



# Lower Colorado River Multi-Species Conservation Program

*Balancing Resource Needs*

## Palo Verde Ecological Reserve Restoration Development Plan: Phase 2



December 2006

# Lower Colorado River Multi-Species Conservation Program Implementation Steering Committee Members

## **Federal Participant Group**

Bureau of Reclamation  
Fish and Wildlife Service  
National Park Service  
Bureau of Land Management  
Bureau of Indian Affairs  
Western Area Power Administration

## **Arizona Participant Group**

Arizona Department of Water Resources  
Arizona Electric Power Cooperative, Inc.  
Arizona Game and Fish Department  
Arizona Power Authority  
Central Arizona Water Conservation District  
Cibola Valley Irrigation and Drainage District  
City of Bullhead City  
City of Lake Havasu City  
City of Mesa  
City of Somerton  
City of Yuma  
Electrical District No. 3, Pinal County, Arizona  
Golden Shores Water Conservation District  
Mohave County Water Authority  
Mohave Valley Irrigation and Drainage District  
Mohave Water Conservation District  
North Gila Valley Irrigation and Drainage District  
Town of Fredonia  
Town of Thatcher  
Town of Wickenburg  
Salt River Project Agricultural Improvement and Power District  
Unit "B" Irrigation and Drainage District  
Wellton-Mohawk Irrigation and Drainage District  
Yuma County Water Users' Association  
Yuma Irrigation District  
Yuma Mesa Irrigation and Drainage District

## **Other Interested Parties Participant Group**

QuadState County Government Coalition  
Desert Wildlife Unlimited

## **California Participant Group**

California Department of Fish and Game  
City of Needles  
Coachella Valley Water District  
Colorado River Board of California  
Bard Water District  
Imperial Irrigation District  
Los Angeles Department of Water and Power  
Palo Verde Irrigation District  
San Diego County Water Authority  
Southern California Edison Company  
Southern California Public Power Authority  
The Metropolitan Water District of Southern California

## **Nevada Participant Group**

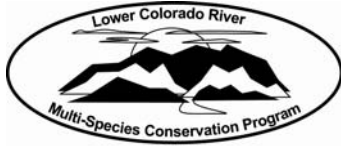
Colorado River Commission of Nevada  
Nevada Department of Wildlife  
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Basic Water Company

## **Native American Participant Group**

Hualapai Tribe  
Colorado River Indian Tribes  
The Cocopah Indian Tribe

## **Conservation Participant Group**

Ducks Unlimited  
Lower Colorado River RC&D Area, Inc.



# **Lower Colorado River Multi-Species Conservation Program**

## **Palo Verde Ecological Reserve Restoration Development Plan: Phase 2**

Lower Colorado River  
Multi-Species Conservation Program Office  
Bureau of Reclamation  
Lower Colorado Region  
Boulder City, Nevada  
<http://www.lcrmscp.gov>

December 2006

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# Acronyms and Abbreviations

GBBO	Great Basin Bird Observatory
HCP	Habitat Conservation Plan
LCR	Lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
NAU	Northern Arizona University
PVER	Palo Verde Ecological Reserve
Reclamation	Bureau of Reclamation
SWFL	Southwestern willow flycatcher
YBCU	Yellow-billed cuckoo

# Background

Palo Verde Ecological Reserve (PVER) encompasses 1,352 acres of Colorado River historic floodplain near Blythe, California. Formerly, the property was known as the Riverview Ranch and was owned by the Travis family. The ranch was acquired by the Trust for Public Lands in the beginning of 2004. On September 3, 2004 the property was conveyed to the State of California. California has identified up to approximately 1,100 acres of active agricultural lands on this property for habitat restoration for the Lower Colorado River Multi-Species Conservation Program (LCR MSCP).

As part of the LCR MSCP, the California Department of Fish and Game (CDFG) and the Bureau of Reclamation (Reclamation) are jointly planning the conversion of portions of PVER from agricultural crops to a mix of native plant species. After planting is complete, the created habitats are then managed for species covered under the LCR MSCP throughout the 50-year life of the program.

The proposed development of the property is shown in Figure 1. Additional site information can be found on the LCR MSCP website under a report entitled “*Palo Verde Ecological Reserve Restoration Development Plan: Overview.*” In Phase 1, during Fiscal Year 2006, 30 acres of riparian nursery were planted. Additional information on the design, planting and monitoring of Phase 1 can be found on the “*Palo Verde Ecological Reserve Restoration Development Plan: Phase 1*” which is posted on the website.

## 1.0 Purpose/Need

Phase 2 creates, develops, and maintains riparian habitat of approximately 80 acres of cottonwood-willow seral stages I, III, and IV. The area will be for southwestern willow flycatcher (SWFL) and other species covered under the LCR MSCP (LCR MSCP 2004). Phase 2 includes three sections:

- Creating cottonwood-willow habitat with known genetic stock,
- Demonstration of design and materials for moist soil/standing water areas, and
- Creating cottonwood-willow habitat using mass transplanting technique.

Each section will function as an area of riparian habitat (Figure 2).

Figure 1: Proposed Phasing Map

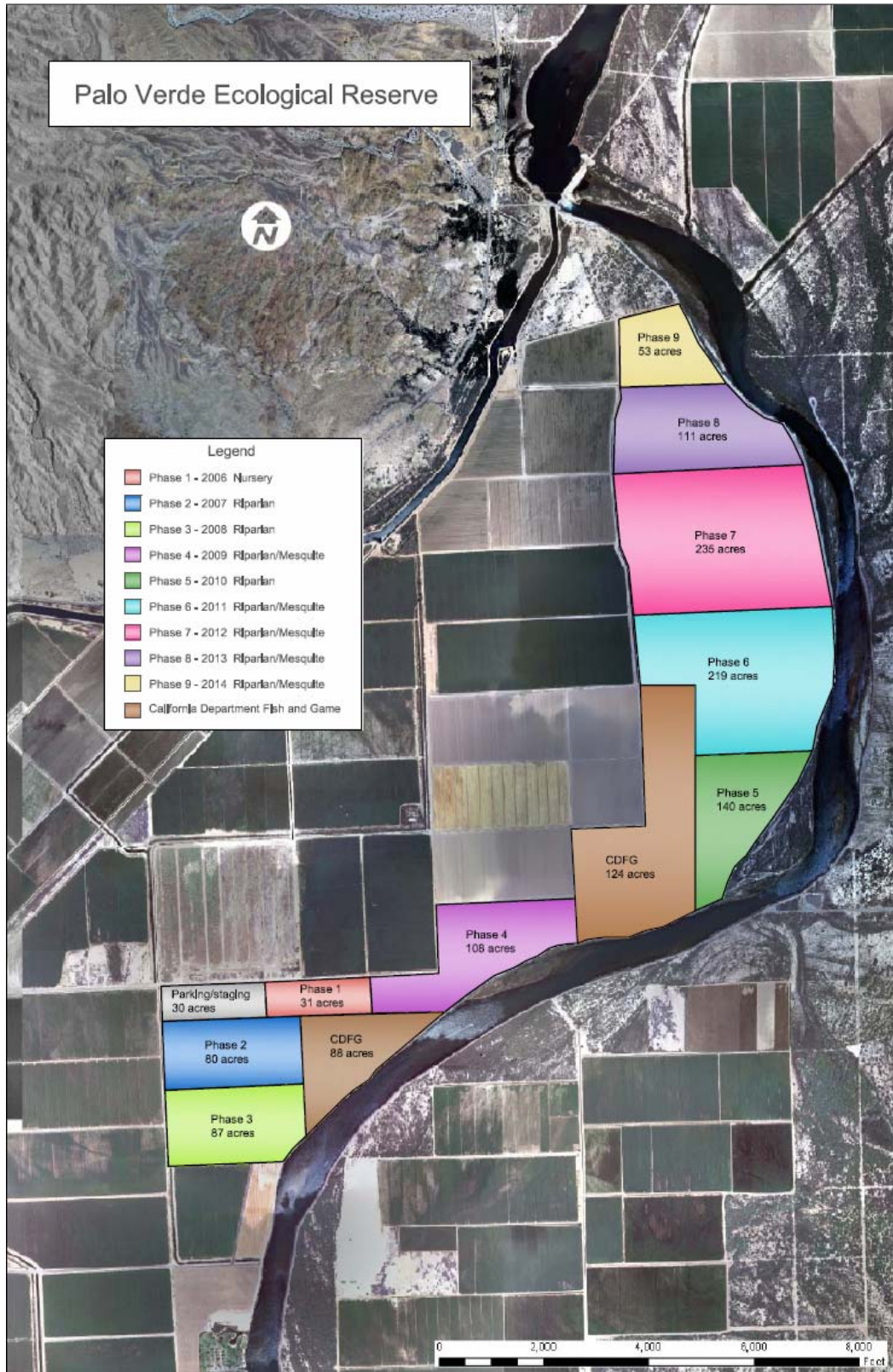
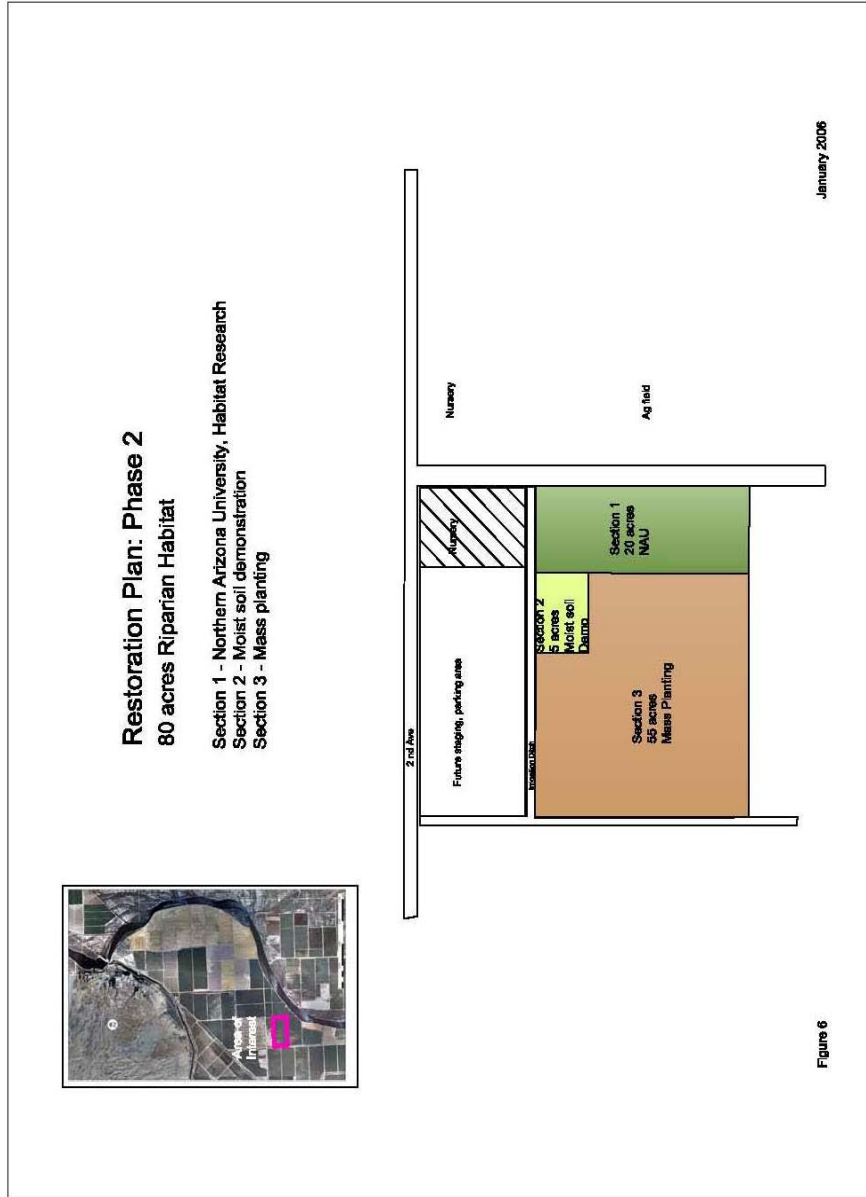


Figure 2: Phase 2 Riparian Habitat Design





## **Section 1: Northern Arizona University**

Twenty acres of cottonwood-willow landcover will be established with the intent of creating habitat using conventional tree planting techniques and utilized for research by Northern Arizona University (NAU). This project focuses on two areas: riparian species composition/density and specific/combined genotype effects, and how they influence the suite of physical habitat parameters and prey base for SWFL. The project will determine if these effects are present in co-evolved riparian communities that influence LCR ecosystems, and their importance for SWFL in the context of practical habitat creation approaches. The goals and objectives of this research are:

- Collect and propagate shoots of Fremont cottonwood (*Populus fremontii*), Goodding willow (*Salix gooddingii*), and coyote willow (*Salix exigua*) from localities along the lower Colorado River (LCR) and its main tributaries.
- Genetically screen propagated shoots of cottonwood and willow to determine if habitat/population-specific genotypes occur, and to estimate genetic diversity. If habitat or population-specific genotypes are identified, these genotypes will be planted according to their genetic similarities in order to facilitate the restoration of co-evolved communities.
- Establish mosaic plantings of cottonwood-willow consisting of different vegetation densities.
- Participate in the long-term monitoring of this site to determine how genetic and vegetation density affects the habitat restoration process and its suitability as habitat for the SWFL (and other species dependent on these riparian habitats).

## **Section 2: Demonstration Area for Moist Soil and Standing Water Products and Techniques**

Approximately 5 acres of cottonwood-willow landcover will be established with the intent of creating habitat and used to demonstrate water retention techniques and materials to create moist soil and standing water areas. This demonstration will evaluate soil amendments and containers to promote areas of moist soil and standing water. Soil amendments and/or products will be placed in small areas (approximately 25' by 50') that are shallow enough to allow flood irrigation to fill and move any residual salts out of the area (6-18"). The wet areas (amendments or containers) will range from small to medium in size and be arranged in

clusters, to create large pockets of standing or saturated soil areas. This will create areas of humidity for insect production needed for a food source for the SWFL and other covered species. Cottonwood-willow and associated riparian vegetation will be planted around the ponding areas, employing both the automated mass transplanting and conventional tree planting techniques.

### **Section 3: Mass Transplanting**

Approximately 55 acres of cottonwood-willow landcover will be established with the intent of creating habitat using automated mass transplanting. The preferred habitat parameters of the SWFL are incorporated into the design, including the maximization of the Goodding willow-coyote willow edge relationship within the mosaic of riparian vegetation. Water intensive trees and shrubs are located closest to the irrigation gates to utilize the higher amount of water around the gates. Plants with the least water requirement (*Atriplex* and mesquite) will be planted farthest away from the gates. The planting design will reflect the currently known conditions preferred by the SWFL.

## **2.0 Design/Planting Plan**

### **Section 1: Northern Arizona University**

Each study square will incorporate different vegetation densities of cottonwood and Goodding willow, which will be contiguous across the 20-acre site. There will be eighteen 1.2-acre plots within the 20-acre field site and six tree density treatment plots per block. Each block will be replicated three times with each treatment having a randomly assigned position within each block in a Latin Square design.

Coyote willow is planted at a single density of 1 plant every 2 m<sup>2</sup>. Goodding willow and cottonwood are each planted at two different densities: low (6.25 percent coverage); and high (25 percent coverage). This will result in the combination of the two tree species being planted in densities ranging from 12.5 percent coverage to 50 percent coverage.

### **Section 2: Demonstration Area for Moist Soil and Standing Water Products and Techniques**

For SWFL and other endangered species, moist soils and standing water are considered important habitat components. The soil texture in many restoration areas of PVER are sandy-silts with almost no appreciable clays. These soils do

not possess natural water holding tendencies; thus, the effectiveness of soil amendments, pond liner products, and plastic pools will be investigated for their capability to hold moisture and water.

Reclamation will investigate products for their functionality, resistance to UV damage, and practicality of installation. The products range in size from 3’ diameters/lengths to 10’ diameters/lengths. Products will be installed from 6” to 18” deep to allow irrigation water to freely flood the product and, after filling, continue to flow down the field. This action should flush salts and refresh these areas. Products may be made of plastic, concrete, rubber, or any combination of man-made or natural commercially available products.

Each product will be arranged in a configuration of three or more and placed near the irrigation gate to follow the flow patterns of the irrigation water (Figure 3). Each product and configuration will be replicated once.

Currently, the field where this demonstration will take place is planted in alfalfa. The alfalfa will be disked and the field will be prepared for planting. The trees and shrubs will be planted using the automated mass transplanting technique. Higher water usage plants/trees such as coyote willow (*S. exigua*), will be planted adjacent to the moist soil/water retention products. Goodding willow (*Salix gooddingii*) and cottonwood (*P. fremontii*) would be planted adjacent to the coyote willow (Figure 4).

### Section 3: Mass Transplanting

The remaining 55 acres are to be planted utilizing automated mass transplanting. The design reflects the current observed configuration of riparian vegetation that would be used by SWFL, and other species covered under the LCR MSCP (Figure 4). The table below lists the species to be planted:

**Table 1: Phase 2 Native Plant Species List**

Scientific Name	Common Name
<i>Populus fremontii</i>	Cottonwood
<i>Salix exigua</i>	Coyote Willow
<i>Salix gooddingii</i>	Goodding Willow
<i>Prosopis glandulosa v. torreyanna</i>	Honey Mesquite
<i>Baccharis sarothroide</i>	Desertbroom
<i>Atriplex lentiformis</i>	Quailbush
<i>Baccharis salicifolia</i>	Mule’s Fat
<i>Distichlis spicata</i>	Salt Grass

Riparian vegetative species with higher water requirements (coyote willow) would be planted nearest the irrigation gates, and vegetation species with lower water requirements (mesquite, quailbush) will be planted farthest from the irrigation gates.

Cottonwood-willow and honey mesquite will be planted in proximity to each other to create an integrated mosaic of habitats that approximate terrestrial communities historically present in the floodplain (LCR MCSP Habitat Conservation Plan). Within this mosaic, areas of standing water or moist soil and open areas (areas with ground covers and low shrubs) are to be incorporated into the design.

**Figure 3: Typical Moist Soil/Standing Water Planting Plan**

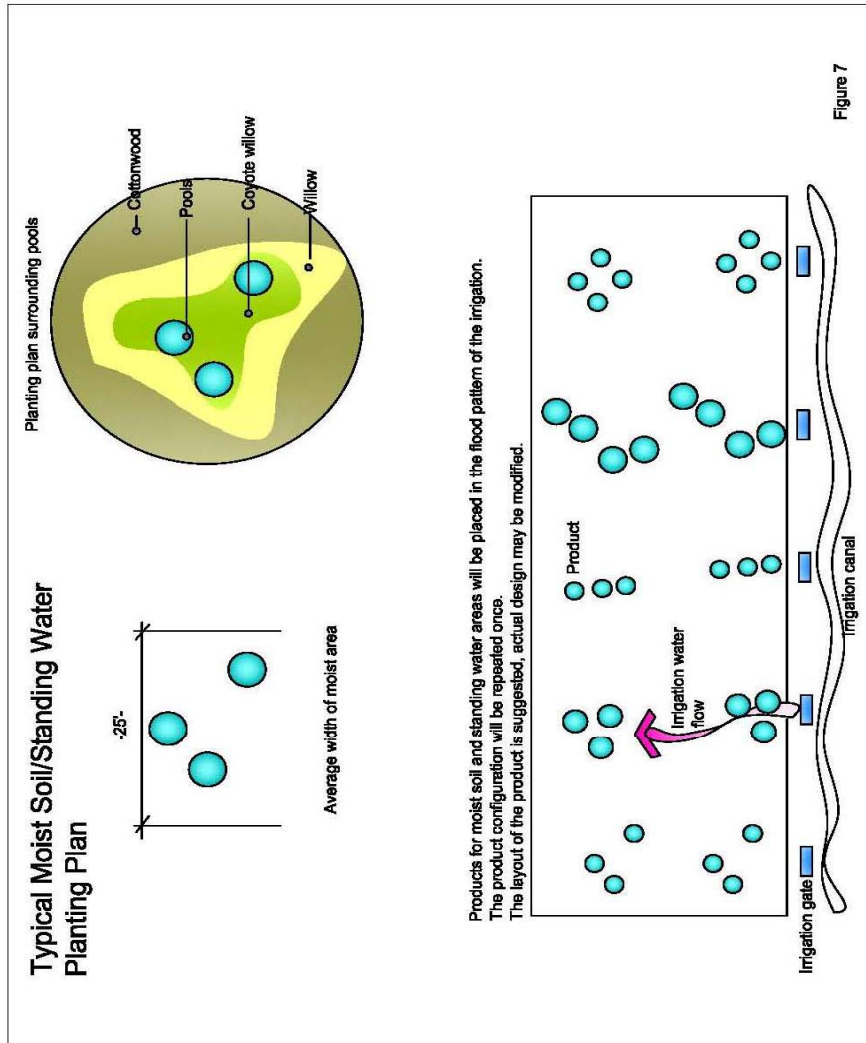
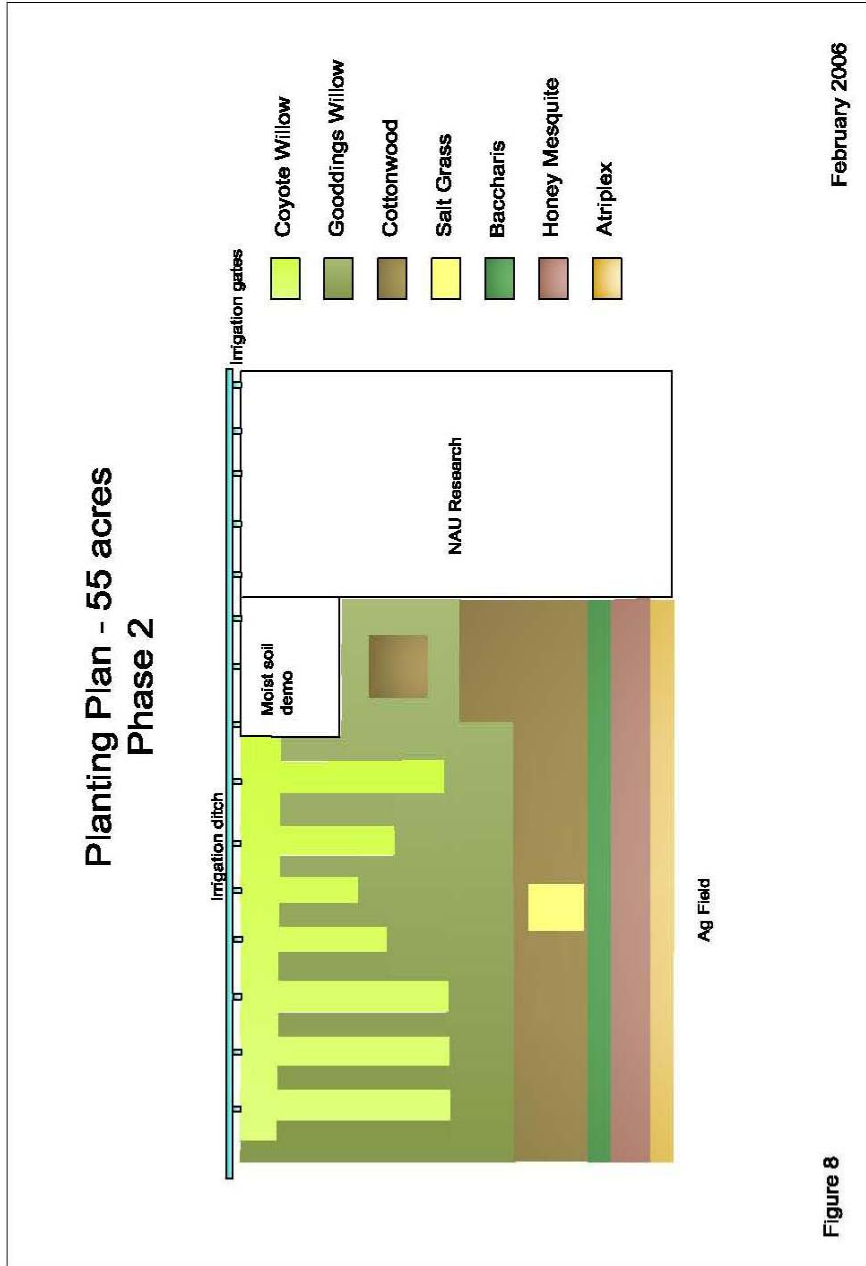


Figure 4: Mass Transplanting Plan



The field will be disked and prepared for automated mass transplanting. The cottonwood-willow will be planted at an in-line spacing of 5-6' with rows 40" apart. Coyote willow will be planted at an in-line spacing of 6' with rows 40" apart. Honey mesquite and shrubs with a lower water requirement will be planted 10' in-line spacing. Mesquite, desert broom, and quailbush will be planted on the southern edge of the site, creating a transitional edge. A cover crop of alfalfa, sterile wheatgrass, and/or a sterile wheatgrass/rye grass will be seeded prior to planting of trees and shrubs.

An approximate one-acre area in the center of the mass planting of cottonwood would be planted with salt grass (*D. spicata*), creating an open area within the tree plantings. The in-line spacing will be 1' with 38" rows. The outer edges will utilize the existing alfalfa crop for cover.

## Grading/Contouring

To achieve proper grading and contouring, the fields will be laser leveled prior to planting. Three borders will be added for efficient water delivery. Hand excavation will be utilized to place the products for moist soil demonstrations. The areas will be excavated to a depth between 6" and 18" to accommodate containers/products.

## Irrigation

The anticipated schedule for the first year is shown in Table 2. Irrigation regimes may be modified due to climatic conditions such as rain, wind, and high temperatures, or to ensure vegetation moisture requirements are met.

**Table 2: Phase 2 Irrigation Schedule**

<b>Day/Week/Month</b>	<b>Frequency</b>	<b>Comments</b>
Planting day	Immediately post planting	
Week 1-4 – April, May	Every 3 days	Or as necessary to keep root ball moist
Week 5-9	Every 5-7 days	Or as necessary to keep root ball moist
Week 10-12	Every 10 days	
Week 12 through August	Every 14 days	
September	Twice	
October	Twice	

## 3.0 Monitoring

Monitoring will be structured into four schemes:

- Predevelopment
- Implementation Monitoring
- Habitat/Species Monitoring
- Vegetation Classification

Results will be analyzed and evaluated based on thresholds and trigger points identified by reference conditions.

The goals for monitoring may be revised depending on the Adaptive Management Program results, science strategy, covered species requirements, and/or other management decisions in the future. Monitoring species will be organized in the following guilds: marshbirds, neotropical birds, cavity nesting birds, small mammals, bats, and reptiles and amphibians. SWFL, Yellow-billed Cuckoo (YBCU), and MacNeill's Sootywing Skipper will be monitored individually.

The research and monitoring for restoration described in Section 1 is being conducted by NAU. Additional monitoring may occur during implementation of project level monitoring, such as point counts; however, additional site specific monitoring will not be conducted at this time in Section 1.

### Predevelopment Monitoring

Predevelopment monitoring of Phase 2 will establish baseline data for evaluating project implementation and effects, and identify whether a covered species currently inhabits PVER. Predevelopment monitoring is divided into abiotic (soil features) and biotic (vegetation and covered species) factors

- Abiotic Monitoring
  - Soil
    - Random sample sites will be collected after plowing the existing crops and before the planting of Phase 2.
    - Samples will be analyzed for moisture, salinity, textural classification, depth to groundwater, and nutrients, including nitrate, ortho-phosphate, and ammonia.
- Biotic Monitoring
  - Vegetation Monitoring
    - Currently, PVER is all farm fields and no riparian or marsh habitat is present, therefore only *Atriplex* spp. will be surveyed and mapped.

- Avian Monitoring:
  - Marshbirds will not be monitored, as marsh habitat is not present.
  - Neotropical birds will be monitored utilizing a standardized point count protocol (GBBO 2003).
  - Cavity nesting birds will not be monitored as riparian or mesquite habitat is not present. However, point count surveys will record any avian species present during the predevelopment monitoring phase.
  - Species-specific SWFL surveys will not be conducted, as riparian habitat is not present. However, point count surveys will record any avian species present during the predevelopment monitoring phase.
  - Species-specific YBCU surveys will not be conducted, as riparian habitat is not present. However, point count surveys will record any avian species present during the predevelopment monitoring phase.
  
- Small mammal presence/absence surveys will be conducted utilizing a standardized protocol. Trapping will occur prior to the implementation of Phase 2 between late September-November 2006 and late February-May 2007. Trapping will be conducted overnight. Traps will be placed in parallel, linear transects of approximately 150 meter in length. A trap station will be located at every 10 meter along each transect. Transects will be located 10 to 15 meters apart, with the actual distance apart determined by the size of the area being surveyed. Trapping will be conducted for a minimum of 500 trap nights.
  
- Bat presence/absence surveys will be conducted utilizing active/passive AnaBat surveys at least 2 days per season (spring, summer, winter, and fall), prior to the implementation of Phase 2, beginning the spring of 2006. All AnaBat system locations will be chosen based on suitable habitat for the covered bat species and ability to maximize data collected.
  
- Amphibian and reptile monitoring will not be conducted because PVER is outside of the known range of the covered amphibian species and does not currently meet covered reptile species habitat requirements.
  
- MacNeill's sootywing skipper presence/absence surveys will be conducted if *Atriplex* spp. is located at PVER. Visual surveys will be conducted when the skipper flies, between April-October (Pollard 1977). A minimum of three surveys will be conducted.



## Implementation Monitoring

Implementation monitoring will be conducted to assess whether land cover type creation and management actions have been implemented as designed for each phase. This type of monitoring quantifies changes immediately after treatments and evaluates whether actions were implemented as prescribed (Block et al. 2001). For example, this type of monitoring will be used to determine if the planting techniques employed were effective and if the vegetation was planted according to the phase design specifications. This monitoring is focused on the habitat (biotic) and conditions therein (abiotic).

- Abiotic Monitoring
  - Soil
    - Samples will be analyzed for moisture, salinity, textural classification, depth to groundwater, and nutrients, including nitrate, ortho-phosphate, and ammonia.
    - Samples will be collected annually until the nutrient and salinity measurements are stable.
  - Water
    - Deliveries will be recorded.
- Biotic Monitoring
  - Vegetation
    - 4 to 6 weeks after planting (or after dormancy break), a subset of trees planted will be counted and an index of conditions recorded to determine initial survivorship. These data will be used to guide initial management activities, such as water use and re-planting.
    - After the first two growing seasons (2009), growth and survivorship will be sampled, utilizing transects through each phase during the dormancy period (October-January). Sample transects would be randomly determined on an annual basis. The number of sample transects will be based on several factors including patch size, restoration technique, vegetation species, and variation within each stand. Within each sample transect, every tree will be counted and recorded by species. Diameter at breast height and tree condition will be recorded for every 100<sup>th</sup> tree sampled. Percent cover will be measured at random 1 meter square plots in each transect to evaluate herbaceous and shrub plant component.

## Habitat/Species Monitoring

Effectiveness monitoring is designed to determine whether each phase is providing the habitat requirements needed for the targeted covered species, if any covered species is utilizing the habitat, and if there are differences in wildlife use of the habitat depending on planting design, composition, and watering regimes. The monitoring is divided into habitat and covered species and will be analyzed incorporating the two.

- Habitat Monitoring
  - Abiotic Conditions
    - Soil
      - Samples will continue to be analyzed annually for moisture, salinity, textural classification, depth to groundwater, and the nutrients (including nitrate, ortho-phosphate, and ammonia) until conditions are stable. When conditions reach the reference points, samples will be analyzed every 3 to 5 years. If conditions change, samples will be analyzed annually until conditions reach the reference point again.
      - Soil moisture probes will be utilized 10 times during the breeding season for SWFL, in SWFL habitat, beginning the year SWFL surveys are conducted.
      - Samples will be conducted minimally at the same site as the predevelopment monitoring.
    - Water
      - Deliveries to each phase will be recorded and analyzed to determine if the necessary amounts were delivered to grow the requisite habitat.
    - Microclimate
      - Random and strategic HOBO H8 Pro data loggers will be placed within the habitat. Data loggers record temperature and relative humidity. The number of loggers for each phase will be based on acreage of restored habitat. Data loggers will be downloaded approximately every four months. If a SWFL and/or YBCU nest is located, a data logger will be placed within 2 meters of the nest. Data loggers will be placed within the habitat in 2010.

- Biotic Conditions
  - Vegetation
    - Beginning at the end of the third growing season (2010), habitat condition will be monitored using a standardized protocol based on a nested sample plot design. Initially, habitat monitoring will occur on an annual basis (years 3 through 6). Monitoring will occur every other year between year 6 and year 10. After year 10, Phase 2 will be sampled every 5 years to monitor successional change through the LCR MSCP period. If a catastrophic disturbance (fire, flood, etc.) occurs to the stand, post disturbance monitoring will mimic the post-restoration monitoring regime.
    - Vegetation monitored will include but is not limited to: overstory trees, sapling, shrub, understory, herbaceous layer, vertical foliage density, and crown closure.
- Covered Species Monitoring
  - Marshbirds
    - Monitoring will not be conducted because no marshbird habitat will be restored.
  - Neotropical Birds
    - A standardized point count protocol (GBBO 2003) will be used. Point counts will be conducted annually during the breeding season (May-July) once each month beginning the first May, after the planting of each phase. A minimum of one point count transect will be conducted in Phase 2 beginning in May 2007.
    - Standardized breeding and winter season banding/mistnetting (DeSante 2005) may be conducted if conditions warrant.
    - Standardized area searches (Ambrose 1989) may be conducted, if conditions warrant (areas less than 20 acres).
    - If covered species are observed, targeted species-specific surveys, nest searches, and banding/mistnetting may be conducted.
  - Cavity Nesting Birds
    - Elf owl surveys will be conducted after 4 to 6 years, depending on when the land cover type structure and density indicates the habitat has achieved the reference conditions. Installed nest boxes will be monitored during the breeding season (April-July) for elf owls. If an elf owl

- is detected during the breeding season, nest searches, and/or targeted banding/mistnetting may be conducted for long-term use of site and refinement of habitat use.
- Gilded flicker and Gila woodpecker will be surveyed as part of the neotropical bird monitoring as mentioned above. Installed snags will be monitored during the breeding season (May-July). If a gilded flicker and/or a Gila woodpecker is detected during the breeding season, nest searches and/or targeted banding/mistnetting may be conducted for long-term use of site and refinement of habitat use.
- Southwestern Willow Flycatcher
    - Standardized presence/absence surveys (Sogge et al. 1997, USFWS 2000) will be conducted in the riparian habitat after three growing seasons (2010). A minimum of 5 surveys, each year, will be conducted beginning in May and ending in July. If a SWFL is detected after June 15, and/or positive breeding evidence is identified, nest searches will be conducted to determine breeding status and use of habitat. Targeted banding/mistnetting may be conducted for long-term use of site and refinement of habitat use.
  - Yellow-billed Cuckoo
    - Standardized presence/absence surveys (Haltermann and Johnson 2005 Draft) will be conducted after three growing seasons (2010). A minimum of 5 surveys will be conducted beginning June and ending September. If an YBCU is detected during the breeding season, nest searches will be conducted and targeted banding/mistnetting may be conducted for long-term use of site and refinement of habitat use.
  - Small Mammals
    - Standardized presence/absence surveys will be conducted at least once annually (beginning in 2007) between September-November and late February-May. Trapping will be conducted overnight. Traps will be placed in parallel, linear transects of approximately 150 meters in length. A trap station will be located at every 10 meter along the transect, and one trap will be located at each trap station. Transects will be located 10 to 15 meters apart, with the actual distance apart determined by the size of the area being surveyed. Trapping will be conducted for a

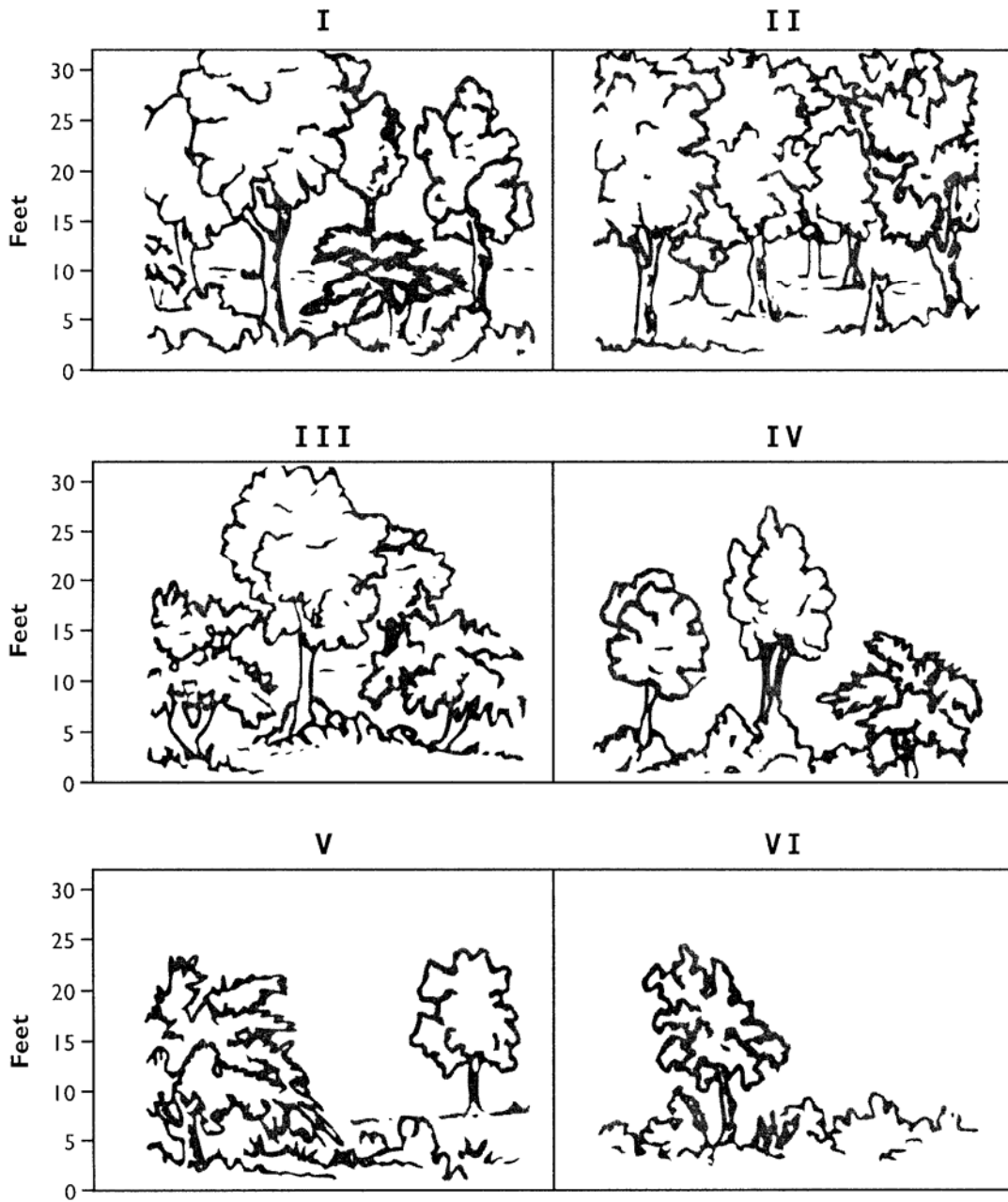
minimum of 500 trap nights. A trap night is defined as setting one trap over one night.

- Bats
  - Presence/absence surveys will be conducted utilizing active/passive AnaBat surveys at least 2 days per season (spring, summer, winter, and fall) annually beginning in 2007. When the vegetation is at sufficient height to hide the AnaBat system, data will be collected daily utilizing one stationary AnaBat/Sonabat system installed in the riparian section. The stationary system will be established for at least 10 years and may be relocated within Phase 2 in order to maximize detections. After 10 years, data will be examined and future monitoring decisions for bat species will be made. All system locations will be chosen based on suitable habitat for the covered bat species and ability to maximize data collected.
  
- Reptiles and Amphibians
  - No monitoring will be conducted because no habitat for reptiles and amphibians will be restored or removed.
  
- MacNeill's Sootywing Skipper
  - Pollard Walks (Pollard 1977) visual surveys will be conducted in the *Atriplex* spp. habitat when the skipper flies between April-October to determine presence/absence. Surveys will be conducted when *Atriplex* crown coverage is approximately 10' x 10'. A minimum of 3 surveys will be conducted.

## Vegetation Classification

The Habitat Conservation Plan (LCR MSCP 2004) outlines the specific habitat acreage to be created and classified utilizing the Anderson and Ohmart (1976, 1984) classification system (Table 3 and Figure 5). Using aerial imagery of the site obtained annually; each phase of the project will be mapped, classified, and ground truthed.

**Figure 5: Vegetation Classification**



Adapted from Anderson and Ohmart (1984).

## Monitoring Analysis and Evaluation

Once the data collected during implementation, effectiveness, and vegetation classification is analyzed, the results will be evaluated based on thresholds and trigger points identified by the reference conditions.

### Reference Conditions

PVER reference conditions will be modeled on conditions found during the SWFL long-term life history site studies along the LCR (McLeod et al. 2005, Koronkiewicz et al. 2005). These variables (Table 3) may change depending on future analysis of the long-term life history studies currently being conducted. Variables that will be referenced include canopy height, canopy closure, vertical foliage density, mean soil moisture (percent volume), mean diurnal temperature, mean maximum diurnal temperature, and mean diurnal relative humidity. These variables were chosen as there were statistically significant differences in use sites versus non-use sites at the SWFL life history study sites (McLeod et al. 2005, Koronkiewicz et al. 2005).

**Table 3: Reference Variables**

Canopy Height (M)	Average greater than 4.0 m
Canopy Closure (percent total)	Greater than 70%
Vertical Foliage Density	Density greatest between 1-4 m above ground. This may change as additional analysis is completed.
Mean Soil Moisture (percent volume)	Minimum of 17% Average of 23%
Mean Diurnal Temperature (Celsius)	Between 26° C and 33° C
Mean Maximum Diurnal Temperature (Celsius)	Maximum of 45° C Average between 32° C and 45° C
Mean Diurnal Relative Humidity (percent)	Greater than 33% Average between 33% and 63%

### Thresholds

Thresholds signal that conditions are appropriate to continue current management practices. The thresholds are as follow:

- Microclimate and vegetation reference conditions are achieved.
- One or more covered species are utilizing PVER during non-breeding season.
- One or more covered species are utilizing PVER during breeding season.
- SWFL and/or YBCU are utilizing PVER during non-breeding season.
- SWFL and/or YBCU are utilizing PVER during breeding season.

In addition, if any monitoring activities document that SWFL and/or YBCU were occupying the site before reference conditions were achieved, management and maintenance activities would be adjusted, as appropriate.

### **Trigger Points**

Trigger points signal the need to alter current management activities to achieve PVER goals of the restoration site or change the goals for PVER. The trigger points are:

- Microclimate and vegetation reference conditions have not been achieved.
- Previously suitable land cover type structures are no longer suitable for any of the targeted covered species.
- Targeted covered species habitat needs exceed water availability.

### **Adaptive Management**

Data will be evaluated annually to determine if the thresholds and/or trigger points were reached. If results indicate that the restoration activities meet or exceed thresholds, recommendations will be made in the annual report for future management activities at PVER, as well as other restoration activities. If results indicate that restoration activities were deleterious to covered species and/or habitats, recommendations on prescriptions and modifications will be identified and other methods tested.

Plant community and structural type are incorporated into performance criteria for woody riparian cover types (Anderson and Ohmart 1984). Criteria used to define woody riparian land cover types are determined by the vegetation classification. Annual reports will summarize the cover type present within the created habitat. Through the adaptive management process, any management prescriptions determined from vegetation classification will be defined in the annual report.



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