Lower Owens River Project
2019 Annual Report

DRAFT

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EXECUTIVE SUMMARY

The 2019 Lower Owens River Project (LORP) Annual Report contains the results from the thirteenth year of monitoring for the LORP. Monitoring results contained in this report include hydrologic monitoring, monitoring of range conditions throughout the project area, saltcedar and weed management. In 2019, LADWP and ICWD conducted a comprehensive evaluation of the LORP with respect to goals and requirements defined in the project's guiding documents. The 2019 LORP Evaluation Report is contained in this report. The MOU Consultants' 2019 Adaptive Management Recommendations are also contained herein.

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 2018-2019 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 11.5 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 led to additional water releases, large wetted acreage areas, and difficulty with measurement access in the summer and fall of the 2018-2019 water year. The seasonal habitat flow ramping reached a peak of 190 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.

Land Management

The 2019 LORP land management monitoring efforts continued with monitoring utilization across all leases and range trend monitoring on the Blackrock and Delta leases inside the LORP management area. All irrigated pastures were evaluated in 2019. Moist floodplain areas along the Lower Owens River continue to be submerged expanding the distribution of wetland vegetation species.

High plant vigor on uplands accompanied by the expansion of perennial grass species where water was spread in 2017 and 2019 is still observable. Pasture utilization for leases within the LORP was within 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 in 2017 in two locations. As of the summer of 2019 the beetle has consumed saltcedar across large swaths inside the LORP Project area, however speculation on the long-term effect of the beetle on saltcedar populations in the LORP is premature.

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 2019 LADWP treated 139 acres of saltcedar in the LORP area, including:

- 14 acres of cut stump treatment,
- 125 acres of cut stump retreatment

LADWP will continue to treat saltcedar resprouts in these areas in 2019-2020 and will continue further treatment in the Blackrock area if feasible.

LORP Weed Report

Significant increases in perennial pepperweed (*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* expansion can be found in the Rapid Assessment Section of the 2018 LORP Report.

LORP Water Quality Observations

ICWD staff collected manual water quality parameters on the Lower Owens River (LOR) during 2019 with a focus on the Seasonal Habitat Flow (SHF) in May and the summer flow ramp-up in June/July. In May 2019, the SHF was conducted with a maximum release of 190 cfs at LOR Intake on May 15 and a maximum flow of approximately 110

cfs arriving at the Pumpback station on May 28. Water temperatures during the SHF ranged from 55-65 degrees Fahrenheit (deg. F). Dissolved oxygen levels ranged from more than 8 mg/L at the LOR Intake to 3.4 mg/L at the Manzanar Bridge. During the June to early July summer flow ramp-up, water temperatures ranged from 64-70 deg. F and DO levels ranged from 6.4 mg/L in the LOR at the Blackrock ditch return area to 2.5 mg/L at Manzanar Bridge. No fish stress or mortality was observed.

LORP 2019 Evaluation

It has been 13 years since the LORP was first implemented. The project is approaching the end of a prescribed 15 years of monitoring-- that has provided the LORP Scientific Team and MOU Parties information and insights into physical processes and ecological shifts that have shaped the project. The biological and ecological processes that shape the project appear to have reached a more or less stable condition.

LADWP and ICWD have prepared the LORP 2019 Evaluation Report to assess the status of the project with respect to the goals and requirements originally outlined for the project. Many goals have been reached through implementation as expected, however some goals have been more difficult to attain. There is a comprehensive list of goals and requirements defined in the guiding documents that were intended to achieve ecological goals in the LORP. However, some of these goals are incompatible in practice, and/or do not seem feasible following implementation and after operating and maintaining the project as described for many years. Following the actions/requirements prescribed in the guiding documents has not always led to the outcomes envisioned. The purpose of this evaluation is to identify project status and to chart a path forward for continuing management of the project.

Volume I of this report outlines the project's history and legal guidance, and briefly summarizes project implementation and post-implementation management. Volume II follows the goals as described in the 1997 MOU following the physical features of the LORP, then additional goals that apply to the entire project area. Each section is structured to: (1) identify each goal and/or requirement, (2) describe relevant progress to date (including successes and challenges), (3) provide current status of whether or not this goal/requirement is being met, and (4) supply recommendations for managing the project differently, if any. Where applicable, additional goals/requirements identified in subsequent Stipulations and Orders or other legal documents are also integrated by physical feature.

Volume II also provides summary tables that identify the goals/requirements, guiding document, status, comments, recommendations and approvals necessary to implement these recommended actions. Next steps include consideration of these

recommendations by the MOU Consultants and Parties as relevant, and further development of interim management plans and associated monitoring.

Adaptive Management Recommendations

We now know that the years of released uniform base flows have resulted in a river supporting a marsh-river type environment. This is not as bad as it appears because many sustaining and very productive resources have and will continue to be provided. After years of trying to change the MOU Party codifying of uniform 40 cfs base flows and mandated low seasonal habitat flow peak releases, Consultants are now accepting that little is going to change flow management in the future. Based on the record and the insurmountable constraints, the MOU Parties have probably gained most of what they are going to accomplish via river flow management. It's now time for the MOU Parties to consider if other reasonable, feasible, economically acceptable, and, especially infrastructure friendly rehabilitation approaches that could increase river health.

Our adaptive management recommendations are summarized as follows:

1. The City and County assign their Scientific Team the responsibility to review, evaluate, and determine the feasibility of testing one or more water control structures in the Lower Owens River. The Scientific Team would determine if water control structures have the capability of controlling the location and abundance of tules and cattails, increased recreational access, providing augmentation water to increase seasonal habitat and flushing flows, assisting in scouring "muck" from down-river channels, increasing available dissolved oxygen down-river, being economically feasible and reasonable, causing no adverse conditions that could not be mitigated, benefiting other down-river water quality conditions (i.e. water clarity), and providing viable short- term and long-term benefits. Their evaluation report findings should appear in the 2020 Annual Report for MOU Party action.
2. The City and the County assign their Scientific Team the responsibility of evaluating the present status of LORP goal attainment. The Scientific Team would also evaluate and identify goals that are unreasonable or could not be met because of over-riding constraints. The Team would provide solutions to those reasonable goals that have yet to be met.
3. The Scientific Team conduct a critical review of limitations that influence project success. Based on the information and suggestions derived from this critical review, the MOU Parties should implement resource management tactics or changes that would address the limitations. This implementation would include any active intervention needed to eliminate a problem, barrier, or any other limitation.
4. The City-County Scientific Team evaluate, document, and submit a report describing the benefits that have been gained to date. This report would then be used by the Team to assist in the evaluations of goal attainment.

5. Almost two years have elapsed since the County attempted to plant willow poles along landforms bordering the lower reaches of the Lower Owens River. The now remaining gallery of standing long white perforated plastic pipes encasing dead willow poles just does not look good Consultants now recommend that this area be cleaned up and returned to its former condition.
6. Initiate a grazing strategy to test the effect of cattle trampling to impact bassia in some riparian pastures, but maintain current grazing utilization standards until it can be determined through additional studies that modifying riparian and upland grazing to 30 and 50%, respectively, will not impact target species habitat or result in a limiting factor.
7. A thorough survey to identify and map pepperweed and salt cedar throughout the project areas and then devise a plan, with funding, to remove the most serious infestations and a method to control noxious weeds into the future. A focused and prioritized program to control salt cedar is the best way to effectively allocate resources between mechanical and physical activities and biological control with beetle infestations.
8. Shifting summer pulse flows to the DHA to the fall and winter flow period in order to maximize open water habitat for migrating waterfowl and creating drying conditions to impact tule/cattail during growth periods – as is done in the Thibault wetlands.
9. Management of off channel lakes and ponds has been quite successful, and they have always remained within compliance standards and met MOU goals. Management should proceed as is.
10. The LADWP, ICWD, and CDFW work with the LORP Scientific Team to develop a new BWMA management plan based upon seasonal wetting and drying cycles.

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 and that 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, following the methods and schedules described in Section 4 of the *Lower Owens River Monitoring Adaptive Management and Reporting Plan* (MAMP, Ecosystem Sciences 2008).

Specific reporting procedures are also described under each monitoring method in the MAMP. The MOU also requires that the County and LADWP provide annual reports describing the environmental conditions of the LORP including monitoring data, the results of analyses, 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 2019 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 a draft of the annual report be provided to the public and representatives of the Parties identified in the MOU. 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 2019, LADWP wrote Sections 1.0 Introduction; 2.0 Hydrologic Monitoring; 3.0 Land Management, and 4.0 LORP Saltcedar Treatment. LADWP, Inyo County Water Department (ICWD), and the Inyo/Mono Counties Agricultural Commissioner's Office authored Section 5.0 LORP Weed Report. ICWD authored Section 6.0 Water Quality Observations. LADWP and ICWD coauthored Section 7.0 LORP 2019 Evaluation. The MOU Consultants authored Section 8.0 Adaptive Management Recommendations.

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 2019.

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 2018 through September 2019, for the 4 in-river stations (see Hydrologic 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 to access a list of PDFs summarizing the most current daily reports.

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 Sontek meters measurement accuracy is affected by factors that influence river stage and flow velocity, including vegetation growth and sediment build up. 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 Sontek meters at least once per month. 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. To maintain flow measurement accuracy, all of the meters on the LORP are calibrated at least once per month following the 2007 Stipulation & Order.

A commentary on each station along the LORP follows:

Below LORP Intake

Measurement Device: Langemann Gate

The Langemann Gate regulates and records the flow rate 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). Because of this infrequent submergence of the Langemann Gate, a WaterLOG H-350XL was installed as a back up to measure flow and is not affected by the high seasonal habitat releases. 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

Flow at the Pumpback Station is calculated by adding the Pumpback Station flow, Langemann Gate Release to Delta flow, and Weir to Delta flow. In most flow conditions these stations have proven to be 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):

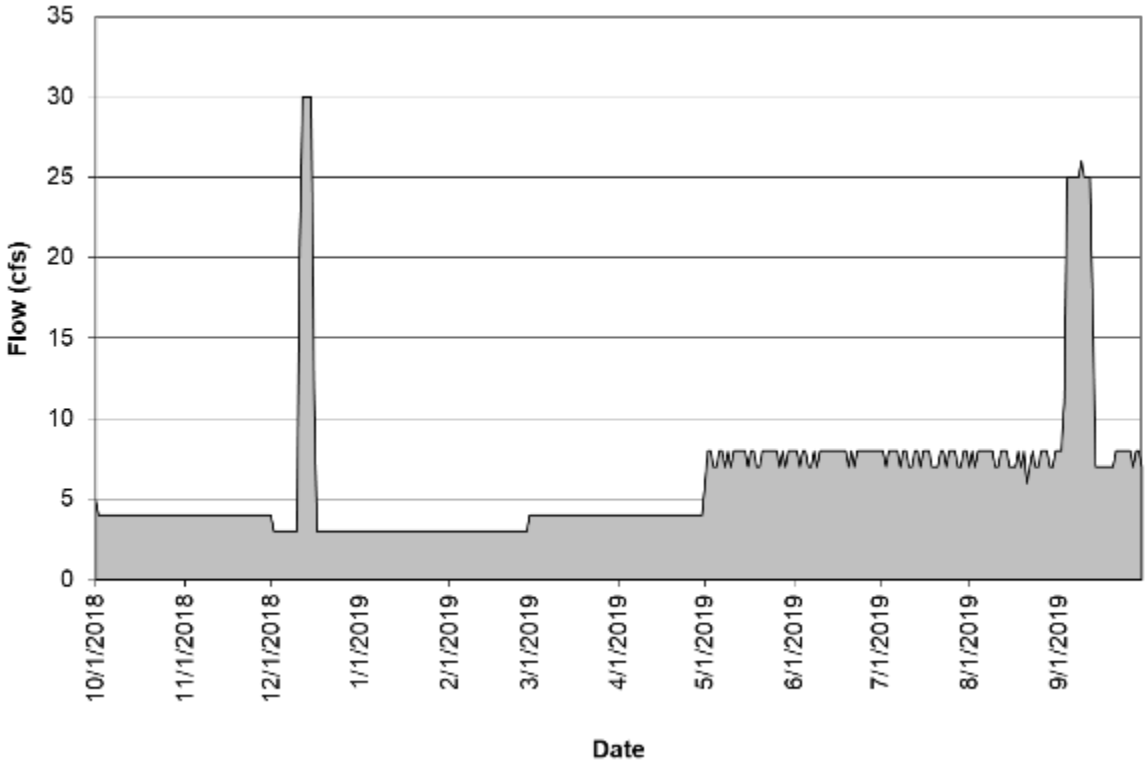
- October 1 to November 30 — 4 cfs
- December 1 to February 28 — 3 cfs
- March 1 to April 30 — 4 cfs
- May 1 to September 30 — 7.5 cfs

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

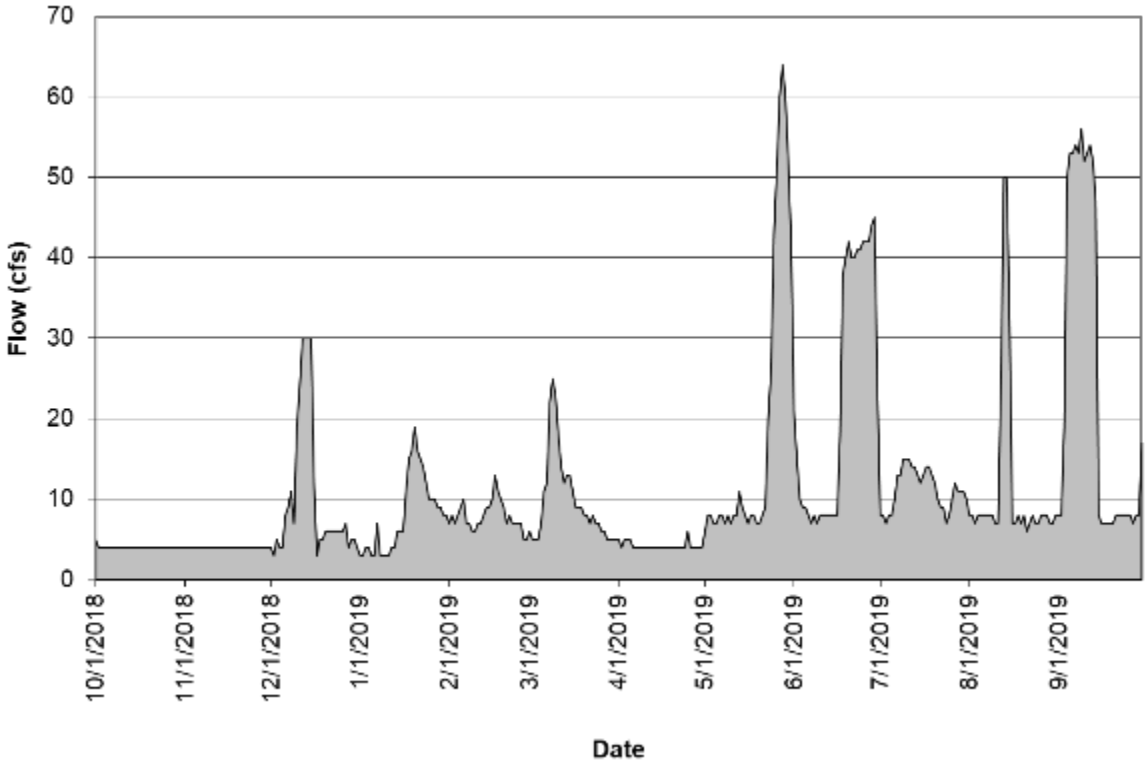
- Period 1: March-April — 10 days at 25 cfs
- Period 2: June-July — 10 days at 20 cfs
- Period 3: September — 10 days at 25 cfs
- Period 4: November-December — 5 days at 30 cfs

Surface runoff created by precipitation events occurring during March 2019 resulted in additional LORP inflows. As such, the Period 1 pulse flow to the Delta was canceled. The Period 2, Period 3, and Period 4 pulse flows were released during the appropriate months.

The releases to the Delta for the 2018-19 water year resulted in an average of 11.5 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.



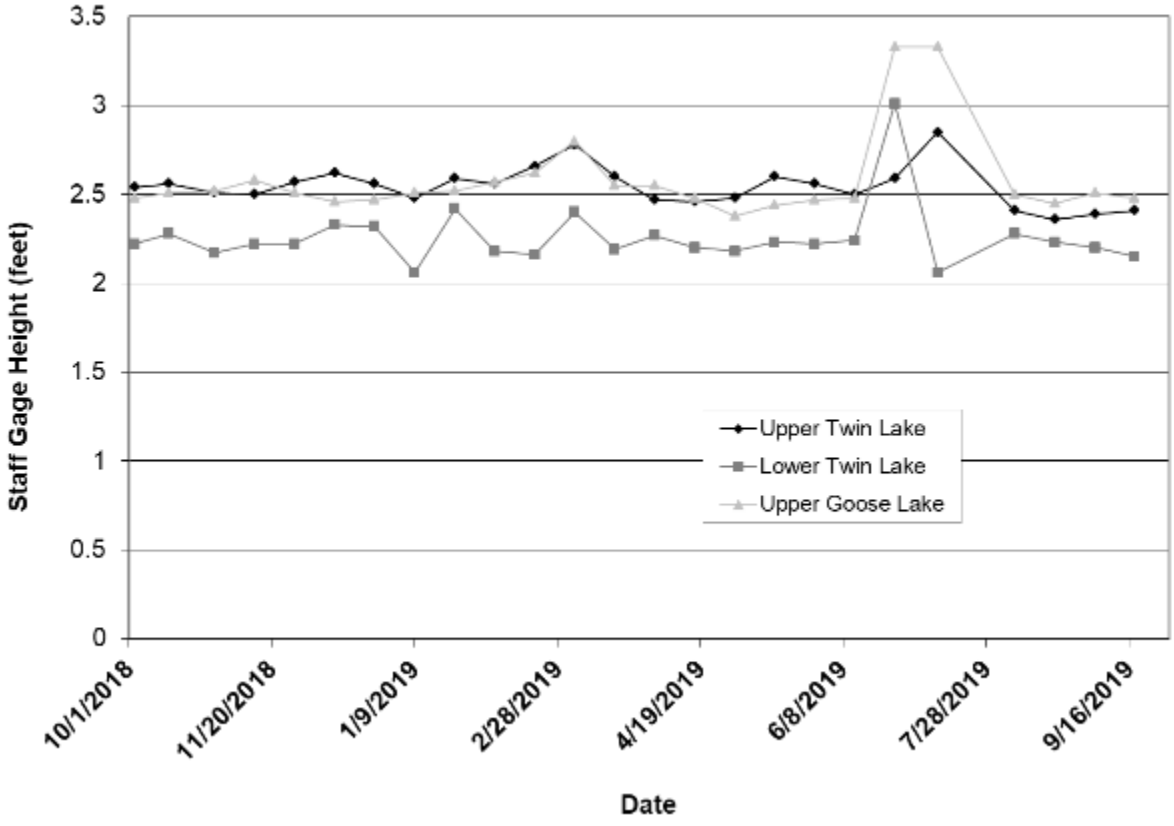
Hydrologic Figure 1. Langemann Release to Delta



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 2.0 and 3.5 feet stage height for the 2018-19 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, which had a minimum daily average flow of 0.5 cfs for the year. (see Hydrologic Table 1, and Hydrologic Appendix 2).

Hydrologic Table 1. LORP Flows – Water Year 2018-19

Station Name	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
Below River Intake	59.8	190.0	42.0
Blackrock Return Ditch	1.2	3.8	0.7
Goose Lake Return	0.0	0.0	0.0
Billy Lake Return	1.2	1.7	0.8
Mazourka Canyon Road	56.2	141.0	38.0
Locust Ditch Return	0.2	6.7	0.0
Georges Ditch Return	0.4	6.2	0.0
Reinhackle Springs	55.6	125.0	41.0
Alabama Gates Return	0.0	0.0	0.0
At Pumpback Station	52.5	111.0	38.0
Pump Station	41.1	48.0	0.0
Langemann Gate to Delta	6.1	30.0	3.0
Weir to Delta	5.3	56.0	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 with 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

ET Season	Read Date	Wetted Acreage	Average Inflow
Spring 18'	5/8/2018	200	3.9
Summer 18'	7/9/2018	128	3.1
Fall 18'	9/14/2018	121	2.5
Winter 18'-19'	1/23/2019	100	0.8
Spring 19'	5/9/2019	156	3.6
Summer 19'	n/a	500+	10.9
Fall 19'	n/a	500+	n/a

Thibaut Unit

ET Season	Read Date	Wetted Acreage	Average Inflow
Spring 18'	n/a	n/a	0.0
Summer 18'	n/a	n/a	0.0
Fall 18'	n/a	n/a	0.0
Winter 18'-19'	n/a	n/a	0.0
Spring 19'	5/9/2019	57	3.4
Summer 19'	n/a	500+	4.9
Fall 19'	n/a	500+	n/a

Drew Unit

ET Season	Read Date	Wetted Acreage	Average Inflow
Spring 18'	5/7/2018	224	4.7
Summer 18'	7/9/2018	253	5.5
Fall 18'	9/14/2018	269	4.5
Winter 18'-19'	1/23/2019	288	1.9
Spring 19'	5/9/2019	295	3.7
Summer 19'	n/a	500+	4.5
Fall 19'	n/a	500+	n/a

Waggoner Unit

ET Season	Read Date	Wetted Acreage	Average Inflow
Spring 18'	n/a	500+	5.5
Summer 18'	n/a	500+	15.3
Fall 18'	n/a	n/a	0.0
Winter 18'-19'	n/a	n/a	0.0
Spring 19'	n/a	n/a	0.0
Summer 19'	n/a	n/a	0.0
Fall 19'	n/a	n/a	0.0

Notes:
Measurements before 4/1/19 count towards the 2018-2019 runoff year acreage goal.
Measurements after 4/1/19 count towards the 2019-2020 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.
Wetted acreage measurements were not conducted in summer or fall seasons of 2019 due to high runoff, saturated ground, and difficult access conditions.

2.5 Blackrock Waterfowl Management Area Results for April 2018 to March 2019

The runoff forecast for runoff year 2018-19 was 78%, so the waterfowl acreage goal was 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 June 1 Winterton Unit was set to 2.7 cfs, and flows to Drew remained at 5.6 cfs. On July 11, wetted perimeter measurements were taken. Drew Unit measured at 253 acres, and Winterton Unit measured at 128 acres.

On August 16, Drew Unit was set to 5.0 cfs, and Winterton Unit was set to 2.5 cfs.

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

On October 16, Drew Unit was set to 1.8 cfs, and Winterton Unit was set to 0.8 cfs. On November 8, Thibaut Pond was set to 1 cfs.

On January 14 and 23, 2019 wetted perimeter measurements were taken. Thibaut Unit measured at 47 total acres which includes Thibaut Pond at 28 acres. Drew Unit measured at 288 acres, and Winterton Unit measured at 100 acres.

On March 15, 2019 flows to Thibaut Pond were shut off.

The average wetted acreage for the 2018-19 runoff year was 399 acres, slightly above the waterfowl acreage goal of 390 acres.

2.6 Blackrock Waterfowl Management Area Results for April 2019 to September 2019

The runoff forecast for runoff year 2019-20 is greater than 100%, therefore the waterfowl acreage goal is 500 acres.

On April 16, flow rates for the spring season were set. Flow to Drew Unit was set to 3.7 cfs, Winterton Unit was set to 3.4 cfs, and Thibaut Unit was set to 3.5 cfs.

On May 9, wetted acreage surveys for the spring season were completed. Drew Unit measured at 295 acres, Winterton Unit measured at 156 acres, and Thibaut Unit measured at 57 acres.

On June 1, flow rates for the summer season were set. Flow to Winterton Unit was reduced from 3.4 cfs to 3.0 cfs. Flows to Thibaut and Drew Units remained at 3.5 cfs and 3.7 cfs respectively.

On August 16, flow rates for the fall season were set. Flow to Drew Unit was reduced from 3.7 cfs to 3.3 cfs. Flow to Thibaut Unit was reduced from 3.5 cfs to 1.8 cfs. Flow to Winterton Unit remained at 3.0 cfs.

No wetted acreage surveys were conducted during the summer or fall seasons as the Waterfowl Area was saturated with difficult access given current conditions.

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 2018 to September 2019. 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 intermittent runoff from precipitation also result in flow increases.

Hydrologic Table 3. Average Monthly River Flow Losses/Gains
From the Intake to the Pumpback Station during the 2018-19 Water Year

	Month	Flow (cfs)	Acre-Feet-Per-Day
2018	OCT	-7	-14
	NOV	+1	+2
	DEC	+8	+15
2019	JAN	+9	+17
	FEB	+9	+19
	MAR	+9	+17
	APR	-3	-5
	MAY	-22	-43
	JUN	-37	-74
	JUL	-38	-75
	AUG	-33	-65
	SEP	-19	-38
	AVG MONTH	**-10 cfs**	**-20 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 43,322 acre-feet, inflows from augmentation spillgates were 2,204 acre-feet, and outflows from the Pumpback Station were 38,028 acre-feet. This yields a loss of 7,498 acre-feet for the year, a daily average of approximately 10.3 cfs between the Intake and the Pumpback Station. Water loss during the 2018-19 water year represents about 16.5% 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 2018 to March 2019, an average flow of 44 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 47 cfs. The average flow reaching the Pumpback Station was 55 cfs, an increase of 8 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 likely stored during earlier periods in subsurface aquifers and may also be a result of higher winter season precipitation.

The river reach from the Intake to the Mazourka Canyon Road gaging station lost an average of 1 cfs, Mazourka Canyon Road to the Reinhackle gaging station gained 4 cfs, and Reinhackle to the Pumpback Station gained 6 cfs (see Hydrologic Table 4). 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 2018 to March 2019

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	44	N/A	N/A
Mazourka	45	-1	-1
Reinhackle	49	+4	+2
Pumpback	55	+6	+9

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 2019 to September 2019, all river reaches lost water. An average flow of 80 cfs was released into the Lower Owens River from the Intake. An additional 3 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. The largest flow losses occurred at the Reinhackle to Pumpback Station reach (-14 cfs) (see Hydrologic Table 5).

Hydrologic Table 5. Summer Flow Losses/Gains, June 2019 to September 2019

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	80	N/A	N/A
Mazourka	72	-11	-11
Reinhackle	65	-7	-18
Pumpback	51	-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.

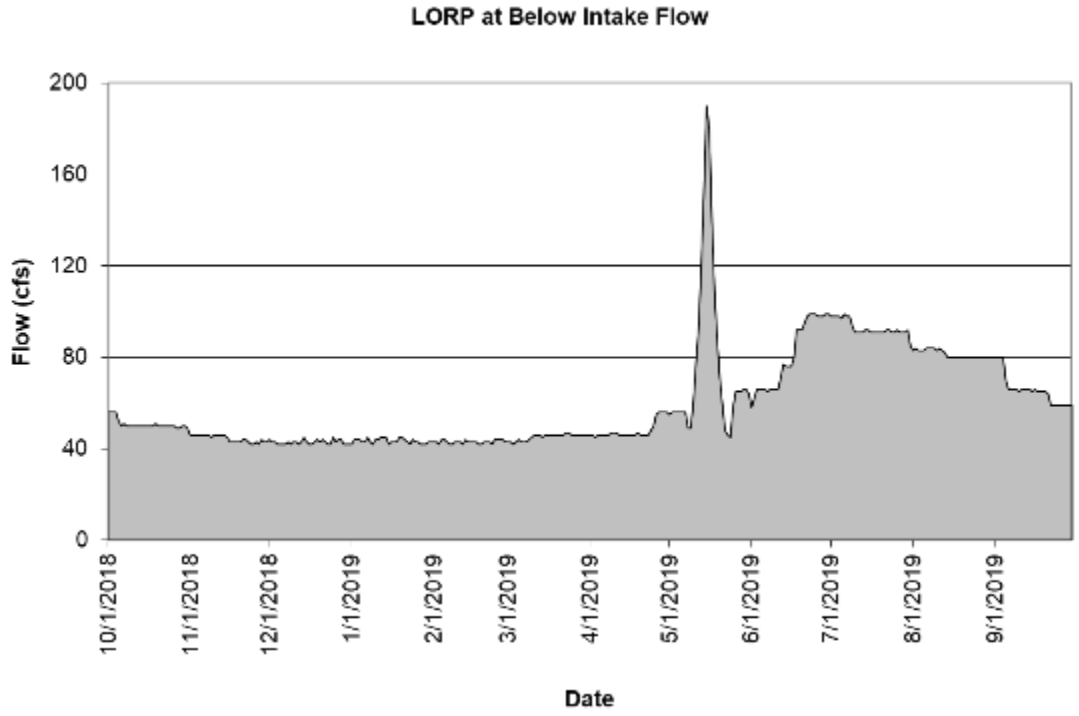
2.11 Seasonal Habitat Flow

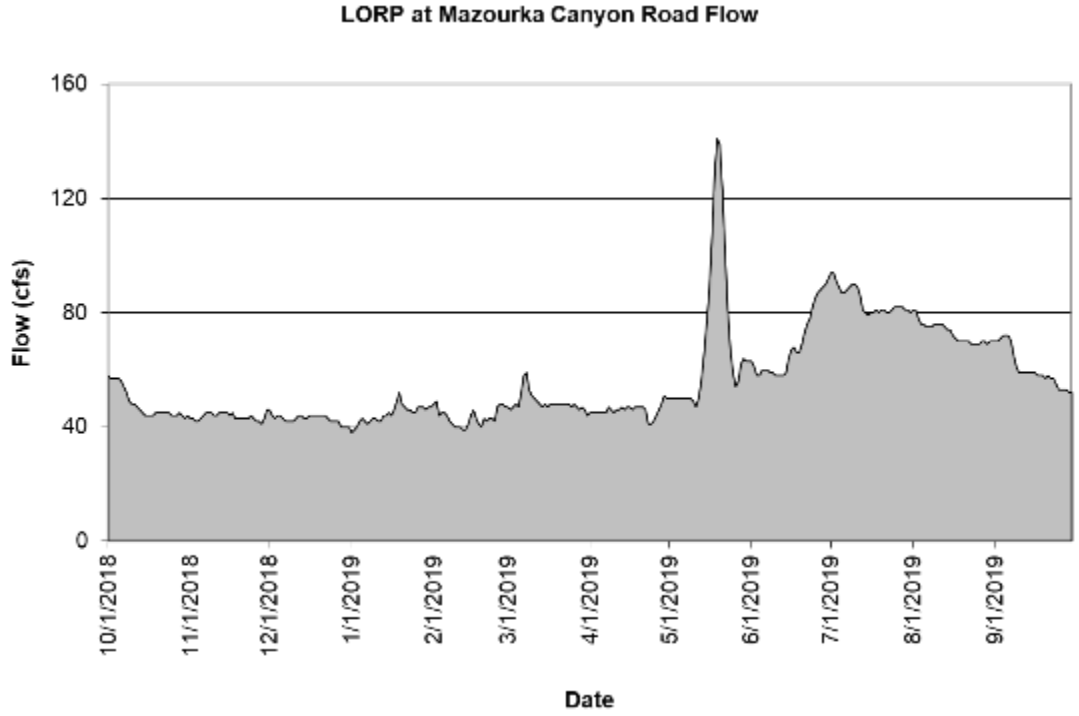
The runoff forecast for runoff year 2019-20 was 137%, and a Seasonal Habitat Flow was released from the LORP Intake in May 2019. Flows from the LORP Intake were ramped up to a peak of 200 cfs over a period of seven days, before ramping down over another seven days.

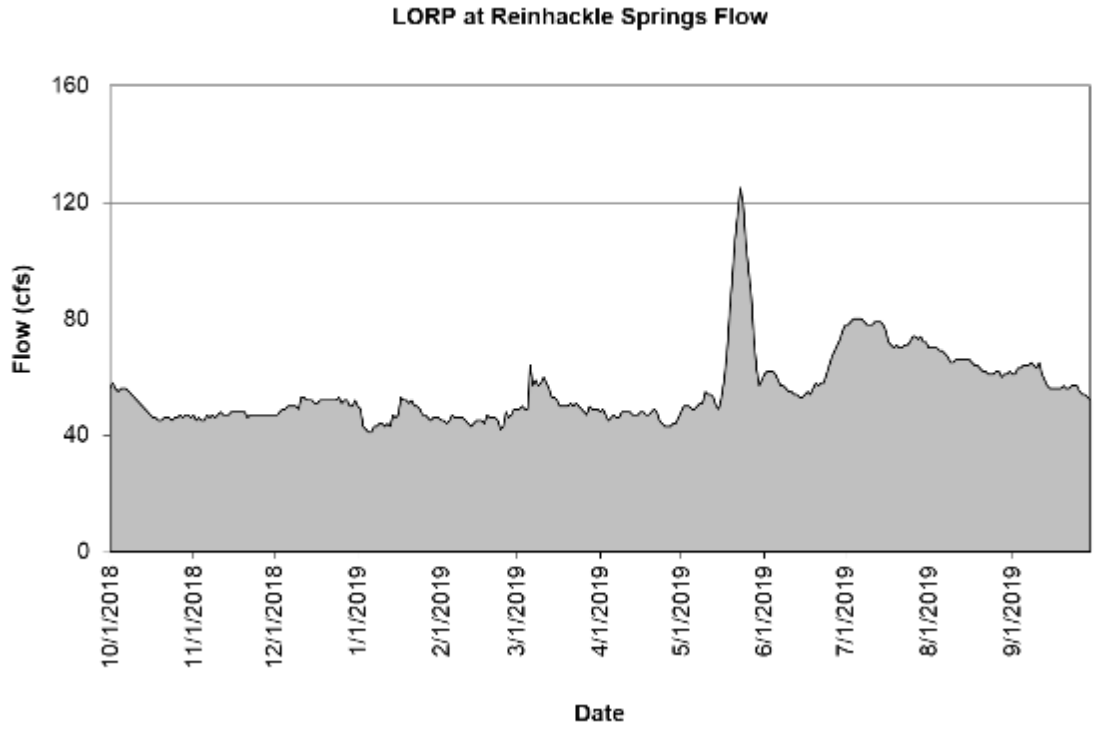
Daily flow rates from the LORP Intake are provided in Appendix 2.

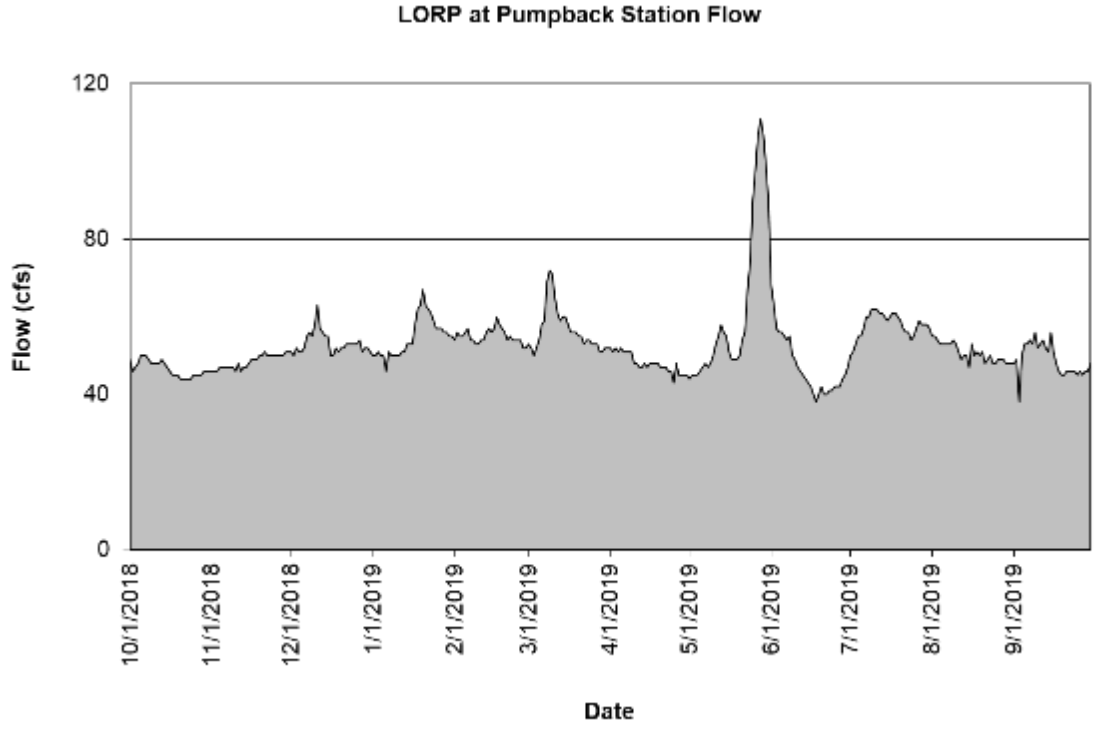
2.12 Appendices

Appendix 1. Hydrologic Monitoring Graphs






LORP at Reinhackle Springs Flow
160
120
80
40
0
Flow (cfs)
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
Date


LORP at Pumpback Station Flow
120
80
40
0
Flow (cfs)
10/1/2018
11/1/2018
12/1/2018
1/1/2019
2/1/2019
3/1/2019
4/1/2019
5/1/2019
6/1/2019
7/1/2019
8/1/2019
9/1/2019
Date

Appendix 2. River Flow Tables

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
10/1/2018	56.0	1.1	0.0	1.5	58.0	0.0	0.0	56.0	0.0	49.0	44.0	5.0	0.0	54.8
10/2/2018	56.0	1.1	0.0	1.4	57.0	0.0	0.0	58.0	0.0	46.0	42.0	4.0	0.0	54.3
10/3/2018	56.0	1.3	0.0	1.4	57.0	0.0	0.2	56.0	0.0	47.0	43.0	4.0	0.0	54.0
10/4/2018	56.0	1.3	0.0	1.3	57.0	0.0	0.2	55.0	0.0	48.0	44.0	4.0	0.0	54.0
10/5/2018	52.0	1.3	0.0	1.3	57.0	0.0	0.2	56.0	0.0	50.0	46.0	4.0	0.0	53.8
10/6/2018	50.0	1.3	0.0	1.2	56.0	0.0	0.2	56.0	0.0	50.0	46.0	4.0	0.0	53.0
10/7/2018	51.0	1.3	0.0	1.2	54.0	0.0	0.2	56.0	0.0	50.0	46.0	4.0	0.0	52.8
10/8/2018	50.0	1.3	0.0	1.2	52.0	0.0	0.2	55.0	0.0	49.0	45.0	4.0	0.0	51.5
10/9/2018	50.0	1.3	0.0	1.2	49.0	0.0	0.2	54.0	0.0	48.0	44.0	4.0	0.0	50.3
10/10/2018	50.0	1.3	0.0	1.3	48.0	0.0	0.2	53.0	0.0	48.0	44.0	4.0	0.0	49.8
10/11/2018	50.0	1.3	0.0	1.3	48.0	0.0	0.2	52.0	0.0	48.0	44.0	4.0	0.0	49.5
10/12/2018	50.0	1.3	0.0	1.4	47.0	0.0	0.2	51.0	0.0	48.0	44.0	4.0	0.0	49.0
10/13/2018	50.0	1.2	0.0	1.4	46.0	0.0	0.2	50.0	0.0	49.0	45.0	4.0	0.0	48.8
10/14/2018	50.0	1.1	0.0	1.4	45.0	0.0	0.1	49.0	0.0	48.0	44.0	4.0	0.0	48.0
10/15/2018	50.0	1.1	0.0	1.4	44.0	0.0	0.1	48.0	0.0	47.0	43.0	4.0	0.0	47.3
10/16/2018	50.0	1.1	0.0	1.4	44.0	0.0	0.1	47.0	0.0	46.0	42.0	4.0	0.0	46.8
10/17/2018	50.0	1.2	0.0	1.4	44.0	0.0	0.1	46.0	0.0	45.0	41.0	4.0	0.0	46.3
10/18/2018	50.0	1.2	0.0	1.4	44.0	0.0	0.1	46.0	0.0	45.0	41.0	4.0	0.0	46.3
10/19/2018	51.0	1.2	0.0	1.4	45.0	0.0	0.1	45.0	0.0	45.0	41.0	4.0	0.0	46.5
10/20/2018	50.0	1.2	0.0	1.4	45.0	0.0	0.1	45.0	0.0	44.0	40.0	4.0	0.0	46.0
10/21/2018	50.0	1.3	0.0	1.4	45.0	0.0	0.1	46.0	0.0	44.0	40.0	4.0	0.0	46.3
10/22/2018	50.0	1.5	0.0	1.4	45.0	0.0	0.1	46.0	0.0	44.0	40.0	4.0	0.0	46.3
10/23/2018	50.0	1.4	0.0	1.5	45.0	0.0	0.1	46.0	0.0	44.0	40.0	4.0	0.0	46.3
10/24/2018	50.0	1.2	0.0	1.4	45.0	0.0	0.1	45.0	0.0	44.0	40.0	4.0	0.0	46.0
10/25/2018	50.0	1.3	0.0	1.4	44.0	0.0	0.1	46.0	0.0	45.0	41.0	4.0	0.0	46.3
10/26/2018	50.0	1.3	0.0	1.4	44.0	0.0	0.1	46.0	0.0	45.0	41.0	4.0	0.0	46.3
10/27/2018	49.0	1.3	0.0	1.3	44.0	0.0	0.1	47.0	0.0	45.0	41.0	4.0	0.0	46.3
10/28/2018	49.0	1.3	0.0	1.4	45.0	0.0	0.1	46.0	0.0	45.0	41.0	4.0	0.0	46.3
10/29/2018	50.0	1.3	0.0	1.4	44.0	0.0	0.1	47.0	0.0	46.0	42.0	4.0	0.0	46.8
10/30/2018	50.0	1.3	0.0	1.3	43.0	0.0	0.1	47.0	0.0	46.0	42.0	4.0	0.0	46.5
10/31/2018	49.0	1.2	0.0	1.3	44.0	0.0	0.1	46.0	0.0	46.0	42.0	4.0	0.0	46.3

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
11/1/2018	46.0	1.2	0.0	1.3	43.0	0.0	0.1	47.0	0.0	46.0	42.0	4.0	0.0	45.5
11/2/2018	46.0	1.2	0.0	1.3	43.0	0.0	0.1	45.0	0.0	46.0	42.0	4.0	0.0	45.0
11/3/2018	46.0	1.2	0.0	1.3	42.0	0.0	0.0	46.0	0.0	46.0	42.0	4.0	0.0	45.0
11/4/2018	46.0	1.2	0.0	1.3	42.0	0.0	0.0	45.0	0.0	47.0	43.0	4.0	0.0	45.0
11/5/2018	46.0	1.2	0.0	1.3	43.0	0.0	0.1	45.0	0.0	47.0	43.0	4.0	0.0	45.3
11/6/2018	46.0	1.2	0.0	1.4	44.0	0.0	0.1	47.0	0.0	47.0	43.0	4.0	0.0	46.0
11/7/2018	46.0	1.2	0.0	1.4	45.0	0.0	0.1	46.0	0.0	47.0	43.0	4.0	0.0	46.0
11/8/2018	46.0	1.2	0.0	1.4	45.0	0.0	0.1	47.0	0.0	47.0	43.0	4.0	0.0	46.3
11/9/2018	45.0	1.2	0.0	1.4	45.0	0.0	0.2	46.0	0.0	47.0	43.0	4.0	0.0	45.8
11/10/2018	46.0	1.2	0.0	1.4	44.0	0.0	0.2	47.0	0.0	46.0	42.0	4.0	0.0	45.8
11/11/2018	46.0	1.2	0.0	1.4	44.0	0.0	0.2	48.0	0.0	48.0	44.0	4.0	0.0	46.5
11/12/2018	46.0	1.2	0.0	1.4	45.0	0.0	0.2	47.0	0.0	46.0	42.0	4.0	0.0	46.0
11/13/2018	46.0	1.2	0.0	1.5	45.0	0.0	0.2	47.0	0.0	47.0	43.0	4.0	0.0	46.3
11/14/2018	46.0	1.2	0.0	1.5	45.0	0.0	0.2	47.0	0.0	47.0	43.0	4.0	0.0	46.3
11/15/2018	45.0	1.2	0.0	1.5	45.0	0.0	0.2	48.0	0.0	48.0	44.0	4.0	0.0	46.5
11/16/2018	43.0	1.3	0.0	1.5	44.0	0.0	0.2	48.0	0.0	49.0	45.0	4.0	0.0	46.0
11/17/2018	43.0	1.4	0.0	1.5	45.0	0.0	0.1	48.0	0.0	49.0	45.0	4.0	0.0	46.3
11/18/2018	43.0	1.4	0.0	1.5	43.0	0.0	0.2	48.0	0.0	49.0	45.0	4.0	0.0	45.8
11/19/2018	43.0	1.4	0.0	1.5	43.0	0.0	0.1	48.0	0.0	50.0	46.0	4.0	0.0	46.0
11/20/2018	43.0	1.3	0.0	1.5	43.0	0.0	0.1	48.0	0.0	50.0	46.0	4.0	0.0	46.0
11/21/2018	44.0	1.2	0.0	1.5	43.0	0.0	0.1	46.0	0.0	51.0	47.0	4.0	0.0	46.0
11/22/2018	44.0	1.2	0.0	1.5	43.0	0.0	0.2	47.0	0.0	50.0	46.0	4.0	0.0	46.0
11/23/2018	43.0	1.2	0.0	1.5	43.0	0.0	0.4	47.0	0.0	50.0	46.0	4.0	0.0	45.8
11/24/2018	42.0	1.2	0.0	1.5	44.0	0.0	0.4	47.0	0.0	50.0	46.0	4.0	0.0	45.8
11/25/2018	42.0	1.2	0.0	1.5	43.0	0.0	0.4	47.0	0.0	50.0	46.0	4.0	0.0	45.5
11/26/2018	43.0	1.1	0.0	1.4	42.0	0.0	0.3	47.0	0.0	50.0	46.0	4.0	0.0	45.5
11/27/2018	42.0	1.1	0.0	1.3	42.0	0.0	0.3	47.0	0.0	50.0	46.0	4.0	0.0	45.3
11/28/2018	44.0	1.2	0.0	1.2	41.0	0.0	0.2	47.0	0.0	50.0	46.0	4.0	0.0	45.5
11/29/2018	43.0	1.3	0.0	1.2	43.0	0.0	0.2	47.0	0.0	51.0	47.0	4.0	0.0	46.0
11/30/2018	43.0	1.6	0.0	1.2	46.0	0.0	0.1	47.0	0.0	51.0	47.0	4.0	0.0	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 / 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
12/1/2018	44.0	1.6	0.0	1.1	46.0	0.0	0.1	47.0	0.0	51.0	47.0	4.0	0.0	47.0
12/2/2018	43.0	1.4	0.0	0.9	44.0	0.0	0.1	47.0	0.0	50.0	47.0	3.0	0.0	46.0
12/3/2018	43.0	1.4	0.0	0.8	43.0	0.0	0.1	48.0	0.0	52.0	47.0	3.0	2.0	46.5
12/4/2018	42.0	1.3	0.0	1.1	44.0	0.0	0.2	49.0	0.0	51.0	47.0	3.0	1.0	46.5
12/5/2018	42.0	1.2	0.0	1.2	44.0	0.0	0.2	49.0	0.0	51.0	47.0	3.0	1.0	46.5
12/6/2018	42.0	1.2	0.0	1.2	43.0	0.0	0.1	50.0	0.0	52.0	44.0	3.0	5.0	46.8
12/7/2018	42.0	1.2	0.0	1.2	42.0	0.0	0.1	50.0	0.0	55.0	46.0	3.0	6.0	47.3
12/8/2018	43.0	1.2	0.0	1.2	42.0	0.0	0.1	50.0	0.0	56.0	45.0	3.0	8.0	47.8
12/9/2018	42.0	1.2	0.0	1.2	42.0	0.0	0.1	50.0	0.0	55.0	48.0	3.0	4.0	47.3
12/10/2018	43.0	1.2	0.0	1.2	42.0	0.0	0.1	49.0	0.0	58.0	39.0	3.0	16.0	48.0
12/11/2018	43.0	1.2	0.0	1.2	43.0	0.0	0.1	53.0	0.0	63.0	39.0	21.0	3.0	50.5
12/12/2018	42.0	1.2	0.0	1.2	44.0	0.0	0.1	53.0	0.0	57.0	27.0	30.0	0.0	49.0
12/13/2018	43.0	1.1	0.0	1.2	44.0	0.0	0.1	52.0	0.0	56.0	26.0	30.0	0.0	48.8
12/14/2018	45.0	1.2	0.0	1.2	43.0	0.0	0.1	52.0	0.0	55.0	25.0	30.0	0.0	48.8
12/15/2018	43.0	1.1	0.0	1.2	43.0	0.0	0.3	52.0	0.0	55.0	25.0	30.0	0.0	48.3
12/16/2018	42.0	1.1	0.0	1.2	44.0	0.0	0.1	51.0	0.0	50.0	38.0	12.0	0.0	46.8
12/17/2018	42.0	1.2	0.0	1.2	44.0	0.0	0.1	51.0	0.0	50.0	47.0	3.0	0.0	46.8
12/18/2018	43.0	1.2	0.0	1.2	44.0	0.0	0.1	52.0	0.0	52.0	47.0	3.0	2.0	47.8
12/19/2018	44.0	1.3	0.0	1.2	44.0	0.0	0.1	52.0	0.0	51.0	46.0	3.0	2.0	47.8
12/20/2018	43.0	1.2	0.0	1.2	44.0	0.0	0.1	52.0	0.0	52.0	46.0	3.0	3.0	47.8
12/21/2018	44.0	1.2	0.0	1.2	44.0	0.0	0.2	52.0	0.0	52.0	46.0	3.0	3.0	48.0
12/22/2018	43.0	1.1	0.0	1.2	44.0	0.0	0.2	52.0	0.0	53.0	47.0	3.0	3.0	48.0
12/23/2018	42.0	1.1	0.0	1.2	43.0	0.0	0.2	52.0	0.0	53.0	47.0	3.0	3.0	47.5
12/24/2018	42.0	1.1	0.0	1.2	42.0	0.0	0.2	52.0	0.0	53.0	47.0	3.0	3.0	47.3
12/25/2018	45.0	1.1	0.0	1.2	42.0	0.0	0.2	53.0	0.0	53.0	47.0	3.0	3.0	48.3
12/26/2018	43.0	1.2	0.0	1.3	42.0	0.0	0.1	51.0	0.0	53.0	47.0	3.0	3.0	47.3
12/27/2018	44.0	1.4	0.0	1.3	42.0	0.0	0.1	52.0	0.0	54.0	47.0	3.0	4.0	48.0
12/28/2018	44.0	1.2	0.0	1.2	40.0	0.0	0.1	52.0	0.0	51.0	47.0	3.0	1.0	46.8
12/29/2018	42.0	1.1	0.0	1.2	40.0	0.0	0.1	50.0	0.0	52.0	47.0	3.0	2.0	46.0
12/30/2018	42.0	1.2	0.0	1.2	40.0	0.0	0.1	50.0	0.0	52.0	47.0	3.0	2.0	46.0
12/31/2018	42.0	1.1	0.0	1.2	40.0	0.0	0.1	52.0	0.0	51.0	47.0	3.0	1.0	46.3
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
1/1/2019	42.0	1.1	0.0	1.3	38.0	0.0	0.2	50.0	0.0	50.0	47.0	3.0	0.0	45.0
1/2/2019	44.0	1.1	0.0	1.3	39.0	0.0	0.2	49.0	0.0	50.0	47.0	3.0	0.0	45.5
1/3/2019	44.0	1.2	0.0	1.2	40.0	0.0	0.1	43.0	0.0	51.0	47.0	3.0	1.0	44.5
1/4/2019	44.0	1.2	0.0	1.2	42.0	0.0	0.1	42.0	0.0	50.0	46.0	3.0	1.0	44.5
1/5/2019	43.0	1.2	0.0	1.2	43.0	0.0	0.1	41.0	0.0	50.0	47.0	3.0	0.0	44.3
1/6/2019	43.0	1.2	0.0	1.2	42.0	0.0	0.1	41.0	0.0	46.0	43.0	3.0	0.0	43.0
1/7/2019	45.0	1.2	0.0	1.2	41.0	0.0	0.1	43.0	0.0	51.0	44.0	3.0	4.0	45.0
1/8/2019	43.0	1.3	0.0	1.1	42.0	0.0	0.1	43.0	0.0	50.0	47.0	3.0	0.0	44.5
1/9/2019	42.0	1.2	0.0	1.1	43.0	0.0	0.1	44.0	0.0	50.0	47.0	3.0	0.0	44.8
1/10/2019	44.0	1.2	0.0	0.9	43.0	0.0	0.2	44.0	0.0	50.0	47.0	3.0	0.0	45.3
1/11/2019	44.0	1.3	0.0	0.9	42.0	0.0	0.2	43.0	0.0	50.0	47.0	3.0	0.0	44.8
1/12/2019	45.0	1.3	0.0	1.0	42.0	0.0	0.2	44.0	0.0	51.0	47.0	3.0	1.0	45.5
1/13/2019	45.0	1.2	0.0	1.1	44.0	0.0	0.1	43.0	0.0	51.0	47.0	3.0	1.0	45.8
1/14/2019	45.0	1.2	0.0	1.1	44.0	0.0	0.1	47.0	0.0	53.0	47.0	3.0	3.0	47.3
1/15/2019	42.0	1.2	0.0	1.2	45.0	0.0	0.1	46.0	0.0	53.0	47.0	3.0	3.0	46.5
1/16/2019	43.0	1.2	0.0	1.2	44.0	0.0	0.1	47.0	0.0	53.0	47.0	3.0	3.0	46.8
1/17/2019	43.0	1.6	0.0	1.4	46.0	0.0	0.2	53.0	0.0	58.0	47.0	3.0	8.0	50.0
1/18/2019	43.0	1.4	0.0	1.4	49.0	0.0	0.1	52.0	0.0	62.0	47.0	3.0	12.0	51.5
1/19/2019	45.0	1.3	0.0	1.4	52.0	0.0	0.1	52.0	0.0	63.0	47.0	3.0	13.0	53.0
1/20/2019	45.0	1.3	0.0	1.3	48.0	0.0	0.2	51.0	0.0	67.0	48.0	3.0	16.0	52.8
1/21/2019	44.0	1.5	0.0	1.3	47.0	0.0	0.1	52.0	0.0	63.0	47.0	3.0	13.0	51.5
1/22/2019	43.0	1.3	0.0	1.3	46.0	0.0	0.1	50.0	0.0	62.0	47.0	3.0	12.0	50.3
1/23/2019	42.0	1.2	0.0	1.2	46.0	0.0	0.2	50.0	0.0	61.0	47.0	3.0	11.0	49.8
1/24/2019	44.0	1.2	0.0	1.1	45.0	0.0	0.2	49.0	0.0	59.0	47.0	3.0	9.0	49.3
1/25/2019	43.0	1.2	0.0	1.0	45.0	0.0	0.2	47.0	0.0	57.0	47.0	3.0	7.0	48.0
1/26/2019	43.0	1.2	0.0	1.1	47.0	0.0	0.2	47.0	0.0	57.0	47.0	3.0	7.0	48.5
1/27/2019	42.0	1.3	0.0	1.3	47.0	0.0	0.1	46.0	0.0	57.0	47.0	3.0	7.0	48.0
1/28/2019	42.0	1.5	0.0	1.4	47.0	0.0	0.1	45.0	0.0	56.0	47.0	3.0	6.0	47.5
1/29/2019	42.0	1.5	0.0	1.4	46.0	0.0	0.1	46.0	0.0	56.0	47.0	3.0	6.0	47.5
1/30/2019	43.0	1.3	0.0	1.4	47.0	0.0	0.1	46.0	0.0	55.0	47.0	3.0	5.0	47.8
1/31/2019	43.0	1.2	0.0	1.3	47.0	0.0	0.1	46.0	0.0	55.0	47.0	3.0	5.0	47.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
2/1/2019	43.0	1.3	0.0	1.2	48.0	0.0	0.1	45.0	0.0	54.0	47.0	3.0	4.0	47.5
2/2/2019	43.0	1.3	0.0	1.3	49.0	0.0	0.1	45.0	0.0	56.0	48.0	3.0	5.0	48.3
2/3/2019	42.0	1.0	0.0	1.3	44.0	0.0	0.1	44.0	0.0	55.0	48.0	3.0	4.0	46.3
2/4/2019	44.0	1.1	0.0	1.3	45.0	0.0	0.4	45.0	0.0	55.0	47.0	3.0	5.0	47.3
2/5/2019	44.0	1.2	0.0	1.3	45.0	0.0	0.2	47.0	0.0	56.0	47.0	3.0	6.0	48.0
2/6/2019	43.0	1.2	0.0	1.3	44.0	0.0	0.3	46.0	0.0	57.0	47.0	3.0	7.0	47.5
2/7/2019	42.0	1.1	0.0	1.3	42.0	0.0	0.3	46.0	0.0	54.0	47.0	3.0	4.0	46.0
2/8/2019	42.0	1.1	0.0	1.2	41.0	0.0	0.2	46.0	0.0	54.0	47.0	3.0	4.0	45.8
2/9/2019	43.0	1.1	0.0	1.2	40.0	0.0	0.2	46.0	0.0	53.0	47.0	3.0	3.0	45.5
2/10/2019	43.0	1.1	0.0	1.2	40.0	0.0	0.2	45.0	0.0	53.0	47.0	3.0	3.0	45.3
2/11/2019	43.0	1.1	0.0	1.2	40.0	0.0	0.2	44.0	0.0	54.0	47.0	3.0	4.0	45.3
2/12/2019	42.0	1.1	0.0	1.1	39.0	0.0	0.2	43.0	0.0	54.0	47.0	3.0	4.0	44.5
2/13/2019	44.0	1.3	0.0	1.0	39.0	0.0	0.1	44.0	0.0	56.0	48.0	3.0	5.0	45.8
2/14/2019	43.0	1.5	0.0	1.2	41.0	0.0	0.1	45.0	0.0	57.0	48.0	3.0	6.0	46.5
2/15/2019	43.0	1.5	0.0	1.4	44.0	0.0	0.1	45.0	0.0	56.0	47.0	3.0	6.0	47.0
2/16/2019	43.0	1.4	0.0	1.4	46.0	0.0	0.1	45.0	0.0	57.0	47.0	3.0	7.0	47.8
2/17/2019	43.0	1.3	0.0	1.4	43.0	0.0	0.2	44.0	0.0	60.0	47.0	3.0	10.0	47.5
2/18/2019	42.0	1.3	0.0	1.3	41.0	0.0	0.2	47.0	0.0	58.0	47.0	3.0	8.0	47.0
2/19/2019	42.0	1.3	0.0	1.3	40.0	0.0	0.2	46.0	0.0	57.0	47.0	3.0	7.0	46.3
2/20/2019	43.0	1.2	0.0	1.3	43.0	0.0	0.2	46.0	0.0	56.0	47.0	3.0	6.0	47.0
2/21/2019	43.0	1.2	0.0	1.3	42.0	0.0	0.2	46.0	0.0	54.0	47.0	3.0	4.0	46.3
2/22/2019	43.0	1.5	0.0	1.3	43.0	0.0	0.1	45.0	0.0	55.0	47.0	3.0	5.0	46.5
2/23/2019	42.0	1.5	0.0	1.3	43.0	0.0	0.2	42.0	0.0	54.0	47.0	3.0	4.0	45.3
2/24/2019	44.0	1.4	0.0	1.2	42.0	0.0	0.1	43.0	0.0	54.0	47.0	3.0	4.0	45.8
2/25/2019	44.0	1.2	0.0	1.2	47.0	0.0	0.1	48.0	0.0	54.0	47.0	3.0	4.0	48.3
2/26/2019	44.0	1.2	0.0	1.2	48.0	0.0	0.1	46.0	0.0	54.0	47.0	3.0	4.0	48.0
2/27/2019	44.0	1.2	0.0	1.3	48.0	0.0	0.1	47.0	0.0	52.0	47.0	3.0	2.0	47.8
2/28/2019	43.0	1.2	0.0	1.1	47.0	0.0	0.8	49.0	0.0	52.0	47.0	3.0	2.0	47.8
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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
3/1/2019	43.0	1.3	0.0	1.2	47.0	0.0	0.3	49.0	0.0	53.0	47.0	4.0	2.0	48.0
3/2/2019	43.0	1.3	0.0	1.2	46.0	0.0	0.2	49.0	0.0	52.0	47.0	4.0	1.0	47.5
3/3/2019	42.0	1.3	0.0	1.2	47.0	0.0	0.2	50.0	0.0	50.0	45.0	4.0	1.0	47.3
3/4/2019	43.0	1.3	0.0	1.5	48.0	0.0	0.2	49.0	0.0	52.0	47.0	4.0	1.0	48.0
3/5/2019	44.0	1.3	0.0	1.5	47.0	0.0	0.2	49.0	0.0	54.0	47.0	4.0	3.0	48.5
3/6/2019	43.0	1.9	0.0	1.7	52.0	0.0	0.4	64.0	0.0	58.0	47.0	4.0	7.0	54.3
3/7/2019	43.0	1.6	0.0	1.6	58.0	0.0	0.6	57.0	0.0	59.0	47.0	4.0	8.0	54.3
3/8/2019	43.0	1.6	0.0	1.4	59.0	0.0	0.3	59.0	0.0	69.0	47.0	4.0	18.0	57.5
3/9/2019	44.0	1.5	0.0	1.4	53.0	0.0	0.2	57.0	0.0	72.0	47.0	4.0	21.0	56.5
3/10/2019	45.0	1.2	0.0	1.5	51.0	0.0	0.2	58.0	0.0	71.0	48.0	4.0	19.0	56.3
3/11/2019	46.0	1.2	0.0	1.5	50.0	0.0	0.3	60.0	0.0	65.0	47.0	4.0	14.0	55.3
3/12/2019	46.0	1.5	0.0	1.5	49.0	0.0	0.3	58.0	0.0	61.0	47.0	4.0	10.0	53.5
3/13/2019	46.0	1.3	0.0	1.4	48.0	0.0	0.6	56.0	0.0	59.0	47.0	4.0	8.0	52.3
3/14/2019	45.0	1.2	0.0	1.2	47.0	0.0	1.1	53.0	0.0	60.0	47.0	4.0	9.0	51.3
3/15/2019	46.0	1.3	0.0	1.2	48.0	0.0	0.7	53.0	0.0	60.0	47.0	4.0	9.0	51.8
3/16/2019	46.0	1.4	0.0	1.3	47.0	0.0	0.4	52.0	0.0	58.0	47.0	4.0	7.0	50.8
3/17/2019	46.0	1.4	0.0	1.1	48.0	0.0	0.3	50.0	0.0	56.0	47.0	4.0	5.0	50.0
3/18/2019	46.0	1.3	0.0	1.2	48.0	0.0	0.3	50.0	0.0	56.0	47.0	4.0	5.0	50.0
3/19/2019	46.0	1.1	0.0	1.2	48.0	0.0	0.4	50.0	0.0	56.0	47.0	4.0	5.0	50.0
3/20/2019	46.0	0.9	0.0	1.2	48.0	0.0	1.0	50.0	0.0	55.0	47.0	4.0	4.0	49.8
3/21/2019	46.0	0.8	0.0	1.2	48.0	0.0	0.7	51.0	0.0	55.0	47.0	4.0	4.0	50.0
3/22/2019	46.0	1.1	0.0	1.0	48.0	0.0	0.5	50.0	0.0	53.0	46.0	4.0	3.0	49.3
3/23/2019	47.0	1.0	0.0	1.1	48.0	0.0	0.5	51.0	0.0	54.0	46.0	4.0	4.0	50.0
3/24/2019	47.0	0.9	0.0	1.3	48.0	0.0	0.3	50.0	0.0	54.0	47.0	4.0	3.0	49.8
3/25/2019	46.0	1.1	0.0	1.3	47.0	0.0	0.3	49.0	0.0	53.0	46.0	4.0	3.0	48.8
3/26/2019	46.0	1.3	0.0	1.2	48.0	0.0	0.3	48.0	0.0	53.0	47.0	4.0	2.0	48.8
3/27/2019	46.0	1.2	0.0	1.2	47.0	0.0	0.5	47.0	0.0	53.0	47.0	4.0	2.0	48.3
3/28/2019	46.0	1.1	0.0	1.2	46.0	0.0	0.5	50.0	0.0	51.0	46.0	4.0	1.0	48.3
3/29/2019	46.0	1.2	0.0	1.1	47.0	0.0	0.4	49.0	0.0	51.0	46.0	4.0	1.0	48.3
3/30/2019	46.0	1.4	0.0	1.1	46.0	0.0	0.3	49.0	0.0	52.0	47.0	4.0	1.0	48.3
3/31/2019	46.0	1.3	0.0	1.2	44.0	0.0	0.7	49.0	0.0	52.0	47.0	4.0	1.0	47.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
4/1/2019	46.0	1.1	0.0	1.2	45.0	0.0	0.6	48.0	0.0	52.0	47.0	4.0	1.0	47.8
4/2/2019	46.0	1.2	0.0	1.1	45.0	0.0	0.5	49.0	0.0	51.0	47.0	4.0	0.0	47.8
4/3/2019	45.0	1.3	0.0	1.0	45.0	0.0	0.4	47.0	0.0	52.0	47.0	4.0	1.0	47.3
4/4/2019	46.0	1.1	0.0	0.9	45.0	0.0	0.3	45.0	0.0	51.0	46.0	4.0	1.0	46.8
4/5/2019	46.0	0.9	0.0	1.2	45.0	0.0	0.3	46.0	0.0	52.0	47.0	4.0	1.0	47.3
4/6/2019	46.0	0.9	0.0	1.2	45.0	0.0	0.3	47.0	0.0	51.0	47.0	4.0	0.0	47.3
4/7/2019	46.0	1.3	0.0	1.2	45.0	0.0	0.3	46.0	0.0	51.0	47.0	4.0	0.0	47.0
4/8/2019	46.0	1.3	0.0	1.1	47.0	0.0	0.3	46.0	0.0	51.0	47.0	4.0	0.0	47.5
4/9/2019	47.0	1.1	0.0	1.0	46.0	0.0	0.4	48.0	0.0	51.0	47.0	4.0	0.0	48.0
4/10/2019	47.0	1.2	0.0	1.2	45.0	0.0	0.3	48.0	0.0	48.0	44.0	4.0	0.0	47.0
4/11/2019	47.0	1.2	0.0	1.3	46.0	0.0	0.4	48.0	0.0	48.0	44.0	4.0	0.0	47.3
4/12/2019	46.0	1.2	0.0	1.2	46.0	0.0	0.4	48.0	0.0	47.0	43.0	4.0	0.0	46.8
4/13/2019	46.0	1.2	0.0	1.1	47.0	0.0	0.3	47.0	0.0	47.0	43.0	4.0	0.0	46.8
4/14/2019	46.0	1.2	0.0	1.1	46.0	0.0	0.3	47.0	0.0	48.0	44.0	4.0	0.0	46.8
4/15/2019	46.0	1.2	0.0	1.2	47.0	0.0	0.3	47.0	0.0	47.0	43.0	4.0	0.0	46.8
4/16/2019	46.0	1.2	0.0	1.3	47.0	0.0	0.4	48.0	0.0	48.0	44.0	4.0	0.0	47.3
4/17/2019	46.0	1.2	0.0	1.4	46.0	0.0	0.2	48.0	0.0	48.0	44.0	4.0	0.0	47.0
4/18/2019	46.0	1.2	0.0	1.4	47.0	0.0	0.4	47.0	0.0	48.0	44.0	4.0	0.0	47.0
4/19/2019	47.0	1.2	0.0	1.4	47.0	0.0	0.2	47.0	0.0	48.0	44.0	4.0	0.0	47.3
4/20/2019	46.0	1.1	0.0	1.3	47.0	0.0	0.3	48.0	0.0	47.0	43.0	4.0	0.0	47.0
4/21/2019	46.0	1.0	0.0	1.2	47.0	0.0	0.2	49.0	0.0	47.0	43.0	4.0	0.0	47.3
4/22/2019	46.0	1.0	0.0	1.2	46.0	0.0	0.2	48.0	0.0	47.0	43.0	4.0	0.0	46.8
4/23/2019	46.0	1.1	0.0	1.3	41.0	0.0	0.3	45.0	0.0	46.0	42.0	4.0	0.0	44.5
4/24/2019	48.0	1.2	0.0	1.5	41.0	0.0	0.3	44.0	0.0	46.0	42.0	4.0	0.0	44.8
4/25/2019	50.0	1.1	0.0	1.6	42.0	0.0	0.2	43.0	0.0	43.0	37.0	4.0	2.0	44.5
4/26/2019	55.0	1.1	0.0	1.6	44.0	0.0	0.2	43.0	0.0	48.0	44.0	4.0	0.0	47.5
4/27/2019	56.0	1.1	0.0	1.6	46.0	0.0	0.2	43.0	0.0	45.0	41.0	4.0	0.0	47.5
4/28/2019	56.0	1.2	0.0	1.5	48.0	0.0	0.3	44.0	0.0	45.0	41.0	4.0	0.0	48.3
4/29/2019	56.0	1.2	0.0	1.4	51.0	0.0	0.3	44.0	0.0	45.0	41.0	4.0	0.0	49.0
4/30/2019	56.0	1.2	0.0	1.3	50.0	0.0	0.3	46.0	0.0	45.0	41.0	4.0	0.0	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
5/1/2019	55.0	0.9	0.0	1.3	50.0	0.0	0.3	48.0	0.0	44.0	38.0	6.0	0.0	49.3
5/2/2019	56.0	1.1	0.0	1.3	50.0	0.0	1.3	50.0	0.0	45.0	37.0	8.0	0.0	50.3
5/3/2019	56.0	1.1	0.0	1.3	50.0	0.0	0.2	50.0	0.0	45.0	37.0	8.0	0.0	50.3
5/4/2019	56.0	1.1	0.0	1.3	50.0	0.0	0.2	50.0	0.0	45.0	38.0	7.0	0.0	50.3
5/5/2019	56.0	1.0	0.0	1.3	50.0	0.0	0.2	49.0	0.0	46.0	39.0	7.0	0.0	50.3
5/6/2019	56.0	1.0	0.0	1.3	50.0	0.0	0.2	49.0	0.0	47.0	39.0	8.0	0.0	50.5
5/7/2019	56.0	1.3	0.0	1.3	50.0	0.0	0.4	50.0	0.0	48.0	40.0	8.0	0.0	51.0
5/8/2019	49.0	1.1	0.0	1.3	50.0	0.0	0.2	51.0	0.0	47.0	40.0	7.0	0.0	49.3
5/9/2019	49.0	1.0	0.0	1.3	50.0	0.0	0.2	51.0	0.0	48.0	40.0	8.0	0.0	49.5
5/10/2019	60.0	1.1	0.0	1.3	49.0	0.0	0.3	55.0	0.0	50.0	43.0	7.0	0.0	53.5
5/11/2019	77.0	1.1	0.0	1.3	47.0	0.0	0.3	54.0	0.0	53.0	45.0	8.0	0.0	57.8
5/12/2019	93.0	1.1	0.0	1.3	50.0	0.0	0.3	54.0	0.0	55.0	47.0	8.0	0.0	63.0
5/13/2019	120.0	1.1	0.0	1.2	56.0	0.0	0.2	53.0	0.0	58.0	47.0	8.0	3.0	71.8
5/14/2019	152.0	1.2	0.0	1.2	65.0	0.0	0.2	50.0	0.0	56.0	47.0	8.0	1.0	80.8
5/15/2019	190.0	1.7	0.0	1.1	76.0	0.0	0.5	49.0	0.0	55.0	47.0	8.0	0.0	92.5
5/16/2019	180.0	3.8	0.0	1.0	88.0	0.0	0.4	53.0	0.0	51.0	44.0	7.0	0.0	93.0
5/17/2019	141.0	2.6	0.0	1.0	105.0	3.7	1.7	59.0	0.0	49.0	41.0	8.0	0.0	88.5
5/18/2019	109.0	1.3	0.0	1.1	128.0	6.7	4.7	68.0	0.0	49.0	41.0	8.0	0.0	88.5
5/19/2019	88.0	1.3	0.0	1.1	141.0	5.8	5.2	82.0	0.0	49.0	42.0	7.0	0.0	90.0
5/20/2019	71.0	1.2	0.0	1.2	139.0	5.3	5.3	94.0	0.0	50.0	43.0	7.0	0.0	88.5
5/21/2019	59.0	1.2	0.0	1.2	123.0	5.4	5.8	107.0	0.0	54.0	46.0	8.0	0.0	85.8
5/22/2019	48.0	1.1	0.0	1.2	101.0	5.3	5.8	116.0	0.0	56.0	47.0	8.0	1.0	80.3
5/23/2019	46.0	1.2	0.0	1.2	81.0	5.4	5.0	125.0	0.0	67.0	47.0	8.0	12.0	79.8
5/24/2019	45.0	1.1	0.0	1.2	67.0	5.5	5.7	120.0	0.0	74.0	48.0	8.0	18.0	76.5
5/25/2019	58.0	1.0	0.0	1.2	59.0	5.6	6.2	107.0	0.0	90.0	47.0	8.0	35.0	78.5
5/26/2019	65.0	1.2	0.0	1.1	54.0	5.1	5.8	97.0	0.0	98.0	47.0	8.0	43.0	78.5
5/27/2019	65.0	1.2	0.0	1.1	56.0	2.5	3.4	89.0	0.0	107.0	47.0	7.0	53.0	79.3
5/28/2019	65.0	1.1	0.0	1.3	62.0	0.4	0.3	74.0	0.0	111.0	47.0	8.0	56.0	78.0
5/29/2019	66.0	1.1	0.0	1.2	64.0	0.4	0.2	63.0	0.0	107.0	47.0	7.0	53.0	75.0
5/30/2019	66.0	1.0	0.0	1.2	63.0	0.3	0.2	57.0	0.0	99.0	47.0	8.0	44.0	71.3
5/31/2019	64.0	1.0	0.0	1.1	63.0	0.3	0.2	59.0	0.0	89.0	47.0	8.0	34.0	68.8
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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
6/1/2019	58.0	1.1	0.0	1.1	63.0	0.2	0.4	61.0	0.0	68.0	47.0	8.0	13.0	62.5
6/2/2019	62.0	1.2	0.0	1.1	61.0	0.5	1.1	62.0	0.0	63.0	48.0	8.0	7.0	62.0
6/3/2019	66.0	1.3	0.0	1.1	58.0	0.5	0.2	62.0	0.0	57.0	47.0	7.0	3.0	60.8
6/4/2019	66.0	1.2	0.0	1.1	58.0	0.3	1.3	62.0	0.0	56.0	47.0	8.0	1.0	60.5
6/5/2019	66.0	1.1	0.0	1.1	60.0	0.4	0.4	61.0	0.0	56.0	47.0	8.0	1.0	60.8
6/6/2019	66.0	1.1	0.0	1.0	60.0	0.4	0.6	59.0	0.0	55.0	47.0	7.0	1.0	60.0
6/7/2019	65.0	1.2	0.0	1.0	60.0	0.3	0.2	57.0	0.0	54.0	47.0	7.0	0.0	59.0
6/8/2019	66.0	1.2	0.0	1.0	59.0	0.3	0.7	57.0	0.0	55.0	47.0	8.0	0.0	59.3
6/9/2019	66.0	1.1	0.0	1.0	59.0	0.2	0.2	56.0	0.0	50.0	43.0	7.0	0.0	57.8
6/10/2019	66.0	1.1	0.0	1.0	58.0	0.2	0.8	55.0	0.0	49.0	41.0	8.0	0.0	57.0
6/11/2019	66.0	1.2	0.0	1.1	58.0	0.2	0.4	55.0	0.0	47.0	39.0	8.0	0.0	56.5
6/12/2019	71.0	1.2	0.0	1.2	58.0	0.1	0.3	54.0	0.0	46.0	38.0	8.0	0.0	57.3
6/13/2019	77.0	1.1	0.0	1.3	58.0	0.1	0.2	54.0	0.0	45.0	37.0	8.0	0.0	58.5
6/14/2019	76.0	1.0	0.0	1.4	59.0	0.0	0.5	53.0	0.0	44.0	36.0	8.0	0.0	58.0
6/15/2019	76.0	0.9	0.0	1.4	64.0	0.0	1.4	53.0	0.0	43.0	35.0	8.0	0.0	59.0
6/16/2019	76.0	1.3	0.0	1.4	67.0	0.0	2.1	54.0	0.0	42.0	34.0	8.0	0.0	59.8
6/17/2019	80.0	1.2	0.0	1.3	68.0	0.0	2.1	55.0	0.0	40.0	22.0	8.0	10.0	60.8
6/18/2019	92.0	0.7	0.0	1.1	66.0	0.0	1.6	54.0	0.0	38.0	0.0	8.0	30.0	62.5
6/19/2019	92.0	1.2	0.0	1.1	66.0	0.0	0.9	56.0	0.0	40.0	0.0	8.0	32.0	63.5
6/20/2019	92.0	1.7	0.0	1.0	69.0	0.0	0.2	58.0	0.0	42.0	0.0	7.0	35.0	65.3
6/21/2019	95.0	2.6	0.0	1.1	73.0	0.0	0.3	57.0	0.0	40.0	0.0	8.0	32.0	66.3
6/22/2019	98.0	2.6	0.0	1.1	76.0	0.0	0.3	58.0	0.0	40.0	0.0	7.0	33.0	68.0
6/23/2019	99.0	2.5	0.0	1.1	78.0	0.0	0.3	58.0	0.0	41.0	0.0	8.0	33.0	69.0
6/24/2019	99.0	2.5	0.0	1.1	82.0	0.0	0.4	61.0	0.0	41.0	0.0	8.0	33.0	70.8
6/25/2019	99.0	2.5	0.0	1.1	85.0	0.0	0.4	64.0	0.0	42.0	0.0	8.0	34.0	72.5
6/26/2019	98.0	2.6	0.0	1.0	87.0	0.0	0.4	67.0	0.0	42.0	0.0	8.0	34.0	73.5
6/27/2019	98.0	2.7	0.0	1.0	88.0	0.0	0.4	69.0	0.0	42.0	0.0	8.0	34.0	74.3
6/28/2019	98.0	2.8	0.0	0.9	89.0	0.5	0.4	71.0	0.0	44.0	0.0	8.0	36.0	75.5
6/29/2019	99.0	3.0	0.0	1.1	90.0	0.0	0.4	73.0	0.0	45.0	0.0	8.0	37.0	76.8
6/30/2019	99.0	2.3	0.0	1.4	92.0	0.0	0.3	76.0	0.0	47.0	23.0	8.0	16.0	78.5

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
7/1/2019	98.0	1.2	0.0	1.5	94.0	0.4	0.4	78.0	0.0	50.0	42.0	8.0	0.0	80.0
7/2/2019	98.0	1.0	0.0	1.5	94.0	0.3	0.5	78.0	0.0	51.0	43.0	8.0	0.0	80.3
7/3/2019	98.0	1.3	0.0	1.4	91.0	0.0	0.6	79.0	0.0	53.0	46.0	7.0	0.0	80.3
7/4/2019	98.0	1.5	0.0	1.3	89.0	0.0	0.6	80.0	0.0	55.0	47.0	8.0	0.0	80.5
7/5/2019	97.0	1.5	0.0	1.2	87.0	0.0	0.6	80.0	0.0	55.0	47.0	8.0	0.0	79.8
7/6/2019	99.0	1.5	0.0	1.1	87.0	0.0	0.6	80.0	0.0	57.0	47.0	8.0	2.0	80.8
7/7/2019	98.0	1.6	0.0	1.3	88.0	0.0	0.6	80.0	0.0	60.0	47.0	8.0	5.0	81.5
7/8/2019	98.0	1.6	0.0	1.2	89.0	0.0	0.7	79.0	0.0	60.0	47.0	7.0	6.0	81.5
7/9/2019	94.0	1.5	0.0	1.1	90.0	0.0	0.6	78.0	0.0	62.0	47.0	8.0	7.0	81.0
7/10/2019	91.0	1.3	0.0	1.0	90.0	0.0	0.6	78.0	0.0	62.0	47.0	8.0	7.0	80.3
7/11/2019	91.0	1.2	0.0	0.9	89.0	0.0	0.6	78.0	0.0	62.0	47.0	7.0	8.0	80.0
7/12/2019	91.0	0.7	0.0	0.9	86.0	0.0	0.6	79.0	0.0	61.0	47.0	7.0	7.0	79.3
7/13/2019	91.0	0.8	0.0	0.9	81.0	0.0	0.5	79.0	0.0	61.0	47.0	8.0	6.0	78.0
7/14/2019	92.0	1.3	0.0	1.0	80.0	0.0	0.5	79.0	0.0	60.0	47.0	8.0	5.0	77.8
7/15/2019	92.0	1.5	0.0	1.0	79.0	0.0	0.5	78.0	0.0	59.0	47.0	7.0	5.0	77.0
7/16/2019	91.0	1.9	0.0	1.0	80.0	0.0	0.5	76.0	0.0	60.0	47.0	8.0	5.0	76.8
7/17/2019	91.0	2.2	0.0	1.0	80.0	0.0	0.9	72.0	0.0	61.0	47.0	8.0	6.0	76.0
7/18/2019	91.0	1.7	0.0	0.9	81.0	0.0	1.1	71.0	0.0	61.0	47.0	8.0	6.0	76.0
7/19/2019	91.0	1.4	0.0	1.0	80.0	0.0	1.2	70.0	0.0	60.0	47.0	7.0	6.0	75.3
7/20/2019	91.0	1.4	0.0	1.1	81.0	0.0	1.0	71.0	0.0	59.0	47.0	7.0	5.0	75.5
7/21/2019	91.0	1.1	0.0	1.1	81.0	0.0	0.7	70.0	0.0	57.0	47.0	7.0	3.0	74.8
7/22/2019	92.0	1.0	0.0	1.0	80.0	0.0	0.6	70.0	0.0	56.0	47.0	8.0	1.0	74.5
7/23/2019	92.0	1.2	0.0	0.9	80.0	0.0	0.5	71.0	0.0	56.0	47.0	8.0	1.0	74.8
7/24/2019	91.0	1.2	0.0	0.9	81.0	0.0	0.4	71.0	0.0	54.0	47.0	7.0	0.0	74.3
7/25/2019	91.0	1.2	0.0	0.9	82.0	0.0	0.4	72.0	0.0	55.0	47.0	8.0	0.0	75.0
7/26/2019	92.0	1.1	0.0	1.0	82.0	0.0	0.3	74.0	0.0	57.0	47.0	8.0	2.0	76.3
7/27/2019	91.0	1.1	0.0	1.0	82.0	0.0	0.3	74.0	0.0	59.0	47.0	8.0	4.0	76.5
7/28/2019	91.0	1.0	0.0	1.1	82.0	0.0	0.2	73.0	0.0	58.0	47.0	7.0	4.0	76.0
7/29/2019	91.0	0.9	0.0	1.1	81.0	0.0	0.3	74.0	0.0	58.0	47.0	7.0	4.0	76.0
7/30/2019	92.0	0.9	0.0	1.1	81.0	0.0	0.4	72.0	0.0	58.0	47.0	8.0	3.0	75.8
7/31/2019	85.0	0.9	0.0	1.0	80.0	0.0	0.4	72.0	0.0	57.0	47.0	8.0	2.0	73.5
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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
8/1/2019	83.0	1.0	0.0	0.9	81.0	0.0	0.3	70.0	0.0	55.0	47.0	7.0	1.0	72.3
8/2/2019	84.0	1.0	0.0	0.8	81.0	0.0	0.3	70.0	0.0	55.0	47.0	8.0	0.0	72.5
8/3/2019	83.0	1.1	0.0	0.9	78.0	0.0	0.3	70.0	0.0	54.0	47.0	7.0	0.0	71.3
8/4/2019	83.0	1.0	0.0	0.9	76.0	0.0	0.3	70.0	0.0	53.0	45.0	8.0	0.0	70.5
8/5/2019	83.0	1.1	0.0	0.8	76.0	0.0	0.3	69.0	0.0	53.0	45.0	8.0	0.0	70.3
8/6/2019	84.0	1.2	0.0	0.8	75.0	0.0	0.3	69.0	0.0	53.0	45.0	8.0	0.0	70.3
8/7/2019	84.0	1.2	0.0	1.0	75.0	0.0	0.3	68.0	0.0	53.0	45.0	8.0	0.0	70.0
8/8/2019	84.0	1.2	0.0	1.1	75.0	0.0	0.2	67.0	0.0	53.0	45.0	8.0	0.0	69.8
8/9/2019	84.0	1.1	0.0	1.1	76.0	0.0	0.1	65.0	0.0	54.0	46.0	8.0	0.0	69.8
8/10/2019	83.0	0.9	0.0	1.1	76.0	0.0	0.1	65.0	0.0	53.0	46.0	7.0	0.0	69.3
8/11/2019	84.0	0.9	0.0	1.0	76.0	0.0	0.1	66.0	0.0	51.0	44.0	7.0	0.0	69.3
8/12/2019	83.0	1.1	0.0	1.0	76.0	0.0	0.1	66.0	0.0	49.0	24.0	8.0	17.0	68.5
8/13/2019	82.0	1.1	0.0	0.9	75.0	0.0	0.1	66.0	0.0	50.0	0.0	8.0	42.0	68.3
8/14/2019	80.0	1.0	0.0	1.0	74.0	0.0	0.1	66.0	0.0	50.0	0.0	8.0	42.0	67.5
8/15/2019	80.0	0.9	0.0	1.1	74.0	0.0	0.1	66.0	0.0	47.0	15.0	7.0	25.0	66.8
8/16/2019	80.0	1.0	0.0	1.1	72.0	0.0	0.1	66.0	0.0	53.0	46.0	7.0	0.0	67.8
8/17/2019	80.0	1.2	0.0	1.2	71.0	0.0	0.1	65.0	0.0	50.0	43.0	7.0	0.0	66.5
8/18/2019	80.0	1.2	0.0	1.2	70.0	0.0	0.1	64.0	0.0	51.0	43.0	8.0	0.0	66.3
8/19/2019	80.0	1.1	0.0	1.2	70.0	0.0	0.1	64.0	0.0	50.0	43.0	7.0	0.0	66.0
8/20/2019	80.0	1.1	0.0	1.2	70.0	0.0	0.1	63.0	0.0	51.0	43.0	8.0	0.0	66.0
8/21/2019	80.0	1.1	0.0	1.3	70.0	0.0	0.1	62.0	0.0	48.0	42.0	6.0	0.0	65.0
8/22/2019	80.0	1.1	0.0	1.3	70.0	0.0	0.1	62.0	0.0	49.0	42.0	7.0	0.0	65.3
8/23/2019	80.0	1.1	0.0	1.3	69.0	0.0	0.1	61.0	0.0	50.0	42.0	8.0	0.0	65.0
8/24/2019	80.0	1.1	0.0	1.2	69.0	0.0	0.1	61.0	0.0	48.0	41.0	7.0	0.0	64.5
8/25/2019	80.0	1.1	0.0	1.2	69.0	0.0	0.1	61.0	0.0	48.0	41.0	7.0	0.0	64.5
8/26/2019	80.0	1.1	0.0	1.2	69.0	0.0	0.1	62.0	0.0	49.0	41.0	8.0	0.0	65.0
8/27/2019	80.0	1.0	0.0	1.2	70.0	0.0	0.1	62.0	0.0	49.0	41.0	8.0	0.0	65.3
8/28/2019	80.0	1.1	0.0	1.2	70.0	0.0	0.1	60.0	0.0	49.0	41.0	8.0	0.0	64.8
8/29/2019	80.0	1.1	0.0	1.1	69.0	0.0	0.1	61.0	0.0	48.0	41.0	7.0	0.0	64.5
8/30/2019	80.0	1.1	0.0	1.1	70.0	0.0	0.1	61.0	0.0	48.0	41.0	7.0	0.0	64.8
8/31/2019	80.0	1.0	0.0	1.0	70.0	0.0	0.1	62.0	0.0	48.0	40.0	8.0	0.0	65.0
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
9/1/2019	80.0	1.0	0.0	1.0	70.0	0.0	0.1	61.0	0.0	48.0	40.0	8.0	0.0	64.8
9/2/2019	80.0	1.1	0.0	1.0	70.0	0.0	0.1	61.0	0.0	49.0	41.0	8.0	0.0	65.0
9/3/2019	80.0	1.1	0.0	1.1	71.0	0.0	0.1	63.0	0.0	38.0	19.0	11.0	8.0	63.0
9/4/2019	80.0	1.1	0.0	1.1	72.0	0.0	0.1	63.0	0.0	50.0	0.0	25.0	25.0	66.3
9/5/2019	70.0	1.4	0.0	1.2	72.0	0.0	0.1	64.0	0.0	53.0	0.0	25.0	28.0	64.8
9/6/2019	66.0	1.5	0.0	1.3	72.0	0.0	0.1	64.0	0.0	53.0	0.0	25.0	28.0	63.8
9/7/2019	66.0	1.0	0.0	1.3	70.0	0.0	0.1	64.0	0.0	54.0	0.0	25.0	29.0	63.5
9/8/2019	66.0	1.0	0.0	1.3	65.0	0.0	0.1	65.0	0.0	53.0	0.0	25.0	28.0	62.3
9/9/2019	66.0	0.9	0.0	1.2	61.0	0.0	0.1	64.0	0.0	56.0	0.0	26.0	30.0	61.8
9/10/2019	65.0	0.9	0.0	1.3	59.0	0.0	0.1	63.0	0.0	52.0	0.0	25.0	27.0	59.8
9/11/2019	66.0	0.9	0.0	1.2	59.0	0.0	0.1	65.0	0.0	53.0	0.0	25.0	28.0	60.8
9/12/2019	66.0	0.9	0.0	1.2	59.0	0.0	0.1	61.0	0.0	54.0	0.0	25.0	29.0	60.0
9/13/2019	66.0	1.0	0.0	1.2	59.0	0.0	0.1	59.0	0.0	52.0	0.0	16.0	36.0	59.0
9/14/2019	66.0	1.0	0.0	1.3	59.0	0.0	0.1	57.0	0.0	51.0	4.0	7.0	40.0	58.3
9/15/2019	65.0	1.1	0.0	1.3	59.0	0.0	0.1	56.0	0.0	56.0	48.0	7.0	1.0	59.0
9/16/2019	66.0	1.0	0.0	1.2	59.0	0.0	0.1	56.0	0.0	51.0	44.0	7.0	0.0	58.0
9/17/2019	65.0	1.0	0.0	1.1	58.0	0.0	0.1	56.0	0.0	48.0	41.0	7.0	0.0	56.8
9/18/2019	65.0	0.9	0.0	1.3	58.0	0.0	0.1	56.0	0.0	46.0	39.0	7.0	0.0	56.3
9/19/2019	65.0	1.1	0.0	1.3	58.0	0.0	0.1	56.0	0.0	45.0	38.0	7.0	0.0	56.0
9/20/2019	65.0	1.1	0.0	1.3	57.0	0.0	0.1	57.0	0.0	45.0	38.0	7.0	0.0	56.0
9/21/2019	64.0	1.2	0.0	1.3	58.0	0.0	0.1	56.0	0.0	46.0	38.0	8.0	0.0	56.0
9/22/2019	59.0	0.8	0.0	1.2	57.0	0.0	0.1	56.0	0.0	46.0	38.0	8.0	0.0	54.5
9/23/2019	59.0	0.8	0.0	1.3	57.0	0.0	0.1	57.0	0.0	46.0	38.0	8.0	0.0	54.8
9/24/2019	59.0	1.0	0.0	1.2	55.0	0.0	0.1	57.0	0.0	46.0	38.0	8.0	0.0	54.3
9/25/2019	59.0	1.1	0.0	1.0	53.0	0.0	0.1	57.0	0.0	45.0	37.0	8.0	0.0	53.5
9/26/2019	59.0	1.0	0.0	0.9	53.0	0.0	0.1	55.0	0.0	46.0	38.0	8.0	0.0	53.3
9/27/2019	59.0	1.1	0.0	0.8	53.0	0.0	0.1	54.0	0.0	45.0	38.0	7.0	0.0	52.8
9/28/2019	59.0	1.0	0.0	0.8	53.0	0.0	0.1	54.0	0.0	46.0	38.0	8.0	0.0	53.0
9/29/2019	59.0	1.4	0.0	0.9	52.0	0.0	0.1	53.0	0.0	46.0	38.0	8.0	0.0	52.5
9/30/2019	59.0	1.3	0.0	1.0	52.0	0.0	0.1	52.0	0.0	48.0	31.0	7.0	10.0	52.8

Notes: These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.

3.0 LAND MANAGEMENT

3.1 Land Management Summary

The 2019 Lower Owens River Project (LORP) land management monitoring efforts continued with monitoring utilization across all leases and range trend monitoring on the Blackrock and Delta leases inside the LORP management area.

Utilization estimates were conducted on all leases in 2018-19. Pasture utilization within the LORP was within the allowable levels of use established for both riparian (up to 40%) and upland (up to 65%) areas. Valley-floor precipitation was above average during the winter with water spreading activities being conducted throughout the LORP project area, resulting in good forage production in the uplands - especially in the Blackrock area. 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 2019. Pastures that scored below 80% in 2019 will be revisited in the summer of 2020. Irrigated pasture scores from 2011-2019 are provided in Land Management Appendix 2 for reference.

3.2 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 that were developed for the ranch leases within the LORP modified the grazing practices in riparian and upland areas on seven LADWP leases in order to facilitate reaching 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 2019 are presented by lease below.

3.3 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.

3.3.1 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 not hinder 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.

3.3.2 Utilization Monitoring

Monitoring methodologies are fully described in Section 4.6.2 of the MAMP (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 2019 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).

3.4 Range Trend

3.4.1 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 (LADWP, 2011). Nested frequency and shrub cover data collected in 2019 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 2019 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 2019 results were compared to all sampling events during the baseline period to determine if results in 2019 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 range of ecological conditions for these sites, which contributed to a robust baseline dataset bracketed by both dry and wet conditions. 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

3.4.2 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%, the pasture is evaluated again in the following year and/or changes to pasture management are implemented.

All irrigated pastures in the LORP management area were evaluated in 2019. Pastures that scored below 80% in 2019 will be revisited in the summer of 2020. Irrigated pasture scores from 2011-2019 are provided in Land Management Appendix 2 for reference.

3.4.3 Fencing

No new fence construction occurred in 2019, just general maintenance and repairs.

3.4.4 Discussion of Range Trend

Range Trend transects on the Blackrock and Delta Leases were read in August, 2019. With the exception of five transects along Reach 2 of the LORP which were read in 2018, all the remaining Blackrock Lease transects were last read in 2016. As expected, in response to the high precipitation levels in 2019, the Saline Meadow sites responded positively. Bassia also responded favorably to the wetter than usual winter and spring. (Land Management Table 2). On the Delta Lease, DISP significantly increased on three of the five transects.

Land Management Table 2. Significant changes in percent frequency between 2016 and 2019 Plant Frequencies (p=0.1) on Moist Floodplain Sites, Blackrock Lease.

MOIST FLOODPLAIN					
	No Change	**DISP**	**BAHY**	**LETR5**	**JUBA**
BLKROC_12	↔				
BLKROC_13	↔				
BLKROC_18	↔				
BLKROC_19					↑11%-18%
BLKROC_20			↑1%-21%	↑29%-63%	
BLKROC_22		↓85%-28%	↑0%-63%		
BLKROC_23	↔				
BLKROC_24	↔				
BLKROC_25	↔				

Land Management Table 3. Significant changes in percent frequency between 2018 and 2019 Plant Frequencies (p=0.1) on Moist Floodplain Sites on Reach 2 of the Blackrock Lease.

	DISP	**ATTO**	**BAHY**	**LACO13**	**HECU3**	**MALE3**
MOIST FLOODPLAIN						
BLKROC_10*		↑7%-23%	↑6%-46%	↓35%-0%	↓62%-35%	↑24%-35%
BLKROC_11*	↓82%-58%		↑1%-16%			
BLKROC_14*	↓42%-15%		↑71%-85%		↑8%-16%	
BLKROC_15*	↓45%-25%	↓12%-26%	↑0%-52%			
BLKROC_17*		↑14%-65%	↑0%-17%			

**Transects are located in Reach 2 (former dry reach of the LORP)*

Land Management Table 4. Significant changes in percent frequency between 2016 and 2019 Plant Frequencies (p=0.1) on Saline Meadow Sites, Blackrock Lease.

SALINE MEADOW										
	No Change	DISP	ATTO	ERNA10	BAHY	JUBA	MALE3	HECU3	TARA	CORA5
BLKROC_01		↑29%-45%	↑5%-18%	↓19%-1%	↑0%-34%		↑ 0%-16%	↑0%-16%	↑0%-39%	
BLKROC_02					↑0%-4%					
BLKROC_03				↓21%-11%	↑0%-11%					
BLKROC_04						↓41%-12%				
BLKROC_05					↑0%-6%	↓6%-0%				
BLKROC_06										↑0%-13%
BLKROC_07	↔									
BLKROC_39		↑56%-76%			↑0-8%				↑0-24%	

Land Management Table 4. Significant changes in percent frequency between 2016 and 2019 Plant Frequencies (p=0.1) on Sodic Fan Sites, Blackrock Lease.

SODIC FAN		
	No Change	ATTO
BLKROC_51	↔	
BLKROC_09		↑4%-26%

Land Management Table 5. Significant changes in percent frequency between 2016 and 2019 Plant Frequencies (p=0.1) on the Delta Lease

Moist Flood Plain					
	No Change	DISP	JUBA	ATTO	BAHY
DELTA_01	↔				
DELTA_02		↑47%-62%			
DELTA_04		↑81%-75%			
DELTA_05	↔				
DELTA_07		↑48%-62%			

3.5 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 3. 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*	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

3.5.1 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 associated 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. These spoil piles now support shrubs associated with upland communities. The sandy soils and depth of the piles will likely impede any future development of a meadow plant community. 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 2019.

Summary of Range Trend Data and Conditions

Range Trend data was not collected in 2019 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

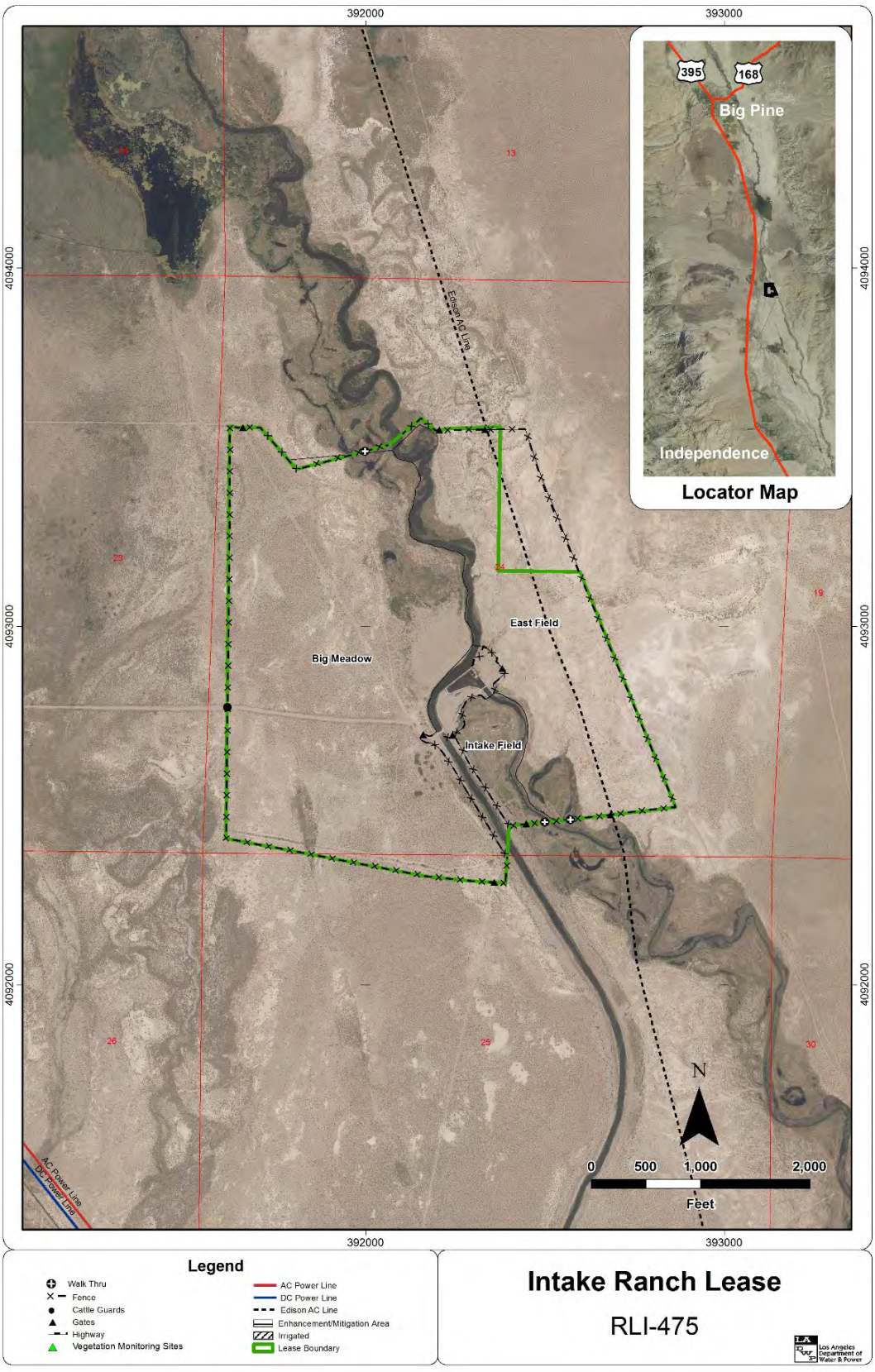
There was no new fence construction on the lease in 2019.

Salt and Supplement Sites

There are no salt and supplement sites on the lease.

Burning

No burns were conducted on the lease in 2019.



Land Management Figure 1. Intake Ranch Lease

3.5.2 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 within 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 within the allowable standard of 65% in all fields.

Summary of Range Trend Data and Conditions

Range trend data were not collected in 2019 at the lease level.

Irrigated Pastures

There are no irrigated pastures on the Twin Lakes Lease.

Fencing

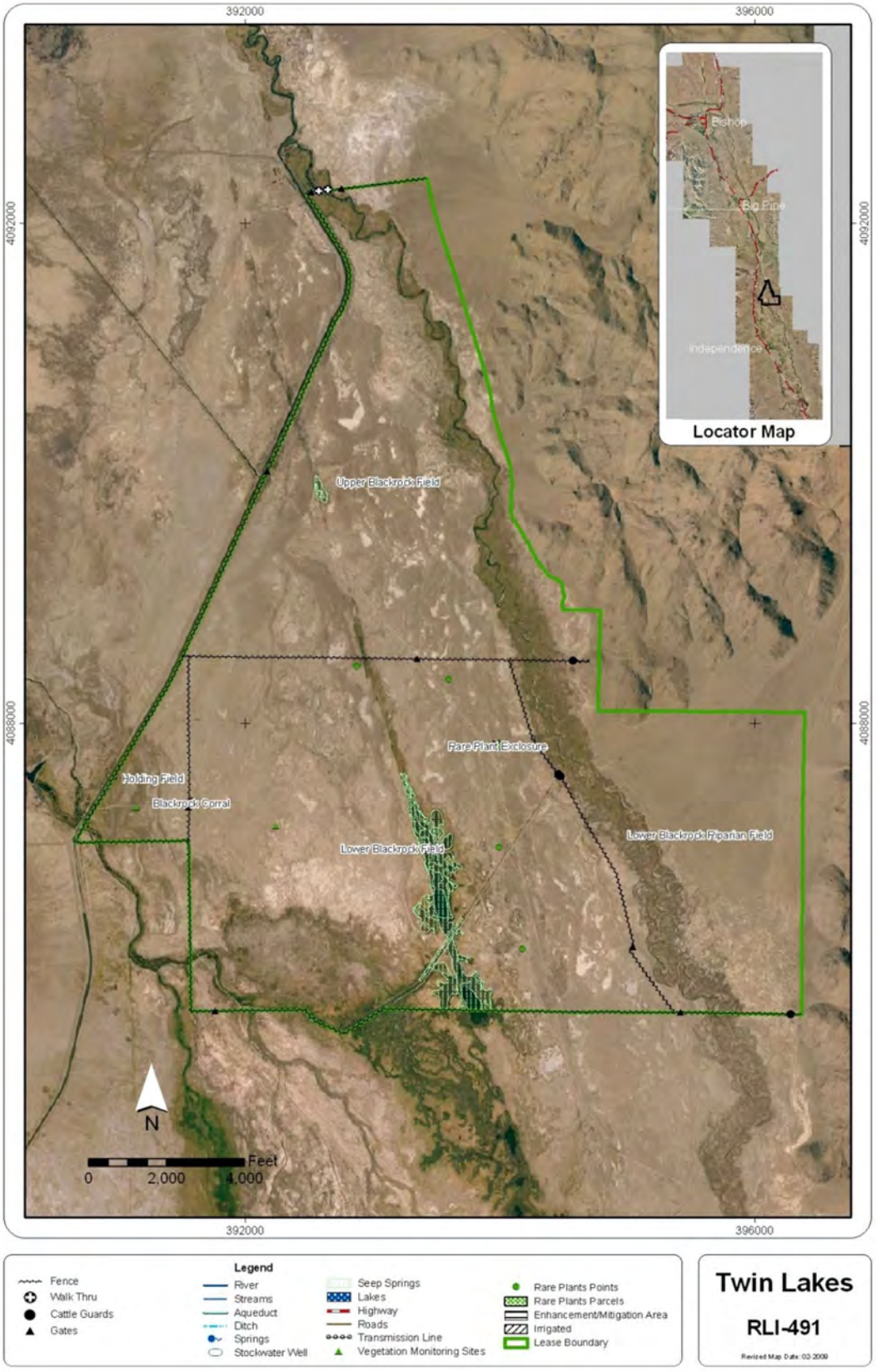
There were no new fences constructed on the lease in 2019.

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

Saltcedar slash pile burns were conducted on the lease in 2019.



Land Management Figure 2. Twin Lakes Lease

3.5.3 Blackrock Lease

The Blackrock Lease is a cow/calf operation consisting of 32,674 acres. 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 transects were read on the Blackrock lease. Above average valley floor precipitation in the winter and spring of 2019 led to a marked increase in Bassia (BAHY), particularly on Saline Meadow sites. Aside from the predictable increase in Bassia (BAHY), most changes were positive on the transects.

Irrigated Pastures

There are no irrigated pastures on the Blackrock Lease.

Stockwater Sites

All stockwater wells are planned to be in operation before 2020.

Fencing

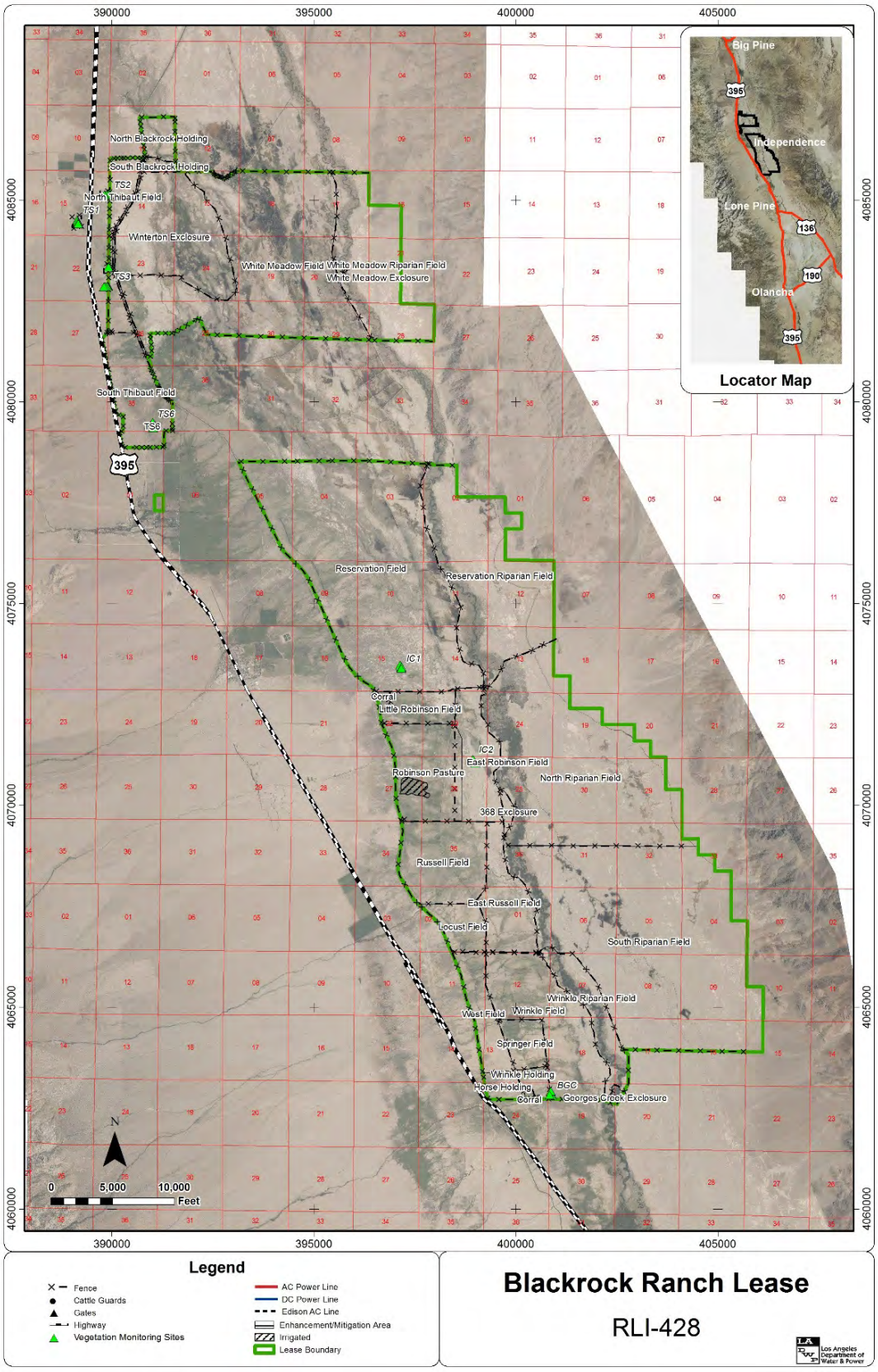
There was no new fencing on the lease in 2019.

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 was conducted in fall 2018 with the burn occurring in the spring of 2019. The Winterton Burn preparations did occur during the 2018-19 winter but no burn was completed due to conditions. The Winterton Burn was conducted in December 2019.



Land Management Figure 3. Blackrock Ranch Lease

3.5.4 Thibaut Lease

The 5,259-acre Thibaut Lease is utilized 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 2019. 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 through strong plant vigor throughout the summer of 2019.

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 2019 at the lease level.

Irrigated Pastures

Irrigated pasture evaluations were conducted in 2019. The irrigated pasture in the Thibaut Field was 72%, below the allowable score of 80% in 2019. This was due weeds, poor irrigation practices, and spot grazing.

Stockwater Sites

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

Fencing

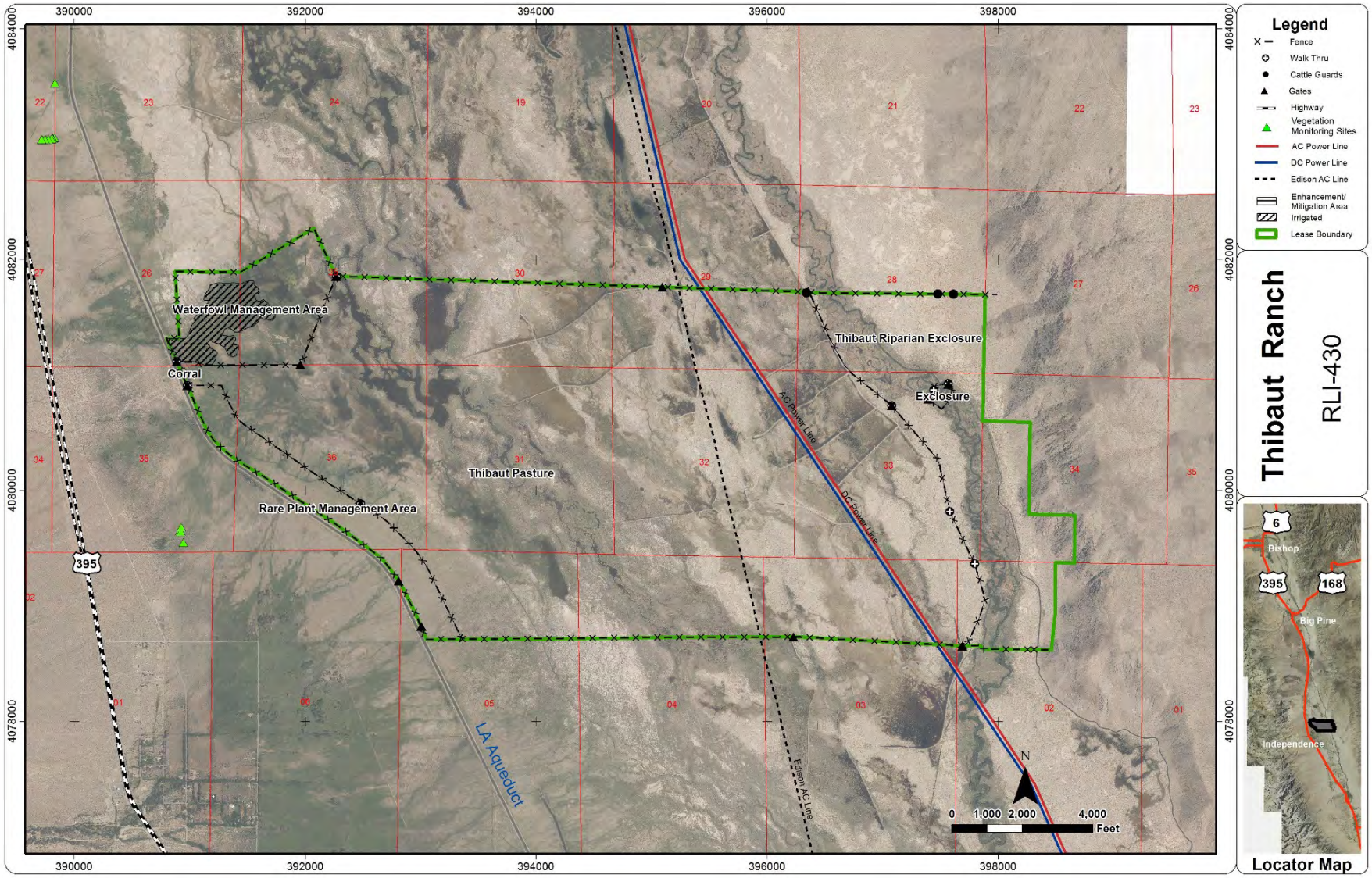
No new fences were constructed in 2019.

Salt and Supplement Sites

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

Burning

No prescribed burns were conducted on the lease in 2019.



Land Management Figure 4. Thibaut Ranch Lease

3.5.5 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 2019. 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 2019.

Summary of Range Trend Data

No range trend data were collected on the Islands Lease in 2019.

Irrigated Pastures

The irrigated pastures located within the Bull Pasture and River Field each rated 86% in 2019. 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

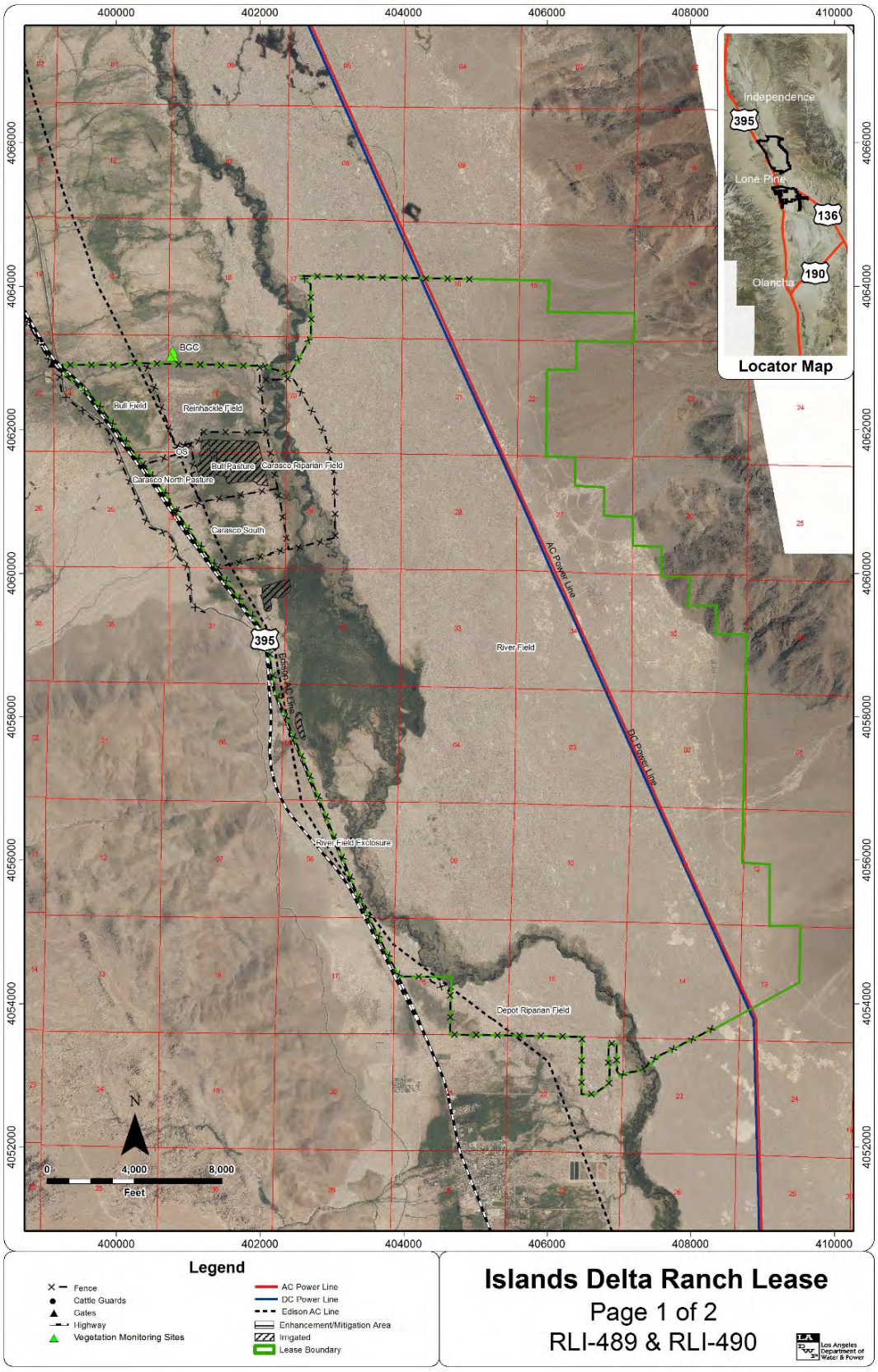
There were no new fences constructed on the lease in 2019.

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

No prescribed burns nor wildfires occurred on the lease in 2019.



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

3.5.6 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 within 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

No range trend data were collected on the Lone Pine Lease in 2019.

Stockwater Sites

LADWP plans to complete installation of the pump and storage tank during the winter of 2019-20.

Fencing

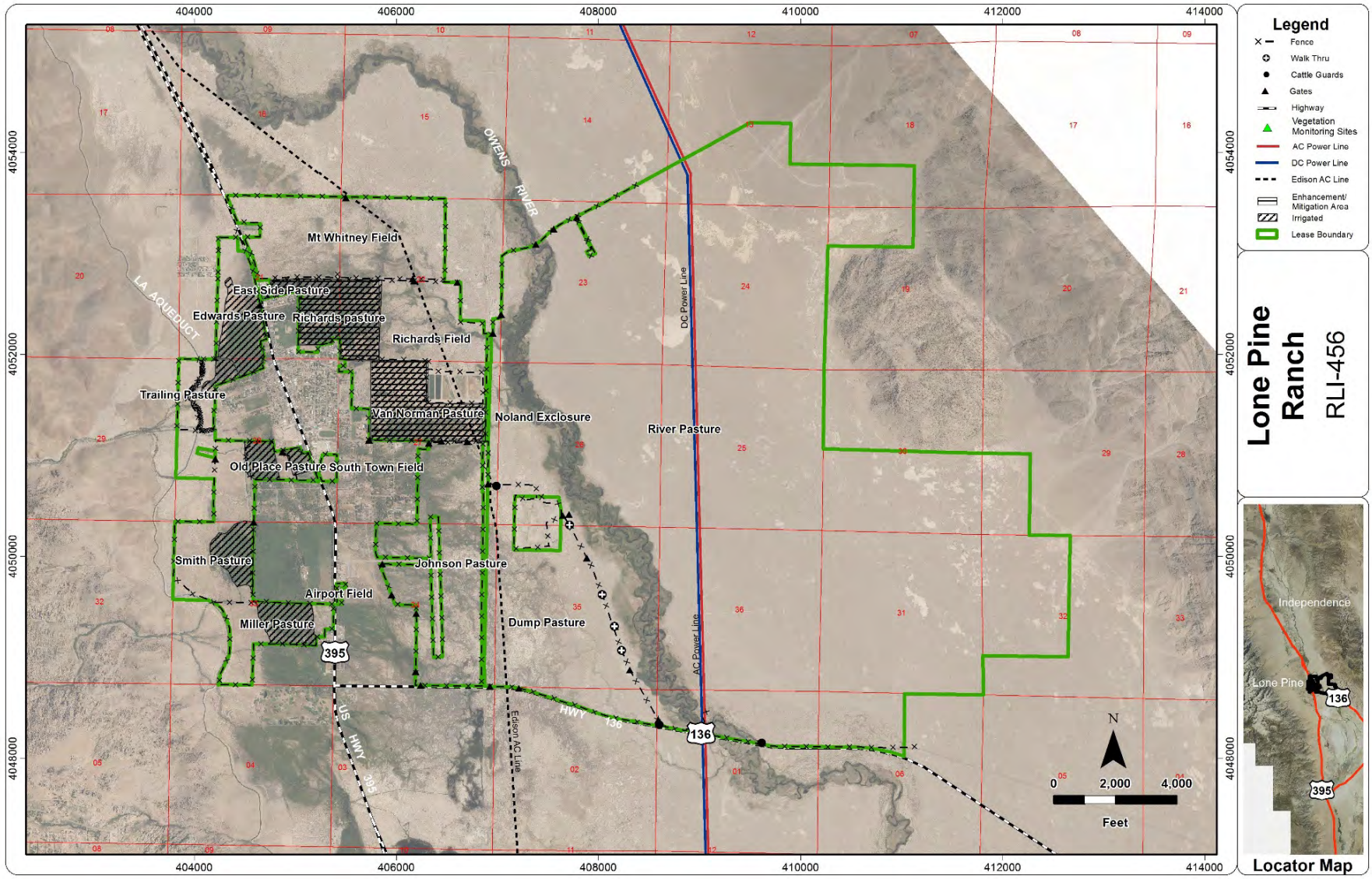
There was no new fencing constructed on the lease during 2019.

Salt and Supplement Sites

All supplement tubs were situated outside of the flood plain.

Burning

No burns were conducted on the lease in 2019.



Land Management Figure 6. Lone Pine Ranch Lease

3.5.7 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

Range Trend transects were read in 2019 on the Delta Lease. Sites responded favorably to the above average winter and spring runoff, with saltgrass significantly increasing on three sites and remaining static on the other two sites.

Irrigated Pastures

The Lake Field is located west of U.S. Highway 395 north of Diaz Lake. This irrigated pasture was evaluated in 2019 at 86%.

Stockwater Sites

Stockwater for the Bolin Field is supplied from a diversion that runs from Tuttle Creek.

Fencing

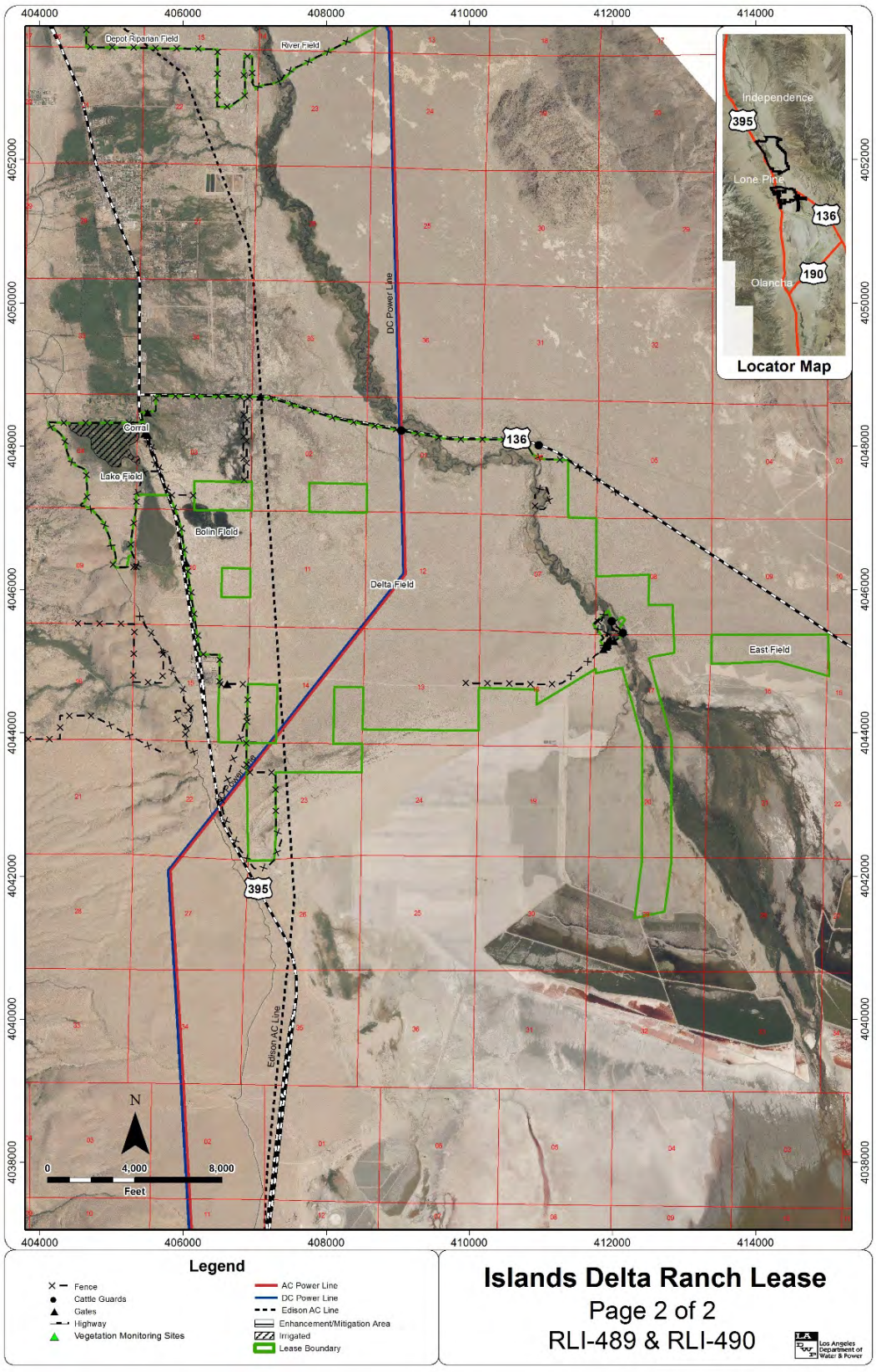
There was no new fencing on the lease for 2019.

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 2019.



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

3.6 Land Management Conclusion

Utilization

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

Above normal precipitation and water spreading activities in 2019 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 affecting portions of the Blackrock lease. Continued loss of meadow habitat and stressed woody species has increased on both Islands and Blackrock leases.

Range Trend

Range trend results point towards stable or upward trends in plant frequency of saltgrass and sacaton on moist floodplain sites.

Bassia

The non-native annual species *Bassia hyssopifolia* (BAHY) continues to persist and explode during wetter than normal years on Reach 2. Sites where BAHY appeared to be the densest were in locations where little to no livestock were present (Figures 8 and 9). The mechanical trampling of BAHY by livestock helps with the breakdown of persistent BAHY litter and opens up moist floodplain sites for colonization by more desirable plant species during average and less than average winters. We are proposing to the LORP Scientific Team to increase utilization to 65% on certain pastures where BAHY abundance has not decreased. The three leases where this change in utilization would occur are on the Twin Lakes Lease, the Blackrock Lease, and the Thibaut Lease. On the Twin Lakes Lease the change would only occur on the Lower Blackrock Riparian Field and only south of Blackrock Ditch to the southern boundary fence with the Blackrock lease. On the Blackrock lease, the change would apply to the White Meadow Riparian Pasture and the Reservation Riparian Pasture. On the Thibaut Lease, the change would apply to the Thibaut Riparian Pasture. In all of these areas, moist floodplain sites are currently in poor condition with minimal meadow habitat. Short of significant supplemental feeding on these sites, it is highly unlikely that grazing will ever reach 65%. Raising the current limitation to 65% should help contribute to greater livestock presence in these areas and attenuate BAHY abundance.

Land Management Figure 8. Blackrock 011, grazed location. Noted BAHY patch on right edge of photo which is inside a grazing exclosure. See next photo.

Land Management Figure 9. Blackrock 025, inside grazing exclosure. Note BAHY infestation.

Riparian Management Areas

Range burns, mowing, and high intensity short duration grazing could positively affect riparian areas of the LORP. These management practices can reduce shrub encroachment, increase native perennial grass growth, and enhance recruitment of desirable tree species.

Upland Management Areas- Tamarisk Beetles

The northern tamarisk beetle (*Diorhabda carinulata*) was observed on the LORP Area in 2017 and has increased its presence across the entire LORP Project area. During the summer of 2019, widespread herbivory was observed, increasing the likelihood of large scale tamarisk mortality. The LORP Scientific Team should develop a management strategy to address the beetle. The continued cutting and burning of tamarisk trees by LADWP while the tamarisk beetle is killing the same tree species in the same area may be a redundant activity. Money and personnel may be put to use on other endeavors if the beetle proves to be successful in reducing tamarisk trees.

Prescribed Fire

The Long Pond Burn was successfully completed in spring of 2019 after four previous years of burn preparation and inadequate conditions to carry out the fire. The fire appears to have successfully converted a shrub dominated saline meadow back to a grass dominated meadow. Unfortunately, the repeated burn preparations required discing firebreaks for four consecutive years, and saltgrass rhizomes where effectively killed and the breaks themselves were rendered barren. These broad open swaths of mineral soils were then colonized by BAHY and now serve as vectors bisecting and encircling the newly grass-dominated meadow (See Figures 10 and 11).

Land Management Figure 10. Center fire break, Long Pond Burn site.

Land Management Figure 11. East fire break, Long Pond Burn site.

Based on observation on the White Meadow Burn in 2015, discing one year and then burning the area does not preclude recolonization of desirable perennial grasses, however evidence from the Long Pond prescribed fire suggest that multiple years of discing leads to a loss of resilience and increased susceptibility of the area to colonization by undesirable ruderal species such as BAHY. Given the lag time between burn preparation and actually getting fire on the ground by CalFire, mowing instead of discing should be the first choice for future preparation for prescribed burns.

Irrigated Pastures

All irrigated pastures were evaluated in 2019. All pastures scored above 80% except Thibaut (72%). An improved management strategy will be discussed with the lessee in order to improve the pastures condition.

3.7 References

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Land Management Appendix 1. End of Season Utilization by Lease and Pasture, 2007-2019

End of Season Utilization by Lease and Pasture, 2007-2019															
Lease Name	**Pasture Name**	**Transect Name**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Blackrock	Horse Holding	BLKROC_09	67%	13%	1%	36%	29%	31%	0%	0%	0%	0%	0%	0%	0%
		HORSEHOLD_02		59%	37%	34%				0%					0%
	Horse Holding Total		67%	36%	19%	35%	29%	31%	0%	0%	0%	0%	0%	0%	0%
	Locust Field	BLKROC_06	68%	15%	14%	34%	13%	32%	32%	53%	18%	32%	0%	25%	0%
	Locust Field Total		68%	15%	14%	34%	13%	32%	32%	53%	18%	32%	0%	25%	0%
	North Riparian Field	BLKROC_12		67%	6%	16%									
		BLKROC_22	72%	36%	36%	43%	31%	10%		21%	20%	23%	20%	12%	9%
	North Riparian Field Total		72%	51%	21%	29%	31%	10%		21%	20%	23%	20%	12%	9%
	Reservation Field	BLKROC_02	69%	31%		36%		18%	35%	0%	17%	11%	30%	0%	0%
		BLKROC_03	81%	44%	54%	46%	53%	27%	33%	12%	13%	13%	11%	3%	0%
		BLKROC_44	72%	37%	49%	45%		28%	40%	22%	43%	10%	0%	0%	3%
		BLKROC_49	41%	10%	12%	16%	0%	11%	0%	0%	0%	0%	0%	0%	0%
		BLKROC_51	80%	46%	48%	33%	41%	39%	44%	15%	30%	16%	12%	26%	0%
		RESERVATION_06			29%	48%	23%	34%	30%	18%	15%	13%	30%	0%	2%
	Reservation Field Total		68%	34%	38%	37%	29%	26%	30%	11%	20%	10%	14%	5%	1%
	Robinson Field	BLKROC_04	76%	58%	14%	22%	8%	38%	24%		9%	1%	0%	0%	6%
		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%	6%
	Russell Field	BLKROC_05	85%	43%	19%	48%	13%	24%	22%	2%	2%	13%	0%	13%	9%
		RUSSELL_02		55%	12%	31%	0%	28%	31%	0%	1%	4%	0%	13%	0%

End of Season Utilization by Lease and Pasture, 2007-2019															
Lease Name	**Pasture Name**	**Transect Name**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	Russell Field Total		85%	49%	15%	39%	6%	26%	26%	1%	1%	8%	0%	13%	5%
	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%	15%
		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%	15%
	Springer Field	BLKROC_08	77%	43%						0%	5%	1%	0%	0%	1%
	Springer Field Total		77%	43%						0%	5%	1%	0%	0%	1%
	White Meadow Field	BLKROC_01	7%	2%	4%	4%	0%	9%	18%	0%		7%	0%	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%	2%
		WHITEMEADOW_04		7%	0%	0%	0%	3%	0%	5%	0%	0%	0%	0%	0%
		WHITEMEADOW_05		17%	52%	34%	36%	54%	32%	29%	0%	35%	0%	13%	4%
	White Meadow Field Total		3%	9%	19%	10%	9%	19%	19%	7%	3%	12%	0%	3%	1%
	White Meadow Riparian Field	BLKROC_11			75%	0%	68%	55%		16%	27%	26%	22%	5%	11%
		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%		

End of Season Utilization by Lease and Pasture, 2007-2019															
Lease Name	**Pasture Name**	**Transect Name**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	White Meadow Riparian Field Total		87%	0%	75%	0%	57%	32%		17%	27%	19%	13%	13%	11%
	Wrinkle Field	BLKROC_07	51%	28%	26%	40%		7%	28%	6%	7%	16%	0%	4%	0%
		WRINKLE_03		37%	28%	48%	24%	34%	17%	35%	0%		0%	9%	7%
	Wrinkle Field Total		51%	33%	27%	44%	24%	20%	22%	21%	3%	16%	0%	6%	3%
	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%	11%
		BLKROC_20	0%	11%	34%	53%	12%				28%	15%	13%	0%	13%
		BLKROC_21	0%	9%	28%	38%	6%				15%	19%	0%	0%	12%
	Wrinkle Riparian Field Total		8%	13%	29%	41%	18%				14%	16%	5%	6%	12%
	West Field	WRINKLE_02				22%	38%	41%	36%	9%	39%	7%	0%	0%	0%
	West Field Total					22%	38%	41%	36%	9%	39%	7%	0%	0%	0%
Delta	Bolin Field	BOLIN_02							25%		5%			16%	0%
		BOLIN_01						65%	27%	16%				0%	0%
	Bolin Field Total							65%	26%	16%	5%			8%	0%
	Main Delta	DELTA_01	58%	56%	59%	70%	38%	30%	19%	39%	35%	53%	9%	3%	26%
		DELTA_02	61%	49%											
		DELTA_03	72%	60%	54%	71%	12%	45%	26%	50%	8%	59%	12%		18%
		DELTA_04	83%	50%	55%	62%	33%	44%	38%	30%	11%	63%	15%	5%	31%
		DELTA_05	50%	73%	54%	29%	50%	42%	40%	22%	60%	43%	24%	14%	0%
		DELTA_06	26%	50%	35%	23%	42%	41%	26%	30%	66%	55%	36%		8%
		DELTA_07	60%	65%	61%	49%	51%	58%	36%	49%	63%	20%	13%	21%	14%
	Main Delta Total		58%	58%	53%	51%	38%	43%	31%	37%	41%	49%	18%	11%	16%
	Dune Pasture	DELT_UP_01					0%							0%	0%
	Dune Pasture						0%							0%	0%

End of Season Utilization by Lease and Pasture, 2007-2019															
Lease Name	**Pasture Name**	**Transect Name**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	Total														
Intake	Intake	STUART_01				0%					0%	0%	0%	0%	0%
	Intake Average					0%					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%	5%
		ISLAND_09	92%	40%	49%	49%	25%	67%	39%	91%	71%	48%	9%	40%	2%
		RIVERFIELD_07				26%	29%	52%	47%	19%	60%	61%	24%	14%	10%
		RIVERFIELD_09				9%	8%	9%		51%		15%	27%		
		RIVERFIELD_12				44%	41%	71%	58%	38%	63%	53%	1%	0%	30%
	Depot Riparian Field Total		82%	29%	30%	30%	20%	53%	43%	46%	54%	41%	16%	17%	12%
	Lubkin	LUBKIN_01	48%	0%	14%		0%	5%	6%	3%	16%	34%	33%	8%	0%
	Lubkin Total		48%	0%	14%		0%	5%	6%	3%	16%	34%	33%	8%	0%
	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%	20%
		ISLAND_11	0%	6%	22%		11%	6%	0%		7%	0%	0%	3%	1%
		ISLAND_12			25%	0%	34%	31%	0%	41%	28%				
		RIVERFIELD_08			47%	3%	0%	71%	52%		34%	0%	5%		17%
		RIVERFIELD_11				0%	58%	89%	0%		20%				
		RIVERFIELD_06				0%	0%	31%		0%	0%				

End of Season Utilization by Lease and Pasture, 2007-2019															
Lease Name	**Pasture Name**	**Transect Name**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
		ISLAND_14						81%	20%	48%	49%	67%	0%		
	River Field - Islands Total		42%	11%	27%	4%	15%	50%	17%	18%	23%	27%	3%	13%	12%
	South Field	ISLAND_02	31%	15%	8%		23%	0%		0%		14%			0%
		ISLAND_59	74%	47%	18%	0%				0%	0%	29%		0%	0%
		SOUTHFIELD_02			3%	7%	24%	19%		0%	0%	36%		14%	0%
	South Field Total		52%	31%	8%	3%	23%	10%		0%	0%	26%		7%	0%
Lone Pine	Johnson Pasture	LONEPINE_05	44%	0%	34%	63%	14%	0%		79%	0%	21%	0%	10%	0%
	Johnson Pasture Total		44%	0%	34%	63%	14%	0%		79%	0%	21%	0%	10%	0%
	River Field - Lone Pine	LONEPINE_01	80%	45%	61%	49%	28%	22%		38%	42%	26%	26%	37%	39%
		LONEPINE_02	79%	47%	48%	25%	30%	32%		30%		29%	24%	45%	29%
		LONEPINE_03	81%	49%	70%	37%	52%	63%		64%	49%	45%	25%	28%	26%
		LONEPINE_04	67%	55%	47%	32%	45%	45%		20%	40%	29%	26%	47%	20%
		LONEPINE_06	78%	44%											
		LONEPINE_07		52%	51%	38%	8%	21%		0%	19%	25%	13%	20%	5%
		LONEPINE_08						42%		52%	21%	24%	35%	49%	
	River Field - Lone Pine Total		77%	49%	55%	36%	32%	37%		34%	34%	30%	25%	38%	24%
Twin Lakes	Drew Slough	BLKROC_37	40%	9%	0%	0%	0%	5%	15%		2%		5%	16%	3%
		BLKROC_FIELD_04		10%		0%	0%		23%				7%	0%	
		TWINLAKES_02	16%	17%		0%	4%		0%	6%		0%	0%		0%
		TWINLAKES_05	65%	23%											

End of Season Utilization by Lease and Pasture, 2007-2019															
Lease Name	**Pasture Name**	**Transect Name**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	Drew Slough Total		40%	14%	0%	0%	1%	5%	13%	6%	2%	0%	4%	8%	1%
	Lower Blackrock Riparian Field	BLKROC_RIP_07		61%	53%		34%	72%		14%	0%		0%	11%	0%
		TWINLAKES_03	82%	28%	21%	6%	42%	36%				0%	14%		0%
		TWINLAKES_04	85%												
		TWINLAKES_06													
	Lower Blackrock Riparian Field Total		89%	44%	37%	6%	38%	54%		14%	0%	0%	7%	11%	0%
	Upper Blackrock Field	BLKROC_RIP_05			52%	21%	25%	51%		9%	0%	10%	3%	2%	26%
		BLKROC_RIP_06			53%	19%	29%	74%		10%		0%		56%	
		BLKROC_RIP_08		41%	42%	17%	18%	70%		50%		69%	27%	61%	66%
		INTAKE_01	45%		25%	13%	30%	49%		10%	12%	2%	9%	4%	0%
		BLKROC_RIP_09									43%				
	Upper Blackrock Field Total		45%	41%	43%	17%	26%	61%		20%	18%	20%	13%	31%	31%
Thibaut	Rare Plant Management Area	RAREPLANT_02	76%		77%	0%					0%		16%	22%	0%
		RAREPLANT_03	98%		58%	7%		45%	4%		8%	15%			
		THIBAUT_02	88%		49%	0%		34%	36%	29%	13%	34%	11%	7%	0%
	Rare Plant Management		87%		61%	2%		39%	20%	29%	7%	25%	14%	14%	0%

End of Season Utilization by Lease and Pasture, 2007-2019															
Lease Name	**Pasture Name**	**Transect Name**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
	Area Total														
	Thibaut Field	THIBAUT_03	89%	65%	36%	65%	74%	15%	20%	40%	6%	56%	78%	16%	3%
		THIBAUT_08		15%	8%	4%	0%	14%	0%	0%	1%	7%	2%	0%	8%
		THIBAUT_09		3%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
		THIBAUTFIELD_02	81%	64%	62%	31%	76%	30%	0%	22%		44%			0%
		THIBAUTFIELD_03			13%	3%	0%		5%	0%		2%	0%		0%
		THIBAUTFIELD_04			6%	0%	0%	0%	0%	0%		7%	0%		0%
	Thibaut Field Total		85%	37%	22%	17%	25%	12%	4%	10%	2%	19%	16%	8%	1%
	Waterfowl Management Area	THIBAUT_01	80%			3%				50%	40%	3%	9%	0%	1%
		WATERFOWL_02	15%			40%	30%			56%	30%	16%	8%		
		WATERFOWL_03				21%	33%			33%	25%	4%		7%	0%
		WATERFOWL_04	57%			11%	51%								
		WATERFOWL_05	77%				39%								
	Waterfowl Management Area Total		57%			19%	38%			46%	32%	8%	8%	3%	1%

Land Management Appendix 2. LORP Irrigated Pasture Condition Scores, 2011-2019

X = Pasture not rated

LORP Irrigated Pasture Condition Scores, 2011-2019										
Lease	**Pasture**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Thibaut										
	Thibaut Field	82	81	78	X	X	80	X	X	72
Islands										
	B Pasture	X	90	90	X	X	88	X	X	86
	D Pasture	X	90	90	X	X	88	X	X	86
Delta										
	Lake Field	X	X	74	X	X	88	X	X	86
Lone Pine										
	Edwards	X	X	84	X	X	84	X	X	80
	Richards	X	X	84	X	X	84	X	X	92
	Van Norman	X	X	84	X	X	84	X	X	84
	Old Place	X	X	84	X	X	76	86	X	96
	Smith	X	X	84	X	X	84	X	X	94
	Miller	X	X	86	X	X	84	X	X	90

4.0 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 in 1997 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 2019:

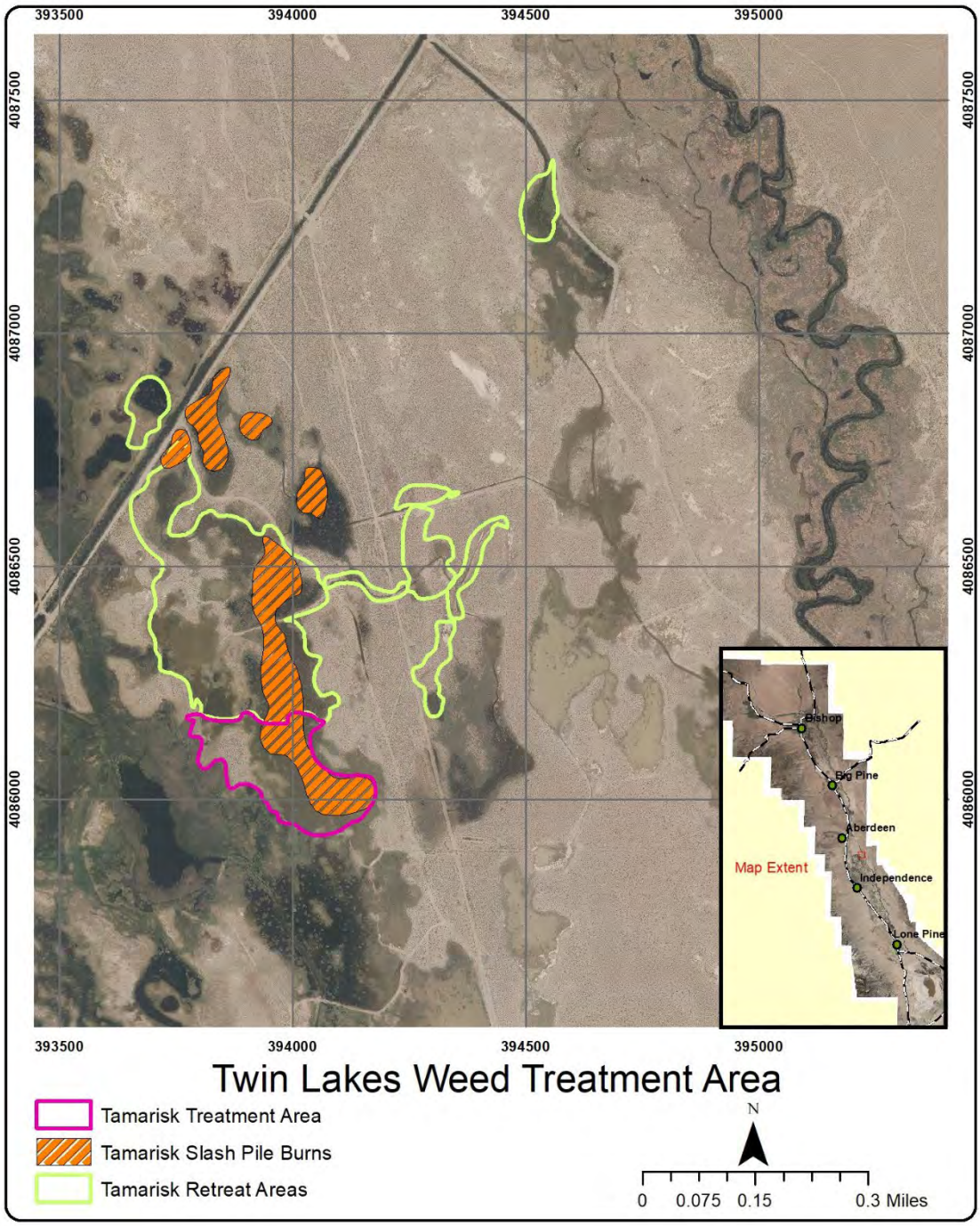
- Hand pulling of small plants
- Cut stump treatment (plant is cut at the base, then Garlon 4 Ultra, a chemical herbicide, is applied to prevent re-sprouting)
- Basal bark of applications of herbicide (lower portions of smaller plants are sprayed with Garlon 4)
- Foliar applications of herbicide
- The Chinese tamarisk leaf eating beetle, a natural insect herbivore of saltcedar leaves, that has been used for saltcedar control throughout western US riparian corridors for many years, is currently established within the LORP area (per LADWP Watershed Resources Staff). However, the current effect of the beetle on the LORP invasive saltcedar populations is unknown. The landscape-level control of saltcedar through this biocontrol agent is a worthwhile area of study and/or monitoring., especially as it relates to resources currently allocated to mechanical control.

In 2019 LADWP treated 139 acres of saltcedar in the LORP area, including:

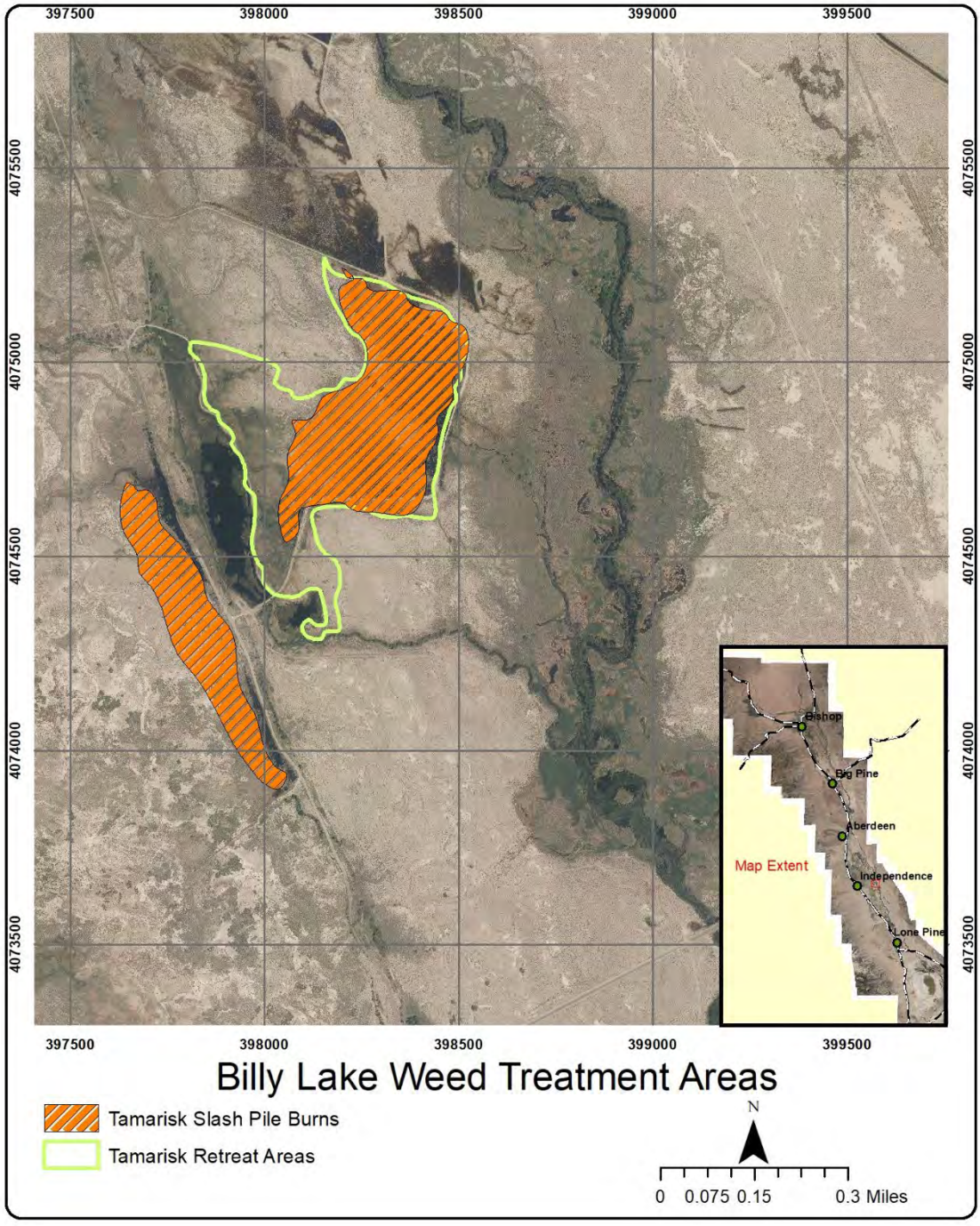
- 14 acres of cut stump treatment (Saltcedar Figure 1)
- 125 acres of cut stump retreatment (Saltcedar Figures 1-2)

LADWP will continue to treat saltcedar resprouts in 2019-2020 that occur in the areas of treatment identified in Saltcedar Figures 1-2. 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 (slash) and placing them in large burn piles.

During the winter of 2018-2019 LADWP also worked with Cal Fire to burn approximately 500 slash piles created from the last few years of treatment (Saltcedar Figures 1-2). This work was completed under a Cal Fire Vegetation Management Plan (VMP) and required extensive coordination and support between LADWP and Cal Fire crews to accomplish. As a result, all slash from previous years was completely burned and remaining coals and ash were raked out. Work in 2019-2020 will return focus to saltcedar removal and treatment. Slash will continue to be stacked for burning in the future.



Saltcedar Figure 1. Twin Lakes 2019 Saltcedar Treatment Areas



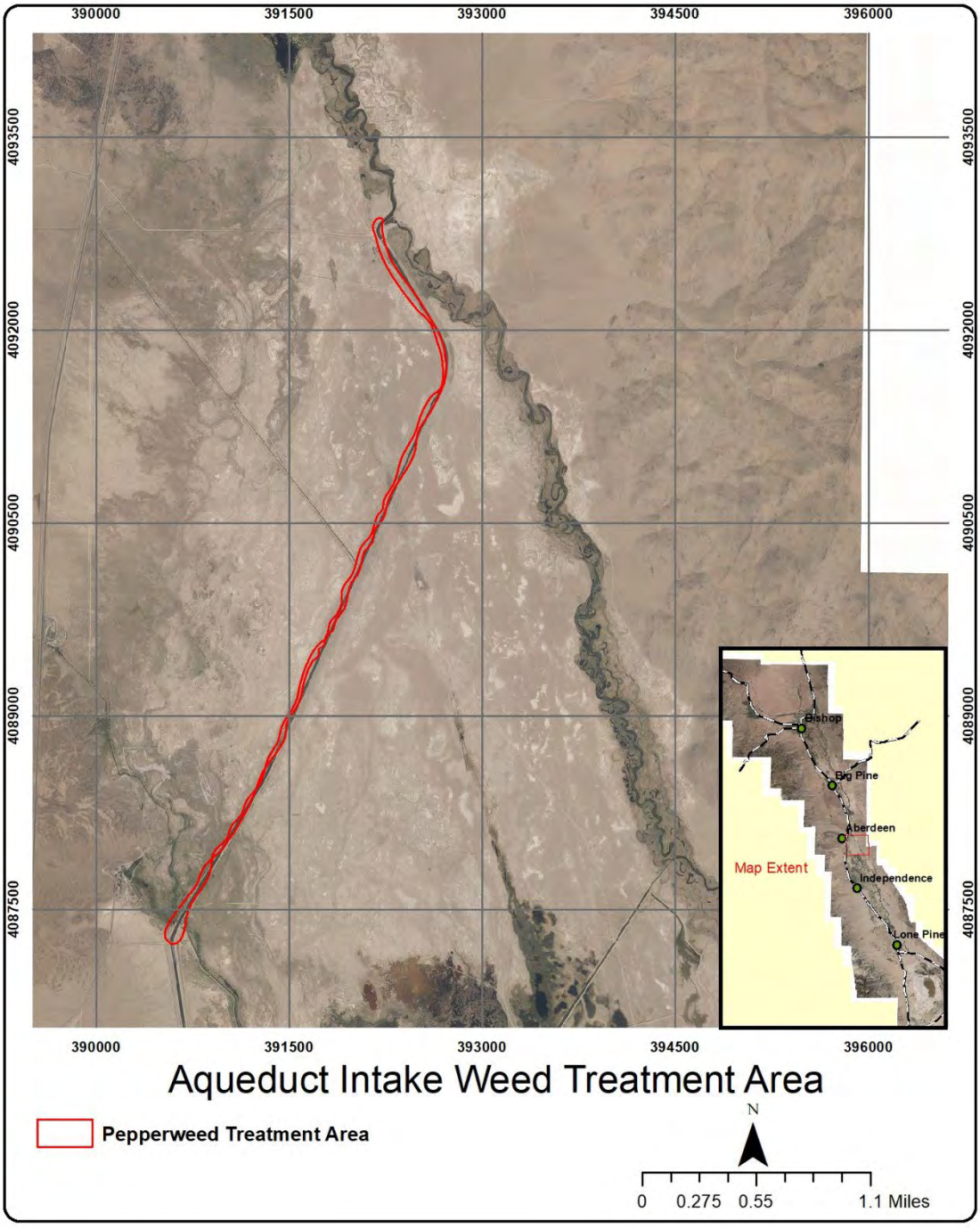
Saltcedar Figure 2. Billy Lake 2019 Saltcedar Treatment Areas

5.0 LORP WEED REPORT

5.1.1 LADWP Activities

Weed treatment in the LORP by LADWP personnel in 2019 was conducted along the Los Angeles Aqueduct from the Aqueduct intake, 12 miles north of Independence, to the Blackrock Fish Hatchery. The primary species controlled was broadleaved pepperweed (*Lepidium Latifolium*). Approximately 64 acres along the four mile stretch of aqueduct was treated using chlorsulfuron a broadleaf specific herbicide (Weed Figure 1).

The limited area treated by LADWP in the LORP in 2019 was due to above average snowpack runoff. Each year LADWP weed crews begin in the headwaters of the Owens Valley near Pleasant Valley (PV) Reservoir and work south along water conveyances, irrigated meadows, and water spreading areas. Due to the high snowpack runoff in 2019 many of these low lying areas were inaccessible until late in the summer. As a result of the late start, crews were only able to treat weeds from PV reservoir south to Gus Cashbaugh Lane in Bishop, south along the Big Pine canal to Big Pine, and along the upper reach of the LA aqueduct before dormancy set in.

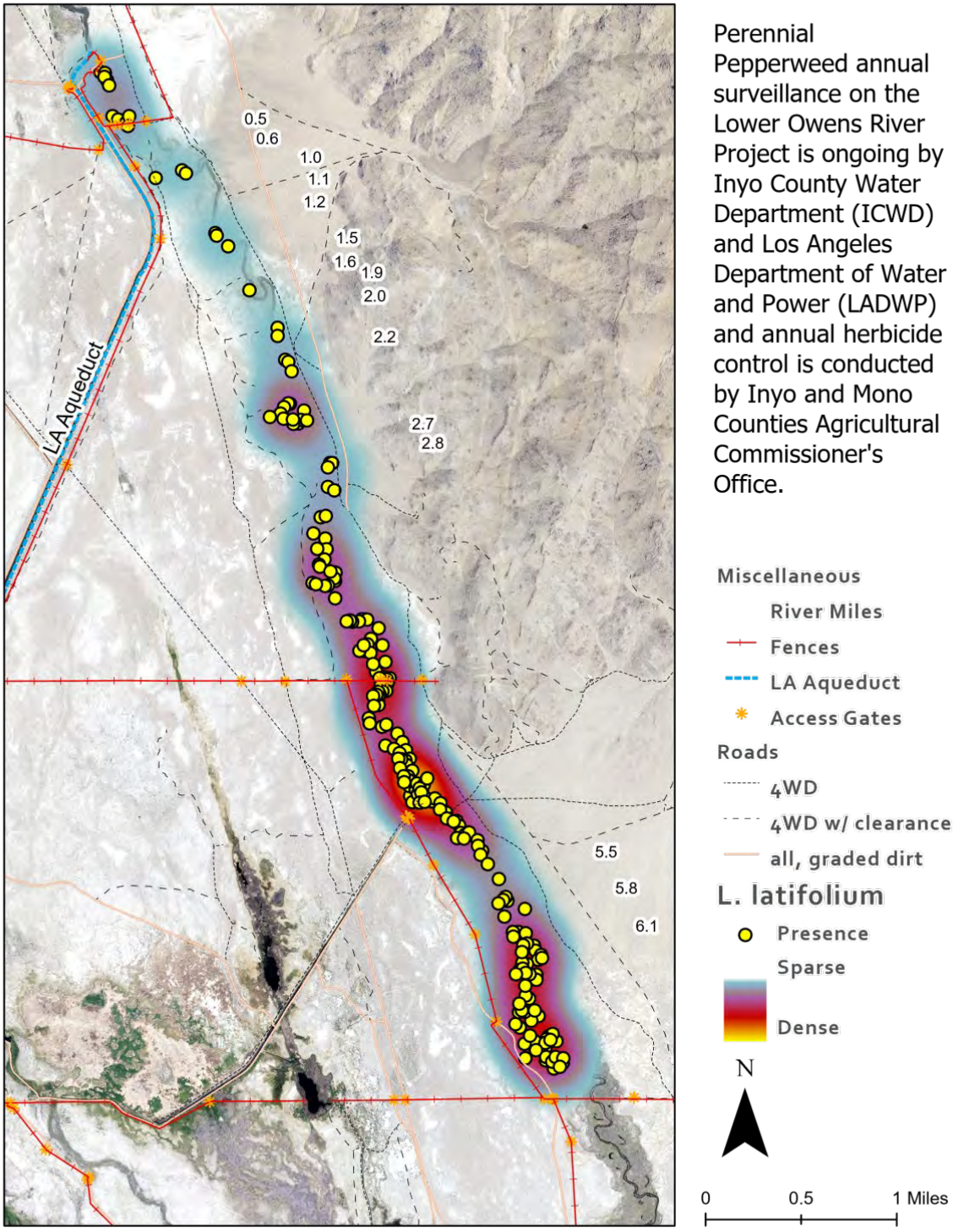


Weed Figure 1. Weed Treatment Areas within the LORP 2019.

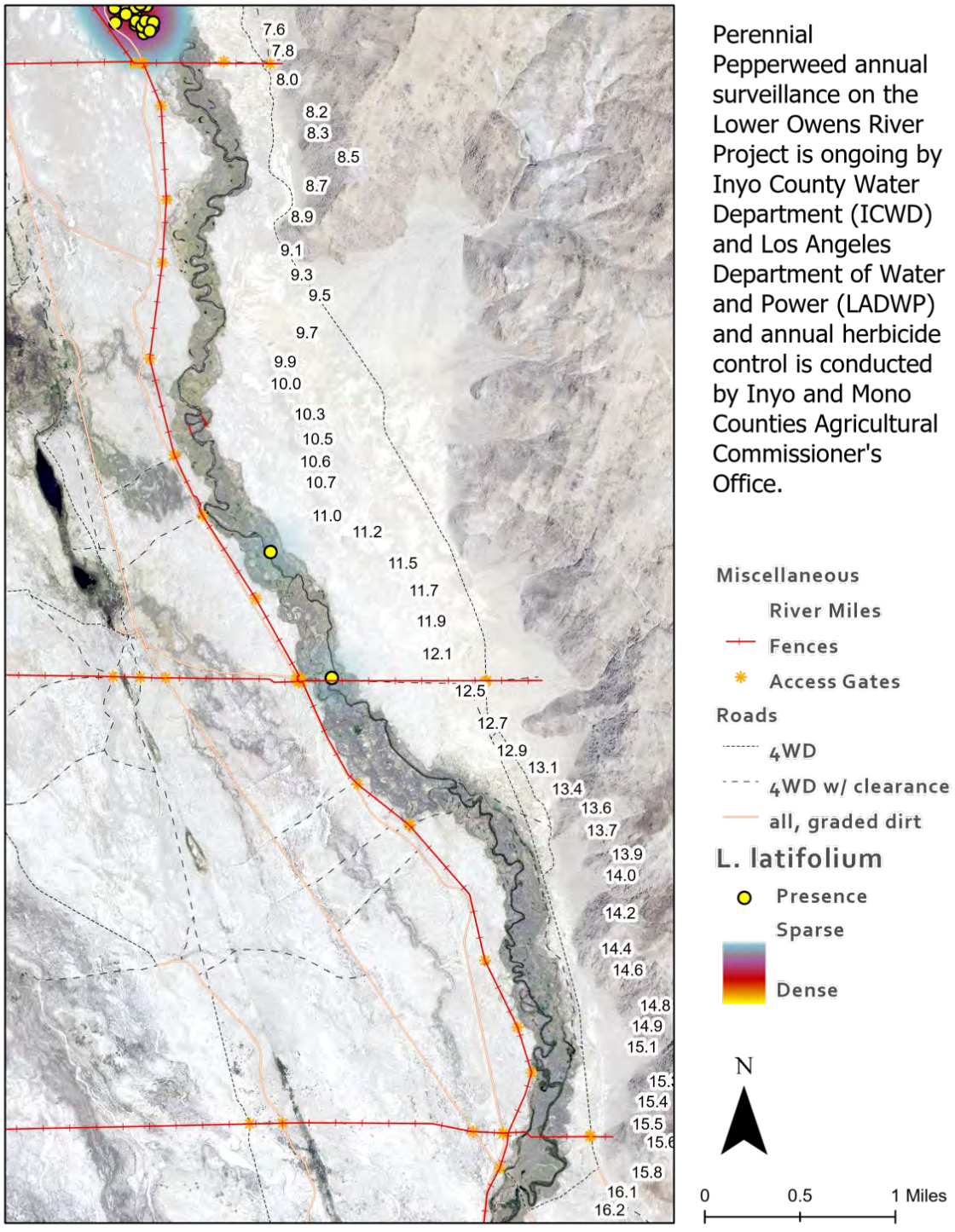
5.1.2 LORP Rapid Assessment Survey

In summer of 2019, the ICWD surveyed the historic floodplain of the Lower Owens River for *Lepidium latifolium*, concentrating downstream and within areas of previously known infestations. No major changes in distribution were noted compared to previous years. Two main stretches of the Lower Owens River are hot spots for establishment and will prove challenging to control in the future. The first hotspot is from river mile 0 to 8 from the Los Angeles Aqueduct Intake to three miles south of the Blackrock Ditch Return east of Twin Lakes (Weed Figure 2). Downstream from this first hotspot, a few detections have occurred east of Goose Lake from river mile 9-12 (Weed Figure 3), likely influenced by upstream seed sources. These areas will be important to monitor in the future and it will be important to aggressively control these areas to prevent widespread establishment. The second hotspot is located south of Manzanar Reward Rd from river mile 28 to 33 just upstream from Reinhackle Gauging Station Rd (Weed Figure 4).

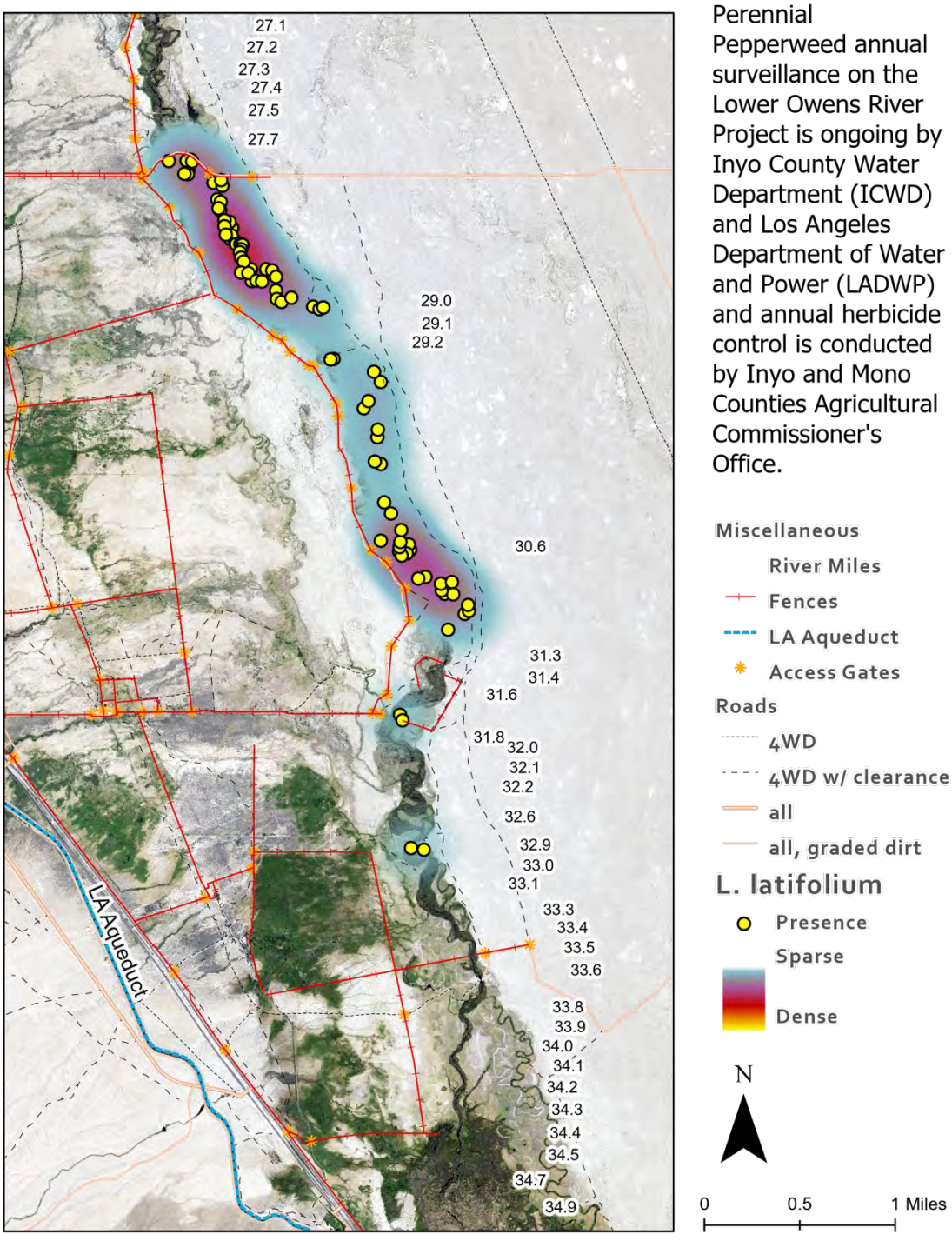
Many upstream sources of seed exist allowing hydrochorous spread along the river and water conveyances connected to the LORP as well as zoochorous spread via wildlife and livestock. The density of detections has increased in recent years and aggressive control is warranted as well as close coordination with Inyo County Water Department (ICWD), Inyo-Mono Counties Agricultural Commissioner's Office (CAC) and Los Angeles Department of Water and Power (LADWP) to limit spread. The LORP workplan for the 2020 fiscal year should identify the necessary resources required to adequately monitor any undesirable spread downstream from the two problem areas described above.



Weed Figure 2. LELA2 detections from LAA Intake to east of Twin Lakes, river mile 0-8.



Weed Figure 3. LELA2 east of Goose Lake from river mile 9-12.



Weed Figure 4. LELA2 south of Manzanar Reward Rd from river mile 28 to 33.

5.1.3 Inyo/Mono Counties Agricultural Commissioner's Office

Introduction:

The Inyo and Mono Counties Agricultural Commissioner's Office (CAC) manages certain invasive weed infestations within the LORP project area in conjunction with the City of Los Angeles Department of Water and Power (LADWP), and in coordination with the Inyo County Water Department. Funds from all three agencies are used to support the effort.

Target weeds for CAC management and control include California Department of Food and Agriculture (CDFA) designated noxious weeds with a significant focus on *Lepidium latifolium* (perennial pepperweed). Management of Lepidium in the LORP is accomplished both by efforts to control and eradicate known weed populations in the area as well as monitoring for pioneer populations. This program is managed to prevent the widespread establishment of invasive weed populations throughout the 78,000 acre LORP area.

While eradication of all known weed populations in the LORP is the long-term goal of the program, new populations will continue to establish so long as a source of seed and root fragments entering the area. Thus, the detection component of the program is critical to the protection of the LORP's newly developing habitat--early detection is critical to limit the spread of weeds. It is far less costly to find and treat newly established infestations then to do so once establish.

In the LORP, operations and maintenance activities, flooding, wildlife activity and cattle grazing, off road vehicles and other recreational uses all create disturbances and can carry and spread weeds. A significant source of weed contamination comes from outside the LORP boundary. The middle Owens River from the Pleasant Valley Dam to the LORP Intake provides a source of Lepidium that can be mobilized to contaminate the Lower Owens River and LORP area. To limit spread, CAC now treats areas of extensive Lepidium populations from Pleasant Valley to Warm Springs Road, and LADWP is managing invasive weeds on city owned lands including along the Owens River from Warm Springs Road to the LORP intake.

Protecting native habitat is the paramount goal of controlling weeds and maintaining a healthy native plant habitat that will support wildlife (including some threatened and endangered species), help reduce stream bank erosion, control dust, maintain healthy fire regimes, preserve the viability of open-space agriculture, and enhance recreational experiences.

Summary of LORP Weed Management Activities in 2019 and Comparison with Previous Years' Activities

In 2019, the CAC was staffed with a Field Operations Supervisor, and two seasonal field assistants. CAC staff began surveillance activities in early April and treatment in May. A total of 2.99 net acres were treated this season. Treated means some sort of intervention (chemical or mechanical) has been applied to a weed population. Net acreage treated is calculated, not by

physically measuring the treated area, but rather by the amount of dilute herbicide applied by calibrated spray equipment—chemical use provides a rough proxy for population density. The County Agricultural Department does not have sufficient personnel to conduct ground surveys to measure physical area.

Challenges

This was the second season following record high runoff and the resulting flooding of the LORP in the summer of 2017 severely limited access to and treatment of known Lepidium sites. Under flood conditions only 0.02 net acres were able to be treated in 2017, and 6.67 net acres were treated in 2018. Because there were significant access issues due to persistent flooding which prevented access to much of the treatment sites, the 2017 net acreage measurement is considered to be an anomaly and uncharacteristic. The 1.05 net acres treated in 2016 is the last reliable data for comparison. There was a 1.94 net acres difference (increase) between the 2019 and 2016 season. This indicates that Lepidium populations are still above pre-flood numbers.

Geographic Distribution

In 2019, fewer Lepidium populations were found along the Lower Owens River and in the Blackrock Waterfowl Management (BWMA) Area than in the previous year; however, overall, Lepidium populations are now returning to pre-flood year levels observed in the 2016 assessment, and of concern, increases in the net acreage of known sites and dozens of new infestations in the river-riparian area were observed (Chart 1).

Comparing 2018 to 2019, the distribution of Lepidium along the Lower Owens River appeared not to expand; however, the area surveyed was focused on populations discovered in 2018, including twelve miles downriver of the LAA intake and five miles downstream from Manzanar Reward Road.

In 2018, newly observed infestations were discovered along the Owens River from the LORP Intake to the southern boundary of the Twin Lakes Ranch Lease (river mile 7.8) for a total of 4.18 net acres. In 2019 that same area required only 1.0 acre of treatment; that is a reduction of 76% in that section alone and possibly suggests a decline in Lepidium in that area.

The section from Manzanar Reward Road (river mile 27.8) to the southern boundary of the Blackrock Ranch Lease (river mile 31.7) had the highest increase in net acres treated; 0.43 net acres were treated in 2018 and 1.37 net acres were treated in 2019. The increase in Lepidium populations in these areas is attributed to the spread of both seed and root fragments by the 2017 LORP flooding. Fortunately, the increased and new populations are concentrated in sections of the river where Lepidium has been previously reported and treated.

Although a few new pioneer populations were observed within a few miles downstream of previously infested areas, no sites were found from Mazourka Canyon Road (river mile 20.7) to

Manzanar Reward Road (river mile 27.8) or from the Reinhackle Gauge (river mile 33.6) to the Owens Dry Lake (river mile 57.6). These sections remain free of Lepidium.

Treatment Challenges

In May 2019 the CAC began treatment activities of all known Lepidium sites and new populations discovered during the 2018 season. Low-volume, directed spot treatments using the selective herbicide Telar XP were employed. Applications were made from all-terrain vehicles where terrain allowed and from backpack sprayers in more challenging terrain. Care was taken to minimize damage to native plant communities within the LORP.

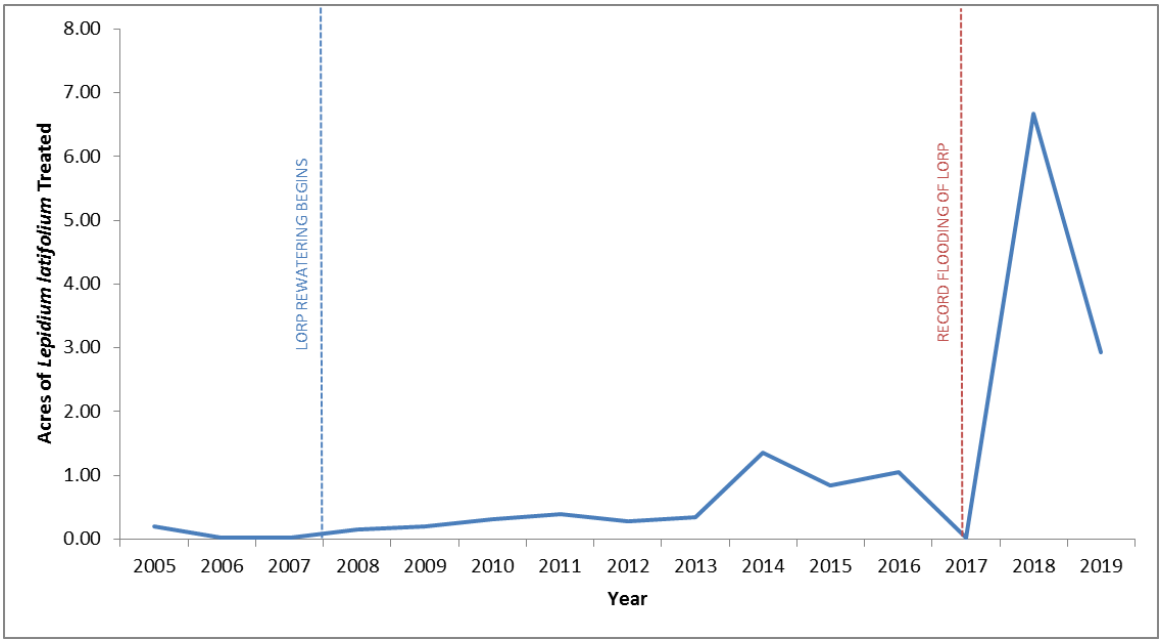
Rapid Assessment Survey (RAS) data provided by ICWD was received by the CAC in late July and early August 2019. CAC staff visited each of these observed populations and reported outlier populations from the RAS in late August and September. This new information led CAC staff to treat an additional 0.73 acres.

The total net Lepidium acreage treated in 2019 was 2.99 acres. This represents a 55% decrease from the total 6.67 net acres treated in 2018. 2.76 net acres were treated along the Owens River channel. 0.10 net acres in the Drew management Unit, 0.01 net acres in the Thibaut management unit, and 0.12 net acres in the Winterton Management Unit of the Blackrock Wildfowl Management Area were treated. Chart 1 depicts the net weed acreage trend from 2005 to 2019.

No Lepidium populations in the LORP have been fully eradicated. Eradicated means there have been 5 consecutive years of survey and no plants have been detected. Eradication is a goal, but given available resources, the focus of the CAC's effort is on treating to gain control and prevent the geographic spread of weeds.

The most significant management difficulty continues to be maintaining adequate staffing for effective management of such a large project. The 2019 permanent and seasonal CAC staff assigned to the project are shared between the LORP project and several other weed management projects. If additional funding could be acquired, the dedication of seasonal staff to work solely within the LORP project area would be preferred in future years, allowing greater focus and progress on the project.

Chart 1 – Net Acreage of Weed Population on LORP

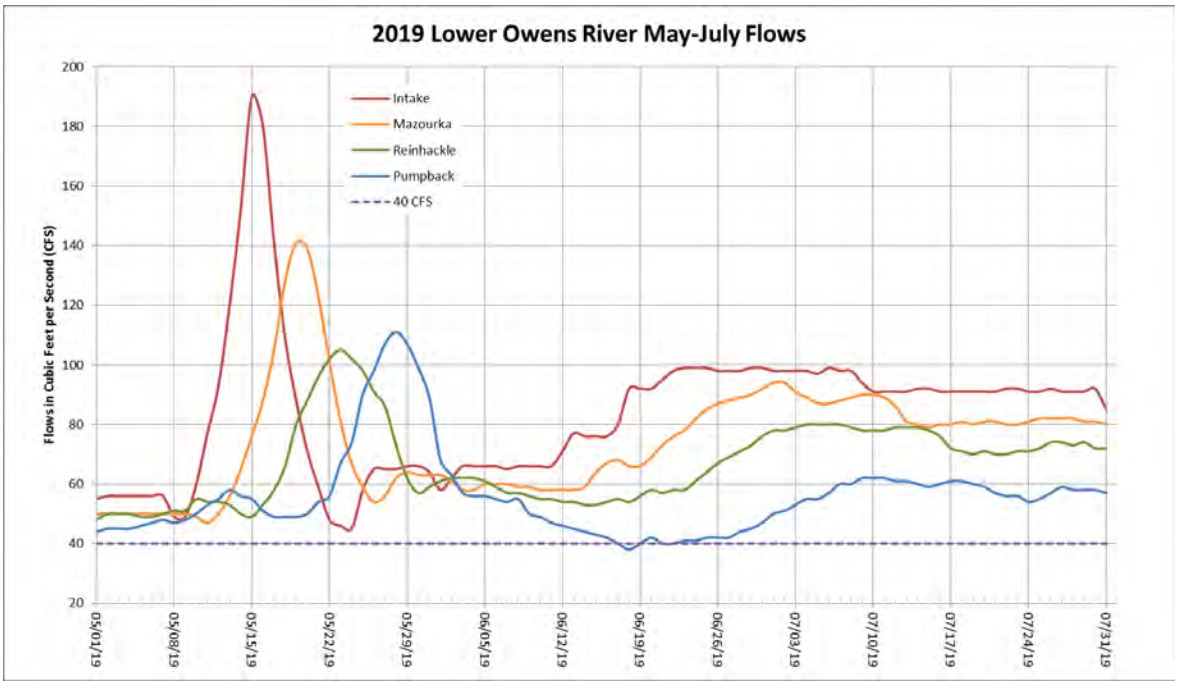


6.0 LORP WATER QUALITY OBSERVATIONS

ICWD staff collected manual water quality parameters on the LOR during 2019 with a focus on the Spring Habitat Flow in May and the summer flow ramp-up in June/July. An In-Situ AquaTROLL 400 Multi-parameter probe was used to collect instantaneous water temperature, dissolved oxygen (DO), conductivity and pH measurements from the LOR Intake to the Pumpback station. The primary objective of this limited field campaign was to document changes in DO levels caused by changes in LOR flows and to document whether DO levels were lowered to ranges which produce fish stress or mortality.

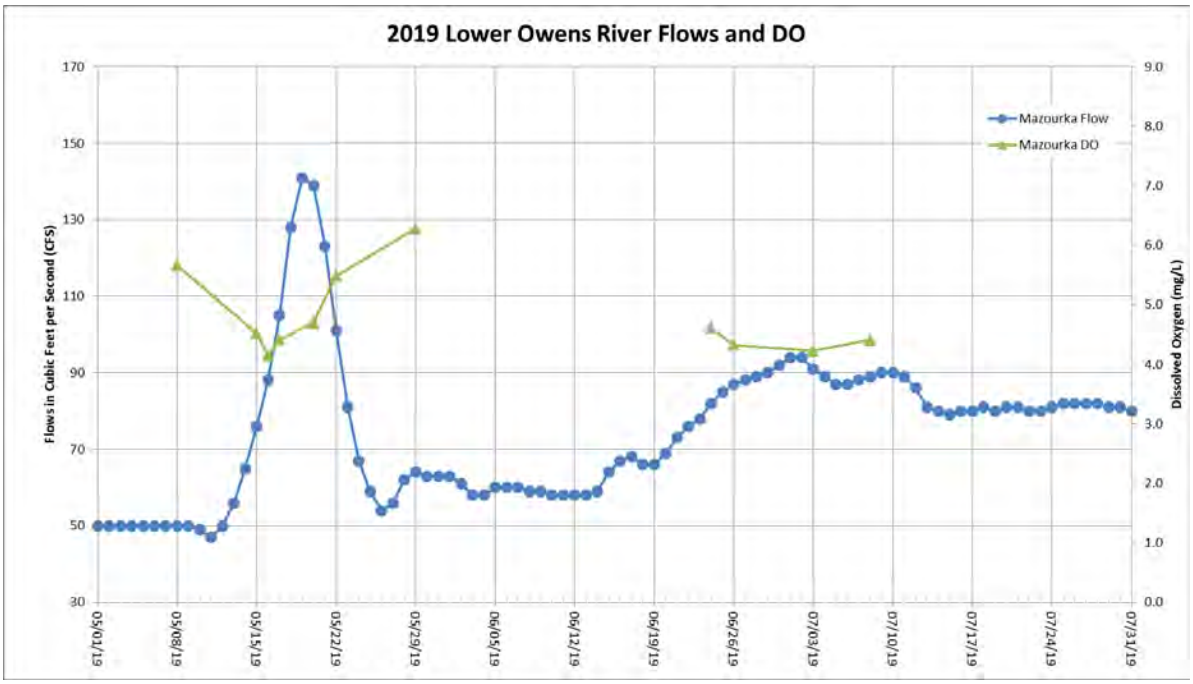
As documented and discussed in previous LORP Annual Report water quality sections (2008-10, 2014-15, 2017) changes in flow can mobilize LOR sediments, increasing biologic oxygen demand from aerobic microbial decomposition of suspended sediments and release of hydrogen sulfide from disturbed channel-bed muck. This increased DO demand, especially during periods of elevated water temperature, can lower DO levels in the water column to critical levels. Fish stress and mortality have been observed in previous years (2010, 2013, 2017) when DO levels fell below 1 mg/L.

In May 2019, the Spring Habitat Flow (SHF) was conducted with a maximum release of 190 cfs at LOR Intake on May 15 and a maximum flow of approximately 110 cfs arriving at the Pumpback station on May 28 (Figure 1).

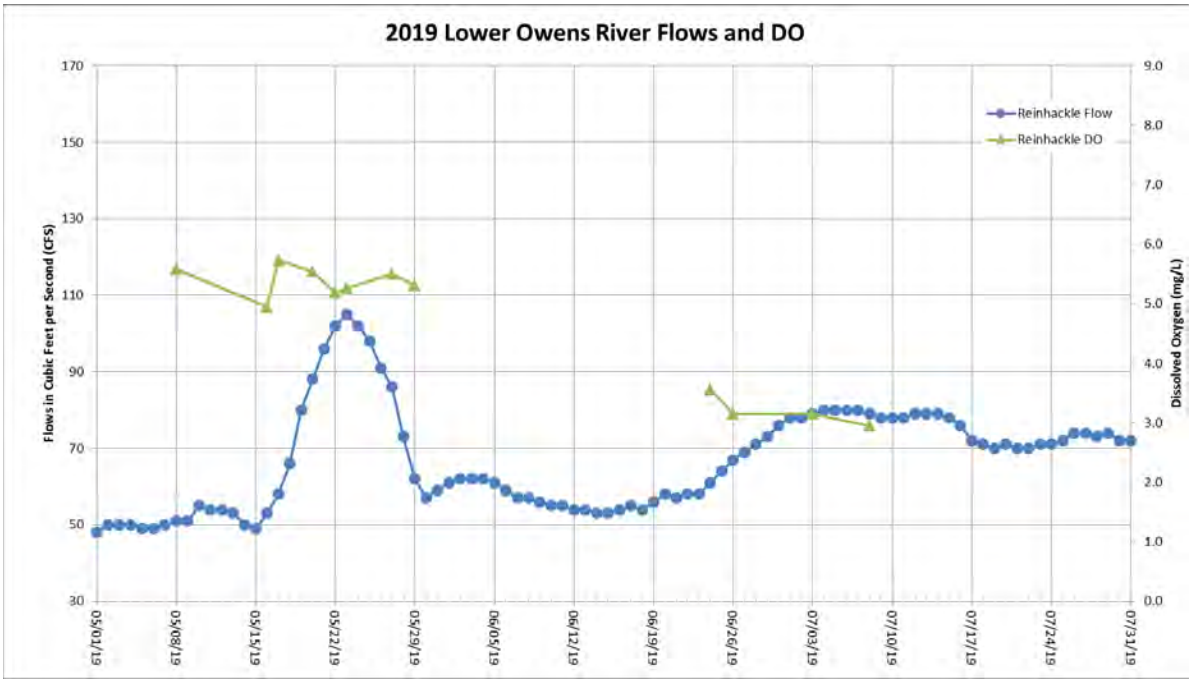


Water Quality Figure 1. 2019 Lower Owens River May-July Flows.

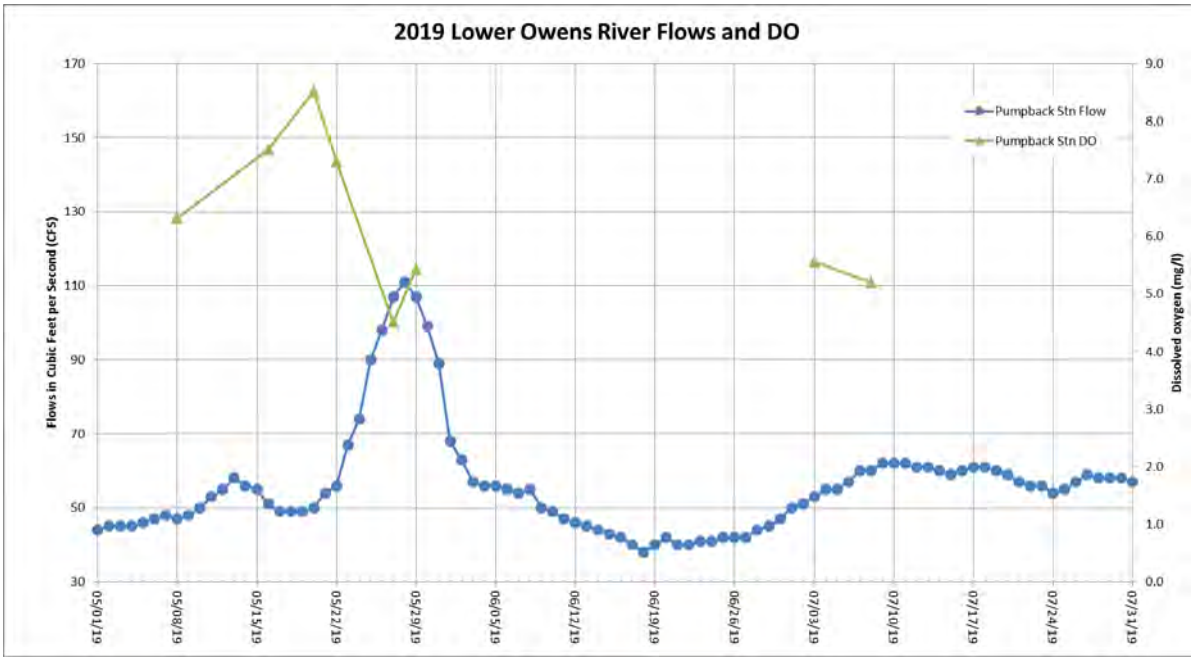
Water temperatures during the SHF ranged from 55-65 degrees Fahrenheit (deg. F). Dissolved oxygen levels ranged from more than 8 mg/L at the LOR Intake to 3.4 mg/L at the Manzanar Bridge. No fish stress or mortality was observed. During the June to early July summer flow ramp-up (required to ensure flows of 40 cfs at the Pumpback Station are maintained during peak summer ET demand), water temperatures ranged from 64-70 deg. F and DO levels ranged from 6.4 mg/L in the LOR at the Blackrock ditch return area to 2.5 mg/L at Manzanar Bridge. Once again no signs of fish stress or mortality were observed. Figures 2, 3, and 4 compare flow versus (cfs) versus DO (mg/L) for Mazourka Bridge, Reinhackle and Pumpback Station. The pattern of lowered DO as flows ramp-up is consistent and of the same relative magnitude as previous year's observations.



Water Quality Figure 2. Lower Owens River Flows and DO.



Water Quality Figure 3. 2019 Lower River Flows and DO.



Water Quality Figure 4. 2019 Lower River Flows and DO.

Additional parameters were recorded with pH values ranging from 8.3 to 7.3 pH units from May to July with the more alkaline waters at both the Intake and Pumpback Stations and the more acidic waters in the reach between Mazourka Bridge and Reinhackle Springs. Slightly depressed (less than 0.5 pH units) pH values were observed at most river reaches during the elevated SHF flows. Specific conductance values ranged from 290 uS/cm to 880 uS/cm. Increasing conductivity of LOR waters from northern to southern reaches was observed throughout the May-July period. At most river reaches, peak conductivities were observed during the elevated SHF flows.

7.0 LORP 2019 EVALUATION

Lower Owens River Project
2019 Evaluation

Volume I: Summary of
Project History and Legal Guidance
Project Implementation
Post-Implementation Management

LA DWP Los Angeles Department of Water & Power

COUNTY OF INYO CALIFORNIA

January 2020

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Acronym/Abbreviation List

BWMA	Blackrock Waterfowl Management Area
DHA	Delta Habitat Area
ICWD	Inyo County Water Department
LADWP	Los Angeles Department of Water and Power
LORP	Lower Owens River Project
MAMP	Monitoring and Adaptive Management Plan
MOU	Memorandum of Understanding
PIA	Post Implementation Agreement

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1. Introduction

It has been 13 years since the Lower Owens River Project (LORP) was first implemented. The project is approaching the end of a prescribed 15 years of monitoring-- monitoring that has provided the LORP Scientific Team and Memorandum of Understanding (MOU) Parties information and insights into physical processes and ecological shifts that have shaped the project. The biological and ecological processes that shape the project appear to have reached a more or less stable condition. The question we need to explore is, is this LORP satisfactory—does it meet the goals assigned the project? If not, what initial presumptions, found to be fully unattainable can we dispense with; and/or what reasonable actions can be taken to achieve goals?

Volume I of this LORP 2019 Evaluation Report outlines the project's history and legal guidance, and briefly summarizes project implementation and post-implementation management. Volume II describes the project's progress relative to management requirements and environmental goals. We evaluate the development of the LORP by describing the successes and challenges that have been observed in the ecosystem and through implementing, operating, and maintaining the project as defined. We also make recommendations as to what monitoring activities or studies might be implemented in the future to answer specific questions that might improve the project. We also recommend in this document adaptive management actions that can be designed and implemented experimentally to attempt to achieve unrealized goals.

1.1 What is the Lower Owens River Project (LORP)?

Through rewatering 62 miles of the Lower Owens River, the Lower Owens River Project (LORP) truly represents one of the most ambitious ecosystem restoration efforts ever undertaken in the western United States. Like most large ecological restoration projects, the LORP is a difficult to manage experiment; nature will do its own things, on its own terms despite the best intentions of its human designers and managers.

The overarching goals of the LORP are "to establish a healthy, functioning Lower Owens River riverine-riparian ecosystem, establish healthy functioning ecosystems in the other physical features of the LORP, for the benefit of biodiversity and threatened and endangered species, and provide for the continuation of sustainable uses including recreation, livestock grazing, agriculture and other activities" (MOU Section II.B.).

The LORP is located in Inyo County, California on City of Los Angeles lands. Within its 78,000 acre boundary are various water features that are managed and maintained as components of the overall restoration effort. There are four primary restoration elements of the LORP: (1) releasing water to the Lower Owens River to enhance native and game fisheries and riparian habitats along 62 miles of river channel; (2) providing water to the Owens River Delta Habitat Area (DHA) to maintain and enhance wetland and aquatic habitats; (3) enhancing the 1,500

acre off-river Blackrock Waterfowl Management Area (BWMA) by creating open-water wetlands in support of waterfowl and shorebirds; and (4) maintaining five off-river lakes and ponds to maintain a recreational fishery and encourage wildlife. In order to maintain sustainable uses of LORP lands, the project specifies development of range management programs, and lays out recreational management strategies.

The LORP was implemented by the Los Angeles Department of Water and Power (LADWP) and the County of Inyo (County) following the certification of the LORP Environmental Impact Report (EIR) in June 2004 by the LADWP Board of Water and Power Commissioners. Flows were released to the project on December 6, 2006 following initial project construction and required base flows of approximately 40 cubic feet per second (cfs) were certified by Inyo County Superior Court in July 2007.

2. Project History and Legal Guidance

2.1 1991 Environmental Impact Report and Inyo/Los Angeles Water Agreement

In 1913, the City of Los Angeles completed the Los Angeles Aqueduct from the Owens Valley to Los Angeles. The primary source of water was surface water diverted from the Owens Valley, and after 1940, to a lesser extent, from the Mono Basin. In 1970, a second Aqueduct was completed by the City of Los Angeles that was supplied from three sources: increased surface diversions and groundwater pumping from Owens Valley and increased surface diversions from the Mono Basin (LADWP and EPA 2004).

In 1972, the County sued the City of Los Angeles under the California Environmental Quality Act (CEQA) to require the LADWP to prepare an Environmental Impact Report (EIR) on its groundwater pumping to supply the second Aqueduct. LADWP was ordered to prepare an EIR. LADWP issued EIRs in 1976 and 1979, but both were found to be legally inadequate (LADWP and EPA 2004).

In the 1980s, the County and LADWP conducted discussions to develop a cooperative water management plan. An interim agreement was executed in 1984 between the County and LADWP, which called for more cooperative studies and certain environmental enhancement projects (E/M projects), including the Lower Owens River Rewatering Project (Rewatering Project), and continued negotiations on a long-term agreement. The Rewatering Project was initiated in 1986 by LADWP and the County. Under the project, 18,000 acre-feet per year was to be released from the Blackrock spillgate to maintain a continuous flow in the Lower Owens River from the Blackrock area to the Owens River Delta. The objective of the project was to improve habitat for waterfowl, shorebirds, and fish in the river corridor and at the Owens River Delta. In addition, water was supplied to the project through various spillgates along the Aqueduct to support the following lakes: Upper and Lower Twin Lakes, Goose Lake, Thibaut Ponds, and Billy Lake (LADWP and EPA 2004).

In October 1991, the County and LADWP approved the *Inyo County/Los Angeles Long Term Water Agreement* (Agreement). Under the Agreement, the LORP was also identified and consisted of rewatering the Lower Owens River below the Aqueduct Intake with an unspecified flow of water, maintenance of off-river lakes and ponds, a pumpback system near Keeler Bridge with a pumping capacity of up to 50 cfs to recover water released to the river and return it to the Los Angeles Aqueduct, with average annual pumping not to exceed approximately 35 cfs. The Agreement provided that a management plan to be developed by LADWP, the County, and California Department of Fish and Game (CDFG, now CDFW) would set the amount of the river flows and water releases to the southern end of the river and the Owens River Delta, maintain existing off-river lakes and ponds, and set forth management to maintain the project elements (LADWP AND EPA 2004).

Subsequently, an EIR for the Agreement was completed by LADWP and the County and issued in 1991 (1991 EIR). It addressed the impacts of all water management practices and facilities associated with the second aqueduct from 1970-1990 and the impacts of projects and water management practices that would occur after 1990 under the Agreement. The Agreement committed LADWP and the County to implement the Lower Owens River Project (LORP). The LORP was compensatory mitigation for impacts related to groundwater pumping by LADWP from 1970 to 1990 that were difficult to quantify.

The 1991 EIR clarified and expanded upon the description of the LORP contained in the Agreement by stating that the pump station was intended to return water to the Aqueduct so a substantially larger flow could be placed in the river without requiring additional groundwater pumping in the valley to make up for the loss and to prevent excessive flows through the Delta onto Owens Lake dry lake bed. The 1991 EIR provided that a 56-mile reach of the river from Blackrock to Lone Pine would be rewatered with a flow of water averaging approximately 35 cfs annually. Seasonal releases of water to wetland areas near Blackrock and the Delta, to supply two major waterfowl management units consisting of approximately 850 acres, were added to the project (LADWP and EPA 2004).

2.2 1997 Memorandum of Understanding

Concerns over the legal adequacy of the 1991 EIR were presented to the Court by state agencies and environmental groups. After several years of settlement discussions among all parties, a Memorandum of Understanding (MOU) was executed in June 1997 that resolved the concerns over the adequacy of mitigation described in the EIR for impacts due to LADWP's water gathering in the Owens Valley from 1970 to 1990. The parties to the MOU are LADWP, the County, CDFW, California State Lands Commission (SLC), Sierra Club, Owens Valley Committee (OVC), and Carla Scheidlinger (hereafter called the "MOU Parties") (LADWP and EPA 2004).

The MOU augmented the Agreement and the 1991 EIR. The MOU added specific goals for the LORP, a timeframe for the development and implementation of the project, requirements that

certain actions be undertaken, and a requirement that a LORP ecosystem management plan be prepared to guide the implementation and management of the project. It also provides certain minimum requirements for the LORP related to flows, locations of facilities, and habitat availability for various wildlife species. The overall goal of the LORP, as stated in the MOU (Section II.B.), 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 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 MOU provides that natural habitats will be created and maintained consistent with the needs of certain Habitat Indicator Species (HIS) through flow and land management in the project area. The MOU identifies the four physical features of the LORP: (1) Lower Owens River Riverine-Riparian Ecosystem; (2) Owens River Delta Habitat Area; (3) Blackrock Waterfowl Habitat Area; and (4) Off-River Lakes and Ponds. A summary of the four physical features of the LORP is provided below:

- *Riverine-Riparian Habitats.* The MOU specifies that a baseflow of 40 cfs will be established throughout the river, an increase from the 35 cfs specified in the Agreement. The MOU also specifies a seasonal habitat flow of up to 200 cfs. The annual amount of the seasonal habitat flow will depend on the runoff amount in Owens Valley each year. The MOU includes goals for certain HIS associated with the river. This element of the LORP also includes a pump station designed to capture water released to the river, and to convey the water to the Los Angeles Aqueduct or the Delta.
- *Owens River Delta Habitat Area.* The MOU specifies that an average annual baseflow of approximately 6 to 9 cfs be released from the pump station to the Delta to enhance and maintain approximately 325 acres of existing habitat, and to establish and maintain new habitats in the Delta. This base flow does not include any flows that bypass the pump station during the seasonal habitat flows in the river. The MOU includes goals for certain HIS associated with the Delta.
- *Blackrock Waterfowl Management Area (BWMA).* The MOU specifies that a 1,500-acre off-river area with a mixture of pasture and wetlands be enhanced through flow and land management to benefit wetlands and waterfowl. Approximately 500 acres of the habitat area are to be flooded at any given time when runoff is forecasted to be average or above average with reductions in water supplies in less than average runoff years. The MOU includes goals for HIS associated with the BWMA.
- *Off-River Lakes and Ponds.* The MOU specifies that existing off-river lakes and ponds near the BWMA be maintained for fisheries, waterfowl, shorebirds, and other animals through flow and land management. The off-river lakes and ponds identified in the MOU are: Billy Lake, Goose Lake, Thibaut Ponds, and Upper and Lower Twin Lakes. The

MOU includes goals for HIS related to the off-river lakes and ponds (LADWP and EPA 2004).

The MOU also requires management of livestock grazing and recreation uses consistent with other goals of the LORP, and contains additional provisions unrelated to the LORP.

2.3 2002 LORP Ecosystem Management Plan

The MOU included a requirement that LADWP and the County direct and assist Ecosystem Sciences, Inc. to serve as the MOU Consultant to prepare and implement the LORP Ecosystem Management Plan (LORP Plan) that would include plans for river management, wildlife and wetlands management, habitat conservation, land management, and monitoring. The LORP Plan was finalized in August 2002. As provided in the MOU, the LORP Plan states that the LORP will be adaptively managed if ongoing monitoring and analysis reveal that such modification is necessary to ensure the successful implementation of the project and the attainment of the project goals (LADWP and EPA 2004).

2.3 2004 LORP EIR

Development of a draft EIR for the LORP began in January 2000 to evaluate the project as described in the 1997 MOU, which augmented the project previously described as the Rewatering E/M Project, and in the Agreement and 1991 EIR.

The U.S. Environmental Protection Agency (EPA) was initially involved in the development of a joint LORP EIR/Environmental Impact Statement (EIS), as the NEPA lead agency who could assist Inyo County in funding/carrying out the LORP. However, disagreements ensued among the MOU Parties over the maximum capacity of the pump station and in order to avoid further delay in the release of the environmental document, LADWP as the CEQA lead agency moved forward in December 2000 and described alternative pump capacities that reflect the differing opinions of LADWP and the other MOU parties. After the publication of the Draft EIR/EIS, the MOU parties continued to hold additional negotiations to resolve the dispute over the two alternatives for the pump station capacity and other issues related to the MOU. In 2004, the MOU parties reached an agreement, and a Stipulation and Order was entered in Inyo County Superior Court in September 2004 (Amended Stipulation and Order, Case S1CVCV01-29768, hereinafter referred to as 2004 Stipulation and Order). The LORP Final EIR (FEIR) was certified by the LADWP Board of Water and Power Commissioners June 23, 2004.

2.3.1 Permits Required for Implementation of the LORP

LADWP obtained and complied with all necessary permits to implement the LORP following the adoption of the LORP FEIR in 2004. These permits included:

- Regional Water Quality Control Board, Lahontan Region- Board Order R6V-2005-0020, NPDES No. CA0103225

- California Department of Fish and Game- Streambed Alteration Agreement 1600-2004-0127-R6
- California State Lands Commission- Lease Agreement PRC 8576.9 for the placement of two stream gages in the Owens River Delta on CSLC property
- Caltrans- Encroachment Permit 0904-NUC 0268 for new power poles to be placed in the state's right of way.
- Bureau of Land Management- Right of way grant CACA 42347 for a new powerline from Cottonwood Power Plant to an existing powerline.

2.4 2004 Stipulation and Order

The 2004 Stipulation and Order further specified the following with respect to the LORP project description:

- The maximum flow to be diverted by the pump station from the river will be 50 cfs.
- LADWP will provide matching funds for LORP saltcedar control equal to the amount obtained by the County up to a total of $1.5 million. Matching funds will be in addition to the funds provided by LADWP for saltcedar control under the Inyo County/Los Angeles Long Term Water Agreement.
- An implementation schedule for the LORP, and requires that the initial release of water be commenced on or before September 5, 2005.

2.5 2005 Court Order

In April 2005, proceedings were commenced to hear motions that LADWP was in violation of the 2004 Stipulation and Order, as the schedule in the MOU for releasing flows to the LORP had not been met. On August 8, 2005, Inyo County Superior Court issued a Court Order that required LADWP to pay $5,000 per day (commencing September 5, 2005) into an escrow account until LADWP established a permanent base flow of approximately 40 cfs in the LORP.

2.6 2005 LORP Funding Agreement

On September 16, 2005, the County and LADWP entered into a settlement agreement (LORP Funding Agreement) whereby LADWP agreed to provide $5,242,965 (with adjustments) to the County. Per the Inyo/LA Water Agreement, the County had an obligation to fund $3.75 million of the LORP implementation costs. The LORP Funding Agreement provides that LADWP will provide a credit to the County in the amount of $2,989,932 and discharged the County's obligation for the payment of $3.75 million for the LORP initial construction costs (LADWP and County of Inyo 2010).

Per the LORP Funding Agreement, $2,253,033 will be a credit held in trust by LADWP; this credit is also known as the LORP Post-Implementation Credit, which will be used to fund the County's half of the LORP post-implementation costs. The LORP Funding Agreement also provides that an escrow account, required to be established by the 2005 Court Order, will be established in the Inyo County Treasury as a trust account, which the County can pay its share of the LORP

post-implementation costs from the trust account after exhausting the post-implementation credit (LADWP and County of Inyo 2010).

2.7 2006 LORP Supplemental EIR

On October 6, 2004, a lawsuit was filed by the Sierra Club challenging the adequacy of the Final EIR with respect to analysis of project impacts on an area described as the brine pool transition area. As a result of the lawsuit, a stipulated judgement was entered in Inyo County Superior Court (Case Number S1CVPT04-37217, Sierra Club v. City of Los Angeles et al., July 25, 2005). The stipulated judgement required LADWP to prepare a Supplemental Environmental Impact Report (SEIR) addressing environmental impacts of the LORP on the brine pool transition area. The draft SEIR was circulated for public review in December 2005. The SEIR focuses on evaluation of the impacts on the brine pool transition area, and includes descriptions of the existing biological resources and hydrologic conditions, descriptions of the change in hydrologic and habitat conditions expected under the LORP, and analysis of potential impact on habitats and wildlife, particularly birds.

No significant impacts on the brine pool transition area were identified as a result of the environmental analysis presented in the SEIR; therefore no revisions were adopted by the Board of Water and Power Commissioners concerning the Final EIR or the Mitigation Monitoring and Reporting Program that was previously approved.

2.8 2007 Stipulation and Order

On July 11, 2007, the parties to the MOU entered into a Stipulation and Order to resolve issues involving compliance with the 2005 Court Order. In the 2007 Stipulation and Order, the Parties agreed that as of July 11, 2007, LADWP had established a permanent baseflow of approximately 40 cfs in the LORP. With the entry of the 2007 Stipulation and Order, LADWP ceased making payments of $5,000/day into the Trust Account (LADWP and County of Inyo 2010).

The 2007 Stipulation and Order also provides for monitoring and reporting of the baseflows throughout the LORP. More specifically, it provides:

- 40 cfs base flow criteria for the Lower Owens River,
- Description for modification to the configuration of the flow measuring stations,
- Guidance on temporary and permanent measuring stations,
- Flow monitoring requirements including real time data,
- Guidance for noncompliance payments for violating base flow criteria, and
- Procedures and timelines for annual LORP public meetings and public review of LORP reports

2.9 2008 Monitoring and Adaptive Management Plan

The MOU requires that data and information be collected and evaluated so that (1) recommendations and decisions are scientifically based, and appropriate changes to

management can be implemented (adaptive management procedures) to ensure that LORP goals are achieved or (2) so that it can be determined if any of the LORP goals are not achievable under the current management paradigm.

The LORP Monitoring and Adaptive Management Plan (MAMP) was finalized by the LORP MOU Consultant (Ecosystem Sciences Inc.) on April 28, 2008. The MAMP describes the methods used to collect baseline data and conduct future monitoring of environmental conditions in the LORP area. Monitoring protocols are described for measuring base and seasonal habitat flows, rapid assessment surveys, habitat monitoring, avian and creel census monitoring, vegetation mapping, and range monitoring. The MAMP describes monitoring methods, data management, data analysis and reporting, quality control, and adaptive management methods for the project for a 15 year period post-implementation (through 2023).

2.10 2009 LORP Post-Implementation Funding Agreement

The commitment of LADWP and the County to jointly fund and operate post-implementation costs and activities of the LORP under the PIA commenced on July 11, 2007, coincident with certification of the base flows and the 2007 Stipulation and Order. The *Agreement Between the County of Inyo and City of Los Angeles Department of Water and Power Concerning Operations and Funding of the Lower Owens River Project* (LORP Post-Implementation Agreement, or PIA) was adopted by the LADWP Board of Water and Power Commissioners on May 18, 2010, by Resolution 010-323, and approved by the Inyo County Board of Supervisors on June 8, 2010. The PIA identifies responsibilities for jointly funding and conducting post-implementation activities required to be undertaken from July 11, 2007 until July 11, 2022. Following July 11, 2022, required flows will continue to be conducted, however the Parties will decide what level of operations, maintenance, habitat monitoring, and adaptive management will be conducted (LADWP and County of Inyo 2010).

During the implementation period, LADWP paid for all costs of implementing the LORP including construction, channel modification, planning, and development work required to implement and initially operate the project, as well as the County's $3.75 million share of LORP implementation costs (per the 2005 LORP Funding Agreement).

Per the PIA Section II.B., post-implementation costs and activities that are the sole responsibility of LADWP include:

- All operation and maintenance costs of the LORP Pump Station, including hydrologic monitoring and data collection and reporting costs, the maintenance of all roads used exclusively to provide access to these facilities, all pipelines, electrical transmission lines, release structures, dikes, dams, flow measuring devices and ponds associated with the facilities
- Design and construction of permanent flow measuring stations

- All costs of monitoring, inspecting, maintaining, and repairing LADWP roads identified in Exhibit A of the PIA, except when road improvements are a result of activities attributable to the LORP
- Funding of up to $50,000 per year for monitoring and control of noxious weeds inside the LORP area, and $150,000 per year for monitoring and control of noxious weeds outside the LORP area that could serve as a seed source for the LORP area for the first seven years of the LORP
- All costs associated with management and monitoring of livestock grazing and utilization in the project area
- Cost of any water supplied to any component or element of the LORP
- All costs associated with the implementation of mitigation measures and with the restoration or repair of facilities or property that were damaged or deteriorated as a result of LORP construction activities during project implementation and/or other activities associated with project implementation
- Payment of Non-Compliance Payment assessed pursuant to the 2007 Stipulation and Order
- Costs of LADWP personnel in the planning and development of work programs and budgets

Per the PIA Section II.C., post-implementation costs and activities that are the sole responsibility of the County include:

- Development of a recreational use plan for the Owens River within the project area
- Development of any campgrounds along the Owens River within the project area
- Except as identified above, the costs of monitoring, inspecting, maintaining and repairing County maintained roads identified in Exhibit A of the PIA
- Payment of any portion of a Non-compliance Payment assessed pursuant the 2007 Stipulation and Order that is attributable to an action or inaction by the County
- Costs of County personnel in planning and development of work programs and budgets

Per the PIA Section II.D., post-implementation costs and activities that are the joint responsibility of LADWP and the County include:

- Costs associated with operating and maintaining the flow measuring stations and the costs of hydrologic monitoring and data reporting associated with the physical features of the LORP identified in Exhibit B of the PIA
- LADWP and the County will each be responsible for one-half of a portion of the annual cost of maintaining ditches and aqueduct spillgates shown in Exhibit C of the PIA
- Annual costs of habitat and water quality monitoring and associated data collection and reporting
- Costs of consultants who assist in LORP related monitoring, data collection, data analysis, and/or reporting
- Costs of monitoring, treatment, and public education for mosquitos, data analysis, and/or reporting

- Costs of monitoring, treatment, and public education for mosquitos arising from the various components of the LORP
- LADWP and the County will each be responsible for one-half the annual costs of maintaining BWMA spillgates, ditches, dikes, berms, ponds, and other features shown on Exhibit D of the PIA
- Costs of beaver control and beaver dam removal
- Costs of salt cedar control that are covered by funding for salt cedar control provided pursuant to Section 6 of the 2004 Stipulation and Order
- Costs associated with preparation of an annual report as required by Section 2.10.4 of the LORP FEIR and by Section L of the 2007 Stipulation and Order
- Costs of permits or environmental assessments associated with conducting any of the activities described in an annual work plan

The PIA Sections II.F-J require LADWP and the County to prepare annual work plans and budgets for the LORP as well as accounting reports to summarize actual costs spent on the project per fiscal year. These reports are subject to approval to LADWP and the County's governing boards annually. The PIA also describes procedures for adjustments to the LORP Post-Implementation Credit and Trust Accounts for the County's portion of payments for the project.

2.11 2010 LORP Routine Maintenance Agreement

The *Long Term Agreement Regarding Proposed Routine Maintenance Activities for the Lower Owens River Project* (RMA) between LADWP and CDFW was finalized and became effective December 29, 2010. The RMA is a long term Streambed Alteration Agreement that allows LADWP to conduct routine maintenance activities in the LORP area that are subject to Section 1602 of the CDFW Code. Activities covered under this agreement include maintenance needed at the LORP Intake Facility, Pump Station, measuring stations, flumes, culverts, obstruction removal, etc., as needed to operate and maintain the project. The LORP RMA expires October 13, 2020; LADWP intends to renew this agreement with CDFW prior to its expiration to continue necessary maintenance activities in the LORP.

3. Implementation of the LORP

3.1 Facility Construction and Other Preparatory Activities

LADWP began reconstruction on the historic Los Angeles Aqueduct Diversion structure in December 2005 (Figure 1). The historic diversion structure was modified to accommodate and accurately record flows of up to 200 cfs. Three radial gates were refurbished and over 300 feet of river channel was lined with concrete (Figure 2). A Langemann flow control gate was installed that has the capability to remotely adjust and ensure accurate flows are being released to the Lower Owens River. The first mile of river channel was cleared of dormant vegetation and sediment plugs to facilitate base flows of 40 cfs (Figure 3). Channel obstructions such as rock and earthen dams were removed throughout the 62-mile river channel. Measuring stations were constructed in ten locations along the river and were calibrated (Figure 4). Beaver trapping and dam removal activities were also implemented. Invasive non-native salt cedar trees and slash were removed from the river channel.

The LORP Pump Station was constructed at the mouth of the Owens River upstream from the Owens River Delta in order to allocate flows up to 50 cfs to the Los Angeles Aqueduct for domestic water supply needs, the Owens River Delta, and the Owens Lake Dust Mitigation Project (Figure 5 and 6).

Physical improvements to achieve the flooded acreage in the BWMA included improvements to existing ditches, berms and spillgates and the addition of a new ditch and water control structures.

Off-river lakes and ponds to be maintained include Billy Lake, Goose Lake, Thibaut Ponds and Upper and Lower Twin Lakes. Minor work was performed to maintain these existing waterbodies as part of the project.

LADWP installed approximately 80 miles of new fencing for grazing and recreation management purposes, including walkthroughs, gates, and designated parking areas. Grazing management plans were implemented on each lease in the LORP planning area to best reach watershed goals and sustain historic livestock use in the Owens Valley. The land management is intended to compliment flow management to facilitate recovery of riparian and riverine habitats. LADWP also installed six kiosks in the project area to inform users of LADWP's day use policies, primary access routes, cultural resources protection, and invasive species prevention.

Capital costs of implementing the LORP were approximately $73.9 million and were paid by LADWP. The photos below document some of the project construction and preparatory activities that occurred.

Figure 1. LORP Intake Construction, looking northwest, February 2006

Figure 2. Concrete lined section at LORP Intake, July 2006

Figure 3. Channel clearing work downstream of the LORP Intake, pre-project

Figure 4. LADWP Construction Crews laying geotextile fabric at one of ten original measuring stations, June 2006

Figure 5. LORP Pump Station Forebay, October 2006

Figure 6. LORP Pump Station during construction, November 2006

3.2 Flow Release and Certification

LADWP released initial project flows into the Lower Owens River from the LORP Intake Structure in December 2006. The 40 cfs base flow was certified by Inyo County Superior Court July 11, 2007, and the first seasonal habitat/flushing flow of 200 cfs was released in February 2008. Figures 7 and 8 illustrate conditions following the initial flow releases for the project.

Figure 7. Aerial view of LORP Intake looking south post construction and release of flows

Figure 8. Aerial view of LORP Pump Station looking north following flow release, February 2007

4. Post-Implementation Management of the LORP

4.1 LORP Workplans and Budgets

The 2004 LORP FEIR Section 2.2.1 states that the Inyo/Los Angeles Technical Group (Technical Group) will develop and adopt an annual work program for the LORP which describes LORP work to be performed in the following fiscal year. LORP Work Plans and Budgets are also prepared according to the LORP PIA sections II.D, E, and F. Following adoption by the Technical Group, the work programs and budgets are submitted to the County and LADWP governing boards for approval. Each governing board must approve the plan and budget before it can be implemented. Work Plans and Budgets include required monitoring tasks identified in the MAMP as well as any Adaptive Management measures that are to be undertaken in a given fiscal year.

The PIA also requires an annual accounting report that describes the work performed pursuant to the previous year's approved Work Plan, and the costs incurred by each Party in performing such work be submitted to the governing board for approval. These accounting reports identify actual costs of the project by both entities since 2009. Table 1 summarizes total actual costs on the LORP that are subject to the PIA since 2009.

Table 1. LORP Fiscal Year Work Plan and Budget Total Actual Project Expenses 2009-2019

Fiscal Year	Hydrologic Monitoring	Biological/ Water Quality*	Operations and Maintenance	Mosquito Abatement	Rodent Control	Noxious Species Control	MOU Consultant	Adaptive Management-County	Adaptive Management-LADWP	Urgent Work (PIA Section 3)-LADWP	Total
2009-2010	$ 196,853	$ -	$ 238,468	$ -	$ -	$ -	$ 71,210	$ -	$ 45,304	$ -	$ 551,835
2010-2011	$ 100,211	$ -	$ 274,992	$ -	$ -	$ -	$ 328,570	$ -	$ -	$ -	$ 703,773
2011-2012	$ 73,373	$ 7,375	$ 92,654	$ 60,000	$ -	$ -	$ 175,424	$ -	$ 115,374	$ -	$ 524,200
2012-2013	$ 149,527	$ -	$ 294,133	$ 60,000	$ 10,100	$ 50,000	$ 179,732	$ -	$ -	$ -	$ 743,492
2013-2014	$ 38,970	$ -	$ 119,540	$ 60,000	$ 8,556	$ 50,000	$ 308,026	$ -	$ -	$ 1,335	$ 586,427
2014-2015	$ 75,590	$ -	$ 200,483	$ 60,000	$ 6,300	$ 50,000	$ 237,569	$ -	$ 87,485	$ -	$ 717,427
2015-2016	$ 62,921	$ -	$ 224,711	$ 35,734	$ 9,000	$ 50,793	$ 137,433	$ -	$ -	$ -	$ 520,592
2016-2017	$ 70,530	$ -	$ 727,695	$ 16,042	$ 10,800	$ 50,000	$ 78,493	$ 10,000	$ 10,000	$ -	$ 973,560
2017-2018	$ 93,720	$ -	$ 170,905	$ 8,696	$ 9,900	$ 50,000	$ 58,780	$ -	$ -	$ -	$ 392,001
2018-2019	$ 68,938	$ -	$ 94,042	$ 36,192	$ 18,000	$ 50,000	$ 52,456	$ -	$ -	$ -	$ 319,628
	$ 930,633	**$ 7,375**	**$ 2,437,623**	**$ 336,664**	**$ 72,656**	**$ 350,793**	**$ 1,627,693**	**$ 10,000**	**$ 258,163**	**$ 1,335**	**$ 6,032,935**

**Biological and Water Quality Monitoring is accounted for with staff time from Inyo County and LADWP. These are considered additional expenses*

4.2 Monitoring and Reporting

The LORP MAMP was finalized in April 2008. The MAMP describes an extensive 15 year monitoring program for each physical element of the LORP, as summarized below.

- *Riverine-Riparian Habitat*: river flow measurements and water quality for base and seasonal habitat flows, flooded extent for seasonal habitat flows, rapid assessment surveys, riparian habitat development monitoring, vegetation mapping, fish habitat suitability, bird monitoring to track diversity with the recovering river.
- *Delta Habitat Area*: Delta flow compliance, wetland habitat development, vegetation mapping, and seasonal habitat flow and aerial surveys, bird monitoring.
- *Blackrock Waterfowl Management Area*: wetland habitat and compliance monitoring, vegetation mapping, bird monitoring.
- *Off-river Lakes and Ponds*: lakes and ponds water surface elevation monitoring
- *Land Use*: range trend monitoring, utilization, irrigated pasture condition scoring

Monitoring is outlined to occur for 15 years upon implementation of the project. Some modifications to monitoring as proposed in the MAMP have been made since project implementation due to various factors. For example, the large scale vegetation mapping efforts were proposed to be conducted every 3 years; this timeline was shifted to coincide with the regular 5 year capture frequency of new aerial imagery. Table 2 below summarizes the monitoring that was conducted each year and summarized in those respective reports.

Table 2. Summary of Monitoring Conducted and Summarized by LADWP and County Staffs and MOU Consultants in LORP Annual Reports

LORP Annual Report Year											
Annual Report Chapter	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Hydrologic Monitoring	X	X	X	X	X	X	X	X	X	X	X
Seasonal Habitat Flow	X	X	X	X	X						
Water Quality	X	X	X				X	X		X	
Rapid Assessment Survey	X	X	X	X	X	X	X	X	X	X	X
Land Management	X	X	X	X	X	X	X	X	X	X	X
Weed Control	X	X	X	X	X	X	X	X	X	X	X
Salt Cedar	X	X	X	X	X	X	X	X	X	X	X
Adaptive Management Recommendations	X	X	X	X	X	X	X	X	X	X	X
BWMA - Avian Census/HIS			X	X				X	X	X	X
BWMA - Landscape Vegetation Mapping			X					X			X
DHA - Avian Census/HIS		X				X					X
DHA - Landscape Vegetation Mapping		X				X					X
River - Avian Census/HIS †			X					X		X	X
River - Landscape Vegetation Mapping			X					X			X
River - Site Scale Vegetation Mapping			X								
Fisheries - Creel Census			X	X		X	X				
Fisheries - Fish Habitat			X								
Woody Recruitment					X						
Flow Modeling					X						
Alabama Gates Flow Releases						X					
Tule Management and Control							X				
Analysis of Conditions of the Islands East Side Channel										X	
Adaptive Management - Pole Planting of Tree Willow and Cottonwood										X	
Woody Recruitment Success											X

†: A graduate student collected additional avian data in 2017 as part of a MS thesis. Inyo and LADWP have those data.

4.3 Adaptive Management

LADWP and Inyo County have implemented several adaptive management measures in the LORP since implementation. Table 3 summarizes this work by fiscal year and provides costs expended on these additional projects. The text that follows describes each of these projects in more detail as well as Urgent Work performed pursuant to the PIA following a wildfire in 2013.

Table 3. LORP Adaptive Management Implemented to Date per Approved Budget/Work Plans

Fiscal Year Work Plan	Project/Task	Description	Costs		
			Inyo	LADWP	**Total**
2009-2010	Delta Habitat Area Flow Assessment	Assessment of change in vegetation composition and cover since implementation; conducted by MOU Consultant.	$ -	$ 45,304.00	$ 45,304.00
2011-2012	Development of a River Flow Model	Develop a HEC-RAS model for the five channel reaches using available data; contracted through Northwest Hydraulic Consultants (NHC).		$115,374.00	$115,374.00
2014-2015	Prescribed Burns for Winterton and Waggoner Units in the BWMA	Conduct prescribed burns in the Winterton and Waggoner Units of the BWMA to remove emergent vegetation and weeds and to prepare the areas for flooding in management rotation.		$ 79,815.00	$ 79,815.00
2016-2017	Pilot Pole Planting Project	Implement a pilot pole planting project to assess feasibility of actively developing stands of tree willow and cottonwood in the LORP; contracted through the Landscape Center.	$10,000.00	$ 10,000.00	$ 20,000.00
		Total	**$10,000.00**	**$250,493.00**	**$260,493.00**

2009-2010 Delta Habitat Area Flow Assessment

An assessment of the DHA flows was identified as an adaptive management measure in the 2009-2010 LORP Work Plan and Budget in order to evaluate how the flows have influenced vegetation cover and composition since project implementation. For this task, the MOU Consultants conducted an in-depth study of vegetation in the DHA using past satellite imagery coupled with ground-truthed information, flow data, and comparisons to baseline conditions.

The assessment was designed to provide insight to DHA changes and allow for adaptive management decisions related to modification of seasonal pulse flows as necessary. The MOU Consultants submitted their report in November 2009.

2011-2012 Development of a River Flow Model

The MOU Consultants recommended the development of a Lower Owens River Flow Model in their 2010 Adaptive Management Recommendations. The 2011-2012 LORP Work Plan and Budget was approved by the Technical Group in February 2011 but was amended in June 2011 to include an agreed upon scope of work for Northwest Hydraulic Consultants (NHC) to develop a HEC-RAS flow model for each of the five channel reaches.

Using available data, NHC developed a model for the LORP capable of simulating steady and unsteady flows that utilized sediment transport analysis, water temperature modeling, and hydraulic design of stable channels. The model was developed to represent existing channel topographic and vegetation conditions, and was calibrated using observed streamflow, inundation, and stage data. The flow model was completed in 2012. Results were included in the 2012 LORP Annual Report.

2014-2015 Winterton/Waggoner Prescribed Burns

Prescribed burns in the Winterton and Waggoner Units of the BWMA were identified as adaptive management in the 2014-2015 LORP Work Plan and Budget in order to remove emergent vegetation and weeds and to prepare the areas for flooding in management rotation. Both units were prepared for burning but a burn ban prevented the burns from occurring during the 2014-2015 fiscal year.

Preparation work conducted by LADWP included disking of firebreaks around the units, disking of tule beds within the units, and handwork for burn preparation around fence posts, measuring stations, and other facilities in/around the burn area. Although the burns were not conducted, costs of the burn prep and disking work were beyond the $79, 815 budgeted in the Work Plan. The Winterton Unit was returned to service in 2015.

2016-2017 Pilot Pole Planting Project

The managed flow regime of the Lower Owens River is inadequate to provide fluvial disturbances large enough to scour the river and deposit muck and mud on the floodplain. Such disturbance is a critical process in riverine systems and lays the groundwork for diversifying the floodplain; including stimulating the recruitment of trees. Flood-susceptible infrastructure, such as road crossings, Owens Lake flow restrictions, pumpback limitations, and legal constraints of the MOU don't allow the release of flooding flows of the magnitude needed for dynamic processes leading to large-scale recruitment of trees on the Lower Owens River. Given these management and infrastructure constraints, the majority of the floodplain along the Lower Owens River can be considered relic—detached from river processes.

Some natural recruitment is occurring around the wetted features of the LORP, but at a very small-scale. Overall the LORP has shown a net loss of trees. If a gain in tree canopy is a desired project condition then tree planting is one possible solution.

In the 2016-17 LORP Work Plan, Inyo County and LADWP agreed to a pilot pole planting project (planting of fresh cut stems at groundwater depth) to actively develop stands of tree willow and cottonwood along the Lower Owens River. The goal of this effort was to augment existing seed sources and boost natural recruitment. If the pilot project proved effective, third-party funding for additional planting might be sought by Inyo County. Pole planting has been successfully implemented in other areas of the Owens Valley.

The area chosen for the experiment was a section of the relic floodplain just north of Highway 136. The planting site was chosen for its ease of access, favorable soils, and a variety of landforms and hydrologic features. The river banks in the area had been dominated by large mature woody trees, but a wildfire swept through the area in 2013 affected most of the mature trees. Some of the burned trees reestablished through vegetation sprouting from basal buds, but their tree form has been lost and their ability to contribute seed diminished. The project included planting 576 individual trees in 12 groves (Figures 9-11). The poles were staked and surrounded with protective covers to aid their establishment. The work was contracted to The Landscape Center (Riverside, California) at a cost of $20,000. Planting sites were selected based on expected depth to water, proximity to the river, and locations relative to relic landforms. Methods used to install the poles were based on restoration research and case studies (Dreesen 2002). Individual plants were mapped and identified by grove and species.

Figure 9. Drilling planting holes. Up to 30 poles, supports, and plant protectors were installed per hour

Figure 10. Fresh cut dormant willow and cottonwood pole stock

Figure 11. Tree willow and Cottonwood installed along the Lower Owens River near Keeler Bridge, March 23, 2017

Despite successful installation, historically high runoff in 2017 required releasing high flows into the Lower Owen River. In the planting project area, flows are typically 40-50 cfs year-round with a high flow ramped up to 90 when a seasonal habitat flow is released. Flows in 2017 were greater than 200 cfs (recorded 4.6 miles downriver). As a result, the majority of the planting sites experienced flooding for an extended period of time (June 20 to August 15 (47 days) (Figure 12). Newly planted poles can accommodate fluctuation in groundwater, but cannot

survive prolonged inundation. Conditions were such that most trees died. Only three trees located on higher landforms have survived as of 2019.

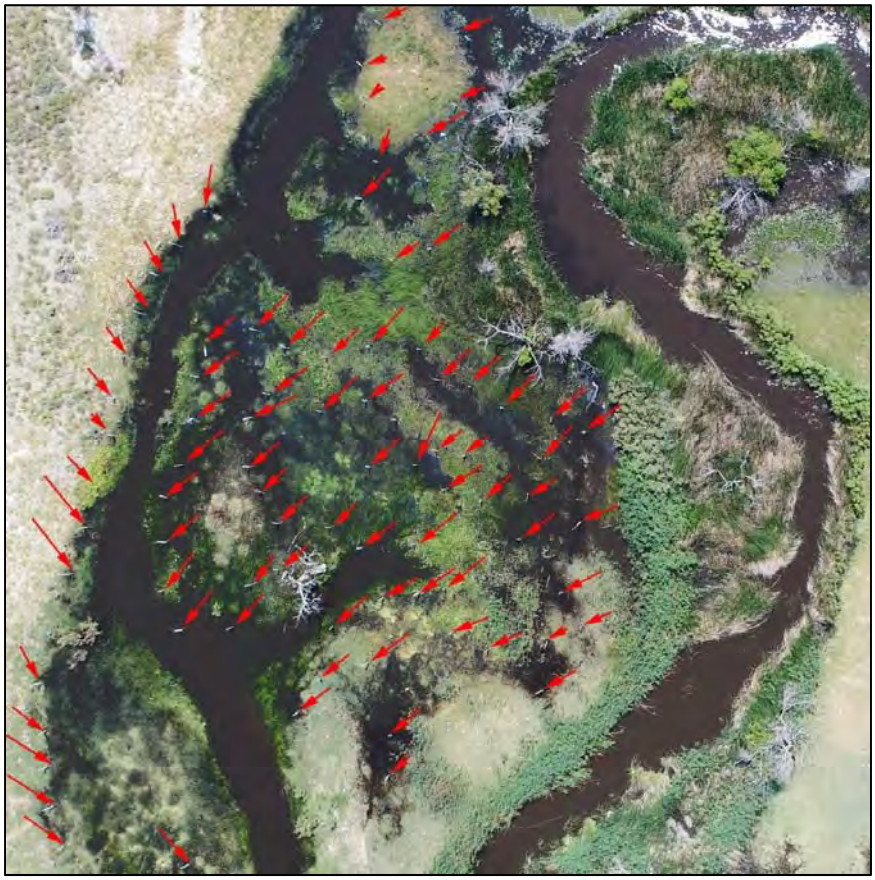

Figure 12. White plant protectors (arrows) housing pole plantings are seen above floodwaters during 190 cfs flow near Keeler Bridge, July 7, 2017

Urgent Work - River Fire Post-Burn Response (2013)

The week of February 23, 2013 a wildfire designated the River Fire burned approximately 400 acres of the riparian corridor along the Lower Owens River east of Lone Pine (Figure 13). In response LADWP and Inyo County invoked Section II.H. of the PIA (Urgent Work) that allows an adaptive management response to occur that is outside the approved annual LORP Work Plan. Urgent work: removing cattle from floodplain; removing beaver dams and tule mats with a tracked excavator; releasing the March/April Delta Pulse Flow (10 days at 25cfs) from the LORP Intake; coordinating clean-up with a community group (Figure 14); closing roads to the floodplain; signing road closures; collecting tree willow seed during seed fly and distributing during the seasonal habitat flow; planting 30 pole cuttings in an exclosure; and monitoring range conditions.

Figure 13. River Fire overview. February 27, 2013

Figure 14. Volunteers led by Inyo County staff, Jerry Zatorski, set out to reseeding sites. May 31, 2013

Lower Owens River Project
2019 Evaluation

Volume II: Status of the LORP

LA DWP Los Angeles Department of Water & Power

COUNTY OF INYO CALIFORNIA

January 2020

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Acronym/Abbreviation List

BWMA	Blackrock Waterfowl Management Area
DHA	Delta Habitat Area
ICWD	Inyo County Water Department
LADWP	Los Angeles Department of Water and Power
LORP	Lower Owens River Project
MAMP	Monitoring and Adaptive Management Plan
MOU	Memorandum of Understanding
PIA	Post Implementation Agreement

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1. Current Status of the LORP- Where Are We Now?

Volume I describes how the LORP was developed, including the legal guidance that directs LORP administration. Volume II will describe the effort that has been completed in implementing, operating, monitoring, and maintaining the project. It also evaluates the project relative to management requirements and environmental goals based on monitoring data and staff observations that combined give us an indication of LORP successes and challenges.

Many goals have been reached through implementation of the project, as expected; however, some goals have been more difficult to attain. There is a comprehensive list of goals and requirements defined in the guiding documents that were intended to achieve ecological goals in the LORP. However, some of these goals are incompatible in practice, and/or do not seem feasible following implementation and after operating and maintaining the project as described for many years. Following the actions/requirements prescribed in the guiding documents has not always led to the outcomes envisioned. After 13 years project managers are reaching decision points. What can we or might we do to manage the project into the future? This is in part because several LORP goals are broad and largely unquantifiable so, the measure of project success depends on interpretation of the guiding documents. It is appropriate and timely to assess the project status as the 15-year timelines identified in both the LORP Post-Implementation Agreement and Monitoring and Adaptive Management Plan are quickly approaching (2021 and 2023, respectively). The purpose of this evaluation is to chart a path forward for continuing management of the project.

Volume II is written to follow the goals as described in the MOU following the physical features of the LORP, then additional goals that apply to the entire project area. Each section is structured to:

(1) identify each goal and/or requirement,
(2) describe relevant progress to date (including successes and challenges),
(3) provide current status of whether or not this goal/requirement is being met, and
(4) supply recommendations for managing the project differently, if any.

Where applicable, additional goals/requirements identified in subsequent Stipulations and Orders or other legal documents are also integrated by physical feature. Volume II provides a quick reference table to summarize this information before describing next steps for LADWP, the County, and the MOU Parties.

1.1 Riverine Riparian Habitat Goals/Requirements

The overall concept for the riverine-riparian area is the establishment of a healthy, functioning Lower Owens River for the benefit of biodiversity and threatened and endangered species. MOU Section II.C.1.a states “the goal for the Lower Owens River Riverine-Riparian System is to create and sustain healthy and diverse riparian and aquatic habitats, and a healthy warm water

recreational fishery with healthy habitat for native fish species. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species" for the riverine-riparian system. These habitats will be as self-sustaining as possible." The MOU goes on to describe a flow regime with a 40 cubic foot per second (cfs) base flow and seasonal habitat flow up to 200 cfs annually for the project.

1.1.1 Riverine Riparian Base Flow of 40 cfs

Goal/Requirement

- MOU Section II.C.b.i.: "A base flow approximately 40 cfs from at or near the Intake to the pumpback system to be maintained year round."
- MOU Section II.C.iii.: "A continuous flow in the river channel will be maintained to sustain fish during periods of temporary flow modifications."
- 2007 Stipulation and Order Section E. 40 cfs Baseflow Criteria: "Upon entry of this Stipulation and Order as an order of the Court, baseflows shall be deemed in compliance with this Stipulation and Order as long as each of the following conditions in the Lower Owens River exists:
    1) A minimum flow of 40 cfs is released from the Intake at all times;
    2) None of the 10 in-river flow measuring stations described in Section F. below has a 15 day running average of less than 35 cfs;
    3) The mean daily flow at each of the 10 in-river measuring stations must equal or exceed 40 cfs on at least 3 individual days per any continuous 15 day period, except that this requirement shall not apply to the flow measuring stations at Reinhackle Springs and Lone Pine Narrow Gage Road between November 1 and April 30 of each runoff year;
    4) The 15 day running average of the 10 in-river flow measuring stations is no less than 40 cfs."
- The 2007 Stipulation and Order Section G also outlines monitoring and reporting requirements for LADWP regarding LORP baseflows, and Section F describes when payments are required if LADWP is out of compliance with the flow guidance in Section E of the 2007 Stipulation and Order (described above).

Progress to Date

LADWP constructed ten original measuring stations in the LORP during initial project construction at the following locations: Intake, Owens River above Blackrock Ditch Return, Owens River east of Goose Lake, Owens River at Two Culverts, Owens River at Mazourka Canyon Road, Owens River and Manzanar Reward Road, Owens River at Reinhackle Springs, Owens River at Lone Pine Narrow Gage Road, Owens River at Keeler Bridge, and the Pumpback Station.

Construction included installing a Langemann gate at the LORP Intake for very accurate flow release and measurement as well as removing channel obstructions in the first mile of river

channel downstream of the Intake. First flows to the project were released in December 2006 and the 40-cfs baseflows were certified by Inyo County Superior Court in July 2007.

In July 2009, the Standing Committee designated the four permanent monitoring stations for the project to be at the Intake, Owens River at Mazourka Canyon Road, Owens River at Reinhackle Springs, and the LORP Pump Station. LADWP operations staff releases the required flows, and conducts the monitoring and reporting following the guiding legal documents.

On average, LADWP releases more than 40 cfs at the LORP Intake to meet the baseflow requirement at the four measuring stations within the project. Flow data is provided in the Hydrologic Monitoring chapters of the 2008-2018 LORP Annual Reports for each respective year. Real time flow data can be found at http://wsoweb.ladwp.com/Aqueduct/realtime/owensrealtime.htm.

Successes

Restored Ecological Value/Expanded Riparian Vegetation
Rewatering the Lower Owens River has been beneficial in promoting primarily marsh and meadow/wet meadow vegetation communities and new habitat for aquatic and wildlife species (LADWP and County of Inyo 2018).

Legal Compliance
LADWP has been able to consistently release, monitor, and report on the LORP baseflows in compliance with the legal requirements described above. Infrastructure is functioning as designed; allowing accurate flow monitoring and water releases that consistently meet flow requirements with few short-lived exceptions.

Challenges

Tule Encroachment, Compromised Water Quality
The low gradient and low stream power of the Lower Owens River combined with a relatively invariable flow that is lower than had existed pre-settlement has resulted in predictable consequences related to aggradation, including the increased extent of cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acut*us). Growth of emergent aquatic vegetation has resulted in reduced open water habitat, slowed river flows, increased evapotranspiration, provided competition for other riparian species, and reduced access for recreationists and other visitors. Moreover, emergent vegetation has occluded the river in some areas rendering it largely unnavigable.

Consequently, during the summer months, up to 90 cfs now must be released at the LORP Intake to achieve a continuous flow of 40 cfs throughout the length of the river. Reduced flow velocity due to tule encroachment decreases the river's sediment carrying capacity and lack of sediment transport leads to aggradation. In addition, decomposing tules increase organic matter accumulation in the in the river. These processes are self-reinforcing.

The current flow releases are insufficient to alleviate accumulated organic matter and degraded water quality that endangers the fishery. During the warmer months, dissolved oxygen levels can decline to concentrations that kill fish and invertebrates. This happens when organic material is entrained by higher flows and aerobically decomposed. Hydrogen sulfides, which are a toxic by-product of decomposing organic matter, can also be released into the water when organic material is stripped from the channel bed by high flows.

Current Status

Baseflow requirements of the LORP are currently being met as described in the guiding legal documents and both aquatic and riparian vegetation have increased along the river corridor since the baseflows were initiated. However, the 40 cfs baseflow has also resulted in tule encroachment throughout much of the river and has left much of the river unnavigable for recreation. Proposals have been made by LADWP, the County, the MOU Consultants and the MOU parties to modify the LORP flow regime and to experiment with alternate seasonal hydrographs to potentially improve the outcome of the channel vegetation or water quality conditions. However, LADWP required that any experiments with changing seasonal hydrographs were to be water neutral so that if volumes of water were needed that exceeded the pumpback station's capacity, the capacity would need to be increased so that the water would not be lost to the Delta and Owens Dry Lake. The MOU Parties would not agree to an increase in the pumpback station capacity, and proposals to experiment with larger volumes of water were not developed further owing to this impasse between LADWP and the MOU parties. The County would like for the LORP Scientific Team to continue exploring alternate hydrographs to help meet LORP goals.

Continuing to manage the project under current court-mandated requirements will maintain existing riparian and aquatic vegetation, but adaptive management will be limited in its effectiveness. Current baseflows will therefore not improve project conditions related to vegetative encroachment and low dissolved oxygen.

Aggrading conditions on the LORP have resulted in a static-wetland functional trajectory rather than a dynamic river system which has encouraged dominance of hydric vegetation (tules) as described above. This long term trajectory is a primary concern but also very difficult to alter. The introduction of a consistent baseflow, particularly in dry reaches of river which began to support riparian trees within the LOR channel, has led to inundation and significant riparian tree loss in sections of the river. This is inconsistent with LORP goals and pre-project predictions of an increase of 854 acres of riparian forest (LADWP and EPA 2004).

Recommendations

The LORP Scientific Team should continue exploring flow management that may help meet LORP goals.

1.1.2 Riverine Riparian Seasonal Habitat Flow of Up to 200 cfs

Goal/Requirement

- MOU Section II.C.b.ii.: "A seasonal habitat flow. It is currently estimated that in years when the runoff in the Owens River watershed is forecasted to be average or above average, the amount of planned seasonal habitat flows will be approximately 200 cfs, unless the Parties agree upon an alternative habitat flow with higher unplanned flows when runoff exceeds the capacity of the Los Angeles Aqueduct[…] In years when runoff is forecasted to be less than average, the habitat flows will be reduced from 200 cfs to as low as 40 cfs in general proportion to the forecasted runoff in the watershed…"

  This section continues: "The purpose of the habitat flow is the creation of a natural disturbance regime that produces a dynamic equilibrium for riparian habitat, the fishery, water storage, water quality, animal migration and biodiversity which results in resilient and productive ecological systems. To achieve and maintain riparian habitats in a healthy ecological condition, and establish a healthy warm water fishery with habitat for native species, the plan will recommend habitat flows of sufficient frequency, duration, and amount that will:
  1) minimize the amount of muck and other river bottom material that is transported out of the riverine-riparian system, but will cause this material to be redistributed on banks, floodplain and terraces within the riverine-riparian system and the Owens River Delta for the benefit of vegetation;
  2) fulfill the wetting, seeding, and germination needs of riparian vegetation, particularly willow and cottonwood;
  3) recharge the groundwater in the streambanks and the floodplain for the benefit of wetlands and the biotic community;
  4) control tules and cattails to the extent possible;
  5) enhance the fishery;
  6) maintain water quality standards and objectives; and
  7) enhance the river channel."
- 2004 LORP FEIR Section 2.3.5.3 provides additional guidance on how the volume of water for the Seasonal Habitat Flow (SHF) and ramping schedules are determined based on runoff conditions.

Progress to Date

LADWP has implemented the SHF as described in the MOU and LORP FEIR since implementing the project. Table 1 shows annual runoff forecast since 2007, required and actual peak SHFs that were released, start dates, and number of days in ramping schedule by year based on this guidance.

Table 1. LORP Seasonal Habitat Flows by Year (2007-2019)

LORP Seasonal Habitat Flows					
Runoff Year	**Runoff Forecast (% normal)**	**Required Peak Flow (cfs)**	**Actual peak (cfs)**	**Start date**	**# days in Ramping Schedule**
2007-2008	58%	N/A; base flow establishment	N/A	N/A	N/A
2008-2009	86%	210- winter pulse flow	220	2/13/2008	14 day
2009-2010	71%	105	110	5/24/2009	9 day
2010-2011	95%	200	209	6/25/2010	12 day
2011-2012	150%	200	205	6/16/2011	14 day
2012-2013	65%	88	92	5/29/2012	7 day
2013-2014	54%	53	58	5/21/2013	4 day
2014-2015	50%	40 (no SHF)	N/A	N/A	N/A
2015-2016	36%	40 (no SHF)	N/A	N/A	N/A
2016-2017	71%	107	106	5/17/2016	10 day
2017-2018	197%	274- spring flushing flow	274	3/29/2017	
		200	200	5/2/2017	14 day
2018-2019	78%	130	130	6/1/2018	12 day
2019-2020	137%	200	200	5/9/2019	14 day

Beginning in 2008 the MOU Parties began to discuss changing the flow regime for the LORP for one year including the seasonal habitat flows and modifications to the pump station to accommodate such changes. The intent was to provide some flexibility in flows provided to the LORP while staying within the water volume approved by the LADWP Board of Water and Power Commissioners when they adopted the LORP EIR and flow release requirements (time and duration of flow prescribed releases results in volume of water). Discussions eventually broke down in 2012 when the MOU Parties could not reach a unanimous agreement on amending the pumpback station capacity. SHF (and base) flows have met or exceeded the required flow amounts.

Successes

Groundwater Recharge, Fishery and River Channel Enhancement

The SHF have effectively recharged the shallow ground water in the vicinity of the river channel. Surface water recharge to groundwater during peak flows creates a temporary water mounding effect that slowly releases comparatively cooler groundwater to the river during the ensuing warm summer months. Also, high flows allow fish to transit portions of the river that are inaccessible during the standard flow regime and, thus, provide new areas for habitation. As documented by the elevated conductivity and turbidity measurements during SHF, some transport of river sediments in solution or, to a lesser degree, in suspension is occurring. Finally,

high flows cause localized changes in channel shape and form, through scour and deposition, and in turn, allow different organisms to colonize these disturbed areas.

Legal Compliance

LADWP has been able to successfully implement, monitor, and report on the SHF annually as described in the guiding documents.

Challenges

Failure to Mobilize Sediments through the Riverine System

Both seasonal habitat flows and base flows are sufficient to mobilize some sediment in the river. However, this mobilization is limited to localized portions of the river, where open channel exists and stream velocities are relatively high (NHC 2012). However, this mobilization is limited to the portions of the river where open channel exists and stream velocities are relatively high. Primarily such conditions occur in the upper reaches of the river and explaining why tules have not expanded into the channel in those areas. However, for most of the river, because of the high density of tules in the channel, velocities are too low to effectively mobilize sediment except locally.

Limited Woody Recruitment

While the SHF has been effective in wetting the banks in the floodplain and recharging the water table, it has not proven to be an effective means of establishing woody recruitment to the level that was suggested in the LORP FEIR.

The LORP FEIR suggested that "new riparian forest would be created as willows and cottonwood colonize barren streambars, mostly in the dry reach above Mazourka Canyon Road and, less extensively, existing wetlands and riparian habitats along the wet reach of the river to the south. It was estimated that an additional 854 acres of riparian forest will be created over time. However, given the extensive existing and future flooding and the absence of streambars necessary for establishing new riparian forest in the Lower Owens River, these estimates may be optimistic" (LADWP and EPA 2004).

Comprehensive Rapid Assessment Survey (RAS) results from twelve consecutive years (2007-2018) showed a much slower tree establishment rate than what was predicted in the LORP FEIR. Successful recruitment events occurred on average at 6 locations per mile on the upper half of the LORP and less than one successful establishment site per mile along the lower half of the LORP (LADWP and County of Inyo 2019: 7-1). Rather than an increase in trees in response to LORP implementation, mapping efforts in 2018 show a decline in riparian trees from 449 acres in 2000 to 190 acres in 2017. This decrease in trees is outpacing the rate of successful recruitment events and indicates a decline in woody riparian trees following the implementation of the LORP. The LORP Scientific Team has experimented with the timing of seasonal habitat flows, with reduced livestock grazing intensities in riparian zones (based on the assumption that decreased herbivory would facilitate woody recruitment), and with limited willow tree plantings. None of these efforts have proven successful in reaching the additional

854 acres of riparian forest predicted in the LORP FEIR. The aim to establish 854 acres of additional riparian forest from LORP implementation is proving to be improbable if LORP activities continue to be limited to passive management of flows and livestock grazing. Active restoration of riparian vegetation in the southwest has increasingly implemented deep-planting techniques that connect the root ball of the plant to the capillary fringe of the water table minimizing or reducing the need for irrigation. The County would support a pilot project in areas where tree recruitment has been successful to test the efficacy of these methods in increasing tree cover on the LORP.

Failure to Control Cattails and Tules through SHF

The SHF as designed has not been effective at "controlling" tules and cattails in the river. It was originally proposed that reintroduction of flows would be sufficient to remove and prevent the re-colonization of tules along reaches with extant tules (LADWP and EPA 2004). It was suggested tule dominance would be precluded by adequate scouring and drowning by the proposed flows and also shading from the newly established riparian tree canopy. None of these suggestions came to fruition however (LADWP and County of Inyo 2014).

Results from an aerial-photo analysis (years 2000 to 2017) show that since 2000 (pre-project conditions), marsh has occupied approximately half to two-thirds of the total LORP area, with overall acreage almost doubling from 765 acres in 2000 to 1433 acres in 2017 (Figure 1 from LADWP and County of Inyo 2018). Unfortunately, also during this period, tree canopy has declined by approximately 60%, and has been replaced by increases in marsh, a simultaneous near doubling of wet meadow, or increases in water via inundation (LADWP and County of Inyo 2018). The overall extent of riparian shrub cover, such as coyote willow, has remained relatively constant by comparison.

It is evident that after 15 years since the inception of the LORP, that flow management alone, as implemented per the guiding documents, is insufficient to control and/or reduce tules nor is it effective at promoting conditions suitable for tree willow establishment. Consequently, marsh will continue to be the dominant vegetation type if flow regimes and management actions remain unchanged.

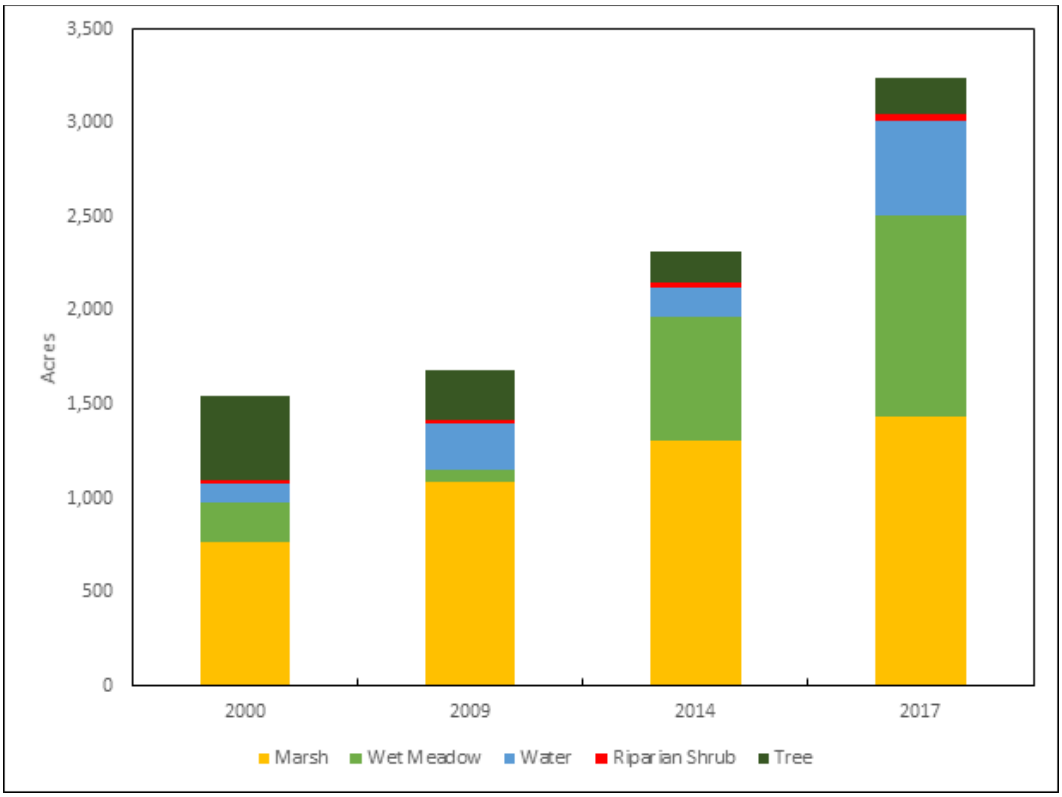

Figure 1. Trends in riparian vegetation from 2000 to 2017 in the LORP riverine-riparian area (LADWP and County of Inyo 2018).

Compromised Water Quality/Fish Kills

The 2004 FEIR suggests that degraded water quality would likely be a limiting factor in the LORP during the first several years of the project and that no feasible mitigation existed. The poor water quality is related to both low dissolved oxygen and elevated hydrogen sulfide concentrations which can lead to fish stress and mortality. To minimize the impacts to water quality, the FEIR recommended that management of flows be utilized, but also stated that some deleterious effects on water quality were unavoidable. Further, it was stated that once riparian vegetation matured, steady-state flows were achieved, and organic material on the channel bed was removed, that water quality would improve (Ecosystem Sciences 2002 and 2004).

Increased marsh vegetation promotes biomass accumulation within the LORP river channel. These deposits of organics, when disturbed by high flows, are re-suspended into the water column and aerobically decomposed by bacteria, rapidly depleting available oxygen in the water. This situation is exacerbated in the summer due to the inverse relationship between water temperature and dissolved oxygen solubility concentrations and increased microbial activity. Additionally, hydrogen sulfide can be released when channel bed sediments are disturbed. We have learned that high flows should not be released during the warmer months if at all possible. Water quality data collected during the past decade indicate that increased flows

when water temperature exceeds 70 degrees Fahrenheit can lead to depressed dissolved oxygen levels, fish stress, and fish mortality. The administrative requirements that hamper releasing the seasonal habitat flow earlier should be fixed.

Seven major fish kills (related to low dissolved oxygen and/ or elevated hydrogen sulfide concentrations) have been documented in recent history: 1969, 1986, 1989, 1993, 2010, 2013 and 2017 (ICWD 2014). It is worth noting that 4 of the 7 fish kills occurred prior to the implementation of the LORP, indicating that poor water quality was an inherent characteristic of the river during this time period. Low DO conditions will likely continue periodically within the LORP due to the continued accumulation of organic material in the river. However, previous fish kills and subsequent recovery has shown that the fishery is resilient and is able to recover from these low DO events without the need for restocking.

Current Status

Implementation of a SHF up to 200 cfs has been a benefit to the LORP by annually increasing bank storage, transporting some sediment either through solution or in suspension, and increasing the available fish habitat. LADWP is meeting the mandated SHF requirements as specified in guiding documents. However, flows up to 200 cfs have proven ineffective in moving sediments throughout the system, facilitating tree recruitment, controlling tules, and has caused poor water quality in the river when releases coincided with seasonally-high water temperatures above approximately 65-70 degrees F). LADWP, the County, and the MOU Consultants have proposed flow regime modifications, but these proposals were not unanimously agreed to by the MOU Parties and thus were not implemented.

The current seasonal habitat flows will continue to meet court mandated guidelines but will likely fail to substantially improve project conditions.

Recommendations

It is recommended that LADWP and the County continue to follow the guidance in the MOU and LORP FEIR regarding volume and ramping rates of the annual SHF. However, it is recommended that the SHF be released in the early spring when LOR water temperatures are typically below 70 degrees F, reducing the probability of a fish kill due to lowered dissolved oxygen levels.

The MOU goal of “fulfilling the wetting, seeding and germination needs of riparian vegetation, particularly willow and cottonwood” (MOU 1997), which involves channel scouring and sediment deposition (Ecosystem Sciences 2008) to allow for woody riparian tree recruitment has not been met. Inyo staff recommends the LORP Scientific Team develop a pilot project to establish new and enhance existing riparian forest, which by necessity will include adaptive - and active - management. A plan could include a systematic pole-planting or seeding approach to test several viable locations along the river, including: 1) sections of reaches 2 and 3 (formerly dry channel) predicted to support woody recruitment (LADWP and EPA 2004), 2)

areas which currently support or have supported riparian forest, or 3) sections of remnant floodplain with appropriate groundwater availability and soil salinity. LADWP is in support of limited pole planting in the project area through outside funding or volunteer efforts should they become available.

1.1.2.1 Consultation with CDFW on Setting Annual SHF

Goal/Requirement

MOU Section II.C.b.ii and PIA Section II.O.5.a define the purpose and process for setting the seasonal habitat flows each year. In LORP FEIR Section 2.3.5.3 Chart 2-1 and Chart 2.2 further define SHF flow amounts and schedule in relationship to the annual Eastern Sierra Runoff Forecast. Although seasonal habitat flows are clearly defined in the FEIR's charts, this section delegates final approval of the flows and schedule to the Inyo Los Angeles Standing Committee. As currently implemented, LADWP develops its annual Eastern Sierra Runoff Forecast by mid-April, LA and ICWD staff consult Charts 2-1 and 2-2 to determine flow amounts and timing, discuss these flows during a 10-day consultation process with CDFW, and then agendize final SHF approval for the May Standing Committee meeting.

Progress to Date

LADWP and the County have followed this procedure as directed. As written the earliest date that the SHF can be released is following CFDW consultation and ensuing Standing Committee approval in early May One of the original intents of a May/June seasonal habitat flow was to coincide with the spring cottonwood seed fly to promote woody recruitment along the riverine-riparian corridor. However, it has been demonstrated that SHF alone do not lead to woody recruitment. Releasing SHF in May/June coincides with elevated water temperatures that, when combined with increased microbial oxygen demand related to SHF sediment disturbance, can lead to detrimental water quality conditions. Therefore, an earlier SHF release would take advantage of cooler spring water temperatures with corresponding higher dissolved oxygen levels, which could be more protective of the fishery.

Current Status

The SHF requirements are being met. LADWP and the County consult with CDFW on proposed SHF in mid to late April of each year and present recommendations for Standing Committee approval in May.

Recommendations

LADWP and the County propose a modified process for setting the annual SHF timing by the LORP Scientific Team to allow for the SHF release earlier in the season when water temperatures are lower. This would necessitate the Standing Committee and MOU parties approving a programmatic approval process that removes annual obligation to 'stamp' the SHF

at the May Standing Committee meeting and instead allow the release to happen shortly after consensus on the characteristics of the SHF is reached among the Scientific Team.

FEIR Charts 2-1 and 2-2 clearly specify the SHF amounts and schedule. CDFW through more than a decade of annual consultation is well aware of the SHF procedure as is the Standing Committee. Once the Eastern Sierra Runoff Forecast is completed, if there is no deviation from the SHF policy specified by the FEIR, then CDFW and the Standing Committee members should be notified that the SHF has been set according to Charts 2-1 and 2-2. SHF flows could then begin one week after the Standing Committee and CDFW have been notified and as water temperatures dictate.

1.1.3 Four Permanent Flow Measuring Stations in the Riverine System

Goal/Requirement

- MOU Section II.C.c.: "Appropriately placed gaging stations in sufficient numbers (to include at least 4 stations) to measure and manage the flow in the river channel will be established as identified in the LORP Plan. These stations will be sited so that flow can be managed in each of the hydrologically varying sections of the river channel in order to meet the goals and objectives of the LORP."
- 2007 Stipulation and Order Sections F.1 and 2 and G also outline modifications to the configuration of the flow measuring stations, conditions for temporary and permanent flow measuring stations, and very specific monitoring and reporting requirements for flow data obtained at these stations.

Progress to Date

As provided in Section F.2 of the 2007 Stipulation and Order, 10 flow measurement stations were to be maintained and operated until at least July 11, 2009, and at least four permanent monitoring stations must be maintained and operated after that date. The 10 temporary measuring stations were constructed at the following locations: Intake, Owens River above Blackrock Ditch Return, Owens River east of Goose Lake, Owens River at 2 Culverts, Owens River at Mazourka Canyon Road, Owens River and Manzanar Reward Road, Owens River at Reinhackle Springs, Owens River at Lone Pine Narrow Gage Road, Owens River at Keeler Bridge, and the Pumpback Station.

On July 9, 2009, the Standing Committee designated the four permanent monitoring stations that will be operated and maintained after July 11, 2009. The four permanent stations are at the Intake, Owens River at Mazourka Canyon Road, Owens River at Reinhackle Springs, and the LORP Pump Station.

Current Status

Four permanent gauging stations have been constructed and are being used to provide the data specified in the 2007 Stipulation and Order. This requirement has been met.

Recommendations

None.

1.1.4 Pump Station Limited to 50 cfs Capacity

Goal/Requirement

- 2004 Stipulation and Order Section 1: "LADWP shall build a "stand alone" (non-expandable) LORP pump station that is limited to a maximum capacity of 50 cfs. At any given time, the rate of pumping by the pump station may be up to, but shall not exceed 50 cfs…"

Progress to Date

The Lower Owens River Pump Station was constructed 2004-2006 as designed as part of initial project construction. Beginning in 2008 the MOU Parties began meeting to discuss raising the 50 cfs limit on pumping from the LORP Pumpback Station. The intent was to provide some flexibility and variability in flows provided to the LORP while releasing a water volume approved by the LADWP Board of Water and Power Commissioners when they adopted the LORP EIR. Discussions eventually broke down in 2012 when the MOU Parties could not reach the unanimous agreement required to alter the Pumpback station capacity.

Current Status

The LORP Pump Station has been constructed and is functioning as designed. This requirement has been met.

Recommendations

None.

1.1.5 Riverine Aquatic Habitat and Recreational Fishery Goals

Goal/Requirement

- MOU Section II.B.: "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."

- MOU Section II.C.1.a.: "The goal for the Lower Owens Riverine-Riparian System is to create and sustain healthy and diverse riparian and aquatic habitats, and a healthy warm water recreational fishery with healthy habitat for native fish species."

Progress to Date

LADWP and the County initiated the Rewatering Project in 1986 that provided water releases from the Independence, Locust, and Georges Aqueduct spillgates, which provide water to the LORP area downstream of Mazourka Canyon Road for fish and wildlife habitat enhancement. Prior to implementation of the LORP in 2006, approximately 24 river miles from the LORP Intake to Mazourka Canyon Road of the total 62 river miles were dry. This 24-mile section of the Lower Owens River (Reach 4) received flows only three times since 1980 when the capacity of the Los Angeles Aqueduct was exceeded due to high runoff or large precipitation events.

Perennial flow was reestablished in the Lower Owens River in December 2006. Creel surveys were conducted to track the development and health of the fishery in the river channel, oxbows, side channels, and off-river lakes and ponds and to document compliance with the LORP goals. A total of five creel surveys were conducted with one prior to implementation (2002) and four post-implementation (LADWP and County of Inyo 2010, 2011, 2013 and 2014) (Table 2).

Successes

Create and Sustain a Healthy Warm Water Recreational Fishery

Once flows from the LORP were reintroduced to the Lower Owens River, fish were able to recolonize the approximate 24-mile reach of formerly dry river channel by migrating either from the Middle Owens River through the LORP intake structure, or migrating upstream from the Rewatering Project from the Blackrock Ditch and the Goose Lake Fish Corridor.

All reaches in all years supported a warm water fishery after perennial flows were reestablished meeting the LORP goal of creating a warm water recreational fishery. Creel surveys detected bass, bluegill (*Lepomis macrochirus*), and brown trout (*Salmo trutta*).

Table 2. Catch per unit effort results for Lower Owens River creel surveys 2003, 2010, 2011, 2013, and 2014 (LADWP and County of Inyo 2010, 2011, 2013, 2014).

	2003			2010			2011			2013			2014		
Reach	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour
1	98	31.5	**3.1**	20	28	**0.7**	20	35	**0.6**	63	28	**2.3**	81	35	**2.3**
2	76	24.5	**3.1**	13	21	**0.6**	13	35	**0.4**	40	21	**1.9**	123	24.5	**5.0**
3	50	24.5	**2.0**	61	35	**1.7**	61	28	**2.2**	82	28	**2.9**	98	35	**2.8**
4	DRY	DRY	**DRY**	54	28	**1.9**	54	35	**1.5**	67	35	**1.9**	67	35	**1.9**

Another component of the LORP goals for fisheries is for the warm water recreational fishery to be self-sustaining. While the 1991 EIR referenced fish stocking in the LORP, CDFW does not stock warm water fish in the LORP. Therefore, the LORP must rely on a naturally reproducing, self-sustaining fishery.

To ascertain whether or not the LORP fishery is naturally reproducing, total fish lengths were analyzed looking for size classes from young of the year (YOY) to sexually mature adults. If both size classes are observed one can conclude that the adults are successfully spawning and YOY are successfully surviving to adulthood, thus the population is self-sustaining.

There are limitations on the data gathered using the creel survey versus other capture methods. One limitation is anglers usually try to catch the larger fish in the population (adults) and use tackle that is too large for YOY to be caught. The few YOY that are caught are usually bycatch. Another limitation is most anglers usually target a specific species (bass) and other species like bluegill, brown bullhead (*Ameiurus nebulosus*), channel catfish (*Ictalurus punctatus*), and Owens Sucker (*Catostomus fumeiventris*) would not typically be sampled.

Laarman and Schneider (1985) found that female largemouth bass became sexually mature at 7.8 to 8.7 inches while males became sexually mature at 8.1 to 8.7 inches. Examining maximum total lengths collected during the four creel surveys, all years and all reaches except for reach one in 2011 had sexually mature bass (Table 3).

It appears that each reach produced YOY bass (4 to 6 inches) at least once in the four years the creel survey was conducted (Table 3). Based on limited data (few smaller fish targeted and caught), it can be assumed that the Lower Owens River bass are successfully spawning and YOY are successfully surviving to sexual maturity.

Table 3. Maximum and minimum total lengths of largemouth bass collected during the 2010, 2011, 2013, and 2014 creel surveys (LADWP and County of Inyo 2010, 2011, 2013, 2014).

Reach	Length (Inches)	2010		2011		2013		2014	
		First Period	Second Period	First Period	Second Period	First Period	Second Period	First Period	Second Period
1	Max	12	11	8	6	16	17	15	17
	Min	4	5	6	4	8	8	6	8
2	Max	14	12	14	10	12	10	18	10
	Min	10	12	5	6	7	5	6	5
3	Max	18	15	16	14	19	18	15	18
	Min	5	6	4	8	10	10	8	10
4	Max	14	15	18	17	16	16	14	16
	Min	5	4	5	8	8	7	7	7

Bluegill were the second most abundant fish caught during the creel surveys. Sigler and Sigler (1987) stated that by the end of their first year bluegill can reach a length of 2 inches and grow about an inch a year thereafter. Sigler and Miller (1963) indicated that bluegill can be sexually mature at one year, but more often mature in years two and three. The limited creel survey data on bluegill demonstrates that the LORP contains fish of sufficient length (3-8 inches) to be sexually mature (Table 4). Due to the method of capture, few YOY bluegill were caught during the four years the creel survey was conducted. Although few bluegill were captured (hook and line), they indicate that the LORP contains a cohort of YOY bluegill. With a bluegill population containing multiple size classes from adults to YOY, it is evident that the LORP's bluegill fishery is self-sustaining.

Table 4. Maximum and minimum total lengths of bluegill collected during the 2010, 2011, 2013, and 2014 creel surveys (LADWP and County of Inyo 2010, 2011, 2013, 2014).

Reach	Length (inches)	2010		2011		2013		2014	
		First Period	Second Period	First Period	Second Period	First Period	Second Period	First Period	Second Period
1	Max		3	6	4	5	6		6
	Min		3	4	4	4	3		3
2	Max	5	5	8	6	6	8	6	8
	Min	5	5	4	3	3	3	1	3
3	Max	5		7	7	5	6	8	6
	Min	5		5	4	4	2	6	2
4	Max		8					6	
	Min		4					4	

Three other warm water fish species including brown bullhead, common carp (*Cyprinus carpio*), and channel catfish were caught during the four creel surveys. Overall catch numbers for each species was low due to the capture method but minimum and maximum total lengths still show multiple age classes from YOY to adults. For brown bullhead, total length ranged from 2 inches to 9 inches. The total length range for common carp ranged from 6 inches to 22 inches and channel catfish ranged from 5 inches to 10 inches.

Two cold water fish species were caught during the four years the creel survey was conducted. They include brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*). Lengths on the brown trout ranged from 4 inches to 24 inches and for rainbow trout lengths ranged from 12 inches to 20. Lack of spawning gravel and elevated summer water temperatures in the LOR are not conducive for trout reproduction.

Based on creel survey data it appears that the managed flows and available habitat found in the Lower Owens River is not a limiting factor for warm water fish successful spawning, rearing, feeding and survival to adulthood.

Challenges

Lack of Quality Fish Data Collected

Although creel censuses have been conducted prior to and following implementation of the LORP, they are likely biased to larger fish and to specific species as described above, thus the information contained in this type of these data are limited. The intention of these surveys was to sample the recreational fishery and not necessarily estimate population sizes or existing species composition and distribution. Creel censuses are dependent on a number of factors, including but not limited to method of capture, angling experience, and fish identification competence. In early years, the MOU Consultants determined that some anglers were misidentifying largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieu*) and possible brown bullhead and channel catfish. Further, only a small subset of the total warm water fishery was sampled and was likely biased toward older age classes and waters with easy fishing access. Progressive tule encroachment confounded the creel census as participants reported that they had trouble reaching fishable water during the 2014 census.

Fish Kills from Low Dissolved Oxygen/H_2S

In the 13 years since the project flows were reestablished two large fish kills occurred in association with low dissolved oxygen levels. The first fish kill occurred in June 2013 after an unintended flow release to the Islands from the Alabama Gates; this flow release occurred as a precaution during a thunderstorm for workers' safety in the Los Angeles Aqueduct. The flow released was turbid because the storm occurred over a recent burn scar mobilizing sediment and also mobilized organic sediments found on the river bottom. Due to the warm June water temperatures and the high biological oxygen demand (BOD), from aerobic microbial decomposition the dissolved oxygen level plummeted to lethal levels for fish. Based on staff observations, the most heavily impacted reach of the river was from Lone Pine Narrow Gauge Road south to the Pump Station. Approximately 400 to 500 largemouth bass, 5 to 10 common carp and under 10 bluegill were observed dead within the Pump Station forebay; more fish were likely entrained upstream in the tules.

The 2014 creel survey was conducted to determine what affect the 2013 fish kill had on the LORP's warm water fishery. Results from the 2014 creel survey showed that catch per unit effort from Lone Pine Narrow Gauge Road to the Pumpback Station remained comparable to 2013 (LADWP and County of Inyo 2014). Based on the available data it appears that the 2013

fish kill did not permanently impact the warm water fishery in the LORP and that either through natural reproduction or migration, the LOR was able to sustain warm water fish populations.

The second fish kill was a result of above-average flows in the LORP due to the 197% of normal runoff following the 2016/2017 winter. Like the 2013 fish kill, higher flows re-suspended organic sediment causing an increase in the BOD and lowering dissolved oxygen to lethal levels. The 2017 fish kill was observed from Two Culverts north of Mazourka Canyon Road downstream to the Pump Station with dissolved oxygen levels measured below 0.5 mg/L and noticeable hydrogen-sulfide odor throughout these reaches. A creel survey was not conducted following the 2017 fish kill, however LADWP and ICWD staff working in and along the river have qualitatively observed bass, carp, and bluegill of various sizes in these reaches in the ensuing two years. The river has experienced multiple fish-kill events pre and post LORP and the fishery has shown signs of recovery after each event, so it is unlikely that the fishery has been extirpated. Additional studies would be necessary to document the effect on the fishery by the 2017 high flow event.

Healthy Habitat for Native Fish Species

A considerable challenge facing the LORP is the inability to meet two competing fishery goals. Because the LORP has achieved the goal of creating and sustaining a warm water fishery it will not be capable of simultaneously hosting suitable habitat for focal native fish species identified in the MOU.

There are four fish species endemic to the Owens Valley and the Lower Owens River. The Owens pupfish (*Cyprinodon radiosus*) is State and Federally Endangered, and is a California fully protected species. The Owens tiu chub (*Siphateles bicolor snyderi*) is a State and Federally Endangered species. The Owens sucker and the Owens speckled dace (*Rinichthys oculus spp.*) are listed as California Species of Special Concern.

The Owens pupfish can be found only in a few refuges in the Owens Valley and in one location within the LORP boundary (Well 368 Mitigation Project). To be self-sustaining, Owens pupfish need isolated refuges free of nonnative warm water game species (bass, bluegill, and catfish) due to direct competition and predation. Most potential habitat for Owens pupfish within the LORP contain warm water fish species rendering it unsuitable habitat. Another impediment to distributing the metapopulation of Owens pupfish throughout Owens Valley is its California fully protected status preventing permits for incidental take. Consequently, LADWP cannot introduce this species on City of Los Angeles property because it needs to perform routine maintenance on its ditches or waterways. If CDFW could issue a Safe Harbor Agreement (SHA) for this species, LADWP could facilitate the expansion of this endangered fish through its waterways, lessening the risk of extinction.

Owens tui chub are isolated to a few refuges with in the Owens valley and are not found within the LORP boundary. Owens tui chub are endangered due to hybridization with introduced Lahontan tui chub (*Gila bicolor obesa*). Except for the few isolated refuges, tui chub found in the Owens Valley including the LORP are hybridized. Removal of hybridized tui chub at this

point is unfeasible and unless completely isolated within the LORP, any introduced populations of pure Owens tui chub will eventually become hybridized.

Owens speckled dace are abundant in the Owens Valley and are mainly found in small creeks, waterways used for irrigation, and or water conveyances. Like Owens pupfish, the Owens speckled dace need isolated refuges that are free of non-native warm water game species due to direct competition and predation. With a thriving warm water fishery in the LORP, Owens speckled dace population will not be self-sustaining.

Of the four native fish, the Owens sucker may be only remaining native fish species inhabiting the Lower Owens River. It is the only species that can successfully compete with the non-native warm water fish species. Due to a lack of fish data outside of creel surveys, the status of the Owens sucker in the LORP is unknown at this time.

While the concept of creating suitable habitat for threatened and endangered native fish species within the LORP is laudable, it's not compatible with the competing goal of hosting a warm water recreational fishery. As the LORP continues, options to increase the likelihood of native fish species persistence will be explored in areas of isolated refuges within the LOR project area. Some of this planning will depend on the issuance of a safe harbor agreement by CDFW.

Current Status

The goals of creating and sustaining a healthy warm water fishery in the riverine riparian portion of the LORP are being met.

Creating and sustaining a warm water fishery is at odds with simultaneously providing habitat for native fish. The native fish (Owens Pupfish, Owens tui chub, and Owens speckled dace) would succumb to predation by the non-native fish if co-located. Based on current data, it is unknown whether the native Owens sucker occurs in the LORP. The goal of providing suitable habitat for native fish in the LORP riverine system is incompatible with sustaining a warm water fishery.

Recommendations

An electroshocking fish survey should be conducted by CDFW at various locations in the Lower Owens River to estimate current species composition.

1.1.6 Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species (River)

Goal/Requirement

- MOU Section II.B.1: “Create and maintain through flow and land management, to the extent feasible, diverse natural habitats consistent with the needs of the “habitat indicator species”.
- MOU Section II.C.1.a: “… Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the “habitat indicator species” for the riverine-riparian system. These habitats will be as self-sustaining as possible.”
- MOU Attachment A., LORP Action Plan, Table 5- Riverine-Riparian System HIS:

Riverine-Riparian Habitat Indicator Species

Fish Species

Owens Sucker	*Catostomus fumeiventris*
Channel Catfish	*Ictalurus punctatus*
Blue Gill	*Lepomis macrochirus*
Largemouth Bass	*Micropterus salmoides*
Smallmouth Bass	*Micropterus dolomieu*

Other Species to receive proper consideration:

Owens Speckled Dace	*Rhinichthys osculus robustus*
Owens Tui Chub	*Siphateles bicolor snyderi*
Owens Pupfish	*Cyprinodon radiosus*

Bird Species

Wood Duck	*Aix sponsa*
Yellow-billed Cuckoo	*Coccyzus americanus*
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
Least Bittern	*Ixobrychus exilis*
Great Blue Heron	*Ardea herodias*
Northern Harrier	*Circus hudsonius*
Red-shouldered Hawk	*Buteo lineatus*
Swainson's Hawk	*Buteo swainsoni*
Long-eared Owl	*Asio otus*
Belted Kingfisher	*Megaceryle alcyon*
Willow Flycatcher	*Empidonax traillii*
Nuttall's Woodpecker	*Picoides nuttallii*
Warbling Vireo	*Vireo gilvus*
Tree Swallow	*Tachycineta bicolor*
Marsh Wren	*Cistothorus palustris*
Yellow-breasted Chat	*Icteria virens*
Yellow Warbler	*Setophaga petechia*
Blue Grosbeak	*Passerina caerulea*

Mammals

Owens Valley Vole	*Microtus californicus vallicola*

1.1.6.1 Avian Species

Progress to Date

The avian habitat indicator species list is composed of 19 species that use riverine-riparian ecosystems. The avian habitat indicator species for the riverine-riparian area were placed into one of three categories: riparian obligate, riparian dependent and wetland-associated (Table 5) based on Rich (2002) and expert opinion regarding local species habitat associations. Riparian obligate species are those that place >90% of their nests in riparian vegetation or for which >90% of their abundance in the breeding season occurs in riparian vegetation (Rich 2002). The riparian obligate habitat indicator species are Yellow-billed Cuckoo, Belted Kingfisher, Willow Flycatcher, Yellow-breasted Chat, Yellow Warbler and Blue Grosbeak. Riparian dependent species are those that place 60-90% of their nests in riparian vegetation or 60-90% of their abundance is in riparian vegetation (Rich 2002). Five of the habitat indicator species are riparian dependent: Swainson's Hawk, Long-eared Owl, Nuttall's Woodpecker, Warbling Vireo, and Tree Swallow. Wetland associated bird species are those whose distribution and abundance on LORP is expected to be more closely tied to wet meadow, marsh or swamp-like areas which include a mix of wet meadow, marsh and woody riparian vegetation. Wetland-associated habitat indicator species are: Wood Duck, Virginia Rail, Sora, Least Bittern, Great Blue Heron, Northern Harrier, Red-shouldered Hawk and Marsh Wren.

Table 5. Riverine- Riparian Habitat Indicator Species and Habitat Association

	Habitat Association		
Riverine-Riparian Habitat Indicator Species	Riparian Obligate	Riparian Dependent	Wetland Associated
Wood Duck			X
Yellow-billed Cuckoo	X		
Virginia Rail			X
Sora			X
Least Bittern			X
Great Blue Heron			X
Northern Harrier			X
Red-shouldered Hawk			X
Swainson's Hawk		X	
Long-eared Owl		X	
Belted Kingfisher	X		
Nuttall's Woodpecker		X	
Willow Flycatcher	X		
Warbling Vireo		X	
Tree Swallow		X	
Marsh Wren			X
Yellow-breasted Chat	X		
Yellow Warbler	X		
Blue Grosbeak	X		

Monitoring of avian species in the LORP has been conducted preceding and following the implementation of the project. While not specifically designed to track populations of the riverine-riparian habitat indicator species, the avian monitoring program established by Point Reyes Bird Observatory (PRBO) (now Point Blue Conservation Science), is a scientifically robust breeding bird survey program to track breeding songbird communities (Heath and Gates 2002). The avian monitoring program consists of three visits to the established point count stations during the peak breeding season for songbirds (May through June) (Heath and Gates 2002). PRBO conducted baseline surveys in 2002 and 2003 and the monitoring program was adopted for the LORP. LADWP and the County have continued to implement the point count survey program established by PRBO and conducted post-project implementation avian point count surveys in 2010 and 2015. Cal State LA and ICWD continued riverine point counts in 2017 and 2018. LADWP has mapped vegetation for the riverine-riparian area based on 2000, 2009, and 2015 and 2017 conditions.

As specified in the MAMP, the availability of suitable habitat for each of the avian indicator species was estimated with the California Wildlife Habitat Relationship system (California Department of Fish and Game-CIWTG 2014). CWHR is simply a database of habitat characteristics associated with a habitat suitability score for feeding, reproduction, and cover. By attributing mapped vegetation units with the variables of CWHR vegetation type, stand age, and cover class, habitat suitability maps can be created for each indicator species.

Successes

Expansion of Wetland Habitats

The reestablishment of perennial flow has resulted in a net increase of 1,715 acres of land cover types associated with wetland habitats (Table 6). The wetland land cover types that have experienced the greatest increase are wet meadow, marsh and water. Increases in these cover types are most beneficial to the wetland-associated avian habitat indicator species. Through the creation of a continuous riverine corridor and increased availability of wetland habitats, LORP has likely resulted in improved conditions for many wildlife species.

Table 6. Mapped acreage of LORP Riverine-Riparian Wetland Land Cover Types, 2000, 2009, 2015 and 2017.

LORP Riverine-Riparian Wetland Land Cover Types	Mapping Year				Net Change Since 2000
	2000	2009	2014	2017	
Water	100	251	154	510	410
Marsh	765	1,090	1,310	1,433	668
Reed	25	24	51	51	26
Wet Meadow	214	60	656	1,071	857
Riparian Shrub (excluding tamarisk)	20	20	32	33	13
Tree	449	265	165	190	-259
Total Acreage	**1,573**	**1,710**	**2,368**	**3,288**	**1,715**

Habitat Indicator Species Presence on LORP

Avian point count surveys have documented the presence of 17 of the 19 avian habitat indicator species in the riverine-riparian area (Table 7). Breeding has been confirmed or suspected for 10 of these species. Since implementation of LORP, breeding activity has been documented for Wood Duck and Yellow-breasted Chats. Breeding activity was not observed for these two species during the baseline studies conducted in 2002 and 2003. Red-shouldered Hawks are also occasionally seen along the river in the project area (D. House, pers. com), however, they have not been detected during point counts. The only habitat indicator species not yet detected on the river is the Long-eared Owl. This species occurs in the general LORP area and may occur in the LORP riverine-riparian area, but can be difficult to detect as they generally roost and nest in dense patches of trees.

Table 7. Avian Habitat Indicator Species presence and breeding status in the LORP riverine-riparian area during survey years. Species confirmed or suspected to breed are indicated by "Y", and those for which no evidence of breeding was observed are indicated by "N"

Riverine-Riparian Habitat Indicator Species	2002	2003	2010	2015	2017	2018
Wood Duck			Y	Y		
Yellow-billed Cuckoo					N	
Virginia Rail	Y	Y	Y	Y	Y	Y
Sora	Y	Y	Y	Y	Y	Y
Least Bittern			N			
Great Blue Heron	Y	Y	Y	Y	Y	Y
Northern Harrier	Y	Y	Y	Y		Y
Red-shouldered Hawk						
Swainson's Hawk			N			N
Long-eared Owl						
Belted Kingfisher	N				N	
Nuttall's Woodpecker	Y	Y	Y	Y		Y
Willow Flycatcher	N	N	N	N	N	
Warbling Vireo	N		N	N	N	
Tree Swallow			N	N		N
Marsh Wren	Y	Y	Y	Y	Y	Y
Yellow-breasted Chat			Y	Y	Y	N
Yellow Warbler	N	N	N	N	N	N
Blue Grosbeak	Y	Y	Y	Y	Y	Y

2017 and 2018 data courtesy of Robert Taylor, Cal State Los Angeles.

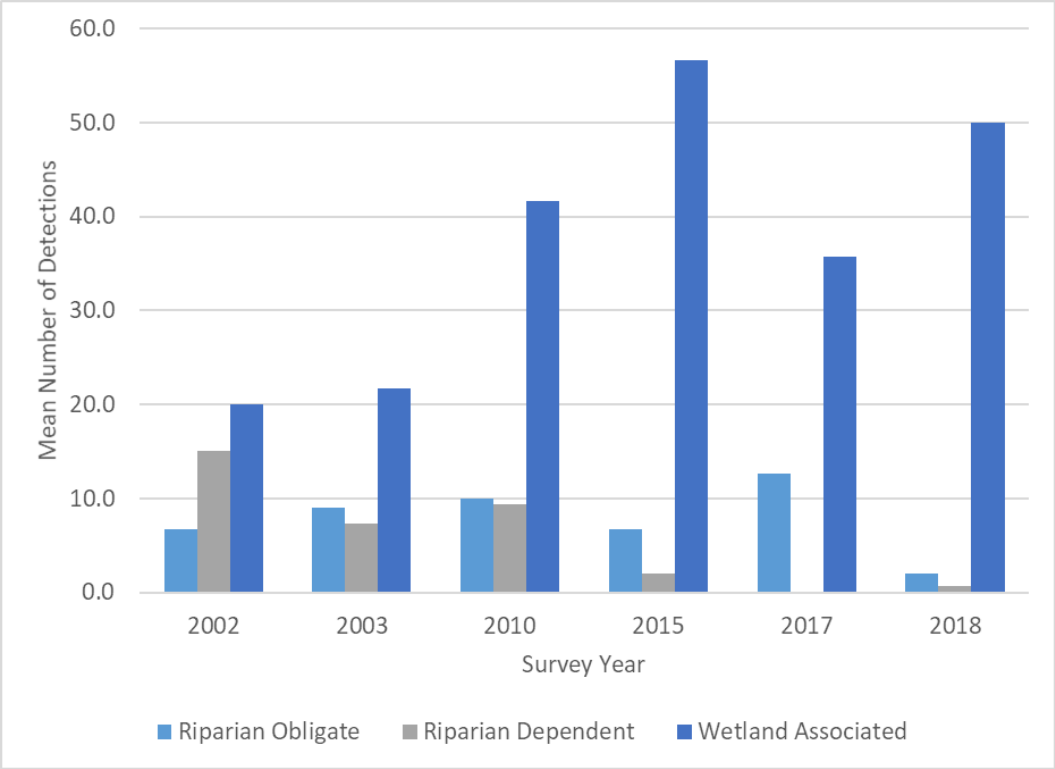

Figure 2. The mean number of detections of riparian obligate, riparian dependent, and wetland associated avian habitat indicator species, by survey year. Bird numbers were averaged over the three breeding bird surveys per survey year.

Wetland associated habitat indicator species have responded favorably to the LORP and the increased availability of wetland habitats (Figure 2).

Challenges

Limited Riparian Woodland Development

More than half of the LORP riverine-riparian system habitat indicator species are either riparian obligate or riparian dependent species and thus the riparian tree and shrub composition and structure is foundational in their habitat. Riparian trees and shrubs are a necessary component of the habitat for many of the habitat indicator species as they provide foraging opportunities, nest sites, perch sites, and cover. Although wetland land types have increased in response to LORP, the current trajectory of vegetation succession in the LORP is toward the development of an elongated marsh, and a continued decline of riparian trees as recruitment is not keeping pace with the loss of woody riparian vegetation due to fire, beaver activity, and mortality from continuous inundation. Ecosystem Sciences (1997) provided predictions on the development of woody riparian vegetation in response to the project rewatering and land management. Based on HEC-2 data, landform mapping, vegetation mapping and cross-channel transects woody riparian vegetation was predicted to increase from 685 to 1,288 acres. This prediction includes

acreages of 'vegetation complexes' with riparian woodland only one component of the complex intermixed with alkali meadow and emergent vegetation. More recent fine-scale mapping of woodlands in 2017 determined that approximately 190 acres of woody riparian canopy currently exists on the LORP, representing a significant loss of trees since project implementation. Maintaining habitats consistent with the needs of riparian obligate and riparian dependent habitat indicator species presents long-term challenges.

Limitations of Avian Monitoring Program

Although the avian point count monitoring program is scientifically robust, assessing the response to the LORP will be challenging for many of the habitat indicator species. Point count monitoring programs are most appropriate for long-term monitoring of easily detectable species that readily vocalize. Bitterns and rails (3 of the 20 species) do not readily vocalize, and can only reliably be surveyed using playback calls. Similarly, Yellow-billed Cuckoo is surveyed using playback calls. The increase in marsh and meadow habitats on the LORP since implementation would be expected to benefit bitterns and rails, however point count monitoring data are inadequate to verify this prediction because playback surveys are the standard for monitoring secretive marsh birds. In addition, several of the habitat indicator species are rare to uncommon on the landscape (i.e. Yellow-billed Cuckoo, Long-eared Owl), or in the region, thus their presence may be not be easily detected, and populations not large enough to detect change.

CWHR Models and challenges

The extent of potential suitable habitat for the habitat indicator species is also assessed using the California Wildlife Habitat Relationship model and landscape vegetation mapping interpreted from periodic aerial imagery. The California wildlife habitat relationship suite of models are lookup tables associating habitat suitability scores for feeding, cover and nesting with mapped vegetation attributes. These habitat lookup table models have their own set of challenges. Being developed at the state level, the habitat types do not translate perfectly to the Owens Valley, and the suitability scores in the CWHR models were independent of any spatial considerations such as adjacency considerations of habitat types or minimum patch size.

The effect of omitting spatial considerations is to over-predict the acreage of suitable habitat for some species. Although vegetation types classified as suitable for habitat indicator species according to CWHR are present in the LORP (Table 8), realistically, the actual acreage of habitat suitable for most indicator species is less than calculated using the CWHR model, largely due to its failure to account for area sensitivity or minimum patch size and the spatial configuration of the vegetation mosaic. For some species, the overestimation of suitable habitat may be substantial, as is the case for Willow Flycatcher. For Willow Flycatcher, the two LORP vegetation types suitable are tree/riparian shrub and wet meadow. Based on the 2015 CWHR analysis, a total of 850 acres of suitable habitat were present on the LORP for Willow Flycatcher (198 acres of "Desert Riparian" and 653 acres of "Wet Meadow"), but it is important to realize that area sensitivity and spatial configuration aren't considered. Willow Flycatcher is a riparian obligate species that requires dense woody riparian vegetation to nest, and high quality habitat is typically interspersed with small openings of open water or meadow for foraging (U.S. Fish and

Wildlife Service 2002). The documented mean size of breeding habitat patches is 21.2 acres (U.S. Fish and Wildlife Service 2002). In 2015, 198 acres of woody riparian vegetation was mapped on the LORP; however, the average polygon size was only 0.04 acres, and the largest single polygon was 8.2 acres, well below a possible area sensitivity threshold for Willow Flycatcher. Similarly, Yellow-billed Cuckoo is known to be sensitive to patch size, with 50 acres or more continuous riparian woodland suggested as a minimum requirement for occupancy. Less is known about area sensitivity for other riparian woodland obligate species. While CWHR can be used to estimate a first approximation for species that might occur in a given area within California, it is not robust enough to be predictive of habitat suitability for each of the habitat indicator species. Now that empirical avian presence data has been collected and detailed landscape mapping has been conducted including Lidar-based vegetation structure, it would be worthwhile to construct data-driven occupancy models that include spatial context to better evaluate the distribution of suitable habitat for each indicator species throughout the LORP.

Indicator species concept and evaluation

One challenge of using the avian habitat indicator species list as a LORP goal has been a lack of articulation on what exactly the habitat indicator species were originally envisioned to indicate: creation and maintenance of their own suitable habitat as described in the MOU or a proxy for the concept of 'ecosystem health' as suggested by the MOU consultants in their 2014 adaptive management recommendations (LADWP and County of Inyo 2014). Over the last decade since the LORP commenced, these two different interpretations of what the indicator species were intended to indicate have been used inconsistently, especially since the literature on 'ecological indicators' has developed and much has been written on the topic. MOU Section II.B.1 described that a LORP goal is to "Create and maintain through flow and land management, to the extent feasible, diverse natural habitats consistent with the needs of the habitat indicator species". From this MOU language, it could be interpreted that the observed presence of these species on the LORP, indicating the creation and maintenance of each of these species' habitats was the goal of specifying the specific MOU habitat indicator species list. However, in other documents, the purpose of the habitat indicator species evaluations have seemingly different interpretations. For instance, in the 2014 LORP annual report adaptive management recommendations, the MOU consultants write "The MOU includes some 28 indicator species of fish, birds and mammals. These are listed in the MAMP (2008) as members of guilds. Guilds are grouped based on similarities in feeding and breeding strategies, habitat preferences, and behavior and species size. In theory, because all species in a guild are affected similarly by habitat changes, one guild member, or indicator species, can be used to assess impacts on other members (MAMP, 2008; Rice, et al. 1984). In the case of avian indicator species, it was expected that they could be distributed into four guilds parallel to the river: wetland, open water, successional shrub, woodland, and grassland. Avian surveys in these ecotypes have found most of the target species, however only one (Marsh Wren) is abundant. The question is, are these indicator species the most appropriate or are these guilds too limited to reflect food web dynamics?" This 2014 AMR section goes on say: "The idea of using indicator species to monitor the LORP was enacted because they can signal a change in biological condition of the project's various restored ecosystems. Indicator species can then be a proxy to diagnose the health of the overall LORP ecosystem (McDonough et al. 2009). Therefore, managers can use an

indicator species (or suite of indicator species) as a surrogate for overall biodiversity, monitoring the outcomes of management practices by measuring the rise or fall of the population of the indicator species (McDonough et al.2009). In practice this is what should be occurring in the LORP, especially in the riverine-riparian area. Unfortunately, due to a lack of direct observation or habitat mapping, within the riverine-riparian area, it is difficult to determine the health of the ecosystem or the effectiveness of using indicator species to monitor the LORP."

Since this AMR in 2014, riparian avian surveys have been conducted in 2015, 2017 and 2018 and habitat mapping was conducted based on imagery acquired in 2014 and 2017, which provides the direct observation and habitat mapping that the MOU consultants lamented was lacking in 2014.

It appears that two or more subtly different ideas of the indicator species list have become potentially conflated with one another over time. On one hand, the MOU describes that one goal of the LORP is to create and maintain habitat for the indicator species; and on the other hand, some narratives in recent reports have used language from the 'ecological indicator' literature to describe the purpose of the MOU indicator species list to be surrogates for 'ecosystem health'; and other interpretations of the indicator species list have aggregated the species into different 'guilds', the members of which have been identified based on the type of vegetation structure that they primarily forage or nest in (i.e. trees, shrubs, grassland, open water, marsh).

The *Riparian Bird Conservation Plan: A strategy for reversing the decline of riparian associated birds in California*, recognized the importance of considering individual species and their unique niches in riparian ecosystems, leading to the creation of a focal species list (http://www.prbo.org/calpif/htmldocs/riparian.html). Each of the species either (1) used riparian vegetation for their primary breeding habitat, (2) had special management status, (3) had experienced a reduction from their historical breeding range, (4) were common enough to obtain adequate samples sizes for statistical comparisons, allowing evaluation of trends in response to management such as restoration, or (5) had breeding requirements that represented the full range of successional stages of riparian ecosystems (PIF 2004).

The PIF focal species list and the MOU habitat indicator species list have much overlap as recognized in the MAMP (Ecosystem Sciences 2008: 2-115). However, not all of the PIF focal species or the MOU habitat indicator species met criteria 4 above, that the species were common enough to provide the sample sizes adequate to inform whether or not habitat suitability was changing over time, especially in response to management. There is probably a need to identify a more comprehensive riparian focal species list for the Owens Valley that meets the sample size criteria so that the evaluations of the avian survey data can be linked to specific riparian features.

To evaluate the goal or creating and maintaining habitat for the MOU indicator species, the presence or abundance of these species can be reported over time and by spatial location

within the LORP. A challenge with this approach, that presence must be verified to meet goals, is that suitable habitat often goes unoccupied for a variety of reasons, thus lack of habitat indicator species observations could be due to a lack of suitable breeding habitat but could also be due to conspecific factors such as lack of suitable mates or heterospecific factors such as nest parasitism, competition and predation. For neotropical migrants, often the limiting factor for population stability is habitat quality in the overwintering range, not the breeding range. This may be true for Yellow-billed Cuckoo, whose breeding populations have been steadily declining in the Kern River Valley in recent years despite suitable habitat. Overwintering in the Gran Chaco region of Paraguay, Bolivia and Argentina, population trends may be more reflective of pesticide usage on overwintering grounds rather than habitat availability on breeding grounds.

1.1.6.2 Mammal Species

Progress to Date

The Owens Valley Vole (*Microtus Californicus vallicola)* is the only mammal species that was listed as an MOU Habitat Indicator Species. Owens Valley Voles inhabit grassy banks, upland meadows and unused agricultural fields (Nelson et al 2006, Parmenter et al 2007, Bailey 1900). Prior to implementation of the LORP, the former "dry reach" was likely unsuitable for voles possibly imposing a migratory barrier that reduced habitat connectivity and dispersal along the river corridor. From 2008-2011, evidence of Owens Valley Vole activity including the presence of 'runways', droppings, clippings, or live animals was recorded opportunistically during Rapid Assessment Surveys.

Successes

One notable change after the reestablishment of perennial flows to the river was the recolonization of voles to the former "dry reach" area between the Intake and Two Culverts. By 2009, sign of vole activity including runways, droppings and cut vegetation along runways was seen throughout this area of the formerly dry reach (LADWP and County of Inyo 2010). By 2010, vole runways and droppings were recorded in every river reach and on both banks.

Challenges

None.

1.1.6.3 Fish Species

Progress to Date

As discussed in Section 4.1.5, the MOU goals of creating and sustaining a healthy warm water recreational fishery and creating healthy habitat for native fish species are seemingly incompatible with one another. The LORP can either support a warm water fishery or a native fishery but not both, largely due to non-native warm water fish predating native fish. Thirteen

years into the LORP project it has become apparent that the LORP has developed a warm water recreational fishery, which was identified as an MOU goal, but the LORP cannot simultaneously support a native fishery.

The River-Riparian System HIS list includes four non-native and four native fish species. These species include: largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), blue gill (*Lepomis macrochirus*), channel catfish (*Ictalurus punctatus*), Owens sucker (*Catostomus fumeiventris*), Owens pupfish (*Cyprinodon radiosus*), Owens tui chub (*Siphateles bicolor snyderi*), and Owens speckled dace (*Rinichthys oculus* spp). In the 2014 LORP Annual Report, HIS were reviewed for each of the four features of the LORP (LADWP and County of Inyo 2015). The HIS review evaluated and provided justification for whether or not each species should be included or removed from the HIS list.

The 2014 review of the HIS recommended that due to the direct competition and predation of native fish that all native fish except for the Owens sucker be removed from the HIS list owing to lack of suitable habitat when non-native predatory fish species are present. It is believed that the Owens sucker is the only native fish that can successfully coexist with the introduced non-native fish. The 2014 review also recommended that smallmouth bass be removed from the HIS list due to relatively small population and overlap in habitat dimensions with largemouth bass. Largemouth bass, blue gill, and channel catfish were left on the HIS list for the River-Riparian System as they have slightly different niche space in the fish community.

Successes

As of the last creel survey in 2014, largemouth bass, bluegill, and channel catfish were present in the Lower Owens River.

Challenges

As mentioned previously, it is unlikely that the native Owens pupfish, Owens tui chub, and Owens speckled dace can coexist in the LORP Riverine-Riparian Area with the non-native fishery, and it is unknown whether or not the project supports Owens sucker due to a lack of robust survey data.

The effects of the emergency release of high flows and extensive flooding in the summer of 2017 on the fishery were not quantified but this incident led to a fish kill documented by CDFW (Feb. 14, 2018 memo).

Current Status – HIS Associated with the River

The goal of the LORP supporting all of the Riverine-Riparian habitat indicator species listed in the MOU is not being met. The presence of non-native fish HIS is incompatible with the presence of native fish HIS through predatory and competitive exclusion effects. Some avian

HIS require riparian woodland habitat characteristics that are lacking on the LORP, however 17 of 19 of the habitat indicator species have been documented in the riverine riparian area.

Recommendations

Incorporate a "Focal Species" analysis to evaluate avian community response to restoration. The focal species list would include species that are readily detectable with point count surveys and that have sufficient sample sizes allowing quantification of trends over time. In order to evaluate whether healthy, diverse riparian and aquatic habitats are being created and sustained with regard to the wildlife community, the diversity and abundance of bird species using riparian and aquatic habitat in the riverine-riparian system will be evaluated. The use of particular focal groups will be used as well as individual focal species whose abundance in LORP allows for the determination of trend.

Develop Habitat Relationship Models for Predictive Mapping
Now that empirical avian presence data and increasingly precise landscape mapping has been conducted including Lidar-based vegetation structure, it would be worthwhile to construct data-driven occupancy and abundance models that can be applied to generate predictive maps of wildlife habitat suitability in response data acquired through remote sensing and field measurements. Compared to the CWHR model, the wealth of empirical data now available for the LORP avian habitat indicator species can provide greater insight about the health and diversity of riparian and aquatic habitats on the LORP, the response of the avian community, and whether the current indicator species observable on the LORP represent the full range of conditions envisioned in the MOU when the list was originally developed.

Some mature riparian tree-dependent avian HIS species are not currently present on the LORP. If we interpret the HIS list was included to ensure certain habitat types associated with these species were created, enhanced, or sustained, then Inyo county staff suggests the Inyo/LADWP scientific team evaluate steps to create and enhance riparian forest consistent with needs of riparian forest dependent avian HIS , since tree cover community type has declined instead of being created on the LORP.

The value of the LORP as migration stopover habitat may be underappreciated. Point count surveys in 2010 and 2015 that started in mid-May rather than the start of June, detected significant use of the LORP by neotropical songbird migrants. It may be worthwhile to conduct a limited number of surveys during migration to better quantify the use of the LORP as stopover habitat for migrants traveling along the Pacific Flyway. Surveys will be conducted based on staff availability.

1.2 Owens River Delta Habitat Area Goals/Requirements

The Owens River DHA is a large wetland complex at the terminus of the Owens River on the Owens Lakebed. The DHA is one of the four elements of LORP for which restoration objectives and management actions were developed.

The Owens River DHA contains two main channels and numerous shallow braided channels, small ponds, and large expanses of marsh, and wet and dry meadows. Flows from the Owens River spread across the flat alluvial fan of the DHA and create small, shallow seasonal water bodies. Prior to implementation of the LORP, the Delta cycled through seasonal drying, typically drying from mid-May through early October.

1.2.1 Enhance/Maintain "Delta Conditions" for Shorebirds, Waterfowl, and Other Animals

Goal/Requirement

- MOU Section II.C.2: "The goal is to enhance and maintain approximately 325 acres of existing habitat consisting of riparian areas and ponds suitable for shorebirds, waterfowl, and other animals … within the Owens River Delta Habitat Area. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the 'habitat indicator species' for the Owens River Delta Habitat Area. These habitats will be as self-sustaining as possible."
- EIR Section 2.4.1: "LADWP, as the CEQA lead agency, believes that by enhancing and maintaining the acreage of vegetated wetlands and water that existed in 1996 (645 acres); at the time of the approval of the MOU, LADWP will have met and exceeded the MOU goals of maintaining and enhancing 325 acres of existing Delta habitats. Notwithstanding this position, LADWP is in concurrence with Ecosystem Sciences' analysis, the proposed flow regime for the Delta Habitat Area will enhance and maintain the approximately 831 acres of water and vegetated wetland that existed in 2000 and the water and vegetated wetland within the Delta Habitat Area boundary existing at the time of the implementation of flows to the Delta under the LORP. The water and vegetated wetland within the Delta Habitat Area boundary existing at the time of the implementation of flows to the Delta under the LORP are hereafter referred to as the "Delta conditions." Delta conditions will be described both in terms of areal extent and quality as measured by Habitat Suitability Index. The vegetation types to be included in the definition of "Delta conditions" are: alkali marsh, wet alkali meadow, alkali meadow (on floodplain and lucustrine landtypes), Gooding-red willow, and water. The intermittently flooded playa (unvegetated) within the brine pool transition area will not be included in the definition of "Delta conditions.""

Progress to Date

For the LORP, LADWP has established year-round base flows and provided seasonal pulse flows to the DHA. During the first year of flow implementation, outflow from the Delta was recorded

hourly at temporary gauging stations at the terminus of vegetation along both the east and west branches. This flow data was used to determine flow needed to maintain wetland vegetation existing at the time. Water needs were assumed to have been met for the wetland vegetation when outflow occurred from the Delta Habitat Area.

Vegetation mapping of the DHA has been conducted three times to evaluate whether Delta Conditions were being maintained. The results of the mapping were summarized by year and wetland vegetation type and compared to pre-project data collected in 2000 and 2005.

Successes

Periodic vegetation mapping demonstrates that the aerial extent of Delta wetland habitat types has increased from 851 acres in 2000 to 1,144 acres in 2017 (Table 8).

Table 8. Total Wetland Acreage in the DHA (LADWP and County of Inyo 2019).

Mapping Year	Total Wetland Acreage
2000	851
2005	785
2009	992
2012	1068
2017	1144

Challenges

Goals for the DHA include not only an acreage component of wetland, but also a goal to provide the environmental factors supporting Delta habitat indicator species.

Suitable habitat for DHA indicator species is decreasing as the DHA trends towards monotypic stands of tall dense cattail and bulrush marsh. Since project implementation, the perennial flow of water to the Delta through the growing season has perpetuated the conversion of a previously meadow-dominated system to a marsh-dominated system (*Figure 3*). Riparian forest has also decreased from 18 acres to less than 1 acre due to flooding and a lack of recruitment. Although the 2017 mapping showed an increase in open water, this increase was due to the timing of the aerial image capture coinciding with the large runoff year of 2017-2018. Open water areas increase temporarily when additional releases above base flow inundate playa or meadow habitats.

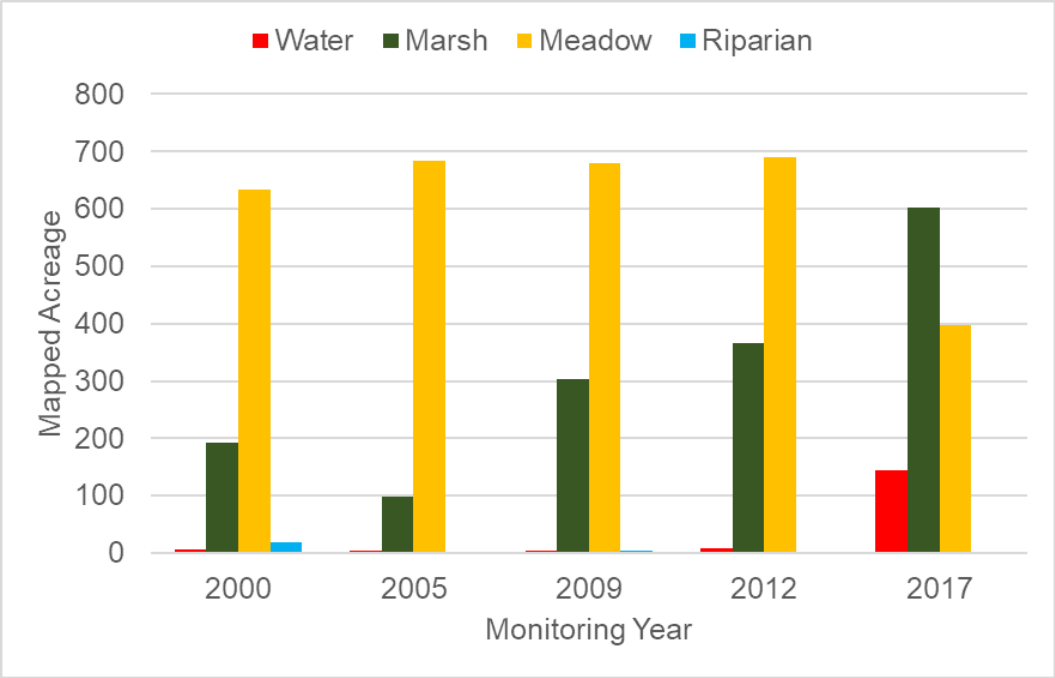

Figure 3. Mapped acreage of wetland vegetation type in DHA by monitoring year (LADWP and County of Inyo 2019).

Current Status

The aerial extent of wetland vegetation in the DHA has increased since implementation of LORP and thus the required wetland acreage is being maintained. Vegetation type conversion has occurred however, and is changing the nature of the DHA. Habitat quality for waterfowl and shorebirds is declining. While the increase in marsh vegetation may be favorable for some specific habitat indicator species such as rails, the changes occurring will decrease habitat quality for most DHA habitat indicator species because of their need for open habitats such as open water of flooded meadow or playa.

Recommendations

DHA management involves potential adjustment in the amount, timing or duration of flows. There is no indication that adjustments to the amount of water released to the DHA require adjustment as total wetland acreage is being maintained and is increasing.

The timing and duration of flows, however require a reevaluation in order to maintain habitat diversity and habitat quality for DHA habitat indicator species. The proposed changes to the timing and duration of flows involves a redistribution of the current seasonal water allotments for the Delta.

Recommendations regarding revisions to the timing and duration of flows consider the negative effect that a consistent water supply throughout the growing season has had on habitat quality in the DHA, and the efficiency of the current pulse flow management in providing habitat for indicator species in a manner that would be most beneficial for these species.

The first proposed change includes reducing base flows during the growing season to 3 cfs, which is the minimum required flow (LORP FEIR). The purpose of this change is to induce hydrologic stress on tall emergent marsh vegetation with the desired effect of halting the expansion of, and resulting in an eventual retraction of acreage of this vegetation type.

The second proposed change is to alter the pulse flow schedule to more effectively target habitat enhancement for migratory waterfowl and shorebirds. Releases above the baseflow have been effective at enhancing conditions for indicator species by inundating meadow habitats, flooding playa, and resulting in flow in the Brine Pool Transition area. When flooded, playa and meadow attract indicator species and manipulating flows to enhance and maintain such flooded areas will create suitable foraging habitat for waterfowl, waders and shorebirds. Based on data from weirs located at the upstream and downstream end of the Delta (in place the first year of the project), the travel time of water through the delta is very rapid. Flow recorded at the downstream end of the DHA tracked releases from the pumpback station but with a 1-2 day time lag. Thus, the water from pulse flows pass through the Delta, potentially only providing habitat benefits for a short period of time. The majority of indicator species use the DHA as a migratory stopover site in spring and fall and the migration period over which the suite of HIS move through the Delta each season, is on the order of weeks while the current pulse flows are 5-10 days in length. The change to the pulse flow schedule involves a redistribution of the summer water allotment to the fall, winter and spring periods. Pulse flow periods will be longer in duration during fall and spring, resulting in longer periods of flooding to coincide with seasonal presence of shorebirds and waterfowl. Winter flows will be maintained in order to ensure outflow to the brine pool transition area to support wintering ducks and geese. . A lengthening of the time period over which increased flows occur is expected to maintain flooded conditions for longer periods of time, and improve habitat conditions for indicator species.

1.2.2 Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species (DHA)

Goal/Requirement

- MOU Section II.C.2: "…and to establish and maintain new habitat consisting of riparian areas and ponds suitable for shorebirds, waterfowl, and other animals. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species" for the Owens River Delta Habitat Area. These habitats will be as self-sustaining as possible", and will be managed by adjusting frequency, duration, and amount of water.

- MOU Attachment A., LORP Action Plan, Table 1- DHA HIS:

  Owens River Delta Habitat Area

Owens pupfish	Resident, migratory and wintering waterfowl
Owens tui chub	Resident, migratory and wintering wading birds
	Resident, migratory and wintering shorebirds

1.2.2.1 Avian Species

Progress to Date

Avian surveys have been conducted in order to assess use by Habitat Indicator Species in the DHA. These surveys are conducted seasonally (spring, summer, fall and winter), and are conducted during years that vegetation mapping on new imagery occurs. In combination with the vegetation mapping data, avian survey data is being used to evaluate progress towards the LORP goal of creating and maintaining diverse habitats consistent with the needs of habitat indicator species. In order to evaluate project effects on use by habitat indicator species, the total number of habitat indicator species detected per survey was summed by season and year as an index of habitat indicator species richness. The maximum number of habitat indicator species detected per survey was also summed as an index to habitat indicator species abundance and seasonal use patterns.

Successes

A total of 32 Habitat Indicator Species have been found in the Delta (Table 9). Waterfowl and shorebirds have been almost equally abundant overall, followed by wading birds and rails. Avian survey data suggests an increase in habitat indicator species richness in summer and fall as compared to pre-project survey results (Figure 4). This response is not unexpected as the project has increased water availability during the summer and early fall months. The presence of open water ponds of the adjacent Owens Lake Dust Control Program may also be influencing use of the Delta by indicator species. The Delta offers more opportunities for cover and nesting, while dust control ponds have better foraging habitat for indicator species.

The occurrence of HIS per survey was summed by season, and represents seasonal HIS species richness. Because the number of surveys per season differed, results should be compared across years, within season in order to evaluate HIS response. Indicator species richness has shown an increase in both summer and fall months over preproject conditions, owing to the addition of water. The response has been strongest for fall which is also expected as this period includes the presence of migratory species. The spring surveys, however do not show increased HIS richness above pre-project, and HIS presence was actually lowest in 2018 owing to the conversion of open meadow to more dense marsh vegetation.

Table 9. Total Habitat Indicator Species Summed by Species Group and Year

Species Group	Species	2005	2009	2013	2018	Total All Years
Anseriformes (Waterfowl)	American Wigeon	4				4
	Blue-winged Teal	2				2
	Canada Goose			5		5
	Cinnamon Teal	43	2	24	17	86
	Gadwall	16	4	33		53
	Green-winged Teal	18	3			21
	Mallard	153	119	154	158	584
	Northern Pintail	1	4			5
	Snow Goose		2			2
	Unidentified Teal		1		1	2
	Total Waterfowl	**237**	**135**	**216**	**176**	**764**
Charadriiformes (Shorebirds)	American Avocet	10	78	4	105	197
	Black-necked Stilt	2				2
	Calidris sp.		24		6	30
	Greater Yellowlegs	2	5	68	11	86
	Killdeer	17	7	97	34	155
	Least Sandpiper	162	6	81		249
	Lesser Yellowlegs			2	1	3
	Long-billed Curlew		13	3	1	17
	Long-billed Dowitcher			1		1
	Unidentified Shorebird species			1		1
	Western Sandpiper			5		5
	Willet			2	6	8
	Wilson's Phalarope		1	3		4
	Wilson's Snipe	5	10	15	10	40
	Total Shorebirds	**198**	**144**	**282**	**174**	**798**
Gruiformes (Rails and Cranes)	American Coot	7	18	13	6	44
	Sandhill Crane	1				1
	Sora	24	30	9	57	120
	Virginia Rail	5	113	29	75	222
	Total Rails and Cranes	**37**	**161**	**51**	**138**	**387**
Pelecaniformes (Wading Birds)	American Bittern	10	19	2	22	53
	Black-crowned Night-Heron	24	7	8	4	43
	Great Blue Heron	1	7	7	12	27
	Great Egret	3	3	13	4	23
	Least Bittern	1	5			6
	Snowy Egret	13	32	17	1	63
	White-faced Ibis		156	158	5	319
	Total Wading Birds	**52**	**229**	**205**	**48**	**534**
Total Habitat Indicator Species by Year		**524**	**669**	**754**	**536**	**2483**

The maximum number of HIS observed on any one survey has varied. The maximum number observed in spring was highest pre-project and lowest in 2018. Summer and fall peak numbers were highest in the first two post-implementation monitoring periods (2009 and 2013), but declined to near pre-project levels in 2018 (Figure 5).

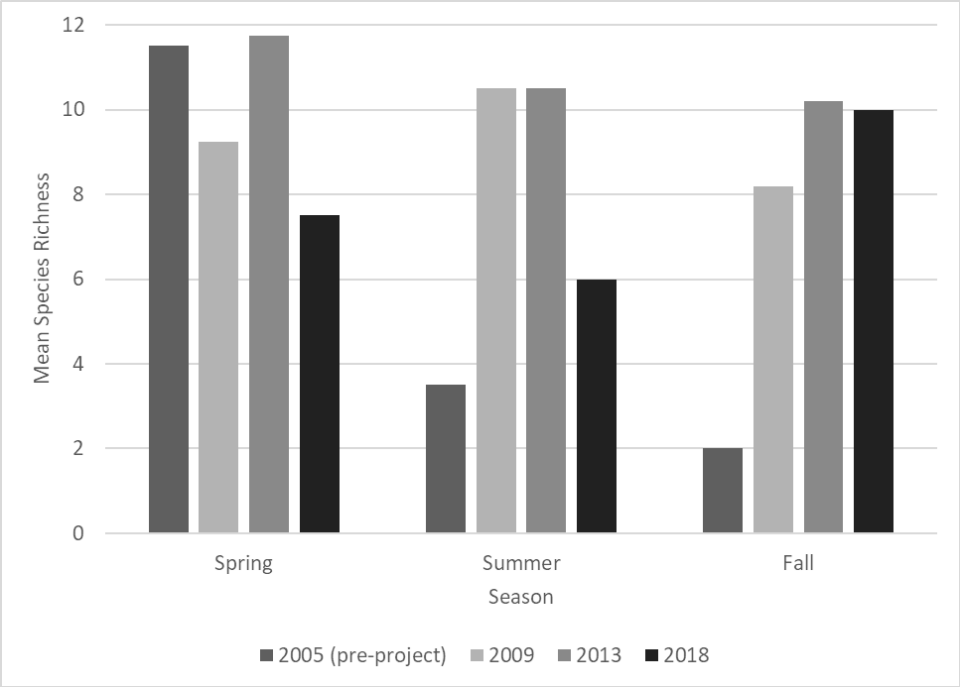

Figure 4. Mean species richness by season and year.

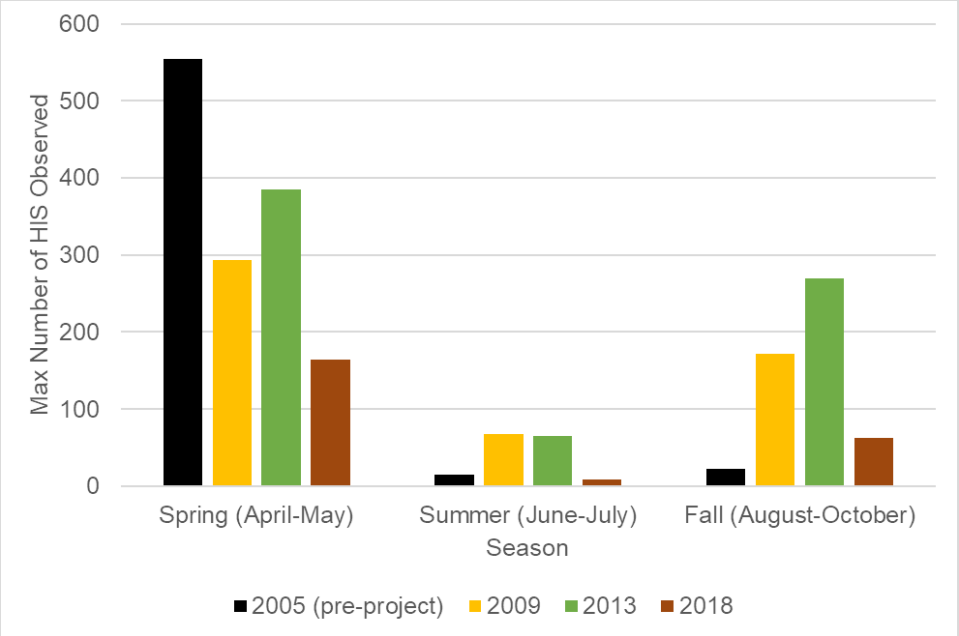

Figure 5. Seasonal Abundance of HIS represented by totaling the maximum number of each HIS observed during any one seasonal count.

Challenges

Although taken as a whole, the entire suite of Indicator Species for the DHA use each wetland vegetation type to various extents, open water and periodically flooded playa and meadow are higher quality habitats than tall, emergent marsh. The current trajectory of increasing cattail dominance observed in the Delta will result in reduced habitat suitability for the majority of indicator species as open habitats are preferred by these species. Although other factors may be at play, the decrease in use by Indicator Species observed in 2018 could be indicative of habitat changes trending towards reduced habitat diversity and quality. Although permanent open water ponds are limited in the Delta due to the flat, alluvial nature of the area, seasonal ponds are generally high quality habitats for waterfowl and shorebirds. The availability of seasonal ponds in the DHA can be enhanced through improved flow management.

1.2.2.2 Fish Species

Progress to Date

In the 2014 LORP Annual Report, HIS were reviewed for each of the four features of the LORP, including the DHA. While the goals for the DHA did not specifically reference a fishery, the HIS list contained in the MOU included both Owens pupfish and Owens tui chub as HIS for the DHA. The 2014 review of HIS determined that while there could be suitable habitat for native fish in the DHA, the presence of a non-native fishery renders is unsuitable due to direct competition. Similar to the riverine riparian system, the DHA most likely has a population of hybridized tui chub and any introduction of pure Owens tui chub will result in hybridization.

The most southern sampling area in the LORP from the creel surveys is Lone Pine Narrow Gage Road to the Pump Station, thus no sampling of fish has been conducted in the DHA as part of this project. LADWP and the County do not have information on presence/absence of these native fish in the DHA.

Current Status – HIS Associated with the DHA

This goal is being met for some but not all DHA HIS. As mentioned above, the entire suite of avian HIS for the DHA use each wetland habitat type to various degrees, and overall numbers of HIS in the DHA are higher than pre-project conditions, suggesting the notion that the implementation of the project has had an overall benefit to HIS. However, changes to flow management of the DHA could possibly arrest the meadow to marsh conversion and maintain more open habitat while also providing more water during migratory and overwintering periods which could further benefit a greater number of species including the shorebird, waterfowl, and wader guilds.

Habitat needs of native and non-native fish for the DHA are in conflict with each other; accommodating all species on HIS list is not attainable in the DHA given these competing goals.

Recommendations

Flow management has been the primary tool for managing the DHA, and more active management of the frequency or duration of flows may be needed in order to maintain productivity and diversity of the DHA wetlands. Although base flows have not resulted in long-term increases in open water habitats as predicted (EIR 6-23), seasonal flow increases are effective at creating temporary open water areas in the DHA and this management approach could be used for greater advantage for short-term and long-term benefits for HIS. Changes to flow management for habitat enhancement of the DHA will be further discussed in Section 1.2.3.

1.2.3 Average Annual Base Flow of 6-9 cfs to the Delta Habitat Area

Goal/Requirement

- MOU Section II.C.2.: "Subject to applicable court orders concerning the discharge of water onto the bed of Owens Lake, the quantity of water that will be released below the pumpback station for these purposes will be an annual average of approximately 6 to 9 cfs (not including water that is not captured by the station during periods of seasonal habitat flows)…"
- FEIR Section 4, Page S3: The management action for creating and enhancing habitats in the Delta is to establish baseflows to the Delta with an average annual flow of 6 to 9 cfs, as specified in the MOU. Within the 6 to 9 cfs annual average flow, four pulse flows of 20 to 30 cfs will be released to the Delta for short periods of time. The daily baseflow would be the amount necessary to maintain Delta conditions and to conserve water for use in the Delta during other times of the year (within the 6-9 cfs annual average and a minimum of 3 cfs) and for delivery to Los Angeles. In addition, higher flows may pass through the pump station to the Delta during the annual seasonal habitat flows in the Lower Owens River of up to 200 cfs.

Progress to Date

Prior to implementation of LORP, water flow in the Delta was seasonal and the DHA generally dried during the summer months. Surface water and outflows from the Delta to the brine pool of Owens Lake occurred from October/November through March/April (Final SEIR 2006).

The management action for creating and enhancing habitat in the DHA was to establish base flows with an average annual flow of 6 to 9 cfs. Within the 6 to 9 cfs annual average flow, four pulse flows of 20-30 cfs are released to the DHA for short periods of time. The daily base flow would be the amount necessary to maintain DHA conditions and conserve water for use in the DHA during other times of the year. A minimum daily base flow of 3 cfs was established. Additional water releases may occur in the DHA when high flows pass through the Pump Station to the DHA during the annual seasonal habitat flow to the river. The annual average flow of 6 to 9 cfs is calculated by including the base flow and four seasonal pulse flows, but

does not include water not captured by the pumpback station during periods of the SHF in the Owens River (MOU).

The restoration of the DHA did not initially include physical modifications such as modifying existing channels, creating new channels, constructing berms or otherwise modifying the topography to increase spreading or ponding in the DHA (LORP FEIR section 2-29). Although these actions may be considered part of adaptive management, the management instead relies on flow management and natural hydraulic and biological processes to maintain and enhance wetlands. Management options in the DHA include the adjustment of the amount, timing and duration of flows (Ecosystem Sciences 2002).
The total amount, duration and timing of pulse flows may be adjusted based upon the following monitoring triggers (EIR):

1) A decrease of 10 percent or more during any 3-year period of total acreage of vegetated wetlands plus water
2) A 20 percent or greater reduction in habitat suitability index as measured at 5-year intervals

Successes

Creation of Wetland Habitat, Habitat for HIS
Release of base and pulse flows to the DHA have been successful in creating wetland habitat, and suitable habitat for HIS in the DHA as discussed above.

Legal Compliance
Base flows and pulse flows have been released to the DHA annually (as required) as the management tool to support the habitat goals in the DHA (Table 10). The project has been successful as far as total water releases to the DHA as the annual base flow to the delta has been at least 6 cfs in all years, but in some years has exceeded the upper target level of 9 cfs (Figure 6). Flows to the delta for the 2016-2017 water year (October 2016- September 2017) were well above targeted flows due to heavy winter precipitation and high spring and summer runoff.

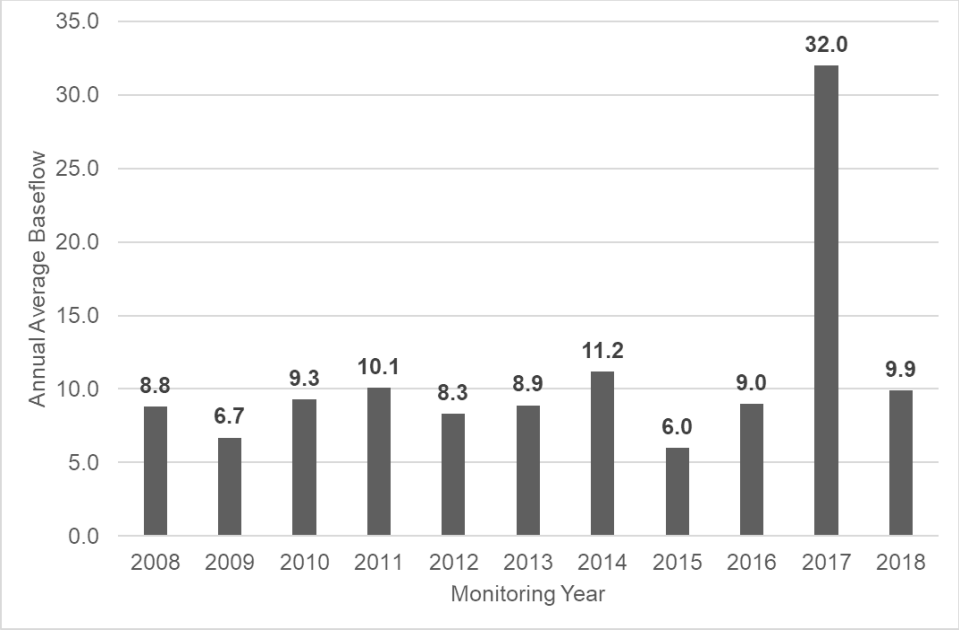

Figure 6. Annual Average Base Flows in the DHA.

Table 10. Number of Pulse Flow Days per Year and Period.

Pulse Flow Period	Number of Pulse Flow Days Per Year and Period										
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Period 1-March/April	-	10		10		10			15		2
Period 2-June/July	-	8	7	10*	10*	10*		10	61	10	13
Period 3-September	10	10	10	10	10		1	10	1	10	-
Period 4-November/December	5	5	5	5		5		5		5	-

*Period 2 flows occurred in late July

Challenges

The current flow regime, most notably, a consistent water supply during the entire growing season, has resulted in the conversion to a tall marsh-dominated system, and reducing habitat quality for HIS.

Current Status

This goal is being met with an average of 6-9 cfs being released to the DHA as required in the guiding documents. However, a change in the timing and duration of the pulse flows could further improve habitat conditions in the DHA.

Recommendations

If monitoring indicates flows to the DHA can be reduced while meeting MOU goals and conditions present in 2000, the requirement of 6-9 cfs average annual flow can be adjusted downward (Ecosystem Management Plan) as appropriate. Habitat for indicator species is the goal, and not the base flow in and of itself. The total amount of water allocated to pulse flows is 1,687 acre-feet per year (FEIR). Flow management has been the primary tool for managing the DHA, and more active management of the frequency or duration of flows may be needed in order to maintain productivity and diversity of the DHA wetlands. It is recommended that the DHA flows be managed to maximize open water, and flooded meadow and playa habitats during seasonal periods of use by indicator species. In addition, it is recommended to reduce flows during the growing season to avoid further expansion of tall marsh vegetation. In order to achieve this and remain within the water budget for DHA, the current base-flow and pulse flow schedule should be evaluated and revised.

It is recommended to implement the modified flow regime in the DHA described below for 5 years on an interim basis to further improve habitat conditions (Figure 7). The intent is to maintain required baseflows and flow to the Brine Pool Transition Area and also to redistribute summer and winter pulse flows to increase flows in fall and spring to improve habitat during those seasons for migratory birds. (*Proposed flows may be modified as necessary based on operational emergencies but will stay within the DHA water budget.*)

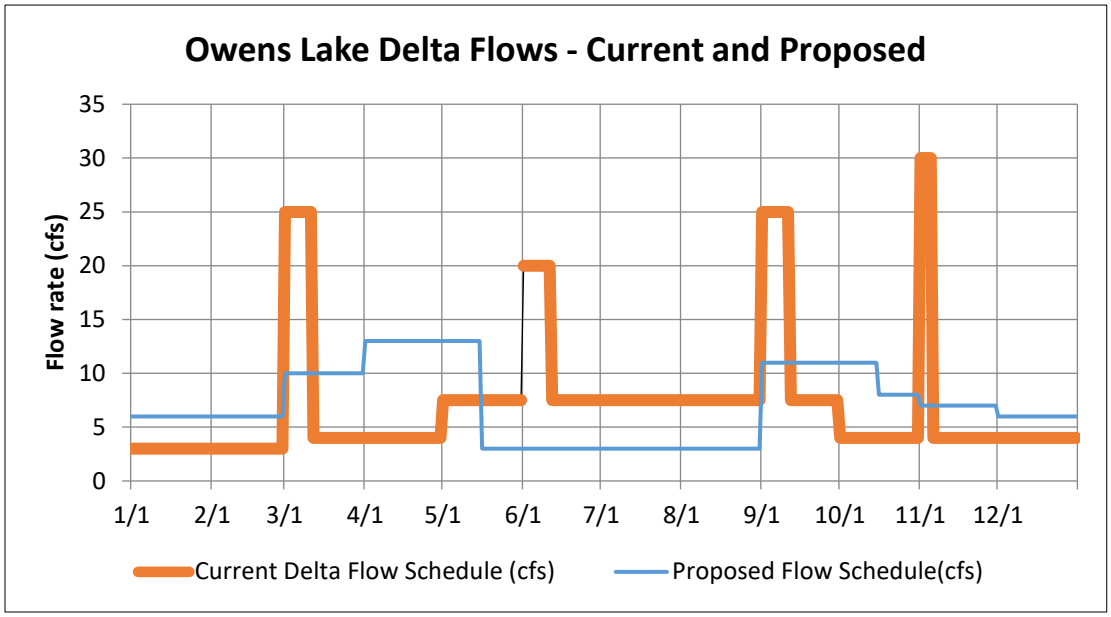

Figure 7. Owens Lake DHA Flows -Current and Proposed Schedules.

Specific recommendations include:

- Reduce base flows during the growing season to the current minimum required of 3 cfs. The objective of this recommendation is to reduce cattail extent and prevent further cattail expansion.

- Maintain outflow to “brine pool” during late fall through winter, but discontinue winter pulse flow as long as some outflow to the “brine pool” is occurring. It is estimated that a 6 cfs winter base flow from December through February will achieve this.
- Eliminate Period 2 (June/July) and Period 4 (November/December) pulse flows. Redistribute water budgeted for Period 2 and Period 4 pulse flows to Periods 1 (March/April) and 3 (September).
- Extend the duration of Period 1 and Period 3 pulse flows to flatten peaks in water flow and create flooded habitats over longer time periods that coincide with seasonal migratory patterns of HIS.
- Spring “pulse flows” would begin March 1 and end May 15. From March 1-31, the daily flow release would be approximately 10 cfs. From April 1-May 15, flows would be increased to approximately 13 cfs, to maintain conditions as evapotranspiration rates increase.*
- Fall “pulse flows” would initiate September 1. From September 1-October 15, the proposed daily flow release is 11 cfs. After October 15, flows will be ramped down until winter base flows are reached at 6 cfs by December 1.*
- A program to evaluate the effectiveness of this flow strategy in enhancing habitats will be developed. After a five-year period, an assessment will be conducted to determine the effectiveness of the proposed flow refinements.
- Refine avian monitoring program to evaluate the effectiveness of habitat enhancement associated with pulse flows.

1.3 Blackrock Waterfowl Management Area Goals/Requirements

- MOU Section II.C.4: The goal of the BWMA is "to maintain this waterfowl habitat area to provide the opportunity for the establishment of resident and migratory waterfowl populations as described in the EIR and to provide habitat for other native species. Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species" for the Blackrock Waterfowl Habitat Area. These habitats will be as self-sustaining as possible.
  Approximately 500 acres of the habitat area will be flooded at any given time in a year when the runoff to the Owens River watershed is forecasted to be average or above average. In years when the runoff is forecasted to be less than average, the water supply to the area will be reduced in general proportion to the forecasted runoff in the watershed… Even in the driest years, available water will be used in the most efficient manner to maintain habitat."
- LORP FEIR Section 2.5.3 provides the following primary objectives for the BWMA:
  - "Provide a reliable and dependable source of water and wetland habitat that will attract resident and migratory waterfowl and shorebirds and the other MOU indicator species for this project element
  - Maintain a ratio of open water wetlands to emergent wetlands so that emergent wetlands do not exceed 50 percent of the flooded area of any management unit
  - Create and maintain diverse habitats while minimizing the use, extent and frequency of intervention and manipulation."

1.3.1 Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species (BWMA)

Goal/Requirement

- MOU Section II.C.4. "Diverse natural habitats will be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species" for the Blackrock Waterfowl Habitat Area. These habitats will be as self-sustaining as possible."
- MOU Attachment A., LORP Action Plan, Table 1- BWMA HIS:

Blackrock Waterfowl Habitat Area

Owens pupfish	Resident, migratory and wintering waterfowl
Owens tui chub	Resident, migratory and wintering wading birds
	Resident, migratory and wintering shorebirds
	American bittern
	Least bittern
	Rails
	Marsh wren

1.3.1.1 Avian Species

Progress to Date

The Habitat Indicator Species for BWMA are primarily wetland dependent bird species. Wetland dependent waterbird species require a diverse and abundant forage base. Waterfowl habitat management over the past 60 years in North America has focused on forage availability (energy resources) in combination with open water. Carefully timed seasonal flooding events can maximize moist-soil seed production, which improves the utility of the wetland to waterfowl and shorebirds. This is accomplished through a wetland management regime based on timely drawdowns for plant germination, summer irrigation, and soil disturbance." (LADWP and County of Inyo 2015).

Avian surveys have been conducted in order to assess use by Habitat Indicator Species in the BWMA. Surveys are conducted during the first two years of active flooding of a unit. Twelve surveys were conducted each year of monitoring, and survey dates are classified as to season (spring, summer, fall and winter). The indicator species were placed into indicator species groups (Waterfowl, rails, wading birds, shorebirds, Northern Harrier, and Marsh Wren). The total number of birds observed per indicator species group was summed for all units and years 2009-2018. Vegetation mapping had been conducted every 5 years or as new imagery is available.

Successes

Flooding of BWMA under LORP has attracted up to 60 Habitat Indicator Species, including 23 waterfowl, 22 shorebird, and 9 wading bird species (Table 11). BWMA has been most successful in attracting waterfowl as the birds in this species group have comprised 66% of all indicator species seen at BWMA (Figure 8). Wading birds and shorebirds have each comprised 15% of habitat indicator species totals.

Table 11. Habitat Indicator Species Observed in the Blackrock Waterfowl Management Area

Order	English Name	Scientific Name
Anseriformes (Waterfowl)	Snow Goose	*Anser caerulescens*
	Ross's Goose	*Anser rossii*
	Greater White-fronted Goose	*Anser albifrons*
	Canada Goose	*Branta canadensis*
	Tundra Swan	*Cygnus columbianus*
	Wood Duck	*Aix sponsa*
	Blue-winged Teal	*Spatula discors*
	Cinnamon Teal	*Spatula cyanoptera*
	Northern Shoveler	*Spatula clypeata*
	Gadwall	*Mareca strepera*
	American Wigeon	*Mareca americana*
	Mallard	*Anas platyrhynchos*
	Northern Pintail	*Anas acuta*
	Green-winged Teal	*Anas crecca*
	Canvasback	*Aythya valisineria*
	Redhead	*Aythya americana*
	Ring-necked Duck	*Aythya collaris*
	Lesser Scaup	*Aythya affinis*
	Bufflehead	*Bucephala albeola*
	Common Goldeneye	*Bucephala clangula*
	Hooded Merganser	*Lophodytes cucullatus*
	Common Merganser	*Mergus merganser*
	Ruddy Duck	*Oxyura jamaicensis*
Gruiformes (Rails)	Virginia Rail	*Rallus limicola*
	Sora	*Porzana carolina*
	Common Gallinule	*Gallinula galeata*
	American Coot	*Fulica americana*
Charadriiformes (Shorebirds)	Black-necked Stilt	*Himantopus mexicanus*
	American Avocet	*Recurvirostra americana*
	Black-bellied Plover	*Pluvialis squatarola*
	Semipalmated Plover	*Charadrius semipalmatus*
	Killdeer	*Charadrius vociferus*
	Whimbrel	*Numenius phaeopus*
	Long-billed Curlew	*Numenius americanus*
	Marbled Godwit	*Limosa fedoa*
	Dunlin	*Calidris alpina*
	Least Sandpiper	*Calidris minutilla*
	Western Sandpiper	*Calidris mauri*

	Short-billed Dowitcher	*Limnodromus griseus*
	Long-billed Dowitcher	*Limnodromus scolopaceus*
	Wilson's Snipe	*Gallinago delicata*
	Spotted Sandpiper	*Actitis macularius*
	Solitary Sandpiper	*Tringa solitaria*
	Lesser Yellowlegs	*Tringa flavipes*
	Willet	*Tringa semipalmata*
	Greater Yellowlegs	*Tringa melanoleuca*
	Wilson's Phalarope	*Phalaropus tricolor*
	Red-necked Phalarope	*Phalaropus lobatus*
Pelecaniformes (Wading Birds)	American Bittern	*Botaurus lentiginosus*
	Least Bittern	*Ixobrychus exilis*
	Great Blue Heron	*Ardea herodias*
	Great Egret	*Ardea alba*
	Snowy Egret	*Egretta thula*
	Cattle Egret	*Bubulcus ibis*
	Green Heron	*Butorides virescens*
	Black-crowned Night-Heron	*Nycticorax*
	White-faced Ibis	*Plegadis chihi*
Accipitriformes (Hawks)	Northern Harrier	*Circus hudsonius*
Passeriformes (Perching Birds)	Marsh Wren	*Cistothorus palustris*

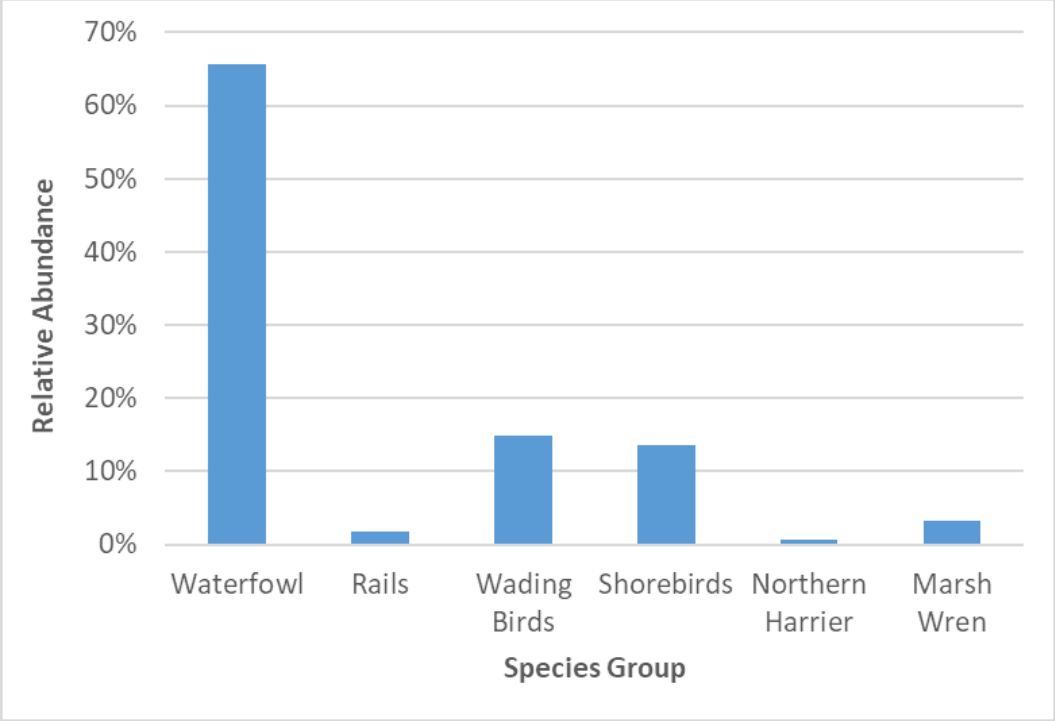

Figure 8. The relative abundance of each Habitat Indicator Species group BWMA; 2009-2018

Challenges

Habitat goals for the BWMA include not only an acreage component, but also a habitat quality component to ensure these habitats are consistent with the needs of BWMA habitat indicator species.

Limited Habitat Value After First Year

The greatest challenge to the BWMA project is the inability to provide reliable and dependable wetland habitat as described in the LORP FEIR beyond the first year a cell is in operation. The FEIR states this goal is to "Provide a reliable and dependable source of water and wetland habitat that will attract resident and migratory waterfowl and shorebirds and the other MOU indicator species for this project element" (Section 2.5.3, LADWP 2004). Reliable habitat is critical for migratory avian species passing through Owens Valley during fall and spring migrations. The LORP Annual Reports document the decline of habitat quality with each additional year a unit remains active in the BWMA (LADWP and County of Inyo 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018). The effect of prolonged flooding on habitat productivity is evident from the Drew Unit avian survey data. Avian surveys of the Drew Unit were conducted in 2010 (the second year of flooding), and in spring and early summer of 2015, year seven of flooding. Although Drew reverted to inactive in 2015, the unit remained flooded through early summer. The results of the four comparable surveys conducted in year 2 vs. year 7 of flooding show a dramatic decrease in use by the two most abundant indicator species groups - waterfowl and shorebirds of the Drew Unit (Figure 9).

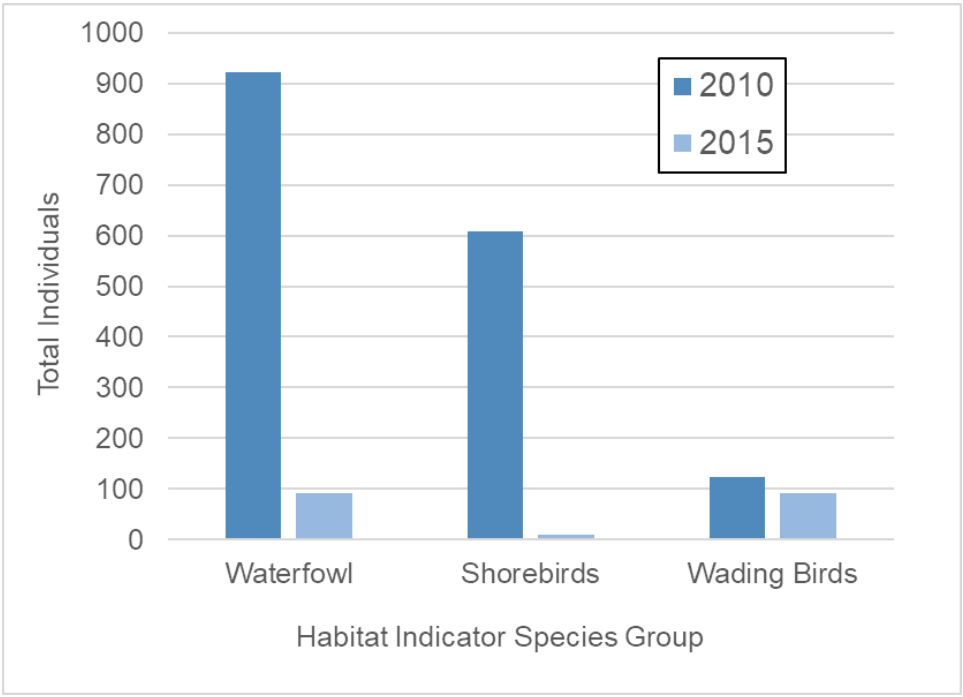

Figure 9. A comparison of total Habitat Indicator Species use in Year 2 vs. Year 7 of active flooding of the Drew Unit

Units productive in the spring during the initial wetting phase are rapidly colonized by cattails in the summer. By fall of the first year, habitat quality is already compromised. Prolonged flooding ceases nutrient cycling, precludes opportunities for seed production from early seral species to be available for migrating waterbirds during the fall and spring. Structurally, available open water steadily decreases, as tule and cattail encroachment expands. Returning migrating waterbirds encounter lower quality habitat than what was present during the first flooding of a unit the previous spring. This downward trajectory negates the ability to provide reliable and dependable habitat for returning migratory species from one season to the next.

50% open water wetlands to emergent wetlands

The LORP FEIR presents the objective to "maintain a ratio of open water wetlands to emergent wetlands so that emergent wetlands do not exceed 50 percent of the flooded area of any management unit (Section 2.5.3, LADWP 2004). The 50:50 ratio of open water to emergent wetlands is the concept of the "hemi-marsh". Weller and Spatcher (1965) found that species richness was greatest in wetlands characterized by a 50:50 emergent cover to water ratio. Wetland managers often replicate the physical appearance of hemi-marshes by intensely managing vegetation (Euliss et al 2008). The problem with this approach is that it is not the ratio alone that creates productive wetlands, but the hydrologic process of wet and dry cycles that naturally form hemi-marsh conditions and create productive conditions.

In BWMA, the 50% open water criteria will not only lead to inefficient use of resources and potentially unproductive wetlands, but to date, there is also no formal monitoring of changes in open water availability in active units. Decisions to rotate units are based on professional assessments by LADWP, ICWD, and the MOU Consultants in consultation with California Department of Fish and Wildlife (CDFW). Open water on a unit is considered when evaluating a change in units. Incidentally, the MOU makes no mention of an open water criteria for the BWMA. Implicit in the 50% ratio is that open water is a valid indicator for habitat quality as it pertains to wetland-dependent bird species and reinforces the assumption that flooded units lasting more than a season with open water is acceptable. Migrating waterbirds require energy resources, not open water *per se*. For this reason, off-river lakes and ponds (with the exception of Thibaut Pond which is flooded seasonally) do not support large numbers of waterbirds. The limiting factor for viable waterbird habitat is a forage-rich wetland, not solely open water. Waterfowl habitat management over the past 60 years in North America has focused on forage availability (energy resources) in combination with open water. CDFW describes this requirement for successful wetland management as follows: "Seasonally flooded wetlands and permanent open water provide important habitat to migratory waterfowl. Carefully timed seasonal flooding events can maximize moist-soil seed production, which improves the utility of the wetland to waterfowl and shorebirds. This is accomplished through a wetland management regime based on timely drawdowns for plant germination, summer irrigation, and soil disturbance." (LADWP and County of Inyo 2015). CDFW reiterates this point again in their response to the 2016, 2017, and 2018 LORP Annual Monitoring Reports: "The best available science strongly supports seasonal wetland management for migratory waterfowl and shorebirds…" (LADWP and County of Inyo 2016, 2017, 2018).

Maintenance, Tule/Cattail Encroachment and Water Use

Another objective described in the LORP EIR, "Create and maintain diverse habitats while minimizing the use, extent and frequency of intervention and manipulation" (Section 2.5.3, LADWP 2004), has not been met. Because of the MOU commitment to maintain flooded acreage at any given time of the year, widespread cattail encroachment into open waterfowl habitats is unavoidable. When a unit is planned to be flooded anew, the unit will typically be burned. Since 2007, the Winterton unit has been burned twice, and the Waggoner and Drew Units burned once each. Conducting prescribed fires requires large amounts of time and expenditures. After conducting a successful burn, conditions on a unit typically revert to what they were prior to the fire by the middle of the summer of the first season. This contrasts to a shrub encroached meadow burn which can maintain an open meadow for more than 10 years. The costs associated with prescribed burning can be offset by disking. However, disking will not stymie cattail encroachment if units are flooded during the growing season for prolonged periods (LADWP and County of Inyo 2015; Smith et al. 1994). Again, by seasonally flooding units, and avoiding inundation during the summer, preparation expenditures for new units would be significantly less.

Flooded acreage varies annually and requires annual maintenance of berms, spillgates, and cleaning of obstructions. Some berms that function to contain water on one year are flooded and damaged the following year because of an increase in required acreage. Because the following year's acreage is determined in April, the varying amount of water to be spread by May results in a very limited window to prepare units.

1.3.1.2 Fish Species

Progress to Date

In the 2014 LORP Annual Report, HIS were reviewed for each of the four features of the LORP, including the BWMA. While the goals for the BWMA did not specifically reference a fishery, the HIS list contained in the MOU included both Owens pupfish and Owens tui chub as HIS for the BWMA. The 2014 review of the HIS recommended that both species be removed as indicator species due to direct competition and predation from the non-native warm water fish species. There is also the issue of resident populations of hybrid tui chubs hybridizing with introduced pure Owens tui chub. It was also noted that due to the BWMA's current management of flooding and drying of habitat units to maintain optimal waterfowl habitat, that only temporary fish habitat will be provided.

Current Status – HIS Associated with BWMA

This goal is being met for some but not all Habitat Indicator Species associated with the BWMA. Habitat needs of native and non-native fish for the BWMA are in conflict with each other; additionally, management by flooding and drying of cells in the BWMA will only create temporary fish habitat. Attaining all species on the HIS list is not feasible given the current project trajectory.

Habitat *quantity* requirements have been met for avian habitat indicator species in the BWMA. Units have been flooded consistently, throughout the year, based upon a given water year. Habitat that will attract resident and migratory waterfowl, shorebirds, and other indicator species has not been met in all years. Monitoring efforts have repeatedly documented a decline in habitat quality following the initial spring flooding of a unit. LADWP, ICWD, and CDFW (LADWP and County of Inyo 2015, 2016, 2017, 2018) have collectively identified that the inability to seasonally flood units, which would avoid inundation during the summer, is the primary obstacle impeding the development of high quality migrating waterbird habitat.

Recommendations

It is recommended that LADWP and the County implement a seasonal flooding regime to improve wetland productivity to the further benefit of the BWMA Habitat Indicator Species. Specifically:

(1) Implement seasonal sustained flooding during the fall, winter, and spring but avoid flooding during the summer. Flood units beginning in mid-September with a complete draw down by May 1st.
(2) Allow for a rapid early summer 'irrigation' release of water to facilitate the production of early seral vegetation.
(3) Flood a fixed 500 acres each year in the BWMA between September and May and discontinue varying flooded acreage on specific water year. Wetted acreage measurements will occur on or around November 1 and March 1, with the average of those two measurements being used to determine compliance with the 500 acre value.
(4) Develop a new criteria to evaluate habitat focused on forage production for migrating waterbirds. Focus efforts on developing habitat for migrating waterbirds, and not resident populations. Wetlands in the Intermountain West such as those found at BWMA are extremely important as stopover sites for migrating waterbirds. Some sites support breeding populations, however the overwhelming majority of birds using BWMA are non-resident, migratory waterfowl, shorebirds and wading birds.

The LORP Scientific Team will develop a five-year interim management plan for the BWMA that incorporates the elements of the rotational seasonal flooding regime described above. This plan will describe how flooding of the units will be managed as well as associated monitoring to assess the effectiveness of this strategy.

A reevaluation of the HIS list for the LORP BWMA is suggested to determine its appropriateness, given the ecological setting, trajectory, and project constraints.

It is further recommended to discontinue the use of the simplistic CWHR models to quantify habitat suitability. Better information can be obtained by continuing waterbird surveys to evaluate the response to management changes, and by implementing an efficient and effective method of evaluating wetland productivity. To evaluate the effectiveness of managing the units

for stopover forage quality the spatial distribution of waterbird habitat use within the units should be analyzed to gauge the efficacy of the new seasonally-flooded management in the context of forage quality. Small-scale behavioral observations can be implemented to quantify foraging rates for diving and dabbling ducks if a measure of habitat quality in response to a new management regime is desired.

1.3.2 Approximately 500 acres Flooded When Runoff is Forecast to be Average/Above Average

Goal/Requirement

- MOU Section II.C.4: "Approximately 500 acres of the habitat area will be flooded at any given time in a year when the runoff to the Owens River watershed is forecasted to be average or above average. In years when the runoff is forecasted to be less than average, the water supply to the area will be reduced in general proportion to the forecasted runoff in the watershed… Even in the driest years, available water will be used in the most efficient manner to maintain habitat."
- LORP EIR Section 2.3.5.3 provides specific guidance on how the flooded acreage is to be calculated.

Progress to Date

LADWP and the County have complied with the guidance in the MOU and FEIR since implementation of the project. Table 12 below provides flooded acreage requirements by year (based on runoff forecast), as well as actual acreage flooded.

Current Status

LADWP and the County are complying with guidance on flooded acreage for the BWMA as described in the MOU and LORP EIR. This requirement is being met. However, as discussed in Section 1.3.1 above, for some time there has been consensus among the Scientific Team that managing the BWMA cells seasonally, as is typically recommended for waterfowl management elsewhere, would provide increases in habitat quality and overall value to migrating and overwintering waterbirds.

Table 12. BWMA Flooded Acreage by Year since LORP Implementation

Blackrock Waterfowl Management Area				
Runoff Year	**Runoff Forecast (% normal)**	**Flooded Acreage Requirement**	**Cells Flooded**	**Average Acreage Flooded**
2007-2008	58%	290	Winterton and Thibaut	477
2008-2009	86%	430	Winterton and Thibaut	494
2009-2010	71%	355	Drew and Waggoner	385
2010-2011	95%	475	Drew and Waggoner	669
2011-2012	150%	500	Drew and Winterton	480*
2012-2013	65%	325	Drew	327
2013-2014	54%	270	Drew	308
2014-2015	50%	250	Drew	275
2015-2016	36%	180	Winterton	234
2016-2017	71%	355	Winterton and Thibaut	530
2017-2018	197%	500	Winterton and Thibaut	700+
2018-2019	78%	390	Winterton and Drew	423
2019-2020	137%	500	Winterton, Drew, and Thibaut	*In process*

**flooded acres ranged between 372-539 acres*

Recommendations

As stated in Section 1.3.1, a seasonal flooding regime is recommended for future management of BWMA. Specifically,

(1) Implement seasonal flooding during the fall, winter, spring, and avoid flooding during the summer. Flood units beginning in mid-September with a complete draw down by May 1st.

(2) Implement spring drawdowns and allow for a rapid early summer 'irrigation' release of water to facilitate the production of early seral vegetation. Spring drawdowns stimulate germination of plants adapted to recently exposed moist soils (Fredrickson and Taylor 1982; Gray et al. 1999). These plants can produce rich food sources comprised of seeds, invertebrates, tubers and browse for winter waterbirds when flooded in the fall. If post-drawdown rainfall is minimal (which is typical in the Owens Valley), moist-soil management can require a second pulse of water to ensure continued growth of target plants until seed setting (USFWS 2007; Smith et al. 1994). Timing and duration of these late season vs. early season drawdowns will produce differing results. Rapid early season drawdowns tend to produce low diversity of moist-soil plants but those species can be highly desirable forage plants. Slow drawdowns can produce a greater diversity of moist-soil plants but may not be as productive, however a gradual drawdown will extend favorable habitat for shorebirds (Smith et al. 1994; USFWS 2007). A consistent

theme in the literature on moist-soil management emphasizes the importance of site specific conditions in determining outcomes and the high level of variability within a single locale (Fredrickson and Taylor 1982; Naylor 2002, Smith et al. 1994; USFWS 2007). Experimentation to tailor local conditions is integral to a successful wetland management program.

(3) Having the ability to release up to 35 cfs during a 10 day period across units in the late spring and early summer will allow managers the flexibility to effectively implement moist-soil management on the BWMA units if an additional moisture input is required to reach seed production for key plant species. Flood a fixed 500 acres each year between September and May and discontinue basing flooded acreage on specific water year.

(4) Develop new criteria to evaluate habitat focused on forage production for migrating waterbirds. Monitoring the effectiveness of varying treatments would occur prior to fall flooding to determine the optimal method to maximize forage production. There are several different monitoring techniques available for the scientific team to consider (Naylor et. al. 2005; Tavernia et al. 2016).

1.3.2.1 Annual Consultation with CDFW on the Amount of Flooded Area in the BWMA when Runoff is Forecast to be Less than Average

Goal/Requirement

- PIA Section II.P.2 describes the process for setting flooded acreage at the BWMA when runoff is forecast to be less than average, which requires LADWP and the County to consult with CDFW and get approval by the Standing Committee before implementing a Dry Year Blackrock Management Plan. It states: ““In order to address the requirement that when runoff is forecasted to be less than average, the amount of acreage to be flooded will be set by the Standing Committee in consultation with DFG the following process will be followed.
  a) Soon after the first of April each year, LADWP will develop its annual runoff year forecast for the Owens River Basin. The runoff year forecast will be developed as described in Section 2.3.5.3 of the LORP EIR. In the event the runoff forecast equals or exceeds "normal runoff' as defined in Section 2.3.5.3 of the 2004 Final LORP EIR, no further action is required.
  b) If the runoff forecast is for less than the normal runoff, the year will be considered a Dry Year, and consultation with the Department of Fish and Game ("DFG") will occur on the development of a Dry Year Blackrock Management Plan. In a Dry Year, by approximately the second or third week in April, LADWP and the County will transmit the recommendation concerning the amount of acreage to be flooded, along with LADWP's annual runoff year forecast for the Owens River Basin to DFG. DFG will be requested to, within ten business days from receipt of the recommendation, provide their concurrence with the recommendation or provide their own recommendation as to the amount of acreage to be flooded, along with the scientific basis for its differing recommendation.

c) In dry years when DFG has a differing recommendation, a report on the difference will be provided to the Standing Committee and a Standing Committee meeting will be scheduled. An action item entitled "Establishment of Dry Year Blackrock Management Plan" will be placed on the Standing Committee agenda. The Standing Committee will provide an opportunity for DFG to make a presentation at the meeting concerning its recommendations. Following any such presentation by DFG, the Standing Committee will consider adoption of a Dry Year Blackrock Management Plan".

Current Status

This procedural requirement is being met. Annual recommendations to date have been based on guidance in the MOU and LORP FEIR.

Recommendations

None. If the interim plan for BWMA is implemented, this procedure will be unnecessary as 500 acres will be flooded seasonally each year.

1.4 Off-River Lakes and Ponds Goals/Requirements

1.4.1 Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species (Off River Lakes and Ponds - ORLP)

Goal/Requirement

- MOU Section II.C.3.: "The goal is to maintain and/or establish Billy Lake, Goose Lake, Thibaut Ponds, Upper and Lower Twin Lakes to sustain diverse habitat for fisheries, waterfowl, shorebirds, and other animals as described in the EIR. Diverse natural habitats will be created through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species" for the Off-River Lakes and Ponds. These habitats will be as self-sustaining as possible."
- MOU Attachment A., LORP Action Plan, Table 1- Off-River Lakes and Ponds HIS:

Off-River Lakes and Ponds

Largemouth bass	Resident, migratory and wintering waterfowl
Smallmouth bass	Resident, migratory and wintering wading birds
Blue gill	American bittern
Channel catfish	Least bittern
Owens pupfish	Rails
Owens tui chub	Marsh wren
	Osprey

- LORP FEIR Sections 2.6 and 8 also provide guidance for the Off-River Lakes and Ponds.
- The MAMP Section 4.5 describes three types of monitoring for the LORP Off-River Lakes and Ponds: Flow and Wetland Monitoring, Rapid Assessment Survey, and Creel Census.

1.4.1.1 Avian Species

Progress to Date

Although several avian species were listed as HIS for Off-River Lakes and Ponds in Attachment 1 of the MOU, there was no monitoring for avian species developed under the MAMP. Therefore, no data on presence/absence of avian species has been collected at the Off-River Lakes and Ponds as part of LORP. EBird, an online citizens science database, was reviewed to determine if data were available for ORLP. Billy Lake is a popular birding location, and thus data were available for this ORLP. . The eBird data indicates that waterfowl, wading birds, Least Bittern, rails (Sora and Virginia Rail), Marsh Wren and Osprey have all been observed at Billy Lake since 2006. The Off-River Lakes and Ponds have largely been managed for their value as a recreational warm water fishery rather than for value to avian species.

1.4.1.2 Fish Species

Progress to Date

As part of the LORP, LADWP was to continue to supply water to Upper and Lower Twin Lakes, Goose Lake, and Billy Lake and maintain set staff gauge heights. Many decades ago, warm

water game fish were introduced into these waters for recreational angling. The hydrologic connectivity provided to the river through the implementation of the LORP has maintained this fishery. There were no known populations of native fish in the Off-River Lakes and Ponds prior to implementation of the LORP (LORP FEIR).

A total of five creel surveys have been conducted to date, one prior to implementation (2002) and four post-implementation (LADWP and County of Inyo 2010, 2011, 2013 and 2014). As with the Riverine-Riparian System and the DHA, the HIS list for the Off-River Lakes and Ponds was evaluated. At that time, it was determined that a native fishery would not be self-sustaining due to the direct competition and predation by the established warm water fishery and introduced pure strain Owens tui chub would eventually hybridize with resident hybrid tui chub. For these reasons, it was recommended in 2014 to remove the native fish from the Off-River Lakes and Ponds HIS list. It was also recommended that smallmouth bass be removed from the HIS list due to rare occurrences in the Off-River Lakes and Ponds.

Successes

As discussed previously in Section 1.1.5, creel censuses were conducted in 2003, 2010, 2011, 2013, and 2014 in the Off-River Lakes and Ponds (Table 13). Based on this information, it is evident that the LORP's Off River Lakes and Ponds are sustaining a warm water recreational fishery. Of the six HIS for the Off-River Lakes and Ponds, presence of largemouth bass, bluegill, and brown bullhead were confirmed during the creel censuses.

Table 13. Catch per unit effort results for Lower Owens River creel surveys 2003, 2010, 2011, 2013, and 2014 (LADWP and County of Inyo 2010, 2011, 2013, 2014).

	2003			2010			2011			2013			2014		
Reach	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour	# of fish caught	hours fished	fish/ hour
5	120	45.5	**2.6**	52	28	**1.9**	58	28	**2.1**	26	14	**1.9**	74	24.5	**3.0**

The warm water fishery in the LORP is to be self- sustaining. While the 1991 EIR referenced fish stocking in the LORP, CDFW does not currently do so. Information obtained from the creel census suggest that the fishery is sustainable and naturally reproducing.

To determine whether or not the LORP fishery is naturally reproducing, fish length from creel censuses at each lake were binned into young of the year (YOY) and sexually mature adult size classes. Since both size classes are observed in all lakes, it is inferred that adults are successfully spawning and YOY are successfully surviving to adulthood, which confirms that the population is self-sustaining. The statements in previous sections regarding the utility of creel survey data apply.

Laarman and Schneider (1985) found that female largemouth bass became sexually mature at 7.8 to 8.7 inches while males became sexually mature at 8.1 to 8.7 inches. Based on these

criteria, the four lakes apparently produced bass of sufficient length to be sexually mature (Table 14).

The data is limited on YOY bass size classes (4 to 6 inches) across the four lakes (Table 14). Six-inch fish were found at both Goose and Billy Lakes which is within the YOY size class. However, upper Twin Lake's smallest fish sampled was 9 inches and Lower Twin Lake's smallest fish sampled was 8 inches, both of which are considered to be sexually mature. The lack of smaller fish within the YOY sizes classes doesn't necessarily mean spawning doesn't occur in these lakes since sampling methods are biased to larger fish as previously discussed.

Table 14. Maximum and minimum total lengths of fish sampled by lake, during the four creel surveys. (LADWP and County of Inyo 2010, 2011, 2013, 2014)

Lake	Bass		Bluegill		Brown Bullhead	
	Minumum Length (inches)	Maximum Length (Inches)	Minumum Length (Inches)	Maximum Length (Inches)	Minumum Length (Inches)	Maximum Length (Inches)
Upper Twin	9	17	2	8		
Lower Twin	8	16	3	6	12	12
Goose	6	17	3	5	8	9
Billy	6	17	3	5		

Bluegill were the second most abundant fish caught during the creel surveys but data is also limited in regards to YOY. Sigler and Miller 1963 indicated that bluegill can reach sexual maturity in by 1 to 2 years but the average is more likely 2 to 3 years old. Creel surveys confirmed all ORLP contain bluegill of sufficient length (3-8 inches) to be sexually mature (Table 14). Only one bluegill that was caught in Upper Twin Lake was within the YOY size class criteria. Sigler and Sigler (1987) stated that, by the end of their first year, bluegill can reach a length of 2 inches and grow about an inch a year thereafter. Therefore, the three-inch bluegill sampled in Lower Twin, Goose, and Billy Lakes were likely two-year-old fish. The size classes consistent with both adults, second-year and one YOY suggests that the ORLP's bluegill fishery is potentially self-sustaining. An unbiased survey that more easily detects smaller fish would help confirm this.

Brown bullhead was the third warm water fish species caught within the ORLP: two from Goose Lake and one from Lower Twin (Table 14). Limited sample size precludes conclusions about size classes and whether or not brown bullhead is reproducing in the ORLP.

Challenges

Lack of Quality Fish Data Collected

Although creel censuses have been conducted prior to and following implementation of the LORP, they are biased to certain size classes and species limiting their value to accurately

represent the full range of species composition and population age structure. The intention of these surveys was to provide a first approximation of the recreational fishery but quantifying population size and structure is beyond the scope of these data.

Evaluating the Off-River Lakes and Ponds fishery was challenging due to the quality of the data collected during the four creel surveys. Creel censuses are dependent on a number of factors, including but not limited to method of capture, angling experience, and fish identification experience. Only bass, bluegill, and brown bullhead were detected during the creel surveys. No native fish were observed during the creel surveys.

Current Status – HIS Associated with Off River Lakes and Ponds

This goal is being met for some but not all LORP HIS. The ORLP are being managed for their value as a recreation warm water fishery and supporting nonnative, warm water fish species. Coexistence of native and nonnative fish HIS is an unlikely outcome as described elsewhere in this document.
Deep, permanent ponds such as those in the ORLP component of LORP are not preferred habitat for majority of the avian indicator species, however, data from eBird for Billy Lake indicates that avian habitat indicator species use this ORLP, and can be expected to use other ORLP to some degree.

Recommendations

As noted in Section 1.1.5, it is recommended that an electroshock fish survey be conducted by CDFW at the ORLP to provide an estimate of current species composition.

1.5 Land Management Goals/Requirements

1.5.1 Recreation Management

Goal/Requirement

- MOU Section II.B: "…for the benefit of biodiversity and threatened and endangered species, providing for the continuation of sustainable uses including recreation, livestock grazing, agriculture, and other activities."
- MOU Section II.B.5: "Management of livestock grazing and recreational use consistent with other goals of the LORP."
- 2004 LORP FEIR Section 2.9 outlines recreation management actions that LADWP is responsible for in implementing the project. These include new fencing and signage in the project area.
- PIA Section C. states the County is responsible for developing a recreational use plan for the Owens River within the project area.

Progress to Date

In compliance with Section 2.9 in the LORP FEIR, LADWP installed six kiosks in the project area to inform users of LADWP's day use policies, primary access routes, cultural resources protection, and invasive species prevention. These kiosks are located at the following locations:

- Aberdeen (Aberdeen Station Road and Lower Owens River)
- BWMA (Highway 395 and Blackrock Hatchery Road)
- Mazourka (Mazourka Canyon Road and Lower Owens River)
- Manzanar (Manzanar Reward Road and Lower Owens River)
- Lone Pine (Lone Pine Narrow Gauge Road and Lower Owens River)
- Pump Station (Owens Lake Access/Brady Highway and Lower Owens River)

Inyo County released a Preferred Recreation Use Plan on January 15, 2013. The plan was developed with the assistance of recreation planners M.I.G Inc. and was informed by an extensive stakeholder and public outreach process. More than 100 stakeholders were interviewed included elected officials, tribal leaders, conservationist, recreation groups, business leaders, and public agencies.

The plan took into account LORP goals, existing conditions, ecological constraints, LADWP operational needs, surrounding recreational uses, and predicted future demand. The plan was informed by extensive public outreach over a two year period. Stakeholder interviews identified five goals as being central to the LORP recreation plan:

1. Strengthen the area's nature-based tourist economy
2. Create opportunities for low-impact exploration and wildlife observation
3. Design a system to improve area access and wayfinding
4. Improve river and lake access for fishing, canoeing and kayaking
5. Inspire cultural and environmental education, learning, and stewardship

Current Status

LADWP has implemented recreational controls noted in the LORP FEIR. The annual LORP Rapid Assessment has recorded evidence of recreation including fire rings, vehicles accessing the floodplain, OHV activity, concentrations of trash, vandalism, the development of trails and informal water access locations.

During the development of the recreation plan, M.I.G. consultants found general agreement among stakeholders that tule management should be considered, as tules were blocking public access to the river and having a significant impact on recreation. There was concern that tules have taken over areas that were previously open water reducing fishing and boating opportunities, impacting wildlife viewing and hunting, and creating dangerous and unsafe conditions for those that attempted to navigate portions of the channel in boats and kayaks. Most participants also suggested that there is a critical need to provide LORP wayfinding assistance and information about LORP recreation opportunities and public access policies.

Recommendations

It would support recreation to develop and distribute maps that help visitors navigate the network of roads in the LORP. A secondary purpose would be to minimize recreation impacts by guiding visitors to areas that have traditionally been used for recreation, and away from areas that are biologically sensitive, culturally significant, or have the potential to interfere with LADWP infrastructure and operations and maintenance activities.

1.5.2 Grazing Management

Goal/Requirement

- MOU Section II.B: "…for the benefit of biodiversity and threatened and endangered species, providing for the continuation of sustainable uses including recreation, livestock grazing, agriculture, and other activities."
- MOU Section II.B.5: "Management of livestock grazing and recreational use consistent with other goals of the LORP."
- MAMP Section 4.6 describes the original range management monitoring protocols. Over time these protocols have been refined and are described in the 2009 LORP Annual Report (LADWP and the County 2009) and in the 2019 Annual Owens Valley Report (LADWP 2019).

Progress to Date

All grazing leases inside the LORP Project area have grazing management plans and are adhering to the grazing utilization standards described in Section 2.8.1.2 of the LORP FEIR. Riparian pastures were constructed and are integrated into individual grazing management plans. Monitoring protocols have been refined and are described in the 2009 LORP Annual Report (LADWP and County of Inyo) and 2019 Owens Valley Annual Report (LADWP 2019).

Successes

Rare plant exclosures were constructed, monitored, and ultimately removed based on analysis indicating exclusion from grazing did not benefit targeted species and in some cases grazing appeared to maintain rare plant populations (LADWP 2015).

Livestock utilization standards in both riparian and upland pastures have been implemented and with few exceptions, lessees have been able to graze within standards.

In Reach 1 and 2 moist floodplain meadow has expanded resulting in an increase in forage production.

A four year study looking at livestock influence on woody riparian recruitment sites concluded, that under existing conditions, livestock are not contributing to the failure of woody recruitment on the LORP (LADWP and County of Inyo 2014).

Challenges

The implementation of the LORP has resulted in a loss of productive moist floodplain meadow on the Blackrock, Islands and Lone Pine Leases.

Implementing grazing standards on LORP leases has reduced the operational flexibility of lessees.

New off-road vehicle and motorcycle recreation has increased the risk of vehicle-cattle crashes. This risk has ranchers concerned about public safety and potential liability.

Current Status

This goal is being met through the implementation of LADWP's grazing management plans for the LORP.

Recommendations

Explore opportunities to utilize livestock as a mechanical tool to decrease *Bassia hyssopifolia.* Evaluate the assumption that the dormant season 40% riparian grazing standard is appropriate for conditions adjacent to the Lower Owens River. Look for additional opportunities to increase operational flexibility for the lessee while adhering to the goals of the LORP.

1.5.3 Noxious Species Management

Goal/Requirement

- MOU Section II.B.4: "Control of deleterious species whose presences within the LORP Planning Area interferes with the achievement of the goals of the LORP. These control measures will be implemented jointly with other responsible agency programs."
- Saltcedar. The 2004 Stipulation and Order Section 6 requires LADWP to provide matching funds for LORP saltcedar control equal to the amount obtained by the County up to a total of $1.5 million. Matching funds will be in addition to the funds provided by LADWP for saltcedar control under the Inyo County/Los Angeles Long Term Water Agreement. This funding is also required as Mitigation Measure V-3 in the LORP FEIR (Section 10.4.4) and in PIA Section D.
- Pepperweed and other noxious weeds. LORP FEIR Section 10.4.4 (Mitigation Measure V-2) requires LADWP to provide $50,000 to fund the monitoring and control of new infestations of perennial pepperweed and other noxious weeds and $150,000 to control existing pepperweed infestations and other noxious weeds in the LORP Area to the Agricultural Commissioner for the first seven years of LORP implementation. This funding obligation is also referenced in PIA Section B.

Progress to Date

Inyo/Mono Ag to provide

Current Status

Noxious species treatment will continue as resources are available. Financial obligations for the control of noxious species in the LORP have been met.

Recommendations

The LORP Scientific Team will develop a map to track defoliation of saltcedar by the tamarisk beetle in the LORP Area.

1.6 Additional Goals/Requirements

1.6.1 Compliance with State and Federal laws

Goal/Requirement

- MOU Section II.B.2: "Compliance with state and federal laws (including regulations adopted pursuant to such laws) that protect threatened and endangered species."

Progress to Date

LADWP acquired and complied with the necessary permits noted in Section 1.2.3.1 to implement the project. LADWP operates and maintains the project under a long term streambed alteration agreement noted in Section 1.6.6.

Current Status

This goal is being met. LADWP and the County are complying with State and Federal laws while operating and maintaining the LORP.

Recommendations

None.

1.6.2 Water Quality Objectives

Goal/Requirement

- MOU Section II.B.3.: "Management consistent with applicable water quality laws, standards, and objectives"

Progress to Date

Since implementation of the project, water quality in the LORP has primarily met both the designated beneficial uses (13 total) and water quality standards (19 total) defined by Lahontan Regional Water Quality Control Board (LRWQCB 1994). However, the river has failed to continually meet two water quality standards: 1) dissolved oxygen and 2) toxicity. Currently, the LORP does not support the LRWQCB's criteria of a 7-day mean of dissolved oxygen level of ≥ 6.0 mg/L for most of the summer months (LADWP and County of Inyo 2015 and 2017). Additionally, hydrogen sulfide (which is toxic to all life) has been measured (LADWP 1993) and anecdotally noted during high-flow events and is thought to be a factor in major fish kills (ICWD 2014). These sulfides are the by-product of the decomposition of organic material that forms much of the channel bed and banks in the LORP. When these organics are disrupted these sulfides can be released and can lead to the death of aquatic life.

The current dissolved-oxygen standard is dependent on the LORP being originally designated as supporting a cold-water fishery (FEIR 2004). However, water quality monitoring demonstrates that low dissolved oxygen levels are common throughout the LORP (ICWD 1993, ICWD 1996, LADWP and County of Inyo 2015 and 2017) and that these conditions are largely unavoidable (FEIR 2004). Removing the beneficial usage of cold-water fisheries from the LORP and designating it solely as a warm water fishery would lower the dissolved oxygen standard. However, even this designation would not ensure that LORP would or could continually meet its dissolved oxygen standard given the limitations of flow management and ecological setting (e.g. tule marsh).

Successes

As noted above, the LORP is generally satisfactory in terms of water quality. Seventeen of the 19 water quality standards developed from the beneficial usages defined for the LORP meet or exceed the standards developed by the LRWQCB.

Challenges

The standard of toxicity is likely never to be met under current flow conditions because the river cannot transport the massive amounts of organics that have accumulated in the river and are the source of sulfide production. However, hydrogen sulfide releases can be mitigated by controlling high-flow releases during the summer months and minimizing disturbances of the channel bed and banks. Higher flows can occur during cooler months, when water temperatures are and dissolved oxygen levels higher and more favorable for aquatic organisms.

Current Status

In general terms the LORP is satisfactory in terms of water quality. Seventeen of the 19 water quality standards developed for the LORP meet or exceed the standards developed by the LRWQCB. However, low dissolved oxygen levels and the production and release of hydrogen sulfide are continual problems. The issue of low dissolved oxygen during the summer months is largely unavoidable because of the setting of the river (wide and shallow, with little aeration and shade to cool) (FEIR 2004). The sulfides are a function of the decomposition of the voluminous amounts of organics residing in the river and are released when the channel bed is disturbed. These releases can kill aquatic organisms. Given the current flow management, the production of sulfides will continue to exist because of the river's inability to remove the accumulation of organics. However, controlled releases of high-flows during cooler months can minimize disturbance to the river bed and reduce the likelihood of sulfide releases.

Recommendations

It is recommended that the LRWQCB amend its beneficial use designation for the LORP as a cold water fishery. The LORP is being managed as a warm water fishery and its physical setting and fish assemblage supports that designation.

It is recommended that the release of high flows should be done in a manner that limits, to the extent possible, entrainment of organic material during warmer months to reduce the potential of hydrogen sulfides from being released into the river.

1.6.3 Annual Monitoring Report Preparation and LORP Public Meeting

Goal/Requirement

- 2007 Stipulation and Order Section L: "LADWP and the County will release to the public and 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 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 comments submitted, the Technical Group will conduct the meeting described in Section 2.10.4 of the Final LORP EIR."
- LORP FEIR Section 2.10.4 also outlines this process.

Current Status

Annual Reports are completed as required. Annual LORP meetings occur in compliance with direction in the 2007 Stipulation and Order. This requirement is being met.

Recommendations

None.

1.6.4 Annual LORP Work Plan and Budget Preparation

Goal/Requirement

- PIA Sections F and G describe the process required of the County and LADWP to develop a LORP work plan and budget for the upcoming fiscal year including detailed procedures and necessary approvals.

Current Status

LADWP and the County prepare annual work plans and budgets for their governing boards in compliance with the direction in the PIA and LORP FEIR. This requirement is being met.

Recommendations

None.

1.6.5 Annual LORP Accounting Report Preparation

Goal/Requirement

- PIA Section J.3. describes the process required of the county and LADWP to produce annual accounting reports describing work performed pursuant to the previous year's work plans and actual costs and submit them for approval to their governing boards.

Current Status

LADWP and the County prepare annual accounting reports for their governing boards in compliance with the direction in the PIA. This requirement is being met.

Recommendations

None.

1.6.6 Long Term 1600 Agreement with California Department of Fish and Game (Wildlife)

Goal/Requirement

- MOU Section II.I.2.: "The Parties agree to work cooperatively to develop a long-term section 1601 agreement with respect to the LORP that covers any such activities that are described and addressed in the LORP EIR.
- PIA Section Q further details this requirement.

Current Status

LADWP has a 10 year Routine Maintenance Agreement in place with CDFW for the LORP. LADWP will renew this agreement prior to its expiration in October 2020. This requirement is being met.

Recommendations

None.

2. Next Steps/Conclusion

Table 15 and Table 16 summarize the information contained in Section 1. These summary tables identify the goals/requirements, guiding document, status, comments, recommendations and approvals necessary to implement recommended actions. Next steps include consideration of these recommendations by the MOU Consultants and Parties as relevant, and further development of interim management plans and associated monitoring.

Table 15. Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations

Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations											
	Goal/Requirement	Guiding Document	Achieving Goal/Meeting Requirement?			Recommendation	Necessary Approval to Implement Recommendation				
			Yes	No	Comments		LORP Scientific Team	Inyo/LA Technical Group	Inyo/LA Standing Committee	MOU Parties	Inyo County Superior Court
Riverine Riparian Area	Riverine Riparian Base Flow of 40 cfs	MOU, 2007 Stipulation and Order	✓		This goal/requirement is currently being met as described in the guiding legal documents and has created substantial aquatic/riparian habitat along the river corridor. However, the 40 cfs baseflow has also resulted in tule encroachment throughout much of the river, compromised water quality, and has left much of the river unnavigable for recreation. Previous attempts have been made by LADWP, the County, and the MOU Consultants to modify the LORP flow regime to improve project conditions but this did not result in unanimous agreement among the MOU Parties. Continuing to manage the project under this requirement will continue to meet court mandated guidelines and will maintain existing riparian vegetation, but will not improve project conditions related to the consistent 40 cfs baseflow regime.	The LORP Scientific Team should continue exploring flow management that may help meet LORP goals.	✓				
	Riverine Riparian Seasonal Habitat Flow (SHF) of up to 200 cfs	MOU, LORP FEIR	✓		Implementation of SHF up to 200 cfs has been a benefit to the LORP by recharging groundwater and enhancing the fishery and river channel. LADWP is meeting the mandated SHF requirements as written in the guiding documents. However, flows up to 200 cfs have proven ineffective in moving sediments throughout the system, facilitating woody	It is recommended that LADWP and the County continue to follow the guidance in the MOU and LORP FEIR regarding volume and ramping rates of the annual SHF. However, it is recommended that the SHF be released in the early spring when LOR water temperatures are typically below 70 degrees F, reducing the probability of a fish kill due to lowered dissolved oxygen levels.	✓				

Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations											
	Goal/Requirement	Guiding Document	Achieving Goal/Meeting Requirement?			Recommendation	Necessary Approval to Implement Recommendation				
			Yes	No	Comments		LORP Scientific Team	Inyo/LA Technical Group	Inyo/LA Standing Committee	MOU Parties	Inyo County Superior Court
					recruitment, controlling tules, and has resulted poor water quality in the river when released when temperatures are high. Previous attempts have been made by LADWP, the County, and the MOU Consultants to modify the LORP flow regime but did not result in unanimous agreement among the MOU Parties. The current seasonal habitat flows will continue to meet court mandated guidelines but will likely fail to substantially improve project conditions.	Inyo staff recommends the LORP Scientific Team develop a pilot project to establish new and enhance existing riparian forest, which by necessity will include adaptive and active management. A plan could include a systematic pole-planting or seeding approach to test several viable locations along the river, including: 1) sections of reaches 2 and 3 (formerly dry channel) predicted to support woody recruitment, 2) areas which currently support or have supported riparian forest, or 3) sections of remnant floodplain with appropriate groundwater availability and soil salinity. LADWP is in support of limited pole planting in the project area through outside funding or volunteer efforts should they become available.	✓				
	SHF Procedure: Consultation with California Department of Fish and Game on Seasonal Habitat Flows	MOU, PIA	✓		This requirement is being met. LADWP and the County consult with CDFW on proposed SHF in April of each year and present recommendations for approval by the Inyo/LA Standing Committee annually in May. However, given that this timing is generally not resulting in notable woody recruitment along the riverine-riparian corridor and it has resulted in compromised water quality, an earlier SHF release could be beneficial.	LADWP and the County propose a modified process for setting the annual SHF timing by the LORP Scientific Team to allow for the SHF release earlier in the season when water temperatures are lower. This would necessitate the Standing Committee and MOU parties approving a programmatic approval process that removes annual obligation to 'stamp' the SHF at the May Standing Committee meeting and instead allow the release to happen shortly after consensus on the characteristics of the SHF is reached among the Scientific Team.	✓		✓		
	Four Permanent Flow Measuring Stations in Riverine System	MOU, LORP FEIR, 2007 Stipulation and Order, PIA	✓		Four permanent gaging stations have been constructed and are being used to provide the data specified in the 2007 Stipulation and Order. This requirement has been met.	None.					
	Pump Station that is Limited to 50 cfs Capacity	2004 Stipulation and Order	✓		The LORP Pump Station has been constructed and is functioning as designed. This requirement has been met.	None.					

Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations											
	Goal/Requirement	Guiding Document	Achieving Goal/Meeting Requirement?			Recommendation	Necessary Approval to Implement Recommendation				
			Yes	No	Comments		LORP Scientific Team	Inyo/LA Technical Group	Inyo/LA Standing Committee	MOU Parties	Inyo County Superior Court
	Riverine Aquatic Habitat and Recreational Fishery Goals: Create and sustain healthy and diverse aquatic habitats, healthy warm water recreational fishery, and healthy habitat for native fish species	MOU	✓	✓	The goals of creating and sustaining a healthy warm water fishery in the riverine riparian portion of the LORP are being met. Creating and sustaining a healthy warm water fishery with habitat for native fish are two competing goals, as the native fish (Owens Pupfish, Owens tui chub, and Owens speckled dace) would likely succumb to predation by the nonnative fish in the same system. Based on current data, it is unknown whether the native Owens sucker occurs in the LORP. The goal of providing suitable habitat for native fish in the LORP riverine system is incompatible with sustaining a warm water fishery.	It is recommended that an electroshocking fish survey be conducted by CDFW at various locations in the Lower Owens River to estimate current species composition.	✓				
	Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species: Create and maintain diverse natural habitats consistent with the needs of the Habitat Indicator Species (HIS) associated with the river	MOU	✓	✓	This goal is being met for some but not all Riverine-Riparian HIS. The presence of non-native fish HIS is incompatible with the presence of native fish HIS through predatory and competitive exclusion effects. Avian point count surveys have documented the presence of 17 of 19 HIS. Wetland associated species have benefitted the most from LORP. Declines have been observed among riparian obligate and riparian dependent avian HIS.	It is recommended that the LORP Scientific Team conduct a focal species analysis to evaluate avian community response to restoration. In order to evaluate whether healthy, diverse riparian and aquatic habitats are being created and sustained with regard to the wildlife community, the diversity and abundance of bird species using riparian and aquatic habitat in the riverine-riparian system will be evaluated.	✓				
						It is recommended to discontinue CWHR assessment and to develop a habitat relationship model using existing data. This model will be used for predictive habitat suitability mapping of Habitat Indicator Species in the LORP.	✓				
						It may be worthwhile to conduct a limited number of surveys during migration to better quantify the use of the LORP as stopover habitat for migrants traveling along the Pacific Flyway. Surveys will be conducted based on staff availability.	✓				

Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations											
	Goal/Requirement	Guiding Document	Achieving Goal/Meeting Requirement?			Recommendation	Necessary Approval to Implement Recommendation				
			Yes	No	Comments		LORP Scientific Team	Inyo/LA Technical Group	Inyo/LA Standing Committee	MOU Parties	Inyo County Superior Court
Delta Habitat Area	Enhance and maintain approximately 325 acres (831 acres in LORP FEIR) of existing habitat consisting of riparian areas and ponds suitable for shorebirds, waterfowl, and other animals within the Owens River Delta Habitat Area	MOU, LORP FEIR	✓		This goal is being met. The aerial extent of wetland vegetation in the DHA has increased since implementation of LORP and the required wetland acreage is being maintained. Vegetation type conversion has occurred however and is changing the nature of the DHA. Habitat quality for waterfowl and shorebirds is declining. While the increase in marsh vegetation may be favorable for some Habitat Indicator Species such as rails, the changes occurring will decrease habitat quality for others that need open water, flooded meadow, or playa.	It is recommended to implement a modified flow regime in the DHA for 5 years on an interim basis to further improve habitat conditions. This interim flow regime will maintain the required minimum baseflows during the growing season and redistribute summer and winter pulse flows to fall and spring. This approach will more effectively enhance habitat for migratory waterfowl and shorebirds. Proposed flow modifications are further described in Section 1.2.3.	✓				
	Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species: Create and maintain diverse natural habitats consistent with the needs of the Habitat Indicator Species (HIS) associated with the Delta Habitat Area	MOU	✓	✓	This goal is being met for some but not all DHA HIS. The entire suite of avian HIS for the DHA use each wetland habitat type to various degrees, and overall numbers of HIS in the DHA are higher than pre-project conditions, suggesting the notion that the implementation of the project has had an overall benefit to HIS. Perennial water to the DHA has perpetuated the conversion of meadow to a marsh dominated system which will reduce habitat quality for HIS. However, changes to flow management of the DHA could possibly arrest the meadow to marsh conversion and maintain more open habitat while also providing more water during migratory and overwintering periods which could further benefit a greater number of species including the shorebird, waterfowl, and wader guilds. Habitat needs of native and non-native fish for the DHA are in conflict with each other; accommodating all species on HIS list is not attainable in the DHA given these competing goals.	It is recommended to implement a modified flow regime in the DHA for 5 years on an interim basis to further improve habitat conditions. This interim flow regime will maintain the required minimum baseflows during the growing season and redistribute summer and winter pulse flows to fall and spring. This approach will more effectively enhance habitat for migratory waterfowl and shorebirds. Proposed flow modifications are further described in Section 1.2.3.	✓				

Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations											
	Goal/Requirement	Guiding Document	Achieving Goal/Meeting Requirement?			Recommendation	Necessary Approval to Implement Recommendation				
			Yes	No	Comments		LORP Scientific Team	Inyo/LA Technical Group	Inyo/LA Standing Committee	MOU Parties	Inyo County Superior Court
	Average annual baseflow of 6-9 cfs	MOU, LORP FEIR	✓		This goal is being met with an average of 6-9 cfs being released to the DHA as required in the guiding documents. However, a change in the timing and duration of the pulse flows could further improve habitat conditions in the DHA.	It is recommended to implement a modified flow regime in the DHA for 5 years on an interim basis to further improve habitat conditions. This interim flow regime will maintain the required minimum baseflows during the growing season and redistribute summer and winter pulse flows to fall and spring. This approach will more effectively enhance habitat for migratory waterfowl and shorebirds. Proposed flow modifications are further described in Section 1.2.3.	✓				
Blackrock Waterfowl Management Area	Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species: Create and maintain diverse natural habitats consistent with the needs of the Habitat Indicator Species (HIS) associated with BWMA	MOU, LORP FEIR	✓	✓	This goal is being met for some but not all Habitat Indicator Species associated with the BWMA. Habitat needs of native and non-native fish for the BWMA are in conflict with each other; additionally, management by flooding and drying of cells in the BWMA will only create temporary fish habitat. Attaining all species on the HIS list is not feasible given the current project trajectory.Habitat quantity requirements have been met for avian habitat indicator species in the BWMA. Units have been flooded consistently throughout the year as defined in the guiding documents. However, monitoring efforts have documented a decline in habitat quality following the initial flooding of a unit. LADWP, ICWD, and CDFW have collectively identified that the inability to seasonally flood units, which would avoid inundation during the summer, is the primary obstacle impeding the development of high quality migrating waterbird habitat. Changes to flow management of the BWMA could further enhance habitat quality to avian species.	The LORP Scientific Team will develop a five-year interim management plan for the BWMA that describes a proposed seasonal flooding regime for improved habitat conditions. This plan will propose seasonal sustained flooding of 500 acres in BWMA in the fall, winter and spring each year, an early summer irrigation release, and develop new criteria to evaluate habitat for waterbirds. Elements of the proposed plan are further described in Section 1.3.1. Once prepared, this plan will be considered by the MOU Parties prior to implementation.	✓			✓	✓
						Discontinue CWHR assessment. Other methods of habitat assessment than CWHR should be considered and explored for future analysis of conditions in the LORP. Future avian monitoring in the BWMA should be geared toward effectiveness monitoring of the modified flooding regime with respect to the HIS to note habitat quality of active units.	✓				

Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations											
	Goal/Requirement	Guiding Document	Achieving Goal/Meeting Requirement?			Recommendation	Necessary Approval to Implement Recommendation				
			Yes	No	Comments		LORP Scientific Team	Inyo/LA Technical Group	Inyo/LA Standing Committee	MOU Parties	Inyo County Superior Court
	Approximately 500 acres will be flooded at any given time with runoff forecast to be average or above average	MOU, LORP FEIR	✓		LADWP and the County are complying with guidance on flooded acreage for the BWMA as described in the MOU and LORP EIR. This requirement is being met. However, as discussed in Section 1.3.1 above, for some time there has been consensus among the Scientific Team that managing the BWMA cells seasonally, as is typically recommended for waterfowl management elsewhere, would provide increases in habitat quality and overall value to migrating and overwintering waterbirds.	The LORP Scientific Team will develop a five-year interim management plan for the BWMA that describes a proposed seasonal flooding regime for improved habitat conditions. This plan will propose seasonal sustained flooding of 500 acres in BWMA in the fall, winter and spring each year, an early summer irrigation release, and develop new criteria to evaluate habitat for waterbirds. Elements of the proposed plan are further described in Section 1.3.1. Once prepared, this plan will be considered by the MOU Parties prior to implementation.	✓			✓	✓
	BWMA Procedure: Annual consultation with California Department of Fish and Game on the amount of flooded area in the Blackrock Waterfowl Management Area	MOU, PIA	✓		This procedural requirement is being met. Annual recommendations to date have been based on guidance in the MOU and LORP FEIR.	None. If the interim plan for BWMA is implemented, this procedure will be unnecessary as 500 acres will be flooded seasonally each year.					
Off-River Lakes/Ponds	Diverse Natural Habitats Consistent with Needs of the Habitat Indicator Species: Maintain and establish diverse natural habitats consistent with the needs of the Habitat Indicator Species (HIS) associated with the Off River Lakes and Ponds	MOU, LORP FEIR	✓	✓	This goal is being met for some but not all LORP HIS. The ORLP are being managed for their value as a recreation warm water fishery and supporting nonnative, warm water fish species. Coexistence of native and nonnative fish HIS is an unlikely outcome as described elsewhere in this document. Deep, permanent ponds such as those in the ORLP component of LORP are not preferred habitat for majority of the avian indicator species, however, data from eBird for Billy Lake indicates that avian habitat indicator species use this ORLP, and can be expected to use other ORLP to some degree.	It is recommended that an electroshock fish survey be conducted by CDFW at the ORLP to provide an estimate of current species composition.	✓				

Summary of LORP Goals, Status, Recommendations, and Necessary Approvals to Implement Recommendations											
	Goal/Requirement		Guiding Document	Achieving Goal/Meeting Requirement?			Recommendation	Necessary Approval to Implement Recommendation				
				Yes	No	Comments		LORP Scientific Team	Inyo/LA Technical Group	Inyo/LA Standing Committee	MOU Parties	Inyo County Superior Court
Land Management	Recreation Management		MOU, LORP FEIR, PIA	✓		LADWP has implemented recreational controls noted in the LORP FEIR including fencing, access points, location maps, and signage. However, monitoring data has documented fire rings, vehicles accessing the floodplain, OHV activity, concentrations of trash, vandalism, the development of trails and informal water access locations. Inyo County's LORP Recreational Use Plan identified some additional measures to manage recreation in the project area.	The LORP Scientific Team will consider additional recreation controls to assist visitors in navigating the road networks within the LORP.	✓				
	Grazing Management		MOU, MAMP	✓		This goal is being met through the implementation of LADWP's grazing management plans for the LORP.	Explore opportunities to utilize livestock as a tool to decrease *Bassia hyssopifolia* on the floodplain. Evaluate the assumption that the 40% riparian grazing standard is appropriate for conditions adjacent to the Lower Owens River. Look for additional opportunities to increase operational flexibility for the lessee while adhering to the goals of the LORP.	✓				
	Noxious Species Management		MOU	✓		This goal is being met. Noxious species treatment will continue as resources are available.	The LORP Scientific Team will develop a map to track defoliation of saltcedar by the tamarisk beetle in the LORP Area.	✓				
	Noxious Species Funding	LADWP will provide matching funds for LORP saltcedar control equal to the amount obtained by the County up to a total of $1.5 million. Matching funds will be in addition to the funds provided by LADWP for saltcedar control under the Inyo County/Los Angeles Long Term Water Agreement.	2004 Stipulation and Order, LORP FEIR, PIA	✓		LADWP submitted the last payment for this funding obligation 6/26/15. This requirement has been met.	None.					
		LADWP shall provide $50,000 to fund the monitoring and control of new infestations of perennial pepperweed and other noxious weeds and $150,000 to control existing pepperweed infestations and other noxious weeds in the LORP Area to the Agricultural Commissioner for the first seven years of LORP implementation.	LORP FEIR, PIA	✓		LADWP submitted the last payment for this funding obligation 8/28/12. This requirement has been met.	None.					

Table 16. Additional Project Goals/Requirements

Additional Project Goals/Requirements										
Goal/Requirement	**Guiding Document**	**Achieving Goal/Meeting Requirement?**			**Recommendation**	**Necessary Approval to Implement Recommendation**				
		Yes	**No**	**Comments**		**LORP Scientific Team**	**Inyo/LA Technical Group**	**Inyo/LA Standing Committee**	**MOU Parties**	**Inyo County Superior Court**
Compliance with State and Federal Laws	MOU	✓		This goal is being met. LADWP and the County are complying with State and Federal laws while operating and maintaining the LORP.	None.					
Water Quality Objectives	MOU	✓	✓	The LORP is generally satisfactory in terms of water quality. Seventeen of the 19 water quality standards for the LORP meet or exceed standards required by LRWQCB. However, low dissolved oxygen levels and the production and release of hydrogen sulfide are continual problems. The issue of low dissolved oxygen during the summer months is largely unavoidable because of the setting of the river (wide and shallow, with little aeration and shade to cool) (FEIR 2004). The sulfides are a function of the decomposition of the voluminous amounts of organics residing in the river and are released when the channel bed is disturbed. These releases can kill aquatic organisms. Given the current flow management, the production of sulfides will continue to exist because of the river's inability to remove the accumulation of organics. However, controlled releases of high-flows during cooler months can minimize disturbance to the river bed and reduce the likelihood of sulfide releases.	It is recommended that the LRWQCB amend its beneficial use designation for the LORP as a cold water fishery. The LORP is being managed as a warm-water fishery and its physical setting and fish assemblage supports that designation.	✓				
					It is recommended that the release of high flows should be done in a manner that limits, to the extent possible, entrainment of organic material during warmer months to reduce the potential of hydrogen sulfides from being released into the river.	✓				
Annual Monitoring Report Preparation and LORP Public Meeting	LORP FEIR, 2007 Stipulation and Order	✓		Annual Reports are completed as required. Annual LORP meetings occur in compliance with direction in the 2007 Stipulation and Order. This requirement is being met.	None.					
Annual Work Plan and Budget Preparation	LORP FEIR, PIA	✓		Annual Work Plans and Budgets completed as described. Requirement is being met.	None.					
Annual Accounting Report Preparation	PIA	✓		Annual Accounting Reports completed as described. This requirement is being met.	None.					
Long Term 1600 Agreement with California Department of Fish and Game	MOU, PIA	✓		LADWP has a 10 year Routine Maintenance Agreement in place with CDFW for the LORP. LADWP will renew this agreement prior to its expiration in October 2020. This requirement is being met.	None.					

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8.0 ADAPTIVE MANAGEMENT RECOMMENDATIONS

2019 LOWER OWENS RIVER PROJECT

ADAPTIVE MANAGEMENT RECOMMENDATIONS

by

MOU CONSULTANTS

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and

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Contents

EXECUTIVE SUMMARY

We now know that the years of released uniform base flows have resulted in a river supporting a marsh-river type environment. This is not as bad as it appears because many sustaining and very productive resources have and will continue to be provided. After years of trying to change the MOU Party codifying of uniform 40 cfs base flows and mandated low seasonal habitat flow peak releases, Consultants are now accepting that little is going to change flow management in the future. Based on the record and the insurmountable constraints, the MOU Parties have probably gained most of what they are going to accomplish via river flow management. It's now time for the MOU Parties to consider if other reasonable, feasible, economically acceptable, and, especially infrastructure friendly rehabilitation approaches that could increase river health.

Our adaptive management recommendations are summarized as follows:

1. The City and County assign their Scientific Team the responsibility to review, evaluate, and determine the feasibility of testing one or more water control structures in the Lower Owens River. The Scientific Team would determine if water control structures have the capability of controlling the location and abundance of tules and cattails, increased recreational access, providing augmentation water to increase seasonal habitat and flushing flows, assisting in scouring "muck" from down-river channels, increasing available dissolved oxygen down-river, being economically feasible and reasonable, causing no adverse conditions that could not be mitigated, benefiting other down-river water quality conditions (i.e. water clarity), and providing viable short- term and long-term benefits. Their evaluation report findings should appear in the 2020 Annual Report for MOU Party action.
2. The City and the County assign their Scientific Team the responsibility of evaluating the present status of LORP goal attainment. The Scientific Team would also evaluate and identify goals that are unreasonable or could not be met because of over-riding constraints. The Team would provide solutions to those reasonable goals that have yet to be met.
3. The Scientific Team conduct a critical review of limitations that influence project success. Based on the information and suggestions derived from this critical review, the MOU Parties should implement resource management tactics or changes that would address the limitations. This implementation would include any active intervention needed to eliminate a problem, barrier, or any other limitation.
4. The City-County Scientific Team evaluate, document, and submit a report describing the benefits that have been gained to date. This report would then be used by the Team to assist in the evaluations of goal attainment.
5. Almost two years have elapsed since the County attempted to plant willow poles along landforms bordering the lower reaches of the Lower Owens River. The now remaining gallery of standing long white perforated plastic pipes encasing dead willow poles just does not look good Consultants now recommend that this area be cleaned up and returned to its former condition.
6. Initiate a grazing strategy to test the effect of cattle trampling to impact bassia in some riparian pastures, but maintain current grazing utilization standards until it can be determined through additional studies that modifying riparian and upland grazing to 30 and 50%, respectively, will not impact target species habitat or result in a limiting factor.

7. A thorough survey to identify and map pepperweed and salt cedar throughout the project areas and then devise a plan, with funding, to remove the most serious infestations and a method to control noxious weeds into the future. A focused and prioritized program to control salt cedar is the best way to effectively allocate resources between mechanical and physical activities and biological control with beetle infestations.
8. Shifting summer pulse flows to the DHA to the fall and winter flow period in order to maximize open water habitat for migrating waterfowl and creating drying conditions to impact tule/cattail during growth periods – as is done in the Thibault wetlands.
9. Management of off channel lakes and ponds has been quite successful, and they have always remained within compliance standards and met MOU goals. Management should proceed as is.
10. The LADWP, ICWD, and CDFW work with the LORP Scientific Team to develop a new BWMA management plan based upon seasonal wetting and drying cycles.

LOWER OWENS RIVER RIVERINE-RIPARIAN ECOSYSTEM

SHOULD IMPROVING FLOW MANAGEMENT CONTINUE TO TAKE CENTER STAGE

SITUATION

This section displays some of the historic flow management records, legal guidelines, and MOU Party concerns in support of the Consultants suggestion that future efforts to improve Lower Owens River flow management should not continue to take up most of the available time and resources. Consultants now believe the very high flow releases needed to make major environmental improvements in the Lower Owens River are probably unreasonable to release. As will be demonstrated, there are just too many constraints, potential infrastructure damage, and undesirable effects on other resources to fully implement needed flow volumes. Instead of concentrating on changes in river flow management, available time and resources may be better used to consider other feasible rehabilitation approaches. Reasonable rehabilitation approaches to increase the health and productivity of the Lower Owens River and not be so difficult, damaging, or so costly to implement.

For many years the MOU Consultants (Hill and Platts) and the MOU Party Consultants (Patton and Vorster) made continuous annual suggestions to dramatically increase the 1997 MOU and court approved Stipulation and Order Lower Owens River flow rates. Much higher flow releases were recommended for testing and evaluation to determine if they would improve the health of the Lower Owens River. Major flow recommendations were made to alter base flows, increase the size of seasonal habitat flow peaks, add down-river augmentation water, and begin very high-volume spring flushing flows. As experience has shown and will be discussed later in this report accepting and implementing recommended flow changes in the Lower Owens River was, and will be in the future, an extremely difficult if not impossible task. Experience has also shown that implementing these recommended flow changes, high enough in magnitude to produce beneficial results, was not possible anyway. Too many restrictions, constraints, and roadblocks stood in the way.

Numerous constraints stand in the way blocking the release of high flows for testing and evaluation. Constraints include resulting sever and costly infrastructure damage, the set quantity of water available, legal binding flow requirements, high economic cost to implement, and the big unknown, the actual potential of the river to even respond to any management change. All of these constraints make's changes in flow management extremely difficult to get approval let alone implement. Thirteen LORP years have now passed without any beneficial LORP flow management change being approved or implemented. No worthy testing or evaluation occurred during this time period to determine if any flow change had any chance to improve. This lack of effort alone justifies the Consultants suggestion to spend more of the available time and resources in the future on other possible efforts.

The following sections describe major constraints and background material supporting the Consultant's recommendation that more of the available time be spent evaluating other reasonable rehabilitative alternatives.

FLOW LEGAL MANDATES

The 1997 MOU provided resolution and was to settle concerns over provisions and requirements outlined in the 1991 EIR. The 1997 MOU goal was to create and maintain through flow management, to the extent feasible, diverse natural habitats. Flow management was to be consistent with the needs of the "habitat indicator species". Habitats to be formed would be as self-sustaining as possible. To meet these requirements, however, we must first have a river with the potential to react favorably to the management changes applied. Also, meeting LORP goals and requirements, under the legal constraints in place, handicaps management opportunities.

The MOU Ecosystem Management Plan, the 1997 MOU, and the LORP 2004 EIR all list adaptive management as the key process in determining, through testing, monitoring, evaluation, and implementation, how to best manage the river. Adaptive management also allows managers the opportunity to determine what the actual river potential will allow when influenced by the management tools applied. Whether restrictions or constraints be legal, economic, social, or low river reaction potential, they control and will determine the final results. Consultants believe the river, under LORP management, has responded very well in providing important beneficial resources. Especially when you consider the constraints and roadblocks purposely put in the way.

In 2007, even prior to the first Lower Owens River LORP combined flow release, Consultants were pointing out to the MOU Parties that their flow rate certification standards were applying management handicaps. The coded uniform constant 40 cfs base flow and accompanying Stipulation and Order flow restrictions were predicted to conflict later in the meeting of the listed goals of the 1997 MOU. Consultants also predicted that restoration success of the Lower Owens River would be put at risk by these constraints (Consultants letter to MOU Parties, May 24, 2007). Consultants requested the MOU Parties instead contemplate implementing short-term and long-term flow release approaches for testing and evaluation. They recommended that decisions resulting from these evaluations then continue through the adaptive management process. Consultants also predicted in 2007, a prediction that now has come true, that these certified flow rates mandated by the MOU Party would create many canal-like characteristics within the river.

ADAPTIVE MANGEMENT SUCCESS

By 2011, MOU Consultants (Hill and Platts) and also MOU Party Consultants (Patton and Vorster) were pointing out that the newly applied adaptive management process, mandated by the 1997 MOU, were not among the many successes of the LORP (2011 Annual Report). CDFW (2018) pointed out that water quality parameters (i.e. temperature and available dissolved oxygen) during summer months would likely prevent the increased establishment of Owens sucker within the river. They also believed It is unlikely that river conditions will improve without substantive changes in the adaptive management processes. Adaptive Management has been, by far, the hardest LORP implementation process for the MOU Parties to successfully provide productive guidance or decisions.

GOAL CHALLENGES

As stated in the Consultants 2017 seasonal habitat flow recommendation and their following adaptive management report, there is evidence the past and present flow regime will not allow all MOU goals to be met. Consultants expected this because some MOU goals do not fit what the real world is going to allow. Meeting goal attainability when management is restricted by water availability, potential overriding infrastructure (valley and lake) damage, available economic resources, and especially the powerful natural control of potential makes it difficult. The future will probably determine, however, that under all the constraints and roadblocks, the MOU Parties did the best they could in trying to meet all the goals with what they had to work with.

WHERE ARE WE TODAY

The County, in their response to the Consultants 2017 Adaptive Management Recommendations, displayed a very grim description of today's Lower Owens River condition. The County laid it out all that we now have a low gradient dessert river with low dissolved oxygen condition levels. Dissolved oxygen levels that are hazardous to fish and invertebrates. They concluded that when river flows are above 70 to 80 cfs and river temperatures are above 60 to 65 degrees F, hazardous dissolved oxygen conditions form. The County also believe poor water quality conditions downstream are now expanding upstream. The County goes on further to describe a river channel now infested with tules and cattails, a tree recruitment that is insufficient, and therefore, a tree canopy over the river that is not developing.

The County also describes an aggrading river channel that exacerbates tule growth. Also, earlier in their 2013 Annual Report (also in Jensen 2014), the County described that the current flow regime was increasing this channel aggradation. The County summed it all up when they stated that the present flow regime was furthering tule-cattail expansion, increasing summer water quality critical conditions, stagnating woody recruitment, and decreasing existing woody vegetation. Not a pretty picture described by the County, but, as the Consultants continually remind the MOU Parties, the river has already developed many valuable sustainable resources. Resources that were not there prior to the LORP project. This over-all gain in resource benefits must be taken into account whenever doing an overall evaluation of river condition.

FLOW HISTORY

SITUATION

Twenty-six years have lapsed since the first flow management plan was considered for the Lower Owens River. This plan recommended flows very similar to those being released today. The first LORP rehabilitation flows for the Lower Owens River were released during the winter of 2006. Monitoring of results from these flow releases was initiated in 2007. Monitoring was recommended to continue over a 15-year period. A 15-year period (till 2022) was considered sufficient time needed to determine if MOU goals would or would not be attained.

As stated earlier, MOU Consultants in 2007, objected to the codifying minimum and maximum river flows (Consultants letter to MOU Parties 2007). They believed these uniform instream flows, mandated by the MOU Parties, would result in tules and cattails clogging the river. A condition that would form canal like environments that would not be favorable to river condition or "species of concern". The previous 2002 LORP management plan, even before the Consultants letter, supported this concern. The plan warned, 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 would result in the degradation of river conditions. Technical Memorandum #9, acknowledged very early in the LORP planning process that it would be necessary to control tules and cattails if all goals of the 1997 MOU were to be met. Experience now demonstrates that "muck" environmental influences are not going to go away in the future as long as present river flow regimes are implemented.

The Lower Owens River flow regime, as currently configured, is a major force in dictating how successful the Lower Owens River is and will become. Tule and cattail invasions were already blocking fishing, boating, hunting, and other resource access as early as 2009. Today, aquatic habitat diversity continues to decline, channel aggradation continues, and summer hypoxia impairs water quality even during normal basin run-off years (2018 Annual Report). If the Lower Owens River continues to be managed as it has been over the last 13-years we can expect little environmental improvement in the future over what is already gained. Degrading consequences to the river ecology will continue (CDFW 2018). The riverine-riparian corridor is on a future trajectory that will not meet LORP goals (CDFW 2018).

Past and present flow management has and will in the future continue to produce many benefits. For example; marsh, riparian vegetation, wet meadow, fish and wildlife distribution, and open water habitat have greatly increased throughout the LORP since the initiation of perennial flow in 2006. These valuable benefits, that are already acquired, have not been measured or considered near enough in the LORP evaluation process. When evaluating LORP goal attainment, these important resource benefits already gained need to be considered. Consultants recommend (see Recommendations section) that these benefits be evaluated and documented. Also, as common as it is for us to keep on harping on how bad tules and cattails are, we need an abundance of them in the river to compensate for and buffer the poor water quality conditions entering the Lower Owens River from the Middle Owens River

PAST FLOW MANAGEMENT RECOMMENDATIONS AND CONCERNS

CONSULTANTS CONCERNS

Earlier in the LORP process (2008), Consultants recommended adjusting river flows, hoping to alleviate tule encroachment, tule abundance, and improve water quality conditions. Consultants in 2011 alerted the MOU Parties that the Lower Owens River bordering riparian vegetation recruitment and aggrading channel (high muck accumulation) conditions were formed and controlled by base flow releases only. Seasonal habitat flows were having no documented or observed beneficial ecological influence. Flow management of this type could not be counted on in the future to provide additional benefits. Jensen (2014) later also agreed.

In the 2011 Annual Report, Consultants recommended changes in flow timing, flow duration and flow augmentation to help improve Lower Owens River resources. They continued each year to recommend flow changes to help improve river water quality conditions. In 2013 the Consultants recommended that a late spring flushing flow be released in 2014. They emphasized in 2014, that their 2013 flushing flow recommendations are still valid. The MOU Consultants recommended the following year (2014 adaptive management recommendations) that a new Lower Owens River base flow management strategy needs to be developed.

In 2014 Consultants recommended a seasonal habitat flow of 300 cfs or more be released annualy for testing and evaluation. In 2015 the Consultants recommended implementing the City's proposed base, seasonal habitat, and flushing flows for testing and evaluation. They again recommended a late spring flushing flow of 300 cfs. Based on experience and observation, the Consultants finally realized that a 300 cfs flow would be too low to be of much value. Consultants, in turn, recommended the river receive at least a series of 800 cfs flushing flows for evaluation. They recommended this knowing that valley and lake infrastructure damage would be so severe that flow releases of this magnitude could not be justifiable and thus they would never purposely be implemented.

Continued concern resulted in the Consultants recommending River Summit #2 be held to delve deeper into developing more favorable river flows. In an attempt to improve water quality conditions, Consultants recently recommended that larger multiple seasonal habitat, flushing, and flooding flows be tested and evaluated to determine if water quality conditions can be improved. Drastic base flow manipulation was recommended for testing to determine if drying out (desiccating), and/or a winter freezing process could help control tules abundance and distribution. None of these recommendations have been accepted and implemented by the MOU Parties to date. This is not all bad because most of the early pleas by the Consultant for testing higher flows were probably poor recommendations to begin with because these flows were too low to begin with.

CDFW CONCERNS

Each year CDFW has supported releasing higher flows into the Lower Owens River. CDFW is extremely concerned that flows being implemented would not support needed improvement in the health of the river-riparian ecosystem. They believed that without substantive implementation of adaptive management, the LORP would continue to fail to meet the goals set forth in the 1997 MOU. CDFW acknowledged that stream power generated by the existing seasonal habitat flow releases was

insufficient. These flows would not scour out accumulated channel organic detritus or maintain existing river banks.

CDFW, in their 2016 Annual Report review response, again pointed out that Lower Owens River flows, as now being released, will not achieve LORP goals. CDFW also pointed out that experience has shown (and Jensen (2014) supports) that the extreme low river power, in combination with increasing tule-cattail abundance, will not allow river conditions to improve. Present peak flows released as high as 200 cfs are not strong enough to dislodge established mature plants (CDFW 2016 Annual Report Response).

In a May 2019 letter to the City and the County, CDFW (and the Consultants supported) recommended a seasonal habitat flow with a peak release of 200 cfs regardless of basin runoff volume. They also requested a series of additional flows each year between 350 and 375 cfs be released over a two-week period.

CITY CONCERNS

The much higher than normal unplanned flow releases into the Lower Owens River (up to 325 cfs) during the summer of 2017 were high enough to begin testing valley infrastructure response. Detrimental damaging effects were reported from these flows on vehicle transportation infrastructure. Culverts, bridges, water diversions, and road sections showed they were not in condition to pass high flows without damage. The City expressed great concern that increased river flows would damage the very expensive Owens Lake dust reducing control structures. The case is strongly building that the Lower Owens River cannot receive the high flows needed to make major environmental changes without causing extensive damage to valley and lake infrastructure and other resources. This makes it very difficult to ever implement high enough flows to produce effective results. Whether the implementation of higher river flows will produce beneficial or negative effects has not been tested and evaluated.

OTHER MOU PARTY CONCERNS

OVC pointed out that the unprecedented 2017 summer high water releases (over 300 cfs) into the Lower Owens River were still too low to result in any beneficial environmental effects. However, these flows were high enough to cause negative impacts to fish and enabled noxious weeds to spread. OVC believed it was unfortunate that a test flow release of over 1,000 cfs wasn't attempted for evaluation. OVC and their Consultant Dr. Vorster in the past, pushed for the release of very high flows during high basin run-off years. They called for high flows that would simulate natural conditions and be of such magnitude that it would result in channel clearance conditions. OVC recommended that future released flow levels be similar to those levels released in 1969. They further ask that these levels be a future commitment by the City and the County. OVC (and the Consultants also believe) that MOU flows, as presently implemented, have minimal potential to further improve the Lower Owens River over its present condition (2018 Annual Report).

TAKE-AWAY

Lower Owens River flow management planning begin 26 years ago. Flow levels selected from these early decisions are still being implemented today. The first Lower Owens River base flow was set and released 14 years ago. This flow regime still remains exactly the same today. The first channel flushing flow, which was successful, was released 12 years ago, but not followed through in coming years. Annual seasonal habitat flows have been released for 10 years ranging from 0 cfs to 200 cfs peaking effects, depending on volume of basin runoff. The point of all this history is that sufficient years have gone by to now be able to evaluate the results of the past flow scenarios applied. Years of uniform flow releases without testing and evaluating any other flow scenarios provides insufficient information for decision making on the value of higher flows. Constraints are of such magnitude that applying very high flows in the river for future testing and evaluation, is not going to happen.

We now know that the years of released uniform base flows resulted in a river supporting a marsh-river type environment. This is not as bad as it appears because many sustaining and very productive resources have and will continue to be provided. After years of trying to change the MOU Party codifying of uniform 40 cfs base flows and mandated low seasonal habitat flow peak releases, Consultants are now accepting that little is going to change flow management in the future. Based on the record and the insurmountable constraints, the MOU Parties have probably gained most of what they are going to accomplish via river flow management. It's now time for the MOU Parties to put more effort into considering other reasonable, feasible, economically acceptable, and, especially infrastructure friendly rehabilitation approaches that could increase river health.

TIME FOR THE SCIENTIFIC TEAM TO "STAND UP"

SITUATION (2006 to 2018)

As the record displays in Appendices 1 through 4, the Scientific Team (Team), from 2006 through 2018, was a very minor player in LORP planning, testing, evaluation and implementation. During this period very little input was provided by the Team. No input that would be of any value in better managing the LORP. During this period, however, requests and assignments for the Scientific Team to provide input were voluminous (Appendices 1 through 4). The many requests for Team help were so numerous and took up so much of this report space they had to be put in the Appendix. To leave all this verbiage up front in this report would have plugged up the reading of the report. We encourage the reader, however, to brief Appendices 1 through 4. These appendices document how important the Scientific Team could have been and the need for the Team to "Stand Up" in the future.

The following sections describes how a Scientific Team came to be, what are the Team's responsibilities, how important the Team could have been, and what the Team could accomplish if they were ever used. Under the Recommendation section, there is a push to use the Team in the future. Consultants believe an effective Team receiving good support and direction could help greatly in the future management of the LORP.

SCIENTIFIC TEAM COMPOSITION

MOU Consultants were the first to acknowledge the need and importance of a Scientific Team. They pointed out early on (2006) the constant need for their input, guidance, and oversight into the LORP Project. Consultants were calling for Scientific Team input even before the implementation of the first Lower Owens River LORP flows. Consultants believed that the future adaptive management process would only be successful if a "skilled team" (Scientific Team); whose only interest is making the LORP successful, is put in place (Hill 2006).

The 1997 MOU required the development of a long-term monitoring, adaptive management and reporting plan. The resulting mandated 2008 MAMP required that a "Team Approach" be used for all phases of LORP monitoring, adaptive management, and implementation. The LORP Ecosystem Management Plan, however, does not mention forming or using a Scientific Team.

By 2012, Consultants were expressing concerns that the Scientific Team was not being used wisely in LORP management (MAMP). They emphasized continually that the Team should get on with doing their job. Consultants in a May 2, 2012, letter advised the MOU Parties that a "Team", as described in the MAMP, has not coordinated any input with the Consultants as required. The reason was very simple, a Team was yet to be established or used. Also, in 2012, Consultants recommended the Scientific Team update and improve the LORP 2008 Monitoring and Adaptive Management Plan. As the record documents (Appendices 1 through 4), the use of and input from the Team has contributed very little value to the process.

The County, in a letter to the City, and also documented in the 2008 MAMP plan, identified the LORP Scientific Team as composed of members from the City, the County, and the MOU Consultants. Documents listed Dr. Martin (City), Mr. Freilich (County) and Consultants Dr. Platts and Mr. Hill as the makeup of the Scientific Team. The 2018 Annual Report, however, reduced the Scientific Team members to be composed only of unidentified employees from the City and the County.

SCIENTIFIC TEAM DUTIES AND ACCOMPLISHMENTS

MOU Consultants only get to review the environmental conditions of the Lower Owens River one day each year. Consultants are not authorized to collect data, do scientific studies, conduct research, or plan new management scenarios. Their assigned Task Orders are quite restrictive and relate mainly to review and comment on the Annual Report. Based on information gleaned from the Annual Reports they submit Adaptive Management Recommendations. Therefore, the MOU Parties must depend more and more, if the future management of the LORP is going to improve, on the Team providing the needed information for their decision-making process.

The Team has not produced enough product to date, to be able to evaluate if the Team itself is capable of providing this needed data and information. Adequate and timely information is needed, so MOU Parties and Consultants (in their adaptive management responsibilities) can fulfill their LORP assigned responsibilities adequately.

Consultants, early on, recommended that all MOU goals be evaluated by the Scientific Team to determine which goals have been met and what needs to be done to allow those that are realistically attainable to be met. They pointed out that this analysis needs to be conducted under the 1997 MOU

requirement of what is feasible, reasonable, natural, holistic, and self-sustaining. Both the City and the County now support conducting a goals assessment for the LORP at this stage after 13 years of implementation (2018 Annual Report).

The Scientific Team, now staffed by City and the County personnel, are scheduled to meet and evaluate project progress and likely trajectory (2018 Annual Report). From this directional meeting the Team will identify opportunities and limitations for the LORP project. Their findings, along with recommendations for future management, will be presented to the MOU Parties in the fall of 2019 (2018 Annual Report). This assignment is an excellent test to determine the capability of the Team. The Scientific Team now entering the planning, testing, evaluation and implementation of LORP management phases is very encouraging.

If the 2020 basin water runoff is above normal the Scientific Team was also instructed by the County and the City to meet and discuss the possibility of experimenting with an early spring pulse flow. The City and the County further assigned their Team to assess how well the LORP Program is meeting its objectives. If objectives are not being met, the Team was then assigned to determine why not and what actions should be taken (2018 Annual Report). Another important assignment by the City and the County is that the Team now has the responsibility for maintaining program momentum and progress.

Only time and experience will determine if the Scientific Team is a "skilled team" and up to fulfilling these tough to do tasks. The 2008 MAMP did not call for Just a team, it strongly inferred it would be a Scientific Team. There is a major difference. Especially important, does the MOU Parties have the capability to use their advice and counsel effectively. The past was not too favorable. Time will give us the answer.

PAST SCIENTIFIC TEAM ASSIGNMENTS (2006 through 2018)

A cursory review of LORP files demonstrated how often the LORP process needed help from the Scientific Team (see Appendices 1 through 4). This short file review also showed that even though the City, County, and Consultants demanded much from the Team, to help in the management of the LORP, the Team actually did not function. Therefore, the Team did not produce any significant amount of product from 2006 to 2018.

The following short summary demonstrates the importance the County, City, and Consultants placed on Scientific Team input from 2006 to 2018. The summary also points out a weak phase in LORP management that needs attention. The MOU Parties should work on this phase and make it more effective.

SCIENTIFIC TEAM ACCOMPLISHMENTS (2006 THROUGH 2018)

FOR THE CONSULTANTS

Consultants recommended or requested the City-County assign the Scientific Team to complete at least 40 projects. The Scientific Team has not worked on or completed any of these assignments requested by the Consultants (Appendices 1).

FOR THE COUNTY

The County assigned a minimum of 15 projects for the Scientific Team to complete. To date, none of these projects have been completed and submitted for action (Appendices 4).

FOR THE CITY

The City assigned a minimum of 6 projects for the Scientific Team to complete. To date, none of these projects have been completed and submitted for action (Appendices 3).

FOR THE OTHER MOU PARTIES

So far, the Consultants do not know of any completed Scientific Team assignment that has elevated the level of MOU Party decision making.

TAKE-AWAY

The record shows that the MOU Consultants have, over a very long period of time, pushed constantly for Scientific Team input to improve LORP management. The historic record definitely shows that there was much the Scientific Team needed to do. Shortcomings in failure to implement good adaptive management measures could have been sorted out and addressed by the Scientific Team. The Team can, however, be very valuable resource in the future LORP process if supported and used wisely.

The Scientific Team could be of little help in the LORP process if the MOU Parties cannot use their input effectively and seriously consider their advice and counsel. Also, the Team has yet to prove it is capable of inputting successfully into the present and especially the future management of the LORP. A major Consultant concern is that it may take quite a bit of time for the Scientific Team to get up and running. Just this short analysis of over 50 team proposed assignments, with little accomplishment, is much cause for concern.

CAN ACTIVE INTERVENTION RESULT IN ANY BENEFITS?

SITUATION

CDFW and the Sierra Club, early in the beginning of the LORP project, were recommending extensive mechanical removal of emergent vegetation in the river channel to control tules and cattails. They recommended that active rehabilitation interventions combined with river-flow modification are the best two options for gaining a self-sustaining fluvial habitat as described in the 1997 MOU. OVC is on record that increasing river flows using the same quality water being released today, into tule-infected reaches, will not control tules. OVC, also countered, however, that tules (tules and cattails) be allowed to “live-out” their time on the river because they may be successional to the next wave of dominant (beneficial)vegetation.

The 2004 EIR project description and direction may be a stumbling block for implementing certain active management proposals. The EIR states that extensive removal or active management of tule (tule and cattail) stands to retard the expansion of tule growth or to increase open water habitat for habitat purposes will not be considered. The EIR also states that, “Only if funding for tule-cattail control is obtained from sources other than the City or the County will tule-cattail control be considered”. Also,

the MOU Parties have not tested, evaluated, or implemented to date any adaptive management recommendation that may have any chance to control tule-cattail abundance and location.

Because of concern constantly being expressed by certain MOU Parties on tule-cattail influences, Consultants in 2012 recommended a "MOU Party Working Meeting". The sole purpose of this meeting was to identify solutions to the tule-cattail problem. The meeting would consider feasible and reasonable actions that could be used to manage these plants. The MOU Parties did not accept this recommendation.

The following sections describe MOU Party concerns and identifies serious constraints that will have major influences on implementing future LORP active intervention projects.

MOU PARTY CONCERNS AND SUGGESTIONS

SITUATION

A combination of passive and active restoration is commonly used in ecosystem restoration. River active restoration projects may include modification of the river channel, removal or control of invasive plants in the channel or along-side the banks and eliminating muck and/or sediment from the channel. Consultants, in their 2010 Adaptive Management Recommendations, suggested the MOU Parties consider the application of both passive and active approaches to river management. The Consultants recommended to the MOU Parties; however, that no active restoration be implemented in the future without first developing a sufficient justification, testing, monitoring, evaluation, and implementation plan

As early as 2000, the Ecosystem Management Plan was suggesting that active intervention, such as planting of riparian and upland vegetation, can be employed if adaptive management analysis determines they would be feasible, reasonable and beneficial. Dr. Patton (Sierra Club Consultant) expressed that as much as passive restoration may be the most logical approach from an ecological perspective, once systems have been greatly altered some active restoration may be necessary to restore a system to a healthy functional state.

Consultants recommended the Scientific Team conduct an initial evaluation of feasible and reasonable active rehabilitation interventions. Interventions that could be tested for success or failure. There evaluations would then be submitted to the MOU Parties for action. The 2017 Annual Report emphasized that with large scale flood events not being a viable option, active intervention to expand riparian woodlands appears to be the only viable route to meet avian goals. We have not and probably will ever have a sufficient planned and implemented large-scale flood event in the Lower Owens River. In 13 years of LORP implementation, the MOU Parties have yet to even implement any changes in river flows that would have any chance to improve environmental conditions in the Lower Owens River.

SIERRA CLUB CONCERNS

The Sierra Club has stressed that managing tules properly will require active intervention (2013 Annual Report Response). If river flow implementation and changes in land management do not create a proper functioning Lower Owens River, then the Sierra Club believes feasible and sensible active management approaches should be considered.

The Sierra Club is concerned that the passive restoration approach, which has dominated the project so far, will not achieve LORP goals (2015 Annual Report). They recommend that some active restoration approaches be evaluated (2014 Annual Report). The Sierra Club maintains that even peak flows of 200 or 300 cfs will not be strong enough to scour out established mature tules and cattails. Therefore, they support significant management changes to control the now established tule domination. This will most likely require active intervention.

OVC CONCERNS

OVC believes that since flows alone will not achieve a clearer channel and healthier river, active intervention will be needed. They pushed for a combination of mechanical means (including explosives as appropriate) along with annual flushing flows to remove tules and detritus. They stressed these actions must be attempted now for the health of the river (2018 Annual Report). OVC also believes that mechanical vegetative clearing and reestablishment of a river channel through the Islands is essential. If the lessee is going to continue grazing cattle on the Islands, then active intervention must be done. OVC supports the type of mechanical intervention activities proposed by the County in their "Owens River Water Trail' project. OVC suggests that active intervention be an item to be discussed among the MOU Parties. OVC also countered that tules and cattails be allowed to live out their evolution and go through the successional episodes, as they may be replaced by another type (beneficial) of vegetation.

CDFW CONCERNS

CDFW believes that continuing the present flow regime, without extensive mechanical intervention, will likely result in the project failing to meet LORP goals (2016 Response to Annual Report). They emphasize that It is now clear that the low river power generated by the existing seasonal habitat flow regime is insufficient to scour the channel or the banks. CDFW (2018) believes the current flow regime has not restored all needed process. They believe the past and present flow regime has created today's static system. A static system lacking diversity of flow conditions and disturbance regimes required to restore proper function to the Lower Owens River.

CDFW supports discussing with the other MOU Parties, the need for mechanical removal of emergent vegetation (tules and cattails). They believe that extensive mechanical removal of emergent vegetation, in conjunction with higher flow releases, provides the best option. They believe this is a must to develop a self-sustaining fluvial habitat, as described in the 1997 MOU. CDFW recommends that once the channel has been cleared of vegetation by mechanical means, flushing flows as required by the MOU, may be more effective. Because current river flows are not creating disturbed habitat necessary for natural tree recruitment; CDFW supports appropriate active intervention to create sites for tree establishment (2014 and 2017 Annual Report responses).

CDFW believes active Interventions that could maintain the river channel should be investigated and implemented to ensure the survival of existing riparian vegetation. CDFW is willing to partner with the other MOU Parties and implement selective channel clearing. Test reaches in the Lower Owens River would be selected to assess feasibility and maintenance cost. In addition to mechanical clearing, CDFW believes other (active) options should be considered as well.

CDFW supported having a MOU Party meeting during the spring or summer of 2019 to discuss river management needs. This meeting never took place. They believe changes in the Lower Owens River regime may deter future bulrush and cattail growth. They point out that even peak flows as high as 200 cfs are not strong enough to dislodge established mature plants (CDFW 2014 Annual Report). Therefore, changes in distribution of established plants will likely require implementing active intervention methods.

COUNTY-CITY CONCERNS

The County believes there is general agreement that emergent vegetation cannot be controlled on a large scale by methods that are within the limits of available resources (i, e., economics). The County-City believes, given all the constraints, it is unlikely that a principal goal of the LORP, to increase riparian woodland to attract and support tree obligate avian species, will be met (2017 Annual Report). Without large scale flood events active intervention to expand riparian woodland appears to be the only viable routs to meet avian LORP goals. Inyo County initiated a medium-scale active intervention to plant and establish willows on different landform types in the lower river reach. Although a complete failure some knowledge and experience may have been gained.

Given the challenges that dominate and control a successful natural tree recruitment needed to meet key LORP goals, the County-City believes there are two management options, 1) accept the current conditions and reset LORP goals: 2) attempt active intervention to create an advantage for recruitment (2018 Annual Report).

ACTIVE INTERVENTION CONSTRAINTS

MOU PARTY CONSTRAINTS

To plan, evaluate, approve, and implement reasonable, feasible, and successful active management projects is going to be very difficult for the MOU Parties. Even more difficult than the MOU Parties faced the past 13 years attempting to plan and implement better river flow management which was not that successful. To justify and implement an active management project under all the constraints (I, e. legal, environmental, feasible, economic, reasonable, river potential, and especially severe valley and lake infrastructure incompatibility) will more than test the MOU Parties capability. Especially when any proposed or recommended active intervention approach will likely require all MOU Parties approval by consensus before the activity can be approved and implemented.

INYO COUNTY INFRASTRUCTURE CONCERNS

The County maintains that the Consultants recommended 300 cfs flushing flow release is far outside their anecdotal experience and modeling. They believe that even this low flushing flow volume presents significant risks of a substantial fish-kill. This level of flow will also damage road crossings and other infrastructure (2014 Annual Report). The County position is that the Consultants 300 cfs flushing flow recommendation would result in a waste of water resources. Because of this waste they would not approve its release. This type of reasoning, although justifiable, applies a major constraint to implement future flow management. The County also believes it is unlikely that the Consultant recommended series of 800 cfs flushing flows could be released successfully given the Intake Structure design and its hydraulic resistance (2017 Annual Report). If this 800 cfs flushing flow was ever released, the cost of rebuilding damaged valley infrastructure would certainly be high and above the County's means.

The County found it would be obvious to all that a 800 cfs flushing flow release would, in turn, sheet water across floodplains. This water would inundate considerable stretches of cross-river roads. Levee roads would need to be constructed in companion with elevated bridges. This considerable high construction expense is beyond the County's means. Even with released flows less than 250 cfs the County witnessed road bed saturations and other road surfaces that were compromised (Inyo County Response to Consultants 2017 Adaptive Management Recommendations). Based on just the County's, concerns the case is strong and justifiably so, that any future flow management recommendation submitted by the Consultants high enough in flow volume to produce favorable results, is "off-the-table".

CITY INFRASTRUCTURE CONCERNS

The City claims that a flushing flow exceeding 300 cfs will be difficult to release. This is because accurate flow measurements over 200 cfs released at the LORP Intake Langeman Gate are not possible. The City also cautions that releasing a 300 cfs flushing flow into the Lower Owens River is only possible when there are also sufficient Middle Owens River flows available at the time of the flushing flow release (2014 Annual Report). Even if there are sufficient flows in the Middle Owens River, the City will not commit to releasing a 300 cfs flushing flow because there would be a loss of water (not "water neutral") from such a flow. In addition, a 300 cfs flushing flow release cannot be managed and would, therefore, be a waste of resources (2014 Annual Report).

The City cautioned at the LORP River Summit # 1, that the Consultants suggested 600 cfs flushing flows released into the Lower Owens River would result in major damage to many roads and bridges. Consultants now believe flushing flows, to have any chance of being effective, would have to be at least 800 cfs and preferable much higher.

Consultants requested (adaptive management recommendation) the City and the County provide a ball-park estimate of what it would cost to modify valley infrastructure to pass an 800 cfs flushing flow release down the Lower Owens River without causing infrastructure damage. The City rejected this recommendation because the cost to modify the Pumpback station (to increase pump-out), by itself, would be greater than the cost of the current facility. They pointed out that no road crossing could handle a flow of this magnitude without expensive modifications. The City also pointed out the extensive damage that would occur to the Owens Lake Bed Dust control infrastructure. Damage that

would be extremely expensive to repair. When considering both the County's and City's concerns, which to the Consultants are factional and reasonable, the case is quite solid that flushing flow releases high enough in magnitude to produce needed favorable results, is "off-the-table".

WATER AVAILABILITY CONSTRAINTS

OVC and the Sierra Club object to the use of the term "water neutral" used by the City. The City maintains that any changes to LORP operations must be "water neutral" compared to current operations. That is, no additional water will be lost to LORP operations than already occurs under the 2007 Stipulation and Orders (2014 Annual Report). The City maintains that any changes in flow volume must not exceed the agreed upon water budget for the project identified in the LORP EIR. Volumes of water (for management purposes) used must be "water neutral" (2019 Response from City to CDFW). The MOU Consultants fully support the City's position on "water neutral". This support will continue until the MOU Parties show they can use the water presently available in a capable and productive manner.

On April 18, 2019 and again on May 2, 2019, CDFW submitted letters to the City requesting the release of a series of annual flows between 350 and 375 cfs. These flows were recommended to be released into the Lower Owens River over a course of a two-week period during mid May 2019. The City responded they were unable to fulfill this request because; (1) The request is outside the legal guidelines set forth for the project until modified by the MOU Parties and the Inyo County Superior Court, and, (2) These flows would exceed the water budget for the LORP as described in the LORP 2004 EIR adopted by the LADWP Commissioners as the lead agency and by CDFW as a cooperative agency, and (3) These flows would put the City's infrastructure for the Owens Lake Dust Mitigation Project at risk. The City does not agree to releasing any additional flows on top of those discussed at the LORP River Summit (2014 Annual Report).

The County believes it is unreasonable to think that the MOU Parties will ever accept unlimited pump-out at the Pumpback Station (2014 Annual Report). Time as shown the County is correct. The County also believes that the Consultants stated benefits gained by adding down-river flow augmentation flows are not fully supported by past analysis. The County believes that adding very high flows to the Lower Owens River would cause as many challenges as it does added benefits. No supporting data or justification to support this position was presented by the County.

Experience has shown that controlling tules and cattails in the Lower Owens River will require scouring flows much higher than acceptable (500 cfs and over- Dr. Patton recommendation; 800 cfs and over- Consultants' recommendation). Physical or mechanical control of tules and cattails may be too high in cost to be effective. Chemical control could be unacceptable, could damage other resources, and also be too costly. The 2004 EIR states that, "Active tule removal would only be conducted in rare instances". With the many qualifications and restrictions, it appears increasing river habitat and flushing flows and mechanically removing emergent vegetation from the channel in an attempt to form a healthier riverine-riparian environment, may be a mute issue at this time. Instead of Consultants to continuing to recommend annually that MOU Parties release very high flushing and habitat flows for testing and evaluation, it may be more productive to focus on other reasonable rehabilitation efforts.

LEGAL CONSTRAINTS

The over-riding goal expressed in the 1997 MOU is for the LORP to be a natural, self-sustaining ecosystem to the extent possible. The 2008 MAMP plan also pushes for self-sustainable ecological restoration. The plan calls for restoration that does not rely upon a human built and artificially maintained ecosystems. All adaptive management direction (calling for active intervention) for implementing the LORP must be reasonable and feasible and abide by the constraints of the MOU (2008 MAMP). This all infers that passive restoration is the preferred alternative. The LORP Management Plan (2002) requested managers give the system 15 to 20 years to rehabilitate before evaluations are made about restoration success. We are not quite there yet.

The 2004 EIR calls for active tule removal only in rare instances. Extensive removal or active intervention of tule (tule and cattail) stands to retard or control the expansion of tules to increase open water habitat will not be considered unless funding for such work is obtained from sources other than the City or the County (FEIR, 2-16). The removal or control of tules or cattails will only be considered where there are significant obstructions along the river or blocking culverts.

The City and the County alerted other Party members they must be cognizant of the constraints that legal mandates place on the success of the LORP. They suggest the MOU Parties acknowledge and accept the likely trajectory of the LORP. The alternate is to be willing to negotiate changes to those legal restrictions that thwart the effective management of the project (2018 Annual Report).

TAKE-AWAY

Like the MOU Parties trying to implement better flow management to increase the health of the Lower Owens River, which did not progress very far, the MOR Parties will find implementing successful active restoration projects even more complicated. As Dr Patton (Sierra Club Consultant) would probably state, “flow management is not one of the successes of the LORP”. Based on past experience, future active intervention attempts may not be all that successful either. The MOU Consultants continuous past predictions to the MOU Parties that, “You now have the river you are going to get”, seems to be getting more credible each year.

This is not all bad as it appears because many beneficial results have already been attained from LORP management. Regardless of what seems insurmountable constraints, the Consultants encourage the MOU Parties to spend more effort in determining if there are any reasonable and economically feasible active intervention actions that show promise in enhancing LORP resources.

AN ACTIVE INTERVENTION PROPOSAL --- IN-RIVER CONTROL STRUCTURES

SITUATION

Recommendations to install in-river water control structures to improve environmental conditions in the Lower Owens River is nothing new. Inyo County recommended, even before the beginning of the LORP Project, that beneficial results could be obtained by installing a series of water control structures to create more open water habitat for resources of concern (Groeneveld). The MOU Consultants in 2011, and to a lesser degree a few years earlier, verbally recommended a series of cross-channel water control structures be evaluated to determine if they could control tule-cattail encroachment. Consultants

suggested it may be possible these structures could also be used to improve river flows for improved water quality purposes. This Consultant recommendation, which did not get much attention, may still be unreasonable, but may still be worthy of some consideration. As Dr. Patton (Sierra Club Consultant) constantly reminded the Parties, it is time to start thinking and considering things outside the box.

Most snow-melt driven natural flow rivers have a very productive and important stream side ecozone transition area. An area that lies between the base flow water surface contour effect and the high flow contour effect. The Lower Owens River does not have this ecozone because high flow releases are too small and too short in time to produce erosive or flooding results. Also, there is such a slight increase in height between the low water surface and high flow levels the zone would be very small anyway. The present riverine-riparian habitat, including this absent ecozone condition, is governed only by the influence applied by the uniform required 40 cfs base flow. Therefore, no ecozone exists. A zone which is one of the needed components of successful tree recruitment and survival. The wider this ecozone the less chance tule and cattail can survive. In pre-historic and even early historic time (during maximum valley irrigation periods) this zone was so dominant in the Owens River that tules and cattails seldom survived in the river channel.

An increased expansion of deeper open water habitat (via water control structures) within the Lower Owens River could provide increased recreational access, more watercraft passage, increased wildlife numbers, and open up larger areas for fishing access. There could, however, be some negative effects such as, control structures during water storage or flow control periods could cause fish migration blocks. Adjacent water tables could increase in height during certain periods of the year. Water control structure spills, as demonstrated in the Owens Gorge, could provide an increased dissolved oxygen supply to down-river reaches.

If release flows to the river were also managed, in combination with water control structures so low flows could be used to desiccate shallow channel areas now dominated by tules and cattails, open water habitat may increase. Lowering water surface elevations during freezing soil periods in winter could also increase tree survival and reduce cattail and tule abundance. Periods of deeper water depths, especially in the spring, would cause very high tule-cattail mortality over large areas.

A 11-foot water control structure would mimic the same river ponding effect as a 550 cfs flushing flow. There would, however, be no channel scouring effect. Increasing down-river channel scouring of “muck” is a possibility if storage water was released to augment and increase the volume of released flushing flows.

WATER STORAGE CAPIBILITY AND RIVER DEPTH INCREASES

Solberg and Higgins (1993 and 2006) recommended flooding 3 to 4 feet over the tops of stems of tules and cattails in the spring to kill these plants. An additional 7- to 8-feet of channel water depth in reaches of the Lower Owens River, in combination with a fluctuating water level, could have a very large effect on reducing the abundance and distribution of tules and cattails. Water depth manipulation is generally thought of as the most cost-effective way and efficient method available to control emergent vegetation. Degree of water depth is the strongest driver of where tules and cattails can and cannot grow. Hydroperiod, which structures would control or influence, also affects where tules and cattails

can survive. Applying desiccation in the summer, freezing in the winter, high flooding mortality in the spring, could control tules and cattails over wide areas.

To maintain ecosystem productivity, wetlands need to experience periodic surface water level fluctuations (2015 Annual Report). Water level manipulations are one of the most effective tools in wetland management to influence the food resources that attract wildlife (2015 Annual Report). These conclusions refer to marsh or ponded water habitats. They could, however, also apply to a marsh-like river like the Lower Owens River. Miller, et.al. 2013, found that the greater this inundation expressed as changes in water surface area, water depth, water duration, wetting frequency, seasonality, and volume of surface water, generally reduces vegetation abundance in stream channels. River channel water control structures managed properly have the capability to increase inundation dramatically.

CHECK DAM APPLICATION IN THE LORP

Jurisdictional dams are dams that are under the regulatory powers of the State of California. A "dam" is any artificial barrier, together with appurtenant works as described in Sections 6002 and 6003 of the California Water Code. A dam owner is a person or non-federal entity with legal responsibility for the dam.

If the dam height is more than 6 feet and it impounds 50 acre-feet or more of water, or if the dam is 25 feet or higher and impounds more than 15 acre-feet of water, it will be under California's jurisdictional oversight, unless it is exempted.

The 2012 hydrologic survey of the LORP by NHC used the HEC-RAS model. They surveyed 5, 2-mile plots (reaches identified in the Ecosystem Management Plan, the MAMP, and the EIR) with 60 to 80 cross-sections per plot reach. Output from the model is detailed cross sectional area diagrams with water surface elevations at various flows from 20 up to 200 cfs. These cross-section plots can be used to estimate dam height and pool length.

For example, if the old hydro measuring station at East of Goose Lake is selected as a site to install a check dam the HEC-RAS model shows the WSE at 48 cfs is 3608 ft. The stream bottom is at an elevation of 3603 ft. If the dam is built to increase the WSE by 4 ft to 3612 ft, the dam would be 9 ft tall. Using the upstream cross-section figures in the report to identify a cross-section where the WSE would match the 3612 ft elevation, the backwater would create a pool upstream of the dam approximately 2800-3000 ft long.

Of course, depth will vary within the pool, but the value of the HEC-RAS model is its predictability. The model can be used to calculate pool volume. While the dam height of 9 ft would indicate it falls within the jurisdiction of the State, volume may be less than the 50 acre- feet threshold, which can be determined from the model.

In addition to x-y coordinates and elevation information in the model, each survey point contained a code describing the physical feature (i.e., channel invert, tules, top, channel end or beginning, water's edge, etc.) of the point. These descriptors were used to estimate the locations of tules, main (open) channel, vegetated floodplain, and other features for designating channel roughness values in the model cross sections.

The model can predict volume and wetted width, but that means actually using the HEC-RAS model. The message is that the Scientific Team has the necessary data and model to identify potential sites, run the model for depth, volume, wetted width etc. Using Jensen's 2017 vegetation mapping and channel characterization is the place to start to identify sites where a check dam is needed to drown tules and a channel condition (entrenched with high banks) that could give a good amount of storage. Then run the HEC-RAS model for that reach to determine the dam height needed and calculate volume and depth.

Check dams, placed strategically to impact high density tule/cattail stands, can have a salutary effect on water loss during summer months. For example, during 2019 evapotranspiration losses amounted to about 295 acre-feet. Some of this loss could be attributed to normal channel gain/loss dynamics, but that loss amount is negligible compared to ET loss. How much water can be saved from ET with check dam reduction of tules/cattails probably cannot be calculated with any accuracy. Nevertheless, any reduction in ET loss makes water conservation sense.

LEGAL CHANGES NEEDED

To allow a water control structure to be effective, the MOU Parties would need to modify and void their coding of base flows appearing in their 2013 Stipulation and Order. The Stipulation and Order requires the City to meet the following base flow requirements:

1. No in-river measuring station can have a 15-day running average of less than 35 cfs.
2. The mean daily flow at each in-river station must equal or exceed 40 cfs on 3 individual days out of every 15 days.
3. The 15-day running average of any in-river flow monitoring station cannot be less than 40 cfs.

These handicaps the City has had to live with all these years should be eliminated anyway. They have and will continue in the future to infringe on the Cities ability to manage the river. As experience has shown, the flow coding mandated is part of the reason the river has and will always function similar to a canal. The MOU Parties can amend, delete, or add to the 1997 MOU, or it's under the umbrella Stipulation and Orders at any time by unanimous written agreement of all Parties. The Consultants past adaptive management recommendations requesting the MOU Parties void these Stipulation and Orders and lift the cap on the Pump Back Station pump-out volume still stand.

TAKE AWAY

The County has already proposed two active interventions; The Owens River Water Trail and The Lower Owens River Enhancement and Improvement Study. These actions have yet to be implemented and evaluated. The County has implemented two active interventions; willow pole planting which failed and tule-cattail removal from the channel to increase open water for access, which was successful. The City has conducted two active interventions for evaluation. One was increasing grazing intensity to decrease bassia abundance and distribution along the river border. The other was to rough-up or disturbed floodplain or bank areas to increase tree recruitment and survival. Neither of these actions were ever reported on or results documented so we have not record of conclusions.

The County in past Annual Reports, has pointed out that there is general agreement that emergent vegetation (tules and cattails) cannot be controlled on a large scale. They believe control methods are not available that would be within the limits of available resources. The County has spent time and monies planning mechanical and manual removal of tules and cattails from the channel to allow watercraft travel.

The County in their response to the Consultants 2015 Adaptive Management Recommendations, correctly emphasized and pointed out that the MOU Consultants ARE THE PROBLEM (Annual Report 2015). They go on to state that Consultants offer no recommendations for small scale experiments in active management of tule and cattail control that might be scaled up if funding resources can be found (Annual Report 2015). The County requested, and Consultants agree, that it would be helpful if the MOU Consultants would offer specific suggestions for similar modest active management programs (i.e. their Water Trail) that could be upscaled.

The following recommendation, to evaluate and determine if there is any potential that water control structures can gain added benefits, is our first attempt. Consultants recommend the Scientific Team evaluate the capability of in-river structures to control tule and cattail abundance and location, increase open water habitat needed by other resources, augment seasonal habitat and flushing flows, provide flows to scour down-stream channels, increase recreation access, and improve down-stream dissolved oxygen conditions. Consultants provide this one active option for MOU Party consideration until time allows Consultants to develop better reasonable and feasible active intervention options. Options that are worthy of being taken through the adaptive management process.

BLACKROCK WATERFOWL MANAGEMENT AREA

CURRENT WETLAND CONDITION

The Blackrock Waterfowl Management Area (BWMA) consists of the Drew, Waggoner, Winterton, and Thibaut management units: Drew is 827 acres, Thibaut is 4735 acres, Waggoner is 1554 acres, and Winterton is 1917 acres. As described in the vegetation mapping in the 2018 annual report, Drew and Thibaut have been in operation (flooded) more continuous years than the other units. Waggoner was only used during the 2009-10 water year. Winterton has been in use since 2015.

The extent to which wetlands units are flooded each year is dictated by the runoff forecast. For example, the runoff forecast for 2018 was 78%, which set a wetland acreage goal of 390 acres, and the 2019 runoff forecast greater than 100% of normal required flooding 500 acres. How the units are managed to meet the wetted area requirement is exemplified in this year's actions: given the goal of 500 acres, flow to Drew was set to 3.7 cfs, Winterton was set to 3.4 cfs inflow, and Thibaut was set to 3.5 cfs. Measurements in early May indicated Drew held 295 acres, Winterton had 156 acres, and Thibaut held 56 acres. The flow rates were modified in early June to account for summer conditions and again in the fall.

The decision to use a particular wetland unit is governed by the vegetative condition of a unit and whether it can meet the 50% open water area criteria. The extent of open water was not reported in the annual report. However, no measurements of wetted area were taken in the summer or fall

because of saturated conditions. With the exception of Thibaut, the units are managed only to meet the annual wetted area requirement. Thibaut is managed to allow summer drying conditions to control some tule/cattail growth. The continuous use of the units just to meet the MOU obligations has not created healthy wetland conditions.

The effect of overuse of Drew can be seen from the 2017 vegetation mapping. 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. In effect, rather than providing quality habitat for waterfowl, Drew's vegetation structure is being modified. Continuation of the current management practices will alter the vegetative structure of the other wetland units in time and, ultimately, diminish the value of the BWMA for waterfowl.

FUTURE WETLAND MANAGEMENT

Current research and wetland management strategies indicate that the most appropriate management is to annually dry a wetland and seasonally flood it. Based on this latest research, in 2015 we recommended a plan that replaces both the 50% emergent vegetation standard and indefinite wetted cycles. However, the annual target acreage of up to 500 acres based on the water year should remain as the goal described in the MOU. LADWP's comments in the 2015 annual report indicated support for a plan that increases seasonal flooding cycle between units "as long as such a change would be water neutral from current practice". LADWP's basic concept is to create optimal waterfowl habitat in wetland units with seasonal flooding coinciding with spring and fall waterfowl migrations and subsequent drawdowns to occur early enough to control saltcedar and tules in the summer.

Perhaps a management strategy that would achieve more shallow flooding without compromising the acreage is to create a pulse release into an empty cell at the right time of year, while shutting off the water to an active cell – creating a draw-down that exposes the mudflats. The shallow flooding appears to be focused on wading birds in the spring and fall. Therefore, in the spring and the fall, either water could be shut off from an active cell for short periods, and released into another cell to create shallow flooding, while simultaneously opening mudflat habitat for shorebirds. The MOU Consultants have not done an analysis, but this could likely be achieved without losing a large amount of acreage, as the water will persist in the flooded units for a longer period in the spring and fall.

Another option would be to have an outlet structure put in on the downstream end of the units (if possible) that could be used to release water in the spring and the fall into adjacent grasslands. Another option is to modify one of the units specifically for shallow flooding – using a series of little berms or some manipulation. It does make sense to have a water regime that varies seasonally rather that annually, as most wetlands function that way. By moving the flows up and down over the course of the year will create varied habitats, and a healthy wetland system. There is value in the deep-water habitats and the tule and cattail habitat. The need for shallow-water and mudflat habitat in the spring and fall can be achieved without losing the other habitats.

The seasonal approach to managing the Thibault Pond exemplifies the best management practice that can be applied to the other wetland units. The MOU Consultants strongly recommend the LADWP, ICWD, and CDFW work with the LORP Scientific Team to develop a new BWMA management plan based upon seasonal wetting and drying cycles.

OWEN RIVER DELTA HABITAT AREA

The Delta Habitat Area consists of 3283 acres of mostly marsh, wet meadow, eolian, and playa. In 2015 the recommendation to eliminate Period 2 (June-July) pulse flows was adopted much to the benefit of fall and winter waterfowl habitat and usage. The MOU mandated average annual inflow of 6 to 9 cfs has been complied with each year. These flows have also maintained the wetted area of the brine pool at the southern extreme of the DHA.

Vegetation mapping from 2000 to 2017 (see 2018 LORP Annual Report) show a steady conversion of vegetation classes over time such that about 300 acres of wetland vegetation has developed from project inception. The 300 acres of new vegetation comes from the conversion of playa and eolian (wind deposited sand, typically with sparse vegetation). As of 2017 the DHA included marsh (385 acres), short marsh (217) acres, wet meadow (254 acres), and meadow (113 acres) wetland classes.

From 2015 to 2018 the MOU Consultants recommended the City release the three DHA habitat flows from the Intake instead of the Pumpback Station. We recommended Period 1 (April-May), Period 3 (September-October), and Period 4 (November-December) DHA habitat flows be released from the Intake to improve the total seasonal habitat flow through the river. This recommendation was not adopted. MOU Consultants also recommended discontinuing the summer pulse flow to allow for more drying of the wetlands and use that water in the Fall and winter to create more open water habitat for migrating waterfowl. This recommendation was not adopted.

In 2019, LADWP released pulse flows in the summer (Period 2: June-July, 10 days @25 cfs), Fall (Period 3: September, 10 days @ 20 cfs), and winter (Period 4: November-December, 5 DAYS @ 30 CFS). Scheduled spring flows (Period 1: March-April, 10 days @ 25 cfs) were not released due to excess runoff which exceeded the planned inflows. The average flow to the DHA was 11.5 cfs.

The MOU Consultants recognize that flows into the DHA will continue as is to maintain the 6 to 9 cfs annual and the four periodicity pulse flows. Based on LADWP bird surveys over time, Fall and winter pulse flows are providing good open water habitat for target waterfowl species. It is also apparent that the conversion of playa and eolian areas is nearly maxed out, and further plant diversity is not likely to occur, rather, the DHA will probably move to greater tule dominance.

OFF RIVER LAKES AND PONDS

The LORP includes several lakes and ponds off the river channel. 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.

Lakes and ponds compliance in the MAMP is consistent with the MOU and is defined as “maintaining the existing lakes and ponds”. Monitoring entails recording staff gage elevations at the lakes and monitoring vegetation trends through habitat mapping.

To achieve the MOU goal of maintaining the existing lakes and ponds, the Final EIR/EIS describes the following management objectives for the off-river lakes and ponds:

- Upper and Lower Twin Lakes: Existing staff gages will be maintained between 1.5 and 3.0.
- Goose Lake: Goose Lake must be kept full in order to spill over and provide a continuous flow to the river. Therefore, Goose Lake will always be full. Typical staff gage readings reflecting Goose Lake at full capacity are between 1.5 and 3.0.
- Billy Lake: Billy Lake will remain full in order to maintain a continuous spill to the river. A staff gage was never placed in Billy Lake because it has always been operated at a spillover level.
- Thibaut Ponds: One or more gaging stations will be installed to monitor pond levels and will be maintained at 28 acres.

Water from the Aqueduct would be provided through the existing network of spillgates and ditches. Lake levels will be maintained by either maintaining existing flows, or by controlling lake levels at the outlet weirs. Flows to all but Upper Twin Lake and Thibaut Ponds will be part of the riverine-riparian enhancement program in which corridors will be established for non-native game fish.

As in most past years, all 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, Lower Twin Lake, and Goose Lake were between 2.0 and 3.5 feet stage height throughout the year.

Because the water levels in the lakes and ponds have never been out of compliance or violated the MOU, the Consultants have never made any recommendations to modify or change how the water bodies are managed. However, during the course of monitoring tule encroachment into the lakes and ponds has been noted. The" Grass Lake" complex developed as a consequence of project operations but soon filled with cattails and tules and never became a viable recreational lake.

Management of Thibaut Ponds was changed in 2016 to a periodic wet/dry cycle; flooding in the Fall and winter and drying in the spring and summer. This periodicity was found to be a way to control tule and cattail growth and provide much better habitat for shorebirds, waders and other indicator species particular during migrations.

Because Thibaut is such a success story, the MOU Consultants have consistently recommended adopting a periodicity cycling plan for the BWMA.

LAND MANAGEMENT

CURRENT RANGE CONDITIONS

The 2019 range monitoring included one-third of the leases measured for range trend; Blackrock and Delta leases. The annual report describes results for each lease. All leases were evaluated for utilization as were all irrigated pastures. The leases typically exhibited good management, staying within utilization standards. All pastures utilization was well below the allowable levels for riparian pastures (up to 40%) and upland pastures (up to 65%).

Range trend results indicated Saline Meadow[1] ecological sites exhibited a strong response to the high precipitation in 2019. Bassia also continued to expand in response to wetter winter and spring conditions. Monitoring also indicated range trends stable or upward trends on Moist Floodplain ecological sites.

Several pastures are eligible for burning to reduce rabbit brush and other vegetation densities, but only one burn was completed this year on the area around Long Pond. A second burn was planned for the south Winterton area but was not performed. Burning is a recommended method to improve grazing while improving plant diversity. Burning typically results in conversion to meadow conditions. This year only one pasture showed excessive grazing but was quickly remedied by staff working with the lessee.

Scoring of irrigated pastures showed all pastures were above 80% except Thibaut (72%). LADWP will work with the lessee to make small changes in grazing duration and weed management to improve the scoring on Thibaut. It should be noted that in eight years of scoring irrigated pastures, only four pastures have scored less than 80%.

SHOULD UTILIZATION CRITERIA BE MODIFIED

A central theme of the LORP is multiple uses. The project is intended to not only restore the river-riparian system, wetlands and adjacent habitat, but improvement and continuation of livestock grazing is a key element in the definition of multiple use.

Early in the project the MOU Consultants worked with LADWP staff and each of the leasees to develop comprehensive land management plans for each of the seven leases and 57 pastures within the LORP boundaries. Overtime these plans, under the adaptive management concept, have been modified to better use the grazing lands and enhance productivity and diversity.

There are three categories of pastures; riparian, irrigated and uplands. Grazing standards were set for riparian pastures at 40% utilization and 65 % for uplands have been called into question by the leasees and staff scientists. Because plant diversity and forage base have improved over time with implementation of lease management plans, the thinking is that it may now be permissible to alter the standards to 30% for riparian pastures and 50% for uplands.

Establishing grazing standards at 40 and 65% was intended to do more than just improve grazing. Rather the standards were set to meet a key goal of the MOU which is to create and sustain *habitat* for target species, especially Owens Valley vole (a category two, state species of concern), Swainson's Hawk (a state threatened species), and Northern Harrier (a state species of concern). These species are dependent upon grassland and woodland habitats. These habitats also need to be recognized as a continuum from the river through the uplands; a reach termed the "biological stream width"[2] because of accumulative energy transfer in which one energy gradient subsidizes the next. In this context even uplands have connectivity to the riverine habitat. A limiting factor will occur when a successive energy

[1] Moist Floodplain is the most common ecological site in the LORP; dominated by saltgrass and alkali sacaton. Saline Meadow is the second most common ecological site dominated by perennial grass.
[2] See Muehlbauer, J. et al. 2014. Ecology 95(1) pp. 44-55 for discussion on biological stream width and energy transfer as part of the food chain

gradient, or ecotype, is non-existent or of such poor quality that energy transfer is minimal. Before the LORP grazing standards are modified it must be determined if increasing utilization in riparian and upland habitats will result in lower quality habitats for the target species or impose a limiting factor.

However, bassia stands have increased in the LORP especially within the river corridor. LADWP has requested the MOU Consultants to agree to a change in grazing standards from the Twin Lakes to Thibaut riparian pastures as a test to determine if cattle grazing, by virtue of crushing bassia, can be a control method. If successful, cattle grazing might be a way to open up bassia covered areas to allow regrowth of salt grass and other understory vegetation. During the Fall site visit, the MOU Consultants agreed to this test but requested LADWP develop a clear plan that includes specific areas, how cattle will be held in bassia areas, expected outcomes and how the knowledge gained can be applied in other areas of the LORP.

NOXIOUS WEEDS

In 2019, ICWD surveyed the distribution of perennial pepperweed *(Lepidium latifolium)* in the LORP. As concluded in their report, pepperweed density has increased and continues to do so throughout some river reaches. ICWD identified and mapped several locations; RM 0-8, RM 9-12, RM 28-33. Two primary concentrations of pepperweed occurred in the reach from the Intake to Blackrock Ditch (RM 0-8), and south of Manzanar Reward Road to Reinhackle (RM 28-33). As noted in the annual report, *Lepidium* in 2018 covered over 27 acres. It is likely that the survey by ICWD will indicate an even greater expansion as consequence of the 2017 water spreading.

In addition to the spread of pepperweed, the MOU Consultants noted substantial regrowth and spread of salt cedar in water spreading basins, oxbows and other areas flooded in 2017. It would appear that the effort to control salt cedar was been overtaken by new growth in areas previously treated as well as in new areas along the river corridor. LADWP has initiated mechanical removal and piling techniques in response to ending of the grant funding to Inyo County and the retirement of their program manager. To the extent feasible, LADWP will try to control salt cedar. In 2019 the LADWP treat 139 acres. Re-sprouts will be treated as will treatment in the BWMA and along the river corridor be prioritized.

It was also noted in the annual report that the tamarisk beetle was frequently seen in the LORP area and appears to have increased its range. Beetles were widespread and were eating tamarisk leaves, which will eventually lead to plant mortality. It was suggested that the Scientific Team develop a management strategy regarding the beetle so that mechanical removal of salt cedar is not redundant with beetle infestations. The MOU Consultants concur with this suggestion. A focused and prioritized program to control salt cedar is the best way to effectively allocate resources between mechanical and physical activities and biological control from beetle infestations.

RECOMMENDATIONS

RECOMMENDATION 1

The MOU Consultants agree with the City's response to the Consultants 2017 adaptive management recommendation concerning the need to investigate active management options. A City response advised that, "any potential active intervention proposal would need to be extensively analyzed for feasibility, costs, and short- and long-term benefits". With this direction from the City, Consultants submit the following recommendation:

MOU Consultants recommend the City and County assign their Scientific Team the responsibility to review, evaluate, and determine the feasibility of testing one or more water control structures in the Lower Owens River. The Scientific Team would determine if water control structures have the capability of controlling the location and abundance of tules and cattails, increasing recreational access, providing augmentation water to increase seasonal habitat and flushing flows, assisting in scouring "muck" from down-river channels, improving available dissolved oxygen conditions down-river, being economically feasible and reasonable, causing no adverse conditions that could not be mitigated, benefiting other down-river water quality conditions (i.e. water clarity), and providing viable short- term and long-term benefits. Their final report findings should appear in the 2020 Annual Report for MOU Party consideration and possible action.

RECOMMENDATION 2

Dr. Patton (Sierra Club Consultant) in 2013, advised the MOU Parties that the overall goals of the LORP should now be assessed. This assessment should evaluate the success level and progress of each goal. The assessment should determine those management changes needed to accomplish reasonable goals yet to be met. Based on this advice the MOU Consultants recommend the following:

MOU Consultants recommend the City and the County assign their Scientific Team the responsibility of evaluating the present status of LORP goal attainment. The Scientific Team would also evaluate and identify goals that are unreasonable or could not be met because of over-riding constraints. The Team would provide solutions to those reasonable goals that have yet to be met. The Scientific Team has partially fulfilled this recommendation, but more progress needs to be made.

RECOMMENDATION 3

MOU Consultants recommend the Scientific Team conduct a critical review of limitations that influence project success. Based on the information and suggestions derived from this critical review, the MOU Parties should implement resource management tactics or changes that would address the limitations. This implementation would include any active intervention needed to solve a problem, barrier, a constraint, or any other limitation. Their final review report should be included in the 2020 Annual Report for MOU Party consideration and possible action.

RECOMMENDATION 4

Marsh, wet meadow, open water habitat, riparian vegetation, fish distribution, wildlife numbers, aquatic life and other beneficial resources have all increased from the MOU Parties implementation of the LORP project. The MOU Consultants recommend the City-County Scientific Team evaluate, document, and submit a report describing the LORP benefits that have been gained to date. This report would then be used by the Scientific Team to assist in the evaluations of goal solutions and attainment.

RECOMMENDATION 5

Almost two years have lapsed since the County attempted to plant willow poles along landforms bordering the lower reaches of the Lower Owens River. The now remaining gallery of standing long white perforated plastic pipes encasing dead willow poles just does not look good. A large sore spot has been constructed in an otherwise pleasing environment. Consultants suggested to the County and the City a year ago that this mess should be cleaned up. This suggestion was ignored. Consultants now recommend that this area be cleaned up and returned to its former condition.

RECOMMENDATION 6

Maintain current grazing utilization standards until it can be determined through additional studies that modifying riparian and upland grazing to 30 and 50%, respectively, will not impact target species habitat or result in a limiting factor.

RECOMMENDATION 7

We recommend a thorough survey to identify and map pepperweed and salt cedar throughout the project areas and then devise a plan, with funding, to remove the most serious infestations and a method to control noxious weeds into the future. A focused and prioritized program to control salt cedar is the best way to effectively allocate resources between mechanical and physical activities and biological control with beetle infestations.

RECOMMENDATION 8

Clearly LORP management is unwilling to implement flow alternatives to the DHA such as releasing pulse flows via the Intake. Nevertheless, the MOU Consultants continue to recommend shifting summer pulse flows to the DHA to the winter flow period in order to maximize open water habitat for migrating waterfowl and creating drying conditions to impact tule/cattail during growth periods – as is done in the Thibault wetlands.

RECOMMENDATION 9

Management of off channel lakes and ponds has been quite successful has always remained within compliance standards and met MOU goals. Management should proceed as is.

RECOMMENDATION 10

The seasonal approach to managing the Thibault Pond exemplifies the best management practice that can be applied to the other wetland units. The MOU Consultants strongly recommend the LADWP, ICWD, and CDFW work with the LORP Scientific Team to develop a new BWMA management plan based upon seasonal wetting and drying cycles.

RESPONSE TO LADWP/ICWD LORP EVALUATION

The MOU Consultants used the majority of their time to review and develop Adaptive Management Recommendations from the monitoring data and work performed in 2019. We reserved a few hours for review and comment on the LADWP/ICWD evaluation, but we were not anticipating a two-volume report. Nevertheless, with the time available we are able to make comments and suggestions on the major components of the evaluation.

In general, we are encouraged to see that the Scientific Team will play a primary role to implement the actions recommended. The Scientific Team has been largely ignored and seldom used in the past, so it remains to be seen if the intentions expressed in the evaluation will actually be realized.

Volume I is a detailed and accurate recitation of the LORP history and legal foundation. We encourage anyone who is relatively new to the LORP and unfamiliar with how the project was developed and decisions made, to read Volume I. At this stage of the project and after many years of implementation and monitoring, now is a good time for everyone to reacquaint ourselves with the goals and limitations before us as we go into the final monitoring years.

The analysis for each of the LORP components in Volume II is thorough and makes use of the data and analysis collected and performed over the years. The MOU Consultants concur with many of the conclusions and recommendations; however, there are some areas in which we recommend different actions as presented below.

LIVESTOCK GRAZING

A disappointing weakness in the County-City 2019 LORP Evaluation Report is the lack of information in the livestock management narrative and recommendation portions of their goal-recommendation status. The goals, objectives, and requirements listed in each lease grazing plan in the MOU, and especially in the 2004 FEIR are not listed. Nor is any information presented as to how and if these requirements have been met or in the process of being met. The Consultants outlined some of these goals and requirements in the 2018 Annual Report. The main recommendation infers that it's time to consider increasing the 40 % utilization level in riparian-streambank areas. This could very well be true, but to do this without first demonstrating how the goal, objective, and requirement mandates applied to grazing management have been addressed and met is putting the cart way out in front of the horse.

Based on about 15 years of observation and without any real riparian-streamside data, the MOU Consultants have consistently maintained that the grazing management portion of the LORP was one of the major accomplishments of the LORP at this time. The lessees have done a remarkable job of managing livestock within the LORP and based on field observations the results show it. Consultants strongly support the City's recommendation to begin increasing livestock management operational flexibility. Verbally, Consultants have offered a few suggestions to do this, but none have been accepted to date.

Consultants recommend the City-County take each goal, each objective, and each requirement mandated in the Lease Grazing Plan, the MOU, and especially those listed in the 2004 EIR and display how each goal or each requirement has been met or will be met.

ELECTROFISHING RECOMMENDATIONS

The County continues to annually recommend that the Lower Owens River fish population be sampled via electrofishing analysis. The only reason given is that it would determine fish species composition. At the very beginning of the LORP process, the MOU Consultants recommended that the Lower Owens River be monitored through electrofishing analysis. However, we now recognize that given the condition of the river, electrofishing cannot be performed effectively.

The enormous amount of money that would have to be spent on electrofishing would not give us much more knowledge than we now have. As the LORP phases into the future the major limiting factor in improving conditions in the LORP is going to be the lack of money. The evaluation does not realize what it would cost to statistically sample the fish population with required scientific validity in the Lower Owens River. The statistical power and confidence boundaries needed to provide scientifically defensible estimates has not even been considered. For MOU and Lower Owens River management purposes, we already have a sufficient understanding of the Lower Owens River species composition.

Because of the inherent large built-in and external controlling physical biases (that you cannot get rid of) in electrofishing sampling studies, along with the large sampling handicaps the Lower Owens River provides, it's doubtful that electrofishing results could come up with species composition estimate much better than we already have.

Up until 2017, we know that the City met its goal of providing a healthy recreational fishery in the Lower Owens River. To waste large amounts of money that could be used for more beneficial rehabilitation purposes makes no sense.

WATER QUALITY OBJECTIVES

The MOU Consultants disagree with the County-City recommendation to limit river flows to only those low levels that would cause no entrainment of organic material in and down the river channel. The purpose of the low river flow requirements would be to eliminate the production of hydrogen sulfides in the water column. The Consultants do not know of any data or any information that demonstrates that hydrogen sulfide content in the river water column has ever been a limiting factor influencing aquatic life in the Lower Owens River.

Consultants have constantly recommended, without any success, much higher river flow levels are needed to entrain large amounts of organic material out of the system. This entrainment flow period would only occur during seasonal periods when hydrogen sulfide production would not occur or be at a minimum and below the incipient lethal levels. For the channel and the river to be as dynamic and healthy as possible, the natural process of removing excess organic stored material should be allowed to go on. The river is already a dumping ground for organics. We should not place handicaps that will make it even more difficult to maintain a functional healthy river.

WATER REGIME CHANGE IN BWMA

The recommendation to revamp the way the Blackrock Waterfowl Management Area is managed with annual flow changes to periodicity is in line with adaptive management recommendations the MOU Consultants have made for many years.

As described…"*Having the ability to release up to 35 cfs during a 10 day period across units in the late spring and early summer will allow managers the flexibility to effectively implement moist-soil management on the BWMA units if an additional moisture input is required to reach seed production for key plant species. Flood a fixed 500 acres each year between September and May and discontinue basing flooded acreage on specific water year*" …makes sense and will result in improved habitat and a healthy wetland system.

However, we have consistently requested that LADWP analyze the water duty associated with such changes. The difference in water used or saved with the actions described above may conflict with the LADWP position of "water neutrality". If this analysis has already been performed to arrive at the recommendation, then that should be displayed to the MOU Parties. If, on the other hand, the water duty shows that this change in flood regime and a fixed 500 acre flooded will commit LADWP to a greater volume of water then under current practice, that needs to be known along with the acceptance of LADWP to the change.

PHYSICAL INTERVENTIONS

As noted in our adaptive management recommendations, it is time to accept the fact that river flows are not going to be modified, and even if a flow regime could be developed that passes muster with all the MOU Parties, it is likely too late to change the ecological trajectory of the river. Higher and lower seasonal flows will not be sufficient at this stage of tule development to have a beneficial impact. Riparian vegetation is not going to develop on landforms already occupied by tules, which will make the success of pole plantings unlikely.

The Scientific Team should give strong consideration to physical interventions such as check dams we describe and recommend. Development of deep pools within the channel will at least create and maintain stretches of open water, while recognizing that the overall ecological trajectory for the river is toward a marsh ecosystem, which at this stage cannot be reversed.

SCHEDULING

The recommendations given in Table XX describe actions to be taken but do not include any real time frame. It is a big step from listing recommendations and necessary actions to implementation of them. Without a detailed implementation schedule with assignments, funding and reporting responsibilities it all remains vague and indeterminate. The MOU Consultants recommend the Scientific Team convene and workout a schedule to cover at least the next three years of monitoring (monitoring is planned to end in 2022). The actions should also establish desired endpoints that can be measured over the next three years.

REFERENCES

Miller, K. A. et al. 2013 Environmental Flows Can Reduce the Encroachment of Terrestrial Vegetation into River Channels: A Systematic Literature Review. Environmental Management Pages 1-14.

Solberg K. and K. Higgins 1993 Effects of glyphosphate herbicide on cattails, invertebrates, and waterfowl in South Dakota wetlands. Wildlife Society Bulletin 21:299-307.

Solberg K. and K. Higgins 2006 Chemical treatment of monodominant cattail stands in semipermanent wetlands: duck, invertebrate, and vegetation response. Cattail Management Symposium. United States Geological Survey, Northern Prairie Wildlife Research Center, Jamestown North Dakota.

APPENDIX

APPENDICES 1

SOME PAST MOU CONSULTANTS PROPOSED ASSIGNMENTS FOR THE SCIENTIFIC TEAM

Consultants recommended the Scientific Team develop a series of improved seasonal habitat and flushing flow scenarios for testing and evaluation (2018 Annual Report).

Consultants recommended the Scientific Team develop an information package so the MOU Parties could better understand what is causing fish kills.

Consultants recommended that before any more willow pole plantings are attempted in the LORP that a detailed experimental plan be developed and vetted through the Scientific Team.

If river flow implementation and changes in land management do not create a proper functioning Lower Owens River, then feasible and sensible active management approaches should be considered. Before this happens, however, the Consultants recommend the Scientific Team identify, justify, and detail the possible reasonable active approaches the MOU Parties should consider.

Consultants recommended the Scientific Team conduct an initial evaluation to determine a series of feasible active interventions that could be tested for successes (2017 Annual Report).

Consultants recommended the Scientific Team design improved flushing flow scenarios for further testing and submit a summary report to the City and County for their review and evaluation.

Consultants recommended the Scientific Team develop a scientific based testing, monitoring, and evaluation plan to evaluate all future flushing flow effects.

Consultants recommended the Scientific Team be given the responsibility to properly collect all needed information to evaluate all future fish kills. It is recommended the team evaluate all future fish kills.

Consultants recommended the Scientific Team review all collected all GSI data, summarize this data, map outputs, and report on seasonal habitat flows and flooded extent (2010 and 2011 Annual Reports).

The Scientific Team should review the actual GSI files and data bases prior to the drafting of the modeling report. In addition, the team should review all summarized data, map outputs, and report findings (2010 Annual Report).

Timing of the release of the seasonal habitat flow is important and should be decided by the Scientific Team as described in the LORP 2008 MAMP (2009 Annual Report).

The Scientific Team should consider tree seed development, seed drop, weather conditions, time of year, and other ecological and climatic conditions, and then determine the optimum time for seasonal habitat flow releases (2009 Annual Report).

Consultants recommended the County evaluate the efficacy and validity of the 2008 MAMP recreational fishing census methods. Then develop improved methods as needed. The County should then submit their evaluations to the Scientific Team for conclusion (2015 Annual Report).

Consultants recommended during the winter of 2015-2016 that the MOU Parties develop a document determining the present status of meeting MOU goals and requirements. The Scientific Team would then use this document to assist in their responsibilities of providing the science to ensure goals and requirements are met and sustained prior to the ending of the LORP.

The Scientific Team should evaluate each MOU goal and requirement and submit management solutions to the Technical Group for action (2015 Annual Report).

The Scientific Team should make goal and requirement attainment analysist a high priority in 2016.

The Consultants flow augmentation recommendations, appearing in past Adaptive Management Reports since 2010 are still supported. These augmentation flows should be considered for evaluation and implementation by the Scientific Team in 2016.

Consultants recommended that the County, through the Scientific Team solve the recreational fishery methodology arguments prior to the 2016 LORP monitoring period.

Consultants recommended that the City-County MAMP Plan “draft” be sent to the Scientific Team, during the winter of 2015-2016 for their review, revisions, and finalization.

Consultants recommended the Scientific Team, during the 2017-2018 winter, develop a “Draft River Rehabilitation Report” and submit to the MOU Parties for their consideration.

The MOU Consultants recommended the MOU Parties conduct a two-day “Goal Analysis and Solution” workshop. The workshop purpose would be to develop guidance for the Scientific Team to assist in their responsibilities of providing the science to ensure goals and requirements are met and sustained prior to the ending of the LORP.

Consultants recommended that the Scientific Team develop a new draft management plan to ensure MOU goals and requirements are met.

Consultants recommended that a down-river flow augmentation plan be developed by the Scientific Team and submitted to the MOU Parties for consideration.

Consultants recommended the Scientific Team conduct an initial evaluation of some feasible active rehabilitation interventions that could be tested for success or failure.

Consultants recommended in their 2014 adaptive management recommendations that final flow patterns be reviewed and evaluated by the Scientific Team and submitted for action in time to be implemented in 2015.

Consultants recommended the Scientific Team develop a flow augmentation management plan for the Lower Owens River (2012 Adaptive Management Recommendations). This plan should be able to adjust to whatever flow patterns the MOU Parties finally decide to implement in the Lower Owens River (2014 Annual Report).

Consultants recommended the City and the County prepare a specific set of goals pertaining to each reach and the entire LORP area. This report would be presented to the Scientific Team for evaluation and acceptance. In consultation with the Scientific Team, the appropriate list of recommendation actions to address each goal should be determined.

Consultants recommended that during the winter of 2014-2015, the County prepare a "draft" of a document – "A Comprehensive LORP Scientific Research, Data, and Evaluation Needs" and submit this document to the Scientific Team for review, comment, corrections, changes, additions, and updates. The Scientific Team would then meet and make necessary changes and additions that would allow their approval. The Scientific Team would then submit their final product to the County and City for action.

Consultants recommended the City proposed combined flow pattern (Figure 2 – 2014 Annual Report) be reviewed and evaluated by the Scientific Team and submit their recommended findings for action in time that it could be implemented in 2015.

Consultants recommended the Scientific Team develop a monitoring program to evaluate effectiveness of the proposed DHA flow release at the Intake Station to buffer river limiting factors. The Scientific Team would then send this monitoring and evaluation package to the Technical Group for review and action (2014 Annual Report).

Consultants recommended the Scientific Team thoroughly analyze the benefits of the OVC recommendation to allow tributary streams to flow directly into the Lower Owens River instead of the City's aqueduct and present their findings to the MOU Parties.

Consultants recommended the Scientific Team, during the winter of 2017-2018, develop a "River Rehabilitation Status Report".

Consultants recommended the Scientific Team develop a scientific based testing, monitoring, and evaluation plan to evaluate all future flushing flow effects. This methodology should be capable of determining success, failure. No effect, or any needed flow modifications.

Consultants recommended the Scientific Team draft a series of feasible flushing and augmentation flow scenarios along with a predicted effect analysis. This report would then be submitted to the City and

the County for review and then forwarded to the MOU Parties to use in the coming "Working-Decision Meeting".

Consultants recommended the Scientific Team test, monitor, and evaluate the Consultants recommended 2018 flushing flows to determine their success, failure, non-effect, or any flow modifications needed.

Consultants recommended the Scientific Team submit their "draft" report on their flushing flow analysis to the City and the County for their review.

Consultants again recommended the Scientific Team be given the responsibility to evaluate all future fish kills in a professional manner. This would be accomplished via reliable data collection, documentation, analysis, and report submission.

Consultants recommended the Scientific Team prepare for a second "River Summit" by spending considerable time reviewing and discussing all elements of the LORP to agree upon priority goals for going forward.

Consultants recommended 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 recommended the City and the County explore and evaluate feasible and reasonable active intervention methods to manage tules, cattails, and trees in a manner that will enhance LORP resources. The Scientific Team should do most of the preliminary work.

APPENDDICES 2

SOME PAST COUNTY ASSIGNMENTS FOR THE SCIENTIFIC TEAM

The County instructed the Scientific Team to evaluate LORP project progress and likely trajectory. The team will then identify opportunities and limitations for the project and present their findings, along with recommendations, to the MOU Parties in the fall of 2019.

The County requested the Scientific Team consult with CDFW to evaluate and develop a revised plan for the BWMA. This plan would then be sent to the MOU Parties for consideration. Their final report will be included in the 2019 Annual Report.

The County requested that a proposal be developed by the Scientific Team on how to test flow regimes. This report is to be released in 2014.

The County recommended a cool water flushing flow be implemented as an experiment to determine if water quality could be improved. The Scientific Team would then discuss and design an appropriate monitoring method to determine if a late winter-early spring pulse flow mobilizes organic material in the river channel and what effect that might have on water quality (2013 Annual Report).

The County is seeking outside funding to have another Consultant come in to study, design, plan, permit, and implement the construction of a channel through the Island area. If funding is found the Scientific Team will direct the project and design a monitoring program.

The County suggested that augmentation strategies that could boost flow in the lower reaches of the river be fully considered by the Scientific Team. These strategies would have sufficient safeguards by implementing the flows during periods of cool water temperatures only (Inyo County 2015).

Scientists, observing trends in the Delta, have recommended changes in water delivery to the Delta Habitat Area that they believe will provide habitat benefits and avoid undesirable conditions. The County would then have the Scientific Team discuss the suggestions (Inyo County 2015).

The Scientific Team will evaluate a range of management options for the DHA and prepare findings for the 2019 Annual Report.

The County recommended "A River Flow Augmentation Plan" that would Improve management effectiveness be developed and modeled by the Scientific Team (2014 Annual Report).

The County recommended the Scientific Team develop a plan for the Delta Habitat Area pulse flow from the Intake Control Structure that can be used to experimentally answer certain questions about water quality. This report would then be sent in a "final draft" to the Technical Group for processing (2014 Annual Report).

The County acknowledged the City is developing a management plan for the BWMA. This pan will then be vetted by the Scientific Team.

The County recommended convening a Scientific Team meeting to reconsider the habitat indicator species list.

The County suggested that the proposed "LORP Scientific Research, Data, and Evaluation" document, if ever produced, should be a Scientific Team document.

The County concurred that the Scientific Team review and revise a draft "LORP Scientific Research, Data, and Evaluation" document and send a final re-worked draft to the Technical Group for action.

The County stated that 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 Consultants.

In 2008, at the very beginning of complete Lower Owens River flow releases, Consultant 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 successful flow alternatives. Consultants recommended the Scientific Team do this analysis and submit their findings to the MOU Parties.

APPENDICES 3

SOME PAST CITY ASSIGNMENTS FOR THE SCIENTIFIC TEAM

The City advised that the Scientific Team will evaluate project progress and likely trajectory. The team will then identify opportunities and limitations for the project and present their findings, along with their recommendations, to the MOU Parties in the fall of 2019 (2018 Annual Report).

If 2019 runoff projections are substantially above normal, the City will have the Scientific Team meet and discuss the possibility of experimenting with an early spring pulse flow.

The City designated the Scientific Team to consult with CDFW to evaluate and possibly develop a revised plan for the BWMA. This plan would then be considered by the MOU Parties. This report will be included in the 2019 Annual Report.

The Scientific Team will evaluate a range of management options for the DHA and prepare findings for the 2019 Annual Report.

The City believes given the limited budget for the LORP, investigating soil moisture influences on rare plants should be considered a new and separate study and subject to review by the Scientific Team before implementation.

APPENDICES 4

OTHER PAST ASSIGNMENTS FOR THE SCIENTIFIC TEAM

Over-all, management decisions on when and where to implement mechanical channel material removal will rest with the Scientific Team (2008 MAMP).