CHAPTER 15. RECOMMENDATIONS AND DATA GAPS

BACKGROUND

As has been emphasized throughout this document, specific restoration actions must be based on site-specific analysis of relevant parameters. The following generalized recommendations are intended to assist the prioritization process, but they are not meant to imply that a given recommended action is appropriate for all, or even most, sites.

Prime locations for restoration should be selected based on the importance of various limiting factors, probability of success, proximity to core habitat areas, landowner willingness and ability to participate, and cost/benefit tradeoffs. Restoration activity should be focused in areas that are the most likely to respond to management actions. To the extent possible, restoration should be coordinated among the landowners and other stakeholders in the subbasin to take advantage of possibilities to leverage multiple efforts for greater benefit. It is particularly important to develop an effective and affordable long-term monitoring program, so that the effectiveness of various restoration actions can be evaluated and documented.

RECOMMENDATIONS

Aquatic Species and Habitats

Restoration activities for aquatic species should be concentrated in areas with the best potential for success of coldwater species. Coldwater species such as redband trout exhibit high levels of sensitivity to habitat degradation and are great indicator species. Therefore, efforts should be focused on projects that help to establish or maintain their populations as well as recreate connectivity between populations.

Management actions to improve fish habitat should focus on preserving and recreating riparian corridors. Properly functioning riparian corridors will help bank stabilization, prevent erosion and substrate embedment, improve large woody debris recruitment potential and reduce stream temperatures. Other important activities should include identifying and removing fish passage barriers, and restoring properly functioning wetlands and floodplains. Actions such as these will benefit all native species of fish in the Lower Sprague and Lower Williamson rivers.

Action recommendations include the following:

- Encourage restoration of stream connectivity by eliminating barriers and obstacles to fish passage. Restoration and enhancement projects should focus on physical barriers that, when removed or repaired, create access to the greatest amount of high-quality fish habitat.
- Identify stream reaches that may serve as "oases" or refugia for fish during the summer months, such as at the mouth of small or medium-sized tributaries and coldwater springs. Protect or enhance these streams and spring riparian buffers and develop proper functionality.

- Encourage community participation in fish monitoring activities. Raise awareness about potential problems associated with introducing non-native fish species into rivers and streams.
- Work cooperatively with landowners to improve fish habitat conditions. Develop BMPs for agriculture and cattle grazing. Establish inexpensive passive restoration and enhancement projects to restore properly functioning conditions in riparian corridors.
- Provide landowners and appropriate entities with additional resources to assist in restoration and enhancement projects (e.g., find grant funding, help with project planning).

Channel Characteristics

Substantial changes to channel conditions occurred as a result of federal flood control efforts in the 1950s. Some of the effects of these actions, such as eradication of riparian vegetation, are easily reversible, and have been reversed in places. Other effects, such as channelization and diking, are more problematic because certain land uses now depend upon those modifications. Also, because flood control efforts involved substantial engineering and earth-moving, reversing the effects of these actions can be very costly. Nevertheless, opportunities to mitigate the negative hydrologic and biological effects of these modifications should be investigated.

While the Watershed Assessment can help to guide general restoration planning, site-specific field condition evaluations are needed for individual project scoping. It is recommended that a field-based analysis of channel conditions be conducted in advance of any detailed restoration project planning. One such analysis is currently being conducted by the Klamath Tribes Natural Resource Department. Members of the Working Landscapes Alliance can assist with site-specific plans.

At this time limited data are available on channel characteristics within the assessment area, particularly at the large scale of the assessment area. Many site-specific assessments of channel characteristics have been conducted on different stream reaches within the subbasin. However, no comprehensive study of the channel characteristics within the assessment area has been located.

Action recommendations include the following:

- Increase overall understanding of channel morphology conditions through more detailed field-based analyses.
- Investigate feasibility of restoring channel function.
- Where appropriate, improve pools and riffles while increasing in-stream large woody material by placing large wood and/or boulders in streams with channel types that are responsive to restoration activities and have an active channel less than 30 feet wide.
- Continue landowner visits based on Proper Functioning Condition (PFC), as well as programs to increase understanding of the importance of appropriate channel function, including the role of vegetation management on channel function.
- Establish and manage riparian pastures for both optimum channel stability and forage production; investigate options for timing and stocking of pastured livestock; and where appropriate, manage access to sensitive riparian areas with off-site watering and/or riparian fencing.

Geologic Processes

Erosion problems in the watershed can be addressed in some areas by riparian planting efforts and especially by efforts to control sediment inputs from roads and streambanks. Emphasis should be placed on road repair and decommissioning in roaded areas that are in proximity to the stream channel and on steep slopes, and also on riparian enhancement subbasin-wide. Erosion control efforts in upland portions of the watershed should be especially focused on areas subject to recent or ongoing land-disturbing activities.

Roads should be considered for closure and/or stabilization if they are presently causing, or are likely to cause, serious future erosion, are near fish-bearing streams, have excessively high maintenance costs or are determined to be unneeded. Stabilization of closed roads can include measures such as water bar installation, removal of fill material, culvert removal, and planting of native grasses and other plants.

Action recommendations include the following:

- Identify in greater detail areas of excessive streambank and gully erosion.
- Implement management changes or native vegetation plantings in riparian zones that are experiencing excessive erosion.
- Decommission roads that are no longer needed, especially those near streams, on steep slopes, and where road maintenance has been difficult.

Hydrology and Water Use

In the uplands, the ability of the watershed to capture, store and safely release available precipitation has been reduced as a result of changes in stocking levels, stand structure, increased canopy closure and vegetation composition. Optimizing the capture of available precipitation will result in significant benefits with respect to all beneficial uses, including irrigation, fish habitat and water quality. Measures that can be taken to improve the capture of available precipitation are discussed in the following section (Terrestrial Vegetation).

There is much uncertainty regarding the impact of diversions and water uses on habitat and hydrologic function. The state and transition of riparian and wetland communities are dynamic in time and space. The dynamic process has confused the interpretation of mechanisms that may result in changes in ecological function. Consequently, efforts to enhance function or productivity may fail. Moreover, the ability to "restore" an historic community state may not be achievable due to broader environmental changes. Until the science behind riparian and wetland state and transition mechanisms is better defined, much time, effort and funding may produce few positive results.

Some uncertainty is due to the ongoing adjudication process. But there are also unanswered questions regarding the impact of groundwater pumping, the role of irrigated pastures in groundwater storage, and the effect of irrigation development on total annual flows. While it is assumed that reducing unnecessary applications of diverted water would provide benefits to all users, it is critical that the above questions be resolved, so it will be clearer what potential there is for improvement.

Riparian Area

One of the most effective measures to enhance the overall health of the Lower Sprague-Lower Williamson River subbasin would be improvement of riparian health and associated in-stream habitat conditions. Efforts should be directed toward restoration of native riparian vegetation, especially native sedges, rushes, woody shrubs and trees. Restoration activities need to be assessed on a site-specific basis, with the landowner's management objectives in mind.

PFC site assessments are an excellent way to initiate the restoration process and to determine what type of restoration, if any, is necessary. Private landowners should be provided with the assistance to develop riparian restoration plans that can be effectively implemented within the constraints of their operating resources.

Some benefits of these riparian enhancement efforts will be seen almost immediately, while some may not be seen for several years. Still others will be manifested over a period of decades or longer. The vegetation type and overall conditions present in a specific area should be verified on the ground before planning any restoration activity.

High priority should be placed on preserving areas that currently are functioning well and providing acceptable habitat for riparian-dependent species. Such areas should be managed to further promote the development of desirable features, including densely rooted riparian plants, sediment capture, water storage capacity, large conifers and cottonwoods where appropriate, downed logs, snags and high species diversity.

Action recommendations include the following:

- Work with landowners, the community and other entities to develop a local PFC or site assessment team.
- Work with landowners, the community and other entities to secure funds to coordinate data collection, prioritization of projects and identification of priority surveys areas.
- Continue to work cooperatively with landowners, the community and other entities to conduct PFC site assessments of important riparian areas.
- Assist in implementation of land use practices that enhance or protect riparian areas, while maintaining the landowner's management objectives.
- Work with NRCS and other agencies to help identify sites within prioritized reaches where restoration is needed. Protect riparian areas by providing stock water systems, riparian fencing and shade trees outside of the stream channel and riparian zones, which would complement other management practices. Fence riparian areas as appropriate.
- Work with the Army Corp of Engineers to identify dikes where removal would increase floodplain access and improve stream function. Investigate the need to remove dikes along the streams.
- Identify sites where planting native riparian trees, shrubs and understory vegetation in areas with poor or fair riparian area conditions would be beneficial in accelerating recovery, where sites have potential for them. Work with landowners who know areas where these species were removed in the 1950s and 60s.

- Manage forested riparian zones for uneven-aged stands with large diameter trees and younger understory trees to allow establishment of shade-intolerant riparian species to establish.
- Maintain areas with good native riparian vegetation, noting that non-native species such as canary reedgrass may currently play a critical role for maintaining function.
- Where appropriate, establish buffers of native trees and/or shrubs, depending upon local conditions. If sites do not have potential for woody vegetation, manage for establishment of sedge/rush communities to aid in channel narrowing and reduction of width-to-depth ratios.
- Identify riparian zones dominated by xeric species and non-native plants and work to reestablish a higher water table that will support riparian/wetland species.

Terrestrial Vegetation

The uplands of the Lower Sprague-Lower Williamson subbasin, which consist primarily of ancient volcanic landforms (strato volcanoes, cinder and lava cones, basalt flows and deposits of welded tuff), wind-deposited volcanic ash and pumice, and ancient lake (lacustrine) sediments, make up the vast majority of the basin. These landforms, now expressed as mountains and hills and their associated side-slopes and alluvial fans, and the tablelands, tilted lava lands, lake terraces and ancient beaches have given rise, over time, to a wide array of soils with vastly different capabilities. These soils vary in the kinds and amounts of vegetation they produce, in the way they process precipitation and in the way they respond to treatment (management).

Much of this information is available to landowners, land managers and planners and can be found in the NRCS and Forest Service Soil Survey publications developed under the National Cooperative Soil Survey Program. It is strongly recommended that these locally prepared reports be referred to in the early stages of planning and in the application of any land treatment. However, site specifics must be checked in order to verify the soil survey reports.

Significant changes in plant community composition and plant density have occurred since the arrival of Europeans in the area. Future decisions regarding land use and treatment need to promote the capture of precipitation where it falls, the storage of that moisture in the soil for plant use and other forms of biological activity, and the eventual safe release of that moisture to deep percolation for groundwater recharge and lateral flow that maintains springs, seeps and streams.

Historic timber management has resulted in a loss of late and early seral stage forests and overstocking of current mid-seral stage woodlands. Suppression of fire has led to an overabundance of understory growth. Management to protect and develop late successional forest habitat, including the use of prescribed fire where appropriate, will promote the health and diversity of terrestrial ecosystems. Such habitat should be fostered, where possible, in large blocks rather than small patches. This process should be accompanied by thinning to reduce overstocking. Increased prevalence of late successional forest habitat will benefit a large number of species that utilize such habitat for their prosperity or survival.

Every effort should be made to curtail the spread of noxious and exotic plants and eradicate isolated patches of noxious weeds before they spread. Management actions could include cleaning large silvicultural and agricultural machinery of weed seeds and propagules to prevent unintentional

dispersal of the plants. Such preventive actions would likely be more successful than attempted treatments after a particular invasive species has invaded.

It will be important to reintroduce frequent, low intensity fire as an important component of forest management in the ponderosa pine lands. Fire provides an essential function in riparian and wetland communities by recycling nutrients and preventing lodgepole pine encroachment. Fire is also important in the control and reduction of encroachment of juniper into shrub and grassland habitat.

Action recommendations include the following:

- Manage upland vegetation to maximize capture and safe release of available precipitation.
- Restore fire frequency and intensity to enhance ecological processes.
- Eradicate invasive, non-native plants.
- Reduce lodgepole pine encroachment into riparian and wetland communities.
- Reduce juniper encroachment into grasslands and riparian shrublands.
- Monitor the spread and extent of noxious weeds and invasive plants.

Terrestrial Wildlife

Much of the wildlife diversity in the assessment area is associated with early seral conditions and semi-open canopy forests, which are less common now than under the natural fire regime. Efforts to enhance watershed function through upland restoration will help sustain biological diversity and terrestrial wildlife.

Open woodland of western juniper has been an important habitat for wildlife in the Lower Sprague-Lower Williamson subbasin. However, the expansion of dense stands of juniper into shrub and grassland communities represents an important threat to wildlife associated with shrub-steppe vegetation. A return to a more normal (historically speaking) fire regime will contribute to restoration of shrub and grassland communities.

Local forestry and agricultural practices can lead to improved or diminished habitat conditions for elk, depending upon the resulting changes to vegetation patterns. Forest management that promotes late seral stage woodland with open areas can lead to improved elk habitat.

Action recommendations include the following:

- Promote the development of late seral ponderosa pine forest.
- Manage woodlands for creation of snags and large downed wood, especially near streams.
- Reduce fuels loading by implementing forest thinning operations.
- Create periodic openings in dense mid-seral stage forests.
- Manage for increased plant species diversity, especially in wetlands and riparian areas.
- Control invasive non-native plants.

Water Quality

In 1998, the Oregon Department of Water Quality (ODEQ) listed the Sprague and Williamson rivers as water quality limited for temperature, pH, and dissolved oxygen. Therefore, activities to improve and restore riparian conditions will have beneficial effects on water quality by increasing the amount of stream shading, increasing bank stability, decreasing erosion and preventing stream widening. Properly functioning riparian conditions will increase the potential for large woody debris deposition and increase sediment loading along streambanks, thereby decreasing in-channel substrate embedment and increasing pool and stream channel depth.

Furthermore, it is suggested that the decrease in properly functioning riparian corridors has lead to an increase in phosphorus loading. Increased erosion of naturally high-phosphorus soils and irrigation returns may be contributing to elevated phosphorus concentrations in subbasin streams and Upper Klamath Lake. Such an effect contributes to eutrophication. Therefore, efforts to restore properly functioning riparian corridors and control erosion will have beneficial effects on several aspects of water quality.

Action recommendations include the following:

- Continue monitoring and incorporation of existing projects within the subbasin to help increase our understanding and management practices. In addition, expand monitoring efforts to include more tributaries and main-stem sites to increase our ability to understand and manage the subbasin.
- Investigate the feasibility of constructing tailwater reuse systems or designing tailwater treatment wetland ponds for irrigation returns.
- Support projects that restore proper stream function by developing and/or reestablishing floodplains and wetlands.
- Increase shade and stream depth by managing to restore properly functioning riparian corridors.
- Develop livestock grazing practices (e.g., rotation grazing and seasonal grazing) that limit stream access during critical growing seasons for riparian vegetations. In addition, provide stock water systems and shade trees outside of the stream channel and riparian zones to limit cattle congregation along stream edges. Fence riparian areas to limit or exclude cattle from foraging along critical riparian corridor areas.
- Manage for robust riparian communities. Develop management strategies that maintain and create properly functioning riparian corridors.

Wetlands

There are many opportunities for wetland enhancement and restoration within the assessment area. It may be necessary to reconnect streamside wetlands and springs that have been hydrologically isolated from the stream system through non-natural processes. These areas, once reconnected, may provide rearing habitat and off-channel refugia for fish and other aquatic organisms during high flow periods. They also may provide important moderating controls on hydrology by helping to decrease peak flows and increase low flows.

Wetland restoration often involves engineering efforts to restore previously altered hydrological conditions. Such projects are often large, complex and expensive. However, there is also a great need for many smaller wetland restoration projects to restore hydrological connections to small, off-channel, low-lying areas. The cumulative benefits in terms of water retention and habitat enhancement can be substantial if many such projects are undertaken.

Action recommendations include the following:

- Encourage practices that limit adverse effects on existing wetlands, such as off-channel watering, hardened crossings, livestock exclusion (part or all of the year), and that provide stream shade.
- Increase awareness of wetland functions and benefits.
- Reconnect to the stream system, where practical, streamside wetlands, floodplains, and other areas having hydric soils.
- Reestablish beaver populations where appropriate, giving consideration to agricultural needs.

Restoration Projects

It is important to recognize the many activities that have been conducted on public and private lands to restore watershed and habitat conditions. These projects sometimes succeed and sometimes fail. It is important to learn from the successes, but also to learn from the failures, so they are not repeated.

Action recommendations include the following:

- Monitor restoration projects and best management practices.
- Determine which are succeeding and which are failing and, if possible, why.
- Conduct baseline monitoring, as well as post-project monitoring.

DATA GAPS

A number of data gaps were identified in the process of conducting this assessment. In the following sections, data gaps are described.

Aquatic Species and Habitats

- Locations of fish passage barriers (in particular, culverts). Identification and removal of fish passage barriers would provide fish access to upstream areas, potentially increasing the amount of available habitat. Fish passage barrier removal is one of the most effective means of improving conditions for fish populations. Field inventories of potential barriers, such as culverts, would be required. The U.S. Forest Service has inventoried some culverts on its lands, but not all potential barriers have been assessed for fish passage.
- Stream surveys. Stream surveys are extremely limited within this subbasin. Conducting additional stream surveys on stream reaches for which surveys have not been conducted would provide valuable baseline data for the condition and improvement potentials of the stream reaches.

Channel Characteristics

- Channel modifications. The major channel modifications that are a result of federal flood control efforts should be inventoried.

Geologic Processes

- *Detailed soils information.* Detailed soils maps in SSURGO format should be available for approximately 95 percent of the watershed (all except Fremont National Forest) in a seamless coverage by 2011. At that time, analysis on the erosion risks and hazards can be re-run on this detailed soils information.
- *Streambank erosion.* A survey of streambank erosion along reaches of Sprague River, Williamson River and larger tributaries should be conducted. This survey should include causes and explanation of excessive amounts of streambank erosion, particularly in terms of riparian-wetland functions.

Riparian Vegetation

- *Refinement of riparian vegetation information.* More information on riparian plant community species composition would be helpful in identifying areas of high quality riparian vegetation. Additional field verification and refinement of the air photo and LiDAR-based analyses of riparian vegetation could greatly improve the understanding of riparian vegetation in the Lower Sprague-Lower Williamson subbasin. Half-meter aerial photos from the summer of 2005 are expected to become publicly available from the State of Oregon in 2007 and may provide a high enough level of resolution to further classify riparian plant communities.

Roads

- *Detailed road and culvert condition information, including mapped locations of problem culverts and road segments.* Detailed road and culvert information would help prioritize actions to reduce erosion and sediment contribution to the stream system. Although the U.S. Forest Service maintains limited information on road conditions in this subbasin, data are incomplete in many parts of the subbasin. Data on roads outside of federally managed public lands are very limited.

Stream Channels

- *Channel modifications.* There are stream channels throughout the Lower Sprague-Lower Williamson subbasin that have experienced substantial channel modification due to federal flood control measures and other activities, as well as gullying, stream incisement, and channel widening. Unfortunately, few data exist regarding the specific locations of channel modifications and historical channel disturbances. A geomorphological study is currently being conducted for parts of the assessment area, but that information was not available for inclusion in this Assessment.

Weeds

- *Information regarding distribution and trends of establishment for noxious and exotic weed species.* The development of a noxious weed database that allows analysis and characterization of the status of noxious and exotic weeds would be useful. Information regarding the location of weeds could be gathered in the field during routine weed eradication efforts or obtained directly from landowners, and the information could be analyzed on a periodic basis to determine trends and spatial patterns of noxious weed populations in the subbasin.

Wetlands

- *Historical wetland distribution.* Information regarding the historical location of wetlands would be useful for planning riparian and wetland restoration activities. Historical wetlands could be mapped by identifying hydric soils from SSURGO and U.S. Forest Service soils maps. The NRCS is conducting soils inventories that will be useful to assess historical hydric soils.