Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Beal Lake Conservation Area

2011 Development and Monitoring Plan

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

April 2013

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

Beal Lake Conservation Area

2011 Development and Monitoring Plan

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ACRONYMS AND ABBREVIATIONS

1997 BO	1997 Biological and Conference Opinion on Routine Operations and Maintenance of the Lower Colorado River
BLCA	Beal Lake Conservation Area
dS/m	deci-siemens per meter
EC	electrical conductivity
Havasu NWR	Havasu National Wildlife Refuge
HCP	Habitat Conservation Plan
LCR	lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
Reclamation	Bureau of Reclamation
RPA3	Reasonable and Prudent Alternative 3
USFWS	U.S. Fish and Wildlife Service

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BACKGROUND

This report is intended to document the rational for and design of a marsh within and adjacent to the existing riparian restoration area. The marsh within is being created to manage an undeveloped portion of the site to reduce future maintenance costs, and the marsh directly adjacent to a dense willow stand is being created to provide both nesting habitat and foraging grounds specifically to meet the habitat requirements of the southwestern willow flycatcher (*Empidonax traillii extimus*).

1.0 SITE HISTORY

The restoration of Beal Lake was originally initiated under the 1997 Biological and Conference Opinion on Routine Operations and Maintenance of the Lower Colorado River (1997 BO). Within the 1997 BO, Reasonable and Prudent Alternative 3 (RPA 3) required the Bureau of Reclamation (Reclamation) to complete and maintain native fish impoundments. To meet these conditions of compliance, Beal Lake, which resides on the Havasu National Wildlife Refuge (Havasu NWR) and within the 100-year historic flood plain of the Lower Colorado River (LCR), was identified as a low-quality aquatic habitat that could benefit from restoration activities (figure 1). A partnership was formed with the landowners (U.S. Fish and Wildlife Service [USFWS]), and dredging began in 2001 to create a viable refuge for native fishes. Dredging involves excavating bottom sediments and depositing the dredged material elsewhere. Placement and reuse of this material is often the limiting factor when estimating the total cost of establishing a backwater; therefore, Reclamation determined that the project offered an opportunity to research efficient ways of using dredged material.

Figure 1.—Aerial view of the two projects that compose the Beal Lake Conservation Area: Beal Lake and the Beal Lake Riparian Restoration Area.

1.1 Riparian Restoration

An adjacent riparian restoration research project was initiated to attempt blending dredge material with existing soils and replanting the mixed soils with native vegetation (figure 1). The Beal Lake Riparian Restoration Area was broken into two phases: the first planting began in 2002 and the second in 2004. The project area, which is divided into fields that can be independently irrigated and managed, was designed to provide a location for testing various riparian restoration methods and techniques for site preparation, planting, irrigation, monitoring, and management.

Over the last 5 years, in the process of testing riparian restoration techniques, many of the fields developed into habitat that has attracted Lower Colorado River Multi-Species Conservation Program (LCR MSCP) covered species. At the end of the 2010 monitoring season, the Beal Lake Riparian Restoration Area had nesting pairs of Sonoran yellow warbler (*Dendroica petechia sonorana*), Arizona Bell's vireo (*Vireo bellii arizonae*), summer tanager (*Piranga rubra*), and western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (Reclamation 2010a). The riparian restoration site currently provides approximately 107 acres (43.3 hectares) of cottonwood, willow, and mesquite habitats and also continues to contribute valuable information about restoration techniques and management practices.

1.2 Beal Lake

Once Beal Lake was identified as a site that could provide Endangered Species Act compliance, construction and management efforts involved improving the quality of the habitat and isolating the backwater for native fishes, primarily the razorback sucker (*Xyrauchen texanus*) and bonytail chub (*Gila elegans*). Rooms and channels were dredged out of the shallow 225-acre lake to allow for areas of deeper water where fish would be able to survive during the summer months when temperature and evaporation rates peak.

In an effort to isolate the backwater from non-native species, a permeable rock filtration system (the rock structure) was installed in the year 2000 (see figure 1); however, shortly after its installation, the surface water elevation of Beal Lake began to drop, tracking at nearly 2 feet below Topock Marsh in subsequent months. These observations indicated the rock structure was restricting fresh surface water flows from entering the lake at the rate necessary to compensate for evaporative losses, which could heavily compromise water quality during the heat of the summer (i.e., increase temperatures and decrease dissolved oxygen). To allow for an adequate volume of water to be transferred from Topock Marsh to Beal Lake while still excluding non-natives from entering the lake, the rock structure was retrofitted in 2005 with four 18-inch-diameter polyvinyl chloride pipes (figure 2). Three of the four pipes were capped on each end

Figure 2.—Pictures showing the rock structure being retrofitted (2005) with pipes capped on each end with 0.6-millimeter slot-sized screens (left) and the western control structure (2011), which will allow the screen system to be consistently cleaned during the summer months (right).

with 0.6-millimeter slot-sized screens, while the fourth was capped with blank flanges until it was determined that a fourth pair of screens was necessary.

In November 2009, the screen system went through a 5-year evaluation and intensive cleaning. During this event, a fourth set of screens was added to the previously closed off pipe. The structural integrity of the system was sound; however, the inability to keep a consistent screen cleaning regimen throughout the summer months was cited as a major issue. As a result, a water control structure was constructed in January 2011 in which the embayment on the Beal Lake side of the rock structure meets Beal Ditch (see figure 2). With a new control structure in place, water on both sides of the rock structure can be pumped down during the summer months to allow for an adequate, consistent cleaning regimen, which should maintain the hydraulic capacity of the screens to move water from Topock Marsh into Beal Lake.

1.3 Beal Lake Conservation Area

In 2005, when the Record of Decision for the LCR MSCP was signed, the RPA 3 obligations of the 1997 BO were included under the program (Reclamation 2004).

In April 2010, the riparian area (107 acres) was confirmed as a LCR MSCP conservation area by the program's Steering Committee; combined with the backwater component, they are known collectively as the Beal Lake Conservation Area (BLCA).

1.4 Location

The BLCA is located on the Havasu NWR and within the 100-year historic flood plain of the LCR, adjacent to River Mile 237 on the Arizona side (figure 3).

1.5 Landownership

The land is owned by the USFWS. They have dedicated land and water resources to create and manage the conservation area.

1.6 Water

At the time Havasu NWR was created, Topock Marsh was the primary attraction and focus of most refuge activities (Shoreline 2006). The Havasu NWR possesses a 2nd and 3rd priority water entitlement provided by Supreme Court Decree No. (7) to fulfill the purposes of the refuge (Executive Order No. 8647 and Public Land Order No. 559). The Havasu NWR's entitlement of 37,339 acre-feet per year of consumptive use and a 41,839 acre-foot diversionary right of Colorado River water is used to fill Topock Marsh through two instrumented inlet canals. The water used for irrigation at the Beal Lake Riparian Restoration Area is supplied from Topock Marsh.

1.7 Agreements

A Land Use Agreement was executed in 2010 between Reclamation and the USFWS to secure land and water resources for the BLCA for the remainder of the 50-year LCR MSCP. The agreement outlines the rights and responsibilities of each partner in regard to the project's development and maintenance.

2.0 BEAL RIPARIAN RESTORATION DEVELOPMENT PLAN

2.1 Goal

Historical monitoring data show that within the Havasu NWR, adjacent to Topock Marsh and less than 3 miles northeast of the BLCA, southwestern willow flycatchers (*Empidonax traillii extimus*) were still nesting on the main stem of

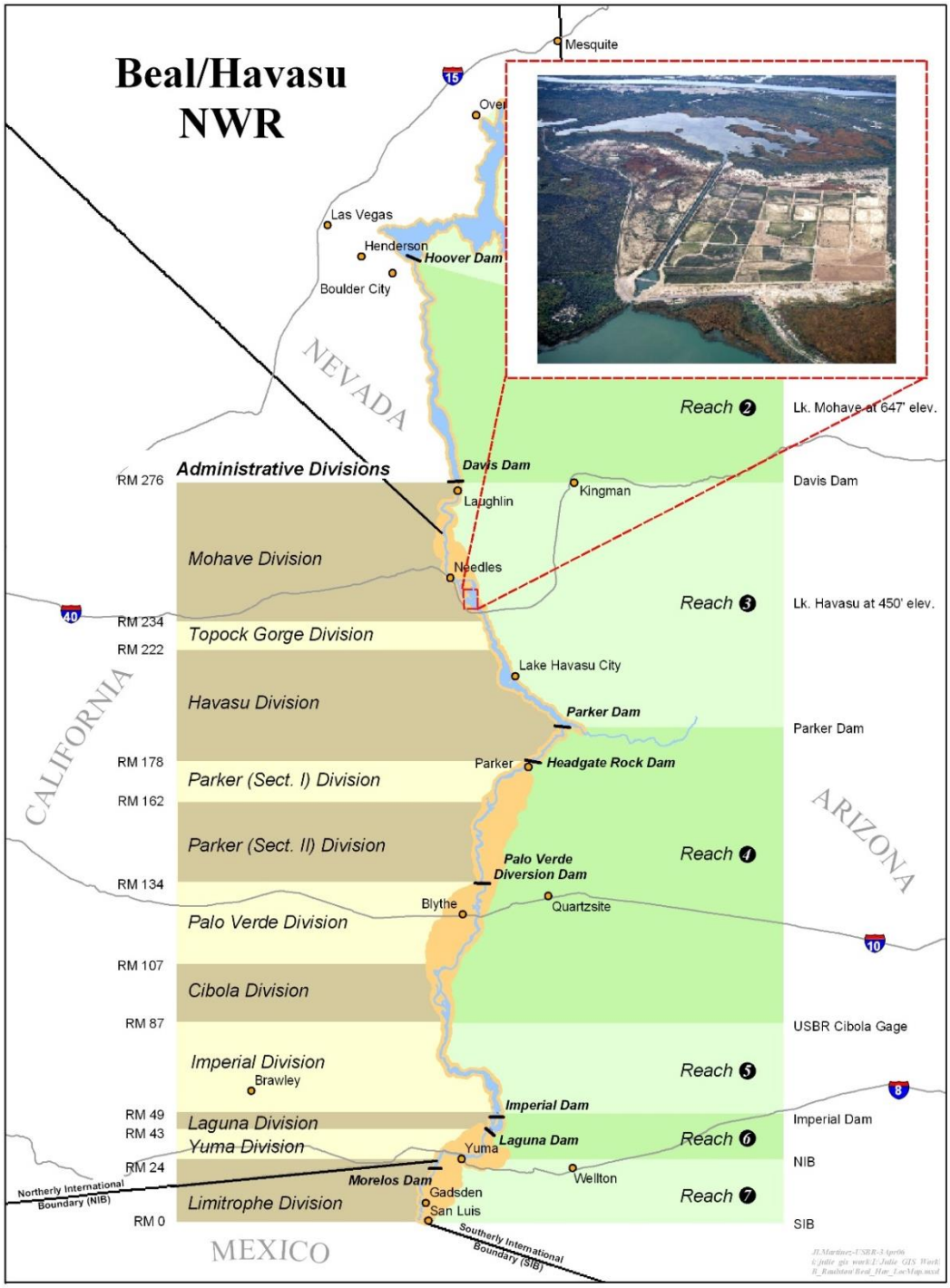


Figure 3.—Map showing the location of the BLCA within the context of the LCR MSCP reaches and Reclamation's administrative divisions.

the LCR as of 2010 (McLeod and Pellegrini 2011). The primary goal of the habitat improvement actions described below is to augment the quality of habitat at the Beal Lake Riparian Restoration Area in ways that specifically target the habitat requirements of southwestern willow flycatcher. Two key habitat characteristics have been identified as beneficial for this species to nest and fledge young: moist soil conditions (ideally standing water) under a dense tree canopy and foraging grounds adjacent to their nesting site (Sogge and Marshall 2000; Ahlers and Moore 2009; Sogge and Sferra 2010). In an effort to create these conditions, two habitat improvement actions are planned: (1) the creation of a willow marsh and (2) a field-scale demonstration using Lassenite Pozzolan to increase soil moisture.

2.2 Actions

2.2.1 Southwestern Willow Flycatcher Willow Marsh

2.2.1.1 Purpose

To create a marsh directly adjacent to a dense willow stand to provide both nesting habitat and foraging grounds specifically to meet the habitat requirements of southwestern willow flycatcher.

2.2.1.2 Description

A small acreage (14 acres) with a shallow groundwater table (2–4 feet) and access to surface water inflows during the summer months is being converted into a willow marsh. The project will consist of clearing, grubbing, and contouring Fields EE and NN of the Beal Lake Riparian Restoration Area (figure 4). Once the contouring is finished, the area will be planted with native vegetation in a terraced design. Marsh plants will be planted along the low elevation contours, and appropriate riparian and facultative species will be planted along the higher elevation contours. The riparian species selected for this project will focus heavily on coyote willow (*Salix exigua*), as it is the species historically used by southwestern willow flycatcher.

2.2.1.3 Methods

Existing soil data for the BLCA was gathered and compiled into a Geographic Information System Shapefile format that allowed the distribution of samples to be geospatially evaluated. Many soil samples had been taken throughout the site since 2002; however, there were no soil data for Field NN, one of the two fields selected to be converted into the willow marsh. Soil samples were collected at four evenly distributed locations throughout Field NN to a depth of 3 feet (figure 4). These samples were taken to Reclamation's Soil Lab and analyzed for the standard suite of tests (electrical conductivity [EC], pH, percent moisture,

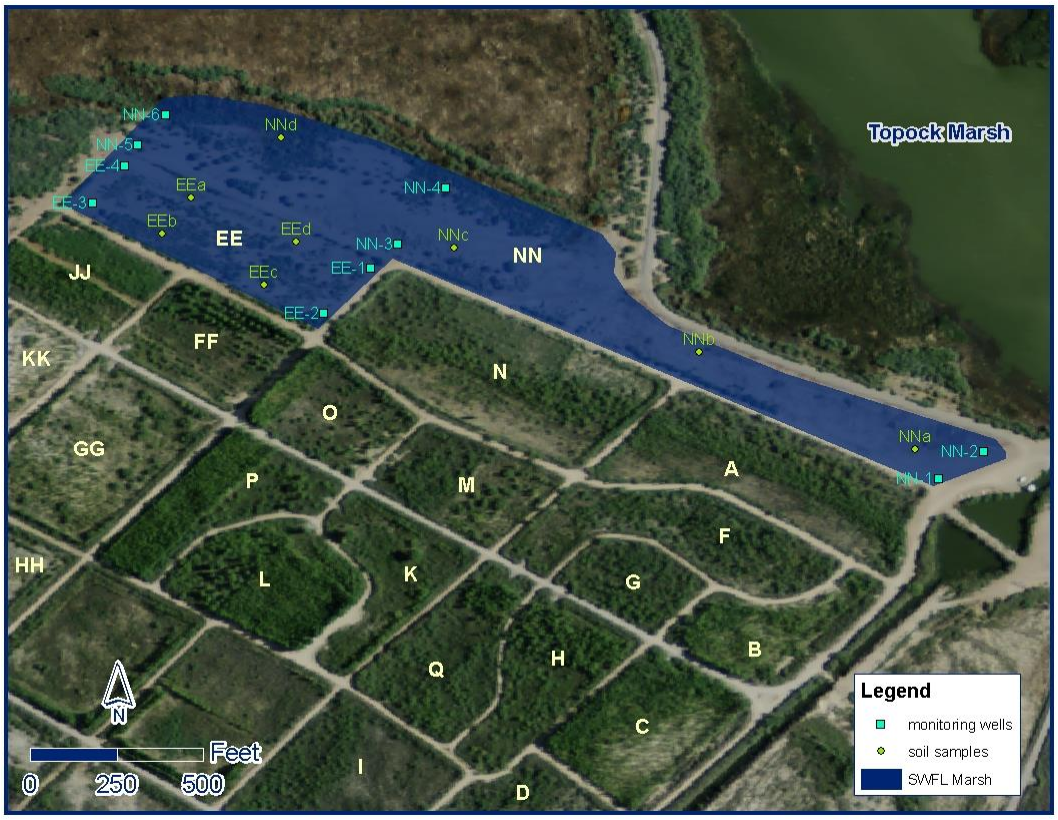
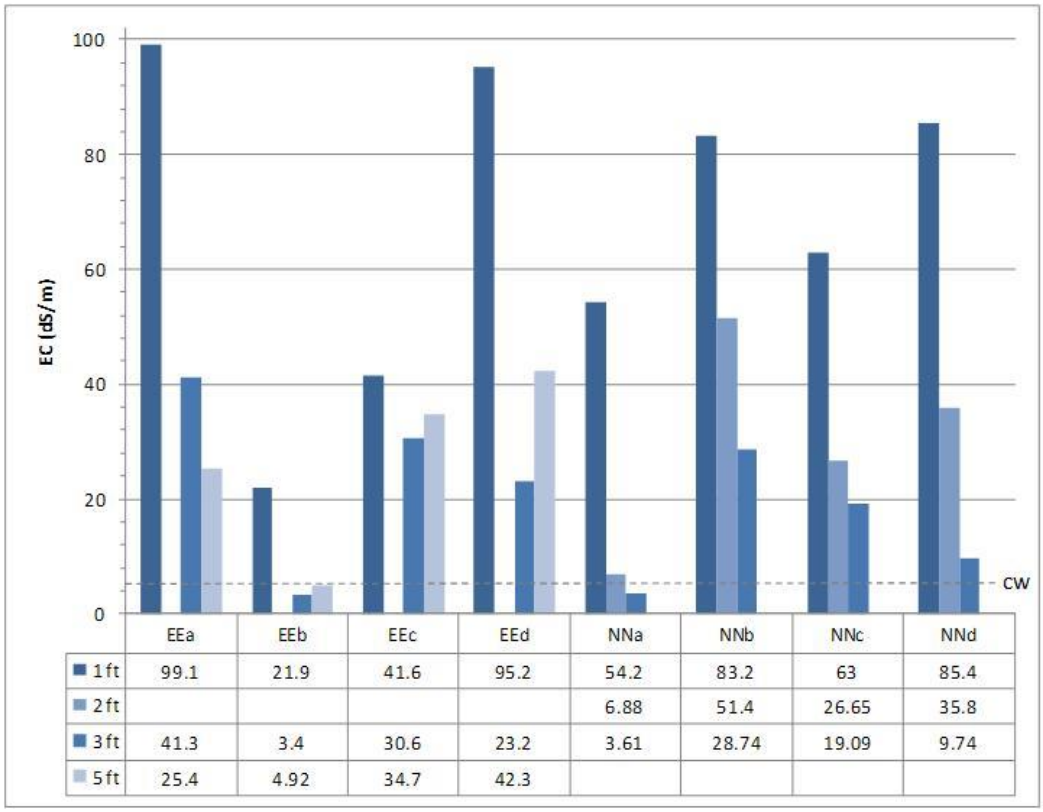


Figure 4.—Aerial photo showing the location of the southwestern willow flycatcher marsh within the BLCA, the locations of the monitoring wells used to assess groundwater elevations, and the locations of collected soil samples.

phosphate, nitrate, nitrite, and ammonia) as well as a mechanical analysis. The results from these analyses were combined with data collected in 2004 from Field EE to determine the existing salinity conditions for the willow marsh acreage.

Colorado River riparian species, especially willow, have been shown to struggle in soils with EC greater than 5 deci-siemens per meter (dS/m) (GeoSystems Analysis, Inc. 2007). Electrical conductivity is a gross measure of dissolved salts in soil solution and is positively correlated with salinity (milligrams per liter). The acreage selected for the willow marsh habitat has extremely high EC within the first foot of soil. Eight soil samples taken throughout Fields EE and NN (see figure 4) ranged between 21.9 and 99.1 dS/m within the first foot of soil. While the soils samples taken at the 2- and 3-foot depths showed that EC decreased at increased depths, the samples gathered in 2004 within Field EE showed EC generally increased at the depth of 5 feet (figure 5).

In an effort to mitigate the most extreme saline soils, the first foot of soil will be removed from the 14 acres and used as build-up material on a nearby unimproved road that will eventually become an accessible refuge road. Additionally,

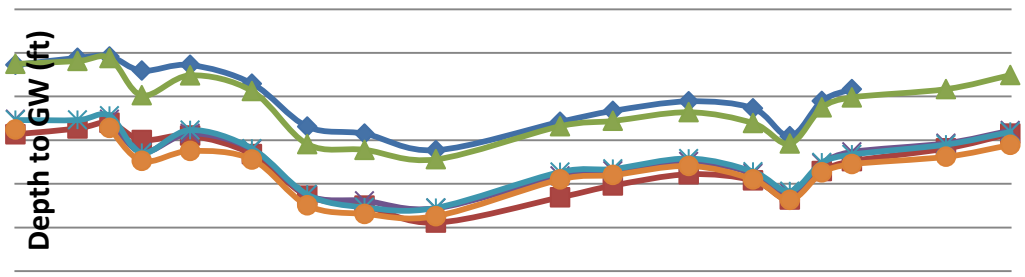


	EEa	EEb	EEc	EEd	NNa	NNb	NNc	NNd
1 ft	99.1	21.9	41.6	95.2	54.2	83.2	63	85.4
2 ft					6.88	51.4	26.65	35.8
3 ft	41.3	3.4	30.6	23.2	3.61	28.74	19.09	9.74
5 ft	25.4	4.92	34.7	42.3				

Figure 5.—EC readings from soil samples collected within Field EE (2004) and NN (2010) vary from less than 4 dS/m to greater than 99 dS/m.
The dashed line labeled "CW" designates the salinity tolerance for coyote willow.

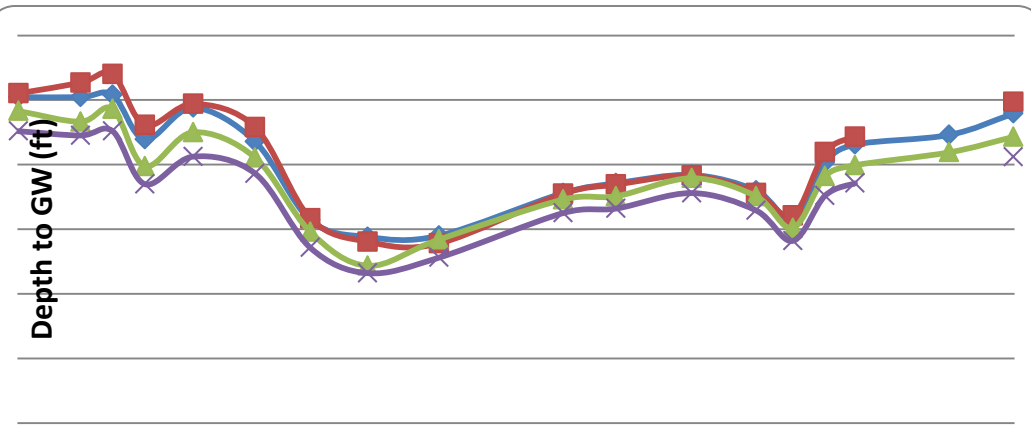
Field EE will be irrigated after the first foot of soil has been removed. This is a practice known as leaching, which is accomplished by ponding fresh water on the soil surface and allowing it to infiltrate. Typically, a unit depth of water will remove nearly 80 percent of the salts from a unit depth of soil (Abrol et al. 1988). Due to the sandy, well-draining nature of the soils, leaching is expected to dramatically reduce the soil salinity. Soil samples will be taken prior to and following the leaching event to ensure salinity levels are appropriate for planting.

In concert with EC data, seasonal groundwater and Topock Marsh surface water levels were used to determine the desired elevations of the new contours and culvert system. Recent discrete groundwater measurements were used to estimate the groundwater elevation (figures 6 and 7), and Topock Marsh surface water elevations from the South Dike gauge were obtained from Reclamation's Blythe Office to understand the seasonal rise and fall of the surface water (figure 8). The elevation of the culvert that will supply surface water to the willow marsh was selected based on the criteria that it would be above groundwater during construction (January and February) yet be positioned at a low enough elevation that it could convey surface water to the acreage as Topock Marsh rises in March.



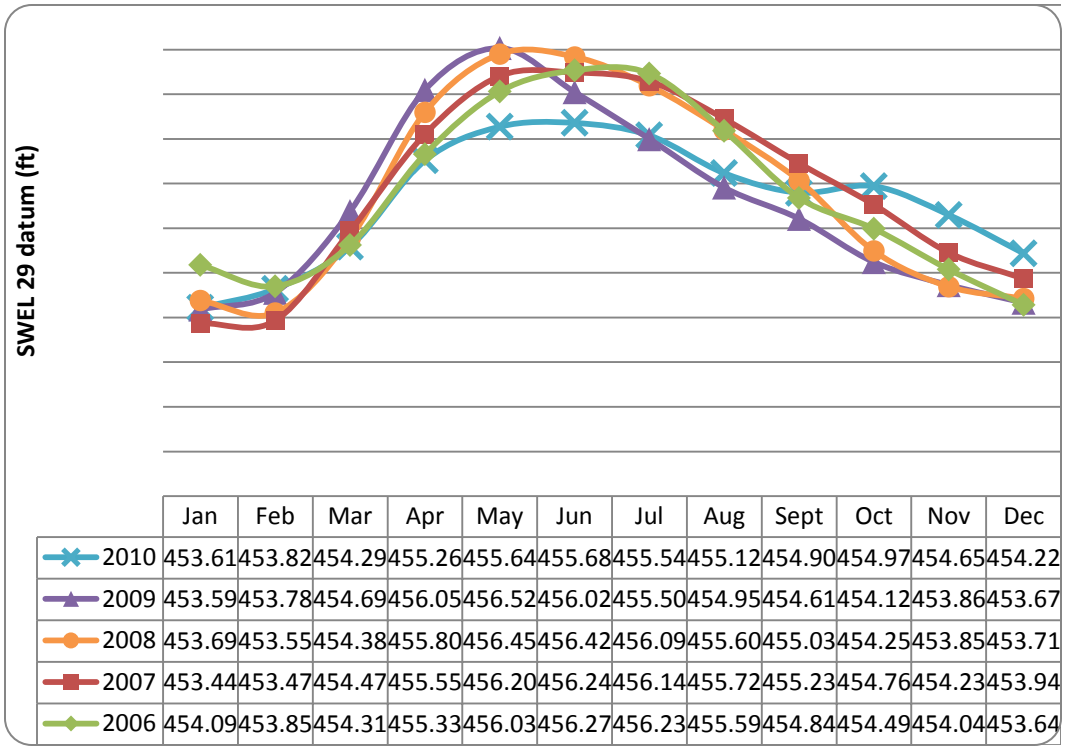
	2-Dec-09	29-Dec-09	12-Jan-10	26-Jan-10	16-Feb-10	15-Mar-10	8-Apr-10	3-May-10	3-Jun-10	27-Jul-10	19-Aug-10	21-Sep-10	19-Oct-10	4-Nov-10	18-Nov-10	1-Dec-10	11-Jan-11	8-Feb-11
NN1	4.72	4.89	4.92	4.59	4.72	4.30	3.31	3.15	2.77	3.42	3.67	3.89	3.73	3.09	3.90	4.17		
NN2	3.14	3.27	3.40	3.00	3.10	2.68	1.73	1.50	1.11	1.69	1.96	2.22	2.08	1.64	2.29	2.52	2.81	3.15
NN3	4.75	4.81	4.88	4.03	4.48	4.12	2.91	2.78	2.56	3.32	3.44	3.64	3.39	2.92	3.75	3.98	4.17	4.49
NN4	3.48		3.48	2.73	3.15	2.79	1.74	1.61	1.44	2.18	2.30	2.51	2.24	1.78	2.47	2.73	2.93	3.22
NN5	3.46	3.46	3.56	2.71	3.23	2.81	1.76	1.46	1.45	2.27	2.34	2.58	2.28	1.83	2.49	2.67	2.9	3.19
NN6	3.25		3.28	2.52	2.75	2.56	1.51	1.31	1.26	2.10	2.20	2.41	2.1	1.63	2.26	2.45	2.62	2.89

Figure 6.—Discrete groundwater measurements from monitoring wells within Field NN.



	2-Dec-09	29-Dec-09	12-Jan-10	26-Jan-10	16-Feb-10	15-Mar-10	8-Apr-10	3-May-10	3-Jun-10	27-Jul-10	19-Aug-10	21-Sep-10	19-Oct-10	4-Nov-10	18-Nov-10	1-Dec-10	11-Jan-11	8-Feb-11
EE1	5.05	5.05	5.08	4.39	4.88	4.36	3.14	2.88	2.90	3.56	3.71	3.84	3.6	3.16	4.03	4.31	4.46	4.79
EE2	5.10	5.27	5.40	4.61	4.94	4.58	3.17	2.81	2.78	3.55	3.69	3.83	3.56	3.21	4.19	4.43		4.97
EE3	4.83	4.67	4.86	3.98	4.50	4.11	2.96	2.43	2.84	3.46	3.51	3.79	3.51	3.02	3.82	3.99	4.19	4.43
EE4	4.52	4.45	4.52	3.70	4.12	3.86	2.71	2.32	2.56	3.25	3.32	3.56	3.29	2.82	3.52	3.71		4.12

Figure 7.—Discrete groundwater measurements from monitoring wells within Field EE.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2010	453.61	453.82	454.29	455.26	455.64	455.68	455.54	455.12	454.90	454.97	454.65	454.22
2009	453.59	453.78	454.69	456.05	456.52	456.02	455.50	454.95	454.61	454.12	453.86	453.67
2008	453.69	453.55	454.38	455.80	456.45	456.42	456.09	455.60	455.03	454.25	453.85	453.71
2007	453.44	453.47	454.47	455.55	456.20	456.24	456.14	455.72	455.23	454.76	454.23	453.94
2006	454.09	453.85	454.31	455.33	456.03	456.27	456.23	455.59	454.84	454.49	454.04	453.64

Figure 8.—Monthly average surface water elevations of Topock Marsh measured at the South Dike gauging station.

A site visit was conducted in August 2010 with Reclamation's Provo Area Office, who will head the crew performing the clearing, grubbing, and contouring for the marsh in January 2012. During the site visit, a surveyor from the Provo office surveyed the existing elevations of the project area to a 1/2-foot contour resolution. Following an evaluation of the existing site elevations, the desired contour elevations for the marsh were supplied by the LCR MSCP Project Manager.

Earth work will be completed during the winter months, the low water period of the year, for ease of construction, compliance with 404 regulations, and to avoid potentially disturbing species covered under the LCR MSCP.

2.2.1.4 Design

Southwestern willow flycatchers are listed as an endangered species along the LCR, and since the inception of the LCR MSCP, two habitat characteristics required by southwestern willow flycatcher to select a nesting site have been identified: moist soil conditions under a dense tree canopy and foraging grounds immediately adjacent to their nesting site. These conditions may not be possible to create at all conservation areas along the LCR; however, there is a potential to

create these conditions within the BLCA. While the design of the acreage aims to encourage southwestern willow flycatcher habitation and nesting, the marsh has the potential to benefit a variety of other targeted species.

The 14-acre footprint of the southwestern willow flycatcher marsh is expected to take a maximum of 2 months (in conjunction with the soil amendment demonstration) to clear, grub, and contour the land. Once contoured, the area currently known as Field EE will be irrigated to leach the salts from the soil. The area will be planted with coyote willow and added to the BLCA's irrigation schedule. Eventually, this acreage will form a dense thicket of trees with the flexibility to be irrigated when necessary. The remainder of the cleared acreage will be converted into a marsh by contouring the land to coincide with seasonal groundwater elevations, installing a 24-inch culvert to passively supply surface water from Topock Marsh, and planting the area with native marsh species. The basic approach is to remove the most saline soils from the surface and then alter the topography and surface water supply to support native wetland and riparian vegetation.

A preliminary engineering design is depicted on figures 9 and 10. Heavy equipment will be used to accomplish this habitat creation effort. A low ground pressure dozer and excavator will be onsite. The area is not densely vegetated, but the saltcedar that does need to be cleared will be gathered and buried in a designated disposal area. The project is designed to utilize the site's existing topography and seasonal hydrology to create a low maintenance wetland that will provide nesting and foraging ground for southwestern willow flycatcher.

2.2.1.5 Planting

The planting plan incorporates native LCR wetland and riparian plant species (table 1). Plant species will be stratified according to water demand and depth to develop a viable willow marsh mosaic (figure 11). Tall emergent vegetation, California bulrush (*Schoenoplectus californicus*), will be planted in areas of deeper water; cattails (*Typha L.*) are expected to naturally establish. Three-square oleyni will be selected primarily for the intermediate zones where water depth is expected to fluctuate between 1–3 inches to promote the development of black rail habitat. Once established, inland saltgrass (*Distichlis spicata*), which adapts to varying water depths and higher salinities, will therefore be planted along the marsh edges to stabilize the bank line and prevent non-native colonization. Coyote willow will be planted along the higher elevation contours and within Field EE specifically to attract southwestern willow flycatcher. An effort will be made to not disturb the established mesquite trees within Field EE.

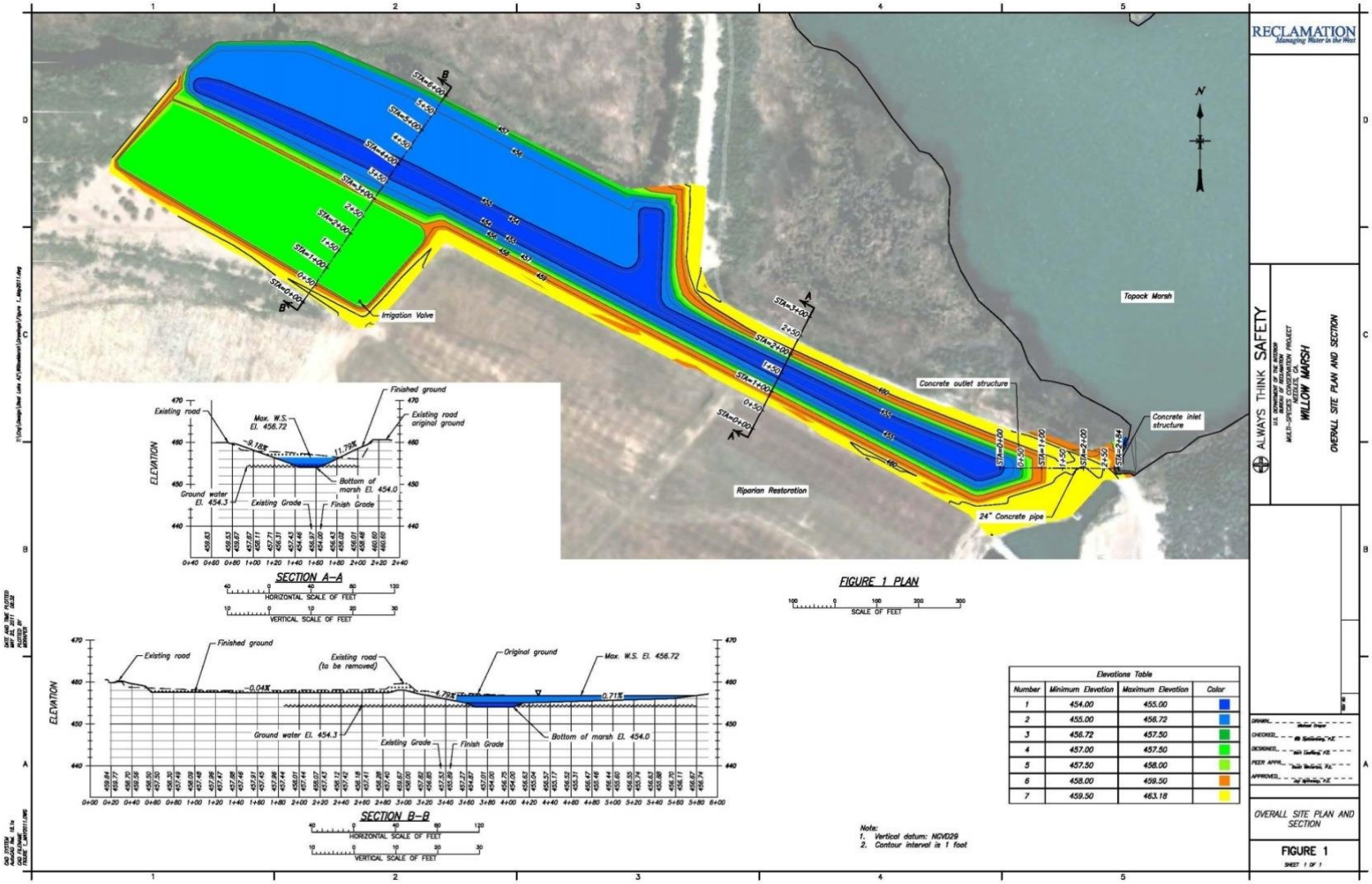


Figure 9.—Preliminary engineering design for the BLCA willow marsh project.

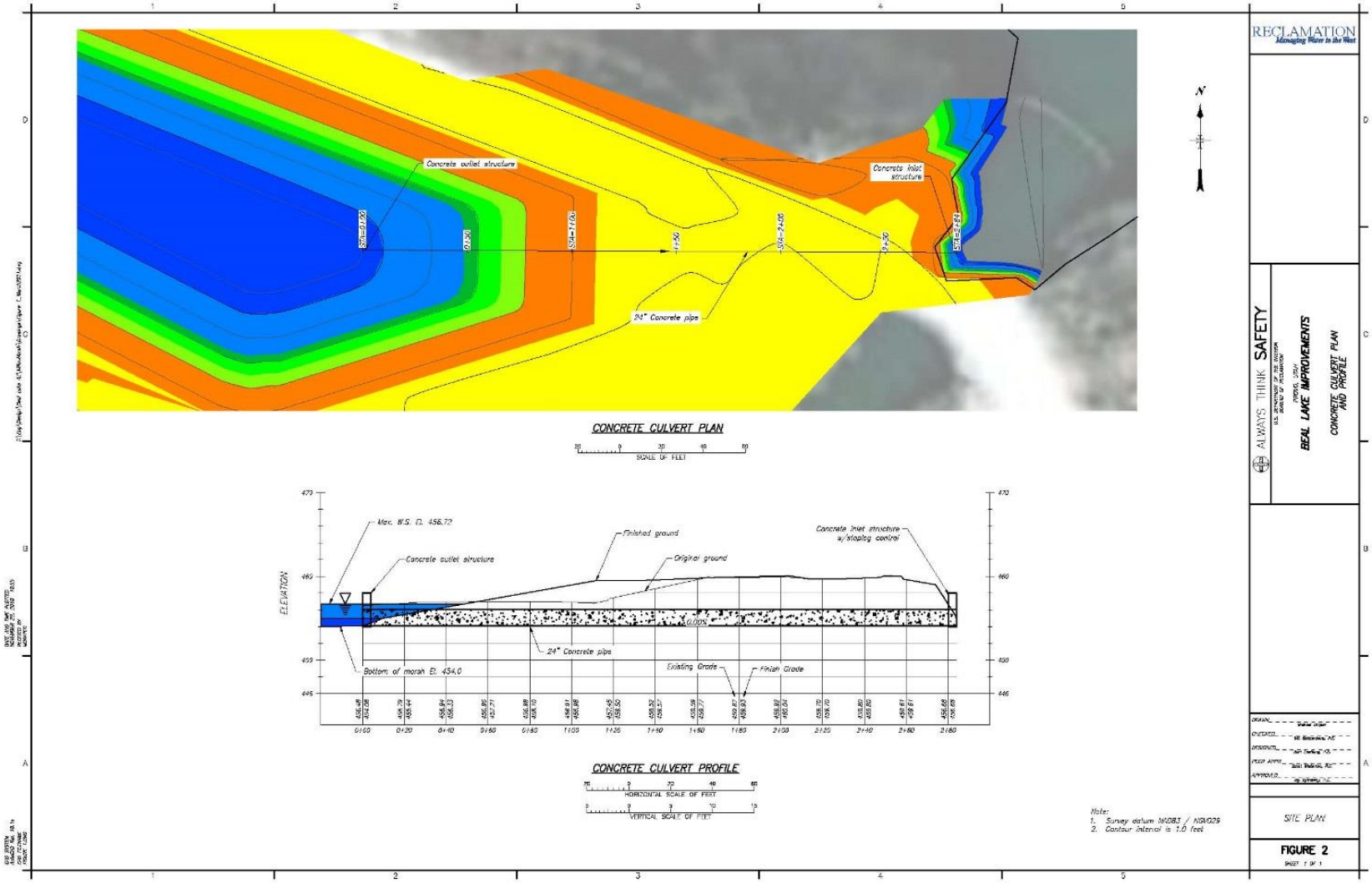


Figure 10.—Detailed view of the preliminary engineering design of the culvert system for the BLCA willow marsh project.

Table 1.—Native plant species list

Scientific name	Common name	Number of plants	Hand planted as:
Salix exigua	Coyote willow	4,500	6-inch saplings
Distichlis spicata	Salt grass	5,000	Plugs
Schoenoplectus californicus	California bulrush	10,000	Plugs
Scirpus olneyi	Three-square olneyi	15,000	Plugs

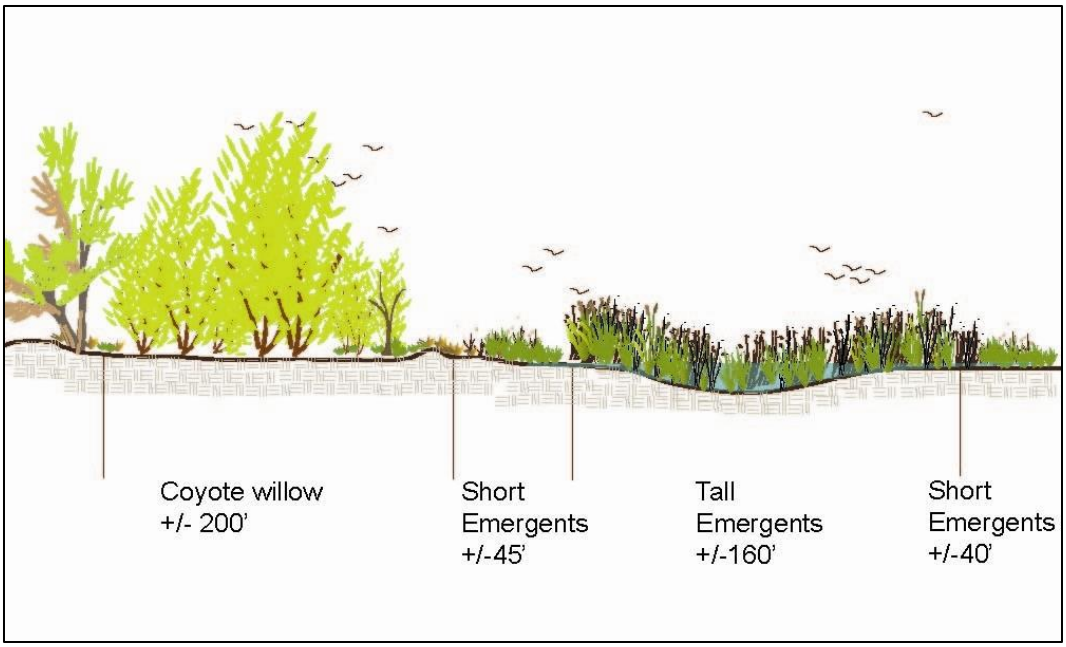


Figure 11.—Schematic diagram of planting along the cross section designated in the preliminary engineering design (see figure 10).

2.2.1.6 Management

The willow stand planted in Field EE will be incorporated into the site's irrigation schedule. Minimal management of the marsh is anticipated. The system is designed to fluctuate seasonally with Topock Marsh. As Topock Marsh rises from diversions made off the Colorado River in the spring, the new marsh acreage will passively fill. When Topock Marsh water elevations begin to recede in the fall, the new marsh will also recede.

Saltcedar and other non-native species found within the willow marsh area will be removed regularly by a contactor until native vegetation establishes to a level that invasive species is no longer a concern.

2.2.2 Lassenite Pozzolan Field Demonstration

2.2.2.1 Purpose

1. Create a dense willow stand with a moist understory within the BLCA by amending the soil and mass transplanting saplings

2. Demonstrate whether the addition of the soil amendment Lassenite Pozzolan reduces the amount of time it takes to flood irrigate a field with sandy soil

3. Determine if irrigation frequency can be reduced when sandy soils are amended with Lassenite Pozzolan by continuously monitoring soil moisture

2.2.2.2 Description

A demonstration using Lassenite Pozzolan, a commercially available soil amendment, will be implemented using Fields KK and GG within the BLCA (figure 12). A soil amendment is any material added to an existing soil that aims to improve its physical properties (i.e., water retention, permeability, water infiltration, drainage, aeration, and structure) to create a better environment for the roots of plants (Davis and Wilson 2005). Lassenite Pozzolan is a volcanic ash mixed with diatomaceous earth that increases the moisture holding capacity of sandy soils, has the potential to reduce the frequency of irrigation and fertilization at restoration sites, and may reduce irrigation time by allowing water to move laterally across a field more efficiently.

2.2.2.3 Methods

The process of determining the appropriate soil amendment for habitat restoration purposes started with a literature and product review. Various types of soil amendments, along with their benefits and drawbacks, were researched and summarized in the 2007 report, Feasibility of Using Soil Amendments to Increase Water Retention at Restoration Sites on the Lower Colorado River. Out of this report, Lassenite Pozzolan was recommended as a material that would increase the moisture holding capacity of sandy soils, not decompose, and make water and nutrients available to plants by absorbing and releasing them slowly over time (Pierce 2007).

In addition to the information gathered in the 2007 report, Reclamation conducted laboratory tests using Lassenite Pozzolan at the Technical Service Center located in Denver, Colorado. Three tests were designed to address questions and concerns about using the product under the conditions created by flood irrigation.

Figure 12.—Aerial photo showing the cells designated for the soil amendment demonstration.

The results showed that Lassenite Pozzolan did not move through the soil column, increased the moisture holding capacity of sandy soil, and allowed water to move laterally across the soil surface more efficiently (Reclamation 2010c).

Following the positive lab results, approval for field implementation was sought. While Lassenite Pozzolan is not expensive ($35.00 per ton), shipping fees can be costly in comparison ($100–140 per ton). To determine if the benefits of using Lassenite Pozzolan justify the cost, a demonstration will be performed to show the effect of the soil amendment on irrigation time, soil moisture, and soil salinity. Data that will be collected during the demonstration are depicted on figure 13.

2.2.2.4 Demonstration Plan

Fields KK and GG on the BLCA will be cleared by the Provo Area Office construction crew in January 2012 under the same mobilization effort as the southwestern willow flycatcher marsh project. Once the fields are cleared, and prior to soil amendment incorporation, infiltration testing and soil sampling will be conducted at several locations per field to establish baseline data (i.e., gravimetric water content and soil salinity). Additionally, an irrigation event will be monitored to determine the time required for water to traverse from

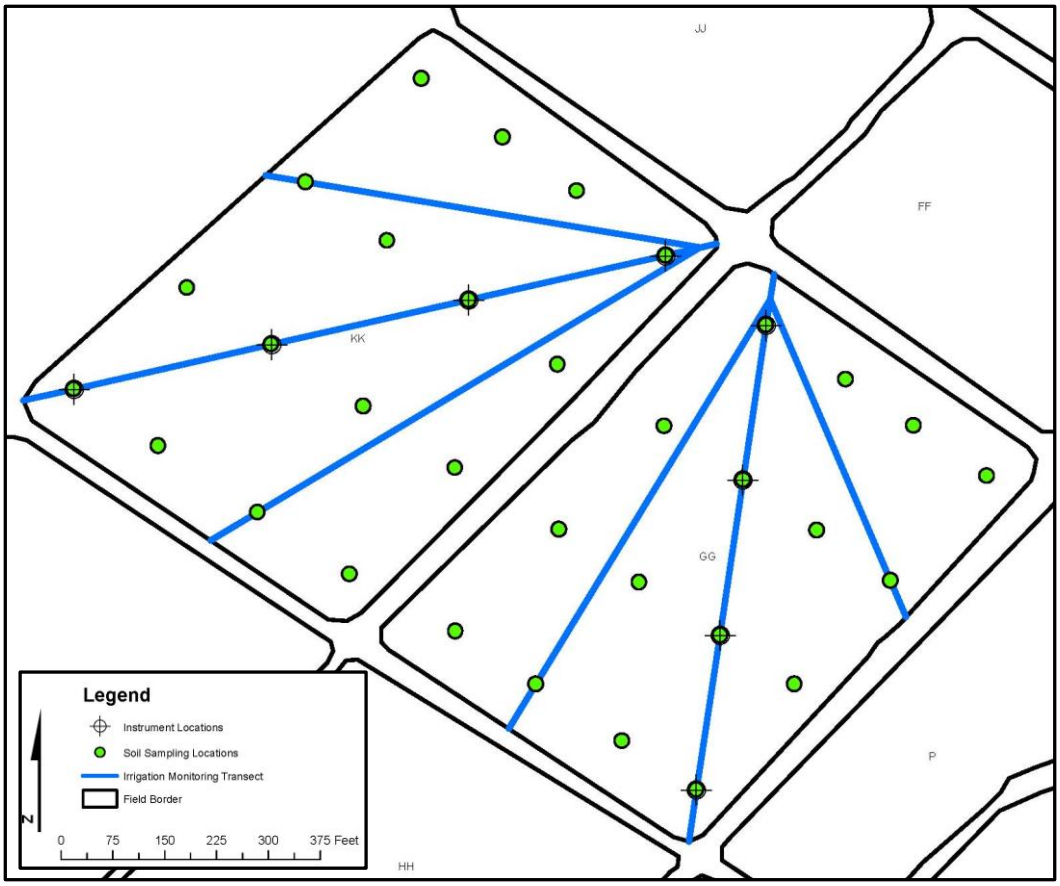


Figure 13.—Soil amendment demonstration monitoring layout (from GeoSystems Analysis, Inc.).

the irrigation point source to the opposite end of the field. After baseline data are collected, Lassenite Pozzolan will be incorporated into the top 6 inches of soil within Field GG (the treatment field); Field KK will be left untreated to function as the control.

Infiltration tests, soil samples, and the timed irrigation event will be repeated to compare them against baseline measurements. In addition to baseline comparisons, moisture content sensor nests will be used to monitor how long plant-available water persists within the soil. Sensors will be installed at predetermined intervals within and beneath the amended soil and between the irrigation source and the opposite corner of each field. Data loggers connected to the sensors will be programmed to collect data at regular intervals for the timed irrigation event and will be left in place through the 2012 growing season. After the initial timed irrigation event, data will be manually downloaded on 3-month intervals. During each data download trip, additional soil samples will be collected to determine gravimetric water content at a higher sample density. At the end of the growing season, soil salinity will again be determined.

Upon completing the demonstration, irrigation time and soil moisture will be analyzed for dramatic changes. This demonstration will provide the information required to show Lassenite Pozzolan's effect on the moisture holding capacity of the soil and could eventually contribute to informing management decisions about irrigation frequency. A cost/benefit analysis will be performed to determine if the price of purchasing, transporting, and installing Lassenite Pozzolan are worth the time, water, and pumping costs saved over time.

2.2.4.5 Planting

After completing the initial phase of the demonstration, both Fields GG and KK will be fallow and ready for planting in the spring of 2012. Under the same planting effort as the willow marsh, each field will be planted with the same mixture of coyote willow and Fremont cottonwood (*Populus fremontii*). Soil moisture will continue to be monitored throughout the first growing season.

2.2.4.6 Management

Following the planting, the fields will be appropriately incorporated into the irrigation regime of the BLCA.

3.0 MONITORING

Monitoring at the southwestern willow flycatcher willow marsh and the Lassenite Pozzolan field demonstration site at the BLCA will be based on elements described in the Habitat Conservation Plan (HCP) (Reclamation 2004) and Final Science Strategy (Reclamation 2007). Monitoring results will be used as part of the adaptive management process as discussed in this section.

3.1 Pre-Development Monitoring

Pre-development monitoring is designed to establish baseline data for evaluating post-development data and to identify whether covered species inhabit an area prior to implementation of each phase. Pre-development monitoring is divided into abiotic and biotic factors. Monitoring (abiotic and biotic) has been conducted at the BLCA since 2003 and is detailed in the Beal Riparian and Marsh Restoration Development & Monitoring Plan: Overview (Reclamation 2010b). Monitoring was conducted throughout the BLCA, which included the fields being targeted for habitat improvements.

3.2 Post-Development Monitoring

Post-development monitoring only addresses monitoring in the southwestern willow flycatcher marsh and the Lassenite Pozzolan field demonstration site where appropriate. The remainder of the conservation area is monitored under existing development and monitoring plans.

3.2.1 Habitat/Species Monitoring

Habitat/species monitoring is designed to determine whether conservation areas are providing the habitat requirements (as defined by performance management guidelines) needed for the LCR MSCP covered species. The monitoring will also document whether other species are using the conservation areas. Monitoring protocols have been developed, or are in development, for documenting habitat characteristics and species response to created land cover types.

- **Vegetation** – Vegetation parameters may be collected based on management goals and objectives.

- **Marsh birds** – Marsh bird surveys will be conducted for the LCR MSCP covered marsh bird species according to the Standardized North American Marsh Bird Monitoring Protocol (Conway 2006). Survey points will be established in the marsh habitat. One survey will be conducted monthly from March through May, with each survey being at least 2 weeks apart. Surveys at the marsh that are currently under development will begin in March 2014.

- **Southwestern willow flycatcher** – Standardized presence/absence surveys (USFWS 2000) will be conducted. A minimum of five surveys each year will be conducted beginning in May and ending in July. Surveys will be conducted at the two habitat improvement projects (marsh and soil amendment) starting in the spring of 2014.

- **Neotropical birds** – A double-sampling approach involving rapid and intensive surveys will be used to monitor neotropical avian birds (Bart et al. 2010; Great Basin Bird Observatory 2010). The breeding territories of all LCR MSCP covered species will be mapped (Great Basin Bird Observatory 2010). Surveys will be conducted annually during the breeding season beginning in April 2014 at the two habitat improvement projects (marsh and soil amendment).

4.0 ADAPTIVE MANAGEMENT RECOMMENDATIONS

Adaptive management relies on the initial receipt of new information, the analysis of that information, and the incorporation of the new information into the design and/or direction of future project work (Reclamation 2007). Under the Adaptive Management Program, habitat creation sites will be assessed for biological effectiveness and whether they fulfill the conservation measures outlined in the Habitat Conservation Plan for 26 covered species and potentially benefit 5 evaluation species. Post-development monitoring and species research results will be used to adaptively manage habitat creation sites after initial implementation. If it is determined through the monitoring results that additional information is needed to better define covered species habitat requirements, these data will be collected using the procedures outlined in the LCR MSCP Final Science Strategy (Reclamation 2007). The strategy provides for an adaptive management process for improving the effectiveness of HCP implementation and identification of monitoring and research priorities. Alterations or changes to habitat creation sites can be accomplished through management activities; these activities will be initiated through the adaptive management process. Habitat creation sites will be managed for covered species using the best available science throughout the term of the HCP.

4.1 Monitoring Analysis and Evaluation of Management Guidelines

Monitoring data will be assessed to determine whether the site meets the targeted species management guidelines. Created habitats are not anticipated to be managed at these limiting factors but rather at a higher standard. In order to more effectively and efficiently manage created habitats, sites will be designed to a higher habitat quality standard and monitored over time to see whether habitat quality decreases as the sites change.

If it is determined that the site does not meet management guidelines for targeted covered species, recommendations for site modifications may be made by the following means:

- Comparison of monitoring results with management guidelines to identify those standards not being met that can be remedied by site manipulations (plant removal, additional plantings, site contouring, etc.) or changes to the watering regime

- Comparison of other phase results with previous successful and unsuccessful habitat restoration projects to look for differences in site characteristics (elevation, distance to river, climate, etc.), baseline conditions, planting design, plant and animal species composition, watering regimes, and abiotic conditions that may help explain why the site has not met the management guidelines

- Review of other studies that may provide insight into additional covered species habitat requirements or different restoration techniques to achieve the desired conditions

These recommendations of how to move toward achieving management guidelines will be included in the annual report once they have been established. These recommendations will also be used to improve future project designs where appropriate.

The results from the two habitat improvement actions to augment the quality of habitat at the Beal Riparian Restoration Area will be evaluated and incorporated into the adaptive management process and then reported in the annual report following completion of the demonstration project described above.

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