AQUATIC RESOURCES
ADAPTIVE MANAGEMENT AND MONITORING PROGRAM

AQUATIC RESOURCES
ADAPTIVE MANAGEMENT AND MONITORING PROGRAM

1.0 DESCRIPTION OF ADAPTIVE MANAGEMENT AND MONITORING PROGRAM

Chapter 8 of the San Juan Creek and western San Mateo Creek SAMP EIS addresses SAMP permitting procedures' compliance with the Section 404(b)(1) Guidelines (40 cfr 230.10). As discussed in Chapter 8 (see Sections 8.5.3, protections for listed species, and 8.8.3, minimization measures), the SAMP must demonstrate that it avoids, minimizes and compensates for impacts to aquatic resources resulting from implementation of the proposed permitting processes. The primary tool that responds to the minimization and compensatory mitigation provisions of 40 CFR 230.10 is the Aquatic Resources Conservation Plan (ARCP) and, particularly, the Aquatic Resources Adaptive Management Program (ARAMP) element of the ARCP.

The ARCP has been formulated as part of the South Orange County Coordinated Planning Process (SOCCPP) that included the preparation and approval of the Ranch Plan GPA/ZC and Planned Community Text and preparation of the Southern Subregion NCCP/MSAA/HCP (see Chapter 2 for a full discussion of the SOCCPP). The SOCCPP effort has involved the County of Orange, Wildlife Agencies (CDFG and USFWS), USACE, RMV and other landowners and public interest groups.

As explained in Chapter 1 of the SAMP EIS, the overall SAMP ARCP consists of three elements:

1. **Aquatic resources conservation areas (ARCA)**

ARCA are areas designated by the ARCP based on the distribution of the wetland/riparian vegetation communities found within the RMV property. First and second order USACE jurisdictional streams are included within the ARCA. These resources would be subject only to preservation and would not be adaptively managed under the terms of the ARAMP. Jurisdictional third order and higher riparian reaches within the ARCA are set aside for preservation and adaptive management under the ARAMP (*Figure 1*). Areas that would be included within the ARCA consist of:

- Wetland/riparian vegetation communities in open space previously protected through recorded conservation easements such as Ladera Ranch Open Space, the Upper Chiquita Canyon Conservation Easement area and Donna O'Neill Land Conservancy; and
- Wetland/riparian vegetation communities in RMV open space that will be dedicated by RMV in accordance with the proposed SAMP Phased Dedication Program.

2. **The aquatic resources restoration plan (ARRP)**

The ARRP element of the ARCP provides the restoration template for wetland and riparian resources within the ARCA consistent with the USACE Engineer Research and Development Center Restoration Plan (Appendix F1). The ARRP is discussed in Chapter 5 of the SAMP EIS and in Appendix F2.

3. The aquatic resources adaptive management and monitoring plan (ARAMP)

The ARAMP element, which is the subject of this *Appendix,* provides for long-term adaptive management and monitoring of aquatic vegetation communities and related species that are contained within the ARCA. Recognizing the nature of contemporary adaptive management science, and recognizing that the SAMP and ARCP are part of a coordinated planning and regulatory process for southern Orange County, the ARAMP does not focus solely on proposed adaptive management and monitoring measures for aquatic vegetation communities. As explained in this *Appendix*, contemporary adaptive management science relies on monitoring and management of the species that are associated with the vegetation communities that are being preserved and managed over the long-term. Accordingly, even though the USACE does not authorize Incidental Take or grant “regulatory coverage” of species, it is necessary to discuss monitoring and management of individual species as part of the ARAMP.

It is also important to note that the ARAMP element of the ARCP has been formulated, and is intended to be implemented, in coordination with the overall Habitat Reserve Management and Monitoring Program (HRMP) that has been concurrently prepared for the larger 33,269-acre Habitat Reserve under the NCCP/MSAA/HCP. The creation of the 33,269-acre Habitat Reserve and HRMP is fully expected to be approved by the Wildlife Agencies soon after final action on the SAMP and ARCP by the USACE. However, if for any reason the NCCP/MSAA/HCP is not approved or approved in a timely fashion, it will be necessary for each element of the ARCP (i.e., the ARCA, the ARRP and the ARAMP) to be capable of being implemented as part of a coordinated and independent avoidance, minimization and mitigation program consistent with the provisions of Section 404 of the CWA and Section 230.10 of the regulations.

Accordingly, care is taken in terms of ARAMP implementation (e.g., provision for a management organization and funding) to assure that appropriate avoidance, minimization and mitigation related to proposed impacts on aquatic resources would be addressed in a manner consistent with the provisions of the CWA, whether or not the NCCP/MSAA/HCP HRMP is approved and implemented in a timely manner.

2.0 OVERVIEW OF THE AQUATIC RESOURCES ADAPTIVE MANAGEMENT PROGRAM (ARAMP)

ARAMP activities would be conducted as mitigation for impacts to wetland and riparian aquatic species and vegetation communities that would receive regulatory coverage under the SAMP.

Section 1.0 provides a brief overview of the ARAMP that will be implemented on the dedicated RMV open space and previously protected lands identified above

Section 2.0 generally describes the concept of adaptive management and its relationship to contemporary adaptive management science, the draft Watershed and Sub-basin Planning Principles for the Southern NCCP Subregion, federal adaptive management guidelines (i.e., USFWS and USGS), and the SAMP Tenets.

Section 3.0 describes the organizational structure, function and coordination of the ARAMP management and monitoring programs, including:

- The structure and coordination within the ARCA (Section 3.1);
- The Rancho Mission Viejo Land Conservancy (RMVLC) and the ARCA Manager, also referred to as the ARCA Manager for purposes of the ARCP and ARAMP (Section 3.2);
- The Science Advisory Panel (Section 3.3);
- The timeline for initiation of the ARAMP (Section 3.4);
- The process for revisions to the ARAMP based on management and monitoring data and scientific review (Section 3.5);
- Data collection, storage and analysis (Section 3.6);
- Program implementation tracking, reporting and analysis (Section 3.6); and
- Funding the ARAMP (Section 3.7).

Section 4.0 provides an overview of the ARAMP, including:

- A description of the environmental stressor approach (Section 4.1);
- An explanation of how management objectives were formulated (Section 4.2);
- An explanation of the relationship between adaptive management and experimental research (Section 4.3); and
- A discussion of the role of baseline studies (Section 4.4).

Section 5.0 addresses the elements of the ARAMP, including discussion of passive and active adaptive management.

Section 6.0 describes ARAMP management and monitoring provisions for the wetland/riparian vegetation communities. For both vegetation communities these descriptions include five topics:

- Adaptive management issues;
- Adaptive management goals, objectives and strategies designed to achieve the goals and objectives;
- Monitoring activities;
- Management activities; and
- Restoration activities, including invasive species control.

Section 7.0 describes an additional management plan, the Water Quality Management Plan (WQMP) that will be coordinated with, but carried out independently, of implementation of the ARAMP as part of the overall ARCP. As noted above, the WQMP will be "adaptively" implemented and coordinated with the ARAMP because it provides important supporting functions, including addressing specific habitat and species "stressors" reviewed in this *Appendix*. 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). As part of the WQMP, "stream walk monitoring" will be conducted within designated stream reaches within the ARCA to assist in addressing the effectiveness of the WQMP in protecting aquatic resources within the ARCA. By addressing these stressors, the WQMP helps assure that these stressors will not significantly impact aquatic resources protected, restored and managed under the ARCP.

3.0 RELATIONSHIP OF THE ARAMP TO STATE AND FEDERAL GUIDELINES AND POLICIES

During the processing of the County Ranch Plan GPA/ZC, the role of adaptive management was a subject of public discussion and comment. In response to questions raised about adaptive management, the County requested that Drs. Barry Noon and Dennis Murphy, two nationally recognized conservation biologists, comment on importance of the adaptive management approach to the County's efforts to protect and manage sensitive biological resources over the long term. Drs. Noon and Murphy declared that adaptive management is an essential element of any future conservation strategy. As stated by Murphy and Noon:

> *…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.*(Dr. Noon and Murphy, 2004, p 1)

This section discusses the relationship of the ARAMP to: (1) contemporary adaptive management; (2) the SAMP Tenets; (3) the Watershed and Sub-basin Planning Principles; (4) the 404(b)(1) Guidelines; and (5) the USGS guidelines on adaptive management and monitoring that were prepared jointly with the USFWS and CDFG.

3.1 Contemporary Adaptive Management Science

The science of adaptive management has evolved 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).

3.2 ARAMP Consistency with Federal and State Planning and Regulatory Policies and Guidelines

As explained in Chapters 1 through 3 of the EIS, the ARCP and, particularly the ARAMP, has been formulated in a manner to assure that it is adequate to carry out the provisions and recommendations of USACE’s planning and regulatory programs and policies relevant to the preservation and long-term management of aquatic resources. Specifically, the ARAMP is consistent with the following:

- the SAMP Tenets adopted by USACE;

- the Section 404(b)(1) Guidelines (CDR 230.10, et. seq.);

- the draft Watershed and Sub-Basin Planning Principles; and

- the USGS guidance (i.e., non-regulatory) document released in 2004 entitled Designing Monitoring Programs in an Adaptive Management Context for Regional Multiple Species Conservation Plans.

The USGS guidance document is particularly useful because, although it was designed for multiple species conservation plans, the same principles of species and vegetation community management apply to multiple species HCPs and to the ARCP. The USGS document was prepared in partnership with the CDFG and USFWS to "provide a step-by-step procedure for developing effective monitoring programs in an adaptive management context." (p. 1). The USGS guidance document is not binding on the USACE or this ARCP, however, it does provide a helpful set of prescriptions for preparing and implementing a long-term monitoring program to support an adaptive management approach. The document identifies nine steps in creation of a monitoring program.

The nine steps identified in the USGS document provide a useful introductory outline for understanding the elements of the ARAMP addressed later in detail in this Chapter. Under each step is a description of how the step should be implemented and how the ARAMP described in this Chapter 5 and this Appendix is consistent within the USGS document.

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

This is an essential phase of the management and monitoring plan because only by having measurable goals and objectives can progress toward the goals and objectives and the effectiveness of the ARCA be evaluated. According to the USGS document, the goals and objectives should be:

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

The ARAMP provides a general discussion of goals and objectives of the program in Section 4.0 that addresses landscape processes, major vegetation communities and species. Sections 6.0 and 7.0 identify more specific goals and objectives, and the strategies that will be used to achieve the goals and objectives, for the wetland/riparian and woodland vegetation communities addressed by the ARAMP.

2. 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 ARCP presented in this *Appendix* does each of these things. The geographic scope (No. 1), land ownership constraints (No. 2) and spatial scale (No. 4) of the ARCP is defined by the ARCA (see *Figure 1*). The primary "audience/users" of the ARCP are SMWD, RMV and the

USACE. The general public also will be an "audience/user" through public disclosure of ARCA activities and possible public education and use. Relevant time scales for the program include the term of the ARCP and SAMP permits (25 to 30 years); the time it is expected to take for full assemblage of the ARCA (15 to 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 ARCA. 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, see p. 19); e.g., what is the appropriate time scale for assessing arroyo toad reproduction in relation to precipitation cycles?

3. 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 4 describes the data and information sources used for preparation of this SAMP 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.

4. 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 ARAMP organizes the adaptively managed/monitored measures for the wetland/riparian and woodland vegetation communities and abiotic resources and processes.

5. 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 to:

- 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 ARAMP provides preliminary "management-oriented" stressor-based conceptual models for the two vegetation communities and associated focal species. These models are based on the available scientific literature and on the professional judgment and experience of biologists familiar with the ARCA and thus are intended to combine basic ecological theory, empirical scientific studies and direct observations of existing conditions in the ARCA. As preliminary models it is expected that they will be refined by the ARCA Manager and Science Panel as the first 5-year MAP is prepared, and as working models, in general will be subject to continual revision and refinement.

6. 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 both vegetation communities and focal species associated with a vegetation community, site-specific resources, and habitat linkages and wildlife corridors, the ARAMP uses conceptual models to identify “Adaptive Management Issues” for these resources (see Sections 6.0 and 7.0). For example, as discussed in Section 6.0, stressors on wetland/riparian 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 ARAMP 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.

7. 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 above. The MAP is the plan that allows the ARCA Manager to begin implementing concrete management and monitoring on the ground.

8. Develop data quality assurance, data management, analysis and reporting strategies (see Sections 3.5 and 3.6).

9. Complete the adaptive management loop by ensuring effective feedback for decision-making (see Section 3.5).

As the above section illustrates, the ARCP, and particularly the ARAMP element, described in this *Appendix* is substantially consistent with the core recommendations of the USGS document for designing adaptive management and monitoring programs.

4.0 ADMINISTRATION AND COORDINATION OF MANAGEMENT AND MONITORING PROGRAMS

4.1 Administrative Structure and Coordination within the ARCA

If the ARCP is implemented, but the NCCP/MSAA/HCP is not approved, aquatic resources within the ARCA (i.e., aquatic resources within RMV lands) would continue to be managed under the authority of the Rancho Mission Viejo Land Conservancy (RMVLC). The RMVLC is described below.

a. Rancho Mission Viejo Land Conservancy (RMVLC)

The RMVLC will be a 501(c)(3) non-profit organization whose specific purposes are the preservation and enhancement of natural and open space lands (the RMVLC) for aesthetic, ecological, recreational, scientific, open space, charitable and education uses and to receive, administer and maintain one or more conservation easements related thereto. The ARCA are included within the RMVLC boundary (see *Figure 1*) and would be protected, monitored and managed consistent with the terms of the approved ARCP and ARAMP. The following discussions describe how the RMVLC Board of Directors (Board) would implement the ARAMP within the ARCA portion of the RMVLC. The terms and provisions of the ARCP and ARAMP would be binding on the Board.

1. Structure

A Board will oversee all operations of the RMVLC and ARCA but will not be considered to be a <u>separate</u> ARCA Board. The ARCA will not have a separate Board of Directors. The RMVLC Board will oversee all corporate activities and operations of RMVLC committees or divisions should the Board choose to form committees or divisions. The Board will have the power to select, appoint and replace officers, the power to contract on behalf of RMVLC and the power to direct its funds. All major decisions affecting the RMVLC and ARCA must be approved by the Board.

The Board will consist of an as yet undetermined number of directors anticipated to be from, but not limited to, the following entities: DMB Ladera LLC; RMV, LLC; the County of Orange; and one or more local, regional and/or national conservation or similar public benefit non-profit organization(s).

2. Officers

The Board shall select the officers of the RMVLC. The officers of the RMVLC are anticipated to be a Chairman of the Board or a President or both, a Secretary, and a Chief Financial Officer. The RMVLC may also have, at the Board discretion, one or more Vice Presidents, one or more Assistant Secretaries, one or more assistant financial officers and such other officers as may be appointed by the Board. The responsibilities of the officers are set forth as:

- Chairman–preside at meetings of the Board, and shall exercise and perform such duties as the Board may assign from time to time.

- President–serve as the general manager and chief executive officer of RMVLC and shall supervise, direct, and control RMVLC activities, affairs and officers, subject to such supervisory powers as the Board may give to the Chairman, if any, and subject to the control of the Board.

- Vice President–in the absence of the President, perform all duties of the President.

- Secretary–keep, or cause to be kept, at the RMVLC Principal Office, a book of minutes of all meeting, proceedings and actions of the Board and of the committees of the Board.

- Chief Financial Officer–maintain, or cause to be maintained, adequate and correct books and records of accounts of RMVLC properties and transactions. The CFO shall prepare all financial statement and reports required to be given by law, the by-laws, or by the Board. The CFO will deposit all money and other valuables in the name and to the credit of RMVLC, will disburse funds as the Board may order, render an account of all transactions and will have such other powers as the Board or the by-laws describe.

3. Duties

The duties of the RMVLC Board with respect to the RMVLC and the ARCA component will include, but are not limited to:

1. Selecting a ARCA Manager (note: the ARCA Manager and the Reserve Manager are the same person in the event that the NCCP/MSAA/HCP is approved);
2. Receiving conservation easements dedicating land to the RMVLC;
3. Considering and taking action on the 5-year Management Action Plan (MAP) prepared by the ARCA Manager;
4. Receiving assessment or other funds designated for use by the RMVLC/ARCA;
5. Establishing an annual ARAMP budget based on available funding to implement ARAMP actions;
6. Determining annual priorities for management, monitoring and research activities in the ARCA, taking into account the Science Advisory Panel recommendations and the 5-year MAP (note: a separate MAP would be prepared in the event a NCCP/MSAA/HCP is not approved);
7. Approving selection of consultant/contractors proposals for management, monitoring and research activities in accordance with the established ARAMP priorities;
8. Overseeing the preparation of annual reports by the ARCA Manager as required by the approved SAMP and ARCP;
9. Receiving and filing the annual ARCA report prepared by the ARCA Manager:
10. Overseeing preparation of policies governing public access by the ARCA Manager;
11. Approving the public access policies prepared by the ARCA Manager consistent with terms and provisions of the ARAMP and ARCP;
12. Overseeing preparation of a public education program by the ARCA Manager; and

13. Approving the public education program prepared by the ARCA Manager consistent with terms and provisions of the ARAMP and ARCP.

b. ARCA Manager

As noted above, the ARCA Manager will be selected by and report to the RMVLC Board. The ARCA Manager will be the same individual that serves as the Reserve Manager for the NCCP/MSAA/HCP Habitat Reserve, of which the ARCA is a part. As part of the overall responsibilities, the ARCA Manager will be responsible for managing the ARCA pursuant to the approved SAMP and ARCP. The duties of the ARCA Manager with respect to the ARCA include but are not limited to:

1. Managing the ARCA pursuant to the approved RMV long-term permit;
2. Preparing, in coordination with the Science Advisory Panel, a 5-year MAP;
3. Submitting the ARCA component of the 5-year MAP to the RMVLC Board for approval;
4. Coordinating with Science Panel to develop management, monitoring and research priorities based on the overall ARAMP, the 5-year MAP and the annual budget established by the RMVLC Board;
5. Participating in the determination of priorities by the RMVLC Board;
6. Issuing RFP's for management, monitoring and research priorities for the ARCA as established by the RMVLC Board;
7. Evaluating and making recommendations, in coordination with the Science Panel to the RMVLC Board regarding ARCA consultant/contractor selection;
8. Overseeing ARCA consultant/contractor implementation and/or self-implement the management, monitoring and research priority tasks;
9. In coordination with the Science Panel, interpreting result of the management, monitoring and research tasks performed pursuant to item 8 above;
10. Reviewing, commenting on and synthesizing technical studies or reports generated as a result of item 8 above and incorporate same into annual consideration of priorities;
11. Meeting with Science Panel as necessary;
12. Meeting with RMVLC Board as necessary;
13. Preparing public access policies for the ARCA component of the RMVLC for consideration by the Board;
14. Preparing an ARCA public education program for consideration by the Board;
15. Implementing the approved public education program;

16. Coordinating with the NCCP Administrative Entity regarding ARAMP activities that affect the ARCA component of the RMVLC portion of the Habitat Reserve (e.g., invasive species control, fire management); and

17. Providing annual reports as required by the approved RMV long-term permit.

c. Coordinating Administrative Entity

In the event that the NCCP/MSAA/HCP is approved, carrying out the ARCP will benefit from creation of an Administrative Entity to coordinate ARAMP activities with the adaptive management activities undertaken as part of the NCCP/MSAA/HCP (see discussion in Chapter 5, Section 5.5.3.2). If the NCCP/MSAA/HCP is not approved, then an Administrative Entity would not be needed. The Administrative Entity and structure is described briefly below.

A coordinating Administrative Entity would be created to serve as the body responsible for coordinating management and monitoring within the ARCA and the NCCP/MSAA/HCP Habitat Reserve. The primary duties of the Administrator relate to compliance of the SAMP with federal and state permit conditions, including:

- Assisting the Participating Landowners and Wildlife Agencies in assembling the ARCA and annual accounting for lands added to the Reserve;

- Providing coordination and technical assistance for various activities involving ARCA managers, including ARAMP element of the ARCP within the ARCA;

- Coordinating funding (primarily outside funding sources) and other implementation activities;

- Summarizing management and monitoring activities undertaken by, or on behalf of, owners of the ARCA during the prior year; and

- Accounting for the loss of aquatic habitat within the development areas and areas designated for the ARCA (e.g., infrastructure-related impacts) during the prior year.

4.2 Science Advisory Panel

Objective review and advice from independent outside scientists and technicians is a key element of the ARAMP. As shown in the adaptive management flowchart, *Figure 2*, scientists, along with the stakeholders and resource managers play an important role in setting the management objectives for the ARAMP and scientists are a primary source of information and data for generating and refining the conceptual models that are the foundation of the ARAMP. The primary purpose and role of the independent Science Advisory Panel (Science Panel) is to provide assistance in obtaining the best scientific information available so that “effectiveness monitoring” within the RMVLC is carried out in accordance with the ARAMP concepts set forth in this *Appendix*.

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

a. Structure of the Science Panel

The Science Panel would be composed as follows:

1. A 5-member panel (including a Chairperson) selected by mutual agreement between RMV, County, USACE, USFWS and CDFG.

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 and serve a 5-year term.

3. Each Science Panel member term would be 5-years and renewable by mutual agreement of the Science Panel and program participants (RMV, County, USACE, USFWS and CDFG).

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 ARCA Manager.

b. Duties of the Science Panel

An annual ARAMP budget will be established by the RMVLC Board based on prior year assessment revenues and any other assured sources of revenues. Within the funding framework established by the annual budget, the Science Panel would:

1. Recommend priorities for management, monitoring and research activities in the ARCA to the ARCA Manager. The RMVLC Board would make the final decision on priorities taking into account the Science Panel recommendations and other considerations, including 404 permit conditions;

2. Recommend appropriate targets for monitoring, including surrogate “focal species” and other variables to the ARCA Manager and the RMVLC Board that may serve to address key environmental conditions pertinent to the goals of the ARCP;

3. Evaluate and recommend sampling approaches to the ARCA Manager to support the monitoring program.

4. Evaluate and recommend analytical tools, including modeling approaches, for use in assessing available monitoring information;

5. Assist the ARCA Manager in interpretation of results of monitoring and other data collection activities;

6. Review, comment on, and synthesize technical studies or reports generated by supplemental research activities in the ARCA and submit to the ARCA Manager;

7. Meet with the RMVLC Board and ARCA Manager as requested;

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

9. Review and prepare evaluations of consultant proposals for the ARCA Manager for carrying out management, monitoring and research activities in the ARCA.

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.

4.3 Initiation of the ARAMP

During the months immediately following execution of the SAMP, the Participating Landowners will begin to take steps that ultimately will lead to full implementation of the ARCP. These initial steps will include: (1) creation of the RMVLC; (2) initiation of ARRP actions; (3) hiring of an ARCA Manager; and (4) formation of a Science Panel to assist the RMVLC Board and ARCA Manager during formulation and implementation of the ARAMP element of the ARCP.

The timing and sequence of ARAMP implementation is strongly influenced by the amount of time that will be needed to assemble the overall ARCA (i.e., it may take as long as 15-20 years or more to assemble all of the lands designated for inclusion in the ARCA). Within the first 12 months following approval of the SAMP, lands consisting of the wetland/riparian and woodland portions of the previously set aside RMV easements and conservancies (e.g., Ladera Open Space, Upper Chiquita Canyon Conservancy, Donna O'Neill Land Conservancy, and GERA) will be available for ARAMP implementation within the RMVLC. Other RMVLC lands containing portions of the ARCA will be dedicated by RMV as open space in phases as development occurs overtime.

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

a. Near-Term Baseline Monitoring

During the first years of ARCP implementation, baseline information concerning the overall vegetation database will be updated, and monitoring of wildlife species and wildlife corridors/habitat linkages will be conducted.

1. Vegetation Database Update

Priority actions concerning the vegetation database for the entire ARCA within the first two (2) years following issuance of the long-term permit, will include completing an evaluation and update of the ARCA vegetation map. The entire ARCA vegetation map will be evaluated no earlier than year 2008 nor later than 2010 using 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 ARCA to establish statistically acceptable and valid error rates for the aerial photo interpretation, as set by the ARCA Manager and Science Panel. As additional lands are transferred to the ARCA, 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 Sections 6.3 and 7.3 for more details on the vegetation monitoring). If a NCCP/MSAA/HCP and HRMP is approved, updating the vegetation database for the ARCA will be integrated with implementation of the HRMP.

2. Wildlife Species Monitoring

The Science Panel will recommend to the ARCA Manager a set of priority species for monitoring during the first several years of the ARCP program. Selected monitoring activities will involve consideration of the entire ARCA, with priority given to lands already in the ARCA, and will reflect the availability of funding for any given year.

b. Near-Term Management Measures

In the first five years following issuance of the long-term permit for the SAMP, several actions will be initiated to commence implementation of the ARAMP. These actions will include preparation of the ARCA portion of the first 5-year Management Action Plan (MAP), and initiation of the ARAMP element on a limited basis within portions of the ARCA.

1. Commencement of Invasive Species Control in San Juan Creek

The goal would be for the County to commence invasive species controls to proposed mitigation for its future Prima Deshecha Landfill expansion 404 permit during the near-term phase of the ARCP 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 USACE, Wildlife Agencies and permit applicants will request that the USFS begin its invasive control as soon as possible following issuance of the long-term permit in order to avoid delays in commencement of invasive species control measures along the San Juan Creek corridor.

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

Substantial details of the ARAMP are presented in this Chapter in terms of baseline information, goals, objectives, and the strategies that are designed to meet program goals and objectives. However, the ARAMP presented in this *Appendix* is programmatic and will require more detailed prioritization of monitoring and management actions that reflects: (1) the need to assemble the ARCA 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 ARAMP describes a process by which candidate focal species that could be used as surrogates for measuring ARCA function are identified. However, determining which set of candidate focal species will best serve the ARAMP in the long term should be further evaluated by the Science Panel in consultation with the ARCA Manager (see Section 4.2.c).

The ARCA Manager, with assistance by the Science Panel and in coordination with County staff as necessary (*e.g.,* regarding invasive species), will use the information presented in this *Appendix* and the associated ARRP and Invasive Species Control Plan (ISCP) (Appendices F2 and F4) to prepare a "5-year MAP that describes in sufficient detail the spatial and temporal aspects of the ARAMP in the first of sequential MAPs that would be developed for the ARCP. The MAP will provide guidance that will allow the ARCA Manager to implement the ARAMP 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; and
- other relevant monitoring/management options.

The initial 5-year MAP, in addition to outlining the ARAMP actions for the first five years of the program, will need to demonstrate the ability to accomplish selected monitoring/management tasks with available funding. The following implementation milestones are proposed for the first three (3) years of the ARAMP:

1. The Science Panel will be established and convened within six (6) months following issuance of the long-term permit;

2. The ARCA Manager, with Science Panel assistance, will prepare and submit a proposed ARCA MAP to the RMVLC Board 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 wetland/riparian and woodland 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 ARCA;

    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 based on the funding available to carry out management and monitoring actions;

    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 ARAMP 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 Board will review and approve the ARCA MAP within 60 days of submittal by the ARCA Manager. This 60-day time period will include any necessary discussions between the Board, the ARCA Manager and the Science Panel to resolve issues concerning the MAP prior to its approval by the Board.

4. Requests for Proposals will be prepared within 45 days of Board approval of the MAP, 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 ARCA Manager, with appropriate input from the Science Panel, subject to approval by the Board, 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 ARCA Manager/RMVLC Board. 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 RMVLC Board approval of the MAP. The initial MAP and subsequent 5-year MAPs will address the ARCA phased land dedication schedule and projected generation of funding for the ARAMP.

c. Starting the ARAMP within the Initial ARCA

During the initial years of the ARCP, ARAMP measures will be limited to wetland/riparian and woodland vegetation communities that were previously set aside as prior conservation easements and conservancies and designated for inclusion in the permanent ARCA (*Figure 1)*. These lands consist of the Ladera Open Space, the Upper Chiquita Canyon Conservation Area, the Donna O'Neill Land Conservancy and GERA. The scope of initial ARAMP management and monitoring actions will be determined by the ARCA Manager with the assistance of the Science Panel. It necessarily will address management priorities identified by the Science Panel and ARCA Manager in response to the limited funding that <u>may</u> be available during the first 5 to 7 years of the ARCP unless the ARAMP is integrated with the NCCP/MSAA/HCP. The NCCP/MSAA/HCP will have access to funds already collected pursuant to conditions of approval as part of prior 4(d), Section 7 and other regulatory approvals (refer to Section 3.7). However, if the NCCP/MSAA/HCP is not approved and implemented, funds collected pursuant to the Section 4(d) and Section 7 approvals may not be available for use as part of the SAMP. Accordingly, initial funding approaches need to account for potentially less funding during the initial years of ARAMP implementation when compared to ARAMP implementation in concert with HRMP AMP.

d. ARAMP Implementation

Long-term implementation of the ARAMP element of the ARCP will be correlated with available funding and the dedication schedule for the ARCA. Following issuance of the long-term permit, and pursuant to its terms, already protected wetland/riparian vegetation contained in the Ladera Open Space, Upper Chiquita Conservation Area and the Donna O'Neill Land Conservancy would become available for management. The remaining lands acres designated for inclusion the ARCA would be assembled over time. ARAMP funding will be phased over time in increasing amounts in relation to the development timeline (see Section 3.7). As a result, ARAMP actions will need to be correlated both with the assemblage of the ARCA and the actual receipt and disbursement of development-generated funds.

4.4 Process for Revisions to the ARAMP 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 2*). 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 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 ARCA Manager, with assistance by the Science Panel, will prepare a 5-year MAP that describes the spatial and temporal aspects of the ARAMP that will allow direct implementation of the ARAMP (also see Section 3.6, 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 ARAMP based on information collected in the field and new independent scientific information that may warrant changes in the ARAMP. 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 ARCA 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 ARCA Manager of management and monitoring actions and results and submitted to the Science Panel for review, synthesis and comment prior to submittal to the RMVLC Board (see Section 3.6 for more detail). In the case of an unexpected or catastrophic event, an evaluation of the event and its impact on the ARCA will be made as quickly as is feasible by the ARCA 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 ARAMP, 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 ARCA 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 for review and approval. The comprehensive annual report jointly prepared by the ARCA Manager, with assistance by the Science Panel, will summarize the field report information, provide a discussion of the results in the context the ARAMP and make necessary recommendations for modifications of the ARAMP. Approved modifications also will be incorporated into an updated MAP so that the ARCA Manager has specific information to implement the modified actions.

4.5 Data Collection, Storage, and Analysis

Data collection, storage, and analysis are fundamental components of the ARCP, and particularly the ARAMP, 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 SAMP study area. The specific data collection, storage and analyses methods will be developed as part of the initial 5-year MAP. The following subsections provide guidance for the collection, storage and analysis of data that meets these goals (the reader is referred to Chapter 6 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 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 ARCA Manager will work with the USACE and Wildlife Agencies to develop a data management and storage protocol that, to the extent feasible is compatible with both the USACE needs and the state system.

c. Data Analysis

Data analyses will be tailored to the goals and objectives of the ARCP. 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, programs CAPTURE or MARK can be used to estimate populations using short term capture/recapture data. The ARCA 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 USACE and other conservation programs, as appropriate, as part of the Annual Reports. However, it will not be the responsibility of the ARCP or the Science Panel to analyze shared data for uses beyond the scope of implementing the ARCP. By mutual agreement of the Board, USACE and other entities such analyses could be conducted by the ARCA Manager and/or Science Panel to address species issues beyond the ARCA or SAMP Study Area boundaries, provided that the entity requesting such an analysis would bear the additional cost and the effort would be consistent with SAMP objectives.

4.6 Program Implementation Tracking, Reporting, and Analysis

Overall tracking of implementation of the ARAMP elements of the ARCP will be coordinated by the Administrative Entity mentioned in Section 3.1. Program tracking focuses on *Compliance Monitoring*. *Compliance Monitoring* refers primarily to administrative duties related to verifying that the permit applicant is carrying out the terms of the SAMP and the long-term permit. Such activities would include:

- Accounting for the location and amount of impacts on focal species and wetland/riparian and woodland vegetation communities;
- Accounting for lands added to the ARCA;
- Monitoring to measure performance of mitigation measures; and
- Summarizing actions related to assemblage and management and monitoring of the ARCA.

4.7 Funding for the Aquatic Resources Adaptive Management Program

Funding for the ARAMP is considered with respect to two different timeframes. The first discussion addresses funding during the first six years of the ARCP (ARAMP Phase I). The six-year Phase I time span reflects the amount of time required before new RMV development permitted under the proposed permitting procedures would generate ARAMP funds. The second discussion addresses funding needed for long-term implementation of the ARAMP.

a. Short Term Funding (Phase 1)

Funding for ARAMP monitoring and management measures within the ARCA will be limited during the first several years of the ARCP. The extent of funding limitations during these first several years will largely depend on whether the pending Southern Subregion NCCP/MSAA/HCP is approved.

1. Short-term Funding – No NCCP/MSAA/HCP

If the pending NCCP/MSAA/HCP is not approved, available funding during the first few years of the ARCP would be limited to: (a) the $700,000 collected pursuant to regulatory approvals for RMV's Ladera Planned Community; and (b) the $700,000 contributed by SMWD under the terms of this SAMP (subject to the approval of the SMWD Board of Directors). Thus, about $1,400,000 would be available for ARAMP implementation during Phase 1 of the ARCP.

2. Short-term Funding – Approved NCCP/MSAA/HCP

If the NCCP/MSAA/HCP is approved, ARAMP actions on ARCA lands already set aside as part of the NCCP/MSAA/HCP Habitat Reserve also would be eligible to receive a portion of funds collected as a part of past regulatory approvals involving Section 4(d) permits, Section 7 consultations and Section 1600 streambed alternation agreements. These additional monies include funds already collected and funds that would be collected on an annual basis during the Phase 1 term in accordance with these previous regulatory approvals. As of the publication of this draft SAMP, funding that already has been collected totals about $1.342 million and includes monies held in a trust account by The Nature Conservancy that was collected from Coto de Caza, Talega, the cities of San Clemente and San Juan Capistrano, and other individual development projects.

In addition to already-collected monies, funding generated annually during the first several years of the ARCP pursuant to these prior approvals (e.g., about $87,500 annually from the Talega Community, at $25 per unit per year, equaling about $525,000 for 6 years) and *in lieu* fees collected as mitigation for development of designated lands pursuant to the NCCP/MSAA/HCP. The *in lieu* fees would include impact fees of $60,000 per acre for new homes built in Coto de Caza (15 of the 30 or so developable lots left in Coto de Caza) and for other development on about 11 acres within the cities (totaling about $1.4 million).

Thus, total Phase 1 funding under the "approved NCCP/MSAA/HCP" scenario including an as yet undetermined share of funds available following approval of the NCCP/MSAA/HCP would approach $4.67 million. This available funding includes (see above):

• Ladera Planned Community funding	$ 700,000
• SMWD funding	$ 700,000
• TNC Trust Account funds	$1,342,000
• Ongoing Annual Talega Funds	$ 525,000
• *In lieu* Fees	$1,400,000
Total Phase I Funding	$4,667,000

b. Long-Term Implementation Funding

Long-term implementation funding availability also changes in response to whether the pending NCCP/MSAA/HCP is approved. In addition to the available funding under the above short-term scenarios, long-term funding would be available in accordance with the following conditions.

1. Anticipated Long-term Funding – No NCCP/MSAA/HCP

If the NCCP/MSAA/HCP is not approved, long term funding would be limited to: (a) funds remaining from the Phase 1 Ladera and SMWD funding and remaining earnings from the Ladera and SMWD monies cited above; and (b) annual funding generated by Ranch Plan Property Owner Assessments for residential and non-residential development constructed in accordance with the approved RMV long-term permit. Based on an EDU ("equivalent dwelling units") formula, the new residential and non-residential development proposed within RMV under the County GPA/ZC, would generate an estimated total of 16,500 EDUs at full buildout. The Property Owner Assessments would be $60.00 per year per EDU. At buildout, the Assessments would result in total annual funding of $990,000.00 although it will take a number of years for RMV to reach the buildout condition of 16,500 EDUs. Without an approved NCCP/MSAA/HCP, the ARAMP would share the Property Owner Assessments for the benefit of the ARCA in accordance within RMV Open Space pursuant to the County-approved GPA/ZC Adaptive Management Program.

2. Long-term Funding – Approved NCCP/MSAA/HCP

Upon approval of the NCCP/MSAA/HCP, the ARCP and ARAMP would have access to an undetermined share of: (a) the funds and earnings remaining at the end of Phase 1 (at least $800,000) and identified in the short-term funding discussion; (b) annual funding generated by annual assessment fees related to non-RMV development (e.g., the Talega and Coto de Caza assessment fees); (3) the monies collected annually as part of the RMV Property Owner Assessments based on buildout of the Ranch Plan consistent with the approved RMV long-term permit; and (4) a RMV "Benefit Fee" that would be collected upon sale/conveyance of individual, subdivided parcels subsequent to initial development of RMV Planning Areas. The Benefit Fee would be a recurring obligation established through recordation of a fee agreement that would bind and encumber each individual parcel for all recurring conveyances. The amount of the individual Benefit Fee would be equal to a fixed percentage of the purchase price identified in the sales contract, however the amount of the Benefit Fee has not been determined at this time.

c. Other Potential ARAMP Funding Sources

In addition to the known funding sources discussed in Sections a. and b. above, the ARCA Reserve Manager and RMVLC will continue to seek funding from several alternative sources. These potential sources of funding include existing state and federal programs, creation of a Habitat Maintenance Assessment District and/or creation of a Community Facilities District. Each of the potential sources is discussed briefly below.

1. State and Federal Programs

Depending upon timing and availability of funds, the following programs may provide supplemental funding for the benefit of the Phase II ARAMP.

- Proposition 40 – via the California Clean Water, Clean Air, Coastal Protection, and Safe Neighborhood Parks Acts;
- Proposition 50 – through the California Water Security, Clean Drinking Water and Coastal and Beach Protection Acts; and
- Federal programs such as the Private Stewardship Grants Program and Landowner Incentive Program.

2. Habitat Maintenance Assessment District

In accordance with the provisions of Fish and Game Code Section 2900 *et. seq*. and Government Code Section 50060 *et. seq.,* the County could establish a habitat maintenance assessment district (HMAD) for the improvement and long-term maintenance of lands within the ARCA. Pursuant to the HMAD, landowners with the district would pay an annual fee toward preservation and maintenance of the ARCA subject to the statutory cap of $25.00 per annum.

3. Community Facilities District

Pursuant to Government Code Section 5331(d), a legislative body may establish a community facilities district (CFD) to finance the maintenance of parks, parkways, and open space with the district. The County and RMV could explore the establishment of a CFD to assist in the long-term maintenance of the ARCA through funding the ARAMP.

d. Summary of Long-Term Funding Resources

The combination of funding options described in Sections 3.7 a. through c. above demonstrates the availability of significant annual funding for both Phase I (Short-term) and Phase II (Long-term) of the ARAMP. The annual funding generated by a funding mechanism such as the Benefit Fee cannot be quantified with precision at this time; however, it is clear that this Fee will generate very significant annual funding even after the buildout of the Ranch Plan. Accordingly, the combination of known and potential funding sources provides sufficient evidence to conclude that implementation of the ARAMP within the ARCA would be adequately funded.

5.0 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 and are applicable to the ARCP:

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 ARCA? 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 ARCA specific management plans should be prepared. These plans will incorporate the management objectives for the ARCA and be tied to conceptual models of each focal vegetation type that describe known and/or hypothesized dynamic relationships for the vegetation type.

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 ARAMP.

These five elements of an adaptive management program identified by the Science Advisors are addressed in the ARAMP component of the ARCP, but with some clarification of element No. 2, which refers to preparing specific management plans for each management unit of the ARCA.

Figure 2 shows a conceptual flowchart for adaptive management that incorporates these fundamental concepts and which are addressed in the description of the ARAMP that follows.

Section 4.1 describes the environmental stressor approach as the foundation for the ARAMP and includes a description of the conceptual stressor models for major vegetation communities and for aquatic listed species and “focal species.” Generally, focal species are species that may be valuable for the purposes of managing and monitoring the ARCA as surrogates, indicator or umbrella species. Section 4.2 lays out the goals, objectives and strategies for the ARAMP at three scales: landscape processes, vegetation communities, and species. Section 4.3 describes the relationship between monitoring and research and Section 4.4 describes the baseline phase of the ARAMP.

5.1 Environmental Stressor Approach─Focusing on Natural and Human-caused Stressors

The *first and underlying guiding principle* of the ARAMP 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 (2003a) 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)*

These environmental stressors, however, may have both adverse and beneficial effects on ecosystem characteristics such as vegetation communities and species. For instance, periodic flooding may cause short term losses of aquatic habitat and species but, over the long-term, create new habitat for aquatic species such as the least Bell's vireo and arroyo toad.

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 include habitat loss and fragmentation, wildfires, 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* 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 ARCA 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). 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 ARAMP both because it is state of art science for management and monitoring of ecological systems (e.g., Noon 2003a) and because it is particularly appropriate for the ARCA.

a. Characteristics of Conceptual Environmental Stressor Models

The *second fundamental element* of an adaptive management program identified by the Science Advisors 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 (2003a) and the USGS (2004), they are a fundamental step in the creation of a monitoring program (see Sections 2.1 and 2.2). 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 among "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 ARCA 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 RAMP 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 (2003a) 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)

In order to identify causative environmental factors responsible for ecosystem changes, Noon (2003a) 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 2003a). 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., riparian habitats have evolved in the context of regular flooding).

In contrast, e*xtrinsic 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 (2003a) 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 (<u>noise</u>) from the effects of additive, human-induced patterns of change (<u>signal</u>).* (p. 29, underline added for emphasis)

Noon (2003a) 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.

b. Formulation of General Stressor Models for the Wetland/Riparian Vegetation Community

A preliminary stressor model has been formulated for the wetland/riparian vegetation community addressed by the ARCP. The model is based both on the available scientific literature and on the professional judgment and experience of biologists familiar with the RMV property. As such, the model represents an amalgam of basic ecological theory, empirical scientific studies and direct observation of current Ranch conditions. The model, (*Figure 3*), postulates the relationships between general landscape-level environmental stressors and wetland/riparian vegetation community responses. This model provides a broad overview of the stressor-response relationships and identify eight general environmental stressors known or likely to be relevant to the ARCA:

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 ARCA, all but the precipitation stressor have human-induced components, and thus would be *extrinsic drivers* that may require management and monitoring. Although 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 ARCA scale. However, precipitation can have direct effects on other stressors (e.g., fire) that, in turn, have direct effects on vegetation communities. Air pollution also could be a stressor with a human-induced character; however, like precipitation, it cannot be adaptively managed by the ARAMP and will continue to exert influence over biological resources within the ARCA and the southern California.

Under the model, the “line weights” (Figure 3) represent the postulated strength of the relationship between an environmental stressor and the community response. For example, exotic species, hydrology and geomorphology are postulated to have the strongest direct influences on wetland/riparian vegetation in the ARCA in regard to vegetation community health and stand dynamics. However, these “stressors” are also influenced by, for instance, habitat fragmentation and precipitation. Although Figure 3 depicts a conceptually simple model, it reveals quite complex interactions between environmental stressors and community responses.

c. Formulation of Stressor Models for Wetland/Riparian Focal Species

The second model depicted in *Figure 4* focuses on selected focal species. With regard to focal species, for the purpose of the ARAMP,

> *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).

Noon (2003b) further refines 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.*

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 ARAMP.

The model shows more detail than the vegetation community stressor model and postulates the relationships between stressors, community responses and their consequent impacts on selected focal species. This more detailed model incorporate the postulated relationships between human-induced environmental stressors and community responses of the first model (*Figure 3*), as well as postulated relationships between these and additional environmental stressors and focal species. The pathways between stressors and species may be both direct (e.g., brown-headed cowbirds parasitize least Bell's vireo) or indirect via community responses (e.g., long-term spatiotemporal changes to habitat structure and function cause the gradual decline of a species).

5.2 Formulation of Management Objectives: (1) Landscape Scale, (2) Vegetation Communities/Habitats and (3) Listed and Focal Species

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

1. Ensure 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 ARAMP for achieving these goals and presents conceptual stressor models for riparian/ wetland vegetation communities. 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 ARCA.

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. Wetland and riparian 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 for aquatic listed species or other aquatic focal species. Management and monitoring of these species and species assemblages would be important for assessing habitat conditions over time within the ARCA.

Table 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 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. 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 Section 8.0, Coordinated 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 ARAMP to state the objectives that will allow the ARCA 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 ARAMP addresses several landscape-scale issues in the subregion: (1) hydrology and geomorphology; (2) habitat connectivity; and (3) edge effects and encroachment. These landscape-scale issues and their relation to the ARAMP and the environmental stressor approach are discussed in this section.

1. 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 WQMP and the Sediment Report prepared by Balance Hydrologics (June 2005) comprehensively address hydrology and geomorphology considerations identified in the SAMP Tenets and the draft Watershed Planning Principles. Further, the “hydrology and geomorphology” planning policies set forth in the Baseline Conditions Watershed Planning Principles include the following:

TABLE 1
SUMMARY OF GOALS AND OBJECTIVES OF THE AQUATIC RESOURCES ADAPTIVE MANAGEMENT PROGRAM

Goals	Objectives
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 SAMP 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. Ensure that habitat linkages and wildlife corridors connecting large blocks of habitat in the ARCA function as designed by managing "live-in" and dispersal habitat.	• 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. • 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 ARCA/urban interface.	• Control invasion of the ARCA 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.
Major Aquatic Vegetation Communities: Ensure 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 major 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 species populations. • Maintain and, where feasible, enhance long-term habitat functions and values. • 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 ARCA.

TABLE 1 (Continued)
SUMMARY OF GOALS AND OBJECTIVES OF THE AQUATIC RESOURCES ADAPTIVE MANAGEMENT PROGRAM

Goals	Objectives
Aquatic Focal Species. Maintain conditions that will allow for normal evolutionary processes and genetic integrity and exchange through management of a functional ARCA, including functioning vegetation communities, habitat linkages and wildlife corridors.	• Monitor populations of selected aquatic focal 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 aquatic focal species where possible. • Implement appropriate management actions, as necessary, to stabilize or enhance populations of aquatic focal species, such as habitat restoration, and pest controls (e.g., cowbird trapping, invasive species control).

(a) Surface and Groundwater Hydrology

Emulate, to the extent feasible, the pre-SAMP 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.

2. 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 4.2.c).

- Monitor the use of key identified habitat linkages and wildlife corridors (as discussed in Section 4.1.3.4 and illustrated in Figure 4.1.3-11 of the draft EIS) 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 road kill 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.

3. 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. 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.

Broad objectives of the ARAMP 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 ARCA, 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 Section 7.0 and the Invasive Species Control Plan in Appendix F4 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 ARCA 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 ARCA.
  - Create fuel management zones combining irrigated and non-irrigated native plantings separating the ARCA from adjacent urban uses.
  - Provide barriers, fencing and walls to control access to the ARCA by domestic animals.
  - Implement the Invasive Species Control Plan throughout the ARCA where pest plant and wildlife species are a demonstrated problem or where they have the potential to spread rapidly into the ARCA. The Invasive Species Control Plan (described in Appendix F4) addresses invasive riparian plants (giant reed, pampas grass, tamarisk, castor bean, tobacco tree, and Spanish sunflower) 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.

- o Manage pesticide and herbicide use and fertilizer application techniques in landscaped areas, including golf courses, located adjacent to the ARCA 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 ARCA.

- 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.

b. Vegetation Communities

As stated above, an overall goal of the ARAMP is to implement the ARRP and ARAMP elements of the ARCP in a manner that would be consistent with the federal "no net loss of wetland/riparian function and value" policy. Habitat value may be defined as the ability (quality, suitability or functional level) of a unit area to support a particular organism. Simply put, if a unit of habitat is reduced in quality and is less capable of supporting a particular organism (i.e., the carrying capacity of the area has declined), its habitat value for that organism has declined. Likewise, if a species assemblage is diminished within a habitat area, its net habitat value has declined. With the recognition that habitat systems are dynamic, implementation of the ARAMP is an essential element in assuring no net long-term loss of habitat value in the subregion. The ARAMP maintains net long-term habitat value in the subregion in two fundamental ways.

- Existing habitat value in the ARCA is conserved through implementation of the ARAMP.

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

The ARAMP addresses the wetland and riparian vegetation communities in the ARCA. Management objectives and strategies of the ARAMP 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 ARCA, management priorities, and available funding. Goals and management objectives specific to each of the wetlands/riparian vegetation communities are set forth in their respective Section 6.0.

- Maintain major 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).

  - o Establish the "baseline condition" of existing vegetation communities through aerial, and where appropriate, field mapping of the entire ARCA. At this time the appropriate minimum mapping units for the two vegetation community types will be established based on aerial photo interpretation and ground truth Sampling.

  - o 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. In areas adjacent to roads and development the Science Panel may periodically address the potential need for more frequent monitoring.

- o Periodically (e.g., every 5 years) quantify the acreage of the two vegetation communities addressed in the ARAMP. The ARCA acreages of the two vegetation communities would be allowed to vary in relation to other communities such that net acreage of native vegetation communities remains relatively constant (e.g., dynamic variation in the wetland and riparian communities). A task during preparation of the first 5-year MAP, along with the baseline condition vegetation mapping of the ARCA, will be to establish initial "working management thresholds" for the acceptable range or variation of wetland/riparian vegetation community acreages that will need to factor measurement error, extent of coverage types, patterns of natural variability, and cause(s) of change.

- o Conduct annual on-the-ground monitoring of selected sample plots distributed across the ARCA. Selection of plots first would be based on a prioritization of management and monitoring activities by the ARCA 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 ARCA, including, for example, both interior and edge areas adjacent to urban development (the interior areas serve as controls for edge areas).

- o 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., where giant reed is proliferating).

- Maintain the ability of the subregion to support populations of aquatic listed and focal species by implementing management activities in areas where: (1) habitat degradation has been determined to adversely affect habitat use by those species; and (2) it is unlikely that the area would naturally regenerate without management intervention; e.g., where giant reed invades arroyo toad breeding habitat.

- Maintain and, where feasible, enhance long-term net habitat value in order to mitigate for proposed impacts and to further recovery of listed aquatic species. Note that initial habitat 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 Appendix F3 and F4 respectively):

  - o 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.

  - o Maintain flow characteristics of episodic events and assure water quality in drainages supporting the arroyo toad.

  - o Conduct invasive plant controls along Arroyo Trabuco Creek to improve breeding habitat for the least Bell's vireo.

  - o Protect existing habitat in Gobernadora Creek (GERA) through management and restoration actions.

- Identify and restore existing wetland/riparian areas with little or no habitat value as necessary to attain the goal of no net loss of wetland/riparian function and value.

- As opportunities arise in the future, use restoration to increase long-term net habitat value in the ARCA.

c. Aquatic Listed Species and Non-Listed Focal Species

The ARAMP addresses two general classes of aquatic species: (1) aquatic species that are listed at the state or federal levels and (2) other non-listed aquatic focal species. Identification of the listed aquatic species is easily accomplished and understood. The concept of focal species was introduced in Section 4.1 and the process of selecting such focal species could use some explanation*.* 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).

1. 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 ARAMP.

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 habitats at a landscape level through designation of ARCA 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 habitat/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 habitat management;
- The species is locally genetically indistinct; or
- No individual action is needed other than habitat 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 monitored at the species-specific level. 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 habitat;
- 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. Achieving ARAMP goals would involve monitoring the status of these species, or a selected subset of species, to ensure 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).

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 habitat-types" also were included. Finally, invasive species (e.g., brown-headed cowbird, bullfrog) and edge species such as the argentine ant that are indicators of disturbance or declining habitat quality are considered (e.g., see study on habitat fragments in urban environments by Bolger *et al.* 1997a) were added to the list. Monitoring these potential indicator species will be valuable for detecting negative trends in ARCA function and selected listed and Focal Species populations.

Species that do not rely on either wetland/riparian communities 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 41 candidate focal species shown in Table 2.

TABLE 2
WETLAND/RIPARIAN 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
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
European Starling	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Great Horned Owl	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Least Bell's Vireo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Nuttall's Woodpecker	Yes	Yes	Yes	Yes	?	Yes	Yes	BI
Red-tailed Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Snowy Egret	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Yellow Warbler	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
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
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
Common Yellowthroat	Yes	Yes	Yes	Yes	?	?	No	Rejected
Cooper's Hawk	Yes	Yes	Yes	Yes	Yes	Yes	No	Rejected

TABLE 2 (Continued)
WETLAND/RIPARIAN 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
Red-shouldered Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Red-winged Blackbird	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Sora	Yes	No	No	?	?	?	Yes	Rejected
Southwestern Willow Flycatcher	No	Yes	?	No	?	No	Yes	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
Silvery Legless Lizard	No	No	No	?	?	?	No	Rejected
Two-striped Garter Snake	Yes	No	No	No	?	?	No	Rejected
Gray Fox	Yes	Yes	Yes	?	?	?	No	Rejected
Southern Steelhead	Yes	Yes	Yes	No	No	No[1]	Yes	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.

Table 2 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.

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?

4. Does the species exhibit low sampling variability (consistent and high detectability)?

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 through 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 the issue of *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 its 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 ARCA 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, even with effective detection methods, its use as a focal species would be limited. For example, rare winter migrant birds 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

When selecting focal species, a key question 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. 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 1998). Likewise, the bullfrog is a documented predator on arroyo toads in general (USFWS 1999) 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.

2. Selection of Candidate Aquatic Focal Species

Tables 2 and *3* present the results of this filtering process for selecting a "short list" of candidate focal species from the 41 species on the "long list." *Table 2* shows the results of the seven questions and *Table 3* provides a summary of the candidate focal species in relation to vegetation type, focal species category and known potential environmental stressors. 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 and/or generally accepted species survey protocols (e.g., for 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 ARAMP and the effort required to collect the data.

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, bullfrogs are known predators of arroyo toads, and cowbirds are known to parasitize vireos, *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) or possibly indicators of degraded edge habitat (e.g., argentine ants are common along the urban-wildland interface). In some cases causal relationships between the presence of stressors and the decline or absence of a native species are not known; i.e., the observation is correlation. It may be unclear, for example, whether the stressor directly reduces reproductive success of the native species (e.g., nest parasitism by brown-headed cowbirds), or acts more indirectly through reduction of habitat quality.

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 silvery legless lizard 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.

TABLE 3
WETLAND/RIPARIAN CANDIDATE FOCAL SPECIES

Common Name	Vegetation Type(s)	Focal Species Category	Environmental Stressor(s)[1]
Birds			
Least Bell's Vireo	Riparian	Early warning and biodiversity indicator	Flood regime, invasive species, mesopredators, cattle-related impacts, noise
Yellow Warbler	Riparian	Early warning and biodiversity indicator	Flood regime, exotic species, mesopredators, cattle-related impacts
Nuttall's Woodpecker	Riparian	Biodiversity Indicator	Habitat loss?
Ash-throated Flycatcher	Riparian	Biodiversity indicator	Nest competitors
Barn Owl	Riparian	Umbrella species	Habitat loss?
European Starling	Riparian	Early Warning Species and, indicator of habitat degradation	Edge-enhanced species and nest competitor
Brown-headed Cowbird	Riparian and wetlands	Early Warning indicator	Nest parasite of native passerines
Great Horned Owl	Riparian and wetlands	Umbrella species	Habitat loss?
Red-tailed Hawk	Riparian and wetlands	Umbrella species	Habitat loss?
Snowy Egret	Wetlands	Early warning and biodiversity indicator	Sensitive to human disturbance
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
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	Riparian	Umbrella species	Habitat fragmentation, vehicle collisions, human recreation
Coyote	Riparian and wetlands	Early warning	Absence from habitat patches indicates potential mesopredator release and loss of native species
Mountain Lion	Riparian	Umbrella species	Habitat fragmentation, vehicle collisions, depredation, human recreation, loss of prey
Mule Deer	Riparian	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

TABLE 3 (Continued)
WETLAND/RIPARIAN CANDIDATE FOCAL SPECIES

Common Name	Vegetation Type(s)	Focal Species Category	Environmental Stressor(s)[1]
Invertebrates			
Argentine Ant	Riparian and wetlands	Early warning indicator	Edge-enhanced species that displaces native prey and directly kills natives
Imported Fire Ant	Riparian and wetlands	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 initial filtering process using the seven questions posed above narrowed the species list to 23 candidate focal species, including 12 birds, three amphibians, two reptiles, four mammals, two fish and two invertebrates (*Table 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 wetland/riparian 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 1998). It should be kept in mind, however, that many of 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 ARAMP and would be adjusted as new information becomes available.

5.3 <u>Relationship Between Adaptive Management and Experimental Research</u>

Adaptive management, by definition, takes an experimental approach to management. However, there is a clear distinction between experimental management for the purposes of the ARAMP described here and experimental research for broader purposes and applications. The ARAMP will be informed by the best available information from data collection onsite, 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 ARAMP. However, participation and coordination in such an effort may occur if it does not incur additional costs for the ARAMP, is consistent with the ARAMP, and does not in any way compromise the ability of the ARCA Manager to conduct the ARAMP.

5.4 <u>Role of Baseline Studies</u>

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 habitat conditions through time, as well as directed studies that might more typically be referred to as research. Hence under the rubric of monitoring, the ARAMP 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 ARCA Manager and Science Panel as part of the preparation of the initial 5-year MAP and annual program updates.

6.0 ELEMENTS OF THE AQUATIC RESOURCES ADAPTIVE MANAGEMENT PROGRAM

The ARAMP provides the technical and institutional framework for monitoring and undertaking management actions necessary or helpful to sustain and facilitate persistence and health of aquatic listed and focal species and their habitats over the long-term, while adapting management actions to new information and changing habitat conditions. The ARAMP would address the three previously stated broad goals of the program:

- Ensure the persistence of a native-dominated vegetation mosaic in the ARCA.
- Restore or enhance the quality of degraded wetland/riparian vegetation communities to the extent necessary to achieve the USACE policy of “no net loss of wetland/riparian functions and values.
- Maintain and restore biotic and abiotic natural processes, at all identified scales, for the ARCA.

6.1 Passive and Active Management

The ARAMP 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 ARCA are determined to be functioning well without intervention, no management actions would be taken. However, *passive management* could recognize and take advantage of opportunities to informally monitor conditions within the ARCA while conducting ranching or other activities.

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 riparian vegetation 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 ARAMP 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 ARCA 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 ARAMP 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."[1] Experimental management can be approached in two ways:

1. *A priori* (pre-defined) management experiments that inform the management of the overall ARCA; 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 ARCA, 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 ARCA by independent scientists not directly affiliated with the Science Panel, RMVLC Board, Wildlife Agencies or USACE. However, independent studies must be authorized by the RMVLC Board. Such studies also must be coordinated and consistent with the ongoing adaptive management goals and objectives of the ARCA.

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. For example, within a wetland, an *Opportunistic* experimental management action could involve re-introducing a sensitive plant (i.e., southern tarplant) as an opportunistic exercise related to overall restoration of a degraded wetland.

The distinction between "routine management" and "experimental management" as described here is sometimes blurred (also see discussion in Section 4.3, Relationship Between Adaptive Management and Experimental Research). In some cases management actions may be clear or

[1] 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.

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 (e.g., bullfrog controls) may be found to not work very well, thus triggering the need to conduct experimental management. Consequently, the ARAMP 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.

6.2 ARAMP 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.

1. Ensure the Persistence of a Native-dominated Vegetation Mosaic in the ARCA

The ARAMP would achieve this goal through periodic management and monitoring of the wetland/riparian vegetation communities in the ARCA. 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 Section 6.0.

In addition to the periodic assessment of vegetation communities throughout the ARCA (e.g., at 5-year intervals), decisions concerning what specifically would be monitored and why it would be monitored would be tied to hypotheses generated by the conceptual environmental stressors models described in Section 4.1. 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)

As discussed in Section 4.1, and in relation to the USGS (2004) monitoring guideline document described in Section 2.2, 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 ARAMP 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, a conceptual stressor model for the arroyo toad involved creation of a model testing the effects on the toad of bullfrogs and crayfish.

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., 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 local habitat and landscape level and allow the ARCA 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 ARAMP is comprised of four steps to ensure the persistence of a native-dominated vegetation mosaic in the ARCA: (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 wetland/riparian vegetation community (Figures 3 and 4). 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. A Water Quality Management Plan (WQMP) is reviewed in Section 7.0. The WQMP will be coordinated with the ARAMP to address particular stressors addressed by the ARAMP.

2. An assessment of vegetation communities throughout the entire ARCA 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 open space with aquatic resources in the Arroyo Trabuco Golf Course conservation easement, Ladera Open Space, Upper Chiquita Conservation Area, and Donna O'Neill Land Conservancy to detect any coarse, landscape changes in the vegetation mosaic; and (b) permanent sample transects established using GPS within representative plots within wetland/riparian vegetation communities that represent the physiographic gradients within the ARCA (elevation, 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 ARCA Manager in consultation with the 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 RMV lands are transferred to the ARCA, sample plots will be expanded into these areas as needed to provide a representative sample of the ARCA.

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. In most cases, vegetation changes over time following a natural disturbance would be expected to reflect the natural successional stages of the adaptive ecosystem (e.g., flooding may cause destruction of riparian vegetation, 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 major flood event, more frequent monitoring than the standard 5-year interval may be warranted on a case-by-case basis to ensure that irreversible adverse changes in the vegetation community do not occur (e.g., invasion of a recovering riparian area by giant reed). It will be the responsibility of the ARCA 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 community is becoming degraded or wetland/riparian 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 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 previously. 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 ARAMP because it completes the information feedback loop necessary to reassess the conceptual model(s), 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 ARCP.

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

Habitat restoration is broadly defined as the process of intentionally altering a degraded habitat area or creating new habitat to re-establish a defined pre-existing habitat or ecosystem or enhance function of a degraded habitat or ecosystem. In the context of the SAMP's proposed permitting procedures (i.e., the Individual Permits and Letters of Permission), the goal of restoration would be to emulate the natural structure, function, diversity and dynamics of the habitat or ecosystem such that there would be no net loss of wetland/riparian habitat value and function. This goal generally would be achieved through implementation of coordinated/ integrated restoration plans and related management plans, including:

- An Aquatic Resources Restoration Plan (Appendix F2)
- An Invasive Species Control Plan (Appendix F4), and
- The Coordinated WQMP (Appendix D).

The 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 ARCA component of the ARCP subject to the ARAMP (e.g., giant reed control in San Juan Creek).

3. Maintain and Restore Abiotic Natural Processes, at All Identified Scales, Capable of Supporting the ARCA.

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. For hydrologic/erosional processes, the objectives of the ARAMP were listed in Section 4.2.a.2. To assist in addressing the protection and management of abiotic resources and in coordination with the WQMP discussed in Section 7.0, the ARAMP will provide for:

- Stream walks conducted by geomorphologists or engineers familiar with flood conveyance estimation and bed conditions that would meet the habitat needs for species of concern. Stream walks will occur in years 1, 2, 3, 4, 5 and 10 following substantial grading in designated stream basins;
- Major stream cross-sections monitoring will be established for monumented cross section on designated streams;
- Periodic aerial photography of the entire project will conducted during May or June following project approval and during each subsequent May or June in years ending in “0” or “5” until the project is completed;
- Evaluations of changes downstream of ponds and basins will be conducted based on longitudinal profiles or drainage cross sections; and
- Where appropriate, supplemental assessments may be conducted as deemed needed by the ARCA manager in consultation with the Science Panel.

7.0 WETLAND/RIPARIAN RESOURCES

This section addresses the adaptive management of wetland/riparian resources within the ARCA. Resources addressed here include those summarized in *Tables 2* and *3* and include wetland/riparian vegetation communities.

7.1 Adaptive Management Issues

Conceptual stressor models were presented in Section 4.1 for wetland/riparian vegetation and associated focal species (Figures 3 and 4). The key stressors on the wetland/riparian 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 terms of vegetation_community responses, but they do indirectly affect the wetland/riparian community via fire, exotics, hydrology and geomorphology (note: this applies to the ARCA and is not intended to apply to wetland/riparian lands in general). 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 4, specific impacts on focal species are related to these broad environmental stressors (e.g., changes in habitat 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 4), 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, feral 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 wetland/riparian focal species; i.e., arroyo toad, snowy egret, least Bell's vireo, southwestern pond turtle, arroyo chub and threespine stickleback. 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 wetland/riparian focal species.

This model would allow the ARCA Manager and Science Panel to develop experimental management hypotheses. It also would allow the ARCA Manager 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 vegetation.

7.2 Adaptive Management Goals and Objectives

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

- Ensure the persistence of the physiographic diversity of wetland/riparian vegetation communities and associated focal species in the ARCA.

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

- Maintain and restore abiotic processes at all identified scales capable of supporting the ARCA.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value of the wetland/riparian habitat system in the ARCA. These primary objectives are captured by the SAMP tenets stated in Section 2.2 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 6.3 and 6.3 (wetland/riparian habitat). With respect to objective number 8, the “Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species” (PCR et al. 2002) was prepared in support of the ARCP and SAMP process to provide information on the physical processes that significantly affect structural habitat and life history requirements of listed wetland/riparian species in the planning area – arroyo toad, least Bell’s vireo and southwestern willow flycatcher.

Section 6.3 of Chapter 6 describes the relationship of the draft Southern Watershed Planning Principles to the SAMP tenets in a format that allows a direct translation to appropriate management actions. As an example, Tenet 1 addressing no net loss of acreage and functions of the waters of the U.S./State is related to the following Baseline Conditions 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 ARCA would have to be monitored and potentially managed over the long term consistent with these principles. The reader is directed to *Section 6.3* for a full treatment of the planning principles in relation to the SAMP tenets. The WQMP describe d briefly in Section 7.0 and in detail in Appendix D demonstrates how these objectives will be addressed through implementation of the WQMP.

7.3 Strategies for Monitoring Wetland/Riparian Resources

The key points for the monitoring program for the wetland/riparian vegetation community are summarized here:

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

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

a. Vegetation and Abiotic Systems Monitoring

Periodic evaluation and update of the wetland/riparian vegetation community would occur at 5-year intervals and would be part of the overall review of the ARCA vegetation database. Wetland/riparian systems pose a complex monitoring challenge because of the number of interacting processes, including geomorphology, hydrology and biology. Consequently, in order to determine whether the ARAMP 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 wetland/riparian habitats also would include monitoring channel morphology and hydrology. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the ARCA within two (2) years of issuance of the long-term permit;

- 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 in the draft EIS Chapter 8 WQMP discussion and Appendix D; and

- Monitoring of stream and groundwater hydrology as described below and in the draft EIR Chapter 8 WQMP discussion and Appendix D.

As reviewed in Section 6.2, 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 ARCA, 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 wetland/riparian 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 WQMP and ARCA. These data would be used to monitor long-term water supplies and changes in streamflow characteristics in relation to the health of the wetland/riparian 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 SAMP EIS Chapter 8 and Appendix D.

Wetland/riparian 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 wetland/riparian 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, hydric soils 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 22 candidate focal species for wetland/riparian habitats was identified in Section 4.2.c, including 14 early warning indicators, 9 biodiversity indicators, and 6 umbrella species (note: some species fill more than one role). These species are presented in Table 3.

Table 3 summarizes the stressors known or expected to act on these focal species. For example, the least Bell's vireo and yellow warbler, as avian indicators of high wetland/riparian 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).

Although precise monitoring locations for wetland/riparian species have not been selected, and additional field studies would likely need to be conducted by the ARCA 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
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

The ARCA Manager and Science Panel will need to evaluate the importance of monitoring these locations in relation to the overall monitoring program for the species.

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 other riparian species such as yellow warbler and yellow-breasted chat, can be conducted concurrently.

7.4 Management of Wetland/Riparian and Focal Species

The ARAMP for wetland/riparian habitats includes the two types of management described above in Section 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.

Wetland/riparian systems are often complex, are 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 significant active long-term management.

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 ARCA: arroyo toad, least Bell's vireo and southwestern willow flycatcher. Abiotic stressors (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 that would be carried out through the WQMP. 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 4.2. The WQMP described in Chapter 8 and Appendix provides the detail for how these abiotic processes will be managed consistent with the goals and objectives of the ARCP and this ARAMP.

At the site-specific level, 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).

- Control of human access and recreational activities in wetland/riparian habitat areas.

- Management of sand and gravel mining operations related to the Ortega Rock 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 exotic aquatic predators (bullfrogs and possibly crayfish and introduced fishes)

- Control of specimen 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.

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 report "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 wetland/riparian habitat species. Other documents that provide valuable background information for the ARAMP are the Baseline Geomorphic and Hydrologic Conditions report (Appendix C) and the draft Watershed Planning Principles (Appendix B2).

A number of management hypotheses can be generated from the community and focal species stressor models illustrated in Figures 3 and 4. 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 habitat composition and quality and associated species composition following disturbance events should be included in the monitoring program. For example, after a significant flood event, 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 through the WQMP-proposed Combined Control System 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 ARAMP 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 (Appendix G), provides the scientific foundation for the management and monitoring approach. This 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 habitats 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)

- Vehicular mortality

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.

7.5 Restoration of Wetland/Riparian Resources

Restoration of wetland/riparian resources in the ARCA is comprised of two main components:

1. Pre-designated enhancement and revegetation areas per the ARRP (*Appendix F2*); and

2. Invasive species control per the ISCP (Appendix F4)

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

- Maintain and restore riparian ecosystem integrity; and
- Maintain/protect/restore riparian corridors.
- Maintain and restore flood plain connections.

The reader is directed to *Appendices F2* and *F4* for further details.

8.0 COORDINATED WATER QUALITY MANAGEMENT PLAN

In conjunction with the review and approval of the RMV GPA/ZC, a Water Quality Management Plan (WQMP) was prepared and updated to support this SAMP (*Appendix D*). The WQMP was prepared to address water quality/stormwater flow requirements established by the San Diego RWQCB and the County of Orange Municipal Stormwater Permit (MS 4 Permit). In meeting Clean Water Act/State of California water quality requirements in furtherance of the coordinated planning process, the WQMP addresses the substantive considerations identified in the 404(b)(1) Guidelines and the water quality integrity and hydrologic integrity considerations presented in the cited ERDC reports prepared for the SAMP, as well as the draft Southern Watershed Planning Principles.

The draft WQMP is intended to address Water Quality Integrity and Hydrologic Integrity by managing post-development conditions in terms of the following three types of potential impacts:

- “Pollutants” generated by urban development with the potential to impact species and habitats;

- “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 habitats; and

- “Altered geomorphic processes” with the potential to impact species and habitats

The SAMP Tenets set forth in Chapter 6 and in the draft Southern Watershed Planning Principles provide the policy direction for addressing each of the above categories of potential development impact. A summary of the WQMP is presented in Chapter 8.

As reviewed in this Appendix, ARCA will be adaptively managed over the long-term to maintain net aquatic habitat value and functions. Although the WQMP addresses areas located outside ARCA, the WQMP will also be managed adaptively and will be coordinated with the management of ARCA in order to assure that potential impacts involving Pollutants of Concern and Hydrologic Conditions of Concern are fully addressed through ongoing avoidance, minimization and mitigation measures.

This sub-section presents a brief summary of the WQMP adaptive management approach (set forth in Chapter 6 of the WQMP) that will be used to evaluate whether the 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” (see also the more extensive discussion in the WQMP summary in Chapter 8).

The WQMP adaptive management plan proposes the following elements:

- BMP Inspection and Performance Monitoring (see WQMP Chapter 6).

- Hydrologic Monitoring (see WQMP Chapter 6 and Section 5.2 of this Appendix addressing monitoring of hydrologic/erosion processes).

- 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 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 (see WQMP Chapter 6).