



CHARTING A COURSE

The vision of a healthy and vibrant Laguna, as captured in the minds of the community, is a courageous mixture of hopes and ideals, but strides toward the realization of that vision need to be directed if they are to be effectual. At an all-encompassing level, that direction has been charted on a simple statement of goals, which is:

“To preserve and enhance the Laguna de Santa Rosa watershed through ecological restoration, research, and care that supports biological diversity, improves water quality, provides flood protection, enhances groundwater resources, and provides for human needs, thereby leaving a lasting legacy for future generations.”

To add clarity to this all-encompassing goal, twelve high-level goals have been established, they are:

1. To restore the native habitats and to enhance the biological diversity of the Laguna, thus preserving both rare and common species.
2. To establish the Laguna as a biological hotspot, thereby allowing it to act as a dispersal source, to nearby regions, of plant and animal life.
3. To maintain the role of the Laguna as a stopover for migratory birds, thereby helping to preserve worldwide bird diversity.
4. To establish a center for ecological research, thus deepening our understanding and helping us to better care for the Laguna's natural resources.
5. To equilibrate the Laguna's hydrology and hydraulics and to eliminate erosion, thereby reducing the impacts of channelization and sedimentation.
6. To prevent encroachment of the Laguna's floodplain, thereby retaining the beneficial values of floodwater while reducing downstream flood damage.
7. To improve the quality of water throughout the watershed, thereby protecting human health and the environment.
8. To develop environmentally-sensitive creek maintenance activities, thereby promoting healthy stream systems.

Twelve high-level goals for the Laguna

9. To preserve groundwater recharge areas, thereby sustaining our aquifers.
10. To support agricultural use of the land, thus maintaining a healthy farm-based economy within the Laguna.
11. To promote environmental education, eco-tourism, and active participation in the Laguna's care, thereby fostering greater public understanding of the Laguna.
12. To establish habitat-sensitive trails and wildland-compatible recreation, thereby enhancing public appreciation for the Laguna.

The purpose of this plan, *Enhancing and caring for the Laguna*, is to provide guidance and recommendations for the active restoration and management of the Laguna de Santa Rosa. The design of individual restoration projects and the preparation of site-specific management plans should strive to meet the objectives spelled out here. Projects and plans that follow the suggested recommendations will collectively help to build towards the stated common goals. All stakeholders are invited to consider how they can participate in implementing these recommendations. The concerted efforts of the broad stakeholder community will strengthen the outcome of many smaller contributions.

In the outline below the symbol ➤ is used to indicate an *objective*, the symbol ☆ is used to indicate a *recommendation*, and the symbol ★ is used to indicate a *high priority* recommendation.



WATERSHED OBJECTIVES

- 1 ➤ *Communicating a vision:* Communicate the vision of a restored Laguna watershed to the citizens of Sonoma County as well as state and federal elected officials, and to individuals and organizations throughout the region who appreciate the natural treasures of our area.
- 2 ➤ *Assessing needs:* Provide an assessment of the high-priority knowledge gaps, restoration and management challenges for the Laguna, and the research or additional tools needed to move forward with substantive restoration projects.
- 3 ➤ *Advancing knowledge:* Promote the use of science as a basis of environmental policy and restoration. Support the development of research programs and partnerships to gain further knowledge about the physical and biological processes that shape the ecology of the Laguna watershed, adapting plans and management efforts as better information becomes available from research and monitoring.

- 4 ➤ *Identifying opportunities:* Identify restoration opportunities and maintain an active list of recommended projects in the Laguna watershed for implementation by property owners, restoration organizations, local municipalities, state and federal agencies, and watershed groups.
- 5 ➤ *Developing funding:* Assist in the development of external funding sources for preservation, restoration and management activities in the Laguna watershed, including state bond funds, private donors, and federal appropriations.
- 6 ➤ *Strengthening partnerships:* Strengthen collaborations for restoration and management of Laguna lands and waters among all levels of government, the private sector, environmental organizations and individuals who wish to participate in watershed stewardship.
- 7 ➤ *Involving the community:* Promote public involvement and volunteerism in Laguna restoration, and environmental education for students of all ages—recognizing that healthy waterways and natural areas depend on public support and personal commitments to environmental integrity.

Watershed
objectives



HABITAT RESTORATION AND MANAGEMENT

- 8 ➤ *Self-sustaining ecosystems:* Promote healthy, self-sustaining and functional ecosystems.
 - 8.1 ☆ *Hydrologic restoration and diversity:* Natural hydrologic processes support the development of natural stream conditions and riparian communities representing a spectrum of successional stages. Restore natural hydrology and hydraulics wherever possible and retain a diversity of such conditions within the Laguna system—waterways, ponds, high marsh, low marsh, seasonal wetlands and floodplains—to provide diverse habitat types and support healthy and diverse native plant and animal communities, thus managing not only for high floods, but also for annual floods, bankful and base-flows conditions.
 - 8.2 ☆ *Sediment control planning for the Laguna watershed:* Residential and agricultural development has accelerated natural rates of erosion throughout the watershed, degrading stream conditions and increasing flood risks. Develop a watershed-scale erosion control plan to address the need for better adherence to best management practices among land owners and land managers; coordinate this planning effort with the Standard Urban Stormwater Mitigation Plans of the watershed's cities. Identify sites of active erosion and implement erosion control projects through-

out the watershed, to address both large-scale sediment sources and non-point source contributions. Place special emphasis on erosion control in the upper watershed, promoting restoration-based methods where possible.

See also 9.1-9.5; 11.1, 11.2; 14.1, 14.3-14.5; 16.1, 16.2; 17.1-17.3, 17.5; 18.1; 20.1, 20.4; 22.1, 22.6, 22.7, 22.8; 23.2; 24.2

- 9 ➤ *Natural restoration templates:* Design and implement new restoration projects and expand current projects to reflect the diversity and structure of natural habitats.

9.1 ☆ *Prioritize habitat connectivity:* Enhance habitat connectivity within the Laguna and across the region and create large and contiguous habitat areas. Small, disconnected preserve areas have much lower ecological value than large or interlinked preserves. Prioritize land protection and design restoration projects that form links between existing areas of habitat, thus increasing the size of large, contiguous habitat areas, or forming corridors between habitat patches. Favor projects and parcels with adjoining land uses that are compatible with restoration goals.

9.2 ☆ *Plant native plants:* Native trees, shrubs and other plants are the base of healthy food webs and wildlife communities. Plants that are adapted to local conditions will have the highest success and require the least effort to become established.

9.3 ☆ *Species diversity in restoration:* Species diversity depends on the presence of parent plants to provide seeds and other propagules, and can be important for long-term restoration success and ecological value. Multi-species restoration plantings increase the quality of wildlife habitat by providing variation in habitat structure and food plants. Restoration projects should incorporate diverse plant species, including trees, shrubs, grasses and herbaceous perennials.

9.4 ☆ *Phased restoration plantings:* The most diverse plant communities, supporting the greatest variety of wildlife, are mosaics of different successional stages. To mimic these natural processes, restoration projects should ideally be phased: first planting trees and shrubs that tolerate harsher conditions, then following up with more shade-tolerant understory plants after the first plantings have begun to fill in.

9.5 ☆ *Restore vegetation structure:* Natural plant communities have complex vegetation structure, with different species of different sizes and age classes often growing in clumps and patches. Res-

toration projects should be designed to reproduce this structural complexity to enhance the ecological value of restoration sites.

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- 9.6 ☆ *Reference systems:* The best guide for restoring a degraded habitat is a healthy habitat nearby—ideally within the same ecosystem. Reference habitats indicate which species are locally adapted and appropriate, and can potentially be a source of parent material for plant propagation. Wherever possible, restoration practitioners should find and use reference sites within the Laguna watershed.

See also 8.1; 11.1; 14.1, 14.3-14.4; 16.1, 16.5; 17.1-17.3, 17.5; 18.1; 19.1; 20.1; 22.2, 22.3

- 10 ➤ *Increase effectiveness:* Continuously improve the effectiveness of restoration, management and monitoring efforts.

- 10.1 ☆ *Watershed-scale research and planning:* Ecological processes and conditions occurring in the upper parts of the watershed strongly affect processes and conditions downstream. For this reason it is essential to undertake research and management planning for water and other environmental resources at the scale of the entire Laguna watershed.

- 10.2 ☆ *Focus on collaboration:* Working on the scale of the entire watershed must be an interdisciplinary endeavor, and many research, restoration and management programs cross jurisdictional boundaries. Without pooled intellectual and financial resources, it is difficult to leverage watershed-scale projects. Coordinate efforts of all agencies and organizations working within the watershed, continually working to develop synergistic partnerships.

- 10.3 ☆ *Promote research:* Increase knowledge of the Laguna's ecology and species biology through scientific research and monitoring. Support and develop scientific research programs on the physical and biological processes that contribute to the ecology of the Laguna; fostering partnerships between local restoration practitioners, researchers from universities and government agencies in both basic and applied sciences. Develop science-based measures to quantify the success of restoration projects.

- 10.4 ☆ *Develop, communicate, and refine adaptive management practices:* The science of restoration and adaptive management is continually evolving, and the greatest progress is made when knowledge is shared between different members of the community. Consult with landowners, restoration scientists, local jurisdictions and

- public agency staff to continuously improve best management practices and restoration techniques. Develop communication channels to share this information between practitioners.
- 10.5 ☆ *Focus on habitats:* Where possible, restoration and management should focus on habitats and ecosystems rather than single-species conservation. When managing for the recovery of rare species, include monitoring for additional species and environmental factors.
- 10.6 ☆ *Develop indicators:* Without measurable, standardized indicators it is difficult to quantify the progress and success of restoration and management activities. Different types of indicators are used to measure different environmental factors: for example, the presence or absence of certain bird or invertebrate species are used to measure the health of forests or aquatic systems. Develop appropriate indicators that are specific to environmental concerns in the Laguna watershed, using research, field surveys, monitoring and mapping information.
- 10.7 ☆ *Funding for maintenance of restoration projects:* Many restoration projects are located in public areas, and planted by students and volunteers. Without regular maintenance, restoration projects can have high failure rates, become overgrown with invasive species, and contribute to local flooding when overgrown vegetation traps sediment and debris, undermining support for future projects. Whenever possible, restoration plans and grant applications should include at least three years of follow-up into their budgets. Public landowners should include funding for long-term maintenance into their operations or public works budgets.
- 10.8 ☆ *Share the wealth:* Not only do more hands make less work, but the more that citizens participate in growing the health of the watershed, the more there will be widespread appreciation of the Laguna's value to the community. Expand abilities to provide financial assistance and technical advice to private landowners and grassroots groups conducting conservation or restoration activities.
- 10.9 ☆ *Establish a Laguna ecosystem database:* Many classes of data are being gathered for different purposes throughout the greater Laguna watershed. To expedite research and enhance the collective understanding of the Laguna's biological and physical systems, these data must be consolidated into a central, web-ac-

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cessible GIS database. This database is the appropriate repository of monitoring data from preserves, and will allow researchers to evaluate species data within the context of other environmental variables. Integrate with the Russian River Interactive Information System, The Nature Conservancy's Weed Information Management System, and other regional and national databases.

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- 10.10 ★ *Standardized data collection:* Without standardization it can be difficult or impossible to combine data sets to analyze problems and patterns at larger geographic scales. Develop standard operating procedures (SOPs) for monitoring, experiments, and field surveys wherever feasible to support the collection and analysis of data in the Laguna ecosystem database. Place special emphasis on standardized water monitoring and biological surveys. Data collection methods must be simple enough to be accurately executed by individuals with a range of abilities.
- 10.11 ★ *Streamlined restoration permitting:* Riparian restoration on both public and private lands is often slowed or limited by the complexities of the permitting process. Other watersheds have greatly increased the number and rate of restoration projects by working with regulatory agencies to bundle or streamline permits. This effort can result in substantial cost savings over the long term, as it increases the efficiency of the process for both regulators and project proponents.
- 10.12 ★ *Reauthorization of Sonoma County Agricultural Preservation and Open Space District:* Many of the most important restoration and conservation activities in the Laguna watershed depend on the reauthorization of SCAPOSD to bring key properties into public ownership, to provide compensation for landowners for setting aside land for conservation purposes, and to help maintain the financial viability of farming in the watershed. Long-term restoration and stewardship endowments should be factored into the cost of all acquisitions to support the environmental quality of these lands.
- 10.13 ★ *Establish a Laguna stakeholder council:* The Laguna de Santa Rosa is a complex watershed, whether measured by social or ecological standards. Given this complexity, rigorous environmental planning will require broad consultation between different stakeholders. Establishing a formal stakeholder council may be the

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- most effective and efficient way to share knowledge and gather input on specific projects and policies.
- See also 8.1-8.2; 9.1-9.6; 11.1-11.3, 11.7-11.10, 11.13-11.14; 12.1-12.4; 14.2; 15.2-15.4; 16.3; 17.4; 18.4; 19.2-19.8; 20.4, 20.6-20.7; 21.2-21.14; 22.1; 23.1; 24.1-24.6, 24.8
- 11 ➤ *Invasive species*: Preserve the biological diversity of natural communities by proactively limiting the introduction and spread of aggressive invasive species; restoring the ecosystem to make it more resistant to invasive species; and when necessary, instituting control efforts using integrated pest management practices while considering the context of the entire watershed.
- 11.1 ☆ *Prevention through restoration*: Pursue restoration efforts throughout the watershed that promote healthy native plant communities and control invasive species. All restoration plans must have a weed prevention and control component.
- 11.2 ☆ *Reduce invasive species introductions*: Reduce horticultural introductions and other accidental introductions of invasive species through environmental education to gardeners and collaborations with nurseries, and by raising the awareness of the public about other invasion pathways.
- 11.3 ☆ *Early detection and rapid response*: The likelihood of success is much greater and the costs and control impacts are much less if invasive species control efforts can be implemented when populations are very small. Prioritize invasive species surveys and mapping to increase early detection, and prioritize funding and implementation of control programs for small satellite populations of invasive species.
- 11.4 ☆ *Integrated pest management*: Much of the controversy surrounding invasive species stems from the use of chemical pesticides. Improper and excess use of pesticides can have unwanted impacts on non-target plants and animals. Integrated pest management is a strategy that incorporates a range of different control techniques to minimize pesticides use for weed management, and control programs should always seek to follow an integrated pest management approach.
- 11.5 ☆ *Collaborative planning and implementation*: Invasive species know no property boundaries, so control programs almost always require cooperation and collaboration between landowners. Support regional collaborations between agencies and environmental organizations through the Marin/Sonoma Weed Management
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Area. Support local collaborations between public and private landowners as well as watershed and volunteer groups. Respect philosophical differences in views and values. Provide technical assistance and support to private landowners seeking to control invasive species.

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- 11.6 ☆ *Aggressive control for aggressive species:* Initiate collaborative control efforts for the most aggressive high-priority invasive species. Use an integrated pest management approach that considers the geographic and ecological context of the invasion, minimizes the control effort and minimizes non-target impacts.
- 11.7 ☆ *Long-term control requires research:* Expand research on ecology and control methods for the worst invasive species. Include funding for invasive species research and monitoring into grant applications for invasive species control projects.
- 11.8 ☆ *Invasive species mapping and monitoring:* It is essential to track invasive species to improve control and adaptive management. Map and monitor the highest-priority invasive species on public properties in the Laguna, including both weeds and animals. Collect data in the Laguna ecosystem database and integrate it with the Nature Conservancy's Weed Information Management System. Provide assistance for private landowners interested in participating with monitoring on their properties. Use research and mapping information to develop numeric targets for control of highest-priority invasive species.
- 11.9 ★ *Site-specific invasive species management plans for public properties:* All public properties in the Laguna should have site-specific plans for invasive species management. Plans should define explicit management objectives—for example, managing preserves for California tiger salamander (CTS) or managing farms for wastewater disposal—and reflect differences in environmental conditions and species of concern, as well as constraints on available control measures.
- 11.10 ★ *Ludwigia research:* Expand current research efforts on *Ludwigia* taxonomy, ecophysiology, population biology and community ecology—including research on biological control organisms—to support long-term restoration-based *Ludwigia* control.
- 11.11 ★ *Ludwigia control program:* Implement the *Ludwigia* Task Force's recommendations for interim and long-term *Ludwigia* control, as described in the *Ludwigia* Management Plan.

- 11.12 ★ *Pepperweed control program*: Develop and implement plans to eradicate perennial pepperweed from the greater Laguna watershed. Institute collaborative control agreements for work on neighboring properties. Habitat restoration and management
- 11.13 ★ *Turkey monitoring*: Future management actions to control wild turkey numbers in the Laguna will depend on having good population data and, if possible, records of ecological interactions with other species. Develop monitoring protocols and initiate monitoring program for wild turkeys on public lands in the Laguna, collecting this information in the Laguna ecosystem database. Provide outreach and assistance for private landowners interested in participating with monitoring on their properties.
- 11.14 ★ *Wild turkey policy and management*: Wild turkey population growth is likely to create conflicting management objectives on public preserve lands in the Laguna. To strengthen the legal basis for instituting wild turkey reduction strategies, explicitly develop turkey policy statements for site-specific management plans in the Laguna.
- 11.15 ★ *Wild turkey ecological research*: Very little is known about the current and potential ecological impacts of wild turkeys on the Laguna ecosystem. Initiate research to evaluate turkey impacts to oak restoration, endangered species, and invasive plant establishment.
- 11.16 ★ *Crayfish research*: Two species of non-native crayfish have been introduced to the Laguna: the Louisiana swamp crayfish and the Signal crayfish. There were no crayfish native to this area, but they are now found in huge numbers. Crayfish appear to be an important part of the diets of raccoons, otter, and large wading birds in the Laguna, and are themselves omnivorous, preying on fish, turtles, amphibians, and other aquatic invertebrates as well as live and decaying plant material. Given their central food web position and great abundance, it is likely that crayfish are having a profound effect on the ecology of Laguna wetlands, but these effects have never been evaluated. Much more research is needed to inform management recommendations.

See also 8.1-8.2; 9.1-9.6; 10.2, 10.7-10.11; 12.1; 14.1, 14.3-14.4; 15.1-15.6; 16.1-16.2, 16.5, 16.10-16.12; 17.2-17.4; 18.1-18.2, 18.4; 19.7, 19.9; 20.1, 20.7; 21.14; 23.2; 24.1-24.2; 24.5

- 12 ➤ *Human contributions to ecosystems*: Balance human and ecological needs in restoration and management, recognizing the importance of healthy

communities, a healthy economy and broad public participation for environmental well-being—including the need to support local agriculture and a diversity of land uses.

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- 12.1 ☆ *Protect agricultural land use:* Agricultural areas provide essential buffers between preserve lands and developed areas. The ecological value of natural areas will be greatly increased by protecting the agricultural open space around them. Species conservation areas will need to share space with ranch or dairy operations, in part because much of the land is in private ownership, but also because without management the health of grasslands and seasonal wetlands will further decline.
- 12.2 ☆ *Promote backyard wildlife refuge areas:* Backyards in both rural and urban residential areas can provide stepping-stone connectivity for many species when planted with native landscaping. Educating the community about how to “restore” their own backyards can help to enhance and support wildlife on nearby public preserves.
- 12.3 ☆ *Ecological value of human-altered features and landscapes:* Given the substantial changes that have occurred over time in the watershed, there are now a number of animals like bats and barn swallows that rely on the human-altered components of the landscape. These include agricultural areas, water channels, buildings, roadways, bridges, ponds, telephone poles, and urban back yards. Large non-native trees or old orchards may provide essential nesting habitat for birds and other animals while native restoration plantings mature. Restorationists and land managers should consider the ecological value of these features while planning restoration projects.
- 12.4 ★ *Plant hedgerows for habitat and connectivity:* Agricultural hedgerows increase habitat quality and connectivity at the wildland/agricultural interface. Implement hedgerow projects in upland areas to increase linkages between natural areas, reduce runoff and erosion, and provide habitat for insects, birds and wildlife on farms and along roadsides. Hedgerows should incorporate a diversity of native trees, shrubs and herbaceous plants.
- 12.5 ★ *Build bird boxes, bat houses and raptor perches:* Many birds and bats prefer to nest in the cavities and crevasses of old trees, which are frequently missing from our human-altered landscapes. Although restoration practitioners should attempt to keep natural cavities whenever possible, building bird and bat houses and

establishing them in natural areas can have a beneficial effect on cavity-dependent species. It is important to monitor these structures annually to ensure they are not colonized by starlings or other non-native species. Raptor perches and telephone poles take the place of old snags in the grasslands, where hawks can perch and watch for rodents and other prey.

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See also 10.2, 10.8, 10.12-10.13; 15.1-15.6; 17.4; 18.1-18.2, 18.4; 21.6



SPECIFIC HABITATS

- 13 ➤ *Habitat diversity*: Preserve the diversity of habitat types in the Laguna, including grasslands, oak savannah, oak woodland, mixed riparian forests, high marsh, low marsh, and seasonal wetlands. Support environmental education programs that encourage public awareness of the unique value and beauty of the varied habitat types of the Laguna watershed.
- 14 ➤ *Riparian forest corridors*: Restore and protect riparian corridors to enhance aquatic and riparian ecosystem integrity, control erosion and sedimentation; and promote water quality improvements.
 - 14.1 ☆ *Restore 300 miles of riparian forest buffers by 2020*: Riparian forests are essential for ecosystem health, but more than half of the stream channels in the Laguna watershed have no stream canopy. Restoration at this scale will require public and private collaborations for planning, funding, implementation and management, as well as outreach and education programs. Many existing efforts can contribute to the overall goal. Top priority areas include the Middle Reach of the Laguna channel between Highway 12 in Sebastopol and Guerneville Road, the Sunland reach of the Laguna channel, Colgan Creek, Gossage and Washoe Creeks near Cotati, the Laguna channel from its headwaters to the confluence with Copeland Creek; and the Wilfred and Hinebaugh flood control channels.
 - 14.2 ☆ *Riparian corridor baseline evaluation*: Riparian restoration requires careful reach-by-reach site-specific surveys to evaluate the health, density and diversity of existing vegetation, and potential site-specific challenges. Use field reconnaissance and GIS data to assess the state of riparian vegetation on perennial and ephemeral stream channels in the Laguna watershed.
 - 14.3 ☆ *Riparian buffer width*: The most healthy and sustainable riparian corridors have their width determined by natural hydrological conditions, but this is not possible in many developed areas.

Work with public and private landowners to determine the optimal feasible width and composition of riparian forest buffers in different geographic areas and land use conditions. Encourage the planting of riparian vegetation in rural areas with these suggested widths: 100 feet on each side for major creeks, 70 feet on each side for all other creeks with year-round flow, 40 feet on each side for intermittent waterways.

Specific
habitats

- 14.4 ☆ *Expand riparian woodlands:* Certain species, like the yellow-billed cuckoo, need large blocks of forest. Use historical ecology and hydrological analyses of the floodplain to identify which parcels are likely to support extensive riparian tree plantings without impeding flood protection.

- 14.5 ☆ *Stream and wetland protections:* Riparian and floodplain areas have far-reaching environmental functions that are essential to the overall health of the Laguna ecosystem. Support development of a strong NCRWQCB stream and wetland protection policy that recognizes the importance of maintaining healthy hydrology and vegetation in riparian areas and floodplains, and the connectivity between riparian, floodplain and wetland areas. Policies should be developed through consultation with the public, and reflect the constraints of existing development.

- 14.6 ☆ *Expansion and public ownership of stream setbacks, wetlands and floodplain:* Stream setbacks are quite narrow in many urban areas—as little as 30 feet in some cases. Narrow setbacks provide little room for restoring natural meanders or riparian vegetation, and give little protection from flooding or bank failure. Because encroachment and loss of native habitat in urban areas is so severe, the need for wide riparian corridors through cities is greater than it is for ex-urban areas. New residential and commercial developments should work with SCAPOSD to acquire land along creeks. Cities should also adopt plans that expand the width of setbacks in new developments in order to increase habitat connectivity and allow for future restoration and ongoing maintenance.

See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.1-11.12; 12.5; 15.1-15.6; 16.1-16.2, 16.11-16.14; 17.5; 19.1-19.8; 20.2-20.7; 22.1, 22.7-22.8, 22.10; 23.1, 23.3, 23.5; 24.1-24.2; 24.5

- 15 ➤ *Urban waterways:* Meet the joint objectives of riparian restoration and flood protection in urban areas and maintain public support for ecological

values by restoring urban riparian corridors and developing environmentally-appropriate maintenance plans.

Specific
habitats

- 15.1 ☆ *Urban tree canopy:* Urban streams must often be managed like linear parks rather than natural areas, but healthy urban riparian corridors are essential for providing habitat connectivity between the floodplain and the hills surrounding the plain. Develop restoration projects to increase the amount of tree canopy where the Laguna channel and its tributaries pass through urban and suburban areas.
- 15.2 ☆ *Urban creek planning:* Sustainable urban creek restoration depends on careful planning to balance human and environmental needs. Support existing urban creek restoration projects, including full implementation of the Santa Rosa Creek Master Plan, and the Santa Rosa Citywide Creek Master Plan. Expedite a Creek Master Plan process for the southern Laguna (Rohnert Park and Cotati).
- 15.3 ☆ *Creek stewardship:* The City of Santa Rosa and SCWA jointly fund a creek steward position for creek channels in Santa Rosa. The creek steward performs education and outreach to the public, and facilitates community involvement in creek restoration projects. Support the continued funding of this position, and the development of a new creek steward position for channels outside the city of Santa Rosa, with special focus on the urbanized areas in the southern Laguna watershed.
- 15.4 ☆ *Community-based restoration:* When volunteers and students participate in creek restoration they develop a unique appreciation and sense of personal responsibility for the environment. Support community-based riparian restoration and environmental education programs, to educate about the importance of riparian processes and create connection to the land and the community.
- 15.5 ☆ *Increase public trails along urban creeks:* Increased public access raises environmental awareness about the importance of riparian corridors. Where there are well-used trails and bike paths there is less vandalism and illegal camping. Where appropriate, service roads and rights-of-way should be developed as walking or biking trails.
- 15.6 ☆ *Channel maintenance in developed areas:* Under natural conditions, many developed areas on the Santa Rosa Plain would flood, especially if the riparian corridor were allowed to grow unre-

strained. As riparian corridors are essential for ecosystem health, they must be regularly maintained to allow continued flood capacity in developed areas—through vegetation management, invasive species control, and sediment or debris removal if necessary. Develop site-specific management plans for all the Laguna tributaries and flood control channels, including maintenance policies, schedules and practices.

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See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.1-11.12; 12.5; 14.1-14.6; 16.1-16.2; 17.5; 19.1-19.8; 20.2-20.7; 22.1, 22.4-22.5, 22.10; 23.1, 23.3-23.5; 24.1-24.2; 24.5

16 ➤ *Wetland habitats*: Support the health and diversity of wetland habitats in the Laguna.

16.1 ☆ *Keeping all the parts*: Given competing land uses and lack of natural hydrologic disturbances that sustain habitat diversity, not all areas that could potentially support riparian forest should be restored to riparian forest. Some riparian areas are emergent wetlands, grading to wet meadows and floodplain seasonal wetlands, and these should be protected for their distinct habitat values.

16.2 ☆ *Wetland restoration research*: The Laguna wetlands are the most biologically diverse, productive and complex habitat in the ecosystem, yet little is known about the details of their ecological functions, and how biological and physical processes interact. Much more research is needed to inform restoration and management programs for seasonal wetlands, floodplains, and emergent perennial wetlands and waterways.

16.3 ☆ *Improve wetland mitigation policies*: There are well-established laws allowing mitigation for wetland loss by creating or restoring wetland areas, but the science and techniques to ensure these practices accomplish their objectives are still evolving. Policy changes are needed to promote experimental efforts to improve techniques for wetland creation and restoration, such as awarding extra mitigation credits for projects designed as experiments, and allowing longer evaluation times. Increase emphasis on wetland function and habitat connectivity. Require adequate endowments for perpetual stewardship.

16.4 ☆ *Increase public awareness about the value of seasonal wetlands*: Increase opportunities for the public to view and appreciate restored seasonal wetlands and other Laguna habitat complexes in ways that respect the environmental sensitivity of these habitats.

- 16.5 ☆ *Restore tule marshes without *Ludwigia**: Tule marshes are an essential habitat element in the Laguna watershed. One of the suggestions for *Ludwigia* management is to flood or drain areas vulnerable to *Ludwigia* infestation, but this potentially eliminates tule habitat. It is critically important to develop management strategies that sustain emergent marshland in the watershed. Specific habitats
- 16.6 ☆ *Restoring wetlands with fewer mosquitoes*: Develop a scientific research program to better understand the ecological interactions of mosquitoes and wetland systems, in order to develop methods of wetland management that reduce mosquito production without impairing wetland function or requiring excessive mosquito-control products. Work collaboratively with staff from the Marin/Sonoma Mosquito and Vector Control District.
- 16.7 ☆ *Re-opening the Middle Reach channel*: Opening up the narrow half mile reach of the Laguna, situated between the broad and deep channel located within Sebastopol and the similarly broad and deep channel south of Occidental Road, would create an opportunity for greater public access by allowing summer kayaking between Highway 12 and Guerneville Road. In this reach the channel passes through a large ongoing riparian restoration project, and parallels a new trail being established by the SCA-POSD. This project would require substantial sediment removal and channel clearing, and would require feasibility studies to evaluate its effects on local hydrology, but might be effective in providing flood protection within Sebastopol.
- 16.8 ☆ *Restore Lake Jonive*: The Laguna de Santa Rosa historically had several large lakes, including Lake Jonive, north of Sebastopol. In addition to the benefits of replicating historical conditions and increasing flood-storage capacity, restoration of a Laguna lake would greatly benefit fish and wildlife, and would be a tremendous public resource for recreational boating and nature viewing.
- 16.9 ☆ *Sunland Reach of the Laguna*: The elevation of the Laguna main channel between Stony Point and Llano roads determines the summertime water depths of the Bellevue-Wilfred channel upstream. Under current conditions, the Bellevue-Wilfred channel is ponded and stagnant, infested by *Ludwigia*, and a substantial source of mosquito production. It is a high priority to evaluate the feasibility of establishing low-flow channel in this reach.

- 16.10 ★ *CDFG Wildlife Area*: The portion of the Laguna Wildlife Area located between Occidental and Guerneville Roads has been undergoing rapid hydrologic and hydraulic changes that appear to be associated with sedimentation patterns. Historically, this area was extensively modified, including drainage and filling of wetlands and seasonal lakes, and channelization to open land for agriculture. It is now highly invaded by *Ludwigia*, and is a candidate for extensive restoration. However, restoration cannot proceed without further studies and feasibility analyses, to predict the future direction of hydrologic changes and to develop engineered solutions that will be in dynamic equilibrium and sustainable over time, rather than rapidly filling in with sediment.
- 16.11 ★ *Balletto Wetlands/Middle Reach Restoration project*: One of the few remaining stands of Sebastopol Meadowfoam occurs on wetlands adjoining the City of Sebastopol's Meadowlark Field on the Laguna Wetland Preserve. Although this is a floodplain wetland, rather than a vernal pool, it represents an excellent opportunity for public viewing and appreciation of vernal pool wildflower communities. The property is scheduled to be transferred to the SCAPOSD, and the wetland is adjacent to planned trail alignments. Restoration planning should include consideration of future seasonal public access to wetland areas, via ADA-compliant boardwalks.
- 16.12 ★ *Wilfred/Bellevue restoration*: The Wilfred/Bellevue flood control channel is one of the most degraded in the Laguna watershed, with a wide, flat trapezoidal cross-section and scant riparian vegetation. The channel bottom is vulnerable to aquatic weed infestation, specifically *Ludwigia*. Feasibility studies should be conducted to install a meandering low flow channel to hold summer water in order to reduce weed growth and allow shade trees to be planted at the toe of the bank. Ideally, there should be public purchase of wider setbacks along either bank, to increase opportunities for riparian restoration.
- 16.13 ★ *Land protection for the Turner Creek / Blucher Creek confluence*: The floodplain of both Turner and Blucher Creeks, just above where they join the Laguna, represents an important riparian floodplain of exceptionally high value. Further acquisitions into the public realm, from willing sellers, should be sought in order to

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habitats

protect both the high quality habitat and the beneficial flood dampening effect of this area.

- 16.14 ☆ *Land protection for Lower Gossage Creek / Old Washoe Creek:* The final mile of each of these two creeks, prior to joining the Laguna, is at the frontier of the Cotati urban boundary. The area is very low-lying and will become the recipient of increased floodwaters as construction and development picks up pace to the south. Existing county zoning should be safeguarded in this area.

- 16.15 ★ *Land protection for Cunningham Marsh:* This and other remnant upland wetlands in the western portions of the watershed are the most endangered habitat type in the watershed, supporting some of the rarest plant species. Although a conservation easement protects a portion of Cunningham Marsh, species recovery efforts would be greatly aided if more of the marsh and surrounding uplands were to be purchased from willing landowners.

See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.1-11.12, 11.16; 12.5; 14.1, 14.5-14.6; 19.1-19.8, 19.9; 20.1; 21.1-21.14; 22.1-22.10; 23.1-23.6; 24.1-24.8

- 17 ➤ *Oak habitat:* To ensure the long-term sustainability of oak populations—for their beauty and cultural value, habitat value, and ability to stabilize soils—on the Plain as well as the hill slopes of the watershed, by planting and protecting acorns and seedlings in their ancestral range, developing management strategies that promote their survival, and supporting research and management to reduce the vulnerability of mature oaks to sudden oak death and other diseases.

- 17.1 ☆ *Preserve existing mature trees:* Oaks take many decades to mature before they reach their most productive stage and host the greatest number of different animal and insect species. Whenever possible, oaks should be retained throughout the watershed.

- 17.2 ☆ *Oak restoration:* Oak recruitment is the factor most limiting for oak population recovery in the Laguna watershed. Plant replacements for oaks nearing the end of their natural life spans, and promote oak re-colonization of grasslands where feasible, increasing oak density. As oaks take many years to reach maturity, it is important to undertake restoration efforts as soon as possible.

- 17.3 ☆ *Stablize hillsides:* Oak woodlands and perennial grasses stabilize hillsides. Historic clearing of oak woodlands and conversion to

Specific
habitats

annual grasslands have contributed to significant increases in erosion, especially in geologically unstable areas. Work with public and private landowners to initiate large-scale restoration projects planting oaks and deep-rooted native perennial grasses on slopes around the Santa Rosa Plain, especially in the southern portions of the watershed.

- 17.4 ☆ *Oak management*: Develop management techniques and policies that enhance the survival of acorns, oak seedlings and saplings in ways that are compatible with other land uses such as hay production, grazing and irrigation with treated wastewater. Support research to develop new management techniques and policies to reduce the vulnerability of mature oaks to sudden oak death and other diseases.

- 17.5 ☆ *Save the snags*: Dead and dying oaks and other trees provide invaluable habitat for many animals. Wherever possible, these should be retained, and allowed to naturally decay. When dead or dying trees must be taken down for safety reasons, the logs and branches should be left in the landscape.

See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.1-11.9, 11.13-11.15; 12.5; 18.1-18.4; 19.1-19.5, 19.9; 20.1; 21.6, 21.11, 21.14; 24.1

- 18 ➤ *Grassland habitat*: Support the recovery of endangered CTS and vernal pool wildflowers and restore healthy ecosystem conditions for all wildlife in conservation areas on the Santa Rosa Plain by increasing the cover of native perennial grasses and annual wildflowers. Develop management techniques and policies that will support long-term sustainability of native species in these grasslands.

- 18.1 ☆ *Grassland restoration in conservation areas*: The health of vernal pools and swales is inseparable from the health of their upland matrix. To be successful, vernal pool restoration must be accompanied by grassland management to control invasive species and restoration to improve habitat values. Without restoring the matrix, vernal pool communities will experience wave after wave of invasion by non-native grasses and problem species like perennial pepperweed.

- 18.2 ☆ *Site-specific grazing plans*: Grazing is the most sustainable tool now available for managing and restoring grassland, oak savannah and seasonal wetland ecosystems in the Laguna watershed. Grazing can also exacerbate environmental degradation, and to avoid these problems, it is critical to develop site-specific plans. To develop grazing plans for preserve areas and restoration sites,

restorationists must work closely with local producers and UC Extension range management advisors who are familiar with local conditions and issues. Grazing regimes must be flexible to support financially viable livestock production, as well as conservation goals.

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habitats

- 18.3 ☆ *Propagation of native grass seed:* Large-scale grassland restoration will not be possible until there is a large-scale source of local native grass seed. Work with agricultural producers to propagate native grass seed on the Santa Rosa Plain using locally collected stock.
- 18.4 ★ *Grassland restoration pilot projects:* Initiate one or more grassland restoration demonstration projects on public land. Design projects as experiments to: (1) compare the productivity and forage levels of restored and unrestored grasslands, (2) evaluate the ability of native perennial grasses to stabilize soil on eroding hillsides, (3) evaluate wildlife use of restored native grassland as compared to remnant native patches and fields dominated by non-natives, (4) test alternative restoration techniques, and (5) where appropriate, test the success of different grazing regimes in achieving management goals. The Laguna Uplands Preserve is an excellent candidate site for a grassland restoration pilot project.
- See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.1-11.9, 11.12-11.15; 12.1, 12.4-12.5; 17.1-17.5; 19.1-19.5, 19.9; 20.1; 21.1-21.6, 21.11-21.12, 21.14; 24.1



BIOLOGICAL DIVERSITY

- 19 ➤ *Keep common species common:* To protect the Laguna's biodiversity by keeping common native species common; and supporting actions that assist the recovery of threatened and endangered plants and animals, ensuring that no more native species are lost from the watershed.
- 19.1 ☆ *Protect genetic integrity:* For long-term sustainability, it is important to retain locally-adapted genetic strains and within-population genetic diversity when implementing restoration projects. Ideally, seed should be collected from a large number of parent individuals growing at a nearby reference site. If this is not possible, native seed or plants should be purchased from local native seed companies or nurseries. Records should be kept on the origin of all plant material used in restoration projects.

- 19.2 ☆ *Species conservation requires population biology:* It is very difficult to determine the most effective ways to promote species recovery without an understanding of their population dynamics, ecological interactions, and vulnerable life stages. Increase understanding of species and habitats by promoting research, mapping and monitoring of species and physical conditions on the Santa Rosa Plain. Biological
diversity
- 19.3 ☆ *Time projects to protect sensitive species:* Restoration projects frequently involve some form of environmental disturbance—for example digging or invasive plant removal. Whenever possible, projects should be timed to minimize disturbance to the greatest number of species, using special care to reduce disturbance to particularly sensitive or rare species. Disturbance that affects listed species is considered a form of “take” and is regulated by natural resource agencies.
- 19.4 ☆ *Bird monitoring:* Birds are probably the most visible form of wildlife in the Laguna watershed, and the Laguna has become a popular destination area for birdwatchers. Birds play very important ecological roles as predators and seed dispersers, and as they have complex habitat requirements, certain species can be excellent indicators for environmental quality—allowing comparisons between sites for adaptive management. For all these reasons, land managers should work with avian ecologists and volunteers to develop bird-monitoring programs for all large restoration projects. Compile these data in the Laguna ecosystem database.
- 19.5 ☆ *Vegetation mapping and species lists:* Vegetation mapping establishes a baseline for restoration efforts, and provides information about the relative diversity and distribution of different species and habitat types in the watershed. Species lists are much more detailed surveys, often compiled over many years and seasons, of which plants are found on individual parcels or preserves. Both are invaluable for long-term biodiversity research and monitoring. Support vegetation mapping efforts by CNPS and other groups. Develop plant species lists for all preserve lands in the watershed. Integrate these with monitoring and GIS data in the Laguna ecosystem database.
- 19.6 ☆ *Floodplain ecosystem research:* Very little is known about how salmonids and other fish species use inundated floodplains and small drainages. Flooded areas are likely an important source of

nutrients, especially during warmer, late-season events when animals have increased metabolic rates. However, when waters recede, floodplains may be a source of fish mortality, and a rich hunting ground for fishing animals and birds. We need studies evaluating the role of floodplains in the ecosystem, and comparing the role of grassland floodplains to flooded riparian forests.

- 19.7 ☆ *Fish community surveys:* Although steelhead trout and coho salmon have had substantial attention in the Laguna watershed, relatively little is known about the ecology and distribution of the other fish species found here. Survey the fish community in both the main Laguna channel and major tributaries in summer and winter to characterize the ecology of the system, develop indicators for water quality and stream condition, and identify potential problems, such as non-native predators. Compile these data in the Laguna ecosystem database.
- 19.8 ☆ *Western pond turtle studies:* Western pond turtles are a recognized species of concern in California, but they have received little conservation attention in the Laguna watershed. Habitat enhancement for pond turtles includes creating basking structures where they can pull out of the water and lie in the sun. However, serious population recovery will require much more research on the conservation biology of western pond turtles in the Laguna: their distribution, population growth rates, and mortality factors.
- 19.9 ☆ *Rewilding the Laguna:* Historical records describe large herds of elk and pronghorn antelope in the Laguna, which were wiped out by hunters more than a century ago. Tule elk have been successfully reintroduced to Point Reyes National Seashore, and a small reintroduction of elk or pronghorn antelope would be an excellent focal point for environmental education and boost tourism, as well as provide alternative grazing animals for vernal pool and grassland restoration. Such reintroductions would require careful management and feasibility studies to evaluate the effects of these native grazers on CTS and vernal pool plants, and to address potential concerns about disease transmission between elk and domestic livestock.

See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.1-11.16; 12.1-12.5; 14.1, 14.4; 15.1; 16.1-16.15; 17.1-17.5; 18.1-18.4; 20.1-20.7; 21.1-21.14; 22.8; 23.1-23.6; 24.1-24.2, 24.6.

- 20 ➤ *Return anadromous fish:* Help return thriving populations of steelhead trout and establish habitat for coho salmon recovery in the greater Laguna de Santa Rosa watershed, by restoring healthy stream conditions in Mark West Creek, Santa Rosa Creek, and smaller headwater tributaries of the Laguna. Biological
diversity
- 20.1 ☆ *Improve water quality:* Refine and then attain water quality targets for salmonid-bearing headwater streams that protect spawning and rearing requirements of steelhead and coho. Refine and attain water quality targets for the Laguna main channel that support salmonid migration. Support education campaigns that reduce the household and commercial use of chemical fertilizers and pesticides that interfere with salmonid development.
- 20.2 ☆ *Maintain adequate flows in spawning areas:* Salmon and steelhead need year-round water in creeks where they spawn. Although some ephemeral streams have deep pools where juveniles can survive the summer, creeks need to be deep enough that the water stays sufficiently cool, and so that fish can travel up them in the fall and down in the spring. In the Laguna tributaries, channel down-cutting and groundwater pumping threaten the sustainability of summertime flows. Water budgets should be developed for salmonid-bearing streams to evaluate their current status and future needs. This is an issue on which it pays to be proactive with land use decisions and water conservation planning.
- 20.3 ☆ *Woody debris:* Like birds in the forest, fish prefer structured habitats. In mature riparian forests, this structure is provided in part by fallen trunks and tree limbs that create pools and eddies—hiding places for fish, and resting and feeding sites for their invertebrate prey. In developed areas, fish needs for habitat structure must be balanced with flooding concerns. Preserve large woody debris within stream channels wherever possible, but restorationists should work closely with regulators, local jurisdictions, SCWA and local landowners to reduce flood risks.
- 20.4 ☆ *Erosion surveys:* Conduct outreach to landowners and on-the-ground surveys of roads, hillsides and stream channels to identify sites of active erosion and opportunities for erosion control projects throughout the watershed, to address both large-scale sediment sources and non-point source contributions.
- 20.5 ☆ *Sun on Santa Rosa Creek:* It will be difficult to entirely restore the environmental integrity of the Santa Rosa Creek system

until Santa Rosa and Matanzas Creeks are day-lighted from their culverts where they flow through downtown Santa Rosa. Restoring this downtown stretch of the two creeks would allow the Prince Memorial Greenway to be extended further into the heart of the city.

- 20.6 ★ *Historical ecology of stream channels:* Research historical ecology of streams in the Laguna watershed to determine which streams had large coho or trout populations, using historical documents and descriptions of Laguna tributaries. Use these descriptions as part of the basis for determining which streams should be targeted for restoration.

- 20.7 ★ *Stream habitat surveys:* Conduct on-the-ground surveys of all potential salmonid-bearing streams to identify barriers to migration, sites of active erosion, and other conditions that would benefit from restoration or remediation. Highest priority reaches are the entire extent of Mark West, Porter, Windsor, and Pool creeks. Next in priority are the upper reaches of Santa Rosa, Matanzas, and Spring creeks, followed by Copeland and Blucher.

See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.4, 11.8, 11.16; 14.1-14.6; 15.1-15.6; 16.1-16.15; 19.1-19.3, 19.6-19.8; 22.1-22.3, 22.5-22.8, 22.10; 23.1-23.6; 24.1-24.8

- 21 ➤ *Santa Rosa Plain conservation:* Recovery of California tiger salamander (CTS) and listed vernal pool plant species leading to long-term stable populations.

- 21.1 ☆ *Implementation of Santa Rosa Plain Conservation Strategy:* The Santa Rosa Plain Conservation Strategy Team developed a detailed list of quantitative goals and objectives for the recovery of CTS and listed vernal pool plant species on the Santa Rosa Plain. Actions to achieve these objectives should be implemented as soon as possible; with emphasis on protecting large, contiguous preserve lands ahead of mitigation needs. Further expand these objectives to include greater emphasis on genetic research for plant populations, and to develop a program to collect and bank seeds for future restoration of declining populations.

- 21.2 ☆ *Centralize preserve coordination and management:* Standardize preserve management practices among private and publicly owned preserve properties. Ensure effectiveness and efficiency of preserve management by assigning responsibility for coordination,

consolidated management, monitoring, and data synthesis to a single local conservation organization.

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diversity

- 21.3 ☆ *Nested management plans*: Include nested, consistent, and complementary management and monitoring plans as a central feature of implementing the Conservation Strategy—such plans reflect the geographic hierarchy of individual preserves nested in conservation areas, and conservation areas supporting species recovery at the scale of the entire plain.
- 21.4 ☆ *Detailed monitoring for better management*: Increase the effectiveness of preserve management with broad-based, long-term monitoring programs that track diverse environmental factors, catalogue and map biodiversity information for other animals and plants on preserves, and gather all data into the Laguna ecosystem database.
- 21.5 ☆ *Public ownership of preserve lands*: Management is complicated when CTS and vernal pool mitigation sites are in private ownership. It is difficult to monitor management requirements and to enforce easement restrictions. Promote ownership and management of preserve lands by public agencies and local conservation organizations.
- 21.6 ☆ *Compatible land uses*: Certain agricultural land uses are compatible with CTS and vernal pool plant conservation efforts on the Santa Rosa Plain. In particular, it may be essential to allow grazing in upland areas to suppress the growth of non-native grasses. Support compatible agricultural use of preserve uplands and buffer areas, and develop locally customized conservation instruments that help maintain the economic viability of these land uses.
- 21.7 ☆ *Seed banking of vernal pool plant species*: Rare species are at great risk of losing genetic variation within and among populations. Seed collections should be made of listed vernal pool plants in order to preserve the current population variation, and stored at appropriate seed storage facilities (e.g. Rancho Santa Ana Botanic Gardens), to allow use of these seeds in future restoration efforts of declining populations. Collections should be made over several years to capture genetic variation within species for different preferred germination conditions.
- 21.8 ☆ *Expanded vernal pool plant population genetics*: Currently, the CDFG is funding a study of the genetic variation in Sebastopol meadowfoam, Burke's goldfields, and Sonoma sunshine.

These genetic assessments should be expanded to include other declining vernal plant species such as Many-flowered navarretia, Baker's navarretia, Dwarf downingia; Gairdner's yampah; Douglas's pogogyne; and Lobb's aquatic buttercup; and vernal pool animal species such as CTS and California linderiella. Genetic assessments should be continued over several years and correlated with climatic fluctuations to deduce possible genetic variation of populations among years.

- 21.9 ★ *Lasthenia burkei* habitat research: *Lasthenia burkei* is the most at-risk of all the vernal pool species on the Santa Rosa Plain, and although little is known about its habitat requirements and how best to design vernal pool creation or restoration projects, habitat mitigation projects continue to be approved. Targeted research is urgently needed to support *L. burkei* recovery efforts.
- 21.10 ★ *CTS breeding pool studies*: Long-term breeding pool studies are needed to assess regional population dynamics, and benefits and problems associated with habitat restoration and enhancement. Annual larval sampling to determine the proportion of occupied pools is believed to be the most effective and accurate way to track CTS status on the Santa Rosa Plain, expanding current monitoring efforts.
- 21.11 ★ *CTS upland ecology*: Adult CTS spend greater than 95% of their lives underground, yet very little is known about this life-stage. There is almost nothing known about the ecological relationship between CTS and burrowing mammals, such as gophers, except that CTS are dependent on burrows for survival.
- 21.12 ★ *CTS migration and dispersal*: To determine optimal location, size and management of protected habitats, there is a critical need for more information on salamander movement, migration, and dispersal—using radio telemetry of migrating adults and juveniles and upland pitfall traps to determine migration patterns and occupied uplands.
- 21.13 ★ *Additional CTS research*: Other urgent research needs include determining the pattern and timing of “colonization” of constructed pools, optimal depth of pools for CTS persistence, effects of non-native crayfish on CTS, timing of larval metamorphosis and the implications for pool depth, and effects of pool size on CTS reproduction.
- 21.14 ★ *Research on grazing management for preserve lands*: Grazing is probably the most sustainable method for grassland management,

and recent studies have shown that it has great benefits for some seasonal wetlands. However, depending on conditions, grazing can also degrade grasslands and seasonal wetlands. Research is needed on the optimal grazing regimes for CTS and vernal pool preserves on the Santa Rosa Plain. Studies should evaluate how site-specific conditions and different grazing management strategies interact with the ecology of wetland plants and animals.

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See also 8.1-8.2; 9.1-9.6; 10.1-10.13; 11.1-11.6, 11.8-11.9, 11.12-11.16; 12.1; 16.2-16.3, 16.6; 18.1-18.4; 19.1-19.3, 19.5, 19.9; 24.1



WATER RESOURCES

- 22 ➤ *Equilibrate hydrology*: Restore the hydrology and hydraulics of the greater Laguna watershed, and support environmentally-appropriate management of waterways and floodplains, thus providing diverse high-quality habitat for wildlife and plant species; maintaining healthy stream conditions; reducing erosion and sedimentation; promoting groundwater recharge; reducing flood risk in developed areas while maintaining the flood storage capacity of the Laguna floodplain; and providing an aesthetic public resource.
- 22.1 ☆ *Basin planning for water resources*: Expand and coordinate multi-agency research and planning efforts evaluating Laguna hydrology and hydraulics at the scale of the entire watershed as well as in targeted planning areas, to provide sound information on which to base water management decisions involving restoration, flood protection, water quality and quantity, water conservation measures, groundwater withdrawals, and recycled water discharges.
- 22.2 ☆ *Floodwater retention in the upper watershed*: Reduce risk of flooding in developed areas of the Santa Rosa Plain, as well as for Russian River communities, by retaining as much water as possible in the upper watershed, reducing the height of peak discharges and flashiness of flows.
- 22.3 ☆ *Continue flooding the floodplain*: Encroaching development reduces the area of open land on the floodplain, and interferes with natural hydrological processes. Support the public purchase of lands or conservation easements in the floodplain to retain open space for seasonal flood storage areas, while still allowing compatible uses such as agriculture, parks and wildlife habitat. Use

- floodplain models to evaluate where setting back levees or other actions can reclaim historical floodplain areas.
- 22.4 ☆ *Distributed water retention and infiltration:* Stormwater can be a valuable resource if it can recharge groundwater aquifers rather than run off during storm events. Encourage distributed retention and infiltration of stormwater, especially in groundwater recharge areas, through engineered retention basins and the use of permeable surfaces, such as those described in the Standard Urban Stormwater Mitigation Plan; and educate the public about ways that they can reduce stormwater and sediment discharge on private properties. Where catchment areas are specifically designed to trap sediment, annual maintenance for sediment removal must be built into the design and permitting. Develop programs and partnerships to provide technical assistance and incentives to individual landowners for design, permitting and implementation of small-scale projects.
- 22.5 ☆ *Reduce mosquito abundance through better design and planning:* Constructed wetlands and stormwater retention basins can produce high numbers of mosquitoes if improperly managed. Design and manage constructed wetlands, storm water retention basins and flood storage areas in consultation with the Marin/Sonoma Mosquito and Vector Control District such that basins do not promote mosquito production.
- 22.6 ☆ *Sediment remediation:* Implement environmentally appropriate sediment removal projects in areas where excess sediment accumulation has degraded environmental conditions. For example, such projects may include restoring low-flow channels, or restoring one or more historic deep-water features in the Laguna.
- 22.7 ★ *Riparian fencing and bank stabilization:* Partner with willing landowners to implement riparian-fencing projects throughout the greater Laguna watershed to control the access of livestock to streams and waterways. Streamside fencing should be installed with livestock bridges and gates as appropriate; damaged stream banks should be laid back and vegetative armor should be used to restore impaired waterways to healthy conditions. Top priority areas are in the southern Laguna: due to the nature of the soil conditions, land use, and lack of perennial plant cover around upper Gossage Creek, substantial erosion occurs on nearly every tributary and swale in the area.

- 22.8 ★ *Hydrologic restoration at the Mark West Creek confluence:* The confluence of the Laguna and Mark West Creek has been shifted in historic times, and Mark West is reported to deposit large quantities of gravel onto the floodplain. Research the feasibility and potential benefits—to salmonids, sediment transport and flood protection—of hydrological restoration on the lower portions of Mark West Creek, by improving conditions in the current channel alignment, and potentially by providing alternate fish passage in the original Mark West channel. Hydrologic studies would provide information on potential solutions that could support the interests of local landowners as well as regulators and upstream communities.
- 22.9 ★ *East Rohnert Park infiltration basins:* Sediment retention and water infiltration basins are an engineering-based solution to addressing sedimentation and flooding concerns. While it is best to control erosion and reduce runoff in the upper watershed, it is also necessary to evaluate the feasibility of establishing flood water infiltration and sediment capture basins in ground water recharge areas east of Rohnert Park—to reduce the height of peak discharge, reduce the volume of sediment entering the southern Laguna water system, and provide a public recreational resource.
- 22.10 ★ *Southern Laguna urban creek planning:* The Cities of Rohnert Park and Cotati have plans to embark on an urban creek master planning process to coordinate creek restoration and public access. To accelerate the implementation of restoration efforts, hydrology studies should be initiated in parallel to the planning process, to evaluate the baseline conditions and feasibility of potential restoration projects such as establishing low flow channels.
- See also 8.1-8.2; 10.1-10.3, 10.7-10.13; 11.9-11.10; 14.1-14.6; 15.1-15.6; 16.7-16.14; 19.3, 19.6; 20.2-20.7; 23.1, 23.4, 23.6; 24.1-24.3, 24.5
- 23 ➤ *Water quality:* Implement restoration projects and policies that improve water quality in the Laguna and its tributaries—by reducing inputs of nitrogen, phosphorus and other nutrients; reducing sedimentation; and restoring natural processes that keep waterflow cool and increase dissolved oxygen—to support beneficial uses and greater ecosystem stability.
- 23.1 ☆ *TMDL process:* Initiate a Laguna TMDL process as a comprehensive and inclusive basin-scale study of factors influencing water quality in the Laguna, involving diverse stakeholders in both

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resources

- identifying problems and developing solutions to water quality impairments. Process should include a stratified and standardized water quality monitoring program, a study of beneficial uses, land-use factors, and the development of policies and management practices to expedite improvements, increase public awareness, responsibility and participation.
- 23.2 ☆ *Relocate wastewater discharges*: Phase-out direct discharges of treated wastewater into the Laguna channel. Expand the capacity of current disposal alternatives, including agricultural and urban re-use, water conservation, and repair of the current piping system to reduce infiltration and infill. Identify and develop new environmentally favorable disposal options. Until the phase-out can occur, Laguna discharges should be limited to November–February, when *Ludwigia* and other aquatic weeds are not actively growing.
- 23.3 ☆ *Restoration and conservation*: Develop and implement restoration and public works projects that enhance water quality through riparian and grassland restoration, urban and agricultural re-use of wastewater, constructed and restored wetlands, reduced run-off, and increased infiltration. Reduce dry-weather urban run-off by encouraging water conservation and sprinkler maintenance.
- 23.4 ☆ *Wetlands for stormwater treatment and flood storage*: Created wetlands are increasingly recognized as a valuable BMP for improving water quality. Although Kelly Marsh is very effective at polishing treated wastewater, there are a number of environmental concerns with creating wastewater treatment wetlands in upland areas. Instead, wetland restoration and creation efforts should be targeted at lower elevation areas in the floodplain for habitat, stormwater treatment and flood storage.
- 23.5 ☆ *Promote personal responsibility for water quality*: Develop and support environmental education programs that inform the public how individual actions and daily choices affect water-quality in the Laguna. Increase public awareness of the value of healthy creeks and wetlands; promote a sense of individual responsibility toward water quality and water conservation in the citizens of the Laguna watershed; and develop incentives and mechanisms that increase participation in pollution reduction programs.
- 23.6 ☆ *Flood protection for the Subregional Wastewater Treatment Facility*: Continued changes in channel capacity or global weather patterns

will increase the Subregional Wastewater Treatment Facility's vulnerability to extreme flood events, and the consequent risk of major sewage spills. Such a spill would have negative and long-lasting environmental effects on the Laguna waterways. Initiate engineering and feasibility studies for a system to protect water treatment infrastructure from flooding and prevent future catastrophic spills of untreated effluent, anticipating increases in extreme weather events. Design system to minimize flood risk to downstream neighbors.

See also 8.1-8.2; 10.1-10.4, 10.6-10.13; 11.1-11.4, 11.10-11.11; 14.1-14.6; 15.1-15.6; 16.2-16.6, 16.8-16.14; 19.3, 19.6-19.7; 20.1-20.7; 22.1-22.3, 22.6-22.7, 22.9-22.10, 24.1-24.8

- 24 ➤ *Baseline characterization of the watershed:* To support science-based restoration planning and adaptive management by developing rigorous baseline characterization of the watershed's physical and biological attributes, especially as they relate to water resources. Baseline characterizations should be conducted at multiple geographic scales—including the scale of the entire watershed, the scale of geophysical regions, and the scale of individual project areas.
- 24.1 ☆ *Baseline assessments on nested geographic scales:* Robust restoration planning and formal adaptive management require accurate evaluations of initial conditions. For restoration at individual project sites, baseline assessments are used to evaluate features needing restoration and features needing protection. These assessments, along with ongoing monitoring, form a basis for adaptive management analyses. For the most rigorous watershed restoration planning, baseline assessments may be needed at several geographic scales, for example: the scale of the individual site, the scale of the property or preserve area, and the scale of the entire watershed.
- 24.2 ★ *Basin-scale modeling:* Coordinate and expand modeling and monitoring efforts of Army Corps, SCWA, USGS and other agencies to provide baseline characterization of Laguna watershed and ability to project future scenarios that incorporate changes to channel/floodplain geometry and weather patterns. Use these models to plan and prioritize restoration, flood protection, and pollution control projects.
- 24.2.a ★ *LIDAR:* The Laguna floodplain has an extremely low gradient, and several inches difference in elevation makes huge differences for determining flood-risk areas and habitat condi-

tions for aquatic plants like *Ludwigia*. High-resolution digital elevation data, along with 2-D floodplain models, is essential for long-term flood protection and pollution control planning, evaluating which areas will be vulnerable to *Ludwigia*, and for designing successful restoration projects.

- 24.2.b ★ *Two-dimensional floodplain model*: The USGS is now developing a pilot 2-D model for a portion of the Laguna floodplain. Expansion of this model, combined with LIDAR data, is essential for long-term flood protection and pollution control planning, evaluating which areas will be vulnerable to *Ludwigia*, and for designing successful restoration projects.
- 24.3 ☆ *Expand data collection to support basin models*: Support watershed research and modeling efforts by increasing the amount of data collected within the Laguna watershed: (1) expand the network of rainfall gauges to better capture variation between the Santa Rosa Plain and the upper montane regions; (2) add new gauges along Copeland, Colgan, Gossage, and Blucher Creeks to measure discharge and stage; (3) locate or develop GIS layers on land use and physical attributes of land surfaces.
- 24.4 ☆ *Expand and standardize water quality monitoring*: Water quality in the Laguna watershed is highly variable, depending on channel conditions, natural processes, season, and anthropogenic pollution inputs. Without further research and monitoring it will not be possible to determine the relative impacts of different sources of impairments. Implement a permanent and geographically stratified water-quality research and monitoring program with standard water quality monitoring protocols to track impairments and improvements in the Laguna and its tributaries.
- 24.5 ☆ *Characterize in-stream conditions and riparian vegetation*: Stream conditions and surrounding vegetation strongly affect water quality and aquatic communities. Initiate field surveys to characterize in-stream conditions throughout the watershed—including spatial and temporal patterns of water quality impairments, stratification, animal and plant communities, and the condition of riparian areas.
- 24.6 ☆ *Impacts of natural processes on water quality and beneficial uses*: Conduct research and modeling to increase understanding of the biological and physical processes affecting water quality in the watershed, patterns of spatial and temporal variation in water quality, and the needs of different animal and plant communi-

ties; and use the results of these studies to ensure that regulations support appropriate beneficial uses.

Water
resources

- 24.7 ☆ *Fish toxicity studies:* Conduct studies to evaluate whether fish in the Laguna have bioaccumulations of heavy metals or other toxins; initial efforts should focus on higher trophic levels (predatory fish), and on non-native crayfish to evaluate impacts on fish and wildlife. Researchers should also interview members of the fishing community to determine which species are being caught for consumption, and include these species in the analysis.
- 24.8 ☆ *Dissolved oxygen dynamics:* The Laguna main channel is 303(d) listed as *impaired* for low dissolved oxygen (DO). Dissolved oxygen levels are a function of biophysical processes—DO is elevated by air mixing at the water surface and by photosynthesis of aquatic plants, and decreased by microbial decomposition of organic matter. Research is needed to study the driving forces for low DO in the Laguna: whether organic material is derived from aquatic or terrestrial origins, the effect of *bioturbation* (the stirring or mixing of sediment by organisms) on the breakdown of organic matter in sediments, and the influence of nutrient availability.

See also 8.2; 9.6; 10.1, 10.6, 10.9-10.10; 11.8, 11.13; 14.2; 15.1; 16.2; 18.2; 19.4-19.5, 19.7; 20.4, 20.6-20.7; 21.4; 23.1



TRAILS AND RECREATION

- 25 ➤ *Wetland and wildlands:* Develop trails and recreation on public lands that enable the general public to visit the wetland and wildlands of the Laguna.
- 25.1 ☆ *SCAPOS D trails plan:* Follow the SCAPOS D plans, developed with community input, that specify public access on the City of Santa Rosa's farms. Use these plans to site trailheads, trails, picnic facilities, and interpretive signs.
- 25.2 ☆ *Develop consolidated trails and recreation plan:* Work with all of the public land managers in the Laguna to develop a consolidated trails and recreation plan. Use the SCAPOS D plan as a framework for further opening adjacent public properties to the general public. Include in the plans the properties owned by CDFG, Sonoma County Regional Parks Department, SCWA, SCAPOS D, Sebastopol, Cotati, Rohnert Park, Windsor and

- Santa Rosa. Consider passive forms of recreation including: wildlife viewing, hiking, biking, horseback riding, kayaking and canoeing. Trails and recreation
- 26 ➤ *Laguna Community Corridor*: Develop plans for a multi-use north-south system of trails.
- 26.1 ☆ *Public and private*: Utilize public lands whenever possible and utilize bike lanes on roadways whenever necessary.
- 26.2 ☆ *Transportation and recreation*: Establish the corridor as both a transportation facility and an open space recreational opportunity.
- 26.3 ☆ *Connect existing trails*: Connect the Santa Rosa Creek trail with the Joe Rodota Trail and connect the Joe Rodota Trail to the cities of Cotati and Rohnert Park.
- 27 ➤ *Greenways and creekways*: Develop plans for the urban creeks and nearby greenbelt properties.
- 27.1 ☆ *Use existing rights-of-way*: Develop existing SCWA rights-of-way into a multi-use trail system in the Rohnert Park/Cotati area. Install sufficient infrastructure, including bridges, tunnels and fords, to provide connectivity among the network of trails.
- 27.2 ☆ *Connect greenbelt areas*: Connect SCAPOSD greenbelt easement properties, situated between Rohnert Park and Santa Rosa, into a “string of pearls” connected by creekside trails.
- 27.3 ☆ *Continuous corridor*: Provide connectivity between the existing trails of the Rohnert Park/Cotati area with the proposed Laguna Community Corridor that will extend northwest to Sebastopol and the Santa Rosa Creek trail.
- 28 ➤ *El camino de los pájaros*: Create an automobile touring route using existing roads that skirt the Laguna wetlands perimeter.
- 28.1 ☆ *Automobile scenic route*: Provide automobile access to the Laguna and its many discontinuous properties by mapping a safe and scenic route along nearby back country roads.
- 28.2 ☆ *Protect sensitive wildlife areas*: Provide birding and other wildlife viewing opportunities to the general public without intruding into sensitive wildlife refuges.
- 28.3 ☆ *Promote birding*: Promote eco-tourism that showcases the Laguna as a rich ecosystem of freshwater wetlands and nearby uplands with world-class birding opportunities.



HISTORICAL RESEARCH

Historical
research

- 29 ➤ *Understanding our heritage:* Examine the historical record to support our ability to restore and manage the Laguna's natural resources
 - 29.1 ☆ *Historic maps:* Examine historic maps, photographs and sketches to understand the history behind landscape changes and to help develop sustainable restoration projects.
 - 29.2 ☆ *Lost wetlands:* Determine the extent to which freshwater wetlands and adjacent floodplains have been lost. Use site-specific research to determine the feasibility and advisability of recreating historic wetlands.
 - 29.3 ☆ *Extirpated species:* Examine the written record of the early explorers, settlers, and naturalists to develop an understanding of what has been extirpated. Use this understanding to establish realistic objectives for native habitat restoration.
 - 29.4 ☆ *Understand human/nature codependence:* Examine the pre-contact evidentiary record, including anthropological and archeological artifacts to understand the role of indigenous people in the active management of their landscape. Use this understanding to further refine our own management practices. Develop a deeper appreciation for humans in nature as being integral and codependent.
 - 29.5 ☆ *Comply with cultural resource laws:* Honor those who lived here before us and respect the cultural artifacts they left behind.



MARKING OUR PROGRESS

- 30 ➤ *Sharing the vision:* Convene an annual gathering of professionals, stakeholders and citizens to share and refine the common vision for the Laguna, and to promote communication and collaboration among the participants.
 - 30.1 ☆ *State of the Laguna conference:* Institute a regular State of the Laguna conference, bringing together restorationists, community groups and researchers to share information about projects taking place throughout the watershed, to articulate further restoration and research needs, and to refine community goals and vision for the watershed. Focus the next conference on the Laguna's many land uses and the need to resolve conflicting objectives among restoration, conservation, agriculture and development, and paths toward mutually-beneficial solutions.

- 30.2 ☆ *Stakeholder council*: Establish an ongoing stakeholder council where the work of implementing restoration and management actions can be discussed. Hold periodic stakeholder meetings where progress can be reported, where new problems and concerns can be brought to the group's attention; and where collaborative ideas can be fostered and refined. Marking our progress
- 30.3 ☆ *Public agency forum*: Establish a public agency forum where city, county, state, and federal representatives can meet to work on shared solutions to mandates that relate to the Laguna. The Laguna's multi-jurisdictional pattern of ownership and management suggests that such a forum would be helpful in ensuring fewer overlapping efforts and fewer missing gaps.
- 31 ➤ *Reporting our progress*: Develop an annual State of the Laguna watershed report card—with measurable objectives that can be tracked and assessed as restoration activities progress over coming decades.
- 31.1 ☆ *State of the Laguna watershed report card*: Develop an annual report on the progress of Laguna restoration, building on baseline assessments of ecosystem health, and tracking quantitative and science-based indicators of improvements or declines. Indices should be developed as summaries of many combined indicators to evaluate: 1) progress made toward conserving and enhancing native species, 2) progress made toward protecting and restoring natural areas, 3) progress made toward controlling the spread of harmful invasive species, 4) progress made toward improving water quality, 5) progress made toward improving the sustainability of farming, 6) progress made towards community participation in land stewardship, 7) progress made toward public participation and environmental education.

