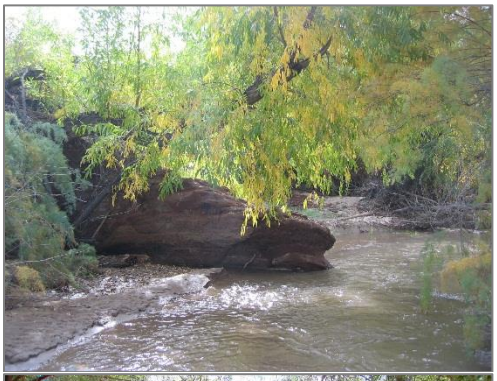
Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Lower Colorado River Vegetation Monitoring

2013 Annual Report




U.S. Department of the Interior
Bureau of Reclamation

December 2014

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Lower Colorado River
Multi-Species Conservation Program

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December 2014

Parametrix and GeoSystems Analysis, Inc., 2014. Lower Colorado River Vegetation Monitoring, 2013 Annual Report. Prepared for the Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada. December 2014.

ACRONYMS AND ABBREVIATIONS

BLCA	Beal Lake Conservation Area
BWRE	Bill Williams River East
cm	centimeter(s)
CNU1	Cibola National Wildlife Refuge Unit 1 Conservation Area
CRANE1	Cibola National Wildlife Refuge Unit 1 Conservation Area Crane Roost 1
CRANE2	Cibola National Wildlife Refuge Unit 1 Conservation Area Crane Roost 2
CVCA	Cibola Valley Conservation Area
CWN	Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North
DBH	diameter at breast height
DC	diameter class
FNA	Flora of North America
HC	height class
Hippie Burn	Cibola National Wildlife Refuge Unit 1 Conservation Area
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
m	meter(s)
m^3/m^2	cubic meter(s) per square meter(s)
Mass Transplanting	Cibola National Wildlife Refuge Unit 1 Conservation Area Mass Transplanting
Nature Trail	Cibola National Wildlife Refuge Unit 1 Nature Trail
Project Team	Parametrix and GeoSystems Analysis, Inc.
PVER	Palo Verde Ecological Reserve
Reclamation	Bureau of Reclamation
SC	size class
SE	standard error

Symbols

>	greater than
<	less than
≤	less than or equal to

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Part D – Cibola Valley Conservation Area Maps
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EXECUTIVE SUMMARY

In 2013, Parametrix and GeoSystems Analysis, Inc., (Project Team) completed the third consecutive year of vegetation surveys to support habitat creation site evaluations for the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). Field work was conducted between September and December. Four habitat creation areas, Beal Lake Conservation Area (BLCA), Palo Verde Ecological Reserve (PVER), Cibola Valley Conservation Area (CVCA), and Cibola National Wildlife Refuge Unit 1 Conservation Area (CNU1) were monitored along with one reference site at Bill Williams River National Wildlife Refuge (Bill Williams River East [BWRE]). Field measurements were recorded at 428 plots during 31 days in the field. The Project Team assisted with reviewing and testing several iterations of the Bureau of Reclamation (Reclamation) vegetation database and, following completion of field data collection, entered data into the Reclamation database template.

The following vegetation data were summarized by site:

- Tree and shrub density
- Tree and shrub height
- Canopy closure
- Foliar density
- Species composition

As an additional task, the Project Team tested iterations of Mobile Electronic Field Forms being developed by Reclamation for the project methodology. Methods, results, and recommendations for the forms are summarized in a separate document (Parametrix and GeoSystems Analysis, Inc. 2014).

Habitat creation areas were generally comprised of a dense overstory of native trees and shrubs, resulting in a mean canopy closure of 76 percent (standard error of 2 percent), with a variably dense mix of primarily native understory vegetation and a minor component of saltcedar. Tree density ranged from 71 trees per acre at PVER Site 1 to 1,583 trees per acre at CNU1 Mass Transplanting. Arrowweed was abundant at BLCA (94-percent frequency), common at CNU1 Crane Roost 1 (33-percent frequency) and CVCA Site 4E (17-percent frequency), and rare elsewhere. BWREt plots were dominated by a mix of native trees and saltcedar, with a mix of native and non-native understory vegetation. Canopy closure was 88 percent. Tree density (including saltcedar) was 397 trees per acre. Arrowweed was common (39-percent frequency), but coyote willow was not observed at this site. Age and size class distribution were more widely spread compared to that of other LCR MSCP restoration sites.

Spanish false fleabane (*Pulicaria paludosa*), a non-native plant that can become invasive if not treated, was observed at PVER Sites 5 and 6, along corridors (e.g., roads and canals), and at BWRE. Buffelgrass (*Pennisetum ciliare*) was observed at PVER Sites 5 and 7 and CVCA Site 4E. No Buffelgrass has been detected at BLCA since 2011. Morning glory (*Ipomea purpurea*), a noxious weed, continues to be prevalent at CVCA, particularly at Sites 1 and 2. Morning glory was also encountered throughout PVER Sites 5 and 6. Sahara mustard (*Brassica tournefortii*) was encountered, but not yet common, at PVER Site 6 and CVCA Sites 5 and 6.

The signs of extensive feral pig activity were observed at BLCA, with rooting activities affecting the different sites within the conservation area. A coyote was also regularly observed at BLCA. Wild burro and cattle signs were observed throughout and adjacent to the BWRE survey area. A javelina was observed this year near the Mineral Wash portion of BWRE.

Enhanced and reduced effort surveys provide intensive data on vegetation characteristics for LCR MSCP habitat creation and reference sites. The 2013 monitoring protocol adjustments provided additional refinements and will allow for efficient transition to electronic data collection for future surveys. Rotational plot protocols implemented this year allowed for documentation of vegetation characteristics with increased efficiency compared to enhanced-level protocols; however, the use of data from rotational plot protocols in monitoring for annual vegetation changes is limited because the survey area differed for these plots between years. Collaboration with biologists and managers of other LCR MSCP projects is recommended to ensure that data collected through this project are optimized for incorporation into habitat assessments and adaptive management. For this purpose, completing vegetation collection earlier in the year is recommended to document vegetation characteristics as near to the avian nesting season as possible and to avoid bias due to annual leaf drop.

1.0 INTRODUCTION

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) is a 50-year effort aimed at balancing the use of lower Colorado River water resources with the conservation of native species and habitats. To achieve these goals, the Bureau of Reclamation (Reclamation) is tasked with creating and maintaining habitat to conserve 26 Federal or State-protected LCR MSCP species while potentially benefitting 5 additional evaluation species that might be listed in the future. To achieve these objectives, the Habitat Conservation Plan specifies the creation of 8,132 acres of various habitat types, including 5,940 acres of cottonwood-willow cover and 1,320 acres of honey mesquite cover (Reclamation 2004, 2011). Key vegetation species, which are either directly planted or establish passively at these habitat creation areas, include:

- Cottonwood (*Populus fremontii*)
- Goodding's willow (*Salix gooddingii*)
- Coyote willow (*Salix exigua*)
- Willow baccharis (*Baccharis salicina*)
- Mule fat (*Baccharis salicifolia*)
- Desert broom (*Baccharis sarothroides*)
- Honey mesquite (*Prosopis glandulosa*)
- Screwbean mesquite (*Prosopis pubescens*)
- Heliotrope (*Heliotropium curassavicum*)
- Quail bush (*Atriplex lentiformis*)
- Saltcedar (*Tamarix* spp.)
- Arrowweed (*Pluchea sericea*)

To assist in vegetation establishment and trend monitoring at LCR MSCP cottonwood-willow and honey mesquite habitat creation areas and reference locations, Reclamation implements annual vegetation surveys at established locations. Protocols and the vegetation monitoring design are detailed in Bangle (2013).

Parametrix and GeoSystems Analysis, Inc. (Project Team) conducted vegetation surveys for Reclamation during 2013 under Contract GS10F0013N/R11PD30179. The team worked with Reclamation to develop minor changes to the survey methodology and to develop revised field instructions and data sheets. Field surveys were conducted between September 30 and December 10, 2013, at four habitat creation areas on the lower Colorado River: Beal Lake Conservation Area (BLCA), Palo Verde Ecological Reserve (PVER), Cibola Valley Conservation Area (CVCA), and Cibola National Wildlife Refuge Unit 1 Conservation Area (CNU1). In addition, surveys were conducted on Bill Williams River National Wildlife Refuge near the confluence with Mineral Wash (Bill Williams River East [BWRE), which supports a high density and diversity of avifauna and serves as a reference site. An overview of the survey locations is provided on figure 1.

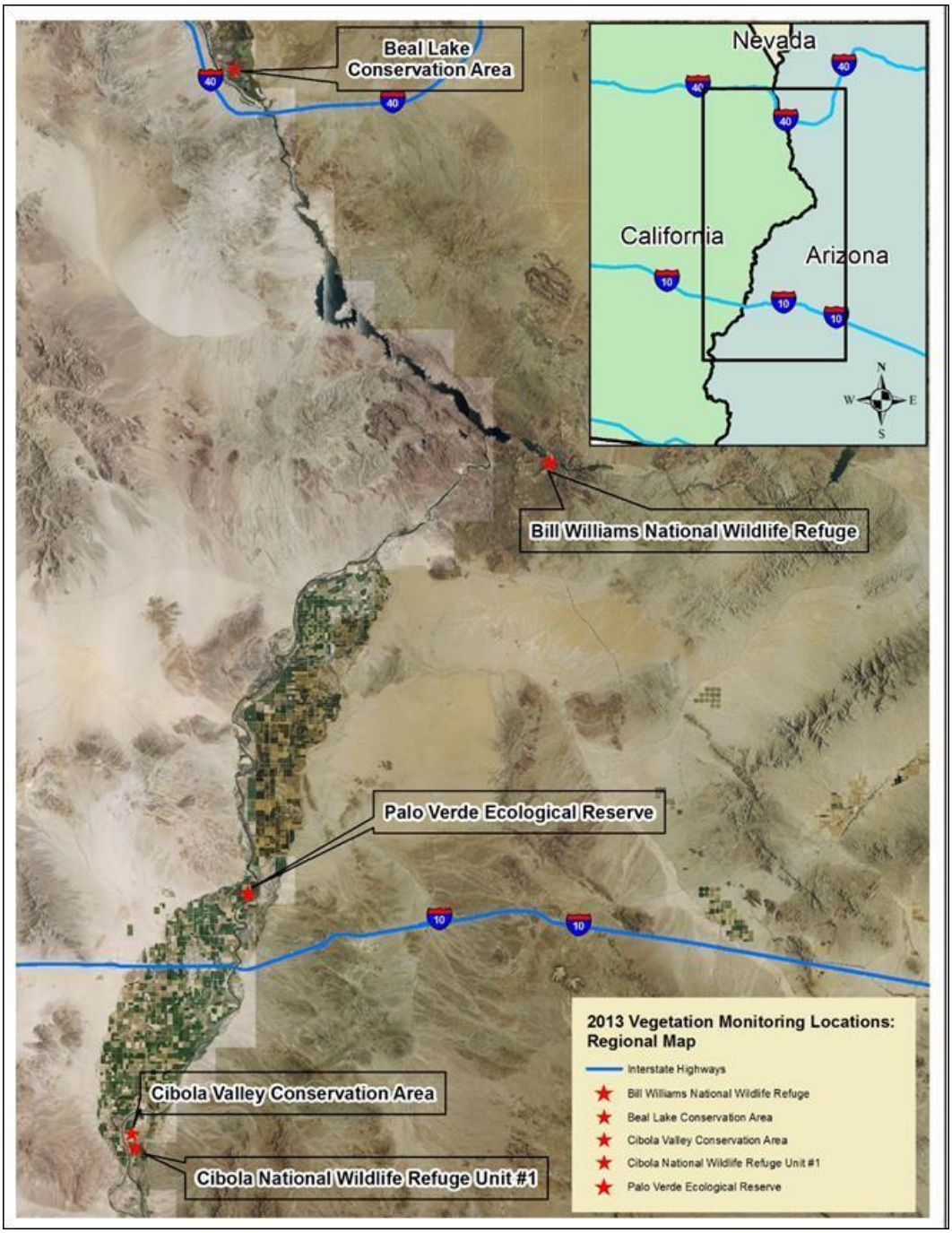

Figure 1.—2013 vegetation monitoring locations: regional map.

The Project Team provided multiple rounds of review, comments, and recommendations on the 2013 Reclamation database. Data were entered into a revised version of the Microsoft Access database that was compatible with the 2013 field methods. Following data entry, vegetation data were summarized for each of the project sites.

During this project year, the team assisted Reclamation with testing Mobile Electronic Field Forms, to include pilot-level data collection, recommendations for changes to increase efficiency and accuracy of electronic data collection, and provide recommendations for full-scale implementation during future project years. This task (Task 3) was summarized as a separate report (Parametrix and GeoSystems Analysis, Inc. 2014) and is not detailed in this annual report.

This report documents methods, recaps survey efforts, summarizes basic statistics for each monitored site, and provides near-term recommendations for surveys conducted in subsequent years. Section 2 reviews methods, section 3 provides results and a discussion, and section 4 presents conclusions and recommendations.

2.0 METHODS

2.1 Survey Overview

Crews surveyed a total of 428 vegetation monitoring plots in 2013. Three types of surveys were conducted: enhanced, reduced effort, and rotational:

- **Enhanced** surveys were implemented at BWRE and habitat creation areas with at least 3 years of post-planting growth that are not mowed by farm machinery for weedy plant reduction.

- **Reduced effort** surveys were implemented in areas planted during the spring of 2013 (i.e., PVER Site 8, CNU1 Hippie Burn [Hippie Burn]), the spring of 2012 (i.e., PVER Site 7), and where mowing occurs between planted rows of honey mesquite and quail bush (CVCA Site 4E).

- **Rotational** plot protocols were added for 2013 monitoring and were designed to document key vegetation parameters while requiring less effort compared to enhanced-level surveys. It was intended that survey protocols switch between enhanced and rotational data collection methods in subsequent years (Bangle 2013). The number, type, and plots surveyed for project years to date are detailed by conservation area and site in table 1.

Table 1.—Summary of plots surveyed to date

Site	Monitored acreage	Number of plots		
		2011	2012	2013
Beal Lake Conservation Area				
BLCA	47	35	35	35
Bill Williams River East				
BWRE	100	36	36	36
Cibola Valley Conservation Area				
CVCA1	91	16	19	19
CVCA2	71	19	19	19
CVCA3	103	8	13	13
CVCA4E	45	4	6	6
CVCA4W	58	11	11	11
CVCA5	71	13	13	13
CVCA6	89	15	15	15
Cibola National Wildlife Refuge Unit 1 Conservation Area				
CWN[1]	19	6	6	6
Hippie Burn	73	0	0	17
Nature Trail	36	24	24	24
Mass Transplanting	20	6	6	6
Crane Roost	147	18	27	27
Palo Verde Ecological Reserve				
PVER1	31	8	8	8
PVER2	72	18	17	17
PVER3	80	22	22	22
PVER4	97	20	20	20
PVER5	210	28	28	28
PVER6	213	40	40	40
PVER7	226	0	40	40
PVER8	35	0	0	6
Total:		347	405	428

Note: Cells that are not highlighted indicate enhanced-level surveys, green highlighted cells indicate reduced effort surveys, and purple highlighted cells indicate rotational surveys.

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

2.2 2013 Survey Methodology Adjustments

Per recommendations following 2012 surveys and discussions with Reclamation, several changes were implemented for the 2013 field season. Some of these changes were made to facilitate the migration to electronic field forms in future years. These changes are reflected in the 2013 LCR MSCP protocols (Bangle 2013) and the 2013 Field Instructions (attachment 1). Changes are also reflected in the 2013 Field Data Sheets (attachment 2). Specifications or deviations from surveys conducted during 2012 consisted of:

- Data Sheet Revisions
    - Locations of collection attributes were rearranged on the sheets in order to maximize space and reduce the number of data sheets.
    - Standard trees were consolidated to a single page, regardless of size class (SC), and adjusted to accommodate tallies as described below.
    - "All," "All Trees," and "All Shrubs" were added as columns in the "Tree and Shrub Foliar Cover" section to allow summaries by vegetation growth form.
    - Changes were made to reflect protocol revisions as listed below.
- Methods and Protocol Changes
    - SCs were added to split former SC6 (diameter at breast height [DBH > 40.01 centimeters [cm]) into three size classes: SC6 for 40.1–50 cm, SC7 for 50.1–80 cm, and SC8 for 80.1–100 cm. This change was implemented to accommodate the anticipated growth of trees over the duration of the LCR MSCP.
    - Diameter class (DC) 2, which was formerly 2.51–8.0 cm, was split to provide a diameter range more similar to other classes. This resulted in redesignation of larger stems. The resulting DCs were as follows:
        - DC1: < 2.5 cm
        - DC2: 2.51–5.0 cm
        - DC3: 5.1–8.0 cm
        - DC4: 8.1–12.0 cm
        - DC5: 12.1–20.0 cm
        - DC6: 20.1–40.0 cm

- Height class (HC) ranges were reassigned as follows:

  - HC1: 0.1–1.5 meters (m)
  - HC2: 1.6–3 m
  - HC3: 3.1–6.0 m
  - HC4: 6.1–12.0 m
  - HC5: 12.1–20.0 m
  - HC 6: 20.1–35.0 m

- For standard trees, after five representative-sized trees were measured for each SC, additional trees were tallied into respective size and height classes. This change was made to increase data collection efficiency and facilitate the transition to electronic data collection for future project years.

- For mesquite species and saltcedar, stems of each individual at 10 cm above ground surface were tallied by DCs. This change was made to increase data collection efficiency and facilitate the transition to electronic data collection for future project years.

- In previous years, mule fat and willow baccharis were considered the same species (*Baccharis salicina*) because the Flora of North America (FNA) is considered the primary taxonomic authority for this project, and the FNA online key (www.efloras.org) was inconsistent with differentiating or grouping *B. salicina*, *B. salicifolia*, and *B. emoryi*. However, recent taxonomic revisions in FNA divided species of the *Baccharis* genus, and clearly distinguishable epithets of *B. salicina* and *B. salicifolia* are present in the LCR MSCP sites. Thus, *Baccharis salicina* and *B. salicifolia* were differentiated from each other as BACSAL (willow baccharis) and BACSAL2 (mule fat), respectively, and were placed in a separate section apart from standard shrubs. Stems of all individuals were tallied by DC.

- General stem counts were eliminated from quadrants B1 and B3 because these efforts required significant labor, and results were of limited value to Reclamation.

- For consistency with general stem count protocol removal, coyote willow was no longer split and recorded by DC, but was instead placed into SCs by DBH, as for standard trees. Therefore, plants were recorded as individuals if the plants were separated by ground between the primary stems as opposed to individual stems if the plants branched below 10 cm as done in 2012. This change would be anticipated to result in a lower summarized coyote willow stem density.

- To optimize field data collection while obtaining data for all SCs of coyote willows, SC1 coyote willow was only recorded in E plots, SC2 coyote willow was only recorded in quadrants B1 and B3, and SC3 coyote willow was recorded in all B plots. In 2012, DC2–4 coyote willow was only recorded in quadrants B1 and B3. DC1 was counted in the same E plots for both years.

- After five representative coyote willow trees were measured in each SC, the remaining trees were tallied by height and size classes. In 2012, individuals were only tallied by DC. This change was made to increase data collection efficiency and facilitate the transition to electronic data collection for future project years.

- After five representative stems were measured, additional arrowweed stems were tallied into 0.5-m HCs. This change was made to be consistent with HCs for other shrub species.

- To document mortality of planted trees, standing dead trees smaller than SC4 (dead trees in SC4 or greater are documented as "snags") were tallied in distinct areas. Dead SC3 was tallied in the B plot, dead SC2 was tallied in quadrants B1 and B3, and dead SC1 was measured in the E plots.

- Dead shrubs were tallied for the entire B plot.

- Addition of the term "Felled Trees," which refers to living or dead trees that have fallen over. The presence of felled trees was documented in the "General Notes" section.

- Distance to surface water was eliminated, as these data were seen of limited value for Reclamation because surface water at LCR MSCP conservation areas was typically observed only during irrigation.

2.3 Survey Methodology

Because long-term vegetation monitoring for the LCR MSCP is detailed and complex, vegetation attributes are monitored at several different scales. To do this, the LCR MSCP vegetation monitoring plot design utilizes nested plots for capturing data on different plant life forms, growth habits, and SC. The nested and sometimes overlaying (sub) plots include one A plot (10 x 40 m), one B plot (5 x 15 m divided into four 2.5 x 7.5 m quadrants denoted B1, B2, B3, and B4), four C plots (0.5 x 2 m), five D points, and four 0.5 x 2 m E plots. The B, C, and

E plots and the D points are nested within the A plot and assigned a distinguishing letter unique to the particular measurement subplot or point. Plot dimensions are shown on figure 2, and plot collection schematics for enhanced and rotational surveys are shown on figures 3 and 4, respectively. The data collection schematic for reduced effort plots is not included because all data are collected from the entire 10 x 40 m A plot.

For enhanced and rotational protocols, the data collection area for trees is dependent on SC. For all trees, except saltcedar, honey mesquite, and screwbean mesquite, SC is determined based on DBH as follows:

- SC1: $\leq$ 2.5 cm
- SC2: 2.51–8.0 cm
- SC3: 8.1–12 cm
- SC4: 12.1–20 cm
- SC5: 20.1–40 cm
- SC6: 40.1–50 cm
- SC7: 50.1–80 cm
- SC8: 80.1–100 cm

SC for saltcedar, honey mesquite, and screwbean mesquite was designated by height as follows:

- SC1: $\leq$ 3m tall
- SC2: > 3m tall

The specific vegetation attributes captured within each subplot are summarized more generally below for comparison between enhanced, rotational, and reduced effort plots. Detailed field instructions are included in attachment 1.

Following final protocol revisions (as discussed Section 2.2 2013 Survey Methodology Adjustments), enhanced-level plot surveys included monitoring of:

- Total canopy closure, species-specific vegetation volume, and vertical foliar density at D points

- Canopy gaps within 30 m of plot center (D1)

- SC4 and larger snags within the A plot and the number of cavities they have

- Tree height and DBH for SC4 trees and larger (greater than 12-cm DBH), not including mesquite and saltcedar, in the A plot

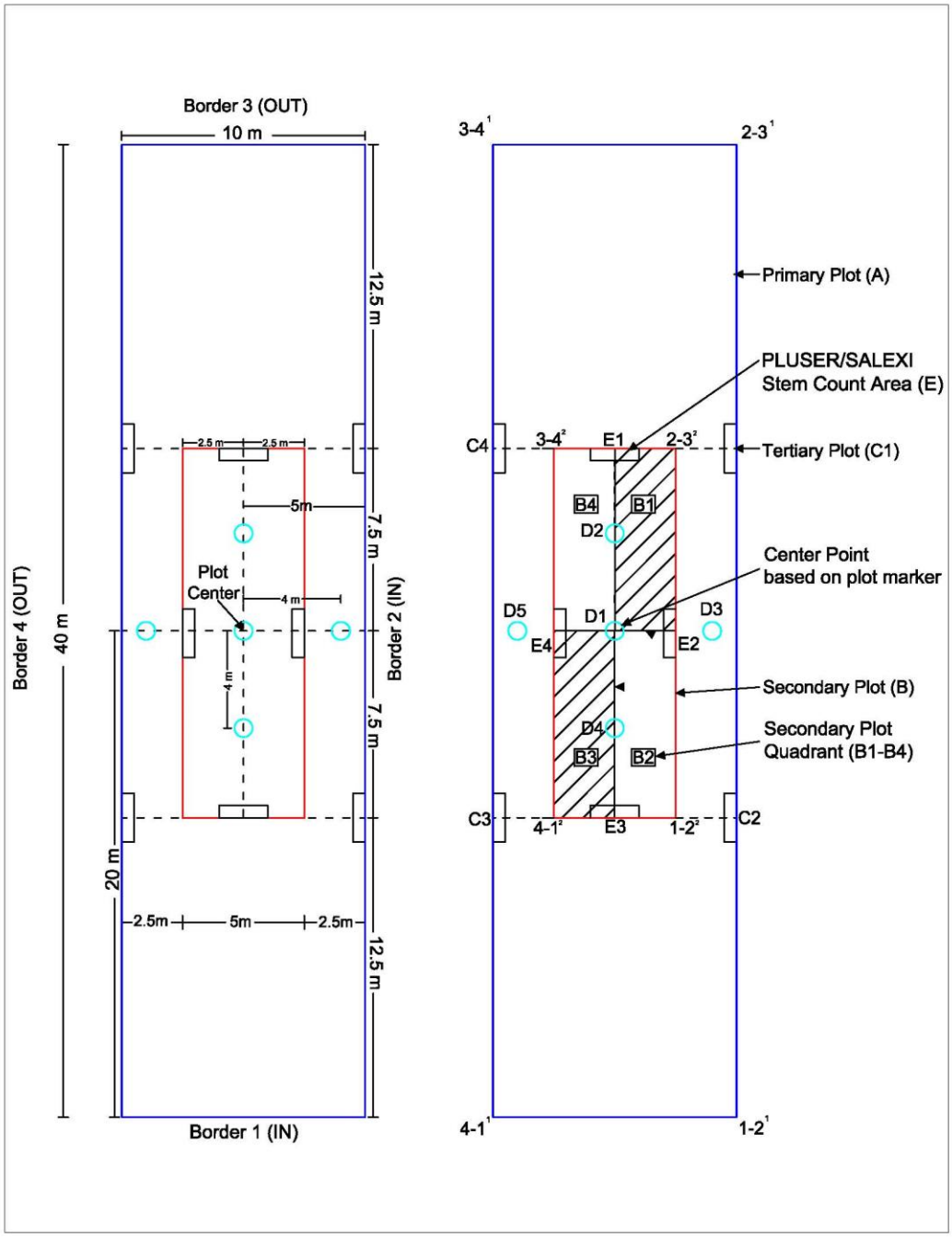

Figure 2.—Plot dimension and collection area naming conventions.

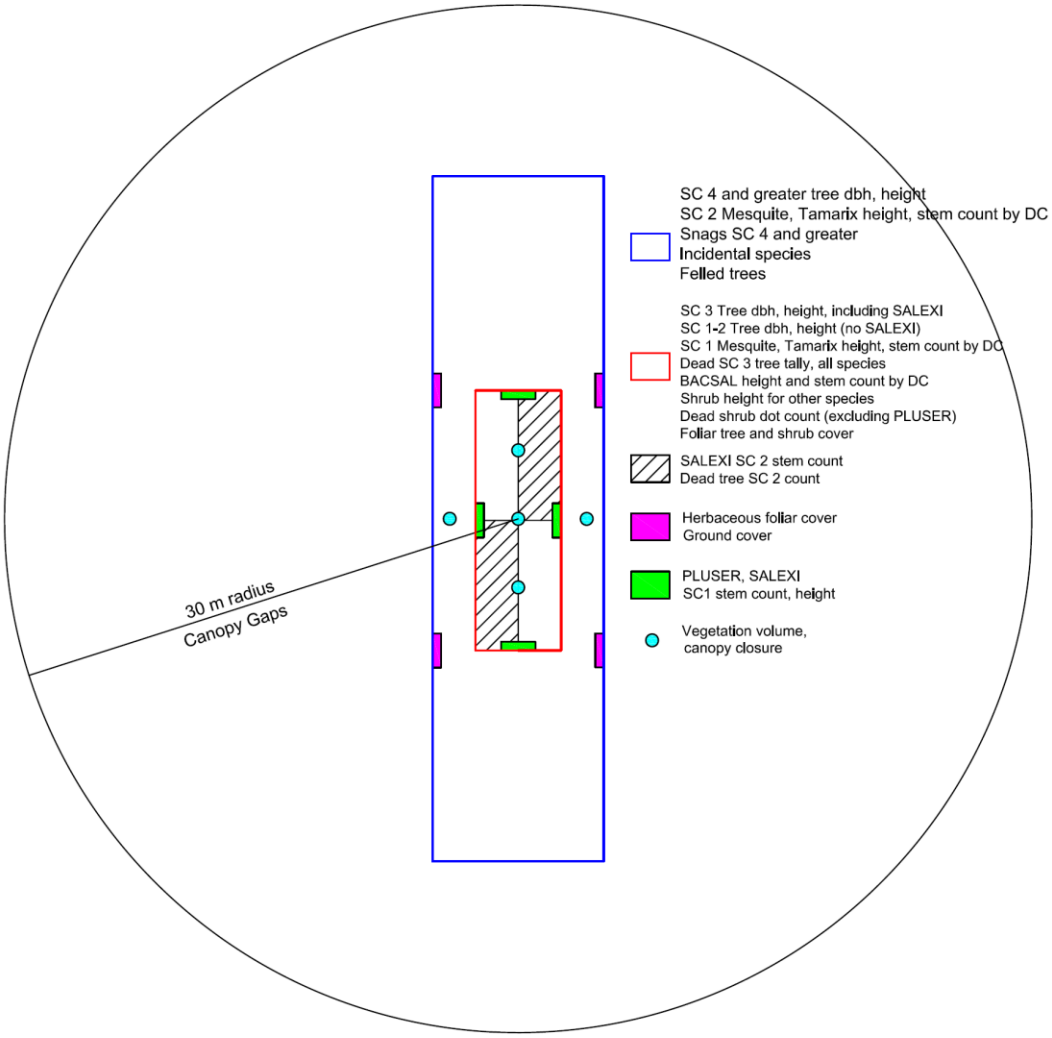

Figure 3.—2013 enhanced-level plot schematics and data collection areas.

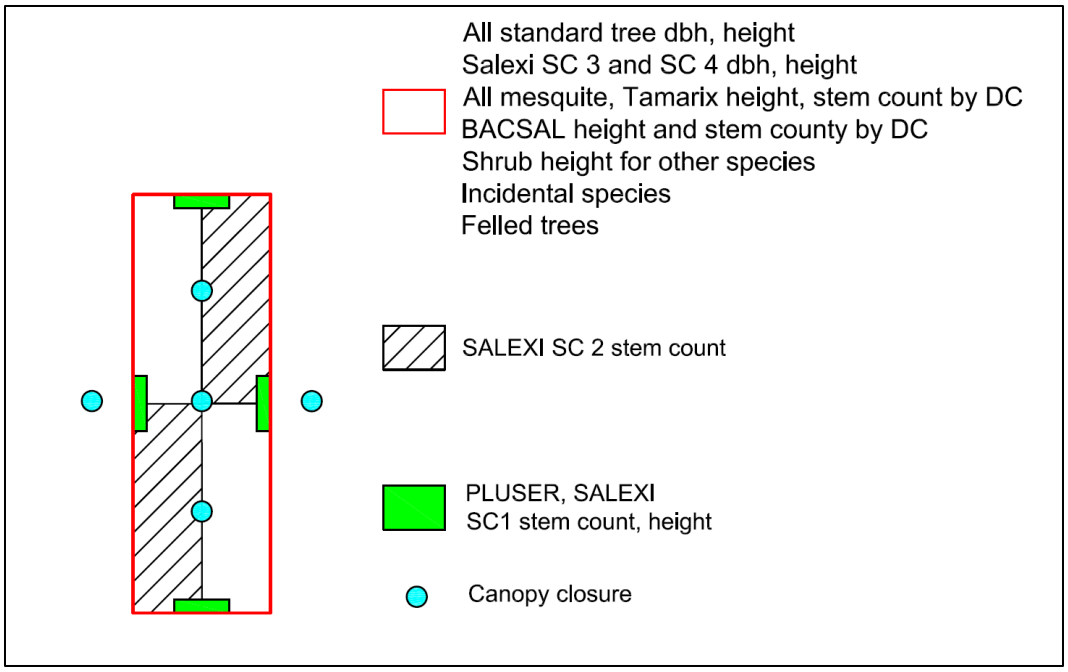

Figure 4.—2013 rotational effort plot schematics and data collection areas.

- Tree height and stem DC for mesquite and saltcedar SC2 (greater than 3 m tall) in the A plot
- Dead or living "felled" trees in the A plot
- Incidental species: Those occurring in the A plot but not documented otherwise
- Tree height and DBH for SC1 through SC3 standard trees (less than or equal to 12-cm DBH) and SC3 coyote willow in the B plot
- Tree height and stem DC for saltcedar and mesquite SC1 (less than or equal to 3 m tall) in the B plot
- Shrub height within the B plot, excluding arrowweed
- Shrub height and stem count by DC for willow baccharis and mule fat in the B plot
- Cover for trees and shrubs in the B plot
- Dead SC3 trees, including saltcedar and mesquite measured like standard trees, in the B plot

- Dead SC2 trees, including saltcedar and mesquite measured like standard trees, in quadrants B1 and B3
- Tree height and DBH for coyote willow SC2 in quadrants B1 and B3
- Height and DBH for SC1 coyote willow in the E plots
- Height of the arrowweed in the E plots
- Herbaceous foliar cover and ground cover in the C plots

Rotational effort plots included monitoring of:

- Canopy closure at D points
- Tree height and DBH for standard trees (all SCs) and SC3 and SC4 coyote willow in the B plot
- Tree height and stem tally by DC for all saltcedar and mesquite in the B plot
- Shrub height for all shrubs except arrowweed in the B plot
- Stem tally by DC for willow baccharis and mule fat
- Number of snags (dead trees SC4 and greater) in the B plot
- Number of dead SC3 trees in the B plot, including saltcedar and mesquite measured like standard trees
- Height and DBH for SC2 coyote willow in quadrants B1 and B3
- Number of dead SC2 trees in quadrants B1 and B3
- Arrowweed and SC1 coyote willow height and DBH in the E plots
- Number of dead SC1 trees in the E plots

Reduced effort plots included monitoring of:

- Tree height and DBH for standard trees and coyote willow in the A plot (all SCs)
- Tree height and stem DCs for all saltcedar and mesquite in the A plot

- Shrub height for only quail bush, desert broom, willow baccharis, and arrowweed in the A plot

- A list of incidental species

To facilitate plot relocation during future surveys, previously unmarked plot centers were marked by survey crews with a t-post, rebar, and engraved plot marker. One piece of rebar was also inserted at each corner of the A plot to increase the probability that the same plot area is established and measured for future surveys when conditions are not favorable for Global Positioning System reception. Exceptions to permanent marking are discussed in section 3. Each section of rebar and t-post was marked with blue and white-striped flagging to increase visibility during future surveys. All previous flagging was removed from plot corners and the plot center.

2.4 Survey Summary

During the 2013 season, surveys were completed at BLCA, BWRE, PVER, CVCA, and CNU1. A list of all the plots sampled is included in attachment 3. Site-specific observations are provided in the site reports (attachment 4); survey summaries and key observations are provided below. Plot location maps for each site are provided in attachment 5. Due to training required for staff added after the field season was underway, inconsistent numbers of members per monitoring team, and three different implemented protocols, survey efficiency was often difficult to determine (refer to attachment 4 for additional information). Overall efficiency for each conservation area was estimated by dividing the total number of plots for the conservation area by the number of "team days." A team day consists of one group of two or sometimes three individuals working together to complete plots surveys for the typical field day duration (approximately 9 hours). Plot survey efficiency was not estimated for PVER because of several incomplete field days resulting from the Government shutdown and relocation required when numerous centerfire rifle deer hunters were encountered at the conservation area.

2.4.1 Beal Lake Conservation Area

BLCA was the second site surveyed by the Project Team during 2013. To overcome delays in the schedule due to the October 2013 Government shutdown, 4 additional crew members were added to the team (for a total of 12 field staff) in order to finish the project before leaf senescence. The Field Supervisor trained five new crew members on enhanced survey protocols on November 5, 2013, while the returning crew began collecting data. Surveys on the 35 enhanced-level plots were finished on November 9. Surveys required a total of 16 team days, for

an efficiency of approximately two plots per day per team. All plot centers and corner stakes were located during the 2013 survey. Flagging from 2012 with excessive fading was replaced to facilitate future plot setup.

2.4.2 Bill Williams River East

Four two-person survey crews completed enhanced-level surveys at the 36 BWRE plots between October 25 and October 29, 2013. Survey efficiency averaged 1.8 plots per team per day. This efficiency was lower than for 2012 because two new crew members were trained during this session. All but four plot center stakes were found during plot setup. The four missing plot center stakes were located in flood-prone areas and were presumably washed away during a high-flow event. Missing plot center stakes were not replaced.

2.4.3 Palo Verde Ecological Reserve

The 181 vegetation monitoring plots (98 enhanced, 37 rotational, and 46 reduced effort) at PVER were surveyed during three field trips. The first field session began on September 30, 2013, but was terminated after receiving a "Stop Work Order" on the evening of October 2. The first day consisted of training for two new crew members and for all crew members on protocol changes between 2012 and 2013 surveys. Thus, this first trip allowed only two full days of surveys. The second field session began on November 16 but was terminated on November 17, 2013, due to safety concerns when deer hunters were observed onsite. Crews relocated to CVCA, where hunting season had already ended, for the remainder of the scheduled trip. On the third field session (December 2–9, 2013), all remaining plots were surveyed.

Six new plots were established in Phase 08. T-posts and a piece of rebar topped with a survey cap stamped with the site phase and plot number were placed at plot center. Corners of the A plot were marked with flagged rebar.

2.4.4 Cibola Valley Conservation Area

CVCA was surveyed between November 17 and November 22, 2013. During the 6-day field trip, crew members trained on rotational and reduced effort plots and completed all 96 plots (60 enhanced, 19 rotational, and 17 reduced effort). Due to an inconsistency between the Scope of Work and the provided Geographic Information System Shapefiles, CVCA Site 4W was surveyed using the reduced protocol when it should have been surveyed using the rotational protocol. This error was not discovered until after the field work was completed. Lumping together the three different survey protocols, each crew averaged approximately four plots per day (96 plots completed during an estimated 24 field crew days).

Plots in Phases 05 and 06 were permanently marked with t-posts and rebar, as these phases will no longer be mowed between planted rows; however, Phase 04W was not marked. Because crew members were instructed to use reduced effort protocols, it was assumed that this site would continue to be mowed.

2.4.5 Cibola National Wildlife Refuge Unit 1 Conservation Area

CNU1 was surveyed during a 6-day field session from December 5 through December 10, 2013. All 80 plots (57 enhanced, 6 rotational, and 17 reduced effort) at this conservation area were surveyed over an estimated total of 20 field crew days for an overall efficiency of approximately 4 plots per team day.

The majority of plots were previously marked with center posts with engraved caps and rebar in the corners, with the exception of the Nature Trail, where plots were not marked if they were highly visible from the trail. Plot centers were marked with t-posts and rebar topped with a stamped survey cap at Hippie Burn. Rebar and flagging were also placed at the A plot corners.

2.5 Data Entry

Following completion of field work, hardcopy data sheets were reviewed again for accuracy and completeness prior to electronic data entry. Seven members of the field crew assisted with entering data into the LCR MSCP Microsoft Access (Microsoft Corporation, Redmond, Washington) vegetation database after a formal training and review of the LCR MSCP data entry instructions. Data entry was completed between January 13 and February 5, 2014. Databases from each of the personnel were reviewed weekly during the data entry process to ensure consistency with the database instructions. After data entry was completed, electronic data were independently reviewed for consistency with the hardcopy data sheet by an individual other than the original data entry person. The databases were delivered to personnel of the LCR MSCP following completion of quality assurance/quality control on February 14, 2014.

2.6 Vegetation Data Summaries

The Project Team analyzed key attributes captured during 2013 vegetation data collection to summarize pre-identified parameters (mean values, and in some cases, distribution of values) for use in annual LCR MSCP summary reports. Data were analyzed in Microsoft Excel (Microsoft Corporation, Redmond, Washington) and JMP® (JMP 9.0.0, SAS Institute, Inc.) by site for the following parameters:

- Tree and shrub plant density and frequency
- Tree and shrub height
- Tree DBH
- Canopy closure
- Ground cover by type
- Foliar cover by species
- Community composition (species frequency richness, diversity, evenness)
- Vertical foliar density

Terms specific to the data analysis are described below:

- *Area*: LCR MSCP management area, which is further subdivided into Sites. Areas measured during the 2013 field season were BLCA, BWRE, PVER, CVCA, and CNU1.

- *Site*: A subarea LCR MSCP designation, which typically is comprised of a field or fields planted in the same year. For example, PVER is subdivided into sites named PVER1, PVER2, PVER3, etc. CNU1 Crane Roost is further separated into two subsites due to differing planting years and vegetation composition. CNU1 Crane Roost 1 (CRANE1) is comprised of the northernmost of the four fields in Crane Roost, planted previously by Cibola National Wildlife Refuge. CNU1 Crane Roost 2 (CRANE2) is comprised of the three southern fields planted by LCR MSCP staff in 2009.

- *Standard tree*: Growth form that includes predetermined species that typically grow with a single trunk or dominant trunk. Standard tree diameter is measured at breast height (specified as 1.5 m above ground surface for this project), and SCs are represented by six individual classes. Species in this growth form are cottonwood and Goodding's willow. Palms and palo verde species have also been measured as standard trees.

- *Saltcedar and mesquite*: Saltcedar and various mesquite species and hybrids are grouped into their own growth form class primarily due to their multi-stemmed growth habit. LCR MSCP protocols specify that saltcedar is defined as a shrub for all program habitat creation areas, whereas it is considered a tree for BWRE. Saltcedar and mesquite are represented by two SCs determined by height of the tallest live branch—SC1 trees are ≤ 3 m tall, and SC2 trees are > 3 m tall.

- *Shrub*: Growth form composed of woody perennial species that typically emerge with multiple stems. Shrubs are generally shorter statured at maturity than multi-stemmed trees. As mentioned previously, saltcedar is considered a shrub at all LCR MSCP habitat creation areas.

- *Coyote willow and arrowweed*: Coyote willow and arrowweed are similarly surveyed primarily because they spread vegetatively from roots. This clonal growth precludes the determination of plant densities following two growing seasons. Therefore, for enhanced and rotational surveys, the plants are represented by stem density and height measurements. For the LCR MSCP, coyote willow is considered a tree, whereas arrowweed is considered a shrub.

A list of all species encountered during field surveys is presented in table 2.

Table 2.—Species encountered during 2013 vegetation surveys[1]

Scientific name	Common name	Native status	Species code
Amaranthus palmeri	Carelessweed	Native	AMAPAL
Amaranthus sp.	Pigweed	N/A	AMASPP
Ambrosia ambrosioides	Ambrosia leaf bur ragweed	Native	AMBAMB
Ambrosia monophylla	Singlewhorl burrobrush	Native	AMBMON
Aristida purpurea	Purple threeawn	Native	ARIPUR
Atriplex lentiformis	Quail bush	Native	ATRLEN
Atriplex semibaccata	Australian saltbush	Introduced	ARTSEM
Baccharis salicina	Willow baccharis	Native	BACSAL
Baccharis salicifolia	Mule fat	Native	BACSAL2
Baccharis sarothroides	Desert broom	Native	BACSAR
Bassia hyssopifolia	Five hook bassia	Introduced	BASHYS
Bebbia juncea	Sweetbush	Native	BEBJUN
Bothriochloa barbinodis	Cane bluestem	Native	BOTBAR
Bouteloua barbata	Sixweeks grama	Native	BOUBAR
Bouteloua gracilis	Blue grama	Native	BOUGRA
Brandegea bigelovii	Desert starvine	Native	BRABIG
Brassica tournefortii	Asian mustard	Introduced	BRATOU
Bromus diandrus	Ripgut brome	Introduced	BRODIA
Carex sp.	Sedge	Unknown	CARSPP
Chamaesyce sp.	Sandmat	Native	CHASPP
Chenopodium sp.	Goosefoot	Native	CHESPP
Conyza canadensis	Canadian horseweed	Native	CONCAN
Cryptantha sp.	Cryptantha	Native	CRYSPP
Cynodon dactylon	Bermudagrass	Introduced	CYNDAC
Cyperus esculentus	Yellow nutsedge	Native/introduced	CYPESC
Cyperus sp.	Nutsedge	Native	CYPSPP
Datura discolor	Desert thorn-apple	Native	DATDIS

Table 2.—Species encountered during 2013 vegetation surveys[1]

Scientific name	Common name	Native status	Species code
Distichlis spicata	Saltgrass	Native	DISSPI
Echinochloa colona	Junglerice	Introduced	ECHCOL
Eleocharis geniculata	Canada spikesedge	Native	ELEGEN
Eragrostis mexicana	Mexican lovegrass	Native	ERAMEX
Helianthus annuus	Common sunflower	Native	HELANN
Heliotropium curassavicum	Heliotrope	Native	HELCUR
Ipomoea purpurea	Morning glory	Introduced	IPOPUR
Juncus torreyi	Torrey's rush	Native	JUNTOR
Lactuca serriola	Prickly lettuce	Introduced	LACSER
Leptochloa fusca	Mexican sprangletop	Native	LEPFUS
Lolium perenne	Perennial ryegrass	Introduced	LOLPER
Lycium andersonii	Water jacket	Native	LYCAND
Lycium fremontii	Fremont's desert-thorn	Native	LYCFRE
Lycium torreyi	Torrey wolfberry	Native	LYCTOR
Machaeranthera asteroides	Fall tansyaster	Native	MACAST
Malvella leprosa	Alkali mallow	Native	MALLEP
Malva parviflora	Cheeseweed mallow	Introduced	MALPAR
Medicago sativa	Alfalfa	Introduced	MEDSAT
Melilotus indicus	Sourclover	Introduced	MELIND
Nicotiana obtusifolia	Desert tobacco	Native	NICOBT
Palafoxia arida	Desert palafox	Native	PALARI
Panicum dichotomiflorum	Fall panicgrass	Native	PANDIC
Parkinsonia florida	Blue palo verde	Native	PARFLO
Paspalum dilatatum	Dallis grass	Introduced	PASDIL
Pectis papposa	Manybristle chinchweed	Native	PECPAP
Pennisetum ciliare	Buffelgrass	Introduced	PENCIL
Phoradendron macrophyllum	Colorado desert mistletoe	Native	PHOCAL
Physalis angulata	Cutleaf groundcherry	Native	PHYANG
Physalis sp.	N/A	N/A	PHYSP
Pluchea odorata	Sweetscent	Native	PLUODO
Pluchea sericea	Arrowweed	Native	PLUSER
Polygonum argyrocoleon	Silversheath knotweed	Introduced	POLARG
Populus fremontii	Cottonwood	Native	POPFRE
Prosopis glandulosa	Honey mesquite	Native	PROGLA
Prosopis pubescens	Screwbean mesquite	Native	PROPUB
Pseudognaphalium arizonicum	Arizona cudweed	Native	PSEARI
Pulicaria paludosa	Spanish false fleabane	Introduced	PULPAL

Table 2.—Species encountered during 2013 vegetation surveys[1]

Scientific name	Common name	Native status	Species code
Salix exigua	Coyote willow	Native	SALEXI
Salix gooddingii	Goodding's willow	Native	SALGOO
Salsola tragus	Prickly russian thistle	Introduced	SALTRA
Schoenoplectus americanus	Chairmaker's bulrush	Native	SCHAME
Setaria pumila	Yellow bristlegrass	Introduced	SETPUM
Sisymbrium irio	London rocket	Introduced	SISIRI
Sonchus asper	Spiny sowthistle	Introduced	SONASP
Sonchus oleraceus	Common sowthistle	Introduced	SONOLE
Sorghum halepense	Johnsongrass	Introduced	SORHAL
Sorghum sp.	N/A	N/A	SORSPP
Sporobolus airoides	Alkali sacaton	Native	SPOAIR
Stephanomeria exigua	Small wirelettuce	Native	STEEXI
Tamarix sp.	Saltcedar	Introduced	TAMSPP
Tiquilia plicata	Fanleaf crinklemat	Native	TIQPLI
Trianthema portulacastrum	Desert horsepurslane	Native	TRIPOR
Tribulus terrestris	Punctureveine	Introduced	TRITER
Typha angustifolia	Narrowleaf cattail	Introduced	TYPANG
Typha spp.	Cattail	N/A	TYPSPP
Washingtonia filifera	California fan palm	Native	WASFIL
Xanthium strumarium	Rough cocklebur	Native	XANSTR

[1] Native status listed as described in USDA PLANTS Database (www.plants.usda.gov). LCR MSCP common names were used; when not available, the USDA PLANTS Database common name was used.

2.6.1 Tree and Shrub Density

Tree and shrub density were estimated by first tallying individuals (or stems for coyote willow and arrowweed) by species and SC for each collection area or subplot (i.e., A, B or E), converting to counts per acre, and summing over SC and subplots for each LCR MSCP vegetation plot, by and over species. All enhanced, reduced effort, and rotational plots were included in this calculation. For enhanced-level surveys, SCs 1–3 were tallied within the 5 x 15 m B plot (SC1 coyote willow and arrowweed were counted in 0.5 x 2 m E plots), and SC4 and above were tallied in the 10 m x 40 m A plot. For reduced effort plots, all SCs were tallied throughout the A plot. For rotational plots, all SC were tallied in the B plot, except for SC1 coyote willow and arrowweed, which were tallied in E plots. Mean and standard error (SE) for density were then calculated over all plots.

Total shrub and tree densities were obtained by summing values over species for each growth form. Relative density was obtained by dividing the species density by the overall tree or shrub density and multiplying by 100.

Because coyote willow and arrowweed are rhizomotous, summaries for these species were considered stem density and were not tabulated by site with other trees and shrubs. These species were tabulated separately for rotational versus enhanced and reduced effort surveys because they were counted at different plot sizes.

2.6.2 Tree and Shrub Height

Tree height was captured using two different methodologies. Up to five individuals per species per SC were measured. For the sixth and subsequent individuals, heights were recorded by HC. To account for the differences in the ways that tree heights are reported, tree height data were analyzed using two different approaches. First, summary statistics of measured tree heights were calculated using JMP®. The mean height of measured trees in each SC was determined for each plot. The mean tree height for each plot was determined by multiplying the mean height of measured trees for each SC by the relative density of that SC in the plot. Summary statistics were then obtained for the plot means within each site. Saltcedar was processed as a tree because height data were collected by SC, but the summary statistics were presented in the shrub height tables. Secondly, the proportion of trees in each HC was determined for each species. For measured trees, HC was not assigned in the field. Measured trees were assigned to HCs.

Mean shrub height was obtained by species for all measured individuals within each plot (up to five per species, measured to nearest 0.1 m), and site summary statistics were obtained for plot means.

2.6.3 Tree Diameter at Breast Height

Standard tree DBH analysis was also conducted in two different ways. First, the distribution of SCs was determined for each area and site by assessing the density of trees per acre by SC. Normalizing to a per-unit basis accounted for differences in area that was surveyed for SC1–SC3 (Plot B) versus SC4 and greater (Plot A). The relative density of trees in each SC was calculated by dividing the density in each SC by the total tree density and dividing by 100.

Additionally, DBH summary statistics were obtained for all “measured” trees of each species. The mean DBH was determined for each species and SC within a plot. The mean DBH for each plot was determined by multiplying the mean for each size class by the relative density of that SC in the plot. Summary statistics were obtained for plot means within a given site.

2.6.4 Canopy Closure

Canopy closure for each D point was determined by multiplying the number of canopy "hits" by 2.702703 (100 divided by the number of line intersections on the densiometer) following methods used previously to analyze these data for the LCR MSCP (BioWest 2010). The mean canopy closure of the five D points was used as the canopy closure for a given plot location. Canopy closure statistics were then obtained by site using the plot means.

2.6.5 Vegetation Structure

Vegetation structure and vertical foliar density were characterized using hits-to-pole data. Vegetation volume was calculated by dividing the total number of "hits" by the number of decimeter intervals monitored (i.e., from ground surface to 7 m for each D point). Vegetation volume was determined by species, and total vegetation volume was also determined using hits for the "All" category. The SE for total vegetation volume was calculated from plot means.

Vertical foliar density was characterized by growth form and species via the number of hits per meter layer. The mean vertical foliar density by and over species was obtained for each plot for each meter layer by taking the mean of the five D Points. Site means by species and SE of total foliar density over species were calculated from the plot means.

2.6.6 Foliar and Ground Cover

Foliar and ground cover were summarized for each site as follows:

1. Shrub and tree foliar cover was summarized by species for each site surveyed using enhanced methods. The midpoint percentage for each cover class was used to approximate cover for each B plot. Foliar cover within a site was obtained by taking the average of all B plots.

2. Ground cover was summarized at each site by cover type, which is recorded as dead vegetation, herbaceous, rock, water, woody, litter, or bare ground in the field. The midpoint percentage for each cover class (e.g., 0.5 percent for less than 1 percent, 5 percent for 1 to 10 percent, 95 percent for 90 to 100 percent, etc.) was used to estimate cover for different ground cover types from each C plot. Mean ground cover of each cover type was obtained for each plot by calculating the average of the four C points. Foliar density for each site is the average of the plot means.

3. Herbaceous foliar cover was summarized for all herbaceous vegetation and by species for each enhanced site and was calculated in the same manner as ground cover. All herbaceous vegetation is shown for sites where more than one herbaceous species was present.

2.6.7 Vegetation Community Parameters

The frequency of all tree and shrub species (i.e., including coyote willow and arrowweed) by species was determined by counting the area that the species was located in, dividing by the number of total plots, and multiplying by 100. The tree or shrub species was considered in frequency calculations if it was listed as an incidental species (i.e., the plant was present in the survey area). The relative frequency was calculated by dividing the frequency of a given species by the overall tree or shrub frequency and multiplying by 100. Vegetation community composition was characterized according to total species richness (number of tree, shrub, and herbaceous species represented) and for tree and shrubs only, Simpson's index of diversity (Equation 1) and Shannon's diversity index (equation 2):

$$D = \frac{\sum_{i=1}^{R} n_i\,(n_i - 1)}{N(N-1)} \qquad \text{Equation 1}$$

where:

D = Simpson's diversity index
R = Richness (total number of tree and shrub species)
n_i = The number of individuals belonging to the *i*th species type
N = The total number of trees and shrubs in the dataset

D is the probability that two individuals drawn randomly from a site are the same species; therefore, higher *D* values indicate lower species diversity. 1-*D* is presented, where higher values indicate higher species diversity.

$$\frac{H'}{H'_{max}}, \text{where } H' = \sum_{i=1}^{R} p_i \ln p_i \text{ and } H'_{max} = lnS \qquad \text{Equation 2}$$

where:

H' = Shannon's index of evenness
H'_{max} = The maximum value of H′
p_i = The proportional abundance of a species
S = The number of species

So, when H'/H'_{max} approaches 1, the community is more even – that is, there are similar numbers of individuals of each species found on the site (e.g., of 100 trees, there are 55 cottonwood and 45 saltcedar), and the site is less even when values are closer to 0 (e.g., of 100 trees, 90 are cottonwood and 10 are saltcedar).

Note that for coyote willow and arrowweed, the number of stems was used in the equation, not the number of individuals, because they are rhizomatous; therefore, it is impossible to distinguish individuals visually.

3.0 SITE CONDITIONS AND VEGETATION CHARACTERISTICS

Ground cover, standard tree DBH, and canopy closure for all sites are summarized in tables 3, 4, and 5, respectively.

Stem density for arrowweed and coyote willow is summarized in table 6 for enhanced and rotational survey sites and table 7 for reduced effort survey sites.

Vegetation composition determined from hits-to-pole data, separated into vegetation classes (tree, shrub, and forb) is summarized in table 8. Total vegetation volume is summarized in table 9. Total vegetation volume (cubic meters per square meter [cm^3/cm^2]) was highest for CRANE1 due to dense honey mesquite and quail bush. Total vegetation volume at BWRE (1.277 m^3/m^2) was similar to the mean value for conservation areas (1.092 m^3/m^2), although saltcedar provided a large portion (approximately one-half) of the vegetation volume at BWRE compared to the conservation areas, where saltcedar comprised an average of 2.4 percent of vegetation volume.

Species richness, evenness, and diversity, by site, are provided in table 10. BWRE had the greatest species richness (42 species present). The species richness in the conservation areas ranged from 6 at CRANE1 to 27 at PVER Site 6. Species evenness ranged from 0.03 at PVER Site 1, where coyote willow stems overwhelmed plant counts of other species, to 0.86 at CVCA Site 5 where no coyote willow or arrowweed was observed. Diversity was also lowest at PVER Site 1 and highest at PVER Site 8 and Hippie Burn. Sites with low evenness and diversity all had high numbers of coyote willow and/or arrowweed stems (BLCA, BWRE, PVER Sites 1 and 2, CVCA Sites 1 and 4E). Tree and shrub density and additional detail by site are provided for each conservation area in the following sections.

In general, LCR MSCP restoration sites were comprised of a dense native riparian tree and shrub overstory with a mix of native and non-native understory vegetation. Tree density (excluding coyote willow) ranged from 71 (at PVER

Table 3.—Percent mean ground cover (and SE) by site for enhanced-level 2013 vegetation surveys

Area	Site	Acres	Litter	Bare	Woody	Herbaceous	Dead	Rock	Water
BLCA	N/A	47	85 (1.7)	9 (1.8)	4 (0.5)	< 1	< 1	0	0
BWRE	N/A	100	61 (3.9)	28 (2.8)	2 (0.4)	< 1	< 1	< 1	7 (2.8)
PVER	PVER1	31	95 (0.4)	< 1	1 (0.9)	< 1	< 1	0	0
	PVER3	80	92 (2.3)	< 1	< 1	4 (2.6)	< 1	0	0
	PVER5	210	89 (3.1)	2 (1.3)	< 1	4 (2.1)	< 1	0	0
	PVER6	213	95 (0.2)	< 1	< 1	< 1	< 1	0	0
CVCA	CVCA1	91	93 (0.6)	< 1	2 (0.6)	1 (0.4)	< 1	0	0
	CVCA3	103	83 (3.5)	9 (2.8)	2 (0.9)	< 1	< 1	0	0
	CVCA5	71	30 (7.3)	61 (6.7)	< 1	3 (2.8)	1 (0.8)	0	0
	CVCA6	89	21 (4.2)	75 (4.5)	< 1	< 1	< 1	0	0
CNU1	Nature Trail	36	87 (2.1)	8 (1.9)	2 (0.4)	< 1	< 1	0	0
	CWN[1]	19	95 (0.0)	1 (0.6)	< 1	< 1	< 1	0	0
	CRANE1	45	88 (5.4)	7 (4.9)	2 (0.9)	0	< 1	0	0
	CRANE2	102	92 (2.2)	< 1	< 1	1 (0.4)	4 (2.2)	0	0

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

Table 4.—Standard tree DBH by site for 2013 vegetation surveys

Area	Site	Cottonwood					Goodding's willow				
		Mean DBH (SE; cm)	n (number of trees)	Number of plots	Range	Median	Mean DBH (SE; cm)	n (number of trees)	Number of plots	Range	Median
BLCA	N/A	14.1 (1.8)	161	17	5.1–28.1	10.5	3.0 (0.6)	59	13	0.5–8.0	2.3
BWRE	N/A	34.3 (7.2)	38	12	6.3–74.7	28.7	24.8 (2.2)	122	25	5.0–40.7	27.0
PVER	PVER1	29.3 (1.5)	19	3	26.7–32.1	29.1	20.3 (0.0)	8	1	20.3–20.3	20.3
	PVER2	13.6 (5.0)	37	5	6.2–33.0	9.8	10.6 (1.0)	87	12	5.1–19.1	9.8
	PVER3	16.5 (0.8)	198	17	12.5–22.7	15.8	6.8 (2.5)	15	5	3.1–16.5	4.5
	PVER4	14.8 (1.0)	102	12	9.8–22.9	14.7	7.3 (0.7)	129	17	2.0–11.4	7.3
	PVER5	11.4 (0.6)	168	21	7.5–17.8	11.5	6.2 (0.6)	148	26	2.0–11.9	5.9
	PVER6	10.5 (0.6)	217	36	3.2–15.0	11.0	6.0 (0.4)	246	35	1.1–13.0	6.0
	PVER7	5.8 (0.2)	357	34	3.3–7.7	5.6	3.2 (0.2)	363	39	0.7–6.7	3.3
	PVER8	0.6 (0.2)	12	4	0.0–1.2	0.6	0.4 (0.2)	8	2	0.2–0.6	0.4
CVCA	CVCA1	20.0 (2.7)	126	13	7.4–43.0	18.7	16.7 (1.5)	35	8	9.0–22.7	16.3
	CVCA2	11.2 (0.9)	89	13	7.0–18.5	9.8	5.2 (0.5)	98	12	1.0–8.2	5.4
	CVCA3	11.8 (2.2)	70	10	4.9–26.0	11.3	2.7 (0.7)	32	4	0.5–3.9	3.1
	CVCA4W	None detected					18.0 (0.0)	1	1	18.0–18.0	18.0
CNU1	Nature Trail	26.3 (4.1)	78	12	12.8–62.0	21.0	4.4 (1.2)	60	6	0.7–8.1	4.0
	CWN[1]	14.6 (0.3)	44	6	13.7–15.7	14.7	None detected				
	Hippie Burn	1.1 (0.2)	96	15	0.0–2.3	1.0	1.1 (0.2)	84	14	0.4–2.7	1.0
	Mass Transplanting	7.4 (0.8)	89	6	6.0–10.7	6.6	0.4 (0.4)	3	2	0.0–0.8	0.4
	CRANE1	32.0 (5.8)	6	3	22.0–42.0	32.1	None detected				
	CRANE2	11.0 (1.9)	59	12	2.9–21.0	8.1	4.6 (1.0)	117	15	0.5–14.2	3.0

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

Table 5.—Canopy closure by site for 2013 vegetation surveys (enhanced-level survey sites only)

Area	Site	Acres	Mean percent canopy closure (SE)	Range of mean percent canopy closure	Median
BLCA	N/A	47	88 (2.5)	38–100	93
BWRE	N/A	100	88 (2.3)	46–100	94
PVER	PVER1	31	84 (8.1)	35–100	94
	PVER3	80	76 (8.6)	0–100	96
	PVER5	210	81 (4.4)	11–99	92
	PVER6	213	82 (3.9)	3–100	91
CVCA	CVCA1	91	94 (1.5)	77–100	96
	CVCA3	103	83 (4.9)	35–99	86
	CVCA5	71	38 (10.1)	0–99	26
	CVCA6	89	31 (5.5)	0–77	28
CNU1	Nature Trail	36	90 (2.4)	58–100	95
	CWN[1]	19	90 (2.6)	79–95	93
	CRANE1	45	99 (0.4)	98–100	99
	CRANE2	102	49 (6.6)	0–99	55

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

Site 1) to 1,583 (at CNU1 Mass Transplanting [Mass Transplanting]) trees per acre. Sites with more than 2 years of growth were dominated by a closed canopy (average of 76 percent across revegetation sites where canopy closure readings were taken) with few snags. Riparian trees were generally comprised of one age class of cottonwood and Goodding's willow, corresponding to the year that the given site was planted. Cottonwood and Goodding's willow DBH typically increased with the number of years since planting.

Five shrub species were variably prevalent: arrowweed, quail bush, willow baccharis, mule fat, desert broom, and saltcedar. Willow baccharis was the most common shrub species at most sites, quail bush was the most common shrub at PVER Site 8 and CVCA Sites 4E and 4W, saltcedar was the most common shrub at CVCA Sites 2 and 5, and desert broom was the most common shrub species at PVER Site 5 and CVCA Site 3. Ground cover was over 80 percent litter at all restoration sites, except CVCA Sites 5 and 6, where bare ground was over 60 percent. Dense arrowweed was observed at BLCA (28,646 stems per acre) and CVCA Site 4E (23,607 stems per acre). Coyote willow stem density was as high as 13,960 stems per acre (PVER Site 2).

Table 6.—Coyote willow and arrowweed stem density (SE) by site for enhanced and rotational 2013 vegetation surveys

Area	Site	Area (acres)	Stem density (stems per acre)	
			Coyote willow	Arrowweed
BLCA	N/A	47	530 (300)	28,646 (4,768)
BWRE	N/A	100	0	5,874 (3040)
PVER	PVER1	31	11,265 (7,279)	0
	PVER2	72	13,960 (2593)	0
	PVER3	80	2,375 (841)	0
	PVER4	97	2,081 (590)	0
	PVER5	210	698 (473)	0
	PVER6	213	3,158 (706)	0
CVCA	CVCA1	91	8,481 (2,599)	0
	CVCA2	71	1,722 (605)	0
	CVCA3	103	1,504 (1,245)	0
	CVCA5	71	0	0
	CVCA6	89	0	0
CNU1	Nature Trail	36	36 (17)	0
	CWN[1]	19	0	0
	Mass Transplanting	20	0	0
	CRANE1	45	0	0
	CRANE2	102	2,309 (1,316)	0

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

Table 7.—Coyote willow and arrowweed density (SE) by site for reduced effort 2013 vegetation surveys

Area	Site	Area (acres)	Density (number per acre)	
			Coyote willow	Arrowweed
PVER	PVER7	226	613 (94)	0
	PVER8	35	0	0
CVCA	CVCA4E	45	0	245 (245)
	CVCA4W	58	0	0
CNU1	Hippie Burn	73	393 (64)	0

Table 8.—Vegetation community composition by site for 2013 vegetation surveys as estimated by hits-to-pole data (enhanced-level survey sites only)

Area	Site	Composition, percent of total vegetation hits (SE)		
		Tree	Shrub	Herbaceous
BLCA	N/A	54 (6.1)	45 (6.0)	1 (0.5)
BWRE	N/A	51 (5.1)	46 (5.3)	3 (1.4)
PVER	PVER1	96 (1.9)	2 (1.7)	2 (1.3)
	PVER3	78 (8.5)	0 (0.0)	22 (8.5)
	PVER5	80 (5.1)	3 (1.7)	17 (4.9)
	PVER6	85 (4.0)	3 (1.5)	12 (3.3)
CVCA	CVCA1	92 (4.1)	0 (0.4)	8 (4.1)
	CVCA3	84 (2.9)	6 (3.4)	10 (1.9)
	CVCA5	65 (11.2)	18 (9.8)	18 (9.0)
	CVCA6	96 (3.2)	0 (0.0)	4 (3.2)
CNU1	Nature Trail	48 (6.3)	38 (6.9)	14 (4.7)
	CWN[1]	86 (4.6)	0 (0.0)	14 (4.6)
	CRANE1	65 (13.0)	35 (13.0)	0 (0.0)
	CRANE2	49 (8.0)	4 (2.0)	47 (7.6)

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

In contrast, BWRE was comprised of a mix of native and non-native overstory of variable age classes, with surface water commonly present within and/or adjacent to plots. Cottonwood and Goodding's willow DBH was much more variable. The standard deviation of cottonwood DBH (3.7) was twice that of any LCR MSCP restoration site. Similar to program creation sites, the canopy was very dense, with an overall canopy closure of 88 percent. Tree density at BWRE was 398 trees per acre, with saltcedar included. Excluding saltcedar, tree density was 110 trees per acre, lower than all LCR MSCP cottonwood-willow restoration sites except PVER Site 1. With saltcedar considered a tree at BWRE, willow baccharis, singlewhorl burrobrush, and water jacket were the shrubs observed in B plots. Coyote willow was not observed, but arrowweed was common (over 5,000 stems per acre).

Table 9.—Vegetation volume (SE) by site for 2013 vegetation surveys as estimated by hits-to-pole data (enhanced-level survey sites only)

Area	Site	Total vegetation volume (m^3/m^2)												
		Cottonwood	Goodding's willow	Coyote willow	Honey mesquite	Screwbean mesquite	Saltcedar	Mule fat	Desert broom	Quail bush	Singlewhorl burrobrush	Willow baccharis	Arrowweed	Total vegetation volume (m^3/m^2)
BLCA	N/A	0.298	0.104	0.049	0.039	0.209	0.027	0.008	0.000	0.000	0.000	0.174	0.477	1.348 (0.103)
BWRE	N/A	0.043	0.261	0.000	0.182	0.000	0.643	0.007	0.000	0.000	0.009	0.028	0.064	1.277 (0.099)
PVER	PVER1	0.063	0.005	0.520	0.213	0.000	0.000	0.000	0.000	0.020	0.000	0.000	0.000	0.830 (0.307)
	PVER3	0.249	0.022	0.088	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.479 (0.067)
	PVER5	0.774	0.421	0.019	0.039	0.000	0.000	0.049	0.005	0.009	0.000	0.001	0.000	1.476 (0.173)
	PVER6	0.526	0.545	0.054	0.003	0.000	0.000	0.021	0.000	0.011	0.000	0.000	0.000	1.238 (0.121)
CVCA	CVCA1	0.314	0.026	0.648	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	1.068 (0.209)
	CVCA3	0.435	0.242	0.032	0.086	0.000	0.002	0.000	0.091	0.006	0.000	0.000	0.000	0.991 (0.163)
	CVCA5	0.000	0.000	0.000	0.515	0.000	0.025	0.000	0.000	0.031	0.000	0.000	0.000	0.592 (0.178)
	CVCA6	0.000	0.000	0.000	0.461	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.472 (0.078)
CNU1	Nature Trail	0.078	0.057	0.009	0.360	0.227	0.000	0.000	0.000	0.000	0.000	0.699	0.000	1.619 (0.165)
	CWN[1]	0.520	0.000	0.000	0.017	0.050	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.757 (0.304)
	CRANE1	0.160	0.000	0.000	1.323	0.000	0.483	0.000	0.000	0.243	0.000	0.100	0.063	2.257 (0.092)
	CRANE2	0.194	0.411	0.152	0.000	0.000	0.035	0.000	0.000	0.000	0.000	0.001	0.000	1.069 (0.204)

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

Table 10.—Vegetation community composition observed during 2013 vegetation surveys

Site	Species richness				Trees and shrubs only		
	Trees	Shrubs	Herbaceous	All species	Trees + shrubs (*S*)	Evenness (H'/H'_{max})	Simpsons index of diversity (1-*D*)
BLCA	5	3	4	12	8	0.19	0.14
BWRE	5	10	27	42	15	0.13	0.11
PVER1	4	2	4	10	6	0.03	0.01
PVER2	3	0	4	7	3	0.18	0.08
PVER3	4	4	6	14	8	0.32	0.23
PVER4	4	2	5	11	6	0.50	0.48
PVER5	4	5	16	25	9	0.66	0.66
PVER6	4	3	20	27	7	0.40	0.37
PVER7	5	3	15	23	8	0.58	0.68
PVER8	3	3	16	22	6	0.74	0.69
CVCA1	4	2	7	13	6	0.12	0.09
CVCA2	4	5	10	19	9	0.52	0.58
CVCA3	4	5	14	23	9	0.62	0.63
CVCA4E	1	3	14	18	4	0.06	0.03
CVCA4W	3	5	11	19	8	0.39	0.36
CVCA5	2	2	17	21	4	0.86	0.57
CVCA6	3	3	13	19	6	0.57	0.47
Nature Trail	5	1	3	9	6	0.51	0.42
CWN[1]	3	1	8	12	4	0.84	0.39
Hippie Burn	4	3	14	21	7	0.66	0.69
Mass Transplanting	3	2	3	8	5	0.37	0.28
CRANE1	2	4	0	6	6	0.75	0.64
CRANE2	4	3	10	17	7	0.39	0.36

[1] Cibola National Wildlife Refuge Unit 1 Conservation Area Cottonwood North.

3.1 Beal Lake Conservation Area

Fields at BLCA were primarily either dominated by cottonwood, with a mixed understory of mesquite and willow, or a honey and screwbean mesquite overstory with a dominant understory of arrowweed and scattered Goodding's willow, coyote willow, and willow baccharis. Several plots were also dominated by arrowweed with scattered mesquite, Goodding's willow, coyote willow, and/or

willow baccharis. Buffelgrass (*Pennisetum ciliare*), observed at BLCA in 2011, was not observed during 2013. Feral pig activity continues to be prevalent at BLCA, with rooting activities variably affecting the fields within BLCA.

Tree and shrub densities and relative tree and shrub densities at BLCA, excluding arrowweed and coyote willow (see table 6), are provided in table 11. Tree and shrub frequency and relative frequency are summarized in table 12. All standard tree species, mesquite species, and saltcedar were encountered at BLCA, but screwbean mesquite comprised the majority of individuals. The shrub class was dominated by willow baccharis, with a smaller component of saltcedar.

Table 11.—Tree and shrub density (SE) at BLCA for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	322 (117)	29
	Goodding's willow	130 (41)	12
	Honey mesquite	12 (6)	1
	Screwbean mesquite	650 (200)	58
Shrubs	Saltcedar	245 (136)	38
	Willow baccharis	401 (127)	62

Table 12.—Tree and shrub frequency at BLCA for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Screwbean mesquite	97	40
	Cottonwood	49	20
	Goodding's willow	46	19
	Honey mesquite	29	12
	Coyote willow	20	8
Shrubs	Arrowweed	94	53
	Willow baccharis	49	27
	Saltcedar	34	19

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

The relative density by SC for each tree species is shown in table 13. Overall tree height is summarized in table 14. Distribution of trees between HCs is shown in table 15. Shrub height data are summarized in table 16.

Table 13.—SC distributions by tree species at BLCA for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	8	56	22	11	2	< 1
Goodding's willow	61	39	0	< 1	0	0
Coyote willow	98	2	0	0	0	0
Honey mesquite	0	100				
Screwbean mesquite	22	78				

Table 14.—Tree height summary at BLCA for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	13.2 (2.0)	161	17	5.5–31.9	11.6
Honey mesquite	5.2 (0.4)	28	10	3.3–7.1	5.2
Screwbean mesquite	4.5 (0.1)	258	34	3.0–6.5	4.6
Coyote willow	3.4 (0.7)	21[1]	5	1.8–5.8	2.9
Goodding's willow	4.0 (0.4)	59	13	1.8–7.4	3.8

[1] Number of stems for coyote willow.

Table 15.—HC summary for standard trees and mesquite at BLCA for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	< 1	8	20	53	15	3
Goodding's willow	2	33	52	12	0	0
Honey mesquite	0	0	80	20	0	0
Screwbean mesquite	5	18	75	3	0	0
Coyote willow	3	50	47	0	0	0

Table 16.—Shrub height summary at BLCA for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs[1])	Number of plots with species	Range (m)	Median (m)
All shrubs[2]	2.5 (0.2)	384	34	0.9–5.0	2.5
Saltcedar	1.8 (0.3)	66	10	0.9–3.8	1.7
Willow baccharis	2.9 (0.2)	318	15	1.7–5.0	3.0
Arrowweed	1.5 (0.1)	991	33	0.3–2.4	1.7

[1] The number of stems is presented for arrowweed.
[2] The "All shrubs" category does not include arrowweed because the number of shrubs was not counted, only the number of stems.

Canopy closure for BLCA is shown in table 5. Vertical foliar density by species is shown on figure 5. Arrowweed was the densest species until the 2–3 m layer, where screwbean mesquite comprised a greater portion of vegetation density. Cottonwood was predominate above 7 m.

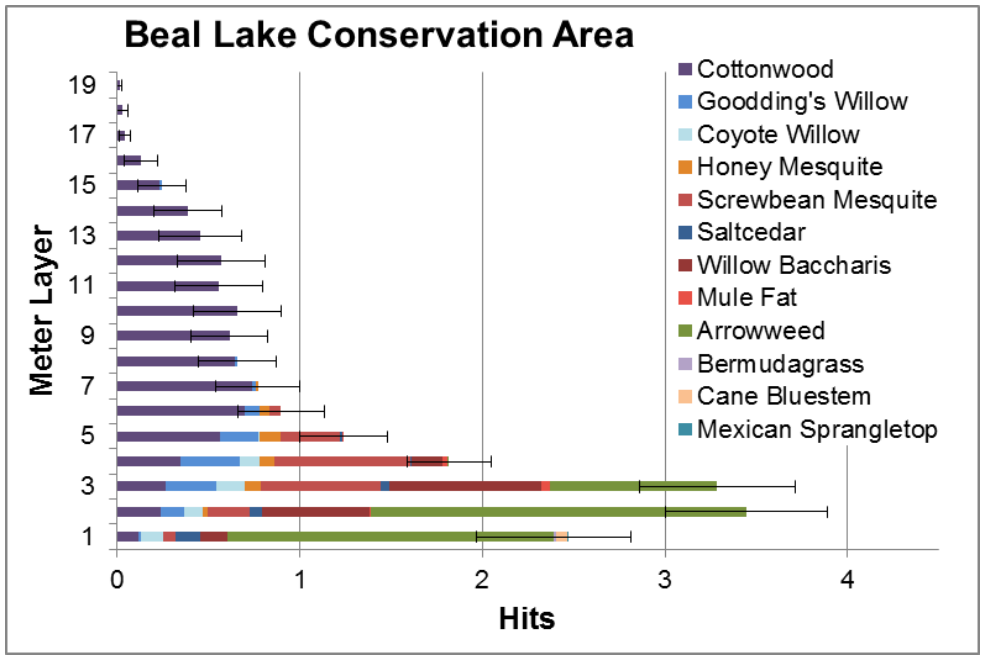

Figure 5.—Vertical foliar density at BLCA for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 17, and herbaceous foliar cover is summarized in table 18.

Table 17.—Tree and shrub foliar cover at BLCA for 2013 vegetation surveys

Species	Cover (percent)	Relative cover (percent)
Total tree and shrub cover	86	Not applicable
Total tree cover	60	54
Total shrub cover	51	46
Cottonwood	28	23
Screwbean mesquite	23	19
Goodding's willow	7	6
Honey mesquite	2	1
Coyote willow	2	1
Arrowweed	40	33
Willow baccharis	17	14
Saltcedar	4	3

Table 18.—Herbaceous foliar cover at BLCA for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous foliar cover	< 1	Not applicable
Bermudagrass	< 1	83
Purple threeawn	< 1	17

3.2 Bill Williams River East

The BWRE survey area was comprised of a mixed native and non-native (saltcedar) overstory, with a variably dense understory growth of native and non-native species. Species richness at BWRE was higher than at all LCR MSCP habitat creation areas. Different cohorts of riparian trees were apparent, with younger trees present nearer the active channel. Surface water was commonly found in or adjacent to plots. These water features included the Bill Williams River, backwater channels, and areas flooded due to beaver dams. As for previous years, wild burro and cattle signs were observed throughout and adjacent to the Bill Williams River National Wildlife Refuge survey area; however, no cattle were observed in the area.

Tree and shrub densities and relative tree and shrub densities at BWRE are provided in table 19. Tree and shrub frequency and relative frequency are summarized in table 20. All standard trees, honey mesquite, and saltcedar were encountered in BWRE, but screwbean mesquite was absent. One blue palo verde

Table 19.—Tree and shrub density (SE) at BWRE for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	19 (9)	5
	Goodding's willow	58 (14)	15
	Blue palo verde	< 1 (< 1)	< 1
	Honey mesquite	32 (8)	8
	Saltcedar	288 (31)	72
Shrubs	Willow baccharis	40 (18)	41
	Singlewhorl burrobrush	51 (43)	53
	Torrey wolfberry	4 (4)	4
	Water jacket	2 (2)	2

Table 20.—Tree and shrub frequency at BWRE for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Saltcedar	100	38
	Goodding's willow	69	27
	Honey mesquite	53	20
	Cottonwood	33	13
	Blue palo verde	6	2
Shrubs	Arrowweed	39	38
	Willow baccharis	33	32
	Mule fat	14	14
	Singlewhorl burrobrush	8	8
	Water jacket	3	3
	Sweetbush	3	3
	Torrey wolfberry	3	3

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

was detected. Saltcedar was the most common tree species. Shrub counts were dominated by willow baccharis, and stem density was dominated by arrowweed (see table 6). Note that mule fat was detected only as an incidental species, and thus height and density estimates were unavailable for this species. The relative density by SC for each tree species is shown in table 21.

Table 21.—SC distributions by tree species at BWRE for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	16	39	0	15	22	9
Goodding's willow	5	15	26	18	26	10
Blue palo verde	0	0	0	100	0	0
Honey mesquite	24	76				
Saltcedar	27	73				

Overall tree height is summarized in table 22. Distribution of trees between HCs is shown in table 23. HC3 (3.2–6.0 m) was most common for all tree species, except Goodding's willow, where HC4 (6.1–12.0 m) was most common. Shrub height data are summarized in table 24.

Table 22.—Tree height summary at BWRE for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	15.8 (1.7)	38	12	5.9-25.0	17.1
Goodding's willow	10.4 (0.7)	122	25	5.6-19.3	10.6
Blue palo verde	8.4 (0.0)	1	1	8.4-8.4	8.4
Honey mesquite	5.3 (0.5)	84	17	0.4-7.9	5.9
Saltcedar	5.1 (0.2)	374	36	1.5-6.8	5.2

Canopy closure for BWRE is shown in table 5. Vertical foliar density by species is shown on figure 6. Saltcedar had the most hits between the 1- and 5-m layer, and Goodding's willow was most common between 5 and 10 m. The upper canopy was comprised primarily of cottonwood.

Tree and shrub foliar cover are summarized in table 25, and herbaceous foliar cover is summarized in table 26.

Table 23.—HC summary for standard trees, mesquite, and saltcedar at BWRE for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	15	0	23	23	27	12
Goodding's willow	7	5	15	46	26	< 1
Blue palo verde	0	0	0	100	0	0
Honey mesquite	19	6	45	28	2	0
Saltcedar	10	16	45	28	< 1	0

Table 24.—Shrub height summary at BWRE for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs[1])	Number of plots with species	Range (m)	Median (m)
All shrubs[2]	1.6 (0.3)	48	14	0.5–3.9	1.5
Singlewhorl burrobrush	1.3 (0.2)	11	2	1.1–1.4	1.3
Torrey wolfberry	2.3 (0.0)	3	1	2.3–2.3	2.3
Willow baccharis	1.9 (0.4)	34	7	0.5–3.9	1.6
Arrowweed	1.6 (0.3)	209	8	0.5–3.1	1.5

[1] The number of stems is presented for arrowweed.
[2] The "All shrubs" category does not include arrowweed because the number of shrubs was not counted, only the number of stems.

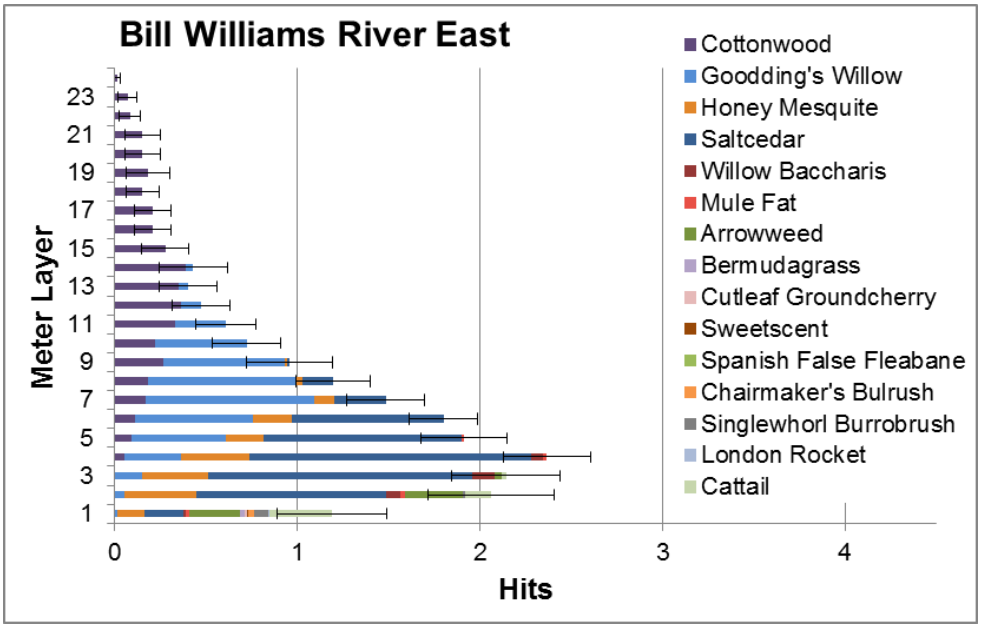

Figure 6.—Vertical foliar density at BWRE for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Table 25.—Tree and shrub foliar cover at BWRE for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	86	Not applicable
Total tree cover	76	93
Total shrub cover	6	7
Saltcedar	48	48
Goodding's willow	21	21
Honey mesquite	14	14
Cottonwood	10	10
Arrowweed	5	5
Willow baccharis	1	1
Singlewhorl burrobrush	1	1
Water jacket	< 1	< 1
Torrey wolfberry	< 1	< 1

Table 26.—Herbaceous foliar cover at BWRE for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	1	Not applicable
Cattail	< 1	61
Bermudagrass	< 1	15
London rocket	< 1	14
Fanleaf crinklemat	< 1	4
Common sowthistle	< 1	3
Pigweed	< 1	< 1
Spiny sowthistle	< 1	< 1
Desert palafox	< 1	< 1
Nutsedge	< 1	< 1
Desert tobacco	< 1	< 1
Cryptantha	< 1	< 1
Yellow nutsedge	< 1	< 1
Spanish false fleabane	< 1	< 1
Chairmaker's bulrush	< 1	< 1

3.3 Palo Verde Ecological Reserve

Vegetation across PVER varied in accordance with the planting plans implemented by Reclamation. These vegetation types included dominant cottonwood, with scattered coyote and Goodding's willow; a mixture of cottonwood and willows; dominant cottonwood, with little understory; dominant Goodding's and coyote willow; dense quail bush (PVER Site 1); a dense understory of alfalfa in newly planted fields; variable cover of Bermudagrass; and minor amounts of honey mesquite and arrowweed. Surface water was not observed at PVER. Several undesirable herbaceous species were observed at PVER: Spanish false fleabane (*Pulicaria paludosa*), a non-native plant of interest, was observed at PVER Sites 5, 6, and 8 and along corridors (e.g., roads and canals); morning glory was identified in PVER Sites 5 and 6, and; buffelgrass was identified in PVER Sites 5 and 7. The site report (attachment 4) lists plots in which these species were observed.

3.3.1 Palo Verde Ecological Reserve Site 1

Tree densities and relative tree densities at PVER Site 1, excluding coyote willow, are summarized in table 27. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 28. Screwbean mesquite was absent, and shrubs were detected only as incidentals. The relative density by SC for each tree species is shown in table 29.

Table 27.—Tree density (SE) at PVER Site 1 for 2013 vegetation surveys

Species	Density (per acre)	Relative density (percent)
Cottonwood	38 (19)	53
Goodding's willow	10 (10)	14
Honey mesquite	23 (16)	33

Overall tree height is summarized in table 30. Distribution of trees between HCs is shown in table 31. Canopy closure for PVER Site 1 is shown in table 5. Vertical foliar density by species is shown on figure 7. Coyote willow and honey mesquite had the most hits between the 1- and 4-m layers. Cottonwood was predominant above 6 m.

Table 28.—Tree and shrub frequency at PVER Site 1 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	38	33
	Coyote willow	38	33
	Honey mesquite	25	22
	Goodding's willow	13	11
Shrubs	Mule fat	13	50
	Quail bush	13	50

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 29.—SC distributions by tree species at PVER Site 1 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	0	0	0	3	87	10
Goodding's willow	0	0	0	63	38	0
Coyote willow	93	7	0	0	0	0
Honey mesquite	29	71				

Table 30.—Tree height summary at PVER Site 1 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	23.1 (0.1)	19	3	22.8–23.3	23.1
Honey mesquite	3.8 (0.4)	17	2	3.3–4.2	3.8
Coyote willow	1.6 (0.5)	103[1]	3	1.0–2.5	1.2
Goodding's willow	13.3 (0.0)	8	1	13.3–13.3	13.3

[1] Number of stems for coyote willow.

Table 31.—HC summary for standard trees and mesquite at PVER Site 1 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	0	0	0	17	83
Goodding's willow	0	0	0	13	88	0
Honey mesquite	0	29	71	0	0	0
Coyote willow	22	46	32	< 1	0	0

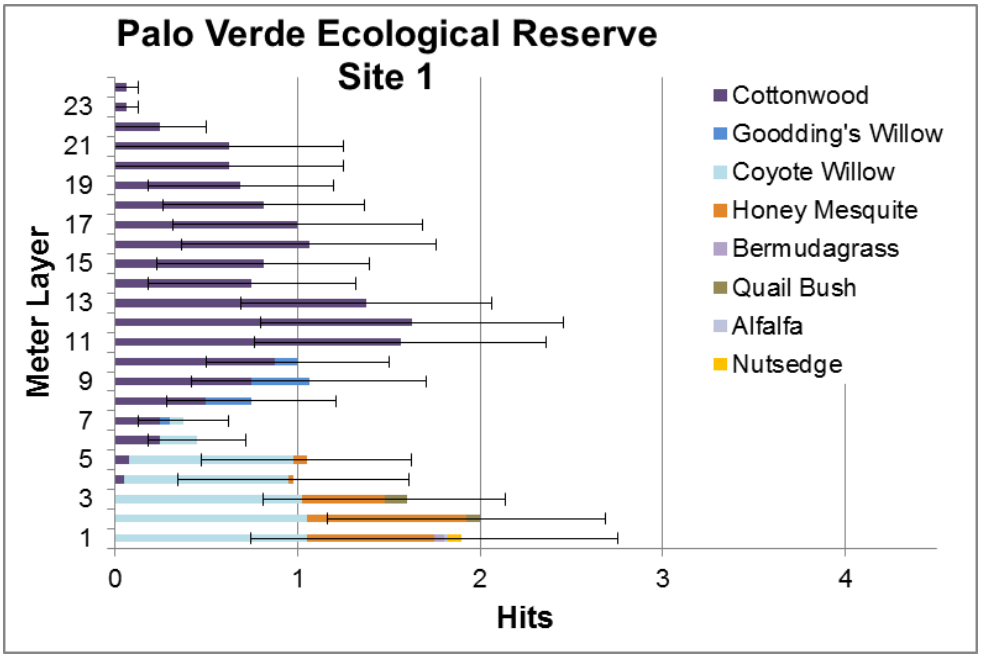

Figure 7.—Vertical foliar density at PVER Site 1 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 32, and herbaceous foliar cover is summarized in table 33.

Table 32.—Tree and shrub foliar cover at PVER Site 1 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	78	Not applicable
Total tree cover	78	100
Total shrub cover	< 1	< 1
Cottonwood	34	44
Coyote willow	24	30
Honey mesquite	13	16
Goodding's willow	8	10
Quail bush	< 1	< 1

Table 33.—Herbaceous foliar cover at PVER Site 1 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	< 1	Not applicable
Nutsedge	< 1	94
Unknown species	< 1	3
Bermudagrass	< 1	3

3.3.2 Palo Verde Ecological Reserve Site 2

Tree densities and relative tree densities at PVER Site 2, excluding coyote willow, are shown in table 34 (no shrubs were detected). Coyote willow density is summarized in table 6. Tree frequency and relative frequency are summarized in table 35. The relative density by SC for each tree species is shown in table 36.

Table 34.—Tree density (SE) at PVER Site 2 for 2013 vegetation surveys

Species	Density (per acre)	Relative density (percent)
Cottonwood	263 (136)	43
Goodding's willow	343 (84)	57

Table 35.—Tree frequency at PVER Site 2 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Coyote willow	88	45
	Goodding's willow	71	36
	Cottonwood	35	18

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 36.—SC distributions by tree species at PVER Site 2 for 2013 vegetation surveys

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	4	20	46	27	4	0
Goodding's willow	1	33	39	23	4	0
Coyote willow	95	5	0	0	0	0

Overall tree height is summarized in table 37. Distribution of trees between HCs is shown in table 38.

Table 37.—Tree height summary at PVER Site 2 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	12.4 (1.6)	37	5	7.9–17.0	12.9
Coyote willow	2.1 (0.2)	273[1]	14	0.6–4.7	2.1
Goodding's willow	10.2 (0.8)	87	12	4.4–13.9	10.0

[1] Number of stems for coyote willow.

Table 38.—HC summary for standard trees and coyote willow at PVER Site 2 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	4	5	27	64	1
Goodding's willow	0	0	7	55	38	0
Coyote willow	19	39	41	1	0	0

3.3.3 Palo Verde Ecological Reserve Site 3

Tree and shrub densities and relative densities at PVER Site 3, excluding coyote willow, are summarized in table 39 (all shrubs aside from desert broom were detected only as incidentals). Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 40. The relative density by SC for each tree species is shown in table 41.

Table 39.—Tree and shrub density (SE) at PVER Site 3 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	317 (48)	89
	Goodding's willow	36 (24)	10
	Honey mesquite	5 (3)	1
Shrubs	Desert broom	2 (2)	100

Table 40.—Tree and shrub frequency at PVER Site 3 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	77	44
	Coyote willow	50	28
	Goodding's willow	27	15
	Honey mesquite	23	13
Shrubs	Quail bush	18	36
	Mule fat	14	27
	Desert broom	14	27
	Saltcedar	5	9

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 41.—SC distributions by tree species at PVER Site 3 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	2	11	15	52	21	0
Goodding's willow	34	61	0	4	< 1	0
Coyote willow	99	1	0	0	0	0
Honey mesquite	100	0				

Overall tree height is summarized in table 42. Distribution of trees between HCs is shown in table 43. Height for desert broom, the only measured shrub at this site, is summarized in table 44. Canopy closure for PVER Site 3 is shown in table 5. Vertical foliar density by species is shown on figure 8. Cottonwood dominated vertical foliar density.

Table 42.—Tree height summary at PVER Site 3 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	17.3 (0.7)	198	17	12.6–23.5	17.3
Honey mesquite	2.6 (0.1)	2	2	2.6–2.7	2.6
Coyote willow	2.7 (0.7)	57[1]	10	1.2–7.2	1.8
Goodding's willow	7.5 (2.6)	15	5	3.5–17.6	5.5

[1] Number of stems for coyote willow.

Table 43.—HC summary for standard trees and mesquite at PVER Site 3 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	< 1	2	11	65	21
Goodding's willow	0	20	47	28	4	0
Honey mesquite	0	100	0	0	0	0
Coyote willow	19	43	38	< 1	0	0

Table 44.—Shrub height summary at PVER Site 3 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
Desert broom	2.7 (0.0)	1	1	2.7–2.7	2.7

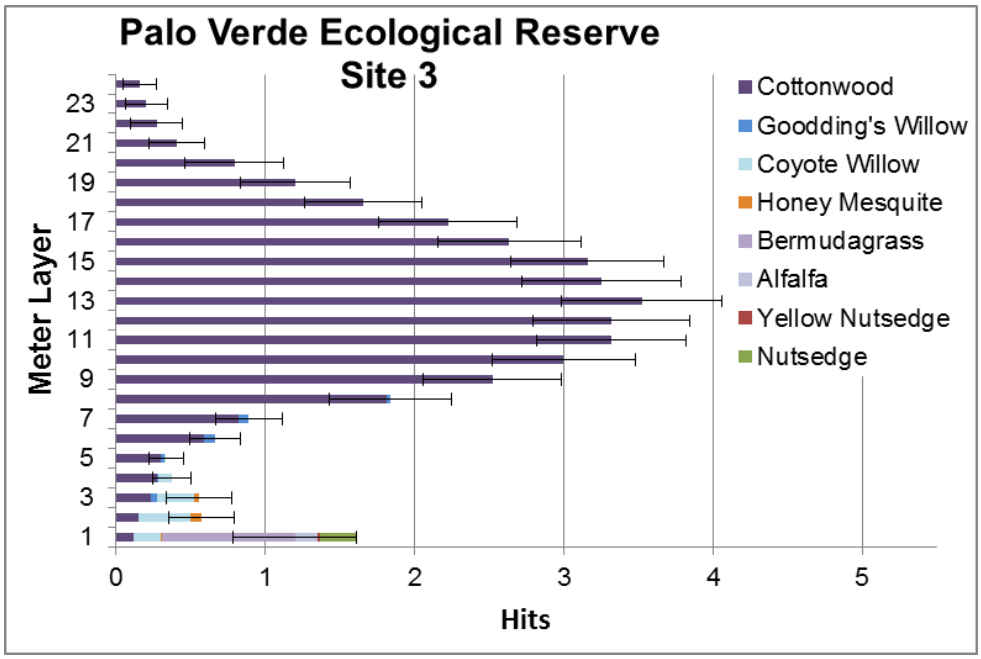

Figure 8.—Vertical foliar density at PVER Site 3 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 45, and herbaceous foliar cover is summarized in table 46.

Table 45.—Tree and shrub foliar cover at PVER Site 3 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	69	Not applicable
Total tree cover	69	100
Total shrub cover	< 1	< 1
Cottonwood	62	81
Coyote willow	10	13
Goodding's willow	4	5
Honey mesquite	1	1
Desert broom	< 1	< 1

Table 46.—Herbaceous foliar cover at PVER Site 3 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	21	Not applicable
Bermudagrass	16	76
Alfalfa	2	10
Nutsedge	2	9
Canadian horseweed	< 1	5
Unknown species	< 1	< 1

3.3.4 Palo Verde Ecological Reserve Site 4

Tree and shrub densities and relative tree and shrub densities at PVER Site 4, excluding coyote willow, are summarized in table 47. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 48. The relative density by SC for each tree species is shown in table 49.

Table 47.—Tree and shrub density (SE) at PVER Site 4 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	326 (84)	37
	Goodding's willow	483 (78)	63
	Honey mesquite	5 (5)	1
Shrubs	Mule fat	16 (7)	40
	Quail bush	24 (17)	60

Overall tree height is summarized in table 50. Distribution of trees between HCs is shown in table 51. Shrub height data are summarized in table 52.

Table 48.—Tree and shrub frequency at PVER Site 4 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Goodding's willow	85	39
	Coyote willow	70	32
	Cottonwood	60	27
	Honey mesquite	5	2
Shrubs	Mule fat	25	71
	Quail bush	10	29

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 49.—SC distributions by tree species at PVER Site 4 for 2013 vegetation surveys

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	2	17	24	44	13	0
Goodding's willow	8	34	48	10	0	0
Coyote willow	95	5	0	0	0	0

Table 50.—Tree height summary at PVER Site 4 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	16.5 (0.5)	102	12	14.1-20.9	15.9
Honey mesquite	4.7 (0.0)	2	1	4.7-4.7	4.7
Coyote willow	2.7 (0.4)	59[1]	14	0.9-6.6	2.1
Goodding's willow	9.9 (0.7)	129	17	4.4-13.8	10.1

[1] Number of stems for coyote willow.

Table 51.—HC summary for standard trees and mesquite at PVER Site 4 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	2	2	19	63	14
Goodding's willow	0	5	12	37	45	0
Honey mesquite	0	0	100	0	0	0
Coyote willow	25	51	23	1	0	0

Table 52.—Shrub height summary at PVER Site 4 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	3.2 (0.1)	20	7	3.0–3.3	3.2
Mule fat	3.1 (0.1)	11	5	3.0–3.3	3.1
Quail bush	3.2 (0.1)	9	2	3.1–3.3	3.2

3.3.5 Palo Verde Ecological Reserve Site 5

Tree and shrub densities and relative tree and shrub densities at PVER Site 5, excluding coyote willow, are summarized in table 53. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 54. The relative density by SC for each tree species is shown in table 55.

Table 53.—Tree and shrub density (SE) at PVER Site 5 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	259 (52)	42
	Goodding's willow	352 (66)	58
	Honey mesquite	1 (1)	< 1
Shrubs	Mule fat	13 (6)	11
	Quail bush	27 (27)	22
	Desert broom	81 (41)	67

Table 54.—Tree and shrub frequency at PVER Site 5 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Goodding's willow	96	49
	Cottonwood	75	38
	Coyote willow	21	11
	Honey mesquite	4	2
Shrubs	Desert broom	43	43
	Mule fat	36	36
	Quail bush	11	11
	Willow baccharis	7	7
	Arrowweed	4	4

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 55.—SC distributions by tree species at PVER Site 5 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	2	24	49	26	< 1	0
Goodding's willow	15	62	19	4	0	0
Coyote willow	98	2	0	0	0	0
Honey mesquite	0	100				

Overall tree height is summarized in table 56. Distribution of trees between HCs is shown in table 57. Shrub height data are summarized in table 58. Canopy closure for PVER Site 5 is shown in table 5. Vertical foliar density by species is shown on figure 9. Cottonwood and Goodding's willow were co-dominant.

Tree and shrub foliar cover are summarized in table 59, and herbaceous foliar cover is summarized in table 60.

Table 56.—Tree height summary at PVER Site 5 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	10.4 (0.4)	168	21	7.0–14.2	10.0
Honey mesquite	4.1 (0.0)	4	1	4.1–4.1	4.1
Coyote willow	1.6 (0.4)	22[1]	4	0.7–2.4	1.7
Goodding's willow	7.3 (0.5)	148	26	3.0–12.8	7.1

[1] Number of stems for coyote willow.

Table 57.—HC summary for standard trees and mesquite at PVER Site 5 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	0	5	69	25	< 1
Goodding's willow	1	5	20	68	6	0
Honey mesquite	0	0	100	0	0	0
Coyote willow	22	37	41	0	0	0

Table 58.—Shrub height summary at PVER Site 5 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.8 (0.2)	44	11	0.9–3.8	1.7
Desert broom	1.4 (0.2)	22	5	0.9–2.0	1.2
Mule fat	3.4 (0.1)	17	5	3.0–3.8	3.4
Quail bush	2.4 (0.0)	5	1	2.4–2.4	2.4

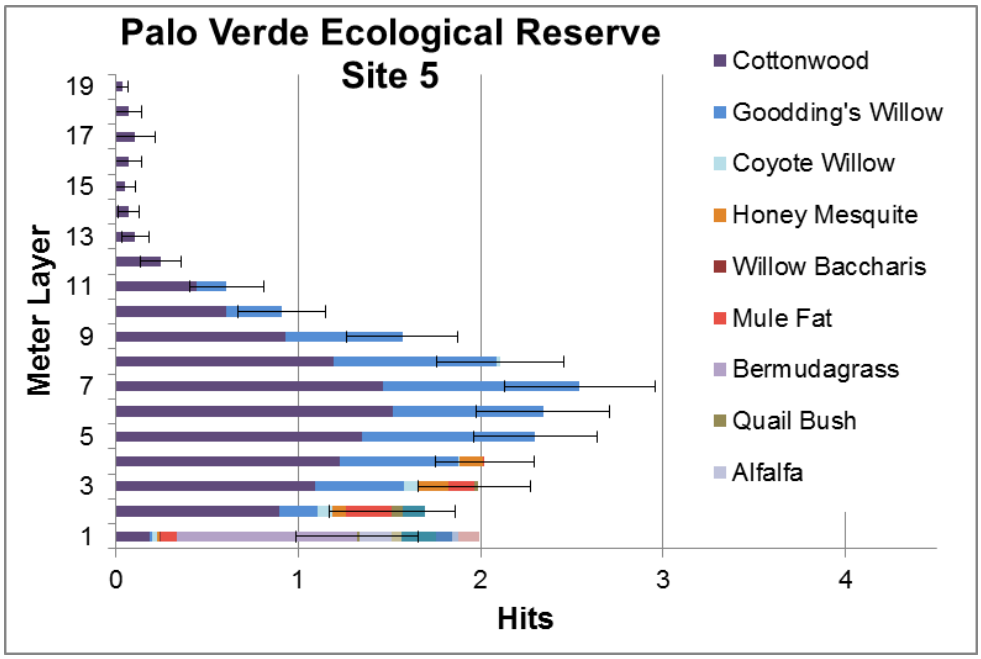

Figure 9.—Vertical foliar density at PVER Site 5 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Table 59.—Tree and shrub foliar cover at PVER Site 5 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	61	Not applicable
Total tree cover	56	91
Total shrub cover	6	9
Cottonwood	33	53
Goodding's willow	22	36
Coyote willow	1	2
Honey mesquite	< 1	< 1
Desert broom	2	4
Quail bush	2	4
Mule fat	1	2
Willow baccharis	< 1	< 1

Table 60.—Herbaceous foliar cover at PVER Site 5 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	16	Not applicable
Bermudagrass	12	78
Nutsedge	1	9
Alfalfa	1	8
Alkali sacaton	< 1	3
Yellow bristlegrass	< 1	1
Canadian horseweed	< 1	< 1
Prickly lettuce	< 1	< 1
Junglerice	< 1	< 1
Buffelgrass	< 1	< 1

3.3.6 Palo Verde Ecological Reserve Site 6

Tree and shrub densities and relative tree and shrub densities at PVER Site 6, excluding coyote willow, are summarized in table 61. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 62. The relative density by SC for each tree species is shown in table 63.

Table 61.—Tree and shrub density (SE) at PVER Site 6 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	341 (79)	40
	Goodding's willow	503 (63)	59
	Honey mesquite	11 (6)	1
Shrubs	Mule fat	22 (10)	80
	Quail bush	5 (4)	20

Overall tree height is summarized in table 64. Distribution of trees between HCs is shown in table 65. Shrub height data are summarized in table 66. Vertical foliar density by species is shown on figure 10. Cottonwood and Goodding's willow were co-dominant.

Table 62.—Tree and shrub frequency at PVER Site 6 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	90	36
	Goodding's willow	90	36
	Coyote willow	55	22
	Honey mesquite	15	6
Shrubs	Mule fat	28	65
	Quail bush	10	24
	Willow baccharis	5	12

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 63.—SC distributions by tree species at PVER Site 6 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	5	61	19	15	< 1	0
Goodding's willow	20	60	20	1	0	0
Coyote willow	99	1	0	0	0	0
Honey mesquite	63	38				

Table 64.—Tree height summary at PVER Site 6 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	9.6 (0.4)	217	36	3.8–12.8	10.3
Honey mesquite	3.2 (0.4)	29	5	2.0–3.9	3.6
Coyote willow	1.7 (0.2)	132[1]	22	0.2–4.3	1.6
Goodding's willow	7.3 (0.3)	246	35	3.1–10.6	7.7

[1] Number of stems for coyote willow.

Table 65.—HC summary for standard trees and mesquite at PVER Site 6 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	< 1	2	12	78	7	0
Goodding's willow	1	5	20	73	< 1	0
Honey mesquite	13	55	33	0	0	0
Coyote willow	30	59	11	0	0	0

Table 66.—Shrub height summary at PVER Site 6 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	2.4 (0.3)	34	8	0.8–3.3	2.6
Mule fat	2.7 (0.3)	30	6	1.4–3.3	2.9
Quail bush	1.2 (0.4)	4	2	0.8–1.6	1.2

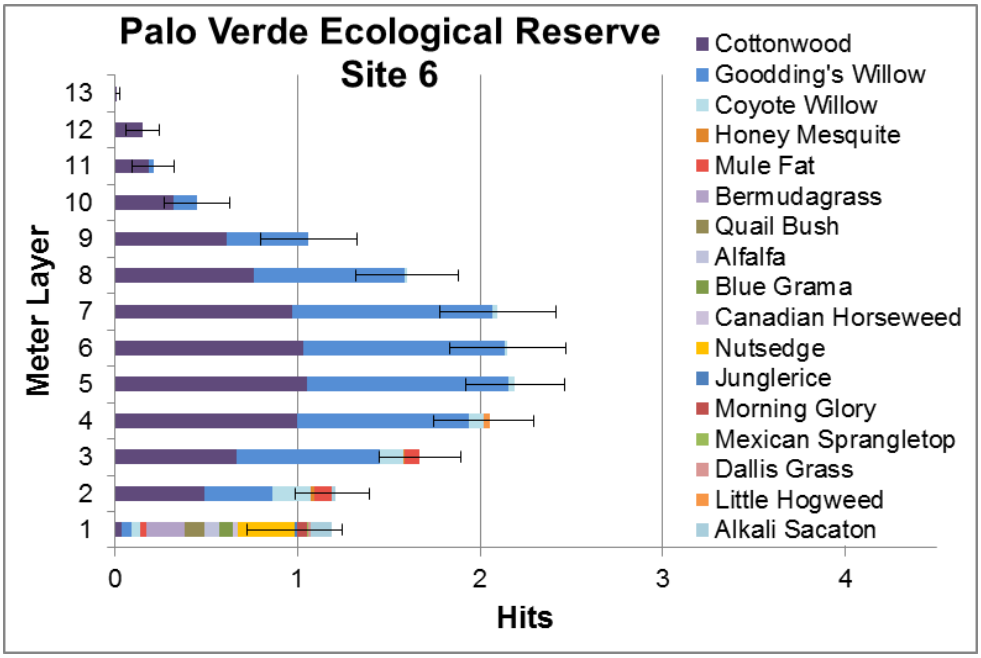

Figure 10.—Vertical foliar density at PVER Site 6 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 67, and herbaceous foliar cover is summarized in table 68.

Table 67.—Tree and shrub foliar cover at PVER Site 6 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	56	Not applicable
Total tree cover	56	98
Total shrub cover	1	2
Cottonwood	28	50
Goodding's willow	26	46
Coyote willow	2	3
Honey mesquite	< 1	< 1
Mule fat	1	1
Quail bush	< 1	< 1

Table 68.—Herbaceous foliar cover at PVER Site 6 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	8	Not applicable
Bermudagrass	4	58
Blue grama	2	25
Nutsedge	<1	11
Alfalfa	<1	2
Yellow bristlegrass	<1	1
Canadian horseweed	<1	<1
Prickly lettuce	<1	<1
Junglerice	<1	<1
Common sowthistle	<1	<1
Alkali sacaton	<1	<1
Silversheath knotweed	<1	<1

3.3.7 Palo Verde Ecological Reserve Site 7

Tree and shrub densities and relative tree and shrub densities at PVER Site 7, excluding coyote willow, are summarized in table 69. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 70. The relative density by SC for each tree species is shown in table 71.

Table 69.—Tree and shrub density (SE) at PVER Site 7 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	562 (98)	48
	Goodding's willow	587 (64)	51
	Honey mesquite	6 (4)	1
	Screwbean mesquite	4 (3)	< 1
Shrubs	Willow baccharis	3 (2)	9
	Mule fat	32 (8)	87
	Quail bush	2 (1)	4

Table 70.—Tree and shrub frequency at PVER Site 7 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Goodding's willow	98	34
	Coyote willow	95	33
	Cottonwood	85	29
	Honey mesquite	8	3
	Screwbean mesquite	5	2
Shrubs	Mule fat	55	76
	Willow baccharis	13	17
	Quail bush	5	7

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 71.—SC distributions by tree species at PVER Site 7 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	8	83	9	0	0	0
Coyote willow	100	< 1	0	0	0	0
Honey mesquite	96	4				
Screwbean mesquite	100	0				

Overall tree height is summarized in table 72. Distribution of trees between HCs is shown in table 73. Shrub height data are summarized in table 74.

Table 72.—Tree height summary at PVER Site 7 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	6.7 (0.1)	357	34	4.9–7.9	6.7
Honey mesquite	1.8 (0.3)	14	3	1.3–2.2	2.0
Screwbean mesquite	1.5 (0.1)	10	2	1.4–1.6	1.5
Coyote willow	2.4 (0.1)	200	38	1.3–3.9	2.5
Goodding's willow	4.8 (0.2)	363	39	2.0–7.4	4.7

Table 73.—HC summary for standard trees and mesquite at PVER Site 7 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	< 1	2	17	80	0	0
Goodding's willow	3	16	52	29	0	0
Honey mesquite	17	78	4	0	0	0
Screwbean mesquite	71	29	0	0	0	0
Coyote willow	25	55	20	0	0	0

Table 74.—Shrub height summary at PVER Site 7 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	2.4 (0.1)	147	24	1.0–3.4	2.4
Mule fat	2.6 (0.1)	128	22	1.3–3.4	2.6
Quail bush	1.2 (0.1)	6	2	1.0–1.3	1.2
Willow baccharis	1.5 (0.3)	13	5	1.1–2.8	1.2

3.3.8 Palo Verde Ecological Reserve Site 8

Tree and shrub densities and relative tree and shrub densities at PVER Site 8, excluding coyote willow, are summarized in table 75. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 76. The relative density by SC for each tree species is shown in table 77.

Table 75.—Tree and shrub density (SE) at PVER Site 8 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	40 (23)	22
	Goodding's willow	29 (23)	16
	Honey mesquite	111 (8)	62
Shrubs	Saltcedar	211 (131)	43
	Mule fat	3 (3)	1
	Quail bush	324 (64)	59

Table 76.—Tree and shrub frequency at PVER Site 8 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Honey mesquite	100	50
	Cottonwood	67	33
	Goodding's willow	33	17
Shrubs	Quail bush	100	60
	Saltcedar	50	30
	Mule fat	17	10

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 77.—SC distributions by tree species at PVER Site 8 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	100	0	0	0	0	0
Goodding's willow	100	0	0	0	0	0
Honey mesquite	100	0				

Overall tree height is summarized in table 78. Distribution of trees between HCs is shown in table 79. Shrub height data are summarized in table 80.

Table 78.—Tree height summary at PVER Site 8 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	1.6 (0.3)	12	4	0.8–2.4	1.5
Honey mesquite	1.6 (0.1)	33	6	1.3–2.0	1.5
Goodding's willow	1.4 (0.3)	8	2	1.1–1.7	1.4

Table 79.—HC summary for standard trees and mesquite at PVER Site 8 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	29	71	0	0	0	0
Goodding's willow	53	47	0	0	0	0
Honey mesquite	61	39	0	0	0	0

Table 80.—Shrub height summary at PVER Site 8 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.2 (0.1)	47	6	1.0–1.4	1.2
Mule fat	1.3 (0.0)	2	1	1.3–1.3	1.3
Quail bush	1.2 (0.0)	30	6	1.1–1.3	1.2
Saltcedar	1.2 (0.1)	15	3	1.0–1.4	1.3

3.4 Cibola Valley Conservation Area

Vegetation across the site varied in accordance with the various planting plans implemented by Reclamation. CVCA Sites 1 and 2 were dominated by cottonwood, Goodding's willow, and/or coyote willow. CVCA Site 3 was dominated by cottonwood, with one plot (CVCA_03_101) dominated by honey mesquite. CVCA Sites 4W, 4E, 5, and 6 are dominated by honey mesquite and quail bush. Saltcedar, arrowweed, and heliotrope, while present in some plots, were not prevalent. Morning glory continues to be prevalent at CVCA Sites 1, 2, 3, 4E, and 4W. Buffelgrass was identified at this site for the first time, in CVCA Site 4E.

3.4.1 Cibola Valley Conservation Area Site 1

Tree and shrub densities and relative tree and shrub densities at CVCA Site 1, excluding coyote willow, are summarized in table 81. Tree and shrub frequency and relative frequency are summarized in table 82. The relative density by SC for each tree species is shown in table 83.

Table 81.—Tree and shrub density (SE) at CVCA Site 1 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	303 (118)	78
	Goodding's willow	85 (70)	22
	Honey mesquite	1 (1)	< 1
Shrubs	Saltcedar	9 (5)	100
	Willow baccharis	0	0

Table 82.—Tree and shrub frequency at CVCA Site 1 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	68	39
	Coyote willow	58	33
	Goodding's willow	42	24
	Honey mesquite	5	3
Shrubs	Willow baccharis	26	63
	Saltcedar	16	38

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 83.—SC distributions by tree species at CVCA Site 1 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	3	28	37	21	10	< 1
Goodding's willow	0	27	54	10	9	0
Coyote willow	84	16	0	0	0	0
Honey mesquite	0	100				

Overall tree height is summarized in table 84. Distribution of trees between HCs is shown in table 85. Shrub height data are summarized in table 86. Canopy closure for CVCA Site 1 is shown in table 5. Vertical foliar density by species is shown on figure 11. Coyote willow comprised the largest portion of vegetation volume until the 6-m layer. Cottonwood was predominant above that layer.

Table 84.—Tree height summary at CVCA Site 1 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	15.6 (1.0)	126	13	10.0–20.7	15.8
Honey mesquite	4.7 (0.0)	1	1	4.7–4.7	4.7
Coyote willow	4.0 (0.2)	208[1]	10	2.8–4.7	4.3
Goodding's willow	11.2 (0.8)	35	8	8.4–14.7	10.9

[1] Number of stems for coyote willow.

Table 85.—HC summary for standard trees and mesquite at CVCA Site 1 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	3	5	39	50	3
Goodding's willow	0	< 1	24	63	12	0
Honey mesquite	0	0	100	0	0	0
Coyote willow	2	19	70	9	0	0

Table 86.—Shrub height summary at CVCA Site 1 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	5.0 (0.8)	26	3	2.2–7.4	5.3
Saltcedar	5.9 (1.0)	25	3	3.9–7.4	6.4
Willow baccharis	2.2 (0.0)	1	1	2.2–2.2	2.2

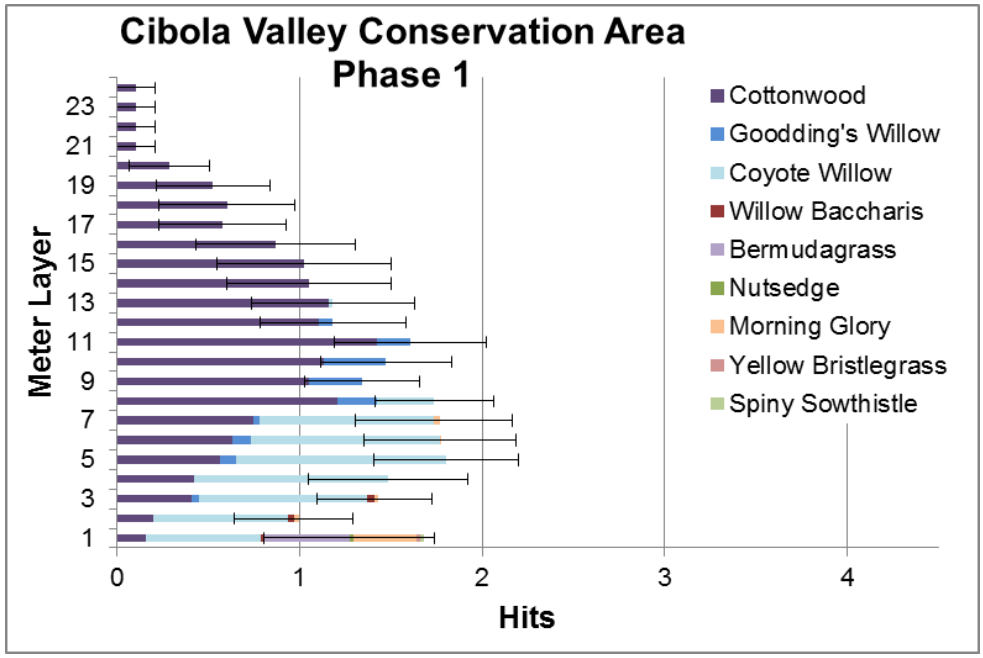

Figure 11.—Vertical foliar density at CVCA Site 1 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 87, and herbaceous foliar cover is summarized in table 88.

Table 87.—Tree and shrub foliar cover at CVCA Site 1 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	78	Not applicable
Total tree cover	78	100
Total shrub cover	0	< 1
Cottonwood	39	50
Coyote willow	31	39
Goodding's willow	9	11
Saltcedar	0.3	< 1
Willow baccharis	0.1	< 1

Table 88.—Herbaceous foliar cover at CVCA Site 1 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	8	Not applicable
Bermudagrass	8	90
Morning glory	< 1	7
Nutsedge	< 1	2
Junglerice	< 1	< 1
Spiny sowthistle	< 1	< 1
Alfalfa	< 1	< 1

3.4.2 Cibola Valley Conservation Area Site 2

Tree and shrub densities and relative tree and shrub densities at CVCA Site 2, excluding coyote willow, are summarized in table 89. Coyote willow stem density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 90. The relative density by SC for each tree species is shown in table 91.

Table 89.—Tree and shrub density (SE) at CVCA Site 2 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	324 (71)	34
	Goodding's willow	630 (147)	66
	Honey mesquite	3 (3)	< 1
Shrubs	Saltcedar	256 (44)	79
	Willow baccharis	26 (10)	12
	Mule fat	3 (3)	1
	Quail bush	14 (10)	7
	Desert broom	3 (3)	1

Table 90.—Tree and shrub frequency at CVCA Site 2 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	68	34
	Goodding's willow	63	32
	Coyote willow	63	32
	Honey mesquite	5	3
Shrubs	Saltcedar	95	64
	Willow baccharis	32	21
	Quail bush	11	7
	Mule fat	5	4
	Desert broom	5	4

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 91.—SC distributions by tree species at CVCA Site 2 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	4	22	54	19	1	0
Goodding's willow	17	73	10	0	0	0
Coyote willow	68	32	0	0	0	0
Honey mesquite	100	0				

Overall tree height is summarized in table 92. Distribution of trees between HCs is shown in table 93. Shrub height data are summarized in table 94.

Table 92.—Tree height summary at CVCA Site 2 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	11.6 (0.7)	89	13	6.3–16.8	11.4
Honey mesquite	0.5 (0.0)	1	1	0.5–0.5	0.5
Coyote willow	5.0 (0.5)	61[1]	11	2.0–6.7	5.8
Goodding's willow	6.7 (0.7)	98	12	2.0–11.4	6.9

[1] Number of stems for coyote willow.

Table 93.—HC summary for standard trees and mesquite at CVCA Site 2 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	< 1	4	55	39	0
Goodding's willow	11	13	11	64	< 1	0
Honey mesquite	100	0	0	0	0	0
Coyote willow	6	21	58	15	0	0

Table 94.—Shrub height summary at CVCA Site 2 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.6 (0.2)	99	19	0.4–3.3	1.7
Desert broom	0.4 (0.0)	1	1	0.4–0.4	0.4
Mule fat	2.9 (0.0)	2	1	2.9–2.9	2.9
Quail bush	1.4 (0.0)	5	2	1.4–1.4	1.4
Saltcedar	1.5 (0.1)	82	18	0.4–2.4	1.6
Willow baccharis	2.1 (0.4)	9	6	0.9–3.3	2.2

3.4.3 Cibola Valley Conservation Area Site 3

Tree and shrub densities and relative tree and shrub densities at CVCA Site 3, excluding coyote willow, are summarized in table 95. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 96. The relative density by SC for each tree species is shown in table 97.

Table 95.—Tree and shrub density (SE) at CVCA Site 3 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	629 (228)	64
	Goodding's willow	349 (190)	35
	Honey mesquite	12 (11)	1
Shrubs	Saltcedar	72 (46)	26
	Willow baccharis	12 (12)	5
	Quail bush	46 (46)	17
	Desert broom	145 (108)	53

Table 96.—Tree and shrub frequency at CVCA Site 3 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	77	40
	Goodding's willow	46	24
	Honey mesquite	38	20
	Coyote willow	31	16
Shrubs	Saltcedar	54	44
	Willow baccharis	31	25
	Mule fat	15	13
	Desert broom	15	13
	Quail bush	8	6

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 97.—SC distributions by tree species at CVCA Site 3 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	1	79	14	5	1	0
Goodding's willow	30	69	1	0	0	0
Coyote willow	98	2	0	0	0	0
Honey mesquite	0	100				

Overall tree height is summarized in table 98. Distribution of trees between HCs is shown in table 99. Shrub height data are summarized in table 100. Canopy closure for CVCA Site 3 is shown in table 5. Vertical foliar density by species is shown on figure 12. A diverse understory is present until the 4-m layer. Cottonwood is dominant above that layer.

Table 98.—Tree height summary at CVCA Site 3 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	9.9 (0.9)	70	10	6.5–13.9	10.0
Honey mesquite	5.3 (0.3)	10	3	4.9–6.0	5.1
Coyote willow	2.6 (0.7)	22[1]	3	1.3–3.3	3.2
Goodding's willow	3.4 (0.7)	32	4	1.8–5.1	3.3

[1] Number of stems for coyote willow.

Table 99.—HC summary for standard trees and mesquite at CVCA Site 3 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	0	7	90	2	0
Goodding's willow	5	27	60	9	0	0
Honey mesquite	0	0	100	0	0	0
Coyote willow	20	56	24	0	0	0

Table 100.—Shrub height summary at CVCA Site 3 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.9 (0.2)	35	4	0.5–2.9	1.9
Desert broom	2.0 (0.1)	10	2	1.9–2.2	2.0
Quail bush	1.7 (0.0)	5	1	1.7–1.7	1.7
Saltcedar	1.4 (0.4)	16	3	0.5–2.0	1.6
Willow baccharis	2.9 (0.0)	4	1	2.9–2.9	2.9

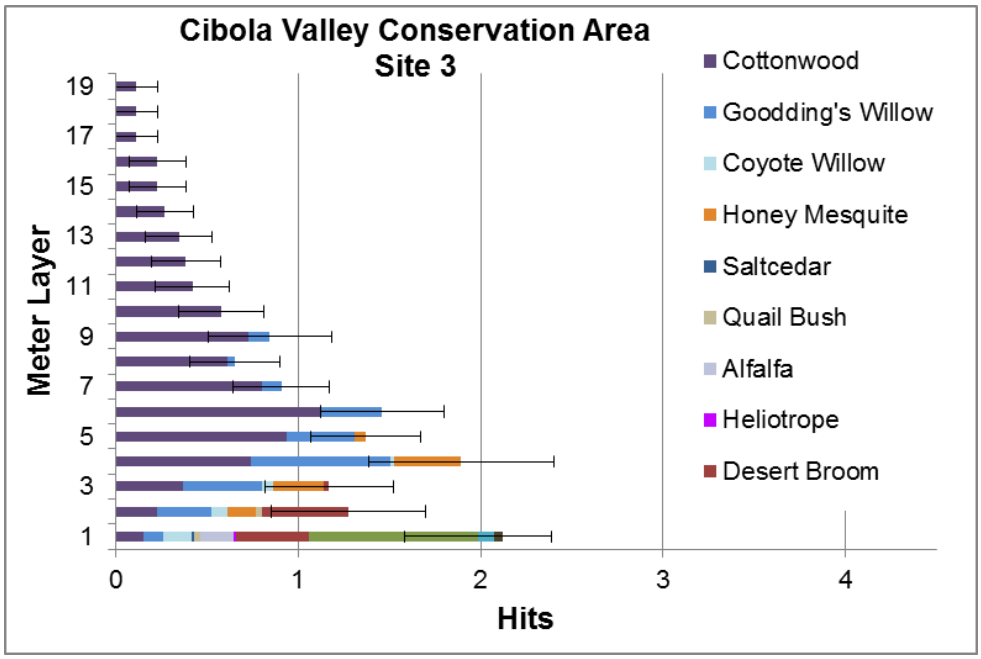

Figure 12.—Vertical foliar density at CVCA Site 3 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 101, and herbaceous foliar cover is summarized in table 102.

Table 101.—Tree and shrub foliar cover at CVCA Site 3 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	78	Not applicable
Total tree cover	78	100
Total shrub cover	0	< 1
Cottonwood	39	50
Coyote willow	31	39
Goodding's willow	9	11
Saltcedar	0.3	< 1
Willow baccharis	0.1	< 1

Table 102.—Herbaceous foliar cover at CVCA Site 3 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	5	Not applicable
Nutsedge	4	86
Sedge	< 1	6
Alfalfa	< 1	4
Sourclover	< 1	2
Morning glory	< 1	1
Desert horsepurslane	< 1	< 1
Heliotrope	< 1	< 1
Bermudagrass	< 1	< 1

3.4.4 Cibola Valley Conservation Area Site 4E

Tree and shrub densities and relative tree and shrub densities at CVCA Site 4E are summarized in table 103. No coyote willow was observed. Tree and shrub frequency and relative frequency are summarized in table 104. The relative density by SC for each tree species is shown in table 105.

Table 103.—Tree and shrub density (SE) at CVCA Site 4E for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Honey mesquite	106 (19)	100
Shrubs	Saltcedar	22 (14)	9
	Quail bush	229 (59)	91

Table 104.—Tree and shrub frequency at CVCA Site 4E for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Honey mesquite	100	100
Shrubs	Quail bush	100	55
	Saltcedar	67	36
	Arrowweed	17	9

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 105.—SC distributions by tree species at CVCA Site 4E for 2013 vegetation surveys
(Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Honey mesquite	27	73				

The overall tree height for honey mesquite is summarized in table 106. Distribution of trees between HCs is shown in table 107. Shrub height data are summarized in table 108.

Table 106.—Tree height summary at CVCA Site 4E for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Honey mesquite	3.3 (0.4)	56	6	2.0–4.9	3.3

Table 107.—HC summary for standard trees and mesquite at CVCA Site 4E for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Honey mesquite	14	16	70	0	0	0

Table 108.—Shrub height summary at CVCA Site 4E for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs[1]	1.4 (0.1)	35	6	1.0–2.0	1.3
Quail bush	1.4 (0.1)	26	6	1.1–1.8	1.3
Saltcedar	1.4 (0.2)	9	4	1.0–2.0	1.3
Arrowweed	1.4 (0.0)	5	1	1.4–1.4	1.4

[1] The "All shrubs" category does include arrowweed because the number of shrubs was not counted due to reduced effort protocols.

3.4.5 Cibola Valley Conservation Area Site 4W

Tree and shrub densities and relative tree and shrub densities at CVCA Site 4W are summarized in table 109. No coyote willow was observed. Tree and shrub frequency and relative frequency are summarized in table 110. The relative density by SC for each tree species is shown in table 111.

Table 109.—Tree and shrub density (SE) at CVCA Site 4W for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Goodding's willow	1 (1)	1
	Honey mesquite	138 (26)	99
Shrubs	Saltcedar	79 (20)	8
	Willow baccharis	27 (11)	3
	Mule fat	7 (6)	1
	Quail bush	928 (112)	89
	Desert broom	1 (1)	< 1

Table 110.—Tree and shrub frequency at CVCA Site 4W for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Honey mesquite	100	85
	Goodding's willow	9	8
	California fan palm	9	8
Shrubs	Quail bush	100	38
	Saltcedar	82	31
	Willow baccharis	55	21
	Mule fat	18	7
	Desert broom	9	3

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 111.—SC distributions by tree species at CVCA Site 4W for 2013 vegetation surveys
(Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Goodding's willow	0	0	0	100	0	0
Honey mesquite	49	51				

Overall tree height is summarized in table 112. The distribution of trees between HCs is shown in table 113. Shrub height data are summarized in table 114.

Table 112.—Tree height summary at CVCA Site 4W for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Honey mesquite	3.3 (0.4)	108	11	0.8–5.1	3.3
Goodding's willow	7.7 (0.0)	1	1	7.7–7.7	7.7

Table 113.—HC summary for standard trees and mesquite at CVCA Site 4W for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Goodding's willow	0	0	0	100	0	0
Honey mesquite	34	18	48	0	0	0

Table 114.—Shrub height summary at CVCA Site 4W for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.6 (0.1)	82	11	0.6–3.1	1.7
Desert broom	0.6 (0.0)	1	1	0.6–0.6	0.6
Mule fat	2.1 (0.0)	2	2	2.1–2.1	2.1
Quail bush	1.6 (0.1)	11	11	1.1–1.9	1.6
Saltcedar	2.1 (0.3)	62	9	0.7–3.1	2.0
Willow baccharis	2.2 (0.1)	6	6	1.9–2.4	2.2

3.4.6 Cibola Valley Conservation Area Site 5

Tree and shrub densities and relative tree and shrub densities at CVCA Site 5 are summarized in table 115. No coyote willow was observed. Tree and shrub frequency and relative frequency are summarized in table 116. The relative density by SC for each tree species is shown in table 117.

Table 115.—Tree and shrub density (SE) at CVCA Site 5 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Honey mesquite	93 (10)	100
Shrubs	Saltcedar	20 (9)	27
	Quail bush	54 (30)	73

Table 116.—Tree and shrub frequency at CVCA Site 5 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Honey mesquite	100	93
	Cottonwood	8	7
Shrubs	Saltcedar	46	50
	Quail bush	46	50

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 117.—SC distributions by tree species at CVCA Site 5 for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Honey mesquite	22	78				

The tree height for honey mesquite is summarized in table 118. Distribution for honey mesquite between HCs is shown in table 119. Shrub height data are summarized in table 120. Canopy closure for CVCA Site 3 is shown in table 5. Vertical foliar density by species is shown on figure 13. A diverse understory is present the first 1-m layer. Honey mesquite is dominant above that layer.

Table 118.—Tree height summary at CVCA Site 5 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Honey mesquite	3.8 (0.3)	115	13	2.0–5.5	3.6

Table 119.—HC summary for standard trees and mesquite at CVCA Site 5 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Honey mesquite	9	18	72	< 1	0	0

Table 120.—Shrub height summary at CVCA Site 5 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.2 (0.2)	16	8	0.4–4.8	1.3
Quail bush	0.6 (0.1)	3	3	0.4–0.7	0.6
Saltcedar	2.9 (0.6)	13	6	1.1–4.8	3.1

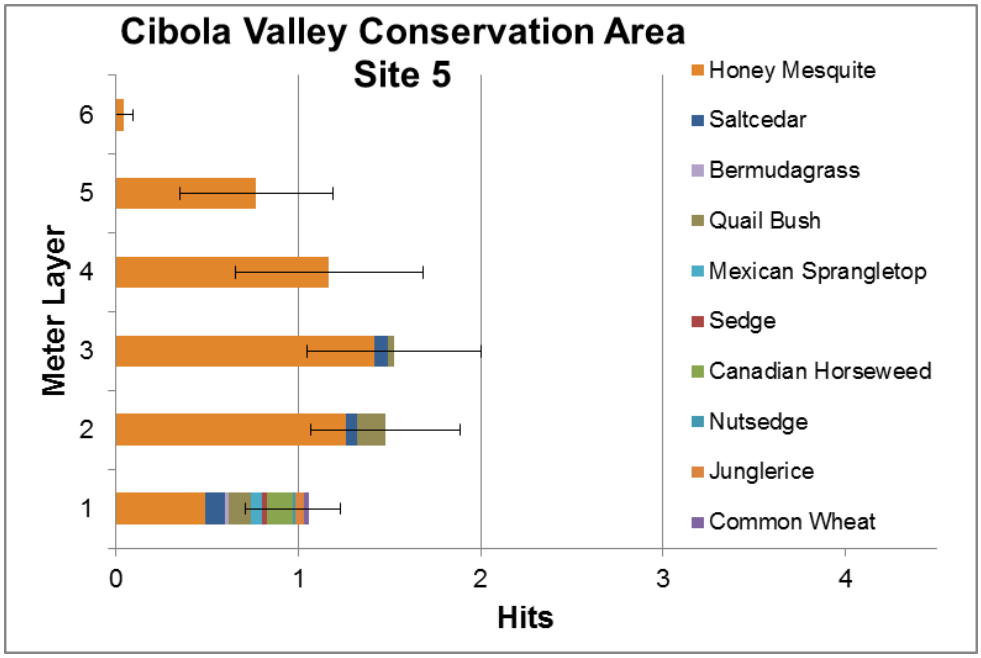

Figure 13.—Vertical foliar density at CVCA Site 5 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 121, and herbaceous foliar cover is summarized in table 122.

Table 121.—Tree and shrub foliar cover at CVCA Site 5 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	16	Not applicable
Total tree cover	16	95
Total shrub cover	1	5
Honey mesquite	16	85
Saltcedar	2	10
Quail bush	1	5

Table 122.—Herbaceous foliar cover at CVCA Site 5 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	7	Not applicable
Bermudagrass	3	38
Junglerice	1	19
Mexican sprangletop	1	19
Canadian horseweed	< 1	10
Goosefoot	< 1	7
Nutsedge	< 1	4
Sedge	< 1	2
Pigweed	< 1	1
Perennial ryegrass	< 1	< 1
Cutleaf groundcherry	< 1	< 1
Desert thorn-apple	< 1	< 1
Asian mustard	< 1	< 1

3.4.7 Cibola Valley Conservation Area Site 6

Tree and shrub densities and relative tree and shrub densities at CVCA Site 6 are summarized in table 123. No coyote willow or arrowweed was observed within CVCA Site 6 E plots, although it was an incidental species in 7 plots (see table 6). Tree and shrub frequency and relative frequency are summarized in table 124.

Table 123.—Tree and shrub density (SE) at CVCA Site 6 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Honey mesquite	179 (27)	100
	Screwbean mesquite	1 (1)	< 1
Shrubs	Saltcedar	15 (11)	18
	Willow baccharis	68 (54)	82

Table 124.—Tree and shrub frequency at CVCA Site 6 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Honey mesquite	100	88
	Cottonwood	7	6
	Screwbean mesquite	7	6
Shrubs	Willow baccharis	33	50
	Saltcedar	27	40
	Arrowweed	7	10

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

The tree heights for honey and screwbean mesquite are summarized in table 125. Distribution for these species between HCs is shown in table 126. The height for saltcedar, the only shrub observed in CVCA Site 6, is summarized in table 127. Canopy closure for CVCA Site 3 is shown in table 5. Vertical foliar density by species is shown on figure 14. Honey mesquite is dominant in all meter layers.

Table 125.—Tree height summary at CVCA Site 6 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Honey mesquite	3.4 (0.2)	187	15	2.0–4.8	3.7
Screwbean mesquite	4.1 (0.0)	1	1	4.1–4.1	4.1

Table 126.—HC summary for standard trees and mesquite at CVCA Site 6 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Honey mesquite	18	31	51	0	0	0
Screwbean mesquite	0	0	100	0	0	0

Table 127.—Shrub height summary at CVCA Site 6 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.2 (0.4)	10	6	0.4–3.2	1.0
Saltcedar	2.6 (0.4)	7	3	1.9–3.2	2.7
Willow baccharis	0.9 (0.4)	3	3	0.4–1.6	0.6

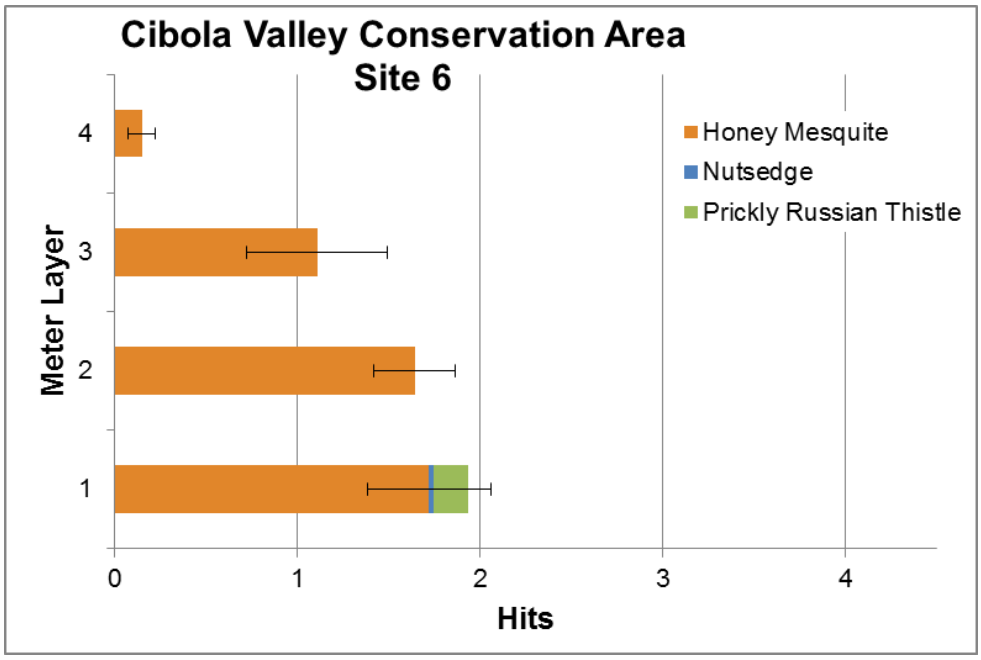

Figure 14.—Vertical foliar density at CVCA Site 6 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 128, and herbaceous foliar cover is summarized in table 129.

Table 128.—Tree and shrub foliar cover at CVCA Site 6 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	30	Not applicable
Total tree cover	30	100
Total shrub cover	< 1	< 1
Honey mesquite	29	93
Cottonwood	< 1	1
Saltcedar	2	5
Willow baccharis	< 1	1

Table 129.—Herbaceous foliar cover at CVCA Site 6 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	4	Not applicable
Prickly Russian thistle	3	80
Bermudagrass	< 1	16
Desert horsepurslane	< 1	3
Junglerice	< 1	< 1
Canadian horseweed	< 1	< 1
Pigweed	< 1	< 1

3.5 Cibola National Wildlife Refuge Unit 1

Vegetation across CNU1 varied due to differences in planting techniques and layouts. CNU1 Cottonwood North (CWN) was dominated by cottonwood, with little understory vegetation. The Nature Trail was variably dominated by cottonwood, Goodding's willow, or willow baccharis. Scattered honey and screwbean mesquite were also present, with Johnsongrass common in the understory. Crane Roost was dominated by cottonwood, Goodding's willow, or mesquite, depending on the location of plots within the planting plan. Stressed riparian vegetation was prevalent at Crane Roost. Mass Transplanting was

dominated by cottonwood, with little understory vegetation. Saltcedar was sometimes present in plots but was not prevalent. No surface water was observed at CNU1. No noxious weeds or Spanish false fleabane were observed.

3.5.1 Cibola National Wildlife Refuge Unit 1 Nature Trail

Tree and shrub densities and relative tree and shrub densities at CNU1 Nature Trail (Nature Trail), excluding coyote willow, are summarized in table 130. Tree and shrub frequency and relative frequency are summarized in table 131. The relative density by SC for each tree species is shown in table 132.

Table 130.—Tree and shrub density (SE) at Nature Trail for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	63 (26)	22
	Goodding's willow	148 (61)	52
	Honey mesquite	47 (12)	17
	Screwbean mesquite	25 (7)	9
Shrubs	Willow baccharis	958 (272)	100

Table 131.—Tree and shrub frequency at Nature Trail for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Honey mesquite	58	28
	Screwbean mesquite	54	26
	Cottonwood	50	24
	Goodding's willow	25	12
	Coyote willow	21	10
Shrubs	Willow baccharis	100	100

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 132.—SC distributions by tree species at Nature Trail for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	4	11	11	42	29	5
Goodding's willow	30	41	24	4	0	0
Coyote willow	0	100	0	0	0	0
Honey mesquite	10	90				
Screwbean mesquite	9	91				

Overall tree height is summarized in table 133. Distribution of trees between HCs is shown in table 134. Height for willow baccharis, the only shrub observed at Nature Trail, is summarized in table 135. Canopy closure for Nature Trail is shown in table 5. Vertical foliar density by species is shown on figure 15. Willow baccharis was prevalent until the 5-m layer, and honey mesquite was co-dominant between 2 and 9 m. Cottonwood dominated vertical foliar density above 8 m.

Table 133.—Tree height summary at Nature Trail for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	15.5 (1.1)	78	12	11.4–23.0	14.5
Honey mesquite	6.6 (0.4)	89	14	4.0–9.6	6.6
Screwbean mesquite	7.0 (0.4)	58	13	5.1–9.6	6.7
Coyote willow	5.1 (0.4)	8[1]	4	3.8–5.5	5.4
Goodding's willow	4.5 (0.8)	60	6	1.9–7.0	4.2

[1] Number of stems for coyote willow.

Table 134.—HC summary for standard trees and mesquite at Nature Trail for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	4	0	< 1	27	59	9
Goodding's willow	5	24	30	40	1	0
Honey mesquite	5	5	28	62	< 1	0
Screwbean mesquite	0	12	18	70	0	0
Coyote willow	0	0	100	0	0	0

Table 135.—Shrub height summary at Nature Trail for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
Willow baccharis	3.0 (0.2)	618	21	1.4–4.6	3.0

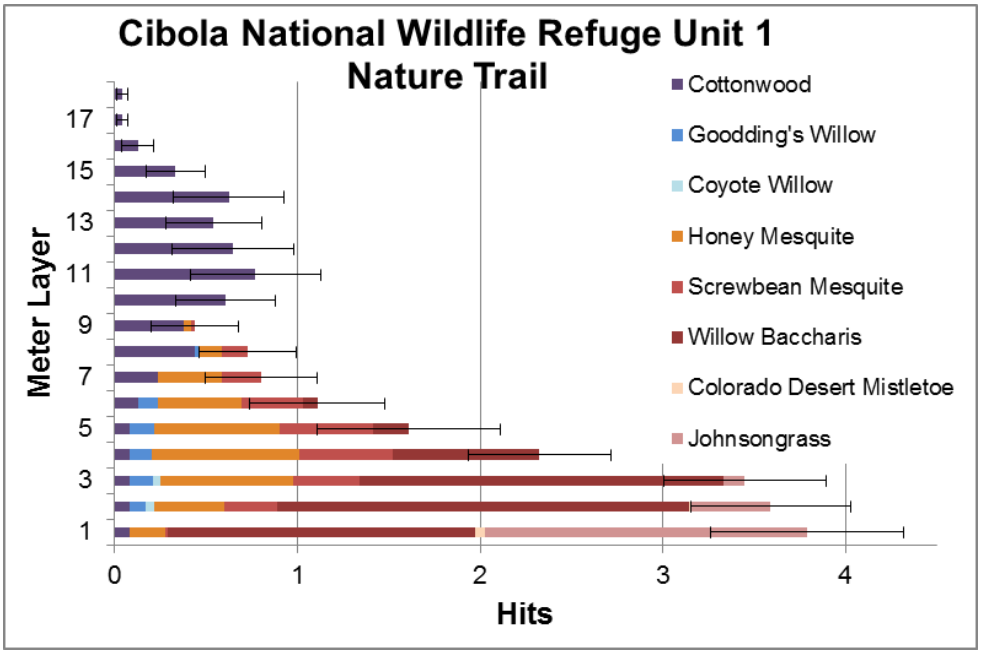

Figure 15.—Vertical foliar density at Nature Trail for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 136, and herbaceous foliar cover is summarized in table 137. Johnsongrass dominates the herbaceous vegetation at Nature Trail.

Table 136.—Tree and shrub foliar cover at Nature Trail for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	74	Not applicable
Total tree cover	38	44
Total shrub cover	48	56
Cottonwood	15	17
Honey mesquite	14	16
Screwbean mesquite	9	10
Goodding's willow	3	4
Coyote willow	1	1
Willow baccharis	48	53

Table 137.—Herbaceous foliar cover at Nature Trail for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	14	Not applicable
Johnsongrass	48	98
Bermudagrass	1	2
Nutsedge	< 1	< 1

3.5.2 Cibola National Wildlife Refuge Unit 1 Cottonwood North

Tree density and relative tree density (only incidental shrubs were found) at CWN are summarized in table 138. Tree and shrub frequency and relative frequency are summarized in table 139. The relative density by SC for each tree species is shown in table 140.

Table 138.—Tree density (SE) at CWN for 2013 vegetation surveys

Species	Density (per acre)	Relative density (percent)
Cottonwood	285 (28)	73
Honey mesquite	105 (43)	27

Table 139.—Tree and shrub frequency at CWN for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	100	46
	Honey mesquite	100	46
	California fan palm	17	8
Shrubs	Willow baccharis	100	100

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 140.—SC distributions by tree species at CWN for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	0	9	9	76	5	0
Honey mesquite	77	23				

Overall tree height for cottonwood and honey mesquite, the only tree species observed at CWN, is summarized in table 141. Distribution of these trees between HCs is shown in table 142. Canopy closure for CWN is shown in table 5. Vertical foliar density by species is shown on figure 16. Bermudagrass was prevalent in the first meter. Cottonwood was predominant in all meters above 1 m.

Table 141.—Tree height summary at CWN for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	12.7 (0.7)	44	6	10.5–16.0	12.5
Honey mesquite	3.2 (0.7)	31	5	1.9–5.3	2.6

Table 142.—HC summary for standard trees and mesquite at CWN for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	0	0	28	72	0
Honey mesquite	52	27	16	5	0	0

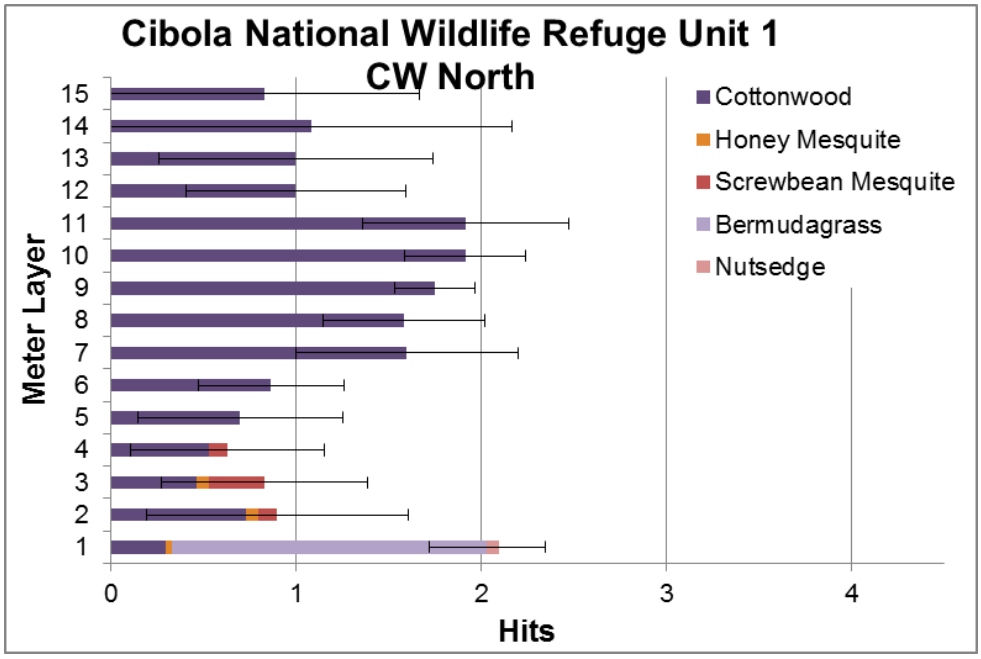

Figure 16.—Vertical foliar density at CWN for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 143, and herbaceous foliar cover is summarized in table 144.

Table 143.—Tree and shrub foliar cover at CWN for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	61	Not applicable
Total tree cover	61	100
Total shrub cover	< 1	< 1
Cottonwood	61	96
Honey mesquite	3	4
Willow baccharis	< 1	< 1

Table 144.—Herbaceous foliar cover at CWN for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All herbaceous vegetation	10	Not applicable
Bermudagrass	10	99
Nutsedge	< 1	< 1
Common sowthistle	< 1	< 1

3.5.3 Cibola National Wildlife Refuge Unit 1 Hippie Burn

Tree and shrub densities and relative tree and shrub densities at Hippie Burn, excluding coyote willow, are summarized in table 145. Coyote willow density is summarized in table 6. Tree and shrub frequency and relative frequency are summarized in table 146. The relative density by SC for each tree species is shown in table 147.

Tree height is summarized in table 148. Distribution of trees between HCs is shown in table 149. Shrub height data are summarized in table 150.

Table 145.—Tree and shrub density (SE) at Hippie Burn for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	526 (85)	46
	Goodding's willow	629 (89)	54
	Honey mesquite	10 (10)	< 1
Shrubs	Willow baccharis	1 (1)	1
	Mule fat	82 (40)	98
	Quail bush	1 (1)	1

Table 146.—Tree and shrub frequency at Hippie Burn for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	79	34
	Goodding's willow	74	32
	Coyote willow	74	32
	Honey mesquite	5	2
Shrubs	Mule fat	21	50
	Quail bush	16	38
	Willow baccharis	5	13

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 147.—SC distributions by tree species at Hippie Burn for 2013 vegetation surveys (Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	90	10	0	0	0	0
Goodding's willow	93	7	0	0	0	0
Coyote willow	100	0	0	0	0	0
Honey mesquite	100	0				

Table 148.—Tree height summary at Hippie Burn for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	2.2 (0.1)	96	15	1.1–3.0	2.2
Honey mesquite	1.3 (0.0)	5	1	1.3–1.3	1.3
Coyote willow	1.7 (0.1)	70	14	1.1–2.6	1.6
Goodding's willow	2.4 (0.2)	84	14	1.6–3.9	2.3

Table 149.—HC summary for standard trees and mesquite at Hippie Burn for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	20	49	31	0	0	0
Goodding's willow	5	58	36	0	0	0
Honey mesquite	88	13	0	0	0	0
Coyote willow	44	56	< 1	0	0	0

Table 150.—Shrub height summary at Hippie Burn for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.7 (0.1)	140	6	0.6–2.0	1.7
Mule fat	1.8 (0.1)	137	4	1.7–2.0	1.8
Quail bush	0.8 (0.0)	2	2	0.8–0.9	0.8
Willow baccharis	0.6 (0.0)	1	1	0.6–0.6	0.6

3.5.4 Cibola National Wildlife Refuge Unit 1 Mass Transplanting

Tree and shrub densities and relative tree and shrub densities at Mass Transplanting, excluding arrowweed and coyote willow, are summarized in table 151. No arrowweed or coyote willow was observed (see table 6). Tree and shrub frequency and relative frequency are summarized in table 152. The relative density by SC for each tree species is shown in table 153.

Table 151.—Tree and shrub density (SE) at Mass Transplanting for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	1,493 (376)	98
	Goodding's willow	27 (18)	2
	Honey mesquite	9 (9)	1
Shrubs	Saltcedar	54 (44)	21
	Willow baccharis	198 (92)	79

Table 152.—Tree and shrub frequency at Mass Transplanting for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Cottonwood	100	67
	Goodding's willow	33	22
	Honey mesquite	17	11
Shrubs	Willow baccharis	83	71
	Saltcedar	33	29

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 153.—SC distributions by tree species at Mass Transplanting for 2013 vegetation surveys
(Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	22	46	20	11	0	0
Goodding's willow	100	0	0	0	0	0
Honey mesquite	100	0				

Tree height is summarized in table 154. Distribution of trees between HCs is shown in table 155. The shrub heights for saltcedar and willow baccharis, the only shrub species observed at Mass Transplanting, is summarized in table 156.

Table 154.—Tree height summary at Mass Transplanting for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	8.4 (0.3)	89	6	7.1–9.6	8.5
Honey mesquite	1.6 (0.0)	1	1	1.6–1.6	1.6
Goodding's willow	1.6 (0.4)	3	2	1.3–2.0	1.6

Table 155.—HC summary for standard trees and mesquite at Mass Transplanting for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	3	11	23	50	13	0
Goodding's willow	33	67	0	0	0	0
Honey mesquite	0	100	0	0	0	0

Table 156.—Shrub height summary at Mass Transplanting for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	2.9 (0.3)	42	5	0.7–4.2	3.1
Saltcedar	0.9 (0.2)	6	2	0.7–1.0	0.9
Willow baccharis	3.4 (0.3)	36	5	2.6–4.2	3.7

3.5.5 Cibola National Wildlife Refuge Unit 1 Crane Roost 1

Tree and shrub densities and relative tree and shrub densities at CRANE1, excluding arrowweed and coyote willow, are summarized in table 157. No coyote willow was observed; arrowweed was not observed in E plots (see table 6) but was present as an incidental species for 33 percent of plots (table 158). Tree and shrub frequency and relative frequency are summarized in table 158. The relative density by SC for each tree species is shown in table 159.

Table 157.—Tree and shrub density (SE) at CNU1 CRANE1 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	10 (6)	6
	Honey mesquite	152 (20)	94
Shrubs	Saltcedar	428 (329)	61
	Willow baccharis	63 (32)	9
	Quail bush	207 (207)	30

Table 158.—Tree and shrub frequency at CNU1 CRANE1 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Honey mesquite	100	67
	Cottonwood	50	33
Shrubs	Saltcedar	83	42
	Willow baccharis	67	33
	Arrowweed	33	17
	Quail bush	17	8

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 159.—SC distributions by tree species at CNU1 CRANE1 for 2013 vegetation surveys

(Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	0	0	0	0	83	17
Honey mesquite	6	94				
Saltcedar	31	69				

The tree heights for cottonwood and honey mesquite, the only tree species sampled at CRANE1, are summarized in table 160. Distribution of these tree species between HCs is shown in table 161. Shrub height data are summarized in table 162. Canopy closure for CRANE1 is shown in table 5. Vertical foliar density by species is shown on figure 17. Honey mesquite and saltcedar were co-dominant up to the 7-m layer. Cottonwood was most common above that layer.

Table 160.—Tree height summary at CNU1 CRANE1 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	18.5 (2.6)	6	3	14.0–23.1	18.3
Honey mesquite	6.7 (0.6)	54	6	3.8–8.0	7.2

Table 161.—HC summary for standard trees and mesquite at CNU1 CRANE1 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	0	0	0	67	33
Honey mesquite	0	7	24	69	0	0

Table 162.—Shrub height summary at CNU1 CRANE1 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	3.9 (0.5)	61	6	2.4–6.6	4.1
Quail bush	2.4 (0.0)	5	1	2.4–2.4	2.4
Saltcedar	4.6 (0.7)	42	5	2.7–6.6	5.0
Willow baccharis	3.9 (0.4)	14	3	3.3–4.7	3.6

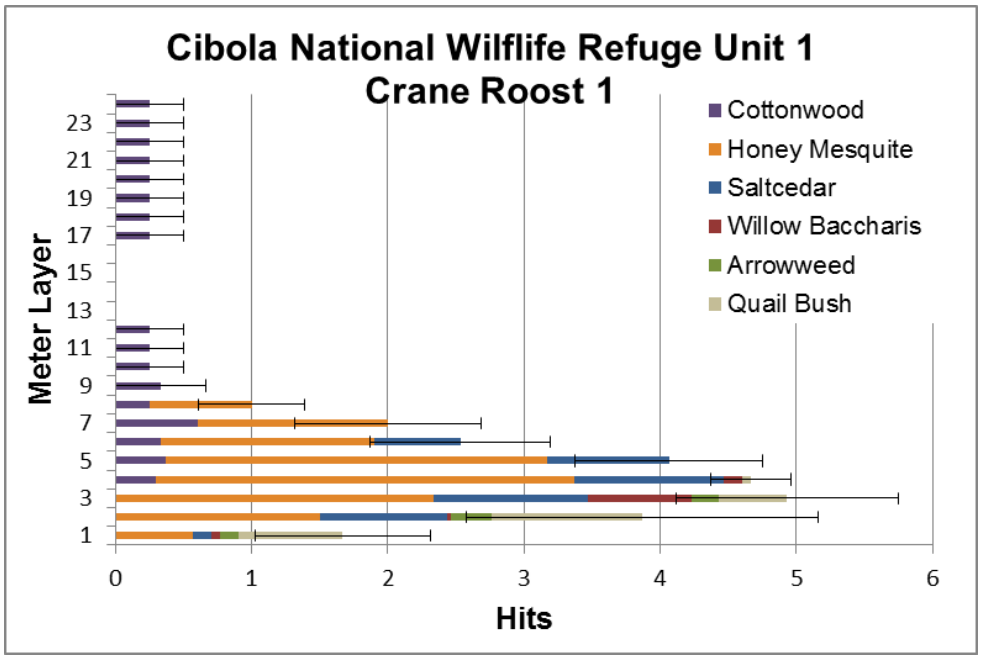

Figure 17.—Vertical foliar density at CRANE1 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 163. No herbaceous foliar cover was observed.

Table 163.—Tree and shrub foliar cover at CNU1 CRANE1 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	91	Not applicable
Total tree cover	84	75
Total shrub cover	28	25
Honey mesquite	56	44
Cottonwood	14	11
Saltcedar	27	21
Arrowweed	11	8
Quail bush	11	8
Willow baccharis	8	6

3.5.6 Cibola National Wildlife Refuge Unit 1 Crane Roost 2

Tree and shrub densities and relative tree and shrub densities at CRANE2, excluding coyote willow, are summarized in table 164. No arrowweed was observed (see table 6). Tree and shrub frequency and relative frequency are summarized in table 165. The relative density by SC for each tree species is shown in table 166.

Table 164.—Tree and shrub density (SE) at CNU1 CRANE2 for 2013 vegetation surveys

Vegetation class	Species	Density (individuals/acre)	Relative density (percent)
Trees	Cottonwood	97 (33)	17
	Goodding's willow	470 (129)	81
	Honey mesquite	13 (7)	2
Shrubs	Saltcedar	861 (350)	99
	Willow baccharis	13 (10)	1

Table 165.—Tree and shrub frequency at CNU1 CRANE2 for 2013 vegetation surveys

Vegetation class	Species	Frequency (percent)	
		Frequency	Relative frequency
Trees	Goodding's willow	76	41
	Cottonwood	62	33
	Honey mesquite	29	15
	Coyote willow	19	10
Shrubs	Saltcedar	95	69
	Willow baccharis	29	21
	Quail bush	14	10

Note: Relative frequency indicates the frequency relative to other species in the same vegetation class.

Table 166.—SC distributions by tree species at CNU1 CRANE2 for 2013 vegetation surveys
(Mesquite classified by height only in first two SCs.)

Species	Relative density (percent)					
	SC1	SC2	SC3	SC4	SC5	SC6
Cottonwood	13	53	19	10	4	0
Goodding's willow	42	47	9	2	< 1	0
Coyote willow	96	4	0	0	0	0
Honey mesquite	62	38				

Tree height is summarized in table 167. Distribution of trees between HCs is shown in table 168. Shrub height data are summarized in table 169. Canopy closure for CRANE2 is shown in table 5. Vertical foliar density by species is shown on figure 18. Bermudagrass and alfalfa were common in the first meter, and cottonwood and Goodding's willow were co-dominant from 3–8 m. Cottonwood was predominant above 8 m.

Table 167.—Tree height summary at CNU1 CRANE2 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of trees)	Number of plots with species	Range (m)	Median (m)
Cottonwood	8.5 (0.8)	59	12	4.4–13.2	8.4
Honey mesquite	2.7 (0.7)	18	4	0.6–3.9	3.1
Coyote willow	2.5 (0.4)	62 a	4	1.5–3.3	2.7
Goodding's willow	4.9 (0.7)	117	15	1.8–11.1	4.4

[1] Number of stems for coyote willow.

Table 168.—HC summary for standard trees and mesquite at CNU1 CRANE2 for 2013 vegetation surveys

Species	Proportion in HC (percent)					
	HC1 (0.1–1.5 m)	HC2 (1.6–3.0 m)	HC3 (3.2–6.0 m)	HC4 (6.1–12.0 m)	HC5 (12.1–20.0 m)	HC6 (20.1–35.0 m)
Cottonwood	0	8	21	65	5	0
Goodding's willow	4	25	52	18	< 1	0
Honey mesquite	21	45	35	0	0	0
Coyote willow	5	50	45	0	0	0

Table 169.—Shrub height summary at CNU1 CRANE2 for 2013 vegetation surveys

Species	Mean (SE; m)	n (number of shrubs)	Number of plots with species	Range (m)	Median (m)
All shrubs	1.8 (0.3)	108	19	0.5–5.7	1.4
Quail bush	2.4 (0.0)	2	1	2.4–2.4	2.4
Saltcedar	1.8 (0.3)	101	19	0.5–5.7	1.3
Willow baccharis	2.2 (0.5)	5	2	1.8–2.7	2.2

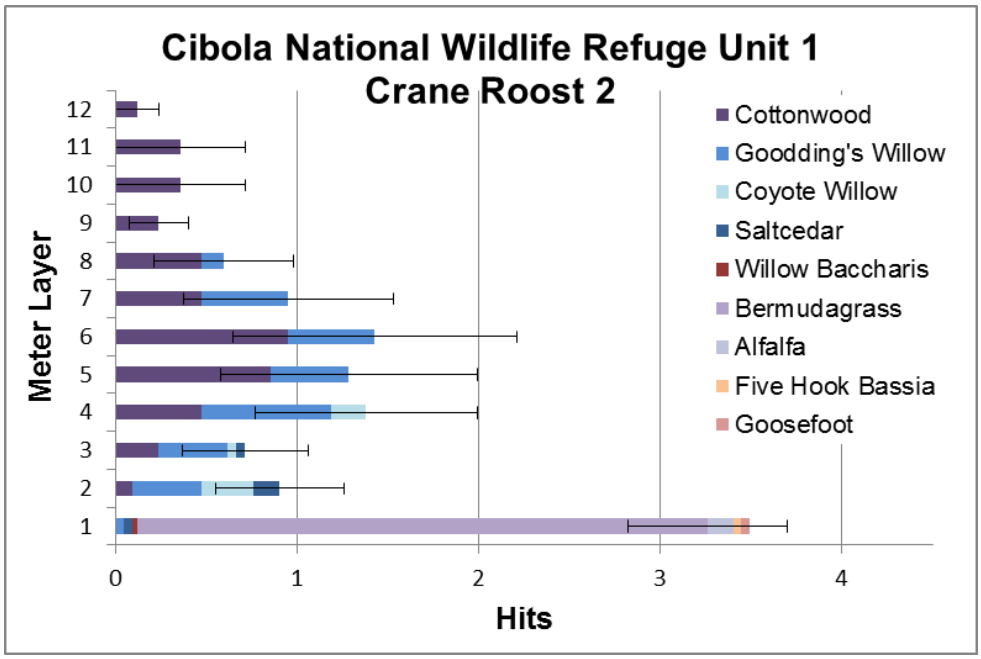

Figure 18.—Vertical foliar density at CRANE2 for 2013 vegetation surveys estimated using a hits-to-pole dataset.
(Error bars indicate one SE of total vegetation hits per meter layer.)

Tree and shrub foliar cover are summarized in table 170, and herbaceous foliar cover is summarized in table 171.

Table 170.—Tree and shrub foliar cover at CNU1 CRANE2 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
Total tree and shrub cover	27	Not applicable
Total tree cover	27	100
Total shrub cover	< 1	< 1
Goodding's willow	13	42
Cottonwood	8	27
Coyote willow	8	26
Honey mesquite	1	2
Saltcedar	1	3
Quail bush	< 1	1
Willow baccharis	< 1	< 1

Table 171.—Herbaceous foliar cover at CNU1 CRANE2 for 2013 vegetation surveys

Species	Cover (percent)	
	Cover	Relative cover
All	37	Not applicable
Bermudagrass	36	97
Goosefoot	< 1	3
Alfalfa	< 1	< 1
Mexican sprangletop	< 1	< 1
Canadian horseweed	< 1	< 1

4.0 CONCLUSIONS AND RECOMMENDATIONS

Habitat creation areas were generally comprised of a dense overstory of native trees and shrubs, with a variably dense mix of primarily native understory vegetation (including quail bush, mule fat, willow baccharis, arrowweed, and desert broom). A minor component of saltcedar was present at all conservation areas. Tree density ranged from 71 trees per acre at PVER Site 1 to 1,583 trees per acre at Mass Transplanting. BWRE plots were dominated by mix of native trees and saltcedar, with a mix of native and non-native understory vegetation. Tree density (including saltcedar) was 397 trees per acre. Arrowweed was common (39-percent frequency), but coyote willow was not observed at this site. Age and SC distribution were more widely spread compared to other LCR MSCP restoration sites.

Continued close observation or treatment and removal of non-native plant species observed at LCR MSCP habitat creation sites and at the Bill Williams River National Wildlife Refuge is recommended. Those detected, excluding saltcedar, for the 2013 field season were:

- Spanish false fleabane: PVER and BWRE
- Buffelgrass: PVER and CVCA
- Morning glory: PVER and CVCA
- Sahara mustard: PVER

Enhanced and reduced effort surveys, as conducted during 2013, appear sufficient to collect data of interest for Reclamation. Enhanced-level protocols allow detailed characterization on multiple scales to capture parameters of interest for the various target LCR MSCP fauna. Rotational protocols allow efficient documentation of vegetation, particularly the density of trees and shrubs, at

habitat creation sites. However, due to the different plot size, alternating yearly between rotational and enhanced-level protocols does not allow detection of year-to-year changes. If year-to-year changes are not of critical interest, and the frequency of change detection of 2 years is acceptable, continuation of rotational method surveys is recommended; the increased survey efficiency will reduce annual monitoring costs. However, if year-to-year changes in variables such as tree density are critical, this data collection protocol should be revisited to include tree data collection in the entire A plot. Alternatively, if surveys do not need to be conducted at every site every year, data interpretation would be simplified by conducting enhanced-level surveys every other year. Reduced effort protocols allow for rapid, comprehensive assessment of riparian vegetation establishment the year of and the year after planting. Finally, revisions to 2012 data collection methods, implemented during the 2013 field season, will facilitate migration to electronic field data collection.

Annual review of the data collection methods is recommended to be able to continue to collect priority data for habitat creation sites. Needs of other LCR MSCP monitoring and research groups should be addressed. It would be ideal from a data consistency and cost efficiency standpoint if vegetation monitoring data could be used across projects to characterize habitat quality for target LCR MSCP fauna. For example, the yellow-billed cuckoo (*Coccyzus americanus*) monitoring team has indicated that vegetation density (i.e., hits-to-pole) data are a key parameter for habitat modeling (J. Stanek, 2004, personal communication). Hits-to-pole data collection requires relatively little field time and should thus be added to reduced effort and rotational protocols.

Finally, completing vegetation data collection earlier in the year is recommended to increase consistency between projects and document vegetation characteristics as close as possible to the avian nesting season.

To maintain data collection quality for future project years, annual training sessions are recommended at the onset of each survey season. In addition to training new crew members, it is essential to review the current detailed methods and field protocols and to orient crews on electronic data collection if implemented. This session should be attended by, at a minimum, the Reclamation Contracting Officer's Representative, the Project Supervisor, and all field crew leaders. It is anticipated that any questions on the protocols or inconsistencies between detailed methods, data sheets, and field instructions can be addressed during this training session.

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ATTACHMENT 1

2013 Field Instructions

ATTACHMENT 1 – PART A

Enhanced Plots

2013 Field Instructions:

River Multi-species Conservation Program Habitat Creation and Existing Riparian Sites

Updated September, 2013

1.0 Plot Setup

1.1 General Notes:

1. Existing Plot Center markers are assumed the center of the plot. All measurements will be based off this center marker.
2. Existing A Plot center markers and corner stakes WILL NOT be moved.
3. New plots to be marked:
    a. Plots at CVCA Phase 5 and 6 will be staked during 2012.
4. For new plots (Plot Centers to be established this year), use ArcPad to navigate to plot centers. Place re-bar in the A Plot corners and the plot center to allow repeated surveys. Place an engraved plot marker on the rebar at the plot center.
    a. If the plot area based on this center location will result in an A Plot's border falling within 5 m of the habitat edge, move the plot toward the interior, which allows all survey area to be more than 5 m from the edge of the habitat. Move the center point in the direction that minimizes deviation from the mapped plot center. On datasheets, note that the plot center was moved, and record the new center point UTM on Datasheet 7.
5. Re-place rebar stakes in the corners of A Plots if the stakes have been disturbed.
6. Note any plots for which engraved center markers are not located.

1.2 Setup Instructions—PLOTS NOT PREVIOUSLY MARKED (Bill Williams River and PVER 8):

1. Use GPS to navigate to plot center marker.
2. Use the plot attributes in ArcPad to determine the azimuth bearing ("Bearing 1") for the long plot edge (Borders 2 and 4). Note that the same bearing is used for all of the plots in a phase.
3. Subtract 90^{o} to determine the azimuth bearing ("Bearing 2") for the short plot edge (Borders 1 and 3).
4. From the plot center, use a compass to line up the measuring tape with Bearing 2 between the plot center and A Plot Border 4.

5. With one person holding the coiled tape at the plot center, pull the 0 mark on the tape out 5 meters to the midpoint of A Plot Border 4. Check the bearing of this line with a compass. Place a pin flag at this location—the midpoint of A Plot Border 4.
6. With one person staying at the midpoint of A Plot Border 4, extend the tape to 10 m total (5 m from plot center) along the bearing line. Place a pin flag at the 10 m mark (the midpoint of A Plot Border 2).
7. Add pin flags at the: 1 m (point D5), 2.5 m (double flag, midpoint of B Plot Border 4), 5 m (plot center/D1), 7.5 m (double flag, midpoint of B Plot Border 2), 9 m (D3)and 10 m (midpoint of A Plot Border 2). Place two pin flags each at 0 m, 2.5 m, 7.5 m, and 10 m.
8. Reel in the tape and move to the midpoint of A Plot Border 2. Determine the direction of Bearing 1 from this location. Have one person stand at this location with the reeled tape and compass, and the second person extend the tape 20 m down A Plot Border 2 to Corner 1-2[1].
9. Once the tape has been extended to 20 m, backsight the tape at several locations to ensure that the azimuth remains at Bearing 1.
10. Place a piece of re-bar at Corner 1-2[1].
11. Attach the clip of the tape at 0 m to the rebar stake. Place double pin flags at the 12.5 m mark of Border 2. The double flag in this location marks the center of plot C2.
12. Continue extending tape along Bearing 1 to the 40 m mark of Border 2 (Corner 2-3[1]). Place double pin flags at the 27.5 m mark of Border 2. The double flag here marks the center of plot C1. Continue to 40m mark. Place a re-bar stake at Corner 2-3[1].
13. From Corner 2-3[1], extend the tape on Bearing 2 for 10 m along Border 3 to reach Corner 3-4[1]. Place a re-bar stake at this corner.
14. From the 27.5 m mark of Border 2, extend the tape 10 m along Bearing 2. Place pin flags at 2.5 m, 5 m (double flag), 7.5 m, and 10 m (double flag). Reel in the tape.
15. Repeat 14 for the 12.5 mark of Border 2.
16. Fill in pin flags along A Plot and B Plot borders.
17. From Plot Center, extend the tape 4 m in each direction along Bearing 1 (this should direct you to double flags on Border 1 and Border 3 of the B Plot) and place a pin flag at these two points (D2 and D4).
18. After conducting surveys, remove corner rebar stakes for Bill Williams River NWR plots. At other locations, leave rebar and flag with blue/white striped flagging.

1.3 Setup Instructions—PLOTS PREVIOUSLY MARKED:

1. Use GPS to navigate to plot center marker and to locate existing A Plot corner rebar stakes.
    a. If corner stakes cannot be located, use a compass and tape to determine plot corner stakes as detailed above.
2. Use the plot attributes in ArcPad to determine the azimuth bearing ("Bearing 1") for the long plot edge (Borders 2 and 4). Note that the same bearing is used for all of the plots in a phase.
3. Subtract 90^{o} to determine the azimuth bearing ("Bearing 2") for the short plot edge (Borders 1 and 3).

4. From plot center, place flags each direction along Bearing 2 at the following locations—double flags at 2.5 m (edge of B plot); single flag at 4 m (D3 and D5); and a single flag at 5 m (midpoints of A plot edges 2 and 4).
5. Attach the clip of the tape at the midpoint of A Plot edge 2. Use Bearing 1 to determine the direction for Border 2. Extend the tape along Bearing 1, and place double pin flags in each direction along Bearing 1 at 7.5 m (midpoint of C1 and C2).
6. Fill in pin flags along Border 2 to guide A Plot surveys. Confirm that the pin flags are in line with previously-marked plot corners 1-2[1] and 2-3[1].
7. From the 12.5 m mark of Border 2 (center of Plot C2), extend the tape 10 m along Bearing 2. Place pin flags at 2.5 m (Corner 1-2[2]), 5 m (double flag at midpoint of E3), and 7.5 m (Corner 4-2[2]).
8. Repeat 7 for the 27.5 m mark of A Plot Border 2.
9. Fill in pin flags along A and B Plot borders. Adjust A Plot Border 4 as needed to align with previously marked plot corners 3-4[1] and 4-1[1].
10. After conducting surveys, remove corner rebar stakes for Bill Williams River NWR plots. At other locations, leave rebar and flag with blue/white striped flagging.

2.0 Enhanced Surveys

2.1 General Notes:

1. **Field and datasheet instructions are to be used to guide survey efforts. If inconsistencies or ambiguities are found, immediately notify the Field Supervisor, who will then notify the Project Supervisor. If crews are at a remote location where cell service is unavailable (i.e. Bill Williams River), crews shall refer to the MSCP Vegetation Monitoring Methods. At the end of the field day, the Field Supervisor will contact the Project Supervisor.**
2. On Datasheet 7, note major problems with the site, which might include prevalence of invasive species or patches of vegetation mortality. If serious conditions such as these are encountered, notify the Field Supervisor, who will then notify the Project Supervisor.
3. Trees, shrubs, etc. will be considered IN a given plot if any portion of the basal cover falls on Border 1 or Border 2 of the given survey area. They will be considered OUT of a given plot if any portion of the basal cover falls on Border 3 or Border 4 of the given survey area. The exception to this rule is for the C Plots—if herbaceous foliage is above the quadrat (regardless of the location of the herbaceous base), it will be included for herbaceous canopy cover; if the basal area of a plant is on the border, the portion of the vegetation inside the quadrat will be considered for basal cover.
4. Height of vegetation (trees/shrubs) is measured as the distance of the maximum live foliage above ground surface in a vertical direction. We are NOT measuring stem length, so do not straighten or extend branches for height measurements.
5. Mesquite, *Tamarix*, and willow baccharis stems are placed into diameter classes based on stem diameter at 10 cm above ground surface. Standard trees are measured at 1.5m above ground to determine diameter at breast height (DBH)
6. Size classes for standard trees are designated by DBH as follows: SC 1 is <2.5 cm DBH; SC2 is 2.5 – 8 cm DBH; SC3 is 8.01 – 12 cm DBH; SC 4 is 12.01 to 20 cm DBH; SC5 is 20.01 – 40 cm DBH; and SC6 is >40 cm DBH. All DBH measurements will be ROUNDED UP to the next 0.5 cm interval. For example, a trunk measured as 2.01 cm would be recorded as 2.5, and would fall in SC 1; a trunk measured 11.6 cm would be recorded as 12, and would fall in SC3; and a trunk measuring exactly 12.0 cm would be recorded as 12. For measuring DBH, measure the diameter of the largest LIVE stem for a given individual. The stem is considered live if there is any green foliage further along the stem.
7. Size classes for mesquite and *Tamarix* are as follows: Size Class (SC) 1 is ≤3 m tall; SC2 is >3 m tall.
8. Diameter classes (DC) for mesquite, *Tamarix* spp., and willow baccharis stems are as follows: DC 1 is ≤2.5 cm diameter; DC2 is 2.51 – 5.0 cm diameter; DC3 is 5.01 – 8.0 cm diameter; DC4 is 8.01 to 12 cm diameter; DC5 is 12.1 – 20 cm diameter; and DC6 is 20.01- 40 cm diameter. **Diameter class is determined at 10 cm above ground surface**. **No true measurements are recorded; it may be necessary to use the calipers on some stems to obtain a search image for stem size classes, but it is not anticipated that all stem diameters will be measured with calipers. NOTE: tree size classes and stem size classes are NOT identical.**

9. Height classes for all trees are as follows:
    1. Height Class 1 – 0.1-1.5 meters
    2. Height Class 2 – 1.6-3.0 meters
    3. Height Class 3 – 3.1-6.0meters
    4. Height Class 4 – 6.1-12.0 meters
    5. Height Class 5 – 12.1-20.0 meters
    6. Height Class 6 – 20.1-35.0 meters

2.2 Datasheets 1-2 (Vegetation Structure, Snags, Cavities, Incidental Species)

1. On each sheet, enter the date, site location, section, and observers.
2. Measure the canopy closure using a convex densiometer. Proceed to points D1 through D5. Place the densiometer level on top of a post, 1.2 m directly above the D points. Count the number of hits for either vegetation (including both live and dead branches/trees) or open sky at each line intersection AND corners. Write the number of hits in the Canopy Closure Section. The total number of hits recorded sums to 37. The orientation of the densiometer measurements is as follows: D1) face "up" the plot; D2-D5) face out from plot center.
3. Conduct hits to pole surveys at D1 through D5. At each location, extend the stadia rod vertically to a height slightly above the canopy, or to its full extent if required.
4. From 0 to 7 m, count the number of hits per meter by species and in one "All" category. A "hit" occurs when LIVE plant material (leaves or live stem) is within 10 cm of the center of the rod for a given 10 cm interval.
5. For 7 m and above, estimate if the number of hits per meter is 0, less than or equal to 5, or greater than 5.
6. When no more hits are encountered, place a "0" in the final blank, and line out spaces for subsequent meter layers.
7. A level should be rested against the side of the stadia rod to ensure it is vertical.
8. Determine the presence of snags [dead trees in SC 4-6 (DBH> 12.0 cm)] regardless of species within the A Plot. Tally by SC on Datasheet 2.
9. If snags have cavities, count and record the number of cavities and record the SC and UTMs of those snags.
10. Record all "incidental" species on Datasheet 2. This list will include ALL species observed in the primary plot which are not recorded otherwise.

2.3 Datasheet 3 (Standard trees; excluding Salexi SC 1 and 2)

1. Survey the entire A Plot area for standard trees (including SALEXI with DBH>12.0cm) with a DBH greater than 12 cm (SC4 and above).
    a. Measure and record height (to the nearest tenth of a meter) and DBH for five trees of size class of each species that represent the size range observed in the plot for the given species/size class.

i. For each measured tree recorded in the A Plot, put a check mark in the adjacent column IF that tree is also within the B Plot area. If it is not within the B Plot area, record a zero in the cell.

ii. Record the species SC in the column header.

b. After five trees are recorded, dot tally all remaining trees in the appropriate grid by SC and Height Class. If a tallied tree from the A Plot also falls in the B Plot, make sure to record the dot tallies in the area designated "In B Plot" on each grid.

c. After a tree is recorded, chalk and/or flag it to prevent re-measuring during A Plot OR B Plot surveys.

2. Survey the B Plot for standard trees with a DBH of <12 cm (SC1 through SC3), including SALEXI with a DBH between 8.1 cm and 12 cm (SC 3).
   a. Collect data as for the A Plot—DBH and height for five representative individuals for each species-SC combination, Size Class/Height Class tally for additional individuals. Note that all trees in SC 4 (DBH >12 cm) have already been measured and a check mark was recorded if the tree occurred within the B Plot area.
   b. Trees shorter than 1.5 m (breast height) in the B Plot will be recorded with a DBH of "0". Trees >1.5 m with branching or non-woody stems at breast height will be recorded with a DBH of 0.5.
   c. As for the A Plot, Border 1 and 2 are "in" for the B Plot.

2.4 Datasheet 4 [Mesquite species and Tamarix]

1. Survey the entire A Plot area for mesquite trees and *Tamarix* spp. that are >3 m tall (SC2) and *Tamarix* spp. greater than 3 m tall (SC2).
   a. Measure and record heights of five trees per species that represent the size range observed in the plot. Height is recorded to the nearest tenth of a meter. Use additional datasheets as needed.
   b. After the 5 measured tree heights, record a height class for each tree.
   c. Record the number of stems in each Diameter Class for each individual.

2. After a tree is recorded, chalk and/or flag it to prevent re-measuring during A Plot OR B Plot surveys.

3. For each tree recorded in the A Plot, put a check mark in the adjacent column IF that tree is also within the B Plot area. If it is not within the B Plot area, record a zero in the cell.

4. Survey the entire B Plot area for mesquite trees or saltcedar that are less than 3.01 m tall.

   a. Collect mesquite and saltcedar data as for the A Plot—height and number of stems in each diameter class for five representative individuals, Height Class and number of stems in each Diameter Class for additional individuals. Note that all SC2

mesquite and saltcedar plants (greater than or equal to 3.01 m tall) have already been measured.

5. As for the A Plot, Border 1 and 2 are "in" for the B Plot.

Record the required information for ALL TREES. Attach additional sheets as necessary.

2.5 Datasheet 5 [Willow baccharis (Bacsal)]

1. Survey the B Plot area for willow baccharis (BACSAL).
    a. For five representative individuals, record the shrub height to the nearest 0.1 m, and tally the number of stems in each DC.
    b. For all additional BACSAL, record the Shrub Class (height to nearest 0.5 m) and the number of stems in each DC.

2.6 Datasheet 6 (B Plot Shrubs, Gaps, Shrub and Tree Foliar Cover)

2. Survey the entire B Plot area for shrub species, NOT including BACSAL, PLUSER or SALEXI (remember SALEXI is always considered a tree under this monitoring protocol not a shrub).
    a. Measure and record height (to the nearest tenth of a meter) for five individuals of each species that represent the size range observed in the plot for the given species. After five shrubs of each species are measured and recorded, dot tally all additional individuals of each species by shrub classes (height to the nearest 0.5m). As for the A Plot, Border 1 and 2 are "in" for the B Plot and each quadrant within.
    b. Dot count all dead shrubs, including BACSAL, but excluding PLUSER.
    c. Estimate the foliar cover classes within the B Plot for each woody species according to the provided cover classes. ****This should include cover estimates for SALEXI and PLUSER, even though we are not recording other measurements for these species in this B Plot.**
        i. Estimate foliar cover classes within the B Plot for "All Trees", "All shrubs", and "All" trees and shrubs combined.
        ii. **Record for all tree and shrub size classes by species, including those recorded on A Plot datasheets.**
        iii. Remember that these are species specific, so cover classes CAN add up to greater than 100%.
3. Determine the presence of or open canopy space (gaps) with an area of greater than or equal to 9 square meters (e.g. 3 m by 3 m) within 30 m of **Plot Center**. "Gap" is defined as without foliated vegetation greater than 2 m off the ground surface. Number each gap, place in distance category (using the distance to the edge of the canopy gap from plot center), denote whether it is a Canopy Gap (space within the planted area) or Edge Gap (open space outside of planted area, e.g. road, edge of field, stream edge), and record UTM coordinates of the center (Canopy

Gap) or edge (Edge Gap). If no gaps exist within 30 m of Plot Center, write "None" and put a "0" in the distance category box.

2.7 Datasheet 7 (C Plots-Ground layer, felled trees)

1. Enter the date, area, site, section, and observers.

2. Estimate total foliar cover OF HERBACEOUS PLANT SPECIES up to 0.5 m within each C Plot collectively, and then by species (i.e. one cover class for total herbaceous cover, followed by one cover class for each species). If no herbaceous species occur in quads, write "no herbs" and enter a "0" in the cover class column.

    a. For C Plots, there are no "out" and "in" borders—if herbaceous foliage is above the open space within the quadrat, it counts for foliar cover.

3. DO NOT INCLUDE SEEDLING TREE OR SHRUB SPECIES WHEN EVALUATING C PLOTS. NOTE: THIS IS DIFFERENT THAN THE 2012 C PLOT PROTOCOLS.
4. Estimate ground cover (coverage of ground surface) for:
    a. Herbaceous species (annual or perennial species that still have living tissue);
    b. Woody species;
    c. Dead (dead plants still attached to the ground, e.g. snags, annual species that have died but are still attached to roots, etc.).
    d. Litter (dead plant material unattached to ground, but laying on the ground surface);
    e. Bare ground;
    f. Rock/Gravel; and
    g. Water
    h. If no cover exists for one or several categories, enter a "0" in the cover class column.
    i. As for foliar cover, there are no "in" or "out" borders. If a portion of a given cover is within the quadrat, it is included for ground cover.
5. Estimate the depth of litter and herbaceous vegetation to the nearest cm at three points in each quad.
    a. The measuring point will be the center point of each third of the 0.5 by 2 m quad. If this point is occupied by woody basal cover, the measuring point shall be the nearest point not occupied by woody basal cover.
    b. Litter depth is the depth of **continuous plant litter** above the ground surface. If no litter is present, record a depth of "0." If litter is present, but less than 0.5 cm deep (e.g. a leaf flat on the ground) record a litter depth of 0.5 cm. If litter depth is greater than 0.5 cm, round to the nearest cm.
    c. Herbaceous vegetation height is the height AT THE MEASURING POINT. If herbaceous vegetation is present but less than 0.5 cm deep, record a height of 0.5 cm. If height is greater than 0.5 cm, round to the nearest cm. **DO NOT INCLUDE NON-WOODY SHRUBS AND TREES IN HERBACEOUS DEPTH MEASUREMENTS.**

6. Note if any felled trees were observed in the plot, and if they are dead (no green stems or foliage) or alive.

2.8 Datasheet 8 (E-Quads, Salexi SC1-2, and Dead SC 1-2)

1. Enter the date, area, site, section, and observers.
2. E-Quads (SALEXI SC1 and PLUSER)
    a. Record measured heights for 5 representative SALEXI SC1 trees (i.e. stems) in E-Quads. For the remaining SALEXI SC1, dot tally by Height Class.
    b. Record measured heights for 5 representative PLUSER in E-Quads. For the remaining PLUSER stems, dot tally by half-meter classes (i.e. shrub class).
    c. Dot tally Dead SC1 trees (all species combined) and Dead Pluser (separately from Dead tree tally) in the E Quads.
3. B1 and B3 (SALEXI SC2 and Dead trees SC2)
    a. Record measured heights for 5 representative SALEXI SC2 trees (i.e. stems) in B1 and B3 quadrants of the B Plot. For the remaining SALEXI SC2, dot tally by Height Class.
    b. Dot tally Dead SC2 trees (all species combined) in B1 and B3 (NOT by Height Class).

ATTACHMENT 1 – PART B

Reduced Effort Plots

3.0 Reduced Effort Plot Instructions

3.1 General Notes:

1. Reduced effort protocols will be implemented at:
    a. Mesquite site - CVCA4E.
    b. First- and second-year plantings for all vegetation types—less vegetation growth which makes some observations irrelevant, minimal cloning of SALEXI. First- and second-year sites for 2013 are, Cibola Hippie Burn, PVER7, and PVER8.
2. All data are collected in A Plot at reduced effort sites.
3. All species within the A Plot will be noted.

3.2 Vegetation Surveys

1. Refer to "Reduced Effort Datasheets" for reduced effort sites.
2. On Datasheets 1 and 2, record ALL tree size classes. **DO RECORD SALEXI (individuals, not stems).**
    a. For standard trees (Datasheet 1): Record height and DBH of five individuals per species, which will represent the range of heights observed in the plot. Dot tally remaining individuals by Size Class and Height Class.
    b. For mesquite and *Tamarix* (Datasheet 2): Record height of the five individuals per species, which will represent the range of heights observed in the plot. Tally stems in each Diameter Class for these five individuals. Record Height Class and stem tallies in each Diameter Class for all additional individuals.
3. For Datasheet 3, survey the entire **A Plot area**.
    a. Record shrub spp. **and PLUSER** for plant counts.
        i. Measure height of five individuals per species. Tally remaining individuals by height to the nearest 0.5 m (shrub height class).
    b. **Note additional species (Incidentals) observed within the entire A Plot..**

ATTACHMENT 1 – PART C

Rotational Plots with Reduced Effort

4.0 Rotational Plots with Reduced Effort - Plot Instructions

4.1 General Notes:

1. Rotational Plot - Reduced effort protocols will be implemented in 2013 at:
    a. CVCA2, CVCA4W, CMP, PVER2, and PVER4.
2. All data are collected in B Plot at Rotational Plot- Reduced Effort sites.
3. All species within the B Plot will be noted.

4.2 Vegetation Surveys

1. Refer to "Rotational Plot - Reduced Effort Datasheets" for rotational plot - reduced effort sites.
2. On datasheets 1 and 2, record ALL tree size classes from B Plot. **DO INCLUDE SALEXI individuals in SC3 and SC4 from the entire B Plot. See below for SALEXI SC1 and SALEXI SC2.**
    a. For standard trees (Datasheet 1): Record height and DBH of the five individuals per species, which will represent the range of heights observed in the plot. Dot tally remaining individuals by Size Class and Height Class.
    b. For mesquite and *Tamarix* (Datasheet 2): Record height of the five individuals per species, which will represent the range of heights observed in the plot. Tally stems in each Diameter Class for these five individuals. Record Height Class and stem tallies in each Diameter Class for all additional individuals.
3. On datasheet 1, record canopy closure at D points per Enhanced Plot instructions.
4. For datasheet 3, survey for willow baccharis per the Enhanced Plot instructions.
5. For Datasheet 4, survey **B Plot area**.
    a. Record shrub spp. (**EXCLUDING PLUSER and BACSAL)** for plant counts in entire **B Plot.**
        i. Measure height of five individuals per species. Tally remaining individuals by height to the nearest 0.5 m (shrub height class).
    b. Record **SALEXI SC2** in the **B1 and B3 quadrants** ONLY.
        i. Measure height and DBH of the five individuals per species, which will represent the range of heights observed in the plot. Dot tally ALL individuals (**including the first 5**) by Height Class.
    c. Record **SALEXI SC1** in the **E-Quads** ONLY.
        i. Measure height and DBH of the five individuals per species, which will represent the range of heights observed in the plot. **Dot tally ALL individuals** by Size Class and Height Class.
    d. Record PLUSER in E-Quads - Measure height of five individuals per species. Tally ALL individuals by height to the nearest 0.5 m (shrub height class).
    e. **Note additional species (Incidentals) observed within the entire B Plot.**

ATTACHMENT 2

2013 Field Data Sheets

LCR-MSCP Vegetation Monitoring **Datasheet 1: Hits to Pole and Canopy Closure**

Date _____ Area _____ Site _____ Section _____

Observers _____

Hits to Pole (D1-D5) Record number of decimeter 'hits to pole' (within 10cm radius) for each meter layer, at collection points D1-D5 up to 7m . Meter layers above 7 meters will be estimated using 0, <5, or >5 hits per meter layer (not decimeter layer).

D1					D2					D3					D4				
Hits by Species					Hits by Species					Hits by Species					Hits by Species				
	ALL					ALL					ALL					ALL			
0_1					0_1					0_1					0_1				
1_2					1_2					1_2					1_2				
2_3					2_3					2_3					2_3				
3_4					3_4					3_4					3_4				
4_5					4_5					4_5					4_5				
5_6					5_6					5_6					5_6				
6_7					6_7					6_7					6_7				
Estimates					Estimates					Estimates					Estimates				
7_8					7_8					7_8					7_8				
8_9					8_9					8_9					8_9				
9_10					9_10					9_10					9_10				
10_11					10_11					10_11					10_11				
11_12					11_12					11_12					11_12				
12_13					12_13					12_13					12_13				
13_14					13_14					13_14					13_14				
14_15					14_15					14_15					14_15				
15_16					15_16					15_16					15_16				
16_17					16_17					16_17					16_17				
17_18					17_18					17_18					17_18				
18_19					18_19					18_19					18_19				
19_20					19_20					19_20					19_20				
20_21					20_21					20_21					20_21				
21_22					21_22					21_22					21_22				
22_23					22_23					22_23					22_23				
23_24					23_24					23_24					23_24				

Closure: Record number of cross hairs/corners covered with vegetation and/or sky (37 total). Record as live/total.

	D1	D2	D3	D4	D5
Canopy					
Sky					

LCR-MSCP Vegetation Monitoring **Datasheet 2: Hits To Pole, Snags, Cavities, Incident**

Date _____ Area _____ Site _____

Observers _____

Hits to Pole (D1-D5)

D5				
Hits by Species				
	ALL			
0_1				
1_2				
2_3				
3_4				
4_5				
5_6				
6_7				
Estimates				
7_8				
8_9				
9_10				
10_11				
11_12				
12_13				
13_14				
14_15				
15_16				
16_17				
17_18				
18_19				
19_20				
20_21				
21_22				
22_23				
23_24				

Incidental species Record all species that are within Plot A that were NOT recorded anywhere else within the plot. No additional data need to be collected on the species listed in this box.

Snags

Dot tally snags (i.e. dead trees) by DBH SC's 4-8.
SC4) 12.01-20cm
SC5) 20.01-40cm
SC6) 40.01-50.0cm
SC7) 50.1-80cm **SC8)** 80.1-100cm

Tallies			
SC4	SC5	SC6	SC7/8

Cavities

If a snag has a cavity, record # of cavities in each snag, the DBH, and GPS location of the snag.

#	DBH	#Cavities	Easting	Northing

LCR-MSCP Vegetation Monitoring Date _____ Section _____ **Datasheet 3: Standard trees (Popfre, Salgoo, Salexi)**

Area _____ Site _____ Record 5 trees' heights and DBH (per species/SC); remaining trees are dot tallied by height class and size class. Measured tree heights should be representative of variation in habitat. Record Salexi SC3 and SC4 on this sheet. Record Dead SC 2 and 3.

Observers _____

A Plot - **SC4-SC8** Standard Trees - **Incl. Salexi SC4**

Spp/SC																
	Tree #	DBH	HT(m)	In B	DBH	HT(m)	In B	DBH	HT(m)	In B	DBH	HT(m)	In B	DBH	HT(m)	In B
Measured	1															
	2															
	3															
	4															
	5															

SC4) 12.1-20.0cm **SC5)** 20.1-40.0cm **SC6)** 40.1-50.0cm **SC7)** 50.1-80.0 **SC8)** 80.1-100.0

B Plot - **SC3** Standard Trees - **Incl. Salexi SC3**

Spp/SC										
	Tree #	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)
Measured	1										
	2										
	3										
	4										
	5										

SC3) 8.1-12.0cm

B Plot - **SC1, SC2** Standard Trees - **DO NOT incl. Salexi SC1 or SC2**

Spp/SC										
	Tree #	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)
Measured	1										
	2										
	3										
	4										
	5										

SC1) <2.5cm **SC2)** 2.5-8.0cm

HC1 0.1-1.5m; **HC2** 1.6-3.0m
HC3 3.1-6.0m; **HC4** 6.1-12.0m
HC5 12.1-20.0m; **HC6** 20.1-35.0m

Tally	Popfre-B Plot			Popfre-A Plot		
	SC1	SC2	SC3	SC4	SC5	SC6
HC1 (0.1-1.5m)				In B Plot	In B Plot	In B Plot
HC2 (1.6-3.0m)				In B Plot	In B Plot	In B Plot
HC3 (3.1-6.0m)				In B Plot	In B Plot	In B Plot
HC4 (6.1-12.0m)				In B Plot	In B Plot	In B Plot
HC5				B	B	B
HC6				B	B	B

Tally	Salgoo - B Plot			Salgoo - A Plot		
	SC1	SC2	SC3	SC4	SC5	SC6
HC1 (0.1-1.5m)				In B Plot	In B Plot	In B Plot
HC2 (1.6-3.0m)				In B Plot	In B Plot	In B Plot
HC3 (3.1-6.0m)				In B Plot	In B Plot	In B Plot
HC4 (6.1-12.0m)				In B Plot	In B Plot	In B Plot
HC5				B	B	B
HC6				B	B	B

	Salexi - B Plot	Salexi - A
Tally	SC3	SC4
HC1		In B Plot
HC2		In B Plot
HC3		In B Plot
HC4		

Dead (SC2-3) - B Plot

Tally all **Dead** trees; include Mesq/Tam by estimating the DBH of largest trunk.

SC2B1	SC2B3	SC3B

LCR-MSCP Vegetation Monitoring **Datasheet 4: Mesquite and Tamarix**

Date _____ Area _____ Site _____ Section _____

Observers _____

	Mesq/Tam Plot A - SC2 (>3.0m Ht)								Mesq/Tam Plot B - SC1 (≤3.0m Ht)							
Spp																
Tree #	HT(m)	Tally						In B	HT(m)	Tally						In B
		DC1	DC2	DC3	DC4	DC5	DC6			DC1	DC2	DC3	DC4	DC5	DC6	
Measured 1																
2																
3																
4																
5																
#	HC	DC1	DC2	DC3	DC4	DC5	DC6	In B	HC	DC1	DC2	DC3	DC4	DC5	DC6	In B
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																
16																
17																
18																
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26																
27																
28																
29																
30																
31																

Record measured height for 5 trees of each mesquite species and saltcedar in each size class. For all remaining trees record the height class. Mesquite and saltcedar stems are dot tallied by diameter class; no measured stems. Only count the stems of mesquite and saltcedar when the split is complete by 10 cm and only when it is a true split. Check the 'In B' box if an A Plot tree is also in B Plot; put

HC1 = 0.1-1.5m; **HC2** = 1.6-3.0m; **HC3** = 3.1-6.0m; **HC4** = 6.1-12.0m; **HC5** = 12.1-20.0; **HC6** = 20.1-35.0m

DC1 = ≤2.5cm; **DC2** = 2.51-5.0cm; **DC3** = 5.1-8.0cm; **DC4** = 8.1-12.0cm; **DC5** = 12.1-20.0cm; **DC6** = 20.1-40.0

NOTE: DC VALUES AREN'T THE SAME AS SC VALUES.

LCR-MSCP Vegetation Monitoring **Datasheet 5: BACSAL 1 and 2**

Date _____ Area _____ Site _____

Observers _____ Section _____

	#	BACSAL__ HT(m)	Tally DC1	DC2	DC3
Measured	1				
	2				
	3				
	4				
	5				
	#	Shrub Class	DC1	DC2	DC3
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				

#	BACSAL__ (Cont.) Shrub Class	Tally DC1	DC2	DC3
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				

#	BACSAL__ (Cont.) Shrub Class	Tally DC1	DC2	DC3
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				

Bacsal1 = *B.salicina*

Bacsal2 = *B. salicifolia*

Record measured height for 5 Bacsal1 and Bacsal2 shrubs. For all remaining individuals record the shrub height class. Bacsal(s) stems are dot tallied by diameter class; no measured stems. Only count the stems of Bacsal(s) when the split is complete by 10 cm and only when it is a true split.

For shrub class, enter one of the following: **0.5m, 1.0m, 1.5m, 2.0m, 2.5m, 3.0m, 3.5m, 4.0m, 4.5m, 5.0m, 5.5m**

DC1 = ≤2.5cm; **DC2** = 2.51-5.0cm **DC3** = 5.1-8.0cm **NOTE: DC VALUES AREN'T THE SAME AS SC VALUES.**

LCR-MSCP Vegetation Monitoring

Datasheet 6 - Shrubs, Gaps, and Plot B Cover

Date _____ Area _____ Site _____ Section _____

Observers _____

Record the **measured** height for 5 individuals of each species to the nearest **0.1 m**. Dot tally additional individuals to the nearest **0.5 m**. Bacsal is recorded on another page.

DO NOT RECORD PLUSER or BACSAL HERE

Plot B - Shrub Species

	Species					
	Shrub #	HT(m)	HT(m)	HT(m)	HT (m)	HT(m)
Measured	1					
	2					
	3					
	4					
	5					

Dot Tallies

Species					
0.5					
1.0					
1.5					
2.0					
2.5					
3.0					
3.5					

Distance to Gap

Estimate distance to all gaps ≥9 square meters (e.g.3x3m) that are within 30 meters of plot center; gap defined as no foliated vegetation greater than 3m from the ground. Next, estimate gap size, and take GPS point at gap center.

Distance from center categories: **1**= <3m, **2**= 3-6m, **3**= 6.1-9m, **4**= 9.1-12m, **5**= 12.1-30m.

Gap Size estimate: write in an estimated size, for example, 2x5m or 3X3m; if edge put road, field, river, or other.

C or E: Record if gap is canopy or edge; UTM pt at gap center or if edge, then at edge of habitat.

Gap Num	Dist Catg	Size/Type	C or E	Easting	Northing

Dead Shrubs

Tally **Dead** shrubs (all together, NOT by species); **INCLUDING Bacsal.**
DO NOT include Pluser stems.

Tree and Shrub Foliar Cover

Include SALEXI and PLUSER.

Estimate foliar cover of each tree and shrub species in Plot B; and by total shrubs and total trees. Include all size classes together. Cover estimates by individual species MAY be greater than 100%.

Guide: Visualize if sun was above you, how much area would be covered by shadows from vegetation?

Enter zero if there are no trees or shrubs.

				By Species					
	All Trees	All Shrubs	All						
Cover Class: Note: 1% of Plot B is approximately 0.75 X 0.75 meters.									

Cover classes: **1)** <1% **2)** 1-10% **3)** 11-25% **4)** 26-50% **5)** 51-75% **6)** 76-90% **7)** >90%

LCR-MSCP Vegetation Monitoring **Datasheet 7- Ground Layer**

Date_____ Area _____ Site _____ Section _____

Observer_____

Herbaceous Foliar Cover (C Plots)

Record foliar cover (vertical projection of vegetation on the ground) of **live** herbaceous plants (not woody) by species. Also record one value for 'All' herbaceous spp. combined. Put zero if there are no plants. **Do not** include seedling trees/shrubs.

Plot C1		Plot C2		Plot C3		Plot C4	
Species	CC	Species	CC	Species	CC	Species	CC
All		**All**		**All**		**All**	

CC1 = <1% **CC2** = 1-10% **CC3** = 11-25% **CC4** = 26-50% **CC5** = 51-75% **CC6** = 76-90% **CC7** = >90%

Ground Cover (C Plots):

Record ground cover (covering the ground surface); herbaceous means all herbaceous plant material (non-woody) combined.

		Cover Class			
	Plot	**C1**	**C2**	**C3**	**C4**
Type	Herbaceous				
	Woody				
	Litter				
	Dead				
	Bare Ground				
	Rock/Gravel				
	Water				

Herbaceous vegetation height and Litter depth at 3 points (visually estimate 3-thirds of each plot and measure center of each third). Record herbaceous veg or litter that is touching meter stick; not tallest or deepest points.

Vegetation HT

Plots	1	2	3
C1			
C2			
C3			
C4			

Litter Depth

Plots	1	2	3
C1			
C2			
C3			
C4			

General Notes: Record unusual observations, disturbances, and descriptions about unknown species; and answer the questions below.

1. Are there any felled trees in the plot?

2. If yes, how many, and are they dead or alive?

LCR-MSCP Vegetation Monitoring **Datasheet 8 - Salexi SC1 - SC2 and E-Quads**

Date_____ Area _____ Site_____ Section_____

Observers_____

E Quads - Measured Heights

Measure height and DBH for 5 Salexi SC1 "trees" to the nearest 0.1m. Measure height of 5 Pluser stems to nearest 0.1m.

	Salexi SC1		Pluser
	HT (m)	DBH	HT (m)
E1			
E2			
E3			
E4			

E-Quad Dot Tallies

Tally Salexi SC1 and Pluser. Tally dead SC1 trees-**ALL** spp. not by HC and dead Pluser.		E1	E2	E3	E4
Salexi SC1	**HC1** 0.1-1.5m				
	HC2 1.5-3.0m				
	HC3 3.1-6.0m				
	HC4 6.1-12.0m				
DEAD →	**SC1 Trees/ Pluser**				
Pluser Tally by shrub height class	**0.5 m**				
	1.0 m				
	1.5 m				
	2.0 m				
	2.5 m				
	3.0 m				
	3.5 m				

Salexi SC2 trees - Plot B1 and B3

Measure height and DBH for **SALEXI** in **SC2**.

Salexi	Quadrant	DBH (cm)	HT (m)
SC2 2.51-8.0cm	B1		
	B3		

Dot tally remaining Salexi **SC2** trees by height class.

		Tally **Salexi SC2** (2.5-8.0cm)
HC1 0.1-1.5m	B1	
	B3	
HC2 1.5-3.0m	B1	
	B3	
HC3 3.1-6.0m	B1	
	B3	
HC4 6.1-12.0m	B1	
	B3	

LCR-MSCP Vegetation Monitoring **Reduced Effort 1**

Date _____

Area _____ Site _____ Section _____

Observers _____

All data are collected in Plot A. Record height and DBH for 5 trees (per species/SC); remaining trees are assigned height class and size class. Measured tree heights should be representative of variation in habitat.

SC1, SC2 Standard Trees - Including Salexi

	Species									
	Tree #	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)
Measured	1										
	2										
	3										
	4										
	5										

SC1) <2.5cm **SC2)** 2.5-8.0cm

SC3 Standard Trees - Including Salexi

	Species									
	Tree #	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)
Measured	1										
	2										
	3										
	4										
	5										

SC3) 8.1-12.0cm

Dot tally	**Popfre**		
	SC1 (≤2.5cm)	SC2 (2.51-8.0cm)	SC3 (8.1-12.0cm)
HC1			
HC2			
HC3			
HC4			

Dot tally	**Salgoo**		
	SC1 (≤2.5cm)	SC2 (2.51-8.0cm)	SC3 (8.1-12.0cm)
HC1			
HC2			
HC3			
HC4			

Dot tally	**Salexi**		
	SC1 (≤2.5cm)	SC2 (2.51-8.0cm)	SC3 (8.1-12.0cm)
HC1			
HC2			
HC3			

HC1 0.1-1.5m; **HC2** 1.6-3.0m; **HC3** 3.1-6.0m; **HC4** 6.1-12.0m

HC5 12.1-20.0m; **HC6** 20.1-35.0m

LCR-MSCP Vegetation Monitoring **Reduced Effort 2**

Date _____ Area _____ Site _____ Section _____

Observers _____

Species		Mesq/Tam - SC2 (>3.0m Ht)														Mesq/Tam - SC1 (≤3.0m Ht)													
	Tree #	HT(m)	Tally						HT(m)	Tally						HT(m)	Tally						HT(m)	Tally					
			DC1	DC2	DC3	DC4	DC5	DC6		DC1	DC2	DC3	DC4	DC5	DC6		DC1	DC2	DC3	DC4	DC5	DC6		DC1	DC2	DC3	DC4	DC5	DC6
Measured	1																												
	2																												
	3																												
	4																												
	5																												
	#	HC	DC1	DC2	DC3	DC4	DC5	DC6	HC	DC1	DC2	DC3	DC4	DC5	DC6	HC	DC1	DC2	DC3	DC4	DC5	DC6	HC	DC1	DC2	DC3	DC4	DC5	DC6
	6																												
	7																												
	8																												
	9																												
	10																												
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	29																												
	30																												
	31																												

In Plot A, record measured height for 5 trees of each mesquite species and saltcedar in each size class. For all remaining trees record the height class. Mesquite and saltcedar stems are always tallied by diameter class. Only count the stems of mesquite and saltcedar when the split is complete by 10 cm and only when it is a true split.

HC1 = 0.1-1.5m; **HC2** = 1.6-3.0m; **HC3** = 3.1-6.0m; **HC4** = 6.1-12.0m; **HC5** = 12.1-20.0; **HC6** = 20.1-35.0m

DC1 = ≤2.5cm; **DC2** = 2.51-5.0cm; **DC3** = 5.1-8.0cm; **DC4** = 8.1-12.0cm; **DC5** = 12.1-20.0cm; **DC6** = 20.1-40.0 **NOTE: DC VALUES AREN'T THE SAME AS SC VALUES.**

LCR-MSCP Vegetation Monitoring **Reduced Effort - Datasheet 3**

Date _____ Area _____ Site _____ Section _____

Observers _____

In Plot A, record the **measured** height for 5 individuals of each species to the nearest **0.1 m** (M section). **Dot tally** height for all additional individuals to the nearest 0.5 m . **INCLUDE BACSAL and PLUSER here.** List all incidental species found in Plot A not recorded elsewhere.

Shrub Species

Species					
#	HT(m)	HT(m)	HT(m)	HT(m)	HT(m)
1					
2					
3					
4					
5					

Tallies

Species				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				

Incidentals- Plot A

Dead

Tally all **Dead** trees; include Mesq/Tam by estimating the DBH of largest trunk.

A Plot

SC1	SC2	SC3	SC4

LCR-MSCP Vegetation Monitoring **Rotation Plot - Datasheet 1**

Date _____

Area _____ Site _____ Section _____

Observers _____

All data are collected in **Plot B**. Record 5 trees' heights and DBH (per species/SC); remaining trees are assigned height class and size class. Measured tree heights should be representative of variation in habitat.

SC1, SC2 Standard Trees - do not include Salexi

	Species									
	Tree #	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)
Measured	1										
	2										
	3										
	4										
	5										

SC1) <2.5cm **SC2)** 2.5-8.0cm

SC3, SC4 Standard Trees - include Salexi

	Species									
	Tree #	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)	DBH	HT(m)
Measured	1										
	2										
	3										
	4										
	5										

SC3) 8.1-12.0cm **SC4)** 12.1-20.0

Closure: Record number of cross hairs/corners covered with vegetation and/or sky (37 total). Record as live/total.		D1	D2	D3	D4	D5
	Canopy					
	Sky					

Dot tally	Popfre			
	SC1	SC2	SC3	SC4
HC1				
HC2				
HC3				
HC4				
HC5				
HC6				

HC1 0.1-1.5m; **HC2** 1.6-3.0m; **HC3** 3.1-6.0m; **HC4** 6.1-12.0; **HC5** 12.1-20.0m; **HC6** 20.1-35.0

Dot tally	Salgoo			
	SC1	SC2	SC3	SC4
HC1				
HC2				
HC3				
HC4				
HC5				
HC6				

HC1 0.1-1.5m; **HC2** 1.6-3.0m; **HC3** 3.1-6.0m; **HC4** 6.1-12.0; **HC5** 12.1-20.0m; **HC6** 20.1-35.0

Dot tally	Salexi	
	SC3	SC4
HC1		
HC2		
HC3		

LCR-MSCP Vegetation Monitoring **Rotation Plot - Datasheet 2**

Date _____ Area _____ Site _____ Section _____

Observers _____

	Mesq/Tam - SC2 (>3.0m Ht) - IN B Plot Only														Mesq/Tam- SC1 (≤3.0m Ht) - IN B Plot Only													
Spp																										
Tree #	HT(m)	Tally						HT(m)	Tally						HT(m)	Tally						HT(m)	Tally						HT(m)	Tally					
		DC1	DC2	DC3	DC4	DC5	DC6		DC1	DC2	DC3	DC4	DC5	DC6		DC1	DC2	DC3	DC4	DC5	DC6		DC1	DC2	DC3	DC4	DC5	DC6		DC1	DC2	DC3	DC4	DC5	DC6
Measured 1																																			
2																																			
3																																			
4																																			
5																																			
#	HC	DC1	DC2	DC3	DC4	DC5	DC6	HC	DC1	DC2	DC3	DC4	DC5	DC6	HC	DC1	DC2	DC3	DC4	DC5	DC6	HC	DC1	DC2	DC3	DC4	DC5	DC6	HC	DC1	DC2	DC3	DC4	DC5	DC6
6																																			
7																																			
8																																			
9																																			
10																																			
11																																			
12																																			
13																																			
14																																			
15																																			
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25																																			
26																																			
27																																			
28																																			
29																																			
30																																			
31																																			

Record measured height for 5 trees of each mesquite species and saltcedar in each size class. For all remaining trees record the height class. Mesquite and saltcedar stems are dot tallied by diameter class; no measured stems. Only count the stems of mesquite and saltcedar when the split is complete by 10 cm and only when it is a true split.

HC1 = 0.1-1.5m; **HC2** = 1.6-3.0m; **HC3** = 3.1-6.0m; **HC4** = 6.1-12.0m; **HC5** = 12.1-20.0; **HC6** = 20.1-35.0m

DC1 = ≤2.5cm; **DC2** = 2.51-5.0cm; **DC3** = 5.1-8.0cm; **DC4** = 8.1-12.0cm; **DC5** = 12.1-20.0cm; **DC6** = 20.1-40.0

NOTE: DC VALUES AREN'T THE SAME AS SC VALUES.

LCR-MSCP Vegetation Monitoring **Rotation Plot - Datasheet 3**

Date _____ Area _____ Site _____

Observers _____ Section _____

	#	BACSAL__ HT(m)	Tally DC1	DC2	DC3
Measured	1				
	2				
	3				
	4				
	5				
	#	Shrub Class	DC1	DC2	DC3
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				

#	BACSAL__ (Cont.) Shrub Class	Tally DC1	DC2	DC3
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				

#	BACSAL__ (Cont.) Shrub Class	Tally DC1	DC2	DC3
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				

Bacsal1 = *B.salicina*
Bacsal2 = *B. salicifolia*

Dead SC1 - SC3		
Tally all **Dead** trees; include Mesq/Tam by estimating the DBH of largest trunk.		
E-Quads	**B1/ B3**	**B Plot**
SC1	**SC2**	**SC3**

Snags			
Dot tally snags (i.e. dead trees)			
B Plot			
SC4	**SC5**	**SC6**	**SC7**

In B Plot, record measured height for 5 Bacsal1 and Bacsal2 shrubs. For all remaining individuals record the shrub height class. Bacsal(s) stems are dot tallied by diameter class; no measured stems. Only count the stems of Bacsal(s) when the split is complete by 10 cm and only when it is a true split.

For shrub class, enter one of the following: **0.5m, 1.0m, 1.5m, 2.0m, 2.5m, 3.0m, 3.5m, 4.0m, 4.5m, 5.0m, 5.5m**

DC1 = ≤2.5cm; **DC2** = 2.51-5.0cm **DC3** = 5.1-8.0cm **NOTE: DC VALUES AREN'T THE SAME AS SC VALUES.**

LCR-MSCP Vegetation Monitoring **Rotation Plot - Datasheet 4**

Date _____ Area _____ Site _____ Section _____

Observers _____

In Plot B, record the **measured** height for 5 individual shrubs of each species to the nearest **0.1 m**. **Dot tally** height for all additional individuals to the nearest **0.5 m**. List all incidental species found in Plot B not recorded elsewhere.

Shrub Species

Species					
#	HT(m)	HT(m)	HT(m)	HT(m)	HT(m)
1					
2					
3					
4					
5					

Incidentals- Plot B

Dot Tallies

Species				
0.5				
1.0				
1.5				
2.0				
2.5				
3.0				

Salexi SC2 Dot Tallies (2.51-8.0)

HC1	B1	
	B3	
HC2	B1	
	B3	
HC3	B1	
	B3	
HC4	B1	
	B3	

*SC2 Salexi - measure 5 total between B1 and B3; not all from one quad

*SC1 Salexi and Pluser measure 5 total between E1-E4; not all from one quad

***HC1** 0.1-1.5m; **HC2** 1.6-3.0m; **HC3** 3.1-6.0m; **HC4** 6.1-12.0m

Salexi SC1 and SC2

	Quad	DBH (cm)	HT (m)
SC2 2.51-8.0cm	B1 - B3		
SC1 <2.5cm	E1 - E4		

Pluser

	DBH (cm)	HT (m)
E1 - E4		

E-Quad Dot Tallies

Salexi SC1

HC1		HC2		HC3	
E4	E1	E4	E1	E4	E1
E3	E2	E3	E2	E3	E2

Pluser

0.5		1.0		1.5		2.0		2.5		3.0		3.5	
E4	E1	E4	E1	E4	E1	E4	E1	E4	E1	E4	E1	E4	E1
E3	E2	E3	E2	E3	E2	E3	E2	E3	E2	E3	E2	E3	E2

ATTACHMENT 3

Plot Locations Sampled During 2013

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Beal Lake Conservation Area	A	92	ENH	11/5/2013	1/21/2014
Beal Lake Conservation Area	A	93	ENH	11/5/2013	1/21/2014
Beal Lake Conservation Area	A	100	ENH	11/5/2013	1/20/2014
Beal Lake Conservation Area	B	5	ENH	11/5/2013	1/16/2014
Beal Lake Conservation Area	B	82	ENH	11/5/2013	1/14/2014
Beal Lake Conservation Area	C	10	ENH	11/7/2013	1/13/2014
Beal Lake Conservation Area	D	94	ENH	11/7/2013	1/21/2014
Beal Lake Conservation Area	D	98	ENH	11/8/2013	1/20/2014
Beal Lake Conservation Area	D	99	ENH	11/7/2013	1/20/2014
Beal Lake Conservation Area	F	34	ENH	11/7/2013	1/21/2014
Beal Lake Conservation Area	F	88	ENH	11/6/2013	1/13/2014
Beal Lake Conservation Area	FF	75	ENH	11/8/2013	Not Recorded
Beal Lake Conservation Area	FF	80	ENH	11/9/2013	1/22/2014
Beal Lake Conservation Area	G	20	ENH	11/8/2013	1/13/2014
Beal Lake Conservation Area	G	81	ENH	11/6/2013	1/14/2014
Beal Lake Conservation Area	H	14	ENH	11/7/2013	1/13/2014
Beal Lake Conservation Area	H	83	ENH	11/7/2013	1/14/2014
Beal Lake Conservation Area	I	95	ENH	11/8/2013	1/21/2014
Beal Lake Conservation Area	I	96	ENH	11/9/2013	1/21/2014
Beal Lake Conservation Area	I	97	ENH	11/8/2013	1/18/2014
Beal Lake Conservation Area	JJ	71	ENH	11/9/2013	1/17/2014
Beal Lake Conservation Area	JJ	79	ENH	11/9/2013	1/22/2014
Beal Lake Conservation Area	K	56	ENH	11/6/2013	1/16/2014
Beal Lake Conservation Area	K	85	ENH	11/6/2013	1/14/2014
Beal Lake Conservation Area	L	37	ENH	11/7/2013	1/16/2014
Beal Lake Conservation Area	L	86	ENH	11/8/2013	1/15/2014
Beal Lake Conservation Area	M	48	ENH	11/5/2013	1/16/2014
Beal Lake Conservation Area	N	89	ENH	11/5/2013	1/22/2014
Beal Lake Conservation Area	N	90	ENH	11/4/2013	1/21/2014
Beal Lake Conservation Area	N	91	ENH	11/5/2013	1/21/2014
Beal Lake Conservation Area	O	53	ENH	11/6/2013	1/13/2014
Beal Lake Conservation Area	P	63	ENH	11/6/2013	1/16/2014
Beal Lake Conservation Area	P	87	ENH	11/6/2013	1/16/2014
Beal Lake Conservation Area	Q	26	ENH	11/7/2013	1/14/2014
Beal Lake Conservation Area	Q	84	ENH	11/8/2013	1/15/2014
Bill Williams River East	Cougar Point	1	ENH	10/29/2013	1/16/2014
Bill Williams River East	Cougar Point	2	ENH	10/29/2013	1/17/2014
Bill Williams River East	Cougar Point	3	ENH	10/29/2013	1/17/2014
Bill Williams River East	Cougar Point	4	ENH	10/28/2013	1/17/2014
Bill Williams River East	Cougar Point	5	ENH	10/27/2013	1/18/2014
Bill Williams River East	Esquerra Ranch	6	ENH	10/28/2013	1/20/2014
Bill Williams River East	Esquerra Ranch	7	ENH	10/27/2013	1/20/2014
Bill Williams River East	Esquerra Ranch	8	ENH	10/27/2013	1/21/2014
Bill Williams River East	Esquerra Ranch	9	ENH	10/28/2013	1/21/2014
Bill Williams River East	Esquerra Ranch	10	ENH	10/28/2013	1/22/2014
Bill Williams River East	Esquerra Ranch	11	ENH	10/28/2013	1/22/2014
Bill Williams River East	Esquerra Ranch	12	ENH	10/27/2013	1/23/2014
Bill Williams River East	Esquerra Ranch	13	ENH	10/28/2013	1/23/2014
Bill Williams River East	Esquerra Ranch	14	ENH	10/28/2013	1/23/2014

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Bill Williams River East	Esquerra Ranch	15	ENH	10/27/2013	1/24/2014
Bill Williams River East	Esquerra Ranch	16	ENH	10/27/2013	1/24/2014
Bill Williams River East	Esquerra Ranch	17	ENH	10/27/2013	1/24/2014
Bill Williams River East	Esquerra Ranch	18	ENH	10/28/2013	1/27/2014
Bill Williams River East	Esquerra Ranch	19	ENH	10/26/2013	1/27/2014
Bill Williams River East	Esquerra Ranch	20	ENH	10/26/2013	1/27/2014
Bill Williams River East	Esquerra Ranch	21	ENH	10/26/2013	1/27/2014
Bill Williams River East	Esquerra Ranch	22	ENH	10/26/2013	1/28/2014
Bill Williams River East	Esquerra Ranch	23	ENH	10/26/2013	1/28/2014
Bill Williams River East	Esquerra Ranch	24	ENH	10/27/2013	1/28/2014
Bill Williams River East	Esquerra Ranch	26	ENH	10/26/2013	1/29/2014
Bill Williams River East	Mineral Wash	25	ENH	10/27/2013	1/29/2014
Bill Williams River East	Mineral Wash	27	ENH	10/26/2013	1/29/2014
Bill Williams River East	Mineral Wash	28	ENH	10/26/2013	1/30/2014
Bill Williams River East	Mineral Wash	29	ENH	10/25/2013	1/30/2014
Bill Williams River East	Mineral Wash	30	ENH	10/25/2013	1/30/2014
Bill Williams River East	Mineral Wash	31	ENH	10/26/2013	1/30/2014
Bill Williams River East	Mineral Wash	32	ENH	10/25/2013	1/30/2014
Bill Williams River East	Mineral Wash	33	ENH	10/25/2013	1/31/2014
Bill Williams River East	Mineral Wash	34	ENH	10/25/2013	1/31/2014
Bill Williams River East	Mineral Wash	35	ENH	10/26/2013	1/31/2014
Bill Williams River East	Mineral Wash	36	ENH	10/26/2013	1/31/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	6	ENH	12/8/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	10	ENH	12/8/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	18	ENH	12/9/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	31	ENH	12/8/2013	Not Recorded
Cibola National Wildlife Refuge Unit 1	Crane Roost	36	ENH	12/10/2013	1/30/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	43	ENH	12/8/2013	2/3/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	45	ENH	12/8/2013	2/3/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	57	ENH	12/8/2013	2/3/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	78	ENH	12/7/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	95	ENH	12/7/2013	2/3/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	103	ENH	12/7/2013	2/3/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	124	ENH	12/9/2013	2/3/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	130	ENH	12/7/2013	2/3/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	131	ENH	12/7/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	134	ENH	12/7/2013	2/5/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	140	ENH	12/9/2013	2/5/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	142	ENH	12/8/2013	2/5/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	145	ENH	12/7/2013	2/5/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	153	ENH	12/7/2013	2/5/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	157	ENH	12/9/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	159	ENH	12/9/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	165	ENH	12/7/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	168	ENH	12/6/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	170	ENH	12/6/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	190	ENH	12/10/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	195	ENH	12/7/2013	2/4/2014
Cibola National Wildlife Refuge Unit 1	Crane Roost	198	ENH	12/7/2013	2/4/2014

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Cibola National Wildlife Refuge Unit 1	CW North	3	ENH	12/6/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	CW North	5	ENH	12/6/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	CW North	7	ENH	12/6/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	CW North	11	ENH	12/6/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	CW North	18	ENH	12/6/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	CW North	20	ENH	12/6/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	12	ROT	12/6/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	14	ROT	12/6/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	19	ROT	12/6/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	23	ROT	12/6/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	27	ROT	12/6/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Mass Transplanting	34	ROT	12/6/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	1	ENH	12/8/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	6	ENH	12/5/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	9	ENH	12/8/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	11	ENH	12/5/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	13	ENH	12/5/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	14	ENH	12/5/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	17	ENH	12/9/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	20	ENH	12/10/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	22	ENH	12/9/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	25	ENH	12/5/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	26	ENH	12/9/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	28	ENH	12/7/2013	1/27/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	31	ENH	12/10/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	33	ENH	12/4/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	35	ENH	12/10/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	36	ENH	12/9/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	42	ENH	12/10/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	44	ENH	12/10/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	46	ENH	12/7/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	48	ENH	12/10/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	50	ENH	12/10/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	52	ENH	12/9/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	53	ENH	12/9/2013	1/28/2014
Cibola National Wildlife Refuge Unit 1	Nature Trail	55	ENH	12/5/2013	1/29/2014
Cibola National Wildlife Refuge Unit 1	HB-12	5	RED	12/10/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	HB-13	10	RED	12/10/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	HB-12	16	RED	12/10/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	HB-13	17	RED	12/10/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	HB-12	23	RED	12/10/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	HB-13	26	RED	12/10/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	HB-12	38	RED	12/10/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	HB-12	48	RED	12/10/2013	1/14/2014
Cibola National Wildlife Refuge Unit 1	HB-10	50	RED	12/10/2013	1/22/2014
Cibola National Wildlife Refuge Unit 1	HB-11	56	RED	12/10/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	HB-09	57	RED	12/10/2013	1/22/2014
Cibola National Wildlife Refuge Unit 1	HB-11	68	RED	12/10/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	HB-10	75	RED	12/10/2013	1/23/2014

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Cibola National Wildlife Refuge Unit 1	HB-11	78	RED	12/10/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	HB-11	87	RED	12/10/2013	1/23/2014
Cibola National Wildlife Refuge Unit 1	HB-14	99	RED	12/9/2013	1/24/2014
Cibola National Wildlife Refuge Unit 1	HB-14	102	RED	12/9/2013	1/24/2014
Cibola Valley Conservation Area	Phase 01	2	ENH	11/18/2013	1/17/2014
Cibola Valley Conservation Area	Phase 01	16	ENH	11/18/2013	1/17/2014
Cibola Valley Conservation Area	Phase 01	21	ENH	11/18/2013	1/20/2014
Cibola Valley Conservation Area	Phase 01	40	ENH	11/18/2013	1/20/2014
Cibola Valley Conservation Area	Phase 01	52	ENH	11/18/2013	1/20/2014
Cibola Valley Conservation Area	Phase 01	56	ENH	11/17/2013	1/22/2014
Cibola Valley Conservation Area	Phase 01	61	ENH	11/17/2013	1/22/2014
Cibola Valley Conservation Area	Phase 01	63	ENH	11/18/2013	1/22/2014
Cibola Valley Conservation Area	Phase 01	91	ENH	11/18/2013	1/22/2014
Cibola Valley Conservation Area	Phase 01	94	ENH	11/18/2013	1/22/2014
Cibola Valley Conservation Area	Phase 01	98	ENH	11/18/2013	1/24/2014
Cibola Valley Conservation Area	Phase 01	104	ENH	11/18/2013	1/24/2014
Cibola Valley Conservation Area	Phase 01	114	ENH	11/17/2013	1/24/2014
Cibola Valley Conservation Area	Phase 01	117	ENH	11/17/2013	1/24/2014
Cibola Valley Conservation Area	Phase 01	119	ENH	11/17/2013	1/27/2014
Cibola Valley Conservation Area	Phase 01	126	ENH	11/17/2013	1/27/2014
Cibola Valley Conservation Area	Phase 01	138	ENH	11/17/2013	1/27/2014
Cibola Valley Conservation Area	Phase 01	147	ENH	11/17/2013	1/28/2014
Cibola Valley Conservation Area	Phase 01	151	ENH	11/17/2013	1/28/2014
Cibola Valley Conservation Area	Phase 02	1	ROT	11/21/2013	1/24/2014
Cibola Valley Conservation Area	Phase 02	4	ROT	11/20/2013	1/24/2014
Cibola Valley Conservation Area	Phase 02	14	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	16	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	19	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	26	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	28	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	30	ROT	11/21/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	39	ROT	11/21/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	44	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	52	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	54	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	59	ROT	11/21/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	68	ROT	11/20/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	73	ROT	11/19/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	76	ROT	11/19/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	83	ROT	11/19/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	91	ROT	11/19/2013	1/27/2014
Cibola Valley Conservation Area	Phase 02	93	ROT	11/19/2013	1/27/2014
Cibola Valley Conservation Area	Phase 03	6	ENH	11/18/2013	1/17/2014
Cibola Valley Conservation Area	Phase 03	24	ENH	11/18/2013	1/17/2014
Cibola Valley Conservation Area	Phase 03	27	ENH	11/19/2013	1/17/2014
Cibola Valley Conservation Area	Phase 03	54	ENH	11/19/2013	1/17/2014
Cibola Valley Conservation Area	Phase 03	60	ENH	11/18/2013	1/19/2014
Cibola Valley Conservation Area	Phase 03	101	ENH	11/19/2013	1/19/2014
Cibola Valley Conservation Area	Phase 03	106	ENH	11/18/2013	1/19/2014

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Cibola Valley Conservation Area	Phase 03	112	ENH	11/18/2013	1/19/2014
Cibola Valley Conservation Area	Phase 03	116	ENH	11/18/2013	1/19/2014
Cibola Valley Conservation Area	Phase 03	121	ENH	11/19/2013	1/20/2014
Cibola Valley Conservation Area	Phase 03	133	ENH	11/18/2013	1/20/2014
Cibola Valley Conservation Area	Phase 03	151	ENH	11/18/2013	1/20/2014
Cibola Valley Conservation Area	Phase 03	162	ENH	11/18/2013	1/20/2014
Cibola Valley Conservation Area	Phase 04E	45	RED	11/21/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04E	117	RED	11/21/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04E	125	RED	11/21/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04E	177	RED	11/21/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04E	232	RED	11/21/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04E	274	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	2	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	21	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	24	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	40	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	45	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	53	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	58	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	60	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	65	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	84	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 04W	88	RED	11/19/2013	1/21/2014
Cibola Valley Conservation Area	Phase 05	9	ENH	11/22/2013	1/21/2014
Cibola Valley Conservation Area	Phase 05	22	ENH	11/22/2013	1/21/2014
Cibola Valley Conservation Area	Phase 05	34	ENH	11/22/2013	1/21/2014
Cibola Valley Conservation Area	Phase 05	36	ENH	11/22/2013	1/22/2014
Cibola Valley Conservation Area	Phase 05	41	ENH	11/22/2013	1/21/2014
Cibola Valley Conservation Area	Phase 05	43	ENH	11/21/2013	1/21/2014
Cibola Valley Conservation Area	Phase 05	61	ENH	11/22/2013	1/22/2014
Cibola Valley Conservation Area	Phase 05	66	ENH	11/21/2013	1/22/2014
Cibola Valley Conservation Area	Phase 05	69	ENH	11/22/2013	1/22/2014
Cibola Valley Conservation Area	Phase 05	74	ENH	11/22/2013	1/22/2014
Cibola Valley Conservation Area	Phase 05	83	ENH	11/22/2013	1/22/2014
Cibola Valley Conservation Area	Phase 05	87	ENH	11/22/2013	1/22/2014
Cibola Valley Conservation Area	Phase 05	97	ENH	11/21/2013	1/22/2014
Cibola Valley Conservation Area	Phase 06	2	ENH	11/21/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	8	ENH	11/20/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	13	ENH	11/20/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	23	ENH	11/20/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	28	ENH	11/20/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	34	ENH	11/20/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	54	ENH	11/21/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	57	ENH	11/21/2013	1/23/2014
Cibola Valley Conservation Area	Phase 06	79	ENH	11/22/2013	1/24/2014
Cibola Valley Conservation Area	Phase 06	81	ENH	11/20/2013	1/24/2014
Cibola Valley Conservation Area	Phase 06	91	ENH	11/20/2013	1/24/2014
Cibola Valley Conservation Area	Phase 06	93	ENH	11/20/2013	1/24/2014
Cibola Valley Conservation Area	Phase 06	102	ENH	11/21/2013	1/24/2014

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Cibola Valley Conservation Area	Phase 06	105	ENH	11/21/2013	1/24/2014
Cibola Valley Conservation Area	Phase 06	108	ENH	11/20/2013	1/25/2014
Palo Verde Ecological Reserve	Phase 01	1	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 01	4	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 01	9	ENH	9/30/2013	1/16/2014
Palo Verde Ecological Reserve	Phase 01	15	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 01	20	ENH	11/16/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 01	24	ENH	11/16/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 01	34	ENH	11/16/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 01	39	ENH	11/16/2013	1/17/2014
Palo Verde Ecological Reserve	Phase 02	4	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	12	ROT	12/6/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	15	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	21	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	26	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	40	ROT	11/17/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	43	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	45	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	53	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	60	ROT	12/7/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	62	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	67	ROT	12/6/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	91	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	93	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	99	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	101	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 02	109	ROT	10/1/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 03	10	ENH	11/17/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	12	ENH	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	21A	ENH	10/2/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 03	21B	ENH	11/16/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 03	26	ENH	10/1/2013	1/20/2014
Palo Verde Ecological Reserve	Phase 03	32	ENH	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	46	ENH	10/2/2013	1/20/2014
Palo Verde Ecological Reserve	Phase 03	52	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	54	ENH	10/2/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 03	64	ENH	11/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	66	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	69	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	78	ENH	11/16/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 03	85	ENH	10/2/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 03	90	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	100	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	113	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	115	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	118	ENH	9/30/2013	1/16/2014
Palo Verde Ecological Reserve	Phase 03	123	ENH	10/2/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	127	ENH	11/16/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 03	129	ENH	11/16/2013	Not Recorded

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Palo Verde Ecological Reserve	Phase 04	4	ROT	11/16/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	22	ROT	11/16/2013	1/17/2014
Palo Verde Ecological Reserve	Phase 04	29	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	36	ROT	12/6/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	43	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	46	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	58	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	79	ROT	11/17/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	83	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	87	ROT	9/30/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	93	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	105	ROT	12/7/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	108	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	113	ROT	12/6/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	121	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	128	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	134	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	136	ROT	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 04	141	ROT	10/1/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 04	146	ROT	11/17/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 05	3	ENH	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 05	28	ENH	10/2/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 05	32	ENH	11/16/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 05	41	ENH	10/1/2013	1/20/2014
Palo Verde Ecological Reserve	Phase 05	64	ENH	10/1/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 05	74	ENH	12/2/2013	1/27/2014
Palo Verde Ecological Reserve	Phase 05	78	ENH	12/2/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	81	ENH	12/2/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	107	ENH	11/16/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	113	ENH	11/17/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	144	ENH	11/17/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	146	ENH	11/16/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	157	ENH	11/16/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	173	ENH	11/16/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	176	ENH	11/16/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 05	190	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	195	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	206	ENH	11/17/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	236	ENH	11/16/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	252	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	264	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	268	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	279	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	287	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	297	ENH	11/6/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	304	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	312	ENH	12/2/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 05	329	ENH	11/16/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 06	1	ENH	12/4/2013	1/21/2014

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Palo Verde Ecological Reserve	Phase 06	4	ENH	12/4/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 06	20	ENH	12/3/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 06	22	ENH	12/3/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 06	25	ENH	12/3/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 06	32	ENH	12/4/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 06	39	ENH	12/3/2013	1/21/2014
Palo Verde Ecological Reserve	Phase 06	54	ENH	12/3/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	58	ENH	12/4/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	65	ENH	12/3/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	69	ENH	12/3/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	79	ENH	12/3/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	87	ENH	12/4/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	91	ENH	12/3/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	109	ENH	12/3/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	121	ENH	12/3/2013	1/22/2014
Palo Verde Ecological Reserve	Phase 06	127	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	130	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	134	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	138	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	153	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	163	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	165	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	173	ENH	12/3/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	184	ENH	12/2/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	186	ENH	12/2/2013	1/23/2014
Palo Verde Ecological Reserve	Phase 06	193	ENH	12/4/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	197	ENH	12/2/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	203	ENH	12/3/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	210	ENH	12/2/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	228	ENH	12/2/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	257	ENH	12/3/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	267	ENH	12/2/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	275	ENH	12/2/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	282	ENH	12/2/2013	1/24/2014
Palo Verde Ecological Reserve	Phase 06	286	ENH	12/3/2013	1/25/2014
Palo Verde Ecological Reserve	Phase 06	289	ENH	12/2/2013	1/25/2014
Palo Verde Ecological Reserve	Phase 06	297	ENH	12/2/2013	1/25/2014
Palo Verde Ecological Reserve	Phase 06	305	ENH	12/2/2013	1/25/2014
Palo Verde Ecological Reserve	Phase 06	318	ENH	12/2/2013	1/25/2014
Palo Verde Ecological Reserve	Phase 07	2	RED	12/6/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	5	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	13	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	20	RED	12/4/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	22	RED	12/4/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	30	RED	12/4/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	35	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	55	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	69	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	76	RED	12/6/2013	1/28/2014

Area	Site	Section	2013 Sample Intensity	Date Sampled	Date Entered
Palo Verde Ecological Reserve	Phase 07	82	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	94	RED	12/4/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	98	RED	12/6/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	106	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	113	RED	12/4/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	115	RED	12/3/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	121	RED	12/5/2013	1/28/2014
Palo Verde Ecological Reserve	Phase 07	128	RED	12/3/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	134	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	142	RED	12/3/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	154	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	162	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	164	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	170	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	182	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	189	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	193	RED	12/5/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	198	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	201	RED	12/4/2013	1/29/2014
Palo Verde Ecological Reserve	Phase 07	212	RED	12/4/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	214	RED	12/4/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	221	RED	12/4/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	226	RED	12/4/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	232	RED	12/5/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	250	RED	12/4/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	252	RED	12/5/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	258	RED	12/3/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	265	RED	12/5/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	268	RED	12/4/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 07	285	RED	12/3/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 08	9	RED	12/8/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 08	12	RED	12/8/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 08	21	RED	12/7/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 08	26	RED	12/8/2013	Not Recorded
Palo Verde Ecological Reserve	Phase 08	35	RED	12/8/2013	1/30/2014
Palo Verde Ecological Reserve	Phase 08	40	RED	12/8/2013	1/30/2014

ATTACHMENT 4

2013 Site Reports

ATTACHMENT 4 – PART A

Beal Lake Conservation Area Riparian Restoration Demonstration Site

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
Beal Lake Conservation Area

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Beal Lake Conservation Area
Dates of Survey: November 5, 2013 – November 9, 2013
Observers: Chad McKenna (Data Manager), Will Widener (Field Supervisor), Cyrus Bullock, Talise Dow, Jarrod Swackhamer, Jay Holt, Matthew Gautreaux, Chris Sanderson, Jesse Perry, Jessyka Wengreen, Amanda Smith, Michelle Ferman, Lindsay Martindale
Reclamation Observers: Dianne Bangle (COR), Michelle Reilly (MSCP Application Developer)

I Summary of Field Activities

During a five day field session (November 5-9, 2013) at Beal Lake Conservation Area (BLCA), crew members performed various tasks such as vegetation data collection, protocol training, vegetation data collection and Electronic Field Form (EFF) testing. Eight crew members were tasked with vegetation data collection during the 2011 and 2012 LCR MSCP survey's; however, due to the October 2013 government shut-down, four additional crew members were added to the team for the remainder of the 2013 field season to help complete data collection before leaf drop. Also, as part of the 2013 vegetation project, Parametrix (PMX)/GeoSystems Analysis (GSA) are performing a pilot study of Trimble® TerraSync™ forms that have been developed by the MSCP Data Management group for recording MSCP vegetation data. The field pilot study will be completed at all five MSCP areas being monitored during the 2013 field season. The emphasis for testing will be to compare the efficiency, accuracy, and precision between the two recording approaches (hardcopy vs. electronic) and to further improve form design and determine an overall process for capturing field data with this method. Crews began the pilot study at BLCA during two days of field work followed by two days of field work at the Bill Williams River National Wildlife Refuge (BWRNWR). Michelle Reilly and Dianne Bangle from MSCP along with Chad McKenna (PMX/GSA Data Manager), Will Widener (Field Supervisor), and three additional field crew members tested the EFF methodology during field work at BLCA to provide data management training, familiarize crews with the Trimble units, and answer questions regarding the EFF.

Below is a day by day summary of field activities that occurred at BLCA during the 2013 field session:

Tuesday 11/5/2013
- Will Widener trained five new field crew members on protocol and hardcopy vegetation data collection (full day)
- Three teams of two field personnel conducted hardcopy vegetation data collection (full day)

Wednesday 11/6/2013
- Will Widener, Chad McKenna, and Michelle Reilly, along with three additional crew members performed EFF testing (full day)
- Two teams of three and one team of two field personnel conducted hardcopy vegetation data collection (full day)

Thursday 11/7/2013
- Will Widener, Chad McKenna, and Dianne Bangle, along with three additional crew members performed EFF testing (full day)
- Two teams of three and one team of two field personnel conducted hardcopy vegetation data collection (full day)

Friday 11/8/2013
- Will Widener and three additional crew members departed BLCA for Bill Williams River NWR (BWRE) to complete EFF testing at the Bill Williams site (full day)
- Three teams of three field personnel (including Chad McKenna) remained at BLCA and continued hardcopy vegetation data collection (full day)

Saturday 11/9/2013

- Will Widener and three additional crew members continued EFF testing at BWRE (full day)
- One team of three and two teams of two completed hardcopy vegetation data collection at BLCA (full day)

All 35 plots within the BLCA site were surveyed during the 5-day field session, as anticipated (scheduled). Plot survey efficiency is difficult to analyze because of the inconsistency in field crew numbers per team and field crew experience. An average work day, including travel to and from BLCA from Lake Havasu City, lasted approximately 10.5 hours. Weather conditions consisted of abundant sunshine and temperatures in the lower 80's (degrees Fahrenheit) throughout the survey, with windy conditions on 11/5/13. No major obstacles or unusual observations occurred during the survey. During the 2012 survey, existing center posts and corners (1/2" re-bar) of each primary plot were marked with blue and white striped flagging to facilitate future plot setup; all plot centers and corner posts were located during the 2013 survey.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Training of new crew members was required for the field methods and field forms.
- EFF testing during the field surveys.
- Plots dominated by thick mesquite (*Prosopis pubescens* and *Prosopis glandulosa*) and arrowweed (*Pluchea sericea*) slowed down plot set-up and data collection.
- Windy conditions on 11/5/13 rendered vegetation by volume and densitometer readings difficult.

III Habitat

Habitat types encountered and surveyed at the site include:

- Plots with a dominant cottonwood (*Populus fremontii*) overstory with mixed mesquite understory and scattered willows (*Salix* sp.).
- Plots with dominant mesquite overstory with dominant arrowweed understory with scattered willows and baccharis (*Baccharis* sp.).
- Plots dominated by arrowweed with scattered mesquite, willow, and baccharis.
- Very few plots within the site contain herbaceous species or tamarix (*Tamarix* sp.).
- No water features within the plots.
- Unknown vegetation species observed within the site include:

Area	Site	Section	Name Given in Field	Identified to…..
BLCA	A	93	Juncus	*Juncus* sp.
BLCA	B	5	*Bothriochloa* SP.	PENDING
BLCA	F	88	Grass 1	PENDING
BLCA	F	34	*Aristida* sp.	*Aristida* sp.

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- Abundant sign (prints, scat, and odor) of feral pigs was observed throughout the project area, with extensive soil and vegetation disturbance apparent in some areas.
- Two feral pigs were observed within the project area.
- Two coyotes were observed within the project area.
- Plots BLCA_M_0048 and BLCA_K_0056 overlap with areas cleared of vegetation for mist net placement.

- Plots that were partially flooded during the 2011 survey as a result of leaks in irrigation outlets were not flooded during the 2012 survey or the 2013 survey.
- Gunshots from hunters were heard throughout the 2013 survey; however, hunters were not observed within the project area.
- Buffelgrass (*Pennisetum ciliare*), observed in plot BLCA_N_0091 during 2011, was not observed during 2012 or 2013 surveys.

ATTACHMENT 4 – PART B

Bill Williams River National Wildlife Refuge; Reference Site

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
Bill Williams River National Wildlife Refuge (BWRE)

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Bill Williams River National Wildlife Refuge
Dates of Survey: October 25, 2013 – October 29, 2013
Observers: Will Widener (Field Supervisor), Cyrus Bullock, Talise Dow, Jason Harris, Jarrod Swackhamer, Jay Holt, Matthew Gautreaux, Chris Sanderson

I Summary of Field Activities

During a five day field session (October 25-29, 2013), four teams of two field personnel completed vegetation data collection at the Bill Williams River National Wildlife Refuge (BWRE). An average of approximately 1.8 plots by each team was completed per day. The number of plots per day completed was less than the previous field year (2.25 plots per day) because training of new crew members was required. All 36 plots within the site were surveyed. The team camped just outside the boundary of the refuge within Bureau of Land Management (BLM) property and hiked to the monitoring plots within the refuge. Time of arrival to the plots varied depending on hiking distance and ability to locate the center of the plots within dense vegetation. An average work day, including hiking to and from the plots and data collection, lasted approximately 10 hours. Weather conditions consisted of sunshine and temperatures in the 80's (degrees Fahrenheit) for the duration of the survey with high winds (wind gusts excess of 40 mph) on 10/28/13.

During the 2012 field survey the center of each plot was marked with a wooden stake (1"x2"x36") with blue and white striped flagging, below is a summary of center plots that were not located during the 2013 survey:

- The center of plots BWRE_ER_0010, BWRE_ER_0022 and BWRE_MW_0031 are located within the river. The center stakes at BWRE-ER-0022 and BWRE-MW-0031 were not located during the 2013 survey and presumably washed away during a high water event; the stakes were not replaced.
- During the 2012 survey, plots BWRE_ER_0019 and BWRE_ER_0023, located within an intermittent wash, were marked with a large fallen tree branch pounded into the ground (instead of a wooden stake) and flagged. The plot center for BWRE_ER_0019 was present during the 2013 survey; however, the plot center for BWRE_ER_0023 presumably washed away and was not replaced.
- The center stake at BWRE-MW-0033 was not located and was not replaced.

A second field survey of the BWRE was conducted on November 8 and November 9, 2013 to test electronic field form (EFF) data collection methods. As part of this year's vegetation project, Parametrix (PMX)/GeoSystems Analysis (GSA) are performing a pilot study of Trimble® TerraSync™ forms that have been developed by the MSCP Data Management group for recording MSCP vegetation data. The field pilot study will be completed at all five MSCP areas being monitored during the 2013 field season. The emphasis for testing will be to compare the efficiency, accuracy, and precision between the two recording approaches (hardcopy vs. electronic) and to further improve form design and determine an overall process for capturing field data with this method. Flagging set up during initial 2013 data collection (10/25/13-10/29/13) was left in-place within designated EFF testing plots for data collection during the follow-up EFF testing survey. Two teams of two field personnel completed approximately 3 plots per day (1.5 plots per team) during EFF testing. This plot efficiency does not include plot setup; plots surveyed with EFFs were previously flagged.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Numerous water crossings and beaver dams/ponds – water levels within the site during the 2013 survey were similar to the 2012 survey.
- Plots dominated by thick mesquite (*Prosopis pubescens* and *Prosopis glandulosa*).

- Difficult hiking conditions at times.
- Limited access to plots.
- Areas dominated by salt cedar (*Tamarix* sp.), usually containing extensive dead and downed woody debris, made passage within the refuge somewhat difficult.
- High winds on 10/28/13 (difficult to read hits to pole, danger of falling branches/dead trees).

III Habitat

Habitat types encountered and surveyed at the site include:

- Plots with a dominant cottonwood (*Populus fremontii*) overstory with mixed mesquite understory and scattered Goodding's willows (*Salix gooddingii*).
- Plots dominated by mesquite.
- Few plots within the site contain herbaceous species and salt cedar.
- Numerous plots included water features such as the Bill Williams River, backwater channels, beaver ponds, and/or wetlands.
- Unknown vegetation species observed within the site include:

Area	Site	Section	Name Given in Field	Identified to……..
BWRE	CP	2	Unknown 1	Pending
BWRE	CP	2	Unknown 2	Pending
BWRE	CP	2	Unknown 3	Pending
BWRE	CP	2	Stuff?	*Tiquilia plicata*
BWRE	CP	3	Ragweed	Pending
BWRE	CP	3	Sisymbrium	*Sisymbrium irio*
BWRE	CP	5	Missletoe	Pending
BWRE	ER	6	Brassicaceae	*Sisymbrium irio*
BWRE	ER	13	Check Nicotiana obtusifolia	Pending
BWRE	ER	13	Porophylla	Pending
BWRE	ER	14	Check Nicotiana obtusifolia	Pending
BWRE	ER	16	Brassicaceae	*Sisymbrium irio*
BWRE	ER	16	Check Nicotiana obtusifolia	Pending
BWRE	Er	16	FM Basal rosette, fuzzy, serrate leaves	Pending
BWRE	ER	18	Check Nicotiana obtusifolia	Pending
BWRE	ER	19	Brassicaceae	*Sisymbrium irio*
BWRE	ER	22	Brassicaceae	*Sisymbrium irio*
BWRE	ER	23	Brassicaceae	*Sisymbrium irio*
BWRE	ER	26	Brassicaceae	*Sisymbrium irio*
BWRE	ER	26	Check Nicotiana obtusifolia	Pending
BWRE	MW	25	Brassicaceae	*Sisymbrium irio*
BWRE	MW	25	Brassicaceae	*Sisymbrium irio*
BWRE	MW	28	Brassicaceae	*Sisymbrium irio*
BWRE	MW	32	Sonchus	Pending
BWRE	MW	33	Brassicaceae	*Sisymbrium irio*
BWRE	MW	34	Ipomoea	Pending
BWRE	MW	34	Solanum?	Pending

BWRE	ER	36	Unknown 4	Pending
BWRE	ER	36	Unknown 5	Pending
BWRE	ER	36	Schoenoplectus 1	Pending
BWRE	ER	8	Eleo?	Eleocharis sp.

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- Accumulation of much dead and down woody debris may pose a fire risk within the refuge. Large woody debris and felled trees were more abundant during the 2013 survey than the previous 2011 and 2012 surveys.
- Spanish false fleabane (*Pulicaria paludosa*), a non-native species with the potential to spread rapidly if not managed, was identified within plots BWRE_CP_0002, BWRE_ER_0007, BWRE_ER_0008, BWRE_MW_0031, and BWRE_MW_0034. Spanish false fleabane is currently not considered a prohibited, regulated and/or restricted noxious weed in Arizona.
- A javelina (peccary) was observed within the Mineral Wash portion of the project site.
- Wild burros and cattle sign were observed within and adjacent to the site, and are likely to cause soil and vegetation disturbance.
- The 2013 survey occurred during quail hunting season. No hunters were observed, nor gunshots heard, during the field surveys.

ATTACHMENT 4 – PART C

Cibola National Wildlife Refuge Unit 1 Conservation Area

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
Cibola National Wildlife Refuge Unit 1 Conservation Area

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Cibola National Wildlife Refuge Unit 1 Conservation Area
Dates of Survey: December 5 – December 10, 2013
Observers: Will Widener (Field Supervisor), Talise Dow, Cyrus Bullock, Jarrod Swackhamer, Jay Holt, Jason Harris, Matthew Gautreaux, Jesse Perry, Jessyka Wengreen, Amanda Smith, Michelle Ferman, Lindsay Martindale

I Summary of Field Activities

During a six day field session (December 5 through December 10, 2013), field personnel completed vegetation data collection at the Cibola National Wildlife Refuge Unit 1 (CNU1). The project site consists of 5 distinct areas:

- CW North (CWN)
- Nature Trail (NT)
- Mass Transplanting (MT)
- Crane Roost (CR)
- Hippie Burn (HB)

Two additional riparian areas exist within CNU1, but were not included in survey efforts—"Seed Feasibility Study" and "Cottonwood Genetics Study."

During the field session, crew members performed vegetation data collection and vegetation data collection/Electronic Field Form (EFF) testing within CNU1. Eight crew members were tasked with vegetation data collection during the 2011 and 2012 LCR MSCP survey's; however, due to the October 2013 government shut-down, four additional crew members were added to the team for the 2013 field season to help complete data collection before leaf drop. Because of the need to complete vegetation surveys before leaf drop, eight crew members departed the Palo Verde Ecological Reserve (PVER) site for CNU1 on December 5th to begin vegetation data collection at CNU1 while four crew members remained at PVER to complete data collection within the remaining phases of the site.

Also, as part of the 2013 vegetation project, Parametrix (PMX)/GeoSystems Analysis (GSA) performed a pilot study of Trimble® TerraSync™ forms that have been developed by the MSCP Data Management group for recording MSCP vegetation data. The field pilot study will be completed at all five MSCP areas being monitored during the 2013 field season. The emphasis for testing was to compare the efficiency, accuracy, and precision between the two recording approaches (hardcopy vs. electronic) and to further improve form design and determine an overall process for capturing field data.

The 2013 vegetation survey at CNU1 included data collection within the following areas:

- "enhanced plots[1]" (full vegetation monitoring protocol) within CWN, NT, and CR.
- "reduced effort plots" (monitoring protocol for recently planted vegetation) within HB.
- "rotational plots" (less intensive vegetation monitoring protocol) within MT.

All plots within CNU1, totaling 57 enhanced plots, 17 reduced effort plots, and 6 rotational plots, were surveyed as scheduled. Below is a day by day summary of field activities that occurred at CNU1 during the 2013 field session:

[1] Formerly named intensive plots

12/5/13

- 8 crew members mobilized to CNU1 from PVER and began vegetation surveys within NT and CR

12/6/13

- Will Widener and 3 additional crew members travelled to PVER from CNU1to conduct EFF testing and to help conduct vegetation surveys
- 2 teams of 2 crew members remained at CNU1 to conducted vegetation surveys within NT, CR, and CWN (CWN completed)

12/7/13

- Will Widener and 2 additional crew members travelled to PVER from CNU1to conduct EFF testing and to help conduct vegetation surveys
- 1 team of 2 and 1 team of 3 crew members remained at CNU1 to conducted vegetation surveys within NT, CR, and MT

12/8/13

- 2 teams of 2 crew members conducted EFF testing at CNU1
- 2 teams of 2 crew members conducted vegetation surveys at CNU1 within NT, CR, HB, and MT (MT completed)

12/9/13

- 2 team of 2 completed EFF testing at CNU1
- 3 teams of 2 crew members conducted vegetation surveys at CNU1 within NT, CR, and HB

12/10/13

- 6 teams of 2 crew members completed vegetation surveys within NT, CR, and HB
- CNU1 completed

Plot survey efficiency is difficult to analyze for the 2013 field season because of the inconsistency in field crew numbers per team, the inconsistent number of teams working within each phase per day, EFF testing, and the various times spent within each phase per day. However, the time required to survey was recorded for a subset of sections. This will allow future comparison of efficiency between EFF and paper form data recording.

A majority of the plots were previously marked with a center T- post, an engraved identification cap, and ½ inch rebar in two corners. During the 2012 field session field crews installed ½ inch rebar and blue/white striped flagging at all four plot corners. An exception to this plot marking, at the request of Cibola National Wildlife Refuge personnel, is that the center and/or corners of plots located within view of the nature trails not be marked.

During this 2013 field session, plots within Hippie Burn, which is in year 1 of surveys, were marked with center T-posts, engraved identification caps, and ½ inch rebar at all four corners.

During the surveys, weather consisted of sunny conditions with temperatures in the 50's (degrees Fahrenheit) with periods of high wind.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Plots dominated by thick seep willow (*Baccharis salicifolia*) and/or screwbean and honey mesquite (*Prosopis pubescens* and *Prosopis glandulosa*) within the Nature Trail and the northernmost field of Crane Roost.
- Senescence on willows rendered it difficult to assess whether some trees were dead and/or partially dead.
- Windy conditions throughout the survey period rendered vegetation by volume and densitometer readings difficult.

III Habitat

Habitat types encountered and surveyed at the site include:

- CW North is dominated by cottonwood (*Populous fremontii*) overstory with little understory vegetation.
- Plots within the Nature Trail are dominated by cottonwood, Goodding's willow (*Salix gooddingii*), and/or seep willow with scattered mesquite (honey and screwbean) and Johnson grass (*Sorghum halepense*).
- Plots within the Crane Roost are dominated by cottonwood, Goodding's willow, and/or mesquite (honey and screwbean). Vegetation stress was apparent in some areas of the Crane Roost.
- Plots within Mass Transplanting are dominated by cottonwood.
- Recently planted Hippie Burn is dominated by Gooding's willow and cottonwood.
- No noxious weeds or Spanish false fleabane (*Pulicaria paludosa*) were identified within any of the plots.
- Tamarix (*Tamarix* sp.) was identified within a few plots (especially Crane Roost), but was not prevalent within the site.
- Unknown vegetation species observed within the site include:

Area	Site	Section	Name Given in Field	Identified to…..
CNU1	CR	95	Macaranthera	MACCAN
CNU1	HB-12	48	Unk 1	To be determined
CNU1	NT	9	Missletoe	*Phoradendron californicum*
CNU1	NT	55	Unknown moss (green not black)	Not sure if we can get this w/out collection
CNU1	NT	55	Unknown black algae	Not sure if we can get this w/out collection

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- None

ATTACHMENT 4 – PART D

Cibola Valley Conservation Area

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
Cibola Valley Conservation Area

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Cibola Valley Conservation Area
Dates of Survey: November 17, 2013 - November 22, 2013
Observers: Will Widener (Field Supervisor), Cyrus Bullock, Talise Dow, Jarrod Swackhamer, Jay Holt, Matthew Gautreaux, Chris Sanderson, Jesse Perry, Jessyka Wengreen, Amanda Smith, Michelle Ferman, Lindsay Martindale

I Summary of Field Activities

During an approximate six day field session (November 17 – 22, 2013) at the Cibola Valley Conservation Area (CVCA), crew members performed various tasks such as vegetation data collection, protocol training for reduced effort and rotational plot survey methods, and Electronic Field Form (EFF) testing. As part of the 2013 vegetation project, Parametrix (PMX) and GeoSystems Analysis (GSA) performed a pilot study of Trimble® TerraSync™ EFF forms that have been developed by the MSCP Data Management group for recording MSCP vegetation data. The emphasis for testing was to compare the efficiency, accuracy, and precision between the two recording approaches (hardcopy vs. electronic) and to further improve form design and determine an overall process for capturing field data.

Eight crew members were tasked with vegetation data collection during the 2011 and 2012 LCR MSCP survey's; however, due to the October 2013 government shut-down, four additional crew members were added to the team for the 2013 CVCA field season to help complete data collection before leaf drop and to assist with EFF testing.

The 2013 vegetation surveys at CVCA included data collection within the following phases of CVCA:

- "enhanced plots[1]" (full vegetation monitoring protocol) within phases 01, 03, 05, and 06.
- "rotational plots" (less intensive vegetation monitoring than the enhanced protocols) within phase 02.
- "reduced effort plots" (monitoring protocol for areas still mowed between rows) within phases 04E and 04W.
    - Note that CVCA 04W was specified for rotational protocols during the 2014 season per the Scope of Work. However, within the GIS shapefiles, CVCA 04W plots were specified as reduced effort. This error was not discovered until after fieldwork was completed using reduced effort protocols.

All plots within the CVCA site, totaling 60 enhanced plots, 17 reduced effort plots, and 19 rotational plots, were surveyed. Below is a day by day summary of field activities that occurred at CVCA during the 2013 field session:

Sunday 11/17/13
- Crew mobilized from the Palo Verde Ecological Reserve (PVER) site to CVCA during the morning to avoid deer hunters at PVER (deer hunting season open in California – closed in Arizona).
- 4 teams of 2 and 1 team of 3 crew members conducted enhanced plot surveys within Phase 01 (approximately 1/2 day).

Monday 11/18/13
- 6 teams of 2 crew members conducted enhanced plot surveys within Phase 01 (approximately 1/2 day) and enhanced plot surveys within Phase 03 (approximately 1/2 day). Phase 01 plots completed.

Tuesday 11/19/13
- Morning training session for reduced effort plots (less than 1/2 day).
- 3 teams of 2 crew members conducted reduced effort plots within Phase 04W (Phase 04W completed).
- 2 teams of 2 crew members conducted enhanced plot surveys within Phase 03 (Phase 03 completed).

[1] Formerly named intensive plots

- Afternoon training for rotational plot surveys (less than 1/2 day).

Wednesday 11/20/13

- 2 teams of 2 crew members performed EFF testing (full day).
- 4 teams of 2 crew members conducted enhanced plot surveys within Phase 06 (approximately 1/2 day) and rotational plot surveys within Phase 02 (approximately 1/2 day).

Thursday 11/21/13

- 2 teams of 2 crew members performed EFF testing (full day).
- 4 teams of 2 crew members conducted enhanced plot surveys within Phase 06 and rotational plot surveys within Phase 02. Both Phase 06 and Phase 02 plots completed.
- 1 team of 2 crew members completed Phase 04E reduced effort plots.
- Crews began collecting data within Phase 05 enhanced plots.

Friday 11/22/13

- 4 teams of 2 and 1 team of 3 crew members completed Phase 05 enhanced plots (approximately 1/2 day).

Plot survey efficiency is difficult to analyze for the 2013 CVCA field season because of the inconsistency in field crew numbers per team, inconsistent number of teams working within each phase per day, and the various times spent within each phase per day. However, the time required to survey was recorded for a subset of sections. This will allow future comparison of efficiency between EFF and paper form data recording.

A subset of plots within CVCA (within non-mowed Sites) were previously marked with a center T- post, engraved identification caps, and ½ inch re-bar at the corners. However, a majority of center T-posts and corner re-bar within phases 05 and 06 were not installed because of the threat to mowing equipment. During the 2013 field session, a center T-post and corner ½ inch re-bar was installed for plots within phases 05 and 06 as these phases will no longer be mowed between planted rows. Note - The centers of these plots were not marked with engraved identification caps. Also, because Phase 04W was denoted as reduced effort in the GIS shapefiles, it was assumed that mowing will continue; thus permanent markings were not installed during this field season.

Weather consisted of mostly sunny conditions and temperatures in the 70's (degrees Fahrenheit) during the first five days of the survey. The last day of the survey (11/22/13) consisted of wind and steady rain. Except for the unusual amount of rain, no major obstacles or unusual observations occurred during the survey.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Training of new crew members was required for rotational and reduced effort monitoring methods.
- EFF testing during the field surveys.
- Changes to schedule as a result of government shut-down.
- Plots that were flooded during the 2011 survey as a result of irrigation were not flooded during the 2012 or 2013 surveys.
- Bird hunters were observed at the site during 2013 survey. When present, crews must take additional safety precautions, such as wearing safety vests and avoiding areas where hunters are present.

III Habitat

Habitat types encountered and surveyed at the site include:

- Phase 01 and 02 plots are dominated by cottonwood (*Populus fremontii*), Gooding's willow (*Salix gooddingii*), and/or coyote willow *(Salix exigua*).

- Phase 03 plots are dominated by cottonwood, except one plot (CVCA3_101) which is dominated by honey mesquite (*Prosopis glandulosa*).
- Phase 04W, 04E, 05, and 06 plots are dominated by honey mesquite and quail bush (*Atriplex lentiformis*). Numerous quail bush seedlings were observed.
- No Spanish false fleabane (*Pulicaria paludosa*) was identified within any of the plots.
- Tamarix (*Tamarix* sp.) and arrowweed (*Pluchea sericea)* was identified within a few plots, but was not prevalent within the site.
- Salt heliotrope (*Heliotropium curassavicum*) was commonly found scattered in the mesquite plots, but never with high densities.
- Unknown vegetation species observed within the site include:

Area	Site	Section	Name Given in Field	Identified to…..
CVCA	Phase 01	61	Unk Grass	To be determined
CVCA	Phase 02	39	Unk 2	To be determined
CVCA	Phase 03	54	Unk Grass 1	*Panicum dichotomiflorum*
CVCA	Phase 03	101	Ann 1	To be determined
CVCA	Phase 03	116	Unk Clover	To be determined
CVCA	Phase 03	162	Clover1	To be determined
CVCA	Phase 04E	274	Eragrostis	To determine species
CVCA	Phase 05	9	Thinopyrum	Need to verify genus/determine species
CVCA	Phase 05	22	Triticum	Need to verify if TRIAES
CVCA	Phase 05	74	Thinopyrum	Need to verify genus/determine species

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- Morning glory (*Ipomoea purpurea*), a noxious weed species with the potential to spread rapidly if not managed was identified throughout the site and was especially abundant within Phases 01 and 02 (see below). *Ipomoea purpurea* is a prohibited noxious weed in Arizona.

- Sahara mustard (*Brassica tournefortii*), a very fast growing and drought tolerant non-native invasive weed was identified in two plots within the site (see below). *Brassica tournefortii* smothers native herbaceous plants and competes with shrubs for light and soil moisture.

- Buffelgrass (*Pennisetum ciliare*), a bunch grass that grows densely and crowds out native plants, was identified within Phase 04E within the site (see below).

Locations of noxious/non-native weeds present within the site are listed below:

Area	Site	Section	Noxious Weed
CVCA	Phase 01	16	*Ipomoea purpurea*
CVCA	Phase 01	21	*Ipomoea purpurea*
CVCA	Phase 01	40	*Ipomoea purpurea*
CVCA	Phase 01	52	*Ipomoea purpurea*
CVCA	Phase 01	56	*Ipomoea purpurea*
CVCA	Phase 01	91	*Ipomoea purpurea*
CVCA	Phase 01	94	*Ipomoea purpurea*
CVCA	Phase 01	104	*Ipomoea purpurea*

Area	Site	Section	Noxious Weed
CVCA	Phase 01	114	*Ipomoea purpurea*
CVCA	Phase 01	119	*Ipomoea purpurea*
CVCA	Phase 01	126	*Ipomoea purpurea*
CVCA	Phase 01	147	*Ipomoea purpurea*
CVCA	Phase 01	151	*Ipomoea purpurea*
CVCA	Phase 02	4	*Ipomoea purpurea*
CVCA	Phase 02	14	*Ipomoea purpurea*
CVCA	Phase 02	19	*Ipomoea purpurea*
CVCA	Phase 02	26	*Ipomoea purpurea*
CVCA	Phase 02	28	*Ipomoea purpurea*
CVCA	Phase 02	30	*Ipomoea purpurea*
CVCA	Phase 02	44	*Ipomoea purpurea*
CVCA	Phase 02	52	*Ipomoea purpurea*
CVCA	Phase 02	54	*Ipomoea purpurea*
CVCA	Phase 02	59	*Ipomoea purpurea*
CVCA	Phase 02	68	*Ipomoea purpurea*
CVCA	Phase 02	76	*Ipomoea purpurea*
CVCA	Phase 02	83	*Ipomoea purpurea*
CVCA	Phase 02	91	*Ipomoea purpurea*
CVCA	Phase 02	93	*Ipomoea purpurea*
CVCA	Phase 03	24	*Ipomoea purpurea*
CVCA	Phase 03	60	*Ipomoea purpurea*
CVCA	Phase 03	112	*Ipomoea purpurea*
CVCA	Phase 03	133	*Ipomoea purpurea*
CVCA	Phase 04E	117	*Pennisetum ciliare*
CVCA	Phase 04E	177	*Ipomoea purpurea*
CVCA	Phase 04W	40	*Ipomoea purpurea*
CVCA	Phase 04W	45	*Ipomoea purpurea*
CVCA	Phase 04W	53	*Ipomoea purpurea*
CVCA	Phase 04W	65	*Ipomoea purpurea*
CVCA	Phase 04W	84	*Ipomoea purpurea*
CVCA	Phase 04W	88	*Ipomoea purpurea*
CVCA	Phase 05	22	*Brassica tournefortii*
CVCA	Phase 06	23	*Brassica tournefortii*

ATTACHMENT 4 – PART E

Palo Verde Ecological Reserve

LONG TERM VEGETATION MONITORING OF MSCP RESTORATION SITES
Individual Site Reports
Palo Verde Ecological Reserve

Project: Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Vegetation Monitoring
Site: Palo Verde Ecological Reserve
Dates of Survey:
Field Session #1 - September 30- October 2, 2013
Field Session #2 - November 16- November 17, 2013
Field Session #3 - December 2 – December 9, 2013
Observers:
Field Session #1 - Will Widener (Field Supervisor), Talise Dow, Cyrus Bullock, Jarrod Swackhamer, Thomas Staudt, Jay Holt, Jason Harris, Matthew Gautreaux.
Field Sessions #2 and #3 - Will Widener (Field Supervisor), Talise Dow, Cyrus Bullock, Jarrod Swackhamer, Jay Holt, Jason Harris, Matthew Gautreaux, Jesse Perry, Jessyka Wengreen, Amanda Smith, Michelle Ferman, Lindsay Martindale

I Summary of Field Activities

During three field sessions totaling 13 days (September 30 – October 2, 2013; November 16 - 17, 2013; December 2 – 9, 2013), field personnel performed various tasks such as vegetation data collection, protocol training, and Electronic Field Form (EFF) testing at the Palo Verde Ecological Reserve (PVER). Three separate field sessions were necessary at PVER as a result of a government shut-down and the presence of deer hunters within the site, as outlined below:

- Field Session #1; September 30 – October 2
  - Field session terminated on October 3rd as a result of a government shut-down
  - Crew members sent home on October 3rd until further notice
- Field Session #2: November 16 – 17
  - Field session terminated on November 17th as a result of safety concerns for crew members (deer hunters observed within the PVER site)
  - Crew mobilized to the Cibola Valley Conservation Area (CVCA) on November 17th and began collecting data at CVCA (deer hunting season closed within Arizona)
- Field Session #3; December 2 – December 9
  - December 5th - eight crew members depart PVER for the Cibola National Wildlife Refuge Unit 1; four crew members remain at PVER
  - December 9th – data collection completed at PVER

Eight crew members were tasked with vegetation data collection during the 2011 and 2012 LCR MSCP survey's; however, due to the October 2013 government shut-down, four additional crew members were added to the team for the 2013 PVER field season to help complete data collection before leaf drop. Because of the need to complete vegetation surveys before leaf drop, eight crew members departed PVER for the Cibola National Wildlife Refuge Unit 1 (CNU1) on December 5th to begin vegetation data collection at CNU1 while four crew members remained at PVER to complete data collection within the remaining phases of the site.

Also, during the field sessions, crew members performed vegetation data collection EFF testing. As part of the 2013 vegetation project, Parametrix (PMX) and GeoSystems Analysis (GSA) performed a pilot study of Trimble® TerraSync™ EFF forms that have been developed by the MSCP Data Management group for recording MSCP vegetation data. The emphasis for testing was to compare the efficiency, accuracy, and precision between the two recording approaches (hardcopy vs. electronic) and to further improve form design and determine an overall process for capturing field data.

The 2013 vegetation surveys at PVER included data collection within the following phases:

- "enhanced plots[1]" (full vegetation monitoring protocol) within Phases 01, 03, 05 and 06.
- "rotational plots" (less intensive vegetation monitoring than the enhanced protocol) within Phases 02 and 04.
- "reduced effort plots" (monitoring protocol for recently planted vegetation) within Phases 07 and 08 .

All plots within the PVER site, totaling 98 enhanced plots, 37 rotational plots, and 46 reduced effort plots were surveyed as scheduled. Below is a day by day summary of field activities that occurred at PVER during the 2013 field sessions:

Field Session #1:

9/30/13

- Protocol training – enhanced monitoring protocol (approximately 1/2 day)
- 4 teams of 2 crew members conducted vegetation surveys (approximately 1/2 day)

10/1/13 and 10/2/13

- 4 teams of 2 crew members conducted vegetation surveys (full day)

10/3/13

- Government "stop work order" received, no surveys conducted, crews sent home

Field Session #2:

11/16/13

- 6 teams of 2 crew members conducted vegetation surveys (1/2 day)
- 4 teams of 2 and 1 team of 3 crew members conducted vegetation surveys (1/2 day)
- Will Widener conducted QA/QC (1/2 day)

11/17/13

- 6 teams of 2 crew members conducted vegetation surveys (approximately 1/2 day)
- Entire crew mobilized to CVCA to avoid deer hunters at PVER

Field Session #3:

12/2/13

- 4 teams of 2 and 1 team of 3 crew members surveyed Phase 05 and Phase 06

12/3/13

- 4 teams of 2 and 1 team of 3 crew members surveyed Phase 05 and Phase 06 – Phase 05 plots completed

12/4/13

- 4 teams of 2 and 1 team of 3 crew members surveyed Phase 06 and Phase 07 – Phase 06 plots completed

12/5/13

- 2 teams of 2 crew members surveyed Phase 07
- 8 crew members mobilized to CNU1 and began vegetation surveys

12/6/13

[1] Formerly named intensive plots

- Will Widener and three additional crew members travelled to PVER from CNU1to conduct EFF testing and help conduct vegetation surveys
- 2 teams of 2 crew members surveyed Phase 07 (Phase 07 completed)
- 1 team of 3 crew members surveyed Phase 02 (Phase 02 completed)

12/7/13

- Will Widener and 2 additional crew members travelled to PVER from CNU1to conduct EFF testing and to help conduct vegetation surveys
- 1 team of 2 crew members surveyed Phase 04

12/8/13

- 2 teams of 2 crew members completed Phase 04 and Phase 08

12/9/13

- 1 team of 2 crew members completed EFF testing at PVER
- All phases within PVER completed

Plot survey efficiency is difficult to analyze for the 2013 PVER field season because of the inconsistency in field crew numbers per team, the inconsistent number of teams working within each phase per day, surveys conducted over three separate field sessions, EFF testing, and the various times spent within each phase per day. However, the time required to survey was recorded for a subset of sections. This will allow future comparison of efficiency between EFF and paper form data recording.

During previous field sessions, plots were marked with a center T-post, engraved signature cap, and ½ inch rebar at each corner. During this 2013 field session, T-posts and engraved signature caps, as well as ½ inch rebar were installed at all four plot corners within the newly planted Phase 08. Additional center T-posts, engraved caps, and/or corner rebar were placed within plots that were not marked during the previous field seasons.

Weather consisted of mostly sunny conditions and temperatures in the 80's (degrees Fahrenheit) during the first survey, 70's during the second survey, and 50's and 60's during the third survey. Windy conditions occurred during a majority of the days during the third survey.

II Obstacles

Minor obstacles encountered at the site which may have affected the project schedule and/or should be considered for future survey efforts include:

- Plots that were flooded during the 2011 survey as a result of irrigation were not flooded during the 2013 survey. Thus, irrigation-related flooding did not delay survey efforts.
- Deer hunters were observed at the site during Field Session #2. When bird hunters are present, crews must take additional safety precautions; however, because deer hunters use high powered rifles, it is recommended that field surveys are not conducted during deer hunting season. The season in this zone begins the first Saturday of November, and extends for 23 days.
- Crop dusting occurred adjacent to phases being surveyed. Crews moved to different areas of the site as to avoid pesticides.
- Minor senescence on mesquite trees along the edge of PVER 6 during the third field session (12/2-12/9), however, there was little to no impact on plot data. Also, minor senescence on coyote willow rendered it difficult to assess whether some trees were dead and/or partially dead.
- Windy conditions during the third survey period (12/2-12/9) rendered vegetation by volume and densitometer readings difficult.

III Habitat

Habitat types encountered and surveyed at the site include:

- Plots with a dominant cottonwood (*Populous fremontii*) overstory with scattered coyote and Gooding's willow (*Salix exigua* and *S. gooddingii*, respectively).
- Plots with a mix of cottonwood and willows (Gooding's and coyote willow).
- Plots dominated by cottonwood.
- Plots dominated by willows (both species).
- Plots dominated by quailbush (*Atriplex lentiformis*).
- Plots with an understory dominated by alfalfa (*Medicago sativa*).
- Plots with variable cover of Bermuda grass (*Cynodon dactylon*).
- Mesquite (*Prosopis glandulosa*) and arrowweed (*Pluchea sericea)* were identified within a few plots, but were not prevalent within the site.
- Unknown vegetation species observed within the site include:

Area	Site	Section	Name Given in Field	Identified to…..
PVER	Phase 01	39	UFS	Unidentifiable cotyledon
PVER	Phase 03	78	Unk 1 (=Annual Forb)	To be determined
PVER	Phase 03	115	Unknown 1 (=Chenopodium sp.?)	Need to verify Chenopodium sp.
PVER	Phase 05	190	Mac sp.	Need to verify Machaeranthera canescens
PVER	Phase 05	190	Unknown A	To be determined
PVER	Phase 06	54	Unk B	To be determined
PVER	Phase 06	127	Unk #1 0153	To be determined
PVER	Phase 06	275	SPOARD	SPOAIR
PVER	Phase 06	305	BAC UNK	CONCAN
PVER	Phase 07	94	Boutla sp.	BOUGRA
PVER	Phase 07	121	Knotweed	POLARG
PVER	Phase 08	21	Unkownn Forb with Purple flowers	To be determined
PVER	Phase 08	35	Will's Unknown	Same as Phase 08 21
PVER	Phase 08	40	Millet	Look up scientific name for Millet

IV Other Considerations

Other considerations for the field site which may require swift management action include:

- Spanish false fleabane (*Pulicaria palidosa*), a non-native plant of interest which may spread throughout the site if not managed, was observed within Phases 05, 06, and 08 (see below).

- Morning glory (*Ipomoea purpurea*), a noxious weed species with the potential to spread rapidly if not managed, was identified within Phases 05 and 06 (see below). *Ipomoea purpurea* is a prohibited noxious weed in Arizona.

- Sahara mustard (*Brassica tournefortii*), a very fast growing and drought tolerant non-native invasive weed, was identified in two plots within Phase 06 (see below). *Brassica tournefortii* smothers native herbaceous plants and competes with shrubs for light and soil moisture.

- Buffelgrass (*Pennisetum ciliare*), a bunch grass that grows densely and out competes native plants, was identified within Phases 05 and 07 within the site (see below).

Locations of noxious/non-native weeds present within the site are listed below:

Area	Site	Section	Noxious Weed
PVER	Phase 05	3	*Ipomoea purpurea*
PVER	Phase 05	32	*Pennisetum ciliare*
PVER	Phase 05	78	*Pennisetum ciliare*
PVER	Phase 05	252	*Ipomoea purpurea*
PVER	Phase 05	312	*Pulicaria palidosa*
PVER	Phase 06	54	*Brassica tournefortii*
PVER	Phase 06	54	*Pulicaria palidosa*
PVER	Phase 06	138	*Pulicaria palidosa*
PVER	Phase 06	197	*Brassica tournefortii*
PVER	Phase 06	257	*Ipomoea purpurea*
PVER	Phase 06	275	*Ipomoea purpurea*
PVER	Phase 06	282	*Ipomoea purpurea*
PVER	Phase 06	305	*Ipomoea purpurea*
PVER	Phase 07	142	*Pennisetum ciliare*
PVER	Phase 08	21	*Pulicaria palidosa*
PVER	Phase 08	35	*Pulicaria palidosa*

ATTACHMENT 5

2013 Plot Location Maps

ATTACHMENT 5 – PART A

Beal Lake Conservation Area Map

Legend

- Beal Fields (Site Name Labeled)
- **2013 Vegetation Plot**
  - ENHANCED
  - REDUCED
  - ROTATIONAL

2013 Vegetation Monitoring Plots: Beal Lake Conservation Area - Various Sites (Fields)

AREA = BLCA
SITE = Various
BEARING = 315

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

ATTACHMENT 5 – PART B

Bill Williams River East Maps

Legend

2013 Vegetation Plot

Plot Type

- REDUCED
- ROTATIONAL
- ENHANCED

2013 Vegetation Monitoring Plots: Bill Williams River East - All Sites

AREA = BWRE
SITE = All

0 100200 400 600 800 Feet

GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

774500 774750

3795750 3795750

Cougar Point 1

Cougar Point 2

Cougar Point 3

Cougar Point 4

Cougar Point 5

3795500 3795500

3795250 3795250

774500 774750

Legend

2013 Vegetation Plot

Plot Type

ENHANCED

REDUCED

ROTATIONAL

2013 Vegetation Monitoring Plots: Bill Williams River East - Cougar Point

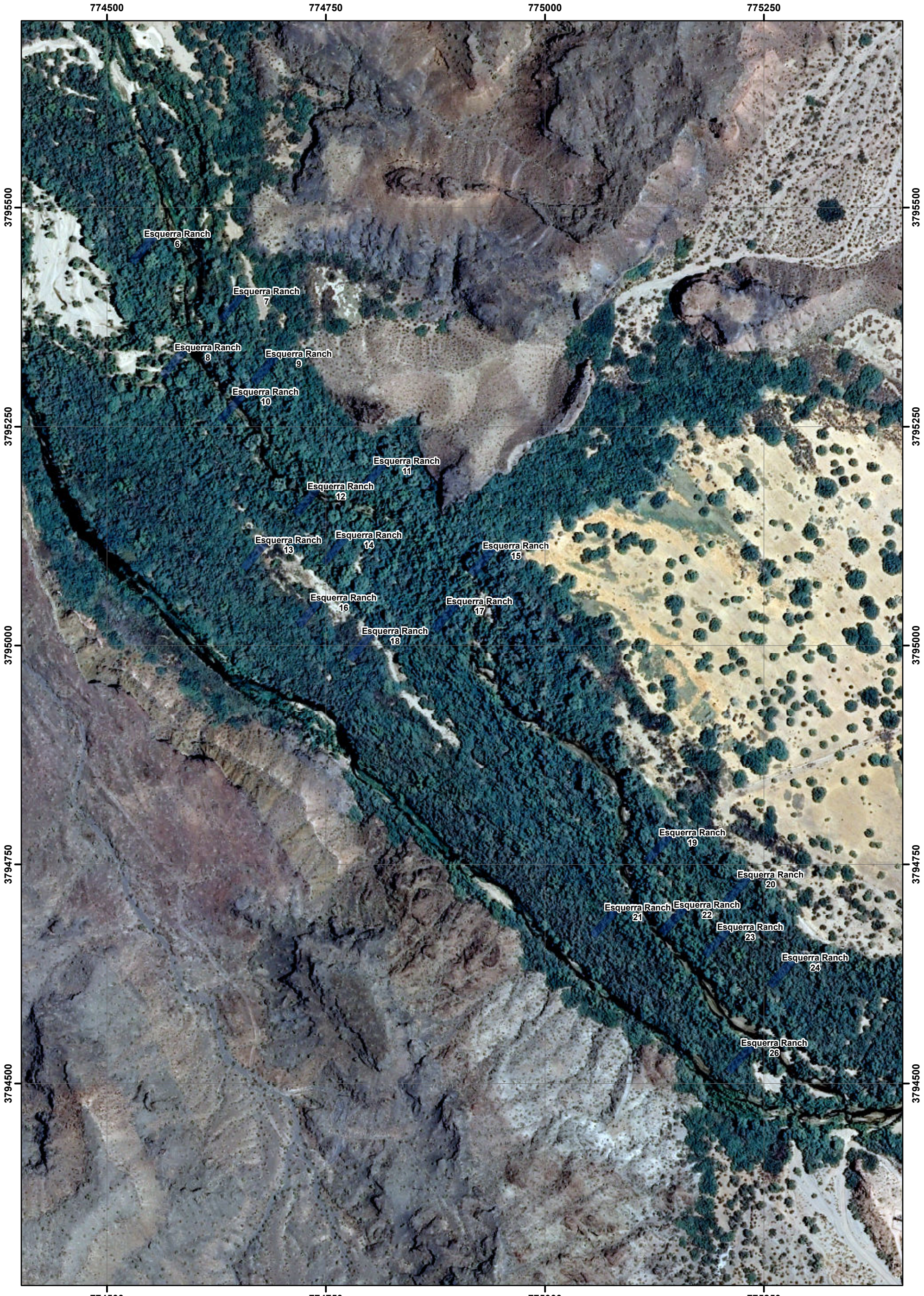
AREA = BWRE
SITE =Cougar Point
BEARING = 40

0 100 200 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING, PLANNING, ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.



Legend

2013 Vegetation Plot

Plot Type

- ENHANCED
- REDUCED
- ROTATIONAL

2013 Vegetation Monitoring Plots: Bill Williams River East - Esquerra Ranch

AREA = BWRE
SITE = Esquerra Ranch
BEARING = 40

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot
REDUCED
ROTATIONAL

Plot Type
ENHANCED

2013 Vegetation Monitoring Plots: Bill Williams River East - Mineral Wash

AREA = BWRE
SITE =Mineral Wash
BEARING = 42

0 100 200 Feet

GSA GeoSystems Analysis, Inc. Innovations in Mycology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

ATTACHMENT 5 – PART C

Palo Verde Ecological Reserve Maps

Legend

2013 Vegetation Plot

Plot Type

- ENHANCED
- REDUCED
- ROTATIONAL

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - All Phases

AREA = PVER
SITE = All Sites
BEARING = Varies by Site

0 1,000 2,000 Feet

GeoSystems Analysis, Inc.

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

729000 729250 729500

3731000 3730750 3730500 3730250

Phase 01 1
Phase 01 4
Phase 01 9
Phase 01 15
Phase 01 20
Phase 01 24
Phase 01 34
Phase 01 39

729000 729250 729500

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 01

AREA = PVER
SITE = Phase 01
BEARING = 268

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

728250 728500 728750 729000

3731000 3730750 3730500 3730250 3730000 3729750

Phase 02 4
Phase 02 12
Phase 02 15
Phase 02 21
Phase 02 26
Phase 02 40
Phase 02 43
Phase 02 45
Phase 02 53
Phase 02 60
Phase 02 62
Phase 02 67
Phase 02 91
Phase 02 93
Phase 02 99
Phase 02 101
Phase 02 109

728250 728500 728750 729000

Legend

2013 Vegetation Plot

Plot Type

ENHANCED

REDUCED

ROTATIONAL

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 02

AREA = PVER
SITE = Phase 02
BEARING = 88

0 100 200 400 600 Feet

GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot

Plot Type

- ENHANCED
- REDUCED
- ROTATIONAL

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 03

AREA = PVER
SITE = Phase 03
BEARING = 88

0 100 200 400 600 Feet

GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 04

AREA = PVER
SITE = Phase 04
BEARING = 87

0 100 200 400 600 800 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 05

AREA = PVER
SITE = Phase 05
BEARING = 87

0 100 200 400 600 800 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot

Plot Type

- REDUCED
- ROTATIONAL
- ENHANCED

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 06

AREA = PVER
SITE = Phase 06
BEARING = 88

0 100 200 400 600 800 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot

Plot Type

- ENHANCED
- REDUCED
- ROTATIONAL

2013 Vegetation Monitoring Plots: Palo Verde Ecological Reserve - Phase 07

AREA = PVER
SITE = Phase 07
BEARING = 88

0 100 200 400 600 800 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on September 25, 2013. Grid projection = UTM, NAD 1983, Zone 11N, meters.

731000

731250

3734500

3734250

3734000

Phase 08
40

Phase 08
9

Phase 08
26

Phase 08
35

Phase 08
12

Phase 08
21

Legend

2013 Vegetation Plot

REDUCED

ROTATIONAL

Plot Type

ENHANCED

2013 Vegetation Monitoring Plots:
Palo Verde Ecological Reserve -
Phase 08

AREA = PVER
SITE = Phase 08
BEARING = 358

0 100 200 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

ATTACHMENT 5 – PART D

Cibola Valley Conservation Area Maps

Legend

2013 Vegetation Plot Plot Type

- REDUCED
- ROTATIONAL
- ENHANCED

2013 Vegetation Monitoring Plots: Cibola Valley Conservation Area - All Sites

AREA = CVCA
SITE = All

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

GSA GeoSystems Analysis, Inc. Watershed & Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCE

717250 717500 717750

3699750 3699500 3699250 3699000 3698750

Phase 01 2
Phase 01 16
Phase 01 21
Phase 01 40
Phase 01 52
Phase 01 56
Phase 01 61
Phase 01 63
Phase 01 91
Phase 01 94
Phase 01 98
Phase 01 104
Phase 01 114
Phase 01 117
Phase 01 119
Phase 01 126
Phase 01 138
Phase 01 147
Phase 01 151

717250 717500 717750

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots: Cibola Valley Conservation Area - Phase 01

AREA = CVCA
SITE = Phase 01
BEARING = 87

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot

Plot Type

- REDUCED
- ROTATIONAL
- ENHANCED

2013 Vegetation Monitoring Plots: Cibola Valley Conservation Area - Phase 02

AREA = CVCA
SITE = Phase 02
BEARING = 269

0 100 200 400 600 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

714250 714500

3698500 3698250 3698000 3697750

Phase 03 6
Phase 03 60
Phase 03 106
Phase 03 151
Phase 03 24
Phase 03 112
Phase 03 133
Phase 03 27
Phase 03 116
Phase 03 162
Phase 03 54
Phase 03 121
Phase 03 101

714250 714500

Legend

2013 Vegetation Plot
REDUCED
Plot Type
ROTATIONAL
ENHANCED

2013 Vegetation Monitoring Plots: Cibola Valley Conservation Area - Phase 03

AREA = CVCA
SITE = Phase 03
BEARING = 179

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

716750

717000

3699250

3699000

3698750

Phase 04E
45

Phase 04E
117

Phase 04E
125

Phase 04E
177

Phase 04E
232

Phase 04E
274

716750

717000

Legend

2013 Vegetation Plot

Plot Type

- ENHANCED
- REDUCED
- ROTATIONAL

2013 Vegetation Monitoring Plots:
Cibola Valley Conservation Area -
Phase 04E

AREA = CVCA
SITE = Phase 04E
BEARING = 88

0 100 200 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

714250

714500

3699000

3699000

Phase 04W
45

Phase 04W
24

Phase 04W
58

Phase 04W
84

Phase 04W
60

Phase 04W
40

Phase 04W
88

Phase 04W
2

Phase 04W
53

Phase 04W
65

Phase 04W
21

3698750

3698750

3698500

3698500

714250

714500

Legend

2013 Vegetation Plot
REDUCED
Plot Type
ROTATIONAL
ENHANCED

2013 Vegetation Monitoring Plots: Cibola Valley Conservation Area - Phase 04W

AREA = CVCA
SITE = Phase 04W
BEARING = 358

0 100 200
Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

714750

715000

3699250

3699000

3698750

Phase 05
83

Phase 05
66

Phase 05
87

Phase 05
34

Phase 05
69

Phase 05
36

Phase 05
22

Phase 05
74

Phase 05
9

Phase 05
41

Phase 05
43

Phase 05
97

Phase 05
61

714750

715000

Legend

2013 Vegetation Plot

Plot Type

ENHANCED

REDUCED

ROTATIONAL

2013 Vegetation Monitoring Plots: Cibola Valley Conservation Area - Phase 05

AREA = CVCA
SITE = Phase 05
BEARING = 359

0 100 200 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots: Cibola Valley Conservation Area - Phase 06

AREA = CVCA
SITE = Phase 06
BEARING = 359

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

ATTACHMENT 5 – PART E

Cibola Valley National Wildlife Refuge Maps

Legend

2013 Vegetation Plot
REDUCED
Plot Type
ROTATIONAL
ENHANCED

2013 Vegetation Monitoring Plots: Cibola National Wildlife Refuge - All Sites

AREA = CNU1
SITE = All

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

714750 715000 715250

3694250 3694000 3693750 3693500 3693250

Crane Roost 18
Crane Roost 36
Crane Roost 140
Crane Roost 124
Crane Roost 157
Crane Roost 190
Crane Roost 142
Crane Roost 159
Crane Roost 6
Crane Roost 57
Crane Roost 145
Crane Roost 130
Crane Roost 195
Crane Roost 78
Crane Roost 10
Crane Roost 43
Crane Roost 131
Crane Roost 95
Crane Roost 165
Crane Roost 198
Crane Roost 45
Crane Roost 134
Crane Roost 31
Crane Roost 168
Crane Roost 153
Crane Roost 170
Crane Roost 103

714750 715000 715250

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots:
Cibola National Wildlife Refuge Unit 1 - Crane Roost

AREA = CNU1
SITE = Crane Roost
BEARING = 179

0 100 200 400 600 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

716000

716250

3695500

3695500

CW North 20

CW North 7

CW North 11

CW North 3

CW North 18

CW North 5

3695250

3695250

3695000

3695000

716000

716250

Legend

2013 Vegetation Plot Plot Type

- REDUCED
- ROTATIONAL
- ENHANCED

2013 Vegetation Monitoring Plots: Cibola National Wildlife Refuge Unit 1 - CW North

AREA = CNU1
SITE = CW North
BEARING = 359

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

Legend

2013 Vegetation Plot

Plot Type

- ENHANCED
- REDUCED
- ROTATIONAL

2013 Vegetation Monitoring Plots: Cibola National Wildlife Refuge Unit 1 - Hippie Burn (Various Sites within)

AREA = CNU1
SITE =Various (HB)
BEARING = 359

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc.

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

715500

715750

3694500

3694250

3694000

Mass Transplanting
12

Mass Transplanting
27

Mass Transplanting
23

Mass Transplanting
14

Mass Transplanting
19

Mass Transplanting
34

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots:
Cibola National Wildlife Refuge Unit 1 -
Mass Transplanting

AREA = CNU1
SITE = Mass Transplanting
BEARING = 359

0 100 200 400 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.

716000

3694500

Nature Trail 1
Nature Trail 11
Nature Trail 26
Nature Trail 53
Nature Trail 35
Nature Trail 42
Nature Trail 55
Nature Trail 52
Nature Trail 13
Nature Trail 20
Nature Trail 28
Nature Trail 36
Nature Trail 6
Nature Trail 14
Nature Trail 50
Nature Trail 22
Nature Trail 31
Nature Trail 44
Nature Trail 48
Nature Trail 9
Nature Trail 17
Nature Trail 25
Nature Trail 33
Nature Trail 46

3694250

716000

Legend

2013 Vegetation Plot
Plot Type
ENHANCED
REDUCED
ROTATIONAL

2013 Vegetation Monitoring Plots: Cibola National Wildlife Refuge Unit 1 - Nature Trail

AREA = CNU1
SITE = Nature Trail
BEARING = 359

0 100 200 Feet

GSA GeoSystems Analysis, Inc. Innovations in Hydrology

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

Map created by Chad McKenna of GeoSystems Analysis, Inc. on April 10, 2014. Grid projection = UTM, NAD 1983, Zone 11N, meters.