Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Cibola Valley Conservation Area Restoration Development Plan: Phase 1

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

July 2007

Lower Colorado River Multi-Species Conservation Program
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National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

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Lower Colorado River
Multi-Species Conservation Program

Cibola Valley Conservation Area
Restoration Development Plan:
Phase 1

Lower Colorado River
Multi-Species Conservation Program Office
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Acronyms and Abbreviations

BACI	Before-After-Control-Impact
CVIDD	Cibola Valley Irrigation and Drainage District
CVCA	Cibola Valley Conservation Area
CW	Cottonwood-willow land cover type, as defined in the LCR MSCP HCP
HCP	Habitat Conservation Plan
LCR	Lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
NWR	National Wildlife Refuge
Reclamation	U.S. Bureau of Reclamation
SWFL	Southwestern Willow Flycatcher
YBCU	Yellow-billed Cuckoo

Background

In 2002, the U.S. Bureau of Reclamation (Reclamation) prepared an initial assessment of the riparian restoration potential of the Cibola Valley Irrigation and Drainage District (CVIDD), a project study area of about 3,800 acres. The Mohave County Water Authority (MCWA) and the Hopi Tribe each purchased a portion of the Cibola Valley from CVIDD in December 2004. The Cibola Valley Restoration Project, which is to be implemented as part of the Lower Colorado River Multi-Species Conservation Program (LCR MSCP), will utilize the lands now owned by the MCWA.

In the valley, 1,019 acres of active agricultural lands owned by MCWA are currently available for restoration. This acreage comprises a number of parcels adjacent to the LCR in Township 1 North, Range 23 West within Sections 19, 20, and 21, and Township 1 North, Range 24 West within Sections 24, 25, and 36, La Paz County, Arizona.

The proposed development of the property is shown in Figure 1. Additional site information can be found on the LCR MSCP Web site under a report titled *Cibola Valley Conservation Area Restoration Development Plan: Overview*.

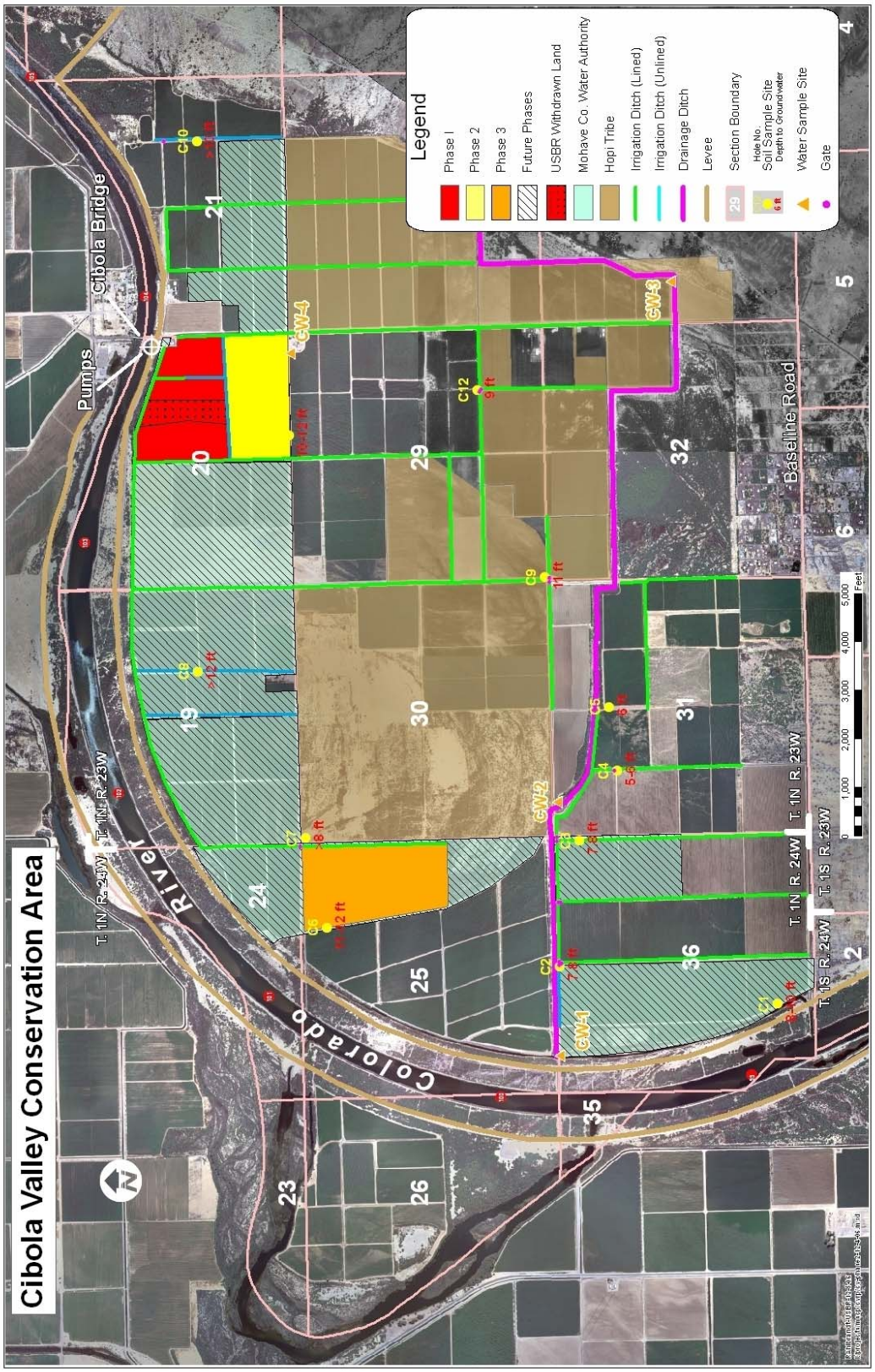
1.0 Purpose/Need

The purpose of Phase 1 is to create approximately 64 acres of riparian habitat that shall be managed for the southwestern willow flycatcher (*Empidonax traillii extimus)* (SWFL), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (YBCU), and other covered species listed in the LCR MSCP Habitat Conservation Plan (HCP). Phase 1 is scheduled to be implemented in Fiscal Year 2006 and is designed to convert approximately 64 acres of active agricultural fields to cottonwood-willow (CW) habitat. Additionally, 22 acres will be established initially as an on-site native plant nursery for future plant stock collection and will be managed for habitat after other nurseries have been developed for the LCR MSCP.

2.0 Design/Planting Plan

Phase 1 converts a total of approximately 86 acres of active agricultural fields to a native plant nursery and CW land cover type that is designed to eventually duplicate native vegetation composition observed in occupied SWFL habitat. Approximately 22 acres (fields E and F) will be established initially as an on-site native plant nursery for future plant stock collection. The remaining 64 acres (fields A through D) are designed to mimic native vegetation composition observed in occupied SWFL habitat. Initially, the fields will be planted with blocks of native plant species, to allow Reclamation to monitor specific planting techniques and watering regimes. Future structure management will address introducing other species into the blocks to achieve more diversity.

Figure 1. Proposed Phasing Map



Planting Plan — Mechanized Planting of Cottonwood-Willow

The 64-acre mechanized CW planting design presented in Figure 2 will be planted to evaluate density spacing of 4-6 feet with the different species of plants arranged in a pattern observed in and around occupied SWFL sites. The area consists of four fields: Field A, 17.8 acres; Field B, 15.3 acres; Field C, 13.6 acres; and Field D, 15.8 acres. Along the transition edges of Goodding's willow and coyote willow, the Goodding's willow will provide significant canopy cover and dense structure along the length of the site and coyote willow will provide the dense understory that SWFLs have been observed to prefer when the other necessary habitat requirements are present. The fields will be laser leveled to ensure complete and even coverage by flood irrigation. An alfalfa cover crop will be planted to help control invasive and exotic plant species. Alfalfa grows to a height of about 18 to 24 inches, adds nitrogen in the soil, is non-aggressive, will last for a few years in areas that have not been shaded out by taller CW, and has a slow growth rate such that it should not compete with small trees.

Fields A and D are duplicate designs, with the plants oriented in north-south rows. The *Baccharis* will be arranged on the outermost edges, creating a thick buffer zone. Moving from west to east (left to right on Figure 2), fields A and D will be planted as follows:

- A 0.5-acre *Baccharis* edge will provide a border between the Field A habitat and adjacent active agricultural fields.
- 2.7 acres of Fremont cottonwood will be planted with 4-foot inline spacing in rows 38 inches apart.
- 2.8 acres of Goodding's willow will be planted with 4-foot inline spacing in rows 38 inches apart.
- 2.8 acres of coyote willow will be planted with 6.5-foot inline spacing in rows 38 inches apart in the middle portion.
- 2.7 acres of coyote willow will be planted with 6.5-foot inline spacing in rows 38 inches apart in the middle portion.
- 2.7 acres of Goodding's willow will be planted with 4-foot inline spacing in rows 38 inches apart.
- 2.6 acres of Fremont cottonwood will be planted with 4-foot inline spacing in rows 38 inches apart.
- A 0.5-acre *Baccharis* edge will provide a border between Field A habitat and Field B.

After the mechanized planting is complete, several potted Fremont cottonwoods will be randomly planted throughout the site, to mimic the presence of sentinel cottonwoods observed in occupied SWFL habitat.

Fields B and C are also duplicate designs, with the plants oriented in north-south rows. However, these fields are planted in wider zones. *Baccharis* will be arranged on the outermost edges, creating a thick buffer zone.

Figure 2. Phase 1: Habitat and Nursery Planting Plan

Native Plant Nursery

To accomplish a program with the scope of the LCR MSCP, vast amounts of native plant material are required for planting on each conservation area (e.g., more than 200,000 plant cuttings for CVCA Phase 1). Recent demonstrations conducted by Reclamation have indicated that to achieve the habitats targeted by the LCR MSCP in a timely manner, plants must be planted in greater densities than have been traditionally planted. In many instances, these dense plantings have successfully out-competed nonnatives in the initial stages of growth. In addition, it is essential to ensure that a mix of genetically known plant stock is available for all restoration activities. Such a supply does not currently exist and purchasing individual plants is costly. The establishment of this nursery will provide a consistent and readily accessible source of plant materials (i.e., cuttings, poles, seeds) for additional phases of restoration at CVCA and future LCR MSCP conservation areas. Reclamation defines the term "cuttings" as plant material less than 1 inch in diameter that is normally used to start rooted nursery stock. Reclamation defines the term "poles" as plant materials 1 to 4 inches in diameter that are taken from larger branches, an entire tree, or from a tree with multiple trunks, and are planted directly into the ground.

The species to be planted include coyote willow, Goodding's willow, Fremont cottonwood, *Atriplex* spp., and *Baccharis* spp. Most plants will be planted 20 feet on center, with the smaller bushes planted 10 feet on center. An alfalfa cover crop will also be planted and the nursery plants will be planted over it. Table 1 presents a plant stock order for the two fields dedicated to establishing the nursery.

Table 1. Nursery Plant Stock

Field E (7.6 acres)

Scientific Name	Common Name	Number of Plants
Salix exigua	Coyote willow	800

Field F (14.9 acres)

Scientific Name	Common Name	Number of Plants
Salix gooddingii	Goodding's willow	700
Populus fremontii	Fremont cottonwood	650
Baccharis salicifolia	Mule's fat	100
B.sarothroides	Desertbroom	100
Atriplex lentiformis	Quailbush	50
A. canescens	Fourwing saltbush	50
A. polycarpa	Cattle saltbush	25

Planting Techniques

Over the last 4 years, Reclamation has conducted demonstrations to investigate the feasibility and effectiveness of various methods to achieve dense, rapid-growth plantings of native species, inhibit the establishment and growth of nonnative plant species on restoration sites, and evaluate any potential cost benefit of the methods.

One such demonstration was conducted at Cibola NWR in 2005 to evaluate an automated mass-planting technique as an alternative to planting either dormant poles or 1-gallon rooted stock and to evaluate density spacing of 1 to 3 feet (Figure 3). The technique proved successful in the first growing season with successful survival and growth rates. This method will be utilized to create cottonwood-willow land cover type in Phase 1 with inline spacing varying from 4 to 9 feet, with a row width of 38 inches.

Figure 3: Automated Mass Planting

Grading

Grading and contouring will consist of laser leveling the fields prior to planting. Borders will be added for efficient water delivery.

Irrigation

It is anticipated that all the fields shall be flood irrigated on a regular basis. Soil moisture and other microclimate monitoring and observation will provide the data necessary to determine an appropriate irrigation schedule.

Once the cottonwood-willow matures, irrigation will be increased during breeding and nesting season of the SWFL to ensure moist soil conditions. Small areas will be created to hold irrigation water during SWFL season (March through September), creating conditions of moist soils, and standing or ponding water necessary for the species' habitat. Moist soils and areas of standing water encourage insect diversity and can also increase the relative humidity within the vegetation, which has been observed as a preferred component of habitat for SWFL.

Water Use Study

A water usage field experiment is being conducted by the University of Arizona in fields A and B to evaluate response of three native trees, *P. fremontii*, *S. gooddingii*, and *S. exigua,* to two different surface irrigation regimes and to fertilization.

Before the experiment, the field was thoroughly mapped using electromagnetic induction, which will allow spatial mapping of soil texture and salinity. Following the planting of trees, these fields will be instrumented with soil moisture probes. Tentatively, the fields will undergo two watering schedules. The first irrigation water regimes will be baseline (6 acre-feet per acre per year) and the second, excessive (150% of baseline). Soil moisture content, drainage, and tree response will be measured with distance from the irrigation ditch in single plots of each irrigation treatment-tree species combination. Measurements at varying distances from the irrigation ditch will allow monitoring along gradients of water availability. Additional sub-plots will receive periodic nitrogen (N) fertilization and plant response will be measured.

Soil water content, drainage, and plant response will be measured for three growing seasons. Soil water content and drainage in each irrigation regime will be measured to a depth of 2.5 m by using an array of capacitance sensors. The sensors will be equipped with telemetry; thus, data will be available in near real time (15-minute intervals). Plant response to the irrigation regimes will be evaluated on whole-plant and leaf bases. Whole-plant measurements will be made four times per year and will include plant height, diameter, and leaf area index. During the growing season, leaf water potential and leaf gas exchange will be measured monthly. Plant transpiration (water use) will be monitored continuously by measuring sap flow. Leaf samples will be collected twice per year for analysis of ^{13}C, which is related to water use efficiency. After the second season, we expect that some tree roots may reach the water table. To ascertain whether trees are using groundwater, stable isotopes of oxygen (^{18}O) or hydrogen (^{2}H) will be analyzed in plant tissues to determine water sources for the trees.

By measuring soil water content in near real time, and by measuring on several temporal scales, we will be able to determine tree response to irrigation. Our results will allow estimation of an appropriate irrigation regime for successful habitat restoration.

3.0 Monitoring

Conservation area monitoring plans will be based on elements described in the HCP (LCR MSCP 2004) and in the *Draft Final Science Strategy* (LCR MSCP 2006)

Monitoring of CVCA will be structured into four main categories:

- Predevelopment
- Implementation Monitoring
- Effectiveness Monitoring
- Vegetation Classification

Pre-development is designed to establish baseline data for evaluating post development and to identify whether a covered species currently inhabits CVCA. Implementation monitoring will analyze whether the site was created as designed. Effectiveness monitoring will analyze whether the site meets the established life requirements necessary to provide habitat for the targeted covered species. Vegetation classification will classify the vegetation within the stand according

to the Anderson and Ohmart (1976, 1984) classification system. Reference conditions will be used as a benchmark for the ultimate goals of the conservation area.

The purpose of the Phase 1 monitoring plan is to evaluate whether restoration parameters established for each covered species habitat are being achieved, whether Phase 1 of the conservation area develops as covered species habitat, and whether the habitat is being utilized by the covered species. Results reported on how the created habitat develops, relative to the restoration and management techniques employed, will be used to refine or develop techniques for future phases. This will ensure that the most cost-effective and efficient approaches are used.

The primary goal of restoration for Phase 1 is to produce SWFL habitat. According to Table 5-3 of the LCR MSCP HCP, the minimum requirements for SWFL are "cottonwood-willow types I-IV with moist surface soil conditions during the breeding season," with a minimum patch size of 10 acres.

Monitoring Design

The monitoring design is based on a quasi-experimental design using the "Before-After-Control-Impact" (BACI) approach (Stewart-Oaten and Osenberg 1992, Bernstein and Zalenski 1983, Green 1979). The BACI approach prescribes the collection of data prior to an activity and comparison to data collected after the activity (Smith 2002). The quasi-experimental design will use pre-restoration phases as controls, along with a long-term control area. The designs will utilize randomization where possible. Subsamples of each phase will be taken at the same or similar randomized points both pre- and post-restoration. Control areas and each implemented phase will be monitored during same or similar time periods. To the greatest extent practicable, pre-restoration monitoring will be conducted for a minimum of 1 year prior to the implementation of each phase.

Population and habitat resources are determined based on the appropriate avoidance and minimization measures (AMMs**)**, monitoring and research measures (MRM**)**, and general and species-specific conservation measures, and monitoring will be conducted both pre- and post-restoration. Select resources will only be monitored post-restoration if no potential exists prior to development for the existing agricultural fields to support populations of targeted covered species (e.g., SWFL has never been found to occupy cotton fields). In most cases, the resources monitoring will focus on guilds of species for efficiency. The pre- and post-restoration resources that will be monitored are summarized in each appropriate monitoring category in the next section of this report. Specific protocols that have been developed for each resource may be found in the document entitled *Draft 2006 Monitoring Protocols for the LCR MSCP*.

Predevelopment Monitoring

Pre-development surveys and monitoring will identify the baseline and controls for post-restoration monitoring. The data will be compared to data from a long-term control site at CVCA (a specific area set aside for approximately 7-10 years prior to development), post-restoration data for each specific phase, and data from other restoration sites implemented as part of the LCR MSCP:

- Abiotic Monitoring
    - Soils
        - Soil samples will be taken in each field to determine baseline soil moisture, pH, salinity, textural classification, depth to groundwater, and nutrients (including nitrates, ortho-phosphate, and ammonia). Approximately 16 samples will be taken on Phase 1 at surface, 1-foot, and 3-foot depths evenly distributed throughout the fields. Soil samples will be collected after existing crops have been harvested and the field has been disked, and prior to planting native vegetation.
- Biotic Monitoring
    - Vegetation Monitoring
        - A qualitative overall description of type of vegetation in each agricultural field will be conducted before planting. Photo points may be established.
    - Avian Monitoring
        - Neotropical birds will be monitored utilizing a standardized point-count protocol (GBBO 2003). Point counts will begin during the breeding season the year before planting (May 2006).
    - Small mammal presence/absence transects will be conducted between January and March 2007 for Phase 1 prior to planting. Traps will be placed in parallel, linear transects approximately 150 m in length. A trap station will be located at every 10 m along each transect, and one trap will be located at each trap station. Transects will be located 10 to 15 m 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.
    - Preliminary presence/absence bat surveys will be conducted utilizing active/passive AnaBat® surveys at least two nights during winter and spring season prior to planting. Signals received from the AnaBat will be analyzed to determine bats present according to genus and species when possible. Two Anabat receivers at a minimum will be placed within the fields where planting will take place, and in the control site for comparison.

Implementation Monitoring

Implementation monitoring will be conducted to assess whether land cover type creation and management actions have been implemented as designed on each phase. This type of monitoring quantifies changes immediately after treatments and evaluates whether actions were implemented as prescribed (Block et al. 2001). The results of this monitoring may:

- Determine whether the appropriate number of acres of created land cover types has been achieved as designed.
- Determine whether the mechanized planting technique is effective and plants have been planted according to design specifications.
- Determine the survival rate, composition, and distribution of trees planted.
- Determine whether planting designs produced different habitat parameters (e.g., canopy cover, tree densities).
- Determine the rate at which coyote willow achieves impenetrable density.
- Determine the amount of water in acre-feet that was utilized per acre annually for each vegetative species and phase of development (i.e., juvenile, targeted habitat, or mature).
- Determine the effectiveness of different irrigation regimes, as defined by project design (i.e., number of acre-feet of water placed on coyote willow, Goodding's willow, and Fremont cottonwood).
- Determine contaminant loads for return irrigation flows to the LCR.
- Determine the survival impacts of harvesting on nursery.

Post-restoration data will be compared and contrasted to predevelopment data where appropriate, data from the long-term control area, the existing habitat data for targeted covered species, and data from other restoration sites implemented as part of the LCR MSCP:

- Abiotic Monitoring
    - Soil Salinity and nutrients
        - Salinity and nutrient levels in each irrigated field will be determined by obtaining soil samples at approximately 10 samples per 40 acres. For Phase 1, this equates to approximately 20 samples evenly distributed throughout the fields. Soil sampling will be conducted annually until a steady state has been achieved and salinity has not increased. Soil sampling will then be conducted every 2 to 5 years, unless data indicated a return to annual sampling.
    - Water use
        - Water deliveries will be recorded by the entity conducting the deliveries.
- Biotic Monitoring
    - Vegetation

- Four to six weeks after planting, a subset of all trees planted will be counted and a general assessment of condition (live, stressed, or dead) will be recorded to determine initial survivorship. This data will be used to guide initial management activities such as water use and re-planting.

- At the end of the first growing season (October 2006), each land cover type will be monitored to determine vegetation survival. Initial success monitoring will be conducted for 2 years to consider survival during establishment and determine whether mortality within the first growing season is due to implementation-related factors (e.g., planting shock, seed viability, water availability, soil conditions and characteristics, and competition with exotics). During the first two growing seasons, growth and survivorship will be sampled utilizing random transects. The number of sample transects will be determined 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 (Table 4) will be recorded for every hundredth tree sampled. Percent cover will be measured at random 1-m square plots in each transect to evaluate herbaceous and shrub plant component.

Table 2. Tree Index of Condition

Condition	Definition
Live	Trees appear in apparently good condition; leaves green, no symptoms of wilting, die-back, or chlorotic appearance of leaves.
Stressed	Trees appear to be in generally poor condition; chlorotic leaves and leaf drop.
Tip die-back	The main stem is in good condition; the most apical portions are in very poor condition exhibiting wilting and die-back symptoms.
Basal sprouts	Main stem dead; new growth is initiated from stem base or root stock.
Not found	Seedling not found during particular sampling period. If seedling not found in two consecutive periods, it is considered dead.
Apparently dead	General appearance of stem is dry and brittle; no live wood observed and no observable green foliage growth; re-sprouting still possible.
Dead	Previously listed as apparently dead; tree in such poor condition that survival by re-sprouting is unlikely.

Habitat/Species Monitoring

Habitat/species monitoring will be conducted to determine whether Phase 1 achieved the reference conditions, as discussed in the reference conditions section of this report, and determine any covered species use of that habitat (Block et al. 2001).

The results of this monitoring may:

- Determine whether vegetation has become SWFL habitat, as determined by the reference conditions.
- Determine whether created habitat supports multiple layers, seral stages, and age cohorts of trees.
- Determine whether the habitat is being utilized by targeted covered species.
- Determine whether there are differences in wildlife use of habitat between different planting and watering techniques in the various fields.

- Habitat Monitoring
    - Abiotic Conditions
        - Microclimate conditions of temperature, relative humidity, and soil moisture will be recorded utilizing data loggers and soil moisture probes. Approximately two to three data loggers per 40 acres will be placed either randomly or in a stratified design within each phase after planting. A stratified design will be used to determine differences in microclimate depending on the distance from an irrigation point. Temperature and relative humidity data will be recorded every 15 minutes and downloaded every 3 to 6 months. Soil moisture will be recorded at the data logger location using a soil moisture probe attached to a data logger. At a minimum, soil moisture will be recorded once daily and downloaded every 3 to 6 months.
    - Biotic Conditions
        - Vegetation Monitoring: After the third growing season, habitat condition will be monitored using a standardized protocol based on a nested sample plot design. Fixed radius plots will be measured to track growth and survival over time. The sample interval will depend on stand maturation. Vegetation monitored will include but will not be limited to: overstory trees, sapling, shrub, understory, herbaceous layer, vertical foliage density, and crown closure. This monitoring will be conducted annually in years 3 through 6 after planting, and will then be conducted every other year between years 6 through 10. After year 10, each site will be sampled every 5 years to monitor successional change through year 50. In the case of a catastrophic disturbance to the site (e.g., fire, flood), post-disturbance monitoring will mimic the post-restoration monitoring regime.

- Covered Species Monitoring

- Neotropical Birds

  - A standardized point-count protocol established by the Great Basin Bird Observatory (GBBO 2003) will be used to monitor avian use. Point counts will be conducted during the breeding season (May through July) for covered species. Point counts will be conducted utilizing the same protocols as pre-restoration monitoring and at the same locations for direct comparison, and will begin the summer after each specific phase is planted. If pre-restoration point counts were not initiated due to time constraints, the point counts will be set up in post-restoration monitoring sites. Comparisons will be to other pre- and post-restoration sites, in addition to the control site.

  - Area searches and migration and winter banding may be conducted to determine winter resident bird species, depending on the targeted covered species habitat to be created and the potential for covered species to inhabit these areas during migration and winter months. Area searches will be conducted in 20-acre blocks, once per month. If winter banding is indicated for larger blocks, banding sites will be set up according to the Monitoring Avian Productivity and Survivorship protocol, and banding will take place 2 to 5 days per month, depending on migration versus winter banding protocols.

- Cavity Nesting Birds

  - Elf owl surveys will be conducted after 4 to 6 years, depending on when the land cover type structure and density indicate the habitat has achieved the reference conditions. Any 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 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. Any installed snags will be monitored during the breeding season (May-July). If a gilded flicker or a Gila Woodpecker is detected during the breeding season, nest searches, and targeted banding/mistnetting may be conducted for long-term use of site and refinement of habitat use.

- Southwestern Willow Flycatcher

  - SWFL presence/absence surveys will be conducted after a minimum of two growing seasons, depending on when the land cover type structure and density indicate the habitat has achieved the reference conditions. Surveys will be conducted utilizing the minimum five-survey protocol approved by the U.S. Fish and Wildlife Service (Sogge et al. 1997, USFWS 2000). If any willow flycatchers are detected after June 15, nest searches will be conducted to determine breeding status and use of habitat. If breeding populations exist, banding may be conducted for long-term use of site and refinement of habitat

use. Data collected at this site will be compared with data from other life history studies being conducted along the LCR.

- Yellow-Billed Cuckoo

  - YBCU presence/absence surveys will be conducted after three to five growing seasons, depending on when the land cover type structure and density indicate the habitat has achieved the reference conditions. If any YBCU are detected during the breeding season, nest searches will be conducted. A minimum of five surveys, evenly distributed throughout the breeding season, will be conducted from June 15 through September 15 on an annual basis.

- Small Mammals

  - Small mammal presence/absence surveys will be conducted utilizing a standardized protocol at least once annually between September-November and late February-May. Trapping will be conducted overnight, and traps will be placed in parallel, linear transects approximately 150 m in length. A trap station will be located at every 10 m along each transect, and one trap will be located at each trap station. Transects will be 10 to 15 m 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 fall of 2006. When the vegetation is at sufficient height to hide the AnaBat system, data will be collected daily utilizing one stationary AnaBat/Sonabat system. The system will be installed in the riparian section. The stationary system will be established for at least 5 years and may be relocated within Phase 1 or within other phases in order to maximize detections. After 5 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.

- MacNeill's Sootywing Skipper

  - Presence/absence surveys will be conducted in post-restoration sites targeted for MacNeill's sootywing skipper habitat. A spring survey will be conducted to determine areas of suitable habitat. If host plants are found during the spring surveys, those sites will be visited three times during summer utilizing a presence/absence protocol. If needed, a fall survey will be conducted to determine habitat characteristics in sites with presence versus sites with absence.

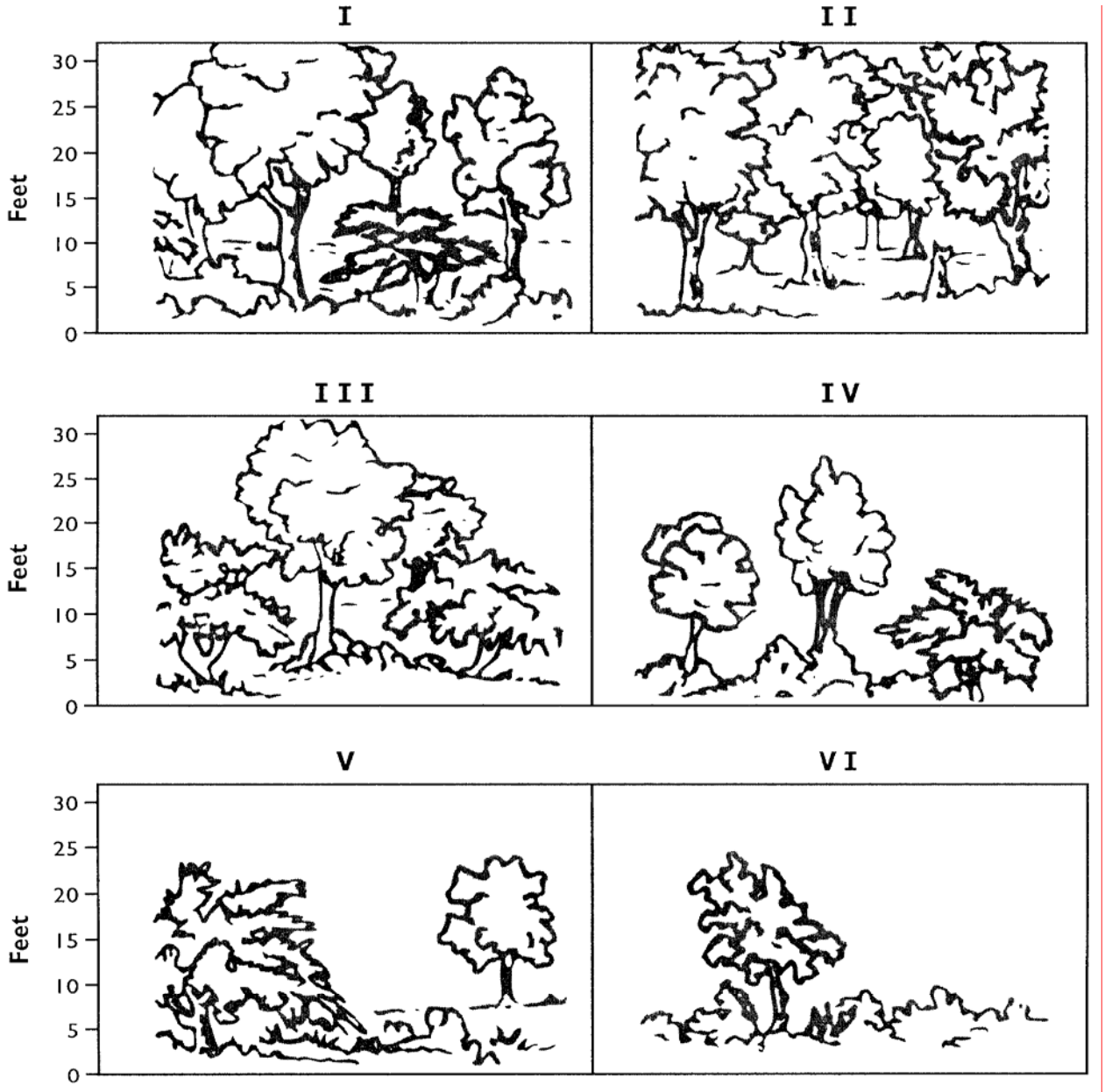
Vegetation Classification

The HCP (LCR MSCP 2004) outlines the specific habitat acreage to be restored and utilizes the Anderson and Ohmart (1976, 1984) classification system as the performance standard. Reclamation will determine vegetation classification annually until target goals have been met. To map the vegetation at CVCA, Reclamation will obtain aerial imagery of the site. With the digital imagery, each phase will be mapped out utilizing the Anderson and Ohmart (1976, 1984) system (Table 4 and 5).

Table 3. Vegetation Communities, Criteria, and Types

Community Type	**Criteria**	**Vegetation Type**
Cottonwood-willow (CW)	*Populus fremontii* and *Salix gooddingii* constituting at least 10% of total trees	I, II, III, IV, V, VI
Saltcedar (SC)	*Tamarix chinesis* constituting 80-100% of total trees	I, II, III, IV, V, VI
Saltcedar-Honey mesquite (SH)	*Prosopis glandulosa* constituting at least 10% of total trees	I, II, III, IV, V, VI
Saltcedar-Screwbean mesquite (SM)	*Prosopis pubescens* constituting at least 20% of total trees	I, II, III, IV, V, VI
Honey mesquite (HM)	*Prosopis glandulosa* constituting at least 90% of total trees	I, II, III, IV, V, VI
Arrowweed (AW)	*Tessaria sericea* constituting at least 90-100% of total vegetation area	I, II, III, IV, V, VI
Atriplex spp. (ATX)	*A. lentiformis*, *A. canescens*, or *A. polycarpa* constituting 90-100% of total vegetation in area	I, II, III, IV, V, VI

Table 4. Vegetation Type — Anderson and Ohmart (1976, 1984) classification system.



Adapted from Anderson and Ohmart (1984).

Reference Conditions

Phase 1 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 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 because 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). Reference variables for Phase 1 are presented in Table 3 and may change as future data refines these ranges.

Table 5. Reference Variables for Phase 1

Canopy Height (M)	Average greater than 4.0 m
Canopy Closure (percent total)	Greater than 70%
Vertical Foliage Density	Density greatest between 1 m and 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%
Contaminant Load for Irrigation Return Flow	Will be defined by water quality samples taken in adjacent drains prior to restoration
Average Soil Salinity Range of Soil Electroconductivity: a function of salinity concentration (mMHO/cm) (Rorabaugh, YAO, various articles from Web)	Will be defined by targeted plant species thresholds Cottonwood < 2.0 Willow < 2.0 Honey and screwbean mesquite < 9.4 *Atriplex* < 16.4 *Baccharis* < 16.4

Monitoring Analysis and Evaluation

Once the implementation and effectiveness monitoring data are analyzed, the results will be evaluated with two sets of management guidance criteria, thresholds, and trigger points. These criteria will be used to evaluate all phases of implementation.

Thresholds

Thresholds signal that conditions are appropriate and to continue current management practices. The thresholds currently established are:

- Microclimate and vegetation conditions have been achieved for reference conditions.
- Phase 1 is being utilized by one or more covered species during migration.
- Site is being utilized by one or more covered species during breeding.
- Site is being utilized by SWFL and/or YBCU during migration.
- Site is being utilized by SWFL and/or YBCU during breeding.

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

Trigger Points

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

- Reference conditions for vegetation and microclimate conditions have not been achieved.
- Cottonwood-willow trees—percent of non-survival and/or low densities.
- Cottonwood-willow habitat type has grown out of early successional stage for SWFL, and has either become habitat for YBCU, or does not provide habitat for either species.
- Soil salinity increases to thresholds above targeted plant tolerances.
- Contaminant loads in return irrigation flows exceed those defined in the reference conditions.
- Targeted covered species habitat needs exceed water availability.

Data Collection and Analysis

All data collected will be entered into the long-term relational database in development for the LCR MSCP. Analysis will be both qualitative and quantitative, depending on the data collected.

For vegetation, a summary of vegetation and habitat characteristics will be produced for pre- and post-restoration. Reference variables for vegetation and microclimate will be compared using the appropriate statistical analysis such as ANOVA and Tukey's multiple comparison tests, similar to analysis found in McLeod et al. (2005).

Soil salinity and water quality analyses will be compared on an annual basis to determine if trigger points have been reached.

The SWFL surveys will record whether any of these birds were found utilizing the site. If they are documented during breeding season, nest monitoring will be conducted to confirm nesting. If nesting is confirmed, data for similar variables to those from current life history studies will be collected and analyzed according to current methodology being conducted by SWCA Environmental Consultants (McLeod et al. 2005).

For avian point counts, all data will be recorded on standardized data forms utilizing the Great Basin Bird Observatory template. Data will be compiled and single factor ANOVA will be used

for detection between survey dates. Species diversity, richness, and evenness will be determined using a natural logarithm version (Nur et al. 1999) of Shannon's Index (Krebs 1989).

The analyses methods for small mammals, bats, and MacNeill's sootywing skipper will focus on presence/absence of the species. All analyses will contain a list of species present and will compare species diversity and richness for both pre- and post-restoration.

Adaptive Management

Data will be evaluated yearly to determine if thresholds and trigger points are reached. An annual monitoring report will be written with summary results of all monitoring studies conducted that year. A 5-year summary report will be written after the first 5 years post-development to give trend analysis and to determine if results indicate that restoration activities meet or exceed thresholds. Recommendations will be made in the annual report and in the 5-year summary report for future management actions and for changes in protocols or monitoring regimes. If results indicate that effects are deleterious to species or habitats, recommendations on prescriptions and modifications will be identified and other methods evaluated. All data and recommendations flow into the AMP.

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