjacency to the trail facility to a special-status fish bearing stream, would remain unchanged in the after condition, six of the highest scoring physical criteria saw their scores reduced to zero. This is an indication that the project will lead to significant improvements in the drainage function of the trail, with corollary long term benefits for water quality, user experience, and the wellbeing of the federal and state protected steelhead spawning in San Anselmo Creek. Looking at the total scores in the before and after condition, one can see that implementation of this project would cut the measure of biophysical impacts associated with this existing facility by approximately 50 percent and would reduce the total baseline score of biophysical impacts in Region 2 by 27 points.

Figure A.2 Cascade Fire Road Rehabilitation Project



The social values reported in table A.5 provide a transparent summary of the Cascade Fire Road trail experience. In contrast to the more suburbanized Dawn Falls Trail, the Cascade Fire Road is relatively remote, at an average of “greater than 0.56 miles” from existing development. Though the project will recontour the existing trail to be more rolling than the current very consistent uphill slope, the overall grade will still be quite steep, even by district standards. Finally, like the Dawn Falls Trail, the Cascade Fire Road provides access to a notable waterfall attraction and connectivity within “0.25 mile to 0.5 mile” to a trail connection with adjacent MMWD lands.

Table A.4 Cascade Fire Road Rehabilitation Project Biophysical Scores

Criterion	Score	
	Before Treatment	After Treatment
Environmental Criteria		
Vegetation Management Zone Average	3.33	3.33
Stream Conservation Area Intersection	2	2
Stream Intersection	2	2
Fish Presence Adjacency	4	4
Nothern Spotted Owl Habitat Zone Intersection	0	0
Rare Plant Area Intersection	0	0
Wildlife Area Intersection	3	3
Serpentine Soil Area Intersection	0	0
Wetland Area Intersection	0	0
Weed Area Intersection	3	3
Trail Density Average	2	2
Physical Criteria		
Trail Gradient	3	3
Worst Drainage Score	5	0
Worst Erosion Score	5	0
Number of Problem Sites	5	0
Erodibility (RUSLE Model)	N/A	N/A
Excavated Soil Volume	N/A	N/A
Drainage Condition	4	0
Wet/Mud Average	0	0
Trail Width	3	3
Tread Condition Average	4	0
Maintenance Average	3	3
Erosion Impact	4	0
Biophysical TOTALS Biological + Physical Combined	55.33	28.33

Table A.5 Cascade Fire Road Rehabilitation Project Social Values

Criterion	Classification
Social Criteria	
Trail length	> 0.5 – 0.9 miles
Distance from Development	> 0.56 mile average
Distance Between Intersections	> 0.37 – 0.61 mile average
Connectivity to Regional Trails	> 0.25 – 0.5 mile from connection
Connectivity to Destination	Direct connection
Vegetation Community Variety	8 to 10 communities
Terrain Quality	High Grade, Rolling Terrain

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