CHAPTER 7: DESCRIPTION OF THE HABITAT RESERVE MANAGEMENT AND MONITORING PROGRAM

SECTION 7.1 OVERVIEW OF HABITAT RESERVE MANAGEMENT AND MONITORING PROGRAM

The overall Habitat Reserve will be managed and monitored according to the collective Habitat Reserve Management and Monitoring Program (HRMP). The 32,818-acre Habitat Reserve is composed of three main elements (see *Chapter 10* and *Figures 135-M* and *136-M)*:

1. Existing County regional and wilderness parks totaling 11,950 acres under the ownership and management of the County of Orange (existing County regional and wilderness parks) (*Figure 135-M*) ;
2. Open space previously protected through recorded conservation easements such as Ladera Ranch Open Space and the Upper Chiquita Canyon Conservation Easement area totaling 4,332 acres (*Figure 135-M*); and
3. RMV open space totaling 16,536 acres ("RMV Habitat Reserve Lands") that will dedicated in accordance with the proposed NCCP/MSAA/HCP Phased Dedication Program (*Figure 136-M*).

This *Chapter 7* describes a proposed HRMP that is based on the best available scientific information and ecological rationale for monitoring and adaptive management measures that will be necessary to accomplish the conservation goals of the proposed Conservation Strategy. There will be three tiers of management applied to the Habitat Reserve:

1. Existing County parklands where management is funded through the County's annual budget and planning process for the County Harbors, Beaches and Parks (HBP);

2. Existing County parklands within the Tier 1 parklands cited above where adaptive management activities would be implemented and funded by the optional Subarea 3 impact fees related to new development on remaining residential lots in Coto de Caza if the Opt-In Program reviewed in Section 13.5 is selected, or by the RMV Adaptive Management Program (AMP) for adaptive management measures related to stressors on parklands identified through the AMP monitoring program and that affect Covered Species and conserved Vegetation Communities within RMV Habitat Reserve Lands; and

3. Previously protected RMV conservation easement area lands and future RMV dedication lands in response to regulatory coverage and that are committed to adaptive management funded by Participating Landowners as mitigation for impacts on Covered Species.

Lands included in the first management tier will be managed and monitored according to the Ongoing Management Program (OMP) element of the HRMP described in *Section 7.1.1* in order to maintain net habitat value on County parklands. For example, the County would continue with its management relating to ongoing impacts caused by public recreational use. Under the second management tier, portions of County Parks Habitat Reserve lands will be managed and monitored according to the AMP element of the HRMP (as specified in *Chapter 7*) with the goal of both maintaining and enhancing net habitat value of lands addressed pursuant to the AMP. RMV Habitat Reserve Lands are the third management tier will be managed and monitored according to the AMP element of the HRMP (see *Figure 136-M*).

Two additional management plans, the Grazing Management Plan (*Appendix G*) and the Water Quality Management Plan (*Appendix K*), will be carried out independently of the HRMP and AMP but will be closely coordinated with the AMP because they provide important supporting functions, including addressing specific habitat and species "stressors" reviewed in this Chapter. These additional management programs are termed "Coordinated Management Plans."

Monitoring of Covered Species and Conserved Vegetation Communities will occur across the entire Habitat Reserve (*i.e.,* both County parklands and RMV Habitat Reserve Lands). Conserved Vegetation Communities" means those vegetation communities that: **(1)** are designated to be managed in accordance with the Adaptive Management Plan (AMP) and Ongoing Management Plan (OMP) components of the Habitat Reserve Management Program (HRMP) discussed in *Chapter 7* of the NCCP/MSAA/HCP; **(2)** are permanently and sufficiently protected consistent with the requirements of the 1993 NCCP Conservation Guidelines (*i.e.,* in terms of the number of acres of vegetation and share of the total vegetation community in the planning area) as part of the Habitat Reserve to be considered conserved; and **(3)** provide the habitat that supports regulatory coverage for the Covered Species identified in this NCCP/MSAA/HCP. Additional discussion of the rationale for designating Conserved Vegetation Communities is set forth in *Chapter 13* of the NCCP/MSAA/HCP.

The general vegetation communities reviewed in *Chapter 13* of the NCCP/MSAA/HCP and treated as Conserved Vegetation Communities pursuant to this Agreement are:

- Coastal sage scrub
- Chaparral
- Grassland
- Riparian
- Marsh
- Alkali meadow
- Open water
- Streamcourses

- Coast live oak woodland
- Coast live oak forest

These Conserved Vegetation Communities are grouped into five aggregate communities for management and monitoring purposes under the AMP preliminary stressor models have been formulated for each of these five aggregate Conserved Vegetation Communities, including: coastal sage scrub, chaparral, native grassland, riparian and wetland (which includes marsh, alkali meadow, open water and streamcourses) and oak woodland (including coast live oak forest).

This *Chapter 7* describes the programmatic HRMP and the OMP and AMP elements of the HRMP. *Section 7.1.1* describes the OMP for County wilderness and regional parklands. *Section 7.1.2* provides a brief overview of the AMP that will be implemented primarily on the future Ranch Mission Viejo Habitat Reserve Lands. *Section 7.1.3* describes the relationship between the AMP and the Prima Deshecha Landfill Project.

Section 7.2 generally describes the concept of adaptive management and its relationship to the NCCP Conservation Guidelines, the contemporary adaptive management approach, the USFWS "Five-Point Policy," the USGS guidance report on designing monitoring programs in an adaptive management context (Atkinson *et. al.* 2004).

Section 7.3. describes the organizational structure, function and coordination of the management and monitoring programs.

Funding is an integral part of implementing the HRMP. The reader is directed to *Chapter 12* for the discussion of funding.

Sections 7.4 through *7.6* provide a general background of the AMP element of the HRMP.

Sections 7.4 through *7.6* are intended to provide the reader with a clear understanding of the stressor-based adaptive management approach selected for this NCCP/MSAA/HCP.

Sections 7.7 through *7.11*, respectively, present the details of the AMP for each of the five Conserved Vegetation Communities and associated Covered Species that will be managed and monitored: coastal sage scrub, chaparral, native grassland, riparian/wetland, and woodlands.

Section 7.12 addresses the adaptive management of site-specific resources, including vernal pools and associated species (*Section 7.12.1*) and plant Covered Species (*Section 7.12.2*).

Section 7.13 addresses the adaptive management of habitat linkages and wildlife corridors. As with the Conserved Vegetation Communities, both *Sections 7.12* and *7.13* discuss adaptive

management issues; goals, objectives, and strategies; monitoring and management; and restoration where applicable.

Sections 7.14 through *7.16* summarize three of the detailed AMP component plans, the:

- Wildland Fire Management Plan (*Section 7.14*; *Appendix N*);
- Habitat Restoration Plan (*Section 7.15; Appendix H*); and
- Invasive Species Control Plan (*Section 7.16; Appendix J*).

In addition to these component plans, a Translocation, Propagation and Management Plan for Special-status Plants (*Appendix I*) identifies the translocation and propagation measures that are included as mitigation measures for Planning Area development but will be monitored and managed under the AMP.

Section 7.17 sets forth the conceptual work plan, schedule and costs for the HRMP. The management and monitoring actions set forth in this section are subject to change based on input from the Science Panel discussed in *Section 7.3.*

Section 7.18 describes the Coordinated Management Plans: the Grazing Management Plan (*Appendix G*) and the Water Quality Management Plan (*Appendix K*). *Section 7.18.1* summarizes the Grazing Management Plan (GMP) for RMV. Cattle ranching, as an historic existing land use on RMV, will be allowed as an ongoing activity in the RMV portion of the Habitat Reserve. Although the GMP is not an element of the HRMP, it will be implemented in a coordinated manner consistent with adaptive management of the RMV Habitat Reserve Lands, including timed-grazing at intensities than can help enhance and restore habitat (*e.g.*, controlling invasive exotic grasses) and identifying sensitive habitat and species areas where grazing will be excluded, typically on a seasonal basis (*e.g.*, vernal pools).

Section 7.18.2 summarizes the Water Quality Management Plan (WQMP), which, like the GMP, is not an element of the HRMP for the Habitat Reserve described in this Chapter, but is "adaptively" implemented and will be coordinated with the AMP element of the HRMP. In particular, the WQMP addresses two main stressors: **(1)** "pollutants" generated by urban development with the potential to impact species and habitats and **(2)** "hydrologic conditions of concern" (addressing hydrologic/geomorphic process). By addressing these stressors, the WQMP helps assure that these stressors will not significantly impact net habitat value.

7.1.1 Description of the Ongoing Management Program for County Parks Implemented by the County Department of Harbors, Beaches and Parks

The County Harbors, Beaches and Parks (HBP) currently owns and operates three large parks within the proposed Habitat Reserve totaling approximately 11,950 acres: **(1)** Caspers Wilderness Park; **(2)** O'Neill Regional Park; and **(3)** General Thomas F. Riley Wilderness Park (*Figure 135-M*). The major focus of the HBP is the protection of park natural habitat and resources to maintain natural values and provide for Compatible Uses including public recreation activities and facilities, such as hiking, biking, equestrian, camping, picnicking, and interpretative and concession facilities (see *Chapter 11* for a discussion of Compatible Uses). Wilderness Parks proposed to be included in the Habitat Reserve have special use restrictions described in *Appendix F* which limit the potential for recreational use impacts on vegetation communities.

HBP management methods, practices and controls are formulated and implemented through the following mechanisms (see *Chapter 11, Section 11.2.3* for a description of Public Access and Recreation Policies for the County parklands and *Appendix F* for more detail on the ongoing HBP management program):

- Preparation of Resource Management Plans by teams of outside specialists representing a broad range of disciplines within the areas of natural and cultural history, including biologists, archaeologists and paleontologists, as appropriate.
- Physical and patrol protection by Park Rangers, including construction and maintenance of barriers and carefully located staging/parking areas to control access, and daily patrols by Park Rangers to manage public use of the parklands consistent with applicable County, state and federal policies and regulations.
- Cooperative management with neighboring land owners and managers including RMV, NAS Starr Ranch, Coto de Caza Planned Community and the CNF with respect to activities such as fire management and invasive species controls.
- Wilderness and regional park maintenance practices consistent with Resource Management Plan emphases on preservation and protection of natural resources.
- Mitigation program and monitoring by HBP's resource monitor is assigned to a full-time licensed landscape architect and certified arborist knowledgeable of the native California flora and fauna. The resource monitor works closely with the Regional Parks Operations Manager and with CDFG, USFWS, developers and County Public Works staff.
- Implementation of environmental programs within the wilderness and regional parks in cooperation with consulting and university biologists and students consulting field research within parks.

Although the OMP is one of two distinct management elements of the HRMP, monitoring within the County parklands will be addressed as part of the overall compliance/effectiveness monitoring programs for the HRMP. In addition, supplemental adaptive management activities within the County parklands may be undertaken (*i.e.,* invasive species controls and fire management) to contribute to the overall health of the Habitat Reserve where the Science Panel has determined that these stressors can cause loss of habitat value within the County parklands and where conditions in the County parklands can adversely affect RMV Habitat Reserve Lands. In carrying out OMP activities on County Habitat Reserve lands, the County will continue to implement monitoring and adaptive management needs consistent with existing management plans for County parklands and the onsite observations conducted by HBP personnel over the years. In addition, HBP will consider recommendations from the Science Panel and Wildlife Agencies regarding priority OMP activities and will adjust OMP funding to respond to these recommendations within the scope of the available budget and in relation to the County's overall obligations regarding County parklands.

Management measures in the County parklands will be undertaken consistent with the provisions of the stressor-based AMP element of the HRMP where:

- Funding for such AMP monitoring of Covered Species and Conserved Vegetation Communities is provided by the RMVLC operating budget;
- Funding for management and restoration activities is provided by other Participating Landowners, state and federal agencies, or other sources (*i.e.,* other sources include fees generated by new residential development on the few remaining undeveloped lots in Coto de Caza through the Coto Opt-In Program) in an amount adequate to conduct the proposed activities;
- The monitoring, management and restoration activities in addition to ongoing management activities are consistent with OMP activities, park management goals, and otherwise are acceptable to HBP; and
- Confirmation from the Wildlife Agencies that impacts associated with the proposed adaptive management activities would receive regulatory coverage as part of implementation of the OMP and AMP components of the HRMP.

7.1.2 Adaptive Management and Monitoring Program for the Rancho Mission Viejo Habitat Reserve Lands

The RMV Habitat Reserve Lands will be managed under the AMP component of the HRMP. *Figure 135-M* shows the other previously protected open space lands totaling about 4,332 acres that will be in the RMV Habitat Reserve Lands and will be managed and monitored according to the AMP: Ladera Ranch Open Space, CDFG easement for the Arroyo Trabuco Golf Course

project, the Upper Chiquita Canyon Conservation Easement, and the Donna O'Neill Land Conservancy at Rancho Mission Viejo. RMV is requesting regulatory coverage for Covered Activities under the NCCP/MSAA/HCP including residential and commercial development and infrastructure construction and maintenance activities. These Covered Activities include all County-approved activities consistent with the 2004 County approval of the GPA/ZC Planned Community text for the RMV property as reflected by the B-12 Alternative. The RMV open space shown in *Figure 136-M* will be committed to the Habitat Reserve as mitigation for Covered Activities (see *Figure 166-M*) and will be subject to the AMP which provides a comprehensive, stressor-based approach to the management and monitoring of biotic and abiotic resources in the RMV Habitat Reserve Lands that is essential to successful implementation of the Conservation Strategy.

7.1.3 Adaptive Management and Monitoring Program Associated with the Prima Deshecha Landfill Project

The County is requesting regulatory coverage for Covered Activities under the NCCP/MSAA/HCP, involving construction, operation and mitigation related to its 1,530–acre Prima Deshecha Landfill project according to the 2001 General Development Plan and its 2002 Amendment and the extension of the Avenida La Pata arterial through the landfill to link the existing Avenida La Pata in the City of San Clemente (see *Chapter 10* and *Figures 163-M* through *165-M*). Covered Activities include onsite landfill operations and restoration/ enhancement that would potentially impact two state-or federally-listed species: least Bell's vireo and coastal California gnatcatcher. Because the landfill open space is designated as Supplemental Open Space (SOS), and thus is not subject to the HRMP, the onsite mitigation for landfill impacts is not discussed further in this Chapter. The onsite mitigation and mitigation program for the project is described in *Appendix M*. However, as noted in *Chapter 10, Section 10.1.4,* Covered Activities also involve offsite habitat enhancement/restoration activities (*e.g.,* invasive species controls in Caspers Wilderness Park) proposed for mitigation for landfill impacts that would be conducted in the Habitat Reserve and that could incidentally affect habitat supporting Covered Species such as the federally-listed endangered arroyo toad. These AMP activities are discussed in *Section 7.10, Riparian/Wetland and Focal Species.*

SECTION 7.2 RELATIONSHIP OF THE ADAPTIVE MANAGEMENT PROGRAM TO STATE AND FEDERAL GUIDELINES AND POLICIES

Adaptive management of the Habitat Reserve is a key element of the overall Conservation Strategy. As stated by Murphy and Noon (2004) in a letter to the County of Orange:

> *…common threats in southern California such as wildfire, invasive species, and extreme weather events have emphasized that reserve management may be even more important*

> *to the success of conservation than reserve extent. Coping with environmental change, both natural and human-caused, is the single greatest challenge facing conservation planners in the new millennium – one that can be met only by using adaptive management.*
> (p 1)

This section discusses the relationship of the AMP element of the HRMP to, and consistency with **(1)** the NCCP Conservation Guidelines (*Section 7.2.1*), **(2)** contemporary approaches to adaptive management (*Section 7.2.2*), **(3)** the USFWS Five-point Policy regarding adaptive management (*Section 7.2.3*), and **(4)** the recently published USGS guidance report on designing monitoring programs in an adaptive management context (Atkinson *et al.* 2004, *Section 7.2.4*).

7.2.1 NCCP Conservation Guidelines

The NCCP Conservation Guidelines adopted by the CDFG (1993) and incorporated into the Section 4(d) Special Rule (Special Rule) for the coastal California gnatcatcher recommend that an "adaptive management" regime should be implemented to manage biological resources in the subregion. As used in the Southern NCCP/MSAA/HCP, adaptive management is defined as a flexible, iterative approach to long-term management of biotic and abiotic resources that is directed over time by the results of ongoing monitoring activities and other information.

The NCCP Conservation Guidelines identified three key areas relevant to the management of coastal sage scrub:

- *Exotic species control, including both animals (in particular, cowbirds and feral and domestic mesopredators such as house cats and introduced red foxes) and plants (weedy species, especially annuals of old world origin).*

- *Recreational use of coastal sage scrub and other open space reserve areas, including identification of suitable low impact recreational pursuits consistent with preservation goals.*

- *The role of fire in natural ecosystem dynamics and processes, including the application of control burns and the control of ignitions of accidental and vandal origin.*
  (NCCP Conservation Guidelines, November 1993, CDFG, at pp. 7-8, *Appendix D*).

With regard to the application of management and restoration, The NCCP Conservation Guidelines state:

> *The NCCP will need to establish a wide range of habitat management and enhancement tools and incorporate a monitoring program to provide guidance for ongoing management.*
> (NCCP Conservation Guidelines, November 1993, CDFG, at p. 9, *Appendix D*).

7.2.2 Contemporary Adaptive Management

The science of adaptive management has evolved since the NCCP Conservation Guidelines were adopted in 1993, but the concept of adaptive management remains essentially the same. By definition, adaptive management is an experimental and flexible approach to resource management that integrates ecological theory, modeling, hypotheses generation, field manipulations and interventions, and feedback that allows for refinement of the model(s) and hypotheses and, ultimately, improved management of the resource. As stated by Gunderson (1999), adaptive management is "adaptive because it acknowledges that managed resources will always change as a result of human intervention, that surprises are inevitable, and that new uncertainties will emerge." A key concept of adaptive management is that the world is uncertain and flexibility in resources management is crucial (Holling 1995; Holling and Meffe 1996). This approach requires a departure from the traditional command-and-control approach to management, which assumes that the managed system is relatively simple and predictable (Holling and Meffe 1996). As stated by Murphy and Noon (2004) regarding the role of adaptive management in the Southern Subregion NCCP/MSAA/HCP:

> *Adaptive management was designed to allow resource managers to act in the face of those diverse and dominating sources of acknowledged uncertainty, designing management actions to reduce uncertainty over time, while allowing change in response to environmental surprises. Instead of seeking precise predictions in advance, adaptive management highlights a range of possible outcomes. It treats management as an element of the learning process rather than as an independent step that follows learning. Management under the adaptive paradigm is an ongoing process that contributes to learning. As a consequence, decisions are always provisional and contingent upon observed responses to prior management actions.*
> (p 2)

Adaptive management programs exhibit the following characteristics:

- Available theory, empirical information, and expertise are used to develop dynamic models that make predictions about the outcomes of different management actions (Carpenter *et al.* 1999; Walters 1997). Modeling is a powerful tool to simulate the spatial and temporal dynamics of key ecosystem factors, or what Holling (1995) terms

"structuring variables," and to generate and screen hypotheses that may not yield useful data or are unlikely to be effective management policies (Walters 1997).

- Models, hypotheses and experiments must meet on-the-ground managers' needs and should be developed in collaboration with managers (Rogers 1998). As part of this process, the monitoring tools, the options and strategies available to managers, and strategies for utilizing new data and information should be developed (Bosch *et al.* 1996).
- Adaptive management is a "dual control problem" where short-term management goals and objectives need to be met while also learning about the managed system (Nichols 1999).
- Adaptive management strategies may not yield decisive results for a decade or two and, thus, the agencies and stakeholders must be patient (Lee 1993; Walters 1997).
- Adaptive management strategies may pose risks for some populations and habitats of endangered and rare species (Johnson 1999a; Walters 1997), but the focus should be on restoring and maintaining ecological resiliency such that risk and catastrophe to other resources are avoided. In other words, there are likely to be difficult tradeoffs in the adaptive management of habitats and species.
- Reversible treatments should be used where possible so that if hypotheses turn out to be incorrect, the resource is not permanently lost (*e.g.*, loss of a population, state-transition of a habitat) (Walters 1997).

The purpose of adaptive management within the framework of the statewide NCCP Program, subregional NCCP/HCPs and individual HCPs is to help maintain and, where feasible, enhance the long-term *net habitat value* within a subregion. The NCCP Conservation Guidelines define the manner in which the creation and management of the Habitat Reserve provide for assuring no net reduction over the long term in the ability of the subregion to provide for the persistence of Covered Species (termed "target species" in the Conservation Guidelines) and their associated habitats:

> *…subregional NCCPs will designate a system of interconnected reserves designed to : (1) promote biodiversity, (2) provide for high likelihoods for persistence of target species in the subregion, and (3) provide for no net loss of habitat value from the present taking into account management and enhancement. No net loss of habitat value means no net reduction in the ability of the subregion to maintain viable populations of target species over the long-term.*
>
> *With improved techniques for management and restoration, the goal of no net loss of habitat value may be attainable even if there is a net loss of habitat acreage.*

(NCCP Conservation Guidelines, November 1993, CDFG, p. 9, underline added for emphasis)

While the NCCP Process and Conservation Guidelines provide the regulatory framework and general guidance for an adaptive management approach, they do not address specific management issues in the subregion. The Southern Orange County Science Advisors (Science Advisors) elaborated on the principles of adaptive management and their "Principles for Adaptive Management" are discussed in detail in *Section 7.4.1*.

7.2.3 Consistency with U.S. Fish and Wildlife Service Five-point Policy

The "Five-point Policy" was promulgated by the USFWS and the National Oceanic and Atmospheric Administration (NOAA) (2000) to provide guidance for the preparation of HCPs to agency staff, landowners and other public agencies. The USFWS provides a general definition of adaptive management in the "Five-point Policy" as a final addendum to the HCP Handbook.

> *Adaptive management is an integrated method for addressing uncertainty in natural resource management (Holling 1978, Walters 1986, Gundersen 1999). It also refers to a structured process for learning by doing. … Therefore, we are defining adaptive management broadly as a method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.*

As part of the Five-point Policy the USFWS distinguishes between two types of monitoring:

> *(1) Compliance monitoring, which monitors the permittee's implementation of the requirements of the HCP, permit, and/or IA; and (2) effects and effectiveness monitoring, which investigates the impacts of the authorized take and the operating conservation program implemented to verify progress toward the biological goals and objectives. A monitoring program should incorporate both types in order to examine effectively all aspects of an HCP, and ensure the ultimate success of the HCP.*

The USFWS goes on to say:

> *Monitoring measures should be commensurate with the scope and duration of the project and the biological significance of its effects. The monitoring program should be flexible so that it can be modified, if necessary, based on the need for additional information.*
> (Addendum to the HCP Handbook, USFWS and NOAA, May 2000)

Compliance Monitoring means monitoring designed to verify that the permittee is carrying out the terms of the HCP Conservation Strategy, permit and Implementation Agreement.

The "effects and effectiveness monitoring" (hereafter called *Effectiveness Monitoring*) referred to in the USFWS Addendum is the heart of the AMP because it maximizes the likelihood that the overall long-term goals and objectives of the NCCP/MSAA/HCP are being met. *Effectiveness Monitoring* relates both to permit *Compliance Monitoring* and long-term function of the Habitat Reserve.

This HRMP has been designed to address the policies and recommendations contained in the USFWS Five-point Policy including:

- Long-term adaptive management of designated habitats that support listed species and other sensitive species;
- *Compliance Monitoring* to determine whether implementation of the adaptive management program is consistent with terms of agency approvals;
- *Effectiveness Monitoring* of designated species and habitats to determine the effectiveness of specific adaptive management measures in terms of promoting species survival and recovery;
- Funding to support the adaptive management and monitoring program; and
- Consideration of alternative conservation actions and approaches.

The reader is directed to *Chapter 14* and *Appendix W* for a more detailed assessment of the consistency of the HRMP with the USFWS Five-point Policy.

7.2.4 Consistency with the USGS Guidance Report on Designing Monitoring Programs in an Adaptive Management Context

The USGS, in partnership with the CDFG and USFWS, produced a guidance (*i.e.*, non-regulatory) document in 2004 entitled *Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans* (Atkinson *et al*. 2004). This document was intended to "provide a step-by-step procedure for developing effective monitoring programs in an adaptive management context." (p. 1). The document identifies nine steps in creation of a monitoring program. The USGS guidance document thus provides a helpful set of prescriptions for preparing and implementing a long-term monitoring program to support an adaptive management approach.

The nine steps identified in the USGS document provide a useful description of the steps involved in designing a monitoring program. Under each step is a description of how the step should be implemented and how the AMP described in this Chapter is consistent within the USGS document.

a. Identify the goals and objectives of the regional conservation plan

This is an essential phase of the management and monitoring program because only by measuring progress toward goals and objectives can the effectiveness of the Habitat Reserve and its management be evaluated. According to the USGS document, the goals and objectives should be:

- Easily understandable
- Biologically meaningful
- Measurable
- Feasible, both financially and scientifically
- Written with a level of detail consistent with level of current knowledge
- Compatible with goals and objectives for all covered species and habitats
- Compatible with goals and objectives for neighboring conservation lands

Section 7.4.2 provides goals and objectives that address landscape processes, Conserved Vegetation Communities and species. *Sections 7.7* through *7.11* also identify more specific goals and objectives, and the strategies that will be used to achieve the goals and objectives, for each of five Conserved Vegetation Communities addressed by the AMP: coastal sage scrub, chaparral, native grassland, riparian/wetlands, and oak woodlands. For wildlife Covered Species that occupy the five Conserved Vegetation Communities, goals and objectives are also discussed in the Species Accounts and Conservation Analyses presented in *Appendix E.* *Section 7.12* provides the goals and objectives for vernal pools and associated species and plant Covered Species. *Section 7.13* provides the goals and objectives for the adaptive management of habitat linkages and wildlife corridors.

b. Identify the scope of the monitoring program

Identifying the scope of the monitoring programs refers to **(1)** the geographic scope of the program; **(2)** land ownership and constraints; **(3)** audiences/users of monitoring program information; **(4)** spatial scales of focus; **(5)** relevant time scales – biological and programmatic; and **(6)** available resources and opportunities.

The HRMP presented in this Chapter does each of these things. The geographic scope (No. 1), land ownership constraints (No. 2) and spatial scale (No. 4) of the HRMP is defined by the Subarea 1 Habitat Reserve. The HRMP has two components: **(1)** the OMP on the County parklands portion of the Habitat Reserve; and **(2)** the AMP on the RMVLC portion of the Habitat Reserve (see *Figure 136-M*). Certain AMP actions also are expected for some areas of County parklands (*e.g.,* invasives controls in San Juan Creek within Caspers Wilderness Park and fire management in the parklands). The primary "audience/users" of the HRMP are the County of Orange, the Wildlife Agencies and the USACE. The general public also will be an "audience/user" through public disclosure of Habitat Reserve activities and public education and use (*e.g.,* public uses of the County parklands and docent-led tours of private properties within the Habitat Reserve). Relevant time scales for the program include the duration of regulatory coverage (75 years) and management/monitoring in perpetuity; the time it is expected to take for full assemblage of the Habitat Reserve (15-20 years or more); the timing of reports (annual reports and comprehensive 5-year reports); and the time scale of the biological and abiotic processes operating in the Habitat Reserve. The biotic and abiotic time scales are generally discussed in the relevant sections of this Chapter and in more detail in the "Management Action Plan" (MAP; described in detail below in *Section 7.3.5.b.3*); *e.g.,* what is the appropriate time scale for assessing arroyo toad reproduction in relation to precipitation cycles?

c. Compile information relevant to monitoring program design

The biotic and abiotic information relevant to the monitoring program design comes from a variety of sources. *Chapter 3* describes the data and information sources used for preparation of this NCCP/MSAA/HCP and provides a detailed description of the existing biological and abiotic setting, including vegetation communities, associated common and sensitive species, habitat linkages and wildlife corridors, and geomorphic and hydrologic conditions and processes. *Chapter 4* (Draft Southern Planning Guidelines) and *Chapter 5* (Draft Watershed Planning Principles) take the baseline information provided in *Chapter 3* and apply comprehensive sets of tenets and principles that address management and monitoring at a sub-basin and watershed scale.

As noted above, additional information will need to be compiled to formulate a comprehensive MAP, such as additional field information regarding sampling sites to achieve the desired biological and statistical representation, the existing condition of certain resources such as oak woodlands, and appropriate receiver sites for translocated or propagated sensitive plant species. Part of the work plan for preparing the first 5-year MAP will be to acquire additional data needed to complete the MAP.

d. Strategically divide the system and set priorities

The USGS document states that "designing effective monitoring and adaptive management programs requires a clear strategy for identifying the most important elements of the system to monitor and the critical uncertainties to address." (p. 13). The AMP organizes the Habitat Reserve adaptively managed/monitored elements by the five Conserved Vegetation Communities listed above, wildlife Covered Species and other focal species associated with the five Conserved Vegetation Communities, site-specific resources (*e.g.*, vernal pools and plant Covered Species), habitat linkages and corridors, and abiotic resources and processes. *Section 7.6* provides a detailed method for prioritizing the five Conserved Vegetation Communities and associated Covered Species and focal species for management and monitoring based on **(1)** the species richness and uniqueness of each of the five Conserved Vegetation Communities (*Section 7.6.2*) and **(2)** the known or potential effects of environmental stressors in the communities (*e.g.*, the risk of sage scrub type conversion to annual grassland from short fire interval) (*Section 7.6.3*). These two factors are used to prioritize the five Conserved Vegetation Communities for management and monitoring; *e.g.*, riparian/wetlands has a high priority for management and monitoring because it harbors a number of sensitive species and is highly vulnerable to stressors such as invasive species and hydrologic and geomorphic alterations while oak woodlands have a lower priority in the Habitat Reserve because they supports fewer sensitive species and are not known to be immediately threatened by environmental stressors.

e. Develop simple management-oriented conceptual models

The USGS document states that "Monitoring and adaptive management program design is greatly assisted by conceptual models…" (p 18) It lists several benefits of using conceptual models to help describe the managed system. Conceptual models help program designers

- Summarize existing knowledge and hypotheses about a system;
- Select and prioritize important components of the system to monitor;
- Identify and prioritize critical uncertainties that require research;
- Communicate understanding of the system to all program participants and encourage interdisciplinary dialog; and
- Facilitate review of the program by outside experts by summarizing complexities in digestible form.

The AMP provides preliminary "management-oriented" stressor-based conceptual models for the five Conserved Vegetation Communities and Covered Species and focal species in *Section 7.4*. These models are based on the available scientific literature and on the professional judgment

and experience of biologists familiar with the Habitat Reserve areas and thus are intended to combine basic ecological theory, empirical scientific studies and direct observations of existing conditions in the Habitat Reserve. As preliminary models it is expected that they will be refined by the Reserve Manager, Science Panel and Wildlife Agencies as the first 5-year MAP is prepared, and as working models, in general will be subject to continual revision and refinement.

f. Determine what to monitor and identify critical uncertainties

The prioritization of resources for monitoring and the conceptual models described above allow for a determination of what to monitor and a determination of critical uncertainties. For each focus Conserved Vegetation Community, suite of Covered Species and focal species associated with a vegetation community, site-specific resources, and habitat linkages and wildlife corridors, the AMP uses the priority rankings and conceptual models to identify "Adaptive Management Issues" in each of the respective sections for these resources (see *Sections 7.7* through *7.13*). For example, as discussed in *Section 7.10,* stressors on riparian/wetland systems that may affect species such as the arroyo toad include water diversions, groundwater extractions, water quality, exotic plants, and exotic predators. Based on site-specific observations in San Juan Creek, giant reed proliferation, a lack of water to support breeding pools, and bullfrogs all may be contributors to the relatively small arroyo toad breeding population on RMV property, but the specific nature or level of these potential stressors generally is unknown (*e.g.*, what is the level of bullfrog predation and is it a limiting factor on toad viability?). This is a "critical uncertainty" for managing the arroyo toad population in San Juan Creek. A management hypothesis specific to the arroyo toad in San Juan Creek thus may be "Control of bullfrogs in CalMat Lake will result in an increase in arroyo toad populations." In this fashion, the AMP uses the adaptive management issues that stem from the prioritizing and modeling exercises to determine what to monitor, what are the critical uncertainties that should be the subject of adaptive management, what are the specific management hypotheses and what are the management (independent) and monitoring (dependent) variables.

g. Determine strategy for implementing monitoring

Once the management issues, critical uncertainties, management hypotheses, monitoring priorities, etc. have been determined, a work plan to implement the program is needed. This is the MAP discussed below in *Section 7.3.5.b.3*. The MAP is the plan that allows the Reserve Manager to begin implementing concrete management and monitoring on the ground.

h. Develop data quality assurance, data management, analysis and reporting strategies

This component of the HRMP is discussed in *Sections 7.3.7* and *7.3.8*.

i. Complete the adaptive management loop by ensuring effective feedback for decision-making

This component of the HRMP is discussed in *Section 7.3.6*.

As the above section illustrates, the HRMP, and particularly the AMP element, described in this Chapter are substantially consistent with the core recommendations of the USGS document for designing adaptive management and monitoring programs (*Atkinson et al. 2004*).

7.2.5 Changed Circumstances

a. Regulatory Definitions

Changed Circumstances are defined under the federal "No Surprises" rule as "changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably be anticipated by plan developers and the USFWS and that can be planned for." Two types of Changed Circumstances are identified in the applicable regulations:

(i) Changed circumstances provided for in the plan: If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances and were provided for in the plan's operating conservation program, the permitted will implement the measures specified in the plan.

(ii) Changed circumstances not provided for in the plan: If additional conservation and mitigation measures are deemed necessary to respond to changed circumstances and such measures were not provided for in the plan's operating conservation program the Director will not require any conservation and mitigation measures in addition to those provided for in the plan without the consent of the Permittee, provided the plan is being properly implemented."
(50 CFR 17.32 (b)(5))

Unforeseen Circumstances are defined as follows:

> "Unforeseen circumstances means changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the Service at the time of the conservation plan's negotiation and development, and that result in a substantial and adverse changed in the status of the covered species."
> (50 CFR 17.3)

The provisions of this subsection are also intended to address Changed Circumstances pursuant to the NCCP Act and 1998 Process Guidelines with regard to assurances.

b. Changed Circumstances and Unforeseen Circumstances

As reviewed in this Chapter, "the first and underlying guiding principle of the AMP is that management and monitoring should be directed towards environmental factors known or thought to be directly or indirectly responsible for ecosystem changes that would be inconsistent with the three overall goals of the AMP." This Chapter extensively reviews the AMP approach to monitoring and responding to internal and extrinsic "stressors" on species and vegetation communities within the Habitat Reserve, including monitoring at three different scales. The AMP comprehensively reviews reasonably foreseeable stressors that could impact proposed Covered Species and five proposed Conserved Vegetation Communities, including providing stressor models for each. *Section 7.3.6* describes the process for responding to Changed Circumstances based on management and monitoring data and scientific review.

Changed Circumstances addressed by the NCCP/MSAA/HCP HRMP include the following environmental stressors:

- Fire frequency and geographic extent within the historic fire record
- Flood and associated hydrologic and geomorphic alterations
- Precipitation cycles, including drought
- Invasion by exotic species

Each of these Changed Circumstances is addressed, as relevant, in the environmental stressor approach and the conceptual models for the five aggregate Conserved Vegetation Communities and focal species presented in this Chapter and for the individual proposed Covered Species addressed in the Species Accounts and Conservation Analyses presented in *Appendix E.* Specific management prescriptions are set forth for Covered Species in *Chapter 13* and for Conserved Vegetation Communities in this Chapter.

The AMP component of the HRMP is designed to respond to these Changed Circumstances in an adaptive fashion through the management and monitoring approaches described in this Chapter. Changed Circumstances provided for in the "operating conservation program" involve responses to stressors as described in this Chapter and funded through the AMP Operating Budget (see *Chapter 12* for a discussion on funding). Changed Circumstances that are foreseeable, but which require responses outside the scope of the AMP stressor management program will be addressed on the basis of the type and extent of impacts and funded through the Changed Circumstances

Reserve Account (also see *Chapter 12*). Generally these two types of Changed Circumstances would be addressed as described below.

Although the Changed Circumstances Reserve Account is intended to be used primarily to address Changed Circumstances on lands already enrolled in the Habitat Reserve, Reserve Account funds also could be applied to: **(1)** RMV lands designated for future dedication as part of the Habitat Reserve; and **(2)** existing County regional/wilderness parklands. For future RMV Habitat Reserve dedication lands, the decision to apply Reserve Account funds would be discretionary and collaborative, based on consultation involving the Reserve Manager and Wildlife Agencies and require agreement of the Reserve Manager. In such instances, factors such as the timing of the future RMV dedication will be considered (*i.e.*, it would be less likely for Reserve Account funds to be applied to areas where dedication would occur in the distant future). For County parklands, the decision to apply such funding will involve collaboration among the Administrator, Reserve Manager and Wildlife Agencies and require the agreement of all parties. Factors to be considered would include the extent to which the use of such funding would benefit RMV Habitat Reserve lands.

Also described below are Unforeseen Circumstances for fire, flood and associated hydrologic and geomorphic alterations, precipitation cycles, (including drought) and invasion by exotic species.

As described in this Chapter, there are two additional management plans, the Grazing Management Plan (GMP; *Appendix G*) and the Water Quality Management Plan (WQMP, *Appendix K*) that will be carried out independently of the HRMP and AMP, but will be closely coordinated with the AMP because they provide important supporting functions, including addressing specific vegetation communities and species addressed in this Chapter and *Chapter 13*. Because of the supporting functions that the GMP provides, although not part of the AMP, Changed Circumstances for grazing are addressed here.

Fire Frequency within the Historic Fire Frequency Record: A Wildland Fire Management Program (*Section 7.14* and *Appendix N*) has been prepared to address fire issues through both tactical and strategic fire protection plans. *Appendix N, Figure N-3* provides an illustration of the fire frequency record for the Southern Subregion for the years 1911 through 2002. With development and increased in human visitation to wildlands, as well as the proximity of MCB Camp Pendleton to the planning area, accidental and intentional human-caused ignitions are likely to increase. While chaparral and coastal sage scrub are fire-adapted communities, short-interval fires can result in conversion of shrub communities to annual grasslands and associated invasions of exotic species. Fires that are within the historic frequency record are Changed Circumstances that are addressed by the NCCP/MSAA/HCP through the following HRMP mechanisms:

1. The Reserve Manager and/or Administrator as applicable, and Science Panel will conduct an assessment of the fire effects to proposed Covered Species and associated vegetation communities and recommend actions to remediate the fire effects (*e.g.*, restoration, invasive species controls) as part of the annual report and update of the MAPs or as an ad hoc response during the year as circumstances dictate.

2. If active remediation actions are determined to be needed, the Reserve Manager and/or Administrator as applicable shall proceed within implementation of the remediation actions as part of the annual adjustments to the MAPs.

Fire within Historic Geographic Extent (up to but excluding 1958 event): A Wildland Fire Management Program (*Section 7.14* and *Appendix N*) has been prepared to address fire issues through both tactical and strategic fire protection plans. *Part IV, Appendix N, Figure N-3* provides an illustration of the fire record for the Southern Subregion for the years 1911 through 2002. *Figure N-3* also shows the geographic extent of fires that have occurred in the Southern Subregion. Fires up to, but excluding the 1958 fire event, are addressed by NCCP/MSAA/HCP through the following HRMP mechanisms:

1. The Reserve Manager and/or Administrator as applicable, and Science Panel will conduct an assessment of the fire effects to proposed Covered Species and associated vegetation communities and recommend actions to remediate the fire effects (*e.g.*, restoration, invasive species controls) as part of the annual report and update of the MAPs or as an ad hoc response during the year as circumstances dictate.

2. If active remediation actions are determined to be needed, the Reserve Manager and/or Administrator as applicable shall proceed within implementation of the remediation actions as part of the annual adjustments to the MAPs.

High Frequency Fires Outside Historic Record and Fires Equal to 1958 Event Size: Fires that are outside the historic record shown in *Figure N-3* in terms of frequency or are equal in geographic extent to the 1958 event are potentially foreseeable, but are considered to be outside the scope of the HRMP "operating conservation program." In the event a fire occurs that is equal to the 1958 event size or multiple fires occur that are outside the historic frequency record, the following conditions shall apply:

1. The Reserve Manager and/or Administrator as applicable, and Science Panel will conduct an assessment of the fire effects to proposed Covered Species and associated vegetation communities and submit this report to the Wildlife Agencies within 60 days of the fire event in the case of a fire outside the specified historic geographic extent or the latest fire in the case of short interval fires on the same area ("Fire Damage Assessment Report").

2. If, based on the Fire Damage Assessment Report, remediation actions outside the regular AMP operating program are determined to be needed, the Reserve Manager and/or Administrator shall consult with the Wildlife Agencies. The Reserve Manager and/or Administrator as applicable, in consultation with the Wildlife Agencies, shall develop a plan for implementing any necessary measures to ameliorate the impacts of the fire until natural processes of fire recovery occur over time. The plan shall identify the costs of the remediation actions. Funding for implementation of the remediation actions shall be through the Changed Circumstances Reserve Account.

Unforeseen Circumstances for Fire: Fire(s) of a greater geographic scale than the 1958 event have not occurred within the Southern Subregion since the recording of fire history. The potential damage due to such an event thus is not foreseeable, nor predictable. Therefore, a fire of a geographic scale greater than the 1958 event shall be considered an Unforeseen Circumstance.

Flood and Associated Hydrologic and Geomorphic Alterations (50- to 100-year Events): 50- and 100-year floods can cause substantial alterations of the spatial and temporal distributions, structure and functions of riparian and wetland communities that provide habitat for numerous species. Mainstem creeks such as San Juan Creek, in particular, are subject to flood events of this magnitude. Disturbances to Conserved Vegetation Communities, such as willow riparian, within mainstem creeks is a natural part of the ecology of this vegetation community. Changes to channel geomorphology are also common within mainstem creeks during events of a 50- to 100-year magnitude and are generally not a cause for management action as such changes result in the downstream movement of sediment and regeneration of riparian plant communities. Tributaries to mainstem creeks, such as Gobernadora Creek, on the other hand, have less of an ability to absorb events of a 50 to 100-year magnitude without showing conditions of concern that may warrant management action. The AMP, in *Section 7.10*, provides several management goals and objectives for maintaining natural hydrologic and geomorphic processes to the maximum extent feasible.

Floods that are of a greater than 100-year magnitude (and up to 200-year magnitude) are Changed Circumstances that are addressed by the operating conservation program through the following HRMP mechanisms:

1. The Reserve Manager and/or Administrator as applicable, and Science Panel will conduct an assessment of the flood effects to proposed Covered Species and associated vegetation communities and recommend actions to remediate the flood effects (*e.g.*, restoration, invasive species controls) as part of the annual report and update of the MAPs. In conducting the assessment, the Reserve Manager and/or Administrator as applicable shall

focus primarily on conditions of concern that may occur in tributaries. Mainstem creeks shall be a secondary focus.

2. If remediation actions are determined to be needed, the Reserve Manager and/or Administrator as applicable shall proceed within implementation of the remediation actions as part of the annual adjustments to the Management Action Plans (MAP) or as an ad hoc response during the year as circumstances dictate (see *Section 7.3.5.b* for description of MAP).

Flood and Associated Hydrologic and Geomorphic Alterations (greater than 100- and up to 200-year Events): Floods of a 100- to 200-year magnitude are potentially foreseeable, but are not addressed by the HRMP operating conservation program. In the event a flood event of this magnitude, the following conditions shall apply:

1. The Reserve Manager and/or Administrator as applicable, and Science Panel will conduct an assessment of the flood effects to proposed Covered Species and associated vegetation communities and recommend actions to remediate the flood effects (*e.g.*, restoration of wetlands/riparian vegetation, invasive species controls) and submit this report to the Wildlife Agencies within 60 days of the cessation of the flood event ("Flood Damage Assessment Report"). In conducting the assessment, the Reserve Manager and/or Administrator as applicable shall focus primarily on conditions of concern that may occur in tributaries. Mainstem creeks shall be a secondary focus.

2. If, based on the Flood Damage Assessment Report, remediation actions are determined to be needed, the Reserve Manager and/or Administrator shall consult with the Wildlife Agencies. The Reserve Manager and/or Administrator applicable, in consultation with the Wildlife Agencies, shall develop a plan for implementing any necessary measures to address the flood damage with regard to habitat conditions. The plan shall identify the costs of the remediation actions. Funding for implementation of the remediation actions shall be through the Changed Circumstances Reserve Account.

Unforeseen Circumstances for Flood and Associated Hydrologic and Geomorphic Alterations (Greater than 200-year Events): The potential damage from a greater than 200-year event is not foreseeable, nor predictable. Therefore, a flood, associated damage and hydrologic geomorphic alterations resulting from a greater than 200-year event shall be considered an Unforeseen Circumstance.

Precipitation Cycles, Including Drought: Precipitation cycles, including drought, are weather phenomena beyond local human control. Drought, in combination with other stressors such as fire, can have a severe effect on habitat quality for the proposed Covered Species and the five

Conserved Vegetation Communities. While precipitation cycles cannot be controlled directly, the AMP addresses the effects of precipitation cycles that are within the historic record for the Southern Subregion through mechanisms such as the Wildland Fire Management Plan (*Appendix N*) and the Invasive Species Control Plan (*Appendix J*). Precipitation cycles that are within the historic record for the Southern Subregion are addressed by the operating conservation program through the following HRMP mechanisms:

1. The Reserve Manager and/or Administrator as applicable, and Science Panel will monitor the effects of precipitation cycles on proposed Covered Species and associated vegetation communities and recommend actions to address the effects of precipitation cycles (*e.g.*, invasive species controls) as part of the annual report and update of the MAPs.

2. If actions to address precipitation effects are determined to be needed, the Reserve Manager and/or Administrator as applicable shall proceed within implementation of the actions as part of the annual adjustments to the MAPs or as an ad hoc response during the year as circumstances dictate.

Unforeseen Circumstances for Precipitation Cycles Outside the Historic Record: The potential damage caused by precipitation cycles outside the historic record is not foreseeable, nor predictable. Therefore, precipitation cycles outside the historic record shall be considered an Unforeseen Circumstance.

Invasion by Exotic Species: A major emphasis of the AMP is on controlling invasive species in the Habitat Reserve, such as giant reed infestations in San Juan Creek. Invasive species are a risk factor for virtually all of the proposed Covered Species and Conserved Vegetation Communities. While the AMP and Invasive Species Control Plan (*Appendix J*) identify a number of known invasive species and management approaches for controlling these species, they also address the event of potential new invasives that have been identified elsewhere in California. Invasive species are addressed by the operating conservation program through the following HRMP mechanisms:

1. The Reserve Manager and/or Administrator as applicable, and Science Panel will monitor for any new invasives or severe outbreaks of known invasive species within the Habitat Reserve as part of the annual report and update of the MAPs.

2. If remediation actions are determined to be needed, the Reserve Manager and/or Administrator as applicable shall proceed within implementation of the remediation actions as part of the annual adjustments to the MAPs or as an ad hoc response during the year as circumstances dictate.

Unforeseen Circumstances for Invasion by Exotic Species: Although the problem of non-native invasive plants and animals, and their effects on vegetation and wildlife is well documented, invasions of non-native plants or animals that are beyond the scale or type documented in Southern Subregion may occur (for example, the scale of the invasion of the brown treesnake that invaded Guam after World War II and caused extirpation of most of the native forest vertebrate species on the island.) The potential damage caused by an invasion of this scale or type is not foreseeable, nor predictable. Therefore, this circumstance shall be considered an Unforeseen Circumstance.

Grazing Management: This Chapter, *Chapter 13* and the GMP review the grazing management practices employed by RMV including rotational grazing and maintenance of a 25 percent residual dry matter that provide overall benefits to the Habitat Reserve, including such benefits as removal of litter and thatch, recycling of nutrients, stimulation of tillering, removal and control of alien (exotic) species and reduced transpiration by alien (exotic) species making more water available for native grasses. Although RMV fully intends to continue grazing pursuant to the GMP, economic factors and/or other considerations could lead RMV to conclude that it no longer wishes to continue grazing. The possibility of RMV discontinuing grazing is therefore foreseeable, but not addressed by the HRMP operating conservation program (which assumes the continuation of grazing pursuant to the GMP). Under such a condition, the following shall apply:

1. RMV shall provide the Reserve Manager and Wildlife Agencies with 60 days notice of its intention to discontinue grazing ("Notice to Discontinue Grazing").

2. The Reserve Manager and Science Panel will conduct an assessment of the potential effects of discontinuing grazing on proposed Covered Species and associated vegetation communities and submit this report to the Wildlife Agencies within 60 days of receiving the above Notice to Discontinue Grazing. ("Notice to Discontinue Grazing Assessment Report").

3. If, based on the Notice to Discontinue Grazing Assessment Report, management actions are determined to be needed, the Reserve Manager shall consult with the Wildlife Agencies. The Reserve Manager, in consultation with the Wildlife Agencies, shall develop a plan for implementing any necessary measures to address the consequences of discontinuing grazing (*e.g.*, increased invasive species control) until the changed circumstances are capable of being addressed through ongoing AMP actions. The plan shall identify the costs of the Changed Circumstances management actions. Funding for implementation of the management actions shall be through the Changed Circumstances Reserve Account.

c. Proposed Procedures for Addressing Unforeseen Circumstances

As described in 50 Code of Federal Regulations, Sections 17.22(b)(5)(C) and 17.32(b)(5)(C), the No Surprises Rule, the USFWS shall have the burden of demonstrating that Unforeseen Circumstances exist, using the best scientific and commercial data available. Any findings of Unforeseen Circumstances will be clearly documented and based upon reliable technical information regarding the biological status and habitat requirements of the affected Covered Species. Except where there is a substantial threat of imminent, significant adverse impacts to a Covered Species, USFWS will provide the Participating Landowners at least sixty 60 days written notice of a proposed finding of Unforeseen Circumstances, during which time the USFWS will meet with the Reserve Manager, Administrator and Science Panel to discuss the proposed finding and potential responses pursuant to the HRMP operating conservation program or other modifications within conserved habitat areas as set forth in applicable regulations. The Participating landowners will have an opportunity to submit information to rebut the proposed finding, as well as to consider and respond to any proposed changes to the HRMP.

SECTION 7.3 ADMINISTRATION AND COORDINATION OF MANAGEMENT AND MONITORING PROGRAMS

7.3.1 Administrative Structure and Coordination within the Habitat Reserve

Carrying out the HRMP will necessitate coordination amongst the various entities responsible for carrying out the OMP and AMP components of the HRMP, in addition to coordination with the Science Panel and Wildlife Agencies/USACE. The five (5) individual components of the HRMP administrative structure are: **(1)** the Rancho Mission Viejo Land Conservancy ("RMVLC"); **(2)** the RMV Reserve Manager ("Reserve Manager"); **(3)** the Independent Reserve Land Easement Holder ("IRLEH"); **(4)** the County NCCP/MSAA/HCP Administrative Coordinator ("Administrator"); and, **(5)** the Science Panel. Each element of the administrative structure will have its own duties, obligations and directorial requirements vis-à-vis implementation of the HRMP. The following is a description of the roles and responsibilities of the five administrative components of the HRMP. The anticipated coordination between these entities is set forth in the relationship figure below.

7.3.2 Administrator

Carrying out the HRMP will require an Administrator to coordinate activities conducted under the OMP and AMP components of the HRMP. This Administrator is described briefly below.

The County of Orange acting as the Administrator will serve as the body responsible for coordinating the HRMP within the Habitat Reserve. The primary duties of the Administrator include the following:

- An evaluation of any significant issues encountered by the County in managing County's Habitat Reserve lands during the previous year (including a description of the proposed resolution strategy for each issue).
- Reporting expenditures made by the County during the previous year in satisfaction of its obligations under the NCCP/MSAA/HCP
- Assisting the Participating Landowners and Wildlife Agencies/USACE in assembling the Habitat Reserve and annual accounting for lands added to the Reserve;
- Providing coordination and technical assistance for various activities involving Habitat Reserve managers, including AMP and OMP components of the HRMP within the Habitat Reserve;
- Coordinating funding (primarily outside funding sources) and other implementation activities;
- Annual accounting for mitigation fees related to the loss of Conserved Vegetation Communities in the subregion by amount and location;
- Annual accounting for all other funds received and disbursed to Participating Landowners/Managers and agencies for management, restoration and acquisition activities (note: future acquisitions, if any, would be related to Non-RMV lands located outside Subarea 1) related to the approved NCCP/MSAA/HCP;
- Preparing an annual report that includes the following information;
    - An overview of the status of the County Habitat Reserve lands
    - A description of OMP and AMP activities, as applicable, conducted on County Habitat Reserve lands during the previous year
    - A description of the OMP and AMP activities, as applicable, anticipated to occur during the forthcoming year
    - An evaluation of any significant issues encountered by the County in managing County's Habitat Reserve lands during the previous year (including a description of the proposed resolution strategy for each issue)
    - Expenditures made by the County during the previous year in satisfaction of its obligations under the NCCP/MSAA/HCP

- Compiling the annual reports prepared by Participating Landowners pursuant to their reporting obligations under this NCCP/MSAA/HCP and submitting same to to the Wildlife Agencies on or before November 15 of every year.

- Providing input to the Reserve Manager and the Science Panel regarding management and monitoring activities undertaken in County Habitat Reserve lands for inclusion in the "State of the Habitat Reserve" report;
- Submitting the "State of the Habitat Reserve" report to the Wildlife Agencies/USACE;
- Using the best available information, accounting for the amount and location of impacts of Covered Activities on Covered Species, Conserved Vegetation Communities and CDFG Jurisdictional Areas, and loss of associated habitat within the development areas and areas designated for the Habitat Reserve (*e.g.*, infrastructure-related impacts) during the prior year.

7.3.3 Rancho Mission Viejo Land Conservancy and Reserve Manager

a. Rancho Mission Viejo Land Conservancy (RMVLC)

Following execution of the IA, the Rancho Mission Viejo Land Conservancy ("RMVLC') will be incorporated as a not-for-profit, tax-exempt entity in accordance with the provisions of Section 501(c)(3) of the U.S. Internal Revenue Code. RMVLC's specific purpose and function will be the collection, investment and distribution of funding for the benefit, preservation and enhancement of the RMV Habitat Reserve Lands (*i.e.*, approximately 4,332 acres of initial, pre-existing RMV conservancy lands and approximately 16,536 acres of Rancho Mission Viejo lands subsequently enrolled into the Habitat Reserve pursuant to the Phased Dedication Program). RMVLC's primary source of funding will be the Benefit Fee discussed in *Chapter 12*. In addition, RMVLC may also seek and accept funding from other sources including, but not limited to, private donations and state/federal grants. Such additional funding would be complimentary to,a nd beyond what is required to implement the HCP.

1. Duties

The duties of the RMVLC Board of Directors will include, but are not limited to:

1. Receive benefit fees and other funds;
2. Manage the investment of all funds received in accordance with the funding expectations set forth in *Chapter 12*;
3. Disburse funds to the Reserve Manager in accordance with the Reserve Manager's annual budget;
4. Receive the annual report prepared by the Reserve Manager;
5. Receive the "State of the Habitat Reserve" report prepared every 5th year by the Reserve Manager;

6. Cause to be prepared by the Reserve Manager a public education program regarding the RMV Habitat Reserve Lands; and
7. Approve the public education program prepared by the Reserve Manager.

2. Meetings

The RMVLC Board of Directors will meet at a minimum of once per year to carry out the duties described above.

b. Reserve Manager

The primary duty of the RMV Habitat Reserve Lands Manager ("Reserve Manager") will be to manage and monitor the RMV Habitat Reserve Lands pursuant to the approved NCCP/MSAA/HCP. The duties of the Reserve Manager include but are not limited to:

1. Manage and monitor the RMV Habitat Reserve Lands pursuant to the approved NCCP/MSAA/HCP;
2. Prepare, in coordination with the Science Panel, a 5-year MAP which will set forth annual management and monitoring priorities based on the overall AMP and the annual budget submitted to the RMVLC Board of Directors by the Reserve Manager;
3. Consult with the Wildlife Agencies/USACE during preparation of the 5-year MAP;
4. Submit the draft 5-year MAP to the Wildlife Agencies/USACE for review and comment;
5. Issue RFP's for management, monitoring and research priorities as established by the 5-year MAP;
6. Oversee consultant/contractor implementation and/or self-implement the management, monitoring and research priority tasks set forth in the 5-year MAP;
7. In coordination with the Science Panel, interpret results of the management, monitoring and research tasks performed pursuant to item above;
8. Review, comment on and synthesize technical studies or reports generated as a result of item above and incorporate same into annual consideration of priorities;
9. Meet with Science Panel;
10. Meet with RMVLC Board of Directors;
11. Meet with the Wildlife Agencies/USACE;
12. Prepare a public education program for the RMVLC for consideration by the Board of Directors;
13. Implement the approved public education program;

14. Coordinate with the Administrator regarding AMP activities that cross property boundaries (*e.g.*, invasive species control, fire management); and

15. In coordination with the Science Panel prepare an annual report that includes:

- An overview of the status of the RMV Habitat Reserve Lands;
- A description of AMP activities conducted on RMV Habitat Reserve lands during the previous year;
- An accounting of the number of acres of RMV lands incorporated into the Habitat Reserve during the previous year (including the total number of RMV acres incorporated into the Habitat Reserve since the Effective Date) and an accounting of acres and location of impacts of Covered Activities during the previous year;
- An evaluation of any significant issues encountered in the RMV Habitat Reserve Lands during the previous year (including a description of the proposed resolution strategy for each issue);
- An assessment of the monitoring data collected to date in terms of estimates of the status and trend of Covered Species, Conserved Vegetation Communities and focal species;
- A description of the changes to the management and monitoring program, if any, to be undertaken as a result of the assessment of the monitoring data per the above;
- Summary of funding received; and
- Expenditures made by the Reserve Manager during the previous year in satisfaction of RMV's obligations under the NCCP/MSAA/HCP.

The annual report will be prepared and submitted to the Administrator on or before November 1 of each year, and shall thereafter be transmitted by the by the Administrator to the Wildlife Agencies on or before November 15.

16. In coordination with the Science Panel prepare a "State of the Habitat Reserve" report every 5th year including an assessment of the monitoring data collected to date in terms of estimates of the status and trend of Covered Species, Conserved Vegetation Communities and focal species. From the results of report, the Reserve Manager will make changes in the management and monitoring program through preparation of a new 5-year MAP.

17. Submit to the RMVLC Board of Directors, the Independent Reserve Land Easement Holder and the Administrator the annual report and "State of the Habitat Reserve" report prepared pursuant to the above.

18. Meet with the Independent Reserve Land Easement Holder

c. Independent Reserve Land Easement Holder

All RMV Habitat Reserve Lands shall be enrolled into the Habitat Reserve by virtue of the execution and recordation of a master conservation easement and spreader amendments thereto granted in favor of an Independent Reserve Land Easement Holder ("IRLEH"). The IRLEH shall be a not-for-profit, tax exempt entity formed in accordance with the provisions of Section 501(c)(3) of the U.S. Internal Revenue Code. Additionally, the IRLEH shall be duly qualified to receive and hold conservation easements in accordance with the mandates of state and federal conservation laws.

The IRLEH may be a local, regional or national organization, provided that the primary purpose of the organization is to preserve and protect open space and natural resources through the receipt, management and administration of conservation easements. The IRLEH shall have responsibility for **(i)** complying with all laws and regulations concerning the holding of the conservation easements granted by RMV, **(ii)** performing such obligations and duties as are specified for the IRLEH in the RMV conservation easements, and (iii) verifying that the RMV Reserve Manager is acting in accordance with the provisions of the RMV conservation easements relative to activities conducted upon the easement propert(y/ies).

7.3.4 Science Panel

Objective review and advice from outside scientists and technicians is a key element of the AMP. As shown in the adaptive management flowchart (*Figure 137-M*), scientists, along with the stakeholders and resource managers play an important role in setting the management objectives for the AMP and scientists are a primary source of information and data for generating and refining the conceptual models that are the foundation of the AMP. The primary purpose and role of the Science Panel is to provide assistance in obtaining the best scientific information available so that "effectiveness monitoring" of the Habitat Reserve is carried out in accordance with the AMP concepts set forth in this Chapter.

Members of the Science Panel will be scientists drawn from academia or other sources with recognized expertise in ecology and conservation science. The target number of panel members is five with representative expertise in plant and animal ecology, quantitative methods and statistical analysis, and conservation planning on private lands. Panel members will be

financially compensated by funding managed by the RMVLC for their involvement including travel expenses and per diem. The "mission" of the Science Panel is summarized in the following purposes:

- Assist in the development of a scientifically credible monitoring program that will provide reliable information needed to assess the status and trend of Covered Species, Conserved Vegetation Communities and focal species within the NCCP/MSAA/HCP area.
- Review the quality and relevance of the scientific and technical information gathered as part of the NCCP/MSAA/HCP monitoring and implementation requirements.
- Contribute to the analysis and interpretation of the monitoring data in light of the regulatory requirements of the NCCP/MSAA/HCP.
- Advise the Reserve Manager, Participating Landowners and the Wildlife Agencies/ USACE on scientific matters that reflect on the design, interpretation or implementation of the AMP.
- Make recommendations for adjustments to the AMP based on review and analysis of the monitoring data.

The following subsections describe the structure and responsibilities of the Science Panel in the AMP.

a. Structure of the Science Panel

The Science Panel would be composed as follows:

1. A 5-member panel will be selected initially by RMV in consultation with the Wildlife Agencies and the USACE. Replacements to fill vacancies will be selected by the RMV and the County.
2. The initial Chairperson would be selected by RMV and serve a three-year term. Thereafter the Chairperson would be selected by the Science Panel members for a three-year term.
3. Each Science Panel member term would be 5-years and renewable by mutual agreement of the Science Panel, RMV and the Wildlife Agencies/USACE.
4. Science Panel recommendations would require the approval of at least three of the five members. Without at least three votes, a recommendation is not forwarded to the Reserve Manager and/or Administrator as applicable.

b. Duties of the Science Panel

Based on its evaluation of the best available information, the Science Panel would assist the Reserve Manager and, as specified elsewhere in this Chapter, the Administrator, in addressing a broad range of AMP issues. In this role, the Science Panel could be asked to provide assistance and counsel to the Reserve Manager/Administrator to:

1. Assure, to the extent possible, that issues relevant to the monitoring of Covered Species, Conserved Vegetation Communities and focal species (*i.e.*, design, implementation, data analysis and interpretation) are scientifically sound and defensible.
2. Make every effort to implement the AMP in a fashion that is neutral with respect to the Participating Landowners and the Wildlife Agencies/USACE.
3. Conduct the process of the design, interpretation and implementation of the AMP data in a fully transparent fashion subject to the provisions of this section.
4. Be responsive, to the extent practicable, to any requests from the Reserve Manager, RMVLC, Participating Landowners or Wildlife Agencies/USACE including clarification of Science Panel deliberations and interpretations of the monitoring data.
5. Recommend priorities for management, monitoring and research activities in the Habitat Reserve to the Reserve Manager and/or Administrator, as applicable. For RMV Habitat Reserve lands, the Reserve Manager would make the final decision on priorities taking into account the Science Panel recommendations, Wildlife Agency comments and other considerations, including IA obligations. For County Habitat Reserve lands, the Administrator would make the final decision on priorities taking into account the Science Panel recommendations, Wildlife Agency comments and other considerations, including IA obligations;
6. Recommend appropriate targets for monitoring, including Covered Species, Conserved Vegetation Communities and focal species and other variables to the Reserve Manager and the Administrator, where applicable, that may serve to address key environmental conditions pertinent to the goals of the NCCP;
7. Evaluate and recommend sampling approaches to the Reserve Manager and/or the Administrator, where applicable, to support the monitoring program.
8. Evaluate and recommend analytical tools, including modeling approaches, for use in assessing available monitoring information;
9. Assist the Reserve Manager and/or the Administrator, where applicable, in interpretation of results of monitoring and other data collection activities;
10. Recommend annual management action priorities to the Reserve Manager and/or the Administrator, where applicable, using results from on-site monitoring and other

information sources, including responding to "changed circumstances" and "unforeseen circumstances" as defined in federal law;

11. Review, comment on, and synthesize technical studies or reports generated by supplemental research activities conducted by outside third parties that may be permitted within the Habitat Reserve and submit comments on such research to the Reserve Manager and/or the Administrator, where applicable;

12. Meet with the Reserve Manager and/or the Administrator, where applicable, and Wildlife Agencies/USACE;

13. Review and provide comments on, as appropriate, drafts of consultant Requests for Proposals prepared by Reserve Manager for management, monitoring and research activities in the Habitat Reserve; and

14. Review and prepare evaluations of consultant proposals for the Reserve Manager for carrying out management, monitoring and research activities in the Habitat Reserve.

15. At least once a year, a written assessment of the monitoring data collected to date in terms of estimates of the status and trend of Covered Species, Conserved Vegetation Communities and focal species. From the results of this written assessment, the Science Panel will make recommendations to the Reserve Manager for changes in the monitoring program as needed.

The Science Panel will meet at least two times per year and will be available for technical assistance by telephone or email on an as-needed basis consistent with the other obligations of the Panel members.

c. Coordination with Participants

The Science Panel will function as an independent body during formulation of adaptive management and monitoring recommendations and shall coordinate with the Planning Participants as follows:

1. The Science Advisors panel shall meet as necessary to conduct "working sessions" to accomplish the duties described above. It is expected that such meetings will be more frequent during early implementation of the AMP, and be less frequent during later phases of the AMP. During early implementation of the AMP, it is expected that face-to-face Science Advisors "working sessions" will occur at least three (3) times per year.

2. As needed, the Science Advisors shall consult via email and teleconferences between "working sessions."

3. Science Advisors "working sessions" and email/teleconference deliberations where adaptive management and monitoring needs, priorities and actions are formulated shall not be considered "public" in order to enable free exchange of information and comment. Attendance and participation shall be limited to the Science Advisors and to technical staff/consultants or others that the Science Advisors determine can best assist its deliberations.

4. Following Science Panel "working sessions" (on the same day or on a date set by the Science Advisors), and prior to distributing the working session meeting minutes and draft findings, priorities and recommended actions to the Reserve Manager, the Administrator, Participating Landowners and Wildlife Agencies/USACE, the Science Panel shall meet with those parties to discuss its draft findings, priorities and recommended actions. The Reserve Manager, Administrator, Wildlife Agencies/ USACE, and Participating Landowners shall have an opportunity to comment on the proposed draft findings, priorities and recommended actions.

5. Following Science Panel briefings and discussions of draft findings, priorities and recommended actions, the Science Panel shall consider the comments received from the Reserve Manager, Administrator, Participating Landowners, and Wildlife Agencies/USACE and determine what, if any, modifications to their draft findings, priorities and recommended actions they think should be made and incorporate such changes into final findings, priorities and recommended actions.

6. The Chair of the Science Panel shall distribute the working session meeting minutes and final findings, priorities and recommended actions to the Reserve Manager, Administrator, Wildlife Agencies/USACE and Participating Landowners.

7. The Chair or a designated member of the Science Panel, as needed, shall attend the RMVLC Board meetings to answer any questions the RMVLC Board may have during its deliberations.

7.3.5 Timeline for Initiation of the Habitat Reserve Management Program

During the months immediately following execution of the IA for the NCCP/MSAA/HCP, the Participating Landowners will begin to take steps that ultimately will lead to full implementation of the HRMP. These initial steps will include: **(1)** appointment of an Administrator to coordinate and administer the overall Habitat Reserve and HRMP; **(2)** creation of the RMVLC; **(3)** formation of the Science Panel to assist the RMVLC during formulation and implementation of the AMP element of the HRMP; and **(4)** designation of the Reserve Manager to carry out the HRMP as described in this chapter.

The timing and sequence of HRMP implementation is strongly influenced by **(1)** the timing of impacts related to Covered Activities, **(2)** the amount of time that will be needed to assemble the overall Habitat Reserve and **(3)** the amount of time that will be needed to fully fund HRMP measures. For instance, it may take as long as 15-20 years or more to assemble all of the lands designated for inclusion in the permanent 32,818-acre Habitat Reserve assuming development of all Planning Areas. Within approximately the first 12 months following execution of the IA, approximately 16,282 acres will be available for management as part of the permanent Habitat Reserve. These lands will consist of: **(1)** the three existing County regional and wilderness parks, totaling about 11,950 acres; and **(2)** the previously set aside RMV easements and conservancies (*e.g.,* Ladera Open Space, Upper Chiquita Canyon Conservancy, Donna O'Neill Land Conservancy) and CDFG open space in Arroyo Trabuco that total about 4,332 acres. The remaining lands designated for inclusion in the approved Habitat Reserve, consisting of about 16,536 gross acres of designated RMV open space, will be dedicated in phases over time as development proceeds within the GPA boundary.[1] Within approximately 12 months of execution of the IA, it is anticipated that impacts related to Covered Activities, namely grading of all or a portion of RMV Planning Area 1, will occur. Thus, it is anticipated that management and monitoring of some or all of the Planning Area 1 Habitat Reserve lands will also be initiated. For a description of the RMV Phased Dedication Program refer to the Implementation Agreement (IA), Part III.

The following discussion briefly describes the likely phasing of HRMP monitoring and management measures within the Habitat Reserve, starting with the need to update the overall biological database for the HRMP to provide a comprehensive baseline database for HRMP implementation.

a. Near-Term Baseline Monitoring

During the first two years following execution of the IA (anticipated to be 2007 to 2009), limited impacts to Covered Species and Conserved Vegetation Communities are anticipated to occur as noted above. *Table 13-19B* sets forth the anticipated impacts to Conserved Vegetation Communities on a Planning Area by Planning Area basis. *Table 14-1* sets forth the anticipated impacts to Covered Species on a Planning Area by Planning Area basis. Impacts resulting for development of Planning Area 1 are quite limited (*e.g.,* 9 acres of coastal sage scrub), thus the level of monitoring necessary to mitigate these impacts is similarly limited. An update of the overall vegetation database will occur and limited monitoring of wildlife species will be conducted as described below.

[1] The 16,536 gross acres dedicated to the Habitat Reserve does not account for infrastructure impacts in the Habitat Reserve. See *Chapter 13, Section 13.3.*

1. Vegetation Database Update

Priority actions concerning the vegetation database for the entire Habitat Reserve within the first two (2) years following execution of the IA will include completing an evaluation and update of the Habitat Reserve vegetation map. The entire Habitat Reserve vegetation map will be evaluated using no earlier than year 2008 nor later than 2010 color infrared aerial photography (digital orthophotos, 1-meter resolution), or an available equivalent imagery. Adequate field-truthing will be conducted on lands already conveyed to the Habitat Reserve to establish statistically acceptable and valid error rates for the aerial photo interpretation, as set by the Reserve Manager and Science Panel. As additional lands are transferred to the Habitat Reserve, the accuracy of the vegetation map for these areas will be evaluated and incorporated at the next 5-year interval for updating the vegetation map (see *Section 7.7.3* for more details on the vegetation monitoring).

2. Wildlife Species Monitoring

The Science Panel will recommend to the County and Reserve Manager a set of priority species for monitoring during the first several years of the HRMP program. Selected monitoring activities will involve consideration of the **(1)** impacts resulting from Covered Activities, *i.e.*, the monitoring actions must bear a relationship to the species and/or Conserved Vegetation Communities being impacted; **(2)** the Habitat Reserve phased land dedication schedule; and **(3)** projected generation of funding for the AMP. Details on the species anticipated to be monitored during the first two years following execution of the IA are set forth in *Section 7.17.*

b. Near-Term Management Measures

In the first five years following execution of the IA for the NCCP/MSAA/HCP, several actions will be initiated to commence implementation of the HRMP for the Habitat Reserve. These actions will include continuation of the OMP element of the HRMP, preparation of the first 5-year Management Action Plan (MAP), and initiation of the AMP element on a limited basis within portions of the Habitat Reserve.

1. Continuing the OMP on County Park Lands

Under the terms of the IA and the HRMP, implementation of the OMP element on 11,950 acres (*Figure 135-M*) contained within the County's three existing regional and wilderness parks can occur seamlessly. The land management measures already in effect within the County parklands will continue to be implemented by the HBP without the need for any formal action on the part of the County HBP, the Administrator or the Wildlife Agencies.

2. Commencement of Invasive Species Control in San Juan Creek

The goal would be for the RMV Reserve Manager, on behalf of the County to commence invasive species controls related to the approval of the Covered Activities related to its Prima Deshecha Landfill during the near-term phase of the HRMP within that portion of San Juan Creek located within Caspers Wilderness Park. However, the USFWS has asked the County to delay invasive controls on its lands until the U. S. Forest Service (USFS) begins invasive controls within the CNF portion of San Juan Creek. Accordingly, the Wildlife Agencies and Participating Landowners will request that the USFS begin its invasive control as soon as possible following execution of the IA in order to avoid delays in commencement of invasive species control measures along the San Juan Creek corridor.

3. Invasive Species Control Reconnaissance

The invasive species control program will initially involve reconnaissance surveys to verify/identify the most important areas for invasives controls. Some limited amount of invasives controls may be implemented on an as-needed basis (note that RMV conducts ongoing artichoke thistle controls on its lands at its own cost that will not be a part of this program until those lands are dedicated to the Habitat Reserve). This "planning period" also will allow the Reserve Manager and Science Panel to assess the invasive species issues and incorporate well-informed control strategies into the first 5-year MAP.

4. Preparation of the Initial 5-Year Management Action Plan (MAP)

Substantial details of the AMP are presented in this Chapter in terms of baseline information, goals, objectives and the strategies that are designed to meet the goals and objectives. However, the AMP presented in this Chapter is programmatic and will require more detailed prioritization of monitoring and management actions that reflects: **(1)** the need to assemble the Habitat Reserve through phased dedications of land by RMV; **(2)** formulation of more detailed management objectives for specific land dedication increments; and **(3)** gathering necessary input from the Science Panel to refine monitoring and management priorities and directives. For example, the AMP describes a process by which candidate focal species that could be used as surrogates for measuring Habitat Reserve function are identified. However, determining which set of candidate focal species will best serve the AMP in the long term should be further evaluated by the Science Panel in consultation with the RMV Reserve Manager and County Staff (see *Section 7.4.2.c*).

The Reserve Manager, with assistance by the Science Panel and in coordination with County staff (*e.g.,* regarding invasive species), will use the information presented in this Chapter and the associated subplans in *Appendices H, I, J* and *N* to prepare a 5-year MAP that describes in sufficient detail the spatial and temporal aspects of the AMP in the first of sequential MAPs that

would be developed for the HRMP. The MAP will provide guidance that will allow the Reserve Manager to implement the AMP on the ground by addressing issues/questions such as:

- where and when specific management and monitoring actions will be conducted;
- what methods will be used;
- what the initial suite of focal species will be;
- RMV phased dedications anticipated to occur within the five-year timeframe of the MAP; and
- other relevant monitoring/management actions.

In the event that RMV dedications do not occur as anticipated, such dedications can be addressed through amendments to the then current MAP prior to completion of the next scheduled five-year MAP.

An Arroyo Toad Monitoring Approach (*Appendix O,* Noon and Murphy) that provides an example of the level of detail that will be included in the Covered Species and Conserved Vegetation Communities monitoring elements of the MAP.

The initial 5-year MAP, in addition to outlining the AMP actions for the first five years of the program following its completion. The following implementation milestones are proposed for the first three (3) years of the AMP:

1. The Science Panel will be established and convened within approximately six (6) months of execution of the Implementation Agreement (IA).
2. The Reserve Manager, with assistance by the Science Panel and in consultation with the Wildlife Agencies/USACE, will prepare and submit a proposed MAP within 18 months of establishment of the Panel. The initial MAP will include, at a minimum, the following items:
    i. Revised or refined conceptual stressor models for the five Conserved Vegetation Communities, as needed;
    ii. Revised or refined management goals, objectives and strategies, as needed, including "working management thresholds" for management actions (*i.e.*, provisional or "starting point" thresholds for species and habitat management actions);
    iii. Identification of key uncertainties for effective management and monitoring of the Habitat Reserve;

iv. Elucidation of an initial set of adaptive management hypotheses to be applied and tested and a description of data analysis methods that will allow for inferences regarding the effectiveness of management actions, including alternative management actions;

v. Prioritization of management and monitoring activities;

vi. Selection of the initial suite of focal species;

vii. Selection of monitoring locations;

viii. Description of field methods for data collection, including identification of sampling locations, variables to be measured, and frequency, timing and duration of field surveys;

ix. Description of data analysis methods that will allow for inferences regarding the effectiveness of management actions, including alternative management actions;

x. The proposed method for incorporating the results of the management and monitoring actions as feedback to the conceptual models and resulting revisions to the AMP and any necessary updates to the MAP;

xi. Identification, where appropriate, of the types of personnel, professional service needs, contractors, etc.; and

xii. Detailed annual budgets for management and monitoring actions.

3. The Reserve Manager will submit the draft MAP to the Wildlife Agencies/USACE for review and approval. Wildlife Agencies/USACE shall promptly review the MAP consistent with the provisions of the IA.

4. Requests for Proposals will be prepared within 45 days of finalization of the MAP by the Reserve Manager with an additional 60-day period allowed for issuance of the RFP and submittal of proposals by prospective management/monitoring contractors.

5. Proposals are evaluated and selected by the Reserve Manager, with appropriate input from the Science Panel, within 60 days of submittal date.

6. In general, immediate management and monitoring actions would be initiated within 30 days following selection of management/monitoring contractors by the Reserve Manager. Other actions would be initiated per the schedule outlined in the MAP and per the dedication schedule.

Initiation of management and monitoring actions pursuant to the initial MAP will begin within 1 year following finalization of the MAP. The initial MAP and subsequent 5-year MAPs will address: **(1)** impacts resulting from Covered Activities, *i.e.*, the management and monitoring

actions must bear a relationship to the species and/or Conserved Vegetation Communities being impacted; **(2)** the Habitat Reserve phased land dedication schedule; **(3)** projected generation of funding for the AMP; and **(4)** results of prior the MAP.

c. Interim Management Policies Relating to Future Phased Land Dedications to the Habitat Reserve

As noted above, it may require 15-20 years or more to assemble the entire Habitat Reserve assuming development of all Planning Areas. AMP funding will initially be limited and it will increase over time in phases as RMV development is completed and occupied. For a complete discussion of funding for the AMP, please see *Chapter 12*. For each area of RMV land designated for future inclusion in the Habitat Reserve (see Phased Dedication open space in *Figure 182-M*), the period of time between execution of the IA and the initiation of AMP management is referred to as the **"**Interim Management Period." During the Interim Management Period existing biotic and abiotic resources designated for inclusion in Habitat Reserve shall be protected. Interim Use Policies, including Covered Activities and Prohibited Uses are set forth in *Chapter 11*.

d. Long-Term HRMP Implementation

Long-term implementation (*i.e.*, post-2009) of the AMP element of the HRMP on lands designated for inclusion in the Habitat Reserve will be correlated with the impacts resulting from implementation of Covered Activities. As described in *Part III*, *Attachment 1* to the IA and in *Chapter 14*, upon commencement of grading of any Planning Area or sub-part thereof, RMV will make an irrevocable covenant for the corresponding open space dedication area (see *Figure 182-M*) to the IRLEH. At the same time, RMV will initiate AMP management and monitoring activities on the Covenant Area. Actual recordation of a conservation easement over the Covenant Area will occur three years after commencement of grading for the related development area. *Section 7.17* sets forth the anticipated monitoring and management activities for the first 25 years of the HRMP correlated with a hypothetical illustrative schedule for development and corresponding Covenant Area phasing.

7.3.6 Process for Revisions to the Adaptive Management Program Based on Management and Monitoring Data and Scientific Review

A fundamental concept of adaptive management is that managed ecological systems have many current uncertainties and that much of the uncertainty is associated with incomplete information and data. Employing management objectives and conceptual models based on current information, an initial adaptive management plan is generated (see conceptual adaptive management flowchart in *Figure 137-M*). Out of this initial plan specific management actions

are formulated and implemented. Importantly, uncertainties or "knowledge gaps" are also identified from the initial plan. Based on the level of uncertainties, alternative management actions or "targeted" research studies may be identified. Over time, the results of monitoring and research activities are then evaluated and used to refine the information and data and conceptual models, which then, in turn, are used to modify the adaptive management plan.

As discussed in the previous section, the Reserve Manager, with assistance by the Science Panel, will prepare a 5-year MAP that describes the spatial and temporal aspects of the AMP that will allow direct implementation of the AMP (also see *Section 7.3.8, Program Implementation, Tracking, Reporting and Analysis*). In the context of the adaptive management approach, the MAP also is intended to be flexible and allow for revisions and modifications to the AMP based on information collected in the field and new independent scientific information that may warrant changes in the AMP. For example, the MAP should incorporate a response action to catastrophic events such as major floods or wildfires that can dramatically alter the management landscape. Also, the Reserve Manager may find that certain management actions or monitoring observations are providing unexpected and/or obvious results (good or bad) that may require immediate modifications to the MAP. At minimum, annual field reports will be prepared by the Reserve Manager of management and monitoring actions and results and submitted to the Science Panel for review, synthesis and comment. In the case of an unexpected or catastrophic event, an evaluation of the event and its impact on the Habitat Reserve will be made as quickly as is feasible by the Reserve Manager and submitted to the Science Panel. Based on the annual reports, or unexpected and catastrophic event reports, the Science Panel will evaluate whether the management and monitoring actions and results are consistent with the goals and objectives of the AMP, and, if not, reexamine aspects of the MAP that may need modification. An important feature of the MAP is enough flexibility to allow for short-term management decisions/modifications by the Reserve Manager and Science Panel based on clear evidence that a particular management action is, or is not, working. The field reports will be compiled into a comprehensive annual report that will be submitted to the RMVLC Board and the Administrator. The comprehensive annual report jointly prepared by the Reserve Manager, with assistance by the Science Panel, will summarize the field report information, provide a discussion of the results in the context the AMP and make necessary recommendations for modifications of the AMP. Approved modifications also will be incorporated into an updated MAP so that the Reserve Manager has specific information to implement the modified actions.

7.3.7 Data Collection, Storage and Analysis

The RMV Reserve Manager shall be responsible for overseeing and carrying out monitoring and adaptive management data collection, storage and analysis. These functions are fundamental components of the HRMP, and particularly the AMP, where feedback from prior management and monitoring actions are essential to adaptive management. Without reliable and valid

methods for collecting, storing and analyzing data, the management and monitoring efforts will be wasted. Although collection, storage and analysis methods and technologies most certainly will evolve overtime, it is imperative that new methods are consistent with prior methods so that data sets are comparable and compatible for conducting statistical tests and trend analyses and drawing inferences. To the extent feasible, the methods should also be compatible with those used by other conservation programs so that data sets can be combined and compared at a broader scale and allow for inferences beyond the Southern Subregion. The specific data collection, storage and analyses methods will be developed as part of the initial 5-year MAP and would involve consultation with other NCCP programs (*e.g.*, Coastal/Central, San Diego MSCP and MHCP, Western Riverside MSHCP, etc.). The following subsections provide guidance for the collection, storage and analysis of data that meets these goals (the reader is referred to Chapter 6 of Elzinga *et al.* 2001 for a more detailed treatment of data collection and management).

a. Data Collection

Field data collection should be automated as much as possible. Currently the most efficient method for field data collection is the use of data loggers, field computers, and/or Global Positioning System (GPS) units, depending on the type of data being collected (*e.g.*, population counts, species composition, spatial information, etc.). Although loggers, field computers and GPS units are initially expensive, they more than compensate for their initial cost over the long-term in terms of quality control and assurance and reliability of the data. Data loggers and computers, for example, provide standardized or predesigned data formats and have the advantage of being directly downloadable to compatible software for conducting analyses without the need for manual transcription that inevitably results in data transcription and input errors. GPS units are invaluable for collection of spatial information that can be input directly into GIS applications for mapping and spatial analyses. Software included with GPS units allows for creation of data dictionaries which, in turn, allow for standardization of data element definitions and database schemes. The use of data dictionaries can eliminate or minimize personal biases or transcription mistakes in the data set being recorded. The specific hardware and software that will be used will be determined during the preparation of the initial MAP and, in part, will depend on the available funding for equipment purchases versus labor costs. Because data management, analysis and reporting can be a substantial portion of the overall budget of a monitoring and management program (an estimated 30-50 percent of the total time for collection of data; Draft Coachella Valley MSHCP [Coachella Valley Association of Governments 2004]; USGS 2004), careful selection of field equipment is paramount for a cost efficient program. A wise initial expenditure of funds for field equipment can provide long-term savings for the program.

b. Data Storage and Management

Data storage and management will be standardized to maintain a high level of quality assurance. This includes specific protocols for naming directories, subdirectories and files; *e.g.,* keeping raw data files separate from summary and analysis files. All data files will be accompanied by metadata that describe in detail the data set in terms of the who, when, how, what, and where information in the data set. A backup system (*e.g.,* CD-ROM or tape drive) will be incorporated to minimize the risk of lost data and backup data will be stored offsite. In addition, data will be stored and managed so that it can be shared, as appropriate and feasible, with other conservation programs, and with the Wildlife Agencies. Consequently, the data management should be compatible with the data management methods use by the state and federal agencies. As noted in the USGS 2004 document *Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans,*

> *The state of California is developing a multi-taxa, multi-level integrated data management system for monitoring data collected throughout the state that will allow powerful queries by species, study type, habitat or geography. With increasing sophistication in technology, it is possible for data collection entities to maintain a copy of the database and mirror those data in near real-time to a state database while maintaining local control over data entry and corrections.*
> (p 39)

Currently, for example, the CDFG uses a database system known as the Biogeographic Information and Observation System (BIOS). At the time the initial MAP is developed, the Reserve Manager will work with the Wildlife Agencies to develop a data management and storage protocol that, to the extent feasible, is compatible with the state system.

c. Data Analysis

Data analyses will be tailored to the goals and objectives of the HRMP. It is anticipated that much of the field data will be analyzed using a standard statistical package such as SAS or SPSS, but also using specialized software to address specific monitoring issues will be utilized as needed. For example, for long-term population trend analyses two software programs, TRENDS (Gibbs *et al.* 1998) and MONITOR (Gerrodette 1987), are available. Likewise, the program CAPTURE can be used to estimate populations using short term capture/recapture data. The Reserve Manager and Science Panel will be responsible for identifying the appropriate analytic software that is appropriate for the management and monitoring data and the questions being posed during preparation of the MAP.

As noted above, data are intended to be shared with the Wildlife Agencies and other conservation programs, as appropriate, as part of the Annual Reports. However, it will not be the responsibility of the HRMP, the Reserve Manager or the Science Panel to analyze shared data for uses beyond the scope of implementing the HRMP (*e.g.*, analyzing the population trend of a species beyond the geographic boundary of the Habitat Reserve).

7.3.8 Program Implementation Tracking, Reporting and Analysis

Overall tracking of implementation of the OMP and AMP elements of the HRMP will be coordinated by the Administrator mentioned in *Section 7.3.1* and described in *Chapter 10*. Program tracking involves to main tasks: **(1)** Compliance Monitoring; and **(2)** Effectiveness Monitoring.

a. Compliance Monitoring

Compliance Monitoring refers primarily to administrative duties related to verifying that the permit applicant is carrying out the terms of the NCCP/MSAA/HCP, the permit and the Implementation Agreement (IA) (65 Federal Register 35253, 6/1/2000**).** Compliance Monitoring will be coordinated annually by the Administrator and include submittal of a tabular summary of dates of completion, revisions and implementation progress on AMP plan components such as the Fire Management Plan, Grazing Management Plan and MAP. *Chapter 10, Section 10.7.4* describes the duties of the Administrator that relate to Compliance Monitoring, including:

- Assist in coordinating the OMP and AMP elements of the overall HRMP;
- Soliciting and summarizing the receipt and expenditure of funds;
- Accounting for the location and amount of impacts on Covered Species, Conserved Vegetation Communities and CDFG Jurisdictional Areas;
- Accounting for lands added to the Habitat Reserve; and
- Summarizing actions related to assemblage and management and monitoring of the Habitat Reserve.

b. Effectiveness Monitoring

Effectiveness Monitoring evaluates the biotic and abiotic effects of the permitted management action to determine whether the Habitat Reserve, in conjunction with implementation of the HRMP, is achieving the biological goals and objectives established by the NCCP/MSAA/HCP (65 Federal Register 35253, 6/1/2000). Effectiveness Monitoring thus is the heart of the

biological management and monitoring program (see a brief discussion of Effectiveness Monitoring and the USFWS Five-point Policy in *Section 7.2.3* of this Chapter and a detailed discussion in *Chapter 14* and *Appendix V*).

The key elements for Effectiveness Monitoring of the Southern Subregion Habitat Reserve include:

- Preparation and ongoing revision of goals and objectives for the five Conserved Vegetation Communities and goals and objectives for each of the Covered Species (see *Sections 7.7* through *7.11* and *Appendix E*);
- Management and monitoring of resources, including the extent to which goals and objectives are met, at three fundamental scale: **(1)** natural community landscape mosaic; **(2)** specific vegetation communities and habitats; and **(3)** species and species assemblages;
- Use of a "stressors" adaptive management concept, including the use of focal species and habitat conditions monitoring to identify stressors that must be addressed in order to maintain the effectiveness of the long-term management program;
- Preparation of implementation plans, including the 5-year MAP;
- Annual reports prepared by the Reserve Manager, with assistance by the Science Panel (described in subsection "1" below);
- Public review of the annual reports prepared by the Administrator; and
- Comprehensive "State of the Habitat Reserve" reports coordinated by the Administrator, with input from the Reserve Manager, the Science Panel, and County HBP, every five years (described in subsection "2" below).

1. <u>Annual Reports</u>

The annual reports will provide at minimum the following information:

- Identification of management and monitoring priorities for that year;
- Updates to the conceptual models for the managed resources;
- The sampling sites and data collected in terms of by whom, frequency, timing and duration;
- A description of the data analysis and results;
- Synthesis/integration of the year's management and monitoring results with previous years as applicable (*e.g.,* analyzing apparent trends, etc.);

- An evaluation of the year's work plan in relation to achieving or progressing toward the management and monitoring goals established in the MAP;
- Identification of significant problems or successes with the program that may alter the management and monitoring program approach, such as:
    - Whether the field protocols or analytic methods are satisfactorily addressing the management/monitoring objectives (*e.g.*, are the measurement methods sensitive enough?) and whether sampling or analysis methods need revision,
    - Whether the data, based on the "working management thresholds," indicate that a species or habitat is declining at a rate that an immediate, possibly unanticipated action is required, and
    - Whether the data indicate an earlier than expected positive response of a species or habitat to an active adaptive management action such that continued testing is unnecessary or becomes a lower priority;
- Suggested changes/revisions to the MAP based on the points listed above;
- Suggested management and monitoring priorities for the coming year; and
- Suggested revisions to coming year's budget based on the above factors, if necessary.

The IA provides that the Reserve Manager is to prepare/tender the annual report to the Administrator on or before November 1 of each calendar year, with the Administrator thereafter transmitting the annual report to the Wildlife Agencies on or before November 15.

2. Comprehensive Five-year Reports

The Administrator, with input from the Reserve Manager, the Science Panel, and the County HBP, will coordinate preparation a comprehensive "State of the Habitat Reserve" every five years. The five-year monitoring report will replace the annual monitoring report for that year, but will evaluate the effectiveness of the HRMP by drawing upon the full set of data collected to that point. The five-year report will examine the cumulative data collected for species or habitat trends, summarize the results of management actions to that point in time and integrate the results with other information collected outside the Habitat Reserve, such as from other conservation programs in southern California to the extent possible and from the general scientific literature. It is anticipated that preparation of the five-year reports will require substantial coordination with and input from the Science Panel and the Wildlife Agencies in order to take advantage of additional scientific and "gray" literature information that may not be readily available to the Reserve Manager. The five-year reports will provide the basis for updates to the MAP, including the conceptual models, management and monitoring technologies, prioritization of future management and monitoring actions and future funding needs.

SECTION 7.4 OVERVIEW OF THE ADAPTIVE MANAGEMENT PROGRAM

In 1998, the Southern Orange County NCCP Science Advisors convened by The Nature Conservancy (TNC) distributed their report *Principles of Reserve Design, Species Conservation and Adaptive Management.* The Science Advisors identified five fundamental elements of an adaptive management program that were reflected in the Draft Southern Planning Guidelines:

1. **Setting Management Objectives:** The specific goals and objectives of the adaptive management program need to be established before specific management actions can be identified; *i.e.*, what is the future desired condition of the Habitat Reserve? The objectives should be measurable, meet the regulatory requirements of the program, should incorporate the diverse views of the stakeholders, and be feasible to implement.
2. **Preparing Management Plans and Conceptual Models:** For each management unit of the Habitat Reserve (*e.g.*, lands managed by different reserve owner/managers) specific management plans should be prepared. These plans will incorporate the management objectives for the Habitat Reserve and be tied to conceptual models of each focal vegetation type that describe known and/or hypothesized dynamic relationships for the vegetation type (*e.g.*, fire effects on coastal sage scrub) that can be empirically tested and refined through management.
3. **Identifying Uncertainties and Knowledge Gaps in Management Plans:** Concurrent with preparation of the conceptual models and management plans, it is important to identify the knowledge gaps and weaknesses in the conceptual models; referred to earlier as "critical uncertainties." These gaps and weaknesses form the basis for posing management questions that can be tested empirically in the field. The feedback from hypothesis-driven management actions is used to refine the conceptual models and lead to better models and management over time.
4. **Monitoring the Management Program:** As stated by the Science Advisors, "The biological monitoring program should be developed specifically to measure and evaluate the effects of management activities. It should identify and measure variables that permit iterative refinement of the management program."
5. **Incorporating Monitoring and Research Results Into Revised Management Plans:** As management actions yield information, the conceptual models and management plans will be revised to reflect the new information, leading to new hypotheses, refined models and more effective management actions better able to meet the goals and objectives of the AMP.

These five elements of an adaptive management program identified by the Science Advisors are addressed in the AMP component of the HRMP, but with some clarification of element No. 2,

which refers to preparing specific management plans for each management unit of the Habitat Reserve. As described in *Section 7.1* the HRMP includes the **(1)** OMP for existing management and monitoring activities on existing County parklands that would be conducted under ongoing programs and **(2)** the AMP activities that would be conducted primarily in previously committed conservation easement areas and future RMV open space as mitigation for impacts on Covered Species, Conserved Vegetation Communities and CDFG Jurisdictional Areas associated with Covered Activities within those areas. The focus of the remainder of this Chapter is on the AMP activities.

Figure 137-M shows a conceptual flowchart for adaptive management that incorporates these fundamental concepts and which are addressed in the description of the AMP that follows.

Section 7.4 provides an overview of the adaptive management approach for the NCCP/MSAA/ HCP. *Section 7.4.1* describes the environmental stressor approach as the foundation for the AMP and includes a description of the conceptual stressor models for the five Conserved Vegetation Communities and for Covered Species and "focal species." Some Covered Species also will serve as focal species and several uncovered species are "other focal species." Generally, focal species are species that may be valuable for the purposes of managing and monitoring the Habitat Reserve as surrogates, indicator or umbrella species. *Section 7.4.2* lays out the goals, objectives and strategies for the AMP at three scales: landscape processes, vegetation communities, and species. *Section 7.4.3* describes the relationship between monitoring and research and *Section 7.4.4* describes the baseline phase of the AMP.

7.4.1 Environmental Stressor Approach

The Science Advisors and Draft Southern Planning Guidelines identify three broad land management goals for the subregion that can be translated and applied to establish the foundation for the AMP:

1. Maximize the likelihood of the persistence of a native-dominated vegetation mosaic in the planning area.
2. Restore or enhance the quality of degraded vegetation communities and other habitat types.
3. Maintain and restore biotic and abiotic natural processes, at all identified scales, for the planning area.

Because these are very broad land management goals, they will be "stepped down" to more focused goals and objectives in the appropriate sections later in this Chapter.

a. Focus on Both Natural and Human-caused Stressors

The *first and underlying guiding principle* of the AMP is that management and monitoring should be directed towards environmental factors known or thought to be directly or indirectly responsible for ecosystem changes that would be inconsistent with meeting the three broad goals cited above. These environmental factors are called "stressors," which Noon (2003) defines as

> *Any physical, chemical, or biological entity or process that induces adverse effects on individuals, populations, communities, or ecosystems.*

Noon focuses on

> *…stressors that cannot be incorporated within the natural disturbance dynamics of a system, exceed the resilience of the system, and potentially drive an ecosystem to a new state.*
> (p. 29)

Although the Noon definition focuses on the adverse impacts associated with stressors, the stressor-based approach under the AMP recognizes that these environmental stressors may have both adverse and beneficial effects on ecosystem characteristics such as vegetation communities and species. While fire is necessary for sustaining healthy stands of chaparral, and likely coastal sage scrub, fire at short intervals can result in the conversion of these communities to annual grassland. Allowing fire to type-convert chaparral or coastal sage scrub to non-native annual grassland would be inconsistent with the goal of ensuring the persistence of a native-dominated mosaic in the planning area.

Environmental stressors may be natural or human-caused, and some may be both. For example, ignitions of wildfires can be both natural (lighting strikes) and human-caused (arson and accidental human-caused ignitions). Natural and human-caused stressors that significantly affect vegetation communities and species in the Southern Subregion planning area include habitat loss and fragmentation, wildfires, cattle-related impacts, exotic plants and animals, altered hydrology, altered geomorphic processes, human uses and recreation, and precipitation cycles.

The emphasis on environmental stressors has increasingly become the central focus of adaptive management in large-scale ecosystem programs such as the Northwest Forest Plan. The 2004 USGS document *Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species* (*Atkinson et al. 2004*) discusses conceptual models for adaptive management and monitoring in the context of stressor (called "pressures" in the document) that "promote or inhibit change in the state of the environment." (p. 19). The USGS document states:

> *A management-oriented conceptual model links pressures on the state of the environment to hypothesized effects of those pressures. This requires a sufficient understanding of the inter-relationships among species, habitats and ecological processes, to speculate on how pressures are affecting the state of the environment, and to make hypotheses about appropriate program actions (conservation strategy and management activities) that should be implemented in response…*
> (p. 20)

It is important to understand that the vegetation communities and associated species in the Habitat Reserve are basically in good general health, but that certain known and potential stressors operate and can be identified (*e.g.*, giant reed invasion of San Juan Creek, three recent fires in the Upper Chiquita Canyon Conservation Area). For this reason, the stressor approach is particularly appropriate and the basic management needs are to: **(1)** address existing stressors so that net habitat value can be increased; and **(2)** identify future stressors that could reduce or adversely alter long-term net habitat value.

In conclusion, the environmental stressor approach guides the AMP both because it is state of art science for management and monitoring of ecological systems (*e.g.*, Noon 2003) and because it is particularly appropriate for the Southern NCCP/MSAA/HCP Habitat Reserve.

b. Characteristics of Conceptual Environmental Stressor Models

The *second fundamental element* of an adaptive management program identified by the Science Advisors and reflected in the Draft Southern Planning Guidelines is the preparation of management plans and conceptual models. Conceptual models are the theoretical bases for the management plans because they illustrate known and hypothesized dynamic ecological relationships that can be empirically tested and refined through management. As noted by Noon (2003) and the USGS (2004), they are a fundamental step in the creation of a monitoring program (see *Section 7.2.4*). Conceptual models can range from basic qualitative models (*e.g.*, unidirectional cause-and-effect) to extremely complex quantitative ecosystem models. The adaptive management approach described here relies on relatively simple qualitative conceptual models that show known and hypothesized directional and interactive relationships of "environmental stressors" (as described below) and vegetation community and species-level responses. In contrast, complex ecosystem models, while having great value for testing and understanding basic and complex ecological relationships, tend to be too unwieldy for the purpose of identifying specific, practical management and monitoring actions; *i.e.*, they tend not to be "management-oriented" as described by the USGS (2004). Direct application of such relatively abstract information to on-the-ground monitoring and practical management of the Habitat Reserve would be difficult. Furthermore, because not all components of general ecosystem models are relevant to monitoring and management, a complex ecosystem model may

obscure the variables most important for monitoring and management. As strongly emphasized by the USGS (2004),

> ***An important point is that a conceptual model is usually designed for a specific purpose; the level of detail and complexity of the model should reflect that purpose.*** *The program may choose to create very basic conceptual models for some parts of the system, while creating very specific and detailed conceptual models for other aspects of the system. The level of focus and detail depends on which aspects of the program have the greatest uncertainty and anticipated difficulty in meeting program objectives.*
> (p. 19, bold face emphasis included in original document)

The AMP would be implemented based on the assumption that practical management and monitoring should focus on the issues most relevant to the managed system. The "environmental stressor" approach to monitoring and managing natural resources is receiving more attention in recent years because it provides a conceptual method more amenable to an enhanced understanding of causal relationships that can be addressed through management actions. Laying the foundation for the environmental stressor approach, Noon (2003) states:

> *To be most meaningful, a monitoring program should provide insights into cause-and-effect relations between environmental stressors or between specific management practices and anticipated ecosystem responses. Prior knowledge of the factors likely to stress an ecological system or the expected outcomes from management should be incorporated into the selection of variables to measure and the sampling design. Indicators should be chosen based on a conceptual model that clearly indicates stressors (e.g., pollutants, management practices) and indicators with pathways that lead to effects on the structure and function of the ecological system (NRC 1995, 2000). This process enables the monitoring program to investigate relations between anticipated stressors, or between management practices and environmental consequences, and provides the opportunity to develop predictive models.* (p. 34)

This environmental stressor approach is currently being applied to other adaptive management programs, and, for example, is an integral component of the *Draft Coachella Valley Multiple Species Conservation Plan and Associated Natural Communities Conservation Plan* (CVAG 2004; see Chapter 8, MSHCP Reserve System Management and Monitoring). Also, as noted above, the stressor approach is highlighted in the USGS (2004) discussion of management-oriented conceptual models.

In order to identify causative environmental factors responsible for ecosystem changes, Noon (2003) distinguishes between two kinds of "disturbance events" or stressors related to ecological change: *intrinsic drivers* and *extrinsic drivers* of ecological change. *Intrinsic drivers* are factors

that occur naturally in the system and cause expected changes, such as stochastic variation, successional trends following disturbance events, and cyclic variation. Intrinsic drivers are not human-induced impacts and generally are not directly amenable to management nor, in many cases, would management be appropriate (Noon 2003). The ecosystem response should behave as a self-regulated system because the system presumably has evolved in the context of the intrinsic driver (*e.g.*, coastal sage scrub has evolved in the context of wet/dry cycles and natural wildfires; riparian habitats have evolved in the context of regular flooding).

In contrast, *extrinsic drivers* are those external factors, usually human-induced, that in combination with intrinsic factors, can drive the ecosystem to a degraded state. These extrinsic drivers push the system beyond its natural resilience (*i.e.*, expected range of variation) and essentially "break" the system. Noon (2003) describes extrinsic drivers and the way they can affect an ecosystem system as follows:

> *Of most interest to monitoring programs are extrinsically driven changes to environmental indicators that arise as a consequence of some human action. Concern arises when extrinsic factors, acting singly or in combination with intrinsic factors, drive ecosystems outside the bounds of sustainable variation. Thus, one key goal of a monitoring program is to discriminate between extrinsic and intrinsic drivers of change; that is, a mechanism to filter out the effects of expected intrinsic variation or cycles (noise) from the effects of additive, human-induced patterns of change (signal).* (p. 29, underline added for emphasis)

Noon (2003) suggests that a goal of monitoring is to develop a "structural model" of how the ecosystem responds to both intrinsic and extrinsic drivers. Indicator variables that are sensitive to intrinsic drivers should be selected and regularly measured to determine their range of natural variation. The model indicates the range of natural variation and provides a benchmark to compare future deviations (*noise + signal*) from the expected natural variation (noise). For example, arroyo toad breeding success appears to vary with wet/dry years in a fairly predictable pattern with reasonably well understood causes (*i.e.*, extent and duration of breeding pools). A model of this cyclic behavior would indicate the "natural" variation in breeding success (*e.g.*, measured by recruitment into the breeding population a following year) in relation to rainfall patterns. Two or three consecutive dry years would be expected to result in low recruitment over those years. However, poor recruitment following an otherwise good year (*e.g.*, above average rainfall and adequate extent and duration of breeding pools) would suggest that an extrinsic driver (stressor) (*e.g.*, bullfrog proliferation) has adversely affected toad breeding success.

c. Formulation of Stressor Models for Vegetation Communities

Preliminary stressor models have been formulated for each of the five Conserved Vegetation Communities in the Southern Subregion: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. The models are based both on the available scientific literature and on the professional judgment and experience of biologists familiar with the RMV property. As such, the models represent an amalgam of basic ecological theory, empirical scientific studies and direct observation of current Ranch conditions.

Two kinds of models were generated for each vegetation community. The first set of models (*Figures 138-M* through *142-M*) postulates the relationships between general landscape-level environmental stressors and vegetation community responses. This set of models provides a broad overview of the stressor-response relationships and identifies eight general environmental stressors known or likely to be relevant to the Habitat Reserve:[2]

1. Habitat fragmentation
2. Too frequent/too infrequent fire
3. Cattle-related impacts
4. Exotics (plants and animals)
5. Altered hydrology
6. Altered geomorphologic processes
7. Human uses and recreation
8. Precipitation

At the scale of the Habitat Reserve, all but the precipitation stressor have human-induced components, and thus would be *extrinsic drivers* that may require management and monitoring. While at a global scale precipitation also may have a human-induced component (*e.g.*, global warming-induced climate change), it cannot be directly managed at the Habitat Reserve scale. However, precipitation can have direct effects on other stressors (*e.g.*, fire) that, in turn, have direct effects on vegetation communities.

Under the first set of models, the "line weights" in *Figures 138-M* through *142-M* represent the postulated strength of the relationship between an environmental stressor and the community response. For example, for coastal sage scrub (*Figure 138-M*), fire is considered to have a stronger direct influence in driving sage scrub to annual grassland than exotic species. Although

[2] The eight identified stressors are intended to address "changed circumstances" as defined in the federal "No Surprises" rule. Changed circumstances are defined under No Surprises rule as "changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably anticipated by the plan developers and the USFWS and that can be planned for."

exotic species directly influence sage scrub and help drive it to grassland, fire is a strong mediator of exotic invasion, as depicted by the arrow from the fire component to the exotics component of the model. Likewise, drought increases the likelihood and intensity of fire through reduced moisture content and greater dead fuel loads, and thus can cause a state-transition of coastal sage scrub to annual grassland. Although *Figures 138-M* through *142-M* depict conceptually simple models, they reveal quite complex interactions between environmental stressors and community responses.

d. Formulation of Stressor Models for Covered and Focal Species

The second set of models depicted in *Figures 143-M* through *147-M* focuses on selected Covered Species and focal species.[3] With regard to focal species, for the purpose of the AMP,

> *Focal species serve an umbrella function in terms of encompassing habitats needed for many other species, play a key role in maintaining community structure or processes, are sensitive to changes likely to occur in the area, or otherwise serve as an indicator of ecological sustainability.* (as defined by the Committee of Scientists, 1999).

Murphy *et al.* (2003) further refine focal species categories:

> *(1) Indicator species*: *"An organism whose characteristics (presence or absence, population density, dispersion, reproductive success) are used as an index of attributes too difficult, inconvenient, or expensive to measure for other species or environmental conditions of interest" (Landres et al. 1998). In addition, Patton (1987) describes an indicator as an organism so intimately associated with particular environmental conditions that its presence indicates the existence of those conditions. Indicator species can further be broken down into 3 categories (Caro and O'Doherty 1999).*
>
> - *Early warning indicator: Provides an early warning of a stressor acting on a key ecosystem process. (Traditional interpretation of an indicator species from ecotoxicology.)*
> - *Population surrogate indicator: Species whose status and trend are indicative of the status and trends of other species.*
> - *Biodiversity indicator: A species, or more commonly a taxonomic group, that functions as a surrogate measure of the number of poorly known taxonomic groups.*

[3] Focal species generally are species that provide information about other species or community structure or processes, are sensitive to environmental changes, or serve as indicators of ecological sustainability. See Section 7.4.2c for a detailed discussion of focal species.

(2) Umbrella species: A species that needs such large areas of habitat that managing for its viability meets the needs of numerous other species with similar resource requirements but smaller area requirements (Wilcox 1984). The principal requirement for an umbrella species is its range is large compared to sympatric species.

(3) Keystone species: A species that significantly affects one or more key ecological processes or elements to an extent that greatly exceeds what would be predicted from its abundance or biomass (Mills et al. 1993, Power et al. 1996).

(4) Flagship species: A species that can be use to anchor a conservation campaign because it arouses public interest and sympathy (normally a charismatic large vertebrate) (Simberloff 1998).

(5) Link species: A species that occupies a key position in a food web and efficiently transfers energy and matter between trophic levels.

(6) Ecological engineer: A species that directly or indirectly controls the availability of resources to other organisms by causing physical state changes in biotic or abiotic materials (Jones et al. 1994, 1997).

Of these various focal species categories, "indicator species" and "umbrella species" likely will be the most useful for the AMP. The Habitat Reserve may support a "keystone species" but no information is yet available to indicate that such a species occurs in the subregion. The subregion also does not support a candidate "flagship species." The mountain lion and golden eagle would be two obvious candidates, but while the Habitat Reserve will accommodate these two species, neither is "symbolic" of the conservation effort. As with "keystone species," there is insufficient information at this time to identify candidate "link species" or "ecological engineers" in the subregion.

Both Covered Species and other non-covered species may serve as focal species for the purposes of the AMP and management and monitoring of these species will facilitate management of the Habitat Reserve.

The models show more detail than the vegetation community stressor models and postulate the relationships between stressors, community responses and their consequent impacts on selected focal species. These more detailed models incorporate the postulated relationships between human-induced environmental stressors and community responses of the first set of models depicted in *Figures 138-M* through *142-M*, as well as postulated relationships between these and additional environmental stressors and focal species. For example, for coastal sage scrub

(*Figure 143-M*) additional species-based stressors include mesopredators, human collection/harassment, roads and trails, and pesticides. The pathways between stressors and species may be both direct (*e.g.,* Argentine ants displace native prey of San Diego horned lizards) or indirect via community responses (*e.g.,* long-term spatiotemporal changes to habitat structure and function cause the gradual decline of a species).

7.4.2 Formulation of Management Objectives: (1) Landscape Scale, (2) Conserved Vegetation Communities and (3) Covered and Focal Species

As noted in the previous section, the three broad goals of the AMP are to:

1. Maximize the likelihood of the persistence of a native-dominated vegetation mosaic in the planning area.
2. Restore or enhance the quality of degraded vegetation communities and other habitat types.
3. Maintain and restore biotic and abiotic natural processes, at all identified scales, for the planning area.

The previous section also described the "environmental stressor" approach as the foundation of the AMP for achieving these goals and presents conceptual stressor models for the five Conserved Vegetation Communities: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. These general goals help define a framework for the identification of specific management objectives and activities that would enable management actions and outcomes to be systematically monitored and measured in the Habitat Reserve.

The conceptual environmental stressor models address management and monitoring of resources at three fundamental scales: **(1)** natural community landscape mosaic; **(2)** specific vegetation communities and habitats; and **(3)** species and species assemblages. Although there is overlap, dependence, and interaction among the difference scales, clearly stated conceptual relationships and coordinated management objectives at all three scales are needed to meet the management goals of the program.

1. *Landscape management* pertains to the dynamic and interacting biotic natural communities and abiotic factors within the entire subregion, and focuses on the natural processes that maintain the condition and dynamics of the natural communities. For example, the interaction of geomorphic and hydrologic processes, periodic events such as flooding, fire, and weather (*i.e.,* drought/wet cycles), and the structure and function of vegetation communities, species and species assemblages must be understood in order to manage resources. A question that may be asked in this landscape context, for example,

is: what is the role of flooding in maintaining southern willow scrub that is suitable breeding habitat for the least Bell's vireo?

2. *Management and monitoring of specific vegetation communities and habitats* refers to site-specific conditions, as contrasted with the broader landscape scale that focuses on the dynamic interaction of biotic and abiotic processes. Vegetation communities would be monitored and managed in terms of *net habitat value* (*i.e.,* defined as "no net reduction in the ability of the subregion to maintain populations of target species over the long term), thus providing flexibility in the management and monitoring in recognition of the natural stressor-induced changes (*i.e.,* intrinsic drivers) that occur in vegetation community associations that alter the relative amounts of the community at any give time (*e.g.,* natural succession, fire, flooding, etc.). This scale of management and monitoring thus is closely associated with maintaining species populations. For example, arroyo toads and least Bell's vireo overlap spatially and temporally over a broad scale in riparian habitats, but toads use open riparian areas and vireos use more densely vegetated areas with substantial understory. Natural disturbance events such as flooding and fires trigger successional patterns that at different time scales favor either the toad or the vireo and consequently the net habitat value of the system for the species at any given time. Management and monitoring will need to take into account these natural successional patterns such that while the net habitat value may vary on a species basis as a result of environmental stressors, the overall net habitat value is relatively consistent.

3. *Management and monitoring of species and species assemblages* refers to maintaining species populations, including Covered Species or other focal species (*e.g.,* indicator or umbrella species as defined above in *Section 7.4.1.d*). Management and monitoring of species and species assemblages would be important for both permit compliance monitoring for Covered Species (see *Chapter 10*) and effectiveness monitoring and adaptive management of the Habitat Reserve.

Table 7-1 provides a summary of the goals and objectives at these three fundamental scales, with the recognition that many of the objectives, while tied to a particular goal, will help achieve other goals. For example, fire management at a landscape level will have profound site-specific effects on vegetation communities and species assemblages. The subsections following *Table 7-1* provide more comprehensive treatments of the relationship between the three scales of management and monitoring, the stated goals, and the objectives identified to achieve the goals.

TABLE 7-1
SUMMARY OF GOALS AND OBJECTIVES OF THE ADAPTIVE MANAGEMENT PROGRAM

Goals	Objectives
Fire. Address the role of fire in maintaining a healthy ecosystem in the subregion such that the planning area at any given time would support a mosaic of upland habitats in stands of various ages	• Identify appropriate spatial scales and patterns for the long-term management of fire. • Develop active fire management prescriptions for shrublands (coastal sage scrub and chaparral) and grasslands focused on increasing abundance and diversity of native plants and promoting structure and composition favored by focal wildlife species. • Quantify the effects of varying fire regimes on selected wildlife species. • Utilize strategic fire reduction projects to reduce unplanned fire events where known ignition corridors place identified social and environmental values at risk. • Define fire prescriptions that aid in the restoration of degraded shrublands. • Investigate active restoration techniques following fire treatments. • Develop a social environment supportive of active fire management.
Hydrology – Surface and Groundwater Hydrology. Maintain natural hydrologic process to the extent possible to preserve natural ecosystem structure and function.	• Emulate, to the extent feasible, the pre-NCCP runoff and infiltration patterns in consideration of specific terrains, soil types and ground cover. • Address potential effects of future land use changes on hydrology. • Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks. • Maintain and/or restore the inherent geomorphic structure of major tributaries and their floodplains. • Utilize infiltration properties of sandy terrains for groundwater recharge and to offset potential increases in surface runoff and adverse effects to water quality.
Hydrology – Water Quality. Manage pollutants generated by urban development with the potential to impact species and habitats.	• Protect and manage water quality using a variety of strategies, with particular emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas.
Geomorphology/Terrains. Maintain natural geomorphic process to the extent possible to preserve natural ecosystem structure and function.	• Recognize and account for the hydrologic response of different terrains to new development, rainfall/climate and proposed management/restoration activities at the sub-basin and watershed level.
Sediment Sources, Transport and Storage	• Maintain coarse sediment yields, storage and transport processes.
Habitat Connectivity. Maximize the likelihood that habitat linkages and wildlife corridors connecting large blocks of habitat in the Habitat Reserve	• Determine an appropriate suite of focal species for monitoring the use of habitat linkages and wildlife corridors. • Monitor the use of key identified habitat linkages and wildlife corridors.

TABLE 7-1
SUMMARY OF GOALS AND OBJECTIVES OF THE ADAPTIVE MANAGEMENT PROGRAM

Goals	Objectives
function as designed by managing "live-in" and dispersal habitat.	• Identify and measure any ongoing stressors on wildlife such as harassment, lighting, noise, vehicle collisions based on monitoring data at key linkages and corridors. • Identify and implement feasible remedial actions, to improve the function of the habitat linkage/wildlife corridor to an acceptable level.
Edge Effects and Encroachment. Control human-caused effects along the Habitat Reserve/urban interface.	• Control invasion of the Habitat Reserve by exotic plants and animals. • Control potential edge impacts such as lighting, increased moisture, pollutants and pesticides. • Protect sensitive resource areas from unauthorized public access and associated impacts such as off-road vehicles (including motorized vehicles and mountain bikes), trampling of vegetation, and harassment and collection of native species.
Conserved Vegetation Communities: Maximize the likelihood of the persistence of a native-dominated vegetation mosaic in the planning area. Restore or enhance the quality of degraded vegetation communities and other habitat types.	• Maintain Conserved Vegetation Communities and associated species and species assemblages, with the recognition that acreages and net habitat values for a particular community will oscillate in relation to natural events (*e.g.,* flood, fire, precipitation). • Maintain the ability of the subregion to support populations of Covered Species. • Maintain and, where feasible, enhance long-term net habitat value in order to mitigate for proposed impacts and to further recovery of listed Covered Species. • Identify and restore existing areas with little or no habitat value to increase long-term net habitat value. • As opportunities arise in the future, use restoration to increase long-term net habitat value in the Habitat Reserve.
Covered and Focal Species. Maintain conditions that will allow for normal evolutionary processes and genetic integrity and exchange through management of a functional Habitat Reserve, including functioning vegetation communities, habitat linkages and wildlife corridors. Manage habitat and populations of Covered Species ensure that they persist and in doing so, "provide for recovery" of Covered Species on a subregional basis and "contribute to recovery" on a rangewide basis.	• Monitor populations of selected Covered Species and/or their habitats to detect population trends in relation to environmental stressors and management issues. Monitoring would focus on *major* and *important populations* and *key locations* of Covered Species where possible. • Implement appropriate management actions, as necessary, to stabilize or enhance populations of Covered Species, such as habitat restoration, and pest controls (*e.g.,* cowbird trapping, invasive species control).

In several cases, strategies for achieving the objectives are also provided. In other cases, the strategies are deferred by reference to other sections of this Chapter because the level of detail is beyond the scope of this section (*e.g.,* hydrology and geomorphology is addressed in detail in *Section 7.18.2, Water Quality Management Plan*). It is important to understand that setting goals and objectives is a "step-down" processes, starting from the general or broadly stated goal, to more precise and measurable objectives designed to meet goals. It is the intent of this conceptual AMP to state the objectives that will allow the Reserve Manager and Science Panel the flexibility to develop precise quantitative objectives for specific adaptive management undertakings where alternative conceptual models/hypotheses are tested and targeted studies area carried out.

a. Landscape-Scale Issues

The AMP addresses several landscape-scale issues in the planning area that were identified by the Science Advisors in their refinement of the NCCP Tenets of Reserve Design: **(1)** fire; **(2)** hydrology and geomorphology; **(3)** habitat connectivity; and **(4)** edge effects and encroachment. These landscape-scale issues and their relation to the AMP and the environmental stressor approach are discussed in this section.

1. Fire

The NCCP/MSAA/HCP HRMP recognizes that the focal vegetation communities in the planning area evolved with the presence of fire, and are dependent on fire (with the possible exception of riparian) to renew vegetation succession and to sustain species of concern and the resources on which they depend. Notably, fire is considered to be a fundamental component of the coastal southern California ecosystem, and particularly of the coastal sage scrub and chaparral shrub communities (see *Chapter 3, Section 3.2*). The HRMP also recognizes that substantial debate exists regarding the historical frequency of fire, its associated extent and intensity, and its role in sustaining and renewing vegetation communities in the modern era of elevated human activities and threats from invasive plant species. An exchange documented in the literature has pitted against one another fire and vegetation experts who point to differences between fire size and frequency north of the U.S.- Mexico border, where ostensibly larger, more intense fires have led to vegetation type conversion events that are deleterious to a number of the species targeted by this plan, and areas south of the border, where smaller less intense fires appear to contribute to sustaining more desirable environmental conditions (Keeley and Fotheringham 2001a, 2001b; Minnich 2001, and many cited publications within them). Despite diametrically differing interpretations of available data on current landscape conditions, both sides in the debate recognize that the role of human fire ignitions is a key variable in today's land management challenge.

The HRMP, recognizing risks to both species and habitat management targets and developed lands from uncontrolled wildfires, proposes to use prescribed fire as one of the tools to meet biotic and other land management goals. The HRMP also recognizes that short fire-return intervals are known to result in vegetation type conversion events that could effectively permanently compromise the ability of the managed lands to meet species-related management goals. Moreover, good data indicate that with development and associated increases of human visitation to wildlands, human-caused ignitions, both accidental and vandal-caused, increase. The management challenge then is to mimic presumed historical fire frequency and intensity to the long-term benefit of desirable species and their habitats, while recognizing that **(1)** unplanned fires are likely to increase; **(2)** current conditions on portions of the planning landscape may make those areas prone to undesirable fire event outcomes; and **(3)** long-term climate change is highly likely to change local fire-vegetation dynamics.

The HRMP will initially limit prescribed fire actions to areas most likely to contribute to the spread and intensification of fire from unplanned ignitions. Initially prescribed fires will avoid areas of higher known occupancy by species of concern. Prescribed fires will be limited in extent, expanding in size and applied to areas occupied by species of concern only as information from the HRMP or other emerging reliable information indicates that such actions are prudent.

Empirical observations of the effects of fire on southern California ecosystems provide the framework for managing and monitoring shrub communities in the Habitat Reserve. As an example, recent fires in the subregion provide the opportunity for examining the response of coastal sage scrub and associated species to frequent fire. Portions of the Upper Chiquita Conservation Area experienced three non-overlapping burns in six years: 1996, 1997 and 2002. Prior to the most recent burn in 2002, Harmsworth (2001) had documented that after three and four years post-burn, the 1997 and 1996 burn areas were recovering to mature coastal sage scrub composition, with general declines in fire-followers such as deer weed (*Lotus scoparius*) and morning glory (*Calystegia macrostegia*), and an increase in the dominance of shrubs such coastal sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Saliva mellifera*), and laural sumac (*Malosma laurina*). Their most recent report (Harmsworth 2004) for the 2003 survey season indicates that the 2002 burn is following the same pattern with deer weed having significant cover the first year after the burn. The 1996 and 1997 burn areas are progressing to shrub-dominated coastal sage scrub and declines in deer weed.

It also should be noted that middle and lower Chiquita Canyon south of Oso Parkway have not burned since the 1950s according to the Orange County wildfire record. The Wiegand fire in 1954 burned lower Chiquita Ridge and Chiquadora Ridge. The Steward fire burned Chiquadora Ridge again in 1958. Notably these areas support the highest densities of the California gnatcatcher in the subregion, so absence of fire for more than almost 50 years does not appear to

be an adverse situation for this species. However, this area also has been subject to grazing during that period of time, so an important interaction between fire and grazing may be related to sustaining highly suitable gnatcatcher habitat in this area (*e.g.,* a more open, lower habitat structure). This potential interaction between a recent absence of fire and grazing is made more complex, however, by the planting of barley in Chiquita Canyon as the main summer forage for cattle, not the annual and native grasslands occurring in a mosaic with coastal sage scrub. There are no direct data on the level of cattle grazing in the coastal sage scrub, so a "critical uncertainty" is the relationship between fire, grazing and barley production in Chiquita Canyon. Understanding the potential interaction between these two stressors (*i.e.,* grazing and fire) in the context of barley production will be crucial for managing the system, especially because allowing wildfires to burn or conducting prescribed burns in some areas of the Habitat Reserve would not be feasible due to public safety and property concerns.

The AMP must address the role of fire (and possibly in conjunction with managed grazing) in maintaining a healthy ecosystem in the subregion such that the planning area at any given time would support a mosaic of upland habitats in stands of various ages (*i.e.,* time since last burn).

Based on the current understanding of the fire ecology of southern coastal shrub and grassland communities, objectives of the AMP for fire that are consistent with the management objectives of species and habitats include:

- Identify appropriate spatial scales and patterns for the long-term management of fire.
- Develop active fire management prescriptions for shrublands (coastal sage scrub and chaparral) and grasslands focused on increasing abundance and diversity of native plants and promoting structure and composition favored by focal wildlife species (this would include both active suppression and prescribed fire applications where appropriate).
- Quantify the effects of varying fire regimes on selected wildlife species.
- Utilize strategic fire reduction projects to reduce unplanned fire events where known ignition corridors place identified social and environmental values at risk.[4]
- Define fire prescriptions that aid in the restoration of degraded shrublands.
- Investigate active restoration techniques following fire treatments.
- Develop a social environment supportive of active fire management.

The Wildland Fire Management Plan to achieve these objectives is described in more detail in *Section 7.14.*

[4] "Strategic fuels reduction projects" means reduction of plant biomass in strategic locations by means of mechanical methods or prescribed fire to limit the rate of spread of a fire or allow control of a fire perimeter where there are identified values at risk (Draft Environmental Impact Statement for the Fire Management Plan for the Santa Monica Mountains National Recreation Area, March 2004).

2. Hydrology and Geomorphology

Abiotic hydrologic and geomorphic processes shape and alter creek systems in the planning area over time and thus are fundamental components of the regional landscape. Maintaining natural hydrologic and geomorphic process to the maximum extent possible is essential for preserving natural ecosystem structure and function. Alterations in hydrologic and morphologic processes have significant impacts on spatial and temporal distributions, structure, and function of riparian and wetland vegetation communities that provide essential habitat for numerous species.

The Draft Southern Watershed and Sub-basin Planning Principles (Draft Watershed Planning Principles) should be used as management objectives of the AMP as follows (see *Chapter 5* for complete text).

(a) Surface and Groundwater Hydrology

- Emulate, to the extent feasible, the pre-NCCP runoff and infiltration patterns in consideration of specific terrains, soil types and ground cover.
- Address potential effects of future land use changes on hydrology.
- Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks.
- Maintain and/or restore the inherent geomorphic structure of major tributaries and their floodplains.
- Utilize infiltration properties of sandy terrains for groundwater recharge and to offset potential increases in surface runoff and adverse effects to water quality.

(b) Water Quality

- Protect and manage water quality using a variety of strategies, with particular emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas.

(c) Geomorphology/Terrains

- Recognize and account for the hydrologic response of different terrains to new development, rainfall/climate and proposed management/restoration activities at the sub-basin and watershed level.

(d) Sediment Sources, Transport and Storage

- Maintain coarse sediment yields, storage and transport processes.

3. Habitat Connectivity

Disruption in habitat connectivity results in habitat fragmentation. Fragmentation, in addition to increased "edge" area addressed in the next section, has two main effects that are generally accepted as adverse to ecosystem function: **(1)** reduction in total habitat area (which affects population sizes and extinction rates); and **(2)** redistribution of the remaining area into disjunct fragments (which affects dispersal and thus immigration rates) (Wilcove *et al.* 1986). Habitat fragmentation has been shown to alter avian species composition and distribution in southern California (*e.g.,* Bolger *et al.* 1997a) and smaller habitat fragments may lose native species assemblages across taxa (*e.g.,* Bolger *et al.* 1997b). The mechanisms for these changes are several, and include differential responses by species to edge effects, isolation of habitat fragments by intervening land uses that species cannot cross (*e.g.,* some small mammals and reptiles will not cross roads) or distances that are beyond their dispersal capabilities, increased predation by mesopredators, and other sources of mortality (*e.g.,* vehicle collisions).

The main goal of the AMP concerning habitat connectivity is to ensure that habitat linkages and wildlife corridors connecting large habitat blocks in the Habitat Reserve function as designed (see General Policies 3 and 4 described in *Section 4.3* of *Chapter 4*) by managing "live-in" and dispersal habitat. Specific objectives to achieve this goal are to:

- Determine an appropriate suite of focal species for monitoring the use of habitat linkages and wildlife corridors (see discussion of focal species in *Section 7.4.2.c*).
- Monitor the use of key identified habitat linkages and wildlife corridors (as discussed in *Section 3.5* of *Chapter 3* and illustrated in *Figure 41-M*) by selected focal species. Monitoring sites would be selected based on their risk of being affected by existing or future development, as determined by the Reserve Manager and Science Panel. Sites would be monitored through various methods as appropriate, including transects, track stations, and remote cameras.
- Identify and measure any ongoing stressors on wildlife such as harassment, lighting, noise, vehicle collisions based on monitoring data at key linkages and corridors. In some cases the stressor may be immediately apparent (*e.g.,* a roadkill hotspot), but in other cases the stressor may be more subtle (*e.g.*, interspecific competition for resources) and several years of monitoring may be required to detect a negative trend (*e.g.,* a decline in tracks or scat of a species at a particular location).

- Identify and implement feasible remedial actions, to improve the function of the habitat linkage/wildlife corridor to an acceptable level (*e.g.*, measurable reduction in vehicle collisions, increase in tracks or scat), such as restoring habitat to improve cover for refugia, placing fencing along roads to funnel wildlife and reduce vehicle collisions, erecting sound walls (as feasible), or redirecting lighting.

4. Edge Effects and Encroachment

Edge effects and encroachment into habitat areas are in large part related to, and exacerbated, by habitat fragmentation. Edge effects may be directly human-caused, such as lighting, noise, increased moisture, invasive plants, pesticides and pollutants, pets and feral animals, recreational activities, species collections, trash dumping, etc., or related to natural distributions of species (*e.g.*, edge vs. interior species). Argentine ants, which rely on moist conditions, may invade naturally xeric areas along habitat edges where there is urban runoff or irrigation for landscaping or agriculture. Fuel modification zones (FMZ) may be considered edge areas because the natural vegetation composition and cover is altered to reduce fire loads. Longcore (2003), for example, observed effects on the coastal sage scrub arthropod community in FMZs, including an increase in the Argentine ant and other exotic arthropod species (European earwigs, pillbugs and sowbugs, and the sowbug killer) and a concomitant decline in native predator species such as scorpians and trap-door spiders.

Edge effects also may be abiotic in origin, but have their effects on biological resources. Examples of abiotic edge effects are increased exposure to sun and wind and changes in soil ecology, with consequent effects on the microclimate at the edge of the habitat area (Lovejoy *et al.* 1989).

Fire also is an edge effect in the sense that human-caused fires (either accidental or deliberate ignitions) are most likely to occur along edges of roads (*e.g.*, cigarettes, exhaust sparks or catalytic converter combustions, and arson) or at the urban-wildland interface (*e.g.*, sparks from lawnmowers, rototillers, accidental or intentional ignitions by children, etc.), but because of the potential for spread of a wildfire, its impacts may be much greater than other types of edge effects that have more discrete and linear incursions into habitat ranging from a few to hundreds of feet (*e.g.*, lighting, noise, urban run-off).

Human encroachment also may go beyond simple edge effects, and can include unauthorized public access into sensitive areas, illegal trails, and other activities within reserve areas that may have negative effects on biological resources.

General Policy 5 (*Section 4.3* of *Chapter 4*) addresses long-term indirect impacts to the Habitat Reserve. Broad objectives of the AMP concerning edge effects and encroachment are stated below, along with strategies designed to meet the broad objective. Some of the strategies listed below are standard project design features that are fairly well established as effective measures for addressing edge effects, such as prohibiting identified invasive plant species in landscaping or controlling artificial lighting in the a reserve, but others will need to be tested in the context of the adaptive management framework. Control of invasives such as giant reed, bullfrogs or Argentine ants can be accomplished with various strategies depending on site-specific conditions, extent of the problem, etc., so testing of different techniques may be needed to identify the techniques best suited and most effective for the situation (see Invasive Species Control Plan in *Appendix J* for discussion of alternative control methods as an example). The details of these management strategy "field tests" will need to be expanded in the first 5-year MAP.

- Control invasion of the Habitat Reserve by exotic plants and animals.
    - Prohibit plants identified by the California Exotic Plant Pest Control as an invasive risk in Southern California from development and fuel management zones adjoining the Habitat Reserve.
    - Create fuel management zones combining irrigated and non-irrigated native plantings separating the Habitat Reserve from adjacent urban uses.
    - Provide barriers, fencing and walls to control access to the Habitat Reserve by domestic animals.
    - Implement the Invasive Species Control Plan throughout the Habitat Reserve where pest plant and wildlife species are a demonstrated problem or where they have the potential to spread rapidly into the Habitat Reserve. The Invasive Species Control Plan (described in detail in *Section 7.16* and *Appendix J*) addresses invasive riparian plants (giant reed, pampas grass, tamarisk, castor bean, tobacco tree, and Spanish sunflower), invasive upland species (artichoke thistle), and invasive animals (bullfrog, brown-headed cowbird, Argentine ant, and red fire imported ant).
- Control potential edge impacts such as lighting, increased moisture, pollutants and pesticides.
    - Shield and/or direct lighting away from habitat areas through the use of low-sodium or similar intensity lights, light shields, native shrubs, berms and other shielding methods.
    - Manage pesticide and herbicide use and fertilizer application techniques in landscaped areas, including golf courses, located adjacent to the Habitat Reserve

or preserved wetlands and provide comprehensive water quality treatment, which may include, but not be limited to, the use of natural treatment systems, prior to discharge of urban runoff into the Habitat Reserve.

- Protect sensitive resource areas from unauthorized public access and associated impacts such as off-road vehicles (including motorized vehicles and mountain bikes), trampling of vegetation, and harassment and collection of native species.
    - Implement policies regarding Uses Prohibited (*Chapter 11, Section 11.3*) and Public Access and Recreation policies in the Habitat Reserve (*Chapter 11, Section 11.2.3*), including:
        - Prohibition of collection or removal of any native plant, animal or microorganism;
        - Prohibition of introduction of any non-native plant, animal or microorganism;
        - Prohibition of firearms, weapons, and fireworks;
        - Restriction of vehicle operations to designated roads.
        - Restriction of hiking, mountain biking and equestrian uses to designated trails; and
        - Restriction of pets to designated locations and trails and restraint of pets by leash at all times.

These encroachment issues, while related to the overall AMP, are treated in detail in *Chapter 11*.

Wildfire control and fuel modification zones and treatments are addressed through the Fire Management Plan, as described below in *Section 7.14.*

b. Conserved Vegetation Communities

As stated above, an overall goal of the AMP is to maintain and, where feasible, enhance the long-term net habitat value within the subregion. Net habitat value as defined above is "no net reduction in the ability of the subregion to maintain viable populations of target species over the long-term." With the recognition that vegetation communities providing habitat are dynamic, implementation of the AMP is an essential element in assuring no net long-term loss of habitat value in the subregion. The AMP maintains net long-term habitat value in the subregion in two fundamental ways.

- Existing habitat value in the Habitat Reserve is conserved through implementation of the AMP.

- Through restoration activities, the AMP provides opportunities for increasing habitat value in areas with lesser existing habitat value such that long-term net habitat value in the Habitat Reserve is increased over current conditions.

The AMP addresses the five Conserved Vegetation Communities in the Habitat Reserve: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. Management objectives and strategies of the AMP concerning vegetation communities and net habitat value are stated below. It is important to note that the application and timing of management actions to achieve these goals would be tied to specific environmental stressors that are known or suspected to be operating in the Habitat Reserve, management priorities, and available funding. Goals and management objectives specific to each of the five Conserved Vegetation Communities are set forth in their respective *Sections 7.7* through *7.11*.

- Maintain Conserved Vegetation Communities and associated Covered Species and species assemblages, with the recognition that acreages and net habitat values for a particular community will oscillate in relation to natural events (*e.g.*, flood, fire, precipitation).
    - Establish the "baseline condition" of existing vegetation communities through aerial, and where appropriate, field mapping of the entire Habitat Reserve. At this time the appropriate minimum mapping units for each of the vegetation community types will be established based on aerial photo interpretation and ground truth sampling.
    - Conduct periodic (*e.g.*, every 5 years) landscape-level vegetation monitoring using remote sensing or other appropriate methods to identify significant disturbances to vegetation communities. Determine whether disturbance is of natural or human-caused origin.
    - Periodically (*e.g.*, every 5 years) quantify the acreage of the five Conserved Vegetation Communities addressed in the AMP. The Habitat Reserve acreages among the focus native vegetation communities would be allowed to vary such that net acreage of native vegetation communities remains relatively constant (*e.g.*, coastal sage scrub converts to chaparral, or either converts to woodland) unless it is clear that *major* or *important populations* of Covered Species in *key locations* are being adversely affected, in which case a management action may be required (*e.g.*, prescribed burn). If the increased grassland is native grassland, no management intervention would be required. A task during preparation of the first 5-year MAP, along with the baseline condition vegetation mapping of the Habitat Reserve, will be to establish initial "working management thresholds" for the acceptable range or variation of the native vegetation community acreage that

will need to factor measurement error, extent of coverage types, patterns of natural variability, and cause(s) of change. For example, if annual grassland increases more than 10 percent in areas formerly supporting native grassland, coastal sage scrub, or chaparral, a restoration/enhancement action may be warranted (*e.g.*, managed grazing, prescribed fire, mechanical treatment such mowing, or revegetation).

- Conduct annual on-the-ground monitoring of selected sample plots distributed across the Habitat Reserve. Selection of plots first would be based on a prioritization of management and monitoring activities by the Reserve Manager and Science Panel. Once priorities are have set, selection of plots would be based on a stratified pseudorandom sampling procedure to ensure a representative sample of the Habitat Reserve, including, for example, both interior and edge areas adjacent to urban development (the interior areas serve as controls for edge areas).
- Focus restoration activities in areas where, due to either human-caused or natural disturbances, the area would continue to degrade without management intervention (*e.g.*, repeated fire in a coastal sage scrub area may require active restoration to avoid type-conversion to annual grassland).

- Maintain the ability of the subregion to support populations of Covered Species.
  - Conduct monitoring of Conserved Vegetation Communities providing habitat supporting Covered Species, with a focus on stressors in selected areas in the Habitat Reserve identified as supporting *major* or *important populations* in *key locations*.
  - Implement management activities in any areas where degradation of vegetation communities providing habitat has been determined to adversely affect use by Covered Species **and** it is unlikely that the area would naturally regenerate without management intervention; *e.g.*, where giant reed invades arroyo toad breeding areas.
- Maintain and, where feasible, enhance long-term net habitat value in order to mitigate for proposed impacts and to further recovery of listed Covered Species. Note that initial vegetation community restoration and invasive species control activities to address most of the following objectives have been identified and are described in their respective plans (set forth in *Appendices H* and *J*):
  - Conduct restoration of coastal sage scrub in designated areas along Chiquita and Chiquadora ridges to improve habitat connectivity and carrying capacity for the California gnatcatcher.

- Conduct restoration of native grasslands in designated areas of upper Cristianitos Canyon to improve habitat quality for thread-leaved brodiaea.
- Manage native grasslands in areas supporting thread-leaved brodiaea through timed-grazing, prescribed burning, and/or selective weeding.
- Implement invasive plant and animal species control plans along San Juan and Cristianitos creeks to improve breeding habitat for the arroyo toad and least Bell's vireo.
- Maintain flow characteristics of episodic events and assure water quality in drainages supporting the arroyo toad.
- Conduct invasive plant controls along Arroyo Trabuco Creek to improve breeding habitat for the least Bell's vireo.
- Protect existing vegetation communities providing habitat in Gobernadora Creek (GERA) through management and restoration actions.

- Identify and restore existing areas with little or no habitat value to increase long-term net habitat value.
  - Conduct restoration of coastal sage scrub in designated areas along Chiquita and Chiquadora ridges and in Sulphur Canyon to improve habitat connectivity and carrying capacity for the California gnatcatcher and other sage scrub species.
  - Conduct restoration of native grasslands and coastal sage scrub/native grassland mix in designated areas such as Chiquita Ridge, upper Cristianitos Canyon, and upper Gabino canyon to improve habitat quality for grassland species such as the grasshopper sparrow.
- As opportunities arise in the future, use restoration to increase long-term net habitat value in the Habitat Reserve.
-

c. Covered Species and Focal Species

The AMP addresses two general classes of wildlife species: **(1)** Covered Species; and **(2)** focal species.

1. Covered Species

The Conservation Strategy (including reserve design) is designed in part to conserve a suite of Covered Species and associated habitats designated by the Southern NCCP/MSAA/HCP. The discussion of Covered Species, including selection of species for state and federal regulatory coverage and the justification for coverage, is provided in *Chapter 13*. The AMP component of

the Conservation Strategy is designed to maximize the likelihood that Conserved Vegetation Communities supporting Covered Species are sustained and, in so doing, would "provide for recovery" of Covered Species on a subregional basis and "contribute to recovery" on a rangewide basis. Management and monitoring of Covered Species would occur, as appropriate, at the landscape level (*e.g.,* Science Advisors Group 2 species) or at the site- and/or species-specific level (*e.g.,* Science Advisors Group 3 species).

Two main goals of the AMP concerning Covered Species are:

1. **Maintain conditions that will allow for normal evolutionary processes and genetic integrity and exchange through management of a functional Habitat Reserve, including functioning vegetation communities, habitat linkages and wildlife corridors.**

   This goal generally would be achieved by meeting the objectives stated above for habitat connectivity, edge effects and encroachment, and Conserved Vegetation Communities (as well as specific goals and management objectives for each of the five Conserved Vegetation Communities set forth in *Sections 7.7* through *7.11*) because they all address the long-term function of the Habitat Reserve for Covered Species and associated Conserved Vegetation Communities.

2. **Manage Conserved Vegetation Communities and populations of Covered Species to maximize the likelihood that Covered Species are sustained, and in so doing "provide for recovery" of Covered Species on a subregional basis and "contribute to recovery" on a rangewide basis.**

Objectives designed to achieve this goal are to:

- Monitor populations of selected Covered Species and/or Conserved Vegetation Communities to detect population trends in relation to environmental stressors and management issues. Monitoring would focus on *major* and *important populations* and *key locations* of Covered Species where possible.
- Implement appropriate management actions, as necessary, to stabilize or enhance populations of Covered Species, such as habitat restoration, and pest controls (*e.g.,* cowbird trapping, invasive species control).

All Covered Species would be managed and monitored at some level, either as an integral aspect of the program or through data gathered through specific monitoring efforts. The management

and monitoring of each Covered Species is described in detail in the Species Accounts and Conservation Analysis in *Appendix E.*

2. Focal Species

In addition to management and monitoring of Covered Species, a selected set of non-covered focal species will be managed and monitored. The concept of focal species was introduced in *Section 7.4.1.b.* Generally, focal species may provide indirect information about habitat quality and function for other species, play a key role in managing and monitoring community structure and processes, and serve as indicators of ecological sustainability (Committee of Scientists 1999).

(a) Methods for Selecting Focal Species

The focal species approach assumes that only a limited number of species can be effectively and practically monitored and managed because of the need to focus on species that provide feedback for management decision-making and the finite resources typically available for programs. Murphy *et al*. (2003) provide a practical and logical method for selecting focal species. This method is essentially a step-down, filtering approach whereby a "long list" of focal species candidates is enumerated and progressively subjected to a series of questions pertaining to their suitability as focal species. Ideally, the selection process identifies a set of species that represents the various taxonomic groups and the relevant aspects of the ecological system being monitored.

The method described here to select focal species is a slight modification of the method suggested by Murphy *et al.* (2003) and uses the currently available Science Advisors species groupings (*i.e.*, Group 1, 2, or 3) described in *Chapter 3* as the foundation for a "long list" of candidate focal species. The definitions of these three groups are restated from *Chapter 3* in the context of the AMP.

Group 1 species require minimal conservation or management action. Their conservation would be minimally affected by management based on the following criteria:

- Management would have a very limited impact on the species;
- The species is not found or is insignificant in the study area; and/or
- The species has very high population numbers in the study area.

Based on these criteria, and particularly the first bullet, no Group 1 species would be selected as focal species.

Group 2 species are best conserved by protecting Conserved Vegetation Communities at a landscape level through general NCCP/HCP reserve design tenets and through adaptive management. Their conservation can be inferred from a well-planned and managed network of reserves in a functioning landscape. Criteria for Group 2 species include one or more of the following:

- The species is relatively widespread in the study area;
- The species occurs in relatively robust populations within the study area and possibly elsewhere;
- Life history characteristics respond to vegetation community/landscape-level conservation;
- Detailed surveys or inventories are not crucial in order to conserve the species;
- The species is known to, or likely to, respond well to vegetation community management;
- The species is locally genetically indistinct; or
- No individual action is needed other than vegetation community conservation and management.

Group 2 species exhibit several characteristics that are desirable in focal species, and in particular, they are common enough to be effectively monitored and that they may respond well to management actions.

Group 3 species are best conserved at the species-specific level. They require one or more of three types of conservation action: **(1)** fine-tuning of reserve design or specific management activities; **(2)** reintroduction and/or specific enhancement; or **(3)** additional data and research are necessary to determine basic needs. Criteria for Group 3 species include one or more of the following:

- The species is known or predicted to occur in extremely low populations;
- The species is narrowly endemic in the study area;
- The species has highly specialized life history requirements;
- The study area is known to be crucial to the survival of the entire species;
- The species is known or suspected to respond poorly to management;

- The species is highly sensitive to small changes in the landscape or vegetation community;
- The species is dependent on intensive conservation activities; or
- The species is widespread, but extremely uncommon.

The conservation and adaptive management requirements for Group 3 species are site-specific and species-specific. By definition, regulatory coverage for these species would involve monitoring the status of these species, or a selected subset of species, to maximize the likelihood of their persistence in the planning area. In some cases, Group 3 species such as arroyo toad or least Bell's vireo may be valuable focal species because they are sensitive to environmental stressors known or likely to affect other species (*e.g.*, altered hydrology and exotic species). Other Group 3 species, such as San Diego and Riverside fairy shrimp, may not be useful focal species because their habitat requirements and life-history characteristics are more unique (however, they would be managed and monitored as Covered Species; see *Appendix E* for details on the management and monitoring of Covered Species).

In addition to using the Group 2 and 3 species as a basis for the "long list" of candidate focal species, umbrella species and other species considered by the Science Advisors to be "indicative of the quality of select vegetation community-types" also were included. One additional proposed Covered Species that were not on the Science Advisors group lists – red coachwhip – was added to the long list. Finally, several invasive species (*e.g.*, brown-headed cowbird, bullfrog) and possible indicators of disturbance or declining habitat quality, such as "edge-enhanced" species (*e.g.*, Anna's hummingbird, house finch, mockingbird; see study on habitat fragments in urban environments by Bolger *et al.* 1997a) were added to the list. Monitoring these potential "early warning" indicator species may be valuable for detecting negative trends in Habitat Reserve function and Covered Species populations. However, it is important to understand that the utility of these species for detecting negative trends has not been rigorously tested and empirically validated and that an important function of the AMP will be to test their utility as focal species.

Species that do not rely on one of the five Conserved Vegetation Communities – coastal sage scrub, chaparral, grassland, riparian and wetland, and oak woodland – were removed from the list (*e.g.*, open water species such as American white pelican, double-crested cormorant, etc.). This vetting process resulted in the "long list" of 73 candidate focal species shown in *Table 7-2*. The table organizes the species by whether they were selected or rejected for the "short list" of candidate focal species based on the vetting process described below. It should be noted that Covered Species not included in the list of candidate focal species will still be managed and monitored (*e.g.*, Riverside and San Diego fairy shrimp), but they do not function as focal species for overall management and monitoring of the Habitat Reserve.

TABLE 7-2
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
Species Selected as Candidate Focal Species								
Arroyo Toad	Yes	Yes	Yes	No	?	Possible	Yes	EW
Bullfrog	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Acorn Woodpecker	Yes	Yes	Yes	Yes	?	Yes	Yes	EW, BI
Anna's Hummingbird	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Ash-throated Flycatcher	Yes	Yes	Yes	?	?	?	Yes	EW
Barn Owl	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Brown-headed Cowbird	Yes	Yes	Yes	?	?	Yes	Yes	EW
Cactus Wren	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
California Gnatcatcher	Yes	Yes	Yes	No	No	Yes	Yes	EW
California Thrasher	Yes	Yes	Yes	?	?	?	Yes	BI
Costa's Hummingbird	Yes	Yes	Yes	?	?	?	Yes	EW, BI
European Starling	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Grasshopper Sparrow	Yes	Yes	Yes	No	No	Possible	Yes	BI
Great Horned Owl	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
House Finch	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Lark Sparrow	Yes	Yes	Yes	?	?	?	Yes	EW
Least Bell's Vireo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Northern Mockingbird	Yes	Yes	Yes	Yes	?	Yes	Yes	BI
Nuttall's Woodpecker	Yes	Yes	Yes	Yes	?	Yes	Yes	BI
Red-tailed Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Rufous-crowned Sparrow	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Snowy Egret	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Wrentit	Yes	Yes	Yes	Yes	?	?	Yes	BI
Yellow Warbler	No	Yes	Yes	?	?	?	Yes	EW, BI
Orange-throated Whiptail	Yes	Yes	Yes	?	?	?	Yes	EW
San Diego Coast Horned Lizard	No	Yes	Yes	?	?	?	Yes	EW, BI
Southwestern Pond Turtle	Yes	Yes	Yes	Yes	?	Yes	Yes	EW, BI
Bobcat	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Coyote	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW

TABLE 7-2
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
Mountain Lion	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Mule deer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Arroyo Chub	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Threespine Stickleback	No	Yes	Yes	?	?	?	Yes	EW, BI
Argentine Ant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Imported Fire Ant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Species Rejected as Candidate Focal Species								
California Treefrog	Yes	Yes	?	?	?	?	No	Rejected
Pacific Chorus Frog	Yes	Yes	Yes	?	?	?	No	Rejected
Western Spadefoot Toad	Yes	No	No	No	?	?	No	Rejected
Black-chinned Sparrow	?	No	No	?	?	No	Yes	Rejected
Burrowing Owl	Yes	Yes	No	?	?	No	Yes	Rejected
California Horned Lark	?	Yes	Yes	No	?	No	Yes	Rejected
Common Yellowthroat	Yes	Yes	Yes	Yes	?	?	No	Rejected
Cooper's Hawk	Yes	Yes	Yes	Yes	Yes	Yes	No	Rejected
Golden Eagle	Yes	Yes	No	No	?	No	Yes	Rejected
Greater Roadrunner	Yes	Yes	No	?	?	?	Yes	Rejected
Loggerhead Shrike	Yes	Yes	Yes	?	?	?	Yes	Rejected
Long-eared Owl	Yes	Yes	Yes	?	?	?	Yes	Rejected
Red-shouldered Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Red-winged Blackbird	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Savannah Sparrow	Yes	Yes	?	?	?	?	No	Rejected
Sora	Yes	No	No	?	?	?	Yes	Rejected
Southwestern Willow Flycatcher	No	Yes	?	No	?	No	Yes	Rejected
Spotted Towhee	Yes	Yes	Yes	?	?	?	No	Rejected
Swainson's Thrush	Yes	Yes	?	?	?	?	No	Rejected
Tricolored Blackbird	Yes	Yes	Yes	No	No	No	Yes	Rejected
Western Screech Owl	Yes	Yes	No	?	?	?	Yes	Rejected
White-tailed Kite	?	Yes	Yes	No	No	No	Yes	Rejected
Yellow-breasted Chat	?	No	Yes	?	?	?	?	Rejected
California Glossy Snake	?	No	No	No	?	No	No	Rejected

TABLE 7-2
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
Coast Patch-nosed Snake	?	No	No	NO	?	No	No	Rejected
Northern Red-diamond Rattlesnake	No	No	No	No	?	No	Yes	Rejected
Red Coachwhip	?	No	No	?	?	No	No	Rejected
Rosy Boa	No	No	No	?	?	?	?	Rejected
Silvery Legless Lizard	No	No	No	?	?	?	No	Rejected
Spotted Night Snake	Yes	No	No	No	?	No	No	Rejected
Two-striped Garter Snake	Yes	No	No	No	?	?	No	Rejected
Dulzura California Pocket Mouse	No	Yes	Yes	Yes	?	Yes	No	Rejected
Dulzura Kangaroo Rat	Yes	Yes	Yes	Yes	Yes	Yes	No	Rejected
Gray Fox	Yes	Yes	Yes	?	?	?	No	Rejected
Southern Steelhead ESU	Yes	Yes	Yes	No	No	No[1]	Yes	Rejected
Behr's Metalmark	?	?	?	?	?	?	?	Rejected
Riverside Fairy Shrimp	Yes	Yes	Yes	No	?	?	Yes	Rejected
San Diego Fairy Shrimp	Yes	Yes	Yes	No	?	?	Yes	Rejected

EW – Early warning indicator; BI – Biodiversity Indicator

[1] Detectable Trends in Occurrence and Population Size cannot be assessed at this time in the planning area because the southern steelhead currently does not occur in the planning area. Where the steelhead occurs it is tends in occurrence and population size can be measured.

Following Murphy *et al.* (2003), a selection filter was applied to the species on the long list that consists of seven questions:

1. Does the species have an unambiguous taxonomy (*i.e.,* are there species or sub-species naming issues)?
2. Is the biology and life history of the species reasonably well known?
3. Is the species "easy" to detect and measure (*e.g.,* is it highly visible such that individuals or its sign such as tracks or scat are likely to be detected if present)?
4. Does the species exhibit low sampling variability (*e.g.,* is the species a reliably detected resident or migrant or does it occur erratically)?
5. Does the species exhibit low demographic and genetic variability?
6. Does the species exhibit detectable trends in occurrence and population size?
7. Are there known relationships between occurrence, population size, and stressors or ecosystem processes?

Questions "4-6" require more explanation to understand the importance of these issues in selecting focal species. Generally these questions relate to the issues of species *generation times* and *population sampling*.

Generation Times

Generation times are the species' average life cycle time between birth and death. Species with very long generation times (*e.g.,* decades) may not be suitable for monitoring because population turnover may too slow to detect population changes in relation to environmental stressors until, it is too late to reverse the trend; *i.e.,* the "lag" time between the stressor effect and species response is too long to effectively manage the stressor. This problem may be overcome to some extent by closely monitoring demographic factors such as age-group distributions, recruitment, etc., but in some long-lived species with low reproductive rates, significant demographic changes may be undetectable for long periods. On the other hand, species with short generation times and highly volatile reproductive cycles also may not be suitable focal species because apparent extirpations, leading to management actions, may simply be part of the natural population oscillation (*i.e., intrinsic driver*) exhibited by the species, and it may be difficult to separate the human-induced stressor component (*i.e., extrinsic driver*) from the natural oscillations because of the high variability. If the population oscillations primarily are caused by intrinsic natural factors and are self-regulating, management would not be warranted and would be wasteful of management and monitoring resources. Ideally, focal species will have generation times that are significantly correlated with the environmental stressors operating in the Habitat Reserve so that

if a population decline is detected, it can be clearly tied to the stressor; *e.g.,* the lag time between the observed stressor and population response is short enough to correlate the two variables and separate out natural causes of population oscillations. While some causal relationships between stressors and the species' response may be obvious (*e.g.,* cowbird parasitism on native passerines), some experimentation within the adaptive management framework may be required to demonstrate causality between the stressor and species response and the efficacy of a management action. In response to information compiled over time, thresholds for triggering management actions would be established and refined.

Population Sampling

In order for management and monitoring to proceed efficiently and for trends and causal relationships to be detectable in relation to stressors, the focal species must be amenable to reasonable sampling regimes. If a species is so rare or occurs in such low densities over a wide distribution such that it is rarely encountered (*i.e.,* question 4 of whether the species has low sampling variability), even with effective detection methods (*i.e.,* question 3 of whether the species is easy to find and measure when present), its use as a focal species would be limited. For example, rare winter migrant birds, that may be easy to detect or identify when present, would make poor focal species because their occurrence is sporadic and linking their presence or absence to environmental stressors would be virtually impossible. That is, the noise (*intrinsic driver*) to signal (*extrinsic driver*) ratio is too large to reliably or practicably measure the signal component. Gibbs (2000) estimated the necessary sampling intensities (*i.e.,* the number of sample plots related to the number of samples per year) that would provide the statistical power for reliably detecting certain population changes (*e.g.,* 10, 25, or 50 percent population reduction) in different taxonomic groups (*e.g.,* large mammals, small-bodied birds). The statistical power of the monitoring program is closely related to the variability of the population index used (*e.g.,* how much does the population vary from year-to-year?). The power to detect a trend is inversely related to the magnitude of index variability; the more variable a population is, the more power the monitoring program has to have. For small-bodied birds, for example, which have moderately high population variability, Gibbs estimated that 30 plots sampled four times per year for 10 years would be required to detect a 25 percent change in the population. To detect a 10 percent change would require 130 plots sampled four times per year for 10 years; *i.e.,* as the change threshold becomes finer-grained, the sampling intensity is magnified for species with high index variability. In contrast, for large mammals that have relatively low variability, Gibbs estimated that only 10 plots sampled four times per year for 10 years would be needed to detect a 10 percent change; *i.e.,* the large mammals are more amenable to statistically reliable sampling with less effort than small-bodied birds because they have lower population variability.

The selection of focal species will need to consider the amount of effort needed to establish population trends for the focal species (*i.e.,* question 6). Species that exhibit high variability indices may not be suitable focal species if an adequate sampling effort cannot be made with the available management funding and resources.

Known Environmental Stressors and Ecosystem Processes

A key question for selecting focal species is whether there are known relationships between occurrence, population size, and stressors or ecosystem processes (*i.e.,* question 7). Some species already have a demonstrated sensitivity to certain stressors, and, in some cases, a demonstrated positive response to management; these would be useful focal species. Known and possible stressors on Covered Species, and positive management actions, if known, are summarized in the Species Accounts (*Appendix E*), and are reflected in the management and restoration objectives for each of the Conserved Vegetation Communities. For example, the least Bell's vireo is nest-parasitized by the brown-headed cowbird. Cowbird trapping has been accepted as an effective management technique and appears to be a primary factor in the rebound of the vireo population in southern California (USFWS 1998b). Likewise, the bullfrog is a documented predator on arroyo toads in general (USFWS 1999c) and on RMV (Ramirez 2003), as well as the California red-legged frog (*e.g.,* Kiesecker 1998; Lawler *et al.* 1999). Control of bullfrogs therefore would be an important tool for managing the arroyo toad, and possibly western spadefoot toad, but it would be important to demonstrate a positive response to bullfrog control and to determine what kinds of controls techniques are most effective under the adaptive management framework.

The relationship between ecosystem processes and species occurrence and population size also is reasonably well known for some species. Again, using the arroyo toad as an example, it is known that arroyo toad breeding success depends on breeding pools persisting into May and June to allow sufficient time for metamorphosis from larvae to juvenile age class. Hydrology, therefore, is a well-understood component of arroyo toad biology.

An example of an analysis of a species as a potential focal species for coastal sage scrub is a study by Chase *et al.* (1998) on the California gnatcatcher, where the research question was whether sites that supported gnatcatchers also supported significantly more other species than sites without gnatcatchers. That is, is the gnatcatcher an indicator of coastal sage scrub species richness? If it could be shown that gnatcatcher presence is positively correlated with bird-species richness, the species could be a valuable habitat indicator. Bird-species richness was evaluated at 17 sites Riverside, San Diego and Orange counties where gnatcatchers were both present and absent. Although there were slightly more species of birds at sites where gnatcatchers were present, the difference was small and not statistically significant; *i.e.,* the

gnatcatcher was not a good indicator or predictor of bird-species richness in this study. This finding is not surprising given that gnatcatchers appear to persist in relatively small, highly fragmented habitat patches (*e.g.*, Dudek 2004) and may occur where overall species richness is relatively low (Chase *et al.* 1998). Although this study suggests that the gnatcatcher may not be a good indicator of bird-species richness, it is retained here as a candidate focal species because it originally was designated as an NCCP "target" species for the coastal sage scrub vegetation community and because this single study does not conclusively rule out its value as a focal species. Furthermore, it is likely that no single species alone will be an adequate indicator or predictor of habitat value and function; several species, ultimately at different trophic levels (*i.e.*, level in the food chain), likely will need to be monitored to maximize the likelihood that the diversity and dynamics of the coastal sage scrub system are being successfully monitored and managed.

(b) Selection of Candidate Focal Species

Table 7-3 presents the results of this filtering process for selecting a "short list" of candidate focal species from the 73 species on the "long list." With regard to taxonomy and life history questions (*i.e.*, questions 1 and 2 above), the California Wildlife Habitat Relationships database was consulted where other information was not readily available. The answers to the questions of whether the species is easy to detect and whether there is low sampling variability primarily relied on local professional experience or published and/or generally accepted species survey protocols (*e.g.*, for California gnatcatcher, least Bell's vireo, arroyo toad, pond turtle, etc.). The answers to whether the species exhibits low demographic and genetic variability and whether it exhibits detectable trends in occurrence and population size are the two most difficult questions to answer with any certainty because of the general lack of information. In most cases, these questions were answered with a "?" indicating that adequate information is unavailable; these are "critical uncertainties" for the utility of these species as focal species. It should be noted, however, that in some cases, we may not know the demographic and genetic variability of the species. If such a species is a high priority for monitoring, the monitoring effort may need to be adjusted to collect adequate data. An important consideration for selecting a focal species thus is the tradeoff between the value of the monitoring data to the overall AMP and the effort required to collect the data.

TABLE 7-3
CANDIDATE FOCAL SPECIES

Common Name	Vegetation Type(s)	Focal Species Category	Environmental Stressor(s)[1]
Birds			
Acorn Woodpecker	Oak woodland	Early warning and biodiversity indicator	Invasive species, low acorn productivity, acorn and nest competitors
Anna's Hummingbird	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation

TABLE 7-3
CANDIDATE FOCAL SPECIES

Common Name	Vegetation Type(s)	Focal Species Category	Environmental Stressor(s)[1]
Ash-throated Flycatcher	Oak woodland	Biodiversity indicator	Nest competitors
Barn Owl	Grassland, riparian, woodland	Umbrella species	Habitat loss?
Brown-headed Cowbird	All types (?)	Early warning indicator	Nest parasite of native passerines
Cactus Wren	Coastal sage scrub	Early warning indicator	Fire, mesopredators, urban-related predators (*e.g.,* cats and dogs)
California Gnatcatcher	Coastal sage scrub	Early warning indicator	Fire, drought, cowbirds
California Thrasher	Coastal sage scrub, chaparral	Biodiversity indicator	Habitat fragmentation sensitive
Costa's Hummingbird	Coastal sage scrub, chaparral	Biodiversity indicator	Habitat fragmentation sensitive, edge-reduced species
European Starling	Riparian and oak woodland	Early warning indicator	Edge-enhanced species and nest competitor. Indicator of habitat degradation
Grasshopper Sparrow	Grassland	Biodiversity indicator	Loss of structural habitat diversity, mesopredators, urban-related predators (*e.g.,* cats and dogs), cowbirds
Great Horned Owl	All types	Umbrella species	Habitat loss?
House Finch	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Lark Sparrow	Grassland, oak woodland	Early warning and biodiversity indicator	Edge-reduced species
Least Bell's Vireo	Riparian	Early warning and biodiversity indicator	Flood regime, invasive species, mesopredators, cattle-related impacts, noise
Northern Mockingbird	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Nuttall's Woodpecker	Oak woodland, riparian	Biodiversity Indicator	Habitat loss?
Red-tailed Hawk	All types	Umbrella species	Habitat loss?
Rufous-crowned Sparrow	Coastal sage scrub	Biodiversity indicator	Edge-reduced species
Snowy Egret	Wetlands	Early warning and biodiversity indicator	Sensitive to human disturbance
Wrentit	Coastal sage scrub, chaparral	Biodiversity indicator	Habitat fragmentation sensitive
Yellow Warbler	Riparian	Early warning and biodiversity indicator	Flood regime, exotic species, mesopredators, cattle-related impacts
Amphibians and Reptiles			
Arroyo Toad	Riparian and wetlands	Early warning indicator	Flood regimes, water quality, invasive species, cattle-related impacts, road kill
Bullfrog	Riparian and wetlands	Early warning indicator	Predator of several native species
Orange-throated Whiptail	Coastal sage scrub, chaparral, woodland	Early warning indicator	Frequent fire, Argentine ants, cattle-related impacts
San Diego Horned Lizard	Coastal sage scrub, chaparral	Early warning and biodiversity indicator	Frequent fire, Argentine ants, cattle-related impacts, collection
Southwestern Pond Turtle	Riparian and wetland	Early warning and biodiversity indicator	Hydrologic alterations, water quality, predation by bullfrogs, mesopredators, cattle-related impacts, collection
Mammals			
Bobcat	Chaparral, riparian, woodland	Umbrella species	Habitat fragmentation, vehicle collisions, human recreation

TABLE 7-3
CANDIDATE FOCAL SPECIES

Common Name	Vegetation Type(s)	Focal Species Category	Environmental Stressor(s)[1]
Coyote	All types	Early warning	Absence from habitat patches indicates potential mesopredator release and loss of native species
Mountain Lion	Chaparral, riparian, woodland	Umbrella species	Habitat fragmentation, vehicle collisions, depredation, human recreation, loss of prey
Mule Deer	Coastal sage scrub, chaparral, riparian, woodland	Umbrella species	Vehicle collisions
Fish			
Arroyo Chub	Wetland	Early warning and biodiversity indicator	Hydrologic alterations, water quality, predation by bullfrogs and exotic fish, invasive plants
Threespine Stickleback	Wetland	Early warning and biodiversity indicator	Hydrologic alterations, water quality, predation by bullfrogs and exotic fish, invasive plants
Invertebrates			
Argentine Ant	All types where there is adequate moisture	Early warning indicator	Edge-enhanced species that displaces native prey and directly kills natives
Imported Fire Ant	All types where there is adequate moisture	Early warning indicator	Edge-enhanced species that displaces native prey and directly kills natives

[1] It is assumed that habitat loss and fragmentation is an environmental stressor for most, if not all, of the native candidate focal species and that many of the stressors, such as edge effects, in part stem for habitat loss and fragmentation. Unless habitat loss and fragmentation has been identified as a particularly important issue for a species (*e.g.,* wrentit, California thrasher, bobcat, mountain lion), it would not be a focal stressor for the purpose of management and monitoring.

The answer to whether there are known relationships between environmental stressors, and population size and occurrence is based on published and anecdotal reports of threats to species. For example, short interval fire is reported to be a threat to gnatcatchers, bullfrogs are known predators of arroyo toads, etc. For the invasive species on the lists, such as brown-headed cowbird, starling, mockingbird, etc., they are either the direct environmental stressor (*e.g.*, cowbirds are nest parasites and European starlings potentially compete with native species for nesting cavities [see Koenig 2003, however, for caveats in drawing inferences about the effects of invasive species]) or possibly indicators of degraded edge habitat (*e.g.*, mockingbirds are common along the urban-wildland interface). In many cases causal relationships underlying the presence of an invasive species, and the decline or absence of a native species are not known; *i.e.*, the observation is correlational. It may be unclear, for example, whether the invasive species actively displaces the native species (*e.g.*, starlings outcompeting native species for nest cavities), directly reduces reproductive success of the native species (*e.g.*, nest parasitism by brown-headed cowbirds), or, on the other hand, more passively colonizes available habitat because the native species has declined or disappeared for some other unrelated reason; the species has not caused the decline, but has responded to the absence of the native species.

Generally, if a species could not be tied to a specific environmental stressor or ecosystem process or characteristic (*e.g.,* habitat quality), it was rejected as a potential focal species. In addition, if the answers regarding taxonomy, biology and life history, ease of detection and measurement, and low sampling variability were consistently "No," the species was rejected for further consideration. For example, reptiles such as the rosy boa typically are little known and hard to reliably detect, and thus are poor candidates as focal species. In most cases, the answer to whether the species has low demographic or genetic variability is unknown, so this factor was not considered as strongly in whether the species was rejected or not as a potential focal species.

The initial filtering process using the seven questions posed above narrowed the species list to 32 candidate focal species, including 20 birds, two amphibians, three reptiles, four mammals, one fish and two invertebrates (*Table 7-3*). Species that passed the first filter and were retained as potential focal species for further consideration were assigned to one or more of the focal species categories described above. For potential umbrella species, the recommendations of the Science Advisors were followed. For indicator species, two types of indicators were identified: early warning and biodiversity indicators. As used here, early warning indicators included species that are known or strongly suspected to be sensitive to environmental stressors that have broad implications for habitat integrity and other species. For example, arroyo toad is designated an early warning indicator because it vulnerable invasions by exotic plants such as giant reed and tamarisk and to bullfrog predation, which in turn affect the entire riparian/wetland ecosystem. Coyote also was designated an early warning indicator because their absence from habitat patches is related to "mesopredator release" and loss of small native species (Crooks and Soulé 1999). Edge-enhanced species (see Bolger *et al.* 1997a), such as the Anna's hummingbird, house finch, and mockingbird, also are designated as potential early warning indicators because their presence may indicate degradation of vegetation communities providing habitat and potential competition with native species vulnerable to edge effects (but again, these relationships have not been rigorously tested and validated and their value as early warning indicators would need to be validated). The grasshopper sparrow is designated a biodiversity indicator because it is associated with structurally diverse grassland habitats, which presumably would support a more diverse species assemblage than a monotypic grassland. It should be kept in mind, however, that these assignments reflect hypothesized relationships based on the best science available, rather than empirically validated relationships. Thus, they are only a starting point for the AMP and would be adjusted as new information becomes available.

A summary by focal species types, vegetation community and taxonomic group is provided in *Table 7-4.*

TABLE 7-4
SUMMARY OF CANDIDATE FOCAL SPECIES
BY TYPE AND CONSERVED VEGETATION COMMUNITY

Taxonomic Group	Covered Vegetation Community				
	Coastal Sage Scrub	**Chaparral**	**Grassland**	**Riparian and Wetland**	**Oak Woodland**
Birds					
Early Warning	California Gnatcatcher Cactus Wren Anna's Hummingbird House Finch Mockingbird	Anna's Hummingbird House Finch Mockingbird	Anna's Hummingbird House Finch Lark Sparrow Mockingbird	Least Bell's Vireo Yellow Warbler Anna's Hummingbird Brown-headed Cowbird European Starling House Finch Mockingbird Snowy Egret	Acorn Woodpecker Anna's Hummingbird European Starling House Finch Lark Sparrow Mockingbird
Biodiversity	California Thrasher Rufous-crowned Sparrow Wrentit	California Thrasher Wrentit	Grasshopper Sparrow Lark Sparrow	Least Bell's Vireo Yellow Warbler Snowy Egret	Acorn Woodpecker Ash-throated Flycatcher Lark Sparrow
Umbrella	Great Horned Owl Red-tailed Hawk	Great Horned Owl Red-tailed Hawk	Barn Owl Great Horned Owl Red-tailed Hawk	Barn Owl Great Horned Owl Red-tailed Hawk	Barn Owl Great Horned Owl Red-tailed Hawk
Amphibians					
Early Warning				Arroyo Toad Bullfrog	
Reptiles					
Early Warning	Orange-throated Whiptail San Diego horned Lizard	Orange-throated Whiptail San Diego horned Lizard		Southwestern Pond Turtle	Orange-throated Whiptail
Biodiversity	San Diego Horned Lizard	San Diego Horned Lizard		Southwestern Pond Turtle	
Mammals					
Early Warning	Coyote	Coyote	Coyote	Coyote	Coyote
Umbrella	Mule deer	Bobcat Mountain Lion Mule Deer		Bobcat Mountain Lion Mule Deer	Bobcat Mountain Lion Mule Deer
Fish					
Early Warning				Arroyo Chub	
Biodiversity				Arroyo Chub	
Invertebrates					
Early Warning	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant
Total					
Early Warning	10	8	7	15	10
Biodiversity	4	4	2	5	3
Umbrella	3	5	3	6	6

(c) Summary of Covered and Other Focal Species

Table 7-5 provides a summary of the Covered Species that were also identified as candidate focal species, Covered Species that were not identified as focal species, and non-covered focal species. Management and monitoring of Covered Species that were not identified as focal species is described in detail in the Species Accounts and Conservation Analysis in *Appendix G.*

TABLE 7-5
COVERED SPECIES AND CANDIDATE FOCAL SPECIES PROPOSED TO BE MANAGED AND MONITORED UNDER THE ADAPTIVE MANAGEMENT PROGRAM[1]

Common Name	Covered Species	Candidate Focal Species
Birds		
Acorn Woodpecker		•
Anna's Hummingbird		•
Ash-throated Flycatcher		•
Barn Owl		•
Brown-headed Cowbird		•
Burrowing Owl	•	
Coastal Cactus Wren	•	•
Coastal California Gnatcatcher	•	•
California Thrasher		•
Cooper's Hawk	•	
European Starling		•
Grasshopper Sparrow	•	•
Great Horned Owl		•
House Finch		•
Lark Sparrow		•
Least Bell's Vireo	•	•
Long-eared Owl	•	
Northern Mockingbird		•
Red-tailed Hawk		•
Rufous-crowned Sparrow		•
Snowy Egret		•
Southwestern Willow Flycatcher	•	
Tricolored Blackbird	•	
White-tailed Kite	•	
Wrentit		•
Yellow-breasted Chat	•	•
Yellow Warbler	•	•
Amphibians		
Arroyo Toad	•	•
Bullfrog		•
Western Spadefoot Toad	•	
Reptiles		
California Glossy Snake	•	
Coast Patch-nosed Snake	•	

TABLE 7-5
COVERED SPECIES AND CANDIDATE FOCAL SPECIES PROPOSED TO BE MANAGED AND MONITORED UNDER THE ADAPTIVE MANAGEMENT PROGRAM[1]

Common Name	Covered Species	Candidate Focal Species
Northern Red-diamond Rattlesnake	•	
Orange-throated Whiptail	•	•
Red Coachwhip	•	
"San Diego" Coast Horned Lizard	•	•
Southwestern Pond Turtle	•	•
Mammals		
Bobcat		•
Coyote		•
Mountain Lion		•
Mule Deer		•
Fish		
Arroyo Chub	•	•
Partially Armored Threespine Stickleback	•	•
Invertebrates		
Argentine Ant		•
Imported Fire Ant		•
Riverside Fairy Shrimp	•	•
San Diego Fairy Shrimp	•	•
Plants		
California Scrub Oak	•	
Chaparral Beargrass	•	
Coast Live Oak	•	
Coulter's Saltbush	•	
Many-stemmed Dudleya	•	
Southern Tarplant	•	
Thread-leaved Brodiaea	•	

[1] The Science Panel will recommend the final list of focal species to the Reserve Manager and County.

It is important to understand how the management and monitoring of Covered Species and focal species relates to the *Effectiveness Monitoring* and *Compliance Monitoring* in accordance with the USFWS Five-point Policy introduced in *Section 7.2.3* and discussed more fully in *Section 7.5 9* (also see *Chapter 14* and *Appendix V*). Because Covered Species are accorded regulatory status, monitoring of these species, either at a vegetation community- or species-based level, is required under *Compliance Monitoring* to ensure that the AMP is consistent with the terms of the Wildlife Agency approvals. Monitoring and management of the focal species, including Covered Species that are also focal species, addresses *Effectiveness Monitoring* to ensure that the Habitat Reserve and AMP are meeting the overall goals and objectives of the NCCP/MSAA/ HCP.

3. Invasive Species

In addition to the focal species discussed above, the AMP will target a suite of invasive plant species that have existing and foreseeable detrimental impacts on the Habitat Reserve. Based on the invasive riparian species assessment conducted by PCR (2002), general observations on the RMV property by T. Bomkamp (pers. comm. 2005), and input by the Wildlife Agencies and others, the priority invasive plants targeted for control are:

- Giant reed (*Arundo donax*) – Priority 1
- Pampas grass (*Cortaderia selloana*) – Priority 2
- Artichoke thistle (*Cynara cardunculus*) – Priority 2
- Castor bean (*Ricinus communis*) – Priority 2
- Tamarisk (*Tamarix ramosissima*) – Priority 3
- Tree tobacco (*Nicotiana glauca*) – Priority 3
- Spanish sunflower (*Pulicaria paludosa*) – Priority 3

The Invasive Species Control Plan is discussed in greater detail in this Chapter in *Section 7.12* and is presented in full in *Appendix J*. Although pampas grass and tamarisk are considered highly invasive species in riparian areas, they have Priority 2 and 3 status at this time in comparison to the Priority 1 giant reed because, based on the PCR (2002) study, they are no an imminent threat. They will be monitored, and if they become more prevalent, their priority levels could be elevated. It should be noted that RMV already has an ongoing artichoke thistle control program related to the cattle ranching operation that would be continued as needed.

7.4.3 Relationship Between Adaptive Management and Experimental Research

Adaptive management, by definition, takes an experimental approach to management. However, there is a clear distinction between experimental management for the purposes of the AMP described here and experimental research for broader purposes and applications. The AMP will be informed by the best available information from data collection on site, and pertinent research and monitoring results from other locations. General experimental research, such as testing different survey protocols or management techniques that may be applied at a regional scale, will not be a direct responsibility of the AMP. However, participation and coordination in such an effort may occur if it does not incur additional costs for the AMP, is consistent with the AMP, and does not in any way compromise the ability of the Reserve Manager to conduct the AMP.

7.4.4 Role of Baseline Studies

Information useful in the assessment of species status and trends will be derived largely from monitoring efforts. Some areas of "critical uncertainty," however, may need to be resolved with focused pilot studies before effectiveness monitoring can be implemented. Responsibilities for monitoring, therefore, may include both traditional assessment of populations and vegetation community conditions through time, as well as directed studies that might more typically be referred to as research. Hence under the rubric of monitoring, the AMP will gather and apply new information from conserved and developed lands by employing diverse methods of data collection, and by accessing diverse sources of data and analyses. The need for and design of baseline studies will be determined by the Reserve Manager and Science Panel as part of the preparation of the initial 5-year MAP and annual program updates.

SECTION 7.5 ELEMENTS OF THE HABITAT RESERVE ADAPTIVE MANAGEMENT PROGRAM

The AMP provides the technical and institutional framework for monitoring and undertaking management actions necessary or helpful to sustain and facilitate recovery of Covered Species and Conserved Vegetation Communities over the long-term, while adapting management actions to new information and changing conditions.

As described in the introduction to this Chapter, the HRMP will be applied to the Habitat Reserve as a whole, but with a three-tiered approach. The main focus of the AMP element of the HRMP in the Habitat Reserve will be on RMV lands because these areas and associated Covered Species and Covered Species will receive regulatory coverage and because of the pressure of increased urbanization. Management and monitoring in other existing open space lands in the Habitat Reserve (*i.e.,* County parks) under the HRMP will be subject to Ongoing Management Programs (OMPs). Under the OMPs, it is assumed that routine management currently carried out on these lands will continue, with a focus on managing potentially detrimental public recreation uses (*e.g.,* mountain biking). Additional adaptive management on these other OMP lands, however, may be undertaken to address stressors that could cause a significant reduction in habitat value such as exotic species (*e.g.,* giant reed in San Juan Creek within Caspers Regional Park) and increased fire risk from excessive fuel buildups. Any supplemental species monitoring would be addressed through outside funds such as the TNC account (see *Chapter 12* on funding).

With this three-tiered distinction as the framework for the HRMP, the AMP for the Habitat Reserve is described in this section.

The AMP would address the three previously stated broad goals of the program:

- Maximize the likelihood of the persistence of a native-dominated vegetation mosaic in the planning area.
- Restore or enhance the quality of degraded vegetation communities.
- Maintain and restore biotic and abiotic natural processes, at all identified scales, for the planning area.

7.5.1 Passive and Active Management

The AMP includes two main types of management activities to address the three broad goals stated above:

a. Passive management

b. Active management

   1. Routine management
   2. Experimental management

a. Passive Management

Passive management does not involve direct and active manipulation of resources. If through the 5-year vegetation assessment and annual monitoring of the sample plots, areas in the Habitat Reserve are determined to be functioning well without intervention, no management actions would be taken.

b. Active Management

Active management would be implemented in cases where monitoring reveals a significant decline or degradation of an important biotic or abiotic resource or process such as a biologically significant decline in coastal sage scrub amount or quality in an area, either as a result of natural or human-caused disturbances. In such cases, and based on a careful evaluation of the situation, direct management actions may be warranted. The key issue in implementing active management is what is the threshold or trigger for a direct management action? In some cases, the need for direct management is obvious, such as an area heavily infested with exotic species or exhibiting extreme erosion. However, in many cases a decline in habitat value or species populations is subtle or insidious and cumulative, such that it often is not easy to detect the change until it is too late to reverse the trend. The monitoring program would need to be

sensitive to early warning signs that a significant adverse trend is occurring and that active management is needed. A key to the AMP is collecting the appropriate data for teasing out natural habitat oscillations (*i.e., intrinsic drivers*) from stressor-induced negative trends (*i.e., extrinsic drivers*) in habitat quality or species populations such that warning signs can be identified. As noted above, the Reserve Manager and Science Panel will set initial "working management thresholds" for management actions during preparation of the first 5-year MAP based on available information. These "working management thresholds" will be subject to refinement annually as part of the 5-year MAP as monitoring information is collected.

Active management is further divided into *routine management* and *experimental management*.

1. Routine Management

Routine management includes management actions that have been identified as necessary components of the AMP based on known environmental stressors. For example, brown-headed cowbird and bullfrog controls would be implemented as a pre-defined, standard management action because of the known adverse effects of these exotic species on native species. As determined in the first 5-year MAP, different control techniques may be utilized to test their efficacy for future applications.

2. Experimental Management

Experimental management is a subset of active management that may be necessary to examine "critical uncertainties."[5] Experimental management can be approached in two ways:

1. *A priori* (pre-defined) management experiments that inform the management of the overall Habitat Reserve; and
2. *Opportunistic* (after the fact) experimental management actions that are implemented in response to a natural or human-caused disturbance event that provide an opportunity for applying different management treatments.

A priori management experiments may be conducted within the Habitat Reserve, in another area within the South Coast Ecoregion with comparable ecological conditions, or within a controlled laboratory setting. It is anticipated that ongoing management experiments could be conducted in the Habitat Reserve by independent scientists not directly affiliated with the management of the Habitat Reserve or the RMVLC, Science Panel, County or Wildlife Agencies. However,

[5] Experimental management is related to "targeted studies" described by the USGS (2004) to address critical uncertainties, but is specifically directed to management uncertainties rather than more general data "gaps" such as species autecology.

independent studies must be authorized by the RMVLC for their Habitat Reserve lands or by the County for their lands. Such studies also must be coordinated and consistent with the ongoing adaptive management goals and objectives of the Habitat Reserve.

Opportunistic experimental management actions in response to natural or human-caused disturbances provide a "natural laboratory" to conduct management and are a bridge between management experiments conducted under highly controlled conditions and management in the real world. As an example, the conceptual stressor model for coastal sage scrub considers the interactive effects of fire and grazing (*Figure 138-M*). This conceptual model leads to the experimental management hypotheses that were listed previously. For example, based on this model, one could hypothesize that an established (late successional) stand of coastal sage scrub that has not been subject to grazing will have a higher overall post-burn species diversity than a same-aged stand that has been grazed. If a wildfire burns an established stand of coastal sage scrub, part of which has been grazed and part of which has not, a component of the adaptive management of these areas would be to establish study plots in the grazed and ungrazed burn areas and monitor post-burn species diversity during the recovery of the study plots. If the grazed plots show lower post-burn diversity the hypothesis has been confirmed. As a follow-up study to this finding, an experimental management action could be to enhance some grazed areas post-burn through seeding while other burned control plots are not seeded. If the seeded plots show greater long-term diversity than the unseeded plots, the practice of seeding grazed areas of coastal sage scrub post-burn could become a standard management action to "jump start" the recovery of the site.

The distinction between "routine management" and "experimental management" as described here is sometimes blurred (also see discussion in *Section 7.4.3, Relationship Between Adaptive Management and Experimental Research*). In some cases management actions may be clear or obvious and thus are implemented as routine management; experimental manipulation would not be needed. In other cases, there may be no clear or obvious management action and experimental testing of several management methods may needed to determine the most effective alternative. However, whatever form of management action is taken (*i.e.,* routine or experimental), monitoring the results of the action would be important to determine whether the action was effective and how, if necessary, it could be modified to make it more effective. For example, a routine management action that was thought to be effective may be found to not work very well, thus triggering the need to conduct experimental management. Consequently, the AMP cannot be designed or "front-loaded" to anticipate all the possible scenarios or opportunities for adaptive management, but rather is the framework for employing adaptive management techniques and strategies.

7.5.2 Adaptive Management Approach to Achieve Program Goals

The proposed management approaches to attaining the three broad goals of the program listed previously and restated here are reviewed below.

a. Maximize the likelihood of the Persistence of a Native-dominated Vegetation Mosaic in the Planning Area

The AMP would achieve this goal through periodic management and monitoring of the five native-dominated Conserved Vegetation Communities in the Habitat Reserve: coastal sage scrub, chaparral, native grassland, riparian/wetlands, and woodlands. The general approach to monitoring and managing native-dominated vegetation communities is described in this section and the detailed programmatic approach for specific communities and associated focal species is described below in *Sections 7.7* through *7.11*.

What specifically is monitored and why it is being monitored would be tied to hypotheses generated by the conceptual environmental stressors models described in *Section 7.4.1.a*. As stated by the Science Advisors,

> *The biological monitoring program should be developed specifically to measure and evaluate the effects of management activities. It should identify and measure variables that permit iterative refinement of the management program.*
> (Science Advisors, Principles for Adaptive Management, p. 4, *Appendix B*)

As discussed in *Section 7.4.1.a,* and in relation to the USGS (2004) monitoring guideline document described in *Section 7.2.4*, conceptual stressor models are useful tools for providing a framework and focus for management actions. They provide a synthesis of current scientific understanding, field observation, and professional judgment. Models may range from relatively simple unidirectional models to extremely complex, interactive and quantitative ecosystem models. The conceptual models recommended for the AMP are qualitative, relatively simple and pragmatic top down "environmental stressor" models that reflect possible broad cause-and-effect relationships between natural and human-induced stressors and effects on ecosystem processes, vegetation communities and species. For example, short fire intervals in coastal sage scrub promote the proliferation of non-native invasive species.

The monitoring program is structured such that the monitoring information allows hypotheses generated by the conceptual models to be tested and refined. In some cases the monitoring would be routine and passive (as described above). In other cases, the monitoring would be tied specifically to ongoing management programs (*e.g.,* fire, exotics control, habitat restoration,

etc.). The various management programs would be integrated with the conceptual environmental stressor models so that "field experiments" can be conducted in a more rigorous and systematic scientific manner; typically on relatively small experimental plots where a defined variable or set of variables (*i.e.,* the independent variables) can be manipulated, while controlling other extraneous variables. In addition, large-scale natural disturbances (*e.g.,* a 10-year flood) create "natural field laboratories" for opportunistically conducting studies on both a vegetation community and landscape level and allow the Reserve Manager and scientists to study processes that cannot be completely understood working at a small scale on experimental plots with a limited set of independent variables.

The AMP is comprised of four steps to maximize the likelihood of the persistence of a native-dominated vegetation mosaic in the planning area: **(1)** preparation of conceptual stressor models and conceptual management plans for vegetation communities; **(2)** periodic assessment of the status of the vegetation communities; **(3)** management of the vegetation communities; and **(4)** evaluation of the effect of the management actions.

1. This Chapter includes draft conceptual stressor models for the five Conserved Vegetation Communities in the Habitat Reserve (*Figures 138-M* through *142-M*). These conceptual models are based on the best scientific information available and depict known and hypothesized relationships between environmental stressors and vegetation community responses. They also help to identify uncertainties and knowledge gaps in our understanding of these complex relationships. In conjunction with the conceptual stressor models, conceptual management plans keyed to these stressors have been prepared to address fire, habitat restoration, and invasive species. These management plans reflect the most current understanding of how a particular vegetation community functions and responds to environmental stressors and management actions. The information gained through implementation of the management plans would be used to modify and refine the conceptual stressor models, which, in turn, would be used to generate new adaptive management actions and hypotheses. Two associated management plans, collectively referred to as the Coordinated Management Plans, are the Grazing Management Plan the (GMP; *Appendix G*) and Water Quality Management Plan (WQMP; *Appendix K*). The GMP and WQMP, reviewed in *Sections 7.17.1* and *7.17.2* respectively, address particular stressors and will be coordinated with the AMP.

2. An assessment of vegetation communities throughout the entire Habitat Reserve would be conducted at a minimum of five (5) year intervals. These assessments would consist of: **(a)** aerial photograph interpretation (*i.e.*, remote sensing) and field mapping of vegetation conditions in previously dedicated areas of the Habitat Reserve (*e.g.,* initially County parklands, Ladera Open Space, Upper Chiquita Conservation Area, and Donna

O'Neill Land Conservancy) to detect any coarse, landscape changes in the vegetation mosaic (*e.g.*, are large areas of coastal sage scrub converting to grasslands?); and **(b)** permanent sample transects established using GPS within representative plots within the vegetation mosaic in previously dedicated areas of the Habitat Reserve. For example, several plots within coastal sage scrub, chaparral, native grassland, oak woodland, etc. that represent the physiographic gradients within the Habitat Reserve (elevation, slope, distance from coast, etc.) would be established. The precise number, distribution and site-specific features of the sample plots will need to be established by the Reserve Manager and Science Panel during preparation of the first 5-year MAP, and would be based on the requirements for cost-effective, but statistically valid sample regimes (*i.e.*, sampling methods that are feasible and practical and achieve acceptable statistical power for detecting trends [in statistics power refers to the probability of actually detecting a trend that exists, or in the parlance of statistics, it is the probability of correctly concluding that the null hypothesis that no trend exists is wrong]). As additional Habitat Reserve lands are transferred to the Habitat Reserve, sample plots will be expanded into these areas as needed to provide a representative sample of the Habitat Reserve.

3. Based on the results of the vegetation monitoring, two courses of action can be taken:

   a. *Passive or "hands-off" management* whereby nature is allowed to take its course. Because the southern California ecosystem presumably is adapted to natural events such as drought cycles and periodic wildfires (*e.g.*, Keeley 1986, 1992a; Keeley and Fotheringham 2001a,b; Minnich 2001), passive management would be the default initial approach to such natural, periodic perturbations or disturbances of vegetation communities. In most cases, vegetation changes over time following the natural disturbance would be expected to reflect the natural successional stages of the adaptive ecosystem (*e.g.*, flooding may cause destruction of riparian forest, that over time comes back as mule fat scrub, southern willow scrub, and ultimately riparian forest as the climax community). Attempting to actively manage a natural successional system would be wasteful of valuable management resources and could result in more harm than good if the natural successional trajectory of the system is altered. However, in the case of a severe wildfire (or a series of short-interval fires) or major flood event, more frequent monitoring than the standard 5-year interval may be warranted on a case-by-case basis to maximize the likelihood that irreversible adverse changes in the vegetation community do not occur (*e.g.*, a state-transition from coastal sage scrub to grassland as a result of too frequent fire or invasion of a recovering riparian area by giant reed). It will be the responsibility of the Reserve Manager, with assistance by the Science Panel, to determine the appropriate monitoring scheme following a major disturbance event.

b. *Active or "hands on" management* whereby direct active manipulation is required to maintain net habitat value of the vegetation community or the ecosystem at a broader scale. Active management would occur where, based on the monitoring program, it is clear that a vegetation is becoming degraded or species are declining and no longer responding naturally (*e.g.,* a vegetation type converting irreversibly to another vegetation type or being overrun by invasive species). Depending on the cause of the impact, active management can include a variety of actions, such as specific fire management actions (*e.g.,* prescribed burns or suppression), grazing management (*e.g.,* increased, reduced or timed grazing), exotics control (*e.g.,* mechanical or hand-labor weeding) and restoration (*e.g.,* seeding and planting of native species).

4. Evaluation of both routine monitoring and passive and active management actions would be conducted to determine whether the monitoring regime is adequate and whether management actions had the desired outcome. All management and monitoring activities would be documented in the annual reports and the 5-year comprehensive reports described in *Section 7.3.9.* What is learned from the monitoring results and management action would be used to improve the management and monitoring program. Evaluating the monitoring program and the effects of management actions is a crucial stage of the overall AMP because it completes the information feedback loop necessary to reassess the conceptual model, make adjustments, generate new or revised hypotheses for testing, and revise the management actions based on the new or revised hypotheses (*i.e.,* it is the definitive step of adaptive management). Over time, the knowledge base and the management actions would be systematically improved and better able to achieve the overall conservation and adaptive management goals of the Southern NCCP/MSAA/ HCP.

b. Restore the Quality of Degraded Vegetation Communities and Other Habitat Types

Habitat restoration is broadly defined as the process of intentionally altering a degraded vegetation community providing habitat value or creating new habitat to re-establish a defined pre-existing habitat or ecosystem or enhance function of a degraded habitat or ecosystem. The goal of restoration is to emulate the natural structure, function, diversity and dynamics of the vegetation community or ecosystem. This goal generally would be achieved through implementation of several coordinated/integrated restoration plans and related management plans, including:

- A coastal sage scrub and valley needlegrass grassland (CSS/VGL) restoration plan (*Appendix H*)

- A wetland and riparian restoration plan focusing initially on Gobernadora and San Juan creeks (*Appendix H*)
- A Wildland Fire Management Plan (*Appendix N*)
- An Invasive Species Control Plan (*Appendix J*)

The CSS/VGL, wetland and riparian restoration, and invasive species control plans identify specific targeted areas for restoration and enhancement based on current and best available information for the RMVLC component of the Habitat Reserve subject to the AMP (*e.g.*, giant reed control in San Juan Creek and CSS/VGL restoration in upper Gabino Canyon). As the AMP progresses, other vegetation communities may be identified for restoration, such as oak woodland and chaparral.

The above plans generally would be guided by the following policies:

- Restoration will be defined to include all activities and measures in this Chapter that are designed to maintain and improve net habitat value over the long-term, including, but not limited to the control of invasive and exotic species, reseeding or planting with native species, fire management, and controlling public access. Restoration permitted within the Habitat Reserve would include the full range of vegetation communities occurring within the Habitat Reserve.
- Restoration will be important to the long-term viability and function of the Habitat Reserve and would be implemented to contribute to overall biological diversity and productivity in the Habitat Reserve in a manner consistent with broad NCCP Planning Guidelines and the detailed Draft Southern Planning Guidelines and Draft Watershed Planning Principles.
- Phased implementation of the plans will reflect the available funding, locations and kinds of species and habitat impacts, and initial priorities.
- The Reserve Manager, with assistance by the Science Panel, would target areas for restoration and set revised priorities over time. The RMVLC would review restoration priorities for consistency with the overall goals and objectives of the AMP. This review would consider the restoration priorities in the context of existing and changing conditions (*e.g.*, vegetation community or species trends) in the Habitat Reserve, as well as the availability of funding for the restoration activity.
- The restoration activities would be implemented in a manner that facilitates the adaptive management approach. These projects would be planned to yield systematic data that can be used to test experimental management hypotheses to the extent possible, including establishing adequate experimental and control plots, different treatment regimes,

rigorous data collection, etc. The Reserve Manager should confer with the Science Panel, and other scientists and experts, to the extent necessary, to ensure that scientifically-justified and sound methods are used.

- Enhancement and restoration activities would be monitored as part of the AMP to evaluate effect, effectiveness and progress. Ongoing monitoring would also identify new enhancement and restoration opportunities/priorities within the Habitat Reserve.

c. Maintain and Restore Abiotic Natural Processes, at All Identified Scales, Capable of Supporting the Habitat Reserve.

The Science Advisors fashioned a new tenet of reserve design – Tenet 7 – to focus on maintaining ecosystem processes and structure, with a particular emphasis on fire and on hydrologic/erosional processes. The objectives of the AMP for fire were listed above in *Section 7.4.2a.1*. For hydrologic/erosional processes, the objectives of the AMP were listed in *Section 7.4.2.a.2*.

SECTION 7.6 PRIORITIZATION OF CONSERVED VEGETATION COMMUNITIES AND ASSOCIATED SPECIES FOR MANAGEMENT AND MONITORING

This section describes the programmatic approach for the adaptive management of Conserved Vegetation Communities and associated species. The five Conserved Vegetation Communities addressed by the AMP are:

- Coastal sage scrub (*Section 7.7*)
- Chaparral (*Section 7.8*)
- Grassland (*Section 7.9*)
- Riparian/wetland (*Section 7.10*)
- Woodlands (*Section 7.11*)

Adaptive management of these Conserved Vegetation Communities, and their function as habitat for species, is an essential element of species coverage for the Covered Species pursuant to the NCCP/MSAA/HCP. As discussed in detail in *Section 7.4*, adaptive management would address Covered Species' habitat needs as they evolve over time in response to natural and human-induced environmental stressors. An example of adaptive management for the habitat needs of specific species is the proposed invasive species control program directed toward benefiting

specific aquatic species such as the arroyo toad and the least Bell's vireo within the mainstem channel of San Juan Creek.

Consistent with the concept of natural communities planning, however, vegetation communities would also be managed as broad scale habitat systems functioning within watershed level hydrologic and geomorphic influences and other "process" influences such as fire regimes. Restoration programs such as those proposed for native grasslands and management programs such as fire management would be undertaken within the context of goals and objectives for habitat systems at a sub-basin, watershed and planning area scale.

Management and monitoring of vegetation communities is focused on understanding vegetation changes and the influences of natural and human-induced factors on the functioning of habitat systems over time. Vegetation transect surveys, monitoring of hydrologic regimes such as groundwater, and tracking wildlife movement are examples of monitoring tools available for assessing physical changes to habitat systems. Such measures would be coupled with the different types of species monitoring summarized above to assess enhancement/restoration undertakings, adaptive management experiments and large-scale vegetation community management decision-making. Monitoring would thus emphasize measuring physical conditions so that management can be adapted over time. Basic research would be encouraged through cooperation with research scientists, but the fundamental emphasis of the AMP would be on generating information that can be used for adaptive management purposes within the Habitat Reserve. The various techniques potentially available for assessing physical changes to vegetation communities over time are reviewed in conjunction with the topical review of each of the five vegetation communities in *Sections 7.7* through *7.11*.

The following sections apply the environmental stressor approach to prioritizing management and monitoring actions in the Habitat Reserve.

7.6.1 Method for Prioritizing Conserved Vegetation Communities for Management and Monitoring

Prioritizing management and monitoring actions is crucial to the success of the AMP. The AMP described herein in provides a comprehensive "tool box" for data acquisition, analytic methods, and adaptive management actions that can be used over time to inform the long-term management of the Habitat Reserve. However, given the stressor focus of the AMP, only those tools appropriate for a particular management action would be employed at that point in time. With diverse vegetation communities and widely varying existing conditions, an objective method to rank monitoring/management needs of the Habitat Reserve was developed to help prioritize and guide management actions. The goal of the ranking outcome, therefore, is to

develop a method that allows the Reserve Manager to allocate available management resources for the greatest net benefit to the Habitat Reserve. This approach also provides a framework for establishing an initial set of management and monitoring priorities. It is anticipated that as monitoring and adaptive management proceeds, and as more empirical information is incorporated, these initial rankings would be revised.

Given the stressor approach of the AMP and finite management resources, it is important to identify those vegetation communities that should be the focus of initial adaptive management activities. For this reason, the conceptual stressor models were used to rank and prioritize the vegetation communities for the initial management and monitoring efforts. For example, a vegetation community that has high ecological importance for the Habitat Reserve and is highly sensitive to stressors would have a high priority ranking. Alternatively, a community may have high ecological value, but is not as sensitive to existing stressors in the Habitat Reserve. This community would have a lower management and monitoring priority.

The rankings were applied at the level of vegetation communities to be consistent with the community-level focus of the AMP. The rankings are based on two key indices: **(1)** the **Importance Value** of the vegetation community; and **(2)** the **Index of Disturbance** of the vegetation community. **Importance Value** generally is defined here as the sum of *species richness* and *species uniqueness* of a particular vegetation community. Rather than enumerating the total or absolute species richness of a particular community (*i.e.*, alpha diversity), which both in theory and practice is difficult, species richness as used here is based on the number of Group 2, Group 3 and Umbrella Species defined by the Science Advisors, as well a few additional species since identified as potential conservation issues (*e.g.,* red coachwhip), that use the five Conserved Vegetation Communities in the subregion. Using this set of species as a surrogate for species richness is justified in this case because the purpose of the Importance Value index is to rank management priorities. For example, 36 of 70 wildlife species on this list use coastal sage scrub, while 19 use oak woodland, so coastal sage scrub would be considered to have higher species richness than oak woodland. *Species uniqueness* is simply the number of species from the Group 2, Group 3, and Umbrella Species list that exclusively (or almost exclusively) occur in a single vegetation community. For example, the California gnatcatcher is considered an "obligate" coastal sage scrub species while the least Bell's vireo is an obligate riparian habitat species. Although both species may occasionally use other vegetation communities, their occurrence depends on the presence of the obligate habitat.

The **Index of Disturbance** reflects the vulnerability of different vegetation communities to various human-caused and natural environmental stressors. The models for the environmental stressor-community responses for the five Conserved Vegetation Communities are depicted in *Figures 135-M* through *139-M*, respectively. For example, fire is a key stressor on coastal sage

scrub; frequent fire can result in type-conversion of coastal sage scrub to non-native grassland (*Figure 135-M*). Likewise, altered hydrology is a stressor on riparian systems; too much or too little water can significantly alter the composition, structure and function of a riparian system. The Index of Disturbance of a vegetation community is a composite index score for the effects of stressors that is generated by summing the individual index scores of various stressors on the vegetation community.

In a next step, **Importance Value** and **Index of Disturbance** are multiplied to yield a **Vegetation Community Ranking**, or **R**. It is important to combine these two indices because a vegetation community that scores high in Importance Value but low in Index of Disturbance may not need much management. Likewise, a vegetation community that scores high in Index of Disturbance, but low in Importance Value would not be a high management priority. Vegetation communities that have both a high Importance Value and a high Index of Disturbance would receive the highest management priority ranking.

The methods used to develop the Importance Value, Index of Disturbance and Covered Vegetation Community Rankings are described below, followed by the results of the analysis.

a. Selection and Community Assignment of Species

The *species richness* and *species uniqueness* variables were parameterized by using the Science Advisors' list of Group 2, Group 3 and Umbrella Species, as well as a few additional species that since have been identified as potential conservation issues (*e.g.,* red coachwhip). These species were used because they include many of the species that the original NCCP Stakeholder Working Group and the Wildlife Agencies were considering for conservation. They include listed species, state Special Concern Species, state Fully Protected Species, U.S. Forest Service Sensitive Species, USFWS Birds of Conservation Concern and Migratory Nongame Birds of Management Concern, and non-sensitive species that may provide focal species value. The Science Advisors Group 1 species were not included because the overall Conservation Strategy, including adaptive management activities, would have little or no impact on these species. Thus, including these species potentially could skew the ranking results toward communities supporting species that would be unaffected by management actions, and, conversely, away from communities that support species that could benefit from management.

The original Science Advisors list of Group 2 and Group 3 species included species that do not use, or do not depend on, at least one of the five Conserved Vegetation Communities: coastal sage scrub, chaparral, grassland, riparian/wetland, and oak woodland. Open water species such as American white pelican, black skimmer and double-crested cormorant thus were deleted from the list. Likewise, species that have narrow microhabitat requirements, such as fairy shrimp,

were deleted because their conservation and management would be site-specific rather than at a vegetation community level. Analyses also were run with and without sensitive plants, which in some cases can be addressed at a community level, while others may require site-species conservation and management. The lists of species selected for the analysis and their vegetation community associations are shown in *Table 7-6*.

TABLE 7-6
SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR CONSERVED VEGETATION COMMUNITIES

Common Name	Coastal Sage Scrub	Chaparral	Grassland	Riparian/ Wetland	Oak Woodland
Barn Owl			●	●	●
Bell's Sage Sparrow	●	●			
Bewick's Wren	●	●		●	●
Burrowing Owl	●		●		
Cactus Wren	●				
California Gnatcatcher	●				
California Horned Lark			●		●
California Thrasher	●	●			
Cooper's Hawk				●	●
Ferruginous Hawk			●		
Golden Eagle	●	●	●		
Grasshopper Sparrow			●		
Lark Sparrow			●		●
Lawrence's Goldfinch	●	●			
Least Bell's Vireo				●	
Loggerhead Shrike	●	●	●		
Long-eared Owl				●	●
Merlin			●		
Mountain Plover			●		
Northern Harrier	●		●	●	
Pacific Slope Flycatcher		●			●
Prairie Falcon			●		
Red-breasted Sapsucker					●
Red-shouldered Hawk				●	●
Rough-legged Hawk			●		
Rufous-crowned Sparrow	●				
Sharp-shinned Hawk	●		●		●
Short-eared Owl			●		
Southwestern Willow Flycatcher				●	
Swainson's Hawk			●		

TABLE 7-6
SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR CONSERVED VEGETATION COMMUNITIES

Common Name	Coastal Sage Scrub	Chaparral	Grassland	Riparian/ Wetland	Oak Woodland
Tricolored Blackbird			●	●	
Western Yellow-billed Cckoo				●	
White-tailed Kte	●		●	●	●
Yellow-breasted Cat				●	
Yellow Warbler				●	
Arboreal Salamander		●			●
Arroyo Toad				●	
California Glossy Snake	●	●	●		
Coast patch-nosed Snake	●	●	●		
Coast Range Newt	●	●			
Coastal Western Whiptail	●				
Northern Red-diamond Rattlesnake	●	●	●		
Orange-throated Whiptail	●	●			●
Red Coachwhip	●	●	●		
Rosy Boa	●	●			
San Diego Banded Gecko	●				
San Diego Horned Lizard	●	●			
San Diego Mountain Kingsnake		●			
San Diego Ringneck Snake		●		●	●
Silvery Legless Lizard	●	●		●	
Southwestern Pond Turtle				●	
Two-striped Garter Snake				●	
Western Skink	●	●	●		
Western Spadefoot Toad	●	●	●		
American Badger	●		●		
Dulzura California Pocket Mouse	●	●			
Gray Fox	●	●		●	
Long-legged Myotis				●	●
Mountain Lion	●	●		●	●
Northwestern San Diego Pocket Mouse	●				
Pallid Bat	●	●			●
San Diego Black-tailed Jackrabbit	●	●	●		
San Diego Desert Woodrat	●				
Southern Grasshopper Mouse	●		●		
Southern Mule Deer	●	●			●
Spotted Bat				●	

TABLE 7-6
SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR CONSERVED VEGETATION COMMUNITIES

Common Name	Coastal Sage Scrub	Chaparral	Grassland	Riparian/ Wetland	Oak Woodland
Townsend's Big-eared Bat			●		●
Arroyo Chub				●	
Threespine Stickleback				●	
Catalina Mariposa Lily	●	●	●		
Chaparral Beargrass	●	●			
Coulter's Matalija Poppy	●	●			
Coulter's Saltbush			●		
Curving Tarweed	●	●	●		●
Heart-leaved Pitcher Sage		●			
Iintermediate Mariposa Lily	●	●	●		
Many-stemmed Dudleya	●	●	●		
Mud Nama				●	
Ocellated Humboldt Lily					●
Palmer's Grapplinghook	●		●		
Parish' Saltbush			●		
Parry's Tetracoccus	●	●			
Prostrate Spineflower	●	●	●		
Rayless Ragwort	●				●
Salt Spring Checkerbloom				●	
San Miguel Savory		●			●
Southern Tarplant			●		
Summer-holly		●			
Thread-leaved Brodiaea	●	●	●	●	
Western Dichondra	●	●			
Wildlife and Plants Combined					
Species Richness	**49**	**41**	**38**	**27**	**23**
Relative Species Richness	**0.27**	**0.23**	**0.21**	**0.15**	**0.13**
Species Uniqueness	**6**	**3**	**11**	**13**	**2**
Relative Species Uniqueness	**0.17**	**0.09**	**0.31**	**0.37**	**0.06**
Importance Value	**0.44**	**0.32**	**0.52**	**0.52**	**0.19**
Wildlife Only					
Species Richness	**36**	**27**	**28**	**24**	**19**
Relative Species Richness	**0.27**	**0.20**	**0.21**	**0.18**	**0.14**
Species Uniqueness	**6**	**1**	**8**	**11**	**1**
Relative Species Uniqueness	**0.22**	**0.04**	**0.30**	**0.41**	**0.04**
Importance Value	**0.49**	**0.24**	**0.51**	**0.59**	**0.18**

b. Species Richness and Uniqueness Indices

Species richness for a particular vegetation community was calculated by summing the number of species that use that community. Assigning species' use of vegetation communities is based on the California Wildlife Habitat Relationships System (WHR) (Zeiner *et al.* 1990), as well as other scientific literature and local biological expertise. Species richness in vegetation community type *j* (s_j , where j = 1, …, 5) is simply expressed as:

$$s_j = \sum_{1}^{S} x_i$$

Where $x_i = 1$ if species *i* occurs in vegetation community type *j*, and $x_i = 0$ otherwise, and *S* is the number of unique species expected to occur across all five vegetation community types.

Based on the species richness value, a relative species richness index was calculated by dividing the species richness value for each vegetation community by the total species richness value summed across the five Conserved Vegetation Communities. Relative species richness rs_j of vegetation community *j* can be expressed as:

$$rs_j = \frac{s_j}{S}$$

The relative species richness index indicates the extent to which a single vegetation community represents the richness of all five vegetation communities. Note that

$$\sum_{1}^{S} rs_j = 1.0$$

Species uniqueness for a particular vegetation community was calculated by summing the number of species that "exclusively" use that community. Because virtually all of the species on the list sometimes use other vegetation communities at least opportunistically some time in their life cycle (*e.g.*, gnatcatchers dispersing through riparian), exclusivity of use is operationally defined here as a vegetation community that is necessary for the presence of the species. For example, California gnatcatchers require coastal sage scrub; therefore coastal sage scrub is a unique vegetation community for this species. The loss of coastal sage scrub equates to the loss of California gnatcatchers. Unique species richness of vegetation community *j* (us_j) can be expressed as:

$$us_j = \sum_{1}^{S} x_i$$

Where $x_i = 1$ if species *i* occurs **only** in vegetation community type *j*, and $x_i = 0$ otherwise, and *S* is the number of unique species expected to occur across all five vegetation communities.

Relative species uniqueness of a vegetation community can be expressed as:

$$rus_j = \frac{us_j}{S}$$

Relative species uniqueness measures the proportion of the total species richness represented by vegetation community *j* **alone**. If this community type were lost from the landscape, the species that contribute to rus_j would be missing. Note that

$$\sum_{1}^{S} rus_j = 1.0$$

Importance Value for vegetation community *j* (I_j) is simply the sum of the species richness and species uniqueness values for that vegetation community, expressed as:

$$I_j = rs_j + rus_j$$

It should be noted that *I*, as calculated here, gives equal weighting to species richness and species uniqueness, and thus they are simply additive. Different weightings could be given to these two variables if one was considered relatively more important than the other.

c. Index of Disturbance

Eight general environmental stressors were used to calculate the **Index of Disturbance**: habitat fragmentation, fire, cattle-related impacts, exotics, altered hydrology, altered geomorphologic processes, human uses and recreation, and precipitation. These eight stressors where chosen based on their demonstrated or hypothesized impacts on one or more of the five vegetation communities and as illustrated in the environmental stressor models for each community (*Figures 138-M* through *142-M*).

For each environmental stressor/community response combination (*e.g.*, fire/coastal sage scrub), a scale value ranging from 1 to 5 was assigned to the combination, using the following definitions:

1 = not a stressor or a very low stressor
2 = low stressor
3 = moderate stressor
4 = high stressor
5 = very high stressor

Because the purpose of the analysis is to rank the relative importance of management and monitoring of the six vegetation communities, the value assigned to each stressor/community combination primarily reflects the relative impact of the stressor on a vegetation community compared to another community. For example, as shown in *Table 7-7*, hydrologic stressors such as dewatering have a relatively greater impact on riparian systems (rated 5) than upland systems such as coastal sage scrub or grassland (rated 1's). Coarse-grain rankings of the stressor impacts in most cases are fairly straightforward, but, for example, whether fire is a "high" stressor versus a "very high" stressor on chaparral is somewhat subjective. In this case chaparral was assigned a "high" rating (4), while coastal sage scrub was assigned a "very high" rating (5), because coastal sage scrub is more likely than chaparral to type-convert to grassland with frequent, short-interval fires. Also, stressors such as human uses and recreation may not have clear direct effects on community responses, but their effects may be indirectly mediated or magnified via other stressors such as shortened fire intervals and invasive species (*e.g.*, accidental fire ignitions). In any case, this analysis reflects a first attempt to quantify the stressors and rank vegetation communities and is subject to revision based on additional information.[6]

TABLE 7-7
INDEX OF DISTURBANCE FOR CONSERVED VEGETATION COMMUNITIES

Stressor	Coastal Sage Scrub		Chaparral		Grassland		Riparian/Wetland		Oak Woodland	
	Raw Score	Index Score	Raw Score	Index Score	Raw Score	Index Score	Raw Score	Index Score	Raw Score	Index Score
Habitat Fragmentation	4	0.75	3	0.50	3	0.50	5	1.00	3	0.50
Too Frequent/ Too Infrequent Fire	5	1.00	4	0.75	2	0.25	4	0.75	4	0.75
Cattle-related Impacts	3	0.50	2	0.25	4	0.75	2	0.25	4	0.75
Exotics	4	0.75	2	0.25	5	1.00	5	1.00	4	0.75
Altered Hydrology	1	0.00	1	0.00	1	0.00	5	1.00	5	1.00
Altered Geomorphological Processes	1	0.00	1	0.00	3	0.50	5	1.00	1	0.00
Human Uses and Recreation	4	0.75	3	0.50	2	0.25	3	0.50	2	0.25
Precipitation	3	0.50	3	0.50	2	0.25	5	1.00	4	0.75
Index of Disturbance		**4.25**		**2.75**		**3.50**		**6.5**		**4.75**

[6] A more fine-grained Index of Disturbance can be calculated using several variables of disturbance, including frequency, extent, magnitude, selectivity, and variability of the stressor. Values for each of these variables would be assigned to each stressor to generate a composite score for the stressor. This method would allow a more precise estimate of the absolute impact of the stressor, but requires substantial information to generate the value assigned to each variable. As new information becomes available through the AMP or the scientific literature, the Index of Disturbance may be refined.

As shown in *Table 7-7*, each raw score was converted to an index score using the following formula:

$$(x_s - x_{min})/(x_{max} - x_{min})$$

where

x_s = the value for the stressor/vegetation community combination
x_{min} = the minimum value for the rating scale (1), and
x_{max} = maximum value for the rating scale (5).

The composite Index of Disturbance (ID) score is the sum of the individual index scores, or

$$ID = \sum((x_s - x_{min})/(x_{max} - x_{min}))$$

as shown in *Table 7-7*.

7.6.2 Conserved Vegetation Community Ranking

The **Conserved Vegetation Community Ranking** score (R) was calculated by taking the product of the IV and the ID, expressed as

$$R = (IV)(ID)$$

The R values are shown in *Tables 7-8a* (including plants) and *7-8b* (excluding plants).

TABLE 7-8a
CONSERVED VEGETATION COMMUNITY RANKINGS WITH PLANTS

Index	Coastal Sage Scrub	Chaparral	Grassland	Riparian/Wetland	Oak Woodland
Importance Value	0.44	0.32	0.52	0.52	0.19
Index of Disturbance	4.25	2.75	3.50	6.5	4.75
Ranking Score	**1.87**	**0.88**	**1.82**	**3.38**	**0.90**

TABLE 7-8b
CONSERVED VEGETATION COMMUNITY RANKINGS EXCLUDING PLANTS

Index	Coastal Sage Scrub	Chaparral	Grassland	Riparian/Wetland	Oak Woodland
Importance Value	0.49	0.24	0.51	0.59	0.18
Index of Disturbance	4.25	2.75	3.50	6.5	4.75
Ranking Score	**2.08**	**0.66**	**1.78**	**3.83**	**0.85**

Table 7-6 presents the results of species richness and species uniqueness analyses for both wildlife and plant species combined and for wildlife species alone. Including both wildlife and plants, coastal sage scrub has the highest relative species richness (0.27) and oak woodland has the lowest relative species richness (0.13). In contrast, riparian/wetland has the highest relative species uniqueness (0.37), with 13 species only occurring in riparian/wetland; compared to oak woodland which has only two species unique to the community and a score of 0.06. Summing the relative species richness and species uniqueness indices results in a ranking of Importance Value (IV) as follows:

1. Riparian/wetland and Grassland (tie)
3. Coastal sage scrub
4. Chaparral
5. Oak woodland

The tie between grassland and riparian/wetland for IV may seem counterintuitive, but the species list includes several raptors that depend on grassland foraging habitat. These raptors are considered highly sensitive by the resource agencies and conservation groups (*e.g.,* Audubon), hence their relatively heavy weighting on the richness and uniqueness indices. Grasslands also score relatively high in uniqueness because several plants only occur in grassland areas, such as the saltbushes and southern tarplant.

Table 7-6 also shows the same analysis for wildlife species only. The relative IV's of the vegetation communities generally remain the same, but with the exclusion of plants, grassland drops to the number 2 ranking behind riparian/wetland, which has a substantially higher relative IV when only considering wildlife.

The results of the Index of Disturbance (ID) analysis are shown in *Table 7-7*. The Conserved Vegetation Community ranks on ID are:

1. Riparian/wetland
2. Oak woodland
3. Coastal sage scrub
4. Grassland
5. Chaparral

Riparian/wetland has the highest ID rating, reflecting its high vulnerability to all of the stressors, except cattle-related impacts (although cattle-related impacts generally are cited as major stressors of riparian systems, its impact on the Ranch is not severe). Oak woodland, in contrast to its relatively low IV, has a relatively high ID. The stressor scores for oak woodland primarily are based on the general scientific literature, however, and may not reflect existing conditions in oak woodlands on the Ranch. Field investigations would be required to determine the actual impact of these potential stressors. The three focus upland vegetation communities have lower ID's, primarily because they are not affected to any great degree by altered hydrology and geomorphologic processes, except for moderate impacts of geomorphology on grasslands (*e.g.*, erosion in upper Gabino and Cristianitos canyons).

The Conserved Vegetation Community Rankings (R) are shown in *Table 7-8a* (with plants) and *Table 7-8b* (excluding plants). With and without plants in the analysis the overall ranking of the vegetation communities is the same:

1. Riparian/wetland
2. Coastal sage scrub
3. Grassland
4. Oak woodland
5. Chaparral

The riparian/wetland system clearly has the highest priority for management, borne out by the fact that it is highly vulnerable to hydrologic and geomorphic alterations, such as flooding, dewatering, overwatering, sediment transport and deposition, etc. It also is highly vulnerable to invasion by exotic plants (*e.g.*, giant reed, tamarisk, and pampas grass) and animals (*e.g.*, brown-headed cowbirds, bullfrogs, and Argentine ants). These stressors are readily observed in the planning area. For example, giant reed is common in San Juan Creek below Bell Canyon and lower Arroyo Trabuco, and occurs to a lesser extent in Verdugo and lower Cristianitos Creek (PCR 2002). Pampas grass is common in lower Cristianitos and present, but less common, in Arroyo Trabuco, Chiquita, and San Juan creeks. Bullfrogs are found anywhere where there is

adequate perennial water to support breeding populations (*e.g.*, CalMat Lake and lower Gabino clay pit ponds). Lack of adequate water in San Juan Creek is a possible contributing cause of limited arroyo toad reproduction below Bell Canyon. Erosion in upper Cristianitos and upper Gabino is a source of fine sediments that have adverse effects on downstream water and habitat quality. Substantial management and habitat restoration efforts (*e.g.*, invasive species control) would be conducted in the Habitat Reserve to address these stressors.

Coastal sage scrub and grasslands have similar R values, with and without plants included in the analysis. They both score relatively high on IV and ID because they are both rich in species and vulnerable to several stressors, as shown in *Tables 7-8a* and *7-8b*. Both vegetation communities have been identified for substantial management and restoration efforts.

For coastal sage scrub, habitat fragmentation, short-interval fires, exotics, cattle-related impacts, hydrology, human uses and recreation, and precipitation are key stressors. Habitat fragmentation effects become a management issue resulting from impacts from adjacent urban land uses and potential impacts on habitat linkages and wildlife corridors that affect wildlife and plant dispersal and movement, pollination, etc. Management to address habitat fragmentation effects include habitat restoration, control of edge effects and management of habitat linkages and wildlife corridors to maximize the likelihood of continued dispersal and movement (see *Section 7.13*). Fire and cattle-related impacts would be addressed through the fire and grazing management plans. The Invasive Species Control Plan targets the artichoke thistle. Other invasive plants such as black mustard and annual grasses primarily would be addressed through fire and grazing management because these two stressors likely are causal factors in the proliferation of exotic plants in coastal sage scrub. Hydrology issues relate to urban runoff and irrigation of landscape vegetation along the urban/Habitat Reserve interface that can facilitate invasions by exotic species such as Argentine ants. These issues are addressed through project design features for the interface zone (see General Policy 5 in *Chapter 4*), the WQMP (*Section 7.18.2*) and the Invasive Species Control Plan (*Section 7.16* and *Appendix J*). Human uses and recreation are addressed through public access and use policies (see *Chapter 11*) and also in relation to how they affect fire and exotics. Precipitation cycles, as a natural stressor, cannot be managed directly, but through appropriate fire and grazing management and invasive species controls their effects can be moderated. For example, during a drought cycle, fire control responses may need to be more aggressive to prevent catastrophic fire.

A goal of the AMP for grassland is to restore native grassland and enhance the quality of degraded existing native grassland in the Habitat Reserve. The key stressors on native grasslands are cattle-related impacts, exotics (including non-native, annual grassland), and altered geomorphologic processes (primarily erosion). Although uncontrolled fire can be a stressor, generally fire would be a beneficial management tool because many plant and wildlife

species respond positively to periodic fires that serve to remove dead thatch and control invasive species. Management of grassland stressors would include implementation of the fire and grazing management plans. In addition, artichoke thistle control, which has been an ongoing program on RMV lands, would be a major component of grassland management. Finally, native grassland restoration would be implemented in upper Gabino and Cristianitos canyons to address the problems of erosion in those areas.

Chaparral and oak woodlands have relatively low R values. Overall, based on general observations, these vegetation communities in the planning area appear to be in good health. No specific active management and restoration activities are planned at this time. However, to ensure program flexibility and the ability to respond to unexpected changes, the general health of chaparral and oak woodlands would be monitored as part of the AMP. At such time as degradation of these vegetation communities becomes apparent, or unanticipated stressors are identified (*e.g.*, Sudden Oak Death), active management actions would be developed and implemented.

SECTION 7.7 COASTAL SAGE SCRUB AND FOCAL SPECIES

This section addresses adaptive management of coastal sage scrub and associated focal species. Through the **Conserved Vegetation Community Ranking** process described in the previous section, coastal sage scrub was identified as a high priority vegetation community for management and monitoring based on its high **Importance Value** and relatively high **Index of Disturbance**.

7.7.1 Adaptive Management Issues

Conceptual stressor models were presented in *Section 7.4.1* for coastal sage scrub and associated focal species (*Figures 138-M* and *143-M*, respectively). The key stressors on the coastal sage scrub vegetation community are habitat fragmentation, fire, cattle-related impacts, exotic species, hydrology, human uses and recreation, and precipitation to a lesser extent (*Figure 138-M*). These stressors can result in reduced nutrient cycling, loss of spatial and temporal habitat structure and diversity, invasions by exotic species, temporary or permanent state-transitions to non-native annual grassland, and alteration of the food web. Temporary vegetation state-transitions at a moderate patch size scale in response to natural stressors such as fire and precipitation cycles probably are normal and may reflect adaptations to these natural processes. Such temporary state-transitions actually may contribute to overall diversity of the ecosystem and reflect a healthy, dynamic system. On the other hand, permanent, large-scale state-transitions -- for example, resulting from short-interval fires in association with cattle-related impacts and/or invasions by exotic species -- are associated with loss of habitat value because of

a decline of plant and wildlife abundance and diversity. The stressor model also shows interactions among the stressors and among the community responses. For example, prolonged drought can increase the likelihood and intensity of fire, which can, in turn, expose coastal sage scrub to invasion by exotic plant species.

The stressor model for focal species (*Figure 143-M*) includes additional stressors that affect wildlife, such as mesopredators and pesticides. Mesopredators can act directly on species, such as increased predation on cactus wrens by domestic and feral cats, or indirectly if mesopredators are competing for resources used by native species.

As an example of how the conceptual stressor models can be used to guide adaptive management actions, several experimental hypotheses are identified, as well as possible ways to measure community responses. For example:

> Hypothesis: Fire intervals of less than 10 years will result in a decrease in diversity of native species and an increase in the frequency of non-native grasses and forbs.
>
> 1. Conduct retrospective study of historic wildfire patterns in subregion and adjacent areas (*e.g.,* Central/Coastal subregion and Camp Pendleton) to determine if areas with history of frequent burning show a decreased diversity of native species and increased frequency of non-native grasses and forbs (*i.e.,* a retrospective study).
>
> 2. Conduct future studies of unplanned wildfires and prescribed burns in coastal sage scrub and measure return diversity of native species and frequency of non-native grasses and forbs (*i.e.,* a prospective study). Prescribed burns may be conducted on small plots of varying age stands (*i.e.,* time since last burn).

This hypothesis could be refined to include seasonal or grazing effects. For example, winter and spring burns will magnify the loss of native diversity and increase non-native grasses and forbs. Similarly, grazing in post-fire, early and mid-successional coastal sage scrub will result in decreased species diversity over time, or an established (late-successional) stand of coastal sage scrub that has not been subject to grazing will have a higher overall post-burn species diversity than a same-aged stand that has been grazed. To test these more refined hypotheses, information about the season(s) in which burns occurred, or the grazing history of a burn site would be needed. A retrospective study likely would answer the hypothesis at a coarse scale, but additional prospective studies likely would be needed to test more refined hypotheses as variables such as differential season or grazing effects are added. Also, as variables are added a large data set (*e.g.,* number of sample sites) would be necessary to maintain adequate statistical power.

Hypotheses also can be posed for relationships between stressors and focal species. For example, as described in *Section 7.4.2.a*, three recent fires in the Upper Chiquita Conservation Area provide an opportunity for examining the response of coastal sage scrub and associated species to frequent fire. Of particular interest is the response of the 1997 fire area that was burned again in 2002. Also it was noted that middle and lower Chiquita Canyon south of Oso Parkway have not burned since the 1950s according to the Orange County wildfire record, but these areas have been grazed in the meantime. Notably these areas support the highest densities of the California gnatcatcher in the subregion, so absence of fire for more than almost 50 years and the presence of cattle grazing appears to not have been an adverse situation at least for this species. On the surface, this observation makes sense because gnatcatchers prefer habitat that is more open and with a broken canopy, and they tend to be absent or occur in low densities in scrub dominated by tall shrubs or with a closed canopy. In the absence of fire, if some level of grazing maintains low shrubs and an open canopy, the habitat may be more suitable for the gnatcatcher. This will be an important management issue because there are areas of coastal sage scrub in the Habitat Reserve where prescribed burning would not be feasible and wildfires would be fought aggressively to protect the public and property. Some level of grazing may beneficial as a surrogate for fire.

Based on the anecdotal observation of a potential positive relationship between grazing and gnatcatcher habitat suitability, an adaptive management question is whether managed grazing by cattle (or goats) is an effective management tool for sustaining coastal sage scrub habitat quality for species such as the California gnatcatcher. This anecdotal observation can be used to state a hypothesis about the relationship between California gnatcatcher occurrence and populations and grazing.

> Hypothesis: In the absence of periodic fire, light to moderate grazing in coastal sage scrub maintains habitat structure and diversity suitable for the California gnatcatcher.

1. Conduct retrospective study of gnatcatcher occurrence in areas of coastal sage scrub in southern and central Orange County and San Diego County comparing areas that have not burned in several decades, including areas that have been grazed and areas that have not been grazed.

2. Conduct prospective study of gnatcatcher occurrence comparing areas where grazing is precluded in the future and where light to moderate grazing is allowed to continue.

7.7.2 Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for coastal sage scrub and associated focal species:

- Maintain the physiographic diversity of coastal sage scrub and associated focal species in the Habitat Reserve.

- Restore coastal sage scrub and enhance the quality of degraded existing coastal sage scrub in the Habitat Reserve such that the net habitat value of the existing coastal sage scrub system is maintained, where net habitat value is defined as no net reduction of the coastal sage scrub system to maintain Covered Species populations. (The reader is directed to the Species Accounts and Conservation Analysis in *Appendix E* for information on the definition of net habitat value for individual Covered Species.)

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance long-term habitat value:

- Conduct monitoring of coastal sage scrub and focal species to track the long-term habitat value of the coastal sage scrub system.
- Restore approximately 363 acres of coastal sage scrub in designated locations that currently are in agriculture, grazed or otherwise do not currently support coastal sage scrub to enhance habitat carrying capacity and connectivity (see Habitat Restoration Plan, *Appendix H*).
- Manage coastal sage scrub fire regimes through implementation of the Wildland Fire Management Plan (*Section 7.14* and *Appendix N*) such that a natural diversity of age-stands is maintained throughout the Habitat Reserve.
- Manage cattle grazing so as not to cause degradation of coastal sage scrub per the GMP (*Appendix G*).
- Control exotics invasions of coastal sage scrub, especially along the Habitat Reserve-urban interface or other identified vulnerable areas (*e.g.*, along existing paved and dirt roads, utility easements).

7.7.3 Strategies for Monitoring Coastal Sage Scrub and Focal Species

The monitoring program described here for coastal sage scrub, as well as the other vegetation communities discussions that follow, provides the framework conceptual strategies for the

monitoring program, along with a few examples of monitoring schemes to indicate the kinds of detail that would be provided through the MAP for the site-specific monitoring plans. The monitoring plans for the Habitat Reserve, including specific monitoring locations (*i.e.*, sample plots, transects, etc.), monitoring schemes and schedules, personnel, etc., will need to be expanded by the Reserve Manager and the Science Panel as part of the first 5-year MAP. Accordingly, specific details of the MAP will be more refined and detailed in terms of the where, when and by whom compared to the examples presented here.

Coastal sage scrub will be monitored at the landscape, vegetation community and species levels. The routine passive, long-term monitoring of coastal sage scrub and focal species would include two main tasks:

1. Evaluation and update of the entire coastal sage scrub vegetation datebase at 5-year intervals using aerial photographs.
2. Annual on-the-ground monitoring of selected sample plots distributed across the Habitat Reserve in a spatial distribution that represents the diversity of the Habitat Reserve and in keys areas where environmental stressors are most likely to operate (*e.g.*, along the Habitat Reserve-development edge).

a. Vegetation Monitoring

Periodic evaluation and update of the vegetation database would allow the Reserve Manager to track large-scale landscape changes in the vegetation communities in the Habitat Reserve. Any adverse changes (*e.g.*, type conversion of coastal sage scrub to grassland or exotic invasion) that may affect the integrity and function of the Habitat Reserve would be documented and appropriate management actions would be taken.

Within two (2) years of executing the IA, the Habitat Reserve vegetation communities would be remapped in detail to establish a baseline for long-term tracking of the Reserve. In order to have the most recent mapping available for the first 5-year MAP, this baseline mapping should use no earlier than year 2008 nor later than 2010 color infrared aerial photography (digital orthophotos, 1-m resolution), or an available equivalent imagery. It is important that the entire Habitat Reserve be mapped at the same time to create a seamless vegetation database, rather than at different times and cobbling together various maps with inherent conflicts along vegetation polygon boundaries (*i.e.*, edge-matching). This mapping would include all Conserved Vegetation Communities and would follow the Orange County vegetation classification system (Gray and Bramlet 1992), with modifications as may be required at the time of the mapping (*e.g.*, the Habitat Reserve may include mapping some classifications not described under the County system). The Reserve Manager, with assistance from the Science Panel or other experts as

necessary, would establish the appropriate mapping unit for each vegetation type to allow for statistically valid tracking of any long-term trends in the vegetation communities (*e.g.,* the ability to infer changes in riparian communities likely will require a much smaller mapping unit than coastal sage scrub or chaparral). In addition, clearly-stated, objective protocols and decision rules for naming vegetation communities would be established for the baseline mapping so that future assessments against the baseline database can as precise and accurate as possible.

Following the initial baseline vegetation mapping, at 5-year intervals updated imagery of at least the same quality as the baseline imagery would be used to evaluate and update the vegetation database for the Habitat Reserve. Although this assessment and update primarily would be based on remote interpretation of the imagery, areas that appear to have undergone substantial change in vegetation, and with no known or obvious natural causes of the change (*e.g.,* wildfire or drought), would be field-truthed, as necessary, to determine whether a change in the vegetation community has occurred and what the possible cause may have been (*e.g.,* invasion by exotics). Initially field-truthing would be conducted on lands previously dedicated to the Habitat Reserve (*e.g.,* County parklands, Ladera Open Space, Upper Chiquita Conservation Area and Donna O'Neill Land Conservancy) and then on lands later transferred to the Habitat Reserve at the next 5-year update interval.

In conjunction with landscape-scale vegetation community monitoring, regional climate, weather and air quality information would be collected in order to examine potential correlations between vegetation changes and these environmental variables.

Within the boundaries of the HRMP (see *Figure 136-M*), annual field studies within the designated plots would be conducted to monitor fine-grained changes within the coastal sage scrub community for at least the first five (5) years of the monitoring program. A set of permanent plots, each with several semi-permanent sample belt-transects, for example, would be established throughout the coastal sage scrub system in the Habitat Reserve to capture the physiographic diversity of the Habitat Reserve, and to ensure that any unique biological resources or areas where stressors may operate are included in the sample population. These permanent sample plots initially would be established on lands previously dedicated to the Habitat Reserve and on more plots, as needed, as additional lands are transferred to the Habitat Reserve.

The sample plots would be as regularly-shaped as possible (square to rectangular), given site conditions (topography, vegetation characteristics and survey logistics), in order to standardize the number of transects within a sample plot and allow for comparable data from different management areas. Baseline data for pre-established sample points for each transect would be recorded, such as dominant and sub-dominant associated species, visually-estimated percent

cover, percent native and non-native plant species, slope, aspect, substrate/soils, and any disturbance conditions or possible threats. Photo-stations would be established at these sample locations along transects to capture the environmental diversity or gradient of the transect. Sample plots, transects, and sample points along each transect would be mapped using GPS accurate to the nearest 0.5-1.0 m (based on year 2005 available GPS technology).

Concurrent with focal species surveys (as described below), botanists would conduct annual floral surveys along the belt-transects in the coastal sage scrub sample plots, typically within the March-May timeframe, but at a time that maximizes the detection of perennial and especially annual plants in any given year. While many floral sampling regimes are possible (*e.g.*, Elzinga *et al.* 2001), based on the sample plots and belt-transects established for wildlife monitoring, the following method is suggested.

Semi-permanent 25-m segments along the center of the belt transect would be established in a pseudo-random fashion. Based on the baseline data for the belt-transects, these segments would cover the diversity/gradient along the transect. Data would be collected by recording each species that intersects an imaginary vertical plane at each 0.5-m mark along the 25-m segment of the sample transect. All species present within a 5-m band centered on the transect line would be recorded. Relative species cover and species diversity would be derived from these data. Additional data collected for the sample transect include evidence of natural or human-induced stressor (*e.g.*, drought, fire, grazing, off-road vehicles, unauthorized trails, trampling, trash, etc.). Each sample transect would be photographed to document the status of the vegetation at the site on an annual basis.

After the first five years of the AMP, the Reserve Manager and Science Panel would assess the results of the monitoring program and make adjustments to the appropriate schedule for future sampling (*e.g.*, every two or three years), as well as modifications to the sample plots (*e.g.*, numbers, locations, etc). These assessments and recommendations, as well as the sampling strategy for the upcoming five years would be included in the 5-year comprehensive report. The appropriate long-term monitoring interval would be based on the resources being managed and monitored and the time scale of potential adverse changes. For example, areas vulnerable to volatile edge effects (*e.g.*, invasion by Argentine ants) probably need to be monitored more frequently than interior areas where adverse changes are more likely to occur, or only be detectable, over a longer time frame.

From a pure statistical perspective, sample plots, transects within the plots, and points within a transect, ideally would be randomly selected throughout the Habitat Reserve to control for sample bias. Practically, however, the selection of sample areas (*i.e.*, sample plots, transects, and points) should reflect the diversity of the Habitat Reserve so that important or unique biological

resources, as well as where environmental stressors are, or thought to be, operating, are not overlooked. Thus, the number and location of the sample plots within the Habitat Reserve, the number and locations of sample transects with a sample plot, and the number and locations of sample points along a transect would depend on landscape, vegetation community and species factors. At the landscape level, it would be important to monitor the physiographic diversity of the Habitat Reserve such as the coastal-inland gradient and elevation. At the vegetation community level, it will be important to sample to the extent practical the diversity of microhabitats within coastal sage scrub such as different slopes, aspects, soils, plant and wildlife community structure, ecotones, proximity to water, and rock outcrops to the extent feasible. At the species level, it will be important to tie sample areas to representative populations of focal species (as described below). And, as noted above, it will also be important to monitor unique biological resources or areas where stressors are, or may in the future be, operating. Although these sampling levels have somewhat different selection criteria, they also are interdependent in that an efficient monitoring program will maximize the relative number of sample areas that meet the selection criteria at all three levels. For example, selecting a location for monitoring habitat linkage function may include selection criteria such as: **(1)** provides a crucial linkage between two large habitat blocks (landscape level); **(2)** provides high quality "live-in" habitat for coastal sage scrub focal species (habitat level); **(3)** supports an *important population* in a *key location* of a Covered Species (species level); and **(4)** is adjacent to urban development.

Although precise locations for sample plots cannot be specified here, areas supporting *major* and *important populations* of the California gnatcatcher and key habitat linkages can be identified and provide good indicators for selecting initial monitoring locations in coastal sage scrub. For example, a set of monitoring locations could be selected from the following areas over time (linkage areas are depicted in *Figure 41-M*):

- Upper Chiquita Canyon Conservation Area – *major gnatcatcher population* in *key location*
- Chiquita Ridge south of Oso Parkway – *major gnatcatcher population* in *key location*, Linkage C
- Chiquita Ridge/San Juan Creek – *major gnatcatcher population* in *key location,* Linkages C and J
- Chiquadora Ridge - *major gnatcatcher population* in *key location,* Linkage G
- Chiquita Canyon north of wastewater treatment plant - *major gnatcatcher population* in *key location,* Linkage E

- North Coto de Caza "Horseshoe" Linkage F between *major gnatcatcher population* in *key location* in Chiquita Canyon and *important gnatcatcher population* in *key location* east Coto de Caza/Starr Ranch
- East Coto de Caza/Starr Ranch *important gnatcatcher population* in *key location*
- Caspers Wilderness Park *important gnatcatcher population* in *key location* east of Ortega Highway
- O'Neill Regional Park *important gnatcatcher population* in *key location* west of Live Oak Canyon Road, Linkages S and T
- O'Neill Regional Park *important gnatcatcher population* between Oso and Avery parkways, Linkage B south of Las Flores
- Trampas Canyon *important gnatcatcher population* in *key location*, Linkage K
- North San Clemente *important gnatcatcher population* in *key location*, Linkage K
- West San Juan Capistrano *important gnatcatcher population* in *key location*
- Upper Cristianitos Canyon *important gnatcatcher population* in *key location*, Linkage N
- Avenida Pico *important gnatcatcher population* in *key location*

The efficacy of these potential monitoring locations would need to be evaluated in the context of other landscape-, vegetation community- and focal species-level monitoring requirements discussed above in order to select the set of sample plots that provide an efficient information return on the monitoring effort. Initially, short-term studies to collect baseline information for focal species occupation and use would be conducted at selected monitoring sites prior to development. Initiation of long-term monitoring of the sample plots would be phased in concert with development that may affect the function of the habitat linkage or wildlife corridor; *i.e.*, the long-term monitoring of the site would be linked to a potential constraint or stressor at the site.

b. Focal Species Monitoring

A suite of candidate focal species for coastal sage scrub was identified in *Section 7.4.2.c*, including ten (10) early warning indicators, four (4) biodiversity indicators, and three (3) umbrella species (*Table 7-9*).

TABLE 7-9
COASTAL SAGE SCRUB CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Cactus Wren	•		
California Gnatcatcher	•		
California Thrasher		•	
Great Horned Owl			•
House Finch	•		
Mockingbird	•		
Red-tailed Hawk			•
Rufous-crowned Sparrow		•	
Wrentit		•	
Reptiles			
Orange-throated Whiptail	•		
San Diego Horned Lizard	•	•	
Mammals			
Coyote	•		
Mule Deer			•
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**10**	**4**	**3**

The cactus wren, California gnatcatcher, California thrasher, rufous-crowned sparrow, wrentit, orange-throated whiptail, and San Diego horned lizard are hypothesized to be general indicators of relatively high coastal sage scrub habitat quality; *i.e.*; their absence from a patch of coastal sage scrub (or southern cactus scrub for the cactus wren) may indicate a loss of function or the presence of a specific threat (*e.g.*, Argentine ant impacts on San Diego horned lizards; Suarez and Case 2002). Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and urban-related predators such as cats, and consequent reduction of small native species (Crooks and Soulé 1999). Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose very common occurrence along the urban/wildland interface may indicate some level of habitat degradation (Bolger *et al.* 1997a) (although it should be noted that these species also occur in very isolated areas far from urban development). The dynamic relationships between the "high habitat quality" indicators and edge-enhanced species (*e.g.*, direct, interspecific competition or simply a negative correlation caused by some other factor) are not understood at this time. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat

requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the AMP would need to be determined. Likewise, mule deer are still relatively common in the planning area and they are easy to detect. Their main value as an umbrella species likely would be in regard to the function of habitat linkages and wildlife corridors because they are sensitive to undercrossing design and size (*e.g.*, bridges and culverts). In addition, as the main prey of mountain lions, their occurrence would be important for maintaining this species in the subregion.

One objective of the AMP during the early years of implementation would be to determine the efficacy of these candidate focal species for management and monitoring of coastal sage scrub in the Habitat Reserve. As such, at minimum the occurrence of these species in the Habitat Reserve would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (*e.g.*, scat, tracks nests, etc.). As the AMP progresses, it may be necessary to drop some of these species as focal species if they do not inform management and monitoring and, alternatively, add new candidates for testing as focal species.

The survey methods used for focal species would need to be tailored to the species and management issue(s) being addressed in relation to the identified or potential environmental stressor. For example, several standard avian survey methods that provide different levels of information can be used. CalPIF (2002) described five standard methods ranging from the least labor-intensive to the most intensive:

1. **Area Search:** This is a habitat specific, time constraint census method to measure relative abundance and species composition. It can provide breeding status, but may not be as reliable as other more intensive methods. This is the standard method used for general presence/absence surveys and does not imply repeated samples over several years.
2. **Point Count:** This method specifically intended to monitor population changes of breeding birds at fixed points and spatial and temporal differences in species composition among habitat areas. This method is appropriate for monitoring bird populations over time.
3. **Mist Netting:** This method provides information about the health and demographics of a population because birds are directly handled. It provides valuable information about productivity, survivorship and recruitment and possible cause and effect relationships (*e.g.*, effects of parasites on health).
4. **Territory Mapping:** This method provides information about spatiotemporal habitat use based on repeated observations of birds' locations. This method provides information about population densities and distributions and intraspecific (within species) and

interspecific (between species) interactions. This method is very labor intensive and is very sensitive to the sampling protocol (*e.g.*, number of visits, season, time of day, weather conditions, etc.). If this method is used, it is critical to carefully define the management question in order to develop the appropriate protocol.

5. **Nest Monitoring:** Similar to mist netting, this method provides information on health and demographics, particularly with regard to nesting activities and reproductive success, such as clutch size, number of broods, number of nesting attempts, etc. Because nests have to be located and frequently monitored, this method tends to be the most labor-intensive. In addition, this method poses the greatest risk to the monitored species because of the risk of causing nest failures of disruption essential activities.

As mentioned above, survey information should be relevant to the management and monitoring goals and issues (*e.g.*, stressors) for the species. For example, if a study site is on the edge of the Habitat Reserve adjacent to urban development, is it being colonized by mockingbirds or some other "edge-enhanced" species? An initial monitoring approach in Habitat Reserve-urban edge study areas may simply be to compile information about focal species composition using a relatively low-intensity method such as point counts. Generally, monitoring presence/absence of species through methods such as point counts limits inferences to correlational relationships and provides little cause-and-effect inferential information. However, if an increase in mockingbirds coincides temporally with a decline in California gnatcatchers, a potential cause-and-effect relationship may be operating and further study or an experimental action would be warranted. Correlational data can be used to generate testable alternative hypotheses that allow for "crucial experiments" of cause-and-effect relations; *i.e.*, the classic "strong inference" model described by Platt (1964). For example, observations of antagonistic interactions between mockingbirds and gnatcatchers may suggest that mockingbirds are actively excluding gnatcatchers and that some type of experimental control of mockingbirds (*e.g.*, misting netting or nest removal) at selected sites along the Habitat Reserve-urban edge is warranted. On the other hand, if there is a time lag between the disappearance of gnatcatchers and the appearance of mockingbirds, some other factor may be responsible for the change (*e.g.*, habitat degradation) and the mockingbird may simply be expanding into available habitat in the absence of the gnatcatcher.

As another example, the correlation observed between lack of fire, grazing and gnatcatcher occurrence in middle and lower Chiquita Canyon leads to the hypothesis that "In the absence of periodic fire, light to moderate grazing in coastal sage scrub maintains vegetation community structure and diversity suitable for the California gnatcatcher." Because this hypothesis questions the relationship between gnatcatcher occurrence, fire and grazing levels, an appropriate study would be to examine gnatcatcher occurrence in areas that have not burned in several decades, including areas that have been grazed and areas that have not been grazed. If grazing in

the absence of fire is positively associated with gnatcatcher occurrence, one could then ask the question of how grazing affects coastal sage scrub structure such that it is suitable for gnatcatchers. However, the long-term value of this information for management of coastal sage scrub may not warrant the additional cost of conducting the study, or at least, it may have a low priority as part of the AMP. In order to allocate funds in the most cost-effective and efficient manner, it will be critical to identify the appropriate level of monitoring for informing the AMP.

In addition to monitoring of focal species, experienced field biologists typically record every wildlife species they encounter in an area. Accordingly, the species data would not be limited to focal species and collection of presence/absence data for other species would be important. Species not considered here as focal species may prove to be valuable in the future and the monitoring program should maintain the flexibility of adding new focal species. Hence, it would be important for the monitoring biologists to record the number of individuals of each species they encounter or have some metric for estimating relative abundance. By having both the number of species and the abundance of each species, it would be possible to generate a diversity index, which in this case would be the number of species in the sample plot and their relative abundance. There are several standard diversity indices that can be used: Shannon-Weiner index, richness index, Brillouin index, and Simpson index. The index or set of indices used would be determined by the Reserve Manager and Science Panel, but selection of the method should be coordinated to the extent possible with the Wildlife Agencies and other conservation programs to facilitate the exchange of data and analyses across a broader area.

7.7.4 Management of Coastal Sage Scrub and Focal Species

The AMP for coastal sage scrub includes the two types of management described above in *Section 7.5.1*: **(1)** passive management; and **(2)** active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

The conceptual stressor model for coastal sage scrub focal species (*Figure 143-M*) depicts known and potential stressors of these species. These stressors also are summarized in *Table 7-3*. The Species Accounts and Conservation Analyses in *Appendix E* provide more detailed conceptual models for Covered Species that are focal species. Stressors generally fall into two categories: **(1)** general, vegetation community-wide stressors; and **(2)** species-specific stressors. However, the distinction between the general and species-specific stressors often is blurred. For example, control of Argentine ants is specific to San Diego horned lizards because of specific impacts on their native prey base, but this problem is also more generic because the adverse impacts of Argentine ants on native vegetation communities and species goes beyond the horned lizard.

7.7.5 Restoration of Coastal Sage Scrub

The AMP includes a coastal sage scrub restoration plan that would restore approximately 363 acres of coastal sage scrub (not including coastal sage scrub/valley needlegrass grassland) and be comprised of two main components:

1. Restoration of pre-designated areas to increase net habitat value of the coastal sage scrub community; and
2. Case-by-case restoration opportunities undertaken during the course of long-term adaptive management of the Habitat Reserve in response to changing conditions and emergencies.

The coastal sage scrub restoration plan is discussed in detail in the Habitat Restoration Plan in *Appendix H.*

The goal of the coastal sage scrub restoration plan is to establish coastal sage scrub in areas that would contribute habitat value to the Habitat Reserve by increasing the carrying capacity for the California gnatcatcher and other sage scrub species. With this goal in mind, several areas have been tentatively identified for coastal sage scrub restoration (see *Figure 42-M*):

- Sulphur Canyon in the Gobernadora sub-basin was identified for restoration to provide additional habitat and enhance connectivity between Chiquita Canyon and Wagon Wheel Canyon to the west and Gobernadora and Bell canyons to the east. Sulphur Canyon is currently characterized by coastal sage scrub on the slopes of the canyon and grazed annual grasses on the valley floor. Opportunities to improve "live-in" habitat and connectivity for California gnatcatchers through enhancement of existing coastal sage scrub will be identified.
- Several side canyons along Chiquita Ridge and adjacent to Chiquita Creek were identified for restoration. Restoration of the two large canyons just northwest and southwest of the "Narrows" would greatly improve the habitat integrity of Chiquita Ridge, which narrows to less than 2,000 feet in width at the top of these side canyons, and provide substantial "live-in" habitat for California gnatcatchers and other species, and improve the integrity of the reserve system.

Final selection of areas for restoration would require additional field study to determine the likelihood of a successful program, including analysis of factors such as soil conditions and presence of exotic species both within the restoration area and surrounding vegetation communities. The timing and extent of restoration actions will be established through the overall

process of prioritizing AMP actions reflecting the recommendations of the Science Panel and the decisions of Reserve Manager. In some areas, the desired habitat is a mosaic of coastal sage scrub and native grassland that emulates the surrounding habitat characteristics. Such areas would provide suitable habitat for coastal sage scrub and grassland species, and especially species that use sage scrub-grassland ecotones (*e.g.*, gnatcatchers and grasshopper sparrows). These primarily are areas that support clay soils and are highly suitable for restoring native grasslands. The following areas are recommended for coastal sage scrub/valley needlegrass grassland (CSS/VGL) restoration: Upper Gabino; and in the Chiquita sub-basin in the area east of the SMWD wastewater treatment plant, the citrus groves west of Chiquita Creek and the disced areas west of the creek to the Chiquita ridgeline.

- Upper Gabino currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration would reduce sediment generation and promote infiltration of stormwater which would reduce downstream impacts. This area has been identified for a mix of coastal sage scrub and native grassland restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse sage scrub. Allowing a mixed community to regenerate may represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for restoration and several patches of low quality native grassland suitable for enhancement.
- As discussed above for coastal sage scrub, restoration of disturbed areas of Chiquita Canyon west of Chiquita Creek would provide additional habitat for upland species occupying Chiquita Ridge, and particularly the gnatcatcher. Restoration of areas previously used for agricultural purposes, including grazing and citrus, would also benefit riparian species by removing uses that may contribute to downstream impacts. Additional field work would be needed to identify the areas best suited for revegetation with coastal sage scrub alone and coastal sage scrub/native grassland.

Case-by-case active/experimental restoration of coastal sage scrub also would occur under the AMP as the Reserve Manager and Science Panel identify areas suitable for restoration. Instances that may warrant an active restoration include the following:

- Existing areas of degraded coastal sage scrub habitat that is not naturally recovering through passive management;
- Areas that are degraded or disturbed by future natural events and that are unlikely to recover naturally (*e.g.*, an area that has burned too frequently);

- Areas that have been temporarily disturbed either by authorized (*e.g.*, an approved infrastructure project) or unauthorized (*e.g.*, an illegal trail) activity; and
- Specific adaptive management research involving restoration treatments.

Generally it would be the decision of the Reserve Manager whether to undertake a restoration project on RMVLC ownership in the Habitat Reserve. However, where the project may affect adjacent lands managed by the County, or be affected by vegetation community conditions on County lands, a coordinated effort by the RMVLC and County may be desirable.

As discussed above, the AMP focus is on conducting restoration activities in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

The details of the coastal sage scrub restoration program are provided in the upland habitat restoration component of the Habitat Restoration Plan (*Appendix H*). The key management activities proposed by the plan are listed here:

- Identification of priority coastal sage scrub restoration areas for the RMVLC portion of the Habitat Reserve;
- Revegetation of existing degraded habitat;
- Re-establishment of coastal sage scrub in areas that have been converted to annual grassland or disturbed habitat due to human activities or too frequent fires;
- Control of invasive or exotic plant and wildlife species, such as artichoke thistle, black mustard, Argentine ants, red imported fire ants, and brown-headed cowbirds;
- Fire management activities;
- Management of grazing and other agricultural activities that adversely affect habitat values and diversity; and
- Controlling public access and recreation to protect/enhance habitat values, including seasonal restrictions during nesting or temporary restrictions designed to provide opportunities for recovery of overused areas.

SECTION 7.8 CHAPARRAL AND FOCUS SPECIES

This section addresses adaptive management of chaparral and associated focal species. Chaparral is the lowest priority for management and monitoring because of its low **Vegetation Community Ranking** score relative to the other Conserved Vegetation Communities addressed by the AMP (Tables *7-7a* and *7-7b*). For this reason, the primary focus of management and monitoring of chaparral would be passive management.

7.8.1 Adaptive Management Issues

Conceptual stressor models were presented in *Section 7.4.1* for chaparral and associated focal species (*Figures 139-M* and *144-M*). The main stressors on the chaparral vegetation community are habitat fragmentation and fire. Cattle-related impacts, exotic species, hydrology, human uses, and precipitation also are identified as stressors, but their effects are considered to be significantly less important than habitat fragmentation and fire. However, both habitat fragmentation and short-interval fires, including the increased risk of fire in a fragmented habitat from human-cause ignitions, can, in turn, increase opportunities for exotic plant species invasions and type conversion of chaparral to annual grassland. Conversely, infrequent fire can result in fuel buildups and, in combination with drought, result in extremely intense, devastating fires. In addition, lack of fire may result in type conversion of chaparral to oak woodland (*e.g.*, Cooper 1922; Wells 1962), although this type of conversion would not necessarily be considered adverse or needing management. These stressors generally result in reduced nutrient cycling, loss of spatial and temporal habitat structure and diversity, invasions by exotic species, temporary or permanent state-transitions to non-native annual grassland, and alteration of the food web. Temporary state-transitions at a moderate patch size scale probably are normal and may reflect adaptations to the natural fire regime, although before European settlement, successional communities may have been native grasslands and coastal sage scrub rather than non-native annual grasses and weedy forbs. Permanent state-transitions, on the other hand, may be associated with loss of habitat value because of a decline of plant and wildlife abundance and diversity. The stressor model in *Figure 139-M* also shows interactions among the stressors and among community responses. For example, prolonged drought can increase the likelihood and intensity of fire, which can, in turn, expose chaparral to invasion by exotic plant species.

As noted above, fire appears to a key factor for chaparral based on the many adaptations of its characteristic species and its resilience[7] in form and composition to periodic burning (Keeley 1986, 1992a,b). Post-fire species composition, however, varies substantially in relation to fire frequency, season and intensity and other environmental variables. In particular, the life history characteristics of "resprouters" versus "obligate seeders" appear to be quite different in relation to fire intervals, xeric versus mesic slopes, and root systems (*e.g.*, resprouters may be more resistant to drought than seeders because they have deeper tap roots) (Keeley 1986).

Several experimental hypotheses relevant to managing chaparral within the Habitat Reserve were identified based on this model and the scientific literature:

[7] Resilience can be defined as a rapid return to pre-perturbation (equilibrium) state (Keeley 1986).

- Chaparral left undisturbed by fire will convert to oak woodland, especially in areas with well-developed soils, and exhibit a decrease in diversity.
- Fire intervals of less than 10 years will result in a decrease in a diversity of chaparral species in favor of "resprouters" compared to "obligate seeders" (*e.g.,* Keely 1977, 1986; Zedler *et al.* 1983).
- Recovery of resprouters and obligate seeders varies in relation to mesic versus xeric slopes, with resprouters favoring mesic slopes and seeders favoring xeric slopes (Keeley 1986).
- Fire intervals of less than 10 years will result in type conversion of chaparral to coastal sage scrub and eventually grassland (*e.g.,* Haidinger and Keeley 1993).
- Fire intervals of less than 10 years will result in recruitment of exotics species such as mustards and bromes (*e.g.,* Haidinger and Keeley 1993).
- Suppression of fire in a stand of coastal sage scrub will result in type-conversion to chaparral.
- Sustained drought will result in domination of chaparral by obligate resprouters such as scrub oak and facultative resprouters such as chamise (*e.g.,* Keeley 2000).

These are just some examples of the many experimental management hypotheses that can be generated. The hypotheses to be tested in the Habitat Reserve should be selected on the basis of their relevance to known or potential environmental stressors and to the long-term management of the Reserve.

The adaptive management issues for chaparral are similar to those for coastal sage scrub, although the state-transition pathways and relationships are somewhat different; *e.g.*, a response to fire by chaparral is a possible transition to coastal sage scrub whereas as burned coastal sage scrub has a moderate probability of converting to grassland. In addition, according to the state-transition model and supporting scientific evidence, chaparral is fairly resilient to state-transitions unless burned frequently.

7.8.2 Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for chaparral and associated focal species:

- Maintain the physiographic diversity of chaparral and associated focal species in the Habitat Reserve.

- In the event that existing chaparral in the Habitat Reserve is degraded, restore and enhance the quality of future degraded chaparral in the Habitat Reserve such that net habitat value of the existing chaparral system is preserved (see definition of net habitat value in *Section 7.7.2*).

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value:

- Conduct monitoring of chaparral and focal species in manner that allows the Reserve Manager to track the long-term habitat value of the chaparral system.
- Manage chaparral fire regimes through implementation of the Wildland Fire Management Plan (*Section 7.14* and *Appendix N*) such that a natural diversity of age-stands and resprouters/obligate seeders is maintained throughout the Habitat Reserve and that existing chaparral stands do not irreversibly type-convert to grassland.
- Manage cattle grazing such that adverse impacts to chaparral do not occur and that existing chaparral stands do not irreversibly type-convert to grassland.
- Control exotics invasions of chaparral, especially along the Habitat Reserve-urban interface or other identified vulnerable areas (*e.g.*, along existing paved and dirt roads, utility easements).

Chaparral received a low **Vegetation Community Ranking** score relative to the other Conserved Vegetation Communities and, at this time, is a low priority for management and monitoring. The chaparral vegetation community in the Habitat Reserve generally is healthy, and no specific areas warranting restoration have been identified. Therefore, in contrast to coastal sage scrub, native grassland and riparian/wetland vegetation communities (described below), a specific *a priori* restoration objective for chaparral has not been formulated, even though restoration of chaparral is a stated goal of the AMP. However, areas within the Habitat Reserve requiring restoration may identified in the future, either as a result of more detailed field investigation of existing conditions or as triggered by natural or human-induced events (*e.g.*, frequent wildfires).

7.8.3 Strategies for Monitoring Chaparral and Focal Species

The monitoring program for chaparral would implement the same general strategies and use the same general methods described above for coastal sage scrub (the reader is directed to *Section 7.7.3* for more detail). The key points for the monitoring program for chaparral are summarized here:

1. Evaluation and update of the entire chaparral vegetation database at 5-year intervals.

2. Annual on-the-ground monitoring of selected sample plots distributed across the Habitat Reserve in a spatial distribution that represents the diversity of the Reserve and in key areas where environmental stressors are most likely to operate (*e.g.*, along the Habitat Reserve-development edge).

The detailed monitoring plans for the Habitat Reserve, including specific monitoring locations (*i.e.,* sample plots, transects, etc.), monitoring schemes and schedules, personnel, etc., will need to be developed by the Reserve Manager and the Science Panel as part of the first 5-year MAP.

a. Vegetation Monitoring

Periodic evaluation and update of the chaparral vegetation community would be part of the overall review of the Habitat Reserve vegetation database that would occur at 5-year intervals, and as described in detail above for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the Habitat Reserve within two (2) years of executing the IA.
- Evaluation and update of the vegetation map based on remote interpretation and spot field verification as part of the overall Habitat Reserve 5-year MAP effort.
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables.
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program.
- Concurrent focal species surveys (as described below).

After the first five years of monitoring of chaparral, the Reserve Manager and Science Panel would assess the results of the monitoring program and make adjustments and recommendations as to the appropriate schedule for future sampling (*e.g.,* every two or three years), as well as modifications to the number of sample plots (*e.g.,* numbers, locations, etc.).

b. Focal Species Monitoring

A suite of candidate focal species for chaparral was identified in *Section 7.4.2.c*, including eight (8) early warning indicators, three (3) biodiversity indicators, and five (5) umbrella species (*Table 7-10*).

TABLE 7-10
CHAPARRAL CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
California Thrasher		•	
Great Horned Owl			•
House Finch	•		
Mockingbird	•		
Red-tailed Hawk			•
Wrentit		•	
Reptiles			
Orange-throated Whiptail	•		
San Diego Horned Lizard	•	•	
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**8**	**3**	**5**

Similar to coastal sage scrub, as described above, the wrentit, California thrasher, San Diego horned lizard and orange-throated whiptail are indicators of high quality chaparral, and their absence may indicate a loss of function or presence of a specific threat. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species. Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The Argentine and red imported fire ants are demonstrated threats to native species along the edges of natural areas. The great horned owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the AMP would need to be determined.

Likewise, mule deer, bobcat and mountain lion are still relatively common in the planning area and they are easy to detect. Their main value as umbrella species likely will be in regard to the function of habitat linkages and wildlife corridors because they are sensitive to undercrossing design and size (*e.g.,* bridges and culverts).

One objective of the AMP during the early years of implementation would be to determine the efficacy of these candidate focal species for management and monitoring of chaparral in the Habitat Reserve. As such, at minimum the occurrence of these species in the Habitat Reserve would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (*e.g.,* scat, tracks nests, etc.). As the AMP progresses, it may be necessary to drop some of these species as focal species if they do not inform management and monitoring and, alternatively, add new candidates for testing as focal species.

General sample methods for monitoring focal species are described above for coastal sage scrub.

7.8.4 Management of Chaparral and Focal Species

The AMP for coastal sage scrub includes the two types of management described above in *Section 7.5.1*: **(1)** passive management; and **(2)** active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Because chaparral appears to be more resilient to state-transitions than coastal sage scrub, for example, it is anticipated that passive management would be the predominant management approach for this community within the Habitat Reserve. Furthermore, partly reflecting this greater resiliency and because it has a relatively low **Importance Value** score, chaparral received a low **Vegetation Community Ranking** score relative to the other Conserved Vegetation Communities and is a low priority for management and monitoring.

The greatest risk to maintaining healthy stands of chaparral in the Habitat Reserve appears to be short-interval fire. Short fire intervals (< 25 years) in chaparral may eliminate obligate seeding species in favor of resprouters and very frequent fires (1, 2 or 3 year intervals) may result in invasion by exotic weeds and annual grasses (*e.g., Brassic nigra, Bromus* spp., *Schismus barbatus*) (*e.g.,* Haidinger and Keeley 1993; Keeley 1986; Zedler *et al.* 1983). The fire management of chaparral is treated in detail in the Wildland Fire Management Plan. Although cattle-related impacts also are a potential stressor, biologists familiar with the RMV property have not observed a significant adverse effect of cattle on chaparral. The Grazing Management Plan (*Appendix G*) describes the existing and future grazing program. Stocking rates would remain the same as present in the near-term and gradually would be reduced as existing pastures

are phased out over the next 20 to 25 years. No new pastures that would impact chaparral are proposed and thus grazing management is not anticipated to be a high priority for this community in the Habitat Reserve.

Because the primary management approach likely would be passive, fewer management resources would be expended for active or experimental management of chaparral compared to coastal sage scrub, native grassland and riparian and wetland communities. Nonetheless, reserve owner/managers should take advantage of opportunities to conduct experimental management actions in chaparral in response to natural or human-induced disturbances such as fire.

The conceptual stressor model for chaparral focal species (*Figure 144-M*) depicts known and potential stressors. The stressors for chaparral focal species are essentially the same as for coastal sage scrub species because of the large overlap between the two lists.

7.8.5 Restoration of Chaparral

There is no identified need for restoring chaparral. The AMP includes as-needed, case-by-case restoration of chaparral undertaken during the course of long-term adaptive management of the Habitat Reserve, with the overall goal of maintaining the existing diversity of chaparral in the Habitat Reserve and as achieved by the two following objectives:

1. Restore chaparral in areas that are degraded or disturbed by future natural events and are unlikely to recover naturally (*e.g.*, an area that has burned too frequently); and

2. Restore chaparral in areas subject to human-caused disturbance and temporary impacts within the Habitat Reserve (*e.g.*, infrastructure maintenance).

Restoring areas that are disturbed in the future is important for maintaining long-term net habitat value. As documented in several studies noted above, frequent disturbances of chaparral (*e.g.*, fire) can result in state-transition to annual grassland and weedy, disturbed habitats. Likewise, areas that have been temporarily disturbed either by authorized (*e.g.*, an approved infrastructure project) or unauthorized (*e.g.*, an illegal trail) activity may be at risk of long-term degradation. In such cases restoration may be required to re-establish chaparral to both maintain existing habitat value and protect adjacent areas from invasions by exotic species that could be established without intervention.

As part of the management of the various lands in the Habitat Reserve supporting chaparral, the Reserve Manager would identify areas suitable or desirable for restoration. Generally it would

be the decision of the Reserve Manager whether to undertake a restoration project on RMVLC ownerships in the Habitat Reserve. However, where the project may affect adjacent lands managed by the County, or be affected by the conditions of vegetation communities on County lands, a coordinated effort by the RMVLC and County may be desirable.

As discussed above, a key feature of the AMP is that restoration activities will be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

SECTION 7.9 NATIVE GRASSLAND AND FOCAL SPECIES

This section addresses adaptive management of native grasslands and associated focal species. Native grassland received a relatively high **Vegetation Community Ranking** score (*Section 7.6.2*), primarily because of its high **Importance Value**, and thus has a high priority for management and monitoring.

7.9.1 Adaptive Management Issues

Adaptive management of grasslands in the Habitat Reserve is complicated by the fact that the system supports both sensitive native grasslands and non-native annual grasslands. Although both types provide valuable habitat for many wildlife species, and annual grassland may be considered a "naturalized" vegetation community or a "new native" (Heady 1977), management and monitoring primarily is geared to native grasslands. Moreover, in some cases, the management of native grassland and other valuable uplands such as coastal sage scrub and chaparral would focus on converting annual grassland back to what was likely the native vegetation community on the site. Over time there likely would be a net loss of non-native annual grassland in favor of net increases in native vegetation communities. The CSS/VGL restoration plan, for example, targets several areas of annual grassland.

The environmental stressor models for native grassland and associated focal species are presented in *Figures 140-M* and *145-M*. The primary stressor on native grassland is exotic annual grasses and weedy forbs that dominate much of the remaining native grassland in the planning area. Exotic species reduce nutrient cycling, affect structure and diversity of native species, promote state-transition to annual grassland and alter the natural prey base. Cattle-related impacts are significant stressors that can directly affect nutrient cycling, structure and diversity, promote state-transition from native to non-native grassland, and alter the food web, but also indirectly can facilitate invasions by exotic species. Native grasslands in upper Gabino Canyon, and upper Cristianitos Canyon to a lesser extent, also suffer from altered geomorphologic process (*i.e.*, erosion) affecting clay soils that result in the generation of fine

sediments. Finally, while periodic fire can favor native grasslands, short interval fires can inhibit native grasses and forbs and favor invasion of non-native species.

Under undisturbed conditions, such as a lack of periodic fire, native and annual grasslands may convert to coastal sage scrub. However, this hypothesized relationship must be tempered with the observation that at least in some regions of southern California annual grasslands appear to have stabilized, perhaps due to permanent changes in soil nutrients and moisture regimes caused by the presence of exotic species (Huenneke and Mooney 1989) and air pollution (Allen *et al.* 1996; Padgett *et al.* 1999; Minnich and Dezzani 1998). Without intervention, such areas can no longer naturally convert to coastal sage scrub and, in fact, the presence of exotics adjacent to coastal sage scrub may cause continued degradation of sage scrub without management intervention.

The relationship between native grasslands and shrub communities in the context of fire also is unclear. Some have suggested that the distribution of native grasses is related to a long history of burning by Native Americans (*e.g.*, Sampson 1944; Bean and Lawton 1973; Timbrook *et al.* 1982), while others attribute the distribution of native grasses to lightning-caused fires (*e.g.*, Heady 1977). Evidence supporting this assertion regarding the importance of fire includes the finding that more common native grassland dominants (*Nassella pulchra, N. lepida*) are adapted to fire by resprouting and producing greater volumes of seed following fire (Ahmed 1983; Keeley and Keeley 1984). Several field studies have reported an increased cover of *Nassella* spp. after burn treatments (Hatch *et al.* 1991; Dyer *et al.* 1996), while other studies have shown mixed effects of burning on species abundance (Hatch *et al.* 1999). Though research has demonstrated increased abundance of native grasses following fire, there is relatively little research describing the role of fire on maintaining other native species within valley and foothill grassland habitat. One example of a positive effect of fire (and grazing) management on native wildflowers is on The Nature Conservancy's Vina Plains Preserve in southern Tehama County (Griggs 2000).

The effects of grazing on valley and foothill grasslands also remain unclear. In spite of the fact that a long history of intensive grazing in California has been cited as one of the primary reasons for the demise of native grasslands (Burcham 1957; Keeley 1990; Bartolome and Gemmill 1981), most research has found that some intensity of grazing is beneficial to, or at least does not negatively affect, native grasses (Huntsinger *et al.* 1996). Several researchers have documented cases where native grasses have not increased in abundance on sites that have been excluded from grazing over 20- to 40-year periods (White 1967; Bartolome and Gemmill 1981; Goode 1981). Heady (1968, 1977) suggested that large native herbivores present prior to European colonization may have been an important factor in grassland formation and ecology. This assertion supports findings that some form of managed grazing may be useful as part of efforts to

maintain or restore native grasses. Menke (1996) considers "Prescribed grazing to constitute the primary component of the first phase of a perennial grass restoration program." (p. 23). Furthermore, as noted above, using grazing as a management tool on the Vina Plains Preserve to control non-native grasses has resulted in a greater abundance of native wildflowers on grazed sites (Griggs 2000).

Another management issue is maintaining the structural diversity of grasslands, whether they are native or non-native. Covered Species such as the grasshopper sparrow and white-tailed kite are sensitive to the structure of the grassland habitat as it relates to perching and foraging activity. For example, grasshopper sparrows require substantial vertical and horizontal structural diversity, with thick grasses and forbs for nest concealment, and tall forbs and grasses for perching, but also open, bare areas for foraging (Payne *et al.* 1998; Smith 1963; Vickery 1996; Zeiner *et al.* 1990). White-tailed kites forage preferentially for voles (*Microtus* spp.), which are limited to tall, dense grasses (Faanes and Howard 1987).

Fuhlendorf and Engle (2001) concluded that natural grassland heterogeneity in the Great Plains of North America reflects a grazing-fire interaction whereby fire and grazing disturbances distributed spatially and temporally over the landscape produce a heterogeneous shifting grassland mosaic that enhances biodiversity and enriches wildlife habitat. The native valley and foothill grasslands of California appear to have been subject to an analogous fire-grazing evolutionary history. The grassland management program therefore should emulate the natural heterogeneity of the grassland ecosystem to promote diversity and enhance wildlife habitat value.

As shown in the conceptual stressor model for native grassland (*Figure 140-M*), invasive exotics and cattle-related impacts are the key stressors of the native grassland ecosystem in the Southern Subregion. While fire would be a management tool to control invasives, it is not depicted in the model as a significant current direct stressor of native grassland.

Erosion is a management issue for native grasslands in upper Gabino and Cristianitos canyons.

For annual grasslands, management issues generally are related to maintaining the highest wildlife habitat value of the existing grasslands. A significant management issue for annual grasslands within the Habitat Reserve would be controlling the proliferation of artichoke thistle. Mustards and sweet fennel also are herbaceous species that can dominate grassland vegetation communities providing habitat and reduce their value for wildlife species.

7.9.2 Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for grasslands and associated focal species:

- Maximize the likelihood of the persistence of the physiographic diversity of native and annual grasslands and associated focal species in the Habitat Reserve.
- Restore native grassland and enhance the quality of degraded existing native grassland in the Habitat Reserve such that net habitat value of the existing grassland system is maintained (see *Section 7.7.2* for definition of net habitat value).
- Improve the quality of annual grasslands as wildlife habitat (*e.g.,* through artichoke thistle control).

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value:

- Conduct monitoring of grassland and focal species in manner that allows the Reserve Manager to track the long-term habitat value of the grassland system.
- Restore approximately 140 acres of native grassland and approximately 100 acres of coastal sage scrub/valley needlegrass grassland (CSS/VGL) to maintain and enhance habitat quality, diversity, and connectivity over the long-term.
- Manage native grassland fire regimes such that germination of native grasses (*Nasella* spp.) is enhanced.
- Manage cattle grazing to facilitate restoration of existing areas of native grassland, to the extent possible within the framework of the Grazing Management Plan (*Appendix G).*
- Control invasions of herbaceous exotic species in both native and annual grasslands, including artichoke thistle, mustards and sweet fennel.

7.9.3 Strategies for Monitoring Grassland and Focal Species

The monitoring program for grasslands would use the same general methods described above for coastal sage scrub and the reader is directed to *Section 7.7.3* for more detail. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire grassland vegetation database at 5-year intervals.

2. Annual on-the-ground monitoring of selected sample plots distributed across the Habitat Reserve in a spatial distribution that represents the diversity of the Reserve and in key areas where environmental stressors are most likely to operate (*e.g.*, along the Habitat Reserve-development edge).

a. Vegetation Monitoring

Period evaluation and update of the grassland vegetation community would be part of the overall review of the Habitat Reserve vegetation database that would occur at 5-year intervals, and as described in detail above for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the Habitat Reserve within two (2) years of executing the IA;
- Evaluation and update of the vegetation map at 5-year intervals based on remote interpretation and spot field verification;
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program; and
- Concurrent focal species surveys (as described below).

After the first five years of monitoring of grasslands, the Reserve Manager and Science Panel would assess the results of the monitoring program and make adjustments and recommendations as to the appropriate schedule for future sampling (*e.g.*, every two or three years), as well as modifications to the number of sample plots (*e.g.*, numbers, locations, etc.).

b. Focal Species Monitoring

A suite of candidate focal species for grasslands was identified in *Section 7.4.2.c*, including eight (8) early warning indicators, three (3) biodiversity indicators, and five (5) umbrella species (*Table 7-11*).

TABLE 7-11
GRASSLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Barn Owl			•
Grasshopper Sparrow		•	
Great Horned Owl			•
House Finch	•		
Lark Sparrow	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Mammals			
Coyote	•		
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**7**	**2**	**3**

The grasshopper sparrow and lark sparrow are possible indicators of high quality grassland, and their absence may indicate a general loss of function for wildlife species. For example, grasshopper sparrows prefer sites with high perennial grass cover and high structural diversity that provide for nest concealment, singing perches and foraging (Vickery 1996). They also are sensitive to habitat fragmentation and edge effects (predation and noise) and their presence appears to require at least 30-75 acres, depending on the geographic location (*e.g.*, Heckert 1994; Kobal *et al.* 1999; Vickery 1996). Lark sparrows are considered by Bolger *et al.* 1997a to be an "edge/habitat fragmentation reduced" species in southern California. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species (Crooks and Soulé 1999). Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl, barn owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the AMP will to be determined.

One objective of the AMP would be to determine the efficacy of these candidate focal species for management and monitoring of grassland in the Habitat Reserve. As such, at minimum the occurrence of these species in the Habitat Reserve would be monitored. All of these species,

and especially the birds, are easily detected, either directly or through indirect indicators (*e.g.*, scat, tracks nests, etc.). As the AMP progresses, it may be necessary to drop some of these species as focal species if they do not inform management and monitoring and, alternatively, add new candidates for testing as focal species.

Sample methods for monitoring focal species in general are described above for coastal sage scrub.

7.9.4 Management of Grasslands and Focal Species

The AMP for grasslands includes the two types of management described above in *Section 7.5.1*: **(1)** passive management; and **(2)** active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Because the management issues related to annual and native grasslands are quite different, they are discussed separately.

a. Annual Grassland

For the most part management of annual grasslands would be passive, except for the control of artichoke thistle. This species readily invades disturbed annual grassland and is especially pernicious in southern Orange County where control programs are absent. On RMV ongoing control efforts over the past 30 years have limited the occurrence and spread of artichoke thistle. The control of artichoke thistle is discussed in the Invasive Species Control Plan (*Appendix J*). Other common exotic species such as black mustard and sweet fennel are very common in the Southern Subregion an in southern California in general. Effective control techniques have not been established for these species, but there have been some attempts to use prescribed fire to control both species. There is mixed success with mustard, with a report of success in five consecutive years of prescribed fire at the Point Lobos State Park by California State Parks[8] but three consecutive years of burns at Crystal Cove State Park have not proven effective for mustard (USFWS, pers. comm., 2005). Likewise, fire has not been demonstrated to directly effectively control fennel, but it could be used as a "pre-control" measure to promote fleshy growth of plants that are susceptible to herbicide application (Trish Smith, TNC, pers. comm. to USFWS, 2005). Controls of black mustard and sweet fennel through the use of prescribed fire

[8] Barry, W.J. and R.W. Harrison. http://www.ice.ucdavis.edu/cafe/agenda97/FireManagement/Planning/1FMBarry.html

or grazing, or through mechanical or chemical treatments will need to be tested within the AMP framework (see Invasive Species Control Plan, *Appendix J*).[9]

Much of the management related to annual grasslands would be directed toward limiting the conversion of other upland native communities (coastal sage scrub, chaparral, oak woodland, and native grassland) to annual grassland so that the long-term net habitat value of these native communities in the Habitat Reserve is not diminished. From the perspective of habitat value, passive conversion of annual grassland to native grassland and shrub vegetation communities in the Habitat Reserve is not considered an adverse effect that would require management.

Because the primary management approach likely would be passive, fewer management resources would be expended for active or experimental management of annual grassland compared to coastal sage scrub. The Reserve Manager should take advantage of opportunities to conduct experimental management actions in grassland in response to natural or human-caused disturbances. In these cases, experimental management actions probably would focus on (1) how to re-establish native vegetation communities in areas at risk of converting to annual grasslands or (2) determining what are the stabilizing factors that prevent annual grasslands from converting to native vegetation communities.

The Reserve Manager should retain the flexibility to respond to future management issues for annual grassland that arise through the monitoring program or independent research on the grassland ecosystem.

b. Native Grassland

The primary management approaches to native grasslands would be active and experimental. Existing native grasslands in the Habitat Reserve likely would require substantial active management because they are subject to invasions by annual grasses and other exotic forbs. For example, of the approximately 1,020 acres of valley needlegrass grasslands mapped by Dudek on RMV in 2001, or included from other mapping efforts, only 17 acres (2 percent) were mapped as high quality (> 25 percent cover of needlegrass), 580 acres (57 percent) were medium quality (10-25 percent cover), 294 acres (29 percent) were low quality (~10 percent cover), and 128 acres (12 percent) had no rating (these areas were from previous mapping efforts that did not quantify native grassland quality). All native grasslands in the Habitat Reserve have a substantial non-native component that likely will need to be actively managed to sustain and enhance the quality of the existing native grassland. Common non-native species observed by Dudek in native grasslands include filarees (*Erodium* spp.), bromes (*Bromus hordaceous, B.*

[9] Element Stewardship Abstract for *Foeniculum vulgare*, Sweet Fennel, The Nature Conservancy, http:/tncweeds.ucdavis.edu/esadocs/documents/foenvul.html

diandrus, *B. madritensis*), wild oat (A*vena* spp.), black mustard (*Brassica* nigra), tocalote (*Centaurea* melitensis), smooth cat's-ear (*Hypochoeris glabra*), common catchfly (*Silene gallica*), bristly ox-tongue (*Picris echiodes*), and Russian-thistle (*Salsola tragus*). As stated by Menke (1996):

> *Introduced, alien grasses and forbs native to southern France, Spain and Portugal present a formidable obstacle to restoration and enhancement of native perennial grass populations in California foothill and valley grasslands. … Their diverse set of plant growth forms and phonologies cause fierce resource competition for light and water beginning soon after fall germination and often continue for the entire growing season.* (p. 22)

Another management issue for native grasslands, even in the relative absence of non-natives, is the buildup of thatch (dead culm-base of native grass) that affects the vigor of the plant. To remain healthy the plants require the removal of the upper portions of the leaves and reproductive culms by grazing, clipping or burning to stimulate new growth (Menke 1991).

Based on the existing habitat quality, the objective for active management would be to maintain existing grasslands at a level of at least medium quality (*i.e.*, greater that 10 percent cover by native grasses. Considering that at present only 2 percent of the native grasses mapped on RMV have a high quality rating (>25 percent cover), and the difficulties inherent in native grassland restoration, setting a "higher quality" objective for native grassland may be unrealistic and would be a lower priority than riparian/wetland, coastal sage scrub, and oak woodland areas. However, because enhancement of native grasslands to at least medium quality likely can be achieved using relatively low cost methods (grazing and fire management described below), native grassland management is an important component of the AMP.

Management of native grasslands would be achieved by two primary methods:

1. Grazing management
2. Fire management

It is important to understand that the Grazing Management Plan (GMP; see *Appendix G*) is not an element of the AMP and that the Ranch grazing operation is an ongoing activity. The purpose of the GMP is to coordinate and manage grazing on RMV consistent with the AMP. Therefore, some necessary grazing practices (*e.g.*, timing of rotations) may not be optimal for native grassland enhancement, but the GMP will not be inconsistent with sustaining existing native grasslands. Where practical and appropriate within the framework of the GMP, grazing will be

conducted in a manner to enhance native grassland. Furthermore, monitoring of timed grazing in relation to restoration of native grassland will be conducted to determine the effects of grazing patterns on native grassland. The details of monitoring program for grazing will be described in the first 5-year MAP prepared by the Reserve Manager and Science Panel.

Grazing would be the preferred management technique because it meshes well with the existing and future cattle operations on the Ranch. Also, as suggested by Menke (1991), grazing is a primary component of native grassland restoration and management, with fire as a secondary component. Appropriately timed grazing can have several beneficial effects on the vigor native grasslands:

- Removal of litter and thatch
- Recyling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available for native grasses

Fire can also have beneficial effects on native grassland, especially with regard to reducing litter and thatch and alien species, but frequent burning (*e.g.*, annual) can damage native grasses. Menke (1991), for example, recommends that burning be used every third or fourth year. In addition, burning may be an effective management tool for native grasslands in conjunction with managing coastal sage scrub and chaparral. In natural mosaics of shrublands, openings often support small patches of native grassland. Periodic burning of sage scrub and chaparral likely would help maintain these native grassland patches and enhance biodiversity and habitat value in these areas.

7.9.5 Restoration of Native Grassland

The AMP includes a native grassland restoration plan comprised of three main components:

1. Pre-designated restoration of areas with native grassland;
2. Pre-designated restoration of coastal sage scrub/grassland; and
3. Case-by-case restoration undertaken during the course of long-term adaptive management of the Habitat Reserve.

The native grassland restoration plan in discussed in detail in the Habitat Restoration Plan (*Appendix H*).

The main goals of the native grassland restoration program are to: **(1)** enhance native grasslands in selected areas that currently support low quality grasslands (*i.e.*, less than 10 percent cover of native grass); **(2)** restore native grasslands in appropriate areas that currently support annual grasslands; and **(3)** restore a mix of coastal sage scrub and native grassland in appropriate areas.

With these goals in mind, several areas have been tentatively identified for native grassland restoration or CSS/VGL restoration (see *Figure 42-M*). Final selection of areas for enhancement/revegetation would require additional field study to determine the likelihood of a successful restoration program, including factors such as soil conditions and presence of exotic species both within the restoration area and surrounding vegetation communities. This task will be completed during preparation of the first 5-year MAP. The timing and extent of restoration actions will be established through the overall process of prioritizing AMP actions reflecting the recommendations of the Science Panel and the decisions of Reserve Manager.

Areas identified for potential native grassland restoration include areas that **(1)** currently support annual grasses, but have suitable soils and are adjacent to existing VGL; **(2)** currently support low quality grassland; and **(3)** would contribute to an overall native grasslands ecosystem (*i.e.*, small, isolated patches of native grasslands would not be considered valuable to the overall system). Because establishing a functioning native grassland system is a goal of the restoration program, impacts to native grasslands in a particular sub-basin may be addressed by restoration in another sub-basin to achieve greater value for the overall reserve system. Upper Cristianitos, lower Chiquita Ridge, and a portion of Blind Canyon mesa are targeted for native grassland restoration.

- Upper Cristianitos is targeted for restoration in order to reduce the generation of fine sediments from clayey terrains, promote stormwater infiltration and to enhance the value of upland habitats adjacent to Cristianitos Creek. This area includes areas of annual grassland underlain by clay soils suitable for revegetation and low quality native grassland suitable for enhancement. These areas also are contiguous with existing medium quality grassland, suggesting a high likelihood of successful restoration.
- Lower Chiquita Canyon is targeted for restoration in an area of annual grassland adjacent to medium quality native grassland. Restoration of native grassland in this area would provide a mosaic of native grassland and coastal sage scrub vegetation communities along Chiquita Ridge. Additional fieldwork in this area may reveal additional restoration opportunities.

- A portion of Blind Canyon mesa north of proposed development in PA 8 is targeted for grassland restoration. This area has low quality native grassland suitable for enhancement. Additional fieldwork in the area may reveal additional restoration opportunities.

In some areas, the desired habitat is a mosaic of coastal sage scrub and native grassland that emulates the surrounding habitat characteristics. Such areas would provide suitable habitat for coastal sage scrub and grassland species, and especially species that use sage scrub-grassland ecotones (*e.g.*, gnatcatchers and grasshopper sparrows). These generally are areas that support clay soils and are highly suitable for restoring native grasslands. The following areas are recommended for coastal sage scrub/valley needlegrass grassland (CSS/VGL) restoration: Upper Gabino Canyon and in the Chiquita sub-basin in the area west of the Santa Margarita Water District wastewater treatment plant; the citrus groves west of Chiquita Creek; and the disced areas west of the creek to the Chiquita ridgeline.

- Upper Gabino Canyon currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration would reduce sediment generation and promote infiltration of stormwater which would reduce downstream impacts. This area has been identified for a mix of coastal sage scrub and native grassland restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse sage scrub. Allowing a mixed community to regenerate may represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for restoration and several patches of low quality native grassland suitable for enhancement.
- As discussed above for coastal sage scrub, restoration of disturbed areas of Chiquita Canyon west of Chiquita Creek would provide additional habitat for upland species occupying Chiquita Ridge, and particularly the gnatcatcher. Restoration of areas previously used for agricultural purposes, including grazing and citrus, would also benefit riparian species by removing uses that may contribute to downstream impacts. Additional field work would be needed to identify the areas best revegetated with coastal sage scrub alone and coastal sage scrub/native grassland.

Case-by-case restoration of native grassland also may occur under the AMP. The Reserve Manager and the Science Panel would identify areas suitable or desirable for restoration. Instances that may warrant active restoration consist of the following:

- Existing areas of degraded or low quality native grassland that are not naturally recovering through passive management;

- Areas that are degraded or disturbed by future natural events and it is determined that they would not, or are unlikely to, recover naturally (*e.g.,* an area that has burned too frequently or is infested with exotic species);
- Areas that have been temporarily disturbed either by authorized (*e.g.,* an approved infrastructure project) or unauthorized (*e.g.,* an illegal trail) activity; and
- Specific adaptive management research involving restoration treatments.

As discussed above, a key feature of the AMP is that restoration activities would be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

The details of the native grassland restoration program are provided in the CSS/VGL restoration component of the Habitat Restoration Plan (*Appendix H*). The key management activities of the plan are listed here:

- Identification of priority native grassland restoration areas (areas on the RMV are described above);
- Revegetation of existing degraded vegetation communities;
- Re-establishment of native grassland in selected areas in upper Cristianitos Canyon that currently support annual grassland;
- Grazing management;
- Fire management; and
- Control of invasive or exotic plants such as non-native grasses (bromes, wild oats, wild rye), artichoke thistle, black mustard, sweet fennel, and other non-native forbs.

SECTION 7.10 RIPARIAN/WETLAND AND FOCAL SPECIES

This section addresses the adaptive management of riparian/wetland resources within the Habitat Reserve. Resources addressed here include those summarized in *Table 3-2* of *Chapter 3*, and include riparian/wetland vegetation communities and watercourses. Vernal pools and vernal pools species are treated separately in *Section 7.12* because they addressed on a site-specific basis.

Through the **Vegetation Community Ranking** process described in *Section 7.6,* riparian/ wetland was identified as a high priority vegetation community for management and monitoring because of its high **Importance Value** and high **Index of Disturbance**.

7.10.1 Adaptive Management Issues

Conceptual stressor models were presented in *Section 7.4.1* for riparian/wetland vegetation and associated focal species (*Figures 141-M* and *146-M*). The key stressors on the riparian/wetland vegetation communities are altered hydrology, altered geomorphologic processes, exotic species and precipitation, with habitat fragmentation, fire and cattle-related impacts also identified as potentially significant stressors. Human uses and recreation are not depicted as direct stressors in community responses, but they do indirectly affect the riparian/wetland community via fire, exotics, hydrology and geomorphology. These stressors are related to a broad range of adverse community responses, such as reduced community size and distribution, altered flow rates, altered water quality, altered natural stand dynamics, and an altered food web. In addition, as depicted in *Figure 141-M*, specific impacts on focal species are related to these broad environmental stressors (*e.g.*, changes in vegetation community structure) as well as species-specific stressors such as predation of native species by bullfrogs.

As illustrated in the conceptual model for focal species (*Figure 146-M*), direct and interactive effects of the stressors can be quite complex. For example, the least Bell's vireo is thought to be affected by several stressors, including too infrequent flood regime, upstream diversion and/or ground water extraction, prolonged drought, exotic plant invasions (giant reed and tamarisk), exotic wildlife invasions (cowbird parasitism, possibly Argentine ants, cats, etc.), and human harassment (*e.g.*, noise). Likewise, the model shows the factors which have the broadest impacts on a range of species. For example, upstream water diversions and/or ground water extraction and exotic plants directly cause reduced habitat size, and/or vigor, less surface water and soil moisture, altered flow rates and seasonality and water quality, which, in turn, adversely affects all riparian/wetland focal species; *i.e.*, arroyo toad, snowy egret, least Bell's vireo, southwestern pond turtle and arroyo chub. A management action, for example, would be to control exotic plant invasions, with the goal of maintaining or enhancing habitat quality for all of the native riparian/wetland focal species.

As with the uplands conceptual models, this model would allow the Reserve Manager and Science Panel to develop experimental management hypotheses. It also would allow the managers to weigh tradeoffs in management actions. For example, different species probably will respond differently to episodic events. While arroyo toads and least Bell's vireo are hypothesized to benefit from periodic flooding, red-tailed hawks and great horned owls may benefit more from maintaining mature riparian woodlands through less frequent flooding.

7.10.2 Adaptive Management Goals and Objectives

The Science Advisors conservation goals for vegetation communities and the Draft Southern Planning Guidelines can be restated in the context of adaptive management for riparian/wetland vegetation communities and associated focal species:

- Maximize the likelihood of the persistence of the physiographic diversity of riparian/wetland vegetation communities and associated focal species in the Habitat Reserve.

- Restore riparian/wetland vegetation communities and enhance the quality of degraded riparian/wetland vegetation communities in the Habitat Reserve such that the net habitat value of the existing riparian/wetland vegetation communities is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value of the riparian/wetland vegetation communities in the Habitat Reserve. These primary objectives are captured by the SAMP tenets stated in *Chapter 5* and restated here:

1. *No net loss of acreage and functions of the waters of the U.S./State*
2. *Maintain/restore riparian ecosystem integrity*
3. *Protect headwaters*
4. *Maintain/protect/restore riparian corridors*
5. *Maintain and/or restore floodplain connection*
6. *Maintain and/or restore sediment sources and transport equilibrium*
7. *Maintain adequate buffer for protection of riparian corridors*
8. *Protect riparian areas and associated habitats of listed and sensitive species.*

The monitoring and management strategies for meeting these primary objectives are described below in *Sections 7.10.3* and *7.10.4*. With respect to objective number 8, the "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" document was prepared in support of the NCCP/MSAA/HCP and SAMP process to provide information on the physical processes that significantly affect structural habitat and life history requirements of listed riparian/wetland species in the planning area – arroyo toad, least Bell's vireo and southwestern willow flycatcher.

Section 5.4 of *Chapter 5* describes the relationship of the Draft Watershed Planning Principles to the SAMP tenets in a format that allows a direct translation to appropriate management actions.

As an example, Tenet 1 of no net loss of acreage and functions of the waters of the U.S./State is related to the following Watershed Planning Principles:

- Principle 2: emulate existing runoff/infiltration patterns
- Principle 3: address potential effects of future land uses on hydrology
- Principle 5: maintain geomorphic structure of major tributaries/floodplains
- Principle 8: protect existing groundwater recharge areas.

Although these are stated as "planning principles," they are also adaptive management objectives because they would have to be monitored and potentially managed over the long term. The reader is directed to *Section 5.4* of *Chapter 5* for a full treatment of the planning principles in relation to the SAMP tenets. The WQMP describes in detail in *Section 7.18.2* how these objectives will be met through implementation of the WQMP.

Finally, while coast live oak riparian forest is included in this section an important component of the riparian/wetland communities in the Habitat Reserve, it will also be subject to the same management and monitoring and restoration descriptions presented in *Section 7.11* for upland coast live oak woodlands.

7.10.3 Strategies for Monitoring Riparian/Wetland and Focal Species

The monitoring program for riparian/wetland vegetation communities would use the same general approach described above for upland vegetation communities. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire riparian/wetland vegetation database as part of the Habitat Reserve 5-year MAP.

2. Annual on-the-ground monitoring of selected sample plots distributed across the Habitat Reserve in a spatial distribution that represents the diversity of the Reserve and in key areas where environmental stressors are most likely to operate (*e.g.*, downstream of development areas and along the Habitat Reserve-development edge).

a. Vegetation and Abiotic Systems Monitoring

Periodic evaluation and update of the riparian/wetland vegetation community would occur at 5-year intervals and would be part of the overall review of the Habitat Reserve vegetation database. However, riparian/wetland systems pose a more complex monitoring challenge than uplands

because of the number of interacting processes, including geomorphology, hydrology and biology. Consequently, in order to determine whether the AMP is meeting the objectives such as "maintain/restore riparian ecosystem integrity" and "maintain and/or restore sediment sources and transport equilibrium" the monitoring program for riparian/wetland vegetation communities also would include monitoring channel morphology and hydrology. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the Habitat Reserve within two (2) years of executing the IA;
- Evaluation and update of the vegetation map at 5-year intervals based on remote interpretation and spot field verification;
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program (as described below);
- Monitoring of channel morphology (as described below); and
- Monitoring of stream and groundwater hydrology (as described below).

As reviewed in *Section 7.17.2*, channel morphology would be monitored by using transect lines for measuring cross-sectional profiles to monitor sediment movement (transport and deposition), peak discharges, and changes in stream morphology. Selection of transect line areas would be based on stressor-related management issues within the Habitat Reserve, such as areas adjacent to, or downstream of, urban development. Selection of specific transect lines within an area would be based on a sampling for various factors such as existing channel pattern characteristics, instream riparian/wetland communities and adjacent upland vegetation communities, and adjacent land uses or extent of human-caused disturbances. Variables to be measured include elevations, breaks of slope in the channel, active floodplain, bankfull elevations, and stream terraces. Permanent endpoints of the transect locations would be recorded using GPS.

Stream hydrology would be monitored through stream gauges placed at representative sites in major drainages, or other locations determined to be relevant to management of the Habitat Reserve. These data would be used to monitor long-term water supplies and changes in streamflow characteristics in relation to the health of the riparian/wetland system.

Groundwater monitoring would be accomplished through collection of well data where groundwater plays a significant role in streamcourse hydrology. Long-term information on subsurface water fluctuations is key to understanding discharge/recharge cycles in relation to

natural wet/dry cycles and development-related influences (*e.g.*, extractions, urban runoff, etc.), and to determine whether groundwater levels are in disequilibrium.

Stream hydrology and groundwater monitoring would be coordinated with the WQMP discussed in more detail in *Section 7.18.2*.

Riparian/wetland plant community monitoring would be conducted in tandem with the channel morphology monitoring along the transects described above. Because riparian systems are long and narrow, sample areas will be perpendicular to the channel transects and generally will be rectangular in shape, following the natural shape of the riparian system. The Orange County vegetation classification system would be used (Gray and Bramlet 1992). Functional variables that would be measured within the riparian/wetland community include species composition and heterogeneity (abundance and richness), native recruitment, density, trunk diameter, plant roughness, coarse woody debris, surfaces suitable for microbial activity, aerial net primary productivity, and percent vegetative cover in each strata. To the extent feasible, sample plots would be within homogeneous plant communities and ecotones would be avoided to reduce the influence of adjacent plant communities.

b. Focal Species Monitoring

A suite of candidate focal species for riparian/wetland vegetation communities was identified in *Section 7.4.2.c*, including 14 early warning indicators, five (5) biodiversity indicators, and six (6) umbrella species. These species are presented in *Table 7-12*.

TABLE 7-12
RIPARIAN/WETLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Barn Owl			•
Brown-headed Cowbird	•		
European Starling	•		
Great Horned Owl			•
House Finch	•		
Least Bell's Vireo	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Snowy Egret	•	•	
Yellow Warbler	•	•	
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•

TABLE 7-12
RIPARIAN/WETLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Mule Deer			•
Amphibians			
Arroyo Toad	•		
Bullfrog			
Reptiles			
Southwestern Pond Turtle	•	•	
Fish			
Arroyo Chub	•	•	
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**14**	**5**	**6**

Table 7-3 summarizes the stressors known or expected to act on these focal species. For example, the least Bell's vireo, yellow warbler and snowy egret, as avian indicators of high riparian/wetland habitat quality, also are sensitive to various kinds of stressors and thus may serve as valuable early warning indicators. The vireo and warbler are sensitive to flood regimes and nest predation by the brown-headed cowbird. The snowy egret nests in ponds and slow-moving streams with dense emergent wetlands and reportedly is extremely sensitive to pesticides and human disturbance (Zeiner *et al.* 1990).

In addition to these focal species, the southwestern willow flycatcher, as a listed Covered Species, would be specifically monitored as described in *Appendix E.*

Although precise monitoring locations for riparian/wetland species have not been selected, and additional field studies would need to be conducted by the Reserve Manager, with assistance by the Science Panel, to select the most appropriate sites, several general areas for monitoring the three listed species – least Bell's vireo, southwestern willow flycatcher, and arroyo toad – are identified, along with the species' populations occurring in the area.

1. Lower Arroyo Trabuco – *important population/key location* of least Bell's vireo
2. GERA – *important populations/key locations* of least Bell's vireo and southwestern willow flycatcher
3. San Juan Creek between Antonio Parkway and Bell Canyon – *major population* of arroyo toad
4. Upper San Juan Creek – *major population/key location* of arroyo toad

5. Lower Bell Canyon – *important population/key location* of arroyo toad
6. Talega Canyon – *major population/key location* of arroyo toad
7. Lower Gabino Canyon – *important population/key location* of arroyo toad
8. Lower Cristianitos Canyon – *important population/key location* of arroyo toad

Some of these general monitoring locations are on County parklands (*i.e.*, Upper San Juan Creek and Lower Bell Canyon). Coordination with HBP involving the Administrator would be necessary to conduct monitoring in these areas. The Reserve Manager and Science Panel will need to evaluate the importance of monitoring these locations to the overall monitoring program for the species.

As with the California gnatcatcher, survey methods that are appropriate for avian species in relation to the specific management issues being addressed would need to be developed, including the number of surveys per breeding season and whether surveys entail area search, point counts, mist netting and/or territory mapping (*e.g.*, CalPIF 2002). Typically surveys for vireos and flycatchers, as well as many other riparian species such as yellow warbler and yellow-breasted chat, can be conducted concurrently.

The survey methods employed for the arroyo toad likewise should be tailored to the kinds of management questions being asked. For example, the number of calling males is the question, surveys would occur early in the breeding season on nights conducive to high activity levels, as noted below. Likewise, studies of breeding pool persistence and local recruitment may focus on periods later in the breeding seasons. The timing of surveys for the arroyo toad is complicated by the fact that toad activity during the breeding season can be variable, with some nights having little activity and others having high activity in relation to factors such as air and water temperature, cloud cover, moonlight and other factors. As an example of a monitoring program element of the MAP, Noon and Murphy prepared an Arroyo Toad Monitoring Approach that shows the level of expertise and detail that will be included in MAP (*Appendix O*).

7.10.4 Management of Riparian/Wetland and Focal Species

The AMP for riparian/wetland vegetation communities includes the two types of management described above in *Section 7.5.1*: **(1)** passive management; and **(2)** active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

These general approaches are described in detail above for coastal sage scrub in *Section 7.7.4*. However, the riparian/wetland systems are often much more complex than the upland systems, probably more sensitive to biotic and abiotic stressors (*e.g.*, giant reed or tamarisk invasion, surface flow and ground water levels, sedimentation, water quality, etc.), and likely would require more active long-term management than the upland systems.

The "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" summarizes the landscape processes and specific habitat requirement for listed riparian species that occur in the Habitat Reserve: arroyo toad, least Bell's vireo and southwestern willow flycatcher. Abiotic stresssors (*i.e.*, altered hydrology and geomorphology) related to urbanization in the planning area would require near-term active management at both a landscape watershed and sub-basin level. Management strategies to address these stressors are:

- Emulate natural flood regimes to maintain coarse sediment yields, storage and transport processes.
- Emulate, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types and ground covers.
- Emulate natural timing of peak flows of each sub-basin relative to mainstem creeks.
- Manage existing groundwater recharge areas supporting riparian zones and maximize groundwater recharge of alluvial aquifers to the extent consistent with aquifer capacity and habitat management goals.
- Manage water quality through various strategies, with an emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas and application of Best Management Practices.

These management objectives are explained in more detail in *Section 5.2.2* of *Chapter 5*. The WQMP described in *Section 7.18.2* and found in *Appendix K* provides the detail for how these abiotic processes will be managed consistent with this AMP.

At the site-specific, vegetation community level management strategies include:

- Management of excessive surface and subsurface water flows and sediment in Gobernadora Creek.
- Management of potential changes in water supplies to San Juan Creek.
- Control of invasive exotic plant species such as giant reed, tamarisk, and pampas grass in riparian zones, particularly in San Juan, lower Arroyo Trabuco and lower Cristianitos creeks.

- Management of ponds and other open waters with lacustrine and fresh emergent vegetation (*e.g.,* water quality and any invasive species that appear).
- Management of grazing activities.
- Management of wildfires.
- Control of human access and recreational activities in riparian/wetland vegetation communities.
- Management of sand and gravel mining operations.

Near-term active management strategies at the focal species level include:

- Control of brown-headed cowbirds.
- Control of Argentine and imported red fire ants.
- Control of human activities around sensitive nesting areas.
- Control of vehicular traffic in the Habitat Reserve.
- Control of exotic aquatic predators (bullfrogs and possibly crayfish and introduced fishes).
- Control of terrestrial urban-related predators and mesopredators (*e.g..*, cats, dogs, skunks, raccoons, opossums).
- Control of collections and harassment by humans.
- Provision of adequate wildlife crossings/habitat linkages and fences along roadways at key crossing locations.
- Control of artificial lighting and noise.

Although some of these strategies (*e.g.,* exotic plant species controls) are discussed in some detail below, the Reserve Manager and Science Panel would need to evaluate potential threats to natural landscape processes during preparation of the first 5-year MAP, vegetation communities and species and implement the appropriate set of management actions.

As emphasized above for upland systems, adaptive management actions should be undertaken within the framework of experimental management hypotheses to the extent feasible. A substantial amount of baseline work has already been completed regarding the hydrology, geomorphology and biology of RMV aquatic systems that would provide a basis for experimental management hypotheses. For example, the document "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" provides information on the physical processes that significantly affect structural and life history requirements on listed

riparian/wetland vegetation community species. Other documents that provide valuable background information for the AMP are the Baseline Geomorphic and Hydrologic Conditions report, the Draft Watershed Planning Principles, and the Draft Southern Planning Guidelines.

A number of management hypotheses can be generated from the community and focal species stressor models illustrated in *Figures 141-M* and *146-M*. Some of these hypotheses could be examined opportunistically in response to natural events at a watershed or sub-basin level. For example:

- Frequent floods resulting in scouring of mature vegetation and replacement by younger stands causes a temporary decline in suitable raptor nest sites.
- Infrequent flood regimes result in maturation of the riparian zone and cause the decline of species dependent upon periodic flooding, including least Bell's vireo, southwestern willow flycatcher, yellow warbler, and arroyo toad.

Tracking the change in vegetation community composition and quality and associated species composition following disturbance events should be included in the monitoring program. For example, after a significant flood event or wildfire, what is the spatial and temporal pattern of species use in relation to riparian stand recovery and age?

Other experimental management hypotheses that could be tested in an *a priori* fashion by setting up experimental and control study plots include:

- Control of bullfrogs in CalMat Lake will increase the arroyo toad and southwestern pond turtle populations.
- Control of giant reed in San Juan Creek below Bell Canyon will increase the local arroyo toad and southwestern pond turtle populations and nesting habitat for species such as least Bell's vireo, southwestern willow flycatcher, and yellow warbler.
- Increasing spring stormwater flows into San Juan Creek will increase breeding habitat quality for the arroyo toad by providing breeding pools that persist longer and support toad metamorphosis.
- Control of Argentine ants will increase the reproductive success of least Bell's vireo, southwestern willow flycatcher, and yellow warbler.

To illustrate how the AMP would address the management and monitoring of a riparian system and associated focal species using the environmental stressor approach, an example using the arroyo toad population in San Juan Creek is provided here.

Information on the autecology of the arroyo toad, as summarized in the *Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species* document, provides the scientific foundation for the management and monitoring approach (also see *Appendix O* for the Arroyo Toad Monitoring Approach). The *Geomorphic and Hydrologic Needs* document summarizes the key arroyo toad habitat components, including:

- Low-gradient streams with periodic scouring and filling regimes characterized by features such as late season or near perennial flow, shallow pools persisting until at least midsummer, open streamside sand/gravel flats, and sparsely vegetated low sandy benches within the channel and along shoreline.
- Sandy and loamy sand soils in both riparian and adjacent upland zones suitable for burrowing.
- Breeding pool substrates of sand or well-sorted fine gravel.
- Adjacent riparian vegetation communities extending up to 330 feet from stream channel, supporting sycamores, cottonwoods, oaks, and willows, with understories of mule fat, short grasses, herbs, leaf litter and patches of bare ground.
- Floodplain connectivity allowing free access between estivation areas and breeding pools.
- Adjacent upland habitat that may be outside 100-year floodplain and used for foraging and estivation. Characterized by friable soils for burrowing and stabilized by brush and trees.
- Periodic and unpredictable hydrology (probably < 10 year cycle) that alters channels, breeding pool locations, sand deposition and vegetation.
- Ponded areas fed by surface flows that persist for a least a few months of the year and have low surface area to volume ratios to prevent premature evaporation.

The known or highly likely "extrinsic" stressors (now and in the future) in San Juan Creek are:

- Bullfrog (there may be other exotic predators on RMV, but bullfrog is clearest problem)
- Giant reed
- Lack of adequate surface water to support breeding pools for duration of season (probably exacerbated by giant reed infestation)
- Groundwater pumping
- Human activities (to a lesser degree)

Based on these habitat requirements and identified stressors, several hypotheses that could be tested through management and monitoring are listed below, along with experimental approaches to test the hypothesis.

- Initial elimination/control of giant reed will increase surface and subsurface water flows and provide for natural regeneration of suitable arroyo toad habitat.
    1. Remove giant reed from RMV property within San Juan Creek and concurrently monitor groundwater and surface flows.
    2. Take cross-sectional profiles to measure sediment transport, peak discharges, changes in stream morphology and changes in vegetation characteristics.
    3. Monitor colonization of restored areas by arroyo toad.

- Timed-grazing will keep giant reed proliferation in check.
    1. Allow cattle into selected areas where mature stands of giant reed have been removed but new growth is appearing; *i.e.,* will the cattle eat the giant reed shoots? Compare with control areas where cattle are excluded.

- Elimination/control of bullfrogs will increase productivity of arroyo toad populations.
    1. Establish arroyo toad baseline population levels at experimental bullfrog elimination/control locations (*e.g.,* CalMat lake and elsewhere they are found within San Juan Creek on RMV property) and at control sites that support toads but do not have a bullfrog problem (*e.g.*, upper San Juan Creek or Bell Canyon).
    2. Eliminate/control bullfrogs at experimental sites.
    3. Monitor reproduction of arroyo toads (*e.g.,* numbers of adult toads, metamorph survival) in proximity to bullfrog locations and at control sites to control for natural variation of toad populations due to *intrinsic* factors such as precipitation.

- Changes in land uses, such as removal of nursery operations for development, may change groundwater and surface flows and affect arroyo toad populations.
    1. Monitor groundwater and surface flows in areas likely to be affected by land use changes and control sites in order to control for short-term weather and long-term climatic variation.
    2. Monitor reproduction of arroyo toads (*e.g.,* numbers of adult toads, metamorph survival) in areas likely to be affected by land use changes and at control sites.

7.10.5 Restoration of Riparian/Wetland

The AMP includes a riparian/wetland restoration plan comprised of two main components:

1. Pre-designated enhancement and revegetation areas; and

2. Case-by-case restoration undertaken during the course of long-term adaptive management of the Habitat Reserve.

The riparian/wetland restoration plan is intended to complement and supplement the protection and management measures for the riparian/wetland ecosystem in the Habitat Reserve. The goals of this integrated protection and restoration program are to:

- Maintain and restore riparian ecosystem integrity; and.

- Maintain/protect/restore riparian corridors.

To achieve these goals, restoration in the RMV Habitat Reserve Lands, primarily through invasives control, is recommended for lower Arroyo Trabuco Creek, middle San Juan Creek, Gobernadora Creek, upper Gabino Creek, and lower Cristianitos Creek. Identification of these areas for restoration is based on riparian system invasive species mapping completed by PCR (2002) as well as the Draft Watershed Planning Principles as summarized below.

- Lower Arroyo Trabuco between Crown Valley Parkway and Avery Parkway supports an abundance of giant reed and a lesser amount of pampas grass. This reach of Arroyo Trabuco supports *important populations* of the least Bell's vireo and yellow warbler.
- Middle San Juan Creek between the creek crossing south of the Colorspot Nursery and the RMV boundary near Bell Canyon supports abundant giant reed and scattered locations of pampas grass and tamarisk. This reach of San Juan Creek supports a *major population* of the arroyo toad and an *important population* of the yellow warbler.
- Gobernadora Creek is targeted for riparian/wetland restoration to address: **(1)** the historic meander conditions; and **(2)** excessive sediment input resulting from upstream land uses. Restoration may include the construction of a detention/water quality basin below Coto de Caza. There are at least four scattered locations of giant reed in Gobernadora Creek, two in the reach just south of Coto de Caza and two in GERA. The GERA portion of the creek supports *important populations* of the least Bell's vireo, southwestern willow flycatcatcher, and yellow warbler. Creation of wetland breeding habitat for a Covered Species, the tricolored blackbird, should be considered a priority in the Gobernadora area because breeding populations have regularly occurred in the ponds in southern Coto de Caza.

Northward expansion of riparian vegetation communities from GERA also would provide additional breeding habitats for Least Bell's vireo, southwestern willow flycatcher, and yellow warbler, as well as raptors and other riparian/wetland species such as yellow-breasted chat and two-striped garter snake.

- Upper Gabino Creek currently generates fine sediments due to extensive gully formation in the headwaters area. To address this excessive sediment generation and reduce downstream impacts, both upland and riparian/wetland vegetation community restoration is recommended. Depending on the type of riparian/wetland restoration in upper Gabino Canyon, various riparian/wetland species could benefit, including focal species such as the yellow warbler and southwestern pond turtle, Covered Species such as the tricolored blackbird, and other riparian/wetland species such as the yellow-breasted chat and two-striped garter snake.
- Lower Cristianitos Creek supports patches of tamarisk near the confluence and giant reed and pampas grass west of the Northrop Grumman facility south to the RMV boundary. This reach support an *important population* of the arroyo toad, a well as several nest sites for least Bell's vireo and other riparian species such as yellow-breasted chat. Restoration in this area also would benefit several listed species downstream of the RMV boundary Cristianitos and San Mateo creeks: least Bell's vireo, southwestern willow flycatcher, tidewater goby and southern steelhead.

In addition to restoration of vegetation communities focused on the control of invasive exotic species, several smaller scale creek stabilizations on RMV Habitat Reserve Lands are recommended to address locally-induced headcuts in Chiquita Creek and upper Cristianitos Creek.

Locally-induced headcuts (as contrasted with valley deepening reflecting longer-term sea level change and geologic processes) are present in Chiquita Creek and Upper Cristianitos Creek. Some headcuts in Chiquita Creek and Upper Gabino Creek are caused by the placement of road crossings or other human-induced causes. Headcuts in Cristianitos Creek may have a similar origin but may also be strongly influenced by long-term geologic processes. Further investigations of the causes of the Cristianitos Creek headcuts, as well as monitoring the results of native grassland restoration in upper Cristianitos Canyon, would be necessary before identifying a specific restoration approach.

The reader is directed to the Habitat Restoration Plan (*Appendix H*) for the details of the riparian/wetland restoration approach for RMV Habitat Reserve Lands.

As described in *Section 7.1.3*, Covered Activities for the Prima Deshecha Landfill Project include offsite habitat enhancement/restoration activities. San Juan Creek within Caspers

Regional Park has been targeted for giant reed control as off-site mitigation for the landfill project. Recent mapping in San Juan Creek by the County (San Juan Creek Arundo Survey, 2004) has documented numerous stands of giant reed (approximately 24.3 acres total) that must be controlled, particularly in concert with downstream giant reed controls on the RMVLC portion of San Juan Creek. Control of giant reed within Caspers Regional Park will greatly enhance habitat quality for the *major population* of the arroyo toad in San Juan Creek, as well as many other aquatic/riparian species.

Riparian/wetland restoration also would be conducted on a case-by-case basis over the long-term management and monitoring of the Habitat Reserve. Through periodic monitoring of the overall vegetation communities and focused frequent monitoring of potential exotics hotspots, the Reserve Manager would target areas for local enhancement and restoration. Because the invasion of the riparian/wetland areas by giant reed, tamarisk and pampas grass is related to dynamic and unpredictable natural events, the Reserve Manager would need to develop protocols for checking areas susceptible to invasions.

As discussed above for upland vegetation communities, case-by-case restoration actions primarily would be the decision of the Reserve Manager, but with assistance by the Science Panel to ensure that the actions are consistent with the goals and objectives of the AMP. In addition, restoration activities will need to be coordinated by the Administrator to involve the County in some locations because exotic species invasions of riparian/wetland systems have profound implications for downstream resources. Restoration in a downstream location would have little long-term benefit if upstream sources of invasives are not also controlled. Generally, restoration should start in the upstream locations and work downstream.

Experimental restoration projects (*e.g.*, testing different methods of control) would be conducted in a manner that the specific management action could be rigorously tested.

SECTION 7.11 WOODLANDS AND FOCAL SPECIES

This section addresses the adaptive management of woodlands resources within and focal species. Woodlands in the Habitat Reserve encompass coast live oak woodland, coast like oak savanna, coast live oak forest and canyon live oak forest (see *Section 3.2.4* of *Chapter 3*). For the purposes of the management and monitoring program, these woodlands are considered upland vegetation communities, as distinct from riparian woodlands and forests. (However, as noted in *Section 7.10*, coast live oak riparian forest would be subject to the same management and monitoring and restoration actions described below as upland oak woodland.) Oak woodland is a lower priority for management and monitoring because of its low **Vegetation**

Community Ranking score relative to the other Conserved Vegetation Communities addressed by the AMP (*Tables 7-8a* and *7-8b*).

7.11.1 Adaptive Management Issues

As illustrated in the community and focal species conceptual stressors models (*Figures 139-M* and *144-M*) a number of natural and human-induced factors have been recognized as important for the conservation and management of oak woodlands in California.

A major stressor of oak woodlands is altered hydrology. Subsurface de-watering or prolonged drought may affect the viability of mature coast live oak that is thought to utilize the water table in some areas by developing deep taproots (Calloway 1990). Loss of available surface water has a detrimental effect on the sprouting of seedlings (Stephenson and Calcarone 1999). Alternatively, over-watering resulting from urban run-off and summer irrigation can make oaks more susceptible to various oak root diseases resulting from water mold fungi such as *Phytopthora* (Raabe 1990).

Fire also is a key stressor of oak woodlands. Oaks are adapted to wildfires and oak recruitment appears to depend on relatively frequent fires (*e.g.,* McClaran and Bartolome 1989). Although fire can kill the tops of seedlings and saplings, they can resprout in the first year after a fire. In addition, Fry (2002) found that scorching of oaks was positively correlated with the crown damage and the likelihood of resprouting. On the other hand, a high intensity fire can severely damage or kill mature trees. Fires that cause trunk scars can make the tree more susceptible to disease (Fry 2002). Also, if fires occur too frequently, ground cover can become dominated by annual grasses that compete for available surface water and affect acorn recruitment and growth.

Grazing and browsing can have both detrimental and beneficial effects on oak woodlands. On the one hand, cattle and mule deer browse on seedlings and saplings, and thus depress oak recruitment. In addition, trampling of soils in the winter results in soil compaction that reduces their ability to absorb water or seeds. On the other hand, managed grazing can control the proliferation of annual grasses and invasive weeds that compete with oak seedlings and saplings for available surface water and soil nutrients, as well as reduce the risk of "laddering" fires than can kill oaks.

Predation on acorns, seedlings, and saplings can have substantial effects on oak woodlands. For example, ground squirrels, deer mice, scrub jays, and acorn woodpeckers prey on acorns, while pocket gophers, cattle, and deer consume seedlings and saplings. Although most of these predators are native species, and presumably oaks have evolved in their presence (*i.e.,* these native predators are examples of *intrinsic drivers*), in combination with non-native predators

such as cattle, and other *extrinsic drivers* such as exotics, altered hydrology, and short fire intervals and/or intense fire, the predation pressure on acorns, seedlings and saplings may exceed the ability of the oak woodland system to withstand these stressors. That is, the system may be pushed beyond its natural resilience.

7.11.2 Adaptive Management Goals and Objectives

The Science Advisors' conservation goals for vegetation communities and those of the Draft Southern Planning Guidelines can be restated in the context of adaptive management for oak woodland vegetation communities and associated focal species:

- Maintain the physiographic diversity of oak woodland vegetation communities and associated focal species in the Habitat Reserve.
- Restore oak woodland vegetation communities and enhance the quality of oak woodland vegetation communities in the Habitat Reserve such that the net habitat value of the existing oak woodland system is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance long-term habitat value of the oak woodland system in the Habitat Reserve.

- Conduct monitoring of oak woodlands and focal species to track the long-term habitat value of the oak woodland system.
- Maintain appropriate subsurface hydrology to avoid under- and over-watering.
- Manage fire regimes in oak woodlands such that a natural diversity and balance of age-stands are maintained throughout the Habitat Reserve; *i.e.,* there is an appropriate mix of mature trees and recruitment of new trees.
- Manage cattle such that adverse impacts to oak woodlands are controlled to preserve habitat value through rotational grazing and the 25 percent residual dry matter (RDM) standard (*i.e.,* light to moderate grazing levels) described in the Grazing Management Plan (*Appendix G*).
- Control exotics invasions of oak woodlands, especially along the Habitat Reserve-urban interface or other identified vulnerable areas (*e.g.,* along existing paved and dirt roads, utility easements).
- Maintain suitable nesting habitat in oak woodlands, and specifically potential nest cavities in snags, dead or decaying limbs, and hollow trunks for acorn woodpecker. (As a primary cavity nester (*i.e.,* species that excavate their own holes for nests), acorn

woodpeckers may be a keystone species for secondary cavity nesters that utilize abandoned holes. Other native cavity nesters that would benefit from management and monitoring of acorn woodpecker include ash-throated flycatcher, Nuttall's woodpecker and western screech owl.)

- Manage large oaks (greater than 50 in. dbh) to the maximum extent feasible to provide granaries for acorn woodpeckers.
- Identify trees with high acorn productivity.
- Maintain acorn production and protect seedlings and saplings to support establishment of new trees. Management would entail addressing the following issues:
    - Maintain acorn production to provide forage for native wildlife such as acorn woodpeckers, scrub jays, squirrels, mice and mule deer. (It is important to maintain native predators of acorns, seedlings and saplings because they may be important components of the oak woodland ecosystem, especially in regard to dispersal of acorns or mycorrhizal fungi. Acorn predators such as mice also provide food for other oak woodland species such as Cooper's hawk and white-tailed kite. The challenge is to balance these natural predators with viable oak woodland systems that can naturally regenerate.)
    - Protect seedlings and saplings in stands of oak woodlands in the Habitat Reserve where predation by native and non-native species is excessive, including by the use of protective structures where necessary.
- Maintain the complex understory of shrubs, grasses annual forbs, leaf litter and downed woody debris that provide habitat for the lark sparrow and orange-throated whiptail, as well as variety of other wildlife species.
- Maintain native vegetation communities adjacent to oak woodlands in the Habitat Reserve to the extent possible to preserve the landscape mosaic.
- Protect vegetation communities supporting upper trophic predators such as bobcats and coyotes within oak woodlands to control native and non-native mesopredators.
- Restore oak woodlands in areas that currently support stands that are damaged or stressed by natural or human-induced factors, and where the adverse impact may not be naturally reversible (*e.g.,* irrigation of drought-stressed trees). (Note that a specific *a priori* restoration objective for oak woodlands has not been formulated, even though restoration of oak woodland is a stated goal of the AMP because at this time specific areas warranting restoration of oak woodlands have not been identified. However, areas within the Habitat Reserve requiring restoration may be identified in the future, either as a result of more detailed field investigation of existing conditions or as triggered by natural or human-induced events.)

- Conduct management activities (*e.g.*, prescribed fire, discing, mowing) in a manner that minimizes impacts to oak woodland wildlife species to the extent feasible. It should be noted that some management activities, that over the long-term benefit oak woodlands and associated species (*e.g.*, controlling exotics to enhance seedling and sapling viability or reduce fire intensity) may temporarily affect focal species such as lark sparrow and orange-throated whiptail. These short-term impacts are considered acceptable in the interest of long-term benefits.

7.11.3 Strategies for Monitoring Woodlands and Focal Species

The monitoring program for oak woodland vegetation communities (including coast live oak woodland and coast live oak forest) would use the same general approach described above for other upland vegetation communities. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire oak woodland vegetation database as part the overall Habitat Reserve 5-year MAP effort.
2. Annual on-the-ground monitoring of selected sample plots distributed across the Habitat Reserve in a spatial distribution that represents the diversity of the Reserve and in key areas where environmental stressors are most likely to operate (*e.g.*, along the Habitat Reserve-development edge).

a. Vegetation Monitoring

Periodic evaluation and update of the oak woodland vegetation community would be part of the overall review of the Habitat Reserve vegetation database that would occur at 5-year intervals, and as described for coastal sage scrub in *Section 7.7.3*. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the Habitat Reserve within two (2) years of executing the IA;
- Evaluation and update of the baseline vegetation map at 5-year intervals based on remote interpretation and spot field verification;
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program; and

- Concurrent focal species surveys (as described below).

Selection of specific monitoring locations for oak woodlands would require additional field work, but would be selected to provide physiographic representation within the Habitat Reserve. Areas with substantial stands of oak woodlands that should be considered for monitoring include:

- Lower Gabino Canyon
- La Paz Canyon
- Upper Gobernadora Canyon
- Lower Cristianitos Canyon
- Blind Canyon
- Donna O'Neill Land Conservancy at Rancho Mission Viejo
- Wagon Wheel Canyon
- The "Narrows" area of Chiquita Canyon
- Lower Chiquita Canyon
- San Juan Creek within Caspers Wilderness Park
- Bell Canyon within Caspers Wilderness Park
- Live Oak Canyon within O'Neill Regional Park

Future monitoring in the County parks would involve coordination by the Administrator with County HBP.

Monitoring of oak woodlands would be drawn from the following methods:

- Establish pseudo-randomized plots around stands. Sample plots should include the range of existing conditions of vegetation communities within the Habitat Reserve, including elevation, slope and aspect, proximity to roads and urban development, and uses within the Habitat Reserve (*e.g.*, recreation, grazing, fully protected areas, etc.). Generally exclude plots with less than 10 percent cover and less than at least three oak trees that meet or exceed 4 in dbh (diameter at breast height, or 4.5 ft from the ground) as such areas would not meet the definition of an oak woodland. However, at the Reserve Manager's discretion, areas that do not meet this standard may be selected for monitoring if there is evidence of incipient oak woodlands.

- Tag trees and record species, tag number, dbh (in), height (ft) and dominance (*i.e.*, is the tree in the canopy of another tree or does it form the canopy?). Note slope and aspect of each tree, understory species (including proportion of natives to exotics), presence of debris and litter, soil type, depth, and parent material and elevation.
- Assess the status of trees as stressed or dead by examination of bark and small branches for dryness and brittleness. Trees would be classified as "healthy" if less than 50 percent brown and leafless, "partially dead" if at least 50 percent brown and leafless, and "dead" of entire tree appears brown and leafless (following Tietje *et al.*, UC Cooperative Extension, Integrated Hardwood Management Program).
- Assess acorn production.
- Create oak tree database through the use of software specially developed to track discrete resources (*e.g.*, TreePro software that links the database to GIS mapping capabilities).

b. Focal Species Monitoring

A suite of candidate focal species for oak woodlands was identified in *Section 7.4.2.c*, including ten (10) early warning indicators, three (3) biodiversity indicators, and six (6) umbrella species. These species are presented in *Table 7-13*.

Table 7-3 summarizes the stressors known or expected to act on these focal species. The acorn woodpecker, in particular, should be an extremely valuable early warning and biodiversity indicator. As stated in the "Oak Woodland Bird Conservation Plan (CalPIF 2002),

> *Of all the birds that rely upon California's oaks, the Acorn Woodpecker is the one most intimately linked to the habitat.* (p. 45)

The acorn woodpecker is highly dependent on acorn production and a reduction in oaks and acorns production may cause a decline of this species in an area; reproduction is tied to acorn productivity. Furthermore, as a primary cavity nester, it excavates its own cavities and provides potential nest sites for secondary cavity nesters such as ash-throated flycatcher and western screech owl.

Both the lark sparrow and orange-throated whiptail use the understory litter and debris associated with oak woodlands. Both species are likely to be sensitive to invasions of the oak understory by non-native annual grasses and weedy forbs, as well as cattle-related impacts and frequent burning. In addition, the orange-throated whiptail is sensitive to invasions by Argentine and red imported fire ants that displace native prey.

TABLE 7-13
OAK WOODLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Acorn Woodpecker	•	•	
Anna's Hummingbird	•		
Ash-throated Flycatcher		•	•
Barn Owl			•
European Starling	•		
Great Horned Owl			•
House Finch	•		
Lark Sparrow	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Reptiles			
Orange-throated Whiptail	•		
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**10**	**3**	**6**

Oak woodlands also provide potential nesting and roosting habitat for the three avian umbrella species: red-tailed hawk, great horned owl and barn owl.

7.11.4 Management of Woodlands and Focal Species

The AMP for woodlands includes the two types of management described above in *Section 7.5.1*: **(1)** passive management; and **(2)** active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Issues that likely would require active management at a vegetation community level include:

- Control of invasive exotic plant species, especially annual grasses.
- Management of surface and subsurface hydrology to avoid both over- and under-watering.

- Cattle grazing, as provided for by the Grazing Management Plan.
- Fire management.
- Control of predation on seedlings and saplings.
- Maintain snags, decaying wood, and dead limbs to provide nesting habitat for primary and secondary nesting-cavity focal species; *i.e.*, acorn woodpecker and ash-throated flycatcher.
- Maintain understory litter and debris to provide habitat for understory focal species; *i.e.*, orange-throated whiptail, and lark sparrow.

Issues that likely would require active management at the focal species level include:

- Control of Argentine and red imported fire ants.
- Control of human activities around sensitive nesting areas.
- Control of vehicular traffic in the Habitat Reserve.
- Control of terrestrial mesopredators (feral cats, dogs, skunks, raccoons, opossums)
- Control of artificial lighting and noise.

Although some of these issues (*e.g.*, exotic plants species) are discussed in some detail below, the Reserve Manager and Science Panel would need to evaluate these potential threats and implement the appropriate set of management actions.

As stressed above for upland systems, adaptive management actions should be undertaken within the framework of experimental management hypotheses to the extent feasible. A number of management hypotheses can be generated from the community and species stressor models illustrated in *Figures 142-M* and *147-M*. Some examples of management hypotheses identified for oak woodlands are:

- Rotational grazing using the 25 percent RDM standard that reduces the cover of annual grasses and weedy forbs while also protecting seedlings and saplings and soils from cattle will facilitate oak reproduction by reducing competition between oaks and exotic species for surface water and nutrients.
- Managed fire regimes that reduce the cover of annual grasses and forbs will facilitate oak reproduction by reducing competition between oaks and exotic species for surface water and nutrients.

- The abundance of starlings (*i.e.*, cavity nesters) in stands of oak woodland will be inversely related to the abundance of native cavity nesting species.
- Presence/absence of dead standing trees and limbs, snags, decaying woodland will be correlated with the abundance of cavity nesting species.
- Presence/absence of understory debris and litter will be correlated with the abundance of understory species.

7.11.5 Restoration of Woodlands

The AMP provides for case-by-case restoration of oak woodlands undertaken during the course of long-term adaptive management of the Habitat Reserve, with the overall goal of maintaining the existing diversity and habitat value of oak woodlands in the Habitat Reserve.

The two main objectives of the oak woodlands restoration program are:

1. To restore oak woodlands in areas that support existing mature trees, but where recruitment and regeneration are being inhibited by factors such as exotic weeds and annual grasses.

2. To restore oak woodlands in areas that are degraded or disturbed by future natural events and it is determined that they would not, or are unlikely to, recover naturally (*e.g.*, an area that has burned too frequently);

The first objective of restoring oak woodlands would be achieved by **(a)** identifying any degraded oak woodlands, and **(b)** focusing the restoration effort in degraded areas adjacent to healthy stands of oak woodland to the extent possible. A near-term management task would be to identify any such areas in the Habitat Reserve. Following management recommendations of CalPIF (2002), sites identified for restoration should then be prioritized on basis of their proximity to high quality sites and their likely success of regeneration and transplanted oak viability. Restoration of sites in close proximity to existing high quality sites have a better chance of being colonized by oak woodland species.

The second objective of restoring areas that are disturbed in the future is important for maintaining long-term net habitat value. For example, sites that currently support high quality oak woodlands but are damaged by a high intensity fire or several fires at short intervals may be identified for restoration.

As part of the management of the various lands in the Habitat Reserve supporting oak woodlands, the Reserve Manager would identify areas suitable or desirable for restoration, with oversight by the RMVLC to ensure that the proposed restoration is consistent with the goals and objectives of the AMP and that the restoration can be adequately funded. Generally it would be the decision of the Reserve Manager whether to undertake an enhancement or restoration project, but where the project may affect adjacent lands managed by the County or some other entity, or be affected by conditions of the vegetation communities on the other ownership, a coordinated effort of the different entities may be desirable.

Restoration sites would be evaluated for their suitability including water table and soil conditions. Merrick *et al.* (1999) describe a knowledge-based model to evaluate sites for restoration suitability for valley oak (*Q. lobata*). If oaks currently are present or the site supported oaks in the recent past, it is considered to be suitable. If the site is not currently occupied by oaks, but has high soil water holding capacity, a high water table and loam soils, it is considered favorable for restoration.

SECTION 7.12 ADAPTIVE MANAGEMENT OF SITE-SPECIFIC RESOURCES

This section addresses the monitoring and AMP for site-specific resources, including vernal pools and associated species and plants that are Covered Species.

7.12.1 Vernal Pools and Associated Species

The Habitat Reserve supports two main areas of vernal pools. PCR (2003b) mapped three pools on Chiquita Ridge and four pools on the Radio Tower Road mesa located between Highway 74 and Trampas Canyon (*Figure 148-M*). Both areas supporting the vernal pools are characterized by native and non-native grasslands. The Chiquita Ridge area formerly was used for cattle grazing but is now in the Ladera Open Space and cattle have been excluded from the area. The Radio Tower Road area currently is grazed, generally from October through May, and planned for continued grazing as part of long-term cattle ranch operations.

The large pool on Chiquita Ridge (pool 4) supports both the Riverside and San Diego fairy shrimp and the small pool (pool 6) supports the San Diego fairy shrimp.[10] Two of the three pools on the Radio Tower Road mesa (pools 2 and 7) support both species and the third (pool 1) supports only the San Diego fairy shrimp.

[10] The San Diego fairy shrimp was collected from vernal pool 6 by Bomkamp in 1996, (Bornkamp, pers. comm., 2005) but is was not present in the 2001 survey conducted by Dudek. Vernal pool 6 was relatively small in 2001 and did not pond water for a long period of time; it was inundated on February 27 but was very shallow by March 13 (Dudek 2001b).

Notably only one special status plant species – the CNPS List 2 mud nama – is known from the vernal pools in the Habitat Reserve. Mud nama is not state- or federally-listed and this species is not proposed as a Covered Species by this NCCP/MSAA/HCP.

a. Adaptive Management Issues

Five main issues typically are considered in the management of the vernal pools and associated species:

1. Hydrology
2. Water quality
3. Cattle-related impacts
4. Invasive exotic species
5. Human disturbance

Hydrology is a key management issue because the flora and fauna of the vernal pools have evolved adaptations to the unique hydrological conditions of vernal pools. Although dramatic year-to-year variations in rainfall occur, and vernal pools species are well-adapted to this variation, over the long term too little inundation may not support the full life cycle of the vernal pool species and extended inundation may lead to mortality of the species that are not truly adapted to an aquatic existence (Barry 1998; USFWS 1998c). Extended runoff from developed areas can be a substantial problem for vernal pools (*e.g.,* Clark *et al.* 1998). Hydrological alterations of the vernal pools in the Habitat Reserve due to direct disturbance of the local contributing watershed (*e.g.*, from grading) or increased urban runoff, are not anticipated to be management issues because existing and planned development areas are at least 1,000 feet from the vernal pools and at lower elevations. However, effects of cattle (for the Radio Tower Road mesa pools) and exotic species on hydrology are considered to be important management issues and, thus, are addressed below.

The Radio Tower Road vernal pools are located in an active pasture and grazing is planned in this area in the future as part of planned long-term cattle operations. Grazing can have both positive and negative impacts on vernal pools and associated species. Grazing can help control the proliferation of invasive exotics species such as annual grasses that choke out native plants and alter the natural hydrology of the pool and local contributing watershed (*e.g.*, Barry 1998), but poorly controlled grazing can result in trampling of fairly shrimp cysts and hatchlings, as well as increase water turbidity. As stressed by Barry (1998), "When resource managers and landowners develop plans to conserve vernal pool vegetation communities, it is imperative they recognize that the current vernal pool landscape has been altered with the proliferation of exotic plant species and the impact of livestock grazing." (p. 237).

In addition to increasing water turbidity, cattle may have other negative impacts on water quality. Vernal pool species have adapted to specific water quality tolerances, and alterations in pH, and water temperature may have significant impacts on these species (Simovitch *et al.* 1996). Cattle are potential sources of nutrients such as phosphorus and nitrogen, as well as organic wastes (manure and urine), that may trigger rapid growth of microorganisms (and thus increased biochemical oxygen demand) and/or aquatic macrophytes (*e.g.,* algae) (Bowling and Jones 2003).

The management issue for the Radio Tower Road pools thus is timing and controlling grazing in way that helps control non-native plants, but does not interfere with the functions and values of the vernal pools, most importantly, the reproductive cycle of vernal pool plant and animal species. Lis and Eggeman (2000) describe an adaptive management study where a combination of grazing and burning was used to control invasive species in vernal pools in the Dales Lake Ecological Reserve in Tehama County, California. They found that carefully timed grazing did not interfere with fairy shrimp reproduction or cause any immediate negative effects on rare plants. They concluded that while grazing "may not return the vernal pool landscape to its condition five hundred years ago…it is likely to move the landscape in that direction." (p. 23).[11]

As described above, invasive exotic species threaten vernal pools because they compete with and displace native plants, and they also interfere with normal surface runoff patterns in the local contributing watershed essential for sustaining vernal pool hydrology (*e.g.,* Barry 1998). The problem with most non-natives occurs in drier years when moisture conditions are conducive to annual grasses such as bromes (*Bromus* spp.) and wild oats (*Avena* spp.) (USFWS 1998c). During wetter years these annual grasses are reduced, but several other non-native species such as rabbit's-foot grass (*Polypogon monspeliensis*), wild rye (*Lolium* spp.) and brass-buttons (*Cotula coronopifolia*) still can dominate vernal pools (USFWS 1998c). Invasive plants observed within ponds on RMV include sharp-toothed timothy (*Crypsis vaginifolia*) and hyssop loosestrife (*Lythrum hyssopifolium*). As discussed above, grazing, and possibly prescribed burns, may be used to control exotic species at the Radio Tower Road pools, but other control methods would be required at the Chiquita Ridge pools because cattle are excluded from the area and prescribed burns may not be feasible so close to residential development.

Human disturbances, primarily trampling and vehicular impacts on species and soils, are ongoing threats to vernal pools throughout the state. Because the vernal pools in both the Chiquita Ridge

[11] Lis and Eggeman (2000) also found that vernal pools burned during a wildfire on the Hog Lake Plateau, resulting in the burning of dense mats of dried spikerush, had no apparent adverse effect on the hatching of fairy shrimp. The study is ongoing, but Lis and Eggeman suggest that timed grazing and prescribed burning may be effective management tools to control non-natives in vernal pools. Prescribed burning as a management tool for grasslands generally, and for vernal pools specifically, also is recommended by Pollack and Kan (1998) based on studies on the Jepson Prairie Preserve showing that late-spring burning reduces non-native grasses and increases the dominance of native species. They also suggest that a combined burning-grazing regime can be used to reduce fire intensity.

and Radio Tower Road areas are at least 1,000 ft from the nearest residential development, human disturbance may be less of a long-term problem in the Habitat Reserve than typically observed elsewhere. Nonetheless human activities would have to be addressed in the AMP.

b. Adaptive Management Goals and Objectives

The overall goal of the AMP for vernal pools and associated species is to maintain existing vernal pools and associated species that occur in the pools within the Habitat Reserve using the "Vernal Pool Functional Assessment" conducted by PCR (2003b) as a guideline. The management objectives designed to meet this goal are to:

- Conduct monitoring of vernal pools and associated species in a manner that allows the Reserve Manager to track the long-term status of the vernal pools and species.
- Manage the hydrological regime of the pools by maintaining the existing local contributing hydrological sources (*i.e.*, the local contributing watershed of the vernal pool).
- Eliminate or control any identified existing threats to existing vernal pools, including poorly-timed or controlled grazing and invasion of pools and the local contributing watershed by non-native species.
- Develop management tools to control the proliferation of non-native species, including timed-grazing, prescribed burns, mowing and selective weeding.
- Manage water quality to emulate baselines conditions in the vernal pools in the Habitat Reserve known to support the Riverside and San Diego fairy shrimp.
- Control public access to vernal pools.

c. Strategies for Monitoring Vernal Pools and Associated Species

Each vernal pool in the Habitat Reserve would be assigned a unique identifying code. GPS locations have already been recorded for the vernal pools on Chiquita Ridge and the Radio Tower Road mesa.

A pre-established monitoring schedule for vernal pools has not been set. The monitoring schedule needs to be flexibly tied to local climatic conditions and the Phased-Dedication schedule. Subject to appropriate weather conditions (*i.e.*, precipitation), vernal pools in previously dedicated open space on Chiquita Ridge, including those in which fairy shrimp were not previously documented (see *Figure 148-M*), would be evaluated within two (2) years of executing the IA by recording variables as described below. Vernal pools on the Radio Tower

Road mesa would be evaluated within two (2) years of the area being transferred to the Habitat Reserve. These evaluations would include a focused survey for fairy shrimp, an assessment of existing habitat quality and the need for specific management actions. For pools that do not warrant immediate management, periodic monitoring would take place on a schedule dictated by predicted climatic conditions for a particular year. In conjunction with predicted climatic patterns, at minimum, pools would be monitored at least three (3) times per decade. The years selected for monitoring would be tied to the predicted rainfall patterns for the year. Pools would be monitored at least once each decade during a year with predicted high (*e.g.*, El Nino), normal, and low (*e.g.*, La Nina) rainfall in order to collect information in relation to variable amounts of rain. Pools subjected to a specific management actions (*e.g.*, grazing, prescribed burning, mowing, weeding, etc.) would be monitored more frequently, at the discretion of the Reserve Manager and as appropriate to the management action(s) (*e.g.*, for three consecutive years following a management action). Monitoring may also occur more frequently in certain pools if discrete field studies by outside scientists are being conducted. It would be the Reserve Manager's responsibility, with review by the Science Panel and oversight from the RMVLC, to coordinate the basic monitoring program with any other studies to ensure that data are collected in a compatible and efficient manner and that normal vernal pool functions are not disrupted (*e.g.*, over-collection of fairy shrimp). For example, any outside scientist proposing to conduct a study of vernal pools within the Habitat Reserve would be required to submit a detailed proposal outlining the work program to the RMVLC, Reserve Manager and Science Panel, who would then evaluate the proposal and ensure that the study is compatible with the goals and objectives for managing the vernal pool resources.[12]

Typical hydrology and water quality variables to be measured include time from inundation to dehydration, periodicity of pool, size of pool, depth, water temperature, pH, dissolved oxygen, specific conductance and salinity. Having baseline measurements for these variables would be essential for detecting any cause and effect relationships between characteristics of the vernal pools and changes in Riverside and/or San Diego fairy shrimp, and, in turn, identifying the cause of any declining trends in these species.

The floral characteristics of vernal pools also would be monitored. Species presence and relative cover would be monitored for each pool. An example of a standard monitoring protocol is described here. Two line transect locations in each of the pools are established with rebar stakes. Species presence and frequency on the transect, species present within the pool but not on the transect and relative cover of each species are recorded. A 50-meter tape is be strung tightly between the two rebar stakes at either end of the transect, and all measurements are taken along a pre-determined side of this line at two decimeter (dm) intervals. A wire, square decimeter is

[12] Such studies also would require the researcher to obtain separate regulatory coverage for the study because the permit for this Southern NCCP/MSAA/HCP does not cover activities outside the described AMP.

placed on the ground and all species present within the square, as well as their percent cover, are recorded.

The status of the Riverside fairy shrimp and San Diego fairy shrimp, as well as other animal species (to measure species richness or diversity), would be monitored in pools both known to support the shrimp in Year 2001 surveys (pools 1, 2, 4, 7) and pools where the shrimp were absent in 2001 surveys (pools 5, 6 and 8). During the aquatic phase of the pools, pole-mounted dip-nets can be used to sample the basins for tadpoles, ostracods, branchiopods and cladocerans. Representative species lists of plants should be recorded at each pool within 15 and 45 days of the dissipation of standing water. Permanent photo stations should be established for each of the pools and color images should be taken throughout the monitoring period in accordance with the following schedule:

- After the first heavy rain;
- After three weeks of standing water, or, if standing water is not present for this period continuously, after the wettest period of the season, to reveal mortality of upland plants;
- After storm events that generate greater than two (2) inches of precipitation;
- After water levels fall; and
- During the dormant season.

d. Management of Vernal Pools and Associated Species

The AMP for vernal pools and associated species includes three types of management activities:

1. Passive management
2. Active management
3. Experimental management

The general approaches to these three types of management are explained above in the discussion for coastal sage scrub in *Section 7.5.1*. The primary management approach for vernal pools in the Habitat Reserve would be passive. These pools are unlikely to be exposed to the same "edge" disturbances characteristic of preserved pool complexes situated in close proximity to urban development, such as increased runoff, pesticides, trampling by the public, off-road vehicles, trash dumping, and pets and feral animals. The Chiquita Ridge pools are located in the Ladera Open Space approximately 1,000 feet east of the Ladera Ranch development. The Radio Tower Road pools are located approximately 1,000 feet west of planned development in Trampas Canyon and approximately 3,500 feet southeast of planned Ortega Gateway

development. The Ladera, Trampas Canyon, and Ortega Gateway developments have no connection to the local contributing watersheds of the vernal pools and thus no direct, development-induced impacts on hydrology or water quality are anticipated.

For the Radio Tower Road pools, the primary management action would be timed-grazing to take advantage of grazing for exotic species control while protecting pools from impacts by cattle during the fairy shrimp reproductive season; *i.e.,* from inundation to dehydration. During the 2001 fairy shrimp surveys these pools showed evidence of cattle impacts, including trampling and feces in the pools. Grazing prior to the onset of the rainy season would be allowed, but once significant rainfall occurs, pools would be protected by exclosures or by excluding cattle altogether from pastures supporting vernal pools until the pools dry. Prescribed burning, in conjunction with grazing, also may be tested at these vernal pools if grazing alone does not appear to be effective in controlling exotics, or if the timing of grazing necessary to protect the pools conflicts with the GMP (*Appendix G*). Prescribed burning should be given a high priority as a supplemental or replacement management tool because, in combination with herbivory, it probably best emulates the natural disturbance regime in which vernal pool systems evolved (see Lis and Eggeman 2000 and Pollack and Kan 1998). Any areas of artichoke thistle would be treated with herbicides as part of the overall thistle control program on RMV. However, the use of herbicides within the contributing hydrological area of the vernal pools would need to be carefully controlled unless it can be demonstrated that the herbicides do not pose a risk to the fairy shrimp or special status plants such as mud nama.

Control of exotic plant species also would be a focus of active management at the Chiquita Ridge pools. Because cattle are excluded from this area and prescribed burning may not be feasible, mowing and selective weeding are two potential management actions to control exotic species at these sites.

Control of human activities may be needed at the Chiquita Ridge site because it is located in Ladera Open Space. The vernal pools should be identified as sensitive resources with interpretive signs that indicate prohibited activities within or in proximity to pools that could affect pool integrity, water quality or fairy shrimp reproduction (*e.g.,* wading in pools, dog feces, etc.).

Control of human activities in the vicinity of the Radio Tower Road pools should be less problematic because the area would continue to be part of the private Ranch operation, but Ranch personnel should be made aware of the sensitive nature of the pools and procedures to avoid impacts.

7.12.2 Plant Covered Species

This section addresses adaptive management of the plant Covered Species presented in *Table 7-14*. Regional and subregional background information for these species is provided in the Species Accounts and Conservation Analyses in *Appendix E*. It is important to note that the data base for the plant Covered Species on RMV property is comprehensive and reflects several survey efforts over the past decade (see *Chapter 3*). It is unlikely that additional *major* or *important populations* in *key locations* will be discovered on the RMV property, although small populations may still be discovered.

TABLE 7-14
COVERED PLANT SPECIES

Species	Known or Potential Stressor(s)
Chaparral Beargrass	• Too frequent fire (?)
Coulter's Saltbush	• Non-native plants (wild radish, Italian ryegrass, Australian saltbush and mustards) • Alteration of soil/water relations • Destruction of cryptogammic soils • Cattle-related impacts[1]
Many-stemmed Dudleya	• Non-native plants (artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, mustards) • Cattle-related impacts • Human activities (hiking, mountain bikes, equestrian)
Southern Tarplant	• Non-native plants (wild radish, Italian ryegrass and mustards) • Alteration of soil/water relations • Population fragmentation
Thread-leaved Brodiaea	• Non-native plants (artichoke thistle, ryegrass, bromes, wild oats, mustards) • Cattle-related impacts • Human activities (hiking, mountain bikes, equestrian)

[1] There is no evidence that under current stocking levels, rotational patterns and the 25 percent RDM standard on RMV that cattle are having an adverse impact on any of the Covered Plant Species. However, cattle-related impacts are identified as a potential stressor because of their documented impacts on biotic and abiotic (*e.g.,* soils, water quality) resources where over-grazing or over-stocking occurs.

a. Adaptive Management Issues

The environmental stressor approach is applied to plant Covered Species in the same manner as to the five Conserved Vegetation Communities and associated focal species. Potential stressors for each of the plant species are identified in *Table 7-14*.

The main stressor of the plant species in the Habitat Reserve is exotic plant species, which affect thread-leaved brodiaea, many-stemmed dudleya, southern tarplant, and Coulter's saltbush. The exotic plants that are most troublesome are artichoke thistle, ryegrass, bromes, wild oats, smooth

cat's-ear, Crete hedypnois, mustards, and wild radish. These exotic species directly displace the native species, disrupt native vegetation communities, and compete for water and nutrients.

As noted in the stressor models for upland vegetation communities (*Figures 138-M* through *140-M, 142-M*), the impact of exotic species can be exacerbated by precipitation cycles, too frequent fire, cattle-related impacts, and human uses and recreation. Thus, the control of exotic species needs to consider the effects of these stressors as well.

Relatively little is known about stressors on chaparral beargrass. As a chaparral species, it can be hypothesized that fire management would be important for chaparral beargrass, but no information is available on the relationship between fire intervals and this species.

b. Adaptive Management Goals and Objectives

The overall goal for plant Covered Species is to maintain *major* and *important populations* of Covered Species in the Habitat Reserve.

This overall goal would be addressed through the following management objectives:

- Conduct periodic monitoring of *major* and *important populations* of Covered Species in a manner that allows the Reserve Manager to track the long-term status of the species in the Habitat Reserve.
- Conduct monitoring of other populations of Covered Species not identified as *major* or *important populations* at the discretion of the Reserve Manager and recommendations of the Science Panel to the extent necessary to understand the natural history and dynamics of the populations (*e.g.*, dispersal mechanisms, pollinators, herbivory, edaphic factors, etc,) and to facilitate management of the species in the Habitat Reserve.
- Control invasions of herbaceous exotic species in areas supporting *major* and *important populations* of Covered Species.
- Within the framework of the Grazing Management Plan, particularly the rotational grazing pattern and 25 percent RDM standard, manage grazing to avoid adverse impacts to, and to the extent feasible, benefit *major* and *important populations* of Covered Species.
- Manage fire to avoid adverse impacts to, and to the extent feasible benefit, of *major* and *important populations* of Covered Species.
- Maintain vegetation communities to support plant dispersal and pollinators between *major* and *important populations* to the extent possible.

c. Monitoring, Management and Restoration of Plant Covered Species

The plant Covered Species management and monitoring program would focus on *major* and *important populations* because these areas by definition are considered to be important for the conservation of the species in the subregion (Draft Southern Planning Guidelines, *Chapter 3*). However, as noted above, the Reserve Manager and Science Panel may determine that management and monitoring of populations not identified as *major* or *important* is warranted in order to better understand the biology of the species and implement management actions. For example, monitoring small populations may provide information about the relationship between population size and extirpation risk and the factors involved, such as invasive species, lack of pollinators, dispersal obstacles, cattle-related impacts, precipitation cycles, etc. Such information would allow the Reserve Manager and Science Panel to establish "working management thresholds" and/or identify specific threats.

Permanent monitoring areas would be established for most species. Selection of sample areas for species with variable spatiotemporal distributions (*e.g.,* southern tarplant), selection of monitoring sites would need to be flexible from survey to survey in order to track the status of the species. In areas where subpopulations of the total population are static, but widely distributed (*e.g.,* many-stemmed dudleya locations in Cristianitos Canyon), sample plots would be established in representative locations within the population. Where populations are relatively discrete and boundaries are definable (*e.g.,* thread-leaved brodiaea on Chiquadora Ridge), the entire local population would be monitored.

The frequency and timing of plant surveys would need to be flexible in order to respond to varying environmental conditions. In general, monitoring should be conducted on a periodic basis and frequently enough to detect population trends; generally, species exhibiting high year-to-year variability need to be monitored more frequently than species with low variability to detect trends. Fairly intensive baseline monitoring of plant populations would be needed to establish the appropriate monitoring schedule. Site visits within a given survey season should be timed to coincide with peak production for the season, possibly requiring more than one site visit per season. Furthermore, because many plant species, and geophytes in particular, are highly opportunistic and responsive to weather conditions, flexibility in timing surveys over different years needs to be retained in the overall monitoring schemes to ensure that surveys capture the variability exhibited by the species, including both years with high and low productivity. Finally, timing of surveys for species known or possibly influenced by major disturbance events (*e.g.,* southern tarplant by flood and chaparral beargrass by fire) should take advantage of these disturbance events to measure species responses.

The plant Covered Species have different management and monitoring needs, and thus, are addressed separately below.

1. Thread-leaved Brodiaea

Thread-leaved brodiaea occurs in seven discrete locations (*Figure 149-M*). Two of the seven locations comprise *major populations* in *key locations*; the location supporting approximately 2,000 individuals on Chiquadora Ridge and the location supporting more than 6,000 individuals in the southern portion of Cristianitos Canyon. The main stressors of these populations are non-native invasive species such as artichoke thistle, ryegrass, bromes, wild oats, and mustards. Cattle-related impacts are also a potential stressor for the Cristianitos Canyon population, although there is no evidence that these stressors are operating on RMV at this time. Conserved areas also would need to be protected from human disturbance such as trampling (by hikers, mountains bikers and equestrians) and collection of flowers.

(a) Monitoring

The monitoring of thread-leaved brodiaea would be focused on the two *major populations* since they account for approximately 88 percent of the counted individuals (about 8,100 of 9,248) in the Habitat Reserve. Periodic monitoring of the other five populations would be conducted at the discretion of the Reserve Manager, as described above. Monitoring would use direct counts or estimates of flower stalks as the index of the population size. Typically there are many corms in the ground for every flower stalk, with an estimated potential range of 5-100 corms for every flowering stalk (pers. comms. Bomkamp and Elvin 2002). Because the two *major population* of brodiaea occur in two fairly discrete locations, complete counts or estimates to the nearest 100 flowering stalks in each location would be conducted. The smaller populations that number at most about 300 flowering stalks, based on previously surveys, would be counted or estimated to the nearest 10 stalks.

The two *major population* locations would be monitored annually for the first five (5) years following initiation of monitoring of a particular area upon dedication of the area to the Habitat Reserve. Annual monitoring over the first five years is important to establish baseline information on the variability of the populations in terms of number of flowering stalks produced annually and to identify any necessary near-term management actions. Following the initial five-year baseline study period, periodic monitoring surveys would be conducted at intervals to be determined by the Reserve Manager and Science Panel. If specific management actions (*e.g.*, a prescribed burn) are implemented during the five-year period, it is anticipated that frequent follow-up monitoring to assess the outcome of the management action would be required. On the other hand, if a population appears to be stable after the initial five years, and no imminent

threats to the population have been identified, less frequent monitoring may be warranted. Likewise, if periodic monitoring of the smaller populations indicates that the populations are stable and non-threatened, monitoring may occur less frequently. In any case, the comprehensive Five-year Reports will need to provide updated information on the status of the thread-leaved brodiaea.

Monitoring would be conducted during the vegetative and blooming periods of this species, which typically is March to June, depending on precipitation. Monitoring the transition from vegetative to blooming may provide valuable information for management; *e.g.,* what proportion of plants bloom and what are the factors that inhibit or promote the transition, such as grazing, exotic species, etc.? Timing of surveys would take advantage of the local weather patterns and at least one survey would be timed to coincide with the expected peak flowering period. This would require at least three site visits during the vegetative-blooming period – one each in the early, middle, and late portions of the season (*e.g.,* March, April and May). As flowering individuals are counted or estimated during each site visit, pin flags would be placed to mark counted/estimated individuals to avoid double counting.

In addition to direct counts or estimates of thread-leaved brodiaea individuals, the presence of native and exotic species would be recorded at sample sites using a standard sampling protocol, an example of which is provided here.

One-meter sample quadrats would be randomly established in each brodiaea *major population* each year. The number of locations would be adequate to provide a representative sample of the area. The sampling methodology would consist of randomly tossing a 1-meter quadrant frame in front or to the side of the field monitor. Native and non-native vegetation cover would be estimated within the quadrat. A count of individual species would be made for each quarter quadrat in a clockwise pattern beginning in the lower left quarter. Individuals would be categorized by size class within one of the quadrat quarters, alternating in a clockwise pattern for each successive quadrat sample. In addition to the random quadrats, permanent photostations would be established through the area to document existing conditions during each survey period.

Additional data that would be recorded during each site visit include observations of pollinators such as sweat bees (Halictidae) and tumbling flower beetles (Mordellidae), soil conditions (*e.g.,* surface disturbances, cracking, etc.), and other evidence of disturbance (*e.g.,* deep hoof prints, human activities).

(b) Management

The main stressor of thread-leaved brodiaea in the Habitat Reserve is anticipated to be exotic species which compete with native species for space, nutrients, and water. Exotic invasions may be exacerbated by short interval fire and cattle-related impacts, although there is no evidence that these stressors are operating on RMV at this time. As such, the monitoring program described above is geared to measure the presence of invasive species at the monitoring locations. A variety of techniques can be used to control exotic species, including time-grazing, prescribed burns, mowing, manual removal (weed-whacking and hand-pulling), and herbicide treatment. Timed-grazing and prescribed burns are the most efficient forms of exotics control, especially where non-native annual grasses such as bromes, wild oats and wild ryes are widespread and for which site-specific, selective manual treatments are not very effective. Herbicide treatment of artichoke thistle has been a successful control method on RMV. A potential limitation of timed-grazing as a management tool is that peak production of annual grasses on RMV coincides with the early growing season of thread-leaved brodiaea and the fleshy stalks are likely to be grazed before they have a chance to flower and set seed. Likewise, a prescribed burn in the spring would also burn stalks before they mature. Given that the locations being managed are by far the two largest populations in the Habitat Reserve, untested management actions that may depress productivity in these locations even temporarily may not be desirable. The smaller populations may be more suitable for testing alternative management actions, but the Reserve Manager and Science Panel will need to weigh the risks and benefits of testing management actions on these populations.

The management recommendations for the two *major populations* are different because the practical long-term management opportunities are different.

1. For the Chiquadora Ridge population, timed-grazing is the recommended management approach and essentially would continue the existing grazing pattern. The "Chiquita Pastures" are grazed from late spring through September, with the focus of grazing on the cultivated barley fields and low levels of grazing in the adjacent natural vegetation. Grazing in this time period would allow the thread-leaved brodiaea on Chiquadora Ridge to bloom and set seed before cattle are introduced. Furthermore, because this location is within a few hundred feet of the eastern edge of planned development in lower Chiquita Canyon, it is unlikely that prescribed burns would be an acceptable management tool for exotic species (although occasional wildfires in the area may benefit the brodiaea over the long-term).

2. For the lower Cristianitos Canyon population, grazing has not been observed to be a problem for the brodiaea, but because cattle are in the area from October through May

during the period of peak annual grass production and the period brodiaea are growing and flowering, populations will be monitored to maximize the likelihood that grazing is not adversely affecting the brodiaea. Furthermore, given that the existing population appears to be healthy under the existing grazing regimen, the benefits of grazing under the present conditions and the future GMP may outweigh any negative impacts. Removal of grazing from the area may allow exotics to proliferate, with a consequent net loss of the brodiaea population. It is recommended that grazing continue in this area and that the population be monitored annually for at least the first five years of the program to determine if there are negative trends in the population and, at least anecdotally, if there is any evidence that cattle are causing harm to the population. If grazing appears to be having a negative impact on the brodiaea, protection of the area from grazing, such as exclosures, and using some alternative method of invasives control may be necessary. This area may be suitable for prescribed burns in the future because it is more remote from planned development. However, before any active alternative management actions are undertaken, it is recommended that an experimental grazing/burn study, as described below, be carried out on smaller populations of brodiaea before being applied to this *major population.*

An experimental adaptive management study of grazing and prescribed burning should be conducted on the smaller populations of thread-leaved brodiaea in Cristianitos Canyon. Several questions could be addressed:

1. What is the effect of grazing on brodiaea during the growing season?
2. What is the effect of prescribed burns on brodiaea during the growing season?
3. What is the effect of combined burning and grazing (*e.g.,* fall burn followed by winter/spring grazing)?

This experiment could be set up as a 2 x 2 factorial design with four combinations as set out in *Table 7-15*. For the grazed/burned site, a combination of fall burning to remove dead thatch and winter/spring grazing to control new annual growth/seed setting may be an effective double treatment to control invasives.

Because of the relatively few number (5) of smaller populations in the Habitat Reserve, concurrent treatments with sufficient replicates for statistical power may not be possible, although the middle Cristianitos population is comprised of several small populations that may be treated separately. Serial replications made over several seasons may be necessary to collect adequate data to determine the most effective management method. Also, data from other brodiaea management programs may be collected and help inform management.

TABLE 7-15
SAMPLE EXPERIMENTAL TREATMENTS FOR
THREAD-LEAVED BRODIAEA ADAPTIVE MANAGEMENT

Treatments	Burned	Unburned
Grazed	Grazed/Burned	Grazed/Unburned
Ungrazed	Burned/Ungrazed	Control (Ungrazed/Unburned)

(c) Restoration

Thread-leaved brodiaea, along with associated clay topsoils to the extent feasible, would be salvaged and translocated to suitable receiver sites where coastal sage scrub and/or native grassland restoration is underway. Potential receiver sites include Chiquita Ridge, Chiquadora Ridge, Sulphur Canyon, upper Cristianitos Canyon, Ladera Open Space adjacent to the Arroyo Trabuco Golf Course, and upper Gabino Canyon. Receiver sites should exhibit clay soils suitable for brodiaea and should be placed in locations that maximize connectivity and genetic exchange; *i.e.*, habitat areas accessible to pollinators from other locations. Details of the translocation approach are described in detail in the Translocation, Propagation and Management Plan for Special-status Species (*Appendix I*).

2. Chaparral Beargrass

Chaparral beargrass occurs in one location in the Habitat Reserve comprised of six individuals in the eastern portion of the Talega sub-basin (*Figure 150-M*). Single individuals also have been recorded in the Foothill-Trabuco Specific Plan (Subarea 2) area between Live Oak Canyon Road and Trabuco Oaks Road, but outside the Habitat Reserve and in open space in the City of Mission Viejo. Because of the rarity of this species in the subregion, the population in the Talega sub-basin is considered an *important population* in a *key location.*

Very little information is available for chaparral beargrass from which to base a management program. The USFS identified protection of the species from frequent fire as a management issue, for example, but no scientific information is available on the relationship between the species and fire frequency to support this management approach.

The management and monitoring program for chaparral beargrass focuses on monitoring the population in the Talega sub-basin at three-year intervals following initiation of monitoring of a particular area upon dedication of the area to the Habitat Reserve. The initial monitoring survey

would document the current status of the population and note general conditions of vegetation communities providing habitat, such as species composition, native/non-native ratio, any observable disturbance conditions, etc. Photostations would be established at the site. It is recommended that the site be visited at least every three (3) years during the blooming season (April-June) to assess reproductive activity of the plants. This species is an evergreen shrub and unlikely to exhibit significant year-to-year variation. If a fire occurs at the site, follow-up surveys should be conducted for at least five (5) consecutive years to determine the species' response to fire. New fires within the area should be suppressed to the extent feasible within this five-year period. If, based on a lack of new vegetative growth or flowering, the individuals do not appear to have recovered from the original fire within this five-year period, additional monitoring and possibly protection of this population from fire may be required beyond this period.

Management actions cannot be determined until more information about the species is collected. With only one population in the Habitat Reserve, experimental management actions are not recommended at this time.

3. Coulter's Saltbush

Coulter's saltbush occurs in three general locations in the Habitat Reserve (*Figure 150-M*). A *major* and two *important populations* occur in Chiquita Canyon, an *important population* occurs in the upper Cristianitos Canyon, and an *important population* occurs in upper Gabino Canyon. This species occurs in alkaline soils, and in Chiquita Canyon is associated with southern tarplant, also a Covered Species.

Little information is available for this species to guide management. It is hypothesized that exotic species and trampling by cattle are likely to be the primary stressors of this species in the Habitat Reserve and management and monitoring actions would be focused on this assumption. For example, populations in Chiquita Canyon may be threatened by proliferation of wild radish, Australian saltbush and mustards and/or by cattle grazing in the meadows adjacent to Chiquita Creek during the summer. In addition, soil/water relations likely are important for this species because of its association with alkaline soils. Many of the populations are associated with cryptogammic soils (Bomkamp, pers. comm. 2005), which could be adversely affected by cattle if crusts are broken up by trampling. It may be appropriate to place exclusion fencing around some of these areas when cattle are in adjacent pastures.

Because little is known about the variability of this species, the management and monitoring program for Coulter's saltbush focuses on monitoring the population in all three locations annually for the first five (5) years following initiation of monitoring of a particular area upon

dedication of the area to the Habitat Reserve. These initial monitoring surveys would document the annual status and annual variability of the population and note general conditions of vegetation communities such as species composition, native/non-native ratio, any observable disturbance conditions (*e.g.*, from cattle). Because of this species affinity for alkalinity, soil samples should be taken during surveys to measure pH. Maintaining an appropriate range of soil alkalinity may be crucial for managing this species. Protection of cryptogammic soils also may be a key element of long-term persistence. Photostations would be established at each of the sites. The site should be visited during the blooming season (March-October) to assess reproductive activity of the plants. The frequency of surveys beyond the first five years would be determined by the Reserve Manager and would be based on the variability of the species observed in during the five-year baseline observations and identified stressors. For example, if the species shows relatively little year-to-year variability and/or threats appear to be low, a less frequent monitoring protocol may be recommended. On the other hand, if the species proves to be highly variable or threats appear to be high, annual monitoring may be continued beyond the first five years. The determination of a long-term monitoring protocol would be made by the Reserve Manager in consultation with the Science Panel.

If Coulter's saltbush is directly impacted by future development, individuals, and associated soils to the extent feasible, will be experimentally translocated to suitable receiver sites in the same sub-basin where the impacts occur. Receiver sites should support alkali soils suitable for the species and should be placed in locations that maximize connectivity and genetic exchange with existing populations in the Habitat Reserve. Details of the translocation approach are described in detail in the Translocation, Propagation and Management Plan for Special-status Species (*Appendix I*).

4. Many-stemmed Dudleya

Many-stemmed dudleya occurs in six general *key locations* of which the large majority will be in the Habitat Reserve (*Figure 151-M*). Three of the six locations comprise *major populations* in *key locations*: the Chiquadora Ridge complex, the Cristianitos Canyon complex, and the upper and middle Gabino Canyon complex. Chiquita Ridge, upper Gobernadora and east Talega support *important populations* in *key locations*. The main stressors of these populations are non-native invasive species such as artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, and mustards. Cattle impacts on the dudleya have not been observed on RMV (T. Bomkamp, pers. comm. 2005). Many-stemmed dudleya typically grows in areas where annual grasses are less prevalent and thus less attractive to cattle. However, cattle are identified as a potential stressor on the Cristianitos Canyon and Gabino Canyon dudleya populations because grazing in the southern pastures coincides with the dudleya growing season and

monitoring for potential cattle impacts is thus warranted. Conserved areas also would need to be protected from human disturbance by hikers, mountains bikers and equestrians.

(a) Monitoring

The monitoring of many-stemmed dudleya would be focused on the three *major populations* and three *important populations* because about 97 percent of the estimated individuals in the Habitat Reserve occur in these six areas. Monitoring would use direct counts of observed individuals or estimates to the nearest 100 individuals as the index of the population size. Similar to thread-leaved brodiaea, it is likely that only a fraction of plants in a population bloom during any given year.

Each of the six general monitoring areas encompasses a relatively broad area and it would not be possible to conduct exhaustive counts of the populations, unlike the thread-leaved brodiaea that is fairly localized. Representative sample plots would be selected within each of the four monitoring areas that reflect the general size, distribution and vegetation communities within the population complex (*i.e.,* stratified). An emphasis would be placed on selecting sample plots where potential stressors such as exotic species, cattle, and human activities could pose risks to the population, and "control" areas where these stressors appear not to be a potential threat, such as where grazing has been eliminated (*e.g.,* the Donna O'Neill Land Conservancy).

The six populations would be monitored annually for the first five (5) years following initiation of monitoring of a particular area upon dedication of the area to the Habitat Reserve. Annual monitoring over the first five years would establish baseline information on the variability of the populations in terms of number of flowering individuals produced annually and to identify any necessary near-term management actions. Following the initial five-year baseline study period, periodic monitoring surveys would be conducted at intervals to be determined by the Reserve Manager and Science Panel. If specific management actions (*e.g.,* a prescribed burn) are implemented during the five-year period, frequent follow-up monitoring to assess the outcome of the management action would be required. On the other hand, if a population appears to be stable after the initial five years, and no imminent threats to the population have been identified, less frequent monitoring may be warranted.

Monitoring would be conducted during the blooming period of this species, which typically is March to June. Timing of surveys would take advantage of the local weather patterns and at least one survey would be timed to coincide with the expected peak flowering period. This likely would require at least three site visits during the blooming period – one each in the early, middle, and late portions of the portions of the season (*e.g.,* March, April and May). As areas of

flowering individuals are counted or estimated during each site visit, pin flags would be placed to mark the areas of counted/estimated individuals to avoid double counting.

The presence of native and exotic species would be recorded at sample sites using a standard sampling protocol, such as described above for thread-leaved brodiaea, as would general soil conditions (*e.g.*, evidence of ground surface disturbances) and other evidence of disturbance.

(b) Management

The main stressor of many-stemmed dudleya in the Habitat Reserve is anticipated to be exotic species which compete with native species for space, nutrients, and water. Exotic invasions may be exacerbated by too frequent fire and cattle-related impacts, although, as noted above, these stressors have not been observed to be operating on RMV. As such, the monitoring program described above is geared to measure the presence of invasive species at the monitoring locations. As discussed above for thread-leaved brodiaea, a variety of techniques can be used to control exotic species, including time-grazing, prescribed burns, mowing, manual removal (weed-whacking and hand-pulling), and herbicide treatment.

Similar to thread-leaved brodiaea, the management recommendations for the three *major populations* and one *important population* are different because the practical long-term management opportunities are different.

1. For the Chiquadora Ridge and Chiquita Ridge populations, timed-grazing is the recommended management approach and essentially would continue the existing grazing pattern. The "Chiquita Pastures" are grazed from late spring through September, with most grazing in the cultivated barley fields and low levels of grazing in the adjacent natural vegetation. This grazing period would allow the many-stemmed dudleya in these two areas to bloom and set seed before cattle are introduced in the late spring. Furthermore, because these locations are relatively close to residential development in Ladera Ranch and lower Chiquita Canyon, it is unlikely that prescribed burns would be acceptable as a management tool (although occasional wildfires may benefit the many-stemmed dudleya over the long-term).

2. For the Cristianitos Canyon and middle/upper Gabino Canyon populations, cattle-related impacts are a consideration because cattle are grazed in the area from October through May during the period of peak annual grass production and the dudleya growth period. Given that the existing populations appear to be healthy under the existing grazing regimen, however, the long-term benefits of grazing may outweigh any negative impacts. Removal of grazing from the areas could allow exotics to proliferate, with a consequent

net loss of the dudleya population. It is recommended that these populations be monitored for at least the first five years following initiation of monitoring of a particular area upon dedication of the area to the Habitat Reserve to evaluate, at least anecdotally, what effect, if any, grazing has on the dudleya populations. Ungrazed populations in the Donna O'Neill Land Conservancy will serve as controls. Small experimental exclosures also may be placed on RMV land to more directly measure the effects of grazing.

If cattle are found to have a net negative impact on many-stemmed dudleya, these areas also may be suitable for prescribed burns because they are more remote from planned development. The efficacy of prescribed burning also would need to be tested on small plots before it would be used on a larger scale to manage many-stemmed dudleya. Depending on funding availability and management priorities during the early implementation phase of the AMP, the Reserve Manager and Science Panel may determine that prescribed burn experiments for dudleya management, perhaps in conjunction with native habitat restoration experiments, are warranted.

(c) Restoration

Translocation of many-stemmed dudleya has been demonstrated to be at least moderately successful, albeit with mixed results (*e.g.*, the San Joaquin Hills Tollroad [SR-73]). Based on previous efforts, translocation of many-stemmed dudleya is a reasonable objective for minimizing and mitigating unavoidable impacts. Many-stemmed dudleya, along with associated clay topsoils to the extent feasible, would be salvaged and translocated to suitable receiver sites where coastal sage scrub and/or native grassland restoration is underway. Potential receiver sites include Chiquita Ridge, Chiquadora Ridge, upper Cristianitos Canyon, upper Gabino Canyon, and the Radio Tower Road area (although there are no documented locations along Radio Tower Road, the area supports clay soils that might be suitable for the dudleya). Receiver sites should support clay, cobbly loam and sandy clay loam soils suitable for many-stemmed dudleya, and should be areas that maximize connectivity and genetic exchange; *i.e.*, vegetation community areas accessible to pollinators from other locations. The Translocation, Propagation and Management Plan for Special-status Plants (*Appendix I*) also includes propagation of many-stemmed dudleya that would include seed collection, greenhouse propagation and introduction of cultivated plants at receiver sites as a priority method and direct seeding at translocation sites as a secondary method. Details of the translocation approach are presented in the Translocation, Propagation and Management Plan for Special-status Plants (*Appendix I*).

5. Southern Tarplant

Southern tarplant occurs in two sub-basins in the Habitat Reserve (*Figure 151-M*). Three population complexes occur in the Chiquita sub-basin, including two *major populations* and one *important* population. A *major population* also occurs in Gobernadora in the northern portion of GERA. This species occurs in alkaline wet meadow, and in Chiquita Canyon is associated with Coulter's saltbush, also a Covered Species. Southern tarplant is well adapted to disturbance associated with flood events and even appears to benefit from occasional discing or other soil disturbing activities. Consistent with this association with disturbance events, southern tarplant populations appear to exhibit high spatiotemporal variation.

It is hypothesized that exotic species are likely to be the primary stressor of this species in the Habitat Reserve and management and monitoring actions would be focused on this assumption. For example, populations in Chiquita Canyon may be threatened by proliferation of wild radish and mustards.

The management and monitoring program for southern tarplant focuses on monitoring the populations in both the Chiquita and Gobernadora sub-basins annually for the first five years following initiation of monitoring of a particular area upon dedication of the area to the Habitat Reserve The first five (5) years of the monitoring program would document the current status and annual variability of the population and note general vegetation community conditions such as species composition, native/non-native ratio, any observable disturbance conditions, etc. Because this species can occur in local populations of tens of thousands and direct counts are not feasible, population estimates to the nearest one thousand individuals would be based on area density estimates. Because of this species affinity for alkalinity, soil samples should be taken during surveys to measure pH. Maintaining an appropriate range of soil alkalinity may be crucial for managing this species. Photographs would be taken during surveys, but the locations likely would be different each time because of the variable distribution of this species from year to year. The frequency of surveys beyond the first five years would be determined by the Reserve Manager and would be based on the variability of the species observed in during the five-year baseline observations and identified stressors. Although this species appears to be highly variable, if long-term threats appear to be low, a less frequent monitoring protocol may be recommended. On the other hand, if threats to the species appear to be high, annual monitoring may be continued beyond the first five years. The determination of a long-term monitoring protocol would be made by the Reserve Manager in consultation with the Science Panel. A potential experimental management treatment is discing, which anecdotally appears to facilitate dispersal and propagation of southern tarplant. This potential management technique would need to be carefully tested to avoid impacts to Coulter's saltbush.

If southern tarplant is directly impacted by development, individuals, and associated soils to the extent feasible, will be translocated to suitable receiver sites in the same sub-basin where the impacts occur. Receiver sites should support alkali soils suitable for the species and should be placed in locations that maximize connectivity and genetic exchange among the local population. Details of the translocation approach are presented in the Translocation, Propagation and Management Plan for Special-status Plants (*Appendix I*).

SECTION 7.13 ADAPTIVE MANAGEMENT OF HABITAT LINKAGES AND WILDLIFE CORRIDORS

This section describes the approach to management and monitoring of key habitat linkages and wildlife corridors. Both avian and ground-dwelling species would be managed and monitored to maximize the likelihood that the habitat linkages and wildlife corridors are functioning as designed.

7.13.1 Adaptive Management Issues

Maintaining functional habitat linkages and wildlife corridors both within the Habitat Reserve and to vegetation communities areas outside the Reserve (*i.e.,* Central/Coastal Subregion, CNF, Camp Pendleton) will be essential for conserving landscape ecosystem processes, vegetation communities and species in the subregion (see discussion in *Section 3.5* of *Chapter 3*). In principle, human-related threats to habitat linkages and wildlife corridors are greater than to "interior" habitat blocks within the Habitat Reserve because linkages corridors have a greater perimeter edge-to-area ratio than large habitat blocks (*i.e.,* they tend to be longer and more narrow or have more edge variations), though this generally is not the case for stressors such as fire and altered geomorphology. Mostly as a result of proportionally greater edge area, potential stressors on functioning habitat linkages and wildlife corridors include:

- Disturbance and degradation of habitat quality such that the habitat linkage may no longer provide suitable "live-in" habitat for resident species (*e.g.,* small native fauna) or that mobile species such as the larger mammals (mountain lion, bobcat, mule deer) no longer use corridors for movement or dispersal. Disturbance or degradation of habitat may include loss of protective cover that provides refugia for wildlife or invasion by exotic wildlife and plant species that displace native vegetation communities and native wildlife species.
- Higher levels of human disturbance such as illegal trails, off-road vehicles, trampling of vegetation, trash and garbage dumping, and accidental and deliberation ignitions of fires.

- Increased chance of vehicle collisions with wildlife where roads cross habitat linkages and movement corridors.
- Increased lighting and noise.
- Increased urban run-off.

7.13.2 Adaptive Management Goals and Objectives

The adaptive management goals for habitat linkages and wildlife corridors include the following:

- Maintain the function of key habitat linkages and wildlife corridors within the Habitat Reserve.
- Maintain the function of key habitat linkages and wildlife corridors that connect to important resources areas outside the planning area, including the Central Subregion, CNF, and Camp Pendleton.

These broad goals would be achieved by meeting the following management and monitoring objectives:

- Monitor occupation and/or uses of identified key habitat linkages and wildlife corridors by the species identified as using or depending on these linkages and corridors.
- Maintain suitable vegetation communities in the key habitat linkages and wildlife corridors for the species associated with the specific linkage/corridor.
- Identify and rectify constraints to use or movement (*e.g.*, physical obstacles or bottlenecks) or sources of disturbance of vegetation communities or degradation in key habitat linkages and wildlife corridors.
- Implement the comprehensive Water Quality Management Plan addressing "Pollutants of Concern" and "Hydrologic Conditions of Concern" (see *Section 7.18.2*)

As discussed in more detail below, monitoring wildlife use of some identified linkages and corridors in areas that are most likely to be affected by future development, based on an evaluation by the Reserve Manager and Science Panel, may be initiated prior to the development occurring in order to establish baseline function of the linkage/corridor and compare pre- and post-development function.

7.13.3 Strategies for Management and Monitoring of Habitat Linkages and Wildlife Corridors

Identified habitat linkages and wildlife corridors in the proposed Habitat Reserve are depicted in *Figure 159-M.* As described in *Chapter 3*, identification of these linkage and corridor functions is based on field studies of wildlife movement in the planning area (*e.g.*, Beier and Barrett 1993, Dudek 1995; MBA 1996; Padley 1992), input from the Science Advisors and the Wildlife Agencies, and the consultant team's review and analysis of the species, vegetation, and physiographic information for the subregion. The specific linkages and corridors and associated species recommended for monitoring are shown in *Table 7-16.* Theses linkages and corridors were selected because they are located in likely strategic areas for maintaining connectivity in the Habitat Reserve and/or are likely to be the greatest risk of disturbance or degradation from nearby development and human activities.

TABLE 7-16
PROPOSED HABITAT LINKAGE AND
WILDLIFE CORRIDOR MONITORING LOCATIONS

Habitat Linkage/Wildlife Corridor[1]	Description and Function	Key Species[2]	Existing or Future Constraints/Threats
B	Habitat linkage between Las Flores and Ladera Ranch residential developments that connects Arroyo Trabuco and Chiquita Ridge	Large mammals such as mountain lion, mule deer, coyote and bobcat. Avian species such as California gnatcatcher and cactus wren	• Antonio Parkway
C	Habitat linkage along Chiquita Ridge and Chiquita Creek that connects San Juan Creek to "horseshoe" of habitat at northern end of Coto de Caza	Large mammals such as mountain lion, mule deer, coyote and bobcat. Avian species such as California gnatcatcher and cactus wren	• Oso Parkway
D	"Narrows" area separating middle and lower Chiquita Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	• Road connection between Oso Parkway and Gobernadora development area • Residential and golf development in middle Chiquita PA 2.
E	East-west wildlife corridor located north of wastewater treatment facility in Chiquita Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	• Residential and golf course development north of the wastewater treatment plant • Road connection between Oso Parkway and Gobernadora development area
G	North-south habitat linkage along Chiquadora Ridge and Gobernadora Creek	Large mammals such as mountain lion, mule deer, coyote and bobcat. Avian species such as California gnatcatcher and cactus wren	• Residential development in Chiquita (PA 2) and Gobernadora (PA 3) • Road connection between Oso Parkway and Gobernadora development area

TABLE 7-16
PROPOSED HABITAT LINKAGE AND WILDLIFE CORRIDOR MONITORING LOCATIONS

Habitat Linkage/Wildlife Corridor[1]	Description and Function	Key Species[2]	Existing or Future Constraints/Threats
H	East-west habitat linkage between Chiquita Canyon and Wagon Wheel Canyon and Gobernadora to provide connection to Caspers Wilderness Park and north-south connection to San Juan Creek.	East-west linkage primarily for large mammals such as mountain lion, mule deer, coyote and bobcat. North-south connection primarily for avian species such as California gnatcatcher and cactus wren	• Existing Coto de Caza residential development north of linkage and new residential development to southwest in Chiquita Canyon (PA 2).
I	East-west habitat linkage through Gobernadora south of Coto de Caza residential development connecting Chiquita Canyon and Caspers Wilderness Park	East-west linkage primarily for large mammals such as mountain lion, mule deer, coyote and bobcat.	• Existing Coto de Caza residential development north of linkage and Gobernadora residential development (PA 3) south of linkage
J	Habitat linkage along San Juan Creek that is central nexus for connecting to Bell, Verdugo, Gobernadora, Chiquita and Trampas canyons in the central portion of planning area.	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher.	• Gobernadora residential development (PA 3) and East Ortega residential development (PA 4).
N	Habitat linkage along Cristianitos Creek connecting San Juan Creek with drainages in San Mateo Watershed, including off-site lower Cristianitos and San Mateo creeks.	California gnatcatchers and large mammals such as mountain lion, mule deer, coyote and bobcat.	• Crisitanitos residential development (PAs 6 & 7). • Improvements to Cristianitos Road.
O	Habitat linkage along lower Gabino Creek connecting Habitat Reserve to CNF.	Large mammals such as mountain lion, mule deer, coyote and bobcat, as well as cactus wren.	• Crisitanitos residential development (PA 7). • Blind Canyon/Talega development (PA 8). • Improvements to Cristianitos Road.
R	Low elevation habitat linkage between planning area and Central Subarea component of Central and Coastal Habitat Reserve	Mammals such as coyote and gray fox.	• Larger mammals such as mountain lion mule deer are limited by existing obstacles to crossing under El Toro Road
T	North-south habitat linkage generally through the Foothill-Trabuco Specific Plan Area	Large mammals such as mountain lion, mule deer, coyote and bobcat.	• Based on configuration of development in Foothill-Trabuco Specific Plan Area

[1] Based on habitat linkages and wildlife corridors depicted in Figure 159-M.

[2] The key species issues are those identified in Section 3.5 of Chapter 3.

Some important habitat linkages shown in *Figure 159-M* were not selected for monitoring because they are remotely located away from proposed development and activity (*e.g.*, Middle Gabino Canyon, La Paz Canyon, etc.). Other linkages/corridors may be added for monitoring in the future if conditions warrant. Likewise, linkages/corridors proposed for monitoring may be

deleted in the future if the monitoring program demonstrates that they are functioning properly and that the risk of disturbance or degradation is low.

As noted in the section above, based on an evaluation by the Reserve Manager and Science Panel monitoring of some locations may initiated prior to development to establish the baseline function of the linkage/corridor and to allow for pre- and post-development comparisons. Based on the anticipated phasing of the proposed development (*Figure 182-M*), the following linkages may be considered for monitoring: D, E, G, H, I and J. These linkages/corridors have been identified as important for wildlife movement through the Chiquita Canyon area and for connecting Arroyo Trabuco in the west, Caspers Wilderness Park in the east and San Juan Creek to the south. The Reserve Manager and Science Panel will need to assess the planned development schedule and determine the most appropriate timing of the monitoring subject to funding considerations and other management and monitoring priorities.

The selection of specific monitoring sites within these general linkage and corridor areas would require additional field work in the early stages of implementing the AMP. Each potential site would be field-checked to identify potential movement routes of large species such as mountain lion, mule deer, coyote and bobcat, as well as potential "live-in" habitat for smaller species such as California gnatcatcher and cactus wren. Site security for long-term monitoring also is an important practical consideration because of the potential of vandalism and theft of monitoring equipment, or simply dense public activity that can interfere with reliable data collection (*e.g.*, trampling of tracking areas). Short-term pilot studies may be required to document wildlife use and the long-term security of an area.

Another consideration for the selection of monitoring sites post-construction is wildlife movement in areas in proximity to an identified corridor such as a bridge or culvert. If, for example, wildlife are crossing a roadway adjacent to the bridge or culvert it may be necessary to place fencing along the roadways to direct wildlife to the crossing. (Note that a proposed minimization measure is 10-ft chain link fence placed within 100 feet of bridges and culverts.)

The Reserve Manager and Science Panel will have the flexibility of selecting the specific sites for survey transects and the suite of species to be monitored at each site, but their selection of sites, the suite of species to be monitored and the monitoring methods to be used would be subject to review and approval by the Reserve Manager.

Generally following the methods used by Crooks and Jones (1998) for the Nature Reserve of Orange County, survey transects would be established at primary and critical habitat linkages and wildlife corridors expected to be used by these species. Mammals such coyote, bobcat, mountain lion, and mule deer would be monitored through standard tracking techniques and

calculation of indices of occurrence most appropriate for the survey transect. Indices to be used may include scat counts, track counts, and remotely-triggered cameras. These indices allow for estimations of distribution, relative abundance, movement patterns and corridor use (Crooks and Jones 1998). Scat and track surveys are economic and reliable measures that can be used in a variety of settings. Remotely-triggered cameras are useful for long-term monitoring of wildlife movement with minimal manual labor and supervision, but should be established only where they can be effectively concealed and risk of theft is minimal. These indices cannot be used to estimate absolute abundance of individuals because many observations of a single individual cannot reliably be distinguished from observations of many individuals (unless an individual has a unique identifying feature such as a missing toe).

Other focal species also would be monitored sites using survey methods appropriate for the management question being asked at the site (see discussion above in *Section 7.7.3* for focal species monitoring). For example, simple presence/absence by a species at a site can be demonstrated through areas search or points counts. A more specific question regarding the long-term function of a habitat linkage may require more detailed information on breeding status and dispersal patterns through mist nesting or nest monitoring. For example, if the question is whether the habitat linkage is functioning to convey dispersing individuals, banding of fledglings may be necessary or intensive monitoring of use of vegetation communities within the linkage during dispersal may be required; if juveniles are observed using the habitat linkage it may be possible to infer that the linkage is an effective dispersal corridor. As another example, if there is a concern that a particular linkage or corridor is vulnerable to urban-related predators, mesopredators or cowbird nest parasitism, monitoring of nest sites to assess reproductive success may be necessary.

Along with focal species data, other variables that would be recorded at monitoring sites include presence of native and non-native mesopredators and urban-related predators (*e.g.*, raccoon, striped skunk, opossum, and dogs and cats), proximity to residential and commercial development, evidence of human activity (footprints, trash and garbage, off-road vehicles, mountain bikes, equestrian), amount of natural vegetation cover, substrate, and presence of noise and artificial lighting. At underpasses, bridges and culverts, the dimension of the structure would be determined and correlated with species use.

Based on the results of the monitoring program, if certain desired species are absent or uncommon at important habitat linkages or wildlife corridors in the Habitat Reserve, appropriate management actions may be taken, including, but not limited to:

- Enhancement or restoration of the corridor with natural vegetation to provide additional cover.

- Placement of fencing to funnel wildlife to safe crossings and away from exposed roadways (note that fencing is proposed as a minimization measure, but site-specific conditions may require additional fencing beyond the 100 feet proposed).
- Redirection or placement of lighting.
- Placement of sound walls or other methods of attenuating noise.
- Fencing or gating to control unauthorized human access and activities.
- Control of urban-related predators and possibly native and non-native mesopredators to the extent feasible.
- To the extent feasible and as appropriate, modification of the features of habitat linkages and corridors to improve their function (*e.g.*, vegetation, substrate, fencing, etc.).

Each of these management actions will need to implemented within the adaptive management framework. For example, if light or noise are suspected to be inhibiting wildlife use of a site, pre- and post-treatment (*i.e.*, measures to reduce lighting or noise) data, such as ambient light, maximum and average noise levels, etc. will be collected to measure the effect of the treatment on wildlife use.

SECTION 7.14 WILDLAND FIRE MANAGEMENT PLAN

This section outlines the Wildland Fire Management Plan (*Appendix N)* for the Habitat Reserve. The Wildland Fire Management Plan (Fire Plan) is a formal component of the HRMP.

As discussed under Landscape Processes in *Section 7.4.2.a*, the upland vegetation communities in the planning area evolved with the presence of fire, and are dependent on fire to renew vegetation succession and to sustain species of concern and the resources on which they depend. But there is substantial debate regarding the historical frequency of fire, its associated extent and intensity, and its role in sustaining and renewing vegetation communities in the modern era of elevated human activities and threats from invasive plant species (*e.g.*, Keeley and Fotheringham 2001a, 2001b; Minnich 2001). Despite differing interpretations of available data on current landscape conditions, both sides in the debate recognize that the role of human fire ignitions is a key variable in today's land management challenge.

The Fire Plan proposes to use prescribed fire as one of the tools to meet biotic and other land management goals. The Fire Plan, however, recognizes that short fire-return intervals can result in vegetation type conversion events that could effectively permanently compromise the ability of the managed lands to meet species-related management goals. Moreover, good data indicate that with development and associated increases of human visitation to wildlands, human-caused

ignitions, both accidental and vandal-caused, increase. The management challenge then is to mimic presumed historical fire frequency and intensity to the long-term benefit of desirable species and related vegetation communities, while recognizing that **(1)** unplanned fires are likely to increase, **(2)** current conditions on portions of the planning landscape may make those areas prone to undesirable fire event outcomes, and **(3)** long-term climate change is highly likely to change local fire-vegetation dynamics.

Within this cautionary context, the Fire Plan for the Habitat Reserve provides details for meeting the following management objectives.

- Identify appropriate spatial scales and patterns for the long-term management of fire.
- Develop active fire management prescriptions for shrublands (coastal sage scrub and chaparral) and grasslands focused on increasing abundance and diversity of native plants and promoting structure and composition favored by focal wildlife species.
- Quantify effects of varying fire regimes on selected wildlife species.
- To the extent appropriate, utilize prescribed fire to reduce unplanned fire events from known ignition corridors.
- Define fire prescriptions that aid in the restoration of degraded shrublands.
- Investigate active restoration techniques following fire treatments.
- Develop a social environment supportive of active fire management.

The Fire Plan describes both tactical and strategic fire protection plans.

The *Tactical Fire Suppression Plan* would be used by Orange County Fire Authority (OCFA) Field Officers as their wildland fire protection by specific fire management units (FMU). The tactical plan includes policies for bulldozer use, creation of new roads, backfiring, ground unit tactics, off-road use, road grading and erosion, water saturation, and fire prevention techniques. The tactical plan includes delineations of fire management compartments (FMC's) in the planning area, generally watersheds, and FMU's, which are sub-divisions of the FMC's. Within these FMC's and FMU's different tactical operational modes are identified, including "aggressive" (direct attack), "standard" (combination of direct and indirect attack) and "modified" (indirect attack – light on land concept).

The *Strategic Fire Protection Plan* is a subcomponent of the HRMP. It addresses the relationship between fire protection and the appropriate role of fire in the Habitat Reserve. The Strategic Fire Protection Plan identifies the structure on ignition sources (*i.e.,* radiation, convection, firebrands [embers]) and determines the appropriate fire protection policies for each

FMC and FMU in the context of the biological resources being managed and the fuel model classifications and expected fire behavior in the Habitat Reserve. Expected fire behavior depends on several variables, including fuel model (*e.g.,* tall dense mature chaparral vs. short grass), slope percents, and weather conditions (*e.g.,* wind speed and direction and humidity).

Based on these analyses, the Strategic Fire Protection Plan specifies fuel treatment options to protect both life and property and biological resources within each FMU. These include: determination of appropriate Fuel Modification Zones (*e.g.,* irrigated zones and thinning zones); determination of appropriate setbacks from slope based on type of building materials, height of structure, fuel model and expected fire weather conditions; and establishment of short- and long-term fire protection planning criteria for new developments.

The *Fire Management Program* component of the Strategic Fire Protection Plan provides the detailed fire program for vegetation communities such as coastal sage scrub, chaparral and native grassland, including programs for restoration sites for these habitats. This program considers the current understanding of fire ecology in the southern California ecosystem.

Finally, the Strategic Fire Protection Plan includes a validation and monitoring component, which is vitally important to the overall HRMP. This component includes a monitoring approach (*i.e.,* general tests and sampling methods) to evaluate and validate fire management actions or non-actions. The response of vegetation communities and wildlife species to wildfires, prescribed burns, and fuel treatments (*e.g.,* mechanical crush and burn, hand labor fuel treatment and burn) are addressed.

SECTION 7.15 HABITAT RESTORATION PLAN

7.15.1 Overview of Habitat Restoration Plan

The Habitat Restoration Plan (*Appendix H*) describes the spectrum of possible upland and riparian/wetland restoration activities within the RMVLC portion of the Habitat Reserve under the NCCP/MSAA/HCP and in areas subject to the Aquatic Resources Conservation Program under the SAMP. The term "restoration" is used very broadly in this plan and covers a range of activities from enhancement of existing degraded vegetation communities providing habitat to creation of new habitats. The restoration activities described in this plan would be undertaken in accordance with certified/approved restoration plans under the NCCP/MSAA/HCP and SAMP.

The Habitat Restoration Plan identifies several restoration areas on the basis of their important location and function in the Habitat Reserve. The overall goal of restoration in these areas is

contribute to and help maintain *net habitat value* in the Habitat Reserve on a *long-term* basis for Covered Species that receive regulatory coverage under the NCCP/MSAA/HCP.

7.15.2 Upland Habitat Restoration Areas

Several areas have been identified for coastal sage scrub (CSS) and valley needlegrass grassland (VGL) as shown in *Figure 42-M*:

- CSS restoration in Sulphur Canyon elsewhere along Chiquadora Ridge in the Gobernadora sub-basin;
- CSS and VGL restoration along Chiquita Ridge in the Chiquita sub-basin;
- VGL restoration in the upper Cristianitos sub-basin and portions of Blind Canyon Mesa in the Gabino and Blind Canyons sub-basin;
- CSS/VGL restoration in upper Gabino Canyon sub-basin; and
- CSS/VGL restoration in the Chiquita Canyon sub-basin.

7.15.3 Riparian/Wetland Restoration Areas

General areas identified for riparian/wetland restoration, as shown in *Figure 42-M,* consist of the following:

- Gobernadora Creek to address historic meander condition and excessive sediment resulting from upstream land uses;
- Creation of breeding habitats in Gobernadora Creek for tricolored blackbird, least Bell's vireo, southwestern willow flycatcher and other riparian species;
- Upper Gabino Creek to address erosion and excessive sediment generation (this restoration program would occur in combination with upland CSS/VGL restoraion); and
- Lower Chiquita Creek and upper Cristianitos to address locally-induced headcuts.

Although not specifically part of the riparian/wetland restoration plan discussed here, additional riparian/wetland areas have been identified for enhancement through control of invasive species such as giant reed (*Arundo donax*), tamarisk (*Tamarix* spp.), pampas grass (*Cortaderia selloana*), castor bean (*Ricinus communis*), and tree tobacco (*Nicotiana glauca*). Major targeted areas include upper and middle San Juan Creek, Arroyo Trabuco Creek and lower Cristianitos Creek. Details of this program are provided in *Section 7.16* below and in the Invasive Species Control Plan (*Appendix J).*

7.15.4 Approaches to Restoration

As indicated above, the term "restoration" is used in the broad sense to refer to the spectrum of restoration activities to be conducted in the Habitat Reserve. Restoration activities may be passive or active, depending on the needs and/or response of a site to restoration.

Passive Restoration generally refers to removing or controlling disturbance events such as discing that perpetuate non-native or disturbed vegetation communities. Passive restoration may involve some site preparation and maintenance such as weed control, and trash and debris removal, but generally the site would be allowed to revegetate naturally without extensive intervention. Some initial seeding may be used if the natural seed bank onsite is inadequate. Passive restoration sites would be monitored, and if the site is not meeting performance standards by a designated period, active restoration may be applied.

Active Restoration broadly refers to the specific application of restoration techniques. On a large scale (*e.g.,* 10s to 100s of acres), active restoration techniques may include timed grazing or prescribed burning, to the extent they are feasible and appropriate and consistent with the Grazing and Wildland Fire management plans (see *Sections 7.17.1* and *7.14,* respectively), and also to the extent that they can be demonstrated to be effective restoration methods. A potential alternative large-scale management technique is mowing, but, as with grazing and fire, its effectiveness in the Habitat Reserve would need to be demonstrated. A goal at the larger scale would be to use the most effective, but low cost and "low tech" or naturalistic restoration method possible so that long-term maintenance is minimized and the restored site is self-sustaining (in principal, more maintenance is required for highly engineered or intensive restoration projects). On a smaller scale (*e.g.,* a few acres or less), active restoration may include site-intensive techniques such as soil preparation, planting and/or seeding, irrigation, weed control, erosion control, etc. Active restoration implies a higher level of effort than passive restoration and typically is used on sites that would not regenerate naturally, or would only regenerate over an unacceptably long period of time without direct intervention. For example, a mitigation requirement that a site meet certain performance standards such as percent native plant cover or species occupation within five years probably would require active restoration to ensure that the performance standards were met.

Along with passive and active restoration, it is important to distinguish between enhancement and revegetation activities.

Enhancement generally refers to restoration of sites that support degraded forms of the target native vegetation community. The level of effort needed to enhance a site typically is less than revegetating a site because the target native community is already present. A primary

enhancement approach in the Habitat Reserve where low quality native habitat is already present would include timed grazing (which can include both grazing and not grazing depending on conditions) and prescribed burning to control non-native invasive grasses and weeds. Mowing or other mechanical methods also may be suitable alternatives where grazing and burning either are not appropriate or not shown to be effective. Weed whacking and other more intensive management such as target herbicide use may be appropriate and cost effective on a smaller scale. Seeding may be used to supplement the existing native vegetation, but planting of container plants and irrigation generally are not used on enhancement sites. Enhancement tends to be more passive, letting nature take its course. Also, enhanced sites are more likely to be self-sustaining and require less maintenance. Regardless of the methods used, it will be important to implement restoration projects in an adaptive fashion so that the alternative methods can be objectively evaluated.

Revegetation involves active restoration of a site whereby container plants and/or seeds are used to create or restore habitat. Typically the target native vegetation community is absent from the site; *e.g.,* a site supporting non-native annual grasslands revegetated with VGL. Site preparation and maintenance may include annual grass and weed control, and trash and debris removal. Depending on site conditions, soil remediation and/or irrigation may be necessary to support a viable revegetation site. Generally, revegetation sites would have higher performance standards than passively restored sites and the monitoring and maintenance program is more specific as far as the responsibilities of a Restoration Ecologist and Installation/Maintenance Contactor.

In practice, there often is not a clear distinction between active and passive restoration, revegetation and enhancement because each site has its own distinct requirements for successful restoration. The Reserve Manager would have the flexibility to implement the appropriate restoration methods in an adaptive fashion to produce the desired results in the most efficient manner. However, specific performance standards would be set for each restoration site so that the effectiveness of the methods can be objectively measured.

7.15.5 Components of Specific Restoration Plans

A detailed restoration plan would be prepared for each restoration site. The appropriate restoration approach would be taken, and may include, but not be limited to:

- Removal or control of the disturbing event
- Specific site preparation such as weeding or trash and debris removal
- Prescribed burning
- Timed grazing

- Mowing
- Mechanical applications (*e.g.,* weed whacking, hand-pulling)
- Herbicides
- Active revegetation, including site preparation, seeding and/or container plant installation, and monitoring

For each site, a set of success criteria would be established to measure whether the restoration project has achieved the desired result. Depending on the type or size restoration project the success criteria may be qualitative or quantitative. For example, for a large passive CSS restoration area, success criteria may be as simple as measuring a consistent increasing trend of percent cover of CSS shrub species and concomitant decline in non-native invasive species such as black mustard or artichoke thistle. For a smaller active revegetation area, specific quantitative performance criteria can be set, such as X percent cover of weedy species after 1, 2, 3, 4 and 5 years. Active revegetation projects also typically specify plant palettes, planting techniques, seed application, irrigation systems and schedules (if necessary), weed control, erosion control, pest control, other maintenance activities, and monitoring and data collection methods.

SECTION 7.16 INVASIVE SPECIES CONTROL PLAN

7.16.1 Overview of Invasive Species Control Plan

An Invasive Species Control Plan (*Appendix J*) was prepared to address the existing and foreseeable impacts of invasive plant and animal species on the RMVLC portion of the Habitat Reserve, as well giant reed in Caspers Wilderness Park in upper San Juan Creek upstream of RMV. This Plan provides the long-term management guidelines for the control of invasive species on RMV. The objectives of the Invasive Species Control Plan are to:

- Census and map invasive plants and introduced vertebrate predators on RMVLC lands.
- Review the ecology and habitat requirements of invasive species targeted control.
- Provide an overview of species-specific and density-dependent control methods.
- Analyze the impacts and benefits of the Plan on focal species and habitats.

The Invasive Species Control Plan is comprised of three main components: **(1)** invasive plants; **(2)** invasive invertebrates; and **(3)** invasive vertebrates.

7.16.2 Invasive Plant Species

The invasive plant species currently targeted for specific controls include several riparian species and one upland species. The riparian invasive plants along with their priority rankings are:

Riparian Species

- Giant reed (*Arundo donax*) – Priority 1
- Pampas grass (*Cortaderia selloana*) – Priority 2
- Castor bean (*Ricinus communis*) – Priority 2
- Tamarisk (*Tamarix ramosissima*) – Priority 3
- Tree tobacco (*Nicotiana glauca*) – Priority 3
- Spanish sunflower (*Pulicaria paludosa*) – Priority 3

The upland plant species currently targeted for specific control is artichoke thistle (*Cynara cardunculus*), a Priority 2 species.

The Invasive Species Control Plan will, as are all aspects of the AMP, be a "living plan" that will be flexible and subject to revision over time to respond to new invasives and control methods. As discussed in *Section 7.9.2,* black mustard and sweet fennel are pernicious weeds in grasslands, although fennel is not a serious issue for the Habitat Reserve at this time (T. Bomkamp, pers. comm. 2006). Although there has been mixed success with burning to control mustard, for example, it has not been demonstrated to be a feasible control method, and it does not appear to be effective for fennel unless coupled with herbicides. Herbicides are effective on mustard, (D. Smith, State Parks, pers. comm. 2005), but on a large scale probably are not practical or demonstrated safe for sensitive species (*e.g.,* potential runoff into arroyo toad habitat if used on a broad scale). The long-term objective of controlling mustard and fennel thus will need to rely on future demonstration of safe and cost-effective methods. An important task of the Reserve Manager and Science Panel will be to keep informed on new developments in weed management and revise the Invasive Species Control Plan accordingly.

For the riparian invasive species, several control methods can be used:

- Manual
- Foliar spray
- Cut stem/stump spray
- Cut, resprout and spray
- Mechanical

Each of these methods has advantages and disadvantages, and application, timing and equipment considerations. The selection of treatment method would depend on site-specific characteristics. For example, in large monotypic areas with minimal other sensitive resource present, mechanical removal with heavy equipment may be the most effective and efficient control technique. On the other hand, in areas with sensitive resources (*e.g.,* arroyo toad breeding habitat), a more "surgical" method such as manual removal (*i.e.,* hand pulling, digging with a shovel, or using a pick-ax, loppers or machete) may be more appropriate.

The control of artichoke thistle has been an ongoing program on RMV property and the problem is much less severe on the Ranch compared to other untreated areas of southern Orange County. While mechanical removal of this species in possible, the most effective treatment is the use of herbicides.

7.16.3 Invasive Invertebrate Species

Two invasive invertebrate species are targeted for control: Argentine ant (*Linepithema humile*) and red imported fire ant (*Solenopsis invicta*). Both species pose direct and indirect threats to native species, including direct predation of native vertebrates and competition/displacement of important invertebrate prey of native species.

The Invasive Species Control Plan acknowledges that eradication of either Argentine or red imported fire ants is not feasible or practical because of their ubiquity in southern California and their ability to colonize new areas. The goal of the program would be to control their populations and prevent their spread into new areas of the Habitat Reserve, especially those areas important for Covered Species. Control methods would include:

- Managing the urban-Habitat Reserve interface to minimize opportunities for colonization (*e.g.,* by controlling moisture).
- Direct nest/mound treatments with insecticides.
- Broadcast applications of insecticides.

The direct nest/mound and broadcast insecticide treatments would be used with great caution in areas of the Habitat Reserve in consideration of the inadvertent impacts on sensitive species and vegetation communities as well as other non-target, native invertebrate species.

7.16.4 Invasive Vertebrate Species

The vertebrate control component of the Invasive Species Control Plan targets four invasive species:

- Bullfrog (*Rana catesbeiana*)
- Crayfish ((*Procambrus* spp.)
- Brown-headed cowbird (*Molothrus ater*)
- European starling (*Sturnus vulgaris*)

As with plant invasive species, the Invasive Species Control Plan will need to be flexible in addressing new sources of vertebrate pests. For example, the non-native African clawed frog *Xenopus laevis*) may prey on native aquatic species and/or compete for resources and has been found throughout southern California.[13] While it does not appear to currently be a threat in the subregion, if the clawed frog appears in the future and becomes a threat to Covered Species such as the arroyo toad, control measures would be implemented. Likewise, fairly common native mesopredators such as raccoon and opossum or urban-related predators such as cats and dogs may need to be controlled in areas where they threaten native species.

As described in *Section 7.4.2.c*, several common native species were selected as candidate focal species for management and monitoring because they are correlated with habitat fragmentation and edge habitats, so-called "edge-enhanced species," such as northern mockingbird, Anna's hummingbird, and house sparrow (Bolger *et al.* 1997a). The causal relationships, if any, between these "edge-enhanced" species and reduction of other native species along habitat edges (*e.g.*, resulting from resource competition or direct agonistic interspecific interactions or simply better adaptation(s) to edge environments) is unknown. As monitoring of these 'edge-enhanced" species reveals their value as focal species and possibly displacement mechanisms, the Reserve Manager and Science Panel may determine that some active control of these species is warranted and the Invasive Species Control Plan will need to be revised.

The following subsections describe the control strategies for the four invasive species listed above.

[13] Fisher, R.N. http://www.werc.usgs.gov/pubbriefs/fisherpbapr2005.pdf. Interestingly the clawed frog has apparently become a "novel" prey item for a sensitive snake – two-striped garter snake. Sometimes non-native species exert unexpected effects and even their control can have potentially undesirable consequences on native species.

a. Bullfrog

Bullfrogs may be the most pernicious invasive animal in the Habitat Reserve. They have a voracious appetite that includes almost any living thing, including other amphibians, arthropods, fish, snakes, birds, and small mammals (including bats). Bullfrogs have few natural predators and have explosive reproductive potential, producing up to 20,000 eggs per female per year. Bullfrog impacts appear to be a significant factor in the decline of native amphibian populations in much of western North America, including the endangered arroyo toad. Most of the ponds, lakes and creeks on RMV support populations of the bullfrog, although some may be too ephemeral to support successful reproduction.

The bullfrog control program would take a watershed approach, as opposed to a pond-by-pond approach, because there may be extensive movement among ponds. Unless source populations in the larger waterbodies, including constructed water quality treatment system basins, are controlled, bullfrogs would continue to be a significant problem in the Habitat Reserve. Control methods would be site-specific and field experiments would be conducted to determine the most effective and cost-efficient control method for a particular site. Potential control methods, ranging from broad approaches to more labor-intensive specific methods, include:

- Pond draining and then killing all bullfrogs left behind, including those burrowing in banks.
- Fencing to prevent movement from the pond areas as it dries and recolonization of the pond.
- Gill netting, seining, and/or sifting water for eggs.
- Shooting and gigging (spearing or hooking)

Public awareness and education also would be an important part of the bullfrog control program. Signs and posting warning of the risks of invasive plants and animals would be placed in key areas at risk for reintroductions of the bullfrog.

b. Crayfish

Crayfish (*Cambarus* spp.) are recognized predators of amphibian eggs and their larvae and thus can contribute to population declines. The arroyo toad and crayfish evolved independently of each other, suggesting that arroyo toad larvae may be considerably more vulnerable to crayfish than bullfrog tadpoles, which share the same historic distribution with crayfish and thus have a linked evolutionary history (*i.e.*, a co-evolved predator-prey relationship). Arroyo toad tadpoles,

being relatively small detrital feeders, are more vulnerable to crayfish predation than the huge algal feeding bullfrog larvae.

Two species of crayfish occur on RMV property: the widely distributed *C. clarkii* and another relatively recent arrival whose species identity currently is unknown. *C. clarkia* is common in San Juan Creek and portions of Gobernadora Creek Both species are abundant in San Juan Creek, and on some reaches are actually super abundant with 3-4 crayfish/sq. m being standard for certain 100-m reaches of creek. *C. clarkii* seems to be the more abundant of the two species overall on RMV. The source of the Gobernadora Creek population may be from upstream areas of Coto De Caza, which has perennial ponds within golf course areas from which crayfish may be washed downstream. Control of this source would be important as it provides a source to invade areas of San Juan Creek subject to ongoing crayfish control.

Arroyo toad breeding distribution in the San Juan Creek Watershed probably is affected by the presence of crayfish in San Juan Creek, and possibly in Gobernadora Creek. Any future detailed survey of arroyo toad populations in San Juan Creek should also survey for the presence of crayfish. Potential control methods for crayfish would be similar to those described above for the bullfrog.

c. Brown-headed Cowbird and European Starling

Brown-headed cowbirds are native to the central plains of North America where they co-evolved with bison. The cowbird's range has expanded to the west with the increase in cattle grazing and irrigated agriculture. As a nest parasite, they now pose a serious threat to native passerine species, and were implicated in the decline of the least Bell's vireo.

The European starling is a non-native species that only arrived in California in the early 1940's. The starling is a secondary cavity nester that usurps nests built by woodpeckers and used by other secondary nesters such as the ash-throated flycatcher. They are an aggressive species that has successfully outcompeted native species. Starlings occur throughout the RMV property, but are particularly common around Cow Camp along San Juan Creek, where they are concentrated in western sycamores and man-made structures.

Brown-head cowbirds and starlings would be controlled by strategically placing Australian cowbird traps in areas where these species are a problem for native host species (*e.g.*, vireos and gnatcatchers for the cowbird and acorn woodpeckers for the starling). The effectiveness of the trapping program would be evaluated annually and trap locations the trapping effort would be adjusted. In addition for starlings, management may include the placement of species-specific

nest boxes that are not accessible to starlings (*e.g.*, small holes) or the use of mist-netting where starling populations are particularly dense (*e.g.*, Cow Camp).

SECTION 7.17 CONCEPTUAL WORK PLAN, SCHEDULE AND COSTS OF THE ADAPTIVE MANAGEMENT PROGRAM

This section describes a conceptual work plan, schedule and costs of the AMP component of the HRMP. The purpose of this section is to demonstrate conceptually the long-term AMP actions and the anticipated general schedule and cost of those actions based on the current understanding of the Habitat Reserve landscape. It is important to understand that, as an adaptive management approach, the details of the management and monitoring program in terms of the work plan and schedule will be flexible subject to input by the Science Panel and Reserve Manager and review and comment from the Wildlife Agencies/USACE. The 5-year Management Action Plans (MAPs), described in *Section 7.3.5*, are the main vehicle by which significant changes to the work plan will be implemented, although minor management and monitoring adjustments may be made on a year-by-year basis subject to Science Panel and Reserve Manager recommendations. The AMP work plan, schedule and costs are projected through the first 25 years of the program; *i.e.*, 2007 through 2031. The 25-year planning horizon allows for a realistic analysis of the projected AMP actions, schedules and costs based on current information. Obviously, as projections are made farther out in time they become less certain and less reliable.

Section 7.17.1 describes the assumptions used for generating the work plan, schedule and costs based on the *Section 7.3.5* description of how the AMP actions will be phased in relation to development of the Planning Areas (PA); *i.e.*, with monitoring and management tied to development impacts. For example, because the impacts of PA 1 on Covered Species and Conserved Vegetation Communities are relatively low, management and monitoring requirements correlated with PA 1 development commensurately would be relatively low. Development of PA 2, on the other hand, triggers substantial management and monitoring because of the relatively greater impacts on Covered Species and Conserved Vegetation Communities.

Section 7.17.2 provides a discussion of the AMP work plan, schedule and costs.

7.17.1 Assumptions for AMP Work Plan, Schedule and Costs

AMP budget projections for the initial 25 years of the program (*i.e.*, 2007-2031) were based on the following assumptions:

- Management and monitoring of Habitat Reserve lands and associated Covered Species will be phased and will come online as to each portion upon initiation of grading of a particular PA or any sub-part thereof. The total Habitat Reserve lands subject to management and monitoring at any given time thus will be the cumulative lands that are subject to either an irrevocable covenant or conservation easement. For example, in 2007, approximately 16,368 acres of Conserved Vegetation Communities will be subject to management and monitoring, including 4,055 acres of prior dedicated RMV lands, 11,387 acres of County parklands, and 926 acres of PA 1 future open space dedication lands (see *Table 13-19B*). Note that as set forth previously in *Section 7.3.5*, RMV will make an irrevocable covenant for the development-related future open space dedication lands at the time of grading for the relevant Planning Area or sub-part thereof and dedicate by recordation of a conservation easement these lands three years after grading.

  RMV provided an illustrative (non-binding) grading schedule for the PAs in order to generate year-by-year acreage estimates for lands in the Habitat Reserve to be managed and monitored, as follows:

  - PA 1 - 2007
  - PA 2 - 2009
  - PA 3 - 2011-2013
  - PA 4 - 2013
  - PA 5 - 2018
  - PA 8 - 2032

  It is understood that this illustrative (non-binding) grading schedule is solely for the purpose of projecting conceptual AMP management and monitoring schedules and costs and does not reflect a final projected development schedule as the development schedule is subject to change due to several factors, for example market conditions .

- Monitoring of Covered Species that can be addressed at a habitat landscape level will occur through the establishment of sample plots appropriately distributed in the Conserved Vegetation Communities that support the species such that a representative and adequate sampling of both the Conserved Vegetation Communities and Covered Species to monitor long-term trends is accomplished. The monitoring objectives for many of these Covered Species in the *Appendix E* Species Accounts generally state that annual botanical and wildlife field studies will be conducted within predesignated sample plots to monitor fine-grained changes (in contrast to the more coarse vegetation mapping) in habitat for the Covered Species and other focal species that use the habitat. Selection of sample plot locations would be pseudorandomized to ensure that *major/important*

populations in *key locations* are adequately sampled; *e.g.*, lower Arroyo Trabuco and GERA for the least Bell's vireo. The 20 Covered Species for which the vegetation-based sample plot method would be appropriate include:

Burrowing Owl
Coastal Cactus Wren
Coastal California Gnatcatcher
Cooper's Hawk
Grasshopper Sparrow
Least Bell's Vireo
Long-eared Owl
Southwestern Willow Flycatcher
Tricolored Blackbird
White-tailed Kite
Yellow-breasted Chat
Yellow Warbler
California Glossy Snake
Coast Patch-nosed Snake
Northern Red-diamond Rattlesnake
Orange-throated Whiptail
Red Coachwhip
San Diego Horned Lizard
California Scrub Oak
Coast Live Oak

The method for estimating the annual vegetation/wildlife plot surveys is discussed in more detail below.

- The remaining 12 Covered Species would be site-specifically addressed per the monitoring objectives for the species outlined in *Appendix E* and as summarized here.

  For each of the site-specific Covered Species, initiation of monitoring was identified in relation to development impacts and corresponding future open space dedication area that supports the species. For several species, initial 5-year baseline monitoring is identified (see *Section 7.12*), with flexibility after the first five years to adjust the monitoring schedule based on monitoring results, environmental conditions, new information, and Reserve Manager and Science Panel recommendations. For the purpose of projecting work schedules and costs, typically a three-year long-term monitoring interval after the initial five consecutive years was assumed.

- Monitoring for the **arroyo toad** would commence in 2009 in association with projected grading of PA 2 because open space dedicated to the Habitat Reserve with projected grading in PA 2 supports populations of the arroyo toad. The arroyo toad population initially would be monitored for five (5) consecutive years to establish baseline information and then it is estimated that toad populations would be monitored, on average, every three (3) years thereafter. The cost estimate generally is based on the conceptual Arroyo Toad Monitoring Program described in *Appendix O*.

- Monitoring for the **southwestern pond turtle** would commence in 2009 in association in projected PA 2 grading and related future open space dedication areas on San Juan Creek and be expanded in 2011 in association with projected PA 3 grading and additional related future open space dedication areas in San Juan Creek. Thereafter, pond turtle populations would be monitored, on average, every three (3) years.

- Monitoring for the **western spadefoot toad** would commence in 2007 because the prior RMV open space and County parklands in the Habitat Reserve support several locations of the spadefoot, including the vernal pools in existing Ladera Open Space on Chiquita Ridge, single locations on Chiquita Ridge in Ladera Open Space north and south of the pools, a location near the Upper Chiquita Conservation Area, and a location in the entrance to Caspers Wilderness Park. The spadefoot toad monitoring program would be expanded in 2009 in association with projected PA 2 grading and related future open space dedication areas in San Juan Creek, in 2011 in association with projected PA 3 grading and additional related future open space dedication areas in San Juan Creek, and in 2018 in association with projected PA 5 grading and related future open space dedication areas of the Radio Tower Road mesa vernal pools. Thereafter, spadefoot toads would be monitored, on average, every three (3) years

- Monitoring for the **partially-armored threespine stickleback** and **arroyo chub** would commence in 2011 in association with projected PA 3 grading and related future open space dedication areas in San Juan Creek. Surveys for the two fish species would be conducted every three (3) years.

- Monitoring of the **Riverside fairy shrimp** and **San Diego fairy shrimp** would commence in 2007 in the vernal pools on Chiquita Ridge in Ladera Open Space. These pools would be monitored for the first five (5) years to establish baseline information and then it is estimated that the pools would be monitored, on

average, every three (3) years thereafter. Monitoring of the Radio Tower mesa vernal pools would come online in 2018 in association with projected PA 5 grading, be monitored for the first five (5) consecutive years, and then every three years (3), on average, thereafter.

- Monitoring of **Coulter's saltbush** and **southern tarplant** would commence in 2009 in association with projected PA 2 grading. These species would be monitored for the first five (5) years to establish baseline information and then it is estimated that they would be monitored, on average, every three (3) years thereafter.

- Monitoring of **many-stemmed dudleya** would commence in 2009 in association with projected PA 2 grading, and be expanded in 2011 in association with projected PA 3 grading, and 2018 in association with projected PA 5 grading. These populations would be monitored for the first five (5) years as they come online, respectively, to establish baseline information and then it is estimated that they would be monitored, on average, every three (3) years thereafter.

- Monitoring of **thread-leaved brodiaea** would commence in 2009 in association with projected PA 2 grading, and be expanded in 2011 in association with projected PA 3 grading. The *major population* on Chiquadora Ridge associated with PA 2 development would be monitored for the first five (5) years to establish baseline information and then it is estimated that this population, and the *important population* associated with projected PA 3 grading and related future open space dedication areas, would be monitored, on average, every three (3) years thereafter.

- For the purpose of the work plan, schedule, and cost projection, it was assumed that each vegetation/wildlife plot would be surveyed twice per year (to provide a broad sample of seasonally variable plants and animals) every other year. Approximately half the total plots would be surveyed each year. As noted above, the monitoring schedule will be flexible and it is quite likely that some plots may require less frequent monitoring while others may require more, such as those closer to urban development and/or at greater risk of disturbances. The number of sample plots was assigned to each Conserved Vegetation Community in rough proportion to the total acreage of the community subject to monitoring and management in the Habitat Reserve at the time. For the upland communities of coastal sage scrub, chaparral and grassland/barley fields, one sample plot per 500 acres of each Conserved Vegetation Community in the Habitat Reserve was assumed. For riparian and woodand/forest, one sample plot per 200 acres was assumed.

These numbers were adjusted somewhat to account for the presence of Covered Species as different areas are dedicated to the Habitat Reserve. For example, in 2007 there would be 7,067 acres of coastal sage in the Habitat Reserve (1,276 acres of prior RMV open space, 5,556 acres of County parklands, and 235 acres of PA 1 open space (see *Table 14-x*). A total of 8 sample plots was assigned to this coastal sage scrub, or about one plot per 884 acres; the relatively few sample plots in relation to the acreage reflects the relative lack of Covered Species in these areas. However, in 2009 when PA 2 open space comes in, resulting in a cumulative total 8,131 acres of coastal sage scrub in the Habitat Reserve, the number of sample plots doubles to 16 because of the significant increase in the number of gnatcatchers and cactus wrens and the relative importance of Chiquita Ridge/Chiquadora Ridge in the Habitat Reserve.

The rough formula of one sample plot/500 acres for uplands and one plot/200 acres for riparian and woodland/forest would result in a total of about 65 sample plots by 2018 when PA 5 is projected to be developed and ultimately 82 sample plots once PA 8-related open space is dedicated to the Habitat Reserve. Again, the total number of plots and their distribution will be subject to modification based on recommendations of the Reserve Manager and Science Panel, with input from the Wildlife Agencies/USACE.

- Management and monitoring of habitat linkages and wildlife corridors is scheduled to come online in 2010. Prior development in PAs 1 and 2 probably will not have significant impacts on the existing function of identified habitat linkages and wildlife corridors. For example, linkage D across Chiquita Canyon and linkage C along Chiquita Ridge are sufficiently robust that linkage/corridor studies probably are not required in these areas. Further, it is likely that sample vegetation/wildlife plots will be established in these areas, thus providing useful wildlife information, even though it would not be specifically focused on wildlife movement. Habitat linkage/wildlife corridors studies initiated in 2010 likely will be focused on linkage G along Chiquadora Ridge, H in Sulphur Canyon, I above the PA 3, and J along San Juan Creek to allow for collection of at least one year of baseline survey data before grading in PA 3 projected for 2011. The habitat linkage/wildlife corridor studies would continue annually until 2022, providing five (5) years of data for studies related to projected PA 5 grading, and thereafter updates would be conducted at 5-year intervals.

- The cost of analyzing and report the monitoring results is conservatively set at 40 percent of the cost of field work/data collection. The USGS (2004) guideline document cites the National Park Service Inventory and Monitoring Program recommendation that 30 percent of monitoring funds go to data management and reporting. The Coachella Valley

MSHCP cites an estimate that 30 to 50 percent of the time for field work/data collection should be allocated to data management and reporting.

- "Other Support Tasks" were identified. These include:

  - Remapping of the vegetation communities in the Habitat Reserve every five (5) years beginning in year 2007.

  - Consultant fees for preparation of the 5-year MAPs, with costs split over years 2008 and 2009 for the first MAP.

  - Science Panel "General Services" as described in *Section 7.3.4.*

  - Science Panel "MAP-related Services" involving its role in preparation of the 5-year MAPs, assuming significant work effort for the first MAP in 2008-2009, and for each of the years following the vegetation community remapping for subsequent MAPs. Funds are also included for intervening years between MAP updates to cover the cost of fine-tuning the MAPs year-by-year.

- "Adaptive Management Tasks" include:

  - Invasive Plant and Wildlife Species Controls, as described in *Appendix J*. Based on existing information for environmental stressors currently operating in in the proposed Habitat Reserve, such as giant reed infestations, artichoke thistle, bullfrogs, etc. invasive species controls planning and implementation will be initiated early in the work schedule, but also tied to development phasing. The invasive species control program in 2007 and 2008 primarily will involve reconnaissance surveys to verify/identify the most important areas for invasives controls. Some limited amount of invasives controls may be implemented in 2007 and 2008 on an as-needed basis (note that RMV conducts ongoing artichoke thistle controls on its lands at its own cost that will not be a part of this program until those lands are dedicated to the Habitat Reserve). This "planning period" also will allow the Reserve Manager and Science Panel to assess the invasive species issues and incorporate well-informed control strategies into the first 5-year MAP. The "formal" invasives species controls will be initiated in 2009 in association with projected PA 2 grading. It is anticipated that giant reed controls, particularly in San Juan Creek, will be the most expensive component of the invasive species control program – a total of about 95 acres of giant reed has been targeted for control on RMV, the removal/control of which is estimated to cost

about $2.4 million. About 21 acres of removal has been identified as development-related mitigation (the Wetland/Riparian Creation program) that will be the responsibility of RMV apart from the AMP, leaving about 74 acres as the AMP responsibility, at a cost of about $1.8 million. Funding through the AMP for giant reed controls, along with associated tamarisk and pampas grass controls, will be initiated in 2013 in association with projected PA 3 development and will be spread out over at least 18 to 20 years with an annual budget of about $100,000. Another reason for doing limited giant reed controls on RMV in the early years of the program is to allow for the USFS and the County to complete its control program upstream in San Juan Creek before controls are initiated on RMV.

- "Immediate Stressor-related AMP Actions" include reasonably foreseeable AMP actions that may arise in the course of adaptive management as part of the HRMP operating conservation strategy responses to "Changed Circumstances" (as discussed in *Section 7.2.5*). Foreseeable Changed Circumstances are already addressed by the AMP and supporting sub-plans, including the Invasive Species Control Plan (*Section 7.16* and *Appendix J*) and Wildland Fire Management Plan (*Section 7.14* and *Appendix N*). However, some potential Changed Circumstances that have not been already identified as management actions under the invasive species control plan may need to be addressed in the future in a very shortened timeframe either as part of the annual update of the MAP or as ad hoc responses during any one as circumstances dictate (see *Section 7.2.5*). Thus funds have been allocated for this purpose.

  It is important to understand that the management needs arising from "Changed Circumstances" that are not addressed by the HRMP operating conservation strategy are not funded under the Immediate Stressor-related AMP Actions task, but rather are covered by the Changed Circumstances Reserve Account as discussed in *Section 7.2.5* and *Chapter 12.*

- Administrative costs include staff and equipment. These costs will be born by the Habitat Reserve Operating Account.

- The actual cost projections for each of the monitoring tasks identified in *Table 7-16* are based on the scope of work for the task and the assumption of consultant/contractor staff with average hourly billing rates of $100 per hour, plus reimbursable costs (*e.g.*, mileage) with a 15 percent markup. The hourly billing rate and 15 percent reimbursable markup

represent typical industry standards for the types of professional services listed in *Table 7-16*. The cost projections for most of the monitoring tasks are based on the experience Dudek and Glenn Lukos Associates biologists have in developing costs proposals for similar tasks that are a part of their typical professional duties, including vegetation mapping, general and special-status plant and wildlife species surveys, data analysis, report preparation, etc. The cost estimates take into consideration the number and type of staff required (*e.g.*, botanist, wildlife biologist), the amount (*e.g.*, acreage) of survey work that can be completed in one 8-hour field day, travel to and from field sites, and the number of annual surveys required to collect adequate field data.

A specific example of how monitoring costs were projected is provided for the arroyo toad based on the Arroyo Toad Monitoring Program (*Appendix O*). There are approximately 19,000 meters of suitable habitat in San Juan and Bell creeks that are divided into 19 1,000-meter blocks, with five 200-meter segments per block. One permanent 200-meter segment within each block is surveyed each year, with the other four segments in the block surveyed as a rotating panel each year (*i.e.*, one panel segment per year), resulting in 100 percent sampling coverage every four years. Each segment is estimated to require about three hours of total survey time for two biologists, including travel time between segments. Separate types of field visits include:

- Up to 6 visits to determine the initiation of the breeding season and the appropriate timing of the monitoring surveys;

- Surveys for egg masses/tadpoles in breeding pools in the permanent and rotating panel segments; and

- Surveys for metamorphs in the permanent and rotating panel segments.

While the arroyo toad monitoring program presented in *Appendix O* is fairly comprehensive to provide an example of the level of expertise and detail that will be included in the MAP, for other Covered Species the estimates are based on more conceptual survey approaches but similar to those typically used in the industry. For example, as also discussed in *Section 7.12 Adaptive Management of Site-specific Resources*, for monitoring of vernal pools, and associated Covered Species (Riverside and San Diego fairy shrimp and western spadefoot) at the appropriate period of their life cycles, surveys would be conducted after the first heavy rain, after three weeks of standing water or after the wettest period of the season, after storm events that generate greater than 2 inches of precipitation, after water levels fall, and during the dormant season. Similarly, the frequency and timing of surveys for plant Covered Species will be

flexible in order to respond to varying environmental conditions, and the possible need for multiple surveys within a season to maximize the likelihood that the peak production period is sampled. Because different plant Covered Species flower at different times of the year, its not possible just to schedule a block of time for plant surveys.

The vegetation/wildlife plot surveys assume a cost of $3,200 per plot/year based on the assumptions of the need for both a botanist and wildlife biologist, typical coverage of one plot per day (*i.e.,* 16 total field hours at $100 per hour), and two site visits per plot per year to increase the likelihood of detecting species. *Section 7.7.3 Strategies for Monitoring Coastal Sage Scrub and Focal Species* includes a description of a standard sample method for illustrative purposes and which will be refined by the Reserve Manger and Science Panel in the first 5-year MAP for specific application to the Habitat Reserve.

It is important to note that the capital costs of specialized field equipment to support the monitoring work, such as GPS units and data trackers, remote cameras for wildlife corridor monitoring, GIS and other analytic software, vehicles, and other miscellaneous field equipment, are built into the consultant/contractor hourly labor fee and are not a separate cost for managing and monitoring the Habitat Reserve.

7.17.2 AMP Work Plan, Schedule and Cost Projection for Years 2007-2031

The results of the AMP work plan, schedule and cost projections through 2031 based on the assumptions discussed above are shown in *Table 7-17*. Monitoring costs are modest in years 2007 and 2008 prior to completion of the first 5-year MAP and projected PA 2 development. With completion of the MAP and projected initiation of grading in PA 2, significant monitoring activities are triggered. Annual monitoring costs from 2009 fluctuate somewhat from year-to-year in relation to the number of surveys for Covered Species and the number of vegetation/wildlife plots, with a range of about $166,000 in year 2026 to $328,000 in year 2011 when PA 3 development is projected to occur and baseline monitoring studies are at a peak. The average annual cost of monitoring from year 2009 to year 2031 is about $236,000.

TABLE 7-17
ADAPTIVE MANAGEMENT PROGRAM WORK PLAN, SCHEDULE AND COST SUMMARY 2007-2031

MONITORING TASKS	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Arroyo Toad			60,000	60,000	60,000	60,000	60,000			60,000
Southwestern Pond Turtle			4,000		6,000			6,000		
Western Spadefoot Toad	4,000		5,000		6,000			6,000		
Threespine Stickleback					5,000			5,000		
Arroyo Chub					5,000			5,000		
Riverside Fairy Shrimp	2,400	2,400	2,400	2,400	2,400			2,400		
San Diego Fairy Shrimp	2,400	2,400	2,400	2,400	2,400			2,400		
Coulter's Saltbush			6,000	6,000	6,000	6,000	6,000			6,000
Many-stemmed Dudleya			9,600	9,600	12,800	6,400	6,400	3,200	3,200	
Southern Tarplant			6,000	6,000	6,000	6,000	6,000			6,000
Thread-leaved Brodiaea			2,400	2,400	4,800	2,400	4,800			4,800
Vegetation/Wildlife Plots			76,800	76,800	92,800	92,800	99,200	96,000	99,200	96,000
Habitat Linkages/Corridors				35,000	35,000	35,000	35,000	35,000	35,000	35,000
Data Analysis/Report Preparation	3,520	1,920	69,840	66,240	83,680	69,440	72,960	50,400	40,960	69,120
Subtotal Monitoring Costs	**12,320**	**6,720**	**244,440**	**266,840**	**327,880**	**278,040**	**290,360**	**211,400**	**178,360**	**276,920**
OTHER SUPPORT TASKS										
5-year Vegetation Mapping	150,000					150,000				
5-year MAP Preparation		50,000	50,000				100,000			
Science Panel General Services	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Science Panel MAP-related Services		50,000	50,000	10,000	10,000	10,000	100,000	10,000	10,000	10,000
Subtotal Other Support Tasks	**200,000**	**150,000**	**150,000**	**60,000**	**60,000**	**210,000**	**250,000**	**60,000**	**60,000**	**60,000**
ADAPTIVE MANAGEMENT TASKS										
Invasive Plant Species Controls	20,000	20,000	70,000	70,000	70,000	70,000	170,000	170,000	170,000	170,000
Invasive Animal Species Controls	20,000	20,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Immediate Stressor-related AMP Actions					50,000					50,000
Subtotal Adaptive Management Costs	**40,000**	**40,000**	**120,000**	**120,000**	**170,000**	**120,000**	**220,000**	**220,000**	**220,000**	**270,000**
Administrative Costs	**50,000**	**50,000**	**75,000**	**75,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**
TOTAL ANNUAL AMP COSTS	**302,320**	**246,720**	**589,440**	**521,840**	**657,880**	**708,040**	**860,360**	**591,400**	**558,360**	**706,920**

TABLE 7-17 (*continued*)
ADAPTIVE MANAGEMENT PROGRAM WORK PLAN, SCHEDULE AND COST SUMMARY 2007-2031

MONITORING TASKS	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Arroyo Toad			60,000			60,000			60,000	
Southwestern Pond Turtle	6,000			6,000			6,000			6,000
Western Spadefoot Toad		8,000			8,000			8,000		0
Threespine Stickleback	5,000			5,000			5,000			5,000
Arroyo Chub	5,000			5,000			5,000			5,000
Riverside Fairy Shrimp		5,000	2,600	2,600	5,000	2,600		5,000		
San Diego Fairy Shrimp		5,000	2,600	2,600	5,000	2,600		5,000		
Coulter's Saltbush			6,000			6,000			6,000	
Many-stemmed Dudleya		14,400	3,200	3,200	14,400	3,200		14,400		
Southern Tarplant			6,000			6,000			6,000	
Thread-leaved Brodiaea			4,800			4,800			4,800	
Vegetation/Wildlife Plots	105,600	102,400	105,600	102,400	105,600	102,400	105,600	102,400	105,600	102,400
Habitat Linkages/Corridors	35,000	35,000	35,000	35,000	35,000	35,000				
Data Analysis/Report Preparation	48,640	53,920	76,320	50,720	55,200	75,040	48,640	53,920	72,960	47,360
Subtotal Monitoring Costs	**205,240**	**223,720**	**302,120**	**212,520**	**228,200**	**297,640**	**170,240**	**188,720**	**255,360**	**165,760**
OTHER SUPPORT TASKS										
5-year Vegetation Mapping	150,000					150,000				
5-year MAP Preparation		100,000					100,000			
Science Panel General Services	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Science Panel MAP-related Services	10,000	100,000	10,000	10,000	10,000	10,000	100,000	10,000	10,000	10,000
Subtotal Other Support Tasks	**210,000**	**250,000**	**60,000**	**60,000**	**60,000**	**210,000**	**250,000**	**60,000**	**60,000**	**60,000**
ADAPTIVE MANAGEMENT TASKS										
Invasive Plant Species Controls	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000	170,000
Invasive Animal Species Controls	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000	50,000
Immediate Stressor-related AMP Actions					50,000					50,000
Subtotal Adaptive Management Costs	**220,000**	**220,000**	**220,000**	**220,000**	**270,000**	**220,000**	**220,000**	**220,000**	**220,000**	**270,000**
Administrative Costs	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**
TOTAL ANNUAL AMP COSTS	**735,240**	**793,720**	**682,120**	**592,520**	**658,200**	**827,640**	**740,240**	**568,720**	**635,360**	**595,760**

TABLE 7-17 (*continued*)
ADAPTIVE MANAGEMENT PROGRAM WORK PLAN, SCHEDULE AND COST SUMMARY
2007-2031

MONITORING TASKS	2027	2028	2029	2030	2031
Arroyo Toad		60,000			60,000
Southwestern Pond Turtle	8,000		6,000		
Western Spadefoot Toad				8,000	
Threespine Stickleback			5,000		
Arroyo Chub			5,000		
Riverside Fairy Shrimp	5,000			5,000	
San Diego Fairy Shrimp	5,000			5,000	
Coulter's Saltbush		6,000			6,000
Many-stemmed Dudleya	14,400			14,400	
Southern Tarplant		6,000			6,000
Thread-leaved Brodiaea		4,800			4,800
Vegetation/Wildlife Plots	105,600	102,400	105,600	102,400	106,600
Habitat Linkages/Corridors	35,000				
Data Analysis/Report Preparation	55,200	71,680	48,640	53,920	73,360
Subtotal Monitoring Costs	**228,200**	**250,880**	**170,240**	**188,720**	**256,760**
OTHER SUPPORT TASKS					
5-year Vegetation Mapping	150,000				
5-year MAP Preparation		100,000			
Science Panel General Services	50,000	50,000	50,000	50,000	50,000
Science Panel MAP-related Services	10,000	100,000	10,000	10,000	10,000
Subtotal Other Support Tasks	**210,000**	**250,000**	**60,000**	**60,000**	**60,000**
ADAPTIVE MANAGEMENT TASKS					
Invasive Plant Species Controls	170,000	170,000	170,000	170,000	170,000
Invasive Animal Species Controls	50,000	50,000	50,000	50,000	50,000
Immediate Stressor-related AMP Actions					50,000
Subtotal Adaptive Management Costs	**220,000**	**220,000**	**220,000**	**220,000**	**270,000**
Administrative Costs	**100,000**	**100,000**	**100,000**	**100,000**	**100,000**
TOTAL ANNUAL AMP COSTS	**758,200**	**820,880**	**550,240**	**568,720**	**686,760**

For Other Support Tasks annual costs vary considerably depending on the tasks in a particular year, with a range of $60,000 per year in non-MAP and non-vegetation remapping years, to $250,000 per year in MAP preparation years.

As noted above, the Adaptive Management Tasks of invasive plant and wildlife species controls begin with preliminary reconnaissance work in years 2007 and 2008 and then formally comes online in 2009 with projected PA 2 development and coordination with the 5-year MAP. At various times "Immediate Stressor-related AMP Actions" will be implemented to address reasonably foreseeable Changed Circumstances that are not already addressed by invasive species controls – the conceptual schedule assumes that these actions would occur on average about every five (5) years, but the actual timing of such Changed Circumstances is unpredictable. The setting of a five-year interval indicates that such Changed Circumstances are unlikely to occur annually, but are expected to occur from time to time. The first conceivable initiation of these actions is about year 2011 because in order to identify a Changed Circumstance, some minimal amount of monitoring of baseline conditions will be required. Exceptions may be for a wildfire or significant flood event where the Changed Circumstance is immediately measurable.

Administrative and equipment costs will be annual expenditures. It is anticipated that minimum staffing requirements will include a full-time Reserve Manager and a part-time administrative assistant. Office and equipment needs will need to be determined, but at minimum likely will include computers and miscellaneous software, office supplies and machines (*e.g.*, printer, fax, scanner/copier), a sub-meter GPS unit, a field vehicle and miscellaneous field equipment (*e.g.*, shovel, saw or chainsaw [*e.g.*, for emergency access on Habitat Reserve roads], ropes, snake guards, first-aid kit, etc.). It is assumed that contractors conducting the various field surveys will supply their own specialized field equipment, such as traps, mist nets, transect tapes, etc.

7.17.3 County OMP/AMP Costs

Section 7.1.1, and *Appendix F* describe the OMP/AMP activities undertaken by the County. As noted in *Section 7.1.1* and *Appendix F,* the current estimated budgets for the County parklands proposed for inclusion in the Habitat Reserve total about $1,492,000 of which approximately one-third is committed to the following classes of resource monitoring and management activities:

- Monitoring of recreational impacts;
- Monitoring of the urban/wildland interface;
- Monitoring of Exotic invasives;
- Abatement of invasives;

Fire Management

- Enforcement/resource protection;
- Habitat enhancement/restoration; and
- Other resource management activities.

Supplemental funding for future County AMP activities will be available through (**1)** the Coto Opt-In Program, (**2)** the AMP Operating Account if the Science Panel determines that stressors (*i.e.,* fire and invasive species) can cause the loss of habitat value within the County parklands and where conditions in the County parklands can adversely affect RMV Habitat Reserve Lands; or (**3)** other sources outside the County such as grant funding.

SECTION 7.18 COORDINATED MANAGEMENT PLANS

As noted in the introduction to this Chapter and frequently referenced in preceding sections, two additional management plans, the Grazing Management Plan (GMP; *Appendix G*) and the Water Quality Management Plan (WQMP; *Appendix K*), will be carried out independently of the HRMP and AMP element, but will be closely coordinated with the AMP because they provide important supporting functions, including addressing specific vegetation communities and species "stressors" reviewed in this Chapter. These additional management plans are termed "Coordinated Management Plans." *Section 7.18.1* discusses the GMP and *Section 7.18.2* discusses the WQMP.

7.18.1 Grazing Management Plan

a. Overview of the Grazing Management Plan

A GMP (*Appendix G*) was prepared for the RMV property within the Habitat Reserve. General Policy 6 of the Draft Southern Planning Guidelines addressed grazing management as follows:

> *Cattle grazing shall be permitted within the Rancho Mission Viejo portion of the Habitat Reserve provided that grazing activities are consistent with a "grazing management plan" approved as part of the certified NCCP/MSAA/HCP.*

Although the GMP is not a formal element of the collective HRMP and the AMP, it is a long-term management plan that will be implemented by RMV or its successor in coordination with the AMP element of the HRMP

RMV has grazed cattle on the property since 1882. Over recent times RMV has practiced a rotational grazing pattern that takes into consideration available water and forage and the goal of maintaining an average of 25 percent residual dry matter (RDM) for natural grass pastures (*i.e.*, pastures not planted in a forage crop such as barley). In turn, available water, forage and RDM dictate the stocking levels of the RDM pastures.

The GMP reviews the literature on grazing as it affects native valley and foothill grasslands. As discussed in detail in the GMP it has been suggested that grazing by large herbivores has been an important factor in the evolution of native grasses in California (*e.g.*, Heady 1968, 1977). While cattle are not a native herbivore, and over-grazing clearly can damage the grassland ecosystem, timed grazing can be a useful part of a native grassland restoration and management program (Menke1996). Some of the beneficial effects of timed grazing include:

- Removal of litter and thatch
- Recycling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available for native grasses.

b. Goals and Objectives of the Grazing Management Plan

The broad goals or purposes of the GMP are as follows:

1. To identify those aspects of the recent RMV grazing regime that are supportive of existing conditions so that they may be continued throughout the implementation of the NCCP/MSAA/HCP (*i.e.*, given examples of severe over-grazing in other areas involved in NCCP planning in Southern California as contrasted with conditions on RMV lands manifesting high levels of biodiversity and high populations of sensitive species, it is important to identify the specifics of the RMV grazing regime).
2. To identify those aspects of grazing on RMV lands (after the lands are dedicated to the Habitat Reserve) to be adjusted on a seasonal basis for purposes of protecting Covered Species; and
3. To review and identify grazing actions that are supportive of vegetation community enhancement and restoration actions identified in this Chapter for possible future action by RMV in conjunction with requests from the RMVLC.

To achieve these goals, the specific objectives of the GMP are:

- Manage grazing consistent with the recent low/moderate grazing regime through implementation of the NCCP/MSAA/HCP:
  - Establish a minimum RDM per acre for active and proposed pastures and stocking levels consistent with recent low/moderate grazing regimes.
  - Identify interim and long-term changes to existing and proposed pasture configurations that will result from land use changes consistent with the NCCP/MSAA/HCP.
  - Identify a timed rotational grazing scheme to maximize use of available forage consistent with the recent low/moderate grazing regime.
  - Outline procedures for monitoring grazing management practices to ensure consistency with GMP objectives, including methods for monitoring forage levels in order to assess range conditions; and
  - Identify pastures that may be subject to prescribed fire. Identify appropriate pasture rest periods following burns, whether planned or unplanned, to promote vegetation community recovery.
- **Identify exclusion areas required to protect sensitive species**
  - Although existing species biodiversity and populations are high on lands that historically have been used for grazing, some types of seasonal exclusion of cattle grazing during breeding seasons of some aquatic species may still be needed. Accordingly, the GMP will identify sensitive habitat areas where cattle grazing shall be excluded seasonally to protect habitat during breeding seasons.
- **Manage grazing, where considered appropriate by the Reserve Manager and where considered feasible by RMV, to further AMP enhancement and restoration measures**
  - The Science Panel will make annual recommendations to the Reserve Manager regarding the priority management actions for the Habitat Reserve, including whether or not to undertake active restoration and/or enhancement of upland vegetation communities. Where such a recommendation is made, agreed with by the Reserve Manager and subsequently determined to be feasible by RMV, the following specific objectives would apply where feasible and appropriate:
    - coordinate grazing with AMP measures to enhance and restore native grasslands (VGL)

- coordinate grazing with Wildland Fire Management Plan adaptive management measures intended to reduce fuel loads and protect vegetation communities areas from wildfires.
- coordinate grazing with AMP measures directed toward the enhancement, restoration and management of thread-leaved brodiaea populations.

c. General Description of Grazing Management Plan

The GMP includes a description of the pastures on RMV in terms of existing environmental conditions (vegetation communities and species) and current grazing status, including stocking levels, timing and rotational practices, estimates of RDM for different pastures and goal RDM values (*e.g.,* 25 percent as a minimum standard for pastures with natural forage).

The GMP describes future grazing strategies designed to meet the goals and objectives stated above. These future strategies include:

- Recommended RDM parameters for each active pasture, taking into consideration rainfall patterns, soils and slopes.
- Recommended stocking rates to achieve the recommended RDM based on projected annual forage per pasture and using Animal Unit (AU) as the standard measurement of livestock forage requirements (UC Extension Leaflet 21456).
- Future grazing practices to be implemented prior to and following transfer of lands to the Habitat Reserve.
- Future pasture configurations and resources, RDM and grazing patterns.
- Sensitive habitat exclusions to protect important resources following dedications to the Habitat Reserve, including seasonal exclusions and short-term post-fire recovery exclusions.
- Future grazing patterns in relation to AMP enhancement/restoration and management goals, including potential grazing in VGL enhancement/restoration areas and time-grazing recommendations for specific sub-basins.

The GMP also sets forth a monitoring approach that includes a discussion of:

- The relationship between the GMP and the stressor-based AMP;
- monitoring objectives;
- forage production and RDM;

- restoration of native vegetation;
- sensitive habitat exclusions; and
- annual reporting.

7.18.2 Water Quality Management Plan

a. Overview of the Water Quality Management Plan

This section discusses the role of the draft WQMP, in conjunction with aspects of the Habitat Restoration Plan, in helping to maintain and increase net habitat value in the Habitat Reserve. The draft WQMP under the proposed Conservation Strategy (see *Chapter 10*) would be implemented in an "adaptive" manner and is modeled after the approach set forth earlier in this Chapter for the AMP. The draft WQMP is set forth in *Appendix K*. The draft WQMP would address three stressors:

1. "Pollutants" generated by urban development with the potential to impact species and vegetation communities;

2. "Altered hydrology" due to urban development (including, in some cases, pre-existing conditions such as runoff from Coto de Caza) or public works projects with the potential to impact species and vegetation communities, and

3. "Altered geomorphic processes" with the potential to impact species and vegetation communities.

The SAMP Tenets set forth in the Draft Watershed Planning Principles provide the policy direction for addressing each of the above stressors. The SAMP Tenets policies include:

- Protect headwaters
- Maintain and/or restore floodplain connection
- Maintain and/or restore sediment sources and transport equilibrium

Similarly, the Draft Watershed Planning Principles address the three sets of stressors (Altered Hydrology is sub-divided into Changes in Surface Water Hydrology and Changes in Groundwater Hydrology) under the following sets of principles, each of which is accompanied by specific policy direction intended to maintain net habitat value:

1. ***Pollutants*** – **Watershed Planning Principles Section** "**v) Water Quality"** sets forth the following principle for water quality/pollutants:

   Principle 9 – Protect water quality by using a variety of strategies, with particular emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas and application of Best Management Practices within development areas to assure comprehensive water quality treatment prior to the discharge of urban runoff into the Habitat Reserve.

2. ***Changes in Surface Water Hydrology*** – **Watershed Planning Principles Section "ii) Hydrology"** sets forth the following principles for surface water hydrology:

   Principle 2 – Emulate, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types and ground cover
   Principle 3 – Address potential effects of future land use changes on hydrology

   Principle 4 – Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks

   Principle 5 – Maintain and/or restore the inherent geomorphic structure of major tributaries and their floodplains

3. ***Changes in Groundwater Hydrology*** – **Watershed Planning Principles Section " iv) Groundwater Hydrology"** sets forth the following principles:

   Principle 7 – Utilize infiltration properties of sandy terrains for groundwater recharge to offset potential increases in surface runoff and adverse effects to water quality

   Principle 8 – Protect existing groundwater recharge areas supporting slope wetlands and riparian zones; and maximize groundwater recharge of alluvial aquifers to the extent consistent with aquifer capacity and habitat management goals

4. ***Changes in Geomorphic Processes*** – **Watershed Planning Principles Section**s **"i) Geomorphology/Terrains" and "iii) Sediment Sources, Storage and Transport"** sets forth the following principles;

   Principle 1 – Recognize and account for the hydrologic response of different terrains at the sub-basin and watershed scale

   Principle 6 – Maintain coarse sediment yields, storage and transport processes

As noted previously, each of the above Principles includes specific policies providing more specific guidance for maintaining net habitat value at a watershed scale. The draft WQMP addresses the above principles within the water quality management framework established by the County of Orange and the San Diego Regional Water Quality Control Board (SDRWQCB). The County and SDRWQCB require that potential development impacts are to be analyzed under two broad headings: **(1)** "Pollutants of Concern" and **(2)** "Hydrologic Conditions of Concern:"

Pollutants of Concern" addressed in the draft WQMP include:

- Bacteria and viruses
- Metals
- Nutrients
- Organic compounds
- Sediments
- Trash and debris
- Oxygen-demanding substances
- Oil and grease

Appropriate regulatory standards, including special standards applicable to species pursuant to the California Toxics Rule, have been applied in formulating the draft WQMP Best Management Practices and in addressing the Water Quality principles set forth in the Baseline Conditions Watershed Principles.

Hydrologic Conditions of Concern are addressed in the draft WQMP in accordance with the following methodology established by the County/SDRWQCB:

- Determine if the downstream channel is fully natural or partially improved with a significant potential for erosive conditions or alteration of habitat integrity to occur as a result of upstream development.
- Evaluate the project's conditions of concern considering the project area's location (from the larger watershed perspective), topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features and other relevant hydrologic and environmental factors to be protected specific to the project area's watershed.

- Review watershed plans, drainage area master plans or other planning documents to the extent available for identification of specific implementation requirements that address hydrologic conditions of concern.
- Conduct a field reconnaissance to observe and report on representative downstream conditions, including undercutting erosion, slope stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies) and the area's susceptibility to erosion or habitat alteration as a result of an altered flow regime or change in sediment transport.
- Compute rainfall runoff characteristics from the project area including peak flow rate, flow velocity, runoff volume, time of concentration and retention volume. These characteristics shall be developed for the two-year and 10-year frequency, Type I storm, of six-hour or 24-hour duration (whichever is the closer approximation of the site's time of concentration) during critical hydrologic conditions for soil and vegetative cover.
- A drainage study report must be prepared identifying the project's conditions of concern based on the hydrologic and downstream conditions discussed above. Where downstream conditions of concern have been identified, the drainage study shall establish that pre-project hydrologic conditions affecting downstream conditions of concern would be maintained by the proposed project by incorporating site design, source control and treatment control requirements identified in the County/SDRWQCB Model Water Quality Management Plan. For conditions where a reduction in sediment transport from the project development and features would significantly impact downstream erosion, the Treatment Control BMPs proposed should be evaluated to determine if use of the BMPs would result in reducing sediment significantly below pre-development levels. Under such conditions alternative BMPs (such as watershed based approaches for erosional sediment control) may need to be considered.

In conformance with the Orange County DAMP and Orange County/SDRWQCB MS4 permit, Chapter 2 of the draft WQMP identifies "pollutants of concern" that are anticipated or potentially could be generated by the Proposed Project, based on the proposed land uses and past land uses that have been identified by regulatory agencies as potentially impairing beneficial uses in the receiving water bodies or that could adversely affect receiving water quality or endangered species. These "pollutants of concern" include fine sediment, nutrients, trace metals, pathogens, hydrocarbons, pesticides and trash and debris. Chapter 4 of the draft WQMP reviews the combined control system elements, including size, required for each sub-basin where development is proposed. Chapter 5 of the draft WQMP discusses pre-and post project pollutants loadings relative to the standards set forth in the San Diego Basin Plan and the California Toxics Rule as applicable or to provide effective performance standards (*e.g.,* while not applicable to non-point stormwater flows, the California Toxics Rule standards are employed

as a conservative performance standard for protecting aquatic species and vegetation communities).

With regard to stormwater discharges and the SDRWQCB's Stormwater Program, the Orange County MS/4 Permit/DAMP has incorporated the major provisions of the SDRWQCB's model SUSMP, including provisions for addressing "Pollutants of Concern" and "Hydrologic Conditions of Concern." In turn, the draft WQMP has framed its analysis around these requirements, along with addressing the Draft Watershed Planning Principles and Baseline Conditions Watershed Planning Principles (see Chapter 2 of the draft WQMP). Chapter 4 of the draft WQMP presents and analyzes the elements of the draft WQMP that address these requirements with respect to the Proposed Project and the draft WQMP presents impact analyses of the B-9 and B-10M Alternatives with respect to these requirements. Pollutants of Concern and Hydrologic Conditions of Concern considerations relating to aquatic vegetation communities supporting sensitive species are specifically addressed in Chapters, 4, 5, and 7 of the draft WQMP, including findings of significance in Chapters 5 and 7.

As indicated above, the draft WQMP includes sections documenting the consistency of the plan both with the above County/SDRWQCB requirements and with applicable principles of the Watershed Planning Principles. In particular, the draft WQMP analyses of Hydrologic Conditions of concern specifically review hydrologic conditions identified in the Watershed Planning Principles for the purpose of maintaining net habitat value with regard to: **(1)** potential increases in dry season streamflow and wet season baseflow between storms; **(2)** changes in the magnitude, frequency, and duration of annually expected flow events (1-2 year events); **(3)** changes in hydrologic response to major episodic storm events; **(4)** potential changes in sediment supply, with short term increases related to construction and longer term reductions related to impervious/landscaped ground cover; and **(5)** potential changes in the infiltration of surface/soil water to groundwater.

For the Gobernadora Creek sub-basin, the sub-basin exhibiting existing conditions stressors due to prior upstream development in Coto de Caza, specific performance criteria for implementation of the Gobernadora Multipurpose Basin have been prepared to complement Gobernadora sub-basin water management measures set forth in the draft WQMP and thereby increase net habitat value over existing conditions.

Potential changes in "Geomorphic Processes" are addressed in part through the Baseline Conditions Watershed Planning Principles consistency review of the B-9 and B-10M Alternatives (see *Appendix P*) relating to Hydrologic Conditions of Concern (including sediment generation and sediment transport) and in part through specific restoration measures reviewed in *Sections 7.15* and *7.16* above. In particular, habitat restoration and erosion control measures in

clay soils will reduce the generation of fine sediments and improve stormwater infiltration/runoff, benefiting species and streamcourse processes. Specific restoration measures in clay soils reviewed in *Section 7.15* include: **(1)** CSS/VGL restoration in Sulphur Canyon; **(2)** grasslands restoration in the Upper Cristianitos sub-basin; **(3)** restoration in the former clay pits in Cristianitos Canyon; and **(4)** landform restoration and CSS/VGL restoration in Upper Gabino.

Thus, the draft WQMP provides specific measures addressing three stressors – potential pollutants, changes in hydrologic processes and changes in geomorphic processes – and, in so doing, helps assure that these three stressors do not significantly impact net habitat value (basic development siting conditions also address potential changes in geomorphic processes – see Baseline Conditions Watershed Principles consistency review of the 'B' Alternatives in *Appendix P*). The draft WQMP, in conjunction with specific restoration/enhancement measures reviewed in *Section 7.15* helps increase net habitat value in **(1)** Gobernadora Creek; **(2)** the Upper Cristianitos sub-basin; and **(3)** Upper Gabino. The draft WQMP also provides opportunities to increase stormwater flows into San Juan Creek to further riparian enhancement and arroyo toad habitat enhancement resulting from control of giant reed to the extent considered desirable under the HRMP. To the extent that restoration and management measures in the San Mateo Watershed reduce the generation of fine sediments, habitat conditions will be improved for the arroyo toad within the subregion and for other aquatic species downstream in San Mateo Creek.

Specific elements of the proposed draft WQMP measures important to long-term habitat protection are summarized in the following section.

b. Key Long Term Management Concepts Embodied in the Water Quality Management Plan

1. Water Balance and Flow Duration Analyses

The potential effects of development on modifying the hydrologic regime within the riparian corridors and the subsequent effect on sediment transport and habitat are "hydrologic conditions of concern." These potential effects were analyzed by comparing "pre"-versus - "post"-development monthly water balance and flow duration.

(a) Water Balance Analysis

The ultimate goal of the draft WQMP is to manage the overall balance, termed "water balance," of all the hydrologic components of the water cycle. The water balance concept is a useful accounting tool for evaluating and controlling the effects of land use changes on hydrology. A

water balance, like a checkbook balance, is intended to show the balance between the "deposits," which include precipitation and irrigation, and "withdrawals" which include: **(1)** infiltration into the soils; **(2)** evapotranspiration; and **(3)** water which runs off the surface of the land. This latter withdrawal is called surface runoff and occurs during storm events or wet weather conditions. The water balance is a monthly accounting of how precipitation and irrigation water become distributed among **(1)** surface runoff; **(2)** groundwater infiltration that contributes to baseflows in streams or deep groundwater recharge; and **(3)** evapotranspiration.

Water that infiltrates into the ground ultimately moves down gradient and can contribute to stream flows. The contribution of groundwater flow provides for flow in streams when it is not raining, and often is referred to as "baseflow." In semi-arid areas, the water balance varies dramatically from season to season, and from stream to stream. In streams where the groundwater storage is sufficient to sustain stream flows throughout the year, the streams are referred to as perennial. In streams sustained by aquifers with limited storage volume, the baseflows are limited to the wet season and the streams are called intermittent or ephemeral streams. In the San Juan and San Mateo watersheds, both types of streams exist, and the distinction is carefully preserved in the impact analysis.

A key element in the evaluation of impacts for the proposed alternatives is modeling changes to the water balance caused by development and the extent to which the existing water balance could be maintained using BMPs. The description of the overall modeling approach is provided in the draft WQMP under the following headings:

- Precipitation
- Landscape irrigation
- Infiltration
- Groundwater Discharge and Baseflows
- Evapotranspiration

Historical dry and wet cycles over a period of years or decades have an important effect on the water balance, and thus the water balance analyses were conducted for dry and wet cycles within the available rainfall record. In semi-arid areas, the variability in the water balance between wet and dry cycles is important to characterize when defining the baseline conditions.

(b) Flow Duration Analysis

The impacts of urbanization on hydrology include increased runoff volumes, peak flow rates, and the duration of flows, especially modest flows less than the 10-year event. Yet it is these more frequent, modest flows that can have the most effect on long-term channel morphology (Leopold 1997). The effect of changes in flow on stream geomorphology is a cumulative one; therefore, the magnitude of flows (volume and flow rate), how often the flows occur (the frequency), and for how long (the duration) are all important. Managing the frequency and duration of flows is referred to herein as "flow duration matching" and refers to matching the post-development flow duration conditions with pre-development conditions. This matching is achieved through appropriate sizing of a flow duration basin and design of the outlet structure. In order to achieve flow duration matching, "excess flows," defined as the difference in runoff volume between the post-development without controls condition and the pre-development condition, must be captured and either infiltrated, stored and recycled, or diverted to a less sensitive stream or stream reach.

The flow duration analyses were conducted for the 53-year continuous rainfall record and the dry and wet cycles within that record as described above.

(c) Combined Flow and Water Quality Control System

As proposed in the draft WQMP, all developments will be designed in order to achieve flow duration matching, address the water balance, and provide for water quality treatment through a combined flow and water quality control system (termed combined control system).

The proposed combined control system will include one or more of the following components as required for the particular drainage catchments served by the individual facilities, each of which provides an important function to the system (see Figure 3-5 of the draft WQMP):

- Flow Duration Control and Water Quality Treatment (FD/WQ) Basin
- Infiltration Basin
- Bioinfiltration Swale
- Storage Facility for Non-Potable Water Supply
- Diversion Conduit to Export Excess Flows out of the Sub-basin

The flow duration control and water quality treatment basin provides the initial flow and water quality treatment control functions to the system. The remaining components address the excess flows, alone or in combination with each other, generated during wet weather. Additional water

quality treatment control is also provided in the infiltration basin and bioinfiltration swale. The following sub-sections describe each combined control system component in more detail.

Flow Duration Control and Water Quality Treatment (FD/WQ) Basin

The flow duration control and water quality treatment (FD/WQ) basin will provide both flow control and water quality treatment in the same basin. Detention basins are the most common means of meeting flow control requirements. The concept of detention is to collect runoff from a developed area and release it at a slower rate than it enters the collection system. The reduced release rate requires temporary storage of the excess amounts in a basin with release occurring over a few hours or days. The volume of storage needed is dependent on **(1)** the size of the drainage area; **(2)** the extent of disturbance of the natural vegetation, topography and soils, and creation of impervious surfaces that drain to the stormwater collection system; **(3)** the desired detention capacity/time for water quality treatment purposes; and **(4)** how rapidly the water is allowed to leave the FD/WQ basin, *i.e.*, the target release rates.

The FD/WQ basin shall incorporate extended detention to provide water quality treatment for storm flows. The FD/WQ basin shall also incorporate wetland vegetation in a low flow channel along the bottom of the basin for the treatment of dry weather flows and small storm events.

To the extent feasible depending on the topography and grade, the FD/WQ basin will be located in areas where there is a larger depth to groundwater and more infiltrative soils. The FD/WQ basin shall be designed to have two active volumes, a low flow volume and a high flow volume. The low flow volume is designed to capture small to moderate size storms, the initial portions of larger storms, and dry weather flows. The high flow volume is designed to store and release higher flows to maintain, to the extent possible, the pre-development runoff conditions.

Infiltration Basin

The second element in the combined control system shall consist of a separate downstream, shallow basin designed to infiltrate stormwater where soils have a high infiltration capacity. The infiltration basin is sized to infiltrate all the flows released from the lower volume in the FD/WQ basin; nonetheless, an overflow system would convey excess flows that may occur during very wet years to the bioinfiltration swale discussed below. Features of the proposed combined control system that shall guard against groundwater contamination include: **(1)** pretreatment of all runoff in a FD/WQ basin before it enters the infiltration basin, and **(2)** locating infiltration basins where there is at least 10 feet of separation to the groundwater.

Bio-infiltration Swale

The third element of the combined control system shall be a bio-infiltration swale that leads from the FD/WQ basin to the stream channel. A bio-infiltration swale is a relatively flat, shallow vegetated conveyance channel that removes pollutants through infiltration, soil adsorption, and uptake by the vegetation. In areas characterized by terrains with good infiltration capabilities, flows released from the FD/WQ basin and carried in the bio-infiltration swale will mimic pre-development conditions, in which low flows infiltrate in the soils and only high flows reach the main stem of the stream channel. In catchments where development is located on less pervious soils and therefore pre-development runoff is higher, the swale may be lined to better mimic pre-development hydrology or flows may be piped to the stream.

Storage Facility for Recycling Water for Non-Domestic Supply

The fourth possible element of the combined control system shall be storage of surface water flows for recycling where there is opportunity for reuse of water for irrigation, such as a golf course, residential common area, or local park. Diversion of outflows from the FD/WQ basin to non-domestic water supply reservoirs will be conducted if feasible and cost effective.

Diversion Conduit to Export Flows out of the Sub-basin

The fifth possible element of the combined control system shall be the provision to export flows out of the sub-basin. This element provides an additional option that may be employed to better preserve the pre-development water balance within the sub-basin. Such diversions may be desirable where excess runoff could result in increased stormwater flows or increased baseflows in sensitive streams. However, all diversions of drainage areas are subject to approval by the County of Orange. The diversions would be for excess runoff only and would only be feasible for development bubbles that adjoin other sub-basins having less sensitive stream channels, or are close to San Juan Creek or Lower Cristianitos Creek, which have characteristics that allow them to handle additional flows without causing damage to the stream channel (in the case of San Juan Creek, additional flows could be made available for arroyo toad habitat enhancement and overall riparian habitat enhancement if desired by the Habitat Reserve managers). In some locations, such as Cañada Chiquita, it may also be feasible to divert flows to the wastewater treatment plant for reclamation.

2. Terrains and Hydrologic Conditions of Concern

In order to address considerations of terrains and hydrologic conditions of concern, draft WQMP Sections 4.2 through 4.9 rely on and address information set forth in the Baseline Conditions

Report (PCR *et al.* 2002) and the Draft Watershed Planning Principles. The Geomorphology/ Terrains; Hydrology; Sediment Sources, Storage and Transport; Groundwater Hydrology; and Water Quality principles from the Draft Southern Watershed Principles have been employed. Additionally, the sub-basin "Planning Considerations" and Planning Recommendations" have been addressed and employed in formulating flow control and water quality control strategies in response to the geographic-specific conditions found in each sub-basin. The sub-basin specific elements include site assessment, planning considerations, and combined control system conceptual design, and are presented in Sections 4.2 through 4.9 of the draft WQMP.

Within each sub-basin, Chapter 4 of the draft WQMP presents flow control strategies prepared both with respect to specific portions of the sub-basin using the "catchment" level of analysis (*e.g.,* see Table 4-6 and Table 4-8 of the draft WQMP) and with respect to overall characteristics of the sub-basin (*e.g.,* see the discussion of the proposed flow management planning for specific development areas). Sediment generation and sediment transport considerations were reviewed in "Geomorphologic Factors Affecting Sediment Generation and Transport under Pre-and Post-Urbanization Conditions at Rancho Mission Viejo and in the San Juan And San Mateo Watersheds, Orange County California (Balance Hydrologics, Inc. 2005); monitoring recommendations set forth in this report have been incorporated into the draft WQMP Adaptive Management Program as reviewed in the following subsection.

Thus, the particular characteristics of each sub-basin's surface and sub-surface drainage systems have been taken into account in each strategy analysis and relate governing physical processes in the sub-basin, including terrains and groundwater, to channel form. For instance, the ground infiltration and surface flow management prescriptions for the Gobernadora sub-basin differ considerably from those for the Chiquita sub-basin even though the two sub-basins adjoin one another and both flow into San Juan Creek. Similarly, the management of "excess flows," takes into account the nature of San Juan Creek and overall goals of supplementing groundwater recharge in the San Juan Creek aquifers. As another example, "excess flows" are proposed to be diverted from the Cristianitos sub-basin into the lower Gabino Creek portion of the Gabino sub-basin and from the Talega sub-basin into Blind Canyon and lower Cristiianitos Creek in response to the relative sensitivity of the different mainstem creeks.

Chapter 5 of the draft WQMP evaluates the impacts of the B-9 and B-10M Alternatives on pollutants of concern and hydrologic conditions of concern at a sub-basin level of analysis taking into account the draft WQMP elements described in Chapter 4. The cumulative impacts analysis in Chapter 7 of the draft WQMP further analyzes the cumulative implications of sub-basin flow management strategies on the large mainstem creeks (San Juan Creek and lower Cristianitos/ San Mateo Creek) both within RMV and downstream of the study area.

The WQMP proposes to undertake a "Stream Stabilization Program" to address potential downstream effects of discharges from the Combined Control System.

c. Long-Term Adaptive Management of the Draft Water Quality Management Plan

This section presents the adaptive management approach that will be used to evaluate whether the draft WQMP elements are functioning as intended and to implement corrective procedures when needed. The issues addressed by this adaptive management approach are management considerations relating to "pollutants of concern" and "hydrologic conditions of concern."
The adaptive management plan entails the following elements:

- *BMP Inspection and Performance Monitoring.* Routine inspection and monitoring of the combined control system components is required to establish that they are being properly maintained and are functioning as intended.
- *Hydrologic Monitoring*. Routine monitoring of the general hydrologic conditions is needed to ascertain if there are changes in the hydrologic regime and subsequent change to stream stability and geomorphology.
- *WQMP Review and Evaluation.* Annual review of the inspection and monitoring data will be conducted to determine if there is a need for corrective action, to evaluate impacts due to changes in watershed conditions on the hydrologic regime or BMP performance, and in general to evaluate if the draft WQMP is effective in meeting the planning objectives.
- *Corrective Measures*. Corrective measures will be undertaken for specific problems or conditions of concern identified in the review and evaluation. Depending on the nature of the problem, corrective measures could involve modification of the BMP design, operation, or maintenance, and/or implementation of additional BMPs. The effectiveness of the corrective measures will themselves be evaluated through continued inspection and monitoring. Thus, the management approach is adaptive to specific problems or conditions as they arise and are identified through ongoing inspection, monitoring, documentation, and evaluation.
- *Documentation and Reporting.* Documentation of all operation, maintenance, inspection, and monitoring activities will establish a continuous record of the condition of combined control system facilities and the health of the hydrologic regime. All records will be available to the public and regulatory and resource agencies.

The following sections expand on each of the adaptive management elements.

1. Combined Control System Component Inspection and Performance Monitoring

Routine and major operation and maintenance (O&M) activities of the combined control system facilities are described in the draft WQMP Section 4.1.4. In conjunction with, or in addition to these O&M activities, performance monitoring of the structural BMPs will be conducted by the Home Owners Association (HOA) or other designated entity. Details of the performance monitoring activities will be included in the project WQMPs. The following sections generally describe the monitoring activities that will be included in the project WQMPs.

(a) Wet Weather Monitoring

Flow Duration Control and Water Quality Treatment (FD/WQ) Basins - Grab samples from influent and effluent flows during wet-weather conditions will provide information about the stormwater treatment performance of the FD/WQ basins. Of those WQ basins that discharge to surface receiving waters (as opposed to infiltration basins), grab samples will be collected for two to three storm events per year at representative basins selected on a rotating basis. Grab samples will be analyzed for TSS and possibly other constituents of concern (*e.g.*, metals, nutrients, pathogens). Inlets and outlet areas of all of the FD/WQ basins will be visually inspected monthly during the wet season for signs of clogging, scouring, and sediment accumulation.

Infiltration Basins – Infiltration basins will be visually inspected monthly during the wet season, preferably during or soon after a rain event. Percolations rates in the infiltration basins will be determined by measuring the drop in water elevation over the sand bed with time during or after a storm event. Percolation rates will be determined following at least one storm event per year at each basin.

Swales – Swales will be visually inspected during wet-weather conditions to verify that there is sufficient capacity to convey storms flows, and to look for signs of scouring; clogging; and sediment, trash, and debris accumulation.

(b) Dry Weather Monitoring

Flow Duration Control and Water Quality Treatment (FD/WQ) Basins – Field water quality measurements of influent and effluent dry weather flows will be collected at representative FD/WQ basins. Annual sediment and vegetation monitoring (see draft WQMP Section 4.1.4)

will also provide an indication of pollutant removal occurring in the FD/WQ basins' low flow water quality wetlands. Collectively, this information will provide an ongoing record of wetland health and performance and indicate if any further chemical testing may be required at a particular site. Such testing would entail collection of grab samples and laboratory analyses for total nitrogen, coliform bacteria, and other pollutants of concern as warranted.

Infiltration Basins – Infiltration basins will be visually monitored to confirm that dry weather flows routed to the infiltration basins are percolating into the subsurface and that there are no dry weather discharges reaching the streams through the bio-infiltration swales.

(c) Hydrologic Monitoring

The WQMP proposes to undertake a "Stream Stabilization Program" to address potential downstream effects of discharges from the Combined Control System in accordance with the following GPA/ZC Mitigation Measure:

MM 4.5-7 Stream Stabilization Program: Prior to the recordation of a subdivision map, unless otherwise specified by the provisions of the applicable master area or planning area-specific ROMPs (as appropriate), the development applicant shall prepare a stream stabilization program, including funding, that will be implemented by the HOA or other responsible entity to mitigate anticipated limited local effects of erosion associated with drainage system outlets from the development or downstream of detention basins. These effects from erosion are to be addressed with non-structural biotechnical and geomorphic approaches aggressively at the first phase and if not effective then limited structural measures would be implemented. These approaches vary by terrain and the character of the channels:

1. Sandy and Silty-sandy terrain: Water quality and infiltration basins and ponds will be constructed along unnamed tributary channels and channel-less valleys. Appropriate energy dissipation will be installed downstream of each structure or control point. 'Hungry water' or potential downcutting will be controlled by a progressive sequence of:

    a. establishment of hydrophytic vegetation, either turf-forming (such as salt grass or sedges) or with interpenetrating roots (such as willows); then

    b. placement of turf-reinforced mats (TRM) or other flexible and biodegradable membrane to abet vegetative growth to stabilizes the small drainages downstream of controls; then,

    c. conventional erosion control fabrics and structures using techniques developed over the years to control gully- or small-channel incision.

In through-flowing named stream corridors, the potential scale of incision is larger, and is most reasonably addressed by a progressive sequence to include:

a. Attempting to reduce runoff volumes and peaks from the watershed, by a combination of additional retarding of flow and use of (reconnecting, where needed) floodplains for flows of moderate to high recurrence.

b. Reducing sediment yields from disturbed watershed upstream, such that avulsion (sudden channel changes, such as recently seen in Gobernadora Creek) can be minimized.

c. Where the bed remains within the root zone of riparian vegetation, widening the riparian corridor, and managing its vegetation to promote dense interpenetrating roots, such as naturally occurs along many reaches of these streams, perhaps in combination with reconfiguring the channel pattern to increase sinuosity to a stable thalweg length-to-channel slope value.

d. Emplacing well-keyed structural grade control, with a wide variety of potential designs.

2. Clayey terrain: Differences between existing and future conditions will be the least in this terrain. Clayey terrains are also most resistant to incision, in most cases. Hence, biotechnical stabilization is most favored in this setting, especially for the smaller unnamed channels downstream from the small retarding and infiltration basins proposed at many locations. A progressive sequence of:

a. establishing hydrophytic or woody riparian vegetation, especially along the bases and crests of banks;

b. installing turf-reinforcing mats and other shear-resistant soft structures;

c. slight widening of channels where feasible without diminishing bank strength imparted by riparian vegetation, if significant; and

d. engineering slopes using fabrics, or placing thoroughly-keyed structural controls, usually in combination with a., b., and c., above.

Hydrologic monitoring will be performed to determine if there are changes in the hydrologic regime and associated changes in stream stability and geomorphology. To minimize costs, visual observation of direct and indirect indicators will be used where practical. Hydrologic monitoring will include:

- *Groundwater levels* – Groundwater levels will be monitored quarterly at existing monitoring wells in the Cañada Gobernadora sub-basin, and at additional monitoring wells to be located in consultation with the management entity responsible for long-term adaptive management of protected habitat areas.

- *Base flows* – Dry weather base flows will be spot checked quarterly in sensitive areas through direct or estimated measurements.

- *Peak Discharges* – Stormwater peak flows will be estimated through stage measurements or measurements of high water marks. Stream channels will be surveyed annually for visual signs of down cutting or aggradation.

(d) Streamcourse/Riparian System Monitoring

In addition to the riparian systems monitoring provided through the HRMP, the following riparian systems monitoring will be undertaken pursuant to the draft WQMP within riparian vegetation communities potentially impacted by the operation of the draft WQMP facilities.

Consistent with the provisions of the applicable master area or planning area-specific Runoff Management Plans (as appropriate), an area-specific stream monitoring program will be developed prior to the construction within the watershed, which will include reporting requirements in order to observe changes in the natural alluvial stream system. The minimum program will include and address the following items:

- *Stream walks* – A geomorphologist or engineer familiar with both (a) flood conveyance estimation, and (b) the bed conditions required to meet habitat needs and conditions for species of concern will walk critical reaches of named channels within the project each year in late April. The stream-walker will note bed conditions, measure high-water marks, note new sources of sediment or bank distress along the channels, estimate Manning's 'n' (roughness) at key locations, and assess whether bed and bank vegetation is suitable to meet conveyance and habitat objectives. Stream walks will occur during years 1, 2, 3, 4, 5 and 10 following substantial grading in a named-stream basin, and during any year within the first 10 seasons when six-hour rainfall intensities exceed the 5-year recurrence at a nearby pre-selected recording rainfall gauge. The stream-walker will also similarly canvass the lower two miles of Bell Canyon and the upper Chiquita watershed north of Oso Parkway, two stream segments with largely-intact and formally-preserved watersheds which can serve as control. Photographs showing key sites or problems will be taken. The individual conducting the walks shall be sufficiently senior and knowledgeable as to be registered as a geologist or engineer with the state. This

individual will prepare an annual report by June 20 of the relevant year(s) specifying maintenance or repair measures needed to maintain suitable sediment transport and bed conditions.

- *Major stream cross-sections monitoring* – Monumented cross-sections will be established and surveyed on:
  - Lower Narrow Creek
  - Chiquita Creek (4 locations)
  - Gobernadora Creek (4 locations)
  - Bell Creek (2 locations)
  - Upper Cristianitos Canyon (3 locations)
  - Lower Gabino Creek (3 locations)
  - Gabino Creek within 0.5 mile of La Paz Creek
  - La Paz Creek within 0.6 mile of Gabino Creek

Additional monitoring sections will also be provided on San Juan Creek and all monitoring locations will first be approved by the County of Orange before implementation. The cross-sections will be spaced approximately 0.6 to 1.2 miles apart and approved by the County. They will be surveyed to the nearest 0.05 feet vertical, and include notations of bed material encountered and qualitative descriptions of vegetation, and other observations conforming to geomorphic conventions, such as the International Hydrologic Vigil Network standards. The initial surveys will be conducted prior to grading, with resurveys during years 1, 3, 5 and 10 following initial grading or at frequencies determined by the County of Orange. Re-surveys will also be conducted during years when six-hour rainfall intensities exceed the five-year recurrence at a nearby pre-selected recording rainfall gauge or selected occurrences by the County of Orange. Results will be analyzed by the stream-walker, and included in the related report, recommending maintenance and restorative measures. The report will be submitted by May 20 of each year, to allow design and implementation (where needed) prior to the next winter.

- *Periodic aerial photography* – Aerial photographs of the entire project area will be taken during May or June following project approval, and during each subsequent May or June of years ending in a '5' or '0', until the project has been completed as defined by the County of Orange. Resolution of the photographs will be sufficient to prepare 200-foot scale maps with 2-foot (or 0.5-meter) contours. Contour maps will be prepared for the San Juan Creek channel corridor from the Verdugo Canyon confluence to 0.5 mile downstream of Antonio Parkway showing the topography of the bed and of the banks to

elevations 15 feet above the adjoining bed. LIDAR (Light Detection and Ranging) or other technologies can be substituted for now-conventional photogrammetric methods. A qualified geomorphologist shall review the aerial photographs of the entire project area, identifying new upland sources of sediment, event-related or land-use disturbance, or evidence of channel change and instability. The geomorphologist will also assess discontinuities in sand transport throughout the project area, and will present an assessment of changes, if any, in the San Juan Creek corridor. Results will be presented in a report to be prepared by July 15 of each year, including recommendations for maintenance, repair, or other actions.

- *Evaluation of changes downstream of ponds and basins* – Longitudinal profiles and channel or drainage-way cross-sections will be established downstream of basins or ponds with capacities exceeding 1 acre foot, or which create a 4-foot elevation change in the energy grade line. Resurveys will occur whenever the stream-walker and/or the geomorphologist reviewing the aerial photos identify actual or incipient incision or erosion. Resurveys will be completed prior to July 1 when and where the need is identified in the May 20 report discussed above.

- *Supplemental assessments* – Adaptive management of channels means changing with the flow of time. Nothing in the program above precludes problem- or condition-related investigations. Additional assessments may be conducted as deemed needed by the applicant to achieve the bed and bank conditions sought.

2. Water Quality Management Plan Evaluation and Corrective Measures

Annual review of the inspection and monitoring data will be conducted to **(1)** evaluate if the structural BMPs are maintained and functioning properly; **(2)** to identify water quality concerns or issues; and **(3)** to identify hydrologic issues of concern and to evaluate whether the BMPs are functioning as intended in terms of hydromodification controls.

Table 7-18, Table 6-1 of the draft WQMP, reproduced below, lists general criteria that should be used in the annual review and evaluation. Additional criteria will likely be needed to address specific and unique circumstances as they arise.

BMP modifications and corrective measures will be undertaken to improve performance and remedy any problems that are identified. Selected actions and remedies will be unique to each situation, and in general should be based on a sound understanding of the possible causes and evaluation of alternatives. *Table 7-18* (*Table 6-1* of the draft WQMP) identifies potential actions and corrective measures that may be considered. Significant changes to the draft WQMP

proposed as a result of the HRMP will be submitted to the RMVLC for coordination purposes and to Orange County for review and approval in accordance with local WQMP requirements.

Table 7-18
Criteria for Review and Evaluation of Monitoring and Inspection Data and Potential Actions and Corrective Measures

Evaluation Topics and Triggers	Potential Actions & Corrective Measures
BMP Status and Sizing	
BMP Maintenance. Are structural BMPs properly maintained?	• Correct maintenance practices and increase management oversight.
BMP Sizing. Are structural BMPs sufficient to address pollutants and hydrologic conditions of concern? Are there any unforeseen or unique changes in the watershed conditions that could potentially increase pollutant loads or runoff?	• Review and implement BMPs to address anticipated pollutant loads or runoff. • Continue and possibly increase watershed and BMP monitoring. • Implement additional source control and/or structural BMPs.
Water Quality Treatment	
FD/WQ Basins. Are the FD/WQ basins providing good water quality treatment performance? This would be evaluated with monitoring data for TSS and other constituents and comparisons with expected effluent quality as determined from information in the National BMP database. Are low flow wetlands in FD/WQ basins healthy in appearance and providing a design level of water quality treatment for dry weather flows? This would be determined through field tests of basic water quality parameters, and possibly through laboratory analysis of grab samples.	• Review O&M history of the facility to determine if poor performance is related to inadequate maintenance. • Review monitoring information on sediment accumulation and removals, and influent TSS levels (if available) to evaluate if influent sediment levels are excessive. Review hydrologic monitoring to determine if there are unique or temporary watershed conditions that could lead to excessive sediment loads (e.g. construction activities, fires). • Potential corrective measures include: – Review and implement erosion control BMPs to reduce sediment loads – Continue and possibly increase BMP monitoring – Evaluate the facility design and modify if necessary • Evaluate possible causes of poor performance in the low flow water quality wetlands: – Review O&M history of the facility to verify proper maintenance of the facility – Verify adequacy of flows to maintain emergent wetland vegetation – Verify that water levels are not too high – Evaluate facilitate design in terms of flow paths and potential bypassing • Potential corrective measures for low flow wetland problems include: – Correct maintenance deficiencies – Adjust water levels or influent flows – Modify the facility design

Table 7-18
Criteria for Review and Evaluation of Monitoring and Inspection Data and Potential Actions and Corrective Measures

Evaluation Topics and Triggers	Potential Actions & Corrective Measures
Infiltration Basins. Are the infiltration basins functioning properly? *i.e.,* are observed percolation rates equivalent to or in excess of the design rate?	• Evaluate possible causes of poor performance: – Determine if there is sufficient groundwater capacity – Verify that the flow duration controls (orifices) are designed and functioning properly – Verify that there is adequate pre-treatment of sediments in the water quality basis and that there is no clogging are crusting in the infiltration basin – Review O&M history of the facility to determine if poor performance is related to inadequate maintenance • Potential corrective measures include: – Modify flow duration controls (orifices) in the FD/WQ basin – Correct maintenance deficiencies – Evaluate and modify the design of the infiltration basin – If groundwater capacity is insufficient, evaluate and implement alternative measures for recycling, infiltration, or diversion of excess flows.
Swales. Are swales functioning as designed? *i.e.,* are wet weather flows properly directed through the swales, with no clogging or bypassing, and with adequate retention time?	• Review O&M history of the facility to determine if poor performance is related to inadequate maintenance. • Evaluate sources of runoff and debris. If excessive, evaluate and implement, if necessary, BMPs to reduce sources of runoff and debris. • Evaluate the facility design and sizing. Modify as necessary and practical.
Hydrologic Conditions	
Elevated Groundwater. Are observed groundwater levels chronically elevated in comparison with pre-development levels? Are maximum groundwater levels maintained 10 ft below infiltration basins?	• Adjust flow duration controls (orifices) to reduce diversions to the infiltration basins. • Look for additional opportunities to increase recycling, and/or ET of runoff. • Look for alternative or additional areas suitable for infiltration. • Divert excess flows to less-sensitive sub-basins or channels (e.g. San Juan Creek)
Elevated Base Flows. Are base flow discharges or seasonal duration chronically elevated in comparison with pre-development levels? Are changes in base flows having an undesirable effect on stream stabilization or riparian vegetation?	• Review adequacy and maintenance of existing dry-weather source control measures. Correct deficiencies as necessary, and look for ways to improve performance of existing source controls. • Look for additional opportunities to reduce dry-weather flows, such as methods to increase ET and recycling. • Divert excess flows to less-sensitive sub-basins or channels (e.g. San Juan Creek)

Table 7-18
Criteria for Review and Evaluation of Monitoring and Inspection Data and Potential Actions and Corrective Measures

Evaluation Topics and Triggers	Potential Actions & Corrective Measures
Elevated Peak Flows. Are estimated peak flows significantly elevated in comparison with pre-development levels? Are wet-weather flows resulting in excessive channel down cutting?	• Review adequacy and maintenance of existing wet-weather source control measures. Correct deficiencies as necessary, and look for ways to improve performance of existing source controls. • Look for additional opportunities for wet-weather source control BMPs. • Look for additional opportunities to store wet-weather runoff for non-potable water supplies. • Look for alternative or additional areas suitable for infiltration. • Divert excess flows to less-sensitive sub-basins or channels (e.g. Lower Cristianitos Creek)

3. Documentation and Reporting

An annual summary of all O&M and monitoring activities will be prepared. The summary report shall include:

- BMP construction and maintenance activities, including maintenance logs;
- All monitoring information, including watershed, hydrologic, and BMP performance monitoring data; and
- Findings of the annual evaluation and response, if any.