

Middle Carson River Habitat Conservation Plan



Prepared by:

JBR Environmental Consultants, Inc.
595 Double Eagle Court, Suite 2000
Reno, Nevada 89521
775.747.5777

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Prepared for:



**Nevada Division of State Parks
Lyon County
Carson Water Subconservancy District
The Nevada Land Conservancy**

Table of Contents

Executive Summary	v
1.0 Introduction	1
1.1 What are the Issues?	2
1.1.1 Poor Connection of the River with its Floodplain	2
1.2.1 Loss of Cottonwood Forest and Lack of Recruitment	2
1.3.1 Annual and Between-Year Variation in Flows	3
1.4.1 Weed Management	4
1.5.1 Mercury Contamination	4
1.2 Habitat Conservation Plan Goals and Objectives	4
1.3 How Does the Plan Address the Issues?	5
2.0 Plan Area	6
2.1 Plan Area Descriptions	6
2.1.1 Lyon County Open Space	6
2.1.2 Dayton State Park	7
2.1.3 Fort Churchill State Historic Park	8
2.1.4 Carson River Ranches	9
2.1.5 Lahontan State Recreation Area	10
2.2 Overall Recommendations from Previous River Assessments	10
2.3 Reach Specific Recommendations from Previous River Assessments	12
3.0 Desired Future Conditions	15
3.1 Riparian Habitat Joint Venture Recommendations	15
3.2 Desired Condition	21
4.0 Project Formulation	24
4.1 Methods	24
4.1.1 Introductory Field Trip	24
4.1.2 Review of Plans and Previous Studies	25
4.1.3 Vegetation Mapping	25
4.1.4 Evaluation Criteria	28
4.1.5 Field Review and Data Collection	30
4.2 Findings of Field Study	31
4.2.1 Accuracy of Vegetation Mapping	31
4.2.2 Species Diversity	31
4.2.3 Riparian Species Recruitment	34
4.2.4 Erosion	35
4.2.5 Off Road Vehicle Use	35
4.2.6 Grazing Effects	35
5.0 Project Considerations	37
5.1 Prioritizing Projects	37
5.2 Addressing Lack of Hydrology	39
5.2.1 Know Your Water Table	39
5.2.2 Deep Planting	39
5.2.3 Hydraulic Barriers	40
5.2.4 Water Right Application for Environmental Purposes	42
5.3 Grazing Management	43
5.4 Invasive Weeds	44
5.5 Mercury	45

6.0	Community Prescriptions.....	47
6.1	Riparian Shrub and Mature Forest (RS and MF)	48
6.2	Old Riparian Forest (OR).....	51
6.3	Big Sagebrush Shrub (BSS).....	54
6.4	Wetland (W).....	55
6.5	Technical Resources	56
7.0	Monitoring	58
8.0	Funding Sources.....	66
8.1	Potential Funding Sources	67
9.0	References	69

List of Figures

Figure 1	Middle Carson River Habitat Management Plan Area
Figure 1a	Habitat Legend
Figure 2	Santa Maria Ranch Park Lyon County Open Space
Figure 3	Dayton State Park and Walker Open Space
Figure 4	Rolling A Ranch Park Lyon County Open Space
Figure 5	Ft. Churchill State Historic Park (West)
Figure 6	Ft. Churchill State Historic Park and River Ranches
Figure 7	Ft. Churchill State Historic Park (East) and River Ranches
Figure 8	Ft. Churchill State Historic Park (Northeast) and River Ranches
Figure 9	Lahontan State Recreation Area
Figure 10	Hydraulic Barrier
Figure 11	Rolling A Ranch Park Enhancement Site 1
Figure 12	Buckland Station Field Enhancement Site 2
Figure 13	Buckland Station Field Slope
Figure 14	West of Overlook Enhancement Site 3
Figure 15	Hercules Well Enhancement Site 4

List of Appendices

Appendix A	Sample Field Data Collection Sheet
Appendix B	Carson River-Dayton Valley Santa Maria Vegetation Enhancement and Restoration Plan
Appendix C	Site Photographs
Appendix D	Carson River-Dayton Valley Upper Rolling A Ranch (formerly known as Walker Property) Vegetation Enhancement and Restoration Plan
Appendix E	Carson River-Dayton Valley Rolling A Ranch Vegetation Enhancement and Restoration Plan
Appendix F	Weed Management Matrix
Appendix G	Project Descriptions Rolling A Ranch Park Buckland Station Field Fort Churchill West of Overlook Fort Churchill Hercules Well

List of Acronyms

ADA	Americans with Disabilities Act
ARS	Agricultural Research Services
BLM	Bureau of Land Management
CWSD	Carson Water Subconservancy District
DVCD	Dayton Valley Conservation District
EDRR	Early Detection, Rapid Response
HCP	Habitat Conservation Plan
IBA	Important Birding Area
JBR	JBR Environmental Consultants, Inc.
LAS	Lahontan Audubon Society
MDB&M	Mount Diablo Base and Meridian
NDOW	Nevada Department of Wildlife
NRCS	Natural Resources Conservation Service
NSP	Nevada State Parks
NvLC	Nevada Land Conservancy
ORV	Off Road Vehicle
PFC	Proper Functioning Condition
RHJV	Riparian Habitat Joint Venture
SCS	Soil Conservation Service (now the NRCS, Natural Resources Conservation Service)
USFWS	U.S. Fish and Wildlife Service
WMA	Weed Management Area

Habitat Acronyms

AG	Agricultural Land
BSS	Big Sagebrush Shrubland
CH	Channel
DEV	Developed/Disturbed Land
EM	Emergent Marsh
ER	Early Successional Riparian Shrub
MFRS	Mature Forest/Willow Forest Dominated with Fremont Cottonwood and a Riparian Shrub understory
ORFX	Old Riparian Forest Dominated with Fremont Cottonwood and a Xeric Shrub understory
OW	Open Water
RS	Riparian Shrublands
W	Wetlands
WM	Wet Meadow

Executive Summary

This Habitat Conservation Plan (HCP) has been developed for the Carson River from the Lyon County line upstream of Dayton to the Churchill County Line at Lahontan State Recreation Area. This reach of the river, referred to as the Middle Carson River, includes multiple stakeholders, both private land owners and public land managers, as well as an interested public. This Plan focuses on publically owned and managed lands.

The Middle Carson River supports a diversity of interests, including ranching, urban development, wildlife habitat and recreational use. Conditions on the river range from relatively stable reaches with areas of desirable wildlife habitats, to areas of eroding and highly unstable banks and degraded riverine habitats. Management of the Middle Carson River is complicated by a variety of constraints, ranging from the patchwork of ownership on river, through variations in seasonal and year-to-year river flows, poor regeneration of the riparian zone, and the need for weed management. Existing development and limited budgets impose further constraints.

This document reviews the challenges faced by land owners and managers working with the river, as well as opportunities for habitat restoration and enhancement. Previous studies of the river are reviewed and management suggestions included in those studies are noted and often incorporated.

Ongoing efforts to improve conditions on the river, including weed management conducted by Lyon County, the Dayton Valley Conservation District and the Nevada Division of State Parks, and such actions as the Important Bird Area (IBA) Conservation Action Plan for the Middle Carson River being undertaken by the Lahontan Audubon Society are also reviewed.

The Plan describes the various habitat types, or communities, found along the Middle Carson River, and presents a series of Community Prescriptions that review the issues, challenges and opportunities associated with each community type.

The Plan then presents a series of projects designed to improve habitat conditions or promote an understanding of the area's history and management. These projects are designed in part to test approaches to improving habitats on the Middle Carson River. Because the responses to changes in management are not entirely predictable, the Plan recommends the use of the proposed projects as tests of the suggested approaches, designed to investigate the responses of vegetation to management changes prior to implementation of any large-scale habitat improvement measures.

Many of the projects include a focus on habitats for avian species. The Plan suggests using these species as indicators of habitat condition, since many avian species have habitat requirements that are closely tied to specific habitats that the Plan actions attempt to enhance. Restoration of these habitats would benefit the target species and a diversity of other species. Similar projects could be undertaken by Middle Carson River stakeholders based upon the success of these test projects.

Note that, due to existing constraints including existing development, the Plan does not propose landscape-level actions to restore natural geomorphic processes. Instead, the Plan reviews challenges

and potential opportunities and proposes implementable measures designed to maintain or enhance existing riparian resources.

Note too that ongoing work designed to enhance habitats along the Middle Carson River has involved a cooperative effort between federal, state, county, and private entities. Continuation of this cooperative approach is seen as a key element to successfully implementing habitat improvement and river stabilization work on the Middle Carson River.

Middle Carson River Habitat Conservation Plan

1.0 Introduction

The Carson River between the town of Dayton, Nevada and Lahontan Reservoir (referred to for the purposes of this plan as the Middle Carson River) contains some of the best remaining cottonwood gallery forests in the State of Nevada and is a critical area for migratory birds. For years, stewards of the area, including local landowners, state federal and local agencies, conservation districts and others, have dedicated many resources and man hours to restore, stabilize and conserve the area. The goal of this habitat conservation plan (Plan) is to compliment and assist the past and current work that has been conducted. This Plan specifically addresses lands managed by Nevada Division of State Parks and Lyon County Open Space lands.

The Comstock Mining Era forever changed the river system throughout this area with the many mines and mills located throughout and directly upstream of the area in the Carson Canyon. In more recent times the river and its habitats have been modified by water diversions, land uses, and the infestation of noxious weeds. These activities have degraded desirable habitats, resulted in a loss of biodiversity, and the river has lost connection to its floodplain in many reaches.

The Nevada Division of State Parks (NSP) and the Carson Water Subconservancy District (CWSD) received funding from the Nevada Division of State Lands State Bond Act (Question 1) to develop this Plan. Nevada Land Conservancy (NvLC) was retained by the CWSD to assist with this effort, and JBR Environmental was selected as project consultant. A steering committee was developed to provide oversight and local knowledge for the project and includes NSP, CWSD, NvLC, Lyon County, Dayton Valley Conservation District (DVCD), Western Nevada Resource, Conservation and Development, Inc., Natural Resources Conservation Service (NRCS), Lahontan Audubon Society (LAS) Important Bird Areas Program (IBA Program), and the Nevada Department of Wildlife (NDOW). These various entities, along with many others, including local landowners, will work together to implement the suggestions in this plan.

This Middle Carson River Habitat Conservation Plan (Plan) reviews issues, challenges, and opportunities and provides a list of projects with descriptions useful for on-the-ground activities designed to enhance biodiversity and sustain healthy native vegetative communities and wildlife habitats within the Middle Carson River riparian corridor and floodplain. The Plan is designed to address both the immediate and long-term future of habitats on the river. The primary mechanisms for enhancing biodiversity are protection of existing higher quality riparian habitat and enhancement of lower quality habitat through riparian plantings and encouragement of natural recruitment of native riparian forbs, shrubs, and trees.

The Plan Area covers Lyon County's public open space lands and lands managed by the Nevada State Parks, namely Dayton State Park, Fort Churchill State Historic Park, Carson River Ranches, and Lahontan State Recreation Area.

1.1 What are the Issues?

1.1.1 Poor Connection of the River with its Floodplain

Opportunities for seasonal overbank flooding and lateral channel migration are limited. Overbank flooding and channel meandering are key hydrogeomorphic processes needed to regenerate riparian communities and replace old-growth cottonwoods. Flooding during spring and early summer high flows deposits sediment as overland water flow slows and loses energy on the lateral floodplain. Newly deposited sediment provides fresh substrate where new riparian vegetation can become established. Bare moist soils are ideal germination sites for cottonwoods, which require exposure to full sunlight with no vegetative competition (Borman 2002). Stream meandering also creates new sites suitable for colonization by new plants in the river corridor. As meanders move, the stream erodes its channel and bank on the higher energy outside bends while simultaneously depositing sediment on the lower energy inside banks. Older established vegetation can be lost on the eroding bank, but the accreting edge provides fresh substrate for recruitment of new riparian vegetation.

1.2.1 Loss of Cottonwood Forest and Lack of Recruitment

Studies evaluating the condition of the Middle Carson River have identified the decline of cottonwood forests and the overall poor condition of riparian community as factors affecting biodiversity on the river. Two recent studies, the *Assessment of the Middle Carson River and Recommendations for the Purpose of Recovering and Sustaining the Riverine Ecosystem* (Otis Bay 2008) and the *Fluvial Geomorphic Assessment of the Carson River, Implications for Management of a Changing River* (Inter-Fluve 1997), have noted that along much of the river, recruitment of young Fremont cottonwoods (*Populus fremontii*) is not occurring. Existing old-growth cottonwood forests are generally sparse and lack the physical structure of healthy riparian forests that include younger age classes of trees and/or an understory canopy. Both the above studies attribute the cottonwood forest decline and poor condition of riparian vegetation to a number of human alterations, including entrenchment resulting from channelization, land conversion, berm construction, watershed alterations, heavy grazing, and extreme baseflow dewatering, as well as water quality decline and floodplain encroachment. The Carson River Delta Important Bird Area Conservation Plan (Lahontan Audubon Society 2006) focuses on avian habitats in the section of the river above Lahontan Reservoir. This document identifies a similar suite of issues affecting habitats in the area: hydrology, noxious and invasive weeds, grazing management, and mercury.

In a natural recruitment scenario, the youngest cottonwood trees are found on the youngest and lowest geomorphic surfaces and oldest trees are found on higher, older stream terraces. As aggradation (i.e., increase in land elevation due to the deposition of sediment) continues over time, the oldest forests become disconnected from the active floodplain and will eventually die out. The process is sustainable

as long as new forests are continually created elsewhere on newly bared surfaces and banks in the active floodplain.

In its present state, the river is not providing favorable soil-moisture conditions that would promote the survival of newly established cottonwood seedlings. Numerous studies have identified slowly declining water tables in spring and early summer as essential to cottonwood (and willow (*Salix* sp.)) survival. Chasing the falling groundwater surface, the cottonwood seedlings grow roots up to an inch per day, but if the rate of water table decline significantly exceeds the biological potential for the rate of root growth (1 inch per day) then the seedlings are unlikely to survive (Otis Bay 2008).

The decline of cottonwood-dominated riparian forests has resulted in declines in native wildlife, including native birds, mammals, fish, and amphibians. The Nevada Partners in Flight (PIF) Bird Conservation Plan states that “Nevada’s lowland riparian habitats are its most productive and among its most drastically altered” (Neel 1999). The Nevada Wildlife Action Plan (Wildlife Action Plan Team 2006) notes that “more than 75 percent of the species in Nevada are strongly associated with riparian vegetation, including 80 percent of the birds.” In California, riparian habitats support the highest number of bird species found in the arid and semiarid environments of the western U.S. (RHJV 2004). The California Riparian Habitat Restoration Handbook (Griggs 2009) notes that riparian corridors represent principal migration and movement corridors for wildlife. Riparian vegetation also shades stream and river channels, helping to maintain lower water temperatures required by trout and other aquatic species.

According to the *Assessment of the Middle Carson River*, native birds associated with riparian habitat and wetlands are uncommon, rare, and in some cases locally extinct. “Species that are associated with dense riparian shrublands or riparian understory are noticeably underrepresented, since this stratum of the vegetation is often the most degraded” (Otis Bay 2008). The fish fauna is dominated by introduced fish that are not native to Nevada and prefer warm, stagnant water. Coldwater fishes such as trout are uncommon in the Middle Carson River. Except within specific areas of the upper Carson River system within Alpine County, California, the native Lahontan cutthroat trout is probably extinct in the Carson River. “Native amphibians are greatly reduced as well, but not yet extinct” (Otis Bay 2008).

1.3.1 Annual and Between-Year Variation in Flows

Unlike the Truckee River, no large dams exist in the Middle and Upper Carson River watershed. The Lahontan Dam is the only large dam on the Carson River system and is located in the lower reaches at Lahontan Reservoir, below the Middle Carson River project area. The lack of dams in the upper and middle reaches limits the ability to regulate flows. Dams on the Truckee River have been used to manipulate river flows such that draw-down of the water table in the river’s floodplain occurs slowly, favoring the establishment of cottonwoods. In the absence of large dams, water supply on the Middle Carson River varies annually with the amounts of precipitation runoff and is subject to the effects of upstream water withdrawals. This problem is usually most severe in late summer, when reaches of the lower Middle Carson may dry completely. The Carson River Delta Important Bird Area Conservation Plan (Lahontan Audubon Society 2006) notes that, “year-round surface waters are rare in this segment of the

river. It is not unusual for the river to cease flow as early as July, with no detectable flows again until October.”

1.4.1 Weed Management

Exacerbating the decline of riparian forests and native species diversity is the displacement of native species by invasive weeds. Weed infestation is a significant problem on much of the Middle Carson River. Common-to-dominant weeds present on the Middle Carson River include the state of Nevada-identified noxious weeds perennial pepperweed (*Lepidium latifolium*), also known as tall whitetop; Canada thistle (*Cirsium arvense*); Russian and spotted knapweed (*Rhaponticum repens* and *Centaurea stoebe*, respectively); hoary cress (*Cardaria draba*); and tamarisk (*Tamarix* sp.); as well as such nuisance weeds as cocklebur (*Xanthium strumarium*); Russian olive (*Elaeagnus angustifolia*); Russian thistle (*Salsola kali*); and cheatgrass (*Bromus tectorum*). Two additional State of Nevada noxious weed species, medusahead (*Taeniatherum caput-medusae*) and yellow star-thistle (*Centaurea solstitialis*), have been found nearby, and could become problems in the Carson River area in the future.

1.5.1 Mercury Contamination

The Carson River from Carson City through Dayton Valley is a U.S. EPA-designated Superfund site due to the high levels of mercury contamination in the floodplain and river sediments that were deposited during the historic Comstock Mining Era. Certain forms of mercury can accumulate within the food chain and become toxic to wildlife. Ironically, the limited opportunities for overbank flooding and lateral channel migration along the Middle Carson River area are in fact, fortunate and desirable, as these factors limit the mobilization of mercury.

1.2 Habitat Conservation Plan Goals and Objectives

The goal of this Plan is to enhance biodiversity and sustain healthy native vegetative communities and wildlife habitats within the riparian corridor and floodplain for the immediate and long-term future.

Plan Objectives

- 1) Include lists of projects with adequate descriptions and science-based justifications useful for on-the-ground projects and to the people who will implement the Plan actions.
- 2) Provide recommendations for monitoring and evaluating completed public restoration and stabilization projects on state parks and Lyon County properties.
- 3) Work with stakeholders to identify potential projects and changes in management strategies to address identified challenges and opportunities and to avoid duplication.
- 4) Coordinate with stakeholders throughout the watershed about this project through the Carson River Coalition (a large stakeholder group representing all regions of the Carson River Watershed).
- 5) Provide Lyon County and the NSP with a product that can be directly incorporated as part of the natural resource element of the county’s master plan and park resource management plans by:
 1. Identifying natural resource assets on state and county lands;
 2. Describing natural resource challenges in the area; and
 3. Suggesting on-the-ground projects to address these challenges, both immediately and for the long term.

- 6) Identify specific projects that will assist with the implementation of the adopted Carson River Watershed Regional Floodplain Management Plan and the Carson River Watershed Stewardship Plan.
- 7) Complement the Lahontan Audubon Society's Nevada Important Bird Area (IBA) Conservation Action Plan for the Middle Carson River, NDOW State Wildlife Action Plan, Nevada Priority Wetlands Inventory, and NSP General Management Plans and other natural resource plans.

1.3 How Does the Plan Address the Issues?

To create truly self-sustaining riparian communities along the Middle Carson would require that the river be allowed to create new acres of floodplain surfaces on which new riparian forests could establish to replace existing acres of old-growth cottonwood forests. This would necessitate allowing channel migration and floodplain expansion. Sufficient instream flows that provide a slowly falling water table during the summer would also be needed.

Previous river assessments have recommendations for better management of the river, including active restoration to widen and reconnect the river to its floodplain (see Section 2.2, Overall Recommendations from Previous River Assessments). Many of the recommendations are not entirely practicable, affordable, or attainable under today's circumstances. Due to legal, political, and economic constraints as well as the constraints imposed by development in and near the floodplain and the presence of mercury in river and floodplain sediments, this Plan does not propose actions to change landscape-level, geomorphic processes. That is, this Plan does not propose to restore natural processes or fix the underlying causes of riparian habitat decline.

- Instead, the Plan reviews challenges and potential opportunities and proposes measures to protect and maintain existing riparian resources. New, or enhanced, management strategies and improvement projects can restore or create a more structurally complex biological community for the benefit of native species. Supplemental plantings can augment existing cottonwood forest with additional cottonwood trees and native understory and prolong the life of a mature cottonwood stand. A change in grazing systems and continued weed management can be used to promote natural recruitment in floodplain communities to obtain a more complete assemblage of native riparian species.

Note that while this Plan does not propose attempts to address the underlying causes of riparian habitat decline, it does not discourage such attempts when economic, expertise, and site-specific conditions allow.

Because the actual responses to a change in management will vary and are not entirely predictable, the Plan also recommends the use of test areas, or plots, to investigate the natural response of vegetation to management changes. Changes in grazing patterns, for example, may enhance riparian shrub recruitment but could negatively affect some weed management efforts. Prior to instituting a significant change in management, the effects of proposed change should be assessed in small control areas to ensure the desired effects are achieved.

2.0 Plan Area

The *Middle Carson River Habitat Conservation Plan* covers seven separate locations (**Figure 1**). From upstream to downstream, these include Lyon County Open Space Santa Maria Ranch Park (**Figure 2**), Dayton State Park and Lyon County Open Space Upper Rolling A Ranch, formerly known as the Walker Property (**Figure 3**); Lyon County Open Space Rolling A Ranch Park (**Figure 4**); Fort Churchill State Historic Park (**Figures 5 through 8**); the Carson River Ranch Properties, managed by Fort Churchill State Historic Park (**Figures 6 through 8**); and Lahontan State Recreation Area (**Figure 9**). **Figure 1a** provides a key to habitat types depicted on **Figures 1-9**.

2.1 Plan Area Descriptions

2.1.1 Lyon County Open Space

Lyon County acquired several open space properties that previously were private ranch properties. These properties are the Santa Maria Ranch Park (approximately 26 acres) (**Figure 2**), Upper Rolling A Ranch/Walker Property Open Space (approximately 43 acres) (**Figure 3**), and the Rolling A Ranch Park (approximately 276 acres) (**Figure 4**).

Santa Maria Ranch Park

Santa Maria Ranch Park (**Figure 2**) was once a part of a ranch operation with alfalfa production and winter cattle grazing. The key feature of the park is a berm along the river that was built by the U.S. Army Corps of Engineers in 1963 and, behind it, a dense old-growth cottonwood forest. (The construction of the berms was intended to increase channel depth, not as flood control.) Lyon County has made improvements to encourage public use of the open space and increase native wildlife habitat. When first acquired by Lyon County, the cottonwood stand lacked an understory of native shrubs and trees. Riparian vegetation along the berm was sparse with areas of undercutting and erosion present along the river banks. At the time, encroachment of musk thistle (*Cardus nutans*) and perennial pepperweed were primary concerns in the uplands, and Russian olive, perennial pepperweed, hoary cress (*Cardaria draba*), and thistles were concerns in the riparian zones. Through assistance from the LAS IBA Program, in cooperation with Lyon County, seeded and planted selected areas in 2009 and 2010 to increase native species diversity and provide additional streambank protection. Native shrubs and trees were planted in the cottonwood forest and along the berm. Treatment of weeds was a priority, and seed mixes used included a selection of grasses and forbs that could compete with weeds with minimal irrigation needs. Monitoring and weed treatment are on-going.

Walker Property/Upper Rolling A Ranch Open Space

The Walker Property/Upper Rolling A Ranch Open Space is at Dayton State Park's eastern boundary (**Figure 3**). An important feature of the Walker Property Open Space is that it is subject to flooding. Flood disturbance and the abandonment of agricultural activities on the property contributed to an infestation of weeds. According to an assessment made by the LAS IBA Program, perennial pepperweed and hoary cress established dense monocultures on approximately 15 acres of the site. A mowing and spraying program has significantly reduced the extent of the weed infestation on this parcel.

Rolling A Ranch Park

The Rolling A Ranch Park (**Figure 4**) was also a part of a ranch operation with alfalfa production and winter cattle grazing. The key features of the public open space are the abandoned agricultural fields, a narrow strip of cottonwood trees along the river, and a small stand of sparse old-growth cottonwoods. Bank stabilization projects, constructed by the DVCD, have successfully reestablished areas of native willows and cottonwoods. A Frisbee golf course has been developed in a cottonwood stand at the western end of the parcel and has become a popular recreation area for community members. When first acquired by Lyon County, approximately 180 acres of the abandoned alfalfa fields had become a monoculture infestation of perennial pepperweed. For several years the DVCD has been actively managing this site to reduce the infestation. The DVCD's approach has been highly effective as the infestation as of 2011 has been reduced to under ½ acre. Treatment involves first burning the perennial pepperweed thatch to expose younger leaves and remove decadent materials, then spraying with water-approved herbicide, and mechanical methods such as mowing. DVCD continually monitors and repeats treatments as necessary. Finally, treated areas are seeded with competitive grasses to reduce re-establishment of weeds.

2.1.2 Dayton State Park

Dayton State Park includes 152 acres with the Carson River bordering the park's eastern side (**Figure 3**). Highway 50 bisects the park, dividing it into an upper section and lower section. The two sections are linked by an underpass beneath the highway. The park includes various historical sites, including the Comstock-era Rock Point Mill, as well as camping and trail facilities. Trail space within the park is limited, but the park has high potential as a hub for other trail systems along the Carson River/Pony Express corridor, toward Virginia City and other locations. All of the currently developed facilities, and most areas available for future development, are located within the river's 100-year floodplain. Another feature of the park includes the Cardelli Ditch, which leaves the river at the southern park boundary and flows north, parallel to the river. A second ditch, the Gee Ditch, leaves the east side of the river at a diversion near the park's southeastern corner.

A 2007 Master Plan developed for the park states that the public has identified a lack of developed access to the Carson River for kayaking and canoeing as an issue. Other constraints recognized in the plan (Nevada Division of State Parks 2007) include the following:

- Fuels management (susceptibility to wildland fire)
- Noxious weeds are issues
- Potential for the Carson River to meander
- Seasonal (spring and summer) high water table
- Lack of precipitation in the summer months
- High potential for erosion in two drainages that enter the park from the Flowery Range to the west. The larger of these two drainages is identified as the most prone to erosion. The existing trails and an interpretive garden have been damaged by high flows on multiple occasions; Beaver impacts to vegetation are noted as an area of concern in the park

The desired focus of park direction will be on self-guided walking tours, with an emphasis on historical features in the upper park and on natural resources, flora, fauna, and the river in the lower park. Some additional development, including construction of an additional covered pavilion and possibly the addition of one or two amphitheaters, is proposed. The existing campground will be converted to a reservation-only group camp and a group picnic area. The existing RV dump station would be closed and/or removed. Construction of improved (safer and more sustainable) trails, including some hard-surfaced trails to provide Americans with Disabilities Act (ADA) access, is proposed, as is acquisition of adjacent parcels along the river and above the park to the west to improve trail connectivity. The existing interpretive garden would be maintained.

The 2007 Master Plan considers both less emphasis and higher emphasis management scenarios for the river corridor and the upland sagebrush communities. Under the higher emphasis scenario, replanting would focus on native trees and shrubs along the riparian corridor. Under both scenarios, fuels management activities would continue and invasive weed control, including cheatgrass control, would be pursued. Hazard trees would be removed, and cottonwood galleries would be protected from beaver activity. The 2007 Master Plan includes a phased approach to implementing the plan.

2.1.3 Fort Churchill State Historic Park

Fort Churchill State Historic Park (**Figure 5**) includes approximately 1,232 acres of land adjacent to the Carson River. The park's central feature is Fort Churchill, a U.S. military post established in 1860. The fort consists of ruins of the original fort as well as reconstructed and new facilities added by the Civilian Conservation Corps in the 1930s. Other facilities present at the park include interpretive exhibits, picnic sites, 20 camp sites, restrooms, and trails. Common activities at Fort Churchill State Historic Park include visiting the multiple historical sites, stream fishing, hiking, and walking in the relaxing outdoor setting.

The original Fort Churchill State Historic Park included only a relatively short reach of the Carson River on its southern boundary. However, acquisitions have added substantially to the amount of river channel included in the park. Additional reaches both up- and downstream are now included in the park. Downstream additions extend to the Lahontan State Recreation Area. South of the Carson River, lands administered by the Bureau of Land Management (BLM) border state-owned lands, creating a potential for cooperative management of this part of the Carson River corridor. Currently, the 100-year floodplain encompasses all of the developed river recreation areas.

A Master Plan for the park was originally published in 1973. As a part of a 1988 update of the Master Plan, a user survey was conducted. This survey indicated that the historical sites at the park were of principle interest to visitors, with outdoor relaxation, stream fishing, and hiking/walking, also favored activities. The Park is located on both the Emigrant Trail and the Pony Express Trail. The Pony Express Trail Association recreates the Pony Express mail run annually, and the section of trail between Fort Churchill and the Mormon Station receives the most use. Additionally, the Desert Trail Association is proposing a Canada to Mexico trail that would connect Fort Churchill with the Pinenut Mountains to the south. A proposed State Parks Connector Trail would be located primarily on public lands in the Carson River Canyon/Pony Express Trail corridor and would connect five state parks including Lahontan State

Recreation Area downstream of Fort Churchill and Dayton State Park to the west, upstream of Fort Churchill State Historic Park.

The 1988 Fort Churchill State Historic Park Development Plan notes that “the primary environmental factor in development and management of Fort Churchill and its developed facilities is the dynamic and flood-prone Carson River. The 100-year floodplain encompasses all of the currently developed river recreation areas. Historically, the river itself constantly shifts its course. With each change in course, river banks may be eroded in one area, while sediment is deposited in another.”

2.1.4 Carson River Ranches

The Carson River Ranch Properties (**Figures 6, 7, and 8**) include approximately 3,221 acres managed by the Fort Churchill State Historic Park and leased for grazing. The Carson River Ranches Grazing Management Plan, Draft Grazing Lease 3 (August 10, 2006) notes the Carson River Ranches area is divided into three sections named after former ranch properties DePaoli, Ghiglia, and Amerongen. The Ghiglia and Amerongen sections are divided into three smaller sections, or pastures. In these sections, a perimeter fence installed along the Carson River approximately 50 yards from the river’s high water mark is intended to “prevent to some degree the impacts of cattle to a . . . sensitive area.” This fence is installed from Scout Camp on the west (upstream) to the Hercules access on the east (downstream).

The grazing plan calls for a cooperative agreement between the park and the lessee regarding noxious weed management issues, as well as cooperation regarding irrigation. The grazing plan stipulates that the Carson River shall not function as a route to move cattle from one side of Highway 95A to the other.

DePaoli Section, Carson River Ranches

The DePaoli section of the Carson River Ranches includes 1,014 acres located west of Highway 95A and continues upstream “to approximately 300 yards before the diversion dam at the BLM boundary. This section includes property both north and south of the Carson River. This section is bounded on the north by the Fort Churchill Road and on the south by the fence line bordering BLM-owned lands.”

Ghiglia Section, Carson River Ranches

The Ghiglia section includes 891 acres located along the Carson River east of Highway 95A downstream to the boundary fence of the Amerongen section near the Horse Camp access. Grazing in this section is not permitted from Highway 95A to the cross fence located approximately 1,000 yards downstream from the Scout Camp. Additionally, the grazing plan calls for installation of a fence along the Carson River approximately 50 yards from the river’s high water mark. According to the plan, “this strip of acreage is made up of sensitive riparian habitat and cottonwood forest that should only be grazed by prescribed grazing practices.” Additionally, the plan states that “the Carson River Ranches trail system placement will be within this acreage throughout this section of the ranch property.” Wells or some other water source would be needed to supply water to cattle in pastures that no longer extend to the river. The river would represent a least preferred alternative water source, with temporary drop gates placed at designated sites to allow cattle to access the river. The Ghiglia section would be divided into two pastures, one of which has not been heavily grazed in the past and is now dominated by sagebrush (*Artemisia tridentata*) and rabbitbrush (*Ericameria nauseosa ssp nauseosa*). The second pasture location

is subject to regular flooding and accordingly supports grass of good quality and in good quantity. Note that as of July 2011, none of these fences were in place.

Amerongen Section, Carson River Ranches

Finally, the Amerongen section includes 1,316 acres below (downstream from) the Ghiglia section and extending downstream to the Lahontan State Recreation Area. The section would be divided into three approximately equal-sized pastures (the Amerongen 1, 2, and 3 pastures), requiring some additional fence construction. An existing fence approximately 50 yards from the river's high water mark would represent a continuation of the fence bordering the river on the Ghiglia section and would keep cattle out of the Carson River's sensitive riparian zone. Amerongen Pasture 2, the driest of the three pastures, would be grazed first. Amerongen Pastures 1 and 3 are affected by seasonal floods in the early season, even in "normal" water years. These pastures would be grazed later, after flood waters recede. Note that as of July 2011, only the fence paralleling the river had been constructed.

USFWS Parcel, Carson River Ranches

It should be noted that an additional 1,570-acre property north of the Carson River between Highway 95A and the Amerongen Ranch, owned by the U.S. Fish and Wildlife Service (USFWS), is managed by Fort Churchill State Historic Park. Although this parcel is owned by the USFWS, the park leases it for livestock grazing. No public access or trails have been developed on this property.

Both the majority of the Fort Churchill State Historic Park and the reach of the river just above Lahontan Reservoir, within the Lahontan State Recreation Area, are within the Lower Carson River IBA. Five Nevada Partners in Flight (PIF) species of concern are known to occur on the area. These species are the Bald Eagle (*Haliaeetus leucocephalus*), the Cooper's Hawk (*Accipiter cooperii*), the Yellow-billed Cuckoo (*Coccyzus americanus*), the Willow Flycatcher (*Empidonax traillii*), and the Western Bluebird (*Sialia mexicana*). The Lower Carson River represents one of the few known Bald Eagle nesting sites in Nevada (Lahontan Audubon Society 2006). As noted below, gallery cottonwood forest above Lahontan Reservoir is reported to be the only known site for Yellow-billed Cuckoos in northern Nevada (Chisholm and Neel 2002). The IBA document states that this area "represents the last best example of a riparian cottonwood forest in western Nevada. In fact, its extent and quality makes it exemplary in much of the West" (Lahontan Audubon Society 2006).

2.1.5 Lahontan State Recreation Area

Lahontan State Recreation Area (**Figure 9**) encompasses a total of 34,014 acres, 10,000 of which are covered by water when the reservoir reaches its maximum capacity of 274,000 acre-feet. Located 18 miles west of Fallon and 45 miles northeast of Carson City, the entire recreation area is located within Townships 17 and 18 North, Ranges 25 and 26 East, Mount Diablo Base & Meridian (MDB&M). The reservoir includes approximately 69 miles of shoreline when full and is almost 17 miles long.

2.2 Overall Recommendations from Previous River Assessments

The *Assessment of the Middle Carson River* (Otis Bay 2008) was prepared for the BLM and provided land management recommendations to preserve, enhance, and sustain the Middle Carson River ecological system. The draft assessment was made in 2004 and completed in 2008. The restoration approach

focused on restoring ecological process, landscape features, and floodplain function to address the underlying causes of riverine ecosystem decline. For the river segment between Empire and Lahontan Reservoir, the *Assessment of the Middle Carson River* recommends the following restoration measures to hasten the recovery of the ecosystem:

1. Reconnection of the channel to its floodplain;
2. Allowing river migration to re-form a meandering channel pattern;
3. Construction or reconnection of river meanders to re-establish a sinuous meander pattern;
4. Removal of levees, riprap, and jetties;
5. Construction of a variety of wetland types (emergent marsh, open water, wet meadow, mudflat playas;
6. Planting of wetland and riparian areas to hasten vegetation community recovery;
7. Implementation of a weed management plan that uses wildlife and water-safe herbicides;
8. Increase of summer base flows to support riparian vegetation;
9. Elimination of grazing or implementation of new grazing strategies that promote recruitment of native plants; and
10. Development and implementation of a comprehensive monitoring plan to determine hydrologic and revegetation success and to monitor aquatic and wildlife species recovery and use.

The *Fluvial Geomorphic Assessment of the Carson River, Implications for Management of a Changing River* (Inter-Fluve 1997) was completed in 1997 for Western Nevada Resource Conservation and Development, Inc. and provided recommendations and options to enhance the stability of the river. While the study was based on river conditions that existed prior to the 1997 New Year's flooding that devastated the river corridor, many of the observations and recommendations are still valid and useful to this day. The report pointed out that development near the river corridor and dewatering of the river through irrigation withdrawals may be "an irrevocable river condition which may impair natural recovery," but it identified a number of beneficial strategies to achieve a state of natural stability. Specific strategies to improve the health of the riparian community recommended in the assessment included:

1. Restore hydrology. Allow greater riparian survival through greater lower-flow discharges. However, the Plan acknowledges this would be difficult to accomplish because of the importance of irrigation withdrawals to the agricultural community.
2. Supplemental planting. The recommended method is using a backhoe-mounted planting tool (i.e., stinger) that provides a deep hole that reaches the low summer water table for planting 3- to 12-inch-diameter dormant cottonwood poles.
3. Restore the floodplain and create geomorphic surfaces suitable for cottonwood establishment. This could be accomplished through lowering the floodplain adjacent to the channel in places where the floodplain is perched relative to the channel, or raising the channel with frequent grade control structures.

Where bank protection was recommended, the assessment consistently recommended "best practices" which include: Evaluation of project's effects on upstream and downstream stability; professionally designed, engineered, and installed; use of vegetation and treatments that benefit fish and wildlife;

identification of likely failure scenarios and anticipated cost for long term maintenance. The assessment also recommended alternative designs for diversion structures to improve sediment transport during high flows.

2.3 Reach-Specific Recommendations from Previous River Assessments

This section describes reach-specific recommendations from previous studies. Previous studies did not cover the Lahontan State Recreation Area.

Santa Maria Ranch (Figure 2)

The 1997 channel stability study identified this area as relatively stable because the berms that were built in 1963 are sufficiently set back, allowing the river some freedom to meander. Restoration priority was considered low. Along areas where berm toes are eroding, the assessment recommended engineered riprap with vegetative plantings be installed at the berm toes to prevent further undercutting. The plan recommended removal of the right bank berm because very little development is present in the historical floodplain. The overall riparian vegetation on the Santa Maria Ranch was noted to be in better condition than on adjacent reaches. To further improve riparian vegetation on the outside of the berm, the assessment recommended discouraging cattle and wild/estray horse grazing until the riparian community has reached full potential. (Estray animals are unclaimed domestic animals, including livestock; also referred to as feral animals).

Since the recommendation was made, the following actions have taken place:

- Riparian corridor was acquired by Lyon County and is an open-space amenity of the Santa Maria Ranch subdivision;
- Public facilities including picnic tables, restrooms, and a boat (canoe/kayak) take out have been added;
- Berm slopes have been stabilized with toe protection and replanted with riparian vegetation;
- The cottonwood grove was fenced to prevent off-road vehicle (ORV) access;
- Cattle and wild/estray horse grazing has been discontinued;
- Perennial pepperweed and musk thistle have been controlled at planting sites;
- Seeding and container plantings to increase native riparian and riparian understory have taken place.

Dayton State Park and Walker Property (Figure 3)

The 1997 *Fluvial Geomorphic Assessment of the Carson River* identified two distinct subreaches for the Dayton State Park. The upstream subreach was identified as stable because historical berms are set back from the active channel and the banks and channel fringe are well vegetated with reproducing woody species. The restoration priority was considered low. The assessment noted that the Cardelli Ditch and recreation facilities are too close to the river and could be threatened by further channel migration. By contrast, the downstream subreach adjacent to the lower park and the Walker Property/Upper Rolling A Ranch were assessed as relatively unstable due to aggradation and channel meandering. The restoration priority was ranked as high. The assessment recommended a number of suitable methods to provide protection, including moving the channel off the bank and removing the berm on the opposite bank.

Since the recommendation was made, the following actions have taken place.

- The Walker parcel/Upper Rolling A Ranch was acquired by Lyon County for open space and floodplain values.
- Weed management has been implemented.
- Restoration of native riparian vegetation, including cottonwood and willows, is planned

Rolling A Ranch (Figure 4)

The 1997 Inter-Fluve assessment made prior to the 1997 New Year's flood identified two distinct subreaches adjacent to the Rolling A Ranch. The upstream subreach was rated stable with a low restoration priority, and the downstream subreach was rated unstable with a high restoration priority. The condition of vegetation in both subreaches was considered poor and well below its potential. The property has sparsely occurring cottonwoods and perennial pepperweed and other noxious weed species in its floodplain. It was suggested that this section would be an excellent candidate for a riparian re-planting program on the floodplain and on the channel banks to increase the width of the narrow riparian zone. Full channel restoration was suggested, but the study cautioned that this site was downstream of "major instability." The assessment suggested that the downstream subreach would be likely to undergo further channel enlargement before it may approach a more stable state naturally.

Since the recommendation was made, the following actions have taken place:

- The riparian corridor was acquired by Lyon County and is an open-space amenity;
- A conceptual park plan has been developed;
- A Frisbee golf course has been added;
- Some bank slopes have been stabilized with toe protection and replanted with riparian vegetation;
- Cattle grazing and cultivation of agricultural fields has been discontinued;
- Several years of perennial pepperweed control have taken place;
- The old agricultural fields have been seeded with grasses to suppress weeds.

Fort Churchill Historic Park West of Highway 95 (Figures 5 and 6)

The 1997 Inter-Fluve assessment described the river from the Buckland Diversion to Highway 95 as an unstable, meandering, incised channel. The floodplain is elevated relative to the active channel from 3 to 4 feet above the Buckland diversion and up to 15 feet through the incised sections below. The majority of banks are 1:1 or steeper and largely unvegetated due to their steepness, regularity of failure, and elevation above the active channel, although recruitment of cottonwood and willows occurs on channel bars. The restoration priority is considered high, since continued erosion of the river's north bank threatens both the Buckland Ditch and the Churchill Canyon Road. An application for funding from the State of Nevada Emergency Management Program to address this reach of the river was submitted. Because the Middle Carson River is a U.S. EPA-identified Superfund site, however, such funding is not available without a waiver from the EPA. NSP is considering applying for such a waiver. In the absence of the waiver, however, a fallback position would be to armor (rip-rap) the channel banks to protect Buckland Ditch and the Churchill Canyon Road.

The 1997 assessment noted better riparian conditions exist along ungrazed sections and recommends that grazed lands be managed to promote riparian regeneration and bank stability. The 2008 Otis Bay assessment rated the quality and quantity of wetland and riparian habitat as low, and the floodplain function received low scores due to a moderate degree of entrenchment.

Fort Churchill River Ranches East of Highway 95 (Figures 6, 7 and 8)

The 1997 Inter-Fluve assessment identified two subreaches between Highway 95 and Lahontan State Park. The upper reach is moderately unstable due to moderate incision of the river causing unstable banks and active lateral migration. Bank heights were observed at up to 10 feet. In this area riparian vegetation is limited or non-existing except on bars. Lack of riparian vegetation was exacerbated by grazing. The channel conditions improve downstream, and the lower section is stable and well paired with its floodplain. In the lower reach banks are lower, at about 2 feet, and allow high flows to dissipate across a relatively wide floodplain. In terms of vegetation, riparian vegetation increases in the downstream direction and eventually a full range of age classes can be seen. The early stages of tamarisk invasion were noted.

Despite the increase in vegetation and floodplain width, the riparian zone had a noticeable lack of vegetation densities. As a consequence, the riparian zone was rated as being far below its potential. The lack of vegetation recruitment and low vegetation densities were attributed to grazing and to minor bank instability. The assessment recommended seasonal exclusions or decreasing the number of cattle grazing the area.

The 2008 assessment observed similar conditions and recommended the implementation of new grazing strategies that include practices of rest-rotation:

- At least two consecutive years of rest between grazing periods;
- Regular changes in across-year grazing season;
- No early season grazing during the growing period of native grasses and forbs;
- No season-long grazing of any pasture;
- A maximum of three consecutive years of grazing between rest periods;
- Stocking rates that will not overuse the riparian-wetland pastures;
- Specified rotational watering areas along the river or use of stock watering ponds constructed away from riparian and wetland areas.

3.0 Desired Future Conditions

3.1 Riparian Habitat Joint Venture Recommendations

In conjunction with California Partners in Flight, the Riparian Habitat Joint Venture (RHJV) has published a riparian bird conservation plan: a strategy for reversing the decline of riparian-associated birds in California (RHJV 2004). This document lists a series of objectives and recommendations for restoration of riparian habitats, with an emphasis on improving habitat for avian riparian species. Some are more applicable to riparian habitat restoration in California, but most have broader applicability. Several of the recommendations of this Plan have been used to develop the Desired Condition section of this Plan (Section 3.2).

The objectives and associated recommendations from the RHJV plan, slightly modified to be more applicable to Nevada and the Middle Carson River, include:

1. *Prioritize riparian sites for protection and restoration. Prioritization should be based on:*
 - 1.1 *Current indicators of avian population health;*
 - 1.2 *Proximity to existing high-quality sites;*
 - 1.3 *Proximity of intact adjacent upland habitats;*
 - 1.4 *Presence of intact natural hydrology or the potential to restore the natural processes of the system's surrounding land uses.*

The prioritization of projects in this Plan are, in part, based on these recommendations (Section 5.1).

2. *Promote riparian ecosystem health (i.e., a self-sustaining, functioning system).*
 - 2.1 *Ensure that the patch size, configuration, and connectivity of restored riparian habitats adequately support the desired populations of riparian-dependent species;*
 - 2.2 *Restore natural hydrology in riparian systems wherever possible.*

The approach put forward in this Plan is designed to enhance riparian diversity and health. Elements such as patch connection would increase patch size and connectivity. Reconnection to the floodplain is also recommended where feasible, but existing development constrains free access to the floodplain in many areas. Maintenance of adequate hydrology, particularly in the later season, remains a problem. In the case of the Carson River, implementation of effective weed management plans and practices are another key to promoting riparian ecosystem health.

3. *Increase the value of ongoing restoration projects for bird species.*
 - 3.1 *Restore and manage riparian forests to promote structural diversity and volume of the understory;*
 - 3.2 *Restore the width of the riparian corridor.*

Restoring and promoting structural diversity is a key element of the current Plan. Successful implementation would tend to increase the width and continuity of the riparian corridor. Creation and/or enhancement of wetlands adjacent to riparian areas would increase habitat diversity, though mercury issues need to be considered prior to any proposed excavation. The availability of shallow

groundwater may often limit the extent of riparian vegetation across the floodplain to the immediate area of the river channel and oxbows and old channels on the floodplain.

4. *Ensure that large landscape-scale management and flood control projects maximize benefits to wildlife while benefiting agriculture and urban populations. Achieving multiple goals simultaneously enhances the overall value of such projects.*
 - 4.1 *Management of new or existing flood bypass areas should consider the benefits of a regenerating riparian habitat against those of other uses.*

Flood control projects per se are not proposed as a part of the current Plan. However, the above recommendations are consistent with objectives described in the *Carson River Watershed Regional Floodplain Management Plan*. The Plan recognizes that floodplain management should be multi-objective. Programs and projects, while providing for public safety, should also maximize opportunities for agricultural conservation and ecosystem protection and restoration (Carson Water Subconservancy District et al. 2008).

5. *Design and implement cultivated restoration projects that mimic the diversity and structure of a natural riparian plant community.*
 - 5.1 *Plant a minimum of two or more species of native shrubs or trees (i.e., avoid monotypic plantings).*
 - 5.2 *Increase shrub richness, shrub density, and the rate of natural reestablishment by including plantings of understory species in restoration design.*
 - 5.3 *Plant native forb and sedge species.*
 - 5.4 *Cultivate tree species where natural hydrological processes are compromised and natural tree regeneration is limited or absent.*
 - 5.5 *Plant vegetation in a mosaic design with dense shrub patches interspersed with trees to achieve a semi-open canopy.*
 - 5.6 *Retain at least some existing trees on restoration sites, planting around them, to promote occupancy of the plot by birds requiring mature trees (e.g., cavity nesters, Bullock's Orioles [*Icterus bullockii*], etc.).*
 - 5.7 *Connect patches of existing riparian habitat with strips of dense, multilayered continuous vegetation that are at least 3-10 meters wide.*

The Plan is built around both retaining and enhancing existing desirable riparian vegetation communities (Fremont cottonwood (*Populus fremontii*) stands, multilayered sandbar (coyote) (*Salix exigua*) and red willow (*Salix laevigata*) stands). These communities would be enhanced by increasing their density and diversity and by supplementing the existing diversity with rarer vegetation types such as buffaloberry (*Shepherdia argentea*) and wild rose (*Rosa woodsii*). Connection of existing desirable habitat would be encouraged, increasing the size of these patches. The creation or enhancement of wetland vegetation would also increase desirable habitat diversity. The Plan recommends treatments to control weed species and replace these species with such desirable herbaceous/grass species as creeping wildrye (*Leymus triticoides*).

6. *Implement and time land management activities to minimize disturbance, which increases avian reproductive success and enhance populations.*
 - 6.1 *Manage riparian and adjacent habitats to maintain a diverse and vigorous understory and herbaceous layer, particularly during the breeding season.*
 - 6.2 *Manage or create “soft” edges (through establishment of hedgerows at field margins) appropriate to historical vegetation patterns.*
 - 6.3 *Avoid the construction or use of facilities and pastures that attract and provide foraging habitat for Brown-headed Cowbirds (*Molothrus ater*).*
 - 6.4 *Brown-headed Cowbird trapping should be used only as an interim/emergency measure. Trapping can save or maintain a threatened population of host species while sustainable, habitat-based solutions are developed but should not be considered a long-term solution.*
 - 6.5 *Manage or influence management at the landscape level (i.e., land surrounding riparian corridors or, preferably, the whole watershed).*
 - 6.6 *Limit restoration activities and disturbance events such as grazing, disking, herbicide application, and high-water events to the nonbreeding season. When such actions are absolutely necessary during the breeding season, time disturbance to minimize its impacts on nesting birds.*
 - 6.7 *Coordinate with management and restoration projects targeted at a variety of species, including non-avian taxa to maximize the benefits of conservation of riparian habitats.*

The principal management activities in the Plan Area are cattle grazing and recreational use. The Plan recommends managing grazing to promote and encourage the establishment and spread of riparian vegetation. The enhancement of riparian vegetation should encourage the aesthetic appeal of the area for recreationists. Management of grazing and recreation may be required to minimize conflicts with the avian nesting cycle. However, establishment of diverse, high-density riparian habitat would provide good nesting cover and minimize the need for more intensive nesting season management. The degree of cowbird parasitism on the Middle Carson River should be investigated and the need for cowbird management determined.

7. *Protect, enhance, or recreate natural riparian processes, particularly hydrology and associated high water events, to promote the natural cycle of channel movement, sediment deposition, and scouring that create a diverse mosaic of riparian vegetation types.*
 - 7.1 *Avoid impacts on the natural hydrology of meadows, streams, and river channels, particularly in high-priority areas managed for riparian species.*
 - 7.2 *At sites with dams or other flood control devices, manage flow to allow a near natural hydrograph (i.e., mimic natural flood events) sufficient to support scouring, deposition, and point bar formation. Time managed flood events to avoid detrimental impacts on Bank Swallow (*Riparia riparia*) nesting colonies.*
 - 7.3 *Control and eradicate/manage non-native, invasive plant species. Such control is best planned and implemented on a watershed scale.*
 - 7.4 *Control and eradicate/manage undesirable non-native animal species.*

Hydrology is one of the major management challenges on the Middle Carson River and throughout the entire Carson River system. However, as previously described, this Plan proposes measures to maintain and enhance existing riparian resources but does not propose actions to change landscape-level, geomorphic processes.

The following items 8.0 through 11.0, below have to do with monitoring avian populations in riparian areas:

8. *Provide data on pressing conservation issues affecting birds. In order to successfully protect and expand native bird populations, managers must have the most recent data available on populations and their habitat needs. Standardized scientific monitoring of populations will provide decision-makers with these essential tools.*
 - 8.1 *Consider reproductive success and survival rates when monitoring populations, assessing habitat value, and developing conservation plans.*
 - 8.2 *Conduct intensive, long-term monitoring at selected sites. In order to analyze trends, long-term monitoring should continue for more than five years.*
 - 8.3 *Investigate the relationship between herbaceous vegetation height and avian productivity and recruitment, especially in wet meadows.*
 - 8.4 *Develop a series of monitoring and research projects that:*
 - 1) *Determine the habitat attributes that affect migratory stopover use.*
 - 2) *Assess how migratory stopover habitat may affect species survival.*
 - 3) *Define conservation priorities and recommendations for stopover habitat.*
 - 8.5 *Conduct selective monitoring at critical sites to determine the effects of cowbird parasitism on the Willow Flycatcher, Warbling Vireo (*Vireo gilvus*), Common Yellowthroat (*Geothlypis trichas*), Blue Grosbeak (*Passerina caerulea*), and Yellow Warbler (*Dendroica petechia*).*
 - 8.6 *Conduct selective monitoring at key sites to determine the factors influencing nest success of the Song Sparrow (*Melospiza melodia*), Lazuli Bunting (*Passerina amoena*), Yellow Warbler, Willow Flycatcher, and Warbling Vireo.*
9. *Maximize the effectiveness of ongoing monitoring and management efforts.*
 - 9.1 *Increase communication and coordination between land managers and specialists hired to implement specific projects or conduct monitoring.*
 - 9.2 *Use standardized monitoring protocols.*
 - 9.3 *Maximize the cost-effectiveness and value of existing specialized monitoring programs for listed species (e.g., those oriented toward Yellow-billed Cuckoo and Western Willow Flycatcher) by collecting standardized data on multiple species (such as point counts) in addition to any specialized protocols aimed at one species.*
 - 9.4 *Determine what habitat and population characteristics are necessary to successfully wean a songbird population from cowbird trapping.*
 - 9.5 *Coordinate with monitoring and research projects targeted at non-avian taxa to maximize the benefits of the protection, management, and restoration of riparian habitats.*

Funding is a perennial problem for public lands management. In the case of the Middle Carson River, a number of interested groups may provide a pool of volunteers to conduct monitoring activities. The use of volunteers provides an opportunity to involve the public and promote interest in habitat enhancement projects. In the absence of a long-term monitoring plan and dedicated monitors, however, standardization of the monitoring effort may be a problem. Contracting with professional bird monitoring organizations, such as the Great Basin Bird Observatory, could increase standardization of the monitoring effort. The University of Nevada or another college or university may have graduate students interested in conducting or participating in research on Carson River riparian habitats and bird populations. Organizations such as 4H or Future Farmers of America might also be a source of volunteers.

10. *Expand research and monitoring of selected special-status species to address pressing conservation issues.*
 - 10.1 *Identify winter range, habitat, and possible overwintering conservation issues for as many Neotropical migrants as possible, including the Western Yellow-billed Cuckoo and Swainson's Hawk (*Buteo swainsoni*).*
 - 10.2 *Inventory for Swainson's Hawk territories and map distributions of nesting and foraging habitat to develop a target population size. Plan management strategies for protecting priority habitats.*
 - 10.3 *Conduct statewide surveys to establish current population and range sizes every five years for the Swainson's Hawk and Bank Swallow and every 10 years for the western Yellow-billed Cuckoo.*

Additional funding may be available for monitoring listed or sensitive species, and some of these activities may be conducted by state or federal agencies. Note that the species included in item 10 are California listed, not federally listed, as threatened or endangered. The Yellow-billed Cuckoo is a candidate for federal listing, and the Swainson's Hawk is a Nevada State Protected Species. In terms of Middle Carson River birds, the Nevada Partners in Flight Bird Conservation Plan (Neel 1999) identifies the Yellow-billed Cuckoo, Bank Swallow and Blue Grosbeak as "obligate" lowland riparian species, and the Lewis's Woodpecker (*Melanerpes lewis*), Ash-throated Flycatcher (*Myiarchus cinerascens*), Western Bluebird and Yellow-breasted Chat (*Icteria virens*) as other priority species.

11. *Use information gathered from avian monitoring and research programs to improve the effects of agricultural and land management techniques on birds.*
 - 11.1 *Work cooperatively with agricultural researchers to assess the potential of agriculture adjacent to existing riparian areas to be more "bird friendly, and incorporate bird friendly best management practices through outreach and education directed at agricultural and other land managers."*

See Item 8.0. The implementation of grazing plans that minimize impacts to riparian habitats during the avian breeding season would benefit riparian-nesting birds.

12. *Encourage regulatory and land management agencies to recognize that avian productivity is a prime criterion for determining protected status of specific habitats, mitigation requirements for environmental impacts, and preferred land management practices.*
 - 12.1 *Land managers should consider avian population parameters, such as reproductive success, as important criteria when designating priority or special-status sites, such as Areas of Critical Environmental Concern (BLM), Research Natural Areas (BLM, USFS), and other publicly owned areas specially managed for biodiversity.*
 - 12.2 *When developing management practices for natural areas, government agencies such as the USFWS and NDOW should consider environmental impacts on local bird populations. Such evaluations should also occur when developing plans for habitat mitigation, habitat conservation, multi-species conservation, and natural community conservation.*
 - 12.3 *Land managers should consider the impacts of horses and burros on riparian vegetation and associated birds when designating acceptable numbers of wild horses and burros on public land.*
 - 12.4 *Incorporate the costs of limited-term (two–five years) or long-term bird monitoring into management endowments prescribed for conservation projects, including mitigation banks, habitat conservation plans, and natural community conservation reserves.*
 - 12.5 *Local governments should establish locally relevant riparian buffer zones to protect riparian habitat and associated surrounding uplands from development and disturbance, through zoning ordinances and/or general plan provisions.*

The presence of wild or estray horses and burros in the area is recognized as an issue in the Plan Area. The BLM conducted a gather of wild horses in the area in the fall of 2010. The Lyon County open space areas represent an effort by local government to protect natural habitats, including riparian habitats along the river.

13. *Increase protection and management actions to benefit severely declining or locally extirpated bird species.*
 - 13.1 *Develop GIS layers representing the extent of riparian zone habitats throughout the [project area] at a resolution fine enough for the analysis of territory-level bird data in association with the occurrence of various habitat types. Resulting maps should be field-verified and may be used to identify suitable habitat for riparian birds, including Yellow-breasted Chats and Western Yellow-billed Cuckoos, and habitats for other declining or sensitive species.*

The characterization of habitats used in this Plan represents an initial attempt to use GIS data to identify and classify habitats in the project area. The scale is much rougher than that recommended by the RHJV but could be used as a basis for more detailed mapping in the future as funds become available. Ideally, successful enhancements of riparian habitats along the Middle Carson River could result in the return of rarer species such as the Yellow-breasted Chat and possibly the Yellow-billed Cuckoo.

3.2 Desired Condition

This Plan proposes measures to maintain existing riparian resources and enhance biodiversity and vegetation communities within specific reaches of the river. The Plan proposes to accomplish these goals by methods described below. A principal goal of the Plan is to improve overall habitat conditions on the Middle Carson River within State Parks and Lyon County Open Space Lands, with a particular emphasis on maintaining and enhancing riparian vegetation. These enhancements would benefit a variety of species, but these species would be expected to respond to habitat enhancements at different rates and to different degrees. Enhancement projects that increase sandbar willow habitat, particularly sandbar willow habitat adjacent to aquatic sites, would be expected to attract Yellow Warblers and Song Sparrows fairly quickly, as the willow habitat became established or increased in size and density. Increases in local Yellow Warbler and Song Sparrow populations may be noted within a few years of successful willow habitat enhancement. Species that might respond favorably to increases in buffaloberry habitat, such as the Yellow-breasted Chat, may only begin to recolonize the area after buffaloberry groves became well established and dense, a period that might require twenty years or more. At the upper end of the habitat enhancement spectrum, Yellow-billed Cuckoos require large stands of gallery cottonwood forest, and creation of additional areas of this habitat type would only occur as a result of continued long-term habitat enhancement and restoration.

Increase riparian vegetation density – An increase in the density of shrubs, in particular, would increase cover for wildlife. Avian surveys conducted as a part of the 2008 *Assessment of the Middle Carson River* included point counts at seven locations along the river, including four locations between Dayton and the Lahontan State Recreation Area. An analysis of the data gathered concluded that “in numbers, the bird community of the survey area is dominated by species that are commonly associated with disturbed open woodlands.” Further, the surveys found that “species associated with riparian shrubs and shrublands” including the Willow Flycatcher, Yellow-billed Cuckoo, and Yellow-breasted Chat “were absent in our surveys. Those shrub-associated species that were detected in the study area, for example Yellow Warbler, Song Sparrow, Common Yellowthroat, Warbling Vireo, and Black-headed Grosbeak, were uncommon in comparison with other species.” Based on these findings, the assessment concluded: “measures to protect and restore riparian shrub thickets would benefit these species and would thus be among the most effective strategies for protecting diversity in this area” (Otis Bay 2008). Increasing riparian vegetation density and width of the riparian corridor is also one of the methods recommended for restoring avian diversity in the California Riparian Habitat Joint Venture (RHJV 2004). Increased tree and shrub density immediately adjacent to the river, ponds, or oxbows would also increase shading of aquatic habitats, limiting increases in water temperature.

Increase riparian plant species diversity and community structure – The diversity of riparian species is limited on the Middle Carson River. While Fremont cottonwood will likely remain the single dominant tree species on the Middle Carson, shrub species diversity could be increased. Sandbar (coyote) willow is the most common riparian shrub species present, with red and possibly black willow (*Salix nigra*) also present, some of which have grown to tree form. Both sandbar and red willow (and black willow where present) provide cover, with red willow offering more structural diversity than sandbar willow (trunks suitable for excavation of nest cavities, branches capable of supporting larger nests). Other riparian shrub species such as buffaloberry and wild rose (Woods rose) are much less common. Increasing

buffaloberry and wild rose would increase available food sources (berries and rose “hips”) and would provide good to excellent cover. Golden currant (*Ribes aureum*) was not observed at sites visited during field visits, but the addition of currant would provide another food source for wildlife. Skunkbush (*Rhus trilobata*), while not a particularly palatable species, occurs near the project area and may be included in planting plans. Skunkbush occurs in a variety of sites including dry rocky slopes, streamsides, seasonal drainages, and canyon bottoms in sun or partial shade and over a wide range of soil types. Skunkbush is reported to be intolerant of flooding and high water tables, but is useful for erosion control due to its strong root development (NRCS 2002d).

The California RHJV document (RHJV 2004) recommends planting a minimum of two or more species of riparian trees and shrubs and increasing shrub richness, shrub density, and the rate of natural reestablishment by including plantings of understory species in restoration design. This document also recommends planting native forbs and sedges (*Carex* sp.), planting in a mosaic pattern with dense shrub patches interspersed with trees to achieve a semi-open canopy, and managing riparian and adjacent habitats to maintain a diverse and vigorous understory and herbaceous layer, particularly during the avian breeding season. The document recommends retaining some existing trees. No removal of existing trees is proposed in the case of this Plan, though the need for management of hazard trees may arise.

Providing age diversity could also be used to enhance wildlife habitat. Cottonwood recruitment is currently limited, but pole plantings within or on the edges of existing stands would increase the structure and diversity of these stands and promote a gallery forest structure. In addition to providing better cover, the increased structure would provide more niches for a greater variety of birds. Shrub plantings within or on the edges of cottonwood stands could also be used to increase habitat structure.

The proportion of dead or decadent (i.e., dying) to young or mature plants in the community is an indicator of the population dynamics of the stand. A healthy community has a mixture of many age classes of plants relative to site potential and climatic condition (Stoddard, Smith, and Box 1975; U.S. Department of the Interior, BLM 2000). If recruitment is not occurring and existing plants are either dying or dead, the integrity of the stand would be expected to decline and other undesirable plants (e.g., weeds or invasives) may increase (Pyke 1995).

Particularly in the case of some sagebrush-dominated areas bordering the river, vegetation present is decadent, dominated by one or a few species and is less productive than a younger and/or more diverse community would be. An understory of tall decadent sagebrush, while providing cover to wildlife, also represents a potential route for wildland fire to crown into the overhead cottonwood canopy. Investigation into the effects of fire on cottonwoods indicates black cottonwood (*Populus trichocarpa*) and related species tend to resprout following fire, but prairie cottonwoods, including Fremont cottonwood, are less prone to resprout after a fire. Accordingly, populations of Fremont cottonwood may be adversely affected by fire (Rood et al. 2007). Rood et al. (2007) note that while fire is historically uncommon in riparian areas, the frequency of fire increases with increased recreational use.

Provide Habitat Patch Connection – Some desirable vegetation species on the Middle Carson River are distributed in relatively small patches of desirable habitat. Field observations suggested plantings could be used to connect these smaller patches and create more continuous and larger blocks of desirable habitat. Smaller blocks, or patches, of habitat tend to support a less diverse wildlife community (Askins et al. 1990; Fitch 1991), and birds nesting in smaller patches of habitat are more vulnerable to brood parasitism by Brown-headed Cowbirds (DeGraaf and Rappole 1995) and to nest predation by such edge specialists as Western Scrub Jays (*Aphelocoma californica*). The California RHJV recommends maintaining or creating patches of existing riparian habitat with strips of dense, continuous vegetation that are at least 3-10 meters wide (RHJV 2004).

Wildlife species that could benefit from enhanced riparian habitat include species that currently occupy such habitats in the area, such as Yellow Warblers and Song Sparrows that occur in willow habitats (as well as such migratory riparian species as Wilson's Warblers (*Wilsonia pusilla*), and Bullock's Orioles, Warbling Vireos, and such cavity-nesting species as American Kestrels (*Falco sparverius*), Northern Flickers (*Colaptes auratus*), and Tree Swallows (*Tachycineta bicolor*) that utilize cottonwood forest. The 2008 *Assessment of the Middle Carson River* (Otis Bay 2008) noted several of these species occur in the area, but in relatively low numbers. Significant improvements in willow riparian habitat could encourage species such as the Willow Flycatcher and possibly the Yellow-breasted Chat to utilize the area. The return of Yellow-billed Cuckoos as a nesting species would require significant improvement of gallery cottonwood forest habitat and may only occur following successful long-term habitat restoration efforts.

Creation or enhancement of open water and emergent wetland habitats would benefit species such as the Common Yellowthroat and Marsh Wren (*Cistothorus palustris*) that are known to occur in the area, and may also attract wading birds and waterfowl. Creation or enhancement of these habitats would also improve potential Northern Leopard Frog (*Rana pipiens*) habitat.

A more thorough discussion of wildlife species that may benefit from enhancement of Middle Carson River habitats, and that could be used to monitor the success of restoration efforts, is included in Chapter 7, Monitoring.

4.0 Project Formulation

4.1 Methods

Project formulation was developed through the following steps and is described in further detail in the following sections. Project formulation involved the following:

- 1 Introductory Field Trip
- 2 Review of Plans and Previous Studies
- 3 Vegetation Mapping
- 4 Development of Evaluation Criteria
- 5 Field Review and Data Collection

4.1.1 Introductory Field Trip

Two field tours were held with Steering Committee members. The first was conducted on July 5, 2010, and the second on August 27, 2010. The field tours provided background and management history of each site and reviewed current and pending restoration and improvement projects in the Plan Area, previous successful projects, and site conditions. Stakeholder needs and concerns were discussed, as were suggested methods to improve riparian conditions.

At various locations, participants in the field trips pointed out the following existing conditions that would make reestablishing native riparian community in the Plan Area difficult:

- Lack of summer flows
- Lack of supplemental irrigation to establish plants
- Lack of affordable or practical methods of irrigation
- Off-Road Vehicle (ORV) use
- Noxious and invasive weed infestation
- Streambank erosion
- Poorly managed Livestock grazing
- Lack of staff to monitor projects

Other issues and concerns that were discussed included the following:

- Previous assessments
- Potential funding sources
- Beaver management
- The use of test plots (recommended)
- Legal hurdles to ORV control
- Mercury contamination

4.1.2 Review of Plan and Previous Studies

A primary concern of the stakeholders was ensuring that the HCP would be consistent with existing planning documents in the Plan Area. Therefore, JBR reviewed the following existing management plans, planning documents, and data inventories to ensure consistence and provide a framework for the Plan:

- Lyon County Parks and Recreation Master Plan
- Lyon County Open Space Plan
- Dayton State Park Master Plan
- Dayton State Park Fuels & Hazard Tree Management Plan
- Fort Churchill State Historic Park Development Plan
- Fort Churchill State Historic Park Hazard Tree Management Plan
- Lahontan State Recreation Area Resource Management Plan
- Carson River Ranches Grazing Management Plan (2006)
- Nevada Priority Wetlands Inventory
- Nevada Natural Heritage Program
- Audubon Society Important Bird Area – Management & Conservation Plans
- Nevada Partners In Flight Bird Conservation Plan
- NDOW State Wildlife Action Plan
- Carson River Watershed Stewardship Plan
- Carson River Watershed Regional Floodplain Management Plan
- Carson River Water Quality Management 208 Plan
- Rolling A Park conceptual plan drawing

4.1.3 Vegetation Mapping

The next step was to define the limits of the “river corridor.” JBR used the *Soil Survey of Lyon County Area* (SCS 1984) to select a study area that included only channel, floodplain, and stream terrace landforms. The soil survey defines the floodplain landform as the low-lying landform adjacent to the channel that may be inundated by overbank flows from the channel. The stream terrace landform is defined as the flat landform above the current floodplain that is no longer subject to inundation.

Next, areas within the Plan Area river corridor were grouped by vegetation community. JBR considered using vegetation mapping from the Southwest Regional Gap Analysis Project. Instead, JBR used vegetation maps developed by Otis Bay for the 2008 *Assessment of the Middle Carson River*. This mapping proved not only to be more accurate but more useful because it is based on geomorphic surfaces. The following definitions of mapping units developed by Otis Bay are as follows:

ORFX—Old Riparian Forest Dominated with Fremont Cottonwood with a Xeric Shrub Understory

Mature tree canopy comprising Fremont cottonwood generally less than one tree height apart with a shrub understory comprising mainly big sagebrush, rubber rabbitbrush, and creeping wildrye. This vegetation community type typically occurs on old stream terraces above the active floodplain.

MFRS—Mature Cottonwood/Willow Forest Dominated with Fremont Cottonwood and a Riparian Shrub Understory

Mixed-age canopy comprising Fremont cottonwood and red willow with tree canopies generally less than one tree height apart and a shrub understory. Dominant understory species include red willow, sandbar willow, Woods rose, and creeping wildrye. Buffaloberry may be present in minor quantities. This vegetation community type typically occurs on temporarily flooded low floodplain terraces.

RS—Riparian Shrublands

Willow and other riparian shrub communities that are not early successional which are present in temporarily flooded areas along the active floodplain. Dominant species typically include sandbar willow, red willow, buffaloberry, Woods rose, and golden currant. Young Fremont cottonwood, black cottonwood, and tamarisk plants may be present in low quantities.

ER—Early Successional Riparian Shrublands

Early successional riparian communities occur along sandbars, gravel bars, pointbars, and newly exposed streambanks of the active channel. Vegetation of these areas typically comprises young recolonizing sandbar and red willow and Fremont and black cottonwood. Tamarisk may be present.

EM—Emergent Marsh

Emergent marsh communities occur in seasonally and semipermanently flooded wetlands associated with oxbow and backwater areas. Dominant species include cattail (*Typha* sp.), hardstem bulrush (*Scirpus acutus*), Olney's bulrush (*Scirpus americanus*), three-square bulrush (*Scirpus pungens*), creeping spikerush (*Eleocharis macrostachya*), Baltic rush (*Juncus balticus*), and mare's tail (*Equisetum* sp.).

WM—Wet Meadow

Wet meadow areas exist where seasonally inundated or saturated conditions are present which support a prevalence of hydrophytic vegetation. Dominant species include Nebraska sedge (*Carex nebrascensis*), woolly sedge (*Carex lanuginosa*), smallwing sedge (*Carex microptera*), Baltic rush, creeping wildrye, creeping spikerush, and inland saltgrass (*Distichlis spicata*). Rabbitbrush and big sagebrush may be present in low quantities where wet meadow transitions into big sagebrush shrublands on upper stream terraces.

BSS—Big Sagebrush Shrublands

Big sagebrush shrublands occur on floodplain terraces and typically transition into xeric shrublands of upland slopes. Dominant species include big sagebrush, rubber rabbitbrush, black greasewood (*Sarcobatus vermiculatus*), Torrey saltbush (*Atriplex torreyi*), four-wing saltbush (*Atriplex canescens*), creeping wildrye, Great Basin wildrye (*Leymus cinereus*), and inland saltgrass. Woods rose may be present.

AG—Agricultural Land

Agricultural land is currently cultivated and/or non-cultivated land used as pasture for cattle/horse grazing. Non-cultivated land with supplemental irrigation may enhance development of wet meadow and transitional wet meadow vegetation and may also contain a mixture of introduced and native upland pasture species. Agricultural lands may also include grazed big sagebrush shrublands along upper stream terraces.

CH—Channel

Channels include permanently flooded active streams, side channels conveying perennial flow, or constructed ditches conveying irrigation water.

DEV—Developed/Disturbed Land

Developed land comprises residential housing, roads, golf courses, and commercial and municipal development. Disturbed land includes weedy, fallow agricultural fields and areas denuded of vegetation for development or agricultural purposes.

OW—Open Water

Open water comprises small, deeper water bodies existing along the Carson River floodplain. These areas are typically old oxbows which have been cut off from the active stream channel and are deep enough to maintain open water without a predominance of emergent vegetation. Open water areas also exist as stock watering ponds within agricultural lands along floodplain terraces.

Modifications to the 2008 Assessment Mapping

Due to the scarcity of the EM and WM habitat types in the Plan Area, JBR grouped these habitats as Wetlands (W):

W—Wetlands

Seasonally or perennially wetted areas that support wetland vegetation species. See EM and WM, above.

In order to identify and differentiate existing high-value habitats, MF, RS, and OR vegetation communities were ranked according to vegetation density as a first-cut measure of habitat quality. The definitions of density categories are as follows:

- RS1** Riparian shrubs are dense and contiguous.
- RS2** Riparian shrubs are sparse and patchy.
- MF1** Cottonwoods are relatively dense with trees generally less than three tree height apart.
- MF2** Cottonwoods are relatively sparse, with trees greater than three tree height apart.
- OR1** Cottonwoods are relatively dense with trees generally less than one tree height apart.
- OR2** Cottonwoods are moderately dense with trees generally more than one tree height apart.
- OR3** Cottonwoods are sparse.

Recognizing that relict channels and swales could be suitable potential planting sites for riparian species (discussed in the section below), JBR also added relict channels and swales to the vegetation maps. While not always discernable on color aerials, these features were more apparent on soil maps for the Lyon County Soil Survey (SCS 1984), infrared photography and LIDAR mapping provided by Lyon County.

4.1.4 Development of Evaluation Criteria

In order to prioritize sites, additional information on community attributes was needed beyond vegetation community type and vegetation density. Characteristics not readily discernable from aerial photographs that were collected included:

- Understory species
- Species diversity
- Diversity of age classes
- Prevalence of weeds and type of weed
- Evidence of natural recruitment
- Hindrances to natural recruitment

Because the number of visits was limited, the site visits used to gather community information were also the only opportunities to evaluate site suitability for a project. Based on the initial introductory tour of the selected sites in the Plan Area, it was clear that one of the biggest limitations to improving riparian habitat conditions through revegetation would be the lack of wetland hydrology. Therefore one set of criteria for site selection was whether the site or a particular type of project could address the lack of hydrology. Potential opportunities to provide hydrology included:

Reconnect to the floodplain – Ensuring the river channel has access to a floodplain allows flood flows to spread over a larger area, reducing flood energy and thereby reducing the potential for erosion and lateral stream migration. Much of the Carson River is incised, and the river's sandy bank material is easily eroded. Erosion increases bed load, and consequent downstream aggradation and lateral migration are problems in much of the Middle Carson River. According to the document *Fluvial Geomorphic Assessment* (Inter-Fluve 1997), these problems are less evident and the river banks are more stable in the river's lower reaches, where bank height is lower and the river does have access to a floodplain. Given sufficient flows, the lower river would represent an area that would have a hydrologic pattern that could support riparian vegetation. Upstream water withdrawals, however, may hamper this potential opportunity.

According to the 1997 Inter-Fluve report, the river in the area of the Santa Maria Ranch has some room for lateral movement within berms constructed at this site. At downstream locations, the river is often constrained by adjacent development. At Fort Churchill State Historic Park, erosion on the river's north bank is threatening at least the fence south of the park's picnic area. Within the Carson River Ranches and Lahontan State Recreation Area, however, the river is much less confined by any development and is more closely connected to its floodplain.

Using oxbows and relict channels – Oxbows, relict channels and swales were identified as opportunities for planting riparian or wetland species because these old channels and topographic lows are closer to the underlying water table and tend to collect overland runoff. Moist soil conditions also offer the potential for natural reproduction for some riparian shrubs such as buffaloberry and Woods rose.

While not a natural oxbow or old channel, cottonwoods and willows have naturally colonized three created stormwater retention basins at Santa Maria Ranch Park. This indicates that excavated

depressions in areas with a persistent high water table could result in the creation of cottonwood nurseries similar to those on the Santa Maria site.

Downslope of irrigation canals – Irrigation ditches represent a hydrology source for vegetation requiring mesic conditions. Planting would not be conducted in the ditches themselves, but planting within the groundwater influence of the ditches, particularly on the downslope side, could provide supplemental hydrology during critical summer months to allow riparian plantings to survive and become established.

Hydraulic barrier site – Due to the permeable nature of much of the Middle Carson River's bed material, surface flows may infiltrate into the bed and be lost. Subsurface flow, however, is often still present. A hydraulic barrier, or hydraulic curtain, is a physical water barrier installed below ground level. The barrier can be as simple as high density polyethylene (HDPE) or can be constructed of poured or injected concrete or grout. This subsurface flow can be captured and elevated behind the barrier/curtain. This local elevation of the water table could be used to increase the survival of species such as willows and possibly cottonwoods. The most effective location for hydraulic barriers would be over a shallow bedrock layer, which would naturally restrict the downward movement of the water table, or over low-permeability soils (clays), which would also tend to restrict the downward movement of the water table. Hydraulic barriers are described in more detail in Section 5.2.3. Potential hydraulic barrier sites cannot be readily identified in the field without geotechnical investigation to identify either underlying bedrock or clay layers that would maintain a naturally high water table. Geotechnical investigations were not conducted as a part of this study.

Use of buffaloberry and other drought-tolerant plants – Buffaloberry represents a desirable shrub species that can provide both food and cover for wildlife. As an alternative to cottonwoods and willows, which are desirable but require considerable water, silver buffaloberry (*Shepherdia argentea*) may be established in somewhat drier sites. According to the NRCS, silver buffaloberry grows in full sunlight and on most well-drained soils and tolerates some salinity and alkalinity. According to the NRCS, seedlings are best established at sites that receive at least 13 inches of precipitation annually (NRCS 2006). Despite this inference that silver buffaloberry would do better in a higher precipitation zone, the species does occur in the Plan Area in stands that appear healthy. Accordingly, any silver buffaloberry plantings utilized in this Plan should be obtained from a local stock, which may be better adapted to our region's drier conditions. Once established, silver buffaloberry is reported to be an excellent bank stabilizer. The species produces berries eaten by many species of birds, is browsed by big game, and provides good cover for wildlife (NRCS 2002a; 2006). Silver buffaloberry can also form dense thickets that provide cover for wildlife.

Golden currant also occurs in riparian areas and on floodplains, as well as in more upland situations and disturbed sites needing stabilization (NRCS 2002b). Golden currant does not attain the size of silver buffaloberry and likely requires less water to become established than cottonwoods or willows. Golden currant was conspicuously absent from the Plan Area but is recommended for planting because of its high value to songbirds and other wildlife that forage on the plant's berries (NRCS 2002b). Woods rose is adapted to a range of moisture conditions (NRCS 2002c) and has been used to revegetate stream

banks and seep sites. The species' rhizome system makes Woods rose useful in soil stabilization and erosion control. Note that currant, buffaloberry, and wild rose were planted at the Santa Maria & Rolling A Ranch sites and are part of the enhancement projects at those sites.

A second set of site evaluation criteria used in evaluating the potential for enhancement was the ability to change community characteristics to increase habitat diversity. Such opportunities include:

Replace species – Certain non-native species adversely affect habitats on the Middle Carson River. The state of Nevada identifies tamarisk as a noxious species. In addition to inhibiting more desirable species such as willows, tamarisk can increase salinity of adjacent waters (University of Nevada Cooperative Extension Service undated). Russian olive is an exotic species identified as a less desirable species than buffaloberry. Habitat conditions could be improved by replacing tamarisk with willow and Russian olive with buffaloberry.

Patch connection – Some desirable species on the Middle Carson River are distributed in relatively small patches of desirable habitat. Field observations suggested plantings could be used to connect these smaller patches and create more continuous and larger blocks of desirable habitat. As described in Section 3.2, Desired Condition, birds nesting in larger patches of habitat are less susceptible to brood parasitism and nest predation.

Open water ponds – Avian surveys on the lower Truckee River found that areas that included small wetland habitats adjacent to mature cottonwood forest supported nearly twice the bird diversity as areas of mature cottonwood forest alone (Otis Bay 2008). JBR observed a similar situation at a pond located south of the Middle Carson River channel near Hercules Well. This pond supported a well-established riparian shrub community on its western side and was surrounded by bulrush (*Scirpus* sp.). Several species of waterfowl and shorebirds as well as blackbirds and swallows were observed at this site.

Change seral stage – Particularly in the case of some sagebrush-dominated areas bordering the river, vegetation present is decadent, dominated by one or a few species and less productive than a younger community would be. Also as noted in Section 3.2, Desired Condition, an understory of tall decadent sagebrush represents a potential route for wildland fire to crown into the overhead cottonwood canopy. Populations of Fremont cottonwood may be less prone to resprout following fire (Rood et al. 2007). The removal or reduction in density of decadent sagebrush would encourage new growth and reduce the fire danger in heavily used areas such as Scout Camp. Decadent sagebrush could be removed manually or mechanically (masticated). Communication with the U.S. Department of Agriculture's (USDA) Agricultural Research Service (ARS) cautioned that with large infestations of perennial pepperweed in the area, alteration of a plant community that is not infested with invasives should be approached only with great caution (Smith 2009).

4.1.5 Field Review and Data Collection

To identify potential locations for habitat improvement projects on the Middle Carson River, an evaluation of species diversity, physical structure, presence of weeds, and potential constraints and

opportunities was conducted. Due to budget constraints, a comprehensive assessment of conditions on all state and county-owned lands was not conducted. Instead, representative areas were selected based on known use and on the vegetation mapping effort. These sites were visited to assess existing conditions. Sites were assessed using data sheets to record species present, habitat conditions, the presence of weeds, and constraints and opportunities present. **Appendix A** presents an example of the data sheets used in the assessments. This approach allowed general assessments of conditions, with the collection of some site-specific data. However, this approach did not permit a more thorough assessment of habitat conditions throughout the Plan Area. The approach also only allowed the development of a more general weed management plan, as a detailed map of weed distribution throughout the Plan Area was beyond the scope of the budget available.

In addition to the two initial site visits, field assessment visits were conducted in 2010 on October 21, 27, 28, and 29 and November 3. Sites visited included Main Camp, Scout Camp, and the Overlook site on the south side of the river and an area on the Ghiglia Ranch north of the river on October 21; Dayton State Park, the Walker Property, Santa Maria Ranch, and Rolling A Ranch on October 27; and sites at Fort Churchill State Historic Park and the USFWS property and the sites on the western side of Lahontan State Recreation Area on October 28. The Horse Camp area and the site of an open water pond near Hercules Well as well as an area in the southeastern part of Lahontan State Recreation Area were visited on October 29. Finally, a site near Buckland Station and sites north of the river near the boundary between the River Ranch Properties on Fort Churchill State Historic Park and the Lahontan State Recreation Area were visited on November 3.

4.2 Findings of Field Study

4.2.1 Accuracy of Vegetation Mapping

Ground truthing identified minor differences between the 2008 assessment mapping effort and conditions on the ground. Several areas identified as BSS vegetation types in the Carson River Ranches area were found to be pastures, some of which have apparently been cleared in the past. These pastures were reclassified as an agricultural (AG) type. Notable differences observed relative to the 2008 plan also included a lack of sedges and golden currant in the Plan Area. Additionally, the 2008 assessment covered areas higher in the Carson River watershed where black cottonwood occurs. Only Fremont cottonwoods were noted in the Plan Area.

4.2.2 Species Diversity

Riparian species diversity in the Plan Area is low. While fairly typical of lower-elevation riparian systems in the West, Fremont cottonwoods are by far the dominant overstory species. Sandbar (coyote) willow is the dominant understory riparian species. Red/black willow is present but much less common. During field visits, a marked lack of sedges (*Carex* sp.) was noted, and both buffaloberry and rose were found to be rare. No currant was observed. In addition, few wetland areas were found, and many of those that do exist have formed behind man-made dikes or berms. Emergent wetlands are particularly uncommon on the majority of the Middle Carson River. However, a fairly large emergent wetland area exists east of the river in the southern part of the Lahontan State Recreation Area.

From highest to lowest site, field visits found that work to increase species diversity at the Santa Maria Ranch is proceeding following the Carson River-Dayton Valley Santa Maria Vegetation Enhancement and Restoration Plan (**Appendix B**), with recently planted shrubs present adjacent to the river. A creeping wildrye understory is present in a park-like setting under the grove of mature cottonwoods west of the river. Natural recruitment of cottonwoods and sandbar willow was occurring along the river banks within the berms, though plants within the berms could be susceptible to loss at high flows. The northern part of the property may receive some flow from the old agricultural ditch system. This area supported some of the densest grass and young cottonwood vegetation outside of the berms. In addition, three detention basins at the site have been colonized by young cottonwoods in sufficient numbers that the basins represent a potential nursery source for cottonwood plantings.

Dayton State Park includes a fairly diverse community. The park and the adjacent Walker Property/Upper Rolling A Ranch Open Space include a backwater area that supports an emergent vegetation community of cattails (Photo C-1, **Appendix C**) (*Typha* sp.). At Dayton State Park, the banks of this backwater support a mixed community that includes both highly desirable species such as young red willow as well as young cottonwoods and sandbar willow, and weedy species including perennial pepperweed, cocklebur, and Russian olive. This backwater area is probably the site at which a Western Pond Turtle (*Actinemys marmorata*) was observed (Otis Bay 2008). The backwater extends onto the Walker Property (Photo C-2), and represents an opportunity for supplemental riparian plantings. The Walker Property/Upper Rolling A Ranch is the site of its own vegetation enhancement and restoration plan (**Appendix D**).

The Rolling A Ranch is also the site of ongoing work, as described in the Carson River-Dayton Valley Rolling A Ranch Vegetation Enhancement and Restoration Plan (**Appendix E**). Diversity is currently low. As described in Section 2.1.5, old agricultural fields on the site were invaded by perennial pepperweed and Russian thistle. The DVCD has been treating these weeds and has succeeded in establishing competitive grasses in these old fields. Russian thistle is still common in parts of the fields. Shrub and tree planting and bank stabilization work have also occurred, and a trail system on the parcel is planned. Riparian diversity at the site is low, however, with a mature cottonwood stand with a park-like understory present at the upstream (western) end and a fairly sparse stand of cottonwoods bordering the river. A Frisbee golf course has been established in the upstream grove. The northern part of the site is primarily open fields (the site of the perennial pepperweed control). The downstream end of the site includes a somewhat denser stand of mature cottonwoods and tall decadent sagebrush between the Kerr Ditch and the river. An old oxbow in the central part of the area represents a potential vegetation enhancement site.

At Fort Churchill State Historic Park east of Highway 95A, some cottonwood regeneration was noted on low benches both north and south of the river, providing some age diversity in the park. Specifically, a stand of younger trees was noted above the river's north bank and upstream of a railroad bridge that crosses the river within the park (Photo C-3). A second bench with young cottonwoods was noted on the river's south bank opposite the picnic area (Photo C-4). The 1997 *Fluvial Geomorphic Assessment of the Carson River* notes that earlier high flow events may be responsible for creating these benches above the river and that these benches may no longer represent sites of potential future cottonwood

regeneration (Inter-Fluve 1997). The existing campground includes an open, park-like understory. Agricultural fields and associated ditches just upstream of the campground add diversity, though some of the riparian vegetation present includes Russian olive.

The site of an abandoned agricultural field north of Buckland Station was visited in early November. The site currently supports tall to decadent big sagebrush, five-horn smother-weed (*Bassia hyssopifolia*, also known as five-hook Bassia), wheatgrass (*Elymus* sp.), and weedy species, including perennial pepperweed. Left fallow, this field would probably trend toward a more weedy decadent sagebrush stand. However, this site is adjacent to Highway 95A and has available parking at the historical Buckland Station site. The site was investigated as a potential habitat enhancement site that could be developed with trails as an easily accessible interpretive walking and birding site.

The USFWS property (north of the river and east of Highway 95A) includes several habitats, ranging from irrigated grazed pasture to dense sagebrush stands and open grassy sites. Little, if any, cottonwood recruitment was noted. A large old channel on the USFWS property, for example, was investigated as a potential planting site. The site includes an OR2 community with an overstory of mature cottonwoods and an understory of big sagebrush. However, augering determined that the depth to the water table at the site appears to be too deep to represent a suitable planting site. Other lands on the USFWS property include active pastures, areas of dense big sagebrush, and ditches. A few mature buffaloberry plants were found in the area. Old oxbow depressions in the eastern part of the area support saltgrass communities and, closer to the river, some bulrush stands.

Main Camp, on the south side of the river, includes an OR1 community with an understory of tall to decadent big sagebrush, creeping wildrye, and some perennial pepperweed. The understory diversity is limited due to the amount of decadent sage present, and the tall sagebrush represents a potential fuel source that could carry a fire into the cottonwood overstory (Photo C-5). Mastication or manual treatment could be considered to reduce the amount of decadent sagebrush in the area and return the understory to an earlier seral stage. The site includes a bar on a shallow outside bend of the river. Recruitment of both cottonwood and sandbar willow is occurring on this bar (Photo C-6). Above the bar, however, 4-foot vertical banks appear to preclude natural cottonwood establishment.

Scout Camp, approximately 0.4 mile below Main Camp, is the site of a previous bank stabilization project. The river's south bank was rip-rapped and planted with sandbar willow. This project site appears stable, with willow established within the riprap. However, the site has sustained some damage from ORV use and disturbed areas support weedy species.

The Overlook site, downstream of Scout Camp, includes sparse cottonwoods and ditches south of the river. Diversity is low away from the river, but mature cottonwood and riparian shrub habitats occur closer to the river. Ditching and a depression adjacent to a berm have been heavily colonized by cocklebur, with perennial pepperweed and some Canada thistle also present. Patchy stands of tall, dense sandbar willow occur on both the north and south sides of the river. A dense stand of younger cottonwoods was found adjacent to the river on a bench upstream from the Overlook site. Beaver damage was evident on a number of the trees in this stand (Photo C-7).

Still south of the river and farther downstream, the Horse Camp site includes a berm that impounds an open water pond. Diversity is low in the fields, with perennial pepperweed and Canada thistle as well as cocklebur common to dense near the river above and below this pond. Sandbar willow shoots in a stand near the river had been grazed and little recruitment was noted. On the positive side, however, several patches of buffaloberry and some Woods rose were noted adjacent to the channel that supplies the open water pond, and in the nearby field. A channel conveying flow below the open water pond has been heavily colonized by cocklebur. A portion of the field below the pond supports a dense stand of wheatgrass that is successfully competing with weedy species.

A second open water pond has been created below the wheatgrass stand. A berm impounds this feature, and dense sandbar willow is established on the pond's north side. Dense perennial pepperweed and some tamarisk are established on the berm.

Below this site, Hercules Well, a 12-inch well owned by the Fort Churchill State Historic Park, is used to irrigate fields to the east. This well may be available as a source of irrigation for downstream enhancement projects.

Evidence of grazing was less apparent and willow recruitment more apparent in the southeastern portion of Lahontan State Recreation Area. Sandbar willow regeneration and some cottonwood recruitment were noted in this area, and a large emergent wetland area exists to the northeast.

A number of anastomosing (branching and recombining) channels and old oxbows are present on the River Ranches parcels in agricultural fields north of the river. Diversity is low in much of this area. Many of the channels lack associated riparian vegetation, but a few support well-developed riparian shrub stands. Near the northern edge of the floodplain, several old oxbows support both riparian shrub and emergent wetland vegetation. Emergent wetland vegetation (bulrush) was also noted behind a dike north of the river above the Lahontan State Recreation Area. This vegetation type is rare on the Middle Carson River and represents high-value habitat. This Plan recommends protecting these sites to preserve these areas of desirable habitat type.

Little evidence of grazing was found in the Lahontan State Recreation Area north of the river, and diversity was at least moderate. Invasive weedy species, primarily perennial pepperweed, were noted, but at the sites visited, dense stands of creeping wildrye were successfully competing with the invasive weedy species. Cottonwood recruitment was noted at several locations adjacent to old oxbows and in the margins of the existing cottonwood community (Photo C-8). A review of aerial photographs determined that many of these areas were flooded by high flows in 2006. The cottonwood establishment noted probably occurred during this or another high flow event.

4.2.3 Riparian Species Recruitment

Cottonwood recruitment was observed, with local areas of recruitment noted in floodplain communities in Dayton State Park, Fort Churchill State Historic Park, and, particularly, in Lahontan State Recreation Area. Specifically, some natural recruitment was observed in an oxbow/backwater area at Fort Churchill

State Historic Park, on the Amerongen and Ghiglia lease areas of the River Ranches, and in the Lahontan State Recreation Area within RS, MF, and W community types. These sites correspond to areas where previous assessments have noted good connection of the river to its floodplain. An examination of aerial photographs shows areas of recruitment, particularly in Lahontan State Recreation Area, were inundated by high flows in the spring of 2006. Recruitment was local, however, and is limited by grazing and probably by the lack of a slowly receding groundwater level in areas above Lahontan Reservoir.

4.2.4 Erosion

While this plan focuses on protecting or restoring riparian habitats, areas of eroding bank that threatened both streambank vegetation and existing facilities were noted. These areas include a location below the Buckland Ditch diversion and near the Fort Churchill State Historic Park picnic area. The upper end of the Buckland Ditch and the portions of the picnic area at Fort Churchill State Historic Park are currently threatened by erosion and mass wasting of near-vertical sandy banks. Park management is currently proposing a channel realignment. The sandy bank of the river south of the Fort Churchill picnic area is also eroding and over time may threaten parts of the picnic area. Currently, an approximately 15-foot vertical cut is present just south of the fence that borders the picnic area on the south.

The 1997 Inter-Fluve report divides the reach of the Carson River between Buckland Station and Lahontan Reservoir into two subreaches. The higher reach is identified as moderately unstable, with generally unstable banks and active lateral channel migration. This higher reach is incised, such that high flow energy is not dissipated on the floodplain. The lower reach, however, was identified as stable, with relatively stable banks and access to a floodplain, allowing dissipation of energy. The current assessment generally agrees with observations made in the 1997 report. Some channel stabilization work has been undertaken on the river at Scout Camp. Banks on a section of the river have been armored with riprap and planted with willows, locally stabilizing the river's south bank. The channel above the upstream Main Camp area remained incised, with exposed vertical sandy banks approximately 4 feet in height.

4.2.5 Off-Road Vehicle Use

ORV use is identified as a problem as river levels drop and some recreationists use the river bed as a roadway for standard vehicles and ORVs. ORV use was evident at both Fort Churchill State Historic Park and Lahontan State Recreation Area when these sites were visited in August 2010. Runoff after storms in October resulted in sufficient flow to prevent use of the riverbed as an ORV route. ORV use can damage vegetation on banks and bars in and bordering the river's channel. Personnel at Fort Churchill State Historic Park noted that current law limits their ability to control ORV use in the area. To address ORV use in the river, an effort is underway to develop an educational program that includes outreach and signage.

4.2.6 Grazing Effects

While many RS communities were reduced to single-aged stands of heavily browsed sandbar willow, there were surprisingly many instances of natural willow and cottonwood recruitment in RS, MF, and W communities within the River Ranches Amerongen and Ghiglia lease areas, and in the Lahontan State Recreation Area. The survival of young willow and cottonwood seedlings and increasing the vigor of

existing riparian vegetation could easily be boosted if grazing systems were specifically managed to promote riparian health.

As noted in the Carson River Ranches Grazing Management Plan, Draft Grazing Lease 3 (August 10, 2006), a fence located along the Carson River approximately 50 yards from the river's high water mark is being or would be designed (only sections of this fence have currently been installed) to minimize grazing in "sensitive riparian habitat and cottonwood forest that should only be grazed by prescribed grazing practices." Fort Churchill State Historic Park personnel have noted that under low water conditions, cattle can access riparian habitats bordering the river by bypassing the ends of this fence. Installation of longer (more continuous) segments of this fence and on-going fence maintenance would minimize this bypassing.

5.0 Project Considerations

5.1 Prioritizing Projects

Priority 1

Preventative maintenance over active restoration

Once a stand has been converted, returning the site to its former community is very difficult and uncertain. Instead, improving the management of the site before the site becomes degraded is recommended (Boggs and Weaver 1992). Important maintenance activities that are implemented or can be implemented to prevent degradation of habitat functions include:

1. Tamarisk control in MF and RS communities
2. Grazing system overhaul (including fencing and fence monitoring) to protect MF and RS communities
3. Noxious weed management
4. Beaver management
5. Fuels reduction

Preventative maintenance projects should be selected in OR1, RS1, MF1 communities over OR2, OR3, RS2, and MF2 sites. OR1, RS, and MF1 communities have greater shrub and tree density, which generally indicates better habitat condition when greater density is attributed to native species and not tamarisk. OR1, RS1 and MF1 sites are believed to have better access to hydrology and are not as impaired as higher numbered sites. These sites, therefore, require less effort to maintain and would benefit from protection alone. Enhancement, in the form of weed management and grazing management should allow these sites to improve with less need for more active and aggressive enhancement.

Priority 2

Project sites within biologically robust areas

The California RHJV recommends prioritization of riparian sites based on current indicators of avian population health; proximity to existing high-quality sites; proximity of intact adjacent upland habitats; presence of intact natural hydrology or the potential to restore the natural processes of the system's surrounding land uses. From high to low, regions of the Plan Area that best meet these criteria are ranked as follows:

1. Lahontan State Recreation Area
2. Fort Churchill River Ranches
3. Fort Churchill State Historic Park
4. Dayton State Park and Walker Property
5. Santa Maria Ranch
6. Rolling A Ranch

Riparian habitats bordering the Middle Carson River in much of the Lahontan State Recreation Area appear to be in relatively good condition and most were mapped as an OR1 community. Accordingly,

much of this area would benefit most from protection measures and would not require a heavy emphasis on active projects.

The Fort Churchill River Ranches area has a mix of category 1, 2 and 3 habitat types, including some MF1 sites. These sites can be enhanced through protection, and offer areas of high-quality habitat adjacent to habitats that could be enhanced by more active means (planting, deep planting, patch connection). The River Ranches area also includes many old channels, oxbows and ditches that represent planting sites with better access to local hydrology.

Lahontan State Recreation Area and Fort Churchill River Ranches have the potential to be biologically robust because they cover large areas, have a mix of habitats, have minimal habitat fragmentation, and are buffered from human disturbance (MacArthur and Wilson 1967). The importance of large, intact habitat areas cannot be understated. Larger habitat areas are able to support larger populations that are less vulnerable to disease and local disturbances. They are able to support a number of separate populations, allowing species to repopulate after disturbances, protecting metapopulations and genetic variation. Select sites that are, and will continue to be, resistant to disturbance from the surrounding landscape.

Particularly above Highway 95A, the river is fairly incised and fewer patches of higher-quality habitat are present. Some opportunities for habitat enhancement are present, including the potential for creation of an interpretive site in the eight-acre field just north of Buckland Station, where a water right is available to create such a project. The proposed realignment of the river's channel to protect the Buckland Ditch could also include habitat enhancement measures. Measures to protect the southern part of the Fort Churchill picnic area from lateral migration of the river would require more of an engineering solution than a habitat enhancement project could provide.

Dayton State Park and the Walker Property/Upper Rolling A Ranch include some intact high-value habitat that would benefit from continued weed management. The public has also expressed interest in the addition of kayak and canoe access, and engineering measures to protect the Cardelli Ditch may be required. Habitat improvement projects could again be included as a part of any engineering project proposed.

Enhancement projects are proceeding at both the Santa Maria Ranch and Rolling A Ranch.

Priority 3

Natural recruitment over active planting

Based on a review of wetland habitat restoration and creation projects across the country, the National Research Council recommends that whenever feasible, natural recruitment sources be used for more resilient vegetation establishment (National Research Council 2001). "Some systems, such as riparian systems are rapidly colonized, and natural recruitment is often equivalent or superior to plantings." The Council further recommended planting mature plants as supplemental rather than required, with the decision depending on early results from natural recruitment and invasive species occurrence. In line with Priority 3, protection and/or enhancement of MF1, RS1, and OR1 sites have a greater chance of

success. The presence of healthy desirable habitat types suggests conditions are favorable for the further spread of these types. On-site seed collection and planting may be an option, particularly since seed collected on-site would be better adapted to local conditions than seed obtained from off-site sources. Protection alone will encourage the regeneration of already-existing desirable species such as willows. However, natural recruitment of buffaloberry and wild rose is not apparent in the Plan Area. The rarity of occurrence severely limits propagule sources. For these species, supplemental planting may be the only means for re-establishment.

5.2 Addressing Lack of Hydrology

The California RHJV recommends prioritizing sites that include the presence of intact natural hydrology or the potential to restore natural processes (RHJV 2004). Due to upstream diversions, porous soils, and natural annual fluctuations in river flow, this is a significant challenge on the Middle Carson River.

5.2.1 Know Your Water Table

Predicting the elevation of groundwater is imperative to select the appropriate plant species and planting techniques. Common methods to determine the average elevation and variation in groundwater levels include water table monitoring wells, observations of the depth of hydric soil indicators, and observations of the water elevation in an adjacent wetland or the river channel. Groundwater elevations vary dramatically within a season and between years. Short term and one-time observations using these methods should be viewed as an unreliable indicator.

A water table monitoring well is essentially a perforated pipe installed using a hand or power auger. Water level is measured using a water level reading instrument (a well sounder or, in the case of a very near-surface water table, a retractable table and flashlight). The top of the well is fitted (loosely) with a vented cap. The well is sealed with clay to prevent surface water from running down the sides of the instrument. Specifications and installation tips can be found in NRCS publication *Installing Monitoring Wells in Soils, Version 1.0* (U.S. Department of Agriculture, NRCS 2008). Suggested monitoring well locations are included in some of the site-specific plans (Section 6, *Community Prescriptions*). Since these monitoring wells are relatively inexpensive, additional wells can be installed at the discretion of park personnel.

Hydric soil indicators are used in soils that are saturated for a long enough time to allow iron reduction to occur. However, this method requires an understanding of how the chemistry of iron (Fe) and magnesium (Mn) oxides affect soil color. Technical criteria are described in the NRCS publication *Redoximorphic Features for Identifying Aquic Conditions* (U.S. Department of Agriculture, NRCS 2008)

5.2.2 Deep Planting

The NRCS has produced a tremendous number of publications related to planning considerations and planting methods for riparian community revegetation. See references listed under Technical Resources, Section 6.5. Guidelines for deep planting cottonwood and willow poles at the suggested planting sites are as follows:

- Plantings should be deep enough for poles to reach the summer water table. Hand auger for shallow holes; power auger for deeper holes. In the Plan Area, late-summer groundwater

elevations may be as important as mid-summer elevations. Depth of holes would be limited by the equipment used (power auger, hydrojet, stinger, etc.) and planting substrate (loam, sand, etc.) but should also consider the length of poles available.

- Pole length - No less than ½ the total length of the cutting should be planted below the ground surface, with 3-4 buds remaining above the ground. In MF and RS sites that are subject to flooding, cuttings need to be longer so that tops are above the high water line.
- Ensure good soil to stem contact when backfilling of hole. “Mudding” the cuttings as described in Hoag 2007 ensures soil to stem contact while minimizing air pockets.
- Poles with roots are more successful than unrooted poles.
- Pole diameter- at least 1 inch or greater, 3-4 inches is preferred.
- For cottonwood and willow plantings, follow the recommendations in Hoag 2007: *How to Plant Willows and Cottonwoods for Riparian Restoration*, NRCS Technical Note TN Plant Materials No. 32, January 2007 revision.

5.2.3 Hydraulic Barriers

The use of subsurface constructed hydraulic barriers to increase the shallow groundwater elevation within the Middle Carson River floodplain may prove to be a feasible restoration method for enhancement of riparian vegetation in the off channel riparian environments. Subsurface hydraulic barriers have been employed for water storage and groundwater elevation management projects and for various types of water quality management projects.

The general configuration of a hydraulic barrier is depicted in **Figure 10**. The increased groundwater elevation is the result of decreasing the permeability of the alluvial material under the defined river channel and associated floodplain alluvium. The Carson River flows subsurface during the driest portion of the season. During this time the porous alluvial material allows for surface waters to infiltrate into the shallow subsurface flow, making it unavailable to support riparian vegetation due to the depth of water from the ground surface.

By modifying the hydraulic conductivity or permeability of the alluvium, the subsurface flow can be captured and therefore create an increase in the shallow groundwater elevation and a corresponding reduction in the depth to groundwater from the ground surface. This change in water surface elevation allows for greater access to the water table by plants to support riparian restoration efforts.

Methods for hydraulic barrier construction differ depending upon the site characteristics, soils, construction access, dewatering opportunities, and cost constraints. Two commonly used methods are applicable for consideration. In areas with relatively shallow subsurface flow, less than 30 feet in total depth, open trenching and installation of an impermeable barrier is frequently the most efficient method to affect the shallow groundwater elevation. This method typically uses 100 mil HDPE liner materials to be placed vertically in a trench across the subsurface flow channel. The size and stability of alluvial materials will dictate trenching feasibility, and the surface conditions will determine the ability of excavation equipment to access the site. Installation of grout or bentonite slurry is also a widely used method to modify the permeability of the alluvial materials. This requires holes to be drilled perpendicular to the direction of flow and the grout or bentonite slurry to be pumped into the ground.

The pumping is done in such a manner as to allow for the “filling,” or “plugging,” of interstitial space from depth up to the ground surface.

Potential sites for hydraulic barriers should be evaluated with the following considerations. Due to the significant cost and specialty type of work involved, appropriate sites should be fairly narrow and shallow with respect to the amount of alluvium that is carrying the shallow groundwater. An ideal application would result in the reduction of permeability of the alluvial material from bedrock to the ground surface. To maximize the area influenced by the installation of a barrier, the area upstream of the barrier should be relatively flat. A gradual upstream slope will provide a great area of the shallow groundwater accessible to riparian planting. **Figure 10** shows the relative area affected in flat reaches versus the effect of a barrier in a steep area.

The investigation and determination of feasibility for this type of restoration effort will require the following steps to be completed prior to the engineering design and construction of this type of project.

Step 1 – Site Selection

A feasible site should be selected for investigation. A successful site should have the following characteristics:

- Upstream slope should be less than 1 percent slope, depending on width of section.
- The site should be a narrow point in the river where bedrock can be identified on each side of the site.
- The main river channel should not be braided at the site location to limit the width of the barrier to capture the main flow of the subsurface water.
- The site should have reasonable access for heavy equipment, consisting of excavators, larger trucks, or drill rigs.

Step 2 – Site Investigation

- Preliminary core samples should be drilled to determine depth to bedrock, and alluvial composition.
- Alluvium should be coarse-grained material with a high permeability.
- Alluvium should be as uniform as possible to facilitate trenching or pressure grouting applications.
- Installation of piezometers on a grid that extends upstream from the potential sites and horizontally from the river will provide shallow groundwater data to characterize the extent and volume of shallow groundwater to be intercepted.
- Prepare an estimate of evapotranspiration for the affected area for use in the water budget calculations.
- Evaluate the geomorphic stability of the river in the reach area of the proposed hydraulic barrier.

Step 3 – Development of a Project Water Budget

- Using historical flow records determines the seasonal effect of the retained shallow groundwater.

- Integrate the evapotranspiration data into the water budget to determine if the available water resulting from the installation of the barrier will provide a sustainable water elevation that is accessible to riparian vegetation during the driest season.
- Coordinate any water right dedication that may be required through discussion with the State Engineer's office.

Step 4 – Engineering Design

- Using the information obtained in steps 1, 2, and 3, contract a qualified engineer with appropriate hydraulic and geotechnical expertise to design and develop construction plans, specifications, and cost estimate.
- Obtain project permits which will include but are not limited to a Working in Waterway Permit, dewater discharge permit, Army Corps of Engineers 404 permit, Nevada State Lands Permit, and appropriate cultural resource approvals.

5.2.4 Water Right Application for Environmental Purposes

The administration of the water rights of the Carson System is conducted under the system of Prior Appropriation. This is also known as first-in-time-is-first-in-right. A prior doctrine allows for a senior (older) water right to receive all of its allocated water before the junior (younger) right can use its allocation. For example, in years when there is insufficient water to supply both rights, a right with a priority date of 1865 will be able to use water longer in the year than a right with a priority date of 1880.

Rededicating existing Alpine Decree surface water rights to specific project areas is an option to obtain irrigation water to establish plantings. All surface waters of the Carson River are adjudicated by the U.S. Federal Water Master through the Alpine Decree. The majority of water rights appropriate to land in the lower Carson River, and specifically to lands within the project area, are agricultural irrigation rights. In the Alpine Decree, the Carson River is divided into segments and each segment is administered autonomously. The season of use is set each year by the Federal Water Master, but typically the season runs from April 1 through October 15.

To ensure water is available for restoration projects, managers may elect to apply existing water rights to lands requiring irrigation for environmental purposes. To do this, several administrative changes must be filed with the Nevada Division of Water Resources (State Engineer's office). These changes include:

- Change in Manner of Use – Applicants that wish to apply water rights that have historically been used for agricultural irrigation should change the Manner of Use to indicate the beneficial use as Environmental.
- Change of Place of Use – If the water rights that are to be used for environmental support are not appurtenant to the same land as the project area, a change in Place of Use will be required.
- Change in Point of Diversion – Depending on how the water is conveyed to the Place of Use, a Change in Point of Diversion may be required.

All of the above water right administrative changes must be filed at the Nevada Division of Water resources. These filings will be accompanied by an application and a map developed by a water right surveyor.

5.3 Grazing Management

At Fort Churchill State Park and Carson River Ranches, grazing leases are an important source of income to fund maintenance and improvement projects. Elimination of grazing would be detrimental to the operations of the Park, and reduction in grazing would not occur without careful consideration of its fiscal consequences.

However, summer grazing within riparian communities (MF and RS communities) should be avoided or reduced in duration to increase the survival of young seedlings and vigor of existing riparian vegetation, (BLM 2006). During summer, riparian trees and shrubs store surplus carbohydrates in their roots and will use the stored carbohydrates to regrow each spring. When grazed, plants use stored carbohydrates to regrow new shoots or leaves. Summer-long grazing doesn't give riparian shrubs sufficient time to replenish their carbohydrate reserves. This decreases the vigor of older, established plants and decreases the chances of survival for younger plants. Additionally, with the reduction in root biomass, plants become shallow-rooted and less able to stabilize streambanks.

Previous river assessments and current recommendations from the Inter-Fluve (1997) document are appropriate and worth repeating:

- A rest rotation scheme should be implemented, or grazing should occur for only a short season in areas with shrub/willow communities.
- Season-long grazing in riparian areas should be avoided.
- If spring grazing is scheduled, range readiness for cattle should be determined prior to turning cattle out. Grazing should not begin until grasses have reached the boot stage and seed set has occurred.
- If summer grazing is scheduled in areas with shrub/willow communities, grazing should end prior to fall color to deter overgrazing of these species.
- Fall grazing may be scheduled rather than earlier-season grazing.
- Rotations should not include back-to-back spring to summer grazing.
- Stocking rates and grazing duration should both be considered when grazing in riparian-wetland pastures.
- Watering areas along the river should be rotated, or use stock watering ponds constructed away from riparian and wetland areas to limit cattle use in sensitive areas.
- Range monitoring should occur regularly to determine condition of willow/shrub communities. Management should be adjusted as necessary to meet the objectives.

Fall grazing, after riparian trees and shrubs have completed their storage of carbohydrates and short period summer grazing are appropriate options as well. Implementation of any of these grazing options would require construction and frequent maintenance and monitoring of fences and a weed monitoring

and control program. The degree to which grazing is currently suppressing weeds is unknown and weed populations could potentially increase without grazing pressure. New water sources for cattle would need to be developed in pastures that no longer extend to the river to discourage use of the river corridor.

Areas selected for planting of cottonwoods, willows, and other desirable species will require grazing exclusion until planted species have become established and can tolerate grazing. Cottonwood and willow plantings near the river will also require beaver management, including the installation of chicken wire or other protective material around individual trees or fencing of planting sites. The NRCS (2000) recommends five years of rest from cattle grazing to re-establish healthy stands of riparian vegetation such as cottonwoods and willows. This period may be shorter or longer depending on climatic conditions when vegetation treatments occur. Areas where grazing is excluded or vegetation is planted should be monitored to assess recruitment and other changes in vegetation and grazing commenced only when vegetation is robust. As noted in Section 1.3, *How Does the Plan Address the Issues?*, responses to altered management practices cannot be predicted with certainty. Initial attempts at restoration through changes in management, planting, or fencing should be monitored to determine if desired results are indeed achieved. Once a treated area is determined successful and ready for grazing, other and potentially larger-scale projects may be undertaken.

5.4 Invasive Weeds

Noxious weeds observed in the Plan Area include perennial pepperweed, tamarisk, hoary cress, spotted knapweed, musk thistle, Canada thistle, and Scotch thistle (*Onopordum acanthium*). Nuisance weeds observed included cocklebur, Russian thistle, and bull thistle (*Cirsium vulgare*). The diversity and density of infestation within the Plan Area appeared to be highly correlated with ground disturbance, livestock grazing, frequency of inundation, and human use. Parking areas, trails, campsites, and public use areas that are frequently disturbed are more susceptible to noxious weed infestation by virtue of animals and people supplying seed sources to these areas in conjunction with surface disturbance. The best evidence of park visitors acting as vectors was made at the parking areas at Fort Churchill State Park and Carson River Ranches. For example, spotted knapweed was not widespread at other locations, but was found at the Scout Camp and Horse Camp parking areas. In general, perennial pepperweed was observed in almost all areas within the Weed Management Area (WMA), particularly on moist soils disturbed by livestock. The largest infestations occur on Carson River Ranches properties.

Within the Plan Area, DVCD, Churchill County Mosquito, Vector and Weed Control District, Lyon County and NSP are keeping noxious and invasive weeds in check as best as budgets and personnel requirements allow, especially in the case of perennial pepperweed and tamarisk. Their efforts are appropriately focused on locations that contain the highest densities of the most aggressive weeds and high risk areas (i.e. locations where activities enable weed seeds to be brought in, cause disturbance where weeds can establish, and/or provide a mechanism for dispersal). Evidence of treatment was observed at parking areas, camping areas and campgrounds, high use visitor areas, high use livestock areas, and abandoned cultivated fields. Control methods at some sites consisted of two or more control actions that provide better control than any one action, taken alone, might provide. At Santa Maria Ranch Park and Rolling A Ranch Park, post treatment seeding with competitive grasses is used to

suppress germination of weeds seeds banked in the soil. At Lahontan State Recreation Area, wherever possible, sandbar willow cuttings are planted after treatment.

As each individual weed within the Plan Area displaces a native plant, continuing an aggressive noxious weed treatment program throughout the Plan Area is the single most important action to maintain existing native communities. Halting the displacement of native plants due to current infestations is necessary before native plant and animal biodiversity along the river corridor can be increased. Instituting an Early Detection, Rapid Response (EDRR) plan, including training on weed recognition, can limit the establishment or spread of new populations of weeds. Standard treatment methods for mechanical, cultural, biological, and chemical control, for selected noxious and invasive weeds are contained in **Appendix F**. Recommended weed suppression seed mixes are listed for each vegetation community in Chapter 6.

5.5 Mercury

Although not readily apparent from on-the-ground observations, mercury in Carson River sediments is a cause for concern. Mercury was used to process gold and silver ore mined on the Comstock in the 1800s. Large quantities of mercury were released to the Carson River or to soils and sediments near the river. Smith (1943) estimated that approximately 7,000 tons of mercury were released to the river. While some of this mercury has either been transported downstream or recovered, mercury remains in sediments in and adjacent to the river. In 1991, the U.S. Environmental Protection Agency designated the Carson River from Carson City through Dayton Valley a Superfund site due to the high levels of mercury contamination.

Mercury may exist in several forms. Vapors of elemental mercury can cause damage to biological organisms, but methylated mercury is highly toxic to biological organisms when ingested. Methyl mercury is also subject to bioaccumulation. Various anaerobic bacteria can methylate elemental mercury. Conditions that favor these bacteria exist in the mud of lake, pond, and river bottoms (Stoker and Seager 1972). Methyl mercury that has been taken up by algae and other primary producers may subsequently be bioaccumulated by aquatic and terrestrial organisms higher in the food chain. Predatory species, in particular, may accumulate mercury in concentrations that can be lethal or result in sublethal effects. Mercury in Carson River sediments may be mobilized during high flows that erode contaminated sediments. To reduce the potential for movement of floodplain sediments into the water column, one of the EPA Superfund mitigation measures is stabilization of the river.

While high mercury concentrations in piscivorous (fish-eating) birds nesting on Lahontan Reservoir has been documented (Henny et al. 2002), a study published in 2007 (Custer et al. 2007) documented high mercury concentrations in cavity-nesting insectivorous birds nesting along the Carson River. The 2007 study found that mercury concentrations in the eggs and livers of Tree Swallows and House Wrens (*Troglodytes aedon*) nesting along the Carson River below Dayton were 15 to 40 times higher than concentrations found in these species nesting near Woodfords, California, a location on the Carson River above the mercury-contaminated reach of the river. The study notes that “the main toxic effects of mercury on reproduction are increased infertility rates and decreased egg hatchability” and that concentrations of mercury found in Tree Swallows and House Wrens nesting on the Middle Carson River

“are within the ranges known to impair reproduction in other bird species.” Indeed, while based on a small sample size, the study documented lower than average hatching rates for both species nesting along the Carson River below Dayton.

The Otis Bay report notes that mercury contamination should be considered in projects that involve earth moving. In particular, the report notes that the creation of wetland ponds may produce conditions conducive to methyl mercury formation. The report also notes that methyl mercury bioaccumulation is more likely to take place in constructed wetlands with low organic content in the sediment (Tuttle et al. 2001).

6.0 Community Prescriptions

This Plan proposes treating habitats along the Middle Carson River by community type (Riparian Shrub, Mature Riparian Forest, Old Riparian, Big Sagebrush Shrubland, etc.). This approach was selected because it incorporates both the existing habitat and the landscape surface (active floodplain, terrace above the floodplain, etc.). Potential restoration opportunities are determined based in part on these landscape features. In particular, potential strategies for enhancing habitat on a site are determined in part based on the site's proximity to the floodplain and the depth to groundwater over the growing season. For example, vegetation communities in Old Riparian sites cannot take advantage of soil moisture provided by seasonal inundation because the OR community is by definition above the active floodplain. Enhancements (i.e., plantings) in Old Riparian communities would exploit relict channels and swales because these features offer better access to the water table. The potential for survival of riparian vegetation enhancement outside of relict channels and swales may be limited by excessive or unpredictable depths to groundwater. Conversely, enhancements are not proposed for Emergent Riparian sites, because these sites occur on channel or bank bars in the active floodplain and are susceptible to erosion and removal of the vegetation community at high flows.

The following sections describe the principal types of vegetation community considered as a part of this Plan. Each community includes a general description based on limited observations in the Plan Area, desired conditions, common problems, desired plant species, and planting considerations. Suggested technical resources and references are listed at the end of this chapter. Every site within the Plan Area can be considered by using one of these specification write-ups. It must be remembered, however, that every site may have significant differences in soil and variations in vegetation characteristics. Each site, therefore, requires a careful on-site evaluation to tailor the type of habitat improvement projects and revegetation protocols best suited for that particular site.

Specific projects are contained in **Appendix G**.

No prescriptions are provided for Early Riparian. ER occurs within the active channel generally on gravel bars, point bars, and secondary channels. The community is inherently dynamic with a high frequency of natural disturbance. Therefore, no habitat improvements are provided for ER sites. Unless associated with bank stabilization project, revegetation is risky because plantings are vulnerable to channel shifting. Where property protection is not needed the stream should be allowed to move as needed.



Santa Maria Ranch Park

6.1 Riparian Shrub and Mature Forest

Site Description

These sites are within the floodplain and are subject to overbank flooding during high flows. Fort Churchill River Ranches and Lahontan State Recreation Area have minimal encroachments within the floodplain and the widest floodplain widths. The ground surfaces of most RS communities are slightly lower than the MF communities and experience a higher frequency of overbank flooding. RS communities are generally areas of sandbar willow and/or tamarisk that lack mature cottonwoods. MF communities consist of mature cottonwoods with sandbar willow, tamarisk, and/or Russian olive. Red willow is also found, but not in great numbers. Buffaloberry and Woods rose were rare in both communities, and no occurrences of golden currant were observed.



Ft. Churchill State Park/Carson River Ranches
West of Overlook

Natural recruitment of sandbar willows, red willows, and cottonwood occurs at Fort Churchill River Ranches and Lahontan State Recreation Area. Although cottonwood seedlings generally don't survive because roots of seedlings cannot remain in contact with groundwater, there appears to be cottonwood survival and establishment in low numbers at Fort Churchill River Ranches and higher success at Lahontan State Recreation Area.

The herbaceous understory of RS and MF sites is dominated by creeping wildrye or, in saline-alkali affected soils, inland saltgrass. Both are desirable soil stabilizers. Sedges of any type were extremely rare. This is probably due to the lack of soil saturation within the rooting zone through the growing season or grazing pressure, or both.

Flood flows are constantly depositing tamarisk, cocklebur, and perennial pepperweed propagules (a vegetative structure that can become detached from a plant and give rise to a new plant) and contribute to the spread of undesirable weeds. At Fort Churchill River Ranches some RS sites have been completely taken over by tamarisk. Canada thistle is more prevalent in grazed areas.

Desired Conditions

- Complexity and physical structure (presence of tree and shrub layers)
- Diversity of tree and shrub types (not just sandbar willow)
- Continuous cover of trees and shrubs (high density)
- Ground cover of native grasses and sedges
- Natural recruitment of native plants
- Survival of native seedlings and establishment of young trees
- Minimal presence of weeds, particularly tamarisk

Common Problem Conditions

1. Low density trees and shrubs (mapped as RS2 and MF2)
2. Lack of shrub layer in some MF communities
3. Insufficient summer flows to promote cottonwood seedling survival
4. Young trees (whips and saplings) rare
5. Woods rose and buffaloberry rare
6. Sedges rare
7. Tamarisk spread
8. In grazed areas, sandbar willow present as severely hedged, single-aged stands
9. Dominance of tamarisk, perennial pepperweed, Canada thistle, and cocklebur

Potential Enhancement Opportunities

1. Tamarisk eradication combined with native woody shrub plantings
2. Supplemental red willow and cottonwood pole plantings
3. Fencing and fence repair
4. Change in grazing system to reduce grazing pressure in summer
5. Change in grazing system to prevent increase in weeds
6. Supplemental buffaloberry, Woods rose, and golden currant plantings
7. Russian olive eradication combined with buffaloberry plantings

RS and MF Desired Species (Compiled from NRCS soil survey and field observations)

Trees and Shrubs

Cottonwood
Buffaloberry
Woods rose
Golden currant
Red willow
Sandbar willow

Herbaceous Ground Cover

Creeping wildrye
Nebraska sedge
Baltic rush
Slender wheatgrass (*Elymus trachycaulus*)
Thickspike wheatgrass (*Elymus lanceolatus*)
Sandberg bluegrass (*Poa secunda*)
Tufted hairgrass (*Deschampsia caespitosa*)
Nevada bluegrass (*Poa nevadensis*)
Meadow barley (*Hordeum brachyantherum*)
Inland saltgrass

Weed Suppression Mix (recommendations from Comstock Seed Company and NRCS)

Kentucky bluegrass

Baltic rush
Siberian wheatgrass VAVILOV*
Streambank wheatgrass SODAR
Great Basin wildrye MAGNAR
Slender wheatgrass Revenue*
Cereal rye Fall V.N.S.
Creeping wildrye*

**Salt tolerant*

RS and MF Planting Considerations

1. Control noxious weeds to less than 5 percent before planting.
2. Plant willows and cottonwoods along the water line, or if set back from the water line, willow and cottonwood poles need to be long enough to reach the summer water table.
3. Buffaloberry and Woods rose are excellent choices for planting. Buffaloberry is more salt/alkali tolerant than Woods rose.
4. Opt for fall container planting and seeding (avoid spring planting/seeding). Fall planting allows seeds and plants to take advantage of peak soil moisture conditions. There is always risk that seasonal overbank flows would destroy prepared seedbeds.
5. Protect saplings from beaver. Wire fencing needs to be maintained. If frequent and regular reapplication is a possibility, methods to dissuade beavers include painting trees and spraying cayenne pepper solution. NSP personnel suggested electric fencing, powered by batteries or solar panels, may be effective in protecting sites from beaver and other grazers.
6. Exclude livestock and any other disturbance for 3-5 years after planting. This period may be shorter or longer depending on climatic conditions when vegetation treatments occur. Plants need sufficient time to establish vigorous roots, which is an important attribute in floodplain communities. Woody plants need to grow to 4 feet or taller, beyond the reach of browsing animals, or have enough exterior stems to protect the interior stems. Areas where grazing is excluded or vegetation is planted should be monitored prior to a resumption of grazing to assess recruitment and vegetation health.

RS and MF Grazing System Considerations

To increase the vigor, deep rooting characteristics, recruitment, and survival of riparian trees and shrubs, the following techniques can be used.

- Option 1: No livestock grazing in summer:
 - Fall grazing should begin only after the end of the growing season when riparian trees and shrubs have completed storage of carbohydrates.
 - Spring grazing should not begin until grasses have reached the boot stage and seed set has occurred.
- Option 2: Rest-rotation system:
 - Rotations should not include back-to-back spring to summer grazing.
 - Stocking rates and grazing duration should both be considered when grazing in riparian-wetland pastures.

The following methods would likely be effective if combined with frequent monitoring of riparian conditions and the use of adaptive management.

- Short period summer grazing
 - High-intensity, short duration grazing.
 - This requires fencing or active herding to keep livestock in the proper areas.
 - If summer grazing is scheduled in areas with shrub/willow communities, grazing should end prior to fall color to deter overgrazing.
 - Watering access areas along the river should be rotated, or stock watering or troughs should be provided away from riparian and wetland areas to limit cattle use in sensitive areas.
 - Range monitoring should occur regularly to determine condition of willow/shrub communities. Management should be adjusted as necessary to meet the objectives
-
- Keep livestock out of recovering MF and RS communities. Lure livestock away with judicious placement of water troughs and salt blocks and by providing better summer forage elsewhere.

6.2 Old Riparian Forest

Site Description

The OR community consists of old cottonwoods typically with an understory of sagebrush. These sites are above the floodplain and are not subject to overbank flooding. Because these sites are not on a geomorphically active surface, natural recruitment of cottonwoods is impossible. Other types of understory shrubs are not common, but when present, the species is typically Russian olive. Buffaloberry and Woods rose are rare.



Ft. Churchill State Park, near Scout Camp



Ft. Churchill State Park at Overlook

Where shaded or where sagebrush has been cleared, creeping wildrye or perennial pepperweed is dominant. Most OR communities have a swale feature or relict channel running through them. The old swales and channels vary in depth and may be seasonally inundated, seasonally saturated, or dry year-round depending on depth and whether there is a hydrologic surface connection to the river. When other understory trees or shrubs are present, they are usually associated with one of these channel features.

Desirable Conditions

- Complexity and physical structure (presence of small tree and shrub layers)
- Diversity of shrub types (not just sagebrush)
- Natural recruitment of shrubs to provide a mix of young and old age classes of shrubs
- High density of trees and shrubs
- Ground cover of creeping wildrye
- Minimal presence of weeds, particularly perennial pepperweed

Common Problem Conditions

1. Woods rose and buffaloberry are rare
2. Existing vegetation associated with relict channels is in poor condition
3. Sagebrush is old; younger shrubs are absent
4. Wetlands, when present, are dominated by perennial pepperweed or cocklebur
5. Perennial pepperweed and Canada thistle are dominant

Enhancement Opportunities

1. Weed management in combination with weed suppression seed mix
2. Riparian plantings in relict channels to increase diversity and structure. Willow and cottonwood where water table allows; buffaloberry, Woods rose, and golden currant in drier sites.
3. Change in grazing system to reduce weeds
4. Russian olive eradication combined with buffaloberry plantings
5. Change in grazing system to increase native grasses and forbs

OR Desired Species

Trees and Shrubs

Sagebrush (*Artemisia tridentata* ssp. *tridentata*)
Rubber rabbitbrush
Threadleaf rabbitbrush (*Ericameria nauseosa* ssp. *consimilis*)*
Smooth horsebrush (*Tetradymia glabrata*) (in relict channels and swales)
Cottonwood and willow where poles can reach the water table
Buffaloberry
Woods rose
Golden currant

Grasses

Creeping wildrye
Great Basin wildrye
Slender wheatgrass
Thickspike wheatgrass
Indian ricegrass (*Achnatherum hymenoides*)
Tufted hairgrass
Nevada blue grass
Alkali sacaton (*Sporobolus airoides*)

Inland saltgrass
Scratchgrass (*Muhlenbergia asperifolia*)
Mat muhly (*Muhlenbergia richardsonis*)

Weed Suppression Mix (recommendations from Comstock Seed Company and NRCS)

Kentucky bluegrass
Siberian wheatgrass VAVILOV*
Streambank wheatgrass SODAR
Great Basin wildrye MAGNAR
Slender wheatgrass Revenue*
Cereal rye Fall V.N.S.
Creeping wildrye*
*Salt tolerant

OR Planting Considerations

1. Control noxious weeds to less than 5 percent before planting.
2. Willows and cottonwoods may be appropriate in swales and relict channels if poles can be planted to the depth of the summer water table. Know the depth of the summer water table before planting!
3. Buffaloberry, Woods rose, and golden currant are excellent choices for planting in swales and relict channels where topographic low position captures overland flow resulting in moist soil conditions in spring. Moist soil conditions in swales and relict channels should increase the survival of plantings and increase the potential for natural recruitment in the future.
4. To maximize survival, irrigate planting holes the day before planting for buffaloberry, Woods rose, and golden currant. Flood irrigation of the swale may be a suitable alternative if water is available. Supplemental irrigation the first season is mandatory, and it may be needed the second growing season.
5. Seeding can occur any time of the year if seeds are incorporated into the soil surface to a depth no deeper than ½ inch. Generally, however, if the no till-broadcast seeding method is used, seeding is best conducted during the fall or late winter rather than in the spring because fall/late winter planting allows seeds and plants to take advantage of peak soil moisture conditions and minimize predation of seeds by wildlife.
6. Exclude livestock for 3-5 years after planting. Plants need sufficient time to establish vigorous roots, which is an important attribute in floodplain communities. Woody plants need to grow to 4 feet or taller, beyond the reach of browsing animals, or have enough exterior stems to protect the interior stems. Once riparian trees and shrubs have become established, avoid summer grazing or use rest-rotation sequence such as 3 years off and 2 years on.

6.3 Big Sagebrush Shrub

Site Description

The BSS community consists of sagebrush and mixed sagebrush-rabbitbrush habitats that typically may include a grass understory. These sites are above the floodplain and transition into xeric shrub habitats. BSS habitats are not on a geomorphically active surface, so natural recruitment of cottonwoods does not occur. Old swales and channels are rare in the BSS community, limiting opportunities to establish riparian vegetation. Instead, enhancement efforts should focus on improving productivity of this community type.



USFWS Property (managed by Ft. Churchill State Park) East of Buckland Station

Desirable Conditions

- Mix of young and old age classes of shrubs
- Perennial grasses
- Minimal presence of noxious weeds

Common Problem Conditions

1. Imbalance of age classes; decadent sagebrush
2. Low diversity
3. Weeds, including perennial pepperweed, hoary cress, spotted knapweed (*Centaurea stoebe* (formerly *C. maculosa*), and thistles

Enhancement Opportunities

1. Change in Grazing System to promote native grasses and forbs
2. Change in Grazing System to prevent spread of weeds
3. Weed management with seeding
4. Change in seral stage
5. Sagebrush thinning

BSS Desired Species List

Shrubs

Basin sagebrush
Rubber rabbitbrush
Threadleaf rabbitbrush*
Four wing saltbush (*Atriplex canescens*)
Desert peach (*Prunus andersonii*)
Quailbrush saltbush (*Atriplex lentiformis*)

Grasses

Creeping wildrye *
Great Basin wildrye

Indian ricegrass
Alkali sacaton *
Bluebunch wheatgrass (*Pseudoroegneria spicata*)
Thurber needle grass (*Achnatherum thurberianum*)

Weed Suppression Mix (recommendations from Comstock Seed Company and NRCS)

Indian ricegrass Rimrock*
Squirrel tail*
Inland saltgrass*
Great Basin wildrye MAGNAR*
Alkali sacaton VNS*
Quailbrush saltbush*
Fourwing saltbush*

**Salt/alkali tolerant*

6.4 Wetland (W)

Site Description

Wetland communities in the Plan Area were generally found in swales and depressions within the OR community. Species diversity was generally low. Wetlands that were inundated or saturated through the summer supported emergent marsh vegetation such as bulrush and narrowleaf cattail (*Typha latifolia*). Wetlands that dried down in early summer were dominated by Baltic rush and spikerush. Saline wet meadows occurred in salt-alkali affected soils dominated by inland saltgrass. At Fort Churchill River Ranches, cocklebur was found in abundance within wetlands. Sedges such as Nebraska sedge were rare.



Ft. Churchill State Park, Horse Camp

Desirable Conditions

- Dominance of native plants
- Minimal presence of noxious weeds

Common Problem Conditions

- Weeds including perennial pepperweed, tamarisk, and cocklebur
- Overutilization by cattle
- Cattle hoof disturbance causing early dry-down

Enhancement Opportunities

1. Weed management in combination with weed suppression seed mix
2. Supplemental plantings
3. Recontoured or deepened to create varied wetland habitat

Weed Suppression Mix (recommendations from Comstock Seed Company and NRCS)

Baltic rush
Alkali sacaton VNS
Creeping red fescue Boreal (*Festuca rubra*)
Inland saltgrass
Intermediate wheatgrass Reliant
Creeping wildrye
Alkali bulrush
Three-square bulrush (*Scirpus americanus*)

For Saline Wet Meadow

Alkali sacaton VNS
Tall fescue Fawn
Inland saltgrass
Basin wildrye MAGNAR
Wheatgrass western ROSANA
Nebraska sedge
Creeping wildrye

6.5 Technical Resources

Hoag 2007: *How to Plant Willows and Cottonwoods for Riparian Restoration*, NRCS Technical Note TN Plant Materials No. 32, January 2007 revision.

NRCS Plant Web Site (plant identification, life history characteristics, forage value, photographs, propagation methods, etc.) <http://plants.usda.gov/>

NRCS Plant Material Web Site (planting methods)
<http://plant-materials.nrcs.usda.gov/technical/publications/seedplant-pubs.html#TN>

NRCS Technical References Web Site (various technical reports including how to install monitoring wells)
<http://soils.usda.gov/technical/>

NRCS Riparian/Wetland Project Information Series for design criteria and planning considerations
<http://plant-materials.nrcs.usda.gov/technical/riparian/riparianwetlandtools.html>

Intermountain Planting Guide AG510 2001. Available at
http://extension.usu.edu/files/publications/publication/pub__7717229.pdf

Livestock Grazing Guidelines for Controlling Noxious Weeds in the Western United States. By Jason C Davison, Ed Smith, and Linda M. Wilson. 2006. Available at
<http://www.cnr.uidaho.edu/rx-grazing/Guidelines.htm>

Riparian area management: Grazing management processes and strategies for riparian-wetland areas.
Technical reference 1737-20. Published by BLM. 2006. Available at
<http://www.blm.gov/nstc/library/techref.htm>

7.0 Monitoring

A number of measurements could be used to assess the success of the Plan. A variety of vegetation community measurements are available. Proper Functioning Condition (PFC) assessments offer a methodology for comparing the functions of stream/riparian areas to their potential. Alternatively, the numbers and types of wildlife species utilizing the river communities could be used both to design and assess the success of the Plan. Specifically, since the needs of many wildlife species utilizing the area are understood, the Plan can be designed to include elements that will benefit desired species and to increase overall species diversity. Species or groups of species could be considered Indicator Species, or Target Species. Their presence or population trend in the area would provide an indication of the effectiveness of the restoration effort. Use of these species or groups requires the collection of baseline data (species composition and numbers) under current conditions, and subsequent post-project monitoring. A number of monitoring methods are again available. Both point counts and more general surveys have been used to monitor wildlife on the Carson River. Transect routes and breeding bird surveys could also be used. The Great Basin Bird Observatory has published an “Instructional Package and Protocol for Point Count Surveys” (Great Basin Bird Observatory 2003). The following provides a list of potential indicator species that could be used to guide the direction and monitor the success of the Plan effort.

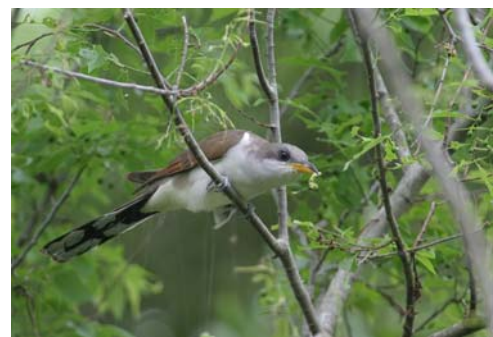
As noted in Chapter 3.0, Desired Habitat Conditions, not all wildlife species would respond to habitat improvements at the same rate. Species such as the Yellow Warbler and Song Sparrow may be expected to respond to increases in willow habitat adjacent to aquatic sites fairly quickly, in part because willows are capable of rapid growth. Species dependant on slower-growing species, or on complex habitats that require long periods of time to develop, will respond to enhancements to these habitat types only as they develop and mature. Yellow-breasted Chats, as noted in Chapter 3.0, may not respond to increased buffaloberry habitat until dense groves have become established, and Yellow-billed Cuckoos may not recolonize areas until large stands of gallery cottonwood forest have developed.

Avian Species

Due to their often specific habitat requirements, active habits, and vocal song, birds represent a useful measure of habitat type and quality.

Mature Gallery Forest Species

The Yellow-billed Cuckoo is identified as a riparian obligate that requires large, dense cottonwood-willow tracts (Neel 1999). Yellow-billed Cuckoos typically forage in the cottonwood canopy, but nesting almost always occurs in willows. Accordingly, Yellow-billed Cuckoos require a multistoried riparian habitat (Neel 1999). Chisholm and Neel (2002) note that the Yellow-billed Cuckoo has suffered serious declines in western Nevada due to the loss of riparian habitat. They note that in the early 1940s, Alcorn (1988) regularly reported the species in the Lahontan Valley (located below Lahontan Reservoir). Since 1946, however, only six



Yellow-billed Cuckoo
Martin Meyers, <http://SierraBirdbum.com>

records of Yellow-billed Cuckoos have been reported in the valley. Yellow-billed Cuckoos have, however, been recorded almost annually “in the cottonwood floodplain forest at the upper end of Lahontan Reservoir just outside of the Lahontan Valley” (Chisholm and Neel 2002). As of 2002, this area was described as “the only known site for cuckoos in northern Nevada” (Chisholm and Neel 2002). Optimal habitat for Yellow-billed Cuckoos is riparian habitat greater than approximately 200 acres in size and wider than 1,900 feet (Laymon and Halterman 1989). The presence of Yellow-billed Cuckoos would be considered an indicator of a good condition gallery cottonwood forest. Documented continued occurrence of this species at a location(s) along the river would be an indication that high-quality riparian habitat exists or has been created in the area. Because the species does require large blocks of gallery cottonwood forest, however, occurrence along the river remains a rarity and the species would not be expected in the smaller areas of cottonwood forest that occur along most of the Middle Carson. None-the-less, as Neel (1999) notes, “all the necessary elements seem to be in place to assist Nevada State Parks in expanding what appears to be suitable Yellow-billed Cuckoo habitat on the Carson River while impacting only a minimum of special interests.”

Riparian Indicator Species

The *Atlas of the Breeding Birds of Nevada* (Floyd et al. 2007) states that 89 percent of atlas blocks on which Yellow-breasted Chats were recorded involved riparian or similar habitat. Both the atlas and Ryser (1985) note Yellow-breasted Chats are more common in the eastern than the western part of the Great Basin. Baicich and Harrison (1997) state that nesting occurs in “thick, tangled growth on woodland edge, old pastures, stream, pond and swamp edges, hedgerows and scrub county.” The *Nevada Partners in Flight Bird Conservation Plan* notes that Yellow-breasted Chats “prefer shrubs with strong twig support, i.e.



Yellow-breasted Chat
Martin Meyers, <http://SierraBirdbum.com>

buffaloberry and Scouler’s willow (*Salix scouleriana*). They are not as likely to be found in sandbar willow with twigs that are weak and flexible” (Neel 1999). Chisholm and Neel (2002) state that “the Yellow-breasted Chat is very sensitive to habitat change and is particularly intolerant of the degradation and removal of the willow-buffaloberry mid-story in riparian corridors.” These authors note the replacement of the riparian mid-story on the lower Carson River by Russian olive may account for the absence of breeding Yellow-breasted Chats. This latter point suggests one action that could be taken to improve habitats on the Middle Carson may be the replacement of Russian olive with native willows other than sandbar willow and with buffaloberry, or at least the encouragement of these two habitat types. It also suggests the presence of Yellow-breasted Chats is probably an indicator of good multi-story riparian condition.

The Yellow Warbler is generally considered an indicator of a good willow community. Yellow Warblers most often are associated with willow habitats in a wide variety of situations but will nest in other vegetation types, including some non-riparian areas (Floyd et al. 2007). Yellow Warbler nests are located in shrubby growth bordering water courses, in wet scrub, gardens, and berry patches. Nests are usually low but may be as high as 40 feet above the ground (Baicich and Harrison 1997). Creation of multi-story riparian habitat and/or creation or enhancement of riparian shrub (willow) habitat would benefit Yellow Warblers. Since creating multi-story gallery forest on much of the Middle Carson River may be more ideal than practical, the Yellow Warbler would be a good choice as an indicator of healthy riparian habitat (i.e., willow stands) throughout most or all of the Plan area.



Yellow Warbler
Martin Meyers, <http://SierraBirdbum.com>

The Wilson's Warbler, a Partners in Flight Priority Species, is a common spring migrant in the area, typically passing through the lower elevation areas of western Nevada in May and into June. The only confirmed breeding in Nevada has been reported at higher elevations in the Carson Range (Floyd et al. 2007). Preferred breeding habitat is stream or lakeside willow and alder riparian vegetation in montane environments (Floyd et al. 2007; Neel 1999; Ryser 1985). Such habitat is also used during migration, and Wilson's warblers would be expected to utilize shrubby riparian habitats along the Middle Carson River as they pass through the area during migration.

Warbling Vireos breed in both mountain forests and riparian habitat. Floyd et al. (2007) found Warbling Vireos throughout Nevada, but most confirmed breeding records were from mountain sites. Baicich and Harrison (1997) state Warbling Vireos typically nest high in trees, including large deciduous trees and mature riparian woodlands. Floyd et al. (2007) state that "this species' association with riparian gallery forests and its apparent sensitivity to riparian habitat change suggest that it may be a useful species for monitoring riparian restoration projects or for evaluation riparian habitat conditions."



Warbling Vireo
Martin Meyers, <http://SierraBirdbum.com>



Black-headed Grosbeak
Martin Meyers, <http://SierraBirdbum.com>

large riparian trees such as cottonwoods, but they will nest in scattered trees found in urban and agricultural settings, especially where water is available (Floyd 2007). The oriole's nest is pendant, suspended from twig forks. Black-headed Grosbeaks and Bullock's Orioles might be used as a secondary indicator, or an indicator of moderate riparian condition with deciduous trees.

More common species that breed in riparian habitats along the Carson River include Black-headed Grosbeaks (*Pheucticus melanocephalus*) and Bullock's Orioles (*Icterus bullockii*). Black-headed Grosbeaks are a wide-ranging species that also breed in pinyon-juniper and mountain mahogany habitats (Linsdale 1936, in Floyd 2007). Black-headed Grosbeaks often nest in thickets and trees along streams and floodplains, as well as in more open situations (Baicich and Harrison 1997).

Bullock's Orioles typically nest in



Bullock's Oriole
Martin Meyers, <http://SierraBirdbum.com>

Robin Wilson of the Lahontan Audubon Society and Nevada Important Bird Area Program noted Willow Flycatchers would be a good indicator for dense canopy willow along the river and that the Western Wood-pewee (*Contopus sordidulus*) could be used as an indicator for willow habitat in lowland riparian systems (Robin Wilson, personal communication, June 2010). The subspecies of Willow Flycatcher that would be expected to breed in western Nevada (*Empidonax traillii adastus*) typically breeds in shrubby riparian vegetation in areas that include at least some surface water and areas of saturated soil (Bombay et al. 2000). Floyd et al. (2007) state that breeding by Willow Flycatchers is a rarity in Nevada, with most records coming from the southern part of the state. These authors note, however, that given suitable habitat, breeding is possible throughout the state. Floyd et al. (2007) note that most recent Western Wood-pewee breeding records in Nevada have been reported in mountain or riparian habitat. These authors state that widespread breeding was reported only in the Carson Range in western Nevada but note that western wood-pewees are known to breed in lowland riparian areas in other parts of their range.

Song Sparrows occur in willow stands, emergent vegetation, and brushy habitats adjacent to wetlands. Song Sparrows nest in "low shrubby growth and thickets in a variety of habitats, but most often in moist or swampy places" (Baicich and Harrison 1997). The species is usually more common than Yellow Warblers and could be used as an indicator species either alone or as part of a wetland and/or riparian species guild.



Song Sparrow
Martin Meyers, <http://SierraBirdbum.com>

Lazuli Buntings also occupy riparian habitats, including willow stands, along the Carson River. The species has also been reported in willow habitats along irrigation ditches (Chisholm and Neel 2002). Nesting occurs in trees and shrubby growth along streams or on nearby hillsides (Baicich and Harrison 1997).

Cavity Nesters

A number of species nest in woodpecker cavities excavated in trees or in nest boxes (artificial cavities). Both Northern Flickers and Downy Woodpeckers (*Picoides pubescens*) occur along the Middle Carson River and excavate nest cavities in cottonwood trees. Other cavity nesting species that occur along the river include Wood Ducks (*Aix sponsa*), American Kestrels (*Falco sparverius*), Western Screech-owls (*Otus kennicottii*), House Wrens, Western Bluebirds, Tree Swallows, and Violet-green Swallows (*Tachycineta thalassina*). These species could be considered together as a guild of species requiring the presence of nest cavities (either natural or artificial).

Northern Flickers may occur “almost anyplace that has a dead tree or two” (Floyd et al. 2007) but may be impacted by the felling of dead or hazard trees. The Nevada Breeding Bird Atlas indicates that 26 percent of breeding Northern Flickers were found in riparian habitat (Floyd et al. 2007). The species is a more common breeder at higher than at lower elevation sites. Floyd et al. (2007) identify the Downy Woodpecker, a second woodpecker species, as “a bird of deciduous or mixed deciduous-conifer forest....typically found near rivers or other waterways.” These authors state the range of the species is restricted by the availability of old dead trees and tree limbs for nest sites.

Wood Ducks require large trees near stream and rivers. The species is known to nest along the Carson River, including along the Middle Carson (Floyd et al. 2007). Wood Ducks may benefit from appropriately placed nest boxes.

American Kestrels are a cavity-nesting species that requires previously excavated tree cavities, nest boxes, or crevices (Floyd et al. 2007). Floyd et al. (2007) note that the largest number of American Kestrel breeding records came from riparian habitats, probably because these areas included tree cavities and nearby foraging habitat. Floyd et al. (2007) note that Western Screech-owls were also most commonly found in riparian habitat. These authors note that the breeding habitat of Western Screech-owls is varied but that riparian and other deciduous woodlands are most commonly used. Western Screech-owls will utilize nest boxes.

House Wrens are a cavity nester often found in deciduous tree habitats, including along river corridors. House Wrens would be expected to occur in areas that include cottonwoods or other trees with nest cavities or where artificial nest boxes have been installed.

The Western Bluebird is an obligate cavity nester found in open woodlands with mature trees in proximity to open foraging space (Neel 1999). Floyd et al. (2007) state that in western Nevada, Western Bluebird breeding was confirmed only in the Carson Range and along adjoining river systems. Breeding has been confirmed on the Middle Carson River. Neel (1999) states that Western Bluebirds breed from the east slope of the Sierra Nevada, with “small breeding populations follow the cottonwood riparian zones down the Truckee, Carson, and Walker Rivers almost to their respective termini.” Western Bluebird populations can be impacted by competition with European starlings (*Sturnus vulgaris*). Western Bluebirds may benefit from the installation of nest boxes.



Western Bluebird
Martin Meyers, <http://SierraBirdbum.com>



Western Bluebird
Martin Meyers, <http://SierraBirdbum.com>

Chisholm and Neel (2002) identify the Tree Swallow as a common migrant but rare breeder in the Lahontan Valley. These authors state that the Violet-Green swallow is absent as a breeder in the Lahontan Valley. Both species may benefit from the installation of nest boxes.

Bank Nesters

Two species of swallow, the Northern Rough-winged Swallow (*Stelgidopteryx serripennis*) and the Bank Swallow nest in at least low numbers in cavities in vertical banks. The presence of these species would be an indication of stable vertical or near-vertical banks. Floyd et al. (2007) state that just over half of the Nevada Breeding Bird Atlas records for Northern Rough-winged Swallow were from riparian habitat. The Nevada Partners in Flight Bird Conservation Plan (Neel 1999) notes that the Bank Swallow is generally regarded as a riparian species, but that a dependence on riparian vegetation has not been demonstrated. Belted Kingfishers (*Ceryle alcyon*) represent another species that nests in vertical to near-vertical stream banks.

Emergent Marsh Nesters

Marsh Wrens build domed nests attached to cattails and bulrushes in marshes. Chisholm and Neel (2002) state that in the nearby Lahontan Valley, “almost no tule or cattail patch is too small to hold at least one Marsh Wren.” Common Yellowthroats nest in low undergrowth near water, with the nest located close to the ground or over water (Baicich and Harrison 1997). Floyd et al. (2007) state that the Common Yellowthroat nests almost exclusively in low, moist vegetation, which, in Nevada, exists almost exclusively in riparian and wetland areas. Marsh Wrens, Common Yellowthroats, and Song Sparrows could be used as an indicator of emergent vegetation habitat types.

While supplemental water for irrigation of wetland or riparian vegetation species may be unavailable, nesting by Marsh Wrens and Common Yellowthroats as well as Song Sparrows may be encouraged locally through creation of excavated areas adjacent to the river's channel or in old oxbows. In addition to willows and possibly cottonwoods, emergent herbaceous vegetation such as cattails or bulrush (*Scirpus* sp.) may become established in excavated sites. Areas of emergent vegetation were also found behind existing dikes in the Carson River Ranches area.

Upland Shrubland Nesters

Upland areas adjacent to the river support sagebrush, salt desert scrub, and altered (primarily agricultural) communities. Brewer's Sparrows (*Spizella breweri*) are often used as an indicator species in sagebrush habitat. The *Nevada Breeding Bird Atlas* (Floyd et al. 2007) identifies the Brewer's Sparrow as a sagebrush specialist but states the species is also "one of the few species commonly found in salt desert scrub." The Black-throated Sparrow (*Amphispiza bilineata*) is another species that occupies salt desert scrub habitats (Floyd et al. 2007). Sage Sparrows (*Amphispiza belli*) also may occur in both sagebrush and salt desert scrub habitat types (Floyd et al. 2007). Horned Larks (*Eremophila alpestris*) occur in salt desert scrub habitat but may be found "just about anywhere without trees" (Floyd et al. 2007). More specifically, Horned Larks are often found in open to barren habitats, and as such would not be a good indicator of improved habitat conditions in the area.

Reptile Species

Western Pond Turtle

The Western Pond Turtle (*Actinemys* [formerly *Clemmys*] *marmorata*) is described as a "thoroughly aquatic turtle of ponds, marshes, rivers, streams and irrigation ditches" (Stebbins 1985). Considered common on the Carson and Truckee Rivers at the turn of the century, the species is now rarely observed. Surveys conducted as a part of the *Middle Carson River Assessment* documented a few Western Pond Turtles on the river in Carson Valley and one individual in backwater habitats in Dayton State Park (Otis Bay 2008). The 2008 assessment stresses the importance of backwater habitats and oxbows, and notes channelization destroys potential Western Pond Turtle habitat. Woody debris such as downed logs as well as vegetation mats, rocks, and banks are used as basking sites. Nests are excavated in sandy ground or in meadows with silty or clay soils. Hibernation is reported to occur in bottom mud and in deep litter (Hays et al. 1999; Nussbaum et al. 1983; Reese 1996; Stone 2009).

Amphibian Species

Northern Leopard Frog

The Northern Leopard Frog may occur in such varied habitats as freshwater sites with profuse vegetation to brackish marshes and moist fields and from desert to mountain meadow habitats (Behler and King 1979). Vegetation structure seems to be more important in habitat selection than species composition (Beauregard and Leclair 1988). In western Montana, Miller (1978) found Leopard Frogs usually occurred in valley habitats, as opposed to the more mountainous areas generally preferred by Spotted Frogs (*Rana luteiventris*). The Leopard Frog is known to be very mobile and is capable of nocturnal excursions of 330 feet or more. However, these frogs rarely move more than 33 feet away from their home range, estimated to vary between 730 and 5,400 square feet (Beauregard and Leclair 1988). In his Montana study, Miller did not find Leopard Frogs more than 66 feet from water.

Leopard Frogs may occur in ponds, oxbows, sloughs, and other slow waters along the Middle Carson River. The 2008 *Middle Carson River Assessment Report* notes that Northern Leopard Frogs were once the most common amphibian species in the waterways of northern Nevada, including the Carson River (Otis Bay 2008). Yet surveys conducted as a part of the 2008 assessment found only isolated populations on the river. Several areas of potential habitat were also identified. Northern Leopard Frogs are subject to predation by introduced Bullfrogs (*Rana catesbeiana*), a species which has been found throughout the Carson River system (Otis Bay 2008).

Recent surveys indicate both the Western Pond Turtle and Northern Leopard Frog are currently rare along the Middle Carson River. Western Pond Turtles have been observed at Dayton State Park. Oxbow habitats in the River Ranch sections of Fort Churchill State Historic Park represent suitable habitat for both species, particularly Northern Leopard Frogs. Protected and enhanced, these habitats represent sites that could serve as restoration habitats for at least northern Leopard Frog populations. The lack of perennial water in the lower reaches of the river compounds efforts to restore Western Pond Turtle populations.

8.0 Funding Sources

Funding for projects and programs are available from a wide variety of sources including federal, state and local agencies and private foundations and businesses. Contact information for these sources and other potential sources is included below.

Federal Sources

Environmental Protection Agency

The USEPA is a significant source of funding for watershed for projects involving river restoration, education and outreach and wetland protection.

EPA Five Star Restoration Program brings together students, conservation corps, other youth organizations, citizen groups, corporations, landowners and government agencies to provide environmental education through projects that restore streambanks and wetlands. The program provides challenge grants, technical support, and opportunities for information exchange to enable community-based restoration projects. The program's objective is to engage five or more partners in each project to contribute funding, land, technical assistance, workforce support or other in-kind services that match the program's funding assistance. Consideration for funding is based upon the project's educational and training opportunities for students and at-risk youth, the ecological benefits to be derived, and the project's social and economic benefits to the community. EPA's funding levels are modest, averaging about \$10,000 per project. However, when combined with the contributions of partners, projects that make a meaningful contribution to communities become possible. Since FY99, over 250 projects have been selected from 1,000 applications. On average, for each dollar of sponsor funds, five additional dollars in matching contributions will be provided by restoration partners in funding, labor, materials, equipment or in-kind services.

<http://www.epa.gov/owow/wetlands/restore/5star/02factsheet.html>

Army Corps of Engineers

U.S. Army Corps of Engineers, Sacramento District established the Sacramento District Wetlands Conservation Fund (Fund). The Fund collects monies generated from wetland mitigation, and enforcement and compliance actions associated with Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act and. Monies would be dispensed selected projects that rehabilitation, re-establishment, establishment, enhancement, or in exceptional circumstances preservation of wetlands and other aquatic resources, and their associated habitats. Federal, State and Local government agencies, Tribe, private non-profit and for-profit organizations, Individuals, community groups, and educational institutions are eligible to apply. Currently, no funds are available for the Carson River Watershed, but funds may be available in the future as monies are collected.

Natural Resource Conservation Service (NRCS)

The NRCS manages two programs that may provide sources of funding for conservation programs implemented by landowners or producers of livestock, agricultural or forest products. The Environmental Quality Incentives Program (EQIP) is a program that provides financial and technical assistance to agricultural producers through contracts up to a maximum

term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. Owners of land in agricultural or forest production or persons who are engaged in livestock, agricultural or forest production on eligible land and that have a natural resource concern on the land may participate in EQIP.

A second program, the Wildlife Habitat Incentive Program (WHIP) is a program for conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Indian land. The NRCS administers WHIP to provide both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat.

Information about these two programs is available at:

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial>

State of Nevada Sources

Nevada Division of Environmental Protection - 319 Program

NDEP disperses the federal CWA 319 program funding. This is a crucial funding source for many of the project and programs that are implemented in the watershed. Funded projects include river restoration, watershed coordinator positions, and outreach and education.

Information about this program can be found at: <http://ndep.nv.gov/bwqp/nps319h.htm>

Local Sources

Carson Water Subconservancy District

The CWSD provides funding for a variety of projects and programs including river rehabilitation, noxious weed abatement and education and outreach. Funds are allocated each year by the CWSD Board of Directors. CWSD funds can be used as match for federal and other sources of funding.

The CWSD web site can be found at: <http://www.cwsd.org/newcms/Userpages/index.aspx>

Carson-Truckee Conservancy District

The CTCD provides funding for a variety of projects and programs including river rehabilitation, noxious weed abatement and education and outreach. The district can be contacted through the City of Reno's web site at: <http://reno.gov/Index.aspx?page=1968>

Landowner Contribution

Without the support of landowners (including the Counties) and in-kind matches that they provide many of the river projects could not be conducted.

8.1 Other Potential Funding Sources

In addition to the above listed funding sources, the following sources should also be investigated. Federal Emergency Management Agency (FEMA): <http://www.fema.gov>

Farm Service Agency (FSA): <http://www.fsa.usda.gov>

U.S. Bureau of Reclamation (USBR): <http://www.usbr.gov>

U.S. Bureau of Land Management (BLM): <http://www.blm.gov/wo/st/en.html>;
Nevada BLM web site: and <http://www.blm.gov/nv/st/en.html>.

Private Foundations

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