2015

Lower Owens River Project Annual Report

March 8, 2016

TABLES

Executive Summary

The 2015 Lower Owens River Project (LORP) Annual Report contains the results from the ninth year of monitoring for the LORP. Monitoring results contained in this report include hydrologic monitoring, avian census and indicator species habitat monitoring for the Riverine-Riparian Area and the Blackrock Waterfowl Management Area (BWMA), vegetation mapping using imagery captured in 2014, land management (including range management and rare plant monitoring), rapid assessment, water quality monitoring, weed and saltcedar management.

Hydrologic Monitoring

The hydrologic monitoring section describes flow conditions in the LORP regarding attainment with the 2007 Stipulation & Order flow and reporting requirements and 1991 Environmental Impact Report (EIR) goals. For the 2014-15 water year, which covers October 2014 to September 2015, LADWP was fully compliant with all the 2007 Stipulation & Order flow and reporting requirements. The mean flow to the Delta Habitat Area (DHA) was 6.0 cfs, achieving the required 6-9 cfs annual flow. The agreement to manage wetted acreage in the Blackrock Waterfowl Management Area (BWMA) by setting constant flows by seasons continued with generally good results. The hydrologic monitoring section also describes flow measurement issues and finishes with a commentary on flow losses and gains through the different reaches of the Lower Owens River.

There was no seasonal habitat flow in 2015 based on hydrologic conditions; thus no seasonal habitat flow data to report.

Avian Census and Habitat Indicator Species
Riverine-Riparian

Avian surveys were conducted in the Riverine-Riparian area in 2015 to evaluate the response of bird species to rewatering of the river and the vegetation change associated with the new fluvial hydrological regime. Multiple linear regression was used to relate vegetation composition and diversity of vegetation categories to breeding bird species diversity, richness and abundance.

Implementation of the LORP has resulted in significant increases in landbird species richness in Reach 2 only. Waterbird use of the LORP was above baseline in all reaches in 2010, but has declined in all reaches except Reach 4 due to the loss of open water and wet meadow habitat associated with the conversion to marsh. Processes which maintain open water habitat and seasonally flooded wet meadow habitat will continue to support waterbird use in the LORP.

Breeding bird species richness and diversity have also increased in Reach 2 and with the establishment of water and marsh, Marsh wren, Common yellowthroat, Song sparrow, and Red-winged Blackbird are now regular to abundant breeders in this reach. Breeding bird abundance has been more responsive to implementation of LORP than other indices as increases have been observed in all reaches except Reach 6.

Variables affecting breeding bird richness indices on LORP include the acreage of woody riparian vegetation, wet meadow, habitat diversity, and marsh.

LORP habitat indicator species has not increased although small-scale changes may be occurring.

Although the California Wildlife Habitat Relationships Model (CWHR) is relatively easy to implement and provides a habitat suitability map for all indicator species, some difficulties have been encountered in applying CWHR to LORP, and the information obtained is of limited usefulness for guiding management. Locally-developed species habitat models can be predictive and can be useful decision support tools for guiding land management. Development of a species habitat association model for the LORP Riverine-Riparian area would likely have distinct advantages over the broad-scale CWHR model currently being used.

We recommend continued work on developing species habitat relationship models for LORP for the purpose of providing a management tool for understanding bird use of the Riverine-Riparian area. Habitat models should also address whether the current indicator species represent habitats and conditions desirable on LORP, and the use of other species as indicators of the health and diversity of riparian and aquatic habitats on LORP.

Avian Census and Habitat Indicator Species
Blackrock Waterfowl Management Area – Drew and Winterton Units

During initial flooding in 2009 and at least through 2010, the Drew Unit was very productive in terms of the number and diversity of habitat indicator species using the area. The surveys conducted in 2015 confirmed that indicator species use has declined significantly since 2010.

Efficient use of water resources in the BWMA and maintaining wetland productivity and use by indicator species may require an alternative approach involving more seasonal manipulation of water levels and seasonal drying to control emergent vegetation.

Indicator species showed a quick response to the spring flooding at Winterton. Although only a few species were present in early April just after releases were initiated, indicator species use increased rapidly. Use of Winterton in fall by waterfowl was high, and the flooded meadow habitats also provided fairly good habitat for wading birds. Shorebird use was not very high due to lack of seasonally exposed mudflats and flooded areas of appropriate depth for foraging. Even though the northern part of the unit was disked prior to flooding to break up the cattails, cattail regrowth was vigorous throughout the entire disked area due to a steady supply of water throughout the growing season.

Consideration should be given to reevaluating the vegetation and avian monitoring program for BWMA to ensure that the information being collected is what is needed to 1) assess habitat quality for indicator species, and 2) guide adaptive management.

Landscape Vegetation Mapping

Landscape vegetation inventories were conducted for the LORP and Blackrock Waterfowl Management Area (BWMA) for 2014 conditions, seven years after the LORP was implemented. Results are compared with similar inventories of 2009 conditions and of 2000 conditions, prior to implementation of LORP. Differences in 2000, 2009, and 2014 conditions are attributed to hydrologic changes associated with rewatering the Owens River, fires, and improvements in the accuracy and precision of mapping.

Hydrologic changes are summarized in terms of states. Prescribed burns converted alkali scrub/meadow to more productive alkali meadow and invigorated production of herbaceous vegetation. A wildfire near Lone Pine reduced the stature of riparian forest and killed some trees. The accuracy and precision of mapping have improved with each successive application.

The influence of the LORP on the distribution of vegetation types generally corresponds to changes in hydrology and channel morphology associated with four states: 1) incised, dry channel; 2) incised, wet, confined floodplain; 3) graded, wet, unconfined floodplain; and 4) aggraded, wet, unconfined floodplain. With implementation of the LORP, the incised, dry channel was wetted, reducing the states to incised channels bordered by high-and-dry terrace, graded channels bordered by moist floodplain, and aggraded channels bordered by saturated floodplain.

In 2014, the length of graded condition tripled and the aggraded condition increased 50 percent relative to 2009 conditions. More than 30 miles of channel that was incised in 2000 has since become graded or aggraded. The length of graded channel increased more than 25 miles since 2009 and aggraded conditions increased by about 2 miles.

Changes in state correspond with changes in the distributions of vegetation. Alkali scrub, bassia (weed), and marsh are prominent for the incised state. More diverse communities including alkali scrub, alkali scrub/meadow, alkali meadow, wet meadow, and marsh are prominent for the graded state. Marsh, wet meadow, and alkali scrub/meadow are prominent for the aggraded state.

The extent of hydric vegetation types increased 673 acres since 2009 and 795 acres since 2000. The extent of mesic vegetation declined 168 acres since 2009 and 128 acres since 2000. Arid vegetation declined 439 acres since 2009 and 602 acres since 2000. Aggrading conditions throughout the LORP correspond with changes towards more hydric herbaceous vegetation types.

The area of riparian forest has decreased from about 450 acres in 2000, to 265 acres in 2009, and 165 acres in 2014. Most of this reduction is attributed to sequentially more precise mapping of tree canopy in 2009 and again in 2014. Also, many trees were either killed or reduced to basal sprouts by the Lone Pine wildfire in 2013. Trees engulfed by marsh in graded reaches that were expected to die, are decadent but alive. A predicted increase in new overstory canopy has not been realized, probably because of the very limited extent of barren substrate suitable for willow colonization in the seasonally flooded zone. The extent of riparian forest is declining and trees are not expected to be replaced.

The LORP is expected to continue to aggrade. The remaining incised reach will become graded; the floodplain of graded reaches will become wetter; and aggraded reaches will continue to slowly expand both upstream and downstream. The river channel is expected to become more occluded and the extent of marsh will increase at the expense of open water.

Conditions are moving towards an herbaceous wetland (e.g. marsh, wet meadow, alkali meadow) and away from more structurally diverse riverine/riparian habitat with open channel conditions.

Although landscape mapping of the BWMA was intended to document 2014 conditions, vegetation was often remnant of previous hydrologic cycles. For example, about 193 acres of marsh in the Waggoner unit and 79 acres of marsh in the Thibaut unit are dead and remnant of flooding that was curtailed in 2010. About 49 acres of marsh in the Winterton unit was also dead in response to curtailment of flooding in 2011, but has been rejuvenated by reflooding in 2015. About 277 acres of marsh and open water in the Drew unit was present in 2014, but dried up in 2015. Similarly, vegetation composition of wet meadow and alkali meadow are an amalgamated response to both historical and contemporary water management. Major differences in upland vegetation types (desert sink scrub, Great Basin mixed scrub, alkali scrub, alkali flat, and slick) are attributed to mapping errors magnified by conditions inherent to landscapes manipulated for water spreading. The usefulness of landscape vegetation mapping of the BWMA is questionable. Alternative approaches to monitoring should be considered.

Land Management

The 2015 Lower Owens River Project (LORP) land management monitoring efforts continued with monitoring utilization across all leases, range trend monitoring on the Lone Pine and Twin Lakes leases inside the LORP management area, and rare plant monitoring. Irrigated pasture evaluations were not conducted due to drought conditions in 2015. The LORP area is currently experiencing its fourth year of extreme drought. Effects from this are a decrease in forage production in the uplands and decreased availability of irrigation water. Despite severe impacts from the historic drought on the uplands, steady base flows in the Lower Owens River have maintained moist floodplains in good condition. Grazing utilization monitoring was conducted on all leases in 2014-15. The 2015 monitoring efforts conclude the seventh year of examining the effects of excluding rare plants from livestock grazing. Results indicated a decline of plant populations in ungrazed sites.

Pasture utilization for leases within the LORP was below the allowable levels of use established for both riparian (up to 40%) and upland (up to 65%) areas except for the Islands and Lone Pine leases. Use on the Blackrock Lease was lower than most other leases in the project area remaining well below all grazing standards. The Twin Lakes Lease has been destocked for the past few years due to drought conditions and grazing has been below allowable utilization. The Islands Lease continues to lose meadows to aquatic vegetation as inundation from flow augmentations for the LORP project continues. Use of the Thibaut Field on the Thibaut Lease was below the allowable upland standard. The Lone Pine Lease has recovered from the 2013 fire, the only major loss was to mature willow trees.

All irrigated pastures were monitored in 2013. Pastures that scored 80% or below were checked in 2014. Due to persisting drought conditions no irrigated pastures were evaluated in 2015 in accordance with grazing plans.

This monitoring year marks the seventh year of evaluating rare plant trend plots for *Sidalcea covillei* (Owens Valley Checkerbloom), and *Calochortus excavatus* (Inyo County Star Tulip) for the LORP. The objective of the study was to determine the effects of grazing exclusion on Owens Valley checkerbloom. Due to confounding factors during previous years (plot inundation, exclosure left open, nutrient tub within plot), trend plots were sampled for two additional years. Results show an increase in numbers over time in grazed sites and a decrease in numbers over time in ungrazed sites. It is recommended to remove the exclosures and discontinue the study.

Rapid Assessment Survey

The LORP Rapid Assessment Survey was conducted in August. Inyo County staff surveyed the river riparian area, the Blackrock Waterfowl Management Area (BWMA), Off-River Lakes and Ponds (ORLP), and the Delta Habitat Area. Observed and recorded were woody recruitment, saltcedar, Russian olive, noxious weeds, trash, recreation impacts, cut fence, elk and beaver activity. Crews returned to sites where beaver and woody recruitment were recorded last year to look for persistence.

Additional monitoring included revisiting all sites where woody recruitment was found in past surveys to determine long-term persistence of tree willow that recruited between 2007 and 2015. Persistence varied between years, with a minimum 35% of the 2010 cohort persisting, and a maximum of 74% of the 2010 cohort still present.

The amount of saltcedar decreased in most river reaches. Less saltcedar was discovered this year than in the previous five years. Still, the level of infestation found in the BWMA and ORLP is concerning. In these areas so many plants exist that it is infeasible to record every site. Saltcedar crews are focusing their work in this area in the 2015-16 field season.

Perennial pepperweed (*Lepidium latifolium)* was again the only noxious weed recorded in the LORP. There was 61 populations recorded, which is up from 25 found last year. The weed is primarily spreading in the area of known and monitored sites in river-reach 1 and 2, and in the Blackrock area.

During the 10-day survey there was nine tree willow recruitment sites and one Cottonwood recruit. These numbers are similar to last year's counts.

Russian olive recruitment was recorded at 51 sites; mostly in the vicinity of existing stands. It does not appear to be spreading.

Beaver activity was noted at 11 locations, and elk sightings and other elk evidence were noted in 70 locations. Beaver evidence is up, and elk evidence is down from the previous year.

Water Quality

Water quality was monitored at six locations in the LORP from February to September 2015. This monitoring was conducted in anticipation of monitoring changes in water quality resulting from altered flow releases to the river in 2015. However, the proposed modified hydrograph/flow regime was not implemented in 2015.

Still, the water quality sonde data support that water quality is generally good to excellent in the river despite the warm and dry conditions that prevailed during the year. For the summer months (June –September) when water quality values would be more likely to be impaired, water temperature varied between 65-75 °F and turbidity values were usually below 5 NTU. Additionally, conductivity (mS/cm) and pH varied little (0.3-0.5 and 7.2-8.2, respectively), and dissolved oxygen ranged between 2 and 4.5 mg/L during the summer, which is above the 1 mg/L threshold for the onset of fish stress. As expected, the fluctuation in dissolved oxygen (DO) was diurnal and corresponded with changes in water temperature. Two instances of sudden 2 mg/L declines in DO at Reinhackle and Narrow Gauge Road apparently were initiated by flows exceeding a threshold between approximately 70-75 cfs when water temperatures were above 65 F. This suggests that high flows during warm water periods may trigger crashes in DO from the mobilization of fine organics into the water column.

Additional analyses should be completed to compare with monitoring results from prior years and to explore whether relationships between flow, temperature, and DO can be developed from these data, as models derived from 2015 alone would not be adequate to design flushing or habitat flow rates.

Weed Management

All known Perennial pepperweed (*Lepidium latifolium)* sites within the LORP area were treated, but staff was not able to treat all sites three times throughout the growing season as had been done in prior years. LORP invasive plant management involved surveying for new weed populations and treatment of known sites throughout the growing season. Only one field staff member was available to work in the LORP, this is down from the usual three.

A total of 51 infestation sites are known, with 5 new sites discovered this year. Of this total, 21 sites had no plants present in 2014, and 11 had no growth for 5 years. Invasive plant populations totaled 0.84 net acres, which represents a 0.52 acre decrease over the previous year. Most of this decrease occurred within one site near the Winterton management unit. This site, which ballooned from a few plants to 1.24 acres in 2014, is now down to one-half acre due to aggressive management activities in 2014. All other sites continue to be small and spotty in nature, containing less than 200 plants each.

Saltcedar

From October to March, Inyo County Water Department (County) saltcedar field crews cut and treated with herbicide approximately 165 acres of saltcedar. About 50 piles of dry slash were burned, less than in previous years due to fire restrictions. About 89 miles of the Lower Owens River floodplain was cleared of saltcedar.

The County saltcedar crews also worked with LADWP, and the California Department of Corrections and Rehabilitation crews, and made progress thinning out dense stands of saltcedar and Russian olive trees that have developed in the Lower Twin Lakes area.

1.0 INTRODUCTION

The Lower Owens River Project (LORP) is a large-scale habitat restoration project in Inyo County, California being implemented through a joint effort by the Los Angeles Department of Water and Power (LADWP) and Inyo County (County). The LORP was identified in a *1991 Environmental Impact Report* (EIR) as mitigation for impacts related to groundwater pumping by LADWP from 1970 to 1990. The description of the project was augmented in a *1997 Memorandum of Understanding* (MOU), signed by LADWP, the County, California Department of Fish and Game (CDFG), California State Lands Commission (SLC), Sierra Club, and the Owens Valley Committee. The MOU specifies the goal of the LORP, timeframe for development and implementation, and specific actions. It also provides certain minimum requirements for the LORP related to flows, locations of facilities, and habitat and species to be addressed.

The overall goal of the LORP, as stated in the MOU, is as follows:

> "The goal of the LORP is the establishment of a healthy, functioning Lower Owens River riverine-riparian ecosystem, and the establishment of healthy, functioning ecosystems in the other physical features of the LORP, for the benefit of biodiversity and Threatened and Endangered Species, while providing for the continuation of sustainable uses including recreation, livestock grazing, agriculture and other activities."

LORP implementation included release of water from the Los Angeles Aqueduct (LAA) to the Lower Owens River, flooding of up to approximately 500 acres depending on the water year forecast in the Blackrock Waterfowl Management Area (BWMA), maintenance of several Off-River Lakes and Ponds, modifications to land management practices, and construction of new facilities including a pumpback station to capture a portion of the water released to the river.

The LORP was evaluated under CEQA resulting in the completion of an EIR in 2004.

1.1 Monitoring and Reporting Responsibility

Section 2.10.4 of the Final LORP EIR states that the County and LADWP will prepare an annual report that includes data, analysis, and recommendations. Monitoring of the LORP will be conducted annually by the Inyo County Water Department (ICWD), LADWP and the MOU consultants, Mr. Mark Hill and Dr. William Platts of Ecosystem Sciences (ES) according to the methods and schedules described under each monitoring method as described in Section 4 of the *Lower Owens River Monitoring Adaptive Management and Reporting Plan* (Ecosystem Sciences 2008).

Specific reporting procedures are also described under each monitoring method. The MOU requires that the County and LADWP provide annual reports describing the environmental conditions of the LORP. LADWP and the County are to prepare an annual report and include the summarized monitoring data collected, the results of analysis, and recommendations regarding the need to modify project actions as recommended by the MOU consultants, ES. This LORP Annual Report describes monitoring data, analysis, and recommendations for the LORP based on data collected during the 2015 field season (March-October). The development of the LORP Annual Report is a collaborative effort between the ICWD, LADWP, and the MOU consultants. Personnel from these entities participated in different sections of the report writing, data collection, and analysis.

The 2007 Stipulation & Order also requires the release to the public and representatives of the Parties identified in the MOU a draft of the annual report. The 2007 Stipulation & Order states in Section L:

> "LADWP and the County will release to the public and to the representatives of the Parties identified in the MOU a draft of the annual report described in Section 2.10.4 of the Final LORP EIR. The County and LADWP shall conduct a public meeting on the information contained in the draft report. The draft report will be released at least 15 calendar days in advance of the meeting. The public and the Parties will have the opportunity to offer comments on the draft report at the meeting and to submit written comments within a 15 calendar day period following the meeting. Following consideration of the comments submitted the Technical Group will conduct the meeting described in Section 2.10.4 of the Final LORP EIR."

Generally, LADWP is the lead author for a majority of the document and is responsible for overall layout and content management. Specifically, LADWP wrote: Sections 1.0 Introduction; 2.0 Hydrologic Monitoring; 3.0 Avian Census and Habitat Indicator Species Monitoring, 4.0 Land Management; and 5.0 Landscape Vegetation Mapping.

ICWD completed Section 6.0 Rapid Assessment Survey, Section 7.0 Water Quality, and Section 9.0 Saltcedar Report. Section 8.0 Weed Control was authored by the Inyo/Mono Counties Agricultural Commission.

The annual report will be available to download from the LADWP website link: http://www.ladwp.com/LORP.

This document represents the reporting requirements for the LORP Annual Report for 2015.

2.0 HYDROLOGIC MONITORING

2.1 River Flows

On July 12, 2007, a Court Stipulation & Order was issued requiring LADWP to meet specific flow requirements for the LORP. From the issue date through September 2015, LADWP has been in compliance with the flow requirements outlined in the Stipulation & Order. The flow requirements are listed below:

1. Minimum of 40 cubic feet per second (cfs) released from the Intake at all times.
2. None of the in-river measuring stations has a 15-day running average of less than 35 cfs.
3. The mean daily flow at each of the in-river measuring stations must equal or exceed 40 cfs on 3 individual days out of every 15 days.
4. The 15-day running average of the in-river flow measuring stations is no less than 40 cfs.

On July 14, 2009, 6 of the 10 original temporary in-river measuring stations were taken out of service, while the Below LORP Intake, Mazourka Canyon Road, Reinhackle Springs, and Pumpback Stations remained in service.

The flow data graphs show that LADWP was in compliance with the Stipulation & Order, from October 2014 through September 2015, for the four in-river stations (see Hydrological Appendix 2).

2.1.1 Web Posting Requirements

The Stipulation & Order also outlined web posting requirements for the LORP data. LADWP has met all the posting requirements for the daily reports, monthly reports, and real time data.

Daily reports listing the flows for the LORP, Blackrock Waterfowl Management Area (BWMA) wetted acreage, and Off-River Lakes and Ponds depths are posted each day on the Web at <http://www.ladwp.com> under About Us → Los Angeles Aqueduct → LA Aqueduct Conditions Reports → LORP Flow Reports and click on the ‘List of LORP Flow Reports’ link.

Monthly reports summarizing each month and listing all of the raw data for the month are posted to the Web at <http://www.ladwp.com> under About Us → Los Angeles Aqueduct → LA Aqueduct Conditions Reports → LORP Monthly Reports.

Real time data showing flows at Below LORP Intake, Owens River at Mazourka Canyon Road, Owens River at Reinhackle Springs, and Pumpback Station are posted to the Web at <http://www.ladwp.com> under About Us → Los Angeles Aqueduct → LA Aqueduct Conditions Reports → Real Time Data and click on the ‘Lower Owens River Project’ link.

2.1.2 Measurement Issues

LORP in-river flows are measured using Sontek SW acoustic flow meters. Both of the Sontek SW meters located in the main channel of the LORP are mounted on the bottom of concrete sections. These devices are highly accurate and final records for the LORP generally fall within normal water measurement standards of +/- 5%.

The accuracy of the Sontek meters are affected by factors which change the levels or velocities in the river. One of those factors is seasonal changes, such as spring/summer vegetation growth, which cause water levels to increase and velocities to decrease. Another factor is sediment build-up. As a band of sediment builds up on or near the measuring station section, the water levels of the section can increase or velocities can be shifted-both of which affect the accuracy of the Sontek meters. In order to account for these environmental changes, LADWP manually meters flows at all of the stations along the LORP to check the accuracy of the meters. Each time current metering is performed, a ‘shift’ is applied to the station to take into account the difference in flow determined by the current metering. If a fundamental change in the flow curve is observed then a new index is created from the current metering data and downloaded to the meter. All of the meters on the LORP are calibrated at a minimum of once per month, per the 2007 Stipulation & Order, to maintain the accuracy of the meters.

A commentary on each station along the LORP follows:

<u>Below LORP Intake</u>

Measurement Device: Langemann Gate

The Langemann Gate regulates and records the flow values at the Intake. This has had very good accuracy and reliability as long as the gate does not become submerged (submergence may be possible at higher flows such as when the seasonal habitat flows are released). In order to attempt to solve the water measurement problems when the Langemann Gate is submerged, a WaterLOG H-350XL was installed as a back up to the Langemann Gate measurement. After a few years of attempting to apply a rating curve to the level measured by the bubbler, it has been determined that the large fluctuations in stage as conditions in the river channel go through seasonal cycles are too large and unpredictable to sustain an accurate measurement using the bubbler. As such, the bubbler has been abandoned and LADWP will no longer use the bubbler as a backup device to measure flow at the Intake.

<u>LORP at Mazourka Canyon Road</u>

Measurement Devices: Sontek SW Meter

The station utilizes a single Sontek SW flow meter in a concrete measuring section and flow measurement accuracy has been excellent.

<u>LORP at Reinhackle Springs</u>

Measurement Device: Sontek SW Meter

The station utilizes a single Sontek SW flow meter in a concrete measuring section and measurement accuracy has been excellent.

LORP at Pumpback Station

Measurement Devices: Pumpback Station Discharge Meter, Langemann Gate, Weir

At the Pumpback Station, the flow is a calculated by adding the Pumpback Station, Langemann Gate Release to Delta, and Weir to Delta. In most flow conditions these stations have proven to be very accurate. However, during the higher flows, the Weir and/or the Langemann Gate can become submerged, thus lowering the measuring accuracy of the submerged device.

2.2 Flows to the Delta

Based upon a review of the flow to Brine Pool and flow to Delta data, and after filtering out unintended spillage at the Pumpback Station to average a flow of 6 to 9 cfs, the flows to the Delta were set to the following approximate schedule (per the LORP *Environmental Impact Report* (EIR), section 2.4):

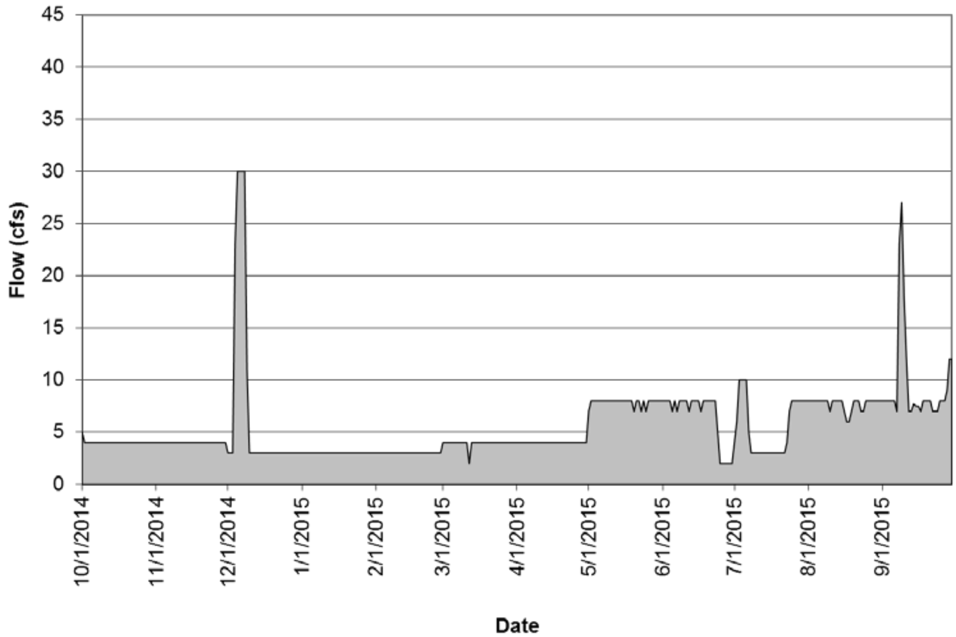
- October 1 to November 30 4 cfs
- December 1 to February 28 3 cfs
- March 1 to April 30 4 cfs
- May 1 to September 30 7.5 cfs

Additionally, pulse flows were scheduled to be released to the Delta (LORP EIR, section 2.4):

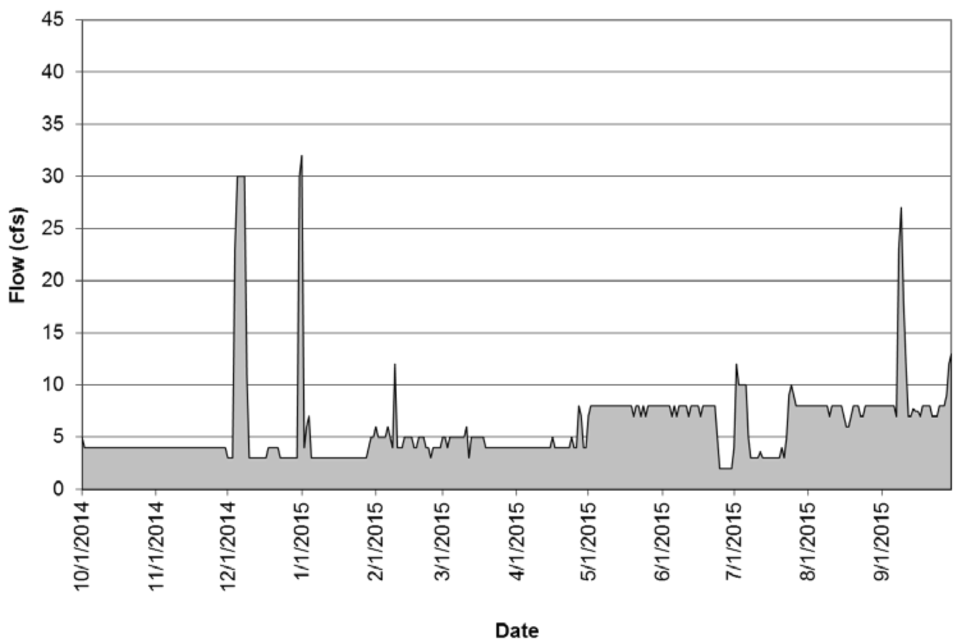
- Period 1: March-April 10 days at 25 cfs
- Period 2: June-July 10 days at 20 cfs
- Period 3: September 10 days at 25 cfs
- Period 4: November-December 5 days at 30 cfs

Due to the Adaptive Management Recommendations only the Period 4 Pulse Flow was released.

The base and pulse flows for the 2014-15 water year resulted in an average of 6 cfs flow to the Delta. Unintended flow to the Delta was greatly reduced this year, mostly due to the lack of rainstorms in an extremely dry year. Unintended flows are released to the Delta when intense rainstorms cause river flows to exceed the limited maximum capacity of the Pumpback Station or when pump outages occur at the Pumpback Station. Flows over the weir are generally unintended flows and flows over the Langemann Gate are scheduled flows (see figures below).



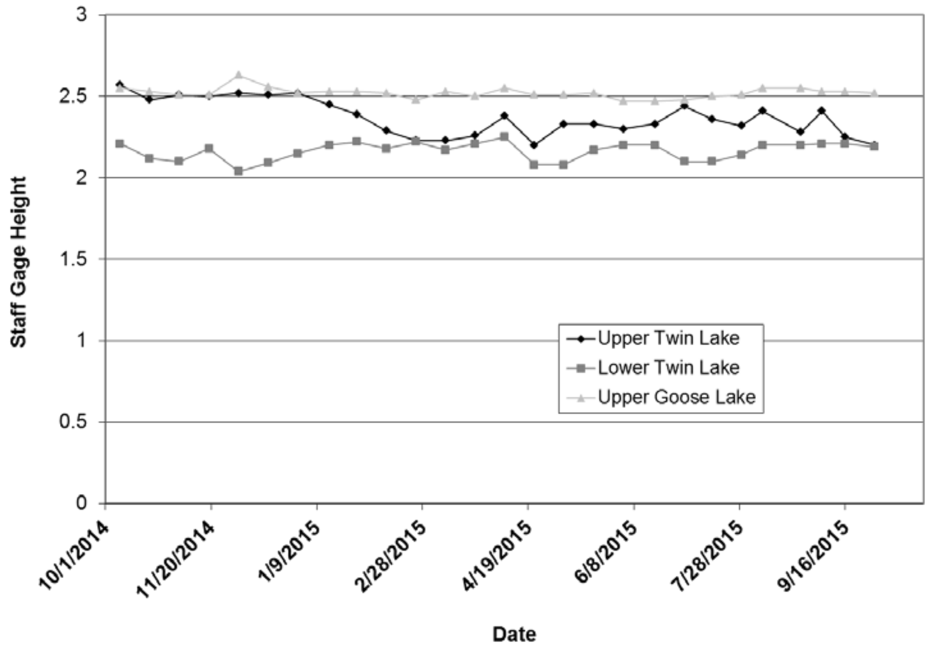
Hydrologic Figure 1. Langemann Release to Delta



Hydrologic Figure 2. Langemann and Weir Release to Delta

2.2.1 Off-River Lakes and Ponds

The BWMA and Off-River Lakes and Ponds Hydrologic Data Reporting Plan requires that Upper Twin Lake, Lower Twin Lake, and Goose Lake be maintained between 1.5 and 3.0 feet on their respective staff gauges, and that Billy Lake be maintained full (i.e., at an elevation that maintains outflow from the lake). All of the staff gages measured above 1.5 feet stage height for the October 2014 to September 2015 reporting period.



Hydrologic Figure 3. Off-River Lakes and Ponds Staff Gages

<u>Billy Lake</u>

Due to the topography of Billy Lake, whenever the Billy Lake Return Station is showing flow, the lake is full. LADWP maintains Billy Lake by monitoring the Billy Lake Return station to always ensure some flow is registering there. The table in Hydrological Appendix 2 presents the annual summary of flows, and shows that at no time did the flow at Billy Lake Return Station fall to zero for a day. Billy Lake Return had a minimum daily average flow of 0.8 cfs for the year, so Billy Lake remained full for the entire year (see the following table).

Hydrologic Table 1. LORP Flows – Water Year 2014-15

Station Name	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
Below River Intake	49.0	78.0	40.0
Blackrock Return Ditch	1.1	3.0	0.0
Goose Lake Return	1.1	1.8	0.8
Billy Lake Return	1.1	1.5	0.6
Mazourka Canyon Road	45.8	64.0	37.0
Locust Ditch Return	1.1	9.6	0.0
Georges Ditch Return	2.3	14.6	0.0
Reinhackle Springs	47.6	75.0	35.0
Alabama Gates Return	0.7	27.0	0.0
At Pumpback Station	46.5	55.0	32.0
Pump Station	40.5	48.0	13.0
Langemann Gate to Delta	5.6	30.0	2.0
Weir to Delta	0.5	29.0	0.0

Thibaut Pond

Thibaut Pond is contained completely within the Thibaut Unit of the BWMA. Each day the Thibaut Pond acreage is posted to the web in the LORP daily reports.

Flow to Thibaut Pond began on October 16, 2014, and continued through the end of March 2015, averaging 0.6 cfs.

2.3 Blackrock Waterfowl Management Area

Flows for the BWMA are set based upon previous data relationships between inflows to an area and the resulting wetted acreage measurements during each of the four seasons based on evapotranspiration (ET) rates.

The seasons are defined as:

Spring	April 16 – May 31
Summer	June 1 – August 15
Fall	August 16 – October 15
Winter	October 16 – April 15

Up until the end of the 2012-13 Runoff Year, wetted acreage measurements were collected eight times per year, once in the middle of each season and once at the end of each season. Starting on the 2013-14 Runoff Year, only the middle of each season measurements have been collected. The end of season measurements were discontinued because they added very little information compared to the middle of season measurements and required extensive manpower for taking the each measurement. The measurements are performed by using GPS and walking the perimeter of the wetted edges of the waterfowl area. When both middle and end of season measurements are made the measurement in the middle of the season counts as the average for the entire season (see table below).

Hydrologic Table 2 BWMA Wetted Acreage

Winterton Unit				Thibaut Unit			
ET Season	**Read Date**	**Wetted Acreage**	**Average Inflow**	**ET Season**	**Read Date**	**Wetted Acreage**	**Average Inflow**
Spring				Spring			
Summer				Summer			
Fall				Fall			
Winter				Winter	1/14/2015	13***	0.6
Spring	5/6/2015	86	6.8	Spring			
Summer	7/10/2015	171**	6.0	Summer			
Fall	9/15/2015	221**	6.0	Fall			

Drew Unit				Waggoner Unit			
ET Season	**Read Date**	**Wetted Acreage**	**Average Inflow**	**ET Season**	**Read Date**	**Wetted Acreage**	**Average Inflow**
Spring	5/8/2014 N/A	309* N/A	4.7	Spring			
Summer	7/8/2014 N/A	278* N/A	4.8	Summer			
Fall	9/16/2014 N/A	270* N/A	4.2	Fall			
Winter	1/15/2015 N/A	267* N/A	1.5	Winter			
Spring	5/6/2015 N/A	235** N/A	0	Spring			
Summer				Summer			
Fall				Fall			

** These measurements count towards the 2014-2015 runoff year acreage goal.*
*** These measurements count towards the 2015-2016 runoff year acreage goal.*
**** This acreage does not include the 28 acres of the Thibaut Pond area.*

2.3.1 Blackrock Waterfowl Management Area Results for April 2014 to March 2015

The runoff forecast for runoff year 2014-15 is 50%, so the waterfowl acreage goal for this year is 250 acres.

On April 16, the spring flows were set and the inflows to Drew were increased to 4.9 cfs. When the wetted perimeter was measured with GPS in the middle of the spring season, the wetted area was 309 acres for Drew.

On May 29, the summer flows were set and the inflows to Drew were decreased to 4.7 cfs. When the wetted perimeter was measured with GPS in the middle of the summer season, the wetted area was 278 acres for Drew.

On August 16, the fall flows were set and the inflows to Drew were decreased to 4.1 cfs. When the wetted perimeter was measured with GPS in the middle of the fall season, the wetted area was 270 acres for Drew.

On October 16, the Thibaut Waterfowl Area inflow was turned on to 1.0 cfs and the winter flows were set for Drew decreasing it to 1.5 cfs. When the wetted perimeter was measured with GPS in the middle of the winter season, the wetted area was 267 acres for Drew and 41 acres for Thibaut.

On December 8, the Thibaut Waterfowl Area inflow was reduced to 0.5 cfs.

The average waterfowl wetted acreage for the 2014-15 year was 275 acres, which is above the goal of 250 acres.

2.3.2 Blackrock Waterfowl Management Area Results for April 2015 to September 2015

The runoff forecast for runoff year 2015-16 is 36%, so the waterfowl acreage goal for this year is 180 acres.

On April 1, the Thibaut Waterfowl Area inflow was turned off, the inflow for Drew was turned off, and the Winterton Waterfowl Area inflows were turned on to 6.6 cfs..

On May 1, the flows to Winterton were reduced to 5.6 cfs. On May 6 the wetted perimeter was measured with GPS. The wetted area was 235 acres for Drew and 86 acres for Winterton.

On June 1, the flows to Winterton were increased to 6.0 cfs. When the wetted perimeter was measured with GPS in the middle of the summer season, the wetted area was 171 acres for Winterton.

Fall flows to Winterton remained at 6.0 cfs. When the wetted perimeter was measured with GPS in the middle of the fall season, the wetted area was 221 acres for Winterton.

The average waterfowl wetted acreage so far through fall is 225 acres, which is above the goal of 180 acres.

2.4 Assessment of River Flow Gains and Losses

This section describes river flow gains and losses for all reaches in the Lower Owens River from the LORP Intake to the Pumpback Station during the period of October 2014 to September 2015. The reaches referred to in this report indicate areas of river between specified permanent gaging stations. This analysis is an attempt at understanding flow losses and gains in the Lower Owens River so that estimates of future water requirements can be made.

2.4.1 River Flow Loss or Gain by Month and Year

Flow losses or gains can vary over time as presented in the table below. ET rates fall sharply during late fall - winter and increase dramatically during the spring - summer plant growing seasons. Thus, the river can lose water to ET during certain periods of the year and maintain or gain water during other periods of the year. December through March are winter periods with low ET that result in gains from increased flows from water stored in the shallow aquifer where groundwater levels are higher than adjacent river levels. Other incoming winter water sources such as local sporadic runoff from storms also result in flow increases.

Hydrologic Table 3. Average Monthly River Flow Losses/Gains From the Intake to the Pumpback Station during the 2014-15 Water Year

	Month	Flow (cfs)	Acre-Feet-Per-Day
2014	OCT	-7	-13
	NOV	+0	+1
	DEC	+5	+10
2015	JAN	+5	+10
	FEB	+6	+13
	MAR	+6	+12
	APR	-3	-7
	MAY	-5	-10
	JUN	-27	-53
	JUL	-37	-73
	AUG	-35	-70
	SEP	-27	-53
	AVG MONTH	**-10 cfs**	**-19 AcFt**

For the entire river, the overall gain or loss is calculated by subtracting Pumpback Station outflow from inflows at the Intake and augmentation spillgates. Inflows from the Intake were 35,447 acre-feet, inflows from augmentation spillgates were 5,326 acre-feet, and outflows from the Pumpback Station were 33,667 acre-feet. This yields a loss of 7,107 acre-feet for the year, a daily average of approximately 9.8 cfs between the Intake and the Pumpback Station. Water loss during the 2014-15 water year (October 2014 to September 2015) represents about 17% of the total released flow from the Intake and augmentation spillgates into the river channel.

2.4.2 Flow Loss or Gain by River Reach during the Winter Period

From December 2014 to March 2015, an average flow of 42 cfs was released into the Lower Owens River from the Intake. An additional 3 cfs was provided from augmentation ditches, for a total accumulated release of 45 cfs. The average flow reaching the Pumpback Station was 51 cfs, an increase of 6 cfs during the period. During the winter, ET is low and any “make water” coming into the river is additive. Part of the “make water” was probably stored during earlier periods in subsurface aquifers and may also be a result of higher winter season precipitation.

The river reach from the Intake to the Mazourka Canyon Road gaging station lost 4 cfs, while the reach from Mazourka Canyon Road to the Reinhackle gaging station gained 3 cfs and Reinhackle to the Pumpback Station gained 7 cfs (see table below). A water “gaining” reach, during harsh winter conditions, can benefit an ecosystem in many ways. Incoming water, especially if it is subsurface, tends to increase winter river water temperatures, reduces icing effects, increases dissolved oxygen, when water surface ice is melted by increasing the re-aeration rate, and adds nutrients.

Hydrologic Table 4. Winter Flow Losses/Gains, December 2014 to March 2015

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	42	N/A	N/A
Mazourka	41	-4	-4
Reinhackle	44	+3	-2
Pumpback	51	+7	+6

Note: All numbers are rounded to the nearest whole value.

Calculations include augmentation and return flows in appropriate reaches, see Appendix 2 for all flows.

2.4.3 Flow Loss or Gain by River Reach during the Summer Period

During the summer period of June 2015 to September 2015, all river reaches lost water. An average flow of 59 cfs was released into the Lower Owens River from the Intake. An additional 14 cfs was provided from augmentation locations throughout the Lower Owens River. The effects of ET are evident from the high total flow loss (-31 cfs) between the Intake to the Pumpback Station. Summer flow losses were 37 cfs higher than conditions during the winter season. The largest flow losses occurred at the Reinhackle to Pumpback reach (-14 cfs) (see following table).

Hydrologic Table 5. Flow Loss or Gain

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	59	N/A	N/A
Mazourka	50	-12	-12
Reinhackle	54	-5	-17
Pumpback	42	-14	-31

Note: All numbers are rounded to the nearest whole value.

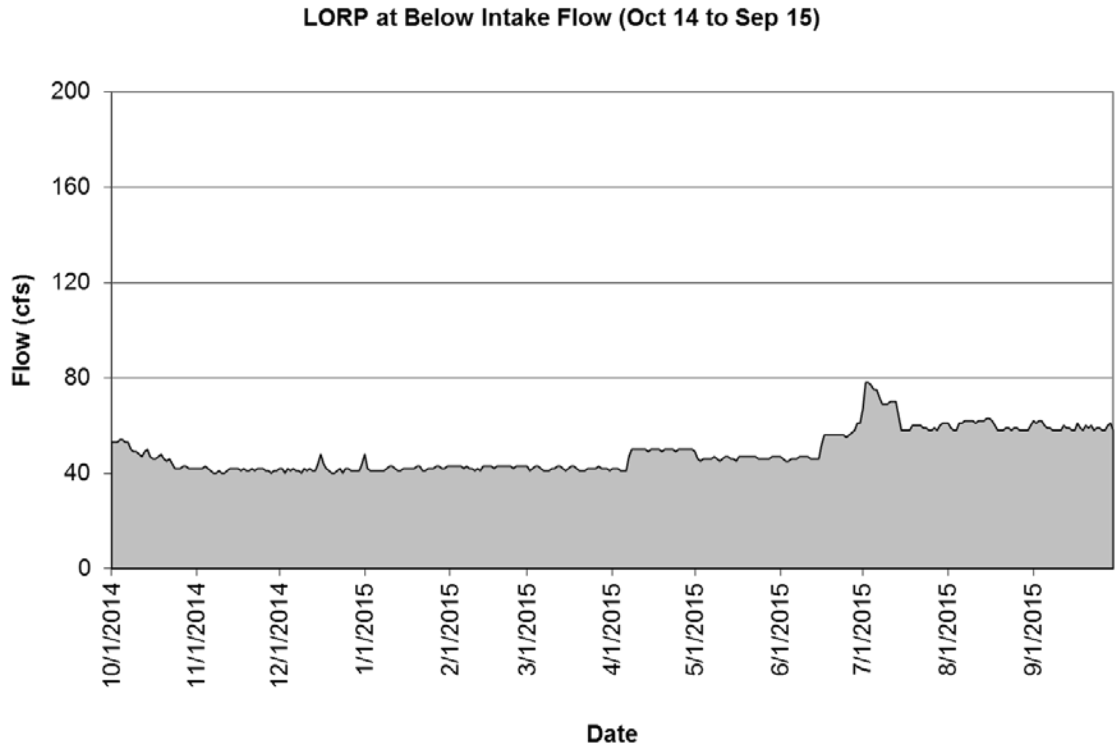
Calculations include augmentation and return flows in appropriate reaches, see Appendix 2 for all flows.

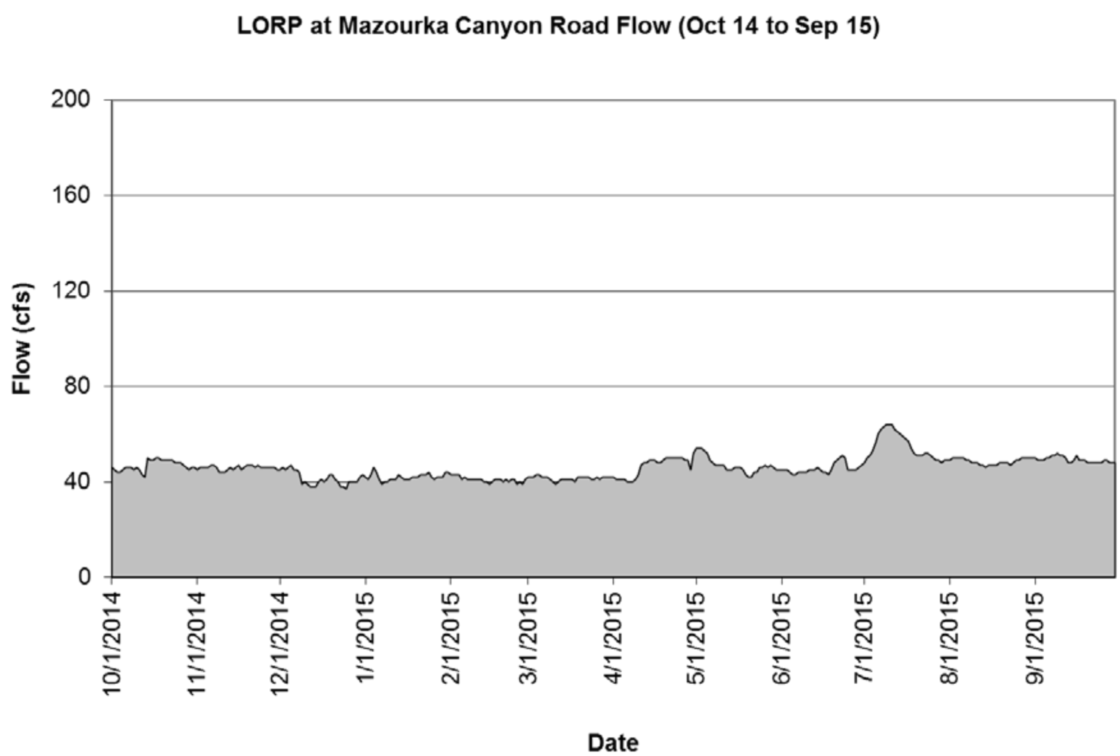
2.5 Seasonal Habitat Flow

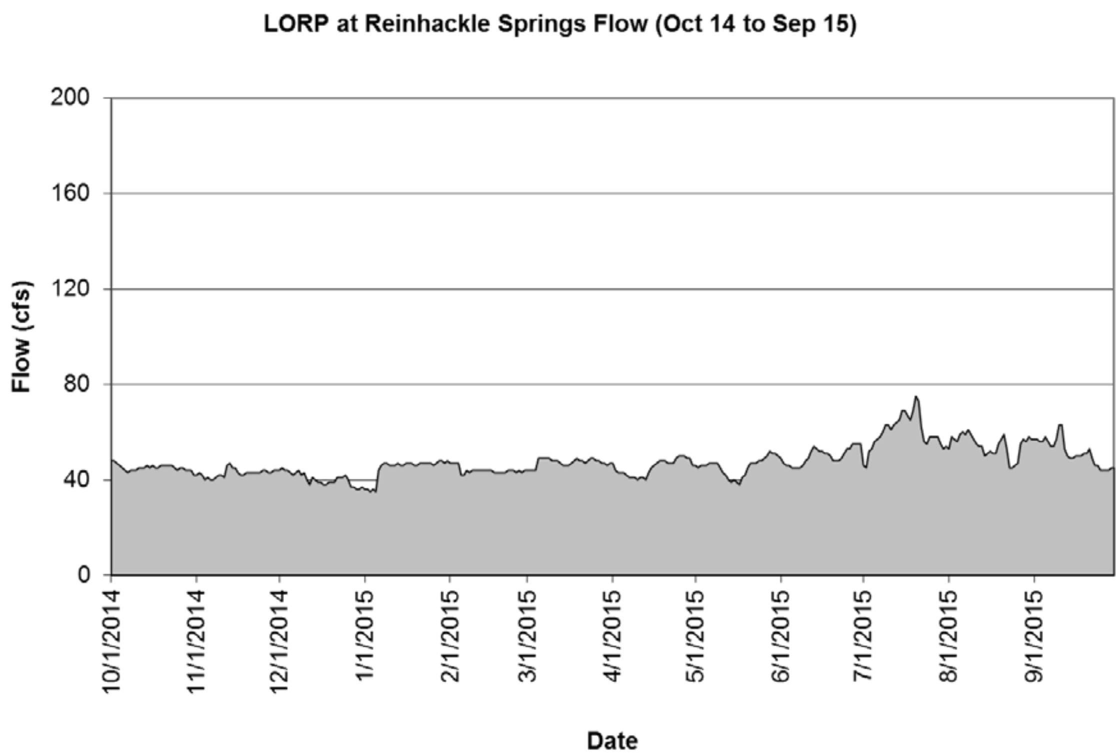
The runoff forecast for runoff year 2015-16 is 36%, so there was no seasonal habitat flow for the year.

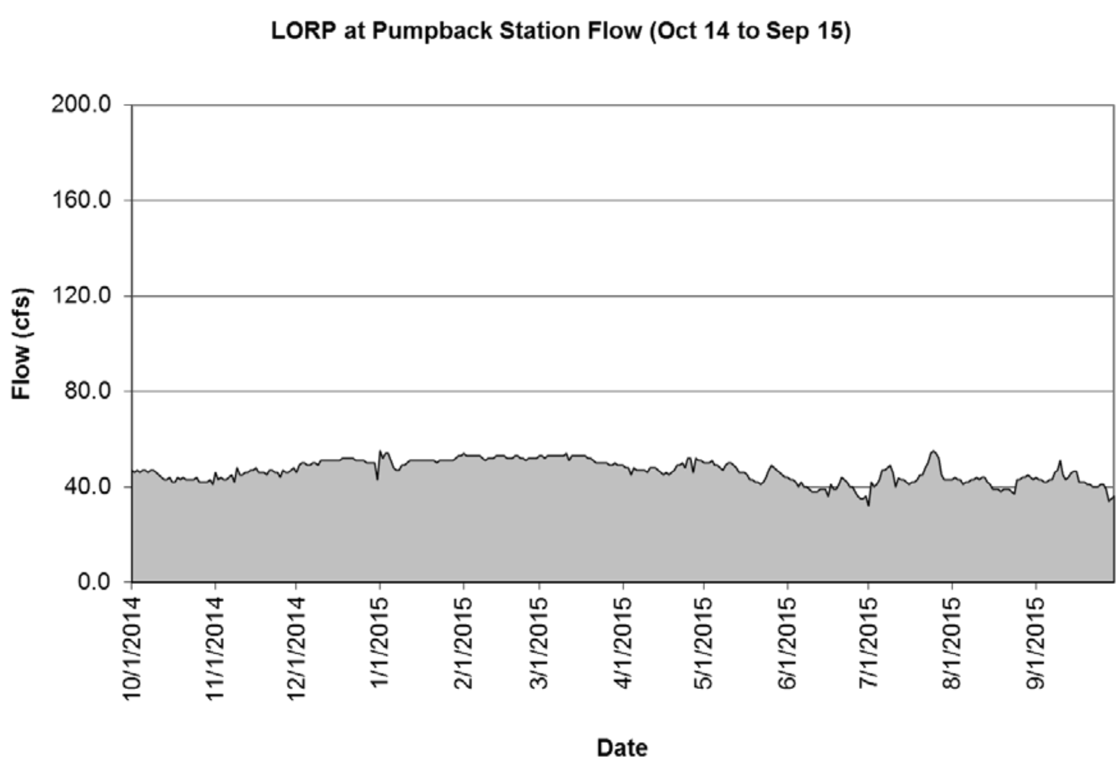
2.6 Appendices

Appendix 1. Hydrologic Monitoring Graphs






LORP at Reinhackle Springs Flow (Oct 14 to Sep 15)
Flow (cfs)
200
160
120
80
40
0
10/1/2014
11/1/2014
12/1/2014
1/1/2015
2/1/2015
3/1/2015
4/1/2015
5/1/2015
6/1/2015
7/1/2015
8/1/2015
9/1/2015
Date


LORP at Pumpback Station Flow (Oct 14 to Sep 15)
Flow (cfs)
200.0
160.0
120.0
80.0
40.0
0.0
10/1/2014
11/1/2014
12/1/2014
1/1/2015
2/1/2015
3/1/2015
4/1/2015
5/1/2015
6/1/2015
7/1/2015
8/1/2015
9/1/2015
Date

Appendix 2. River Flow Tables

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
10/1/2014	53.0	1.0	1.3	1.3	46.0	0.0	0.0	48.0	0.0	47.0	42.0	5.0	0.0	48.5
10/2/2014	53.0	2.0	1.2	1.4	45.0	0.0	0.0	48.0	0.0	46.0	42.0	4.0	0.0	48.0
10/3/2014	53.0	1.0	1.2	1.4	44.0	0.0	0.0	47.0	0.0	47.0	43.0	4.0	0.0	47.8
10/4/2014	54.0	1.0	1.2	1.4	44.0	0.0	0.0	46.0	0.0	46.0	42.0	4.0	0.0	47.5
10/5/2014	54.0	1.0	1.2	1.4	45.0	0.0	0.0	45.0	0.0	47.0	43.0	4.0	0.0	47.8
10/6/2014	53.0	1.0	1.2	1.4	46.0	0.0	0.0	44.0	0.0	47.0	43.0	4.0	0.0	47.5
10/7/2014	53.0	1.0	1.2	1.4	46.0	0.0	0.0	43.0	0.0	46.0	42.0	4.0	0.0	47.0
10/8/2014	50.0	1.0	1.2	1.3	46.0	0.0	0.0	44.0	0.0	47.0	43.0	4.0	0.0	46.8
10/9/2014	49.0	1.0	1.2	1.1	45.0	0.0	0.0	44.0	0.0	47.0	43.0	4.0	0.0	46.3
10/10/2014	49.0	1.0	1.2	1.1	46.0	0.0	0.0	44.0	0.0	46.0	42.0	4.0	0.0	46.3
10/11/2014	48.0	1.0	1.2	1.2	45.0	0.0	0.0	45.0	0.0	45.0	41.0	4.0	0.0	45.8
10/12/2014	47.0	1.0	1.2	1.2	43.0	0.0	0.0	45.0	0.0	44.0	40.0	4.0	0.0	44.8
10/13/2014	49.0	1.0	1.2	1.1	42.0	0.0	0.0	45.0	0.0	43.0	39.0	4.0	0.0	44.8
10/14/2014	50.0	1.0	1.2	1.1	50.0	0.0	0.0	46.0	0.0	43.0	39.0	4.0	0.0	47.3
10/15/2014	47.0	1.0	1.2	1.1	49.0	0.0	0.0	45.0	0.0	44.0	40.0	4.0	0.0	46.3
10/16/2014	46.0	1.0	1.1	1.1	49.0	0.0	0.0	46.0	0.0	42.0	38.0	4.0	0.0	45.8
10/17/2014	46.0	1.0	1.1	1.2	50.0	0.0	0.0	45.0	0.0	42.0	38.0	4.0	0.0	45.8
10/18/2014	47.0	1.0	1.0	1.2	50.0	0.0	0.0	45.0	0.0	44.0	40.0	4.0	0.0	46.5
10/19/2014	48.0	0.4	1.0	1.2	49.0	0.0	0.0	46.0	0.0	43.0	39.0	4.0	0.0	46.5
10/20/2014	46.0	1.0	1.0	1.1	49.0	0.0	0.0	46.0	0.0	44.0	40.0	4.0	0.0	46.3
10/21/2014	45.0	1.0	1.1	1.1	49.0	0.0	0.0	46.0	0.0	43.0	39.0	4.0	0.0	45.8
10/22/2014	46.0	1.0	1.1	1.1	49.0	0.0	0.0	46.0	0.0	43.0	39.0	4.0	0.0	46.0
10/23/2014	44.0	1.0	1.1	1.1	49.0	0.0	0.0	46.0	0.0	43.0	39.0	4.0	0.0	45.5
10/24/2014	42.0	1.0	1.2	1.0	48.0	0.0	0.0	45.0	0.0	43.0	39.0	4.0	0.0	44.5
10/25/2014	42.0	2.0	1.1	1.0	48.0	0.0	0.0	44.0	0.0	44.0	40.0	4.0	0.0	44.5
10/26/2014	42.0	1.0	1.1	1.0	48.0	0.0	0.0	45.0	0.0	42.0	38.0	4.0	0.0	44.3
10/27/2014	43.0	1.0	1.1	1.0	47.0	0.0	0.0	45.0	0.0	42.0	38.0	4.0	0.0	44.3
10/28/2014	43.0	2.0	1.0	1.0	46.0	0.0	0.0	44.0	0.0	42.0	38.0	4.0	0.0	43.8
10/29/2014	42.0	1.0	1.0	1.1	45.0	0.0	0.0	44.0	0.0	42.0	38.0	4.0	0.0	43.3
10/30/2014	42.0	1.0	1.0	1.2	46.0	0.0	0.0	44.0	0.0	43.0	39.0	4.0	0.0	43.8
10/31/2014	42.0	1.0	1.1	1.2	46.0	0.0	0.0	42.0	0.0	41.0	37.0	4.0	0.0	42.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
11/1/2014	42.0	2.0	1.1	1.2	45.0	0.0	0.0	42.0	0.0	46.0	42.0	4.0	0.0	43.8
11/2/2014	42.0	2.0	1.2	1.2	46.0	0.0	0.0	43.0	0.0	43.0	39.0	4.0	0.0	43.5
11/3/2014	42.0	2.0	1.2	1.2	46.0	0.0	0.0	42.0	0.0	44.0	40.0	4.0	0.0	43.5
11/4/2014	43.0	1.0	1.2	1.2	46.0	0.0	0.0	40.0	0.0	43.0	39.0	4.0	0.0	43.0
11/5/2014	42.0	2.0	1.2	1.2	46.0	0.0	0.0	41.0	0.0	43.0	39.0	4.0	0.0	43.0
11/6/2014	41.0	1.0	1.2	1.2	47.0	0.0	0.0	40.0	0.0	44.0	40.0	4.0	0.0	43.0
11/7/2014	40.0	1.0	1.2	1.2	47.0	0.0	0.0	40.0	0.0	45.0	41.0	4.0	0.0	43.0
11/8/2014	40.0	1.0	1.2	1.3	46.0	0.0	0.0	41.0	0.0	42.0	38.0	4.0	0.0	42.3
11/9/2014	41.0	1.0	1.2	1.3	44.0	0.0	0.0	42.0	0.0	48.0	44.0	4.0	0.0	43.8
11/10/2014	40.0	1.0	1.1	1.4	44.0	0.0	0.0	42.0	0.0	45.0	41.0	4.0	0.0	42.8
11/11/2014	40.0	1.0	1.2	1.4	44.0	0.0	0.1	41.0	0.0	45.0	41.0	4.0	0.0	42.5
11/12/2014	41.0	2.0	1.2	1.4	45.0	0.0	0.1	46.0	0.0	46.0	42.0	4.0	0.0	44.5
11/13/2014	42.0	2.0	1.2	1.4	46.0	0.0	0.0	47.0	0.0	46.0	42.0	4.0	0.0	45.3
11/14/2014	42.0	1.0	1.2	1.3	45.0	0.0	0.0	45.0	0.0	47.0	43.0	4.0	0.0	44.8
11/15/2014	42.0	1.0	1.2	1.3	46.0	0.0	0.1	45.0	0.0	47.0	43.0	4.0	0.0	45.0
11/16/2014	42.0	1.0	1.1	1.3	47.0	0.0	0.1	43.0	0.0	48.0	44.0	4.0	0.0	45.0
11/17/2014	41.0	0.5	1.1	1.3	45.0	0.0	0.1	42.0	0.0	46.0	42.0	4.0	0.0	43.5
11/18/2014	42.0	1.0	1.1	1.4	46.0	0.0	0.1	42.0	0.0	46.0	42.0	4.0	0.0	44.0
11/19/2014	41.0	1.0	1.1	1.4	47.0	0.0	0.1	43.0	0.0	46.0	42.0	4.0	0.0	44.3
11/20/2014	41.0	1.0	1.2	1.4	47.0	0.0	0.0	43.0	0.0	45.0	41.0	4.0	0.0	44.0
11/21/2014	42.0	1.0	1.2	1.4	47.0	0.0	0.0	43.0	0.0	47.0	43.0	4.0	0.0	44.8
11/22/2014	41.0	1.0	1.2	1.4	46.0	0.0	0.0	43.0	0.0	47.0	43.0	4.0	0.0	44.3
11/23/2014	42.0	1.0	1.2	1.4	47.0	0.0	0.0	43.0	0.0	46.0	42.0	4.0	0.0	44.5
11/24/2014	42.0	2.0	1.2	1.3	46.0	0.0	0.1	43.0	0.0	46.0	42.0	4.0	0.0	44.3
11/25/2014	42.0	1.0	1.2	1.3	46.0	0.0	0.1	44.0	0.0	44.0	40.0	4.0	0.0	44.0
11/26/2014	41.0	2.0	1.1	1.3	46.0	0.0	0.0	44.0	0.0	47.0	43.0	4.0	0.0	44.5
11/27/2014	41.0	1.0	1.2	1.3	46.0	0.0	0.0	43.0	0.0	46.0	42.0	4.0	0.0	44.0
11/28/2014	40.0	1.0	1.2	1.2	46.0	0.0	0.0	43.0	0.0	46.0	42.0	4.0	0.0	43.8
11/29/2014	41.0	1.0	1.3	1.2	46.0	0.0	0.0	44.0	0.0	47.0	43.0	4.0	0.0	44.5
11/30/2014	41.0	2.0	1.5	1.2	45.0	0.0	0.0	44.0	0.0	48.0	44.0	4.0	0.0	44.5
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
12/1/2014	42.0	1.0	1.6	1.2	45.0	0.0	0.0	44.0	0.0	46.0	43.0	3.0	0.0	44.3
12/2/2014	42.0	1.0	1.7	1.3	46.0	0.0	0.1	45.0	0.0	49.0	46.0	3.0	0.0	45.5
12/3/2014	40.0	1.0	1.8	1.2	45.0	0.0	0.0	44.0	0.0	50.0	47.0	3.0	0.0	44.8
12/4/2014	42.0	1.0	1.7	1.2	46.0	0.0	0.1	44.0	0.0	50.0	27.0	23.0	0.0	45.5
12/5/2014	41.0	1.0	1.7	1.2	47.0	0.0	0.1	43.0	0.0	49.0	19.0	30.0	0.0	45.0
12/6/2014	42.0	1.0	1.6	1.2	45.0	0.0	0.1	42.0	0.0	49.0	19.0	30.0	0.0	44.5
12/7/2014	41.0	2.0	1.6	1.2	45.0	0.0	0.1	43.0	0.0	50.0	20.0	30.0	0.0	44.8
12/8/2014	41.0	1.0	1.5	1.2	44.0	0.0	0.1	44.0	0.0	50.0	20.0	30.0	0.0	44.8
12/9/2014	40.0	1.0	1.5	1.1	39.0	0.0	0.1	42.0	0.0	49.0	38.0	11.0	0.0	42.5
12/10/2014	42.0	1.0	1.5	1.1	40.0	0.0	0.1	43.0	0.0	51.0	48.0	3.0	0.0	44.0
12/11/2014	41.0	1.0	1.5	1.1	39.0	0.0	0.1	40.0	0.0	51.0	48.0	3.0	0.0	42.8
12/12/2014	42.0	1.0	1.5	1.0	38.0	0.0	0.0	38.0	0.0	51.0	48.0	3.0	0.0	42.3
12/13/2014	41.0	1.0	1.5	1.0	38.0	0.0	0.1	41.0	0.0	51.0	48.0	3.0	0.0	42.8
12/14/2014	41.0	1.0	1.4	0.9	38.0	0.0	0.1	40.0	0.0	51.0	48.0	3.0	0.0	42.5
12/15/2014	44.0	1.0	1.4	1.1	40.0	0.0	0.1	39.0	0.0	51.0	48.0	3.0	0.0	43.5
12/16/2014	48.0	1.0	1.4	1.2	41.0	0.0	0.1	39.0	0.0	51.0	48.0	3.0	0.0	44.8
12/17/2014	44.0	1.0	1.4	1.2	40.0	0.0	0.1	38.0	0.0	51.0	48.0	3.0	0.0	43.3
12/18/2014	42.0	1.0	1.3	1.3	41.0	0.0	0.1	38.0	0.0	52.0	48.0	3.0	1.0	43.3
12/19/2014	41.0	1.0	1.3	1.3	43.0	0.0	0.1	39.0	0.0	52.0	48.0	3.0	1.0	43.8
12/20/2014	40.0	1.0	1.3	1.3	43.0	0.0	0.1	39.0	0.0	52.0	48.0	3.0	1.0	43.5
12/21/2014	40.0	1.0	1.2	1.3	41.0	0.0	0.1	39.0	0.0	52.0	48.0	3.0	1.0	43.0
12/22/2014	41.0	1.0	1.0	1.3	40.0	0.0	0.1	41.0	0.0	52.0	48.0	3.0	1.0	43.5
12/23/2014	42.0	1.0	0.9	1.3	38.0	0.0	0.1	41.0	0.0	51.0	48.0	3.0	0.0	43.0
12/24/2014	40.0	1.0	0.9	1.3	38.0	0.0	0.0	41.0	0.0	51.0	48.0	3.0	0.0	42.5
12/25/2014	42.0	1.0	1.0	1.2	37.0	0.0	0.0	42.0	0.0	51.0	48.0	3.0	0.0	43.0
12/26/2014	42.0	1.0	1.0	1.2	40.0	0.0	0.0	40.0	0.0	51.0	48.0	3.0	0.0	43.3
12/27/2014	41.0	1.0	1.0	1.2	40.0	0.0	0.0	37.0	0.0	50.0	47.0	3.0	0.0	42.0
12/28/2014	41.0	1.0	1.1	1.2	40.0	0.0	0.0	37.0	0.0	50.0	47.0	3.0	0.0	42.0
12/29/2014	41.0	1.0	1.1	1.2	40.0	0.0	0.1	36.0	0.0	50.0	47.0	3.0	0.0	41.8
12/30/2014	41.0	1.0	1.1	1.3	42.0	0.0	0.1	36.0	0.0	50.0	47.0	3.0	0.0	42.3
12/31/2014	44.0	1.0	1.1	1.3	43.0	0.0	0.1	37.0	0.0	43.0	13.0	3.0	27.0	41.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
1/1/2015	48.0	1.0	1.2	1.1	42.0	0.0	0.1	36.0	0.0	55.0	23.0	3.0	29.0	45.3
1/2/2015	42.0	0.1	1.2	1.0	41.0	0.0	0.1	36.0	0.0	52.0	48.0	3.0	1.0	42.8
1/3/2015	41.0	1.0	1.2	1.0	43.0	0.0	0.1	35.0	0.0	54.0	48.0	3.0	3.0	43.3
1/4/2015	41.0	1.0	1.2	0.9	46.0	0.0	0.1	36.0	0.0	54.0	47.0	3.0	4.0	44.3
1/5/2015	41.0	1.0	1.2	0.9	44.0	0.0	0.1	35.0	0.0	51.0	48.0	3.0	0.0	42.8
1/6/2015	41.0	1.0	1.1	0.9	41.0	0.0	0.1	44.0	0.0	48.0	45.0	3.0	0.0	43.5
1/7/2015	41.0	2.0	1.2	0.9	39.0	0.0	0.2	46.0	0.0	47.0	44.0	3.0	0.0	43.3
1/8/2015	41.0	2.0	1.2	0.9	40.0	0.0	0.2	47.0	0.0	47.0	44.0	3.0	0.0	43.8
1/9/2015	42.0	1.0	1.3	1.0	40.0	0.0	0.2	47.0	0.0	49.0	46.0	3.0	0.0	44.5
1/10/2015	43.0	1.0	1.3	1.1	41.0	0.0	0.2	46.0	0.0	49.0	46.0	3.0	0.0	44.8
1/11/2015	43.0	1.0	1.3	1.2	41.0	0.0	0.1	46.0	0.0	50.0	47.0	3.0	0.0	45.0
1/12/2015	42.0	2.0	1.3	1.2	41.0	0.0	0.1	46.0	0.0	51.0	48.0	3.0	0.0	45.0
1/13/2015	41.0	1.0	1.3	1.2	43.0	0.0	0.1	47.0	0.0	51.0	48.0	3.0	0.0	45.5
1/14/2015	41.0	1.0	1.4	1.2	42.0	0.0	0.1	46.0	0.0	51.0	48.0	3.0	0.0	45.0
1/15/2015	42.0	1.0	1.4	1.1	41.0	0.0	0.1	46.0	0.0	51.0	48.0	3.0	0.0	45.0
1/16/2015	42.0	1.0	1.2	1.1	41.0	0.0	0.1	47.0	0.0	51.0	48.0	3.0	0.0	45.3
1/17/2015	42.0	1.0	1.2	1.2	41.0	0.0	0.3	47.0	0.0	51.0	48.0	3.0	0.0	45.3
1/18/2015	42.0	2.0	1.2	1.1	42.0	0.0	0.3	47.0	0.0	51.0	48.0	3.0	0.0	45.5
1/19/2015	42.0	1.0	1.3	1.0	42.0	0.0	0.2	46.0	0.0	51.0	48.0	3.0	0.0	45.3
1/20/2015	43.0	2.0	1.3	1.0	42.0	0.0	0.3	46.0	0.0	51.0	48.0	3.0	0.0	45.5
1/21/2015	43.0	2.0	1.3	1.0	43.0	0.0	0.4	47.0	0.0	51.0	48.0	3.0	0.0	46.0
1/22/2015	41.0	1.0	1.3	1.1	43.0	0.0	0.4	47.0	0.0	50.0	47.0	3.0	0.0	45.3
1/23/2015	41.0	2.0	1.2	1.1	43.0	0.0	0.5	47.0	0.0	51.0	48.0	3.0	0.0	45.5
1/24/2015	42.0	1.0	1.2	1.1	44.0	0.0	0.1	47.0	0.0	51.0	48.0	3.0	0.0	46.0
1/25/2015	42.0	1.0	1.1	1.1	42.0	0.0	0.1	47.0	0.0	51.0	48.0	3.0	0.0	45.5
1/26/2015	42.0	1.0	1.1	1.1	41.0	0.0	0.1	46.0	0.0	51.0	48.0	3.0	0.0	45.0
1/27/2015	43.0	2.0	1.1	1.1	42.0	0.0	0.3	47.0	0.0	51.0	48.0	3.0	0.0	45.8
1/28/2015	43.0	1.0	1.2	1.1	42.0	0.0	0.7	48.0	0.0	51.0	48.0	3.0	0.0	46.0
1/29/2015	42.0	1.0	1.2	1.1	42.0	0.0	0.1	48.0	0.0	52.0	48.0	3.0	1.0	46.0
1/30/2015	42.0	1.0	1.2	1.1	44.0	0.0	0.1	47.0	0.0	53.0	48.0	3.0	2.0	46.5
1/31/2015	43.0	1.0	1.1	1.1	44.0	0.0	0.1	48.0	0.0	53.0	48.0	3.0	2.0	47.0

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
2/1/2015	43.0	1.0	1.1	1.1	43.0	0.0	0.1	47.0	0.0	54.0	48.0	3.0	3.0	46.8
2/2/2015	43.0	1.0	1.1	1.0	43.0	0.0	0.1	47.0	0.0	53.0	48.0	3.0	2.0	46.5
2/3/2015	43.0	1.0	1.1	1.0	43.0	0.0	0.1	47.0	0.0	53.0	48.0	3.0	2.0	46.5
2/4/2015	43.0	1.0	1.0	1.1	43.0	0.0	0.1	47.0	0.0	53.0	48.0	3.0	2.0	46.5
2/5/2015	43.0	1.0	1.0	1.1	41.0	0.0	0.1	42.0	0.0	53.0	48.0	3.0	2.0	44.8
2/6/2015	42.0	1.0	1.0	1.1	42.0	0.0	0.1	42.0	0.0	53.0	47.0	3.0	3.0	44.8
2/7/2015	43.0	1.0	1.1	1.1	41.0	0.0	0.1	44.0	0.0	53.0	48.0	3.0	2.0	45.3
2/8/2015	42.0	1.0	1.2	1.1	41.0	0.0	0.1	43.0	0.0	52.0	48.0	3.0	1.0	44.5
2/9/2015	42.0	1.0	1.2	1.1	41.0	0.0	0.2	44.0	0.0	51.0	39.0	3.0	9.0	44.5
2/10/2015	41.0	1.0	1.1	1.1	41.0	0.0	0.2	44.0	0.0	52.0	48.0	3.0	1.0	44.5
2/11/2015	42.0	1.0	1.1	1.1	41.0	0.0	0.3	44.0	0.0	52.0	48.0	3.0	1.0	44.8
2/12/2015	41.0	1.0	1.1	1.1	41.0	0.0	0.3	44.0	0.0	52.0	48.0	3.0	1.0	44.5
2/13/2015	43.0	1.0	1.0	1.1	40.0	0.0	0.2	44.0	0.0	53.0	48.0	3.0	2.0	45.0
2/14/2015	43.0	1.0	1.0	1.1	40.0	0.0	0.2	44.0	0.0	53.0	48.0	3.0	2.0	45.0
2/15/2015	43.0	1.0	1.0	1.1	39.0	0.0	0.2	44.0	0.0	53.0	48.0	3.0	2.0	44.8
2/16/2015	43.0	1.0	0.9	1.1	40.0	0.0	0.3	44.0	0.0	53.0	48.0	3.0	2.0	45.0
2/17/2015	42.0	1.0	0.9	1.1	41.0	0.0	0.3	43.0	0.0	52.0	48.0	3.0	1.0	44.5
2/18/2015	43.0	1.0	0.9	1.1	41.0	0.0	0.3	43.0	0.0	52.0	48.0	3.0	1.0	44.8
2/19/2015	43.0	1.0	0.9	1.1	41.0	0.0	0.3	43.0	0.0	52.0	47.0	3.0	2.0	44.8
2/20/2015	43.0	1.0	0.9	1.1	40.0	0.0	0.3	43.0	0.0	53.0	48.0	3.0	2.0	44.8
2/21/2015	43.0	1.0	1.0	1.1	41.0	0.0	0.1	43.0	0.0	53.0	48.0	3.0	2.0	45.0
2/22/2015	43.0	0.5	1.0	1.1	40.0	0.0	0.1	44.0	0.0	52.0	48.0	3.0	1.0	44.8
2/23/2015	43.0	1.0	1.0	1.1	41.0	0.0	0.1	44.0	0.0	52.0	48.0	3.0	1.0	45.0
2/24/2015	42.0	2.0	0.9	1.2	41.0	0.0	0.2	44.0	0.0	51.0	48.0	3.0	0.0	44.5
2/25/2015	43.0	1.0	0.9	1.2	39.0	0.0	0.1	43.0	0.0	52.0	48.0	3.0	1.0	44.3
2/26/2015	43.0	1.0	1.0	1.2	40.0	0.0	0.1	44.0	0.0	52.0	48.0	3.0	1.0	44.8
2/27/2015	43.0	1.0	1.1	1.2	39.0	0.0	0.1	43.0	0.0	52.0	48.0	3.0	1.0	44.3
2/28/2015	43.0	1.0	1.1	1.2	41.0	0.0	0.1	44.0	0.0	52.0	48.0	3.0	1.0	45.0

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3/1/2015	43.0	1.0	1.2	1.2	42.0	0.0	0.1	44.0	0.0	53.0	48.0	4.0	1.0	45.5
3/2/2015	41.0	2.0	1.3	1.1	42.0	0.0	0.1	44.0	0.0	53.0	48.0	4.0	1.0	45.0
3/3/2015	42.0	1.0	1.4	1.2	42.0	0.0	0.1	44.0	0.0	52.0	48.0	4.0	0.0	45.0
3/4/2015	43.0	1.0	1.3	1.2	43.0	0.0	0.2	44.0	0.0	53.0	48.0	4.0	1.0	45.8
3/5/2015	43.0	1.0	1.2	1.1	43.0	0.0	0.1	49.0	0.0	53.0	48.0	4.0	1.0	47.0
3/6/2015	42.0	1.0	1.2	1.1	42.0	0.0	0.1	49.0	0.0	53.0	48.0	4.0	1.0	46.5
3/7/2015	41.0	1.0	1.2	1.2	42.0	0.0	0.1	49.0	0.0	53.0	48.0	4.0	1.0	46.3
3/8/2015	41.0	1.0	1.1	1.2	42.0	0.0	0.1	49.0	0.0	53.0	48.0	4.0	1.0	46.3
3/9/2015	41.0	1.0	1.1	1.2	41.0	0.0	0.1	49.0	0.0	53.0	48.0	4.0	1.0	46.0
3/10/2015	42.0	1.0	1.1	1.2	40.0	0.0	0.2	48.0	0.0	53.0	48.0	4.0	1.0	45.8
3/11/2015	42.0	2.0	1.1	1.2	39.0	0.0	0.2	48.0	0.0	54.0	48.0	4.0	2.0	45.8
3/12/2015	43.0	1.0	1.1	1.1	40.0	0.0	0.1	48.0	0.0	51.0	48.0	2.0	1.0	45.5
3/13/2015	43.0	1.0	1.1	1.1	41.0	0.0	0.1	47.0	0.0	53.0	48.0	4.0	1.0	46.0
3/14/2015	42.0	1.0	1.1	1.2	41.0	0.0	0.1	46.0	0.0	53.0	48.0	4.0	1.0	45.5
3/15/2015	41.0	1.0	1.1	1.2	41.0	0.0	0.2	46.0	0.0	53.0	48.0	4.0	1.0	45.3
3/16/2015	42.0	1.0	1.0	1.2	41.0	0.0	0.1	46.0	0.0	53.0	48.0	4.0	1.0	45.5
3/17/2015	43.0	1.0	1.0	1.3	41.0	0.0	0.2	47.0	0.0	53.0	48.0	4.0	1.0	46.0
3/18/2015	43.0	1.0	1.1	1.3	40.0	0.0	0.2	48.0	0.0	53.0	48.0	4.0	1.0	46.0
3/19/2015	42.0	1.0	1.2	1.3	42.0	0.0	0.1	49.0	0.0	52.0	48.0	4.0	0.0	46.3
3/20/2015	41.0	1.0	1.2	1.4	42.0	0.0	0.1	48.0	0.0	52.0	48.0	4.0	0.0	45.8
3/21/2015	41.0	1.0	1.2	1.3	42.0	0.0	0.2	48.0	0.0	51.0	47.0	4.0	0.0	45.5
3/22/2015	41.0	1.0	1.1	1.3	42.0	0.0	0.3	47.0	0.0	50.0	46.0	4.0	0.0	45.0
3/23/2015	42.0	1.0	1.1	1.4	42.0	0.0	0.1	48.0	0.0	50.0	46.0	4.0	0.0	45.5
3/24/2015	42.0	1.0	1.1	1.4	41.0	0.0	0.1	49.0	0.0	50.0	46.0	4.0	0.0	45.5
3/25/2015	42.0	1.0	1.0	1.4	41.0	0.0	0.1	49.0	0.0	50.0	46.0	4.0	0.0	45.5
3/26/2015	42.0	1.0	1.0	1.5	42.0	0.0	0.1	48.0	0.0	50.0	46.0	4.0	0.0	45.5
3/27/2015	43.0	1.0	1.0	1.5	41.0	0.0	0.1	48.0	0.0	49.0	45.0	4.0	0.0	45.3
3/28/2015	42.0	1.0	1.0	1.5	42.0	0.0	0.1	47.0	0.0	49.0	45.0	4.0	0.0	45.0
3/29/2015	42.0	1.0	1.1	1.5	42.0	0.0	0.2	47.0	0.0	50.0	46.0	4.0	0.0	45.3
3/30/2015	42.0	1.0	1.0	1.5	42.0	0.0	0.1	46.0	0.0	49.0	45.0	4.0	0.0	44.8
3/31/2015	41.0	1.0	1.0	1.5	42.0	0.0	0.1	47.0	0.0	49.0	45.0	4.0	0.0	44.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
4/1/2015	42.0	1.0	1.0	1.5	42.0	0.0	0.1	47.0	0.0	49.0	45.0	4.0	0.0	45.0
4/2/2015	42.0	1.0	1.0	1.5	41.0	0.0	0.3	44.0	0.0	48.0	44.0	4.0	0.0	43.8
4/3/2015	42.0	0.5	1.0	1.5	41.0	0.0	0.2	43.0	0.0	48.0	44.0	4.0	0.0	43.5
4/4/2015	41.0	1.0	1.1	1.5	41.0	0.0	0.1	43.0	0.0	45.0	41.0	4.0	0.0	42.5
4/5/2015	41.0	1.0	1.1	1.5	41.0	0.0	0.1	43.0	0.0	48.0	44.0	4.0	0.0	43.3
4/6/2015	41.0	0.4	1.1	1.4	40.0	0.0	0.1	42.0	0.0	47.0	43.0	4.0	0.0	42.5
4/7/2015	47.0	1.0	1.1	1.3	40.0	0.0	0.1	41.0	0.0	47.0	43.0	4.0	0.0	43.8
4/8/2015	50.0	1.0	1.1	0.9	40.0	0.0	0.1	41.0	0.0	47.0	43.0	4.0	0.0	44.5
4/9/2015	50.0	1.0	1.1	0.8	41.0	0.0	0.0	41.0	0.0	47.0	43.0	4.0	0.0	44.8
4/10/2015	50.0	1.0	1.1	0.8	43.0	0.0	0.0	40.0	0.0	46.0	42.0	4.0	0.0	44.8
4/11/2015	50.0	1.0	1.2	0.8	47.0	0.0	0.0	41.0	0.0	48.0	44.0	4.0	0.0	46.5
4/12/2015	50.0	1.0	1.2	0.9	48.0	0.0	0.0	41.0	0.0	48.0	44.0	4.0	0.0	46.8
4/13/2015	50.0	1.0	1.2	0.9	48.0	0.0	0.0	40.0	0.0	48.0	44.0	4.0	0.0	46.5
4/14/2015	49.0	1.0	1.1	0.9	49.0	0.0	0.0	43.0	0.0	47.0	43.0	4.0	0.0	47.0
4/15/2015	50.0	1.0	1.1	0.9	49.0	0.0	0.0	45.0	0.0	46.0	42.0	4.0	0.0	47.5
4/16/2015	50.0	1.0	1.0	0.9	49.0	0.0	0.0	46.0	0.0	45.0	40.0	4.0	1.0	47.5
4/17/2015	50.0	1.0	1.0	0.8	48.0	0.0	0.0	47.0	0.0	46.0	42.0	4.0	0.0	47.8
4/18/2015	50.0	1.0	1.0	0.8	48.0	0.0	0.0	48.0	0.0	45.0	41.0	4.0	0.0	47.8
4/19/2015	49.0	1.0	1.1	0.8	49.0	0.0	0.0	48.0	0.0	46.0	42.0	4.0	0.0	48.0
4/20/2015	50.0	1.0	1.1	1.0	50.0	0.0	0.0	48.0	0.0	47.0	43.0	4.0	0.0	48.8
4/21/2015	50.0	1.0	1.1	1.1	50.0	0.0	0.0	47.0	0.0	49.0	45.0	4.0	0.0	49.0
4/22/2015	50.0	1.0	1.1	1.1	50.0	0.0	0.0	47.0	0.0	49.0	45.0	4.0	0.0	49.0
4/23/2015	50.0	1.0	1.1	1.2	50.0	0.0	0.0	47.0	0.0	50.0	46.0	4.0	0.0	49.3
4/24/2015	49.0	1.0	1.1	1.2	50.0	0.0	0.0	49.0	0.0	48.0	43.0	4.0	1.0	49.0
4/25/2015	50.0	1.0	1.1	1.2	50.0	0.0	0.1	50.0	0.0	52.0	48.0	4.0	0.0	50.5
4/26/2015	50.0	1.0	1.0	1.2	50.0	0.0	0.0	50.0	0.0	52.0	48.0	4.0	0.0	50.5
4/27/2015	50.0	1.0	1.0	1.2	49.0	0.0	0.0	50.0	0.0	46.0	38.0	4.0	4.0	48.8
4/28/2015	50.0	1.0	0.9	1.2	49.0	0.0	0.0	49.0	0.0	52.0	45.0	4.0	3.0	50.0
4/29/2015	50.0	1.0	1.0	1.1	45.0	0.0	0.1	49.0	0.0	51.0	47.0	4.0	0.0	48.8
4/30/2015	50.0	1.0	1.0	1.0	52.0	0.0	0.0	46.0	0.0	51.0	47.0	4.0	0.0	49.8
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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
5/1/2015	49.0	1.0	1.0	1.0	54.0	0.0	0.0	46.0	0.0	50.0	43.0	7.0	0.0	49.8
5/2/2015	46.0	1.0	1.0	1.0	54.0	0.0	0.0	45.0	0.0	50.0	42.0	8.0	0.0	48.8
5/3/2015	45.0	1.0	1.0	1.0	54.0	0.0	0.0	46.0	0.0	50.0	42.0	8.0	0.0	48.8
5/4/2015	46.0	1.0	1.0	1.0	53.0	0.0	0.0	46.0	0.0	51.0	43.0	8.0	0.0	49.0
5/5/2015	46.0	1.0	1.0	1.0	52.0	0.0	0.0	46.0	0.0	49.0	41.0	8.0	0.0	48.3
5/6/2015	46.0	1.0	1.1	0.9	49.0	0.0	0.0	47.0	0.0	49.0	41.0	8.0	0.0	47.8
5/7/2015	46.0	1.0	1.1	0.9	48.0	0.0	0.0	47.0	0.0	48.0	40.0	8.0	0.0	47.3
5/8/2015	47.0	1.0	1.0	0.9	47.0	0.0	0.0	47.0	0.0	47.0	39.0	8.0	0.0	47.0
5/9/2015	46.0	1.0	1.0	0.9	47.0	0.0	0.0	47.0	0.0	49.0	41.0	8.0	0.0	47.3
5/10/2015	45.0	1.0	1.0	0.9	47.0	0.0	0.0	45.0	0.0	50.0	42.0	8.0	0.0	46.8
5/11/2015	46.0	1.0	1.0	0.9	47.0	0.0	0.0	43.0	0.0	50.0	42.0	8.0	0.0	46.5
5/12/2015	47.0	1.0	1.0	0.9	45.0	0.0	0.1	42.0	0.0	49.0	41.0	8.0	0.0	45.8
5/13/2015	47.0	1.0	1.0	0.9	45.0	0.0	0.3	40.0	0.0	48.0	40.0	8.0	0.0	45.0
5/14/2015	46.0	1.0	1.0	0.9	45.0	0.0	0.3	39.0	0.0	46.0	38.0	8.0	0.0	44.0
5/15/2015	46.0	1.0	1.0	0.9	46.0	0.0	0.4	40.0	0.0	46.0	38.0	8.0	0.0	44.5
5/16/2015	45.0	1.0	1.0	0.9	46.0	0.0	0.3	39.0	0.0	46.0	38.0	8.0	0.0	44.0
5/17/2015	47.0	1.0	1.1	0.9	46.0	0.0	0.3	38.0	0.0	45.0	37.0	8.0	0.0	44.0
5/18/2015	47.0	1.0	1.1	0.9	45.0	0.0	0.4	41.0	0.0	43.0	35.0	8.0	0.0	44.0
5/19/2015	47.0	1.0	1.1	0.9	43.0	0.0	2.1	42.0	0.0	43.0	35.0	8.0	0.0	43.8
5/20/2015	47.0	1.0	1.1	0.9	42.0	0.0	4.8	45.0	0.0	42.0	35.0	7.0	0.0	44.0
5/21/2015	47.0	1.0	1.1	1.0	42.0	0.0	4.7	47.0	0.0	42.0	34.0	8.0	0.0	44.5
5/22/2015	47.0	1.0	1.1	1.0	44.0	0.0	4.7	47.0	0.0	41.0	33.0	8.0	0.0	44.8
5/23/2015	47.0	1.0	1.0	1.1	44.0	0.0	4.7	47.0	0.0	42.0	35.0	7.0	0.0	45.0
5/24/2015	46.0	2.0	1.3	1.0	46.0	0.0	4.8	48.0	0.0	44.0	36.0	8.0	0.0	46.0
5/25/2015	46.0	1.0	1.4	1.0	46.0	0.0	4.6	48.0	0.0	47.0	40.0	7.0	0.0	46.8
5/26/2015	46.0	1.0	1.3	1.0	47.0	0.0	4.9	49.0	0.0	49.0	41.0	8.0	0.0	47.8
5/27/2015	46.0	1.0	1.2	1.1	46.0	0.0	5.8	50.0	0.0	48.0	40.0	8.0	0.0	47.5
5/28/2015	46.0	1.0	1.1	1.0	47.0	0.0	5.8	52.0	0.0	47.0	39.0	8.0	0.0	48.0
5/29/2015	47.0	1.0	1.0	1.0	46.0	0.0	5.6	51.0	0.0	46.0	38.0	8.0	0.0	47.5
5/30/2015	47.0	1.0	0.9	1.1	45.0	0.0	5.4	51.0	0.0	45.0	37.0	8.0	0.0	47.0
5/31/2015	47.0	1.0	0.9	1.0	45.0	0.0	5.3	50.0	0.0	44.0	36.0	8.0	0.0	46.5
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6/1/2015	47.0	1.0	0.9	1.1	45.0	0.0	5.3	49.0	0.0	44.0	36.0	8.0	0.0	46.3
6/2/2015	46.0	1.0	0.8	1.1	45.0	0.0	5.6	47.0	0.0	43.0	35.0	8.0	0.0	45.3
6/3/2015	45.0	1.0	0.8	1.0	45.0	0.0	5.8	46.0	0.0	43.0	35.0	8.0	0.0	44.8
6/4/2015	45.0	1.0	0.9	0.9	44.0	0.0	5.1	46.0	0.0	42.0	34.0	8.0	0.0	44.3
6/5/2015	46.0	1.0	0.9	1.0	43.0	0.0	4.9	45.0	0.0	40.0	33.0	7.0	0.0	43.5
6/6/2015	46.0	1.0	0.9	1.0	43.0	0.0	4.7	45.0	0.0	42.0	34.0	8.0	0.0	44.0
6/7/2015	46.0	1.0	0.9	1.0	44.0	0.0	4.8	45.0	0.0	40.0	33.0	7.0	0.0	43.8
6/8/2015	47.0	1.0	0.9	0.9	44.0	0.0	5.3	45.0	0.0	40.0	32.0	8.0	0.0	44.0
6/9/2015	47.0	1.0	1.0	0.9	44.0	0.0	6.7	46.0	0.0	39.0	31.0	8.0	0.0	44.0
6/10/2015	47.0	0.0	1.0	0.8	44.0	0.0	8.6	48.0	0.0	38.0	30.0	8.0	0.0	44.3
6/11/2015	47.0	1.0	1.1	0.9	45.0	0.0	10.5	49.0	0.0	38.0	30.0	8.0	0.0	44.8
6/12/2015	46.0	1.0	1.1	0.9	45.0	0.0	11.7	52.0	0.0	38.0	31.0	7.0	0.0	45.3
6/13/2015	46.0	1.0	1.1	1.0	45.0	0.0	11.6	54.0	0.0	39.0	31.0	8.0	0.0	46.0
6/14/2015	46.0	1.0	1.0	1.1	46.0	0.0	11.6	53.0	0.0	39.0	31.0	8.0	0.0	46.0
6/15/2015	46.0	1.0	1.0	1.1	45.0	0.0	11.7	52.0	0.0	39.0	31.0	8.0	0.0	45.5
6/16/2015	52.0	1.0	0.9	1.1	44.0	0.0	11.9	52.0	7.7	36.0	28.0	8.0	0.0	46.0
6/17/2015	56.0	0.0	0.9	1.1	44.0	0.0	11.7	51.0	11.0	41.0	34.0	7.0	0.0	48.0
6/18/2015	56.0	1.0	0.9	1.1	43.0	0.0	11.0	51.0	9.9	39.0	31.0	8.0	0.0	47.3
6/19/2015	56.0	1.0	0.9	1.0	45.0	0.0	10.8	50.0	10.2	39.0	31.0	8.0	0.0	47.5
6/20/2015	56.0	1.0	0.9	0.9	48.0	0.0	10.8	48.0	8.5	41.0	33.0	8.0	0.0	48.3
6/21/2015	56.0	1.0	0.9	0.9	49.0	0.0	11.2	48.0	7.4	44.0	36.0	8.0	0.0	49.3
6/22/2015	56.0	1.0	0.9	0.8	50.0	0.0	11.0	48.0	3.3	43.0	35.0	8.0	0.0	49.3
6/23/2015	56.0	1.0	0.9	0.8	51.0	0.0	11.3	49.0	0.0	42.0	34.0	8.0	0.0	49.5
6/24/2015	56.0	1.0	0.9	0.8	50.0	0.0	11.2	51.0	0.0	40.0	35.0	5.0	0.0	49.3
6/25/2015	55.0	1.0	0.9	0.8	45.0	0.0	11.0	53.0	0.0	40.0	38.0	2.0	0.0	48.3
6/26/2015	56.0	1.0	0.9	0.7	45.0	0.0	11.0	53.0	0.0	38.0	36.0	2.0	0.0	48.0
6/27/2015	57.0	1.0	1.0	0.7	45.0	0.0	11.2	55.0	0.0	36.0	34.0	2.0	0.0	48.3
6/28/2015	58.0	1.0	1.0	0.8	45.0	0.0	11.0	55.0	0.0	35.0	33.0	2.0	0.0	48.3
6/29/2015	61.0	1.0	1.1	0.9	46.0	0.0	11.0	55.0	7.6	35.0	33.0	2.0	0.0	49.3
6/30/2015	61.0	3.0	1.1	1.0	47.0	0.0	6.2	55.0	17.2	36.0	34.0	2.0	0.0	49.8
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7/1/2015	67.0	1.0	1.1	1.0	48.0	0.0	3.7	46.0	23.9	32.0	28.0	4.0	0.0	48.3
7/2/2015	78.0	0.5	1.1	1.2	50.0	0.0	8.9	45.0	27.0	42.0	30.0	6.0	6.0	53.8
7/3/2015	78.0	0.5	1.2	1.3	51.0	0.0	8.9	52.0	21.7	40.0	30.0	10.0	0.0	55.3
7/4/2015	77.0	1.0	1.2	1.3	53.0	0.0	8.4	53.0	16.6	41.0	31.0	10.0	0.0	56.0
7/5/2015	75.0	1.0	1.2	1.3	56.0	0.0	8.7	56.0	18.4	43.0	33.0	10.0	0.0	57.5
7/6/2015	75.0	1.0	1.2	1.3	60.0	0.0	10.4	57.0	6.7	47.0	37.0	10.0	0.0	59.8
7/7/2015	72.0	1.0	1.2	1.4	62.0	0.0	10.3	58.0	0.0	47.0	42.0	5.0	0.0	59.8
7/8/2015	69.0	1.0	1.1	1.4	63.0	0.0	8.5	60.0	0.0	48.0	45.0	3.0	0.0	60.0
7/9/2015	69.0	1.0	1.0	1.4	64.0	0.0	4.2	63.0	0.0	49.0	46.0	3.0	0.0	61.3
7/10/2015	69.0	1.3	1.0	1.3	64.0	0.0	4.9	63.0	0.0	46.0	43.0	3.0	0.0	60.5
7/11/2015	70.0	1.3	1.2	1.3	64.0	0.0	5.3	61.0	0.0	40.0	37.0	3.0	0.0	58.8
7/12/2015	70.0	1.0	1.2	1.3	62.0	0.0	4.9	63.0	0.0	43.6	40.0	3.0	0.6	59.7
7/13/2015	70.0	1.0	1.2	1.3	61.0	0.0	6.8	64.0	0.0	43.0	40.0	3.0	0.0	59.5
7/14/2015	64.0	1.0	1.1	1.2	60.0	0.0	10.3	65.0	0.0	43.0	40.0	3.0	0.0	58.0
7/15/2015	58.0	1.0	1.0	1.1	59.0	1.3	9.8	69.0	0.0	42.0	39.0	3.0	0.0	57.0
7/16/2015	58.0	1.0	1.0	0.9	58.0	4.8	9.5	69.0	0.0	41.0	38.0	3.0	0.0	56.5
7/17/2015	58.0	1.0	1.0	0.8	57.0	7.4	8.8	67.0	0.0	42.0	39.0	3.0	0.0	56.0
7/18/2015	58.0	1.0	0.9	0.7	54.0	7.1	7.2	65.0	0.0	42.0	39.0	3.0	0.0	54.8
7/19/2015	60.0	1.0	0.9	0.6	52.0	7.3	6.9	69.0	0.0	43.0	40.0	3.0	0.0	56.0
7/20/2015	60.0	1.0	1.0	0.7	51.0	7.3	8.7	75.0	0.0	45.0	42.0	3.0	0.0	57.8
7/21/2015	60.0	1.0	1.1	0.9	51.0	7.2	5.5	73.0	0.0	45.0	41.0	3.0	1.0	57.3
7/22/2015	60.0	1.0	1.2	0.9	51.0	7.6	1.3	62.0	0.0	48.0	45.0	3.0	0.0	55.3
7/23/2015	59.0	1.0	1.2	1.0	52.0	8.2	0.1	56.0	0.0	50.0	45.0	4.0	1.0	54.3
7/24/2015	59.0	0.0	1.2	1.1	52.0	8.8	3.2	55.0	0.0	54.0	45.0	7.0	2.0	55.0
7/25/2015	58.0	1.0	1.2	1.1	51.0	9.0	4.7	58.0	0.0	55.0	45.0	8.0	2.0	55.5
7/26/2015	58.0	1.0	1.1	1.0	50.0	9.0	3.5	58.0	0.0	54.0	45.0	8.0	1.0	55.0
7/27/2015	59.0	1.0	1.1	0.9	49.0	9.0	3.5	58.0	0.0	52.0	44.0	8.0	0.0	54.5
7/28/2015	58.0	1.0	1.0	0.8	49.0	9.0	2.0	58.0	0.0	45.0	37.0	8.0	0.0	52.5
7/29/2015	60.0	1.0	1.0	0.8	48.0	9.2	0.2	55.0	0.0	43.0	35.0	8.0	0.0	51.5
7/30/2015	61.0	1.0	1.0	1.0	49.0	9.3	0.0	53.0	0.0	43.0	35.0	8.0	0.0	51.5
7/31/2015	61.0	1.0	1.0	1.0	49.0	9.4	0.0	54.0	0.0	43.0	35.0	8.0	0.0	51.8
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Flow Gaging Station Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
8/1/2015	61.0	1.0	1.1	1.0	49.0	9.5	3.4	53.0	0.0	43.0	35.0	8.0	0.0	51.5
8/2/2015	59.0	1.0	1.2	1.0	50.0	9.5	4.6	58.0	0.0	44.0	36.0	8.0	0.0	52.8
8/3/2015	58.0	1.0	1.2	1.0	50.0	9.6	2.4	57.0	0.0	43.0	35.0	8.0	0.0	52.0
8/4/2015	58.0	1.0	1.1	1.1	50.0	9.6	4.5	56.0	0.0	43.0	35.0	8.0	0.0	51.8
8/5/2015	61.0	1.0	1.1	1.0	50.0	9.6	5.8	59.0	0.0	41.0	33.0	8.0	0.0	52.8
8/6/2015	61.0	1.0	1.1	1.0	50.0	9.6	5.8	60.0	0.0	42.0	34.0	8.0	0.0	53.3
8/7/2015	62.0	1.0	1.1	1.1	49.0	9.6	6.5	59.0	0.0	42.0	34.0	8.0	0.0	53.0
8/8/2015	62.0	1.0	1.1	1.1	49.0	9.0	5.3	61.0	0.0	43.0	35.0	8.0	0.0	53.8
8/9/2015	62.0	1.0	1.1	1.1	48.0	7.4	3.7	59.0	0.0	43.0	35.0	8.0	0.0	53.0
8/10/2015	62.0	1.0	1.0	1.1	48.0	6.8	2.9	57.0	0.0	44.0	37.0	7.0	0.0	52.8
8/11/2015	61.0	0.2	0.9	1.0	48.0	6.9	3.2	55.0	0.0	43.0	35.0	8.0	0.0	51.8
8/12/2015	62.0	1.0	0.9	0.8	47.0	6.9	3.1	54.0	0.0	44.0	36.0	8.0	0.0	51.8
8/13/2015	62.0	1.0	0.8	0.8	47.0	7.0	2.3	54.0	0.0	44.0	36.0	8.0	0.0	51.8
8/14/2015	62.0	1.0	0.8	0.8	46.0	7.0	2.4	50.0	0.0	42.0	34.0	8.0	0.0	50.0
8/15/2015	63.0	1.0	0.8	0.8	47.0	6.7	3.6	51.0	0.0	41.0	33.0	8.0	0.0	50.5
8/16/2015	63.0	1.0	0.9	0.9	47.0	6.1	3.4	52.0	0.0	39.0	32.0	7.0	0.0	50.3
8/17/2015	62.0	1.0	0.9	0.9	47.0	6.2	2.3	51.0	0.0	39.0	33.0	6.0	0.0	49.8
8/18/2015	60.0	1.0	1.0	1.0	47.0	6.3	5.8	51.0	0.0	39.0	33.0	6.0	0.0	49.3
8/19/2015	58.0	1.0	1.0	1.0	48.0	6.2	7.8	55.0	0.0	38.0	31.0	7.0	0.0	49.8
8/20/2015	58.0	1.0	1.0	1.1	48.0	5.9	10.4	57.0	0.0	39.0	31.0	8.0	0.0	50.5
8/21/2015	58.0	1.0	0.9	1.2	48.0	6.0	9.7	59.0	0.0	39.0	31.0	8.0	0.0	51.0
8/22/2015	59.0	0.3	0.9	1.2	48.0	5.9	0.1	53.0	1.5	39.0	31.0	8.0	0.0	49.8
8/23/2015	59.0	1.0	1.0	1.2	47.0	5.9	0.0	45.0	10.3	38.0	31.0	7.0	0.0	47.3
8/24/2015	58.0	1.0	1.0	1.2	48.0	6.0	0.0	45.0	16.0	37.0	30.0	7.0	0.0	47.0
8/25/2015	59.0	1.0	1.1	1.2	49.0	6.1	0.0	46.0	12.2	43.0	35.0	8.0	0.0	49.3
8/26/2015	59.0	1.0	1.1	1.2	49.0	6.3	4.2	47.0	9.5	43.0	35.0	8.0	0.0	49.5
8/27/2015	58.0	1.0	1.1	1.2	50.0	6.2	10.0	55.0	3.8	44.0	36.0	8.0	0.0	51.8
8/28/2015	58.0	1.0	1.1	1.1	50.0	6.1	9.9	57.0	4.5	44.0	36.0	8.0	0.0	52.3
8/29/2015	58.0	1.0	1.1	1.1	50.0	6.1	9.5	56.0	2.5	45.0	37.0	8.0	0.0	52.3
8/30/2015	58.0	0.5	1.1	1.1	50.0	6.0	9.2	58.0	0.2	44.0	36.0	8.0	0.0	52.5
8/31/2015	60.0	1.0	1.1	1.1	50.0	6.0	9.1	57.0	0.0	43.0	35.0	8.0	0.0	52.5
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
9/1/2015	62.0	1.0	1.1	1.1	50.0	5.9	9.4	57.0	0.0	44.0	36.0	8.0	0.0	53.3
9/2/2015	61.0	1.0	1.0	1.1	49.0	5.8	9.9	57.0	0.0	43.0	35.0	8.0	0.0	52.5
9/3/2015	62.0	1.0	1.0	1.1	49.0	5.6	9.1	56.0	0.0	43.0	35.0	8.0	0.0	52.5
9/4/2015	62.0	1.0	1.0	1.0	49.0	5.7	9.1	56.0	0.0	42.0	34.0	8.0	0.0	52.3
9/5/2015	60.0	1.0	1.0	1.0	50.0	5.9	9.0	58.0	0.0	42.0	34.0	8.0	0.0	52.5
9/6/2015	59.0	1.0	1.0	1.0	50.0	5.9	7.2	56.0	0.0	43.0	35.0	8.0	0.0	52.0
9/7/2015	59.0	1.0	1.0	1.0	51.0	5.8	5.4	54.0	0.0	43.0	36.0	7.0	0.0	51.8
9/8/2015	58.0	1.0	1.0	1.1	51.0	2.7	6.1	54.0	0.0	46.0	23.0	23.0	0.0	52.3
9/9/2015	58.0	1.0	1.1	1.1	52.0	0.0	11.4	57.0	0.0	47.0	20.0	27.0	0.0	53.5
9/10/2015	58.0	1.0	1.1	1.2	51.0	0.0	14.6	63.0	0.0	51.0	33.0	18.0	0.0	55.8
9/11/2015	58.0	1.0	1.1	1.2	51.0	0.0	10.6	63.0	0.0	45.0	33.0	12.0	0.0	54.3
9/12/2015	60.0	1.0	1.1	1.2	50.0	0.0	1.8	53.0	0.0	43.0	36.0	7.0	0.0	51.5
9/13/2015	59.0	1.0	1.0	1.2	48.0	0.0	5.3	50.0	0.0	44.0	37.0	7.0	0.0	50.3
9/14/2015	59.0	1.0	1.0	1.2	48.0	0.0	3.2	49.0	0.0	45.7	38.0	7.7	0.0	50.4
9/15/2015	58.0	1.0	1.0	1.2	49.0	0.0	5.2	49.0	0.0	46.5	39.0	7.5	0.0	50.6
9/16/2015	58.0	1.0	1.0	1.2	51.0	0.0	4.9	50.0	0.0	46.5	39.0	7.5	0.0	51.4
9/17/2015	61.0	1.0	1.0	1.2	49.0	0.0	4.8	50.0	0.0	42.0	35.0	7.0	0.0	50.5
9/18/2015	59.0	1.0	0.9	1.2	49.0	0.0	5.2	50.0	0.0	42.0	34.0	8.0	0.0	50.0
9/19/2015	58.0	1.0	0.9	1.2	49.0	0.0	5.0	51.0	0.0	42.0	34.0	8.0	0.0	50.0
9/20/2015	60.0	1.0	0.9	1.2	48.0	0.0	5.2	51.0	0.0	41.0	33.0	8.0	0.0	50.0
9/21/2015	59.0	1.0	0.9	1.2	48.0	0.0	3.9	53.0	0.0	41.0	33.0	8.0	0.0	50.3
9/22/2015	60.0	1.0	0.9	1.2	48.0	0.0	0.0	49.0	0.0	40.0	33.0	7.0	0.0	49.3
9/23/2015	58.0	1.0	0.9	1.3	48.0	0.0	0.0	46.0	0.0	40.0	33.0	7.0	0.0	48.0
9/24/2015	59.0	1.0	0.9	1.3	48.0	0.0	0.0	46.0	0.0	40.0	33.0	7.0	0.0	48.3
9/25/2015	59.0	1.0	0.9	1.2	48.0	0.0	0.0	44.0	0.0	41.0	33.0	8.0	0.0	48.0
9/26/2015	58.0	1.0	0.9	1.2	49.0	0.0	0.0	44.0	0.0	41.0	33.0	8.0	0.0	48.0
9/27/2015	58.0	1.0	0.9	1.2	49.0	0.0	0.0	44.0	0.0	39.0	31.0	8.0	0.0	47.5
9/28/2015	60.0	1.0	1.0	1.2	48.0	0.0	0.0	44.0	0.0	34.0	25.0	9.0	0.0	46.5
9/29/2015	61.0	1.0	1.0	1.2	48.0	0.0	0.0	45.0	0.0	35.0	23.0	12.0	0.0	47.3
9/30/2015	58.0	2.0	1.0	1.2	48.0	0.0	0.0	45.0	0.0	36.0	23.0	12.0	1.0	46.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

3.0 AVIAN CENSUS AND INDICATOR SPECIES HABITAT MONITORING

3.1 Riverine-Riparian

3.1.1 Introduction

The Lower Owens River Project (LORP) is the largest river restoration of its kind ever undertaken in the United States. This dynamic adaptive management project, initiated in December 2006, encompasses re-watering a 62-mile-long stretch of river and adjacent floodplain left essentially dry after the river was diverted into the Los Angeles Aqueduct in 1913.

Avian surveys are being conducted in the Riverine-Riparian area of the LORP to evaluate the response of bird species to rewatering of the river and the vegetation change associated with the new fluvial hydrological regime. The LORP is intended to benefit wildlife through the creation, maintenance, or enhancement of habitat features necessary for survival and reproductive success within the project area. During the initial development of LORP documents, a list of habitat indicator species was developed for the LORP Riverine Riparian Management Area. The presence of these species was thought to indicate whether or not the desired range of habitat conditions were being achieved (Ecosystem Sciences, 2002 and 2008).

A single bird community index would be an attractive metric for riparian conservation and metrics for defining a ‘healthy’ riparian bird community for this purpose have been suggested (Wiens et al. 2008). However, Young et al. (2013) found that a community index that incorporated species weightings based on riparian specialization, underrepresented species and various other weightings didn’t improve indices over a simple measure of species richness of riparian obligates. Species richness, diversity and abundance are reported here for breeding landbirds, waterbirds and for the subset of indicator species.

The availability of habitats consistent with the needs of indicator species is being assessed through the use of the California Wildlife Habitat Relationship (CWHR) system (California Department of Fish and Game-CIWTG, 2014). The CWHR system provides suitability scores for the type of habitat use (i.e. reproduction, cover and feeding) based on a vegetation map that includes attributes of habitat type, size class, and cover class. CWHR, thus serves as a coarse evaluation of expected habitat use. We describe how the mapped vegetation communities of the LORP were translated to CWHR habitat classifications. Moreover we quantify and discuss apparent changes in habitat availability pre and post-LORP implementation.

Models of species diversity, richness and abundance were developed using vegetation composition and vegetation diversity as predictor variables. The density of species detections was plotted across years in geographic space to provide a graphical representation of the change in species occurrence across the LORP.

LADWP Watershed Resources Specialist Debbie House and Inyo County Water Department (ICWD) Vegetation Scientist Zach Nelson conducted bird surveys, data analysis, and reporting. LADWP Watershed Resources Specialist Chris Allen and ICWD Field Program Coordinator

Jerry Zatorski conducted bird surveys. Chris Allen completed the CWHR indicator species habitat analysis and reporting.

This report presents the results of the 2015 avian surveys and CWHR indicator species habitat analysis of the Riverine Riparian area. Results are compared to preproject (2002, 2003) and post-project monitoring data (2010).

3.1.2 Study Area Description and Field and Analysis Methods

Survey Area

The Owens Valley is characterized by flat terrain, and alkaline scrub and meadow communities. There is one main stream, the Owens River, and numerous tributaries draining the east slope of the Sierra Nevada. The Owens River is a meandering low-gradient river system in a geologically closed basin (Hollett et al 1991). The Lower Owens River is considered that portion of the Owens River downstream of the Los Angeles Aqueduct Intake. The Los Angeles Aqueduct, completed in 1913, diverted all water from the Lower Owens River, leaving the channel essentially dry. Downstream areas of the river channel remained wetted due to spring flow and limited releases; however, the upstream portion of the Lower Owens only received water in extremely wet years through intermittent aqueduct releases. The Riverine-Riparian portion of the LORP involves the reestablishment of perennial flow to the river and other land management actions to support the project objectives. The Riverine-Riparian habitat area of the LORP extends from the Los Angeles Aqueduct Intake south to the Pumpback Station just above the Delta Habitat Area.

Vegetation Communities

Vegetation communities in the LORP project area are mapped using remote imagery. The selection of the vegetation communities or habitat types are based on the *LORP Landscape Vegetation Mapping 2014 Conditions* (LADWP 2015), included as Section 5 of this LORP report. The following vegetation communities are recognized in LORP:

Water: River, stream, ponds, and oxbows that are permanently or semi-permanently flooded aquatic habitat and relatively unvegetated.

Streambar: Point bars, secondary channels, or large sediment deposits which are sparsely vegetated.

Marsh: This herbaceous vegetation type occurred on saturated floodplains and in isolated depressions on terraces. Dominant plants included cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acutus*). Three-square bulrush (*Schoenoplectus pungens*), salt marsh bulrush (*Schoenoplectus maritimus*), common reedgrass (*Phragmites australis*), Baltic rush (*Juncus balticus*), Parish spikerush (*Eleocharis parishii*) and yerba-mansa (*Anemopsis californica*) may also be present.

Widely scattered, decadent Goodding willow (*Salix gooddingii var. variabilis*) and red willow (*Salix laevigata*) were present in some parcels.

Reedgrass: This herbaceous vegetation type occurred on floodplain and low terrace with high water table. Reedgrass often forms a thick monotypic stand.

Wet Meadow: This herbaceous vegetation type occurred on floodplains and terraces with high water tables. Dominant plants included saltgrass (*Distichlis spicata*), creeping wildrye (*Leymus triticoides*), Baltic rush (*Juncus balticus*), beaked spikerush (*Juncus rostellata*), three-square bulrush, sunflower (*Helianthus* sp.), and clustered field sedge (*Carex praegracilis*).

Alkali Meadow: This herbaceous vegetation type occurred on the low terrace land type with low water table. Saltgrass was dominant; alkali sacaton (*Sporobolus airoides*) and Baltic rush may also be present. Total vegetation cover was typically greater than 50%.

Riparian Shrub (willow): This tall shrub vegetation type occurred primarily on floodplain and low terrace land types with high water table. Riparian shrub is commonly associated with tributary drainages. A dense thicket of coyote willow (*Salix exigua*) dominates the overstory and Wood's rose (*Rosa woodsii*) may be present.

Tamarisk: In 2000, this tall shrub vegetation type occurred primarily on floodplain with high to low water tables and on high terrace with very low water table. Tamarisk has been mostly cleared in the LORP riparian area with less than an acre mapped in 2014.

Riparian Forest (tree willow): This forested vegetation type occurs on all landtypes in all water regimes. The prominent overstory species is Goodding willow (*Salix gooddingii*) and red willow (*S. laevigata*). Russian olive (*Elaeagnus angustifolia*), tamarisk, and Fremont cottonwood (*Populus fremontii*) may be present in some parcels. The understory may be marsh, wet meadow, alkali meadow, or alkali scrub.

Alkali scrub/meadow: This low shrub vegetation type occurs primarily on low terraces with low water table. Alkali scrub/meadow and alkali meadow are overlapping habitats. The dominant shrubs are Nevada saltbush (*Atriplex lentiformis* ssp*. torreyi*) and rubber rabbitbrush (*Ericameria nauseosus*); greasewood (*Sarcobatus vermiculatus*) was present in some parcels. Total average shrub cover was variable, but typically greater than 25%. Saltgrass, alkali sacaton, Torrey seepweed (*Sueda moquinii*), and creeping wildrye were prominent herbaceous plants; average total herbaceous cover was 50%.

Alkali Scrub: Alkali scrub consists of thickets of Nevada saltbush (*Atriplex lentiformis* ssp. *torreyi*) and rubber rabbitbrush (*Ericameria nauseosus)* with sparse understory that has the potential to change to alkali scrub/meadow in response to channel aggradation.

Irrigated Meadow: This herbaceous vegetation type occurred on the high terrace land type along the western edge of the mapping area. Vegetation was sustained by irrigation and includes both introduced pasture grasses and native species.

Riparian Forest (cottonwood): This forested vegetation type occurred on saturated floodplains and terrace with low to high water tables. Fremont cottonwood is prominent in the overstory.

Bassia: Large stands of bassia best described as impenetrable and of extremely low diversity.

Upland scrub: Upland scrub consists of open scrub canopy of Nevada saltbush, rubber rabbitbrush, and greasewood with a relatively open understory including alkali sacaton and saltgrass. It occurs mostly along the flanks of the river corridor on high terraces with very low water table and is little influenced by river management.

River States

The vegetation communities of the Lower Owens River are directly influenced hydrology and channel morphology corresponding with states. The four distinct hydrogeomorphic states which have been described in the LORP Riverine-Riparian management area, as described in *Lower Owens River Riparian Inventory 2014 Conditions*:

1) **Incised, dry channel:** A deep, dry channel bordered by high terrace with upland vegetation. Alluvial water table is well below the rooting depth of vegetation. Hydric vegetation is mostly absent. This state made up 16.1 miles of the LORP in 2000. This state was present under pre-project conditions.

2) **Incised, wet, confined floodplain:** A deep, wetted channel bordered by high and low terraces. Hydric vegetation is confined to the incised channel. Alluvial water table is mostly below the rooting depth of vegetation of adjacent terraces with upland vegetation. Three reaches totaled 23.7 miles of the LORP in 2000.

3) **Graded, wet, unconfined floodplain:** A wetted channel bordered by floodplain and low terrace. Hydric vegetation fills the channel and overflows to the adjacent floodplain. Alluvial groundwater is mostly within the rooting depth of vegetation on adjacent floodplain with hydric vegetation. One reach comprised 12 miles of the LORP in 2000.

4) **Aggraded, wet, unconfined floodplain:** Saturated conditions extend across a broad floodplain and a channel may not be evident. Alluvial groundwater is at or near the surface. One reach (Island) comprised 4.0 miles of the LORP in 2000.

The vegetation community typically associated with incised dry channel is alkali scrub. Alkali scrub, bassia, and marsh are prominent in the incised, wet, confined state. The graded wet unconfined floodplain typically supports more diverse communities including alkali scrub, alkali scrub/meadow, alkali meadow, wet meadow, and marsh. Marsh, wet meadow, and alkali scrub/meadow are prominent for the aggraded wet, unconfined state.

River Reaches

Prior to reintroduction of perennial flow to the river, the entire LORP river corridor, from the Los Angeles Aqueduct Intake to the Pumpback Station, was partitioned into discrete reaches based on hydrogeomorphic state designation (WHA 2004a). River reaches were expected to respond differently to LORP flow and land management actions (WHA 2004a). The bird data has been summarized by reach to evaluate the relationship between vegetation and hydrogeomorphic changes occurring in a reach to changes in the breeding bird community.

Reach 1- extends from the Los Angeles Aqueduct Intake downstream 3.9 miles. Under preproject conditions, this reach was incised wet, confined floodplain.

Reach 2 - is a 15.7-mile reach extending from approximately two river miles upstream of the Blackrock Ditch, south to near Billy Lake Return Ditch. Prior to implementation of LORP, Reach 2 was an incised, dry channel. The upper 1.3 miles of floodplain in this reach supported patchy dry alkali meadow and reedgrass (*Phragmites australis*), the middle 5.3 miles supported scattered saltcedar or tamarisk (*Tamarix ramosissima*), and the lower 9.1 miles supported tamarisk and a few tree willows. Isolated Fremont cottonwoods (*Populus fremontii*) occur in this reach, and numerous Russian olive trees (*Elaeagnus angustifolia*) existed in the saturated channel upstream of Billy Lake return.

Reach 3 - is a 14.9-mile reach that extends from the area north of Billy Lake Return ditch south to the northern boundary of the Islands area near the Alabama Gates. Persistent low flows existed in this reach under preproject conditions and the area was densely vegetated. Preproject this reach was classified as incised, wet, confined floodplain.

Reach 4 - is a 4-mile reach that includes the area known as the Islands, and extends from approximately the Alabama Gates south to where two branches of the river channel reconverge. This reach lacks a continuous identifiable channel. The floodplain ranges from 700 to 1600 feet wide and is aggraded, wet and unconfined.

Reach 5 - is a 4.3-mile reach that extends from the southern edge of the Islands area south to abandoned railroad bridge crossing north of Lone Pine Narrow Gauge Road. The floodplain varies from 150 to 250 feet wide and was classified as incised, wet, confined preproject.

Reach 6 - is a 10.5-mile reach that extends from the abandoned railroad bridge to the LORP pumpback station downstream. Reach 6 was classified as graded, wet, unconfined floodplain prior to implementation of LORP. Floodplain width ranges from 150 to 700 feet.

Avian Surveys, Riverine-Riparian Area

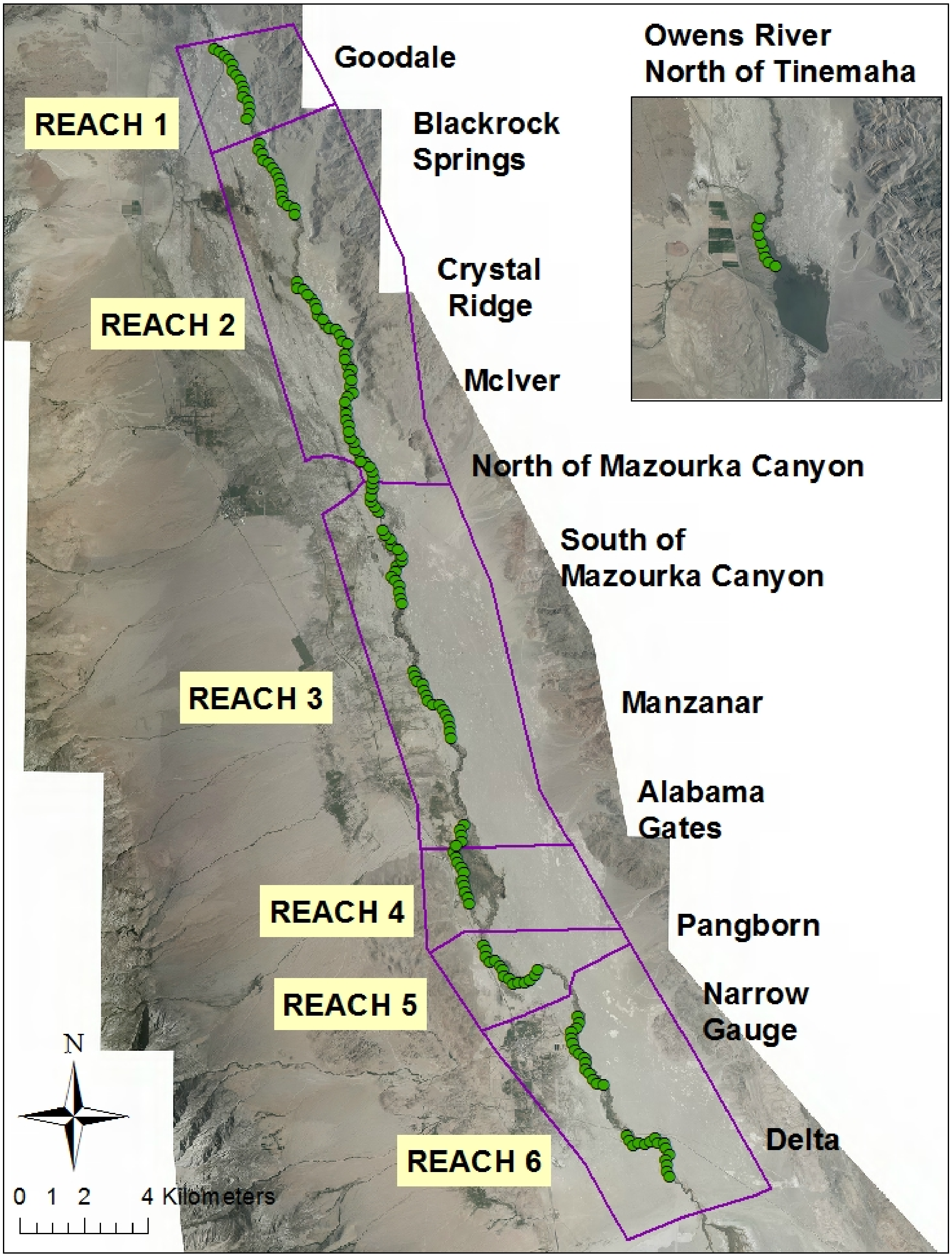
Avian use of the Riverine-Riparian area was assessed through point-count surveys conducted during the peak breeding period for songbirds. There are 11 survey routes in the Lower Owens River Project Area and one route outside the LORP boundary, above Tinemaha Reservoir (Avian Census Figure 1). The Owens River North of Tinemaha route was established as a reference area (Heath and Gates 2002). Starting points for each survey route were selected randomly during establishment of the project by Point Reyes Bird Observatory in 2002 (now Point Blue).

Each LORP survey route consists of 15 point-count stations for a total of 165 point count stations in LORP. The reference site, Owens River North of Tinemaha (ORTI), has eight stations. All point-count stations are located in the floodplain, generally close to the riverbank, approximately 250 meters apart. Due to varying reach lengths, the resulting number of points per reach varied (Avian Census Table 1).

Prior to 2015 surveys, scouting was conducted on some routes to evaluate the need to move points due to changes in accessibility. As was the case in 2010, some points in the Alabama Gates area had to be moved further west due to the expansion of marsh and the development of deep channels preventing access to previously established points. Survey points were relocated as close as possible to the previous survey points while maintaining the appropriate distance from each other (250 meters), and placed adjacent to comparable vegetation types. Avian Census Table 2 provides the coordinates and reach assignment for each survey station.

Avian Census Table 1. Total Point Count Stations Per LORP Reach

Reach or Area	**Number of Stations**
Reach 1	15
Reach 2	55
Reach 3	41
Reach 4	9
Reach 5	15
Reach 6	30
Total number of LORP Stations	165
Owens River North of Tinemaha	8



Avian Census Figure 1. LORP Reach Boundaries, Bird Survey Routes and Point Count Stations

Avian Census Table 2. 2015 Avian Point Count Stations GPS Locations and Reach Assignments, (NAD 83)

Route	Point	Reach	Easting	Northing		Point	Reach	Easting	Northing	Route	Point	Reach	Easting	Northing
Goodale	GOOD01	1	392400	4092549	North of Mazourka Canyon	ORMC15	2	397930	4076614	Pangborn	PANG01	5	403386	4055843
(GOOD)	GOOD02	1	392598	4092409	(ORMC)	ORMC14	2	398126	4076458	(PANG)	PANG02	5	403510	4055628
	GOOD03	1	392805	4092271		ORMC13	2	398151	4076133		PANG03	5	403496	4055378
	GOOD04	1	392997	4092110		ORMC12	2	398300	4075987		PANG04	5	403654	4055179
	GOOD05	1	393112	4091887		ORMC11	2	398397	4075677		PANG05	5	403903	4055191
	GOOD06	1	393120	4091636		ORMC10	2	398588	4075574		PANG06	5	404069	4055016
	GOOD07	1	393302	4091470		ORMC09	2	398747	4075441		PANG07	5	404220	4054826
	GOOD08	1	393446	4091272		ORMC08	2	398877	4075205		PANG08	5	404233	4054574
	GOOD09	1	393536	4091030		ORMC07	2	398898	4074990		PANG09	5	404452	4054458
	GOOD10	1	393599	4090789		ORMC06	3	398846	4074776		PANG10	5	404604	4054263
	GOOD11	1	393553	4090562		ORMC05	3	398873	4074536		PANG11	5	404850	4054305
	GOOD12	1	393761	4090408		ORMC04	3	398786	4074246		PANG12	5	405101	4054329
	GOOD13	1	393842	4090165		ORMC03	3	398783	4074006		PANG13	5	405332	4054413
	GOOD14	1	393818	4089907		ORMC02	3	398938	4073801		PANG14	5	405500	4054610
	GOOD15	1	393739	4089673		ORMC01	3	399099	4073582		PANG15	5	405606	4054837
Blackrock Springs	BLRS01	2	394237	4088677	South of Mazourka Canyon	SOMA01	3	399287	4072846	Narrow Gauge	NAGA01	6	407276	4052928
(BLRS)	BLRS02	2	394181	4088434	(SOMA)	SOMA02	3	399404	4072618	(NAGA)	NAGA02	6	407333	4052689
	BLRS03	2	394329	4088239		SOMA03	3	399596	4072454		NAGA03	6	407197	4052470
	BLRS04	2	394387	4087990		SOMA04	3	399631	4072212		NAGA04	6	407017	4052301
	BLRS05	2	394603	4087861		SOMA05	3	399893	4072027		NAGA05	6	407030	4052053
	BLRS06	2	394754	4087660		SOMA06	3	400054	4071780		NAGA06	6	407054	4051805
	BLRS07	2	394943	4087483		SOMA07	3	400067	4071554		NAGA07	6	407143	4051580
	BLRS08	2	395047	4087260		SOMA08	3	399842	4071365		NAGA08	6	407319	4051400
	BLRS09	2	395113	4087028		SOMA09	3	399788	4071130		NAGA09	6	407531	4051270
	BLRS10	2	395141	4086776		SOMA10	3	399623	4070931		NAGA10	6	407613	4051030
	BLRS11	2	395138	4086519		SOMA11	3	399803	4070759		NAGA11	6	407603	4050769
	BLRS12	2	395207	4086279		SOMA12	3	399960	4070564		NAGA12	6	407767	4050587
	BLRS13	2	395432	4086148		SOMA13	3	399981	4070312		NAGA13	6	407886	4050362
	BLRS14	2	395654	4086036		SOMA14	3	400035	4070062		NAGA14	6	408068	4050203
	BLRS15	2	395692	4085780		SOMA15	3	400046	4069815		NAGA15	6	408303	4050133
Crystal Ridge	CRRI01	2	395790	4083028	Manzanar	MANZ01	3	400532	4067102	Delta	DELT01	6	409273	4048086
(CRRI)	CRRI02	2	395807	4082773	(MANZ)	MANZ02	3	400597	4066860	(DELT)	DELT02	6	409382	4047856
	CRRI03	2	396047	4082691		MANZ03	3	400684	4066630		DELT03	6	409534	4047661
	CRRI04	2	396189	4082481		MANZ04	3	400917	4066536		DELT04	6	409763	4047745
	CRRI05	2	396387	4082327		MANZ05	3	400986	4066299		DELT05	6	410012	4047706
	CRRI06	2	396548	4082131		MANZ06	3	401097	4066083		DELT06	6	410251	4047781
	CRRI07	2	396559	4081879		MANZ07	3	401128	4065838		DELT07	6	410436	4047949
	CRRI08	2	396605	4081634		MANZ08	3	401333	4065703		DELT08	6	410573	4047740
	CRRI09	2	396815	4081473		MANZ09	3	401587	4065693		DELT09	6	410818	4047757
	CRRI10	2	396947	4081270		MANZ10	3	401759	4065506		DELT10	6	410895	4047519
	CRRI11	2	397130	4081100		MANZ11	3	401857	4065268		DELT11	6	411005	4047292
	CRRI12	2	397370	4081030		MANZ12	3	401989	4065057		DELT12	6	410878	4047076
	CRRI13	2	397538	4080831		MANZ13	3	402018	4064817		DELT13	6	410935	4046831
	CRRI14	2	397636	4080597		MANZ14	3	402011	4064572		DELT14	6	410906	4046585
	CRRI15	2	397824	4080445		MANZ15	3	402070	4064336		DELT15	6	411023	4046360
McIver	MCIV01	2	397758	4080041	Alabama Gates	ALGA01	3	402599	4060790	Owens River North of	ORTI01		390328	4104156
(MCIV)	MCIV02	2	397740	4079831	(ALGA)	ALGA02	3	402479	4060577	Tinemaha	ORTI02		390227	4104338
	MCIV03	2	397849	4079595		ALGA03	3	402522	4060334	(ORTI)	ORTI03		390157	4104582
	MCIV04	2	398004	4079419		ALGA04	3	402526	4060078		ORTI04		390101	4104867
	MCIV05	2	397882	4079200		ALGA05	3	402307	4059945		ORTI05		390191	4105106
	MCIV06	2	397982	4079002		ALGA06	4	402168	4059685		ORTI06		390338	4103898
	MCIV07	2	397944	4078711		ALGA07	4	402275	4059459		ORTI07		390491	4103716
	MCIV08	2	398034	4078483		ALGA08	4	402370	4059234		ORTI08		390693	4103616
	MCIV09	2	397857	4078302		ALGA09	4	402480	4059003					
	MCIV10	2	397728	4078108		ALGA10	4	402624	4058795					
	MCIV11	2	397814	4077847		ALGA11	4	402583	4058520					
	MCIV12	2	397788	4077602		ALGA12	4	402637	4058268					
	MCIV13	2	397807	4077359		ALGA13	4	402659	4058017					
	MCIV14	2	397879	4077112		ALGA14	4	402767	4057794					
	MCIV15	2	397925	4076858		ALGA15	4	402805	4057542					

Routes were surveyed three times between May 18 and June 30, 2015 at approximately two-week intervals. Surveys began within 30 minutes of local sunrise, and all points in a route were surveyed within 4-5 hours. In order to minimize the effect of time of day on detection rates, the order in which a route was conducted was alternated between visits. Five minute point counts were conducted after allowing approximately one minute following arrival at a point for both birds and observer to settle. Bird species were recorded using the variable circular plot method, employing the following distance bands: <50 m, 50-75 m, 75-100 m and >100 m. Habitat use was documented by recording the vegetation community the bird was observed in when detected. Habitat types used follow those being used for vegetation mapping of the LORP Riverine-Riparian management area as described above. Bird activity was recorded using one of the following categories: foraging, perching, calling, locomotion, flying over (not using habitat), flushed, unknown and reproductive. If reproductive activity was noted, the specific evidence of breeding was also noted in order to allow the determination of breeding status.

Determination of Breeding Status

The breeding status was determined for all species encountered following guidelines established by California Partners in Flight, and relied on the following criteria from the point count data as well as expert opinion (http://www.prbo.org/calpif/criteria.html):

Confirmed breeding: birds singing on territory all three surveys, nest material carry, nest found, fecal sac carry, distraction display, food carry, feeding fledglings, and independent juveniles with adults (family groups)

Probable breeding: Territorial behavior more than once at same location, singing noted on two or more visits, courtship behavior; agitated behavior or distraction display; visiting nest site (such as cavity); pair in suitable habitat

Possible breeding: Territorial behavior or singing noted only during one survey; also included species known to breed in Owens Valley and observed in appropriate habitat during the breeding season

No evidence of breeding: Includes seasonal migrants, species not known to breed in the Owens Valley, or species in the LORP project area for which no breeding activity has been observed

Riverine-Riparian Indicator Species

The 19 avian habitat indicator species for the LORP Riverine-Riparian area (Avian Census Table 3) are composed primarily of riparian obligate or wetland species. The presence of these species was thought to indicate whether or not the desired range of habitat conditions were being achieved (Ecosystem Sciences, 2002 and 2008). The list includes several special status species including five California State Species of Special Concern, and two Federally-listed and State-listed species. No focused surveys were conducted for indicator species.

Avian Census Table 3. Avian Habitat Indicator Species (19) for the LORP Riverine-Riparian Area

Common Name	Scientific Name	Status
Wood Duck	*Aix sponsa*	
Least Bittern	*Ixobrychus exilis*	California Species of Special Concern
Great Blue Heron	*Ardea herodias*	
Northern Harrier	*Circus cyaneus*	California Species of Special Concern
Red-shouldered Hawk	*Buteo lineatus*	
Swainson's Hawk	*Buteo swainsoni*	
Virginia Rail	*Rallus limicola*	
Sora	*Porzana carolina*	
Yellow-billed Cuckoo	*Coccyzus americanus*	Federal Threatened; State Endangered
Long-eared Owl	*Asio otus*	California Species of Special Concern
Belted Kingfisher	*Megaceryle alcyon*	
Nuttall's Woodpecker	*Picoides nuttallii*	
Willow Flycatcher	*Empidonax traillii*	Breeding subspecies *extimus* Federal Endangered; State Endangered
Warbling Vireo	*Vireo gilvus*	
Tree Swallow	*Tachycineta bicolor*	
Marsh Wren	*Cistothorus palustris*	
Yellow Warbler	*Dendroica petechia*	California Species of Special Concern
Yellow-breasted Chat	*Icteria virens*	California Species of Special Concern
Blue Grosbeak	*Passerina caerulea*	

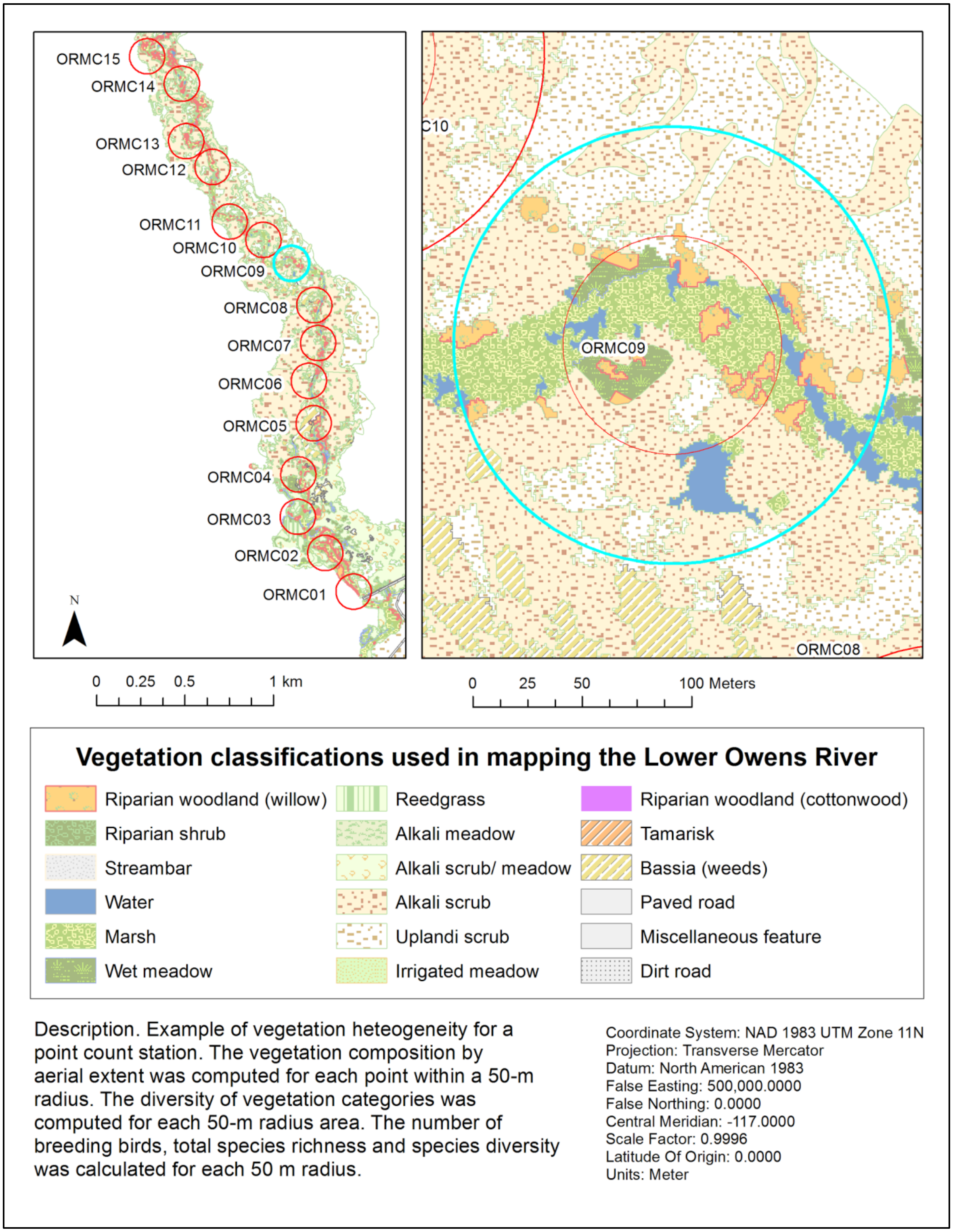
Data Analysis

Vegetation Composition Analysis

The vegetation map derived from a combination of aerial photography interpretation and field validation was used as a base layer for avian habitat analysis (see Avian Census Figure 2 for an example). The methodologies used to develop the landscape vegetation inventory for the LORP are described in *LORP Landscape Vegetation Mapping 2014 Conditions* (LADWP 2015). The aerial extent of vegetation community types was calculated within a 50-meter radius from each point-count station for each vegetation mapping effort: (1) preproject conditions using the 2000 vegetation classification map, (2) post-project conditions using the 2010 vegetation classification map (based on 2009 aerial images) and (3) post-project conditions using the 2015 vegetation classification map (based on aerial images acquired in 2014). The acreage of each habitat type was summed by reach, and the percent change between 2000, 2009, and 2014 was calculated. Some vegetation categories used for mapping were combined for the graphical presentation of change. For example, the acreages for the riparian woody riparian vegetation categories (cottonwood, tree willow and shrub) were combined with the acreage for riparian shrub into a single “total woody riparian” category. Habitat diversity was calculated using a transformation of the Shannon’s diversity index denoted N1 as described in Heath and Gates (2002).

$$N1 = e^{H'} \text{ and } H' = \sum (p_i)(ln\ p_i)(-1)$$

Where S= total number of vegetation communities and p_i is the proportion of the total acreage in 50-meter radius circle around each point count station.



Avian Census Figure 2. Example of Vegetation Heterogeneity Within a Single 100-m Radius From a Point Count Station

Vegetation composition and diversity was computed within each 50-m radius and related to bird diversity, richness and abundance.

Landbird and Waterbird Species Richness and Abundance

Bird use of the Riverine-Riparian area by all bird species was first examined and included all detections within 100-meter radius of each point count station, excluding flyovers. Species were first placed into the general categories of "landbird" or "waterbird". Landbirds included all species in the orders Galliformes, Falconiformes, Columbiformes, Cuculiformes, Strigiformes, Caprimulgiformes, Apodiformes, Coraciiformes, Piciformes, and Passeriformes. Waterbirds included all species in the orders Anseriformes, Gaviiiformes, Podicipediformes, Pelicaniformes, Ciconiiformes (exclusive of Cathartidae), Gruiformes, and Charadriiformes.

Point species richness was determined for landbirds in order to evaluate the relationship between landscape and vegetation features and all landbird species use including migrants. Use of LORP by waterbirds was evaluated by summing the number of waterbirds observed at each point count station over the three surveys.

Breeding Bird Richness, Diversity and Abundance

Breeding bird populations are being monitored as a direct indicator of the effect of ecohydrological changes across the LORP on birds within the riverine-riparian area (Heath and Gates 2002). Data summary and analysis followed that described in Heath and Gates (2002) and involved the calculation of indices that allow the evaluation of status and health of bird communities including breeding bird species richness, diversity and abundance. Species eliminated from the breeding bird analysis included non-breeding migrant or transient species, species whose territories are typically large and where independence of observations between points cannot be assured waterfowl [Anatidae], grebes [Podicipedidae], wading birds [Ardeidae], hawks [Accipitridae], shorebirds [Charadriidae and Scolopacidae], falcons [Falconidae], swallows [Hirundinidae], swifts [Apodidae] and Common Raven, and species that do not routinely vocalize including rails (Rallidae), owls (Strigidae and Tytonidae) and nightjars (Caprimulgidae). In addition, only individuals detected within 50 m from the observer were included in the analysis and flyovers were eliminated since these birds did not appear to be using the habitat. All data were subsetted based on these criteria.

Breeding bird species richness is the total number of breeding species detected at each survey point over the three surveys within a year. Breeding bird species diversity was calculated from the summed detections using a transformation of the Shannon's diversity index denoted N1 as described in Heath and Gates (2002).

$$N1 = e^{H'} \text{ and } H' = \sum (p_i)(ln\, p_i)(-1)$$

Where S= total species richness and p_i is the proportion of the total numbers of individuals of each species (Nur et al 1999). Species diversity indices take into account species richness (total number of species) and evenness (relative abundance). High index scores indicate both high species richness and a more equal distribution of individuals among species.

Whereas the Shannon diversity index ranges from 0 to 1, the transformation expresses diversity in terms of the number of species and is more easily interpreted (Heath and Gates 2002). Breeding bird abundance per point was calculated by averaging the total number of breeding birds at each survey point over the three surveys. Two-way Analysis of Variance (Sigma Stat 3.5) was used to determine if mean breeding bird richness, abundance or diversity varied between reaches or years.

Riverine-Riparian Indicator Species Analysis

The occurrence and breeding status of indicator species by reach was determined for 2015. Indicator species richness was calculated for each reach by year by summing the number of indicator species observed in a reach over the three surveys.

Modeling Species Diversity, Richness and Breeding Bird Abundance

Multiple linear regression was used to relate vegetation composition and diversity of vegetation categories within a 50-m radius to species diversity, species richness and the average annual abundance of breeding birds detected within a 50-m radius. Multiple linear regression was also used to relate vegetation composition within a 50-m radius to the distribution of Marsh Wren, a LORP habitat indicator species. In order to avoid multicollinearity, we evaluated the Pearson correlation coefficient for the twenty vegetation communities and habitat predictor variables and excluded redundant predictor variables. For example, “Total Riparian”, (a summation of riparian shrub, cottonwood, and tree acreage) was highly correlated with riparian shrub and riparian willow, thus “Total Riparian” was used as the predictor of choice due to the generally small acreages of all categories. A few variables were excluded because they did not occur within the 50-m radius sample area, or were a very small component of the landscape (e.g. Tamarisk, 0.1 acre total within plots). Nine vegetation variables were selected to model the variance in bird community indices (Avian Census Table 4). The predicted residual sum of squares (PRESS) was used to evaluate the predictive power of the regressions and aid in model selection. Standardized coefficients were examined to determine the relative influence of predictor variables on bird species richness, diversity and abundance. Parameter significance was declared at the $\alpha = 0.05$ level.

Avian Census Table 4. Vegetation Composition Variables Included in Regression Models Predicting Species Diversity, Richness and Total Breeding Bird Abundance

Habitat Variable	Units
Upland scrub habitat	Acres
Alkali scrub/meadow	Acres
Alkali meadow	Acres
Wet Meadow	Acres
Total Riparian	Acres
Marsh	Acres
Water	Acres
Streambar	Acres
Habitat Diversity	N1 (see calculation above)

CWHR Analysis of Potential Habitat – Riverine-Riparian Indicator Species

The California Wildlife Habitat Relationship System (CWHR) (Version 9.0) was used to evaluate the availability of habitats for LORP Habitat Indicator Species. CWHR is a software program that contains information on life history, habitats for terrestrial vertebrates, and contains habitat suitability values for wildlife species in California vegetation communities. The CWHR program has been integrated with BioView, an application that translates habitat suitability values for wildlife into data that can be used in a Geographic Information System. CWHR is operated and maintained by the California Department of Fish and Wildlife in cooperation with the California Interagency Wildlife Task Group (CIWTG).

CWHR Analysis Methodology

CWHR provides descriptions of vegetation communities found throughout California; these vegetation community classifications include crosswalks with other classification systems. As previously described, the Lower Owens River was mapped in 2015 to dominant vegetation communities diverging in species composition as a function of the fluvial geomorphology and flow regime. CWHR requires these classifications to be grouped into CWHR community types, and in addition, stand structure needs to be represented by two variables size and stage which, for example, can take the form of height and cover.

1. Vegetation community type: Vegetation community types used for the LORP mapping were cross-walked to CWHR habitats (Avian Census Table 5). The CWHR habitat type code was then added as an attribute to each vegetation polygon within ArcGIS.

2. Size (depending on the vegetation community being assessed); a size class was assigned to each polygon after viewing the high resolution 2014 images and reviewing habitat photos taken at each bird monitoring station in 2015. The following attributes are taken into account when assigning size class:
    a. plant height
    b. age
    c. vigor
    d. diameter at breast height
    e. canopy diameter - for riparian forest polygons, an ArcView script was developed that measured the diameter of the polygon and assigned the polygon to a size class. Polygons including more than one tree, with open canopies, or containing a significant portion of non-forest cover were evaluated to determine if the size classification was correct.

3 Stage - refers to canopy cover. Cover category classes were applied to polygons.

    A stage class was assigned to each polygon based on:

    - standard classification system for some communities
    - heads-up cover category assignment of all riparian forest polygons using high resolution 2014 images
    - reviewing habitat photos taken at point count stations

The 2014 aerial imagery of the LORP project area, and the 2015 vegetation mapping polygons were used to assign CWHR vegetation community type, size and stage. Size and stage classifications assigned to various LORP vegetation categories were based on the biological settings and conditions (Avian Census Table 6).

Application of CWHR to LORP Habitats

There are a number of difficulties that have been encountered in applying CWHR to habitats in the Owens Valley and LORP including Owens Valley vegetation classifications being not perfectly represented by the CWHR categories. CWHR has a limited number of habitat classifications that do not correspond perfectly to the mapping conducted on the LORP. In an effort to address these issues, a decision tree was developed in order to improve model performance. This decision tree was developed by LADWP biologists and based on expert opinion regarding the status and distribution of indicator species, and the vegetation communities present on the valley.

Avian Census Table 5. CWHR Habitat Size and Stage Classifications and Crosswalk to LORP Vegetation Types

CHWR_Habitats	**Habitat Description**	**LORP Mapped VEG_NAME**
AGS	Annual Grassland	Bassia (Weeds)
PGS	Perennial Grassland	Alkali Meadow/Alkali Scrub Meadow
WTM	Wet Meadow	Wet Meadow
FEW	Fresh Emergent Wetland	Marsh/Reedgrass
PAS	Pasture	Irrigated Meadow
SIZE_CLASSES		
Code	**Descriptor**	**Description**
1	Short herb	< 12" tall at maturity
2	Tall herb	> 12.1" tall at maturity
STAGES		
Code	**Descriptor**	**Average Cover**
S	Sparse	2 - 9.9%
P	Open	10 - 39.9%
M	Moderate	40 - 59.9
D	Dense	> 60%
Shrub Habitats		
CHWR_Habitats	**Habitat Description**	**LORP Mapped VEG_NAME**
ASC	Alkali Desert Scrub	Alkali Scrub/Upland Scrub
SIZE_CLASSES		
Code	**Descriptor**	**Description**
1	Seedling Shrubs	Seedlings
2	Young shrub	< 1% crown decadence
3	Mature shrub	1 - 24.9 % crown decadence
4	Decadent shrub	> 25 % crown decadence
STAGES		
Code	**Descriptor**	**Average Cover**
S	Sparse	10 - 24.9%
P	Open	25 - 39.9%
M	Moderate	40 - 59.9%
D	Dense	> 60%
Riparian Woody Vegetation		
CHWR_Habitats	**Habitat Description**	**LORP Mapped VEG_NAME**
DRI	Desert Riparian	Riparian Forest (tree willow)/Riparian Forest (cottonwood)/Riparian Shrub/Tamarisk
SIZE_CLASSES		
Code	**Descriptor**	**Crown Diameter/DBH**
1	Seeding tree	DBH < 1"
2	Sapling tree	< 15 feet; DBH 1 - 5.9"
3	Pole tree	15 - 29.9 feet; DBH 6 - 10.9"
4	Small tree	30 - 44.9 feet; DBH 11 - 23.9"
5	Med/large tree	> 45 feet; DBH > 24"
6	Multilayer tree	A distinct layer of size class 5 trees over a distinct layer of size 4 and/or 3 trees, and total tree canopy of layers >/=60%
NOTE:	*Riparian shrub habitats will either be size class 1 or 2 only*	
STAGES		
Code	**Descriptor**	**Average Cover**
S	Sparse	10 - 24.9%
P	Open	25 - 39.9%
M	Moderate	40 - 59.9%
D	Dense	> 60%

Avian Census Table 5 cont. CWHR Habitat Size and Stage Classifications and Crosswalk to LORP Vegetation Types

CHWR_Habitats	**Habitat Description**	**LORP Mapped VEG_NAME**
LAC	Lacustrine	Water
SIZE_CLASSES		
Code	**Descriptor**	**Description**
1	Limnetic	Deep water beyond light penetration (no stage code)
2	Submerged	Ponds that are shallow enough to allow light penetration
3	Periodically Flooded	Unvegetaed areas that are periodically flooded
4	Shore	Water's edge with less than 2% vegetation
STAGES		
Code	**Descriptor**	**Substrate**
O	Organic	Algae, duckweed or plant material present
M	Mud	Mud substrate
S	Sand	Sandy substrate
G	Gravel/cobble	Substrate of gravel or cobble
R	Rubble/boulders	Substrate of rubble or boulders
B	Bedrock	Shouldn't be on LORP!
River		
CHWR_Habitats	**Habitat Description**	**LORP Mapped VEG_NAME**
RIV	Riverine	Water/Streambar
SIZE_CLASSES		
Code	**Descriptor**	**Description**
1	Open Water	Water greater than 2 meters in depth
2	Submerged	Area of permanent water between "open water" and shore
3	Periodically Flooded	Unvegetated areas that are periodically flooded
4	Shore	Seldom-flooded areas with < 10% vegetative cover
STAGES		
Code	**Descriptor**	**Substrate**
O	Organic	Algae, duckweed or plant material present
M	Mud	Mud substrate
S	Sand	Sandy substrate
G	Gravel/cobble	Substrate of gravel or cobble
R	Rubble/boulders	Substrate of rubble or boulders
B	Bedrock	Shouldn't be on LORP!
CHWR_Habitats	**Habitat Description**	**LORP Mapped VEG_NAME**
BAR	Barren	Road/Miscellaneous Feature
SIZE_CLASSES		
Code	**No Size Class**	**Description: None**
STAGES		
Code	**No Stage**	**Substrate: None**

Prior to running the CWHR habitat suitability estimates for the mapped vegetation classifications, suitability values for each CWHR habitat category were reviewed for each indicator species, and we made the following adjustments when applying CWHR. Although CWHR indicates a high suitability value for Belted Kingfisher for BAR, this is only true for unvegetated banks that can be used for nesting. All polygons classified as Barren on LORP were bare upland sites. Thus, for Belted Kingfisher, all barren polygons were assigned a suitability value of “0”, indicating unsuitable. CWHR does not list Desert Riparian as a suitable habitat for Wood Duck, Red-shouldered Hawk, Swainson’s Hawk, or Nuttall’s Woodpecker. All four are Habitat Indicator Species in the riverine-riparian management area, and all breed in riparian habitats in the Owens Valley. Use of DRI code for woody riparian polygons would thus have resulted in the polygons being classified as “not suitable”. In order to better represent the availability of suitable habitat for these species, a surrogate vegetation community was selected. For Wood Duck, Red-shouldered Hawk and Nuttall’s Woodpecker, riparian polygons were coded using MRI for “Montane Riparian”. For Swainson’s Hawk, riparian polygons were coded as VFR or “Valley Foothill Riparian”, which is the only riparian community Swainson’s Hawk is associated with in CWHR. For Size and Stage Categories Definitions, Refer to Avian Census Table 5.

Avian Census Table 6. Size and Stage Classifications Assigned to Various LORP Vegetation Categories Based on the Biological Settings and Conditions

CHWR	LORP Veg name	Biological Setting	Size	Stage
AGS	Bassia	Composed largely of nonnative annual plant species	2	D
ASC	Alkali Scrub	Bordering perennial grasslands and wet meadows; average canopy cover >60%	3	D
ASC	Upland Scrub	Drier sites; more open canopy; average canopy cover <40%	3	P
BAR	Dirt Road		None	None
BAR	Paved Road		None	None
BAR	Miscellaneous Feature		None	None
DRI	Riparian Forest (tree willow)	Mature trees; many single tree polygons	2-6	S-D
DRI	Riparian Forest (cottonwood)	Mature trees; many single tree polygons	2-6	S-D
DRI	Riparian Shrub	Dominant riparian shrub is *Salix exigua*	1-2	D
DRI	Tamarisk	Only two polygons; treated like riparian shrub	2	D
FEW	Marsh	Marsh sites are tall dense cattail and hard-stem bulrush	2	D
FEW	Reedgrass	Reedgrass forms thick monotypic stands	2	D
LAC	Water	Off-river sites/oxbows; aerial images reviewed for presence of visible floating aquatic vegetation	2	O/M
PAS	Irrigated Meadow	Pastures on LORP are dense (>75% cover) and support species >12" tall	2	D
PGS	Alkali Meadow	Occur where water table is low; low growing saltgrass is dominant	1	M
PGS	Alkali Scrub Meadow	Evaluated as a grassland habitat; supports grassland associated wildlife species	1	M
RIV	Water	Active river channel with muddy bottom; limited aquatic vegetation	2	M
RIV	Streambar	Point bars along channel that are inundated under seasonal releases	3	M
WTM	Wet Meadow	Wet meadow sites on LORP are dense (>75% cover) and support species >12" tall	2	D

Habitat Suitability Determination

After assigning variables to all polygons within the riverine-riparian area, BioView was used to calculate the suitability value for each polygon, and each indicator species. The output of BioView includes a separate suitability value for foraging, cover, and nesting, and either the arithmetic or geometric mean. The arithmetic mean was used to determine habitat availability since it would demonstrate whether there was suitable habitat for either foraging, cover, or nesting. The suitability value ranges from 0 – 100. "0" is defined as not suitable. Low suitability was < or = to 33. Medium suitability is 34 to 66. High suitability values are 67-100.

Suitability values were appended to each polygon, and the riverine-riparian area clipped into the six LORP reaches. The acreages of low, medium, and high suitability habitat were calculated by CWHR habitat type and indicator species. The total acreage of all low, medium and high suitability habitats was calculated by species and reach.

Evaluation of Predictive Ability of CWHR

The ability of CWHR to predict species occurrences on LORP was evaluated by determining the correlation between the number of Marsh Wrens observed per point count station in 2015 and habitat suitability value. Marsh Wren was selected as an example as it is the most abundant indicator species on LORP. The habitat suitability value for each point count station was calculated within the 50-m diameter survey area based on the following equation:

Total suitability per point count station:

$$\frac{\sum(\text{HIS} * \text{hectare})}{\text{Total hectare within 50-m diameter area around station}}$$

Where HIS is the suitability value for the specific CWHR habitat and polygon being evaluated. The suitability*hectare values are summed for the entire polygon, then divided by the total number of hectares for the entire 50-m diameter area.

Evaluation of Changes to Indicator Species Habitat Availability

The availability of suitable habitat for LORP indicator species during baseline (2000) and 2009 conditions was also assessed in the riverine-riparian area. Charts were created showing the total acreage of low, medium and high suitability habitats by reach for 2000 and 2009.

3.1.3 Results and Discussion, Riverine-Riparian Area

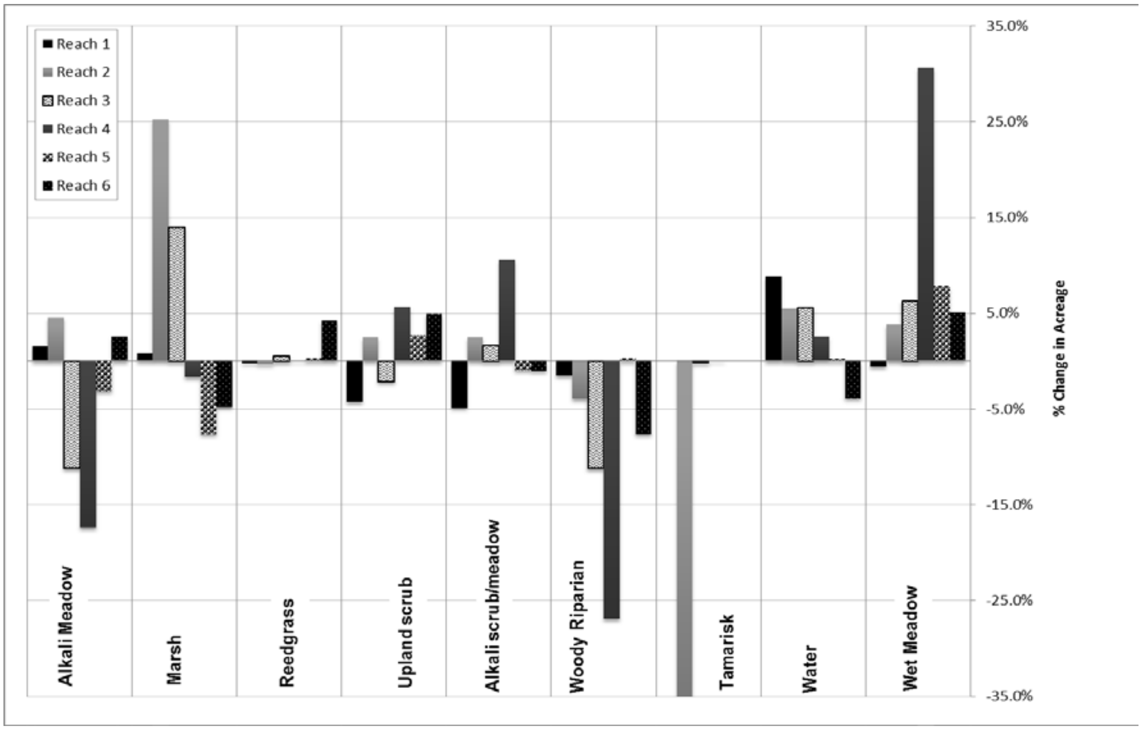
Vegetation Composition Analysis

The dominant vegetation communities within 50 meters of all point count stations combined are marsh, alkali scrub meadow, upland scrub habitat and wet meadow (Avian Census Table 7). Marsh averaged 16-37% of the acreage at the 50-meter scale, while wet meadow ranged from 4%-42%. Woody riparian vegetation which includes cottonwood, tree willow and shrub willow ranged from 1%-18% (average 6%) and was highest in Reach 5. Vegetation diversity is currently highest is Reach 5 and lowest in Reach 4.

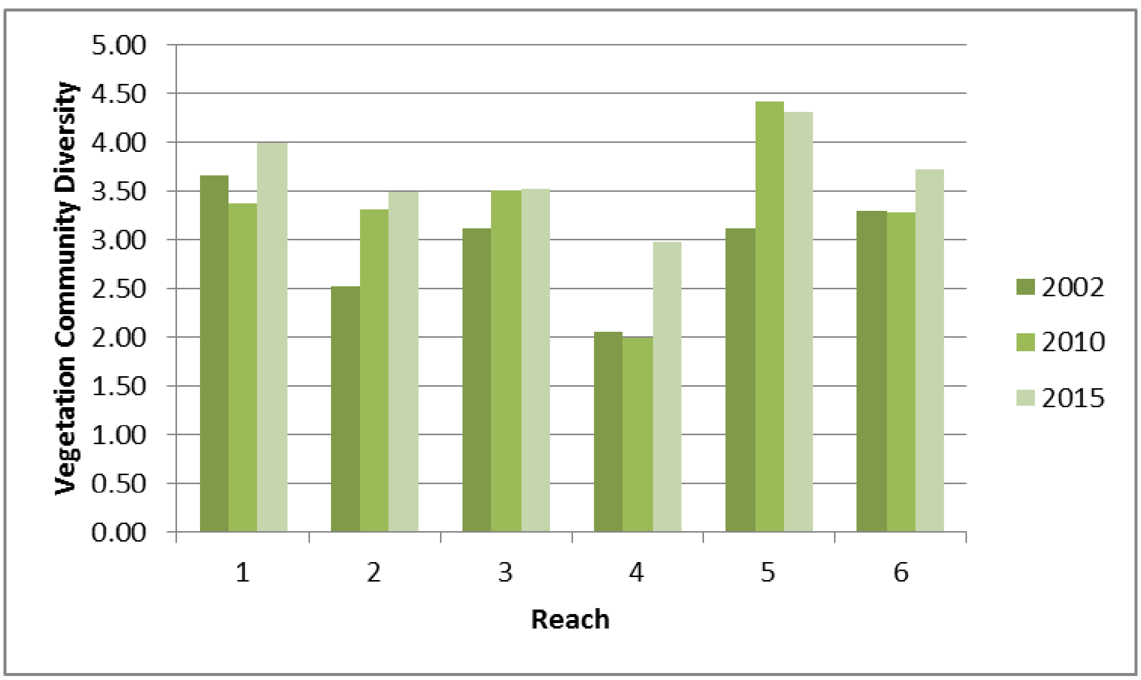
Wetland habitats have increased in the LORP since project implementation (Avian Census Table 7, Avian Census Figure 3). Wet meadow habitat has increased in all reaches except Reach 1, with the greatest increase in Reach 4. Open water has also increased since 2000 in all reaches, except Reach 6 where a slight decrease has been observed. At the 50-meter scale, the most significant within reach changes have been in Reaches 2, 3, and 4. In Reach 2 the most significant vegetation change potentially affecting the riparian breeding bird community has been the elimination of tamarisk, and the increase in the amount of marsh. Marsh as well as wet meadow habitats have also increased in Reach 3. The acreage mapped as marsh has decreased in Reaches 5 and 6. Reedgrass has increased in Reach 6 while open water has decreased. The amount of woody riparian acreage mapped has decreased in all reaches except Reach 5, however with the exception of Reach 6, much of this decrease is attributable to mapping differences between years. Vegetation diversity has increased over baseline in Reaches 2, 4 and 5.

Avian Census Table 7. Vegetation Proportions in 2000 and 2014 by Reach

Proportional Acreage	All Sites		Reach 1		Reach 2		Reach 3		Reach 4		Reach 5		Reach 6	
LORP Vegetation Community	2000	2014	2000	2014	2000	2014	2000	2014	2000	2014	2000	2014	2000	2014
Barren	5.4%				12.4%		5.5%							
Bassia		3.9%				10.2%		1.9%						
Alkali meadow	9.5%	7.4%	19.6%	21.2%	0.8%	5.4%	11.6%	0.4%	19.4%	1.1%	5.3%	2.2%	15.8%	18.5%
Marsh	15.7%	26.0%	20.4%	21.2%		25.6%	22.9%	36.8%	20.1%	17.7%	34.8%	27.2%	20.9%	16.2%
Reedgrass	0.7%	1.5%	3.6%	3.4%	0.8%	0.5%	0.1%	0.7%			0.9%	1.2%		4.3%
Upland scrub habitat	16.4%	18.1%	15.3%	11.0%	29.4%	32.3%	12.0%	9.8%		5.7%	1.7%	4.4%	12.5%	17.5%
Alkali scrub/meadow	20.1%	21.3%	33.1%	28.2%	9.9%	12.6%	25.0%	26.7%	3.2%	13.8%	30.7%	29.8%	26.0%	25.1%
Woody riparian	13.9%	6.4%	2.2%	0.7%	7.9%	4.0%	18.7%	7.5%	45.4%	16.5%	17.8%	18.1%	10.8%	3.2%
Tamarisk	12.7%				38.8%			0.1%						
Water	1.8%	5.4%		8.9%		5.6%	1.3%	7.0%		2.6%	4.6%	4.9%	6.0%	2.1%
Wet Meadow	3.8%	10.0%	5.8%	5.3%		3.9%	2.8%	9.1%	11.8%	42.5%	4.3%	12.2%	8.0%	13.2%



Avian Census Figure 3. Percent Change in Each Vegetation Class Between 2000 and 2014 by Reach



Avian Census Figure 4. Vegetation Community Diversity by Reach in 2002, 2010 and 2015

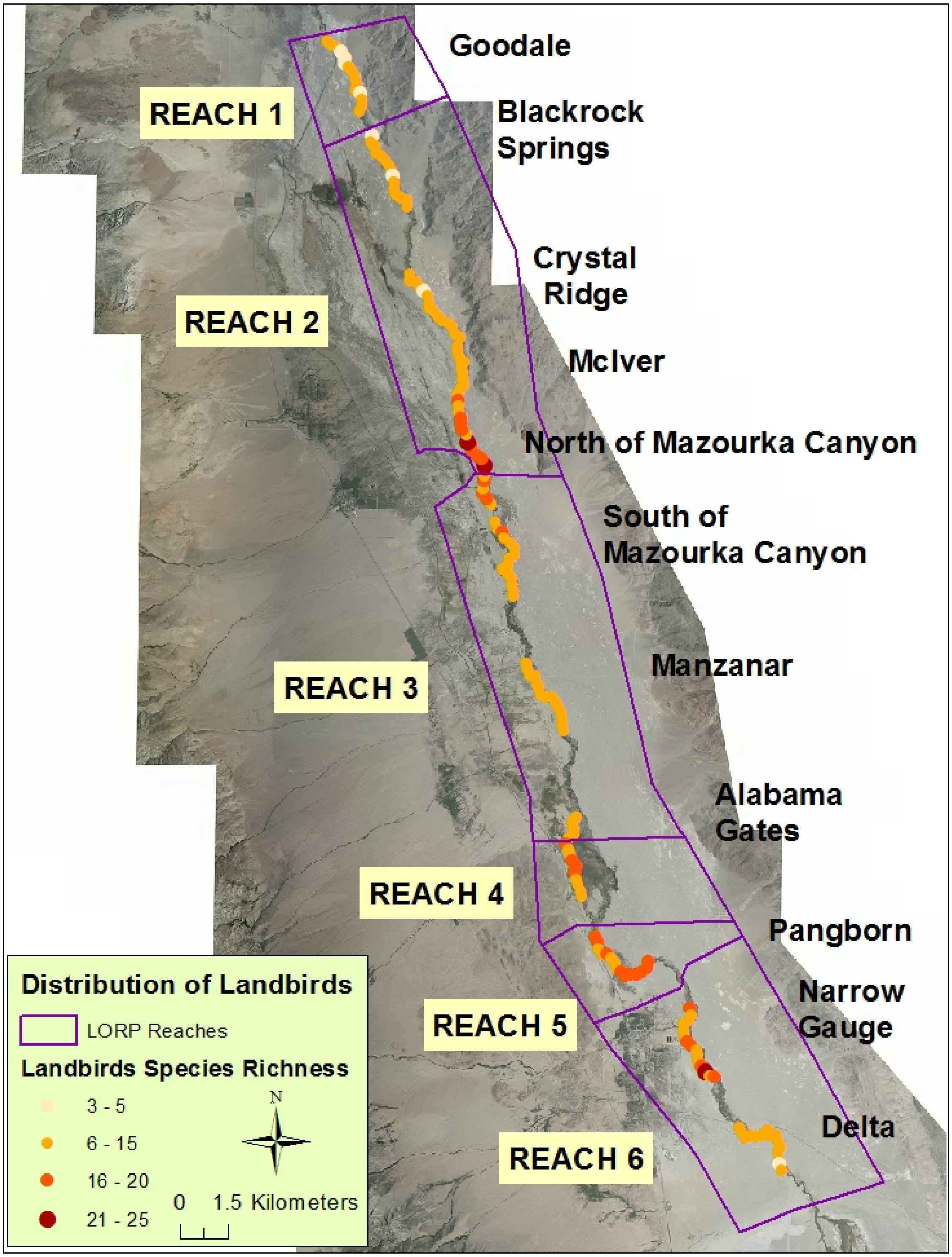
Landbird and Waterbird Species Richness and Abundance

We recorded 6,632 individuals of 93 species in the LORP Riverine-Riparian management area in 2015 including 6,473 landbirds of 77 species and 159 waterbirds of 16 species. In addition to songbird breeding populations (analyzed below in “Breeding Bird Analysis”), the LORP Riverine-Riparian area also supports breeding populations of waterbirds including waterfowl, bitterns, rails, and a few shorebird species. A total of 67 bird species were determined to breed in LORP in 2015 including 34 confirmed, 16 probable, and 17 possible (Avian Census Table 8). Thirty-three of the 93 species detected were migrant or transient species, or those not known to breed in the project area. Breeding status of California Partners in Flight riparian focal species will be updated in the statewide database to assist in documenting the most current breeding distribution of these species in California.

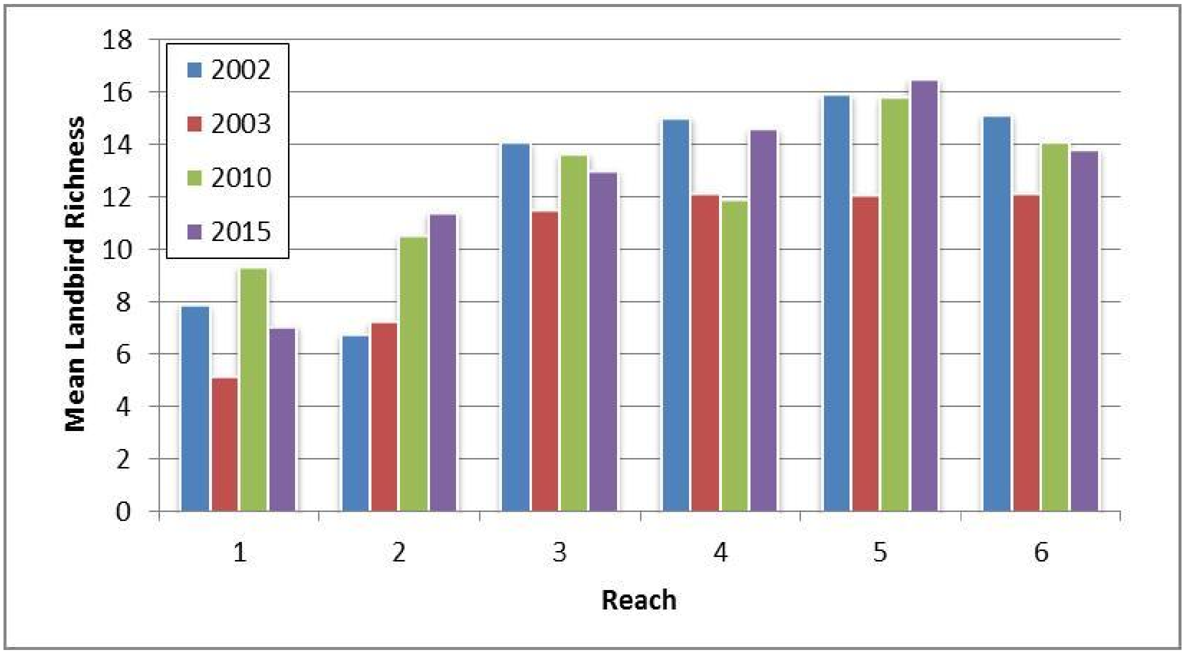
Total landbird species richness varied throughout LORP with the highest average richness seen on North of Mazourka Canyon, Pangborn, and Narrow Gauge routes (Avian Census Figure 5). The lowest average richness was on the Goodale, Blackrock Springs, and Crystal Ridge routes. Increases in landbird species richness have only been observed in Reach 2 since project implementation (Avian Census Figure 6).

Avian Census Table 8. Bird Species Observed in Riverine-Riparian Area in 2015 and Breeding Status

Common Name	Scientific Name	2015 Breeding Status		Common Name	Scientific Name	2015 Breeding Status
Wood Duck	*Aix sponsa*	**Probable**		Loggerhead Shrike	*Lanius ludovicianus*	**Confirmed**
Gadwall	*Anas strepera*	**Probable**		Cassin's Vireo	*Vireo cassinii*	No Evidence
Mallard	*Anas platyrhynchos*	**Probable**		Warbling Vireo	*Vireo gilvus*	No Evidence
Cinnamon Teal	*Anas cyanoptera*	**Probable**		Black-billed Magpie	*Pica hudsonia*	**Confirmed**
Green-winged Teal	*Anas crecca*	**Probable**		Common Raven	*Corvus corax*	**Confirmed**
California Quail	*Callipepla californica*	**Probable**		Tree Swallow	*Tachycineta bicolor*	No Evidence
Pied-billed Grebe	*Podilymbus podiceps*	**Possible**		Violet-green Swallow	*Tachycineta thalassina*	No Evidence
American Bittern	*Botaurus lentiginosus*	**Probable**		Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	**Probable**
Great Blue Heron	*Ardea herodias*	**Probable**		Cliff Swallow	*Petrochelidon pyrrhonota*	**Possible**
Great Egret	*Ardea alba*	No Evidence		Barn Swallow	*Hirundo rustica*	**Possible**
Black-crowned Night-Heron	*Nycticorax nycticorax*	No Evidence		Bushtit	*Psaltriparus minimus*	**Possible**
Turkey Vulture	*Cathartes aura*	No Evidence		House Wren	*Troglodytes aedon*	**Confirmed**
Northern Harrier	*Circus cyaneus*	**Possible**		Marsh Wren	*Cistothorus palustris*	**Confirmed**
Red-tailed Hawk	*Buteo jamaicensis*	**Confirmed**		Bewick's Wren	*Thryomanes bewickii*	**Confirmed**
Virginia Rail	*Rallus limicola*	**Probable**		American Robin	*Turdus migratorius*	**Possible**
Sora	*Porzana carolina*	**Possible**		Northern Mockingbird	*Mimus polyglottos*	**Confirmed**
American Coot	*Fulica americana*	**Possible**		Le Conte's Thrasher	*Toxostoma lecontei*	**Confirmed**
Killdeer	*Charadrius vociferus*	**Confirmed**		European Starling	*Sturnus vulgaris*	**Confirmed**
Spotted Sandpiper	*Actitis macularius*	No Evidence		Cedar Waxwing	*Bombycilla cedrorum*	No Evidence
Wilson's Snipe	*Gallinago delicata*	**Confirmed**		Orange-crowned Warbler	*Oreothlypis celata*	No Evidence
Rock Pigeon	*Columba livia*	No Evidence		Nashville Warbler	*Oreothlypis ruficapilla*	No Evidence
Eurasian Collared-Dove	*Streptopelia decaocto*	**Confirmed**		MacGillivray's Warbler	*Geothlypis tolmiei*	No Evidence
Mourning Dove	*Zenaida macroura*	**Confirmed**		Common Yellowthroat	*Geothlypis trichas*	**Confirmed**
Greater Roadrunner	*Geococcyx californianus*	**Possible**		American Redstart	*Setophaga ruticilla*	No Evidence
Western Screech-Owl	*Megascops kennicottii*	**Confirmed**		Yellow Warbler	*Setophaga petechia*	**Possible**
Great Horned Owl	*Bubo virginianus*	**Confirmed**		Yellow-rumped Warbler	*Setophaga coronata*	No Evidence
Lesser Nighthawk	*Chordeiles acutipennis*	**Probable**		Black-throated Gray Warbler	*Setophaga nigrescens*	No Evidence
Common Nighthawk	*Chordeiles minor*	**Probable**		Wilson's Warbler	*Cardellina pusilla*	No Evidence
White-throated Swift	*Aeronautes saxatalis*	No Evidence		Yellow-breasted Chat	*Icteria virens*	**Probable**
Black-chinned Hummingbird	*Archilochus alexandri*	**Probable**		Spotted Towhee	*Pipilo maculatus*	**Confirmed**
Nuttall's Woodpecker	*Picoides nuttallii*	**Confirmed**		Black-throated Sparrow	*Amphispiza bilineata*	**Probable**
Nuttall's/Ladderbacked hybrid	*Picoides sp*	**Possible**		Bell's Sparrow	*Artemisiospiza belli*	**Confirmed**
Downy Woodpecker	*Picoides pubescens*	**Confirmed**		Savannah Sparrow	*Passerculus sandwichensis*	**Probable**
Northern Flicker	*Colaptes auratus*	**Confirmed**		Song Sparrow	*Melospiza melodia*	**Confirmed**
American Kestrel	*Falco sparverius*	**Confirmed**		Western Tanager	*Piranga ludoviciana*	No Evidence
Olive-sided Flycatcher	*Contopus cooperi*	No Evidence		Black-headed Grosbeak	*Pheucticus melanocephalus*	No Evidence
Western Wood-Pewee	*Contopus sordidulus*	No Evidence		Blue Grosbeak	*Passerina caerulea*	**Confirmed**
Willow Flycatcher	*Empidonax traillii*	**Possible**		Lazuli Bunting	*Passerina amoena*	**Possible**
Hammond's Flycatcher	*Empidonax hammondii*	No Evidence		Red-winged Blackbird	*Agelaius phoeniceus*	**Confirmed**
Gray Flycatcher	*Empidonax wrightii*	No Evidence		Western Meadowlark	*Sturnella neglecta*	**Confirmed**
Dusky Flycatcher	*Empidonax oberholseri*	No Evidence		Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	**Confirmed**
Pacific-slope Flycatcher	*Empidonax difficilis*	No Evidence		Brewer's Blackbird	*Euphagus cyanocephalus*	**Confirmed**
Western Flycatcher	*Empidonax difficilis/occid.*	No Evidence		Great-tailed Grackle	*Quiscalus mexicanus*	**Possible**
Black Phoebe	*Sayornis nigricans*	**Possible**		Brown-headed Cowbird	*Molothrus ater*	Confirmed
Say's Phoebe	*Sayornis saya*	**Confirmed**		Bullock's Oriole	*Icterus bullockii*	Confirmed
Ash-throated Flycatcher	*Myiarchus cinerascens*	**Confirmed**		House Finch	*Haemorhous mexicanus*	**Possible**
Western Kingbird	*Tyrannus verticalis*	**Confirmed**		Pine Siskin	*Spinus pinus*	No Evidence
				Lesser Goldfinch	*Spinus psaltria*	**Possible**



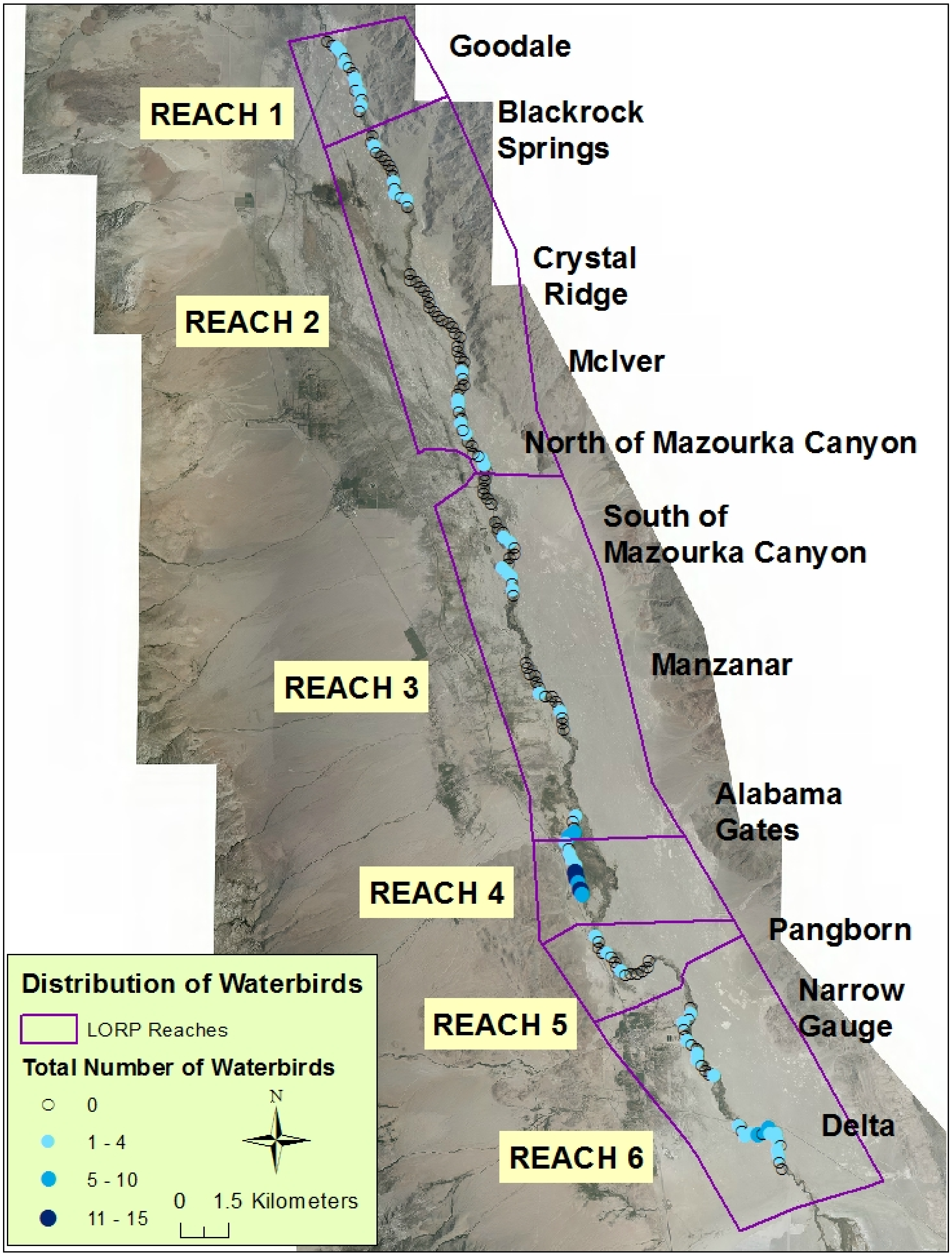
Avian Census Figure 5. Point Count Stations Color Coded by Total Landbird Species Richness Categories



Avian Census Figure 6. Mean Landbird Richness Over the Four Time Periods Reported for Each Individual Reach

The most frequently encountered waterbird species are Killdeer, Mallard, Virginia Rail and Great Blue Heron. The majority of the waterbirds in 2015 were seen on the Alabama Gates route (Avian Census Figure 7, Avian Census Table 9). Many Killdeer were observed on the Delta route on which there are several off-river ponds in abandoned oxbows. Six species of waterbirds were seen on the South of Mazourka route, however many fewer individuals were observed.

Although waterbird use of LORP significantly increased in 2010, waterbird use decreased in 2015 and was not significantly different than preproject levels, except in Reach 4 where waterbird use remained above preproject levels (Avian Census Figure 8).

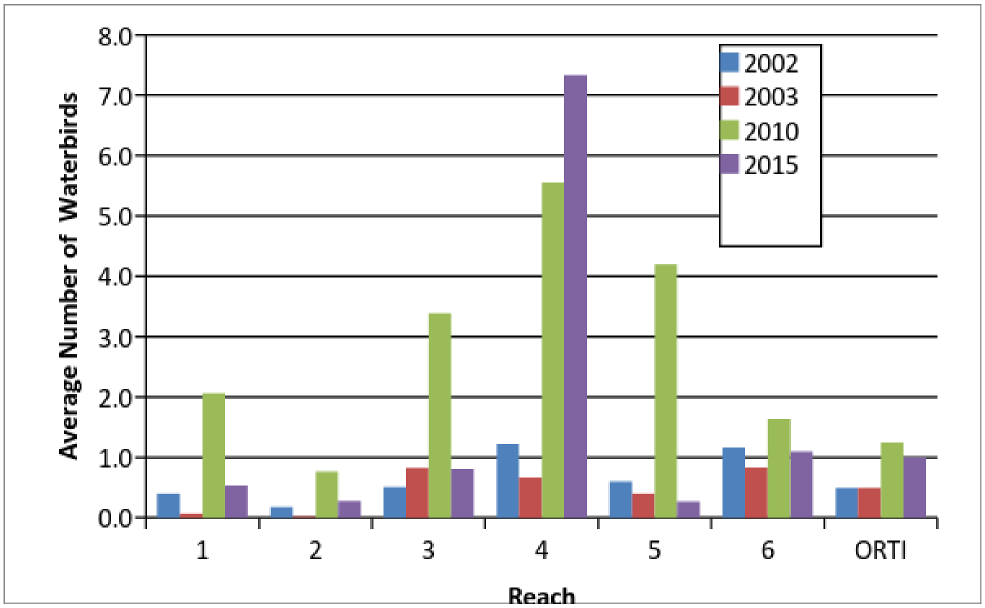


Avian Census Figure 7. Yearly Mean Number of Waterbirds Observed at Each Point

Avian Census Table 9. Total Number of Waterbirds Observed Along Each Route in 2015

Waterbird Species	ALGA	BLRS	CRRI	DELT	GOOD	MANZ	MCIV	NAGA	ORMC	PANG	SOMA	Species Totals
Wood Duck									2		2	4
Gadwall	10		1					1				12
Mallard	16			3	2		2		2		4	29
Cinnamon Teal	7											7
Green-winged Teal	3											3
Pied-billed Grebe											1	1
American Bittern	5									2		7
Great Blue Heron	2	3			4	2	2		1	1	1	16
Great Egret	2											2
Black-crowned Night-Heron	1											1
Virginia Rail	13						1	4			1	19
Sora								1				1
American Coot	1	3										4
Killdeer	12			19	2	2		3		1	1	40
Spotted Sandpiper				2								2
Wilson's Snipe	11											11
Total Waterbirds	**83**	**6**	**1**	**24**	**8**	**4**	**5**	**9**	**5**	**4**	**10**	**159**

ALGA-Alabama Gates; BLRS-Blackrock Springs, CRRI-Crystal Ridge, DELT-Delta, GOOD-Goodale, MANZ-Manzanar, MCIV-McIver, NAGA-Narrow Gauge, ORMC-North of Mazourka, PANG-Pangborn, and SOMA South of Mazourka



Avian Census Figure 8. Average of Waterbirds Per Point Within Each Reach Across Four Time Periods

Breeding Bird Richness, Diversity and Abundance

Forty of the 67 breeding species fit the criteria for inclusion into breeding bird analysis. Restricting the analysis to birds recorded within 50-m of the observer for these forty species accounted for 3,044 of the 6,632 individuals recorded in the LORP Riverine-Riparian management area in 2015.

Breeding bird richness throughout the LORP ranged from 1 to 14 species per survey point (mean 6.3). Breeding species richness is lowest in Reach 1 and highest in Reach 5. In 2015, Reach 5 supported species not found to be breeding at other reaches including Downy Woodpecker, Black-chinned Hummingbird and Yellow Warbler. Since implementation of LORP, breeding bird richness has increased significantly in Reach 2 above that observed in both baseline sampling years (Avian Census Table 10, Avian Census Figure 9). Breeding bird richness has increased slightly in Reach 5 and is above that observed in 2003, only. Slight numerical decreases in richness have been observed in Reach 6 as compared to 2002; however, there is no clear trend established. Breeding species richness has not varied at the Owens River North of Tinemaha site.

In 2015, breeding bird diversity ranged from 1 to 9.6 per survey point (mean 4.9). Diversity was highest is Reach 5 and lowest in Reach 1 (Avian Census Table 10). Diversity was similar in Reaches 2, 3, 4 and 6. Breeding bird diversity has also increased in Reach 2 (Avian Census Figure 3.10). As was observed with species richness, species diversity has also increased slightly in Reach 5. In Reach 4 diversity values indicate a potential decreasing trend. Breeding species diversity has not varied at the Owens River North of Tinemaha site.

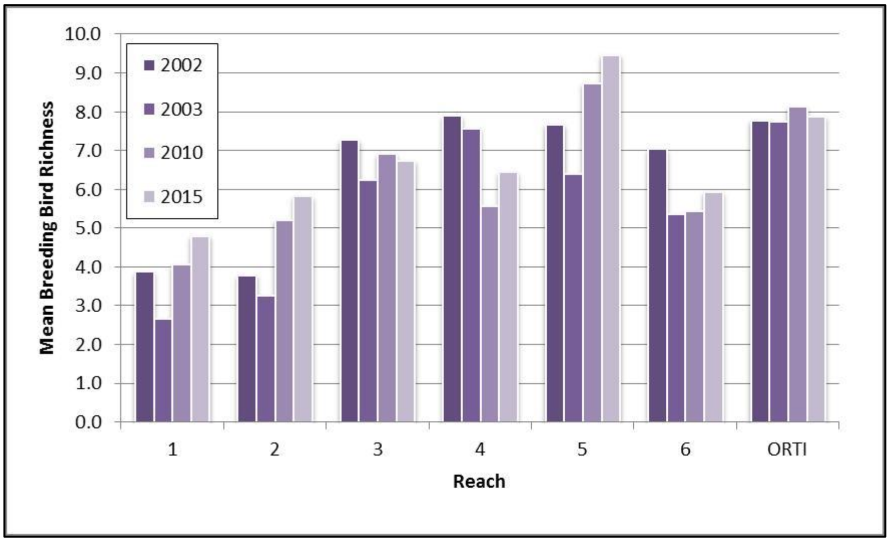
The mean number of birds at each station varied from 0.67 to 16.7 (mean 5.8). Breeding birds were most abundant in Reach 4 and least numerous in Reach 2 (Avian Census Table 10). Breeding bird abundance has been more responsive to implementation of LORP than other indices as increases have been observed in all reaches except Reach 6 (Avian Census Figure 3.11). No change has been observed at Owens River North of Tinemaha.

The most abundant breeding bird species in 2015 LORP were Red-winged Blackbird, Common Yellowthroat, Song Sparrow, and Brown-headed Cowbird (Avian Census Table 11). Other common species are Western Kingbird, Bewick's Wren, Western Meadowlark, Ash-throated Flycatcher and Marsh Wren. Species that have shown the greatest increases have been Red-winged Blackbird, Common Yellowthroat, and Song Sparrow (Avian Census Table 11). There has been a less obvious trend in the response of other common species to rewatering of LORP.

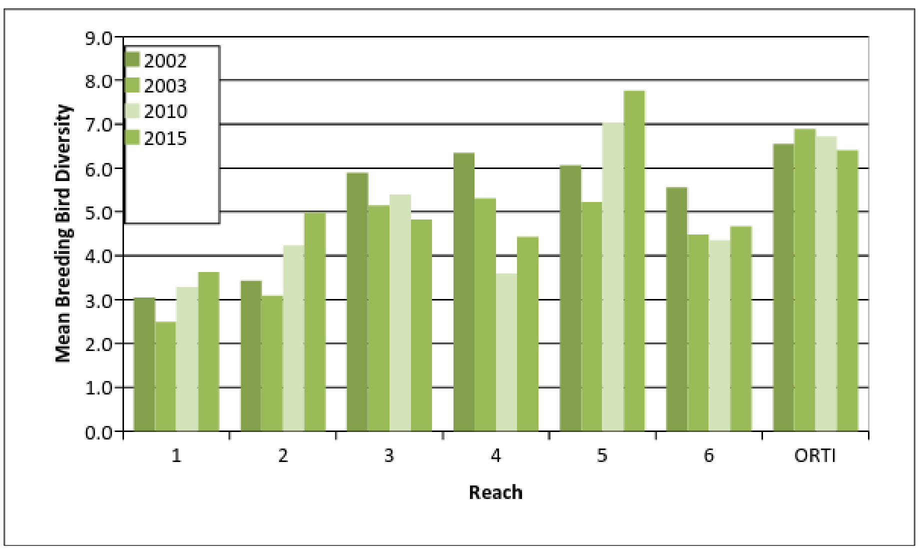
Three species may be declining in LORP - Blue-gray Gnatcatcher, Spotted Towhee and Black-throated Sparrow. Blue-gray Gnatcatcher was found breeding throughout LORP in 2002 (Heath and Gates 2002) and was most abundant in Reaches 2 and 3. In 2010, this species was found in low numbers only in Reach 2 and 3. No breeding birds were recorded in 2015. The density of Spotted Towhees has been declining. Black-throated Sparrow has been quite rare since implementation of LORP. Black-throated Sparrows populations in LORP have typically only been in Reaches 1-3, with the highest density in Reach 2. This species was not recorded in 2010 and found only in small numbers in Reach 3 in 2015.

	Mean Species Richness					Mean Species Diversity					Mean Abundance			
LORP Reach	2002	2003	2010	2015		2002	2003	2010	2015		2002	2003	2010	2015
REACH 1	3.9	2.7	4.1	4.8		3.1	2.5	3.3	3.6		2.9	1.4	3.5*	5**
REACH 2	3.8	3.3	5.2**	5.8**		3.4	3.1	4.2*	4.9**		2.2	1.9	4.5**	4.4**
REACH 3	7.3	6.2	6.9	6.7		5.9	5.2	5.4	4.8		5.0	4.6	6.0*	7.5**
REACH 4	7.9	7.6	5.6	6.4		6.3	5.3	3.6#	4.4		5.7	5.9	6.3	9.1**
REACH 5	7.7	6.4	8.7*	9.4*		6.1	5.2	7.0	7.7*		5.4	4.3	7.0*	7.1*
REACH 6	7.0	5.3#	5.4#	5.9		5.6	4.5	4.4	4.7		5.4	3.6#	3.4#	4.7
ORTI	7.8	7.8	8.1	7.9		6.6	6.9	6.7	6.4		6.5	6.2	7.4	6.7
* > 2003	** > 2002 and 2003			# < 2002										

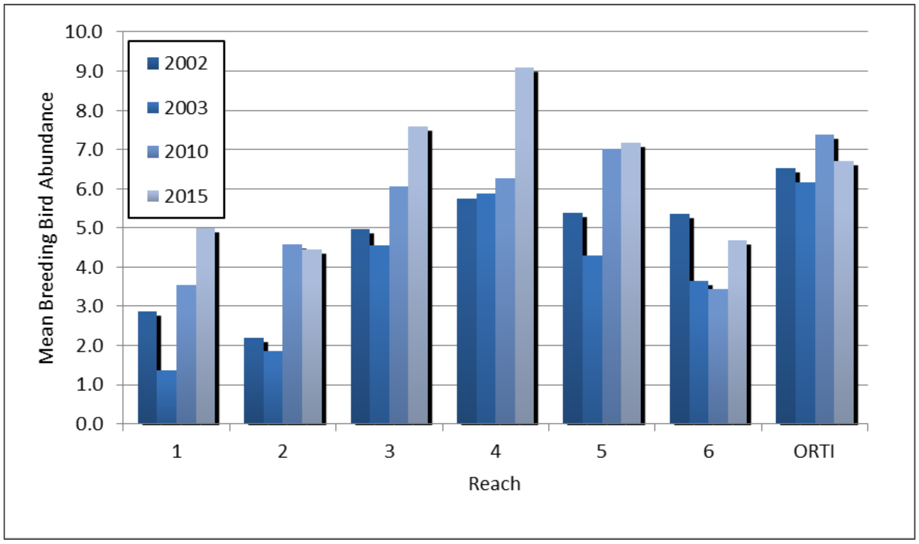
Avian Census Table 10. Breeding Bird Richness, Diversity and Abundance Over the Four Time Periods for Each Reach and the Reference Site (Owens River North of Tinemaha)



Avian Census Figure 9. Mean Breeding Bird Richness Per Reach Across the Four Time Periods



Avian Census Figure 10. Mean Breeding Bird Diversity Per Reach Across the Four Time Periods



Avian Census Figure 11. Mean Breeding Bird Abundance Per Reach Across the Four Time Periods

Avian Census Table 11. Mean Breeding Bird Density (Birds per Hectare) Over the Four Time Periods, Per Reach

Mean Birds Per Hectare	**Reach 1**				**Reach 2**				**Reach 3**			
Breeding Bird Species	**2002**	**2003**	**2010**	**2015**	**2002**	**2003**	**2010**	**2015**	**2002**	**2003**	**2010**	**2015**
California Quail					0.01	0.03	0.17	0.05		0.04	0.08	
Eurasian Collared-Dove												0.03
Mourning Dove	0.03	0.37	0.40	0.03	0.08	0.32	0.18	0.04	0.09	0.37	0.28	0.01
Black-chinned Hummingbird						0.01	0.02					
Ladder-backed Woodpecker					0.02				0.02			
Nuttall's Woodpecker				0.03	0.08	0.01	0.02	0.02	0.04	0.06	0.08	
Downy Woodpecker												
Northern Flicker	0.03	0.03	0.06		0.01	0.03	0.08	0.14	0.04	0.05	0.10	0.22
Willow Flycatcher												
Black Phoebe			0.06		0.04	0.02	0.03	0.02	0.01	0.01	0.02	0.03
Say's Phoebe	0.06	0.11	0.03	0.06	0.02	0.02	0.02	0.02	0.02	0.01		
Ash-throated Flycatcher	0.08	0.06			0.25	0.19	0.18	0.12	0.35	0.22	0.33	0.33
Western Kingbird	0.06		0.03	0.03	0.17	0.03	0.19	0.28	0.55	0.42	0.67	0.30
Loggerhead Shrike		0.08	0.08	0.17	0.04	0.05	0.08	0.13	0.17	0.20	0.20	0.24
Black-billed Magpie	0.03				0.02	0.02	0.01	0.02	0.10	0.03	0.04	0.02
Bushtit					0.02							0.01
House Wren	0.03			0.03		0.04	0.02	0.01	0.01	0.01	0.05	0.03
Marsh Wren		0.06	0.06	0.14	0.02	0.05	0.06	0.15	0.12	0.06	0.07	0.03
Bewick's Wren	0.08	0.03	0.11		0.48	0.33	0.59	0.32	0.34	0.37	0.44	0.38
Blue-gray Gnatcatcher	0.03				0.25	0.13	0.01		0.11	0.07	0.02	
American Robin										0.01		
Northern Mockingbird	0.20	0.20	0.17	0.06	0.02	0.02	0.01	0.07	0.20	0.05	0.13	0.10
Le Conte's Thrasher	0.08				0.05	0.05	0.02	0.06	0.01	0.01		0.04
European Starling			0.06			0.01	0.02		0.01	0.06	0.10	0.06
Common Yellowthroat	0.54	0.25	0.59	0.68	0.03	0.05	0.40	1.00	0.63	0.40	0.69	1.52
Yellow Warbler												
Yellow-breasted Chat												0.02
Spotted Towhee					0.40	0.25	0.15	0.10	0.08	0.07	0.08	0.02
Black-throated Sparrow	0.08	0.08			0.26	0.37			0.02			0.01
Bell's Sparrow		0.11			0.03	0.09	0.04	0.15			0.01	0.03
Savannah Sparrow			0.03	0.03								0.07
Song Sparrow	0.03		0.20	0.20	0.05	0.05	0.85	0.40	0.45	0.52	0.83	0.80
Blue Grosbeak					0.03	0.07	0.07	0.05	0.04	0.06	0.06	0.01
Lazuli Bunting							0.01	0.01	0.02			
Red-winged Blackbird	1.38	0.14	1.95	3.02	0.15	0.02	2.19	1.53	1.90	1.76	2.56	4.25
Western Meadowlark	0.59	0.03	0.14	0.56	0.05	0.05	0.07	0.18	0.37	0.33	0.34	0.26
Yellow-headed Blackbird			0.06	0.40						0.03	0.07	0.03
Brewer's Blackbird	0.03		0.03		0.01				0.03			0.04
Great-tailed Grackle									0.01			
Brown-headed Cowbird	0.31	0.14	0.23	0.59	0.16	0.05	0.28	0.45	0.54	0.56	0.35	0.56
Bullock's Oriole						0.01	0.03	0.18	0.03		0.08	0.07
House Finch		0.06	0.25	0.28	0.06	0.01	0.01	0.03				
Lesser Goldfinch												0.02

Avian Census Table 3.11 cont. Mean Breeding Bird Density (Birds per Hectare) Over the Four Time Periods, Per Reach

Mean Birds Per Hectare	Reach 4				Reach 5				Reach 6			
Breeding Bird Species	**2002**	**2003**	**2010**	**2015**	**2002**	**2003**	**2010**	**2015**	**2002**	**2003**	**2010**	**2015**
California Quail	0.05	0.05				0.06	0.34				0.01	
Eurasian Collared-Dove				0.14			0.03	0.23				0.01
Mourning Dove	0.19	0.42	0.05		0.08	0.31	0.37	0.34	0.04	0.20	0.18	0.10
Black-chinned Hummingbird								0.06	0.03		0.01	
Ladder-backed Woodpecker			0.05									
Nuttall's Woodpecker	0.05	0.09	0.05		0.08	0.03	0.06		0.11	0.08	0.01	0.01
Downy Woodpecker								0.03				
Northern Flicker	0.28	0.14	0.14	0.09	0.03	0.17	0.34	0.17	0.06	0.04	0.03	0.01
Willow Flycatcher								0.06				
Black Phoebe		0.19		0.05				0.06	0.08	0.03	0.07	0.03
Say's Phoebe						0.03			0.08	0.03	0.01	0.08
Ash-throated Flycatcher	0.14	0.14	0.19	0.09	0.31	0.17	0.40	0.42	0.30	0.20	0.32	0.31
Western Kingbird	0.38	0.80	0.38	0.52	0.62	0.73	0.73	0.96	0.82	0.69	0.48	0.25
Loggerhead Shrike	0.09	0.14		0.14	0.23		0.11	0.28	0.07	0.14	0.13	0.23
Black-billed Magpie	0.09	0.28		0.09	0.08	0.08	0.06		0.01		0.01	
Bushtit												
House Wren	0.09	0.42	0.19	0.33	0.03	0.06	0.20	0.14	0.06	0.13	0.11	0.04
Marsh Wren	0.24	0.19	0.42	1.79	0.11	0.17	0.03	0.03	0.11	0.18	0.01	0.11
Bewick's Wren	0.47	0.05	0.05	0.05	0.20	0.37	0.56	0.54	0.16	0.17	0.18	0.16
Blue-gray Gnatcatcher	0.28	0.05			0.11	0.06			0.07			
American Robin		0.09	0.19	0.05								
Northern Mockingbird	0.24	0.09		0.14	0.17	0.14	0.25	0.23	0.32	0.07	0.20	0.30
Le Conte's Thrasher								0.03		0.01		
European Starling	0.47	0.52	0.24	0.19	0.23	0.06	0.31	0.06	0.10	0.06	0.21	0.06
Common Yellowthroat	0.42	0.42	0.42	1.08	0.51	0.34	0.65	0.93	0.17	0.20	0.17	0.56
Yellow Warbler								0.17				
Yellow-breasted Chat								0.11			0.01	
Spotted Towhee					0.11				0.01			0.01
Black-throated Sparrow												
Bell's Sparrow												
Savannah Sparrow				0.05	0.03		0.06					
Song Sparrow	0.19	0.33	0.61	0.24	0.59	0.48	0.87	0.93	0.59	0.45	0.32	0.44
Blue Grosbeak					0.06						0.01	0.01
Lazuli Bunting			0.05				0.03		0.06		0.01	
Red-winged Blackbird	1.74	1.83	4.61	4.70	2.09	1.16	2.00	2.00	2.31	1.23	1.14	2.17
Western Meadowlark	0.42	0.52	0.09	0.24	0.31	0.17	0.28	0.45	0.32	0.37	0.25	0.40
Yellow-headed Blackbird	0.42	0.09		0.89	0.03	0.03	0.06	0.03	0.16	0.01		0.04
Brewer's Blackbird	0.47	0.09		0.09					0.28	0.13	0.14	
Great-tailed Grackle	0.05				0.17				0.01			0.01
Brown-headed Cowbird	0.42	0.47	0.24	0.24	0.54	0.76	0.73	0.65	0.47	0.18	0.23	0.40
Bullock's Oriole	0.09	0.05			0.14	0.11	0.20	0.17	0.03	0.03	0.07	0.08
House Finch				0.05								0.03
Lesser Goldfinch						0.03		0.06			0.01	

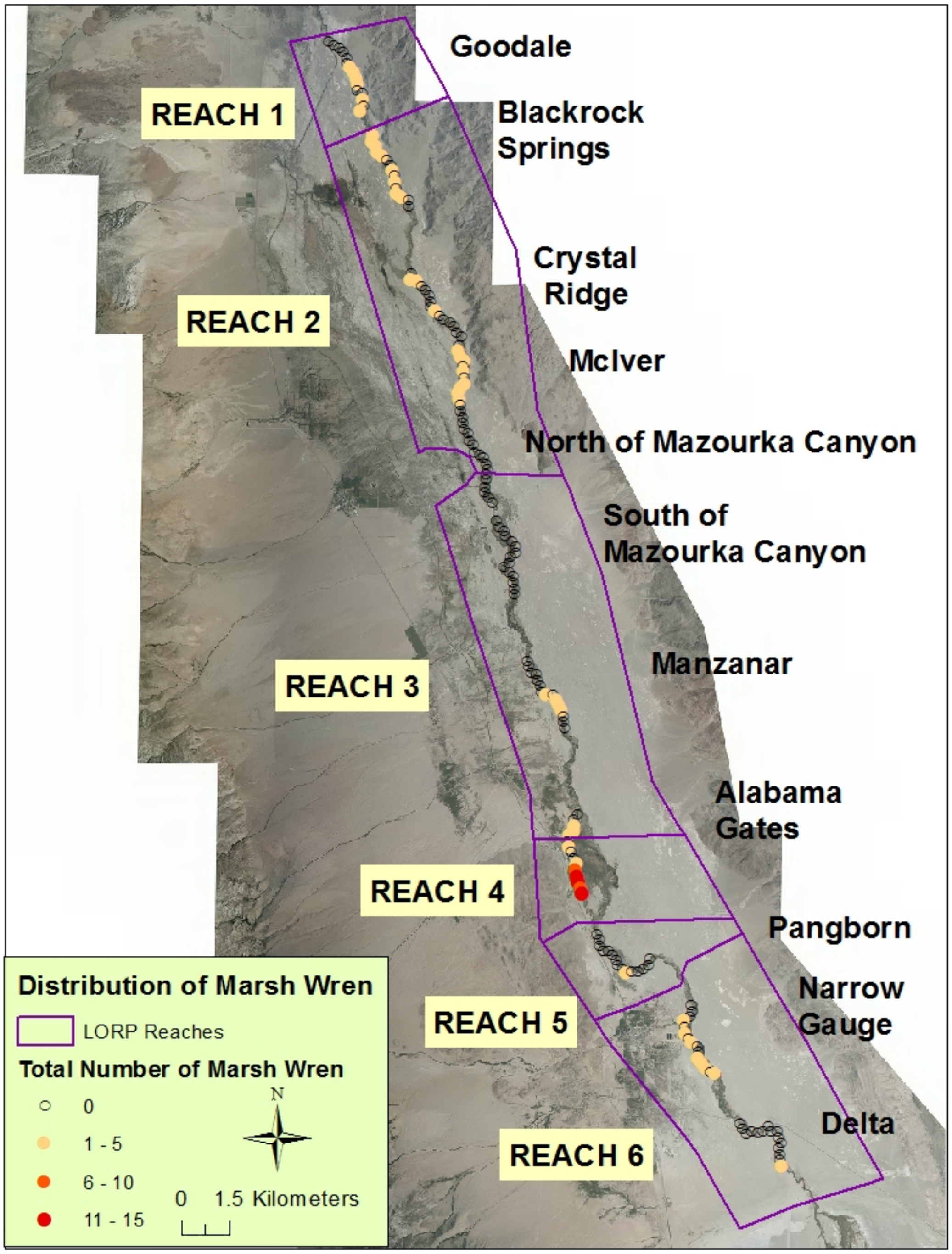
Riverine-Riparian Indicator Species Distribution

Thirteen of the 19 avian habitat indicator species were observed during 2015 surveys, and breeding activity was documented for eleven of these (Avian Census Table 12). Indicator Species for which evidence of potential breeding activity was observed included Wood Duck, Great Blue Heron, Northern Harrier, Virginia Rail, Sora, Nuttall's Woodpecker, Willow Flycatcher, Marsh Wren, Yellow Warbler, Yellow-breasted Chat and Blue Grosbeak. Habitat Indicator Species not observed in 2015 included Red-shouldered Hawk, Swainson's Hawk, Yellow-billed Cuckoo, Long-eared Owl, and Belted Kingfisher. Habitat indicator species use tended to be highest in Reaches 4 and 5. Marsh Wren have been found in all reaches and is the most abundant of all indicator species. Marsh Wren are typically associated with marsh habitat, and marsh vegetation is abundant in all areas of the river. Despite this, Marsh Wren are not found throughout the entire river corridor. Only a few individuals were found at locations where they did occur, with the exception of Reach 4, where they were most abundant (Avian Census Figure 12). All other indicator species have been recorded in low numbers during surveys. This year was the first time Willow Flycatcher, Yellow Warbler and Yellow-breasted Chat have been included as potential breeding species. A singing Willow Flycatcher was observed in a dense patch of shrub and tree willows on May 18 on the Pangborn route. No Willow Flycatcher was heard on the subsequent visit, suggesting this individual was a migrant. Since the bird was in appropriate habitat and could easily have been missed during general point count survey, this species was classified as a potential breeder. Yellow Warbler was also suspected of breeding on the Pangborn route as two singing birds were encountered in mid-June. Yellow-breasted Chats were present as breeding species along the Pangborn route as well as at a spring along the Alabama Gate route. The number of habitat indicator species in Reaches 1 and 2 has increased over baseline (Avian Census Figure 13).

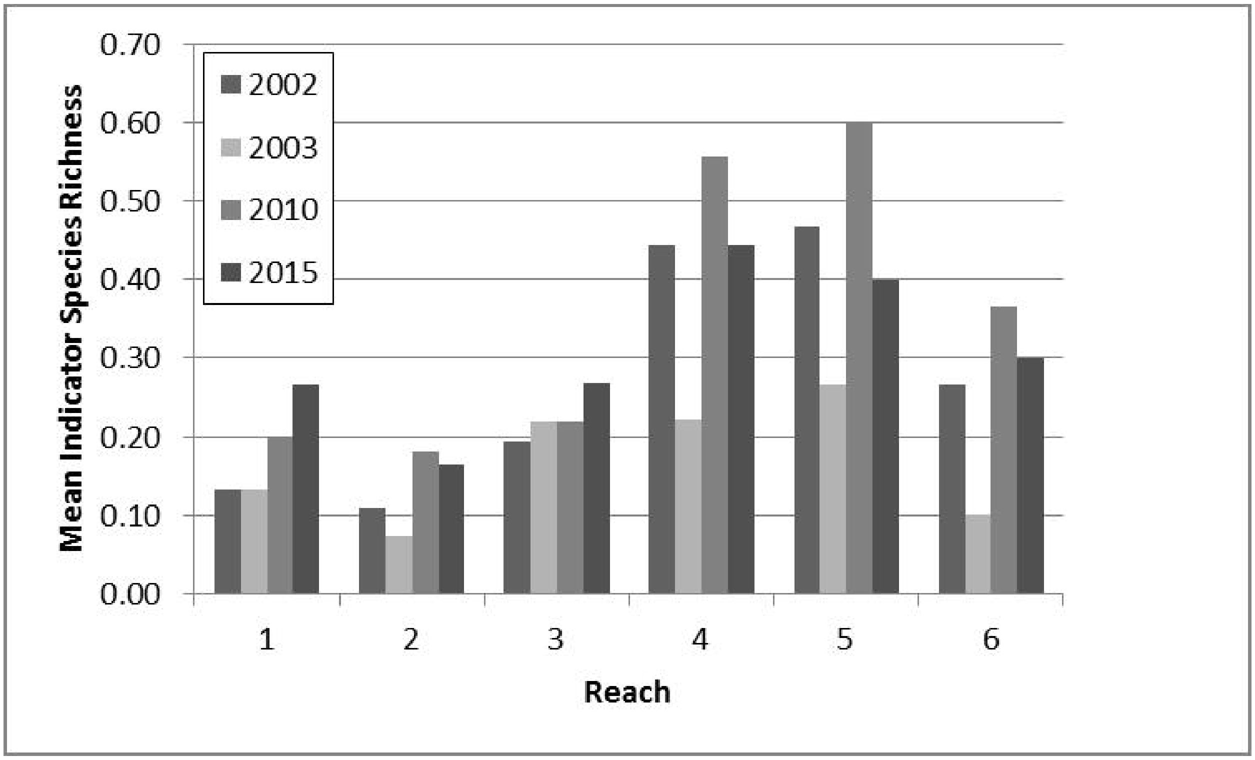
Avian Census Table 12. Possible or Confirmed Breeding Bird Species Within LORP Boundaries in 2015

Bold = Possible or confirmed breeding within LORP boundaries in 2015. **M** = Species present in reach as migrant, potential breeding elsewhere on LORP

	REACH					
HABITAT INDICATOR SPECIES	**1**	**2**	**3**	**4**	**5**	**6**
Belted Kingfisher						
Blue Grosbeak		**x**	**x**			**x**
Great Blue Heron	**x**	**x**	**x**	**x**	**x**	
Least Bittern						
Marsh Wren	**x**	**x**	**x**	**x**	**x**	**x**
Northern Harrier						**x**
Nuttall's Woodpecker	**x**	**x**	**x**			**x**
Sora						**x**
Swainson's Hawk						
Tree Swallow		x	x		x	
Virginia Rail		**x**	**x**	**x**		**x**
Warbling Vireo		x	x			x
Willow Flycatcher		**M**	**M**		**x**	**M**
Wood Duck			**x**			
Yellow Warbler	**M**	**M**	**M**	**M**	**x**	**M**
Yellow-breasted Chat			**x**		**x**	



Avian Census Figure 12. 2015 Distribution of Marsh Wren, a LORP Riverine-Riparian Habitat Indicator Species



Avian Census Figure 13. Average Number of LORP Habitat Indicator Species Seen Per Reach in the Four Time Periods

Modeling Species Diversity, Richness and Breeding Bird Abundance

The results of multiple linear regression analysis indicate that certain vegetation communities and attributes are important predictors of bird species richness, diversity and abundance in the LORP Riverine-Riparian area (Avian Census Table 13).

The total acreage of woody riparian vegetation was the strongest predictor of landbird species richness. The amount of wet meadow and habitat diversity also explained a significant proportion of the variance in landbird richness.

Wet meadow was the best predictor of average waterbird abundance in 2015. Higher waterbird use was associated with areas of higher acreages of wet meadow.

Similar to all landbird richness, total riparian acreage was the most significant predictor for breeding bird richness. Marsh was secondary in importance. Total habitat diversity and the acreage of wet meadow were comparable. Breeding bird diversity was most strongly influenced by total riparian acreage, and secondarily by habitat diversity. The strongest predictor of breeding bird abundance is wet meadow and water. Total riparian and marsh were also positive predictors. Alkali meadow was a negative predictor. The abundance of Marsh Wren was not predicted by marsh, but rather the availability of wet meadow habitat, but appears to be negatively predicted by habitat diversity.

Avian Census Table 13. Predictor Variables Explaining Abundance

Total and Breeding Landbird Richness, Breeding Bird Diversity and Abundance, Waterbird Abundance, and Marsh Wren abundance.

P values and model term coefficients are reported.

Bird Community Index	Habitat Variable	P	β
Total Landbird Richness			
	Wet Meadow	0.087	0.117
	Total Riparian	<0.001	0.509
	Habitat Diversity	0.010	0.180
Mean Waterbird Abundance			
	Wet Meadow	<0.001	0.315
Breeding Bird Richness			
	Wet Meadow	0.015	0.172
	Total Riparian	<0.001	0.340
	Marsh	0.002	0.216
	Habitat Diversity	0.012	0.182
Breeding Bird Diversity			
	Total Riparian	<0.001	0.346
	Habitat Diversity	0.022	0.168
Breeding Bird Abundance			
	Alkali meadow	0.02	-0.165
	Wet Meadow	<0.001	0.374
	Total Riparian	0.006	0.188
	Marsh	0.009	0.188
	Water	<0.001	0.230
Marsh Wren			
	Wet Meadow	<0.001	0.535
	Habitat Diversity	<0.001	-0.248

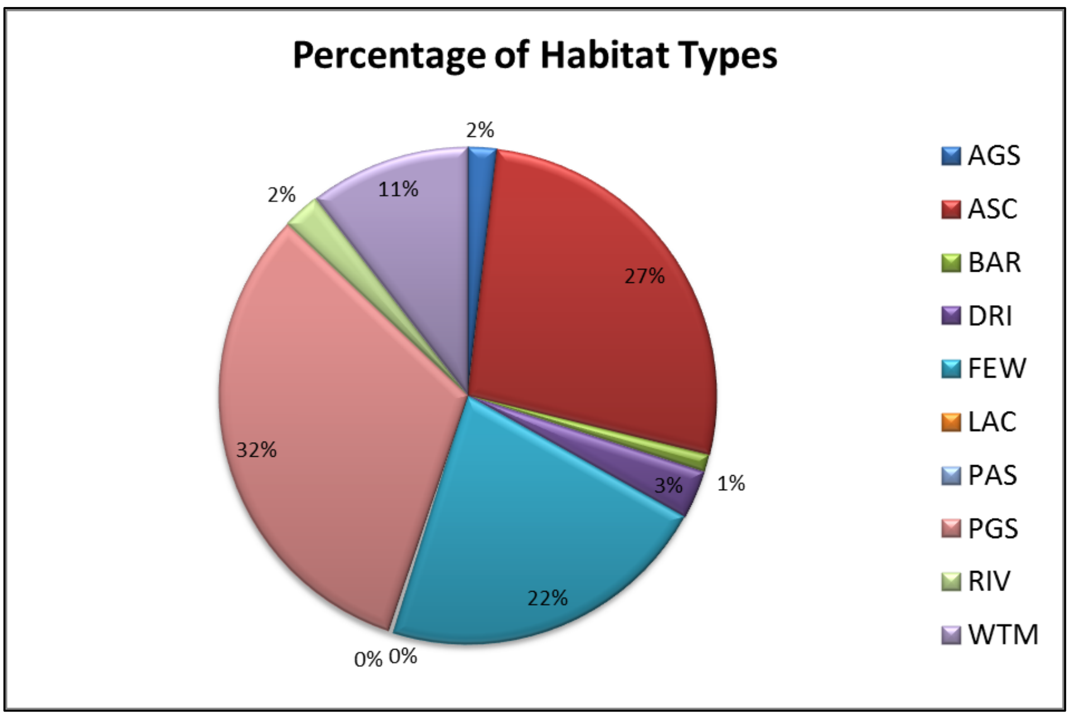
CWHR Analysis of Potential Habitat, Riverine-Riparian Area

CWHR Habitat Composition

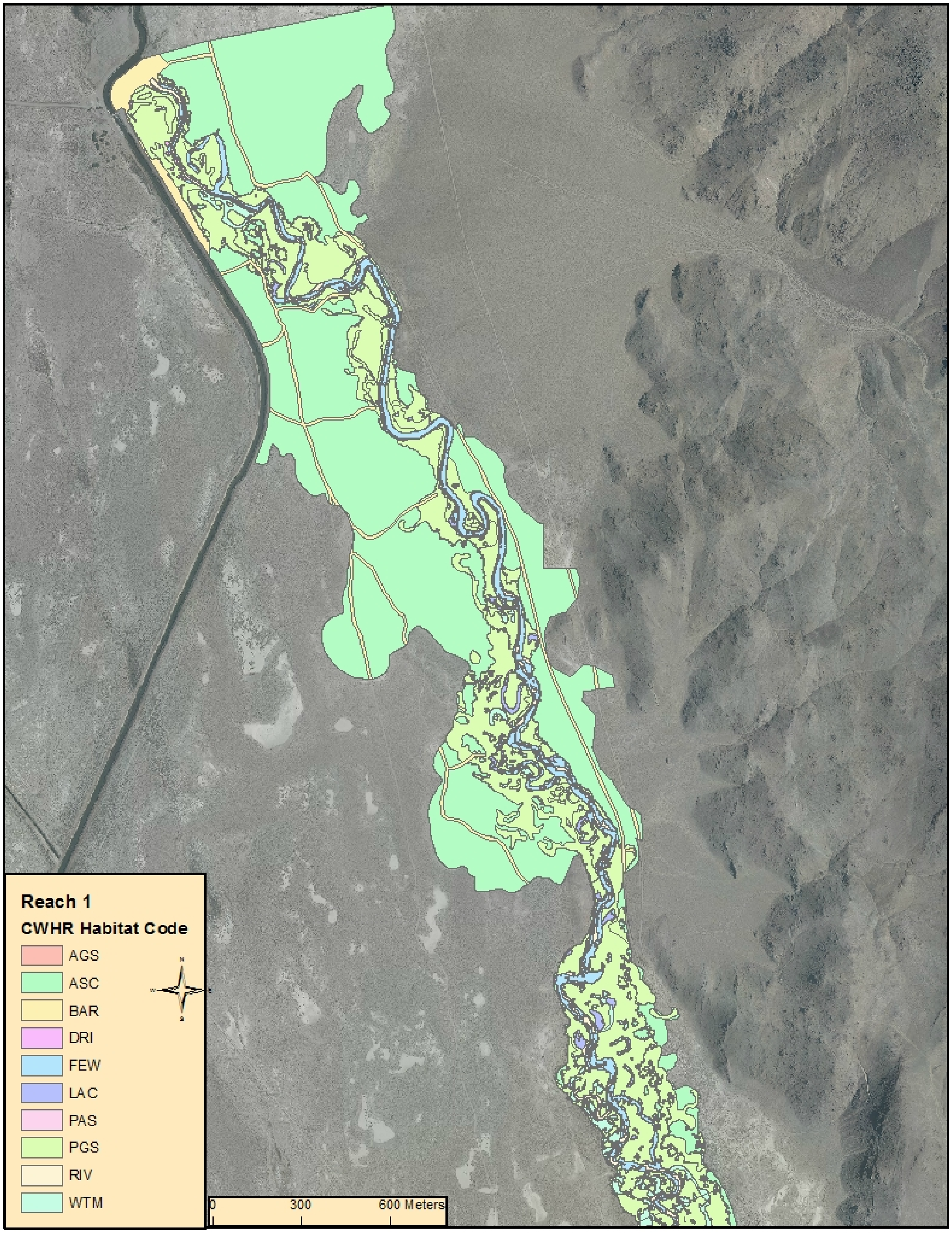
Habitats classified as Perennial Grassland under CWHR were the most abundant in LORP area, followed by Alkali Scrub and Fresh Emergent Wetland (Table 3.14, Figure 3.14) while Lacustrine and Pasture were the least abundant. Annual grassland habitats (i.e. Bassia) were abundant in Reach 2 and absent from reaches 1, 4, 5 and 6. Desert Riparian, Fresh Emergent Wetland and Riverine were most abundant in Reaches 3 and 4. The total acreage of Lacustrine was low for all reaches. Wet Meadow was most abundant in Reach 3. A mosaic of CWHR habitats occurs within each reach (Figures 3.15-3.27).

Avian Census Table 14. CWHR Habitat Composition by Reach, 2015

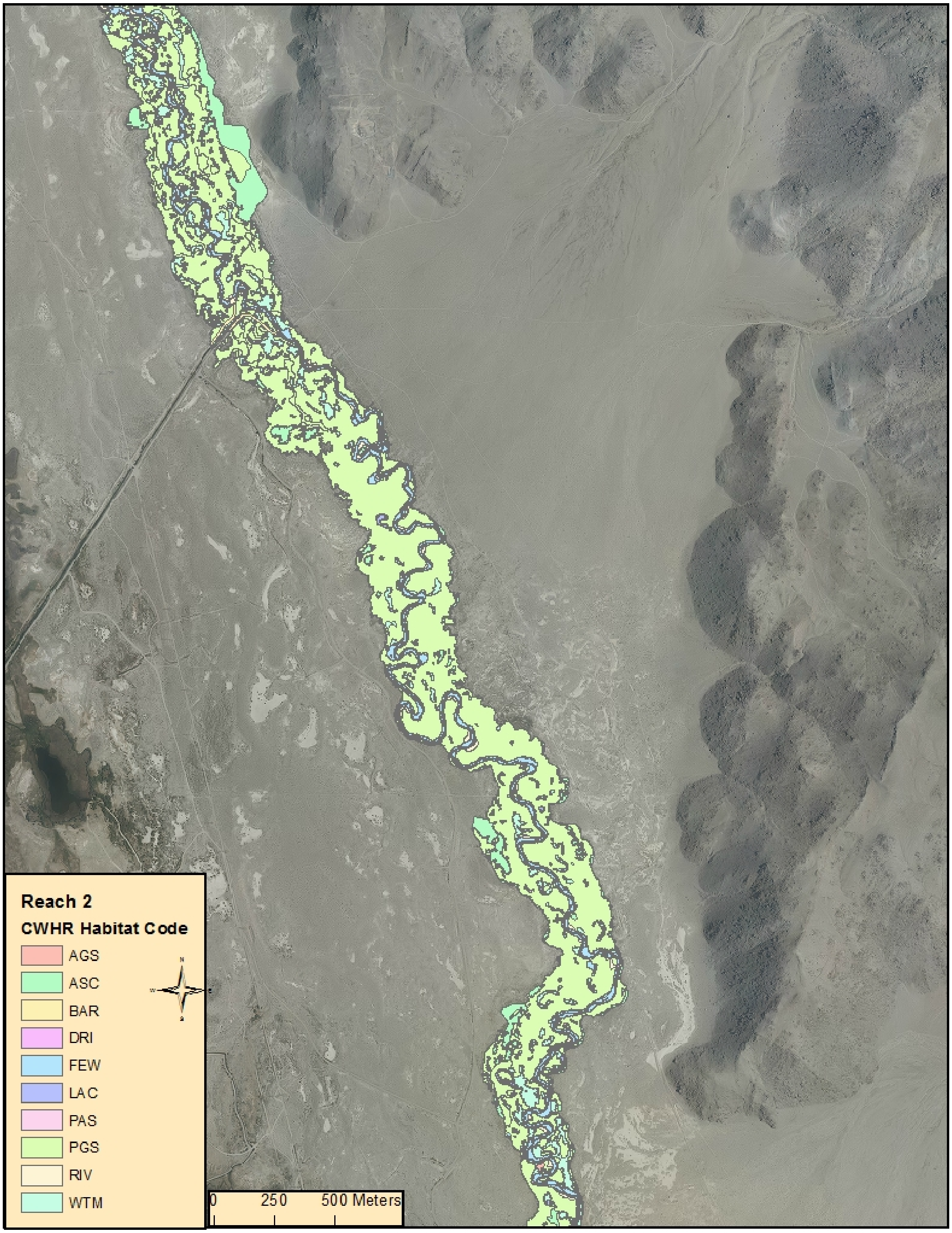
CWHR Habitat Type	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Total by CWHR Habitat Type
AGS		98.1	20.2		0.0		**118.3**
ASC	289.4	555.8	405.3	140.8	35.6	255.6	**1682.4**
BAR	24.5	3.2	17.4	3.1	1.2	20.7	**70.0**
DRI	0.6	23.2	65.5	48.7	23.0	36.7	**197.8**
FEW	33.3	127.6	413.3	550.1	58.9	177.7	**1360.8**
LAC	4.5	3.8	4.7	0.7	1.1	2.3	**17.2**
PAS			2.5	0.8			**3.3**
PGS	159.9	334.9	651.9	244.0	221.4	385.0	**1997.2**
RIV	10.7	31.7	53.0	24.8	9.1	23.0	**152.3**
WTM	11.1	61.0	185.2	212.0	52.2	131.3	**652.8**
Total acreage per reach	**533.9**	**1239.3**	**1819.1**	**1225.0**	**402.5**	**1032.3**	**6252.1**



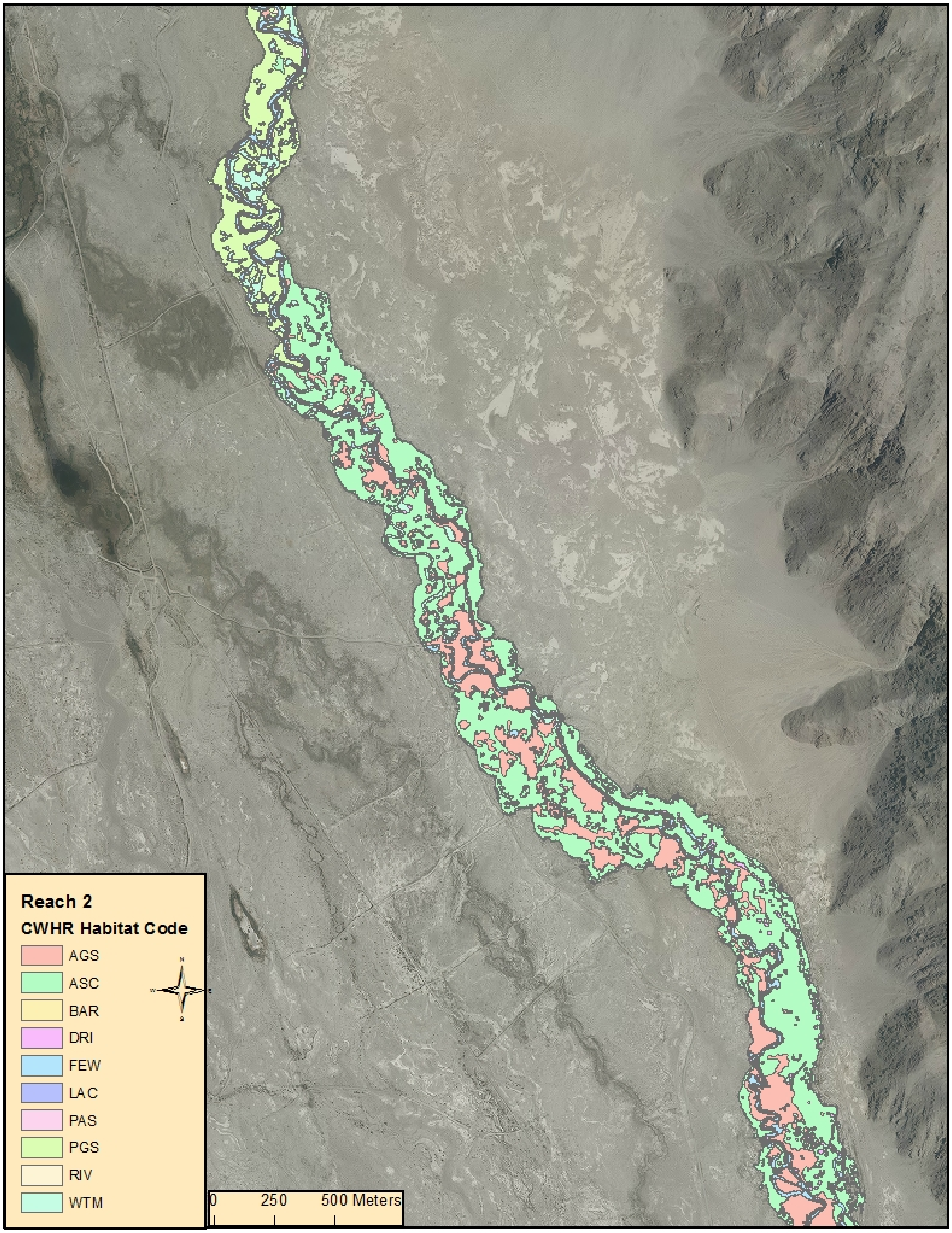
Avian Census Figure 14. Proportion of Each CWHR Habitat Type within the Entire LORP Riverine-Riparian Area



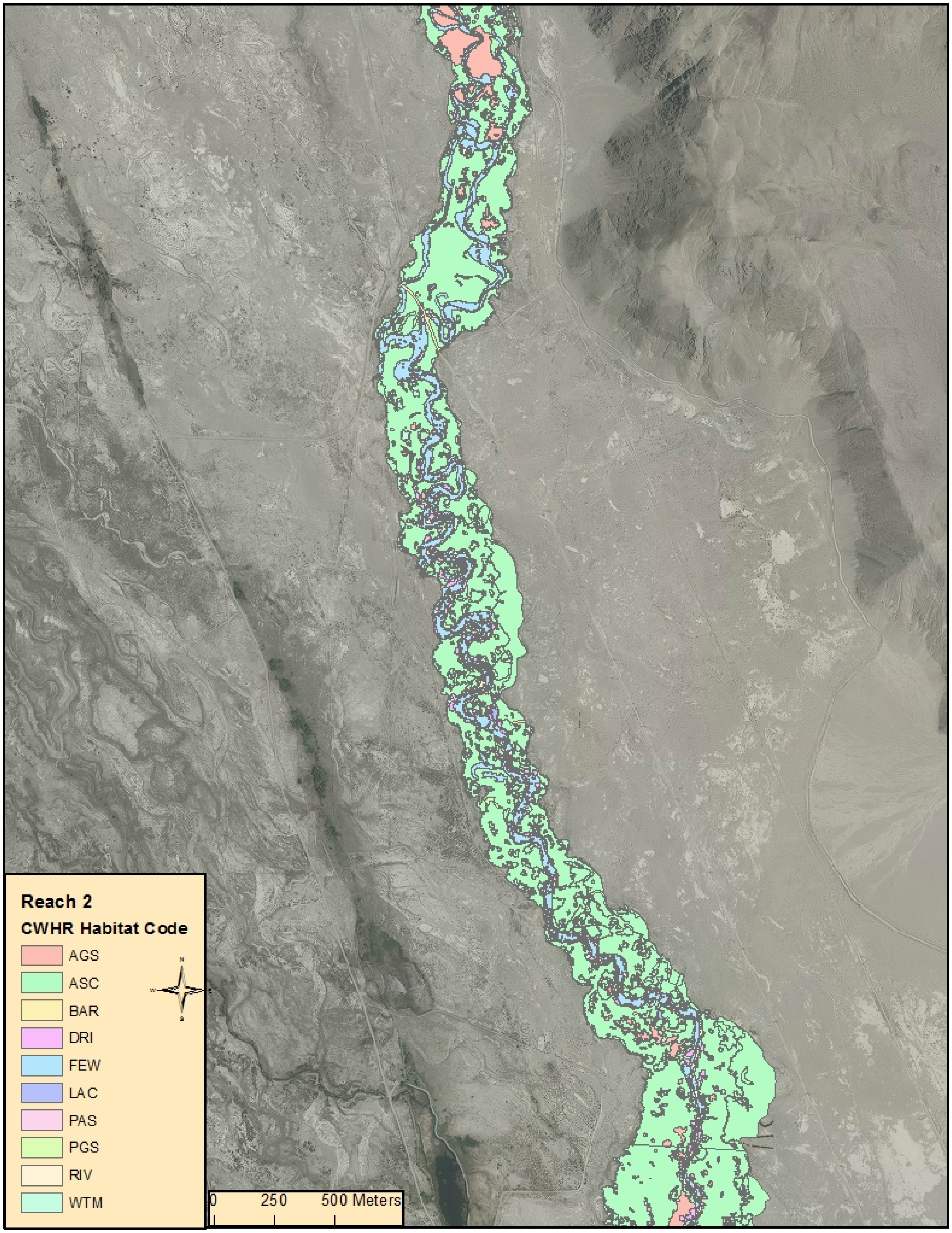
Avian Census Figure 15. CWHR Habitat Map of Reach 1



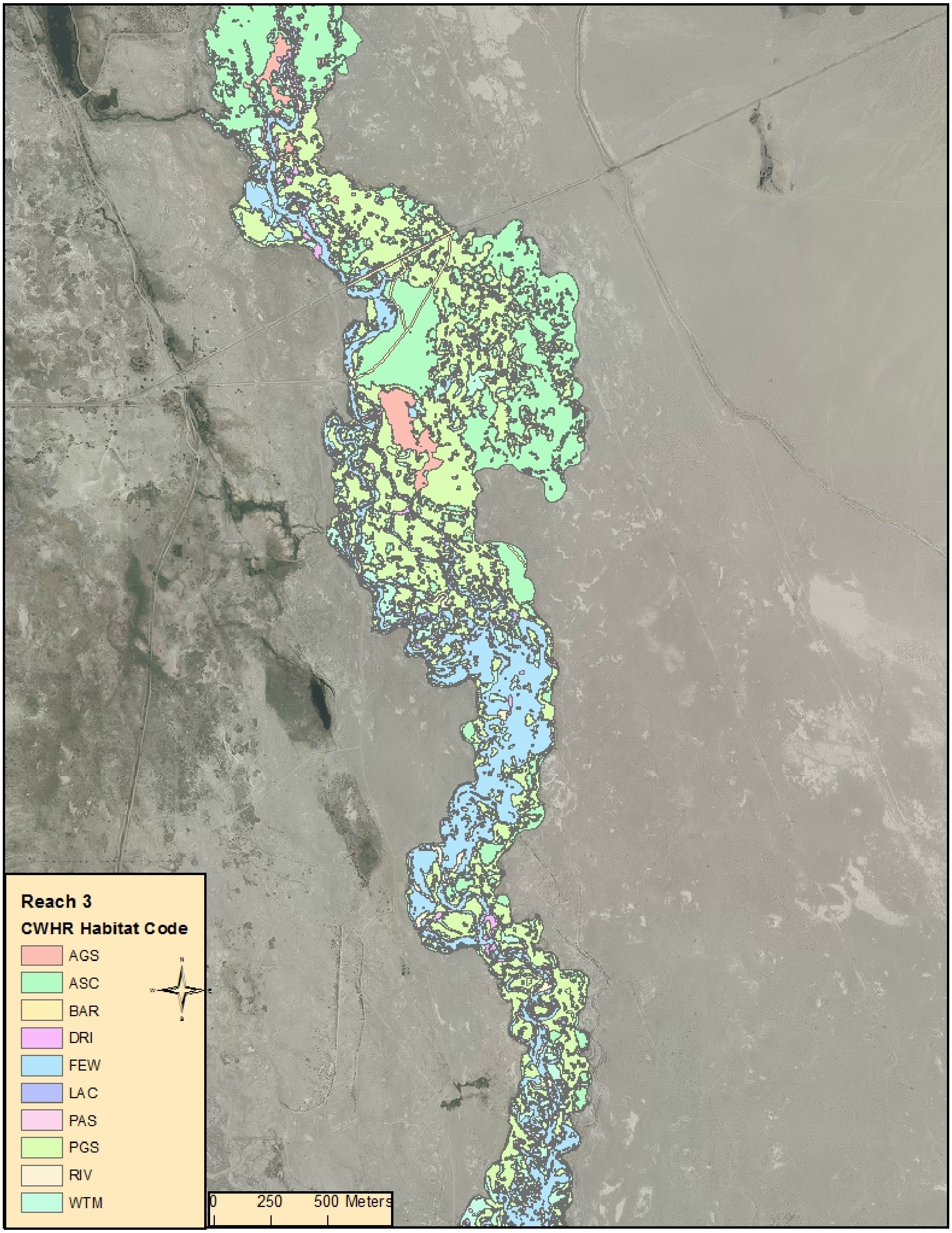
Avian Census Figure 16. CWHR Habitat Map of Reach 2 (1 of 3)



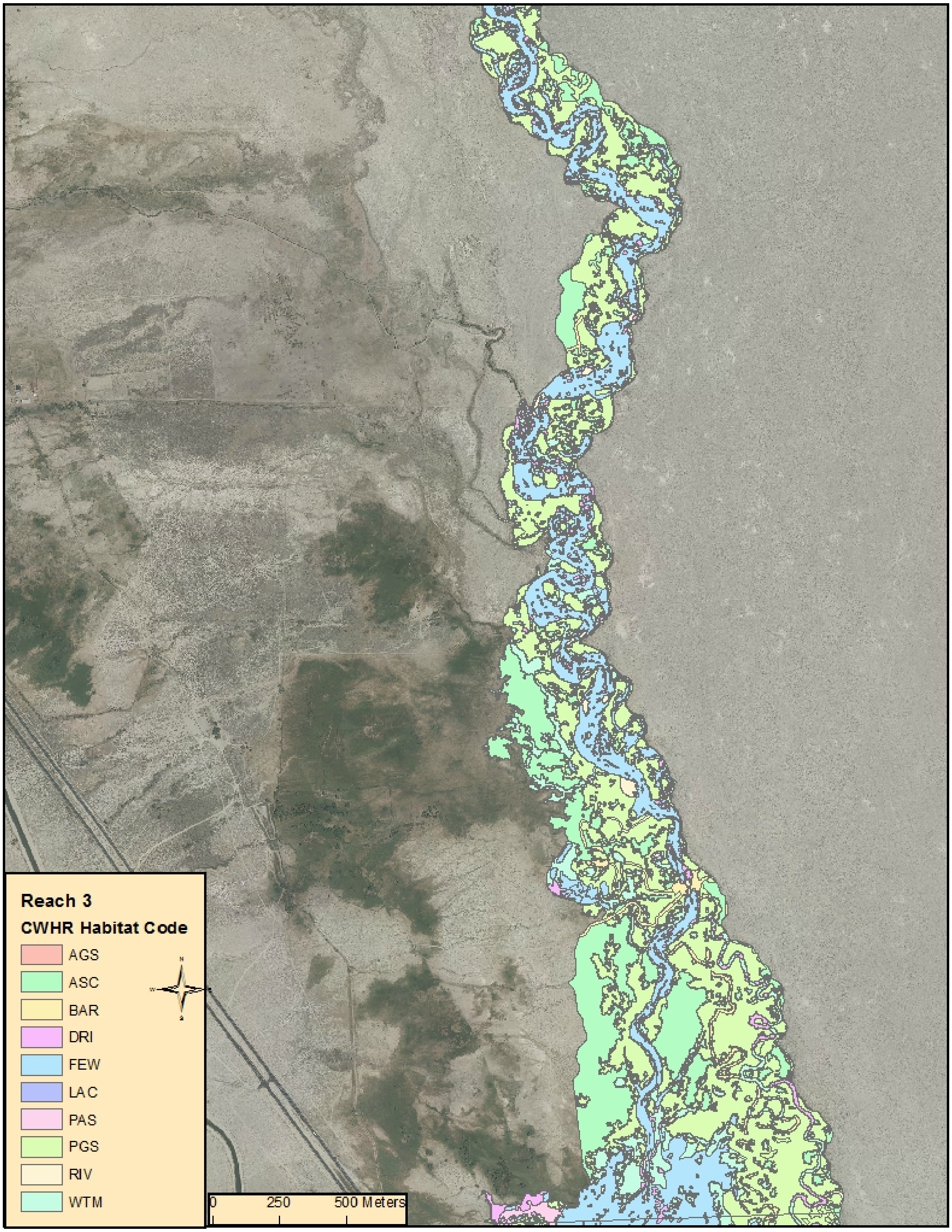
Avian Census Figure 17. CWHR Habitat Map of Reach 2 (2 of 3)



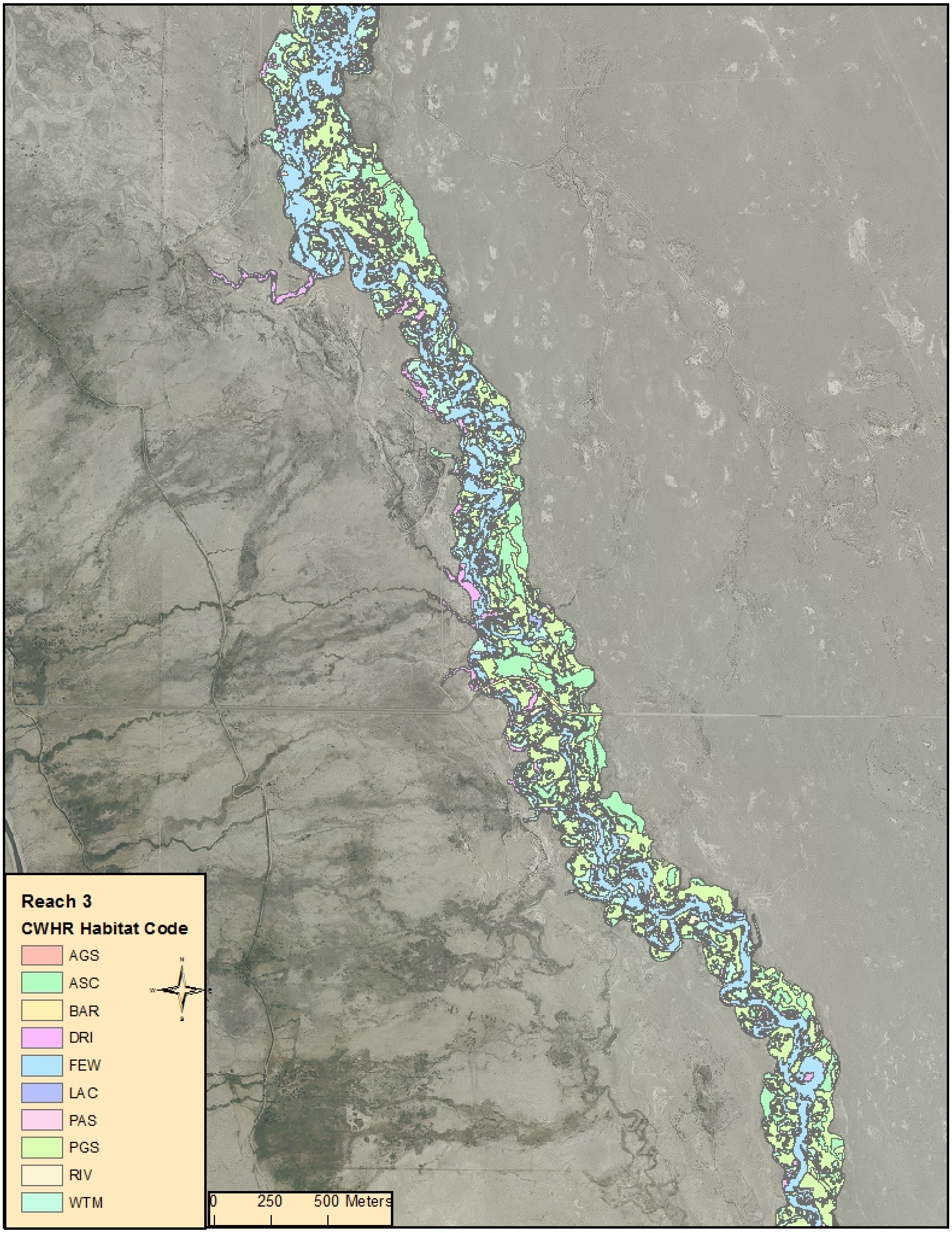
Avian Census Figure 18. CWHR Habitat Map of Reach 2 (3 of 3)



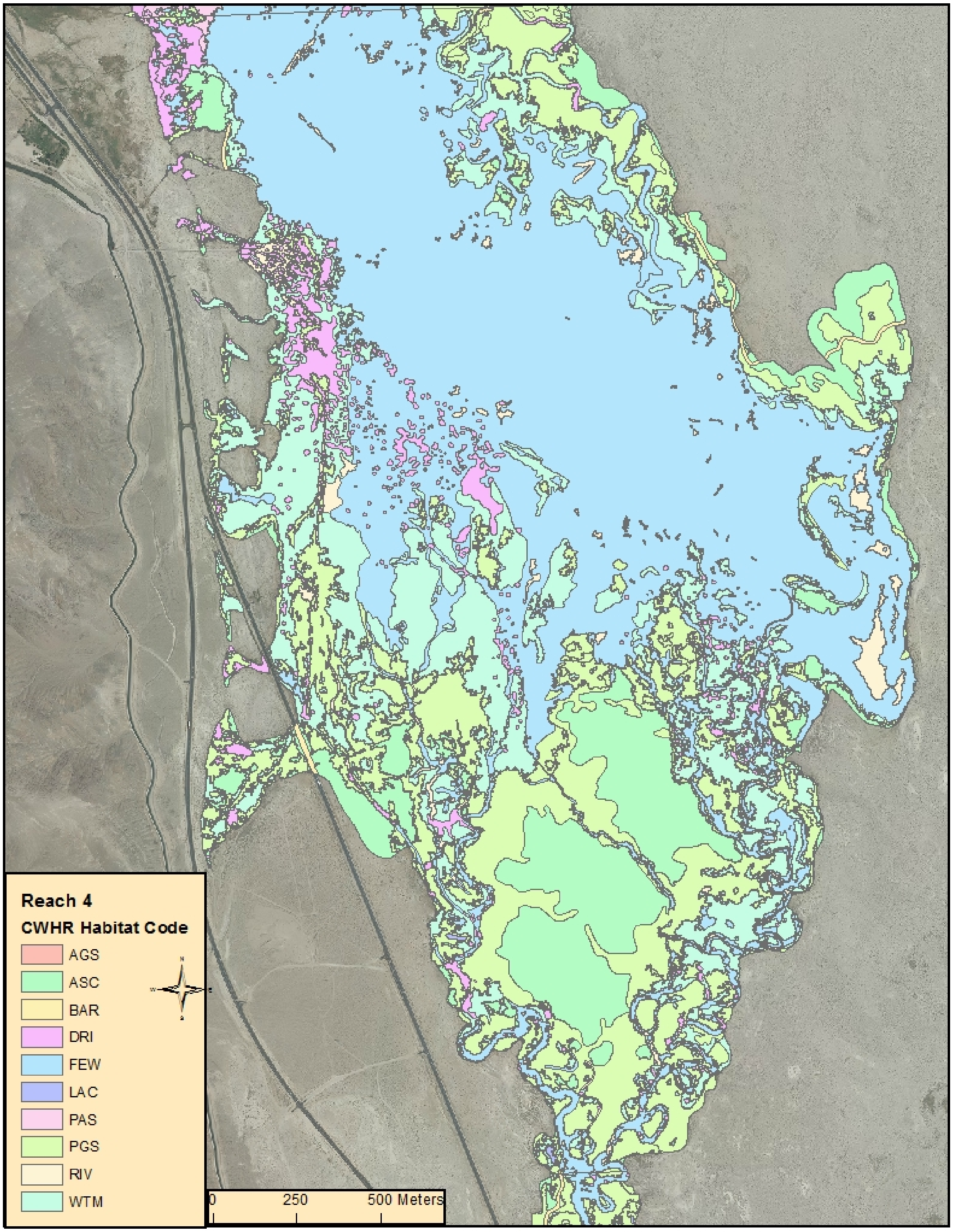
Avian Census Figure 19. CWHR Habitat Map of Reach 3 (1 of 3)



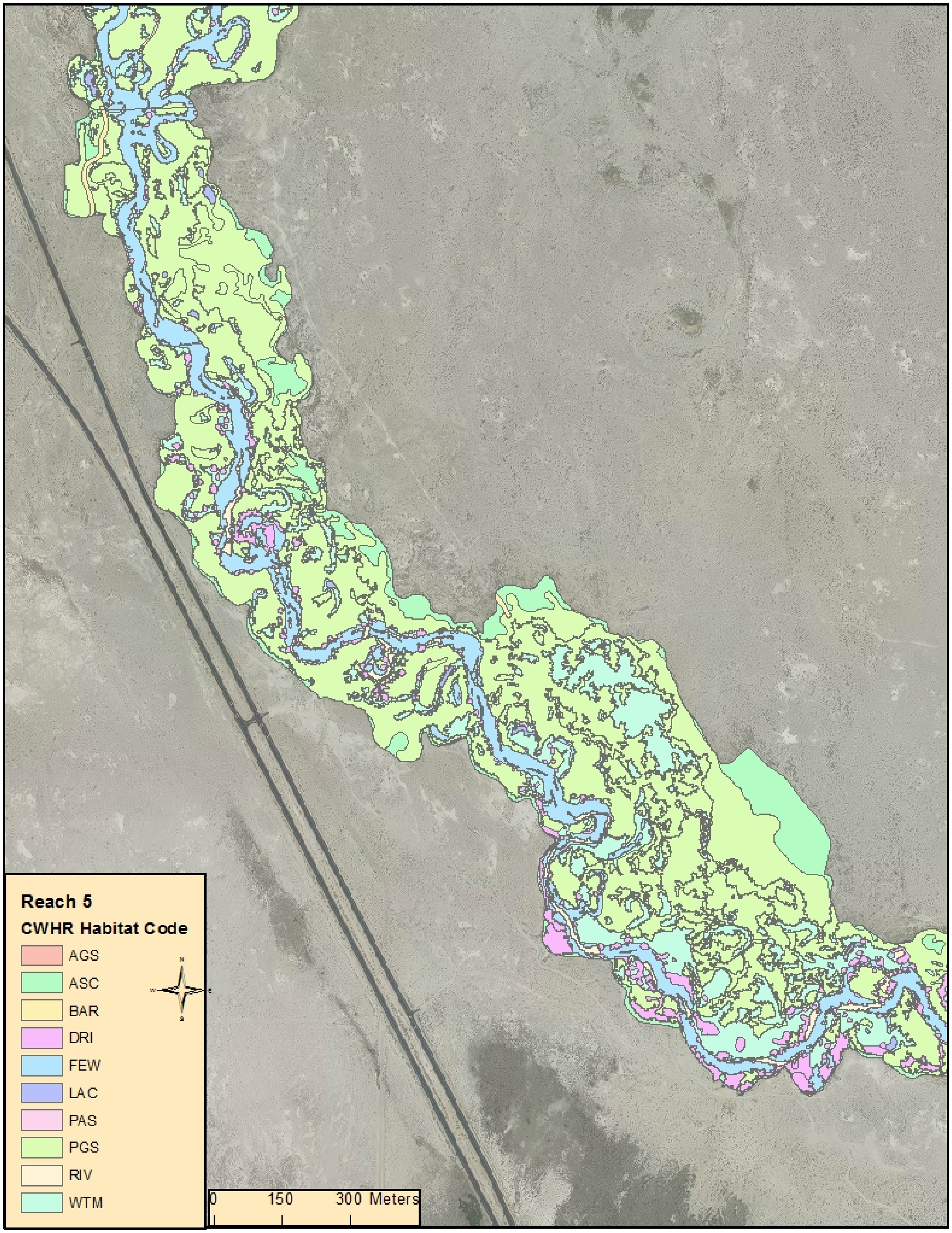
Avian Census Figure 20. CWHR Habitat Map of Reach 3 (2 of 3)



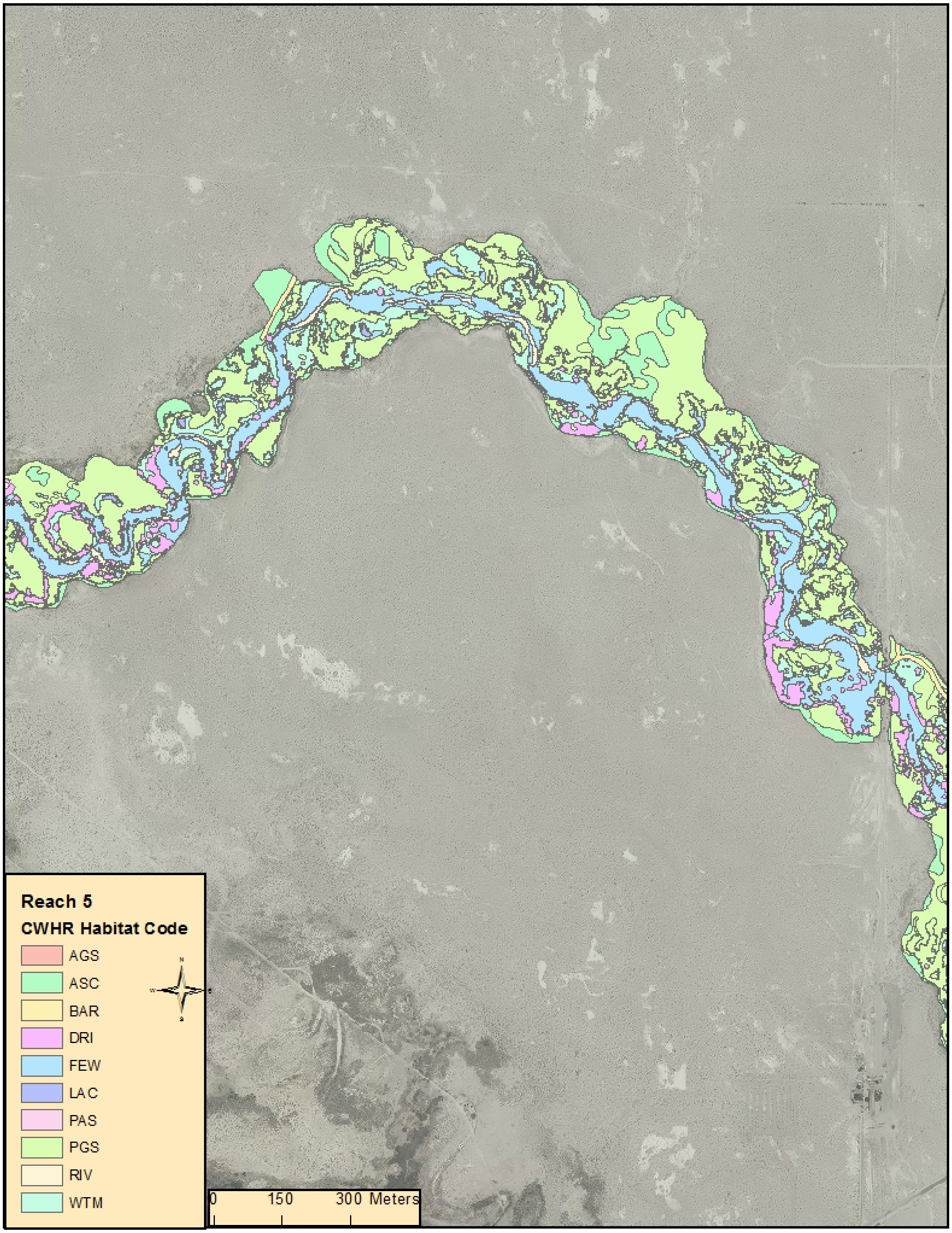
Avian Census Figure 21. CWHR Habitat Map of Reach 3 (3 of 3)



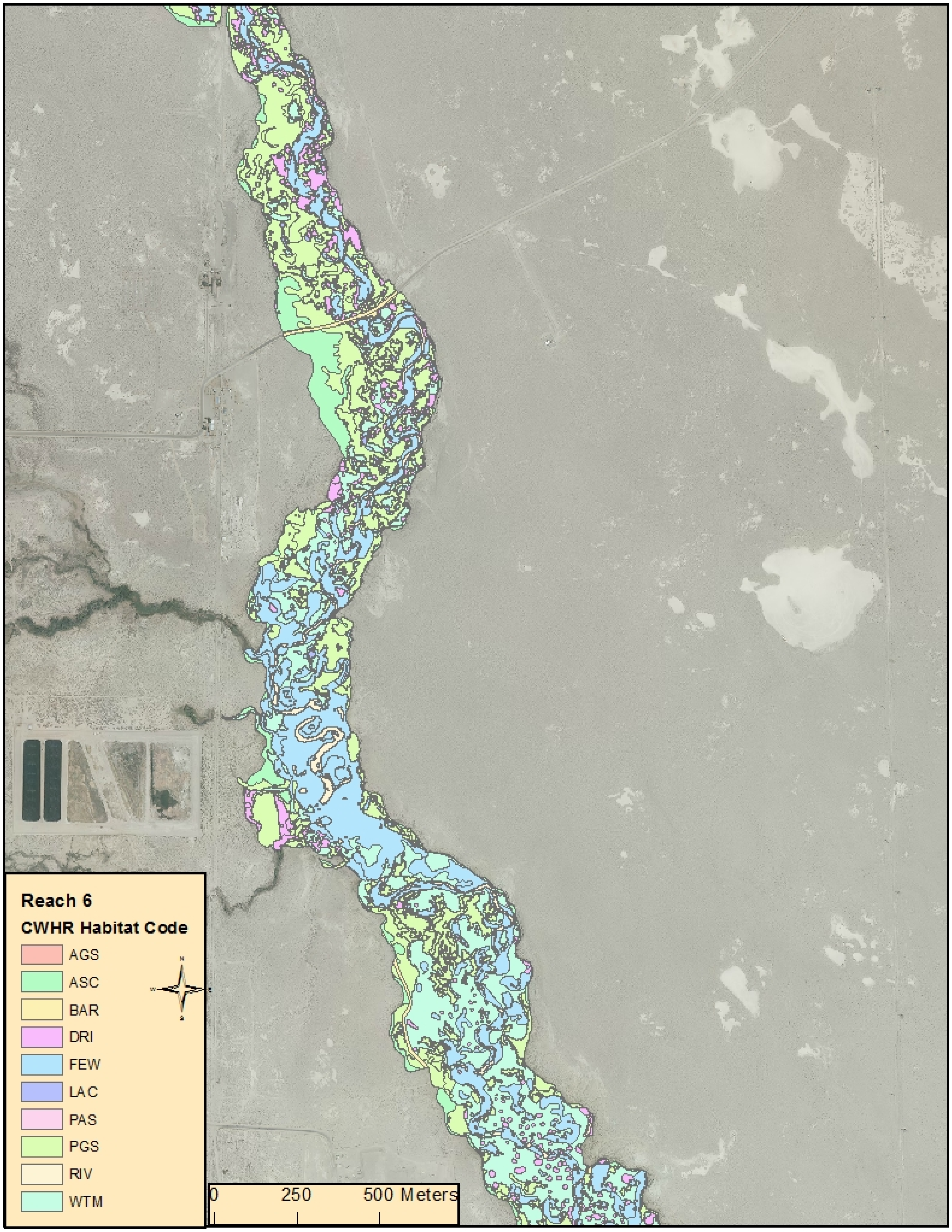
Avian Census Figure 22. CWHR Habitat Map of Reach 4



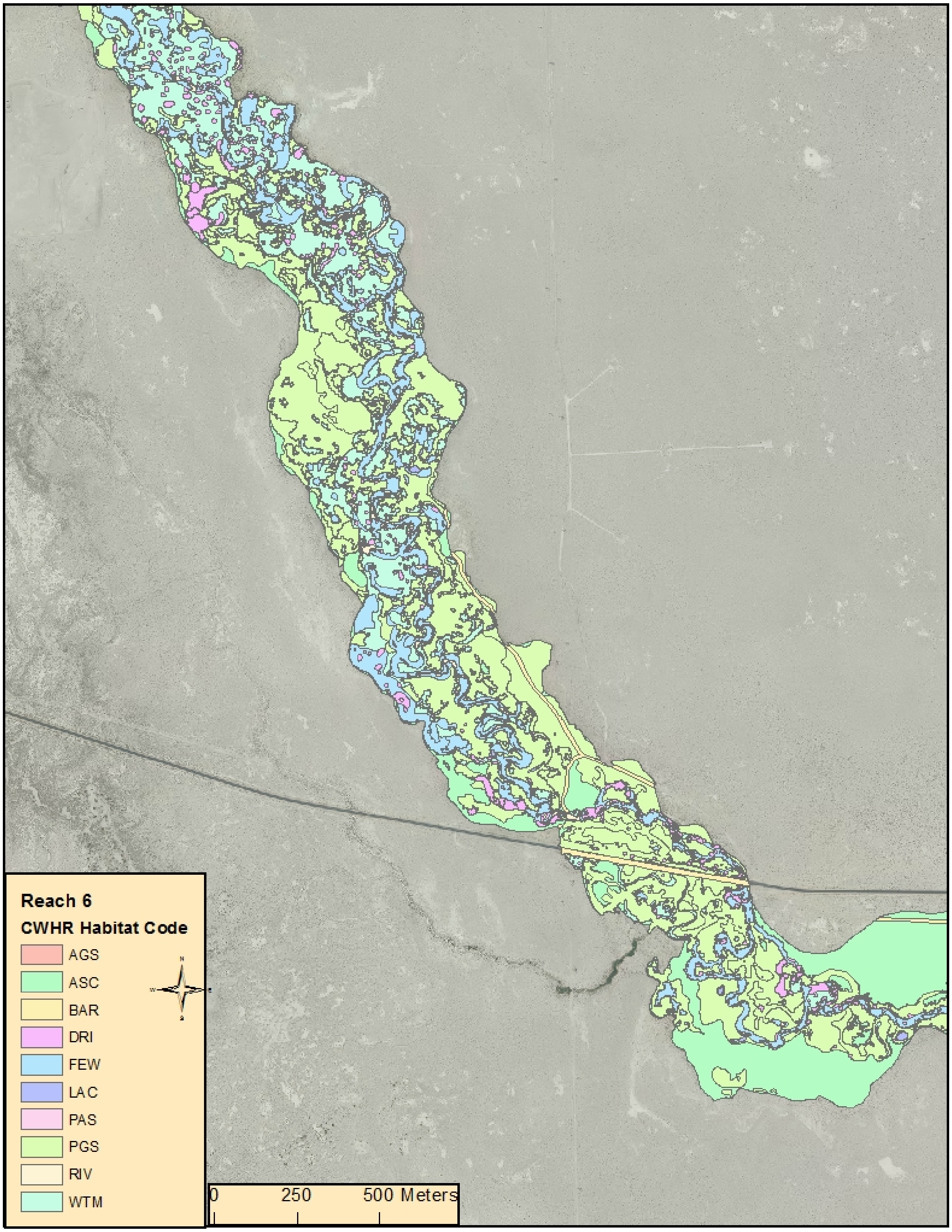
Avian Census Figure 23. CWHR Habitat Map of Reach 5 (1 of 2)



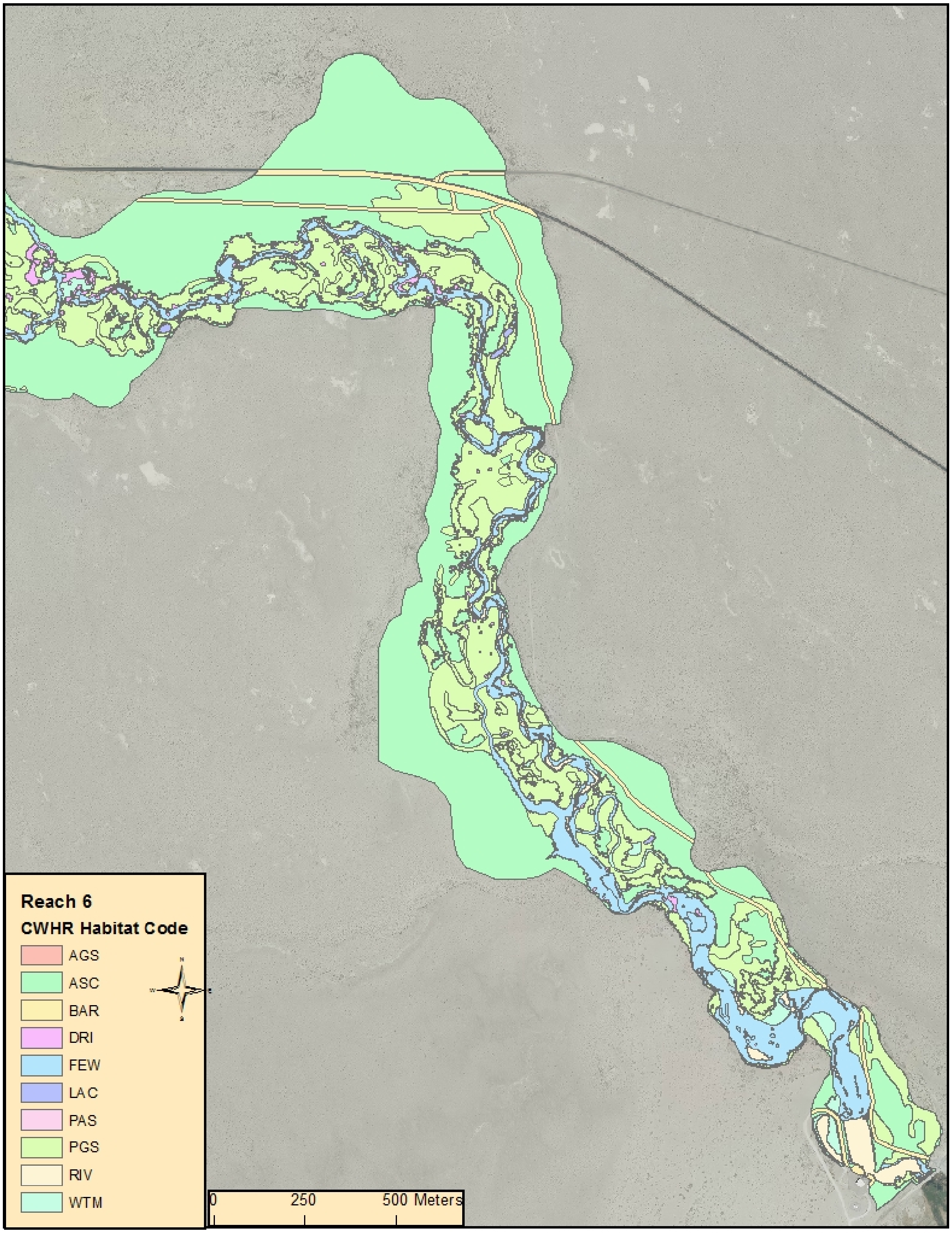
Avian Census Figure 24. CWHR Habitat Map of Reach 5 (2 of 2)



Avian Census Figure 25. CWHR Habitat Map of Reach 6 (1 of 3)



Avian Census Figure 26. CWHR Habitat Map of Reach 6 (2 of 3)



Avian Census Figure 27. CWHR Habitat Map of Reach 6 (3 of 3)

CWHR-Derived Habitat Suitability for Indicator Species

Total acreage of suitable habitat for each indicator species varied between LORP reaches (Avian Census Table 15). In Reach 1, Perennial Grassland, Fresh Emergent Wetland, Riverine and Wet Meadow habitats provide the most acreage of suitable habitat for indicator species. Desert Riparian and Lacustrine habitats are lacking in this reach. Reach 2 provides some suitable habitat for all indicator species, with Annual Grassland, Fresh Emergent Wetland and Perennial Grassland forming the majority of available habitat. Although Annual Grassland has some suitability for several indicator species in CWHR, the suitability of Bassia stands for these species is questionable. Owens Valley Vole sign has been seen along the river corridor in stands of Bassia, but use by other indicator species may be limited. Reach 2 has more acreage of Riverine and Desert Riparian available than Reach 1. Reach 3 habitats consist of primarily Perennial Grassland and Fresh Emergent Wetland; and more acres of Desert Riparian, Lacustrine and Wet Meadow are available in Reach 3 than in Reaches 1 or 2. Reach 4 has the highest acreage of Fresh Emergent Wetland, but also provides Perennial Grassland and Desert Riparian. The most abundant habitat in Reaches 5 and 6 is Perennial Grassland, but these reaches also provide Fresh Emergent Wetland, Desert Riparian, Riverine and some Wet Meadow.

Reach 1 provides essentially no suitable habitat for riparian dependent species such as Yellow-billed Cuckoo, Nuttall's Woodpecker, Willow Flycatcher, Warbling Vireo, Yellow Warbler, and Yellow-breasted Chat (Avian Census Figure 28). Reach 1 provides the most suitable habitat for Owens Valley Vole, but also provides limited acreage of medium and high suitability habitat for waterbirds and marsh-dependent species such as Virginia Rail, Sora, and Marsh Wren. The presence of low, medium and high suitability habitat for indicator species in Reach 2 is similar to Reach 1 except more desert riparian habitat is available for riparian dependent species. Reach 3 provides more suitable habitat for all indicator species. The greatest amount of medium and high suitability habitat is available for species which may forage in or over grassland habitats such Great Blue Heron, Northern Harrier, Tree Swallow and Owens Valley Vole. Reach 4 provides the most acreage of medium and high suitability habitats for species that primarily use marsh or Fresh Emergent Wetland habitats, such as Northern Harrier, Virginia Rail, Sora and Marsh Wren. Reaches 5 and 6 provide the most suitable habitat acreage for species that use perennial grassland and marsh.

Evaluation of Predictive Ability of CWHR

Marsh Wren abundance was not predicted by the total CWHR habitat suitability per point count station ($r = 0.0487$, $p=0.537$). As was found with multiple linear regression modeling, Marsh Wren abundance was positively correlated with the CWHR habitat Wet Meadow ($r=0.538$, $p<0.001$). There was no correlation between Marsh Wren abundance and the CWHR habitat Fresh Emergent Wetland ($r = -0.0752$, $p=0.34$).

Avian Census Table 15. Total Acreage of Suitable Habitat for Indicator Species by Habitat Type and Reach

Reach 1	Species	AGS	ASC	BAR	DRI	FEW	LAC	PAS	PGS	RIV	WTM
	Wood Duck				0.3	33.3	4.5			10.5	
	Least Bittern				0.3	33.3	4.4			10.5	
	Great Blue Heron				0.3	33.3	4.5		159.9	10.7	11.1
	Northern Harrier		289.4	24.5		33.3	4.4		159.9		11.1
	Red-shouldered Hawk				0.6	33.3			82.4		11.1
	Swainson's hawk			24.5	0.5				159.9		11.1
	Virginia Rail				0.1	33.3					11.1
	Sora					33.3					11.1
	Yellow-billed Cuckoo				0.6						
	Long-eared Owl				0.6				159.9		11.1
	Belted Kingfisher				0.6	33.3	4.4			10.7	11.1
	Nuttall's Woodpecker				0.6						
	Willow Flycatcher				0.6						11.1
	Warbling Vireo				0.6						
	Tree Swallow				0.6	33.3	4.5		159.9	10.5	11.1
	Marsh Wren					33.3					11.1
	Yellow Warbler				0.6						
	Yellow-breasted Chat				0.3						
	Blue Grosbeak				0.3						
	Owens Valley Vole					33.3			159.9		11.1

Reach 2	Species	AGS	ASC	BAR	DRI	FEW	LAC	PAS	PGS	RIV	WTM
	Wood Duck				12.9	127.6	3.8			31.7	
	Least Bittern				10.0	127.6	3.7			25.7	
	Great Blue Heron	98.1			12.9	127.6	3.8		334.9	31.7	61.0
	Northern Harrier	98.1	117.5	3.2	23.2	127.6	3.8		334.9	5.8	61.0
	Red-shouldered Hawk	98.1			23.2	127.6			334.9		61.0
	Swainson's hawk	98.1		3.2	21.9				334.9		61.0
	Virginia Rail				1.3	127.6					61.0
	Sora					127.6					61.0
	Yellow-billed Cuckoo				23.2						
	Long-eared Owl	98.1			23.2				334.9		61.0
	Belted Kingfisher				23.2	127.6	3.7			25.9	61.0
	Nuttall's Woodpecker				23.2						
	Willow Flycatcher				23.2						61.0
	Warbling Vireo				23.2						
	Tree Swallow	98.1			23.2	127.6	3.8		334.9	31.7	61.0
	Marsh Wren					127.6					61.0
	Yellow Warbler				23.2						
	Yellow-breasted Chat				10.3						
	Blue Grosbeak	98.1			10.4						
	Owens Valley Vole	98.1				127.6			334.9		61.0

Avian Census Table 15. cont. Total Acreage of Suitable Habitat for Indicator Species by Habitat Type and Reach

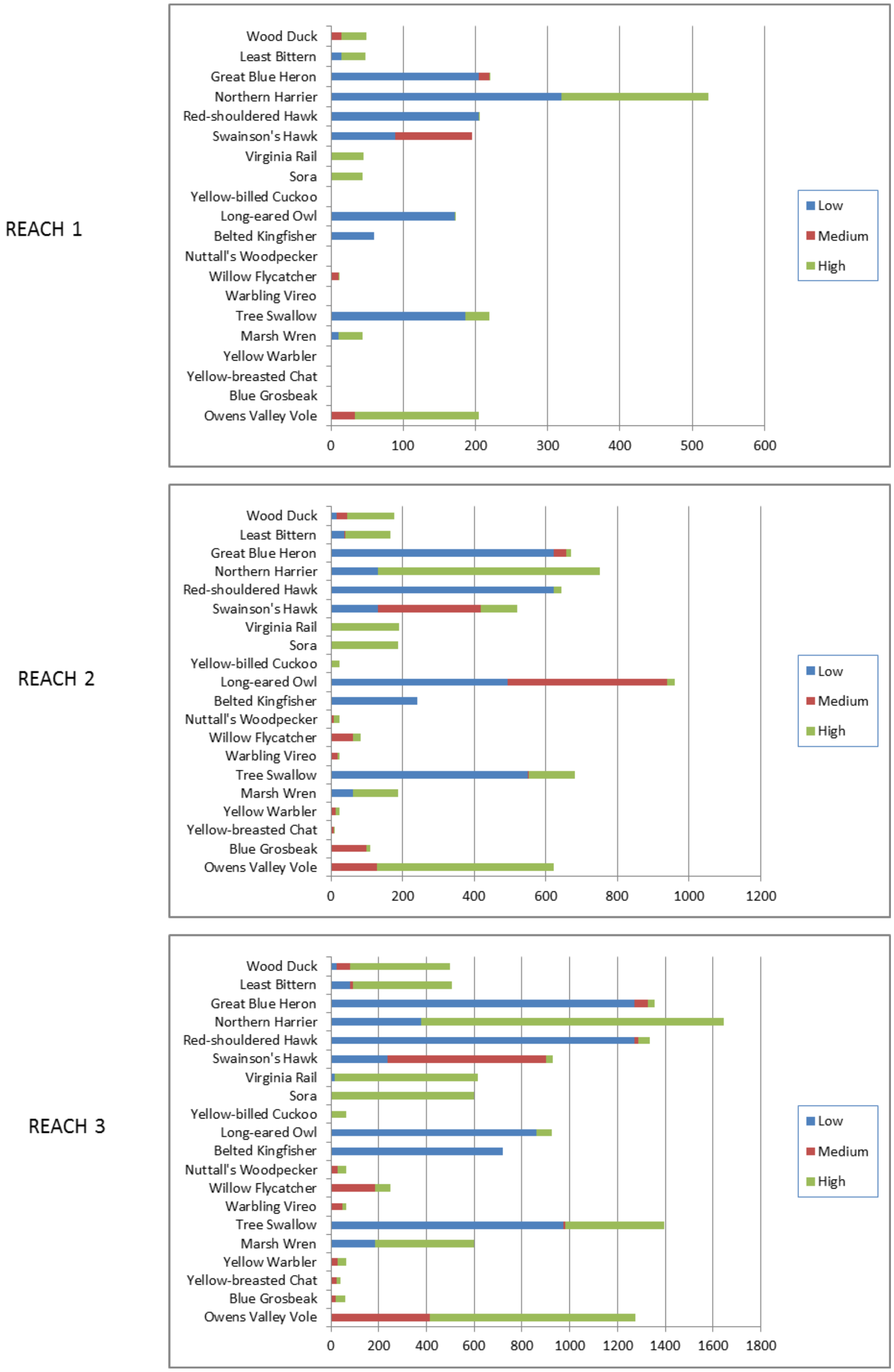
Reach 3	Species	AGS	ASC	BAR	DRI	FEW	LAC	PAS	PGS	RIV	WTM
	Wood Duck				26.9	413.3	4.7			53.0	
	Least Bittern				38.4	413.3	4.7			50.7	
	Great Blue Heron	20.2			26.9	413.3	4.7		651.9	53.0	185.2
	Northern Harrier	20.2	351.7	17.4		413.3	4.7		651.9	2.3	185.2
	Red-shouldered Hawk	20.2			65.5	413.3			651.9		185.2
	Swainson's hawk	20.2		17.4	53.0			2.5	651.9		185.2
	Virginia Rail				15.2	413.3					185.2
	Sora					413.3					185.2
	Yellow-billed Cuckoo				65.5						
	Long-eared Owl	20.2			65.5			2.5	651.9		185.2
	Belted Kingfisher				65.5	413.3	4.7			50.7	185.2
	Nuttall's Woodpecker				65.5						
	Willow Flycatcher				65.5						185.2
	Warbling Vireo				65.5						
	Tree Swallow	20.2			65.5	413.3	4.7		651.9	53.0	185.2
	Marsh Wren					413.3					185.2
	Yellow Warbler				65.5						
	Yellow-breasted Chat				38.7						
	Blue Grosbeak	20.2			38.7						
	Owens Valley Vole	20.2				413.3		2.5	651.9		185.2

Reach 4	Species	AGS	ASC	BAR	DRI	FEW	LAC	PAS	PGS	RIV	WTM
	Wood Duck				24.8	550.1	0.7			24.8	
	Least Bittern				23.8	550.1	0.7			19.7	
	Great Blue Heron				24.8	550.1	0.7		244.0	24.8	212.0
	Northern Harrier		140.8	3.1		550.1	0.7		244.0	5.1	212.0
	Red-shouldered Hawk				48.7	550.1			244.0		212.0
	Swainson's hawk			3.1	41.8			0.8	244.0		212.0
	Virginia Rail				7.7	550.1					212.0
	Sora					550.1					212.0
	Yellow-billed Cuckoo				48.7						
	Long-eared Owl				48.7			0.8	244.0		212.0
	Belted Kingfisher				48.7	550.1	0.7			19.7	212.0
	Nuttall's Woodpecker				48.7						212.0
	Willow Flycatcher				48.7						
	Warbling Vireo				48.7						
	Tree Swallow				48.7	550.1	0.7		244.0	24.8	212.0
	Marsh Wren					550.1					212.0
	Yellow Warbler				48.7						
	Yellow-breasted Chat				23.9						
	Blue Grosbeak				23.9						
	Owens Valley Vole					550.1		0.8	244.0		212.0

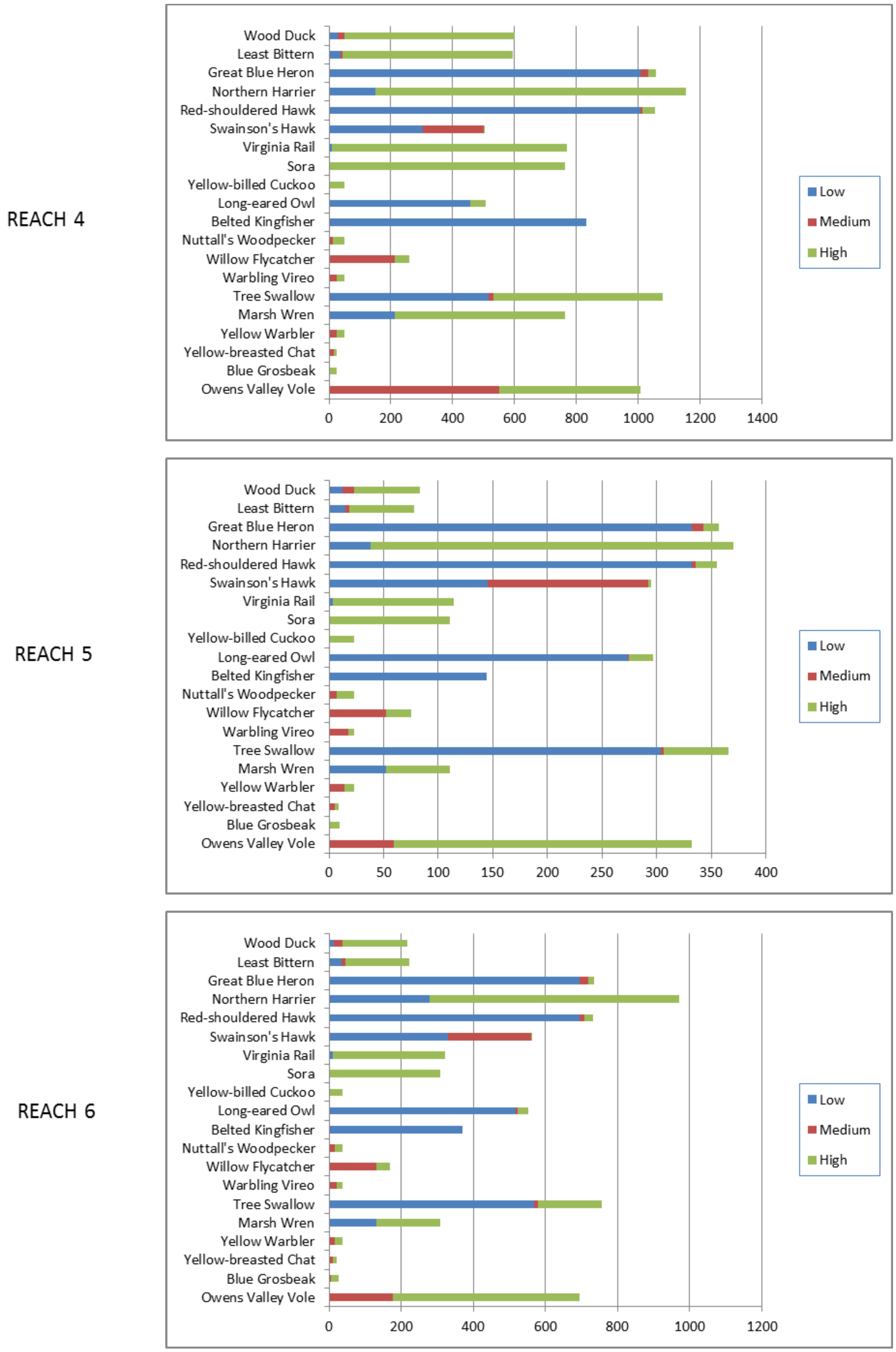
Avian Census Table 15. cont. Total Acreage of Suitable Habitat for Indicator Species by Habitat Type and Reach

Reach 5	Species	AGS	ASC	BAR	DRI	FEW	LAC	PAS	PGS	RIV	WTM
	Wood Duck				14.2	58.9	1.1			9.1	
	Least Bittern				8.8	58.9	0.9			9.0	
	Great Blue Heron				14.2	58.9	1.1		221.4	9.1	52.2
	Northern Harrier		35.6	1.2		58.9	0.9		221.4	0.1	52.2
	Red-shouldered Hawk				23.0	58.9			221.4		52.2
	Swainson's hawk			1.2	19.8				221.4		52.2
	Virginia Rail				3.2	58.9					52.2
	Sora					58.9					52.2
	Yellow-billed Cuckoo				23.0						
	Long-eared Owl				23.0				221.4		52.2
	Belted Kingfisher				23.0	58.9	0.9			9.0	52.2
	Nuttall's Woodpecker				23.0						
	Willow Flycatcher				23.0						52.2
	Warbling Vireo				23.0						
	Tree Swallow				23.0	58.9	1.1		221.4	9.1	52.2
	Marsh Wren					58.9					52.2
	Yellow Warbler				23.0						
	Yellow-breasted Chat				8.8						
	Blue Grosbeak				9.5						
	Owens Valley Vole					58.9			221.4		52.2

Reach 6	Species	AGS	ASC	BAR	DRI	FEW	LAC	PAS	PGS	RIV	WTM
	Wood Duck				15.1	177.7	2.3			23.0	
	Least Bittern				19.7	177.7	1.3			23.0	
	Great Blue Heron				15.1	177.7	2.3		385.0	23.0	131.3
	Northern Harrier		255.6	20.7		177.7	1.3		385.0		131.3
	Red-shouldered Hawk				36.7	177.7			385.0		131.3
	Swainson's hawk			20.7	26.2				385.0		131.3
	Virginia Rail				11.2	177.7					131.3
	Sora					177.7					131.3
	Yellow-billed Cuckoo				36.0						
	Long-eared Owl				36.7				385.0		131.3
	Belted Kingfisher				36.7	177.7	1.3			23.0	131.3
	Nuttall's Woodpecker				36.7						
	Willow Flycatcher				36.7						131.3
	Warbling Vireo				36.7						
	Tree Swallow				36.7	177.7	2.3		385.0	23.0	131.3
	Marsh Wren					177.7					131.3
	Yellow Warbler				36.7						
	Yellow-breasted Chat				21.6						
	Blue Grosbeak				26.6						
	Owens Valley Vole					177.7			385.0		131.3



Avian Census Figure 28. Total Acreages of Habitats Classified as Low, Medium or High Suitability Habitat by Indicator Species Varied Considerably Among Reaches



Avian Census Figure 28. Continued. Total Acreages of Habitats Classified as Low, Medium or High Suitability Habitat by Indicator Species Varied Considerably Among Reaches

Changes in CWHR Habitat Acreages

Apparent and real changes in CWHR habitats have occurred between baseline (2000), 2009, and 2015 (Avian Census Table 16). The apparent change can be attributed to the precision of vegetation mapping and to real vegetation change such as the conversion of open water to marsh, fire which reduces woody cover, and shifts in the relative proportions of wet meadow to perennial grassland.

Lands classified as Annual Grassland were non-existent under baseline conditions, however large stands of Bassia developed initially in Barren areas in Reach 2, and subsequently have declined in extent. There was a decrease in Alkali Scrub overall as some of these habitats have converted to Perennial Grassland. Desert Riparian showed a decrease, but as discussed in Section 6, this decrease can be explained largely by the differences in mapping precision between the three years. A true increase in Fresh Emergent Wetland has occurred, as wet meadow and open water areas have been converted to this habitat type. Perennial Grassland declined in 2015, while wet meadow increased. LAC habitat type increased in 2009, but decreased in 2015 with the conversion of some areas to marsh. That is a typical trend in the LORP as marsh vegetation gradually displaces open water over time. PAS showed a significant decrease in 2015, due primarily to the 2014 veg mapping, which more accurately represents the acreage of pasture in the LORP. Riverine initially showed an increase in 2009, but this habitat has decreased, possibly due to expansion of marsh. There was a significant increase in WTM, with a subsequent decrease in PGS.

Avian Census Table 16. Total Acreages of CWHR Habitats for Baseline (2000), 2009 and Current Conditions

CWHR Habitat Type	Reach 1			Reach 2			Reach 3			Reach 4		
	2000	2009	2015	2000	2009	2015	2000	2009	2015	2000	2009	2015
AGS	0.0	0.0	0.0	0.0	276.8	98.1	0.0	39.2	20.2	0.0	0.0	0.0
ASC	349.8	350.3	289.4	843.3	609.2	555.8	559.2	287.8	405.3	136.5	148.7	140.8
BAR	0.2	8.0	24.5	233.7	73.1	3.2	158.7	53.7	17.4	0.0	5.7	3.1
DRI	2.7	0.2	0.6	39.3	16.6	23.2	152.7	101.1	65.5	185.3	92.3	48.7
FEW	28.7	42.8	33.3	4.3	104.6	127.6	222.9	302.6	413.3	307.8	455.5	550.1
LAC	0.0	2.3	4.5	0.0	2.2	3.8	5.2	25.6	4.7	2.9	4.8	0.7
PAS	0.0	0.0	0.0	0.0	0.0	0.0	63.6	91.9	2.5	0.0	1.1	0.8
PGS	182.8	231.2	159.9	143.8	162.9	334.9	767.6	1079.8	651.9	505.7	458.9	244.0
RIV	15.2	23	10.7	11.1	37.1	31.7	17.2	51.1	53.0	38.4	52.2	24.8
WTM	11.5	0.0	11.1	0.0	0.6	61.0	74.7	24.9	185.2	50.1	8.1	212.0
Total acreage per reach	**590.9**	**657.8**	**533.9**	**1275.5**	**1283.1**	**1239.3**	**2021.8**	**2057.7**	**1819.1**	**1226.7**	**1227.3**	**1225.0**

CWHR Habitat Type	Reach 5			Reach 6			Total by CWHR Habitat		
	2000	2009	2015	2000	2009	2015	2000	2009	2015
AGS	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**316.0**	**118.3**
ASC	56.5	40.6	35.6	264.1	264.2	255.6	**2209.4**	**1700.8**	**1682.4**
BAR	0.0	1.3	1.2	0.0	12.8	20.7	**392.6**	**154.6**	**70.0**
DRI	21.9	22.5	23.0	85.9	69.5	36.7	**487.8**	**302.2**	**197.8**
FEW	70.5	50.2	58.9	161.9	156	177.7	**796.1**	**1111.7**	**1360.8**
LAC	1.7	1.9	1.1	3.7	3.5	2.3	**13.5**	**40.3**	**17.2**
PAS	0.0	0.0	0.0	0.0	0.0	0.0	**63.6**	**93.0**	**3.3**
PGS	223.1	253.2	221.4	412.4	473.6	385.0	**2235.4**	**2659.6**	**1997.2**
RIV	7.4	21.6	9.1	35.8	40.6	23.0	**125.1**	**225.6**	**152.3**
WTM	17.1	7.7	52.2	68.1	11.4	131.3	**221.5**	**52.1**	**652.8**
Total acreage per reach	**398.2**	**399.0**	**402.5**	**1031.9**	**1031.6**	**1032.3**	**6545.0**	**6655.9**	**6252.1**

3.1.4 Conclusions and Recommendations, Riverine-Riparian Area

Marsh, wet meadow, and open water wetland habitats have increased throughout the LORP since the initiation of perennial flow in 2006. Implementation of the LORP has resulted in a significant increase in landbird species richness in Reach 2 only, with the introduction of water, the establishment of marsh and wet meadow habitats, and resulting increase in habitat diversity. However, significant changes in landbird species richness were not observed in other reaches. Although some recruitment is occurring on the LORP, total riparian acreage, which is strong predictor of landbird richness, has not increased significantly in this time period.

Processes which maintain open water habitat and seasonally flooded wet meadow habitat will continue to support waterbird use of the LORP. Waterbird use of the LORP was above baseline in all reaches in 2010, but has declined in all reaches except Reach 4 due to the loss of open water and wet meadow habitat due to the conversion to marsh. Waterbird use, predicted by the acreage of wet meadow, was highest in Reach 4, where the majority of wet meadow is located. The wet meadow habitat where waterbirds were observed, was flooded; thus using this mapped vegetation category as a predictor variable likely does not fully represent habitat conditions affecting waterbird use. Wet meadow habitats will attract waterbirds when flooded, especially when interspersed with open water areas, as is seen in Reach 4. Continuous year-round inundation of wet meadow areas may lead to encroachment by marsh, and a decline in habitat quality for waterbirds.

Breeding bird species richness has followed a similar pattern as all landbird richness in terms of response to rewatering. With the establishment of water and marsh in Reach 2, Marsh Wren, Common Yellowthroat, Song Sparrow, and Red-winged Blackbird are now regular to abundant breeders in this reach leading to increased richness. Breeding bird richness on the LORP was predicted by the amount of total riparian vegetation, wet meadow, habitat diversity and marsh. Reach 5 had the highest richness, greatest acreage of woody riparian cover, and highest vegetation diversity. Woody riparian vegetation, required by many of the LORP habitat indicator species, has not increased although small-scale changes may be occurring. The most significant changes in species richness have been in Reach 2, where breeding bird richness has likely responded to the presence of water and the increase in habitat diversity as marsh and meadow habitats are now present or more abundant. In Reach 6, decreases in species richness may be associated with the decrease in open water in this reach. Due to the influence of woody riparian vegetation on breeding bird richness, it is not surprising that breeding bird richness has not increased in other areas of the LORP.

Data indicate decreases in Blue-gray Gnatcatcher, Spotted Towhee and Black-throated Sparrows in the LORP riverine-riparian area. Pre-project surveys found these shrub-nesting species most abundant in Reach 2. Under pre-project conditions, the river channel in Reach 2 was mostly dry, yet lined with dense tamarisk. Prior to initiation of flows, all tamarisk was removed from the channel in an effort to reduce the spread of this noxious weed in the project area, and reduce competition with native woody species. Tamarisk likely provided appropriate cover and structure for these species under preproject conditions. The tamarisk in the channel in Reach 2 has been replaced by marsh, which does not provide the dense shrubby structure these species require. Other effects should be considered such as impacts from cowbird parasitism, or responses to other landscape changes.

Breeding bird diversity was positively influenced by the amount of woody riparian vegetation and habitat diversity. Although large stands of trees are not common on LORP, even small trees stands or individual trees contribute to diversity by providing appropriate structure or nesting cavities opportunities that is otherwise absent in marsh or surrounding desert scrub habitat.

Species habitat relationships modeling is a tool that can be used to determine factors influencing bird species richness, diversity, and abundance and indicator species occurrence in the riverine-riparian area. Species habitat models can be predictive and can be useful decision support tools for guiding land management. Development of a species habitat association model for the LORP riverine-riparian area would likely have distinct advantages over the broad-scale CWHR wildlife habitat relationships model currently being used. This was demonstrated by evaluating the relationship between predicted Marsh Wren habitat using CWHR model versus occupancy and comparing it to the predictive power of a locally developed model for this species. Locally developed models often provide significant improvements in predictive power as broad-scale habitat associations are not necessarily applicable throughout a species range (Stralberg and Gardali 2007). Assumptions regarding habitat requirement may not hold true in all areas, and modeling may reveal patterns of species or community relationship that may help guide management to achieve project goals.

The preliminary modeling analysis presented in this report utilized readily available GIS data at two scales. Other factors that are known to influence bird populations include riparian width (Hagar 1999, Hodges and Krementz 1996), and vegetation structure, foliage density etc. (Sanders and Edge 1998, Taylor 2001). In addition, species may respond to landscape-vegetation conditions at various scales, thus a multiscale analysis should be considered. We recommend continued work on developing species habitat relationship models for LORP for the purpose of providing a management tool for understanding bird use of the riverine-riparian area. Habitat models should also address whether the current indicator species represent habitats and conditions desirable on LORP, and the use of other species as indicators of the health and diversity of riparian and aquatic habitats on LORP.

Although CWHR is easy to implement and provides a habitat suitability map for all indicator species, some difficulties have been encountered in applying CWHR to LORP, and the information obtained is of limited usefulness for guiding management. The CWHR analysis indicates that in the LORP riverine-riparian Management Area, habitat is available for all indicator species. Habitat is most abundant for species that are associated with Perennial Grassland and Fresh Emergent Wetland. Alkali Desert Scrub is also abundant, but not used by most indicator species. Habitat is most limited for species exclusively associated with Desert Riparian. There is even less Riverine, Lacustrine, and Pasture, but indicator species that are associated with those habitats also use a variety of other habitats.

As with the use of any model, caution should be used in the interpretation of the resulting output. This model may over or under represent the suitability for some species. The alkaline meadow habitats in the Owens Valley are floristically and functionally different from other “Perennial Grassland” types in California. Suitability for wildlife species may be different than classified under CWHR. The use of riparian habitat types other than Desert Riparian for those species that CWHR does not provide suitability values for - namely Wood Duck, Swainson’s Hawk, Red-shouldered Hawk, and Nuttall’s Woodpecker, likely resulted in a fairly accurate representation of suitable habitats on LORP, since the suitability of the riparian habitats is based primarily on the size and stage class. Other landscape factors will influence the relative suitability of individual habitat patches such as proximity to other habitat types, or habitat patch size. These factors are not taken into account in CWHR, but should be considered when interpreting results.

CWHR may be useful for documenting the available habitat for species not targeted for, or not encountered during avian censuses. The avian census project was developed to monitor the breeding songbird bird population on LORP. The avian census project was not designed to monitor the response of indicator species as it is only appropriate for a few of the 19 avian indicator species. Many of the indicator species do not vocalize regularly (e.g. rails), or occur at low abundances in the project area (e.g. Red-shouldered Hawk, Wood Duck); thus statistical inferences or conclusions of trend or response to management action based on the monitoring data are likely inappropriate. Rails (e.g. Virginia Rail and Sora) are secretive marsh birds that often remain hidden in dense vegetation, and vocalize infrequently. Relying on survey data from passive point count surveys will not provide reliable data regarding the population of rails in the riverine-riparian area. Playback call surveys for rails are known to significantly increase the detection rate of these species over passive surveys (Virginia Rail 657%, Sora 103%, Conway and Gibbs, 2005). In addition, State and/or Federal permits are required to conduct species-specific surveys, depending on the legal status. Species-specific surveys can add significantly to the cost of a monitoring program, and may not be warranted, depending on the project objectives.

3.2 Blackrock Waterfowl Management Area

3.2.1 Introduction

The Blackrock Waterfowl Management Area (BWMA) component of the Lower Owens River Project (LORP) is a managed wetland area comprised of four separate management units. Under LORP, rotational flooding of BWMA units occurs in order to provide habitat for waterfowl, shorebirds, wading birds, and other indicator species. Avian surveys are being conducted in order to evaluate use by these indicator species.

The availability of habitat for indicator species is being assessed through the use of the California Wildlife Habitat Relationship (CWHR) system (California Department of Fish and Game-CIWTG, 2014). The CWHR system provides suitability scores for the type of habitat use (i.e. reproduction, cover and feeding) based on a vegetation map that includes attributes of habitat type, size class, and cover class. CWHR thus serves as a coarse evaluation of expected habitat use. This report describes how the mapped vegetation communities of the BWMA were translated to CWHR habitat classifications.

LADWP Watershed Resources Specialists Debbie House and Chris Allen conducted avian surveys, data analysis and reporting of BWMA avian census. Chris Allen completed the CWHR indicator species habitat analysis and reporting. Inyo County Water Department (ICWD) Field Program Coordinator Jerry Zatorski and Vegetation Scientist Zach Nelson conducted avian surveys.

3.2.2 Study Area Description and Field and Analysis Methods

Survey Area

The Blackrock Waterfowl Management Area is located near the town of Aberdeen, and is composed of four management units, all lying east of the Los Angeles Aqueduct and west of the Owens River (Avian Census Figure 29). The BWMA is composed of four units encompassing a total of 1,987 acres. This area supports natural basins, playas, and springs, as well as constructed ditches, levees, culverts and roads. The BWMA has historically been used for water-spreading (LORP EIR 2002).

Under the LORP, LADWP is required to flood up to 500 acres in the BWMA to provide habitat consistent with the needs of these indicator species (MOU 1997). The specific amount of flooded acreage to be maintained in any one year is dependent upon the percent of forecasted run-off. The 1997 MOU specifies that approximately 500 acres of BWMA will be flooded at any given time in years of average or above-average runoff. The MOU states that in years when the forecasted runoff is estimated to be less than average, the flooded acreage will be set by the Standing Committee based upon the recommendations of the Wildlife and Wetlands Management Plan in consultation with California Department of Fish and Wildlife (CDFW).

Based on the 2014-2015 runoff year, the flooded acreage goal for BWMA was 180 acres. In 2015, the Drew Unit was taken out of active status. The Drew Unit has been continuously inundated since it was placed in active status in April 2009. Water releases to Drew were discontinued on April 2, 2015, and the unit slowly dried through the summer.

The Winterton Unit was placed in active status and water releases were initiated April 1. Prior to the release of water, parts of the unit were disked as described in Section 4 of this report entitled "Experimental disking on the Winterton Unit in preparation for flooding". The flooded acreage of a unit is determined once a season by LADWP and Inyo County Water Department staff walking the wetted perimeter (Avian Census Table 17).

Avian Census Table 17. Flooded Acreage by Unit and Season

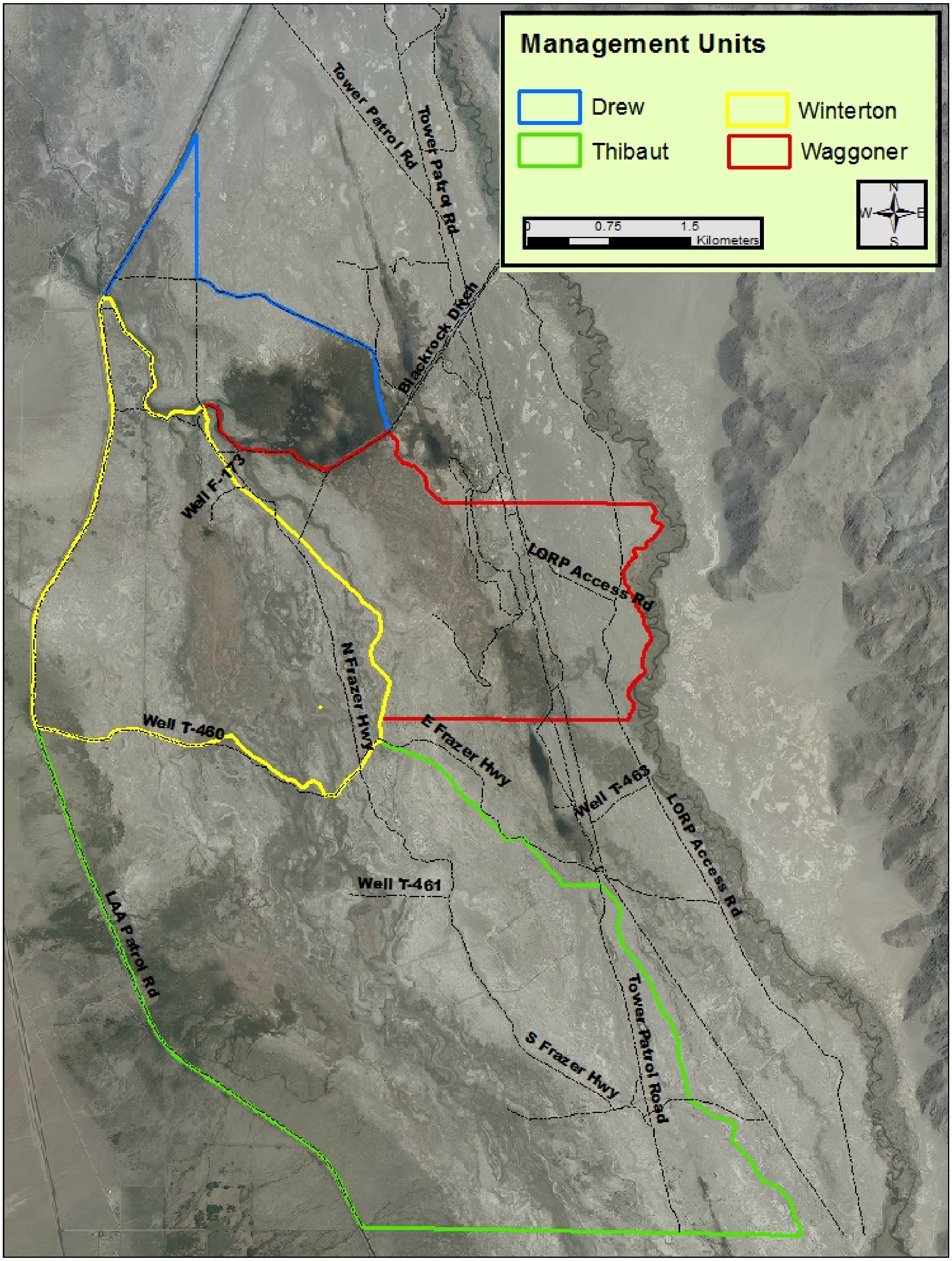
		WINTERTON	DREW
Season	**Date**	**Flooded Acreage**	**Flooded Acreage**
Spring	2010	n/a	276
Summer	2010	n/a	307
Spring	8 May 2014	n/a	309
Summer	8 July 2014	n/a	278
Fall	16 Sept 2014	n/a	270
Winter	15 Jan 2015	n/a	267
Spring	6 May 2015	86	235
Summer	10 July 2015	171	n/a
Fall	15 Sept 2015	221	n/a

BWMA Habitat Indicator Species

Habitat indicator species for the BWMA were initially identified in the Lower Owens River Project Ecosystem Management Plan - Action Plan and Concept Document (Ecosystem Sciences 1997). The presence of these species was thought to indicate whether or not the desired range of habitat conditions were being achieved (MOU 1997). Habitat indicator species for BWMA include all waterfowl, wading birds, shorebirds, plus Northern Harrier, Least Bittern, rails, and Marsh Wren (Avian Census Table 18). The resident, migratory and wintering waterfowl indicator group includes all species in the Family Anatidae. Geese, swans, dabbling ducks (*Anas* spp), and divers (scaup, Ruddy Duck, Bufflehead) are all included in this group. Wading birds includes species in the Family Ardeidae (egrets and herons), and Threskiornithidae (i.e. White-faced Ibis). The shorebird group includes all species in the Order Charadriiformes, exclusive of gulls and terns (Family Laridae). The MOU also identified Least Bittern and Northern Harrier, both California Species of Special Concern as habitat indicator species. Virginia Rail, Sora and American Coot are the three rail species that occur at BWMA. Marsh Wren is the only songbird species that is designated as an indicator species.

Avian Census Table 18. BWMA Habitat Indicator Species (MOU 1997)

WILDLIFE	
Resident migratory and wintering waterfowl	Least bittern
Resident, migratory and wintering wading birds	Northern harrier
Resident, migratory and wintering shorebirds	Rails
	Marsh wren



Avian Census Figure 29. Map of BWMA Management Units

Avian Survey Methodology

Avian surveys were conducted to assess use and seasonal abundance of BWMA habitat indicator species. The following table notes the survey dates by season for Drew and Winterton. Water releases had been discontinued in April and by August the unit was dry. The Winterton Unit was surveyed from initial water releases in April through October.

All surveys were conducted as area counts with observers walking the perimeter of the flooded area and recording all species encountered. Surveys began within 30 minutes of local sunrise, and a unit was generally surveyed within 4-5 hours. Habitat types used follow those being used for vegetation mapping of the LORP area as described above. Bird activity was recorded using one of the following categories: foraging, perching, calling, locomotion, flying over (not using habitat), flushed, unknown and reproductive. If reproductive activity was noted, the specific evidence of breeding was also noted in order to allow the determination of breeding status.

Avian Census Table 19. 2015 Survey Dates by Season for Drew and Winterton Units

	Spring				Summer	Fall				
Date	9 Apr	17 Apr	29 Apr	14 May	11 Jun	5 Aug	24 Aug	8 Sep	21 Sep	5 Oct
Drew	X	X	X		X					
Winterton	X	X	X	X	X	X	X	X	X	X

Avian Survey Data Summaries

The total number of BWMA indicator species were summed by survey and indicator species group for each unit. For the Drew Unit, survey results for 2015 were compared to surveys conducted at comparable times in 2010.

CWHR Analysis of Potential Habitat – BWMA Indicator Species

The California Wildlife Habitat Relationship System (CWHR) (Version 9.0) was used to evaluate the availability of habitats for BWMA Habitat Indicator Species in the same manner as done in the Riverine-Riparian management area. CWHR mapping was only completed for the Drew Unit since this is the only unit that was flooded when the imagery was taken in 2014.

CWHR Analysis Methodology

Vegetation communities in the BWMA project area are mapped using remote imagery. The results of the 2015 mapping using the 2014 imagery can be found in Section 4 of this LORP report - *LORP Landscape Vegetation Mapping 2014 Conditions.*

CWHR requires vegetation communities to be assigned to a CWHR community type, and in addition, stand structure needs to be represented by two variables size and stage which, for example, can take the form of height and cover. The 2014 aerial imagery of BWMA, and the 2015 vegetation mapping polygons were used to assign CWHR vegetation community type, size and stage following the same methodology used described for the analysis conducted in the Riverine-Riparian area. The same vegetation community types were used for both, the LORP and BWMA mapping projects, with the exception of two additional communities added to the BWMA inventory, “Slick” and “Desert Sink”. Slick was cross-walked to Lacustrine CWHR community type, and it was assigned the condition “periodically flooded”, Desert Sink was cross-walked to Alkali Desert Scrub CWHR community type.

3.2.3 Results and Discussion

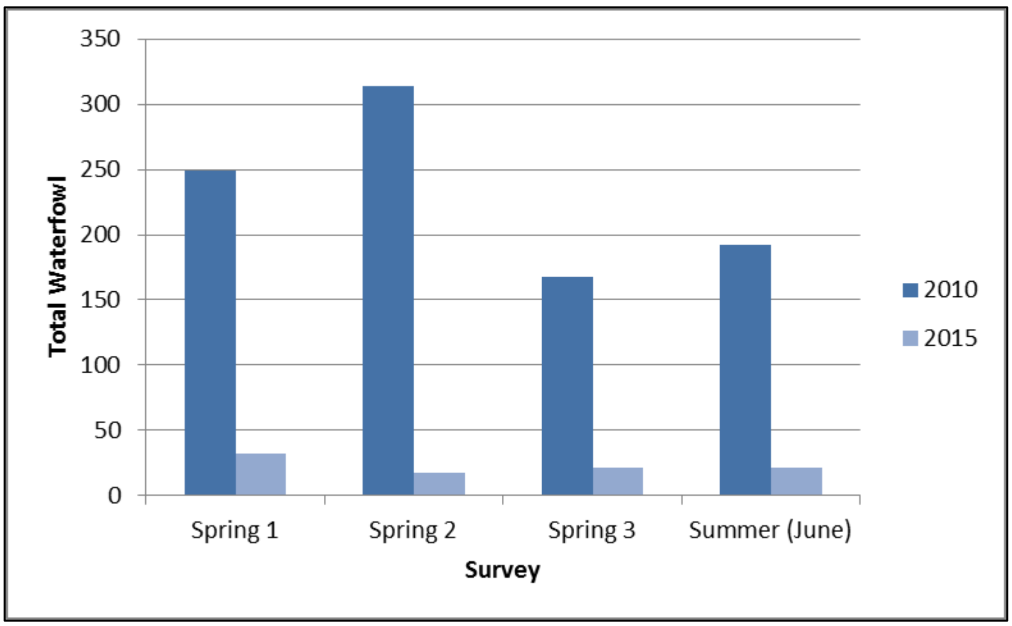
Avian Surveys, Drew Unit

A total of 20 indicator species and 326 individuals were detected at Drew during the four surveys (Avian Census Table 20). Almost equal numbers of waterfowl and wading birds were seen. Rails were also common, however an overwhelming majority of the rails were American Coots. Only 11 shorebirds were observed, and none during June indicating limited to no nesting at the site by shorebirds.

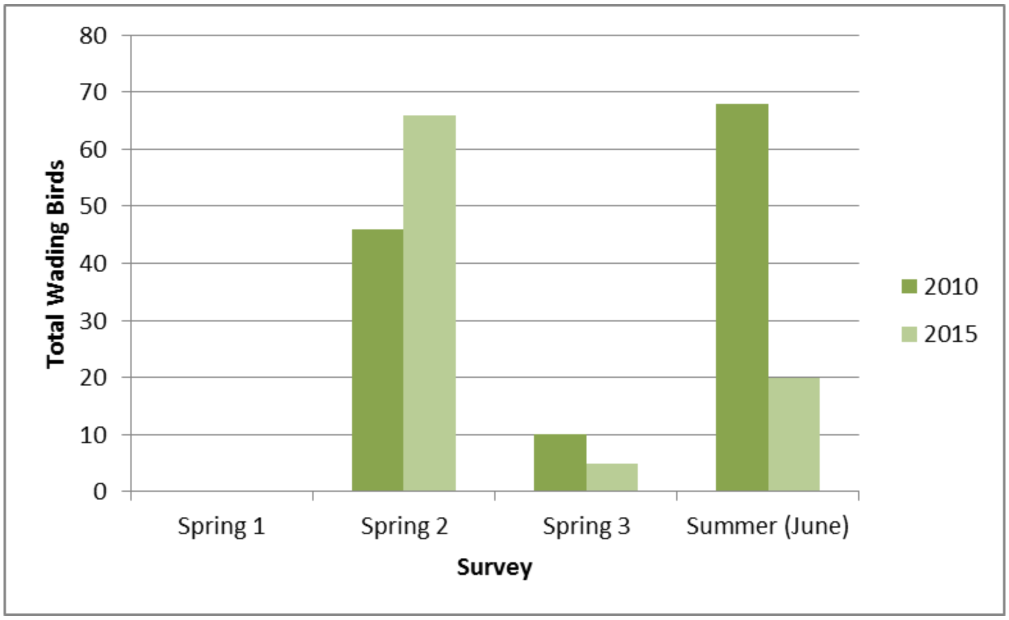
Results from the Drew Unit indicate a significant reduction in use by indicator species relative to 2010. Waterfowl use at Drew in 2015 was significantly below that observed in spring and summer of 2010 (Avian Census Figure 30). Fewer waterfowl species were also observed on each count (Avian Census Table 20). Wading bird use in 2015 was comparable to 2010 during spring in terms of numbers and species richness, but below the 2010 use in summer (Avian Census Figure 31). Shorebirds were virtually absent from Drew in 2015, although this indicator species group was abundant in spring 2010 (Avian Census Figure 32). Fewer shorebird species were seen on all surveys and no shorebirds were detected on two of the surveys (Avian Census Table 20).

Avian Census Table 20. 2015 Habitat Indicator Species Results by Survey - Drew Unit

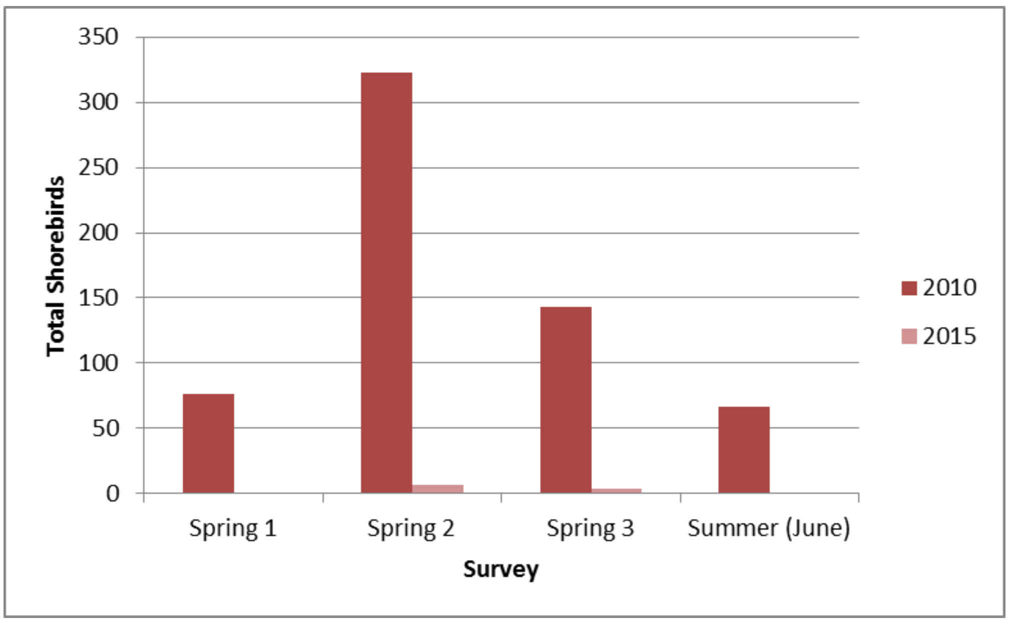
Indicator Species Group	Common Name	9-Apr-15	17-Apr-15	29-Apr-15	11-Jun-15	All Surveys
Waterfowl	Canada Goose	2	2			4
	Gadwall	6		4	3	13
	Mallard	6	6	8	18	38
	Cinnamon Teal	15	9	6		30
	Northern Shoveler		1			1
	Green-winged Teal	3		3		6
	Waterfowl Total	**32**	**18**	**21**	**21**	**92**
Wading Birds	Great Blue Heron		7	3	8	18
	Great Egret			2	10	12
	Snowy Egret		2			2
	Black-crowned Night-Heron				2	2
	White-faced Ibis		57			57
	Wading Bird Total	**0**	**66**	**5**	**20**	**91**
Other	Northern Harrier	2	5	2	1	10
Rail	Virginia Rail	1	1			2
	Sora	3	5			8
	American Coot	14	16	29	4	63
	Rail Total	18	22	29	4	**73**
Shorebirds	Killdeer			3		3
	Spotted Sandpiper		1	1		2
	Greater Yellowlegs		5			5
	Wilson's Snipe		1			1
	Shorebird Total	**0**	**7**	**4**	**0**	**11**
Other	Marsh Wren	16	29	1	3	49
	Total	**68**	**147**	**62**	**49**	**326**



Avian Census Figure 30. Total Waterfowl Observed at Drew Unit - 2010 vs. 2015



Avian Census Figure 31. Total Wading Birds Observed at Drew Unit - 2010 vs. 2015



Avian Census Figure 32. Total Shorebirds Observed at Drew Unit - 2010 vs. 2015

Avian Census Table 21. Indicator Species Seen During Surveys of Drew, 2010 vs 2015

Survey Period	Spring 1		Spring 2		Spring 3		Summer (June)	
Year	2010	2015	2010	2015	2010	2015	2010	2015
Waterfowl	8	5	9	4	10	4	8	2
Wading Birds	0	0	3	3	3	2	6	3
Shorebirds	6	0	7	3	8	2	5	0

Avian Surveys, Winterton Unit

Water resources were limited in the Winterton Unit early in spring since releases were not initiated until April. Spring counts were initially low but for most species; numbers increased throughout the summer and peaked in the fall (Avian Census Table 22 and Avian Census Figure 33). American Coot was the most abundant species, and represented the most dramatic increase. There were 25 in the spring and a total of 2,408 on the fall surveys.

The waterfowl guild was well represented at Winterton, with a total of 3,052 observations, representing 16 species. Canada Goose was present in the spring, and absent during the rest of the year. One Greater White-fronted Goose was present in the fall. The total goose count was low for the entire year. Waterfowl that were only present in the fall included Wood Duck, American Wigeon, Blue-winged Teal, Northern Pintail, Canvasback, Ring-necked Duck, Ruddy Duck and Redhead. The most abundant waterfowl species were Gadwall, Mallard, Cinnamon Teal, Northern Shoveler and Green-winged Teal. They were present throughout the summer, but were most abundant in the fall. Diving Ducks, such as Ruddy Duck, Redhead and Ring-necked Duck were only present in the fall.

Wading birds were observed in all seasons, but were most abundant in spring and fall. The most abundant wading bird was White-faced Ibis, with a total count of 113. It was present throughout much of the year. Great Blue Heron and Great Egret were common, but were more abundant in the fall. There were only 6 observations of Snowy Egret, in the spring. It was absent during summer and fall. There also were only 6 observations of Black-crowned Night Heron, and one Green Heron in fall. There were no detections of Cattle Egret. Sora was the most abundant rail, with 100 total detections recorded over all surveys. Only 4 Virginia Rails were detected. American Coot (mentioned above) is also a rail, but for the purpose of this report, it will be treated separately. The primary reason for this is that the count is so high that it obstructs the ability to display the counts for the rest of the species.

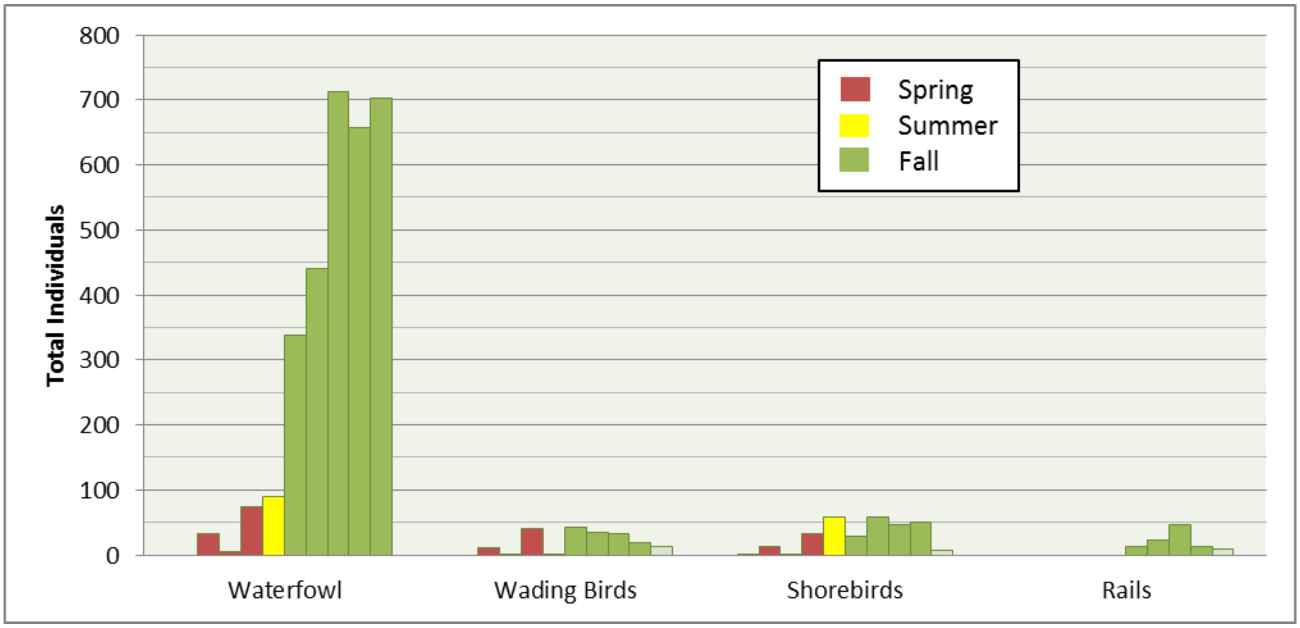
Fourteen species of shorebirds were detected during the surveys. Killdeer was the most abundant shorebird and it was present throughout the year. Other shorebirds that were fairly abundant are Red-necked and Wilson’s phalarope, Black-necked Stilt, Wilson’s Snipe, Least Sandpiper and Greater Yellowlegs. American Avocet, Spotted Sandpiper, Long-billed Curlew, Marbled Godwit, Western Sandpiper and Long-billed Dowitcher were present as well, but in lesser numbers. Wilson’s Phalarope was present all summer, but Red-necked Phalarope occurred only in the fall. Twelve Solitary Sandpipers were seen, which is a rare migrant in the Owens Valley.

Avian Census Table 22. Winterton Survey Results

Common Name	9-Apr-15	17-Apr-15	29-Apr-15	14-May-15	11-Jun-15	5-Aug-15	24-Aug-15	8-Sep-15	21-Sep-15	5-Oct-15	Total
Greater White-fronted Goose										1	1
Canada Goose			8								8
Tundra Swan											0
Wood Duck								2			2
Gadwall			4	30	34	53	50	352	306	232	1061
American Wigeon							3		4	54	61
Mallard		4	10	32	49	73	63	115	107	113	566
Blue-winged Teal									2	5	7
Cinnamon Teal				11	3	54	43	85	89	11	296
Northern Shoveler			6			110	166	25	89	91	487
Northern Pintail							7			12	19
Green-winged Teal		2	4	1	2	36	89	133	56	73	396
Canvasback									2	1	3
Redhead						6	10			11	27
Ring-necked Duck										46	46
Lesser Scaup											0
Bufflehead					1						1
Ruddy Duck						7	9		3	52	71
Great Blue Heron		1	3		2	10	5	7	4	1	33
Great Egret			2	4			10	10	7	3	36
Snowy Egret			6								6
Cattle Egret											0
Green Heron								1			1
Black-crowned Night-Heron						3	2				5
White-faced Ibis		1		36		29	17	14	8	8	113

Avian Census Table 22, continued. Winterton Survey Results

Common Name	9-Apr-15	17-Apr-15	29-Apr-15	14-May-15	11-Jun-15	5-Aug-15	24-Aug-15	8-Sep-15	21-Sep-15	5-Oct-15	Total
Northern Harrier	2				1	1	2	3	7	2	18
Virginia Rail						2	1			1	4
Sora						11	22	47	13	7	100
American Coot				25	15	54	175	30	607	1596	2502
Black-bellied Plover											0
Semipalmated Plover											0
Killdeer	2	1	10	16	17	4	6	9	16	1	82
Black-necked Stilt			2	10	19	4	5				40
American Avocet				2	7						9
Spotted Sandpiper				4	1						5
Solitary Sandpiper				1			4		7		12
Greater Yellowlegs						1	6	4	13	2	26
Willet											0
Lesser Yellowlegs											0
Long-billed Curlew						2			2		4
Marbled Godwit						1					1
Western Sandpiper							1				1
Least Sandpiper						5	12				17
Dunlin											0
Calidris sp.											0
Short-billed Dowitcher											0
Long-billed Dowitcher						1	5				6
Wilson's Snipe						1	13	5	4	2	25
Common Snipe											0
Wilson's Phalarope					15	10			2		27
Red-necked Phalarope							6	28	6	2	42
Marsh Wren	2					6	4	16	10	19	57
Total	6	9	55	172	166	484	736	886	1364	2346	6224



Avian Census Figure 33. Total Guild Count by Survey and Season, Winterton Unit

CWHR Analysis of Potential Habitat

CWHR Habitat Composition of the Drew Unit

The total acreage assessed in 2014 was larger than in 2000 and 2009 because in 2000 and 2009 only the flooded portion of the unit was mapped; in 2014, the entire unit was mapped as habitat (Avian Census Table 23). The most significant change in 2014 was the increase in FEW (Fresh Emergent Wetland) and decrease in LAC (Lacustrine). Much of the open water habitat present in Drew in 2010 had been replaced by marsh (Avian Census Figures 34 and 35). There was also an increase in PGS (Perennial Grassland) in 2014, but this increase was due to the mapping process. Since the entire unit was mapped in 2014, it included large portions of ASC (Alkali Desert Scrub), and PGS, that were not mapped in 2000 and 2009.

Alkali Desert Scrub (ASC) represents the largest portion of CWHR habitat in the Drew Unit, but only 2% of the indicator species use it (Avian Census Figures 36 and 37. The majority of indicator species use Lacustrine habitat type which represents 13% of the Drew Unit. Fresh Emergent Wetland appears to be the most productive habitat type in the Drew Unit. It represents 25% of the unit and 24% of the indicator species use it.

Most of the Lacustrine and Fresh Emergent Wetland in the southeast portion of the Drew Unit was the result of flooding from 2009-2014 (Avian Census Figure 17). Much of the north part of the flooded area was once Alkali Desert Scrub, but gradually converted to Lacustrine and Fresh Emergent Wetland due to the flooding (Avian Census Figure 38). Some Lacustrine ponding areas are shown on the map, surrounded by Alkali Desert Scrub (ASC).

Avian Census Table 23. Acres of CWHR Habitats in the Drew Management Unit

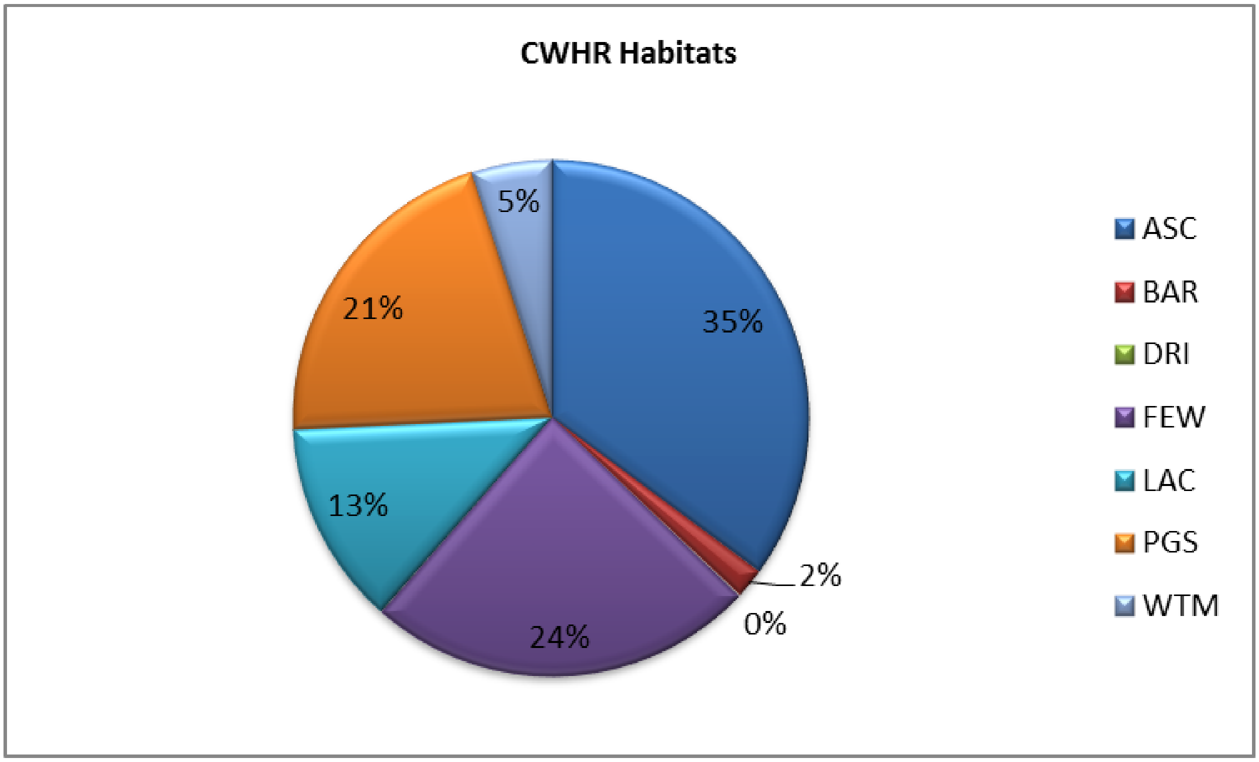
CWHR HABITAT	2000	2009	2015
Alkali Desert Scrub (ASC)	317.3	47.7	288.3
Barren (BAR)	47.4	5.5	15.3
Desert Riparian (DRI)	2.0	0.8	6.2
Fresh Emergent Wetland (FEW)	21.8	104.1	200.3
Lacustrine (LAC)	31	284.5	104.9
Perennial Grassland (PGS)	55.9	50.7	170.3
Wet Meadow (WTM)	17.6	0.0	41.3
Total	**493.0**	**493.2**	**826.6**

Avian Census Figure 34. Drew Slough, Open Water to Marsh

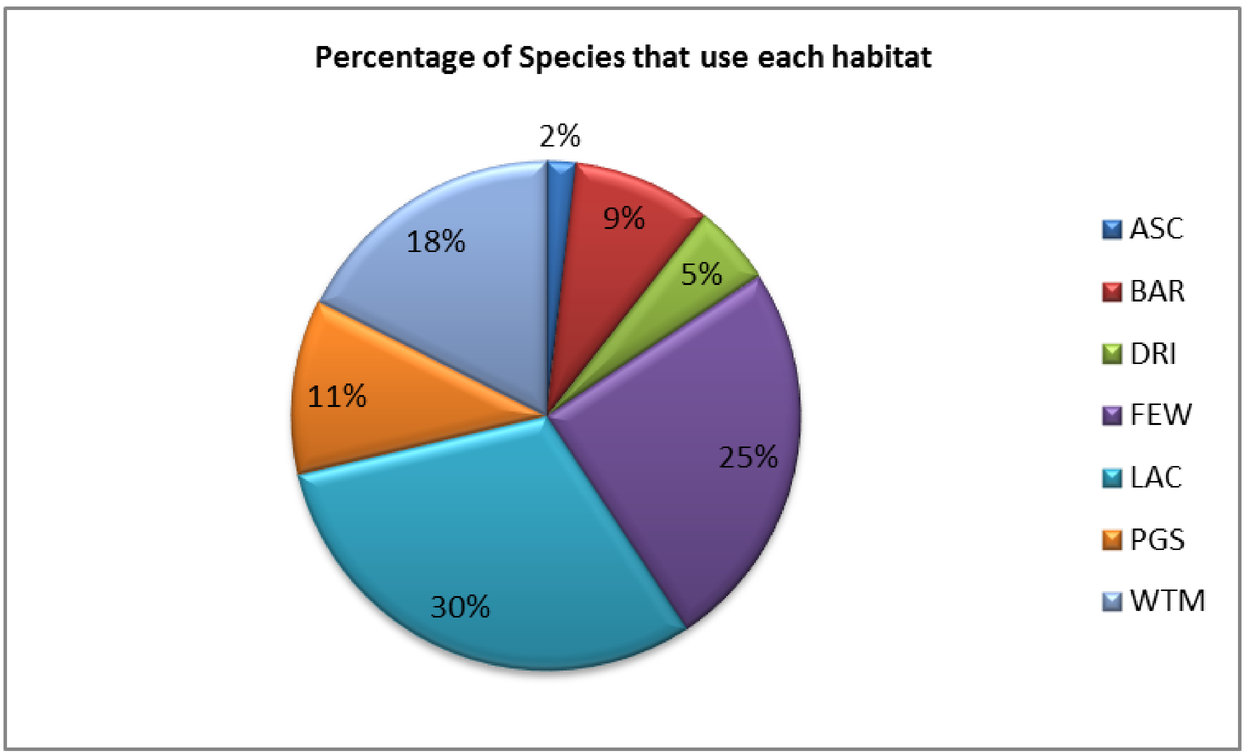
In 2010, most open water in Drew had been replaced by marsh by 2015, reducing the habitat quality and use by waterfowl.

Avian Census Figure 35. Drew Slough, Flooded Desert Sink to Marsh

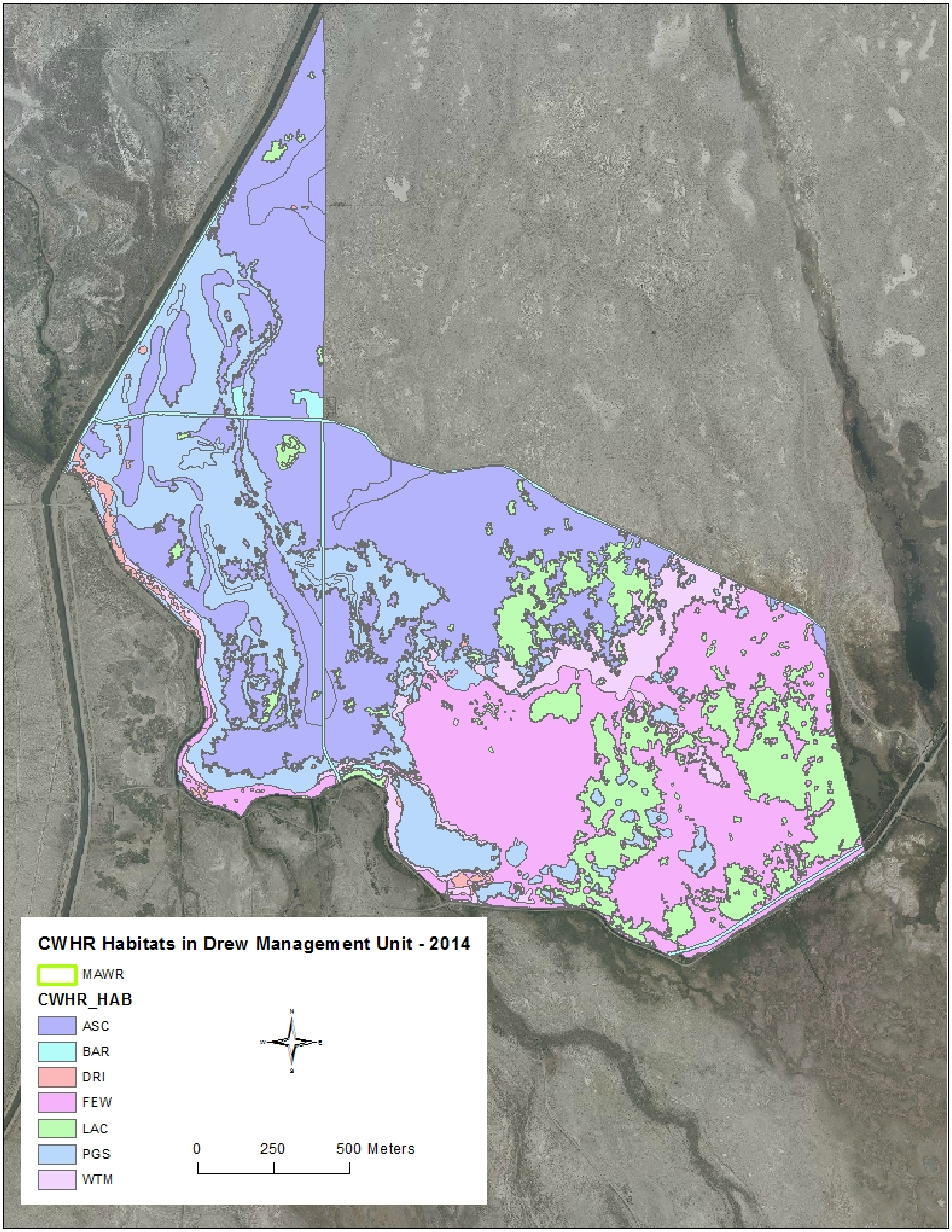
Areas of flooded desert sink such as this that were present in 2010 attracted large numbers of shorebirds at Drew; these areas were filled in with marsh in 2015; shorebirds were almost completely absent from Drew.



Avian Census Figure 36. Percentage of CWHR Habitats, Drew Management Unit, 2014



Avian Census Figure 37. Percentage of Species that Use Each Habitat, Drew Unit



Avian Census Figure 38. CWHR Habitats in the Drew Management Unit in 2014

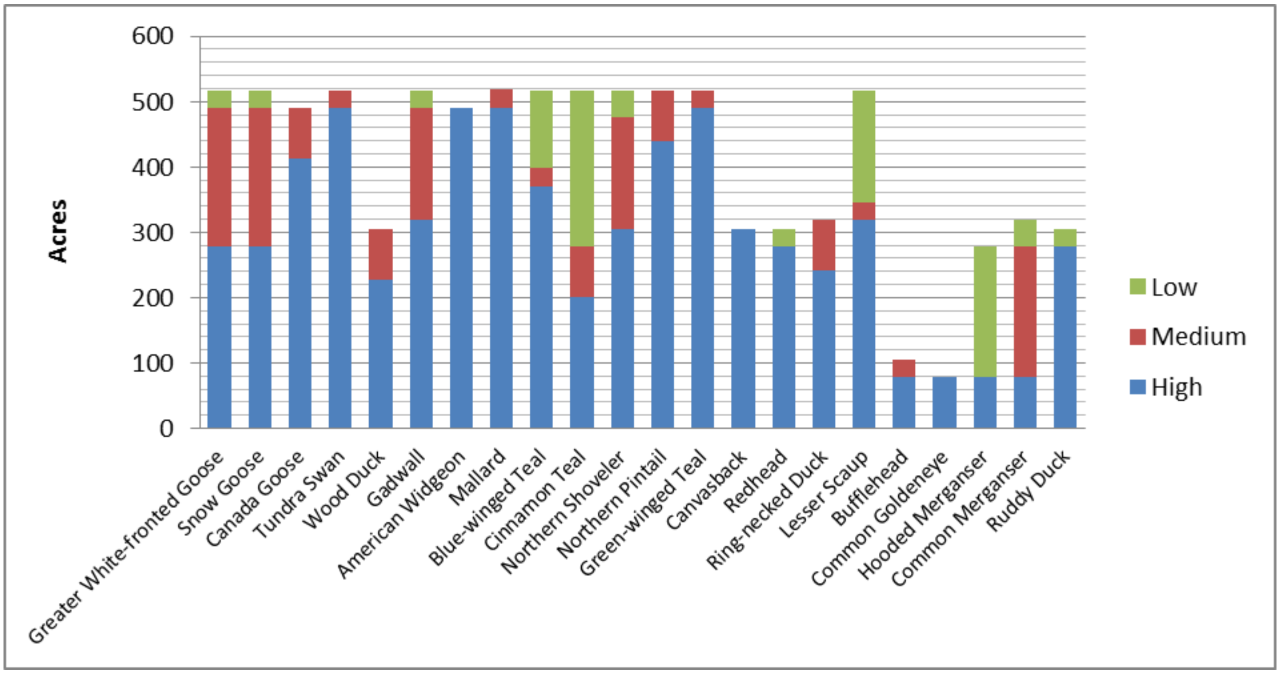
The acreage of suitable CWHR habitat for each species is presented in Avian Census Table 24. The method for determining acres of habitat quality was the same as that used for the riverine CWHR (see section 1.1.2)

Avian Census Table 24. Acreage of Suitable Habitat for Indicator Species by Habitat Type, Drew Unit

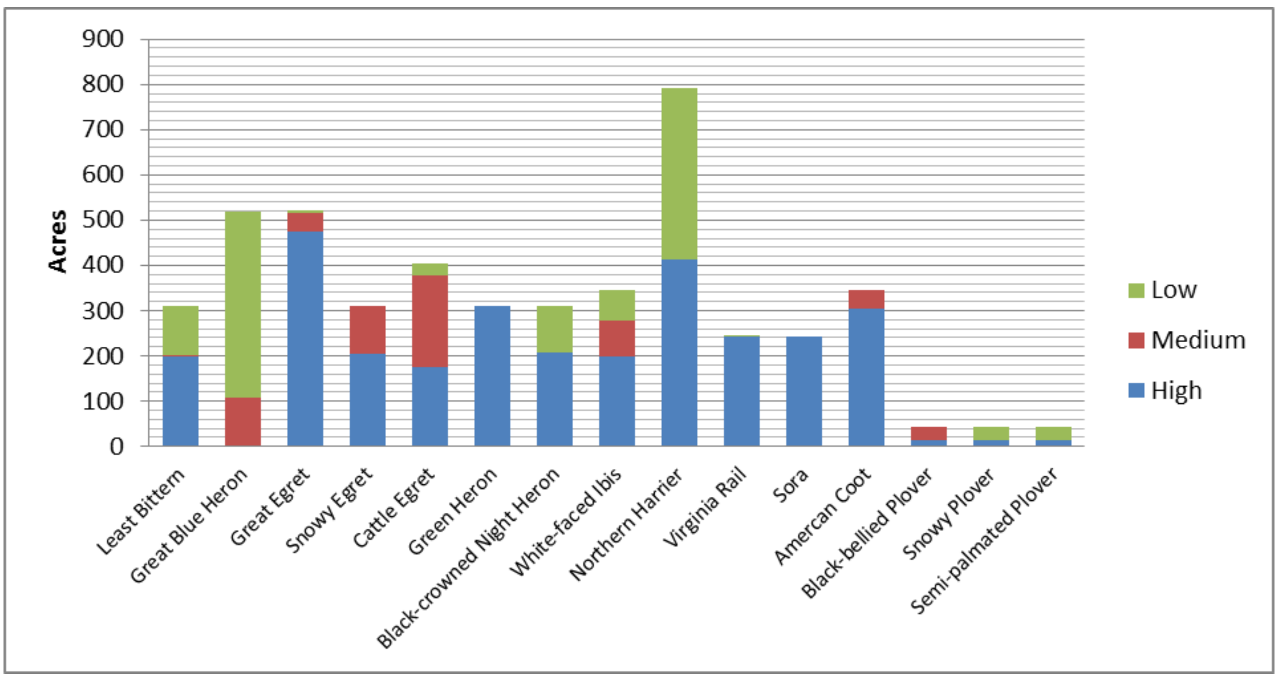
	CWHR Habitat							
Species	**ASC**	**BAR**	**DRI**	**FEW**	**LAC**	**PGS**	**WTM**	**Total**
Greater White-fronted Goose	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Snow Goose	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Canada Goose	0.0	0.0	0.0	200.3	77.6	170.3	41.3	489.5
Tundra Swan	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Wood Duck	0.0	0.0	0.0	200.3	104.9	0.0	0.0	305.2
Gadwall	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
American Widgeon	0.0	0.0	0.0	200.3	77.6	170.3	41.3	489.5
Mallard	0.0	0.0	2.7	200.3	104.9	170.3	41.3	519.5
Blue-winged Teal	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Cinnamon Teal	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Northern Shoveler	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Northern Pintail	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Green-winged Teal	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Canvasback	0.0	0.0	0.0	200.3	104.9	0.0	0.0	305.2
Redhead	0.0	0.0	0.0	200.3	104.9	0.0	0.0	305.2
Ring-necked Duck	0.0	0.0	0.0	200.3	77.6	0.0	41.3	319.2
Lesser Scaup	0.0	0.0	0.0	200.3	104.9	170.3	41.3	516.8
Bufflehead	0.0	0.0	0.0	0.0	104.9	0.0	0.0	104.9
Common Goldeneye	0.0	0.0	0.0	0.0	77.6	0.0	0.0	77.6
Hooded Merganser	0.0	0.0	0.0	200.3	77.6	0.0	0.0	277.9
Common Merganser	0.0	0.0	0.0	200.3	77.6	0.0	0.0	277.9
Ruddy Duck	0.0	0.0	0.0	200.3	104.9	0.0	0.0	305.2
Least Bittern	0.0	0.0	3.7	200.3	104.9	0.0	0.0	309.0
Great Blue Heron	0.0	0.0	2.4	200.3	104.9	170.3	41.3	519.3

Table 3.24. continued, Acreage of Suitable Habitat for Indicator Species by Habitat Type, Drew Unit

	CWHR Habitat							
Species	**ASC**	**BAR**	**DRI**	**FEW**	**LAC**	**PGS**	**WTM**	**Total**
Great Egret	0.0	0.0	3.5	200.3	104.9	170.3	41.3	520.3
Snowy Egret	0.0	0.0	3.7	200.3	104.9	0.0	0.0	309.0
Cattle Egret	0.0	0.0	6.2	200.3	27.3	170.3	0.0	404.1
Green Heron	0.0	0.0	6.2	200.3	104.9	0.0	0.0	311.4
Black-crowned Night Heron	0.0	0.0	6.2	200.3	104.9	0.0	0.0	311.4
White-faced Ibis	0.0	0.0	0.0	200.3	104.9	0.0	41.3	346.5
Northern Harrier	288.3	15.3	0.0	200.3	77.6	170.3	41.3	793.1
Virginia Rail	0.0	0.0	2.7	200.3	0.0	0.0	41.3	244.3
Sora	0.0	0.0	0.0	200.3	0.0	0.0	41.3	241.6
Amercan Coot	0.0	0.0	0.0	200.3	104.9	0.0	41.3	346.5
Black-bellied Plover	0.0	15.3	0.0	0.0	27.3	0.0	0.0	42.6
Snowy Plover	0.0	15.3	0.0	0.0	27.3	0.0	0.0	42.6
Semi-palmated Plover	0.0	15.3	0.0	0.0	27.3	0.0	0.0	42.6
Killdeer	32.1	15.3	0.0	0.0	27.3	0.0	0.0	74.8
Black-necked Stilt	0.0	15.3	0.0	200.3	27.3	0.0	41.3	284.2
American Avocet	0.0	15.3	0.0	200.3	27.3	0.0	41.3	284.2
Spotted Sandpiper	0.0	15.3	0.0	0.0	27.3	0.0	41.3	83.9
Greater Yellowlegs	0.0	0.0	0.0	200.3	104.9	0.0	41.3	346.5
Willet	0.0	0.0	0.0	200.3	27.3	0.0	41.3	268.9
Lesser Yellowlegs	0.0	15.3	0.0	200.3	104.9	0.0	41.3	361.8
Long-billed Curlew	0.0	15.3	0.0	200.3	27.3	170.3	41.3	454.5
Marbled Godwit	0.0	15.3	0.0	200.3	27.3	170.3	41.3	454.5
Westerm Sandpiper	0.0	15.3	0.0	200.3	27.3	0.0	41.3	284.2
Least Sandpiper	0.0	15.3	0.0	200.3	27.3	0.0	41.3	284.2
Dunlin	0.0	15.3	0.0	0.0	27.3	0.0	0.0	42.6
Long-billed Dowitcher	0.0	15.3	0.0	0.0	27.3	0.0	0.0	42.6
Wilson's Snipe	0.0	0.0	0.0	200.3	27.3	0.0	41.3	268.9
Wilson's Phalarope	288.3	0.0	0.0	200.3	104.9	170.3	41.3	805.2
Red-necked Phalarope	0.0	0.0	0.0	0.0	27.3	0.0	0.0	27.3
Marsh Wren	0.0	0.0	0.0	200.3	0.0	0.0	41.3	241.6



Avian Census Figure 39. Acreage of low, medium and high quality habitat per species



Avian Census Figure 39, continued. Acreage of Low, Medium and High Quality Habitat per Species

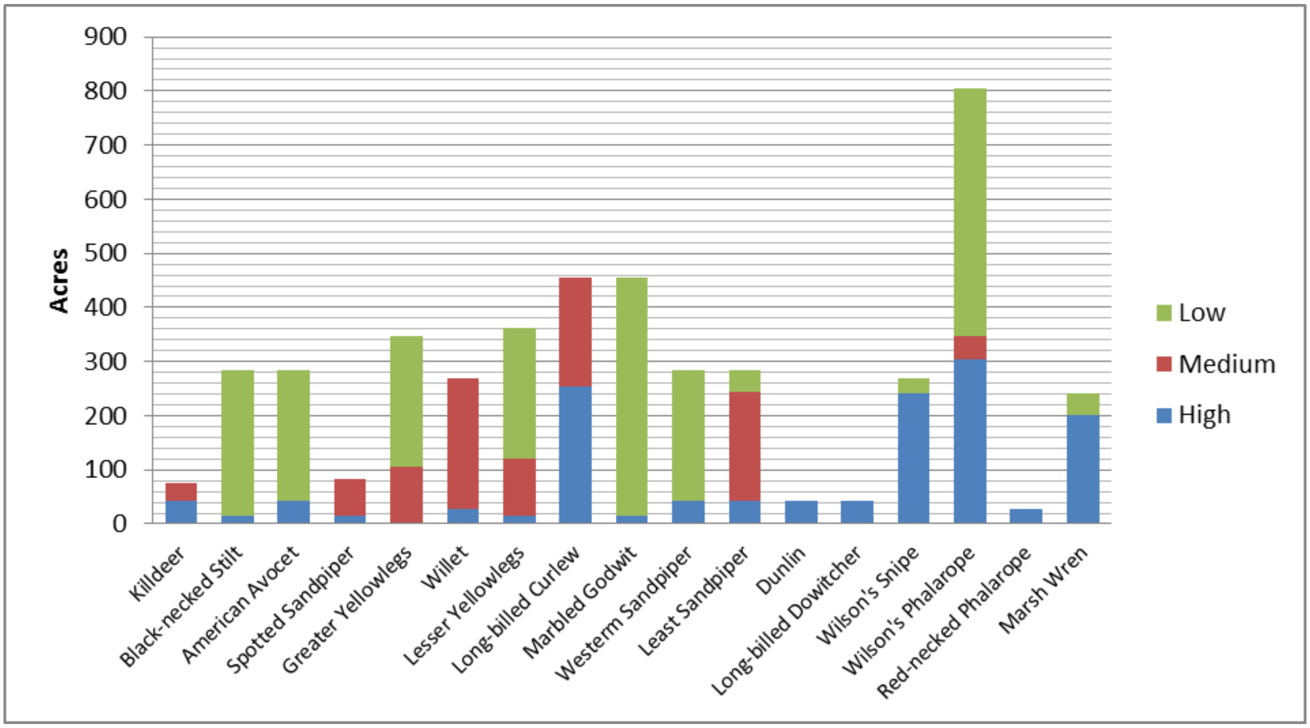


Figure 3.39, continued. Acreage of Low, Medium and High Quality Habitat per Species

Wilson's Phalarope has the largest acreage of suitable habitat in the Drew Unit, 805.2 acres, while Red-necked Phalarope only has 27.3 acres (Avian Census Table 23). According to the CWHR model, suitable habitat for Wilson's Phalarope includes ASC, FEW, LAC, PGS, RIV and WTM. Suitable habitat for Red-necked Phalarope includes only LAC. Northern Harrier has the second largest acreage, 793.5. Most waterfowl have close to 500 acres each, most of which is high quality habitat, but diving ducks have less. Other than Wilson's Phalarope (which is a shorebird), shorebirds have the least amount of suitable habitat, most of which is low to medium quality (Avian Census Figure 39). Suitable habitat available for rails is entirely high quality. They require WTM and FEW. On the average, wading birds have a little more suitable habitat than shorebirds, but less than waterfowl, most of which is high quality. Great Blue Heron, however, has primarily low quality habitat.

3.2.4 Conclusion and Recommendations

Avian Surveys

During initial flooding in 2009 and at least through 2010, the Drew Unit was very productive in terms of the number and diversity of habitat indicator species using the area. Although no surveys were conducted after 2010, casual observations suggest that use by indicator species started declining by year three despite similar wetted acreages in all years since. The surveys conducted in 2015 confirmed that indicator species use has declined significantly since 2010.

In order to maintain productivity, wetlands need to experience periodic water level fluctuations (Ducks Unlimited 2005, Locke et. al 2007), a condition that has not occurred in BWMA due to the current static wetted acreage requirement. Water level manipulations are one of the most effective tools in wetland management to influence the food resources that attract wildlife (Fredrickson 1991). Continuous inundation of wetlands may lead to decreased wetland productivity and an inefficient use of water resources for wildlife benefit. Efficient use of water resources in the BWMA and maintaining wetland productivity and use by indicator species may require an alternative approach involving more seasonal manipulation of water levels and seasonal drying to control emergent vegetation.

Indicator species showed a quick response to the spring flooding at Winterton. Although only a few species were present in early April just after releases were initiated, by the end of April and into early May, indicator species use increased rapidly. Use of Winterton in fall by waterfowl was high as releases had created large open water ponds and shallowly flooded meadow areas attractive to waterfowl. The flooded meadow habitats also provided fairly good habitat for wading birds. Shorebird use was not very high likely due to lack of seasonally exposed mudflats and flooded areas of appropriate depth for foraging. In this first year, Sora use was very high in the northern part of the unit. Even though the northern part of the unit was disked prior to flooding to break up the cattails, cattail regrowth was vigorous throughout the entire disked area due to a steady supply of water throughout the growing season.

CWHR Analysis and Potential Habitat, Drew Unit

Many of the species that were assigned suitable habitat by CWHR were present in the Drew Management Unit during the active period (in 2010, but not in 2015). Waterfowl, grebes and wading birds were fairly abundant. Marsh birds, such as Marsh Wren and Sora, were abundant as well. Diving ducks were less common. Geese and swans did not occur at Drew, even though 500 acres of suitable habitat were available according to CWHR. Geese normally prefer open shoreline, and a transition from ponds to meadow. The Lacustrine ponding areas in Drew were surrounded by tall marsh vegetation, and sufficient shoreline did not exist. The model assigned habitat value to geese and swans based on the availability of lacustrine and grassland habitats, but did not take into account the proximity of these habitats. Some shorebird species, did not occur at Drew, probably due to the fact that adequate habitat size did not exist. The CWHR model does not account for habitat size requirements for species. However, the majority of species with suitable habitat, according to CWHR, did occur at Drew.

Consideration should be given to reevaluating the vegetation and avian monitoring program for BWMA to ensure that the information being collected is what is needed to 1) assess habitat quality for indicator species, and 2) guide adaptive management. One concern is that imagery capture that has been used for CWHR analysis is collected approximately every 5 years, while the cycling of units may be on a different schedule. Thus it may not be possible to relate habitat availability using CWHR to bird use since bird surveys are only conducted when units are flooded, but imagery is captured on a fixed schedule. Other methods of habitat assessment than CWHR should be considered and explored for future analysis of conditions in the LORP.

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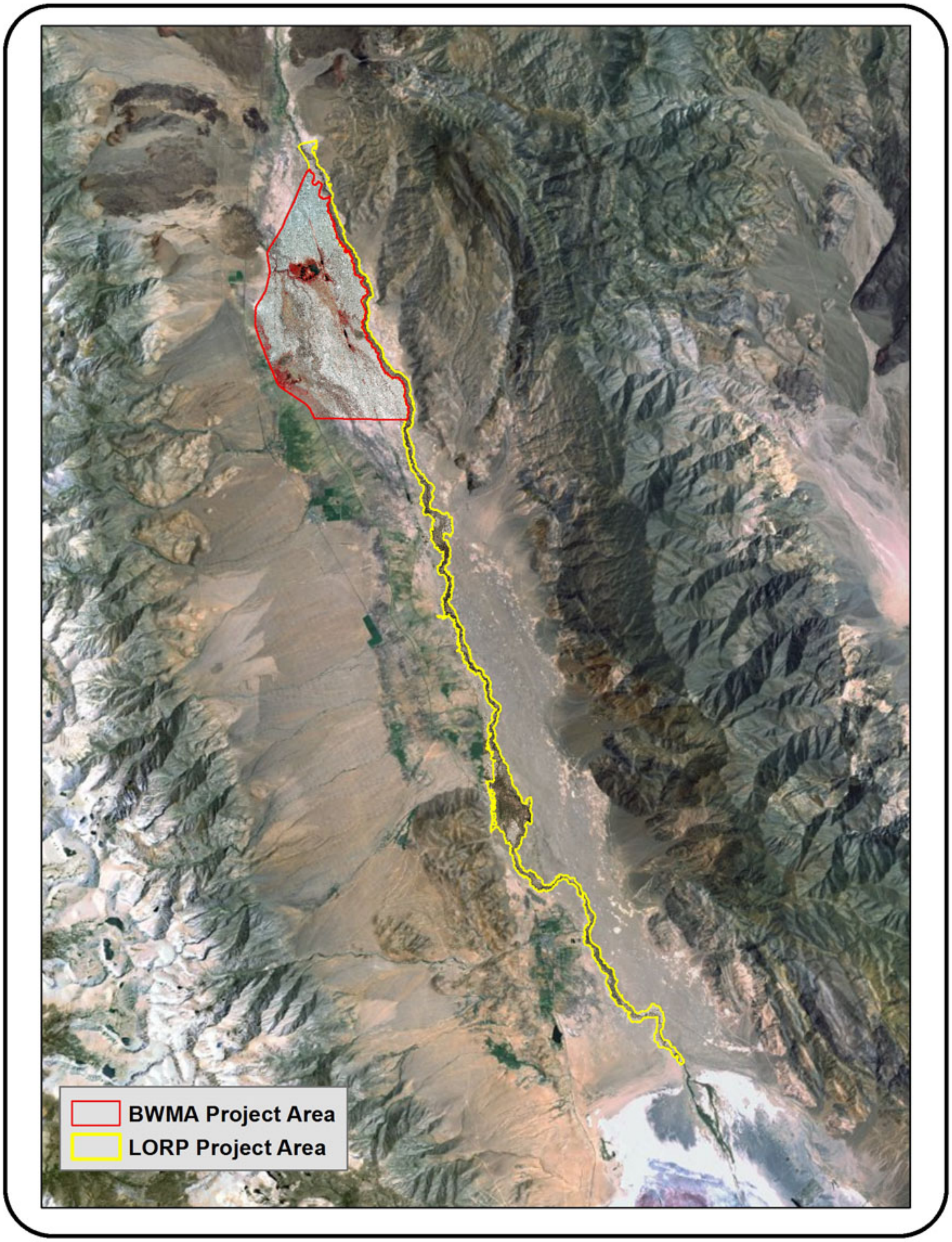
4.0 LORP LANDSCAPE VEGETATION MAPPING 2014 CONDITIONS



October 2015

ACKNOWLEGEMENTS

Sherman Jensen was the principal investigator. He was assisted by Jason Morgan.
David Livingston and Stuart Richardson assisted in accuracy assessments.

EXECUTIVE SUMMARY

Landscape vegetation inventories were conducted for the Lower Owens River Project (LORP) and the Blackrock Waterfowl Management Area (BWMA) for 2014 conditions, seven years after LORP was implemented. Results are compared with similar inventories of 2009 conditions and of 2000 conditions, prior to implementation of LORP. Differences in 2000, 2009, and 2014 conditions are attributed to hydrologic changes associated with rewatering the Owens River, fires, and improvements in the accuracy and precision of mapping.

Hydrologic changes are summarized in terms of states. Prescribed burns converted alkali scrub/meadow to more productive alkali meadow and invigorated production of herbaceous vegetation. A wildfire near Lone Pine reduced the stature of riparian forest and killed some trees. The accuracy and precision of mapping have improved with each successive application.

The influence of the LORP on the distribution of vegetation types generally corresponds to changes in hydrology and channel morphology associated four states: 1) incised, dry channel; 2) incised, wet, confined floodplain; 3) graded, wet, unconfined floodplain; and 4) aggraded, wet, unconfined floodplain. With implementation of the LORP, the incised, dry channel was wetted, reducing the states to incised channels bordered by high-and-dry terrace, graded channels bordered by moist floodplain, and aggraded channels bordered by saturated floodplain.

In 2014, the length of graded condition tripled and the aggraded condition increased 50 percent relative to 2009 conditions. More than 30 miles of channel that was incised in 2000 has since become graded or aggraded. The length of graded channel increased more than 25 miles since 2009 and aggraded conditions increased by about 2 miles. The LORP is aggrading.

Changes in state correspond with changes in the distributions of vegetation. Alkali scrub, bassia (weed), and marsh are prominent for the incised state. More diverse communities including alkali scrub, alkali scrub/meadow, alkali meadow, wet meadow, and marsh are prominent for the graded state. Marsh, wet meadow, and alkali scrub/meadow are prominent for the aggraded state.

The extent of hydric vegetation types increased 673 acres since 2009 and 795 acres since 2000. The extent of mesic vegetation declined 168 acres since 2009 and 128 acres since 2000. Arid vegetation declined 439 acres since 2009 and 602 acres since 2000. Aggrading conditions throughout the LORP correspond with changes towards more hydric herbaceous vegetation types.

The area of riparian forest has decreased from about 450 acres in 2000, to 265 acres in 2009, and 165 acres in 2014. Most of this reduction is attributed to sequentially more precise mapping of tree canopy in 2009 and again in 2014. Also, many trees were either killed or reduced to basal sprouts by the Lone Pine wildfire in 2013. Trees engulfed by marsh in graded reaches

that were expected to die are decadent, but alive. A predicted increase in new overstory canopy has not been realized, probably because of the very limited extent of barren substrate suitable for willow colonization in the seasonally flooded zone. The extent of riparian forest is declining and trees are not expected to be replaced.

The LORP is expected to continue to aggrade. The remaining incised reach will become graded; the floodplain of graded reaches will become wetter; and aggraded reaches will continue to slowly expand both upstream and downstream. The river channel is expected to become more occluded and the extent of marsh will increase at the expense of open water. Conditions are moving towards an herbaceous wetland (e.g. marsh, wet meadow, alkali meadow) and away from more structurally diverse riverine/riparian habitat with open channel conditions.

Although landscape mapping of the BWMA was intended to document 2014 conditions, vegetation was often remnant of previous hydrologic cycles. For example, about 193 acres of marsh in the Waggoner unit and 79 acres of marsh in the Thibaut unit are dead and remnant of flooding that was curtailed in 2010. About 49 acres of marsh in the Winterton Unit was also dead in response to curtailment of flooding in 2011, but has been rejuvenated by reflooding in 2015. About 277 acres of marsh and open water in the Drew unit was present in 2014, but dried up in 2015. Similarly, vegetation composition of wet meadow and alkali meadow are an amalgamated response to both historical and contemporary water management. Major differences in upland vegetation types (desert sink scrub, Great Basin mixed scrub, alkali scrub, alkali flat, and slick) are attributed to mapping errors magnified by mixed up conditions inherent to landscapes manipulated for water spreading. The usefulness of landscape vegetation mapping of the BWMA is questionable. Alternative approaches to monitoring be considered and that landscape vegetation mapping of the BWMA be abandoned.

4.1 INTRODUCTION

The LORP Monitoring, Adaptive Management and Report Plan (ES 2008) stipulates landscape vegetation mapping that measures large-scale vegetation trends and habitat extent be conducted at regular intervals. Landscape vegetation inventories were conducted for the Lower Owens River Project (LORP) and the Blackrock Waterfowl Management Area (BWMA) for 2014 conditions, seven years after LORP was implemented. Results are compared with similar inventories of 2009 conditions (2010 LORP Annual Report) and of 2000 conditions (WHA 2004), prior to implementation of LORP. A vegetation inventory for the Delta Habitat Area (DHA) was conducted for 2012 conditions and reported in the 2014 LORP Annual Report.

4.2 LORP LANDSCAPE VEGETATION MAPPING

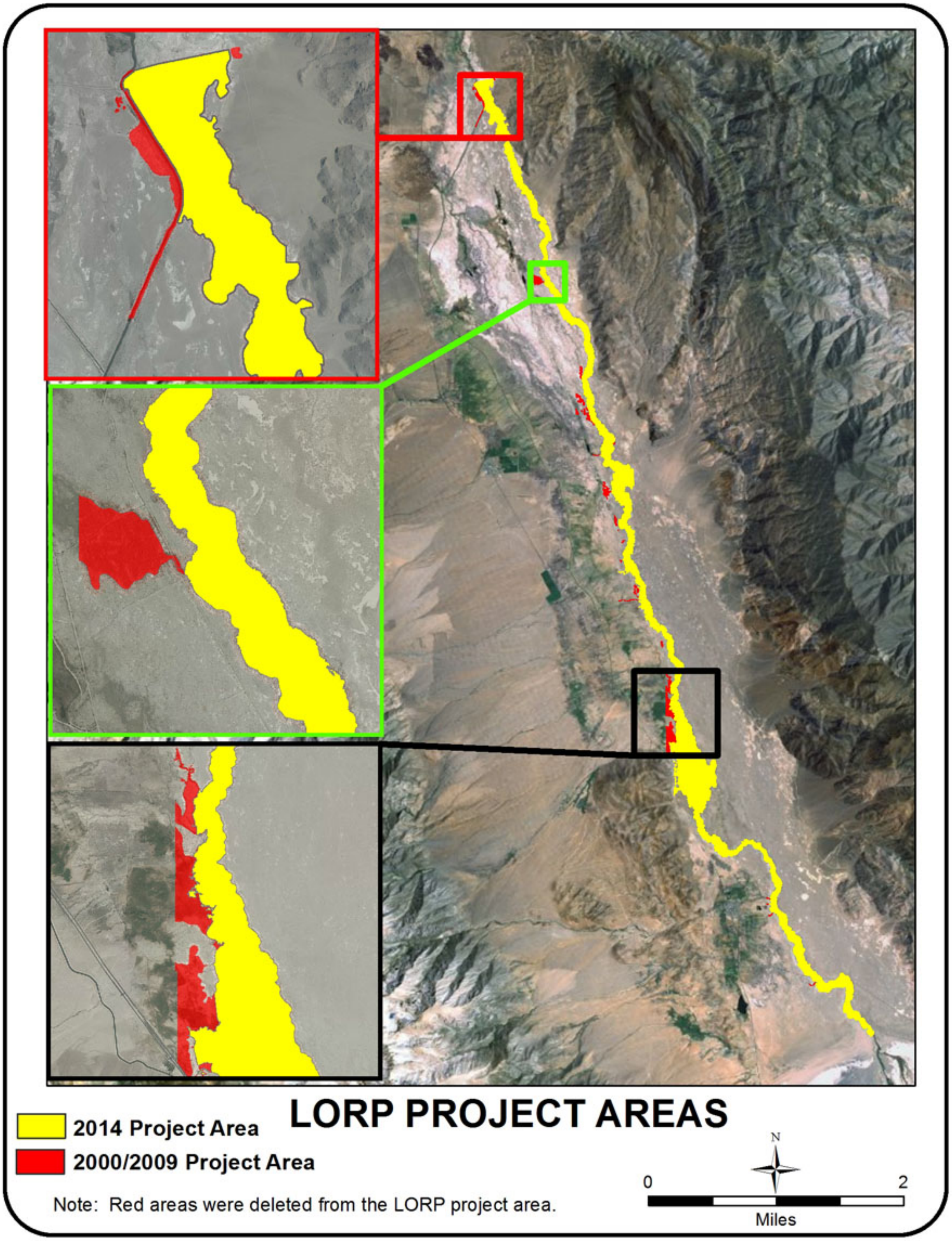
The overall goal of the LORP, as stated in the 1997 MOU, is:

> *… the establishment of a healthy, functioning Lower Owens River riverine-riparian ecosystem, and the establishment of healthy functioning ecosystems in the other elements of the LORP, for the benefit of biodiversity and threatened and endangered species, while providing for the continuation of sustainable uses including recreation, livestock grazing, agriculture, and other activities.*

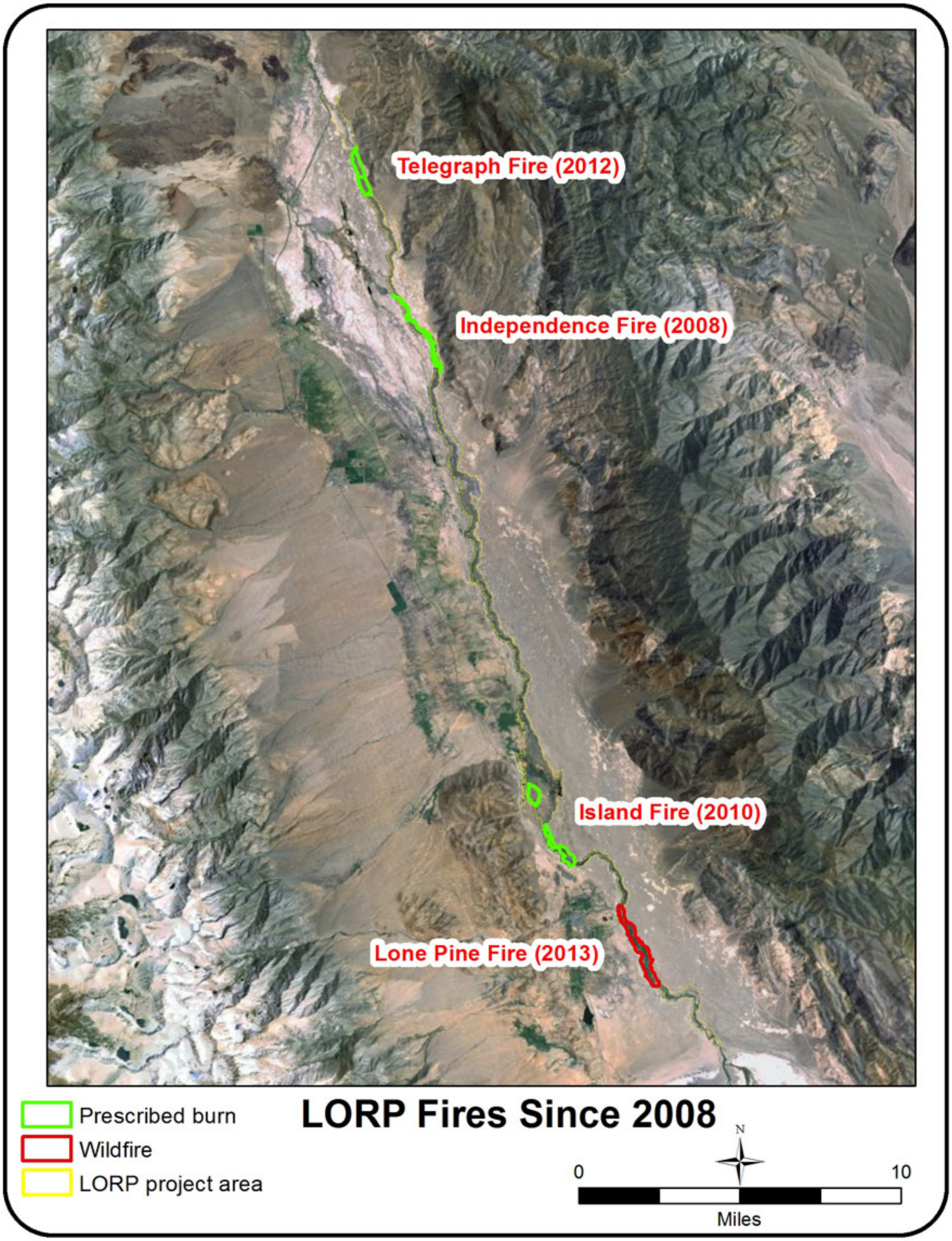
The LORP area was first defined for 2000 conditions based on the area anticipated to be affected by implementation of the project. This initial project area for 2000 conditions was 6,555 acres and included superfluous areas along the west side of the corridor that were functionally unrelated to the LORP (Veg Mapping Figure 1). The project area for 2009 conditions was increased to 6,570 acres to accommodate expansion of the river corridor in a few areas while including the same superfluous areas, as for 2000 conditions. The project area for 2014 conditions was again expanded to accommodate a slightly wider river corridor in a few areas, but superfluous areas were clipped and eliminated from further consideration. The project area for 2014 conditions was reduced to 6,252 acres and was used to clip vegetation mapping for 2000 and 2009 conditions to facilitate valid comparisons of mapping.

Differences in 2000, 2009, and 2014 conditions are attributed to hydrologic changes associated with rewatering the Owens River, fires, and improvements in the accuracy and precision of mapping. Hydrologic changes are summarized in terms of states. Several major fires have affected large portions of the LORP project area since 2008 (Veg Mapping Figure 2). Prescribed burns converted alkali scrub/meadow to more productive alkali meadow and invigorated production of herbaceous vegetation. A wildfire near Lone Pine reduced the stature of riparian forest and killed some trees.

LORP 2000 conditions were delineated on 1:6,000 scale plots of high-resolution (2-foot pixels) imagery, and then digitized. The 2000 mapping was refined using heads-up editing at scales greater than 1:1,000 resulting in 3,968 parcels. LORP 2009 conditions were mapped using a supervised spectral classification of high-resolution (1 foot pixels) imagery, then refined through a significant field effort of more than 200 person-days, resulting in 6,981 parcels. The 2014 conditions were mapped using an unsupervised classification, heads-up editing, and a less significant field effort of about 15 person-days. Technological advances in mapping software provided significant improvement of spectral classifications, resulting in 16,601 parcels. The accuracy and precision of mapping have improved with each successive application.



Vegetation Mapping Figure 1. LORP Project Areas



Vegetation Mapping Figure 2. LORP Fires 2008

4.3 LORP Approach

The 2014 vegetation mapping is based on a 4 band, high-resolution image captured from aircraft during the 2014 growing season. Many TIFF image tiles were mosaicked, and then clipped to the LORP project area boundary with a 100 m buffer to accommodate potential expansion. The clipped image is comprised of 1 foot pixels; each assigned a 16 bit (5 digit) integer for each of 4 color bands. The image can be viewed as either color infrared (CIR) or natural color (Veg Mapping Figure 3). This full resolution image can be viewed at scales greater than 1:1,000 and served as the basis for "heads up" analyses and for refining spectral classification of open water.

The clipped image was generalized to 1 m resolution to reduce file size. An unsupervised spectral classification with 10 classes was first conducted for the entire LORP image. Areas corresponding with open water were typically a single class (Veg Mapping Figure 4), but included numerous commission errors1. Rasters in class 1 that were typically associated with open water were extracted and converted to polygons. The polygon file was then edited and parcels not water (commission errors) were deleted. Shadows associated with trees and shrubs were the most common commission errors associated with open water. The edited parcels derived from the 1 m resolution image were found to be somewhat imprecise and tended to overlap areas not water. In recourse, the preliminary water was used as the area of interest (AOI) that served to refine mapping using the 1 foot resolution imagery (Veg Mapping Figure 5). The AOI was also used to mask the preliminary spectral analysis from which subsequent vegetation classes were extracted.

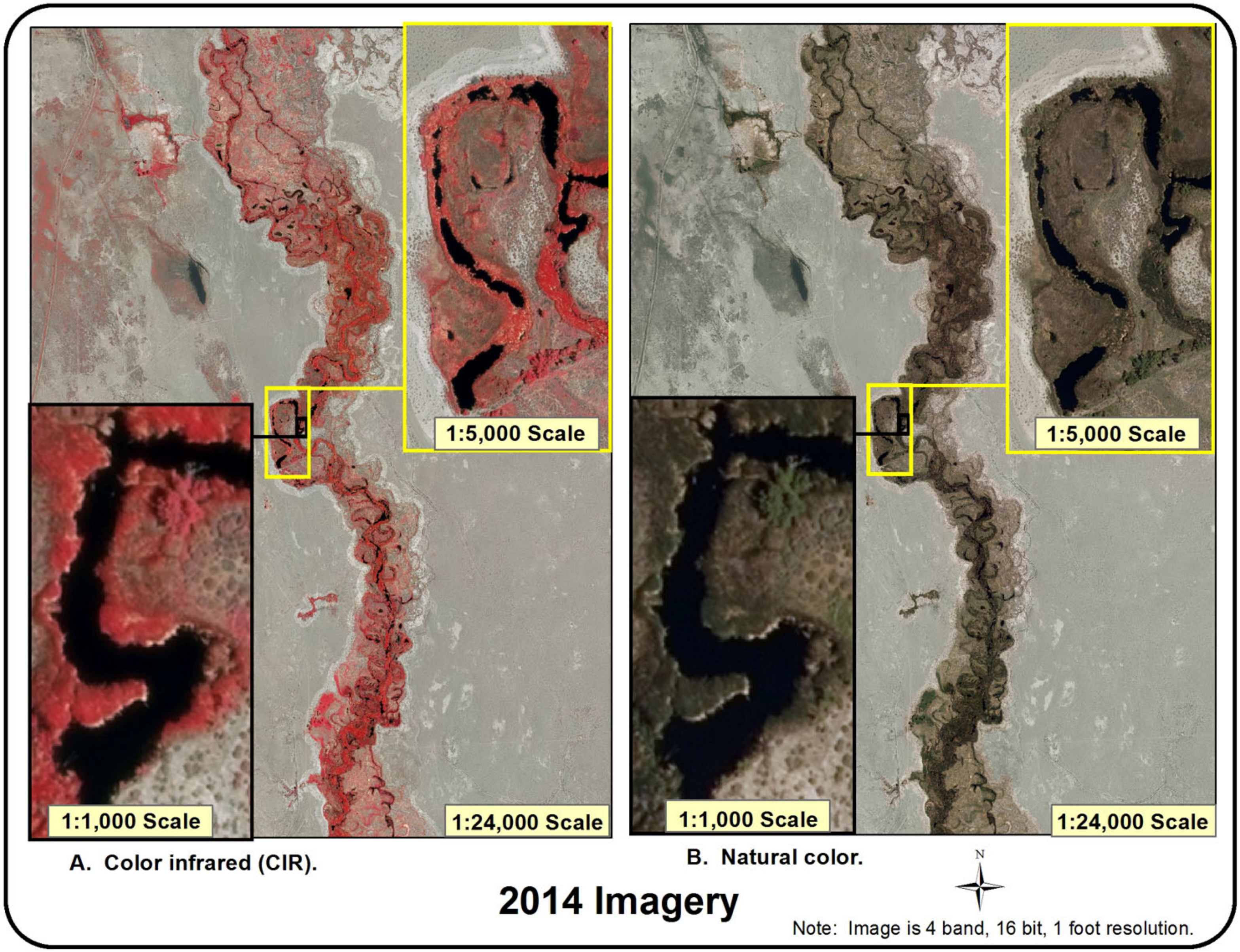
Similarly, spectral classes typically corresponding with marsh were extracted, converted to polygons, edited, saved to a file, and then added to the mask. The same sequence was applied to other distinctive vegetation associations (e.g. alkali scrub/meadow and alkali meadow; riparian forest/shrub; alkali scrub; wet meadow). Each application reduced the complexity of the preliminary spectral analysis (Veg Mapping Figure 6). In this manner, a sequentially derived spectral classification of major vegetation classes was derived. The spectral classification served as a starting point for refined vegetation mapping.

With preliminary spectral classification maps in hand, field reconnaissance was conducted. The purpose was to identify both omission and commission errors and learn to recognize vegetation classes from the 2014 imagery. The field reconnaissance entailed about 15 man-days. Heads-up editing was used to refine the spectral classification map.

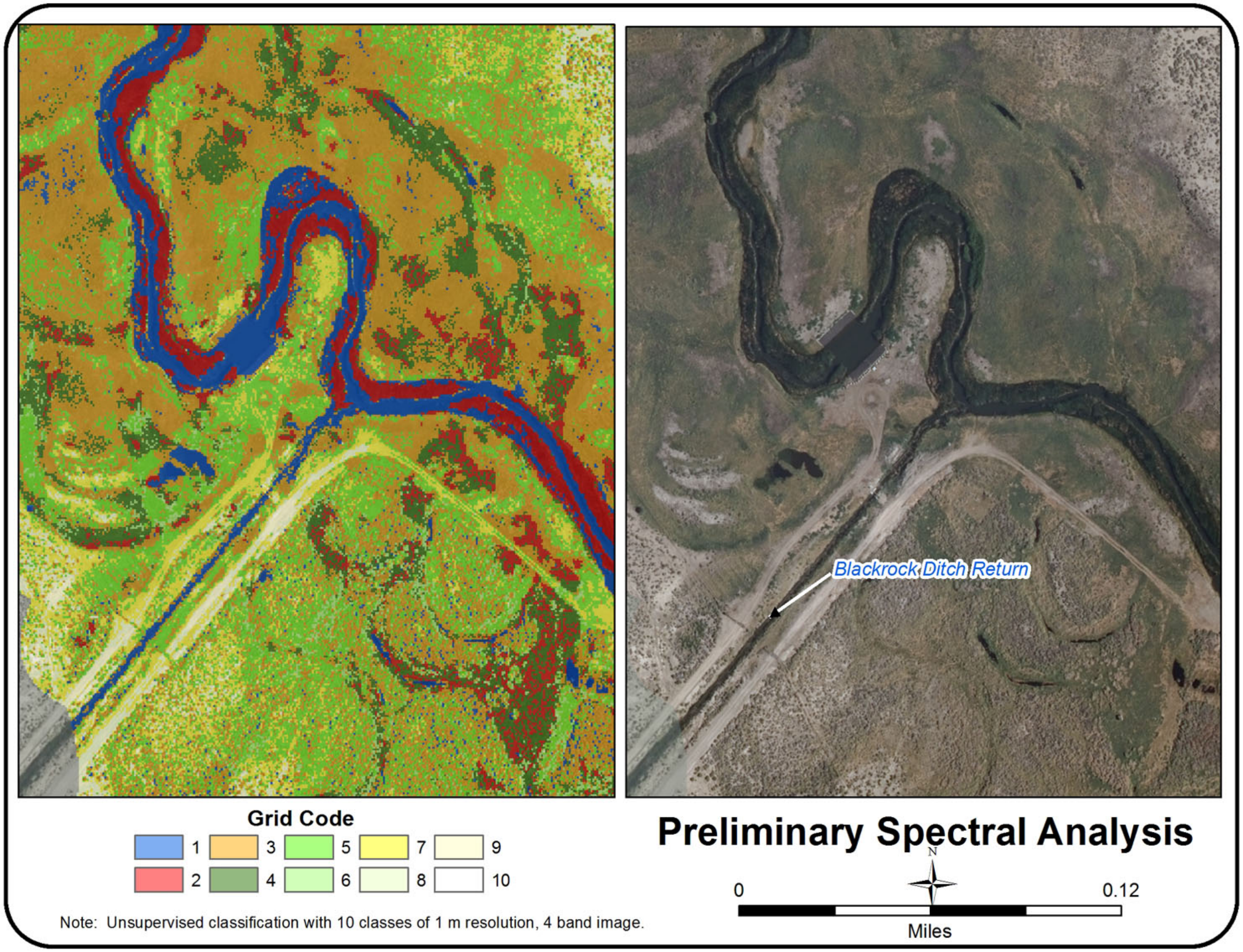
The accuracy of refined mapping was evaluated. Ten accessible parcels of each major vegetation type and 5 parcels of each minor type were randomly selected for evaluation. Selected parcels were marked on a map and the centroid of each parcel was labeled with a sequential number. Field personnel visited each parcel and determined the primary vegetation

[1] A commission error is when the spectral character indicates a class (e.g. water) that is really something else (e.g. shadow). Shadows and water have nearly identical 4-band signatures. Shadows are the principal commission error for water.

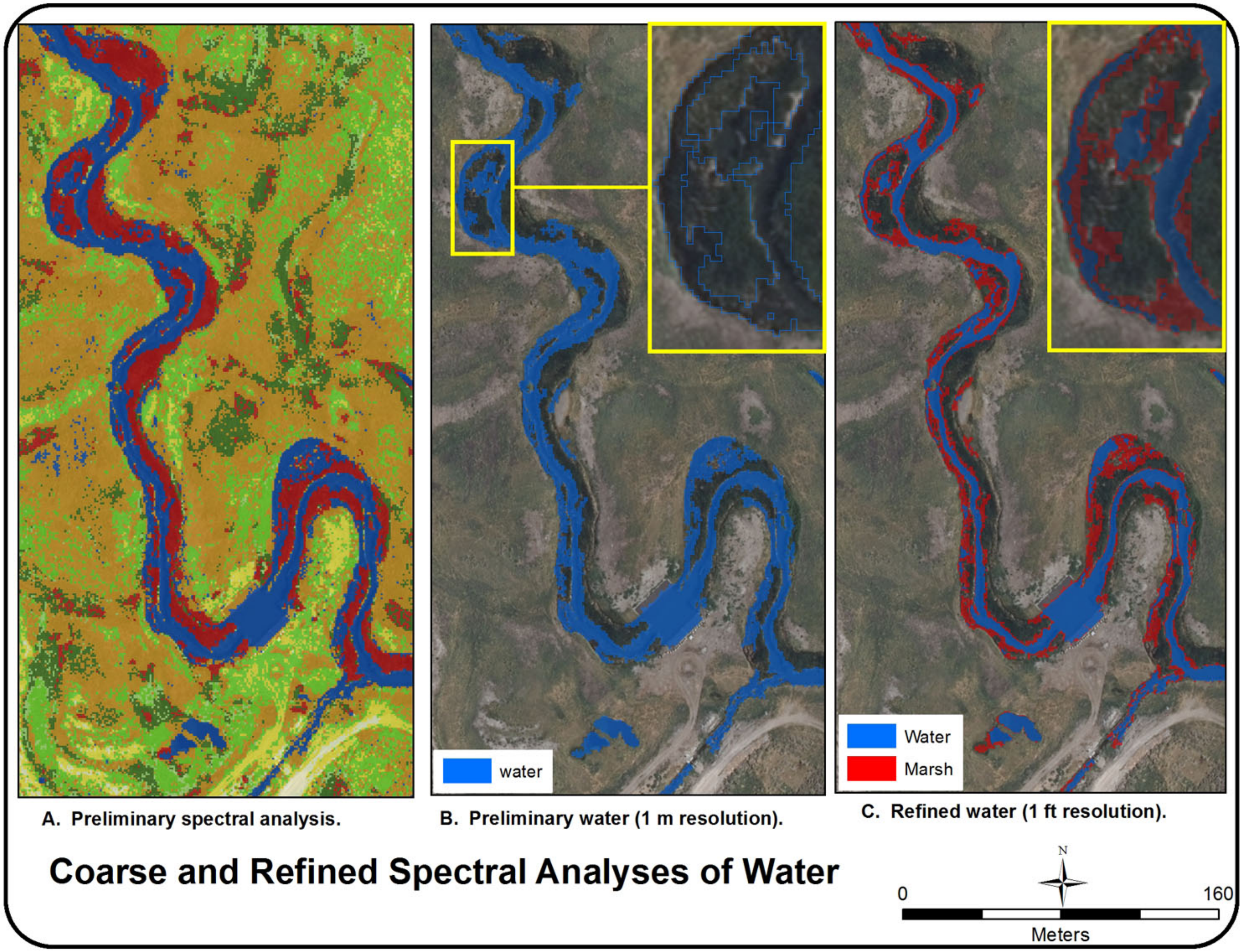
type. The accuracy of many additional parcels en-route to the selected parcels were documented on field maps. Commission errors were also noted. The overall error was estimated as the average error for all vegetation types, weighted by the number of parcels of each type. The target overall error rate was less than 5 percent.



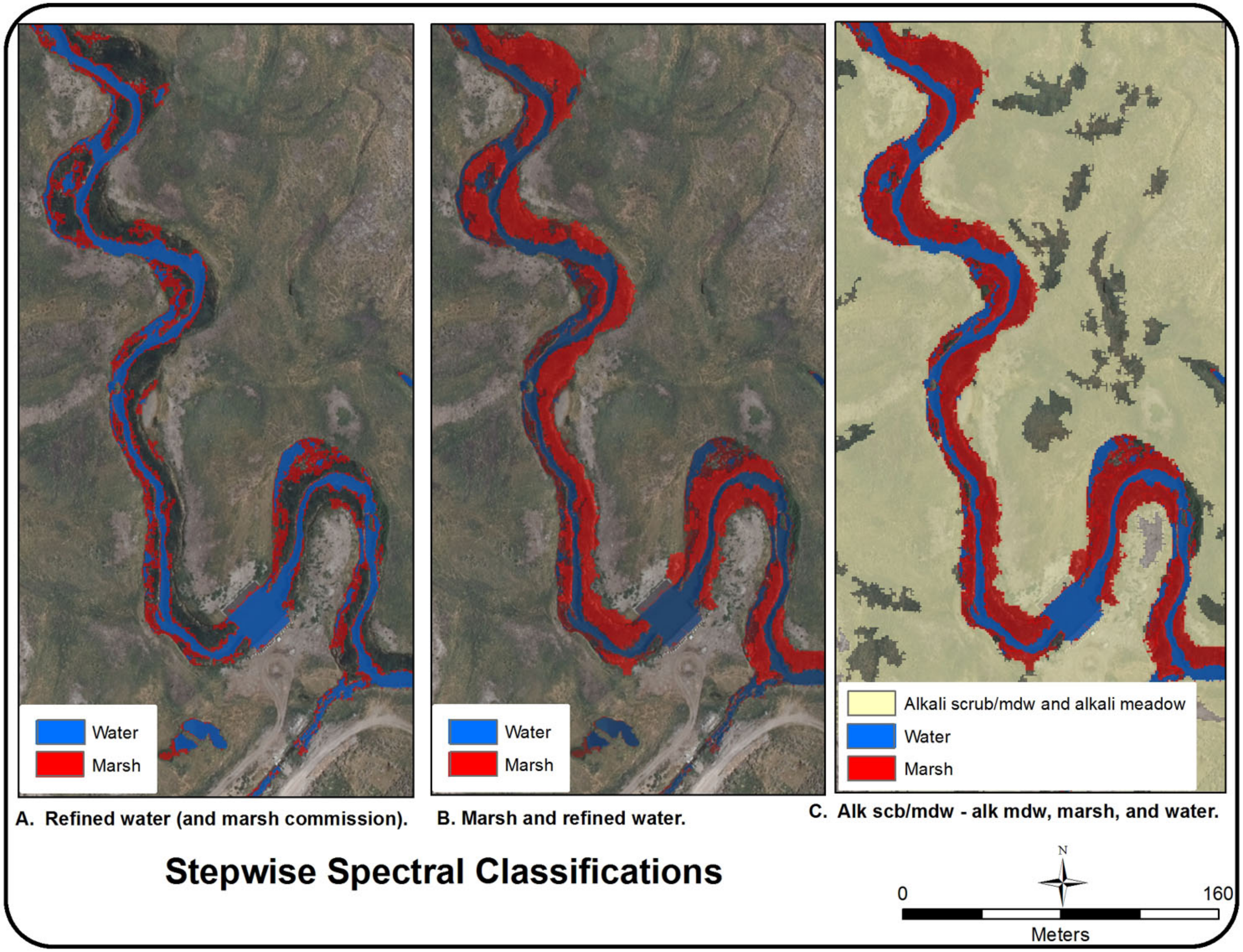
Vegetation Mapping Figure 3. 2014 Imagery



Vegetation Mapping Figure 4. Preliminary Spectral Analysis



Vegetation Mapping Figure 5. Coarse and Refined Spectral Analyses of Water



Vegetation Mapping Figure 6. Stepwise Spectral Classifications

4.4 LORP Results

Vegetation types identified for 2000, 2009, and 2014 conditions are correlated in Table 4-1. Large-scale (1:3,000) maps of vegetation for 2014 conditions are compiled in APPENDIX A. Side-by-side maps of vegetation types for 2000, 2009, and 2014 conditions are compiled in APPENDIX B. Photos are included as APPENDIX C.

The influence of the LORP on the distribution of vegetation types generally corresponds to changes in hydrology and channel morphology associated with states (Veg Mapping Figure 7). Four states were identified for 2000 conditions:

- **Incised, dry channel**: A deep, dry channel bordered by high terrace with upland vegetation. Alluvial water table is well below the rooting depth of vegetation. Hydric vegetation is mostly absent. This state made up 16.1 miles of the LORP in 2000.

- **Incised, wet, confined floodplain**: A deep, wetted channel bordered by high and low terraces. Hydric vegetation is confined to the incised channel. Alluvial water table is mostly below the rooting depth of vegetation of adjacent terraces with upland vegetation. Three reaches totaled 23.7 miles of the LORP in 2000.

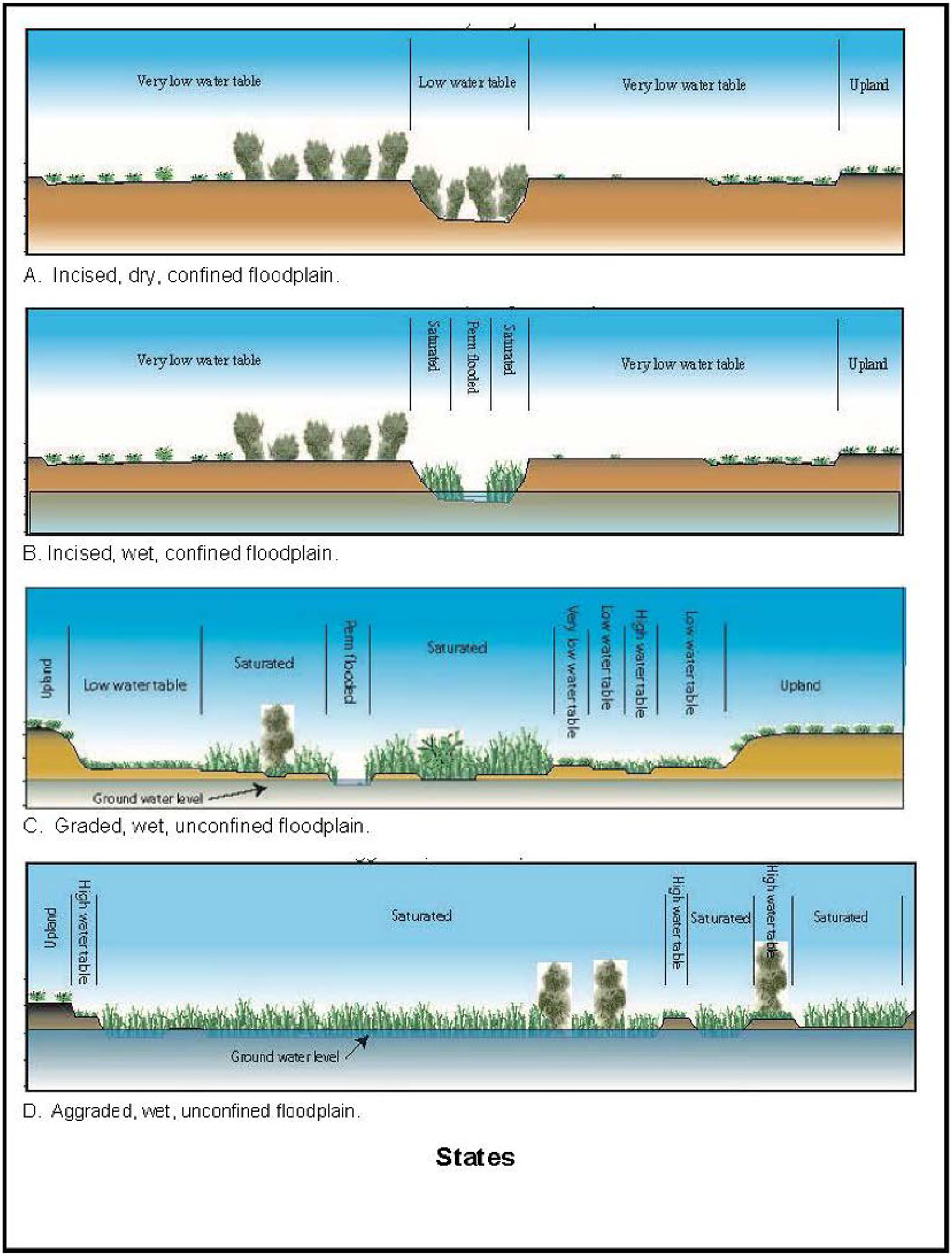
- **Graded, wet, unconfined floodplain**: A wetted channel bordered by floodplain and low terrace. Hydric vegetation fills the channel and overflows to the adjacent floodplain. Alluvial groundwater is mostly within the rooting depth of vegetation on adjacent floodplain with hydric vegetation. One reach comprised 12 miles of the LORP in 2000.

- **Aggraded, wet, unconfined floodplain**: Saturated conditions extend across a broad floodplain and a channel may not be evident. Alluvial groundwater is at or near the surface. One reach (Island) comprised 4.0 miles of the LORP in 2000.

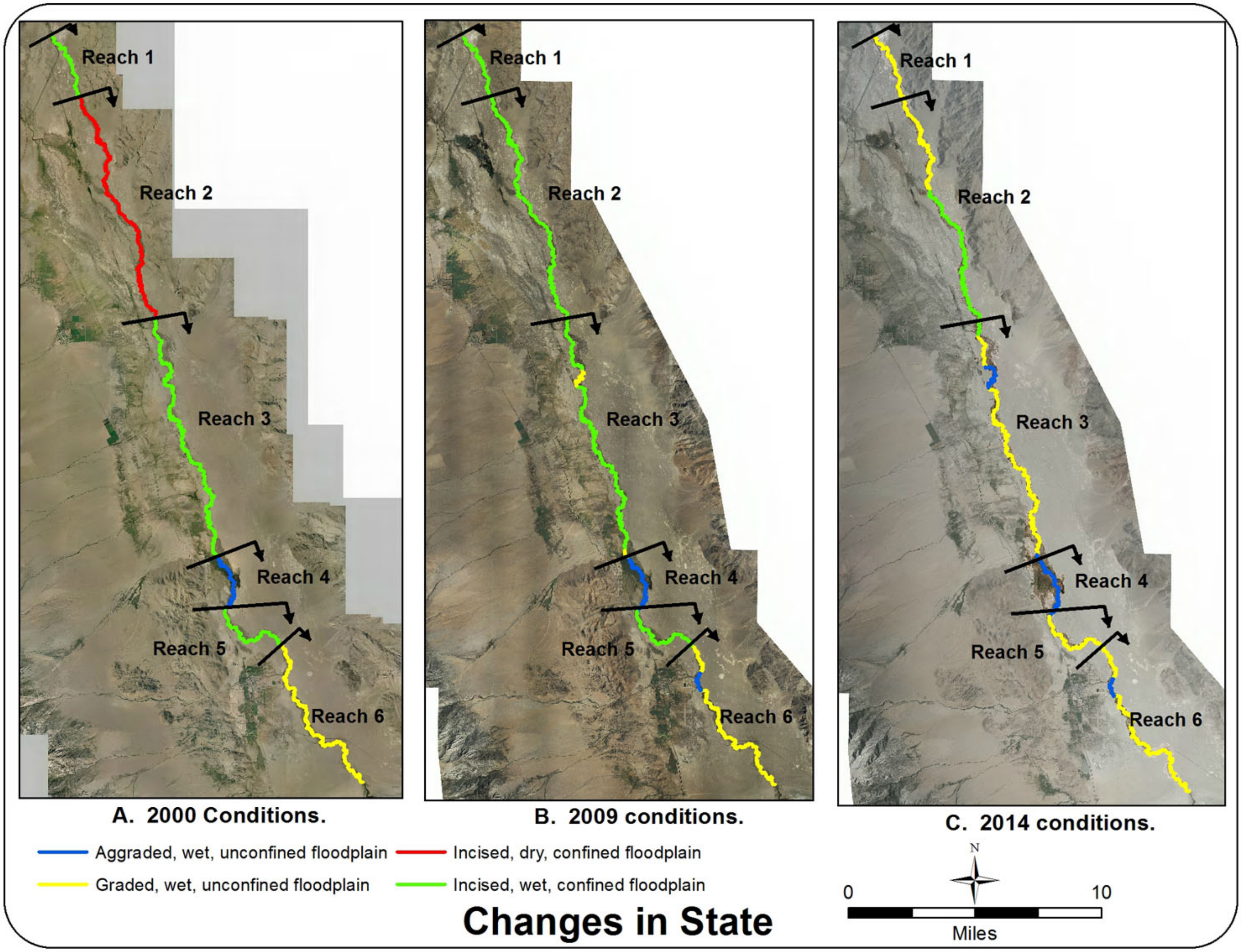
Reaches defined for 2000 conditions (Veg Mapping Figure 8) are based on states prior to implementation of the LORP. With implementation, the dry reach became wet and the length of graded and aggraded conditions increased slightly, as documented for 2009 conditions. In 2014 the length of graded condition tripled and the aggraded condition increased 50 percent relative to 2009 conditions (Veg Mapping Table 2). More than 30 miles of channel that was incised in 2000 have since become graded or aggraded. The length of graded channel increased more than 25 miles since 2009 and aggraded conditions increased by about 2 miles. The LORP is aggrading.

<table>
<tr><th colspan="6">Vegetation Mapping Table 1. Map Unit Correlation</th></tr>
<tr><th colspan="2">2014 Conditions</th><th colspan="2">2009 Conditions</th><th colspan="2">2000 Conditions</th></tr>
<tr><th>Name</th><th>Acres</th><th>Name</th><th>Acres</th><th>Name</th><th>Acres</th></tr>
<tr><td>Water</td><td>154</td><td>Water</td><td>251</td><td>Water</td><td>100</td></tr>
<tr><td>Streambar</td><td>23</td><td>Streambar</td><td>8</td><td>Streambar</td><td>23</td></tr>
<tr><td>Marsh</td><td>1310</td><td>Marsh</td><td>1090</td><td>Marsh</td><td>765</td></tr>
<tr><td>Reedgrass</td><td>51</td><td>Reedgrass</td><td>24</td><td>Reedgrass</td><td>25</td></tr>
<tr><td>Wet meadow</td><td>653</td><td>Wet Alkali Meadow</td><td>57</td><td>Wet Alkali Meadow</td><td>210</td></tr>
<tr><td>Irrigated meadow</td><td>3</td><td>Irrigated Meadow</td><td>3</td><td>Irrigated meadow</td><td>4</td></tr>
<tr><td>Riparian shrub</td><td>32</td><td>Riparian Shrub (willow)</td><td>20</td><td>Riparian Shrub (willow)</td><td>20</td></tr>
<tr><td>Tamarisk</td><td>1</td><td>Tamarisk</td><td>12</td><td>Tamarisk</td><td>249</td></tr>
<tr><td>Riparian forest (cottonwood)</td><td>3</td><td>Riparian Forest (cottonwood)</td><td>5</td><td>Riparian Forest (cottonwood)</td><td>5</td></tr>
<tr><td>Riparian forest (tree willow)</td><td>162</td><td>Riparian Forest (tree willow)</td><td>260</td><td>Riparian Forest (tree willow)</td><td>444</td></tr>
<tr><td>Alkali meadow</td><td>513</td><td>Dry Alkali Meadow</td><td>1034</td><td>Dry Alkali Meadow</td><td>889</td></tr>
<tr><td>Alkali scrub/meadow</td><td>1484</td><td>Rabbitbrush-NV saltbush scrub/meadow</td><td>1132</td><td>Rabbitbrush-NV saltbush scrub/meadow</td><td>1237</td></tr>
<tr><td>Alkali scrub</td><td>492</td><td rowspan="2">Rabbitbrush-NV saltbush scrub</td><td rowspan="2">1787</td><td>Rabbitbrush-NV saltbush scrub</td><td>1728</td></tr>
<tr><td>Upland scrub</td><td>1191</td><td>Undifferentiated upland</td><td>39</td></tr>
<tr><td rowspan="3">Bassia (weeds)</td><td rowspan="3">118</td><td>Bassia</td><td>326</td><td rowspan="3">Barren</td><td rowspan="3">387</td></tr>
<tr><td>Tamarisk / Slash</td><td>1</td></tr>
<tr><td>Barren</td><td>115</td></tr>
<tr><td>Road</td><td>6</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">--</td></tr>
<tr><td>Road</td><td>37</td></tr>
<tr><td>Miscellaneous feature</td><td>19</td><td>Structure</td><td>22</td><td>Structure</td><td>3</td></tr>
<tr><td>TOTAL</td><td>6252</td><td>TOTAL</td><td>6147</td><td>TOTAL</td><td>6128</td></tr>
</table>

Vegetation Mapping Table 2. River Length By State						
State	2000 Conditions		2009 Conditions		2014 Conditions	
	Miles	%	Miles	%	Miles	%
Incised, dry, confined floodplain	16.1	28.9	0.0	0.0	0.0	0.0
Incised, wet, confined floodplain	23.7	42.5	38.2	68.3	9.8	17.6
Graded, wet, unconfined floodplain	12.0	21.4	12.5	22.4	38.6	69.1
Aggraded, wet, unconfined floodplain	4.0	7.2	5.2	9.3	7.5	13.4
TOTAL	**55.9**	**100.0**	**55.9**	**100.0**	**55.9**	**100.0**



Vegetation Mapping Figure 7.Distribution of Veg Types in Relation to Changes Associated with States



Vegetation Mapping Figure 8. Reaches Defined For 2000, 2009, and 2014Conditions are Based on States

Below the dry reach, changes in channel morphology between 1992 and 2000 were towards aggradation (WHA 2004b) in response to relatively consistent 15 cfs base flow since 1987. The low, consistent flow coupled with very low stream gradient (0.08 percent) nurtured profuse marsh that further slowed the water and enhanced aggradation. These observations lead to the prediction:

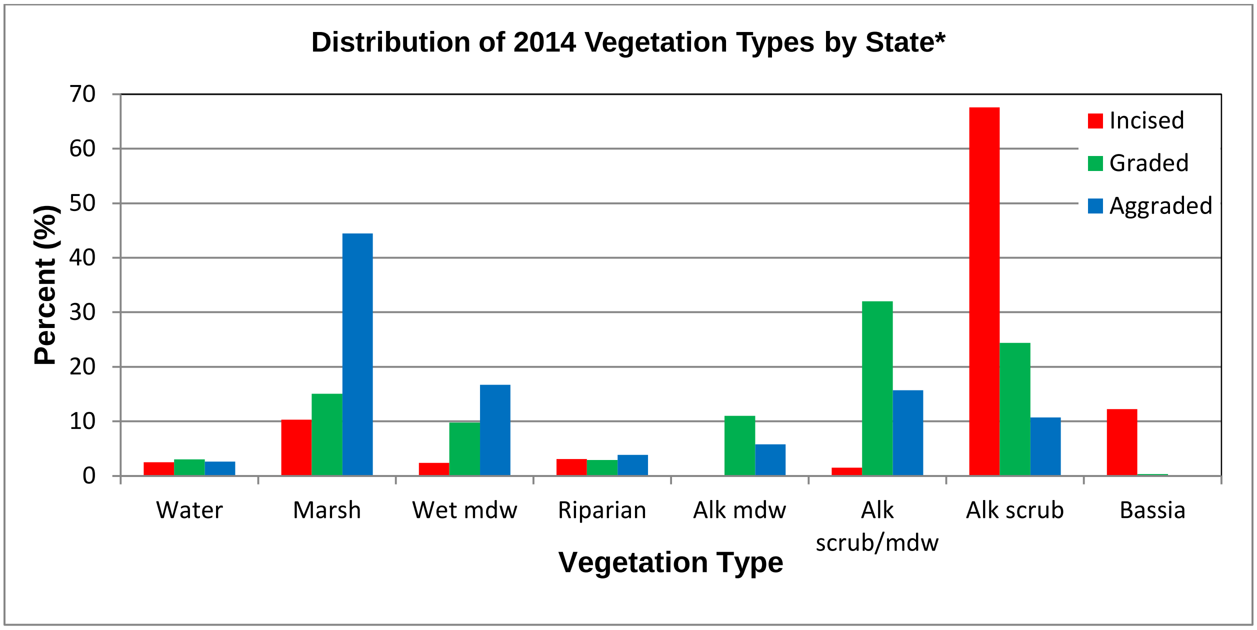
> *It seems unlikely that the proposed 40/200 cfs flows will significantly alter the direction of changes towards graded and/or aggraded conditions… Changes in channel morphology will profoundly affect the distribution of landtypes and water regimes. Parts of dry, low terraces along incised channels will become wet floodplains as the channel becomes graded, typically doubling the area of wetland/water resources.*

Conditions predicted from long-term (5-25 years) aggradation have been achieved in only 7 years. The LORP is aggrading faster than anticipated. The direction of changes toward more graded and/or aggraded conditions is expected to continue for the foreseeable future.

Changes in state correspond with changes in the distributions of vegetation (Veg Mapping Table 3 and Veg Mapping Figure 9). Alkali scrub, bassia (weed), and marsh are prominent for the incised state. More diverse communities including alkali scrub, alkali scrub/meadow, alkali meadow, wet meadow, and marsh are prominent for the graded state. Marsh, wet meadow, and alkali scrub/meadow are prominent for the aggraded state. The extent of hydric vegetation types (water, streambar, marsh, reedgrass, wet meadow, irrigated meadow, riparian shrub, and riparian forest) increased 673 acres since 2009 and 794 acres since 2000 (Veg Mapping Table 4). The extent of mesic vegetation (alkali scrub/meadow and alkali meadow) declined 168 acres since 2009 and 128 acres since 2000. Arid vegetation (alkali scrub, upland scrub, tamarisk, and bassia) declined 439 acres since 2009 and 602 acres since 2000. Aggrading conditions throughout the LORP correspond with changes towards more hydric vegetation types. Vegetation types are subsequently described.

Vegetation Mapping Table 3 Distribution of 2014 Vegetation Types by State						
Vegetation Type	Incised		Graded		Aggraded	
	Acres	%	Acres	%	Acres	%
Water	19	2	102	3	34	2
Streambar	3	0	13	0	7	0
Marsh	86	10	537	14	686	44
Reedgrass	3	0	38	1	10	1
Wet meadow	21	2	374	10	258	16
Irrigated meadow	0	0	0	0	3	0
Riparian shrub	1	0	23	1	9	1
Tamarisk	0	0	1	0	0	0
Riparian forest (willow)	26	3	86	2	50	3
Riparian forest (cottonwood)	0	0	2	0	1	0
Alkali meadow	1	0	421	11	90	6
Alkali scrub/meadow	13	2	1225	32	246	16
Alkali scrub	491	57	0	0	0	0
Bassia	106	12	13	0	0	0
Upland scrub	91	11	932	24	167	11
Road	1	0	38	1	3	0
Miscellaneous feature	0	0	19	1	0	0
TOTAL	**862**	**100**	**3825**	**100**	**1565**	**100**

Vegetation Mapping Table 4. Hydric Status, 2000 Through 2014 Conditions.						
Status	2014 Conditions		2009 Conditions		2000 Conditions	
	Acres	%	Acres	%	Acres	%
Hydric	2392	38	1719	28	1597	26
Mesic	1997	32	2166	35	2126	35
Arid	1801	29	2241	36	2403	39
Not considered	62	1	22	0	3	0
TOTAL	**6252**	**100**	**6147**	**100**	**6128**	**100**



*Water includes streambar; marsh includes reedgrass; wet meadow includes irrigated meadow; riparian includes riparian forest, riparian shrub, and tamarisk; alkali scrub includes upland scrub.

Vegetation Mapping Figure 9. Distribution of 2014 Vegetation Types by State

Water: River, stream, ponds, and divorced oxbows that are permanently or semi-permanently flooded aquatic habitat and relatively unvegetated. The extent of water increased from about 100 acres in 2000 to about 250 acres in 2009. Reach 2 (Veg Mapping Figure 8) was dry in 2000 (Veg Mapping Figure 10A) and water was often too narrow to delineate in other incised reaches. Since 2009, the area of water has decreased by about 100 acres, most of which converted to marsh, especially in the Island area (Veg Mapping Figure 11) where ponds are filling in rapidly. About half of the water mapped in 2009 had changed to marsh in 2014 (Veg Mapping Table 5). Areas of marsh that changed to water are errors attributed to more precise mapping of water in 2014. The area of water is 2-3 percent of all reaches, but is slightly more extensive in graded reaches. With continued aggradation the area of water will continue to decline.

Vegetation Mapping Table 5. Prominent Changes[2], water.

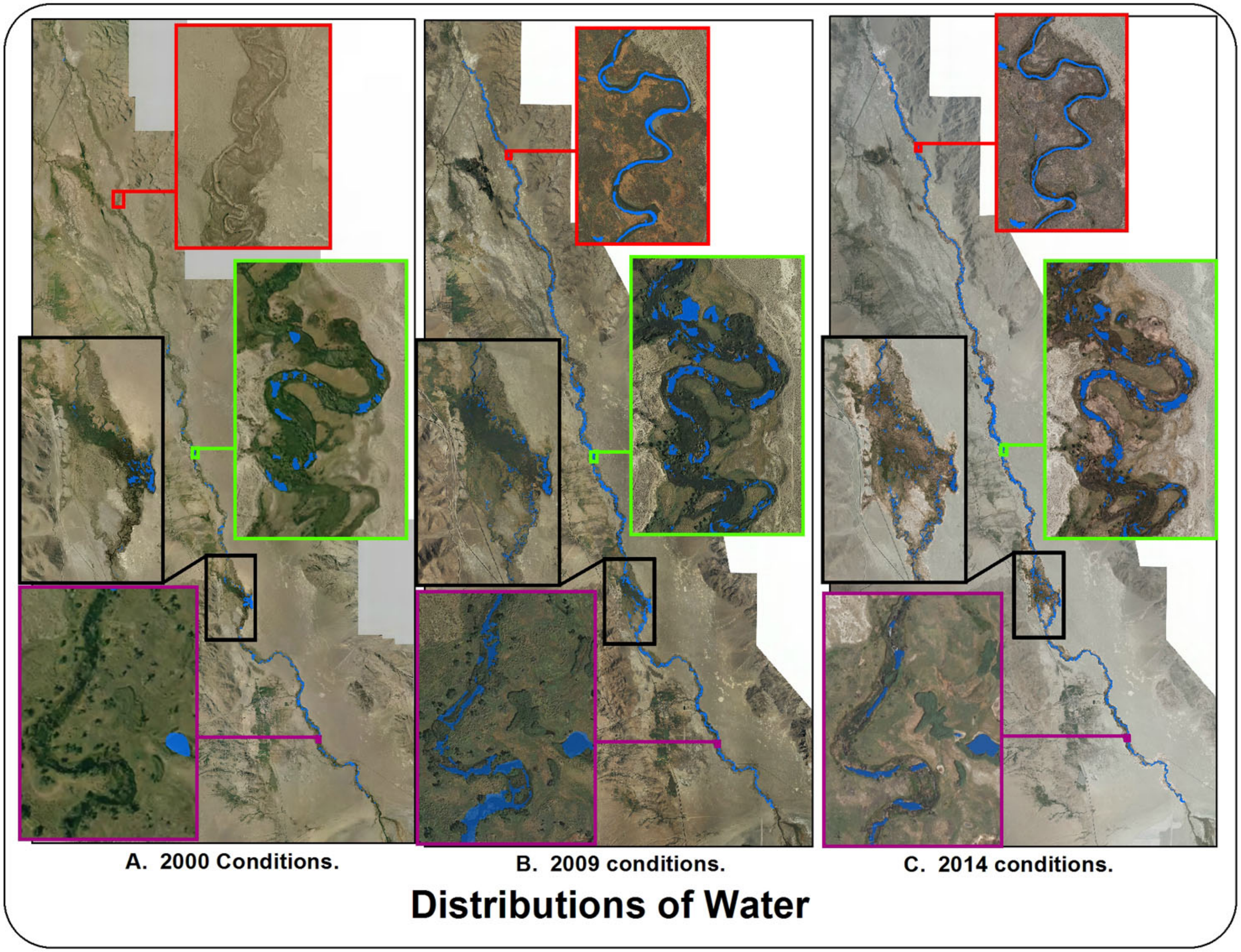
Conditions		Area	
2009	2014	(ac)	(%)
Water	Marsh	134	43
Water	Water	96	31
Marsh	Water	30	10
Alkali meadow	Water	10	3
TOTAL		**270**	**87**

[2] Vegetation types for 2009 and 2014 were intersected. Parcels of water for 2009 or 2014 were selected, then ranked by the total area for the combination. Prominent changes comprise the first 85% of all combinations. This procedure was used to determine *prominent* changes for all types.

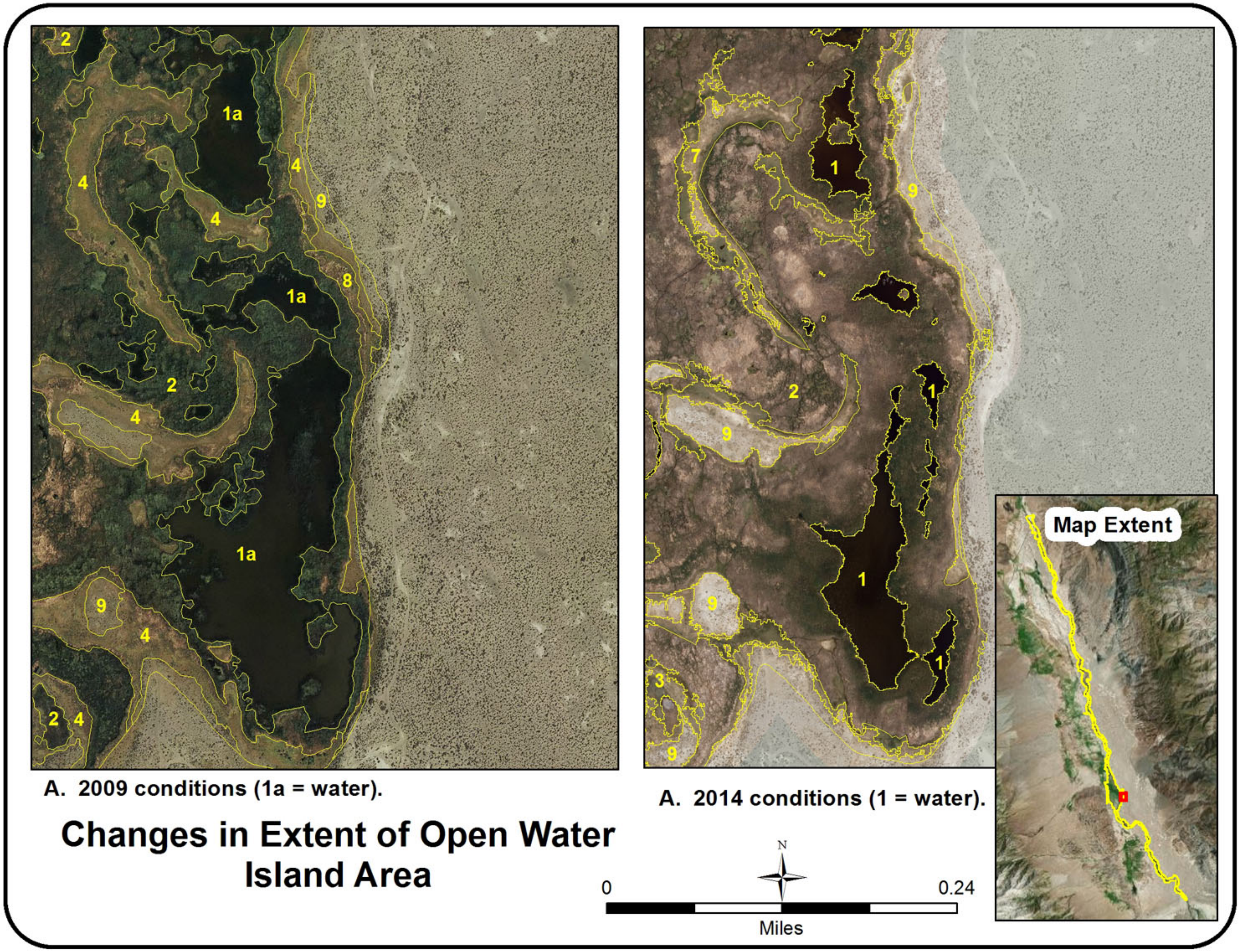
Streambar: In 2000, streambars denote the bottom of a dry, incised river channel and dry secondary channels (Veg Mapping Figure 12). In 2009, they included fresh point bar deposits, mostly in Reach 2, and dry secondary channels. In 2014, they included point bars, secondary channels, a large sediment deposit at the mouth of the Alabama Gates, and several dry ponds. Streambars comprise less than 1 percent of all states. Point bar deposits are sparsely vegetated, sandy habitats suitable for willow colonization. Most of the new willow colonization in reach 2 occurs on streambars. Scratchgrass (*Muhlenbergia asperifolia*) and saltgrass (*Distichlis spicata*) and sparse marsh plants are common. The large sediment deposit near the Alabama Gates is sediment sluiced from the Los Angeles Aqueduct. Prominent changes (Veg Mapping Table 6) reflect boundary errors associated with delineating very small or narrow parcels.

Vegetation Mapping Table 6. Prominent Changes, Streambar.

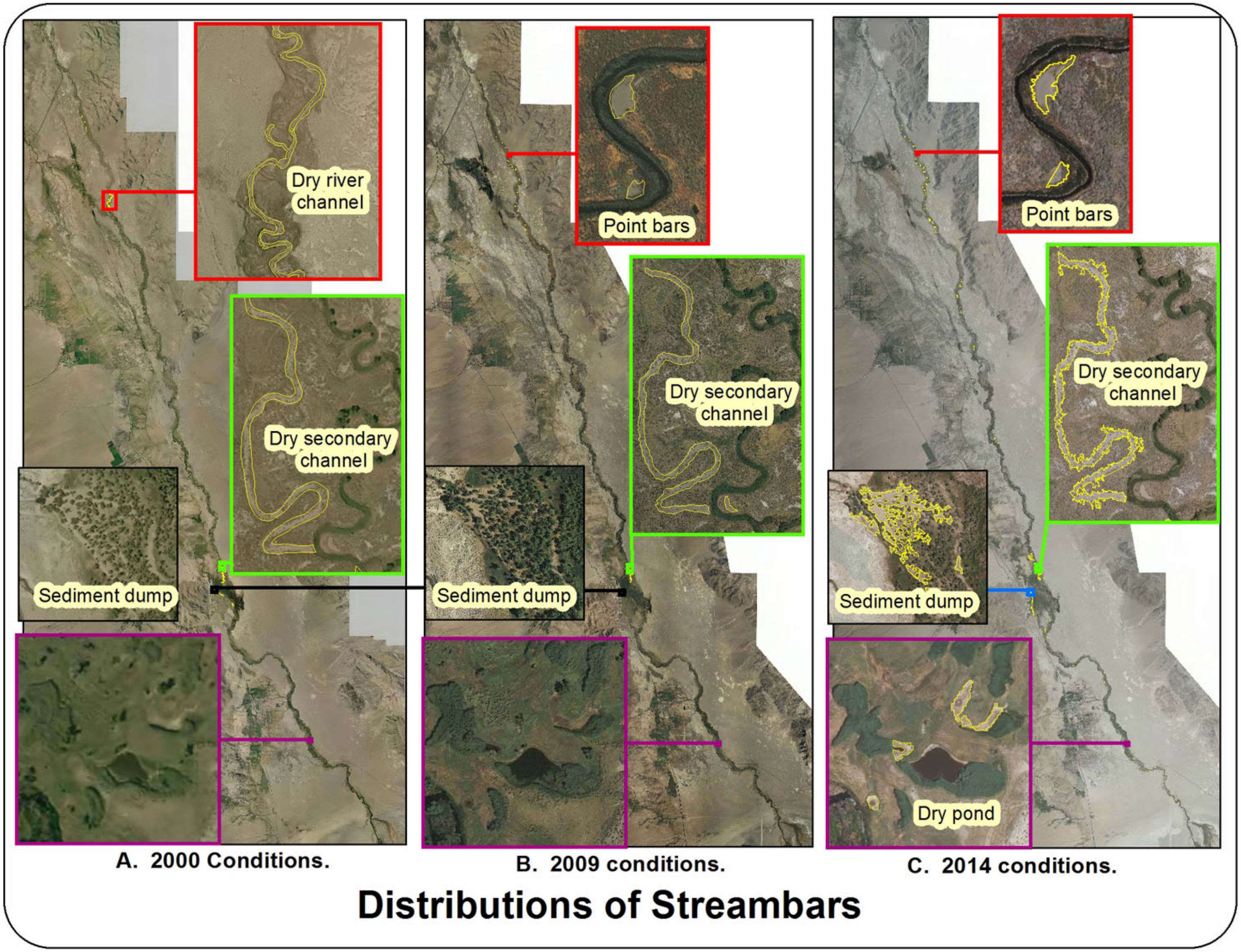
Conditions		Area	
2009	2014	(acres)	(%)
Streambar	Streambar	5	20
Alkali scrub/meadow	Streambar	4	15
Alkali meadow	Streambar	3	12
Alkali scrub	Streambar	3	12
Riparian forest	Streambar	3	11
Bassia	Streambar	2	9
Barren	Streambar	2	8
TOTAL		**22**	**86**



Vegetation Mapping Figure 10. Distributions of Water



Vegetation Mapping Figure 11. Changes in Extent of Open Water Island Area



Vegetation Mapping Figure 12. Distributions of Streambars

Marsh: Occurs in the river channel of incised and graded reaches and extends across broad floodplains of aggraded reaches. The area of marsh increased from 765 acres in 2000 to 1,090 acres in 2009, to 1,310 acres in 2014 (Veg Mapping Table 1). Dominant plants include cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acut*us). Three-square bulrush (*Schoenoplectus pungens*), salt marsh bulrush (*Schoenoplectus maritimus*), common reedgrass (*Phragmites australis*), Baltic rush (*Juncus balticus*), Parish spikerush (*Eleocharis parishii*) and yerba-mansa (*Anemopsis californica*) may also be present. Widely scattered, decadent Goodding willow (*Salix Gooddingii var. variabilis*) and red willow (*Salix laevigata*) were present in some parcels. Total vegetative cover exceeds 85%. Surfaces are typically flooded. Inclusions of water and reedgrass are common.

Marsh comprises 10 percent of incised reaches where it is confined to the river channel. It comprises 14 percent of graded reaches where it fills the river channel, divorced oxbows, and sometimes overflows onto the floodplain. It spreads across 44 percent of aggraded reaches. New marsh in 2014 replaced open water, alkali meadow, and riparian forest mapped for 2009 conditions (Veg Mapping Table 7). Conversion of marsh to wet meadow is attributed to mapping error.

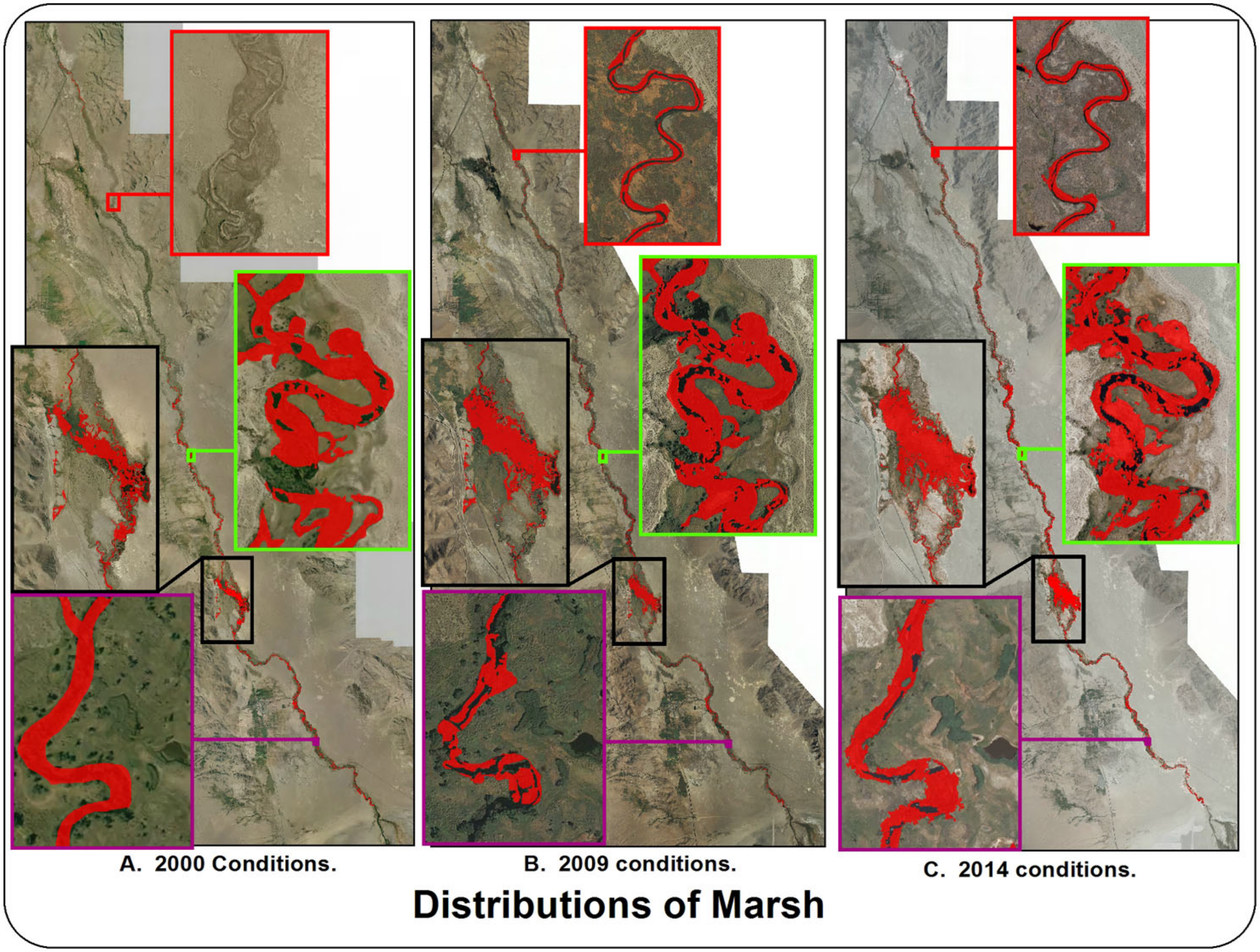
Vegetation Mapping Table 7. Prominent Changes, Marsh

Conditions		Area	
2009	2014	(acres)	(%)
Marsh	Marsh	882	58
Water	Marsh	134	9
Alkali meadow	Marsh	114	8
Riparian forest	Marsh	80	5
Marsh	Wet meadow	73	5
TOTAL		**1283**	**85**

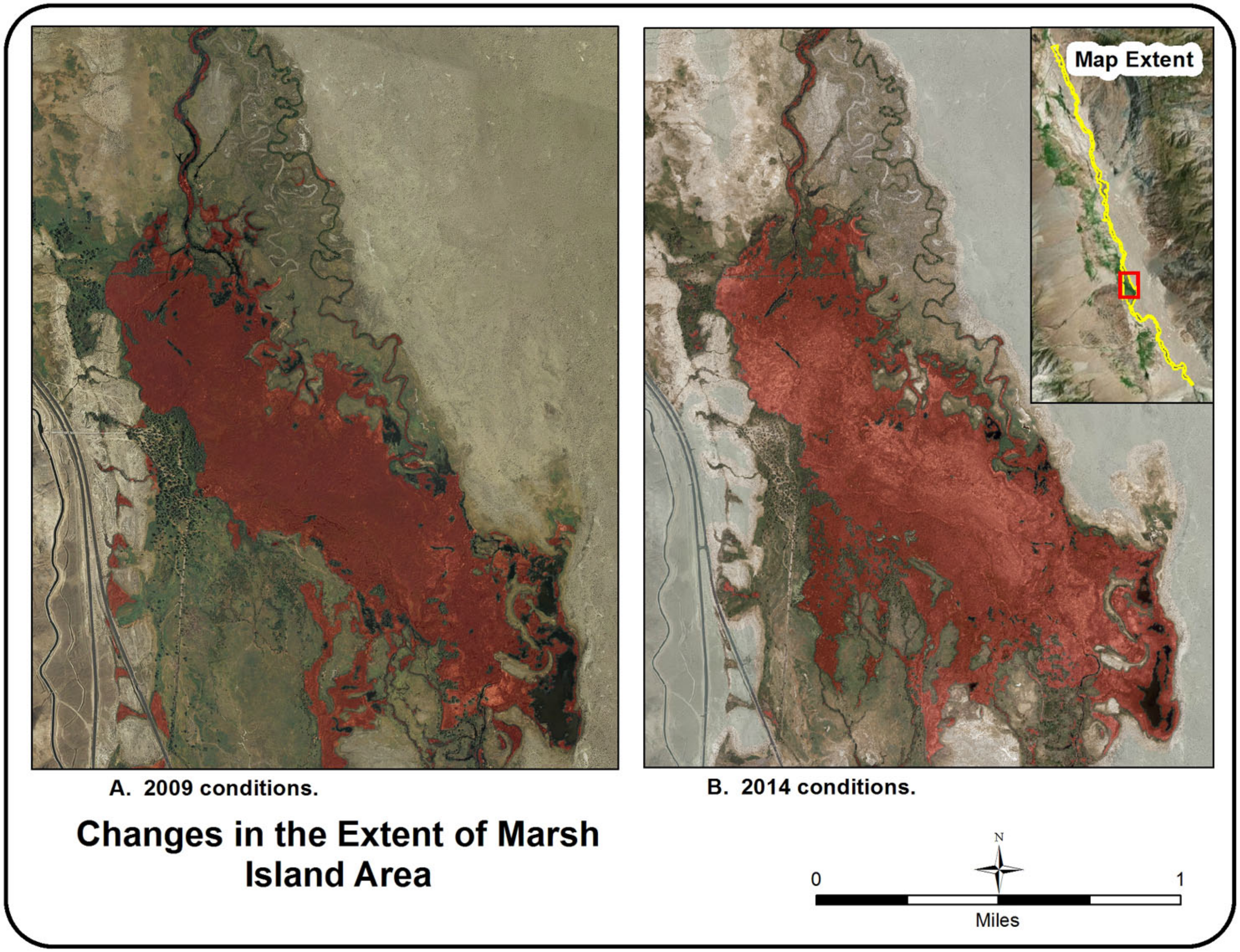
Reedgrass: This herbaceous vegetation type occurs in the stream channel and on floodplain and low terrace with high water table. The extent of reedgrass has doubled from 24 acres in 2009 to more than 50 acres in 2014. It is typically associated with marsh. Reedgrass (*Phragmites australis*) forms a patchy monoculture. Small reedgrass patches are included in marsh parcels.

Vegetation Mapping Table 8. Prominent Changes, Reedgrass

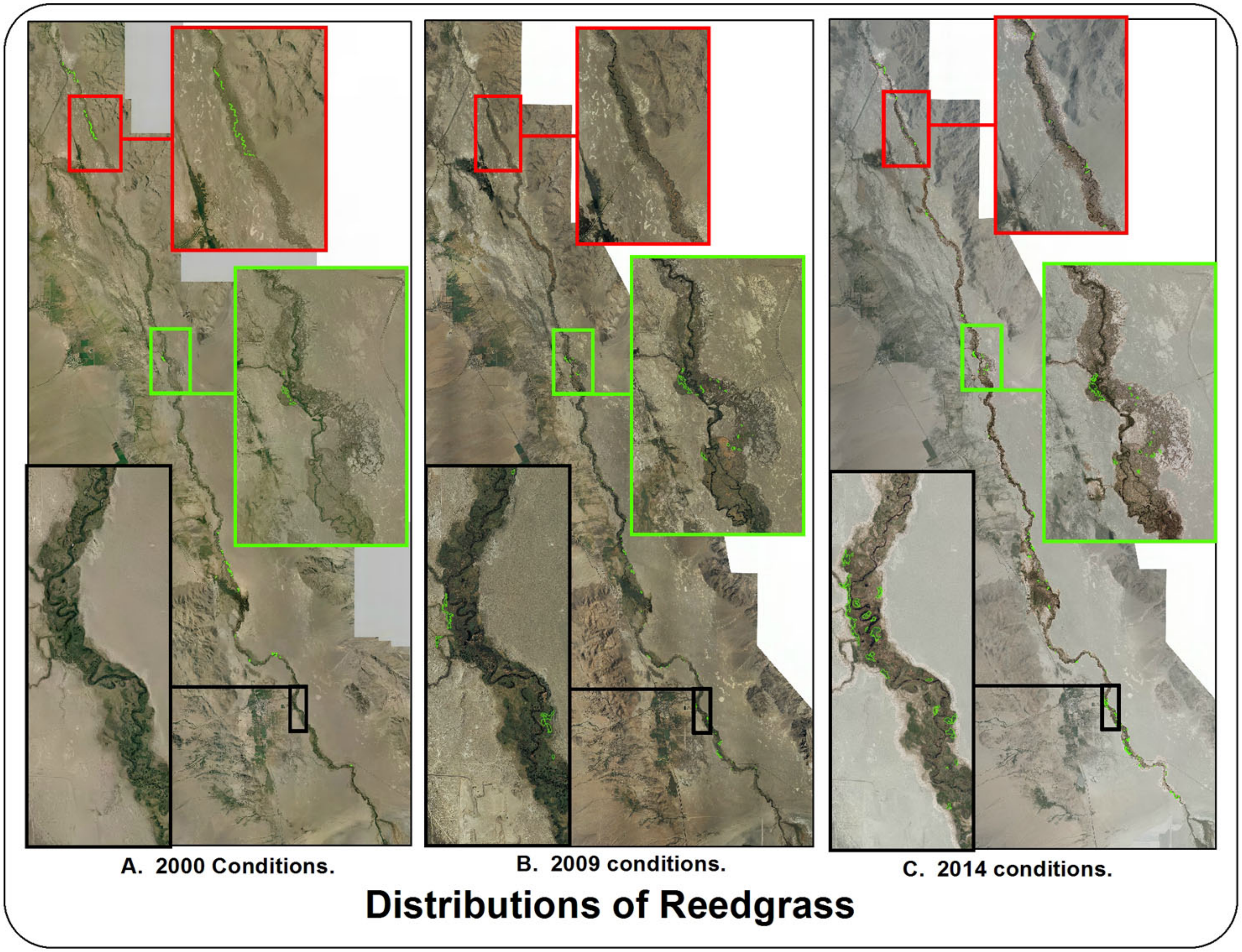
Conditions		Area	
2009	2014	(acres)	(%)
Marsh	Reedgrass	14	24
Reedgrass	Reedgrass	14	24
Alkali meadow	Reedgrass	5	8
Riparian forest	Reedgrass	4	7
Wet meadow	Reedgrass	3	5
Reedgrass	Marsh	3	5
Alkali scrub/meadow	Reedgrass	3	5
Bassia	Reedgrass	2	3
Water	Reedgrass	2	3
TOTAL		**50**	**85**



Vegetation Mapping Figure 13. Distribution of Marsh



Vegetation Mapping Figure 14. Changes in the Extent of Marsh Island Area



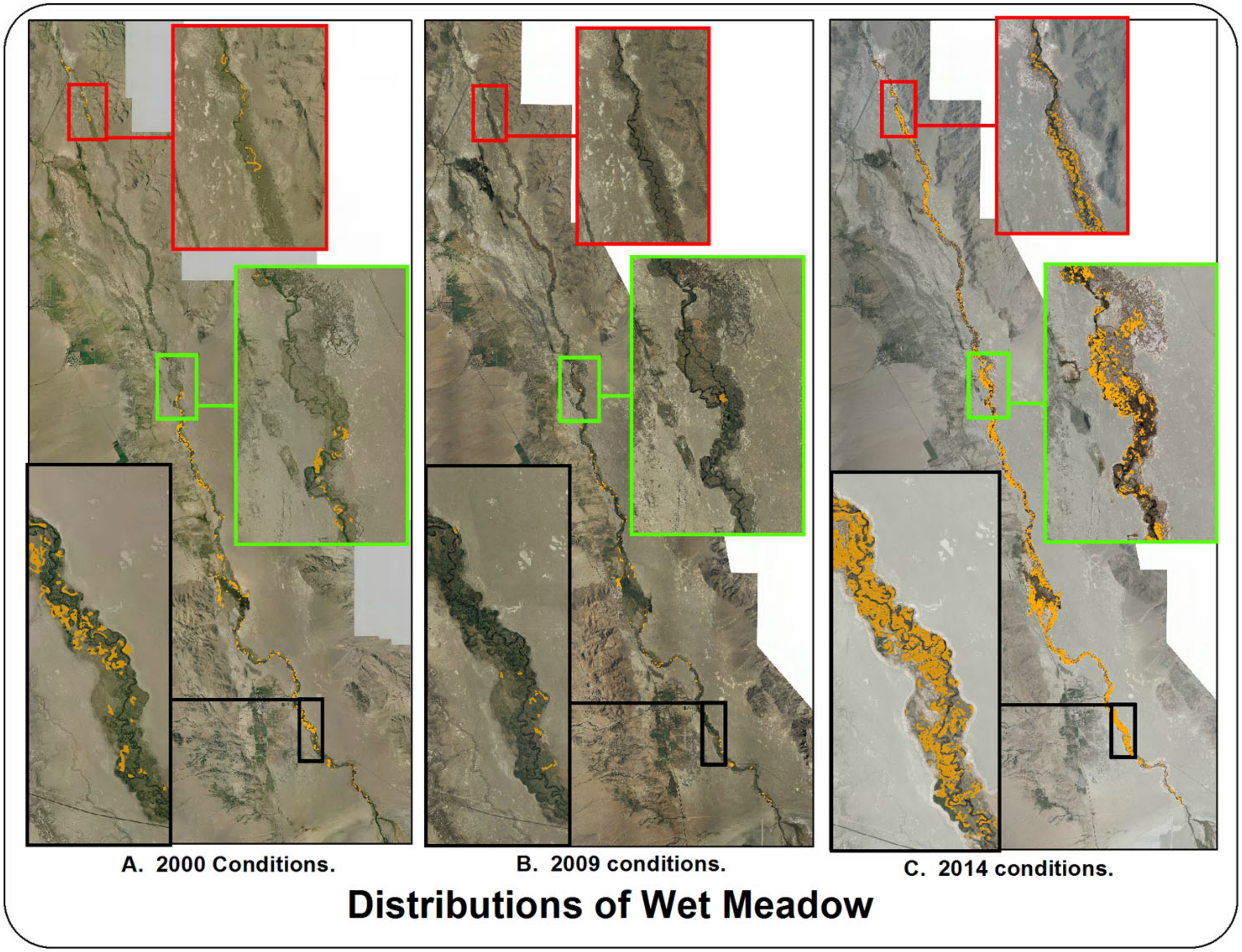
Vegetation Mapping Figure 15. Distribution of Reedgrass

Wet meadow: This herbaceous vegetation type occurs on floodplains and in depressions on terraces with high water tables (Veg Mapping Figure 16). The key criteria distinguishing wet meadow from alkali meadow is that wet meadow does not support alkali scrub. Dominant plants included saltgrass (*Distichlis spicata*), creeping wildrye (*Leymus triticoides*), Baltic rush (*Juncus balticus*), beaked spikerush (*Juncus rostellata*), three-square bulrush (*Schoenoplectus pungens*), sunflower (*Helianthus* sp.), and clustered field sedge (*Carex praegracilis*). Decadent Nevada saltbush (*Artriplex lentiformis, torreyi*) and rubber rabbitbrush (*Ericameria nauseosus*) may be present in parcels transitioning from alkali scrub/meadow to wet meadow. Total vegetative cover was typically greater than 75%.

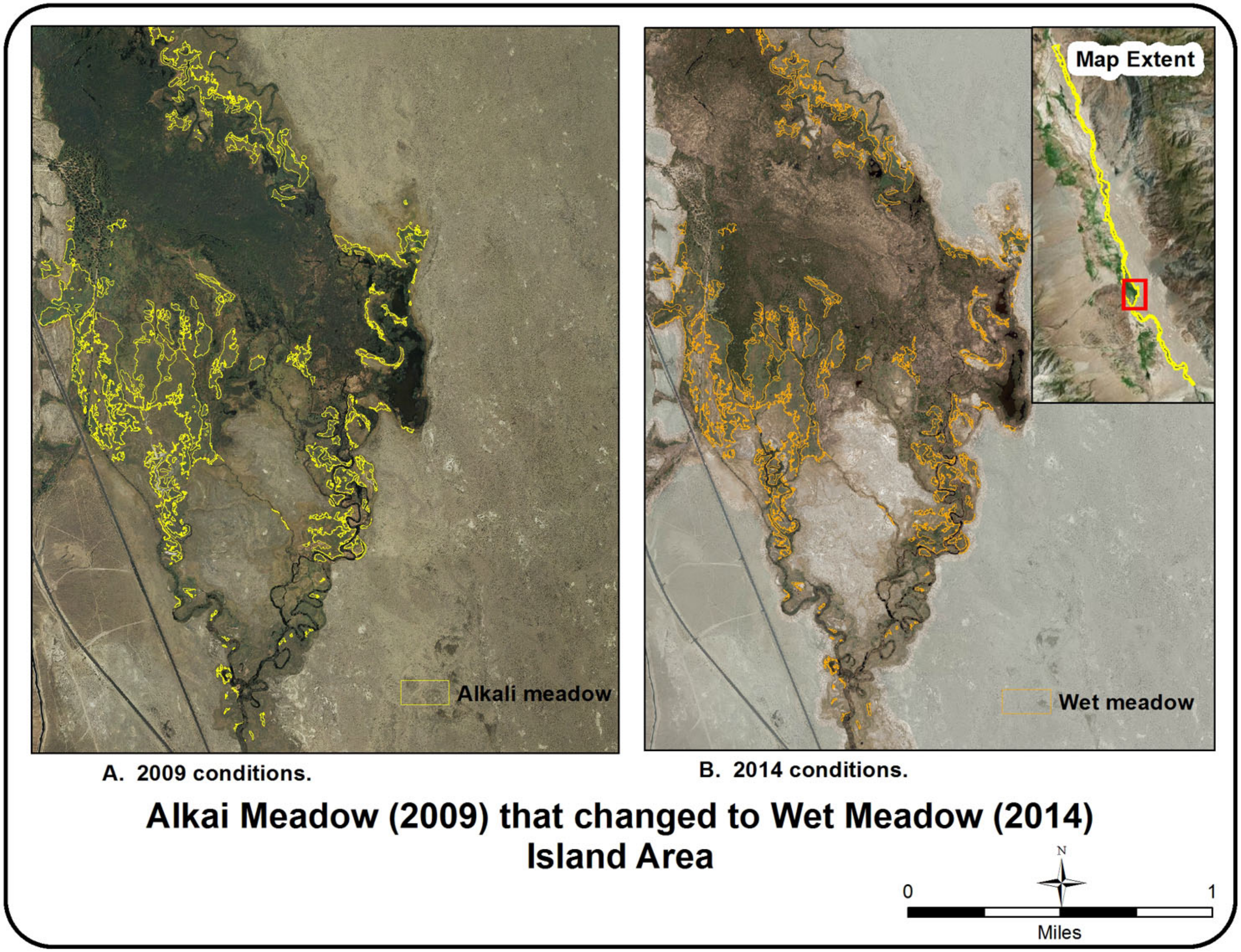
Much of the 210 acres of wet meadow present in 2000 had converted to marsh in 2009. Since 2009, the extent of wet meadow has increased nearly 600 acres, mostly in graded and aggraded reaches. About 328 acres the new wet meadow was alkali meadow in 2009 (Veg Mapping Table 9); alkali meadow and alkali scrub/meadow changed to wet meadow in response to continued aggradation of the Island in 2014 (Veg Mapping Figure 17). While the data suggest that marsh, riparian forest, and alkali scrub converted to wet meadow, these changes are likely errors attributed to more precise mapping in 2014 (Veg Mapping Figure 18).

Vegetation Mapping Table 9. Prominent Changes, Wet Meadow.

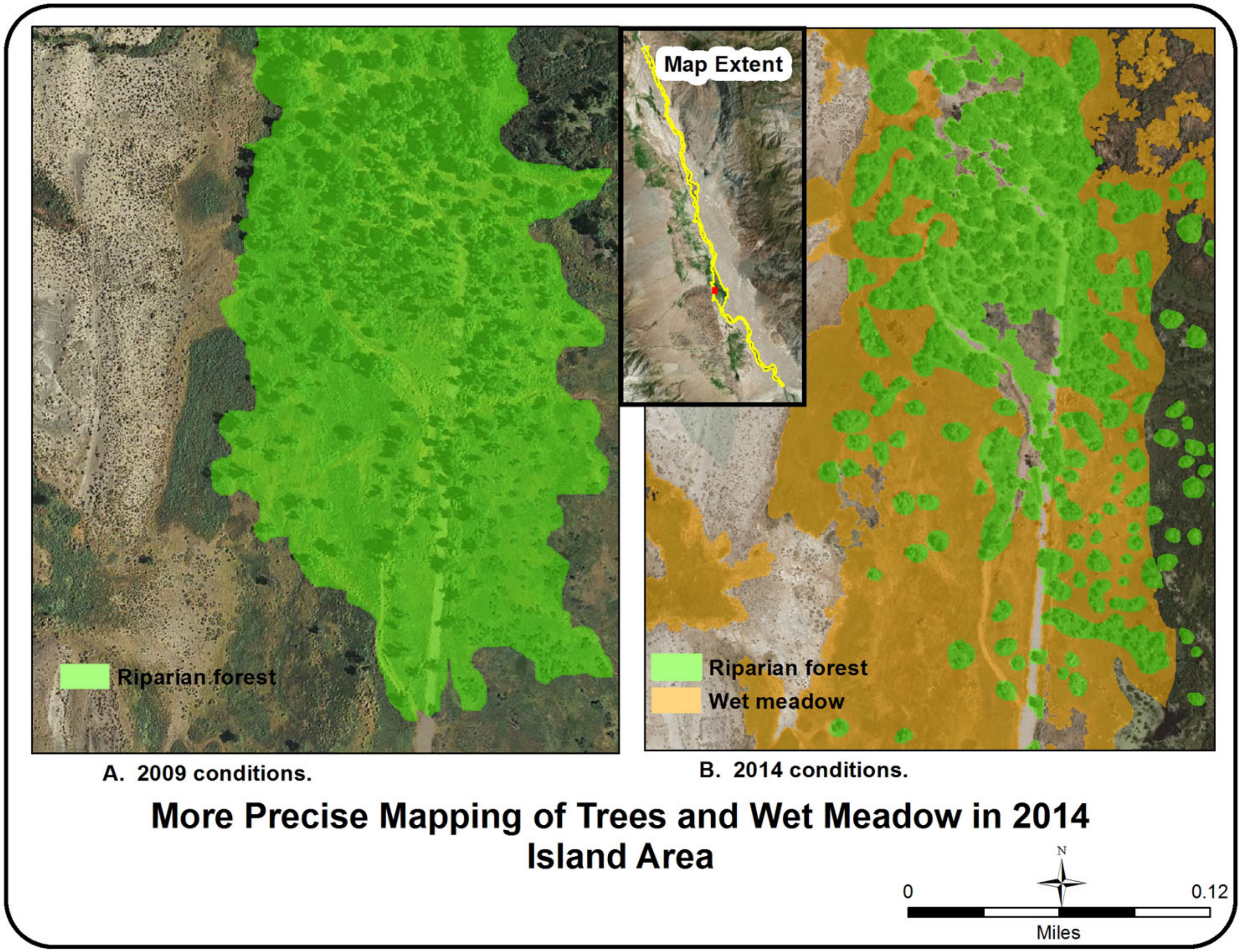
Conditions		Area	
2009	2014	(acres)	(%)
Alkali meadow	Wet meadow	328	48
Alkali scrub/meadow	Wet meadow	112	16
Marsh	Wet meadow	73	11
Riparian forest	Wet meadow	45	7
Alkali scrub	Wet meadow	27	4
TOTAL		**585**	**86**



Vegetation Mapping Figure 16. Distribution of Wet Meadow



Vegetation Mapping Figure 17. Alkali Meadow Changed to Wet Meadow



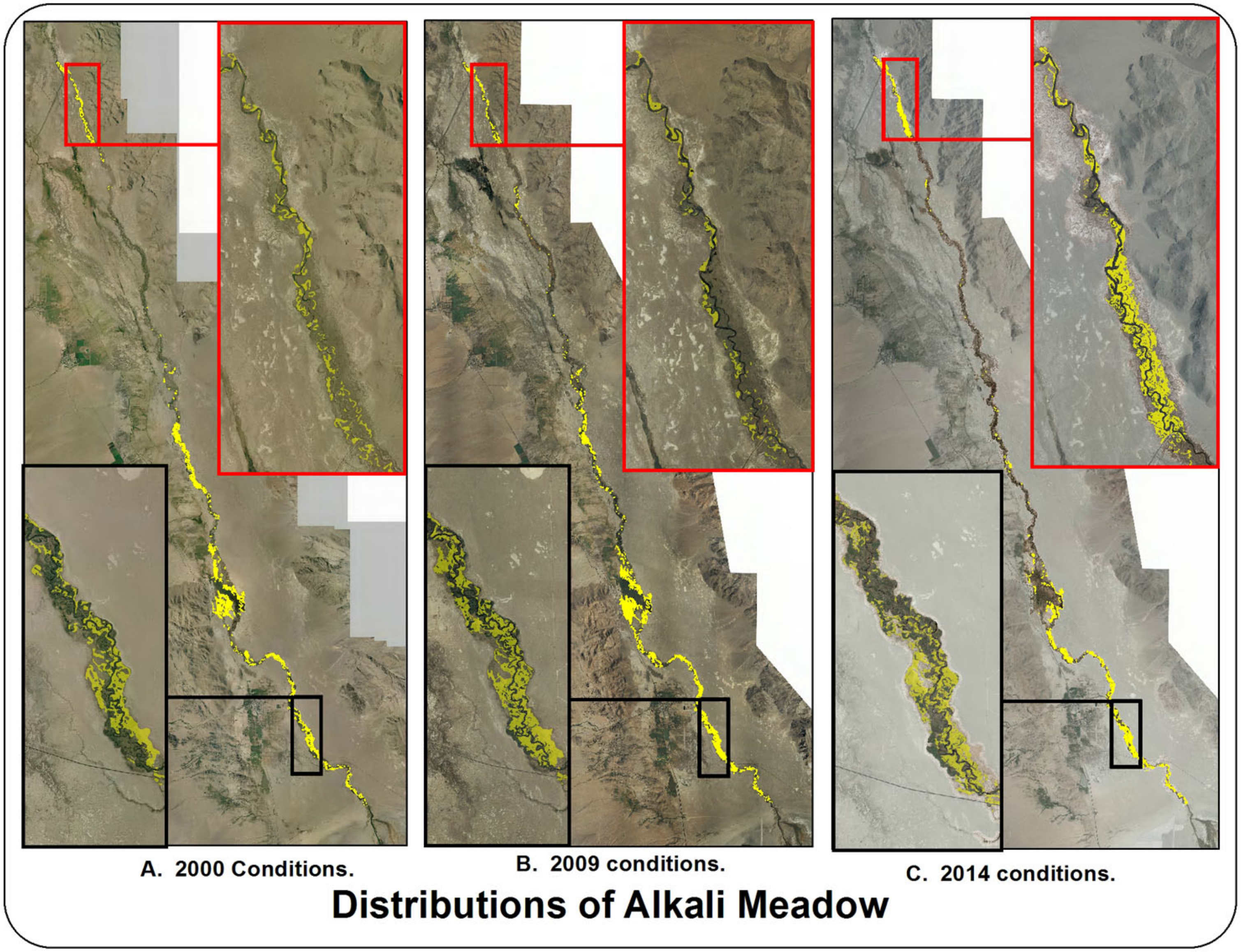
Vegetation Mapping Figure 18. Precise Mapping of Trees and Wet Meadow, 2014 Island Area

Alkali meadow: This herbaceous vegetation type occurs mostly on the low terrace land type with low water table (Veg Mapping Figure 19). Alkali scrub/meadow and alkali meadow are broadly overlapping habitat. If you burn alkali scrub/meadow, you get alkali meadow. Saltgrass (*Distichlis spicata*) is dominant; alkali sacaton (*Sporobolus airoides*) and Baltic rush (*Juncus baliticus*) may also be present. Total herbaceous cover is typically greater than 50%.

Since 2009 there has been a net loss of more than 500 acres of alkali meadow (Veg Mapping Table 1). About 328 acres changed to wet meadow (Veg Mapping Table 10), as previously illustrated in the Island area. Another 240 acres was mapped as alkali scrub/meadow, basically the same habitat, in 2014. Another 114 acres of alkali meadow converted to marsh. About 220 acres of new alkali meadow was created, mostly in response to prescribed burns.

Vegetation Mapping Table 10. Prominent changes, alkali meadow.

Conditions		Area	
2009	2014	(acres)	(%)
Alkali meadow	Wet meadow	328	25
Alkali meadow	Alkali meadow	246	19
Alkali meadow	Alkali scrub/ meadow	240	19
Alkali scrub/meadow	Alkali meadow	155	12
Alkali meadow	Marsh	114	9
Alkali meadow	Upland scrub	67	5
TOTAL		**1151**	**89**



Vegetation Mapping Figure 19. Distributions of Alkali Meadow

Riparian shrub: This tall shrub vegetation type occurs primarily on floodplain and low terrace landtypes with high water table. Riparian shrub is commonly associated with tributary drainages. A dense thicket of coyote willow (*Salix exigua*) dominates the overstory; Woods rose (*Rosa woodsii*) may be present. Creeping wildrye (*Leymus triticoides*) and saltgrass (*Distichlis spicata*) are prominent in the understory.

The area of riparian shrub increased from about 20 acres in 2009 to about 32 acres in 2014. Most of this increase is attributed to mapping error along Shephards Creek in 2009 (Veg Mapping Figure 20) and new shrub willows in response to flooding in the Island area (Veg Mapping Figure 21). Riparian shrub communities are also getting started on point streambars along the river channel in reach 2. Prominent changes (Veg Mapping Table 11) are diverse and include a higher proportion of map error associated with the small riparian shrub parcels.

Vegetation Mapping Table 11. Prominent changes, Riparian Shrub

Conditions		Area	
2009	2014	(acres)	(%)
Riparian shrub	Riparian shrub	11	27
Marsh	Riparian shrub	8	19
Alkali meadow	Riparian shrub	3	8
Riparian forest	Riparian shrub	3	7
Riparian shrub	Reedgrass	2	5
Riparian shrub	Marsh	2	5
Alkali scrub/meadow	Riparian shrub	2	4
Riparian shrub	Alkali scrub/ meadow	2	4
Wet meadow	Riparian shrub	1	3
Riparian shrub	Wet meadow	1	3
TOTAL		**34**	**85**

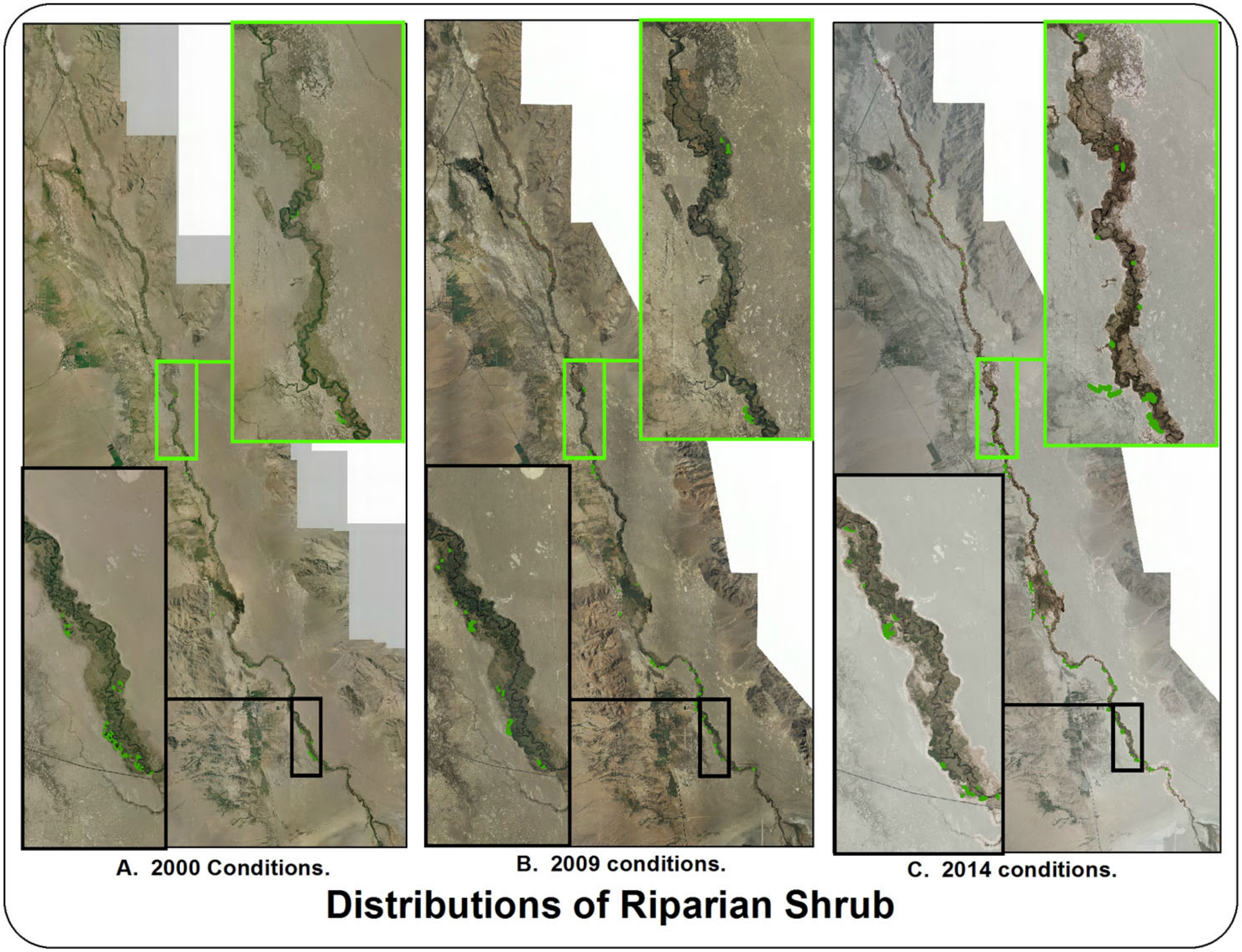
Tamarisk: In 2000, this tall shrub vegetation type occurred primarily on floodplain with high to low water tables and on high terrace with very low water table. A dense to open overstory canopy was dominated by tamarisk (*Tamarisk ramosissima*); Russian olive *(Elaeagnus angustifolia*), Goodding willow (*Salix Gooddingii*), red willow (*Salix laevigata*), and Fremont cottonwood (*Populus fremontii*) was be present in some parcels. Dominant low shrubs included rubber rabbitbrush (*Ericameria nauseosus*) and Nevada saltbush (*Atriplex lentiformis, torreyi*). Herbaceous vegetation was very sparse. Tamarisk has been mostly cleared in the LORP riparian area with less than an acre mapped in 2014.

Riparian forest: This forested vegetation type occurs on all landtypes in all water regimes. The prominent overstory is Goodding willow (*Salix Gooddingii*) and red willow (*Salix laevigata*). Russian olive (*Elaeagnus angustifolia*), tamarisk (*Tamarix ramosissima*), and Fremont cottonwood (*Populus fremontii*) may be present in some parcels. The understory may be marsh, wet meadow, alkali meadow, or alkali scrub.

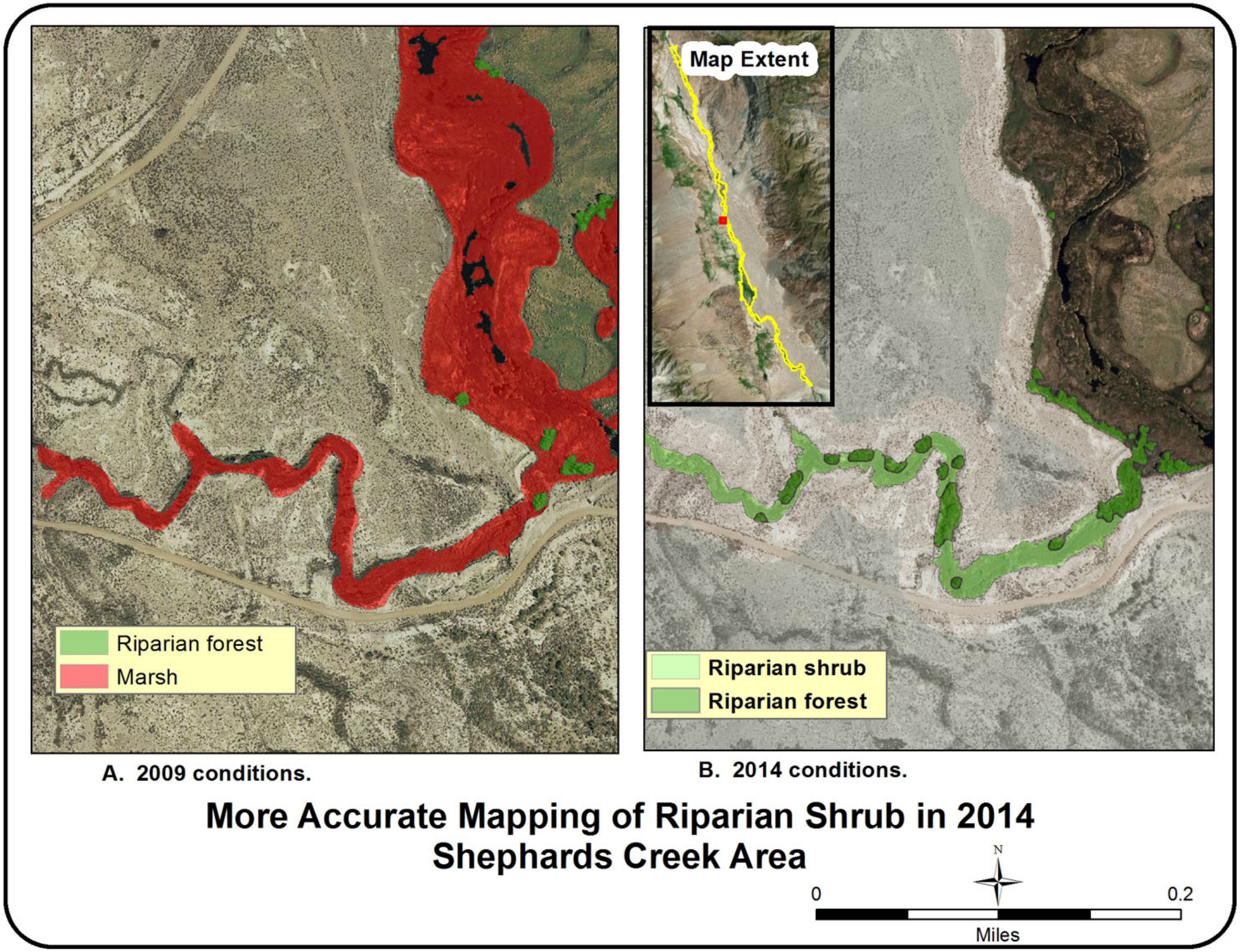
The mapped area of riparian forest decreased from about 265 acres in 2009 to about 165 acres in 2014. Most of this decrease is attributed to more precise mapping of tree canopies (Veg Mapping Figure 18). In 2009, 2,609 riparian tree parcels were identified; in 2014 there were 4,208 smaller parcels. The number of live trees and their dimensions were diminished by the Lone Pine wildfire (Veg Mapping Figure 4-22).

Vegetation Mapping Table 12. Prominent changes, riparian forest.

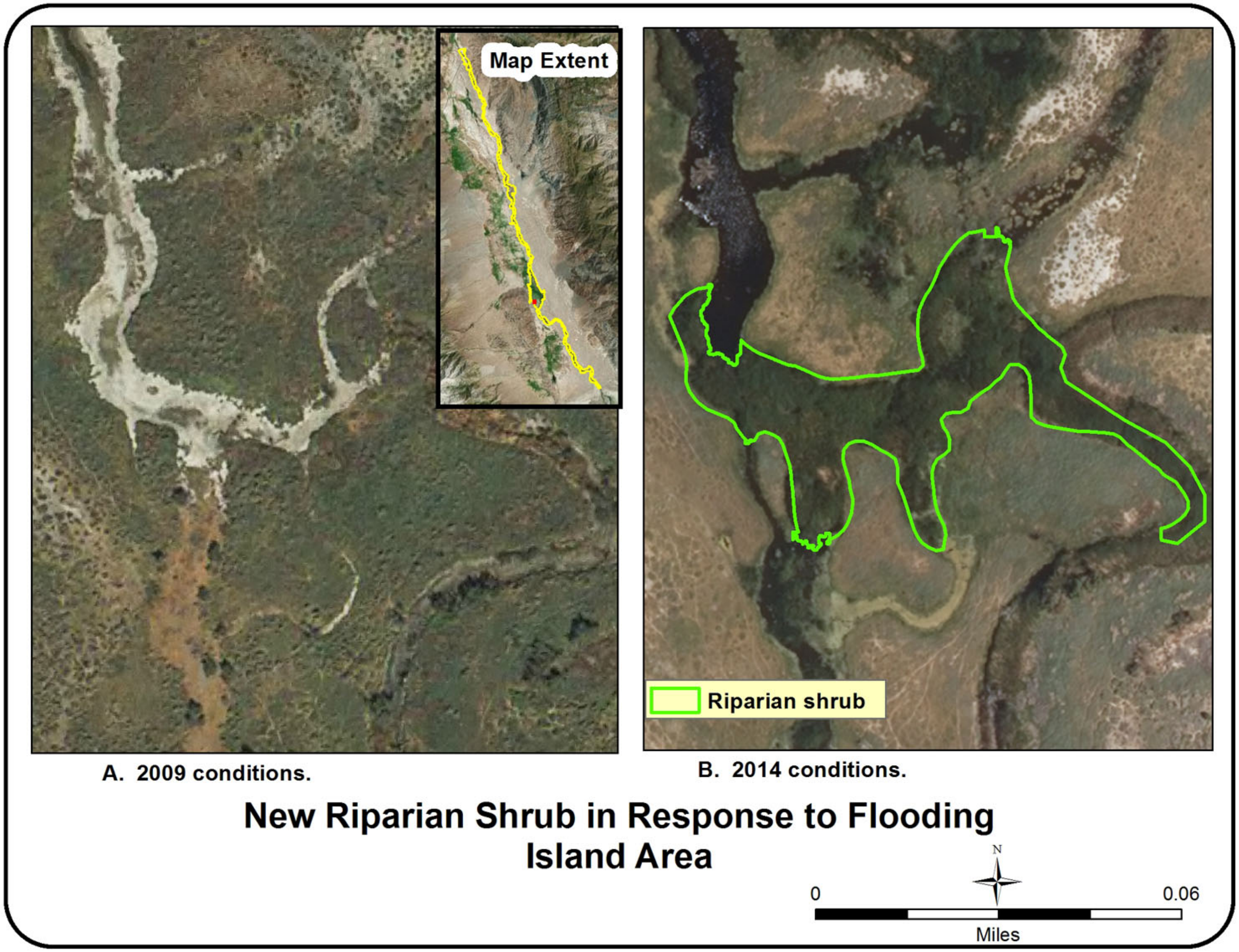
Conditions		Area	
2009	2014	(acres)	(%)
Riparian forest	Riparian forest	94.4	28
Riparian forest	Marsh	80.1	24
Riparian forest	Wet meadow	44.8	13
Marsh	Riparian forest	21.5	6
Dry Alkali Meadow	Riparian forest	11.5	3
Riparian forest	Alkali scrub/ meadow	11.3	3
Alkali scrub	Riparian forest	9.8	3
Alkali scrub/meadow	Riparian forest	9.4	3
TOTAL		**282.8**	**85**



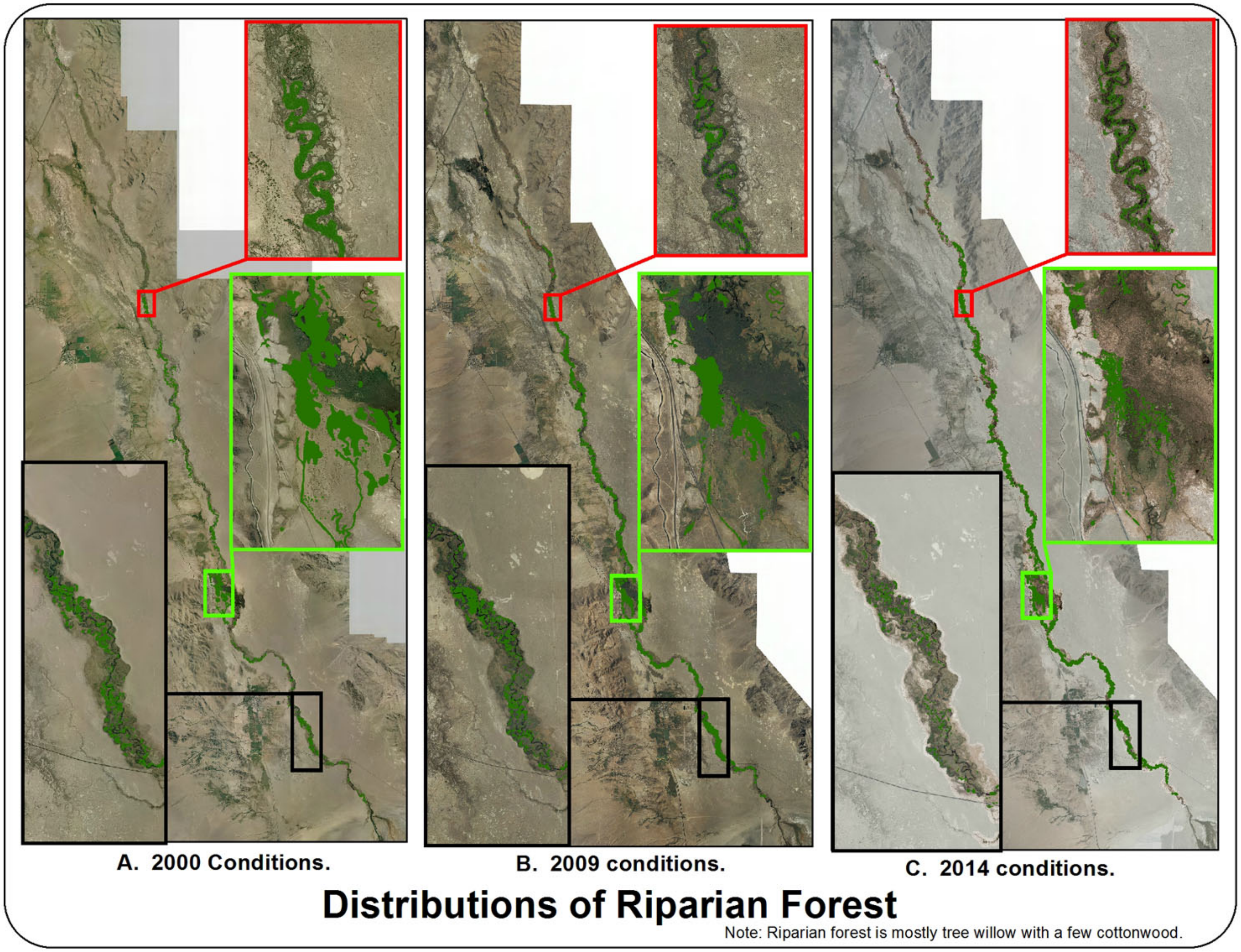
Vegetation Mapping Figure 20. Distributions of Riparian Shrub



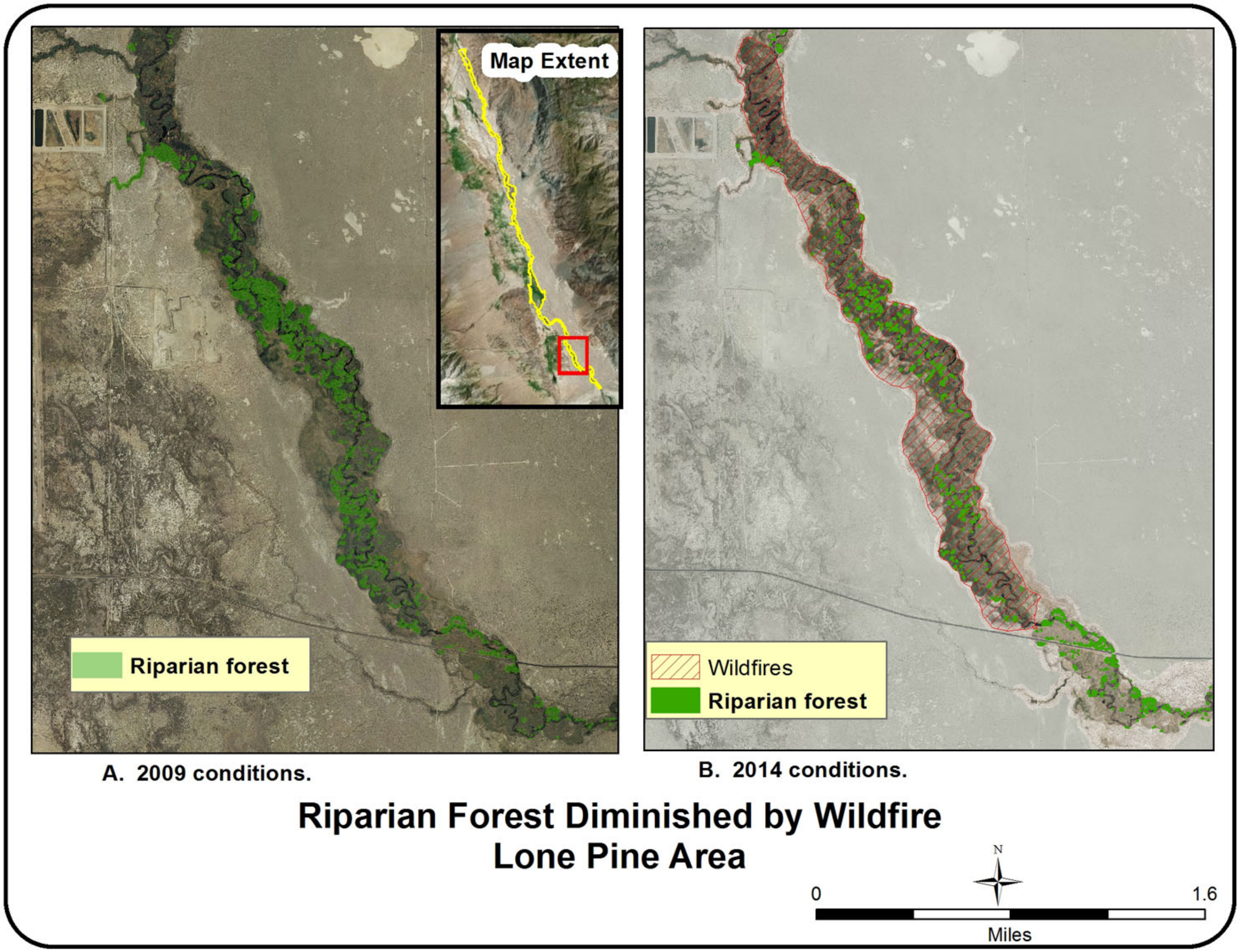
Vegetation Mapping Figure 21. Accurate Mapping of Riparian Shrub, 2014



Vegetation Mapping Figure 22. New Riparian Shrub, Response to Flooding



Vegetation Mapping Figure 23. Distributions of Riparian Forest



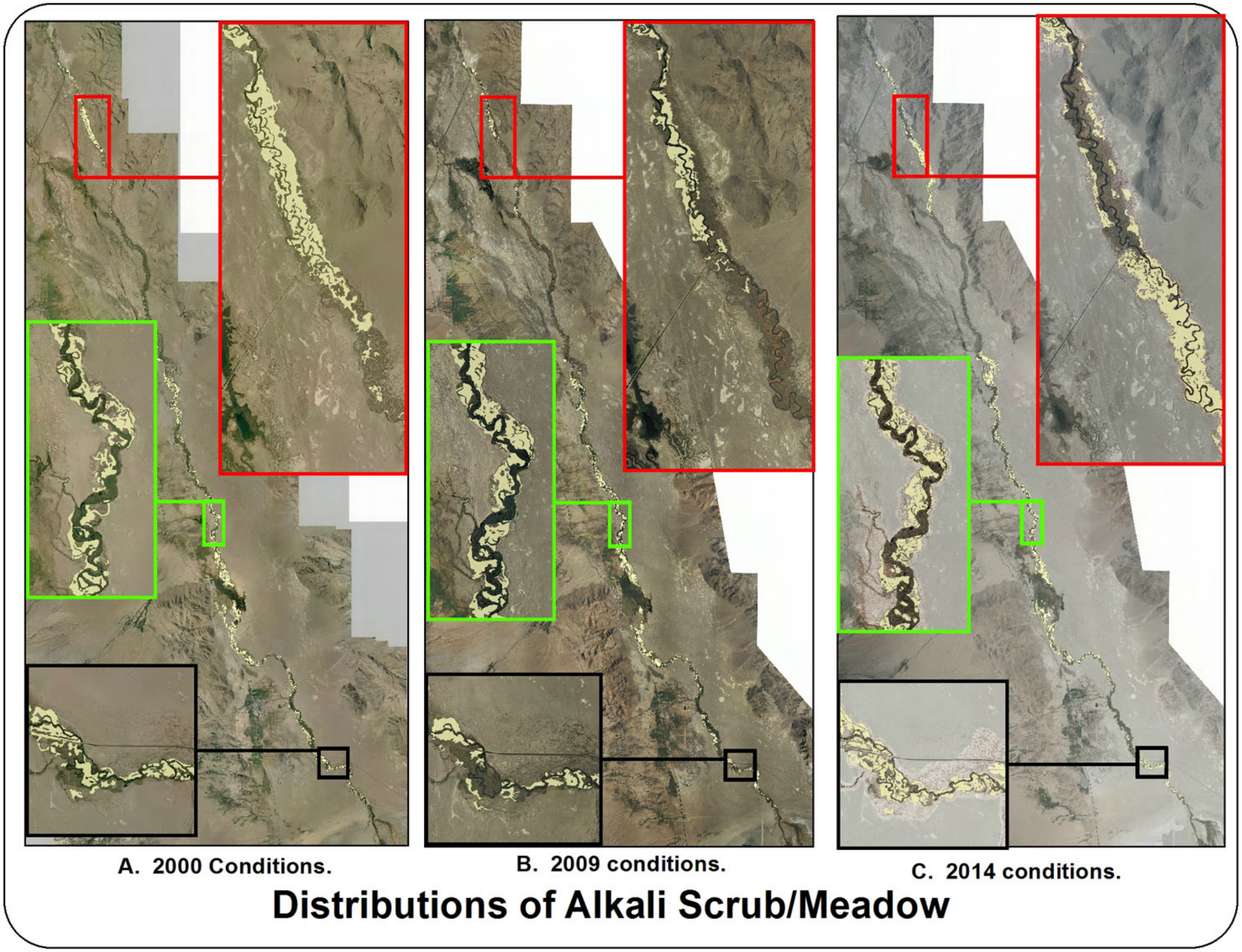
Vegetation Mapping Figure 24. Riparian Forest Diminished by Wildfire, Lone Pine

Alkali scrub/meadow: This low shrub vegetation type occurs primarily on low terraces with low water table (Veg Mapping Figure 25). Alkali scrub/meadow and alkali meadow are overlapping habitats. When you burn alkali scrub/meadow you get alkali meadow. Where the alkali scrub is dead or decadent in response to wetness, burning may leave habitat transitional to wet meadow. The dominant scrub are Nevada saltbush (*Atriplex lentiformis, torreyi*) and rubber rabbitbrush (*Ericameria nauseosus*); greasewood (*Sarcobatus vermiculatus*) is sometimes present, but more typical in upland scrub. Total scrub cover is variable, but typically greater than 25%. Saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), Torrey seepweed (*Sueda moquinii*), and creeping wildrye (*Leymus triticoides*) were prominent herbaceous plants; total herbaceous cover is typically greater than 50%. Inclusions of alkali meadow with sparse scrub and inclusions of alkali scrub with sparse understory are common and may comprise up to about 30 percent of some parcels.

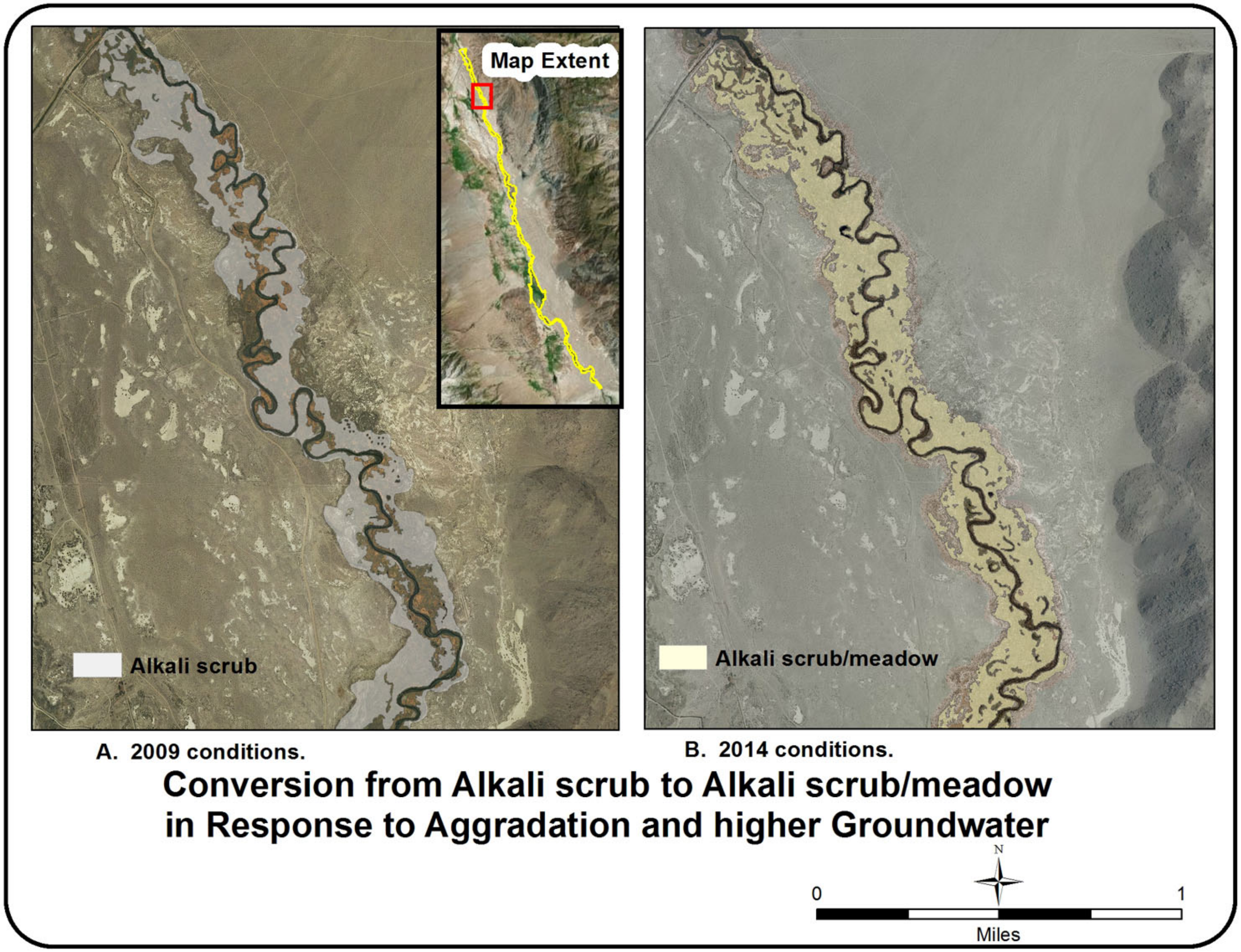
The net increase in alkali scrub/meadow since 2009 is 353 acres (Veg Mapping Table 1). About 440 acres of alkali scrub changed to alkali scrub/meadow in 2014 in response to aggradation and higher groundwater (Veg Mapping Figure 26). Another 240 acres of alkali meadow and 56 acres of bassia changed to alkali scrub/meadow in 2014, including some degree of mapping error. About 155 acres of alkali scrub/meadow was converted to alkali meadow in 2014, mostly in response to prescribed fires. Another 145 acres of alkali scrub/meadow changed to upland scrub and 112 acres changed to wet meadow in 2014 (Veg Mapping Table 13).

Vegetation Mapping Table 13. Prominent Changes, Alkali Scrub/Meadow.

Conditions		Area	
2009	2014	(acres)	(%)
Alkali scrub/ meadow	Alkali scrub/ meadow	630	33
Alkali scrub	Alkali scrub/ meadow	440	23
Alkali meadow	Alkali scrub/ meadow	240	12
Alkali scrub/ meadow	Alkali meadow	155	8
Alkali scrub/ meadow	Upland scrub	146	8
Alkali scrub/ meadow	Wet meadow	112	6
TOTAL		**1724**	**89**



Vegetation Mapping Figure 25. Distributions of Alkali Scrub/Meadow



Vegetation Mapping Figure 26. Conversion From Alkali Scrub to Alkali Scrub/Meadow

Alkali scrub: The concept for the alkali scrub community was changed in 2014. In 2014, alkali scrub consisting of a thicket of Nevada saltbush (*Atriplex lentiformis* ssp. *torreyi*) and rubber rabbitbrush (*Ericameria nauseosus)* with sparse understory that had the potential to change to alkali scrub/meadow was distinguished from upland scrub with more open scrub canopy and that probably will not change to alkali scrub/meadow in response to channel aggradation (Veg Mapping Figure 27). Alkali scrub cover is typically greater than 75 percent and understory is mostly absent. The extent of alkali scrub corresponds with the incised reach (Veg Mapping Figure 8).

Prominent changes are between alkali scrub, upland scrub, alkali scrub/meadow, and barren (Veg Mapping Table 14).

Vegetation Mapping Table 14. Prominent Changes, Alkali scrub.

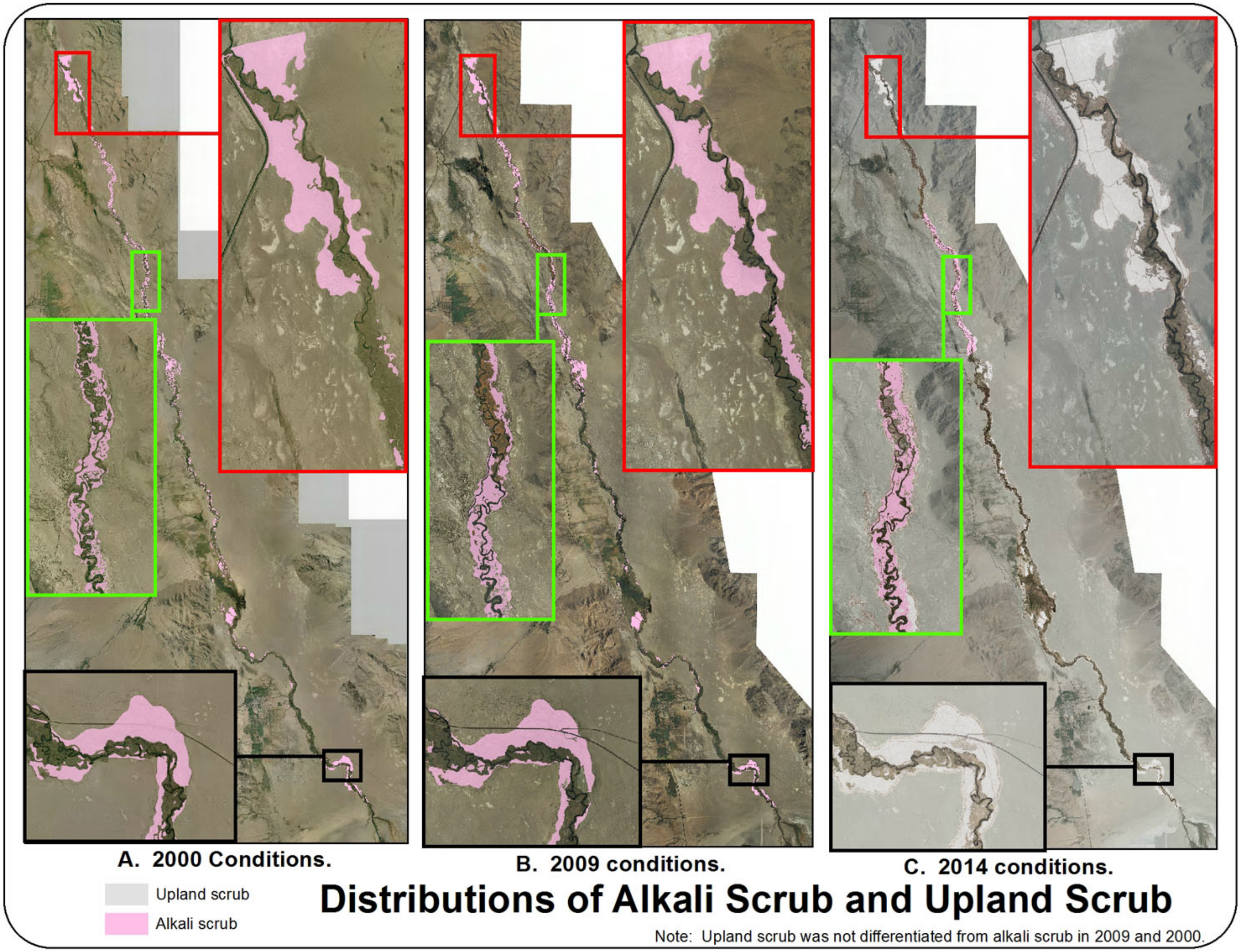
Conditions		Area	
2009	2014	(acres)	(%)
Alkali scrub	Upland scrub	872	42
Alkali scrub	Alkali scrub/ meadow	440	21
Alkali scrub	Alkali scrub	304	15
Alkali scrub/meadow	Upland scrub	146	7
Barren	Upland scrub	69	3
TOTAL		**1832**	**88**

Bassia (weeds): Large areas of bassia or fivehorn smotherweed (*Bassia hyssopfolia)* were first delineated in 2009 on areas that were mostly barren in 2000. Bassia, Nevada saltbush, rubber rabbitbrush, greasewood (*Sarcobatus vermiculatus*), Mojave sealbite (*Suaeda moquinii*), Russian thistle (*Salsola tragus*), alkali mallow (*Malvella leprosa*), and salt heliotrope (*Heliotoprium curassavicum*) form nearly impenetrable thickets. It occurs mostly in the downstream half of reach 2 that was dry in 2000 (Veg Mapping Figure 28).

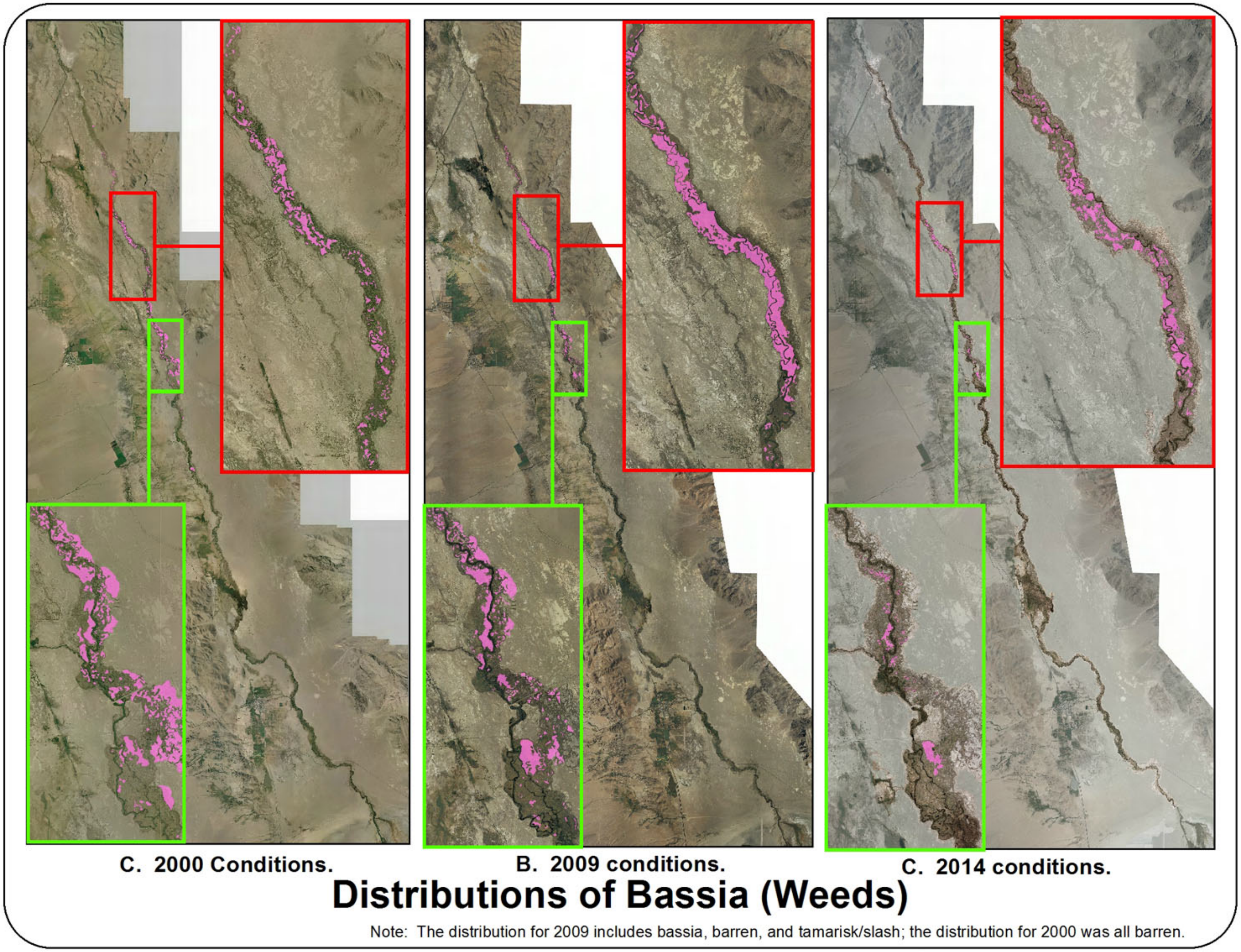
The area of bassia decreased from 326 acres in 2009 to about 118 acres in 2014. Prominent changes were between bassia, alkali scrub, upland scrub, alkali scrub/meadow, and wet meadow (Veg Mapping Table 15).

Vegetation Mapping Table 15. Prominent Changes, bassia.

Conditions		Area	
2009	2014	(acres)	(%)
Bassia	Alkali scrub	122	27
Bassia	Bassia (weeds)	99	22
Barren	Upland scrub	69	15
Bassia	Alkali scrub/ meadow	56	12
Barren	Alkali scrub	25	6
Bassia	Wet meadow	24	5
TOTAL		**396**	**88**



Vegetation Mapping Figure 27. Distribution of Alkali Scrub and Upland Scrub



Vegetation Mapping Figure 28. Distribution of Bassia

Upland scrub: In 2014, *upland scrub* consisting of a more open scrub canopy of Nevada saltbush, rubber rabbitbrush, and greasewood with a relatively open understory including alkali sacaton and saltgrass was distinguished from areas mapped as *alkali scrub* in 2009. It occurs mostly along the flanks of the river corridor on high terraces with very low water table and is little influenced by river management. It comprises about 1,191 acres that was previously classified alkali scrub and alkali scrub/meadow (Veg Mapping Table 16).

Vegetation Mapping Table 16. Prominent Changes, Upland Scrub.			
Conditions		Area	
2009	2014	(acres)	(%)
Alkali scrub	Upland scrub	872	74
Alkali scrub/meadow	Upland scrub	146	12
TOTAL		**1017**	**87**

Roads and Miscellaneous Features: Road polygons were generated as a 10-meter wide buffer centered on an existing line file of roads. Roads comprise about 43 acres of the LORP riparian area. Miscellaneous features include the LORP intake structures, streamflow measuring stations, spoil areas, and other structural features totaling 19 acres.

Inclusions of both similar and contrasting types occur in all map units. Similar inclusions (e.g. alkali scrub/meadow and alkali meadow; wet meadow and alkali meadow; alkali scrub and alkali scrub meadow; marsh and water; marsh and reedgrass) may comprise up to about 30% of any one parcel, but generally a much smaller proportion when viewed over all parcels. Contrasting types (e.g. wet meadow and alkali scrub/meadow; riparian shrub and alkali meadow) may comprise up to 15% of any one parcel, but a much smaller proportion of all parcels.

4.5 Accuracy Assessment

Of the 95 randomly selected parcels for accuracy assessment, 92 were correctly classified (Veg Mapping Table 17). One parcel of alkali scrub/meadow was incorrectly classified alkali scrub; one parcel of wet meadow was incorrectly labeled reedgrass; and one parcel of alkali meadow was labeled alkali scrub/meadow. Errors were between similar vegetation types. The overall accuracy weighted by the number of parcels of each type was about 97 percent. The overall accuracy weighted by the total area of each type was about 95 percent. The target overall error rate of less than 5 percent was achieved.

Vegetation Mapping Table 17. Accuracy Assessment

Type	Accuracy Parcels	
	N	Correct
Water	10	10
Streambar	5	5
Marsh	10	10
Reedgrass	5	5
Wet meadow	10	9
Riparian shrub	5	5
Riparian forest	10	10
Alkali meadow	10	9
Alkali scrub/meadow	10	9
Alkali scrub	5	5
Bassia (weeds)	5	5
Upland scrub	10	10
TOTAL	**95**	**92**

4.6 LORP Summary

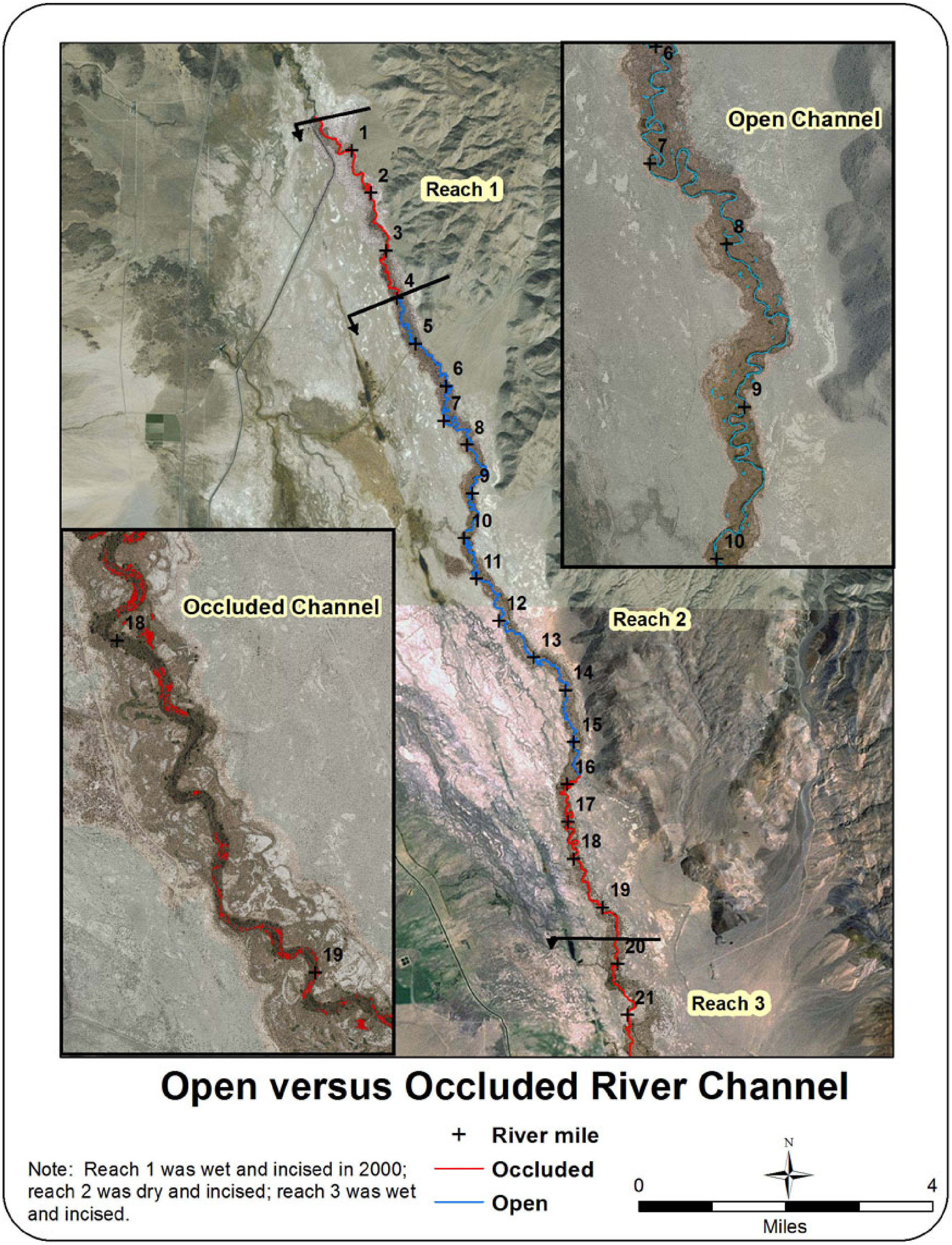
Hydric vegetation was predicted to increase 1,032 acres in response to the LORP (WHA 2004b). Short-term future conditions were predicted in response to two mechanisms: 1) changes to herbaceous strata in response to changes is water regime resulting from establishment of base flow; and 2) changes to overstory in response to flooding from seasonal habitat flows. In practice, hydric herbaceous vegetation has increased 795 acres since 2000, mostly in response to changes in water regime resulting from base flow. The predicted increase in overstory canopy has not been realized, probably because of the very limited extent of barren substrate suitable for willow colonization in the seasonally flooded zone. Tiny point bars along reach 2 are the exception; these relatively unvegetated, sandy streambars support willow seedlings that will likely become riparian shrub and/or riparian forest communities.

For 2000 conditions, six reaches were identified based on channel morphology, hydrology, and degree of confinement (Veg Mapping Figure 7). Changes in the distributions of states are primarily responsible for the increase in hydric vegetation. Since 2000, 16 miles of dry channel has been wetted (Veg Mapping Table 2); the length of incised channel has decreased by about 30 miles; the length of graded channel conditions has increased more than 26 miles; and aggraded channel conditions have increased more than 3 miles. In 2014, only 9.8 miles (18 percent) of incised channel remained. The LORP is clearly aggrading.

In 2014, prominent vegetation types for the incised state are alkali scrub (64%), bassia (14%), and marsh 11%). Prominent vegetation types for the graded state are alkali scrub/meadow (43%), marsh (19%), alkali meadow (15%), and wet meadow (13%). Prominent vegetation types for the aggraded state are marsh (49%), wet meadow 18%), and alkali scrub/meadow (18%). The progression towards more graded and aggraded channel conditions (Veg Mapping Figure 8) corresponds with an increase in hydric herbaceous vegetation (Veg Mapping Figure 9).

Changes in state are principally responsible for the increase in hydric vegetation over time. The 545 acre increase in marsh since 2000 occurred primarily in the confined channel of Reach 2 that was dry, expansion of the Island (Reach 4), and more subtle filling of the channel throughout the LORP. Wet meadow increased nearly 600 acres since 2009 on floodplains of newly graded and aggraded reaches. The 795 acre increase in hydric vegetation since 2000 is believed to be a conservative estimate. Much of the 513 acres of alkali meadow (mesic) in graded and aggraded reaches is transitional to wet meadow.

About 100 acres of open water has been replaced by marsh since 2009. A continuous open river channel is only present in the upper 12 miles of Reach 2 that was dry prior to implementation of the LORP (Veg Mapping Figure 29). Evidence that this 12 mile reach is functioning includes numerous point streambar deposits from seasonal habitat flows. Also, entrainment of sandy substrate can be sensed when standing in the channel. In contrast, reach 1, 3, 4, 5, and 6 are mostly occluded, with only short segments of continuous open channel. Channel substrate is mostly muck. The bottoms of the occluded reaches were filled with marsh prior to implementation of the LORP. A channel had to be excavated through reach 1 to convey initial LORP flows. Base flows have augmented marsh and seasonal habitat flows coupled with very low grade have been inadequate to remove the occlusions.



Vegetation Mapping Figure 29. Open Versus Occluded River Channel

The area of riparian forest has decreased from about 450 acres in 2000, to 265 acres in 2009, and 165 acres in 2014 (Veg Mapping Table 1). Most of this reduction is attributed to sequentially more precise mapping of tree canopy in 2009 and again in 2014. Also, many trees were either killed or reduced to basal sprouts by the Lone Pine fire in 2013 (Veg Mapping Figure 2 and Veg Mapping Figure 24). Wildfire in marsh is a significant threat to existing trees. Surprisingly, trees engulfed by marsh in graded reaches that were expected to die are often decadent, but still alive. The extent of riparian forest is declining and trees are not expected to be replaced.

The LORP is expected to continue to aggrade. The remaining incised reach will become graded; the floodplain of graded reaches will become wetter; and aggraded reaches will continue to slowly expand both upstream and downstream. The river channel is expected to become more occluded and the extent of marsh will increase at the expense of open water. Conditions are moving towards an herbaceous wetland (e.g. marsh, wet meadow, alkali meadow) and away from more structurally diverse riverine/riparian habitat with open channel conditions.

Alternative streamflow scenarios have been suggested for changing the direction of the LORP. Seasonal habitat flows originally intended to help maintain open channel conditions has been found to be ineffective in maintaining an open channel. Reducing base flows below 40 cfs has also been considered as a means of reducing the extent of marsh, but low flows in the Los Angeles Aqueduct in 2015 have only resulted in an “inset marsh” that further occludes the channel (Veg Mapping Figure 30). Alternative streamflow scenarios may not be effective in changing the direction of the LORP.

Vegetation Mapping Figure 30. Inset Marsh Occluding LA Aqueduct in Response to Reduced Flow

4.7 BWMA LANDSCAPE VEGETATION MAPPING

The BWMA consists of the Drew, Waggoner, Winterton, and Thibaut management units (Figure 4-31; Table 4-18). Two off river lakes and pond management units (Twin Lakes and Goose Lake) have traditionally been included with the BWMA vegetation inventory, as reported for 2000 and 2009 conditions. The BWMA vegetation inventory for 2014 conditions includes Twin Lakes and Goose Lake management units.

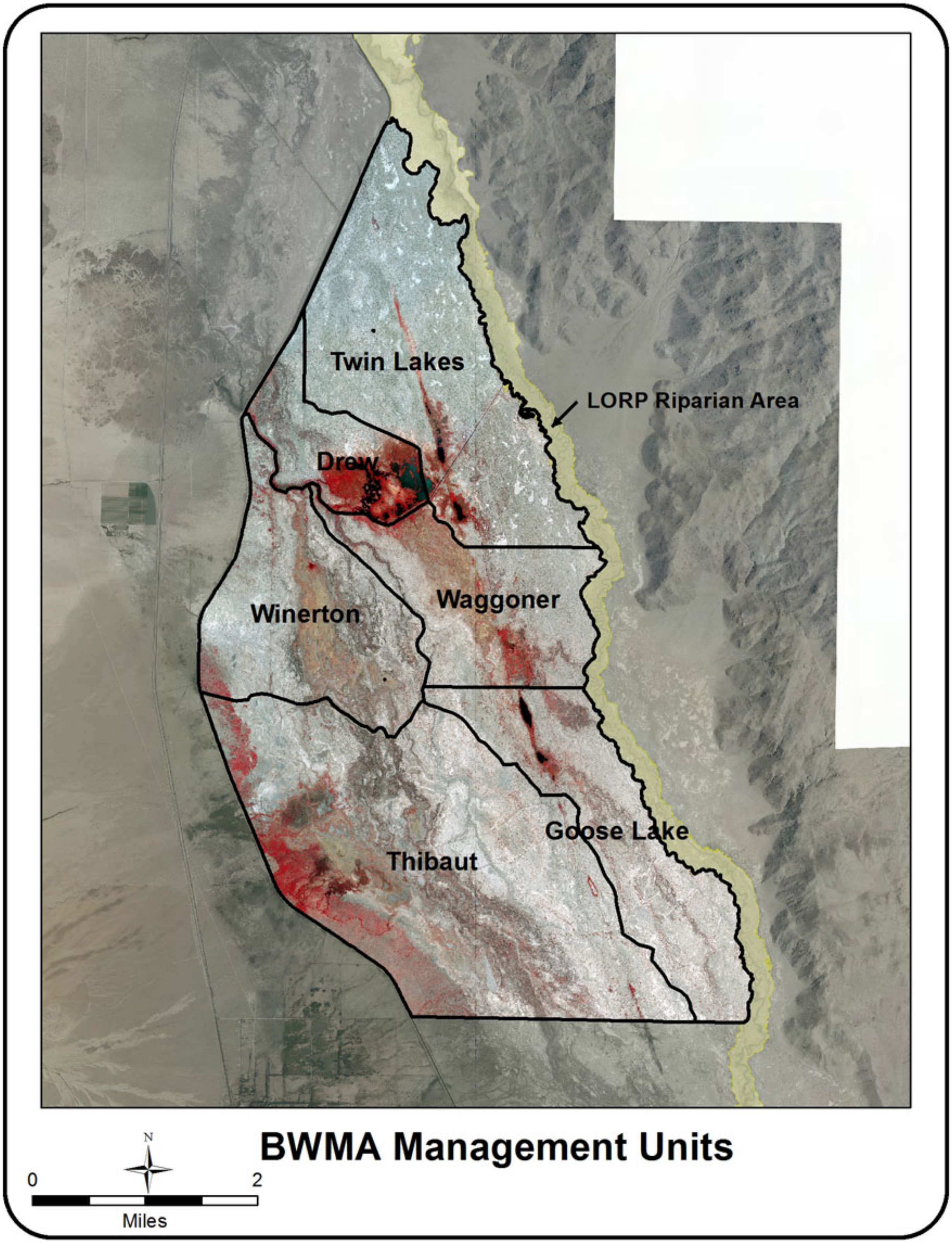
Vegetation Mapping Table 18. BWMA Management Units

Management Unit	Area	
	(acres)	(%)
Drew	827	6
Thibaut	4735	35
Waggoner	1554	11
Winterton	1917	14
Goose Lake	1737	13
Twin Lakes	2898	21
TOTAL	**13668**	**100**

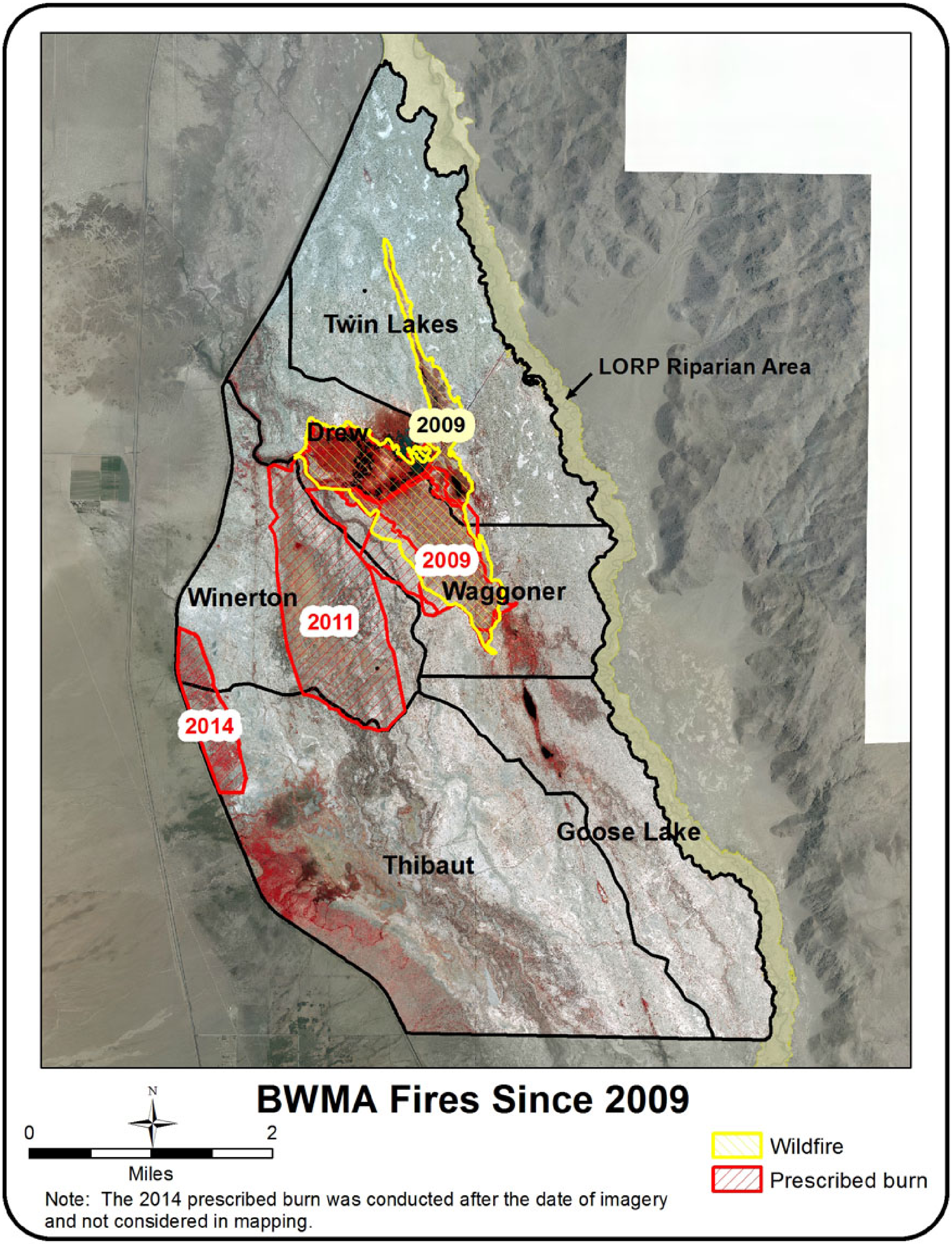
Differences in 2000, 2009, and 2014 conditions are attributed to management, fires, and improvements in the accuracy and precision of mapping.

Water levels in Upper Twin Lake, Lower Twin Lake, and Goose Lake have been maintained based on staff gauges. Hydrologic management of Twin Lakes and Goose Lake management units has remained consistent for 2000, 2009, and 2014 conditions. Seasonal hydrologic management of Drew, Thibaut, Waggoner and Winterton management units are illustrated in Veg Mapping Table 19. The Drew Unit was supplied water from spring 2009 through March 2015. Thibaut was irrigated from 2007 through 2010. Waggoner was irrigated 2009 through 2010. Winterton was irrigated 2007 through summer 2009, then again in 2011.

Several major fires have affected portions of the BWMA project area since 2008 (Veg Mapping Figure 32). Fires converted alkali scrub/meadow to more productive alkali meadow and invigorated production of herbaceous vegetation.



Vegetation Mapping Figure 31. BWMA Management Units



Vegetation Mapping Figure 32. BWMA Fires Since 2009

Vegetation Mapping Table 19. Periods BWMA Management Units were Actively Irrigated

BWMA Management Unit	2007			2008				2009				2010				2011				2012				2013				2014				2015			
	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W	S	S	F	W
Drew																																			
Thibaut																																			
Waggoner																																			
Winterton																																			

4.7.1 BWMA Approach

The approach to mapping the BWMA was nearly identical to that of the LORP riparian area. Mapping is based on the same 4 band, high-resolution image generalized to 1 m resolution to reduce file size. An unsupervised spectral classification with 10 classes was first conducted. Rasters generally corresponding to a vegetation class (e.g. water) were extracted and converted to polygons. The polygon file was then edited and commission errors were deleted. The edited parcels were then used to mask the preliminary spectral analysis from which subsequent vegetation classes were extracted. The same sequence was applied to other distinctive vegetation. Each application reduced the complexity of the preliminary spectral analysis. In this manner, a sequentially derived spectral classification of major vegetation classes was derived. The spectral classification served as a starting point for refined vegetation mapping.

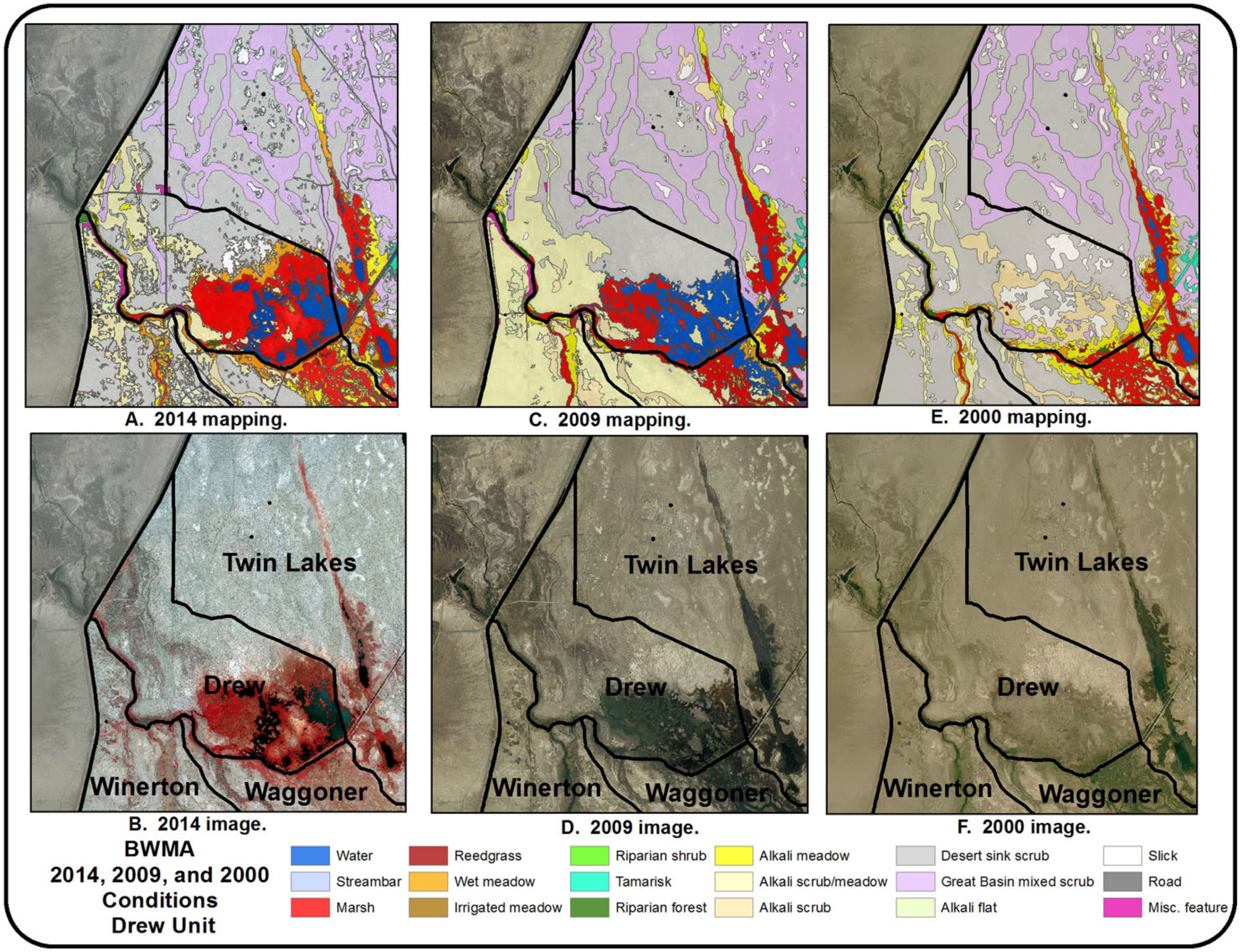
With preliminary spectral classification maps in hand, field reconnaissance was conducted. The purpose was to identify both omission and commission errors and learn to recognize discrete vegetation classes from the 2014 imagery. The field reconnaissance entailed about 10 man-days. Heads-up editing was used to refine the spectral classification map based on what was learned in the field reconnaissance.

The accuracy of refined mapping was evaluated. Ten parcels of each major vegetation type and 5 parcels of each minor type were randomly selected for evaluation. Selected parcels were marked on a map and the centroid of each parcel was marked with a sequential number. Field personnel visited each accessible parcel and determined the primary vegetation type. The accuracy of many additional parcels en-route to the selected parcels were also checked and documented by checking labels on field maps. Commission errors were also noted. The overall error was estimated as the average error for all vegetation types, weighted by the number of parcels of each type. The target overall error rate was less than 10 percent. The target was increased to accommodate diffuse boundaries, similarities in plant species, and difficulty in distinguishing types under changing hydrologic management in the BWMA.

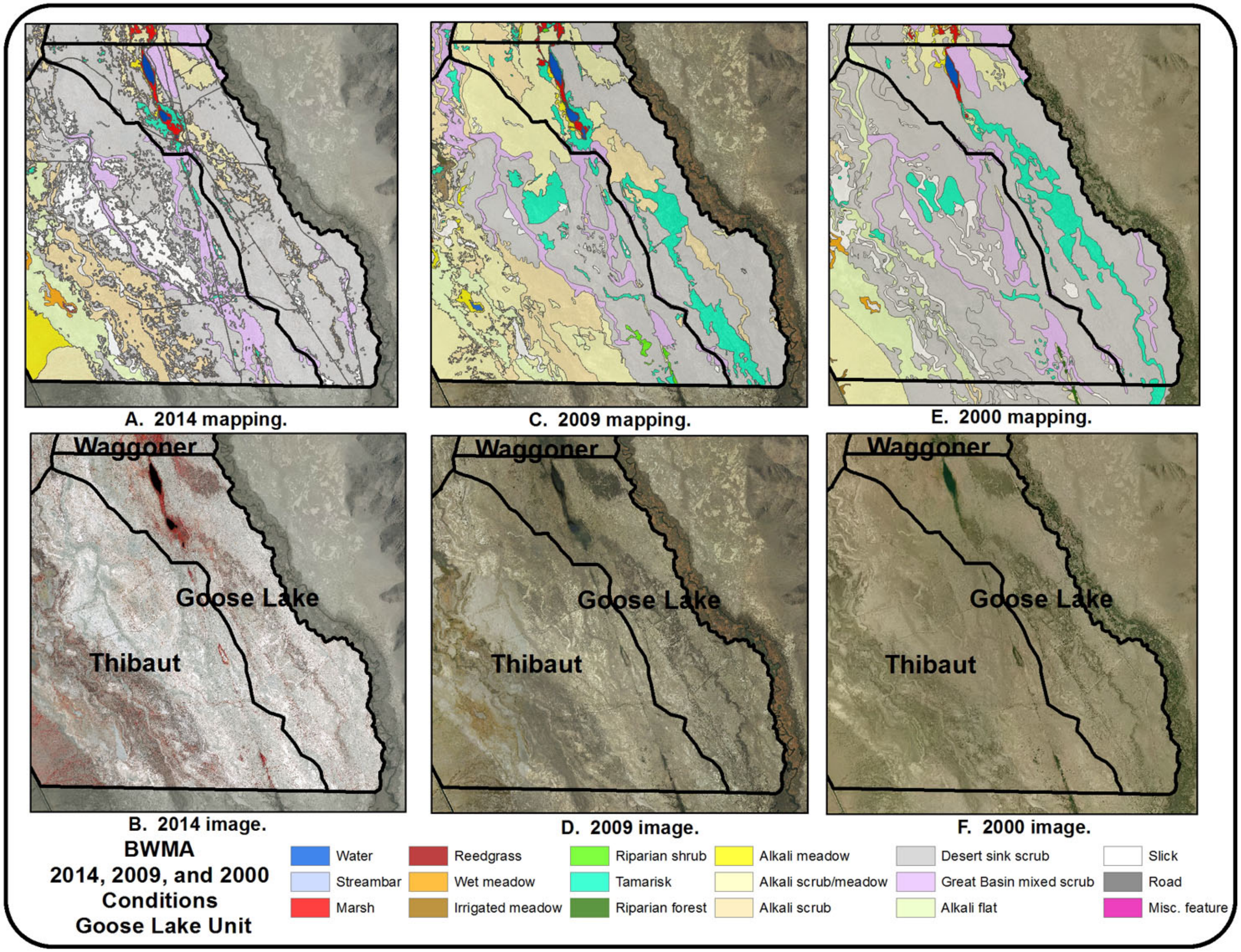
4.7.2 BWMA Results

Vegetation types identified for 2000, 2009, and 2014 conditions are correlated in Veg Mapping Table 4-20. Large-scale (1:6,000) maps of vegetation types for 2014 conditions are compiled in APPENDIX D. Side-by-side maps of vegetation types for 2000, 2009, and 2014 conditions are compiled in APPENDIX E. Small-scale vegetation type maps for Drew, Goose Lake, Thibaut, Twin Lakes, Waggoner, and Winterton management units are Veg Mapping Figures 33 through 4-38. Summaries of vegetation types by management unit and year are listed in Veg Mapping Tables 21 through 26.

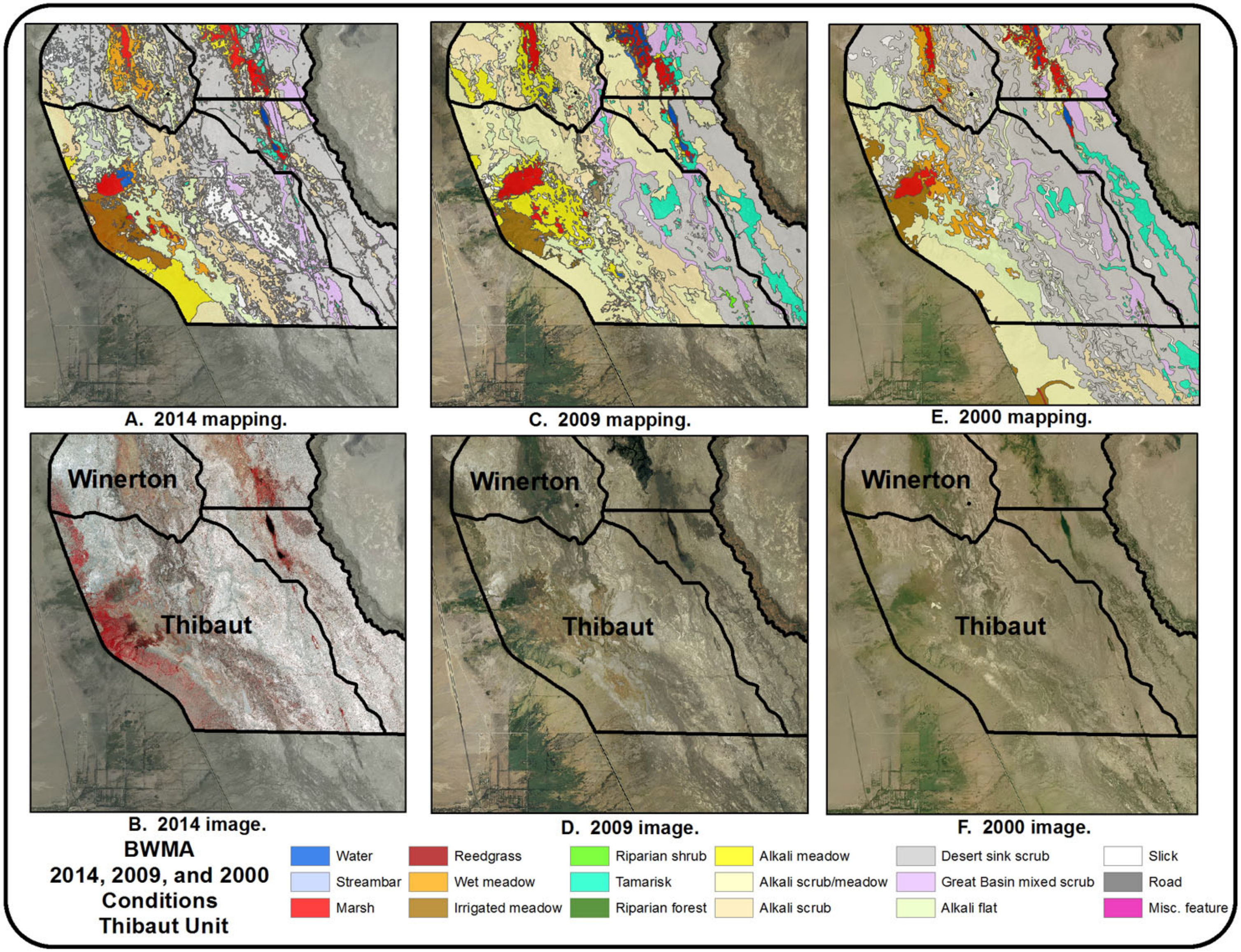
Vegetation Mapping Table 20. Map unit correlation.								
2014 CONDITIONS			2009 CONDITIONS			2000 CONDITIONS		
TYPE	Area		TYPE	Area		TYPE	Area	
	ac	%		ac	%		ac	%
Water	143	1	Water	301	2	Water	35	0
Marsh	622	5	Marsh	630	5	Bulrush-cattail	460	3
Wet meadow	510	4	Wet Alkali Meadow	52	0	Saltgrass-rush	446	3
Riparian shrub	3	0	Riparian Shrub (willow)	5	0	Coyote willow-rose	2	0
Riparian forest	23	0	Riparian Forest (tree willow)	25	0	Goodding-red willow/creeping wildrye-saltgrass	17	0
			Riparian Forest (cottonwood)	0	0	Goodding-red willow/scrub	0	0
Alkali meadow	460	3	Dry Alkali Meadow	742	5	Saltgrass	135	1
Alkali scrub/meadow	980	7	Rabbitbrush-NV saltbush/meadow	3455	25	Rabbitbrush-NV saltbush/saltgrass-alkali sacaton	1236	9
Alkali scrub	977	7	Rabbitbrush-NV saltbush scrub	1496	11	Rabbitbrush-NV saltbush	491	4
Slick	838	6	Bassia	34	0	Abandoned agriculture	46	0
			Barren	335	3	Slick	713	5
Irrigated meadow	281	2	Irrigated Meadow	165	1	Irrigated meadow	210	2
Tamarisk	174	1	Tamarisk	511	4	Tamarisk/alkali flat	277	2
			Russian Willow	14	0	Tamarisk/saltgrass	6	0
						Tamarisk/scrub	101	1
Reedgrass	3	0	Reedgrass	3	0	Reedgrass	2	0
Great Basin mixed scrub	2002	15	Great Basin Mixed Scrub	2233	16	Great Basin mixed scrub	2090	15
Desert sink scrub	5484	40	Desert Sink Scrub	3207	24	Desert sink scrub	6470	47
Alkali flat	910	7	Alkali Flat	403	3	Saltgrass-alkali forb (sparse)	923	7
Road	249	2	Structure	44	0	Cut/fill	13	0
Misc feature	13	0	Cut/Fill	13	0			
TOTAL	**13667**	**100**	**TOTAL**	**13667**	**100**	**TOTAL**	**13667**	**100**



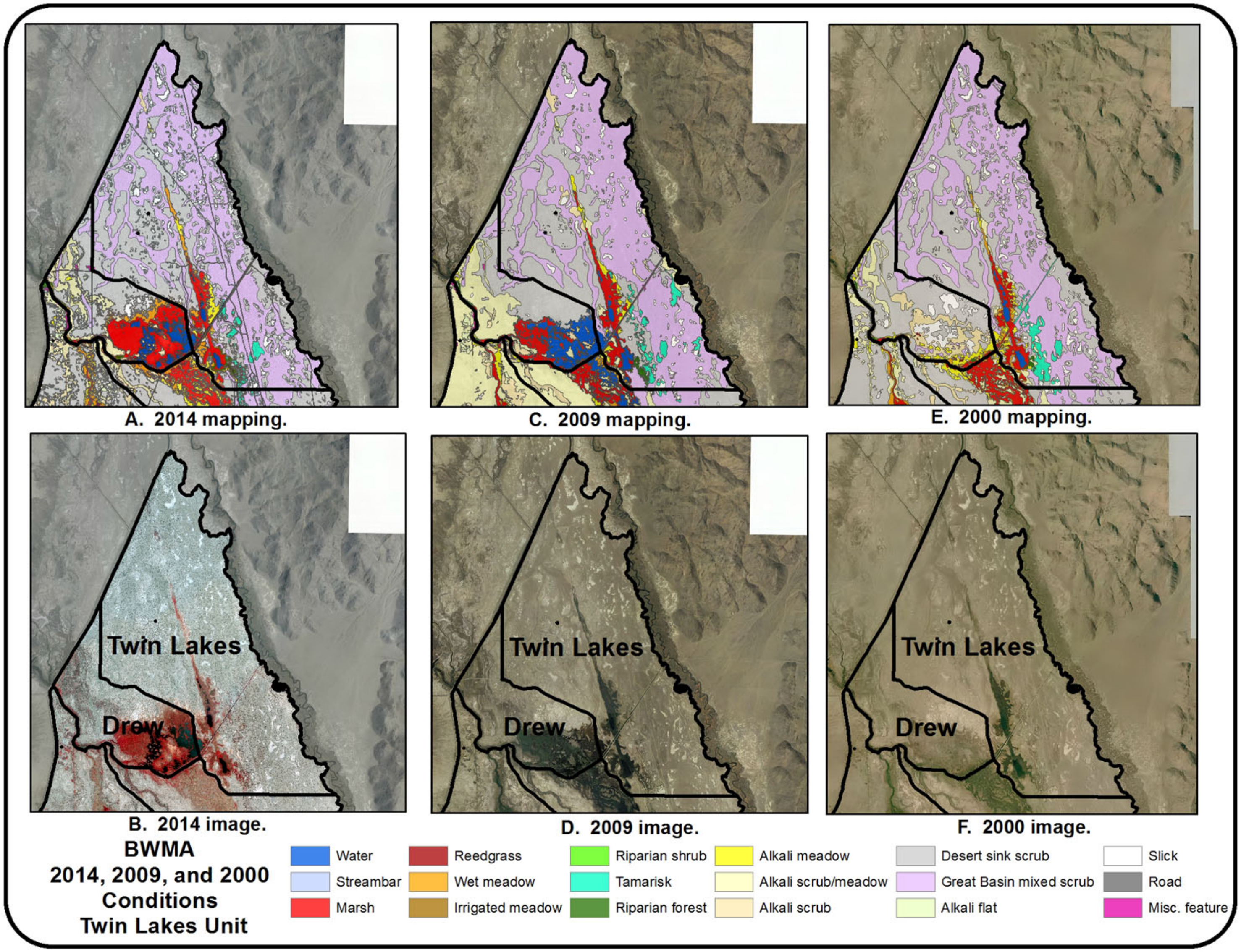
Vegetation Mapping Figure 33. Small Scale Vegetation Maps, Drew Unit



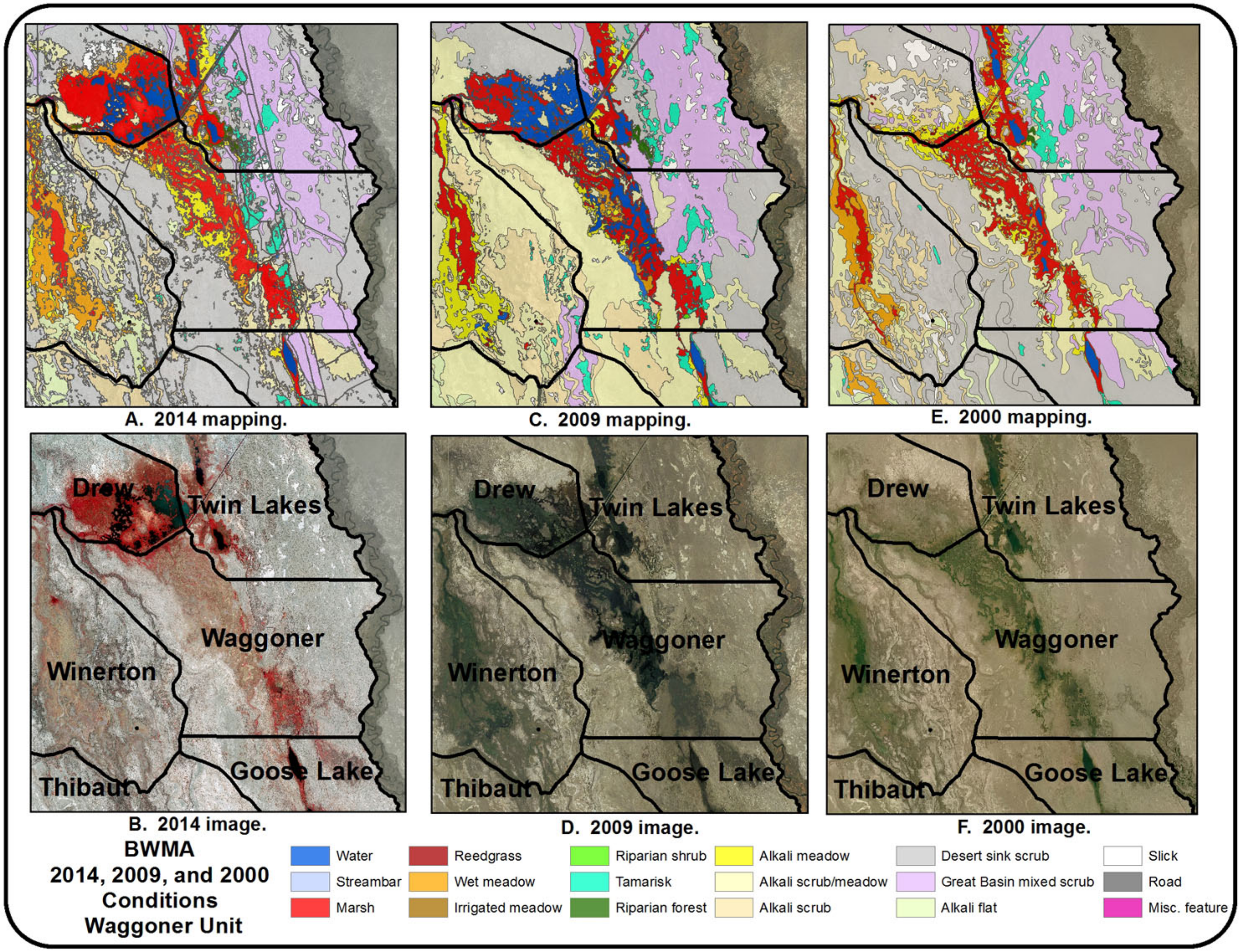
Vegetation Mapping Figure 34. Small Scale Vegetation Maps, Goose Unit



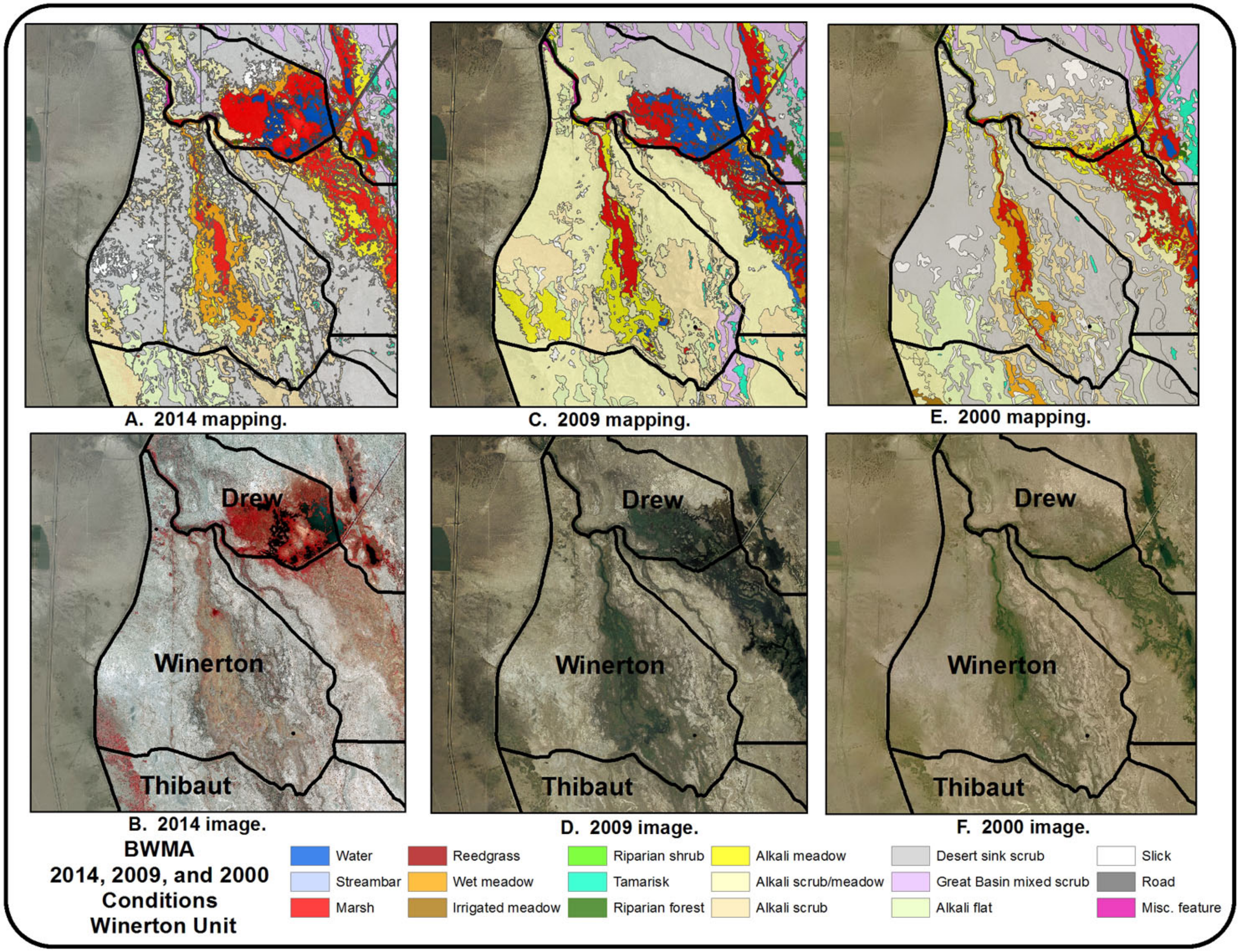
Vegetation Mapping Figure 35. Small Scale Vegetation Maps, Thibaut Unit



Vegetation Mapping Figure 36. Small Scale Vegetation Maps, Twin Lakes Unit



Vegetation Mapping Figure 37. Small Scale Vegetation Maps, Waggoner Unit



Vegetation Mapping Figure 38. Small Scale Vegetation Maps, Winterton Unit

Vegetation Mapping Table 21. Distributions of Vegetation Types, Drew Unit						
Type	2014		2009		2000	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	78	9.4	143	17.3	0	9.4
Marsh	199	24.1	103	12.5	21	24.1
Wet meadow	41	5.0	0	0.0	11	5.0
Riparian shrub	0	0.0	0	0.0	0	0.0
Riparian forest	4	0.5	7	0.9	8	0.5
Alkali meadow	9	1.1	5	0.6	46	1.1
Alkali scrub/meadow	162	19.5	217	26.3	71	19.5
Alkali scrub	0	0.0	27	3.2	126	0.0
Slick	26	3.1	1	0.1	87	3.1
Irrigated meadow	0	0.0	0	0.0	0	0.0
Tamarisk	1	0.2	2	0.2	1	0.2
Reedgrass	1	0.1	0	0.0	2	0.1
Great Basin mixed scrub	32	3.9	38	4.6	51	3.9
Desert sink scrub	256	31.0	281	34.0	401	31.0
Alkali flat	1	0.2	0	0.0	0	0.2
Road	12	1.5	0	0.0	0	1.5
Miscellaneous feature	3	0.3	2	0.3	1	0.3
TOTAL	**827**	**100.0**	**827**	**100.0**	**827**	**100.0**

Vegetation Mapping Table 22. Distributions of vegetation types, Goose Lake Unit						
Type	2014		2009		2000	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	13	0.8	16	0.9	10	0.6
Marsh	18	1.0	16	0.9	9	0.5
Wet meadow	0	0.0	0	0.0	0	0.0
Riparian shrub	0	0.0	0	0.0	0	0.0
Riparian forest	1	0.1	2	0.1	0	0.0
Alkali meadow	9	0.5	11	0.7	5	0.3
Alkali scrub/meadow	134	7.7	235	13.5	86	5.0
Alkali scrub	52	3.0	245	14.1	0	0.0
Slick	36	2.1	1	0.1	15	0.9
Irrigated meadow	0	0.0	0	0.0	0	0.0
Tamarisk	50	2.9	236	13.6	217	12.5
Reedgrass	0	0.0	0	0.0	0	0.0
Great Basin mixed scrub	111	6.4	37	2.1	126	7.2
Desert sink scrub	1262	72.7	937	53.9	1256	72.2
Alkali flat	0	0.0	0	0.0	16	0.9
Road	49	2.8	0	0.0	0	0.0
Miscellaneous feature	0	0.0	1	0.0	0	0.0
TOTAL	**1737**	**100.0**	**1737**	**100.0**	**1737**	**100.0**

Vegetation Mapping Table 23. Distributions of Vegetation Types, Thibaut Unit						
Type	2014		2009		2000	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	24	0.5	3	0.1	0	0.0
Marsh	79	1.7	138	2.9	76	1.6
Wet meadow	118	2.5	0	0.0	234	4.9
Riparian shrub	3	0.1	17	0.4	2	0.0
Riparian forest	2	0.0	1	0.0	4	0.1
Alkali meadow	236	5.0	406	8.6	0	0.0
Alkali scrub/meadow	317	6.7	1527	32.2	539	11.4
Alkali scrub	643	13.6	559	11.8	121	2.6
Slick	496	10.5	212	4.5	406	8.6
Irrigated meadow	281	5.9	165	3.5	210	4.4
Tamarisk	25	0.5	121	2.6	89	1.9
Reedgrass	0	0.0	0	0.0	0	0.0
Great Basin mixed scrub	279	5.9	273	5.8	247	5.2
Desert sink scrub	1418	30.0	936	19.8	2056	43.4
Alkali flat	763	16.1	358	7.6	749	15.8
Road	48	1.0	0	0.0	0	0.0
Miscellaneous feature	1	0.0	17	0.4	0	0.0
TOTAL	**4734**	**100.0**	**4735**	**100.0**	**4735**	**100.0**

Vegetation Mapping Table 24. Distributions of Vegetation Types, Twin Lakes Unit						
Type	2014		2009		2000	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	22	0.8	41	1.4	18	0.6
Marsh	82	2.8	102	3.5	83	2.9
Wet meadow	43	1.5	4	0.2	34	1.2
Riparian shrub	0	0.0	0	0.0	0	0.0
Riparian forest	13	0.4	12	0.4	5	0.2
Alkali meadow	47	1.6	42	1.4	34	1.2
Alkali scrub/meadow	6	0.2	70	2.4	39	1.3
Alkali scrub	6	0.2	32	1.1	1	0.0
Slick	178	6.1	115	4.0	152	5.2
Irrigated meadow	0	0.0	0	0.0	0	0.0
Tamarisk	47	1.6	67	2.3	71	2.5
Reedgrass	0	0.0	0	0.0	0	0.0
Great Basin mixed scrub	1394	48.1	1626	56.1	1456	50.2
Desert sink scrub	990	34.2	780	26.9	1002	34.6
Alkali flat	0	0.0	0	0.0	6	0.2
Road	68	2.3	0	0.0	0	0.0
Miscellaneous feature	1	0.0	6	0.2	0	0.0
TOTAL	**2898**	**100.0**	**2898**	**100.0**	**2898**	**100.0**

Vegetation Mapping Table 25. Distributions of Vegetation Types, Waggoner Unit						
Type	2014		2009		2000	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	3	0.2	90	5.8	7	5.8
Marsh	193	12.4	189	12.1	215	12.1
Wet meadow	97	6.2	47	3.0	57	3.0
Riparian shrub	0	0.0	2	0.1	0	0.1
Riparian forest	0	0.0	1	0.1	1	0.1
Alkali meadow	102	6.5	35	2.3	36	2.3
Alkali scrub/meadow	129	8.3	506	32.5	268	32.5
Alkali scrub	17	1.1	99	6.4	43	6.4
Slick	25	1.6	11	0.7	16	0.7
Irrigated meadow	0	0.0	0	0.0	0	0.0
Tamarisk	48	3.1	68	4.4	3	4.4
Reedgrass	2	0.1	228	14.7	0	14.7
Great Basin mixed scrub	185	11.9	272	17.5	211	17.5
Desert sink scrub	703	45.2	0	0.0	693	0.0
Alkali flat	9	0.6	0	0.0	5	0.0
Road	40	2.6	0	0.0	0	0.0
Miscellaneous feature	0	0.0	4	0.3	1	0.3
TOTAL	**1554**	**100.0**	**1554**	**100.0**	**1554**	**100.0**

Vegetation Mapping Table 26. Distributions of Vegetation Types, Winterton Unit						
Type	2014		2009		2000	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	2	0.1	0	0.0	7	0.4
Marsh	49	2.6	56	2.9	82	4.3
Wet meadow	211	11.0	110	5.7	0	0.0
Riparian shrub	0	0.0	0	0.0	0	0.0
Riparian forest	2	0.1	0	0.0	0	0.0
Alkali meadow	58	3.0	14	0.7	242	12.6
Alkali scrub/meadow	232	12.1	233	12.2	900	46.9
Alkali scrub	258	13.5	200	10.4	535	27.9
Slick	77	4.0	84	4.4	28	1.5
Irrigated meadow	0	0.0	0	0.0	0	0.0
Tamarisk	2	0.1	3	0.1	17	0.9
Reedgrass	0	0.0	0	0.0	3	0.2
Great Basin mixed scrub	0	0.0	0	0.0	31	1.6
Desert sink scrub	853	44.5	1062	55.4	0	0.0
Alkali flat	136	7.1	145	7.6	44	2.3
Road	28	1.5	0	0.0	0	0.0
Miscellaneous feature	8	0.4	12	0.6	27	1.4
TOTAL	**1917**	**100.0**	**1917**	**100.0**	**1917**	**100.0**

Water: Comprised 143 acres of the BWMA in 2014, mostly in Drew (78 acres), Thibaut (24 acres), and Twin Lakes (22 acres) management units. Since 2014, water supplies to Drew and Thibaut were curtailed and shifted to Winterton. The distribution of open water in 2014 was different from that present in 2015. The area of water was more consistent in the Twin Lakes and Goose Lake unit. Prominent changes in water are between marsh, water, and wet meadow (Veg Mapping Table 27).

Vegetation Mapping Table 27. Prominent Changes, Water			
Conditions		Area	
2009	2014	Acres	%
Water	Marsh	156	46
Water	Water	103	30
Marsh	Water	31	9
Water	Wet meadow	16	5
TOTAL		**306**	**90**

Marsh: Vegetation composition is similar to marsh described for the LORP riparian area. It comprised 622 acres of the BWMA in 2014 and 630 acres in 2009. Although marsh was identified in all management units, hydrologic conditions were varied. Marsh in the Drew unit (199 acres) was alive in 2014 when the unit was flooded; it was dead in 2015 after the unit was drained. Marsh in the Waggoner unit (193 acres) was drained and dead in 2014. Marsh in Winterton (49 acres) was dry and dead in 2014, but rewatered and revived in 2015. Marsh in Thibaut was burned and disked in 2014 and remained so in 2015. Marsh in Twin Lakes (82 acres) and Goose Lake (18 acres) is associated with relatively permanent water bodies and maintain wetted condition. Prominent changes are between marsh, wet meadow, alkali meadow, and water (Veg Mapping Table 28).

Vegetation Mapping Table 28. Prominent Changes, Marsh			
Conditions		Area	
2009	2014	Acres	%
Marsh	Marsh	379	60
Marsh	Wet meadow	124	20
Marsh	Alkali meadow	34	5
Marsh	Water	31	5
TOTAL		**568**	**90**

Reedgrass: Vegetation composition is similar to reedgrass described for the LORP riparian area. It comprised only 3 acres of the BWMA in both 2014 and 2009, mostly along the Blackrock Ditch. Prominent changes are between reedgrass, marsh, alkali flat, alkali scrub/meadow, water, and wet meadow (Veg Mapping Table 29).

Vegetation Mapping Table 29. Prominent Changes, Reedgrass			
Conditions		Area	
2009	2014	Acres	%
Marsh	Reedgrass	2	36
Reedgrass	Alkali flat	1	14
Reedgrass	Marsh	1	14
Reedgrass	Alkali scrub/meadow	1	10
Water	Reedgrass	1	9
Reedgrass	Wet meadow	1	8
TOTAL		**6**	**92**

Wet meadow: Vegetation composition is similar to wet meadow described for the LORP riparian area. It comprised 510 acres of the BWMA in 2014 and only 52 acres in 2009. As discussed for marsh, wet meadow in 2014 may be remnant of hydrologic conditions that were changed prior to 2014 and changed again subsequent to 2014. Wet meadow in Drew (41 acres) was dried out in 2015 and changing towards alkali meadow; there was no wet meadow in Goose Lake and there never has been. Wet meadow in Thibaut (118 acres) includes areas that may be sustained by irrigation runoff and areas surrounding a marsh that was drained, burned, and disked prior to 2014; these areas may be changing towards alkali meadow in 2015. In Twin Lakes, wet meadow occurs along the 1972 fault line and in association with relatively perennial lakes. Wet meadows in Winterton (211 acres) appeared decadent on the 2014 images, but were reconstituted in 2015. Wet meadows in Waggoner (97 acres) were decadent on the 2014 image and remain so in 2015. Prominent changes are between wet meadow, alkali meadow, alkali scrub/meadow, and desert sink scrub (Veg Mapping Table 4-30).

Vegetation Mapping Table 30. Prominent Changes, Wet Meadow			
Conditions		Area	
2009	2014	Acres	%
Alkali meadow	Wet meadow	205	38
Marsh	Wet meadow	124	23
Alkali scrub/meadow	Wet meadow	89	16
Desert sink scrub	Wet meadow	29	5
Wet meadow	Alkali meadow	24	4
Wet meadow	Wet meadow	22	4
TOTAL		**492**	**91**

Irrigated meadow: This grass dominated vegetation type includes saltgrass (*Distichlis spicata*), Baltic rush (*Juncus balticus*), Olney bulrush (*Scirpus Americana*), and alkali sacaton (*Sporobolus airoides*), and American licorice (*Glycyrrhiza* lepidota); cover totals about 90 percent. It comprised 281 acres in 2014, 165 aces in 2009, and 210 acres in 2000 along the west flank of the Thibaut management unit. Prominent changes are between irrigated meadow, alkali meadow, and alkali scrub meadow attributed mostly to mapping inconsistencies (Veg Mapping Table 31).

Vegetation Mapping Table 31. Prominent Changes, Irrigated Meadow			
Conditions		Area	
2009	2014	Acres	%
Irrigated Meadow	Irrigated meadow	156	54
Alkali meadow	Irrigated meadow	68	23
Alkali scrub/meadow	Irrigated meadow	37	13
TOTAL		**261**	**90**

Alkali meadow: Vegetation composition is similar to alkali meadow described for the LORP riparian area. It comprised 460 acres of the BWMA in 2014 and 742 acres in 2009. Alkali meadow is a minor component of the Drew (9 acres) and Goose Lake (9 acres) units. It comprises 236 acres of Thibaut, 43 acres of Twin Lakes, 102 acres of Waggoner, and 58 acres of Winterton. Prominent changes are between alkali meadow, alkali scrub meadow, wet meadow, alkali flat, desert sink scrub, irrigated meadow, and alkali scrub (Veg Mapping Table 32).

Vegetation Mapping Table 32. Prominent Changes, Alkali Meadow			
Conditions		Area	
2009	2014	Acres	%
Alkali scrub/meadow	Alkali meadow	296	26
Alkali meadow	Wet meadow	205	18
Alkali meadow	Alkali flat	204	18
Alkali meadow	Desert sink scrub	75	7
Alkali meadow	Irrigated meadow	68	6
Alkali meadow	Alkali meadow	61	5
Alkali meadow	Alkali scrub	49	4
Alkali meadow	Alkali scrub/meadow	43	4
TOTAL		**1000**	**88**

Riparian shrub: Vegetation composition is similar to riparian shrub described for the LORP riparian area. It comprised only 3 acres of the BWMA in 2014 and 5 acres in 2009, mostly along irrigation ditches. Prominent changes are between riparian shrub, marsh, and associated with ditches in irrigated meadow (Veg Mapping Table 33). Most of the riparian shrub along ditches in the Thibaut unit in 2014 has since been cleared.

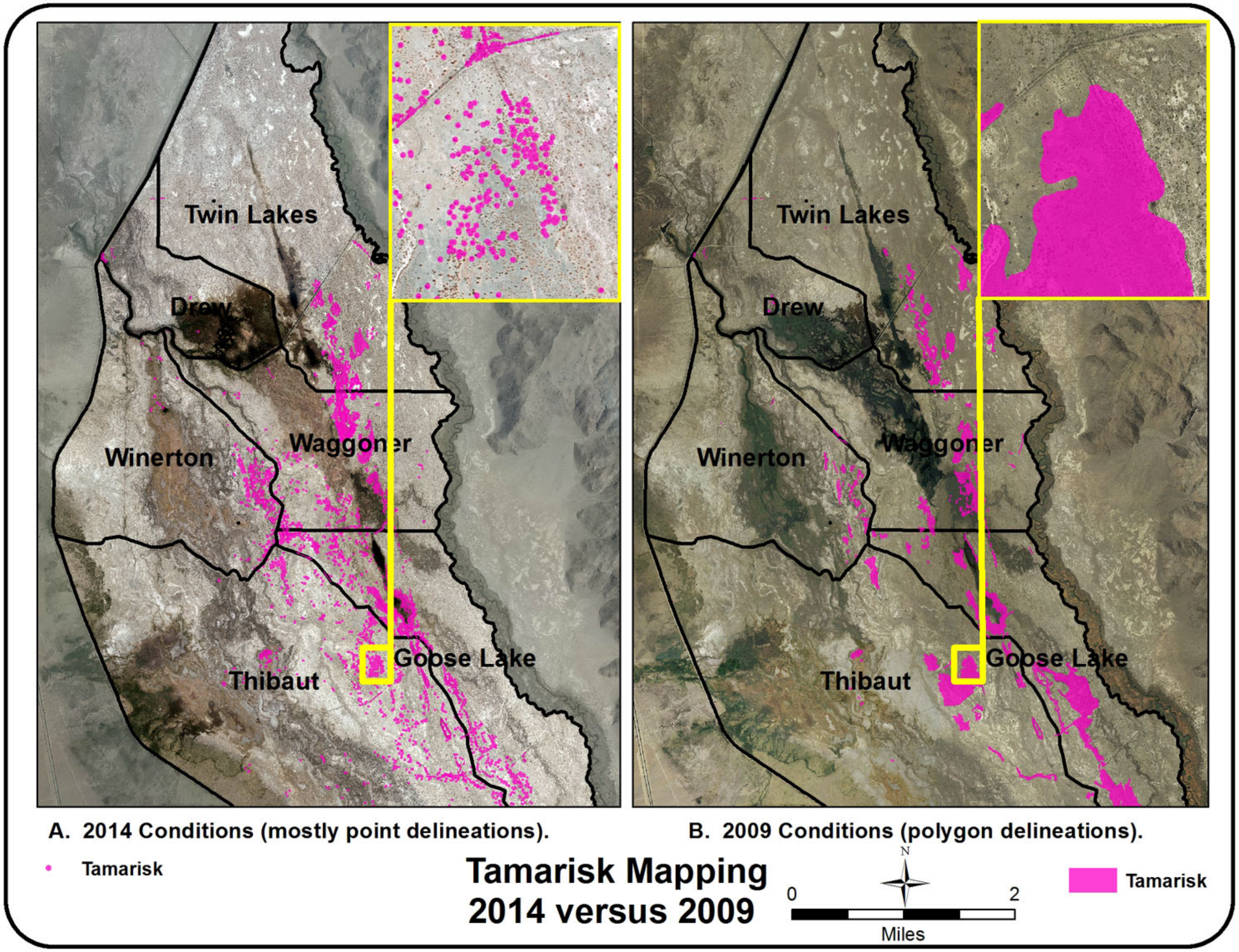
Vegetation Mapping Table 33. Prominent Changes, Riparian Shrub

Conditions		Area	
2009	2014	Acres	%
Riparian shrub	Marsh	2	26
Riparian shrub	Riparian shrub	1	21
Riparian shrub	Irrigated meadow	1	11
Marsh	Riparian shrub	1	9
Riparian shrub	Road	0	7
Misc feature	Riparian shrub	0	7
Irrigated meadow	Riparian shrub	0	5
TOTAL		**6**	**85**

Tamarisk: Mapping of scattered tamarisk was problematic. In 2014 about 174 acres of relative dense tamarisk was delineated as polygons, attempting to conform to the shrub canopy, and another 3,800 shrubs were identified as points (Veg Mapping Figure 9A). Assuming 5 m diameter, the total area of tamarisk canopy for the 3,800 points is about 18 acres. The tagged shrubs provide an indication of the extent of colonization similar to the mapping of 2009 conditions, but probably include only about half of the total number of tamarisk. In 2009 about 511 acres included broadly scattered tamarisk in areas that were otherwise desert sink scrub, slick, alkali scrub/meadow, and alkali scrub (Veg Mapping Table 34).

Vegetation Mapping Table 34. Prominent Changes, Tamarisk Meadow

Conditions		Area	
2009	2014	Acres	%
Tamarisk	Desert sink scrub	286	48
3800Tamarisk	Tamarisk	88	15
Tamarisk	Slick	38	6
Alkali scrub/meadow	Tamarisk	34	6
Tamarisk	Alkali scrub/meadow	26	4
Tamarisk	Alkali scrub	26	4
Great Basin mixed scrub	Tamarisk	19	3
TOTAL		**517**	**87**



Vegetation Mapping Figure 39. Tamarisk Mapping

Riparian forest: Vegetation composition is similar to riparian forest described for the LORP riparian area. It comprised only 23 acres of the BWMA in 2014 and 25 acres in 2009, mostly along irrigation ditches and south of Twin Lakes. Prominent changes are between riparian forest, marsh, tamarisk, wet meadow, alkali meadow, and miscellaneous features (Veg Mapping Table 35).

Vegetation Mapping Table 35. Prominent Changes, Riparian Forest			
Conditions		Area	
2009	2014	Acres	%
Riparian forest	Riparian forest	11	29
Marsh	Riparian forest	5	13
Riparian forest	Tamarisk	4	11
Tamarisk	Riparian forest	2	6
Riparian forest	Wet meadow	2	5
Riparian forest	Alkali meadow	2	5
Misc feature	Riparian forest	1	4
Riparian forest	Alkali scrub/meadow	1	4
Riparian forest	Marsh	1	3
Riparian forest	Road	1	3
Riparian forest	Desert sink scrub	1	3
TOTAL		**31**	**85**

Alkali scrub/meadow: Vegetation composition is similar to riparian shrub described for the LORP riparian area. This community is transitional from riparian to upland. It comprised 980 acres in 2014, a decline from 3,455 acres in 2009 and 1,236 acres in 2000. Areas mapped alkali scrub/meadow in 2009 included desert sink scrub, alkali scrub, alkali meadow, and alkali flat (Veg Mapping Table 36). Species composition tends to be overlapping for all of these vegetation types.

Vegetation Mapping Table 36. Prominent Changes, Alkali Scrub/Meadow.			
Conditions		Area	
2009	2014	Acres	%
Alkali scrub/meadow	Desert sink scrub	1448	38
Alkali scrub/meadow	Alkali scrub/meadow	663	18
Alkali scrub/meadow	Alkali scrub	476	13
Alkali scrub/meadow	Alkali meadow	296	8
Alkali scrub/meadow	Alkali flat	268	7
Alkali scrub	Alkali scrub	165	4
TOTAL		**3315**	**88**

Slick: Nearly barren, white, flat, alkali sinks that may be intermittently flooded following precipitation. Slicks are a major inclusion to desert sink scrub. Lacustrine slicks in the Twin Lakes unit are typically surrounded by eolian Great Basin mixed scrub. More seasonal flooding changes slicks to alkali flats. Prominent changes are between slick, desert sink scrub, alkali scrub, alkali scrub/meadow, and Great Basin mixed scrub (Veg Mapping Table 37).

Vegetation Mapping Table 37. Prominent Changes, Slick			
Conditions		Area	
2009	2014	Acres	%
Desert sink scrub	Slick	367	37
Slick	Slick	176	18
Alkali scrub	Slick	94	9
Slick	Desert sink scrub	75	8
Alkali scrub/meadow	Slick	68	7
Slick	Great Basin mixed scrub	58	6
Great Basin mixed scrub	Slick	52	5
TOTAL		**891**	**89**

Great Basin mixed scrub: Occurs on sandy (eolian) land with very low water table, mostly along the east flank of the BWMA. Total cover is about as 15 percent. Saltgrass and alkali sacaton cover is typically less than 10 percent. Shrub cover averages about 15 percent and may include shadscale (*Atriplex confertifolia*), Mormon tea (*Ephedra nevadensis*), indigo bush (*Psorothamnus arborescens*), little-leaf horsebush (*Tetradymia glabrata*), rubber rabbitbrush, and big sagebrush (*Artemisia tridentata*). Annual forbs are prominent in this type in good precipitation years. It comprised 2,002 acres of the BWMA in 2014, 2,233 in 2009, and 2,090 in 2014. Prominent changes are between Great Basin mixed scrub and desert sink scrub (Veg Mapping Table 38) that are typically adjacent.

Vegetation Mapping Table 38. Prominent Changes, Great Basin Mixed Scrub			
Conditions		Area	
2009	2014	Acres	%
Great Basin mixed scrub	Great Basin mixed scrub	1637	63
Great Basin mixed scrub	Desert sink scrub	413	16
Desert sink scrub	Great Basin mixed scrub	304	12
TOTAL		**2355**	**91**

Desert sink scrub: This sparse vegetation type occurs on lacustrine land with very low water table and on intermittently flooded lacustrine land. Average grass cover is less than 10 percent; alkali sacaton (*Sporobolus airoides*) and saltgrass (*Distichlis spicata*) are prominent. Rubber rabbitbrush, shadscale (*Atriplex confertifolia*), greasewood (*Sarcobatus vermiculatus*), and iodine bush (*Allenrolfea occidentalis*) are typically present with total cover less than 25 percent. It comprised 5,484 acres in 2014, 3,207 acres in 2009, and 6,470 acres in 2000. Prominent changes since 2009 are between desert sink scrub, alkali scrub/meadow, alkali scrub, Great Basin mixed scrub, and slicks (Veg Mapping Table 39). Differences are attributed to mapping errors associated with subtle transitions between similar upland habitats. Much of these areas were impacted by extensive water spreading activities in the BWMA.

Vegetation Mapping Table 39. Prominent Changes, Desert Sink Scrub

Conditions		Area	
2009	2014	Acres	%
Desert sink scrub	Desert sink scrub	2343	37
Alkali scrub/meadow	Desert sink scrub	1448	23
Alkali scrub	Desert sink scrub	757	12
Great Basin mixed scrub	Desert sink scrub	413	7
Desert sink scrub	Slick	367	6
Desert sink scrub	Great Basin mixed scrub	304	5
TOTAL		**5631**	**89**

Alkali flat: These are vegetated alkali sinks. Total vegetation cover is typically less than 25 percent and includes saltgrass (*Distichlis spicata*), five-horn smother weed (*Bassia hyssopifolia*) and annual sunflower (*Helianthus annuus*). Vegetation cover may shrink/swell annually in response to precipitation, irrigation and water spreading. It comprised 910 acres in 2014, 403 acres in 2009, and 923 acres in 2000. Prominent changes since 2009 are between alkali flat, alkali scrub/meadow, alkali meadow, desert sink scrub, slick, and Great Basin mixed scrub (Veg Mapping Table 40). Differences are attributed to mapping errors associated with subtle transitions between similar upland habitats.

Vegetation Mapping Table 40. Prominent Changes, Alkali Flat

Conditions		Area	
2009	2014	Acres	%
Alkali flat	Alkali flat	284	28
Alkali scrub/meadow	Alkali flat	268	26
Alkali meadow	Alkali flat	204	20
Alkali flat	Desert sink scrub	62	6
Slick	Great Basin mixed scrub	58	6
TOTAL		**875**	**85**

Road and Miscellaneous features: Road polygons were generated as a 10-meter wide buffer centered on an existing line file of roads. Roads comprise about 249 acres of the BWMA. Miscellaneous features include spoils dredged from ditches; borrow pits and corrals that comprise about 13 acres of the BWMA.

Inclusions of both similar and contrasting types occur in all map units. Similar inclusions (e.g. alkali scrub/meadow and alkali meadow; wet meadow, alkali meadow, and alkali flat; alkali scrub and alkali scrub meadow; marsh and water; marsh and reedgrass, desert sink scrub and alkali flat) may comprise up to about 30% of any one parcel, but generally a much smaller proportion when viewed over all parcels. Contrasting types (e.g. wet meadow and alkali scrub/meadow; riparian shrub and alkali meadow) may comprise up to 15% of any one parcel, but a much smaller proportion when viewed over all parcels.

4.7.3 BWMA Accuracy Assessment

Of the 92 randomly selected parcels that were checked, 87 were correctly classified (Veg Mapping Table 41). One parcel of wet meadow was incorrectly classified alkali meadow; one parcel of alkali meadow was incorrectly labeled alkali scrub/meadow; one parcel of alkali scrub was labeled alkali scrub/meadow, one parcel of desert sink scrub was labeled slick, and one alkali flat was labeled wet meadow. Errors all entailed similar vegetation types. The overall accuracy weighted by the number of parcels of each type was about 93 percent. The overall accuracy weighted by the total area of each type was about 91 percent. If only hydric types are considered, the accuracy weighted by number of parcels is 94 percent and weighted by area 95 percent. The target overall error rate of less than 10 percent was achieved.

Vegetation Mapping Table 41. Accuracy Assessment		
Type	Accuracy Parcels	
	N	Correct
Water	6	6
Marsh	4	4
Reedgrass	7	7
Wet meadow	6	5
Irrigated meadow	1	1
Riparian shrub	7	7
Riparian forest	7	7
Alkali meadow	7	6
Alkali scrub/meadow	3	3
Alkali scrub	7	6
Great Basin mixed scrub	8	8
Desert sink scrub	7	6
Tamarisk	9	9
Alkali flat	7	6
Slick	6	6
TOTAL	**92**	**87**

4.7.4 BWMA Summary

While mapping was intended to document 2014 conditions, vegetation was often remnant of previous hydrologic cycles. For example, about 193 acres of marsh in the Waggoner unit and 79 acres of marsh in the Thibaut unit are dead and remnant of flooding that was curtailed in 2010. About 49 acres of marsh in the Winterton unit is also dead in response to curtailment of flooding in 2011, but has been rejuvenated by reflooding in 2015. About 277 acres of marsh and open water in the Drew unit was dried up in 2015. Similarly, vegetation composition of wet meadow and alkali meadow are an amalgamated response to both historical and contemporary water management. Major differences in upland vegetation types (desert sink scrub, Great Basin mixed scrub, alkali scrub, alkali flat, and slick) are attributed to mapping errors magnified by mixed up conditions inherent to landscapes manipulated for water spreading. The usefulness of landscape vegetation mapping of the BWMA is questionable. It is suggested that alternative approaches to monitoring be considered and that landscape vegetation mapping of the BWMA be abandoned.

4.8 LITERATURE CITED

Ecoystems Sciences. 2008. Lower Owens River Project Monitoring, Adaptive Management and Reporting Plan. Report to LADWP and Inyo County Water Department.

White Horse Associates. 2004. Lower Owens River Riparian Vegetation Inventory, 2000 Conditions. Report to LADWP and Inyo County.

White Horse Associates. 2004b. Lower Owens River Project Delineation, Prediction, and Assessment of Wetland/Riparian Resources. Report to LADWP and Inyo County.

5.0 LAND MANAGEMENT

5.1 Land Management Summary

The 2015 Lower Owens River Project (LORP) land management monitoring efforts continued with monitoring utilization across all leases, range trend monitoring on the Lone Pine and Twin Lakes leases inside the LORP management area and rare plant monitoring. Irrigated pasture evaluations were not conducted due to drought conditions in 2015. The LORP area is currently experiencing its fourth year of extreme drought. Effects from this are a decrease in forage production in the uplands and decreased availability of irrigation water. Despite severe impacts from the historic drought on the uplands, steady base flows in the Lower Owens River have maintained moist floodplains in good condition. Grazing utilization monitoring was conducted on all leases in 2014-15. The 2015 monitoring efforts conclude the seventh year of examining the effects of excluding rare plants from livestock grazing. Results indicated a decline of plant populations in ungrazed sites.

Pasture utilization for leases within the LORP was below the allowable levels of use established for both riparian (up to 40%) and upland (up to 65%) areas except for the Islands and Lone Pine leases. Use on the Blackrock Lease was lower than most other leases in the project area remaining well below all grazing standards. The Twin Lakes Lease has been destocked for the past few years due to drought conditions and grazing has been below allowable utilization. The Islands Lease continues to lose meadows to aquatic vegetation as inundation from flow augmentations for the LORP project continues. Use of the Thibaut Field on the Thibaut Lease was below the allowable upland standard. The Lone Pine Lease has recovered from the 2013 fire, the only major loss was to mature willow trees.

All irrigated pastures were monitored in 2013. Pastures that scored 80% or below were checked in 2014. Due to persisting drought conditions no irrigated pastures were evaluated in 2015 in accordance with grazing plans.

This monitoring year marks the seventh year of evaluating rare plant trend plots for Owens Valley Checkerbloom (*Sidalcea covillei*), and Inyo County Star Tulip (*Calochortus excavates)* for the LORP. The objective of the study was to determine the effects of grazing exclusion on Owens Valley checkerbloom. Due to confounding factors during previous years (plot inundation, exclosure left open, nutrient tub within plot), trend plots were sampled for two additional years. Results show an increase in numbers over time in grazed sites and a decrease in numbers over time in ungrazed sites. It is recommended to remove the exclosures and discontinue the study.

Streamside Monitoring was not conducted this year.

5.2 Introduction

The land use component of this report is composed of project elements related to livestock grazing management. Under the land management program, the intensity, location, and duration of grazing is managed through the establishment of riparian pastures, forage utilization rates, and prescribed grazing periods (described in Section 2.8.1.3 and 2.8.2 LORP EIR 2004). Other actions include the monitoring and protection of rare plant populations, establishment of off-river watering sources (to reduce use of the river and off-river ponds for livestock watering) and the monitoring of utilization and rangeland trend on the leases.

Grazing management plans developed for the ranch leases in the LORP modified grazing practices in riparian and upland areas on seven LADWP leases in order to support the 40 LORP goals as described in the LORP EIR (2007). The seven leases within the LORP planning area are: Intake, Twin Lakes, Blackrock, Thibaut, Islands, Lone Pine, and the Delta. LORP-related land use activities and monitoring that took place in 2015 are presented by lease in Section 4.9, LORP Ranch Leases.

5.3 Utilization

The Lower Owens River Monitoring Adaptive Management and Reporting Plan (Ecosystem Sciences 2008), developed as part of the LORP Plan, identifies grazing utilization standards for upland and riparian areas. Utilization is defined as the percentage of the current year's herbage production consumed or destroyed by herbivores. Grazing utilization standards identify the maximum amount of biomass that can be removed by grazing animals during specified grazing periods. LADWP has developed height-weight relationship curves for native grass and grass-like forage species in the Owens Valley using locally-collected plants. These height-weight curves are used to relate the percent of plant height removed with the percent of biomass removed by grazing animals. Land managers can use these data to document the percent of biomass removed by grazing animals and determine whether or not grazing utilization standards are being exceeded. The calculation of utilization (by transect and pasture) is based on a weighted average. Therefore, species that only comprise a small part of available forage contribute proportionally less to the overall use value than more abundant species. Utilization data collected on a seasonal basis (mid- and end-points of a grazing period) will determine compliance with grazing utilization standards, while long-term utilization data will aid in the interpretation of range trend data and will help guide future grazing management decisions.

5.3.1 Riparian and Upland Utilization Rates and Grazing Periods

Under the Lower Owens River Monitoring Adaptive Management and Reporting Plan (Ecosystem Sciences, 2008), livestock are allowed to graze in riparian pastures during the grazing periods prescribed for each lease (see Sections 2.8.2.1 through 2.8.2.7 LORP EIR 2004). Livestock are to be removed from riparian pastures when the utilization rate reaches 40% or at the end of the grazing period, whichever occurs first. The beginning and ending dates of the lease-specific grazing periods may vary from year-to-year depending on conditions such as climate and weather, but the duration remains approximately the same. The grazing periods and utilization rates are designed to facilitate the establishment of riparian shrubs and trees.

In upland pastures, the maximum utilization allowed on herbaceous vegetation is 65% annually if grazing occurs only during the plant dormancy period. Once 65% is reached, all pastures must receive 60 continuous days of rest for the area during the plant "active growth period" to allow seed set between June and September. If livestock graze in upland pastures during the active growth period (that period when plants are "active" in putting on green growth and seed), maximum allowable utilization on herbaceous vegetation is 50%. The utilization rates and grazing periods for upland pastures are designed to sustain livestock grazing and productive wildlife through efficient use of forage. Riparian pastures may also contain upland habitat. If significant amounts of upland vegetation occur within a riparian pasture or field, upland grazing utilization standards will also apply to these upland habitat types. Livestock will be removed from a riparian pasture when either the riparian or the upland grazing utilization standards are met. Typically, the riparian utilization rate of 40% is reached before 65% use in the uplands occurs. Because of this pattern, utilization is not quantitatively sampled in adjacent upland areas, but use is assessed based on professional judgment. If utilization appears greater than 50% then utilization estimates using height weight curves will be implemented on the upland areas in the riparian field.

5.3.2 Utilization Monitoring

Monitoring methodologies are fully described in Section 4.6.2 of the *Lower Owens River Monitoring Adaptive Management and Reporting Plan* (Ecosystem Sciences, 2008).

Utilization is compliance monitoring and involves determining whether the utilization guidelines set forth in the grazing plans are being adhered to. Similar to precipitation data, utilization data alone cannot be used to assess ecological condition or trend. Utilization data is used to assist in interpreting changes in vegetative and soil attributes collected from other trend monitoring methods.

These standards are not expected to be met precisely every year because of the influence of annual climatic variation, livestock distribution, and the inherent variability associated with techniques for estimating utilization. Rather, these levels should be reached over an average of several years. If utilization levels are consistently 10% above or below desired limits over an average of several years, then adjustments should be implemented (Holecheck and Galt, 2000; Smith et al., 2007).

Utilization monitoring is conducted annually. Permanent utilization transects have been established in upland and riparian areas of pastures within the LORP planning area. An emphasis has been placed on establishing utilization monitoring sites within riparian management areas. Each monitoring site is visited prior to any grazing in order to collect ungrazed plant heights for the season. Sites are visited again mid-way through the grazing period (mid-season) and again at the conclusion of the grazing period (end-of-season).

All of the end-of-season utilization data are presented in table format in Section 4.10 results of land use by lease.

5.4 Range Trend

5.4.1 Overview of Range Trend Monitoring and Assessment Program

A description of monitoring methods, data compilation, and analysis techniques can be found in the 2008 LORP Monitoring, Adaptive Management and Reporting Plan. More detailed discussion of the Range Trend methods and considerations for interpretation can be found in previous LORP Annual Monitoring reports as well as descriptions of the range trend monitoring sites and their locations. Nested frequency and shrub cover data collected in 2015 are presented for each lease. Major departures from historic ranges of variability will be discussed at the lease level in the following sections.

Range trend monitoring for 2015 involves the quantitative sampling of the following attributes: nested frequency of all plant species and line intercept sampling for shrub canopy cover. Photo documentation of the site conditions is included as part of range trend monitoring.

Because frequency data is sensitive to plant densities and dispersion, frequency is an effective method for monitoring and documenting changes in plant communities (Mueller-Dombois and Ellenberg, 1974; Smith et al., 1986; Elzinga, Salzer et al., 1988; BLM 1996; Heywood and DeBacker, 2007). For this reason, frequency data is the primary means for evaluating trend at a given site. Based on recommendations for evaluating differences between summed nested frequency plots (Smith et al., 1987 and Mueller-Dombois and Ellenberg, 1974), a Chi-Square analysis with a Yate's correction factor was used to determine significant differences between years. The 2015 results were compared to all sampling events during the baseline period to determine if results in 2015 were ecologically significant or remained within the typical range of variability observed for that particular site.

The ecological site on the LORP where the majority of land management monitoring transects are located is the Moist Floodplain ecological site (MLRA 29-20). The site describes axial-stream floodplains. Moist Floodplain sites are dominated by Saltgrass (*Distichlis spicata*), plant symbol DISP and to a lesser extent alkali sacaton *(Sporobolus airoides*), plant symbol SPAI and creeping wildrye *(Leymus triticoides*), plant symbol LETR5. Only 10% of the total plant community is expected to be composed of shrubs and the remaining 10% forbs. This ecological site does not include actual river or stream banks. Stream bank information is available from the Rapid Assessment Survey (RAS) reports and the Streamside Monitoring Report from 2014.

Saline Meadow ecological sites (MLRA 29-2) are the second most commonly encountered ecological sites on the LORP range trend sites. These sites are located on fan, stream, lacustrine terraces, and may also be found on axial stream banks. Potential plant community groups are 80% perennial grass with a larger presence of alkali sacaton than Moist Floodplain sites. Shrubs and trees comprise up to 15% of the community while forbs are only 5% of the community at potential. Saline Bottom (MLRA 29-7) and Sodic Fan (MLRA 29-5) ecological sites were also associated with several range trend sites. These are more xeric stream and lacustrine terrace sites. Saline Bottom ecological sites still maintain up to 65% perennial grasses, the majority of which is alkali sacaton, while shrubs compose up to 25% of the plant community, and forbs occupy the remaining 10%. Sodic Fan ecological sites are 70% shrubs, primarily Nevada saltbush *(Atriplex torreyi)*, plant symbol ATTO, with a minor component of alkali sacaton of up to 25% and 5% forbs.

During the pre-project period, a range of environmental conditions were encountered including "unfavorable" growing years when precipitation in the southern Owens Valley was less than 50% of the 1970-2009 average, "normal" years, when precipitation was 50-150% of average, and "favorable" conditions when precipitation was greater than 150% of average. Many of the monitoring sites responded differently to the variable precipitation conditions during the baseline period. This provided the Watershed Resources staff an opportunity to sample across a broad amplitude of ecological conditions for these sites, which contributed to a robust baseline dataset. Data from the

Lone Pine rain gauges are used to determine the growing conditions for each sampling year on the Islands, Lone Pine, and Delta Leases. Precipitation data from Independence are used for the Thibaut and Blackrock Leases, and data from the Intake are used for the Intake, Twin Lakes, and the northern portion of the Blackrock Leases.

Adaptive management recommended that a modified range trend schedule was implemented beginning 2012. This schedule ensures that there will be some monitoring across the landscape annually, increasing the probability of documenting the influence of significant changes in climate or management on the various ecological sites in the LORP area.

Land Management Table 1. Revised Range Trend Monitoring Schedule for the LORP

2012	2013	2014	2015	2016	2017
Twin Lakes	Blackrock	Thibaut	Twin Lakes	Blackrock	Thibaut
Lone Pine	Delta	Islands	Lone Pine	Delta	Islands

5.5 Irrigated Pastures

Monitoring of irrigated pastures consists of Irrigated Pasture Condition Scoring following protocols developed by the (NRCS, 2001). Irrigated pastures that score 80% or greater are considered to be in good to excellent condition. If a pasture rates below 80%, changes to pasture management will be implemented.

All irrigated pastures were monitored in 2013. Pastures that scored 80% or below were checked in 2014. The results of the monitoring are presented in a table format by lease in Section 4.9. Irrigated pasture condition scoring was not conducted in 2015 due to drought conditions.

5.6 Fencing

The LORP EIR identified approximately 44 miles of new fencing to be built in the project area to improve grazing management and help meet the LORP goals. The new fencing consisted of riparian pastures, upland pastures, riparian exclosures, rare plant exclosures, and rare plant management areas. New rare plant exclosures were constructed on Blackrock Lease and Thibaut Lease (see sections 2.8.1.4, 2.8.2.2, and 2.8.2.3 of the Final LORP EIR June 23, 2004). Fence construction began in September 2006 and was completed in February 2009 with the total fence miles constructed being approximately 50 miles.

No new fence construction occurred within the LORP project boundaries in 2015. Some repairs did occur along with general maintenance.

5.7 Rare Plants

Within the LORP there are 15 trend plots within four rare plant populations on two separate ranch leases, Blackrock and Thibaut. Target species are Owens Valley checkerbloom and Inyo County star-tulip. Owens Valley checkerbloom (*Sidalcea covillei)* is a state endangered species, endemic to the Owens Valley that occurs in alkali meadows. Inyo County Star Tulip (*Calochortus excavatus)* is not state or federally listed but is considered a California Species of Special Concern (CSSC) and rare in its range. A mesic species, Inyo County star-tulip occurs in alkali meadows and seeps, transitioning into chenopode scrubland.

The Blackrock Lease has two 0.25-acre rare plant exclosures built in the Robinson and Little Robinson Pastures and two riparian exclosures were constructed in the White Meadow Riparian and Wrinkle Riparian Fields. The rare plant exclosures were designed to evaluate the effect of grazing on Owens Valley checkerbloom (plant symbol SICO2) and Inyo County star-tulip (plant symbol CAEX2).

The plots have been monitored for seven years to evaluate population trends. As designed, if trends are static or suggest that grazing is beneficial, the exclosure fencing will be removed. In contrast, if trends in data support that exclosures are needed to protect these populations of Owens Valley checkerbloom and Inyo County star-tulip, then LADWP will construct additional exclosures (or a practical variation thereof) and monitoring will continue as needed (see Section 6.6 LORP Annual Monitoring Report 2009).

5.7.1 Rare Plant Monitoring Methods

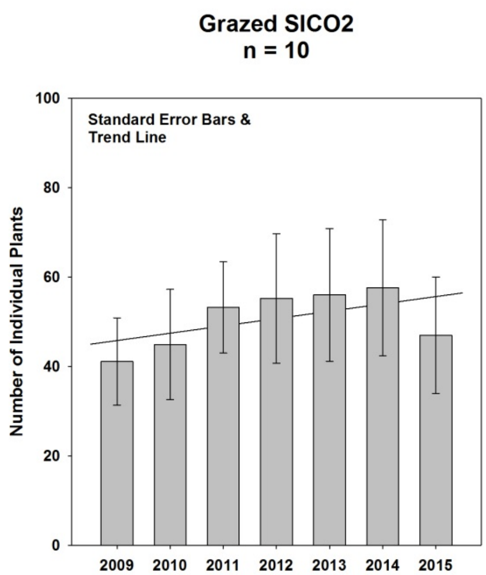
The LORP rare plant trend plots were established inside and outside of exclosures to measure change between grazed and ungrazed plots. Plots are permanently located by driving a piece of rebar into the center of the plot and taking a GPS point of the location. Plots can then be relocated using a hand-held GPS unit and a metal detector. Two 50-meter measuring tapes are used to delineate the plot into four sections with a diameter of 7.24 meters (3.62 meter radius) for a total plot size of 1/100 of an acre. Target species are flagged with a pin flag to aid in accurately identifying all individuals within the plot. Photos are taken in all cardinal directions depicting the plot area containing flagged plants. One measuring tape is then attached to the rebar in the center of the plot to record the distance of individuals within a radius of 3.62 meters. A compass is used to record the bearing of individuals from the center of the plot. By measuring the distance and bearing from the center of the plot, individual plants can then be accurately measured overtime. Data on recruitment, persistence, phenology and if the plants are grazed, are collected. General observational notes on site condition and other environmental factors are also recorded.

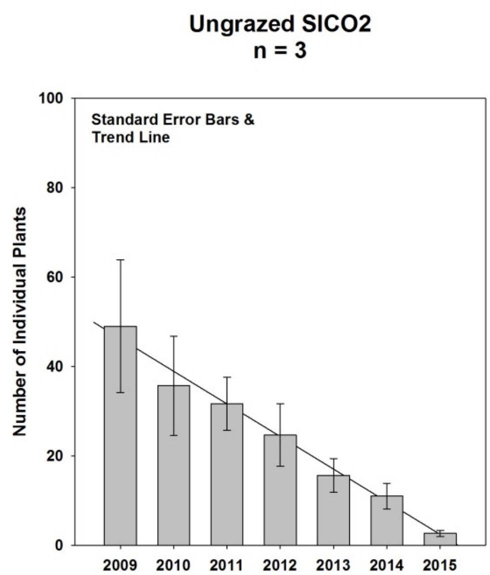
2015 marks the seventh year collecting trend plot data within the LORP. Data was compiled into a comprehensive database to analyze population trend over time.

5.7.2 Rare Plant Summary

Monitoring Results

A two-way repeated measures analysis of variance (ANOVA) was performed to determine if there is a measurable difference in population trend overtime between grazed and ungrazed trend plots. Results of the test show that there is no statistically significant difference between grazed and ungrazed sites (F=1.36, P=0.27) but that there is an effect of different levels of grazing depending on the year (F=3.39, P=0.01). Visually depicting the data showed an increasing trend over time in grazed sites and a decreasing trend over time in ungrazed sites (Land Management Figures 1-2). Additionally, external factors during a given year may be confounding results for the individual trend plots. Looking specifically at individual plots, we were able to formulate ideas on trend for Owens Valley checkerbloom. Because of generally low numbers of Inyo County star-tulip within the plots and the size of the trend plot, a statistical analysis was not performed on Inyo County star-tulip.





***Mean total plants for all sites**

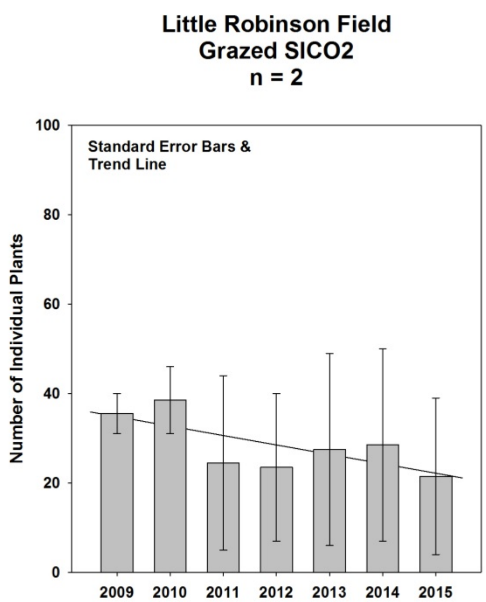
Land Mgmt Figure 1. All Age Classes Combined

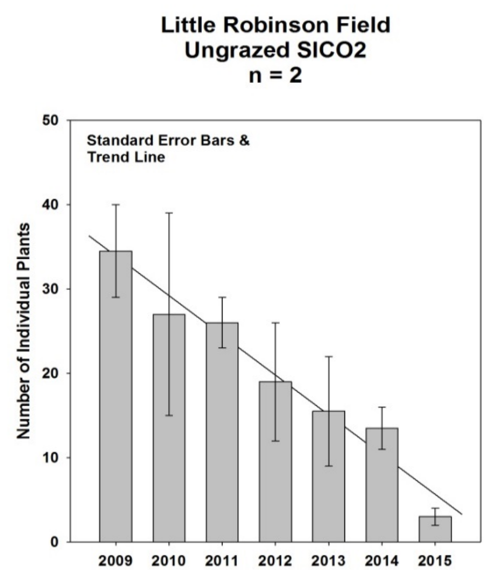
Land Mgmt Figure 2. All Age Classes Combined

Little Robinson Pasture, Blackrock Lease

This pasture contains an Owens Valley checkerbloom population. Trend plots Little Robinson 1EX and Little Robinson 2EX occur within an exclosure; trend plots Little Robinson 1C and Little Robinson 2C are adjacent to the exclosure and are grazed. Trend in the grazed plots are static while the trend in the ungrazed plots is decreasing (Land Management Figures 3-4).

This site illustrates the effect of different types of grazing for a given year. Factors that have additionally influenced these plots are inundation of trend plots due to stock water diversions and a nutrient tub within a trend plot site. Looking at the figures and raw data table, Little Robinson 2C has been inundated 4 of the 7 years of this study. Additionally, a nutrient tub, which provides supplement for livestock, was placed within the plot sometime in 2011 and was removed after the 2012 monitoring season. Based on observational data, the inundation of the site is favoring mesic, wetland species, such as sedge, Baltic rush, and creeping wildrye, which may be outcompeting Owens Valley checkerbloom. The nutrient tub placement may have had an effect due to the density of cattle congregating within the plot, compacting the soil and potentially overgrazing the monitoring site. By removing the nutrient tub in 2012, it appears that the trend may be increasing as observed in Land Management Figure 3. Little Robinson 1EX and 2EX may be experiencing the same issues from inundation. These confounding environmental factors make it difficult to isolate the grazing effect on this rare plant population. However, because both grazed and ungrazed plots have been inundated at some time during this study and trend is decreasing in the ungrazed plots, we may be able to deduce that some level of grazing is beneficial.





***Mean total plants, all age classes combined**

Land Mgmt Figure 3. Grazed, Little Robinson Field **Land Mgmt Figure 4. Ungrazed, Little Robinson Field**

Land Management Table 1. Rare Plant Raw Data

Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Little Robinson 1C (Grazed)	2009	Owens Valley checkerbloom	0	12	28	40
	2010		1	0	45	46
	2011		16	11	17	44
	2012		12	0	28	40
	2013		36	0	13	49
	2014		19	0	31	50
	2015		2	9	28	39
Little Robinson 2C (Grazed)	2009*	Owens Valley checkerbloom	0	12	19	31
	2010*		3	0	28	31
	2011*		4	1	0	5
	2012^		0	0	7	7
	2013*		5	0	1	6
	2014		1	0	6	7
	2015		1	1	2	4
Little Robinson 1EX (Ungrazed)	2009	Owens Valley checkerbloom	0	0	40	40
	2010		0	0	39	39
	2011		0	0	29	29
	2012		3	0	23	26
	2013*		13	0	9	22
	2014		3	0	8	11
	2015		0	2	0	2
Little Robinson 2EX (Ungrazed)	2009	Owens Valley checkerbloom	0	6	23	29
	2010		0	0	15	15
	2011		8	0	15	23
	2012		1	0	11	12
	2013*		6	0	3	9
	2014		0	0	16	16
	2015		0	2	2	4

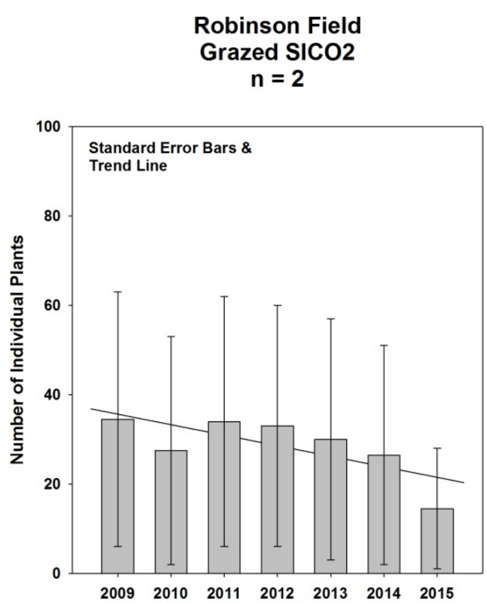
**Plot inundated*
^Nutrient tub in plot

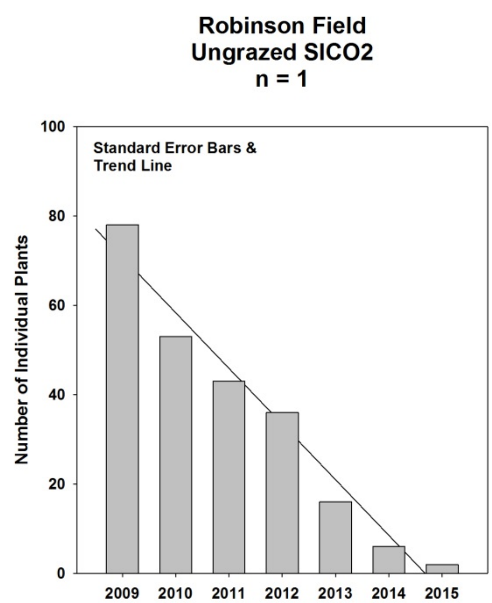
Robinson Field, Blackrock Lease

This pasture contains an Owens Valley checkerbloom population and an Inyo County star-tulip population. Trend plots Robinson 1EX and Robinson 2EX occur within an exclosure containing both Owens Valley checkerbloom and Inyo County star-tulip. Two Owens Valley checkerbloom trend plots (Robinson 1C and Robinson 2C) along with one Inyo County star-tulip trend plot (Robinson 3C) are outside the exclosure within the same pasture. Trend in the grazed plots are static while trend in the ungrazed site is decreasing (Land Management Figures 5-6).

This site is possibly another example of the effect of different types of grazing for a given year. The exclosure for the ungrazed plot was left open in 2011 only to be discovered during the 2012 monitoring season. Observational data suggests that the exclosed site is becoming overgrown and decadent. Treating 2009 as baseline, or pre-exclosure conditions, the precipitous decline may be attributed to the lack of grazing (i.e. disturbance). This may explain the decrease in trend for the ungrazed plot.

Because trend is static in the grazed plots and decreasing in the ungrazed plot, it appears that grazing is maintaining the population.





***Mean total plants, all age classes combined**

Land Mgmt Figure 5. Grazed, Robinson Field

Land Mgmt Figure 6. Ungrazed, Robinson Field

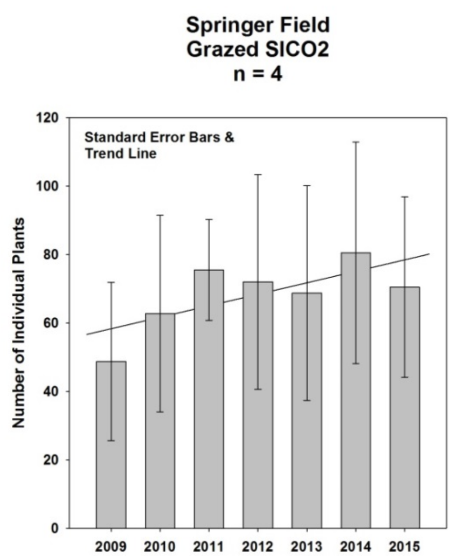
Land Management Table 2. Rare Plant Raw Data, Robinson Field

Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Robinson 1C (Grazed)	2009	Inyo County star-tulip	0	0	12	12
	2010		0	0	38	38
	2011		0	0	30	30
	2012		0	0	2	2
	2013		1	0	2	3
	2014		10	0	23	26
	2015		0	0	25	25
Robinson 1C (Grazed)	2009	Owens Valley checkerbloom	0	0	6	6
	2010		0	0	2	2
	2011		4	0	2	6
	2012		1	0	5	6
	2013		1	0	2	3
	2014		0	0	2	2
	2015		0	1	0	1
Robinson 2C (Grazed)	2009	Inyo County star-tulip	0	0	0	0
	2010		0	0	2	2
	2011		0	0	6	6
	2012		0	0	1	1
	2013		0	0	0	0
	2014		0	0	2	2
	2015		0	0	1	1
Robinson 2C (Grazed)	2009	Owens Valley checkerbloom	0	4	59	63
	2010		1	0	52	53
	2011		22	6	34	62
	2012		12	0	48	60
	2013		7	0	50	57
	2014		11	0	91	101
	2015		0	11	17	28
Robinson 3C (Grazed)	2009	Inyo County star-tulip	0	0	1	1
	2010		0	0	11	11
	2011		0	0	18	18
	2012		0	0	13	13
	2013		0	0	13	13
	2014		7	0	11	18
	2015		0	0	6	6
Robinson 1EX (Ungrazed)	2009	Inyo County star-tulip	0	0	2	2
	2010		0	0	11	11
	2011		0	0	2	2
	2012*		0	0	0	0
	2013		0	0	0	0
	2014		0	0	0	0
	2015		0	0	0	0

Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Robinson 1EX (Ungrazed)	2009	Owens Valley checkerbloom	0	43	35	78
	2010		17	0	36	53
	2011		13	8	22	43
	2012*		13	0	23	36
	2013		7	0	9	16
	2014		2	0	8	10
	2015		0	0	2	2
Robinson 2EX (Ungrazed)	2009	Inyo County star-tulip	0	0	23	23
	2010		2	0	23	25
	2011		0	1	30	31
	2012*		0	0	1	1
	2013		5	0	20	25
	2014		5	0	29	24
	2015		0	0	22	22
**Gate open – Exclosure grazed*						

Springer Pasture, Blackrock Lease

This pasture contains an Owens Valley checkerbloom population with four trend plots; Springer 1C, Springer 2C, Springer 1EXC, and Springer 2EXC, all of which are grazed. Trend across all plots is static (Figure 7). This pasture is consistently grazed year round by both cattle and horses and receives irrigation water from Stevens Ditch. Because of the consistent grazing regime and that trend has remained static to slightly increasing, it appears that the level of grazing is not negatively effecting the Owens Valley checkerbloom population.



***Mean total plants, all age classes combined**

Land Management Figure 7. Grazed, Springer Field

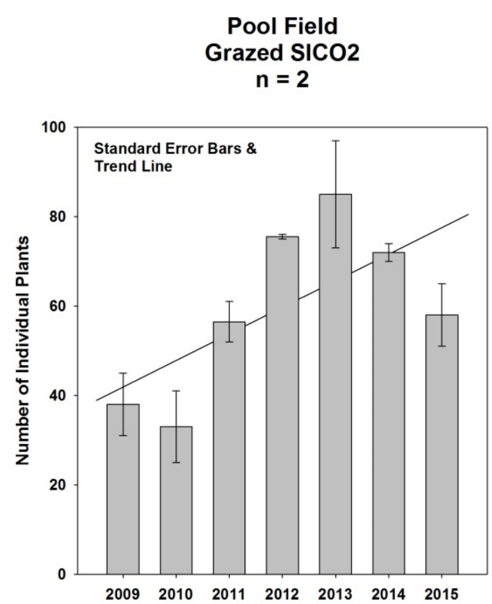
Land Management Table 3. Rare Plant Raw Data, Springer Pasture

Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Springer 1C (Grazed)	2009	Owens Valley checkerbloom	0	74	31	115
	2010		15	0	131	146
	2011		9	31	9	108
	2012		41	0	119	160
	2013		28	0	128	156
	2014		17	0	143	160
	2015		0	2	126	128
Springer 2C (Grazed)	2009	Owens Valley checkerbloom	0	13	24	37
	2010		3	0	49	52
	2011		7	17	33	57
	2012		27	0	44	71
	2013		7	0	59	66
	2014		11	0	91	101
	2015		0	9	89	98
Springer 1EXC (Grazed)	2009	Owens Valley checkerbloom	0	2	5	7
	2010		0	0	16	16
	2011		6	44	42	92
	2012		6	0	10	16
	2013		1	0	8	9
	2014		2	0	8	10
	2015		0	0	10	10
Springer 2EXC (Grazed)	2009	Owens Valley checkerbloom	0	23	13	36
	2010		0	0	37	37
	2011		3	13	29	45
	2012		17	0	24	41
	2013		15	0	29	44
	2014		15	0	36	51
	2015		0	2	44	46

Thibaut Pasture, Thibaut Lease

This pasture contains an Owens Valley checkerbloom and Inyo County star tulip population. Trend for both Pool Field 1 and Pool Field 4 are increasing (Figure 8). An ANOVA test revealed that the positive trend observed is statistically significant, P = .015. The trend is significantly different between years 2010 and 2013, P = .002.

The plots are located within the Rare Plant Management Area and are grazed by horses and mules, which are excluded from grazing from March 1 to September 30. This is to allow the rare plants to complete their life cycle (see section 2.8.2.3 of Final LORP EIR June 23, 2004). Because plant numbers are increasing over time it appears that Owens Valley checkerbloom favors some level of seasonal grazing. The positive trend may also be attributed to the irrigation regime from an irrigation/stock water ditch located between the trend plots. No actual data has been collected on soil moisture at the plots but observational data does not indicate that the plots have ever been inundated or drying out and that the management regime of the ditch has remained consistent.



***Mean total plants, all age classes combined**

Land Management Figure 8. Grazed Pool Field

Land Management Table 4. Rare Plant Raw Data, Pool Field

Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Pool Field 1C (Grazed)	2009	Owens Valley checkerbloom	N/A	N/A	N/A	N/A
	2010		1	0	24	25
	2011		15	5	32	52
	2012		34	0	42	76
	2013		45	0	52	97
	2014		35	0	35	70
	2015		6	26	33	65
Pool Field 1C (Grazed)	2009	Inyo County star-tulip	N/A	N/A	N/A	N/A
	2010		0	0	12	12
	2011		0	0	4	4
	2012		2	0	7	9
	2013		4	0	8	12
	2014		24	0	25	49
	2015		0	0	11	11
Pool Field 4C (Grazed)	2009	Owens Valley checkerbloom	N/A	N/A	N/A	N/A
	2010		3	0	38	41
	2011		9	12	40	61
	2012		31	0	44	75
	2013		28	0	45	73
	2014		22	0	52	74
	2015		4	17	30	51
Pool Field 4C (Grazed)	2009	Inyo County star-tulip	N/A	N/A	N/A	N/A
	2010		0	0	4	4
	2011		0	0	2	2
	2012		0	0	1	1
	2013		0	0	3	3
	2014		1	0	4	5
	2015		0	0	1	1

5.7.3 Rare Plant Conclusions/Recommendations

The objective of the project was to monitor impacts of grazing on rare plants within the LORP. Based on 7 years of data, trend of ungrazed plots appears to be decreasing across all sites. Using the Pool Field and Springer pastures as an example, some level of disturbance, grazing (per the LORP EIR grazing prescriptions) and improved irrigation water management, may contribute to maintaining stable populations of Owens Valley checkerbloom and Inyo County star tulip. It is recommended to remove the grazing exclosures and discontinue the study.

5.8 Experimental Discing on the Winterton Unit in Preparation for Flooding

5.8.1 Background

Active units in the Blackrock Waterfowl Management Area (BWMA) have previously been prepared for flooding through controlled burns, as in the burns for the Winterton and Waggoner Units. Wildland fire has also burned the Drew Unit. The objective behind burning the cells is to eliminate the vertical structure and accumulated biomass created by cattails as a result of prolonged flooding over a series of prior growing seasons. The BWMA must be managed such that at least 51% open water is maintained in a flooded unit. Therefore, reducing preexisting cattails before flooding is intended to maximize open water for the unit at the onset prior to flooding.

The Drew Unit was dried down in Spring 2015 and LADWP began flooding the Winterton Unit with the required flooded acreage per the LORP EIR. Due to excessively dry conditions during the drought and associated area burn restrictions, LADWP prepared the Winterton Unit for flooding using a discing method rather than using prescribed fire. In doing so, a low ground pressure Caterpillar™ pulled a large disc so that all cattail areas in the unit were reduced to small fist-sized peds of organic material, rootballs and mineral soil. Approximately 45% of the Unit was prepared in this manner over a span of five days. In comparison, the adjacent Waggoner Unit was prepared for burning, but LADWP was unable to conduct the burn due to burn restrictions.

The objectives for discing the Winterton Unit were to:

1. Break up/pulverize existing cattail mats comprised of root balls that retain large amounts of water and can delay the time before notable surface ponding occurs on a newly flooded unit.
2. Reduce the water holding capacity by breaking up cattail mats. As a consequence, these areas would not continue to produce cattails while the unit was seasonally drained. The reduction in cattails would help promote the production of more desirable vegetation targeted for waterfowl habitat (early successional, herbaceous vegetation).
3. Expose and desiccate any surviving rootstalks and rhizomes to the sun to reduce cattail regrowth when the unit is active.
4. Increase the amount of surface area exposed to the atmosphere and the subsequent aquatic environment during flooding in order to accelerate decompositional processes.
5. Increase the amount of saturated surface area of organic material (i.e., chopped rootstalks and rhizomes) to facilitate greater production of bacteria, which will lead to a higher forage base for macro-invertebrates.

6. Eliminate vertical structure of vegetation through discing (and burning) which will increase the amount of sunlight on soil surfaces and subsequently, germination and production of early successional, herbaceous vegetation.
7. Evaluate the efficacy of discing for unit preparation versus burning from a management perspective. If discing is effective in reaching LORP goals and is cost effective, LADWP's burn program could instead be geared toward improving rangelands rather than reducing cattail litter in dried management units.

5.8.2 Initial Observations

The reduction of the cattail areas to fist-sized peds was successful with the disc and Caterpillar™. Flooding during the first month broadly dispersed water across the upper section of the unit, rapidly increasing the amount of open water. Because the unit was not drained during the summer season LADWP was unable to assess if there was a reduction in water holding capacity in the unit following a drying period. Based on periodic observations throughout the summer during avian surveys around the unit, cattail expansion during the summer steadily progressed.

Similar to fire, discing does not reduce cattail encroachment if water levels are either static or rising during the growing season. Because all of the cattail biomass was reduced in size, saturated, and exposed to the atmosphere, the assumption is that decomposition was accelerated by discing. The elimination of vertical structure and increase of sunlight to the soil surface appeared to influence the amount of sunflowers interspersed within the cattails in the unit.

As mentioned above, the discing took approximately five days which is a significant reduction in cost when compared to costs associated with prepping and implementing a prescribed burn. Aside from the financial advantages, the flexibility of when discing can occur and the precision of where exactly it will occur contrasts starkly to the unpredictability of when a controlled burn will actually occur and the inherent risks in actually being able to 'control' a burn. The lack of approved burn days during the prescribed fire season is a considerable impediment to maintaining an effective burn program. When days are available, LADWP resources should focus on rangeland burns with 10+ years of positive responses rather than burning out accumulated cattail litter for a unit in a three year rotation. Discing units in preparation for flooding is an effective means of eliminating buildups of cattail biomass in areas which have dried out enough to support the weight of a low ground pressure Caterpillar™ and should be incorporated into the toolkit for managing waterfowl habitats in the BWMA.

5.9 Discussion of Range Trend in 2015

Range Trend transects on the Twin Lakes and Lone Pine leases were read in early August.

2015 is the fourth year where precipitation remains well below average, particularly during the mid- and late winter periods. Effects from the drought vary depending upon location. With regards to the two leases sampled inside the LORP project area, trends remain stable on the moist floodplain sites where water tables remain high due to steady baseflows on the Lower Owens River throughout the year. Off-river Saline Meadow locations are beginning to show impacts from the drought with declining densities of perennial grasses. Continued significant declines of Nevada saltbush along multiple locations on the former dry reach of the Lower Owens continue while in other locations saltbush cover has stabilized for the time being.

5.10 LORP Ranch Lease Summary and 2015 Monitoring Results

The following sections are presented by ranch lease. The discussion includes an introduction describing the lease operations, pasture types, a map of the lease, utilization results from 2015, a summary of range trend results at the lease level, and a presentation of range trend results by transect when significant changes occurred. Reference to plant species by plant symbol are found in the following list of the plant species, scientific names, common names, plant symbol, and functional group assignment for species encountered on the range trend transects.

Common Species Encountered in 2015 Range Trend Transects

Plant Code	Species Name	Common Name
ANCA10	*Anemopsis californica*	yerba mansa
ATTO	*Atriplex torreyi*	saltbush
BAHY	*Bassia hysopifolia*	bassia/smotherweed
DISPS2	*Distichlis spicata*	saltgrass
EQAR	*Equisetum arvense*	field horsetail
FOPU	*Forestiera pubescens*	stretchberry
GLLE3	*Glycyrrhiza lepidota*	licorice
HECU3	*Heliotropis curvassum*	salt heliotrope
JUBA	*Juncus balticus*	Baltic rush
LELA	*Lepidium latifolium*	broadleaf pepperweed
LETR5	*Leymus triticoides*	creeping wildrye
SAEX	*Salix exigua*	narrowleaf willow
SAGO	*Salix gooddingii*	Goodding's willow
SALA3	*Salix laevigata*	red willow
SAVE4	*Sarcobatus vermiculatus*	greasewood
SCAC	*Schoenoplectus acutus*	tule
SCAM	*Schoenoplectus americanus*	common threesquare
SCMA	*Schoenoplectus maritimus*	cosmopolitan bulrush
SPAI	*Sporobolus airoides*	alkali sacaton
TARA	*Tamarix ramossissima*	saltcedar
TYDO	*Typha domingensis*	southern cattail
TYLA	*Typha latifolia*	broadleaf cattail

5.10.1 Intake Lease (RLI-475)

The Intake Lease is used to graze horses and mules employed in a commercial packer operation. The lease, which is approximately 102 acres, is comprised of three fields: Intake, Big Meadow Field, and East Field. The Intake Field contains riparian vegetation and an associate range trend transect. The Big Meadow Field contains upland and riparian vegetation; however, it is not within the LORP project boundaries. There are no utilization or range trend transects in the Big Meadow Field due to a lack of adequate areas to place a transect that would meet the proper range trend/utilization criteria. Much of the meadow in the Big Meadow Field has been covered with dredged material from the LORP Intake. The East Field consists of upland and riparian vegetation. The Big Meadow and Intake Fields were not used by livestock during the construction of the Intake structure, which lasted until the 2008-09 grazing season. There are no irrigated pastures on the Intake Lease. There are no identified water sites needed for this pasture and no riparian exclosures planned due to the limited amount of riparian area within the both pastures.

The following table presents the summarized utilization data for each field for the current year.

End of Grazing Season Utilization on the Intake Lease, RLI-475, 2015

Field	Utilization
Intake Field*	0%

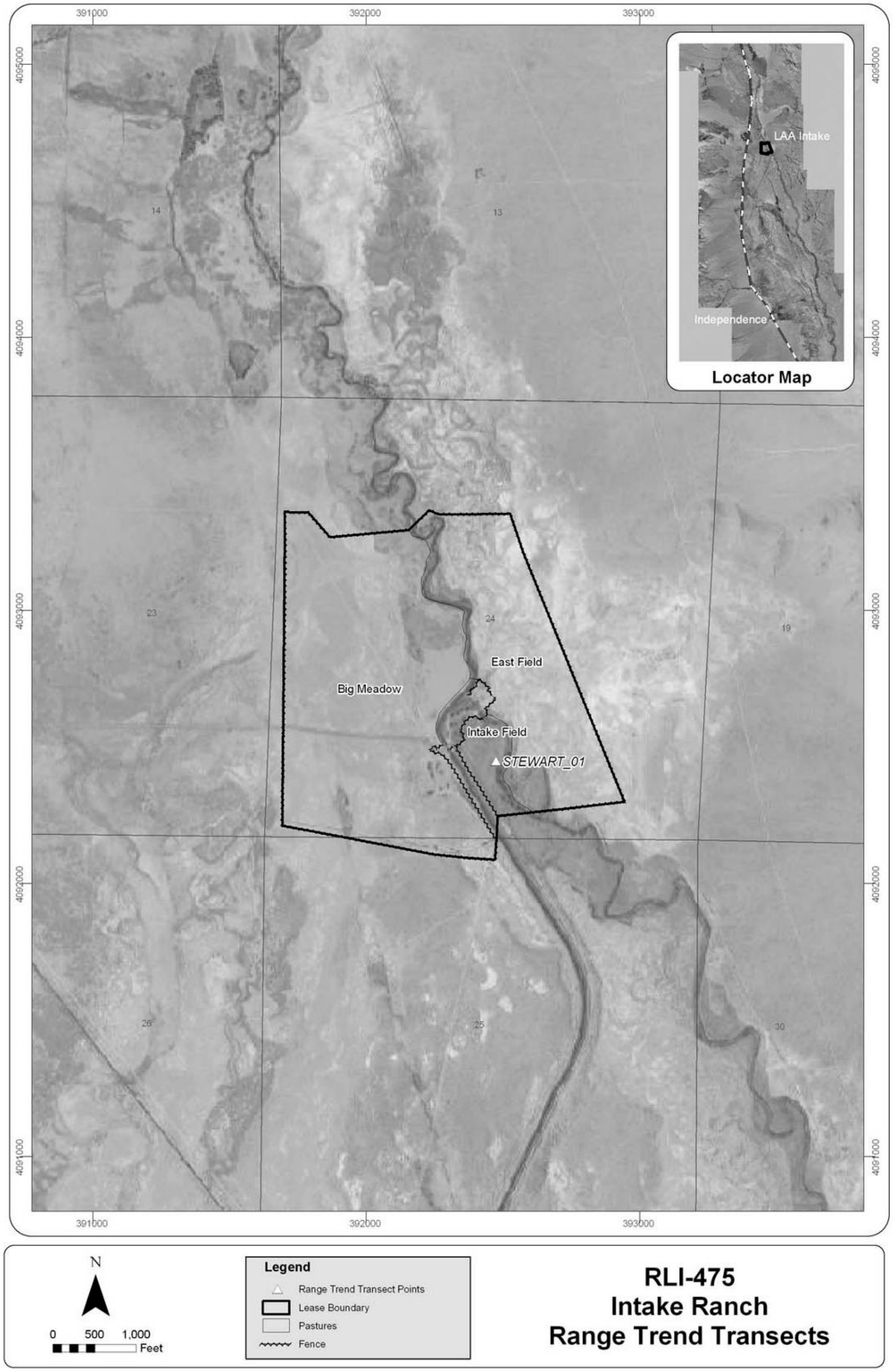
**Riparian Utilization, 40%*

<u>Summary of Utilization</u>

Utilization for the Intake Lease in 2015 was 0%.

<u>Summary of Range Trend Data and Conditions</u>

Range Trend data was not collected in 2015 on the Intake Lease.



Land Management Figure 9. Intake Lease RLI-475, Range Trend Transects

5.10.2 Twin Lakes Lease (RLI-491)

The Twin Lakes Lease is a 4,912-acre cow/calf operation situated just south of the Los Angeles Aqueduct Intake. It includes a reach of the Owens River that lies mainly north of Twin Lakes, which is located at the southern end of the Twin Lakes Lease. Of the 4,912 acres, approximately 4,200 acres are used as pastures for grazing; the other 712 acres are comprised of riparian/wetland habitats and open water. In all but dry years, cattle usually graze the lease from late October or early November to mid-May.

There are four pastures on the Twin Lakes Lease within the LORP boundary: Lower Blackrock Riparian Field, Upper Blackrock Field, Lower Blackrock Field, and the Holding Field. The Lower Blackrock Riparian, Upper Blackrock Riparian, and Lower Blackrock Fields contain both upland and riparian vegetation. The Holding Field contains only upland vegetation. There are no irrigated pastures on the Twin Lakes Lease. Range trend and utilization transects exist in all fields except the Holding Field where livestock grazing does not occur.

The following table presents the summarized utilization data for each field for the current year.

End of Grazing Season Utilization on the Twin Lakes Lease, RLI-491, 2015

Field	Utilization
Lower Blackrock Field	3%
Lower Blackrock Riparian Field*	1%
Upper Blackrock Field*	14%

*Riparian Utilization 40%**

Riparian Management Areas

Utilization in the Lower Blackrock Riparian (1%) and Upper Blackrock Field (14%) was well below the allowable utilization for the grazing season. Much of the grazing occurred around Drew Slough early in the season and then in the adjacent riparian pastures. The Telegraph range burn located within the Upper Blackrock Field and Lower Blackrock Riparian Fields has had continued positive results. Perennial grasses in the meadows are thriving, and many Gooding's willow have re-sprouted after the burn. There are no recommended management changes.

Upland Management Area

Upland utilization was well below the allowable standard of 65% in all fields.

Irrigated Pastures

There are no irrigated pastures on the Twin Lakes Lease.

Fencing

There was no new fencing constructed on the lease in 2015.

Salt and Supplement Sites

Supplement is composed of a liquid mix that is put in large tubs with rollers that the cattle consume. These tubs are placed in established supplement sites and are used every year.

Burning

A range burn was conducted in March of 2013 resulting in 190 acres of riparian pasture being burned. The purpose of the burn was to remove existing saltcedar slash piles and shrubs that had encroached in to existing perennial grass meadows. Prior to the burn, CAL FIRE and LADWP prepared fire breaks and created buffers around existing riparian vegetation, resulting in complete fire containment, with very little loss to riparian vegetation. The burn improved and expanded meadow habitat on the Twin Lakes lease, offsetting the five-year decline in both meadows and wetlands in and around Drew Slough due to flooding the unit for six straight years.

Summary of Range Trend Data and Conditions

Minor changes have occurred across the lease in 2015. A significant decline in alkali sacaton was observed at TWINLAKE_02 while at the same time alkali cordgrass (*Spartina gracilis*) and saltgrass continued to maintain an upward trend which indicates a possible rise in soil salinity across the site.

Significant Changes in Frequency for Twin Lakes Transects Between 2012 and 2015

	No Change	DISP	SPAI	ATTO	BAHY	SPGR
Moist Flood Plain						
TWINLAKE_04*	↔					
TWINLAKE_06*	↔					
TWINLAKE_03	↔					
SALINE MEADOW						
TWINLAKE_05	na					
INTAKE_01	↔					
SALINE BOTTOM WETLAND						
TWINLAKE_02			↓			

**Sites located along historical dry reach, ** Sites where change extends outside historical ranges for the transect. α<0.05, ↑=increase, ↓=decrease,↔=no change*

Upper Blackrock Field

INTAKE_01

INTAKE_01 is located in the Upper Blackrock Field. The soils are mapped as Torrifluvents-Fluvaquentic Endoaquolls Complex; but the majority of the study plot is located on the adjacent soil unit, Torrifluvents, 0-2% slopes, which is associated with the Saline Meadow ecological site. Plant frequencies remain static while shrub cover decreased in 2015.

Frequency (%), INTAKE_01

Species Code	2002	2003	2004	2007	2009	2010	2012	2015
2FORB	0	0	1	0	0	0	0	0
ATPH	0	18	5	0	0	0	0	0
ATTR	0	0	2	0	0	0	0	0
CHST	0	2	0	0	0	0	0	0
CLEOM2	0	2	0	0	0	0	0	0
CLOB	0	3	0	0	0	0	0	0
CRCI2	0	0	7	0	0	0	0	0
ERIAS	0	23	0	0	0	0	0	0
ERIOG	0	5	0	0	0	0	0	0
ERMA2	0	0	2	0	0	0	0	0
MEAL6	0	0	10	0	0	0	0	0
CLPL2	0	0	0	0	0	5	0	0
MACA2	17	0	0	0	0	11	0	0
MALAC3	0	2	1	0	0	0	0	0
STEPH	0	18	16	0	0	0	0	0
SUMO	3	4	4	2	2	2	0	0
DISP	60	54	67	52	82	59	92	77
JUBA	14	19	15	11	11	8	14	15
SPAI	97	117	103	105	109	117	115	101
ATCO	24	15	23	19	25	11	25	19
ATPA3	0	0	0	1	1	2	0	0
ATTO	0	10	8	6	3	11	3	5
ERNA10	9	22	27	26	28	17	12	11
MACA17	0	0	0	14	18	0	10	12
BAHY	0	0	0	0	10	10	0	0
BRTE	0	0	1	0	0	0	0	0
POMO5	0	3	0	0	0	0	0	0
SATR12	0	0	0	0	0	0	0	3
BRRU2	0	0	0	0	1	0	0	0

** indicates a significant difference, α≤0.1, **≤0.05 between 2010 and 2012*

Cover (%) Shrubs INTAKE_01

Species Code	2003	2004	2007	2009	2010	2012	2015
ATCO	1.1	0.9	0.9	0.8	0.7	1.5	0.5
ATTO	0.8	1.3	1.6	1.0	2.3	1.1	0.0
ERNA10	1.2	3.6	3.5	4.5	2.6	2.5	0.7
SAVE4	0.0	0.0	0.3	0.2	0.0	0.0	0.3
SUMO	0.0	0.0	0.0	0.1	0.0	0.2	0.0
Total	3.1	5.8	6.3	6.5	5.6	5.2	1.5

Lower Blackrock Field

TWINLAKES_02

TWINLAKES_02 is located in the Lower Blackrock Field on the Pokonahbe-Rindge Family Association soil series, which corresponds to the Saline Bottom Wetland ecological site. Presently, there is no ecological site description for Saline Bottom Wetland ecological site. Referencing the site to a Saline Bottom ecological site, the similarity index ranged between 42%-62%. The site would be in a higher ecological condition if the wetland component was accounted for in the ecological site description because of the greater abundance of mesic graminoids such as *Juncus balticus* (JUBA) and Alkali cordgrass (*Spartina gracilis)* (SPGR) present on the site, which are typically minor components on the more xeric Saline Bottom ecological site.

The transect was burned in mid-February, 2009. Shrub cover prior to the burn was moderate which resulted in a cooler burn when compared to similar areas further south in Drew Slough. Because of the cool fire, a decrease in shrub frequency, shrub cover, and shrub recruitment were observed in 2009 and 2010. Alkali cordgrass (*Spartina gracilis)* significantly increased in 2010 and continued to increase in 2012. Alkali sacaton (SPAI) also increased markedly in 2012 but subsequently dropped to all-time lows in 2015. Utilization was minimal on the site in 2015 and has historically been very light.

Frequency (%), TWINLAKES_02

Species Code	2002	2003	2004	2007	2009	2010	2012	2015
ATPH	0	2	1	0	0	2	0	0
CHENO	0	2	0	0	0	0	0	0
CHHI	0	0	2	0	0	0	0	0
CLOB	0	8	3	0	0	0	0	0
COMAC	0	0	0	0	0	1	0	0
NIOC2	3	4	2	3	5	15	14	11
PYRA	0	6	2	7	9	12	2	2
STEPH	0	3	0	0	0	0	0	0
DISP	75	61	65	60	73	80	81	89
JUBA	73	96	103	78	72	72	76	79
LECI4	0	4	16	0	0	1	0	4
LETR5	3	4	0	0	0	0	0	0
POSE	0	0	0	0	2	11	0	0
SPAI	60	53	69	44	36	39	68	24**
SPGR	34	20	19	65	57	76	89	90
ATTO	0	6	5	5	0	0	0	0
ERNA10	12	28	24	27	1	0	0	0
FESTU	0	3	1	0	0	0	0	0
POA	0	0	0	11	0	0	0	0

** indicates a significant difference, $\alpha \leq 0.1$, **≤ 0.05 between 2010 and 2012*

Cover (m) Shrubs TWINLAKES_02

Species Code	2003	2004	2007	2009	2010	2012	2015
ATTO	6.4	5.9	4.3	0.3	1.1	1.2	0
ERNA10	18.3	15.9	13.5	0.0	0.0	0.0	0
Total	24.7	21.8	17.8	0.3	1.1	1.2	0

Lower Blackrock Field

TWINLAKES_05

TWINLAKES_05 is located in Lower Blackrock Field on the Manzanar-Division Association, 0-2% slopes soil unit which corresponds to the Saline Meadow ecological site. The transect was burned in late January 2009 and was subsequently submerged when the Drew Unit of the BWMA was flooded. Because of this, range trend sampling and utilization estimates are currently not available.

Lower Blackrock Riparian Field

TWINLAKES_03

TWINLAKES_03 is located in the Lower Blackrock Riparian Field. The soils are Torrifluvents-Fluvaquentic Endoaquolls Complex, which corresponds to the Moist Floodplain ecological site. The similarity index during baseline period ranged between 63%-65%, placing it in good ecological condition, explained by the dominance of saltgrass on the site. Nevada saltbush is much greater than the described potential for the site. The site also lacks in diversity of perennial grasses. Saltgrass on the site has remained relatively static over time on the site. The transect was inside the Twin Lakes burn in 2013 and reduced Nevada saltbush shrub cover to zero in 2015.

Frequency (%), TWINLAKES_03

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012	2015
Perennial Forb	SUMO	0	0	5	11	15	2	14	0
Perennial Graminoid	DISP	145	144	141	153	163	127	158	150
	SPAI	0	1	5	1	2	0	0	0
Shrubs	ATTO	48	0	64	18	31	10	11	0
Nonnative Species	BAHY	0	37	27	0	26	38	0	0

** indicates a significant difference, α≤0.1, **≤0.05 between 2010 and 2012*

Cover (m) Shrubs TWINLAKES_03

Species Code	2003	2004	2007	2009	2010	2012	2015
ATTO	17.0	17.0	6.4	8.4	12.1	8.6	0
SUMO	0.0	0.1	2.4	0.6	0.9	1.1	0.2
Total	17.0	17.1	8.8	9.0	13	9.7	0.2

TWINLAKES_04

TWINLAKES_04 is located in the Lower Blackrock Riparian Field in the former dry reach. The soils are Torrifluvents-Fluvaquentic Endoaquolls Complex, which corresponds to the Moist Floodplain ecological site. The similarity index is poor, ranging between 4-5%. Unlike TWINLAKES_03, which has historically benefitted from a shallow water table, TWINLAKES_04 has yet to respond favorably from returned flows into the Lower Owens River. The site is predominantly Nevada saltbush, inkweed, and fivehorn smotherweed. Frequency significantly increased for bassia and inkweed in 2009 and 2010 when compared to 2007 and disappeared in 2012. Inkweed frequency in 2009 and 2010 was greater than baseline parameters (2002-04 and 2007) but dropped significantly in 2012. Inkweed cover has also substantially increased from trace amounts prior to returning flows to the river to over 37 m of canopy along the transect in 2010 and then dropping to 12.5 m in 2012 and further decreasing to 8.7m in 2015. Nevada saltbush cover appears to be on the upswing over the past two years. No utilization estimates exist for the site due to the absence of key forage species.

Frequency (%), TWINLAKES_04

Species Code	2002	2003	2004	2007	2009	2010	2012	2014	2015
ATTR	0	0	9	0	0	0	0	0	0
CHIN2	0	0	2	0	0	0	0	0	0
CRCI2	0	0	3	0	0	0	0	0	0
SUMO	2	0	1	9	24	33	4	3	3
DISP	17	4	12	0	0	0	0	0	0
LETR5	0	0	0	0	0	0	0	0	4
ATTO	5	8	27	18	13	9	3	0	0
BAHY	0	6	41	0	15	24	0	0	0
DESO2	0	0	7	0	0	0	0	0	0
SATR12	0	4	82	0	0	0	0	0	0

** indicates a significant difference, α≤0.1, **≤0.05 between 2010 and 2012*

Cover (m) Shrubs TWINLAKES_04

Species Code	2003	2004	2007	2009	2010	2012	2014	2015
ATTO	13.6	22.4	11.2	17.9	15.7	12.5	13.6	17.8
SUMO	0.0	0.0	20.0	27.3	37.2	12.5	8.1	8.7
Total	13.6	22.4	31.2	45.1	52.9	25.0	21.7	26.5

TWINLAKES_06

TWINLAKES_06 is located in the Lower Blackrock Riparian Field. Soils are Torrifluvents-Fluvaquentic Endoaquolls Complex, which corresponds to the Moist Floodplain ecological site. Similarity index to the site's potential was 19% between 2006-07. As with TWINLAKES_04, the site is dominated by shrubs, invasive annual forbs, and a scant amount of perennial grasses as the understory. Plant frequency in 2009 indicated a significant increase in Nevada saltbush and bassia. In 2010, saltgrass decreased to its lowest level for the site. A strong pattern of increasing saltbush and decreasing inkweed exists on this site. Shrub cover for Nevada saltbush continues to increase on the site rising from 5.4 m in 2006 to 66.6 m in 2010 and then dropping to 51.8 m which is still well above pre-LORP implementation conditions. In 2012, there was a slight decrease in Nevada saltbush cover and an increase in saltgrass frequency. At the same time SUMO has steadily decreased on the site.

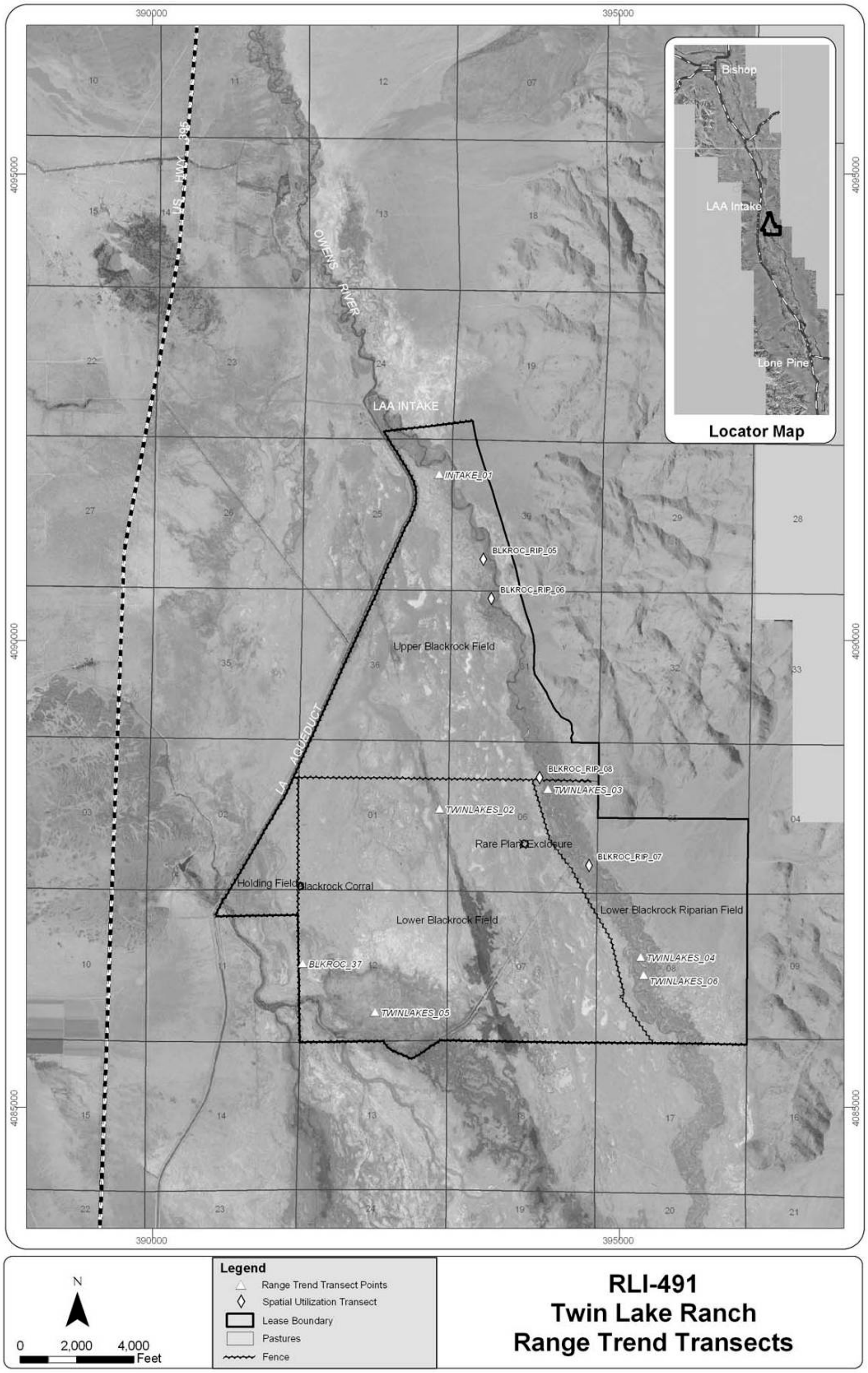
Frequency (%), TWINLAKES_06

Species Code	2006	2007	2009	2010	2012	2014	2015
HECU3	0	0	8	8	11	8	1
SUMO	48	30	29	16	10	9	6
DISP	57	38	32	13	30	53	43
SPAI	0	0	10	0	0	0	2
ATTO	23	20	63	71	51	36	27
BAHY	0	0	22	29	0	0	0
SATR12	11	0	0	0	0	0	0

** indicates a significant difference, α≤0.1, **≤0.05 between 2010 and 2012*

Cover (m) Shrubs TWINLAKES_06

Species Code	2006	2007	2009	2010	2012	2014	2015
ATTO	5.4	11.3	50.2	66.6	62.8	35.9	51.8
SUMO	30.5	44.8	14.9	13.4	3.4	2.4	2.3
Total	35.9	56.1	65.0	80.0	66.1	38.3	54.1



Land Management Figure 10. Twin Lake Lease RLI-491, Range Trend Transects

5.10.3 Blackrock Lease (RLI-428)

The Blackrock Lease is a cow/calf operation consisting of 32,674 acres divided into 24 management units or pastures. Blackrock is the largest LADWP grazing lease within the LORP area. The pastures/leases on the Blackrock Lease provide eight months of fall through spring grazing, which can begin any time after 60 continuous days of rest. A normal grazing season begins in early to mid-October and ends in mid-May or June.

There are twenty pastures on the Blackrock Lakes lease within the LORP boundary: South Blackrock Holding, White Meadow Field, White Meadow Riparian Field, Reservation Field, Reservation Riparian Field, Little Robinson Field, Robinson Field, East Robinson Field, North Riparian Field, Russell Field, Locust Field, East Russell Field, South Riparian Field, West Field, Wrinkle Field, Wrinkle Riparian Field, Spring Field, Wrinkle Holding, Horse Holding, and North Blackrock Holding. Twelve of these pastures are monitored using range trend and utilization. The other eight pastures are holding pastures for cattle processing or parts of the actual operating facilities. As outlined in the lease management plans, holding pastures, traps, and corrals are not monitored because of their small size and/or their role in operations.

Summary of Utilization

The following tables present the summarized utilization data for each field for the current year.

End of Grazing Season Utilization on the Blackrock Lease, RLI-428, 2015

Fields	Utilization
North Riparian Field*	20%
Horse Holding	0%
Wrinkle Riparian Field*	14%
Locust Field	18%
Reservation Field	20%
Robinson Field	8%
Russell Field	1%
White Meadow Field	3%
White Meadow Riparian Field*	15%
Wrinkle Field	3%
South Riparian Field*	12%
West Field	39%

**Riparian utilization 40% **

Riparian Management Area

Riparian grazing on the Blackrock Lease was below the allowable 40% utilization standard. While conducting utilization monitoring, Watershed Resources Staff noticed an increase in flooded and inundated meadows in the North Riparian Field. Meadow habitat has decreased and stressed the existing woody component located within the riparian area.

Upland Management Areas

Fields in the upland portions of the Blackrock Lease remained well below upland utilization standard of 65%.

Summary of Range Trend Data and Condition Blackrock Lease

Range Trend data was not collected in 2015 on the Blackrock Lease.

Irrigated Pastures

There are no irrigated pastures on the Blackrock Lease.

Stockwater Sites

One new stockwater well will be drilled south of Mazurka Canyon road. It will be fitted with a solar pump and necessary plumbing for the trough. The lessee will be responsible for water troughs and installation. There are also three other stockwater sites that have been developed as part of the *1997 Memorandum of Understanding Between the City of Los Angeles Department of Water and Power, the County of Inyo, the California Department of Fish and Game, the California State Lands Commission, the Sierra Club, the Owens Valley Committee, and Carla Scheidlinger*, (MOU), which required additional mitigation (1600 Acre-Foot Mitigation Projects). The “North of Mazourka Project” will provide stockwater in the Reservation Field and the “Well 368/Homestead Project” will provide stockwater in the Little Robinson Field and East Robinson Field.

Fencing

There was no new fencing constructed on the lease in 2015.

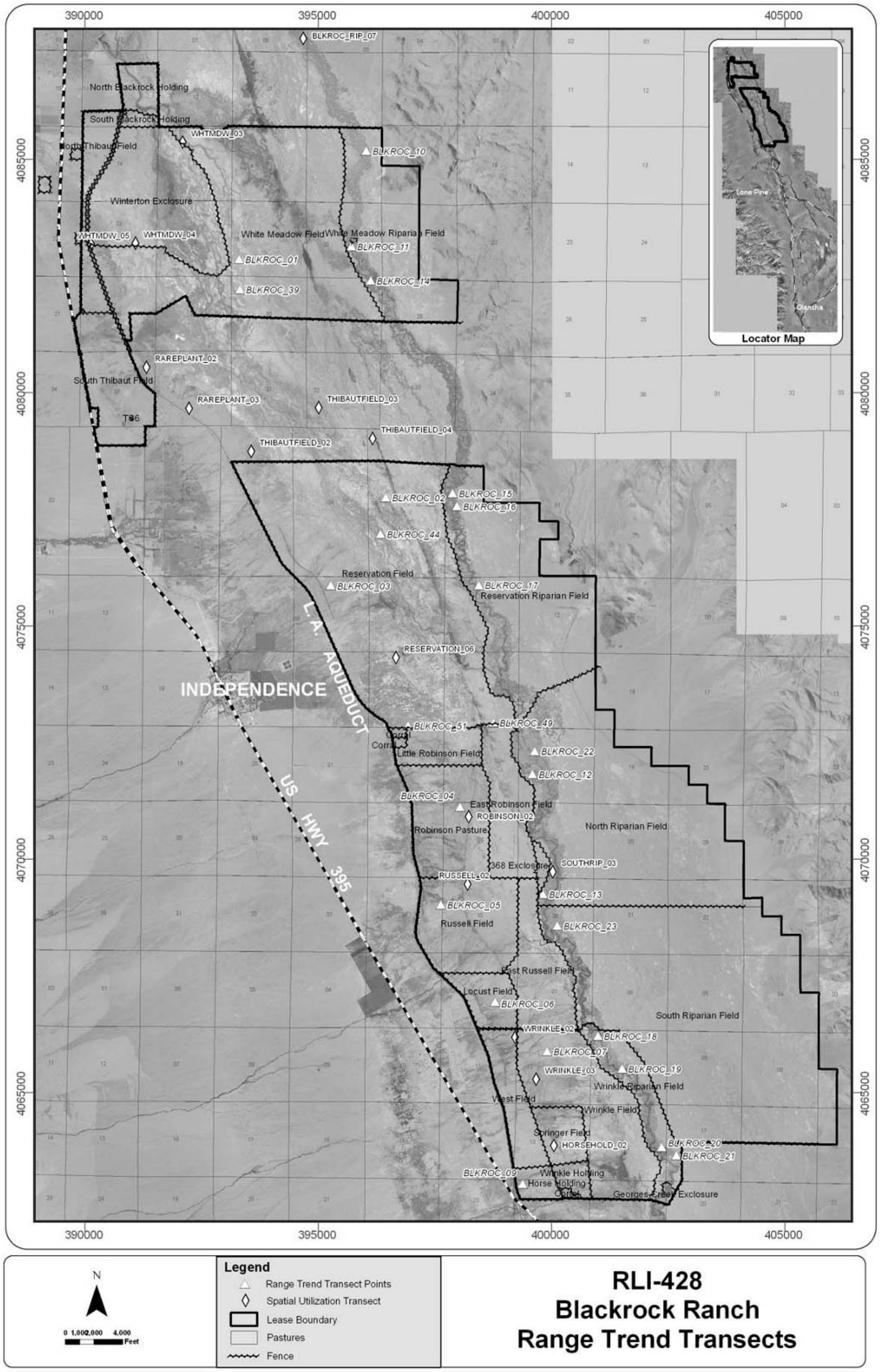
Burning

A range burn was conducted by LADWP of approximately 210 acres in the White Meadow Field. The burn was set up in two units northern and southern. The northern unit (50 acres) was completed. The southern unit was not completed due to a small spot fire that jumped the southern fire break. Due to the fire jumping and increased wind speeds only 7 acres was burned in the southern unit. The results were 57 acres burned with 145 acres remaining. It has not yet been determined if the remaining acreage will be burned in 2016.

Slash pile burning along the river will be conducted is planned for the Blackrock Lease in 2016.

Salt and Supplement Sites

Many of the supplement sites located on the Blackrock Lease have been in place for many years and are located in upland management areas. Some of these sites have been moved in order to adapt to the installation of new fencing. These new locations were selected to better distribute cattle within and near the newly created riparian pastures. A liquid molasses protein is placed in portable feeding stations at these locations.



Land Management Figure 11. Blackrock Lease RLI-428, Range Trend Transects

5.10.4 Thibaut Lease (RLI-430)

The 5,259-acre Thibaut Lease is utilized by three lessees for wintering pack stock. Historically, the lease was grazed as one large pasture by mules and horses. Since the implementation of the LORP and installation of new fencing, four different management areas have been created on the lease. These areas are the Blackrock Waterfowl Management Area, Rare Plant Management Area, Thibaut Field, and the Thibaut Riparian Exclosure. Management differs among these areas. The Blackrock Waterfowl Management Area can be grazed every other year. During the wetted cycle of the Blackrock Waterfowl Management Area management has a utilization standard of 40%. While in dry cycles the utilization standard is 65%. The irrigated pasture portion located in Thibaut Field was assessed using irrigated pasture condition scoring and the upland portions of the field were evaluated using range trend and utilization transects. The Rare Plant Management Area is evaluated using range trend and utilization transects. The Riparian Exclosure has been excluded from grazing for 11 years.

Summary of Utilization

The following table presents the summarized utilization data for each field for the current year.

End of Grazing Season Utilization for Fields on the Thibaut Lease, RLI-430, 2015

Fields	Utilization
Rare Plant Management Area	11%
Thibaut Field	2%
Waterfowl Management Area	32%

Upland Management Areas

The end-of-season use in the Thibaut Field was 2%. Use in the Rare Plant Management Area was 11%, which is well below the allowable utilization grazing standard. The Waterfowl Management Area was grazed to 32% and livestock were removed in December. Watershed Resources allowed the livestock to return in the spring to graze the Waterfowl Management Area to try and control tule growth.

Summary of Range Trend Data and Conditions

Range trend sampling did not occur on this lease in 2015.

Irrigated Pastures

Irrigated Pasture Condition Scores 2011-13

Pasture	2011	2012	2013
Thibaut Field	82%	81%	78%

The northern portion of the Thibaut Pasture (85 acres) comprises the area managed as irrigated pasture for the Thibaut Lease. A result of the completion of the waterfowl management area to the north and the rare plant field to the south is a grazing corridor, which puts heavy pressure on the irrigated pasture. The Thibaut Field was checked in 2014, but not rated. Conditions were similar to 2013 and no evaluations were conducted in 2015 due to drought conditions.

LADWP Watershed Resources staff recommends that livestock be moved out of the area periodically during the grazing season to allow the area to rest. This may be achieved by supplemental feeding further south in the Thibaut Field, or permitting grazing in the Rare Plant Field based on the seven year study which strongly indicates livestock have no effect on the monitored populations.

Stockwater Sites

There is one developed water site in the Thibaut Field, which consists of a flowing well that has a stockwater well drilled next to it, located in the uplands east of the irrigated pastures in the Thibaut Field. Currently, the flowing well is still creating a small wet area for livestock and wildlife. The lessee has also installed a trough near the well.

Fencing

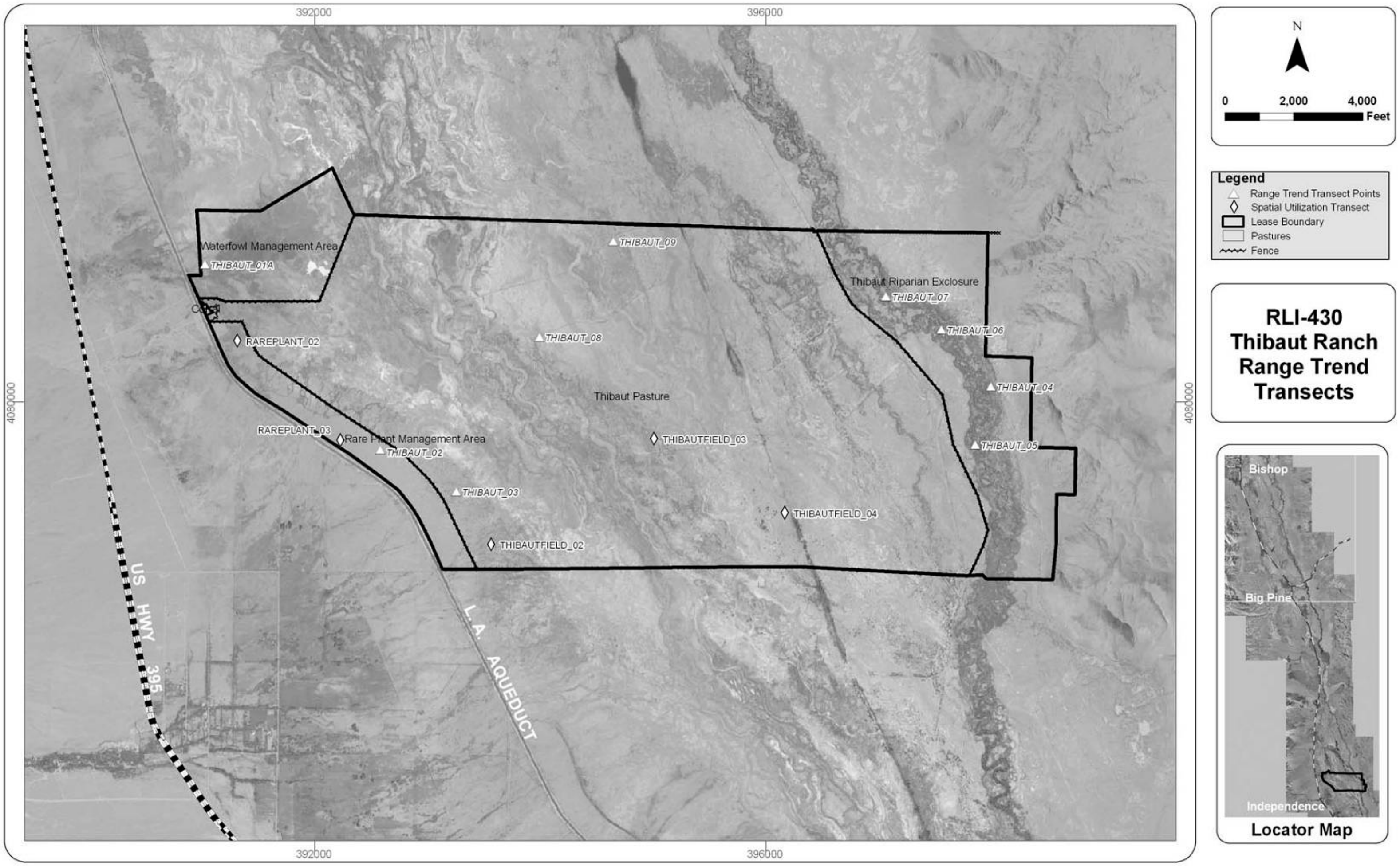
There was no new fence constructed on the lease in 2015.

Salt and Supplement Sites

Hay is spread in locations of the lessees choosing using a truck or a trailer pulled by a truck. Feeding areas had been changed during the 2014-15 grazing season resulting in decreased utilization in the Thibaut Field.

Burning

There were no burns conducted on the lease in 2015.



Land Management Figure 12. Thibaut Lease RLI-430, Range Trend Transects

5.10.5 Islands Lease (RLI-489)

The Islands Lease is an 18,970-acre cow/calf operation divided into 11 pastures. In some portions of the lease, grazing occurs year round with livestock rotated between pastures based on forage conditions. Other portions of the lease are grazed October through May. The Islands Lease is managed in conjunction with the Delta Lease. Cattle from both leases are moved from one lease to the other as needed throughout the grazing season.

There are eight pastures located within the LORP boundary of the Islands Lease:

- Bull Field
- Reinhackle Field
- Bull Pasture
- Carasco North Field
- Carasco South Field
- Carasco Riparian Field
- Depot Riparian Field
- River Field

The Bull Field, Reinhackle Field, and Bull Pasture are spring dominated pastures and are evaluated based on a pasture condition score.

Summary of Utilization

The following tables present the summarized utilization data for each pasture for the current year.

End of Grazing Season Utilization for Fields on the Islands Lease, RLI-489 2015

Fields	Utilization
Carasco Riparian Field*	5%
Depot Riparian Field*	56%
Lubkin Field	16%
River Field *	20%
South Field	0%

**Riparian utilization 40%*

Riparian Management Areas

On the Islands Lease all transects were evaluated, use in the Depot Riparian Field was 56% and the River Field was 20%. Three out of the last four years utilization has exceeded 40% on the Depot Riparian Field. The Depot Riparian Field showed concentration of livestock around transects due to supplemental feeding, which accelerated utilization in the field. This can be seen at the transect level especially ISLAND_09, which had a utilization of 71%. Supplement tubs were also placed on the flood plain which served to amplify grazing impacts on the floodplain. Mid-season utilization was

42% in the Depot Riparian Field and livestock were moved. However, the lack of upland forage and the necessity for the cattle to water at the Owens River caused cattle to walk around the existing drift fence and return to the Depot Riparian Field. Watershed Resources staff recommended extending the drift fence to help eliminate over grazing in the future. The River Field meadows are approximately 85%-90% percent inundated influencing the concentration of cattle in small dry areas. The Carasco Riparian Field and South Field were below the utilization standards.

Upland Management Areas

All upland pastures are well below the allowable 65% utilization rate.

Summary of Range Trend Data in Islands Exclosure

Range trend transects were not sampled in 2015.

Irrigated Pastures

Irrigated Pasture Condition Scores 2011-13

Pasture	2011	2012	2013
B Pasture	X	90%	90%
D Pasture	X	90%	90%

X indicates no evaluation made.

The B and D Pastures located near Reinhackle Spring were rated in 2013 and received an irrigated pasture condition score of 90%. No evaluations were conducted in 2015 due to drought conditions.

Stockwater Sites

There are two stockwater sites located 1-1.5 miles east of the river in the River Field uplands near the old highway. These wells were drilled in 2010 and are now operational. The lessee has not yet installed the water troughs at the wells.

Fencing

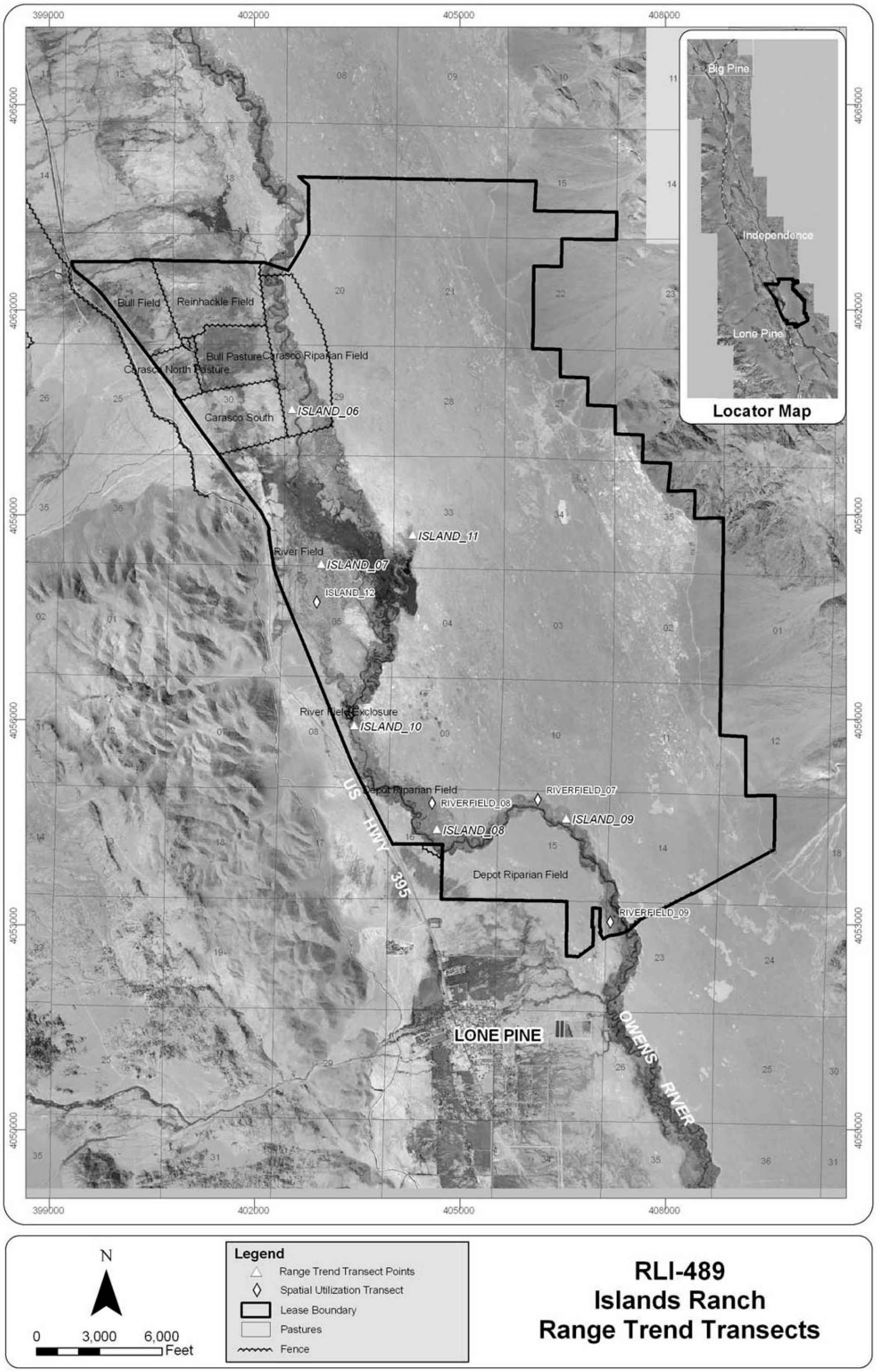
There was no new fence constructed on the lease in 2015.

Salt and Supplement Site:

Cake blocks and molasses tubs that contain trace minerals and protein are distributed for supplement on the lease. The blocks and tubs are dispersed randomly each time and if uneaten they are collected to be used in other areas.

Burning

There were no range burns conducted on the lease in 2015.



Land Management Figure 13. Islands Ranch RLI-489 Range Trend Transects

5.10.6 Lone Pine Lease (RLI-456)

The Lone Pine Lease is an 8,274-acre cow/calf operation divided into 11 pastures and adjacent private ranch land. Grazing on the lease occurs from January 1 to March 30 and then again in late May to early June. In early June the cattle are moved south to Olancha and then driven to Forest Service Permits in Monache.

There are 11 pastures on the Lone Pine Lease located within the LORP project boundary:

- East Side Pasture
- Edwards Pasture
- Richards Pasture
- Richards Field
- Johnson Pasture
- Smith Pasture
- Airport Field
- Miller Pasture
- Van Norman Pasture
- Dump Pasture
- River Pasture

Two of these pastures contain utilization and range trend transects. The remaining nine pastures/fields are irrigated pastures, holding pastures for cattle processing or parts of the actual operating facilities. As outlined in the lease management plans, holding pastures, traps, and corrals are not monitored because of their small size and/or their role in operations. Irrigated pastures are evaluated using the Irrigated Pasture Condition protocol.

Summary of Utilization

The following tables present the summarized utilization data for each pasture for the current year.

End of Grazing Season Utilization for Pastures and Fields on the Lone Pine Lease, RLI-456, 2015

Pastures	Utilization
Johnson Pasture	0%
River Field - Lone Pine*	34%

*Riparian utilization 40%**

Riparian Management Area

The Johnson Pasture had a utilization of 0% below the allowable upland standard of 65%. The River Field utilization was 37%; grazing was high on LONEPINE_3 (49%). Utilization on LONEPINE_3 was discussed while measuring mid-season utilization with the lessee. It will be an ongoing process to reduce utilization on transects. Recovery from the burn in 2013 is continuing; herbaceous vegetation has recovered significantly but tree willow is still in process.

Summary of Range Trend Data

There was a decrease in saltgrass on LONEPINE_06, but this decrease was still within ranges observed previously on the transect. Aside from this one change remaining plant frequencies were static.

LONEPINE_01

This site is in a riparian management area on the west side of the Owens River, just north of Lone Pine Creek in the River Pasture. The soil series associated with the transect is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes, and is on a Moist Floodplain ecological site. During the baseline period from 2002-07, similarity index has ranged between 76% and 79%. Annual aboveground production at this riparian site has exceeded typical quantities found in the Moist Floodplain ecological site description. This site supports four perennial graminoid species and is dominated by saltgrass (*Distichlis spicata* [DISP]). The overall biomass of shrubs is typical for a Moist Floodplain ecological site. No nonnative species were detected at the site. Creeping wildrye (LETR) significantly increased in 2009 and continues to remain stable. All other plant frequencies did not statistically vary when compared to 2009. Shrub cover appears to be decreasing on this site.

Frequency (%), LONEPINE_01

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012	2013	2015
Annual Forb	HEAN3	0	0	0	0	2	0	0	0	0
Perennial Forb	ANCA10	0	0	0	0	2	0	0	0	0
	GLLE3	0	0	0	0	0	0	0	0	0
	MALE3	0	0	0	0	0	0	0	0	0
	PYRA	0	0	0	0	0	0	3	0	3
	SUMO	3	0	0	0	0	0	0	0	0
Perennial Graminoid	DISP	143	133	155	147	136	139	135	150	155
	JUBA	5	4	0	25	13	16	18	10	19
	LETR5	12	29	18	32	50	47	48	49	48
	SPAI	10	13	17	19	14	15	10	12	14
Shrubs	ATTO	2	4	7	3	3	0	0	0	0
	ERNA10	0	0	4	0	0	0	0	0	0

** indicates a significant difference, α≤0.1, **≤0.05*

Cover (%) Shrubs LONEPINE_01

Species code	2003	2004	2007	2009	2010	2012	2013	2015
ATTO	7.1	5.2	4.7	1.8	3.0	3.2	2.9	2.8
ERNA10	2.2	2.6	2.1	0.0	0.1	0.7	0.6	0.8
SUMO	0.1	0.0	0.8	0.0	0.0	0.0	0.0	0.4
Total	9.5	7.8	7.5	1.8	3.0	3.8	3.5	4.0

LONEPINE_02

This site is in a riparian management area on the west side of the Owens River, east of the Lone Pine Dump in the River Pasture. The soil series is Torrifluvents-Fuvaquentic Endoaquolls complex, 0-2% slopes, and is on a Moist Floodplain ecological site. The similarity index ranged between 65% and 87% from 2002 to 2007. The site is in excellent condition. The site is grass-dominated with saltgrass comprising the bulk of the biomass. Saltgrass frequency significantly increased in 2009, outside its historic range from 2002-07 and in 2010-12 returned to levels typically observed on the site. Saltgrass again increased in 2015. No nonnative species were detected at the site.

Frequency (%), LONEPINE_02

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012	2013	2015
Annual Forb	2FORB	0	0	0	0	0	0	0	0	0
	ATPH	0	0	0	0	0	0	0	0	0
Perennial Forb	ANCA10	0	0	0	0	0	0	0	0	0
	PYRA	0	0	0	0	0	0	4	2	0
	STEPH	0	0	0	0	0	0	0	0	0
Perennial Graminoid	DISP	146	125	142	143	164	141	152	132	160**
	JUBA	9	13	20	17	14	15	15	14	0
	LETR5	0	0	0	3	0	1	4	1	0
	SPAI	65	78	65	64	52	65	69	48	0**
Shrubs	ATTO	0	0	3	0	0	0	0	0	0
	ERNA10	0	1	4	3	1	2	3	0	0

** indicates a significant difference, α≤0.1, **≤0.05*

Cover (m) Shrubs LONEPINE_02

Species code	2003	2004	2007	2009	2010	2012	2013	2015
ATTO	2.2	2.2	0.6	0.9	0.0	1.0	0	0
ERNA10	2.1	3.3	1.8	2.4	2.0	3.3	0	0
Total	4.3	5.5	2.4	3.3	2.0	4.3	0	0

LONEPINE_03

This site is in a riparian management area on the west side of the Owens River in the River Pasture. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes, and is on a Moist Floodplain ecological site.

The similarity index has ranged between 74% and 87% during sampling periods between 2002-07, indicating the site is in excellent condition. Site production has exceeded expectations based on the ecological site description in all years of sampling. The site is grass-dominated with saltgrass comprising the bulk of the biomass and creeping wildrye closely reaching the potential described for the site at 13% in 2007. Frequency for creeping wildrye increased significantly in 2009 and remained significantly higher in 2010 when compared to all sampling periods during the baseline period. There were no changes in frequency for all species between 2009 and 2012. Overall shrub cover is minimal. No nonnative species were detected at the site. This site, based on the ecological site description and frequency trends, is stable and in excellent ecological condition. Utilization on this transect was 63%. However this seems to have no effect on the site's ecological condition.

Frequency (%), LONEPINE_03

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012	2013	2015
Annual Forb	2FORB	0	1	0	0	0	0	0	0	0
	HEAN3	0	2	1	0	0	0	5	0	0
Perennial Forb	ANCA10	0	0	0	3	0	7	10	7	7
	GLLE3	12	0	7	0	5	3	2	3	7
	HECU3	0	0	0	0	0	0	0	2	1
	MALE3	7	3	5	2	5	3	0	5	0
	PYRA	7	0	0	0	0	0	0	0	3
Perennial Graminoid	DISP	151	148	152	152	142	137	137	130	169**
	JUBA	39	59	52	41	43	34	42	29	37
	LETR5	34	33	31	34	52	48	54	26	30
	SPAI	9	0	10	5	4	4	5	0	0
Shrubs	ATTO	14	2	13	0	1	3	0	0	0
	ERNA10	0	0	2	0	4	1	0	0	0

** indicates a significant difference, α≤0.1, **≤0.0*

Cover (m) Shrubs LONEPINE_03

Species Code	2003	2004	2007	2009	2010	2012	2015
ATTO	13.5	13.4	6.0	0.8	4.9	5.6	0
ERNA10	2.0	2.7	0.6	2.7	0.6	0.2	0
SAVE4	0.0	0.0	0.0	3.6	0.0	0	0
Total	15.5	16.1	6.6	7.2	5.5	5.8	0

LONEPINE_04

This site is in a riparian management area on the west side of the Owens River in the River Pasture. The transect is located at the edge of the floodplain and currently incorporates a portion of the transition zone to upland vegetation. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes at the beginning of the transect and transitions to the Mazourka-Eclipse complex, 0-2% slopes. The transition in ecological sites is from Moist Floodplain to a Sodic Terrace. Because of the mixed soils and associated ecological sites found across the transect evaluating trend for this site will concentrate on changes on trend rather than how well the site matches ecological site descriptions.

The similarity index has ranged widely between 59% and 73% from 2002-07. Site production has generally been less than potential based on the ecological site description for a Moist Floodplain site. When compared to the Moist Floodplain ecological site description, the site has less than the expected biomass of forage species such as creeping wild rye and Baltic rush (*Juncus balticus* [JUBA]). This is explained by the transition from mesic conditions on the Moist Floodplain to more xeric conditions of the uplands which results in a decreasing abundance of creeping wildrye, Baltic rush, and riparian trees and the disproportionate amount of alkali sacaton which can better thrive in both the mesic and xeric transitional zones. The site is grass-dominated with saltgrass and alkali sacaton comprising the bulk of the biomass. The shrub component of the site is dominated by rubber rabbitbrush (*Ericameria nauseosa* [ERNA10]). As flows on the Lower Owens continue, soil moisture may rise toward the upland zone of the transect and future changes in species composition may be observed. However, frequency data indicates that there is an inverse trend, with decreasing saltgrass, and increasing alkali sacaton which is typical for gradient in zones moving from wet to dry areas. No nonnative species were detected at the site. The site remained static in 2015.

Frequency (%), LONEPINE_04

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012	2013	2015
Annual Forb	2FORB	0	0	1	0	0	0	0	0	0
	ATPH	0	29	12	0	0	10	0	0	0
Perennial Forb	ANCA10	5	7	8	8	7	6	6	4	5
	MACA2	0	0	0	0	0	2	0	0	0
	NIOC2	3	0	0	2	2	0	0	0	2
	STEPH	5	0	11	0	5	0	0	0	0
	SUMO	3	4	6	2	3	0	0	0	3
Perennial Graminoid	DISP	105	101	114	97	88	77	87	88	99
	JUBA	15	18	25	11	15	15	23	14	4
	LETR5	0	0	0	0	0	0	0	0	2
	SPAI	48	63	56	69	79	84	72	60	59
Shrubs	ATCO	0	0	4	0	0	0	0	0	0
	ATTO	0	2	0	0	0	0	0	0	0
	ERNA10	0	2	0	0	0	0	0	0	0
	MACA17	0	0	0	4	0	0	0	1	0
Nonnative Species	BAHY	0	0	0	0	2	0	0	0	0

** indicates a significant difference, $\alpha<0.1$, **<0.05 when compared to prior sampling period.*

Cover (m) Shrubs LONEPINE_04

Species code	2003	2004	2007	2009	2010	2012	2013	2015
ATCO	0.1	0.5	0.0	0.0	0.0	0.4	0.0	0.0
ATTO	0.0	0.0	0.0	10.0	0.2	0.0	0.0	0.0
ERNA10	2.3	2.1	4.5	1.1	1.0	1.4	0.0	0.0
SUMO	12.4	1.0	0.0	0.0	1.3	1.9	0.0	0.8
Total	14.8	3.6	4.5	11.1	2.5	3.6	0.0	0.8

LONEPINE_05

This site is in an upland management area in the Winnedumah fine sandy loam, 0-2% slopes soil series which is associated with a Sodic Fan ecological site, just east of the Lone Pine Airport in the Johnson Pasture. In 2004, the site flooded and was not sampled. An increase from 0 to 14 juvenile *Salix exigua* species in 2007 is evidence of this flooding.

The similarity index has ranged between 69% and 77% between 2002-07. Nevada saltbush (*Atriplex torreyi* [ATTO]) has trended down over time. Frequency of saltgrass significantly increased in 2009 and decreased in 2010 to similar levels to that seen during the baseline period. In 2015, alkali sacaton and saltgrass have dramatically declined. Shrub cover has also decreased significantly in 2015. This site was flooded between 2004-05. The subsequent decline in plant frequency and cover is a result of the area drying out.

Frequency (%), LONEPINE_05

Life Forms	Species	2002	2003	2007	2009	2010	2012	2015
Annual Forb	ATSES	0	3	0	0	0	0	0
	ATTR	0	3	0	0	0	0	0
	ERPR4	0	0	3	0	0	0	0
	LACO13	0	0	5	0	0	0	0
	COCA5	0	0	0	0	0	4	0
Perennial Forb	ARLU	0	0	5	0	0	0	0
	GLLE3	36	26	49	29	37	43	40
	MALE3	15	11	16	8	0	7	1
Perennial Graminoid	ARPU9	0	0	5	0	0	0	0
	DISP	34	40	23	42	24	26	10**
	JUBA	7	4	1	0	3	0	0
	SPAI	53	69	73	77	71	73	39**
Shrubs	ATTO	43	40	24	21	13	9	8
	SAEX	3	0	16	8	4	9	9
	ARTR2	0	0	0	0	2	0	0
Nonnative Species	BAHY	0	16	0	0	0	0	0

** indicates a significant difference, α≤0.1, **≤0.05*

Cover (m) Shrubs LONEPINE_05

Species code	2003	2007	2009	2010	2012	2015
ATTO	32.8	28.9	9.6	13.2	13.4	6.6
SAEX	1.5	14.5	21.1	1.5	4.0	1.9
Total	34.4	43.3	30.8	14.7	17.4	8.5

LONEPINE_06

This site is in a riparian management area on the east side of the Owens River in the River Pasture. This monitoring transect is located inside a riparian exclosure, constructed in February 2009. Over time the site will be used as a non-grazed reference site. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes on a Moist Floodplain ecological site. Last spring (2015) the exclosure was compromised and livestock entered and grazed the exclosure. The fence has since been repaired and extended further into the river.

The similarity index has ranged between 66% and 84% between 2003 and 2007. Site production has varied during the baseline period from above to below the expected based on the ecological site description. Compared to the potential outlined in the ecological site description, this site lacks the forb and woody riparian species component. The forage base is dominated by saltgrass and alkali sacaton. Other forage species such as creeping wild rye and Baltic rush are lacking at this site. One nonnative species, Bassia, has been detected at the site. Frequency results in 2010 indicated that trend continues to be static. There was a significant decrease in salt grass in 2012. The exclosure was completed in February 2009. Alkali sacaton, following the 2013 fire was at its all-time low while in 2015 both alkali sacaton and saltgrass have increased to its highest level seen. Utilization is not estimated because the site is now inside a livestock grazing exclosure.

Frequency (%), LONEPINE_06

Life Forms	Species	2003	2004	2005	2007	2009	2010	2012	2013	2015
Perennial Forb	ANCA10	0	0	0	5	3	0	0	0	0
Perennial Graminoid	DISP	124	136	132	149	145	147	130	145	154
	JUBA	0	0	0	0	0	0	0	0	12
	SPAI	25	28	29	16	20	16	16	3	42**
Nonnative Species	BAHY	0	0	5	0	0	3	0	0	0

** indicates a significant difference, α≤0.1, **≤0.05*

Cover (m) Shrubs LONEPINE_06

Species Code	2003	2004	2005	2007	2009	2010	2012	2015
ATTO	0.5	0.6	0.4	0.5	1.4	1.2	1.5	0
SUMO	0.1	0.3	0.2	0	0	0	0	0
Total	0.5	0.8	0.6	0.5	1.4	1.2	1.5	0

LONEPINE_07

This site is in a riparian management area on the east side of the Owens River in the River Pasture. This site was first established in the summer of 2007. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes on a Moist Floodplain ecological site.

The similarity index was 60% in 2007. Site production was similar to that expected based on the ecological site description. There is a low diversity of perennial graminoids as the only species detected was saltgrass while other forage species such as alkali sacaton and creeping wild rye are lacking on the transect but are present in the area. The biomass of forbs and riparian woody species is less than expected as compared to the desired plant community. No nonnative species were detected at the site. Baseline utilization is not available for this site since it was not established until the summer of 2007. Between 2007 and 2015 frequency has not changed significantly on the site.

Frequency (%), LONEPINE_07

Life Forms	Species	2007	2009	2010	2012	2013	2015
Perennial Graminoid	DISP	150	157	160	151	140	157*

** indicates a significant difference, α≤0.1, **≤0.05*

LONEPINE_08

This site is in a riparian management area on the east side of the Owens River in the River Pasture. This site was first established in the summer of 2011. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes on a Moist Floodplain ecological site. The only change which has occurred has been an increase in *Scirpus americanus.*

Frequency (%), LONEPINE_08

Life Forms	Species	2012	2013	2015
Annual Forb	2FORB	0	4	0
	HEAN3	0	7	0
Perennial Forb	ANCA10	3	83	74
	NIOC2	3	0	0
Perennial Graminoid	CADO2	0	1	0
	CAREX	0	0	5
	DISP	155	144	140
	JUBA	0	0	5
	SCAM6	0	22	37**

Irrigated Pastures

Irrigated Pasture Condition Scores 2011-13

Pasture	2011	2012	2013
Edwards	X	X	84
Richards	X	X	84
Van Norman	X	X	84
Smith	X	X	84
Old Place	X	X	84

X indicates no evaluation made

The irrigated pastures within the LORP project area for the Lone Pine Lease are the Edwards, Richards, Smith, Old Place, and Van Norman Pastures. All of the pastures were rated in 2013 and were above the required minimum irrigated pasture condition score of 80%, despite a dry year and lack of irrigation water. No evaluations were conducted in 2015 due to drought conditions.

Stockwater Sites

One stockwater well was drilled on the Lone Pine Lease located in the River Pasture uplands approximately two miles east of the river on an existing playa. The lessee had made an effort to install a trough but the well had a silting problem that plugged the pipes and floats. Watershed Resources staff and pump mechanics assessed the condition of the well and determined that the well was not drilled deep enough and is not operable. A new well location has been selected a quarter of a mile south of the current location and is planned to be drilled in 2016.

Fencing

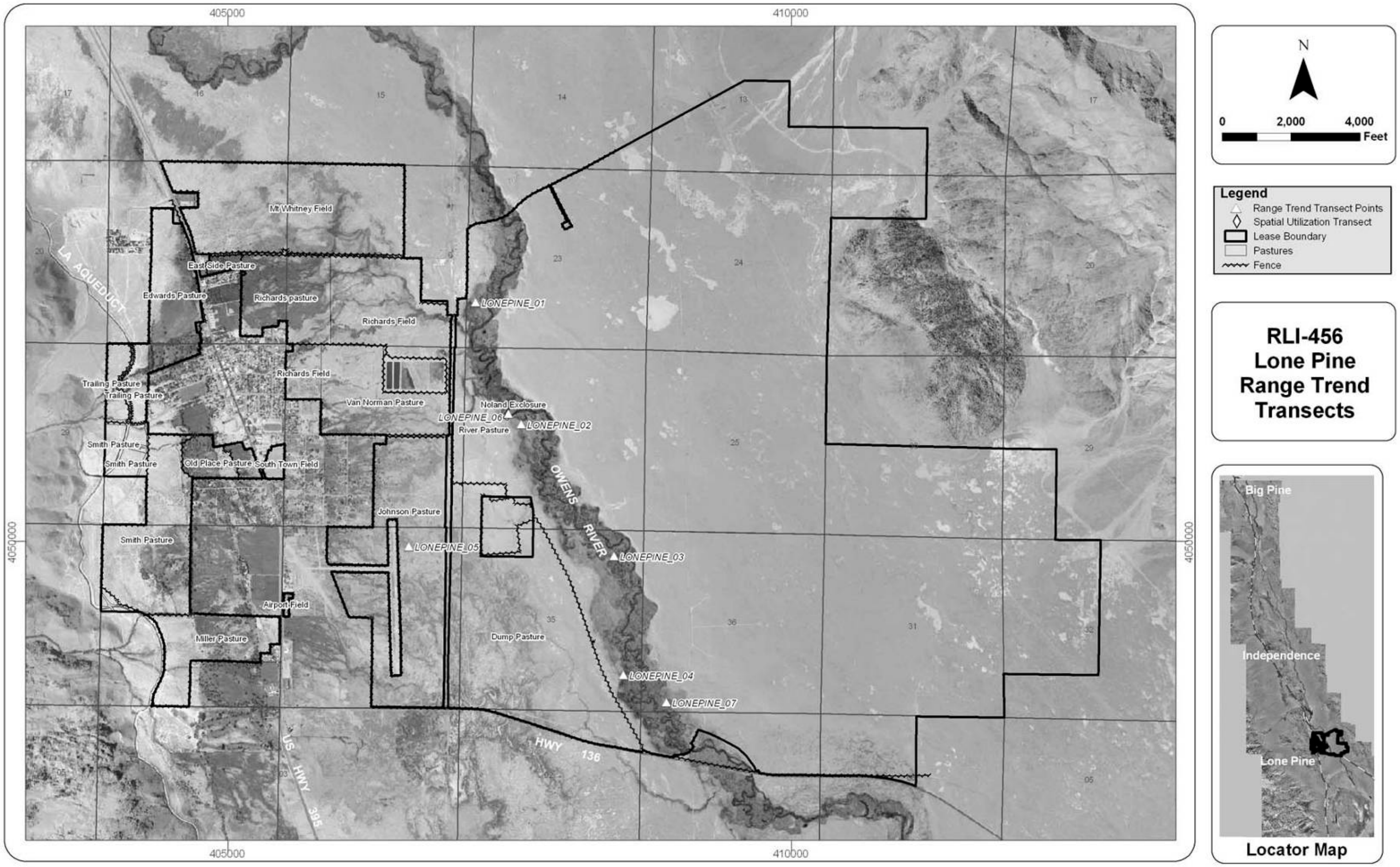
There was no new fencing constructed on the lease during 2015. Repairs have been made to the existing exclosure due to the fire in February.

Salt and Supplement Site:

All supplement tubs were situated outside of the flood plain.

Burning

There were no burns conducted on the Lone Pine lease in 2015.



Land Management Figure 14. Lone Pine Lease RLI-456, Range Trend Transects

5.10.7 Delta Lease (RLI-490)

The Delta Lease is a cow/calf operation and consists of 7,110 acres divided into four pastures. There are four fields located with the LORP project boundary: Lake Field, Bolin Field, Main Delta Field, and the East Field. Grazing typically occurs for 6 months, from mid-November to April. Grazing in the Bolin Field may occur during the growing season. The Delta and Islands Leases are managed concurrently with California State Lands Commission leases.

Grazing utilization is currently only conducted in the Bolin Field and Main Delta Field which contains the Owens River. The Lake Field is evaluated using irrigated pasture condition scoring. The East Field, located on the upland of Owens Lake, supports little in the way of forage and has no stockwater.

Summary of Utilization

The following tables present the summarized utilization data for each field for the current year.

End of Grazing Season Utilization for Fields on the Delta Lease, RLI-490, 2015

Fields	Utilization
Main Delta Field*	41%
Bolin Field	5%

*Riparian utilization 40%**

Riparian Management Areas

RLI-490 end-of-season utilization in the Main Delta was at the allowable 40% utilization standard. The transect data shows that use was fairly even due to an improvement in the livestock distribution in this field. Utilization on transects DELTA_5, 6, 7 was high averaging over 60% this increased the overall utilization in the Main Delta Field. Watershed Resources staff recommends moving the livestock and supplemental feeding to the north periodically during the grazing season.

Upland Management Areas

The Bolin Field was 5%, well below the upland grazing utilization prescription of 65%. Due to drought conditions forage production in this field has dropped, as a consequence grazing was light in the field.

Summary of Range Trend Data and Conditions

Range Trend data was not collected in 2015 on the Delta Lease. Data was collected on the lease in 2013 and will be revisited again in 2016.

Irrigated Pastures

Irrigated Pasture Condition Scores 2011-13

Pasture	2011	2012	2013
Lake Field	X	X	74

X indicates no evaluation made

The Lake Field is located west of U.S. Highway 395 north of Diaz Lake. This irrigated pasture was evaluated in 2013 and received a score of 74%. This is below the allowable score of 80%. The main reason of the decreased condition of this pasture is decreased coverage of water spreading over the field water due to drought conditions. Watershed Resources staff does not believe that change is necessary at this time. There were no irrigated pasture evaluations conducted in 2015. Irrigated pasture evaluations will resume once an average or normal water year occurs, that will allow for normal irrigation.

Stockwater Sites

The Bolin Field was supposed to receive a stockwater site supplied by the Lone Pine Visitors Center's well in 2010. After a more in-depth analysis of water availability, it was determined that there was not an adequate amount of water to sustain both uses. The resulting analysis has stockwater being supplied from a diversion that runs from the LAA. The status of this stockwater situation has not changed in 2015.

Fencing

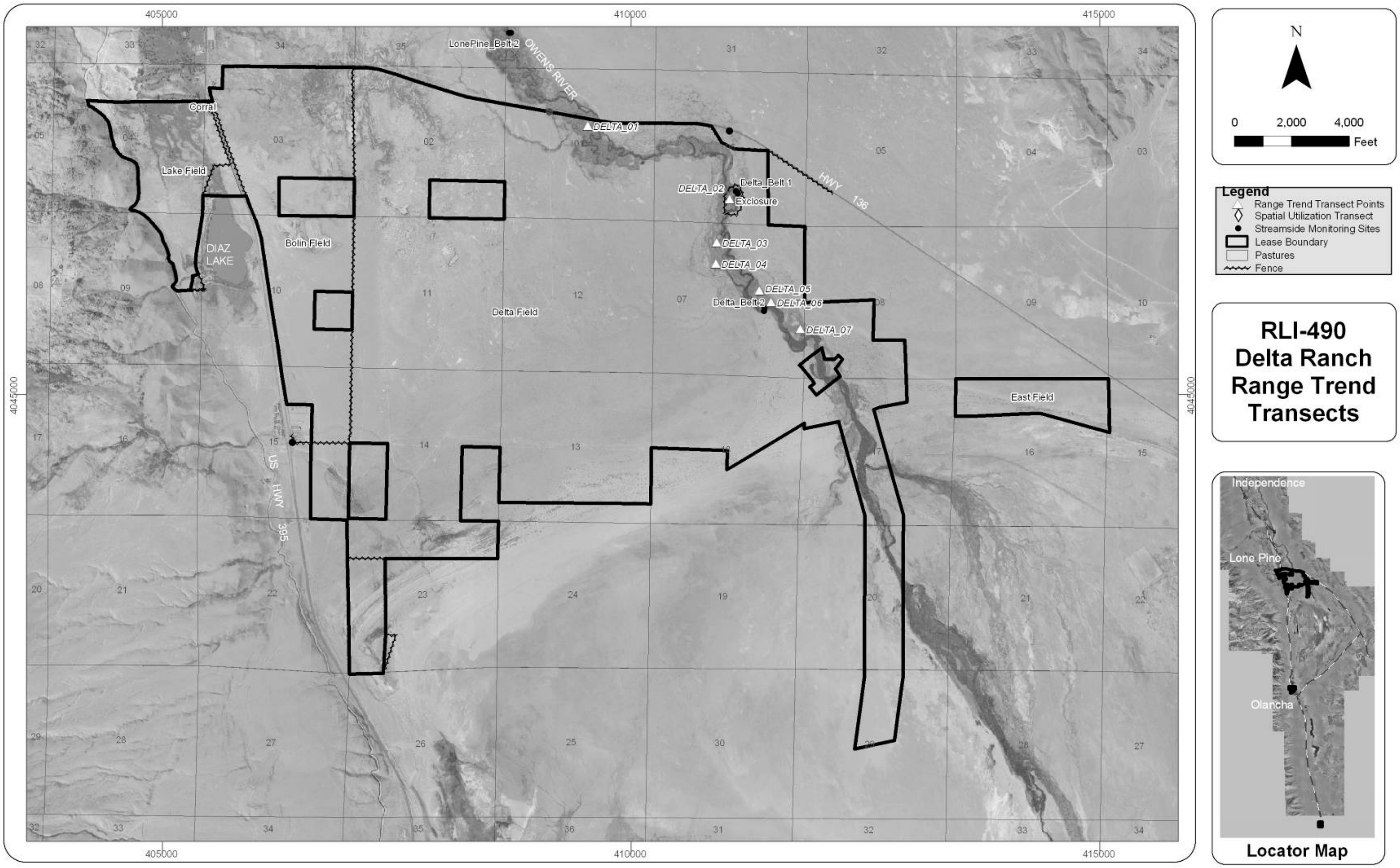
There was no new fencing on the lease for 2015.

Salt and Supplement Sites

Supplement tubs containing protein and trace minerals are used in established supplement sites. Empty tubs are collected by the lessee.

Burning

There were no burns on this lease during 2015.



Land Management Figure 15. Delta Lease RLI-490, Range Trend Transects

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6.0 RAPID ASSESSMENT SURVEY

Prepared by Inyo County Water Department

Lower Owens River Project
2015 Rapid Assessment Survey

Observations

Owens River at Lone Pine c. 1905

Lower Owens River Project
Summary of Rapid Assessment Survey Observations

A survey of the Lower Owens River Project (LORP) area, referred to as the Rapid Assessment Survey or RAS, is conducted annually beginning in August. This year, between August 3 and August 12, Inyo County staff with a representative from LADWP surveyed along the wetted edges of the water features in the LORP. These areas include the Lower Owens River, Blackrock Waterfowl Management Area (BWMA), Off-River Lakes and Ponds (OLP), and the Delta Habitat Area (DHA). The observations recorded during this exercise are presented in this report.

The primary purpose of the RAS is to detect and record the locations of problems that can negatively affect the LORP. These are impacts that require physical maintenance such as repairing a damaged or cut fences, trash pickup, tamarisk slash pile removal, and herbicide treatment of noxious weeds.

Project managers and scientists also use RAS data as rough indicators of basic trends in the ecological development of the riparian and riverine environments, especially when RAS data is compiled with information gathered from other LORP studies. For example, RAS observations of woody recruitment can be considered along with river-edge belt transects, which are intended to look in greater detail at woody recruitment. The combined observations can help project managers understand how and where woody recruitment is taking place, and if it is persisting.

The observations recorded during the RAS are categorized by type and observation code in Table 1. The number of observations by impact type and LORP area are presented in Table 2.

Table 1. Catalog of impacts recorded by the RAS

Observation Code	Observation Type	Description
WDY	Woody Recruitment	This year's cohort of willow and cottonwood seedlings
TARA	Saltcedar	*Tamarisk* spp. seedlings, resprouts from previously treated plants and mature trees.
ELAN	Russian Olive	*Elaeagnus angustifolia*, seedlings and juveniles (height <1m).
NOX	Noxious Weeds	Any of twenty-one species of locally invasive plants, mainly perennial pepperweed
BEA	Beaver	Sightings or evidence of beaver in the LORP
ELK	Elk	*Cervus canadensis* ssp. *nannodes*, sightings or evidence of tule elk
FEN	Fence	Reports of damaged riparian or exclosure fencing
GRZ	Grazing	Evidence of (off-season) grazing in the floodplain.
REC	Recreational Impacts	Evidence of recreational activity and any adverse associated impacts
ROAD	Road	Previously unidentified roads, road building activities, or roads causing impacts
TRASH	Trash	Large refuse or dumping
SLASH	Slash	New piles of recently cut saltcedar slash
OBSTR	Obstructions	Obstructions to river flow
Other	Other	Other impacts

Table 2. Summary of observations collected by category and area; including Blackrock Waterfowl Management Area (BWMA); Off-River Lakes and Ponds (OLP); and the Delta Habitat Area (DHA).

Code	Observation Type	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	BWMA	OLP	DHA	Total Obs.
WDY	Woody Recruitment	1	22	17	0	0	1	6	10	3	60[1]
TARA	Saltcedar Plants (Tamarisk)	10	95	55	20	8	16	63	74	18	359
ELAN	Russian Olive Recruitment	0	1	0	0	0	1	10	40	0	52
NOX	Noxious Weeds (Lepidium)	17	20	6	0	0	0	18	0	0	61
BEA	Beaver	0	3	6	0	2	0	0	0	0	11
ELK	Elk	2	14	5	2	14	29	1	2	1	70
FEN	Fence	0	1	1	0	1	0	1	1	0	5
GRZ	Grazing	0	0	3	3	0	0	1	0	0	7
REC	Recreation Impacts & Use	0	0	11	0	3	5	0	1	0	20
ROAD	Road	1	1	2	0	0	5	0	1	0	10
TRASH	Trash	0	2	1	0	0	4	4	0	1	12
SLASH*	Slash	0	1	0	0	0	0	0	1	0	2
OBST	Obstructions	0	6	0	0	0	0	0	0	0	6
OTHER	Other	0	0	0	0	0	0	2	0	0	2

[1] 51 of the 60 woody recruits discovered were clone derived narrowleaf willow (SAEX).

<u>River-reaches and LORP units</u>--*Table 3*

The Lower Owens River is divided up in to six river-reaches, which are defined by channel/ floodplain morphology, and hydrologic variables (Table 3, and "River-reaches and river-miles map"). For the RAS summary, these reaches offer a convenient way to describe a position on the river, and they serve as a common reference for RAS observations taken year to year. Further, individual observations in the river-riparian corridor are often referenced to the nearest tenth of a river-mile (RM). The Lower Owens River Intake is river-mile 0.0, the pumpback station is at river-mile 53.1, the Delta Habitat Area begins at river-mile 53.7, and the river fades into the Owens Lake playa near river-mile 62.0.

When comparing the number of observations found per river-reach, it is important to note that the lengths of the reaches are unequal. For example, most of woody recruitment observations are recorded in river-reaches 2, 3, and adjoining Blackrock Waterfowl Management Area and off-river lakes and ponds which together encompass about half of river-miles in the entire river-riparian corridor. The number of observations by reach for the various categories has not been normalized to account for the different lengths of the reaches.

Table 3. River reaches: comparisons of reach length, and river type.

	Percent of river length	**Total River-miles (RM)**	**Mile Markers**	**Description**
Reach 1	7%	4.2	0 to 4.2 RM	Wet Incised Floodplain
Reach 2	25%	15.6	4.2 to 19.8 RM	Dry Incised Floodplain
Reach 3	24%	15.1	19.8 to 34.9 RM	Wet Incised Floodplain
Reach 4	6%	3.9	35.0-38.8 RM	Aggraded Wet Floodplain
Reach 5	7%	4.2	38.8 to 43.0 RM	Wet Incised Floodplain
Reach 6	17%	10.7	43.0 to 53.7 RM	Graded Wet Floodplain
Delta Habitat Area (DHA)	13%	8.3	53.7 to 62.0 RM	Delta

Map 1. Lower Owens River Reaches/Off-River Management Units

Summary of Observations by Category

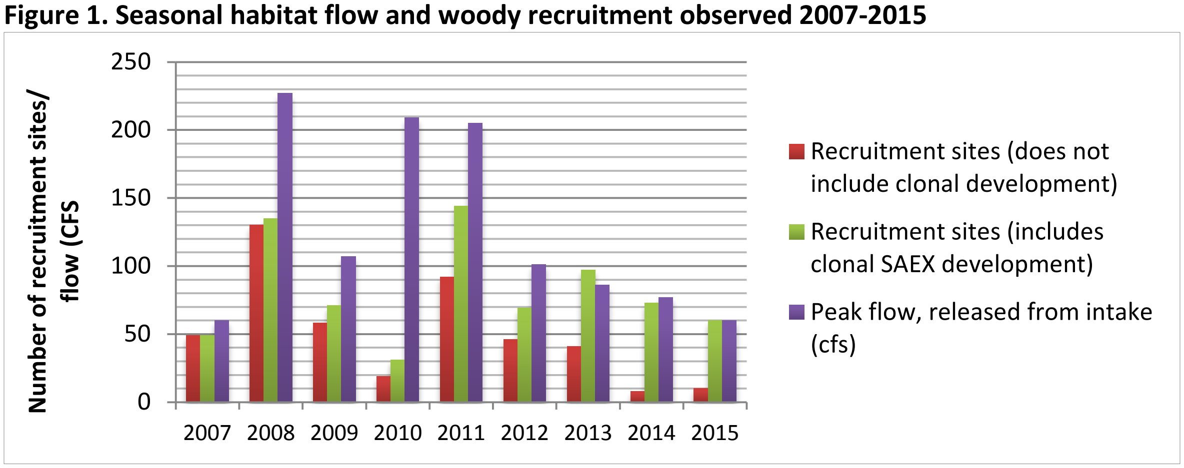
Woody Recruitment (WDY)--*Tables 4-6; Map 2; Figure 1*

Willows and cottonwood provide the vertical structural and diverse natural habitats that are essential to attracting many of the riverine/riparian avian habitat indicator species. These species are key indicators of the project's success. A focus of the RAS has been to identify areas where trees were establishing in the newly wetted areas of the LORP. RAS field staff is trained on how to locate, identify, and record willow and cottonwood recruits that are part of the current year's cohort. It's important to note that the recording and reporting of woody recruitment was often not consistent prior to 2011. The definition of a "woody recruit" for purposes of the RAS was not consistently handled until 2012. Prior to 2010, clonal reproduction of shrub willow (SAEX) by root sprouting was not differentiated from seed derived recruitment of tree willow, resulting in an over reporting of recruitment. In 2011, criteria were established to distinguish sexual from asexual SAEX development.

Notes:

- In 2015, observers located eight tree willow recruits, one cottonwood recruit and one seedling SAEX recruit.
- All of the tree willow recruitment was located in the river-riparian corridor while the single cottonwood recruit was in an off-river lake (Map 2).
- 50 observations of clonal reproduction of narrowleaf willow (SAEX) were concentrated in the upper reaches and off-river locations of the LORP.

Figure 1. Seasonal habitat flow and woody recruitment observed 2007-2015



Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
Recruitment sites (does not include clonal development)	49	130	58	19	92	46	41	8	10
Recruitment sites (all recruitment inc. SAEX clonal development)	49	135	71	31	144	69	97	73	60
Peak flow, released from intake (cfs)	60	227	107	209	205	101	86	77	60

There was no SHF in 2007, 2014, or 2015. The 2008 SHF was released in February. Flows shown 2013-2015 represent maximum flows released from the Intake in the mid-summer to compensate for ET losses and maintain a >40cfs flow throughout the river.

Table 4. Number of distinct recruitment or clonal development sites by species and reach

Species Code	Common Name/ Scientific Name	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	BWMA	OLP	Total
SAEX Seed	Narrowleaf willow/ *Salix exigua*	0	1	0	0	0	0	0	0	0	**1**
SAEX Clone	Narrowleaf willow/ *Salix exigua*	1	17	15	0	0	0	3	5	9	**50**
SAGO	Black willow/ *Salix goodingii*	0	4	1	0	0	0	0	1	0	**6**
SALA3	Red willow/ *Salix laevigata*	0	0	1	0	0	1	0	0	0	**2**
SALIX	Tree species, hybrid, or unknown willow	0	0	0	0	0	0	0	0	0	**0**
POFR2	Fremont Cottonwood/*Pop ulus fremontii*	0	0	0	0	0	0	0	0	1	**1**
Total number of Observations		**1**	**22**	**17**	**0**	**0**	**1**	**3**	**6**	**10**	**60**

Table 5. Plant abundance at recruitment sites

Species Code	Common Name	Abundance (number of plants per site)			
		1 to 5	6 to 25	26 to 100	>100
SAEX	Narrow leaf willow	1	0	0	0
SAGO	Black willow	4	1	1	0
SALA3	Red willow	1	0	1	0
SALIX	Hybrid or unknown	0	0	0	0
POFR2	Fremont Cottonwood	1	0	0	0

Table 6. Distribution of woody recruitment relative to landforms

Species Code	Common Name	Channel	Channel to Bank	Bank	Channel to Floodplain	Floodplain	Upland
SAEX Seed	Narrow leaf willow	0	0	1	0	0	0
SAEX Clone	Narrow leaf willow	0	3	21	2	24	1
SAGO	Black willow	0	0	2	0	4	0
SALA3	Red willow	0	0	1	1	0	0
POFR2	Cottonwood	0	0	1	0	0	0

The RAS is conducted in August to be able to detect seedlings that may have germinated as the result of the annual LORP seasonal habitat flow (SHF), which is timed to accompanying willow seed-fly. Although there has not been a significant seasonal habitat flow since 2011, typically higher flows are released from the intake in mid-summer to compensate for downstream losses due to evapotranspiration. This is necessary in order to maintain a minimum 40 cfs flow throughout the river. These higher flows and resulting increase in stage especially in the upper two reaches may inundate low landforms and effect the survival of recruits.

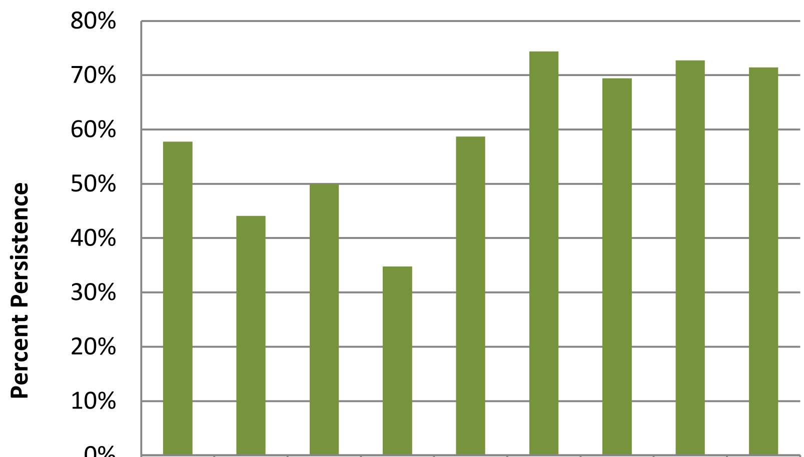
<u>Sites Revisited</u>--*Map 9*

Field crews returned to specific sites where woody recruitment, new roads, and evidence of beaver were recorded in the previous year and noted the presence or absence of the subject. A total of 25 sites were revisited. The results from these revisits are found in this report in corresponding category sections.

All-Years Woody Recruitment Revisits--*Table 7a, 7b; Map 9 (2014 revisits)*

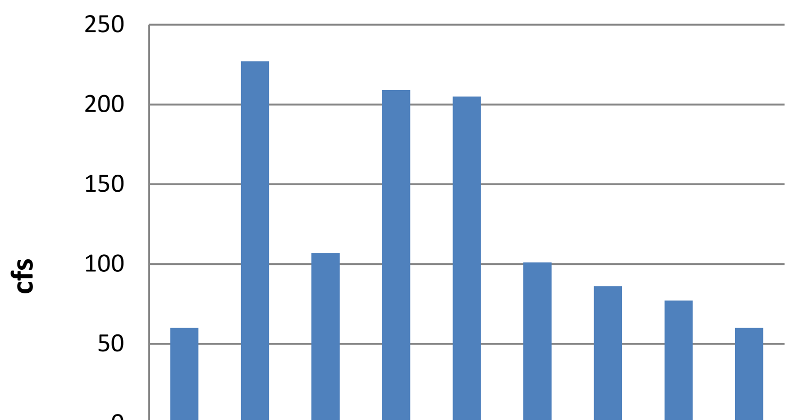
A survey of all recorded tree recruitment sites from 2007 to 2015 was undertaken in September 2015. This was done in order to get a perspective on the long-term persistence of tree willow and cottonwood found along the Owens River and Delta. Factors that are felt to influence persistence include flooding that could drown out new recruits. A graph of maximum flows released from the intake is presented for reference.

Table 7a. Revisit sites: persistence of tree species recruitment from 2007-2015 found in 10/2015 survey



	2007	2008	2009	2010	2011	2012	2013	2014	2015
% persistance	58%	44%	50%	35%	59%	74%	69%	73%	71%

Table 7b. Maximum flows released from the Owens River Intake Station 2007-2015



	2007	2008	2009	2010	2011	2012	2013	2014	2015
Intake Peak Release (cfs)	60	227	107	209	205	101	86	77	60

Saltcedar (TARA)--*Tables 8,9,10; Map 3*

Saltcedar (*Tamarix* spp.) is found throughout the LORP. It is the most abundant noxious weed in the project area. In 2015, TARA was found at 204 locations on the river and at 155 off-river sites. These locations were provided to the ICWD saltcedar program coordinator. Inyo County will begin working to remove TARA in the Blackrock Waterfowl Management Area (BWMA) unit and Off-River Lakes and Ponds (OLP) in 2015. LADWP will continue to treat TARA in the Delta Habitat Area.

Notes:

- Compared to 2014, TARA observations decreased in all river reaches, except for a small increase in reach 1.
- Overall, less TARA was found this year than in the previous five years. Since 2011 TARA observations on the river have declined (Table 10) and the numbers of individuals at each site have declined as well. The majority of TARA found along the river in 2015 were smaller/thinner plants (less than 4 inches in diameter).
- According to reports from 2007-2009, TARA observations on the river and off-river sites were on order of 600-700 each year. However, the protocol for recording TARA has varied. The modifications included different treatment for recording mature plants, and the addition of an abundance category. TARA observations for 2007-2009 are not included in the Table 10 due to this inconsistency.
- In 2015, all TARA in off-river locations was recorded, but this was not the case in 2012-2014, because heavy concentrations of TARA in the off-river lakes and ponds made counting individual plants infeasible.
- TARA levels remain high in the BWMA and Off-river Lakes and Ponds areas.
- In the Delta, fewer TARA were observed in 2015 compared to earlier years.

Table 8. Total number of observation sites and age class of saltcedar by location in 2015

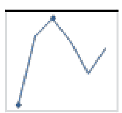
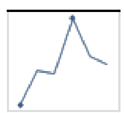
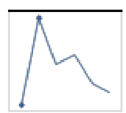
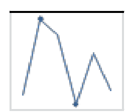
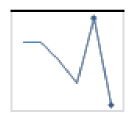
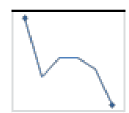
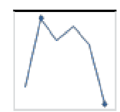
Age Class	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	BWMA	OLP	Total
Seedlings	3	38	6	1	0	3	0	3	5	**59**
Resprouts	1	0	33	8	5	10	16	19	31	**123**
Mature	6	57	16	11	3	3	2	41	38	**177**

Table 9. Saltcedar abundance by river-reach or LORP unit in 2015

	Abundance (number of plants per site)				
Location	**1 to 5**	**6 to 25**	**26 to 100**	**>100**	**Total no. of sites**
BWMA-Drew	4	4	2	0	**10**
BWMA-Thibaut	2	1	0	0	**3**
BWMA- Waggoner	8	5	3	2	**18**
BWMA-Winterton	23	7	1	1	**32**
Delta Habitat Area	15	3	0	0	**18**
Off River – Billy	6	2	1	0	**9**
Off River – Goose	27	14	1	4	**46**
Off River – Twin	10	1	3	5	**19**
Reach 1	9	1	0	0	**10**

Reach 2	80	11	4	0	**95**
Reach 3	46	8	1	0	**55**
Reach 4	11	8	1	0	**20**
Reach 5	8	0	0	0	**8**
Reach 6	16	0	0	0	**16**
Frequency of abundance	**265**	**65**	**17**	**12**	**359**

Table 10. Saltcedar Observations by River Reach in years 2010-2015

Year	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Total
2010	1	46	45	18	34	89	**233**
2011	12	88	119	57	34	40	**350**
2012	15	84	80	49	27	56	**311**
2013	11	152	88	13	17	55	**336**
2014	6	106	64	39	44	46	**305**
2015	10	95	55	20	8	16	**204**
2010-2015 Trend							

Russian Olive (ELAN)--*Table 11; Map 4, 4a*

Although Russian olive (*Elaeagnus angustifolia*) is not listed as a noxious weed in California, the California Invasive Plant Council considers this species highly invasive in riparian systems. All mature ELAN plants along the river and adjacent management units of the LORP have been recorded in prior years. Documenting seedling or juvenile ELAN is the current focus (height less than 1 m). Most of the current recruitment is occurring in off-river sites, e.g., Drew Slough, Thibaut Ponds, Billy, Goose and Twin Lakes.

Table 11. Russian Olive (ELAN) abundance at observation sites, by LORP unit or river reach

Location	Abundance (number of plants per site)				
	1 to 5	6 to 25	26 to 100	>100	Total no. of sites
BWMA-Drew	3	2	1	0	**6**
BWMA-Thibaut	0	4	0	0	**4**
BWMA- Waggoner	0	0	0	0	**0**
BWMA-Winterton	0	0	0	0	**0**
Delta Habitat Area	0	0	0	0	**0**
Off River – Billy	3	0	0	0	**3**
Off River—Goose/Twin	14	10	10	2	**36**
Reach 2	1	0	0	0	**1**
Reach 6	1	0	0	0	**1**
	22	**16**	**11**	**2**	**51***

*Abundance not recorded in one observation

As shown in Map 5, ELAN is concentrating primarily in the Blackrock management area, rather than spreading throughout the LORP or along the river. As illustrated in Map 5a, most of the new recruitment is occurring within or adjacent to existing ELAN sites.

Noxious Weeds (NOX)--*Table 12; Map 5, 5a*

Perennial pepperweed (*Lepidium latifolium*, LELA2) continues to be found within the LORP.

Notes:

- Sixty-one populations of LELA2 were recorded in 2015, compared to 25 in 2014. As shown in Map 5a, population expansion is outward from previously reported LELA2 populations.
- LELA2 is concentrated in the northern part of the LORP with most populations found in reaches 1 and 2 and Winterton unit of the Blackrock Waterfowl Management Area. LELA2 is also present along the river outside the project area north of the Intake.
- Reach 3 populations appear to be stable and not expanding.
- Each year all observations of LELA2 with coordinates are provided to the Weed Management group in the Inyo County Agricultural Commissioner's office following completion of the RAS.
- Observers noted that 23 of the 61 observations appeared to have been treated recently. The majority of the untreated sites were on east side of river. The Inyo Agricultural Commissioner maintains records of annual treatments. Their records indicated that 30 of the reported 61 sites for 2015 were already within larger areas being monitored and treated. A report on their work can be found as a separate section in the LORP Annual Report.
- LELA2 sites reported during the 2015 RAS were previously treated by Inyo County Weed Management between 8/20/2015 and 9/1/2015.

Table 12. *Lepidium latifolium* (LELA2) abundance at observation sites, by LORP unit or river reach

	Abundance categories (number of plants/location)				
Location	**1 to 5**	**6 to 25**	**26 to 100**	**> 100**	**Total**
BWMA – Winterton	5	4	4	5	**18**
Reach 1	4	8	5	0	**17**
Reach 2	5	9	5	1	**20**
Reach 3	1	3	1	1	**6**
Totals	**15**	**24**	**15**	**7**	**61**

Beaver Activity (BEA)--*Map 6*

Beaver activity and evidence was noted at eleven locations. Beaver or beaver evidence was found at six locations last year.

Notes:

- Six sightings in reach 3, three sightings in reach 2, and two sighting in reach 5.
- Seven sites where beaver were found in previous years were revisited; four of the sites were not found. Ponded water and dams were still present at two of the sites, but no recent activity was evident.

Dead Fish (DFISH)

Note:

- No dead fish were recorded.

Elk--*Map 6*

Notes:

- Evidence of elk, or direct sightings (n=5), were noted at 70 locations; 45 fewer than in 2014. More than half were seen in reach 5 and 6.
- The majority of observations were browse or antler rub or both.

LORP Riparian Fence (Observation Code: FEN)--*Map 7*

Staff surveyed exclosure fencing as well as riparian pasture fences.

Note:

- Five records were made of damaged fences in the LORP.

Grazing Management (GRZ)--*Map 7*

Notes:

- Cattle feed stations were found in three locations in the floodplain.
- Cattle were reported in three locations in reach 3 uplands/floodplain. An estimated 70 head were seen in the reach 4 floodplain.

Recreation (REC)--*Map 8*

Twenty discrete impacts associated with recreation, as evidenced by litter, fire rings, trails, and off-road vehicle use impacts. Recreation impacts recorded in 2015 decreased from 75 observations in 2014. Recreation evidence was most abundant near roads, and in the Lone Pine area.

Notes:

- Litter (beverage containers, shotgun shells, fishing gear) was the most frequently observed evidence of river recreation use.
- Three fire rings were noted.
- Resource damage from off road use of vehicles and motorcycles was concentrates in reaches 5 and 6.

Roads (ROAD)--*Map 7*

All roads, or vehicle trails that were not present in 2005, or changes in roads were recorded. There were ten observations, slightly higher than 2014 total of eight.

Notes:

- One-half of the roads were in and distributed through the length of reach 6.
- Most of the roads (80%) were infrequently or rarely used.
- Of the eight roads found in 2014, four were still receiving some use.

Trash--*Map 7*

Observers were asked to record large trash items. Appliances, bathtub, tires, metal, pipe and fencing materials were among materials recorded at 12 locations compared to 26 in 2014.

Tamarisk Slash (SLASH)

Note:

- One pile of new slash was recorded at Goose Lake and a second in the floodplain adjacent to an oxbow in reach 2. Slash at Goose Lake also included ELAN.

River Obstructions (OBST)--*Map 7*

Note:

- Six obstructions consisting of dead vegetation, mainly dead Bassia and cattails.

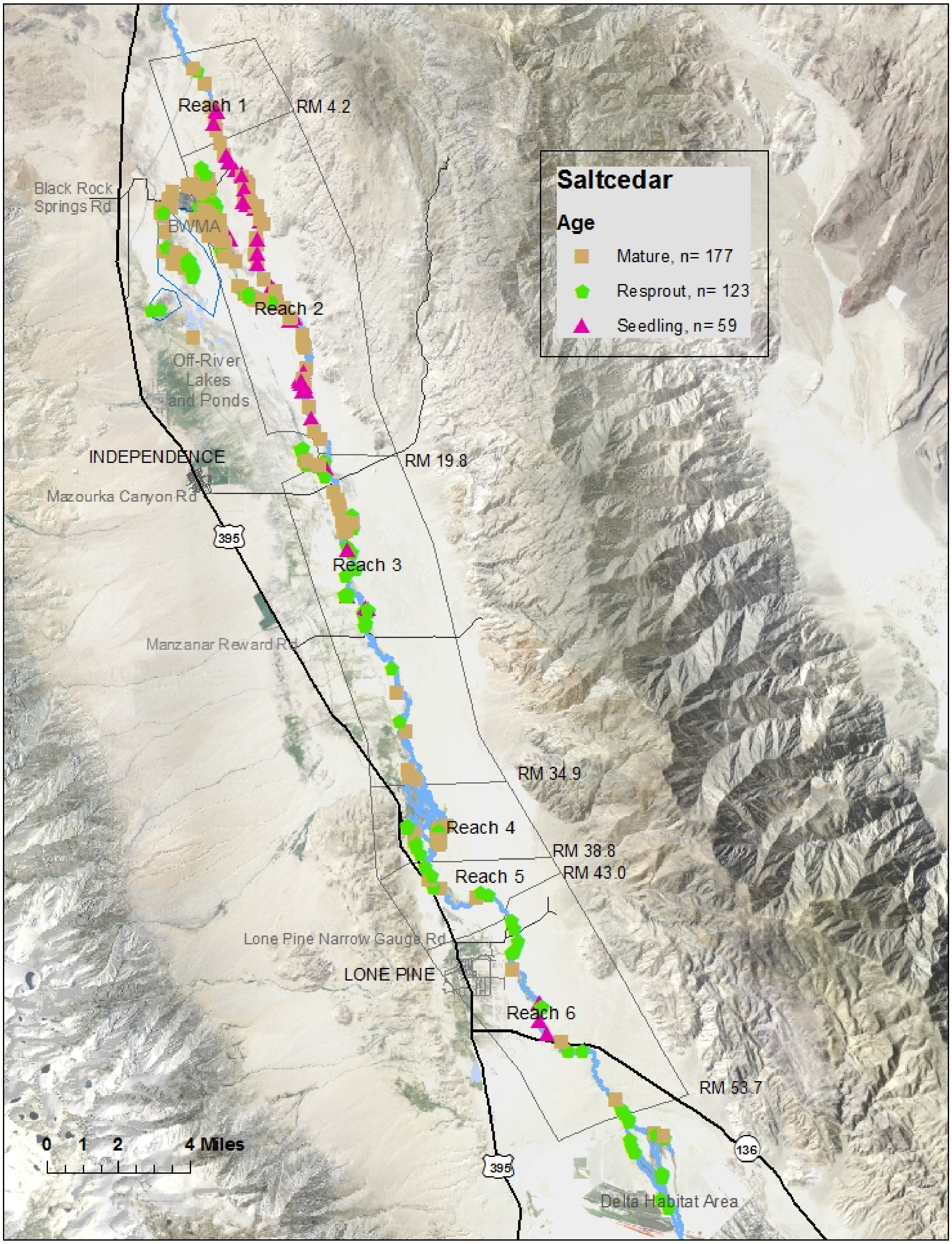
Other--*Map 7*

Note:

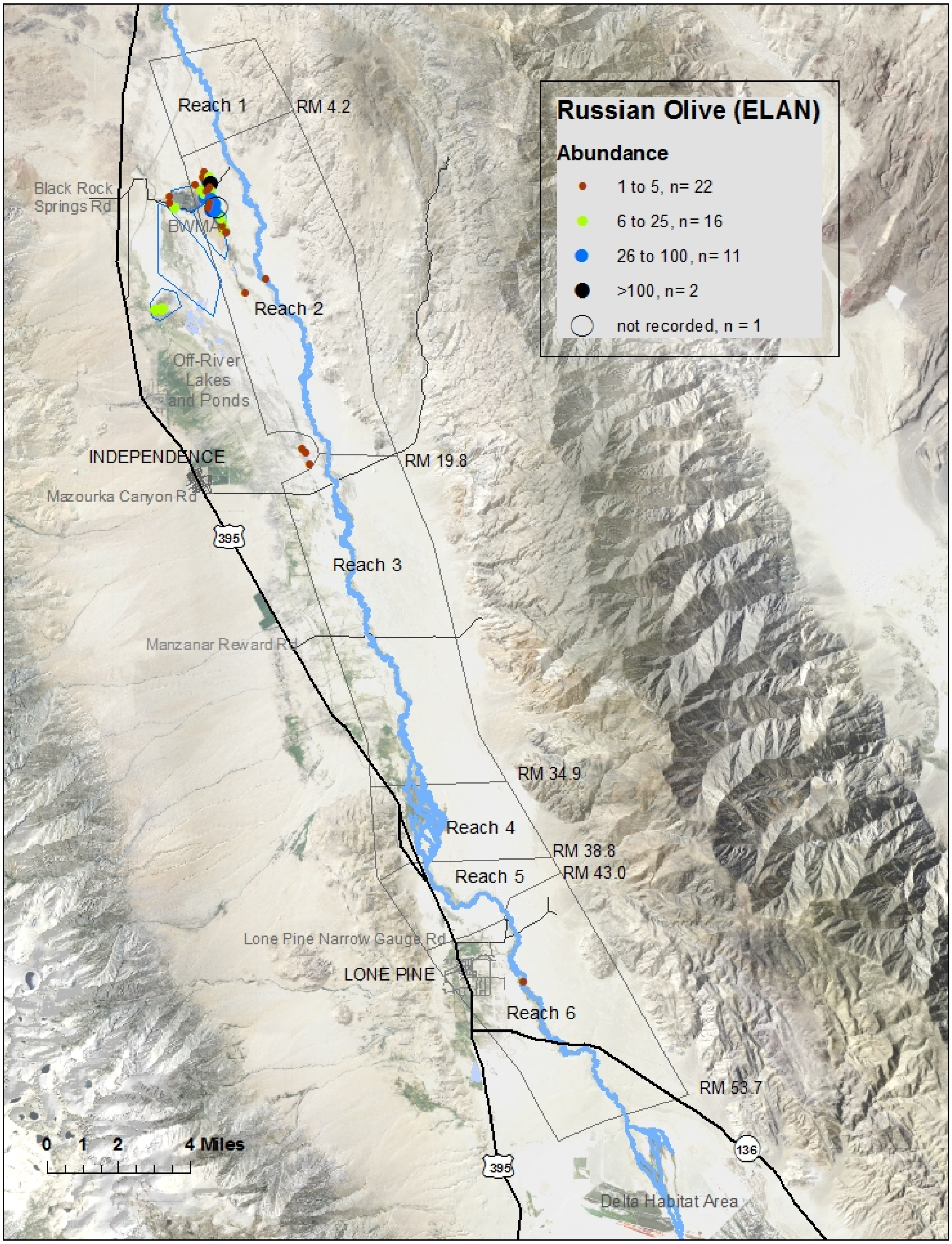
- Observer noted Bassia covering large areas within Thibaut Ponds in Blackrock Waterfowl Management Area.

Map 2. Woody Recruitment

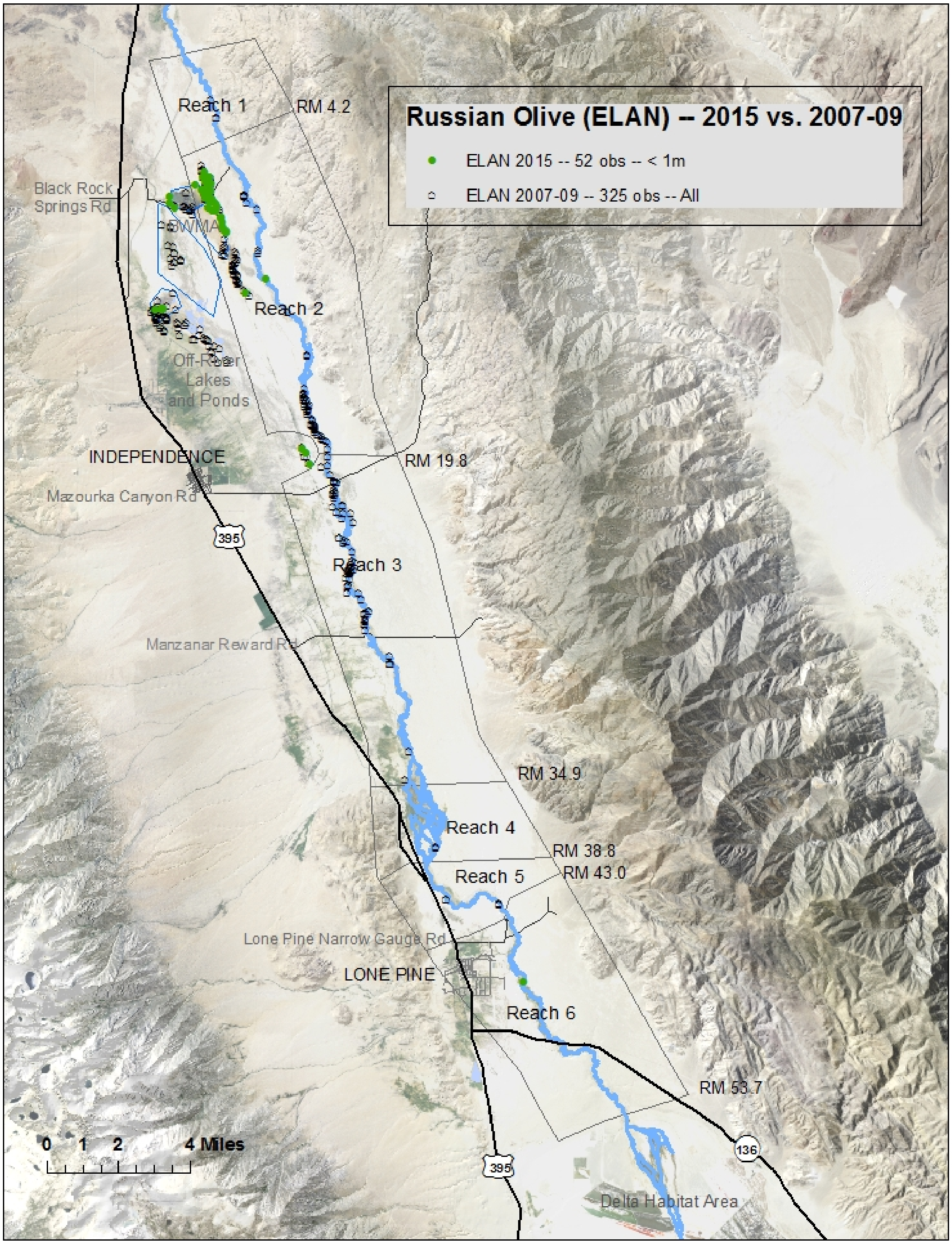
Map 3: Saltcedar



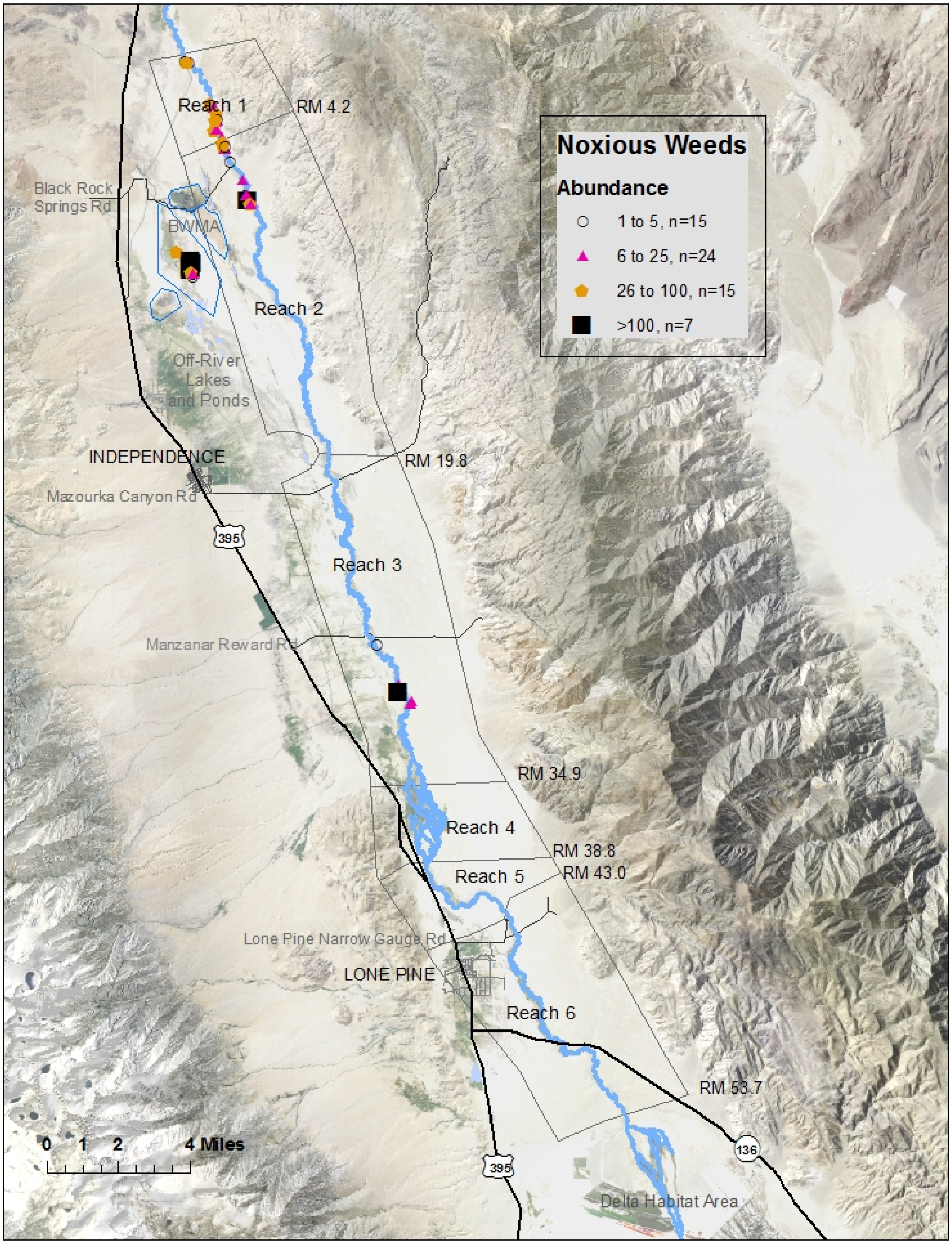
Map 4: Russian Olive Recruitment, *Elaeagnus angustifolia* (ELAN)



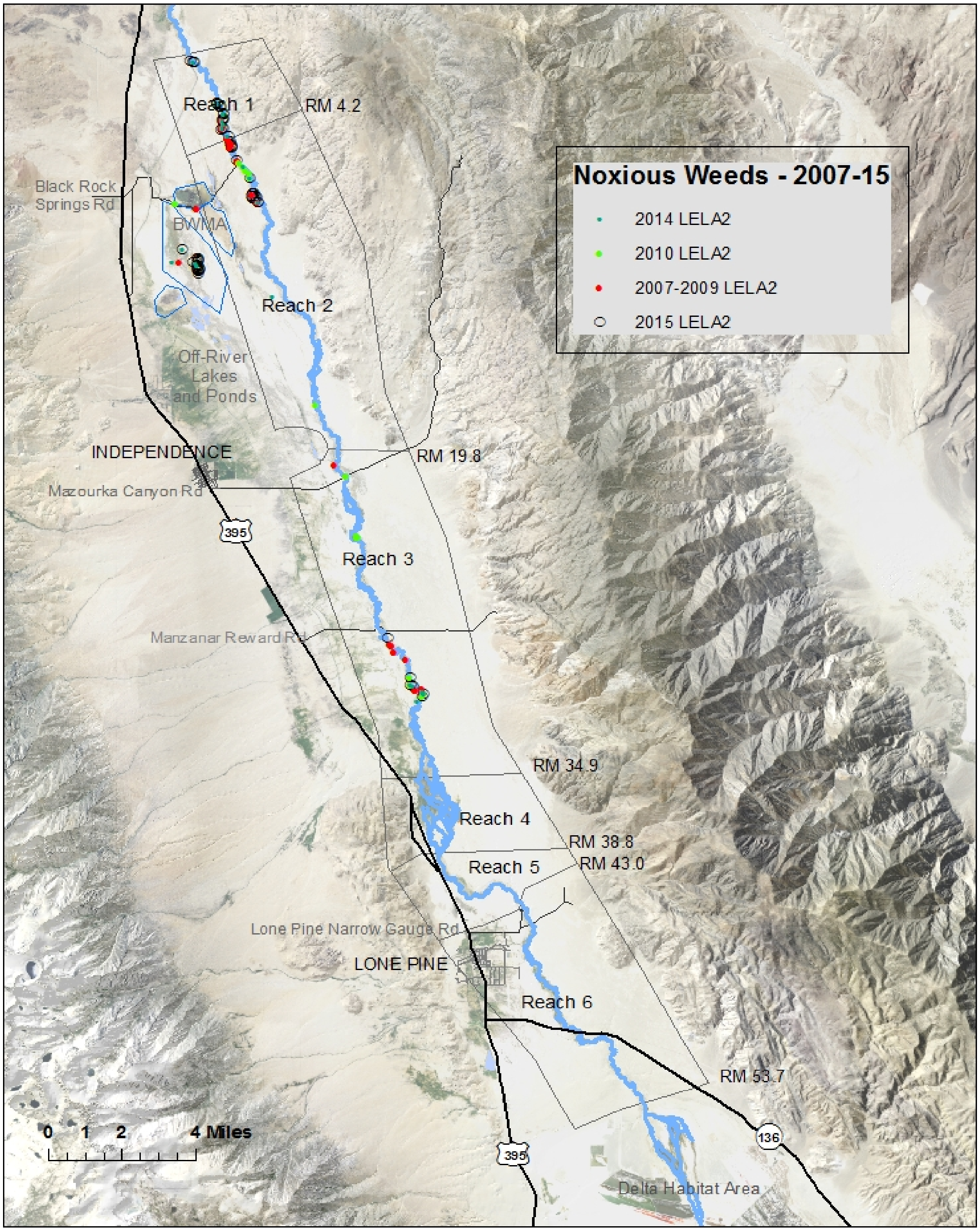
Map 4a: Russian Olive Recruitment, *Elaeagnus angustifolia* (ELAN)



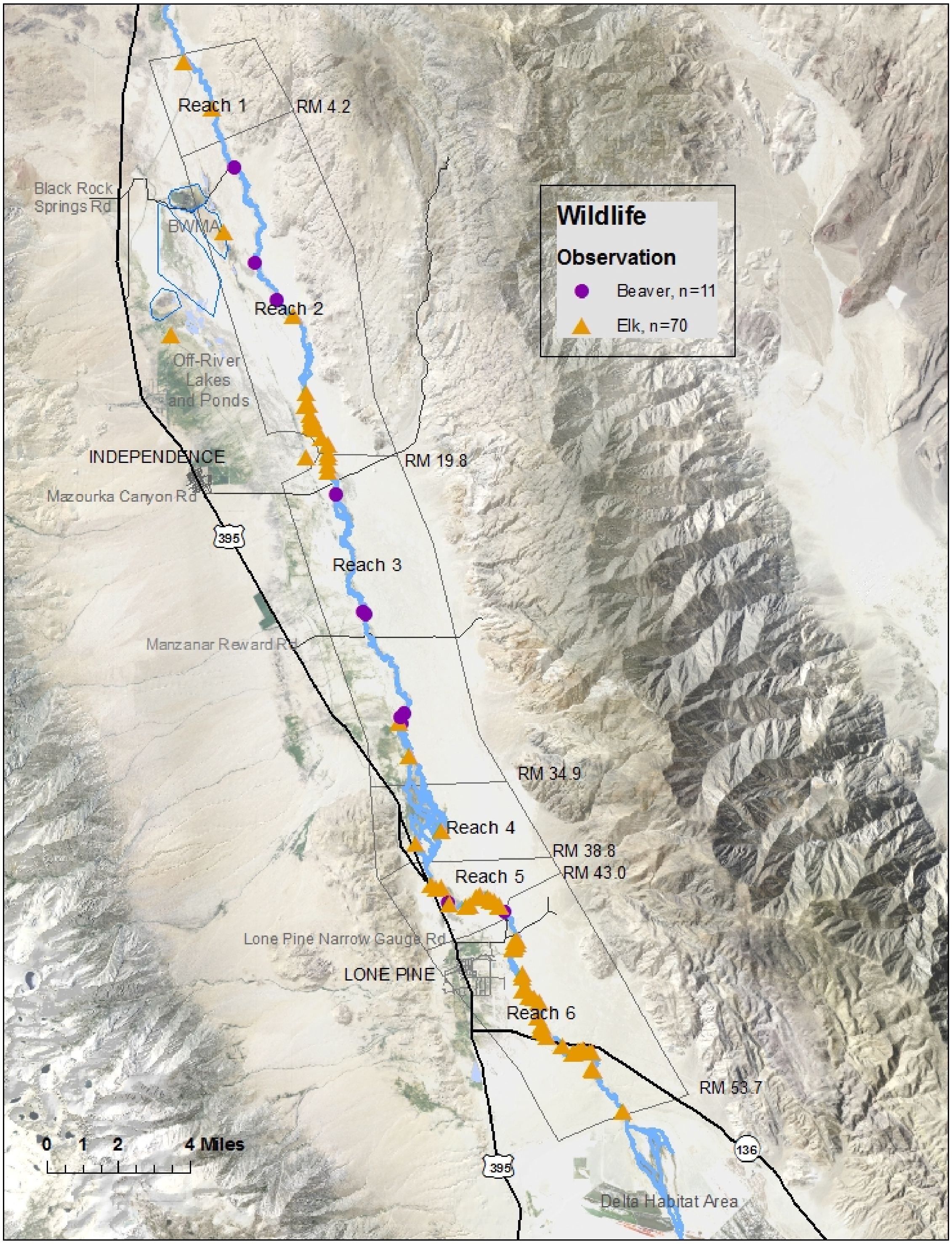
Map 5: Perennial Pepperweed, *Lepidium latifolium* (LELA2)



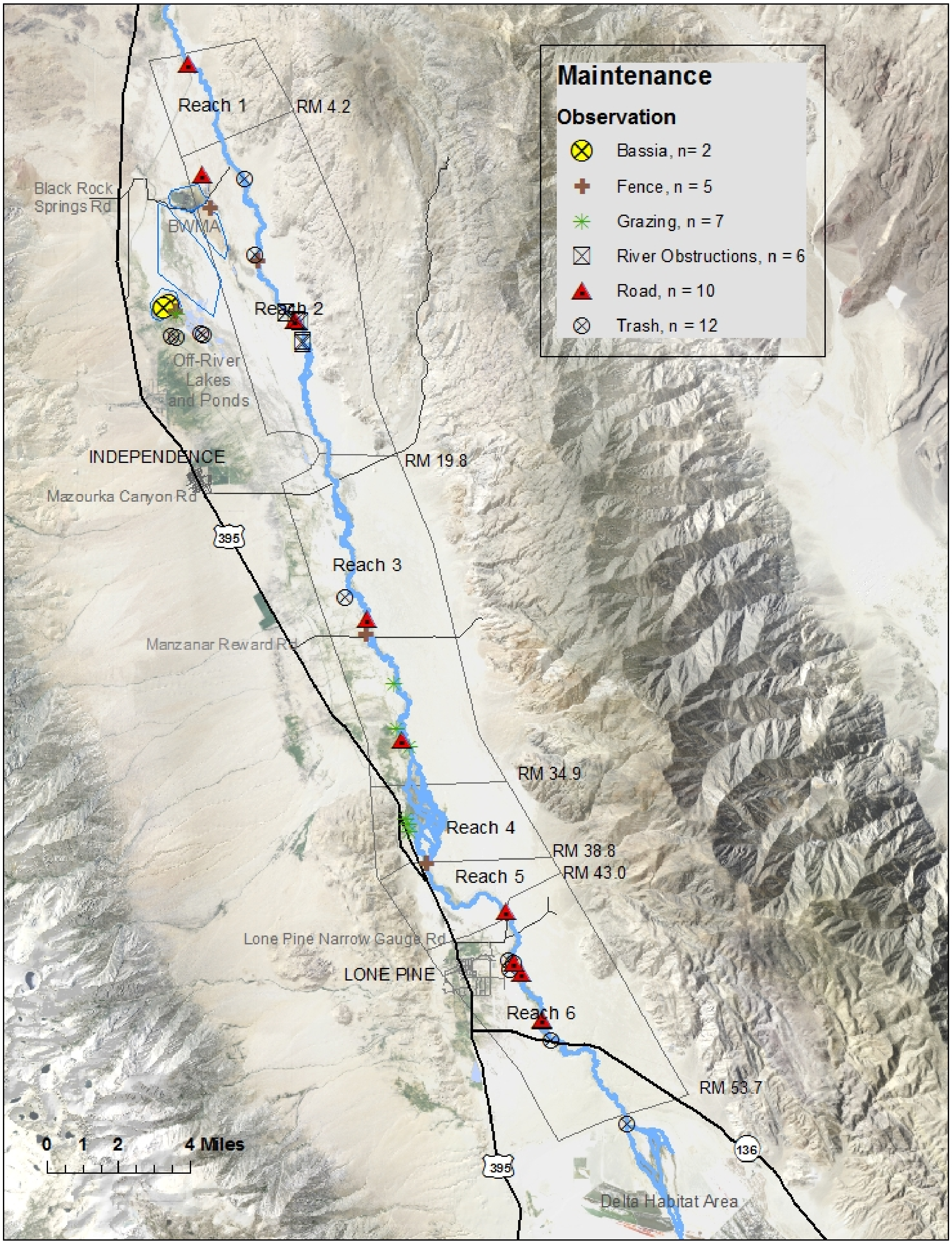
Map 5a: Perennial Pepperweed, *Lepidium latifolium* (LELA2) – Spread from 2007-09 to 2014-15



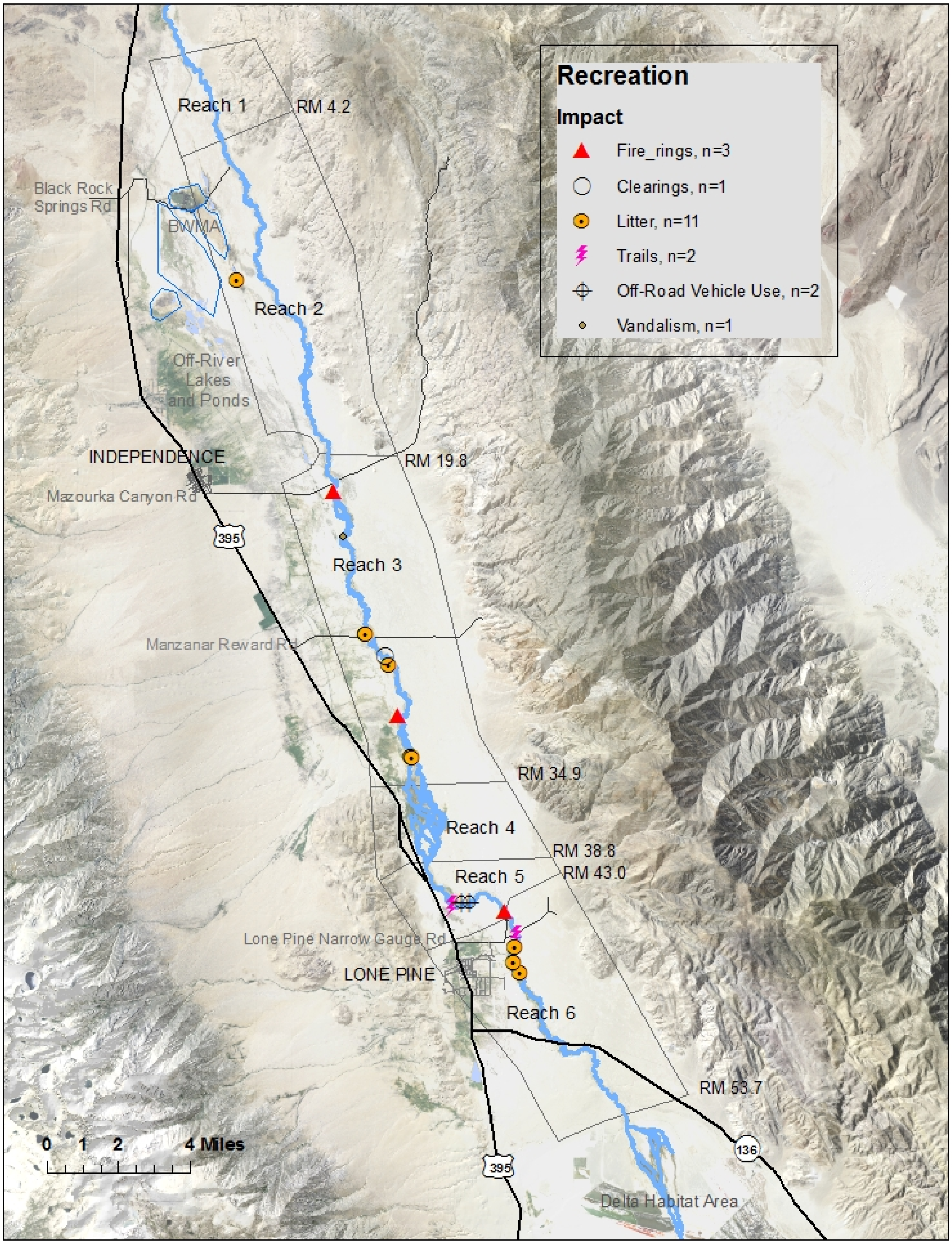
Map 6: Wildlife



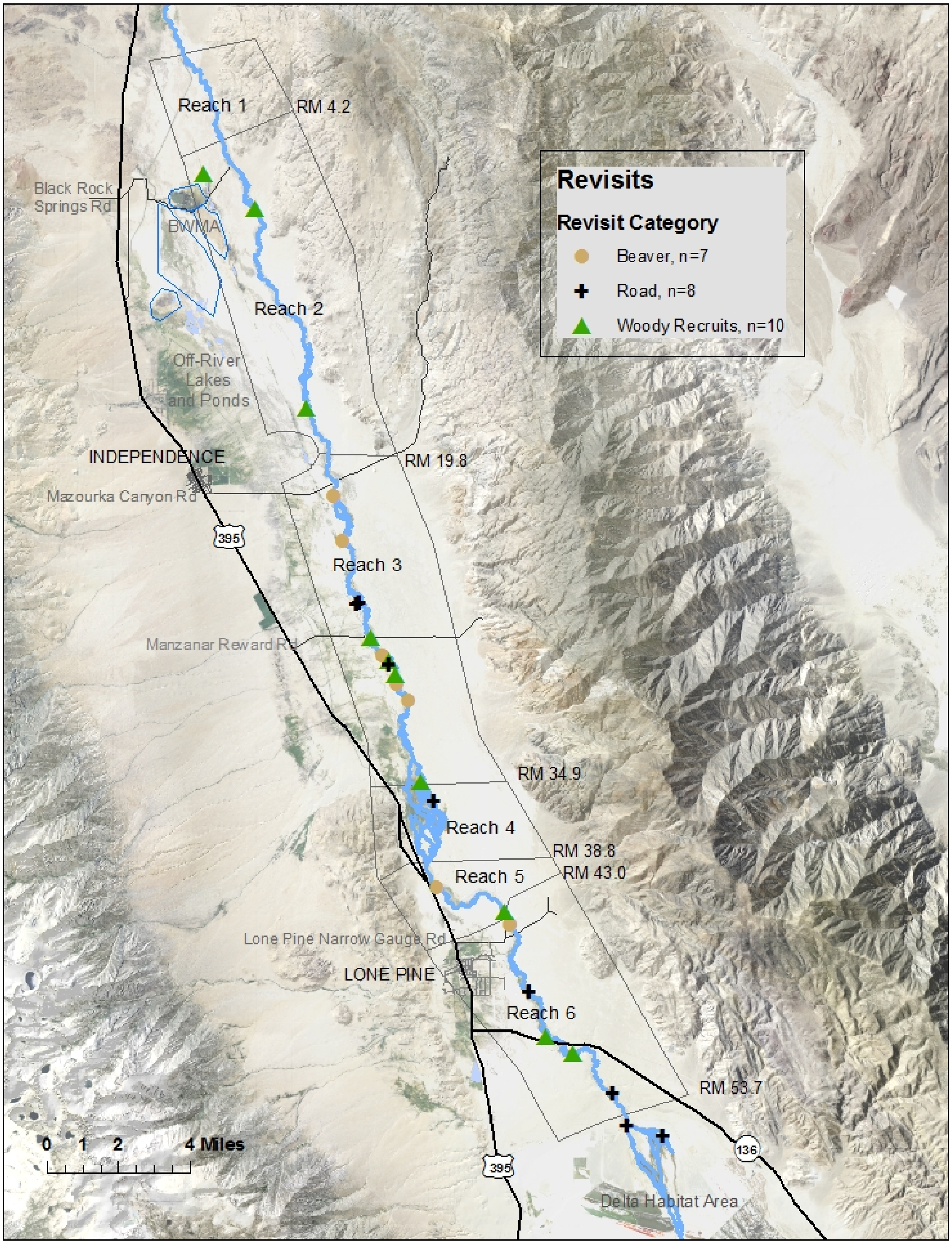
Map 7: Maintenance – Fences, Grazing, Roads, Trash, Obstructions, Bassia



Map 8: Recreation Impacts



Map 9: Revisit of 2014 Observations – Woody Recruitment, Beaver, and Roads



7.0 WATER QUALITY REPORT

Prepared by Inyo County Water Department

Introduction

Multiparameter water quality instruments were installed at six locations in the Lower Owens River in anticipation of monitoring the response to potential changes in water releases to the river being considered by the MOU parties. Initially, a proposal was considered to implement a revised hydrograph prepared by LADWP staff to temporarily replace the flow requirements in the 1997 MOU and 2007 Stipulation and Order. The revised hydrograph included a peak flow release in early spring ostensibly to improve water quality conditions prior to a second and larger release to promote riparian habitat in early summer. Subsequently, the unprecedented low runoff forecast for 2015-16 following three consecutive years of drought prompted LADWP to propose a reduced flow regime to conserve water for use on LADWP irrigated lands. It was anticipated that the required agreements among the MOU parties to reduce the flows in the LORP would likely include provisions for water quality monitoring to gauge the effect of reduced flows. Neither proposal was formally agreed upon by all the MOU parties, but the decision was made by LADWP and Inyo County to continue the monitoring program to September 1.

Methods

Hydrolab DataSonde 4 (four sites) and 5 (two sites) multiparameter water quality instruments, which were in LADWP storage were reconditioned and recalibrated before deployment. In addition, several smaller components necessary for communication with external data loggers and power connections had to be replaced or fabricated before deployment. Monitoring exclosures at several sites were fabricated and installed by LADWP. The instruments measured temperature, dissolved oxygen (DO), pH, specific conductivity (SpC), and turbidity. The instruments were programmed to record data hourly, and LADWP and Inyo County staff visited the gauges to download data, clean, and recalibrate the instruments approximately every three weeks until mid July. Spot measurements of water quality were collected during field visits using a YSI DO meter (one visit), a Hydrolab Quanta multiparameter meter, and a Hach field test kit for DO utilizing the Winkler titration method. The spot measurements were used to recalibrate the DataSondes internally and/or to process raw data following download to correct for calibration drift between spot measurements. Raw data were adjusted when the simultaneous spot measurement and DataSonde measurement exceeded the thresholds shown in Table 1 (Wagner, et al, 2006).

Table 1. Thresholds for instrument recalibration or post processing of raw logged data.

Parameter	Threshold
Water Temperature	$\pm$ 1 ^{o}C (approximately 2 ^{o}F)
Dissolved Oxygen	$\pm$ 1 mg/L
pH	$\pm$ 0.2 pH units
Specific Conductivity	$\pm$ 0.2 mS/cm
Turbidity	$\pm$ 50 NTU

Because neither proposal to adjust flows and monitor water quality was formally approved, the instruments were not replaced when sensors failed. Also, the DataSondes were operated for the month of August without interruption to evaluate the stability of the sensors and battery life.

Water quality instruments were deployed just downstream of the Intake, at Mazourka Canyon Road, at Manzanar Reward Road, at the Reinhackle flow measuring station, at Narrow Gauge Road, and in the edge of the Pumpback Station forebay. The Intake and Pumpback instruments were installed in February and operated almost without interruption until September 1. Mazourka Canyon, Manzanar Reward Road, and Reinhackle instruments were installed in March; the Narrow Gauge instrument was installed in April. All instruments except at the Intake were removed for a period in May to recalibrate, repair, and reprogram the datalogger. The Manzanar Reward DataSonde was the least reliable. The data record only encompassed March-mid April and June, and it ceased to function on July 9. In addition, the large diurnal fluctuation in the March DO and T data suggest those data are unreliable.

Results

DO and Water Temperature

Previous water quality monitoring in the LORP suggested that water temperature and DO were the key parameters related to flow management and fish stress. Two observations are plainly evident in the DO and water temperature data (Figures 1-6). At all sites, DO is generally lowest in the early morning just before or after dawn and highest near sunset. The precise timing of the diurnal cycle varied between sites and times of the year. Seasonally, the inverse relationship between water temperature and DO is evident at each site; water was cooler and DO higher in the Feb-April period. Neither of these patterns was surprising. The remainder of this discussion will focus on DO and temperature measured during the summer months, June-August.

Temperature and DO were generally highest at the Intake (Figure 1). DO was never below 4 mg/L and usually fluctuated between 5-7 mg/L despite water temperatures in excess of 70 ^{o}F for most of the summer. High DO was due to aeration as water spilled over the Langemann gate just upstream of the monitoring location. Aerated water entering the top of the LORP is a favorable condition, but it is not known how far downstream the elevated DO persists. Peak water releases occurred between July 2-13, but there was no evidence that DO fluctuations at the Intake were related to flows within the relatively narrow range experienced in 2015.

Summertime DO measured at downstream sites typically fluctuated between 2 and 4.5 mg/L (Figures 2-6). At no time did DO decline below the 1 mg/L threshold for onset of fish stress and no signs of fish stress were observed on any site visit. DO remained above 2 mg/L except for three instances.

At Narrow Gauge Road on July 3, DO (3.3 mg/l at 1500) began to decline before the typical diurnal maximum was reached and continued to drop suddenly until DO reached 1.7 mg/l at 2300 on July 4. The DO decline was compounded by an increase in water temperatures to between 70-72 ^{o}F but other sites upstream (e.g. Reinhackle) only exhibited a gradual and smaller DO depression in response to the general increase in temperature. Flows were not measured at this site but were estimated from the sum of flow at the Reinhackle monitoring station and Alabama Gates releases (Figure 5). Flow at Reinhackle varied between 45-56 cfs during this period, and no depression in DO was observed at that location. Releases from Alabama gates began on July 1, peaked at 29 cfs on July 2 and declined to zero by July 7. Assuming an estimated three day lag time for the flows measured at Reinhackle (see below) and one day lag for the Alabama gates releases to reach the Narrow Gauge Road, flows at the station increased from approximately 55 cfs on July 2 to 71 cfs on July 3 and peaked at 75 cfs on July 4. DO started to recover at 0600 on July 5. By that time estimated flows dropped to 67 cfs. DO recovered quickly between July 8 and 10 when estimated flows were below about 63 cfs.

At the Reinhackle station on July 19, DO deviated from the usual diurnal cycle and began to decline from 3.1 mg/L to 1.5 mg/L by noon on July 20 (Figure 4) and did not begin to recover until 0800 July 21. Flow releases from the Intake increased to nearly 80 cfs between July 2 and July 13. This pulse of water coupled with relatively constant releases of approximately 6-11 cfs from the George spillgate caused daily average flows at Reinhackle to reach 69 cfs between July 15-19. Flow peaked at 75 cfs on July 20. Water temperature was approximately 65-67 ^{o}F through this period. Flows declined to approximately 56 cfs by July 23, but the depression in DO required approximately four more days to fully recover.

The pulse of water released in early July at the Intake reached the Narrow Gauge Road about July 20. Instead of reaching the diurnal minimum at about 0600 that day, DO kept declining to 1.98 mg/l at 0400 on July 23. (The 3-day difference between minimum DO at Reinhackle and Narrow Gauge Road was used to estimate the lag time in flow between the locations). Water temperatures were between 68-69 ^{o}F. Estimated (lagged) flows were between 65-69 cfs from July 18-22 and peaked at 75 cfs on July 23. The decline in DO at this date did not seem to be related to Alabama gates releases; the only water released near this time was 8 cfs on July 12 (peak flow approximately 71 cfs) several days before the observed decline in DO. DO didn't recover until July 29 after several days of flows below 60 cfs.

All three observations of sudden declines in DO apparently were initiated by flows exceeding a threshold between approximately 70-75 cfs when temperatures were above 65 ^{o}F. At flows below the threshold, DO fluctuated diurnally and related to changes in water temperature as expected; above about 70 cfs, anaerobic sediments were probably exposed to or entrained in the water column causing DO to drop precipitously. It is not known if this anecdotal observation will be repeatable. Additional analysis should be completed to compare with monitoring data collected in previous years and to explore whether flow, temperature, and DO relationships can be developed from these data.

Dissolved oxygen concentrations at the Pumpback Station were similar to sites upstream, but water temperature fluctuated slightly above and below 70 ^{o}F which was slightly higher than sites upstream. The DO declines and increased flow observed on July 3 and July 19-23 at Reinhackle and Narrow Gauge sites was muted at the Pumpback station compared to the other sites. The July 1-6 releases from Alabama gates reached the PBS approximately 5 days later, and the peak releases from the Intake (July 2-13) reached the PBS approximately 20 days later. The two pulses in flow in July at the Pumpback Station roughly coincide with slight declines in DO to below 3 mg/L (Figure 6). The DO decline in late July can more confidently be ascribed to increased flow because water temperatures did not increase during that period. The muted DO response and higher water temperatures at the PBS could be due in part to siting the monitoring equipment in the pond's edge. The volume of water in the pond may buffer fluctuations in water quality arriving from upstream, and quiescent water at the edge of the pond in the metal enclosure could be expected to be warmer than the average river water temperature.

Other Parameters

Conductivity varied little, between 0.3 and 0.5 mS/cm, at all sites upstream of the Islands reach regardless of flow (Figures 7-12). At sites below the Islands, conductivity increased above 0.6 at Narrow Gauge Road and the Pumpback Station coinciding with peak flows in July (accounting for 3-day time lag to arrive at the Narrow Gauge location). The spike in conductivity at the Pumpback Station at the end of June is unexplained and may be a glitch.

Previous monitoring suggested pH varied little in the LORP (Figures 7-12). The record for pH was most complete at the intake where pH varied between 7.4 and 8.2. Similar values were recorded at Mazourka Canyon, 7.4-8.0. The early pH record at Manzanar Reward Road is unreliable. After June 3, pH was relatively stable at 7.9. At Reinhackle pH was slightly lower, 7.2-7.7. The pH data at the Narrow Gauge Road were unreliable, and the early record at the Pumpback Station was probably not reliable. After June 3, pH varied between 7.4 and 7.7 at the Pumpback Station. Tentatively, the data suggest pH may be slightly lower by approximately 0.5 pH units in the river south of Manzanar Reward Road.

For all monitoring stations, turbidity measurements were highly variable and often questionable. The data presented in Figures 13-18 only include measurements when turbidity <20 NTU. This is an arbitrary threshold for graphing purposes to remove the visual clutter because measured turbidity was often in the thousands NTU. Short-lived spikes in turbidity were common and may reflect aquatic life or other obstructions temporarily occluding the sensor. Extended periods when turbidity was obviously exaggerated probably represent complete occlusion of the sensor or other failure of the sensor. The Intake turbidity data were particularly unreliable. Water temperature and dissolved oxygen was highest at this location and the accumulation of biofilm and aquatic life on the DataSonde was particularly troublesome (see photo). Increases in turbidity in August at the Narrow Gauge and Pumpback Station appear unrelated to flow and were probably due to biofilm accumulation on the sensor during the prolonged period between cleanings. It is curious that similar increases during August were not observed at Mazourka Canyon or Reinhackle located above the Islands.

At most sites turbidity was usually below 5 NTU and varied diurnally. Generally, the water was least turbid early morning and most turbid in the evening. The diurnal pattern was reversed at the Pumpback Station in March and April. A few observations related to flow were apparent. Releases from the Alabama Gates in early July caused a noticeable persistent increase in turbidity at Narrow Gauge Road that was not evident at the Pumpback station. The increases in flow (and decreased DO) at Reinhackle and Narrow Gauge Road about July 20-23 from Intake releases did not cause a corresponding increase in turbidity.

Conclusions

Continuous monitoring at six sites in the LORP in 2015 was conducted in anticipation of monitoring changes in water quality resulting from altered flow releases to the river. Unfortunately, the opportunity for monitoring modified river flows was not realized, but the data collected in 2015 constitute a fairly complete record under relatively steady baseflow conditions. The results will be useful as a basis for comparison if are altered in the future.

Water releases to the river channel in 2015 were managed to maintain the required approximately 40 cfs throughout the river with no pulse flows tied to habitat goals. One difference from operations in recent years was reduced releases from the Intake and increased releases from Locust, George, and Alabama spillgates to reach flow requirements in the lower reaches. Because flows varied little for most of the monitoring period, the response of water quality measures to flow variation or management practices was limited.

The LORP reporting deadlines did not allow for an exhaustive analysis of the data, and only a brief summary of results were presented in this report. A few observations of conditions were noted. Summertime DO measured at sites from Mazourka Canyon to the Pumpback station typically fluctuated between 2 and 4.5 mg/L. At no time did DO decline below the 1 mg/L threshold for onset of fish stress and no signs of fish stress were observed during any site visit. For most of the summer, DO fluctuated diurnally and corresponded with changes in water temperature as expected. Two instances of sudden declines in DO at Reinhackle and Narrow Gauge Road apparently were initiated by flows exceeding a threshold between approximately 70-75 cfs when water temperatures were above 65 ^{o}F.

Additional analyses should be completed to compare with monitoring results from prior years and to explore whether relationships between flow, temperature, and DO can be developed from these data. Since flows varied little, however, empirical models derived from 2015 monitoring may have limited utility and most certainly would not be adequate to design flushing or habitat flow rates. The learning curve to refurbish, calibrate, deploy, and operate the gauges in March-May was difficult. It should be much less of an obstacle in the future, and practical experience gained during the field campaign will be valuable in planning and budgeting for future field campaigns.

References

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments

Photo: DataSonde 5 installed at the Intake on June 26, 2015 after approximately 20 days of operation since the last cleaning. Despite the biologic accumulation, the instruments performed adequately except for the turbidity sensor.

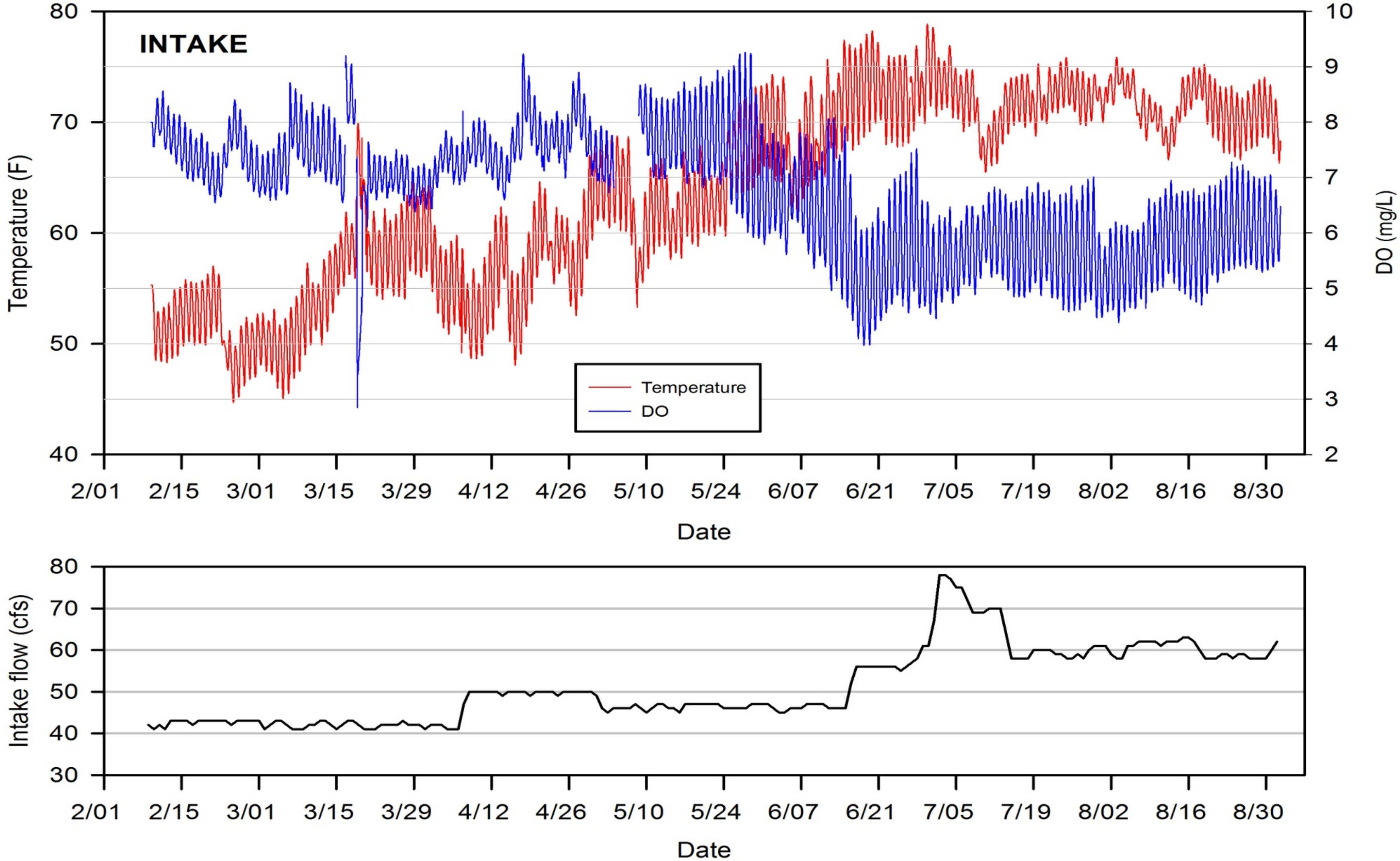


Figure 1. Dissolved oxygen and temperature (top graph) and daily flow (bottom graph) measured at the Intake measuring station.

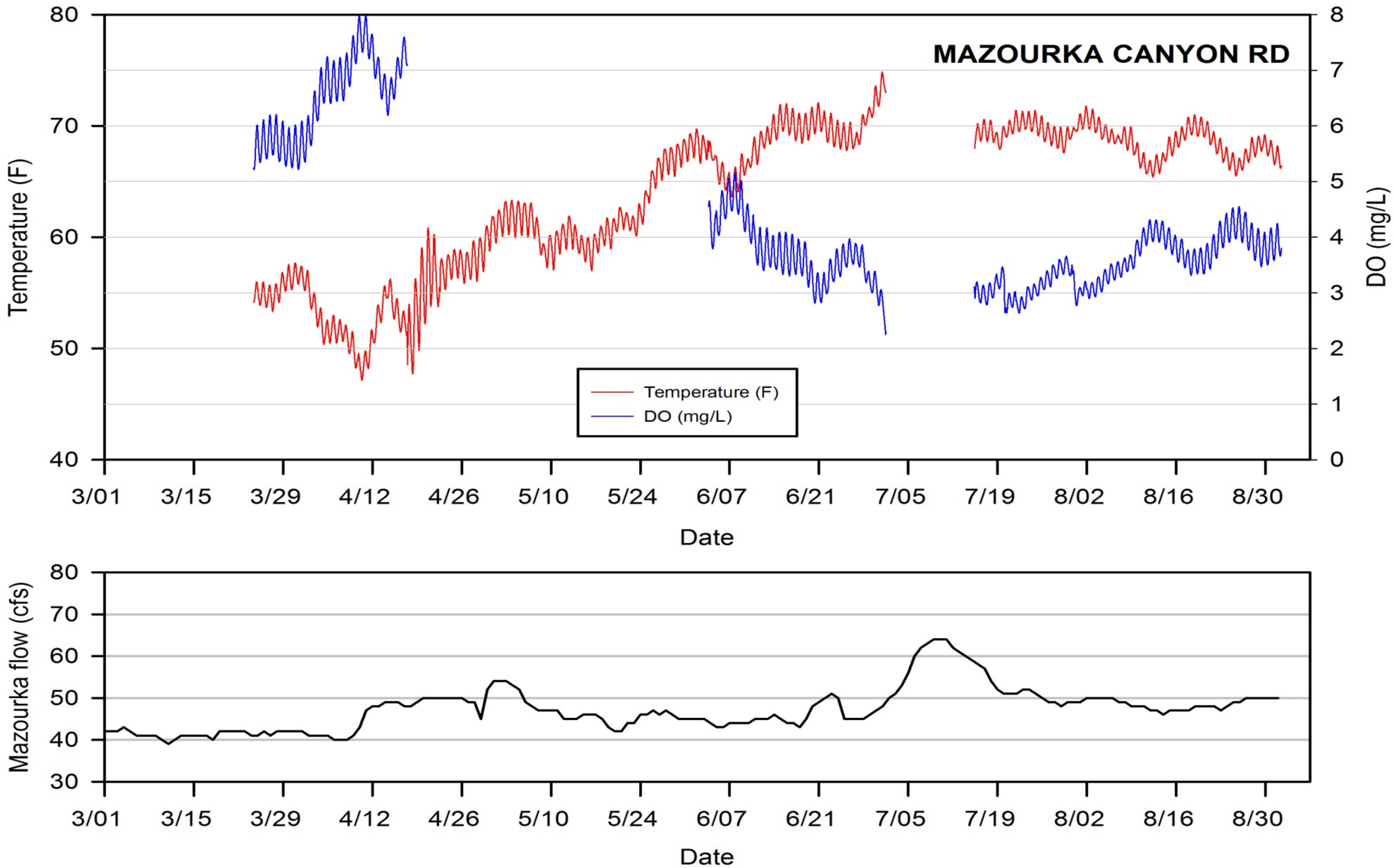


Figure 2. Dissolved oxygen and temperature (top graph) and daily flow (bottom graph) measured at Mazourka Canyon Rd.

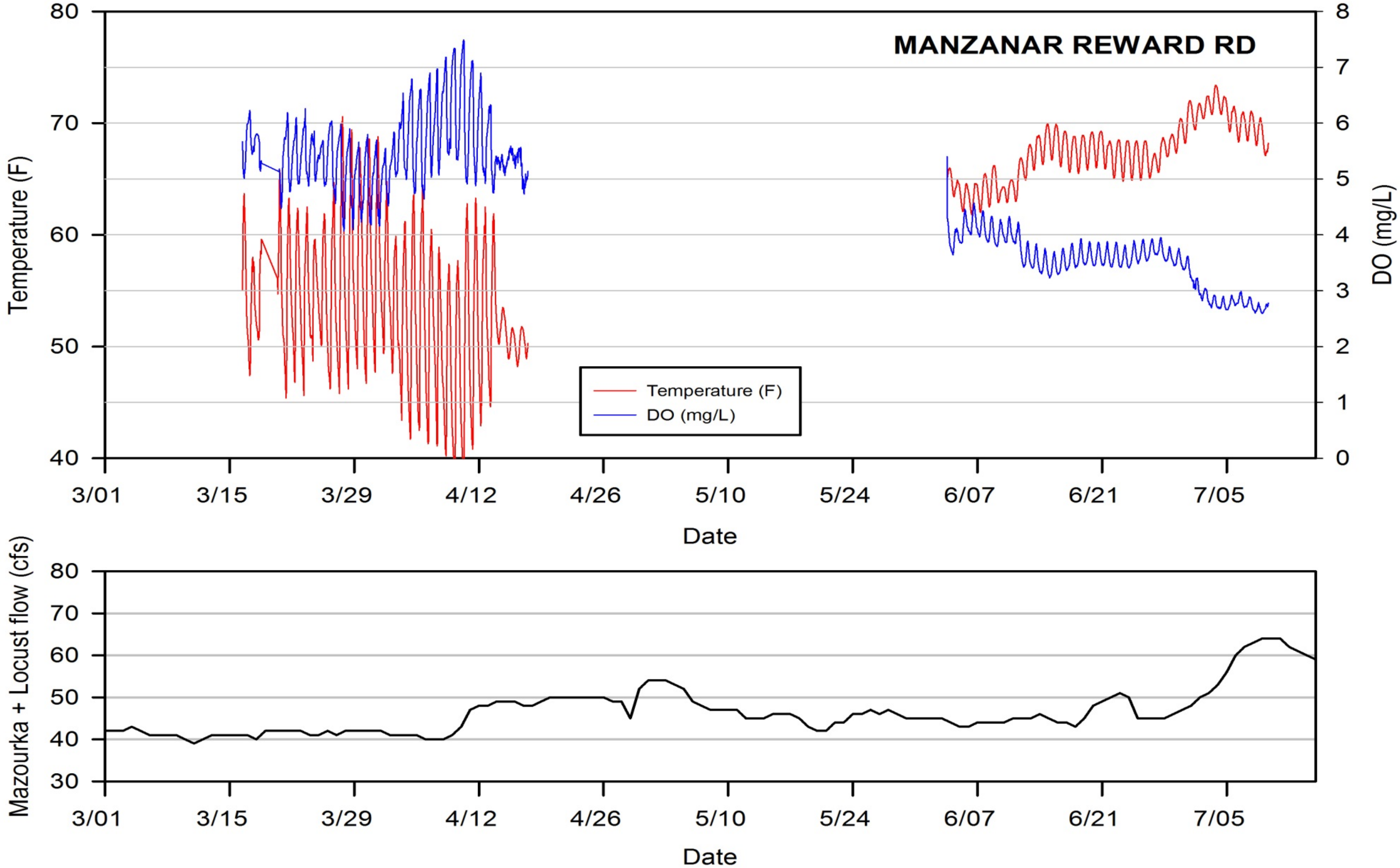


Figure 3. Dissolved oxygen and temperature (top graph) and estimated daily flow (bottom graph) at Manzanar-Reward Rd.

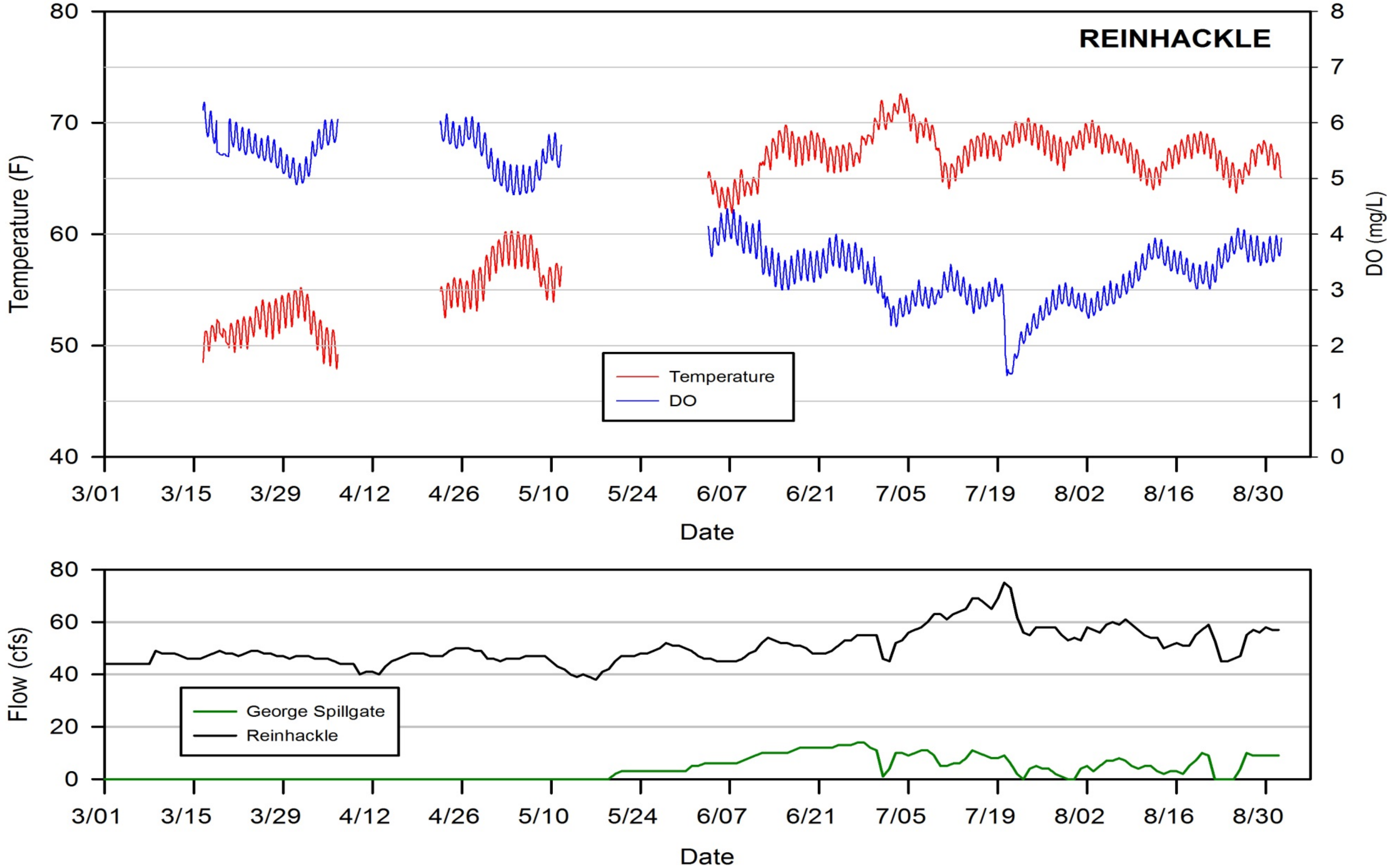


Figure 4. Dissolved oxygen and temperature (top graph) and daily flow (bottom graph) measured at Reinhackle station.

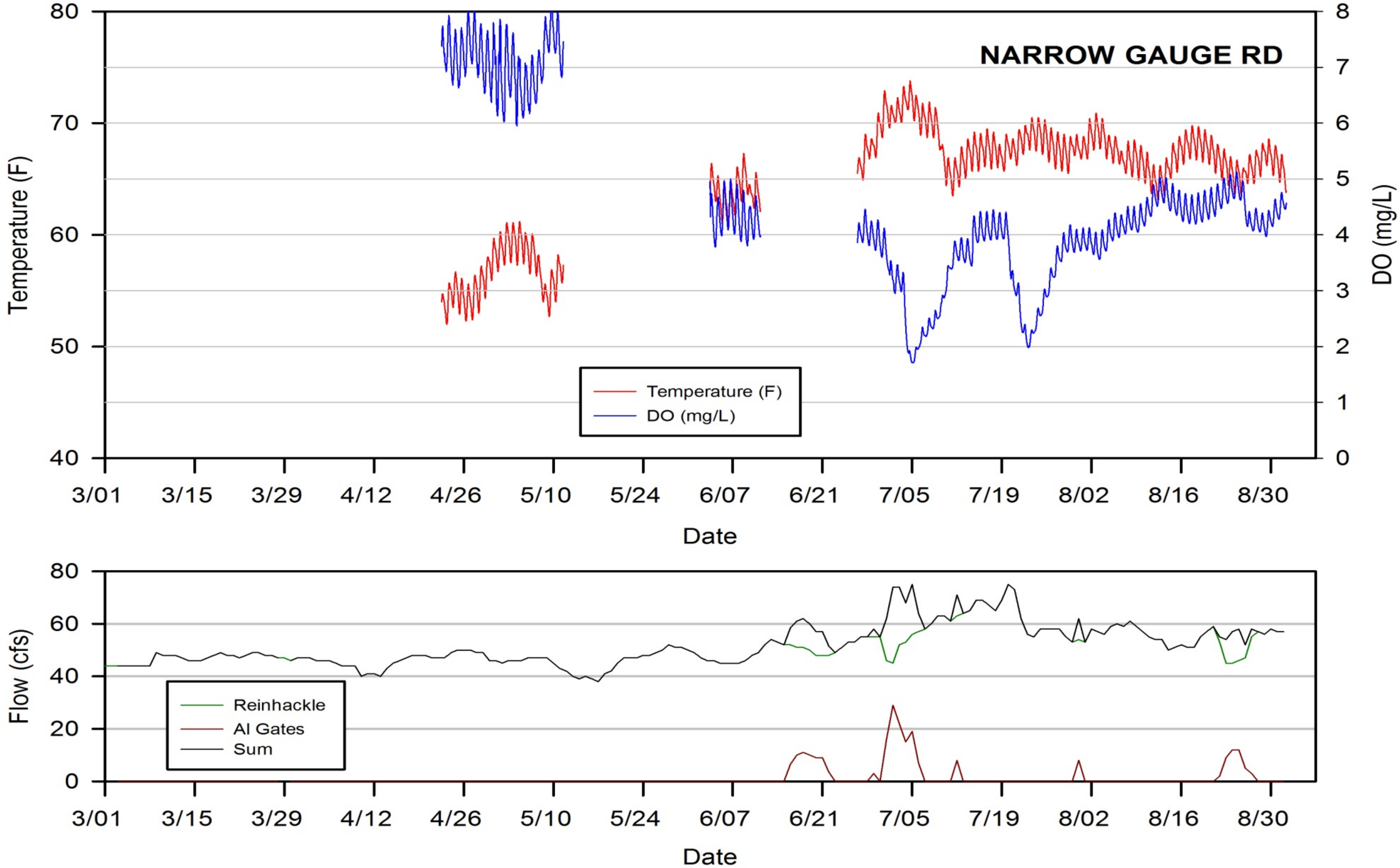


Figure 5. Dissolved oxygen and temp (top graph) and estimated daily flow (Reinhackle + Al Gates releases, bottom graph) at Narrow Gauge Rd.

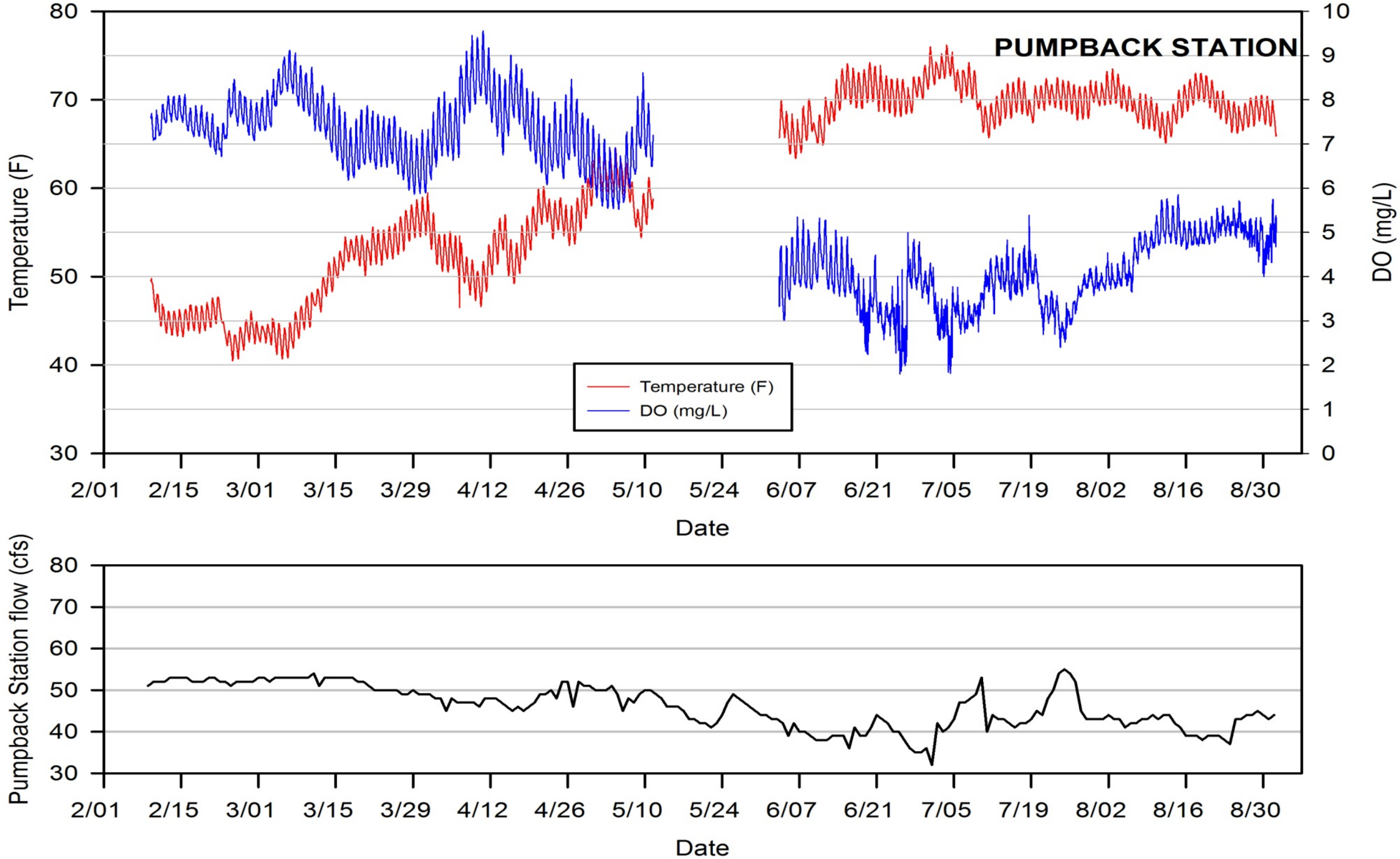


Figure 6. Dissolved oxygen and temperature (top graph) and estimated daily flow (bottom graph) arriving at the Pumpback Station.

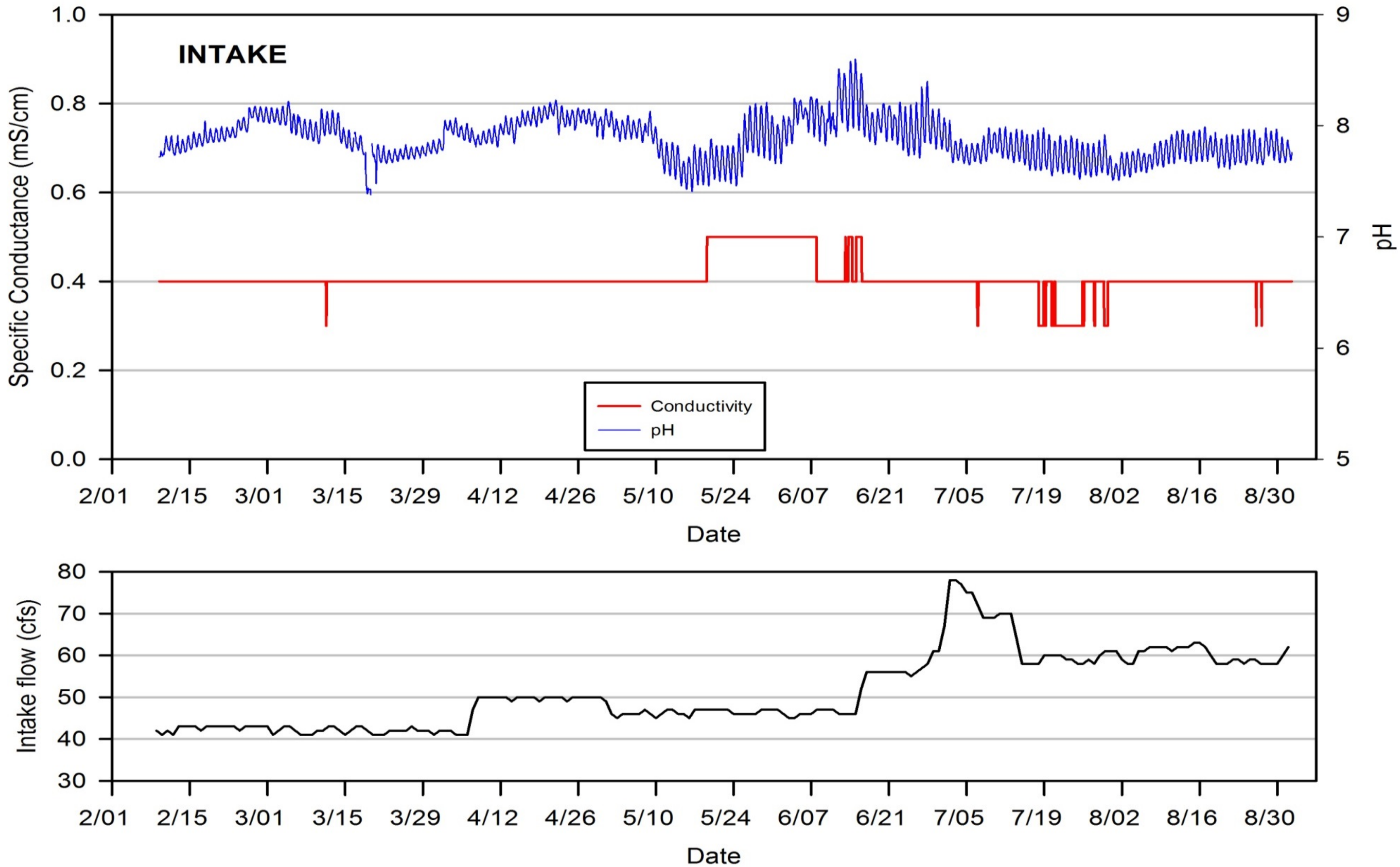


Figure 7. Specific Conductance and pH (top graph) and daily flow measured (bottom graph) at the Intake measuring station.

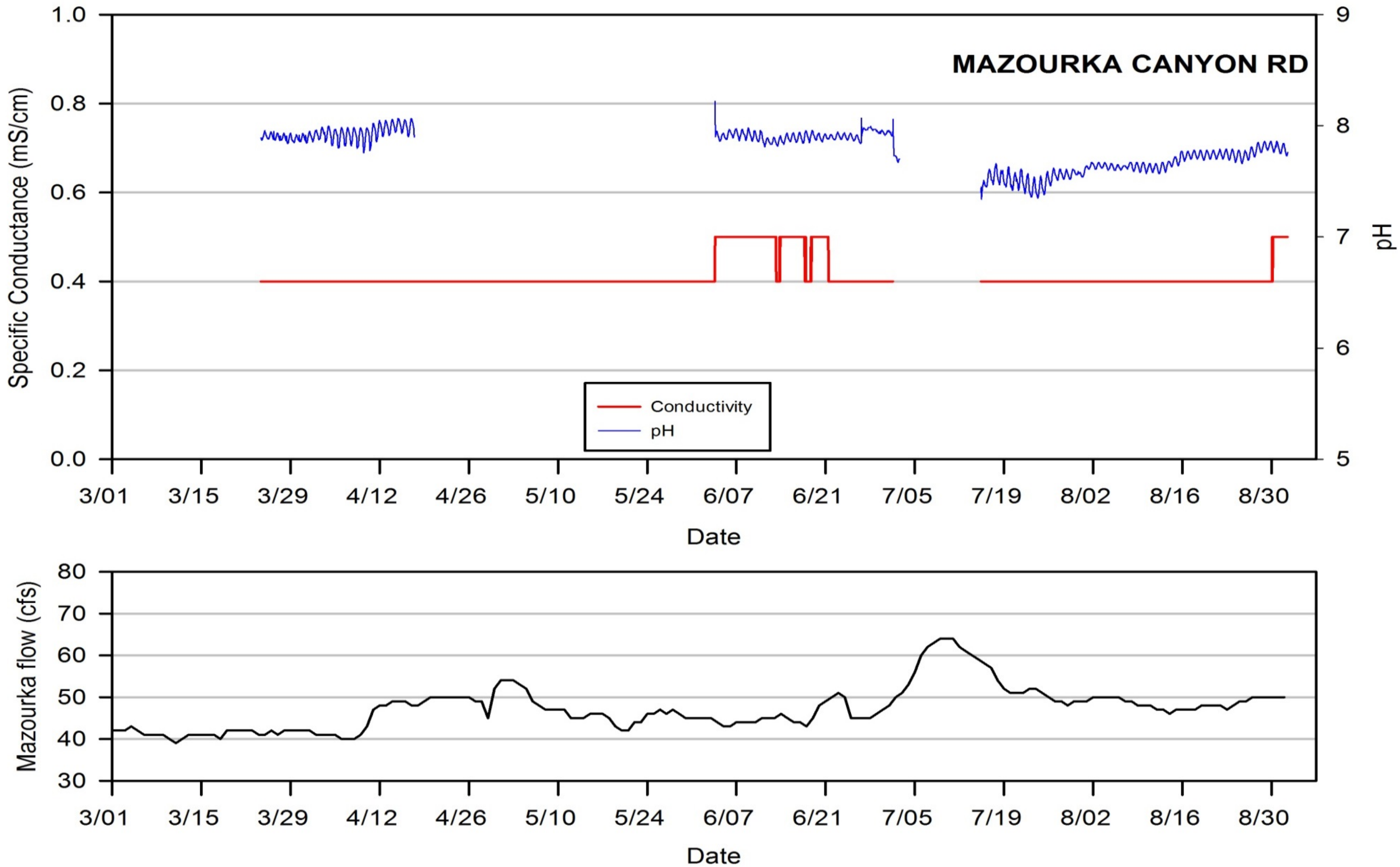


Figure 8. Specific Conductance and pH (top graph) and daily flow measured (bottom graph) at Mazourka Canyon Rd.

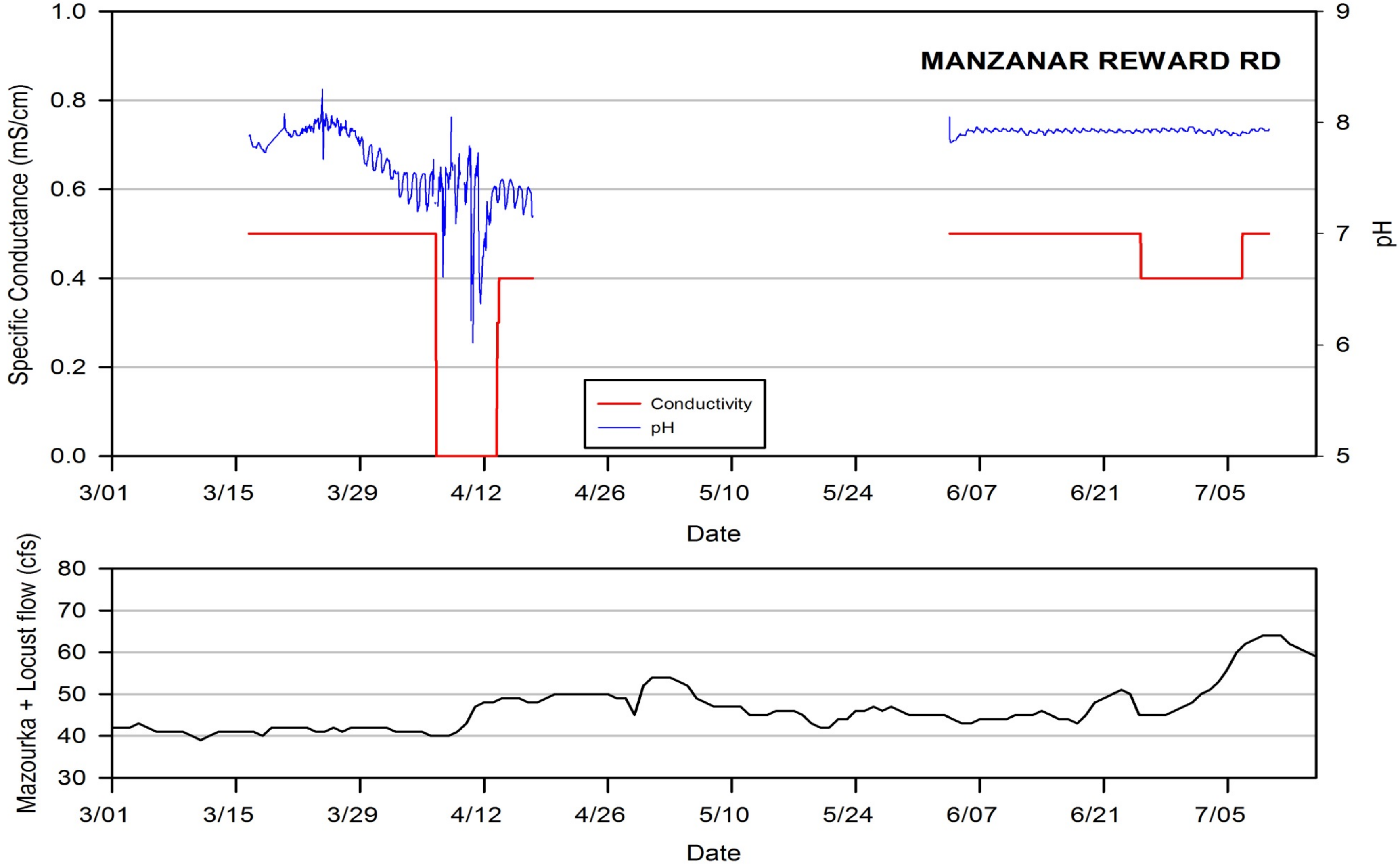


Figure 9. Specific Conductance and pH (top graph) and estimated daily flow (bottom graph) at Manzanar-Reward Rd.

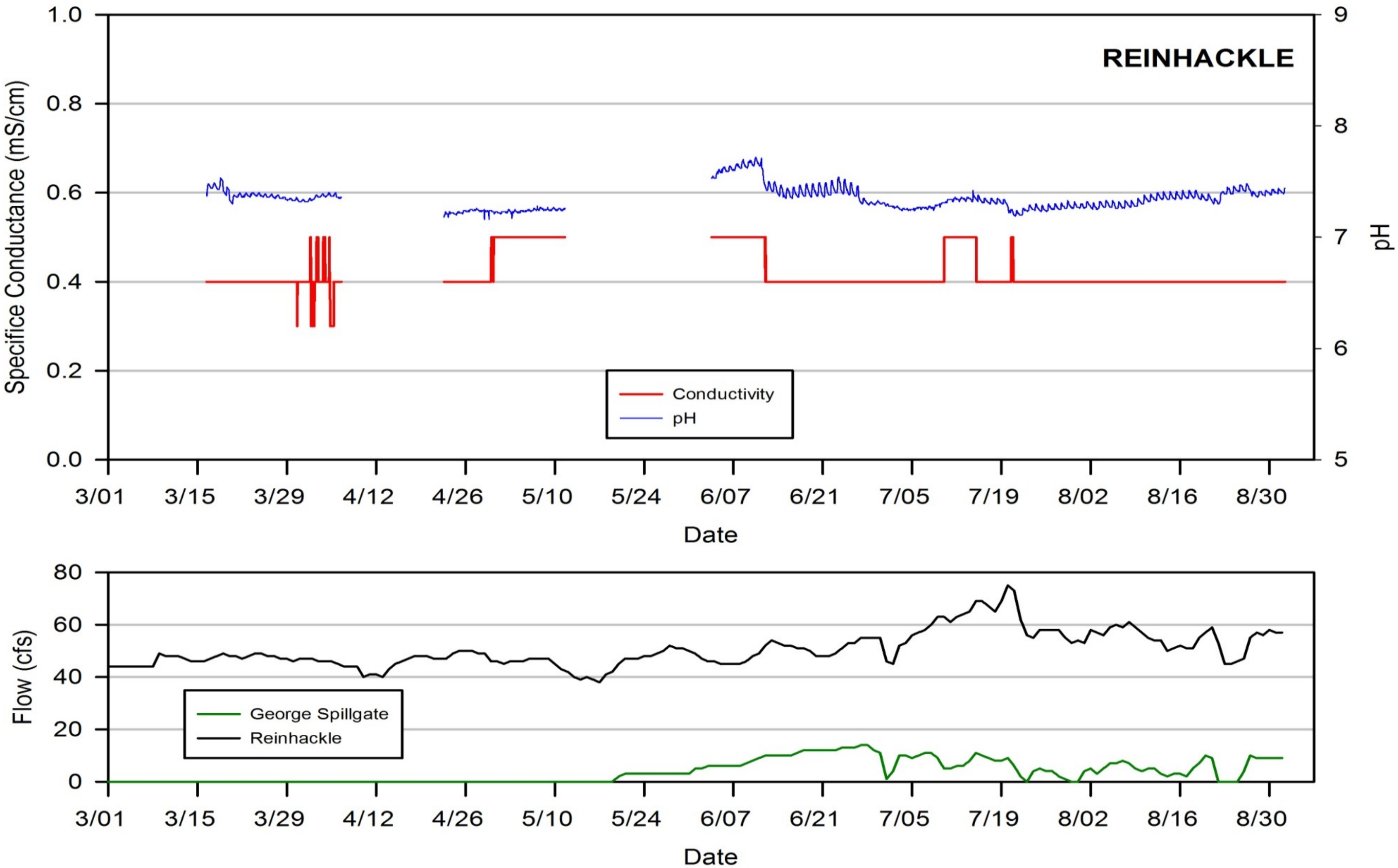


Figure 10. Specific Conductance and pH (top graph) and daily flow (bottom graph) measured at Reinhackle station.

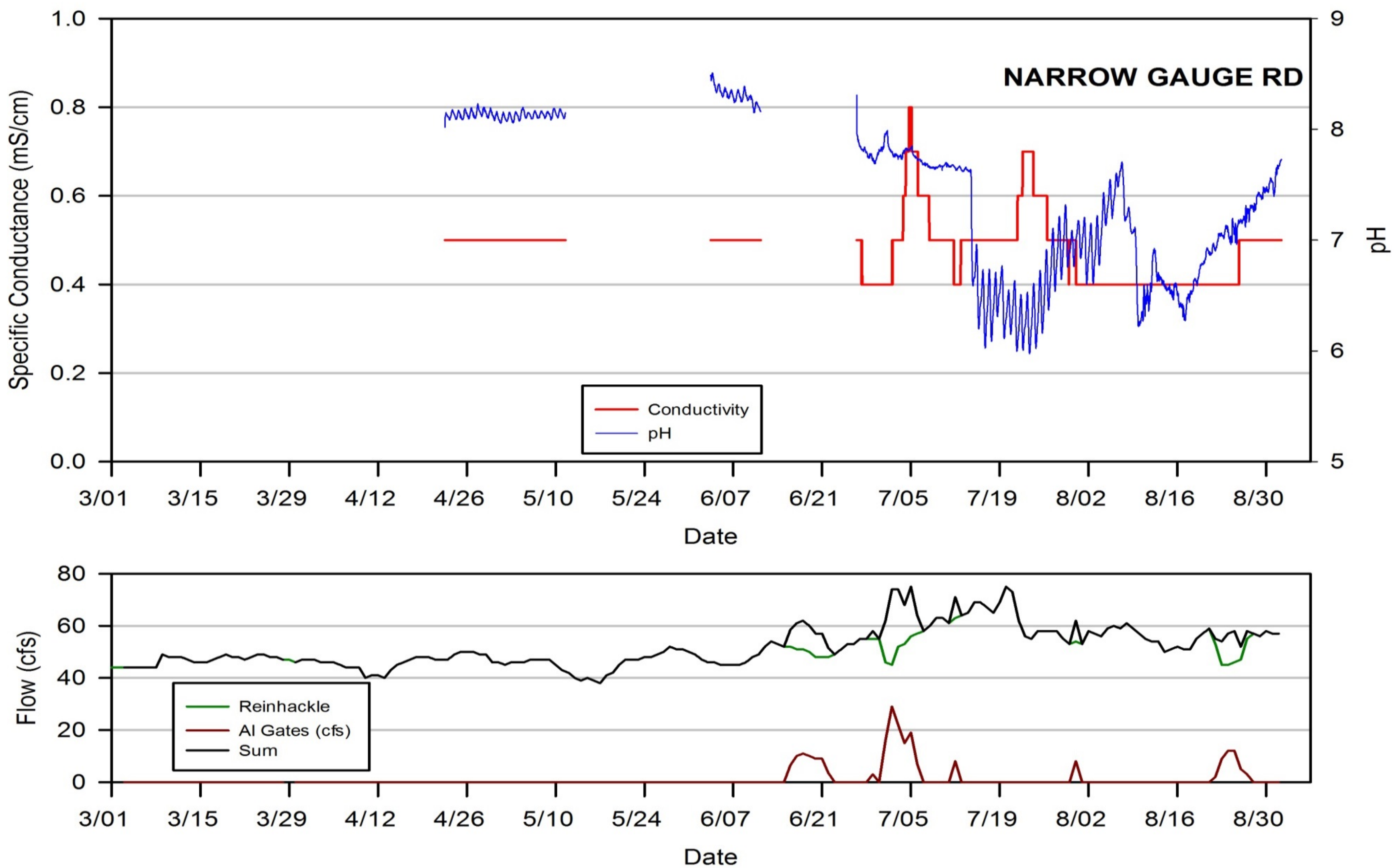
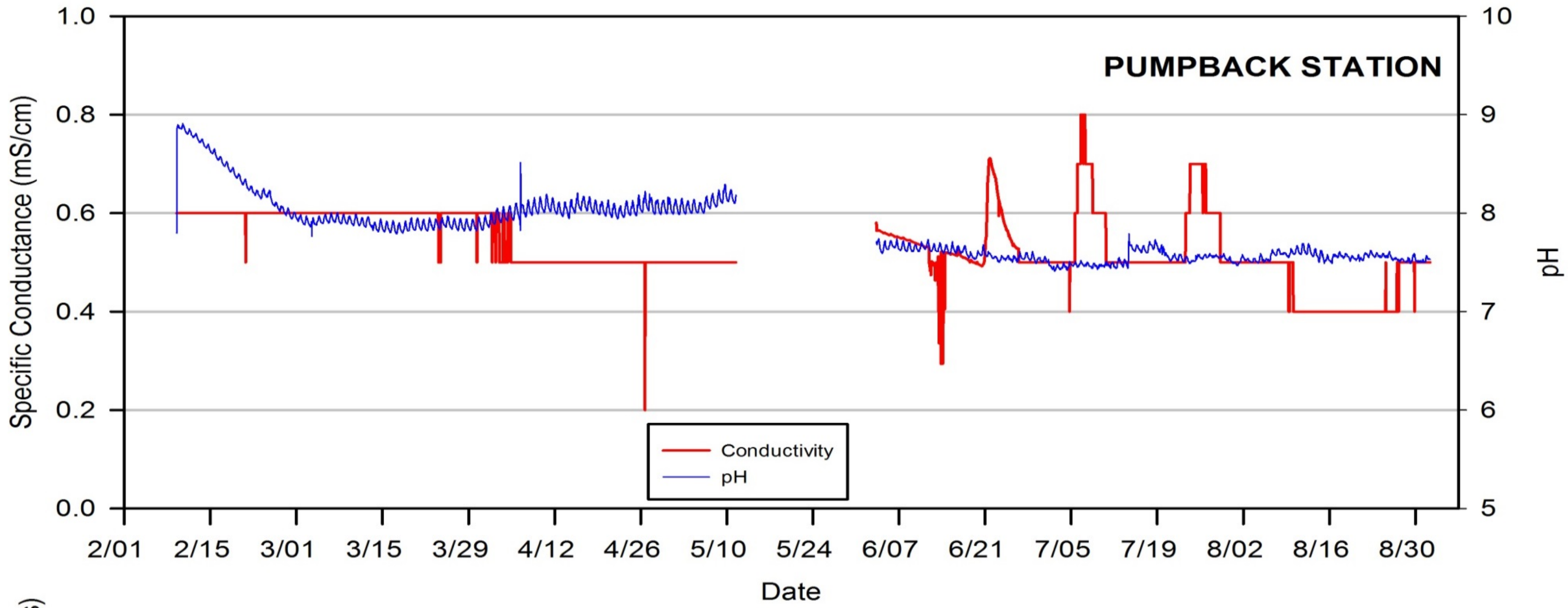


Figure 11. Specific Conductance and pH (top graph) and estimated daily flow (Reinhackle + Al Gates releases, bottom) at Narrow Gauge Rd.



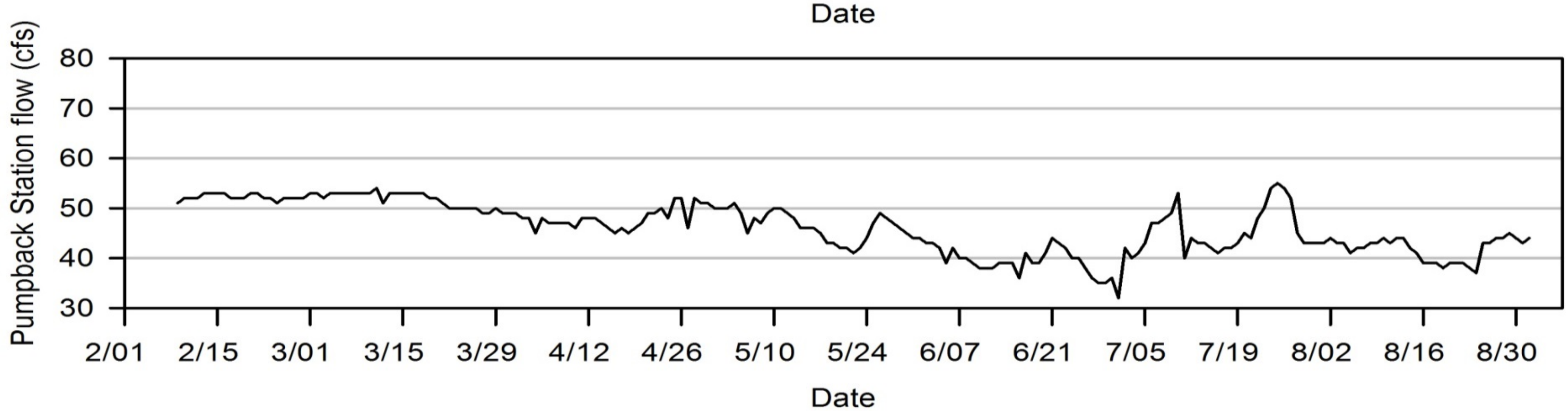


Figure 12. Specific Conductance and pH (top graph) and estimated daily flow (bottom graph) arriving at the Pumpback Station.

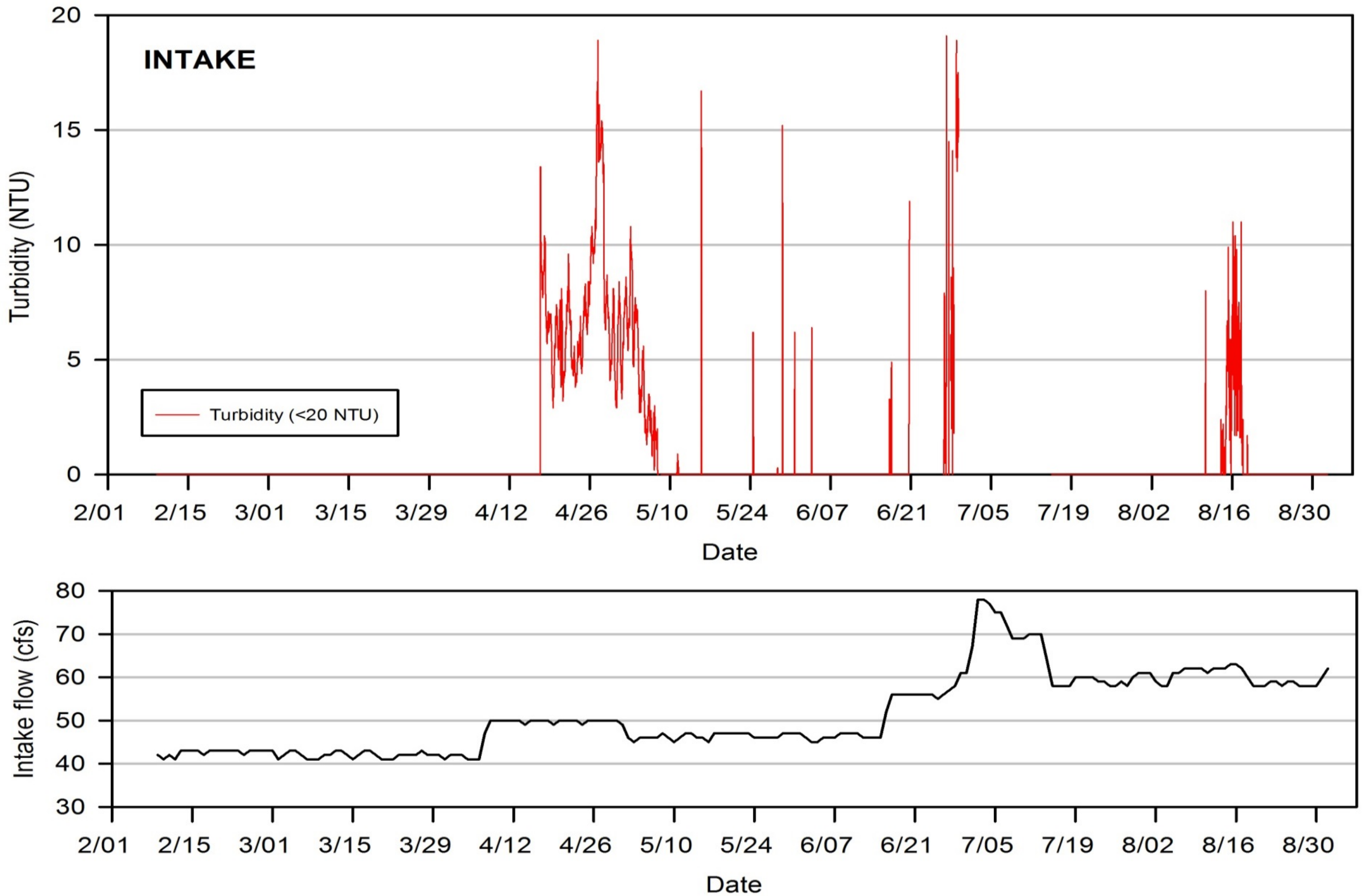


Figure 13. Turbidity (top graph) and daily flow measured (bottom graph) at the Intake measuring station.

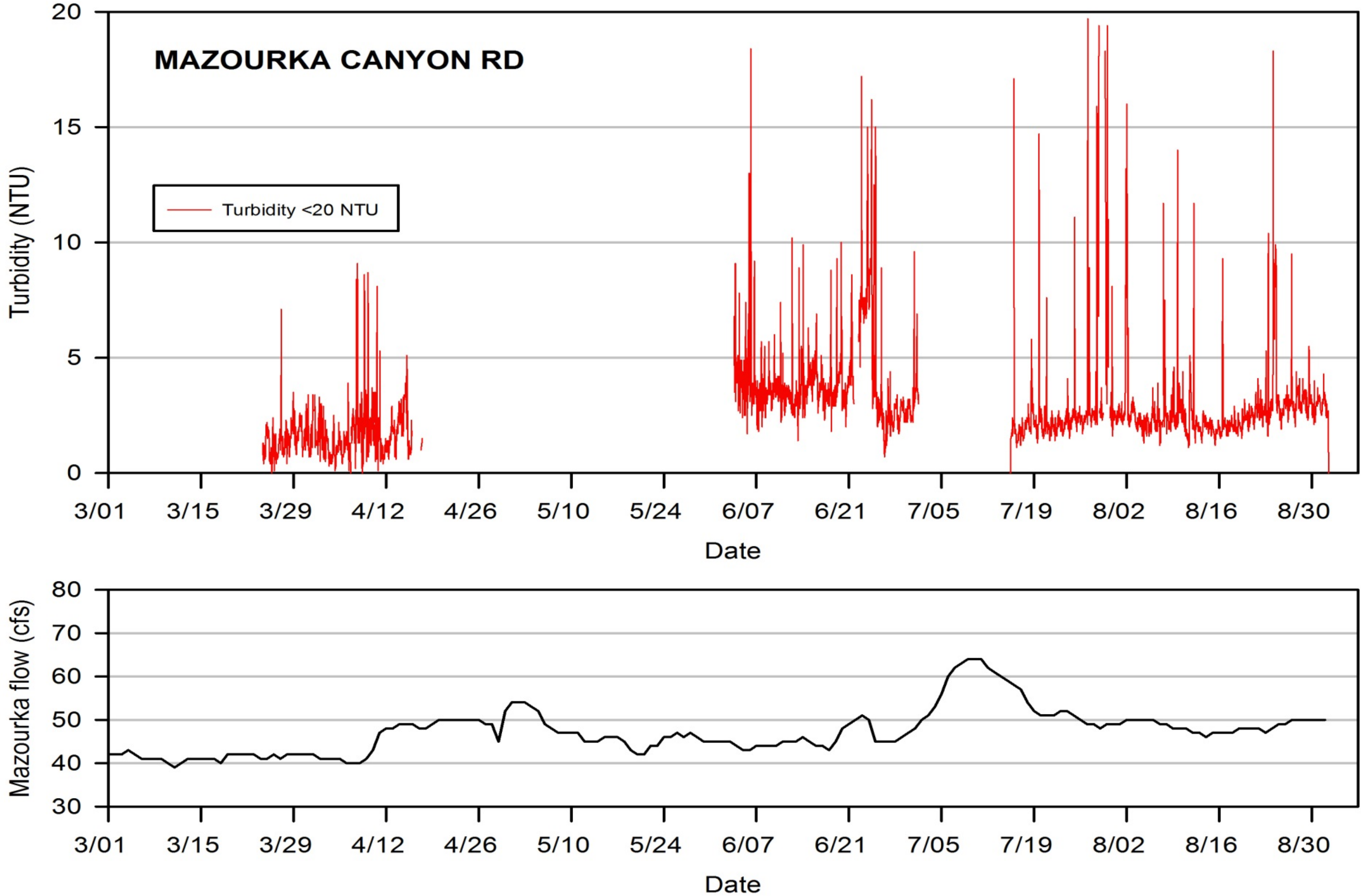


Figure 14. Turbidity (top graph) and daily flow measured (bottom graph) at Mazourka Canyon Rd.

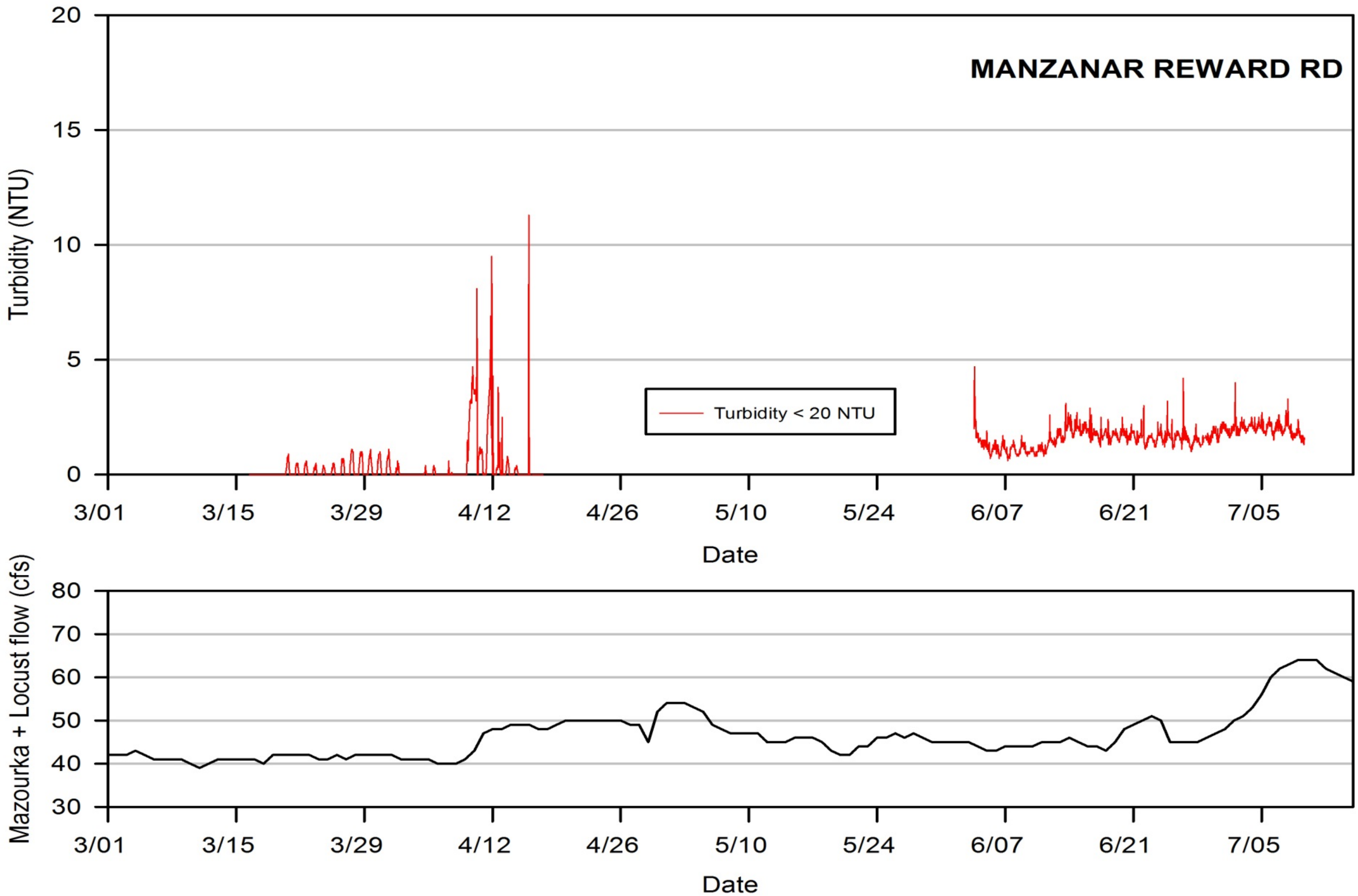


Figure 15. Turbidity (top graph) and estimated daily flow (bottom graph) at Manzanar-Reward Rd.

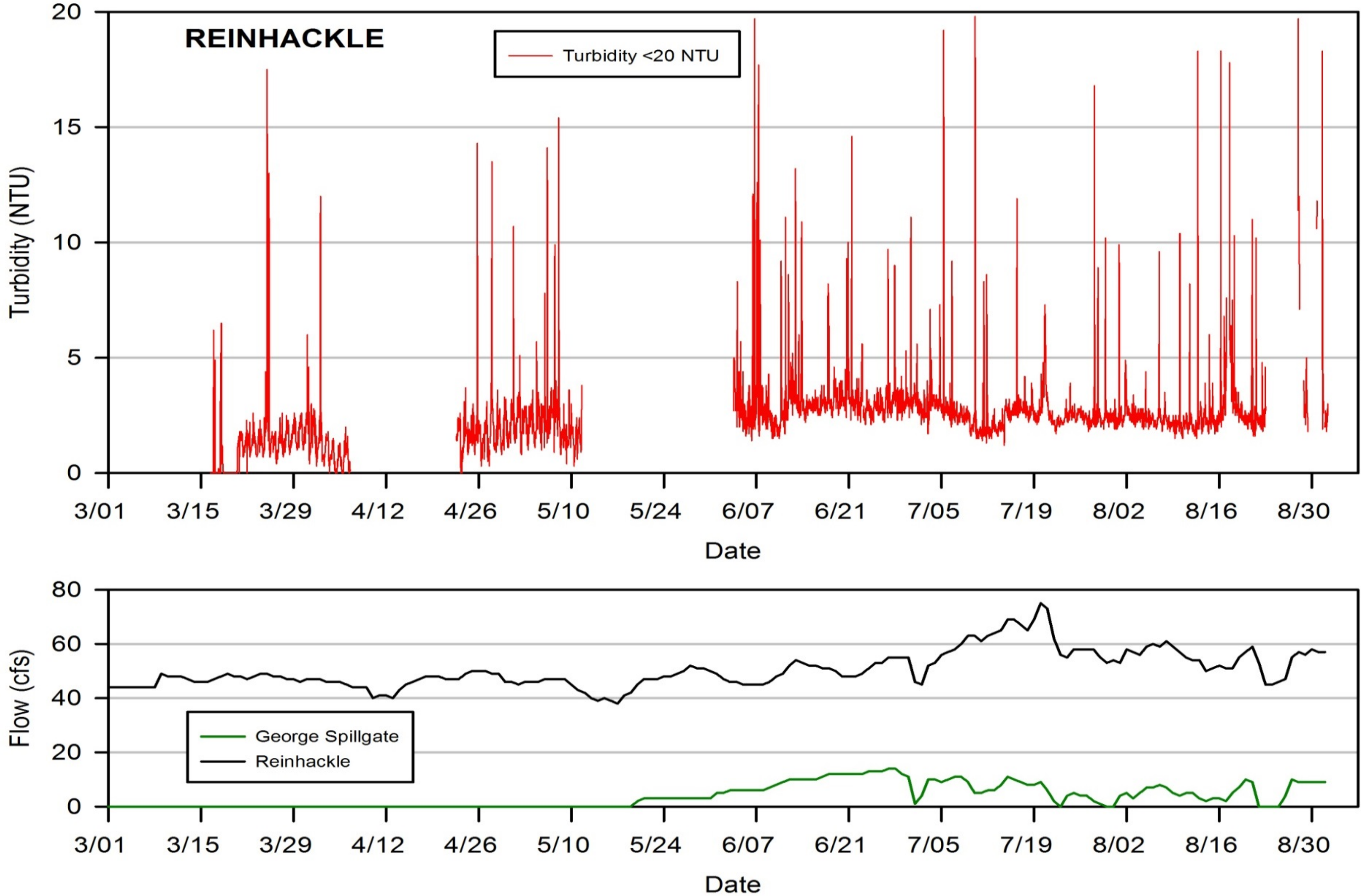


Figure 16. Turbidity (top graph) and daily flow (bottom graph) measured at Reinhackle station.

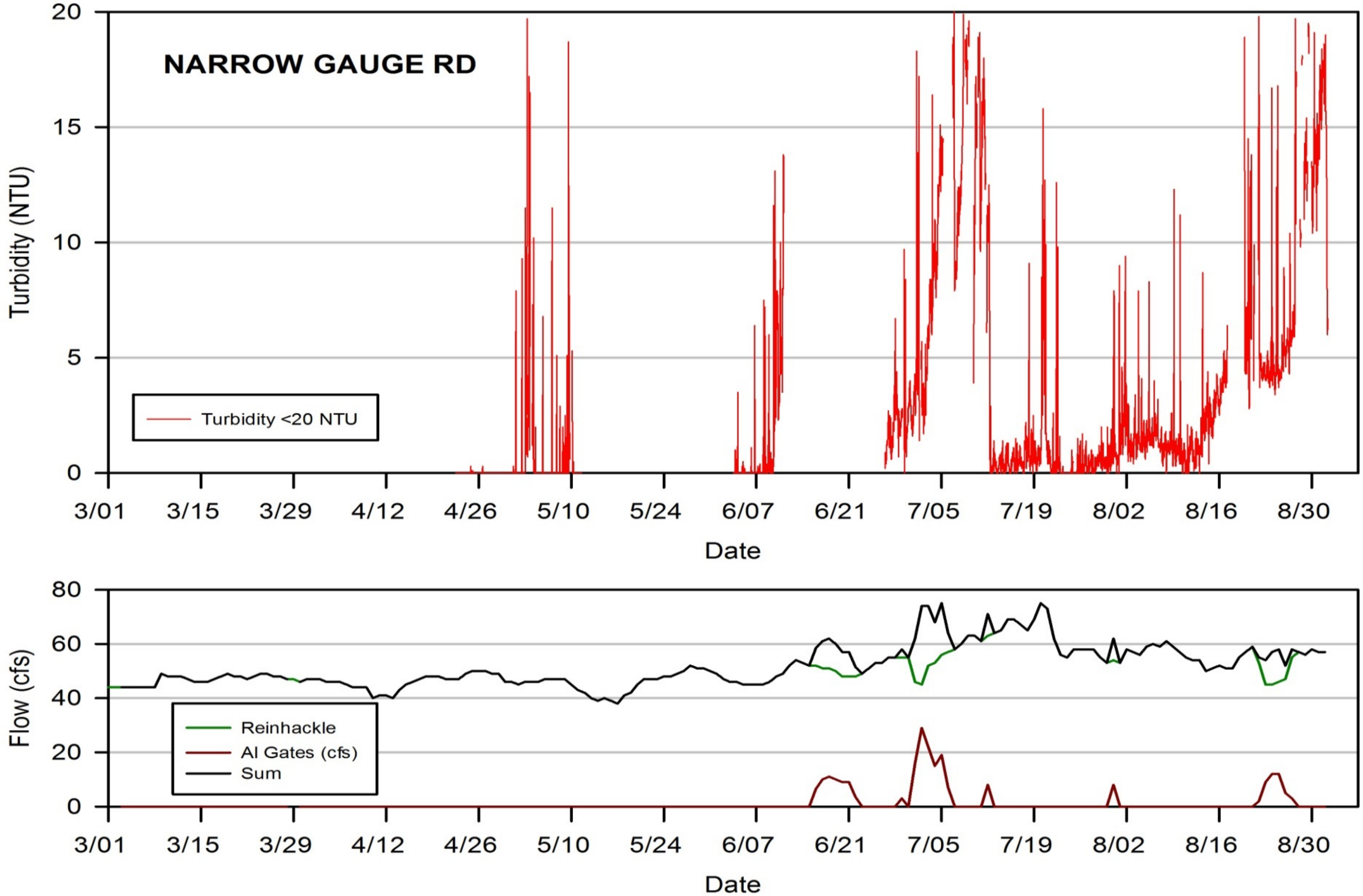


Figure 17. Turbidity and estimated daily flow (Reinhackle + Al Gates releases, bottom graph) at Narrow Gauge Rd.

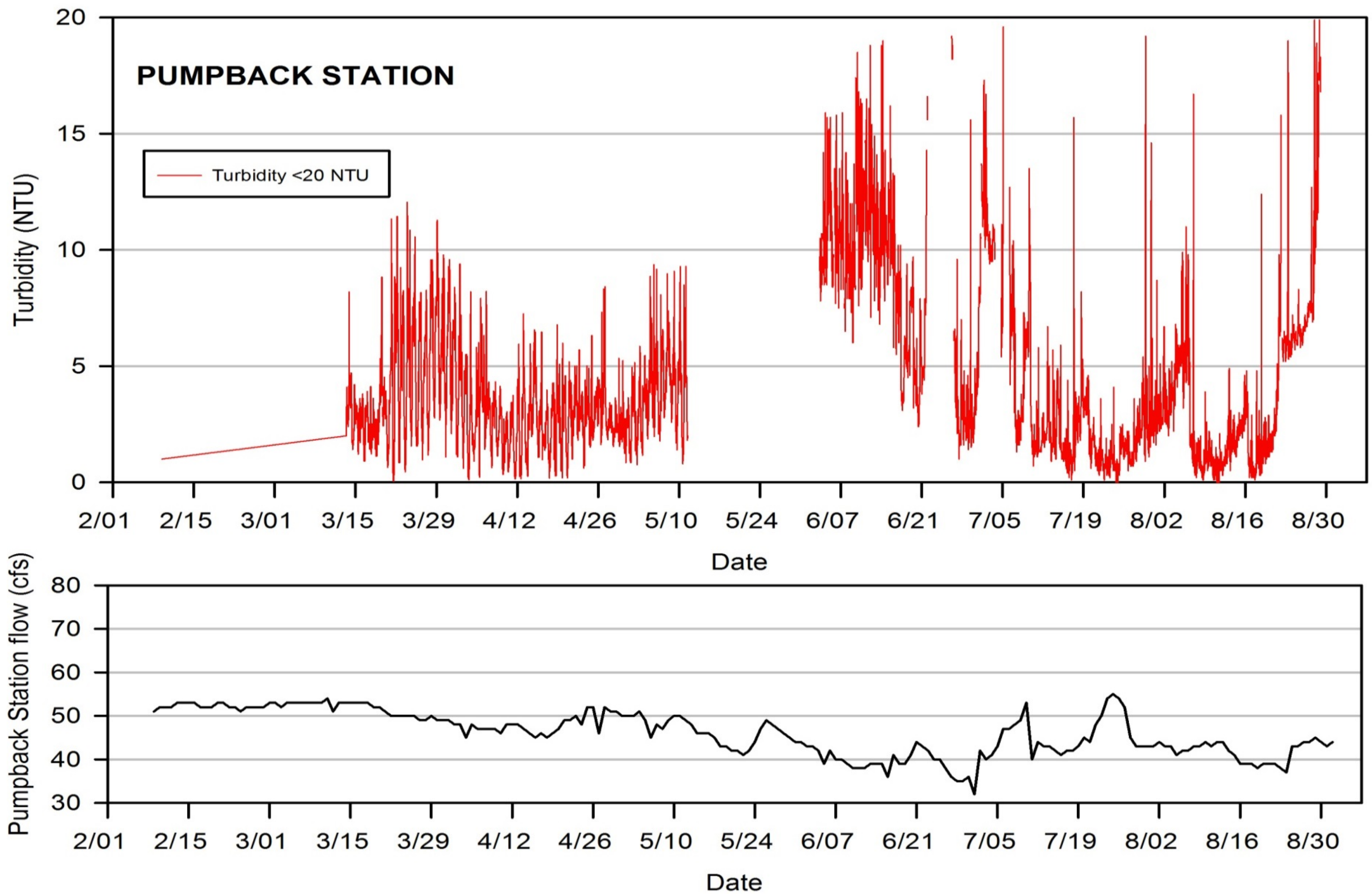


Figure 18. Turbidity (top graph) and estimated daily flow (bottom graph) arriving at the Pumpback Station.

8.0 2015 WEED REPORT

Prepared by the Inyo/Mono Counties Agricultural Commissioner's Office

2015 LORP Weed Report
Inyo/Mono Counties Agricultural Commissioner's Office

Introduction:

The Inyo and Mono Counties Agricultural Commissioner's Office (CAC) manages certain invasive weed infestations within the LORP project area in conjunction with The City of Los Angeles Department of Water and Power (LADWP). Target weeds for CAC management and control include California Department of Food and Agriculture (CDFA) designated weeds. Management of these species is accomplished both by efforts to eradicate known weed populations within the LORP area, as well as through monitoring the LORP area for pioneer populations. The detection component is critical to the protection of the LORP as this region is a recovering habitat with many disturbed areas, and also because eliminating these threats early is far less costly than attempting to do so once established. Disturbed conditions make this area more conducive to weed establishment, as does increasing recreation use.

While protecting native habitat is the paramount goal of this project, there are many other positive consequences resulting from this work. A healthy native plant habitat will support wildlife (including some threatened and endangered species), help to reduce stream bank erosion and dust, maintain healthy fire regimes, preserve the viability of open-space agriculture, and conserve recreational opportunities.

Summary of LORP Weed Management Activities in 2015

LORP invasive plant management during 2015 included both treatments of known sites throughout the growing season as well as ongoing survey activities to identify new infestations. Field staff numbered only one employee from CAC, which is down from three employees in the previous year. All known *Lepidium latifolium* sites within the LORP area were treated, but staff was not able to treat all sites three times throughout the growing season as had been done in prior years. Invasive plant populations totaled .84 net acres, which represents a .52 acre decrease over 2014. Most of this decrease occurred within one site near the Winterton management unit. This site, which ballooned from a few plants to 1.24 acres in 2014, is now one half acre in size due to aggressive management activities in 2014. All other sites continue to be small and spotty in nature, containing less than 200 plants each.

Individual sites totaled 51 in 2014, up 5 sites discovered during surveys. Of the 51 known sites, 21 sites had no plants present in 2014. Of these 21 no growth sites, 11 had no growth for 5 years. After five continuous years of no growth, sites may be considered eradicated.

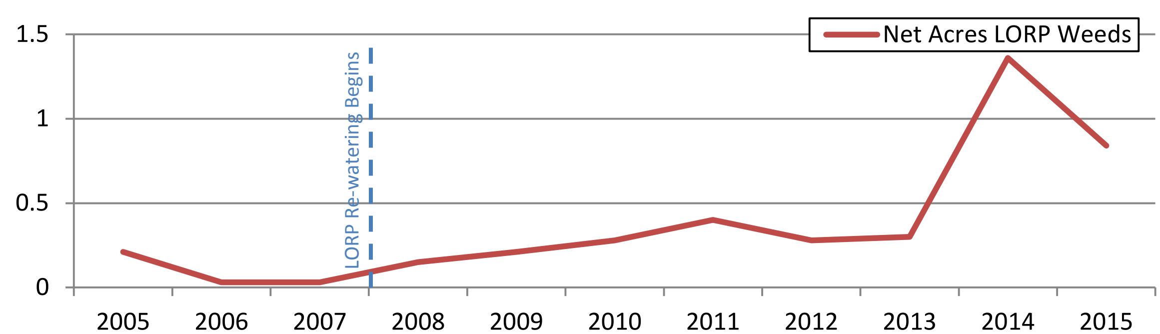
Table 1 – Count of LORP Invasive Weed Sites

Year	Total Number of Sites	New Sites Discovered	Sites with No Growth
2002	2	0	0
2003	2	0	1
2004	3	1	1
2005	4	1	1
2006	4	0	1
2007	4	0	1
2008	12	8	1
2009	17	5	4
2010	32	15	5
2011	35	3	19
2012	38	3	19
2013	39	1	29
2014	46	7	22
2015	**51**	**5**	**21**

Survey efforts continued in 2015, but with only about 10,700 acres surveyed within the LORP area. This represents over 30,000 fewer acres surveyed than 2014. This includes areas of known infestations, one annual survey into other areas to ensure no new populations are allowed to establish undetected, and surveys of areas indicated as containing weed populations during 2014 rapid assessment surveys (RAS).

Treatment methods followed successful strategies used in 2014, including low-volume, directed spot treatments using selective herbicides. These applications were made on foot using backpack sprayers to mitigate damage to native plant communities within the LORP. CAC will continue to employ these methods as long as these results continue and staffing levels permit.

Chart 1 – Net Acreage of Weed Populations on LORP



Management Difficulties

The most significant management difficulty continues to be maintaining adequate resources for effective management. CAC is only able to commit one employee to work on the entire LORP area. Previously discovered populations continue to decline as a result of control efforts, but new populations continue to appear in alarming numbers. Detecting small invasive plant populations in the vast LORP project area early in the colonization cycle has become a difficult task to maintain. Treatment activities are most effective when plant populations are discovered early, saving resources long-term and reducing the threat of seed dispersal.

9.0 SALTCEDAR REPORT

Prepared by Inyo County Water Department

9.0 SALTCEDAR CONTROL PROGRAM

The goal of Saltcedar Control Program is to eliminate existing saltcedar stands, to prevent the spread of saltcedar throughout the Lower Owens River and associated wetland environments, and to sustain the ecological restoration that is now occurring in the LORP.

PROGRAM BACKGROUND

Saltcedar (Tamarix ramosissima) is an invasive non-native shrub or tree that can grow to 25 feet and live up to 100 years. Given favorable conditions, a tree can grow 10 to 12 feet in one season. Saltcedar can compete with native vegetation and degrade wildlife habitat. Its presence in the southern Owens Valley has the potential to interfere with the LORP goals of establishing a healthy, functioning Lower Owens River riverine-riparian ecosystem.

References to the importance of managing saltcedar can be found in documents that guide the saltcedar program and govern the LORP:

- The LORP Monitoring, Adaptive Management, and Reporting Plan (MAMP), notes that saltcedar may increase in some areas of the river because of seed distribution with stream flows. The MAMP states that the potential risk of infecting new areas with saltcedar is considered a significant threat in all management areas

- The 1997 Memorandum of Understanding (MOU), between Inyo County, City of Los Angeles, Sierra Club, Owens Valley Committee, CA Dept. of Fish and Game and California State Lands Commission, expresses that saltcedar reinfestation in the LORP area would compromise the goal of controlling deleterious species whose “presence within the Planning Area interferes with the achievement of the goals of the LORP” (1997 MOU B. 4)

- Parties to the Long-Term Water Agreement (LTWA) recognized that even with annual control efforts saltcedar might never be fully eradicated, but that ongoing and aggressive efforts to remove saltcedar will be required. (Sec. XIV. A)

PROJECT MANAGEMENT AND STAFF

The Saltcedar Control Program is administered by the Inyo County Water Department, and managed by a Saltcedar Program Manager. Work crews are hired seasonally and consist of eight employees and one shared county employee. In addition, the California Department of Forestry and Fire Protection can provide work crews to assist in efforts to cut, pile, and burn saltcedar. In 2014-2015, the field season began in mid-October and concluded in mid-March.

METHODS

The Saltcedar Control Program personnel use chainsaws, brushcutters, herbicides, and controlled burning to treat and control saltcedar, and remove saltcedar slash in the Owens Valley.

WORK ACCOMPLISHED (Figure 1 and 2)
From October 2014-March 2015 Inyo County Water Department saltcedar field crews cut and treated with herbicide approximately 165 acres of saltcedar.

In addition, the saltcedar field crews working with Los Angeles Dept. of Water and Power crews, and California Dept. of Corrections and Rehabilitation crews began a treatment program in the Lower Twin Lake area. This area consisted of dense stands of saltcedar and Russian olive trees.

Each year the saltcedar crews sweep the Lower Owens River and treat resprouts, pull seedlings, and remove mature plants. Crews are guided to the new growth and regrowth by information obtained in the previous year's Rapid Assessment Survey. This year crews covered about 89 miles of riverbank and floodplain.

About 50 piles of dry slash, which had accumulated over the years, were burned in the 2014-2015 field season. Due to fire restrictions related to the ongoing drought the burn window was limited this field season. This effort was assisted by the California Department of Forestry and Fire Protection and the Los Angeles Department of Water and Power.

FUNDING
The County's three-year Wildlife Conservation Board (WCB) saltcedar eradication grant expired in December 2014. This generous funding had enabled a level of effort that would not have been possible with Inyo County and LADWP contributions alone.

An ongoing responsibility of the Saltcedar Program, with the assistance from the LADWP, is to secure grant funding to maintain an active Saltcedar Control Program.

Figure 1. Saltcedar cut areas 2014-2015 under WCB grant

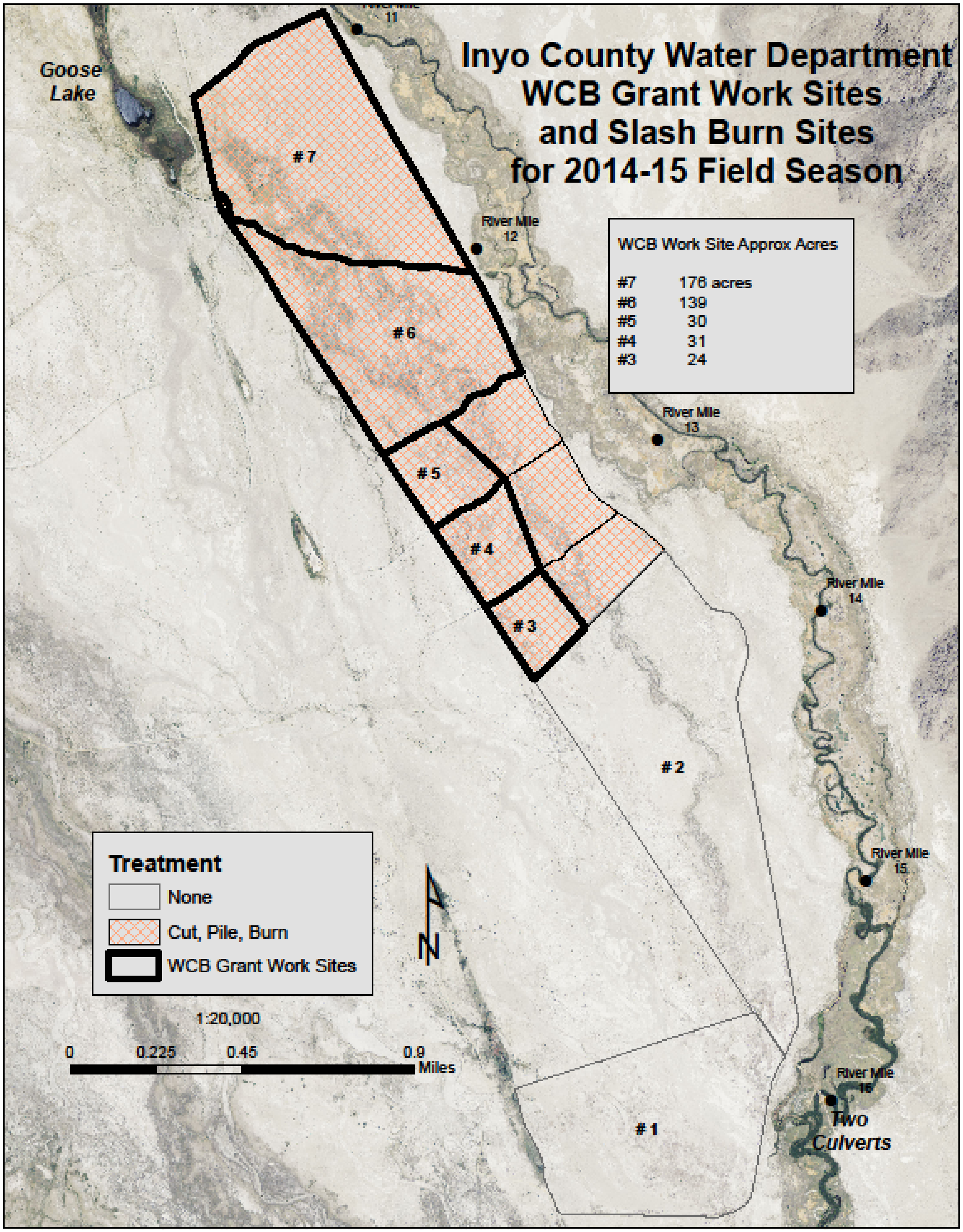


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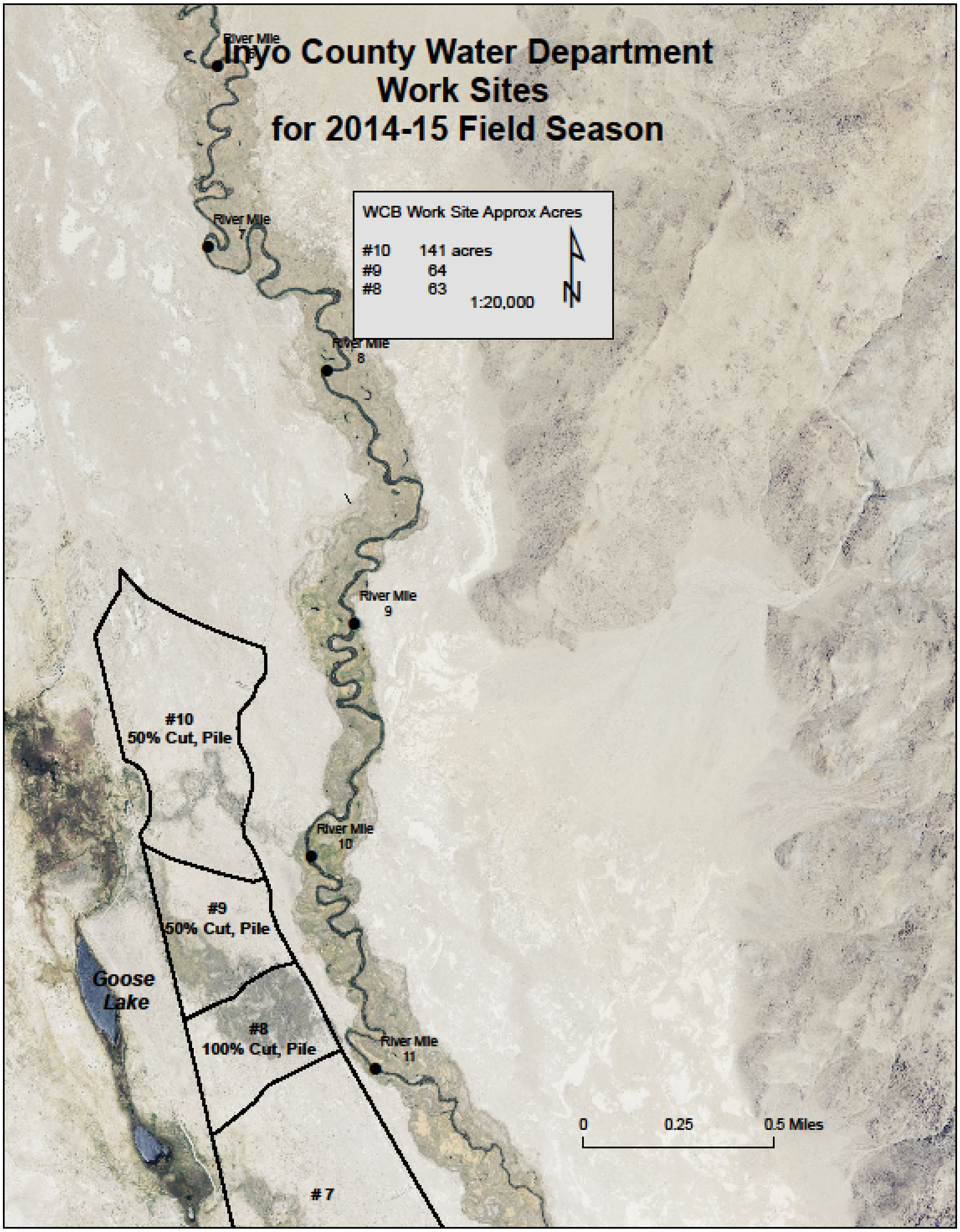
Figure 2. Saltcedar cut areas 2014-2015 post-WCB grant



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10.0 ADAPTIVE MANAGEMENT RECOMMENDATIONS

Prepared by Ecosystem Sciences

2015 LOWER OWENS RIVER PROJECT ANNUAL REPORT

ADAPTIVE MANAGEMENT RECOMMENDATIONS

Prepared by:

MOU Consultants

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Summary of Adaptive Management Recommendations

The MOU Consultants' adaptive management recommendations are presented for the LORP resource areas monitored in 2014-15: hydrology, Blackrock Waterfowl Management Area, off-river lakes and ponds, creel census, avian census, indicator species habitat, land management, landscape vegetation mapping, weed report, RAS, and the HCP. We also evaluate progress toward MOU goals and the Monitoring and Adaptive Management Plan (MAMP). Adaptive management recommendations are described in detail in the following sections and summarized as follows:

- Adaptive management recommendations for changes in base and seasonal habitat flow management, outlined in 2013 and 2014, are still supported and again recommended for testing in 2016.
- Previous flow augmentation recommendations are still supported and again recommended.
- Period 1 (April-May), Period 3 (September-October), and Period 4 (November-December) Delta Habitat Area flows be released in 2016 from the Intake Control Station as displayed in Tables 6 through 8 of this report and waive the 50 cfs pump out restriction at the Pumpback Station during the Period 1, 3, and 4. Any period flow release that turns out to be above "water neutral" would be compensated for by allowing the LADWP to slowly reduce the winter base flow by a similar amount.
- Release a flushing flow, with a 300 cfs peak flow, from the Intake Control Station in April 2016.
- Evaluate the efficacy and validity of the 2008 MAMP creel census methods. Upon completion of this evaluation develop a new method, or combination of methods, if necessary, and submit to the Scientific Team.
- Develop a plan for a four-year cycle with two-year intervals for switching BWMA units. The plan should include employment of multiple tule control treatments, including excavation, burning and experimental use of herbicides in localized areas.
- Examine methods and the cost-benefit of recovering fish during drying-wetting cycles of BWMA wetland units.
- LADWP, ICWD and MOU Consultants meet to discuss a suitable flow release pattern and appropriate monitoring to evaluate the effectiveness of different flow releases in the DHA.

- Develop a monitoring program that evaluates woody vegetation recruitment, survival, sustainability, mortality and vegetative trend conditions over the entire river bank and riverine-riparian system as part of range management monitoring in conjunction with Belt-Plot transects to evaluate animal grazing effects.
- The few allotments in non-compliance for multiple grazing seasons must receive more emphasis on meeting forage grazing utilization requirements in 2016.
- After four years of drought, key irrigated pasture conditions should be evaluated in 2016 to understand how they are responding to extreme drought conditions.
- The RAS should continue to be performed as it has in past years, with the emphasis being on the observations that can make the biggest impact on achieving LORP goals (woody recruitment, Tamarisk, and noxious weeds). In addition, the results of the inventory of past woody recruitment sites should be made available as soon as possible.
- Funding must be increased for the Inyo/Mono Counties Agricultural Commissioner's Office control efforts to ensure that existing noxious populations are treated and that adequate effort can be employed to detect new populations.
- LADWP should remap the Riverine-Riparian Area using the 2009 aerial images and the 2005 IKONOS Imagery. Mapping methodologies should be same as those used in 2015 (2014 conditions). These data should be provided to the MOU Consultants when the mapping is complete.
- Continue with Avian Census Monitoring Program and determine if resources are available to increase the frequency of the program.
- Accept LADWP's recommendation to develop species-specific habitat-relationship models for the LORP for the purpose of providing a management tool for understanding bird use of the riverine-riparian area. Provide the MOU consultants with a and data-driven document explaining the habitat suitability model criteria for each species.
- Explore reevaluating the current indicator species list. If data supports removing indicator species from the list because habitat conditions do not, or will not, warrant their inclusions, then it is suggested that LADWP provide written and data-driven documentation as to why a change in the indicator species list is needed.
- Accept LADWP's recommendation to explore alternative approaches to monitoring the BWMA. Recommend LADWP provide a written proposal of alternative monitoring methods.

- Incorporate the Habitat Conservation Plan (HCP) into the LORP MAMP to fulfill the MOU requirements (Section IIA 2).
- Conduct a "Monitoring and Adaptive Management Workshop" in 2016. The purpose would be to review, upgrade, and/or revise the 2008 MAMP.
- Conduct a second River Summit during the winter of 2015-2016. A primary focus would be on evaluating required MOU (1997) and EIR (2004) goals in relation to present LORP conditions.
- Conduct a "Goals Analysis and Solution" workshop to develop a guidance document to address MOU goals that will be difficult to meet, are not being met, and may never be met. The guidance document will be used to draft a management plan for attainable goals.

Annual Report Deficiencies

The 2015 Annual Report is deficient in several ways. First, ICWD went to great effort and cost to implement the Creel Census. All anglers performed their roles as required; ICWD provided the raw data to the MOU Consultants and LADWP. Unfortunately, LADWP did not follow through to analyze the data and write a Creel Census report. LADWP did not write the report stating that the task was not in the work plan.

Second, ICWD, at the MOU Consultants' request, briefly summarized the water quality work that was performed with LADWP staff. ICWD and LADWP installed and began to calibrate six sondes from about June through August. This monitoring was to be performed in conjunction with flow modifications. However, because agreement amongst the MOU Parties could not be reached to modify flows, the sondes were decommissioned. ICWD expected to make a short report and analysis along with suggestions for continued water quality monitoring. Such a report, even a brief one, would be important information for MOU Parties. Again, this was not a task specifically designated in the work plan and LADWP would not contribute staff time.

Third, in the Blackrock Waterfowl Management Area (BWMA) LADWP began the process of dewatering the Drew Unit and flooding the Winterton Unit. In preparation for this exchange, LADWP apparently built berms throughout the Winterton Unit to contain the inflow. Some of these berms failed and required repair. None of this activity appears in LADWP reports. LADWP does not provide any discussion of what occurred and what actions were taken. The Winterton Unit is being adequately flooded, but knowing how the unit was prepared and what problems were encountered and overcome would be valuable knowledge when the shift to the Waggoner Unit is required.

Fourth, LADWP did not complete a 2015 Draft Annual Report by November 1 as required in the work plan, which is to be made available to the MOU Consultants. Instead, LADWP forwarded individual draft sections to the MOU Consultants for review and formulation of adaptive management recommendations. This piecemeal approach was not thorough and was inconsistent. The MOU Consultants made adaptive management recommendations without having seen a completed draft document.

MOU Consultants could not make a full evaluation of grazing conditions presented in the land management report because LADWP failed to complete the required contracting and funding in time for performance of a field review of range conditions.

The purpose of an annual report is to document activities related to the LORP. MOU Parties are not adequately informed when management ignores or omits actions taken and decisions made; nor can the Scientific Team learn from successes or failures. The LORP cannot be managed as a set of boxes to simply be checked off, regardless of the impact on the project. This has been, and continues to be, a fundamental flaw in management of the LORP. If an action needs to be occur, but is not covered in the work plan, it is not appropriate to take no action. Having the wherewithal to respond to unforeseen events, or collect and analyze additional data, is the purpose of a having a contingency in the work plans and the essence of adaptive management. These deficiencies and lack of management hinder project success.

Attainment of MOU Goals and Obligations

Developing Goals and Requirements

The 1997 MOU, directing the planning, implementation, and adaptive management process for the LORP, has been in effect for 18 years. Negotiations to develop the 1997 MOU were started 5 years earlier. Therefore, LORP decisions makers, LORP managers, and the MOU Parties have had 23 years to plan, implement, and adaptively manage the LORP. These 23 years of planning and management implementation has resulted in today's Lower Owens River (LOR) ecological conditions.

LOR flow management, as directed by the MOU and its accompanying Stipulation and Orders, is now in its ninth year (40 cfs base flow initial release April 1, 2006). Adaptive management to modify LOR management to ensure successful attainment of MOU goals is now in its eighth year. Sufficient time has elapsed to be able to evaluate whether MOU (1997) goals and requirements have been met, will continue to be met, or will not be met in the future, if past and present management methods continue.

LORP Ecological Response

After nine years of management, data collection, observation, experience, and evaluation, it should now be possible to predict (in general terms), using time trend analysis, future LOR conditions in 1-, 5-, 10-, and 20-year horizons. This analysis has not been done. Sections of the LOR have aggraded (Jensen 2014) and will continue to aggrade under past and present flow management. The aggradation has been much faster than anticipated. Because the LOR is in an aggrading ecological state, it is possible to predict the LOR's future if current management continues.

Today's LOR is not developing the desired desert riparian tree canopy (willow and cottonwood) dominated river system (2014 Annual Report). As RAS (2015) data confirms, the LOR is not going to recruit and sustain even present numbers of willow and cottonwood trees. Current river flow management is having a far greater impact on the poor health and low abundance of juvenile tree willow stands than any other LORP management activity (2014 Annual Report).

Riparian forest (tree willow) along the LOR decreased from 444 acres in 2009 to only 162 acres in 2014 (Jensen 2015). Part of this decrease, however, is attributed to more precise mapping of tree canopies in 2009 and 2014. The extent of riparian forest is declining and existing trees are not expected to be replaced (Jensen 2015). Dr. Patten (Sierra Club's Consultant), in his review of the 2013 Annual Report, pointed out that overall recruitment of a healthy riparian habitat dominated by dense woody riparian habitat has failed.

Today's LOR condition is characterized by cattail-tule abundance and distribution that occludes the channel in many locations, impacts water quality, and precludes the river from expelling organic materials and sediments from its channel. Tule-cattail domination is so severe it is detrimentally affecting recreational game fishing, hunting, boating, and other forms of recreational access. It is reasonable to conclude that these limiting conditions will continue to hamper LOR development in the future.

The LOR is expected to become more occluded and the extent of open surface water will continue to decrease (Jensen 2015). Conditions are moving away from a diverse riverine-riparian habitat with open channel. The extent of LOR surface water increased from 100 acres in 2000 to about 259 acres in 2009, but since then the area of open water has decreased to 159 acres (Jensen 2015). Some of this loss can be attributed to mapping errors or methodology changes since 2000, but regardless open water areas are converting to marsh due to the increased distribution of cattail-tules. Open water will continue decline in the future if present flow management continues.

Need to Reevaluate Goals

The MOU Consultants in their 2013 adaptive management recommendations stressed that the time has come to ask and answer the question: will LORP goals, objectives, and requirements be met? In 2013, the MOU Consultants pointed out (with sufficient data and evaluation) that base flow effectiveness, seasonal habitat flow effectiveness, indicator species needs, productive riverine-riparian habitat diversity, and tule-cattail control goals are not being met. MOU Consultants also pointed out that invasive species control, BWMA habitat needs, and some recreational goals were only trending in the right direction, but had not attained MOU goals yet.

The Sierra Club and the Owens Valley Committee, in their review of the 2013 Annual Report, pointed out that progress towards meeting LORP goals and objectives over the life of the project cannot be easily discerned from annual reports. They stressed that annual reports, to date, have failed to show how management actions are allowing MOU goals and requirements to be met. They requested that a clear assessment and analysis of progress and sustainability towards meeting LORP goals and objectives be performed.

Mr. Mark Bagley, MOU Party representative, also noted that LORP goals and objectives attainment cannot be discerned from reading annual reports, and requested that the LADWP and ICWD, as the LORP implementing agencies, use their annual reports to inform the public and decision makers whether the LORP is achieving its goals and objectives. Mr. Bagley requested that annual reports not merely be used as a "check-the-box" exercise in monitoring and flow compliance; or relegating an assessment of progress to the MOU Consultants' adaptive management section. Mr. Bagley also emphasized an important observation when he predicted that passive restoration alone will not achieve LORP goals. He called for active restoration approaches to meet LORP goals.

The MOU Consultants believe that the riverine system that now exists will persist into the future if present LORP management methods continue. At the end of the 15-year monitoring and adaptive management program, the LOR will have much the same ecological condition and characteristics the river has today. The future LOR will have an increased ratio of tules to open water, water quality will be more degraded, the channel will be more aggraded, and there will be more frequent and larger fish kills. It seems unlikely that the proposed 40 cfs base flow and up to 200 cfs seasonal habitat flows will significantly alter the direction of changes towards graded and aggraded conditions for the LOR.

The MOU does not set an end date for meeting all goals and requirements. The MOU strongly infers, however, that all goals and requirements will be met before any LORP ending date is finalized. To wait until 2024 to determine if MOU goals and requirements are met could add years to the LORP process. Determining the status of each MOU goal and requirement at this time will allow a re-direction of LORP resources towards meeting those goals that have proven difficult to attain and reanalyzing those that are impossible to attain in the future.

MOU Goals

The MOU is comprised of multiple goals and requirements for the LORP. A commitment to fulfill these goals and requirements were approved by all Parties at project inception. No evaluation, however, has been performed to-date to determine which goals and requirements have been met and which ones may never be met. Table 1 lists *some* of the more important goals and requirements appearing in the 1997 MOU that the MOU Consultants believe need to be evaluated now for compliance determination.

Table 1. Selected important goals and requirements listed in the LORP 1997 MOU

1. Establish healthy ecosystems in healthy ecological condition
2. Establish functioning ecosystems
3. Establish healthy ecosystems that will benefit biodiversity
4. Establish healthy ecosystems that will benefit "Threatened and Endangered" species
5. Establish and maintain diverse riverine habitats
6. Establish and maintain diverse riparian habitats
7. Establish and maintain diverse wetland habitats
8. Establish wetlands in a healthy ecological condition
9. Create and maintain though flow and land management diverse natural habitats consistent with the needs of "habitat indicator" species
10. Comply with State laws and regulations, Federal laws and regulations, and guidelines that protect "Threatened and Endangered" species
11. Manage to be consistent with applicable water quality laws, water quality standards, and other water quality objectives

12. Control deleterious species (plant and animal) whose presence interferes with achieving LORP goals and requirements
13. Manage livestock grazing consistent with the goals of the LORP
14. Manage recreational use consistent with the goals of the LORP
15. Create and sustain healthy aquatic habitats
16. Create and sustain healthy riparian habitats
17. Create and sustain a healthy warm water recreational game fishery
18. Create and sustain healthy habitat for native fish
19. Minimize the amount of muck on the river channel
20. Minimize the amount of other bottom material on the river channel
21. Cause muck and other sediment bottom material to be transported out of the system or be redistributed on banks, floodplains, and terraces to benefit vegetation
22. Fulfill the wetting, seeding, and germination needs of riparian vegetation, particularly willow and cottonwood trees
23. Recharge groundwater in streambanks and floodplains to benefit wetlands and biotic communities
24. Control tules and cattails to the extent possible
25. Enhance the fishery
26. Maintain good water quality conditions
27. Meet all water quality standards and objectives
28. Enhance the river channel
29. Enhance and maintain in the DHA 325 acres of existing habitat suitable for shorebirds, waterfowl, and other animals
30. Enhance and maintain in the DHA new additional habitats suitable for shorebirds, waterfowl, and other animals
31. To the extent possible make the DHA as self-sustaining as possible
32. In Off-River Lakes and Ponds maintain or establish diverse habitats for fisheries
33. In Off-River Lakes and Ponds maintain or establish diverse habitats for waterfowl
34. In Off-River Lakes and Ponds maintain or establish diverse habitats for shorebirds
35. In Off-River Lakes and Ponds maintain or establish diverse habitats for other animals described in the 2004 EIR
36. In Off-River Lakes and Ponds maintain or establish diverse habitats for habitat indicator species
37. Provide and maintain habitat for habitat indicator species in the Blackrock Waterfowl Management Area as described in the 2004 EIR and the 1997 MOU
38. Provide and maintain waterfowl habitat in the Blackrock Waterfowl Management Area as described in the 2004 EIR and the 1997 MOU
39. Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for riparian habitat (MAMP)
40. Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for the fishery (MAMP)
41. Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for water quality (MAMP)
42. Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for animal migration (MAMP)
43. Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium resulting in productive ecological systems (MAMP)

44. Maintain 755 acres of wetland-riparian areas and surface water suitable for shorebirds, waterfowl, and other animals in the Delta Habitat Area (S&O)
45. Prevent fish kills

Goals and Requirements Which Have Been Met

The LORP has produced some valuable resources, altered other resources, and has already met some of the MOU goals and requirements. Through data evaluation, observation, and experience it's possible at this time to identify those goals and requirements that have been met and will probably continue to be sustained. Table 2 lists some goals and requirements the MOU Consultants deem have been met or are close to being met, though a formal analysis still needs to be completed.

Table 2. A list of some important MOU goals that have been met, are close to being met, or will be met before the 15- year monitoring program period ends.

1. Establish functioning ecosystems
2. Establish and maintain diverse wetland habitats
3. Control deleterious species (plant and animal) whose presence interferes with achieving LORP goals and requirements
4. Manage livestock grazing consistent with the goals of the LORP
5. Manage recreational use consistent with the goals of the LORP
6. Create and sustain healthy habitat for native fish
7. Recharge groundwater in streambanks and floodplains to benefit wetlands and biotic communities
8. Enhance the fishery
9. Enhance and maintain in the DHA's 325 acres of existing habitat suitable for shorebirds, waterfowl, and other animals
10. Enhance and maintain in the DHA new habitats suitable for shorebirds, waterfowl, and other animals
11. To the extent possible make the DHA as self-sustaining as possible
12. In Off-River Lakes and Ponds maintain or establish diverse habitats for fisheries
13. In Off-River Lakes and Ponds maintain or establish diverse habitats for waterfowl
14. Provide and maintain waterfowl habitat in the Blackrock Waterfowl Management Area as described in the 2004 EIR and the 1997 MOU
15. Maintain 755 acres of wetland-riparian areas and surface water suitable for shorebirds, waterfowl, and other animals in the Delta Habitat Area

Goals that Will Be Difficult to Meet

During the long MOU development and approval process, it was difficult to predict the feasibility of MOU goals and requirements. Expectations led to setting goals and requirements that, with today's LORP experience, are not attainable. The science used at the time the 1997 MOU was being generated was not tested for application in a desert river system like the LOR. It was because of these uncertainties that it was agreed that adaptive management would be the guiding principle for the LORP.

Table 3, lists some important goals and requirements the MOU Consultants believe, at this stage of LORP management capability and based on past experience, will be very difficult to meet. An example of questionable goal attainment is the status of all habitat indicator species and whether they are thriving, surviving, or declining. Mr. Bagley (Sierra Club Representative) stressed in his 2014 Annual Report review, that a question to be answered, is the natural habitat being produced that will meet the needs of *each* "habitat indicator species?"

Table 3. Some important MOU (1997) goals and requirements the MOU Consultants believe will be difficult to meet or will not be met before the proposed 15-year monitoring and adaptive management program ends, given current LORP management.

1. Establish healthy ecosystems in healthy ecological condition
2. Establish healthy ecosystems to benefit biodiversity
3. Establish and maintain diverse riverine habitats
4. Establish and maintain diverse and healthy riparian habitats
5. Create and maintain diverse natural habitats consistent with the needs of habitat indicator species
6. Be consistent in meeting all applicable water quality laws, water quality standards, and water quality goals
7. Sustain a healthy warm water recreational fishery
8. Minimize the amount of muck in and on the river channel
9. Minimize the amount of other bottom materials in and on the river channel
10. Cause the muck and other bottom material to be transported out of the system or be redistributed on the streambanks to benefit vegetation
11. Fulfill the wetting, seeding, and germination requirements of willow and cottonwood trees.
12. Control tules and cattails to the extent possible
13. Enhance the river channel
14. Prevent any future warm water fish kills
15. Implement successful adaptive management procedures
16. Apply a habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for water quality
17. Apply a habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for biodiversity
18. Comply with State and Federal laws, regulations, and guidelines that protect" Threatened and Endangered" species
19. Maintain good water quality conditions

Goal Attainment Solutions

The MOU Consultants advised in their 2011 recommendations that on-going adaptive management was not successful and not being implemented correctly and that this will, in the future, ultimately affect the viability and success of the LORP and its long-term ecological health and resulting resource benefits.

Failure to apply needed adaptive management recommendations invites failure to meet MOU goals and objectives and cause ecological setbacks in the LORP.

The future application and implementation of adaptive management is the only instrument that can make feasible LORP goals attainable. The ICWD and the LADWP have the full responsibility to review, determine, and implement the adaptive management process. They will need the backing and guidance of the MOU Parities to make it successful.

The MOU Consultants suggest that the goal evaluation and solution process should start today. Based on this rational, the MOU Consultants submit the following recommendations.

MOU Consultants Recommendations

1. The MOU Consultants recommend during the winter of 2015-2016, the MOU Parties conduct a two-day "Goal Analysis and Solution" Workshop. This Workshop would stress one agenda item only: meeting the goals and requirements of the MOU. The workshop product would be to identify those goals and requirements that are difficult to meet, are not being met, and will probably never be met. The workshop would develop a guidance document for the Scientific Team to assist in their responsibilities of providing the science to ensure goals and requirements are met and sustained prior to the ending of the LORP. The guidance document should be completed by April 2016.
2. Once the MOU Parties have completed the guidance document, the MOU Consultants recommend the Scientific Team review, upgrade, and develop a draft management plan to ensure MOU goals and requirements are met. The Scientific Team would evaluate each MOU goal and requirement previously identified as needing improved management. They would then develop respective management solutions. The Scientific Team would then submit their management solutions to the Technical Group for action.
3. The MOU Consultants recommend the Technical Group review and upgrade the report as necessary and submit the goal attainment solution report to the Standing Committee for action.
4. The MOU Consultants recommend that all stakeholders (i.e., MOU Parties, Scientific Team, Technical Group, and Standing Committee) make goal and requirement attainment a high priority in 2016.

5. The MOU Consultants recommend that future LORP Standing Committee management decisions, especially those guiding the adaptive management process, direct available resources towards attaining those goals and requirements identified in the workshop as difficult to attain.

Flow Management

Base Flows

Twenty years have elapsed since the Lower Owens River (LOR) flow management plan was developed. This plan still guides the LOR flows being released today. The MOU (1997) required base flows were initiated nine years ago in December 2006. Since that time, daily, monthly, and year -to-year base flows have been quite uniform when compared seasonally among years. Nine years of flow management evaluation is sufficient time to determine if base flows will or will not develop desired and required ecological conditions.

The MOU Consultants have pointed out for many years, that nine years of uniform LOR base flows (actually 29 years when previous lower base flow periods are also considered) have formed marsh-canal like river conditions; not near-natural river conditions. Seven years ago, in their 2008 adaptive management recommendations, the MOU Consultants recommended a thorough analysis of all possible LOR flow scenarios, which would lead to a report recommending feasible flow alternatives to test. The recommendation was never accepted and the report was never completed. In their 2013 adaptive management recommendations, the MOU Consultants again pointed out that undesirable conditions were continuing in the LOR due to flow management, and again no action was taken.

Lower Owens River Conditions

The current LOR flow regime is causing ecological stagnation, aggradation, and early signs of stress on aquatic life. Dr. Duncan Patten, Sierra Club's consultant, points out that overall recruitment of healthy riparian habitat dominated by dense woody riparian plant species has failed. Given the current condition, and perhaps historic conditions, the LOR is not, and will not, develop into a woody dominated river system. California Department of Wildlife (CDW) is also concerned and emphasized that by continuing the current flow regime, the LOR will "not" achieve LORP goals as stated in the adaptive management section of the 2013 Annual Report. Dr. Patten's memo also stated that the current LOR flow regime will not result in the achievement of LORP goals and objectives.

The Belt-Plot LOR streamside monitoring program has produced some useful, albeit limited, information. Belt-Plot evaluations in 2013 showed that summer base flows submerged 33% of all juvenile tree willows for 2 to 3 months. This long flooding period leads to the mortality of many potential trees along the LOR. The LADWP's evaluation also showed that the higher summer base flows enabled and increased the expansion of tules and cattails onto gravel and sandbars and adjacent floodplains. This flooding expansion places young willows in direct competition with emergent wetland plant species and decreases future opportunities for tree willow germination on these sites. Increased summer base flows are still causing meadows to be lost to invasion by aquatic vegetation (2015 Annual Report). The loss of previous livestock forage areas (mainly meadows) in the Island grazing lease is a good example. All available flow assessments, to date, demonstrate that future LOR flow management needs improvement.

Over the past 45 years the LOR has continually experienced periods of poor water quality conditions. The 2008 to 2015 RA reports and data demonstrate how difficult it is for streamside zones bordering the LOR to recruit and sustain riparian trees. Instead, a tule-dominated river channel now produces organic material which occludes streambanks and in the fills the river channel. This channel occlusion, under certain flow events, results in poor water quality conditions, inviting the constant threat of fish kills. The continued loss of livestock forage on some grazing leases is also a result of abnormal base flow patterns. To continue with the same annual flow management scenarios year-after-year and expect different LOR ecological conditions is poor river management.

Future Lower Owens River Conditions

LOR base flows are likely the dominant human applied force and effect that created the ecological conditions the LOR occupies today. The LOR is presently going through a phase of very slow, almost static, but aggrading, annual ecological change from year to year. Therefore, if base flows are managed in the future, as they have been in the past, then we now have the river we are going to get. The ecological and physical differences between today's river condition and future river conditions are that the future river will have a more aggraded channel, the ratio of tule to open channel water will increase, fish kills will be more frequent, and water quality will continue to degrade. Based on the LOR's present ecological condition and tempered by the MOU Consultants' predicted future river conditions, the following base flow management recommendations are given.

MOU Consultant Recommendations

1. All of the MOU Consultants adaptive management recommendations for changes in base flow management, outlined in their 2013 and 2014 adaptive management chapters of the annual reports, are still supported and again recommended (See Figure 1). The MOU Consultants recommend the base flow pattern scenarios displayed in Figure 1 be accepted and implemented for testing in 2016. This recommended base flow should be implemented annually until base flows have been properly evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.
2. The MOU Consultants recommend the MOU Parties conduct another one-day River Summit during the winter of 2015-2016. The primary focus would be to again review, evaluate, and discuss the 2013 and 2014 adaptive management recommendation for base flow and seasonal habitat flows. The meeting outcome would be a decision by the MOU Parties to continue present base flow management methods or accept and implement the MOU Consultants' proposed base flow recommendations. If the MOU Consultants' base flow recommendations are again turned down and not implemented, then the MOU Consultants recommend that the MOU Parties develop and implement their own base flow scenarios and initiate them in 2016. These MOU Party flows would be evaluated annually for success, failure, no effect, or needed modification. This is an important recommendation because current base flows will not allow all MOU goals and requirements to be met in the future.

Seasonal Habitat Flows

Six seasonal habitat flows have been released into the LOR over the past 8 years (Table 4). No seasonal habitat flow was released in 2014 or 2015. Completely insignificant seasonal habitat flows (by volume, peak, and duration) have been released 5 out of the past 8 years (Table 4). The primary purpose of the 2008 habitat flow, a required cleansing flow ordered by the LRWQCB, was to remove channel sediments to improve future water quality conditions.

LORP Technical Memorandum #7, the MOU Consultant's 2007 letter to the Court and MOU Parties, and the EIR (2004) all predicted that the MOU 40 cfs all-river base flow requirement, in combination with insufficient seasonal habitat flows, would cause water quality problems, adversely affect fish health, deplete dissolved oxygen, and possibly increase hydrogen sulphide and ammonia gas concentrations. Most of these predictions have come true. Since 1989, dissolved oxygen (DO) levels in the LOR have been recorded at or below 1 mg/l during summer conditions in some river reaches. These are toxic levels in the river, well below minimum basin standards that can result in fish kills as well as the death of other aquatic organisms (Jackson 2014). During the release of the 2010 seasonal habitat flow, dissolved oxygen levels decreased rapidly as seasonal habitat peak flows reached and passed through all LOR river reaches. Fish and other aquatic life were heavily stressed (Platts and Hill personal observations).

Table 4. Seasonal habitat peak flows (cfs) released from the ICS into the LOR by year

Year	Flow (cfs)
2008	220*
2009	110
2010	2009
2011	2005
2012	92#
2013	58#
2014	0
2015	0

*only a cleansing flow
lower than the summer base flows

Flow History

Since LORP initiation (9 years ago) only three seasonal habitat flows were of sufficient peak flow volume to have any effect on the LOR (Table 4). The MOU Consultants now question whether or not a 200cfs peak seasonal habitat flows will contribute any beneficial effects. Seasonal habitat flow peaks, the first four years of LORP implementation (2008 to 2011) averaged 186 cfs. The last four years (2012 to 2015) the average annual seasonal habitat flow peak increase over base was only 37 cfs. These very low seasonal habitat flow releases reflect the controlling and guiding mandates in the MOU, the EIR, and the MAMP that allow the reduction of water availability during low basin annual water runoff conditions.

Flow Effectiveness

Inconsistent past seasonal habitat flow patterns in combination with no on-site or off-site river control sites for comparison makes it difficult to evaluate the effectiveness of seasonal habitat flows. The MOU Consultants believe, however, from annual ocular observation and data, that all seasonal habitat flows combined, to date, have provided limited beneficial effect to the LOR. Implementing these same seasonal habitat flow patterns (or lack thereof) in the future will result in future habitat flows being ineffective. We do know that the continuous tule-cattail encroachment and expansion that creates poor river water quality conditions are the most immediate detrimental issues that were supposed to be corrected through river flow management. We also know that continuing past river flow management will have no beneficial effect in correcting either one of these detrimental issues.

Continual tule-cattail encroachment and the resulting continuous reduction in openwater areas is adversely affecting habitat indicator species, reducing habitat diversity, increasing ET, inhibiting recreational opportunities, decreasing livestock forage on some leases, affecting species diversity, reducing smallmouth bass habitat, reducing water quality, and accelerating river channel aggradation. Increasing ET rates due to tule-cattail expansion is causing LADWP to increase summer base flows to meet stipulation and order requirements, which will continue the downward cycle of the LORP. The ecological condition of the river in the future is going to be determined solely by the base flows if present annual seasonal habitat flow management continues. Based on the LOR's present ecological condition and the MOU Consultants predicted future ecological condition, the following seasonal habitat flow recommendations are submitted:

MOU Consultant Recommendation

1. The MOU Consultants seasonal habitat flow recommendations in the 2013 and 2014 adaptive management chapters (in the respective Annual Reports) still stand and are again recommended for implementation (Figure 1). These seasonal habitat flows should be initiated in 2016 and continued annually until properly evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.
2. The MOU Consultants recommend the MOU Parties conduct a second River Summit during the winter of 2015-2016. A primary focus would be to review and evaluate the MOU Consultants 2013 and 2014 adaptive management seasonal habitat flow and base flow recommendations. The meeting outcome would be to again determine if the MOU Parties want to continue their present flow management or accept the MOU Consultants seasonal habitat flow recommendations. If the MOU Consultants' seasonal habitat flow recommendations are turned down, then the MOU Parties should develop and implement their own annual seasonal habitat flow scenarios. MOU Party developed seasonal habitat flows should be initiated in 2016 and monitored annually and evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.

Augmentation Flows

The MAMP (2008) calls for river flow augmentation if LORP goals are not being met. Both MOU Consultants previously recommended that seasonal habitat flows be flow-augmented as needed to apply larger down-river flows (2013 Annual Report). Augmentation is especially needed in down-river reaches because these reaches receive reduced peak flows. The largest decrease in river peak flow and resulting decreases in river depth, during seasonal habitat flow releases, occurs in the Intake Control Station to the Mazourka Hydro Station river reach. Another significant decrease in peak flow volume occurs from the Mazourka Hydro Station to the Pumpback Station river reach. Additional water to augment down-river flows is available by shortening the seasonal habitat flow duration period, changing location of flow release sites, eliminating the required all-river 40 cfs base flow minimum, and/or using additional water now available under a 2010 Court mandated Stipulation and Order.

MOU Consultant Recommendations

1. The MOU Consultants' flow augmentation recommendations appearing in past adaptive management reports since 2010 are still supported and again recommended. These augmentation flows should be considered for implementation by the Scientific Team in 2016 and continued annually until properly evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.
2. The MOU Consultants recommend the MOU Parties conduct a second River Summit during the winter of 2015-2016. The secondary focus would be to review and evaluate the 2013 and 2014 adaptive management flow recommendations covering flow augmentation needs. The meeting product would be to determine if the MOU Parties want to continue present seasonal habitat flow management or implement needed augmentation flows.

Delta Habitat Area Habitat Flows

If the MOU Parties continue to manage LOR flows in the future as they have in the past, then one flow change that can be made and still abide by the MOU and court restrictions is to release the Delta Habitat Area (DHA) habitat flows from the Intake Control Station instead of the Pumpback Station. To date, *no effective* DHA habitat flow has been released from the Intake Control Station.

DHA habitat flows, released at the Intake Control Station instead of the Pumpback Station, may be able to flush some river organic sediments, now in the water column and deposited on the channel substrate, from the system. In turn, this may provide needed improvements in summer river water quality conditions. The three DHA habitat flow periods recommended to be released from the Intake Control Station occur during cooler periods of the year when river temperature is lower and dissolved oxygen is higher. These more favorable conditions lessen the chance that the recommended flows released during this period from the Intake Control Station would result in fish stress or fish kills.

The MOU Consultants previously recommended that three of the DHA habitat flows be released from the Intake Control Station. The ICWD and the LADWP were not effective in implementing their trial flows. We recommend the ICWD and the LADWP make another attempt to release these flows from the Intake Control Station.

Table 5 lists the four required DHA pulse habitat flows, now programmed for release from the Pumpback Station that the MOU Consultants recommended for a release site change. Tables 6 through 8 display how selected Periods 1, 3, and 4, flows should be released from the Intake Control Station. Because the few DHA habitat flows released in the past from the Intake Control Station were completely ineffective, the MOU Consultants listed their own recommended daily flow volumes in Tables 6 through 8.

Table 5. Habitat flows (cfs) scheduled to be released from the Pumpback Station into the DHA by duration, purpose and date.

Period	Date range	Flow	Purpose
1	March-April	25 cfs for 10 days	Replenish groundwater and lenses
2	June-July	20 cfs for 10 days	Meet high ET rates
3	September	25 cfs for 10 days	Enhance migrant habitat
4	November-December	30 cfs for 5 days	Improve habitat and groundwater

Flow Implementation

Applying shorter duration DHA habitat flows from both the Pumpback and Intake Control Stations allows much higher peak habitat flows to be released. A peak flow released from the Intake Control Station takes 10 to 13 days to show peaking effects at the Pumpback Station. In order for peak flows released at the Intake to coincide with DHA habitat flows, the release must be 10 to 13 days ahead of the DHA flows. The two peak flow release periods need to be coordinated so the flow arriving at the Pumpback Station better fits the 50 cfs maximum pump-out flow restriction the LADWP is bound by.

Table 6, displays the recommended habitat flow release volume by day for Period 1 (March-April) from the Intake Control Station. This habitat flow release from the Intake Control Station covers three days reaching a peak flow of 220 cfs on programmed day 3. Because of difficulty predicting resulting flow volumes arriving at the Pumpback Station, the MOU Consultants have met the LADWP requirement that all flow releases must be "water neutral" by modifying the recommendations section.

Table 6. Recommended Period 1 (March-April) habitat flow (cfs) releases from the Intake Control (ICS) and Pumpback (PBS) Stations.

Day	ICS Base Flow	ICS Habitat Release Flow	Flow Difference from Base	PBS Base Flow DHA	DHA Habitat Flow PBS Required	Flow Difference from Base
1	46	0	0	4	0	0
2	46	70	24	4	0	0
3	46	220	174	4	0	0
4	46	70	24	4	0	0
5	46	0	0	4	0	0
6	46	0	0	4	0	0
7	46	0	0	4	0	0
8	46	0	0	4	0	0
9	46	0	0	4	25	21
10	46	0	0	4	25	21
11	46	0	0	4	25	21
12	46	0	0	4	50	46
13	46	0	0	4	50	46
14	46	0	0	4	50	46
15	46	0	0	4	25	21
16	46	0	0	4	0	0
		Combined Difference	222 cfs			222 cfs

Table 7, displays recommended flow releases from the Intake Control and Pumpback Stations by day and volume. The Intake Control Station flow will cover three programmed days reaching a peak flow of 250 cfs on the 3rd programmed day. As stated in the Period 1 recommended flow, the flow release will be protected to meet the LADWPLADWP's water neutral mandates.

Table 7. Recommended Period 3 (September-October) flow (cfs) releases from the Intake Control (ICS) and Pumpback Stations (PBS).

Day	ICS Base Flow	ICS Habitat Release Flow	Flow Difference from Base	PBS Base Flow DHA	DHA Habitat Flow PBS Required	Flow Difference from Base
1	62	0	0	4	0	0
2	62	79	17	4	0	0
3	62	250	188	4	0	0
4	62	79	17	4	0	0
5	62	0	0	4	0	0
6	62	0	0	4	0	0
7	62	0	0	4	0	0
8	62	0	0	4	0	0
9	62	0	0	4	25	21
10	62	0	0	4	25	21
11	62	0	0	4	25	21
12	62	0	0	4	50	46
13	62	0	0	4	50	46
14	62	0	0	4	50	46
15	62	0	0	4	25	21
16	62	0	0	4	0	0
		Combined Difference	222 cfs			222 cfs

Table 8, displays recommended flows to be released from the Intake Control and Pumpback Stations. The Intake Control Station flow release period covers 3 programmed days with a peak flow release of 208 cfs on Day 3. These flow releases would also be implemented while meeting the LADWP's water neutral mandate.

Table 8. Recommended Period 4 (November-December) flow (cfs) release from the Intake Control (ICS) and Pumpback Stations (PBS).

Day	ICS Base Flow	ICS Habitat Release Flow	Flow Difference from Base	PBS Base Flow DHA	DHA Habitat Flow PBS Required	Flow Difference from Base
1	42	0	0	4	0	0
2	42	70	28	4	0	0
3	42	208	166	4	0	0
4	42	70	28	4	0	0
5	42	0	0	4	0	0
6	42	0	0	4	0	0
7	42	0	0	4	0	0
8	42	0	0	4	0	0
9	42	0	0	4	25	21
10	42	0	0	4	25	21
11	42	0	0	4	25	21
12	42	0	0	4	50	46
13	42	0	0	4	50	46
14	42	0	0	4	50	46
15	42	0	0	4	25	21
16	42	0	0	4	0	0
		Combined Difference	222 cfs			222 cfs

MOU Consultant Recommendations

1. The MOU Consultants recommend that the Period 1 (April-May), Period 3 (September-October), and Period 4 (November-December) DHA habitat flows be released in 2016 from the Intake Control Station as displayed in Tables 6 through 8. These habitat flows would be released annually from the Intake Control Station until properly evaluated by the ICWD and LADWP for success, failure, no effect, or needed modification.
2. The MOU Consultants recommend the MOU Parties allow the LADWP to implement these recommended flows and still meet their "water neutral" mandate. Any period flow release that turns out to be above "water neutral" would be compensated for by allowing the LADWP to slowly reduce the following winter LOR base flow by a similar amount. Any water savings occurring below "water neutral", however, like what occurred in past LADWP habitat flow

releases, would be compensated for by adding the equivalent volume of water to the following year's seasonal habitat flow peak.

3. The MOU Consultants recommend the MOU Parties agree to waive the 50 cfs pump out restriction at the Pumpback Station during the Period 1, 3, and 4 habitat flow release periods. This will make it easier for the LADWP to meet their "water neutral" mandates.
4. The MOU Consultants recommend the ICWD and the LADWP annually evaluate each Period DHA habitat flow release. Findings would appear in in each respective annual report.

Flushing Flow

Since the first LRWQB ordered winter flushing flow was released into the LOR in 2008, no other beneficial flushing flow has been applied to the LOR. The MOU Consultants continue to support and recommend properly applied annual flushing flows. Over the last 5 years the seasonal habitat peak flow release from the Pumpback Station only averaged 37 cfs over the corresponding released base flow. This small flow increase pales in comparison to the summer base flow increases from the Intake Control Station required to meet the 40 cfs over-all river minimum flow requirement.

The LOR channel is aggrading (Jensen 2014). This channel aggradation is due mainly to the annual accumulation of muck, debris, and other sediments. Sufficient sized flushing flows are the only tool available to buffer this situation and hopefully improve LOR poor water quality conditions. Out-of-channel flows of high magnitude are needed to promote establishment of willow and cottonwood trees on the floodplain. Riparian tree populations normally establish in years with large floods, as indicated by RAS data. Future LOR flows need to better match flooding conditions to benefit streamside vegetation.

Table 9 displays the MOU Consultants' recommended flushing flow for 2016. This flow is only recommended if the other flows recommended in this report (as shown in Figure 1) are not accepted and implemented. This cleansing flow would be released from the Intake Control Station and cover a 3-day period reaching a peak flow of 300 cfs on April 13.

Table 9. Recommended April 2016 flushing flow (cfs) release from the Intake Control Station by date, flow, and additional water (acre feet) used

April 2016	Base Flow (cfs)	Pulse Flow plus Base (cfs)	Additional Water Used (af)
10	46	46	0
11	46	46	0
12	46	100	107
13	46	300	504
14	46	100	107
15	46	46	0
			Additional water used 718 af

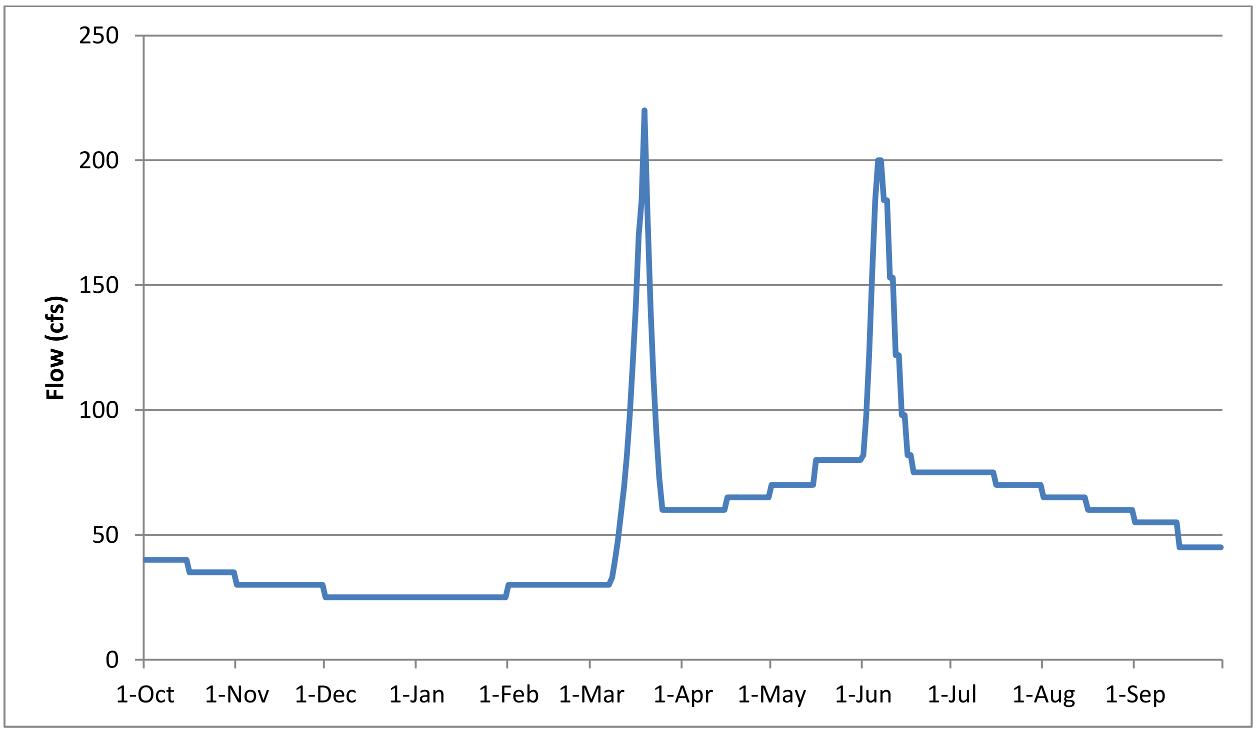

Figure 1. Proposed LORP Base and Seasonal Habitat Flow Regime

Justification

The February 2008 LRWQB mandated flushing flow, which exceeded a 200 cfs peak flow, benefited the river for the following two year period (Platts personal observation). Today's river condition does not allow the river to be so easily flushed and cleansed because of the extensive tule-cattail buildup. A 300 cfs peak annual flushing flow may, however, still provide some beneficial effects to improve LOR water quality conditions, especially during summer periods. The ICWD and LADWP would evaluate these annual cleansing flows to determine their success, failure, no effect, or need for modification. The evaluation would determine if the 300 cfs peak cleansing flow was beneficial, or if the flow volume need to be increased in future years.

MOU Consultant Recommendations

1. The MOU Consultants recommend that a flushing flow, with a 300 cfs peak flow, as displayed in Table 9, be released from the Intake Control Station in April 2016. This recommendation only applies if the MOU Parties do not implement the other needed flows recommended in this Chapter. A required seasonal habitat flow release by itself does not count as covering all needed flows.
2. The MOU Consultants recommend the 718 acre feet of additional water needed to implement the April flushing flow be compensated for. This would be accomplished by the MOU Parties allowing the LADWP to pump-out more than 50 cfs at the Pumpback Station, when additional water is available, during the following November through February period until the 718 acre feet of water is compensated for. This is a feasible solution because during this winter period the LADWP annually passes excess water into the DHA that is not needed to provide benefits to the DHA. A good example occurred in water year 2013-2014 when the average flow to the DHA was 11.2 cfs when the required DHA flow annual release only needs to average between 6.5 to 9 cfs.

   Predicting the timing and magnitude of winter water gain, given sudden contributions of storm water or sudden snow melt conditions, is very difficult. Unintended flows are released to the DHA when intense river storms cause river flows to exceed the limited maximum capacity of the Pumpback Station or when electrical pump outages occur (2010 Annual Report). In case the LADWP cannot make up the full 718 af of water, by taking excess water out during the November through February period, the LADWP would be allowed to meet their “water neutral” requirement by slowly taking it out of the following base flow period.

3. The MOU Consultants recommend the ICWD and LADWP evaluate a series of annual 300 cfs peak April cleansing flows to determine their success, failure, no effect, or needed modification for improving LOR water quality conditions. Findings and evaluations would appear in each respective Annual Report.

Creel Census

Background

Five (2003, 2010, 2013, 2014, and 2015) creel censuses have been conducted in the LORP, evaluated and reported on. In the 2010 adaptive management recommendations, the MOU Consultants recommended that the fall creel census be eliminated and the spring creel census continued. This recommendation was accepted. Spring creel censuses, to date, have assisted in evaluating a primary MOU goal that requires the creation of a healthy warm water recreational fishery in the Lower Owens River (LOR).

Purpose

The 2008 Monitoring and Adaptive Management Plan (MAMP) creel census method designates the number of persons fishing, the duration of their fishing, the seasonal time of fishing, and the location of fishing. Evaluating this census data provides information on the type of fish species caught, fish numbers caught by species, fish average lengths, fishing success, fish species catch composition, river reach fish occupied, age class catch composition, and fish condition. It is very important that the data collected adequately evaluates fish condition; fish species catch composition, and fishing success. Once these conditions are known then the quality and health of the recreational fishery can be determined. This allows the MOU primary goal of creating a healthy recreational fishery in the LORP to be properly evaluated for attainment or non-attainment.

Issues

The ICWD, LADWP, and CDW challenge the validity of using the present 2008 MAMP creel census to adequately evaluate LORP fisheries (ICWD Memo June 10, 2015). The 2015 memo states that ICWD, LADWP, and CDW would not characterize the MAMP LORP creel census as a reliable measure of current fisheries conditions. ICWD pointed out, in their response to the MOU Consultants 2014 adaptive management recommendations, that the creel census is a crude measure of the state of the fishery and cannot ascertain migration patterns or make claims about subtle changes in fisheries over-time. ICWD went on to emphasize that they were skeptical that fishery trends can be found using a creel census that relies on volunteers and does not take into account environmental conditions. (ICWD conducted a 2015 creel census, but LADWP did not contribute the necessary time to analyze the data, determine evaluations, and document results in the 2015 Annual Report. This violates the direction in the MOU that requires LADWP to distribute to the MOU Parties a complete documentation of LORP activities and conditions in each annual report.)

Conflicting Perspective

CDW, in their review of the 2013 Annual Report, expressed concern that the creel census is being inappropriately used to assess warm-water fishery population. CDW expanded on this comment by stating that a creel census is not a measure of the fish population and it should not be used to assess fish abundance or population status.

The 2014 Annual Report, however, states that the 2014 creel census results continue to demonstrate that the LORP contains a healthy diverse warm-water fish community that is self-sustaining with multiple age classes from young-of-the-year to adults. The MOU Consultants agree with this conclusion. The 2014 Annual Report concludes that the census also shows that managed river flows and available habitat are capable of keeping the warm-water fishery in good condition. CDW, in turn, challenged the findings stating that "the 2014 creel census survey results demonstrate that the 2013 LORP fish kill had little to or no effect on the warm-water fisheries." CDW also challenges the statement that the LORP still contains a healthy self-sustaining, warm-water fishery. The 2013 Annual Report concluded that the creel census provides information about fish health, fish abundance, and fish distribution of game fish throughout the LORP. The MOU Consultants support these statements, findings and conclusions, because no evidence has been presented to show otherwise.

Challenges, by some MOU Parties to the 2008 MAMP fisheries monitoring methods, create a monitoring and evaluation problem when it appears so late in the LORP monitoring program. It should be noted that both LADWP and ICWD insisted upon and fully endorsed this methodology during the development of the MAMP. ICWD especially exerted strong input, influence and control on the monitoring method that would be used to evaluate the LORP fisheries. CWD reviewed the MAMP and made no objection to the creel census method.

Initial Monitoring Method

The MOU Consultants originally recommended, during the early MOU development process, a much more robust, resource demanding, and time consuming fishery evaluation methodology (MOU [1997], Appendix 1). MOU Consultants recommended that the LOR and the Off-River Lakes and Ponds fisheries be intensively monitored and evaluated. The MOU Consultants initially recommended that the LOR fishery be monitored by randomly selecting a series of 100 foot river reaches, within each riverine landform type within the LORP. Once reaches were selected, each 100-foot river reach section would be snorkel surveyed to record fish numbers, fish species, fish ages, fish location, fish sizes and fish condition. The evaluation of all combined data collected from all river reaches would then represent the status of the LOR fish population by each individual river section and the combined overall LOR.

The MOU Consultants further recommended that a sub-sample of the selected river reaches representing each LORP land type be electrofished. Handling and evaluating each individual fish collected would provide more detailed information on fish abundance, fish population composition, fish health and fish location preferences. The MOU Consultants justified recommending this expensive and time consuming fisheries monitoring approach based on LADWP conducting similar fisheries monitoring programs in the Mono Lake Basin and Owens Gorge. The MOU Consultants also recommended increasing the power of the previously used fisheries evaluations methods by obtaining and using supporting aerial photographic and habitat type interpretation. Groundtruthing information obtained from aerial photographed landforms would allow more intense monitoring of critical spawning and rearing habitat areas and better evaluate conditions affecting key warm water fish species.

The MOU Consultants' original intensive fish monitoring methods were discarded by all LADWP and ICWD participants from the final approved 2008 MAMP fisheries monitoring methods. The elimination of the MOU Consultants' proposed fisheries monitoring methods occurred because the type of monitoring suggested was expensive, time consuming, and can result in data "over-kill." The proposed intensive methodology would also add human safety problems that would be of concern.

The ICWD must share the cost of post LORP implementation, which includes monitoring costs. Therefore, the ICWD made their position clear from the very beginning and throughout the MOU development process that monitoring could not be open-ended and the program must be least-cost yet still be scientifically credible and meet MOU objectives (MAMP 2008).

The MOU Consultants, to solve the problem, proposed a "Designated Fishing Person Catch Census" to be substituted for their original intensive proposed methods. This catch census method was accepted by ICWD and LADWP and inserted into the MAMP. The MOU Consultants believed this census method, implemented properly, would adequately evaluate the condition of the LOR and Off-River Lakes and Ponds recreational game fisheries.

The MOU Consultants still believe the 2008 MAMP creel census methods will suffice. The large amounts of time, money and resources, the ICWD and LADWP would expend annually, have now been saved and used for other purposes. So, it is contradictory for ICWD and LADWP, as well as CDW, to now challenge the fisheries evaluation method, even though they were instrumental in determining the methodology.

The 2002 LORP Ecosystem Management Plan required angler surveys or creel censuses. The EIR (2004) also required angler censuses (fishing success census) to be part of the LORP monitoring program. As expressed earlier, the census used is a method that does not require large sums of money, resources, and time. Creel censuses in fisheries management have been used very successfully world-wide by scientists for over 90 years. Many of the largest fisheries in the world are totally dependent on using creel census data and evaluation to make recommendations on how to manage these large fisheries.

The ICWD memo went on so far as to emphasize that, "The creel census is not even a reliable measure of current fisheries conditions." ICWD further supported their challenge by stating that, "At least a couple designated fisher-persons could not even reach their fishing holes during the 2015 creel census because of continued tule encroachment." This is not bad information, or illustrative of a flaw in the methodology. Rather it is valuable because this type of information assists in determining if the ICWD and LADWP have met or will not meet the required recreational fishery goal in the MOU.

The MOU Consultants do not believe we have a major problem, but with the ICWD, LADWP and CDW challenges, it is important that we get on with the process of developing a solution.

Solutions

As stated before, a challenge to a LORP monitoring method at this stage of LORP evaluation and adaptive management by members of the MOU Parties creates a serious problem that needs to be resolved. The fact that the census data and evaluations were considered so unimportant that LADWP omitted it from the 2015 Annual Report compounds the seriousness. At the present LORP stage of determining MOU and EIR goal compliance, it is important that ICWD, LADWP, the MOU Consultants, and the rest of the MOU Parties are all on the same page. Even though the MOU Consultants believe the creel census will provide needed answers and be capable of determining attainment of MOU fishery goals, we understand that all parties must feel confident in a monitoring method. The MOU Consultants recommend the ICWD, through the Scientific Team, solve this monitoring and evaluation methods problem prior the 2016 LORP monitoring period.

Another reason to solve the fisheries monitoring methods problem quickly is that CDW, the responsible agency for managing the LOR and Off River Lakes and Ponds fishery, provides no significant fisheries population data or catch rate information. Information that would adequately evaluate or assist in determining the status of the fishery compared to the creel census results. Because CDW cannot supply, at this time, the needed data and information on the fisheries they manage to successfully evaluate the

LOR and Off River Lakes and Ponds fishery (Personal communication with Lacey Greene in 2014); it's up to the MOU Parties to provide the necessary data. Methods used and data collected, however, cannot infringe on CDW'S management and regulatory responsibilities. The following recommendations describe how the MOU Consultants suggest the perceived fishery evaluation methods problem be solved.

Lack of Scientific Approach

In the 2014 Annual Report, ICWD challenged the MOU Consultants for making adaptive management recommendations that lacked scientific backing and scientific justification. ICWD clearly emphasized in their 2014 Annual Report that they would not accept or approve any adaptive management recommendations that does not have supporting research, scientific data, and supportive quantifiable information. Both MOU Consultants agreed with ICWD that they could use more supporting scientific understanding, more improved and reliable scientific data, and more thorough scientific evaluations.

ICWD and LADWP do not provide funds for the MOU Consultants to collect data or perform any kind of research activity; even detailed literature searches. Our scope-of-work focuses on oversight and review. Any data needed to justify our recommendations comes from the monitoring performed by ICWD and LADWP. The MOU Consultants responded to the ICWD's challenge, by strongly recommending that ICWD address this perception by preparing a comprehensive "LORP Scientific Research, Data, and Evaluation Needs" document. This document would detail the scientific omissions, scientific information and scientific evaluation ICWD believes is missing or lacking in the adaptive management process. This recommendation was dismissed by ICWD and no action was taken. This is of concern now, because ICWD continues to believe the monitoring and evaluation fishery methodology is inadequate, but offers no solutions or alternatives.

Solving the Problem

The MOU Consultants strongly recommend that ICWD does not ignore the fishery evaluation issue as they did with the lack of scientific data and evaluation issue. We encourage the ICWD and LADWP and CDW work to solve the problem they point out and not let it go silent. The MOU Consultants cannot solve this problem under present restrictions because MOU Consultants do not make decisions, MOU Consultants are greatly restricted in what they can accomplish by task orders, and MOU Consultants are not allowed to do any scientific research or monitoring methodology development. Therefore, this problem can only be solved by the ICWD, LADWP, and CDW. The MOU Consultants, can, however, provide the following recommendations to move toward a solution.

MOU Consultants Recommendations

1. The Consultants recommend that ICWD and LADWP, during the winter of 2015-2016, evaluate the lack of credibility and validity in the 2008 MAMP creel census methods. Upon completion of this evaluation ICWD and LADWP would then develop a new method, or combination of methods, they are confident will provide the data and information they perceive are needed to adequately evaluate the MOU goal of creating a healthy warm water recreational fishery in the LOR. It is very important that a new methodology evaluate all recreational fisheries in the LORP.
2. Upon completion of Recommendation 1, both MOU Consultants recommend this new or upgraded fishery evaluation methodology be sent to the Scientific Team (by February 2016) for their evaluation and acceptance. The Scientific Team, after making the necessary changes, would then submit a final draft to the Technical Group for action. The Technical Group, after review and approval, would submit the final product to the Standing Committee. Once approved by the Standing Committee, the new fishery evaluation methods would be included into the new MAMP in time for conducting the May 2016 LORP fisheries evaluations.
3. The MOU Consultants recommend the ICWD and the LADWP continue to conduct the MAMP fishery evaluation methods (creel census) in May of 2016. This census would be conducted in companion with an updated or new fisheries methodology developed by ICWD and LADWP. The creel census would continue to follow those methods, procedures, application levels, and number of fisher persons called for in the MAMP. This double monitoring process should continue annually until the new methodology proves reliable and accurate in adequately evaluating the fisheries goals and requirements of the MOU and the EIR.
4. The MOU Consultants recommend that the ICWD and LADWP, while preparing their new fishery evaluation methods, consider the MOU Consultants' first proposed intensive fishery evaluation methods recommended in the MOU development process (MOU [1997], Appendix 1) that were not accepted.
5. The MOU Consultants recommend that both the 2015 and 2016 creel reports be properly evaluated and documented in the 2016 Annual Report.

Blackrock Waterfowl Management Area

During normal and above average water years, the BWMA has a goal of 500 acres of wetted area. During below average runoff years, the flooded area in Blackrock is commensurate with the forecasted

LADWP runoff models and achieves the area-acres determined by the Standing Committee in consultation with the California Department of Wildlife.

The runoff forecast for 2015-16 is 36%, thus the BWMA goal is 180 acres. According to LADWP monthly reports, on April 1, 2015, Thibaut inflow was stopped, the inflow to the Drew Unit was reduced to 0 cfs and the Winterton Unit was turned on to 6.6 cfs, and reduced to 5.6 cfs on May 1. By May 6, the wetted perimeter was measured with GPS and Drew had 235 acres and Winterton had 86 acres. On June 1 inflow to Winterton was increased to 6.0 cfs and remained at that level so that by the fall the wetted area in Winterton was 221 acres; which exceeded the goal for this water year.

After May 6, LADWP did not make any further measurements of Winterton's wetted perimeter (that we are aware of) although the 2015-16 work plan includes flooded extent measurements July through October. We recognize that each of the prescribed field measurements is labor intensive and that eliminating unnecessary measurements is a savings that can be applied to other resource needs in the LORP, yet there is no indication that such savings were applied anywhere else in the LORP. Also, discontinuing or modifying a monitoring activity should have the approval of the Scientific Team rather than as an *ad hoc* action.

Another issue with switching from Drew to Winterton was brought to our attention by warm-water anglers; fish were stranded in the Drew Unit. We do not know of any effort to recover and transfer fish as the unit was dried. With some planning, a fish recovery effort with volunteers could have been done. Capturing fish from ponded water and releasing them to the adjacent Blackrock Ditch would have saved many of the larger bass and given them access to the river. Although this action would not have been covered in the work plan, good management of the LORP requires doing more than the minimum.

BWMA is adaptively managed by modifying timing and/or duration of wet/dry cycles using Drew, Waggoner, and Winterton wetland cells. The BWMA was designed to utilize wetting and drying cycles to meet annual acreage requirements to create habitat for LORP indicator species. The Ecosystem Management Plan and EIR established the criteria of about 50% open area and vegetation as the point to drain one wetland cell and flood another.

Based on additional experience derived from monitoring waterfowl usage (nesting, brooding, resting), LADWP staff concluded that a better management approach is to switch wetland units every two years rather than use a 50% open water criteria. This conclusion is supported by scientific studies in other wetlands. The MOU Consultants concur with this conclusion; however, in 2014 we recommended continued analysis, because Drew provided high quality waterfowl habitat for more than two years.

Unfortunately, this year LADWP began transferring water to the Winterton Unit without informing the Scientific Team. During our field review, we noted that LADWP constructed berms to retain water in Winterton, some failed and required reconstruction. At the same time, we noted water continues to flow into the Waggoner Unit when it should be actively being dried to accommodate a switch from Winterton in two years. Waggoner was burned two years ago to remove tules, but with the water inflow, tules have returned.

Perhaps we can define criteria for changing units based on a process rather than arbitrary thresholds like 50% open water or every two years. The BWMA is unique because of the manner in which it is managed. Unlike many other wetlands, the BWMA is legally obligated to meet specific wetted areas as a function of the runoff year. Most importantly there is a set maximum area of 500 acres beyond which LADWP is not obligated to dedicate more water for more wetted area, regardless of the runoff forecast. Natural, self-sustaining wetlands are not limited by artificial ceilings in wet and dry cycles and can expand and contract in response to water years, resulting in diverse habitat for waterfowl. This is the ecological process that builds productive wetlands.

Following LADWP staff suggestion to change units every two years actually results in a four year cycle. Moving from Drew to Winterton, remaining in Winterton for two year and then to Waggoner for two years and then back to Drew means it is at least four years before Drew is watered again. In that period of time units can be prepared by drying as well as treatments with herbicide to control tule growth and excavation of deeper holes to maintain open water areas longer. This four year rest period would give LADWP staff time to evaluate the effectiveness of tule control mechanisms like herbicides or selective excavations to improve waterfowl habitat. It would also be an opportunity to define an ecological process that might be a better method for moving from one unit to another.

MOU Consultants Recommendation

1. Develop a plan for a four-year cycle with two-year intervals for switching wetland units. The plan should include employment of multiple tule control treatments including excavation, burning and experimental use of herbicides in localized areas.

2. Evaluate the response in waterfowl habitat and usage, especially indicator species, during implementation of the plan and identify an ecological process that might be more suitable criteria for determining the duration of a wetland unit.
3. Examine methods and the cost-benefit of recovering fish during drying-wetting cycles of BWMA wetland units.
4. LADWP cannot ignore the Scientific Team when making decisions about the BWMA; decisions regarding when a unit will be dried or flooded as well as any future management plan must be reviewed and approved by the Scientific Team.

Off River Lakes and Ponds

Lakes and ponds compliance ensures that a water supply will continue to be delivered to Twin Lakes (Upper and Lower), Goose Lake, Billy Lake and Thibaut Ponds to sustain diverse habitat for wildlife.

Lakes and ponds compliance in the MAMP is consistent with the MOU and is defined as "maintaining the existing lakes and ponds". Monitoring entails recording staff gage elevations at the lakes and monitoring vegetation trends through habitat mapping.

To achieve the MOU goal of maintaining the existing lakes and ponds, the Final EIR/EIS describes the following management objectives for the off-river lakes and ponds:

- Upper and Lower Twin Lakes: Existing staff gages will be maintained between 1.5 and 3.0.
- Goose Lake: Goose Lake must be kept full in order to spill over and provide a continuous flow to the river. Therefore, Goose Lake will always be full. Typical staff gage readings reflecting Goose Lake at full capacity are between 1.5 and 3.0.
- Billy Lake: Billy Lake will remain full in order to maintain a continuous spill to the river. A staff gage was never placed in Billy Lake because it has always been operated at a spillover level.
- Thibaut Ponds: One or more gaging stations will be installed to monitor pond levels and will be kept full. However, over time management of Thibaut has been modified to provide waterfowl habitat and tule control by seasonally wetting and drying the pond to achieve 28 acres.

Table 10 shows water surface elevations (wse) for the lakes in winter months in 2008 and 2015 to illustrates how little change in wse has occurred through time, as well as management of the lakes remaining in compliance with the EIR. Winter months are compared rather than summer to account for ET fluctuations.

Table 10. Water surface elevations (wse) for the lakes in the winter months in 2008 and 2015

	wse (ft) Dec 2008	wse (ft) Jan 2015	Change in wse (ft)
Upper Twin Lake	2.58	2.39	-0.19
Lower Twin Lake	2.25	2.22	-0.03
Goose Lake	2.55	2.53	-0.02

During the October 2015 field review by the MOU Consultants, it was noted that the Coyote/Grass Lakes complex (between Lower Twin Lake and Upper Goose Lake) is mostly filled with tules, as is lower Goose Lake. However, the concentration of tules in the other lakes remains relatively unchanged. Tules fringing these lakes impede angler and boating access, but the Goose Lake launch site remains open and is used for these recreational purposes.

Delta Habitat Area

As described in the hydrology chapter, the average annual bypass flows to the Delta were in compliance with the EIR averaging 6 cfs. Because of drought conditions and recognition that in some months too much water is sent to the Delta during pulse flow events, it was decided through the adaptive management and Scientific Team process to discontinue pulse flows except for the Period 4 pulse of 30 cfs for 5-days.

The MOU Consultants examined conditions in the Delta during our October field visit prior to the Period 4 pulse (November-December). Vegetation in the Delta is dominated by tules and salt grass. By October most of the vegetation was dry and had gone to a dormant state. However, this drying did not result in killing tules. Except for the brine pool, there was little open water area.

Results of the 2013 vegetation mapping and indicator species habitat performed by LADWP showed that the current flow management with the 4-pulse flow scenario is not producing the most desirable habitat. LADWP concluded:

> *The DHA appears to benefit indicator species most when the area is flooded and most of the use in the DHA by indicator species is during migratory periods of spring and fall. The timing and magnitude of the pulse flows should be reevaluated to determine if these are still optimum for the goals of maintaining and enhancing habitat for indicator species in DHA. For example, is the winter pulse flow necessary if the DHA is already flooded and water is flowing into the brine pool? In winter, evapotranspiration decreases the indicator species in the region declines, and*

thus the pulse flow may not be necessary to maintain habitat. The water might be more beneficial in other seasons, given environmental conditions, and seasonal patterns of abundance of indicator species.

In the 2014-15 Annual Report the MOU Consultants recommended eliminating the present programmed habitat flow releases for the DHA, and implementing and evaluating three DHA habitat flows (Periods 1, 3, and 4) released from the Intake Control Station over a two year period (2015-2016). Results should help determine if Lower Owens River water quality and other environmental conditions can be improved via flow management. Results will also allow better predictions of how these flows pass downriver and when and how much of the flushing flows arrive in downriver reaches. The three DHA habitat flow periods recommended for release at the Intake Control Station are Period 1 (March-April), Period 3 (September and add October), and Period 4 (November-December).

MOU Consultants Recommendation

1. Because there are clearly different and likely better ways to manage flow into the DHA, the LADWP, ICWD and the MOU Consultants should meet to discuss a suitable flow release pattern and appropriate monitoring to evaluate the effectiveness of different flow releases.

Rapid Assessment Survey

Background

The Rapid Assessment Survey (RAS) is conducted annually to identify problems or potential management issues in the LORP riverine-riparian, wetland, and off-channel lakes and ponds areas; it is intended to provide qualitative project-level feedback regarding changes within the project area. The RAS is designed to identify and track impacts that may be associated with increased or altered recreational use, exotic plant invasions, beaver activity and other potentialities. The intent of the RAS is to identify management issues during intervals between monitoring years and between monitoring sites before they manifest themselves into larger and more expensive management problems. The results of the RAS are used to alert project managers to areas of special concern or land use impacts that may not be compatible with goals of the LORP.

It should be noted that the last update on the draft RAS report was received from Inyo ICWD on October 7th 2015 and that no final report was available for review at the time that this adaptive management report was required to be prepared. Further, the updated draft final RAS report stated, “In order to get a long-term perspective on the persistence of recruits, a field survey of all past observations of woody recruitment from 2007 to 2015 will be undertaken in 2015." At the time this AMR was required to be prepared, no data or report with this information has been received. Assessing the longer-term establishment and persistence of seedlings recruited into the system was a past adaptive management recommendation. The MOU consultants are pleased that it was undertaken. However, it is disappointing that the data and results could not be part of this analysis and recommendations.

Summary

The RAS was conducted between August 3rd and 12th, 2015. This field assessment includes observations made along the Lower Owens River (Riverine-Riparian Management Area), the Blackrock Waterfowl Management Area (BWMA), Off-River Lakes and Ponds (OLP), and the Delta Habitat Area (DHA).

This year's RAS effort cataloged observations and impacts in the following categories: woody tree recruitment, salt cedar, Russian olive, noxious weeds, beaver, elk, fences, grazing, recreation impacts, roads, trash, slash, channel obstructions, and other miscellaneous observations. These categories are very similar to past RAS efforts.

The RAS stands out among LORP monitoring elements for its broad scope and because it is performed on an annual basis. There have been methodological changes over the years and the personnel have varied from year to year. The reliance on the RAS data as an indicator of LORP conditions has increased over the years, as other monitoring efforts including landscape scale vegetation mapping, site-scale vegetation mapping and indicator species habitat monitoring have not been performed despite their requirement by the MAMP. The RAS is a qualitative assessment, and as such its results should not be used to direct management actions, but rather should indicate where targeted monitoring is warranted to further define conditions observed in the field.

Overall, the 2015 RAS results and data collected are consistent with past efforts. Woody recruitment remains low as this year the effort recorded 9 riparian tree recruitment sites. The lack of a seasonal habitat flow and drought conditions do not create conditions conducive to recruitment. The primary noxious weed invading the LORP, perrenial pepperweed, remains a problem. New populations of pepperweed were located in the first three river reaches as well as the BWMA. Saltcedar remains a management issue and necessitates ongoing efforts to control its spread.

Woody Recruitment

Woody recruitment is a subject of interest and discussion in the LORP. The total number of woody riparian recruitment sites was 10 (8 tree willow sites, one cottonwood site and one shrub willow site). In addition, 50 clonal willow shrub (*Salix exigua*) sites were also detected. Although shrub willow provide important habitat, there is a special interest in creating riparian tree habitat in the LORP. The number of non-clonal woody recruitment sites detected by the RAS has declined significantly since 2011, when a total of 92 sites were observed; in 2014 and 2015, only 8 and 10 sites were located (Table 11).

Table 11. Woody recruitment sites 2011 to 2015

Year	Recruitment Sites	% Change from previous year	% Change from 2011
2011	92		
2012	46	50% less	50% less
2013	41	11% less	55% less
2014	8	80% less	91% less
2015	10	25% increase	89% less

The flow regime, stochastic nature of woody riparian recruitment, and the availability of suitable sites all contribute to these results. The region has experienced drought over the past few years and therefore the LORP has had reduced or eliminated spring habitat flows that disperse seed and help with establishment. The high flow in the LORP this year was 78 cfs, which represents the amount released at the intake to meet the 40 cfs mandate at the pump back station. Over the 9 years since the restoration of LORP flows, Three years had no seasonal habitat flow (2007,2014,2015) and in 2008 the flow was released in February, and therefore should not be termed a seasonal habitat flow, but more a flushing water quality flow. In two years the seasonal habitat flows (SHF) were just over 200 cfs (2010-11) and one year it was just over 100 (2009). The remaining years have been less than 100 cfs. The LORP has not had a SHF over 100 cfs since 2011. This reduction in flow events and timing is likely a significant reason that woody recruitment has been observed to decline in recent years.

In addition to recruitment sites where woody species are establishing from seed, there were 50 observations of coyote willow (*Salix exigua*) sites where clonal recruitment was occurring. This is down from the 65 instances observed in 2014. Coyote willow provides an additional woody component to LORP habitat. Even clonal riparian shrubs provide structure and habitat for many species.

Woody riparian, including willow and cottonwood trees, provides structural diversity and varied habitats that are critical to the restoration of riverine-riparian conditions. Woody riparian trees are essential to attracting key avian species that are indicators of overall ecological health. Recruitment in 2015 was low, further delaying canopy development and consequently, the achievement of LORP goals.

Woody recruitment sites from 2014 were revisited in 2015. Of the 10 sites revisited, woody species persisted on 70% of these sites, an increase from the 66% persistence recorded in 2014; however, 43 sites were revisited in 2014 versus only 10 in 2015, therefore this difference is negligible. However, 70% survival after one year is encouraging, though we know little about the fate of recruitment sites one year after recruitment. In 2014, the MOU Consultants recommended an analysis of persistence of woody riparian species at historic recruitment site locations (2007-2015). As stated above, the draft 2015 RAS report states that this will be undertaken in 2015. No results have yet been presented.

Saltcedar

Saltcedar remains an ongoing management challenge and is the most abundant noxious weed in the LORP; it was documented at 204 locations on the river and at 155 off-river sites. Changes were made to the RAS protocol in 2014, which makes comparison to anything prior to 2014 problematic; however, the report states that saltcedar observations have declined since 2011. The trends do reflect that and the 204 observations is the lowest number recorded in the last 6 years. Re-sprouts and seedlings were recorded at 182 sites (versus 220 in 2014). Mature plants were recorded at 177 sites, but were not included in the 2014 survey. Overall, compared to 2014, salt cedar observations declined in all river reaches except for a small increase in Reach 1. The Off-river Lakes and Ponds recorded 74 sites and the BWMA recorded 63 sites. In 2014, Off-river locations were not surveyed and the BWMA observational data is uncertain. The Delta had 18 observations in 2015, a decrease from previous years.

The results of the saltcedar portion of the survey are difficult to interpret. Mature trees were not included in the 2014 survey nor were off-river locations (due to heavy concentrations). The BWMA observations from 2014 only showed 5 observations (but it is noted that it is so infested that recording individuals is not practical). Therefore we view reports of increases or decreases of saltcedar with skepticism. Whether from seed recruitment or re-sprouts, saltcedar continues to reproduce and regenerate throughout the LORP.

The LORP is heavily infested with saltcedar and eradication of saltcedar is currently not realistic given the funding allocated to this effort. Controlling salt cedar has posed a challenge to land managers throughout the west and the LORP is no exception. Proper control and management of salt cedar will require diligent and continual application of resources.

Noxious Weeds

Noxious weeds continue to be a persistent problem. Perennial pepperweed is a significant management challenge in the LORP. This year's RAS detected 61 populations of this noxious weed, an increase from 25 observed in 2014. The number of pepperweed sites doubling in one year period is especially concerning. Pepperweed is concentrated in the northern part of the LORP with most populations in Reaches 1 and 2 and the Winterton unit of BWMA. Mapping shows that that most of these sites are spreading outward from previously reported populations. The number of pepperweed sites has increased significantly in Reaches 1, 2 and BWMA- Winterton, except for reach 3 which appears to be holding steady at 6 observations. Observers noted that of the 23 of the 61 sites appeared to have been treated with herbicide recently. The additional sites have since been treated by Inyo ICWD Weed Management between August 20th and September 1st, 2015, except for 2 sites that were not found to contain pepperweed by the Weed Management group. These results indicate that if managers want to control pepperweed within the LORP, additional resources may be required. Repeated treatment of sites and specific efforts to revisit sites on a more frequent basis may be necessary.

Recreation

Recreation impacts are most abundant near roads and in the Lone Pine area. The number of observations decreased from 75 in 2014 to 20 discreet impacts in 2015. Impacts include the observation of 3 fire rings and litter, such as beverage containers, shotgun shells, and fishing gear – all likely evidence of river recreation. Evidence of continued ORV use was observed in Reaches 5 and 6.

MOU Consultants Recommendations

The RAS remains the only monitoring protocol for woody species that is performed on a regular basis. The other monitoring efforts that could be used to monitor woody species (e.g. landscape scale mapping, site-scale mapping, belt transects, etc.) are either done infrequently or have not been performed. The RAS therefore is a prime source of information for monitoring woody recruitment. Utilizing past RAS data to relocate woody recruitment sites and assess the survivorship would give important insight into where native woody vegetation is not only recruiting, but establishment and survival. This analysis could then be compared to the vegetation monitoring data to bring a further understanding of the future of woody vegetation in the LORP. We look forward to the results of this investigation when it becomes available. This analysis should be performed and the results made available as soon as possible.

The RAS also provides important information regarding noxious weed populations. Aiding in detection of new populations and monitoring of known locations complements the work done by the Inyo/Mono Counties Agricultural Commissioner's Office work to control weeds. This is important work that requires as much effort as is available.

The RAS should continue to be performed as has in past years, with the emphasis being on the observations that can make the biggest impact on achieving LORP goals (woody recruitment, Tamarisk, and noxious weeds). In addition the results of the inventory of past woody recruitment sites should be made available as soon as possible.

Noxious and Invasive Weeds

The Inyo/Mono Counties Agricultural Commissioner's Office (CAC) manages certain invasive weed infestations within the LORP project area, in conjunction with LADWP. The need to control weed populations within the LORP is critical to achieving LORP goals, including the goal of creating diverse native habitats. Due to its vast area and disturbed landscape character, managing weeds in the LORP area is a challenge.

Since the re-watering of the LORP weed populations, specifically perennial pepper weed, have increased dramatically. The RAS continues to document weed populations, including detecting pioneer populations. This information aides the CAC in their detection efforts and allows them to quickly treat known populations. With the ever-growing number of sites that require treatment and monitoring, increased resources are required to perform additional detection of new sites. Unfortunately, this effort has seen a decrease in funding, to the detriment of weed control efforts.

Due to lack of appropriate resources, the CAC office was forced to reduce their workforce assigned to the LORP from three to one. Despite this reduced workforce, all sites within the LORP were treated. Invasive plant population infestation area decreased by 0.52 acres to a 0.84 net acre area. Most of this decrease occurred in one area near the Winterton Unit of the BWMA. However, the reduction in labor and resources available to the project has an impact on project effectiveness; only 10,700 acres were able to be surveyed (a reduction of more than 30,000 acres form 2014) and known sites were not able to be treated three times during the growing season as they had in previous years.

MOU Consultants Recommendations

Controlling invasive weeds should be a priority in the LORP, and resources allocated to this effort should reflect that. We recommend that funding be increased for the CAC control efforts to ensure that existing populations are treated and that adequate effort can be employed to detect new populations. There are 51 known sites and a vast area to be surveyed (this is CAC's report number, the RAS reports more locations). The RAS and other efforts are able to detect some new populations; however these activities occur in specific areas (e.g. the RAS is conducted near the water's edge only). Appropriate resources are required to control perennial pepper weed.

Landscape Vegetation Mapping

The 2014 LORP landscape vegetation mapping provides a remarkable snapshot of the conditions of the Lower Owens River Riparian Area and Blackrock Waterfowl Management Area for 2014. The review indicates the data to be accurate and more precise (greater resolution) than previous years mapping (2000 and 2009). As mentioned in the report, differences in vegetation type acreages are attributed to hydrologic changes associated with re-watering the Owens River (Figure 2), fires, and improvements in the accuracy and precision of mapping (Table 12). Differences in vegetation type acreages associated with hydrologic changes are vital to managing the project and for accurately making adaptive management decisions. Such vegetative changes should be accurately documented in the Landscape Scale Mapping data. Similarly, fires are historical disturbance regimes within the Owens Valley and the changes in vegetation types associated with fire are important and should be documented in the Landscape Scale mapping. Looking at the overall changes of the vegetative communities of the Lower Owens, from 2000 – 2014, it is apparent that the problematic aspect of year-to-year comparisons of the Landscape Scale Mapping data lies in the differences in the mapping methodologies.

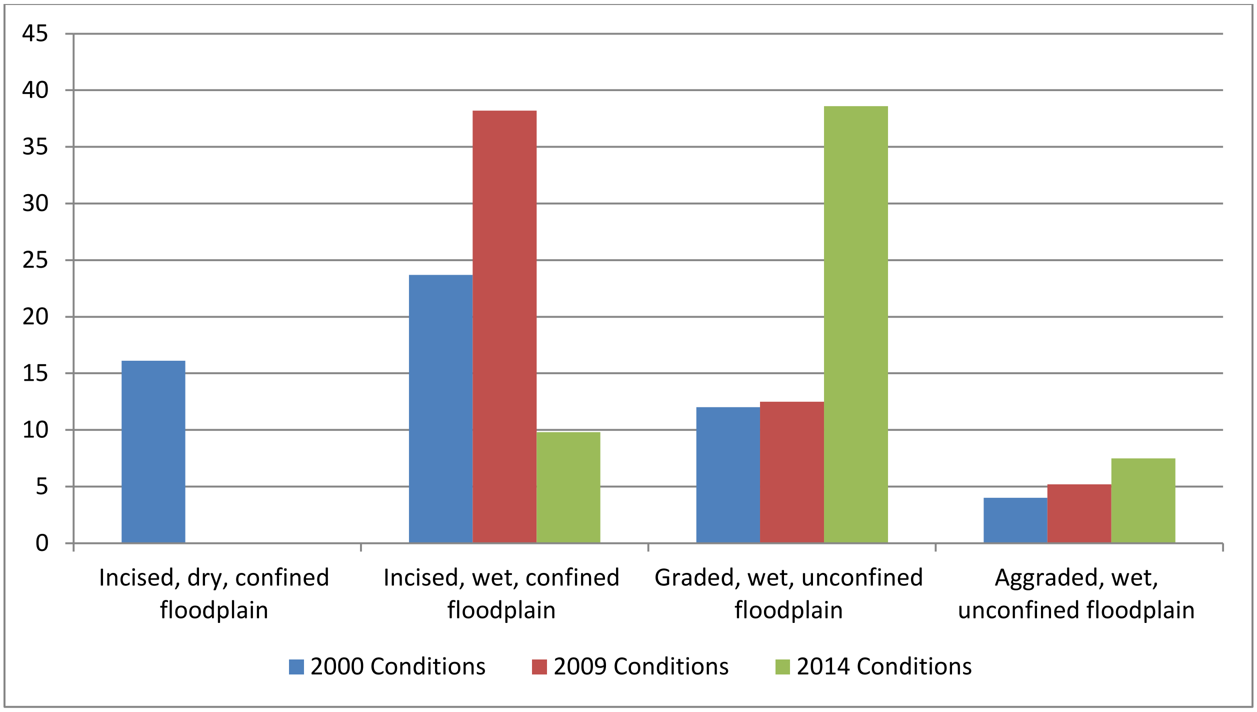

Figure 2. Percent LORP per State

The methodology (digitizing v. remote sensing), mediums (resolution of imagery), parcels delineated (3,968 v. 16,601) and average parcel size (1.5 acres v. 0.38 acres) have all changed significantly from 2000 to 2014 (Table 12). Such differences make year-to-year comparisons difficult at best. These methodology, medium and parcel size issues make accurately identifying trends in the vegetation types and habitat availability to indicator species difficult or misleading. For example, and maybe the most troubling aspect of the mapping data results, is the loss of Riparian Forest (tree willow) from 2000 to 2014 (Figure 3). In that time period, according to the data, the LORP area has lost over 250 acres of Riparian Forest. Reporting this change as solely attributable to mapping differences, fire, and state change is erroneous and misleading. For example, there is no mention of grazing, which is a significant disturbance regime within the Lower Owens.

While it is evident that the Lower Owens river channel is moving towards an herbaceous wetland (e.g. marsh, wet meadow, alkali meadow) and away from more structurally diverse riverine/riparian habitat with open channel conditions (LADWP 2015), there is still ample area for riparian trees to establish and colonize. For example, the RAS (ICWD 2015) data indicates that riparian tree species are establishing and colonizing, albeit in low numbers in recent years. Such data conflicts with the landscape scale mapping results. Basically, with conflicting data and significant changes in mapping methodologies it is hard to define what the actual trend is of the LORP's riparian forests. Additionally, the LORP's Riverine-Riparian Habitat objective as stated in the LORP Monitoring and Adaptive Management Plan (p. 3-42) reads, "*implementation of the LORP (base flow and seasonal habitat flow compliance) is resulting in new recruitment of riparian vegetation (habitat), primarily willow and cottonwood*." Therefore, based on the existing landscape scale mapping data are trends being accurately portrayed?

Table 12. Mapping Differences per Year

Year	Methodology	Image Resolution	Parcels Delineated	Average Parcel Size
2000	Digitized	2ft Pixels	3,968	1.5 acres
2009	Remote Sensing **Supervised** Classification	1ft Pixels	6,981	0.88 acres
2014	Remote Sensing **Unsupervised** Classification	1ft Pixels	16,601	0.38 acres

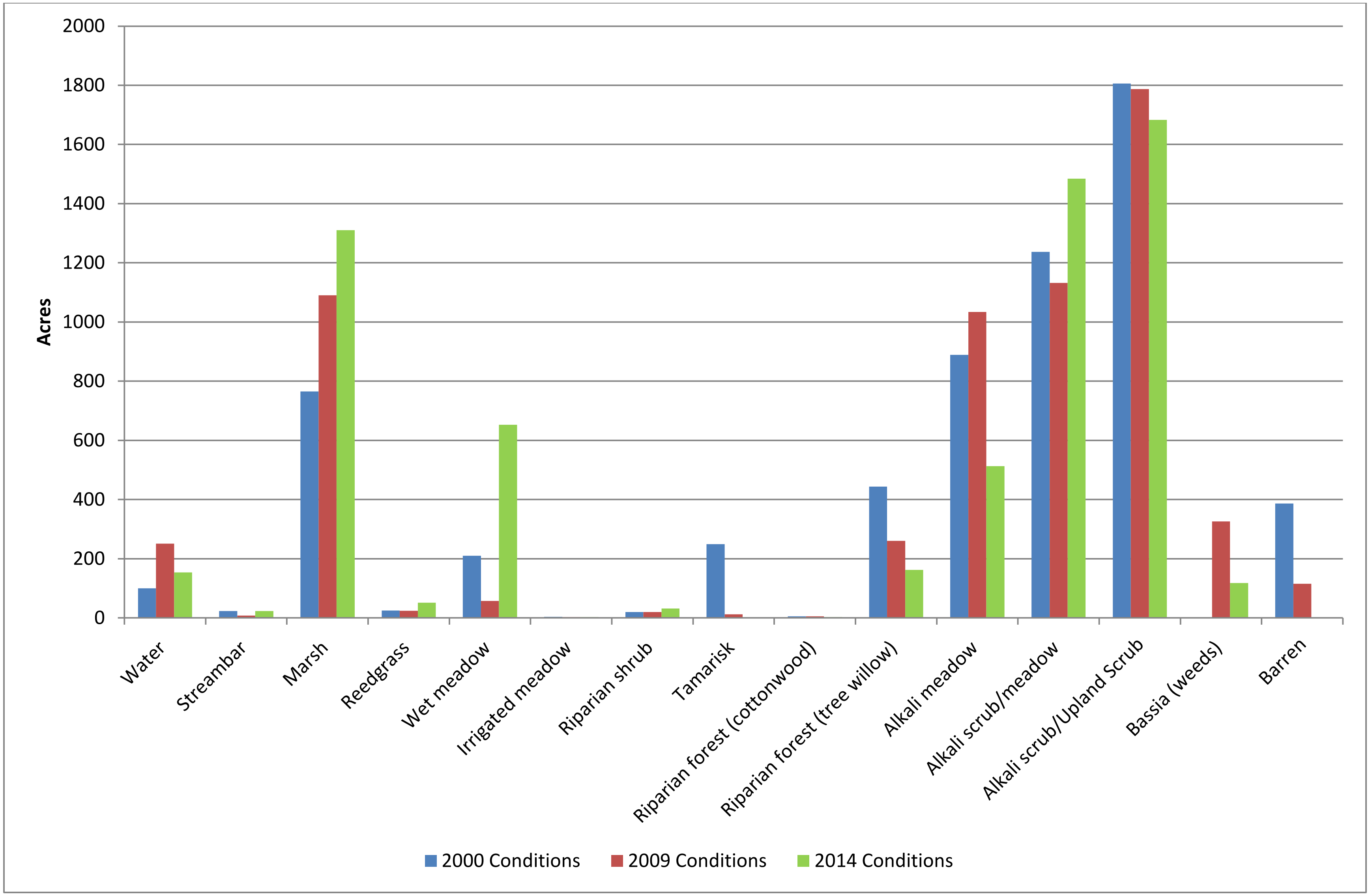

Figure 3. Vegetation Type acreage per year (data cross-walked to 2014 Legend and some classes left out – i.e. roads, structures)

The MOU consultants believe that the changes in mapping methodologies have created an unclear picture of the Lower Owens River conditions since 2000, and feel that to truly garner an accurate trend in the LORP's vegetation types since projection inception that baseline and 2009 conditions should be remapped. The MOU consultants feel that the 2000 conditions do not accurately reflect baseline conditions and should be replaced with 2005 conditions based on 2005 IKONOS imagery. The 2005 IKONOS imagery should be used to map baseline conditions because that imagery is closer to the December 2006 introduction of water to the Lower Owens. Therefore, the MOU Consultants believe that remapping 2005 and 2009 conditions using the same methodologies (remote sensing - unsupervised classification) as used in 2014 would provide sufficient data to accurately identify trends in vegetation types since projection inception (December 2006). LADWP has the expertise and personnel to perform this mapping. In fact, some of the 2009 mapping has been redone for the 2014 report. The states were not mapped in 2009 (LADWP 2010) and were mapped to be included in the 2014 report (LADWP 2015). The MOU Consultants believe that remapping these two time periods will give an accurate depiction of vegetation changes since water was returned to the system and allow more informed adaptive management decisions in the future.

When considering the development of woody riparian vegetation it should be considered that riparian vegetation requires years to develop the canopy cover required to be detected with landscape scale mapping products. If riparian forest is being lost, then identifying those locations and identifying the mechanism behind these losses (flooded, burnt, senescenced, never there due to mapping error, etc.) would provide managers with important data. These areas could be identified by overlaying and intersecting existing GIS layers. An effort that identifies areas of woody species development, including clonal shrub willow sites, would provide information as to the woody riparian areas and their likely development over time.

MOU Consultants Recommendation

1. LADWP remap the Riverine Riparian Area using the 2009 aerial images and the 2005 IKONOS Imagery. And provide this data to the MOU consultants when the mapping is complete.
2. We accept LADWP's recommendation that to explore alternative approaches to monitoring the BWMA. We recommend LADWP provide a written proposal of what the alternative monitoring would be, ensuring that the suggested approach meets the LORP monitoring and adaptive management plan's objective (e.g. 500 acres of habitat area being flooded during average and above average water years).

Avian Census and Indicator Species Habitat

The avian census provides the most quantifiable data on species use of the LORP. This data shows how avian species are responding to re-watering. Changes in avian use were somewhat surprising in 2015 compared to 2010, but overall changes follow with the trend in the LORP system – moving from a riverine riparian system to an herbaceous wetland (LADWP 2015). For example, water fowl use of the LORP significantly increased in 2010, but decreased in 2015 and was not significantly different than pre-project levels, except in Reach 4 where water fowl use remained above pre-project levels (LAWDP Avian 2015). While it is expected that water fowl use would continue to increase based on the increasing acreage of herbaceous wetland, the lack of open water seems to be having an effect on water fowl abundance. The increase in herbaceous wetland is providing increased habitat for one indicator species, the Marsh Wren, which was found in all reaches (LADWP avian 2015).

Conversely, the amount of woody riparian acreage mapped has decreased in all reaches except Reach 5 (some of this is due to mapping differences, which is addressed in the Landscape Vegetation Mapping section), which would cause a decrease in landbird use. Not surprisingly results indicate that mean landbird richness has decreased in all reaches except 2 and 5, since 2000.   While some riparian recruitment is occurring on the LORP, total riparian acreage, which is strong predictor of landbird richness, has not increased in this time period (LADWP avian 2015). This result mirrors the Landscape Vegetation Mapping results, in that decreases in riparian forest and shub habitat has led to decreases in landbird abundance. However, the drop in landbird abundance is not as significant as the reported losses in forest cover, indicating that the loss of riparian forest documented in the landscape mapping may be more a product of mapping methodologies than true forest loss.

The loss of riparian vegetation is influential to the overall LORP system as breeding bird diversity is positively influenced by the amount of woody riparian vegetation, which also increases habitat diversity. Although large stands of trees are not common on LORP, even small trees stands or individual trees contribute to diversity by providing appropriate structure or nesting cavities opportunities that is otherwise absent in marsh or surrounding desert scrub habitat (LADWP 2015). The avian census data indicates the importance of riparian forest and shrubs. Efforts should be made to increase this vegetation type especially since the LORP Monitoring and Adaptive Management Plan calls for increasing riparian tree and shrub habitat (Ecosystem Sciences 2008). Developing riparian vegetation requires years to develop the canopy cover required to be detected on landscape scale mapping products; it may be several years before cover increases on the landscape scale.

Within in the LORP, indicator species have been observed and several are breeding; 13 of the 19 avian habitat indicator species were observed during 2015 surveys, and breeding activity was documented for eleven of these (LADWP 2015). Monitoring these trends is important to documenting successes in the LORP.

Overall, the LORP avian census is a good monitoring program that provides important species-specific data on the LORP. This program should continue as it measures the use of the habitat created through re-watering. Although, the data may not present the picture that managers envisioned during the inception of the LORP, the data does provide information on how species are responding to the re-watering program. More importantly it shows how changes in the system affect the species that use it. Lastly, the avian census shows that if riparian forest dependent species are desired then interventions are needed that promote the vegetation type that supports those species.

MOU Consultants Recommendation

1. Continue with Avian Census Monitoring Program and determine if resources are available to increase the frequency of the program. For example, if a water year allows for a habitat flow, consider performing the census following the habitat flow or in the subsequent year.
2. We accept LADWP's recommendation to develop species specific habitat-relationship models for the LORP for the purpose of providing a management tool for understanding bird use of the riverine-riparian area. Please provide the MOU consultants with a written document explaining the habitat suitability models, and for which species.
3. We are also open to evaluating the current indicator species list. If data supports removing indicator species from the list because habitat conditions do not or will not warrant their inclusions, then we suggest LADWP provide written and data-driven documentation as to why a change in the indicator species list is needed.

Land Management

The failure of LADWP to approve budget for the MOU Consultants prevented completing a livestock grazing assessment and evaluation for the 2015 Annual Report.

General Comment

Over the past four year drought period, LORP grazing lessees have done a better job managing their livestock and meeting most grazing lease guidelines; a difficult task under such harsh climatic conditions. With lower production of annual upland “green-up” vegetation, drought stressed rangeland plants, reduced upland available forage, and reduced pasture irrigation water. Other than this comment, the MOU Consultants are unable to make site-specific comments on range conditions or grazing management.

Monitoring Methods

The MOU Consultants have expressed past concerns verbally and in annual reports about weaknesses in present range and watershed monitoring methods. Especially concerning is the ability to adequately monitor the rehabilitation of the Lower Owens River (LOR) streamside vegetation.

The MOU Consultants pointed out in their 2009 Adaptive Management Recommendations that both grazing forage utilization and range trend monitoring transects, by themselves, are insufficient to adequately monitor LOR impacts and rehabilitation conditions. These transects alone do not adequately monitor or represent LOR streambanks or streamside zone conditions past, present or in the future. Range transects are located in fields and pastures and away from the LOR streamside environment, and therefore, do not inform as to streambank vegetation types, vegetation diversity, vegetation impacts, or vegetation species trends. Especially lacking is a monitoring method that would evaluate the success of tree recruitment and tree survival on streambanks.

The MOU Consultants have questioned, in past annual reports, if monitoring should not be directed more toward evaluating streamside conditions, impacts, and vegetation trends. This information is a requirement for proper evaluation of critical MOU (1997) LORP goals and requirements to determine attainment or non-attainment. Dr. Duncan Patten, Sierra Club’s Consultant, pointed out that these range Belt-Plot transects were eliminated by the LADWP from their monitoring methodology because they contained no willow or cottonwood trees; but removing this monitoring also prevents discovery of browsing on future establishment of these species in these areas (2013 Annual Report). Dr. Patten recommended that this decision be reconsidered.

Present Problem

Belt plots in streamside zones have indicated that annual woody plant (trees) recruitment along the LOR is very low (2014 Annual Report). The MOU Consultants question why the Belt-Plot transects were not evaluated in 2015. However, LADWP set up Belt-Plot transects purposely with bias as related to determining overall LOR riverine-riparian vegetation conditions. Belt-Plots that contained high numbers of juvenile willow were purposely selected and were not randomly selected or selected without bias (2013 Annual Report). Therefore, study results cannot be extrapolated to determine actual vegetative conditions and trends along the entire 124 miles of the LOR banks and low floodplains. The Belt-Plot transects were purposely selected with bias to better determine animal grazing influences on tree recruitment and survival. This study has produced successful results only as related to determining grazing animal influences.

Some Belt-Plot transects were dropped from further data collection that showed little potential to glean any understanding of woody riparian establishment and survival on the LOR from grazing animal influences. The criteria LADWP used to eliminate Belt-Plots from future study were those which had no seedlings or juvenile willow or cottonwood trees (2011 Annual Report). Therefore, the data and information from these Belt-Plots cannot be used to statistically determine tree recruitment, sustainability, mortality, or survival over-time along the 124 miles of the LOR streamside. Due to constant annual adding and subtracting of Belt-Plot transects to improve the methods to determine grazing effects on plants, the ability to relate to overall LOR streamside vegetation reactions suffered. As a result of the Belt-Plot elimination process, only 12 of the original study plots now remain in the evaluation process.

Nineteen additional Belt-Plots have been added to the original 12 to increase the ability to evaluate grazing effects on willow-cottonwood tree recruitment. The present Belt-Plot streamside methodology will adequately determine herbivore grazing effects; it will not adequately monitor the LOR woody recruitment results. The biased plot selection and the low sample size limit the ability to provide accurate statistical evaluation of willow-cottonwood recruitment and survival in the LORP (MOU Consultants 2014 Adaptive Management Report).

Belt-Plot monitoring has produced some valuable information. One example appears in the 2013 Annual Report. The Belt-Plot evaluations showed that summer base flows submerged 33% of all juvenile tree willows for 2 to 3 months. These conditions lead to mortality of many potential trees along the LOR. Belt-Plots also showed that the much higher summer base flow release enabled the expansion of tulles and cattails onto gravel bars, sandbars, and adjacent flood plains. This places young willows in direct competition with emergent wetland plant species and decreases future opportunities for tree willow germination on these sites. These documented assessments add to the wealth of information demonstrating that LOR flow management needs to be greatly improved.

Photographic Evaluation

The LADWP obtains aerial photographic documentation of vegetation conditions over-time on LOR streamside zones. This is good information on what is present, vegetation-wise, on those years aerial coverage is obtained. However, it does not successfully monitor young-of-the-year recruitment or follow their annual survival because of small plant size. Plants cannot be monitored by the aerial methods until their growth is of sufficient size to allow all the trees to be identified from the imagery.

Justification

RAS and Belt-Plot findings demonstrate that trees along the LOR are not being recruited in sufficient numbers to meet MOU (1997) goals and requirements. It is unclear how much recruitment and following mortality or survival is occurring because of the methods used. Ocular annual observation (Platts and Hill) has shown that in some LOR bank locations, willow tree recruitment has and is occurring, but mortality from unknown causes soon eliminates them. A more efficient vegetation monitoring program is needed to provide better answers and solutions to guide future LORP management.

MOU Consultants Recommendations

1. The MOU Consultants, in their 2014 Adaptive Management Report, recommended that LADWP range staff, during the winter of 2014-2015, develop a monitoring program that evaluates woody vegetation recruitment, survival, sustainability, mortality and vegetative trend conditions over the entire LOR streambank and riverine-riparian grazing areas. This recommendation still stands and is again recommended.
2. The MOU Consultants continue to support and recommend the continuation of the LADWP's belt-plot streamside woody recruitment and survivability evaluation study as related to evaluating animal grazing effects on woody vegetation recruitment survival. This monitoring was not completed in 2015 (2015 Annual Report). The MOU Consultants recommend this monitoring be continued in 2016.
3. Almost all grazing pastures and fields in the LORP were continually in grazing utilization compliance in 2015. This is an important accomplishment by the lessees under such harsh series of drought years. A couple of important pastures and fields, however, were in non-compliance again in 2015. One field has been in non-compliance for multiple grazing seasons. The MOU Consultants recommend that these pastures and fields receive more emphasis on meeting forage grazing utilization requirements in 2016.

4. Each individual LORP lease grazing plan allows irrigated pasture condition evaluation ratings to be waved during low water years or during drought conditions. After four years of drought, the MOU Consultants recommend that key irrigated pasture condition be evaluated in 2016 to display how they are responding to extreme drought conditions. This recommendation may have already been fulfilled, as in the 2013 Annual Report the LADWP stated that the condition of irrigated pastures declined on several of the leases in the LORP area. The drop in condition is largely attributed to lack of snowpack runoff, resulting in reduced irrigation supply. The annual report also stated that all irrigated pastures in the LORP will be evaluated again in 2014. The MOU Consultants missed seeing the data or the evaluation, if it was done, and therefore, could not make an analysis and respond.

Habitat Conservation Plan

LADWP has completed a draft Habitat Conservation Plan as prescribed in the MOU (Section II A 2). The draft HCP was to be posted to the Federal Register in October for the public review and comment period. This is a low-effect HCP with an associated 10-year Incidental Take Permit (ITP). By USFWS regulations this type of HCP is intended for "(a) minor or negligible effects on listed, proposed, or candidate species and their habitats; (b) minor or negligible effects on other environmental values or resources in the human environment; and (c) minor to negligible cumulative effects to the human environment."

"Incidental take" means the taking of a species or habitat will be minimized or mitigated to the maximum extent possible and the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild. Thus, under Federal regulations a listed, proposed, or candidate species can be taken. However, the California Endangered Species Act (CESA) is more restrictive. The CESA obligates LADWP to "full mitigation" rather than mitigation to the "maximum extent possible" and any species like the pupfish that are Fully Protected under the CESA cannot be taken except under special conditions. In most situations the CESA is more restrictive than the ESA when it comes to taking of state listed species. USFWS and CDW worked cooperatively with LADWP to complete the draft HCP, so presumably regulatory differences between the ESA and CESA on takings have been worked out.

The draft HCP is based on a 10-year duration of the ITP. The MOU is silent on the expected duration of the HCP. However, the MOU does require that the HCP be "integrated to comprise the overall LORP

Plan". The HCP states "To date there is no single "LORP Plan"" (page 1-18). This is incorrect. The LORP Monitoring and Adaptive Management Plan (MAMP) describes goals and objectives, monitoring methodologies, reporting, and processes and adaptive management in great detail. The LORP Ecosystem Management Plan incorporates requirements under the MOU and the EIR, including the MAMP and HCP; consequently, there is a LORP plan. The HCP references the MAMP for its summaries of monitoring tools or approaches in the LORP.

The Conservation Strategy shown in the HCP consists of four landscape goals and 13 habitat goals for the covered species. As stated in the HCP, "integrating adaptive management and HCP monitoring is critical to the successful implementation of the Conservation Strategy". Consequently, it is imperative that HCP and LORP monitoring are not only compatible and non-exclusive, but are careful not to duplicate monitoring efforts or place adaptive management recommendations and actions at cross purposes.

MOU Consultant's Recommendations

1. Incorporate the HCP into the LORP MAMP to fulfill the MOU requirements (Section IIA 2).
2. Revise the MAMP to prevent monitoring overlap, or enhance monitoring actions to efficiently support HCP needs.
3. Update and revise the MAMP in a workshop to reset schedules, realign monitoring to existing environmental conditions, and revisit initial goals and expectations.

Revision and/or Replacement of MAMP

Background

The MOU did not set an ending date for its legal jurisdiction for guiding and governing the implementation of the LORP. Therefore, the MOU, with its amendments and accompanying Stipulation and Orders, will guide the 2008 Monitoring and Adaptive Management Plan (MAMP) process for as long as the plan exists. The MAMP pointed out that a 5-year evaluation horizon is arbitrary and probably too short a time period for LORP systems to approach a steady state. Therefore, the 2008 MAMP recommended a 15 to 20 year horizon before evaluations are made about LORP restoration success. In practice, we now know that management evaluations need to be made annually to successfully complete the adaptive management process. Annual evaluations also allow goal attainment status to be determined sooner so management corrections can be made during all stages of the rehabilitation project.

Direction and Responsibilities

Direction

The MOU directed that the LORP Ecosystem Management Plan will include a MAMP that would adequately monitor and evaluate the four physical features of the LORP:

1. Lower Owens River (LOR) Riverine-Riparian Ecosystem
2. Delta Habitat Area (DHA)
3. Off-River Lakes and Ponds
4. Blackrock Waterfowl Habitat Area *and* Integrate the Land Management Plan and the HCP into these four physical features

Now that the HCP is finished, this MOU direction is complete. The results from annual monitoring and evaluation could improve the adaptive management process to better manage and rehabilitate the four physical features of the LORP.

How monitoring and evaluation methods will be determined, conducted, and used in the adaptive management process is not defined in adequate detail in the MOU and were instead left to be included in the construction of the MAMP. The MOU, the LORP Action Plan, and the 2004 EIR also directed and influenced the construction of the 2008 MAMP.

The resulting product, the 2008 MAMP, requires that the ICWD, the LADWP, and the MOU Consultants to be responsible for implementing the MAMP. MAMP monitoring and evaluation results were directed to guide the implementation of adaptive management. The ICWD and the LADWP presently have full responsibilities for conducting monitoring, evaluation, and adaptive management implementation. The role of the Consultants has presently been restricted to making adaptive management recommendations. The ICWD and the LADWP make all management decisions and approve and implement all management actions unless directed different by the MOU Parties or the Court (EIR 2004).

Responsibilities

The MAMP proposes monitoring the LORP over a 15-year period. This 15-year period started upon implementation of the LORP (MAMP 2008). Therefore, monitoring and adaptive management could end within the next 6 years. Even though the MAMP infers that monitoring would end after a 15-year period, MOU jurisdiction continues over the life of the LORP. At the end of the proposed 15-year monitoring and evaluation period, the ICWD and the LADWP should be in position to have completely evaluated all goals, objectives, and requirements in the MOU and the EIR. The ICWD and the LADWP will need to demonstrate they have met the goals, will sustain them through time, or request relief from those goals that cannot be met. Therefore, they must be in position to properly identify those goals they will not meet and justify any relief.

2008 MAMP Development

The MOU Consultants submitted their first draft of the MAMP to the LORP MOU Parties in 1999. Nine years later (2008) after the seventh draft re-write and numerous discussions, meetings, and workshops, the final MAMP was accepted by the ICWD and the LADWP.

The LADWP, the ICWD, and at times, other MOU Parties worked through 7 iterations of the draft MAMP to finally come up with the final MAMP in 2008. The ICWD MAMP development team played a major role in the MAMP development. They are responsible for much of MAMP content, beginning with the first iteration in 1999 to the final in 2008. As a result of the team effort, the 2008 MAMP used the best science available, considered the most efficient use of human resources, and met ICWD and LADWP budget constraints. The MAMP also had to meet all legal time constraints. The MAMP has moved the LORP this far and some rehabilitation successes have been accomplished. Some required successes, however, have yet to be fulfilled.

Monitoring Plan Needs

After 8 years of implementation, it's time for a critical evaluation of monitoring methods. For a long-term monitoring and adaptive management program to be successful, monitoring must also be subjected to evaluation and needed changes and additions made through adaptive management. MAMP evaluations are needed now to determine if changes or improvements are justified.

In his 2009 decision regarding the adequacy of the MAMP to meet MOU goals, the Superior Court judge concluded…"I think the consultants are absolutely correct in their conclusion that for the LORP to succeed, there must be flexibility in its management and that the Plan cannot be inviolate, but rather must be adaptable based on experience." As management is implemented over-time, monitoring and evaluation effectiveness must keep up. Monitoring and adaptive management methods, including their accuracy, reliability, and efficiency, need to be re-visited at critical points in time throughout their life. Dr. Peter Vorster, Owens Valley Committee Consultant, pointed out in his review of the 2014 Annual Report, that a recommendation should be made for a more timely and cost effective MAMP.

Many of the monitoring methods and statements appearing in the MAMP (especially guidance and prediction statements) need to be deleted, modified, added to, or improved. As LORP monitoring progressed over the past 8-years, many changes, additions, and deletions have been made ad-hoc in an attempt to improve the basic MAMP. In their review of the 2013 Annual Report, the Sierra Club and Owens Valley Committee also pointed out that as LORP monitoring progressed (since 2008), there has been a growing propensity to make small or seemingly small monitor changes to the MAMP protocols. Also, managers have simply not performed all elements of the protocols. Protocols were completely skipped or scheduled monitoring efforts ignored. These numerous monitoring method changes should have gone through the adaptive management process, but they did not.

Many changes, additions, and deletions to the MAMP were not documented or covered by recorded amendments. Most changes, corrections, or additions were not reviewed or evaluated by the Scientific Team nor approved by the Technical Group and Standing Committee. Changes have also not been well documented and archived for future tracking.

A revised, updated and more refined MAMP is needed to accumulate all piecemeal / ad-hoc monitoring changes and guide future LORP monitoring and adaptive management. A more refined monitoring and adaptive management plan will allow the MOU Parties to better manage the LORP. A MAMP must provide the data and evaluation to adequately evaluate attainment of all goals, objectives, and requirements in the MOU and the EIR. The MOU Consultants recommend a revised MAMP be developed.

MAMP Weaknesses and Errors

Tables 13 through 15 discuss and document errors, weaknesses, and omissions that need to be corrected or eliminated in the MAMP. The MOU Consultants have continually recommended that many monitoring protocols in the MAMP be suspended, modified, or eliminated; either because they do not provide the needed information or better methods are now available. So many changes have occurred in the MAMP protocols that it is now causing confusion.

Table 13 displays selected examples of monitoring protocols that have been changed, need to be reevaluated, need to be added, or need to be eliminated in their entirety from the MAMP.

Table 13. Some selected examples of material in the 2008 MAMP by topic that need correcting in a new MAMP.

1- Livestock Grazing Lease Monitoring

None of the livestock grazing monitoring methods appearing in the main body of the MAMP have been used to evaluate LORP livestock grazing effects. Little resemblance occurs in the method the LADWP is using to monitor its livestock grazing leases and what appears in the MAMP. The LADWP developed a more effective monitoring strategy for determining annual forage utilization rates for pastures and fields being grazed by livestock. Their methods have been used for all 8 monitoring years. This methodology, now appearing in the Appendices, should replace and eliminate the present MAMP methodology. The LADWP's method, however, needs some additional companion methods because the LADWP's present methods do not and will not adequately monitor, evaluate, or determine streamside condition and rehabilitation effectiveness on streamside zones. The LADWP's methods do not analyze direct livestock grazing effects on river-banks and low immediate adjacent flood plain environments.

2- Water Quality Monitoring

The MAMP erred in only requiring water quality monitoring of the LOR only for the first three years of LORP implementation. The reasoning for such a short monitoring and evaluation tenure was that the models predicted LOR water quality would become much improved after this period. This of course was not the case and the new MAMP needs to contain a long-term water quality monitoring program. The EIR threshold trigger for LOR dissolved oxygen is no readings will occur below 1.5 ppm and a downward trend. A new long term water quality program must be capable of testing this trigger.

CDW, in their review of the 2014 Annual Report, requested that all future water quality monitoring be done only by scientists having expertise in river water quality analysis. They also requested additional water quality parameters be expanded including, but not limited to, dissolved oxygen, temperature, turbidity, pH, as well as muck content and quality. The ICWD and the LADWP recently developed some new water quality monitoring methods, but these have not been displayed, evaluated, implemented, or approved. These methods need to be included in the new MAMP after review by the Scientific Team. The methods then need to be approved by the Technical Group and Standing Committee and then implemented by the ICWD and LADWP.

3- Recreational Warm Water Fishery Monitoring

The 2008 MAMP developed a fishing-person catch (creel) census to track the development, health, and success of the LORP warm water recreational fishery. One purpose was to provide information that would describe the abundance and distribution of game fish throughout the LORP area. Another purpose was to evaluate game fish response to managed stream flows over-time along with evaluating fishing success. This information would then assist in evaluating compliance with LORP warm-water recreational fishery goals.

The MAMP creel census methods, however, were mainly developed to evaluate if the LOR and Off-River Lakes and Ponds developed and maintained a successful warm water recreational fishery in good condition. The ability of the census to evaluate the recreational fishery goal is now being questioned and challenged by the ICWD, LADWP, and CDW (ICWD Memo June, 10, 2015). (See the Creel Census Section in this adaptive management chapter for more detailed explanation of the problem).

The challenge creates a major obstacle at this stage of the monitoring and adaptive management process because MOU fisheries goals must be properly evaluated for compliance or non-compliance. The MOU Consultants recommend that the ICWD and LADWP develop a more comprehensive method that will more adequately evaluate all MOU related fisheries goals. Once the ICWD and LADWP develop this new methodology and it passes Scientific Team review and Technical Group approval, these methods need to be included in the new MAMP and then implemented by the ICWD and the LADWP.

4- Fish Habitat Surveys Called for in the 2008 MAMP Have Been Temporarily Discontinued
The MOU Consultants, in their 2010 Adaptive Management Report, recommended that fish habitat surveys outlined in the MAMP be discontinued until needed. Habitat surveys could be discontinued because these methods were not providing any additional needed information required at this time for management purposes. Annual changes in LOR and Off-River Lakes and Ponds fish habitat are extremely small and differences are unmeasurable from year to year. Thus, habitat surveys only need to be completed over long-term intervals when needed. The new MAMP should set the time tables for these surveys.

5- Rapid Assessment Surveys (RAS)
It's time to evaluate the effectiveness and value of the RAS. The MAMP calls for Rapid Assessment Surveys to be conducted for the first 10 years of LORP implementation. This required period is about to end. The new MAMP should evaluate if this 10-year time period has accomplished RAS purposes or if the time-line for the RAS annual assessments should be extended. This assignment should fall under the duties of the Scientific Team.

6- Flood Extent Monitoring
Flood extent monitoring outlined in the MAMP, based on flow conditions, may no longer needed at this time; however, future flow changes in the LOR may dictate implementing this monitoring. The MOU Consultants recommended in past adaptive management reports that flooded extent monitoring be discontinued. This reasoning should be updated and explained in the new MAMP.

7- Fall Fishing Census Monitoring
The MOU Consultants recommended that the LORP fall fishing-person catch census be discontinued. The reasoning was because the spring (May) census alone adequately interprets yearly recreational fishing success conditions. The MOU Consultants recommended that the May fishing creel census continue (2010 Adaptive Management Report). The new MAMP needs to update these changes and designate what years in the future the censuses will be conducted.

8- Adaptive Management
The MOU Consultants consider the LORP adaptive management implementation process to-date a failure. Adaptive management has failed to the extent that future MOU goals and requirements will not be met. Dr. Duncan Patten, Sierra Club Consultant, expressed this failure well in his annual report reviews when, he stated, "It is important that the MOU Consultants point out the application of

adaptive management is *not* among the LORP successes." Dr. Patten went on to state that, "the highly selective approach taken relative to application of adaptive management recommendations should be challenged." Dr. Vorster, Owens Valley Committee Consultant, in his review of the 2014 Annual Report, stated that one could argue that it was the lack of implementation and meaningful and specific adaptive management recommendation program that has also inhibited LORP progress. The new MAMP needs to beef up the adaptive management process. The new MAMP must put more emphasis on how the adaptive management process is to proceed and be implemented in the future.

Another major change is that the new MAMP should require the ICWD and the LADWP to provide more justification and scientific reasoning for ignoring, turning down, or delaying adaptive management recommendations. A fundamental reason why many MOU goals and requirements have not been met to-date can be largely attributed to decision-makers' failure to consider and implement needed adaptive management measures (2013 Annual Report).

9- Habitat Indicator Species

A major goal of the LORP is to provide suitable habitat for all indicator species listed in the MOU Action Plan. Habitat for indicator species is listed for each of the four physical components of the LORP. The MOU Consultants, in their 2014 Adaptive Management Chapter, recommended a new modified habitat indicator species list. Action on this recommendation is still pending. A new evaluation of this recommendation and a final habitat indicator species draft list should be developed by the Scientific Team. After Technical Group approval, the list should become a Section in the updated MAMP.

10-Lower Owens River Self-Designing Approach

The MAMP emphasizes the "self-designing" and "self-organizing" capacity of nature to form the final LORP ecological condition. Now that there are many years of LORP implementation, this sole approach should be reevaluated. This "natural" approach may not allow all MOU goals and requirements to be met. A good example is the colonization, encroachment, and density of tules in the LOR under the "self-design" approach. The results contradict the MAMP prediction that open river channel will form and be maintained. The MAMP predicted a tree canopy covered river with accessible streambanks allowing more convenient recreational opportunity.

In Mr. Bagley's (Sierra Club representative) review comments, to the 2013 Annual Report, he stated that, "We are also concerned that the passive restoration approach, which has dominated the project so far, will not achieve LORP goals". Mr. Bagley recommended that some active restoration approaches should be scheduled. Dr. Patten, in his review of the 2014 Annual Report, believed that both passive and active restoration is important to consider for the LORP. He cautioned that some altered active restoration may be necessary to restore the system (i.e., LOR) to a "healthy functional system." He emphasized that a combination of passive and active restoration is regularly used in ecosystem restoration.

CDW, in their review of the 2014 Annual Report, called for changes needed that would control the distribution of established plants (tule and cattails). They emphasized that this will likely require <u>active</u>

intervention. CDW went on to comment that they support appropriate active intervention to create sites for tree establishment.

The new MAMP should again re-evaluate the now governing “self-designing” approach to determine if this approach has the ability to make sure all LORP goals are met. The new MAMP should consider if allowing more flexibility in applying active management actions is now needed.

11- Monitoring Timing and Sunsets

The MAMP recommended, at the completion of the 15-year monitoring and adaptive management period, that managers review ecosystem development and condition to determine if LORP implementation attained all MOU objectives and requirements. Once this review is accomplished, the MAMP requires decision makers to decide if additional monitoring time is warranted. As addressed earlier, the MAMP recommends a time horizon of 15 to 20 years before goal and requirement evaluations are made about restoration success. The new MAMP should re-evaluate this long time horizon and determine if these evaluations should now be made annually rather than defer to a possible end-point.

12- River Gains and Losses

The Consultants recommended in their 2009 Adaptive Management Report that annual LOR water gains and losses reporting could be discontinued until needed. The LOR is not changing significantly enough year to year in river water gains or losses to make the annual reporting effort payoff. Also, all the required data to determine river gain or loss is being collected annually and stored for anyone’s use. If a stakeholder needs to determine river water gains and losses for any water year or any series or water years, it can be calculated quite quickly. The recommendation to eliminate annual river gains and losses reporting has not been accepted. The new MAMP should again consider this recommendation and evaluate if time and money spent in this evaluation should now be spent on more important monitoring needs.

As part of establishing and justifying monitoring in the MAMP, several predictions on future conditions and attainment of MOU goals were made. As stated previously, many goals and objectives have been met. Nevertheless, many predictions in the MAMP have not been met and statements made nine years ago have now been shown to be incorrect. Now that LORP has 8 years of data collection, data evaluation and on-site experience, we have better information to update and revise the MAMP to reflect what did not happen and adjust predictions, and expectations, for the remaining monitoring years. Monitoring can now be improved and directed more to meeting those MOU goals that are going to be difficult to meet.

Table 14, lists those resource areas most in need of correction with a new MAMP. These include water quality, tules, riparian habitat, woody vegetation and fisheries.

Table 14. MAMP predictions and statements that are out-of-date and need to be re-considered and improved.

1-Water Quality

Water quality was expected to improve over time with adaptive management and adjustment of river flows. Channel muck was predicted to be transported out of the channel onto stream banks and floodplains; biological oxygen demand was supposed to decrease overtime; cattle wastes would be removed from the channel and floodplains; and river temperature would moderate with the development of riparian shading. Also, dissolved oxygen was predicted to be adequate at river flows of 30 cfs. These expectations were predicated on the assumption that seasonal habitat flows (over time and with adaptive management adjustments) would provide the necessary energy and streambank flooding. Obviously, these predictions and statements are no longer valid given the existing biological and physical conditions and flow limitations. A new MAMP needs to include a water quality monitoring program such as that tested by the ICWD and LADWP this summer in order to predict whether the LORP will ultimately meet basin water quality standards or be out of compliance. As recommended previously, new monitoring methods, such as the ICWD's new methods, must be approved by the Scientific Team before adoption.

2-Tule Control

The early model predictions that in many river locations tules would not be controlled at flows less than 200 cfs have been validated. High flows are needed to provide control over tule spreading within the channel. The model prediction that at other river locations, 30 to 50 cfs would be adequate tule control has been proven incorrect, even the prediction that tules would be confined to river margins, oxbows, and side channels did not pan out. A principle concept used in the MAMP is that a four-way interaction of depth, light, velocity and competition would limit tule growth. This has been shown to be wrong because the flows allowed in the river lack sufficient velocity, depth and shading which are not adequate under base flows and because of few, consistent seasonal habitat flows, shading from riparian canopy has never developed. We also have learned that tules will out-compete any vegetation on floodplains. A new MAMP needs to address these now known to be erroneous assumptions and statements and use the knowledge acquired to revise tule control predictions.

3-Riparian Habitat

A willow-cottonwood tree canopy was expected to develop with out-of-channel flows. Instead, little woody riparian habitat has developed and marsh vegetation, particularly tules, has been the most responsive vegetation type to the steady-state base flows and infrequent high seasonal habitat flows. Not only was riparian habitat expected to have developed significantly by now, but this was to improve water quality, control tules and create large and small-mouth bass habitat. Woody debris (from riparian inputs) is important to small-mouth bass habitat, thus habitat for small-mouth bass is in short supply. The expectations for initial flows (base and seasonal habitat) have not occurred, and adaptive management recommendations made through the years recognized this and focused on changing the magnitude, duration, and timing of base and seasonal habitat flows. The MOU Consultants continue to recommend flow changes and if these recommendations are adopted and implemented, monitoring must be revised or replaced in a new MAMP to measure whether water quality, riparian habitat, and other MOU goals can be attained.

4-Fisheries
As stated above, small-mouth bass, an indicator species, have not been successful as predicted, when the expectation was that large-mouth bass (a fish more aligned with lake-type habitats) would be less successful. The reverse is true. Because the river flow has resulted in much backwater, low velocities, and some beaver ponds, this habitat is more lake or pond-like, more suitable for large-mouth bass. The fishery was expected to include blue gill, channel catfish, Owens sucker, Owens dace and non-native species like Sacramento sucker. The extent to which these species have been able to thrive in the river is unknown.

It is not known that the Owens native fish are not going to survive or thrive in today's Lower Owens River. Additionally, the prediction that small-mouth bass would become the dominate game species, and utilize these native species as a food base component is not a condition of the current river system. Given the condition of the river and the manner in which it has evolved under the LORP, a new MAMP needs to emphasize a better fisheries monitoring method than creel censuses if we want to truly understand species occurrence, population and distribution. The prediction that the Owens tui chub and Owens pup fish will be returned to the river environment will probably never happen.

Additional General Reasons for Revising or Replacing the MAMP

Table 15 adds to the list some additional general issues that need to be evaluated and revised in the MAMP. Table 15 adds supporting information along with the points expressed previously that the MOU Consultants believe confirms the need to immediately improve the MAMP.

Table 15. Selected general reasons the 2008 MAMP needs to be revised and/or replaced

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1-Annual Report Completion and Review Timing
The MOU requires the ICWD and the LADWP to prepare and distribute an annual report describing monitoring data, evaluation of this data, and information and updating on adaptive management recommendation results. The annual report must describe Owens Valley environmental conditions and report on all studies, projects, and activities conducted under the Inyo-Los Angeles Agreement and the MOU. The MOU calls for the ICWD and LADWP annual Report to be released on or about May 1 of each year.

Because of LADWP budgetary deadlines, the schedule for collecting monitoring data, analyzing this data, compiling adaptive management recommendations, and submitting the annual report has been moved back in time and drastically shortened. The schedule to complete the adaptive management report is now very compressed. The bulk of the review, data analysis, and report writing must be completed in about one month. This time reduction makes it difficult for all MOU Parties and other stakeholders to participate in reviews and participate in follow up meetings effectively.

CDW, in their review of the 2013 Annual Report, was very supportive for an extended review period for evaluating future annual reports. The Sierra Club and the Owens Valley Committee, in this same review period, also pointed out, that as previously noted multiple times by MOU Parties and others, including the MOU Consultants, the review process for the annual report and opportunities to provide meaningful input on the annual report, including adaptive management recommendations, is flawed. They requested that this problem be addressed by the MOU Parties. The Sierra Club and Owens Valley Committee also stressed that, every year the MOU Parties have to go through a perfunctory process that inhibits providing meaningful input and make the necessary adaption to achieve LORP objectives in a cost-efficient manner. The in-time reporting schedules outlined in the MAMP are no longer being followed. The annual report time-line and review process needs to be updated, clarified and better justified in the new MAMP.

2-Clarification of the Adaptive Management Process

Confusion existed, that has now been mainly addressed and resolved, concerning the responsibility of the MOU Consultants and the Scientific Team in preparing and submitting adaptive management recommendations. In a May 9, 2012, letter from the ICWD responding to a April 27, 2012 letter from the LADWP, the ICWD expressed the view that the MOU Consultants must act independently in preparing and presenting draft adaptive management recommendations. The MOU Consultants annual adaptive management recommendations would then be sent to ICWD and LADWP staffs to determine the merits of the recommendations and actions to be taken, if any.

The LADWP, in their previous April letter, expressed the opinion that the LORP Scientific Team should make annual adaptive management recommendations. The MOU Consultants in their May 2, 2012 responding letter clarified that the LADWP incorrectly invoked Section 3.3 of the MAMP when a more appropriate and more important section expanded the Consultants adaptive management participation (4.1 and 4.1.2 of the 2008 MAMP). The MOU Consultants also pointed out that after 8 years of LORP implementation, no effective Scientific Team has ever been formed. The MOU Consultants in their letter recommended a 9 step process for determining, reporting, and applying adaptive management recommendations. They recommended that this 9-step process be approved and added as an addendum to the 2008 MAMP. This approval and addendum was never done. The revised MAMP should address the confusion and record the MOU Consultants independence in conducting the LORP adaptive management recommendation process as required in the MOU and subsequent court decisions.

3-RAS Annual Monitoring

The methods in which woody riparian plants (mainly trees) along the LOR are recorded and evaluated have been modified numerous times in the RAS. The MAMP does not adequately explain and document RAS responsibilities, protocol, or include updated methods. The revised MAMP needs to update this section to display the presently used RAS methodology. Because RAS is only a 10 year effort, which is almost over, the new MAMP needs to re-evaluate the need to continue the RAS, or if now is the time to eliminate the annual RAS.

4-A New Water Quality Monitoring Approach

The ICWD has recently led in the development of a new water quality monitoring strategy. This new methodology, timing, and continuation of sampling is not covered in the MAMP nor does it appear as an amendment. The Scientific Team has never evaluated or approved the ICWD's new methods; nor has the methods gone through the adaptive management process. This omission can be corrected by incorporating the new water quality strategy into the revised MAMP after Scientific Team review and Technical Group approval.

5-MAMP Duration
The MAMP anticipated that LORP goals will largely be achieved within a 15-year time period. After 9 years of LORP management it is becoming very questionable if this time frame is sufficient. The revised MAMP should now be able to place better timing and reasoning for MOU goal attainment.

Recommendations

1. The Consultants recommend the 2008 MAMP be re-evaluated during the winter of 2015-2016. The existing 2008 MAMP would be used to develop a new revised draft MAMP to better guide future monitoring and adaptive management implementation.
2. The MOU Consultants recommend that the completed ICWD-LADWP MAMP draft be sent to the Scientific Team during the winter of 2015-2016 for review, revisions, and draft finalization.
3. The Consultants recommend the Scientific Team final draft be used by the MOU Parties to conduct a "Monitoring and Adaptive Management Workshop" during the winter of 2015-2016. The "Workshop" purpose is to obtain MOU Party review and input before going through the Technical Group and Standing Committee approval process. Upon approval by the Standing Committee the ICWD and the LADWP would then be the responsible agencies for implementing the new MAMP.

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11.0 RESPONSE TO ADAPTIVE MANAGEMENT RECOMMENDATIONS

Response to Comments on Ecosystem Sciences'

2015 Lower Owens River Project Annual Report
Adaptive Management Recommendations
LADWP and ICWD (December 2015)

Annual Report Deficiencies:

LADWP:
Page 3 concerning creel census: *LADWP did not budget work days for writing the creel census report in the 2014-2015 Work Plan. This was further communicated to ICWD and it was understood that if a report was to go into the 2015 LORP Annual Report that Inyo would perform the analysis and reporting.*

ICWD: Although the creel census was not budgeted for in the 2014-15 Work Plan, following the LORP Summit, Inyo, LA and the MOU consultants concurred that monitoring the fishery would provide useful baseline information if agreement could be reached that would allow experimentation with a new hydrograph. The County agreed to conduct the census, and spent considerable time and resources organizing and implementing the survey. However a new flow regime was not established, so this data collection exercise was largely unnecessary. The County did request that LADWP assist with reporting (LADWP has such expertise and has provided this reporting in all previous years), but LADWP refused on grounds that the work wasn't budgeted.

Page 3 concerning water quality work*: The document states that LADWP did none of the work for water quality monitoring. LADWP covered the majority of the field work (deploying instruments and downloading data) of the water quality monitoring although initially responsible only for deploying and calibrating the data sondes. ICWD conducted the analysis and reporting to offset the large number of hours that LADWP contributed in the field.*

All of this was done by both LADWP and ICWD despite the revisions to the MOU never being adopted requiring this water quality monitoring. The findings from this experiment can be found in Chapter 7 of this 2015 Draft Annual Report.

ICWD: The water quality instruments were owned by LADWP, and it was agreed that LADWP would refurbish, calibrate, and install the instruments. Because of the condition of the instruments when retrieved from storage and the need to install secure monitoring enclosures, the time necessary to complete this task was underestimated. All instruments were installed and operating by the beginning of June 2015 (some sites were operating since February). Inyo downloaded and maintained the equipment on two occasions in June. LADWP did the same in July, and staff from both agencies removed the equipment in September. Data analysis was shared and ICWD compiled the data and prepared the summary for the Annual Report. There were no agreements with the MOU parties that specified monitoring or reporting requirement, nor was there budget allocated for the consultants to review or analyze the water quality data.

Attainment of MOU Goals and Obligations:

MOU Consultants Recommendations

1. The MOU Consultants recommend during the winter of 2015-2016, the MOU Parties conduct a two-day "Goal Analysis and Solution" Workshop. This workshop would stress one agenda item only: meeting the goals and requirements of the MOU. The workshop product would be to identify those goals and requirements that are difficult to meet, are not being met, and will probably never be met. The workshop would develop a guidance document for the Scientific Team to assist in their responsibilities of providing the science to ensure goals and requirements are met and sustained prior to the ending of the LORP. The guidance document should be completed by April 2016.

LADWP: LADWP will take this recommendation under advisement.

ICWD: The MOU Consultants have already provided the parties their professional opinions on the goals and requirements that are difficult to meet, are not being met, and will probably never be met. The MOU consultants, through their Adaptive Management Recommendations (AMR), have already provided their professional opinions and guidance on the science and actions they see as being necessary to meet goals. We are unclear on how such a workshop would provide any additional guidance to the Scientific Team (scientists from the LADWP, scientists from the ICWD and scientists and staff from the MOU Consultant's group) about the status of achieving goals or the science required working toward meeting goals. That said, the Scientific Team invites the comments and suggestions from the MOU Parties and the public, through the LORP Annual Report process, on how they believe the science may be improved. This type of feedback has proven to be helpful.

2. Once the MOU Parties have completed the guidance document, the MOU Consultants recommend the Scientific Team review, upgrade, and develop a draft management plan to ensure MOU goals and requirements are met. The Scientific Team would evaluate each MOU goal and requirement previously identified as needing improved management. They would then develop respective management solutions. The Scientific Team would then submit their management solutions to the Technical Group for action.

LADWP: LADWP will take this recommendation under advisement.

ICWD: Each year, based on LORP monitoring, Inyo, LADWP, and MOU consultants make assessment of current and projected conditions and considers appropriate adaptive management actions that will benefit the project. These management actions are incorporated in the LORP work plan, or appended to the LORP work plan as needed, and submitted to the Technical Group. The process outlined by the Consultants is too elaborate to be incorporated into the annual planning process. Since conditions and challenges to meeting project goals have not changed greatly since the 2014 River Summit, we do not view the series of summits/meetings proposed by the consultants as critical to planning or implementing measures, experiments, or monitoring to improve the LORP. However, the MOU parties should meet to consider the adaptive management recommendation to alter flows in the river before the 2016 growing season.

3. The MOU Consultants recommend the Technical Group review and upgrade the report as necessary and submit the goal attainment solution report to the Standing Committee for action.

LADWP: LADWP will take this recommendation under advisement.

ICWD: See above.

4. The MOU Consultants recommend that all stakeholders (i.e., MOU Parties, Scientific Team, Technical Group, and Standing Committee) make goal and requirement attainment a high priority in 2016.

LADWP: LADWP will take this recommendation under advisement.

ICWD: Meeting the goals of the LORP has been a high priority in all years.

5. The MOU Consultants recommend that future LORP Standing Committee management decisions, especially those guiding the adaptive management process, direct available resources towards attaining those goals and requirements identified in the workshop as difficult to attain.

LADWP: LADWP will take this recommendation under advisement. Resources should be concentrated on goals that can be realistically attained. The MOU Parties should evaluate which of the original goals may not be reached based on knowledge gained nine years post implementation. Effort should be concentrated on goals that are feasible with reasonable effort.

ICWD: Agreed.

Additional Comments:

LADWP:
Page 7-9, Table 1: *The 45 goals listed above are not identified in the MOU. What is the source for these goals?*

Page 10, Table 3: *Some important MOU (1997) goals and requirements the MOU Consultants believe will be difficult to meet or will not be met before the proposed 15-year monitoring and adaptive management program ends, given current LORP management.*

Page 10, Goal 1: *Using the term 'healthy' is very subjective and difficult to quantify. Defining this term as it may apply to the multiple land types along and adjacent to the LOR would benefit managers' ability to accurately evaluate variety of land types within the project area as they relate to a targeted condition. For example with the implementation of 40cfs flows in April of 2006 moist floodplain locations, specifically Alkali scrub/meadow locations along the LOR have improved in some locations- please refer to Figure 3 in the 2015 Adaptive Management Recommendations report. This response is linked to goal 7 in Table 2: Recharge groundwater in streambanks and floodplains to benefit wetlands and biotic communities.*

Page 10, Goal 14: *This goal is contradictory to Goal 16 and Goal 17 where disturbance during the warm season could lead to fish kills.*

Page 10, Goal 18: *The issue of compliance with T&E species laws and regulations should be expanded or discussed.*

Page 10, Goal 19: *Water quality has been good with the exception of anticipated warm season disturbance events associated with a natural dynamic equilibrium. Again this goal contradicts Goal 16 and Goal 17.*

ICWD: **Page 58, Lower Owens River Self-Designing Approach**
Local and global increases in biodiversity have been documented, and overall the project has benefitted the southern Owens Valley and beyond, but local declines have been dramatic. The LORP woodland, to provide habitat for birds that were identified by project planners as markers of the project's success, is an example. Riparian forest has decreased from about 450 acres in 2000, to 265 acres in 2009, and 165 acres in 2014. The evolving river-riparian ecosystem, functioning as it is within the constraints of allowable management, seems to preclude widespread establishment of trees. Woody recruitment lacking, and trees dead or dying, an argument can be made to experiment with tree planting to establish missing habitat and increase seed availability. This was not discussed in the MOU Consultants recommendations.

The MOU Consultants acknowledge that "natural" approach management alone may not allow all LORP goals to be met. MOU Consultants identify tule colonization, encroachment, and density as an example of passive management that hasn't resulted in a desired condition and may prevent meeting important LORP goals; primarily goals tied to water quality. There is general agreement that emergent vegetation cannot be controlled on a large scale by methods that are within the limits of available resources, but the consultants offer no recommendations for small scale experiments in active management of tules that might be scaled up if resources can be found.

The County is seeking outside funding to hire a consultant to study, design, plan, permit, and implement the construction of a channel, or channels through the Islands area. If funding is found, the LORP scientific team will direct the project, and design a program of monitoring. A small scale study assessing the effectiveness of mechanically opening up channel, if proven effective, would help make a case for funding a larger project. For example, the County has experimented with manually removing tules from within the waterway, and developed tools and techniques that efficiently clear tules open narrowed channel. These techniques can be used to establish stretches of open waterways—paddle trails—that can accommodate paddlecraft. Based on the success of this small scale experiment, the County submitted a proposal to the California Natural Resources Agency requesting funds to establish a six mile long Owens River Water Trail in the Lone Pine Area. The proposed project offers recreational access to the river and improves habitat and water quality. Mechanical and manual removal of tules from parts of the river channel would open occluded channel to allow boat passage and associated improvements in flow will facilitate the transport of organic materials and sediment which accumulate in this stretch of the river. It would be helpful if the consultants could offer specific suggestions for similar modest programs in active management that can be upscaled.

Flow Management

Base Flows

MOU Consultant Recommendations

1. All of the MOU Consultants adaptive management recommendations for changes in base flow management, outlined in their 2013 and 2014 adaptive management chapters of the annual reports, are still supported and again recommended (See Figure 1). The MOU Consultants recommend the base flow pattern scenarios displayed in Figure 1 be accepted and implemented for testing in 2016. This recommended base flow should be implemented annually until base flows have been properly evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.

LADWP: LADWP is willing to implement alternate flow schedules as long as the new flow scenario is water neutral.

ICWD: The consultant recommendations are confusing because their 2013, 2014, and 2015 flow recommendations which are recommended are different and often incompatible. The County responded to the 2013 and 2014 recommendations previously. Inyo County supports changes to flow management proposed to the MOU parties in 2015, and hopes the MOU Parties can agree to modify the MOU and Stip and Order to allow for adaptive management to meet LORP goals.

2. The MOU Consultants recommend the MOU Parties conduct another one-day River Summit during the winter of 2015-2016. The primary focus would be to again review, evaluate, and discuss the 2013 and 2014 adaptive management recommendation for base flow and seasonal habitat flows. The meeting outcome would be a decision by the MOU Parties to continue present base flow management methods or accept and implement the MOU Consultants' proposed base flow recommendations. If the MOU Consultants' base flow recommendations are again turned down and not implemented, then the MOU Consultants recommend that the MOU Parties develop and implement their own base flow scenarios and initiate them in 2016. These MOU Party flows would be evaluated annually for success, failure, no effect, or needed modification. This is an important recommendation because current base flows will not allow all MOU goals and requirements to be met in the future.

LADWP: LADWP is willing to implement alternate flow schedules as long as the new flow scenario is water neutral.

ICWD: Inyo County supports changes to flow management, and hopes the MOU Parties can agree to modify the MOU and Stip and Order to allow for needed changes in flow management. Another summit is unnecessary to adopt the hydrograph that has already been supported by both Inyo and Los Angeles; however, a meeting of the MOU parties should be arranged to seek agreement on the documents necessary to implement adaptive river flow management

Seasonal Habitat Flows

MOU Consultant Recommendations

1. The MOU Consultants seasonal habitat flow recommendations in the 2013 and 2014 adaptive management chapters (in the respective Annual Reports) still stand and are again recommended for implementation (Figure 1). These seasonal habitat flows should be initiated in 2016 and continued annually until properly evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.

LADWP: LADWP is willing to implement alternate flow schedules as long as the new flow scenario is water neutral.

ICWD: See above and the County's comments in previous Annual Reports regarding the 2013 and 2014 flow recommendations. Inyo County supports changes to flow management, and hopes the MOU Parties agree to modify the MOU and Stip and Order to allow experimenting with a new hydrographs designed to best fit adaptive management needs.

2. The MOU Consultants recommend the MOU Parties conduct a second River Summit during the winter of 2015-2016. A primary focus would be to review and evaluate the MOU Consultants 2013 and 2014 adaptive management seasonal habitat flow and base flow recommendations. The meeting outcome would be to again determine if the MOU Parties want to continue their present flow management or accept the MOU Consultants seasonal habitat flow recommendations. If the MOU Consultants' seasonal habitat flow recommendations are turned down, then the MOU Parties should develop and implement their own annual seasonal habitat flow scenarios. MOU Party developed seasonal habitat flows should be initiated in 2016 and monitored annually and evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.

LADWP: An additional river summit is unneeded unless or until the MOU Parties are willing to support a water neutral change in flow management. LADWP is in support of alternate flow scenarios that are water neutral but such concepts were rejected by MOU Parties in 2015.

ICWD: See above and the County's comments in previous Annual Reports regarding the 2013 and 2014 flow recommendations. Inyo County supports changes to flow management, and hopes the MOU Parties can agree to modify the MOU and Stip and Order to allow for needed changes in flow management. Another Summit is not necessary at this time.

Additional Comments:

LADWP:

***Page 14 regarding water quality**: Recent data collected on the LOR indicates high water temps lead to poor water quality conditions…not low, static flows.*

ICWD: Water quality problems and fish kills have resulted from high flows during the warm summer season, not from steady 40 cfs baseflows.

Augmentation Flows

MOU Consultant Recommendations

1. The MOU Consultants' flow augmentation recommendations appearing in past adaptive management reports since 2010 are still supported and again recommended. These augmentation flows should be considered for implementation by the Scientific Team in 2016 and continued annually until properly evaluated by the ICWD and the LADWP for success, failure, no effect, or needed modification.

LADWP: Augmentation as described will result in additional water lost above current conditions and is not water neutral. LADWP will not implement adaptive manage recommendations that are not water neutral.

ICWD: Sections of river below the islands never realize the benefits of a full flushing flow released from the Intake. Augmentation strategies that can boost flow in the lower reaches of the river need to be fully considered by the Scientific Team with sufficient safeguards to implement the flows during periods with cool water temperatures only. We have little more than anecdotal experience with substantial Alabama Gates releases and resulting higher flows in the river below the islands, and the thresholds of temperature and flow that result in fish kills are poorly understood.

2. The MOU Consultants recommend the MOU Parties conduct a second River Summit during the winter of 2015-2016. The secondary focus would be to review and evaluate the 2013 and 2014 adaptive management flow recommendations covering flow augmentation needs. The meeting product would be to determine if the MOU Parties want to continue present seasonal habitat flow management or implement needed augmentation flows.

LADWP: Augmentation as described will result in additional water lost above current conditions and is not water neutral. LADWP will not implement adaptive manage recommendations that are not water neutral.

ICWD: Again, sections of river below the islands never realize the benefits of a full flushing flow released from the Intake. Augmentation strategies that can boost flow in the lower reaches of the river need to be fully considered by the Scientific Team.

Delta Habitat Area Habitat Flows

MOU Consultant Recommendations

1. The MOU Consultants recommend that the Period 1 (April-May), Period 3 (September-October), and Period 4 (November-December) DHA habitat flows be released in 2016 from the Intake Control Station as displayed in Tables 6 through 8. These habitat flows would be released annually from the Intake Control Station until properly evaluated by the ICWD and LADWP for success, failure, no effect, or needed modification.

LADWP: Flow releases as described for Period 1, Period 3, and Period 4 will result in additional water lost above current conditions and is not water neutral. LADWP will not implement adaptive manage recommendations that are not water neutral.

ICWD:

2. The MOU Consultants recommend the MOU Parties allow the LADWP to implement these recommended flows and still meet their "water neutral" mandate. Any period flow release that turns out to be above "water neutral" would be compensated for by allowing the LADWP to slowly reduce the following winter LOR base flow by a similar amount. Any water savings occurring below "water neutral", however, like what occurred in past LADWP habitat flow.

LADWP: Reducing winter base flow at the LORP Intake does not allow DWP to recover any water. Almost all water currently released into the LORP during the winter months is recovered at the LORP Pump Back Station.

ICWD: There are likely flow strategies in which water can be saved and banked for above normal releases from the Intake and augmented flows. This needs to be investigated. Concurrently, the MOU Parties need to consider changes to the MOU and Stip and Order that will allow water savings and avoid ineffective use of water in the Delta.

3. The MOU Consultants recommend the MOU Parties agree to waive the 50 cfs pump out restriction at the Pumpback Station during the Period 1, 3, and 4 habitat flow release periods. This will make it easier for the LADWP to meet their "water neutral" mandates.

LADWP: If the pump back limitation were lifted for the entire period of high flows at the pump back station resulting from the pulse flows as described, then LADWP could remain water neutral and would consider implementing these proposed flow releases.

ICWD: Agreed.

4. The MOU Consultants recommend the ICWD and the LADWP annually evaluate each Period DHA habitat flow release. Findings would appear in in each respective annual report.

LADWP: Clarification is needed for "annually evaluate each Period DHA habitat flow release." What data or information is going to be needed/used to evaluate the effect of the habitat flows?

ICWD: LADWP scientists, observing trends in the Delta, have recommended changes in water delivery to the area that they believe will provide habitat benefits, or avoid undesirable conditions. As well, these changes are water saving. It's likely not necessary to evaluate all of the pulse flows, however, an annual evaluation of the effectiveness of flow changes in the LORP annual report would be appropriate. The Scientific Team will discuss this suggestion.

Flushing Flow

MOU Consultant Recommendations

1. The MOU Consultants recommend that a flushing flow, with a 300 cfs peak flow, as displayed in Table 9, be released from the Intake Control Station in April 2016. This recommendation only applies if the MOU Parties do not implement the other needed flows recommended in this Chapter. A required seasonal habitat flow release by itself does not count as covering all needed flows.

LADWP: Clarification is needed for the statement "does not count." Please elaborate.

ICWD: Regular flushing flows are desirable or perhaps essential to support optimal development of the river-riparian ecological system—we'll learn more once we experiment with a new hydrograph—however, this recommendation comes without rationale for selecting a flow of 300 cfs. What would be the effect of such a flow under current conditions? The County favors implementing alternative flow regimes as part of adaptive management (see above), but cannot support recommendations with sufficient rationale that the measures will improve the LOR.

2. The MOU Consultants recommend the 718 acre feet of additional water needed to implement the April flushing flow be compensated for. This would be accomplished by the MOU Parties allowing the LADWP to pump-out more than 50 cfs at the Pumpback Station, when additional water is available, during the following November through February period until the 718 acre feet of water is compensated for. This is a feasible solution because during this winter period the LADWP annually passes excess water into the DHA that is not needed to provide benefits to the DHA. A good example occurred in water year 2013-2014 when the average flow to the DHA was 11.2 cfs when the required DHA flow annual release only needs to average between 6.5 to 9 cfs.

Predicting the timing and magnitude of winter water gain, given sudden contributions of storm water or sudden snow melt conditions, is very difficult. Unintended flows are released to the DHA when intense river storms cause river flows to exceed the limited maximum capacity of the Pumpback Station or when electrical pump outages occur (2010 Annual Report). In case the LADWP cannot make up the full 718 af of water, by taking excess water out during the November through February period, the LADWP would be allowed to meet their "water neutral" requirement by slowly taking it out of the following base flow period.

LADWP: Because in some years less than 718 acre-feet of water is available at the pumpback station as additional pumping potential, LADWP will need the option of recovering the water over a multi-year period. As long as LADWP has approval from the other MOU Parties to pump more than 50 cfs between November and February and can recover the water over a multi-year period, then LADWP can remain water neutral and accept this flushing flow recommendation.

ICWD: Inyo County supports changes to flow management, and hopes the MOU Parties agree to modify the MOU and Stip and Order to allow for needed changes in flow management.

3. The MOU Consultants recommend the ICWD and LADWP evaluate a series of annual 300 cfs peak April cleansing flows to determine their success, failure, no effect, or needed modification for improving LOR water quality conditions. Findings and evaluations would appear in each respective Annual Report.

LADWP: As long as LADWP has approval from the other MOU Parties to recover the water lost during the flushing flows by pumping in excess of the 50 cfs limit at the pumpback station and *continues to recover the water from such flushing flows later in the year when additional water is present at the pumpback station, then LADWP agrees with this recommendation.*

ICWD: Inyo County supports changes to flow management, and hopes the MOU Parties agree to modify the MOU and Stip and Order to allow for needed changes in flow management.

Additional Comments:
LADWP:
Page 15 regarding Table 4: *Flow values 2009 and 2005 cfs should be corrected.*

Page 23, Figure 1: *Please explain how this flow scenario is going help maintain open water wetlands in the LORP and an open channel.*

Creel Census

MOU Consultants Recommendations

1. The Consultants recommend that ICWD and LADWP, during the winter of 2015-2016, evaluate the lack of credibility and validity in the 2008 MAMP creel census methods. Upon completion of this evaluation ICWD and LADWP would then develop a new method, or combination of methods, they are confident will provide the data and information they perceive are needed to adequately evaluate the MOU goal of creating a healthy warm water recreational fishery in the LOR. It is very important that a new methodology evaluate all recreational fisheries in the LORP.

LADWP: LADWP will take this under advisement. LADWP understands the usefulness of a periodic creel census to identify species that are using the LORP but does not think that it is necessary to conduct this monitoring every year.

ICWD: Existing creel census methods, which are used simply to assess the general health of the fishery require no modification. The census should be conducted every few years under normal conditions, in all years when a fish kill is observed to assessed resilience and recovery, and in years after a substantial planned or unplanned alteration in river flow. The County does not object to creel census methods in general as implied by the consultants. The County objects when the consultants put forth conclusions not substantiated by the type or quality of the monitoring data.

2. Upon completion of Recommendation 1, both MOU Consultants recommend this new or upgraded fishery evaluation methodology be sent to the Scientific Team (by February 2016) for their evaluation and acceptance. The Scientific Team, after making the necessary changes, would then submit a final draft to the Technical Group for action. The Technical Group, after review and approval, would submit the final product to the Standing Committee. Once approved by the Standing Committee, the new fishery evaluation methods would be included into the new MAMP in time for conducting the May 2016 LORP fisheries evaluations.

LADWP: LADWP will take this under advisement.

ICWD: A new fisheries assessment method is not required at this time; however, if tule encroachment continues to overtake open water then the creel census as it's currently conducted will be impossible because anglers will not be able to sample enough open water. At that point new methods will need to be investigated. Additionally, if channel conditions degrade substantially from poor water quality, channel aggradation, or tule encroachment, it *may then be necessary to conduct a fishery evaluation to assess whether that goal is being met. It is not necessary to develop and implement such methods at this time.*

3. The MOU Consultants recommend the ICWD and the LADWP continue to conduct the MAMP fishery evaluation methods (creel census) in May of 2016. This census would be conducted in companion with an updated or new fisheries methodology developed by ICWD and LADWP. The creel census would continue to follow those methods, procedures, application levels, and number of fisher persons called for in the MAMP. This double monitoring process should continue annually until the new methodology proves reliable and accurate in adequately evaluating the fisheries goals and requirements of the MOU and the EIR.

LADWP: LADWP will take this under advisement. However, if fishery monitoring is modified by both ICWD and LADWP to be more relevant to the goals of the LORP, LADWP does not support "double monitoring" using new and old methodologies. This is a waste of resources that could be directed elsewhere and it does not need to be conducted annually.

ICWD: A creel census has been budgeted for in 2016. A creel census was conducted in 2015 but not analyzed. Unless there is a change in conditions, or change in flows, the analysis of the 2015 data, presented in the 2016 LORP report, may be considered sufficient monitoring.

4. The MOU Consultants recommend that the ICWD and LADWP, while preparing their new fishery evaluation methods, consider the MOU Consultants' first proposed intensive fishery evaluation methods recommended in the MOU development process (MOU [1997], Appendix 1) that were not accepted.

LADWP: LADWP will take this under advisement.

ICWD: If needed, we will review various methods of fishery assessment and select the study that best fits our inquiry.

5. The MOU Consultants recommend that both the 2015 and 2016 creel reports be properly evaluated and documented in the 2016 Annual Report.

LADWP: LADWP will take this under advisement. However, LADWP did not budget work days for the 2015 Creel Census in the 2014-2015 Work Plan. ICWD should perform any reporting associated with the 2015 Creel Census that they conducted.

ICWD: The 2015 survey may substitute for the planned 2016 census. In that case the 2015 analysis will appear in next year's report.

Blackrock Waterfowl Management Area

MOU Consultants Recommendation

1. Develop a plan for a four-year cycle with two-year intervals for switching wetland units. The plan should include employment of multiple tule control treatments including excavation, burning and experimental use of herbicides in localized areas.

LADWP: Seasonal flooding of the units should be considered as opposed to the two and four-year cycle mentioned in this recommendation. Literature recommends that waterfowl units should be dried and flooded on a seasonal basis, not every two years. Prolonged flooding (greater than one year) is contrary to wetland management for waterfowl which is based on the principles of moist soil management; an approach that has been widely used in the United States for the past 60 years. To further substantiate this fact with regard to waterfowl, LORP avian census surveys from 2010 and 2015 indicated the unit provided extremely poor quality habitat during the last five years. Please refer to Figure 30, Figure 31, and Figure 32 of the avian surveys for Drew in the 2015 Annual LORP Report.

Additionally, seasonal flooding should eliminate conditions that would warrant significant operational costs associated with maintenance and preparation for flooding by allowing drawdowns to occur early enough to eliminate the establishment of saltcedar and tules during the summer months.

ICWD: LADWP has taken the lead in investigating a new management regime for the BWMA. In consultation with CDFW, the County will participate in the development and review of the draft plan. The County believes the changes being proposed by LADWP could result in higher quality habitat for waterfowl and possibly shorebirds depending on site-specific topography of flooded extent. Seasonal flooding associated with the moist-soil management framework is worthy of experimentation.

2. Evaluate the response in waterfowl habitat and usage, especially indicator species, during implementation of the plan and identify an ecological process that might be more suitable criteria for determining the duration of a wetland unit.

LADWP: LADWP will take this under advisement, recognizing that percent open water may not be an accurate metric to evaluate waterfowl habitat.

ICWD: Any new management plan will include monitoring that evaluates the effectiveness of the changes.

3. Examine methods and the cost-benefit of recovering fish during drying-wetting cycles of BWMA wetland units.

LADWP: The LORP EIR recognized that fish loss could occur with drying down the units. CDFW is the only MOU Party with the authority to rescue fish therefore any fish rescue that may occur must be performed by, or under the direction of CDFW. A fish rescue was performed by CDFW with LADWP's assistance in June 2015 while drying down the Drew Unit.

ICWD: Inyo County notified CDFW that fish could be stranded by the dewatering of the Drew Unit. CDFW and LADWP worked to transplant as many fish as possible into adjacent Blackrock Ditch. Resources might not always be available to move fish. This might not be a *concern in the future given the direction of proposed management changes in the BWMA favors shallow water flooding that is unlikely to support a significant fishery.*

4. LADWP cannot ignore the Scientific Team when making decisions about the BWMA; decisions regarding when a unit will be dried or flooded as well as any future management plan must be reviewed and approved by the Scientific Team.

LADWP: LADWP drained the Drew Unit and flooded the Winterton Unit in response to the MOU Consultants' direct request. Refer to the memorandum sent by Ecosystem Sciences to Dr. Robert Harrington and Mr. James Yannotta dated April 22, 2015 with the subject heading: 2015 Seasonal Habitat Flow Release and Blackrock Waterfowl Management Area Recommendations. Specifically stated in Ecosystem Sciences April 22, 2015 memo: "DWP has initiated water holding and spreading improvements in the Winterton Unit, and this unit is largely ready for use. The MOU Consultants recommend draining Drew at a rate equal to the wetting of Winterton so that a final wetted area in Winterton of 180 acres is attained as required by the predicted 2015 runoff of 36% of normal."

This memo followed an April 13, 2015 letter from LADWP to CDFW also outlining the seasonal habitat flow and BWMA recommendations on which the MOU Consultants and all MOU Parties were copied. An additional memo dated April 28, 2015 was sent to LADWP and ICWD from CDFW supporting the decision to drain the Drew Unit and flood Winterton and requesting coordination with LADWP to salvage fish where feasible.

ICWD:

Additional Comments:
LADWP:
Page 31 regarding Thibaut Flow: *The reference to the Thibaut Flow ceasing on April 1st has no connection to the BWMA as those flows were for the Thibaut Pond which is a separate project from the BWMA.*

Page 31, regarding monitoring the wetted perimeter of Winterton: *Monitoring the wetted perimeter of Winterton was conducted by ICWD in July and September 2015. These results are found in Table 2 of the Hydrologic Monitoring Chapter of the 2015 LORP Annual Report the wetted areas were also presented in Table 17 of the Avian Census report in the 2015 LORP Annual Report.*

Page 31 regarding fish rescue: *A fish rescue effort was performed when the Drew Unit was drying down. This was not a requirement of LADWP nor does LADWP have the authority to rescue fish. Further, the LORP EIR recognized that fish loss could occur with drying down the units. However, a fish rescue effort was spearheaded by Lacey Greene of CDFW and was assisted by LADWP Watershed Resources staff in June 2015.*

Page 32: *When presenting a possible flooding sequence, the MOU Consultants omitted the fourth and largest available unit in the BWMA matrix, the Thibaut Unit.*

Page 32 regarding berms at Winterton and water in Waggoner Unit: *Berms in the Winterton Unit did fail but because of the inundation, repairing the berms was impossible. Water is not flowing into the Waggoner Unit, what the MOU consultants may have observed was the water conveyance directly east of the Waggoner Unit which provides water to the off river lakes of Lower Twin and Upper Goose. Additionally, the Waggoner unit was not burned* *two years ago. The last burn in Waggoner was in 2009 in preparation for flooding for that same year. The tules observed by the MOU consultants were tules from the last period it was flooded (2009 to 2010). LADWP made plans to burn the Waggoner unit in the spring of 2015 but was not permitted to conduct the burn due to the Round Fire.*

Page 32, reference to excavating and herbicides to maintain deep open water: *Deep water is not an ideal habitat for most waterfowl species. Waterfowl need shallow water and generally feed in water less than 12".*

Page 32-33, General recommendations for BWMA:
The recommendation by the MOU consultants does not include the Thibaut Unit (not to be confused with the Thibaut Pond) which is the fourth unit to be incorporated into the BWMA flooding regime. LADWP supports the concept of increasing the flooding cycle between the units while at the same time decreasing the period of flooding of each unit to a seasonal basis as long as such a change would be water neutral from current practice. For each unit, optimal waterfowl habitat would require seasonal flooding and drying to a minimum amount adequate enough for the smaller population of resident birds. The seasonal timing of those events should coincide with spring and fall waterfowl migrations and subsequent drawdowns to occur early enough to eliminate the establishment of saltcedar and tules during the summer. Deep water is not an ideal habitat for most waterfowl species. Waterfowl need shallow water and generally feed in water less than 12".

The change in flows for the Thibaut Pond is an excellent case study in the effectiveness of this regime. During the last three winters an estimated 98% of the pond has been open water. Flows into Thibaut Pond cease April 1st which allows for the area to dry out early enough to preclude the establishment of saltcedar and tules which in turn eliminates any preparation for flooding for the following November. This early dry down also permits the establishment of early successional forbs and grasses which serve as the primary food source for waterfowl during the winter. A recurring theme in the MOU consultants' recommendations emphasizes the need to maintain open water for long periods of time. The longer units are flooded the more preparation time is required to flood them again which then leads to the desire to maintain a unit flooded and avoid the costs associated in preparing the next unit. Hydrologic stress is another option which might also be beneficial in terms of water savings, habitat productivity, improving habitat for some indicator species (shorebirds), and improving grazing conditions. Prolonged flooding (greater than one year) is contrary to wetland management for waterfowl which is based on the principles of moist soil management; an approach that has been widely used in the United States for the past 60 years.

ICWD:

Off River Lakes and Ponds

Delta Habitat Area

MOU Consultants Recommendation

1. Because there are clearly different and likely better ways to manage flow into the DHA, the LADWP, ICWD and the MOU Consultants should meet to discuss a suitable flow release pattern and appropriate monitoring to evaluate the effectiveness of different flow releases.

LADWP: LADWP agrees with this recommendation.

ICWD: Agreed.

Noxious and Invasive Weeds

MOU Consultants Recommendations

Controlling invasive weeds should be a priority in the LORP, and resources allocated to this effort should reflect that. We recommend that funding be increased for the CAC control efforts to ensure that existing populations are treated and that adequate effort can be employed to detect new populations. There are 51 known sites and a vast area to be surveyed (this is CAC's report number, the RAS reports more locations). The RAS and other efforts are able to detect some new populations; however these activities occur in specific areas (e.g. the RAS is conducted near the water's edge only). Appropriate resources are required to control perennial pepper weed.

LADWP: LADWP supports this recommendation if the Inyo/Mono Agricultural Department can secure additional grant funding.

ICWD: The County will work with the I/M Agricultural Department to assure that maximum effort is put into control of pepperweed in the LORP.

Landscape Vegetation Mapping

MOU Consultants Recommendation

1. LADWP remap the Riverine Riparian Area using the 2009 aerial images and the 2005 IKONOS Imagery and provide this data to the MOU consultants when the mapping is complete.

LADWP: The MOU Consultants make a case for remapping 2000/2005 and 2009 conditions based solely on discussion of riparian forest. The MOU consultants consistently attribute differences to "accuracy" (is it this or is it that). Riparian forest constitutes a relatively small (3 percent) component of the LORP mapping and differences due to improved mapping are most attributed to enhanced "precision" (refined boundaries and fewer inclusions). Mapping technology will undoubtedly be improved for the next cycle of mapping. We can expect mapping for 2019 conditions to be more precise and accurate than for 2014 conditions.

Because tree canopies are such an amalgamation of color values associated with light/ shadow and leaf surface, they could not be delineated spectrally for either 2009 or 2014 conditions. Trees were delineated manually (heads-up). Riparian forest delineated for 2000 conditions included inter-canopy understory (mostly meadow); riparian forest delineated for 2009 and 2014 conditions were refined to the tree canopy (and associated shadow). Heads-

up mapping was difficult because the canopies of decadent trees were often so sparse that only the shadow of nearly barren trunk and branches was evident. An alternative to spectral value (e.g. foliage height) is needed to refine mapping of riparian forest.

Also, it would be very difficult to evaluate the accuracy of remapping 2005 and 2009 conditions, because they no longer exist. Remapping the Riverine Riparian Area from 2005 and 2009 is infeasible and unwarranted.

ICWD: The riparian tree vegetation category was delineated in 2000 but the minimum mapping unit was larger than the tree canopy and typically included the meadow understory, while in 2009 and 2014 the tree canopy was considered the minimum mapping unit. Because of these mapping differences, direct comparisons of the areal extent of trees between the pre and post watering of the LOR are inappropriate. Yet, this is an important question to answer and continue to monitor. The County's vegetation program manager (J. Zatorski) has developed an independent mapping of trees on the LOR (using heads up digitizing from 2014 NAIP 1-m aerial imagery). This product should be compared to the recent riparian woodland mapping by LADWP. These features could be overlaid onto the 2005 IKONOS imagery to provide a mostly-completed tree layer. Trees that have died since 2005 could be digitized (i.e. top-killed tree willows after fire north of Keeler Bridge in 2013) and added to the 2005 map. Trees that have established on point bars and secondary channels along the LOR post-LORP implementation are likely still too small to be detectable from manual aerial imagery interpretation. In summary, the County believes using the most recent tree mapping efforts as a starting point for reconstructing a 2005 tree layer based on the 2005 IKONOS imagery is worthwhile and would provide a more accurate depiction of change in tree cover on the LOR. Because of the inability to perform accurate ground truth, we do not agree with the recommendation to remap the baseline, 2005, or 2009 conditions for the entire project area. Also, the benefits of capturing intermediate stages of vegetation changes experienced to date are questionable. Many of the important trends or changes are obvious in Jenson's comparison of baseline and present conditions (e.g. marsh expansion). The real issue is how to change project management to improve the present conditions.

2. We accept LADWP's recommendation that to explore alternative approaches to monitoring the BWMA. We recommend LADWP provide a written proposal of what the alternative monitoring would be, ensuring that the suggested approach meets the LORP monitoring and adaptive management plan's objective (e.g. 500 acres of habitat area being flooded during average and above average water years).

LADWP: LADWP will take this under advisement.

ICWD: Water Department staff is working with LADWP to develop an enhanced avian monitoring program. RAS monitoring in the area will continue. A new BWMA management plan should include emergent vegetation monitoring.

Additional Comments:

LADWP: ***Page 41:*** *The MOU Consultants state "differences in vegetation type acreages associated with hydrologic changes are vital to managing the project and for accurately making adaptive management decisions." Project management and adaptive management decisions can be better determined based on changes in state (Figure 8 of Landscape Vegetation Mapping). States are clearly associated with distinctive assemblages of vegetation types (Table 3 and Figure 8) and hydric status (Table 4). Differences in vegetation type acreages associated* *with hydrologic changes are discussed both with respect to individual types (e.g. wet meadow) and with regard to the LORP Summary (section 4.6).*

Page 42: *The MOU Consultants state, in the context of riparian forest: "there is no mention of grazing, which is a significant disturbance regime within the Lower Owens." Nine years of monitoring livestock grazing and plant communities grazed by livestock with results reviewed by the MOU Consultants have indicated otherwise. It is not evident how livestock have affected the status of mature riparian forest. The MOU Consultants should provide data supporting livestock impacts to mature riparian forest.*

Page 42: *The MOU Consultants state that RAS (ICWD 2015) data conflicts with landscape scale mapping results. The RAS identified 8 sites in 2015 where tree willow and cottonwood recruitment occurred along 62 miles of the river. Recruitment areas range from 1-25 m with trees <0.5 m tall and total less than 0.25 acres. Recruitment sites correspond with streambars identified in Landscape Vegetation Mapping. Streambars were characterized in the 2015 annual report as "sparsely vegetated, sandy habitats suitable for willow colonization." Rather than conflicting, the RAS (ICWD 2015) supports the landscape scale mapping results.*

Page 42 regarding statement that RAS provides conflicting data compared to mapping results: *The analysis conducted by Jensen was performed at the landscape level. Total area of woody recruitment sites between 2008 and 2014 were estimated at 0.1% along both sides of the LOR (LORP Annual Monitoring Report, 2014). The RAS identified 8 sites in 2015 where tree willow and cottonwood recruitment occurred on two sides of the 62 miles of the LOR. Typical recruitment area ranges from <1m to 25m and mean tree heights in the first year are <0.5m. Total number of trees in the 1-5 category comprised 66% of 8 sites. These sites are technically contributing to the overall landscape (at values of <1%, and less than a ¼ of an acre in 2015) and can only be detected during pedestrian surveys. To fault a landscape analysis performed from aerial imagery in presenting conflicting data is dubious. As stated later in the Landscape Vegetation Mapping comments from the MOU consultants in the 2015 Annual Management Recommendations: "When considering the development of woody riparian vegetation it should be considered that riparian vegetation requires years to develop the canopy cover required to be detected with landscape scale mapping products."*

ICWD: Agreed. The consultants are comparing apples and oranges and inappropriately conclude the results contradict when actually the programs simply observe different things (e.g. recruits vs. a mappable tree canopy).

Page 43: *We disagree that changes (improvements) in mapping methodologies have created unclear picture of conditions since 2000 and that remapping of baseline and 2009 conditions is necessary to determine trend. "The MOU Consultants believe that remapping 2005 and 2009 conditions using the same methodologies (remote sensing – unsupervised classification) as used in 2014 would provide sufficient data to accurately identify trends…" "Remote sensing" refers to any approach to mapping from landscape imagery and not just spectral analysis. Regardless, riparian forest was not delineated using spectral analysis; it was mostly drawn manually. The basis for the MOU Consultants belief is incorrect.*

It is unlikely that remapping 2005 and 2009 conditions using a spectral approach will resolve the precision of riparian forest mapping. We recommend that alternatives to spectral analysis based on structural measures (e.g. LiDAR) be considered as a basis for refining the accuracy and precision of landscape vegetation mapping as they become available.

Avian Census and Indicator Species Habitat

MOU Consultants Recommendation

1. Continue with Avian Census Monitoring Program and determine if resources are available to increase the frequency of the program. For example, if a water year allows for a habitat flow, consider performing the census following the habitat flow or in the subsequent year.

LADWP: What do the MOU Consultants hope to learn by "performing the census following the habitat flow or in the subsequent year"?

ICWD: Increasing the frequency of avian surveys could help disentangle background climatic and broader population trends from trends associated with habitat quality associated with LOR. It is unclear, however, what specific question the MOU consultants are implicitly invoking with the suggestion to time surveys with habitat flows.

2. We accept LADWP's recommendation to develop species specific habitat-relationship models for the LORP for the purpose of providing a management tool for understanding bird use of the riverine-riparian area. Please provide the MOU consultants with a written document explaining the habitat suitability models, and for which species.

LADWP: *LADWP concurs with the recommendation to develop species specific habitat-relationship models for the LORP.*

ICWD: ICWD concurs with this recommendation.

3. We are also open to evaluating the current indicator species list. If data supports removing indicator species from the list because habitat conditions do not or will not warrant their inclusions, then we suggest LADWP provide written and data-driven documentation as to why a change in the indicator species list is needed.

LADWP: The Evaluation of LORP Habitat Indictor Species for Retention or Elimination with Recommendations (Ecosystem Sciences 2014) already discusses the need to reevaluate and revise the habitat indicator species list. This document provides as an alternative to the current indicator species list, the use of focal groups and species, and bird community indices were recommended to evaluate whether healthy, diverse riparian and aquatic habitats are being created and sustained. Existing LORP monitoring data provides an opportunity to development explanatory and predictive models to advise reconsideration of appropriate wildlife indicator species or indices. LADWP would like to continue to work collaboratively with ICWD in developing models to aid long-term management of LORP. LADWP agrees that proposed changes need to be substantiated and data-driven but recognize that changes to the current list will require collaboration.

ICWD: Habitat indicator species should be tied to specific features that are articulated to be key in the description of what a healthy riparian/riverine ecosystem means in the context of the LORP. Characteristics of riparian woodland (density, dbh) largely determine habitat suitability of the majority of LORP avian indicator species. The presence/absence of certain species provides a first approximation of whether key habitat features are provided or missing respectively. Importantly, suitable habitat often goes unoccupied owing to low population numbers or social attraction considerations; moreover, presence and abundance can be a *misleading metric for evaluating habitat quality as individuals may settle in suboptimal habitat (habitat sinks) (i.e. presence of cowbird nest parasitism).*

Land Management

MOU Consultants Recommendations

1. The MOU Consultants, in their 2014 Adaptive Management Report, recommended that LADWP range staff, during the winter of 2014-2015, develop a monitoring program that evaluates woody vegetation recruitment, survival, sustainability, mortality and vegetative trend conditions over the entire LOR streambank and riverine-riparian grazing areas. This recommendation still stands and is again recommended.

LADWP: LADWP dropped the streambank sampling of the non-woody component to eliminate plots that are devoid of seedling or juvenile trees in direct response to the MOU Consultants' recommendation in the 2011 Adaptive Management Recommendations: "In addition, the MOU Consultants recommend doubling the number of sites and recording woody riparian only; eliminating other vegetation and cover measurements. Having only 16 sites along the river limits the ability of the protocol to capture an accurate picture of woody species recruitment in the LORP. "(2011 LORP Annual Monitoring Report, p. 10-25).

Again it should be pointed out that LADWP was sampling along the streambank as part of its SMP that was designed by the MOU Consultants in 2010 and 2011. It should be noted that these sites were selected by the MOU Consultants in conjunction with LADWP and it was understood at that time and subsequently mentioned in later reports that because of the lack of random sampling associated with the protocol extrapolating results across the entire LOR would not be possible. Despite the lack of random sampling, LADWP effectively monitors a large cross section of woody vegetation survival and mortality across virtually all of the LOR, simply because these locations are scarce along the LOR. Woody riparian areas comprise 0.1% of the LOR. By using the SMP in conjunction with recent RAS findings of additional germination/recruitment events we are able to accurately describe conditions in both existing and new areas and we feel our sample size adequately represents woody recruitment areas across the project area. LADWP's approach is similar to what one would use if sampling for rare plants or any other species that occupies 0.1% of the landscape. Initial action would be a broad, cursory survey (i.e. RAS) and then select an adequate number of sites containing the rare species in question for a more detailed analysis (i.e. SMP). LADWP agrees to revisit existing streamside monitoring plots and to incorporate additional plots which contain seedling or juvenile riparian trees which have not exceeded 6'.

Regarding the monitoring of the riverine-riparian grazing areas, LADWP has conducted said monitoring since the initiation of flows in 2006 with the range trend plots. LADWP at present does not monitor other vegetation aside from woody riparian trees along the stream bank (per the MOU Consultants' recommendation in 2011). As stated in the 2015 LORP AMR the current condition and future trend of the LOR is a gradual transition from riparian to marsh and then an expansion of marsh across the lower floodplains. "The MOU Consultants believe that the riverine system that now exists will persist into the future if present LORP management methods continue."(2015 LORP AMR) This trend of expanding marsh along the LOR has been thoroughly documented in the Landscape Vegetation Analysis, the RAS, and the SMP. LADWP questions the value of conducting additional monitoring along streambanks to simply confirm known trends already validated through numerous other efforts, especially if the driver and potential solutions for current conditions have already been identified elsewhere.

ICWD:

2. The MOU Consultants continue to support and recommend the continuation of the LADWP's belt-plot streamside woody recruitment and survivability evaluation study as related to evaluating animal grazing effects on woody vegetation recruitment survival. This monitoring was not completed in 2015 (2015 Annual Report). The MOU Consultants recommend this monitoring be continued in 2016.

LADWP: LADWP agrees with the recommendation and will revisit the SMP plots if resources are available to do so.

ICWD: ICWD concurs with this recommendation

3. Almost all grazing pastures and fields in the LORP were continually in grazing utilization compliance in 2015. This is an important accomplishment by the lessees under such harsh series of drought years. A couple of important pastures and fields, however, were in non-compliance again in 2015. One field has been in non-compliance for multiple grazing seasons. The MOU Consultants recommend that these pastures and fields receive more emphasis on meeting forage grazing utilization requirements in 2016.

LADWP: LADWP concurs with this recommendation.

ICWD: ICWD concurs with this recommendation

4. Each individual LORP lease grazing plan allows irrigated pasture condition evaluation ratings to be waved during low water years or during drought conditions. After four years of drought, the MOU Consultants recommend that key irrigated pasture condition be evaluated in 2016 to display how they are responding to extreme drought conditions. This recommendation may have already been fulfilled, as in the 2013 Annual Report the LADWP stated that the condition of irrigated pastures declined on several of the leases in the LORP area. The drop in condition is largely attributed to lack of snowpack runoff, resulting in reduced irrigation supply. The annual report also stated that all irrigated pastures in the LORP will be evaluated again in 2014. The MOU Consultants missed seeing the data or the evaluation, if it was done, and therefore, could not make an analysis and respond.

LADWP: There is nothing to evaluate based on the current irrigated pasture condition scoring criteria. If the pastures are rated during the existing drought conditions they would fail due to lack of irrigation water. They will likely take several years to recover.

ICWD:

Additional Comments:
LADWP: The MOU Consultants provided no recommendation concerning the Rare Plant Monitoring's recommendation to discontinue the project, based on strong evidence that livestock do not influence the abundance of the two plant species in question.

Page 48, Monitoring Methods: *The frequency and line intercept protocols used in the Range Monitoring program were never intended to monitor the immediate edge of the LOR and its progression through time. One of the MOU goals was to maintain sustainable livestock grazing and the above protocols provide a metric to evaluate the attainment of that specific goal. Plots* *are selected to represent where typical use by livestock is occurring on the moist floodplains and the uplands within the LORP.*

Page 48 regarding selection of plots: *In response to Dr. Patten and the MOU consultant's most recent questioning of the 2012 decision to eliminate plots that are devoid of seedling or juvenile trees, LADWP dropped plots in 2012 in direct response to the MOU Consultants recommendation in the 2011 Adaptive Management Recommendations (stated above). The streamside monitoring program (SMP) samples in September each year and measures mean tree height on each plot, sampling at the same time is critical for data integrity. Approximately 10 days are spent conducting this sampling, analyzing and incorporating it into the AMP along with range trend and various other responsibilities. Sampling plots that have no woody trees will increase the time required to complete the annual monitoring effort.*

If the MOU consultants feel that the information regarding establishment and trends over time from woody riparian vegetation gleaned from plots that have no woody riparian vegetation will be more useful than from plots that do have established seedling and juvenile trees, then the request may be incorporated but because of time limitations plots containing trees will be dropped. LADWP does see the value of capturing recruitment events in a plot and tracking those trees over time, as discussed in the 2013 report LADWP incorporates recent RAS results to establish additional plots.

Habitat Conservation Plan

MOU Consultant's Recommendations

1. Incorporate the HCP into the LORP MAMP to fulfill the MOU requirements (Section IIA 2).

LADWP: This is unnecessary because LADWP's HCP took into consideration the LORP.

ICWD: The MOU states, "Habitat conservation plans for Threatened and Endangered Species will be incorporated [in the LORP Plan] if and where appropriate." The HCP took into account the LORP Plan, and can stand alone. The Scientific Team will consider if any changes in methods or monitoring are needed to address HCP goals and objectives.

2. Revise the MAMP to prevent monitoring overlap, or enhance monitoring actions to efficiently support HCP needs.

LADWP: LADWP will take this under advisement.

ICWD: Changes to existing monitoring to assess HCP goals and objectives, if any, will be documented in future LORP reporting. It is unnecessary to revise the MAMP.

3. Update and revise the MAMP in a workshop to reset schedules, realign monitoring to existing environmental conditions, and revisit initial goals and expectations.

LADWP: Recommendations for changes to the MAMP are irrelevant until there is some change in flow management adopted by the Parties to apply to the project. Changes to the project may warrant a change in monitoring, but until then modifying the MAMP is unnecessary.

ICWD: Revisions to the document are unnecessary.

Revision and/or Replacement of MAMP

MOU Consultant's Recommendations

1. The Consultants recommend the 2008 MAMP be re-evaluated during the winter of 2015-2016. The existing 2008 MAMP would be used to develop a new revised draft MAMP to better guide future monitoring and adaptive management implementation.

LADWP: While some elements of the MAMP are in need of updating, recommendations for formal changes in monitoring methodologies, the need for additional monitoring or other changes to the MAMP are irrelevant until there is some change in flow management adopted by the Parties to apply to the project. Changes to the project may warrant a change in monitoring, but until then modifying the MAMP is unnecessary.

ICWD: Changes to monitoring methods and schedules are decided by the Scientific Team. The MAMP provides a backbone for LORP management; however, adaptive management requires flexibility to respond to evolving conditions. Management is refined, some monitoring is added, altered, dropped or delayed, such as the site scale vegetation monitoring, which was meant to addresses local changes in vegetation cover, which are observed in other monitoring. Rapid assessment monitoring (RAS) has evolved to focus on two main subjects, woody recruitment, and invasive and noxious species. Subtle changes to observation and recording criteria are made year-to-year, and sometimes day-to-day during the RAS to better observe impacts that are most concerning. Changes to management are, or should be noted in the annual report, but it is impractical at this time before significant adaptive management measures have been agreed upon to make wholesale changes to the MAMP.

2. The MOU Consultants recommend that the completed ICWD-LADWP MAMP draft be sent to the Scientific Team during the winter of 2015-2016 for review, revisions, and draft finalization.

LADWP: Recommendations for changes to the MAMP are irrelevant until there is some change in flow management adopted by the Parties to apply to the project. Changes to the project may warrant a change in monitoring, but until then modifying the MAMP is unnecessary.

ICWD: See earlier response.

3. The Consultants recommend the Scientific Team final draft be used by the MOU Parties to conduct a “Monitoring and Adaptive Management Workshop” during the winter of 2015-2016. The “Workshop” purpose is to obtain MOU Party review and input before going through the Technical Group and Standing Committee approval process. Upon approval by the Standing Committee the ICWD and the LADWP would then be the responsible agencies for implementing the new MAMP.

LADWP: LADWP will take this under advisement.

ICWD: See earlier response.

12.0 PUBLIC MEETING AND COMMENTS

12.1 LORP Annual Report Public Meeting

The LORP 2015 Draft Annual Report public meeting was held on January 13, 2016, at the LADWP Bishop office. The following page lists those in attendance.

2016 LORP Public Meeting

January 13, 2016

Name	Affiliation	E-Mail/Phone
Zach Nelson	ICWD	znelson@inyocounty.us
Jerry Zatorski	ICWD	jzatorski@inyocounty.us
April Zrelak	Lone Pine Paiute-Shoshone Res	aircoordinator@lppsr.org
Alyse Bertenthal	—	abertent@uci.edu
Sally Manning	Big Pine Paiute Tribe also OVC	s.manning@bigpinepaiute.org
Deb Murphy	Sierra Wave	dmurphy49@outlook.com

12.2 Public Meeting

The audio recording of the LORP 2015 Draft Annual Report public meeting is included on the enclosed disk.

12.3 2015 Draft LORP Report Comments

The comment period for the 2015 Draft LORP Report was from December 22, 2015 through January 28, 2016. The following pages are the comments received.

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Inland Deserts Region-R6
Bishop Field Office
787 North Main Street, Suite 220
Bishop, CA 93514
(760) 872-1171

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

January 25, 2016

James Yannotta
Los Angeles Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, CA 93514

Dr. Robert Harrington
Director
Inyo County Water Department
P.O. Box 337
Independence, CA 93526-0337

Subject: LOWER OWENS RIVER PROJECT 2015 DRAFT ANNUAL REPORT COMMENTS

Dear Mr. Yannotta and Dr. Harrington:

The California Department of Fish and Wildlife (CDFW) appreciates the opportunity to provide comments on the Lower Owens River Project 2015 Draft Annual Report. The three main biological challenges facing the Lower Owens River Project (LORP) identified at the 2014 LORP Summit were water quality, bulrush and cattail growth, and low levels of woody recruitment. By considering and implementing both flow management and active intervention, CDFW believes these challenges can be overcome and most of the LORP goals can be met. Re-evaluation of LORP goals is not necessary at this time. CDFW continues to support changes to the Lower Owens River flow regime and also supports changing flow management in the Blackrock Waterfowl Management Area to improve conditions for waterfowl. The following comments are aimed to address the goals and challenges of the LORP as discussed in the 2015 Draft Report. Specific page number references from the 2015 Draft Report are provided in parenthesis throughout this letter.

LOWER OWENS RIVER FLOWS

CDFW continues to be concerned that the current flow regime on the Lower Owens River will not result in achievement of the LORP goals. CDFW continues to support changes to the flow regime for a trial period in which comprehensive monitoring would elucidate the impacts on various water quality parameters as well as tree seedling and sapling survival. CDFW continues to support using higher magnitude flushing flows and seasonal habitat flows, releasing delta habitat flows from the intake, and potentially altering the timing and ramp down from seasonal habitat flows to better support recruitment of riparian trees. The specific timing and magnitude flow changes warrant further discussion: For example, depending on temperature, Los Angeles Department of Water and Power's (LADWP) proposed seasonal flow in June may impact the warm water fishery by decreasing dissolved oxygen in the water. In addition, lowering winter flows may need to be reconsidered, as that might encourage the development of inset marshes that could further occlude the river channel (4-53). Further, CDFW believes that conditions for habitat indicator bird species at the Blackrock Waterfowl Management Area could be improved by changes in water management.

CDFW continues to be open to considering a modification the legal documents that set the base and peak flows on the Lower Owens River, understanding consensus among all MOU Parties would be required. At this time, CDFW supports a temporary lifting of pumpback station restrictions in order to provide the flexibility to implement different flow recommendations. CDFW also supports changing the wetted area regulations for Blackrock Waterfowl

Management Area. CDFW encourages the MOU parties to continue to work together, making adjustments to legal documents as necessary, to continue to improve the LORP functions and goals.

WATER QUALITY

CDFW was glad to see additional water quality monitoring of dissolved oxygen and temperature, following previous adaptive management recommendations. In particular, the observation that "All three observations of sudden declines in DO [dissolved oxygen] apparently were initiated by flows exceeding a threshold between approximately 70-75 cfs when temperatures were above 65 F" is particularly helpful in guiding management recommendations and decisions. While this data does contribute to our baseline knowledge, CDFW recommends that systematic water quality monitoring is continued on a longer term basis, to build on our understanding of how flow changes impact water quality. Furthermore, CDFW agrees with the recommendation that additional analyses should be completed to compare flow, temperature, and DO relationships from all available data.

BULRUSH AND CATTAIL GROWTH

Although bulrush and cattail growth were identified as one of the main biological challenges at the 2014 LORP Summit, there appears to have been no progress on this topic. CDFW recommends LADWP and Inyo County Water Department (ICWD) continue David Livingston's (LADWP) work testing treatment methods and develop a plan to apply successful methods at larger scales. This challenge is particularly important to address as the vegetation change analysis and aggrading state of the river indicate bulrush and cattail will likely increase along the Lower Owens River in the future. Methods to reduce or limit river aggradation should be investigated. Also, the potential for lower winter flows to allow bulrush and cattail encroachment on the channel should be investigated before winter flows are reduced.

LACK OF WOODY RECRUITMENT

The loss or riparian trees documented by the vegetation change analysis and the limited amount of tree recruitment documented in the Rapid Assessment Survey (RAS) continues to be of concern because riparian trees are a necessary habitat component for several habitat indicator species and "even small tree stands or individual trees contribute to diversity by providing appropriate structure and nesting cavity opportunities" (3-64). At the public meeting on January 13, 2016, CDFW was glad to hear Aaron Steinwand describe how ICWD had revisited past observed individual tree seedlings and saplings and found a relatively high survival rate beyond the first two years. This information should be added to the final report. However, the overall trend is clearly a loss in riparian tree habitat and CDFW agrees that the "predicted increase in overstory canopy has not been realized; probably because of the very limited extent of barren substrate suitable for willow colonization in the seasonally flooded zones"(4-51). Because the currently discussed flows are not capable of creating the disturbed habitat necessary for natural tree recruitment, CDFW supports active intervention to create sites for tree establishment. In coordination and cooperation with grazing lease holders, CDFW supports further investigation on the potential for high density grazing in small restricted areas to create the disturbance needed to support riparian tree recruitment. In addition, current riparian trees are potentially threatened by aggradation (4-53) and interventions to maintain the river channel should be investigated.

HABITAT CONSERVATION PLAN

On October 7, 2015, LADWP sent a letter to the MOU parties, which included the "Habitat Conservation Plan for Los Angeles Department of Water and Power's Operations, Maintenance, and Management Activities on its land in Mono and Inyo Counties, California" (hereafter referred to as the HCP) and the "Recovery Attainability of Threatened and Endangered Species on Los Angeles Department of Water and Power Land in Inyo and Mono Counties" (hereafter referred to as the Recovery Document). LADWP stated that taken together, the HCP and the Recovery Document were intended to fulfill the requirements described in the 1997 MOU for a habitat conservation plan (hereafter referred to as hcp*). The 1997 MOU calls for an hcp* for indigenous threatened and endangered species that "will identify conservation areas within the planning area which will be managed to facilitate restoration of threatened and endangered species to viable populations" (1997 MOU, Attachment A, incorporated by reference, p. 6). However, a federal HCP does not require, and LADWP's draft HCP does not include, the identification of specific conservation areas. CDFW determined that even when taken together, the Recovery Document and the HCP fail to meet the 1997 MOU requirements for an hcp*. The main flaws with these combined documents are that LADWP limits the HCP to only seven species (a small subset of threatened and endangered species on their lands) and for the seven species considered, LADWP fails to clearly identify conservation areas for each species and commit to managing these areas to facilitate species restoration to viable populations. Further details of this assessment are provided in a comment letter from CDFW to USFWS and LADWP dated January 14, 2016 (Attachment A).

BLACKROCK WATERFOWL MANAGEMENT AREA

CDFW concurs with LADWP's findings that wetland productivity and use by habitat indicator bird species at the Blackrock Waterfowl Management Area would be improved by more 'seasonal manipulation of water levels' including 'seasonal drying to control emergent vegetation' (3-85).

Seasonally flooded wetlands and permanent open water provide important habitat to migratory waterfowl. Carefully timed seasonal flooding events can maximize moist-soil seed production, which improves the utility of the wetland to waterfowl and shorebirds. This is accomplished through a wetland management regime based on timely drawdowns for plant germination, summer irrigation, and soil disturbance. These strategies have been successfully implemented throughout California on federal wildlife refuges, state wildlife areas, and private duck clubs, resulting in dramatically increased waterfowl, passerine, and shorebird usage. In a similar way, conditions for waterfowl and shorebirds at Blackrock Waterfowl Management Area could be improved by changing the management scheme from a permanently flooded area into a seasonal wetland with semi-permanent ponds for waterfowl breeding production.

Data from the southern Central Valley (California) and Imperial Valley (California) have shown that seasonally managed wetlands require less water per acre to provide higher quality habitat to water birds when compared to permanently flooded wetlands. CDFW recommends setting the water use at Blackrock Waterfowl Management Area based on previous years' water use (2008-2015), varying with annual runoff projections. In this way, changing to seasonal wetlands at Blackrock Waterfowl Management Area could be both water neutral and the total wetland acreage created by transitioning to seasonal wetlands will exceed the amount created by previous management strategies. Please see the California Waterfowl Association's Principles of Wetland Management for more information.

Specifically, CDFW recommends the following actions:

- Build a collaborative Blackrock Waterfowl Management Area team including CDFW, ICWD, LADWP and the California Waterfowl Association to guide, fund, and implement significant adaptive management to switch largely from perennial to seasonal wetland.
- Implement science-based wetland management practices to maximize use by migratory and resident waterfowl, migratory shorebirds, and passerine birds.
- MOU party meeting to discuss changing regulations at Blackrock Waterfowl Management Area to allow a set amount of water to replace the regulatory standard of wetted acreage that currently exists.
- Develop alternative monitoring to replace current landscape vegetation mapping (4-3).
- Fine-scale topographic mapping of the Blackrock Waterfowl Management Area to determine flow direction and current topographic fall for assessing current management capabilities.
- Construction or modification of wetland unit infrastructure to allow for efficient flood-up and drawdown activities.
- Systematic waterfowl surveys three times per year (peak fall migration, overwinter, spring breeding), in accordance with CDFW protocol and validated by follow-up ground surveys to evaluate the effect of seasonal wetland management.

Additional information should be added to the LORP Annual Report that describes the pre-flooding berm creation within the Winterton unit, similar to Section 5.8 that describes the methods and results of disking. Effective adaptive management requires an understanding of what management actions have been taken and the outcome of those actions.

OTHER COMMENTS

Page 3-2: Please include the dominant and common species within the reedgrass vegetation type.

Page 3-6: Point Reyes Bird Observatory is now called Point Blue Conservation Science.

Page 3-55: CDFW agrees with the report observation that crosswalking Bassia and Weed vegetation categories over as Annual Grassland may not result in accurate habitat suitability assessment.

Page 3-65: CDFW finds the avian census project a useful tool in monitoring the breeding songbird population on the LORP but also further agrees that species specific monitoring may be necessary to determine the status of many of the Habitat Indicator Species.

Page 4-3: CDFW agrees that landscape vegetation mapping at Blackrock Waterfowl Management Area should be reconsidered in light of the manipulated water spreading at this site.

Page 5-1: CDFW is concerned that pasture utilization has been repeatedly above allowable levels for the islands and Lone Pine leases (5-1). CDFW concurs with LADWP staff recommendation to extend the drift fence within the islands lease (5-39) and recommends corrective actions also be identified and implemented to bring the Lone Pine lease utilization down to allowable levels.

Page 5-1: CDFW agrees that data indicate that it is acceptable to remove grazing exclosures based on the rare plant monitoring results. However, CDFW recommends rare plant monitoring be continued to assess impacts from removing exclosures. After two more years, monitoring could be reduced in frequency (biannually) and distribution (subset of sites).

CDFW would like to see data results and analysis in next year's annual report on the impacts of the large grazing exclosures associated with the LORP.

CDFW appreciates having an extended review period and having the public meeting after the holiday season. In addition, CDFW appreciates that the draft report format was word-searchable and able to be saved with electronic comments.

Thank you for the opportunity to comment on the Draft 2015 Lower Owens River Project Annual Report. If you have any questions regarding this matter, please contact me at (760) 872-0751 or Heidi.Calvert@wildlife.ca.gov.

Sincerely,

Heidi Calvert

Heidi Calvert
Senior Environmental Scientist (Supervisor)

cc: Chron
Bruce Kinney, CDFW
Nick Buckmaster, CDFW