III. Regional Goals

The long-term objective of the Southern California Wetlands Recovery Project is to reestablish a mosaic of fully functioning wetlands systems, with a diversity of habitat types and connections to upland communities, which preserves and recovers self-sustaining populations of species. A fully-functioning regional mosaic of wetlands will also provide important socio-economic values such as: sustainable habitat and food support for fish and wildlife, including some commercially important species; improved water quality in coastal streams, beaches, and the nearshore waters; increased potential to buffer flood waters and recharge groundwater aquifers; increased opportunities for human interaction with nature – a valuable resource in a highly urbanized landscape; and increased opportunities for public education and research on the unique natural landscape features of southern California coastal watersheds.

The WRP has identified six regional goals to guide its efforts towards achieving this long-term vision:

1. Preserve and restore[1] coastal wetland ecosystems
2. Preserve and restore stream corridors and wetland ecosystems in coastal watersheds
3. Recover native habitat and species diversity
4. Integrate wetlands recovery with other public objectives
5. Promote education and compatible access related to coastal wetlands and watersheds
6. Advance the science of wetlands restoration and management in Southern California

These goals, along with key strategies for achieving each of them, are discussed below and summarized in Table 3.1.

Goal 1: Preserve and restore coastal wetland ecosystems.

Statement of Need

Southern California's coastal wetlands are among the most productive habitats on the Pacific Coast. The wetlands provide habitat for hundreds of fish and wildlife species, including feeding and nesting habitat for migratory birds on the Pacific Flyway and habitat and food chain support for commercial and recreational fisheries. As discussed in Chapter 2, Southern California's coastal wetlands have been severely impacted by human activity, with only about 25 percent, or roughly 15,000 acres, of the historic coastal wetlands remaining. Portions of many coastal

[1] Preservation, as used in this document, is defined as any actions that facilitate protection of existing resources, including acquisition of property in fee by public agencies or through partnerships with private conservation organizations, acquisition of conservation easements, or implementation of best management practices on private property. The WRP relies on a non-regulatory approach and will only acquire property from willing sellers.

Restoration is also defined broadly to include any efforts that increase the quantity or quality of wetland resources in the region, including wetlands enhancement and improvement projects.

Table 3.1 Regional Goals and Key Strategies

REGIONAL GOAL	KEY STRATEGIES
Goal 1: Preserve and restore coastal wetland ecosystems.	A. Acquire privately-owned coastal wetlands and associated uplands. B. Acquire contiguous wetland and upland areas at sites that are already primarily in public (or conservation) ownership. C. Restore diversity and quality of wetland habitat types. D. Restore ecosystem functions. E. Address watershed impacts.
Goal 2: Preserve and restore stream corridors and wetland ecosystems in coastal watersheds.	A. Preserve riparian and aquatic habitat along stream corridors. B. Restore riparian and aquatic habitat along stream corridors. C. Reconnect creek and river corridors to their floodplains. D. Restore sediment transport functions and characteristic patterns. E. Reduce erosion, both along stream channels and from upland areas. F. Improve water quality. G. Preserve and restore wetlands, particularly vernal pools, in coastal watersheds.
Goal 3: Recover native habitat and species diversity.	A. Restore a diversity of habitat types. B. Employ a multi-species approach to wetlands recovery. C. Preserve and restore habitat linkages and fish and wildlife corridors. D. Preserve and restore rare wetlands, including vernal pools. E. Preserve and restore surrounding upland and dune habitat. F. Remove exotic species and re-establish native species. G. Recover native, extirpated species.
Goal 4: Integrate wetlands recovery with other public objectives.	A. Promote integration of wetlands conservation planning and priorities into related public policies and projects. B. Promote wetlands projects that achieve multiple public objectives.
Goal 5: Promote education and compatible access related to coastal wetlands and watersheds.	A. Develop compatible public access opportunities. B. Integrate interpretive programs into wetlands and watershed projects. C. Promote opportunities for experiential learning. D. Promote development and dissemination of educational materials and activities related to coastal wetlands and coastal watersheds. E. Research and disseminate information about the economic value of wetlands. F. Promote practices to reduce urban impacts on wetlands and watersheds.
Goal 6: Advance the science of wetlands restoration and management in Southern California.	A. Promote research on wetland ecology and restoration science, as well as on issues affecting the success and long-term sustainability of wetland restorations in Southern California. B. Promote development of more effective monitoring programs for both regional and project-specific assessments. C. Disseminate Information.

wetlands were filled for agricultural or urban development. Oil extraction facilities have been erected in several coastal wetlands. In others, ponds have been created for salt extraction, sewage treatment, or duck hunting purposes. In those areas where wetland habitat remains, urban development has typically reduced, degraded, or eliminated the surrounding upland habitat that is a critical part of the wetland ecosystem. The loss of wetland habitat has left several species struggling to survive.

In addition to providing critical habitat for plants and animals, coastal wetlands serve many other critical functions. These include:

- Water quality functions, including the filtering and transformation of pollutants from watershed runoff;
- Hydrology, including flood control, moderating sediment delivery, groundwater recharge, and protection of shoreline from erosion;
- Food chain support, including the production of material that fuels both aquatic and terrestrial ecosystems.

Losses of coastal wetlands in Southern California, as well as the degraded state of those remaining, have greatly reduced the natural functions in the landscape.

The dramatic reduction of water quality functions in coastal wetlands severely impairs the quality of one of Southern California's most valuable resources: its coastal waters. Wetlands detoxify contaminants, filter bacteria, and remove and transform nutrients that enter into streams and rivers from urban and agricultural development. The loss of wetlands in coastal watersheds has contributed to deteriorating water quality in beaches, coastal lagoons and bays, and the marine environment. The decline in water quality in these areas ultimately affects the revenue that California earns from tourism and commercial fisheries.

As discussed in Chapter 2, the natural hydrology of the coastal wetlands has been greatly modified. Water is imported into the region for urban and agricultural use, and the discharge of this water as wastewater effluent and non-point source flows has changed the quantity as well as the seasonal pattern of freshwater discharge to the coast. These changes have resulted in the disturbance of the natural habitats in coastal wetlands, stressing native plant and animal communities and allowing for the invasion of opportunistic exotic species. Tide gates, diking, roadway construction, and coastal developments have greatly restricted natural tidal connections, resulting in reduced tidal prisms. This reduces the natural scouring in creek channels and coastal lagoons and bays, and exacerbates sedimentation problems in these areas.

Population growth and related development pressures continue to impact the region's coastal wetlands, and will increase as the population grows. Supporting upland habitat continues to be lost and corridors that link coastal wetlands to upstream habitats are quickly disappearing. Wetlands created in upland areas to mitigate for coastal wetland loss from development often do not perform the same ecological functions as those that were destroyed. Filled areas that were historically part of a coastal wetland can potentially be restored to wetland; however, these areas may not be fully protected under state and federal wetlands statutes and could be lost if not

acquired. Hydrologic and land use changes in the coastal watersheds also continue to impact downstream wetlands.

Natural variability on seasonal, annual, and decadal time scales are inherent in the physical processes (such as temperature, rainfall, sea level) affecting wetlands. While healthy ecosystems are generally resilient to natural variability, wetlands stressed by encroaching development are particularly vulnerable to change. Thus, global climate change and the predicted rise in sea level could have an enormous impact on Southern California's coastal wetlands. Tidal marshes are extremely sensitive to elevation changes, where a six-inch elevation difference can produce significantly different habitats. The encroachment of surrounding development leaves few opportunities for coastal wetlands to migrate landward if sea level should rise. Climate change may also result in a change in the quantity, delivery method (e.g., snow versus rain), and timing of water delivered to the coast. Higher frequencies of catastrophic flooding events or droughts may act as an additional stressor to the native plant and animal communities that have adapted to coastal wetlands.

Tidal wetlands in Southern California are small and relatively scarce, particularly in comparison to tidal wetlands along the Atlantic and Gulf coasts. This was true even historically. Tidal wetlands are a transitional habitat between terrestrial and marine environments, and can only be established within a small elevation range and a compatible geologic setting. The region's rugged topography and actively uplifting coastline limits the establishment of tidal wetlands. This, combined with extensive coastal development, restricts opportunities for restoring or creating tidal wetlands in Southern California.

Key Strategies

Given the extent of historical loss and the limited opportunities remaining, preservation and restoration of tidal wetlands in the region is a high priority. Wetland restoration in Southern California encompasses a broad range of activities, from small enhancement efforts to large-scale reconstruction of wetland systems. Significant changes in land use, watershed hydrology, and site topography limit the extent to which historic conditions can be feasibly restored. In many cases, restoration will involve creating a functioning wetland system, but not re-creating the historic conditions. For the Wetlands Recovery Project, restoration is viewed broadly to include any efforts that increase the quantity or quality of coastal wetland habitat in the region.

A. Acquire from willing sellers coastal wetlands and associated upland habitats that are primarily privately owned, and not subject to any conservation guarantees. High priority sites for acquisition include the Oxnard Plain, Ballona wetlands complex, Los Cerritos wetlands complex, and the Huntington Beach/Santa Ana River Mouth wetlands complex. These sites are consistent with the priorities identified by the WRP Science Advisory Panel at a regional planning meeting in 1997.

B. Acquire from willing sellers contiguous wetland and upland areas that function as part of the wetland ecosystem at sites that are already primarily in public (or conservation) ownership. Several of the remaining coastal wetlands in Southern California are already primarily in public ownership. At most of these sites there is additional wetland, riparian, or upland habitat that is part of the wetland ecosystems that is privately owned. Acquisition of these

areas will help preserve the entire wetland ecosystem and possibly provide space for the wetland to migrate in response to a rise in sea level.

C. Restore diversity and quality of wetland habitat types (see Goal #3 for discussion).

D. Restore ecosystem functions. The goal of restoration is to restore the physical and biological processes that are characteristic of healthy wetland ecosystems. In addition to providing quality habitat, restoration of these processes can result in water quality improvements, groundwater replenishment, and better flood control. A recent National Academy of Science study found that while many wetlands are recreated or restored to compensate for wetland loss in other areas, many of these wetlands do not replicate the same level of functions provided by natural wetlands. Restoration of ecological functions through proper conceptual design and long-term maintenance, monitoring, and adaptive management is a priority. One key ecological function to restore is tidal exchange and circulation within tidal salt marshes. As discussed above, anthropogenic changes in wetland and watershed hydrodynamics have significantly reduced the tidal prism and circulation in many of Southern California's salt marshes. Re-establishing tidal circulation will improve the health and functioning of these ecosystems.

E. Address impacts of watershed inputs affecting coastal wetlands, including freshwater, sediment, nutrients, water contaminants, and invasive species. Watershed impacts should be addressed through both source control measures, such as implementation of best management practices (BMPs) on upstream property, and treatment measures such as sediment basins.

Goal 2: Preserve and restore stream corridors and wetland ecosystems in coastal watersheds.

Statement of Need

Many of the creeks and rivers in Southern California's coastal watersheds have been significantly altered as a result of agricultural and urban development over the past 100 years. Dams were built in the upper watersheds for water storage, flood control, and hydroelectric purposes. Creek and river systems have been highly engineered with channels moved, confined to concrete, and placed underground. Extensive urban development has replaced native vegetation with concrete. The ever-increasing population has spurred the import of water from a variety of sources – fundamentally changing the region's hydrologic landscape. Human activities have generated billions of pounds of contaminants, much of which has ended up in the region's waterways. These changes have severely degraded the habitat, ecosystem functions, and water quality of the region's stream corridors.

The confinement and hardscaping of Southern California's creeks and rivers has led to substantial losses of the region's floodplain, riparian, and aquatic habitats. Faber et al. (1989) estimated that 90-95 percent of the riparian community has been lost. Some systems, such as the Los Angeles River, have been almost completely disconnected from their floodplain and denuded of nearly all riparian habitat. Several species that rely on these habitats are listed as

species of concern, including the least Bell's vireo, steelhead trout, red-legged frog, and arroyo toad. Historically, migratory birds also used this habitat, but now face population declines due to overcrowding and disease. Riparian corridors often function as linkages between larger habitat areas. Loss of these movement corridors has contributed to fragmentation of the remaining wildlife habitat in the region. Invasive species such as *Arundo donax* have reduced the quality of riparian and aquatic habitat.

Urban and agricultural development in Southern California coastal watersheds has also significantly altered other natural stream functions including water quality, hydrology, and sediment transport functions. Water quality impairments include increases of both non-toxic elements such as sediment, nutrients, and water temperature, as well as toxic contaminants such as pesticides and heavy metals. The loss of wetland habitat throughout the coastal watersheds has aggravated water quality problems, since wetlands can improve water quality by removing or sequestering many contaminants. The degraded water quality affects fish and wildlife habitat quality, and limits recreational use of Southern California beaches, bays, and lagoons.

Hydrologic patterns in Southern California watersheds have been altered by many different factors. Thousands of square miles of the region have been paved, increasing the quantity and speed of storm water runoff. The loss of floodplains in many watersheds has intensified this effect. Irrigation of both agricultural and urban areas increases dry-season flows in the region's creeks and rivers. Many streams that were previously intermittent now flow year round. Base flows have also increased due to the significant amount of water imported into the region. Conversely, in some systems water diversions and groundwater pumping have depleted base flows. Today, the Santa Ana River, which drains the largest watershed in Southern California, rarely flows to the ocean due to diversions for groundwater recharge.

Sediment flows in coastal streams have been changed in several ways. First, dams in the upper watersheds of streams and rivers create barriers to sediment transport, thereby reducing flows of sediment to downstream areas. Conversely, urbanization has increased storm water runoff, increasing channel and bank erosion. Disturbance of the natural vegetation cover – usually as a result of urban or agricultural development activities – has led to excessive erosion within many watersheds and along stream corridors. Another change is that erosion now occurs year round as a result of urban and agricultural runoff during the dry season, and dry season root growth makes it more difficult to flush excess sediment from the area's streams. Finally, flood management practices have reduced the scouring of creek channels and downstream estuaries and flushing of sediments into the ocean. As a result, the region suffers simultaneously from excess sedimentation in downstream estuaries, causing the infilling of stream channels, bays and coastal lagoons, and from a lack of natural sand replenishment to beaches and dunes.

Vernal pool habitat in Southern California has been reduced by approximately 90 percent. Vernal pools are a wetland type unique to Mediterranean climates, and in Southern California are found primarily in San Diego and Santa Barbara Counties. Vernal pools are dependent on runoff from surrounding uplands for their water. Thus, vernal pools have been lost due to both direct impacts to the pools, and indirect changes to the hydrology of surrounding upland areas.

Population growth and related development in Southern California will continue to exacerbate impacts to coastal wetlands and watersheds.

Key Strategies

The Wetlands Recovery Project has identified several considerations to help focus its work in coastal watersheds. High priority areas include: 1) areas where humans activities in the watershed are significantly impacting downstream coastal wetlands or other coastal resources; 2) stream corridors that provide connections to upland habitat areas; and 3) stream corridors that provide existing or potential anadromous fish habitat (e.g., for steelhead). The WRP will focus on preserving and restoring aquatic and riparian habitat, and re-establishing ecosystem functions such as hydrologic processes (including groundwater recharge and buffering of flood waters), erosion control and sediment transport, and water quality polishing. Many of the strategies aimed at improving habitat will also improve water quality.

A. Preserve riparian and aquatic habitat along stream corridors. Stream corridors will be preserved through several mechanisms, including acquisition of property, acquisition of conservation and agricultural easements, and coordination with landowners to implement practices that preserve and protect stream corridors.

B. Restore riparian and aquatic habitat along stream corridors. Key restoration activities include removing exotic species and revegetating with native species, removing fish passage barriers, stabilizing creek banks and channels through environmentally sensitive measures, replacing concrete and other hardscaping with biotechnical flood control and stabilization mechanisms, and "daylighting" creeks.

C. Reconnect creek and river corridors to their floodplains. Floodplains perform many important ecosystem functions in a watershed, including supporting riparian habitat, detaining flood waters to slow and reduce flood peaks, and facilitating groundwater recharge. Periodic flooding is a critical component of healthy riparian ecosystems. Opportunities in Southern California to reconnect creeks and rivers to their floodplains are very limited due to the encroachment of development. For this reason, preserving systems with intact floodplains and areas where floodplains can be re-established are high priorities for the WRP.

D. Restore sediment transport functions and characteristic patterns. As described above, sediment transport functions have been altered in several ways. Restoration activities could include removing dams and other barriers to sediment transport, managing storm flows to increase scouring and flushing of downstream sediments, trapping sediment, and removing excess sediment in downstream estuaries. Specific priorities must be set individually for each watershed.

E. Reduce erosion, both along stream channels and from upland areas. Stream bank and channel erosion should be controlled through environmentally-sensitive stabilization measures that minimize channel hardscaping. Efforts to reduce erosion from upland areas will focus on working with landowners to implement erosion control management measures.

F. Improve water quality. Several of the strategies discussed above will have beneficial impacts on water quality by reducing sediment flows, contaminant loads, and water temperatures, and by detaining storm waters. Water quality concerns should be addressed through both source control measures, such as implementation of BMPs on upstream property, and treatment measures such as sediment detention basins.

G. Preserve and restore wetlands, particularly vernal pools, in coastal watersheds. As discussed above, both the vernal pool and its supporting upland area must be preserved to ensure survival of the pool.

Goal 3: Recover native habitat and species diversity.

Statement of Need

As a result of the region's extensive development, the region's coastal wetland habitats and wetland-dependent species have declined sharply from historical ranges and some have completely disappeared. Over 90 species of concern rely on Southern California's coastal wetlands for breeding and foraging habitat, and many more species of concern are found in the coastal watersheds.

The biological diversity of Southern California's coastal wetlands and watersheds has been affected on several different scales. On a regional scale, there have been significant losses of all types of habitat as a result of agricultural and urban development, with tidal wetlands and lower riverine habitat affected the most severely. Diversity of habitat types within individual wetland ecosystems has also suffered as portions have been filled or degraded.

Habitat and species diversity has also declined due to the loss of connectivity between habitats. Linkages between habitat areas are critical for species that require large ranges or access to a diversity of habitat types. Linkages are also critical for supporting multiple populations of species, which in turn helps to maintain genetic diversity. Natural habitat areas in Southern California are now highly fragmented by widespread development. In particular, the channelization and destruction of stream corridors has severely reduced movement corridors between regional habitat areas. On a smaller scale, connections between wetland habitats and surrounding upland and dune habitats have also been lost, degrading the overall functioning of these wetland ecosystems.

Species diversity is highly dependent on habitat diversity, and similar patterns of impact are seen. For instance, many species that rely on tidal wetlands have declined in numbers and are now species of concern. Species that depend on multiple habitat types for different activities or different life stages have also declined. Vernal pools are one of the rarest wetland types found in Southern California, and they contribute significantly to regional biodiversity. Several species that depend on these pools are now listed as species of concern. Extensive habitat modification has greatly reduced the carrying capacity of the regional ecosystem, and hence native species abundance.

Biological diversity in Southern California has also been impacted by the introduction of exotic species. Invasive exotic plants, such as Arundo and tamarisk, alter the hydrology, community structure and function, nutrient cycling, burn frequency, and soil chemistry of wetland ecosystems, and they compete with, hybridize, or exclude native species. Exotic predators, such as red fox and bullfrogs, have decimated populations of native fish and wildlife.

Key Strategies

The efforts of the WRP to preserve and restore coastal wetlands and stream corridors in coastal watersheds are largely aimed at preserving and recovering the region's biodiversity. Significant changes to the natural landscape and the related reduction in the carrying capacity of the regional ecosystem limit the extent to which historic habitat and species conditions can be restored. Therefore, the WRP will focus its efforts on: 1) preserving and restoring the regional diversity of wetland habitats; 2) restoring fully functioning wetlands ecosystems with a diversity of habitat types and connections to upland communities; and 3) preserving and recovering self-sustaining populations of species. Key strategies for accomplishing these goals include:

A. Restore a diversity of habitat types within individual wetland ecosystems (where appropriate and feasible). Larger wetlands will be best able to sustain a diversity of habitat types.

B. Employ a multi-species approach to wetlands recovery. The WRP advocates a multiple-species approach that also recognizes the more imminent threat to listed species. In general, this approach focuses on biological diversity at the ecosystem and habitat level, rather than on the species level. Listed species will continue to receive special attention; however, the objective is to maximize diversity and abundance of both listed and non-listed species.

C. Preserve and restore habitat linkages and fish and wildlife corridors. This includes linkages from the coastal wetlands up into the watersheds, as well as between wetlands along the coast.

D. Preserve and restore rare wetlands, including vernal pools.

E. Preserve and restore surrounding upland and dune habitat that are part of the wetland ecosystem.

F. Remove exotic species and re-establish native species, including plant, fish and predator species. For non-native species that are dispersed through the water, such as Arundo, removal and management efforts must be planned and implemented on a watershed scale.

G. Recover native, extirpated species.

Goal 4: Integrate wetlands recovery with other public objectives.

Statement of Need

Wetlands recovery efforts should be integrated with efforts to achieve other public objectives such as stormwater management, water quality improvement, beach nourishment, groundwater recharge, and recreation. Without an integrated approach, efforts to achieve these other public objectives may frustrate wetland recovery efforts. For example in many watersheds in Southern California, flood management efforts have worked at odds with wetland recovery objectives. Channelization of waterways and removal of riparian habitat are common flood control practices throughout the region. These practices continue in the rapidly urbanizing areas of the region, despite efforts in older areas to restore stream corridors and take a more integrated approach to flood management. With its extensive network of federal, state, and local agencies, the WRP is well-situated to facilitate agency communication and cooperation.

Key Strategies

A. Promote integration of wetlands conservation planning and priorities into related public policies and projects. Many of the federal, state and local agencies that are responsible for pursuing or regulating the other public objectives listed above participate in the Wetlands Recovery Project. The WRP will use these agency connections to promote a more integrated approach to achieving multiple public benefits. A key strategy is including consideration of wetlands issues and wetlands objectives in planning and policy documents for other types of projects. Key public objectives that relate to WRP efforts include:

- Stormwater management
- Transportation and other infrastructure projects
- Water quality improvements
- Recreation
- Fire suppression measures
- Public safety
- Landscaping of public property

B. Promote wetland projects that achieve multiple public objectives. The WRP will place priority on wetlands and watershed projects that achieve public objectives in addition to habitat objectives. Types of wetland and watershed projects that could facilitate other such public objectives are outlined below. Several of these strategies are discussed in greater detail under another Regional Goal.

- Stormwater management:
  - Reconnect creek and river corridors to their floodplains. As discussed under Goal 2, reconnecting creek and river corridors to their floodplains will not only provide additional storage capacity for storm waters, it will also increase riparian and aquatic habitat, facilitate groundwater recharge, and improve water quality by reducing erosion and sedimentation.

- Restore or create wetlands adjacent to stream corridors. Similar to floodplains, these wetlands can be designed to provide additional storage capacity for stormwater.
- Promote vegetation management practices that both limit flood impacts and achieve habitat objectives.

- Water quality
  - Promote projects that integrate water quality and habitat objectives. Treatment wetlands can be designed to remove specific constituents from water such as nutrients, metals, or bacteria. These are *new* wetlands created in upland areas. Although water quality objectives will be paramount in these projects, habitat objectives can also be achieved.
  - Restore watershed ecological functions. Almost all of the strategies discussed under Goal 2 will also benefit water quality. These include restoring stream corridors, reconnecting waterways with their floodplains, restoring sediment transport functions, reducing erosion, and preserving and restoring wetland habitat.

- Beach nourishment
  - Promote nearshore disposal of sediments. Several wetland sites in Southern California will require significant removal of sediments as part of any future restoration. Disposal of these sediments in the nearshore waters would facilitate sand replenishment on area beaches. The WRP will work with state and federal partners to develop protocols for nearshore disposal of sediments that both protects water quality and maximizes beach nourishment impacts.
  - Remove barriers to sediment transport in stream corridors.

- Recreation and access
  - Provide compatible access and recreation opportunities. As discussed under Goal 5, the WRP wants to promote compatible access to wetland and watershed resources. It must be recognized that in Southern California natural habitats are limited not only for birds and wildlife, but also for people. Southern California's coastal wetlands and watersheds provide oases of calm in the hectic urban landscape. The WRP is committed to the idea that through compatible access measures, humans and wildlife can successfully share these remaining pieces of nature.

Goal 5: Promote education and compatible access related to coastal wetlands and watersheds.

Statement of Need

Recovery of Southern California coastal wetlands and coastal watersheds cannot be achieved by a single agency or even a group of agencies. It can only be realized with the sustained support and commitment of the region's communities. Education[2] is a critical tool for building this

[2] Education is defined broadly and includes public awareness campaigns.

support and achieving long-term success. Communities will only be committed to preserving and restoring their wetland and watershed resources if they understand their ecological, economic, and aesthetic value.

Education about coastal wetlands and watersheds must be targeted at the decision-makers of both today and tomorrow – that is, at both adults and children. In addition, education efforts must also be targeted to reach key ethnic communities found in Southern California. Given the strong ecological connections between Southern California and Baja, Mexico, international education efforts are also needed.

For all communities and ages, one of the most effective education methods will be through first-hand experience of the resources. Thus, there is a great need to incorporate public access, interpretive programs, and opportunities for experiential learning into wetlands and watershed projects. Public access, however, must be structured in a way that is compatible with wetland resources.

Key Strategies

A. Develop compatible public access opportunities. Public access must be designed to be compatible with the overall habitat goals of wetlands recovery efforts. In general, compatible access to wetland and watershed resources should be located around the edges of habitat areas to leave large areas in the middle undisturbed by human presence. Seasonal restrictions on access may be needed to adequately protect species during critical life stages. Access limitations may vary with user groups; for instance, a group of volunteers working on removal of exotic plants could have a greater level of access than a group of school children on a field trip. Even restrictions on access provide opportunities for learning if properly explained through interpretive signs. Areas where access is restricted in order to protect a sensitive species or a re-establishing habitat can highlight the fragility of the system and the need for cooperative efforts to protect it.

B. Integrate interpretive programs into wetland and watershed projects. Interpretive signs at viewing areas and along access trails are a simple way to promote wetlands education. The WRP will encourage and fund the installation of interpretive signs and development of other interpretive materials as part of restoration projects. The WRP will also promote the development of wetland and watershed interpretive centers distributed throughout Southern California. The WRP Small Grants Program will continue to prioritize restoration and enhancement projects with an education element.

C. Promote opportunities for experiential learning. Experiential learning opportunities include hands-on projects related to wetlands and watershed resources. Common examples include citizen monitoring programs, creek clean-ups, and volunteer work brigades to remove invasive plants or plant native species. Opportunities for student research projects can be coordinated with local high schools and colleges. The WRP Small Grants Program will continue to target restoration and enhancement projects with a community involvement element.

D. Promote development and dissemination of educational materials and activities related to coastal wetlands and coastal watersheds. The Education subcommittee of the Public Advisory Committee will continue to produce materials and sponsor activities that describe the values of wetlands and watersheds to target audiences, and will facilitate dissemination of materials developed by other sources. The subcommittee will also work with the Science Advisory Panel to identify opportunities for promoting wetlands and watershed education at the university level.

E. Research and disseminate information about the economic value of wetlands and habitat preservation based on factors such as tourist economy, water quality benefits, groundwater retention, and avoided stormwater conveyance costs.

F. Promote practices to reduce urban impacts on wetlands and watersheds. This includes implementation of best management practices on private property, as well as behavioral changes such as staying on trails and keeping dogs leashed.

Goal 6: Advance the science of wetlands restoration and management in Southern California.

Statement of Need

Advancing the understanding of wetlands restoration science and incorporating this new knowledge into project designs are critical for the long-term success of wetlands recovery efforts in Southern California. As the science advances, the efficacy and cost-effectiveness of restoration and management efforts will improve. By investing in a greater understanding of restoration science now, the WRP will save far more money in the future.

Wetlands restoration is a relatively new practice, and much remains to be learned about the design and implementation of successful restoration projects. Research on coastal wetlands ecology and restoration has generally been focused on wetlands found along the Altantic and Gulf coasts. Very little information that is specific to the unique climatic, geologic, and hydrologic conditions in Southern California is available, and research is needed to develop this knowledge. The WRP Science Advisory Panel has placed a high priority on research regarding the ecology of restoration sites in Southern California, as well as the restoration techniques that will optimize results. One priority identified by the WRP Science Advisory Panel is to develop and evaluate better restoration practices including, but not limited to, the physical design of restoration projects and techniques for promoting plant establishment.

Monitoring is a critical tool for evaluating both individual restoration projects and the health of the regional ecosystem. Currently, most monitoring for wetlands restoration projects is driven by permit requirements, and may not adequately evaluate ecological development of the system. A priority should be placed on restoration projects that incorporate experimental approaches. These projects, such as the Model Marsh restoration in the Tijuana Estuary (San Diego county), allow for evaluation of restoration techniques through continued monitoring, and for the adaptive management of the system. Additional research into monitoring protocols and appropriate

indicators (such as edge and indicator species) could increase the cost-effectiveness of monitoring. Existing long-term monitoring datasets can be analyzed to refine restoration designs, and determine more cost-effective management strategies. One consideration in designing monitoring programs is to gather the most useful information within a limited budget. Additional research into monitoring protocols and appropriate indicators (such as edge and indicator species) could increase the cost-effectiveness of monitoring.

Key Strategies

A. Promote research on wetland ecology and restoration science, as well as on issues affecting the success and long-term sustainability of wetland restorations in Southern California. The WRP will promote wetlands restoration research in two main ways. First, the WRP will work with researchers to integrate wetland restoration research into WRP projects, similar to what was done at the Tijuana Estuary Model Marsh. Second, the WRP will develop an extramurally-funded research program on wetland ecology and restoration science through the Science Advisory Panel. The WRP Science Advisory Panel has identified three key areas for which additional data and research is needed:

- Prioritizing wetlands acquisition and restoration Projects – In order to most effectively and efficiently achieve the WRP's regional goal, the WRP needs to target its limited resources to the highest priority projects. The Science Advisory Panel is currently working to create an analytical framework for prioritizing acquisition and restoration projects based on ecological benefits to the region. This analytical framework will be refined and revised as additional information becomes available. Key data and research priorities for building this decision support tool include:

    - Estimate of historical quantity and distribution of wetland habitat types.
    - Estimate of current quantity and distribution of wetland habitat types. The Southern California Coastal Wetlands Inventory compiled acreage data on existing wetland habitat types for the major coastal wetlands in the region, but did not compile spatial data on habitat types. No estimates of riparian habitat for the region have been made.
    - Research and describe the ecological relationships in wetland and stream ecosystems, including the connections and interdependence between wetlands and adjacent uplands, and the role and effectiveness of habitat corridors.

- Addressing constraints to restoration projects – Wetlands restoration projects in Southern California take place in a highly complex urban environment. The effects of these urban surroundings on water and sediment quality can constrain the ability of the WRP to implement projects. Further research is needed to assess the scientific basis of these constraints, identify the circumstances under which they are most likely to be important, and identify how they should be addressed in project designs to ensure the WRP's long-term success. Key areas for further research and data collection include:

    - Identify the most common and difficult impediments to wetlands restoration.
    - Evaluate the role of marshes in nearshore public health issues, including, but not limited to, bacteria, viruses, pathogens, and mosquitoes. Estimate natural background levels of bacteria in coastal waters.

- Evaluate the effects of watershed sediment dynamics and sediment management practices on the health of coastal marshes.
- Evaluate the role and function of coastal wetlands in urban runoff control and management.
- Evaluate the effects of natural and anthropogenic changes to water level, tidal exchange, and shoreline stability on coastal wetlands.

- Optimizing restoration implementation and evaluation – Restoration of coastal wetlands and riparian corridors is a relatively new practice, and there is still much to be learned about the design and implementation of successful restoration projects. Every project provides opportunities for increasing our understanding of key ecological processes and beneficial restoration techniques which will improve the success of future restoration efforts. Effective monitoring is a critical tool for capitalizing on these opportunities. Key areas for further research and data collection include:

  - Develop and evaluate better restoration techniques including, but not limited to, the physical design of restoration projects and techniques for promoting plant establishment, including rare and endangered plants.
  - Define success criteria for individual projects and identify measurable indicators of those criteria.
  - Define and test performance curves for assessing restoration progress and success.
  - Test and implement a region-wide monitoring program.
  - Identify important edge species that can serve as indicators of ecosystem integrity and evaluate their habitat requirements.

B. Promote development of more effective monitoring programs for both regional and project-specific assessments. The WRP will promote the development of better monitoring programs by requiring *and funding* monitoring programs for WRP projects. The WRP will also pursue development of standardized monitoring guidelines and more cost-efficient monitoring techniques. Key areas for further research are discussed under section A above.

C. Disseminate information. Through its network of federal, state, and local partners, the WRP will serve as a clearinghouse for information about wetlands research and restoration practices. Monitoring data from WRP projects will be made available on the WRP web site. In addition, the WRP will create forums for sharing research findings and recommendations. The WRP will also create or facilitate the creation of a data repository for wetlands restoration research.