# 12 SUMMARY OF WATERSHED CONDITIONS, RESEARCH RECOMMENDATIONS AND RESTORATION OPPORTUNITIES

## SUMMARY OF WATERSHED CONDITIONS

This Watershed Assessment has attempted to characterize the pre-settlement conditions within the upper Williamson River subbasin and to describe how the landscape and rivers have changed over time. The following section summarizes the most sweeping changes the subbasin has experienced and how those changes are reflected in the landscapes and rivers we see today.

Prior to the early 1800s, approximately 500 to 1,000 people (the Klamath Marsh band of the Klamath Indians) relied upon the resources of the upper Williamson River subbasin. It is reasonable to believe that the anthropogenic impacts to natural systems were not a significant issue during this time. Beginning in the mid- to late 1800s, the population and pressures had begun to increase. Land uses changed from subsistence hunting and gathering to large-scale grazing, agriculture, and timber harvesting. Riparian and wetland areas, including Klamath Marsh, began to be modified in more substantial ways as a result of these activities, and also by the reduction or elimination of beaver populations.

Written historic records and GLO maps indicate Klamath Marsh is a dynamic system that changes in response to a variety of factors. Historically, water levels were higher, there was more open water, and willow thickets were more prevalent. It has been readily accepted that anthropogenic forces have modified the Marsh, but it would appear that natural climate cycles have played an even more significant role in modifying the Marsh. According to climatic data, it is possible that the current, dry marsh conditions may not be static, and that wetter conditions may ensue.

The Williamson River originates from a series of springs in the southern part of the subbasin and flows north for 35 miles before rounding the corner and flowing west into the Klamath Marsh. Historically, the Williamson River spread out over a wide delta when it entered the Marsh, but the natural channel has since been diked and diverted to supply drier areas of the Marsh. Upstream of the marsh, most of the tributaries are ephemeral, flowing only during spring snowmelt. Most of the perennial streams that drain the eastern side of the Cascades infiltrate into the pumice fields before reaching the marsh. The exceptions to this rule were historically Sand and Scott Creeks, which likely made it to the marsh, particularly during wet climate cycles, but are now diverted for irrigation purposes. Downstream of Klamath Marsh the Williamson River has a more pronounced runoff response due to inflow from ephemeral tributaries and direct runoff from the surrounding area. Surface flow downstream of the marsh is controlled primarily by Kirk Reef, a basalt sill at the marsh outlet. In most summers, flow is absent at Kirk Reef as the water level drops due to diminished inflows and evapotranspiration at the marsh.

A preliminary evaluation of consumptive water use (primarily irrigation) within the subbasin indicates that, due to the relatively constant hydrograph and the relatively small amount of consumptive use, minimum instream flow levels can be maintained above the marsh. Conversely, in average years the consumptive uses exceed the estimated volume of natural stream flow below the marsh from July through October.

Land uses have dramatically altered the riparian and wetland areas throughout the subbasin, in both the upper and lower elevations. Historically, the forested areas of the upper elevations were characterized by open stands of large trees, but forest management practices and fire suppression have resulted in overstocked stands with a high proportion of young, overstory trees and diminished large wood recruitment opportunities. Fire suppression has also resulted in the encroachment of lodgepole pine in riparian and wetland meadow areas, thereby changing the habitat characteristics within these areas.

In the lower elevations, the meadow riparian and wetland vegetative conditions have been altered by draining, grazing, and irrigation, which have given a competitive advantage to graminoid species over wetland species. In contrast to the historic willow and aspen dominated communities, less diverse grasslands have a reduced ability to provide important functions such as bank stabilization, stream-side shading, and providing riparian and aquatic structure.

The upper Williamson River is known to have relatively low sediment yields due to a combination of subdued volcanic terrain, the porous volcanic ash and pumice soils, and the relatively low precipitation, which falls mostly as snow. The two significant sources of sediment that have been identified are bank erosion along the mainstem and lower portions of larger tributaries and road erosion from the extensive road network. The low energy nature of this system suggests that the ability of the system to fully “heal” itself is low and will require active restoration.

The channel types that are most sensitive to changes are the low-gradient reaches along the mainstem of the upper Williamson River. In these reaches, the channel form has adjusted to the increases in sediment loads, as well as other influences such as loss of bank-stabilizing riparian vegetation and channel modifications. In the reaches above the marsh the channel has widened, become shallower, and increased its width-to-depth ratio, thereby reducing aquatic habitat and sediment transport capacity. In downstream reaches more directly affected by channel modifications, the channel has incised, widened, and become isolated from its floodplain.

From a water quality perspective, conditions within the upper Williamson River are relatively good and do not limit beneficial uses such as fish spawning and rearing. Although several impoundments in the headwaters appear to result in rapid heating of the river, inputs from springs play an important role in cooling the river. When viewed with respect to DEQ temperature standards for streams with redband trout, the mainstem Williamson River may be negatively impacted by high water temperatures. Anecdotal evidence suggests the sport fishery is quite healthy in the area, but improved temperature conditions could still result in an improvement to the aquatic habitat.

Important native fish found within the upper Williamson River subbasin include the redband trout and the Miller Lake lamprey. The lamprey was once considered extinct, but was rediscovered in the 1990s and is known to occur above Klamath Marsh in the subbasin. Redband are found primarily in the mainstem and Klamath Marsh and possibly in a few tributaries. Interactions between the native redband and the non-native brook trout could potentially occur through competition for resources, but the fact that redband populations within the mainstem are healthy is suggestive that potential competition between these species does not occur at a significant level.

Despite limited spawning habitat along the mainstem, redband recruitment appears sufficient to fully stock all existing available functional habitat. The standing crop of trout is presently dictated by the holding capacity of the upper portions of the river, to which fish migrate during the hot summer months. As channel morphology and riparian vegetation is restored, thereby improving fish habitat quality and progressively cooling the lower reaches of the river, the capacity of the river should dramatically increase. As this occurs, existing available spawning habitat may become limiting.

The traditional migratory patterns of the trout have been impacted by hydrologic alterations (in the form of natural climate cycles as well as water diversions) that have disconnected tributaries from the mainstem and from Upper Klamath Marsh. The lower water elevations create barriers that prevent passage, interfere with the trout's migratory life history, and diminish the gene flow between populations. Road crossings and other channel modifications may also restrict fish passage within the subbasin.

When the results from each of the Watershed Assessment chapters are considered and synthesized it becomes apparent that **restoring appropriate river channel morphology and the riparian zones may have the greatest impact on the riverine and wetland ecosystems within the subbasin.** Restoring the channels and the riparian areas will lead to the following improvements:

- Enhancing habitat for redband trout
- Improving water quality
- Reconnecting the channel and floodplain
- Decreasing channel instability
- Restoring the higher elevation wetlands
- Increasing scrub-shrub wetland habitats
- Reducing sedimentation
- Improving overall watershed health

# EXISTING RESTORATION EFFORTS IN THE SUBBASIN

The people that live and work in the upper Williamson River subbasin recognized long ago that there were things they could do to improve their landscape and rivers. The restoration work that has been ongoing in the subbasin for decades now has taught us many lessons about what does and doesn't work and what forms of restoration are most effective. The following section briefly describes just a few of the historic and ongoing restoration efforts within the subbasin. This information is useful for informing future restoration efforts in the subbasin.

## Restoration on Private Lands

Between 1973 and 1978 the Oregon Department of Fish and Wildlife (ODFW), using volunteer help from the Klamath County Flycasters, spent over $5,000 on riparian saplings and fencing material. Trees consisted of willow, aspen, cottonwood and poplar. ODFW focused on the Royce tract and the Rocky Ford area. Possibly for the same reasons mentioned by the Refuge, little to no success was observed from the tree plantings. However, vegetative recovery was reported in both the Royce tract and Rocky Ford area through improved livestock management (Roger Smith, pers. comm. 2005).

In 1988 the Upper Williamson River Coordinated Resource Management Plan (CRMP) was created to bring landowners together to address issues within their watershed (this evolved into the Upper Williamson River Catchment Group in approximately 1994). The CRMP was successful in implementing several riparian restoration projects on private land (Roger Smith, pers. comm. 2005).

In 1988-1989 ODFW and the Klamath County Soil and Water Conservation District (SWCD) using Governor's Watershed Enhancement Board funds, installed 355 lodgepole pine trees in the mainstem Williamson River to provide trout habitat and to reduce the width and increase the depth of the river. This project was considered successful in accomplishing its objectives (Roger Smith, pers. comm. 2005).

Riparian fencing has been installed to limit livestock impacts along several reaches of the Williamson River above the marsh. In addition, off-channel watering sites have been excavated in areas away from the river for the purpose of decreasing livestock use of the river. Off-channel watering and riparian fencing are known to be effective, as summarized in a 1992 ODFW and Winema National Forest evaluation that demonstrated the stream channel had narrowed and deepened as a result of these restoration efforts (Roger Smith, pers. comm. 2005).

In 1999 the USFWS-ERO, USFS, and Deep Creek Ranch partnered on a project to establish riparian fencing and a solar-powered, off-stream watering project. The project was determined effective, and improvements to the riparian area were observed a few years later. Subsequently, however, allotment plans changed and the fences were removed due to lack of maintenance (Sue Mattenberger, pers. comm 2005).

Willow caging has occurred on the private lands above the marsh for over a decade. Willow caging is usually an enjoyable group effort, involving a variety of public and private entities that have included the property owners, Upper Williamson River Catchment Group, Klamath County Flycasters, ODFW, USFWS-ERO, Winema National Forest and Chiloquin High School. Willow caging protects existing willows from grazing pressures and allows them to mature to a size that can provide riparian shading and bank stabilization. It is estimated that thousands of willows along the mainstem Williamson River have been protected through these caging efforts.

### Restoration Funded by USFWS-ERO

The USFWS–Klamath Basin Ecosystem Restoration Office (USFWS-ERO) provides technical as well as financial assistance in developing projects to improve the ecosystem of the Klamath Ecoregion. Restoring the form and function of the Klamath Basin ecosystem is the primary goal of their Habitat Restoration Program. Habitat restoration efforts focus on 1) coordination, 2) long-range planning, 3) on-the-ground restoration projects, and 4) outreach.

Table 12-1 lists the restoration projects that have been funded by USFWS-ERO in the upper Williamson River subbasin since 1995, and provides a brief description of the restoration action and the habitat on which the restoration was focussed.

*Table 12-1. USFWS-ERO Restoration in the Upper Williamson River Subbasin*

| PROJECT NAME | DESCRIPTION | HABITAT TYPE |
|---|---|---|
| Jack/God Creek 95 | Meadow Restoration | Wetland |
| Davis Flat Meadow 97 | Meadow Restoration | Wetland |
| Johnson Meadow 98 #1-#3 | Culvert Installation and Road Removal | Riparian |
| Skellock Draw 98 | Road Crossing | Wetland |
| Telephone Draw 98 | Road Crossing | Wetland |
| First/State Meadow 98-mult. actions | Lodgepole Control, Burn, Planting | Upland |
| Deep Creek 99 | Fencing | Riparian |
| Yamsi 2000 | Cattle Crossing, Off-Stream Watering | Riparian |
| Yamsi 2000 Mod1 | Streambank Revegetation | Riparian |
| Yamsi 2000 Mod2 | Planting Protection | Riparian |
| Ganong | Fencing | Wetland/Riparian |
| Soloman Flat | Riparian & Wetland Restoration | Wetland/Riparian |
| Soloman Flat Mod #1 | Riparian & Wetland Restoration | Wetland/Riparian |
| Patterson | Riparian, Streambank, Wetland Fence | Wetland/Riparian |
| Knight | Fencing, Planting | Upland/Riparian |
| Lawrence | Riparian | Riparian |
| Rocky Ford Ranch | Plan | Other |
| Rocky Ford | Instream Restoration | Instream |

Sue Mattenberger, Hydrologist with USFWS-ERO, indicated that their projects with private landowners in the upper Williamson are all going very well. A variety of riparian projects are currently under way, including fencing, plantings, adding large wood, deepening pools, and pulling back some of the incised channels. Fencing and easements are considered very useful tools in relieving grazing pressures (Mattenberger pers. comm 2005).

### Restoration at the Klamath Marsh National Wildlife Refuge

*The following descriptions of restoration efforts on the Refuge are adapted from information obtained from Walt Ford, Klamath Marsh National Wildlife Refuge Manager.*

Restoration efforts at Klamath Marsh National Wildlife Refuge (Refuge) have included the use of prescribed fire, willow planting, and mechanical removal of trees in an overstocked forest.

The Refuge has successfully utilized prescribed fire as a restoration tool in grass uplands and marsh habitats. The use of prescribed fire in the grass uplands is essential in halting conifer encroachment into historic meadow habitat. The periodic use of prescribed fire in marsh habitats is important in converting monotypic stands of tules into a healthy marsh (a favorable habitat for a diversity of species).

Restoration of willows on the Refuge has had mixed results. Experience has shown that successful willow planting requires specific environmental and plant conditions, including adequate and sustained soil moisture, before the cuttings will take root and survive beyond one year.

In August 2003 the Refuge and the U.S. Fish and Wildlife Service initiated the Fire Hazard Reduction and Wildlife Habitat Enhancement Project. Through this restoration project, fire will be allowed and encouraged in the forest habitat on the Refuge once the unnaturally high fuel load caused by decades of fire suppression has been reduced to an acceptable level by way of mechanical removal of surplus fuels.

### Restoration in the Winema National Forest

*The following information was provided by Jayne Goodwin of the Chemult District of the Winema National Forest.*

**Jack Creek Riparian Restoration.** These restoration projects focus on four vegetative types: uplands, wet lodgepole pine stands, moist meadows, and wet meadows with shrubs. Treatments include removal of heavy concentrations of dead lodgepole pine, thinning of overstocked green trees, and cutting of lodgepole pine encroachment in the meadows. Lodgepole pines have spread from the uplands and wet lodgepole stands into the moist and wet meadows displacing grasses, forbs, and shrubs that provide unique, diverse, and scarce habitats. Encroaching trees have reduced meadow size and water-holding capacities. Removal of encroachment restores meadow size, increases water-holding capacity, and helps to re-establish meadow plant species. Thinning of green trees within uplands and wet lodgepole zones promotes development of large-diameter lodgepole pine habitat and reduces the amount of hazardous fuels.

**Bullfrog Meadows.** Through this restoration project unique meadow habitat was enhanced to provide big game forage for elk. Encroaching lodgepole trees were cut and lopped into eight-foot sections, which were then broadcast-burned. Buffers of dense trees were left remaining along the edges of the meadows for calving and fawning habitat. The Rocky Mountain Elk Foundation was a partner in the project.

**Rake's Meadow Headcut Repair.** The objective of this project was to provide headcut stabilization to a 300-yard intermittent section of Jack Creek. The headcuts left a downcut, gullied channel that lowered the water table and caused drying of the meadow. These effects changed the meadow's vegetative composition and ability to store water for late summer release. Trees were placed in the channel at or below the bank-full elevation. Trees were anchored by burying up to one-third of their length into the streambank with the rootwad as an anchor. Branches were left attached to the trees, with the treetops oriented upstream so that the tree branches would help to slow water velocities, accumulate sediment, and create sites for vegetation to become established.

**Scott Creek Campground.** Compacted soil in campsites caused erosion that drained directly into Scott Creek. An old vault toilet posed a potential for leaking effluent into the creek. Picnic tables, fire pits, and parking areas were moved away from the stream. Traffic barriers were installed. A new sealed vault toilet was installed.

**Pothole Creek Road 2308 Culvert Replacement.** An old undersized culvert was replaced with a culvert sized for 100-year peak flow events. The roadbed was reconstructed to accommodate snowmobile and trail groomer travel. Slopes were rip-rapped to minimize erosion.

**Meadow Road Crossings.** This restoration project addressed three areas where roadbeds crossed stringer meadows. In these areas the culverts were too small to handle spring runoff, so water flowed over the road and compaction of the roadbeds hindered subsurface flow. Objectives of the project were to improve water transport and storage, benefiting both hydrologic functions and road use. The road surfaces were elevated and culverts raised to the height of the meadow surface.

**Jack Creek Dispersed Camps.** Vehicle traffic and camping activities in meadows and riparian areas have caused damage to native vegetation, soil, stream channels, and water quality. Vehicle barriers at strategic points prevent vehicle access to protect meadows and riparian areas. Camping sites are provided nearby, but outside sensitive areas. Hazard trees, dead trees, and small green trees are removed to make alternate camping sites safe and usable for campers.

# RESEARCH RECOMMENDATIONS AND RESTORATION OPPORTUNITIES

A Watershed Assessment is intended to gather existing information to draw conclusions about the status of the watershed or, in this case, the subbasin. A Watershed Assessment is not intended to provide recommendations for site-specific areas or landowners. Because of the intended Assessment methodology, combined with the large size of the subbasin, there was very little field validation of the Assessment components. As a result, the findings within the Assessment are general.

This Watershed Assessment has resulted in a list of research recommendations and restoration opportunities that are intended to focus on those elements that may have the greatest benefit to the aquatic and riparian resources within the upper Williamson River subbasin. Many of the restoration opportunities identified within this Assessment will require additional evaluations before a site-specific restoration project can be developed and implemented. Field inventories and other types of assessments may be necessary to assess site-specific conditions prior to identifying the restoration actions that will most benefit the subbasin.

## Research Recommendations

The research recommendations identified within the Watershed Assessment can be summarized as follows:

1. **Riparian/Channel**

    A. Conduct a geomorphic channel assessment on private lands within the upper Williamson River subbasin (possibly with the use of LiDAR) to 1) characterize the location, impacts, and feasibility of removing channel modifications, 2) determine the cause of channel instability in targeted areas (such as between Sand Creek and the marsh), 3) identify areas that have poor floodplain connections, and 4) identify properly functioning reaches.

    B. Conduct a riparian, land-cover assessment to 1) identify properly functioning reaches for purposes of protection, 2) determine the degree and extent that riparian areas are suffering from encroachment of mesic species, and 3) identify riparian areas most requiring restoration actions.

2. **Wetlands**

    A. Obtain hydric soils information to assist in identifying the historic extent of wetlands in both riparian and wet meadow areas.

    B. Determine the degree and extent to which wetland areas are suffering from encroachment of mesic species.

C. Identify target wetlands for purposes of conducting functional assessments and determining their influence on late-season flows.

D. Determine the effects of riparian grazing on wetland vegetation composition.

**3. Hydrology**

A. Determine the impact of juniper expansion on water levels and flows.

B. Determine the best locations for stream gages within the subbasin.

C. Evaluate the effects of land uses (or other factors) on late-season flows.

D. Conduct a climatalogical and hydrological study of the relative impacts of climate cycles and human induced change on upper Williamson River/Klamath Marsh system flows.

**4. Erosion Control**

A. Conduct a comprehensive road inventory in order to prioritize road erosion restoration efforts.

**5. Water Quality**

A. Existing DEQ FLIR imagery should be georectified for use in standard GIS platforms. This data should then be used to analyze which reaches of the upper Williamson provide cold water inputs.

B. Research water quality and chemistry dynamics within Upper Klamath Marsh. May include collecting FLIR data that can be incorporated into a standard GIS platform.

C. Identify critical springs.

**6. Fisheries**

A. Research redband utilization of the upper Williamson River, including Upper Klamath Marsh and tributaries, to determine the extent and types of migration barriers and the effect of irrigation diversions. Includes surveying diversions to evaluate the need for screening and conducting a pit tag/telemetry study.

B. Identify redband spawning sites and cold-water refugia.

C. Research year class formation in redband trout.

D. Evaluate fish use of Upper Klamath Marsh.

## Restoration Opportunities

During the process of preparing the Watershed Assessment the following restoration opportunities were developed in response to the issues observed within the subbasin. The following restoration actions have the potential to improve multiple watershed elements:

- Restore floodplain connections in those areas identified under 1.A., above.
- Control encroachment of lodgepole pine in areas identified under 1.B. and 2.B., above.
- Restore the natural geomorphic processes as identified under 1., above.
- Install exclosure fencing in riparian areas identified under 1.A. and 1.B., above.
- Provide stock watering areas away from waterways.
- Increase proportion of palustrine scrub-shrub wetland communities.
- Enhance wetlands that could contribute to late-season flows as identified under 2.C., above.
- Install additional stream gages at locations identified by 3.B., above.
- Enhance summertime streamflows through voluntary measures such as improving landowner communications regarding water diversion timing and increasing irrigation efficiencies.
- Implement erosion control measures in roadway areas identified under 4.A., above.
- Prepare Critical Spring Site Protection Plans for private landowners on springs identified under 5.B., above.
- Prepare grazing management plans for private landowners to facilitate improvements to water quality.
- Install exclosure fencing in riparian areas identified under 1.A. and 1.B., above.
- Provide stock watering areas away from waterways.
- Protect existing redband spawning sites and refugia, as identified under 6.B, above. This may include the development of spawning site protection plans for private landowners.
- Restore migratory pathways for redband trout, including restoring historic connections between the Williamson River and tributaries likely to provide redband spawning habitat.
- Screen water diversions as identified under 6.A., above.
- Remove the barriers to migration on Miller Creek to allow Miller Lake lamprey to move back into Miller Lake.

When planning restoration efforts, it is important to make the distinction between the east and west sides of the subbasin. The west side is characterized by a deep pumice substrate that is not supportive of surface flows. Therefore, there are very few connections now, nor were there historically, between the tributaries and the mainstem and marsh. As a result, restoration efforts may be more effective when conducted in areas with greater connectivity, such as the tributaries and uplands along the east side of the subbasin, the mainstem of the Williamson River, and Upper Klamath Marsh.

For most, if not all, of these restoration actions, monitoring of conditions before and after project completion is highly recommended in order to measure project success and areas for improvement.

These restoration opportunities can be used as a first step in developing an action plan and monitoring strategies to benefit the upper Williamson River subbasin. A strategic approach to restoration efforts and monitoring will facilitate funding and will ensure those funds are targeted towards the projects that will have the greatest benefit to the watershed.