Lower Owens River Project
2018 Annual Report

February 2019

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EXECUTIVE SUMMARY

The 2018 Lower Owens River Project (LORP) Annual Report contains the results from the twelfth year of monitoring for the LORP. Monitoring results contained in this report include hydrologic monitoring, LORP vegetation mapping, avian census monitoring for the Delta Habitat Area and the Drew Unit of the Blackrock Waterfowl Management Area (BWMA), monitoring of range conditions throughout the project area, rapid assessment, woody recruitment, 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 2017-2018 water year LADWP was compliant with all the 2007 Stipulation & Order flow and reporting requirements. The mean flow to the Delta Habitat Area (DHA) was 9.9 cfs, exceeding 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, but high runoff from last year led to additional water releases, large wetted acreage areas, and difficulty with measurement access in the first part of 2017-2018 water year. The seasonal habitat flow ramping reached a peak of 130 cfs and covered six days, before ramping down over another six days. This section also describes flow measurement issues and includes commentary on flow losses and gains through the different reaches of the Lower Owens River.

Vegetation Mapping- LORP, Delta Habitat Area, and Drew Slough, 2017 Conditions

Vegetation inventories were conducted for the Lower Owens River Project (LORP), the Delta Habitat Area (DHA), and Drew Slough management unit of the BWMA for 2017 conditions, ten years after LORP was implemented. The aerial imagery that served as a basis for mapping was collected July 28-29 and August 1-2, 2017 near peak runoff.

LORP results are compared with similar inventories of 2009 and 2014 conditions resulting from the LORP and for 2000 conditions prior to implementation of LORP. Differences in conditions are primarily attributed to hydrologic changes associated with re-watering the Owens River, fires, and improvements in the accuracy and precision of mapping. Other management applications (e.g. grazing) may also have affected change.

The runoff for 2017 was the second highest year on record. In June, inflow to the LORP exceeded 240 cfs and peaked at 325 cfs. A 274 cfs flushing flow was also released in

April. Water was spread extensively in the BWMA and two diversions (McIver and Eclipse water spreading diversions) were used to spread water east of the Owens River. At the time of imagery in late July and early August, discharge at the intake was on the descending limb following four months when inflow approached or exceeded 100 cfs. Discharge to the DHA approached 60 cfs in late July and early August after exceeding 100 cfs the previous month. Water was spread throughout much of the BWMA in spring and summer of 2017.

Hydrologic changes for LORP are summarized in terms of states. About 10 miles of incised channel has become graded since 2014 and there was a net increase of 4 miles of aggraded condition, corresponding with a net increase of about 900 acres of hydric vegetation since 2014. The LORP continues to aggrade. Prescribed burns in 2008, 2010, and 2012 converted scrub/meadow to more productive meadow and invigorated production of herbaceous vegetation. A wildfire near Lone Pine in 2013 also converted scrub/meadow to meadow and reduced the stature of trees. The Moffat fire burned the Islands and the Owens River bottom 3 miles upstream of the Islands in 2018. The accuracy and precision of mapping have improved with each successive application. Vegetation height calculated from LiDAR was used to enhance the precision of some vegetation types (e.g. trees and scrub) for 2017 conditions.

In the DHA the area of open water (144 acres) was about 16 times the area of water in 2012. Discharge to the DHA approached 60 cfs on the date of imagery and exceeded 100 cfs a month previous. The area of hydric vegetation increased 76 acres since 2012, 152 acres since 2009, and 359 acres since 2005 (baseline). The extremely wet conditions in 2017 likely biased mapping towards more hydric vegetation (e.g. meadow appeared as wet meadow, wet meadow as short marsh).

The Drew management unit of the BWMA was also mapped in 2017. The distribution of vegetation reflects two years of drying followed by water spreading in spring and early summer 2017. Open water covered several areas not previously flooded. About half of the marsh was dead in 2017. The area of hydric vegetation in the Drew unit in 2017 increased 54 acres since 2014, 128 acres since 2009 and 298 acres since 2000.

Avian Census and Habitat Indicator Species for the Delta Habitat Area and Drew Unit, Blackrock Waterfowl Management Area

Avian surveys were conducted from 2002 to 2018 in the Delta Habitat Area (DHA) and the Drew Unit of Blackrock Waterfowl Management Area (Drew Slough) to provide information regarding trends in seasonal use of indicator species. Habitat availability for the set of habitat indicator species for each unit was calculated by classifying land types from 2017 aerial imagery. This information was input into the California Wildlife Habitat

Relationship (CWHR) system allowing calculation of available habitat acreage for each indicator species. In Drew 47 indicator species have been detected over the 2002-2018 period, while 32 have been detected in DHA. Presence of indicator species requiring open-water foraging habitat in Drew have tracked the proportion of open water to marsh habitat over time, with waterbird use peaking in 2010 and decreasing in 2015 and 2018. Avian Census revealed a similar pattern in DHA, with overall decreases in water bird presence, however with increased tall marsh vegetation, visibility into open water habitats may also have decreased, plausibly decreasing detection probabilities of waterbirds at DHA in recent years.

Land Management

The 2018 LORP land management monitoring efforts continued with monitoring utilization across all leases and range trend monitoring on the Twin Lakes and Lone Pine leases inside the LORP management area. Moist floodplain areas along the Lower Owens River have responded from the 2017 high flows with an increase in ruderal species along areas submerged during the summer of 2017. Shrub mortality remains high in Reach II and marsh continues to expand on the Lone Pine riparian corridor.

High plant vigor on uplands where water was spread in 2017 is still observable. 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.

The northern tamarisk beetle (*Diorhabda carinulata*) was observed on the Lower Owens River last summer (2017) in two locations. This summer the beetle has consumed saltcedar across large swaths inside the LORP Project area. The long term effect of the beetle on saltcedar in the LORP is currently unknown.

Rapid Assessment Survey

The 2018 RAS addressed questions about the effects of high water and flooding last year, such as: did beavers take advantage of flooding and high flows to disperse; did noxious weeds spread outside of localized populations; were roads or fences affected; did tree willow that had recruited at the edges of the floodwaters in 2017 persist; had woody recruitment that developed in past years survive prolonged flooding?

One significant finding was that *Lepidium latifolium*, a noxious weed that requires considerable resources to eradicate, has spread into new areas. Ninety-five new populations were located. This is the greatest number of observations recorded in any RAS survey.

A promising discovery is that twice as many populations of tree seedlings were found this year then was found in 2017. In fact, more tree recruitment had been observed in 2018 than in any of the previous six annual surveys.

Woody Recruitment Success

Goals of the Lower Owens River Project (LORP) include the establishment and persistence of woody riparian trees. In this report, the extent of tree recruitment on the LORP is described for the period 2007-2018.

Main Findings. Since 2007, 535 successful recruitment sites on the LORP have been mapped where tree willow or cottonwood has survived into its second growing season; 198 of these sites were still occupied by surviving trees into 2018. In total, 1,032 trees have established from 2007-2017: 812 Black Willow (*Salix, goodingii*), 155 Red Willow (*Salix laevigata*), 62 Willow Hybrids (*Salix goodingii x laevigata*), and three Fremont Cottonwood (*Populus fremontii*).

Shortly after rewatering, in 2008, the number of recruitment sites peaked at 178, stabilized below 50 per year from 2009-2013, and declined to under 10 per year in the last three years of drought in 2014-2016. Both 2017 and 2018 yielded increasing numbers of recruitment sites with 71 found in 2018, the highest number since 2008. The density of recruitment sites was highest in reaches 2 and 3, a 31 mile stretch of river, with approximately 6 recruitment sites per river mile added since the project started. In the remaining 50% of the LORP, less than one recruitment site per river mile was compatible with cohort persistence to 2018.

Sites occupied by trees were mapped with Lidar data acquired by LADWP in 2017 (see Section Landscape Mapping, this report). The 198 sites with successful recruitment during the post-implementation period represent about 4% of these Lidar-mapped tree occupied sites on the LORP. Whether the addition of new sites continues at the current rate into the future or levels off may depend on climate, flow management and the unknown distribution of potential recruitment sites under current flow regime management. Monitoring of tree distribution and density with Lidar data could be one practical way to periodically inventory LORP riparian woodland into the future.

LORP Saltcedar Treatment

Inyo County administered the Saltcedar Control Program for City lands in the Owens Valley since 1997 through funding from LADWP under the Inyo-Los Angeles Water Agreement and Wildlife Conservation grants. In 2017, with the retirement of the Saltcedar Program Manager and cessation of grant funding in 2016, Inyo County suspended their saltcedar program. As a consequence, LADWP initiated a saltcedar control program to manage the species on City property including the LORP area.

In 2017-2018 LADWP treated 822 acres of saltcedar in the LORP area, including:

- 403 acres of foliar applications of herbicide,
- 156 acres of cut stump treatment,
- 254 acres of cut stump retreatment, and
- 9 acres of cutting and submerging plants under water.

LADWP will continue to treat saltcedar resprouts in these areas in 2018-2019 and will continue further treatment in the Blackrock area if feasible.

Weed Report

Significant increases in *Lepidium* latifolium populations were detected along the Owens River and in the Blackrock Waterfowl Management Area. Increases in net acreage of known sites, as well as dozens of new infestations were observed.

Plants were found at much greater distances from the river than had been previously observed.

The total net *Lepidium latifolium* acreage treated in 2018 was 9.27 acres. This represents an 883% increase from the total 1.05 net acres treated in 2016.

The most significant challenge facing the program in the LORP continues to be maintaining adequate staffing for effective management of a large and growing project.

Additional observations about this year's Lepidium outbreak can be found in the Rapid Assessment Section of the 2018 LORP Report.

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, 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. This LORP Annual Report describes monitoring data, analysis, and recommendations for the LORP based on data collected during the 2018 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. In 2018, LADWP wrote Sections 1.0 Introduction; 2.0 Hydrologic Monitoring; 3.0 LORP Vegetation Mapping, 5.0 Land Management, and 8.0 LORP Saltcedar Treatment. ICWD completed Section 4.0 Avian Census and Habitat Indicator Species, 6.0 Rapid Assessment Survey, and 7.0 Woody Recruitment Success. Section 9.0 Weed Report was authored by the Inyo/Mono Counties Agricultural Commissioner’s Office.

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

This document fulfills the reporting requirements for the LORP Annual Report for 2018.

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. 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 have 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 2017 through September 2018, for the 4 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.

2.2 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.

LORP at Mazourka Canyon Road

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.

LORP at Reinhackle Springs

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.

2.3 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):

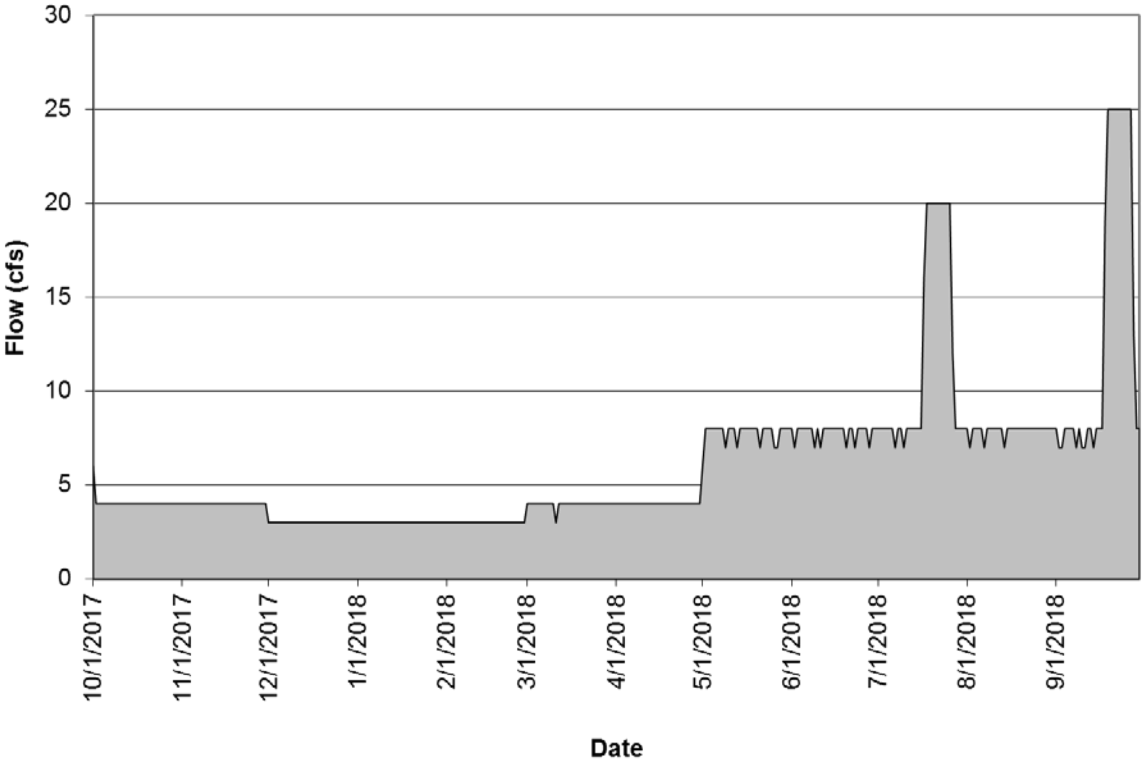
October 1 to November 30	4 cfs
December 1 to February 28	3 cfs
March 1 to April 30	4 cfs
May 1 to September 30	7.5 cfs

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

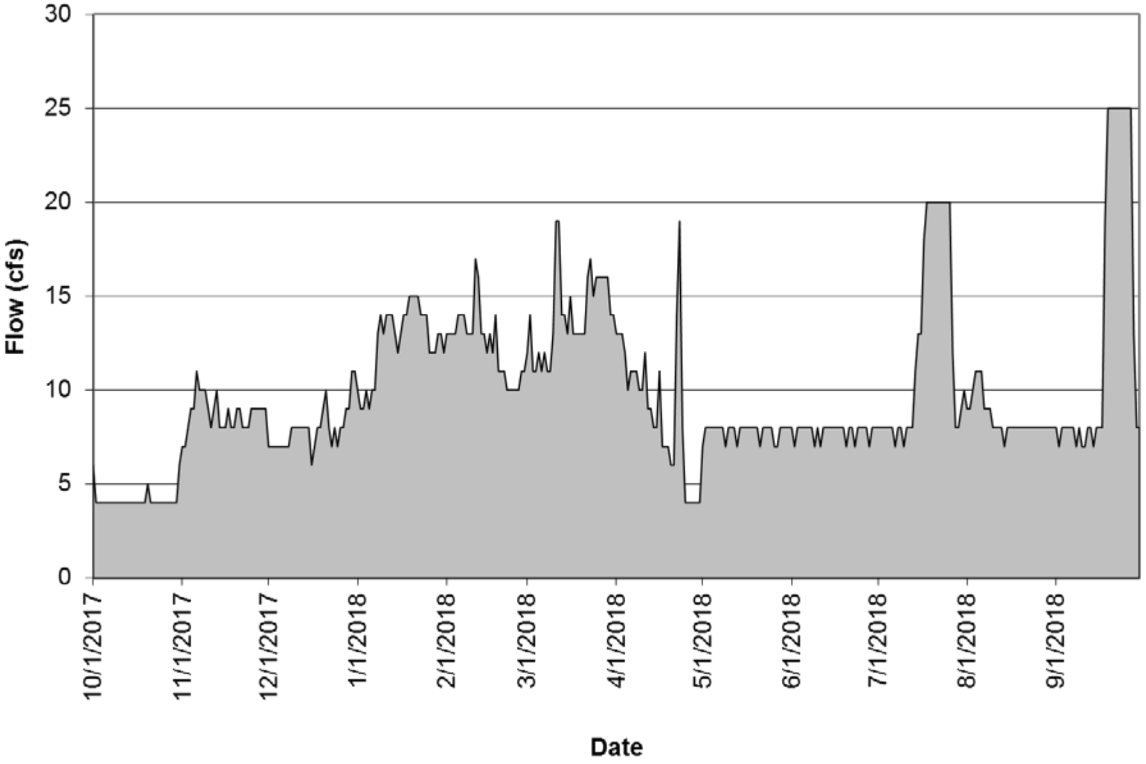
Period 1: March-April	10 days at 25 cfs
Period 2: June-July	10 days at 20 cfs
Period 3: September	10 days at 25 cfs
Period 4: November-December	5 days at 30 cfs

The Period 4 and Period 1 scheduled flow to the Delta was canceled due to the extremely high runoff and significant releases to the Delta from the 2017-18 water year. Period 2 and Period 3 pulse flows were released during the appropriate months.

The releases to the Delta for the 2017-18 water year resulted in an average of 9.9 cfs flow to the Delta. Unintended flows are released to the Delta when rainstorms cause river flows to exceed the maximum allowed flowrate 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.



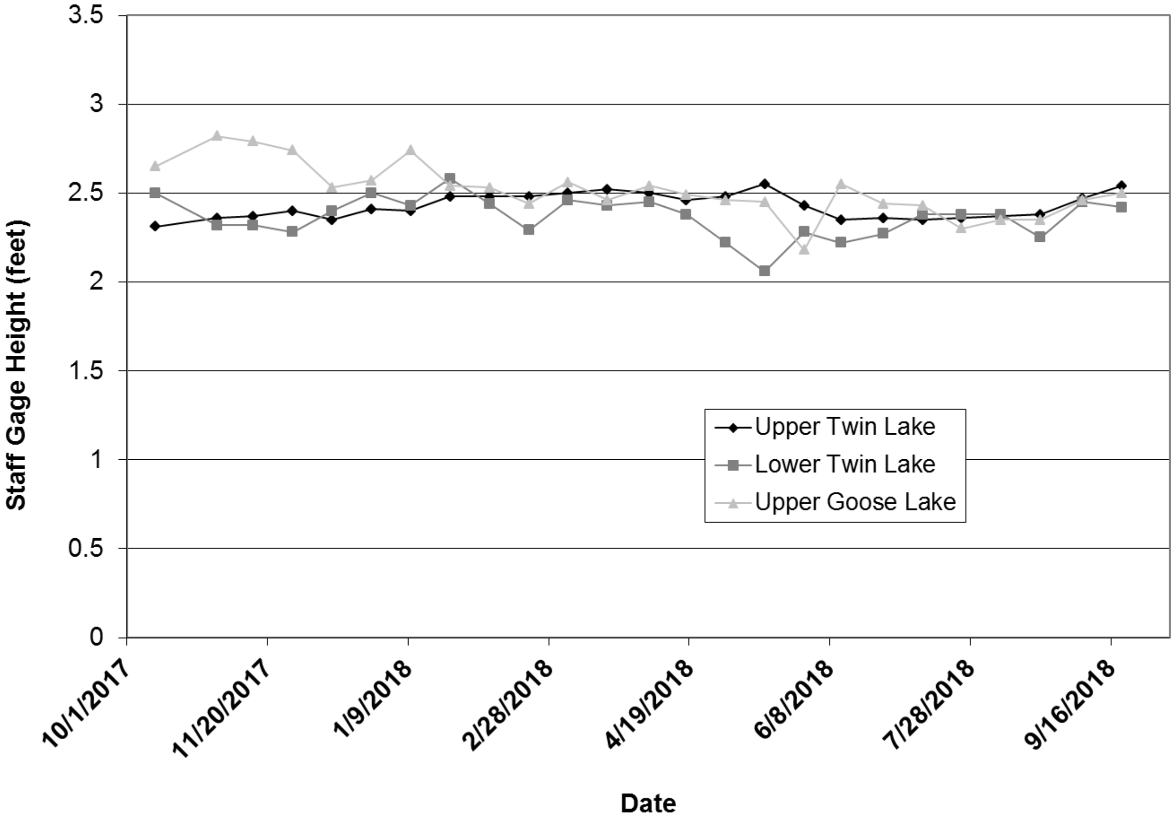
Hydrologic Figure 1. Langemann Release to Delta



Hydrologic Figure 2. Langemann and Weir Release to Delta

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 between 1.5 and 3.0 feet stage height for the 2017-18 water year.



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

Billy Lake

Due to the topography of Billy Lake in relation to the Billy Lake Return station, whenever the Billy Lake Return station is showing flow, Billy 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 0.5 cfs for the year, so Billy Lake remained full for the entire year (see the following table).

Hydrologic Table 1. LORP Flows – Water Year 2017-18

Station Name	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
Below River Intake	55.9	127.0	41.0
Blackrock Return Ditch	1.2	6.0	0.5
Goose Lake Return	0.0	0.6	0.0
Billy Lake Return	1.2	4.9	0.5
Mazourka Canyon Road	56.9	103.0	40.0
Locust Ditch Return	0.0	0.6	0.0
Georges Ditch Return	0.2	1.4	0.0
Reinhackle Springs	55.9	79.0	41.0
Alabama Gates Return	0.0	8.4	0.0
At Pumpback Station	52.4	67.0	31.0
Pump Station	42.6	48.0	20.0
Langemann Gate to Delta	6.2	25.0	3.0
Weir to Delta	3.7	16.0	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.

2.4 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 measurement. The measurements are performed by using GPS and walking the perimeter of the wetted edges of the waterfowl area.

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	n/a	500+	10	Spring	n/a	500+	14.5
Summer	n/a	500+	21	Summer	n/a	500+	8.8
Fall	10/3/2017	190	4.4	Fall	10/3/2017	454	3.4
Winter	1/22/2018	201	1.1	Winter	1/18/2018	466	1.9
Spring	5/8/2018	200	3.9	Spring			
Summer	7/9/2018	128	3.1	Summer			
Fall	9/14/2018	121	n/a	Fall			
Drew Unit				**Waggoner Unit**			
ET Season	**Read Date**	**Wetted Acreage**	**Average Inflow**	**ET Season**	**Read Date**	**Wetted Acreage**	**Average Inflow**
Spring	n/a	500+	4.2	Spring	n/a	500+	5.5
Summer	n/a	500+	3.2	Summer	n/a	500+	15.3
Fall				Fall			
Winter				Winter			
Spring	5/7/2018	224	4.7	Spring			
Summer	7/9/2018	253	5.5	Summer			
Fall	9/13/2018	269	n/a	Fall			

Notes:
Measurements before 4/1/18 count towards the 2017-2018 runoff year acreage goal.
Measurements after 4/1/18 count towards the 2018-2019 runoff year acreage goal.
Thibaut wetted acreage does not include the 28 acres of the Thibaut Pond area.
Values of “500+” are for the total combined wetted acreage in the BWMA. Flows were also released to Drew and Waggoner areas during Water Year 2016-2017 due to high runoff.
Wetted acreage measurements were not conducted in Spring or Summer 2017 due to high runoff, saturated ground and difficult access conditions, the significant flows being released to the BWMA, and the 700+ wetted acres measured during Winter 2016-2017.

2.5 Blackrock Waterfowl Management Area Results for April 2017 to March 2018

The runoff forecast for runoff year 2017-18 was 196% of normal, so the waterfowl acreage goal for this year was 500 acres.

On April 16, 2017 the flow to Thibaut Waterfowl Area was increased from 0 cfs to 6.5 cfs, and flow to Winterton Waterfowl Area was increased from 1.7 cfs to 5.8 cfs.

An average daily inflow of 46 cfs entered the Blackrock Ditch via the Blackrock Spillgate and Blackrock Siphon for the month of May. An average of 1.1 cfs returned to the LORP via Blackrock Return Ditch, netting an approximate average delivery of 45 cfs into the Waterfowl Area, in addition to ongoing Winterton and Thibaut flows.

No wetted acreage survey was done in the first season of runoff year 2017-18 as the Waterfowl Area was quite wet, had difficult access given conditions, the final wetted acreage survey of runoff year 2016-17 was over 700 acres, and water inflows were substantially above those required to provide 500 acres of habitat, as described above.

For the month of June, an average of approximately 133 cfs entered the Blackrock Ditch, with roughly 2 cfs average returning to the LORP. Flow releases from Winterton and Thibaut also continued. For the reasons noted above, no wetted perimeter survey was done during June.

On July 27, 2017 flows to Thibaut Waterfowl Area were set to 6.4 cfs and flows to Winterton Waterfowl Area were set to 2.9 cfs.

On August 15, 2017 flows to Thibaut Waterfowl Area were set to 3.4 cfs and flows to Winterton Waterfowl Area were set to 3.6 cfs.

On October 2 and 3, 2017 wetted acreage surveys were conducted. Winterton Waterfowl Area measured 190 acres, and Thibaut Waterfowl Area measured 454 acres.

On October 16, 2017 flows to Thibaut Waterfowl Area were set to 2.1 cfs, and flows to Winterton Waterfowl Area were set to 1.2 cfs.

On January 18 and 22, 2018 wetted acreage surveys were conducted. Winterton Waterfowl Area measured 201 acres, and Thibaut Waterfowl Area measured 466 acres.

Every waterfowl wetted area measurement taken during the runoff year totaled above 500 acres, which was the target acreage for this runoff year.

2.6 Blackrock Waterfowl Management Area Results for April 2018 to September 2018

The runoff forecast for runoff year 2018-19 is 78%, so the waterfowl acreage goal for this year is 390 acres.

On April 3 Drew Unit was set to 5.6 cfs and Winterton Unit was set to 3.4 cfs, while Thibaut Unit was turned off. On April 16 Winterton Unit was set to 4.0 cfs.

On May 7 and 8, wetted perimeter measurements were taken. Drew Unit measured at 224 acres, and Winterton Unit measured at 200 acres.

On August 16, Winterton Unit was set to 2.5 cfs, and Drew Unit was set to 5 cfs.

On September 13 and 14, wetted perimeter measurements were taken. Drew Unit measured at 269 acres, and Winterton Unit measured at 121 acres.

2.7 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 2017 to September 2018. 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.

2.8 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 2017-18 Water Year

	Month	Flow (cfs)	Acre-Feet-Per-Day
2017	OCT	-4	-8
	NOV	+11	+22
	DEC	+10	+20
2018	JAN	+12	+24
	FEB	+13	+26
	MAR	+15	+29
	APR	+8	+16
	MAY	-11	-21
	JUN	-41	-81
	JUL	-33	-64
	AUG	-30	-60
	SEP	-24	-47
	AVG MONTH	**-6 cfs**	**-12 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 40,465 acre-feet, inflows from augmentation spillgates were 1,961 acre-feet, and outflows from the Pumpback Station were 37,958 acre-feet. This yields a loss of 4,469 acre-feet for the year, a daily average of approximately 6.2 cfs between the Intake and the Pumpback Station. Water loss during the 2017-18 water year represents about 10.5% of the total released flow from the Intake and augmentation spillgates into the river channel.

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

From December 2017 to March 2018, an average flow of 43 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 48 cfs. The average flow reaching the Pumpback Station was 58 cfs, an increase of 12 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 gained 1 cfs, while the reach from Mazourka Canyon Road to the Reinhackle gaging station gained 5 cfs and Reinhackle to the Pumpback Station gained 6 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 2017 to March 2018

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	43	N/A	N/A
Mazourka	47	+1	+1
Reinhackle	52	+5	+6
Pumpback	58	+6	+12

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.

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

During the summer period of June 2018 to September 2018, all river reaches lost water. An average flow of 78 cfs was released into the Lower Owens River from the Intake. An additional 2 cfs was provided from augmentation locations throughout the Lower Owens River. The effects of ET are evident from the high total flow loss (-32 cfs) between the Intake and the Pumpback Station. Summer flow losses were 44 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. Summer Flow Losses/Gains, June 2018 to September 2018

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	78	N/A	N/A
Mazourka	72	-8	-8
Reinhackle	62	-10	-18
Pumpback	48	-14	-32

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.

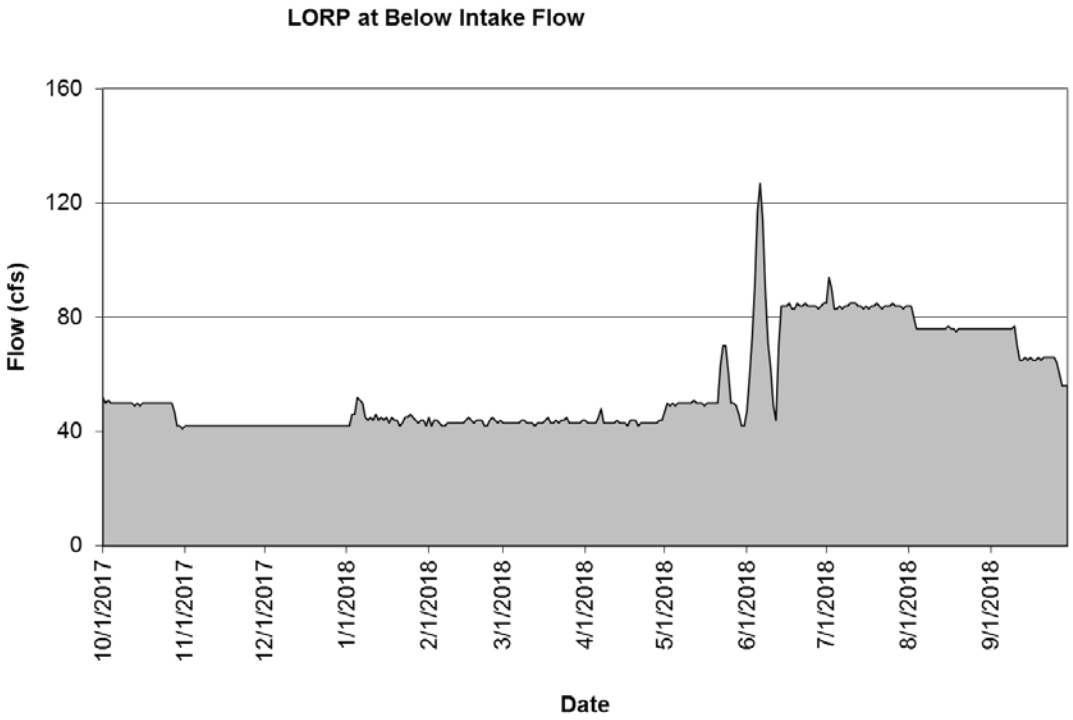
2.11 Seasonal Habitat Flow

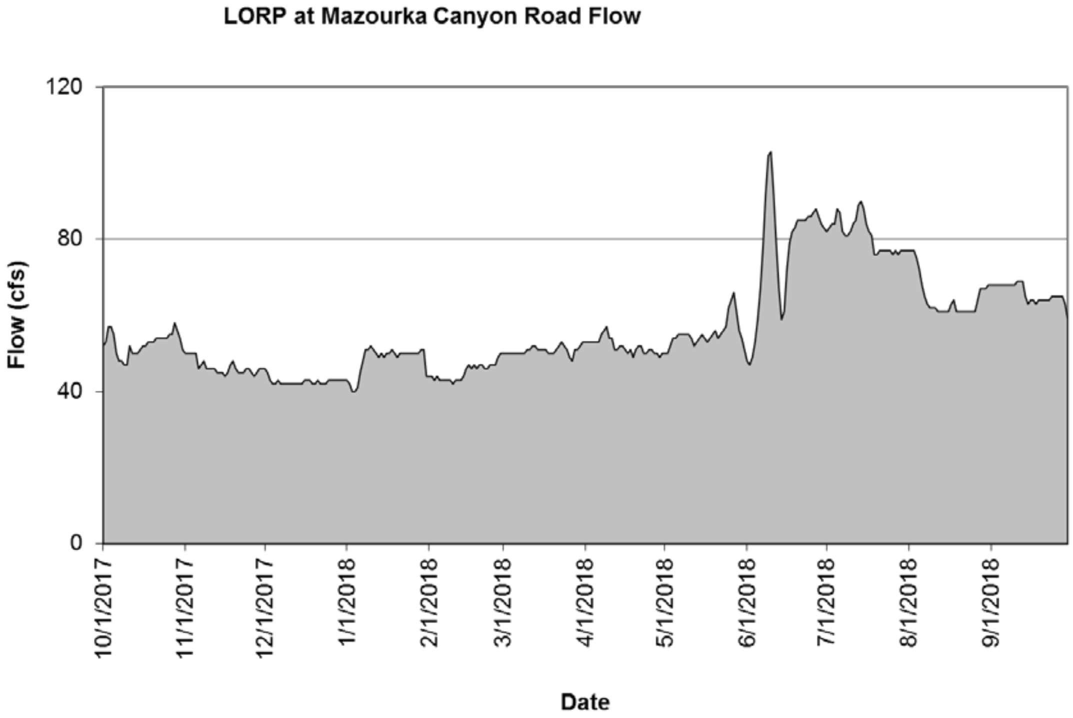
The runoff forecast for runoff year 2018-19 was 78%, and a Seasonal Habitat Flow was released from the LORP Intake in June 2018. Flows from the LORP Intake were ramped up to a peak of 130 cfs over a period of six days, before ramping down over another six days.

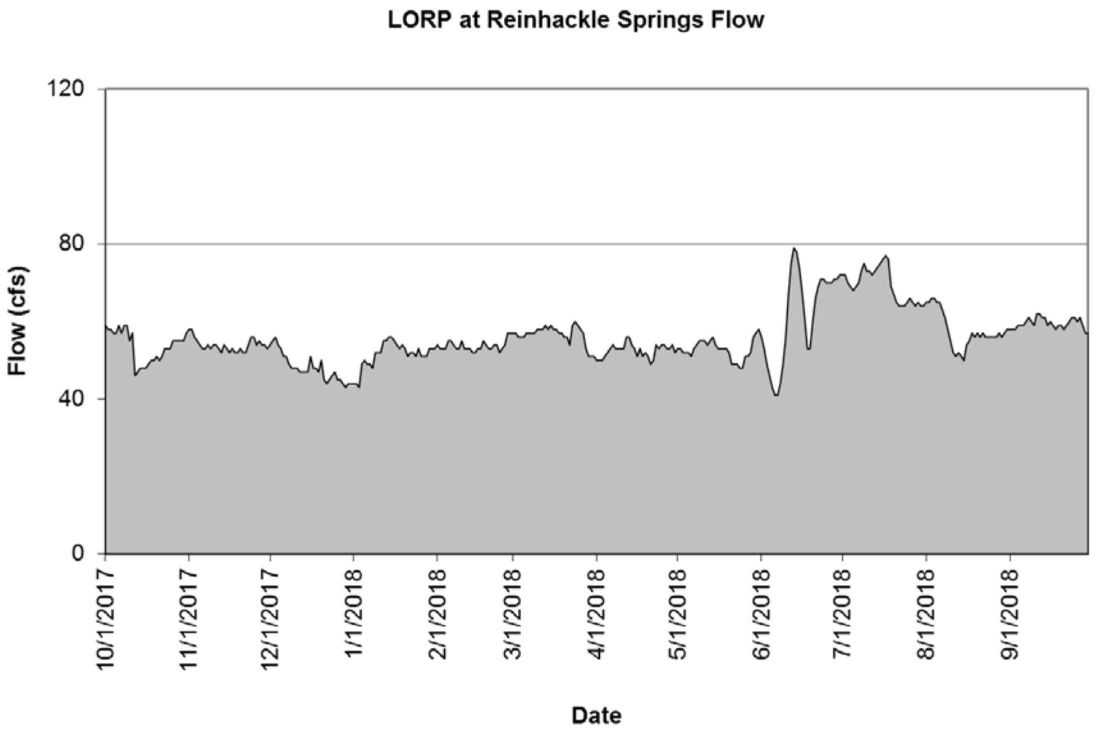
See Appendix 2 for daily flow rates from the LORP Intake.

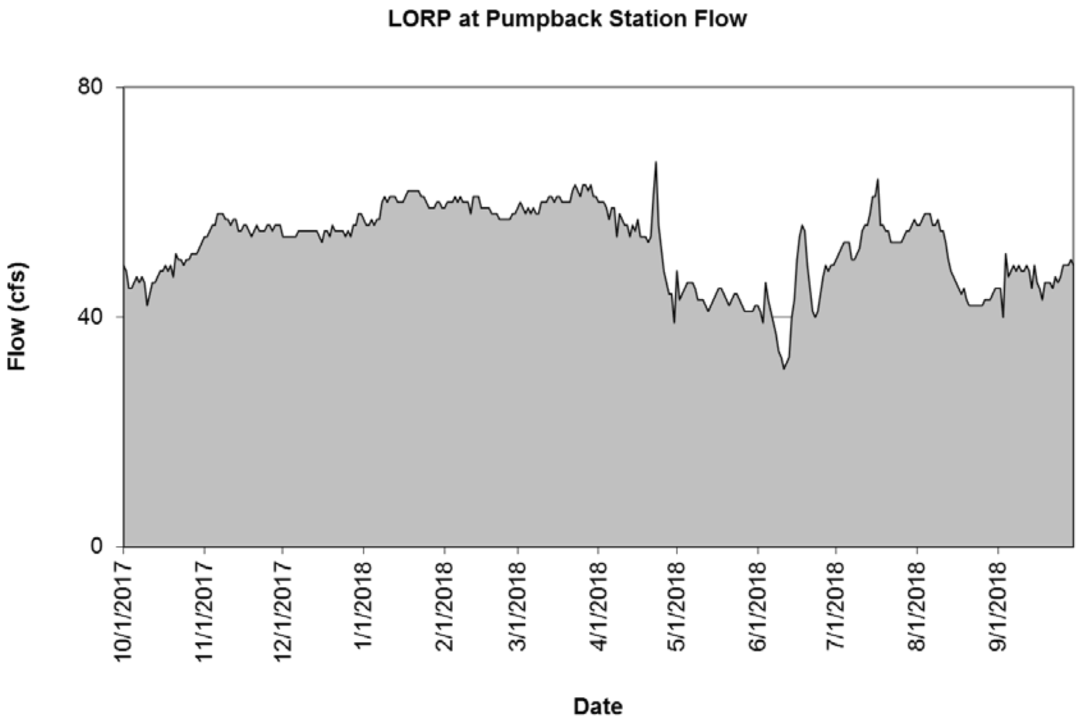
2.12 Appendices

Appendix 1. Hydrologic Monitoring Graphs






LORP at Reinhackle Springs Flow


LORP at Pumpback Station Flow

Appendix 2. River Flow Tables

Flow Gaging Station	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
Date														
10/1/2017	52.0	6.0	0.1	1.1	52.0	0.0	0.1	59.0	0.0	49.0	43.0	6.0	0.0	53.0
10/2/2017	50.0	3.0	0.1	1.0	53.0	0.0	0.1	58.0	0.0	48.0	44.0	4.0	0.0	52.3
10/3/2017	51.0	2.0	0.1	1.0	57.0	0.0	0.0	58.0	0.0	45.0	41.0	4.0	0.0	52.8
10/4/2017	50.0	1.0	0.1	1.0	57.0	0.0	0.0	57.0	0.0	45.0	41.0	4.0	0.0	52.3
10/5/2017	50.0	1.0	0.2	1.0	55.0	0.3	0.1	57.0	0.0	46.0	42.0	4.0	0.0	52.0
10/6/2017	50.0	1.0	0.2	1.0	50.0	0.1	0.3	59.0	0.0	47.0	43.0	4.0	0.0	51.5
10/7/2017	50.0	1.0	0.2	1.0	48.0	0.2	0.2	57.0	0.0	46.0	42.0	4.0	0.0	50.3
10/8/2017	50.0	1.0	0.2	1.0	48.0	0.0	0.1	59.0	0.0	47.0	43.0	4.0	0.0	51.0
10/9/2017	50.0	1.0	0.1	0.9	47.0	0.0	0.0	59.0	0.0	46.0	42.0	4.0	0.0	50.5
10/10/2017	50.0	1.0	0.1	0.9	47.0	0.0	0.1	55.0	0.0	42.0	38.0	4.0	0.0	48.5
10/11/2017	50.0	1.0	0.1	1.0	52.0	0.0	0.3	57.0	0.0	44.0	40.0	4.0	0.0	50.8
10/12/2017	50.0	1.0	0.1	1.0	50.0	0.0	0.0	46.0	0.0	46.0	42.0	4.0	0.0	48.0
10/13/2017	49.0	1.0	0.1	1.0	50.0	0.0	0.0	47.0	0.0	46.0	42.0	4.0	0.0	48.0
10/14/2017	50.0	1.0	0.1	1.0	50.0	0.0	0.0	48.0	0.0	47.0	43.0	4.0	0.0	48.8
10/15/2017	49.0	1.0	0.1	1.1	51.0	0.0	0.1	48.0	0.0	48.0	44.0	4.0	0.0	49.0
10/16/2017	50.0	1.0	0.2	1.1	52.0	0.0	0.1	48.0	0.0	48.0	44.0	4.0	0.0	49.5
10/17/2017	50.0	1.0	0.3	1.1	52.0	0.0	0.1	49.0	0.0	49.0	45.0	4.0	0.0	50.0
10/18/2017	50.0	1.0	0.4	1.1	53.0	0.0	0.2	50.0	0.0	48.0	44.0	4.0	0.0	50.3
10/19/2017	50.0	1.0	0.5	1.1	53.0	0.0	0.1	50.0	0.0	49.0	45.0	4.0	0.0	50.5
10/20/2017	50.0	1.0	0.5	1.1	53.0	0.0	0.1	51.0	0.0	47.0	42.0	4.0	1.0	50.3
10/21/2017	50.0	1.0	0.5	1.1	54.0	0.0	0.0	50.0	0.0	51.0	47.0	4.0	0.0	51.3
10/22/2017	50.0	1.0	0.5	1.1	54.0	0.0	0.2	51.0	0.0	50.0	46.0	4.0	0.0	51.3
10/23/2017	50.0	1.0	0.5	1.1	54.0	0.0	0.1	53.0	0.0	50.0	46.0	4.0	0.0	51.8
10/24/2017	50.0	1.0	0.4	1.2	54.0	0.0	0.1	53.0	0.0	49.0	45.0	4.0	0.0	51.5
10/25/2017	50.0	1.0	0.5	1.2	54.0	0.0	0.1	53.0	0.0	50.0	46.0	4.0	0.0	51.8
10/26/2017	50.0	1.0	0.5	1.2	55.0	0.0	0.3	55.0	0.0	50.0	46.0	4.0	0.0	52.5
10/27/2017	50.0	1.2	0.5	3.1	55.0	0.0	0.2	55.0	0.0	51.0	47.0	4.0	0.0	52.8
10/28/2017	47.0	1.2	0.5	4.9	58.0	0.2	0.1	55.0	0.0	51.0	47.0	4.0	0.0	52.8
10/29/2017	42.0	1.0	0.5	2.3	56.0	0.6	0.1	55.0	0.0	51.0	47.0	4.0	0.0	51.0
10/30/2017	42.0	2.0	0.5	1.5	54.0	0.4	0.1	55.0	0.0	52.0	48.0	4.0	0.0	50.8
10/31/2017	41.0	2.0	0.5	1.5	51.0	0.1	0.1	57.0	0.0	53.0	47.0	4.0	2.0	50.5
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	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
Date														
11/1/2017	**42.0**	**1.0**	**0.6**	**1.4**	**50.0**	**0.0**	**0.1**	**58.0**	**0.0**	**54.0**	**47.0**	**4.0**	**3.0**	**51.0**
11/2/2017	**42.0**	**1.0**	**0.6**	**1.3**	**50.0**	**0.0**	**0.1**	**58.0**	**0.0**	**54.0**	**47.0**	**4.0**	**3.0**	**51.0**
11/3/2017	**42.0**	**1.0**	**0.5**	**1.1**	**50.0**	**0.0**	**0.1**	**56.0**	**0.0**	**55.0**	**47.0**	**4.0**	**4.0**	**50.8**
11/4/2017	**42.0**	**1.0**	**0.5**	**0.9**	**50.0**	**0.0**	**0.1**	**55.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**50.8**
11/5/2017	**42.0**	**1.0**	**0.4**	**0.8**	**50.0**	**0.0**	**0.3**	**54.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**50.5**
11/6/2017	**42.0**	**1.0**	**0.4**	**0.7**	**46.0**	**0.2**	**0.1**	**53.0**	**0.0**	**58.0**	**47.0**	**4.0**	**7.0**	**49.8**
11/7/2017	**42.0**	**2.0**	**0.4**	**0.8**	**47.0**	**0.2**	**0.1**	**53.0**	**0.0**	**58.0**	**48.0**	**4.0**	**6.0**	**50.0**
11/8/2017	**42.0**	**1.0**	**0.4**	**0.9**	**48.0**	**0.0**	**0.1**	**54.0**	**0.0**	**58.0**	**48.0**	**4.0**	**6.0**	**50.5**
11/9/2017	**42.0**	**2.0**	**0.4**	**0.9**	**46.0**	**0.0**	**0.1**	**53.0**	**0.0**	**57.0**	**47.0**	**4.0**	**6.0**	**49.5**
11/10/2017	**42.0**	**2.0**	**0.2**	**0.9**	**46.0**	**0.0**	**0.1**	**54.0**	**0.0**	**57.0**	**48.0**	**4.0**	**5.0**	**49.8**
11/11/2017	**42.0**	**2.0**	**0.0**	**0.9**	**46.0**	**0.0**	**0.1**	**54.0**	**0.0**	**56.0**	**48.0**	**4.0**	**4.0**	**49.5**
11/12/2017	**42.0**	**1.0**	**0.0**	**0.9**	**46.0**	**0.0**	**0.1**	**53.0**	**0.0**	**57.0**	**48.0**	**4.0**	**5.0**	**49.5**
11/13/2017	**42.0**	**2.0**	**0.0**	**1.0**	**45.0**	**0.0**	**0.3**	**52.0**	**0.0**	**57.0**	**47.0**	**4.0**	**6.0**	**49.0**
11/14/2017	**42.0**	**2.0**	**0.0**	**1.1**	**45.0**	**0.0**	**0.2**	**54.0**	**0.0**	**55.0**	**47.0**	**4.0**	**4.0**	**49.0**
11/15/2017	**42.0**	**2.0**	**0.0**	**1.2**	**45.0**	**0.0**	**0.1**	**53.0**	**0.0**	**55.0**	**47.0**	**4.0**	**4.0**	**48.8**
11/16/2017	**42.0**	**1.0**	**0.0**	**1.3**	**44.0**	**0.0**	**0.1**	**52.0**	**0.0**	**56.0**	**48.0**	**4.0**	**4.0**	**48.5**
11/17/2017	**42.0**	**1.0**	**0.0**	**1.3**	**45.0**	**0.0**	**0.1**	**53.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**49.0**
11/18/2017	**42.0**	**1.0**	**0.0**	**1.4**	**47.0**	**0.0**	**0.0**	**52.0**	**0.0**	**55.0**	**47.0**	**4.0**	**4.0**	**49.0**
11/19/2017	**42.0**	**1.0**	**0.0**	**1.3**	**48.0**	**0.0**	**0.2**	**52.0**	**0.0**	**54.0**	**46.0**	**4.0**	**4.0**	**49.0**
11/20/2017	**42.0**	**1.0**	**0.0**	**1.3**	**46.0**	**0.0**	**0.2**	**53.0**	**0.0**	**55.0**	**46.0**	**4.0**	**5.0**	**49.0**
11/21/2017	**42.0**	**2.0**	**0.0**	**1.3**	**45.0**	**0.0**	**0.1**	**52.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**48.8**
11/22/2017	**42.0**	**1.0**	**0.0**	**1.2**	**45.0**	**0.0**	**0.1**	**52.0**	**0.0**	**55.0**	**47.0**	**4.0**	**4.0**	**48.5**
11/23/2017	**42.0**	**2.0**	**0.0**	**1.2**	**45.0**	**0.0**	**0.1**	**54.0**	**0.0**	**55.0**	**47.0**	**4.0**	**4.0**	**49.0**
11/24/2017	**42.0**	**1.0**	**0.0**	**1.3**	**46.0**	**0.0**	**0.2**	**56.0**	**0.0**	**55.0**	**47.0**	**4.0**	**4.0**	**49.8**
11/25/2017	**42.0**	**1.0**	**0.0**	**1.3**	**46.0**	**0.0**	**0.2**	**56.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**50.0**
11/26/2017	**42.0**	**1.0**	**0.0**	**1.3**	**45.0**	**0.0**	**0.1**	**54.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**49.3**
11/27/2017	**42.0**	**1.0**	**0.0**	**1.2**	**44.0**	**0.0**	**0.1**	**55.0**	**0.0**	**55.0**	**46.0**	**4.0**	**5.0**	**49.0**
11/28/2017	**42.0**	**1.0**	**0.0**	**1.2**	**45.0**	**0.0**	**0.1**	**54.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**49.3**
11/29/2017	**42.0**	**2.0**	**0.0**	**1.2**	**46.0**	**0.0**	**0.2**	**54.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**49.5**
11/30/2017	**42.0**	**2.0**	**0.0**	**1.2**	**46.0**	**0.0**	**0.1**	**53.0**	**0.0**	**56.0**	**47.0**	**4.0**	**5.0**	**49.3**
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
12/1/2017	**42.0**	**2.0**	**0.0**	**1.2**	**46.0**	**0.0**	**0.1**	**54.0**	**0.0**	**54.0**	**47.0**	**3.0**	**4.0**	**49.0**
12/2/2017	**42.0**	**2.0**	**0.0**	**1.2**	**45.0**	**0.0**	**0.1**	**55.0**	**0.0**	**54.0**	**47.0**	**3.0**	**4.0**	**49.0**
12/3/2017	**42.0**	**1.0**	**0.0**	**1.1**	**43.0**	**0.0**	**0.1**	**56.0**	**0.0**	**54.0**	**47.0**	**3.0**	**4.0**	**48.8**
12/4/2017	**42.0**	**2.0**	**0.0**	**1.1**	**42.0**	**0.0**	**0.2**	**54.0**	**0.0**	**54.0**	**47.0**	**3.0**	**4.0**	**48.0**
12/5/2017	**42.0**	**2.0**	**0.0**	**1.0**	**42.0**	**0.0**	**0.8**	**53.0**	**0.0**	**54.0**	**47.0**	**3.0**	**4.0**	**47.8**
12/6/2017	**42.0**	**2.0**	**0.0**	**0.9**	**43.0**	**0.0**	**0.6**	**51.0**	**0.0**	**54.0**	**47.0**	**3.0**	**4.0**	**47.5**
12/7/2017	**42.0**	**2.0**	**0.0**	**0.9**	**42.0**	**0.0**	**0.1**	**51.0**	**0.0**	**55.0**	**48.0**	**3.0**	**4.0**	**47.5**
12/8/2017	**42.0**	**2.0**	**0.0**	**1.0**	**42.0**	**0.0**	**0.1**	**49.0**	**0.0**	**55.0**	**48.0**	**3.0**	**4.0**	**47.0**
12/9/2017	**42.0**	**2.0**	**0.0**	**1.1**	**42.0**	**0.0**	**0.1**	**48.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.8**
12/10/2017	**42.0**	**2.0**	**0.0**	**1.2**	**42.0**	**0.0**	**0.1**	**48.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.8**
12/11/2017	**42.0**	**2.0**	**0.0**	**1.3**	**42.0**	**0.0**	**0.0**	**48.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.8**
12/12/2017	**42.0**	**2.0**	**0.0**	**1.3**	**42.0**	**0.0**	**0.0**	**47.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.5**
12/13/2017	**42.0**	**2.0**	**0.0**	**1.2**	**42.0**	**0.0**	**0.0**	**47.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.5**
12/14/2017	**42.0**	**1.0**	**0.0**	**1.2**	**42.0**	**0.0**	**0.0**	**47.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.5**
12/15/2017	**42.0**	**1.0**	**0.0**	**1.2**	**42.0**	**0.0**	**0.1**	**47.0**	**0.0**	**54.0**	**46.0**	**3.0**	**5.0**	**46.3**
12/16/2017	**42.0**	**1.0**	**0.0**	**1.2**	**43.0**	**0.0**	**0.1**	**51.0**	**0.0**	**53.0**	**47.0**	**3.0**	**3.0**	**47.3**
12/17/2017	**42.0**	**2.0**	**0.0**	**1.2**	**43.0**	**0.0**	**0.0**	**48.0**	**0.0**	**55.0**	**48.0**	**3.0**	**4.0**	**47.0**
12/18/2017	**42.0**	**1.0**	**0.0**	**1.2**	**43.0**	**0.0**	**0.1**	**48.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**47.0**
12/19/2017	**42.0**	**1.0**	**0.0**	**1.1**	**42.0**	**0.0**	**0.0**	**47.0**	**0.0**	**54.0**	**46.0**	**3.0**	**5.0**	**46.3**
12/20/2017	**42.0**	**1.0**	**0.0**	**1.0**	**42.0**	**0.0**	**0.0**	**50.0**	**0.0**	**56.0**	**47.0**	**3.0**	**6.0**	**47.5**
12/21/2017	**42.0**	**2.0**	**0.0**	**1.0**	**43.0**	**0.0**	**0.0**	**45.0**	**0.0**	**55.0**	**45.0**	**3.0**	**7.0**	**46.3**
12/22/2017	**42.0**	**1.0**	**0.0**	**0.9**	**42.0**	**0.0**	**0.2**	**44.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**45.8**
12/23/2017	**42.0**	**1.0**	**0.0**	**0.9**	**42.0**	**0.0**	**0.3**	**45.0**	**0.0**	**55.0**	**48.0**	**3.0**	**4.0**	**46.0**
12/24/2017	**42.0**	**1.0**	**0.0**	**0.9**	**42.0**	**0.0**	**0.2**	**46.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.3**
12/25/2017	**42.0**	**1.0**	**0.0**	**1.0**	**43.0**	**0.0**	**0.2**	**47.0**	**0.0**	**54.0**	**47.0**	**3.0**	**4.0**	**46.5**
12/26/2017	**42.0**	**1.0**	**0.0**	**1.2**	**43.0**	**0.0**	**0.2**	**45.0**	**0.0**	**55.0**	**47.0**	**3.0**	**5.0**	**46.3**
12/27/2017	**42.0**	**1.0**	**0.0**	**1.3**	**43.0**	**0.0**	**0.2**	**45.0**	**0.0**	**54.0**	**46.0**	**3.0**	**5.0**	**46.0**
12/28/2017	**42.0**	**1.0**	**0.0**	**1.4**	**43.0**	**0.0**	**0.1**	**44.0**	**0.0**	**56.0**	**47.0**	**3.0**	**6.0**	**46.3**
12/29/2017	**42.0**	**2.0**	**0.0**	**1.4**	**43.0**	**0.0**	**0.1**	**43.0**	**0.0**	**56.0**	**47.0**	**3.0**	**6.0**	**46.0**
12/30/2017	**42.0**	**1.0**	**0.0**	**1.5**	**43.0**	**0.0**	**0.1**	**44.0**	**0.0**	**58.0**	**47.0**	**3.0**	**8.0**	**46.8**
12/31/2017	**42.0**	**1.0**	**0.0**	**1.5**	**43.0**	**0.0**	**0.1**	**44.0**	**0.0**	**58.0**	**47.0**	**3.0**	**8.0**	**46.8**
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station	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
Date														
1/1/2018	42.0	1.0	0.0	1.5	43.0	0.0	0.1	44.0	0.0	57.0	47.0	3.0	7.0	46.5
1/2/2018	42.0	1.0	0.0	1.5	42.0	0.0	0.1	44.0	0.0	56.0	47.0	3.0	6.0	46.0
1/3/2018	46.0	1.0	0.0	1.5	40.0	0.0	0.1	43.0	0.0	56.0	47.0	3.0	6.0	46.3
1/4/2018	46.0	0.5	0.0	1.5	40.0	0.0	0.1	49.0	0.0	57.0	47.0	3.0	7.0	48.0
1/5/2018	52.0	3.0	0.0	1.5	41.0	0.0	0.1	50.0	0.0	56.0	47.0	3.0	6.0	49.8
1/6/2018	51.0	1.0	0.0	1.5	45.0	0.0	0.1	49.0	0.0	57.0	47.0	3.0	7.0	50.5
1/7/2018	50.0	1.0	0.0	1.6	48.0	0.0	0.1	49.0	0.0	57.0	47.0	3.0	7.0	51.0
1/8/2018	45.0	2.0	0.0	1.5	51.0	0.0	0.1	48.0	0.0	60.0	47.0	3.0	10.0	51.0
1/9/2018	44.0	2.0	0.0	1.5	51.0	0.0	0.2	52.0	0.0	61.0	47.0	3.0	11.0	52.0
1/10/2018	45.0	1.0	0.0	1.6	52.0	0.0	0.1	52.0	0.0	60.0	47.0	3.0	10.0	52.3
1/11/2018	44.0	1.0	0.0	1.6	51.0	0.0	0.1	52.0	0.0	61.0	47.0	3.0	11.0	52.0
1/12/2018	46.0	1.0	0.0	1.5	50.0	0.0	0.1	55.0	0.0	61.0	47.0	3.0	11.0	53.0
1/13/2018	44.0	1.0	0.0	1.5	49.0	0.0	0.2	55.0	0.0	61.0	47.0	3.0	11.0	52.3
1/14/2018	45.0	1.0	0.0	1.5	50.0	0.0	0.2	56.0	0.0	60.0	47.0	3.0	10.0	52.8
1/15/2018	44.0	1.0	0.0	1.5	49.0	0.0	0.2	56.0	0.0	60.0	48.0	3.0	9.0	52.3
1/16/2018	45.0	1.0	0.0	1.5	50.0	0.0	0.2	55.0	0.0	60.0	47.0	3.0	10.0	52.5
1/17/2018	43.0	1.0	0.0	1.5	50.0	0.0	0.2	54.0	0.0	61.0	47.0	3.0	11.0	52.0
1/18/2018	45.0	1.0	0.0	1.4	51.0	0.0	0.2	53.0	0.0	62.0	48.0	3.0	11.0	52.8
1/19/2018	44.0	1.0	0.0	1.4	50.0	0.0	0.2	54.0	0.0	62.0	47.0	3.0	12.0	52.5
1/20/2018	44.0	1.0	0.0	1.4	49.0	0.0	0.2	53.0	0.0	62.0	47.0	3.0	12.0	52.0
1/21/2018	42.0	1.0	0.0	1.4	50.0	0.0	0.2	51.0	0.0	62.0	47.0	3.0	12.0	51.3
1/22/2018	43.0	2.0	0.0	1.4	50.0	0.0	0.2	52.0	0.0	62.0	47.0	3.0	12.0	51.8
1/23/2018	45.0	1.0	0.0	1.4	50.0	0.0	0.2	52.0	0.0	61.0	47.0	3.0	11.0	52.0
1/24/2018	45.0	1.0	0.0	1.3	50.0	0.0	0.2	51.0	0.0	61.0	47.0	3.0	11.0	51.8
1/25/2018	46.0	1.0	0.0	1.3	50.0	0.0	0.2	53.0	0.0	60.0	46.0	3.0	11.0	52.3
1/26/2018	45.0	1.0	0.0	1.4	50.0	0.0	0.2	51.0	0.0	59.0	47.0	3.0	9.0	51.3
1/27/2018	44.0	1.0	0.0	1.4	50.0	0.0	0.2	51.0	0.0	59.0	47.0	3.0	9.0	51.0
1/28/2018	43.0	1.0	0.0	1.5	50.0	0.0	0.2	51.0	0.0	59.0	47.0	3.0	9.0	50.8
1/29/2018	44.0	2.0	0.0	1.5	51.0	0.0	0.4	53.0	0.0	60.0	47.0	3.0	10.0	52.0
1/30/2018	44.0	1.0	0.0	1.4	51.0	0.0	0.2	53.0	0.0	60.0	47.0	3.0	10.0	52.0
1/31/2018	42.0	1.0	0.0	1.2	44.0	0.0	0.2	53.0	0.0	59.0	47.0	3.0	9.0	49.5
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	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
Date														
2/1/2018	45.0	1.0	0.0	1.2	44.0	0.0	0.2	54.0	0.0	59.0	46.0	3.0	10.0	50.5
2/2/2018	42.0	1.0	0.0	1.2	44.0	0.0	0.2	53.0	0.0	60.0	47.0	3.0	10.0	49.8
2/3/2018	44.0	1.0	0.0	1.2	43.0	0.0	0.2	53.0	0.0	60.0	47.0	3.0	10.0	50.0
2/4/2018	44.0	2.0	0.0	1.2	44.0	0.0	0.2	53.0	0.0	60.0	47.0	3.0	10.0	50.3
2/5/2018	43.0	1.0	0.0	1.2	43.0	0.0	0.2	55.0	0.0	61.0	47.0	3.0	11.0	50.5
2/6/2018	42.0	1.0	0.0	1.2	43.0	0.0	0.2	55.0	0.0	60.0	46.0	3.0	11.0	50.0
2/7/2018	42.0	1.0	0.0	1.2	43.0	0.0	0.2	54.0	0.0	61.0	47.0	3.0	11.0	50.0
2/8/2018	43.0	1.0	0.0	1.2	43.0	0.0	0.2	53.0	0.0	60.0	47.0	3.0	10.0	49.8
2/9/2018	43.0	1.0	0.0	1.2	43.0	0.0	0.2	53.0	0.0	60.0	47.0	3.0	10.0	49.8
2/10/2018	43.0	1.0	0.0	1.2	42.0	0.0	0.2	55.0	0.0	60.0	47.0	3.0	10.0	50.0
2/11/2018	43.0	1.0	0.0	1.2	43.0	0.0	0.2	53.0	0.0	58.0	41.0	3.0	14.0	49.3
2/12/2018	43.0	1.0	0.0	1.2	43.0	0.0	0.2	53.0	0.0	61.0	45.0	3.0	13.0	50.0
2/13/2018	43.0	2.0	0.0	1.2	43.0	0.0	0.1	53.0	0.0	61.0	48.0	3.0	10.0	50.0
2/14/2018	43.0	1.0	0.0	1.1	44.0	0.0	0.1	52.0	0.0	61.0	48.0	3.0	10.0	50.0
2/15/2018	44.0	1.0	0.0	1.1	46.0	0.0	0.2	52.0	0.0	59.0	47.0	3.0	9.0	50.3
2/16/2018	45.0	1.0	0.0	1.2	47.0	0.0	0.2	53.0	0.0	59.0	46.0	3.0	10.0	51.0
2/17/2018	44.0	1.0	0.0	1.3	46.0	0.0	0.2	53.0	0.0	59.0	47.0	3.0	9.0	50.5
2/18/2018	43.0	1.0	0.0	1.3	47.0	0.0	0.2	55.0	0.0	59.0	45.0	3.0	11.0	51.0
2/19/2018	44.0	1.0	0.0	1.3	46.0	0.0	0.1	54.0	0.0	58.0	47.0	3.0	8.0	50.5
2/20/2018	44.0	2.0	0.0	1.3	47.0	0.0	0.1	53.0	0.0	58.0	47.0	3.0	8.0	50.5
2/21/2018	44.0	2.0	0.0	1.3	47.0	0.0	0.1	53.0	0.0	58.0	47.0	3.0	8.0	50.5
2/22/2018	42.0	2.0	0.0	1.3	46.0	0.0	0.2	54.0	0.0	57.0	47.0	3.0	7.0	49.8
2/23/2018	42.0	2.0	0.0	1.3	46.0	0.0	0.2	54.0	0.0	57.0	47.0	3.0	7.0	49.8
2/24/2018	44.0	1.0	0.0	1.3	47.0	0.0	0.2	52.0	0.0	57.0	47.0	3.0	7.0	50.0
2/25/2018	45.0	1.0	0.0	1.3	47.0	0.0	0.2	53.0	0.0	57.0	47.0	3.0	7.0	50.5
2/26/2018	44.0	1.0	0.0	1.3	47.0	0.0	0.2	54.0	0.0	57.0	47.0	3.0	7.0	50.5
2/27/2018	43.0	1.0	0.0	1.3	49.0	0.0	0.2	57.0	0.0	58.0	47.0	3.0	8.0	51.8
2/28/2018	44.0	1.0	0.0	1.3	50.0	0.0	0.2	57.0	0.0	58.0	47.0	3.0	8.0	52.3
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	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
Date														
3/1/2018	43.0	1.0	0.0	1.2	50.0	0.0	0.1	57.0	0.0	59.0	47.0	4.0	8.0	52.3
3/2/2018	43.0	1.0	0.0	1.2	50.0	0.0	0.1	57.0	0.0	60.0	46.0	4.0	10.0	52.5
3/3/2018	43.0	1.0	0.0	1.1	50.0	0.0	0.1	56.0	0.0	59.0	48.0	4.0	7.0	52.0
3/4/2018	43.0	1.0	0.0	1.1	50.0	0.0	0.1	56.0	0.0	58.0	47.0	4.0	7.0	51.8
3/5/2018	43.0	2.0	0.0	1.2	50.0	0.0	0.1	56.0	0.0	59.0	47.0	4.0	8.0	52.0
3/6/2018	43.0	1.0	0.0	1.2	50.0	0.0	0.1	57.0	0.0	58.0	47.0	4.0	7.0	52.0
3/7/2018	43.0	1.0	0.0	1.2	50.0	0.0	0.1	57.0	0.0	59.0	47.0	4.0	8.0	52.3
3/8/2018	44.0	1.0	0.0	1.2	50.0	0.0	0.2	57.0	0.0	58.0	47.0	4.0	7.0	52.3
3/9/2018	44.0	1.0	0.0	1.2	50.0	0.0	0.2	57.0	0.0	58.0	47.0	4.0	7.0	52.3
3/10/2018	43.0	2.0	0.0	1.3	51.0	0.0	0.2	58.0	0.0	60.0	47.0	4.0	9.0	53.0
3/11/2018	43.0	2.0	0.0	1.3	51.0	0.0	0.2	58.0	0.0	60.0	41.0	3.0	16.0	53.0
3/12/2018	43.0	2.0	0.0	1.3	52.0	0.0	0.2	58.0	0.0	60.0	41.0	4.0	15.0	53.3
3/13/2018	42.0	1.0	0.0	1.2	52.0	0.0	0.2	59.0	0.0	61.0	47.0	4.0	10.0	53.5
3/14/2018	43.0	1.0	0.0	1.2	51.0	0.0	0.2	58.0	0.0	61.0	47.0	4.0	10.0	53.3
3/15/2018	43.0	1.0	0.0	1.2	51.0	0.0	0.2	59.0	0.0	60.0	47.0	4.0	9.0	53.3
3/16/2018	43.0	1.0	0.0	1.2	51.0	0.0	0.3	58.0	0.0	61.0	46.0	4.0	11.0	53.3
3/17/2018	44.0	2.0	0.0	1.2	51.0	0.0	0.2	58.0	0.0	61.0	48.0	4.0	9.0	53.5
3/18/2018	45.0	1.0	0.0	1.1	50.0	0.0	0.3	57.0	0.0	60.0	47.0	4.0	9.0	53.0
3/19/2018	43.0	1.0	0.0	1.1	50.0	0.0	0.3	57.0	0.0	60.0	47.0	4.0	9.0	52.5
3/20/2018	43.0	1.0	0.0	1.1	50.0	0.0	0.3	56.0	0.0	60.0	47.0	4.0	9.0	52.3
3/21/2018	44.0	1.0	0.0	1.2	51.0	0.0	0.3	56.0	0.0	60.0	47.0	4.0	9.0	52.8
3/22/2018	43.0	1.0	0.0	1.2	52.0	0.0	0.3	54.0	0.0	62.0	46.0	4.0	12.0	52.8
3/23/2018	44.0	1.0	0.0	1.3	53.0	0.0	1.0	59.0	0.0	63.0	46.0	4.0	13.0	54.8
3/24/2018	44.0	1.0	0.0	1.0	52.0	0.0	1.4	60.0	0.0	62.0	47.0	4.0	11.0	54.5
3/25/2018	45.0	1.0	0.0	0.7	51.0	0.0	0.5	59.0	0.0	61.0	45.0	4.0	12.0	54.0
3/26/2018	43.0	0.8	0.0	0.5	49.0	0.0	0.3	58.0	0.0	63.0	47.0	4.0	12.0	53.3
3/27/2018	43.0	1.0	0.0	0.5	48.0	0.0	0.2	57.0	0.0	63.0	47.0	4.0	12.0	52.8
3/28/2018	43.0	1.0	0.0	0.7	51.0	0.0	0.2	53.0	0.0	62.0	46.0	4.0	12.0	52.3
3/29/2018	43.0	1.0	0.0	1.3	51.0	0.0	0.2	51.0	0.0	63.0	47.0	4.0	12.0	52.0
3/30/2018	43.0	1.0	0.0	1.4	52.0	0.0	0.2	51.0	0.0	61.0	47.0	4.0	10.0	51.8
3/31/2018	44.0	1.0	0.0	1.4	53.0	0.0	0.3	51.0	0.0	61.0	47.0	4.0	10.0	52.3
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	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
Date														
4/1/2018	44.0	0.5	0.0	1.3	53.0	0.0	0.2	50.0	0.0	60.0	47.0	4.0	9.0	51.8
4/2/2018	43.0	1.0	0.0	1.1	53.0	0.0	0.3	50.0	0.0	60.0	47.0	4.0	9.0	51.5
4/3/2018	43.0	1.0	0.0	1.2	53.0	0.0	0.2	50.0	0.0	60.0	47.0	4.0	9.0	51.5
4/4/2018	43.0	1.0	0.0	1.2	53.0	0.0	0.3	51.0	0.0	59.0	47.0	4.0	8.0	51.5
4/5/2018	43.0	1.0	0.0	1.4	53.0	0.0	0.2	52.0	0.0	57.0	47.0	4.0	6.0	51.3
4/6/2018	45.0	1.0	0.0	2.8	53.0	0.0	0.3	53.0	0.0	59.0	48.0	4.0	7.0	52.5
4/7/2018	48.0	2.0	0.0	4.1	55.0	0.0	0.1	54.0	0.0	59.0	48.0	4.0	7.0	54.0
4/8/2018	43.0	1.0	0.0	3.5	56.0	0.0	0.1	53.0	0.0	54.0	43.0	4.0	7.0	51.5
4/9/2018	43.0	1.0	0.0	1.8	57.0	0.0	0.1	53.0	0.0	58.0	48.0	4.0	6.0	52.8
4/10/2018	43.0	1.0	0.0	0.6	54.0	0.0	0.1	53.0	0.0	57.0	47.0	4.0	6.0	51.8
4/11/2018	43.0	1.0	0.0	0.8	54.0	0.0	0.7	53.0	0.0	56.0	44.0	4.0	8.0	51.5
4/12/2018	43.0	1.0	0.0	1.0	51.0	0.0	0.4	56.0	0.0	56.0	47.0	4.0	5.0	51.5
4/13/2018	44.0	1.0	0.0	1.4	51.0	0.0	0.3	56.0	0.0	54.0	45.0	4.0	5.0	51.3
4/14/2018	43.0	1.0	0.0	1.4	52.0	0.0	0.2	54.0	0.0	56.0	48.0	4.0	4.0	51.3
4/15/2018	43.0	1.0	0.0	1.4	52.0	0.0	0.2	53.0	0.0	55.0	47.0	4.0	4.0	50.8
4/16/2018	43.0	1.0	0.0	1.2	51.0	0.0	0.3	51.0	0.0	57.0	46.0	4.0	7.0	50.5
4/17/2018	42.0	1.0	0.0	1.5	50.0	0.0	1.3	53.0	0.0	54.0	47.0	4.0	3.0	49.8
4/18/2018	44.0	1.0	0.0	1.4	51.0	0.0	0.7	51.0	0.0	54.0	47.0	4.0	3.0	50.0
4/19/2018	44.0	2.0	0.0	1.2	49.0	0.0	0.2	52.0	0.0	54.0	47.0	4.0	3.0	49.8
4/20/2018	44.0	2.0	0.0	1.4	51.0	0.0	0.1	51.0	8.4	53.0	47.0	4.0	2.0	49.8
4/21/2018	42.0	1.0	0.0	1.1	52.0	0.0	0.2	49.0	0.0	54.0	48.0	4.0	2.0	49.3
4/22/2018	43.0	1.0	0.0	1.2	52.0	0.0	0.7	50.0	0.0	61.0	47.0	4.0	10.0	51.5
4/23/2018	43.0	1.0	0.0	1.2	50.0	0.0	0.4	54.0	0.0	67.0	48.0	4.0	15.0	53.5
4/24/2018	43.0	2.0	0.0	1.6	50.0	0.0	0.3	53.0	0.0	56.0	48.0	4.0	4.0	50.5
4/25/2018	43.0	2.0	0.0	1.6	51.0	0.0	0.2	54.0	0.0	52.0	48.0	4.0	0.0	50.0
4/26/2018	43.0	1.0	0.0	1.6	51.0	0.0	0.2	54.0	0.0	48.0	44.0	4.0	0.0	49.0
4/27/2018	43.0	1.0	0.0	1.5	50.0	0.0	0.1	53.0	0.0	46.0	42.0	4.0	0.0	48.0
4/28/2018	43.0	2.0	0.0	1.3	50.0	0.0	0.1	53.0	0.0	44.0	40.0	4.0	0.0	47.5
4/29/2018	44.0	2.0	0.0	1.1	49.0	0.0	0.1	54.0	0.0	44.0	40.0	4.0	0.0	47.8
4/30/2018	44.0	1.0	0.0	1.1	50.0	0.0	0.3	52.0	0.0	39.0	35.0	4.0	0.0	46.3
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Flow Gaging Station	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
Date														
5/1/2018	47.0	1.0	0.0	1.1	50.0	0.0	1.1	53.0	0.0	48.0	41.0	6.0	1.0	49.5
5/2/2018	50.0	2.0	0.0	1.2	50.0	0.0	0.1	53.0	0.0	43.0	35.0	8.0	0.0	49.0
5/3/2018	49.0	2.0	0.0	1.3	52.0	0.0	0.1	52.0	0.0	44.0	36.0	8.0	0.0	49.3
5/4/2018	50.0	1.0	0.0	1.3	54.0	0.0	0.1	52.0	0.0	45.0	37.0	8.0	0.0	50.3
5/5/2018	49.0	1.0	0.0	1.3	54.0	0.0	0.1	52.0	0.0	46.0	38.0	8.0	0.0	50.3
5/6/2018	50.0	1.0	0.0	1.4	55.0	0.0	0.2	51.0	0.0	46.0	38.0	8.0	0.0	50.5
5/7/2018	50.0	1.0	0.0	1.4	55.0	0.0	0.1	53.0	0.0	46.0	38.0	8.0	0.0	51.0
5/8/2018	50.0	1.0	0.0	1.4	55.0	0.0	0.2	54.0	0.0	45.0	37.0	8.0	0.0	51.0
5/9/2018	50.0	0.5	0.0	1.4	55.0	0.0	0.2	55.0	0.0	43.0	36.0	7.0	0.0	50.8
5/10/2018	50.0	1.0	0.0	1.3	55.0	0.0	0.3	55.0	0.0	43.0	35.0	8.0	0.0	50.8
5/11/2018	50.0	1.0	0.0	1.3	54.0	0.0	0.3	55.0	0.0	43.0	35.0	8.0	0.0	50.5
5/12/2018	51.0	1.0	0.0	1.2	52.0	0.0	0.3	54.0	0.0	42.0	34.0	8.0	0.0	49.8
5/13/2018	50.0	1.0	0.0	1.3	53.0	0.0	1.0	55.0	0.0	41.0	34.0	7.0	0.0	49.8
5/14/2018	50.0	1.0	0.0	1.3	54.0	0.0	0.2	56.0	0.0	42.0	34.0	8.0	0.0	50.5
5/15/2018	50.0	1.0	0.0	1.5	55.0	0.0	0.2	54.0	0.0	43.0	35.0	8.0	0.0	50.5
5/16/2018	49.0	1.0	0.0	1.4	54.0	0.0	0.2	53.0	0.0	44.0	36.0	8.0	0.0	50.0
5/17/2018	50.0	1.0	0.0	1.3	53.0	0.0	0.3	53.0	0.0	45.0	37.0	8.0	0.0	50.3
5/18/2018	50.0	1.0	0.0	1.3	54.0	0.0	0.5	53.0	0.0	45.0	37.0	8.0	0.0	50.5
5/19/2018	50.0	1.0	0.0	1.3	55.0	0.0	0.4	53.0	0.0	44.0	36.0	8.0	0.0	50.5
5/20/2018	50.0	1.0	0.0	1.2	56.0	0.0	0.3	52.0	0.0	43.0	35.0	8.0	0.0	50.3
5/21/2018	50.0	1.0	0.0	1.1	54.0	0.0	0.2	49.0	0.0	42.0	35.0	7.0	0.0	48.8
5/22/2018	63.0	1.0	0.0	1.1	55.0	0.0	0.2	49.0	0.0	43.0	35.0	8.0	0.0	52.5
5/23/2018	70.0	1.0	0.0	1.2	56.0	0.0	0.3	49.0	0.0	44.0	36.0	8.0	0.0	54.8
5/24/2018	70.0	1.0	0.0	1.3	57.0	0.0	0.3	48.0	0.0	44.0	36.0	8.0	0.0	54.8
5/25/2018	61.0	1.0	0.0	1.3	62.0	0.0	0.2	48.0	0.0	43.0	35.0	8.0	0.0	53.5
5/26/2018	50.0	1.0	0.0	1.4	64.0	0.0	0.2	51.0	0.0	42.0	35.0	7.0	0.0	51.8
5/27/2018	50.0	1.0	0.0	1.4	66.0	0.0	0.1	51.0	0.0	41.0	34.0	7.0	0.0	52.0
5/28/2018	49.0	1.0	0.0	1.4	61.0	0.0	0.3	52.0	0.0	41.0	33.0	8.0	0.0	50.8
5/29/2018	46.0	1.0	0.0	1.4	56.0	0.0	1.3	56.0	0.0	41.0	33.0	8.0	0.0	49.8
5/30/2018	42.0	1.0	0.0	1.4	54.0	0.0	0.3	57.0	0.0	41.0	33.0	8.0	0.0	48.5
5/31/2018	42.0	1.0	0.0	1.4	51.0	0.0	0.1	58.0	0.0	42.0	34.0	8.0	0.0	48.3
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6/1/2018	47.0	1.0	0.0	1.3	48.0	0.0	0.1	56.0	0.0	42.0	34.0	8.0	0.0	48.3
6/2/2018	59.0	1.0	0.0	1.3	47.0	0.0	0.1	53.0	0.0	41.0	34.0	7.0	0.0	50.0
6/3/2018	73.0	1.0	0.0	1.2	49.0	0.0	0.1	49.0	0.0	39.0	31.0	8.0	0.0	52.5
6/4/2018	91.0	1.0	0.0	1.1	53.0	0.0	0.1	46.0	0.0	46.0	38.0	8.0	0.0	59.0
6/5/2018	117.0	1.0	0.0	1.1	59.0	0.0	0.1	43.0	0.0	43.0	35.0	8.0	0.0	65.5
6/6/2018	127.0	1.4	0.0	1.1	67.0	0.0	0.1	41.0	0.0	41.0	33.0	8.0	0.0	69.0
6/7/2018	114.0	1.2	0.0	1.1	78.0	0.0	0.2	41.0	0.0	39.0	31.0	8.0	0.0	68.0
6/8/2018	89.0	1.2	0.0	1.1	92.0	0.0	0.1	44.0	0.0	37.0	29.0	8.0	0.0	65.5
6/9/2018	71.0	1.2	0.0	1.1	102.0	0.0	0.4	49.0	0.0	34.0	27.0	7.0	0.0	64.0
6/10/2018	62.0	1.0	0.0	1.2	103.0	0.0	1.2	56.0	0.0	33.0	25.0	8.0	0.0	63.5
6/11/2018	49.0	1.2	0.0	1.2	92.0	0.0	0.6	67.0	0.0	31.0	24.0	7.0	0.0	59.8
6/12/2018	44.0	1.2	0.0	1.2	79.0	0.0	0.4	75.0	0.0	32.0	24.0	8.0	0.0	57.5
6/13/2018	70.0	1.2	0.0	1.0	67.0	0.0	0.2	79.0	0.0	33.0	25.0	8.0	0.0	62.3
6/14/2018	84.0	1.3	0.0	1.1	59.0	0.0	0.1	78.0	0.0	40.0	32.0	8.0	0.0	65.3
6/15/2018	84.0	1.2	0.0	1.0	61.0	0.0	0.1	74.0	0.0	43.0	35.0	8.0	0.0	65.5
6/16/2018	84.0	1.1	0.0	1.2	72.0	0.0	0.1	68.0	0.0	50.0	42.0	8.0	0.0	68.5
6/17/2018	85.0	1.2	0.0	1.1	79.0	0.0	0.1	61.0	0.0	54.0	46.0	8.0	0.0	69.8
6/18/2018	83.0	1.2	0.0	1.1	82.0	0.0	0.1	53.0	0.0	56.0	48.0	8.0	0.0	68.5
6/19/2018	83.0	1.2	0.0	1.0	83.0	0.0	0.1	53.0	0.0	55.0	47.0	8.0	0.0	68.5
6/20/2018	85.0	1.2	0.0	1.0	85.0	0.0	0.1	60.0	0.0	49.0	42.0	7.0	0.0	69.8
6/21/2018	84.0	1.0	0.0	1.0	85.0	0.0	0.2	66.0	0.0	45.0	37.0	8.0	0.0	70.0
6/22/2018	84.0	0.7	0.0	1.0	85.0	0.0	0.1	69.0	0.0	41.0	33.0	8.0	0.0	69.8
6/23/2018	85.0	0.9	0.0	0.9	85.0	0.0	0.1	71.0	0.0	40.0	33.0	7.0	0.0	70.3
6/24/2018	84.0	1.2	0.0	1.0	86.0	0.0	0.1	71.0	0.0	41.0	33.0	8.0	0.0	70.5
6/25/2018	84.0	1.3	0.0	1.0	86.0	0.0	0.1	70.0	0.0	44.0	36.0	8.0	0.0	71.0
6/26/2018	84.0	1.2	0.0	1.0	87.0	0.0	0.0	70.0	0.0	47.0	39.0	8.0	0.0	72.0
6/27/2018	84.0	1.2	0.0	1.0	88.0	0.0	0.0	70.0	0.0	49.0	41.0	8.0	0.0	72.8
6/28/2018	83.0	1.2	0.0	1.0	86.0	0.0	0.0	71.0	0.0	48.0	41.0	7.0	0.0	72.0
6/29/2018	84.0	1.2	0.0	0.9	84.0	0.0	0.0	71.0	0.0	49.0	41.0	8.0	0.0	72.0
6/30/2018	85.0	1.2	0.0	0.9	83.0	0.0	0.0	72.0	0.0	49.0	41.0	8.0	0.0	72.3
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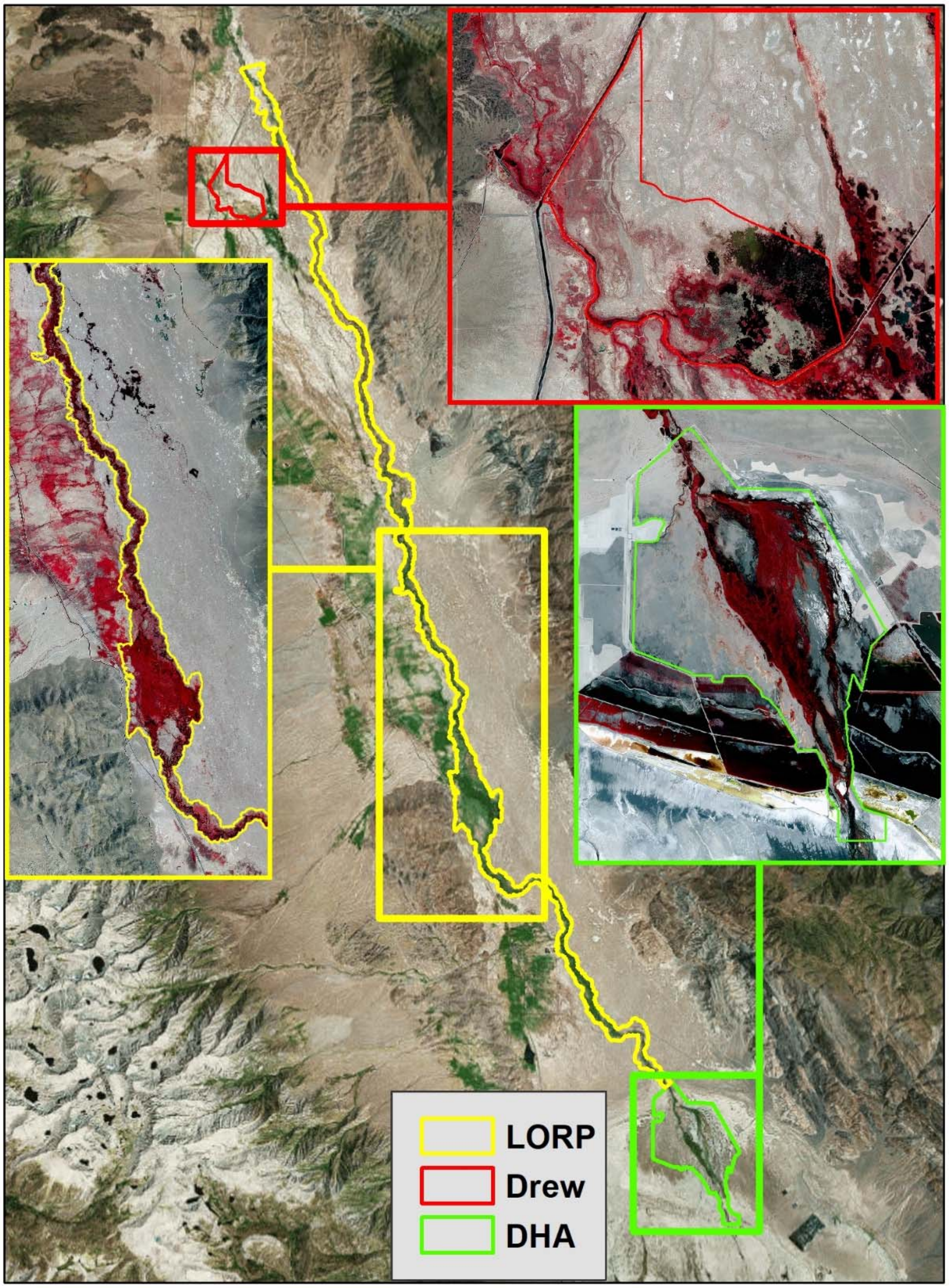
Flow Gaging Station	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
Date														
7/1/2018	**85.0**	**1.2**	**0.0**	**0.9**	**82.0**	**0.0**	**0.0**	**72.0**	**0.0**	**50.0**	**42.0**	**8.0**	**0.0**	**72.3**
7/2/2018	**94.0**	**1.4**	**0.0**	**0.9**	**83.0**	**0.0**	**0.0**	**72.0**	**0.0**	**51.0**	**43.0**	**8.0**	**0.0**	**75.0**
7/3/2018	**90.0**	**1.4**	**0.0**	**0.9**	**84.0**	**0.0**	**0.0**	**70.0**	**0.0**	**52.0**	**44.0**	**8.0**	**0.0**	**74.0**
7/4/2018	**83.0**	**1.5**	**0.0**	**0.9**	**84.0**	**0.0**	**0.0**	**69.0**	**0.0**	**53.0**	**45.0**	**8.0**	**0.0**	**72.3**
7/5/2018	**83.0**	**1.3**	**0.0**	**0.9**	**88.0**	**0.0**	**0.0**	**68.0**	**0.0**	**53.0**	**45.0**	**8.0**	**0.0**	**73.0**
7/6/2018	**84.0**	**1.1**	**0.0**	**0.9**	**87.0**	**0.0**	**0.0**	**69.0**	**0.0**	**53.0**	**45.0**	**8.0**	**0.0**	**73.3**
7/7/2018	**83.0**	**1.1**	**0.0**	**0.9**	**82.0**	**0.0**	**0.0**	**70.0**	**0.0**	**50.0**	**43.0**	**7.0**	**0.0**	**71.3**
7/8/2018	**84.0**	**1.1**	**0.0**	**0.9**	**81.0**	**0.0**	**0.1**	**73.0**	**0.0**	**50.0**	**42.0**	**8.0**	**0.0**	**72.0**
7/9/2018	**84.0**	**1.1**	**0.0**	**1.2**	**81.0**	**0.0**	**0.0**	**75.0**	**0.0**	**51.0**	**43.0**	**8.0**	**0.0**	**72.8**
7/10/2018	**85.0**	**1.1**	**0.0**	**1.3**	**82.0**	**0.0**	**0.0**	**73.0**	**0.0**	**52.0**	**45.0**	**7.0**	**0.0**	**73.0**
7/11/2018	**85.0**	**1.2**	**0.0**	**1.3**	**84.0**	**0.0**	**0.0**	**73.0**	**0.0**	**55.0**	**47.0**	**8.0**	**0.0**	**74.3**
7/12/2018	**85.0**	**1.2**	**0.0**	**1.4**	**85.0**	**0.0**	**0.0**	**72.0**	**0.0**	**56.0**	**48.0**	**8.0**	**0.0**	**74.5**
7/13/2018	**84.0**	**1.2**	**0.0**	**1.4**	**89.0**	**0.0**	**0.2**	**73.0**	**0.0**	**56.0**	**48.0**	**8.0**	**0.0**	**75.5**
7/14/2018	**84.0**	**1.2**	**0.0**	**1.9**	**90.0**	**0.0**	**0.1**	**74.0**	**0.0**	**58.0**	**47.0**	**8.0**	**3.0**	**76.5**
7/15/2018	**83.0**	**1.3**	**0.0**	**1.4**	**88.0**	**0.0**	**0.1**	**75.0**	**0.0**	**61.0**	**48.0**	**8.0**	**5.0**	**76.8**
7/16/2018	**84.0**	**1.2**	**0.0**	**0.9**	**84.0**	**0.0**	**0.0**	**76.0**	**0.0**	**61.0**	**48.0**	**8.0**	**5.0**	**76.3**
7/17/2018	**83.0**	**1.2**	**0.0**	**1.4**	**82.0**	**0.0**	**0.0**	**77.0**	**0.0**	**64.0**	**46.0**	**16.0**	**2.0**	**76.5**
7/18/2018	**84.0**	**1.2**	**0.0**	**1.6**	**81.0**	**0.0**	**0.0**	**76.0**	**0.0**	**56.0**	**36.0**	**20.0**	**0.0**	**74.3**
7/19/2018	**84.0**	**1.2**	**0.0**	**1.4**	**76.0**	**0.0**	**0.0**	**69.0**	**0.0**	**56.0**	**36.0**	**20.0**	**0.0**	**71.3**
7/20/2018	**85.0**	**1.1**	**0.0**	**1.4**	**76.0**	**0.0**	**0.1**	**67.0**	**0.0**	**55.0**	**35.0**	**20.0**	**0.0**	**70.8**
7/21/2018	**84.0**	**1.1**	**0.0**	**1.3**	**77.0**	**0.0**	**0.4**	**65.0**	**0.0**	**55.0**	**35.0**	**20.0**	**0.0**	**70.3**
7/22/2018	**83.0**	**1.1**	**0.0**	**1.4**	**77.0**	**0.0**	**0.2**	**64.0**	**0.0**	**53.0**	**33.0**	**20.0**	**0.0**	**69.3**
7/23/2018	**84.0**	**1.3**	**0.0**	**1.4**	**77.0**	**0.0**	**0.1**	**64.0**	**0.0**	**53.0**	**33.0**	**20.0**	**0.0**	**69.5**
7/24/2018	**84.0**	**1.2**	**0.0**	**1.4**	**77.0**	**0.0**	**0.0**	**64.0**	**0.0**	**53.0**	**33.0**	**20.0**	**0.0**	**69.5**
7/25/2018	**84.0**	**1.2**	**0.0**	**1.4**	**77.0**	**0.0**	**0.0**	**65.0**	**0.0**	**53.0**	**33.0**	**20.0**	**0.0**	**69.8**
7/26/2018	**85.0**	**1.2**	**0.0**	**1.4**	**76.0**	**0.0**	**0.1**	**66.0**	**0.0**	**53.0**	**33.0**	**20.0**	**0.0**	**70.0**
7/27/2018	**84.0**	**1.2**	**0.0**	**1.4**	**77.0**	**0.0**	**0.0**	**65.0**	**0.0**	**54.0**	**42.0**	**12.0**	**0.0**	**70.0**
7/28/2018	**84.0**	**1.2**	**0.0**	**1.2**	**76.0**	**0.0**	**0.6**	**64.0**	**0.0**	**55.0**	**47.0**	**8.0**	**0.0**	**69.8**
7/29/2018	**84.0**	**1.3**	**0.0**	**1.2**	**77.0**	**0.0**	**0.1**	**65.0**	**0.0**	**55.0**	**47.0**	**8.0**	**0.0**	**70.3**
7/30/2018	**83.0**	**1.3**	**0.0**	**1.2**	**77.0**	**0.0**	**0.5**	**64.0**	**0.0**	**56.0**	**47.0**	**8.0**	**1.0**	**70.0**
7/31/2018	**84.0**	**1.3**	**0.0**	**1.3**	**77.0**	**0.0**	**0.2**	**64.0**	**0.0**	**57.0**	**47.0**	**8.0**	**2.0**	**70.5**
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	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
Date														
8/1/2018	84.0	1.3	0.0	1.2	77.0	0.0	0.0	65.0	0.0	56.0	47.0	8.0	1.0	70.5
8/2/2018	84.0	1.2	0.0	1.1	77.0	0.0	0.0	65.0	0.0	56.0	47.0	7.0	2.0	70.5
8/3/2018	80.0	1.2	0.0	1.1	77.0	0.0	0.0	66.0	0.0	57.0	47.0	8.0	2.0	70.0
8/4/2018	76.0	1.2	0.0	1.1	75.0	0.0	0.1	66.0	0.0	58.0	47.0	8.0	3.0	68.8
8/5/2018	76.0	1.2	0.0	1.1	72.0	0.0	0.4	65.0	0.0	58.0	47.0	8.0	3.0	67.8
8/6/2018	76.0	1.0	0.0	1.1	68.0	0.0	0.1	65.0	0.0	58.0	47.0	8.0	3.0	66.8
8/7/2018	76.0	1.2	0.0	1.0	65.0	0.0	0.0	63.0	0.0	56.0	47.0	7.0	2.0	65.0
8/8/2018	76.0	1.2	0.0	1.0	63.0	0.0	0.0	61.0	0.0	56.0	47.0	8.0	1.0	64.0
8/9/2018	76.0	1.2	0.0	1.1	62.0	0.0	0.0	58.0	0.0	57.0	48.0	8.0	1.0	63.3
8/10/2018	76.0	1.1	0.0	1.2	62.0	0.0	0.1	55.0	0.0	55.0	47.0	8.0	0.0	62.0
8/11/2018	76.0	0.9	0.0	1.3	62.0	0.0	0.0	52.0	0.0	55.0	47.0	8.0	0.0	61.3
8/12/2018	76.0	0.6	0.0	1.2	61.0	0.0	0.0	51.0	0.0	53.0	45.0	8.0	0.0	60.3
8/13/2018	76.0	0.8	0.0	1.2	61.0	0.0	0.1	52.0	0.0	50.0	42.0	8.0	0.0	59.8
8/14/2018	76.0	1.0	0.0	1.1	61.0	0.0	0.0	51.0	0.0	48.0	41.0	7.0	0.0	59.0
8/15/2018	76.0	1.3	0.0	1.0	61.0	0.0	0.2	50.0	0.0	47.0	39.0	8.0	0.0	58.5
8/16/2018	77.0	1.2	0.0	1.0	61.0	0.0	0.1	54.0	0.0	46.0	38.0	8.0	0.0	59.5
8/17/2018	76.0	1.2	0.0	1.1	63.0	0.0	0.5	55.0	0.0	45.0	37.0	8.0	0.0	59.8
8/18/2018	76.0	1.1	0.0	1.1	64.0	0.0	0.2	57.0	0.0	44.0	36.0	8.0	0.0	60.3
8/19/2018	75.0	1.1	0.0	1.0	61.0	0.0	0.1	56.0	0.0	45.0	37.0	8.0	0.0	59.3
8/20/2018	76.0	1.3	0.0	1.0	61.0	0.0	0.0	57.0	0.0	43.0	35.0	8.0	0.0	59.3
8/21/2018	76.0	1.9	0.0	1.1	61.0	0.0	0.0	56.0	0.0	42.0	34.0	8.0	0.0	58.8
8/22/2018	76.0	1.1	0.0	1.1	61.0	0.0	0.1	57.0	0.0	42.0	34.0	8.0	0.0	59.0
8/23/2018	76.0	0.8	0.0	1.1	61.0	0.0	0.1	56.0	0.0	42.0	34.0	8.0	0.0	58.8
8/24/2018	76.0	0.9	0.0	1.2	61.0	0.0	0.1	56.0	0.0	42.0	34.0	8.0	0.0	58.8
8/25/2018	76.0	0.8	0.0	1.2	61.0	0.0	0.0	56.0	0.0	42.0	34.0	8.0	0.0	58.8
8/26/2018	76.0	0.9	0.0	1.2	61.0	0.0	0.0	56.0	0.0	42.0	34.0	8.0	0.0	58.8
8/27/2018	76.0	0.8	0.0	1.2	64.0	0.0	0.2	56.0	0.0	43.0	35.0	8.0	0.0	59.8
8/28/2018	76.0	1.1	0.0	1.2	67.0	0.0	0.2	57.0	0.0	43.0	35.0	8.0	0.0	60.8
8/29/2018	76.0	1.3	0.0	1.2	67.0	0.0	0.2	56.0	0.0	43.0	35.0	8.0	0.0	60.5
8/30/2018	76.0	1.3	0.0	1.2	67.0	0.0	0.1	57.0	0.0	44.0	36.0	8.0	0.0	61.0
8/31/2018	76.0	1.3	0.0	1.3	68.0	0.0	0.1	58.0	0.0	45.0	37.0	8.0	0.0	61.8
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	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
9/1/2018	76.0	1.2	0.0	1.3	68.0	0.0	0.1	58.0	0.0	45.0	37.0	8.0	0.0	61.8
9/2/2018	76.0	1.2	0.0	1.3	68.0	0.0	0.0	58.0	0.0	45.0	38.0	7.0	0.0	61.8
9/3/2018	76.0	1.2	0.0	1.3	68.0	0.0	0.1	58.0	0.0	40.0	32.0	7.0	1.0	60.5
9/4/2018	76.0	1.2	0.0	1.3	68.0	0.0	0.1	59.0	0.0	51.0	43.0	8.0	0.0	63.5
9/5/2018	76.0	1.2	0.0	1.2	68.0	0.0	0.0	59.0	0.0	47.0	39.0	8.0	0.0	62.5
9/6/2018	76.0	1.2	0.0	1.1	68.0	0.0	0.1	59.0	0.0	48.0	40.0	8.0	0.0	62.8
9/7/2018	76.0	1.2	0.0	1.2	68.0	0.0	0.0	60.0	0.0	49.0	41.0	8.0	0.0	63.3
9/8/2018	76.0	1.1	0.0	1.3	68.0	0.0	0.0	61.0	0.0	48.0	41.0	7.0	0.0	63.3
9/9/2018	76.0	1.1	0.0	1.0	68.0	0.0	0.0	60.0	0.0	49.0	41.0	8.0	0.0	63.3
9/10/2018	77.0	1.4	0.0	1.1	68.0	0.0	0.0	59.0	0.0	48.0	41.0	7.0	0.0	63.0
9/11/2018	70.0	1.5	0.0	1.3	69.0	0.0	0.0	62.0	0.0	48.0	41.0	7.0	0.0	62.3
9/12/2018	65.0	1.5	0.0	1.3	69.0	0.0	0.0	62.0	0.0	49.0	41.0	8.0	0.0	61.3
9/13/2018	65.0	1.2	0.0	0.9	69.0	0.0	0.5	61.0	0.0	48.0	40.0	8.0	0.0	60.8
9/14/2018	66.0	1.2	0.0	1.0	65.0	0.0	0.3	61.0	0.0	45.0	38.0	7.0	0.0	59.3
9/15/2018	65.0	1.2	0.0	1.1	63.0	0.0	0.0	59.0	0.0	49.0	41.0	8.0	0.0	59.0
9/16/2018	66.0	1.1	0.0	1.1	64.0	0.0	0.0	60.0	0.0	46.0	38.0	8.0	0.0	59.0
9/17/2018	65.0	1.2	0.0	1.1	64.0	0.0	0.1	59.0	0.0	45.0	37.0	8.0	0.0	58.3
9/18/2018	65.0	1.1	0.0	1.2	63.0	0.0	0.0	58.0	0.0	43.0	24.0	19.0	0.0	57.3
9/19/2018	66.0	1.1	0.0	1.2	64.0	0.0	0.0	59.0	0.0	46.0	21.0	25.0	0.0	58.8
9/20/2018	65.0	1.2	0.0	1.3	64.0	0.0	0.0	59.0	0.0	46.0	21.0	25.0	0.0	58.5
9/21/2018	66.0	1.4	0.0	1.3	64.0	0.0	0.0	58.0	0.0	46.0	21.0	25.0	0.0	58.5
9/22/2018	66.0	1.5	0.0	1.2	64.0	0.0	0.1	59.0	0.0	45.0	20.0	25.0	0.0	58.5
9/23/2018	66.0	1.5	0.0	1.1	64.0	0.0	0.0	60.0	0.0	47.0	22.0	25.0	0.0	59.3
9/24/2018	66.0	1.4	0.0	1.1	65.0	0.0	0.4	61.0	0.0	46.0	21.0	25.0	0.0	59.5
9/25/2018	66.0	1.2	0.0	1.1	65.0	0.0	0.3	61.0	0.0	47.0	22.0	25.0	0.0	59.8
9/26/2018	64.0	1.2	0.0	1.3	65.0	0.0	0.1	60.0	0.0	49.0	24.0	25.0	0.0	59.5
9/27/2018	60.0	1.1	0.0	1.3	65.0	0.0	0.0	61.0	0.0	49.0	24.0	25.0	0.0	58.8
9/28/2018	56.0	1.1	0.0	1.4	65.0	0.0	0.2	59.0	0.0	49.0	36.0	13.0	0.0	57.3
9/29/2018	56.0	1.1	0.0	1.8	63.0	0.0	0.2	57.0	0.0	50.0	42.0	8.0	0.0	56.5
9/30/2018	56.0	1.1	0.0	1.8	59.0	0.0	0.0	57.0	0.0	49.0	41.0	8.0	0.0	55.3
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

3.0 VEGETATION MAPPING- LORP, DELTA HABITAT AREA, AND DREW SLOUGH, 2017 CONDITIONS

VEGETATION MAPPING
LORP, DHA, AND DREW SLOUGH
2017 CONDITIONS



October 2018

EXECUTIVE SUMMARY

Vegetation inventories were conducted for the Lower Owens River Project (LORP), the Delta Habitat Area (DHA), and Drew Slough management unit of the BWMA for 2017 conditions, ten years after LORP was implemented. The aerial imagery that served as a basis for mapping was collected July 28-29 and August 1-2, 2017 near peak runoff.

LORP results are compared with similar inventories of 2009 and 2014 conditions resulting from the LORP and for 2000 conditions prior to implementation of LORP. Differences in conditions are primarily attributed to hydrologic changes associated with re-watering the Owens River, fires, and improvements in the accuracy and precision of mapping. Other management applications (e.g. grazing) may also have affected change.

The runoff for 2017 was the second highest year on record. In June, inflow to the LORP exceeded 240 cfs and peaked at 325 cfs. A 274 cfs flushing flow was also released in April. Water was spread extensively in the BWMA and two diversions (McGiver and Eclipse water spreading diversions) were used to spread water east of the Owens River. At the time of imagery in late July and early August, discharge at the intake was on the descending limb following four months when inflow approached or exceeded 100 cfs. Discharge to the DHA approached 60 cfs in late July and early August after exceeding 100 cfs the previous month. Water was spread throughout much of the BWMA in spring and summer of 2017.

Hydrologic changes for LORP are summarized in terms of states. About 10 miles of incised channel has become graded since 2014 and there was a net increase of 4 miles of aggraded condition, corresponding with a net increase of about 900 acres of hydric vegetation since 2014. The LORP continues to aggrade. Prescribed burns in 2008, 2010, and 2012 converted scrub/meadow to more productive meadow and invigorated production of herbaceous vegetation. A wildfire near Lone Pine in 2013 also converted scrub/meadow to meadow and reduced the stature of trees. The Moffat fire burned the Island and the Owens River bottom 3 miles upstream of the Island in 2018. The accuracy and precision of mapping have improved with each successive application. Vegetation height calculated from LiDAR was used to enhance the precision of some vegetation types (e.g. trees and scrub) for 2017 conditions.

In the DHA the area of open water (144 acres) was about 16 times the area of water in 2012. Discharge to the DHA approached 60 cfs on the date of imagery and exceeded 100 cfs a month previous. The area of hydric vegetation increased 76 acres since 2012, 152 acres since 2009, and 359 acres since 2005 (baseline). The extremely wet conditions in 2017 likely biased mapping towards more hydric vegetation (e.g. meadow appeared as wet meadow, wet meadow as short marsh).

Only the Drew management unit of the BWMA was mapped in 2017. The distribution of vegetation reflects two years of drying followed by water spreading in spring and early summer 2017. Open water covered several areas not previously flooded. About half of the marsh was dead in 2017. The area of hydric vegetation in the Drew unit in 2017 increased 54 acres since 2014, 128 acres since 2009 and 298 acres since 2000. Mapping is likely somewhat biased by the wet conditions resulting from water spreading.

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APPENDIX A – LORP VEGETATION, 2017 CONDITIONS
APPENDIX B – LORP VEGETATION, 2000, 2009, 2014, AND 2017 CONDITIONS
APPENDIX C – DHA VEGETATION MAPS, 2017 CONDITIONS
APPENDIX D – DHA VEGETATION MAPS, 2005, 2009, 2012 AND 2017 CONDITIONS

1.0 INTRODUCTION

The LORP Monitoring, Adaptive Management and Report Plan (ES 2008) stipulates vegetation mapping that measures large-scale vegetation trends and habitat extent be conducted at regular intervals. Vegetation inventories were conducted for the Lower Owens River Project (LORP), the Delta Habitat Area (DHA), and the Drew Slough management unit of the Blackrock Waterfowl Management Area (BWMA) for 2017 conditions, ten years after LORP was implemented. Results were compared with 2000, 2009, and 2014 inventories of the LORP project area and with 2000, 2009, and 2012 inventories of the DHA.

2.0 LORP 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 project 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 (Figure 2-1). 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 2017 and 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, 2014, and 2017 LORP 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 (Figure 2-2). Prescribed burns in 2008, 2010, and 2012 converted scrub/meadow to more productive meadow and invigorated herbaceous vegetation. A 400 acre wildfire centered on the Owens River corridor east of Lone Pine reduced the stature and killed some trees in 2013. The 1,000 acre Moffat fire burned the Island and 3 miles of the Owens River corridor in 2018, subsequent to the 2017 inventory.

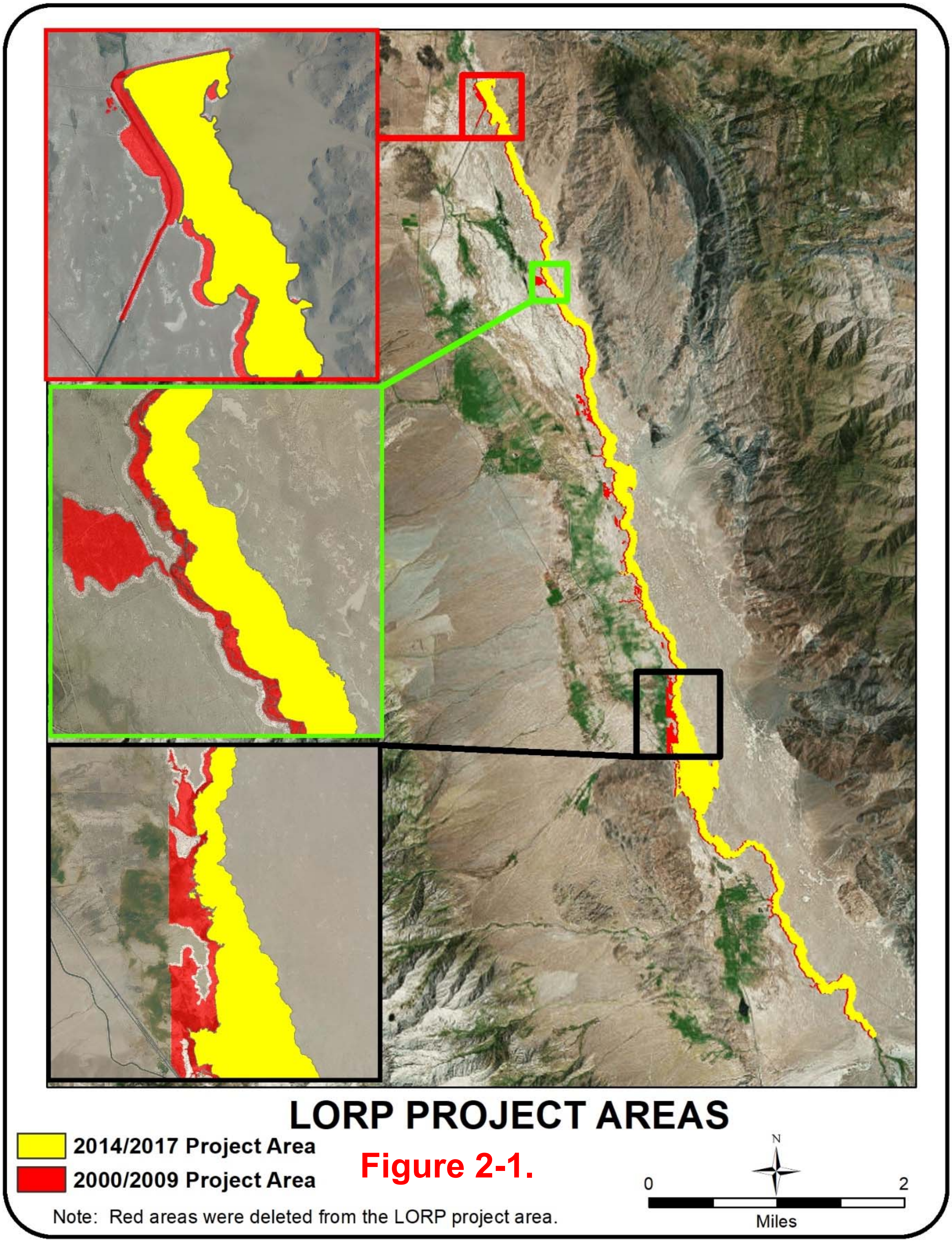


Figure 2-1.

Note: Red areas were deleted from the LORP project area.

LORP Fires Since 2008

Figure 2-2

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 (16,601 parcels) were mapped using an unsupervised spectral classification, heads-up editing, and a less significant field effort of about 15 person-days. The 2017 conditions were again mapped using an unsupervised spectral classification, LiDAR analyses, more limited heads-up editing, and a minimal field effort of about 5 person-days resulting in about 46,000 parcels. The accuracy and precision of mapping have improved with each successive application.

Eastern Sierra runoff in 2017 was the second highest year on record. Average discharge to LORP at the intake (Figure 2-3) in May, June, and July was more than double the average discharge for those months since the project was implemented. Peak average discharge in June of 2017 was 244 cfs. Water was diverted from the Owens River to the McIver and Eclipse ditches for water spreading. At the Reinhackle gage just above the Island (Figure 2-4), average monthly flow in June and July exceeded 100 cfs. On the days imagery was collected (July 28 through August 2) discharge was on the descending limb, ranging from 131 to 117 cfs. The wet conditions likely biased mapping towards identification of hydric classes.

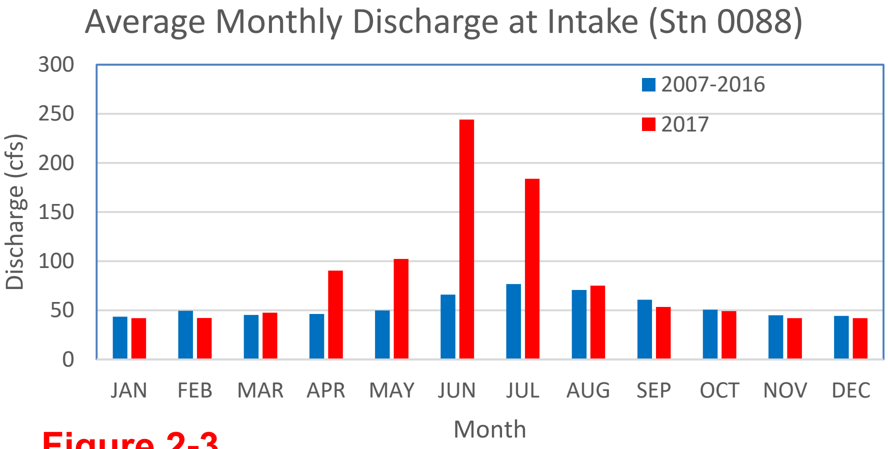


Figure 2-3

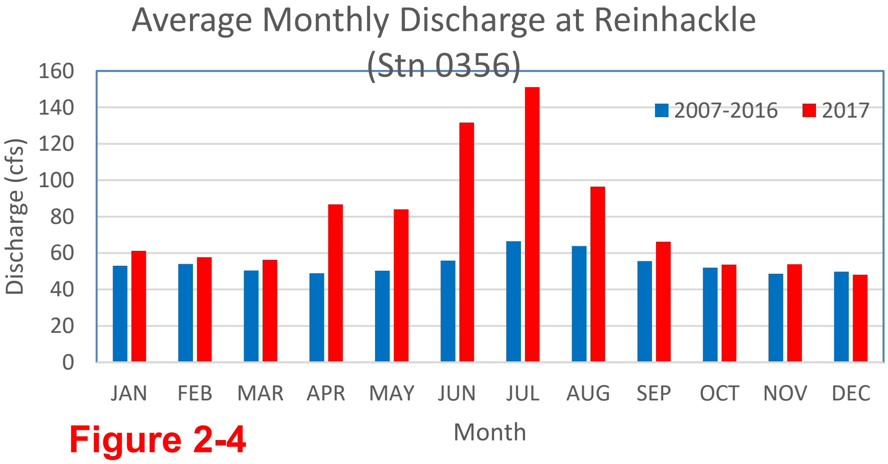


Figure 2-4

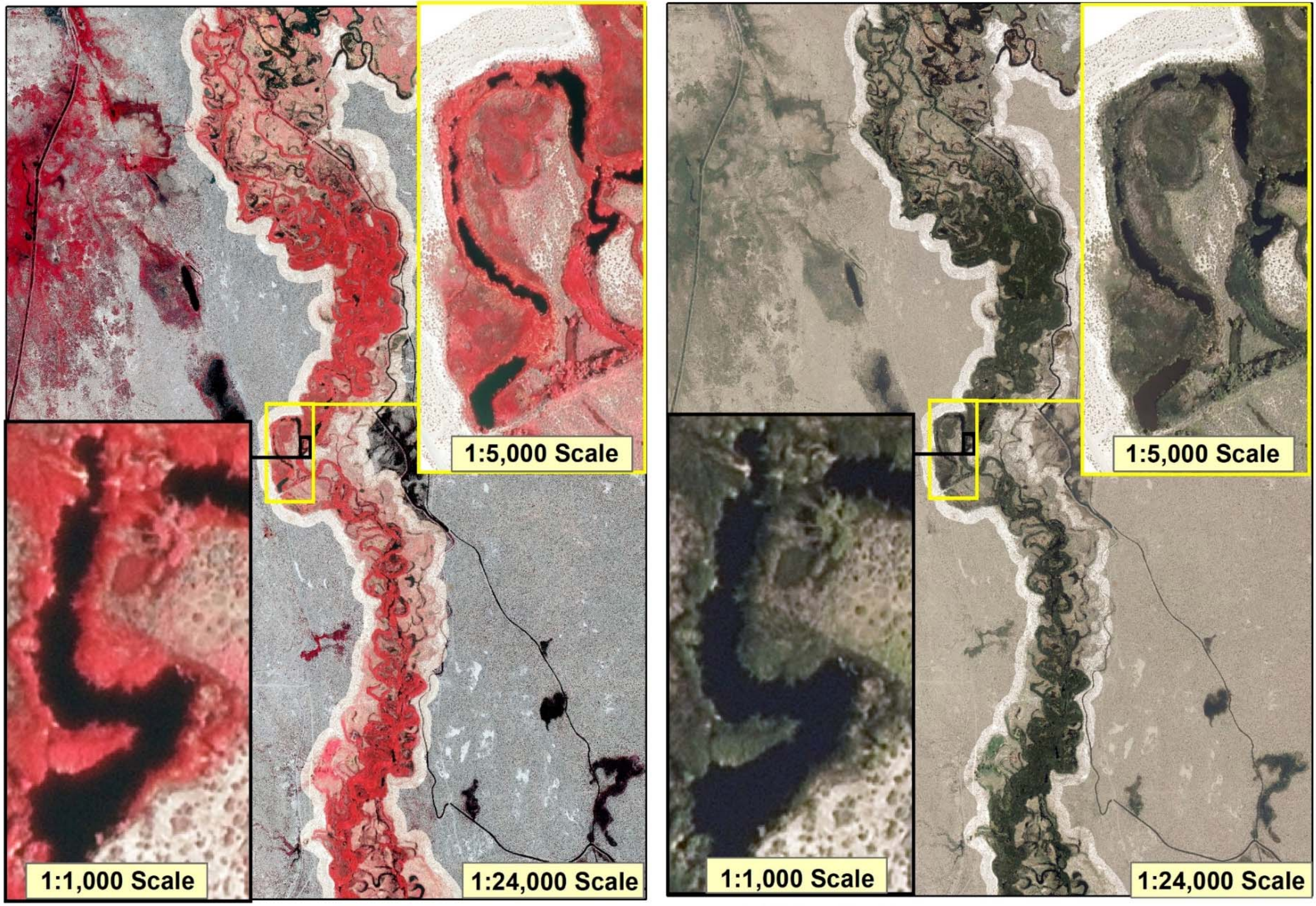
2.1 LORP Approach

The 2017 vegetation mapping is based on a 4 band, high-resolution image captured from aircraft July 27-28 and August 1-2, 2017. Many TIFF image tiles were mosaicked, and then clipped to the LORP project area boundary with a 50 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 (Figure 2-5). This full resolution image can be viewed at scales greater than 1:1,000 and served as the basis for both successive spectral classifications and “heads up” editing.

First, an unsupervised spectral classification with 20 classes was applied to each of 6 reaches of LORP, the DHA, and the Drew Slough management unit of the BWMA. The 20 classes were then grouped into six classes each consisting of a relatively narrow range of vegetation types. Very small parcels were eliminated; commission errors were evaluated “heads-up”. Each of the six edited classes was then extracted and subjected to another unsupervised spectral classification with 20 classes that were again combined to identify more discrete vegetation types. Successive spectral classification was effective for identifying some, but not all vegetation types.

Light detection and ranging (LiDAR) was acquired in October 2017 for the LORP and DHA. The technology entails laser measures of elevation including vegetation canopy and the ground at very high (0.2 meter) resolution. A Digital Surface Model (DSM) depicting the vegetation canopy and a Digital Terrain Model (DTM) of the ground surface were subtracted, yielding raster measures of vegetation height (feet). Trees were identified as vegetation height at least 10 feet with a 2 meter buffer. Scrub/meadow was distinguished from meadow using a maximum vegetation height at least 2 feet over a 5 square meter area. LiDAR was also used to distinguish short marsh from tall marsh in the DHA. LiDAR was useful for distinguishing vegetation types based on structure and for refining some spectral classes.

Some vegetation types (e.g. riparian shrub, reed) were difficult to distinguish spectrally or from vegetation height. Heads-up editing was used to capture these types.



A. Color infrared (CIR).

B. Natural color.

Figure 2-5

2017 Imagery

Note: Image is 4 band, 16 bit, 1 foot resolution.

2.2 LORP Results

Vegetation types identified for 2000, 2009, 2014, and 2017 conditions are correlated in Table 2-1. Large-scale (1:5,000) maps of vegetation for 2017 conditions are compiled in APPENDIX A. Side-by-side maps of vegetation types for 2000, 2009, 2014, and 2017 conditions are compiled in APPENDIX B.

The influence of LORP on the distribution of vegetation types generally corresponds with changes in hydrology and channel morphology associated with states (Figure 2-6). 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 on 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. Marsh fills the active channel. Alluvial groundwater is within the rooting depth of hydric vegetation on the floodplain. 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.

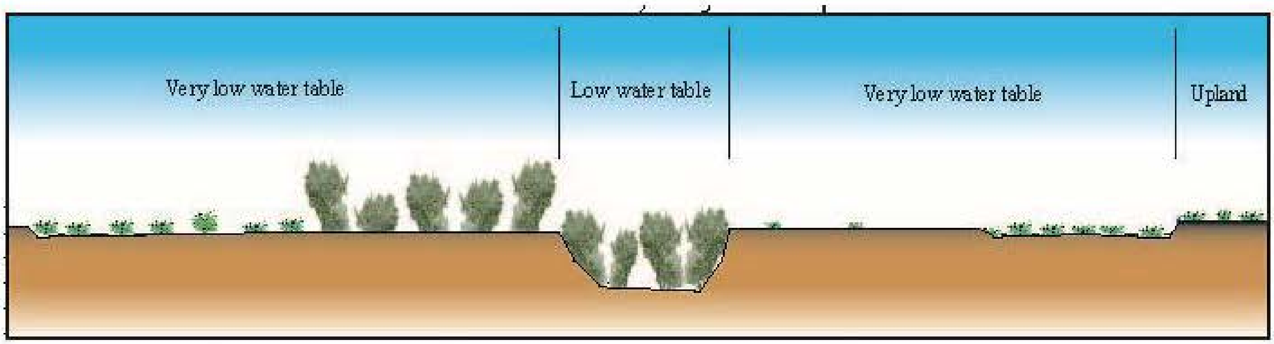
Reaches defined for 2000 conditions (Figure 2-7) are based on states prior to implementation of the LORP. With implementation, the dry reach became wet and the length of graded and aggraded conditions increased slightly, as documented for 2009 conditions. In 2014 the length of graded condition tripled and the aggraded condition increased 50 percent relative to 2009 conditions (Table 2-2). The length of graded channel increased about 6 miles since 2014 and aggraded conditions increased by about 4 miles. The LORP is aggrading!

Table 2-2. Changes in state.

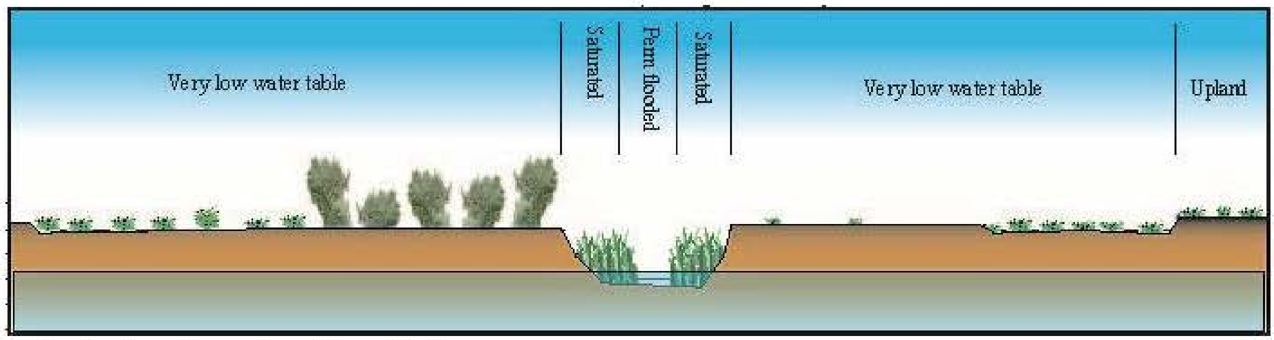
State	2000 Conditions		2009 Conditions		2014 Conditions		2017 Conditions	
	Miles	%	Miles	%	Miles	%	Miles	%
Incised, dry, confined floodplain	16.1	28.9	0.0	0.0	0.0	0.0	0.0	0.0
Incised, wet, confined floodplain	23.7	42.5	38.2	68.3	9.8	17.6	0.0	0.0
Graded, wet, unconfined floodplain	12.0	21.4	12.5	22.4	38.6	69.1	44.5	79.6
Aggraded, wet, unconfined floodplain	4.0	7.2	5.2	9.3	7.5	13.4	11.4	20.4
TOTAL	**55.9**	**100.0**	**55.9**	**100.0**	**55.9**	**100.0**	**55.9**	**100.0**

Table 2-1. Map unit correlation.

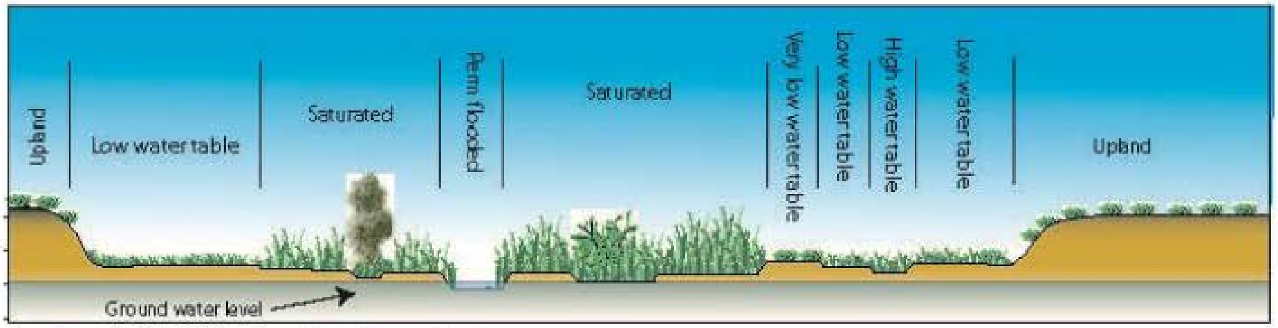
2017 Conditions		2014 Conditions		2009 Conditions		2000 Conditions	
Name	Acres	Name	Acres	Name	Acres	Name	Acres
Water	510	Water	154	Water	251	Water	100
Streambar	3	Streambar	23	Streambar	8	Streambar	23
Marsh	1433	Marsh	1310	Marsh	1090	Marsh	765
Reed	51	Reedgrass	51	Reedgrass	24	Reedgrass	25
Wet meadow	1071	Wet meadow	653	Wet Alkali Meadow	57	Wet Alkali Meadow	210
		Irrigated meadow	3	Irrigated Meadow	3	Irrigated meadow	4
Riparian shrub	33	Riparian shrub	32	Riparian Shrub (willow)	20	Riparian Shrub (willow)	20
		Tamarisk	1	Tamarisk	12	Tamarisk	249
Tree	190	Riparian forest (cottonwood)	3	Riparian Forest (cottonwood)	5	Riparian Forest (cottonwood)	5
		Riparian forest (tree willow)	162	Riparian Forest (tree willow)	260	Riparian Forest (tree willow)	444
Meadow	619	Alkali meadow	513	Dry Alkali Meadow	1034	Dry Alkali Meadow	889
Scrub/meadow	1433	Alkali scrub/meadow	1484	Rabbitbrush-NV saltbush scrub/meadow	1132	Rabbitbrush-NV saltbush scrub/meadow	1237
Scrub	876	Alkali scrub	492	Rabbitbrush-NV saltbush scrub	1787	Rabbitbrush-NV saltbush scrub	1728
		Upland scrub	1191			Undifferentiated upland	39
Weed	0	Bassia (weeds)	118	Bassia	326	Barren	387
				Tamarisk / Slash	1		
				Barren	115		
Road	31	Road	6	--	--	--	--
		Road	37				
Misc feature	1	Miscellaneous feature	19	Structure	22	Structure	3
TOTAL	**6252**	**TOTAL**	**6252**	**TOTAL**	**6147**	**TOTAL**	**6128**



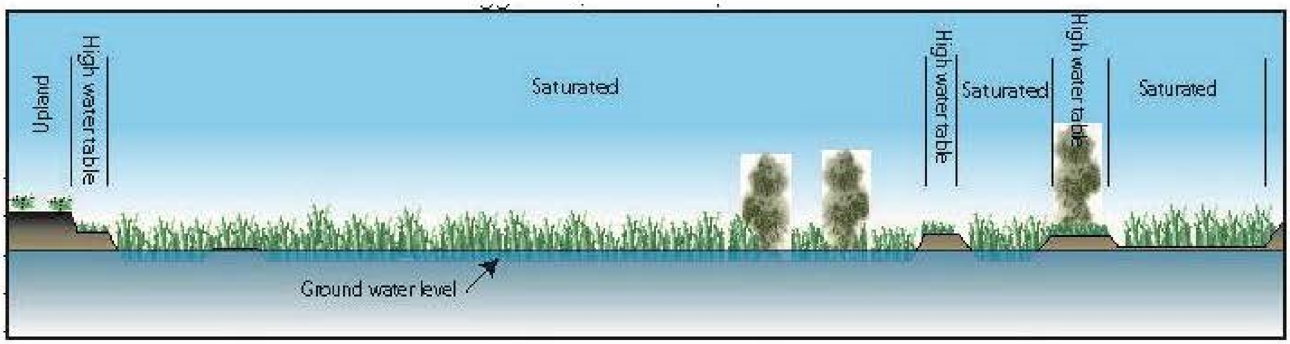
A. Incised, dry, confined floodplain.



B. Incised, wet, confined floodplain.



C. Graded, wet, unconfined floodplain.



D. Aggraded, wet, unconfined floodplain.

States

Figure 2-6

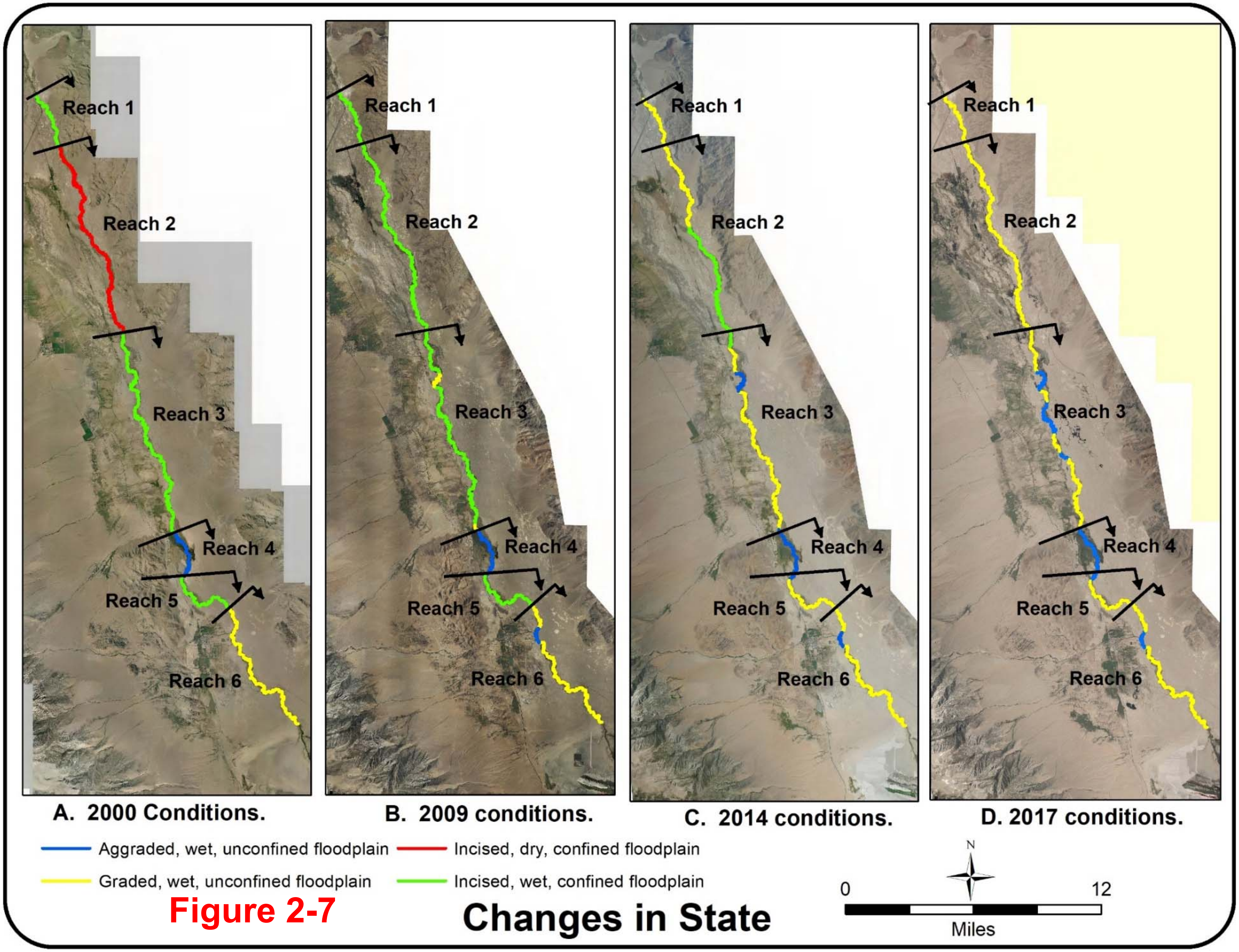


Figure 2-7

Changes in State

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 marsh in the channel bottom that further slowed the water and enhanced aggradation. These observations led 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 10 years. The LORP is aggrading faster than anticipated. The direction of changes toward more aggraded conditions is expected to continue for the foreseeable future.

Changes in state correspond with changes in the distributions of vegetation (Table 2-3 and Figure 2-8). Marsh is prominent in the aggraded state, comprising almost half of the river bottom. A more diverse assemblage of vegetation is present in the graded state, with marsh more restricted to the active river channel. The extent of hydric vegetation types (water, marsh, reed, wet meadow, riparian shrub, and riparian forest) increased 896 acres (15 percent) since 2014 and 1,691 acres (27 percent) since 2000 (Table 2-4). The extent of mesic vegetation (scrub/meadow and meadow) has remained relatively consistent since 2000. Arid vegetation (scrub) declined 983 acres (16 percent) since 2014 and 1,585 acres (26 percent) since 2000. Aggrading conditions throughout the LORP correspond with changes towards more hydric vegetation types.

Table 2-3. Distribution of vegetation types by state, 2017 conditions.

Class	Aggraded		Graded	
	(acres)	(%)	(acres)	(%)
Water	135	7	375	9
Marsh	903	46	531	12
Reed	13	1	39	1
Wet meadow	200	10	871	20
Meadow	245	12	374	9
Scrub/meadow	206	10	1227	29
Tree	71	4	119	3
Riparian shrub	14	1	18	0
Scrub	171	9	648	15
Road	13	1	78	2
Misc feature	0	0	2	0
TOTAL	**1971**	**100**	**4281**	**100**

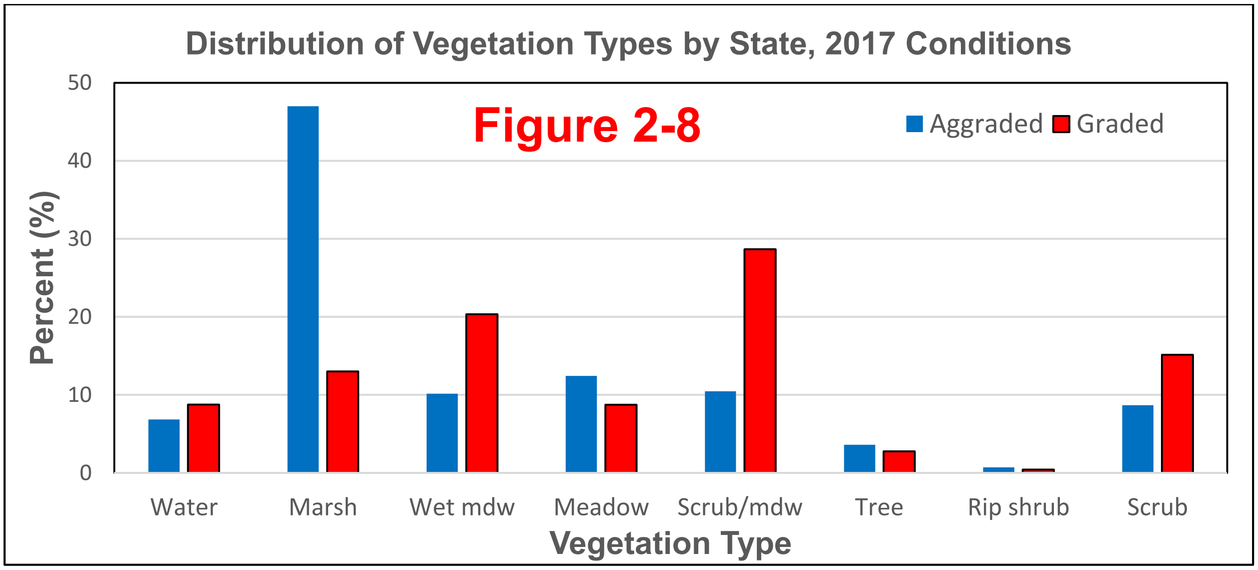


Table 2-4. Hydric status, 2000 through 2017 conditions.

Status	2017 Conditions		2014 Conditions		2009 Conditions		2000 Conditions	
	Acres	%	Acres	%	Acres	%	Acres	%
Hydric	3288	53	2392	38	1719	28	1597	26
Mesic	2053	33	1997	32	2166	35	2126	35
Arid	818	13	1801	29	2241	36	2403	39
Not considered	93	1	62	1	22	0	3	0
TOTAL	**6252**	**100**	**6252**	**100**	**6147**	**100**	**6128**	**100**

Vegetation types are subsequently described.

Water: River, stream, ponds, and divorced oxbows that are relatively un-vegetated. Previously, open water was mostly permanently or semi-permanently flooded aquatic habitat. In 2000 reach 2 (Figure 2-7) was dry, water was often too narrow to delineate in other incised reaches, and only 100 acres of water was delineated (Figure 2-9). The extent of water increased about 150 acres in 2009, but subsequently decreased about 100 acres in 2014 as marsh encroached into open water, most notably ponds in the Island area. In 2017 inflow to the LORP averaged 244 cfs in June and 184 cfs in July and water spreading was occurring both east and west of the LORP. The extent of open water more than tripled, at least briefly, in 2017 (Figure 2-10). The 2017 increase was most apparent in graded reaches were water overflowed both primary and secondary channels and spilled onto floodplains. It was less evident in aggraded reaches (Figure 2-11) where water spread under tules that continue to encroach into open water.

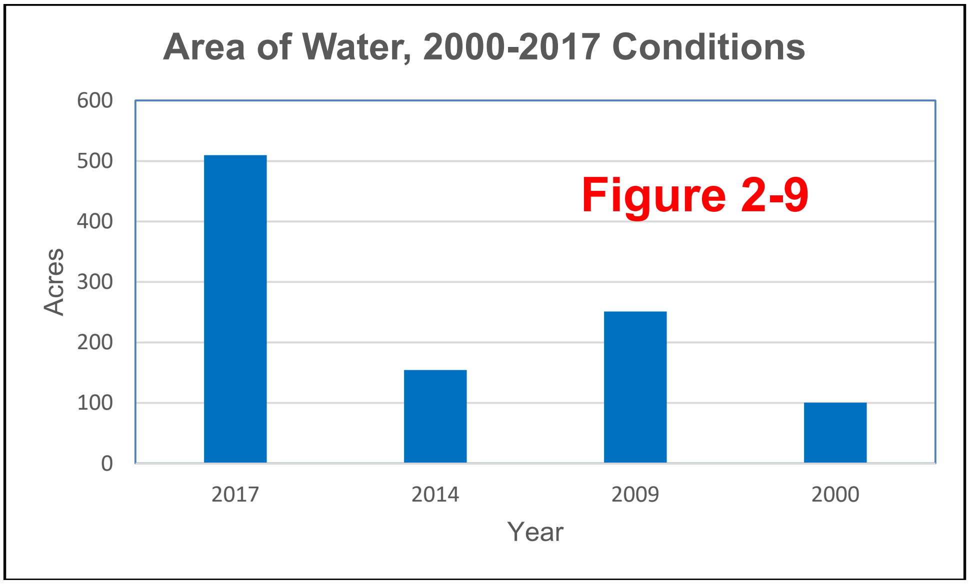
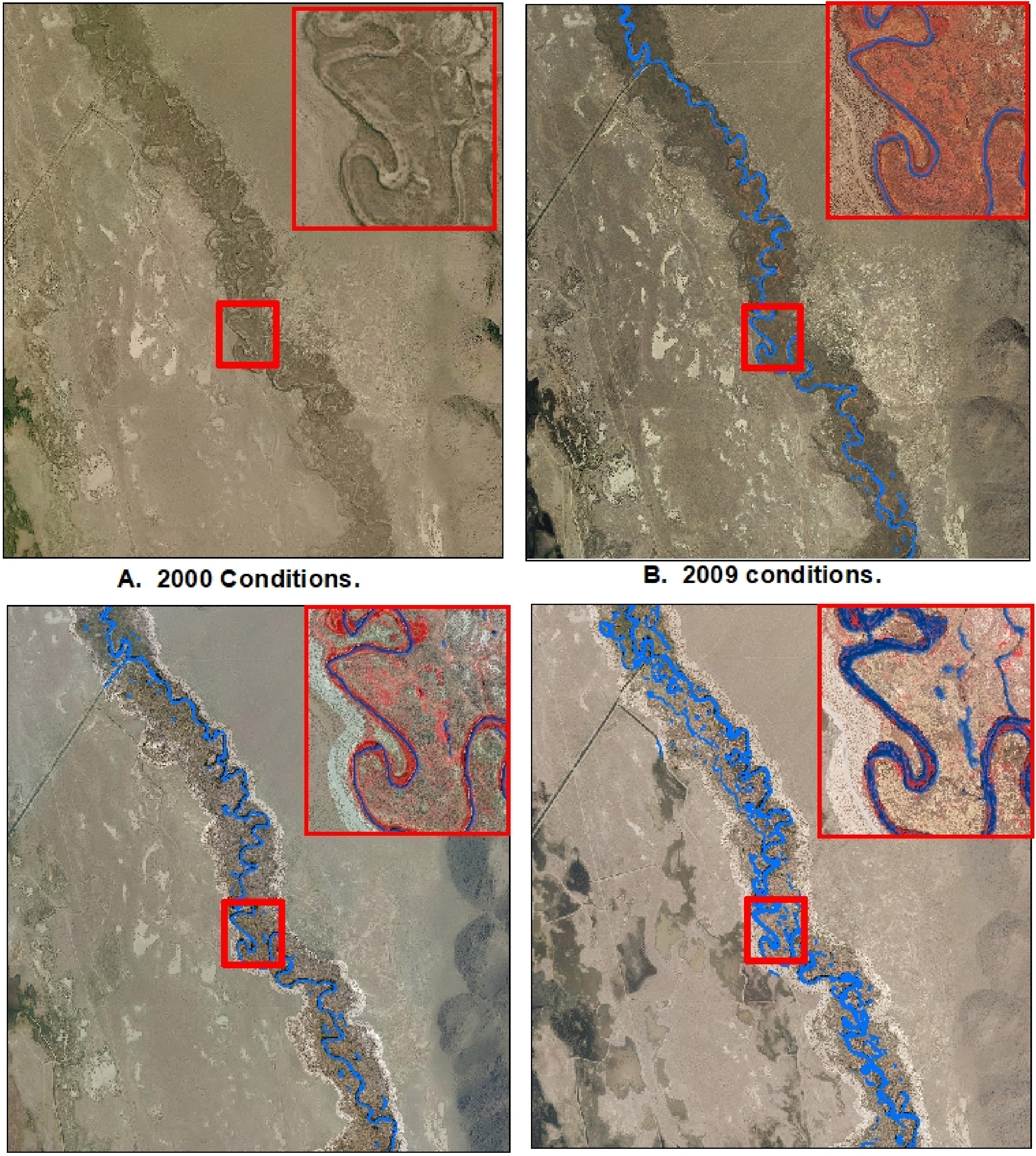


Figure 2-9

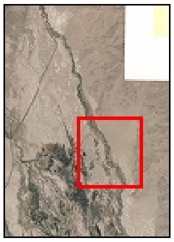


A. 2000 Conditions.

B. 2009 conditions.

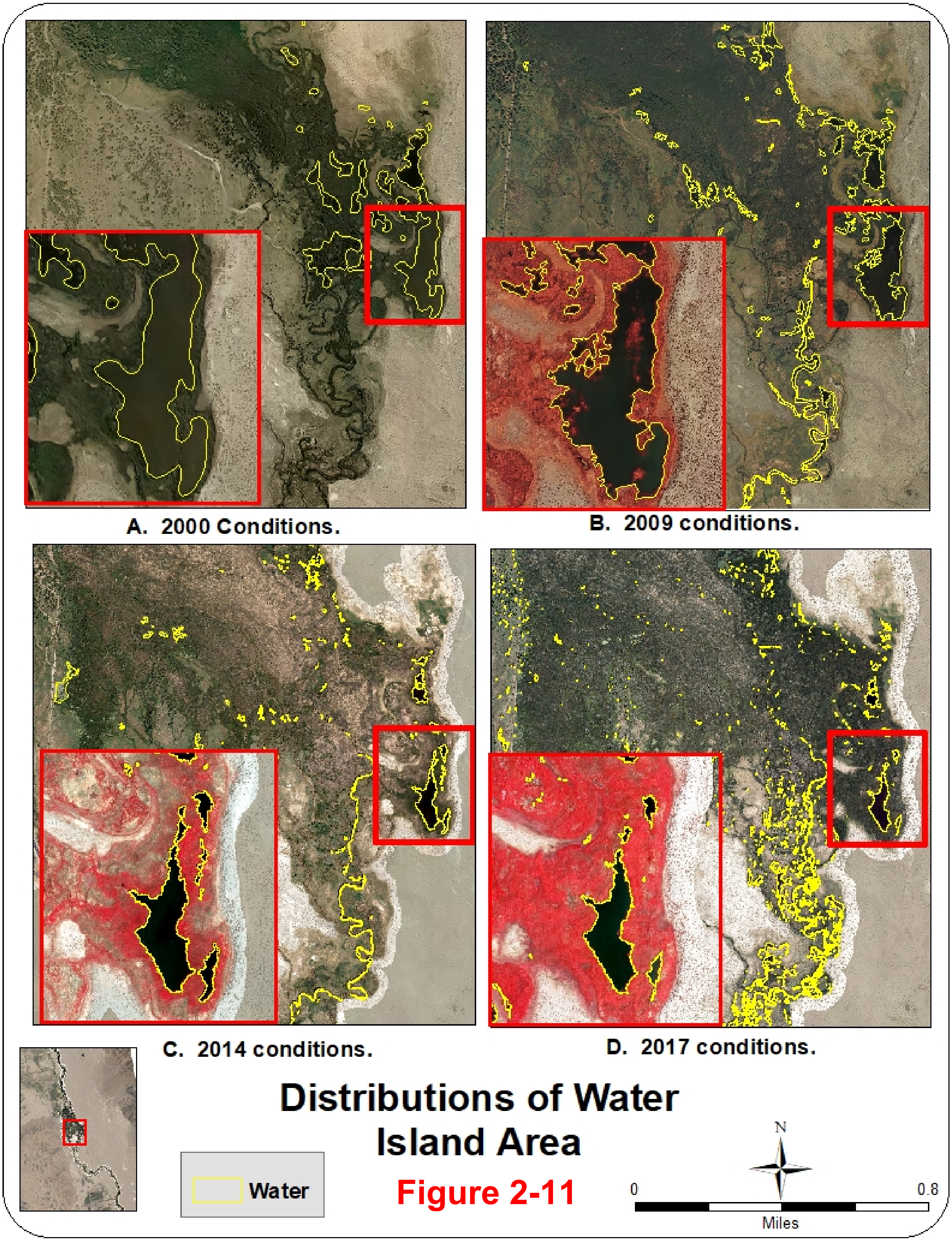
C. 2014 conditions.

D. 2017 conditions.



Distributions of Water
Reach 2

Figure 2-10



A. 2000 Conditions.

B. 2009 conditions.

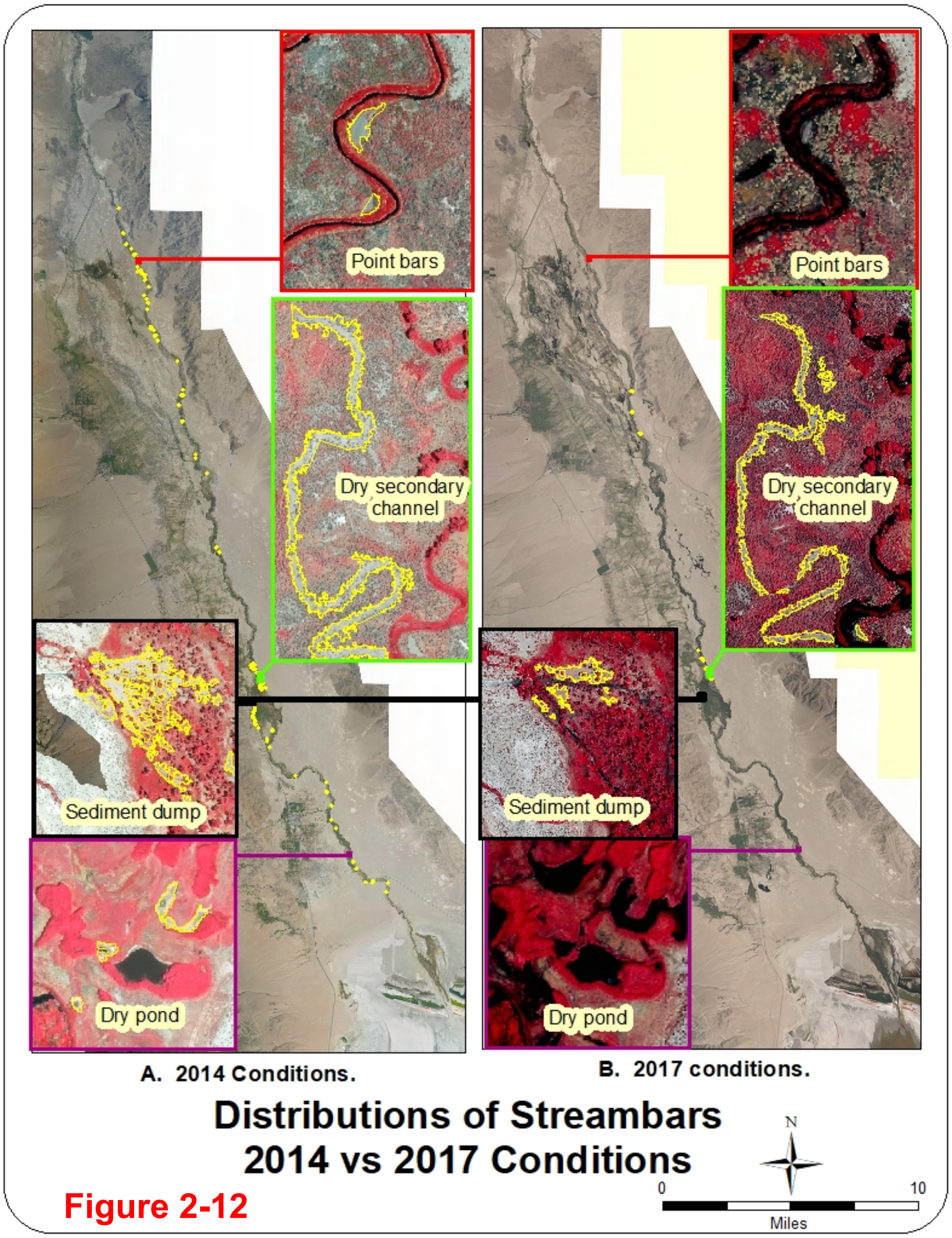
C. 2014 conditions.

D. 2017 conditions.

Distributions of Water Island Area

Figure 2-11

Streambar: In 2000, 23 acres of streambars included the bottom of a dry, incised river channel and dry secondary channels (Figure 2-12). In 2014, mapping of 23 acres of streambars included point bars, secondary channels, a large sediment deposit at the mouth of the Alabama Gates, and several dry ponds. Point bar deposits are sparsely vegetated, sandy habitats are suitable for willow colonization. Most of the new willow colonization in reach 2 occurred 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. In 2017, only 3 acres of streambar was identified as streambar vegetated or was inundated by high water.



Distributions of Streambars
2014 vs 2017 Conditions

Figure 2-12

Marsh: Occurs in the river channel of 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, to 1,434 acres in 2017 (Figure 2-13). 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 percent. Surfaces are typically semi-permanently flooded. The expansion of marsh is evident in the Island area (Figure 2-14). Inclusions of water and reed are common.

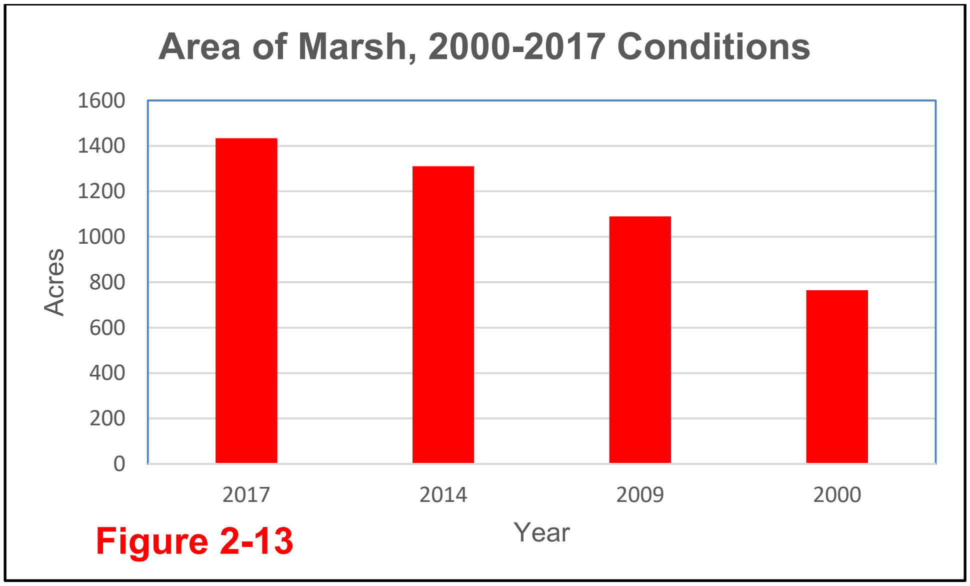
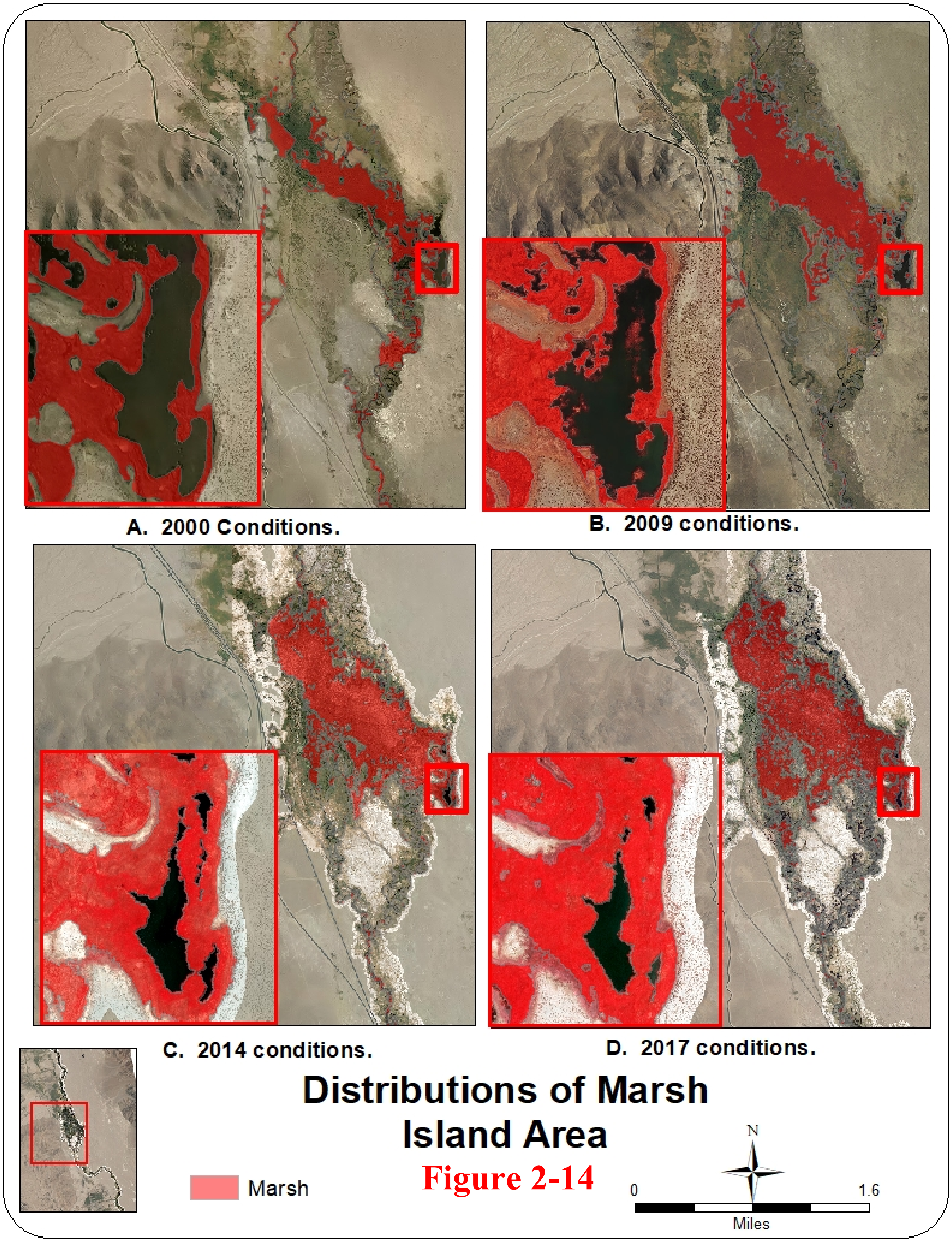


Figure 2-13



A. 2000 Conditions.

B. 2009 conditions.

C. 2014 conditions.

D. 2017 conditions.

Distributions of Marsh Island Area

Figure 2-14

Reed: This herbaceous vegetation type occurs in the channel and on floodplain with high water table (Figure 2-15). The extent of reed doubled from 24 acres in 2000 and 2009 to more than 50 acres in 2014 and 2017. It is typically associated with marsh. Reedgrass (*Phragmites australis*) forms a monoculture. Small patches of reed are included in marsh. Reed was difficult to distinguish spectrally or structurally from marsh and was mostly delineated "heads-up".

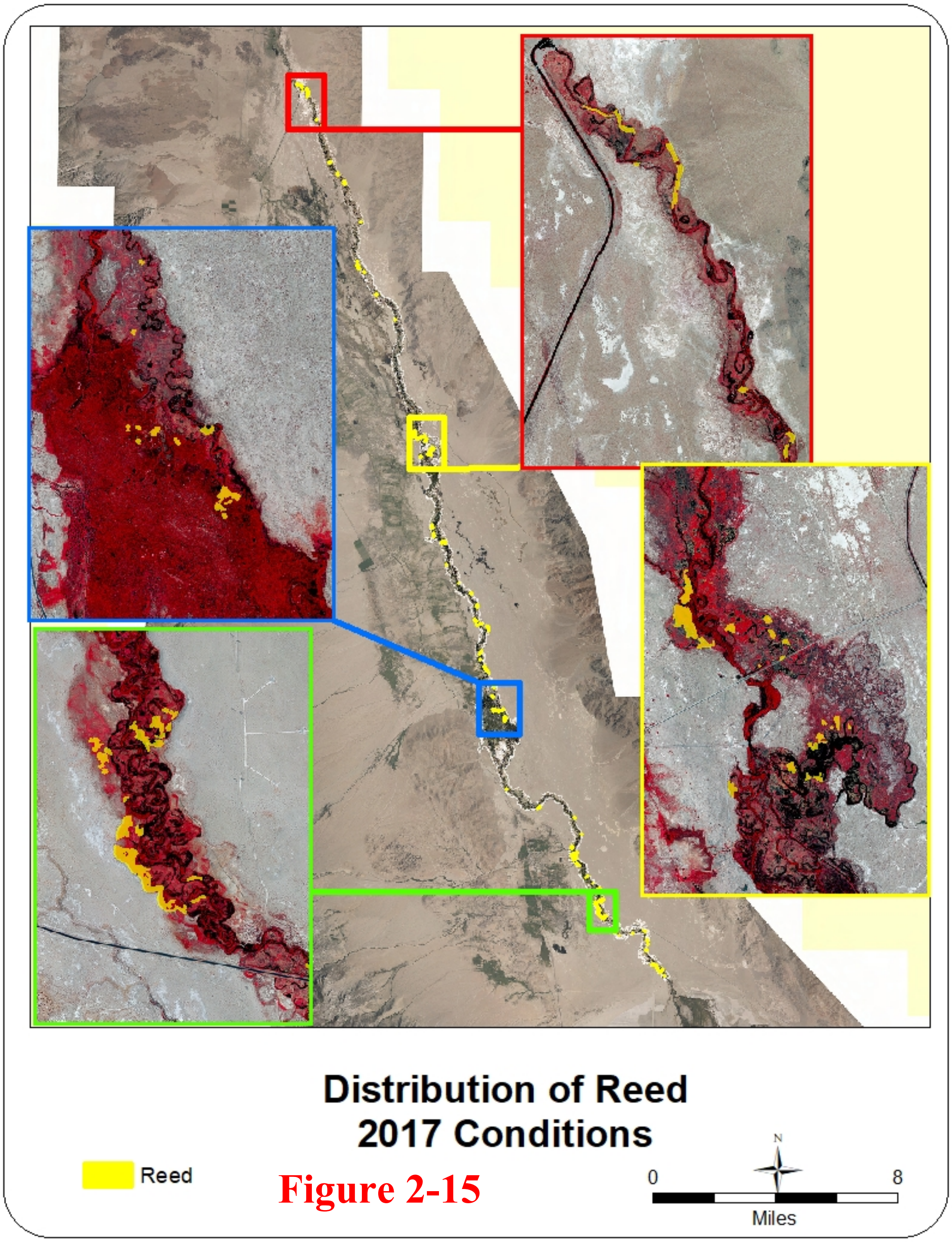
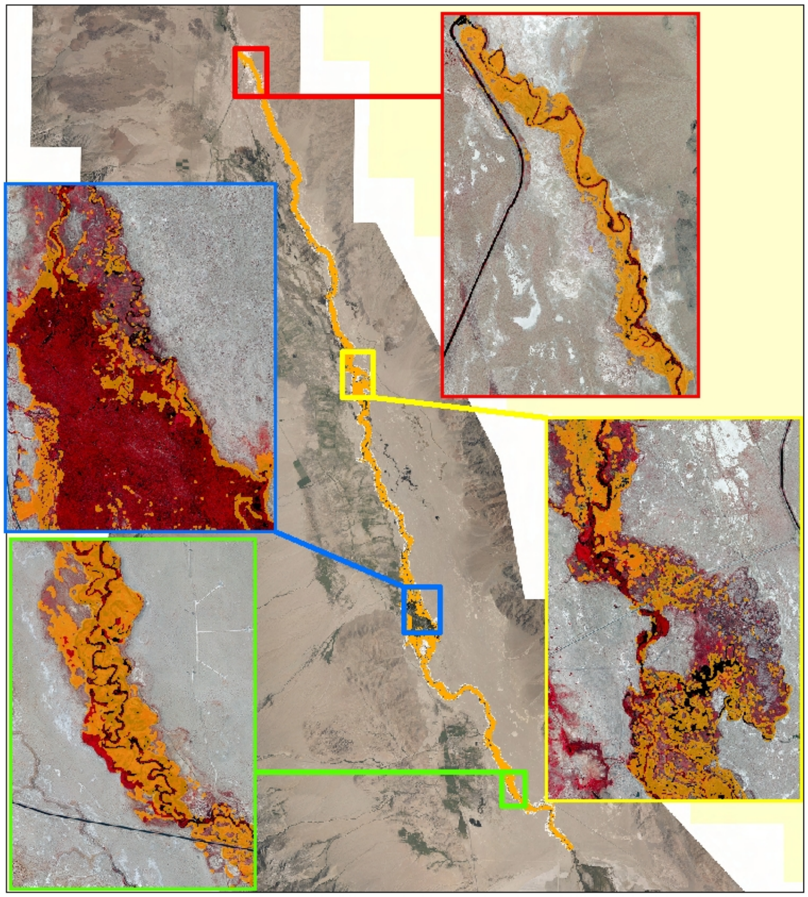


Figure 2-15

Wet meadow: This herbaceous vegetation type occurs on floodplains and in depressions on terraces with high water tables (Figure 2-16). 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 scrub/meadow to wet meadow. Total vegetative cover was typically greater than 75 percent.

Most of the 210 acres of wet meadow present in 2000 had converted to marsh in 2009. Wet meadow increased to 653 acres in 2014 and to 1,071 acres in 2017, mostly in response to burning of shrubs that became decadent in response to wetness. Also, about 116 acres of scrub meadow burned in the 2018 Moffat fire, leaving additional meadow and wet meadow not counted in the 2017 inventory.



Distribution of Wet Meadow
2017 Conditions

Figure 2-16

Meadow: This herbaceous vegetation type occurs mostly on the low terrace land type with low water table (Figure 2-17). Scrub/meadow and alkali meadow are broadly overlapping habitat. If you burn scrub/meadow[1], you get alkali meadow. Saltgrass (*Distichlis spicata*) is dominant; alkali sacaton (*Sporobolus airoides*) and Baltic rush (*Juncus balticus*) may also be present. Total herbaceous cover is typically greater than 50 percent.

Since 2009 there has been a net loss of more than 400 acres of meadow (Figure 2-18), but an increase of over 1,000 acres of wet meadow. In addition to the 1,690 acres present in 2017, about 116 acres of meadow and wet meadow was created when scrub/meadow burned in the 2018 Moffat fire.

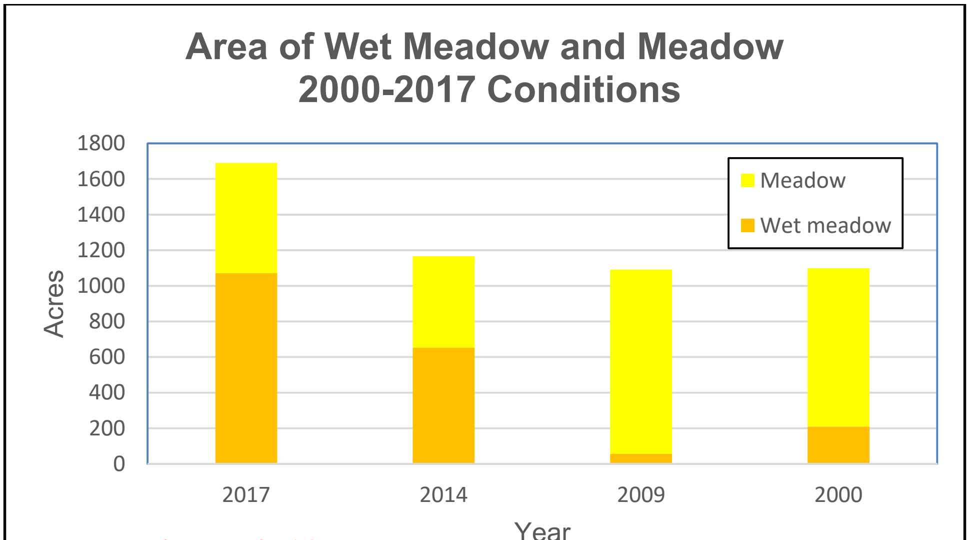


Figure 2-18

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[1] If scrub is decadent in response to wetness, burning leaves wet meadow.

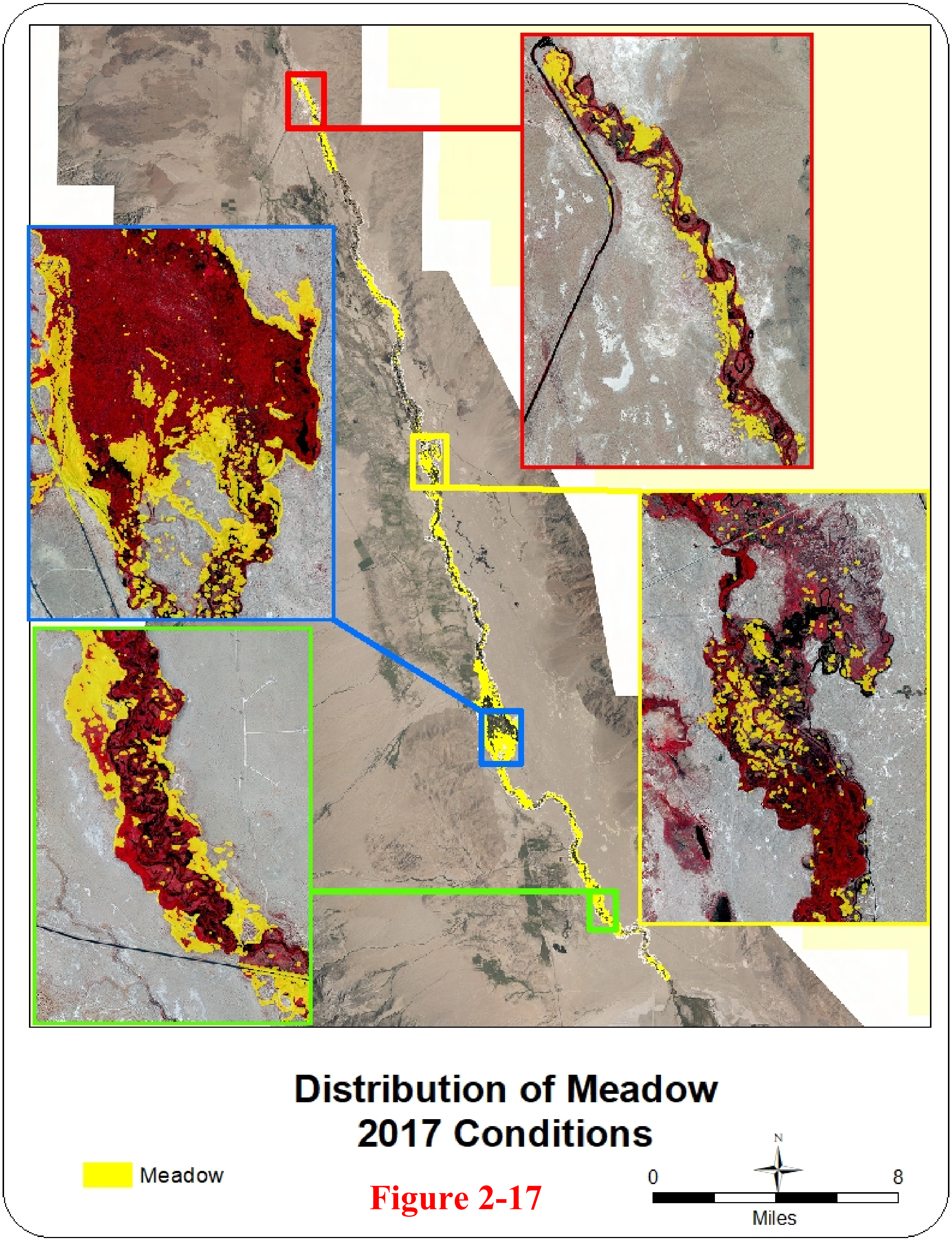
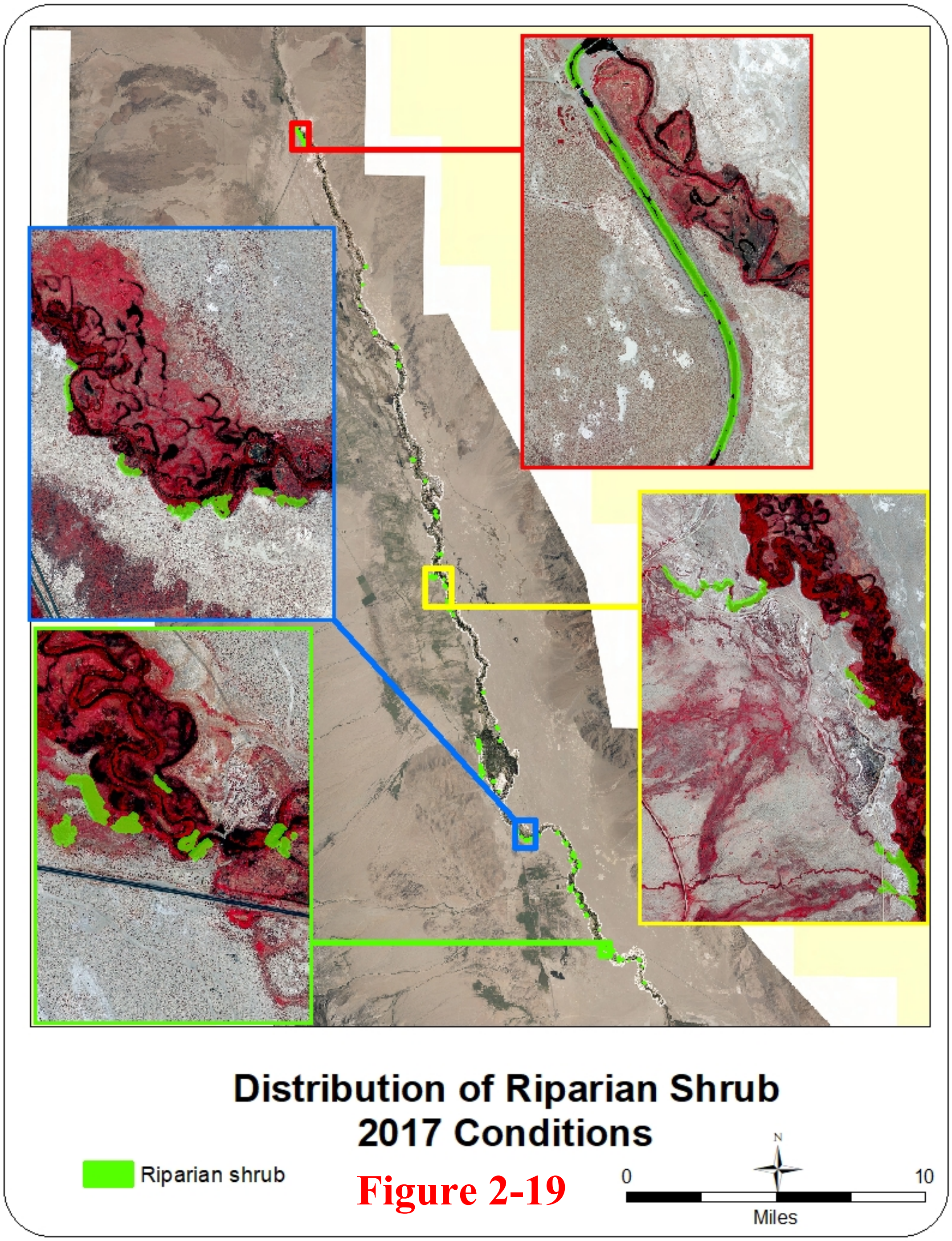


Figure 2-17

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 (Figure 2-19). 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 20 acres in 2000 and 2009, to 32 acres in 2014, and to 33 acres in 2017. New riparian shrub communities are also getting started on point streambars in reach 2.



Distribution of Riparian Shrub
2017 Conditions

Figure 2-19

Tree: This forested vegetation type occurs on all landtypes and 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, meadow, scrub/meadow or scrub. Once established, trees seem indifferent to drought and flooding and re-sprout after fire. Trees in the Island area have endured prolonged inundation while they are also common survivors in dry scrub habitat. Most of the trees burned in the Lone Pine fire (2013) have re-sprouted.

The mapped area of tree decreased from 449 acres in 2000, to 260 acres in 2009, and to 162 acres in 2014, probably in response to more precise mapping of tree canopy. A still more precise approach in 2017 identified 190 acres of trees (Figure 2-20) as a 2 meter buffer on LiDAR measures of vegetation height greater than 10 feet. The LiDAR mapping likely included dead and decadent trees. The Moffat fire in 2018 burned 36 acres of trees identified in 2017.

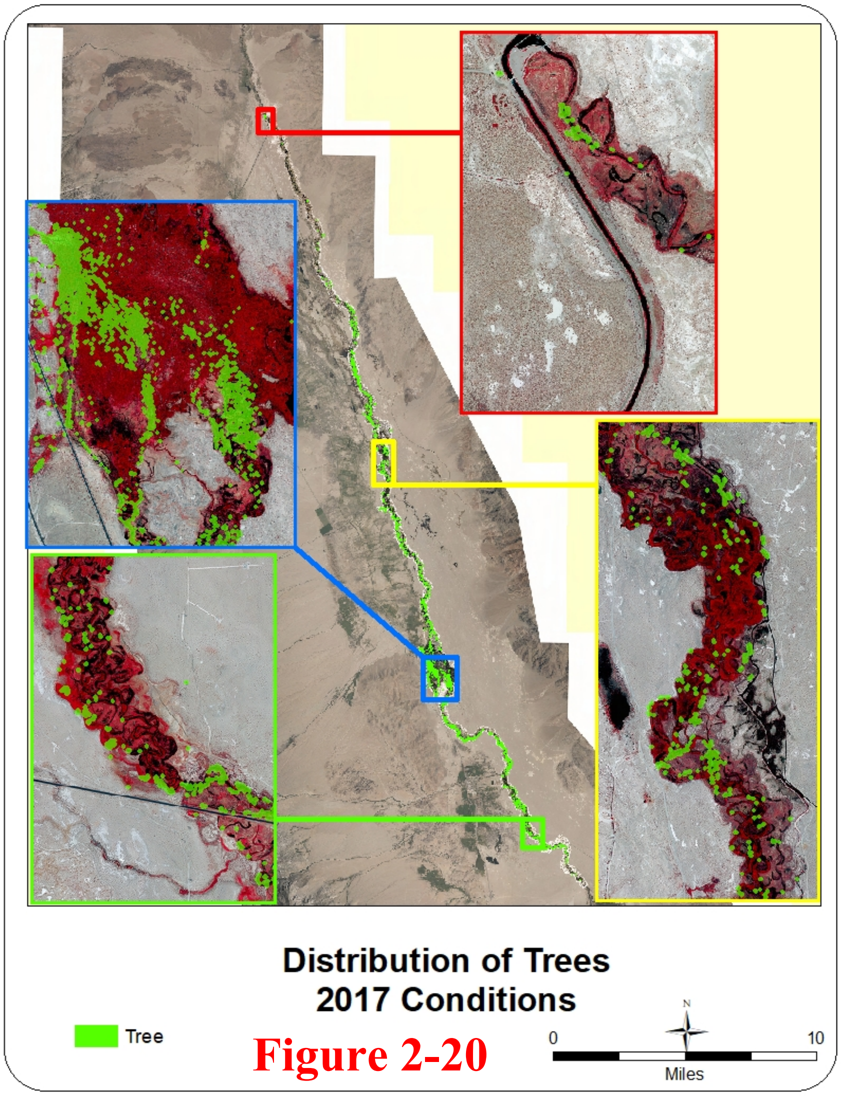


Figure 2-20

Scrub/meadow: This low scrub vegetation type occurs primarily on low terraces with low water table (Figure 2-21). Scrub/meadow and meadow are overlapping habitats. When you burn scrub/meadow you get meadow. Where the scrub is dead or decadent in response to wetness, burning may leave 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 percent. Saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), Torrey seepweed (*Sueda moquinii*), and creeping wildrye (*Leymus triticoides*) are prominent herbaceous plants; total herbaceous cover is typically greater than 50 percent. Inclusions of meadow with sparse scrub and inclusions of scrub with sparse understory are common and may comprise up to about 30 percent of some parcels.

Despite the extensive fires that converted scrub meadow to meadow and wet meadow, the extent of scrub/meadow has increased since 2000 (Figure 2-22). The increase of scrub/meadow is believed to be a response to rising water table on low terrace and conversion of scrub to scrub/meadow. About 116 acres of scrub/meadow identified in 2017 burned in the 2018 Moffat fire. Much of the remaining scrub in scrub/meadow is dead or decadent in response to wetness – another sign that the LORP is aggrading.

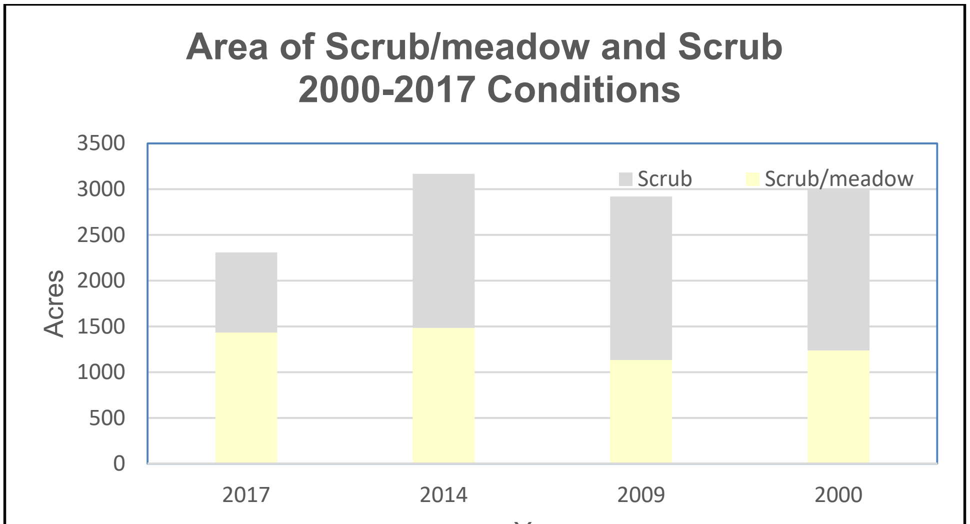
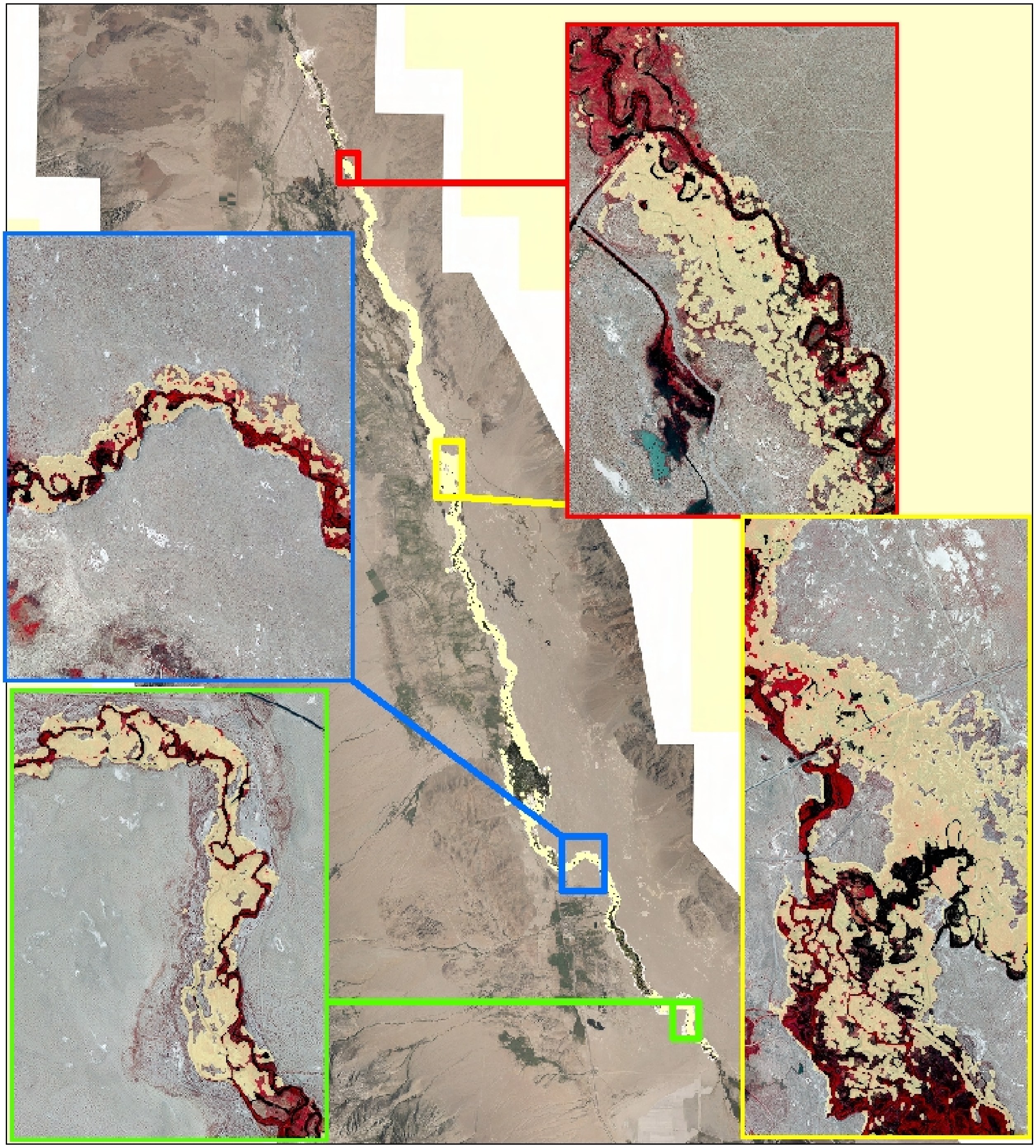


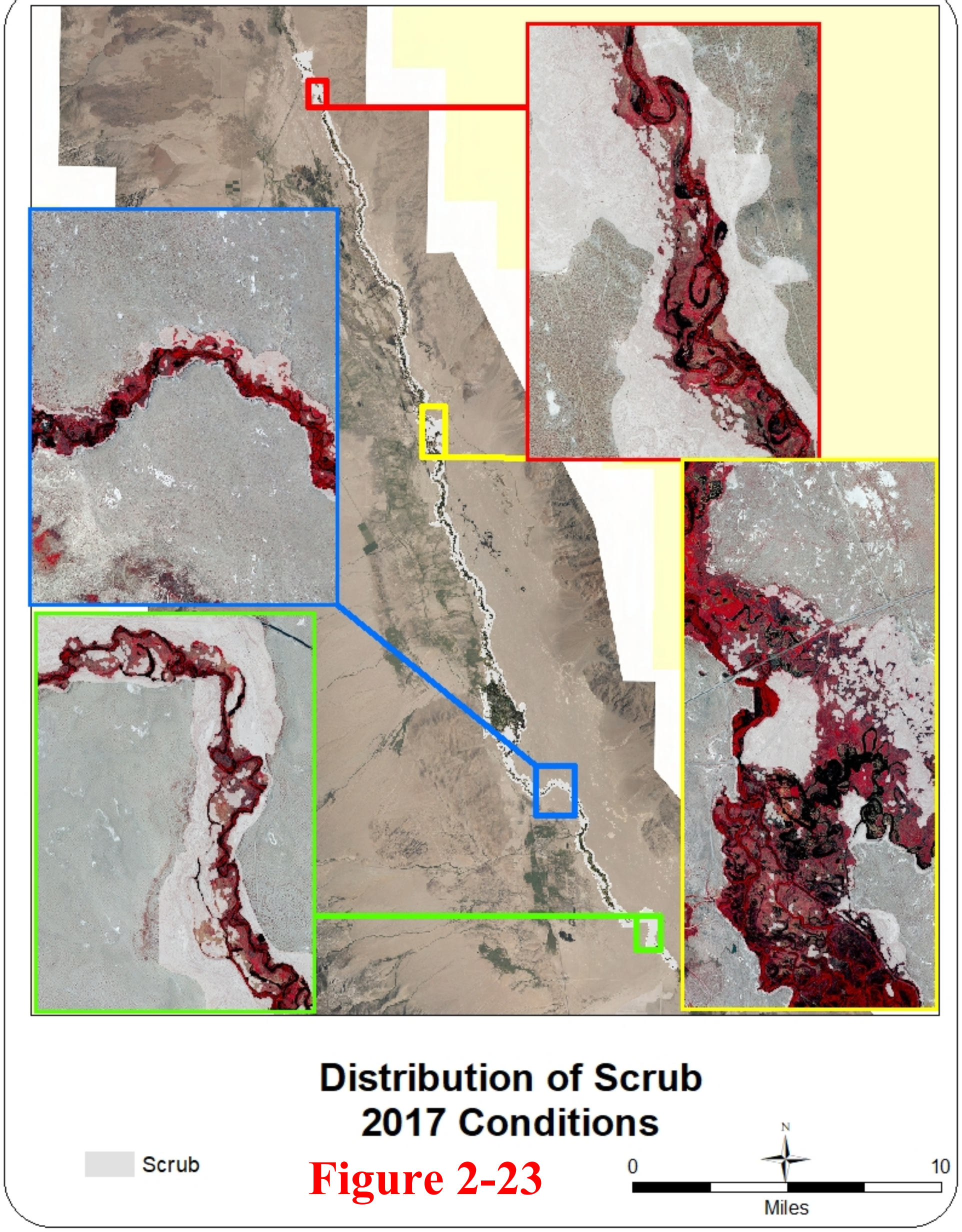
Figure 2-22



Distribution of Scrub/meadow
2017 Conditions

Figure 2-21

Scrub: Scrub consists of a thicket of Nevada saltbush (*Atriplex lentiformis* ssp. *torreyi*) and rubber rabbitbrush (*Ericameria nauseosus)* with sparse understory that occurs on terrace with very low water table, mostly along the flanks of the Owens River corridor (Figure 2-23). With channel aggradation and rise in alluvial groundwater table, scrub may change to scrub/meadow. Scrub cover is typically greater than 75 percent and understory is mostly absent. The extent of scrub was relatively consistent (about 1,775 acres) in 2000 and 2009, decreased only about a hundred acres in 2014, then decreased about 800 acres in 2017, most of which changed to scrub/meadow in response to channel aggradation and rising groundwater level[2].



Distribution of Scrub
2017 Conditions

Figure 2-23

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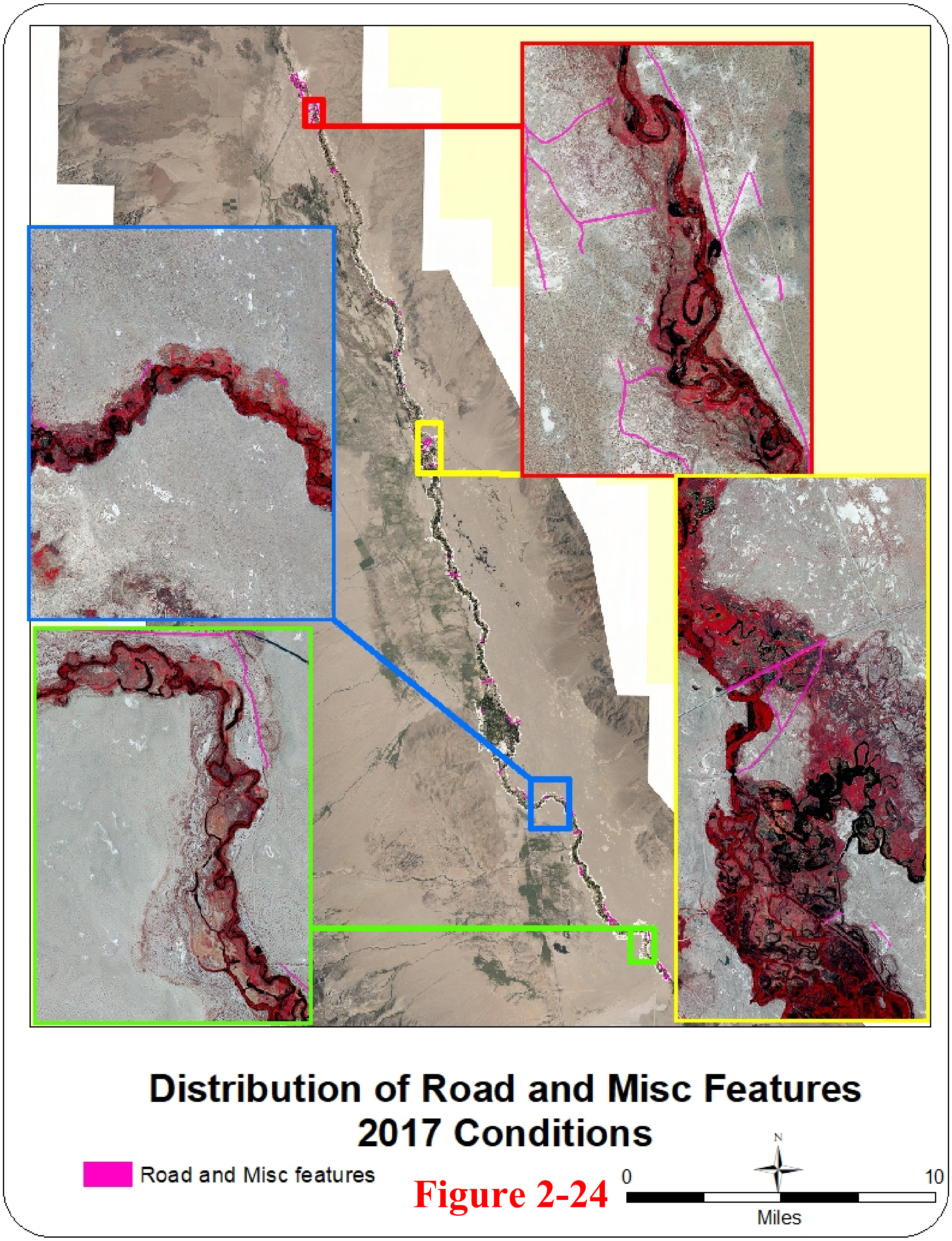
[2] It is possible that the very wet 2017 conditions caused some areas of scrub to be misidentified (e.g. scrub/meadow).

Roads and Miscellaneous Features: Road polygons were generated as a 16 feet wide buffer centered on an existing line file of roads (Figure 2-24). Roads comprise 31 acres of the LORP riparian area. Miscellaneous features include the LORP intake structures, streamflow measuring stations, spoil areas, and other structural features totaling less than an acre.



Distribution of Road and Misc Features
2017 Conditions

Figure 2-24

Inclusions of both similar and contrasting types occur in all map units. Similar inclusions (e.g. scrub/meadow and meadow; wet meadow and 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 scrub/meadow; riparian shrub and meadow) may comprise up to 15% of any one parcel, but a much smaller proportion of all parcels.

2.3 LORP Summary

For 2000 conditions, six reaches were identified based on channel morphology, hydrology, and degree of confinement (Figure 2-9). Changes in the distributions of states are primarily responsible for an increase in hydric vegetation. Since 2000, the length of incised channel has decreased about 40 miles; the length of graded condition has increased more than 32 miles; and aggraded condition has increased more than 7 miles. The LORP is clearly aggrading.

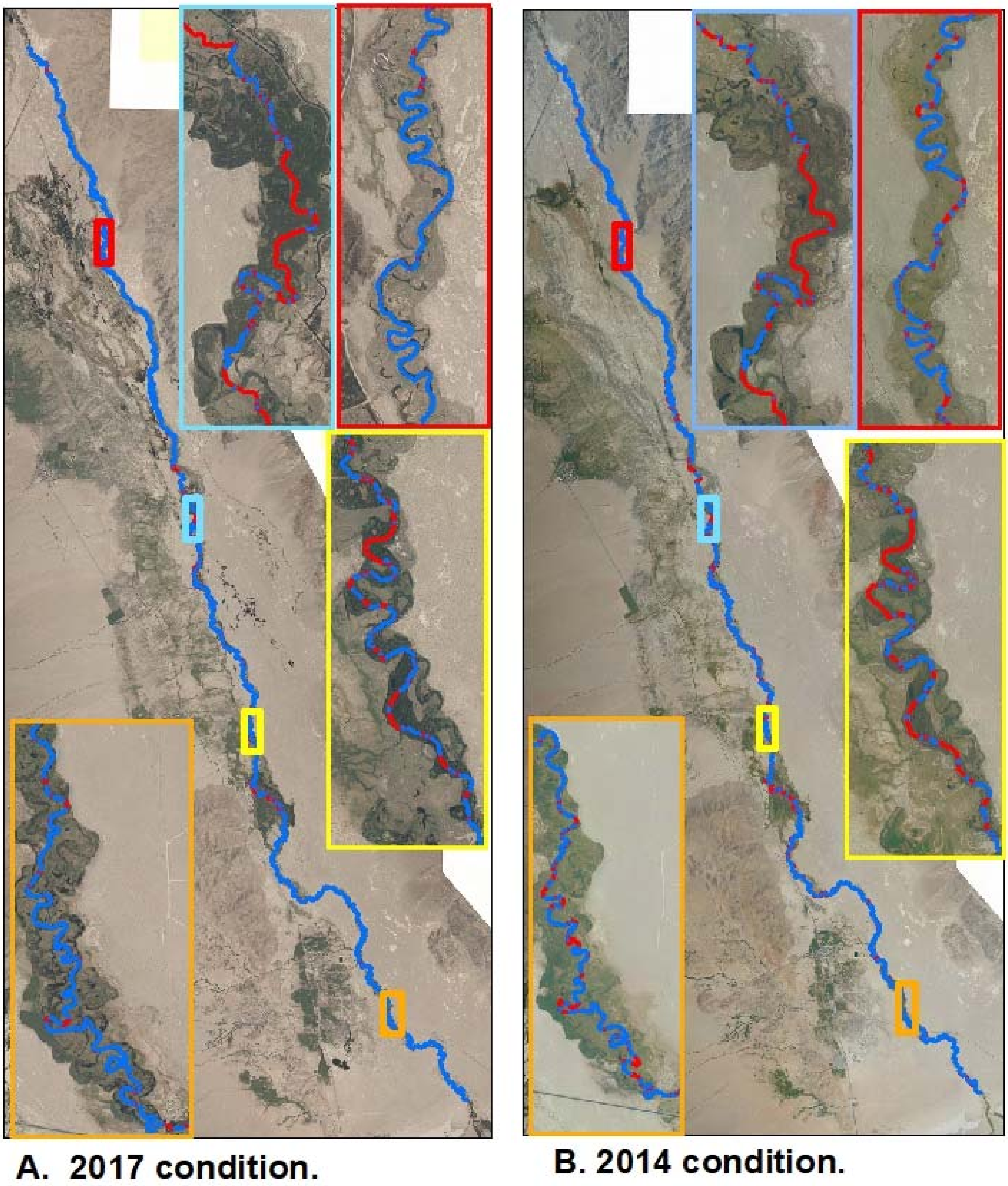
Hydric vegetation was predicted to increase 1,032 acres in response to the LORP (WHA 2004b). Short-term future conditions were predicted in response to two mechanisms: 1) changes to herbaceous strata in response to changes in state from establishment of base flow; and 2) changes to overstory in response to flooding from seasonal habitat flows. In practice, hydric herbaceous vegetation has increased 1,691 acres since 2000 in response to changes in state. The predicted increase in overstory canopy has not been realized, probably because of the very limited extent of barren substrate suitable for new willow colonization in the seasonally flooded zone[3].

In 2017 open water increased by about 3-fold in response to release approaching 250 cfs prior to the image window. The length of occluded channel decreased 11 miles and open channel increased the same amount (Figure 2-25). We remain uncertain as to the permanency of open channels. While most of the streambar identified in 2014 was inundated, it is likely that additional streambars were formed when the high 2017 flows receded, especially in Reach 2. Marsh and the combined area of wet meadow/meadow have continued to expand. The net area of scrub/meadow has remained relatively constant while the extent of scrub has decreased. Riparian shrub has not changed much since 2014. The difference in the area of trees is primarily in response to more precise mapping using LiDAR.

As predicted in 2014, “the remaining incised reach will become graded; the floodplain of graded reaches will become wetter; and aggraded reaches will continue to slowly expand”. Since 2014 about 10 miles of incised channel has become graded and there has been a net increase of 4 miles of aggraded condition. The river channel is expected to become more occluded and the extent of marsh will increase at the expense of open water. As the LORP continues to aggrade, its functional character becomes more like an elongated marsh and less like a riverine system. The exception is Reach 2 where deposition of channel substrate as streambars remains evident in a few areas.

---

[3] Tiny point bars along reach 2 are the exception; these relatively un-vegetated, sandy streambars supported willow seedlings that will likely become riparian shrub and/or tree vegetation; additional streambars may be exposed by recession of 2017 flooding.



Open verus Occluded River Channel

Figure 2-25

Condition	2014 Condition		2017 Condition	
	(mi)	(%)	(mi)	(%)
Occluded	29	49	18	31
Open	29	49	40	67
TOTAL	**59**	**100**	**59**	**100**

🟥 Occluded
🟦 Open

Alternative streamflow scenarios have been suggested for changing the direction of the LORP. Record flows of relatively long duration in 2017 will be a good test of whether more open channel conditions will be maintained with the return of more normal flows. In the past, seasonal habitat flows of somewhat lower magnitude and duration have 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 (Figure 2-26). Alternative streamflow scenarios may not be effective in changing the direction of the LORP.

Figure 2-26. Inset marsh occluding LA Aqueduct in response to reduced flow.

3.0 DELTA HABITAT AREA (DHA) VEGETATION MAPPING

As specified in the LORP-FEIR:

> Prior to implementation of LORP, the water and vegetated wetlands in the Delta Habitat Area will be mapped from aerial photographs … This map will serve as the description of the "Delta conditions". The aerial photographs that will be used to develop the "Delta conditions" map (as well as those to be used in future monitoring) will be taken between June and September.

Baseline condition for the Delta Habitat Area (DHA) was mapped from a 2005 Ikonos image. Conditions were again mapped in 2009 and 2012.

Average monthly discharge to the DHA in July 2017 (Figure 3-1) was 100 cfs, ten times the average July discharge from 2007-2016. On the dates of imagery (July 28 – August 2), discharge ranged from 71 to 53 cfs. Mapping of the DHA is likely biased towards more hydric classes.

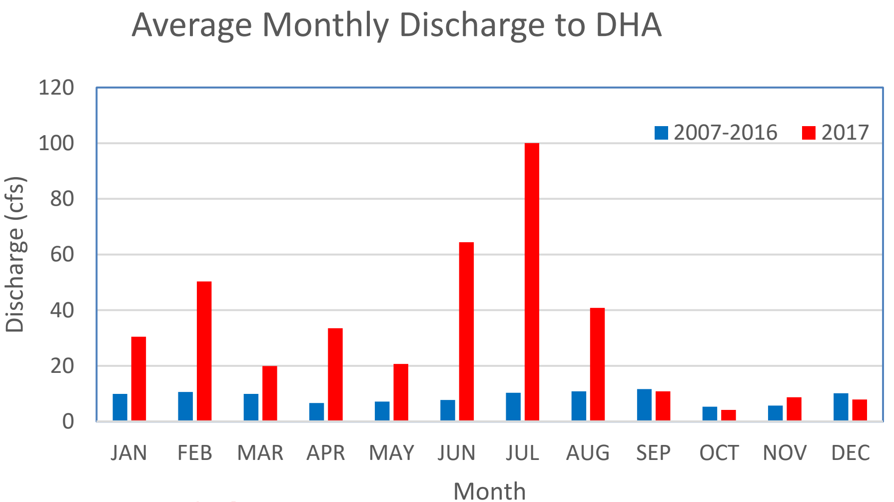


Figure 3-1

3.1 DHA Approach

Successive spectral classification, LiDAR analyses, and heads-up editing similar to that described for the LORP inventory was used to map 2017 conditions of the DHA. Results were compared with inventories of 2000, 2005, 2009, and 2012 conditions.

3.2 DHA Results

Results of the 2017 inventory of the DHA are depicted in Figure 3-2. Map units are correlated in Table 3-1. The expansion of prominent hydric vegetation types is evident from 2005 through 2017 conditions (Figure 3-3). Large-scale (1:5,000) maps of 2017 conditions are compiled as APPENDIX C. Large-scale comparisons of 2005, 2009, 2012 and 2017 conditions are presented in APPENDIX D.

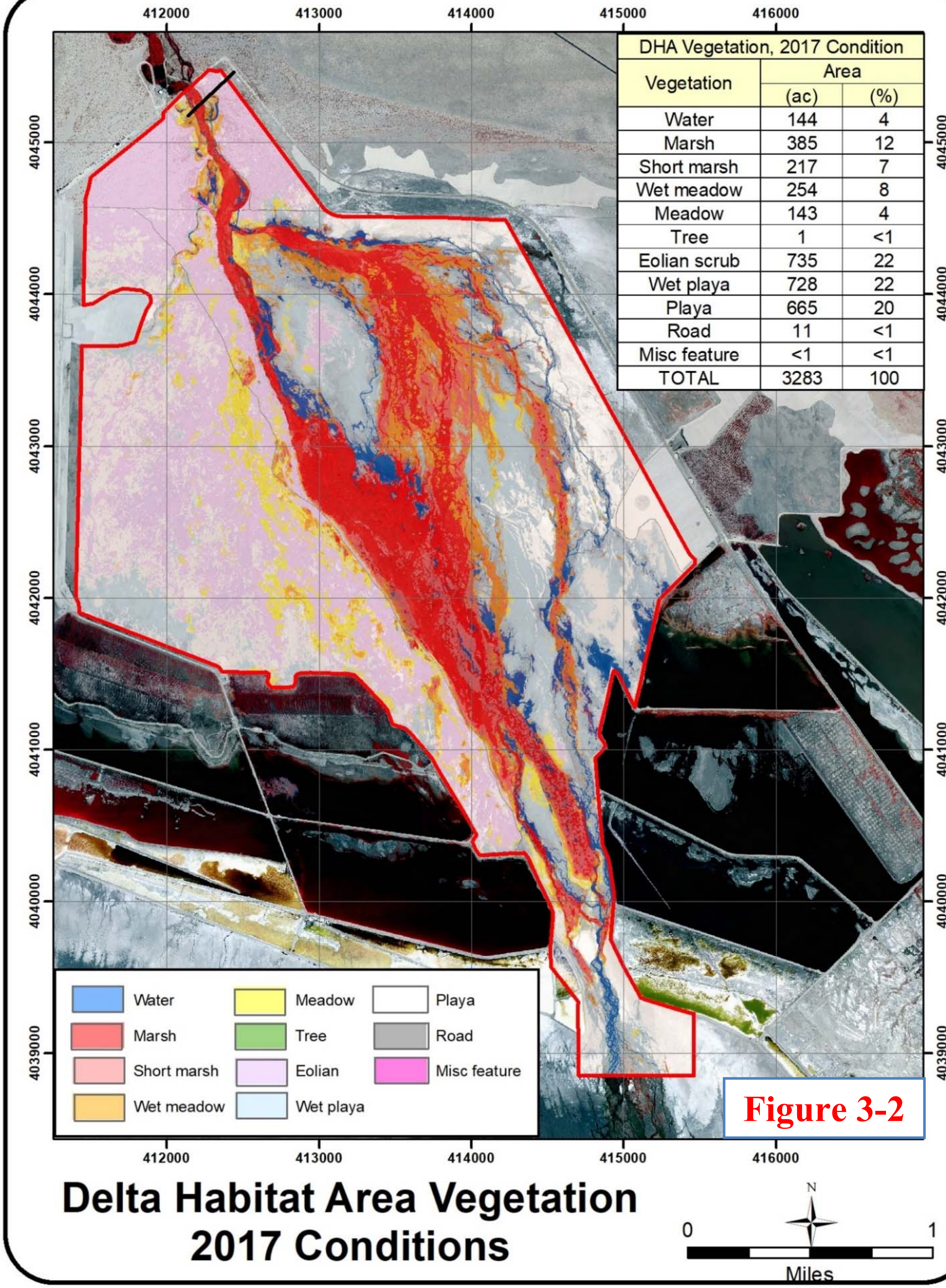
With a few exceptions, vegetation types are similar to those described for the LORP area. Vegetation types specific to the DHA are:

Short marsh: Typically occurs along the expanding front of marsh and appears to be a successional stage towards (tall) marsh. Prominent species include prairie rush (*Schoenoplectus maritimus*), chairmakers bulrush (*Schoenoplectus americanus*), and spikerush (*Eleocharis spp*.). It was distinguished from (tall) marsh using LiDAR measures of average height less than a foot.

Eolian scrub: Wind deposited sand, typically with sparse vegetation. Vegetation on broad shallow deposits typically include Parry saltbush (*Atriplex parryi*) and bush seepweed (*Suaeda moquinii*); dunes may support greasewood (*Sarcobatus vermiculatus*). Very shallow deposits with sparse saltgrass vegetation were included with meadow.

Playa: Unvegetated lake deposit. Wet playa and (dry) playa were distinguished, for no reason other than I could.

The area of open water (144 acres) was about 16 times the area of water in 2012. Discharge to the DHA approached 60 cfs on the date of imagery and exceeded 100 cfs a month previous. The area of hydric vegetation increased 76 acres since 2012, 152 acres since 2009, and 359 acres since 2005 (baseline). The extremely wet conditions likely biased mapping towards more hydric vegetation (e.g. meadow appeared as wet meadow, wet meadow as short marsh).

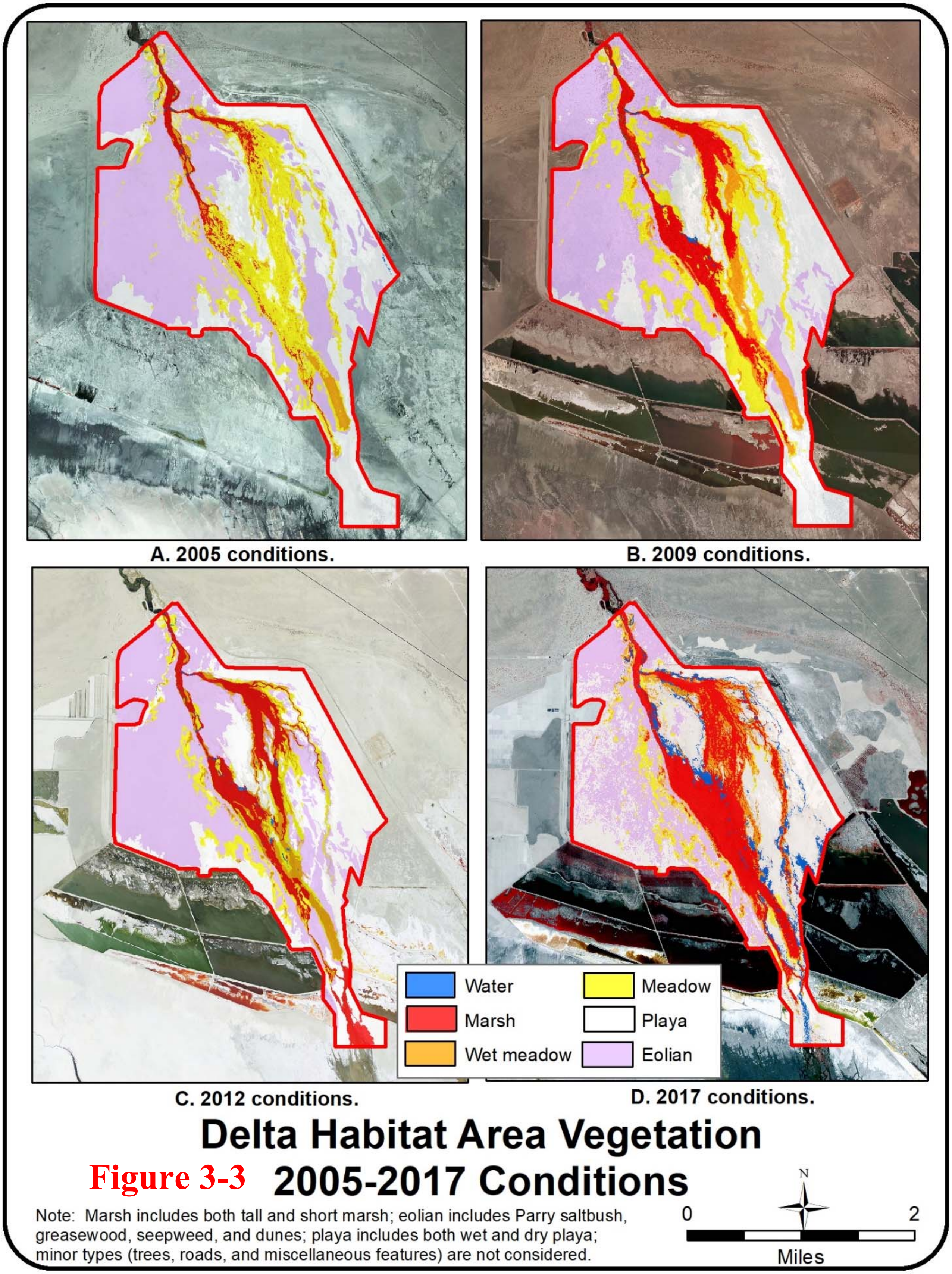


DHA Vegetation, 2017 Condition

Vegetation	Area	
	(ac)	(%)
Water	144	4
Marsh	385	12
Short marsh	217	7
Wet meadow	254	8
Meadow	143	4
Tree	1	<1
Eolian scrub	735	22
Wet playa	728	22
Playa	665	20
Road	11	<1
Misc feature	<1	<1
TOTAL	3283	100

Figure 3-2

Delta Habitat Area Vegetation 2017 Conditions



A. 2005 conditions.

B. 2009 conditions.

C. 2012 conditions.

D. 2017 conditions.

Figure 3-3 **Delta Habitat Area Vegetation 2005-2017 Conditions**

Note: Marsh includes both tall and short marsh; eolian includes Parry saltbush, greasewood, seepweed, and dunes; playa includes both wet and dry playa; minor types (trees, roads, and miscellaneous features) are not considered.

Table 3-1. DHA map unit correlation

2017 Condition		2012 Condition		2009 Condition		2005 Condition		2000 Condition	
Class	(ac)	Class	(ac)	Class	(ac)	Class	(ac)	Class	(ac)
Water	144	Water	9	Water	5	Water	4	Water	7
Marsh	385	Alkali marsh	314	Bulrush-cattail	303	Bulrush-cattail	98	Bulrush-cattail	192
Short marsh	217	Short marsh	51						
Wet meadow	254	Wet alkali meadow	194	Saltgrass-rush	156	Saltgrass-rush	113	Wet alkali meadow	388
Meadow	143	Alkali meadow	282	Saltgrass	523	Saltgrass	570	Saltgrass	245
		Eolian DISP	215						
Tree	1	Riparian forest	2	Goodding-red willow	4	--	--	Gooding-red willow	18
Subtotal	**1144**	**Subtotal**	**1068**	**Subtotal**	**992**	**Subtotal**	**785**	**Subtotal**	**851**
Scrub/meadow	0	Scrub/meadow	3	Scrub/meadow	6	Scrub/meadow	56	Scrub/meadow	8
Eolian	735	Eolian	178	Parry saltbush	1087	Eolian complex	1398	Parry saltbush-seepweed	1190
		Eolian scrub	897	Seepweed	31				
		Eolian SAVE	129	Greasewood	17			Dune	50
Wet playa	728	Wet playa	123			Playa	1039	Playa	1180
Playa	665	Playa	870	Playa	1151				
Road	11	--	--	--	--	--	--	--	--
Not mapped	0	Not mapped	16	Not mapped	0	Not mapped	5	Not mapped	5
TOTAL	**3283**	**TOTAL**	**3283**	**TOTAL**	**3283**	**TOTAL**	**3283**	**TOTAL**	**3283**

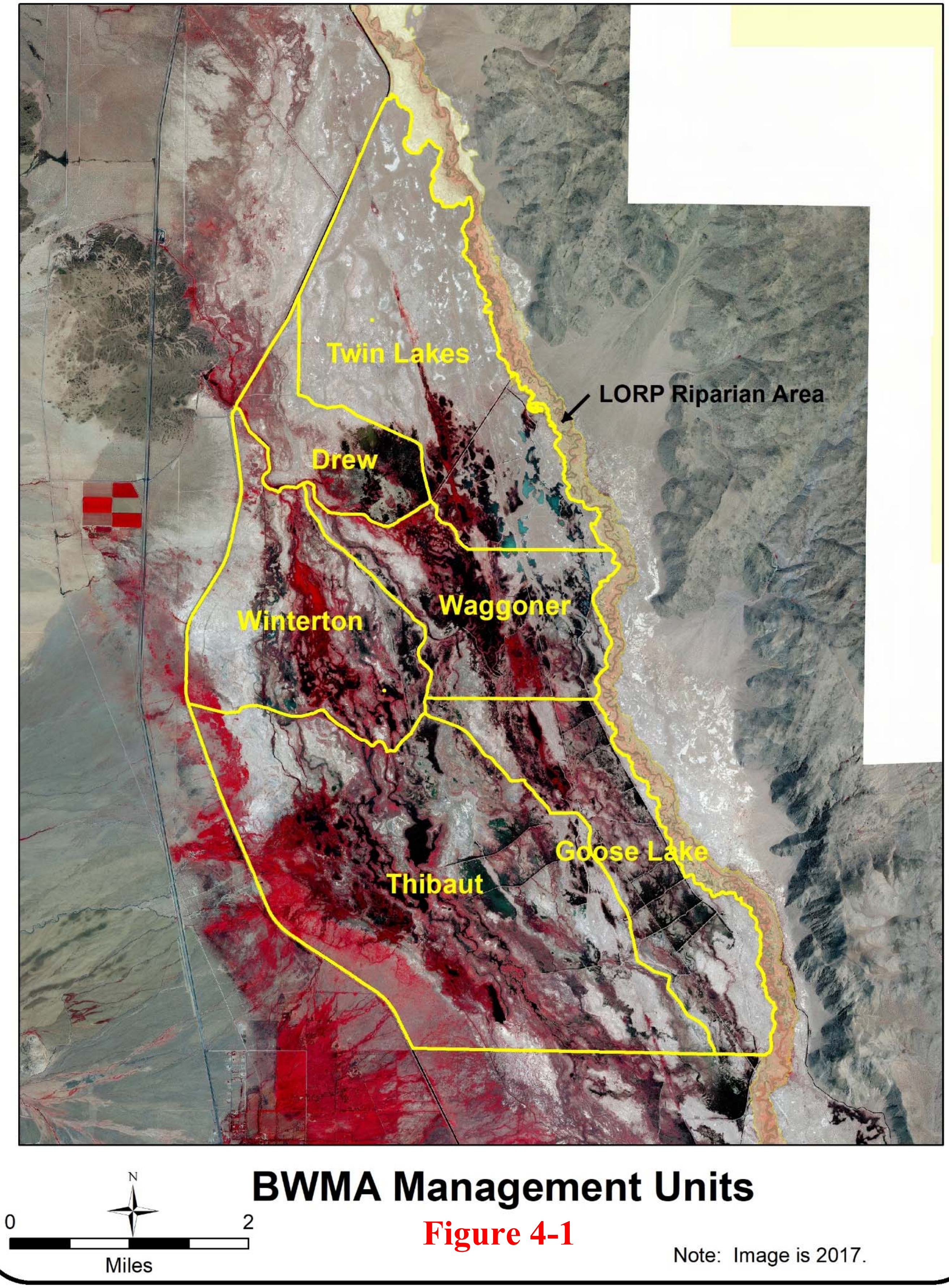
4.0 BWMA VEGETATION MAPPING

The BWMA consists of the Drew, Waggoner, Winterton, and Thibaut management units (Figure 4-1; Table 4-1). 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 2017 conditions includes only the Drew management unit.

Table 4-1. 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**

Seasonal hydrologic management of Drew, Thibaut, Waggoner and Winterton management units are illustrated in Table 4-2. The Drew unit was dry 2015-2016 and was flooded by water spreading in spring and summer 2017.



BWMA Management Units

Figure 4-1

Note: Image is 2017.

Table 4-2. Periods BWMA management units were actively flooded.

Unit	2007			2008				2009				2010				2011				2012				2013				2014				2015				2016				2017			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Drew								🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦									🟥	🟥		
Thibaut	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦																					🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦
Waggoner								🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦																									🟥	🟥		
Winterton	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦							🟦	🟦	🟦	🟦													🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦	🟦

🟦 = Flooded 🟥 = Additional water spreading

4.1 BWMA Approach

The approach to mapping the BWMA was nearly identical to that of the LORP riparian area. Successive spectral analyses and heads-up editing were applied. LiDAR was not available.

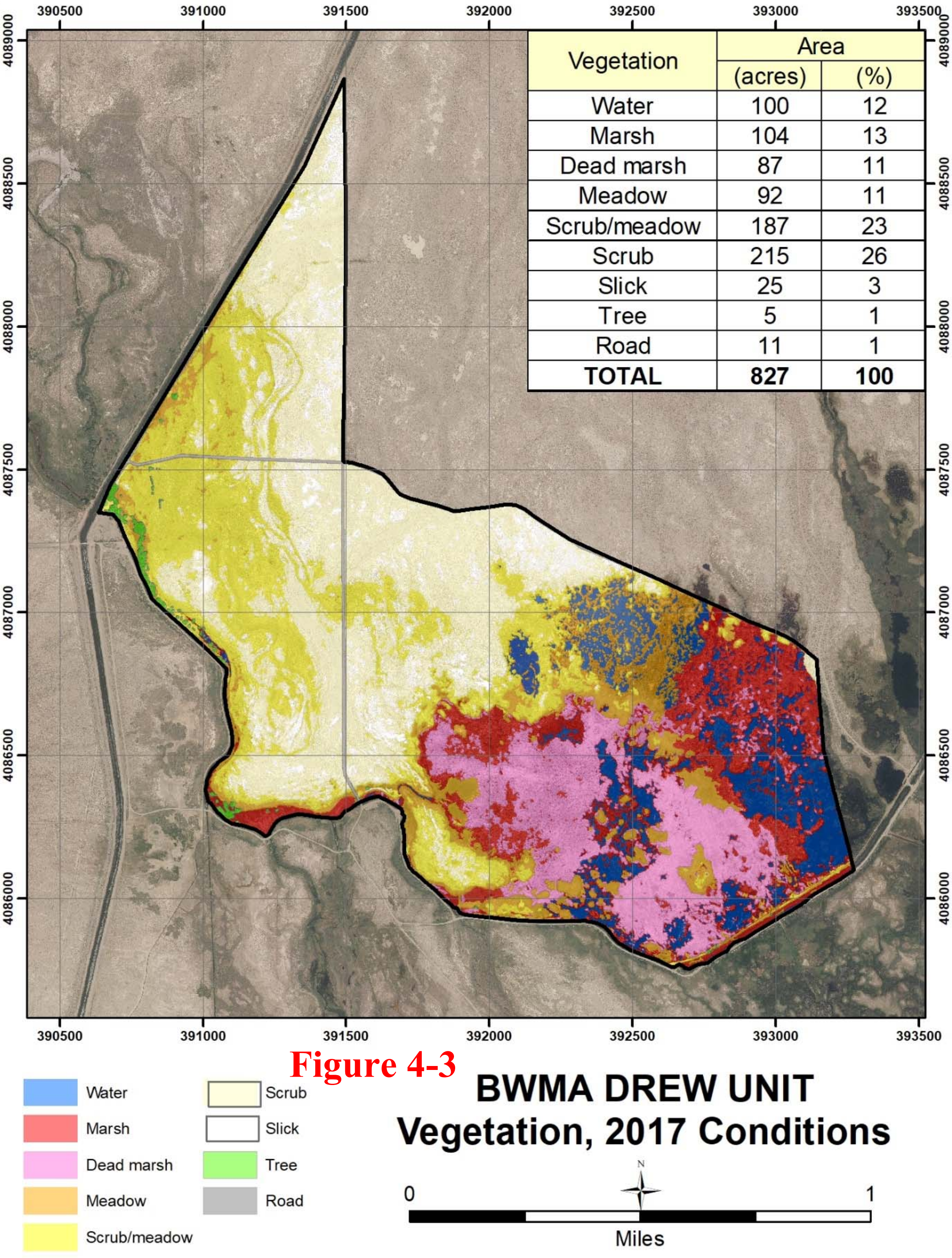
4.2 BWMA Results

Vegetation types for 2017 conditions are presented as Figure 4-3. Vegetation types identified for 2000, 2009, 2014, and 2017 conditions of Drew Slough are listed in Table 4-3 and illustrated in Figure 4-4.

Table 4-3. Distributions of vegetation types, Drew unit, 2000-2017.

Type	2017		2014		2009		2000	
	(acres)	(%)	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	100	12	78	9	143	17	0	9
Marsh	191	23	200	20	103	12	23	20
Meadow	92	11	50	6	5	1	57	6
Tree	5	1	6	1	9	1	9	1
Hydric subtotal	**388**	**47**	**334**	**35**	**260**	**31**	**90**	**35**
Scrub/meadow	187	23	162	20	217	26	71	20
Scrub	216	26	288	22	346	42	578	22
Slick	25	3	27	3	1	0	87	3
Road	11	1	15	2	2	0	1	2
TOTAL	**827**	**100**	**826**	**100**	**827**	**100**	**827**	**82**

The distribution of vegetation in the Drew unit reflects two years of drying followed by water spreading in spring and early summer 2017. Open water covered several areas not previously flooded. About half of the marsh was dead in 2017. The area of hydric vegetation increased 54 acres since 2014, 128 acres since 2009 and 298 acres since 2000. Mapping is likely somewhat biased by the wet conditions resulting from water spreading.

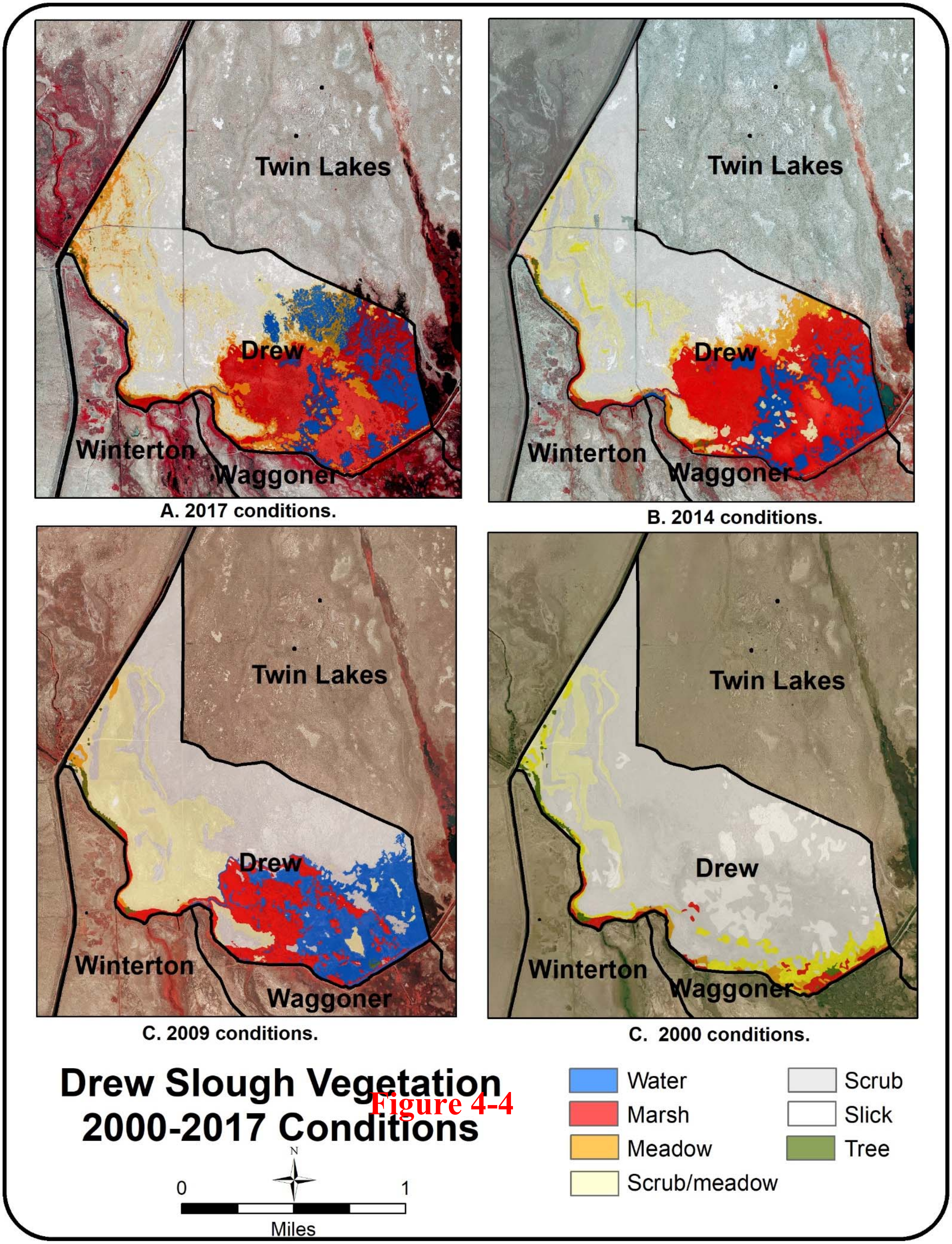


Vegetation	Area	
	(acres)	(%)
Water	100	12
Marsh	104	13
Dead marsh	87	11
Meadow	92	11
Scrub/meadow	187	23
Scrub	215	26
Slick	25	3
Tree	5	1
Road	11	1
TOTAL	**827**	**100**

Figure 4-3

BWMA DREW UNIT
Vegetation, 2017 Conditions

Note: Image dated late July - early August 2017 and reflects water spreading in Drew Unit.



Drew Slough Vegetation 2000-2017 Conditions

Figure 4-4

5.0 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.

APPENDIX A
LORP VEGETATION TYPE MAPS
2017 CONDITIONS
1:5,000 SCALE

APPENDIX B
LORP VEGETATION TYPE MAPS
2000, 2009, 2014, AND 2017 CONDITIONS

APPENDIX C
DHA VEGETATION TYPE MAPS
2017 CONDITIONS
1:5,000 SCALE

APPENDIX D
DHA VEGETATION MAPS
2005-2017 CONDITIONS

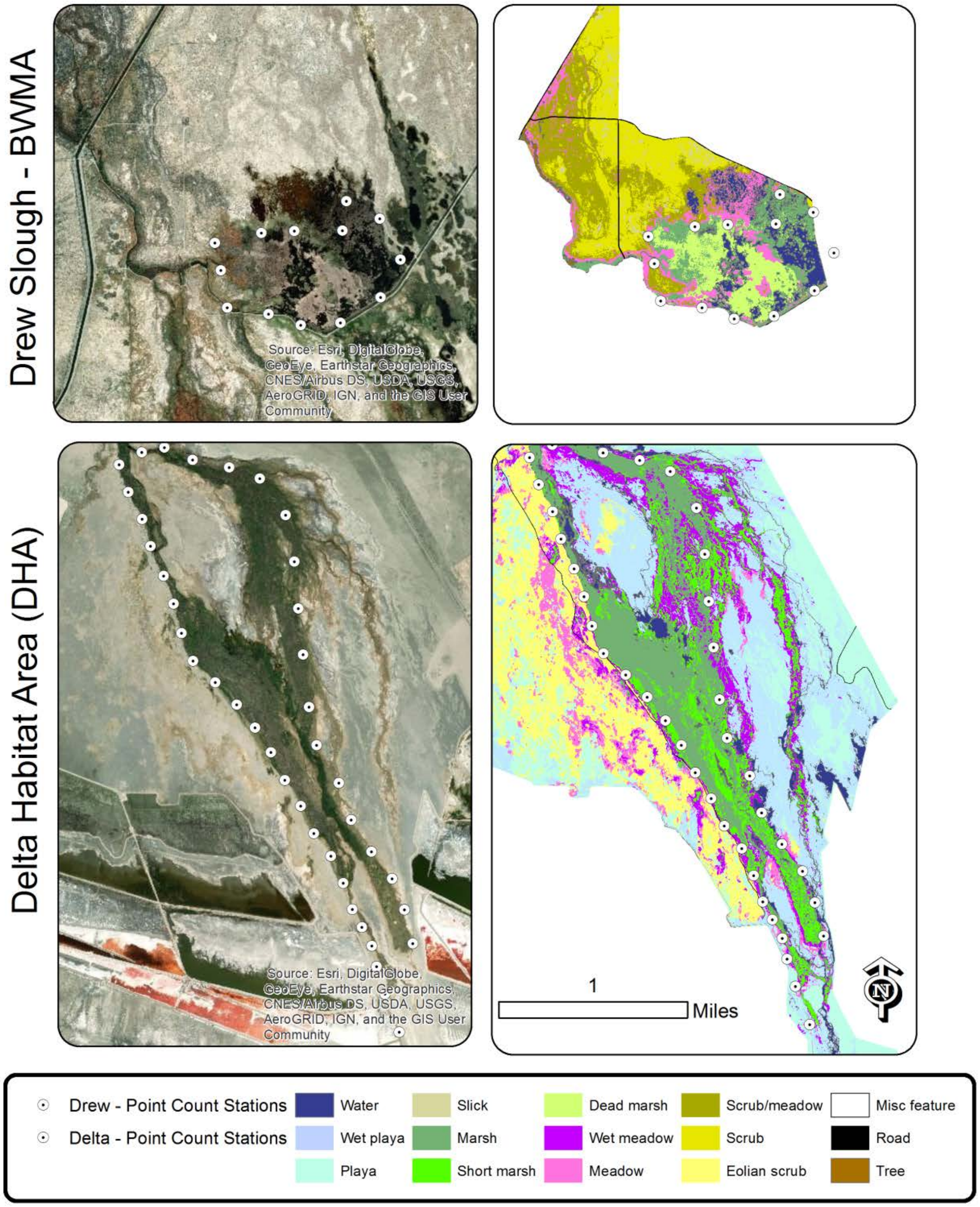
4.0 HABITAT INDICATOR SPECIES AND AVIAN CENSUS, DELTA HABITAT AREA AND DREW UNIT, BLACKROCK WATERFOWL MANAGEMENT AREA

4.1 Habitat Indicator Species Analysis – BWMA and DHA

Habitat indicator species for the DHA and BWMA were first described in the MOU and the Lower Owens River Project Ecosystem Management Plan respectively (MOU 1997, Ecosystem Sciences 1999). The presence of these species was thought to indicate if the desired range of habitat conditions for each management unit were being achieved (MOU 1997, Ecosystem Sciences 1999). Habitat indicator species for BWMA and DHA include all waterfowl, wading birds, shorebirds and species. For BWMA, rails, Marsh Wren and Northern Harrier were also included.

4.1.1 Habitat Mapping

Vegetation communities in the BWMA project area and Delta Habitat Area were mapped using aerial photography acquired in 2017, spectral classification routines and post-classification expert interpretation (Avian Census Figure 1). Details of these methods and results of the 2018 mapping using the 2017 imagery can be found in Section 3 of this LORP report - Landscape Vegetation Mapping, 2017 Conditions.



Avian Census Figure 1. Avian point count routes (left) and vegetation types classified from 2017 aerial imagery (right).

Drew Slough was conducted as an area count, using the previous point count route as the survey route.

4.1.2 California Wildlife Habitat Relationship System (CWHR)

The California Wildlife Habitat Relationship System (CWHR, CDFW 2014) is being used to evaluate the availability of habitats for BWMA and DHA Habitat Indicator Species. CWHR is a database developed by California Department of Fish and Wildlife, containing lookup tables for habitat characteristics and habitat suitability scores for feeding, cover and reproduction for California terrestrial vertebrates. The CWHR BioView module allows batch processing of multiple species and multiple habitat types. Typically, the habitat input data is spatial, so that the output suitability scores can be joined back to a GIS polygon feature class allowing production of habitat suitability maps.

Vegetation classifications for DHA (Avian Census Table 1) and Drew Slough (Avian Census Table 2) were cross-walked to CWHR habitat types and attributed with CWHR ‘stage’ and ‘size’ characteristics for each habitat type using imagery interpretation, photo points and expert interpretation.

Distinct combinations of CWHR attributes were used as input into the CWHR-Bioview Version 9.0 software program for all indicator species in each unit (CDFW 2014). Bioview outputs habitat suitability scores for cover, foraging and reproduction and the arithmetic average of the three.

The foraging score (high, medium, low) is reviewed here for each distinct habitat combination in DHA and Drew Slough (Avian Census Table 4). Acreages are subtotaled by suitability score across each habitat type for each species and separately across each habitat type for each species, including high, medium and low foraging suitability scores in the Delta Habitat Area and Drew Slough management areas (Avian Census Table 3). High suitability scores are assigned for habitat that is optimal for species occurrence, supporting relatively high population densities at high frequencies. Medium suitability is defined where habitat is suitable for species occurrence supporting relatively moderate population densities at moderate frequencies. Low habitat suitability rating is defined where habitat is marginal for species occurrence and habitat can support relatively low population densities at low frequencies.

4.1.3 CWHR Input

Avian Census Table 1. Delta Habitat Area (DHA)

Distinct habitat types and characteristics mapped from 2017 aerial imagery, used as input into the California Wildlife Habitat Relationship (CWHR) species habitat suitability models.

LA.habitat	CWHR.habitat	CWHR.stage	CWHR.size	CWHR.height	Total.acreage
Wet playa	Riverine	organic	periodically flooded	NA	**0.01**
Wet playa	Lacustrine	mud	periodically flooded	NA	**727.70**
Wet meadow	Wet Meadow	dense	tall herb	> 12 in tall at maturity	**254.32**
Water	Riverine	organic	periodically flooded	NA	**55.08**
Water	Riverine	mud	periodically flooded	NA	**14.44**
Water	Riverine	organic	submerged	NA	**14.32**
Water	Riverine	mud	submerged	NA	**0.01**
Water	Lacustrine	mud	periodically flooded	NA	**58.04**
Water	Lacustrine	mud	submerged	NA	**2.38**
Tree	Desert Riparian	dense	pole	15 - 29.0 ft; DBH 6 - 10.9	**0.82**
Short marsh	Fresh Emergent Wetland	dense	short herb	< 12 in tall at maturity	**216.68**
Road	Barren	NA	NA	NA	**10.75**
Playa	Barren	NA	NA	NA	**665.30**
Misc feature	Barren	NA	NA	NA	**0.37**
Meadow	Perennial Grassland	dense	short herb	< 12 in tall at maturity	**143.02**
Marsh	Fresh Emergent Wetland	dense	tall herb	> 12 in tall at maturity	**384.98**
Eolian scrub	Barren	NA	NA	NA	**734.68**
				Total	**3282.89**

Avian Census Table 2. Drew Unit in Blackrock Waterfowl Management Area (BWMA)

Distinct habitat types and characteristics mapped from 2017 aerial imagery, used as input into the California Wildlife Habitat Relationship (CWHR) species habitat suitability models.

LA.habitat	CWHR.habitat	CWHR.stage	CWHR.size	CWHR.height	Total.acreage
Water	Lacustrine	organic	submerged	NA	**68.09**
Water	Lacustrine	mud	periodically flooded	NA	**29.64**
Water	Riverine	organic	submerged	NA	**0.96**
Water	Riverine	mud	submerged	NA	**0.90**
Water	Lacustrine	mud	submerged	NA	**0.02**
Tree	Desert Riparian	dense	sapling	< 15 ft; DBH 1 - 5.9 in	**4.35**
Tree	Desert Riparian	dense	small tree	30 - 44.9 ft; DBH 11 -23.9 in	**0.50**
Tree	Desert Riparian	dense	pole	15 - 29.0 ft; DBH 6 - 10.9	**0.03**
Slick	Barren	NA	NA	NA	**24.83**
Scrub/meadow	Perennial Grassland	moderate	short herb	< 12 in tall at maturity	**187.50**
Scrub	Alkali Desert Scrub	open	tall herb	> 12 in tall at maturity	**215.44**
Road	Barren	NA	NA	NA	**10.54**
Meadow	Perennial Grassland	dense	short herb	< 12 in tall at maturity	**91.97**
Marsh	Fresh Emergent Wetland	dense	tall herb	> 12 in tall at maturity	**104.37**
Dead marsh	Fresh Emergent Wetland	dense	tall herb	> 12 in tall at maturity	**87.46**
				Total	**826.61**

Avian Census Table 3. Habitat Indicator Species.

Habitat Indicator Species detected in Drew-BWMA Unit and Delta Habitat Area for which CWHR-modeled habitat suitability summaries were generated.

Order	Family	Foraging Technique	Common Name
Accipitriformes	**Accipitridae**	Low Patrol	Harrier, Northern
Anseriformes	**Anatidae**	Dabbler	Mallard
Anseriformes	**Anatidae**	Dabbler	Wigeon, American
Anseriformes	**Anatidae**	Dabbler, Ground Gleaner	Pintail, Northern
Anseriformes	**Anatidae**	Dabbler, Surface Dives	Gadwall
Anseriformes	**Anatidae**	Ground Gleaner, Dabbler	Teal, Green-winged
Anseriformes	**Anatidae**	Surface Dips	Shoveler, Northern
Anseriformes	**Anatidae**	Surface Dips, Dabbler	Goose, Snow
Anseriformes	**Anatidae**	Surface Dips, Dabbler	Teal, Blue-winged
Anseriformes	**Anatidae**	Surface Dips, Dabbler	Teal, Cinnamon
Anseriformes	**Anatidae**	Surface Dips, Dabbler	Unidentified Teal
Charadriiformes	**Charadriidae**	Ground Gleaner	Killdeer
Charadriiformes	**Charadriidae**	Ground Gleaner	Plover, Semipalmated
Charadriiformes	**Recurvirostridae**	Prober	Avocet, American
Charadriiformes	**Recurvirostridae**	Prober, Ground Gleaner	Stilt, Black-necked
Charadriiformes	**Scolopacidae**	Ground Gleaner, Prober	Calidris sp.
Charadriiformes	**Scolopacidae**	Ground Gleaner, Prober	Sandpiper, Least
Charadriiformes	**Scolopacidae**	Ground Gleaner, Prober	Sandpiper, Western
Charadriiformes	**Scolopacidae**	Ground Gleaner, Prober	Unidentified Shorebird Species
Charadriiformes	**Scolopacidae**	Prober	Dowitcher, Long-billed
Charadriiformes	**Scolopacidae**	Prober	Dowitcher, Short-billed
Charadriiformes	**Scolopacidae**	Prober	Snipe, Wilson's
Charadriiformes	**Scolopacidae**	Prober	Unidentified Dowitcher
Charadriiformes	**Scolopacidae**	Prober	Willet
Charadriiformes	**Scolopacidae**	Prober	Yellowlegs, Greater
Charadriiformes	**Scolopacidae**	Prober, Ground Gleaner	Curlew, Long-billed
Charadriiformes	**Scolopacidae**	Prober, Ground Gleaner	Godwit, Marbled
Charadriiformes	**Scolopacidae**	Prober, Ground Gleaner	Yellowlegs, Lesser
Charadriiformes	**Scolopacidae**	Surface Dips, Prober	Phalarope, Wilson's
Gruiformes	**Gruidae**	Prober, Ground Gleaner	Crane, Sandhill
Gruiformes	**Rallidae**	Ground Gleaner, Prober	Sora
Gruiformes	**Rallidae**	Prober, Ground Gleaner	Rail, Virginia
Gruiformes	**Rallidae**	Surface Dips, Ground Gleaner	Coot, American

Passeriformes	**Troglodytidae**	Ground Gleaner, Foliage Gleaner	Wren, Marsh
Pelecaniformes	**Ardeidae**	Ambusher	Egret, Great
Pelecaniformes	**Ardeidae**	Ambusher	Egret, Snowy
Pelecaniformes	**Ardeidae**	Ambusher	Heron, Black-crowned Night
Pelecaniformes	**Ardeidae**	Ambusher	Heron, Great Blue
Pelecaniformes	**Ardeidae**	Ambusher, Ground Gleaner	Bittern, American
Pelecaniformes	**Ardeidae**	Ambusher, Ground Gleaner	Bittern, Least
Pelecaniformes	**Threskiornithidae**	Prober, Ground Gleaner	Ibis, White-faced

4.1.4 CWHR Output

The distribution of mapped vegetation in the Drew Unit in 2017 followed two years of drying followed by water spreading in spring and early summer 2017. Open water covered several areas not previously flooded in 2017 and about half of the marsh was dead in 2017. The area of hydric vegetation in the Drew unit in 2017 increased 298 acres since 2000. Mapping from 2017 imagery was likely biased toward wet conditions resulting from water spreading compared to 2018 conditions.

Avian Census Table 4. Suitable habitat acreage supporting foraging needs in the Delta Habitat Area (DHA) and Drew Slough management areas (Drew).

Acreage is shown by CWHR habitat type and categorized by ‘suitability’ score: High, Med or Low. Acreages are subtotaled for each species by suitability category across habitats and for each habitat across suitability scores. Foraging habitat suitability scores are presented here.

	DHA			DHA Total	Drew			Drew Total
Row Labels	**High**	**Med**	**Low**		**High**	**Med**	**Low**	
AMERICAN AVOCET	**2197**	**70**	**856**	**3122**	**65**		**192**	**257**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland			602	**602**			192	**192**
Lacustrine	786			**786**	30			**30**
Riverine		70		**70**				
Wet Meadow			254	**254**				
AMERICAN BITTERN	**602**		**872**	**1474**	**192**		**100**	**291**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine			788	**788**			98	**98**
Riverine			84	**84**			2	**2**
AMERICAN COOT	**1871**			**1871**	**571**			**571**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	788			**788**	98			**98**
Perennial Grassland	143			**143**	279			**279**
Riverine	84			**84**	2			**2**

	DHA			DHA Total	Drew			Drew Total
Row Labels	**High**	**Med**	**Low**		**High**	**Med**	**Low**	
Wet Meadow	254			**254**				
AMERICAN WIGEON	**1016**			**1016**	**541**			**541**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2			**2**	68			**68**
Perennial Grassland	143			**143**	279			**279**
Riverine	14			**14**	2			**2**
Wet Meadow	254			**254**				
BLACK-BELLIED PLOVER	**1411**	**1215**		**2626**	**35**	**309**		**344**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland		217		**217**				
Lacustrine		786		**786**		30		**30**
Perennial Grassland		143		**143**		279		**279**
Riverine		70		**70**				
BLACK-CROWNED NIGHT HERON	**618**	**855**		**1474**	**262**	**30**		**291**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2	786		**788**	68	30		**98**
Riverine	14	70		**84**	2			**2**
BLACK-NECKED STILT	**2197**	**70**	**856**	**3122**	**65**		**192**	**257**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland			602	**602**			192	**192**
Lacustrine	786			**786**	30			**30**
Riverine		70		**70**				
Wet Meadow			254	**254**				
BLUE-WINGED TEAL		**1390**	**397**	**1787**		**290**	**279**	**569**
Fresh Emergent Wetland		602		**602**		192		**192**
Lacustrine		788		**788**		98		**98**
Perennial Grassland			143	**143**			279	**279**
Wet Meadow			254	**254**				
BUFFLEHEAD	**788**			**788**	**98**			**98**
Lacustrine	788			**788**	98			**98**
CANADA GOOSE	**999**		**17**	**1016**	**471**		**70**	**541**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine			2	**2**			68	**68**
Perennial Grassland	143			**143**	279			**279**
Riverine			14	**14**			2	**2**
Wet Meadow	254			**254**				
CANVASBACK	**1019**	**385**		**1404**	**100**	**192**		**291**
Fresh Emergent Wetland	217	385		**602**		192		**192**
Lacustrine	788			**788**	98			**98**
Riverine	14			**14**	2			**2**

	DHA			DHA Total	Drew			Drew Total
Row Labels	High	Med	Low		High	Med	Low	
CATTLE EGRET	**143**	**602**	**855**	**1600**	**279**	**192**	**30**	**501**
Fresh Emergent Wetland		602		**602**		192		**192**
Lacustrine			786	**786**			30	**30**
Perennial Grassland	143			**143**	279			**279**
Riverine			70	**70**				
CINNAMON TEAL	**688**	**786**	**254**	**1728**	**262**	**30**		**291**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2	786		**788**	68	30		**98**
Riverine	84			**84**	2			**2**
Wet Meadow			254	**254**				
COMMON GOLDENEYE	**17**			**17**	**70**			**70**
Lacustrine	2			**2**	68			**68**
Riverine	14			**14**	2			**2**
COMMON MERGANSER	**618**	**254**		**873**	**262**			**262**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2			**2**	68			**68**
Riverine	14			**14**	2			**2**
Wet Meadow		254		**254**				
DUNLIN	**2266**	**217**		**2483**	**65**			**65**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland		217		**217**				
Lacustrine	786			**786**	30			**30**
Riverine	70			**70**				
EARED GREBE	**604**	**14**		**618**	**260**	**2**		**262**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2			**2**	68			**68**
Riverine		14		**14**		2		**2**
GADWALL	**618**		**397**	**1016**	**262**		**279**	**541**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2			**2**	68			**68**
Perennial Grassland			143	**143**			279	**279**
Riverine	14			**14**	2			**2**
Wet Meadow			254	**254**				
GREAT BLUE HERON	**1871**			**1871**	**571**			**571**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	788			**788**	98			**98**
Perennial Grassland	143			**143**	279			**279**
Riverine	84			**84**	2			**2**
Wet Meadow	254			**254**				
GREAT EGRET	**1617**	**254**		**1871**	**571**			**571**

	DHA			DHA Total	Drew			Drew Total
Row Labels	High	Med	Low		High	Med	Low	
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	788			**788**	98			**98**
Perennial Grassland	143			**143**	279			**279**
Riverine	84			**84**	2			**2**
Wet Meadow		254		**254**				
GREATER WHITE-FRONTED GOOSE	**1001**		**870**	**1871**	**539**		**31**	**571**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2		786	**788**	68		30	**98**
Perennial Grassland	143			**143**	279			**279**
Riverine			84	**84**			2	**2**
Wet Meadow	254			**254**				
GREATER YELLOWLEGS	**70**	**802**	**856**	**1728**		**100**	**192**	**291**
Fresh Emergent Wetland			602	**602**			192	**192**
Lacustrine		788		**788**		98		**98**
Riverine	70	14		**84**		2		**2**
Wet Meadow			254	**254**				
GREEN HERON	**1474**			**1474**	**291**			**291**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	788			**788**	98			**98**
Riverine	84			**84**	2			**2**
GREEN-WINGED TEAL	**1016**	**855**		**1871**	**541**	**30**		**571**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2	786		**788**	68	30		**98**
Perennial Grassland	143			**143**	279			**279**
Riverine	14	70		**84**	2			**2**
Wet Meadow	254			**254**				
HOODED MERGANSER	**17**		**602**	**618**	**70**		**192**	**262**
Fresh Emergent Wetland			602	**602**			192	**192**
Lacustrine	2			**2**	68			**68**
Riverine	14			**14**	2			**2**
HORNED GREBE			**2**	**2**			**68**	**68**
Lacustrine			2	**2**			68	**68**
KILLDEER	**2266**	**217**		**2483**	**468**			**468**
Alkali Desert Scrub					215			**215**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland		217		**217**				
Lacustrine	786			**786**	30			**30**
Perennial Grassland					187			**187**
Riverine	70			**70**				
LEAST BITTERN	**385**		**1089**	**1474**	**192**	**4**	**100**	**296**

	DHA			DHA Total	Drew			Drew Total
Row Labels	**High**	**Med**	**Low**		**High**	**Med**	**Low**	
Desert Riparian			1	**1**		4	0	**4**
Fresh Emergent Wetland	385		217	**602**	192			**192**
Lacustrine			788	**788**			98	**98**
Riverine			84	**84**			2	**2**
LEAST SANDPIPER	**2266**	**602**	**254**	**3122**	**65**	**192**		**257**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland		602		**602**		192		**192**
Lacustrine	786			**786**	30			**30**
Riverine	70			**70**				
Wet Meadow			254	**254**				
LESSER SCAUP	**86**	**786**		**872**	**70**	**30**		**100**
Lacustrine	2	786		**788**	68	30		**98**
Riverine	84			**84**	2			**2**
LESSER YELLOWLEGS	**1481**	**802**	**856**	**3139**	**35**	**100**	**192**	**327**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland			602	**602**			192	**192**
Lacustrine		788		**788**		98		**98**
Riverine	70	14		**84**		2		**2**
Wet Meadow			254	**254**				
LONG-BILLED CURLEW	**2664**	**602**		**3265**	**344**	**192**		**536**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland		602		**602**		192		**192**
Lacustrine	786			**786**	30			**30**
Perennial Grassland	143			**143**	279			**279**
Riverine	70			**70**				
Wet Meadow	254			**254**				
LONG-BILLED DOWITCHER	**2197**	**70**		**2266**	**65**			**65**
Barren	1411			**1411**	35			**35**
Lacustrine	786			**786**	30			**30**
Riverine		70		**70**				
MALLARD	**1016**	**855**		**1871**	**541**	**34**		**575**
Desert Riparian						4		**4**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2	786		**788**	68	30		**98**
Perennial Grassland	143			**143**	279			**279**
Riverine	14	70		**84**	2			**2**
Wet Meadow	254			**254**				
MARBLED GODWIT	**1411**	**786**	**999**	**3196**	**35**	**30**	**471**	**536**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland			602	**602**			192	**192**

	DHA			DHA Total	Drew			Drew Total
Row Labels	**High**	**Med**	**Low**		**High**	**Med**	**Low**	
Lacustrine		786		**786**		30		**30**
Perennial Grassland			143	**143**			279	**279**
Wet Meadow			254	**254**				
MARSH WREN	**602**		**254**	**856**	**192**			**192**
Fresh Emergent Wetland	602			**602**	192			**192**
Wet Meadow			254	**254**				
NORTHERN HARRIER	**999**	**31**	**1411**	**2441**	**471**	**69**	**251**	**791**
Alkali Desert Scrub							215	**215**
Barren			1411	**1411**			35	**35**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine		2		**2**		68		**68**
Perennial Grassland	143			**143**	279			**279**
Riverine		29		**29**		1		**1**
Wet Meadow	254			**254**				
NORTHERN PINTAIL	**1787**	**84**		**1871**	**569**	**2**		**571**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	788			**788**	98			**98**
Perennial Grassland	143			**143**	279			**279**
Riverine		84		**84**		2		**2**
Wet Meadow	254			**254**				
NORTHERN SHOVELER	**1390**			**1390**	**290**			**290**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	788			**788**	98			**98**
PIED-BILLED GREBE	**618**			**618**	**262**			**262**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2			**2**	68			**68**
Riverine	14			**14**	2			**2**
REDHEAD	**2**	**786**	**616**	**1404**	**68**	**30**	**194**	**291**
Fresh Emergent Wetland			602	**602**			192	**192**
Lacustrine	2	786		**788**	68	30		**98**
Riverine			14	**14**			2	**2**
RED-NECKED PHALAROPE	**786**			**786**	**30**			**30**
Lacustrine	786			**786**	30			**30**
RING-NECKED DUCK	**858**			**858**	**260**			**260**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2			**2**	68			**68**
Wet Meadow	254			**254**				
RUDDY DUCK	**387**		**786**	**1173**	**260**		**30**	**290**
Fresh Emergent Wetland	385			**385**	192			**192**
Lacustrine	2		786	**788**	68		30	**98**

	DHA			DHA Total	Drew			Drew Total
Row Labels	High	Med	Low		High	Med	Low	
SEMIPALMATED PLOVER	**1411**		**1160**	**2571**	**35**		**309**	**344**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland			217	**217**				
Lacustrine			786	**786**			30	**30**
Perennial Grassland			143	**143**			279	**279**
Riverine			14	**14**				
SNOW GOOSE	**1001**		**870**	**1871**	**539**		**31**	**571**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2		786	**788**	68		30	**98**
Perennial Grassland	143			**143**	279			**279**
Riverine			84	**84**			2	**2**
Wet Meadow	254			**254**				
SNOWY EGRET	**1089**	**385**		**1474**	**100**	**192**		**291**
Fresh Emergent Wetland	217	385		**602**		192		**192**
Lacustrine	788			**788**	98			**98**
Riverine	84			**84**	2			**2**
SNOWY PLOVER	**1411**	**786**		**2197**	**35**	**30**		**65**
Barren	1411			**1411**	35			**35**
Lacustrine		786		**786**		30		**30**
SORA	**856**			**856**	**192**			**192**
Fresh Emergent Wetland	602			**602**	192			**192**
Wet Meadow	254			**254**				
SPOTTED SANDPIPER	**2266**	**254**		**2521**	**65**			**65**
Barren	1411			**1411**	35			**35**
Lacustrine	786			**786**	30			**30**
Riverine	70			**70**				
Wet Meadow		254		**254**				
TUNDRA SWAN	**1016**	**855**		**1871**	**541**	**30**		**571**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	2	786		**788**	68	30		**98**
Perennial Grassland	143			**143**	279			**279**
Riverine	14	70		**84**	2			**2**
Wet Meadow	254			**254**				
VIRGINIA RAIL	**856**			**856**	**192**		**4**	**196**
Desert Riparian							4	**4**
Fresh Emergent Wetland	602			**602**	192			**192**
Wet Meadow	254			**254**				
WESTERN SANDPIPER	**2266**		**856**	**3122**	**65**		**192**	**257**
Barren	1411			**1411**	35			**35**
Fresh Emergent Wetland			602	**602**			192	**192**

	DHA			DHA Total	Drew			Drew Total
Row Labels	High	Med	Low		High	Med	Low	
Lacustrine	786			**786**	30			**30**
Riverine	70			**70**				
Wet Meadow			254	**254**				
WHITE-FACED IBIS	**17**	**855**	**999**	**1871**	**70**	**30**	**471**	**571**
Fresh Emergent Wetland			602	**602**			192	**192**
Lacustrine	2	786		**788**	68	30		**98**
Perennial Grassland			143	**143**			279	**279**
Riverine	14	70		**84**	2			**2**
Wet Meadow			254	**254**				
WILLET	**786**	**925**	**143**	**1854**	**30**	**192**	**279**	**501**
Fresh Emergent Wetland		602		**602**		192		**192**
Lacustrine	786			**786**	30			**30**
Perennial Grassland			143	**143**			279	**279**
Riverine		70		**70**				
Wet Meadow		254		**254**				
WILSON'S PHALAROPE	**858**	**602**	**397**	**1857**	**98**	**192**	**495**	**784**
Alkali Desert Scrub							215	**215**
Fresh Emergent Wetland		602		**602**		192		**192**
Lacustrine	788			**788**	98			**98**
Perennial Grassland			143	**143**			279	**279**
Riverine	70			**70**				
Wet Meadow			254	**254**				
WILSON'S SNIPE	**856**	**855**		**1711**	**192**	**30**		**221**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine		786		**786**		30		**30**
Riverine		70		**70**				
Wet Meadow	254			**254**				
WOOD DUCK	**1457**	**17**		**1474**	**221**	**70**		**291**
Fresh Emergent Wetland	602			**602**	192			**192**
Lacustrine	786	2		**788**	30	68		**98**
Riverine	70	14		**84**		2		**2**

4.1.5 CWHR Discussion

The CWHR habitat availability calculations for Drew and DHA (Avian Census Table 4) likely bracket the high end of open water availability in the DHA and Drew for extremely wet years when water spreading is necessary. More detailed analysis will need to be conducted to ascertain the fitness of the CWHR models in predicting available habitat. The 2017-based CWHR model output is not directly comparable to 2018 avian census data owing to the widespread water spreading that occurred in 2017 and not in 2018.

4.2 Avian Census

4.2.1 Drew Unit

The Drew Unit in BWMA was active 2009 to April 2015 when it was taken out of active status and allowed to dry during the summer of 2015. The 2017 mapping of Drew follows two years of drying (2015-2016) followed by water spreading in spring and early summer 2017. Tamarisk subsequently invaded the basin and was mowed prior to returning Drew to active status in 2018. No measures were taken prior to flooding for controlling tall marsh vegetation (tule and cattail). In 2018 Drew was put back into active status with an average inflow of 4.7 cfs in spring and 5.5. cfs during summer. Wetted perimeter measurements of Drew yielded 224 acres of flooded habitat in May 2018 and 269 acres in September 2018.

Avian Census Figure 2. Drew Unit, August 3, 2017

4.2.2 Delta Habitat Area

As of 2013, compared to baseline conditions in 2005, vegetation type conversion had taken place in many areas along the east branch wherein alkali meadow areas have converted to wet alkali meadow, and wet alkali meadow areas have converted to alkali marsh. Similar changes had been observed along the west branch as alkali marsh expanded southward compared to 2005 condition. Marsh habitat continued to expand through the 2017 mapping (see Table 3-1 and Figure 3-3, section Vegetation Mapping, 2017 Conditions). Tall marsh vegetation increased by 71 acres and short marsh increased by 166 acres from 2012 mapping compared to 2017 mapping. Conditions in the 2018 growing season were drier than 2017 mapping condition, but it is unknown the degree to which type conversions continued into 2018. Flows to the Delta in 2017-2018 water year averaged 6 to 9 cfs including pulse flows in June-July 2018 (10 days at 20 cfs) and September 2018 (10 days at 25 cfs).

Avian Census Figure 3. DHA July, 20, 2017 (left) and June 26, 2018 right

4.2.3 Surveys

Avian surveys were conducted to assess use and seasonal abundance of DHA and BWMA Indicator Species. Drew surveys were conducted as area counts by walking the perimeter of the unit following the previously established point count route and recording all birds seen throughout the unit. Delta surveys were conducted as point counts with observers walking the perimeter of the flooded area and recording all species encountered. Species encountered between points were also recorded if determined to be independent of point count observations. Surveys began within 30 minutes of local sunrise, and a unit was generally surveyed within 4-5 hours. Habitat types followed those tabulated in Avian Census Tables 1-2. 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.

4.2.4 Avian Survey Data Summaries

The total number of each indicator species was summed by survey. To compare inter-annual trends, surveys were summarized by month using the maximum single count of each indicator species per month. This summary statistic was used in lieu of others such as total count per season, since survey number varied across months, and rather than the proportional abundance, since large ephemeral flocks can obscure species-level seasonal trends. This number represents the number of each indicator species that can be reasonably detected during a single route within the given month. For 2018 comparisons, data was summarized for March-October for Drew (Avian Census Table 4) and April-October for DHA (Avian Census Table 5). Interannual-seasonal comparisons of indicator species are tabulated by phylogenetic order and species life history trait groupings - foraging technique, foraging substrate and food type based on the Land Condition Trend Analysis (LCTA) Avian Database: Ecological Guild-based Summaries (Schreiber and Whitworth 1998). The LCTA database provides ecological attributes for 676 species occurring in the continental United States. This database provides land managers the capability to generate ecological guild-based summaries with no additional fieldwork. For data summaries here, Killdeer (Charadriiformes) and American Coot (Gruiformes) were removed from the summary that aggregated counts to taxonomic order, to focus trends of Gruiformes on Sora and Virginia Rail and trends of Charadriiformes on migratory shorebirds.

4.3 Drew Results and Discussion

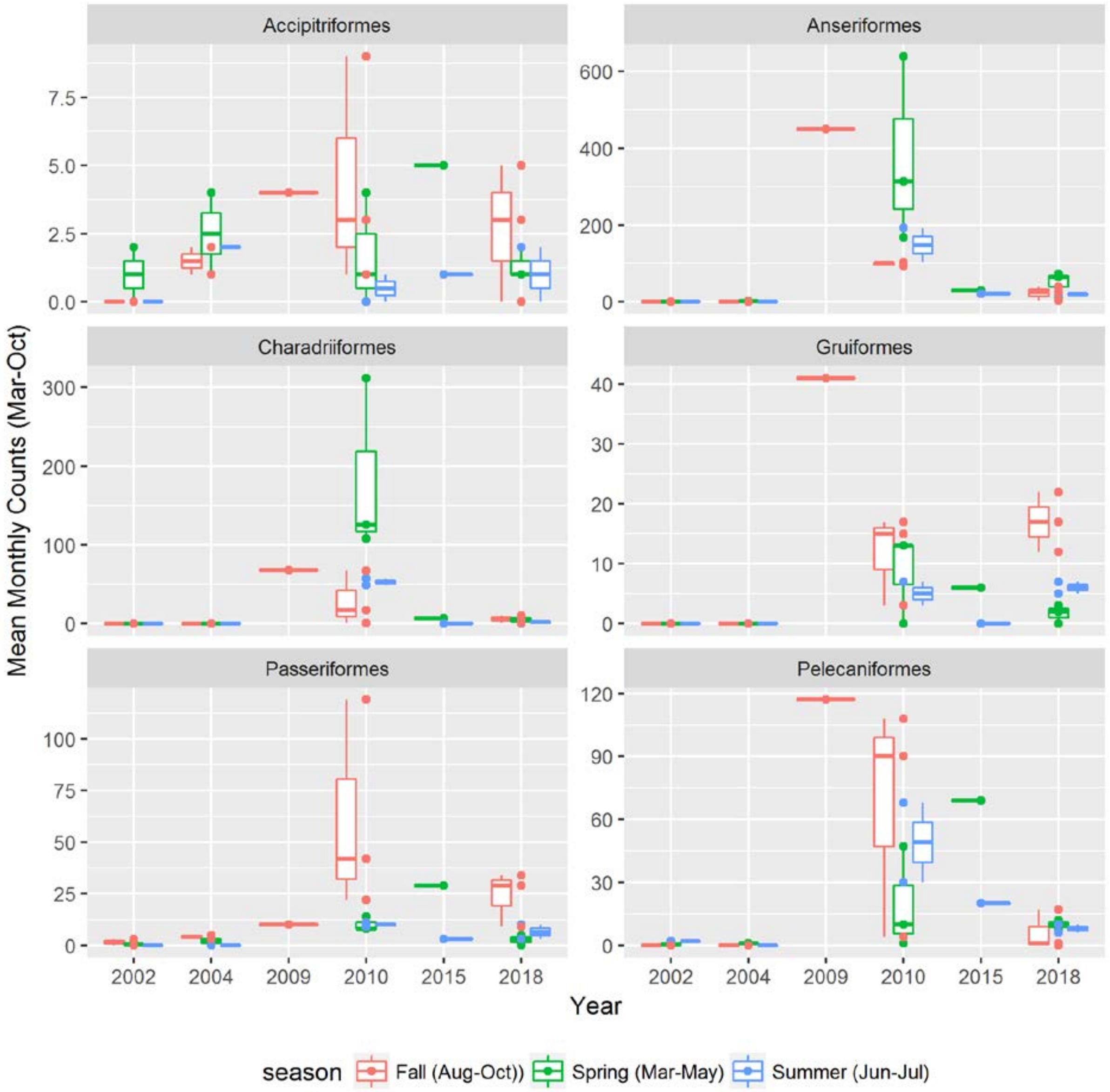
Trends in avian numbers by survey year and season are aggregated into phylogentic order in Avian Census Figure 4, and tabulated by species and foraging guild in Appendix B, Avian Census Table 5. The primary trend evident from avian census data in the Drew Management Unit are lower numbers of foraging guilds that require open water, shoreline, and exposed mudflat for foraging. From 2009 to 2017 mapping (Section Vegetation Mapping Table 4-3), marsh habitat increased from 12% to 23% of the Drew Unit, while water habitat declined from 17% to 12% of the Drew Unit. These trends are reflected in trends in the *Anseriformes* order including all ducks from the *Anatidae* family (Avian Census Figure 4). In the dabbler foraging guild: American Wigeon and Gadwall numbers were down from 2010. Mallard numbers were less affected and have comparable counts over this period (Avian Census Appendix B-Table 5). Surface-dipping dabblers, such as Cinnamon Teal were down substantially, most likely owing to the reduced open water habitat. Green-winged teal, a ground-gleaner, dabbler, had lower spring numbers but comparable fall numbers. In the diver guild, consistent with reduced open water habitat, Ruddy Duck, Ring-necked Duck, and Redhead have all decreased in number since 2015.

In the *Charadriiformes* order in the Ground-gleaner prober guild, Least and Western Sandpipers were observed as April migrants in 2010 and were not observed in 2015 or 2018, indicating a loss of open mudflat or additionally lower detection probability owing to increased emergent vegetation surrounding water margins. In the prober guild, both American Avocet and Greater Yellowlegs have decreased in detections possibly owing to reduced open foraging habitat. Dowitchers were observed only in April in 2018 compared to April and August in 2010. However, only one survey was conducted in August in 2018, likely decreasing the likelihood of migrant detection. In the prober, ground-gleaner guild, Black-necked Stilt and White-faced Ibis (order *Pelecaniformes*) have comparably low numbers compared to 2010 as these species need open foraging habitat.

In the Ambusher foraging guild, utilizing aquatic invertebrates, fish and small vertebrates, Snowy Egret, Great Egret and Black-crowned Night Heron (order *Pelecaniformes*) numbers were slightly down compared to 2010, while Great Blue Heron and American Bittern numbers were similar compared to 2010.

Consistent with the prevalence of marsh habitat, Marsh Wren (order Passeriformes), Sora and Virginia Rail (order Gruiformes) numbers appear stable or increasing compared to 2010, and Northern Harrier (order Accipitridae) been consistent with a few pairs foraging throughout the spring, summer and fall.

In summary, change in foraging guild prevalence is consistent with mapped increases in marsh and reduction in open foraging habitats. It is reasonable to speculate that while habitat availability contributes to these trends, increase in dense emergent vegetation lowers visual detections of ground and water foragers that do not vocalize often, plausibly accentuating apparent trends in guild seasonal occurrence.



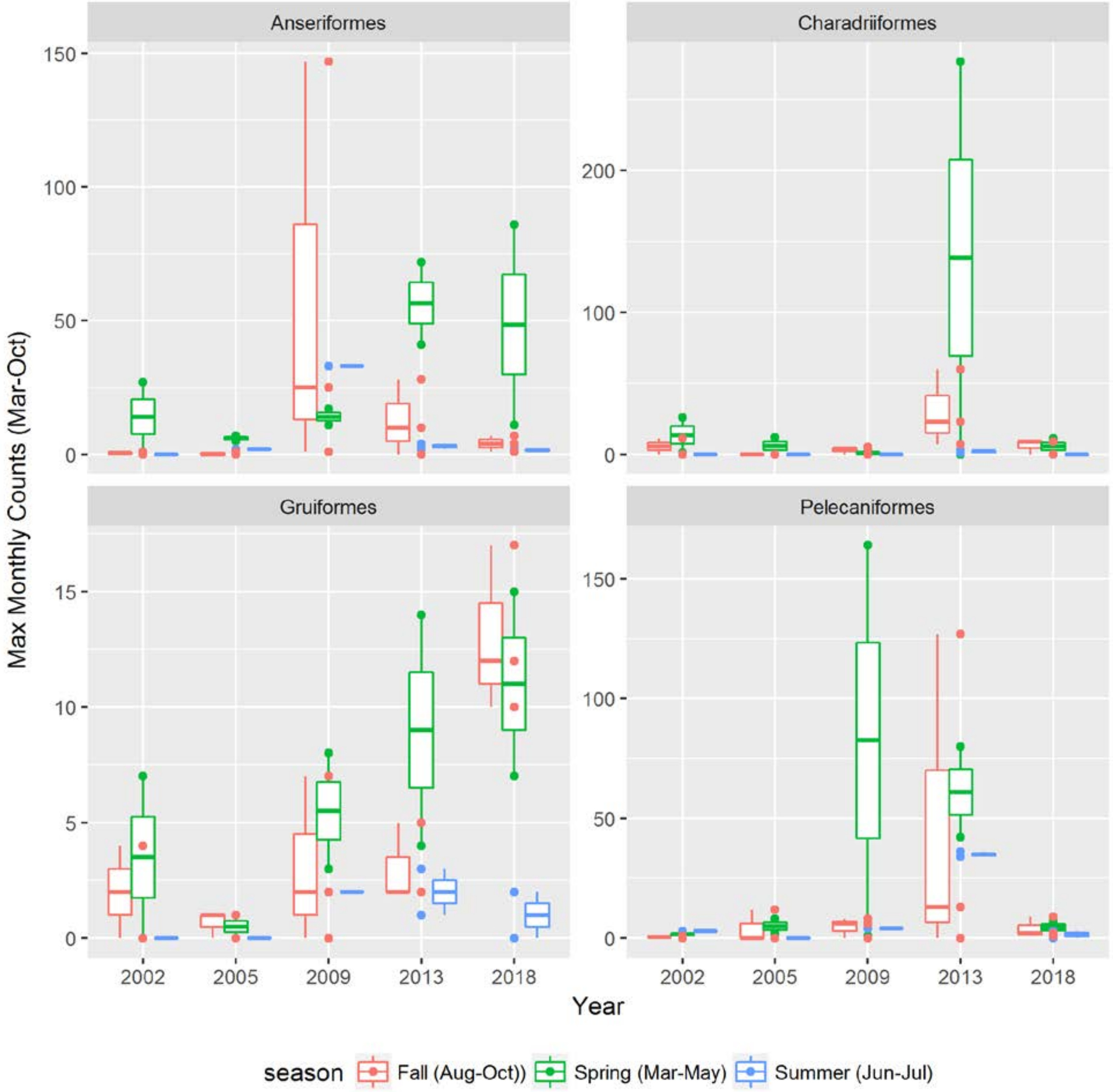
Avian Census Figure 4. Max monthly counts in Drew Unit (2002-2018) aggregated by season and taxonomic order

4.4 DHA Results and Discussion

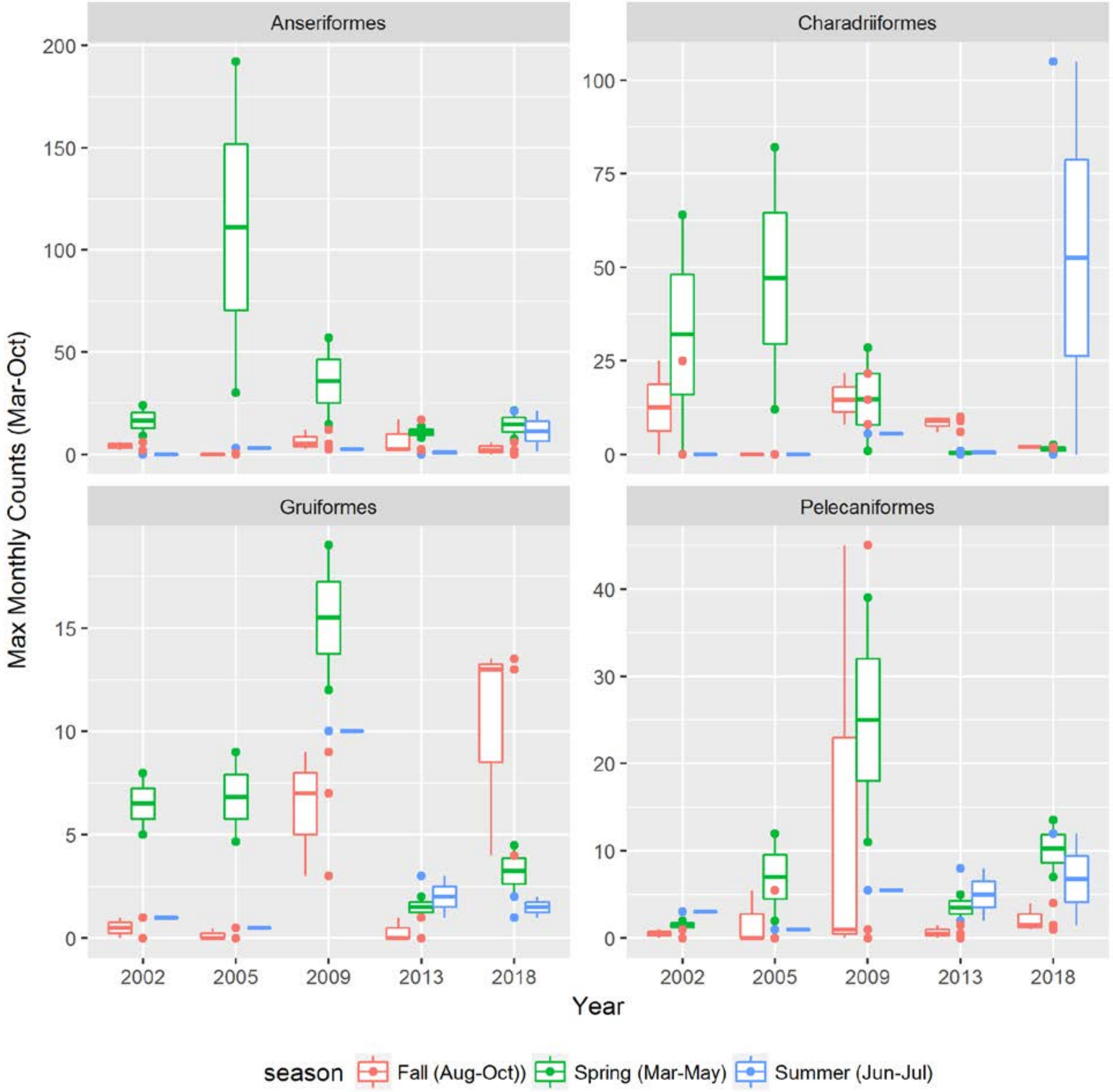
Trends in avian numbers by survey year and season are aggregated into taxonomic order in Avian Census Figure 5 (Delta East) and Figure 6 (Delta West), and tabulated by species and foraging guild in Appendix B, Avian Census Table 6.

Since baseline surveys from 2002-2005, ducks (order Anseriformes) have slightly increased in DHA east for spring counts and decreased slightly for fall and summer counts (Avian Census Figure 5). Duck counts have remained stable for summer and fall, and decreased for spring counts in DHA west (Avian Census Figure 6). Shorebird (order Charadriiformes) numbers have remained low in DHA east and were comparable to baseline numbers in 2018. Some large flocks were detected in spring of 2013 in DHA east and spring and summer in DHA west. The stochastic nature of spring and fall migratory habitat use compounded with possibly low detection probability of shorebirds with increased tall marsh vegetation must be considered in interpreting trends. Rails (order Gruiformes) have increased (DHA East) or remained stable (DHA west). Wading birds (order Pelicaniformes, Herons, Egrets, Bitterns, Ibis) have decreased since 2009 in DHA east and west but are comparable to baseline numbers. Similar to the ephemerality of migratory shorebird habitat use, white-faced ibis flocks are influential in the Pelecaniformes group trends and differences in years could be due to stochasticity of use, changing detection probability with changing vegetation structure, habitat change alone, as well as a combination of the three.

From 2012 to 2017 mapping (Section Vegetation Mapping Table 3-1), marsh habitat increased from 11% to 18% of the DHA. Owing to 2017 high runoff and increased flooding, mapped open water habitat was much higher in 2017, 144 acres compared to 9 acres in 2012. However, open water habitat in 2018 likely more closely resembled 2012 open water habitat availability.



Avian Census Figure 5. Max monthly counts in DHA East (2002-2018) aggregated by season and taxonomic order



Avian Census Figure 6. Max monthly counts in DHA West (2002-2018) Aggregated by Season and Taxonomic Order

4.5 Drew Slough Indicator Species Counts

Counts were totaled over all points on the route and for months with multiple surveys, the maximum count is shown here (Mar-Oct) for years 2018, 2015, 2010, 2004 and 2002. Years 2002 and 2004 represent pre-project conditions. Species are grouped by foraging technique, foraging substrate and food type. Surveys were conducted in months with numeric values – surveys were not conducted in cells that are blank.

Avian Census Table 5. Drew Slough Indicator species counts

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Ambusher								
Water								
Aquatic Inverts, Fish								
Egret, Snowy								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	7	0	6	0	0	5	0
2015		2		0				
2018	0	0	0	0	0	0	0	0
Fish, Aquatic Inverts								
Heron, Great Blue								
2002		0	0	2		0		0
2004	0	0		0		0	0	
2010	1	0	0	0	0	8	6	1
2015		10		8				
2018	0	7	3	2	3	0	6	1
Fish, Small Verts								
Egret, Great								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	10	2	5	16	24	33	0
2015		2		10				
2018	5	3	1	0	0	0	0	0
Heron, Black-crowned Night								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	7	3	1	5	2	0
2015		0		2				
2018	0	0	1	0	0	0	0	0
Ambusher, Ground Gleaner								
Water, Ground								
Fish, Aquatic Inverts								
Bittern, American								
2002		1	0	0		0		0
2004	1	1		0		0	0	
2010	0	1	0	0	3	3	1	0
2015		3		0				
2018	7	0	6	3	1	0	0	0

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Dabbler								
Water								
Greens, Aquatic Inverts								
Wigeon, American								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	14	4	0	0	0	36	3	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Seeds, Greens								
Mallard								
2002		0	0	0		0		0
2004	1	2		0		0	0	
2010	124	98	41	28	52	35	35	18
2015		20		18				
2018	10	18	64	10	22	2	39	10
Dabbler, Ground Gleaner								
Water, Ground								
Seeds, Greens								
Pintail, Northern								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	14	1	2	0	0	0	0	3
2015		0		0				
2018	0	0	0	0	0	0	6	0
Dabbler, Surface Dives								
Water								
Greens, Insects								
Gadwall								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	6	45	36	117	8	25	46	75
2015		10		3				
2018	0	13	35	5	0	1	5	3
Ground Gleaner								
Ground								
Insects								
Killdeer								
2002		0	0	0		0		0
2004	0	1		0		0	0	
2010	14	34	17	10	19	0	1	0

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
2015		3		0				
2018	5	2	13	8	4	5	2	0
Insects, Aquatic Inverts								
Sandpiper, Spotted								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	0	1	0	0	0	0
2015		2		0				
2018	0	0	1	0	0	10	1	0
Insects, Small Verts								
Egret, Cattle								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	0	1	1	0	0	0
2015		0		0				
2018	0	0	1	0	0	0	0	0
Ground, Water								
Aquatic Inverts, Insects								
Plover, Semipalmated								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	13	0	0	0	0	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Ground Gleaner, Dabbler								
Ground, Water								
Seeds, Aquatic Inverts								
Teal, Green-winged								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	61	106	0	4	0	4	7	0
2015		6		0				
2018	0	20	0	0	0	0	11	12
Ground Gleaner, Foliage Gleaner								
Ground, Foliage								
Insects, Aquatic Inverts								
Wren, Marsh								
2002		1	0	0		0		3
2004	4	0		0		4	8	
2010	8	14	14	9	11	34	170	42

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
2015		46		3				
2018	0	3	7	5	10	9	50	34
Ground Gleaner, Prober								
Ground, Water								
Insects, Aquatic Inverts								
Sandpiper, Least								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	281	0	0	0	0	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Sandpiper, Western								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	5	0	0	0	0	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Seeds, Insects								
Sora								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	15	10	5	2	20	19	2
2015		8		0				
2018	2	0	2	6	7	15	29	9
High Dives								
Water								
Fish, Small Mammals								
Osprey								
2002		0	0	0		0		0
2004	0	0		0		0	1	
2010	0	0	1	0	0	0	1	0
2015		2		0				
2018	1	0	0	0	0	0	0	0
Low Patrol								
Ground, Air								
Small Mammals, Small Verts Ground, Air								
Harrier, Northern								
2002		0	2	0		0		0
2004	1	4		2		3	1	
2010	1	5	0	0	1	3	10	1
2015		9		1				

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
2018	2	1	1	0	2	0	6	5
Prober								
Water								
Aquatic Inverts, Insects								
Avocet, American								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	5	31	5	9	0	3	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Dowitcher, Long-billed								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	16	0	0	0	4	0	0
2015		0		0				
2018	0	9	0	0	0	0	0	0
Dowitcher, Short-billed								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	3	0	0	0	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Unidentified Dowitcher								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	66	0	0	0	0	0	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Fish, Insects								
Yellowlegs, Greater								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	36	35	20	0	0	1	14	1
2015		5		0				
2018	0	1	0	0	0	0	0	0
Insects								
Snipe, Wilson's								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	6	5	3	0	1	0	0	0
2015		1		0				

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
2018	0	0	0	0	0	0	1	6
Prober, Ground Gleaner								
Water, Ground								
Aquatic Inverts, Insects								
Ibis, White-faced								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	29	1	52	9	100	67	3
2015		57		0				
2018	0	0	0	9	2	0	14	0
Stilt, Black-necked								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	5	46	48	39	61	1	0
2015		0		0				
2018	0	0	3	4	0	0	0	0
Insects, Aquatic Inverts								
Rail, Virginia								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	2	3	2	1	3	1	1
2015		2		0				
2018	0	0	2	3	0	2	7	3
Yellowlegs, Lesser								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	0	0	0	0	2	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Surface Dips								
Water								
Greens, Aquatic Inverts								
Shoveler, Northern								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	16	18	1	1	0	0	5	2
2015		1		0				
2018	0	0	0	0	0	0	2	0
Surface Dips, Dabbler								
Water								
Greens, Aquatic Inverts								

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
Goose, Canada								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	1	0	0	0	0	0
2015		4		0				
2018	0	0	2	0	0	0	0	0
Goose, Greater White-fronted								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	0	0	0	0	19	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Seeds, Greens								
Teal, Blue-winged								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	3	0	1	1	0	0	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Seeds, Insects								
Teal, Cinnamon								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	285	201	30	31	43	88	47	0
2015		30		0				
2018	2	20	4	8	0	0	3	0
Surface Dips, Ground Gleaner								
Water, Ground								
Greens, Aquatic Inverts								
Coot, American								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	597	626	266	146	372	615	625	838
2015		59		4				
2018	10	4	41	4	0	0	0	12
Surface Dips, Prober								
Water								
Aquatic Inverts, Seeds								
Phalarope, Red-necked								
2002		0	0	0		0		0

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
2004	0	0		0		0	0	
2010	0	0	22	0	0	1	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Phalarope, Wilson's								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	0	1	3	0	6	0	0
2015		0		0				
2018	0	0	0	0	0	0	0	0
Surface Dives								
Water								
Aquatic Inverts, Fish								
Grebe, Eared								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	0	1	1	15	1	2	2	13
2015		0		0				
2018	0	0	0	0	0	0	0	0
Grebe, Pied-billed								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	5	12	5	13	16	26	13	0
2015		1		0				
2018	0	0	7	6	0	0	0	0
Aquatic Inverts, Greens								
Duck, Ruddy								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	6	20	45	8	1	7	6	1
2015		0		0				
2018	0	0	0	0	0	0	0	0
Greens, Aquatic Inverts								
Duck, Ring-necked								
2002		0	0	0		0		0
2004	0	0		0		0	0	
2010	62	22	7	0	0	0	0	0
2015		0		0				
2018	0	2	0	0	0	0	0	0
Redhead								
2002		0	0	0		0		0

Row Labels	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT
2004	0	0		0		0	0	
2010	0	2	4	2	0	0	6	0
2015		0		0				
2018	0	0	0	0	0	0	0	0

4.6 Delta Habitat Area Indicator Species

Counts were totaled over all points on each route separately for Delta East and Delta West, and for months with multiple surveys, the maximum count for either route is shown here (Apr-Oct) for years 2018, 2013, 2009, 2005 and 2002. Years 2002 and 2005 represent pre-project conditions. Species are grouped by foraging technique, foraging substrate and food type. Surveys were conducted in months with numeric values – surveys were not conducted in cells that are blank.

Avian Census Table 6. DHA Indicator species counts

Row Labels	APR	MAY	JUN	JUL	AUG	SEP	OCT
Ambusher							
Water							
Aquatic Inverts, Fish							
Egret, Snowy							
2002	0	0	0		0		0
2005	2	11	0		0	0	0
2009	7	25	0		0	0	0
2013	17	12	0	5	0	0	0
2018	0	0	0	0	0	1	0
Fish, Small Verts							
Egret, Great							
2002	0	1	0		0		1
2005	3	1	0		0	0	0
2009	0	4	1		1	5	0
2013	6	5	10	6	8	0	0
2018	1	2	0	0	0	0	1
Ambusher, Ground Gleaner							
Water, Ground							
Fish, Aquatic Inverts							
Bittern, American							
2002	2	0	3		0		0
2005	1	7	0		0	0	0
2009	0	9	3		1	1	0
2013	1	0	3	0	0	0	0
2018	6	1	3	0	1	1	1

Row Labels	APR	MAY	JUN	JUL	AUG	SEP	OCT
Bittern, Least							
2002	0	1	0		0		0
2005	0	0	1		0	0	0
2009	0	1	2		0	0	0
2013	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
Dabbler							
Water							
Greens, Aquatic Inverts							
Wigeon, American							
2002	0	0	0		0		0
2005	7	0	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
Seeds, Greens							
Mallard							
2002	25	9	0		1		0
2005	199	25	2		0	0	0
2009	22	57	26		4	5	0
2013	69	25	4	2	21	1	0
2018	86	11	1	21	1	6	3
Dabbler, Ground Gleaner							
Water, Ground							
Seeds, Greens							
Pintail, Northern							
2002	1	0	0		2		0
2005	55	1	0		0	0	0
2009	4	0	6		0	0	5
2013	1	0	0	0	0	4	0
2018	0	0	0	0	0	0	0
Dabbler, Surface Dives							
Water							
Greens, Insects							
Gadwall							
2002	4	0	0		0		0
2005	50	0	0		0	0	0
2009	0	3	1		0	0	0
2013	8	16	0	0	4	0	0
2018	0	0	0	0	6	0	0
Ground Gleaner							

Row Labels	APR	MAY	JUN	JUL	AUG	SEP	OCT
Ground							
Insects							
Killdeer							
2002	11	2	0		1		0
2005	8	6	8		1	1	0
2009	1	0	2		2	2	6
2013	5	7	1	4	36	9	2
2018	4	3	4	2	2	6	2
Ground, Water							
Aquatic Inverts, Insects							
Plover, Semipalmated							
2002	20	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	0		0	0	0
2013	4	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
Ground Gleaner, Dabbler							
Ground, Water							
Seeds, Aquatic Inverts							
Teal, Green-winged							
2002	0	0	0		0		0
2005	41	0	0		0	0	0
2009	0	0	0		0	0	3
2013	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
Ground Gleaner, Prober							
Ground, Water							
Insects, Aquatic Inverts							
Sandpiper, Least							
2002	14	0	0		0		10
2005	192	0	0		0	0	0
2009	12	0	0		4	2	2
2013	21	0	0	0	32	21	7
2018	0	0	0	0	0	0	0
Sandpiper, Western							
2002	26	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	0		0	1	0
2013	0	0	0	0	5	0	0
2018	0	0	0	0	0	0	0
Unidentified Shorebird Species							

Row Labels	APR	MAY	JUN	JUL	AUG	SEP	OCT
2002	0	0	0		25		0
2005	0	0	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	1	0	0
2018	0	0	0	0	0	0	0
Seeds, Insects							
Sora							
2002	5	0	0		0		4
2005	8	7	1		1	1	0
2009	7	5	7		1	2	1
2013	7	1	1	0	0	0	3
2018	4	2	0	2	4	13	6
Prober							
Water							
Aquatic Inverts, Insects							
Avocet, American							
2002	0	0	0		0		0
2005	0	10	0		0	0	0
2009	0	1	4		0	0	0
2013	0	0	0	0	4	0	0
2018	0	0	0	105	0	0	0
Dowitcher, Long-billed							
2002	0	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	1	1	0
2018	0	0	0	0	0	0	0
Dowitcher, Short-billed							
2002	0	0	0		0		0
2005	12	0	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
Unidentified Dowitcher							
2002	0	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	0	0	0
2018	1	0	0	0	0	0	0
Fish, Insects							
Yellowlegs, Greater							

Row Labels	APR	MAY	JUN	JUL	AUG	SEP	OCT
2002	8	0	0		0		0
2005	11	0	0		0	0	0
2009	0	0	0		0	4	0
2013	29	0	0	1	24	3	4
2018	0	0	0	0	0	4	6
Insects							
Snipe, Wilson's							
2002	0	0	0		0		1
2005	2	0	0		0	0	0
2009	2	0	0		0	0	0
2013	3	0	0	0	4	2	3
2018	1	5	0	0	0	2	1
Insects, Aquatic Inverts							
Willet							
2002	0	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	0	2	0
2018	4	0	0	0	2	0	0
Prober, Ground Gleaner							
Water, Ground							
Aquatic Inverts, Insects							
Godwit, Marbled							
2002	0	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	0	1	0
2018	0	0	0	0	0	0	0
Ibis, White-faced							
2002	0	0	0		0		0
2005	0	0	0		0	0	0
2009	12	137	0		8	75	0
2013	14	62	25	23	125	12	0
2018	19	12	0	1	0	8	2
Stilt, Black-necked							
2002	0	0	0		0		0
2005	0	2	0		0	0	0
2009	0	0	0		0	0	0
2013	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
Insects, Aquatic Inverts							

Row Labels	APR	MAY	JUN	JUL	AUG	SEP	OCT
Curlew, Long-billed							
2002	0	1	0		0		0
2005	1	0	0		0	0	0
2009	0	0	5		43	13	6
2013	1	0	1	0	5	1	2
2018	0	0	0	0	0	3	1
Rail, Virginia							
2002	3	5	1		0		1
2005	3	2	0		0	0	0
2009	13	14	9		11	11	2
2013	7	3	3	3	2	2	2
2018	11	7	2	0	8	10	9
Yellowlegs, Lesser							
2002	0	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	0		0	0	0
2013	1	0	0	0	1	0	0
2018	0	0	0	0	0	0	1
Surface Dips, Dabbler							
Water							
Seeds, Greens							
Teal, Blue-winged							
2002	0	0	0		0		0
2005	1	0	0		0	1	0
2009	0	0	0		0	0	0
2013	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0
Seeds, Insects							
Teal, Cinnamon							
2002	4	0	0		0		0
2005	173	4	4		0	1	0
2009	0	0	2		0	0	0
2013	10	0	0	0	3	10	17
2018	10	4	1	2	0	0	0
Unidentified Teal							
2002	0	0	0		0		6
2005	0	0	0		0	0	0
2009	0	0	0		1	25	140
2013	0	0	0	0	0	2	0
2018	0	0	0	0	0	1	1
Surface Dips, Ground Gleaner							

Row Labels	APR	MAY	JUN	JUL	AUG	SEP	OCT
Water, Ground							
Greens, Aquatic Inverts							
Coot, American							
2002	0	0	0		0		1
2005	1	1	0		0	0	4
2009	0	0	0		0	1	3
2013	7	1	6	0	1	0	0
2018	4	0	0	0	0	0	2
Surface Dips, Prober							
Water							
Aquatic Inverts, Seeds							
Phalarope, Wilson's							
2002	0	0	0		0		0
2005	0	0	0		0	0	0
2009	0	0	1		0	0	0
2013	0	0	3	0	0	0	0
2018	0	0	0	0	0	0	0
Surface Dives							
Water							
Aquatic Inverts, Fish							
Grebe, Pied-billed							
2002	0	0	0		0		1
2005	0	0	0		0	0	0
2009	1	0	0		0	0	0
2013	0	0	0	0	0	0	0
2018	0	0	0	0	0	0	0

4.7 Recommendations

Detections of indicator species foraging in open water and exposed mud in the interior of the DHA is likely low since routes circumnavigate the perimeter of the Unit and unobstructed views into interior habitat is likely decreasing based on photo evidence compared to past census years. Since high detectability is a necessary requirement for using indicator species as surrogates of environmental condition (Siddig *et al* 2016), alternate area search methods amenable to visually surveying currently obstructed open habitats in the interior of DHA could be explored.

For the Drew Unit in BWMA, encroaching tall marsh into previously open water habitat is reducing waterfowl habitat. Timing of flooding to coincide with fall migration, overwintering habitat and spring migration could be beneficial to waterfowl if the unit is dried in the summer to control growth of tall marsh vegetation.

4.8 References

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5.0 LAND MANAGEMENT

5.1 Land Management Summary

The 2018 Lower Owens River Project (LORP) land management monitoring efforts continued with monitoring utilization across all leases and range trend monitoring on the Twin Lakes and Lone Pine leases inside the LORP management area.

Utilization estimates were conducted on all leases in 2017-18. Pasture utilization within the LORP was below the allowable levels of use established for both riparian (up to 40%) and upland (up to 65%) areas. Valley floor precipitation was low during the winter but water spreading activities in 2017 resulted in good forage production in the uplands especially in the Blackrock area. A reduction in the amount of livestock due the previous 5 year drought along with good forage production decreased grazing intensity along the Lower Owens River corridor. End of season utilization data for LORP leases from 2007 to present is provided in Land Management Appendix 1.

All irrigated pastures were evaluated in 2016. Pastures that scored below 80% in 2016 were revisited in the summer of 2017. No irrigated pastures were evaluated in 2018, but irrigated pasture scores from 2011-2018 are provided in Land Management Appendix 1 for reference. All irrigated pastures in the LORP management area will be evaluated in 2019.

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 are 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 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 2018 are presented by lease below.

5.3 Utilization

The Lower Owens River Monitoring Adaptive Management and Reporting Plan (MAMP, Ecosystem Sciences, 2008) 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. 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 LORP MAMP, 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. Utilization data for 2018 is located in Land Management Appendix 1.

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 or immediately prior to the end of plant dormancy (end-of-season).

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 MAMP. 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 2018 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 2018 involves nested frequency monitoring of all plant species and line intercept sampling for shrub canopy cover. Photo documentation of 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 2018 results were compared to all sampling events during the baseline period to determine if results in 2018 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,* DISP), and to a lesser extent alkali sacaton *(Sporobolus airoides*, SPAI), and creeping wildrye *(Leymus triticoides*, 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 2016-18 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 SPAI 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 SPAI, 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 SPAI 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 be implemented in 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 LORP Range Trend Monitoring Schedule

2016	**2017**	**2018**	**2019**	**2020**	**2021**
Blackrock	Thibaut	Twin Lakes	Blackrock	Thibaut	Twin Lakes
Delta	Islands	Lone Pine	Delta	Islands	Lone Pine

5.4.2 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 evaluated in 2016. Pastures that scored below 80% in 2016 were revisited in the summer of 2017. No irrigated pastures were evaluated in 2018, but irrigated pasture scores from 2011-2018 are provided in Land Management Appendix 1 for reference. All irrigated pastures in the LORP management area will be evaluated in 2019.

5.4.3 Fencing

A new eight-acre exclosure was constructed on the Thibaut lease along the Lower Owens River (Land Management Figure 4). Enclosed inside the exclosure is the transect Thibaut_06 which will maintain one transect in ungrazed status on the Thibaut Riparian Pasture.

5.4.4 Discussion of Range Trend

Range Trend transects on the Twin Lakes and Lone Pine Leases were read in August, 2018. Twin Lakes transects were last read in 2017 and Lone pine transects were last read in 2015. Twin Lakes frequency trends on moist floodplain sites and saline meadow sites were static on most locations with the exception for Twinlakes_06 where significant increases in ruderal species were observed (Land Management Table 2). On the Lone Pine Lease, DISP had declined on two sites. These decreases have remained within the range of low frequency values observed on these sites during past sampling events (Land Management Table 3).

Land Management Table 2. Significant changes between 2017 and 2018* Plant Frequencies (p=0.1) on the Twin Lakes Lease

	No Change	DISP	DESO2	HECU3	BAHY	MALE3	SCAM6	LACO13
Moist Floodplain								
Intake_01	↔							
Twinlakes_03	↔							
Twinlakes_04								
Twinlakes_06				↑	↓			↑
Saline Meadow								
Twinlakes_02 (last sampled in 2015)*	↔							

Land Management Table 3. Significant changes between 2015 and 2018 Plant Frequencies (p=0.1) on the Lone Pine Lease

	No Change	DISP	DESO2	HECU3	BAHY	SPAI	SCAM6	LETR5
Moist Floodplain								
Lonepine_01		↓						↓
Lonepine_02		↓						
Lonepine_03	↔							
Lonepine_04	↔							
Lonepine_06	↔							
Lonepine_07		↓						

5.5 LORP Ranch Lease Summary and 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, and a summary of range trend, utilization, and irrigated pasture results where relevant. 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.

Land Management Table 4. Common Species in Range Trend Transects

USDA Plant Code	Species Name	Common Name
ANCA10	*Anemopsis californica*	yerba mansa
ARPU9	*Aristida purpurea*	purple threeawn
ATSE2	*Atriplex serenana*	bractscale
ATTO	*Atriplex torreyi*	Torrey’s saltbush
ATTR	*Atriplex truncata*	wedgescale saltbush
BAHY	*Bassia hyssopifolia*	fivehorn smotherweed
CHHI	*Chenopodium hians*	hians goosefoot
CHIN2	*Chenopodium incanum*	mealy goosefoot
CHLE4	*Chenopodium leptophyllum*	narrowleaf goosefoot
DESO2	*Descurainia sophia*	herb sophia
DISP	*Distichlis spicata*	saltgrass
EQAR	*Equisetum arvense*	field horsetail
ERNA10	*Ericameria nauseosa*	rubber rabbitbrush

Common Species Encountered in Range Trend Transects, continued:

USDA Plant Code	Species Name	Common Name
FOPU2	*Forestiera pubescens*	stretchberry
GITR	*Gilia transmontana*	transmontane gilia
GLLE3	*Glycyrrhiza lepidota*	American licorice
HECU3	*Heliotropium curassavicum*	salt heliotrope
JUBA	*Juncus balticus*	Baltic rush
LASE3	*Langloisia setosissima*	Great Basin langloisia
LEFL2	*Lepidium flavum*	yellow pepperweed
LELA2	*Lepidium latifolium*	broadleaved pepperweed
LETR5	*Leymus triticoides*	beardless wildrye
MALE3	*Malvella leprosa*	alkali mallow
NADE	*Nama demissum*	purplemat
POMO5	*Polypogon monspeliensis*	annual rabbitsfoot grass
SAEX	*Salix exigua*	narrowleaf willow
SAGO	*Salix gooddingii*	Goodding’s willow
SALA3	*Salix laevigata*	red willow
SAVE4	*Sarcobatus vermiculatus*	greasewood
SCAC3	*Schoenoplectus acutus*	hardstem bulrush
SCAM6	*Schoenoplectus americanus*	chairmaker’s bulrush
SCMA	*Schoenoplectus maritimus*	cosmopolitan bulrush
SPAI	*Sporobolus airoides*	alkali sacaton
TARA	*Tamarix ramosissima*	saltcedar
TYDO	*Typha domingensis*	southern cattail
TYLA	*Typha latifolia*	broadleaf cattail

5.5.1 Intake Lease

The Intake Lease is utilized by horses and mules. The lease, which is approximately 102 acres, is comprised of three fields:

- Intake
- Big Meadow Field
- 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 transects that would meet the proper range trend/utilization criteria. Much of the meadow in the Big Meadow Field was covered with dredged material from the LORP Intake during the implementation of the LORP project. The East Field consists of upland and riparian vegetation. 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.

Utilization

The Intake Field had no grazing in 2018.

Summary of Range Trend Data and Conditions

Range Trend data was not collected in 2018 on the Intake Lease.

Irrigated Pastures

There are no irrigated pastures on the Intake Lease.

Stockwater Sites

There are no stockwater sites on the lease. Stockwater is provided by the Owens River.

Fencing

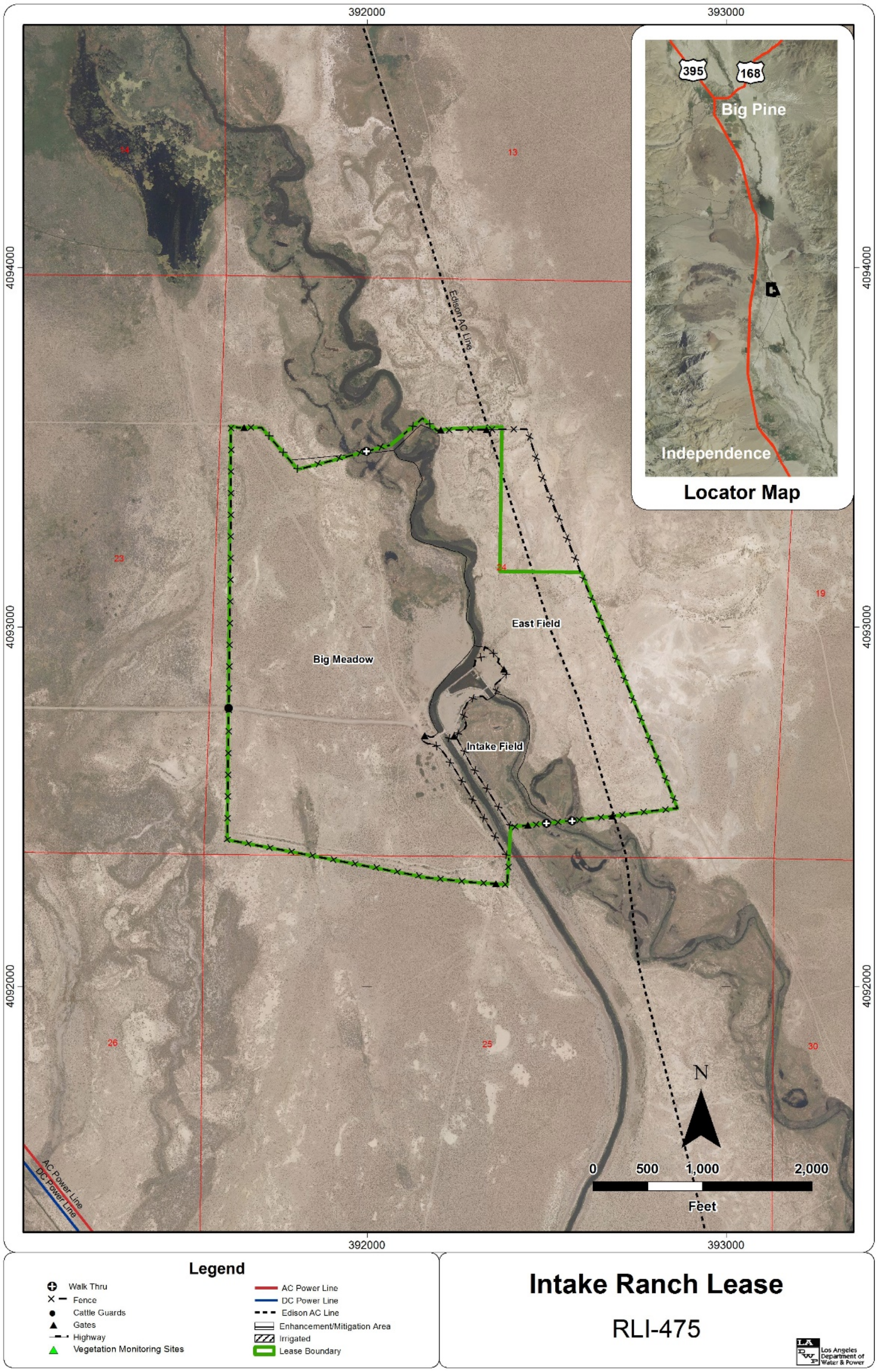
There was no new fence construction on the lease in 2018.

Salt and Supplement Sites

There are no salt and supplement sites on the lease.

Burning

No burns were conducted on the lease in 2018.



Land Management Figure 1. Intake Ranch Lease

5.5.2 Twin Lakes Lease

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. 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
- 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.

Riparian Management Areas

Utilization in the Lower Blackrock Riparian and Upper Blackrock Field was below the allowable utilization standard of 40% for the grazing season. Much of the grazing occurred in the uplands of all pastures due to water spreading activities. There are no recommended management changes for the lease.

Upland Management Area

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

Summary of Range Trend Data and Conditions

Minor changes have occurred across the lease in 2018. A significant decline in SPAI was observed at TWINLAKE_02 while at the same time alkali cordgrass (*Spartina gracilis* SPGR) and DISP continued to maintain an upward trend which indicates a possible rise in soil salinity across the site.

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 xeric Saline Meadow ecological site. Plant frequencies remain static while shrub cover continues to decrease in 2018.

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 Baltic rush (*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.

This transect was burned in mid-February 2009. Shrub cover prior to the burn was moderate which resulted in a lower intensity burn when compared to similar areas further south in Drew Slough. Because of the low intensity fire, a decrease in shrub frequency, shrub cover, and shrub recruitment were observed in 2009-12 and total disappearance of shrubs on the transect in 2015-18. SPGR and DISP significantly increased in 2010 and continued to increase in 2018. SPAI also increased markedly in 2012 but subsequently dropped to all-time lows in 2015 and then slightly increased in 2018. Utilization was minimal on the site in 2018 and has historically been very light.

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 unavailable.

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 DISP on the site. Nevada saltbush was much greater than the described potential for the site prior to 2013. The site also lacks in diversity of perennial grasses. DISP on the site has remained relatively static over time on the site. Salt heliotrope (*Heliotropium curassavicum* HECU3) appeared for the first time on the site in 2018. Fivehorn smotherweed returned to the site again in 2018. The transect was inside the Twin Lakes burn in 2013 which reduced Nevada saltbush shrub cover to zero from 2015 to present.

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 bassia. Salt heliotrope (HECU3) dramatically increased within the site in 2018 and dominated a large portion of the area supplanting wildrye. Frequency significantly decreased for bassia in 2018. Inkweed frequency in 2009 and 2010 was greater than baseline parameters (2002-04 and 2007) but dropped significantly in 2012 and has disappeared over the last two years. Nevada saltbush cover appears to be on the upswing after its near disappearance in 2017. There is a large population of LELA2 in the general area. No utilization estimates exist for the site due to the absence of key forage species.

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 in the understory. Plant frequency in 2009 indicated a significant increase in Nevada saltbush and bassia. Bassia disappeared until 2017 and was absent again in 2018. In 2010, DISP decreased to its lowest level for the site but has since recovered. LELA2 is found in and around the area. Flooding in 2017 eliminated all Nevada saltbush on the site and inkweed has not been observed over the last two years of sampling.

Irrigated Pastures

There are no irrigated pastures on the Twin Lakes Lease.

Fencing

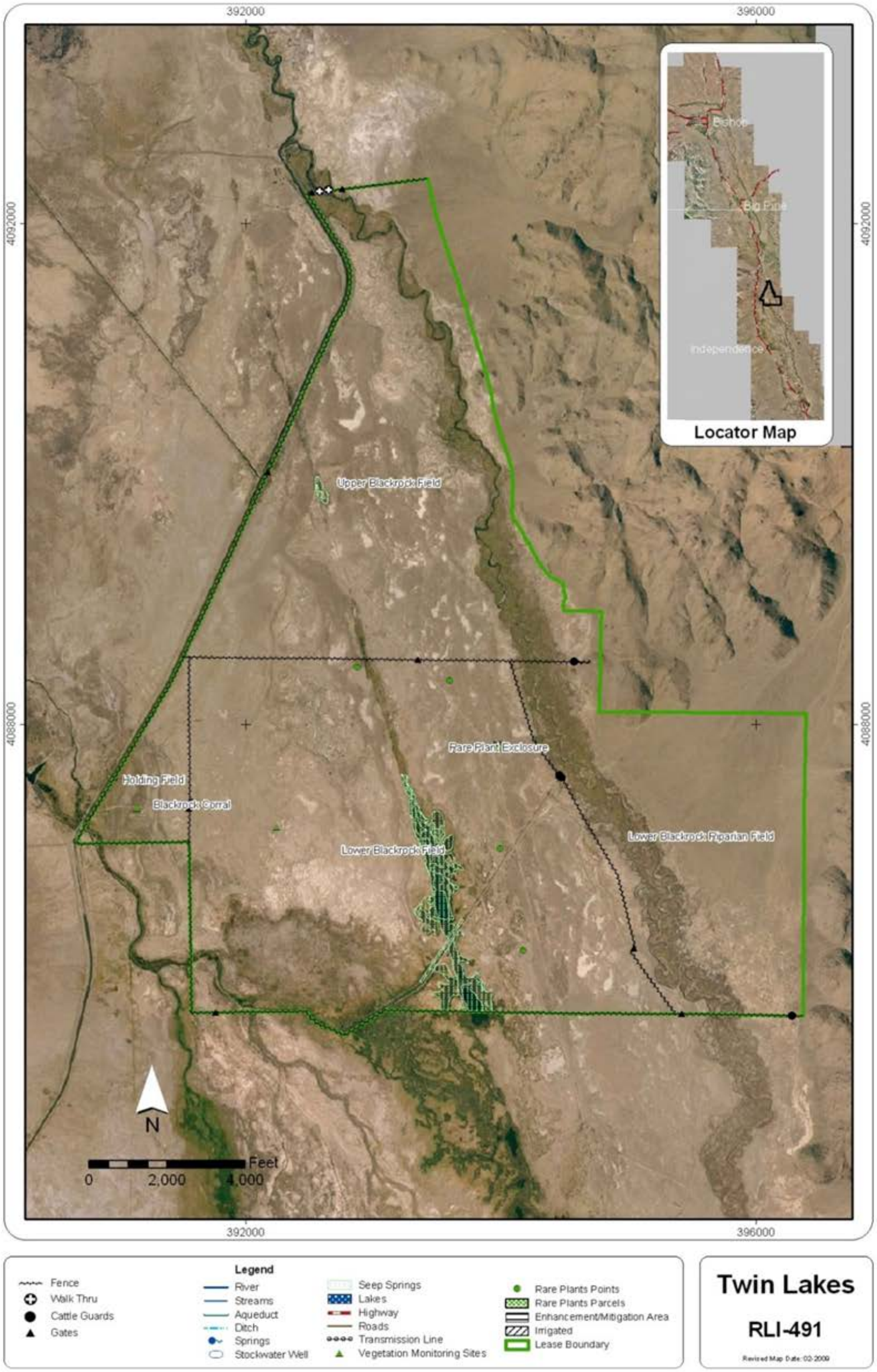
There was no new fencing constructed on the lease in 2018.

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

No burns were conducted on the lease in 2018.



Land Management Figure 2. Twin Lakes Lease

5.5.3 Blackrock Lease

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 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 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
- North Blackrock Holding

Twelve of these pastures are monitored using range trend and utilization. The other eight 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.

Riparian Management Area

Riparian grazing on the Blackrock Lease was below the allowable 40% utilization standard. High flows this summer contributed to loss of riparian meadow due to extended periods of inundation.

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 were not collected in 2018.

Irrigated Pastures

There are no irrigated pastures on the Blackrock Lease.

Stockwater Sites

Two new stockwater wells were drilled this fall on the Blackrock Lease. One south of Mazourka Canyon Road and one north of Mazourka Canyon Road. The wells will be fitted with a solar pumps and necessary plumbing for the trough. The lessee will be responsible for water troughs and installation.

Fencing

There was no new fencing constructed on the lease in 2018.

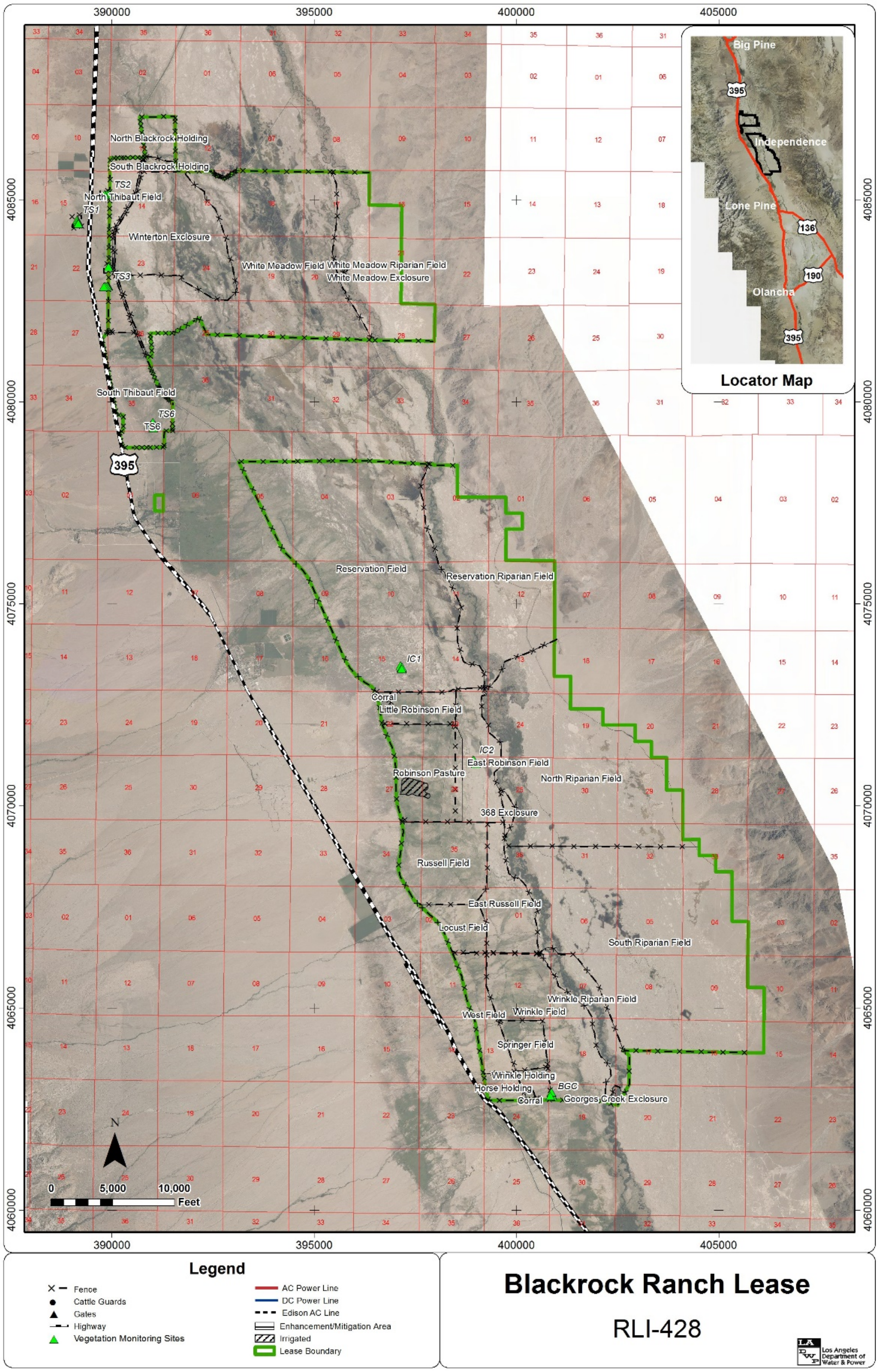
Salt and Supplement Sites

Many of the supplement sites located on the Blackrock Lease have been in place for many years and are located in upland management areas. A liquid molasses protein is placed in portable feeding stations at these locations.

Burning

In 2016 LADWP finalized Vegetation Management Plans (VMP) for the Winterton and Long Pond Prescribed Burns with Calfire. Per these agreements, Calfire will serve as the lead agency implementing the burns on City of Los Angeles property and LADWP will serve in a contingency role and provide manpower and resources as necessary. These agreements are both valid until March 2020. Due to highly saturated conditions, these burns were not conducted in the 2016-2017 winter or spring, nor did they occur in 2018. Burn prep for the Long Pond Burn is anticipated to again occur in fall 2018 with the burn occurring shortly thereafter. The Winterton Burn and associated preparation will also occur in winter 2018-2019 if conditions allow.

The Moffat Fire (wildlife) burned approximately 150 acres in the southern portion of the Wrinkle Riparian pasture in early April 2018.



Land Management Figure 3. Blackrock Ranch Lease

5.5.4 Thibaut Lease

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:

- Blackrock Waterfowl Management Area
- Rare Plant Management Area
- Thibaut Field
- Thibaut Riparian Exclosure

The irrigated pasture portion located in the Thibaut Field is assessed using irrigated pasture condition scoring and the upland portions of the field were evaluated using utilization transects. Large areas of the Thibaut Lease were flooded beginning in early January 2017. Similar to the flooded portions of the Blackrock Lease, residual areas that were not totally underwater exhibited unusually high plant vigor while other areas that were underwater showed a decrease in forage production due to plant mortality. Residual moisture from the water spreading continued to manifest itself thru strong plant vigor throughout the summer of 2018.

Riparian Management Areas

The Thibaut Riparian Pasture has been excluded from grazing since the implementation of the LORP project. A grazing exclosure was constructed during the winter of 2018 (Land Management Figure 4). Livestock will now be permitted to graze the remainder of the Thibaut Riparian Pasture.

Upland Management Areas

The end-of-season use was below the allowable utilization grazing standard of 65%.

Summary of Range Trend Data and Conditions

Range trend data were not collected in 2018 at the lease level.

Irrigated Pastures

No irrigated pasture evaluations were conducted in 2018. The irrigated pasture in the Thibaut Field met the minimum standard of 80% in 2016.

Stockwater Sites

Stockwater is provided by the Los Angeles Aqueduct and a stockwater well located in the Thibaut Field.

Fencing

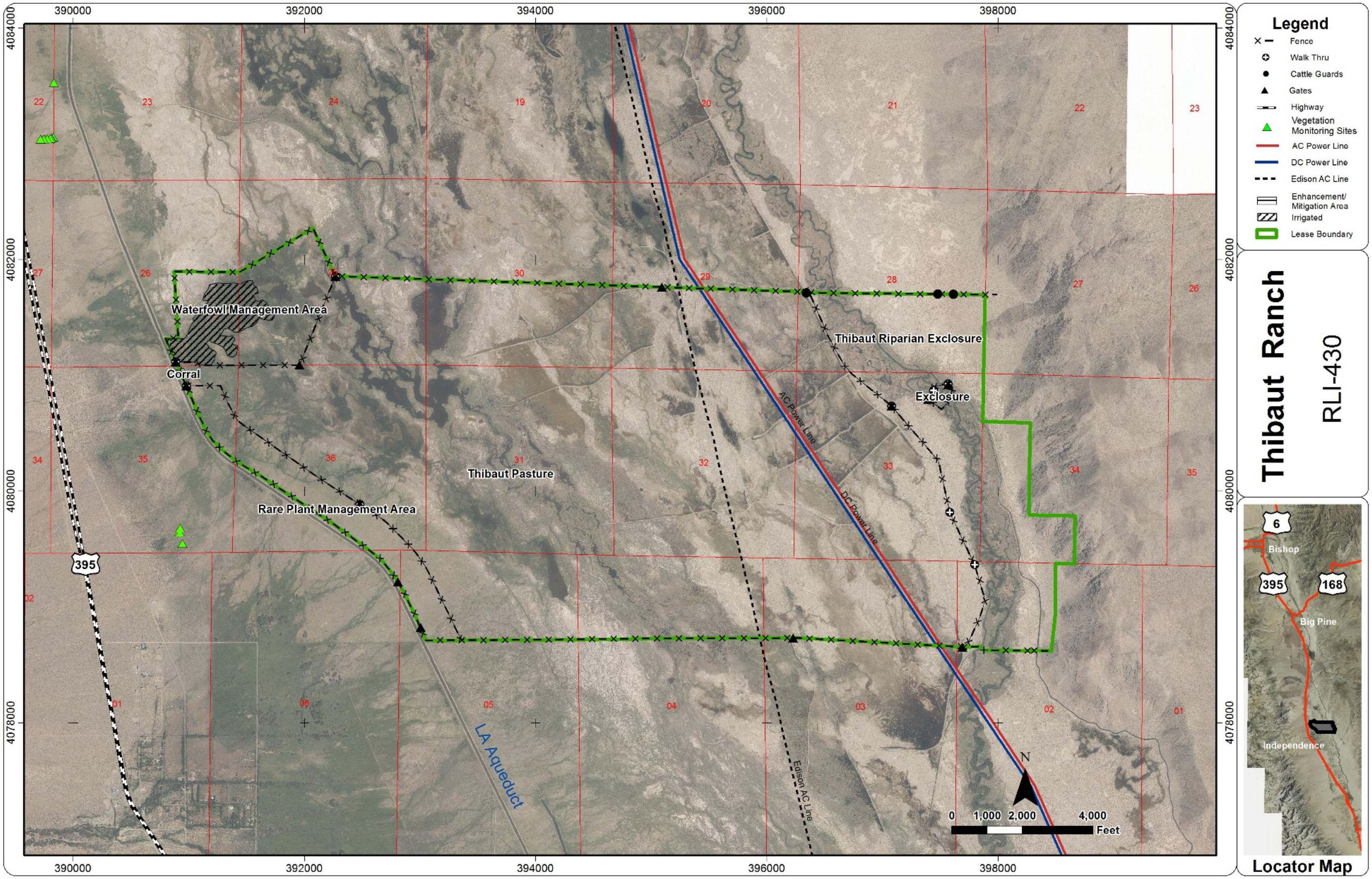
A grazing exclosure was constructed in the Thibaut Riparian Pasture during the winter of 2018.

Salt and Supplement Sites

Horses and mules are fed hay in the winter. There are no established supplement sites on the lease.

Burning

No burns were prescribed burns were conducted on the lease in 2018.



Land Management Figure 4. Thibaut Ranch Lease

5.5.5 Islands Lease

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, Carasco North, Carasco South, and Bull Pasture are spring dominated upland pastures.

Riparian Management Areas

All utilization transects on the Islands Lease were evaluated in 2018. Due to the continued inundation in the River Field, all of the meadows in the immediate area of the islands were flooded leaving only the southern end of the River Field for grazing. The southern portion of the Islands was below the allowable utilization standard of 40%.

Upland Management Areas

All upland pastures were well below the allowable 65% utilization rate in 2018

Summary of Range Trend Data

No range trend data were collected on the Islands Lease in 2018.

Irrigated Pastures

The B and D Pastures located near Reinhackle Spring rated 88% in 2016. No evaluations were conducted in 2018. There are no management changes recommended.

Stockwater Sites

There are two stockwater sites located 1-1.5 miles east of the river in the River Field uplands. These stockwater wells were drilled in 2010 and are now operational. The lessee has yet to install the water troughs at the wells.

Fencing

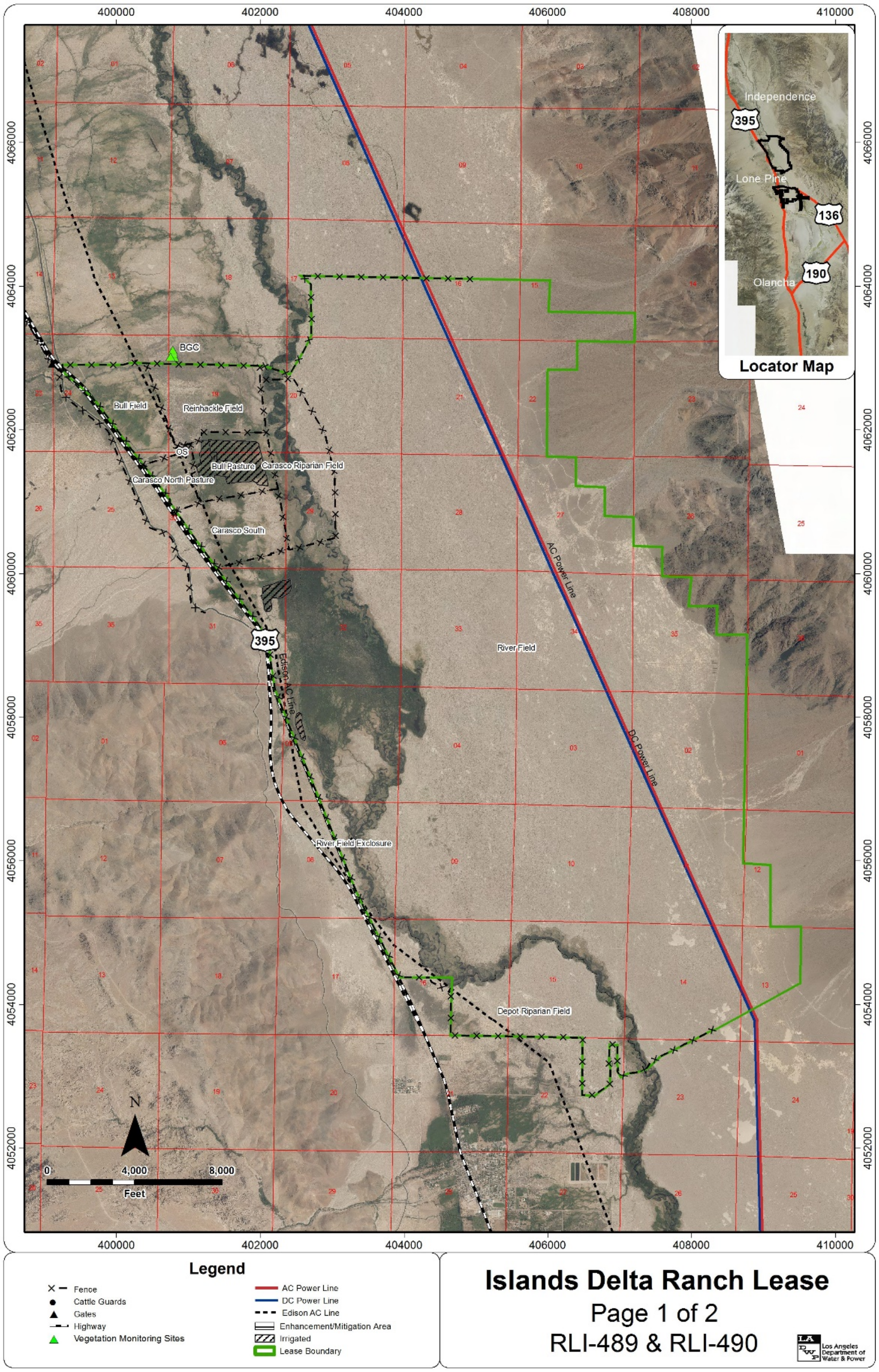
There was no new fence constructed on the lease in 2018.

Salt and Supplement Sites

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

The Moffat Fire (wildfire) burned a large portion of the Carasco Riparian Field and the River Field in early April 2018. The fire improved meadow habitat along the edges of the burn in the drier areas. The wetted areas recovered vigorously with bulrush.



Land Management Figure 5. Islands and Delta Ranch Leases (Islands Portion)

5.5.6 Lone Pine Lease

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 typically 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 to Forest Service grazing allotments on the Kern Plateau.

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

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

Riparian Management Area

Utilization was below the allowable 40% utilization standard. Herbaceous vegetation has fully recovered since the burn in 2013. Woody riparian species are continuing to recover and many willows are re-sprouting.

Upland Management Area

The upland utilization was below the allowable standard of 65%.

Summary of Range Trend Data and Conditions

There was a decrease in DISP on LONEPINE_06, but this decrease was still within ranges observed previously on the transect. Aside from this one change, all other 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 had 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 DISP. The overall biomass of shrubs is typical for a Moist Floodplain ecological site. No non-native species were detected at the site. LETR5, 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 DISP comprising the bulk of the biomass. DISP frequency significantly increased in 2009, outside its historic range from 2002-07 and in 2010-12 returned to levels typically observed on the site. DISP again increased in 2015 and then decreased in 2018 to levels typical for the site. SPAI increased slightly in 2018 but still remains well below historical levels for the site. No non-native species were detected at the site.

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 had ranged between 74% and 87% during sampling periods between 2002-07, indicating the site is in excellent condition. The site is grass-dominated with DISP 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 non-native species were detected at the site. This site, based on the ecological site description and frequency trends, is stable and in excellent ecological condition.

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 had 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 LETR and 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 LETR, JUBA and riparian trees and the disproportionate amount of SPAI which can better thrive in both the mesic and xeric transitional zones. The site is grass-dominated with DISP and SPAI 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 River 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 DISP, and increasing SPAI which is typical for gradient in zones moving from wet to dry areas. No non-native species were detected at the site. The site remained static in 2018.

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.

The similarity index has ranged between 69% and 77% between 2002-07. Nevada saltbush (*Atriplex torreyi* [ATTO]) has trended down over time. Frequency of DISP significantly increased in 2009 and decreased in 2010 to similar levels to that seen during the baseline period. In 2015, SPAI and DISP 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. In 2017 the site was fully submerged with cattail present in the sampling area. Range trend transects are selected in part because they are representative of a larger area or ecological site that has been identified as important for land managers. Because of these atypical impacts to the Lonepine_05 are not representative of the Johnson Pasture as a whole, the transect was not read in 2018.

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. This exclosure is a non-grazed reference site. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes on a Moist Floodplain ecological site. In the spring of 2015 the exclosure was compromised and livestock entered and grazed the exclosure. The fence has since been repaired and extended further into the river to prevent cattle reentry.

The similarity index had ranged between 66% and 84% between 2003 and 2007. Site production had 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 DISP and SPAI. Other forage species such as LETR and JUBA are lacking at this site. One non-native species, bassia, has been detected at the site. Frequency results in 2010 were static since baseline. There was a significant decrease in salt grass in 2012. The exclosure was completed in February 2009. SPAI, following the 2013 fire was at its all-time low while in 2015, both SPAI and DISP had increased to its highest level seen. Utilization is not estimated because the site is inside a livestock grazing exclosure. Trends were static in 2018.

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 DISP. Other forage species such as SPAI 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 non-native species were detected at the site. Between 2007 and 2015 frequency had not changed significantly on the site. In 2018, DISP significantly decreased but still remained inside the historical range for the transect.

LONEPINE_08

This site is located 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 that had occurred has been an increase in *Scirpus americanus.* In 2018 this site was enveloped by marsh and has become inaccessible to monitor.

Irrigated Pastures

The irrigated pastures within the LORP project area for the Lone Pine Lease are the Edwards, Richards, Smith, Old Place, and Van Norman Pastures. Irrigated pasture evaluations were conducted in 2016 and all pastures except the Old Place rated above the minimum score of 80%. The Old Place pasture could benefit from more irrigation water as well as better water distribution. In 2017 the Old Place pasture rated 86%. The Old Place pasture was not rated in 2018.

Stockwater Sites

One stockwater well was drilled on the Lone Pine Lease 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 was not operable. A new well location had been selected a quarter of a mile south of the current location and was drilled during the winter of 2018. LADWP plans to complete installation of the pump and storage tank during the winter of 2018-19.

Fencing

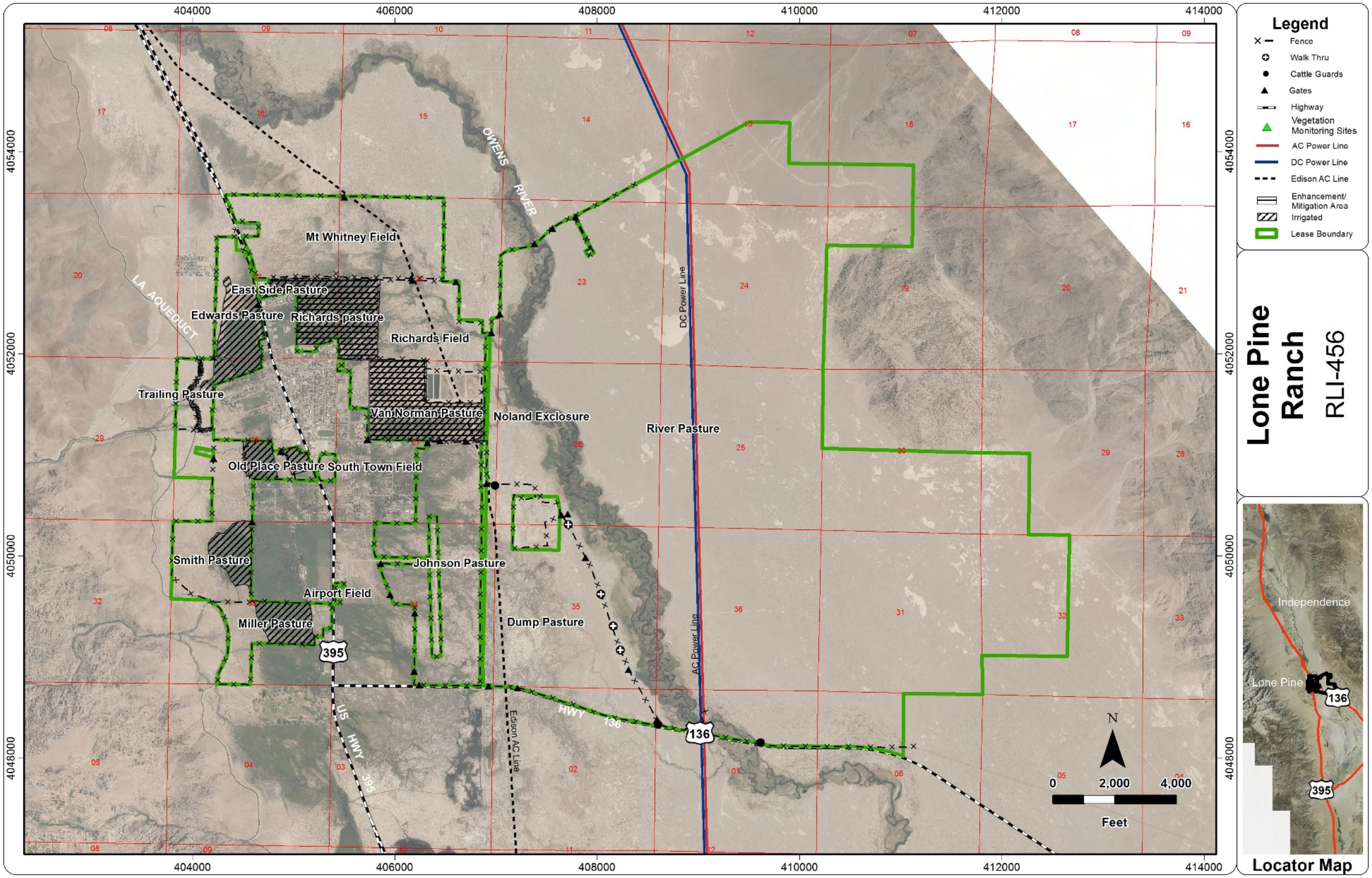
There was no new fencing constructed on the lease during 2018.

Salt and Supplement Sites

All supplement tubs were situated outside of the flood plain.

Burning

No burns were conducted on the lease in 2018.



Land Management Figure 6. Lone Pine Ranch Lease

5.5.7 Delta Lease

The Delta Lease is a cow/calf operation and consists of 7,110 acres divided into four fields within the LORP project boundary:

- Lake Field
- Bolin Field
- Main Delta Field
- 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 estimates are taken 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 portion, northwest of Owens Lake, supports little in the way of forage and has no stockwater.

Riparian Management Areas

End-of-season utilization was below the allowable utilization standard of 40%.

Upland Management Areas

The upland grazing was below the allowable utilization standard of 65%.

Summary of Range Trend Data and Conditions

No range trend transects were read on the Delta Lease.

Irrigated Pastures

The Lake Field is located west of U.S. Highway 395 north of Diaz Lake. This irrigated pasture was evaluated in 2016 and received a score of 88%. The Lake Field was not rated in 2018.

Stockwater Sites

The Bolin Field was to receive stockwater, supplied by the Lone Pine Visitor 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 the visitor center and provide stockwater. Stockwater is supplied from a diversion that runs from Tuttle Creek.

Fencing

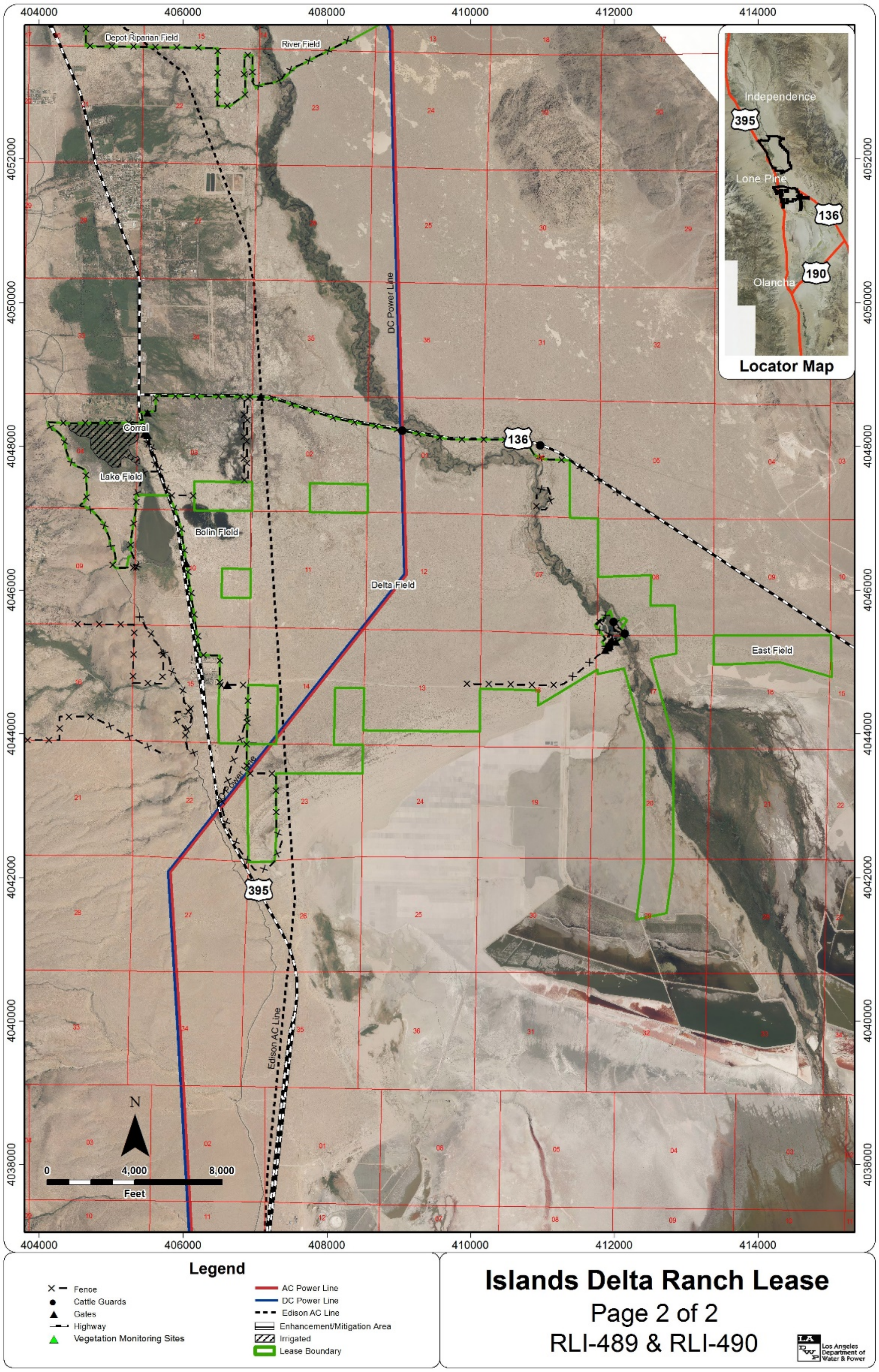
There was no new fencing on the lease for 2018.

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

No burns were conducted on the lease in 2018.



Land Management Figure 7. Islands and Delta Ranch Leases (Delta Portion)

5.6 Land Management Conclusion

Utilization

Utilization on all leases continues to meet with grazing management plan utilization standards.

Above normal precipitation and water spreading activities in 2017 has allowed for good forage production in the upland portions of these leases. The Islands lease will continue to operate below normal stocking rates due to riparian pastures still being continually inundated. Past and current flow management has perpetuated this problem beyond the Islands lease and is now effecting portions of the Blackrock lease. Continued loss of meadow habitat and stressed woody species has increased on both Islands and Blackrock leases. This will put more grazing pressure on the available forage in riparian pastures and increase the probability of impacts on riparian obligate species.

Terminating irrigation practices in Mono County will significantly reduce summer grazing in Long Valley. LORP lessees (RLI-491 & RLI-428) who lose the forage base in Long Valley and lack viable alternatives will likely look to extending grazing periods within the LORP project area to offset the elimination of AUMs (animal unit months) in Long Valley. Land managers and the lessees need to closely examine potential adaptive management strategies for modifying grazing practices and periods within the LORP. However, the scientific team will need to evaluate the potential effects those changes could have on other elements of the LORP prior to implementation.

Range Trend

Riparian Management Areas

Range trend results point towards stable or upward trends on moist floodplain sites. On sites along Reach II HECU3 increased dramatically on several sites where they have typically been absent or only detected in sparse amounts.

Upland Management Areas

Upland areas remained stable in 2018. Field observations indicate perennial grasses still exhibit strong vigor, likely in response to a shallow water table caused by the 2017 water spreading efforts.

Terminating irrigation practices in Mono County will significantly reduce AUMs in Long Valley. LORP lessees who grazed cattle on irrigated pastures in Long Valley may wish to offset this reduction by extending grazing periods within the LORP project area. Historically, livestock grazing has only occurred in the LORP area during the dormant season because of the availability of summer pastures in Long Valley and the Kern plateau. Summer grazing on the LORP would require extra vigilance by both land managers and livestock operators to ensure that existing rangeland conditions do not deteriorate with the increase of grazing pressure throughout the year. While adjustments to the period of use within the LORP will be considered, the LORP scientific team will need to evaluate the potential affects those changes could have on other elements of the LORP prior to implementation.

The northern tamarisk beetle (*Diorhabda carinulata*) was observed on the Lower Owens River last summer in two locations. This summer the beetle has consumed saltcedar in several areas inside the LORP Project area. The effect of the beetle on saltcedar in the LORP is currently unknown.

Irrigated Pastures

All irrigated pastures were evaluated in 2016. Pastures that scored below 80% in 2016 were revisited in the summer of 2017, but none were evaluated in 2018. All irrigated pastures in the LORP management area will be rated again in 2019.

5.7 References

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Land Management Appendix 1. End of Season Utilization by Lease and Pasture, 2007-2018

End of Season Utilization by Lease and Pasture, 2007-2018

Lease Name	Pasture Name	Transect Name	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Blackrock	Horse Holding	BLKROC_09	67%	13%	1%	36%	29%	31%	0%	0%	0%	0%	0%	0%
		HORSEHOLD_02		59%	37%	34%				0%				
	Horse Holding Total		67%	36%	19%	35%	29%	31%	0%	0%	0%	0%	0%	0%
	Locust Field	BLKROC_06	68%	15%	14%	34%	13%	32%	32%	53%	18%	32%	0%	25%
	Locust Field Total		68%	15%	14%	34%	13%	32%	32%	53%	18%	32%	0%	25%
	North Riparian Field	BLKROC_12		67%	6%	16%								
		BLKROC_22	72%	36%	36%	43%	31%	10%		21%	20%	23%	20%	12%
	North Riparian Field Total		72%	51%	21%	29%	31%	10%		21%	20%	23%	20%	12%
	Reservation Field	BLKROC_02	69%	31%		36%		18%	35%	0%	17%	11%	30%	0%
		BLKROC_03	81%	44%	54%	46%	53%	27%	33%	12%	13%	13%	11%	3%
		BLKROC_44	72%	37%	49%	45%		28%	40%	22%	43%	10%	0%	0%
		BLKROC_49	41%	10%	12%	16%	0%	11%	0%	0%	0%	0%	0%	0%
		BLKROC_51	80%	46%	48%	33%	41%	39%	44%	15%	30%	16%	12%	26%
		RESERVATION_06			29%	48%	23%	34%	30%	18%	15%	13%	30%	0%
	Reservation Field Total		68%	34%	38%	37%	29%	26%	30%	11%	20%	10%	14%	5%
	Robinson Field	BLKROC_04	76%	58%	14%	22%	8%	38%	24%		9%	1%	0%	0%
		ROBINSON_02		52%	15%	23%	4%	18%	25%			7%	0%	0%
	Robinson Field Total		76%	55%	14%	23%	6%	28%	25%		9%	4%	0%	0%
	Russell Field	BLKROC_05	85%	43%	19%	48%	13%	24%	22%	2%	2%	13%	0%	13%
		RUSSELL_02		55%	12%	31%	0%	28%	31%	0%	1%	4%	0%	13%
	Russell Field Total		85%	49%	15%	39%	6%	26%	26%	1%	1%	8%	0%	13%
	South Riparian Field	BLKROC_13	45%	29%	28%	10%	31%			15%		0%	5%	23%
		BLKROC_23	25%	8%	43%	20%	22%	8%			27%	0%	25%	7%
		SOUTHRIP_03		39%	5%	33%	19%			7%	12%	0%	7%	
		SOUTHRIP_04					20%			2%	5%		0%	5%
	South Riparian Field Total		35%	25%	26%	21%	23%	8%		8%	15%	0%	9%	12%

Land Management Appendix 1. End of Season Utilization by Lease and Pasture, 2007-2018, continued

	Springer Field	BLKROC_08	77%	43%						0%	5%	1%	0%	0%
	Springer Field Total		77%	43%						0%	5%	1%	0%	0%
	White Meadow Field	BLKROC_01	7%	2%	4%	4%	0%	9%	18%	0%		7%	0%	0%
		BLKROC_39	0%	4%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%
		WHITEMEADOW_03		15%	37%	12%		29%	43%	0%	10%	19%		4%
		WHITEMEADOW_04		7%	0%	0%	0%	3%	0%	5%	0%	0%	0%	0%
		WHITEMEADOW_05		17%	52%	34%	36%	54%	32%	29%	0%	35%	0%	13%
	White Meadow Field Total		3%	9%	19%	10%	9%	19%	19%	7%	3%	12%	0%	3%
	White Meadow Riparian Field	BLKROC_11			75%	0%	68%	55%		16%	27%	26%	22%	5%
		BLKROC_14	87%	0%										
		BLKROC_26					45%			18%				31%
		WMRIP_T2										0%	0%	
		WMRIP_T5						23%				11%	3%	
		WMRIP_T4						23%				44%		4%
		WMRIP_T1						26%				12%	27%	
	White Meadow Riparian Field Total		87%	0%	75%	0%	57%	32%		17%	27%	19%	13%	13%
	Wrinkle Field	BLKROC_07	51%	28%	26%	40%		7%	28%	6%	7%	16%	0%	4%
		WRINKLE_03		37%	28%	48%	24%	34%	17%	35%	0%		0%	9%
	Wrinkle Field Total		51%	33%	27%	44%	24%	20%	22%	21%	3%	16%	0%	6%
	Wrinkle Riparian Field	BLKROC_18	30%	21%	43%	46%	48%				3%	10%	7%	10%
		BLKROC_19	0%	10%	12%	26%	8%				10%	18%	0%	13%
		BLKROC_20	0%	11%	34%	53%	12%				28%	15%	13%	0%
		BLKROC_21	0%	9%	28%	38%	6%				15%	19%	0%	0%
	Wrinkle Riparian Field Total		8%	13%	29%	41%	18%				14%	16%	5%	6%
	West Field	WRINKLE_02				22%	38%	41%	36%	9%	39%	7%	0%	0%
	West Field Total					22%	38%	41%	36%	9%	39%	7%	0%	0%
Delta	Bolin Field	BOLIN_02							25%		5%			16%
		BOLIN_01						65%	27%	16%				0%
	Bolin Field Total							65%	26%	16%	5%			8%

Land Management Appendix 1. End of Season Utilization by Lease and Pasture, 2007-2018, continued

	Main Delta	DELTA_01	58%	56%	59%	70%	38%	30%	19%	39%	35%	53%	9%	3%
		DELTA_02	61%	49%										
		DELTA_03	72%	60%	54%	71%	12%	45%	26%	50%	8%	59%	12%	
		DELTA_04	83%	50%	55%	62%	33%	44%	38%	30%	11%	63%	15%	5%
		DELTA_05	50%	73%	54%	29%	50%	42%	40%	22%	60%	43%	24%	14%
		DELTA_06	26%	50%	35%	23%	42%	41%	26%	30%	66%	55%	36%	
		DELTA_07	60%	65%	61%	49%	51%	58%	36%	49%	63%	20%	13%	21%
	Main Delta Total		58%	58%	53%	51%	38%	43%	31%	37%	41%	49%	18%	11%
	Dune Pasture	DELT_UP_01					0%							0%
	Dune Pasture Total						0%							0%
Intake	Intake	STUART_01				0%					0%	0%	0%	0%
	Intake Average					0%					0%	0%	0%	0%
Islands	Carasco Riparian Field South	ISLAND_06	28%	18%	11%			26%	21%		5%	41%	3%	0%
	Carasco Riparian Field South Total		28%	18%	11%			26%	21%		5%	41%	3%	0%
	Depot Riparian Field	ISLAND_08	72%	18%	12%	20%	0%	68%	27%	31%	23%	25%	16%	13%
		ISLAND_09	92%	40%	49%	49%	25%	67%	39%	91%	71%	48%	9%	40%
		RIVERFIELD_07				26%	29%	52%	47%	19%	60%	61%	24%	14%
		RIVERFIELD_09				9%	8%	9%		51%		15%	27%	
		RIVERFIELD_12				44%	41%	71%	58%	38%	63%	53%	1%	0%
	Depot Riparian Field Total		82%	29%	30%	30%	20%	53%	43%	46%	54%	41%	16%	17%
	Lubkin	LUBKIN_01	48%	0%	14%		0%	5%	6%	3%	16%	34%	33%	8%
	Lubkin Total		48%	0%	14%		0%	5%	6%	3%	16%	34%	33%	8%
	River Field - Islands	ISLAND_07	63%		46%	0%	0%		0%	0%				
		ISLAND_10	63%	16%	3%	28%	0%	40%	44%	0%	25%	40%	8%	22%
		ISLAND_11	0%	6%	22%		11%	6%	0%		7%	0%	0%	3%
		ISLAND_12			25%	0%	34%	31%	0%	41%	28%			
		RIVERFIELD_08			47%	3%	0%	71%	52%		34%	0%	5%	
		RIVERFIELD_11				0%	58%	89%	0%		20%			
		RIVERFIELD_06				0%	0%	31%		0%	0%			
		ISLAND_14						81%	20%	48%	49%	67%	0%	
	River Field - Islands Total		42%	11%	27%	4%	15%	50%	17%	18%	23%	27%	3%	13%

Land Management Appendix 1. End of Season Utilization by Lease and Pasture, 2007-2018, continued

	South Field	ISLAND_02	31%	15%	8%		23%	0%		0%		14%		
		ISLAND_59	74%	47%	18%	0%				0%	0%	29%		0%
		SOUTHFIELD_02			3%	7%	24%	19%		0%	0%	36%		14%
	South Field Total		52%	31%	8%	3%	23%	10%		0%	0%	26%		7%
Lone Pine	Johnson Pasture	LONEPINE_05	44%	0%	34%	63%	14%	0%		79%	0%	21%	0%	10%
	Johnson Pasture Total		44%	0%	34%	63%	14%	0%		79%	0%	21%	0%	10%
	River Field - Lone Pine	LONEPINE_01	80%	45%	61%	49%	28%	22%		38%	42%	26%	26%	37%
		LONEPINE_02	79%	47%	48%	25%	30%	32%		30%		29%	24%	45%
		LONEPINE_03	81%	49%	70%	37%	52%	63%		64%	49%	45%	25%	28%
		LONEPINE_04	67%	55%	47%	32%	45%	45%		20%	40%	29%	26%	47%
		LONEPINE_06	78%	44%										
		LONEPINE_07		52%	51%	38%	8%	21%		0%	19%	25%	13%	20%
		LONEPINE_08						42%		52%	21%	24%	35%	49%
	River Field - Lone Pine Total		77%	49%	55%	36%	32%	37%		34%	34%	30%	25%	38%
Twin Lakes	Drew Slough	BLKROC_37	40%	9%	0%	0%	0%	5%	15%		2%		5%	16%
		BLKROC_FIELD_04		10%		0%	0%		23%				7%	0%
		TWINLAKES_02	16%	17%		0%	4%		0%	6%		0%	0%	
		TWINLAKES_05	65%	23%										
	Drew Slough Total		40%	14%	0%	0%	1%	5%	13%	6%	2%	0%	4%	8%
	Lower Blackrock Riparian Field	BLKROC_RIP_07		61%	53%		34%	72%		14%	0%		0%	11%
		TWINLAKES_03	82%	28%	21%	6%	42%	36%				0%	14%	
		TWINLAKES_04	85%											
		TWINLAKES_06												
	Lower Blackrock Riparian Field Total		89%	44%	37%	6%	38%	54%		14%	0%	0%	7%	11%
	Upper Blackrock Field	BLKROC_RIP_05			52%	21%	25%	51%		9%	0%	10%	3%	2%
		BLKROC_RIP_06			53%	19%	29%	74%		10%		0%		56%
		BLKROC_RIP_08		41%	42%	17%	18%	70%		50%		69%	27%	61%
		INTAKE_01	45%		25%	13%	30%	49%		10%	12%	2%	9%	4%
		BLKROC_RIP_09									43%			
	Upper Blackrock Field Total		45%	41%	43%	17%	26%	61%		20%	18%	20%	13%	31%

Land Management Appendix 1. End of Season Utilization by Lease and Pasture, 2007-2018, continued

Thibaut	Rare Plant Management Area	RAREPLANT_02	76%		77%	0%					0%		16%	22%
		RAREPLANT_03	98%		58%	7%		45%	4%		8%	15%		
		THIBAUT_02	88%		49%	0%		34%	36%	29%	13%	34%	11%	7%
	Rare Plant Management Area Total		87%		61%	2%		39%	20%	29%	7%	25%	14%	14%
	Thibaut Field	THIBAUT_03	89%	65%	36%	65%	74%	15%	20%	40%	6%	56%	78%	16%
		THIBAUT_08		15%	8%	4%	0%	14%	0%	0%	1%	7%	2%	0%
		THIBAUT_09		3%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		THIBAUTFIELD_02	81%	64%	62%	31%	76%	30%	0%	22%		44%		
		THIBAUTFIELD_03			13%	3%	0%		5%	0%		2%	0%	
		THIBAUTFIELD_04			6%	0%	0%	0%	0%	0%		7%	0%	
	Thibaut Field Total		85%	37%	22%	17%	25%	12%	4%	10%	2%	19%	16%	8%
	Waterfowl Management Area	THIBAUT_01	80%			3%				50%	40%	3%	9%	0%
		WATERFOWL_02	15%			40%	30%			56%	30%	16%	8%	
		WATERFOWL_03				21%	33%			33%	25%	4%		7%
		WATERFOWL_04	57%			11%	51%							
		WATERFOWL_05	77%				39%							
	Waterfowl Management Area Total		57%			19%	38%			46%	32%	8%	8%	3%

Land Management Appendix 2. LORP Irrigated Pasture Condition Scores, 2011-2018

X= Pasture not rated

LORP Irrigated Pasture Condition Scores, 2011-2018									
Lease	**Pasture**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Thibaut									
	Thibaut Field	82	81	78	X	X	80	X	X
Islands									
	B Pasture	X	90	90	X	X	88	X	X
	D Pasture	X	90	90	X	X	88	X	X
Delta									
	Lake Field	X	X	74	X	X	88	X	X
Lone Pine									
	Edwards	X	X	84	X	X	84	X	X
	Richards	X	X	84	X	X	84	X	X
	Van Norman	X	X	84	X	X	84	X	X
	Old Place	X	X	84	X	X	76	86	X
	Smith	X	X	84	X	X	84	X	X
	Miller	X	X	86	X	X	84	X	X

6.0 RAPID ASSESSMENT SURVEY

LORP Rapid Assessment Report 2018

Dog Head Bend, Lower Owens River east of Lone Pine, CA

Lower Owens River Project
Summary of 2018 Rapid Assessment Survey Observations

An annual survey of the Lower Owens River Project (LORP) area, referred to as the Rapid Assessment Survey (RAS), has been conducted annually beginning in August. The survey this year was conducted August 1 through August 13. Inyo County staff surveyed the wetted edges of the Lower Owens River and the Delta Habitat Area (DHA). Other LORP units, including the Blackrock Waterfowl Management Area (BWMA) and Off-River Lakes and Ponds (OLP) were not surveyed. The 427 observations recorded during this exercise are in the subject of this report.

The primary purpose of RAS monitoring is to detect and record the locations of impacts that can affect the LORP. Some impacts that are recorded by the RAS simply require physical maintenance to correct such as repairing a damaged or cut fence or removing trash and slash. Other impacts such as noxious weeds are long-term challenges that require ongoing surveillance and a strategic response. Positive impacts such as woody tree recruitment documenting reestablishment of native trees are also recorded.

Biological observations allow us to note basic trends in the ecological development of the riparian and riverine environment, wetlands, and ponds. Project managers and scientists use RAS data to track ecological development. For instance, observations as to the quantity of woody recruitment seen year-to-year, and the persistence of new trees, is worth knowing in that the many of the avian habitat indicator species—key markers of the LORP's success--depend on mature tree canopy.

High flows and flooding and the 2017 RAS

A RAS survey was not anticipated in 2018, but extraordinary hydrologic conditions in the LORP in 2017 both prevented access to areas during a typical RAS, and created conditions not anticipated under normal flow management. The 2018 RAS gave us an opportunity to look at the effects of the unusual high flows and flooding that otherwise would not be experienced.

The snow melt associated with the record Sierra snowpack in the winter 2016-2017 led to runoff that proved impossible to contain. To avoid overwhelming the Los Angeles Aqueduct, LADWP was compelled to spread water throughout the Owens Valley including the BWMA area. Water spreading alone could not fully capture the runoff and LADWP had little option but to dispose of the excess water down the Lower Owens River. Peak flows from the intake topped 300 cfs, and flows above 200 cfs were released for 40 days April 4 through July 19, 2017. In response, the water table climbed above the floodplain causing general flooding and in places secondary channels were filled and running (Figure 2).

Last year during the 2017 RAS, flows ranged from 98-125 cfs, which is at least twice the flow experience during all previous years' surveys. The GPS tracks recorded during the 2017 survey showed that the path observers took were in many cases further from the river than in previous years (Map 1). This inconsistency is why, 2018 observations were sometimes compared to 2016 or earlier observations.

Although flows were well above previous experience in all reaches in 2017, and spilled over riverbanks in many places, there was little reported evidence that high flows and flooding physically altered the channel or floodplain. The unique hydrology in 2017 caused some saltbush and rabbitbrush dieback, and areas of saltgrass were covered in algae, but few other flood related observations were recorded

The RAS is designed to note specific impacts, and is generally not a good method to gauge geomorphic and biological effects that might be attributed to high flows or flooding.

During the 2018 RAS field staff was able to access areas thought to be most influenced by high water in 2017. Observations answered important questions about the effects of high water and flooding in 2017-2018, such as: did beaver relocate; did noxious weeds spread outside of localized populations; were roads or fences affected; did tree willow that had recruited at the edges of the floodwaters in 2017 persist; would previous year's woody recruitment survive prolonged flooding?

Map 1. Tracks made by observers 2016, 2017, and 2018

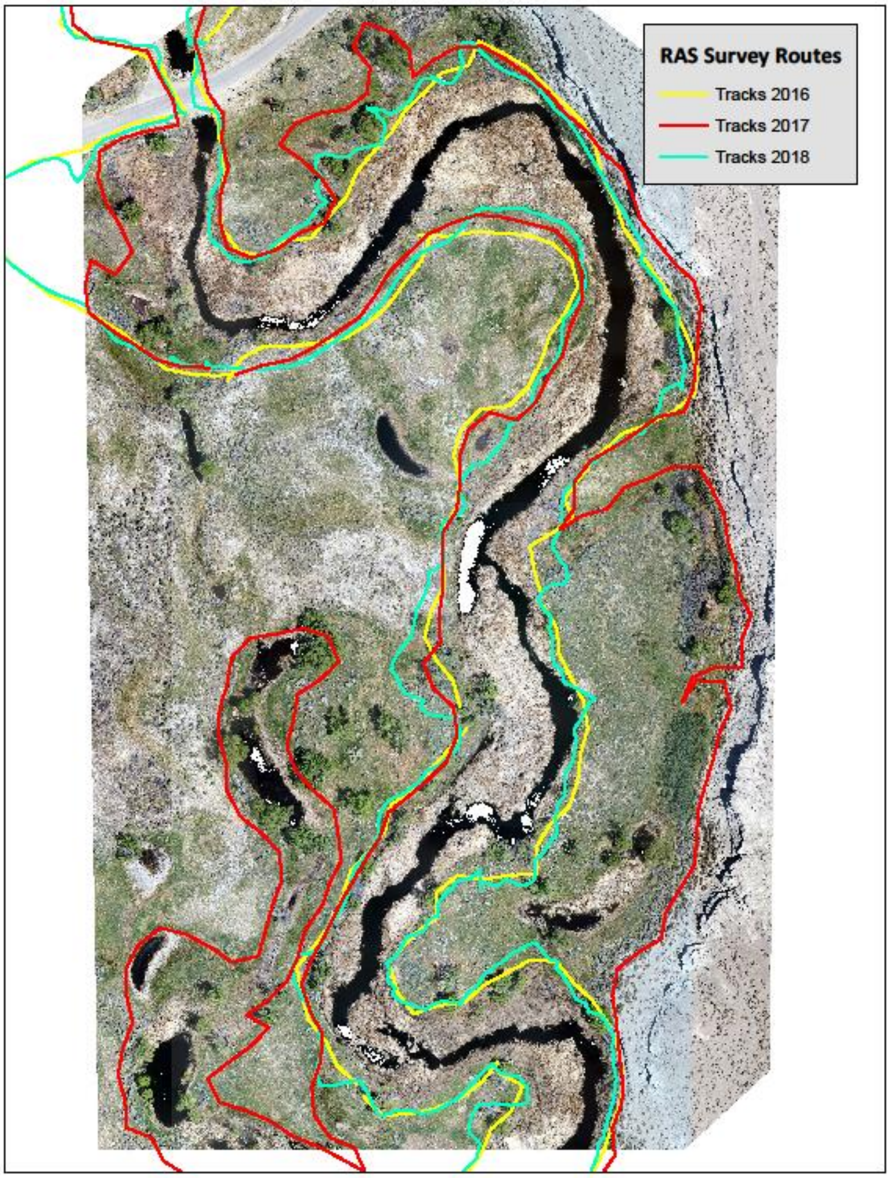


Figure 2. Floodplain inundation example--river reach 5 at 190 cfs on July 17, 2017

2018 RAS Observations

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

Table 1. Catalog of observations recorded by the RAS in 2018*

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.
NOX	Noxious weeds	Any of twenty-one species of locally invasive plants, mainly perennial pepperweed. Only previously unrecorded populations were recorded.
BEA	Beaver	Direct sightings or evidence of beaver activity.
FEN	Fence	Reports of damaged riparian or exclosure fencing.
GRZ	Grazing	Direct sightings of cattle, or evidence of off-season grazing in the floodplain.
REC	Recreational impacts	Evidence of recreational activity and any associated adverse impacts.
ROAD	Road	Previously unidentified roads, road building activities, or roads causing impacts.
TRASH	Trash	Large refuse items or dumping.

* Dead fish, elk sighting and evidence, Russian olive recruitment had been surveyed in previous years, but not in 2018

Table 2. Summary of observations collected by category and location

Code	Observation Type	Map	River Reach 1	River Reach 2	River Reach 3	River Reach 4	River Reach 5	River Reach 6	DHA	Total Observations
WDY	**Woody recruitment**	Map 3	2	32	34	0	1	2	0	71
TARA	**Saltcedar plants (Tamarisk)**	Map 5	21	76	54	10	21	16	22	220
NOX	**Noxious weeds (Lepidium)**	Map 6	19	40	36	0	0	0	0	95
BEA	**Beaver**	Map 7	0	4	3	1	1	0	0	9
FEN	**Fence**	Map 8	0	2	5	1	1	2	0	11
GRZ	**Grazing**	Map 8	0	0	1	0	2	0	0	3
ROAD	**Road**	Map 8	0	0	0	5	2	6	0	13
TRASH	**Trash**	Map 8	0	1	3	0	0	2	0	6
REC	**Recreation impacts & use**	Map 9	0	1	2	0	2	6	0	5

River-reaches

The Lower Owens River is divided up in to six river-reaches, which are defined by channel/ floodplain morphology and hydrologic conditions (Table 3). For the RAS summary these reaches offer a uniform reference for RAS observations taken year to year. Individual observations in the river-riparian corridor are referenced to the nearest tenth of a river-mile. The Lower Owens River Intake is river-mile 0.0, the pumpback station is located at river-mile 53.1, the Delta Habitat Area begins at river-mile 53.7, and the river recedes into the Owens Lake playa somewhere near river-mile 57.6.

When comparing the number of observations found per river-reach it is important to note that the lengths of the reaches are unequal, and that the number of observations by reach for the various categories has not been normalized to account for the differing lengths of the reaches. For example, 90% of the woody recruitment observed in 2018 along the river was recorded in reaches 2 and 3, which together total just about half of river-miles in the entire river-riparian corridor.

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

	Percent of river length	Total river-miles (RM)	River mile extent	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	14%	8.3	53.7 to 62.0 RM	River delta

Map 2. Lower Owens River Reaches/Off-River Management Units

Summary of Observations by Category

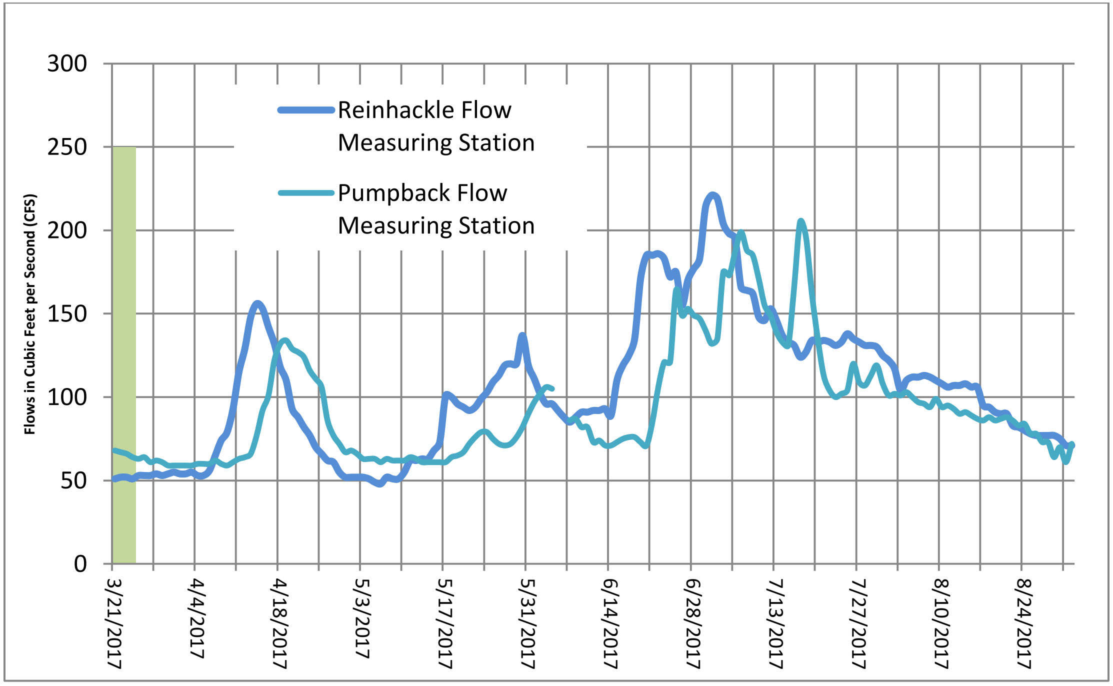
Woody Recruitment (WDY)--*Tables 4-8; Map 3; Figure 2,3*

A focus of the RAS has been to identify areas where trees are establishing. Field observers participating in the RAS are trained to locate, identify, and record willow and cottonwood recruits that are part of the current year's cohort.

The RAS is conducted in early August to be able to detect seedlings that may have germinated as the result of the annual LORP seasonal habitat flow (SHF), which is generally timed to accompany willow seed-fly. Typically, flows above the 40 cfs baseflow are released from the intake in the warmer months of the growing season to offset downstream losses due to evapotranspiration. This is necessary in order to maintain the prescribed 40 cfs flow throughout the river. Some years, the SHF released from the intake has been eclipsed by the flow required to maintain baseflow later in the summer.

In 2017, high flows, up to 326 cfs, began in April, when an early pulse flow was released, and spiked in June and July as runoff peaked (Figure 2). These higher than the prescribed LORP flows inundated the floodplain and low landforms for over a month. Greater than average recruitment observed in 2018 might be attributed to 2017 flooding that hydrated soils and inhibited the established herbaceous layer, which allowed seed establishment on moist soil. It is thought that competition for seeding sites is one of main reasons that yearly recruitment is not as robust as had been predicted.

Figure 2. Lower Owens River flood hydrograph March 21, 2017 to September 1, 2017



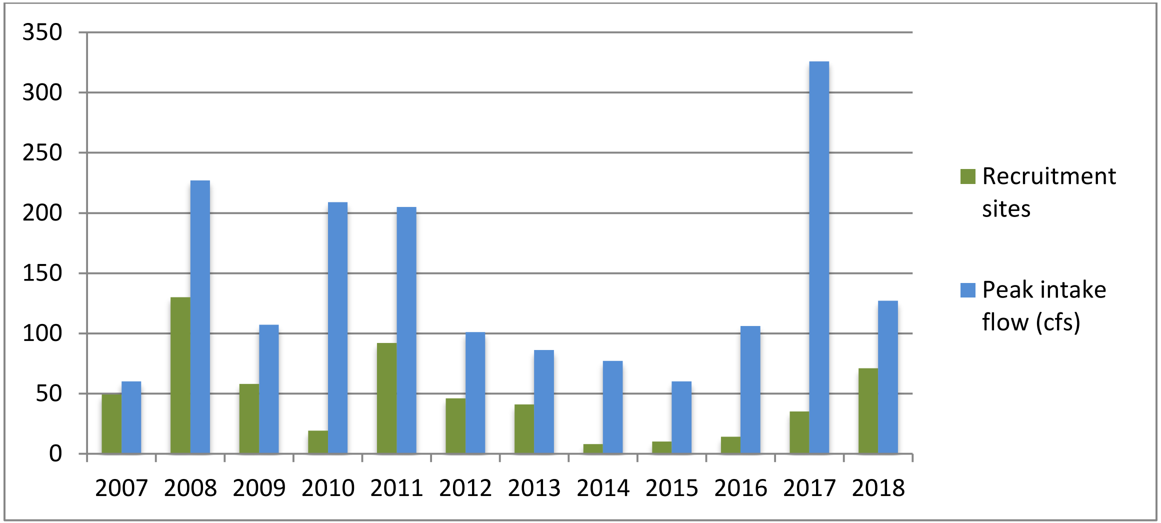
This year, as has been done in past surveys, field staff revisited previous year's recruits to document persistence. Additionally, after the 2018 RAS was completed, another revisit survey was conducted to investigate the persistence of recruitment found during the RAS in all previous years. This report is found as a separate section of the 2018 LORP Annual Report.

In 2018, observers located 71 tree willow recruitment sites and no cottonwood recruits. Total number of recruits was is 200% greater than observed in the 2017 and more tree recruitment than had been observed in the previous six years (Figure 3, Table 4).

All but four willow recruitment sites were found in reaches 2 and 3. About 80% of the recruitment in reach 2 was concentrated between Blackrock Ditch Return and Goose Lake Return; whereas populations were evenly distributed the length of reach 3, from Mazourka Canyon Road to the top of the Islands (Map 3).

Although the higher flows in 2017 may have encouraged recruitment this year, it's unknown how those flooding flows affected previous year's recruitment. Many juvenile plants were in standing water for more than a month. Mature trees were also inundated, but were not surveyed as part of the RAS.

Figure 3, Table 4. Seasonal habitat flow and woody recruitment observed 2007-2018



Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Recruitment sites (not including clonal establishment)	49	130	58	19	92	46	41	8	10	14	35	71
Peak flow, released from intake (cfs)	60	227	107	209	205	101	86	77	60	106	326	127

Notes: The recording and reporting of woody recruitment was 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 (SAEX recruitment ≥ 5 meters from a mature SAEX plant or stand would be considered non-clonal).

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 5. Number of distinct non-clonal recruitment sites by species and reach

Species Code	Common/ Scientific Name	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	BWMA*	OLP*	Total
SAEX	Narrowleaf willow/ *Salix exigua*	0	0	0	0	0	0	0	na	na	**0**
SAGO	Black willow/ *Salix goodingii*	2	32	30	0	1	2	0	na	na	**67**
SALA3	Red willow/ *Salix laevigata*	0	0	4	0	0	0	0	na	na	**4**
SALIX	Hybrid, or unknown	0	0	0	0	0	0	0	na	na	**0**
POFR2	Fremont Cottonwood/*Populus fremontii*	0	0	0	0	0	0	0	na	na	**0**
Total number of Observations		**2**	**32**	**34**	**0**	**1**	**2**	**0**	na	na	**71**

*Not surveyed in 2018

The total numbers of plants found at each recruitment site differed noticeably from last year (Table 5). In 2018, about 50% of recruits were found in small assemblages of 1-5 seedlings, whereas in the previous year only about 10% of recruits were in similarly sized groupings.

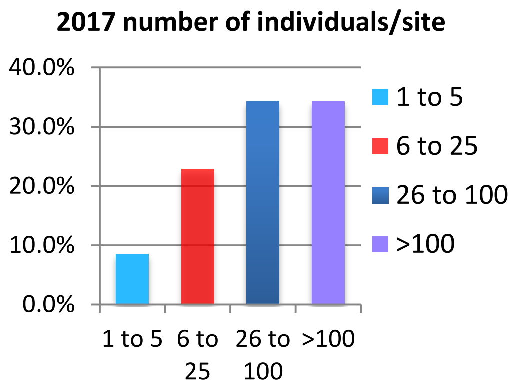
Comparing 2017 to 2018, the number of plants collected in groups of 26-100 individuals decreased fourfold (Table 6). The 2017 seedling success, in terms of density, might be attributed to new opportunities due to flooding. Perhaps an elevated water table, wetted soils elevated above grass and herbaceous species that typically colonize the floodplain under an unvarying hydrologic regime allowed deposited willow seed an interspecific advantage at these new wetted soil locations. Because the path of the RAS survey in the flood of 2017 was often further from the river than in previous years and 2018, any comparison is likely challenging at best (Table 7a, 7b).

It's also possible that 2018's elevated recruitment could be attributed to other environmental stresses and changes in the environment caused by flooding, such as knocking back the herbaceous layer and exposing fresh moist soil to potential seed. While studying flood effects is outside the scope of the RAS, an empirical look at flooding effects on recruitment may be afforded by observing recruitment trends in the future.

The distribution of woody recruitment by reach and year from 2012-2018 is presented in Table 8. Over time the annual distribution of recruitment per reach remained fairly constant with about 34% in Reach 2, and 33% in Reach 3. The OLP area showed the greatest variation in recruitment with 5%-32%. In all other reaches and units, recruitment was less than 10% of the total recruitment in any one year.

Table 6. Plant abundance at recruitment sites in 2018

Species Code	Common Name	Abundance (number of plants per site)			
		1 to 5	6 to 25	26 to 100	>100
SAGO	Black willow	33	23	3	8
SALA3	Red willow	0	1	0	1
SALIX	Hybrid or unknown	0	0	0	0
POFR2	Fremont Cottonwood	0	0	0	0



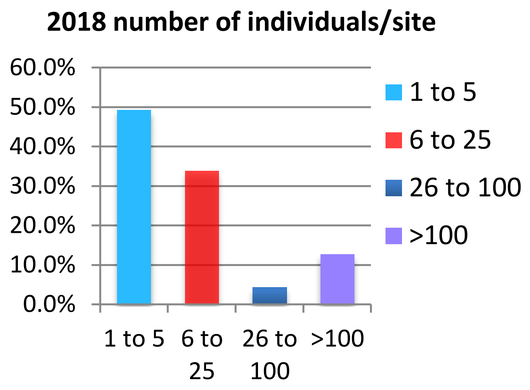


Table 7a. 2018 landform distribution

Species Code	Common Name	Channel	Channel to Bank	Bank	Channel to Floodplain	Floodplain	Upland
SAGO	Black willow	0	5	30	3	29	0
SALA3	Red willow	0	0	3	0	1	0
Percent of total		**0.0%**	**7.0%**	**46.5%**	**4.2%**	**42.3%**	**0.0%**

Table 7b. 2017 landform distribution

Species Code	Common Name	Channel	Channel to Bank	Bank	Channel to Floodplain	Floodplain	Upland
SAGO	Black willow	0	1	12	0	17	0
SALA3	Red willow	0	0	2	0	0	0
Percent of total		**0.0%**	**3.1%**	**43.8%**	**0.0%**	**53.1%**	**0.0%**

Table 8. Distributions of woody recruitment by reach and year, 2012-2018

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	BWMA*	OLP*	Delta	SUM
2012	2	24	18	8	9	6	0	4	2	**73**
2013	3	47	25	1	3	7	5	6	0	**97**
2014	0	11	21	0	2	26	5	6	2	**73**
2015	1	22	17	0	0	1	6	10	3	**60**
2016	4	14	26	0	1	0	0	8	0	**53**
2017	2	19	17	2	1	0	3	21	0	**65**
2018	2	32	34	0	1	2	na	na	0	**71**
Sum total by unit	**14**	**169**	**158**	**11**	**17**	**42**	**19**	**55**	**7**	**492**

*BWMA and OLP not surveyed in 2018

Sites Revisited--Map 4

Sites where woody recruitment, new roads, and evidence of beaver were recorded in the 2017 survey were resurveyed to check for persistence. A total of 57 sites were identified for revisiting, including 31 woody recruitment sites, 22 Lepidium sites, and four beaver sites. The results from these revisits are found in this report in corresponding category sections.

Woody Recruitment Revisits

Woody recruitment sites found in 2017 were revisited in 2018. Of the 31 sites revisited, about 11 (35%) of the 2017 flood-year cohort were found to persist. Of those persisting, six populations had decreased in abundance. The level of recruitment persistence seen in the 2017 cohort is significantly less than that measured in previous years. The unusual hydrology seen in 2017 may have spurred recruitment which did not persist under normal prescribed conditions. Additional study would be required to verify this hypothesis.

A survey of all recorded tree recruitment sites from 2007 to 2015 was be presented in the 2015 LORP Annual Report. A similar survey of all recruitment persistence from 2007 to 2017 will be presented in the 2018 LORP Annual Report.

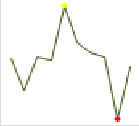
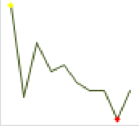
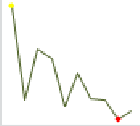
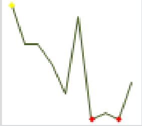
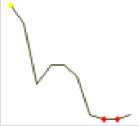
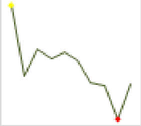
Saltcedar (TARA)--Tables 9, 10; Map 5

Saltcedar (TARA) occurs throughout the LORP. It is the most abundant noxious weed in the project area. In 2018, TARA was only surveyed along the river and in the delta. The BWMA and OLP were not surveyed during the RAS due to the known high density of mature TARA in these areas. In the river and delta, 220 occurrences of TARA were recorded; 198 discrete locations of TARA seedlings and resprouts were found along the river and 22 in the delta. Fewer TARA were observed 2017 likely due to lack of access near the river due to flooding. Comparing 2018 to 2016, the numbers of TARA observed along the river and in the delta were similar except for river reach 1 where observations exceeded all years back to 2012.

Table 9. Total number of observation sites and age class of saltcedar by location in 2018

Age Class	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	Total
Seedlings	2	28	19	0	0	2	0	**51**
Resprouts	0	4	5	5	17	9	8	**48**
Mature	19	44	30	5	4	5	14	**121**
Totals	**21**	**76**	**54**	**10**	**21**	**16**	**22**	**220**

Table 10. Saltcedar Observed by River Reach 2009-2018 with Trends

	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	Total
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**
2016	9	88	55	18	10	12	**192**
2017	0	12	15	4	8	12	**51**
2018	21	76	54	10	21	16	**198**
Trends							

Noxious Weeds (NOX) -- *Table 11, 12; Map 6; Figure 4; 2018 Annual LORP Weed Report*

Ninety-five observations of recent occurrences of Perennial pepperweed, Lepidium latifolium (LELA2) were made along the river.

Since the beginning of the project, LELA2 was largely confined to two distinct locations, one adjacent to the BWMA, and the other below Manzanar Reward Road. These populations were well managed by annual herbicide treatments, and prior to 2017 new plants discovered during the RAS were largely in these separate locations. However, following the flooding in 2017 there was an increase the spread and total number of observations.

Of interest, all LELA2 discovered in the BWMA area in 2016 had been east of the river except for a single population located at the junction of Blackrock Return Ditch and the river. LELA2 occurrences had been recorded on the west side in prior years. The east/west isolation the river might have provided here was apparently lost after the flood event in that 21 new populations were discovered on the west side of the river.

The river's east/west isolation persisted in the Manzanar Reward Road population. There was a doubling of new sites between 2016 and 2018, but of the 36 new populations found in this area in 2018, all were found on the east side of the river.

One could hypothesize that either a different vector or mechanism is responsible for the spread in the BWMA clusters, versus the largely static Manzanar Reward Road populations, or that local geomorphic or hydrologic conditions under flood were dissimilar; where the BWMA populations inhabited the dry incised floodplain and the Manzanar Reward Road populations colonizing a wet incised floodplain. It's also possible that confinement to one side of the river is the result of mammals, rodents in particular, collecting and disbursing seed. More research would be required to determine why the river appears to be a barrier to LELA2 in some areas and not others.

Summary of LELA2 observations:

- LELA2 had been found to be abundant in parts of the BWMA in earlier surveys. The BWMA was not surveyed in the RAS in 2018. The Inyo and Mono Counties Agricultural Commissioner's Office did survey the BWMA (*2018 Annual LORP Weed Report).*
- 95 distinct populations of LELA2 were recorded in 2018, compared to 36 in 2017. The 2017 numbers were likely an undercount, in that observers were unable to access some areas where LELA2 was known to exist. That said, the 2018 count represents an increase over all previous years. The average number of new locations observed 2012-2017 is 38.
- Three of the 36 LELA sites in 2017 showed symptoms of being treated in 2018.
- Past reference: The spread of perennial pepperweed, from 2007 to 2015, is documented in the 2015 LORP RAS Report (2015 Report, Map 5a).

Table 11. *Lepidium latifolium* (LELA2) abundance by LORP unit and river reach

Location	Abundance categories (number of plants/location)				
	1 to 5	6 to 25	26 to 100	> 100	Total
BWMA – Winterton	na	na	na	na	**na**
BWMA-Drew	na	na	na	na	**na**
Reach 1	8	8	2	1	**19**
Reach 2	17	18	4	1	**40**
Reach 3	15	13	8	0	**36**
Reach 4	0	0	0	0	**0**
Reach 5	0	0	0	0	**0**
Reach 6	0	0	0	0	**0**
DHA	0	0	0	0	**0**
Totals	**40**	**39**	**14**	**2**	**95**

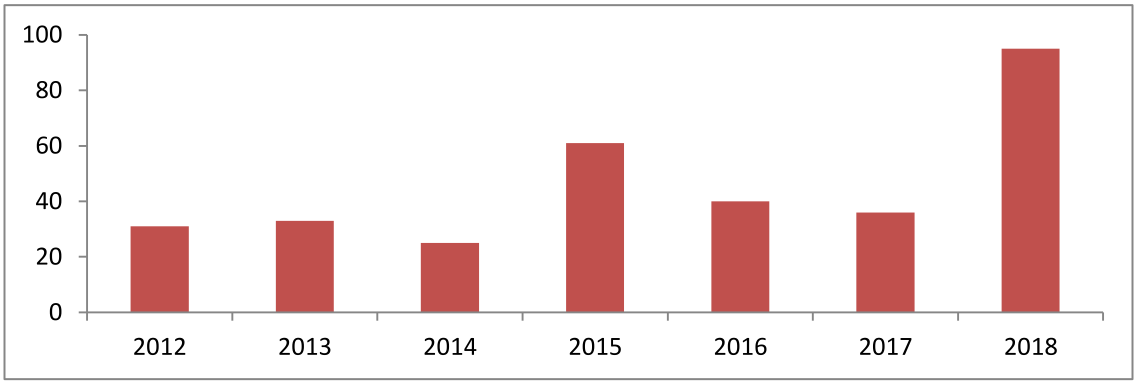
** In 2018, Lepidium latifolium was not surveyed in the BWMA or OLP.*

Table 12. *LELA2 sites observed, per unit from 2012 to 2018*

Year	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	BWMA*	OLP*	Delta	Total New sites per year
2012	9	11	7	0	0	0	3	1	0	**31**
2013	14	14	1	0	0	0	4	0	0	**33**
2014	11	3	6	0	0	0	4	1	0	**25**
2015	17	20	6	0	0	0	18	0	0	**61**
2016	6	7	16	0	0	4	7	0	0	**40**
2017	4	2	1	0	0	0	29	0	0	**36**
2018	19	40	36	0	0	0	na	na	0	**95**
Sum per Unit	**80**	**97**	**73**	**0**	**0**	**4**	**65**	**2**	**0**	**321**

**In 2018, Lepidium latifolium was not surveyed in the BWMA or OLP.*

Figure 4. *LELA2 sites observed, 2012 to 2018*



** In 2018, Lepidium latifolium was not surveyed in the BWMA or OLP. In 2017, 29 observations of new infestations were recorded in the BWMA. Factoring in past observations, the 2018 total might be expected to be at least 20% higher than indicated in the graph.*

Beaver Activity (BEA)--Map 7, Table 13

Beaver activity and evidence was noted at nine locations in 2018, which three fewer than were observed in 2016. However, evidence seems to suggest that the distribution of the animals has changed. The cluster of beaver sites observed in 2016 and 2017 were near Mazourka Canyon Road, the south end of the Islands, and in reach 2. This distribution is still evident in 2018.In 2016, beaver sign was broadly distributed in the middle to upper sections of reach 3. In 2018, beaver sign was absent in this area

In 2018, evidence of a new dam was found at the south end of the Islands, and a new hut was found in reach 2. Evidence of beaver includes three tree cuts, two huts, and four dams.

Table 13. ***Beaver sign observed 2012 to 2018***

Year	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	BWMA*	OLP*	Delta	Total New sites per year
2012	1	1	8	0	3	0	0	0	0	**13**
2013	2	2	1	0	0	0	0	0	0	**5**
2014	0	0	4	0	1	1	0	0	0	**6**
2015	0	3	6	0	2	0	0	0	0	**11**
2016	1	1	7	2	0	1	0	0	0	**12**
2017	0	4	0	0	0	0	0	0	0	**4**
2018	0	4	3	1	1	0	na	na	0	**9**
Sum per Unit	**4**	**15**	**29**	**3**	**7**	**2**	**0**	**0**	**0**	**60**

** In 2018, Beaver sign was not surveyed in the BWMA or OLP.*

LORP Riparian Fence (Observation Code: FEN)--Map 8

Staff surveyed enclosure fencing as well as riparian pasture fences. Eleven records were made of damaged fences in the LORP, including fences damaged in the Moffat Fire (April 19, 2018). Missing posts, gaps in the wire, and fence that was completely knocked down were recorded.

Grazing Management (GRZ)--Map 8

Two observations were made of feed stations during the survey. One cow was found on the bank of the river.

Roads (ROAD)--Map 8

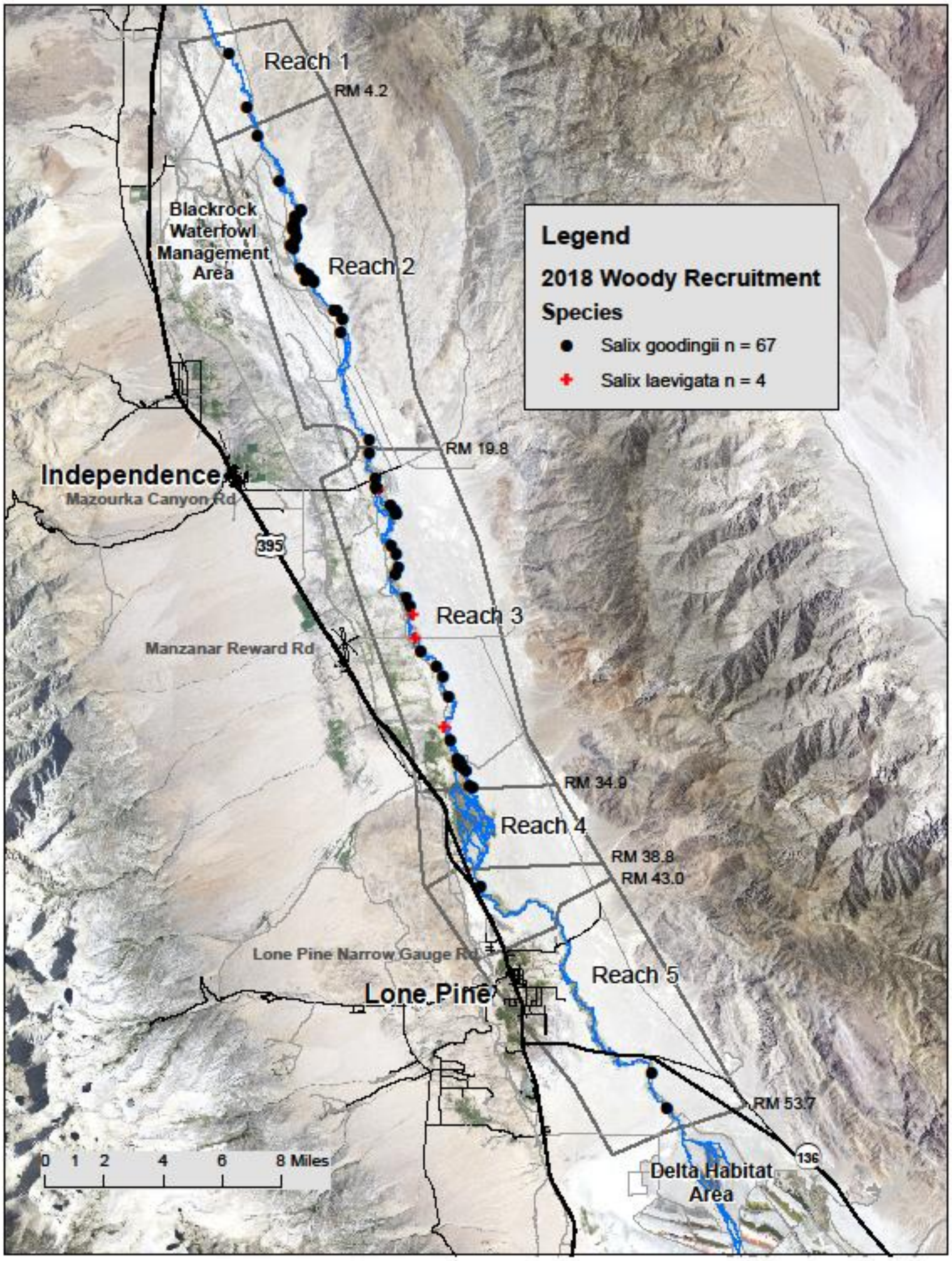
There were 14 observations made of the use of roads that are not on LORP maps. Three of these were characterized as having recently been created. At least two of these roads were made for fire suppression in the effort to impede the spread of the Moffat Fire.

Recreation (REC)--Map 9

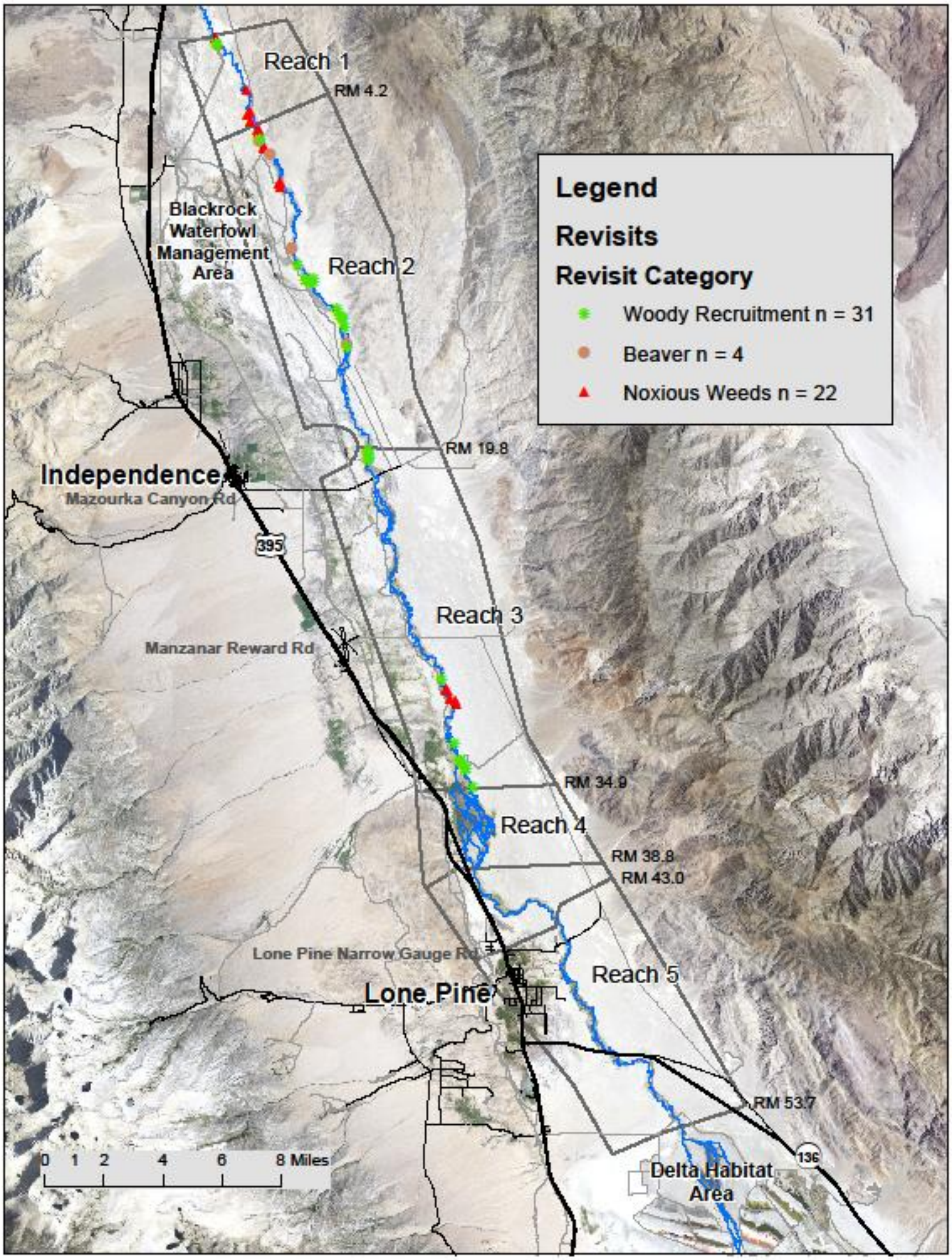
Five discrete impacts were associated with recreation. Evidence includes off-road ORV use, blinds, fire rings, graffiti, and an abandoned crayfish trap. Recreation evidence was most abundant near roads, and in the Lone Pine area.

MAPS

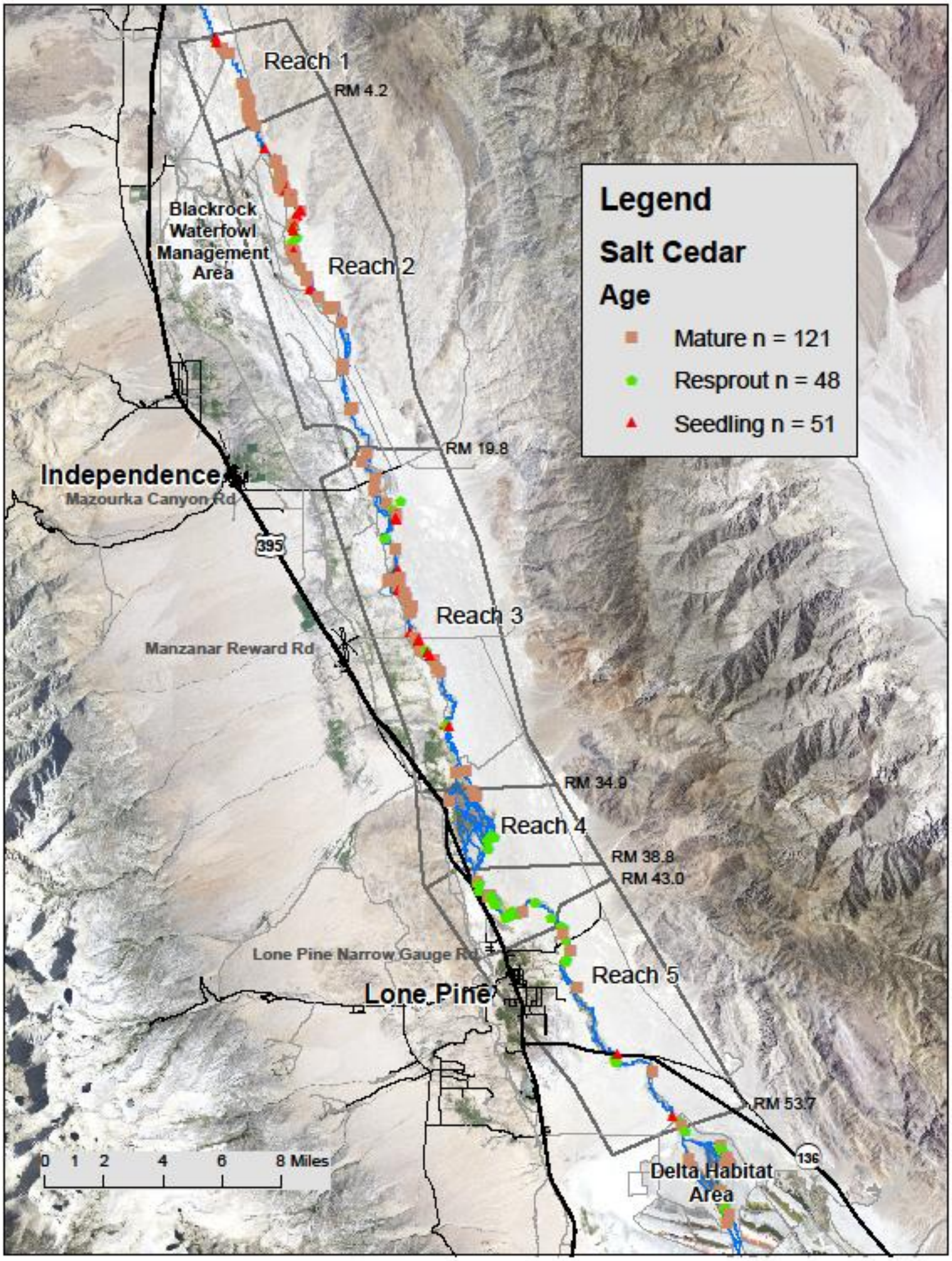
Map 3. Woody Recruitment (WDY)



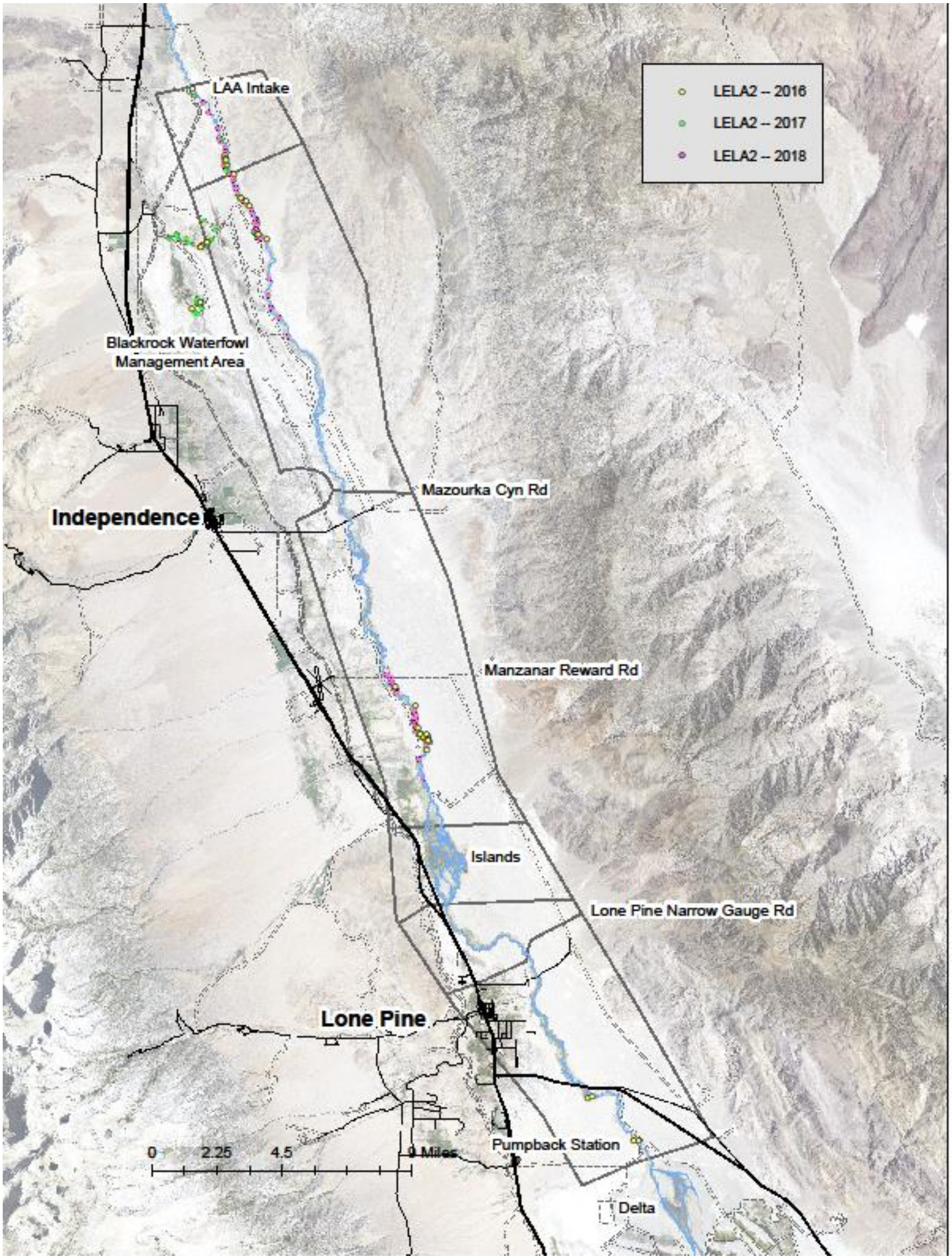
Map 4: Revisits of impacts observed in 2017



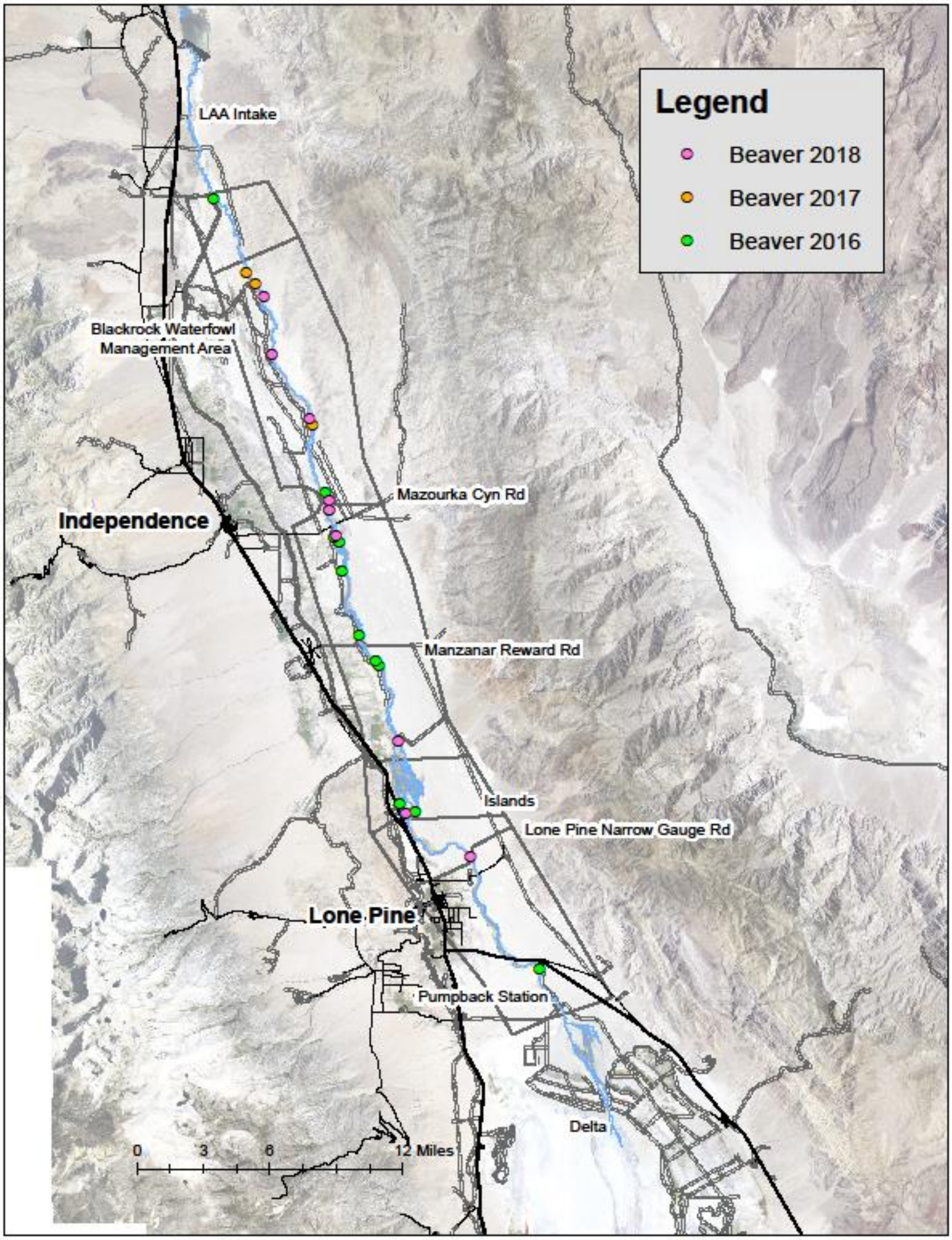
Map 5: Saltcedar (TARA)



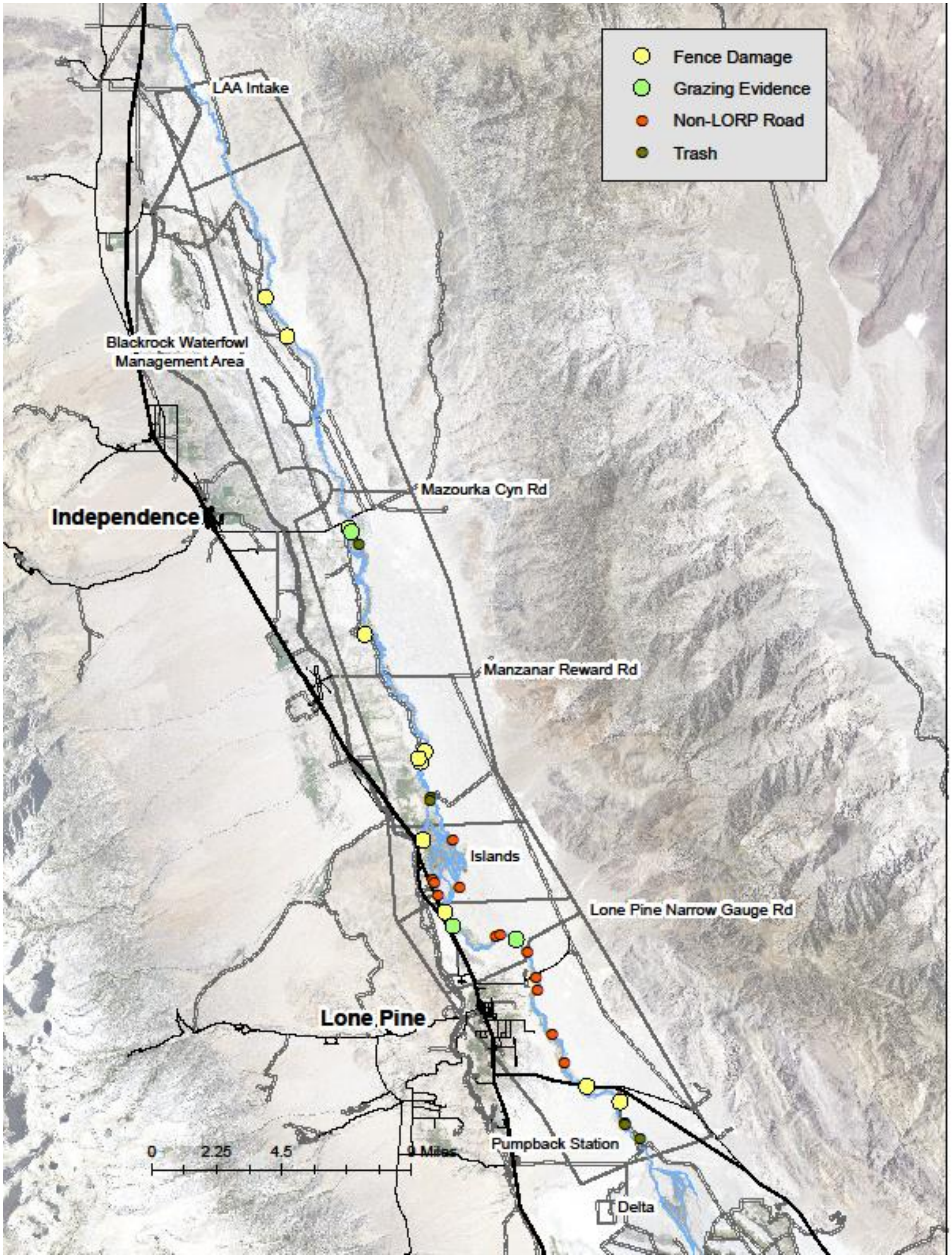
Map 6: Perennial Pepperweed (LELA2)



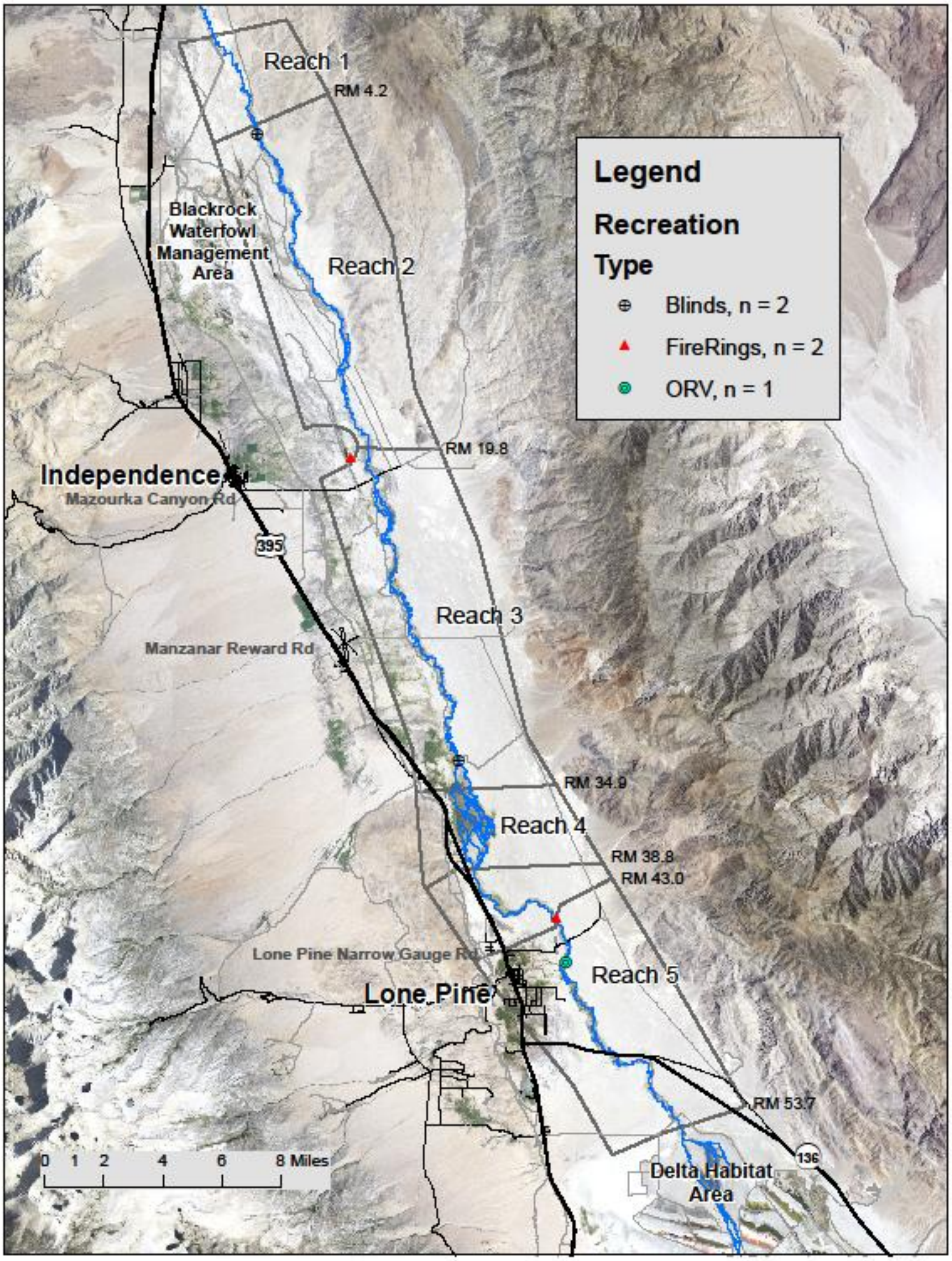
Map 7: Beaver (BEA)



Map 8: Maintenance (FEN, GRZ, ROAD)



Map 9: Recreation (REC)



7.0 WOODY RECRUITMENT SUCCESS

Woody Recruitment Success 2007-2017

Executive Summary

Goals of the Lower Owens River Project (LORP) include the establishment and persistence of woody riparian trees. In this report, the extent of tree recruitment on the LORP is described for the period 2007-2018.

Main Findings. Since 2007, 535 successful recruitment sites on the LORP have been mapped where tree willow or cottonwood has survived into its second growing season; 198 of these sites were still occupied by surviving trees into 2018. In total, 1,032 trees have established from 2007-2017: 812 Black Willow (Salix, goodingii), 155 Red Willow (*Salix laevigata*), 62 Willow Hybrids (*Salix goodingii* x *laevigata*), and three Fremont Cottonwood (*Populus fremontii*).

Shortly after rewatering, in 2008, the number of recruitment sites peaked at 178, stabilized below 50 per year from 2009-2013, and declined to under 10 per year in the last three years of drought in 2014-2016. Both 2017 and 2018 yielded increasing numbers of recruitment sites with 71 found in 2018, the highest number since 2008. The density of recruitment sites was highest in reaches 2 and 3, a 31 mile stretch of river, with approximately 6 recruitment sites per river mile added since the project started. In the remaining 50% of the LORP, less than one recruitment site per river mile was compatible with cohort persistence to 2018.

Sites occupied by trees were mapped with Lidar data acquired by LADWP in 2017 (see Section Landscape Mapping, this report). The 198 sites with successful recruitment during the post-implementation period represent about 4% of these Lidar-mapped tree-occupied sites on the LORP. Whether the addition of new sites continues at the current rate into the future or levels off may depend on climate, flow management and the unknown distribution of potential recruitment sites under current flow regime management. Monitoring of tree distribution and density with Lidar data could be one practical way to periodically inventory LORP riparian woodland into the future.

Definitions

RAS – LORP rapid assessment survey

Recruitment Site –locations where seedling tree willow or cottonwood were recorded durning the RAS.

Cohort - One to many individual(s) of the same age.

Successful Recruitment Site – Sites where cohorts persisted to August in the second growing season.

2018 Revisits—the total list of successful recruitment sites from years 2007 to 2017 inclusive that were reinventoried in 2018.

Introduction

One goal of the Lower Owens River Project (LORP) was the establishment of woody riparian trees following rewatering of the river channel. Prior to project implementation, in order of prevalence, riparian woodland in the LORP was primarily composed of Black Willow (*Salix goodingii*) and Red Willow (*Salix laevigata*), and Fremont Cottonwood (*Populus fremontii*).

In this report, successful recruitment sites from 2007-2017cohorts are mapped, summarized by river reach, and summarized by temporal trend. The spatial proximity of recruitment sites to mapped established trees is spatially summarized. An estimate of total tree-occupied sites on the LORP is calculated, using the Lidar-derived tree layer described in this report (see Vegetation Mapping Fig 2-20). The number and spatial distribution of successful recruitment sites that have been added over the post-implementation period is compared numerically and spatially to the lidar-derived total tree-occupied sites on the LORP.

Methods

Study Area

Prior to the initial water releases into the project the Owens River stretch of the LORP was divided into six management reaches along with the river delta. The first four river miles, Reach 1, extending from the LA Aqueduct Intake to the Blackrock Ditch confluence, was a meandering channel, with low flows compatible with meadow vegetation in the historic floodplain. The next 16 miles, Reach 2 extending to Billy Lake, was a dry incised meandering channel, supporting saltbush shrubland and Tamarisk (*Tamarix sp.*), which was largely removed prior to re-watering. The next 15 miles, Reach 3 extends south to the 'Islands' - east of the northern Alabama Hills, and was characterized by one to a few channels, and the historic floodplain supported a mixture of meadows, salt shrub and marsh. The Islands, Reach 4, is a 4-mile stretch of low-gradient river influenced by a fault block that opened a broad flat area allowing the river to spread in multiple channels. This reach supported a mosaic of marsh, meadow, salt shrub, riparian woodland, and tamarisk woodland. The next four miles, Reach 5, extends to the historic Lone Pine train trestle. This was a fairly contained slow-moving channel with a steep riparian-upland transition slope on the south-east. The reach supported numerous oxbow ponds, meadow, salt shrub, riparian woodland and Tamarisk trees. The next 11 miles, Reach 6, extending to the Pumpback Station just upstream above the delta, was a slow meandering channel with a steep slope bordering the upland, supporting marsh, meadow, riparian woodland and Tamarisk trees. The four-mile Delta Habitat Area stretching from the Pumpback station into the Owens Lake playa, begins with a single slow moving channel and fans out to multiple channels and supported a combination of sinuous marsh and meadow with many well established Tamarisk trees.

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The Rapid Assessment Survey (RAS) is conducted in the first two weeks of August (2007-2018). Both sides of the river are walked by field crews and the location, photo record, and number of tree seedlings are recorded. Beginning in 2008, field staff revisited previous year's recruitment sites from 2007 to determine whether these cohorts had persisted to August of the second growing season. Sites with surviving cohorts in the second growing season were then designated as 'successful recruitment sites'. In 2018, the full list of successful recruitment sites from cohorts 2007-2016 were revisited to quantify (1) multi-year cohort survival, and (2) cumulative number of successful recruitment sites with cohorts persisting to 2018.

The spatial proximity of recruitment site locations to known locations of trees was quantified based on digitization of LORP trees from 2014 aerial imagery. A more recent tree layer derived from 2017 Lidar data (see Vegetation Mapping Fig 2-20) was used to coarsely estimate total tree-occupied sites within 80 m of the channel, providing context for the relative significance of the number of sites added since the post implementation period.

Results

Since 2007, 535 successful recruitment sites on the LORP have been mapped where tree willow or cottonwood has survived to the second growing season: cohorts in 198 of these sites had persisted to 2018 (Figure 1), with 1,032 established trees: 812 Black Willow (Salix, goodingii), 155 Red Willow (*Salix laevigata*), 62 Willow Hybrids (*Salix goodingii* x *laevigata*) and three Fremont Cottonwood (*Populus fremontii*).

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Based on 2017 vegetation mapping on the LORP (see Vegetation Mapping Fig 2-20), some 5,162 polygons were delineated representing either single trees or clusters of trees. The 198 sites, that have hosted successful recruitment, represent about 4% of the sites currently occupied by trees on the LORP. In comparison to the spatial distribution and density of already occupied sites within 80 m of the river channel, a significant proportion of recruitment sites have been added to the most tree-depauperate areas (e.g. upstream half of Reach 2, Figure 4).

Maps displaying the locations of successful recruitment sites 2007-2017 and new recruitment sites found in 2018 are displayed in Appendix A (Figures 5-7).

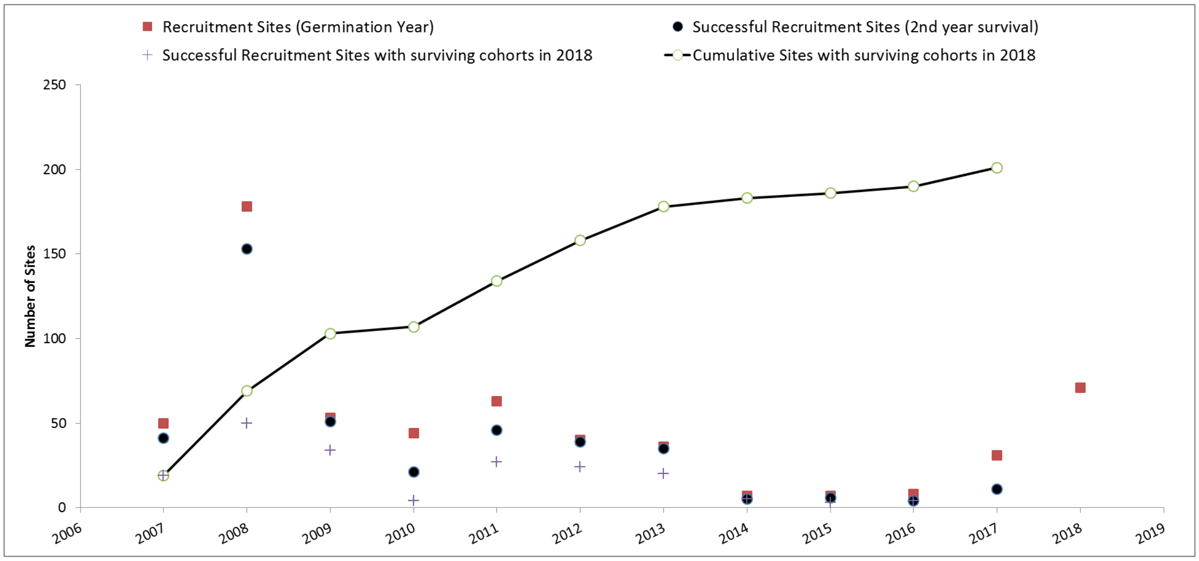


Figure 1. Number of recruitment sites with seedlings present (Recruitment Sites), sites with cohorts surviving to the second growing season (Successful Recruitment Sites), Number of these sites with cohorts persisting to 2018, and the cumulative number of successful recruitment sites with surviving cohorts to 2018.

Table 1. Number of successful recruitment sites (cohorts 2007-2017) in each reach including delta, with surviving cohorts during the August 2018 revisit survey. Number of sites per river mile are reported to account for differences in reach length.

LORP Area	Successful Recruitment Sites with Cohorts persisting in 2018	%	River Miles	Sites/River Mile
reach 1	3	2%	4	0.8
reach 2	102	52%	16	6.5
reach 3	74	37%	15	5.0
reach 4	2	1%	4	0.5
reach 5	6	3%	4	1.4
reach 6	10	5%	11	0.9
delta	1	1%	4	0.2

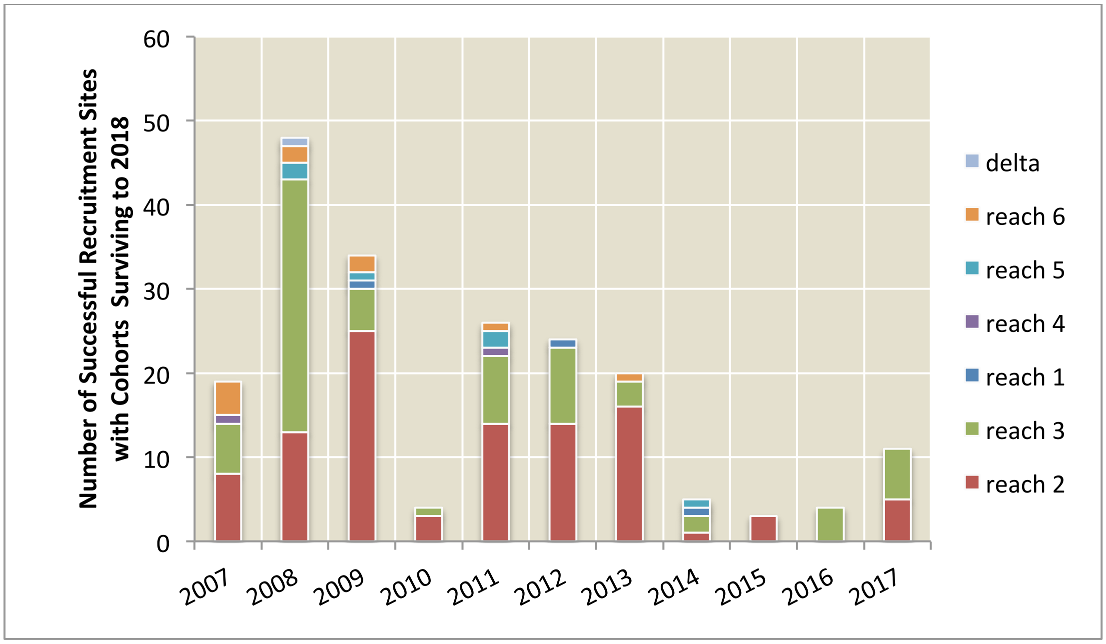


Figure 2. Number of successful recruitment sites by year and reach that retained surviving cohorts through 2018. The half of the LORP that is reach 2 and 3 (31 river miles) shown at the bottom of the stacked bar plot hosted 9 out of 10 recruitment sites compatible with long term cohort persistence.

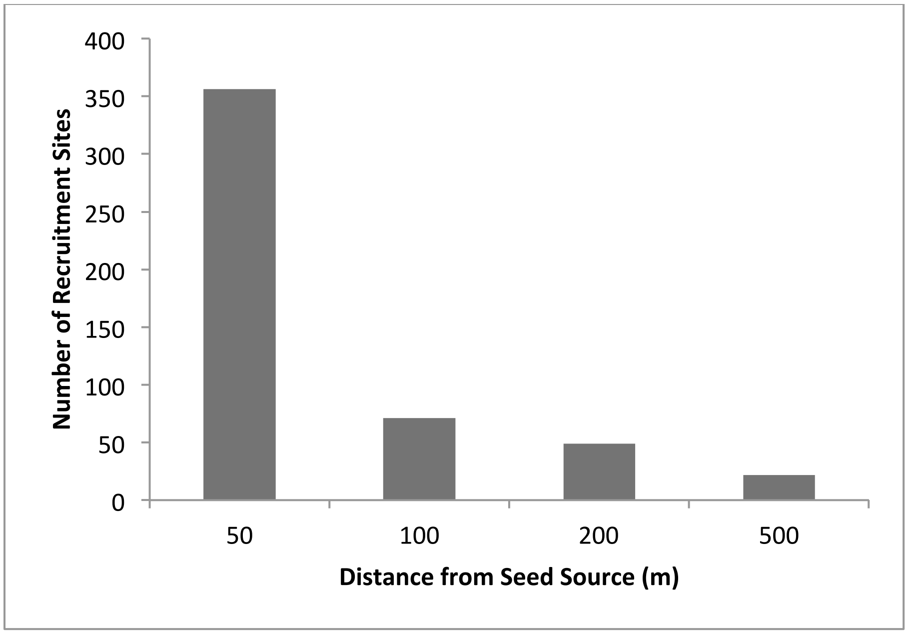


Figure 3. Location of successful recruitment sites, with cohorts surviving to the second growing season, compared to the distance from a known tree willow or cottonwood seed source.

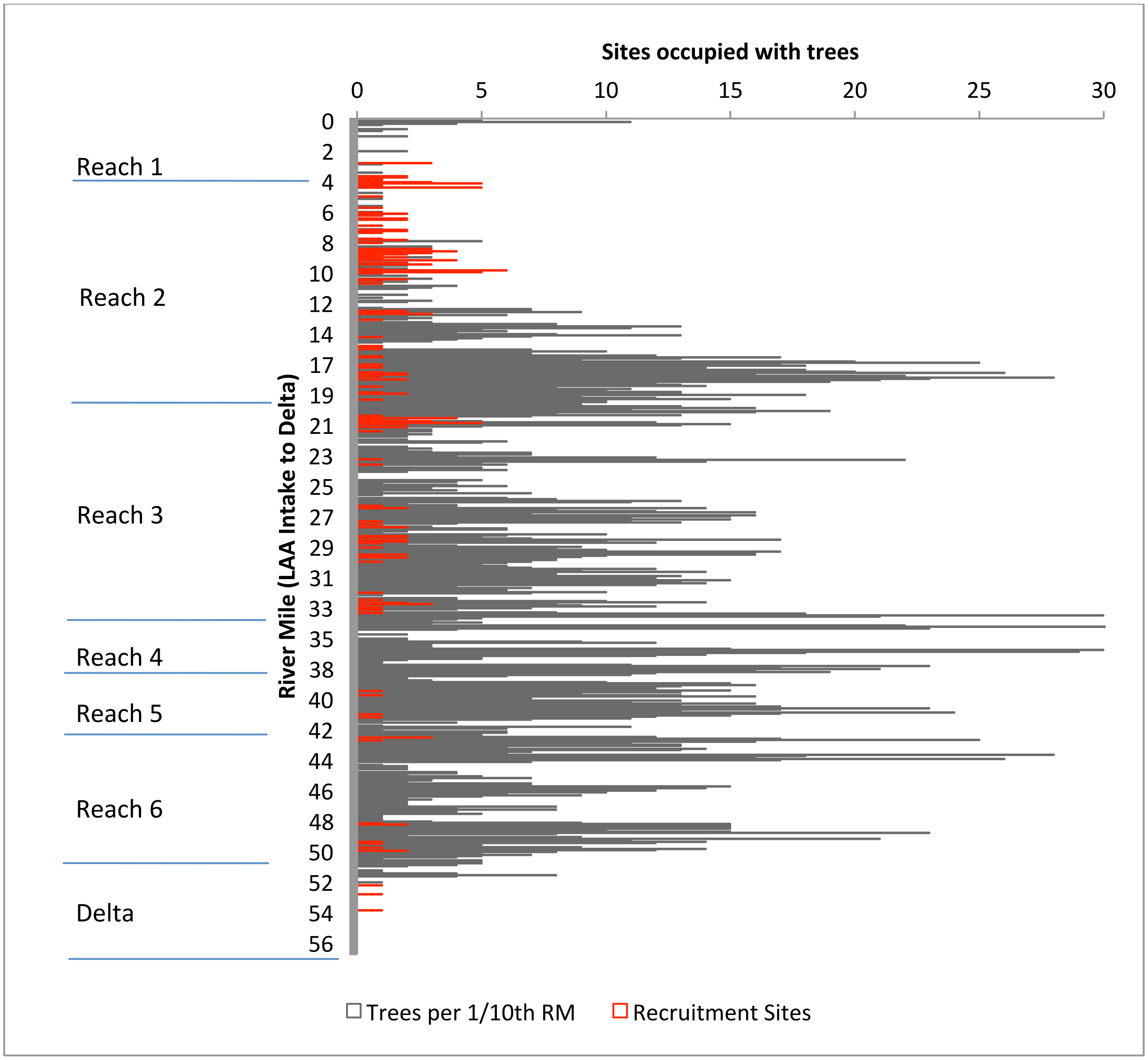


Figure 4. Number of tree-occupied sites on the LORP by river mile (Intake to Delta). Trees per 1/10th river mile were estimated based on the tree mapping from Lidar data (see Vegetation Mapping Fig 2-20). Recruitment Sites 2007-2017 are plotted in red.

Discussion

Since 2007, 535 successful recruitment sites on the LORP have been mapped where tree willow or cottonwood has established - with approximately 6 recruitment sites per river mile in reaches 2, 3; and less than one successful recruitment site, per river mile, elsewhere. Prior to rewatering the floodplain, Reaches 2 and 3 had mature trees to serve as a seed source for future recruitment, and open substrate to allow recruitment. Other reaches also had mature trees, but to a higher degree, the established grass, forb, shrub and tree layer limited the number of suitable recruitment sites comparatively.

Recruitment was highest initially after rewatering in 2008 as suitable establishment sites were not yet occupied by heterospecifics. The number of new recruitment sites found each year stabilized below 50 per year until the last three years of drought 2014-2016 yielding only a few sites each year. In 2017 and 2018 recruitment sites increased to pre-drought levels with 2018 yielding the highest number of new sites since 2008, presumably owing to high river flows and greater flooding and wetting of the floodplain in winter spring of 2016-2017.

Based on 2017 vegetation mapping on the LORP (see Vegetation Mapping Fig 2-20), approximately 5,000 polygons were delineated representing either single trees or clusters of trees. The 198 sites, that have hosted successful recruitment, represent about 4% of the sites currently occupied by trees on the LORP.

Natural turnover within mixed-age stands could maintain the current tree-occupancy of these sites. Whether or not new sites continue to be colonized at similar rates as in the first 10 years of the LORP will depend on climate, flow management, and unknowns in the distribution of potential recruitment sites under current flow regime management. With the availability of Lidar data, used to map trees in this report (see Vegetation Mapping Fig 2-20), the floodplain vegetation structure including the development of the tree canopy over time may be a practical way to monitor the tree balance for the LORP in the future.

Appendix A – Maps of recruitment sites

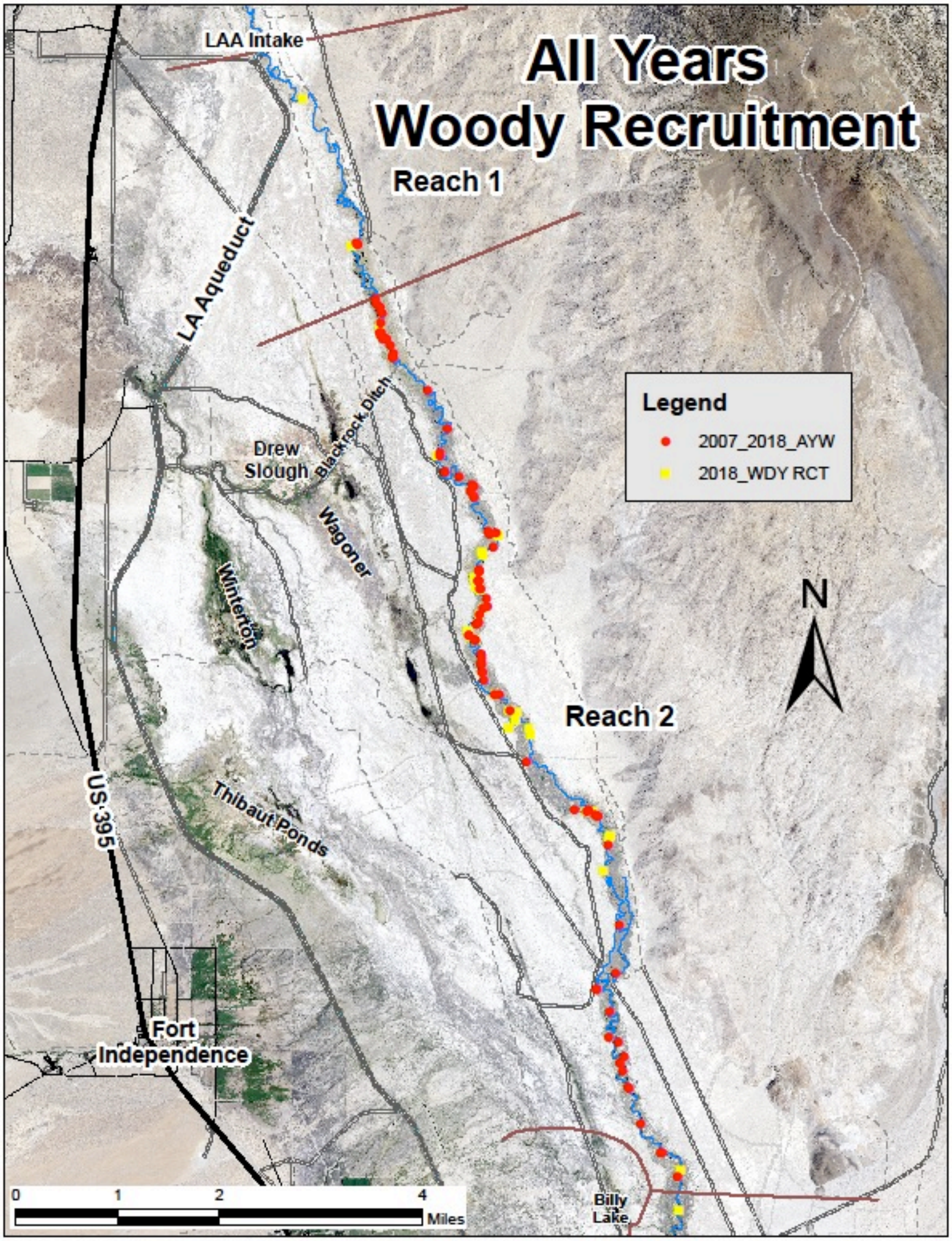


Figure 5. Sites in Reach 1-2 where recruitment was observed during the LORP RAS monitoring 2007-2017 combined (red) and most recent August 2018 survey (yellow)

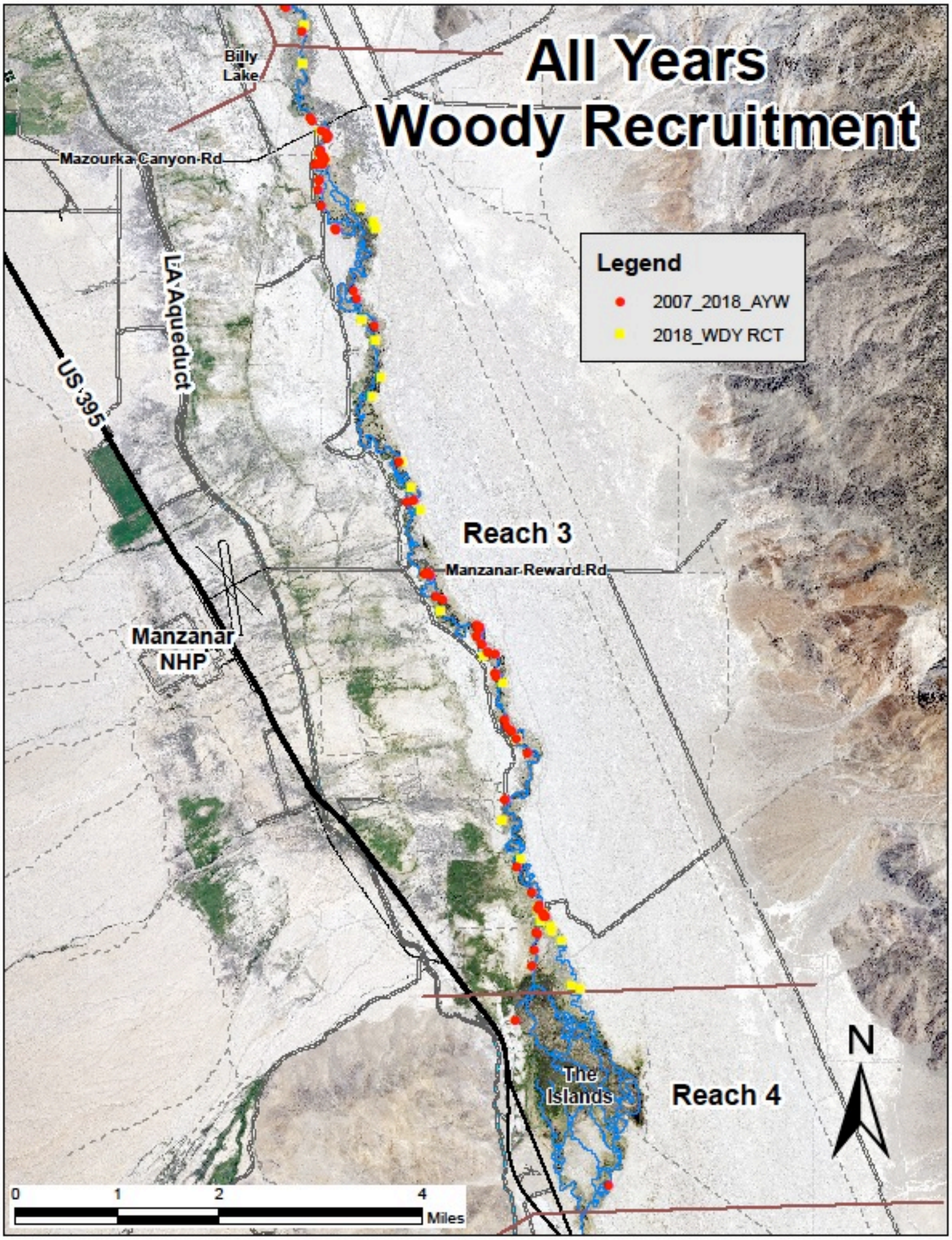


Figure 6. Sites in Reach 3-4 where recruitment was observed during the LORP RAS monitoring 2007-2017 combined (red) and most recent August 2018 survey (yellow)

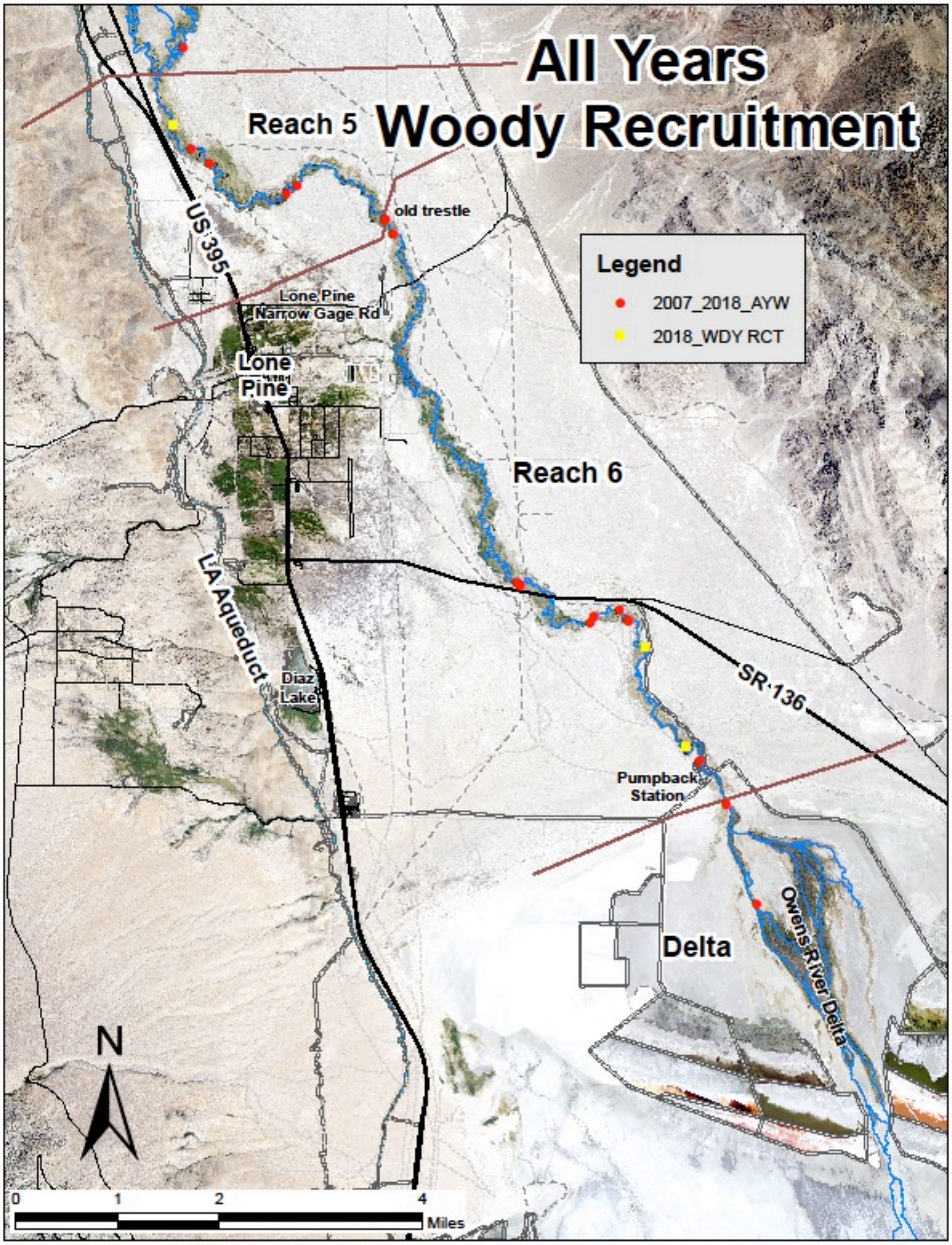


Figure 7. Sites in Reach 5-6 and Delta where recruitment was observed during the LORP RAS monitoring 2007-2017 combined (red) and in August 2018 survey (yellow).

8.0 LORP SALTCEDAR TREATMENT

Saltcedar (*Tamarix ramosissima*) is a non-native invasive plant that spreads rapidly in the Owens Valley where conditions are favorable for its establishment. It was introduced into the United States in the early 1800s as a windbreak and ornamental. Since that time, it has invaded most major drainage systems in the southwest, including the Owens Valley. It colonizes moist areas that have been disturbed by land clearing, grading, or other disturbances that removes native plants. Once established, saltcedar is a very hardy plant that can withstand adverse soil and weather conditions. It displaces native plants as it grows in size and reproduces, creating dense stands of tall shrubs. Saltcedar is undesirable because it threatens native plant communities and the associated wildlife. (LORP EIR 10.4.1.4)

Starting in1997 the Inyo County Water Department administered the Salt Cedar Control Program for treatment on City of Los Angeles lands in the Owens Valley. The program was funded by LADWP under the Inyo-Los Angeles Water Agreement and was supplemented with grant funding. In 2017, with the retirement of the Inyo County Saltcedar Program Manager and cessation of a Wildlife Conservation Board grant in 2016, Inyo County suspended their saltcedar program. In October 2017, LADWP initiated a saltcedar control program to manage saltcedar on City property including the LORP.

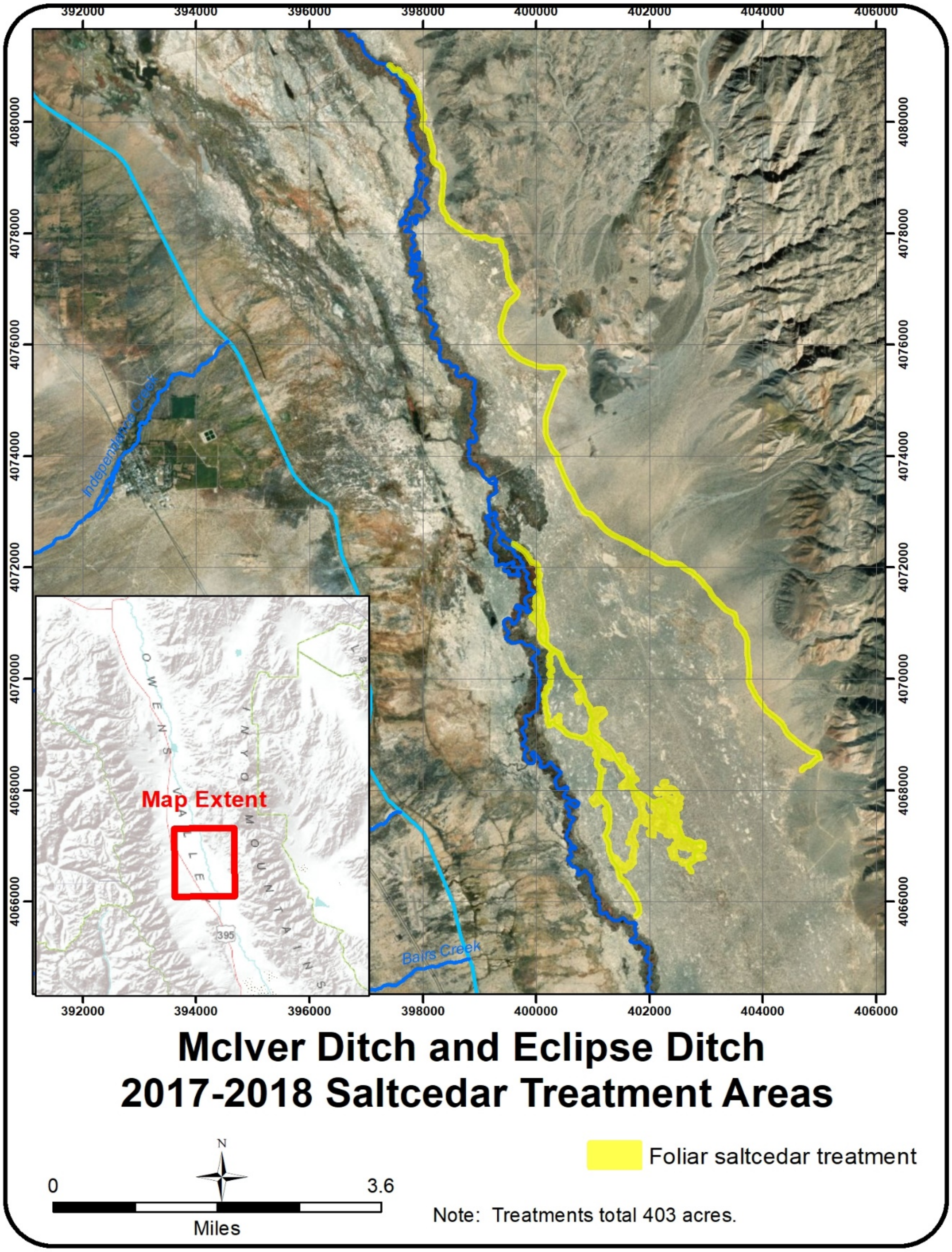
LADWP used the following saltcedar treatment methods in 2017-2018:

- Hand pulling of small plants
- Cut stump treatment (plant is cut at the base, then Garlon 4, a chemical herbicide, is applied to prevent re-sprouting)
- Basal bark of applications of herbicide (lower portions of smaller plants are sprayed with Garlon 4)
- Foliar applications of herbicide
- Cutting and submerging the plants under water for extended periods, typically 2 weeks. (Required duration of submersion depends on environmental conditions such as turbidity of the water since availability of light promotes saltcedar re-sprouting.)
- The Chinese tamarisk leaf eating beetle, a natural insect predator to saltcedar, is currently established within the LORP area (per LADWP Watershed Resources Staff). However, the effect of the beetle on the LORP saltcedar is unknown.

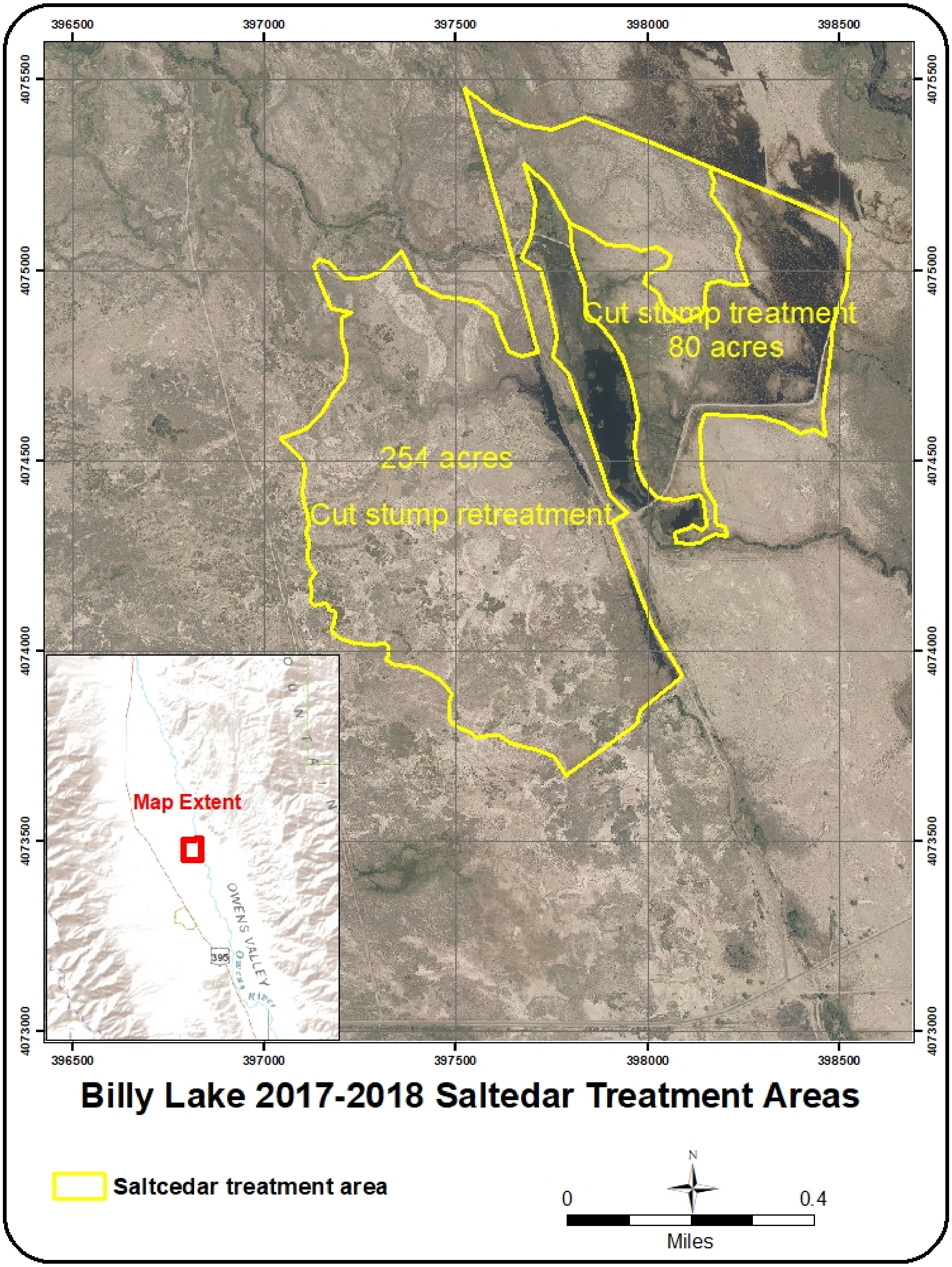
In 2017-2018 LADWP treated 822 acres of saltcedar in the LORP area, including:

- 403 acres of foliar applications of herbicide (Saltcedar Figure 1),
- 156 acres of cut stump treatment (Saltcedar Figures 2-3),
- 254 acres of cut stump retreatment (Saltcedar Figure 2), and
- 9 acres of cutting and submerging plants under water (Saltcedar Figure 4).

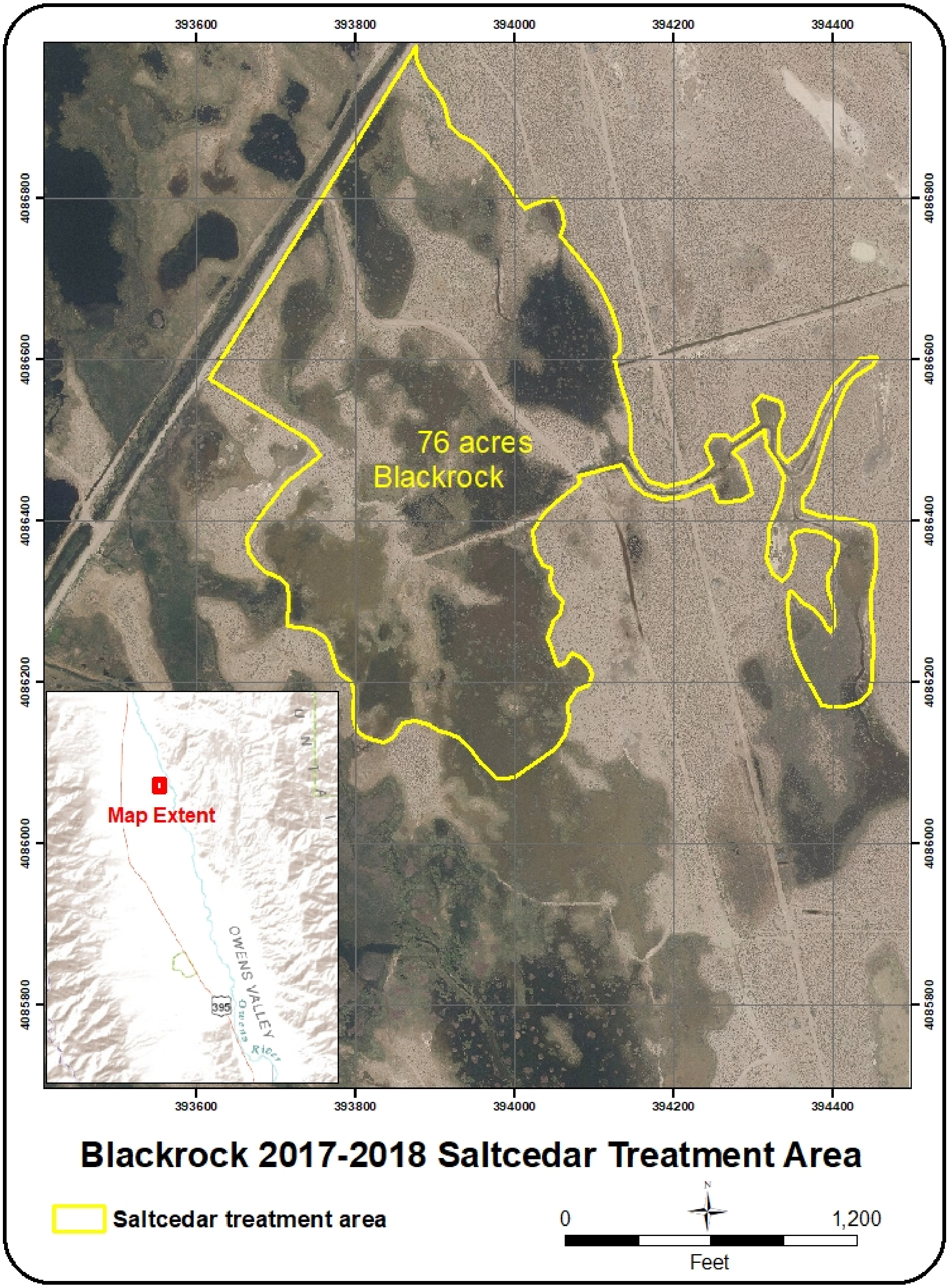
LADWP will continue to treat saltcedar resprouts in 2018-2019 that occur in the areas of treatment identified in Saltcedar Figures 1-4. If feasible, LADWP will continue further treatment in the Blackrock area. LADWP has purchased additional equipment to speed treatment in heavily infested areas. This new equipment consists of attachments for skid steers that can cut large diameter saltcedar much faster and efficiently than cutting with chainsaws. LADWP has also purchased additional attachments for handling saltcedar cuttings and placing them in large burn piles. LADWP is also working with Calfire on a Vegetation Management Plan (VMP) to burn slash piles created from the last few years of treatment.



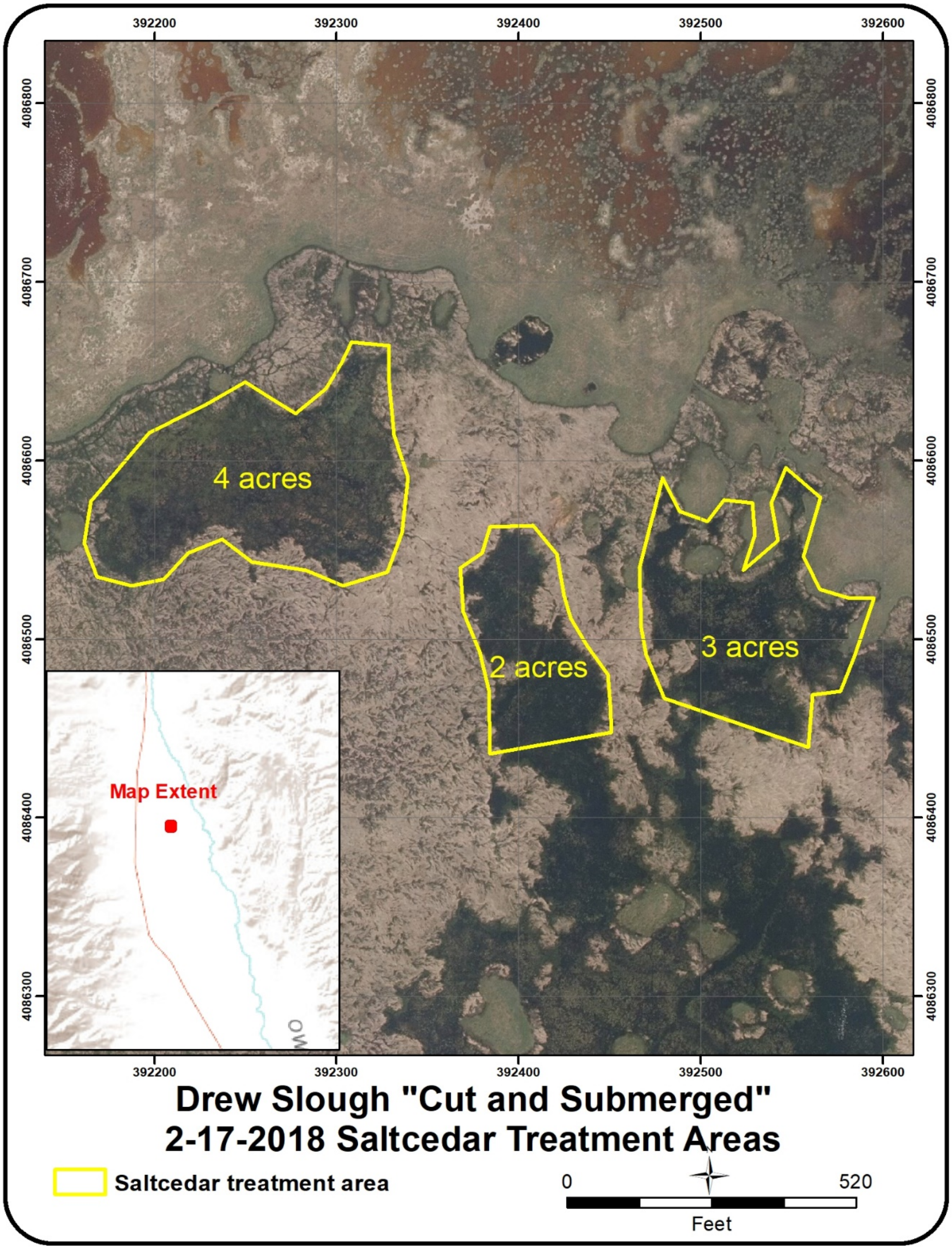
Saltcedar Figure 1. McIver and East Side Spreading Diversions, 2017-2018 Saltcedar Treatment Areas



Saltcedar Figure 2. Billy Lake 2017-2018 Saltcedar Treatment Areas



Saltcedar Figure 3. Blackrock 2017-2018 Saltcedar Treatment Area



Saltcedar Figure 4. Drew Slough "Cut and Submerged", 2017-2018 Saltcedar Treatment Areas

9.0 LORP WEED REPORT

Woody Recruitment Success 2007-2017

Executive Summary

Goals of the Lower Owens River Project (LORP) include the establishment and persistence of woody riparian trees. In this report, the extent of tree recruitment on the LORP is described for the period 2007-2018.

Main Findings. Since 2007, 535 successful recruitment sites on the LORP have been mapped where tree willow or cottonwood has survived into its second growing season; 198 of these sites were still occupied by surviving trees into 2018. In total, 1,032 trees have established from 2007-2017: 812 Black Willow (Salix, goodingii), 155 Red Willow (*Salix laevigata*), 62 Willow Hybrids (*Salix goodingii* x *laevigata*), and three Fremont Cottonwood (*Populus fremontii*).

Shortly after rewatering, in 2008, the number of recruitment sites peaked at 178, stabilized below 50 per year from 2009-2013, and declined to under 10 per year in the last three years of drought in 2014-2016. Both 2017 and 2018 yielded increasing numbers of recruitment sites with 71 found in 2018, the highest number since 2008. The density of recruitment sites was highest in reaches 2 and 3, a 31 mile stretch of river, with approximately 6 recruitment sites per river mile added since the project started. In the remaining 50% of the LORP, less than one recruitment site per river mile was compatible with cohort persistence to 2018.

Sites occupied by trees were mapped with Lidar data acquired by LADWP in 2017 (see Section Landscape Mapping, this report). The 198 sites with successful recruitment during the post-implementation period represent about 4% of these Lidar-mapped tree-occupied sites on the LORP. Whether the addition of new sites continues at the current rate into the future or levels off may depend on climate, flow management and the unknown distribution of potential recruitment sites under current flow regime management. Monitoring of tree distribution and density with Lidar data could be one practical way to periodically inventory LORP riparian woodland into the future.

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Introduction

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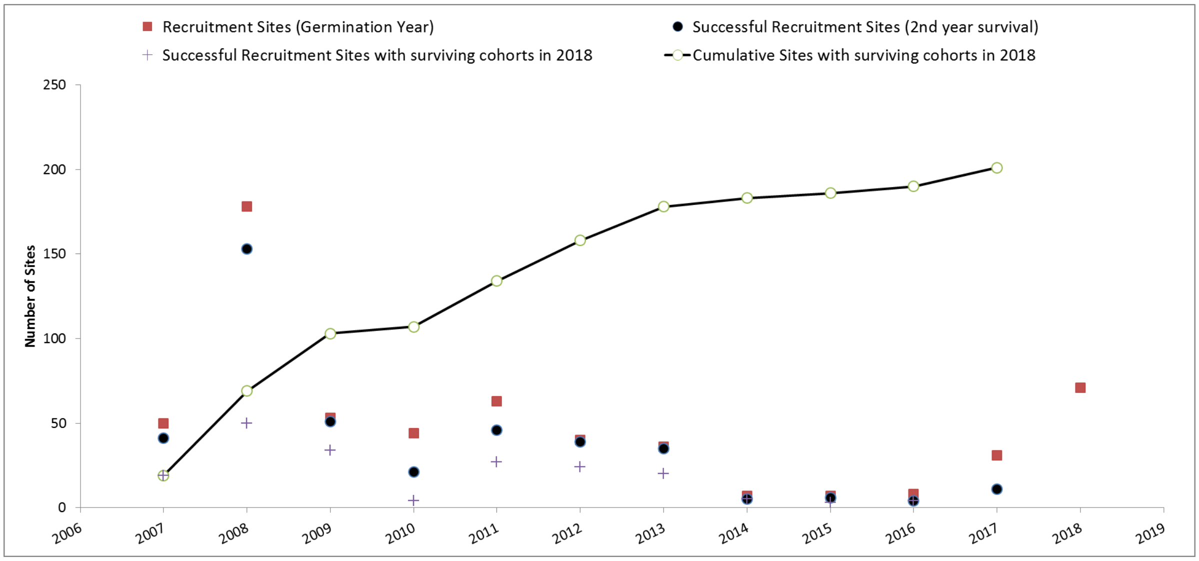

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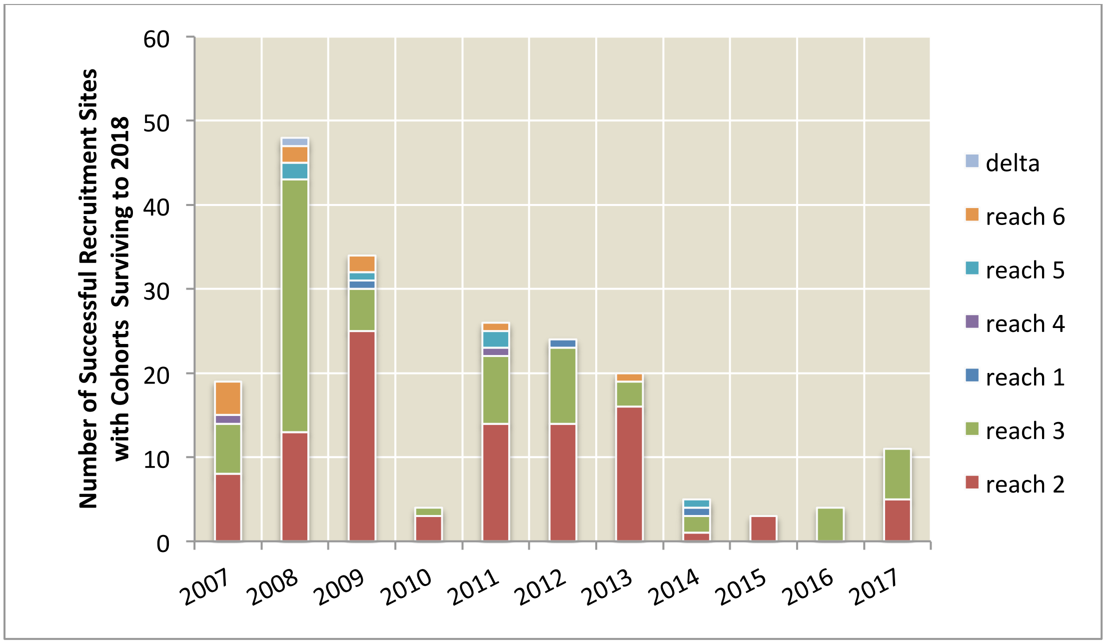

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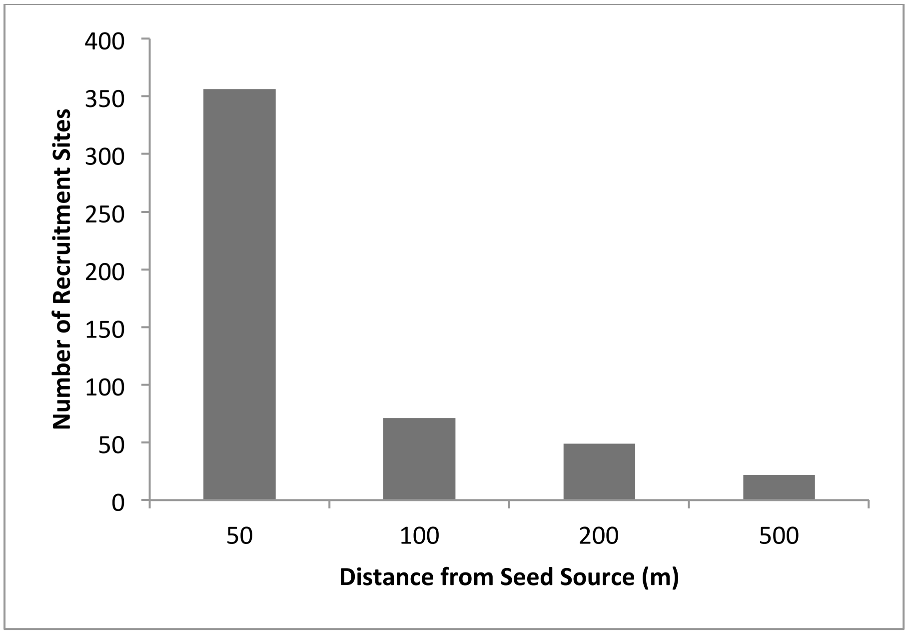

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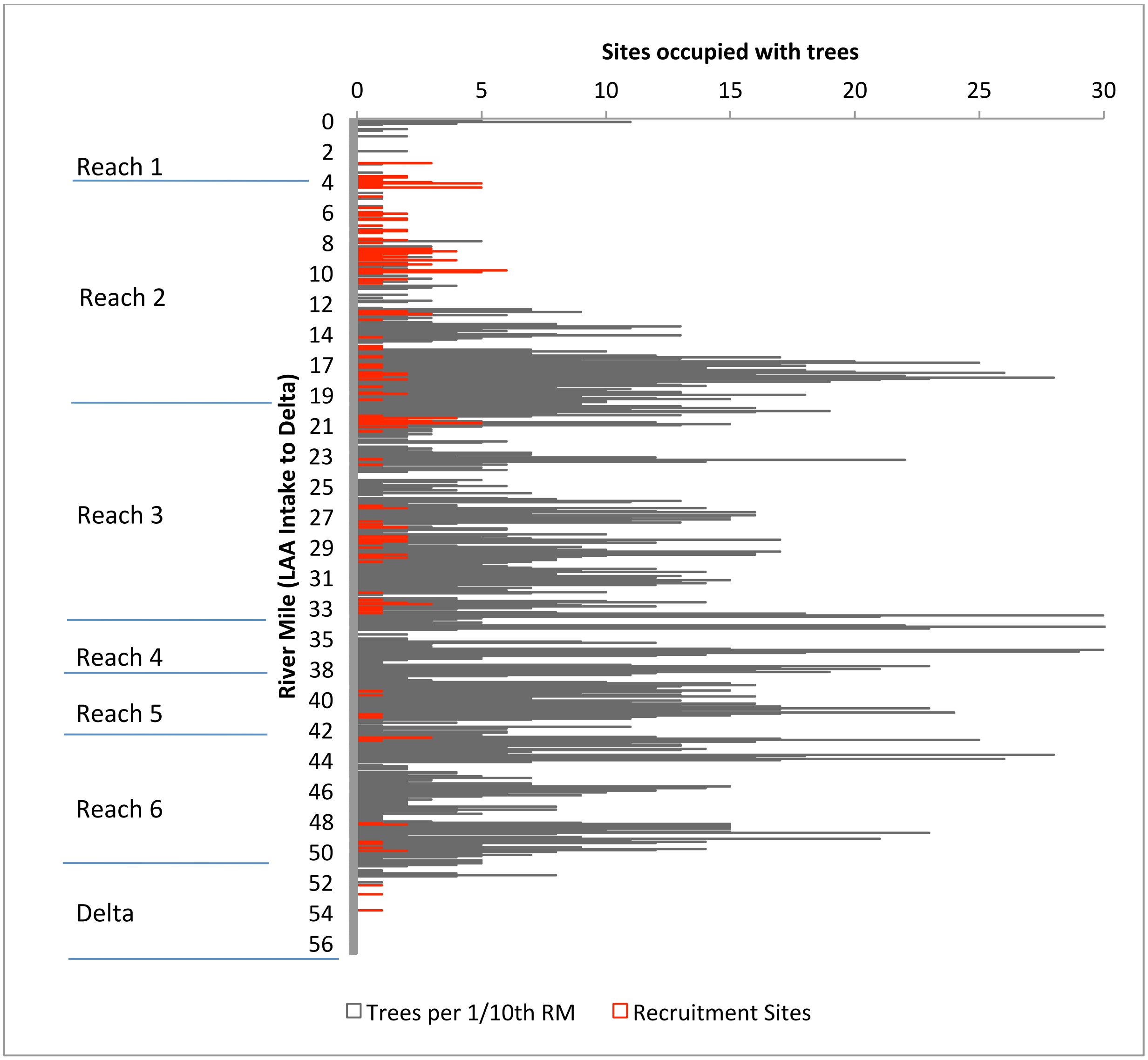

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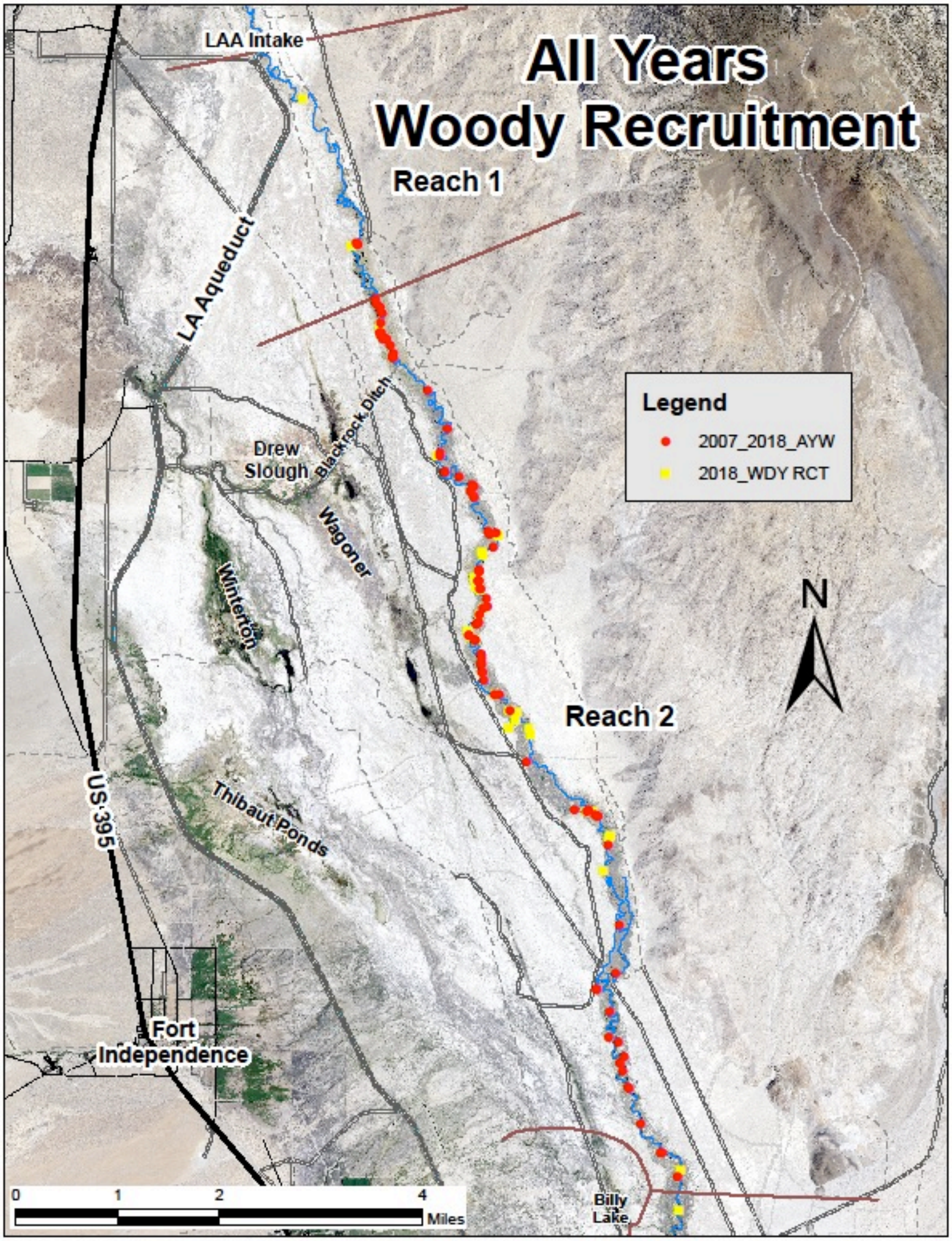

Figure 5. Sites in Reach 1-2 where recruitment was observed during the LORP RAS monitoring 2007-2017 combined (red) and most recent August 2018 survey (yellow)

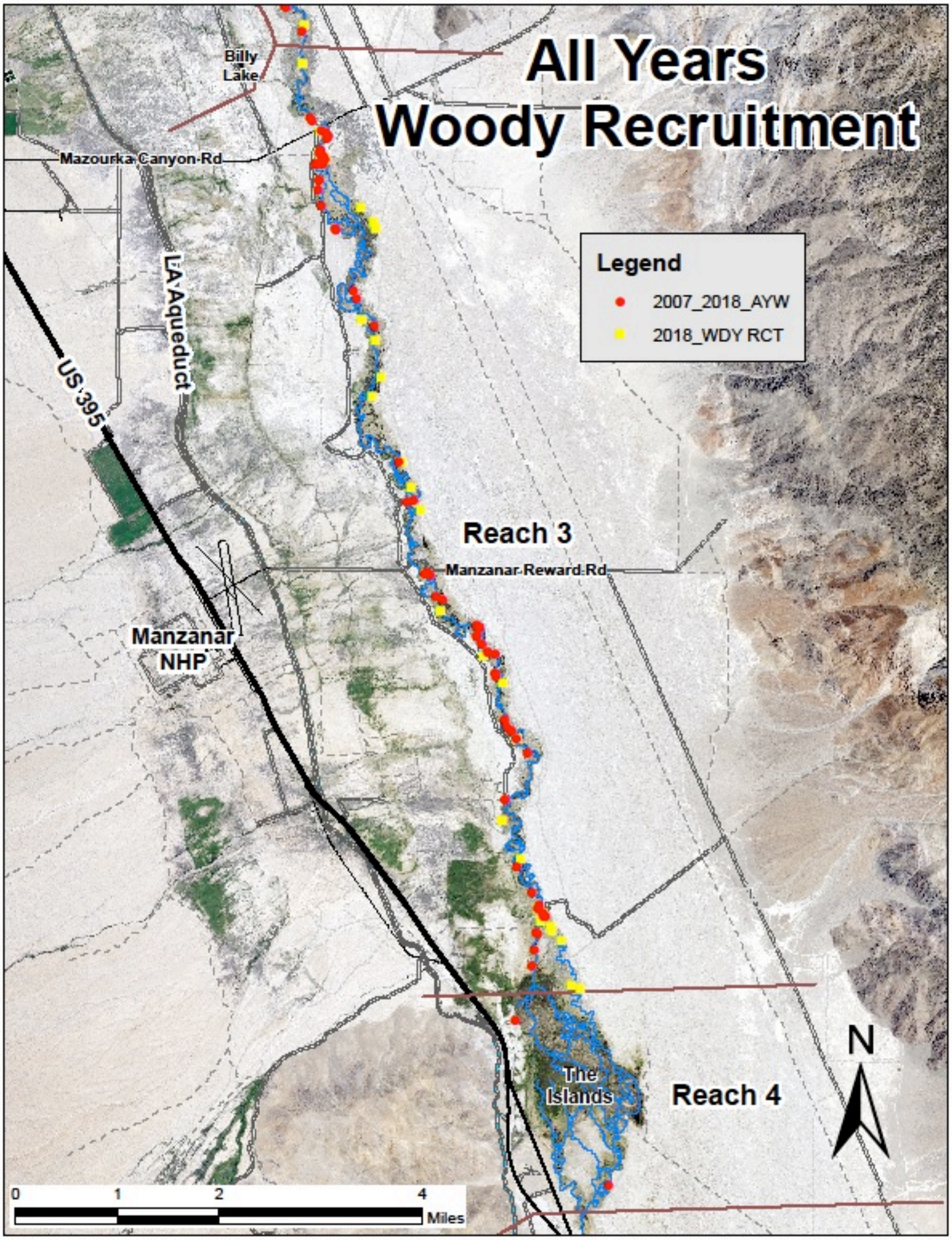

Figure 6. Sites in Reach 3-4 where recruitment was observed during the LORP RAS monitoring 2007-2017 combined (red) and most recent August 2018 survey (yellow)

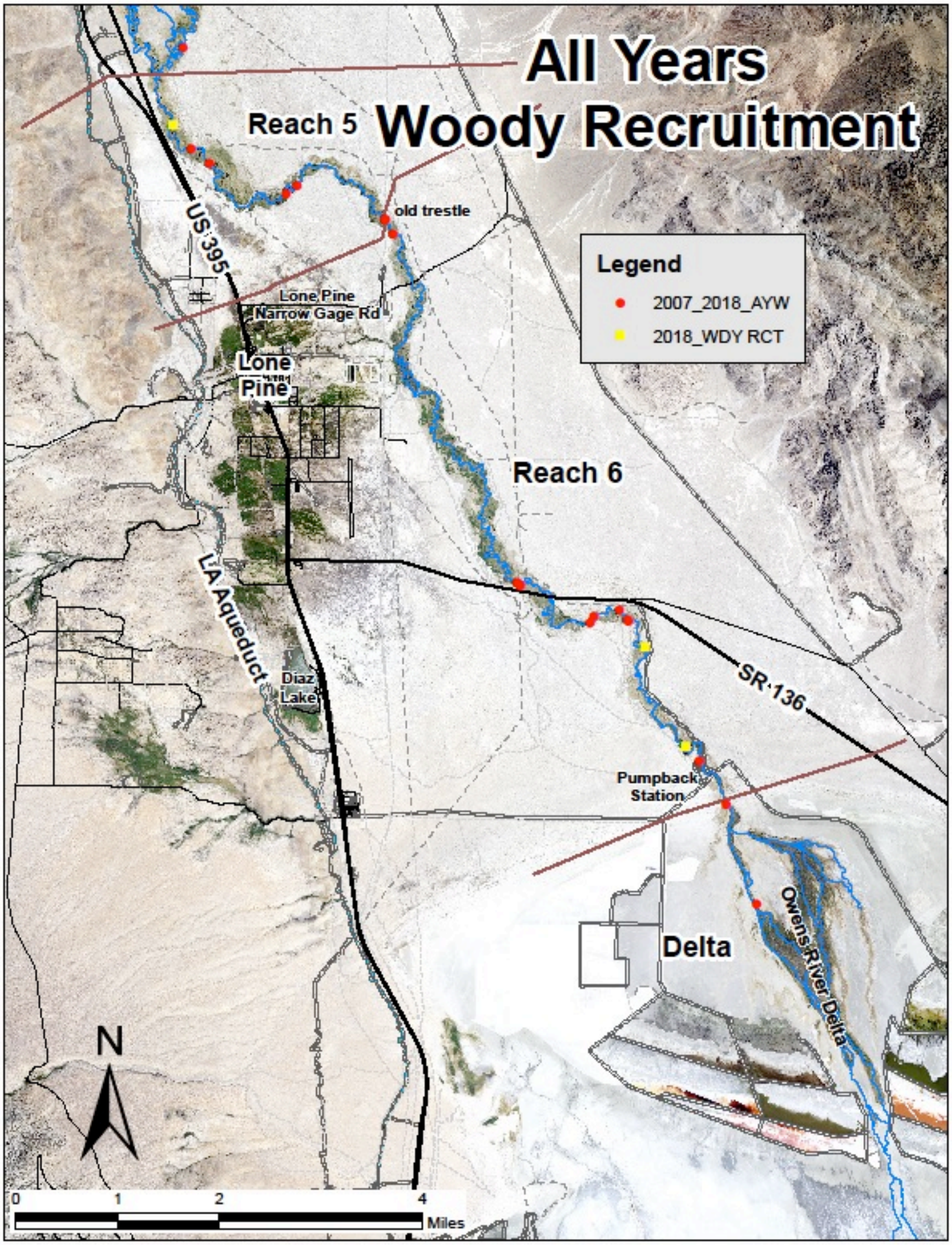

Figure 7. Sites in Reach 5-6 and Delta where recruitment was observed during the LORP RAS monitoring 2007-2017 combined (red) and in August 2018 survey (yellow).

10.0 ADAPTIVE MANAGEMENT RECOMMENDATIONS

2018 LOWER OWENS RIVER PROJECT

ADAPTIVE MANAGEMENT RECOMMENDATIONS

by

MOU CONSULTANTS

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and

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EXECUTIVE SUMMARY

Consultants recommend the County and the City sponsor a two-day "River Summit #2" in 2019. The priority should be on "Where Do Go from Here." In preparation for the summit, the Scientific Team must spend considerable time reviewing and discussion all elements of the LORP to agree upon the priority goals for going forward.

Consultants recommend that the Scientific Team develop a series of improved seasonal habitat and flushing flows to test and evaluate. This report would be submitted to the MOU Parties by June of 2019 for their consideration and action.

Consultants recommend that the County begin to explore a process with the City that could replace the present 1997 MOU process. This next management phase would need to address:

> Management flexibility to study, evaluate, and implement more favorable habitat, flushing, flooding, drought, and freezing flows
>
> Evaluate feasible and reasonable active intervention methods to manage tules, cattails, and trees in a manner that will enhance LORP resources
>
> Update and/or replace all present outdated LORP Plans, including the Monitoring and Adaptive Management, Ecosystem Management, Blackrock Waterfowl Management, and Delta Habitat Area Management Plans, especially the river management plan, and finalize and implement the HCP.
>
> Develop and use an Advisory Team including CDW, SC, and OVC as members that would provide specialized input.

The Consultants recommend the Scientific Team thoroughly analyze the OVC flow recommendation to improve water quality and present its detailed findings with all supporting evidence in report form to the MOU Parties for their consideration and action by June of 2019. Preliminary findings and recommendations would be presented by the Scientific Team at "River Summit #2".

Implementation of the HCP is critically late in the LORP process. The Consultants recommend LADWP pressure the USFWS into issuing an ITP. The HCP must be presented to the MOU Parties with explanations how it will be incorporated into the LORP management as soon as possible.

INTRODUCTION

The principle responsibility of the MOU Consultants in this phase of the LORP is to (1) ensure monitoring is performed appropriately by LADWP and ICWD staff, (2) review the draft annual report for completeness and accuracy, and (3) use the annual monitoring data and conclusions presented by staff to make adaptive management recommendations. Adaptive management recommendations (AMRs) are made in relation to the goals set out in the 1997 Memorandum of Understanding (MOU). The MOU Consultants use the monitoring data to identify trends over time in the river, wetlands, and off-river lakes and ponds toward the established goals. Corrective actions are recommended if trends are clearly not in the right direction. It is the responsibility of management (LADWP and ICWD) to accept and implement the AMRs.

The first rehabilitation flows were released into the Lower Owens River in the winter of 2006. Monitoring of the LORP was initiated in 2007- 2008. LORP monitoring is planned to cover a 15-year period. This length of time was considered adequate to determine if the LORP would achieve the MOU goals. Consequently, to understand the status of the LORP we must understand the initial goals, what has been attained, and what has not and may not be attained. This year marks the eleventh year of monitoring and we have enough data to realistically describe the status of the LORP relative to the goals, and the ecological conditions of the river, Blackrock Waterfowl Management Area, the Delta, off-channel lakes and ponds, and rangelands.

2018 MONITORING

The Monitoring and Adaptive Management Plan (MAMP) lists the monitoring tasks for 2017-18, which includes the following 11 tasks:

- Flow Monitoring in the river
- Discharge to the Delta
- Seasonal Habitat Flow implementation
- Rapid Assessment Surveys on the river, wetlands, and off-channel lakes and ponds
- Indicator Species Habitat along the river, in the wetlands (BWMA and Delta), and off-channel lakes and ponds
- Landscape Vegetation Mapping
- Flooded Acreage in the BWMA, Thibaut, and Thibaut Pond

- Avian Census on the river, BWMA, Delta and off-channel lakes and ponds
- Range Trend
- Utilization
- Irrigated Pasture Scoring

Over time adaptive management recommendations and experience has resulted in modification of some monitoring tasks designated in the MAMP. For example, vegetation landscape mapping is now performed every five years in coordination with LADWP's remote imagery collection on all of its lands in the Owens Valley. The RAS surveys have been attenuated to focus on the presence/absence of riparian plants along the river corridor. After several years of collection, LADWP and ICWD decided to end creel census surveys. LADWP and ICWD also decided to eliminate the site scale vegetation and elevation mapping early in the monitoring program. Other monitoring tasks such as water quality monitoring were intended to phase out after the initial years of project implementation; however, LADWP and ICWD elected to continue monitoring water quality during some critical periods such as the extreme water year in 2017. Other monitoring has been implemented over time such as belt-plot transects which, however, became inundated in many reaches and are no longer measured. Early in the program, LADWP elected to develop a detailed cross-section hydrologic data base as a baseline for channel change detection and predictions. ICWD initiated a large-scale experiment to plant and establish willows on landform types in the lower river and monitored this effort.

Because of these monitoring modifications over time, the 2017-18 monitoring tasks included hydrologic monitoring (river flows, delta and BWMA inflows, seasonal habitat flows), vegetation mapping, land use (grazing), indicator species habitat analysis and avian census, an attenuated RAS, salt cedar and weed control.

Monitoring was generally performed in accordance with methods described in the MAMP. Vegetation mapping was the most extensive monitoring effort and used LIDAR to inventory vegetation throughout the Lower Owens River corridor, Drew Slough in the BWMA (but not the Winterton or Waggoner wetland units) and the Delta Habitat Area. Results were compared to 2000, 2009, 2012, and 2014 inventories. However, the LIDAR data acquired in 2017 was collected during the extraordinary water year in which runoff was the second highest year on record. Consequently, when LIDAR imagery was collected from July 28 through August 2, discharge in the river corridor was descending but still high, ranging from 131 to 117 cfs and off-channel areas such as oxbows were still inundated to some degree. The DHA had received such high flows that open water was 16 times the area of water recorded in 2012 because discharge to the Delta at the time of imagery acquisition was 60 cfs and over 100 cfs the previous month. Therefore, direct comparisons to previous years inventories were heavily biased toward more hydric vegetation. Also, some vegetation types like riparian shrub and reed were difficult to distinguish "spectrally or from vegetation height". This required "heads-up" editing to evaluate these types. Heads-up editing is not defined in the annual report, but the site plot mapping and elevation task that was discontinued in the initial stages of monitoring would have greatly informed the LIDAR mapping and avoided assumptions. Unfortunately, a critical question to be answered with the vegetation mapping was how much of the channel is occluded by tules and how much is open. Figure 2-25 in the vegetation mapping section shows a table indicating that in 2014 29 miles of the river were occluded and 29 miles open, but in 2017 mapping showed 18 miles occluded 40 miles open. This is counterintuitive. The reason more of the river was mapped as open was due to the high flows not because tules had decreased.

STATUS OF THE LORP

The present status of the LORP, and especially the Lower Owens River physical feature, is generally well documented and understood. The past City-County Annual Report presented a good description of present river conditions as follows:

> The report describes a desert river with dissolved oxygen levels falling to lethal levels under certain river conditions. Fish kills can occur when river flows exceed 70 to 80 cfs and river temperatures are above 60 to 65 F. Poor water quality conditions are expanding upstream from the Keeler Bridge (and downstream from the Intake Control Station). The river channel is infested with tulles and cattails, and recruitment of surrounding trees and resulting canopy is ineffective and not improving.

This City-County report description leaves out the environmental gains and the numerous beneficial resources the LORP has already produced. The OVC in their review of the Annual Report listed some of the favorable environmental conditions produced to date. The City-County description, however, does a good job describing what and where the physical and environmental problems are in the LORP. The river environmental status provides some justification to advance to another phase of LORP management which will be discussed later under recommendations.

This more detailed status evaluation is presented to provide a base and justification for past and present adaptive management recommendations and concentrates mainly on problems. Hopefully this will synergize further discussion and analysis by the MOU Parties.

GOAL ATTAINMENT

The MOU includes the LORP Ecosystem Management Plan and Appendices, and the LORP Monitoring, Adaptive Management and Reporting Plan (MAMP). Therefore, the MOU is comprised of multiple explicit and implicit goals and requirements for the LORP. A commitment to fulfill these goals and requirements were approved by all Parties at project inception. In their 2015 AMR report, the MOU Consultants presented detailed tables describing the LORP goals, which goals have been or will be met in time, and those goals which cannot be met. Table 1 lists *some* of the more important goals and requirements appearing in the 1997 MOU that the MOU Consultants believe have been met, or will be met, and those which will be difficult to meet or will not be met before the 15-year monitoring and adaptive management program ends, given current LORP management.

Table 1. Status of explicit and implicit goals and requirements from the 1997 MOU (including the Ecosystem Management Plan and MAMP).

MOU GOAL	ATTAINABLE	QUESTIONABLE
Establish healthy ecosystems in healthy ecological condition		**x**
Establish functioning ecosystems	**x**	
Establish healthy ecosystems that will benefit biodiversity		**x**
Establish healthy ecosystems that will benefit “Threatened and Endangered” species		**x**
Establish and maintain diverse riverine habitats		**x**
Establish and maintain diverse riparian habitats		**x**
Establish and maintain diverse wetland habitats	**x**	
Establish wetlands in a healthy ecological condition	**x**	
Create and maintain though flow and land management diverse natural habitats consistent with the needs of “habitat indicator” species		**x**
Comply with State laws and regulations, Federal laws and regulations, and guidelines that protect “Threatened and Endangered” species		**x**
Manage to be consistent with applicable water quality laws, water quality standards, and other water quality objectives		**x**
Control deleterious species (plant and animal) whose presence interferes with achieving LORP goals and requirements	**x**	
Manage livestock grazing consistent with the goals of the LORP	**x**	
Manage recreational use consistent with the goals of the LORP	**x**	

Create and sustain healthy aquatic habitats		x
Create and sustain healthy riparian habitats		x
Create and sustain a healthy warm water recreational game fishery		x
Create and sustain healthy habitat for native fish		X
Minimize the amount of muck on the river channel		x
Minimize the amount of other bottom material on the river channel		x
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		x
Fulfill the wetting, seeding, and germination needs of riparian vegetation, particularly willow and cottonwood trees		x
Recharge groundwater in streambanks and floodplains to benefit wetlands and biotic communities	x	
Control tules and cattails to the extent possible		x
Enhance the fishery	X	
Maintain good water quality conditions		x
Meet all water quality standards and objectives		x
Enhance the river channel		x
Enhance and maintain in the DHA 325 acres of existing habitat suitable for shorebirds, waterfowl, and other animals	x	
Enhance and maintain in the DHA new additional habitats suitable for shorebirds, waterfowl, and other animals	x	
To the extent possible make the DHA as self-sustaining	x	
In Off-River Lakes and Ponds maintain or establish diverse habitats for fisheries	x	
In Off-River Lakes and Ponds maintain or establish diverse habitats for waterfowl	x	
In Off-River Lakes and Ponds maintain or establish diverse habitats for shorebirds	x	
In Off-River Lakes and Ponds maintain or establish diverse habitats for other animals described in the 2004 EIR	x	
In Off-River Lakes and Ponds maintain or establish diverse habitats for habitat indicator species		
Provide and maintain habitat for habitat indicator species in the Blackrock Waterfowl Management Area as described in the 2004 EIR and the 1997 MOU	x	
Provide and maintain waterfowl habitat in the Blackrock Waterfowl Management Area as described in the 2004 EIR and the 1997 MOU	x	
Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for riparian habitat (MAMP)		x
Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for the fishery (MAMP)		x
Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for water quality (MAMP)		x
Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium for animal migration (MAMP)		x
Apply a LOR habitat flow that will create a natural disturbance regime that produces a dynamic equilibrium resulting in productive ecological systems (MAMP)		x
Maintain 755 acres of wetland-riparian areas and surface water suitable for shorebirds, waterfowl, and other animals in the Delta Habitat Area	x	
Prevent fish kills		x

It can be seen from this table that, in the opinion of the MOU Consultants, fewer than half of the 45 LORP goals set out in the MOU and guiding documents have been or will be attained. While most of the goals established for the Blackrock Waterfowl Management Area, the Delta Habitat Area, Rangelands, and Off-channel Lakes and Ponds have been or will be attained, the same cannot be said for the river ecosystem.

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 questionable. 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.

As early as 2007 the MOU Consultants objected to the codifying of minimum and maximum river flows because unvaried instream flows would result in the tule clogging canal conditions we see today in the LOR.

The MOU Consultants advised in all subsequent recommendations that on-going adaptive management was not successful and not being implemented correctly and that this would, 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 invited failure to meet MOU goals and objectives and cause ecological setbacks in the LORP.

The following sections describe in detail the status and condition of key LORP elements and whether these ecological components are trending toward meeting MOU goals.

WATER QUALITY STATUS

Over the past century, and even prior to this, the Owens River experienced serious lethal water quality problems. These limiting, and sometimes lethal conditions, affected what are now LORP resources. Today's poor water quality conditions are nothing new, they are just more noticeable. Seasonal river flow volume during the past century was also detrimentally affecting some resources. An example is from 1927 to 1985, when flows passing under the Keeler Bridge varied from an average flow of 3 cfs one year to a high annual average flow of 358 cfs on another year. In more recent times the LORP 2002 Management Plan warned, to what would later become a reality, that a future prolific tule growth and its annual die-off in all reaches of the Lower Owens River could result in continuous deleterious river effects. The major effect would be decreased available dissolved oxygen because of increased biological oxygen demand from increased organic decomposition. The same process that had already occurred before the LORP in the lower reaches of the river

Both LORP Technical Memorandum # 7 and the 2004 EIR concluded that the MOU mandated uniform 40 cfs base flow, in combination with low seasonal habitat flows, would result in insufficient water quality improvement. They predicted degradation would continue under these flows that would adversely affect fish and other aquatic life. In these documents, degradation was predicted to occur mainly due to the depletion of available dissolved oxygen and possible increases in hydrogen sulphide and ammonia. This desert river has always and will always in the future, have natural high spring-summer river temperatures. Water temperature levels that can greatly synergize other stressor's (i.e., low dissolved oxygen) ability to form impaired conditions leading to fish kills even under small minor changes in river flow volume.

Tule and cattail complexes in the Lower Owens River not only degrade water quality they can also improve water quality. Observations by the Consultants during all seasons and over many years provides evidence that the prolific abundance of tules and cattails in the upper reaches of the Lower Owens River provides substantial filtering of bedload, suspended sediments, and solution turbidity materials in the water column; all diverted into the Lower Owens River by the Intake Control Structure. This very important and needed environmental cleansing function is a resource saver as quite frequently flows released into the Lower Owens River carry high sediment loads creating high river turbidity. If this incoming high turbidity carried down-stream through the system, the warm water recreational fishery would be detrimentally affected. Fishing would even cease during certain periods of the year.

During the first years of LORP flow releases, incoming turbid water was soon clarified by the tule-cattail filtering and deposition process. This clarity occurred before the river traveled half way to the Blackrock flow measuring station. A few years later the heavy build-up of tules and cattails was only able to filter and clear the water column by the time the flow reached just upstream from the Blackrock flow measuring station. An additional few years later the tule-cattail complex was only able to clear the river water column by the time it reached the Goose flow measuring station. Today, the filtering and deposition effectiveness process has even been further reduced. Today, turbid water released, during certain turbid flow conditions, can now be observed to travel down-river as far as the Twin Culverts flow measuring station. before water clarity occurs. In November of 2018 moderate turbidity water entering from the Intake resulted in light turbidity as far down as the Two Culverts site. Sediment accumulations in the channel can now be observed in the upper reach.

If in the future, this filtering capability becomes so ineffective that high turbidity water continues down through the system dire consequences will occur to the warm-water recreational fisheries. This presents a conundrum because heavy concentrations of tules and cattails are needed in the channel to buffer incoming poor water quality while at the same time these complexes block fishing access and other recreational activities. The tule-cattail complex also influences down-river water quality because of their large annual contributions to the organic mass deposited and decaying in the channel.

In 2010 the Lower Owens River suffered its first unfavorable observed water quality conditions since LORP inception. The seasonal habitat flow applied heavy stress to fish and other aquatic life. The 2004 EIR threshold trigger for dissolved oxygen was exceeded in most river reaches. In 2013 Consultants again pointed out that future water quality conditions will continue to detrimentally affect LORP resources.

Low river channel gradient (average 0.07%) results in very low river power under all MOU mandated flow volumes released to date. This low stream power is incapable of eliminating all deposited inorganic and especially organic channel sediments. Nothing feasibly can be done to buffer the natural high river spring-summer river temperatures. This means its more efficient to direct resources towards improving low dissolved oxygen problems in the water column. Natural storm events, accidental and required river flow releases, sudden incoming flood flows, infrastructure accidents, channel aggradation, and the continuation of present flow management will provide some very challenging water quality problems for managers to explain and over-come in the future.

In an attempt to improve water quality conditions, Consultants constantly recommended that larger multiple seasonal habitat, flushing, and flooding flows be tested and evaluated to determine if water quality condition can be improved. Drastic base flow manipulation was recommended for testing to determine if a drying out and/or freezing processes could control tule abundance, encroachment, and location. None of this recommended testing and evaluation of flows was accepted by the MOU Parties and implemented.

Lower Owens River water quality present status is that, under certain river flow and temperature conditions, water quality condition is going to be lethal to aquatic life. Fish kills will occur and it is going to stay this way far into the future.

RIVER FLOW MANAGEMENT STATUS

Lower Owens River base flows (uniform 40 cfs) were initiated in December 2006. The first flushing flow (220 cfs), which took the place of a seasonal habitat flow, was released in 2008. River flow volumes and release time periods as mandated by the 1997 MOU have been implemented since that time. The 1997 MOU-Action Plan immediately warned that the initial river mandated flow levels will soon need to be altered if all LORP objectives are to be met. CDW was also challenging that flow regimes applied will not result in achievement of LORP goals. They also pointed out that this weakness is further compounded by the failure of management to implement needed Adaptive Management Recommendations.

In 2008, at the very beginning of complete LORP flow implementation, Consultants alerted the MOU Parties that their future decisions on adjusting river flows, to try and control tule-cattail abundance and encroachment, will require a thorough analysis of potentially successful flow alternatives and their different scenarios. The Scientific Team was recommended to do this analysis and their findings were to be submitted to the MOU Parties for their consideration and action. This Adaptive Management Recommendation was never accepted. As a result, base flows are the only flow scenario applied to date that formed and still maintains today’s river conditions. For 15 years uniform base flows have been contributing to the build-up of “muck” and other organics in the channel. Seasonal habitat flows and the rarely released flushing flows were too low in volume and duration and to infrequent to compensate for what base flows cannot do.

The first seasonal habitat flows released in 2008 and 2009 (220 and 110 cfs respectively) did not create any observed adverse water quality conditions. No water quality parameters were known to have been breached or violated during these flows. Upper river channel reaches were still relatively bare from tules and cattails and as a result there was very little organic buildup in that reach of the channel. By 2009, Consultants were recommending augmenting seasonal habitat flows down-river to counter large decreases occurring in down-river flow volume. Consultants were concerned that the decreases in down-river habitat flows could increase the already detrimental water quality conditions. Down-river flows were so low they were completely incapable of eliminating the build-up of channel “muck”.

In 2010, Consultants again recommended decreasing seasonal habitat flow duration (to stay “water neutral”) so more water would be available to release larger peak flows. These higher peak flows could then be tested to determine if they could buffer organic build-up and improve spring-summer water quality conditions. We now doubt today that this recommendation had any merit at all. The recommendation was never tested or evaluated. Consultants now believe this recommendation had no chance of any success because seasonal habitat flow volumes allotted did not provide near enough water to work with.

Also, in 2010, Consultants again alerted the MOU Parties that two dangerous developments had already occurred, and they needed immediate attention. These are the increasing tule-cattail channel encroachment and already existing and continuing detrimental water quality conditions. The uniform 40 cfs base flow had no chance of correcting this situation. The river, artificially forced to function with summer base flows higher than spring runoff flows, mimics no natural disturbance regime. These artificial flows produced artificial results with some results being unfavorable.

The following year (2011), the MOU Consultants, and the Sierra Club Consultant and OVC Consultant, expressed their concerns that to rely only upon the low volume annual seasonal habitat flows to benefit the river system was not a feasible solution. Low channel gradient resulting in low river power at any MOU mandated flow level would not export the large amounts on accumulated organic material aggrading the river channel. Detrimental environmental conditions were now informing that something very different in management implementation will have to be done if water quality is to ever be improved.

In 2012 the Sierra Club and OVC Consultants along with the MOU Consultants again all stressed that seasonal habitat flows were too low in volume and too short in duration to correct the deteriorating conditions dominating down-river reaches. All Consultants were now unanimous in their recommendations that the river needs much higher flushing flows. Dr. Patton, Sierra Club Consultant, cautioned that to control tules will require scouring flows over 500 cfs.

During this critical management period some MOU Party members were casting doubt on any management change that was suggested. The County maintained that no evidence existed that increasing base flow from 40 cfs to an annual average of 55 cfs, as the City recommended, would better accomplish flow related objectives (Annual Report 2014). The County is correct that there was no evidence and there will not be any evidence until the County allows testing and evaluation of alternative flows. Consultants have recommended many times that the County and City provide the evidence they continue to say does not exist. Consultants are not allowed to collect evidence, do research, or evaluate out-side related evidence, if any exist. Consultants can only work with what the City and

County put in their annual reports. Very little evidence appears in the annual reports. An abundance of evidence exists that the mandated uniform 40 cfs base flow is not solving all LORP problems. Even though there is this abundance of evidence this flow scenario is still being applied.

The County also challenged the Consultant's recommendation that a 300 cfs spring flushing flow be applied annually for testing and evaluation. The County correctly pointed out that the 300 cfs flow suggestion lacks enough explanation on how this specific change will benefit the river. If something with potential is never tested no one will never know if flushing flows or any other change in flow management can provide any benefits. The City is on record that they are willing to test higher flow scenarios. The County has provided no suggestions, no evidence or no incentives in their Annual Reports that could have any potential to improve river conditions.

In 2017, higher than normal unexpected and unplanned summer flows were shunted into the lower reaches of the river. The run-off for 2017 was the second highest year on record. In June inflow into the LORP exceeded 240 cfs and peaked at 325 cfs. A 274 cfs peak flushing flow was released in April. These flows were insufficient in magnitude and duration to overcome the accumulation of organics and tule-cattail complexes covering the channel. The rivers ecological trajectory was not observed to be altered or reset by these unusual summer flows. These flows did cause large fish kills. The minor flooding also may have had some influence on willow pole plantings but was probably only minor. The higher than normal summer flows (over 300 cfs) flooded areas that may, in the future, be invaded by salt cedar. Mortality may have occurred in recently recruited tree seedlings from long-term flooding. There is no data or information available to determine this. The OVC correctly concluded that these unplanned summer flows did nothing to flush out excessive amounts of in-channel vegetation and these flows did nothing to remove tules.

OVC also expressed that the Consultant's recommendation to increase all annual seasonal habitat flows to a 400 cfs peak flow for testing and evaluation will do nothing to help meet LORP goals. Their conclusions, with no supporting evidence, could very well be true. The problem is that the MOU Parties, except for the City, are presenting nothing that could be tested and evaluated that may better help meet LORP goals in the future. This is an important obstacle that needs facing if they believe there are goals that have not already been met. Many goals have been met. Many years of experimental high and low flow releases in combination with other needed changes in management actions will need to be analyzed to determine what, if anything, can be done to improve river conditions. The Parties are probably not up to taking on this task. But then the river condition under LORP management has already produced and will continue to produce many beneficial resources.

The current flow regime has increased river channel aggradation, furthered tule-cattail expansion, increased summer water quality critical conditions, stagnated woody recruitment, and decreased existing woody riparian vegetation (Annual Report 2103, Jensen 2014). The river continues to aggrade annually. This is not all bad as aggrading rivers are usually more productive that degrading rivers. If organic channel sediment build-up cannot be managed, then river water quality conditions cannot be managed successfully. Even if the MOU Parties in the future somehow improve flow management, the river may not have the ability to change enough to meet some expectations. River flows have now been managed much the same each year for 13 years. To manage flows the same year after year and expect different results in not facing reality. To apply a constant and expect variability in response is not logical.

Enough time has taken place to predict fairly accurately the direction the Lower Owens River is going to take if present management continues. River trajectory has now come into line with applied river flow regimes and surrounding land condition influences.

Future Lower Owens River status, under continuation of present flow management, will be very similar to the present river status the County and City describe in their Annual Report. Consultants predict that the status of river flow management and resulting conditions are not going to change significantly in the near future.

TULE-CATTAIL STATUS

The Lower Owens River is a desert river intensively controlled by flows that encourage the domination and encroachment of the channel by tules and cattails. Open surface water habitat needed by some indicator species will continue to diminish in the future. The dominant tule-cattail abundance and expansion, still occurring today, is nothing new even though these plants were very sparse in the river channel during pre-historic times. In early historic times, tules and cattails in the river channel were still very sparse in the river channel and almost missing during pre- and especially during early historic crop-pasture irrigation time. This all changed with changing river flows and the re-watering of the river below the Billy Lake Return in the late 1980's. Tules and cattails have dominated wetted reaches of the channel from Mazourka Canyon Road to the Delta Habitat Area since that time. Tules and cattails dominated some river reaches of the Lower Owens River long before the LORP was ever implemented.

Once the LORP was initiated, tule and cattail abundance, expansion, and domination greatly accelerated and exceeded expectations. Marsh, wet meadow, and also open water habitats have increased throughout the LORP since the initiation of perennial flow (Annual Report 2015). Early LORP studies and the predictive models used to guess the future status of the tule-cattail complex were erroneous. Modeling also made emergent vegetation predictions that were underestimated.

Consultants, once annual observations informed, suggested early in the management process that controlling tules and cattails with large changes in the volume of spring, summer, and winter flows may have potential. They pushed for those methods that would increase river depth as the most important variable for controlling tules and cattails. Drawdown of summer and winter flows were suggested to dry-out or freeze tule-cattail masses. The drawdown periods could also provide managers with an opportunity to treat areas that prohibit recreational access. These suggestions along with the Sierra Club Consultant and OVC Consultant suggestions did not get very far with the MOU Parties.

Early in LORP management Consultants pointed out that uniform base flows (40 cfs) were producing a “canal” environment. A condition ideally suited for heavy tule and cattail dominance. CDW correctly identified that no progress has been made to improve bulrush and cattail management. CDW and the Sierra Club were soon recommending extensive mechanical removal of emergent vegetative growth to control tules and cattails. They recommended that active intervention combined with river flow modification are the two best options for gaining a self-sustaining fluvial habitat as described to be attained in the 1997 MOU. The OVC, however, countered that tules be allowed to “live out” their time because they may be successional to the next wave of dominant vegetation. OVC is also on the record that increasing river flows (of the same quality water as applied today) into tule infected reaches will not control tules. OVC statements are worthy of further consideration and analysis.

2004 EIR guidelines may be a stumbling block for future tule-cattail management. The EIR states that extensive removal or active management of tule stands to retard the expansion of tule growth or to increase open water habitat for habitat purposes will not be considered. The only exception that would be considered is if it is determined that the benefits out-weigh the environmental effects of such measures. The EIR also stated that <u>ONLY</u> if funding for tule-cattail control is obtained from sources other than the City or the County will tule-cattail control be considered. Cattail and bulrush marsh proliferation, at the expense of open water habitat may be here to stay. To date, the MOU Parties have not tested and evaluated any Adaptive Management Recommendation that may have a chance to control tule-cattail complexes.

Consultants list controlling tule-cattail abundance and encroachment as the second management priority right behind trying to improve water quality condition. The two control and influence each other. Consultants in 2012, in an attempt to determine if there was any possible solution to this problem, recommended that a" MOU Party Working Meeting" be conducted for the purpose of considering feasible and reasonable actions to manage these plants. This recommendation was never accepted by the MOU Parties and the meeting never took place.

Cattail-tule complex present status is that they dominate the river channel and control water quality conditions. This control and domination will stay this way far into the future. The cattail-tule complex will continue to cause fish kills whenever environmental conditions line up to allow it.

RIPARIAN WOODY SPECIES STATUS

CDW, Sierra Club, and OVC are constantly concerned, and rightfully so, that seasonal habitat flows have not resulted in enough woody plant establishment; particularly the taller stature species (trees). CDW requested that the efficacy of the seasonal habitat flows in establishing woody riparian vegetation be evaluated. CDW also emphasized that the current river flow regime is not capable of creating disturbed habitat necessary for natural tree recruitment and therefore supports active intervention to create sites for tree establishment (Annual Report 2016).

The Sierra Club and the OVC (2010) expressed concerns that recruitment and survival of riparian vegetation (trees) in the lower reaches of the LORP may be inhibited.   Dr. Patton (Sierra Club Consultant) lends support to their position by stating that overall, recruitment of a healthy riparian habitat dominated by diverse woody riparian species has failed.

Jensen (2013) predicts that channel aggradation over-time will become more extensive and the area suitable for persistent riparian forest will diminish. Existing trees will become engulfed in saturated marsh leading to decadent individuals similar to those in the Island reach. Jensen believes, as the MOU Consultants believe, that the low seasonal habitat flows being released will not enhance either tree recruitment or persistence. Riparian forest along the Lower Owens River has decreased from 450 acres in 2000, to 265 acres in 2009, and only 165 acres in 2014 (Annual Report 2015). In Jensen's report (2018 Annual Report) he stated that tree habitat decreased from 449 acres in 2000, to 200 acres in 2009, and to 162 acres in 2014 probably to more precise mapping. A still more precise approach in 2017 identified only 190 acres of trees. Twice as many tree seedlings were recorded in 2018 than in 2017. More tree recruitment was observed in 2018 than in the total of the last six RAS surveys. This, however, is nothing to get excited about, because seedling sites recorded in 2018 only averaged about one site per mile of river. It does indicate that releasing higher summer flows could increase the number of seedling sites.

Today's tree status is that the evolved riverine-riparian ecosystem functioning today within the constraints of management, precludes the widespread establishment of trees (Annual Report 2015). Native trees were never a dominant component of the Lower Owens River riparian habitat and they will never be in the future. The MOU goal of a forested riparian habitat is probably an unreasonable goal.

FISH KILL STATUS

The recent influx of fish kills demonstrates just how critical water quality conditions can become in the Lower Owens River. Fish kills are nothing new, however, because over the last century, the Owens River continually experienced fish kills because of poor water quality or in combination with low and extreme flow conditions. Fish kills occurred long before LORP initiation. In 2010, the Lower Owens River experienced its first observed large-scale detrimental water quality event since the initiation of base flows. The resulting poor water quality conditions heavily stressed warm water fish and other aquatic animals to a critical survival point. Soon to follow in the summer of 2013, when a small unplanned flow was shunted into the lower river, water quality conditions become so harsh that large fish kills resulted. Fish kills occurred again in the summer of 2017.

Fish kill present status is that kills can occur at any time when spring-summer flow and river temperatures line up. Kills will occur in the future and there is little that can be done to prevent them. Fish kills occurred before the LORP and they will occur after the LORP. The largest risk today, because of the present fish-kill potential, is that on any given day fish kills could set in and become a public issue. A public issue that will be very hard for management to handle in the future.

RECREATIONAL FISHING STATUS

Fishing success analysis begin in 2003 before project implementation. Five recreational fishing success evaluations (2003, 2010, 2013, 2014, and 2015) have been conducted in the Lower Owens River and Off River Lakes and Ponds. Data from the first two post-project implementation periods (by 2010 and 2013), showed that the LORP was already supporting a healthy warm water recreational fishery.

The 2004 EIR calls for a 5-year window period AFTER water quality conditions have been met before fishery goals have to be maintained. This presents a conundrum. Water quality condition requirements will probably never be met unless quality requirements are adjusted fairly to fit a low gradient desert "working" river.

The 2013 fishing success information results continued 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 (Annual Report 2013). The over-all fishing success rate was 2.7 fish per hour and of the fish caught 96% were in good condition.

Today, the present warm water recreational fishing status cannot be determined. The monitoring and evaluation methods in the Monitoring and Adaptive Management Plan used to determine recreational fishing status is not now supported by the County. The County ignored the Adaptive Management Recommendations to continue fishing success analysis and did not conduct a fishing success evaluation in 2018. Therefore, there is no information to evaluate the 2017 fish kill impacts. The County has not come up with anything suitable to replace the fishing success evaluation even though the Consultants strongly recommended they do so in the past two Annual Reports. Consultants assume a healthy recreational fishery exists today.

HABITAT INDICATIOR SPECIES STATUS

Habitat indicator species for the Blackrock Waterfowl Management Area (BWMA) and the Delta Habitat Area (DHA) were selected by committee during the development of the Lower Owens River Project Ecosystem Management Plan - Action Plan and Concept Document (Ecosystem Sciences 1997). Participants argued that the presence or absence of these select species would indicate whether the desired range of habitat conditions were being achieved (MOU 1997). The initial list of indicator species by habitat type for the Lower Owens Riverine-Riparian system are shown in Table 2.

Table 2 . Initial list of indicator species by habitat type.

WETLAND/OPEN WATER	SUCCESSIONAL SHRUB	GRASSLAND	WOODLAND
Belted Kingfisher	Blue Grosbeak	Northern Harrier	Long-eared Owl
Great Blue Heron	Willow Flycatcher	Swainson’s Hawk	Nuttal’s Woodpecker
Marsh Wren	Yellow Breasted Chat		Red Shoulder Hawk
Sora	Yellow Warbler		Warbling Vireo
Virginia Rail			Yellow-Billed Cuckoo
Western Least Bittern			Tree Swallow
Wood DUck			

Since the initial list was promulgated, habitat indicator species have been added and dropped to more accurately reflect the species expected and known to use wetland habitat in this region. The habitat indicator species include “waterfowl, wading birds, shorebirds, plus Northern Harrier, Least Bittern, rails, and Marsh Wren. 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 include 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”[1].

Table 3 lists these habitat indicator species for the BWMA and the DHA. Data from the 2018 avian census taken in Drew and the Delta were used to generate presence/absence status for each indicator species. The wetland goal is to build suitable habitat for these species over time. That is, habitat development should be cumulative year-by-year so that more habitat is available for indicator species. This simple presence/absence analysis shows that in 2018 the current management practice is not building sustained habitat for all indicator species. Using Drew as a surrogate for the BWMA, habitat is insufficient to attract 52% of indicator species, while in the DHA 58% of indicator species were absent in 2018 due to lack of suitable habitat. The 2017 and 2018 annual reports for the avian censuses provide detailed analysis of habitat suitability as modeled with the CWHR.

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[1] 2018 LORP Annual Report; avian census section

Table 3. Habitat indicator species for the BWMA (Drew) and the DHA and their Presence or Absence in the 2018 avian census (presence is assigned if the species was counted more than 5 times from March through October).

BWMA	P/A	DHA	P/A
Egret, Snowy	A	Egret, Snowy	A
Egret, Great	P	Egret, Great	A
Bittern, American	P	Bittern, American	P
Heron, Great Blue	P	Bittern, Least	A
Wigeon, American	A	Wigeon, American	A
Mallard	P	Mallard	P
Pintail, Northern	P	Pintail, Northern	A
Gadwall	P	Gadwall	P
Killdeer	P	Killdeer	P
Plover, Semipalmated	A	Plover, Semipalmated	A
Teal, Green-winged	P	Teal, Green-winged	A
Sandpiper, Least	A	Sandpiper, Least	A
Sandpiper, Western	A	Sandpiper, Western	A
Sora	P	Sora	P
Avocet, American	A	Avocet, American	P
Dowitcher, Long-billed	P	Dowitcher, Long-billed	A
Dowitcher, Short-billed	A	Dowitcher, Short-billed	A
Yellowlegs, Greater	A	Yellowlegs, Greater	P
Snipe, Wilson's	P	Snipe, Wilson's	P
Heron, Black-crowned Night	A	Willet	P
Sandpiper, Spotted	P	Godwit, Marbled	A
Ibis, White-faced	P	Ibis, White-faced	P
Stilt, Black-necked	P	Stilt, Black-necked	A
Egret, Cattle	A	Curlew, Long-billed	A
Rail, Virginia	P	Rail, Virginia	P
Yellowlegs, Lesser	A	Yellowlegs, Lesser	A
Teal, Blue-winged	A	Teal, Blue-winged	A
Teal, Cinnamon	P	Teal, Cinnamon	P
Coot, American	P	Coot, American	P
Phalarope, Wilson’s	A	Phalarope, Wilson’s	A
Grebe, Pied-billed	P	Grebe, Pied-billed	A
Wren, Marsh	P		
Osprey	A		
Harrier, Northern	P		
Shoveler, Northern	A		
Goose, Canada	A		
Goose, Greater Whitefronted	A		
Phalarope, Red-necked	A		
Grebe, Eared	A		
Duck, Ruddy	A		
Duck, Ring-necked	A		
Redhead	A		

The status of each wetland area in the LORP is described in the following sections. However, it can be concluded that if the project is to meet the goal of creating habitat and attracting indicator species then one of two things needs to be done; either modify the list of indicator species to more narrowly reflect the limitation on habitat development with current management practices or change management practices so that more suitable habitat is developed. Obviously, the latter is the preferred action.

WETLANDS STATUS

BLACKROCK WATERFOWL MANAGEMENT AREA

The BWMA consists of three units; Winterton, Waggoner, and Drew. Thibaut is hydrologically separated from the other three units and is managed differently. Thibaut Pond is required to contain 28 acres of water and is not managed as a wetland. The current management in the BWMA is required by the MOU to follow a sliding scale of wetted area up to 500 acres based on the annual runoff. For example, in 2018 the runoff estimate was 78% of normal which required 390 acres of wetted area in the BWMA. To meet this goal in 2018, the Winterton Unit was flooded to 121 acres and Drew to 269 acres. The MOU set a trigger of 50% open water and 50% closed vegetative area to initiate a switch from one unit to another. Thibaut is managed to provide fall and spring open water habitat for migrating species and is dewatered in the summer to control tule growth. During the period when Thibaut is wetted it is counted as part of the annual flooded area requirement.

It has long been known that the current BWMA management is not the best practice to attract indicator species and provide suitable habitat. Year after year the MOU Consultants, along with the CDW, ICWD and wetland scientists, have recommended moving away from management that simply meets wetted area requirements to cycling the wetlands through flooded and drying periods that correlate with bird migration patterns. Basically, this means maintaining flooded area in the fall and spring with drying in other times of the year. Not only would this type of cycling provide more suitable habitat for indicator species but would simultaneously provide some control over tules and other unwanted plant encroachment.

This management concept was unintentionally tested in 2017. As described in the habitat indicator species and avian census report "…the high runoff conditions in 2017 presented the unique opportunity to observe habitat indicator species use in areas that are not normally flooded, and to evaluate the response of habitat indicator species to additional flooded acreage. The habitat indicator species responded positively to the increase in available habitat, as indicated by the almost 500% increase in total numbers as compared to 2016. Although significant increases were observed in almost all habitat indicator species groups (waterfowl, wading birds, shorebirds, rails, Marsh Wren and Northern Harrier), the increased use by waterfowl in fall was most dramatic”.

Results of the avian census in Drew (as in previous census years in other BWMA units) validated the observation with counts that use of the wetlands by water birds peaks in the spring and fall. Open water areas during these seasons provide the habitat benefits that attract indicator species. However, maintaining open water for this seasonal pattern will not result in suitable habitat for breeding water birds. The analysis in the annual report addressed this issue …”Breeding waterfowl populations are low in the Great Basin Intermountain West region in general representing approximately 5% of the breeding waterfowl in the United States (Petrie 2013). The low abundance of breeding waterfowl in the Great Basin is due to variation in annual patterns of precipitation and wetland abundance (Petrie 2013)”.

Unlike the practices with which “managed” wetlands are operated (flooded for three seasons, fall, winter, and spring with drying in the summer), BWMA wetlands units manage for the maximum wetted area in the summer. Maintaining maximum wetted areas in the summer only benefits American coot (the most common water bird in BWMA) and tules, while providing very limited habitat benefits for breeding waterfowl. LADWP and ICWD biologists conclude that with less water in the summer, there will still be some breeding waterfowl habitat with even a small amount of open water.

The MOU goals for indicator species habitat in the BWMA are not being met with current management practices.

DELTA HABITAT AREA

Habitat indicator species for the DHA include all waterfowl, wading birds, and shorebirds species shown in Table 3. As reported for the BWMA (Drew Unit), the trend in the DHA is toward lower numbers of foraging guilds that require open water, shoreline, and exposed mudflat for foraging (2018 Annual LORP Report).

The MOU Consultants examined conditions in the Delta during our early November 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 is dry and 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 and 2017 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 in 2015 that …"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 2015 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).

Regardless of how flows are delivered to the DHA, the 2018 avian census results show that current management is not meeting the goals for indicator species and habitat.

THIBAUT

When the LORP was initiated, the Thibaut wetland unit was managed similar to the BWMA with maximum summer wetted area. The consequence of this management in the very shallow wetted area was a proliferation of tules to the extent the unit was essentially 100% covered with vegetation. As the project progressed, LADWP returned to the original management technique used when Thibaut was first developed years ago as a mitigation project – open water in the spring and fall and drained in the summer to provide habitat and control tules.

The 2018 avian census found the highest waterfowl counts were in the farthest open water pond to the south, further validating that waterfowl select open water habitat in the spring and fall. However, as noted in the 2018 LORP Annual Report, Thibaut is the last to be filled in the spring and the first to be drained in the fall because of where it lies in reference to where water is diverted to the Thibaut Unit. Currently, LADWP is developing a better water inflow channel, which should speed up filling the basin. Avian biologists conclude in the 2018 annual report that if the maximum wetted extent was maintained fall through spring, waterfowl would have had a longer period to accumulate and the counts would likely have been higher.

Current Thibaut management can be improved with better flow control that allows drying in the summer to reduce tules, which are inhibiting use by waterfowl indicator species, and maintaining wetted area from fall to spring to attract more species.

SPECIES OF CONCERN STATUS

The LORP consists of riverine, wetland, lake, and upland type habitats. Within these habitats fourteen indicator species were identified as protected by state and/or federal listing. Table 4 lists each of the species of concern and their listing level at the time of project implementation.

It was expected that the project would result in habitat suitable for many of these species and would aid in the recovery or delisting of some. While habitat has been or can be developed for many of the avian species as well as the Owens Valley vole, little can be done to enhance the listed fish species populations. Owens tui chub and pupfish continue to be held in isolated ponds and spring reaches. The goal of developing a warmwater fishery centered on gamefish species largemouth, smallmouth and bluegill is not compatible with the recovery of native species like pupfish and tui chub because of predation. Also, the scant evidence from creel censuses indicates that the Owens sucker and speckled dace may be influenced by bass competition and predation.

The MOU specifies that the recoverability and attainability of delisting of these species was to be determined through the Habitat Conservation Planning process with T&E species monitoring integrated into the overall monitoring effort. The HCP would be developed in cooperation with the USFWS and CDW.

Table 4. LORP indicator species and their Federal and/or State protection status.

Species	Federal Endangered	Federal Threatened	Federal Sensitive	California Category 2	California Endangered	California Threatened	California Special Concern	California Watch
Owens Sucker							X	
Owens Tui Chub	X				X			
Owens Pupfish	X				X			
Owens Speckled Dace							**X**	
Great Blue Heron								X
Western Least Bittern				X			X	
Swainson's Hawk		X						
Northern Harrier							X	
Yellow-billed Cuckoo					X			
Long-eared Owl							X	
Willow Flycatcher					X		X	
Yellow Warbler							X	
Yellow Breasted Chat							X	
Owens Valley Vole				X			X	

INTEGRATION OF THE HCP

LADWP has completed a Habitat Conservation Plan as prescribed in the MOU (Section II A 2). The HCP was posted to the Federal Register in 2015 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."

By "incidental take" that 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 then the ESA when it comes to taking of state listed species.

The 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 Conservation Strategy shown in the draft 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 we should be careful to not duplicate monitoring effort or place adaptive management recommendations and actions at cross purposes.

The HCP was undertaken years ago and is still in process with the USFWS awaiting issuance of the ITP, according to LADWP. In order for it to be integrated meaningfully into the LORP, the HCP needs to be finalized and implemented.

OFF-CHANNEL LAKES AND PONDS STATUS

The MOU designated five off-river lakes and ponds as part of the LORP; Upper and Lower Twin Lakes, Goose Lake, Billy Lake, and Thibaut Pond. The MOU requires Billy Lake to be maintained full (i.e., at an elevation that maintains outflow to the river channel), the water surface elevation of the other lakes must be maintained between 1.5 and 3.0 feet of their respective gage heights. Thibaut Pond is maintained 28 acres.

As in most past years, all of the staff gages measured between the mandatory 1.5 and 3.0 feet in 2018. Billy Lake had a continuous outflow indicating the lake was always full; Upper Twin Lake gage was 2.51 feet; Lower Twin Lake was 2.17 feet; and Goose Lake was 2.52 feet.

GRAZING MANAGEMENT STATUS

Lease Grazing Plans were designed to qualify as Best Management Practices (BMP's). Grazing management systems that would enhance existing conditions, address water quality conditions, enhance fisheries and wildlife habitat, enhance riparian-wetland vegetation, and meet all watershed goals in the MOU. The 2004 EIR required grazing management plans that will increase plant production, increase cover in riparian areas, provide more food for small mammals and birds, and increase ground and understory cover for nesting birds.

Not one of these objectives and expectations listed in the governing and guidance documents has ever been tested, monitored for, or evaluated to see if grazing management now meets MOU and EIR requirements. Consultants, however, based on their semi-annual range management condition evaluations believe that the riparian habitat within the rangeland complex has made good steady improvement under LORP applied grazing management. An exception to this would be the woody plant (trees) component that has not met MOU and EIR expectations. MOU and EIR expectations are probably too high. The very high large fire frequency (about one large fire every 1.5 years) the LORP suffers from, by itself, will preclude large mature stands of forest along the river.

Present grazing management status within the LORP is that rangelands and especially the riparian habitat portion of the rangeland have improved. Improvement should continue in the future if present grazing management plans are abided by or are improved. Implementation of LORP grazing management plans has produced favorable results and should continue to produce favorable results in the future if managed properly.

MOU IMPLEMENTATION STATUS

The 1997 MOU does not set an ending date for its legal jurisdiction authority to guide and govern the implementation of the LORP. The MOU, with its amendments and stipulation and orders, also guides the Monitoring and Adaptive Management Process for as long as the MOU exists. Evidently there is no definite sunset for either one. As displayed later under Recommendations it took many working phases to get where the City and County are today in LORP management. The MOU phase may go on as long as there are goals yet to be met. Determining when all goals are met or cannot be met under a governing feasible, reasonable, holistic, self-sustaining, and natural evaluation set of requirements is going to take some very difficult and time-consuming analysis.

By 2009, Consultants were on the record stating that progress was being made toward attaining LORP goals in all management areas. At the same time, however, Consultants were pointing out the continued proliferation and expansion of tules and cattails in riverine-riparian areas was becoming a serious problem.

The Sierra Club, in their 2017 Annual Report review, pointed out that there was monitoring data displayed, but very little information and analysis presented to determine if the City and County were meeting LORP goals. The OVC, at the same time, however, was pointing out that the Lower Owens River is in pretty good shape. OVC found there was an abundance of life in wetlands and riparian areas, fish and birds appear to be surviving, tules and cattails over the long-term may be out-competed by more favorable plants, and there is no degradation of water quality as far as warm water fishery is concerned. Consultants provided an in-depth analysis of LORP goal attainment in past Adaptive Management Recommendations, but not all Parties agreed with the out-come and some did not think this was the time to make goal requirement evaluations.

The present status of MOU implementation is that the City has been very successful in following MOU mandates, Stipulations and Orders, and EIR direction. This was no easy task with all the on-site requirements and restrictions and the City deserves a lot of credit. The status of MOU goal and objective accomplishment evaluation is on hold.

RECOMMENDATIONS

The LORP, under MOU and EIR direction, has produced many successes, many resources, and many added benefits. Large improvement in riparian vegetation occurred, existing fish populations expanded, additional habitat was provided for indicator species, some avian species dramatically increased, recreational fishing expanded over a broader area, and riparian diversity increased. Environmental conditions after LORP initiation are more productive than conditions before the LORP. The MOU Parties can take credit for the many accomplishments that have already been made. When weighing in on what some see as failures in LORP implementation, the weighing process should also be balanced with all the successes.

When reading the Consultants past and present Adaptive Management Recommendations you would think, however, that the LORP was not doing very well. Consultants purposely zeroed in on those issues they thought would improve LORP management. They almost totally ignored the many benefits gained. The MOU Parties need to consider both the benefits gained and what they believe still needs to be gained when evaluating the Consultants recommendations. Both sides of the issue need balanced consideration when determining what future adaptive management direction to take. Consultants will continue to concentrate on those recommendations they believe if implemented will further improve LORP resources.

RECOMMENDATION #1 --- SPONSOR RIVER SUMMIT # 2

DISCUSSION

Changes in management implementation that may further improve LORP resources, is mainly in a holding pattern and not making much progress, if any. An information, analysis, and recommendation-implementation mechanism should be added to the LORP process that provides decision makers, managers, researches, users, and the public a forum. A forum that offers open debate and understanding on how to proceed in the future so final results will better meet LORP goals and objectives. Consultants believe, as CDW does, that holding "River Summits" over needed time intervals best fulfills this forum need.

CDW, Sierra Club, OVC, and the Consultants all recommended in 2013 that "River Summit #2" was needed to guide future planning and implementation. CDW supports the continuation of "River Summits" and recommended a "River Summit" occur every 5th year. "River Summit #1" was sponsored in 2014, therefore, a summit in 2019 would fit the recommended 5th year period. After completing 11 years of monitoring and evaluation, it is clearly time to revisit how all this work fits into the evaluation of goals and expectations. It is time for new ideas and approaches. Without communication there will be no new ideas and approaches.

"River Summit #1" centered in on specific issues. They included the Lower Owens River fish kills, tule-cattail domination of the river channel, insufficient woody (trees) riparian recruitment, and an aggrading river channel moving towards a wetland-marsh landscape rather than a riverine landscape. Since the 2014 "River Summit #1", progress has been very slow in improving any of these issues. A sufficient discussion and analysis of Adaptive Management Recommendations and other Party signatory recommendations having the potential to improve LORP resources is needed.

OVC and the Consultants both recommended that the MOU Parties set up a meeting to re-evaluate LORP goals and their attainment status. Consultants have recommended that all goals should be evaluated to determine if they have been met under the requirement of what is feasible, reasonable, natural, holistic, and self-sustaining for each goal. This would identify any goal that was not attainable. River Summit #2 should begin the approach to evaluate and determine the status of goal and objective attainment. Other issues that could be addressed are how do we improve water quality, control cattail-tule abundance and expansion, establish more trees in the bordering riparian habitat, and how to increase biodiversity in the riparian habitat for indicator species.

RECOMMENDATION

Consultants recommend the County and the City sponsor a two-day "River Summit #2" in April of 2019. The priority could be on "Where Do Go From Here."

RECOMMENDATION #2 --- 2019 SEASONAL HABITAT FLOW

DISCUSSION

CDW, Sierra Club, and Sierra Club Consultant and OVC Consultant, over the years all continually expressed concerns that flow regimes being applied may not result in the achievement of all LORP goals. Their continued support for changes to the present flow regime for testing, monitoring, and evaluation was also expressed. CDW (2017) and Jensen (2014) both stated that it is clear that the Lower Owens River stream power generated by past and existing seasonal habitat flows is insufficient to scour accumulated organic detritus from the channel or maintain existing bank and riparian vegetation.

Three higher than normal artificial flows occurred during the 2017 water year. An April experimental pulse flushing flow peaking at 274 cfs, a May seasonal habitat flow peaking at about 200 cfs, and an unplanned and unexpected June to August high summer flow peaking about 330 cfs. As a result, the MOU Parties had the opportunity to test and evaluate some elevated flow volumes to determine if they have any chance to improve water quality conditions or influence tule-cattail abundance. The higher than normal flows in June and July provided some good information about their effects on water quality and fish kills, but a one-year accidental unplanned and unprepared test with inadequate monitoring is not going to provide much information to help guide future LORP management. Very little testing and evaluation were completed in 2018.

Seasonal Habitat Flow Peaks Released From the Intake Control Station

Year	Flow
2008	220
2009	110
2010	209
2011	208
2012	92
2013	58
2014	0
2015	0
2016	106
2017	197
2018	130
2019	follow MOU direction

RECOMMENDATION

Consultants recommend that because past Annual Reports show no documented benefits from implementing past seasonal habitat flows and the Consultant's adaptive management flow recommendations were not accepted by the MOU Parties, there is no need for the Consultants to continue recommending seasonal habitat flows under present mandated flow volume and flow limitations. Consultants recommend that the City, in 2019, release the 2019 seasonal habitat flows as mandated by the MOU.

Consultants also recommend that the Scientific Team develop a series of improved seasonal habitat and flushing flows to test and evaluate. This report would be submitted to the MOU Parties by June of 2019 for their consideration and action. If the MOU Party's turn down the Scientific Teams recommendations, then future flow management might as well stay the course, remain the same, and the MOU Parties live with the results.

RECOMMENDATION #3 --- FUTURE OF THE LOWER OWENS RIVER

DISCUSSION

The original scope of the LORP was described in the 1991 Inyo County/Los Angeles Long-Term Agreement and also in the 1991 EIR. The resulting 1997 MOU directing the planning, implementation and adaptive management process for the LORP has been in effect for 21 years. Accounting for the planning and development time periods prior to the 1997 MOU, LORP decision makers, managers, and MOU Party signatories have had 26 years to plan, implement and adaptively manage the LORP. This 26 years of effort, time, money, and resources expended produced the Lower Owens River conditions that the MOU Parties control today. More than sufficient time has elapsed to be able to evaluate MOU Party accomplishments and non-accomplishments with confidence.

Implementation of Adaptive Management Recommendations has not been successful and continuously hampered by mandates in the 1997 MOU and added on Stipulation and Orders. By 2011, Consultants were pointing out to the MOU Parties that the many restrictions and handcuffs were stifling the potential improvement of Lower Owens River management. Following are some constraint examples that may be affecting LORP rehabilitation efforts:

The not to exceed 50 cfs pump-out restriction placed on the Pump Back Station

County believes it is unreasonable to think MOU Parties will accept unlimited pump-out at the pump back station

Mandated uniform continuous 40 cfs base flow

Low seasonal habitat flows of only 0 to 200 cfs applied annually with flow volumes depending on basin runoff conditions (Out of the past 11 seasonal habitat flows only 4 have reached the 200 cfs peak flow level)

All new management actions must be "cost" and "water neutral"

All tule-cattail active control projects must be done with monies generated outside of the City and the County

Managers failure to sponsor productive annual working and planning sessions

Consensus (unanimous approval) required to make any changes in MOU direction or LORP management implementation

Inadequate and outdated LORP Management Plan and all other companion plans

Models used in the very beginning of the planning process did not fit the situation and were not capable of adapting to actual Owens Valley conditions

Middle Owens River flows released from the Intake into the Lower Owens River have periods of poor water quality condition

Managers inability to accept and implement needed Adaptive Management Recommendations

Valley infrastructure keeping improved flow management from being applied

City questions that high river flows may not even be capable of being diverted into the Lower Owens River

County believes that flows even less than 250 cfs will saturate road bases and it would take extensive and expensive modifications to pass high flows which is beyond the County's means

No in-river hydro measuring station can have a 15-day running average less than 35 cfs

The mean daily flow at each in-river flow measuring station must equal or exceed 40 cfs on 3 individual days out of every 15 days

The 15-day running average of the in-river flow measuring stations is no less than 40 cfs

The many different views and expectations of the MOU Parties

County position that recommended 300 cfs flushing flows would be a waste of resources and County would not approve (2014 Annual Report)

City's position on releasing Delta Habitat Area flows from the Intake that such releases must not exceed the City's water commitment (i.e., water neutral)

Water Neutrality occurs when the average release of water into the Lower Owens River via the Intake does not exceed an average of 61 cfs and the total volume of water flowing into the Delta Habitat Area does not exceed 5,612-acre feet per year

Nine words that will have a very large controlling influence on all future management decisions are "feasible", "reasonable", "holistic", "self-sustaining", "natural" and "sustain existing uses."

EIR (2004) guidance that active tule and cattail control or removal would only be considered in rare instances

The MOU and its added-on Stipulation and Orders restrictions do not conform to any ecological or natural processes. Even canals do not face these kinds of handcuffs in their operation. The LORP Management Plan never intended to place such binding and non-essential restrictions and requirements. The plan intent was to allow the adaptive management process, based on good monitoring and evaluation information, to guide needed changes to improve river flow management. The restrictions listed above have caused and will continue to cause "stagnation" in the ability of the MOU process to function properly.

The Lower Owens River is a “working river” that must continuously supply valuable products to take care of critical human needs. Thus, to return to natural conditions is not an option. As a result, tules and cattails will continue to dominate and proliferate, water quality conditions will continue to cause fish kills, the river will aggrade resulting in a more wetland-marsh condition, and the river may not be capable of meeting all expectations assigned to it by the MOU. In designing the future of the Lower Owens River expectations are going to have to be balanced with the rivers capabilities under all the restrictions placed on it.

The LORP Management Plan (2002) requested managers give the system time to rehabilitate. The plan cautioned managers to at least assume a time horizon of 15 to 20 years before evaluations are made about restoration success. The LORP now fits within this time boundary recommended. It is common that a 20-year monitoring, evaluation and adaptive management program is needed before determining response and goal achievement of a riverine-riparian system (SFPUG, 2014). The LORP time scale is fairly close enough to meet this time requirement. Sufficient time now allows evaluations to form needed changes in direction.

The 2004 EIR correctly predicted that by 2019 the Lower Owens River will approach “steady-state” condition. This was an accurate prediction because we now have much the same river condition we had last year and the year before and the same condition we will have next year and many years after this. The river is very close to a “steady state” matching all past and present management controls. Because the rehabilitation progress curve has now been flat over the past few years, Consultants constantly remind that, “You now have the river you are going to get” and you might as well get on with what you have to work with. Consultants predict the Lower Owens River, as it exists today, will be the persistent river condition long into the future under current LORP management. This is not all bad because many resources have already benefited.

RECOMMENDATION

Consultants recommend that “River Summit #2” spend time preparing for the summit and discussing in detail the future of the Lower Owens River and priority actions.

RECOMMENDATION #4 --- BEGIN A NEW MANAGEMENT PHASE

DISCUSSION

The County of Inyo is the Petitioner-Plaintiff in the 1997 MOU while the City is the Respondent-Defendant. The amici curial (OVC, SC, CDW, SLC) were brought into the MOU process to determine the adequacy of the EIR. As determined in the MOU, the City and the County jointly manage the LORP and to date have made all final management decisions. Other MOU Party signatories provide oversight to ensure agreements made in the MOU are fulfilled. The MOU does not set an ending date or “sunset” when all goals and expectations have to be met. The MOU does set some beginning dates but does not set a closing procedure in case the MOU phase becomes unproductive and an improved phase needs to replace it. A phase that runs “out of steam”, becomes “stalemated” or is impractical is hopefully replaced with a new phase of operation that has an improved chance on making progress.

The historic impacts and response management periods, prior to the LORP, went through many phases. Some phases were very productive, other phases were much less productive, and some phases quite negative as far as the LORP is concerned. Getting through these phases, along with their demand of time, money and resources expended were required to wind up to where the City and the County are today in LORP management. The present phase has been a long one.

Twenty- one years have elapsed, and that does not include 5 years of pre-LORP negotiations, since the County and the City submitted their 1997 MOU to the Court for approval to guide the future implementation of the LORP. Twenty- eight years have passed since the first LORP EIR was submitted. Standing and Technical Committees have been in existence for 36 years. An abundance of time has passed and enough experience gained to allow an evaluation of where the LORP is and where the LORP is going. If progress has not been sufficient after this long period of time then a maybe new phase may be needed to move the LORP to where it could be.

The following very briefly condenses the time frames the many different past phases occupied:

Time Period	Phases
???? to 1849	Native Americans used the resources provided by what is now the LORP in complete harmony and did not affect it in anyway that was detrimental to changing its natural condition and processes
1850 to 1859	Incoming settlers and outside users began annual large cattle and sheep drives through the basin resulting in the first large impacts to valley floor vegetation (Barcham 1957, Sauder 1994).
1860 to1900	Lower Owens River flows diverted for agriculture
	Permanent ranches established
	River base flow drastically reduced
	River flows below Intake averaged only 4 cfs during summer periods
	Year-around Livestock grazing begin and forage use quickly accelerated
	Over 250 miles of large canals and ditches constructed
	All flowing water in the Owens River appropriated for agriculture
	Lower Owens River completely dry below the Sanger and Black ditch diversion dams
	Less than 2 cfs river flow passing under the Independence Bridge during summer periods
	Harsh unstable conditions resulted in very few fish surviving in the river south of Bishop (Babb 1989)
	Owens River in its worst environmental condition of the recent geologic history
1900 to 1920	First Basin-to-City aqueduct completed
	41,026 acres irrigated via an extensive canal system
	75% of all the annual runoff diverted for irrigation
	Flows drastically or totally reduced during summer periods, while winter monthly average base flow on some years was over 500 cfs
1921 to 1969	Long Valley and Pleasant Valley Reservoirs storing water
	Mono Basin water diverted to Owens Basin

	Ground water pumping initiated
	Lower Owens River de-watered from the Intake to Owens Lake
1970 to 1979	Second aqueduct reach completed
	County sues City under CEQA to prepare and EIR
	Court rules City must prepare an EIR
	EIR'S Issued by the City in 1976 and 1979 legally inadequate
	City releases 5 to 10 cfs from aqueduct to sustain fish and wildlife habitat in the lower 30 miles of river
	Owens River much more productive because of increased flows
1980 to 1991	First MOU signed in 1982 with Technical and Standing Committees formed
	1991 EIR calls for City to implement the LORP
	City uses Billy Lake return ditch to re-water a reach of the Lower Owens River
	River flows (average 11 cfs) maintained from Independence Billy Lake return to Delta
	Lower Owens River re-watered from Blackrock area to Delta
	OVC formed
	City adopts the LORP as a mitigation measure
	First EIR completed
	City and County Long Term Ground Water Agreement
	City and County enter into a Water Management Agreement
	LORP a requirement of the Long-Term Water Agreement
	LORP concept initiated
1992 TO 2005	LORP Management Plan Completed
	Variable river flow study completed
	Second MOU signed
	Green Book now in use
	Action Plan outlines scope of LORP Plan
	Draft LORP management plan submitted to MOU Parties

	LORP flow planning begins
2006 to 2018	First Lower Owens River base and seasonal habitat flows released
	First River Summit
	Recreational warm water fishery expands
	Tule-cattail expansion detrimentally affecting recreational resources
	Consultants predict “You now have the river you are going to get”
	50 cfs pump-out restriction applied by 2004 Stipulation and Order
	0 to 200 cfs annual seasonal habitat flows applied
2019 to ?	??

Some result indicators suggest It may be time to enter another phase of LORP management. Without changes in priority and management implementation, Consultants believe LORP management will continue in its present form of development. Consultants do not know what the next phase should look like or encompass, instead this is the responsibility of the County and the City with help from an advisory committee.

Some indicators support the time may be right to enter another management phase. Other indicators indicate the LORP may already have entered another phase as follows:

LORP environmental conditions in a “stalemate” with little change occurring year to year.

LORP managers going beyond the MOU direction to try and solve problems they think they cannot solve themselves.

County’s push for an outside water quality specialist to study organic decay conditions

Specialists brought in by the County attempting to unsuccessfully plant willow trees

MOU Parties may no longer be using their own individual Consultants and MOU Consultants suggestions.

The County stating, they would rather spend time seeking out-side expertise on possible solutions than try new recommended management approaches.

The County now preferring to seek outside funding to implement the LORP rather than spending time trying to understand known challenges (what needs to be done and how to do it).

MOU Party Signatory Consultants and the MOU Consultants no longer attend MOU Party meetings

Adaptive Management a failure under the MOU process

Applying a constant management process and expecting a variable response is not possible Other broader reasons also exist to justify a change may be needed in management phase. For example, the County in their constant quest for outside the MOU expertise for guidance. There is no “Great Wakan Tanka” out there with a spiritual ever encompassing mind that can come in and solve all the problems. This is not thinking in reality and is not going to happen. The County track record of bringing in outside expertise has not been productive. Consultants have stated many times that it is not lack of science stagnating LORP progress, its lack of proper adaptive management evaluation and follow-up implementation. Dr. Patton, Sierra Club Consultant, stated many times that the Adaptive Management process is not one of the LORP successes.

The best scientific knowledge and expertise available from any source, as far as the Lower Owens River is concerned, resides within CDW, the City and the County. Nobody has a better combination of experience and knowledge of what is needed to better manage the LORP. The present management MOU process does not use what they have effectively. The OVC and Sierra Club brought in renowned river scientist in Drs. Patton and Voister, but their knowledge and advice were not used effectively by the Parties or even at all.

RECOMMENDATION

Consultants recommend that the County (MOU Petitioner-Plaintiff) begin to explore a process, with the City (Defendant-Responder), that could replace the present 1997 MOU process. One very preliminary idea would be to replace the MOU process with a new 10-year LORP Management Plan developed by the City and the County with input from CDW and the public. Whatever the new phase would comprise the next phase would need to address:

Allow management flexibility to study, evaluate, and implement more favorable habitat, flushing, flooding, drought, and freezing flows

Evaluate feasible and reasonable active intervention methods to manage tules, cattails, and trees in a manner that will enhance LORP resources

Update and replace all present outdated LORP Plans, including the Monitoring and Adaptive Management, Ecosystem Management, Blackrock Waterfowl Management, and Delta Habitat Area Management Plans, and especially the river management plan.

Develop and use a Advisory Team including CDW, SC, and OVC as members that would provide specialized input

RECEOMMENDATION #5 --- IMPROVE LOWER OWENS RIVER ENVIRONMENTAL CONDITION

DISCUSSION

The OVC recommended in their Annual Report review comments that the natural water flowing from streams coming off the Sierras be allowed to enter the Lower Owens River. These flows would enter the river from below the Intake to the Pumpback Station reach rather than being intercepted by the City aqueduct. This OVC recommendation has much merit that warrants further detailed consideration by the MOU Parties. These flows have the potential to put needed variability in river flows over time that could improve water quality and dependent resources.

If the Lower Owens River continues to receive poor quality water from the Middle Owens River, and the Consultants predict it will definitely continue to do so, new ideas need to be tested and evaluated. The river flows, as implemented today, will continue the organic build-up problem in the river channel increasing biologic oxygen demand and decreasing dissolved oxygen. Something very innovative needs to be done to buffer or improve river condition.

This higher-quality water, the OVC calls for to by-pass the aqueduct and enter the river directly as it did naturally, could result in many increased benefits. A influx flow with 7 to 9 mg/l dissolved oxygen could have some benefits when released into a river with dissolved oxygen less than 1 mg/l. For each cfs of tributary water entering the river from Sierra streams and springs, a cfs of water would be reduced from the Intake flow or compensated for by approving increased Pumpback Station pump-out. The Pumpback Station pump-out limitation increase would only be used to match the streams input. Therefore, it would be "Pumpback neutral". The new flow management operation would remain "water neutral". As stated before, Consultants support the City's "water neutral" position until the Parties prove they are capable of efficiently using the water they already have available. The following Stipulation and Orders would have to be eliminated:

No in-river hydro measuring station can have a 15-day running average less than 35 cfs

The mean daily flow at each in-river flow measuring station must equal or exceed 40 cfs on 3 individual days out of every 15 days

The 15-day running average of the in-river flow measuring stations is no less than 40 cfs

A balance would need to be worked out by the Scientific Team as to what the Pumpback Station would pump-out versus what amount would be reduced from the Intake flow. The final flow management plan would need to best fit the over-all river's needs. This should not be difficult to do. It may be possible that during most of the flow year, the Pumpback Station increase capability could handle much of the incoming flow. The average pump-out flow from the Pumpback Station to date has averaged 42.6 cfs. Under today's mandates and restrictions this could be increased to 50 cfs. This new flow scenario could be made "water neutral" but it may not be "cost neutral", but something is going to have to give. The Scientific Team should also determine cost to pass streams over the aqueduct as LADWP is now doing for Lubkin and Cottonwood Creeks.

RECOMMENDATION

The Consultants recommend the Scientific Team thoroughly analyze the OVC recommendation and present its detailed findings with all supporting evidence in report form to the MOU Parties for their consideration and action by June of 2019. Preliminary findings and recommendations would be presented by the Scientific Team at "River Summit #2" in 2019. River Summit attendees would then evaluate their findings for reliability, completeness and especially critique their recommendations and identify anything that is missing. This recommendation, if accepted, should then be considered at the next MOU Party meeting.

RECOMMENDATION #6 --- REVISE WETLAND MANAGEMENT PLANS

DISCUSSION

The LORP has been very successful in creating thousands of acres of wetlands in the BWMA, Thibaut, and DHA. However, simply wetting acreage year after year has not created habitat suitable for all of the LORP indicator species. As shown in the monitoring data over time, only half of the indicator species find the wetlands suitable. We also now know that the best habitat, the most attractant habitat, is for migrants from fall to spring. The best management practice is obvious. Maintaining water year around, particularly in the summer months, does not provide the most suitable habitat but also encourages prolific tule and cattail growth; the wetland units should be managed on a periodicity schedule drawing down the units in the summer and keeping them flooded fall through the spring. This management not only provides the most suitable habitat for the greatest number of indicator species but is a better way to manage undesirable vegetation. The Consultants have advocated for many years to revise the pulse pattern for DHA inflows to better match open water periods, again fall through spring, to indicator species' use. While Thibaut management has been revised to follow this periodicity pattern and has been shown to be successful at attracting indicator species and controlling tule growth, Thibaut is the last to be filled in the spring and the first to be drained in the fall because of where it lies in reference to where water is diverted to the Thibaut Unit. Better inflow/outflow management will improve Thibaut.

RECOMMENDATION

Managing the wetlands should not be focused on simply checking off boxes each year by ensuring the requisite number of acres are flooded and that the 50% open/closed threshold is met. All of the wetlands must be managed with a periodicity pattern – wetted from fall through spring and dried in the summer. To achieve this and create habitat suitable for indicator species, a new, detailed wetlands management plan needs to be written and implemented. The first step is to calculate the water duty for a new management practice to determine how such a plan would be compatible with the MOU obligation of up to 500 acres of wetted area in an average water year. A new plan also needs to eliminate the 50% open/closed threshold. The DHA pulse flows need to be revisited as well to manage the wetland on a seasonal basis like the BWMA and Thibaut, while maintaining the MOU mandated 6 to 9 cfs average annual inflow.

RECOMMENDATION #7 --- IMPLEMENT THE HABITAT CONSERVATION PLAN

DISCUSSION

When the MOU was first being devised a critical expectation, even hope, of the MOU Parties was that the numerous T&E species and species of concern would benefit, perhaps even recover, as the LORP progressed. Central to this expectation was a Habitat Conservation Plan. The Parties recognized that developing an HCP would be a time-consuming process requiring input from the USFWS and CDW. However, once the HCP was completed it was to be incorporated into the LORP management plans and implemented.

Monitoring, other than incidental sightings during avian censuses and other work, has not focused on T&E and species of concern while the HCP was being developed. It was assumed that this would be a part of the HCP. Since the HCP has not been implemented, nothing can be said about the status of these species or whether the project has benefited them or if delisting any of the species is feasible.

As described previously, the HCP that is has been drafted by the City in cooperation with the USFWS and CDW is a 10-year Incidental Take Permit (ITP). The MOU Parties have not weighed in on this type of HCP and whether a 10-year limit on its implementation is what they envisioned.

RECOMMENDATION

Development and implementation of the HCP is critically late in the LORP process. LADWP must pressure the USFWS into issuing an ITP. The HCP must be presented to the MOU Parties with explanations how it will be incorporated into the LORP management as soon as possible.

11.0 RESPONSE TO ADAPTIVE MANAGEMENT RECOMMENDATIONS

LADWP and Inyo County Response to the LORP MOU Consultant's 2018 Adaptive Management Recommendations

Recommendation #1 - Sponsor River Summit #2

Consultants recommend the County and the City sponsor a two-day "River Summit #2" in April of 2019. The priority could be on "Where Do Go From Here."

In this section of the 2018 LORP Adaptive Management Recommendations (AMR), the Consultants state *"Consultants have recommended that all goals should be evaluated to determine if they have been met under the requirement of what is feasible, reasonable, natural, holistic, and self-sustaining for each goal."* LADWP and Inyo County support conducting a goals assessment for the LORP at this stage, 12 years post implementation. The LORP Scientific Team, staffed by LADWP and Inyo County's technical staff will meet, and based on monitoring results the group will evaluate project progress and likely trajectory. From this discussion the Scientific Team will identify opportunities and limitations for the project and present their findings along with recommendations for future management, to the MOU parties in the fall of 2019.

Recommendation #2 - 2019 Seasonal Habitat Flow

Consultants recommend that because past Annual Reports show no documented benefits from implementing past seasonal habitat flows and the Consultant's adaptive management flow recommendations were not accepted by the MOU Parties, there is no need for the Consultants to continue recommending seasonal habitat flows under present mandated flow volume and flow limitations. Consultants recommend that the City, in 2019, release the 2019 seasonal habitat flows as mandated by the MOU.

Agreed. LADWP and Inyo County will recommend to the Standing Committee and CDFW a seasonal habitat flow schedule as described in the 1997 MOU and Section 2 of the LORP EIR. If runoff projections are substantially above normal the Scientific Team will meet and discuss the possibility of experimenting with an early spring pulse flow.

Consultants also recommend that the Scientific Team develop a series of improved seasonal habitat and flushing flows to test and evaluate. This report would be submitted to the MOU Parties by June of 2019 for their consideration and action. If the MOU Party's turn down the Scientific Teams recommendations, then future flow management might as well stay the course, remain the same, and the MOU Parties live with the results.

LADWP and the County are willing to revisit the proposed modified flow regime that was originally put forth in 2014 and is discussed in previous LORP Annual Reports and Adaptive Management Recommendations. Implementing this modified hydrograph would require lifting the pump station limitation of 50 cfs to avoid excessive water reaching Owens Lake to the detriment of the Delta Habitat Area and Lake, and to conserve fresh water; a scarce resource in the State.

Recommendation #3 - Future of the Lower Owens River

Consultants recommend that "River Summit #2" spend time preparing for the summit and discussing in detail the future of the Lower Owens River and priority actions.

LADWP and the County are in agreement with the discussion that the MOU Consultants provide in this section regarding the legal constraints that have limited the success of the project throughout its planning, implementation, and adaptive management stages. LADWP and the County share this frustration and see value in assessing the project's current state and how it can reasonably and feasibly be improved, if at all. All Parties must be cognizant of the constraints that legal mandates place on the success of the LORP, and acknowledge and accept the likely trajectory, or alternatively, be willing to negotiate changes to those legal restrictions that thwart effective management of the project. The LORP Scientific Team will conduct a thorough evaluation of the project as discussed previously. This information and recommendations will then be shared with the MOU Parties.

Recommendation #4 - Begin a New Management Phase

Consultants recommend that the County (MOU Petitioner-Plaintiff) begin to explore a process, with the City (Defendant-Responder) that could replace the present 1997 MOU process. One very preliminary idea would be to replace the MOU process with a new 10-year LORP Management Plan developed by the City and the County with input from CDFW and the public. Whatever the new phase would comprise the next phase would need to address:

- Allow management flexibility to study, evaluate, and implement more favorable habitat, flushing, flooding, drought, and freezing flows
- Evaluate feasible and reasonable active intervention methods to manage tules, cattails, and trees in a manner that will enhance LORP resources
- Update and replace all present outdated LORP Plans, including the Monitoring and Adaptive Management, Ecosystem Management, Blackrock Waterfowl Management, and Delta Habitat Area Management Plans, and especially the river management plan.
- Develop and use an Advisory Team including CDW, SC, and OVC as members that would provide specialized input

This recommendation is outside the scope of the consultants' responsibilities and is inconsistent with current guiding documents and detached from the direction of the Lower Owens River Project since its inception. LADWP and Inyo County are complying with the 1997 MOU, LORP EIR, and related Court Stipulations and Orders.

Recommendation #5 - Improve Lower Owens River Environmental Condition

The Consultants recommend the Scientific Team thoroughly analyze the OVC recommendation and present its detailed findings with all supporting evidence in report form to the MOU Parties for their consideration and action by June of 2019. Preliminary findings and recommendations would be presented by the Scientific Team at "River Summit #2" in 2019. River Summit attendees would then evaluate their findings for reliability, completeness and especially critique their recommendations and identify anything that is missing. This recommendation, if accepted, should then be considered at the next MOU Party meeting.

LADWP: This concept is inconsistent with the LORP guiding documents and is simply not feasible.

ICWD: The Scientific Team, in its LORP evaluation will consider along with monitoring data the input and annual comments received from all of the MOU Parties and the MOU Consultant.

Recommendation #6 – Revise Wetland Management Plans

Managing the wetlands should not be focused on simply checking off boxes each year by ensuring the requisite number of acres are flooded and that the 50% open/closed threshold is met. All of the wetlands must be managed with a periodicity pattern – wetted from fall through spring and dried in the summer. To achieve this and create habitat suitable for indicator species, a new, detailed wetlands management plan needs to be written and implemented. The first step is to calculate the water duty for a new management practice to determine how such a plan would be compatible with the MOU obligation of up to 500 acres of wetted area in an average water year. A new plan also needs to eliminate the 50% open/closed threshold. The DHA pulse flows need to be revisited as well to manage the wetland on a seasonal basis like the BWMA and Thibaut, while maintaining the MOU mandated 6 to 9 cfs average annual inflow.

LADWP and the County are in support of evaluating cost effective, water neutral options for improving habitat for the LORP habitat indicator species through an improved flooding regime at BWMA and Delta pulse flows. The Scientific Team will evaluate a range of management options for the BWMA and DHA and prepare findings for the 2019 LORP Annual Report.

Recommendation #7 – Implement the Habitat Conservation Plan

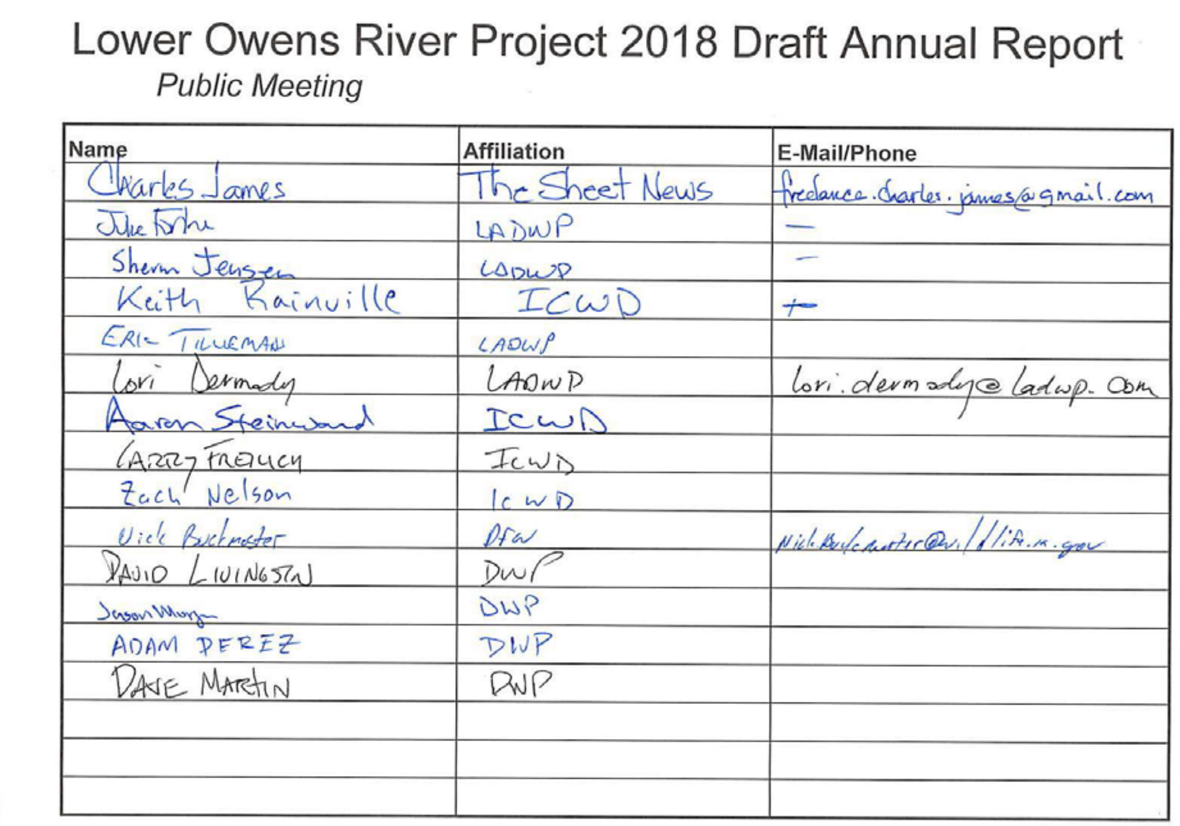
Development and implementation of the HCP is critically late in the LORP process. LADWP must pressure the USFWS into issuing an ITP. The HCP must be presented to the MOU Parties with explanations how it will be incorporated into the LORP management as soon as possible.

LADWP has worked in cooperation with USFWS and CDFW to develop the Habitat Conservation Plan for many years. It will be implemented following issuance of the Incidental Take Permit by USFWS.

12.0 PUBLIC MEETING AND COMMENTS

12.1 LORP Annual Public Meeting

The LORP 2018 Draft Annual Report public meeting was held on December 20, 2018, at the LADWP Bishop office. The following table lists those in attendance.



Lower Owens River Project 2018 Draft Annual Report

Public Meeting

Name	Affiliation	E-Mail/Phone
Charles James	The Sheet News	freelance.charles.james@gmail.com
Julie Forhe	LADWP	—
Sherm Jensen	LADWP	—
Keith Rainville	ICWD	+
ERIC TILLEMAN	LADWP	
Lori Dermody	LADWP	lori.dermody@ladwp.Com
Aaron Steinwand	ICWD	
LARRY FRENCH	ICWD	
Zach Nelson	ICWD	
Nick Buckmaster	DFW	Nick.Buckmaster@wildlife.ca.gov
DAVID LIVINGSTON	DWP	
Jason Morgan	DWP	
ADAM PEREZ	DWP	
DAVE MARTIN	DWP	

12.2 Public Meeting

The audio recording of the LORP 2018 Draft Annual Report public meeting is available upon request.

12.3 LORP 2018 Draft Annual Report Comments

The comment period for the LORP 2018 Draft Annual Report was from December 5, 2018 through January 4, 2019.

12.3.1 California Department of Fish and Wildlife Comments on the LORP 2018 Draft Annual Report

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Inland Deserts Region
3602 Inland Empire Boulevard, Suite C-220
Ontario, CA 91764
(909) 484-0167
www.wildlife.ca.gov

***EDMUND G. BROWN, Jr.**, Governor*
***CHARLTON H. BONHAM**, Director*

January 3, 2019

Clarence Martin
Los Angeles Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, CA 93514

Aaron Steinwand
Director
Inyo County Water Department
P.O. Box 337
Independence, CA 93526-0337

Subject: LOWER OWENS RIVER PROJECT 2018 DRAFT ANNUAL REPORT COMMENTS

Dear Mr. Martin and Mr. Steinwand:

The California Department of Fish and Wildlife (CDFW) appreciates the opportunity to provide comments on the Lower Owens River Project (LORP) 2018 Draft Annual Report. CDFW continues to support changes to the Lower Owens River flow regime, as well as changing wetland management practices in the Blackrock Waterfowl Management Area to improve conditions for waterfowl and shorebirds, as is contemplated through adaptive management as described in the 1997 MOU. CDFW is extremely concerned with the health of the river-riparian ecosystem throughout the LORP. The 2018 LORP Draft Annual Report includes a comprehensive synopsis of flow magnitude and associated water quality measurements during 2018, and it is apparent that without substantive adaptive management the LORP will continue to fail to meet the goals set forth in the 1997 MOU. Despite widespread acknowledgement by MOU parties that the stream power generated by the existing seasonal flow regime is insufficient to scour the accumulated organic detritus or maintain the existing banks and channel, minimal and insufficient adaptive management has occurred. Continuation of the flow regime will result in a continued failure to meet LORP goals. CDFW concludes that it is imperative to immediately implement substantial and effective adaptive management actions to achieve the MOU goals. CDFW requests a meeting of the MOU parties as soon as possible to discuss and approve effective adaptive management actions.

The following comments are intended to address issues impeding the achievement of the goals of the LORP. Specific page number references from the 2018 Draft Report are provided in parentheses throughout this letter.

LOWER OWENS RIVER FLOWS

CDFW continues to be concerned that the current flow regime on the Lower Owens River are not achieving LORP goals. CDFW supports changes to the flow regime for a trial period in which monitoring would further elucidate the impacts on various water quality parameters and riparian tree recruitment and survival. The flushing flows in the LORP are intended to remove accumulated organic debris from the river, maintain channel width, (which creates scoured banks for riparian seedlings to germinate), and maintain topographic diversity (2004 EIR). As stated in our 2017 Seasonal Habitat Flow and Annual Report comment letters, there is no evidence that the existing flow regime is meeting these goals. This is due to the insufficient stream power generated by the LORP seasonal habitat flow. Below is an abbreviated discussion of the Lower Owens River Riverine-Riparian System Goals as outlined in Section II(c)(1) of the 1997 MOU and described in the 2018 Annual Report. In addition, Table 1 of the MOU Consultants Recommendations specifically addresses every MOU, Monitoring and Adaptive Management Objective, and Ecosystem Management Plan.

a) Create and sustain healthy and diverse riparian habitat
As stated in Section 3 of the 2018 Annual Report, the river channel continues to aggrade and marsh habitat continues to increase, forming a cattail/bulrush monoculture and resulting in negative impacts to water quality, riparian tree habitat, and river channel. While riparian tree recruitment during the high flows in 2017 was higher than previous years, this is almost certainly an anomaly, and extent of 'tree' habitat has declined ever year surveys were conducted (Page 3-8). The riparian corridor continues on a trajectory that does not meet LORP goals.

b) Create and sustain healthy and diverse aquatic habitat
Aquatic habitat diversity continues to decline with channel aggradation, and summer hypoxia continues to impair water quality during normal years.

c) Create and sustain a healthy warm water recreational fishery
The status of the fishery remains unknown following the 2017 fish kill. CDFW supports an assessment of the fishery following the fish mortality that occurred; however, as stated in our January 2015 and January 2018 comment letters, CDFW recommends LADWP and Inyo County complete this assessment using the appropriate methodology. As stated in our 2015 Comment Letter, Creel Census surveys (as proposed in the LORP Annual Report) should be avoided when assessing fish populations (Inland Fisheries Management in North America, 2010), and CDFW encourages both Inyo County and LADWP to consider augmenting or substituting the planned creel census with additional surveys utilizing more robust methodologies. The 2018 Annual Report should analyze and interpret all survey results within the limitations of their chosen study

methods. CDFW's recommendation that a discussion of extent of the 2017 fish kill be included in the 2017 annual report was not followed, further limiting the understanding of the fishery.

d) Create and sustain healthy habitats for native fish species
No native fish been observed within the Lower Owens River for years. Of the four native fish species within the Owens River, only Owens Sucker (*Catostomus fumeiventris*) have potential to occur in the riverine habitat. The specific habitat requirements of the Owens Sucker are poorly understood; however, it is likely the summer water quality within the LORP precludes their persistence within the river. The related Sacramento Sucker (*C. occidentalis*) cannot survive temperatures in excess of 25 C in waters with low dissolved oxygen (Cech *et al.* 1989). These water quality parameters are routinely exceeded in the LORP during summer months, and likely prevent the reestablishment of Owens Suckers within the riverine component of the LORP. It is therefore unlikely that this objective will be met without substantive adaptive management.

The 1997 MOU states that "should... reported information reveal that adaptive modifications to the LORP management are necessary to ensure the successful implementation of the project, or the attainment of the LORP goals, such adaptive modifications will be made.". The goal of adaptive management needs to be focused on shifting the river into an alternate stable state (*e.g.* Suding *et al.* 2004) through a management change, rather than recurring maintenance (such as channel clearing). Potential adaptive management options for the Lower Owens River also need to consider the constraints of the system: based on the data LADWP collected for their hydraulic model (LADWP 2012), seasonal habitat flows of 800-3500 cfs may be required to meet LORP goals using flows alone. These flows are in excess of the existing infrastructure capacity to deliver and are in excess of the proposed flows discussed in the 1997 MOU. As discussed in the 2018 Annual Report Public Meeting on December 20, 2018, CDFW believes the following adaptive management actions are potentially feasible, and these actions or alternatives to achieve similar outcomes need to be implemented:

- *Selective channel clearing/creation with slightly increased seasonal habitat flows.* CDFW is willing to partner with MOU parties to permit and implement selective channel clearing within test reaches of the Lower Owens River to assess the feasibility and maintenance costs. In addition to mechanical clearing, other options should be considered as well. As demonstrated in Fish Slough, the use of explosives can create low-cost, long-lasting channel features in low gradient areas within the Owens Valley. If channel clearing occurs, CDFW recommends a slightly increased seasonal habitat flow of shorter duration to maintain the created channel.

- *The proposal by the Owens Valley Committee to bypass natural streams into the LORP.* While this proposal is unlikely to solve the problems created by tule encroachment, tributary streams may improve water quality and ameliorate the effect of river hypoxia. Prior to implementation of this concept, CDFW recommends careful consideration of the changes to tributary water quality as it flows across the fan.

At this time, CDFW does not support burning or herbicide alone as a method of emergent vegetation control because it fails to address the geomorphic effect of the root masses on the river channel. In addition, CDFW agrees with LADWP that decreasing flows, especially in the growing season, will result in an 'inset marsh,' and further occlude the channel (Annual Report 3-31).

BLACKROCK WATERFOWL MANAGEMENT AREA

CDFW concurs with LADWP's conclusion that wetland productivity and use by habitat indicator bird species at the Blackrock Waterfowl Management Area would be improved by more seasonal manipulation of certain habitat areas, including seasonal drying to control emergent vegetation (2017 Annual Report pages 3-9 and 3-10). The best available science strongly supports seasonal wetland management for migratory waterfowl and shorebirds (Ducks Unlimited 2007, Olsen 2013, Davis 2014).I In addition to increased waterfowl and shorebird use, seasonal wetland habitat management (CWA 2015) has decreased water-use at U.S. Fish and Wildlife Service (USFWS) and CDFW-operated wetland areas and decreased maintenance costs at these locations. Data from California's Imperial and Central Valleys indicates that perennial-flood regimes result in decreased value to migratory waterfowl and shorebirds, increased maintenance costs, and increased water loss (CDFW 2014, Ducks Unlimited 2007, CWA 2015, Olsen 2013, Davis, 2014). Cost- and water- effective wetland management for waterfowl and shore birds has been implemented across California by CDFW, USFWS, and non-governmental organizations, and CDFW would like to encourage LADWP, Inyo County, and the MOU parties to implement similar management regimes.

CDFW supports LADWP and Inyo County's assessment of waterfowl use within the Blackrock Waterfowl Management Area (Section 4 of the Annual Report). CDFW would like to continue to re-iterate our 2016, 2017, and 2018 recommendations for the Blackrock Waterfowl Management Area. Specifically, CDFW recommends the following actions to help Blackrock Waterfowl Management Area meet the goals of the 1997 MOU:

- Build a collaborative Blackrock Waterfowl Management Area team including CDFW, Inyo County, 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.
- Arrange a MOU party meeting to discuss changing management at Blackrock Waterfowl Management Area to allow a set amount of water to replace the standard of wetted acreage that currently exists.
- Develop alternative monitoring to replace current landscape vegetation mapping. Develop fine-scale topographic mapping of the Blackrock Waterfowl Management Area to determine flow direction and current topographic fall for assessing current management capabilities.
- Modify wetland unit infrastructure to allow for efficient flood-up and drawdown activities.
- Conduct 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.

CDFW understands that adaptive management will require consultation and planning with all MOU party representatives, and CDFW requests Inyo County and LADWP immediately engage with the 1997 MOU parties regarding this. CDFW supports an MOU party meeting occur during spring or summer of 2019 to discuss this.

If you have any questions regarding this letter, please contact Nick Buckmaster at (760) 872-1110 or Nick.Buckmaster@wildlife.ca.gov.

Sincerely,

Scott Wilson

Scott Wilson
Environmental Program Manager
Inland Deserts Region

cc: Chron
Nancee Murray (CDFW Office of General Counsel)
Nick Buckmaster, CDFW
1997 MOU parties

Work Cited:

California Department of Fish and Wildlife. 2017. *Comment Letter on 2017 Lower Owen River Project Seasonal Habitat Flow and Blackrock Waterfowl Area Flooded Acreage.*

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12.3.2 Owens Valley Committee Comments on the LORP 2018 Draft Annual Report

the Owens Valley Committee

P.O. Box 77, Bishop, CA 93515
January 9, 2019

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Manager of Aqueduct
Lost Angeles Dept. of Water & Power
300 Mandich St.
Bishop, CA 93514

Aaron Steinwand
Director
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P O Box 337
Independence, CA 93526

Owens Valley Committee Comments on the LORP 2018 Draft Annual Report

Please accept these comments on the LORP 2018 Draft Annual Report from the Owens Valley Committee. In accord with other MOU parties, the Owens Valley Committee desires a healthy sustainable Owens River system which meets the goals of the MOU, including the environment, recreation, and agriculture.

LORP Flows/Adaptive Management

After reviewing the LORP 2018 Draft Annual Report, it appears that the unprecedented 2017 releases of water down the LORP were too low to cause any beneficial effects (e.g. creating a channel through the islands or eliminating tules). However, the flows were high enough to cause a negative impact to fish and enabled noxious weeds to spread.

It is unfortunate that a release of over 1,000 cfs wasn't attempted. Instead, water that could have flushed the river was diverted eastward through historic canals. The 2017 run-off year represented a unique opportunity to assess if such a high flushing flow would have assisted in clearing the obstructions in the river channel. The decision to divert water to the east also resulted in excessive bulldozing of land along historic canals. This land had largely revegetated over the past century. The extraordinary spread of invasives, like Russian thistle, was a result of this damaging and unnecessary process and it will take decades for the land to recover. The moderate flows that were released in 2017 had little benefit because the Owens River channel is occluded with vegetation, demonstrating that the prescribed MOU flows have minimal potential to improve the river in its present condition.

Since flows alone will not achieve a clearer channel and healthier river, a combination of mechanical means (including explosives as appropriate) and annual flushing flows to remove tules and detritus must be attempted for the health of the river. Once the channel has been cleared by mechanical means, then flushing flows as required by the MOU may be more effective. Further, the use of very high flows in high run-off years to simulate natural conditions and maintain channel clearance, as occurred in 1969, should be a commitment by the LADWP and Inyo County.

The Owens Valley Committee has been supportive of creating a river channel in the Islands area of the LORP. The geology of the area suggests that it may be a sag pond related to faulting, but the creation of a definite channel will assist water movement, improve water quality, and reduce the conversion of meadow to marsh land.

The Owens Valley Committee would like to put forward again our recommendation for tributary streams to be reconnected to the river. A healthy river has streams flowing into it. This action would improve the water quality of the river.

The Owens Valley Committee continues to object to the use of the term “water neutral”. This term is not a part of the EIR, the MOU or the LADWP/Inyo County Water Agreement. LADWP started to use the term about five years ago, and the concept has no bearing on water management in the Owens Valley, including the LORP.

Though it is not permitted in the 1991 EIR and Inyo/LA Water Agreement, plans are being discussed concerning the export of Owens Valley Water to the Indian Wells Valley groundwater basin for water banking, instead of leaving water in the Owens Valley to benefit the environment. Proposals like this, even though not permissible, are why the Owens Valley Committee has steadily opposed any increase in the size of the pumpback station.

Recreation

Once again, one of the stated goals of the LORP—recreation—was completely ignored in the Draft Report. Little has changed since last year’s LORP Draft Annual Report. Excepting the year, our comments remain the same:

“OVC believes the omission of the Owens River Water Trail (ORWT) from the 2018 Annual Report is one of the document’s most glaring deficiencies. We urge its inclusion in the final report. LADWP considers the ORWT to be merely a county recreation project. Yet it has a strong potential to improve water quality and river habitat. Mechanical in-river excavation will clear 0.8 miles of river obstructions. Hand labor and specialized water craft will be used to open and maintain 1.75 miles of tule-constricted channel.”

The Owens River Water Trail is a good example of the kind of project that can dramatically improve flows in the river. Those of us who have been involved in helping to clear the channel have witnessed this firsthand. The Owens River Water Trail needs to be recognized as an adaptive management project in the LORP 2018 Draft Annual Report.

Agriculture

As mentioned earlier in these comments, mechanical clearing and reestablishment of a channel in the Islands area of the LORP is essential for continued use by the lessee for cattle grazing. Agriculture is one of the co-equal sustainable uses of the LORP as specified in the MOU. By attempting to improve flows in constricted areas of the LOR such as the Islands, both agriculture and species diversity will be improved.

LADWP's dewatering of Mono County meadows has the potential to affect lessees in the Owens Valley. Impacted lessees may need to move cattle from those leases in Mono County to the LORP grazing areas.

On page 5-35 of the draft report, these statements are made:

"Land managers and the lessees need to closely examine potential adaptive management strategies for modifying grazing practices and periods within the LORP. However, the scientific team will need to evaluate the potential effects those changes could have on other elements of the LORP prior to implementation."

The Owens Valley Committee is concerned that if there is a delay in evaluating additional AUMs or grazing periods on the LORP agricultural leases, lessees will experience fiscal impacts that may make their operations unsustainable. This is unacceptable, and further demonstrates that LADWP's dewatering of the Mono County leases affects the goals and sustainable practices of the LORP as specified in the MOU. Sustainable agriculture is a kingpin of environmental maintenance in the Owens Valley, with ranchers spreading water and maintaining native pastures and hedgerows. Ranching families must be able to have certainties from year to year, including the continuing ability to juggle livestock from one area to another to prevent impacts to the resource and to maintain enough stock to continue operating in a fiscally sound manner.

Blackrock Waterfowl Management Area

The Owens Valley Committee supports a meeting of the MOU parties to review management of the Blackrock Waterfowl area in order to improve conditions for migratory and other birds. Any modifications need to assure that more water remains in the Owens Valley to boost the ecosystems upon which this wildlife relies.

Public Engagement

OVC continues to reiterate that steps must be taken to enhance the quality of public engagement for the LORP Annual Report meeting:

1. Schedule meetings at hours convenient to the general public, i.e. in the evenings after the average work day.
2. Rotate meeting locations to Lone Pine and/or Independence so residents of southern Owens Valley, where the LORP is located, have a chance to provide input.
3. OVC once again requests that future LORP comment periods not coincide with the holiday season. Schedule comment periods well before or well after the holidays.

The Future of LORP

The OVC supports a meeting of the MOU parties to work on issues of concern in the LORP. Instead of a “summit” with a head table of experts and an audience, OVC envisions this meeting as a working group where members bring ideas and earnestly attempt to find solutions. The date for such a meeting should be set in consultation with all of the MOU parties.

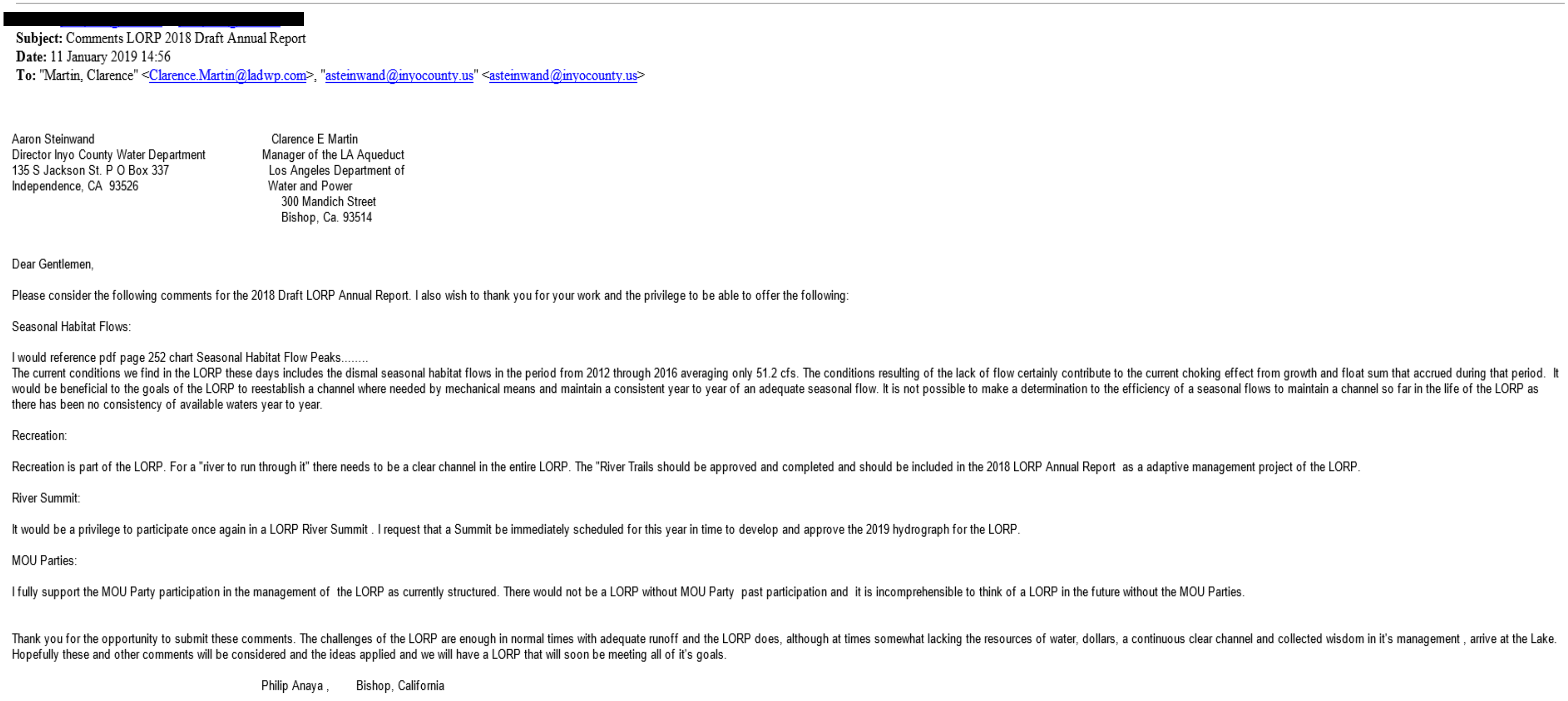
We look forward to having our comments incorporated in the LORP 2018 Draft Annual Report, and to a future productive meeting of the MOU parties focusing on viable solutions.

Sincerely,

Mary Roper

Mary Roper
President, Owens Valley Committee

12.3.3 Public Comments



[redacted]
Subject: Comments LORP 2018 Draft Annual Report
Date: 11 January 2019 14:56
To: "Martin, Clarence" <Clarence.Martin@ladwp.com>, "asteinwand@inyocounty.us" <asteinwand@inyocounty.us>

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Clarence E Martin
Manager of the LA Aqueduct
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300 Mandich Street
Bishop, Ca. 93514

Dear Gentlemen,

Please consider the following comments for the 2018 Draft LORP Annual Report. I also wish to thank you for your work and the privilege to be able to offer the following:

Seasonal Habitat Flows:

I would reference pdf page 252 chart Seasonal Habitat Flow Peaks........
The current conditions we find in the LORP these days includes the dismal seasonal habitat flows in the period from 2012 through 2016 averaging only 51.2 cfs. The conditions resulting of the lack of flow certainly contribute to the current choking effect from growth and float sum that accrued during that period. It would be beneficial to the goals of the LORP to reestablish a channel where needed by mechanical means and maintain a consistent year to year of an adequate seasonal flow. It is not possible to make a determination to the efficiency of a seasonal flows to maintain a channel so far in the life of the LORP as there has been no consistency of available waters year to year.

Recreation:

Recreation is part of the LORP. For a "river to run through it" there needs to be a clear channel in the entire LORP. The "River Trails should be approved and completed and should be included in the 2018 LORP Annual Report as a adaptive management project of the LORP.

River Summit:

It would be a privilege to participate once again in a LORP River Summit . I request that a Summit be immediately scheduled for this year in time to develop and approve the 2019 hydrograph for the LORP.

MOU Parties:

I fully support the MOU Party participation in the management of the LORP as currently structured. There would not be a LORP without MOU Party past participation and it is incomprehensible to think of a LORP in the future without the MOU Parties.

Thank you for the opportunity to submit these comments. The challenges of the LORP are enough in normal times with adequate runoff and the LORP does, although at times somewhat lacking the resources of water, dollars, a continuous clear channel and collected wisdom in it's management , arrive at the Lake. Hopefully these and other comments will be considered and the ideas applied and we will have a LORP that will soon be meeting all of it's goals.

Philip Anaya , Bishop, California