2012
Lower Owens River Project
Annual Report

January 31, 2013

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EXECUTIVE SUMMARY

The 2012 Lower Owens River Project Annual Report contains the results of the fifth year monitoring of the Lower Owens River Project (LORP). Monitoring included hydrologic monitoring, seasonal habitat flow including flood extent, rapid assessment survey, land (range) management, saltcedar and weed control.

The hydrologic monitoring section describes flow conditions in the LORP regarding attainment with Stipulation & Order flow and reporting requirements and LORP *1991 Environmental Impact Report* (EIR) goals. For the 2011-12 water year, which covers October 2011 to September 2012, LADWP was fully compliant with all Stipulation & Order flow and reporting requirements. Off-River Lakes and Ponds level goals were fully met and the flows to the Delta achieved the required 6-9 cfs annual flow. The agreement to manage wetted acreage in the BWMA by setting constant flows by seasons, continued with generally good results. The section also describes flow measurement issues and finishes with a commentary on flow losses and gains through the different reaches of the Lower Owens River.

The 2012 seasonal habitat flow was timed to occur with seed release of woody riparian vegetation; which is an objective of the flow release pertinent to the 1997 MOU. The time for the peak 88 cfs flow to move down the Lower Owens River was 13 days 4 hours from the LORP Intake to the Pumpback Station. Flooding was estimated to cover approximately 1,836 acres within the Lower Owens River. Given the low peak release only marginal inundation was observed during the peak flow in the LORP monitoring plots.

The Rapid Assessment Survey (RAS) was conducted in August 2012 and required approximately 60 people days to complete. Overall, the 2012 RAS results were consistent with past efforts. There were no significant new or pressing management concerns identified this year.

The 2012 LORP land management monitoring efforts continued with monitoring utilization across all leases, rare plant monitoring, and streamside monitoring for woody recruitment, irrigated pasture condition scoring was conducted on leases that rated below the standard of 80% the previous year.

In general, pasture utilization adhered to standards established for both riparian (up to 40%) and upland (up to 65%) areas. Use on the Blackrock Lease was lower than most other leases in the project area remaining well below all grazing standards. All other leases adhered to utilization standards except the Islands and Twin Lakes leases. The Islands Lease had over utilization in the River Field (50%) and Depot Riparian (64%). Twin Lakes had over utilization in the Upper Blackrock Field (61%) and Lower Blackrock Field (54%). Use in the Thibaut Field in the Thibaut Lease was below the allowable standard due in part to the utilization standards being removed for the Waterfowl Management Area prior to burning. This allowed much of the grazing pressure to be removed from the rest of the lease. Watershed Resources staff are concerned with the continued dry weather conditions expected for the 2012-13 grazing season. Utilization rates will not be adjusted for dry conditions in upland or riparian pastures.

Irrigated pastures in the Islands, Lone Pine and Delta Leases all had rated above the minimum rating of 80% in 2010; therefore, they did not need to be rated in 2012. The Thibaut Lease rated 82% in 2011 and 81% in 2012 meeting the minimum score of 80%. The lessee and LADWP are in the process of improving this score. All irrigated pastures in the LORP will be evaluated again in 2013.

2012 was the fourth year of collecting trend plot data for *Sidalcea covillei* and *Calochortus. excavatus* for the LORP. While no statistical analysis has been conducted on this data, it indicates thus far that populations of both *S. covillei* and *C. excavatus* are generally static. However, *S. covillei* appears to be decreasing in the exclosure in the Robinson Pasture in the Blackrock Lease, as documented in the Robinson 1EX plot. In contrast, plots surveyed in the Springer Pasture in the Blackrock Lease where no plants are excluded are markedly increasing. Future data will be useful to further define trends of *S. covillei* and *C. excavatus* within the LORP area.

The Streamside Monitoring Protocol underwent modifications this year with an expansion of quadrat size, quantitative definitions for varying levels of browsing, and the selection of additional sites where tree willow recruitment is actively occurring. These changes provided useful insights into understanding browsing levels in the spring compared to summer use of willows, provided evidence that there is a correlation between increased livestock grazing precipitating a shift to increased tree willow browsing, and increased the sampling population of juvenile tree willows, allowing for more accurate trend estimates.

LORP area weed management efforts 2012 mirrored 2011 levels essentially. All known *Lepidium latifolium* sites within the LORP area were treated or surveyed in 2012; most were treated three times, with four sites treated only twice because early spring flooding precluded herbicide application. Invasive plant populations totaled 0.28 net acres, down 30% over 2011. Individual sites totaled 38 in 2012, up 3 new sites discovered by multi-agency Rapid Assessment Surveys (RAS). Of the 38 known sites, 50%, or 19 sites had no plants present in 2012. After five continuous years of no growth, sites may be considered eradicated.

In 2011-2012, saltcedar crews worked in 1600 acre-foot project boundaries and in the water-spreading basins that border the west side of the Lower Owens River and in the LORP riverine-riparian area along the river.

1.0 LOWER OWENS RIVER PROJECT 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 pump station to capture a portion of the water released to the river.

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

1.1 Monitoring and Reporting Responsibility

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

Specific reporting procedures are also described under each monitoring method. The MOU requires that the County and LADWP provide annual reports describing the environmental conditions of the LORP. LADWP and the County are to prepare an annual report and include the summarized monitoring data collected, the results of analysis, and recommendations regarding the need to modify project actions as recommended by the MOU consultants, ES. This LORP Annual Report describes monitoring data, analysis, and recommendations for the LORP based on data collected during the 2012 field season (March-October). The development of the LORP Annual Report is a collaborative effort between the ICWD, LADWP, and the MOU consultants. Personnel from these entities participated in different sections of the report writing, data collection, and analysis.

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

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

Generally, LADWP is the lead author for a majority of the document and is responsible for overall layout, and content management. Specifically, LADWP wrote: Sections 1.0 Introduction; 2.0 Hydrologic Monitoring; 3.0 Seasonal Habitat Flow; 4.0 Land Management; and Section 10.0 Public Comments.

Section 7.0, Weed Control was authored by the Inyo/Mono Counties Agricultural Commission. ICWD completed the 5.0 Rapid Assessment Survey and Section 8.0 Saltcedar Reports.

Section 9.0 Flow Modeling is provided by Northwest Hydraulic Consultants.

The annual report will be available to download from the LADWP website link: http://www.ladwp.com/ladwp/cms/ladwp014936.jsp.

This document represents the reporting requirements for the LORP Annual Report for 2012.

1.2 2012 Monitoring

2012 was the fifth year of monitoring for the LORP. The monitoring that was conducted included:

- Seasonal Habitat Flow Flooded Extent and Water Quality (May 2012)
- Rapid Assessment Survey (August 2012)
- Hydrologic Monitoring (throughout 2012)
- Land Management (throughout 2012)
- Streamside Monitoring for Woody Species Regeneration and other Riparian (September 2012)
- Weed Monitoring and Treatment (growing Season 2012)

2.0 HYDROLOGIC MONITORING

2.1 River Flows

On July 12, 2007, a Court Stipulation & Order was issued requiring LADWP to meet specific flow requirements for the LORP. From the issue date through September 2012, LADWP has been in compliance with the flow requirements outlined in the Stipulation & Order. The flow requirements are listed below:

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

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

The flow data graphs show that LADWP was in compliance with the Stipulation & Order, from October 2011 through September 2012, for the 4 in-river stations (see Hydrological Appendix 2).

2.1.1 Web Posting Requirements

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

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

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

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

2.1.2 Measurement Issues

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

The accuracy of the Sontek meters are affected by factors which change the levels or velocities in the river. One of those factors is seasonal changes, such as spring/summer vegetation growth, which cause water levels to increase and velocities to decrease. Another factor is sediment build-up. As a band of sediment builds up on or near the measuring station section, the water levels of the section can increase or velocities can be shifted-both of which affect the accuracy of the Sontek meters. In order to account for these environmental changes, LADWP manually meters flows at all of the stations along the LORP to check the accuracy of the meters. Each time current metering is performed, a 'shift' is applied to the station to take into account the difference in flow determined by the current metering. If a fundamental change in the flow curve is observed then a new index is created from the current metering data and downloaded to the meter. All of the meters on the LORP are calibrated at a minimum of once per month, per the 1997 Stipulation & Order, to maintain the accuracy of the meters.

A commentary on each station along the LORP follows:

Below LORP Intake

Measurement Devices: Langemann Gate & WaterLOG H-350XL Bubbler System

The Langemann Gate regulates and records the flow values at the Intake. This has had very good accuracy and reliability as long as the gate does not become submerged (submergence may be possible at higher flows such as when the seasonal habitat flows are released). In case of submergence, the WaterLOG H-350XL was installed as a back up to the Langemann Gate measurement. The WaterLOG H-350XL is a bubbler system that uses pressurized air to measure stage, which is applied to a rating curve. It was hoped the bubbler system would possibly allow for an accurate measurement of stage even in silt/sediment conditions. However, any system of water measurement using stage must be calibrated through the full range of flows and in similar seasonal conditions in order for measurements to be accurate. Also, due to the flat slope of the river channel in the LORP, velocities in the river are extremely low causing large fluctuations in stage as conditions in the river channel go through the normal seasonal cycles of vegetation activity and dormancy in the summer and winter, respectively.

Similar to the 2011 seasonal habitat flow, in the 2012 seasonal habitat flow the Langemann Gate was used for measurement through the entire schedule of flow releases. Unlike 2010, the LORP Intake downstream level did not rise to a level where submergence of the Langemann Gate occurred. The lower stage height was likely due to the lower flow release for the 2012 seasonal habitat flow.

To date, calibrating the bubbler for seasonal habitat flows has proven difficult and will likely never give accurate results. More data points can be collected to allow for a better flow curve to be established, but with the flat slope of the upper reaches of the river causing low velocities, using stage height only to measure flow accurately at the LORP Intake may not be possible.

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.

<u>LORP at Reinhackle Springs</u>

Measurement Device: Sontek SW Meter

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

<u>LORP at Pumpback Station</u>

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

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

2.2 Flows to the Delta

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

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

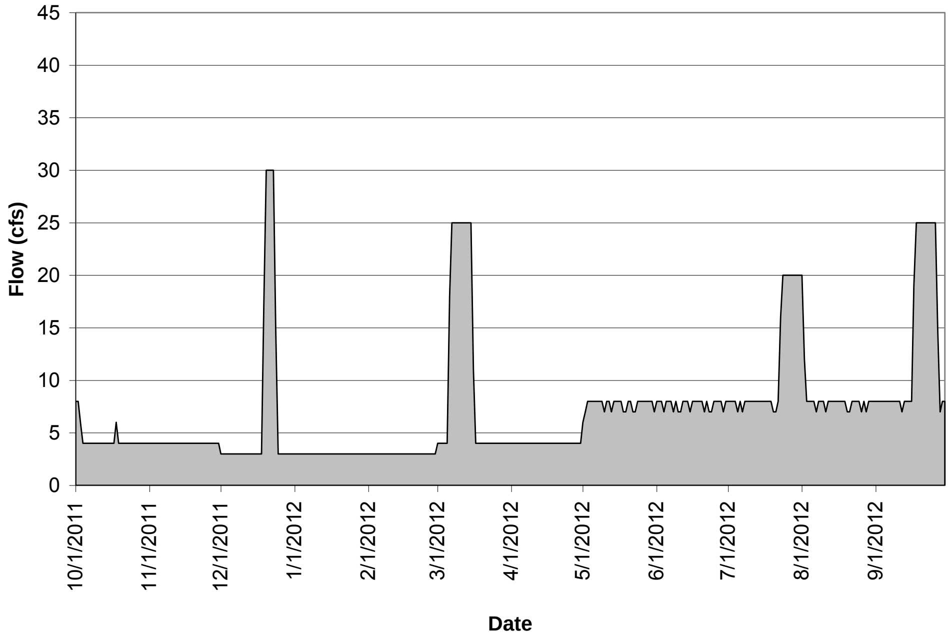
Additionally, pulse flows were scheduled to be released to the Delta (LORP EIR, section 2.4):

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

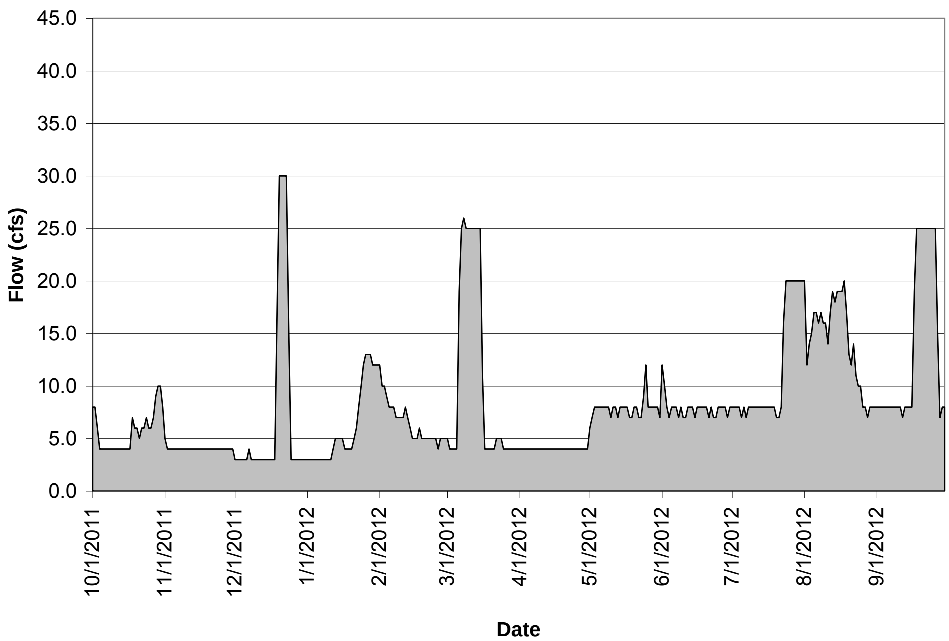
The scheduled base and pulse flows for the 2011-12 water year targeted an average of 7 cfs to the Delta. Due to unintended flows, the release to Delta was much higher than the planned 7 cfs even after excluding Delta releases during the seasonal habitat flow. Unintended flows are released to the Delta when intense rainstorms cause river flows to exceed the limited maximum capacity of the Pumpback Station or when pump outages occur at the Pumpback Station. Flows over the weir are generally unintended flows and flows over the Langemann Gate are scheduled flows (see figures below).

All of the scheduled flows to the Delta were released as planned except for the June-July Delta pulse flow, which ran 2 days into August.

The final October 2011 to September 2012 average flow to Delta was 8.3 cfs. The flow schedule for the October 2011 to September 2012 period will remain the same as the previous years' schedule unless adaptive management measures are proposed and implemented.



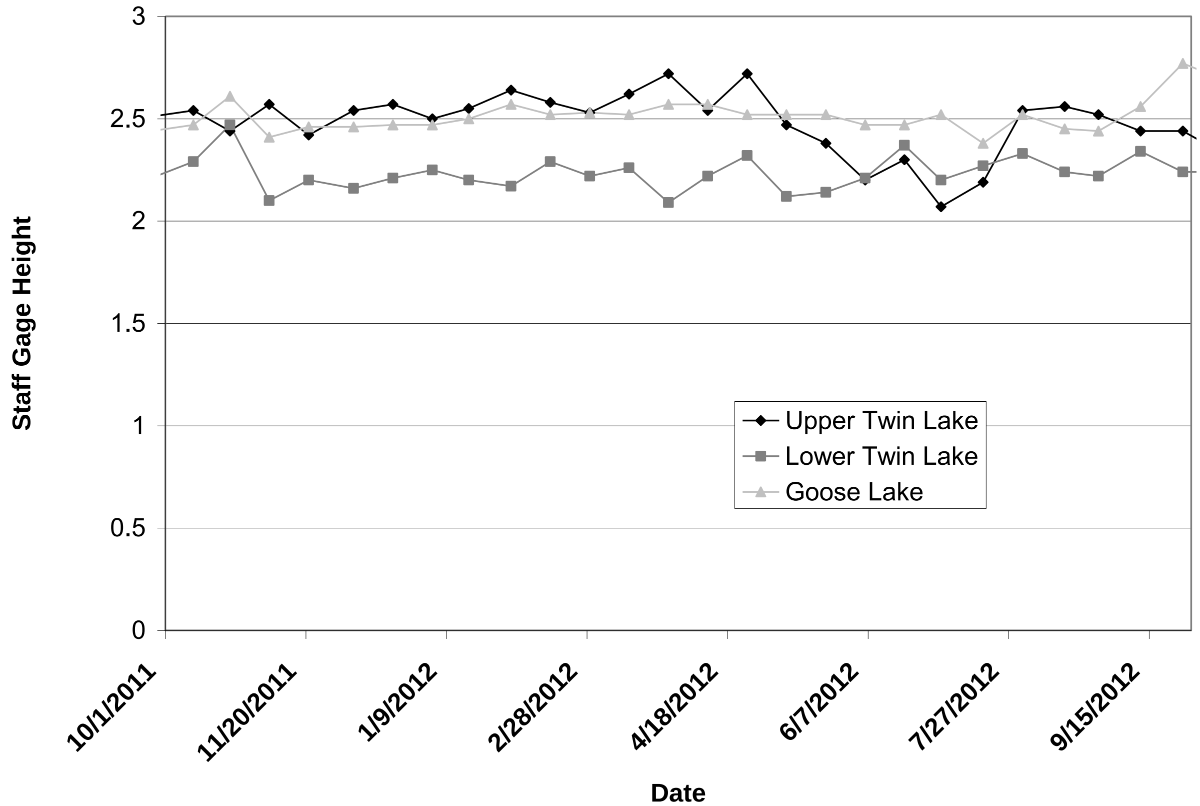
Hydrologic Monitoring Figure 1. Langemann Release to Delta



Hydrologic Monitoring Figure 2. Langemann and Weir Release to Delta

2.3 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 existing staff gauges, and that Billy Lake be maintained full (i.e., at an elevation that maintains flow from the lake). At no time during the period of October 2011 to September 2012, did any of the gages indicate below a 1.5 foot stage height.



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

<u>Billy Lake</u>

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

Hydrologic Monitoring Table 1. LORP Flows – Water Year 2011-12

Station Name	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
Below River Intake	57.8	101.0	43.0
Blackrock Return Ditch	1.4	4.0	1.0
Goose Lake Return	1.3	2.0	0.9
Billy Lake Return	1.3	1.8	0.8
Mazourka Canyon Road	60.0	92.0	45.0
Locust Ditch Return	0.7	8.3	0.0
Georges Ditch Return	1.0	9.6	0.0
Reinhackle Springs	60.4	86.0	48.0
Alabama Gates Return	1.3	20.0	0.0
At Pumpback Station	49.5	67.0	30.0
Pump Station	41.2	48.0	16.0
Langemann Gate to Delta	7.1	30.0	3.0
Weir to Delta	1.2	12.0	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 found at <http://www.ladwp.com/ladwp/cms/ladwp009121.jsp>.

An adaptive management recommendation was implemented on April 1, 2011, and flow to Thibaut Pond was turned off to dry out the pond. No further water has been released through the end of September 2012.

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

Wetted acreage measurements are collected eight times per year, once in the middle of each season and once at the end of each season. These measurements are done by using GPS and walking the perimeter of the wetted edges of the waterfowl area. The measurement in the middle of the season counts as the average for the entire season with the data collection points at the end of each season being used as reference points (see table below).

Hydrologic Monitoring Table 2. BWMA Wetted Acreage

Winterton Unit

ET Season	Read Date	Wetted Acreage	Inflow
Spring	5/10/2011 5/31/2011	84* 142	4.6
Summer	7/6/2011 8/16/2011	137* 178	5.3
Fall	9/14/2011 10/18/2011	189* 267	5.5
Winter	1/18/2012 4/17/2012	244* 170	1.9
Spring	5/9/2012	93	0
Summer			0
Fall			0

Thibaut Unit

ET Season	Read Date	Wetted Acreage	Inflow

Thibaut Unit was out of service.

Drew Unit

ET Season	Read Date	Wetted Acreage	Inflow
Spring	5/10/2011 5/31/2011	288* 292	6.6
Summer	7/6/2011 8/16/2011	280* 280	6.2
Fall	9/14/2011 10/18/2011	276* 306	5.2
Winter	1/17/2012 4/17/2012	295* 275	1.7
Spring	5/5/2012 5/31/2012	306** 330	7.1
Summer	7/12/2012 N/A	318** N/A	7.1
Fall	9/18/2012	334**	5.6

Waggoner Unit

ET Season	Read Date	Wetted Acreage	Net Inflow
Spring	5/12/2011	74	0

Waggoner Unit was out of service after 5/12/2011.

** These measurements count towards the 2011-2012 runoff year acreage goal.*
*** These measurements count towards the 2012-2013 runoff year acreage goal.*

2.4.1 Blackrock Waterfowl Management Area Results for April 2011 to March 2012

The runoff forecast for runoff year 2011-12 was well over 100%, resulting in a waterfowl acreage goal for the year of 500 acres. Thibaut Pond was shut off on April 1, 2011, followed by Waggoner Waterfowl Area on April 16, to burn the excessive vegetation growth. The Winterton Waterfowl Area was turned on to replace the waterfowl acreage lost by shutting off Waggoner.

On April 1, 2011, the Winterton Waterfowl Area inflow was turned on to 4.6 cfs in order to “pre-wet” the area for use beginning on April 16. The wetted perimeter was measured with a GPS mid-spring, the area was 288 acres for Drew and 84 acres for Winterton, resulting in a spring total wetted area of 372 acres.

On June 1, the inflow to Winterton was increased to 5.3 cfs and the inflow to Drew was decreased to 6.2 cfs. The wetted perimeter was measured with a GPS during the mid-summer season (mid-August) the wetted area was 280 acres for Drew and 137 acres for Winterton, resulting in a summer total wetted area of 417 acres.

On August 16, the fall flows were set and so the inflows to Winterton were increased to 5.5 cfs and the inflows to Drew were decreased to 5.2 cfs. When the wetted perimeter was measured with a GPS mid-fall season, the wetted area was 276 acres for Drew and 189 acres for Winterton, resulting in a fall total wetted area of 465 acres.

On October 20, the winter flows were set and the inflows to Winterton were decreased to 1.9 cfs and the inflows to Drew were decreased to 1.7 cfs. When the wetted perimeter was measured with a GPS mid-winter season, the wetted area was 295 acres for Drew and 244 acres for Winterton, resulting in a winter total wetted area of 539 acres.

The average waterfowl wetted acreage for the 2011-12 was 480 acres, which was just under the goal of 500 acres.

2.4.2 Blackrock Waterfowl Management Area Results for April 2012 to September 2012

The runoff forecast for runoff year 2012-13 is 65%, so the BWMA acreage goal for this year is 325 acres.

On April 17, the spring flows were set and so the inflows to Winterton were shut off and the inflows to Drew were increased to 7.1 cfs. The wetted perimeter was measured with GPS mid-spring season; the wetted area was 306 acres for Drew.

The flows to the Drew area for the summer season were not changed from the spring time flows because calculations based on the previous year’s average coming up nearly the same (0.2 cfs lower) as the April 16 set flow. The wetted perimeter was measured with a GPS mid-spring season; the wetted area was 318 acres for Drew.

On August 16, the fall season flows were set to 5.6 cfs. Following this, on September 18, GPS measurements were completed, resulting in a wetted area of 334 acres.

The average wetted acreage for the 2012-13 Runoff Year is 320 acres through the end of the fall season.

2.5 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 2011 to September 2012. 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.

2.5.1 River Flow Loss or Gain by Month and Year

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

Hydrologic Monitoring Table 3. Average Monthly River Flow Losses/Gains From the Intake to the Pumpback Station during 2011 and 2012.

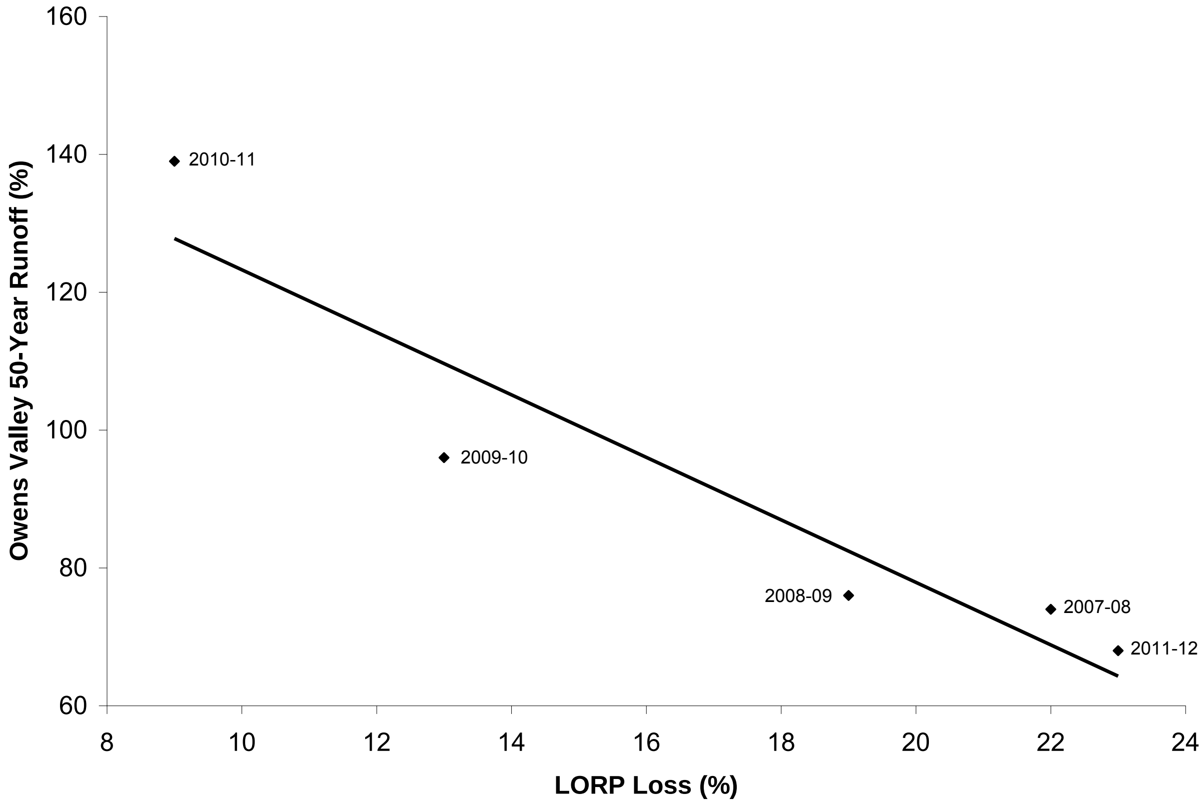
	Month	Flow (cfs)	Acre-Feet-Per-Day
2011	OCT	-7	-14
	NOV	-2	-4
	DEC	-2	-3
2012	JAN	+5	+10
	FEB	+3	+6
	MAR	+1	+3
	APR	-11	-23
	MAY	-25*	-50*
	JUN	-55*	-109*
	JUL	-54	-107
	AUG	-18	-35
	SEP	-16	-32
	AVG MONTH	**-15 cfs**	**-30 AF**

** Data influenced by the 2012 seasonal habitat flow*

The summer flow losses for May and June 2012 were influenced by the Seasonal Habitat Flow and may not be typical for predicting future losses.

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 41,931 acre-feet, inflows from augmentation spillgates were 4,970 acre-feet, and outflows from the Pumpback Station were 35,965 acre-feet. This yields a loss of 10,936 acre-feet for the year, a daily average of approximately 15.1 cfs between the Intake and the Pumpback Station. Water loss during the 2011-12 water year (October 2011 to September 2012) represents about 23% of the total released flow from the Intake and augmentation spillgates into the river channel.

For the year, the river lost an average of 15.1 cfs (23%) compared to an average loss of 5.5 cfs (9%) the previous year. This is the first time that the rivers loss has increased on a year to year basis since the LORP was implemented. It is also the first time that the runoff has decreased in the Owens Valley since the LORP started. A correlation between runoff and river loss resulted in a near linear correlation, showing that losses are closely related to how dry or wet the year is (see figure below).



Hydrologic Monitoring Figure 4. Runoff vs. LORP Losses

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

From December 2011 to March 2012, an average flow of 45 cfs was released into the Lower Owens River from the Intake. An additional 4 cfs was provided from augmentation ditches, for a total accumulated release of 50 cfs. The average flow that reached the Pumpback Station was 52 cfs, an increase of 2 cfs during this period. During the winter, ET is low and any "make water" coming into the river is additive. Part of the "make water" was probably stored during earlier periods in subsurface aquifers and may also be a result of higher winter season precipitation.

The river reach from the Intake to the Mazourka Canyon Road gaging station gained 2 cfs, while the reach from Mazourka Canyon Road to the Reinhackle gaging station gained 3 cfs and Reinhackle to the Pumpback Station lost 3 cfs (see table below). A water "gaining" reach, during harsh winter conditions, can benefit an ecosystem in many ways. Incoming water, especially if it is subsurface, tends to increase winter river water temperatures, reduces icing effects, increases dissolved oxygen, when water surface ice is melted by increasing the re-aeration rate, and adds nutrients.

Hydrologic Monitoring Table 4. Winter Flow Losses/Gains, December 2011 to March 2012

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake*	45	N/A	N/A
Mazourka	52	+2	+2
Reinhackle	55	+3	+5
Pumpback	52	-3	+2

Note: All numbers are rounded to the nearest whole value

* The following augmentation stations are added
  2 cfs added at the Blackrock Return Ditch
  1 cfs added at the Goose Lake Return
  1 cfs added at the Billy Lake Return

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

During the summer period of June 2012 to September 2012, all river reaches lost water. The effects of ET are evident from the high total flow loss (-36 cfs) between the Intake to the Pumpback Station. Summer flow losses were 38 cfs higher than conditions during the winter season. The largest flow losses occurred at the Reinhackle to Pumpback Station reach (-21 cfs) (see table below).

Hydrologic Monitoring Table 5. Summer Flow Losses/Gains, June 2011 to September 2011

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake*	78	N/A	N/A
Mazourka**	74	-7	-7
Reinhackle***	69	-7	-14
Pumpback	50	-21	-36

Note: All numbers are rounded to the nearest whole value

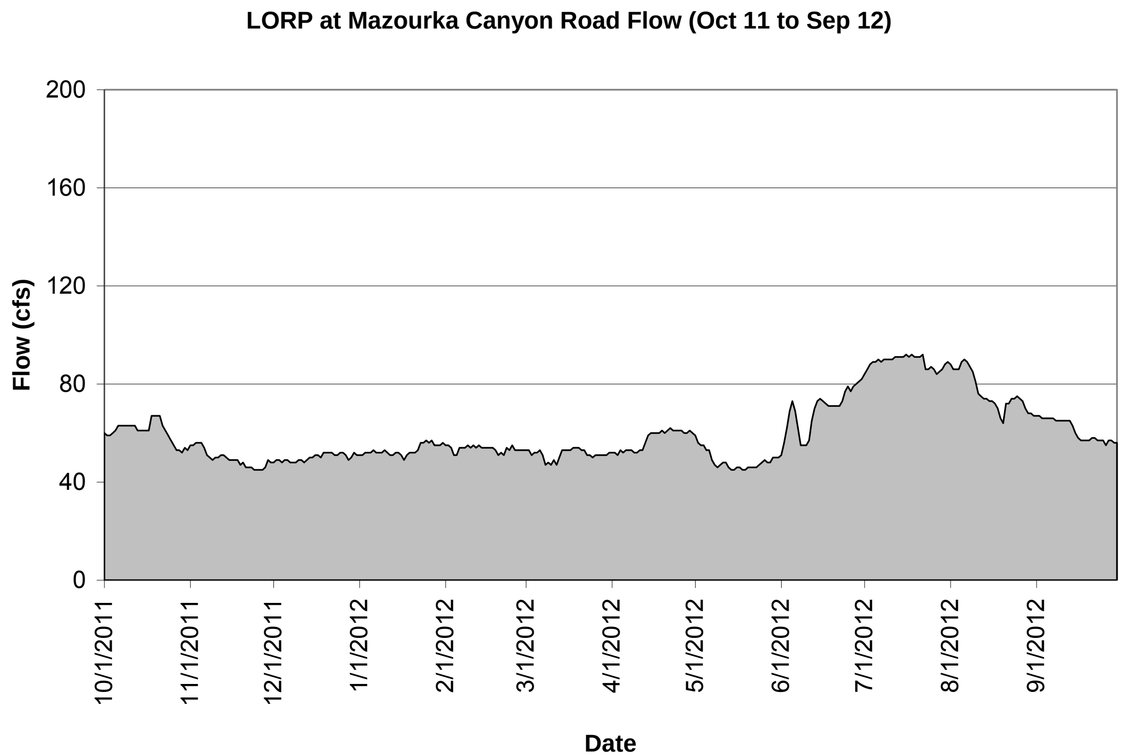
* The following augmentation stations are added
  1 cfs added at the Blackrock Return Ditch
  1 cfs added at the Goose Lake Return
  1 cfs added at the Billy Lake Return

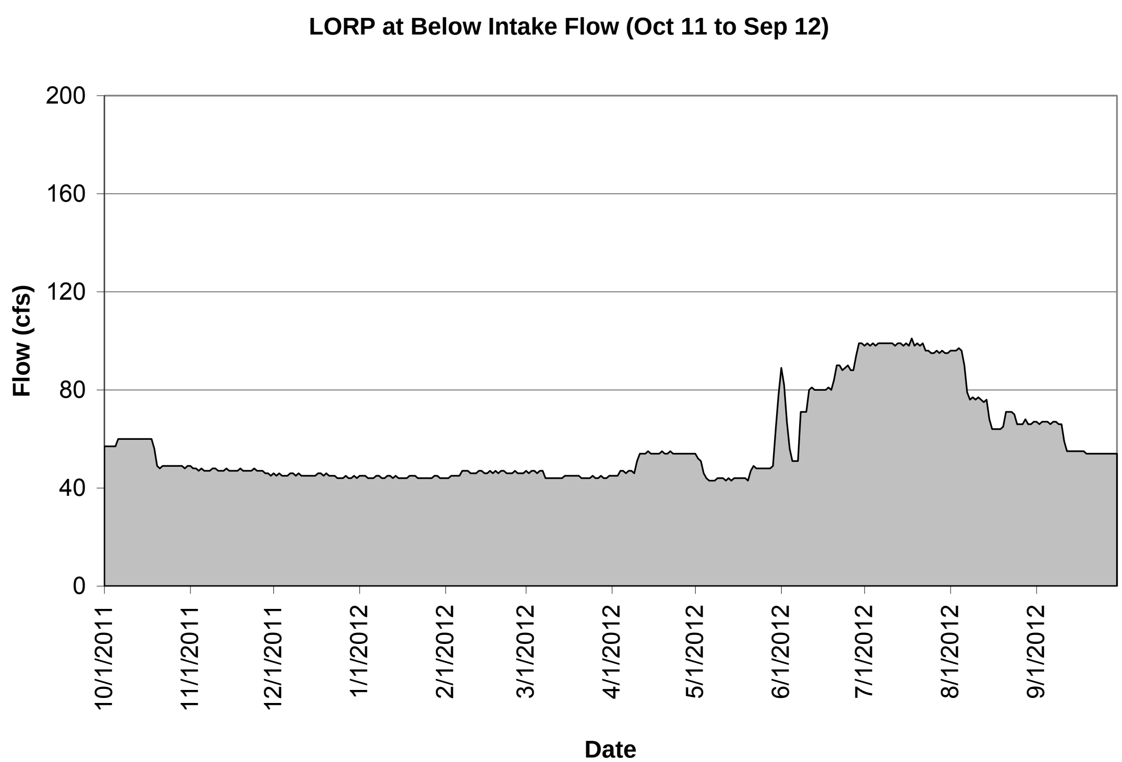
** The following augmentation station is added
  1 cfs added at the Locust Ditch Return
  1 cfs added at the Georges Ditch Return

*** The following augmentation station is added
  3 cfs added at the Alabama Gates Return

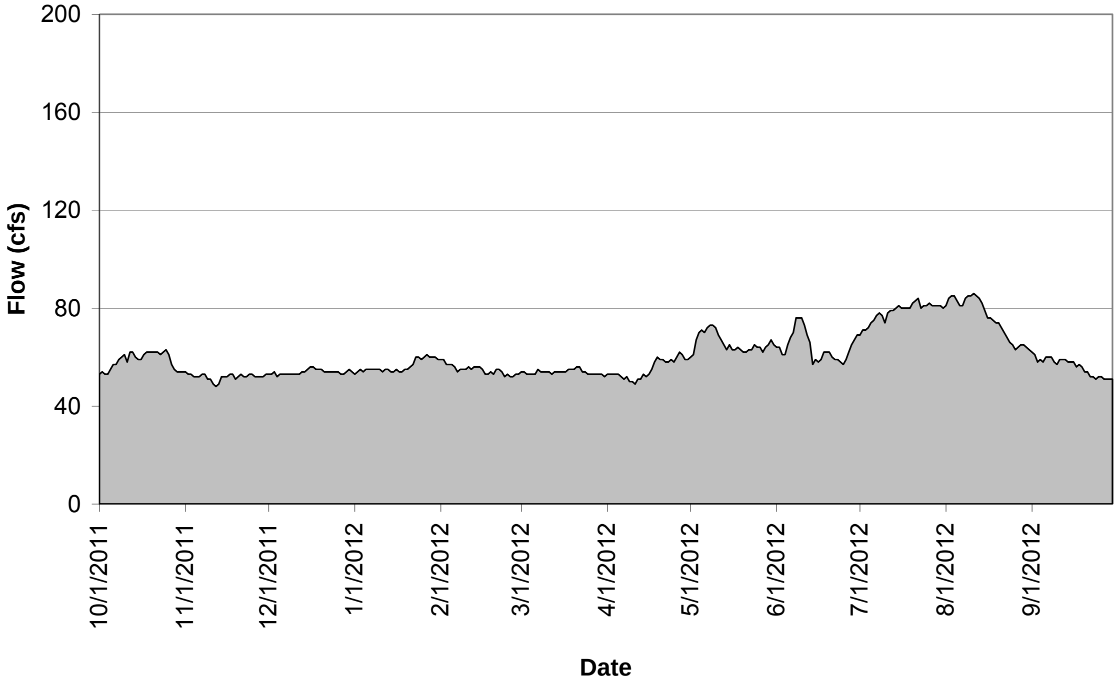
2.6 Appendix

Appendix 1. Hydrologic Monitoring Graphs

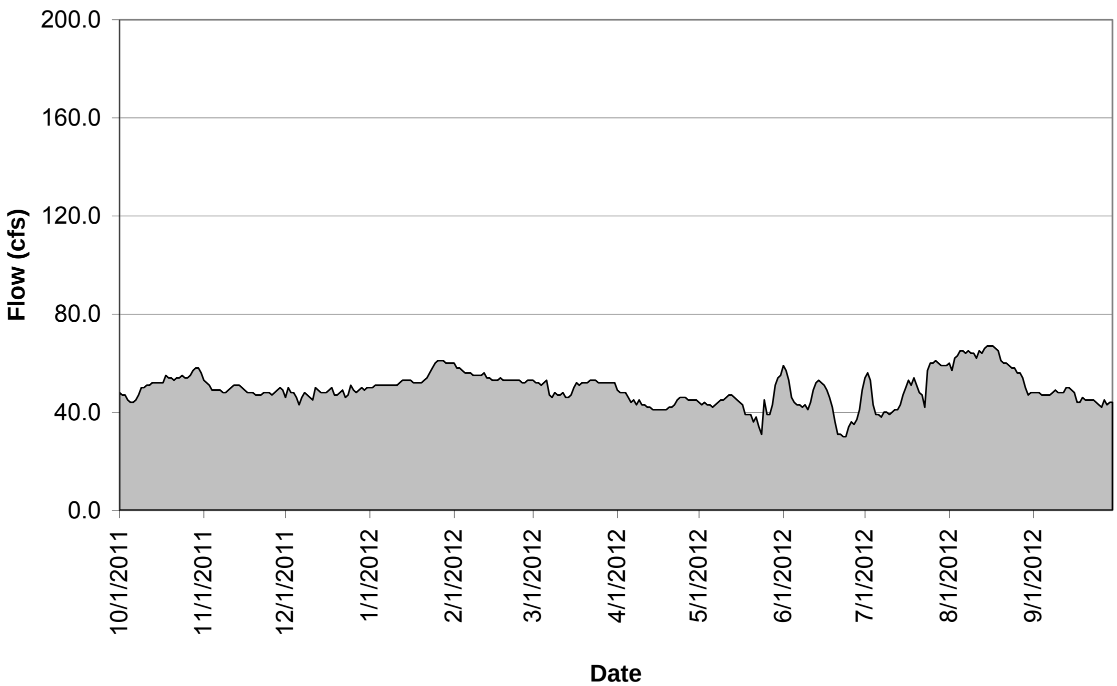




LORP at Reinhackle Springs Flow (Oct 11 to Sep 12)



LORP at Pumpback Station Flow (Oct 11 to Sep 12)



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	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
10/1/2011	57.0	1.0	1.1	0.9	60.0	0.0	0.0	53.0	0.0	48.0	40.0	8.0	0.0	54.5
10/2/2011	57.0	1.0	1.0	0.9	59.0	0.0	0.0	54.0	0.0	47.0	39.0	8.0	0.0	54.3
10/3/2011	57.0	1.0	1.0	0.9	59.0	0.0	0.0	53.0	0.0	47.0	41.0	6.0	0.0	54.0
10/4/2011	57.0	2.0	1.0	0.9	60.0	0.0	0.0	53.0	0.0	45.0	41.0	4.0	0.0	53.8
10/5/2011	57.0	1.0	1.1	1.3	61.0	0.0	0.0	55.0	0.0	44.0	40.0	4.0	0.0	54.3
10/6/2011	60.0	2.0	1.4	1.4	63.0	0.0	0.0	57.0	0.0	44.0	40.0	4.0	0.0	56.0
10/7/2011	60.0	1.0	1.4	1.4	63.0	0.0	0.0	57.0	0.0	45.0	41.0	4.0	0.0	56.3
10/8/2011	60.0	1.0	1.2	1.3	63.0	0.0	0.0	59.0	0.0	47.0	43.0	4.0	0.0	57.3
10/9/2011	60.0	1.0	1.2	1.2	63.0	0.0	0.0	60.0	0.0	50.0	46.0	4.0	0.0	58.3
10/10/2011	60.0	1.0	1.2	1.2	63.0	0.0	0.0	61.0	0.0	50.0	46.0	4.0	0.0	58.5
10/11/2011	60.0	1.0	1.3	1.1	63.0	0.0	0.0	58.0	0.0	51.0	47.0	4.0	0.0	58.0
10/12/2011	60.0	1.0	1.3	1.2	63.0	0.0	0.0	62.0	0.0	51.0	47.0	4.0	0.0	59.0
10/13/2011	60.0	1.0	1.3	1.0	61.0	0.0	0.0	62.0	0.0	52.0	48.0	4.0	0.0	58.8
10/14/2011	60.0	1.0	1.3	1.0	61.0	0.0	0.0	60.0	0.0	52.0	48.0	4.0	0.0	58.3
10/15/2011	60.0	1.0	1.4	1.0	61.0	0.0	0.0	59.0	0.0	52.0	48.0	4.0	0.0	58.0
10/16/2011	60.0	1.0	1.4	1.1	61.0	0.0	0.0	59.0	0.0	52.0	48.0	4.0	0.0	58.0
10/17/2011	60.0	1.0	1.3	1.1	61.0	0.0	0.0	61.0	0.0	52.0	48.0	4.0	0.0	58.5
10/18/2011	60.0	2.0	1.3	1.4	67.0	0.0	0.0	62.0	0.0	55.0	48.0	6.0	1.0	61.0
10/19/2011	56.0	1.0	1.3	1.4	67.0	0.0	0.0	62.0	0.0	54.0	48.0	4.0	2.0	59.8
10/20/2011	49.0	1.0	1.4	1.4	67.0	0.0	0.0	62.0	0.0	54.0	48.0	4.0	2.0	58.0
10/21/2011	48.0	1.0	1.4	1.3	67.0	0.0	0.0	62.0	0.0	53.0	48.0	4.0	1.0	57.5
10/22/2011	49.0	1.0	1.5	1.4	63.0	0.0	0.0	62.0	0.0	54.0	48.0	4.0	2.0	57.0
10/23/2011	49.0	1.0	1.5	1.4	61.0	0.0	0.0	61.0	0.0	54.0	48.0	4.0	2.0	56.3
10/24/2011	49.0	2.0	1.4	1.4	59.0	0.0	0.0	62.0	0.1	55.0	48.0	4.0	3.0	56.3
10/25/2011	49.0	1.0	1.2	1.4	57.0	0.0	0.0	63.0	0.2	54.0	48.0	4.0	2.0	55.8
10/26/2011	49.0	1.0	1.1	1.3	55.0	0.0	0.0	61.0	0.2	54.0	48.0	4.0	2.0	54.8
10/27/2011	49.0	1.0	1.3	1.2	53.0	0.0	0.0	57.0	0.1	55.0	48.0	4.0	3.0	53.5
10/28/2011	49.0	2.0	1.2	1.3	53.0	0.0	0.0	55.0	0.0	57.0	48.0	4.0	5.0	53.5
10/29/2011	49.0	1.0	1.2	1.3	52.0	0.0	0.0	54.0	0.0	58.0	48.0	4.0	6.0	53.3
10/30/2011	48.0	1.0	1.2	1.4	54.0	0.0	0.0	54.0	0.0	58.0	48.0	4.0	6.0	53.5
10/31/2011	49.0	1.0	1.4	1.4	53.0	0.0	0.0	54.0	0.0	56.0	48.0	4.0	4.0	53.0

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	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
11/1/2011	49.0	1.0	1.2	1.4	55.0	0.0	0.0	54.0	0.0	53.0	48.0	4.0	1.0	52.8
11/2/2011	48.0	3.0	1.2	1.4	55.0	0.0	0.0	53.0	0.0	52.0	48.0	4.0	0.0	52.0
11/3/2011	48.0	1.0	1.2	1.4	56.0	0.0	0.0	53.0	0.0	51.0	47.0	4.0	0.0	52.0
11/4/2011	47.0	1.0	1.1	1.4	56.0	0.0	0.0	52.0	0.0	49.0	45.0	4.0	0.0	51.0
11/5/2011	48.0	1.0	1.0	1.4	56.0	0.0	0.0	52.0	0.0	49.0	45.0	4.0	0.0	51.3
11/6/2011	47.0	1.0	1.0	1.4	54.0	0.0	0.0	52.0	0.0	49.0	45.0	4.0	0.0	50.5
11/7/2011	47.0	2.0	1.0	1.4	51.0	0.0	0.0	53.0	0.0	49.0	45.0	4.0	0.0	50.0
11/8/2011	47.0	1.0	1.1	1.4	50.0	0.0	0.0	53.0	0.0	48.0	44.0	4.0	0.0	49.5
11/9/2011	48.0	1.0	1.2	1.3	49.0	0.0	0.0	51.0	0.0	48.0	44.0	4.0	0.0	49.0
11/10/2011	48.0	1.0	1.2	1.2	50.0	0.0	0.0	51.0	0.0	49.0	45.0	4.0	0.0	49.5
11/11/2011	47.0	1.0	1.2	1.2	50.0	0.0	0.0	49.0	0.0	50.0	46.0	4.0	0.0	49.0
11/12/2011	47.0	1.0	1.2	1.2	51.0	0.0	0.0	48.0	0.0	51.0	47.0	4.0	0.0	49.3
11/13/2011	47.0	1.0	1.2	1.3	51.0	0.0	0.2	49.0	0.0	51.0	47.0	4.0	0.0	49.5
11/14/2011	48.0	1.0	1.2	1.3	50.0	0.0	0.0	52.0	0.0	51.0	47.0	4.0	0.0	50.3
11/15/2011	47.0	2.0	1.2	1.3	49.0	0.0	0.0	52.0	0.0	50.0	46.0	4.0	0.0	49.5
11/16/2011	47.0	1.0	1.2	1.3	49.0	0.0	0.0	52.0	0.0	49.0	45.0	4.0	0.0	49.3
11/17/2011	47.0	1.0	1.2	1.3	49.0	0.0	0.5	53.0	0.0	48.0	44.0	4.0	0.0	49.3
11/18/2011	47.0	1.0	1.2	1.3	49.0	0.0	0.3	53.0	0.0	48.0	44.0	4.0	0.0	49.3
11/19/2011	48.0	2.0	1.1	1.1	47.0	0.0	0.0	51.0	0.0	48.0	44.0	4.0	0.0	48.5
11/20/2011	47.0	1.0	1.2	1.1	48.0	0.0	0.0	52.0	0.0	47.0	43.0	4.0	0.0	48.5
11/21/2011	47.0	1.0	1.2	1.0	46.0	0.0	0.0	53.0	0.0	47.0	43.0	4.0	0.0	48.3
11/22/2011	47.0	1.0	1.2	0.9	46.0	0.0	0.0	52.0	0.0	47.0	43.0	4.0	0.0	48.0
11/23/2011	47.0	1.0	1.2	1.1	46.0	0.0	0.0	52.0	0.0	48.0	44.0	4.0	0.0	48.3
11/24/2011	48.0	1.0	1.2	1.2	45.0	0.0	0.0	53.0	0.0	48.0	44.0	4.0	0.0	48.5
11/25/2011	47.0	1.0	1.2	1.2	45.0	0.0	0.0	53.0	0.0	48.0	44.0	4.0	0.0	48.3
11/26/2011	47.0	1.0	1.1	1.2	45.0	0.0	0.0	52.0	0.0	47.0	43.0	4.0	0.0	47.8
11/27/2011	47.0	1.0	1.0	1.1	45.0	0.0	0.0	52.0	0.0	48.0	44.0	4.0	0.0	48.0
11/28/2011	46.0	1.0	1.1	1.5	46.0	0.0	0.0	52.0	0.0	49.0	45.0	4.0	0.0	48.3
11/29/2011	46.0	1.0	1.1	1.7	49.0	0.0	0.0	52.0	0.0	50.0	46.0	4.0	0.0	49.3
11/30/2011	45.0	1.0	1.0	1.8	48.0	0.0	0.0	53.0	0.0	49.0	45.0	4.0	0.0	48.8

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

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12/1/2011	46.0	2.0	1.1	1.6	48.0	0.0	0.0	53.0	0.0	46.0	43.0	3.0	0.0	48.3
12/2/2011	45.0	2.0	1.0	1.4	49.0	0.0	0.3	53.0	0.0	50.0	47.0	3.0	0.0	49.3
12/3/2011	46.0	2.0	1.0	1.3	49.0	0.0	0.3	54.0	0.0	48.0	45.0	3.0	0.0	49.3
12/4/2011	45.0	2.0	1.1	1.1	48.0	0.0	0.3	52.0	0.0	48.0	45.0	3.0	0.0	48.3
12/5/2011	45.0	2.0	1.1	0.8	49.0	0.0	0.2	53.0	0.0	46.0	43.0	3.0	0.0	48.3
12/6/2011	45.0	2.0	1.1	0.8	49.0	0.0	0.1	53.0	0.0	43.0	40.0	3.0	0.0	47.5
12/7/2011	46.0	2.0	1.1	0.8	48.0	0.0	0.0	53.0	0.0	46.0	42.0	3.0	1.0	48.3
12/8/2011	46.0	2.0	1.2	0.8	48.0	0.0	0.0	53.0	0.0	48.0	45.0	3.0	0.0	48.8
12/9/2011	45.0	2.0	1.2	0.9	48.0	0.0	0.0	53.0	0.0	47.0	44.0	3.0	0.0	48.3
12/10/2011	46.0	2.0	1.2	0.9	49.0	0.0	0.0	53.0	0.0	46.0	43.0	3.0	0.0	48.5
12/11/2011	45.0	2.0	1.2	1.0	49.0	0.0	0.0	53.0	0.0	45.0	42.0	3.0	0.0	48.0
12/12/2011	45.0	3.0	1.3	1.1	48.0	0.0	0.0	53.0	0.0	50.0	47.0	3.0	0.0	49.0
12/13/2011	45.0	2.0	1.2	1.1	49.0	0.0	0.0	54.0	0.0	49.0	46.0	3.0	0.0	49.3
12/14/2011	45.0	2.0	1.3	1.2	50.0	0.0	0.0	54.0	0.0	48.0	45.0	3.0	0.0	49.3
12/15/2011	45.0	3.0	1.3	1.2	50.0	0.0	0.0	55.0	0.0	48.0	45.0	3.0	0.0	49.5
12/16/2011	45.0	2.0	1.3	1.2	51.0	0.0	0.0	56.0	0.0	48.0	45.0	3.0	0.0	50.0
12/17/2011	46.0	2.0	1.3	1.2	51.0	0.0	0.0	56.0	0.0	49.0	46.0	3.0	0.0	50.5
12/18/2011	46.0	2.0	1.3	1.2	50.0	0.0	0.0	55.0	0.0	50.0	47.0	3.0	0.0	50.3
12/19/2011	45.0	2.0	1.2	1.2	52.0	0.0	0.0	55.0	0.0	47.0	30.0	17.0	0.0	49.8
12/20/2011	46.0	2.0	1.2	1.2	52.0	0.0	0.0	55.0	0.0	47.0	17.0	30.0	0.0	50.0
12/21/2011	45.0	3.0	1.2	1.2	52.0	0.0	0.0	54.0	0.0	48.0	18.0	30.0	0.0	49.8
12/22/2011	45.0	2.0	1.3	1.2	52.0	0.0	0.0	54.0	0.0	49.0	19.0	30.0	0.0	50.0
12/23/2011	45.0	2.0	1.2	1.2	51.0	0.0	0.0	54.0	0.0	46.0	16.0	30.0	0.0	49.0
12/24/2011	44.0	2.0	1.2	1.2	51.0	0.0	0.0	54.0	0.0	47.0	32.0	15.0	0.0	49.0
12/25/2011	44.0	2.0	1.2	1.2	52.0	0.0	0.2	54.0	0.0	51.0	48.0	3.0	0.0	50.3
12/26/2011	44.0	2.0	1.2	1.2	52.0	0.0	0.0	54.0	0.0	49.0	46.0	3.0	0.0	49.8
12/27/2011	45.0	3.0	1.2	1.2	51.0	0.0	0.0	53.0	0.0	48.0	45.0	3.0	0.0	49.3
12/28/2011	44.0	2.0	1.2	1.2	49.0	0.0	0.0	53.0	0.0	49.0	46.0	3.0	0.0	48.8
12/29/2011	44.0	2.0	1.2	1.2	50.0	0.0	0.0	54.0	0.0	50.0	47.0	3.0	0.0	49.5
12/30/2011	45.0	3.0	1.2	1.2	52.0	0.0	0.0	55.0	0.0	49.0	46.0	3.0	0.0	50.3
12/31/2011	44.0	2.0	1.1	1.1	51.0	0.0	0.0	54.0	0.0	50.0	47.0	3.0	0.0	49.8

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

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
1/1/2012	45.0	2.0	1.2	1.2	51.0	0.0	0.0	53.0	0.0	50.0	47.0	3.0	0.0	49.8
1/2/2012	45.0	2.0	1.2	1.2	51.0	0.0	0.0	54.0	0.0	50.0	47.0	3.0	0.0	50.0
1/3/2012	45.0	2.0	1.2	1.2	52.0	0.0	0.0	55.0	0.0	51.0	48.0	3.0	0.0	50.8
1/4/2012	44.0	1.0	1.3	1.2	52.0	0.0	0.0	54.0	0.0	51.0	48.0	3.0	0.0	50.3
1/5/2012	44.0	1.0	1.3	1.3	52.0	0.0	0.1	55.0	0.0	51.0	48.0	3.0	0.0	50.5
1/6/2012	44.0	1.0	1.3	1.3	53.0	0.0	0.1	55.0	0.0	51.0	48.0	3.0	0.0	50.8
1/7/2012	45.0	1.0	1.3	1.4	52.0	0.0	0.2	55.0	0.0	51.0	48.0	3.0	0.0	50.8
1/8/2012	45.0	1.0	1.3	1.4	52.0	0.0	0.1	55.0	0.0	51.0	48.0	3.0	0.0	50.8
1/9/2012	44.0	1.0	1.3	1.4	52.0	0.0	0.1	55.0	0.0	51.0	48.0	3.0	0.0	50.5
1/10/2012	44.0	1.0	1.3	1.4	53.0	0.0	0.1	55.0	0.0	51.0	48.0	3.0	0.0	50.8
1/11/2012	45.0	1.0	1.3	1.4	52.0	0.0	0.2	54.0	0.0	51.0	48.0	3.0	0.0	50.5
1/12/2012	45.0	2.0	1.4	1.3	51.0	0.0	0.2	55.0	0.0	52.0	48.0	3.0	1.0	50.8
1/13/2012	44.0	2.0	1.4	1.3	51.0	0.0	0.2	55.0	0.0	53.0	48.0	3.0	2.0	50.8
1/14/2012	45.0	1.0	1.4	1.3	52.0	0.0	0.1	54.0	0.0	53.0	48.0	3.0	2.0	51.0
1/15/2012	44.0	2.0	1.4	1.4	52.0	0.0	0.4	54.0	0.0	53.0	48.0	3.0	2.0	50.8
1/16/2012	44.0	1.0	1.3	1.3	51.0	0.0	0.4	55.0	0.0	53.0	48.0	3.0	2.0	50.8
1/17/2012	44.0	1.0	1.2	1.3	49.0	0.0	0.2	54.0	0.0	52.0	48.0	3.0	1.0	49.8
1/18/2012	44.0	1.0	1.2	1.2	51.0	0.0	0.2	54.0	0.0	52.0	48.0	3.0	1.0	50.3
1/19/2012	45.0	1.0	1.2	1.2	52.0	0.0	0.2	55.0	0.0	52.0	48.0	3.0	1.0	51.0
1/20/2012	45.0	1.0	1.2	1.2	52.0	0.0	0.2	55.0	0.0	52.0	48.0	3.0	1.0	51.0
1/21/2012	45.0	1.0	1.4	1.3	52.0	0.0	0.3	56.0	0.0	53.0	48.0	3.0	2.0	51.5
1/22/2012	44.0	2.0	1.6	1.3	53.0	0.0	0.1	57.0	0.0	54.0	48.0	3.0	3.0	52.0
1/23/2012	44.0	2.0	1.8	1.4	56.0	0.0	0.1	60.0	0.0	56.0	48.0	3.0	5.0	54.0
1/24/2012	44.0	2.0	2.0	1.5	56.0	0.0	0.1	60.0	0.0	58.0	48.0	3.0	7.0	54.5
1/25/2012	44.0	1.0	1.9	1.4	57.0	0.0	0.1	59.0	0.0	60.0	48.0	3.0	9.0	55.0
1/26/2012	44.0	2.0	1.9	1.3	56.0	0.0	0.1	60.0	0.0	61.0	48.0	3.0	10.0	55.3
1/27/2012	44.0	2.0	1.8	1.3	57.0	0.0	0.1	61.0	0.0	61.0	48.0	3.0	10.0	55.8
1/28/2012	45.0	1.0	1.8	1.2	55.0	0.0	0.1	60.0	0.0	61.0	48.0	3.0	10.0	55.3
1/29/2012	45.0	1.0	1.7	1.3	55.0	0.0	0.1	60.0	0.0	60.0	48.0	3.0	9.0	55.0
1/30/2012	44.0	2.0	1.7	1.5	55.0	0.0	0.1	60.0	0.0	60.0	48.0	3.0	9.0	54.8
1/31/2012	44.0	2.0	1.7	1.4	56.0	0.0	0.2	59.0	0.0	60.0	48.0	3.0	9.0	54.8

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langemann Gate to Delta	Weir to Delta	In Channel Average Flow
2/1/2012	44.0	2.0	1.6	1.5	55.0	0.0	0.3	59.0	0.0	60.0	48.0	3.0	9.0	54.5
2/2/2012	44.0	2.0	1.6	1.4	55.0	0.0	0.3	59.0	0.0	58.0	48.0	3.0	7.0	54.0
2/3/2012	45.0	2.0	1.6	1.4	54.0	0.0	0.2	57.0	0.0	58.0	48.0	3.0	7.0	53.5
2/4/2012	45.0	2.0	1.6	1.4	51.0	0.0	0.2	57.0	0.0	57.0	48.0	3.0	6.0	52.5
2/5/2012	45.0	2.0	1.6	1.4	51.0	0.0	0.2	57.0	0.0	56.0	48.0	3.0	5.0	52.3
2/6/2012	45.0	2.0	1.6	1.4	54.0	0.0	0.2	56.0	0.0	56.0	48.0	3.0	5.0	52.8
2/7/2012	47.0	2.0	1.6	1.4	54.0	0.0	0.1	54.0	0.0	56.0	48.0	3.0	5.0	52.8
2/8/2012	47.0	2.0	1.7	1.4	54.0	0.0	0.1	55.0	0.0	55.0	48.0	3.0	4.0	52.8
2/9/2012	47.0	2.0	1.7	1.4	55.0	0.0	0.1	55.0	0.0	55.0	48.0	3.0	4.0	53.0
2/10/2012	46.0	2.0	1.7	1.4	54.0	0.0	0.1	55.0	0.0	55.0	48.0	3.0	4.0	52.5
2/11/2012	46.0	2.0	1.6	1.4	55.0	0.0	0.4	56.0	0.0	55.0	48.0	3.0	4.0	53.0
2/12/2012	46.0	2.0	1.5	1.4	54.0	0.0	0.3	55.0	0.0	56.0	48.0	3.0	5.0	52.8
2/13/2012	47.0	2.0	1.4	1.4	55.0	0.0	0.3	56.0	0.0	54.0	47.0	3.0	4.0	53.0
2/14/2012	47.0	2.0	1.3	1.4	54.0	0.0	0.3	56.0	0.0	54.0	48.0	3.0	3.0	52.8
2/15/2012	46.0	2.0	1.3	1.3	54.0	0.0	0.2	56.0	0.0	53.0	48.0	3.0	2.0	52.3
2/16/2012	46.0	2.0	1.2	1.2	54.0	0.0	0.1	55.0	0.0	53.0	48.0	3.0	2.0	52.0
2/17/2012	47.0	2.0	1.2	1.2	54.0	0.0	0.1	53.0	0.0	53.0	48.0	3.0	2.0	51.8
2/18/2012	46.0	2.0	1.2	1.2	54.0	0.0	0.3	53.0	0.0	54.0	48.0	3.0	3.0	51.8
2/19/2012	47.0	2.0	1.2	1.2	53.0	0.0	0.5	54.0	0.0	53.0	48.0	3.0	2.0	51.8
2/20/2012	46.0	4.0	1.2	1.2	51.0	0.0	0.3	53.0	0.0	53.0	48.0	3.0	2.0	50.8
2/21/2012	47.0	3.0	1.3	1.2	52.0	0.0	0.3	55.0	0.0	53.0	48.0	3.0	2.0	51.8
2/22/2012	47.0	3.0	1.3	1.2	51.0	0.0	0.1	55.0	0.0	53.0	48.0	3.0	2.0	51.5
2/23/2012	46.0	3.0	1.3	0.8	54.0	0.0	0.1	54.0	0.0	53.0	48.0	3.0	2.0	51.8
2/24/2012	46.0	2.0	1.2	1.5	53.0	0.0	0.4	52.0	0.0	53.0	48.0	3.0	2.0	51.0
2/25/2012	46.0	3.0	1.2	1.5	55.0	0.0	0.2	53.0	0.0	53.0	48.0	3.0	2.0	51.8
2/26/2012	47.0	3.0	1.2	1.5	53.0	0.0	0.1	52.0	0.0	52.0	48.0	3.0	1.0	51.0
2/27/2012	46.0	2.0	1.2	1.5	53.0	0.0	0.1	52.0	0.0	52.0	47.0	3.0	2.0	50.8
2/28/2012	46.0	3.0	1.2	1.5	53.0	0.0	0.2	53.0	0.0	53.0	48.0	3.0	2.0	51.3
2/29/2012	46.0	2.0	1.0	1.6	53.0	0.0	0.4	53.0	0.0	53.0	48.0	3.0	2.0	51.3

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3/1/2012	47.0	2.0	1.3	1.5	53.0	0.0	0.1	54.0	0.0	53.0	48.0	4.0	1.0	51.8
3/2/2012	46.0	2.0	1.3	1.5	53.0	0.0	0.1	54.0	0.0	52.0	48.0	4.0	0.0	51.3
3/3/2012	47.0	2.0	1.3	1.5	51.0	0.0	0.4	53.0	0.0	52.0	48.0	4.0	0.0	50.8
3/4/2012	47.0	2.0	1.3	1.5	52.0	0.0	0.2	53.0	0.0	51.0	47.0	4.0	0.0	50.8
3/5/2012	46.0	1.0	1.3	1.5	52.0	0.0	0.2	53.0	0.0	52.0	48.0	4.0	0.0	50.8
3/6/2012	47.0	2.0	1.3	1.5	53.0	0.0	0.1	53.0	0.0	53.0	34.0	18.0	1.0	51.5
3/7/2012	47.0	1.0	1.3	1.5	51.0	0.0	0.0	55.0	0.0	47.0	22.0	25.0	0.0	50.0
3/8/2012	44.0	1.0	1.3	1.5	47.0	0.0	0.1	54.0	0.0	46.0	20.0	25.0	1.0	47.8
3/9/2012	44.0	2.0	1.3	1.5	48.0	0.0	0.2	54.0	0.0	48.0	23.0	25.0	0.0	48.5
3/10/2012	44.0	1.0	1.3	1.6	47.0	0.0	0.1	54.0	0.0	47.0	22.0	25.0	0.0	48.0
3/11/2012	44.0	1.0	1.3	1.6	49.0	0.0	0.1	54.0	0.0	47.0	22.0	25.0	0.0	48.5
3/12/2012	44.0	1.0	1.3	1.6	47.0	0.0	0.3	53.0	0.0	48.0	23.0	25.0	0.0	48.0
3/13/2012	44.0	1.0	1.3	1.6	50.0	0.0	0.2	54.0	0.0	46.0	21.0	25.0	0.0	48.5
3/14/2012	44.0	1.0	1.3	1.5	53.0	0.0	0.1	54.0	0.0	46.0	21.0	25.0	0.0	49.3
3/15/2012	45.0	1.0	1.3	1.5	53.0	0.0	0.1	54.0	0.0	47.0	22.0	25.0	0.0	49.8
3/16/2012	45.0	2.0	1.4	1.4	53.0	0.0	0.0	54.0	0.0	50.0	39.0	11.0	0.0	50.5
3/17/2012	45.0	2.0	1.3	1.4	53.0	0.0	0.1	54.0	0.0	52.0	48.0	4.0	0.0	51.0
3/18/2012	45.0	1.0	1.3	1.4	54.0	0.0	0.0	55.0	0.0	51.0	47.0	4.0	0.0	51.3
3/19/2012	45.0	1.0	1.2	1.4	54.0	0.0	0.0	55.0	0.0	52.0	48.0	4.0	0.0	51.5
3/20/2012	45.0	2.0	1.2	1.4	54.0	0.0	0.0	55.0	0.0	52.0	48.0	4.0	0.0	51.5
3/21/2012	44.0	2.0	1.4	1.4	53.0	0.0	0.0	56.0	0.0	52.0	48.0	4.0	0.0	51.3
3/22/2012	44.0	1.0	1.5	1.4	53.0	0.0	0.0	56.0	0.0	53.0	48.0	4.0	1.0	51.5
3/23/2012	44.0	1.0	1.6	1.4	51.0	0.0	0.0	54.0	0.0	53.0	48.0	4.0	1.0	50.5
3/24/2012	44.0	1.0	1.6	1.3	51.0	0.0	0.5	54.0	0.0	53.0	48.0	4.0	1.0	50.5
3/25/2012	45.0	2.0	1.6	1.3	50.0	0.0	0.0	53.0	0.0	52.0	48.0	4.0	0.0	50.0
3/26/2012	44.0	1.0	1.6	1.3	51.0	0.0	0.0	53.0	0.0	52.0	48.0	4.0	0.0	50.0
3/27/2012	44.0	1.0	1.6	1.4	51.0	0.0	0.1	53.0	0.0	52.0	48.0	4.0	0.0	50.0
3/28/2012	45.0	1.0	1.6	1.4	51.0	0.0	0.0	53.0	0.0	52.0	48.0	4.0	0.0	50.3
3/29/2012	44.0	2.0	1.6	1.4	51.0	0.0	0.2	53.0	0.0	52.0	48.0	4.0	0.0	50.0
3/30/2012	44.0	2.0	1.6	1.4	51.0	0.0	0.1	53.0	0.0	52.0	48.0	4.0	0.0	50.0
3/31/2012	45.0	1.0	1.8	1.2	52.0	0.0	0.2	52.0	0.0	52.0	48.0	4.0	0.0	50.3

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4/1/2012	45.0	1.0	1.5	1.1	52.0	0.0	0.0	53.0	0.0	49.0	45.0	4.0	0.0	49.8
4/2/2012	45.0	1.0	1.5	1.0	52.0	0.0	0.0	53.0	0.0	48.0	44.0	4.0	0.0	49.5
4/3/2012	45.0	1.0	1.4	1.1	51.0	0.0	0.0	53.0	0.0	48.0	44.0	4.0	0.0	49.3
4/4/2012	47.0	1.0	1.3	1.3	53.0	0.0	0.0	53.0	0.0	48.0	44.0	4.0	0.0	50.3
4/5/2012	47.0	1.0	1.3	1.6	52.0	0.0	0.0	53.0	0.0	46.0	42.0	4.0	0.0	49.5
4/6/2012	46.0	1.0	1.3	1.6	53.0	0.0	0.0	52.0	0.0	44.0	40.0	4.0	0.0	48.8
4/7/2012	47.0	1.0	1.2	1.6	53.0	0.0	0.4	51.0	0.0	45.0	41.0	4.0	0.0	49.0
4/8/2012	47.0	1.0	1.2	1.6	53.0	0.0	0.6	52.0	0.0	43.0	39.0	4.0	0.0	48.8
4/9/2012	46.0	1.0	1.2	1.6	52.0	0.0	0.0	50.0	0.0	45.0	41.0	4.0	0.0	48.3
4/10/2012	51.0	1.0	1.3	1.5	52.0	0.0	0.0	50.0	0.0	43.0	39.0	4.0	0.0	49.0
4/11/2012	54.0	1.0	1.4	1.5	53.0	0.0	0.0	49.0	0.0	43.0	39.0	4.0	0.0	49.8
4/12/2012	54.0	2.0	1.5	1.6	53.0	0.0	0.0	51.0	0.0	42.0	38.0	4.0	0.0	50.0
4/13/2012	54.0	1.0	1.6	1.5	56.0	0.0	0.1	51.0	0.0	42.0	38.0	4.0	0.0	50.8
4/14/2012	55.0	1.0	1.6	1.5	59.0	0.0	0.0	53.0	0.0	41.0	37.0	4.0	0.0	52.0
4/15/2012	54.0	1.0	1.6	1.5	60.0	0.0	0.0	52.0	0.0	41.0	37.0	4.0	0.0	51.8
4/16/2012	54.0	1.0	1.5	1.5	60.0	0.0	0.0	53.0	0.0	41.0	37.0	4.0	0.0	52.0
4/17/2012	54.0	1.0	1.4	1.5	60.0	0.0	0.0	55.0	0.0	41.0	37.0	4.0	0.0	52.5
4/18/2012	54.0	1.0	1.3	1.5	60.0	0.0	0.0	58.0	0.0	41.0	37.0	4.0	0.0	53.3
4/19/2012	55.0	1.0	1.3	1.4	61.0	0.0	0.3	60.0	0.0	41.0	37.0	4.0	0.0	54.3
4/20/2012	54.0	2.0	1.3	1.3	60.0	0.0	0.1	59.0	0.0	42.0	38.0	4.0	0.0	53.8
4/21/2012	54.0	1.0	1.3	1.2	61.0	0.0	0.1	59.0	0.0	42.0	38.0	4.0	0.0	54.0
4/22/2012	55.0	1.0	1.3	1.2	62.0	0.0	0.0	58.0	0.0	43.0	39.0	4.0	0.0	54.5
4/23/2012	54.0	1.0	1.2	1.2	61.0	0.0	0.0	58.0	0.0	45.0	41.0	4.0	0.0	54.5
4/24/2012	54.0	1.0	1.2	1.2	61.0	0.0	0.0	59.0	0.0	46.0	42.0	4.0	0.0	55.0
4/25/2012	54.0	1.0	1.2	1.1	61.0	0.0	0.0	58.0	0.0	46.0	42.0	4.0	0.0	54.8
4/26/2012	54.0	2.0	1.3	1.1	61.0	0.0	0.6	60.0	0.0	46.0	42.0	4.0	0.0	55.3
4/27/2012	54.0	1.0	1.3	1.1	60.0	0.0	0.1	62.0	0.0	45.0	41.0	4.0	0.0	55.3
4/28/2012	54.0	1.0	1.3	1.1	60.0	0.0	0.0	61.0	0.0	45.0	41.0	4.0	0.0	55.0
4/29/2012	54.0	1.0	1.3	1.0	61.0	0.0	0.0	59.0	0.0	45.0	41.0	4.0	0.0	54.8
4/30/2012	54.0	1.0	1.2	0.8	60.0	0.0	0.2	59.0	0.0	45.0	41.0	4.0	0.0	54.5

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5/1/2012	54.0	1.0	1.3	1.1	59.0	0.0	0.7	60.0	0.0	44.0	38.0	6.0	0.0	54.3
5/2/2012	52.0	1.0	1.2	1.1	56.0	0.0	2.2	61.0	0.0	43.0	36.0	7.0	0.0	53.0
5/3/2012	51.0	1.0	1.2	1.0	55.0	0.0	7.6	67.0	0.0	44.0	36.0	8.0	0.0	54.3
5/4/2012	46.0	1.0	1.2	1.0	55.0	2.3	7.9	70.0	0.0	43.0	35.0	8.0	0.0	53.5
5/5/2012	44.0	1.0	1.1	1.1	53.0	4.7	7.8	71.0	0.0	43.0	35.0	8.0	0.0	52.8
5/6/2012	43.0	2.0	1.1	1.1	53.0	5.0	8.0	70.0	0.0	42.0	34.0	8.0	0.0	52.0
5/7/2012	43.0	2.0	1.1	1.0	49.0	4.4	8.3	72.0	0.0	43.0	35.0	8.0	0.0	51.8
5/8/2012	43.0	1.0	1.0	1.0	47.0	3.7	8.4	73.0	0.0	44.0	36.0	8.0	0.0	51.8
5/9/2012	44.0	1.0	1.0	1.1	46.0	3.8	8.4	73.0	0.0	45.0	37.0	8.0	0.0	52.0
5/10/2012	44.0	1.0	1.1	1.1	47.0	4.0	8.5	72.0	0.0	45.0	38.0	7.0	0.0	52.0
5/11/2012	44.0	1.0	1.2	1.1	48.0	3.9	8.4	69.0	0.0	46.0	38.0	8.0	0.0	51.8
5/12/2012	43.0	1.0	1.2	1.1	48.0	3.7	8.6	67.0	0.0	47.0	39.0	8.0	0.0	51.3
5/13/2012	44.0	1.0	1.2	1.2	46.0	3.9	8.7	65.0	0.0	47.0	40.0	7.0	0.0	50.5
5/14/2012	43.0	1.0	1.1	1.1	45.0	3.9	8.2	63.0	0.0	46.0	38.0	8.0	0.0	49.3
5/15/2012	44.0	1.0	1.1	1.1	45.0	3.9	7.2	65.0	0.0	45.0	37.0	8.0	0.0	49.8
5/16/2012	44.0	1.0	1.1	1.1	46.0	4.2	7.2	63.0	0.0	44.0	36.0	8.0	0.0	49.3
5/17/2012	44.0	1.0	1.1	1.0	46.0	4.0	7.9	63.0	0.0	43.0	35.0	8.0	0.0	49.0
5/18/2012	44.0	1.0	1.1	1.0	45.0	3.9	9.6	64.0	0.0	39.0	32.0	7.0	0.0	48.0
5/19/2012	44.0	1.0	1.1	1.1	45.0	4.0	9.2	63.0	0.0	39.0	32.0	7.0	0.0	47.8
5/20/2012	43.0	1.0	1.1	1.1	46.0	4.0	8.2	62.0	0.0	39.0	31.0	8.0	0.0	47.5
5/21/2012	47.0	1.0	1.1	1.1	46.0	5.2	8.1	62.0	10.0	36.0	28.0	8.0	0.0	47.8
5/22/2012	49.0	1.0	1.2	1.1	46.0	7.0	8.0	63.0	20.0	38.0	31.0	7.0	0.0	49.0
5/23/2012	48.0	1.0	1.2	1.0	46.0	7.4	8.6	63.0	12.9	34.0	27.0	7.0	0.0	47.8
5/24/2012	48.0	1.0	1.2	1.0	47.0	7.3	8.0	65.0	10.0	31.0	22.0	8.0	1.0	47.8
5/25/2012	48.0	1.0	1.1	1.0	48.0	8.0	6.5	64.0	16.7	45.0	33.0	8.0	4.0	51.3
5/26/2012	48.0	1.0	1.1	1.1	49.0	8.1	6.5	64.0	20.0	39.0	31.0	8.0	0.0	50.0
5/27/2012	48.0	2.0	1.1	1.4	48.0	8.2	6.6	62.0	20.0	39.0	31.0	8.0	0.0	49.3
5/28/2012	48.0	2.0	1.1	1.5	48.0	8.1	7.9	64.0	16.5	43.0	35.0	8.0	0.0	50.8
5/29/2012	49.0	2.0	1.1	1.5	50.0	8.1	8.2	65.0	10.0	51.0	43.0	8.0	0.0	53.8
5/30/2012	64.0	2.0	1.1	1.5	50.0	7.9	8.1	67.0	10.0	54.0	46.0	8.0	0.0	58.8
5/31/2012	78.0	1.0	0.9	1.2	50.0	8.1	7.7	65.0	10.2	55.0	48.0	7.0	0.0	62.0

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6/1/2012	89.0	1.0	1.1	1.4	51.0	8.3	7.7	64.0	10.0	59.0	47.0	8.0	4.0	65.8
6/2/2012	82.0	1.0	1.1	1.4	56.0	7.8	7.9	64.0	10.0	57.0	47.0	8.0	2.0	64.8
6/3/2012	67.0	1.0	1.1	1.3	62.0	8.3	7.7	61.0	10.0	53.0	45.0	8.0	0.0	60.8
6/4/2012	56.0	1.0	1.1	1.2	69.0	8.2	7.5	61.0	10.0	46.0	39.0	7.0	0.0	58.0
6/5/2012	51.0	1.0	1.0	1.2	73.0	7.6	8.4	65.0	10.0	44.0	36.0	8.0	0.0	58.3
6/6/2012	51.0	2.0	1.0	1.2	69.0	7.8	8.3	68.0	10.0	43.0	35.0	8.0	0.0	57.8
6/7/2012	51.0	1.0	1.0	1.2	62.0	7.7	8.1	70.0	10.0	43.0	35.0	8.0	0.0	56.5
6/8/2012	71.0	1.0	1.0	1.2	55.0	7.7	8.1	76.0	10.0	42.0	35.0	7.0	0.0	61.0
6/9/2012	71.0	1.0	1.1	1.2	55.0	7.8	7.9	76.0	10.0	43.0	35.0	8.0	0.0	61.3
6/10/2012	71.0	1.0	1.1	1.2	55.0	7.8	8.1	76.0	10.0	41.0	34.0	7.0	0.0	60.8
6/11/2012	80.0	1.0	1.1	1.1	57.0	7.9	8.1	73.0	10.0	44.0	37.0	7.0	0.0	63.5
6/12/2012	81.0	1.0	1.1	1.1	65.0	7.8	8.1	69.0	9.7	49.0	41.0	8.0	0.0	66.0
6/13/2012	80.0	1.0	1.1	1.1	70.0	4.6	4.8	66.0	9.6	52.0	44.0	8.0	0.0	67.0
6/14/2012	80.0	1.0	1.1	1.1	73.0	0.0	0.1	57.0	10.0	53.0	45.0	8.0	0.0	65.8
6/15/2012	80.0	1.0	1.2	1.1	74.0	0.0	0.0	59.0	5.8	52.0	45.0	7.0	0.0	66.3
6/16/2012	80.0	1.0	1.2	1.1	73.0	0.0	0.0	58.0	0.0	51.0	43.0	8.0	0.0	65.5
6/17/2012	80.0	1.0	1.2	1.0	72.0	0.0	0.0	59.0	0.0	49.0	41.0	8.0	0.0	65.0
6/18/2012	81.0	1.0	1.2	1.0	71.0	0.0	0.1	62.0	0.0	46.0	38.0	8.0	0.0	65.0
6/19/2012	80.0	1.0	1.1	0.9	71.0	0.0	0.0	62.0	0.0	42.0	34.0	8.0	0.0	63.8
6/20/2012	84.0	1.0	1.0	0.9	71.0	0.0	0.0	62.0	0.0	36.0	28.0	8.0	0.0	63.3
6/21/2012	90.0	2.0	0.9	1.0	71.0	0.0	0.0	60.0	6.7	31.0	24.0	7.0	0.0	63.0
6/22/2012	90.0	1.0	0.9	1.0	71.0	0.0	0.0	59.0	10.0	31.0	23.0	8.0	0.0	62.8
6/23/2012	88.0	1.0	0.9	1.0	73.0	0.0	0.0	59.0	9.6	30.0	23.0	7.0	0.0	62.5
6/24/2012	89.0	1.0	1.0	1.0	77.0	0.0	0.0	58.0	8.0	30.0	23.0	7.0	0.0	63.5
6/25/2012	90.0	2.0	1.0	1.0	79.0	0.0	0.0	57.0	14.3	34.0	26.0	8.0	0.0	65.0
6/26/2012	88.0	1.0	1.0	1.1	77.0	0.0	0.0	59.0	20.0	36.0	28.0	8.0	0.0	65.0
6/27/2012	88.0	1.0	1.0	1.2	79.0	0.0	0.0	62.0	20.0	35.0	27.0	8.0	0.0	66.0
6/28/2012	94.0	1.0	1.0	1.2	80.0	0.0	0.0	65.0	20.0	37.0	29.0	8.0	0.0	69.0
6/29/2012	99.0	1.0	1.1	1.3	81.0	0.0	0.0	67.0	9.5	41.0	34.0	7.0	0.0	72.0
6/30/2012	99.0	1.0	1.2	1.2	82.0	0.0	0.0	69.0	0.0	49.0	41.0	8.0	0.0	74.8

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7/1/2012	98.0	2.0	1.2	1.3	84.0	0.0	0.0	69.0	0.0	54.0	46.0	8.0	0.0	76.3
7/2/2012	99.0	1.0	1.2	1.3	86.0	0.0	0.0	71.0	0.0	56.0	48.0	8.0	0.0	78.0
7/3/2012	98.0	1.0	1.2	1.3	88.0	0.0	0.0	71.0	0.0	53.0	45.0	8.0	0.0	77.5
7/4/2012	99.0	1.0	1.2	1.3	89.0	0.0	0.0	72.0	0.0	43.0	35.0	8.0	0.0	75.8
7/5/2012	98.0	1.0	1.2	1.2	89.0	0.0	0.0	74.0	0.0	39.0	32.0	7.0	0.0	75.0
7/6/2012	99.0	1.0	1.2	1.2	90.0	0.0	0.0	75.0	0.0	39.0	31.0	8.0	0.0	75.8
7/7/2012	99.0	1.0	1.1	1.2	89.0	0.0	0.0	77.0	0.0	38.0	31.0	7.0	0.0	75.8
7/8/2012	99.0	2.0	1.1	1.2	90.0	0.0	0.0	78.0	0.0	40.0	32.0	8.0	0.0	76.8
7/9/2012	99.0	2.0	1.1	1.2	90.0	0.0	0.0	77.0	0.0	40.0	32.0	8.0	0.0	76.5
7/10/2012	99.0	1.0	1.0	1.3	90.0	0.0	0.0	74.0	0.0	39.0	31.0	8.0	0.0	75.5
7/11/2012	99.0	1.0	1.0	1.3	90.0	0.0	0.0	78.0	5.6	40.0	32.0	8.0	0.0	76.8
7/12/2012	98.0	1.0	1.0	1.4	91.0	0.0	0.0	79.0	10.0	41.0	33.0	8.0	0.0	77.3
7/13/2012	99.0	1.0	1.0	1.4	91.0	0.0	0.0	79.0	10.0	41.0	33.0	8.0	0.0	77.5
7/14/2012	99.0	1.0	1.0	1.4	91.0	0.0	0.0	80.0	10.0	43.0	35.0	8.0	0.0	78.3
7/15/2012	98.0	1.0	1.0	1.4	91.0	0.0	0.0	81.0	10.0	47.0	39.0	8.0	0.0	79.3
7/16/2012	99.0	1.0	0.9	1.4	92.0	0.0	0.0	80.0	5.8	50.0	42.0	8.0	0.0	80.3
7/17/2012	98.0	1.0	1.0	1.4	91.0	0.0	0.0	80.0	0.0	53.0	45.0	8.0	0.0	80.5
7/18/2012	101.0	1.0	1.0	1.3	92.0	0.0	0.0	80.0	0.0	51.0	43.0	8.0	0.0	81.0
7/19/2012	98.0	1.0	1.1	1.3	91.0	0.0	0.0	80.0	0.0	54.0	46.0	8.0	0.0	80.8
7/20/2012	99.0	1.0	1.2	1.3	91.0	0.0	0.0	82.0	0.0	51.0	44.0	7.0	0.0	80.8
7/21/2012	98.0	1.0	1.3	1.3	91.0	0.0	0.0	83.0	0.0	48.0	41.0	7.0	0.0	80.0
7/22/2012	99.0	1.0	1.2	1.3	92.0	0.0	0.0	84.0	0.0	47.0	39.0	8.0	0.0	80.5
7/23/2012	96.0	1.0	1.2	1.4	86.0	0.0	0.0	80.0	0.0	42.0	26.0	16.0	0.0	76.0
7/24/2012	96.0	1.0	1.3	1.4	86.0	0.0	0.0	81.0	0.0	57.0	37.0	20.0	0.0	80.0
7/25/2012	95.0	1.0	1.4	1.4	87.0	0.0	0.0	81.0	0.0	60.0	40.0	20.0	0.0	80.8
7/26/2012	95.0	1.0	1.4	1.3	86.0	0.0	0.0	82.0	0.0	60.0	40.0	20.0	0.0	80.8
7/27/2012	96.0	1.0	1.4	1.3	84.0	0.0	0.0	81.0	0.0	61.0	41.0	20.0	0.0	80.5
7/28/2012	95.0	1.0	1.4	1.3	85.0	0.0	0.0	81.0	0.0	60.0	40.0	20.0	0.0	80.3
7/29/2012	96.0	1.0	1.4	1.4	86.0	0.0	0.0	81.0	0.0	59.0	39.0	20.0	0.0	80.5
7/30/2012	95.0	1.0	1.4	1.3	88.0	0.0	0.0	81.0	0.0	59.0	39.0	20.0	0.0	80.8
7/31/2012	95.0	1.0	1.2	1.3	89.0	0.0	0.0	80.0	0.0	59.0	39.0	20.0	0.0	80.8

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8/1/2012	96.0	1.0	1.3	1.2	88.0	0.0	0.0	81.0	0.0	60.0	40.0	20.0	0.0	81.3
8/2/2012	96.0	1.0	1.2	1.2	86.0	0.0	0.0	84.0	0.0	57.0	45.0	12.0	0.0	80.8
8/3/2012	96.0	1.0	1.1	1.3	86.0	0.0	0.0	85.0	0.0	62.0	48.0	8.0	6.0	82.3
8/4/2012	97.0	1.0	1.0	1.2	86.0	0.0	0.0	85.0	0.0	63.0	48.0	8.0	7.0	82.8
8/5/2012	96.0	1.0	1.1	1.2	89.0	0.0	0.0	83.0	0.0	65.0	48.0	8.0	9.0	83.3
8/6/2012	90.0	1.0	1.3	1.3	90.0	0.0	0.0	81.0	0.0	65.0	48.0	8.0	9.0	81.5
8/7/2012	79.0	1.0	1.3	1.3	89.0	0.0	0.0	81.0	0.0	64.0	48.0	7.0	9.0	78.3
8/8/2012	76.0	1.0	1.2	1.4	87.0	0.0	0.0	84.0	0.0	65.0	48.0	8.0	9.0	78.0
8/9/2012	77.0	1.0	1.2	1.4	85.0	0.0	0.0	85.0	0.0	64.0	48.0	8.0	8.0	77.8
8/10/2012	76.0	1.0	1.3	1.4	81.0	0.0	0.0	85.0	0.0	64.0	48.0	8.0	8.0	76.5
8/11/2012	77.0	1.0	1.3	1.4	76.0	0.0	0.0	86.0	0.0	62.0	48.0	7.0	7.0	75.3
8/12/2012	76.0	1.0	1.3	1.4	75.0	0.0	0.0	85.0	0.0	65.0	48.0	8.0	9.0	75.3
8/13/2012	75.0	1.0	1.3	1.4	74.0	0.0	0.0	84.0	0.0	64.0	45.0	8.0	11.0	74.3
8/14/2012	76.0	1.0	1.2	1.4	74.0	0.0	0.0	82.0	0.0	66.0	48.0	8.0	10.0	74.5
8/15/2012	68.0	1.0	1.2	1.4	73.0	0.0	0.0	79.0	0.0	67.0	48.0	8.0	11.0	71.8
8/16/2012	64.0	1.0	1.1	1.5	73.0	0.0	0.0	76.0	0.0	67.0	48.0	8.0	11.0	70.0
8/17/2012	64.0	1.0	1.2	1.5	72.0	0.0	0.0	76.0	0.0	67.0	48.0	8.0	11.0	69.8
8/18/2012	64.0	1.0	1.3	1.5	70.0	0.0	0.0	75.0	0.0	66.0	46.0	8.0	12.0	68.8
8/19/2012	64.0	1.0	1.3	1.3	66.0	0.0	0.0	74.0	0.0	65.0	48.0	8.0	9.0	67.3
8/20/2012	65.0	1.0	1.3	1.4	64.0	0.0	0.0	74.0	0.0	61.0	48.0	7.0	6.0	66.0
8/21/2012	71.0	1.0	1.4	1.4	72.0	0.0	0.0	72.0	0.0	60.0	48.0	7.0	5.0	68.8
8/22/2012	71.0	2.0	1.4	1.2	72.0	0.0	0.0	70.0	0.0	60.0	46.0	8.0	6.0	68.3
8/23/2012	71.0	2.0	1.4	1.2	74.0	0.0	0.0	68.0	0.0	59.0	48.0	8.0	3.0	68.0
8/24/2012	70.0	1.0	1.5	1.3	74.0	0.0	0.0	66.0	0.0	58.0	48.0	8.0	2.0	67.0
8/25/2012	66.0	1.0	1.5	1.3	75.0	0.0	0.0	65.0	0.0	58.0	48.0	8.0	2.0	66.0
8/26/2012	66.0	1.0	1.4	1.4	74.0	0.0	0.0	63.0	0.0	56.0	48.0	7.0	1.0	64.8
8/27/2012	66.0	1.0	1.3	1.4	73.0	0.0	0.0	64.0	0.0	56.0	48.0	8.0	0.0	64.8
8/28/2012	68.0	1.0	1.3	1.5	70.0	0.0	0.0	65.0	0.0	54.0	47.0	7.0	0.0	64.3
8/29/2012	66.0	1.0	1.3	1.4	68.0	0.0	0.0	65.0	0.0	50.0	42.0	8.0	0.0	62.3
8/30/2012	66.0	1.0	1.3	1.5	68.0	0.0	0.0	64.0	0.0	47.0	39.0	8.0	0.0	61.3
8/31/2012	67.0	1.0	1.5	1.3	67.0	0.0	0.0	63.0	0.0	48.0	40.0	8.0	0.0	61.3

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9/1/2012	67.0	1.0	1.3	1.4	67.0	0.0	0.0	62.0	0.0	48.0	40.0	8.0	0.0	61.0
9/2/2012	66.0	2.0	1.2	1.4	67.0	0.0	0.0	61.0	0.0	48.0	40.0	8.0	0.0	60.5
9/3/2012	67.0	1.0	1.1	1.4	66.0	0.0	0.0	58.0	0.0	48.0	40.0	8.0	0.0	59.8
9/4/2012	67.0	1.0	1.2	1.4	66.0	0.0	0.0	59.0	0.0	47.0	39.0	8.0	0.0	59.8
9/5/2012	67.0	1.0	1.3	1.4	66.0	0.0	0.0	58.0	0.0	47.0	39.0	8.0	0.0	59.5
9/6/2012	66.0	1.0	1.3	1.4	66.0	0.0	0.0	60.0	0.0	47.0	39.0	8.0	0.0	59.8
9/7/2012	67.0	1.0	1.4	1.4	66.0	0.0	0.0	60.0	0.0	47.0	39.0	8.0	0.0	60.0
9/8/2012	67.0	1.0	1.4	1.4	65.0	0.0	0.0	60.0	0.0	48.0	40.0	8.0	0.0	60.0
9/9/2012	66.0	1.0	1.4	1.4	65.0	0.0	0.0	58.0	0.0	49.0	41.0	8.0	0.0	59.5
9/10/2012	66.0	1.0	1.4	1.4	65.0	0.0	0.0	57.0	0.0	48.0	40.0	8.0	0.0	59.0
9/11/2012	59.0	1.0	1.4	1.2	65.0	0.0	0.0	59.0	0.0	48.0	40.0	8.0	0.0	57.8
9/12/2012	55.0	1.0	1.4	1.5	65.0	0.0	0.0	59.0	0.0	48.0	41.0	7.0	0.0	56.8
9/13/2012	55.0	1.0	1.4	1.5	65.0	0.0	0.0	59.0	0.0	50.0	42.0	8.0	0.0	57.3
9/14/2012	55.0	2.0	1.4	1.5	63.0	0.0	0.0	58.0	0.0	50.0	42.0	8.0	0.0	56.5
9/15/2012	55.0	1.0	1.4	1.4	60.0	0.0	0.0	58.0	0.0	49.0	41.0	8.0	0.0	55.5
9/16/2012	55.0	1.0	1.3	1.5	58.0	0.0	0.0	58.0	0.0	48.0	40.0	8.0	0.0	54.8
9/17/2012	55.0	2.0	1.3	1.5	57.0	0.0	0.0	56.0	0.0	44.0	25.0	19.0	0.0	53.0
9/18/2012	55.0	2.0	1.2	1.4	57.0	0.0	0.0	57.0	0.0	44.0	19.0	25.0	0.0	53.3
9/19/2012	54.0	1.0	1.2	1.4	57.0	0.0	0.0	56.0	0.0	46.0	21.0	25.0	0.0	53.3
9/20/2012	54.0	1.0	1.2	1.4	57.0	0.0	0.0	54.0	0.0	45.0	20.0	25.0	0.0	52.5
9/21/2012	54.0	2.0	1.2	1.4	58.0	0.0	0.0	54.0	0.0	45.0	20.0	25.0	0.0	52.8
9/22/2012	54.0	1.0	1.5	1.3	58.0	0.0	0.0	52.0	0.0	45.0	20.0	25.0	0.0	52.3
9/23/2012	54.0	1.0	1.7	1.3	57.0	0.0	0.0	52.0	0.0	45.0	20.0	25.0	0.0	52.0
9/24/2012	54.0	1.0	1.6	1.3	57.0	0.0	0.0	51.0	0.0	44.0	19.0	25.0	0.0	51.5
9/25/2012	54.0	1.0	1.4	1.3	57.0	0.0	0.0	52.0	0.0	43.0	18.0	25.0	0.0	51.5
9/26/2012	54.0	1.0	1.3	1.2	55.0	0.0	0.0	52.0	0.0	42.0	17.0	25.0	0.0	50.8
9/27/2012	54.0	1.0	1.0	1.1	57.0	0.0	0.0	51.0	0.0	45.0	30.0	15.0	0.0	51.8
9/28/2012	54.0	1.0	1.0	1.1	57.0	0.0	0.0	51.0	0.0	43.0	36.0	7.0	0.0	51.3
9/29/2012	54.0	1.0	2.0	1.1	56.0	0.0	0.0	51.0	0.0	44.0	36.0	8.0	0.0	51.3
9/30/2012	54.0	1.0	2.0	1.1	56.0	0.0	0.0	51.0	0.0	44.0	36.0	8.0	0.0	51.3

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

3.0 Seasonal Habitat Flow Report

3.1 Purpose of the Seasonal Habitat Flow

The goal of the LORP, as stated in the *1997 Memorandum of Understanding between the City of Los Angeles Department of Water and Power, County of Inyo, the California Department of Fish and Game, the California State Lands Commission, the Sierra Club, and the Owens Valley Committee* (1997 MOU):

> "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."

The 1997 MOU requires that flow and land management be used in conjunction to "create and maintain, to the extent feasible, diverse natural habitats consistent with the needs of the 'habitat indicator species.' "

The purpose of the seasonal habitat flow, as described in the 1997 MOU, is to create a dynamic equilibrium for riparian habitat, the fishery, water storage, water quality, animal migration, and biodiversity, which results in resilient productive ecological systems. The 1997 MOU outlines flow regimes for seasonal habitat flows. For average to above average runoff years, the flow regime includes releasing 200 cubic feet per second (cfs) into the Lower Owens River. For below average runoff years, the flow regime includes a reduction from 200 cfs to as low as 40 cfs in general proportion to the forecasted runoff in the watershed (MOU 1997, Section II, page 12).

Seasonal habitat flows are "to be of sufficient frequency, duration and amount, and will be implemented in order to (1) minimize the quantity 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 floodplains and terraces within the Riverine-Riparian system and the Owens River Delta for the benefit of the 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 actions; and (7) enhance the river channel" (Hill and Platts 1995).

The 1997 MOU specifies that the amount of seasonal annual habitat flow be set by the Standing Committee, "subject to any applicable court orders concerning the discharge of water onto the bed of the Owens Lake and in consultation with California Department of Fish and Game (CDFG) and to be based on the Lower Owens Riverine-Riparian ecosystem element of the LORP Plan which will recommend the amount, duration and timing of flows necessary to achieve the goals for the system under varying hydrologic scenarios" (MOU 1997, Section II, page 12).

The Standing Committee approved the Technical Group's recommendation for the 2012 Seasonal Habitat Flow at the May 4, 2012 Standing Committee meeting. Based on the guidance provided in the LORP EIR, section 2.3.5.3, and the forecasted runoff of 65% of normal, the Technical Group recommended a seasonal habitat flow peak of 88 cfs and ramping duration of nine days. The Technical Group recommended that the release of the Seasonal Habitat Flow coincide with the first indication of willow seed fly, but to occur no later than June 15. The timing was intended to maintain dissolved oxygen levels to avoid negative effects on the fishery, yet still provide opportunity for willow and cottonwood recruitment.

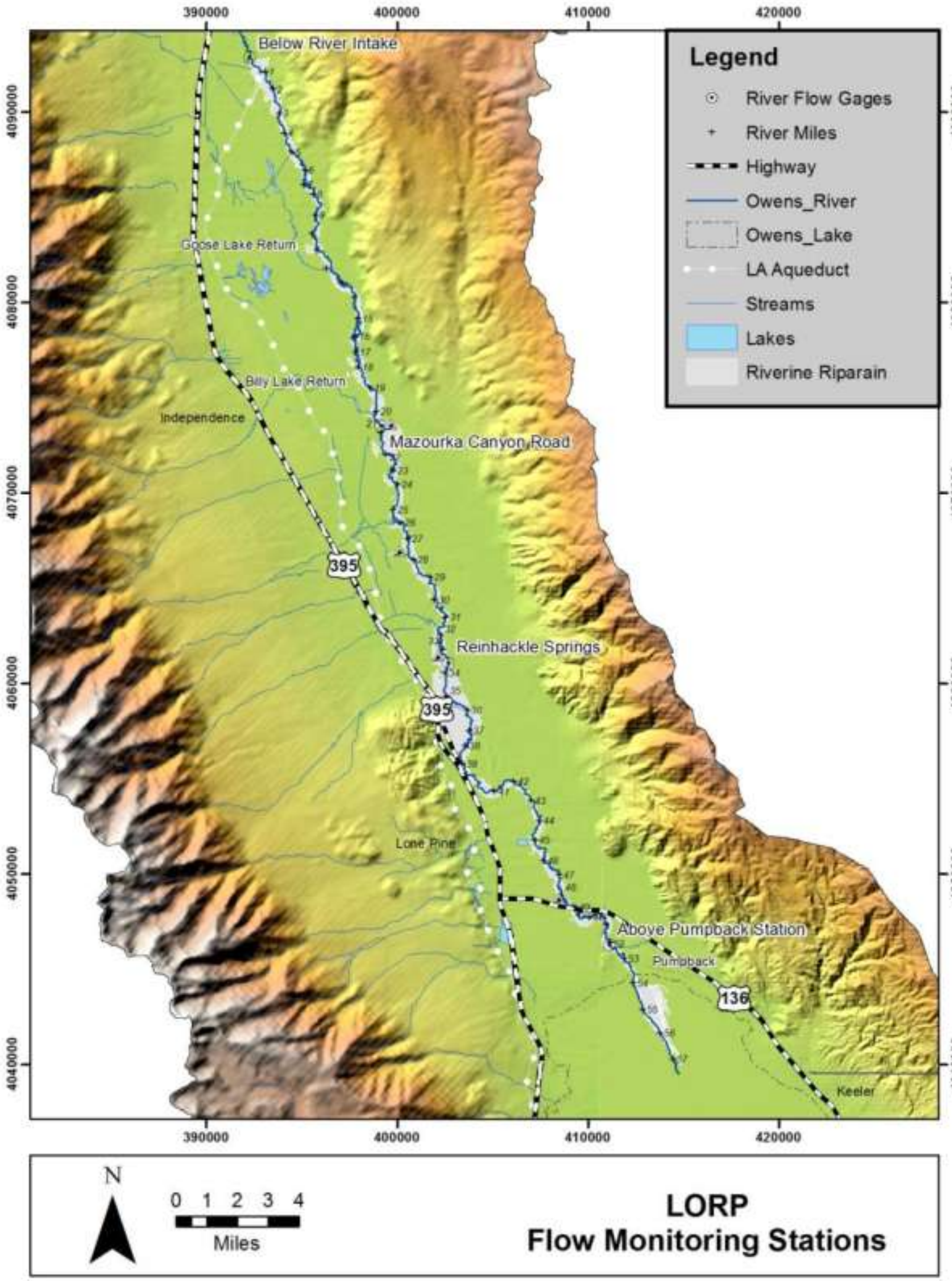
3.2 Hydrologic Infrastructure

Automated flow monitoring in the Lower Owens River occurred at four locations from the gated release at the LORP Intake to the Pumpback Station, upstream of the Delta. Flow is also monitored in six spillgate ditch tributaries. Seasonal Habitat Flow Table 1 lists the flow monitoring stations. Seasonal Habitat Flow Figure 1 displays the locations of the flow monitoring stations. Additional detailed information, including descriptions of base flow monitoring and flow measuring stations can be found in Section 4.3.1 of the *LORP Monitoring, Reporting, and Adaptive Management Plan* (Ecosystems Sciences 2008).

Seasonal Habitat Flow Table 1. LORP Measuring Stations with Altitude Values

STATION NAME	ALTITUDE (m)	ALTITUDE (ft)
***Below River Intake**	**1,164**	**3,818**
Above Blackrock Ditch Return	1,159	3,802
Goose Lake Return	1,154	3,786
Billy Lake Return	1,144	3,753
***Mazourka Canyon Road**	**1,140**	**3,740**
Locust Ditch Return	1,143	3,750
Georges Return Ditch	1,124	3,688
***Reinhackle Springs**	**1,119**	**3,671**
Alabama Gates	1,117	3,665
***Above Pumpback Station**	**NA**	**NA**
***Pumpback Station**	**1,098**	**3,602**

**** In-river stations***



Seasonal Habitat Flow Figure 1. Flow Monitoring Stations

3.3 Hydrographic Analysis

3.3.1 Seasonal Habitat Flows

Flows in the Lower Owens River and its tributaries, including return ditches, are monitored by LADWP's automatic and manual metering equipment. The maximum daily flow released from the LORP Intake during the seasonal habitat flow was 89 cfs on June 1. This resulted in a maximum daily average flow of approximately 73 cfs, reaching Mazourka Station on June 5, 76 cfs at Reinhackle on June 8, and 53 cfs at Above Pumpback Station on June 14. Flows returned to normal base flow conditions at all stations by June 19, 2012. See Seasonal Habitat Flow Appendix 1.

3.3.2 LORP Inflows

Just before the high flow release, the LORP inflows were 48 cfs at the Intake with an additional 40 cfs added down river at various augmentation points. The seasonal habitat flows were scheduled to be released at the Intake as described below.

Seasonal Habitat Flow Table 2. Prescribed Flow Change

Date	Prescribed Flow Change
May 29	from 46 to 50 cfs
May 30	from 50 to 63 cfs
May 31	from 63 to 79 cfs
June 1	from 79 to 88 cfs
June 2	from 88 to 70 cfs
June 3	from 70 to 56 cfs
June 4	from 56 to 46 cfs

3.3.3 Flow Peaks and Travel Times

The time for the peak 92 cfs flow to move down the LORP was approximately 13 days from the Intake to the Pumpback Station. Based on previous studies, the velocities averaged well under 1 ft/sec during the seasonal habitat flows. A schedule of the peaks and travel times taken at the Lower Owens River measuring stations is presented in the following table.

Seasonal Habitat Flow Table 3. Flow Peaks and Time Schedule

Station	Peak	Peak Flow (cfs)	Travel Time from Intake	Distance (miles)
Intake	June 1 at 8 p.m.	92	--	--
Mazourka	June 5 at 9 p.m.	75	4 days, 1 hour	24
Reinhackle	June 8 at 5 a.m.	79	6 days, 9 hours	13
Above Pumpback Station	June 14 at noon	53	13 days, 4 hours	21

The travel time for the 2012 seasonal habitat flows to move from the Intake to the Pumpback Station was similar to the 2009 seasonal habitat flows. Both flows were also similar in the amount of water released at their peak. In 2008, the total peak flow travel time was eight days, the quickest observed, likely due to little vegetation in the channel. In 2009 the travel time was 13 days, in 2010 increased to 16 days and 13 hours, in 2011 decreased to 15 days and 6 hours, and in 2012 decreased to 13 days and 4 hours. Since 2010 the trend in peak flow travel time has been decreasing.

3.3.4 Peak Flow Stage Height

At the Intake measuring station the water depth during peak release was 6.57 feet, 1.94 feet higher at peak flow compared to base flow on March 1, 2012. At Mazourka measuring station the stage height at peak flow was 4.68 feet, an increase of 0.36 feet compared to base flow. At Reinhackle measuring station (river mile 34) the stage height at peak flow was 4.03 feet, an increase of 0.73 compared to base flow. At Keeler Bridge the stage height was 4.11 feet on June 12, 2012, an increase of 0.24 feet over base flow on March 1, 2012.

3.3.5 Flooded Extent Mapping

Aerial digital imagery taken from a helicopter flyover of the LORP study area were used to map the flooded extent at base flow and peak flow during the seasonal habitat flow. These data were used to derive the amount of area flooded (expressed in acres), the types of landforms flooded when the peak high flow occurred at the various monitoring plots during the seasonal habitat flow. These methods are described below. Note that flow measurements discussed through the remainder of Section 3 are daily averages.

3.3.6 Site Scale - Plot Mapping Analysis Methods

Aerial digital video was taken when the peak flow was between the Mazourka measuring station and the Reinhackle measuring station on June 6, 2012. During the helicopter flights, staff captured high quality digital still images that were used for digital mapping of the flooded extent. Still frame digital images of plots were taken using a *Canon Powershot* digital camera.

The aerial photos were used to digitize flooded extent in *ArcView 10.1*. Baseflow digitized from 2011 and seasonal habitat flow flooded extent were digitized on screen, side-by-side with the digital imagery. Additionally, orthorectified aerial photos of the Owens Valley taken during early August 2009 were used as a background for digitizing.

Seasonal Habitat Flow Table 4. Average Daily Flow (cfs) and Date of Helicopter Flights

Date	Measuring Station (flows in cfs)			
	Intake (River mile 0)	Mazourka (River mile 20.7)	Reinhackle (River mile 34)	Above Pumpback Station (River mile 53)
05/28/12	48	48	64	43
05/29/12	49	50	65	51
05/30/12	64	50	67	54
05/31/12	78	50	65	55
06/01/12	89	51	64	59
06/02/12	82	56	64	57
06/03/12	67	62	61	53
06/04/12	56	69	61	46
06/05/12	51	73	65	44
*06/06/12	51	69	68	43
06/07/12	51	62	70	43
06/08/12	71	55	76	42
06/09/12	71	55	76	43
06/10/12	71	55	76	41
06/11/12	80	57	73	44
06/12/12	81	65	69	49
06/13/12	80	70	66	52
06/14/12	80	73	57	53
06/15/12	80	74	59	52
06/16/12	80	73	58	51
06/17/12	80	72	59	49
06/18/12	81	71	62	46
06/19/12	80	71	62	42

** Date of helicopter flight with aerial photos*

3.3.7 Flooded Area by Plot

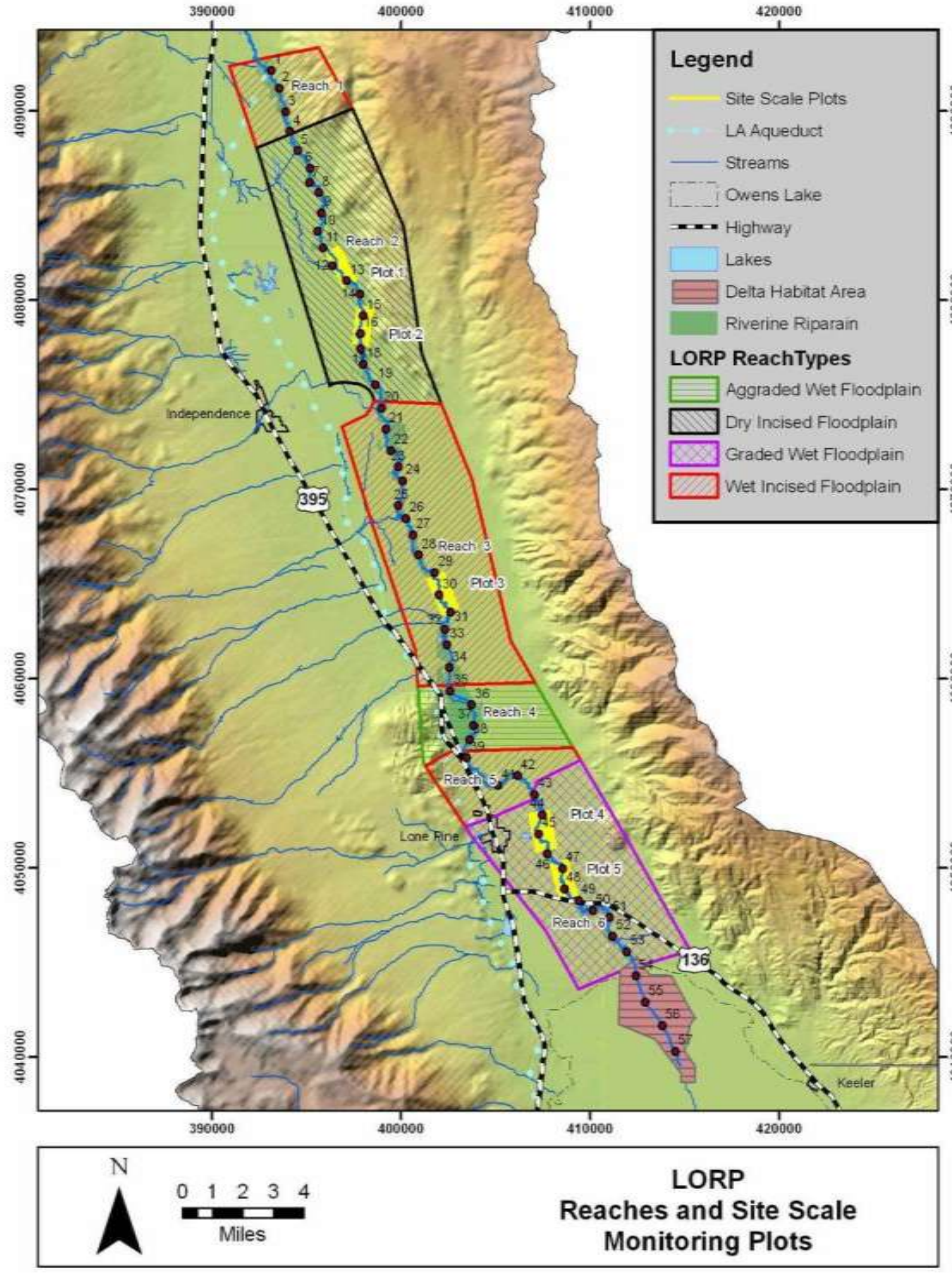
Flooded area is used to determine the amount of area (expressed in acres) flooded during the seasonal habitat flow. Only plot 2 in the formally dry incised floodplain reach and plot 3 in the wet incised flood plain reach were mapped. Plot 1 is in the same reach as plot 2 and the remaining reach (graded wet floodplain) with plots 4 and 5 did not experience a substantive flow increase due to attenuation of the low seasonal habitat flow peak release. The peak seasonal habitat flow in the graded wet floodplain was similar (and sometimes higher) to some periods during base flow. Flooded area per plot for the base flow and the peak flow (Seasonal Habitat Flow Table 5) was measured using each GIS shapefile digitized from the wetted extent data.

Seasonal Habitat Flow Table 5. Flooded Area by Plot at Base Flow and Peak Flow

Plot	Plot Size (Acres)	Flow	Amount Flooded (Acres)	Percent Flooded
2	164.7	Base flow	25.4	15.4%
2	164.7	Peak flow	28.1	17.1%
3	153.1	Base flow	36.0	23.5%
3	153.1	Peak flow	37.7	24.7%

3.3.8 Landform Types Flooded by Plot

Whitehorse Associates (WHA) mapped the landforms of the Lower Owens River in 2004 (WHA 2004). This mapping effort was performed before LORP flows were initiated, which leads to abnormally high percentage of inundation on these landforms, since these areas are now inundated at base flow. Inundation is calculated from this pre-project mapping; however, analysis is also performed that assesses inundation above base flow. It is also important to note that base flows are not consistent throughout the entire river, as the Lower Owens has losing and gaining reaches. Landforms that were identified in the plots include floodplain, low terrace, and high terrace. The *ArcGIS Analysis Intersect Tool* was used to clip the landforms shapefile to each flooded extent shapefile (base flow and peak flow associated with seasonal habitat flow). The landform and the wetted extent shapefiles were used to determine the landform types that were inundated during the seasonal habitat flows. Inundated landform type acreages were summed to determine the total acreage per landform type flooded during different flows (Seasonal Habitat Flow Table 6). Note that that total acreage inundated may be slightly lower than in Seasonal Habitat Flow Table 5 due to flooding that occurred outside of mapped landforms. The percent landform type flooded per plot was derived by dividing inundated landform type by the total acres of that landform type per plot (Seasonal Habitat Flow Table 8 and 9).



Seasonal Habitat Flow Figure 2. River Reaches and Site Scale Monitoring Plots

3.4 Results and Discussion

3.4.1 Base Flow and Peak Flow Flooded Extent Mapping

Results of the analyses are presented at two different scales: the site or plot scale and the river reach/river-wide scale. The site scale section describes the results of the site scale mapping. The variable, such as percent landform type flooded per plot, was derived from analysis of the site scale mapping and was used to extrapolate to the entire Lower Owens River.

3.4.2 Site Scale - Plot Analysis Results

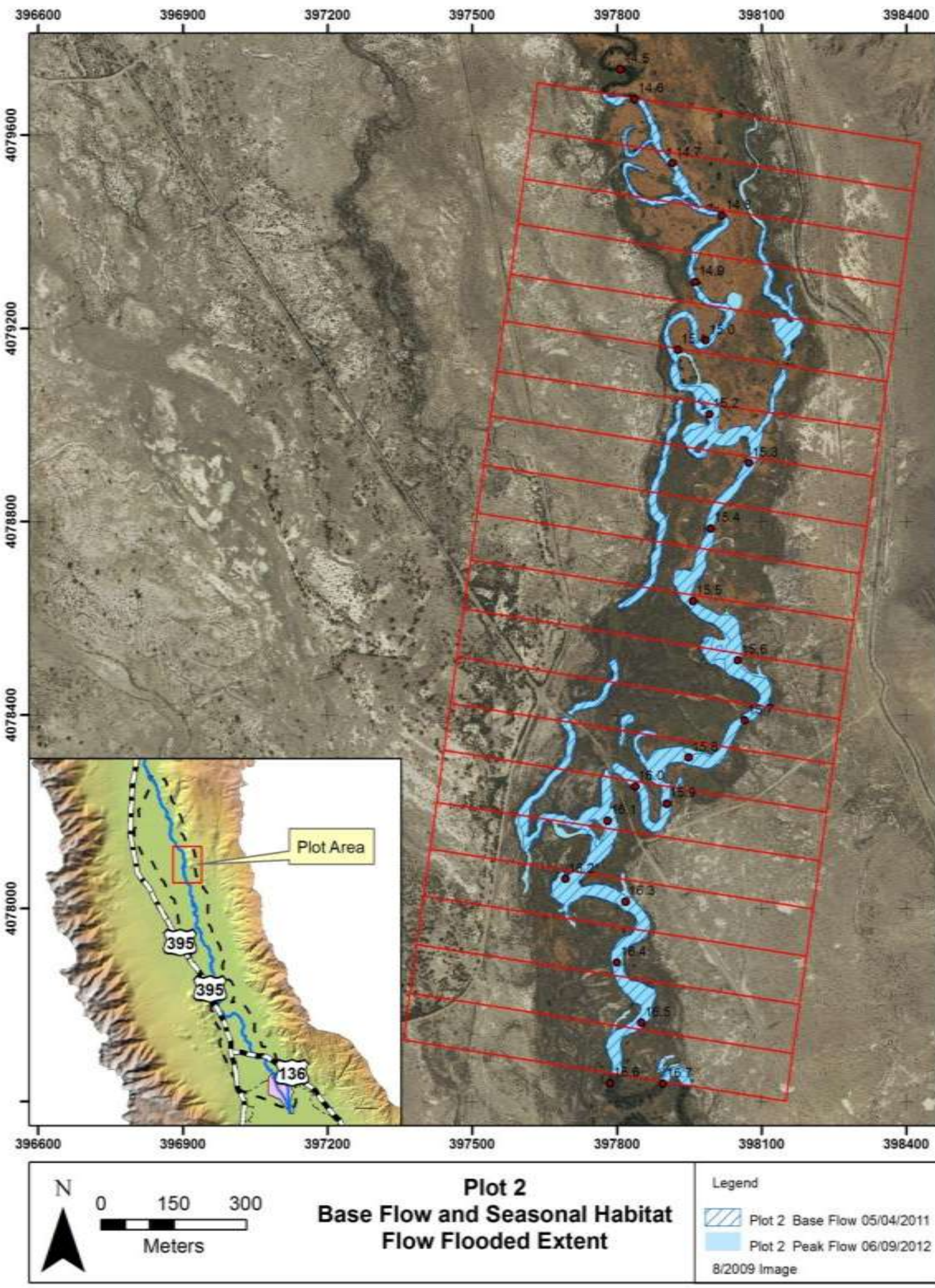
Seasonal Habitat Flow Table 6 present the percent flooded area per plot at base flow and peak flow levels. The following Seasonal Habitat Flow Figures 3 and 4, present the digitized flooded extent at base and peak flow. Plot 2 flooded extent increased by 2.6 acres. Plot 2 had 0.3 acres of off-channel area flooded at base flow which increased to 0.77 acres flooded during peak flow. Plot 3 inundated acreage increased by1.7 acres during peak flow. Plot 3 had 2.04 acres of off-channel area flooded at base flow which decreased to 1.33 acres during peak flow.

<u>Landforms Flooded</u>

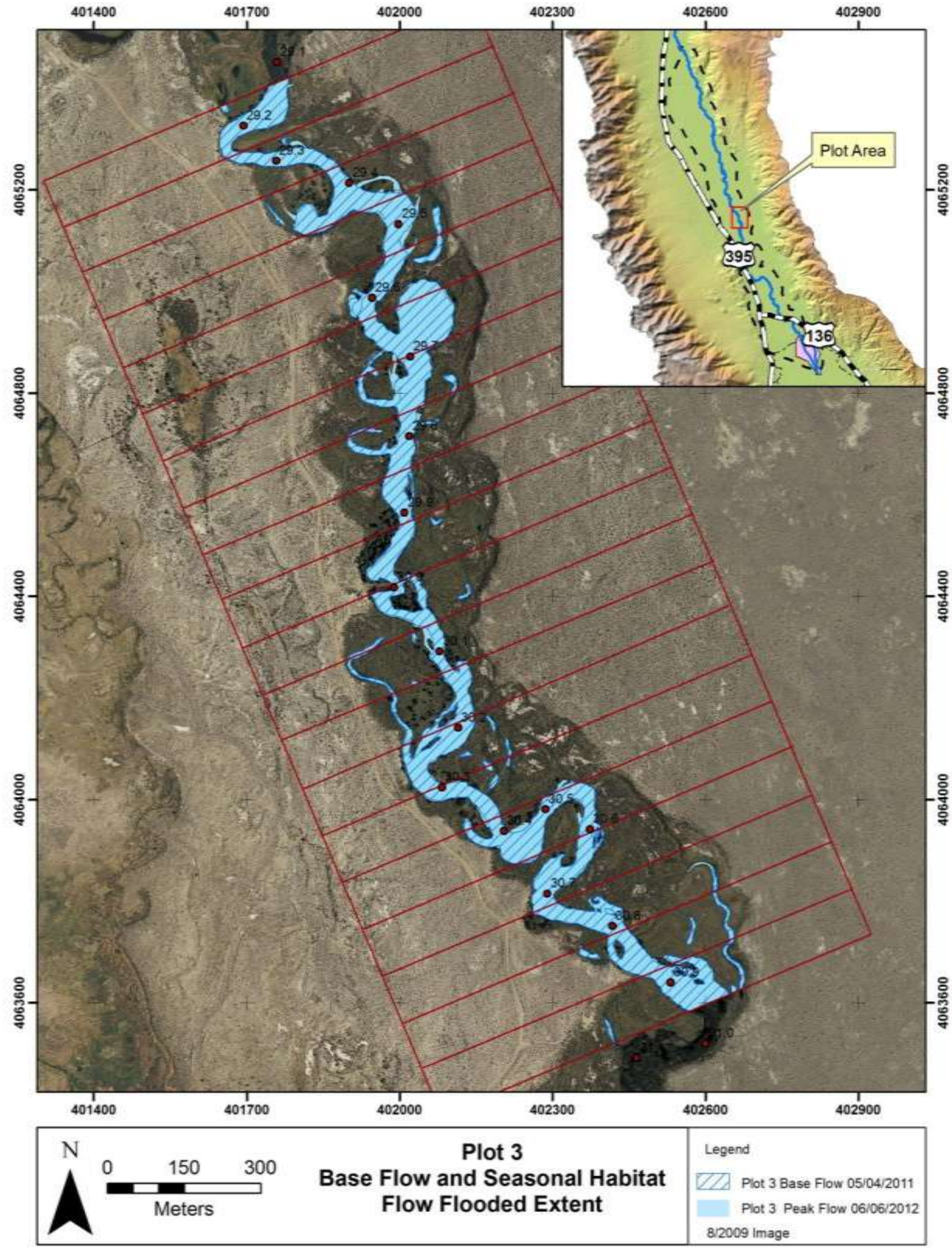
Plot 2, located in the formally dry incised floodplain reach type, contains narrow floodplains flanked by high terraces, experienced flooding on only 50.9% of its floodplains during base flows and 55.5% during peak flows. Plot 3 had the highest percentage of floodplain flooded of the monitoring plots, 78.9% during peak flow. Most of the flooding at peak flow occurs on the floodplain. There is some inundation of terraces adjacent to the floodplain; the wet incised floodplain (Plot 3) experienced the highest inundated acreage of terraces with 9.1 acres, since most of the floodplain in this reach is inundated at peak flow.

Seasonal Habitat Flow Table 6. Landform Acreage Inundated by Plot at Base Flow and Peak Flow

Plot	Flow	Floodplain (Acres)	Floodplain (%)	Low Terrace (Acres)	Low Terrace (%)	High Terrace (Acres)	High Terrace (%)
2	Base	22.9	50.9%	0.0	0.0%	2.0	1.7%
2	Peak	25.1	55.5%	0.0	0.0%	2.5	2.1%
3	Base	28.2	77.8%	7.6	10.3%	0.1	0.3%
3	Peak	28.6	78.9%	8.9	12.0%	0.2	0.4%



Seasonal Habitat Flow Figure 3. Plot 2 Flooded Extent



Seasonal Habitat Flow Figure 4. Plot 3 Flooded Extent

3.5 References

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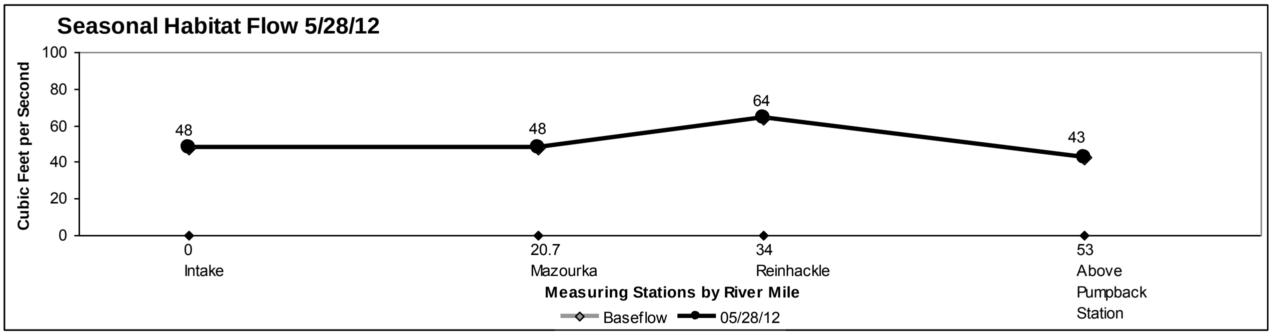
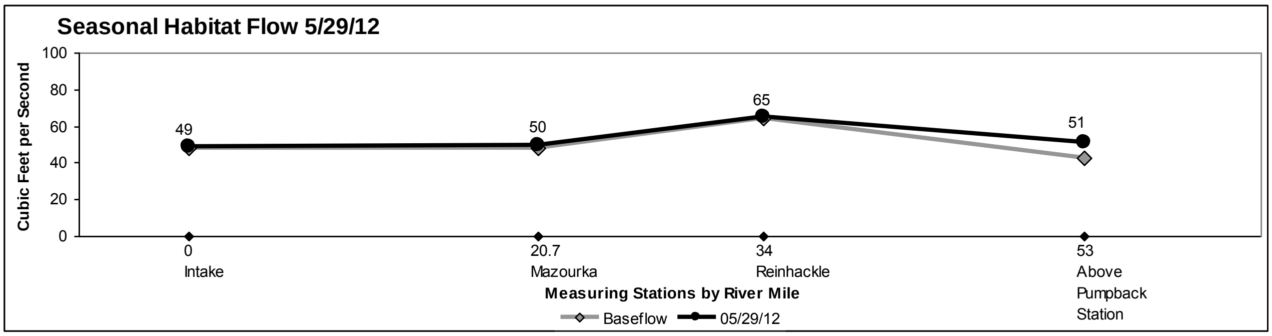
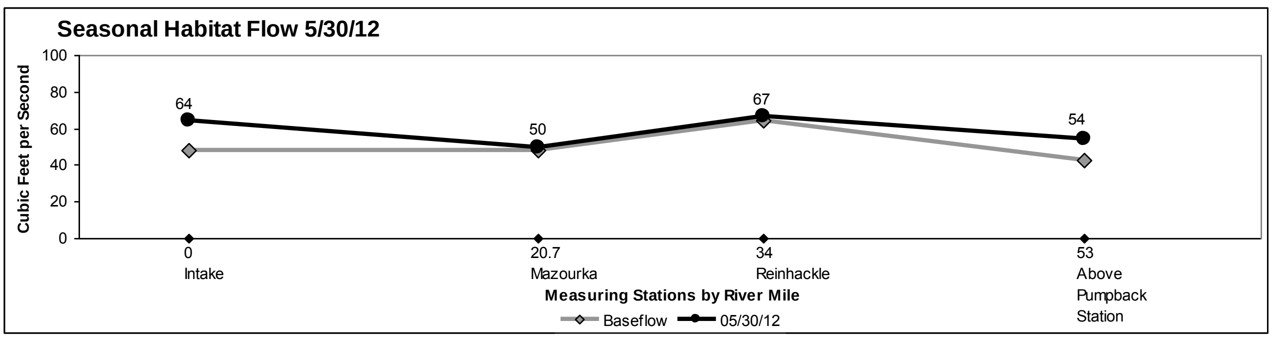
3.6 Seasonal Habitat Flow Appendices

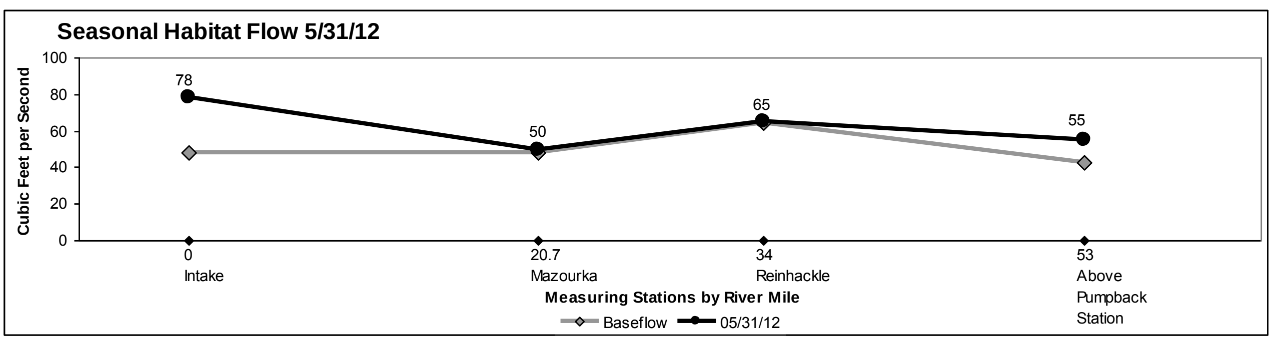
Appendix 1. Daily Average River Flow by Measuring Station and River mile for each day that the flow release occurred.

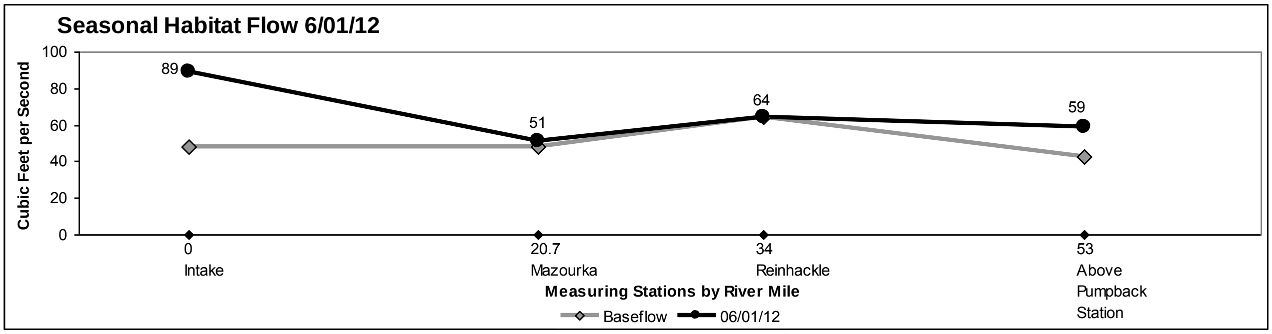
Values reported at the Pumpback Station represent the amount of flow being pumped back to the LAA. The difference between the Above Pumpback Station and Pumpback Station is the amount of water released to the Owens Lake Delta.

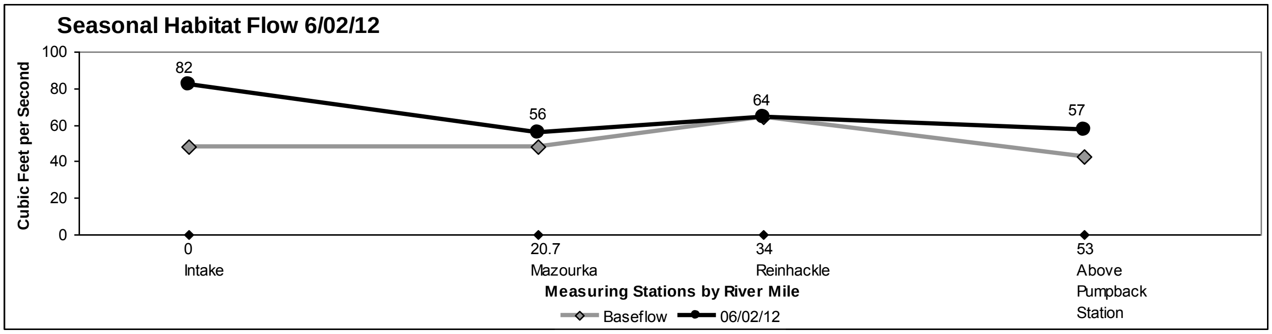


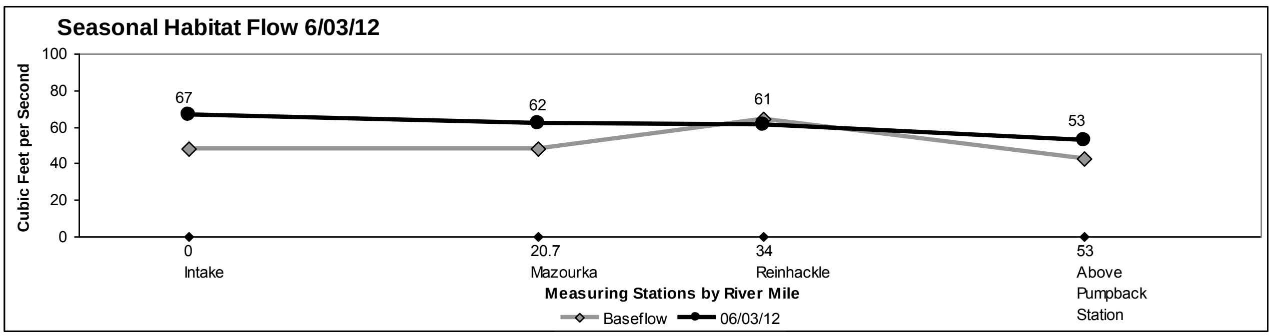


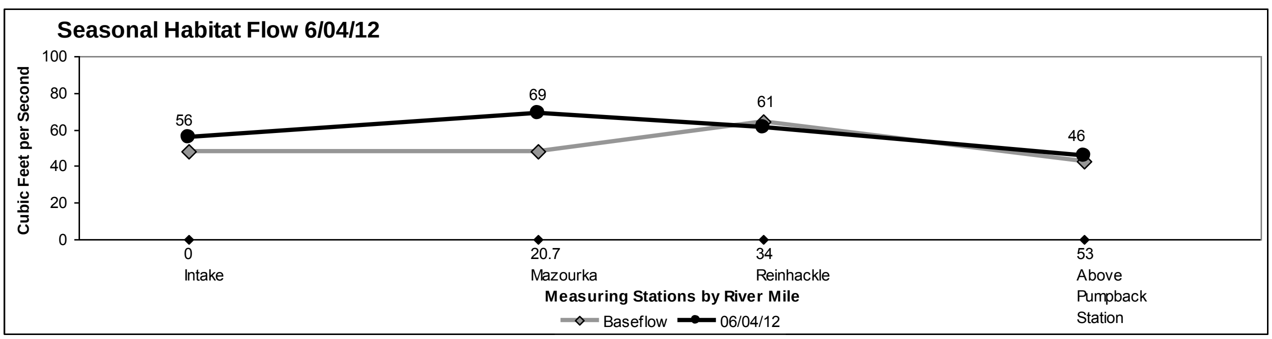


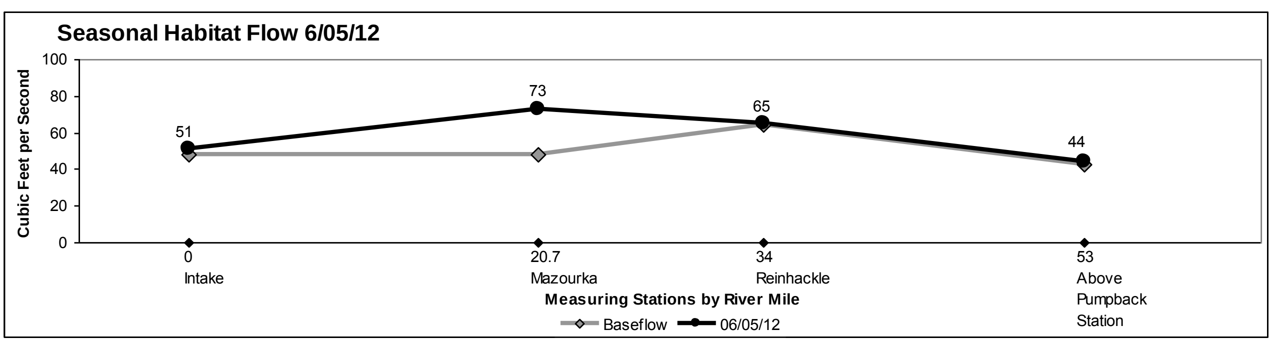


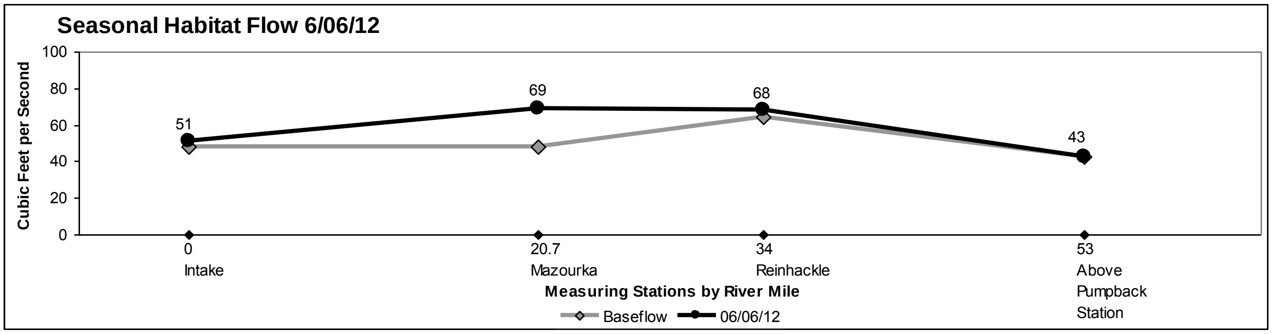

Seasonal Habitat Flow 6/01/12
Cubic Feet per Second
100
80
60
40
20
0
89
51
64
59
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/01/12


Seasonal Habitat Flow 6/02/12
Cubic Feet per Second
100
80
60
40
20
0
82
56
64
57
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/02/12

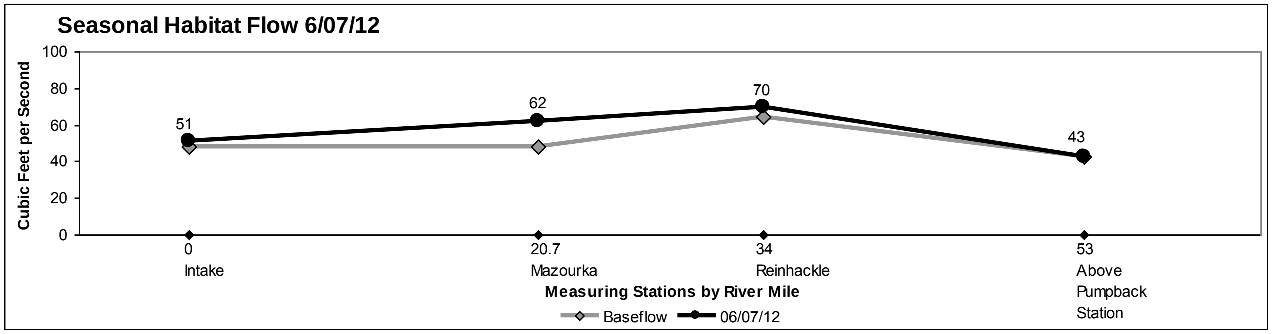

Seasonal Habitat Flow 6/03/12
Cubic Feet per Second
100
80
60
40
20
0
67
62
61
53
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/03/12


Seasonal Habitat Flow 6/04/12
Cubic Feet per Second
100
80
60
40
20
0
56
69
61
46
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/04/12

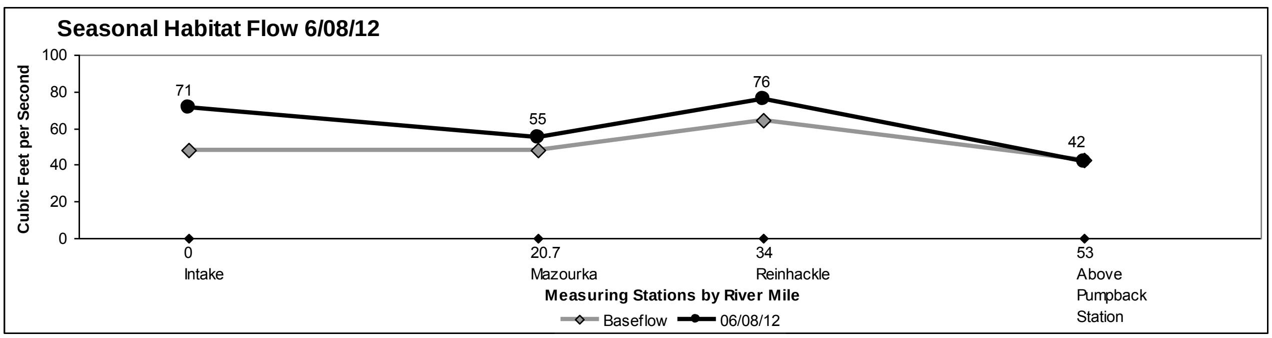

Seasonal Habitat Flow 6/05/12
Cubic Feet per Second
100
80
60
40
20
0
51
73
65
44
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/05/12



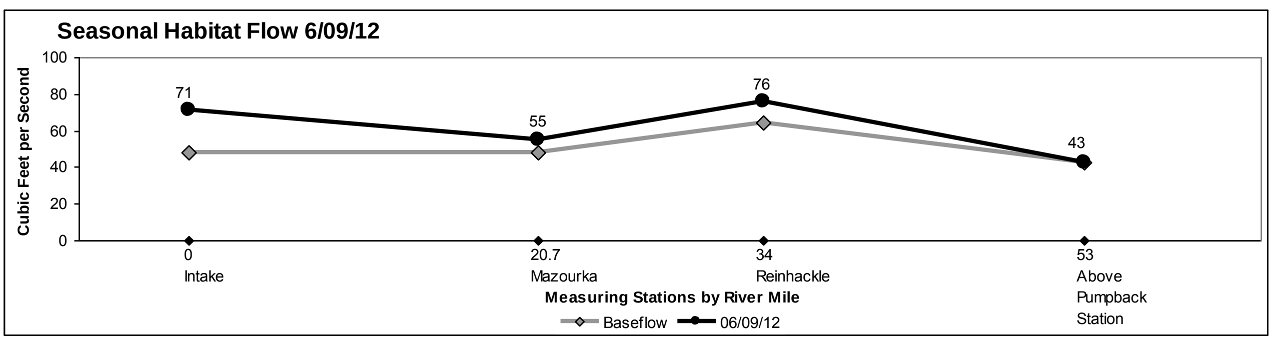
Seasonal Habitat Flow 6/06/12
Cubic Feet per Second
100
80
60
40
20
0
51
69
68
43
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/06/12



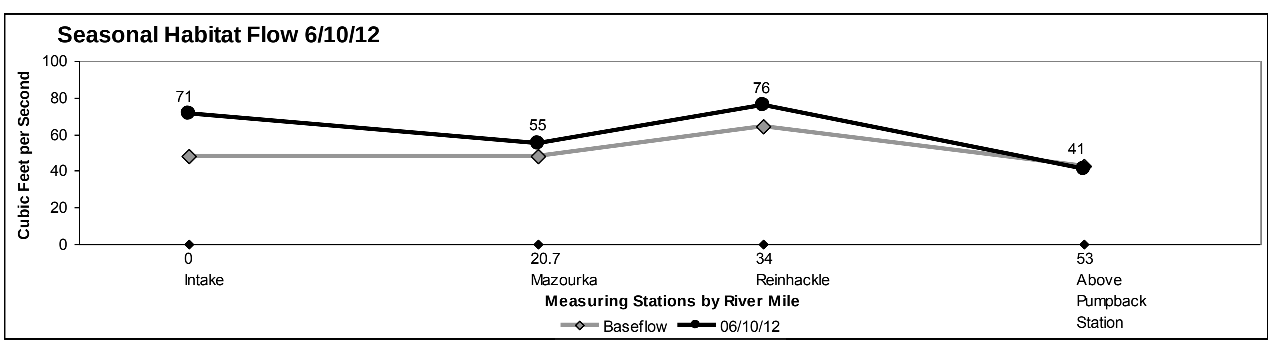
Seasonal Habitat Flow 6/07/12
Cubic Feet per Second
100
80
60
40
20
0
51
62
70
43
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/07/12



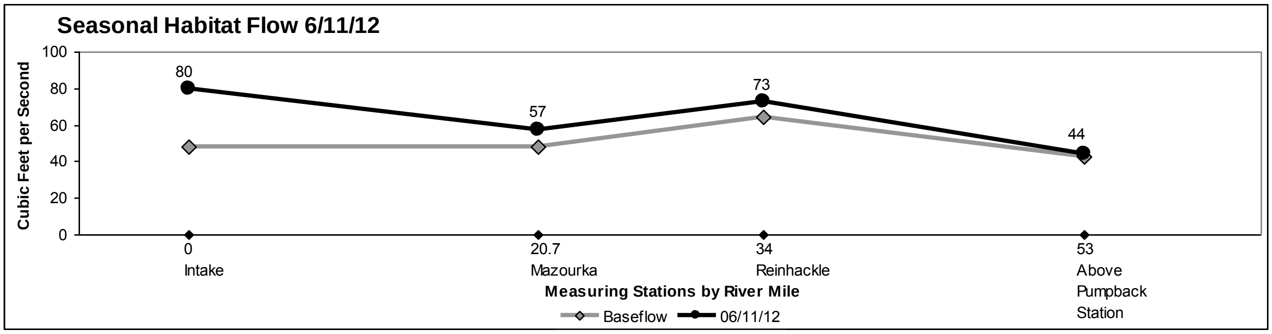
Seasonal Habitat Flow 6/08/12
Cubic Feet per Second
100
80
60
40
20
0
71
55
76
42
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/08/12



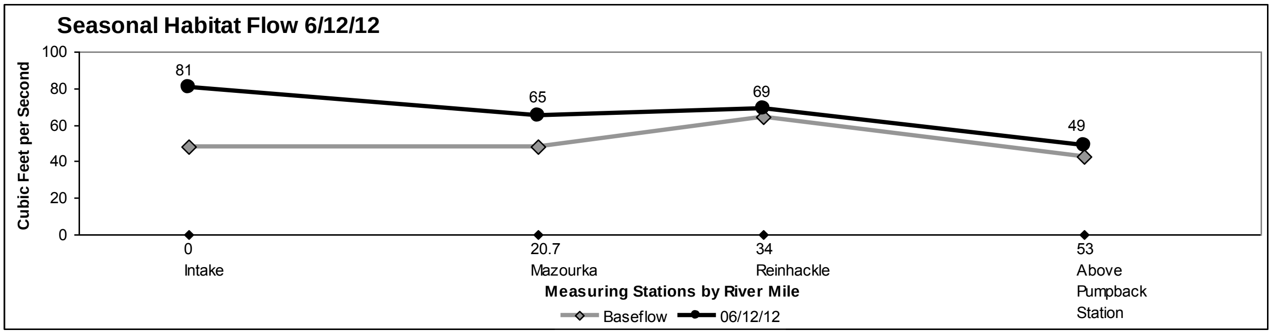
Seasonal Habitat Flow 6/09/12
Cubic Feet per Second
100
80
60
40
20
0
71
55
76
43
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/09/12



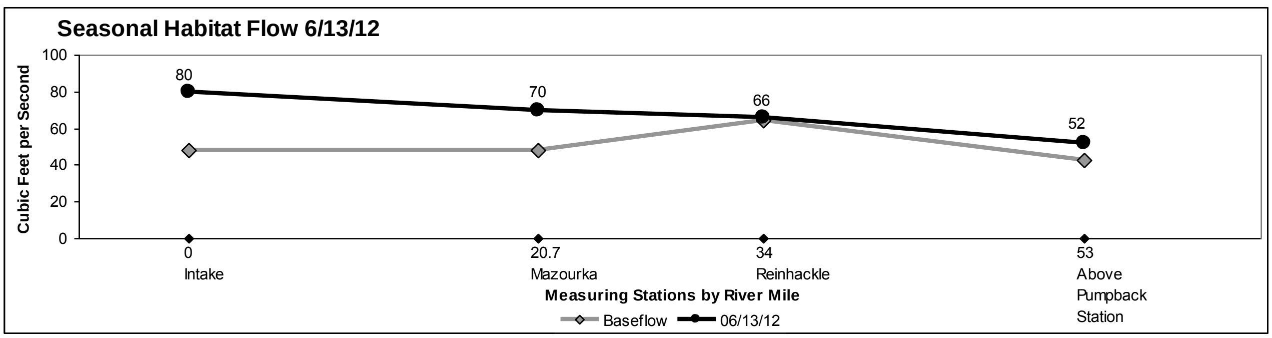
Seasonal Habitat Flow 6/10/12
Cubic Feet per Second
100
80
60
40
20
0
71
55
76
41
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/10/12



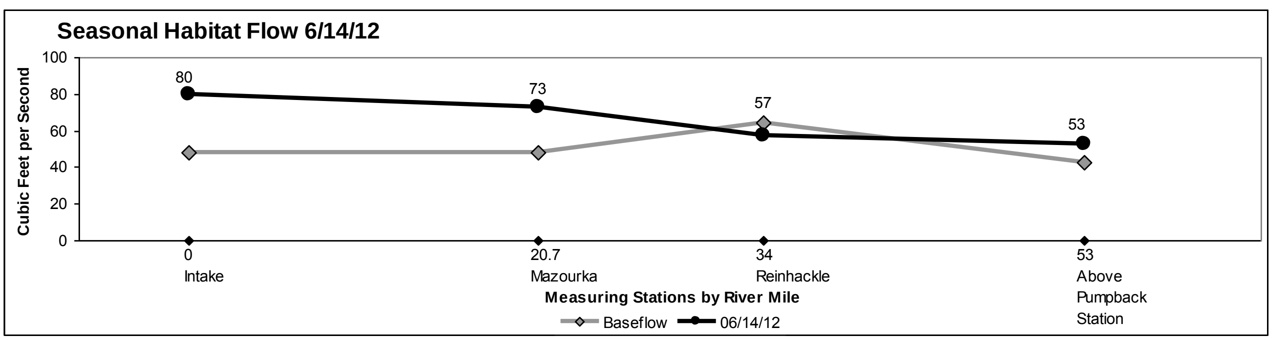
Seasonal Habitat Flow 6/11/12
Cubic Feet per Second
100
80
60
40
20
0
80
57
73
44
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/11/12



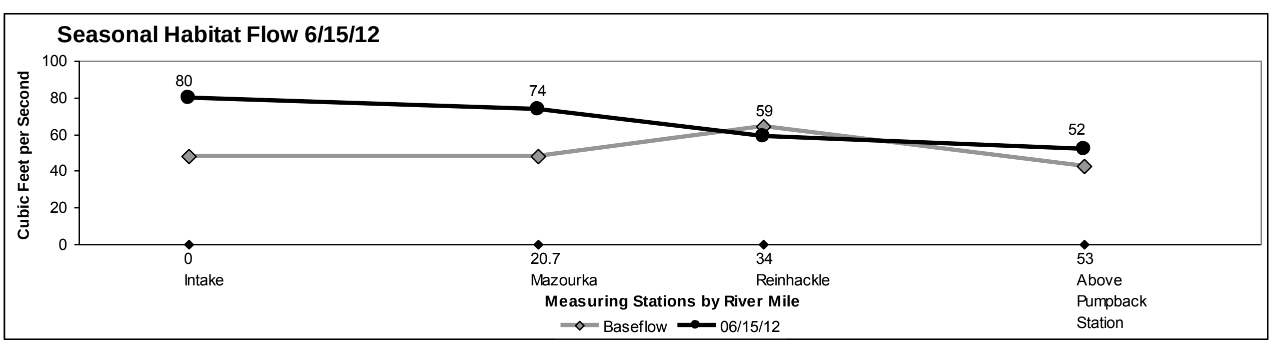
Seasonal Habitat Flow 6/12/12
Cubic Feet per Second
100
80
60
40
20
0
81
65
69
49
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/12/12



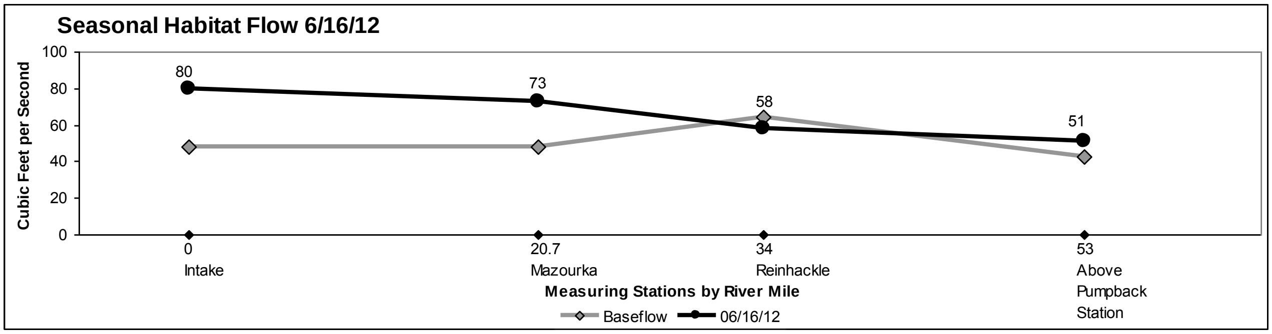
Seasonal Habitat Flow 6/13/12
Cubic Feet per Second
100
80
60
40
20
0
80
70
66
52
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/13/12

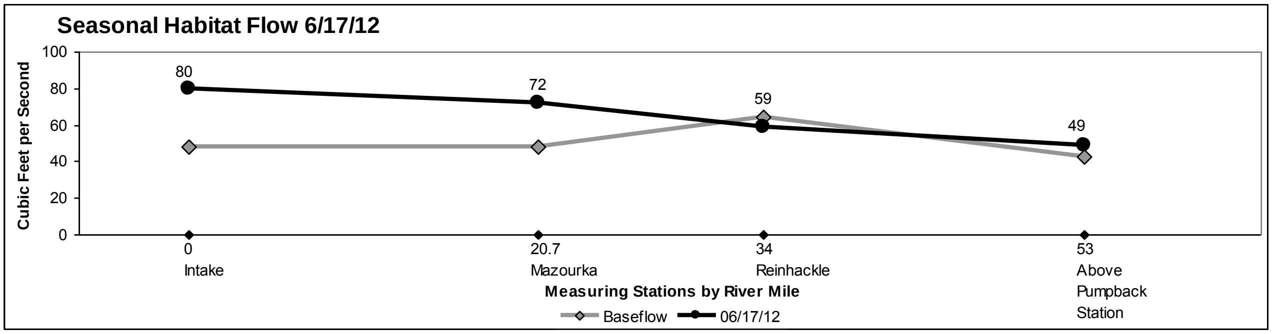


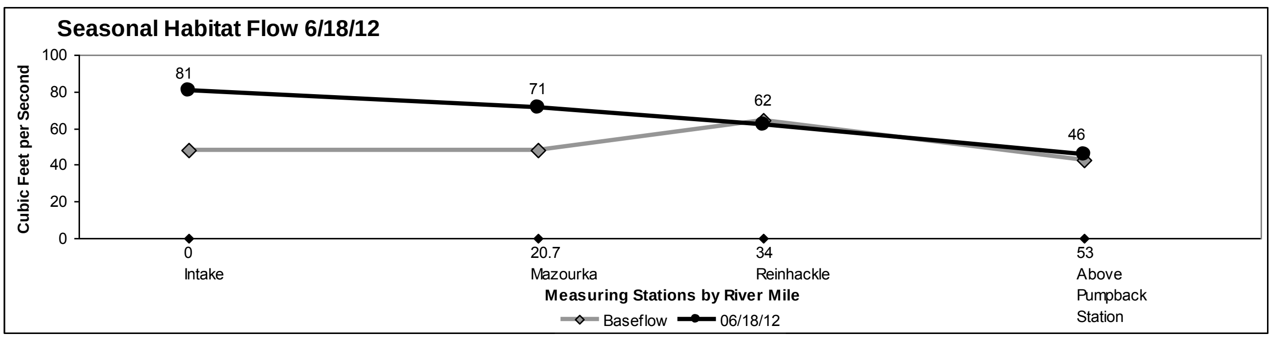
Seasonal Habitat Flow 6/14/12
Cubic Feet per Second
100
80
60
40
20
0
80
73
57
53
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/14/12

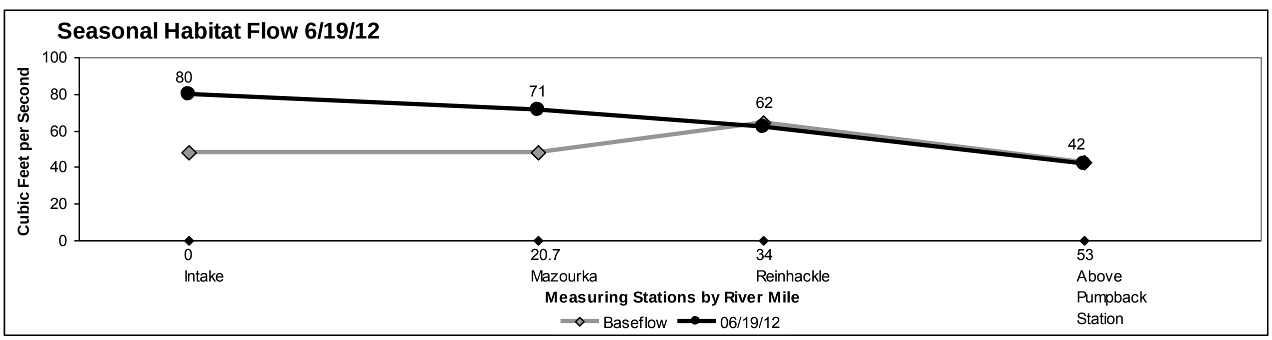


Seasonal Habitat Flow 6/15/12
Cubic Feet per Second
100
80
60
40
20
0
80
74
59
52
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/15/12


Seasonal Habitat Flow 6/16/12
Cubic Feet per Second
100
80
60
40
20
0
80
73
58
51
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/16/12


Seasonal Habitat Flow 6/17/12
Cubic Feet per Second
100
80
60
40
20
0
80
72
59
49
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/17/12


Seasonal Habitat Flow 6/18/12
Cubic Feet per Second
100
80
60
40
20
0
81
71
62
46
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/18/12


Seasonal Habitat Flow 6/19/12
Cubic Feet per Second
100
80
60
40
20
0
80
71
62
42
0
Intake
20.7
Mazourka
34
Reinhackle
53
Above
Pumpback
Station
Measuring Stations by River Mile
Baseflow
06/19/12

4.0 LAND MANAGEMENT

4.1 Land Management Summary

The 2012 Lower Owens River Project (LORP) land management monitoring efforts continued with monitoring utilization across all leases, rare plant monitoring, and streamside monitoring for woody establishment. Range trend macroplots were monitored on the Lone Pine and Twin Lakes leases as well as all the floodplain macroplots along the former dry-reach section of the LORP north of Two Culverts to the Intake. Irrigated pasture condition scoring was conducted on leases that rated below 80% the previous year.

In general, pasture utilization adhered to standards established for both riparian (up to 40%) and upland (up to 65%) areas. Use on the Blackrock Lease was lower than most other leases in the project area remaining well below all grazing standards. All other leases adhered to utilization standards except the Islands and Twin Lakes leases. The Islands Lease had over utilization in the River Field (50%) and Depot Riparian (64%). Twin Lakes had over utilization in the Upper Blackrock Field (61%) and Lower Blackrock Field (54%). Use in the Thibaut Field in the Thibaut Lease was below the allowable standard due in part to the utilization standards being removed for the Waterfowl Management Area prior to burning. This allowed much of the grazing pressure to be removed from the rest of the lease. Watershed Resources staff are concerned with the continued dry weather conditions expected for the 2012-13 grazing season. Utilization rates will not be adjusted for dry conditions in upland or riparian pastures.

Irrigated pastures in the Islands, Lone Pine and Delta Leases all had rated above the minimum rating standard of 80% in 2010; therefore, they did not need to be rated in 2012. The Thibaut Lease rated 82% in 2011 and 81% in 2012 meeting the minimum score of 80%. The lessee and LADWP are in the process of improving this score. All irrigated pastures in the LORP will be evaluated again in 2013.

2012 was the fourth year of collecting trend plot data for *Sidalcea covillei* and *Calochortus. excavatus* for the LORP. While no statistical analysis has been conducted on this data, it indicates thus far that populations of both *S. covillei* and *C. excavatus* are generally static. However, *S. covillei* appears to be decreasing in the exclosure in the Robinson Pasture in the Blackrock Lease, as documented in the Robinson 1EX plot. In contrast, plots surveyed in the Springer Pasture in the Blackrock Lease where no plants are excluded are markedly increasing. Future data will be useful to further define trends of *S. covillei* and *C. excavatus* within the LORP area.

The Streamside Monitoring Protocol underwent modifications this year with an expansion of quadrat size, quantitative definitions for varying levels of browsing, and the selection of additional sites where tree willow establishment is actively occurring. These changes provided useful insights into understanding browsing levels in the spring compared to summer use of willows, provided evidence that there is a correlation between increased livestock grazing precipitating a shift to increased tree willow browsing, and increased the sampling population of juvenile tree willows, allowing for more accurate trend estimates.

4.2 Introduction

The land use component of this report is composed of project elements related to livestock grazing management. Under the land management program, the intensity, location, and duration of grazing is managed through the establishment of riparian pastures, forage utilization rates, and prescribed grazing periods (described in Section 2.8.1.3 and 2.8.2 LORP EIR 2004). Other actions include 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 throughout the leases. In 2010, an additional monitoring component was added to note woody establishment that is occurring in the LORP following project implementation.

Grazing management plans developed for the LORP leases modified grazing practices in riparian and upland areas on seven LADWP leases in order to support the 40 LORP goals as written in the EIR. 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 2012, are presented by lease in Section 4.10, LORP Ranch Leases.

4.2.1 Utilization

The *Lower Owens River Monitoring Adaptive Management and Reporting Plan* (Ecosystem Sciences 2008), developed as part of the LORP Plan, identifies grazing utilization standards for upland and riparian areas. Utilization is defined as the percentage of the current year's herbage production consumed or destroyed by herbivores. Grazing utilization standards identify the maximum amount of biomass that can be removed by grazing animals during specified grazing periods. LADWP has developed height-weight relationship curves for native grass and grass-like forage species in the Owens Valley using locally-collected plants. These height-weight curves are used to relate the percent of plant height removed with the percent of biomass removed by grazing animals. Land managers can use this data to document the percent of biomass removed by grazing animals and determine whether or not grazing utilization standards are being exceeded. 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.

The calculation of utilization (by transect and pasture) is based on a weighted average. Therefore, species that only comprise a small part of available forage contribute proportionally less to the overall use value than more abundant species.

4.2.2 Riparian and Upland Utilization Rates and Grazing Periods

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

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

4.2.3 Utilization Monitoring

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

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

These standards are not expected to be met precisely every year because of the influence of annual climatic variation, livestock distribution, and the inherent variability associated with techniques for estimating utilization. Rather, these levels should be reached over an average of several years. If utilization levels are consistently 10% above or below desired limits during this period 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 approximately mid-way through the grazing period (mid-season) and again at the conclusion of the grazing period (end-of-season).

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

4.3 Range Trend

4.3.1 Overview of Monitoring and Assessment Program

A description of monitoring methods, data compilation, and analysis techniques can be found in the *2008 LORP Monitoring, Adaptive Management and Reporting Plan*. More detailed discussion of the Range Trend methods and considerations for interpretation can be found in previous LORP Annual Monitoring reports. Descriptions of the range trend monitoring sites and their locations on the leases can be found in the individual lease monitoring narratives and maps in this section. Nested frequency, shrub cover data are presented for each lease and are presented as range trend transect data tables for each sampling transect and sampling year.

Range trend monitoring for 2012 involves the quantitative sampling of the following attributes: nested frequency of all plant species and line intercept sampling for shrub canopy cover. Photo documentation of the site conditions is included as part of range trend monitoring.

Because frequency data is sensitive to plant densities and dispersion, frequency is an effective method for monitoring and documenting changes in plant communities (Mueller-Dombois and Ellenberg, 1974; Smith et al., 1986; Elzinga, Salzer et al., 1988; BLM 1996; Heywood and DeBacker, 2007). For this reason frequency data is the primary means for evaluating trend at a given site. Based on recommendations for evaluating differences between summed nested frequency plots (Smith et al., 1987 and Mueller-Dombois and Ellenberg, 1974), a Chi-Square analysis with a Yate's correction factor was used to determine significant differences between years. Analysis compared 2012 data to the prior sampling period (2010). If there were significant differences, 2012 results were compared to all sampling events during the baseline period to determine if results in 2012 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 beardless wildrye (*Leymus triticoides* [LETR]). Only 10% of the total plant community is expected to be composed of shrubs and the remaining 10% forbs. This ecological site does not include actual river or stream banks. Stream bank information is available from the Rapid Assessment Survey (RAS) reports and the Streamside Monitoring Report. These data from 2012 of monitoring will be presented in this section of the 2012 LORP Annual Report.

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

During the preproject 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 to the variability in precipitation during the baseline period. This provided the Watershed Resources staff an opportunity to sample across a broad amplitude of ecological conditions for these sites, which contributed to a robust baseline dataset. Data from the Lone Pine rain gauges are used to determine the growing conditions for each sampling year on the Islands, Lone Pine, and Delta Leases. Precipitation data from Independence are used for the Thibaut and Blackrock Leases, and data from the Intake will be used for the Intake, Twin Lakes, and the northern portion of the Blackrock Leases.

Per adaptive management recommendations a modified range trend schedule was implemented beginning this year. This schedule will ensure that there will be some monitoring across the landscape annually, increasing the probability of documenting the influence of significant changes in climate or management on the various ecological sites in the LORP area.

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

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

4.4 Irrigated Pastures

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

All irrigated pastures were monitored in 2010. Pastures that scored 80% or below have been monitored in 2012. The results of the monitoring will be presented in a table format by lease in Section 4.9. Irrigated pasture condition scoring for all pastures will take place again in 2013.

4.5 Fencing

No new fence construction occurred within the LORP project boundaries in 2012-13.

4.6 Rare Plants

Baseline data for the LORP rare plant trend plots was collected in 2009. Data has also been collected in 2010 and 2011. There are 15 trend plots within the LORP located in four rare plant populations on two separate ranch leases (Blackrock and Thibaut Leases). Target species are Owens Valley checkerbloom (*Sidalcea covillei*) and Inyo star-tulip (*Calochortus excavatus*). *S. covillei* is a state endangered species, endemic to the Owens Valley that occurs in alkali meadows. *C. excavatus* is not a state or federally listed species but is a Species of Special Concern. A mesic species, *C. excavatus* occurs in alkaline meadows and seeps transitioning into chenopod scrubland.

These plots will be monitored for five years to evaluate population trends. If trends are static or suggest that grazing is beneficial, the exclosure fencing will be removed following the fifth year of monitoring. In contrast, if trends in data support that exclosures are needed to protect these populations of *S. covillei*, then LADWP will construct additional exclosures (or a practical variation thereof) and monitoring will continue as needed.

4.6.1 Rare Plant Monitoring Methods

The LORP rare plant trend plots were established inside and outside exclosures by sinking a piece of rebar into the earth and taking a GPS point of the location. The plots were relocated using a hand-held GPS unit and a metal detector. Two 50-meter measuring tapes were used to delineate the plot into four sections with a radius of 3.62 meters. Target species were marked with a pin flag to aid in accurately identifying all individuals within the plot. Photos were taken in all cardinal directions depicting the plot area containing flagged plants. One measuring tape was then attached to the rebar in the center of the plot to record the distance of individuals within a radius of 3.62 meters. A compass was used to record the bearing of individuals from the center of the plot. The bearing and distance from the center of the plot is utilized in subsequent years to relocate individual plants. Data on recruitment, persistence, size of individuals, and flowering and seed presence were collected. This data is provided below by lease.

4.6.2 Rare Plant Summary

2012 was the fourth year of collecting trend plot data for *S. covillei* and *C. excavatus* for the LORP. While no statistical analysis has been conducted on this data, it indicates thus far that populations of both *S. covillei* and *C. excavatus* are generally static. However, *S. covillei* appears to be decreasing in the exclosure in the Robinson Pasture in the Blackrock Lease, as documented in Robinson 1EX. In contrast, plots surveyed in the Springer Pasture in the Blackrock Lease where no plants are excluded are markedly increasing. These differences could be due to a number of factors that include, but are not limited to: whether or not the plot is excluded from livestock grazing, recent precipitation patterns, or other surface water uses such as irrigation, or could be a combination of influences at these sites. Future data will be useful to further illustrate trends of *S. covillei* and *C. excavatus* within the LORP area.

4.7 Discussion Range Trends in 2012

Twin Lakes and the Lone Pine Lease Range Trend transects were read this summer along with transects located along the former ‘dry reach’ from Twin Culverts to the north. Despite the dry year and heavy utilization on the Twin Lakes Lease, trends remain either stable or slightly upward. Perennial grasses either remained static or increased across the two leases. The only real evidence of drought was a decrease in Fivehorn smotherweed across all sites.

Range trend plots on the ‘former dry reach’ section continue to show dynamic changes with significant increases in saltgrass and sun heliotrope (HECU) and decreases in Fivehorn smotherweed (BAHY) and Nevada saltbush. There are significant diebacks of Nevada saltbush along the river in the Thibaut section. The dead shrubs showed massive amounts of sap exiting branches and soils were saturated indicating that the dieback is likely a result of a rising water table either from naturally rising water tables from returned flows to the river or augmented flows this summer to meet downstream flow requirements.

Land Management Table 2. Significant changes in plant frequencies for former dry reach section, 2010 and 2012

	No Change	DISP	JUBA	ATTO	BAHY	HECU	MALE
Moist Flood Plain							
THIBAUT_04*				↓	↓**		
THIBAUT_05*					↓**	↑	
THIBAUT_06*		↑			↓	↑	
THIBAUT_07*					↓**		
TWINLAKE_04*					↓		
TWINLAKE_06*		↑		↓			
BLKROC_10*					↓		
BLKROC_11				↓	↓		
BLKROC_14					↓		

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

4.8 Streamside Monitoring for Woody Species

In response to adaptive management recommendations by the MOU consultants, LADWP implemented a streamside monitoring program in 2010. The objective of the monitoring effort was to document establishment of woody vegetation in the riparian corridor of the LORP, browsing activity, and streamside conditions that were being missed in other monitoring activities. The monitoring approach evaluated vegetation and bank attributes within a 3 meter wide belt extending from the summer base flow water's edge into the adjacent riparian area. There were16 locations on the river that were surveyed, sampling conditions on both sides of the river for a total of 32 transects. This streamside monitoring effort was to be conducted twice a year for the first three years (if needed) to establish baseline conditions, and then once annually at 3-year intervals until the completion of all project monitoring in 2022. The timing of the monitoring was designed to be completed in the spring and late summer/early fall to correspond with livestock rotation. The complete streamside monitoring protocol can be found in *Land Management Appendix 4 in the 2010 Final Lower Owens River Project Annual Report*.

MOU consultants made several adaptive management recommendations in the *2011 LORP Annual Report* to modify the protocol for Streamside Monitoring for Woody Species. In response, LADWP Watershed staff developed several modifications to the protocol: quadrat size was expanded from 3m to10m in width from the river's edge at base flow in an effort to capture additional woody riparian trees. The 100m length remains unchanged, resulting in a $10000m^2$ sampling area for each transect. This expansion of quadrat size precluded the need to record canopy overhang which was dropped this year. A count of all inundated 'in channel' trees at base flow level from the transect edge, across to the other side of the river was incorporated into the protocol. The objective for this is to track survivability of older pre-LORP trees which colonized the bottom of the channel prior to the return or augmentation of flows throughout the LORP. These existing trees presently serve as the primary seed source for tree establishment. When future aerial imagery becomes available, trends for in-channel trees will be further explored as it is difficult at times for field crews to see all in-channel trees due to the obstruction of cattails (*Typha domingensis)* and tules (*Schoenoplectus acutus*). A refined classification of browsing was integrated into the protocol this spring. Rather than noting only if a tree was browsed or not, each tree was evaluated as either no leaders browsed (0%), less than 25% leaders browsed, or greater than 25% of leaders browsed for trees less than 6 feet in stature. Two underlying assumptions are that juvenile trees can typically withstand the removal of less than 25% of its leaders before overall growth of the tree becomes stunted, the second assumption is that trees that exceed 6 feet will be able to grow to their natural heights because they will have grown above the browse line (Platts, personal communication, 2012). To monitor highlining of mature trees greater than 6 feet, the same classes of leader use were applied to leaders below the browse line which was typically less than 6 feet. The final modification to the streamside monitoring for woody species regeneration was the dropping of belt transects which showed little potential to glean any understanding of woody riparian establishment and survivability on the LORP, the criteria to eliminate plots were those which had no seedling or juvenile willow or cottonwood trees. The only plots which remained were plots with more than one seedling or juvenile tree and all plots inside of the livestock grazing/browsing exclosures. The result of this was that 12 original plots remained while 20 plots were dropped. Using results from previous RAS surveys that identified locations with woody recruitment, over 30 additional locations were surveyed for their potential as long-term study plots for the project. Criteria for visiting these new sites identified in the RAS were locations that had greater than 5 seedlings on the site. Out of the 30 potential locations, 19 additional plots were incorporated into the project. All plots located within grazing exclosures were sampled this year and will continue to be sampled in the future. There were several non-exclosure sites which did not have red willow (*Sailix laevigata)* or Goodding's willow (*Salix gooddingii*) and only contained coyote willow (*Salix exigua*). These will be dropped next year and replaced with several new sites identified during the 2012 RAS efforts.

The Streamside Monitoring study examines the interactions between the combined browsing of elk and livestock and interaction of elk alone on woody riparian juvenile and mature trees. In this study a juvenile tree is defined as a tree >1yr and a <3"DBH (Diameter at Breast Height), with the exception of coyote willow. The distinction between trees used solely by elk versus elk and cattle is done by sampling plots in May immediately after most livestock have left the river and revisiting the same sites again in late September, allowing for a 4-5 month period when only Tule Elk are present on the river. We are also, to a lesser extent, able to use livestock exclosures to make similar spatial comparisons on the few exclosure sites which support tree willows. The study also examines intensity of highlining or browsing accessible leaders to large ungulates on mature trees. There are several avian species which require the lower branches of mature riparian tree species for nesting. This study will also look at long-term trends overtime as it relates to the survivability of tree willows both in the belt transect along the stream bank and inside the channel.

It is important to point out that all sites in this study which contain willows were <u>not</u> randomly selected. These locations were intentionally chosen because of their potential to: 1) provide a greater understanding of willow survivability over time, 2) riparian tree susceptibility to different levels of browsing/highlining, 3) what influences livestock, beaver, and elk may play upon young willow stands during the dormant and growing season. The following results cannot be extrapolated to represent conditions typical to the entire 124 miles of riverbank which comprises the Lower Owens River. The following table summarizes 2012 RAS survey results focusing on the number of tree willow sites [cottonwood (*Populus fremontii*, POFR), Goodding's willow (*Salix goodingii* SAGO), red willow (*Sailix laevigata* SALA3)*,* arroyo willow (*Salix lasiolepis* SALA6)] containing seedlings to juvenile trees <1m, broken into three separate number classes. Results from surveying 124 miles of riverbank resulted in only 14 sites which contained a significant (6-25 or 26-100 trees) amount of seedlings and/or juveniles where long-term establishment may be viable.

Land Management Table 3. 2012 RAS survey.

Includes tree willow [cottonwood (Populus fremontii POFR), Goodding's willow (Salix goodingii SAGO), red willow (Sailix laevigata SALA3), arroyo willow (Salix lasiolepis SALA6)] sites distributed by number classes.

Class for Number of Tree Willows	Number of Sites
1-5	27
6-25	11
26-100	3

The following section presents results at the transect level, organized by lease and further broken down to pasture. Data presented in the following sections were collected during two periods in 2012, the first between May 1-3 and the second between September 10-25, for ease in presenting data these periods will be referred to as Spring 2012 and Fall 2012, respectively.

4.9 Results by Transect and Lease

4.9.1 Twin Lakes Lease

TWN_3b

TWN_3b was established in late April of 2012 and is located on the east side of the river in the Lower Blackrock Riparian Field on the Twin Lakes Lease. The belt transect includes a sand bar where most of the young Goodding's and Red willows were located. The site contains two tree willow species; Goodding's and red willow. Seedlings were detected this fall as well. As with most of the transects in the upper reach of the LORP, cattail encroachment up the banks increased greatly this summer in response to augmented flows needed to meet flow requirements downstream. Utilization at the two nearest transects (on the other side of the river) Twinlakes_03 and BLKROC_RIP_07 are presented below. BLKROC_07 exceeded 40% this winter and likely contributed to browsing of willows this spring at TWN_3b. No browsing was observed during the summer period. Approximately 90% of juvenile tree willows on the site are resprouts from beaver chiseling.

Photo 1 TWN_3b location

TWN_3b Goodding's willow and red willow counts, Fall 2012.

	SAGO	SALA3	Total
Seedling		13	13
Juvenile	7	12	19

TWN_3b Comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

TWN_3b		0%	<25%	>25%
Fall 2012	n=32	100%	0%	0%
Spring 2012	n=16	44%	44%	12%

Utilization sampled from two points nearest the transects in April 2012.

	Twinlakes_03	BLKROC_RIP_07
2012	36%	72%

TWN_4a

TWN_4A is located on the west bank in the Lower Blackrock Riparian Field. This is a new plot which had 42 juvenile Goodding's willows in 2012. Utilization was 53% this year for the pasture; however, there are no utilization transects close to this plot. There was no willow browsing observed in May or September of 2012. Beaver are active in this area. Augmented summer flows contributed to substantial cattail expansion on this site.

Photo 2 TWN_4a

TWN_4a Shrub and Tree Willows counted in Fall 2012.

	SAGO	SALA3	Total
Seedling			
Juvenile	42	1	43
Mature	1		1
Decadent			
Dead			

TWN_4a Comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

TWN_4a		0%	<25%	>25%
Fall 2012	n=42	100%	0%	0%
Spring 2012	n=40	100%	0%	0%

TWN_4a Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		1	1	

4.9.2 Blackrock Lease

White Meadow Riparian Field

BLK_1a

BLK_1a is located inside the White Meadow Exclosure and is characterized as wet meadow with some woody vegetation; the site is dominated by creeping wildrye. The water's edge consists of living and dead cattails and banks are covered by litter. There is no floodplain developed within the transect location. Downstream from the transect there does exist a vegetated point bar. No seedlings or juvenile trees have been detected inside the transect. There is an established coyote willow stand inside and outside the exclosure. Beaver are present on the site and actively consuming willow. Because this site and its parallel transect on the east side, BLK_1b, are inside the exclosure they will continue to be read.

Photo 3 From south to north, BLK_1a, BLK_1b, BLK_10b, and BLK_9b.

BLK_1a Shrub and Tree Willows counted in Fall 2012.

	SAEX	SAGO	SALA3	TARA	Total
Juvenile				1	1
Mature	25	1	1		27

BLK_1a Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		2		1

BLK_1a comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=12	100%	0%	0%
Spring 2012	n=2	100%	0%	0%

BLK_1b

BLK_Belt1b is also in the White Meadow exclosure on the east side and is characterized as marsh dominated by cattails along the water's edge, with abundant threesquare bulrush and creeping wildrye away from the water. The bank on this side of the river was noted as vegetated or root stabilized but also has saltcedar slash. Species documented along this transect included threesquare bulrush, cattails, creeping wildrye, Baltic and Torrey's rush (*Juncus torreyi)*, scratchgrass (*Muhlenbergia asperifolia*), saltgrass, and saltcedar. This area is in the exclosure so adjacent livestock use has no influence on current vegetated conditions. One juvenile Goodding's willow is in the plot. There was no browsing in the plot; however, similar to the other bank, beaver are actively consuming both the mature and juvenile willows.

Photo 4 Downed SAGO by beaver, BLK_1b

BLK_1b Shrub and Tree Willows, and saltcedar counted in Fall 2012.

		SAGO	TARA	Total
Fall 2012	Seedling			
	Juvenile	1	1	2
	Mature	4		4

BLK_10b

BLK_10b is located just up from BLK_1b, outside the exclosure, along a long flood plain which receives occasional flooding when flows exceed 40cfs. The plot is comprised of threesquare bulrush, cattails, creeping wildrye, Baltic and Torrey's rush, scratchgrass, saltgrass, and saltcedar. Based on sustained high flows cattails have replaced areas previously occupied by Baltic rush. See following photos. Browsing on willows continued into the summer though to a lesser degree of intensity compared to the spring, the browsing noted for the summer was caused by beaver. Neither period experienced browsing levels which should impede the long-term growth of the young trees.

Photo 5 Blk_10b looking downstream into plot. Note cattail encroachment from oval in left image (May 2012) to right hand image oval (September 2012).

BLK_10b Goodding's and saltcedar counted in Fall 2012.

	SAGO	TARA	Total
Seedling	2		2
Juvenile	29	7	36

BLK_10b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=28	68%	25%	7%
Spring 2012	n=19	42%	47%	11%

BLK_10b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		1		

BLK_9b

BLK_9b is located just up from BLK_10b, outside the exclosure, along the same flood plain which receives occasional flooding when flows exceed 40cfs. The plot conditions are similar to those described for BLK_10b above. Spring browsing of willows was high, especially when compared to summer use of willows which was minimal. Although the overall use for the pasture was 33%, localized use at transect BLKROC_11, directly across the river was 55% this past winter.

BLK_9b counts for Coyote, Goodding's, and Red willow in fall 2012.

	SAEX	SAGO	SALA3	Total
Seedling	4	6	2	12
Juvenile		17	4	21
Mature		2		2
Dead		1		1

BLK_9b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=34	97%	3%	0%
Spring 2012	n=16	38%	25%	37%

BLK_8a

BLK_8a is a new study plot located in the White Meadow Riparian pasture. The majority of the plot is within a densely vegetated point bar consisting of threesquare bulrush, cattails, and creeping wildrye. Utilization on WMRIP_T4, 200m from BLK_8a was 23% this winter. Browsing was high this spring on the site and nonexistent in the summer. Vigor of observed trees was poor when sampled this fall likely a result of being partially submerged during the extended augmented flows this summer.

Photo 6 BLK_8a

Freemont cottonwood, coyote willow, Goodding's willow, red willow and saltcedar counts for fall 2012.

	POFR	SAEX	SAGO	SALA3	TARA	Total
Seedling		25				25
Juvenile	1	25	7	6	7	46

BLK_8a comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

	0%	0%	<25%	>25%
Fall 2012	n=64	100%	0%	0%
Spring 2012	n=41	61%	2%	37%

Photo 7 Downstream view BLK_8a, note cattail encroachment into floodplain in right photo (September 2012).

Reservation Riparian Field

BLK_17b

BLK_17b is located on the east side and upstream from the Mazourka Gauging Station. The plot is located on a small functioning floodplain. The floodplain has high cover, predominantly saltgrass, beardless wildrye, juncus sp. and a declining presence of rubber rabbitbrush likely in response to a rising water table. No seedlings were seen this year although the count for juvenile trees was high. There was no evidence of browsing this summer with minor use this past winter.

BLK_17b Russian olive, Freemont cottonwood, coyote willow, Goodding's willow, and saltcedar counts for fall 2012.

	ELAN	PRPU	SAEX	SAGO	SALA3	TARA	Total
Juvenile		12	54	72	2	1	141
Mature	4	7	23	5	2		41

7)

BLK_17b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=141	100%	0%	0%
Spring 2012	n=105	74%	14%	11%

BLK_17b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
PRPU				2
SAGO		5	2	1

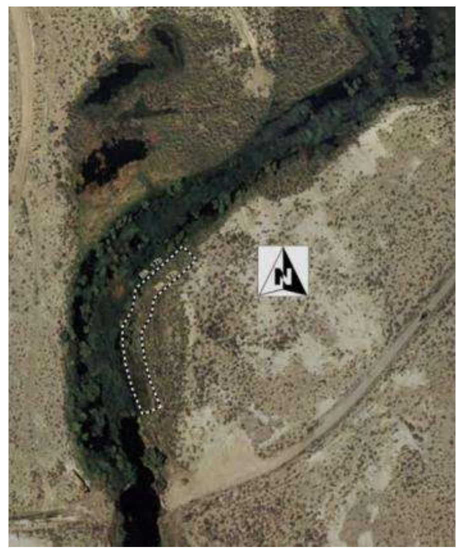


Photo 8 BLK_17b

North Riparian Field
BLK_12b

BLK_12b is located in the North Riparian Field on the east side of the river downstream of the Mazourka Gauging Station. The area has an existing string of healthy mature tree willows; the juvenile trees are predominantly located along a breeched gravel dike that drains towards the southeast. Browsing was minor on the site in the spring and did not occur this summer. Use for the pasture was approximately 10% in 2012.

BLK_12b Goodding's willow and red willow counts in 2012.

	SAGO	SALA3	Total
Juvenile	56	2	58
Mature	15	1	16
Decadent	1		1

BLK_12b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=58	100	0	0
Spring 2012	n=72	88	7	5

Photo 9 BLK 12b

BLK_12b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO	1	7	6	1

BLK_13b

BLK_13b is located in North Riparian pasture along a gravel bar of an abandoned oxbow which receives water during seasonal habitat flows. Herbaceous cover is high, divided amongst beardless wild rye, saltgrass, and scratchgrass. In the lowest area of the oxbow cattails are present, amongst the cattails the older juvenile trees can be found, likely establishing themselves before the later onset of cattails.

Photo 10 BLK_13b

BLK_13b count of Goodding's willow and saltcedar (which were subsequently pulled).

	SAGO	TARA	Total
Seedling	6	1	7
Juvenile	104	9	113
Mature		2	2

BLK_13b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=120	95	4	1
Spring 2012	n=43	88	7	5

BLK_14b

BLK_14b is situated along an abandoned oxbow which is inundated during flows exceeding 70cfs. The site is dominated by a gradient of cattails, transitioning to juncus and rushes then to scratchgrass, saltgrass, and beardless wildrye. Seedlings were counted this fall as well as the numerous juvenile Goodding's willow. Browsing this spring and fall was nominal.

Photo 11 BLK_14b

BLK_14b Coyote willow, Goodding's willow, red willow counts for fall of 2012

	SAEX	SAGO	SALA3	Total
Seedling		39		39
Juvenile	3	173	1	177
Mature		2	3	5
Dead		3		3

BLK_13b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=216	96	3	0
Spring 2012	n=153	90	4	7

BLK_14b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO	1	1		

BLK_5b

BLK_5b is located in the South Riparian field. The plot has high herbaceous cover composed of cattail and tules on the river's edge, juncus and rushes changing to saltgrass and beardless wild rye. The dominant tree species is coyote willow with one mature Goodding's willow. Because of coyote willow's hardiness this is a site that may be shelved for a better site identified in the RAS. Utilization this past spring was <10%, taken from a utilization transect (BLKROC_23) that is less than 150m from BLK_5b. Despite the low use on the grazing transect, heavy use was noted in May when BLK_5b was read. Cattle were at the location at that time and actively browsing coyote willow.

Photo 12 BLK_5b

BLK_5b counts for coyote willow and Goodding's willow for fall 2012.

	SAEX	SAGO	Total
Juvenile	13		13
Mature	302	1	303
Decadent	1		1
Dead			

BLK_5b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
FALL_12	n=139	91	9	0
SPR_12	n= 97	22	36	42

BLK_5b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAEX		2		
SAGO		8		

BLK_15a

BLK_15a is located in the South Riparian Field on the west side between a gravel bar and the river's edge. The majority of *Salix sp.* are growing in the gravel bar which has very low vegetative cover (<10%). Evidence of beaver was noted in the fall of 2012. Use was minimal on site, with none during the spring of 2012 and minor use this summer.

Photo 13 BLK_15a

BLK_15a counts for Goodding's and red willow for fall 2012.

Data	SAGO	SALA3	Total
Seedling	1	11	12
Juvenile	14	45	59
Mature	3	7	10
Decadent	1		1
Dead	1	1	2

BLK_15a comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

Season		0%	<25%	>25%
Fall 2012	n=69	87	10	3
Spring 2012	n=25	100	0	0

BLK_15a Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		4	4	2
SALA3		1		

BLK_7a

BLK_Belt7a is located within the George's Creek Exclosure along a steep bank on the western side of the Lower Owens River. This area along the water's edge was primarily marsh with a dense well established corridor of narrowleaf willow. The water's edge is dominated by cattails. The bank in this area is primarily vegetated or litter covered. Species along the transect included cattails, yerba mansa, narrowleaf willow, Baltic rush, tules, greasewood (*Sarcobatus vermiculatus*), American licorice (*Glycyrrhiza lepidota),* scratchgrass, threesquare bulrush, and saltgrass. Narrowleaf willow is the dominant species on this transect and the only *Salix sp.* on the transect. No browsing of coyote willow was noted.

Photo 14 BLK_7a, BLK 7b (top left and right), BLK 16a bottom left.

BLK_7a counts for coyote willow, fall 2012.

	SAEX
Seedling	6
Juvenile	4
Mature	162

BLK_7b

BLK_Belt7b was classified as marsh and woody vegetation, is dominated by cattails and Goodding's willow along the water's edge. The bank in this area was primarily vegetated with some root stabilized soil. Species recorded along the water's edge included tules and cattails, yerba mansa, threesquare bulrush, creeping wildrye, Goodding's willow, Baltic rush, and saltgrass. The plot is in a large grazing exclosure, there was no use by wildlife in the plot. There was only one Goodding's willow juvenile recorded in May 2012.

BLK_7b counts for Goodding's willow, red willow, and saltcedar for fall 2012.

	SAGO	**SALA3**	**TARA**	**Total**
Juvenile	1		2	3
Mature	9			9
Decadent	5	1		6

4.9.3 Thibaut Lease

THIB_2a

THIB_2a is located in the Thibaut exclosure on the west side of the river. Establishment occurred on a vegetated point bar. There were six dead juvenile trees observed on the site, these trees were likely impacted from the protracted high flows this summer. No seedlings were observed at the site although further upstream (100m) there was another location with young willows present. No browsing was observed in the spring and fall of 2012.

Photo 15 THIB_2a

THIB_2a counts for coyote willow, Goodding's willow and red willow.

	SAEX	SAGO	SALA3	Total
Seedling				
Juvenile	1	33	1	35
Dead		6		6

THIB_2a Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		1		

THIB_3b

THIB_3b is located on a point bar on the east side of the river. The coyote willow and saltcedar establishment is occurring on an exposed gravel bar with low herbaceous cover. All saltcedar observed were pulled this fall. Some browsing by deer or elk were observed this spring.

Photo 16 THIB_3b

THIB_3b counts for coyote willow, Goodding's willow, arroyo willow, and saltcedar for the fall of 2012.

Data	SAEX	SAGO	SALA6	TARA	Total
Juvenile	68			9	77
Mature	7	8	1		16

THIB_3b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=69	100	0	0
Spring 2012	n=33	91	0	9

4.9.4 Islands Lease

BLK_16a

BLK_16a is located on a depositional confluence of George's Creek and the Owens River in the northern most section of the River Field on the Islands Lease. The floodplain likely receives water during high seasonal habitat flows as well as sediment loads from Georges Creek. The plot is within a riparian gallery forest. Juvenile *Salix sp.* on the plot are likely occupying newly created niches from tamarisk removal efforts beneath the forest canopy. There is a large diversity of *Salix sp.* in the plot and a high number of juveniles. Evidence of elk was observed on the plot and recent browsing of juvenile trees was recorded in the browsing results. There were no livestock browsing the plot in the spring or fall of 2012.

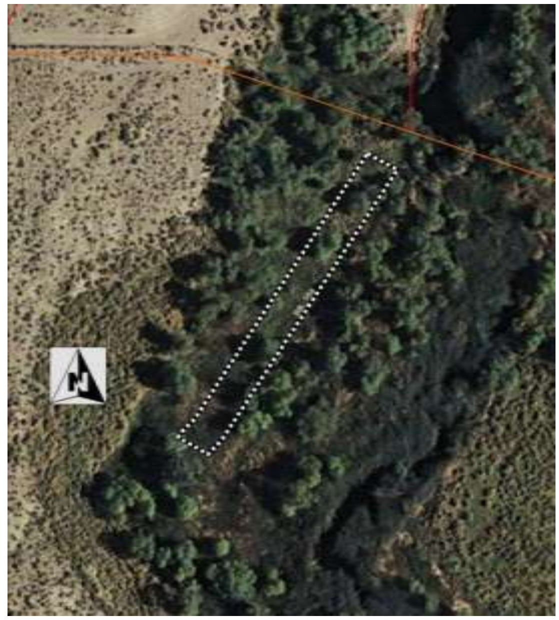


Photo 17 BLK_16a

BLK_16a counts for coyote willow, Goodding's willow, red willow, arroyo willow, saltcedar, desert olive for fall 2012.

	SAEX	SAGO	SALA3	SALA6	TARA	FOPU	Total
Seedling		2	2				4
Juvenile	7	16	15	1		4	43
Mature		6			3		9
Decadent		2					2

BLK_16a comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
Fall 2012	n=49	61	4	35
Spring 2012	n=51	100	0	0

BLK_16a Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
BLK_16A	3	27	4	
SAGO	1	24	4	
SALA3	2	3		

ISL_1a

ISL_1a is located in an exclosure on the Islands lease on the west side of the river. There were no trees on the banks of the river within the study plot.

ISL_1b

ISL_1b parallels ISL_1a on the east side of the river inside an exclosure. There was only a single coyote willow observed in the plot and it was not browsed.

ISL_1b count for coyote willow, fall 2012.

	SAEX
Juvenile	1

ISL_1a and ISL_1b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
ISL_1A				
SAGO		3		3
ISL_1B				
SAGO	1	1	1	3

Photo 18 ISL_1a (left) and ISL_1b (right).

ISL_4b

ISL_4b is nestled along the east bank of the Owens River in the River Field. Willow establishment on this site was confined to a sediment filled abandoned oxbow in the center of the transect which receives additional water during seasonal habitat flows and augmentation discharges. Approximately 300m to the east of the site is RIVERFIELD_08, a utilization site. Utilization last spring was 71%, ISLANDS_08 600m south east was at 68% last spring. This heavy use undoubtedly resulted in the high browsing rates shown in the table below with greater than 25% of the leaders removed across 88% of the juvenile trees. There was no use observed on the trees during the fall.

Photo 19 ISL_4b

ISL_4b counts for Goodding's willow for fall 2012.

	SAGO	Total
Juvenile	35	35
Mature	3	3
Dead	1	1

ISL_4b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

	0%	<25%	>25%
Fall n=37	100%	0%	0%
Spring n=59	7%	5%	88%

ISL_4b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		1	1	2

ISL_5b

ISL_5b is tucked away on the east side of the Owens River in the Depot Riparian Field on the Islands Lease. Juvenile tree willows on the site are confined to a heavily vegetated point bar which receives water when flows exceed baseflows, tree willows were amongst three-square, cattails and tules. Trees were in the water during the augmentation flow period this summer. There is a utilization transect, RIVERFIELD_12, 130m north of ISL_5b, use this spring was 71%. Despite the heavy grazing in the area, livestock did not seem to dramatically impact the willows present on the site, browsing was light (87% unbrowsed). The difference between ISL_5b and ISL_4b which both received identical grazing intensities but dramatically different browsing effects on young tree willows may be explained in part because the tree willows on ISL_5b are in amongst cattails as opposed to ISL_4b where tree willows are more exposed amongst the low growing juncus and rushes.

Photo 20 ISL_5b.

ISL_5b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
9/12/2012	n=7	100%	0%	0%
5/2/2012	n=15	87%	0%	13%

ISL_5b counts for Goodding's willow, red willow, arroyo willow, saltcedar, desert olive, September 12, 2012.

	SAGO	SALA3	SALA6	TARA	FOPU	Total
Juvenile	11	5	1	2		19
Mature	4	1			1	6
Decadent	1					1
Dead	1					1

ISL_5b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		1		1

4.9.5 Lone Pine Lease

LP_1a

LP_1a is the western plot of the parallel plot complex within the fenced exclosure on the River Field on the Lone Pine Lease. The plot traverses an outer bend of the river and is heavily vegetated with cattails and tules on the water's edge transitioning to beardless wild rye and alkali sacaton up on the banks. There were no living willows on the banks.

LP_1b

LP_1b follows the outer edge of a point on the river. Vegetation cover and litter are high. The only recruitment observed for the site were juvenile sprouts from larger coyote willow shrubs. This summer there was no evidence of browsing while this spring indicated significant browsing though not at high levels per individual tree; this browsing was done by Tule elk.

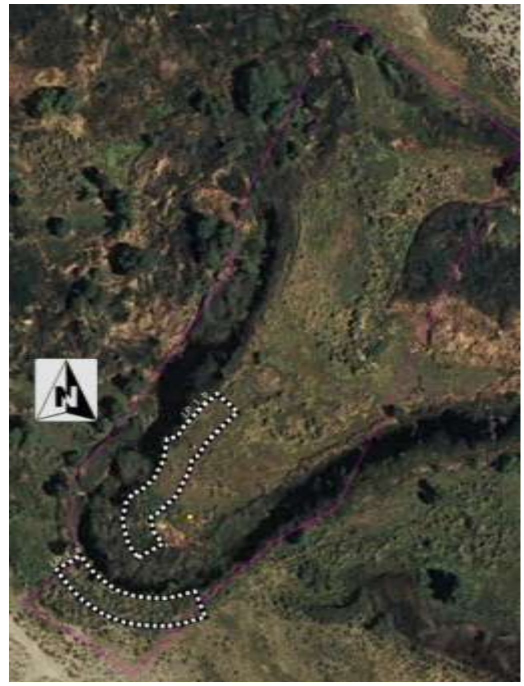


Photo 21 LP_1a and LP_1b

LP_1b coyote willow, Gooding willow, and red willow counts 9/11/2012.

Data	SAEX	SAGO	SALA3	Total
Seedling	4			4
Juvenile	12			12
Mature	47	3	1	51
Decadent		2		2
Dead		1		1

LP_1b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
9/11/2012	n=4	100%	0%	0%
5/03/2012	n=24	8%	92%	0%

LP_1a and LP_1b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
LP_1A				
SAGO		3	1	5
LP_1B				
SAGO		2		2
SALA3		1	1	

LP_3b

LP_3b is located in a wooded section on the east side of the Owens River in the River Field. The site is densely vegetated with beardless wild rye, saltgrass, and sacaton. Nevada saltbush and rubber rabbitbrush are also on the plot. This area was not affected by increased flows this summer. There were 8 juvenile tree willows noted as browsed in May, these same willows were also inspected by the MOU consultants, these 8 willows were not present in the fall. The assumption is that these trees were eliminated by elk use during the summer. Livestock utilization for the pasture was 42% in 2012.

Photo 22 LP_3b

LP_3b counts for Goodings willow and red willow from this fall and spring.

SEASON		SAGO	SALA3	Total
9/11/2012	Mature	4	3	7
	Decadent		3	3
5/3/2012	Juvenile	6	2	8
	Mature	2	7	9

LP_3b comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
9/11/2012	n=0	na	na	na
5/3/2012	n=8	38%	38%	26%

LP_3b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO		1	1	1
SALA3		1	1	

LP_2a

LP_2a is located on a heavily vegetated point, and is characterized as primarily woody with some marsh. Browsing occurred on the two coyote willows and Goodding's willow trees less than 6 feet in height both in the spring and into the summer. Livestock utilization was 42% for the pasture in 2012.

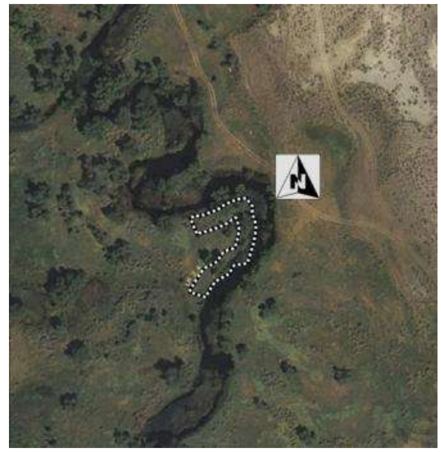


Photo 23 LP_2a

LP_2a counts for coyote willow, Gooddings willow, red willow, and saltcedar, 9/11/2012

	SAEX	SAGO	SALA3	TARA	Total
Juvenile	2		1	1	4
Mature	2	10			12
Decadent		5			5

LP_2a comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than six feet in height.

		0%	<25%	>25%
9/11/2012	n=3	33%	33%	33%
5/1/2012	n=3	0%	0%	100%

LP_2a Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO	1	1		
SALA3		1		

4.9.6 Delta Lease

DELTA_3a

Delta_3a is located on the Delta Lease on the west side of the river along an inside bend. The plot traverses a fairly vertical bank with no active floodplain. Vegetation cover is dense shrub with some perennial grass. Coyote seedlings (3) were growing amongst the cattails in the plot. There was no browsing in the spring or fall on the site. Utilization for the pasture was 43% this winter and spring.

Photo 24 DELTA_3a

DELTA_3a count for coyote willow, Goodding's willow, and saltcedar

	SAEX	SAGO	TARA	Total
Seedling	3			3
Juvenile	5		1	6
Mature	12	1		13
Decadent		1		1

DELTA_3a comparison between fall and spring browsing of willow leaders within three browse classes (0% leaders browsed, less than 25% leaders browsed or greater than 25% leaders browsed) for trees less than 6 feet in height.

		0%	<25%	>25%
9/11/2012	n=4	100	0	0
5/3/2012	n=3	100	0	0

DELTA_3a Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAGO				2

DELTA_1a and DELTA_1b

DELTA_1a spans the outside bend of the river in the Delta Grazing exclosure and Delta_1b traverses the inside bend of the river. Both plots are marsh with common reed (*Phragmites australis*) and tules being the predominant species at the water's edge. Saltgrass and saltbush dominate the adjacent wet meadow. The streambank was characterized mostly as vegetated or litter. The banks are fairly steep and there is no active floodplain on the two plots. Both of these plots are within a livestock grazing exclosure. There was no browsing on either plot.

Photo 25 DELTA_1a (left) and DELTA_1b (right).

DELTA_1a count for coyote willow, Goodding's willow, 9/11/2012.

	SAEX	SAGO	Total
Mature	115	1	116

DELTA_1b count for coyote willow and Goodding's willow, 9/11/2012.

	SAEX	SAGO	Total
Juvenile		1	1
Mature	49		49

DELTA_1a and DELTA_1b Species and age class of trees rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
DELTA_1a				
SAGO		1		
DELTA_1b				
SAGO				1

4.10 General Results

There were 30 belt transects sampled this spring and fall. Fall identification of trees appears to be more accurate than counts completed in the spring, likely because all trees had broken dormancy and spotting young juveniles with full, mature foliage amongst cattails and tules was easier to both locate and identify to the species level. Long-term survivorship of trees will be compared between years from fall counts. Because this was the first year for the majority of transects that contain juvenile willows, no year to year comparison will be made from 2012 results. Total counts for all trees rooted inside the belt transect are presented in the following table (Land Management Table 4). A total of 2005 trees were counted this fall, Goodding's willow followed by coyote willow and red willow were the most common juvenile willow species observed in the belt transects. There was a relatively equal distribution between juvenile (48%) and mature (43%) trees across all transects, juvenile Gooding willows comprised 30% of all trees sampled (Land Management Table 5).

Land Management Table 4. Total Fall 2012 Count of Age Classes

Russian olive (*Elaeagnus angustifolia* ELAN), cottonwood (*Populus fremontii* POFR), screwbean mesquite (*Prosopis pubescens* PRPU), coyote willow (*Salix exigua* SAEX), Goodding's willow (*Salix goodingii* SAGO), red willow (*Sailix laevigata* SALA3), arroyo willow (*Salix lasiolepis* SALA6), saltcedar (*Tamarix ramosissima* TARA), and desert olive (*Forestiera pubescens* FOPU2) across all belt transects.

	ELAN	POFR	PRPU	SAEX	SAGO	SALA3	SALA6	TARA	FOPU	Total
Seedling				42	56	28		1		127
Juvenile		1	12	195	618	95	2	42	4	969
Mature	4		7	744	88	20	1	5	1	870
Decadent				1	18	4				23
Dead					15	1				16

Land Management Table 5. Relative Distribution of Age Classes for All Trees Sampled in Belt Transects for 2012

Seedling	6%
Juvenile	48%
Mature	43%
Decadent	1%
Dead	1%

Of the thirty plots, there are 21 sites which contain juvenile tree willows. Categorized by landform and belt transects with juvenile willows (sites with active establishment), point bars contained 43% (n=9) of the sites followed by meanders 33% (n=7), then abandoned oxbows 19% (n=4) and finally one depositional floodplain. Two sites, BLK_14b and BLK_13b, both abandoned oxbows, contained the highest numbers of juvenile tree willows, 174 and 104 juveniles trees, respectively. There were 14 belt transects that contained greater than 10 juvenile trees and the ratio between juvenile trees to mature trees across those sites was 7:1 which indicates that in order to have recruitment events the need for a high density of adjacent seed bearing trees may not be necessary. A site in eastern Oregon exhibited similar circumstances on a 5-kilometer stringer where SALA3 and SAEX seedlings emerged annually despite the lack of mature seed producing trees along the same 5-kilometer corridor (Shaw, 1992).

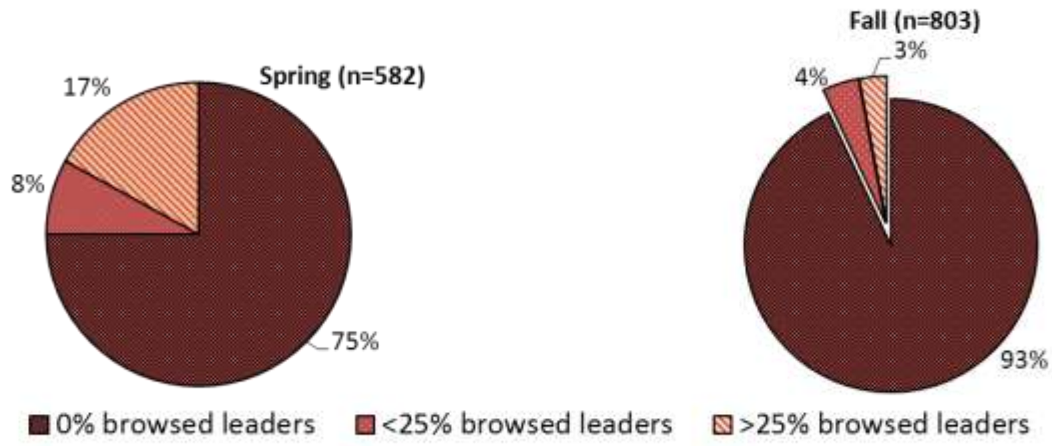
There were a total of 150 trees rooted in water at base flow (Land Management Table 6). Identifying all trees within the projected transect spanning across the river to the opposite bank was difficult because of visual obstruction by tules and cattails prohibited a clear view. Mature tree willows were the dominant age class observed in the channel comprising 56% of all trees observed followed by dead trees at 20%, decadent trees at 18%, and finally, juvenile trees at 5%. The dominant in channel tree species was Goodding's willow. With future aerial imagery further analysis of live in channel trees over time will be implemented.

Land Management Table 6. Total number of trees across all belt transects by species and age class rooted in water at base flow.

	Juvenile	Mature	Decadent	Dead
SAEX		2		
SAGO	5	76	25	31
SALA3	2	7	2	
Total:	7	85	27	31
			Grand Total: 150	

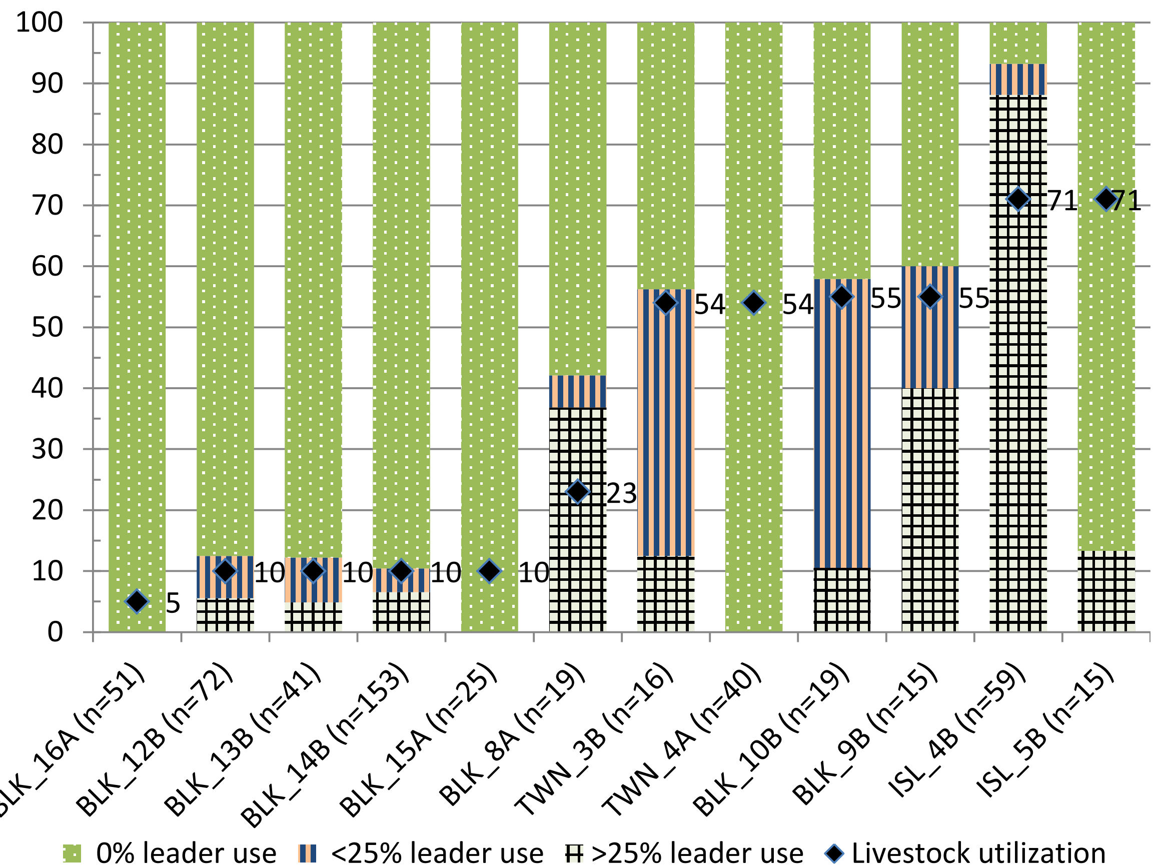
In Section 5 of this report the 2012 Rapid Assessment Survey discusses woody tree recruitment. The biological definition of recruitment refers to seedlings that have germinated this year (germinants). This growth stage of a plant is usually its most vulnerable and is prone to high mortality (Leck,M. et. al., 2008). What is more useful for assessing long term condition of the Lower Owens River with regards to woody riparian trees would be the examination of recruitment sites over subsequent years and shifting the focus to the survivorship of seedlings identified from the first recruitment event. Cooper (Cooper et. al, 1999) used the concept of establishment defined as the survivorship of seedlings after three growing seasons. This study also examines woody riparian establishment on sites by conducting density counts of trees, categorizing these trees by growth stage (seedling, juvenile, mature, decadent, and dead) and revisiting these sites under a meaningful time line to track changes of trees and identify if individuals have progressed into the next growth stage. Because most belt transects in this study which have significant numbers of seedlings and juveniles were established this year, results from 2012 are not able to quantify establishment or general trend of woody riparian communities.

Excessive browsing can inhibit potential heights of trees and shrubs, decrease leader densities, and in some cases completely alter the species composition of riparian zones (Belsky et al, 1999; Boggs and Weaver, 1992; Green et al, 1995). Lacking successful willow recruitment, riparian systems can develop unbalanced age class distributions eventually leading to the die off of willow stands (Kauffman, 1987). Moderate spring and fall forage utilization (36%-55%) has shown to have little impact on SALA3 and SAEX survivorship and the tree's ability to reach full growth potential, while heavy utilization (56%-75%) and summer long use can retard both growth and seedling densities (Shaw, 1992). The single finding common to all studies of livestock impacts on riparian areas is that no two situations are similar (Kauffman and Krueger, 1984; Kovalchik and Elmore, 1992). This known variability serves to emphasize the need for continued study of livestock impacts on the Lower Owens River. Successful stand establishment on the Owens River is thought to require browsing intensities where less than 25% of juvenile leaders are browsed annually (Platts, 2012). Browsing of willow leaders were estimated both in May and in September of 2012 to gain a better understanding browsing intensity and what impacts were caused by livestock and elk, or elk alone on willow sites on the Lower Owens River.



Land Management Figure 1. Comparison between spring sampling and fall sampling of percent browsed tree willow leaders
(SAGO, SALA3, SALA6) leaders on trees <6' tall for all sites accessible to livestock and elk (non-exclosure sites)

Critical leader use (>25% of browsed leaders) for trees less than 6 feet in height occurred on 17% of the 582 juvenile trees sampled during the spring estimates which captured the December-May grazing period. Fall estimates, which examines all browsing occurring between May and September showed a 14% decrease in critical leader browsing, down to 3% in the >25% browsed leader class as well as a 4% decrease in the <25% browsed leader class (Land Management Figure 1). The main assumption drawn from Figure 1 is that with the removal of livestock in May, leader browsing intensity decreases. Winter precipitation was well below average on the valley floor in 2012. One result was a poor spring 'green up' of ephemeral forbs and grasses on the east side of the Lower Owens River which lead to increased use along the riparian corridor on several leases. Elk may have browsed juvenile tree willows in the spring; however, on the sites where heavy tree willow browsing occurred, the only evidence of large ungulates at the time were livestock. When results from livestock utilization transects adjacent to belt transects are compared to browsing rates there appears to be a relationship between increased tree willow browsing concomitant with increased livestock utilization of nearby herbaceous vegetation (Land Management Figure 2).

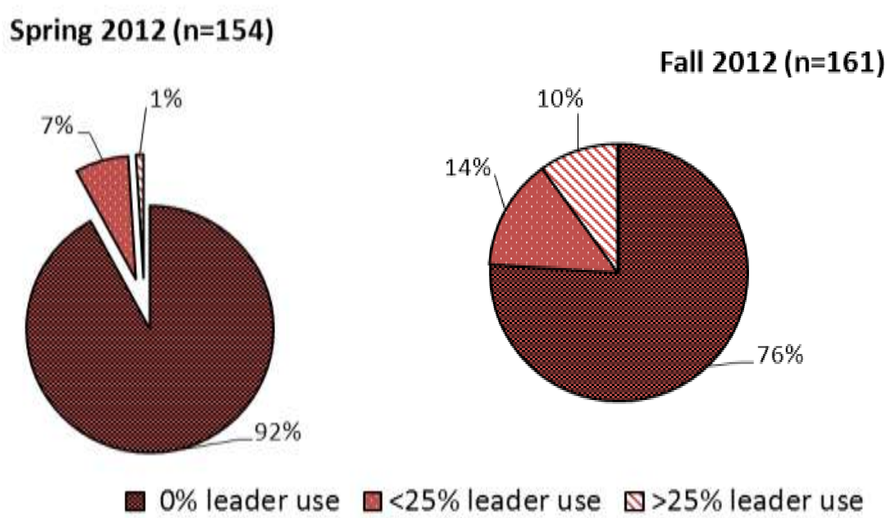


Land Management Figure 2. Spring 2012 Percent Leader Use (y-axis)
Non-exclosure tree willow sites on trees less than 6' in height from transects with counts greater than 10 tree willows combined with end of season utilization rates taken from nearest transect or pasture mean in spring 2012.

Four out of the six sites where nearby utilization transects were greater than 40% at the end of the grazing season, leader use occurred on more than half of the juvenile trees. On one site, ISL_4B, 88% of the juvenile trees were browsed to the >25% leader class, the adjacent utilization transect was 71% (Land Management Figure 2). This increase in willow browsing coupled with increased grazing utilization is a common in grazed riparian systems (Clary and Webster 1989; Mosely, et. al 1998; Green and Kauffman, 1995; Shaw, 1992; Kovalchik and Elmore, 1992).

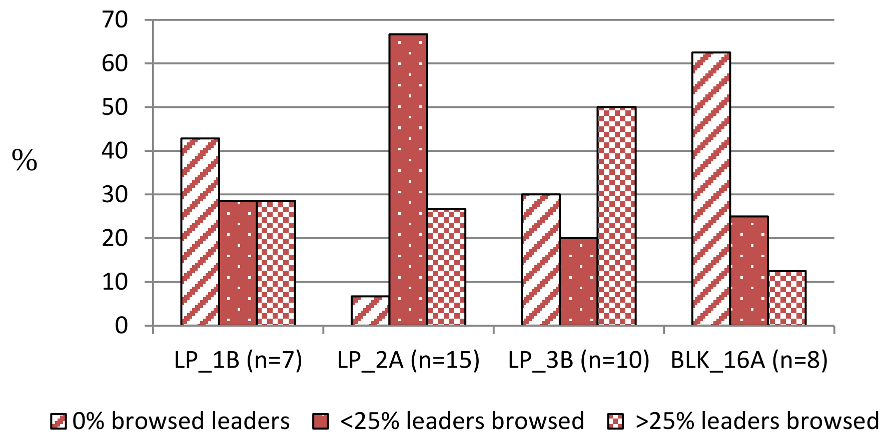
There are two outliers to the pattern in Land Management Figure 2; belt transect TWN_4A and ISL_5B were in pastures that received heavy utilization but experienced minimal use on juvenile trees. TWN_4A is located on a small sand bar separated from the main bank by a side channel of about 3 inches in depth. All of the trees at this site are growing among cattails in very wet soils with ponding. Similarly, ISL_5B juvenile trees are growing in a marshy cutoff oxbow amongst dense rushes and sedges. Utilization 130m north of ISL_5B was 71%, while juvenile tree browsing was less than 13%. ISL_4B, the most severely browsed site on the LORP this year experienced an identical utilization level (71%). The principle difference between the two sites is that the juvenile trees in ISL_4B are located on a grassy site exposed to livestock and in less saturated soils. Use at the herbaceous dominant belt transect ISL_4B was likely even higher than the adjacent utilization transect. Beardless wildrye, the only cool season perennial grass on the floodplain and various sedges and rushes tend to be located along the lowest portions of the floodplain where the water table is the shallowest and salt deposits are minimal, this results in early spring green up along the streambanks and drawing livestock to concentrate in these areas first, particularly if there are no annuals in the uplands.

The final component of the streamside monitoring effort was to look at the browsing of leaders on trees greater than 6 feet in height to gain a better understanding of the alteration of tree understory structure (highlining) of mature riparian trees. Heavy browsing of established, mature trees can alter tree willow volume and structure in riparian areas and decrease the abundance of nesting passerine birds (Taylor, 1986). Least Bell's Vireo, a federally threatened species sighted in the Owens Valley, requires a dense willow understory for nesting, as nests typically are located between 1.5 to 4.5 feet above ground (Franzreb, 1989). Similar willow structure requirements are needed for the Southwestern Willow Flycatcher (U.S. Fish and Wildlife Service, 2002), another federally listed species which nests in the Owens Valley. Results in 2012 for the browsing of mature trees showed an inverse pattern compared to browsing on juvenile trees for the same year. Increased leader browsing occurred during the summer months while there was minimal use during the spring estimates (Land Management Figure 3).



Land Management Figure 3. Comparison between fall and spring 2012 percent leader use by class (0% leader use, <25% leader use, and >25% leader use) for tree willows greater than 6 feet in height across all belt transects.

Overall, increased leader use was nonexistent along most of the river in the summer. For this reason results were not presented at the transect level, rather they were summarized in this section. The only real highlining which occurred on the entire river were on the three belt transects on the Lone Pine Lease and one transect on the Islands lease (Land Management Figure 4). This use corresponds with observations by LADWP Watershed staff, LADWP ranch lessees, Tom Noland and Gabe Fogarty who run the Lone Pine Lease, and Bill Platts of Ecosystem Sciences. Tule Elk are present throughout LORP project area however elk further up river seem to have a less obvious impact on the river.



Land Management Figure 4. Distribution of browsed leaders on sites with greater than 5 trees/transect which experienced browsing in the fall of 2012, n=number of trees sampled

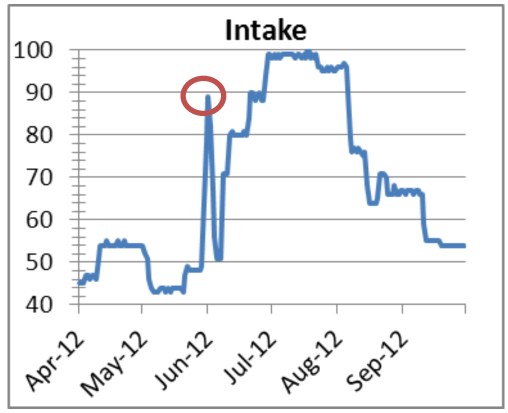
Discussion

The adjustment this year to select additional sites containing willow populations where establishment has occurred in the last several years created an opportunity to document substantial numbers of juvenile tree willows, browsing during different seasons, and age class distributions. Browsing of juvenile tree willows by livestock and probably less so by elk, is occurring primarily during the winter and spring. Spring browsing in most instances was low, however there is strong evidence pointing to a correlation between increased grazing intensity of perennial grasses in the floodplain and increased browsing of nearby juvenile willows. There were several sites which were heavily browsed by livestock, in tandem with heavy grazing in the same areas.

Elk are browsing mature trees and less so juveniles in the summer. These impacts on the river are concentrated on the Lone Pine and Islands Lease. In these two areas, elk herds remain on the floodplain throughout the year, and in particular the summer; herds to the north will move back and forth from the river to saline meadows and irrigated pastures west of the river during the summer.

Additional observations during the fall sampling period were the effects of the elevated base flows from this summer (Land Management Figure 5). Several transects were inundated and juvenile trees were flooded and visibly stressed (TWN_4a, THIB_2A) when examined in September. The increased river levels above the typical base flow for three months (June thru early September) allowed for the greater expansion of cattails into the floodplains and up the stream banks, particularly along the Twin Lakes, Thibaut, and Blackrock Leases. The peak seasonal habitat flow of 89cfs on June 1 at the Intake and subsequent 73cfs at Mazourka on June 5 were intended to coincide with willow seed dispersal and facilitate germination at the highest wetted extent along the river's floodplains and riverbanks. However, when seasonal habitat flow levels are compared to the prolonged increased base flows later in the summer; meant to maintain minimum flow requirements further downstream, flows actually eclipsed seasonal habitat flows. At the Intake gauging station, flows ranged between 7-10cfs greater than the seasonal habitat flow for approximately 30 days. At Mazourka gauging station, flows exceeded 10cfs for more than 30 days. Willow seed viability is short lived (<10days) (Densmore and Zasada, 1983) which would imply that seed germination events that may have occurred in the advent of the Seasonal Habitat Flow would have subsequently been submerged during the increased base flows. Freemont cottonwood seedlings will not survive inundations lasting longer than two weeks (Auchincloss et al., 2012), and similar time periods for *Salix sp.* may exist.

Future modifications of the Streamside Monitoring Protocol will incorporate some type of metric to track changes in young tree structure over time. This will help better understand what the physical impacts are resulting from different levels of browsing intensity.



Land Management Figure 5 Summer hydrographs for Intake and Mazourka gauging stations, y axis= cfs, circle indicates peak seasonal habitat flow.

4.11LORP Ranch Leases

The following sections are presented by ranch lease. The discussion will include an introduction describing the lease operations, pasture types, a map of the lease, and utilization results from 2011-12, a summary of range trend results at the lease level and a presentation of range trend results by transect. The tables refer to plant species by plant symbol. Refer to Appendix 1, which contains a list of the plant species, scientific names, common names, plant symbol, and functional group assignment for species encountered on the range trend transects.

4.11.1 Intake Lease (RLI-475)

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

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

End of Grazing Season Utilization for Fields on the Intake Lease, RLI-475, 2012

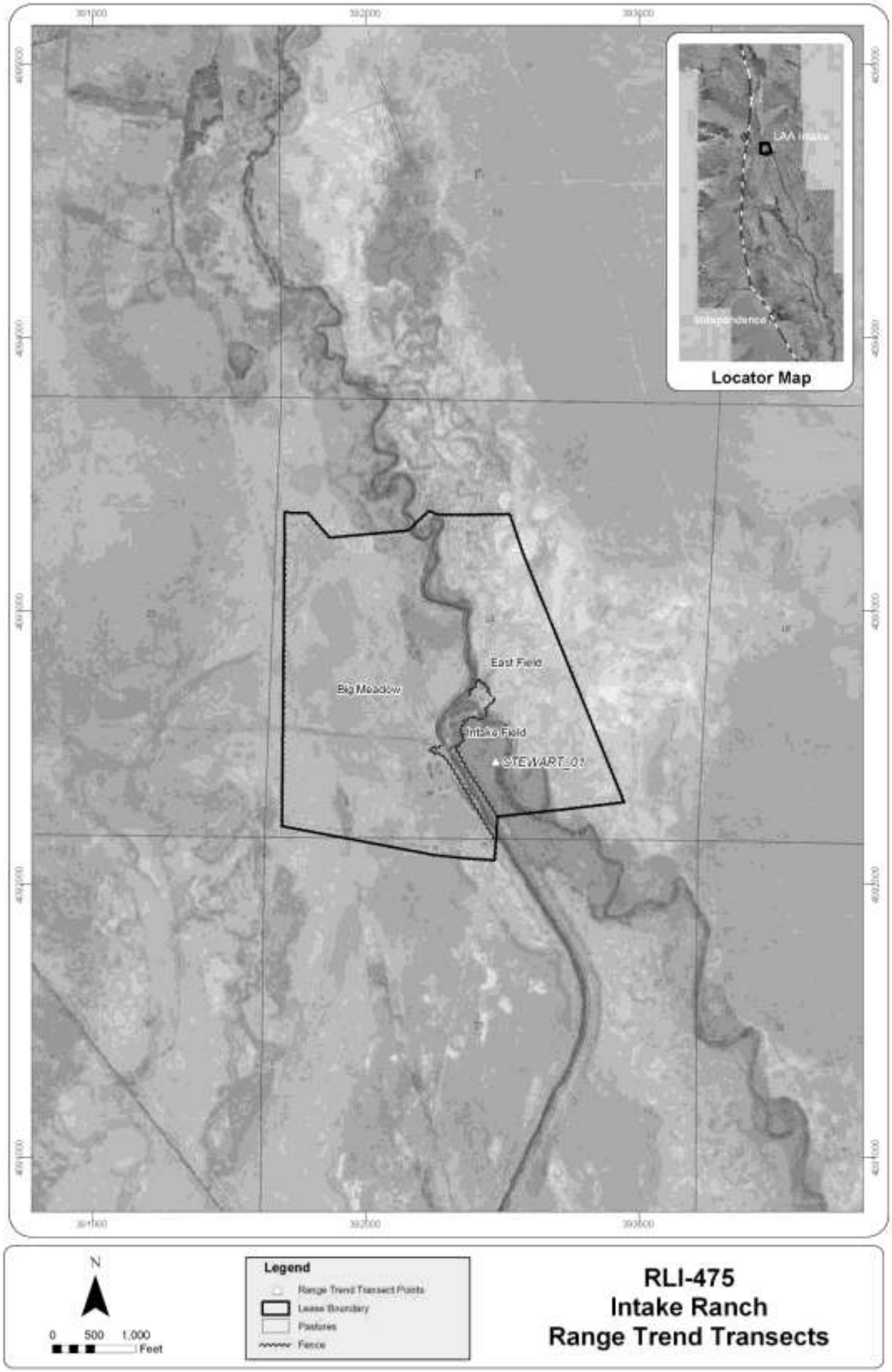
Field	Utilization	Transect	Utilization
Intake Field*	28%	*STEWART_01	28%
**Riparian Utilization, 40%*			

Summary of Utilization

Utilization for the Intake Lease in 2012 was well below the allowable 40% utilization standard.

Summary of Range Trend Data and Conditions

No range trend transects were read on the Stewart Lease in 2012.



Land Management Figure 6. Intake Lease RLI-475, Range Trend Transects

4.11.2 Twin Lakes Lease (RLI-491)

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

There are four pastures on the Twin Lakes Lease within the LORP boundary: Lower Blackrock Riparian Field, Upper Blackrock Field, Lower Blackrock Field, and the Holding Field. The Lower Blackrock Riparian, Upper Blackrock Riparian, and Lower Blackrock Fields contain both upland and riparian vegetation. The Holding Field contains only upland vegetation. There are no irrigated pastures on the Twin Lakes Lease. Range trend and utilization transects exist in all fields except the Holding Field.

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

End of Grazing Season Utilization for Fields, on the Twin Lakes Lease, RLI-491, 2012

Field	Utilization
Lower Blackrock Field	5%
Lower Blackrock Riparian Field*	54%
Upper Blackrock Field*	61%

*Riparian Utilization 40%**

Riparian Management Areas

Utilization was over 40% in all fields except the Lower Blackrock Field. This was a result how the cattle were managed. However, the use in the Lower Blackrock Field was very low and Watershed Resources staff recommended that cattle be moved to the Lower Blackrock Field sooner during the 2012-13 grazing season. If dry conditions persist more vigilant livestock movement will be needed in order to avoid over grazing by the lessee.

Upland Management Area

Upland utilization was well below the allowable standard of 65% in the Lower Blackrock Field.

Fencing

There was no new fencing constructed on the lease in 2012.

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

There are no burns planned on the lease in 2013.

Summary of Range Trend Data and Conditions

Significant changes in plant frequencies in 2012 on the Twin Lakes Lease were decreases in fivehorn smotherweed (BAHY) on three sites (TWINLAKE_04, TWINLAKE_03, INTAKE_01) closest to the river and a decrease in Nevada saltbush (ATTO) on another river site (TWINLAKE_06). Saltgrass (DISP) increased on three sites (TWINLAKE_06, TWINLAKE_03, INTAKE_01) significantly and alkali sacaton (TWINLAKE_02) on one upland site. Line intercept results also showed a decrease of Nevada saltbush on the river sites.

Significant Changes in Frequency for Twin Lakes Transects Between 2009 and 2010

	No Change	DISP	SPAI	ATTO	BAHY	SPGR
Moist Flood Plain						
TWINLAKE_04*	↔					
TWINLAKE_06*		↓**	↓			
TWINLAKE_03		↓		↓		
SALINE MEADOW						
TWINLAKE_05	↔					
INTAKE_01	↔					
TWINLAKE_05	na					
SALINE BOTTOM						
TWINLAKE_02						↑
BLKROC_37	↔					

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

Significant Changes in Frequency for Twin Lakes Transects Between 2010 and 2012

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

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

Upper Blackrock Field

INTAKE_01

INTAKE_01 is located in the Upper Blackrock Field. The soils are mapped as Torrifluvents-Fluvaquentic Endoaquolls Complex; but the majority of the study plot is located on the adjacent soil unit, Torrifluvents, 0-2% slopes, which is associated with the Saline Meadow ecological site. Site similarity to the potential ranged during the baseline monitoring period between 71-77%, placing the site in high ecological condition. Frequency for saltgrass significantly increased in 2009 when compared to 2007 and subsequently decreased in 2010, and then rose again to the highest level for the site in 2012. Utilization on this transect was 49%, the highest seen for the site.

Utilization by Weighted Average and Species, INTAKE_01

	Weighted Average	DISP	SPAI
2007	44%	29%	55%
2009	19%	15%	21%
2010	13%	5%	20%
2011	30%	5%	50%
2012	49%	18%	66%

Frequency (%), INTAKE_01

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012
Annual Forb	2FORB	0	0	1	0	0	0	0
	ATPH	0	18	5	0	0	0	0
	ATTR	0	0	2	0	0	0	0
	CHST	0	2	0	0	0	0	0
	CLEOM2	0	2	0	0	0	0	0
	CLOB	0	3	0	0	0	0	0
	CRCI2	0	0	7	0	0	0	0
	ERIAS	0	23	0	0	0	0	0
	ERIOG	0	5	0	0	0	0	0
	ERMA2	0	0	2	0	0	0	0
	MEAL6	0	0	10	0	0	0	0
Perennial Forb	MACA2	17	0	0	0	0	11	0
	MALAC3	0	2	1	0	0	0	0
	STEPH	0	18	16	0	0	0	0
	SUMO	3	4	4	2	2	2	0
Perennial Graminoid	DISP	60	54	67	52	82	59	92**
	JUBA	14	19	15	11	11	8	14
	SPAI	97	117	103	105	109	118	115
Shrubs	ATCO	24	15	23	19	25	11	25*
	ATPA3	0	0	0	1	1	2	0
	ATTO	0	10	8	6	3	11	3
	ERNA10	9	22	27	26	28	17	12
	MACA17	0	0	0	14	18	0	10**
Nonnative Species	BAHY	0	0	0	0	10	10	0**
	BRTE	0	0	1	0	0	0	0
	POMO5	0	3	0	0	0	0	0
	BRRU2	0	0	0	0	1	0	0

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

Cover (%) Shrubs INTAKE_01

Species Code	2003	2004	2007	2009	2010	2012
ATCO	1.1	0.9	0.9	0.8	0.7	1.5
ATTO	0.8	1.3	1.6	1.0	2.3	1.1
ERNA10	1.2	3.6	3.5	4.5	2.6	2.5
SAVE4	0.0	0.0	0.3	0.2	0.0	0
SUMO	0.0	0.0	0.0	0.1	0.0	0.2
Total	3.1	5.8	6.3	6.5	5.6	5.2

Lower Blackrock Field

TWINLAKES_02

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

The transect was burned in mid-February, 2009. Shrub cover prior to the burn was moderate which resulted in a cooler burn when compared to similar areas further south in Drew Slough. Because of the cool fire, a decrease in shrub frequency, shrub cover, and shrub recruitment were observed in 2009 and 2010. Alkali cordgrass (*Spartina gracilis)* significantly increased in 2010 and continued to increase in 2012. Alkali sacaton (SPAI) also increased markedly in 2012. There was no utilization on this transect in 2010.

Utilization by Weighted Average and Species, TWINLAKES_02

	Weighted Average	DISP	LECI4	SPAI	SPGR
2007	17%	25%	43%	11%	5%
2008	17%	16%		30%	
2009	100%	100%	100%	100%	100%
2010	0%	0%	0%	0%	0%
2011	4%	2%		10%	
2012	2%	2%		2%	

Frequency (%), TWINLAKES_02

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

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

Cover (m) Shrubs TWINLAKES_02

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

Lower Blackrock Field

TWINLAKES_05

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

Lower Blackrock Riparian Field

TWINLAKES_03

TWINLAKES_03 is located in the Lower Blackrock Riparian Field. The soils are Torrifluvents-Fluvaquentic Endoaquolls Complex, which corresponds to the Moist Floodplain ecological site. The similarity index during baseline period ranged between 63%-65%, placing it in good ecological condition, explained by the dominance of saltgrass on the site. Nevada saltbush is much greater than the described potential for the site. The site also lacks in diversity of perennial grasses. Frequency for saltgrass and Nevada saltbush increased between 2009-07. Saltgrass frequency was significantly higher than all previous sampling events in 2009 while in 2010 saltgrass decreased to its lowest value since monitoring has begun on the site and in 2012 rose to one of the highest levels for the transect. Utilization was minimal for this transect with all of the utilization occurring on saltgrass.

Utilization by Weighted Average and Species, TWINLAKES_03

	Weighted Average	DISP	SPAI
2007	82%	82%	
2008	28%	25%	50%
2009	19%	21%	21%
2010	6%	7%	0%
2011	42%	40%	58%
2012	36%	35%	58%

Frequency (%), TWINLAKES_03

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

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

Cover (m) Shrubs TWINLAKES_03

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

TWINLAKES_04

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

Frequency (%), TWINLAKES_04

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012
Annual Forb	ATTR	0	0	9	0	0	0	0
	CHIN2	0	0	2	0	0	0	0
	CRCI2	0	0	3	0	0	0	0
Perennial Forb	SUMO	2	0	1	9	24	33	4**
Perennial Graminoid	DISP	17	4	12	0	0	0	0
Shrubs	ATTO	5	8	27	18	13	9	3
Nonnative Species	BAHY	0	6	41	0	15	24	0**
	DESO2	0	0	7	0	0	0	0
	SATR12	0	4	82	0	0	0	0

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

Cover (m) Shrubs TWINLAKES_04

Species Code	2003	2004	2007	2009	2010	2012
ATTO	13.6	22.4	11.2	17.9	15.7	12.5
SUMO	T	T	20.0	27.3	37.2	12.5
Total	13.6	22.4	31.2	45.1	52.9	25

TWINLAKES_06

TWINLAKES_06 is located in the Lower Blackrock Riparian Field. Soils are Torrifluvents-Fluvaquentic Endoaquolls Complex, which corresponds to the Moist Floodplain ecological site. Similarity index to the site's potential was 19% between 2006-07. As with TWINLAKES_04, the site is dominated by shrubs, invasive annual forbs, and a scant amount of perennial grasses as the understory. Because of this, and the fact that the area is inaccessible to livestock, utilization is not estimated on this site. Plant frequency in 2009 indicated a significant increase in Nevada saltbush and bassia. In 2010 saltgrass decreased to its lowest level for the site. Shrub cover for Nevada saltbush continues to increase on the site rising from 5.4 m in 2006 to 66.6 m in 2010. In 2012 there was a slight decrease in Nevada saltbush cover and an increase in saltgrass frequency. At the same time SUMO has steadily decreased on the site.

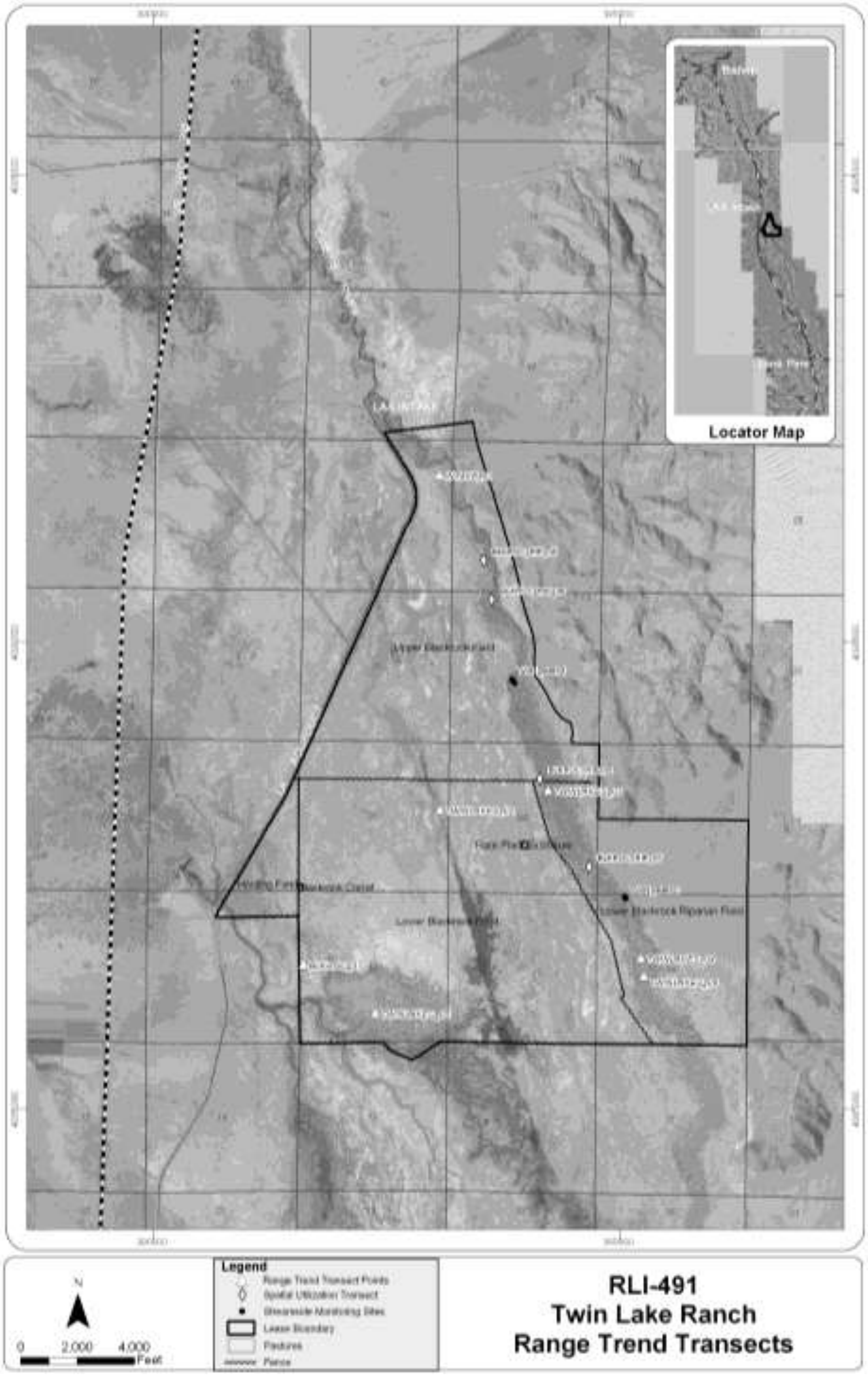
Frequency (%), TWINLAKES_06

Life Forms	Species	2006	2007	2009	2010	2012
Perennial Forb	HECU3	0	0	8	8	11
	SUMO	48	30	29	16	10
Perennial Graminoid	DISP	57	38	32	13	30**
	SPAI	0	0	10	0	0
Shrubs	ATTO	23	20	63	71	51*
Nonnative Species	BAHY	0	0	22	29	0**
	SATR12	11	0	0	0	0

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

Cover (m) Shrubs TWINLAKES_06

Species Code	2006	2007	2009	2010	2012
ATTO	5.4	11.3	50.2	66.6	62.8
SUMO	30.5	44.8	14.9	13.4	3.4
Total	35.9	56.1	65.0	80.0	66.2



Land Management Figure 7. Twin Lake Lease RLI-491, Range Trend Transects

4.11.3 Blackrock Lease (RLI-428)

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

There are twenty pastures on the Blackrock Lakes lease within the LORP boundary: South Blackrock Holding, White Meadow Field, White Meadow Riparian Field, Reservation Field, Reservation Riparian Field, Little Robinson Field, Robinson Field, East Robinson Field, North Riparian Field, Russell Field, Locust Field, East Russell Field, South Riparian Field, West Field, Wrinkle Field, Wrinkle Riparian Field, Spring Field, Wrinkle Holding, Horse Holding, and North Blackrock Holding. Twelve of these pastures are monitored using range trend and utilization. The other eight pastures are holding pastures for cattle processing or parts of the actual operating facilities.

<u>Summary of Utilization</u>

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

End of Grazing Season Utilization for Fields on the Blackrock Lease, RLI-428, 2012

Fields	Utilization
North Riparian Field*	10%
Horse Holding	31%
Wrinkle Riparian Field*	24%
Locust Field	32%
Reservation Field	26%
Robinson Field	28%
Russell Field	26%
White Meadow Field	19%
White Meadow Riparian Field*	31%
Wrinkle Field	22%
South Riparian Field*	23%
West Field	38%

*Riparian utilization 40% **

<u>Riparian Management Area</u>

Riparian use in all fields was below the 40% utilization limit and all upland fields did not reach 65% for the grazing season. There was plenty of available forage left in all fields and there was a noticeable increase in meadow areas located in the White Meadow Riparian Field. These areas had been burned previously removing saltcedar slash and dead brush.

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

There are 26 range trend sites on the Blackrock Lease. In 2013 range trend transects will be monitored across the entire lease.

Irrigated Pastures

There are no irrigated pastures on the Blackrock Lease.

Stockwater Sites

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

Fencing

There was no new fencing constructed on the lease in 2012.

Rare Plant Trend Plot Monitoring

Little Robinson Pasture, Blackrock Lease

This pasture contains a *S. covillei* population. Trend plots Little Robinson 1EX and Little Robinson 2EX occur within an exclosure; plots Little Robinson 1C and Little Robinson 2C are adjacent to the exclosure. The pasture was moderately grazed during the 2012 season. In 2012, phenology included individuals that were vegetative to individuals that were in bud.

Little Robinson Pasture, Blackrock Lease

Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Little Robinson 1C	2009	*S. covillei*	0	12	28	40
	2010		1	0	45	46
	2011		16	11	17	44
	2012		12	0	28	40
Little Robinson 2C	2009	*S. covillei*	0	12	19	31
	2010		3	0	28	31
	2011*		4	1	0	5
	2012		0	0	7	7
Little Robinson 1EX	2009	*S. covillei*	0	0	40	40
	2010		0	0	39	39
	2011		0	0	29	29
	2012		3	0	23	26
Little Robinson 2EX	2009	*S. covillei*	0	6	23	29
	2010		0	0	15	15
	2011		8	0	15	23
	2012		1	0	11	12

**80% of plot inundated.*

Robinson Pasture, Blackrock Lease

This pasture contains a *S. covillei* population and a *C. excavatus* population. Trend plots Robinson 1EX and Robinson 2EX occur within an exclosure capturing both *C. excavatus* and *S. covillei* species for use in tracking trends of both species. Two *S. covillei* trend plots, Robinson 1C and Robinson 2C along with one *C. excavatus* trend plot, Robinson 3C are outside the exclosure within the same pasture. In 2012, phenology included individuals that were vegetative to individuals that had already set seed.

Robinson Pasture, Blackrock Lease

Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Robinson 1C	2009	*C. excavatus*	0	0	12	12
	2010		0	0	38	38
	2011		0	0	30	30
	2012		0	0	2	2
Robinson 1C	2009	*S. covillei*	0	0	6	6
	2010		0	0	2	2
	2011		4	0	2	6
	2012		1	0	5	6
Robinson 2C	2009	*C. excavatus*	0	0	0	0
	2010		0	0	2	2
	2011		0	0	6	6
	2012		0	0	1	1
Robinson 2C	2009	*S. covillei*	0	4	59	63
	2010		1	0	52	53
	2011		22	6	34	62
	2012		12	0	48	60
Robinson 3C	2009	*C. excavatus*	0	0	1	1
	2010		0	0	11	11
	2011		0	0	18	18
	2012		0	0	13	13
Robinson 1EX	2009	*C. excavatus*	0	0	2	2
	2010		0	0	11	11
	2011		0	0	2	2
	2012*		0	0	0	0
Robinson 1EX	2009	*S. covillei*	0	43	35	78
	2010		17	0	36	53
	2011		13	8	22	43
	2012*		13	0	23	36
Robinson 2EX	2009	*C. excavatus*	0	0	23	23
	2010		2	0	23	25
	2011		0	1	30	31
	2012*		0	0	1	1
**Gate open – Exclosure grazed*						

Springer Pasture, Blackrock Lease

This pasture contains a *S. covillei* population. Trend plots were established but because of concerns raised by the lessee, the MOU Group decided that the planned exclosure would not be constructed. This decision was based on the concerns of the lessee and lack of data concluding that grazing is detrimental to *S. covillei*. Trend plots Springer 1EX and Springer 2EX occur within the area of the planned exclosure but are grazed; plots Springer 1C and Springer 2C are adjacent to the planned exclosure. The pasture was moderately grazed during the 2012 season. In 2012, phenology included individuals that were vegetative to individuals that were in seed.

Springer Pasture, Blackrock Lease

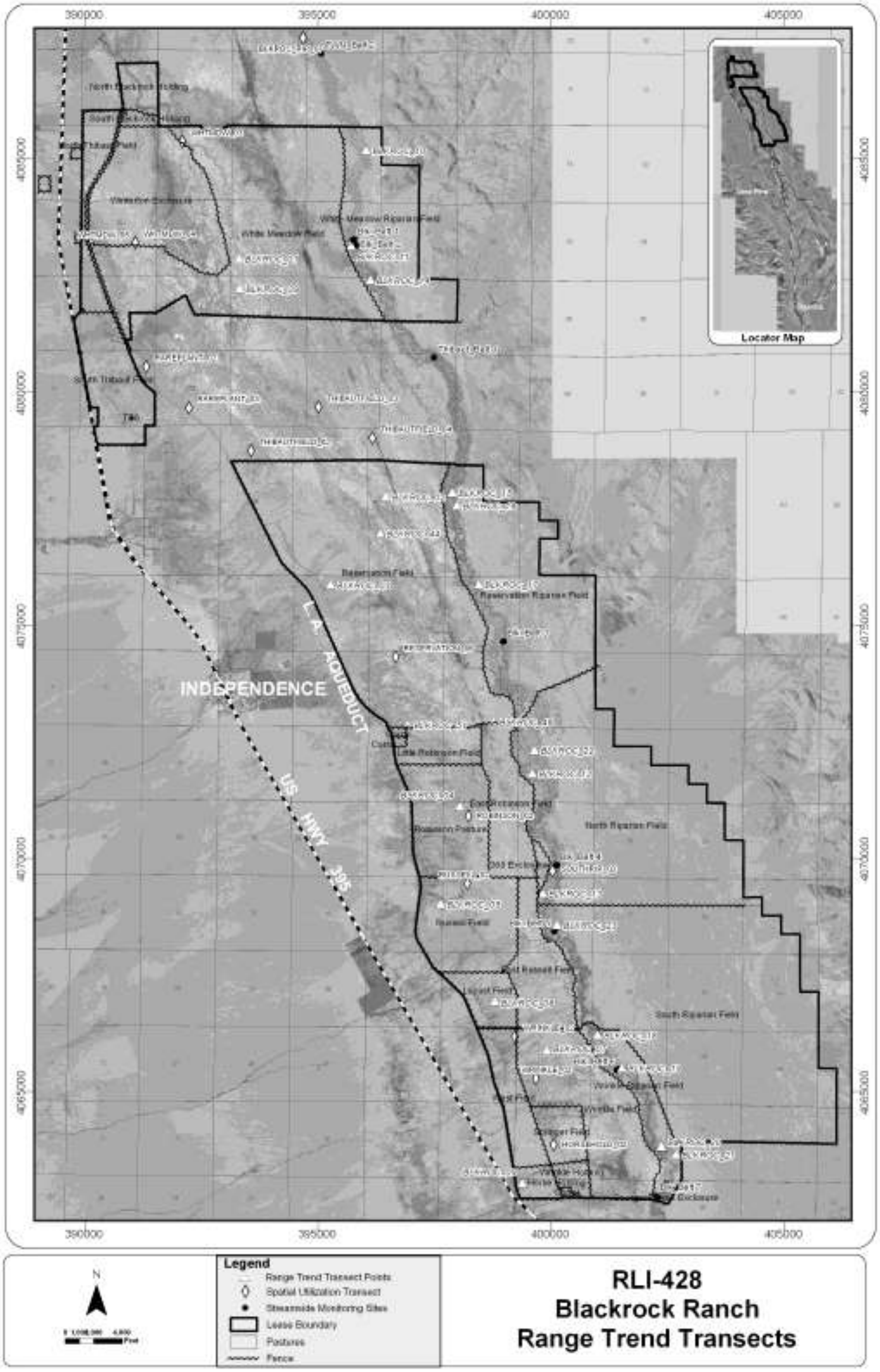
Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Springer 1C	2009	*S. covillei*	0	74	31	115
	2010		15	0	131	146
	2011		9	31	9	108
	2012		41	0	119	160
Springer 2C	2009	*S. covillei*	0	13	24	37
	2010		3	0	49	52
	2011		7	17	33	57
	2012		27	0	44	71
Springer 1EX	2009	*S. covillei*	0	2	5	7
	2010		0	0	16	16
	2011		6	44	42	92
	2012		6	0	10	16
Springer 2EX	2009	*S. covillei*	0	23	13	36
	2010		0	0	37	37
	2011		3	13	29	45
	2012		17	0	24	41

Salt and Supplement Sites

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

Burning

Slash pile burning, along the river, is planned for the Blackrock Lease in 2012, and will be done by Inyo County. Several range burn sites have also been identified for 2013; these sites are still being evaluated for vegetation composition and acreage.



Land Management Figure 8. Blackrock Lease RLI-428, Range Trend Transects

4.11.4 Thibaut Lease (RLI-430)

The 5,259-acre Thibaut Lease is utilized by three lessees for wintering pack stock. Historically, the lease was grazed as one large pasture by mules and horses. Since the implementation of the LORP and installation of new fencing, four different management areas have been created on the lease. These areas are the Blackrock Waterfowl Management Area, Rare Plant Management Area, Thibaut Field, and the Thibaut Riparian Exclosure. Management differs among these areas. The Blackrock Waterfowl Management Area can be grazed every other year. The 2011-12 season was an on-grazing year and the area was not flooded for waterfowl habitat. Water was only released for stockwater. Thibaut Pond was dried out for burning with utilization standards during an on-grazing status being 65%. During the wetted cycle of the Blackrock Waterfowl Management Area management will revert back to a utilization standard of 40%. The irrigated pasture portion located in Thibaut Field was assessed using irrigated pasture condition scoring and the upland portions of the field were evaluated using range trend and utilization transects. The Rare Plant Management Area is evaluated using range trend and utilization transects. The Riparian Exclosure has been excluded from grazing for 10 years.

Summary of Utilization

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

End of Grazing Season Utilization for Fields on the Thibaut Lease, RLI-430, 2012

Fields	Utilization
Rare Plant Management Area	39%
Thibaut Field	12%
Waterfowl Management Area	Burned

Upland Management Areas

The end-of-season use in the Thibaut lease was well below the allowable upland standards. This was due to the removal of grazing restrictions in the Waterfowl Management Area prior to burning. By allowing the stock to graze unrestricted much of the normal grazing pressure placed on the Rare Plant Management Area and Thibaut Field was removed. Grazing restrictions will be reinstated in the Waterfowl Management Area for the 2012-13 grazing season. Also the upland utilization standard will be lowered to 50%. This standard is being lowered because the lease was not allowed 60 continual days of rest during the growing season. With the lowered utilizations standards vigilant grazing monitoring will be needed in order to not exceed utilization standards in all fields during the 2012-13 grazing season.

Summary of Range Trend Data and Conditions

2012 was an off-year for Range Trend analysis on the Thibaut lease. However there were four transects read in the Thibaut Riparian pasture which are briefly described in the general summary at the beginning of this chapter.

Irrigated Pastures

The northern portion of the Thibaut Pasture (85 acres) comprises the area managed as irrigated pasture for the Thibaut Lease. With the completion of the new fencing for the LORP creating the Waterfowl management area located directly north, and rare plant management area located south west. A grazing corridor has been created that puts heavy pressure on the irrigated pasture. Due to the lack of grazing prescriptions in the Waterfowl Management Area pressure was reduced greatly on the irrigated pasture. This allowed the irrigated pasture condition score to improve (81%).

LADWP Watershed Resources staff recommends that livestock be moved out of the area periodically during the grazing season to allow the area to rest. This may be achieved by supplemental feeding further south in the Thibaut Field, electric fencing, or turning the livestock out in the southern end of Thibaut Field instead of the corral area. This irrigated pasture will be re-evaluated in the 2012-13 grazing season.

Stockwater Sites

There is one developed water site in the Thibaut Field, which consists of a flowing well that has a stockwater well drilled next to it, located in the uplands east of the irrigated pastures in the Thibaut Field. This well has not produced adequately since its installation. Currently, the flowing well is still creating a small puddle area for livestock and wildlife. The lessee has not yet installed a water trough.

Fencing

There was no new fence constructed on the lease in 2012.

Rare Plant Management Area Thibaut

This pasture contains both *S. covillei* and *C. excavatus* populations. Trend plots for Rare Plant Management Area 1 and Rare Plant Management Area 4 are within an exclosure that is restricted from grazing from early March through early October per the LORP EIR during the rare plants' flowering, fruiting, and seeding period. The pasture was grazed with end-of-season utilization at 38%. In 2012, phenology included individuals that were vegetative to individuals that were in flower.

Rare Plant Management Area, Thibaut Lease

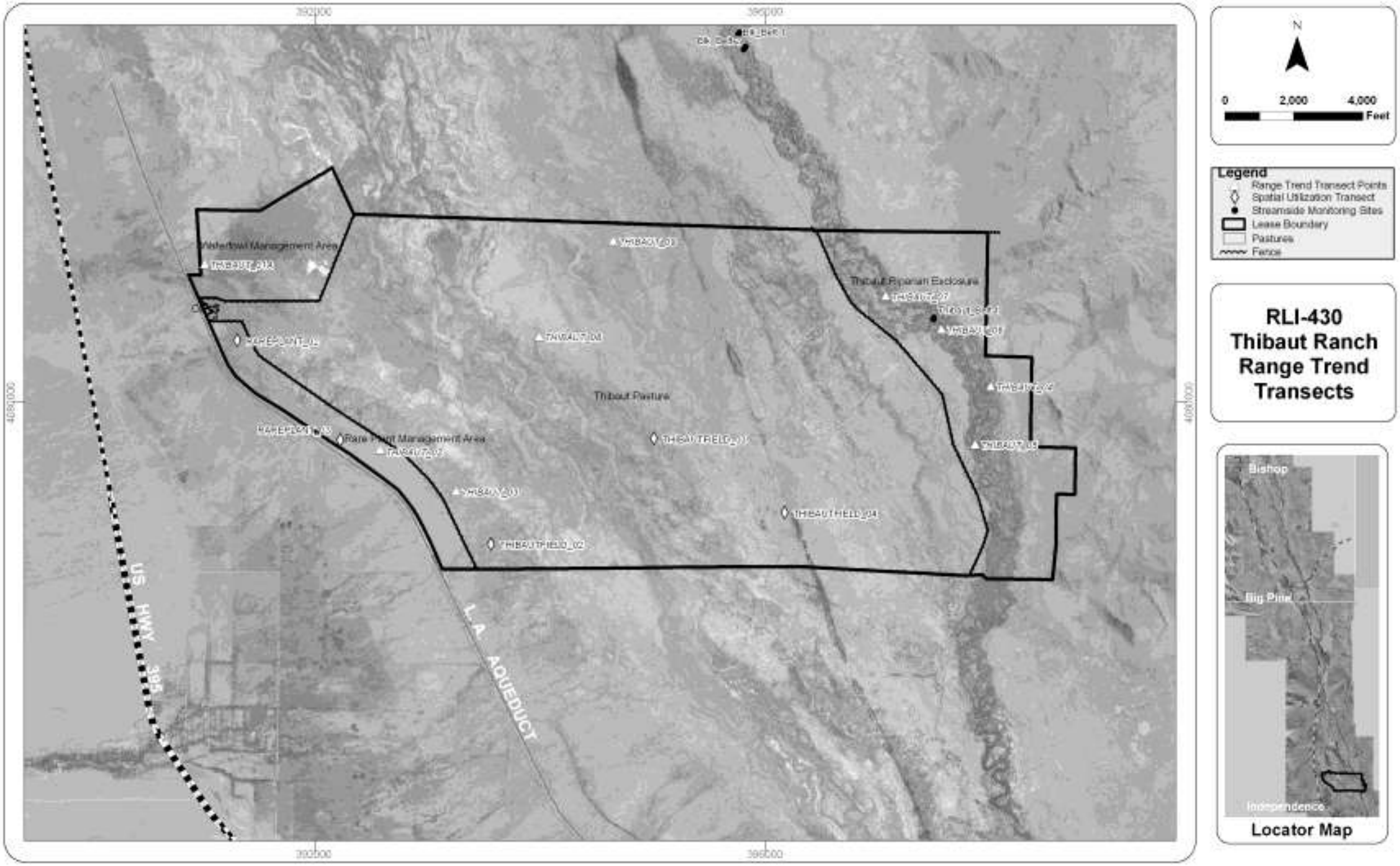
Plot Number	Year	Species	Seedling	Juvenile	Mature	Total
Rare Plant Management Area 1	2009	*C. excavatus*	0	0	3	3
	2010		0	0	12	12
	2011		0	0	4	4
	2012*		2	0	7	9
Rare Plant Management Area 1	2009	*S. covillei*	0	9	21	30
	2010		1	0	24	25
	2011		15	5	32	52
	2012*		34	0	42	76
Rare Plant Management Area 4	2009	*C. excavatus*	0	0	2	2
	2010		0	0	4	4
	2011		0	0	2	2
	2012*		0	0	1	1
Rare Plant Management Area 4	2009	*S. covillei*	0	7	32	39
	2010		0	0	38	38
	2011		9	12	40	61
	2012*		31	0	44	75
**Some grazing by elk or livestock.*						

Salt and Supplement Sites

Hay is spread over an area using a truck or trailer pulled by a truck. Feeding areas have not been rotated resulting in heavy livestock concentrations on the west end of the Thibaut Field and associated negative grazing impacts. However, with the improvements to an existing road to the east vehicles will be able to feed in the dry areas away from the meadow.

Burning

Thibaut Pond was dried out and burned during the winter of 2012. It is still dry while a management plan is being devised to improve open water habitat.



Land Management Figure 9. Thibaut Lease RLI-430, Range Trend Transects

4.11.5 Islands Lease (RLI-489)

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

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

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

<u>Summary of Utilization</u>

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

End of Grazing Season Utilization for Fields on the Islands Lease, RLI-489 2012

Fields	Utilization
Carasco Riparian Field*	26%
Depot Riparian Field*	64%
Lubkin Field	5%
River Field *	50%
South Field	10%

**Riparian utilization 40%*

<u>Riparian Management Areas</u>

The Depot Riparian Field was 64% and the River Field was 50%, both utilization rates had exceeded the 40% standard. The highest use occurred in the River Field on the east side of the river. The use on the west side of the river, specifically the Islands, was low. The Carasco Riparian Field and South Field were well below the utilization standards. Supplement was also observed in the floodplain in all portions of the lease, which had a direct result in increased utilization in the River Field and Depot Riparian Field. Supplement is not allowed in the floodplain and LADWP Watershed Resources staff recommended that new locations be selected for the 2012-13 grazing season. This should lower utilization levels in both fields and help distribute livestock.

Upland Management Areas

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

Summary of Range Trend Data in Islands Exclosure

2012 was an off year for Range Trend on the Islands Lease.

Irrigated Pastures

The B and D Pastures located near Reinhackle Spring were rated in 2012 and received an irrigated pasture condition score of 90%. These pastures will be rated again in 2013.

Irrigated Pasture Condition Scores 2010-12

Pasture	2010	2011	2012
B Pasture	90%	X	90%
D Pasture	90%	X	90%

X indicates no evaluation made.

Stockwater Sites

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

Fencing

There was no new fence constructed on the lease in 2012.

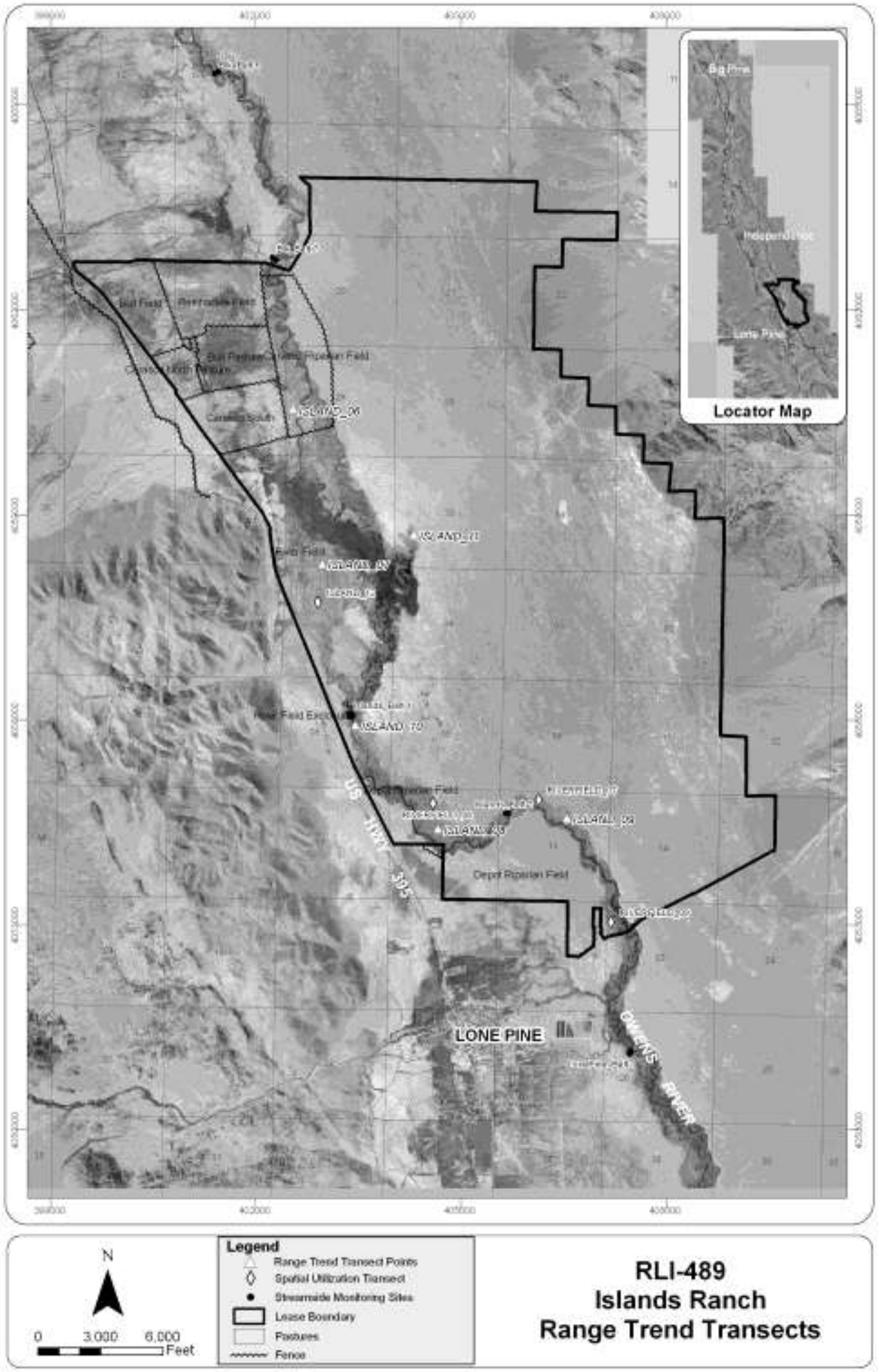
Salt and Supplement Site:

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

There are established sites that have been used for countless years. It would not be feasible to move them and disturb a new area. However, supplement was found in the floodplain during the grazing season which led to increased utilization. The lessee was notified and the old existing sites will be used in 2012-13.

Burning

There are currently no range burns planned for the lease for 2013.



Land Management Figure 10. Islands Ranch RLI-489 Range Trend Transects

4.11.6 Lone Pine Lease (RLI-456)

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

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

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

Summary of Utilization

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

End of Grazing Season Utilization for Pastures on the Lone Pine Lease, RLI-456, 2012.

Pastures	Utilization
Johnson Pasture	0%
River Pasture - Lone Pine*	37%

*Riparian utilization 40%**

Riparian Management Area

Utilization was 37% in the River Field, 3% below the 40% limit. Several transects in the River Field (LONEPINE_03, 04, and 08) were all over 40%, if a few other transects had been higher utilization would have exceeded 40%. LADWP Watershed Resources staff realized that it had been a dry winter and the normal spring forage was not available to move cattle out of the riparian areas. Despite the lack of spring green-up, utilization rates must not be exceeded and more proactive livestock movements should be undertaken during dry grazing seasons. LADWP recommended that the lessee review the use on the transect level and try to decrease use on the above-mentioned transects during the 2012-13 grazing season.

Upland Management Area

There was no utilization in uplands on the lease.

Summary of Range Trend Data

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

Significant changes in selected plant frequencies for Lone Pine transects between 2010 and 2012.

	No Change	DISP	SPAI	ATTO	BAHY
Moist Flood Plain					
LONEPINE_01	↔				
LONEPINE_02	↔				
LONEPINE_03	↔				
LONEPINE_04	↔				
LONEPINE_06		↓			
LONEPINE_07	↔				
SODIC FAN					
LONEPINE_05	↔				

*** Sites where change extends outside historical ranges for the transect.*
α<0.1, ↑=increase, ↓=decrease,↔=no change

LONEPINE_01

This site is in a riparian management area on the west side of the Owens River, just north of Lone Pine Creek in the River Pasture. The soil series associated with the transect is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes, and is on a Moist Floodplain ecological site. During the baseline period from 2002-07, similarity index has ranged between 76% and 79%. Annual aboveground production at this riparian site has exceeded typical quantities found in the Moist Floodplain ecological site description. This site supports four perennial graminoid species and is dominated by saltgrass (*Distichlis spicata* [DISP]). The overall biomass of shrubs is typical for a Moist Floodplain ecological site. No nonnative species were detected at the site. Creeping wildrye (LETR) significantly increased in 2009 and continues to remain stable. All other plant frequencies did not statistically vary when compared to 2009. Shrub cover appears to be decreasing on this site. Utilization was low this year at 22%.

Utilization by Weighted Average and Species, LONEPINE_01

	Weighted Average	DISP	LETR5	SPAI
2007	80%	82%		78%
2008	42%	28%	43%	62%
2009	61%	61%		
2010	49%	49%	31%	54%
2011	28%	28%		
2012	22%	16%		62%

Frequency (%), LONEPINE_01

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

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

Cover (%) Shrubs LONEPINE_01

Species Code	2003	2004	2007	2009	2010	2012
ATTO	7.1	5.2	4.7	1.8	3.0	3.2
ERNA10	2.2	2.6	2.1	0.0	0.1	0.7
SUMO	0.1	0.0	0.8	0.0	0.0	0
Total	9.5	7.8	7.5	1.8	3.0	3.8

LONEPINE_02

This site is in a riparian management area on the west side of the Owens River, east of the Lone Pine Dump in the River Pasture. The soil series is Torrifluvents-Fuvaquentic Endoaquolls complex, 0-2% slopes, and is on a Moist Floodplain ecological site. The similarity index ranged between 65% and 87% from 2002 to 2007. The site is in excellent condition. The site is grass-dominated with saltgrass comprising the bulk of the biomass. Saltgrass frequency significantly increased in 2009, outside its historic range from 2002-07 and in 2010-12 returned to levels typically observed on the site. No nonnative species were detected at the site. Utilization on this transect was 32%

Utilization by Weighted Average and Species, LONEPINE_02

	Weighted Average	DISP	LETR5	SPAI
2007	79%	75%	na	85%
2008	45%	31%	na	58%
2009	48%	37%	na	64%
2010	25%	7%		50%
2011	30%	24		38%
2012	32%	20%		46%

Frequency (%), LONEPINE_02

Life Forms	Species	2002	2003	2004	2007	2009	2010	2012
Perennial Graminoid	DISP	146	125	142	143	164	141	152
	JUBA	9	13	20	17	14	15	15
	LETR5	0	0	0	3	0	1	4
	SPAI	65	78	65	64	52	65	69
Shrubs	ATTO	0	0	3	0	0	0	0
	ERNA10	0	1	4	3	1	2	3

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

Cover (m) Shrubs LONEPINE_02

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

LONEPINE_03

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

The similarity index has ranged between 74% and 87% during sampling periods between 2002-07, indicating the site is in excellent condition. Site production has exceeded the expected based on the ecological site description in all years of sampling. The site is grass-dominated with saltgrass comprising the bulk of the biomass and creeping wildrye closely reaching the potential described for the site at 13% in 2007. Frequency for creeping wildrye increased significantly in 2009 and remained significantly higher in 2010 when compared to all sampling periods during the baseline period. There were no changes in frequency for all species between 2009-10 and 2012. Overall shrub cover is minimal. No nonnative species were detected at the site. This site, based on the ecological site description and frequency trends, is stable and in excellent ecological condition. Utilization on this transect was 63%. However this seems to have no effect on the site's ecological condition.

Utilization by Weighted Average and Species, LONEPINE_03

	Weighted Average	DISP	LETR5	SPAI
2007	81%	83%	74%	81%
2008	46%	38%	25%	66%
2009	70%	72%	23%	66%
2010	37%	37%	43%	
2011	52%	50%	25%	74%
2012	63%	66%	44%	50%

Frequency (%), LONEPINE_03

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

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

Cover (m) Shrubs LONEPINE_03

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

LONEPINE_04

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

The similarity index has ranged widely between 59% and 73% from 2002-07. Site production has generally been less than potential based on the ecological site description for a Moist Floodplain site. When compared to the Moist Floodplain ecological site description, the site has less than the expected biomass of forage species such as creeping wild rye and Baltic rush (*Juncus balticus* [JUBA]). This is explained by the transition from mesic conditions on the Moist Floodplain to more xeric conditions of the uplands which results in a decreasing abundance of creeping wildrye, Baltic rush, and riparian trees and the disproportionate amount of alkali sacaton which can better thrive in both the mesic and xeric transitional zones. The site is grass-dominated with saltgrass and alkali sacaton comprising the bulk of the biomass. The shrub component of the site is dominated by rubber rabbitbrush (*Ericameria nauseosa* [ERNA10]). As flows on the Lower Owens continue, soil moisture may rise towards the upland zone of the transect and future changes in species composition may be observed. However, frequency data indicates that there is an inverse trend, with decreasing saltgrass, and increasing alkali sacaton which is typical gradient in zones moving from wet to dry areas. No nonnative species were detected at the site. There were no changes in frequency from 2010 to 2012. End-of-season utilization at this site was 45%.

Utilization by Weighted Average and Species, LONEPINE_04

	Weighted Average	DISP	LETR5	SPAI
2007	61%	52%	na	71%
2008	51%	43%	na	59%
2009	43%	37%	na	51%
2010	32%	24%		42%
2011	45%	31%		62%
2012	45%	26%		70%

Frequency (%), LONEPINE_04

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

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

Cover (m) Shrubs LONEPINE_04

Species Code	2003	2004	2007	2009	2010	2012
ATCO	0.1	0.5	0.0	0.0	0.0	0.4
ATTO	0.0	0.0	0.0	10.0	0.2	0
ERNA10	2.3	2.1	4.5	1.1	1.0	1.4
SUMO	12.4	1.0	0.0	0.0	1.3	1.9
Total	14.8	3.6	4.5	11.1	2.5	3.6

LONEPINE_05

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

The similarity index has ranged between 69% and 77% between 2002-07. Nevada saltbrush (*Atriplex torreyi* [ATTO]) has trended down over time. Frequency of saltgrass significantly increased in 2009 and decreased in 2010 to similar levels to that seen during the baseline period. There were no other significant changes on the site. End-of-season utilization on this transect has consistently remained low except for 2010.

Utilization by Weighted Average and Species, LONEPINE_05

	Weighted Average	DISP	SPAI
2007	44%	23%	49%
2008	2%	9%	0%
2009	34%	na	34%
2010	63%		63%
2011	14%		14%
2012	0%		0%

Frequency (%), LONEPINE_05

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

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

Cover (m) Shrubs LONEPINE_05

Species Code	2003	2007	2009	2010	2012
ATTO	32.8	28.9	9.6	13.2	13.4
SAEX	1.5	14.5	21.1	1.5	4.0
Total	34.4	43.3	30.8	14.7	17.4

LONEPINE_06

This site is in a riparian management area on the east side of the Owens River in the River Pasture. This monitoring transect is located inside a riparian exclosure, constructed in February 2009. Over time the site will be used as a non-grazed reference site. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes on a Moist Floodplain ecological site.

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

Utilization by Weighted Average and Species, LONEPINE_06

	Weighted Average	DISP	LETR5	SPAI
2007	78%	77%	na	84%
2008	42%	18%	na	66%

Frequency (%), LONEPINE_06

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

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

Cover (m) Shrubs LONEPINE_06

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

LONEPINE_07

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

The similarity index was 60% in 2007. Site production was similar to that expected based on the ecological site description. There is a low diversity of perennial graminoids as the only species detected was saltgrass while other forage species such as alkali sacaton and creeping wild rye are lacking on the transect but are present in the area. The biomass of forbs and riparian woody species is less than expected as compared to the desired plant community. No nonnative species were detected at the site. Baseline utilization is not available for this site since it was not established until the summer of 2007. Between 2007 and 2012 frequency has not changed significantly on the site.

Utilization by Weighted Average and Species, LONEPINE_07

	Weighted Average	DISP
2008	44%	44%
2009	51%	51%
2010	38%	38%
2011	8%	8%
2012	21%	21%

Frequency (%), LONEPINE_07

Life Forms	Species	2007	2009	2010	2012
Perennial Graminoid	DISP	150	157	160	151

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

No shrubs present on site.

LONEPINE_08

This site is in a riparian management area on the east side of the Owens River in the River Pasture. This site was first established in the summer of 2011. The soil series is Torrifluvents-Fluvaquentic Endoaquolls complex, 0-2% slopes on a Moist Floodplain ecological site.

Utilization by Weighted Average and Species, LONEPINE_08

	Weighted Average	DISP
2012	42%	42

Frequency (%), LONEPINE_08

Life Forms	Species	2012
Perennial Forb	ANCA10	**3**
	NIOC2	**3**
Perennial Graminoid	DISP	**155**

Irrigated Pastures

The irrigated pastures within the LORP project area for the Lone Pine Lease are the Edwards, Richards, Smith, Old Place and Van Norman Pastures. All of these pastures were rated in 2007 with the exception of the Van Norman Pasture. The Van Norman Pasture was not irrigated in 2007-08 due to the irrigation water pump burning up. There was no irrigation water available for this pasture thus it could not meet the irrigated pasture evaluation criteria and was not rated. However, the remaining pastures within the project area on the lease were rated. All pastures except the Edwards and Richards Pastures met the minimum allowed score of 80%.

In 2010, the Edwards and Richards Pastures were evaluated again and both maintained good condition. The Van Norman pasture was also evaluated for the first time since the well that supplies irrigation water was repaired and received a score of 80%. It should only take several years for this pasture to improve from 80%. All irrigated pastures on the lease will be re-evaluated in 2013.

Irrigated Pasture Condition Scores 2007-10

Pasture	**2007**	**2008**	**2009**	**2010**
Edwards	80	80	94	90
Richards	64	82	92	84
Van Norman	X	X	X	80
Smith	88	X	X	96
Old Place	86	X	X	90

X indicates no evaluation made

Stockwater Sites

One stockwater well was drilled on the Lone Pine Lease located in the River Pasture uplands. The approximate location is two miles east of the river on an existing playa. The lessee has made an effort to install a trough. However, the water is very muddy and will clog the plumbing for the trough so installation has been postponed until the problem is fixed.

Fencing

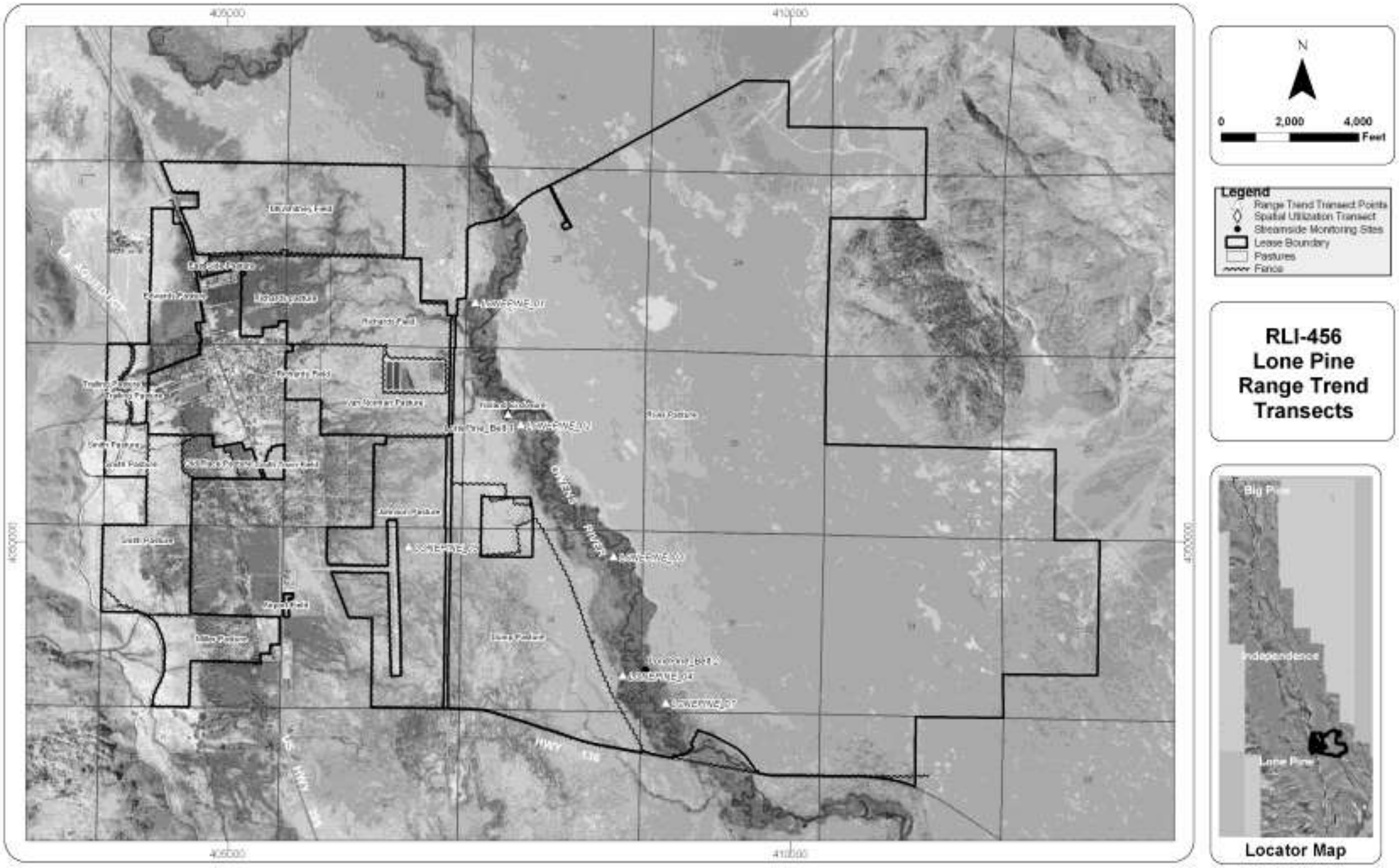
There was no new fencing constructed on the lease during 2012.

Salt and Supplement Site:

There are numerous supplement sites located on the Lone Pine Lease and most occur within the floodplain. These supplement sites are going to now be rotated in an effort to keep them away from the river and decrease the amount of disturbed sites in the flood plain.

Burning

There may be a burn conducted on the north end of Lone Pine in efforts create a fire break. The burn will be conducted by California Department of Forestry. Some of the area is salt grass meadow and will benefit forage production.



Land Management Figure 11. Lone Pine Lease RLI-456, Range Trend Transects

4.11.7 Delta Lease (RLI-490)

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

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

Summary of Utilization

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

End of Grazing Season Utilization for Fields on the Delta Lease, RLI-490, 2012

Fields	Utilization
Main Delta Field*	43%
Bolin Field	65%

*Riparian utilization 40%**

Riparian Management Areas

Utilization in the Main Delta was 43%, slightly exceeding the 40% standard. The data at the transect level showed that use was fairly even throughout, with slightly less utilization in the northern portion of the Main Delta Field. Watershed Resources staff are not concerned with the utilization levels and overall the lease has improved in grazing management.

Upland Management Areas

The Bolin Field met the upland utilization standard of 65% and the field maintained good condition.

Summary of Range Trend Data

No range trend transects were read on the Delta Lease in 2012.

Irrigated Pastures

The Lake Field is located west of U.S. Highway 395 north of Diaz Lake. This irrigated pasture was last evaluated in 2010 and received a score of 90%. This pasture will be re-evaluated in 2013.

Irrigated Pasture Condition Scores 2007-10

Pasture	2007	2008	2009	2010
Lake Field	84	X	X	90

X indicates no evaluation made.

Stockwater Sites

The Bolin Field was supposed to receive a stockwater site supplied by the Lone Pine Visitors Centers well in 2010. After a more in-depth analysis of water availability was undertaken, it was ascertained that there was not an adequate amount of water to sustain both uses. The resulting analysis has stockwater being supplied from a diversion that runs from the LAA. The status of this stockwater situation has not changed in 2012.

Fencing

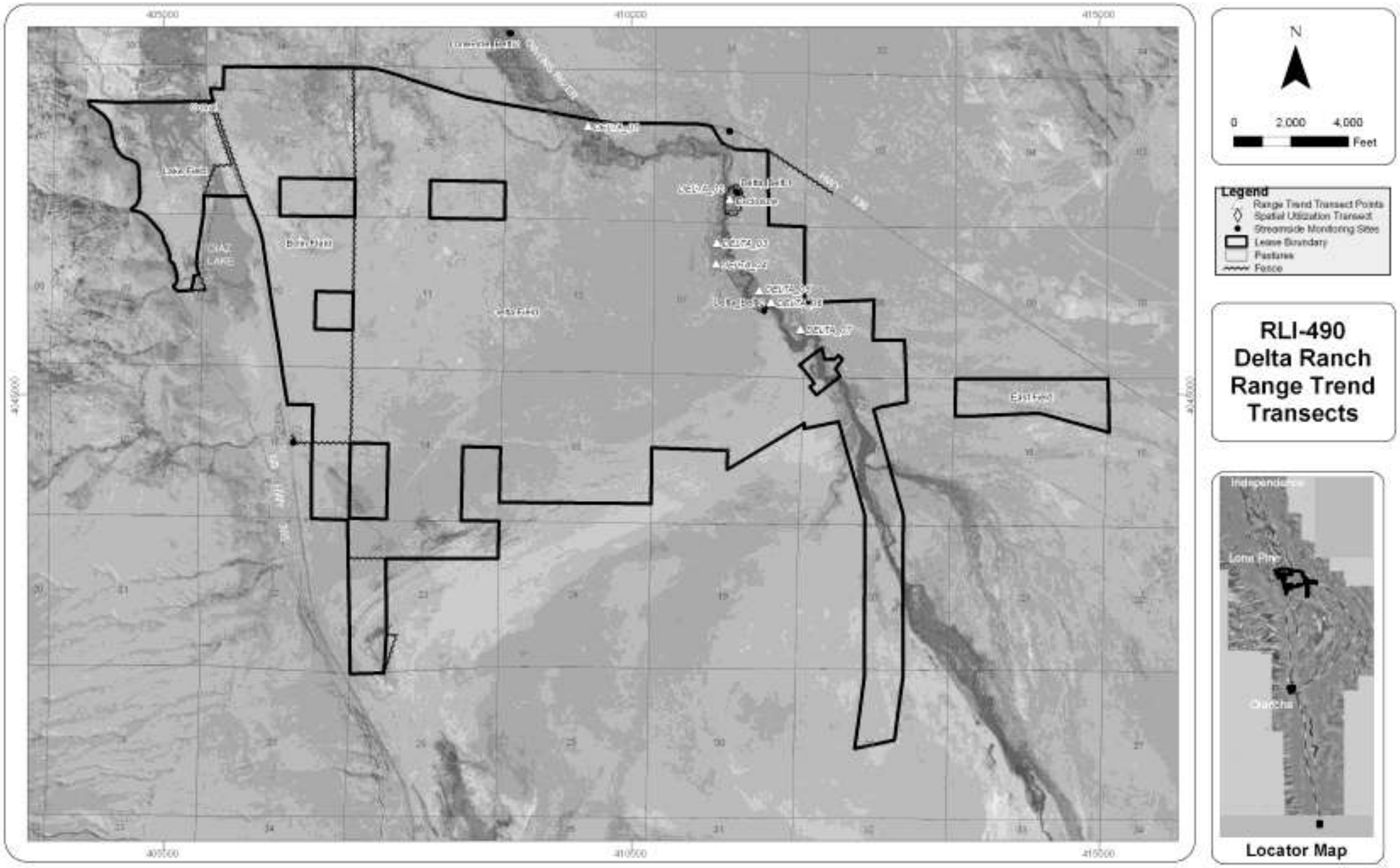
There was no fencing constructed on the lease during 2012.

Salt and Supplement Sites

Cake blocks that contain trace minerals and protein are distributed for supplement on the lease. The blocks are dispersed randomly each time and if uneaten they biodegrade within one grazing season. There are also supplement tubs that are used in established supplement sites.

Burning

There are no planned burns for this lease during 2013.



Land Management Figure 12. Delta Lease RLI-490, Range Trend Transects

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Land Management Appendix 1. Species Encountered Along 40 cfs Base Flow During Spring 2012 Streamside Monitoring.

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

5.0 2012 RAPID ASSESSMENT SURVEY

Lower Owens River Project
2012 Rapid Assessment Survey

Observations

Summary of Rapid Assessment Survey Observations

A survey of the Lower Owens River Project (LORP) area, referred to as the Rapid Assessment Survey, or RAS, is conducted annually. Between August 1 and August 10, 2012, Inyo County and LADWP staffs spent 60 person-days walking more than 225 miles along the Lower Owens River, and at water's edge in the Blackrock Waterfowl Management Area (BWMA), Off-River Lakes and Ponds (OLP), and the Delta Habitat Area (DHA) (see map "River-reaches and river-miles"). The observations recorded during this exercise are presented in this report.

The primary purpose of the RAS is to detect and identify problems that require maintenance, such as fences in need of repair; trash, slash piles and river obstructions that may require removal; and invasive or noxious species that require treatment.

Project managers and scientists can also use RAS data as rough indicators of basic trends in the ecological development of the riparian and riverine environments; especially when RAS data is compiled with information gathered from other LORP studies. For example, RAS observations of woody recruitment can be considered along with river-edge belt transects, which are designed to look in greater detail for woody recruitment. The combined observations can help project scientists deduce where woody recruitment is occurring, and if this recruitment is persisting. The observations made during the RAS effort are categorized by type and impact code (Table 1).

Table 1. Catalog of impacts recorded by the RAS

Impact Code	Observation Type	Description
WDY	Woody Recruitment	Spring cohort of willow and cottonwood seedlings
TARA	Saltcedar	Saltcedar seedlings (*Tamarisk* spp.), resprouts from treated and mature plants
ELAN	Russian Olive Recruitment	Seedling and juvenile (height <2m) Russian olive plants (*Elaeagnus angustifolia*)
NOX	Noxious Weeds	Any of twenty-one species of locally invasive plants, mainly perennial pepperweed
BEA	Beaver	Sightings or evidence of beaver in the LORP
ELK	Elk	Sightings or evidence of tule elk use (*Cervus canadensis* ssp. *nannodes*)
FEN	Fence	Reports of fence damage
GRZ	Grazing	Evidence of off-season grazing, or non-compliance with grazing plan
REC	Recreational Impacts	Evidence of recreational activity
ROAD	Road	Unauthorized roads or road/trail building activities
TRASH	Trash	Large refuse or dumping
SLASH	Slash	Substantial piles of recently cut saltcedar

The number of observations within each observation type by river-riparian reach or by management unit, and the total number of observations within each type are presented in Table 2.

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

Impact Code	Observation Type	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	BWMA	OLP	DHA	Total Obs.
WDY	Woody Recruitment	2	24	18	8	9	6	0	4	2	69
TARA	Saltcedar Plants (Tamarisk)	15	84	80	49	27	56	26	11	32	380
ELAN	Russian Olive Recruitment	1	1	7	0	0	0	7	8	0	24
NOX	Noxious Weeds (Lepidium)	9	11	7	0	0	0	6	0	0	31
BEA	Beaver	1	1	8	0	3	0	0	0	0	13
ELK	Elk	0	1	5	4	2	11	1	0	6	30
FEN	Fence	0	0	2	0	0	1	0	0	0	3
GRZ	Grazing	0	0	1	0	0	1	0	0	0	2
REC	Recreation Impacts & Use	0	1	7	0	1	15	0	0	0	24
ROAD	Road	1	0	0	0	2	6	0	0	0	9
TRASH	Trash	1	1	0	0	1	1	0	0	0	4
SLASH	Slash	0	1	0	0	0	0	0	0	0	1

River-reaches and LORP Units
Table 3

River sections, called reaches, divide the Lower Owens River. The six river-reaches are delineated by river stretches that share similar geomorphology (Table 3, and "River-reaches and river-miles map"). In the RAS summary, reaches offer a convenient way to describe a position on the river, and serve as a common reference for RAS observations taken year to year.

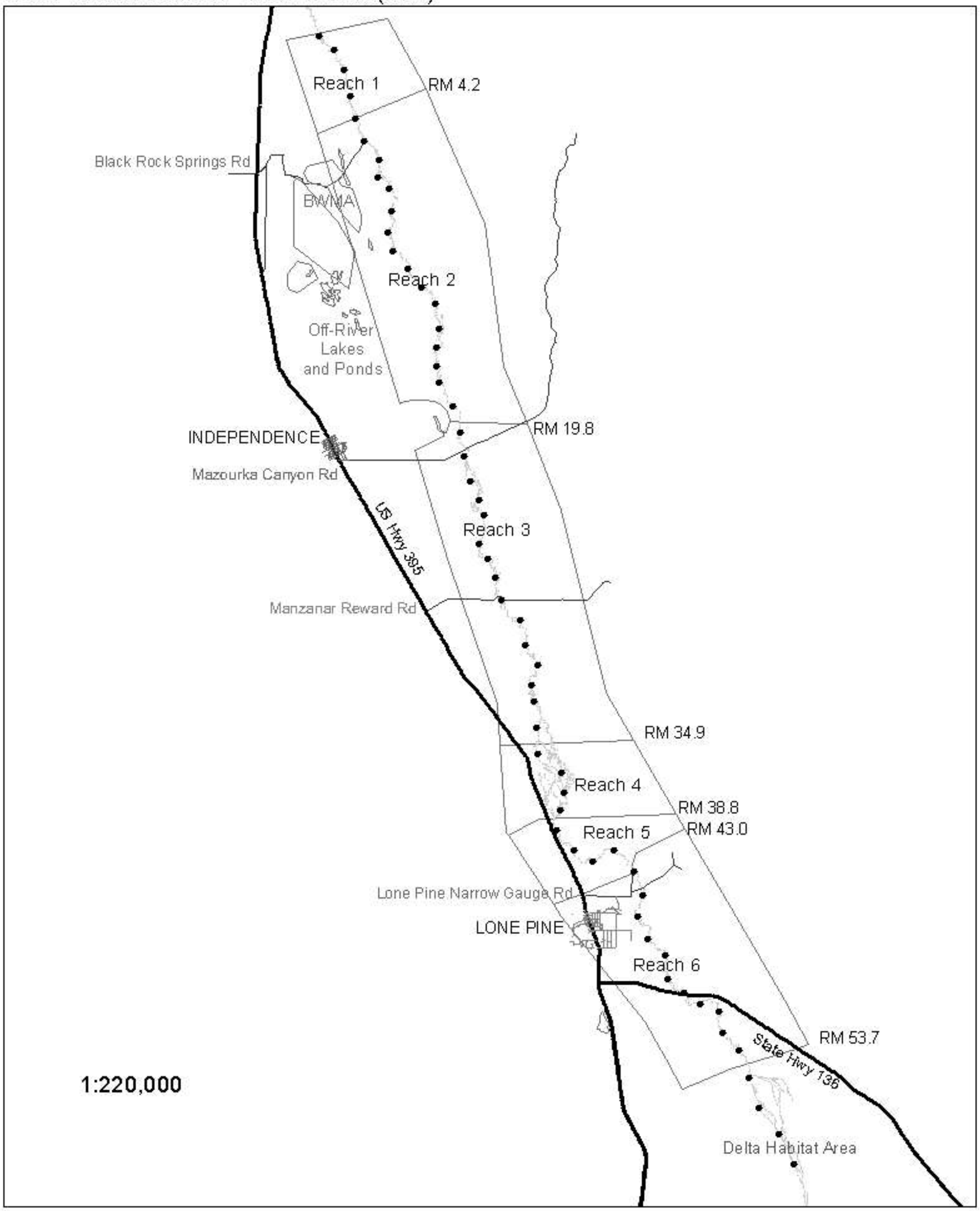
Individual observations in the river-riparian corridor are often referenced to the nearest river-mile (RM), to the nearest tenth of a mile. The Lower Owens River Intake is river-mile 0.0, the river mouth at the Owens Lake Delta is river-mile 53.7, and the river disappears into the bed of Owens Lake near mile 62.0. When comparing observations per river reach, or looking at distribution of observations along the length of the river, note that the length of each reach and the percentage of river covered by each reach vary considerably For example, most woody recruitment is found in reaches 2 and 3, which is understandable given that 49 percent of river-miles are contained in these two reaches.

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

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

[1] Reach types are distinguish by valley form, channel/floodplain morphology, and hydrologic variables.

River Reaches and River Miles (RM)



Revisited Sites
Maps 1a & 1b

Observers returned to specific sites where woody recruitment and saltcedar seedlings were recorded during the 2011 RAS, and noted the presence or absence of the targeted subject. A total of 136 sites were revisited. The results from these revisits are found in the relevant sections.

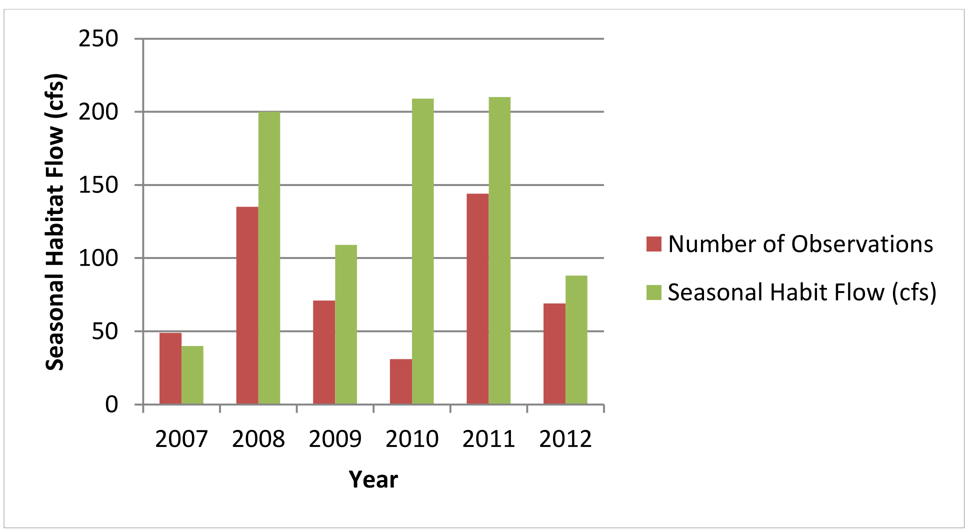
Summary of Observations by Category

Woody Recruitment (Impact Code=WDY)
Figure 1; Tables 4-6; Maps 2a, 2b, & 2c

A central focus of the RAS has been to identify areas where new trees and shrubs were developing. Surveyors were trained on how to locate, identify, and record willow (Salix spp.) and cottonwood (Populus fremontii) seedlings. Willow and Cottonwood provide the structural diversity and varied natural habitats that are essential to attracting key avian species that are indicators of the project's success.

In 2012, RAS found 69 tree willow recruits, but no sign of new cottonwood. The new willow was located in the river-riparian corridor or in the DHA. While the amount of woody recruitment was down from 2011, the number of plants found in 2012 is comparable to that observed in 2007, 2009 and 2010, when a similar SHF of 110 cfs was released (Figure 2, Table 4).

Figure 1. Seasonal Habitat Flow and Woody recruitment observed 2007-2012



The 2008 seasonal habitat flow was released in the winter (February 13, 2008)

Table 4. Number of woody recruits recorded per year, and river flow released during the seasonal habitat flow

Year	2007	2008	2009	2010	2011	2012
Recruitment sites	49	135	71	31	144	69
Peak Seasonal Habit Flow, released from LA Aqueduct Intake (cfs)	40 base	200	109	209	210	88

The RAS is conducted in August to be able to detect seedlings that may have germinated as the result of the annual LORP seasonal habitat flow (SHF). This year's RAS was undertaken six weeks after the SHF, so it is likely that seedlings that developed in response to the flow would have reached a stage of maturity that favored detection. While no correlation has been established between the SHF volume and the number of woody recruits observed, this relationship, along with other environmental factors, are being considered, and may guide adjustments to river flow.

Notes:

- Woody species were found at about 57% of recruitment sites (n=39). The remaining recruitment was shrub willow (SAEX).
- In all years observers hunted for woody recruitment, however protocol for recording was not consistent. For example, in 2008 and 2009, SAEX juveniles, some of which represented clonal recruitment, were lumped into the woody recruitment category. To the extent possible, clonally recruitment was separated out in the data during QA/QC.
- Reaches 4 and 5 had the greatest number of recruitment sites per river mile (Table 5).
- Most seedlings were recorded on a riverbank (n=43); others were found in the channel (n=18), floodplain (n=6), and off-river (n=2) (Table 6).
- In terms of the numbers of seedlings present at each of the recruitment sites; 37 sites had 1-5 seedlings, 25 sites had 6-25 seedlings, and at 7 sites more than 26 seedlings were found. Often, the recruitment sites with the greatest number of plants are located on soils under a mature tree.

Table 5. Number of recruitment sites, by species and location; number of recruitment sites, per river-mile (RM), per reach

Species Code	Common Name/ Scientific Name	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	BWMA	OLP	Total
SAEX	Narrow leaf willow/ *Salix exigua*	1	10	11	0	0	6	2	0	0	**30**
SAGO	Black willow/ *Salix gooddingii*	0	0	0	8	7	0	0	0	0	**15**
SALA3	Red willow/ *Salix leevigata*	0	3	4	0	1	0	0	0	0	**8**
SALIX	Tree species, hybrid, or unknown willow	1	11	3	0	1	0	0	0	0	**16**
POFR2	Fremont Cottonwood/ *Populus fremontii*	0	0	0	0	0	0	0	0	0	**0**
Total number of Observations		**2**	**24**	**18**	**8**	**9**	**6**	**2**	**0**	**0**	69
Number of Observations/RM		**0.5**	**1.5**	**1.2**	**2.1**	**2.1**	**0.6**	–	–	–	

Table 6. Location of recruitment sites, by species

Species Code	Common Name	Channel	Bank	Floodplain	Off-River
SAEX	Narrow leaf willow	2	23	3	2
SAGO	Black willow	7	7	1	0
SALA3	Red willow	4	3	1	0
SALIX	Hybrid, or unknown willow	5	10	1	0
POFR2	Fremont Cottonwood	0	0	0	0
Total number of seedlings, by landform		18	43	6	2

Woody Recruitment Revisits

Table 7; Map 1a

Woody recruitment sites found in 2011 were revisited in 2012. Of the 60 sites revisited about 72% of last year's cohort were relocated.

Table 7. Revisit sites: persistence of 2011 woody recruitment

	WOODY RECRUITMENT REVISITS recruitment sites n=60	
Reach/Area	Present	Absent
Reach 1	1	0
Reach 2	19	8
Reach 3	15	4
Reach 4	2	0
Reach 5	1	2
Reach 6	5	3
Total per Category	43	17
Percent of total	72%	28%

Saltcedar (USDA Plant Code=TARA)

Tables 8, 9; Map 3

Saltcedar (Tamarix spp) is found throughout the LORP, and is the most abundant noxious weed in the project area. In 2012, resprouts, seedlings, as well as mature plants were recorded; a total of 380 observations sites were located (Table 8).

Notes:
Although only 69 TARA sites were located in the BWMA and Off-river Lakes and Ponds units, plant populations at these sites were larger. Twenty-six percent the TARA located off-river were of populations of between 26 and >100 plants, while on the river, only 2.2% of the TARA located had populations in these categories (Table 8).

- Eighty-five percent of the TARA populations located along the river were of 1-5 individuals (Table 9).

Table 8. Total number of observation sites and age class of saltcedar by location; observations per river-mile

Age Class	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6	DHA	BWMA	OLP	Total
Seedlings	5	37	8	2	2	1	1	19	11	**86**
Resprouts	5	10	33	25	20	33	31	6	0	**163**
Mature	5	37	39	22	5	22	0	1	0	**131**
Total number of Observation Sites	**15**	**84**	**80**	**49**	**27**	**56**	**32**	**26**	**11**	**380**
Number of Observation/RM	**3.8**	**5.4**	**5.4**	**12.9**	**6.4**	**5.2**				

Table 9. Abundance at observation sites, by LORP unit, or river-reach

	Abundance (number of plants per site)				
Location	**1 to 5**	**6 to 25**	**26 to 100**	**>100**	**Total no. of sites**
BWMA-Drew	0	4	0	0	**4**
BWMA-Thibaut	0	2	1	0	**3**
BWMA- Waggoner	0	2	0	5	**7**
BWMA-Winterton	6	1	4	1	**12**
Delta Habitat Area	21	8	3	0	**32**
Off River - Billy	0	0	0	1	**1**
Off River - Goose	1	6	1	2	**10**
Reach 1	14	1	0	0	**15**
Reach 2	60	18	4	2	**84**
Reach 3	68	12	0	0	**80**
Reach 4	47	2	0	0	**49**
Reach 5	25	2	0	0	**27**
Reach 6	52	3	1		**56**
Total number of plants, by abundance	**294**	**61**	**14**	**11**	**380**

Notes:

- River reach 4, a short section of the river, had the greatest number of TARA sites per mile.
- A small numbers of plants (1-5 individuals) were common at each site, however four sites had >100 seedlings and sixteen sites supported 26-100 plants.
- When possible, seedlings were recorded, then pulled by staffs.
- The majority of seedlings were located along the river.
- About half of all mature plants and a third of all resprouts were found in off-river locations in the LORP area. Resprouts in the DHA were from all from stumps cut in early 2011, while resprouts in BWMA and OLP were plants resprouting from fire.
- Compared to 2010, three times as many seedling sites were found on the river.
- About 60% of saltcedar found on the river were in reaches 2 and 3.

Saltcedar Revisits

Table 10, Map 1b

Saltcedar (*Tamarix* sp.) revisits in 2012 looked at seedling recruitment sites, which were found, but not pulled in 2011. Of the 76 sites revisited, young saltcedar plants were still present at 54 sites, representing a total survivorship of 71%.

Table 10. Saltcedar Revisits

	SALTCEDAR (n=76)	
Reach/Area	**Present**	**Absent**
Reach 1	3	1
Reach 2	28	9
Reach 3	14	10
Reach 4	3	1
Reach 5	3	1
Reach 6	3	0
Total per Category	**54**	**22**
Percent of total	**71%**	**29%**

Russian Olive (USDA Plant Code=ELAN)

Table 11; Map 4

Russian olive (*Elaeagnus angustifolia*) does not appear to be spreading in the areas surveyed during the RAS, but for surveillance purposes ELAN recruitment is recorded.

Table 11. Abundance at observation sites, by LORP unit, or river reach

	Abundance (number of plants/location)				
Location	**1 to 5**	**6 to 25**	**26 to 100**	**>100**	**Total no. of sites**
BWMA-Drew	4	1	0	0	**5**
BWMA-Thibaut	0	0	0	0	**0**
BWMA- Waggoner	0	1	0	0	**1**
BWMA-Winterton	1	0	0	0	**1**
Delta Habitat Area	0	0	0	0	**0**
Off River - Billy	1	4	2	0	**7**
Off River--Goose	0	1	0	0	**1**
Reach 1	1	0	0	0	**1**
Reach 2	1	0	0	0	**1**
Reach 3	7	0	0	0	**7**
Reach 4	0	0	0	0	**0**
Reach 5	0	0	0	0	**0**
Reach 6	0	0	0	0	**0**

Noxious Weeds (Impact Code=NOX)

Table 12; Map 5

Perennial pepperweed (Lepidium latifolia), USDA Plant code=LELA2) was the only noxious species reported this year. Infestations recorded from previous years, and plants that had been sprayed with herbicide this season, were not recorded. The Inyo Mono Agricultural Commission, weed management program, continues to treat previously identified populations; the RAS goal is to identify new populations.

Notes:

- The Inyo County Agricultural Commissioner's office was provided coordinates for new pepperweed sites, and spray crews were dispatched.
- Thirty-one populations of LELA2 were recorded in 2012, of which 26 were previously unreported.
- Most new LELA2 populations were found near known populations, with the notable exception of new populations in Reach 1, which are upstream of all sites recorded in 2011.

Table 12. Abundance categories of LELA2 in newly identified populations, by location

	Abundance categories (number of plants/location)				
Location	**1 to 5**	**6 to 25**	**26 to 100**	**> 100**	**Total**
BWMA-Drew	1	2	0	0	**3**
BWMA – Waggoner	1	0	0	0	**1**
Reach 1	1	5	1	2	**9**
Reach 2	5	2	3	1	**11**
Reach 3	2	3	2	0	**7**
Reach 4	0	0	0	0	**0**
Reach 5	0	0	0	0	**0**
Reach 6	0	0	0	0	**0**
Total number of populations	**10**	**12**	**6**	**3**	**31**

Beaver Activity (Impact Code=BEA)

Map 6

Beaver activity and evidence was noted at 13 locations.

Note:

- Evidence of recent beaver activity was found at river-mile 31.8 (tail slap), and at river-mile 33.2 (beaver sighted).

Owens Valley Vole (Impact Code=OV VOLE)

Voles were not included in the 2012 RAS. This category was removed because past RAS efforts have documented a stable, if not expanding, population of vole in the LORP area.

Elk (Impact Code=ELK)

Map 6

Evidence of elk, and direct sightings were noted at 30 locations. Elk were seen in the Delta, and in the Islands area in reach 3 and 4.

Notes:
- Browse was recorded at 11 locations.
- Antler rub was noted at seven locations.

LORP Riparian Fence (Impact Code=FEN)

Map 7

Staff surveyed exclosure fencing as well as riparian fence.

Notes:
- Only three records were made of damage to fence.
- A recommendation was made to replace fencing and replacing older pass-through at the Manzanar Reward river bridge.
- No exclosure fence was damaged

Grazing Management (Impact Code=GRZ)

Map 7

Note:
- Two cattle feed stations were found on the west side of the river in the floodplain; one just south Mazourka Canyon Road, the other just south of Keeler Bridge.

Recreation (Impact Code=REC)

Map 8

Previously, REC included only evidence of damaging, or incompatible recreational uses, but beginning in 2011, this category had been expanded to include signs of select types of recreation occurring in the LORP. Twenty-nine impacts were recorded in the river corridor, as evidenced by litter, including food waste, shell casing and fishing tackle. Off-road vehicle play areas, and cuts made through tules to access the river were also used as evidence.

Notes:
- No evidence of recreational use impact was recorded in the BWMA, or DHA. Most activity was recorded in the Lone Pine area and just north of the Islands in reach 3.
- Trails were found at two locations on the river.
- Evidence of hunting or fishing activity was recorded at two locations.
- Evidence of ORV use was found in the Lone Pine area.

Roads (Impact Code=ROAD)

Map 7

All roads, or vehicle trails, that were not present in 2005, or changes in new roads were recorded. There were nine observations.

Notes:

- All but one observation was recorded in the Lone Pine area.
- All but one observation were of vehicles accessing the floodplain.

Trash (Impact Code=TRASH)

Map 7

Observers were asked to record large trash items. Furniture, appliances, and building materials were recorded at four locations.

Note:

- A couch recorded over the past four years had not been removed.

Tamarisk Slash (Impact Code=SLASH)

Map 7

Piles of recently cut Tamarisk slash were recorded in 2012.

Note:

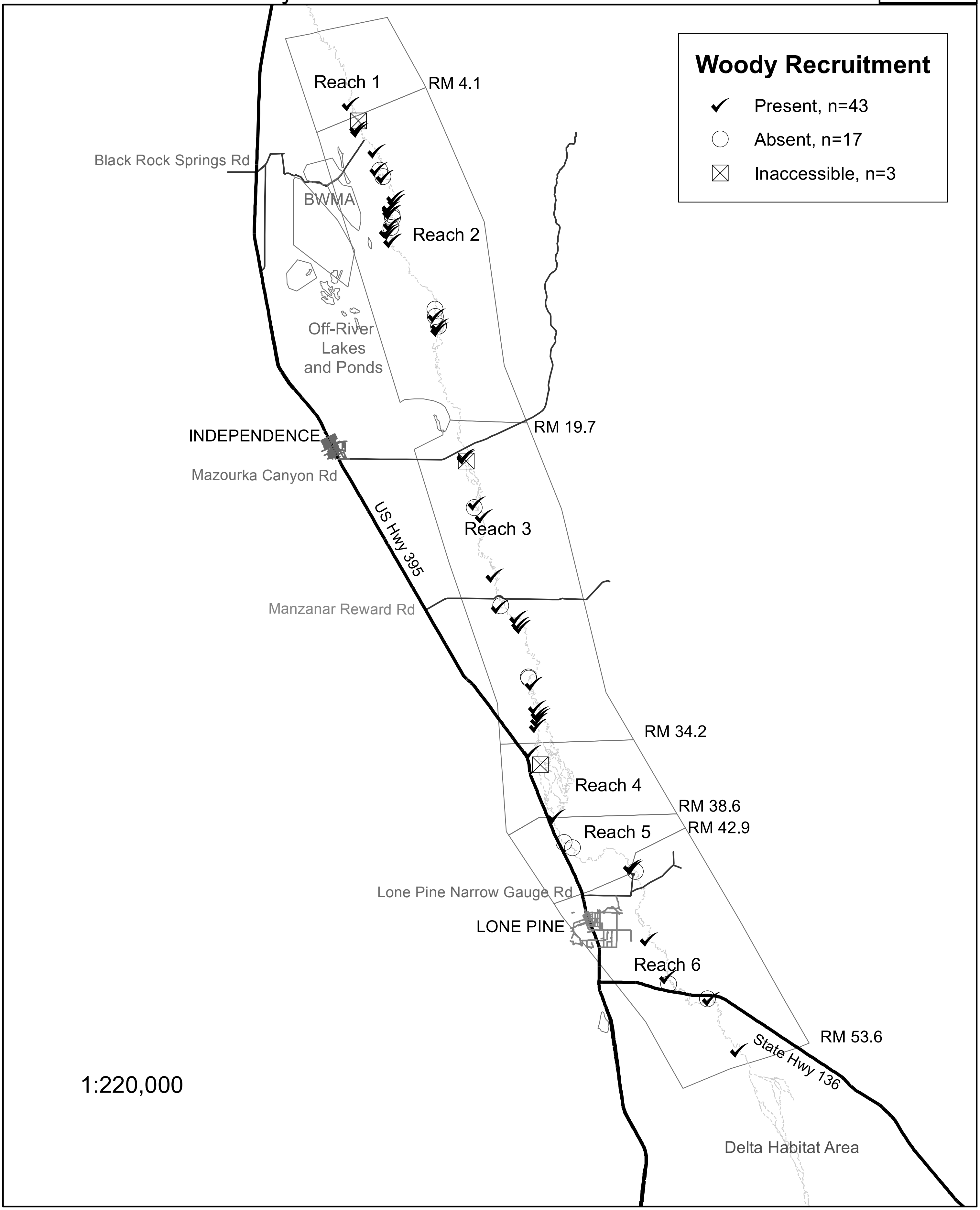
- One pile was located in reach 2.

River Obstructions (Impact Code=OBST)

Surveyors found no river obstruction, other than two, which were noted as “falling water” under feature category Beaver (BEA).

Revisited Sites -- Woody Recruitment

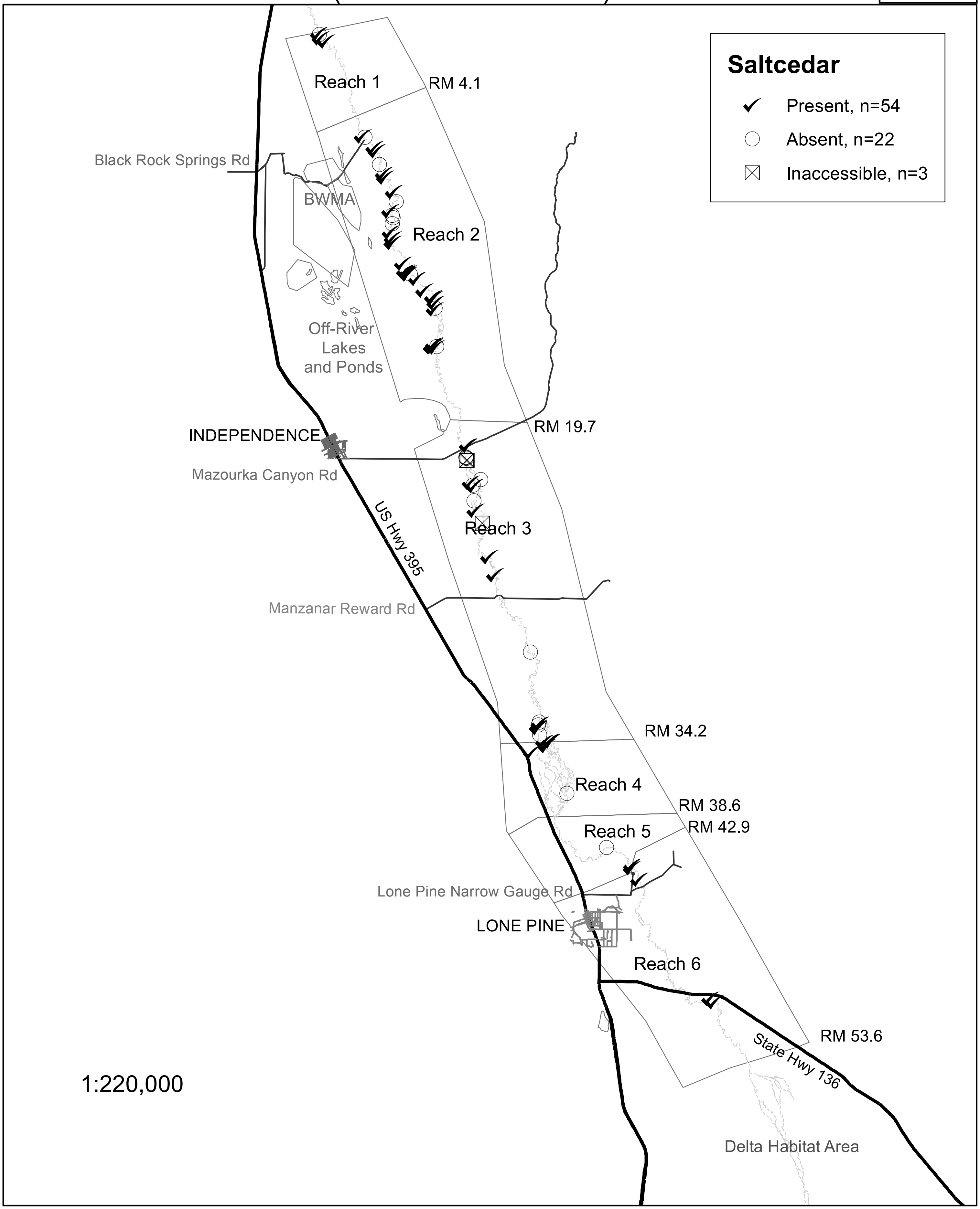
MAP 1a



2012 LORP RAS Maps

Revisited Sites -- Saltcedar (*Tamarix Ramossisima*)

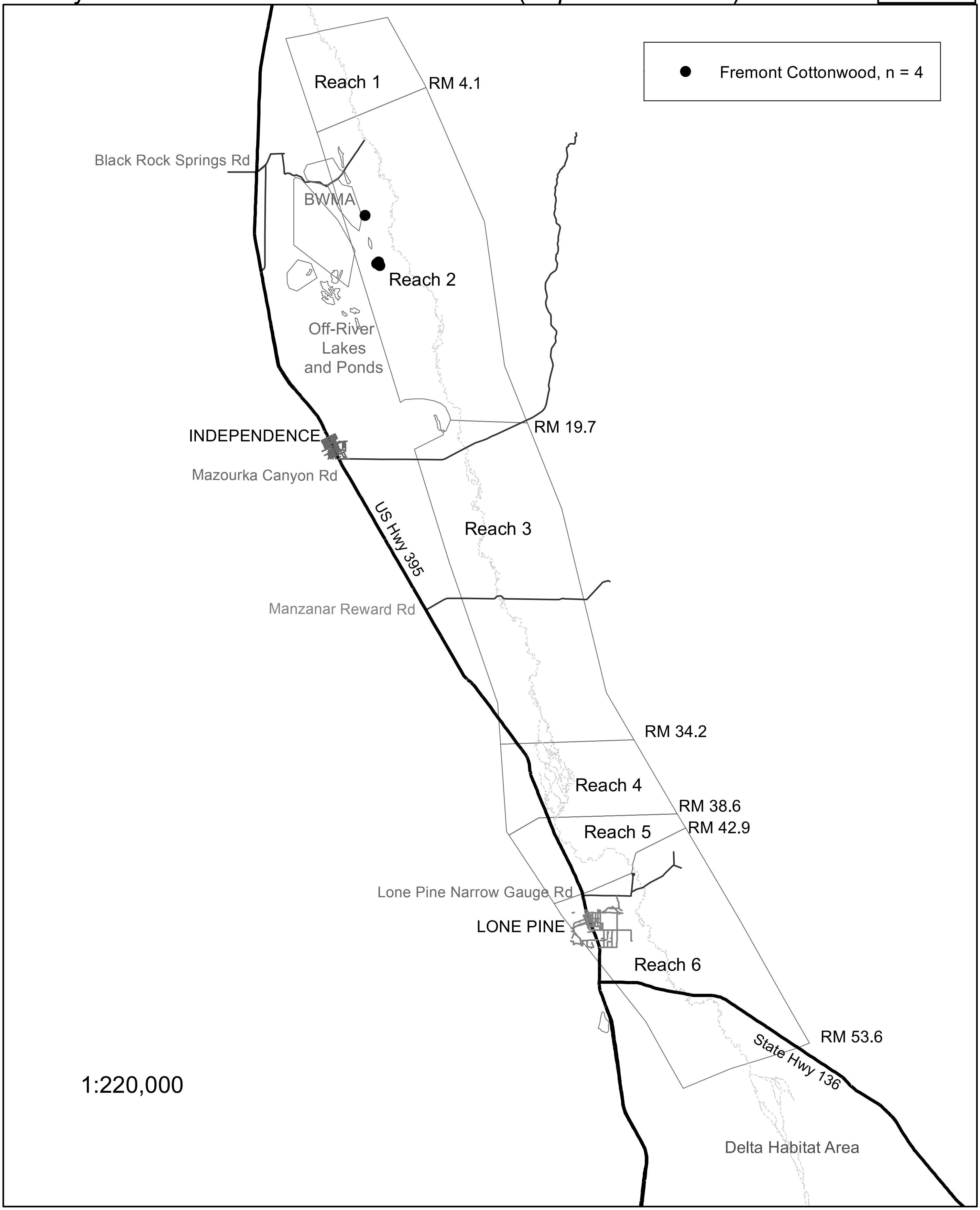
MAP 1b



2012 LORP RAS Maps

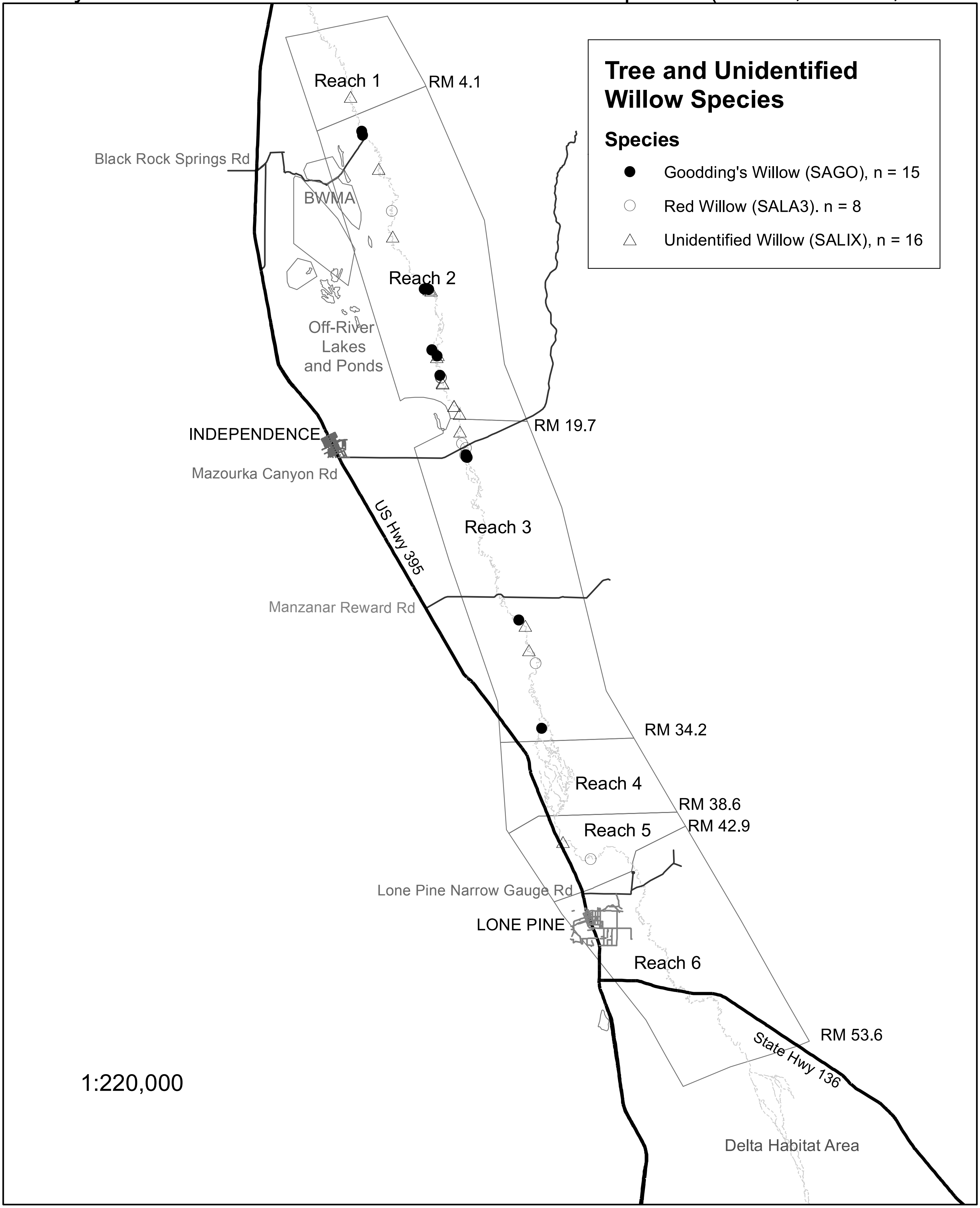
Woody Recruitment - Fremont Cottonwood (*Populus fremontii*)

MAP 2a



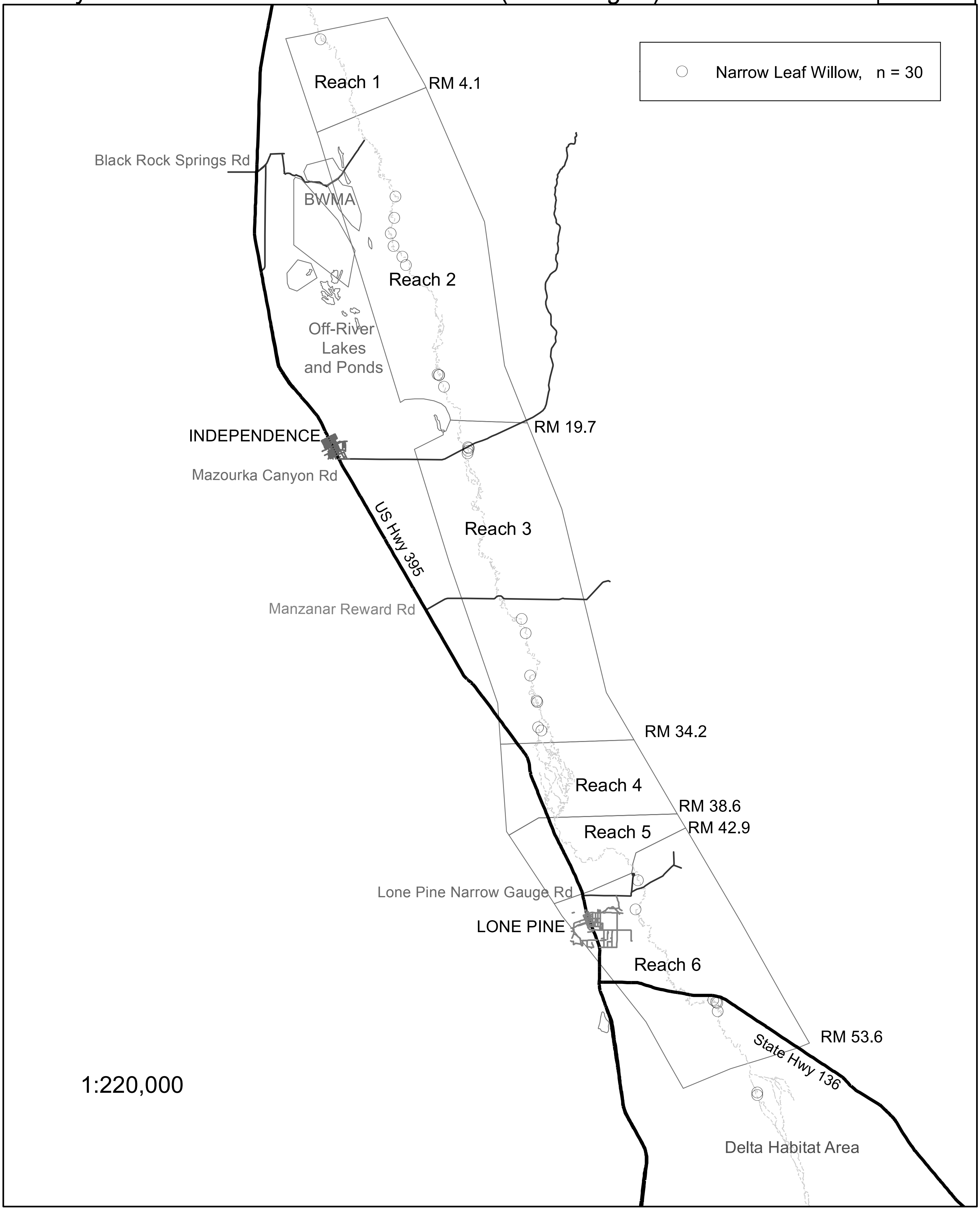
MAP 2b

Woody Recruitment - Tree and Unidentified Willow Species (SAGO, SALA3, SALIX)



Woody Recruitment - Narrow Leaf Willow (*Salix exigua*)

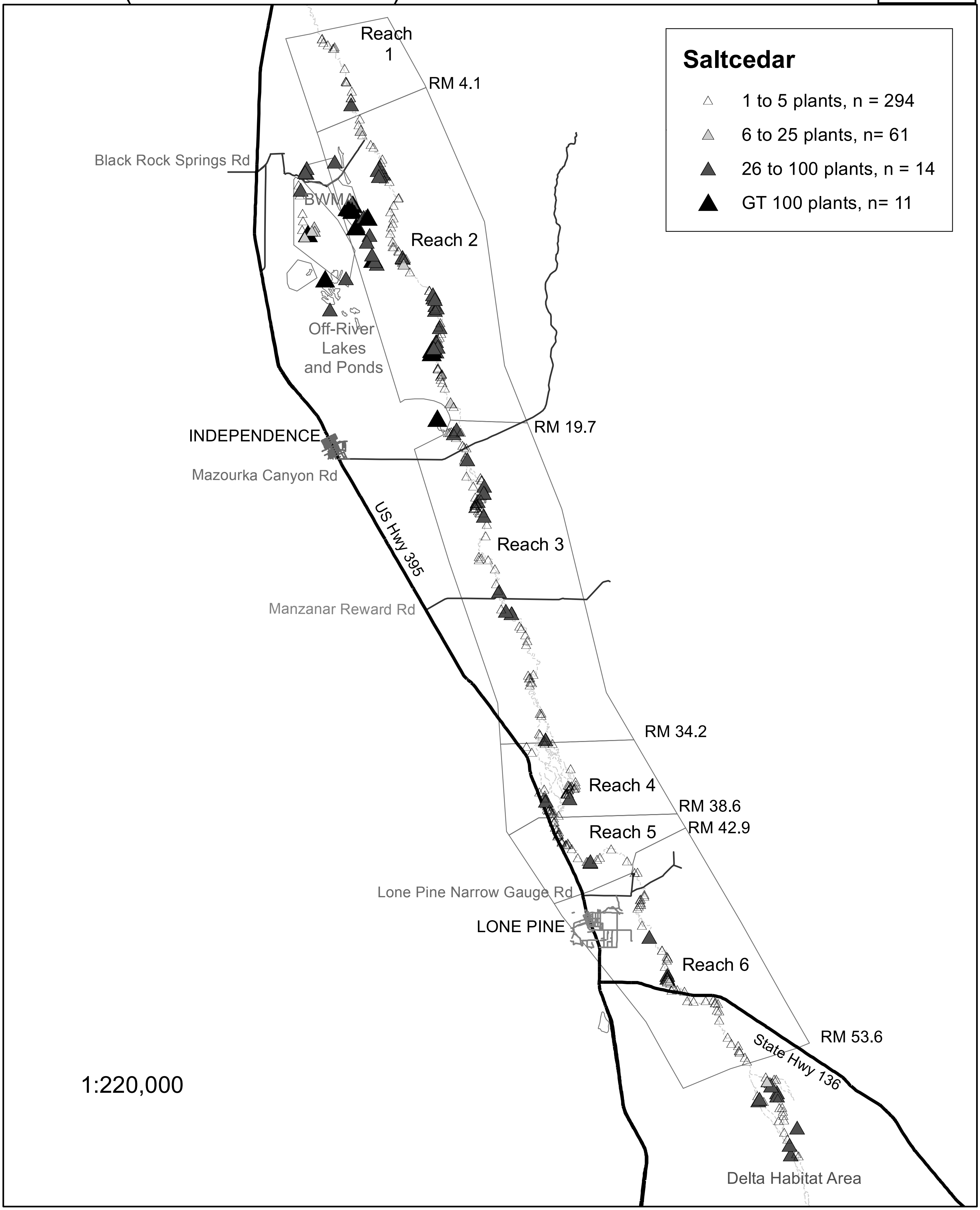
MAP 2c



2012 LORP RAS Maps

Saltcedar (*Tarmarix ramossisima*)

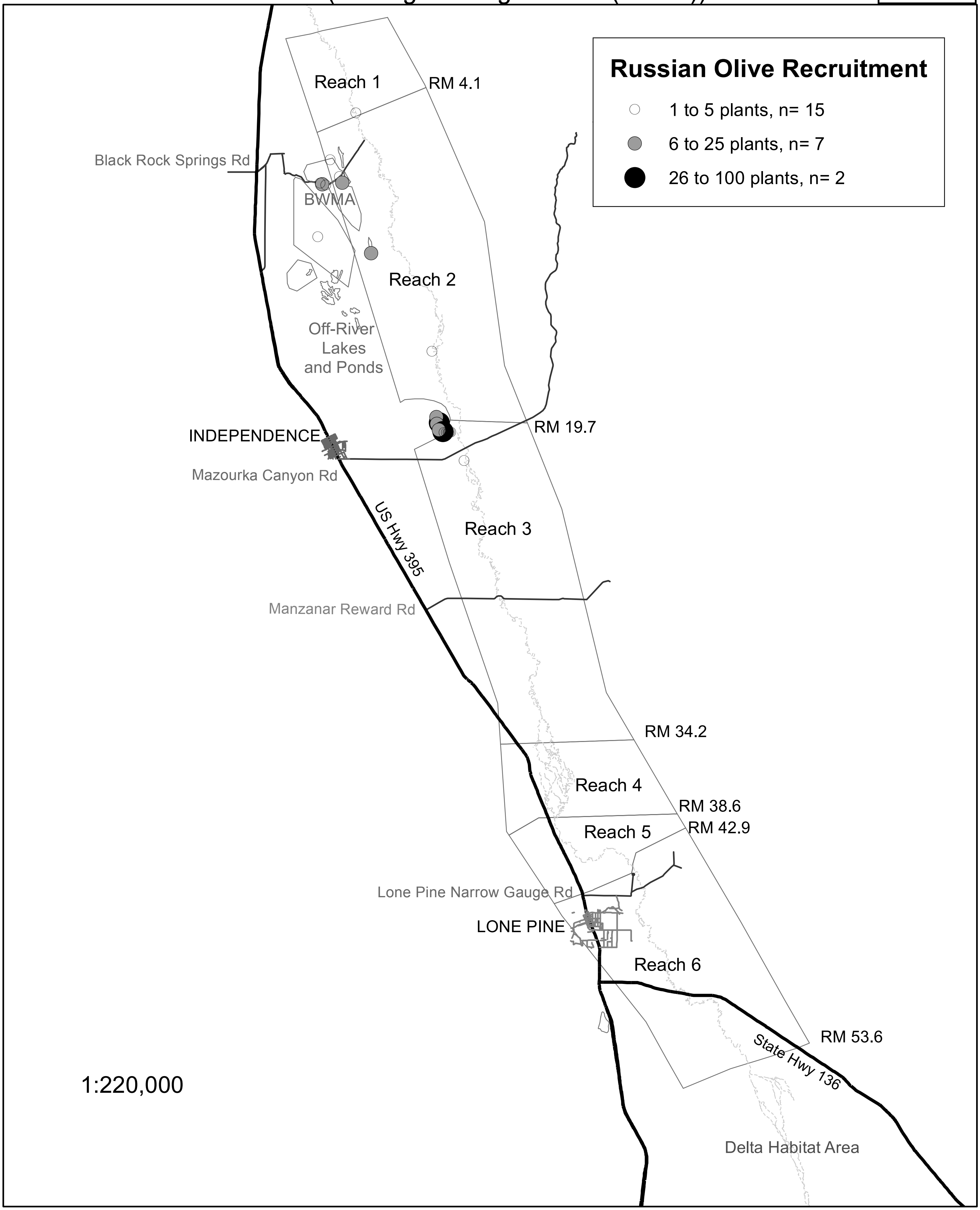
MAP 3



2012 LORP RAS Maps

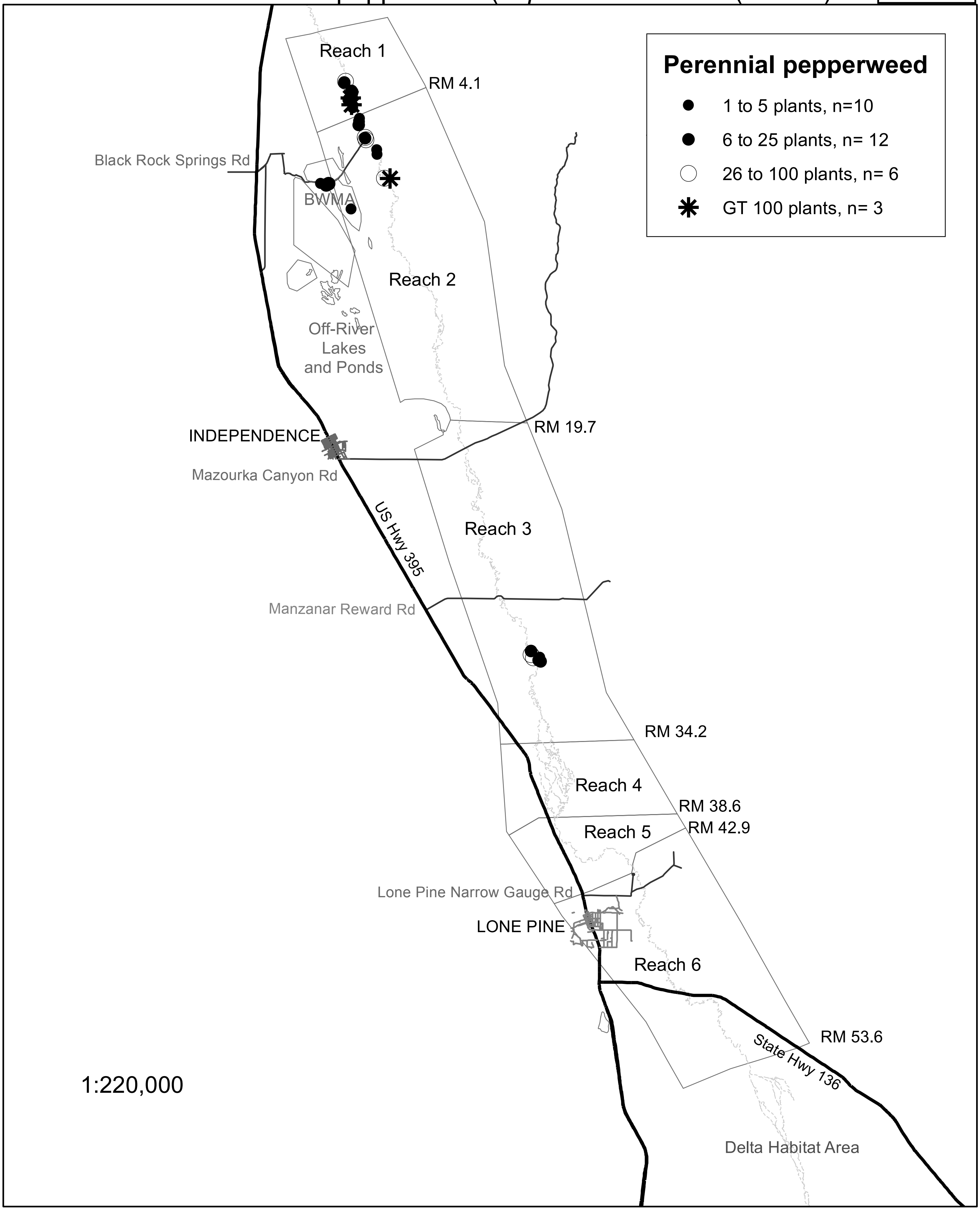
Russian Olive Recruitment (*Elaeagnus angustifolia* (ELAN))

MAP 4



Noxious Weeds - Perennial pepperweed (*Lepidium latifolium* (LELA2)

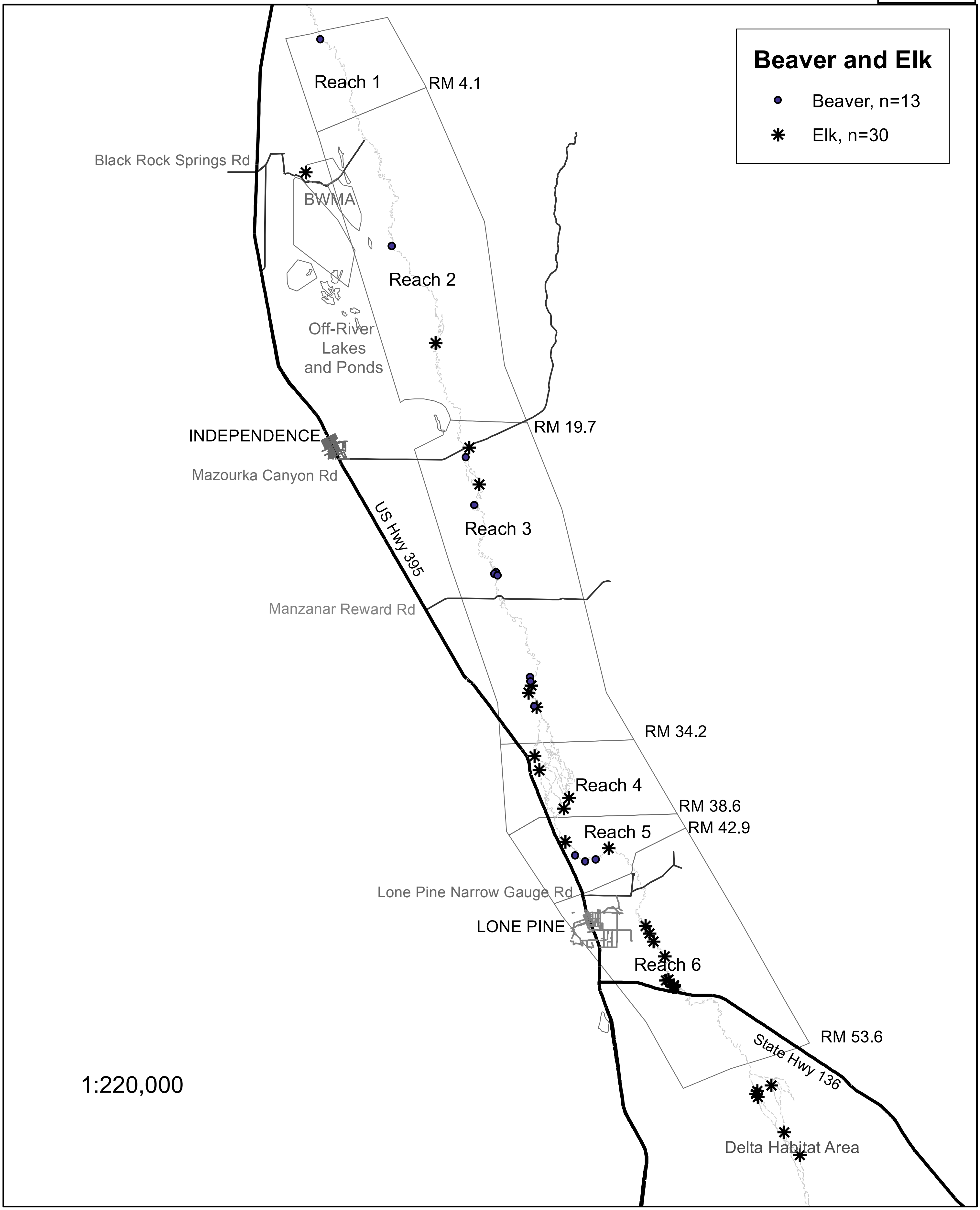
MAP 5



2012 LORP RAS Maps

Beaver and Elk

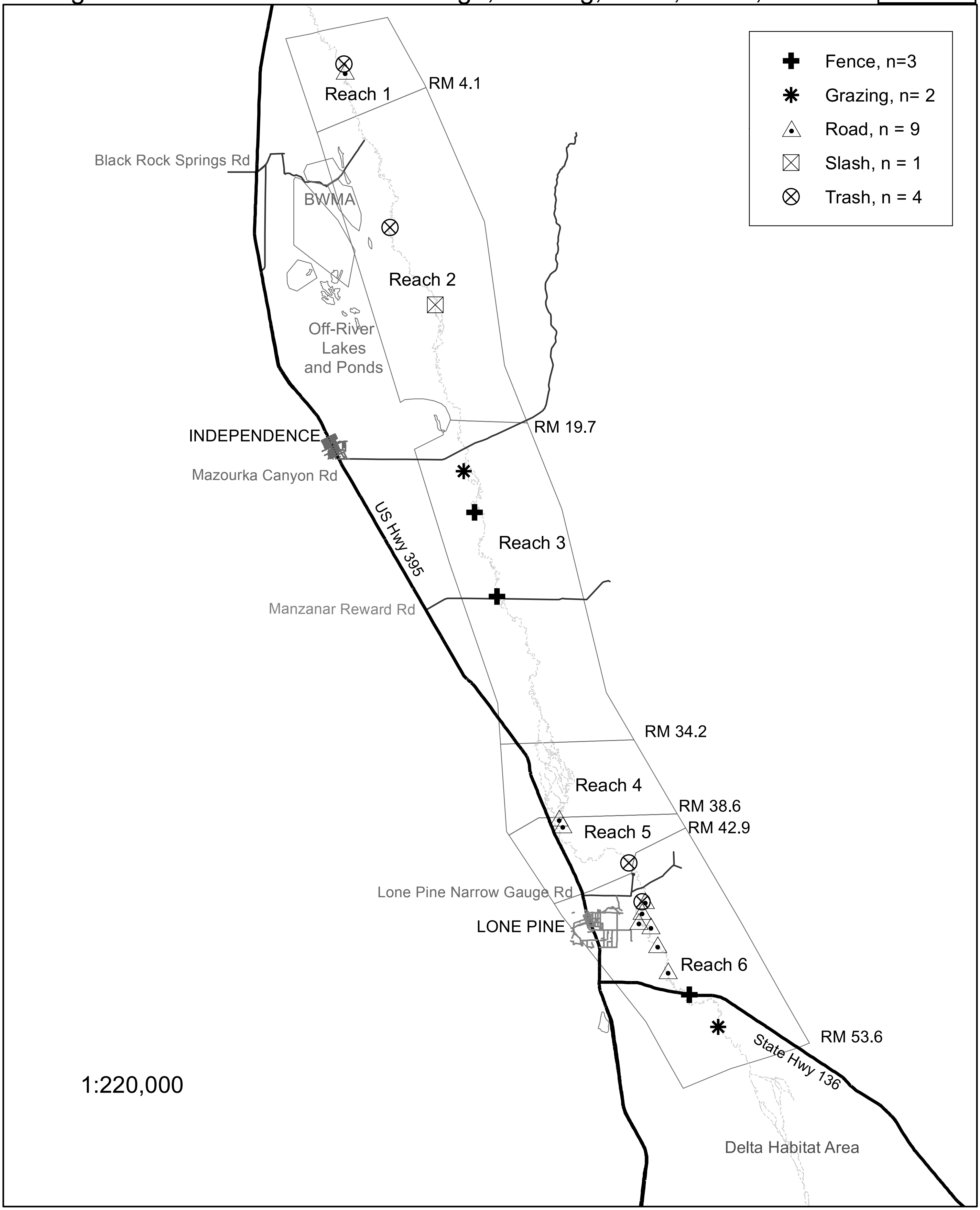
MAP 6



2012 LORP RAS Maps

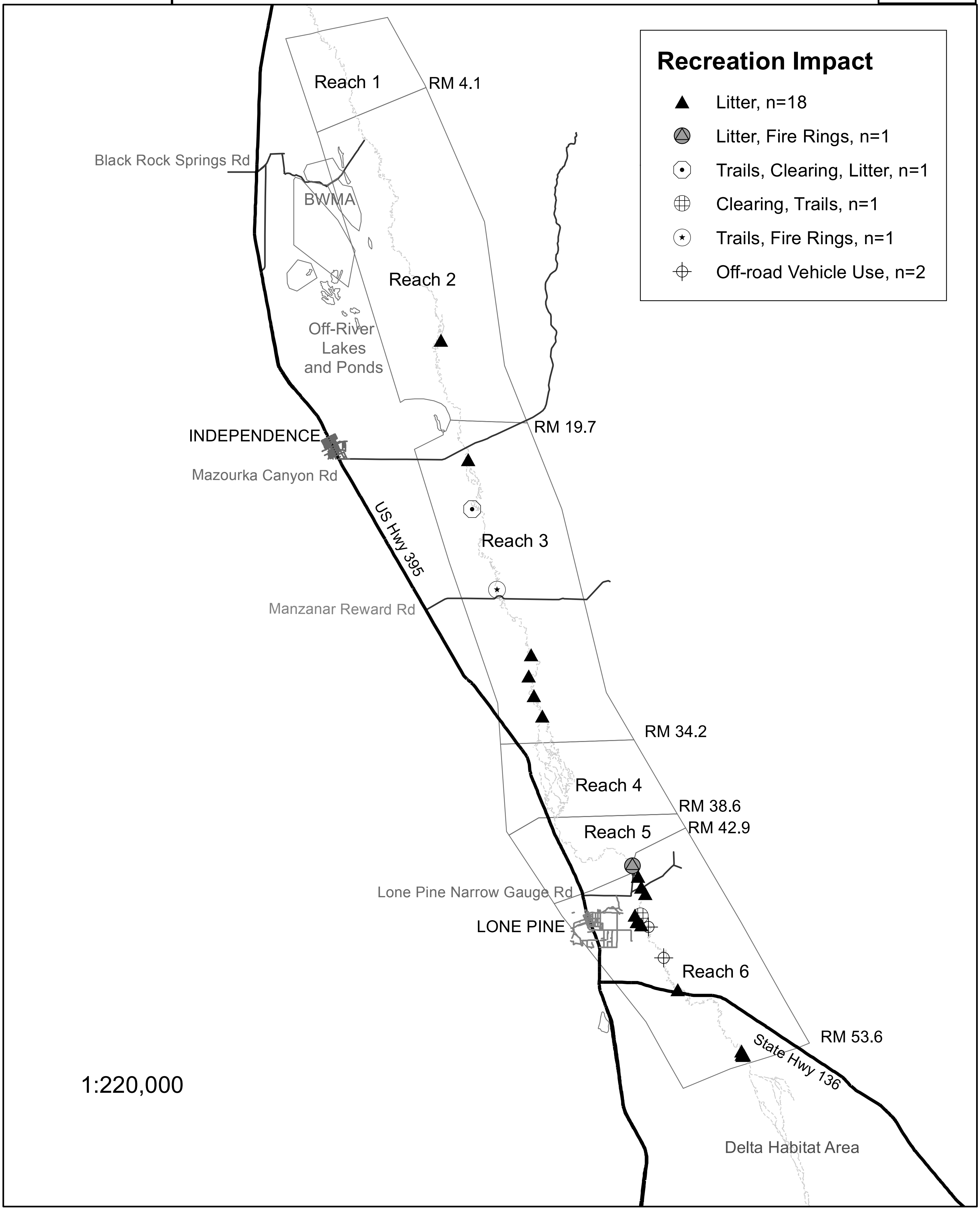
Management Concerns - Fence Damage, Grazing, Road, Slash, Trash

MAP 7



Recreation Impacts

MAP 8



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6.0 SUMMARY WOODY RECRUITMENT

6.1. Woody Recruitment Observations 2008-2012

The Lower Owens River Project Rapid Assessment Survey (RAS) monitoring has been conducted annually since 2008 as part of the LORP Monitoring and Adaptive Management Plan (MAMP) (Ecosystem Sciences 2008). During the RAS, both banks of the river are traversed on foot, with observers walking near the wetted edge of the channel and oxbows. One of the items observers are directed to look for and record while conducting the RAS is the occurrence of native woody riparian species recruitment including willows and Fremont cottonwood. Recruitment of riparian vegetation through the implementation of LORP base flow and seasonal habitat flow is one of the project objectives identified in the LORP MAMP.

From 2007-2010, LADWP was the project lead and staff performed the majority of the planning. LADWP biologists performed the majority of the surveys from 2007-2009. In 2010, the Inyo County Water Department field coordinator and seasonal field crews performed half of the river surveys. In 2011-2012, all river surveys were conducted by Inyo County with occasional oversight and participation by LADWP staff.

The following report provides a summary of the woody recruitment data collected during the Lower Owens River Project Rapid Assessment Survey monitoring from 2008-2012. Potential factors to be considered while reviewing this data will be presented also.

6.2. Woody Recruitment Defined

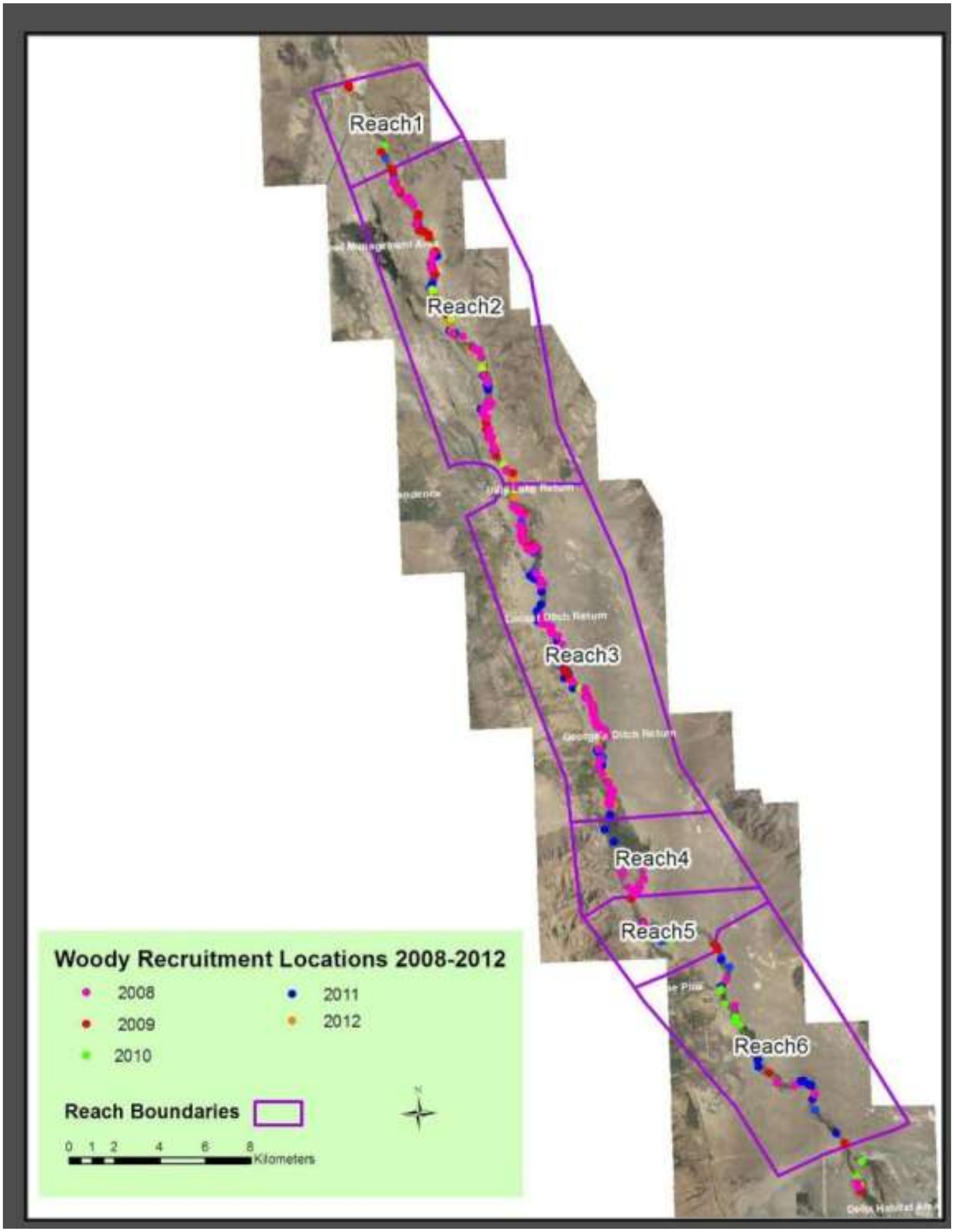
For purposes of recording new woody recruitment during the LORP RAS, observers are asked to look for and record only plants believed to have germinated or sprouted during the calendar year of survey. While the survey includes all native woody riparian species, the most abundant species on the LORP are Goodding's willow (Salix gooddingii), red willow (S. laevigata), narrow-leaved willow (S. exigua), and Fremont cottonwood (Populus fremontii).

Three rules have been implemented to help observers determine new woody recruitment:
1) the plant must be less than one meter high and 2) have no or minimal branching, and 3) have a non-woody base. All three features must be present in the young plant(s) in order for the area to be marked as a woody recruitment site for the year. Some species such as S. exigua reproduce readily asexually or by clonal reproduction. Clonal recruitment of S. exigua has presented a more difficult situation to document. The same rules that were applied to defining new seedling recruitment were applied to determining new clonal recruitment that has occurred during the calendar year of survey. Thus, the documentation of S. exigua clonal recruitment locations has been fundamentally consistent and comparable to that of seedling recruitment documentation. The difficulty arises in applying abundance categories to clonal recruitment sites as discriminating between individuals can be challenging or impossible. From 2008-2009, clonal versus seedling recruitment of S. exigua was not always clearly distinguished, and must be inferred through written comments or the photo record. In 2010, clonal recruitment of S. exigua was recorded separately from seedling recruitment. In 2011, specific rules were applied to distinguish clonal versus seedling reproduction by S. exigua. Any S. exigua recruitment within 5 meters of an established plant was recorded as clonal recruitment.

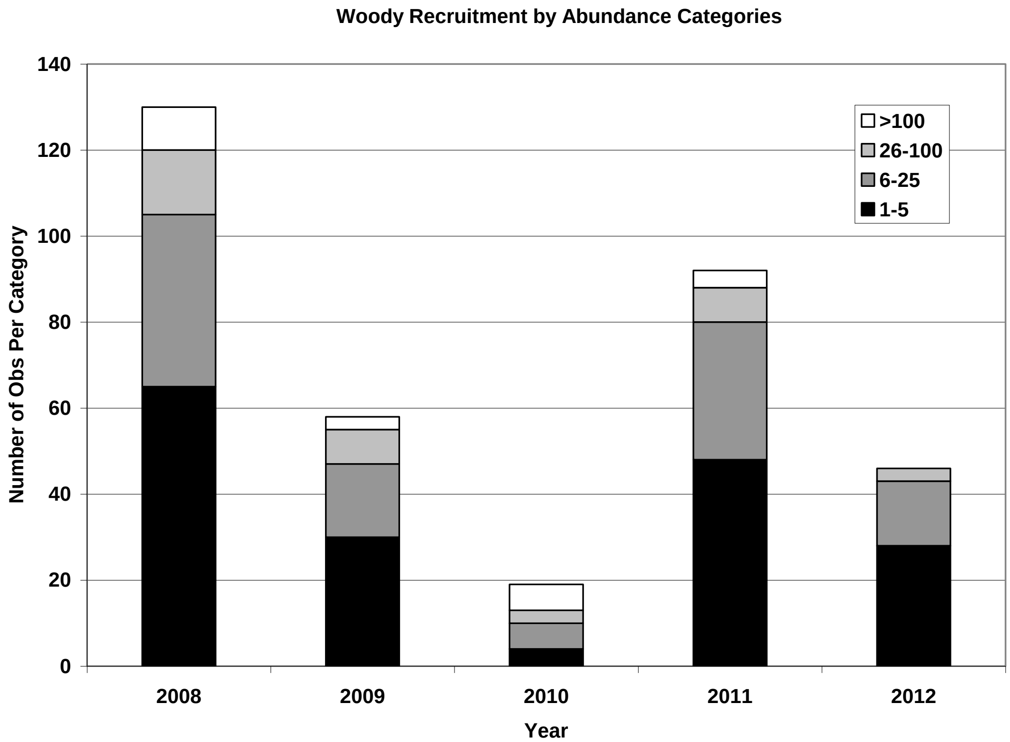
6.3. Overview of Woody Recruitment Occurring on LORP

Woody Recruitment Figure 1 shows all the woody recruitment sites documented by RAS from 2008-2012. As shown in this figure, woody recruitment has occurred on LORP every year, and throughout the river corridor in all reaches. Woody Recruitment Figure 2 shows the number of woody recruitment sites and the abundance category recorded for those sites with S. exigua clonal sites excluded. The number of sites in this figure may differ for some years (specifically 2008-2009) as compared to values reported in the LORP Annual Report, as this evaluation has excluded clonal recruitment sites for those years.

The main point from Woody Recruitment Figure 2 is that the majority of points shown on the map (Woody Recruitment Figure 1) represent sites where 1-5 or 6-25 seedlings were found. Some of the sites in the ">100" category represent areas where 300-500 or more seedlings were seen. Thus recruitment is occurring throughout the river system, although most sites consist of relatively small numbers of individuals.



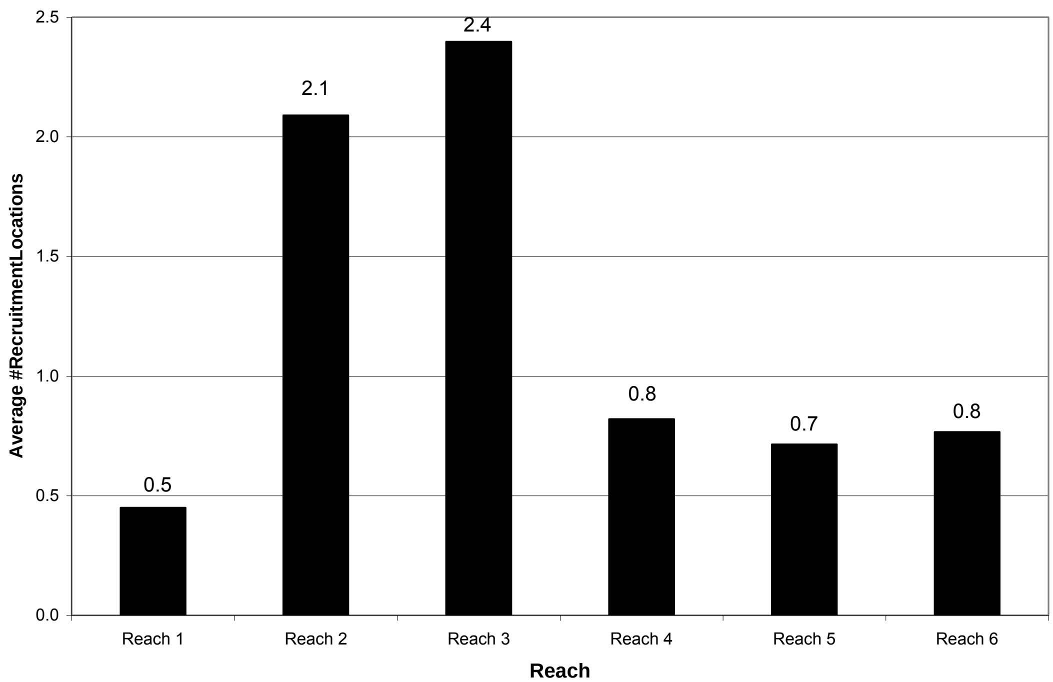
Woody Recruitment Figure 1. Woody Recruitment Documented During LORP RAS 2008-2012


Woody Recruitment by Abundance Categories
140
120
100
80
60
40
20
0
Number of Obs Per Category
>100
26-100
6-25
1-5
2008
2009
2010
2011
2012
Year

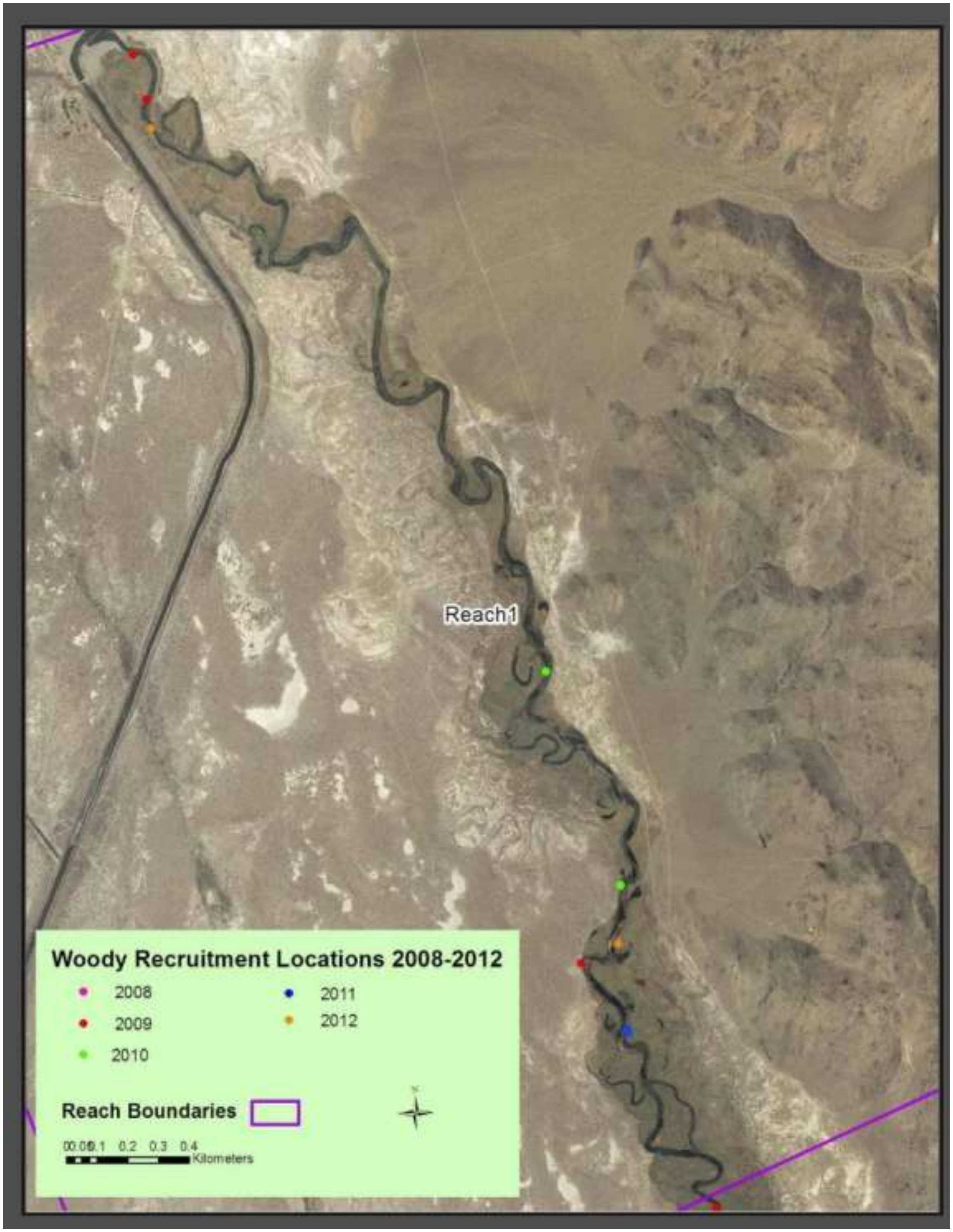
Woody Recruitment Figure 2. Woody Recruitment Sites Per Abundance Category

6.4. Number of Recruitment Locations Per LORP Reach

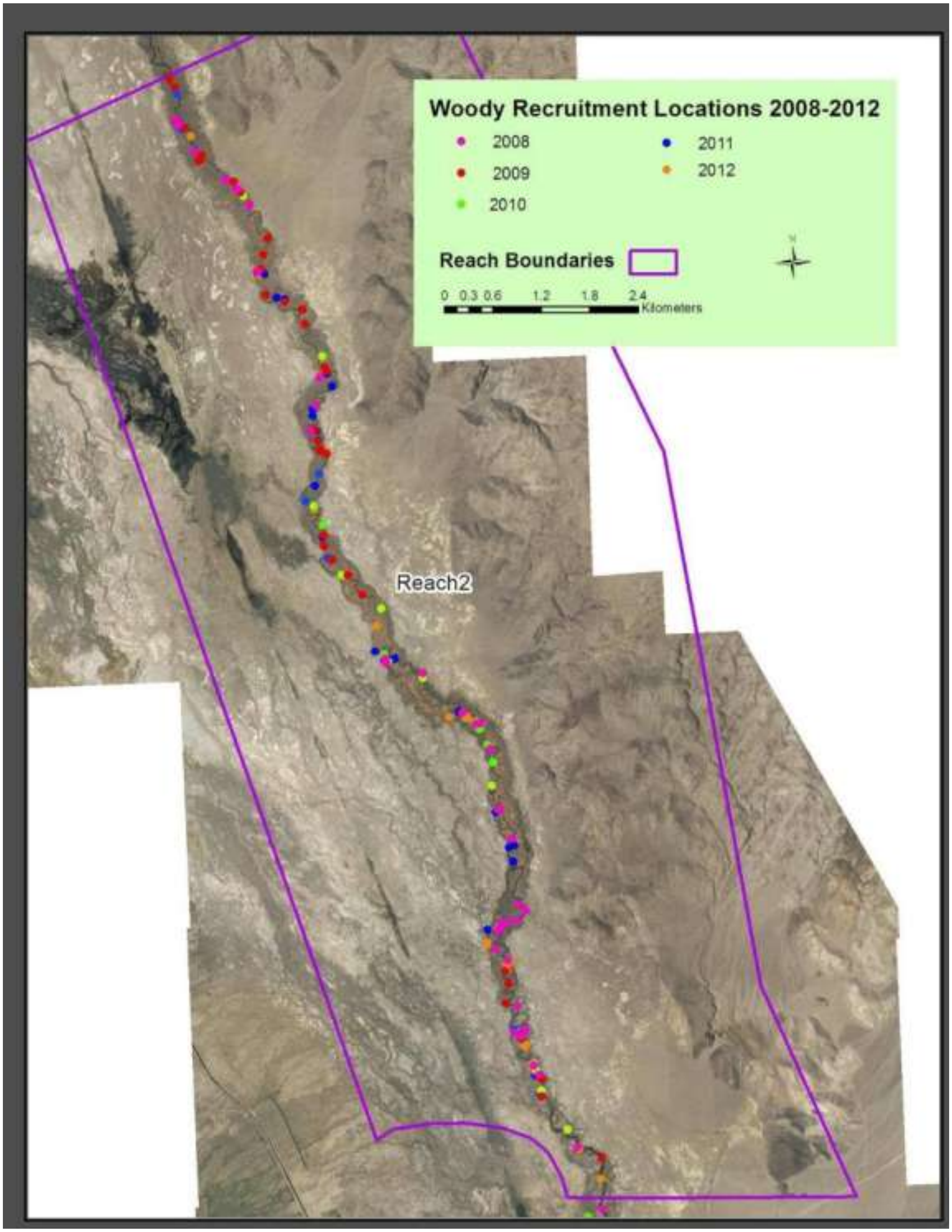
RAS has detected a difference in the amount of recruitment taking place among the different LORP reaches. To illustrate this, the total number of recruitment locations recorded from 2008-2012 was divided by the total river miles in each reach to determine the average number of recruitment locations per river mile during this time period (see Figure 3). Recruitment has been highest in Reaches 2 and 3, and lowest in Reach 1, and fairly equitable throughout reaches 4 through 6. Recruitment in reaches 2 and 3 has been three to four times that observed in all other parts of the river. Figures 4 through 7 show the recruitment locations for each reach by year. In Reach 1, recruitment has only taken place in two general areas and not in all years. In reaches 2 and 3, recruitment has been observed throughout the lengths of these reaches, and in all years. In Reach 4, most of the recruitment was found near the downstream end of this reach where a more defined channel exists, with the majority of observations in 2008. Recruitment has been found in scattered locations in reaches 5 and 6, with some local areas within these reaches supporting recruitment multiple years.



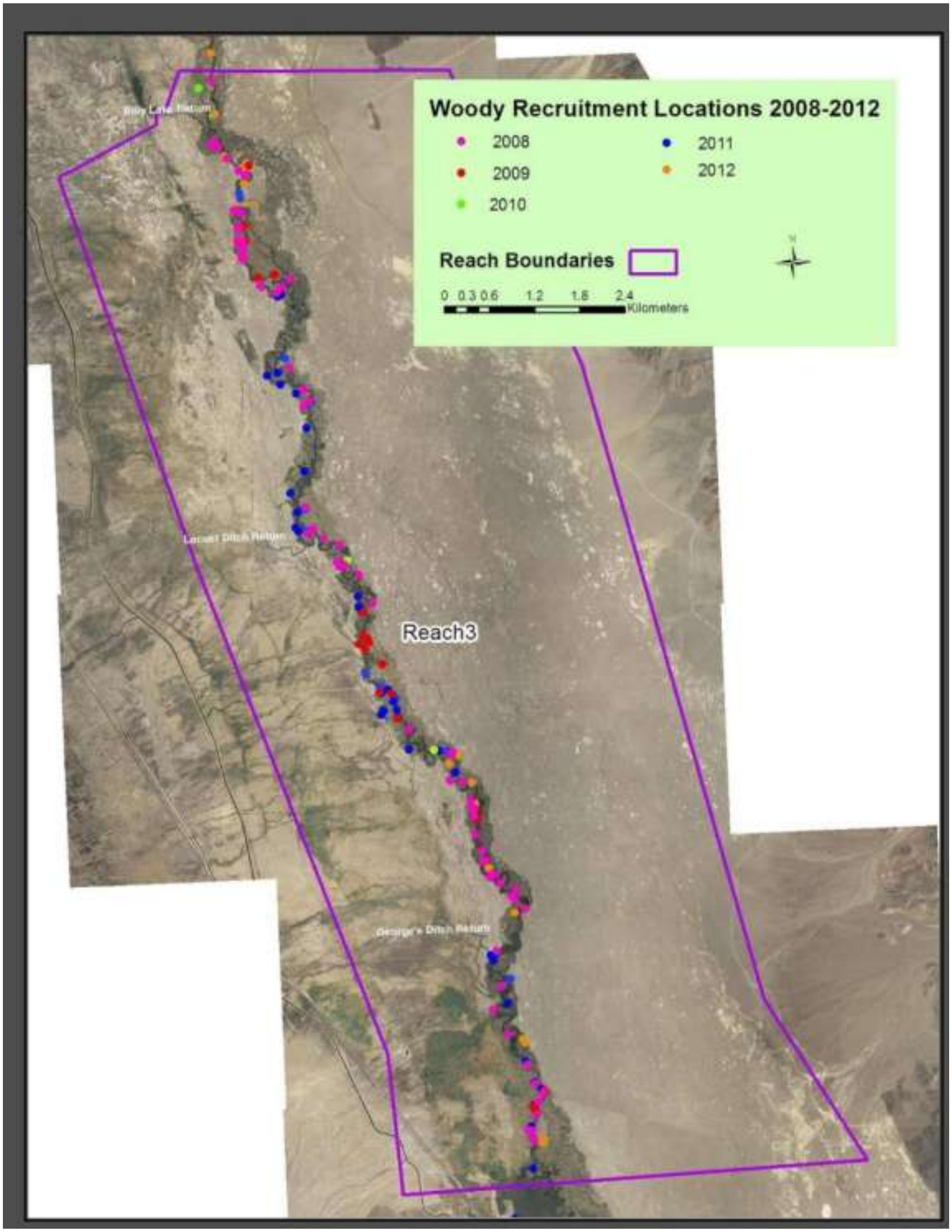
Woody Recruitment Figure 3. Average Number of Recruitment Sites Per River Mile Per Reach – 2008-2012



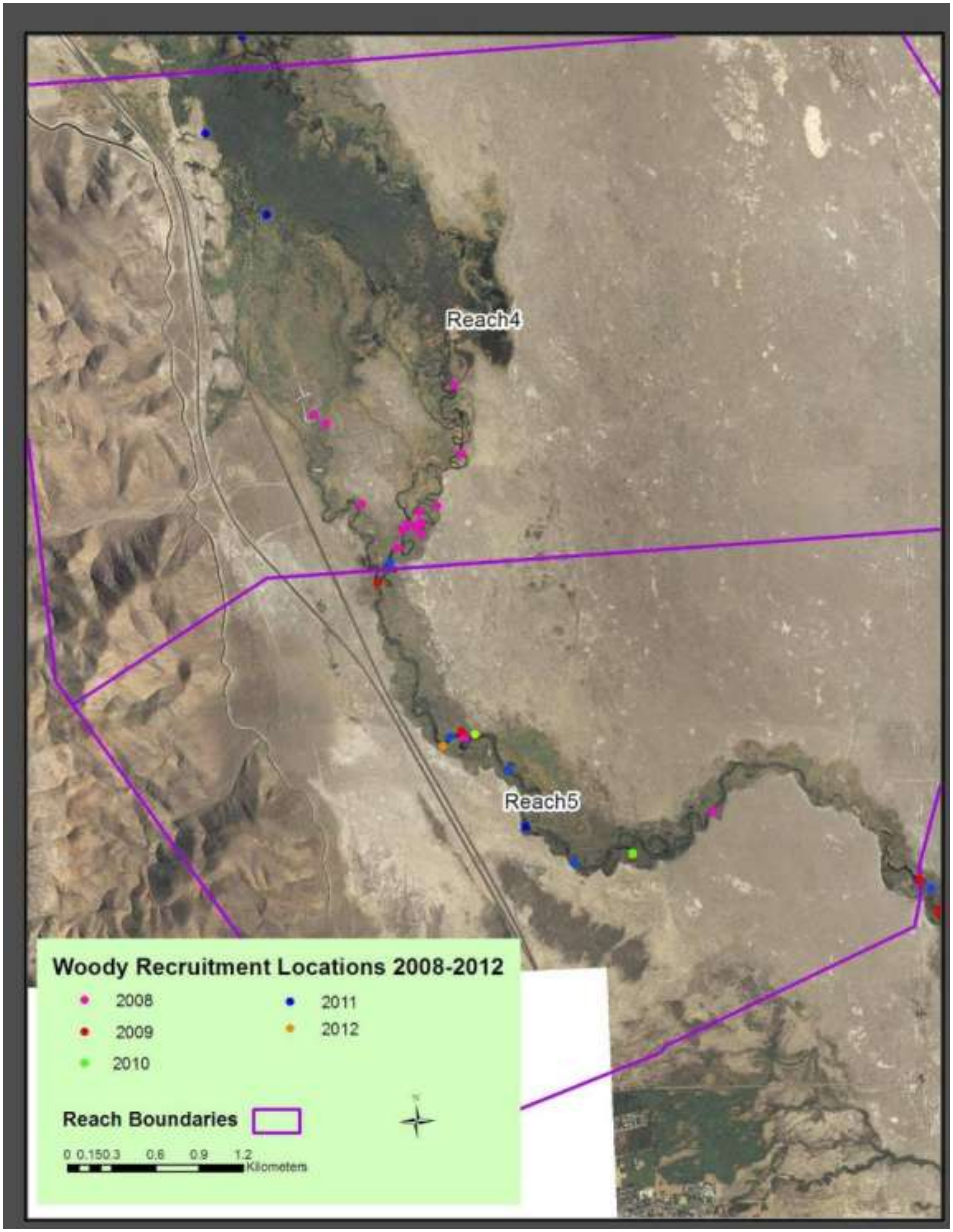
Woody Recruitment Figure 4. Reach 1 Woody Recruitment Locations 2008-2012



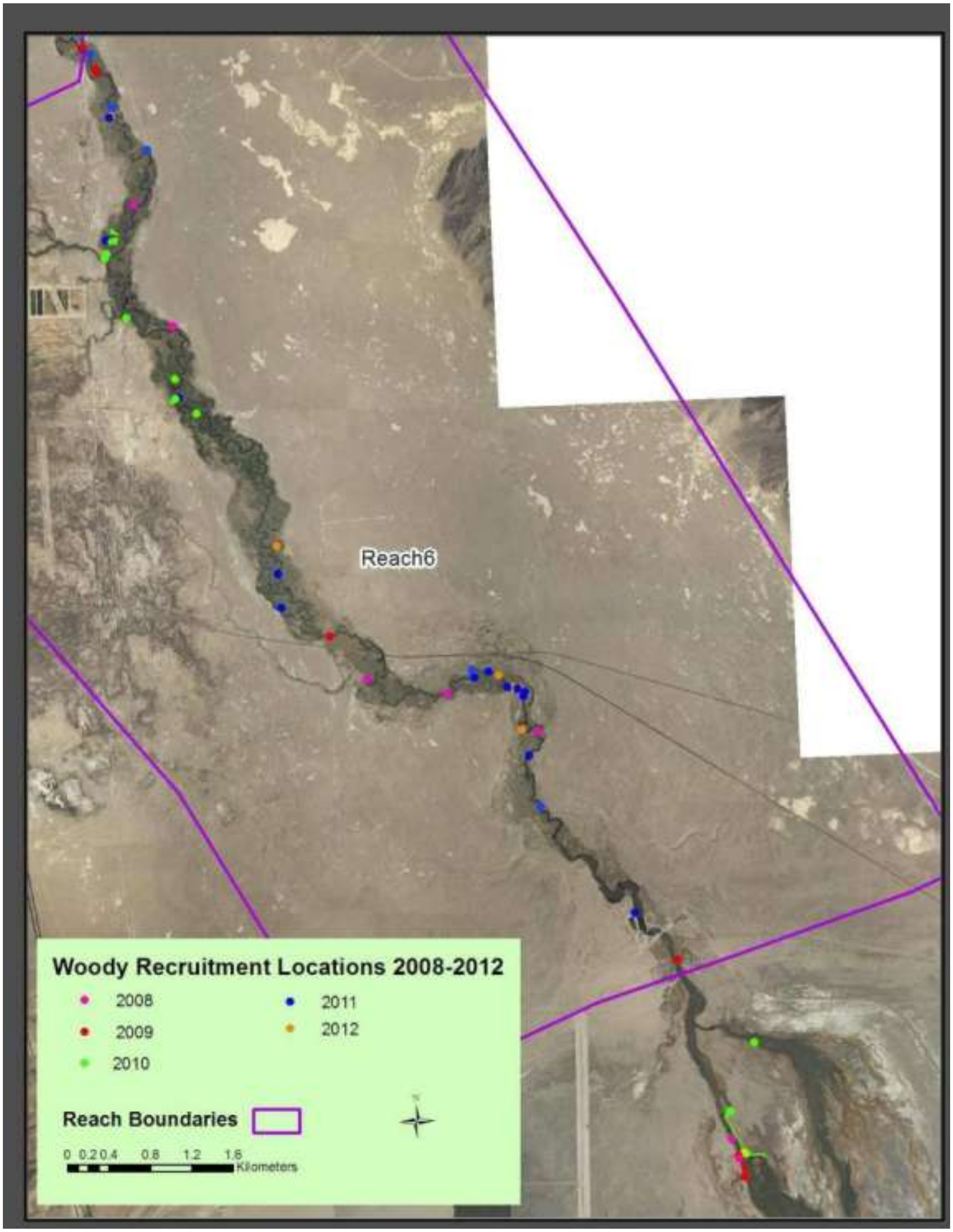
Woody Recruitment Figure 5. Reach 2 Woody Recruitment Locations 2008-2012



Woody Recruitment Figure 6. Reach 3 Woody Recruitment Locations 2008-2012



Woody Recruitment Figure 7. Reach 4 and 5 Woody Recruitment Locations 2008-2012



Woody Recruitment Figure 7. Reach 6 and Delta Habitat Area
Woody Recruitment Locations 2008-2012

6.5. Typical Recruitment Site Locations

The majority of recruitment sites have been found in one of two general microhabitats. Most recruitment sites are immediately adjacent to the river bank, although some recruitment has been found in oxbows. The more typical recruitment sites are sandy or muddy unvegetated or lightly-vegetated areas. Microhabitats such as these are most abundant in Reach 2. Woody Recruitment Figure 8 shows an example of this microhabitat type in Reach 2 that has frequently supported willow or cottonwood seedlings. Other areas that have often supported recruitment are low terraces adjacent to the river, that, while grass-covered, often remain wetted longer in the summer than other more steeply terraced banks. Woody Recruitment Figure 9 shows an area south of Independence that is a low terrace site where tree willow recruitment is taking place.

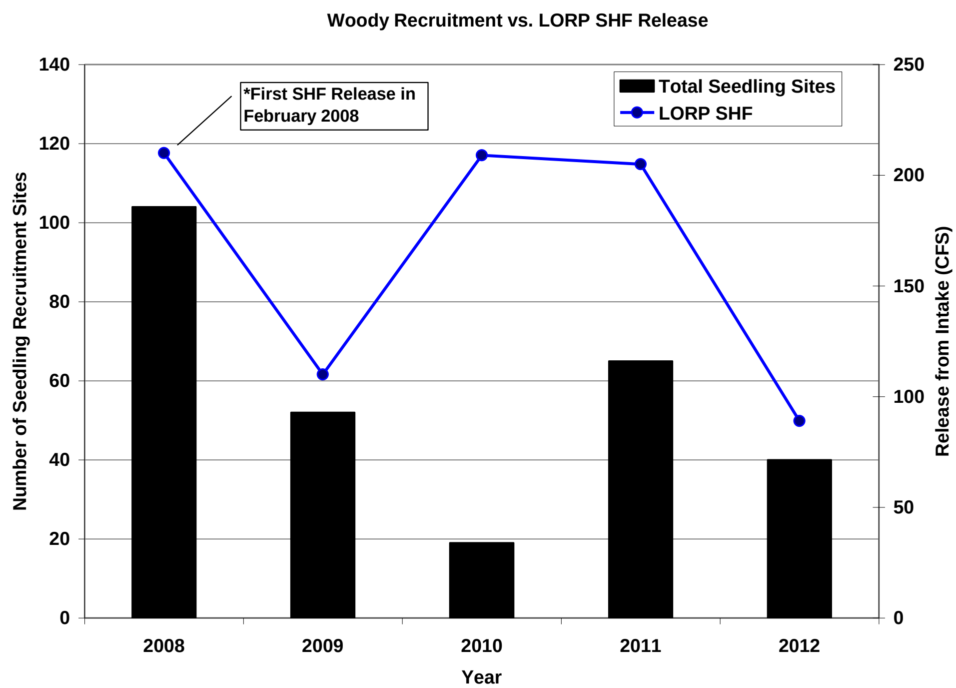
Woody Recruitment Figure 8. Microhabitat in Reach 2 that has Frequently Supported Recruitment

Woody Recruitment Figure 9. Low Terrace Area Adjacent to River Supporting Tree Willow Recruitment

6.6. Woody Recruitment vs. LORP Seasonal Habitat Flow Release

The LORP receives an annual seasonal habitat flow (SHF) release, the magnitude of which is determined annually based on each year's runoff conditions. Objectives of the SHF include fulfilling the wetting, seeding, and germination needs of riparian vegetation, recharging the groundwater in the streambanks and floodplain, and controlling tules and cattails to the extent possible (Ecosystem Sciences 2002). The timing of the seasonal habitat flow is designed to coincide with seed production of willows and cottonwoods in the floodplain, thereby providing an opportunity to stimulate growth of new trees on the floodplain adjacent to the river channel (Ecosystem Sciences 2002). Recharging the groundwater in the streambanks and floodplain may also stimulate asexual reproduction in those species for which this is a mode of reproduction.

Woody Recruitment Figure 10 shows the number of woody recruitment sites where tree seedlings have been recorded, and the yearly maximum LORP SHF release. Shrub willow observations were removed from this figure since the primary mode of reproduction by the main shrub willow on LORP, *S. exigua* is clonal, and seasonal habitat flows are likely of less importance to their reproductive cycle. The maximum SHF of 200 cfs has been released in 3 of the past five years. Flows below this maximum took place in two of five years and consisted of a release of 110 cfs in 2009 and 89 cfs in 2012. The initial SHF in 2008 was a winter release in February, and therefore not timed with seed production. The winter release was done to comply with permit requirements addressing concerns related to potential water quality compromises during the first habitat flow. All other SHF releases have taken place coincident with willow seed production along the river, as verified by field reconnaissance by LADWP staff. Woody Recruitment Table 1 shows the dates when the maximum flow was for each year was achieved at the intake, the dates at which flows returned to base level at all measuring stations following the SHF, when RAS was started, and the number of days that elapsed between the end of the SHF and the start of RAS.



Woody Recruitment Figure 10. LORP SHF releases and number of seedling woody recruitment sites 2008-2012

Woody Recruitment Table 1. Dates of SHF Peak Releases, Return to Baseflow, and RAS Survey

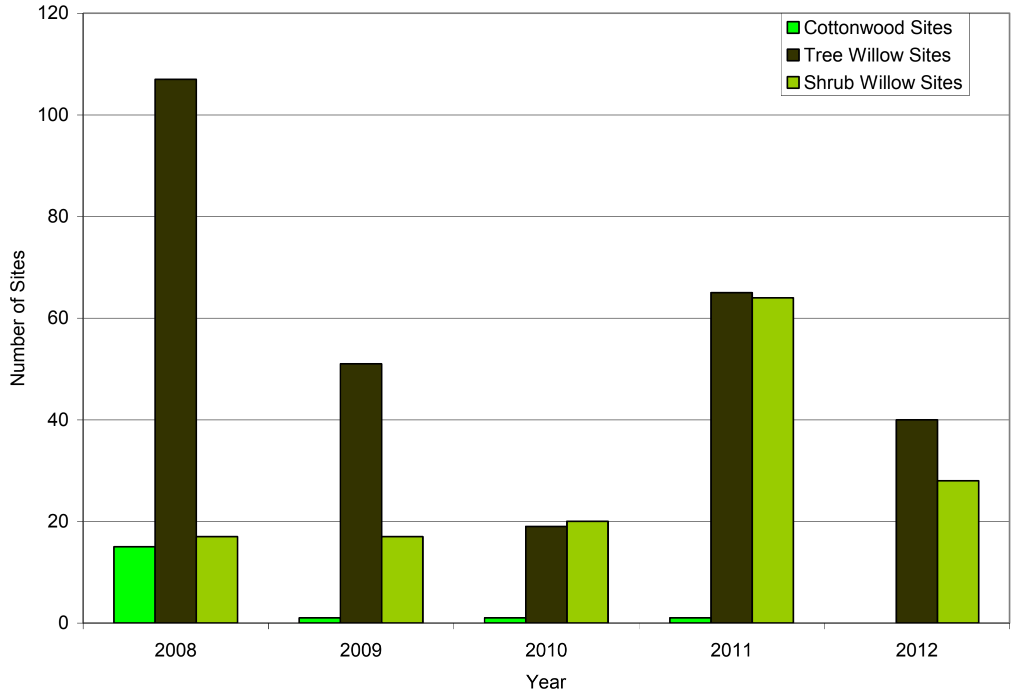
	2008	2009	2010	2011	2012
SHF Peak release from intake	21-Feb	27-May	30-Jun	22-Jun	1-Jun
SHF return to baseflow	9-Mar	16-Jun	20-Jul	17-Jul	19-Jun
Start of RAS	18-Aug	10-Aug	2-Aug	1-Aug	1-Aug
Number of days between end of SHF and RAS	159	54	12	14	42

The greatest number of seedling recruitment sites was recorded in 2008, when the timing of the SHF was uncoupled from the seed production of willows and cottonwoods. Although similar magnitude SHF releases occurred in 2010 and 2011, fewer seedling recruitment sites were documented during RAS as compared to 2008. Fifty-two sites were found in 2009 when the SHF was 110 cfs, while 40 sites were documented in 2012 after the 89 cfs flow.

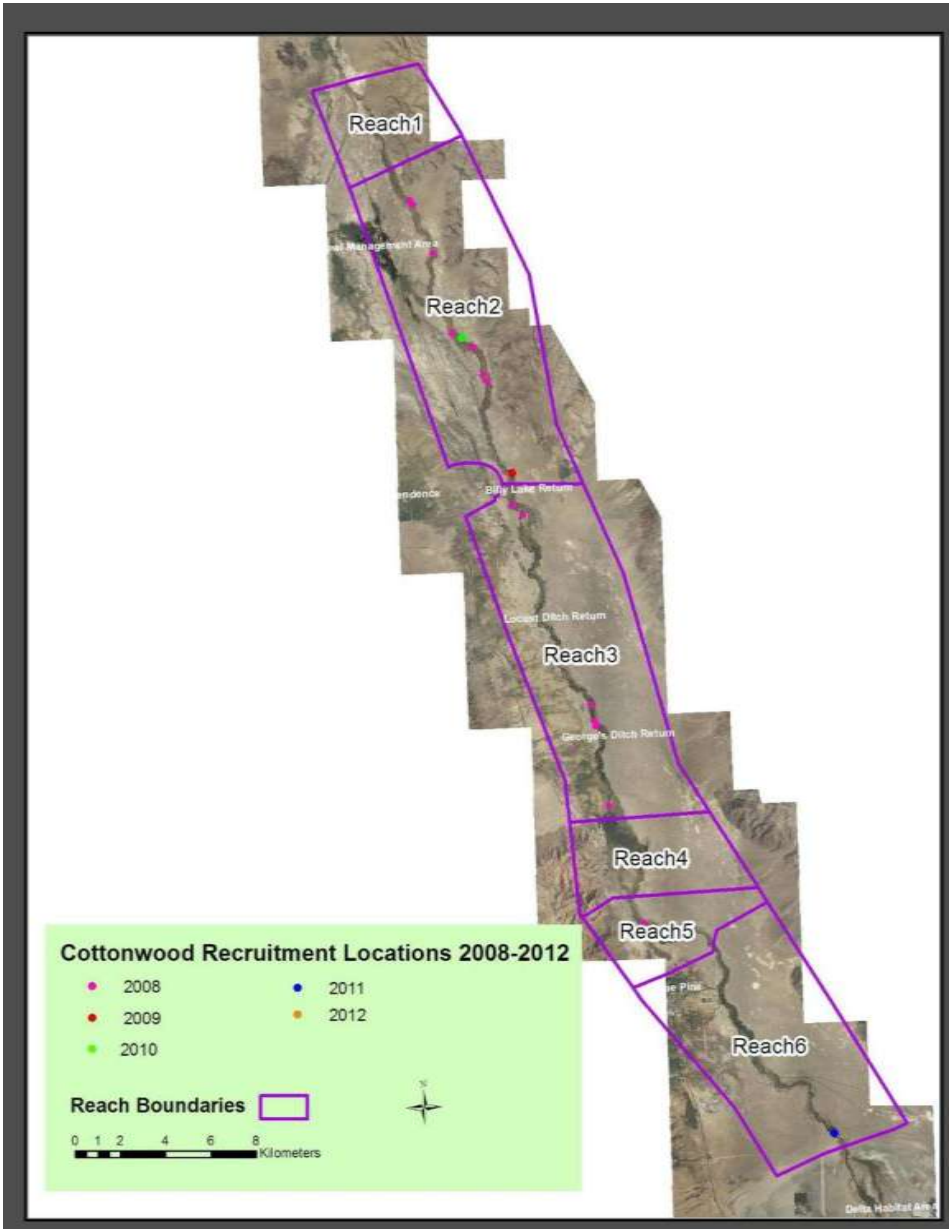
A number of factors should be taken into consideration when evaluating this information including issues that affect seed germination, the growth of seedlings, and seedling detection. Factors which affect seed germination and the growth of seedlings include seed viability, seed contact with soil, temperature, soil moisture, and competition for resources. Factors affecting the detection of seedlings include observer experience, seedling size, and the influence of microhabitat, such as the presence of concealing vegetation. Another factor that should be taken into consideration is the timing of the RAS survey versus when the SHF flow was completed. In both 2010 and 2011, the number of days between the end of the SHF and the RAS were only 12 and 14 days respectively. With this limited amount of time between the habitat flow and the RAS, seedlings if present, may still be quite small and difficult to detect. It is unknown for sure, but the short time period between the SHF and the RAS could account for less recruitment recorded, based on the RAS data alone, than was expected in 2010 and perhaps 2011, given the habitat flow magnitude released. All of the above factors interplay and likely affect the number of seedlings and recruitment sites found during RAS.

6.7. Recruitment by Species

Woody Recruitment Figure 11 shows the number of cottonwood, tree willow, and shrub willow recruitment sites each year. Due to the difficulty in identifying very young tree willow seedlings to species, and the fact that *S. gooddingii* x *S. laevigata* hybrids occur on LORP, all tree willow sites were combined. Limited cottonwood recruitment has occurred on LORP with most taking place the initial years of implementation. Cottonwood recruitment sites are shown in Woody Recruitment Figure 12. In 2008, 15 cottonwood sites were recorded, although some of these sites may represent individuals that germinated since the initiation of LORP flows in December of 2006. From 2009 through 2011, only one cottonwood recruitment site was found on the river each of these years. No cottonwood recruitment was found in 2012. Cottonwood recruitment sites have involved one to a few individual seedlings. Young cottonwoods revisited three years in row were found to be present and looked healthy. Tree willow seedling sites comprised the majority of sites recorded in 2008 and 2009. Shrub willow (*S. exigua*) sites have been proportionally more abundant since 2010.



Woody Recruitment Figure 11. Total Number of Cottonwood, Tree Willow, and Shrub Willow Recruitment Sites

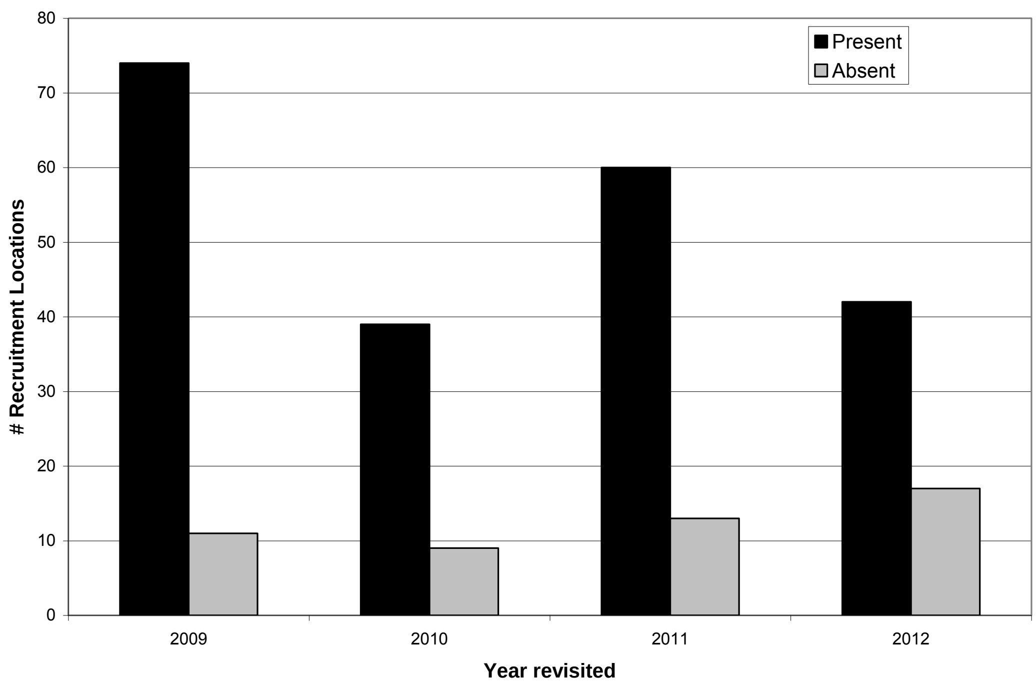


Woody Recruitment Figure 12. Cottownood Recruitment Sites 2008-2012.

6.8. Recruitment Persistence

Woody Recruitment sites are revisited during the following years RAS. Observers note whether the recruitment was found or not, and note the number of plants using the one of the four abundance categories. This has been done to provide information regarding first year's survival of new willows and cottonwoods. With the exception of young cottonwoods, new recruitment has only been revisited the year following germination and seedling stage.

Woody Recruitment Figure 13 shows the number of sites where recruitment was present versus absent the following year. From 2009-2012, woody recruitment has persisted at 71% to 87% of the sites revisited. The number of plants reported at sites that are persisting are most often in the same abundance category as was reported the previous year. Douhovnikoff et. al (2005) notes that several studies report at or near 100% mortality of first year cottonwood and willow seedlings. The available data from RAS indicates that first year survival of willows and cottonwood is high on LORP. The high percentage of persistence noted for recruitment sites on LORP by RAS is encouraging.



Woody Recruitment Figure 13. Number of recruitment sites found to be present versus absent when visited one year after germination

6.9. Factors to Consider Concerning the RAS Data

The data from the RAS provides, at a minimum, a broad-brush overview of woody recruitment over the entire length of the river. There is no other LORP monitoring that has provided a more thorough documentation of this particular part of the restoration process than RAS. With regard to woody recruitment along LORP, the RAS has provided spatial data, information regarding which species are recruiting, numbers of recruitments at sites, and persistence of new recruits.

Slight modifications have been made to the methodology over the years to improve consistency among observers, however, in all years, observers have walked the river, recording new recruitment of all native woody species. The species of *Salix* was recorded when known, and generally observers were able to differentiate young *S. exigua* from tree willow seedlings. The first refinement was in 2009 when the use of abundance categories was implemented. From 2010 on, *S. exigua* root sprouting was recorded separately from recruitment by seed by this species. In 2011, a rule was implemented to distinguish asexual vs. sexual reproduction in *S. exigua*. Therefore the number of recruitment sites recorded is comparable year to year. If one wishes to evaluate sexual recruitment only, eliminating all *S. exigua* observations in all years would provide a comparable data set.

Because of the scale of the effort (surveying the entire river on foot), and an emphasis to keep the project as a “rapid assessment” there are limitations on the data set, and what conclusions can be drawn from it. Observers may differ in their ability to detect woody recruitment thus leading to missed sites or improper categorization of abundance. As discussed previously, a short window of time between the end of the SHF and the RAS may affect the ability of observers to detect young seedlings. The information on abundance is categorical, and based on either a direct count, or an estimate (if large numbers exist). The use of abundance categories to accurately quantify asexual recruitment by *Salix exigua* is questionable. Precise information regarding survival rate is not available from RAS. Because RAS is only tracking one year persistence of recruitment sites, data on long-term survival of recruitment is not available from RAS. No information is taken regarding specific substrates where recruitment is occurring, although photos provide visual documentation of recruitment sites.

6.10. Comparison of RAS data with Streamside Monitoring Data

Another component of the LORP monitoring is the Streamside Monitoring program. The objective of the Streamside monitoring effort is to document the establishment of woody vegetation in the riparian corridor of the LORP, livestock and wildlife browsing activity, and streamside conditions including vegetation and bank attributes within 10 meter wide belts extending from the summer base flow water’s edge into the adjacent riparian area. There are currently 31 100-meter long streamside monitoring belts in the LORP. Some of the monitoring sites were chosen after recruitment was identified by RAS. The streamside monitoring is quantitative in nature and involves repeated monitoring at fixed locations. The Streamside Monitoring provides additional information not available from RAS with regard to recruitment such as streamside conditions and substrates available for germination on LORP, and long-term survival of recruitment.

The 2012 Streamside Monitoring Report provides a detailed analysis of findings.

6.11. Predicted Vegetation Types on LORP

White Horse Associates completed assessments predicting vegetation types on the Lower Owens River, assuming 40 cfs baseflows and 200 cfs SHFs (Ecosystem Sciences 1997, White Horse Associates 2004). The initial assessment conducted in 1997 (based on 1992 conditions) was updated in 2004 (and based on 2000 conditions). The updated assessment (White Horse Associates 2004) was based on a refined hydrologic analysis and incorporated refined reach delineations, and the baseline landtype, water regime, vegetation mapping conducted in 2000. Woody Recruitment Table 2 shows the existing, short-term (1-3 years post-implementation), and mid-term (3-5 year) predictions for wetland vegetation associations supporting riparian woody species. The coyote willow association is characterized by dense thickets of *S. exigua* dominating the canopy, with saltgrass (*Distichlis spicata*) or creeping wild rye (*Leymus* *triticoides*) forming the understory (White Horse Associates 2004b). White Horse does not provide a specifc definition of the Goodding-red-coyote willow/creeping wildrye-saltgrass association, but it can be assumed to be a willow-dominated community with a variable tree willow overstory, coyote willow mid-canopy, and grass understory. The Goodding-red willow/bulrush cattail association supported an average of 40% tree cover overstory, with an understory of bulrush and cattail species. The cottonwood vegetation associations are similar to the willow, except that cottonwood is the dominant overstory species.

Woody Recruitment Table 2. Existing versus predicted wetland woody riparian vegetation types (from White Horse Associates 2004)

Acreage of Wetland Vegetation Association

Vegetation Association	Existing (2000)	Predicted Short-term (1-3 years)	Predicted Mid-term (3-5 years)	Long-term Conditions (5-25 years)
Coyote Willow	21	4	3	Increase
Goodding-red-coyote willow/creeping wildrye-saltgrass	0	0	123	Increase 5-10 times
Goodding-red willow/bulrush-cattail	112	272	279	Replaced by bulrush-cattail
Cottonwood	4	5	5	Decrease
Total Acreage Wetland Woody Riparian Associations	137	281	410	

Percent of Floodplain Area Supporting Wetland Vegetation Association

Vegetation Association	Existing (2000)	Predicted Short-term (1-3 years)	Predicted Mid-term (3-5 years)
Coyote Willow	0.33%	0.06%	0.05%
Goodding-red-coyote willow/creeping wildrye-saltgrass	0.00%	0.00%	1.91%
Goodding-red willow/bulrush-cattail	1.74%	4.23%	4.33%
Cottonwood	0.06%	0.08%	0.08%
Total Percent Wetland Woody Riparian Associations	2.13%	4.37%	6.37%

In 2000 under preproject conditions, wetland riparian woodland associations totaled 137 acres or 2.13% of the floodplain area. The short-term prediction was for the acreage to increase to 281 acres or 4.37% of the floodplain. Virtually all of this increase was to come from increases in Goodding-red willow/bulrush-cattail. The 3-5 year prediction was for 410 acres, or 6.37 acres. The increases in this time frame were from increases in the Goodding-red-coyote willow/creeping wildrye-saltgrass association. Over the entire mid-term period, only one acre of additional cottonwood vegetation association was expected. Over a 5-25 year time period, White Horse predicted that all of the 279 acres of Goodding-red-willow/bulrush-cattail and Fremont cottonwood/bulrush-cattail would be replaced by bulrush-cattail as the trees succumb to flooding and or fire (White Horse 2004). He also suggested that coyote willow might become a major component of the community due to its rhizomatous nature. The Goodding-red-coyote willow/creeping wildrye-saltgrass community is expected to expand and become more dominant over time. This would provide vegetation conditions similar to those found in graded reaches of the Middle Owens River.

White Horse assumed that the future vegetation types would be established 5-10 years after flow implementation, but maturity of riparian trees and shrub vegetation types would take 25 years. These predictions do not take into account impacts from beaver, but do assume impacts from livestock and large ungulates will be minimal.

It is important to point out that while the acreage of the coyote willow and Goodding-red-coyote willow/creeping wildrye-saltgrass associations represent willow dominated sites and thus predominantly willow acreage, the other vegetation associations do not necessarily. Therefore the acreage values for these other community types cannot be directly interpreted as willow acreage. Thus, if one is interested in understanding the expected acreage of willow and or cottonwood trees on LORP given the landtypes, water regime and vegetation, the value may be somewhat less than is present in Woody Recruitment Table 2.

6.12. Discussion

The RAS data indicates that recruitment is occurring annually on LORP, although at differing levels throughout the river. More recruitment has taken place in Reaches 2 and 3 likely due at least in part, to the presence of appropriate substrates and landforms for recruitment. Streamside monitoring data in the LORP indicate that 95% of the banks sampled were covered with live or dead vegetation, with less than 5% of the banks barren or eroding. Existing vegetation on streambanks can interfere with recruitment as some species such as cottonwood are extremely small and not able to compete against existing vegetation (Rood and Mahoney 1995). Rood and Mahoney however, (1995) still found willows to be abundant in areas where streambank vegetation such as grasses and sedges was dense. LADWP staff have noted large numbers of willow seeds along the river, and the SHF has been timed to match peak seed production. Other studies have noted conditions where an abundance of viable seeds are produced in a river system, yet little new recruitment occurs. In the absence of large disturbances which result in barren substrates upon which seeds can germinate and survive, clonal reproduction by some species may be a significant method by which regeneration occurs (Doughovnikoff 2005). The ability of certain species such as *S. exigua* to reproduce asexually will contribute to recovery of woody riparian shrub layer, even in the absence of large disturbances. White Horse Associates predictions based on the 40/200 cfs flow regime are consistent with these studies. The observation of increased proportional abundance of *S. exigua* recruitment sites detected by RAS may also be an early indicator of this process.

Large increases in willow or cottonwood acreage are not predicted for LORP, at least initially. Long-term predictions (out to 25 years) call for an expansion of the shrub and tree willow communities, with coyote willow becoming a more dominant species. Within this time period of transition, it is also expected that some individual trees will be lost to flooding or fire. Cottonwood is not expected increase on the river over time.

Woody recruitment is occurring on LORP over a large geographic area, but at a small and localized scale where suitable landforms and substrates exist. Available information indicates survival of new recruitment is high. The majority of the recruitment has persisted, at least to the second year after germination. Previous studies estimated up to 25 years before newly established vegetation reaches maturity.

6.13. References

Ecosystem Sciences. 1997. *Predicted Future Vegetation Types - Lower Owens River.* Prepared for Los Angeles Department of Water and Power. Prepared by Whitehorse Associates for Ecosystem Sciences. January 1997.

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7.0 2012 Inyo/Mono Counties Agricultural Commissioner's Office LORP Weed Report

2012 Inyo/Mono Counties Agricultural Commissioner's Office LORP Weed Report

Introduction:

Current Inyo and Mono Counties Agricultural Commissioner's Office (AgComm) efforts on LADWP lands focus on the protection of the LORP area during habitat restoration from noxious weed invasion. This is accomplished primarily by efforts to eradicate known weed populations within the LORP area, and also by monitoring the LORP area for pioneer populations. The detection component is critical to the protection of the LORP, as this region is a recovering habitat with many disturbed areas. Disturbed conditions make this area more conducive to weed establishment, as does increasing recreation use.

While protecting native habitat during the critical first stage of the lower Owens River re-watering is the paramount goal of this project, there are many other positive consequences resulting from this work. A healthy native plant habitat will support wildlife (including some threatened and endangered species), help to reduce stream bank erosion and dust, maintain healthy fire regimes, preserve the viability of open-space agriculture, and conserve recreational opportunities.

Summary of LORP Weed Management Activities in 2011

LORP area weed management efforts during 2012 mirrored 2011 levels essentially. Field staff numbers were reduced due to the reductions from both the termination of the AgComm/LADWP Invasive Plant Management Agreement, as well as the deletion of baseline weed management area funding from the California Department of Food and Agriculture. The loss of staff members was mitigated by increased efforts by remaining staff following the termination of AgComm responsibility to manage invasive plants on LADWP lands outside the LORP on July 1, 2012. After this date, staff worked almost exclusively in the LORP area.

All known *Lepidium latifolium* sites within the LORP area were treated or surveyed in 2012; most were treated three times, with four sites treated only twice because early spring flooding precluded herbicide application. Invasive plant populations totaled .28 net acres, down 30% over 2011. Individual sites totaled 38 in 2012, up 3 new sites discovered by multi-agency Rapid Assessment Surveys (RAS).
Of the 38 known sites, 50%, or 19 sites had no plants present in 2012. After five continuous years of no growth, sites may be considered eradicated.

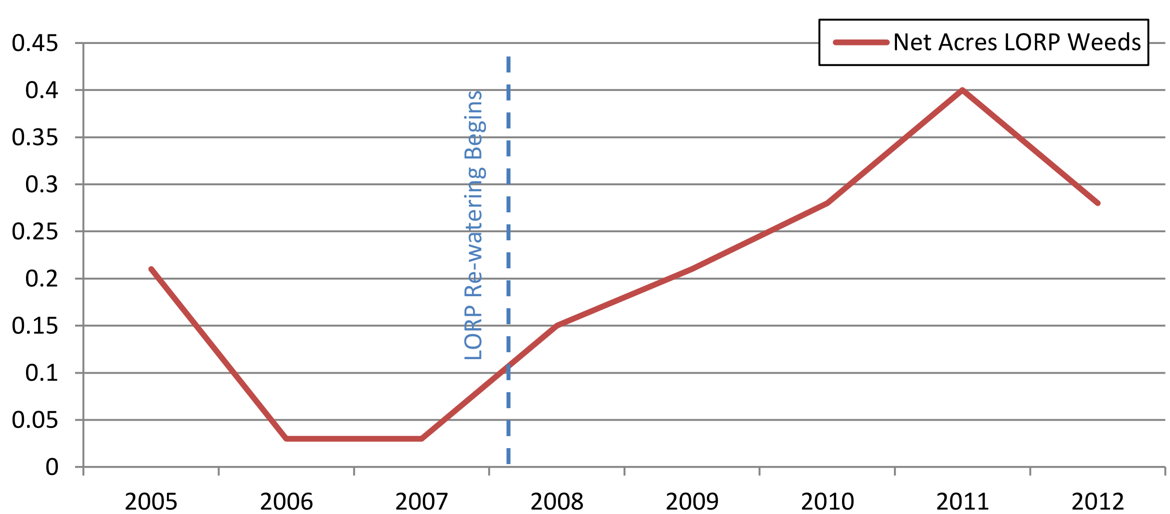
Table 1 – Count of LORP Invasive Weed Sites

Year	Total Number of Sites	New Sites Discovered	Sites with No Growth
2002	2	0	0
2003	2	0	1
2004	3	1	1
2005	4	1	1
2006	4	0	1
2007	4	0	1
2008	12	8	1
2009	17	5	4
2010	32	15	5
2011	35	3	19
2012	38	3	19

Survey efforts continued in 2012, with 47,319 acres surveyed within the LORP area. This includes areas of known infestations, as well as several surveys into other areas to ensure no new populations are allowed to establish undetected. As of October 2012 known weed sites within the LORP project area total 320 gross acres, which is equal to 2011 figures.

Treatment methods followed successful strategies used in 2011, including low-volume, directed spot treatments using selective herbicides. These applications were made on foot using backpack sprayers to mitigate damage to the recovering native plant communities within the LORP. As stated above, the strategy used produced a 30% reduction between years, and AgComm will continue to employ these methods as long as these results continue and staffing levels permit.

Chart 1 – Net Acreage of Weed Populations on LORP



Management Difficulties

The most significant management difficulty continues to be maintaining adequate resources for effective management. Although previously discovered populations continue to decline as a result of control efforts, new populations continue to appear, and survey efforts may not be adequate. Detecting small invasive plant populations in the vast LORP project area early in the colonization cycle while treatment activities are most effective, has become a difficult task to maintain.

Each of these concerns is exacerbated by the continual threat to seasonal field staffing. Whether seasonal staff will be feasible in 2013 remains unclear and the potential for the entire weed management program falling to one staff member rises each day that no new funding materializes.

8.0 SALTCEDAR CONTROL PROGRAM

The goal of Saltcedar Control Program is to eliminate existing saltcedar stands, to prevent the spread of saltcedar throughout the Lower Owens River and associated wetland environments, and to sustain the ecological restoration that is now occurring in the LORP.

PROGRAM BACKGROUND

Saltcedar (*Tamarix ramosissima*) is an invasive non- native shrub or tree that can grow to 25 feet and live up to 100 years. Given favorable conditions, a tree can grow 10 to 12 feet in one season. Saltcedar can compete with native vegetation and degrade wildlife habitat. Its presence in the southern Owens Valley has the potential to interfere with the LORP goals of establishing a healthy, functioning Lower Owens River riverine- riparian ecosystem.

References to the importance of managing saltcedar can be found in documents that guide the saltcedar program and govern the LORP:

- The LORP Monitoring, Adaptive Management, and Reporting Plan (MAMP), notes that saltcedar may increase in some areas of the river because of seed distribution with stream flows. The MAMP states that the potential risk of infecting new areas with saltcedar is considered a significant threat in all management areas

- The 1997 Memorandum of Understanding (MOU), between Inyo County, City of Los Angeles, Sierra Club, Owens Valley Committee, CA Dept. of Fish and Game and California State Lands Commission, expresses that saltcedar reinfestation in the LORP area would compromise the goal of controlling deleterious species whose “presence within the Planning Area interferes with the achievement of the goals of the LORP” (1997 MOU B. 4)

- Parties to the Long- Term Water Agreement (LTWA) recognized that even with annual control efforts saltcedar might never be fully eradicated, but that ongoing and aggressive efforts to remove saltcedar will be required. (Sec. XIV. A)

PROJECT MANAGEMENT AND STAFF

The Saltcedar Control Program is administered by the Inyo County Water Department, and managed by a Saltcedar Project Manager. Work crews are hired seasonally and consist of eight employees and one shared county employee. In addition, the California Department of Forestry (CDF) can provide work crews to assist in efforts to cut saltcedar and remove slash. In 2011-2012, the field season began in mid- October and concluded in mid- April.

METHODS

The Saltcedar Control Program uses chainsaws, brushcutters, herbicides, and fire to treat and control saltcedar, and saltcedar slash in the Owens Valley.

WORK ACCOMPLISHED (Figure 1)

In 2011, crews cleared saltcedar within the boundaries of the new 1,600 acre-foot mitigation projects. The North of Mazourka Project, and the Homestead Project, both located east of Independence and west of the river, were cleared of saltcedar and Russian olive by Inyo and LADWP crews prior to the release of water into the projects.

In 2012, work began under the new Wildlife Conservation Board grant. This work focused on eradicating saltcedar in the water- spreading basins that lie just to the west of the Lower Owens River and river- riparian area (these spreading basins are a concern because they harbor mature saltcedar thickets that function as reservoirs of seed).

Surveying the river to locate and remove saltcedar is an annual and ongoing activity. At various times during the cutting season, crews worked along the river to treat resprouts and pull seedlings. Many mature plants that were located in the process of clearing the river were also treated. Crews cut and treated 45 acres in the spreading basins and revisited 89 miles of river bank and floodplain.

About 300 pile of slash were prepared for burning in the 2012-13 field season. For the purpose of developing a burn plan, crewmembers and staff participated in a test burn late in the season.

FUNDING

The County's three- year Wildlife Conservation Board (WCB) saltcedar eradication grant expired in April 2011. This generous funding has enabled a level of effort that would not have been possible with Inyo County and LADWP contributions alone. An ongoing responsibility of the Saltcedar Program is to secure grant funding to maintain a strong program. LADWP has assisted the County in its efforts to renew the WCB grant. The Inyo County Water Department was awarded a new grant from the WCB for $350,000 in December 2011. The Los Angeles Department of Water and Power will match the new grant dollar for dollar. The $350,000 matching funds from LADWP will fulfill their obligation of $1,500,000 under the 2004 Stipulation and Order.

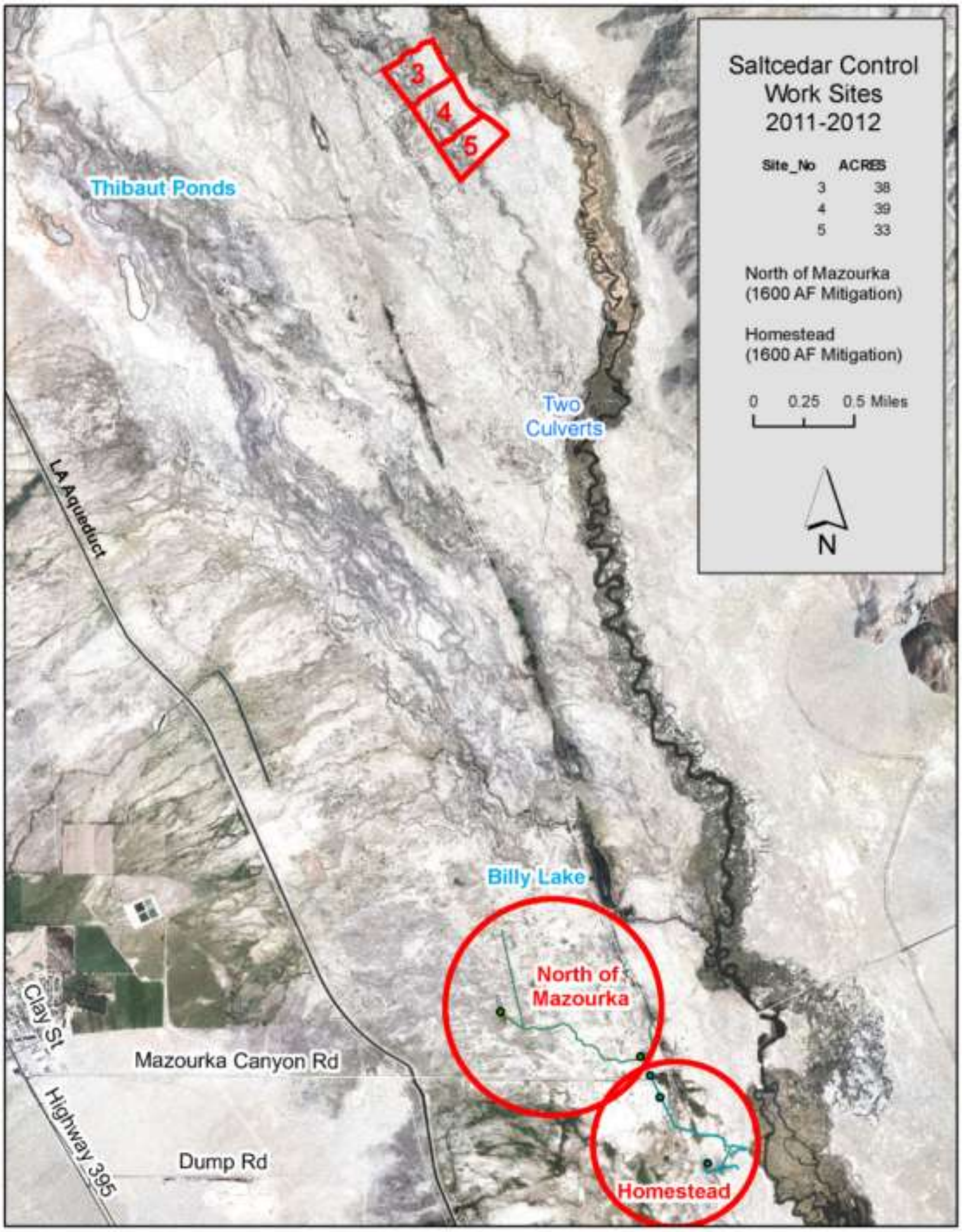


Figure 1. Saltcedar cut areas 2011-2012

9.0 LORP FLOW MODELING

10.0 PUBLIC COMMENTS

10.1 LORP Annual Report Public Meeting

The LORP 2012 Draft Annual Report public meeting was held on Thursday, January 3, 2012, at the LADWP Bishop office. The following table lists those in attendance.

In Attendance:		
Clarence Martin		Mark Midgultt Thibaut Lease
Brian Tillemans (BT)		Philip Anaye (PA) – Local Resident
Dave Martin (DM)		Dow Mattingly – Local Resident
Bob Harrington		Dan Stroud – Sierra Nevada Conservancy
Mark Bagley (MB) – OVC and Sierra Club		Ron Yribarren – Ranch Lessee
Larry Freilich (LF)		
Jim Campbell		**By Phone**
Chris Plakos		Mark Hill (MH)
Eric Tillemans		Bill Platts (BP)
Mike Prather		Peter Vorster (PV)
Darla Heil – Owens Valley Indian Water		

10.2 Minutes Taken at the Public Meeting

LADWP Staff Overview of Monitoring Efforts Conducted this Year and Related Comments

DM: Fifth year monitoring, overview of the report sections.

Mr. Eric Tillemans, LADWP provided an overview of the Hydrology section of the LORP report. Blackrock Waterfowl Management Area, goal was 500 acres of wetted area, reached 488 acres. Discussed River gains and losses and trends, new figure shows correlation.
MB: Is there an explanation for losses?
ET: Maybe the amount of evapotranspiration, with increased vegetation, or drier year.
PA: Is there any study of climatology data?
ET: We keep track of the evaporation, but that's it.

PV: Daily spread sheets, can you explain higher flow?
ET: Generally try to avoid running Alabama Gates but we have flow requirements from the Stip&Order to maintain 40 cfs. Lessee will experience ponding areas, so we try to run as little as possible, 12 out of 15 days. After seasonal habitat flow it dropped, more than anticipated losses but not what was seen. To get the water there in time and avoid a fine we have to turn on Alabama Gates.
Seasonal Habitat flow guesses are tricky.

PV: Alabama Gates – on and off, trial and error, how long it takes to get to the Pumpback Station?
ET: 5 days to get to the Pumpback
MB: Did the Department do anything about the ditch that takes water from Alabama Gates back to river – ponding.

BT: Sandy and high maintenance, flat area, still see ponding, not an area where you can create a ditch.

MB: How many times did you use Alabama Gates?
ET and PV: Three times.

ET: Trying to avoid using it to prevent ponding, the big reason. The whole LORP area had ponding.
MB: Look at consultant recommendations for a ditch.

DM: Seasonal Habitat Flow – peak was 88 cfs, timed release with seed fly, 13 days, 4 hours for it to show at the Pumpback station. 1,840 acres flooded, additional water was released.

LF: Did you compare this release to past releases?
PV: Chapter 3, Seasonal Habitat Flow, where do you explain the reason 88 cfs was released, why this amount? How to you come up with a certain number. Provide how these decisions are made.
BH: We refer to the Standing Committee decisions following the protocols in the 2004 LORP EIR.

MB: Emphasize that point, document this information.
DM: Land Management, Twin Lakes and Islands are the two problem areas. Lessee expected green-up. Irrigated Pasture Conditions, Thibaut pastures. Other pastures not monitored because they exceeded the 90% threshold. 2013 next big year to monitor.
Trends in rare plants, numbers of populations in exclosures are dropping off in rare plants.
Stream monitoring – tease out any recruitment that is surviving, effects of wildlife or livestock grazing. Fall – just wildlife, Spring – wildlife and livestock.

Mark Midgultt: Off the river for 10 years, will we ever get back on the river?
DM: It is 5 years

DM: Weed report, data collection differences, we have one group using polygons and one using points.

MB: Discrepancy in RAS data, class for tree species. Land management Table 3 – Streamside Monitoring. RAS seedlings and juveniles high numbers.

DM: expect differences because of how RAS is done vs. streamside monitoring.
MB: Want to see frequency data, how many plots, that would relate to sites frequency in plots.

LF: RAS PowerPoint, walk around the margin. 225 miles, 60 people days. August 1, survey begins quantitative information. RAS is a tally (how many occurrences) identify impacts. We look for: woody recruitment, beaver or elk disturbance, human impacts, exotic and noxious weeds. Also revisit sites, note surviving recruitment. Explained reaches, landforms, data that reflects regions within the reaches. Total RAS observations. Woody recruitment, survey for 1 ½ days, training, recruitment of willows, new and existing.

MB: Do you look for Royal Willow?
PV: Cottonwoods?
LF: Yes to both, seedlings are noted, but we look where they are expected to be found.
MP: Are other species noted?
LF: Use common names, not looking at quantitative data.
MP: Assume from last graph, numbers are confusing.

LF: Trying to pool data, show how we are making changes.
BH: Nature of the survey is not quantitative, observe trends.
MB: RAS data important, not as thorough, emphasize in text the expectations, and include what is going-on overtime.

BT: Intent of RAS is not quantitative data, gives the opportunity to look at problem areas, assess the problems in less intensive years.
LF: PowerPoint, shows various populations, sites revisited, and where to treat noxious weeds.
BT: Treat areas that the County weed people have identified.

LF: Weed report looks at polygon, RAS looks at points.
BT: Do you coordinate with Weed people? Weed people would treat as a polygon.
LF: Surveyors are trained to count and categorize each individual site.
Survey tamarisk per reach, per unit, and per river mile. Populations are recorded.
More found in Blackrock area, will come up with a plan. Russian olive is a potential problem.

MB: Do we know the number of occurrences? How far apart to be new site?
LF: Survey is done with a visual sphere and survey.
MP: Russian Olive, not part of the RAS.
LF: LADWP treats both saltcedar and Russian Olive.
MB: Three weed management groups going, LADWP, County, ?
Does Russian Olive have some status? County and Saltcedar crews don't address it. Is there a policy in place for treating Russian Olive?
BT: Less Russian Olive then before, if part of the Ad Hoc we take care of it.
MB: Russian Olive coming back through the area?
CEM: Saltcedar crew not allowed to treat Russian Olive with the grant dollars.
MB: Continue with treating Russian olive.

LF: Could be a major concern, will watch. Wildlife, such as beaver and elk, direct sightings.
MB: Go back to the Vole, general wildlife sighting, not recorded for documentation.

LF: Grazing, feed supplements, dead fish – none found this year. Recreation, trends in use.
Improve the LORP Recreation Plan. Hunting, access cuts.
MP: Can arrange for volunteer project to help address trash.

CEM: Lone Pine Dump fees have increased.
BT: More people dumping.

LF: Cut fence
PV: Is the RAS the best place to observe and record trash.

LF: roads, new and existing, river obstruction, slash, paddle boarding the river.
MP: Recall a lot of quad activity, been out with Dale Schmidt to the Lone Pine area.
LF: Saltcedar program – dedicated crew to remove mature saltcedar, work with LADWP.
New grant, National Wildlife Federation Board, will give geographic location. Moving into slash removal, getting help from CalFire burning.
MB: Slash last year still not addressed.
BT: Making an effort to coordinate work to remove slash.
MB: How many piles of slash? 10-20% have been burned.
BH: About 200 piles have been burned of the 600-700, this is all weather dependent.

Tim McGuire and Bill Platts (BP) with Ecosystem Sciences: Discuss the history and future of the river.
BP: Concerns: three environmental conditions. 1) Water quality – limiting factors, what can be done to assist process of organic bio-mass. River is experiencing a build-up of organic bio-mass. MOU consultants will want to adjust the baseflow and seasonal habitat flows, maybe later. Like to see flushing flows, proposing we release flows. Three flushing flows during the cooler season to remove material out of river system. Move Seasonal Habitat Flow to later in the year.
Concern – augmentation of Seasonal habitat Flow, Reinhackle oxygen did drop, 200 cfs – faced fish kills. MOU gives the opportunity to recommend baseflow.
Need better action in tule management.

PV – What did BP mean by tules clean-up, trapping?
BP: High turbidity carrying particles, the tules grab the particles and act as a filter for a clear stream. High organic load, need to manipulate the baseflow. Lone Pine landfill needs to clean it up. MOU parties need to address the Pumpback Station, get back together for a solution to increase pumpback capacity.
MB: Perhaps look to consultants for clues as to what is useful, what the requirements would be for the river.
BP: No task order to address this. Future higher capacity to have an effect. Anything that exceeds has to go to the Delta Habitat Area.
MB: Modeling, nothing to stop Ecosystem Sciences recommendations.
CEM: Will have to see if it agrees with the City Charter.

PV: County and LADWP – take recommendations and act on decision, understanding or rational decision.
MB: Should be recommended in the 2012 report what is expected, what is not rational.
CEM: City charter doesn't allow waste of water, discussion for the past 3 to 4 years.
MB: Asking for a number from the consultants.
CEM: Numbers have to be evaluated.
MB: Ball is in City's court.
PV: River Summit, cost efficient, "Bill, what is River Summit?"
BP: Report provides direction, no idea what it will look like at the end of the project, MOU concerns. County and City look at river future, have a common understanding.

PV: Is specific adaptive management included.
BP: Yes, Section 10
PV: River Summit, where is this going?
BP: Would take more understanding.
MB: I think MOU Parties should be included in the River Summit.
BH: County would want this, but how does it differ with what we are doing today?
PV: Releasing ideas, fully prepared, specific recommendations, workshop to deal with the monitoring suggestions. This is not the best way to handle discussion, rushed by holding the meeting during the holiday.

BH: April won't work with County.
BP: More time to assess outcomes and recommendations.
LF: River Summit, is it an annual meeting. Seasonal Habitat Flow magically appear
PV: Hands on for the MOU Parties to be a part of the recommendations.
MH: Should not be dropped, need to set objectives and define these objectives.
BP: Blackrock Waterfowl Management Area, Thibaut Unit problems, MOU Consultants blew-it, lost open surface water. Brian Tillemans developed first plan, Ecosystem Sciences wanted it to remain wet/surface water. Brian Tilleman's solution, to go back to what we were doing. Plan written before anything is done.

Mark Midgultt: Waterfowl enclosure grew tules like a sponge, soaks up water, will only grow more tules. Don't put water back where it is burned.
BT: Not good to put water back where burned, put in areas where there isn't so many tules. Thibaut Pond, prior to LORP it attracted waterfowl, late winter situation. Not meant as a situation with perennial water that grew tules. In order to attract wildlife and maintain Thibaut it needs to be dried. Shots of water for wildlife, not a perennial pond and was never targeted as a fishery. Mimic what was going on before the LORP.

MH: Obligations with the EIR to maintain 28 acres of ponded water in Thibaut.
MB: Is it in the MOU?
BT: It's in the EIR, don't think the MOU has the 28 acres.
BH: EIR mitigation project
BT: It was difficult to define where the pond was, it was alkali slicks. This is not like a pond (Buckley).
MB: Field trip LADWP/County – with MOU Parties
MH: Way to get around 28 acres at Thibaut.
BP: Thibaut – lost wetland habitat, need to develop a plan. Delta Habitat Area going well.
PV: LADWP had a chance to assess recommendations.
ET: Unclear

BP: Increase water. Releasing 200 cfs, hard time, getting water to arrive at Pumpback Station.
ET: Water will spread, spilling extra water into Delta Habitat Area every day.
LF: What do you mean spilling?
ET: Extra water to Delta Habitat Area.
MB: Would be easy to do a waiver, Eric, will this happen?
MP: Mou Parties and LADWP work together to agree with a plan.
MB: Will there be flows in the winter time.
PV: Will this require extra water?

ET: Langemann to Delta
BT: Permanent and annual? Waiver 72 cfs redundancy capacity, pulse flows.
BP: 96 cfs
PV: If we went to 72 cfs what would you do differently?
BP: There is no task order to complete this, we know what the river gains. Need to flush the river. Eric Tillemans has the experience to handle it.
PV: Tule management, clear water.

Tim McGuire, Ecosystem Sciences: Recommend include RAS Woody recruitment, saltcedar, and weed control. Monitoring protocols, assess LORP data warehouse and make data available. River flow modeling by transects to determine approach.

BP: Model allows and has capabilities.
MH: Model is accurate to half a foot.

PV: Need more detailed, transect by transect, can it be used now?

MB: LADWP, these changes need to go through the process. Page 3, “Habitat for most indicator species continues to develop.” Need support for this statement.
BP: Should not say “all,” not a wildlife expert.
MB: All species are not being considered, need to change “all.”
BP: Need to address this with Debbie House.

DM: Will not capture new imagery, postponed till 2015.
Estimation was too early again, not enough change to the landscape. 99% sure there will not be enough change to assess this yet.

BT: Can’t say, there is more to the habitat with what’s happening in the understory and canopy.
PV: Suggest another report or document accessible to the public, that is easy to understand.
BH, LF: Executive Summary provides an easy overview.
LF: The addendum that was added regarding the tules is a good source.
Mark Hill developed the tule management.
BH: Despite a river Summit, information from the public is vital now to complete the project. Now is the time to read and provide concerns and comments while the Workplan is being developed. Time consuming steps.
MB: Analysis of recruitment tree species, need to collect data that would address riparian forest development. Important specific recommendation. Proposal for flow to Pumpback Station not an issue for increasing capacity.
BH: Pumpback Station language, that was addressed, we want something permanent.
MP: Likes the consultants three priorities. Water Quality, Tules, and woody recruitment. Will volunteer if needed.
PA: Self-generated report card, sense of pride, great foundation but not an easy read for public. General ideas that people can process. Los Angeles people should know about it. And thanks for allowing the public to hear this information.
LF: Would like to encourage public to come out to these meetings and bring ideas on how to get this information out.
MP: Broad announcement of a plan doesn’t always reach the public. Maybe at the fair, booth, and or public event.

10.3 Comments for the 2011 LORP Annual Report

The following comments were received on Thursday, February 09, 2012, from Mr. Mark Bagley, Sierra Club Owens Valley MOU Representative and Owens Valley Committee Policy Director. These were sent to LADWP, Inyo County Water Department, and Ecosystem Sciences.

> "Hi all,
>
> Unfortunately, we have had a number of issues that have caused a delay in getting you our comments on the LORP annual report. I did receive draft comments from Peter Vorster last night and I plan on getting you our final comment letter in by Wednesday next week. I will be out of town on family business tomorrow through Monday.
>
> However, we had Duncan Patten review the report, primarily Chapter 10, and I am attaching his comment letter that was done as the OVC and Sierra Club ecological consultant. We agree with his comments.
>
> Let me just make a couple of additional comments here. As we have stated the past couple of years, and is still applicable given the 2011 data, we are very concerned about the great attenuation of the seasonal habitat flows in the lower reaches of the LOR. We are also concerned with the very low amount of recruitment of riparian tree species that is reported. We await the results of the flow modeling study and we would like the MOU parties to have the opportunity to participate in the report presentation by the model developers this spring and participate in the development and evaluation of flow scenarios that will be modeled. Additionally, we agree that augmentation of the seasonal habitat flow downstream of the intake to increase stage height and floodplain inundation in the lower reaches, particularly below the Islands, is necessary. Augmentation at Alabama Gates in order to enhance woody riparian recruitment downstream of the Islands will provide better opportunities for riparian recruitment and survival. We recommend that the implementing agencies develop the specific route and carry out any necessary channel work so that efficient flow augmentation from Alabama Gates can occur in future years. We also recommend that the modeling team evaluate increasing the duration of the 200 cfs flow release at the intake and at Alabama Gates to see how much of stage increase can be achieved in the downstream reaches. If the results of that modeling are promising, we recommend empirically testing that in the future.
>
> We agree with the proposal to augment base flow in the winter to improve water quality conditions, particularly dissolved oxygen concentrations, during the seasonal habitat flow later in the year. We also recommend that the base flow augmentation occur next winter from Alabama Gates for water quality improvement prior to next years SHF. We recommend that the model and other analytical tools be used to evaluate whether the recommended base flow augmentation will be sufficient to improve water quality conditions.
>
> Sorry for the delay in getting you our complete comments.
>
> Mark "

The following comment letter was provided as an attachment to Mr. Bagley's comments. Mr. Duncan T. Pattern is the OVC and Sierra Club ecological consultant.

Duncan T. Patten

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From: Duncan Patten, Research Professor
Montana State University

To: Mark Bagley, Policy Director
Owens Valley Committee

Date: January 29, 2012

Via Email

Subject: Comments on LORP Annual Report with Emphasis on Adaptive Management

Below is a brief commentary on several aspects of the LORP Annual Report. These comments are based on a fairly quick review of the document and emphasis was placed on Adaptive Management recommendations.

Non-Adaptive Management Comments

RE: RAS, pg 5-6. The RAS shows no cottonwood seedlings in 2011 as in 2010 and yet Table 6 indicates there were cottonwoods. Are these from prior years and not seedlings? This is not clear as there appears to be an obvious contradiction.
What is Table 7 on page 5-6? Not clear what this is showing.

Comments on Adaptive Management Section That Was Prepared by the MOU Consultants

It is important that the consultants point out the application of adaptive management "is not among LORP successes". They point out that difficult prescriptions are not followed nor are explanations given as to why they are not followed, whereas, the easiest and least restrictive prescriptions are followed. This highly selective approach taken relative to application of adaptive management should be challenged.

They recommend, and I support, that there should be action on adaptive management recommendations or justification of "no action".

Page 10-2 the consultants tabulate adaptive management processes that have or have not been implemented, and/or should be implemented in 2012.

They recommend that the river flow model be completed which is critical if the recommendations of changes in Seasonal Habitat Flows (SHF) are to be designed properly and implemented accordingly.

The MOU consultants recommend, and I support, changes in SHF timing, duration and magnitudes to ensure appropriate changes in channel development and improvement in riparian vegetation establishment and maintenance. Although woody recruitment is occurring along the Lower Owens, enhancing the potential for future recruitment with flows that are more conducive to riparian woody plant establishment, especially cottonwood that presently show limited recovery, would ensure a more stable long-term recovery of the Lower Owens.
I also support the MOU consultants' recommendation that SHF flows be augmented downstream from the primary inflow point in order to reduce the attenuation of flow volume downstream along the full LOR channel. This will help maintain the shallow alluvial water table that is supported by these flows and helps maintain the established riparian vegetation.

More Specific Comments.
1. River Flow Modeling: As pointed out above, this is critical to understand effects of actual flows and potential changes in flows (especially SHF) as these might, and probably should be adjusted in timing and magnitude. For example, 2011 was a very high snow pack year and flows above 200 cfs should seriously have been considered. Limits on higher flows might be due to the capacity of pump back but if that is an issue than the pump back capacity should be increased when possible.

2. The consultants present a good discussion of tule/cattail control along the LOR. Physical cutting seems to be the best control and the recommendation to avoid drawdowns during summer (another water management recommendation) is critical as this triggers invasion and expansion of cattail.

3. I also support the recommendations for consideration of modification of magnitude, duration and timing of the SHF. The EIR (2004) required two SHF flows. One initially of 200 cfs as a flushing, scouring flow in the winter, and then regular spring 200 cfs peak flows when the precipitation is equal or above normal. The consultants recommend that anytime the water year is equal or greater than normal a 200 cfs SHF be achieved. They also recommend that when water year runoff is less then normal the SHF be changed to include a peak of 200 cfs, but so designed to continue to use the same amount of water that the original EIR ramping schedule would have used at a given water year. These recommendations seem like a reasonable approach to creating some higher flows during most years.
I believe that serious consideration should be given to investigating SHF flows exceeding 200 cfs if and when the water year would allow it (that is, the water year is well above normal, for example, like 2011) and the river model shows the advantages of higher level flows on channel formation, tule and sediment scouring, and riparian vegetation recruitment and maintenance.

4. Augmentation:
SHF Augmentation: A 2010 addendum to the LORP EIR allows augmentation to maintain 200 cfs in the lower reaches when this is the SHF and "objectives" aren't met. When possible flows to augment flow below the River Intake should be seriously considered as a regular component of SHF. Compared with the original EIR SHF ramping and flow durations with releases only from the intake, this would allow an additional 928 af into the Delta which may be returned to the aqueduct through increasing the capacity of the pump station.

Augmentation should allow greater depth increases in the river over the base flow to create more inundation and recharge of the shallow groundwater, both enhance riparian recruitment and maintenance.

Base flow augmentation: There is also a need to augment baseflows to correct a water chemistry issue where there may be high BOD and low dissolved oxygen, a condition that is not good for river biota. I also agree with the MOU consultants recommendation to release flows aimed for the Delta from the Intake (March- April and Nov.-Dec.) rather than the pumpback in order to move fresh water through the system.

5. Delta Habitat Area Flows (DHA flows)

Recommended DHA flow changes are designed to reduce length of the "dry out" periods, a logical use of water. However, it is not apparent whether the DHA flows have been modeled (if not, they should be). If so, how do recommended changes in DHA flows fit the models?

It appears, however, that comments supporting each flow change recommendation are based on some level of model (conceptual or otherwise?). This is not clear.

The logic behind the recommendation of modifying the DHA flows through increased flows (pg 10-17) seems like a very useful recommendation designed to improve habitat conditions in the Delta.

6. Other recommendations:

RAS. I agree with recommendations on improvements in the RAS process (pg 10-19).

Salt Cedar. I agree that prevention of spread of salt cedar is desirable but it may be nearly impossible to completely eradicate salt cedar along the LOR. Consequently, accepting a few stands of salt cedar may not be ecologically disastrous as long as recruitment of cottonwood and willow stands are the paramount goal of riparian management along with prevention of salt cedar spread. This is because some literature shows that in established arid-region woody riparian stands salt cedar supports avian populations and provides some functions similar to other large native, woody riparian species ((e.g., Stromberg, JC 1998. Functional equivalency of salt cedar (*Tamarix chinensis*) and Fremont cottonwood (*Populus fremontii*) along a free flowing river. Wetlands 18:675-686)).

Beavers: I suspect beavers were ubiquitous over much of North America (pre-trapping in early 1800s) and thus native to the LOR (see, for example, Naiman, RJ, CA Johnston and JC Kelbey 1988. Alteration of North American streams by beavers. BioScience 38:753-762). They were reintroduced after extirpation, however, the fact that they might have been native doesn't mean that with early reestablishment of a riparian vegetation community, a community that is very susceptible to destruction by a rapidly expanding beaver community, beaver control should not be undertaken.

Consequently, I agree with the MOU consultants' recommendations on controlling beaver populations (pg 10-22). Beavers will build dams and/or establish colonies where there are appropriate resources which includes both proper river conditions and an adequate supply of woody plant material for food and structures. Beaver dams help elevate the water table which enhances riparian vegetation expansion and maintenance. Beavers may occupy one location for a while and then move on to other appropriate reaches of the river. Abandoned dams should be left alone to allow continued water table elevation, recognizing that high flows and/or time will eventually destroy them. During the early recovery of the LOR it is unlikely that many beaver colonies can be supported by newly establishing riparian vegetation and thus it would be fruitful to allow very few colonies during this early recovery period. It is difficult to recommend any particular number of beaver colonies to leave, however, annual surveys will offer some evaluation of beaver density and riparian losses which should guide adaptive management of beaver populations.

Range Belt Transects: The recommendations that the whole transect should be used for vegetation monitoring and widened to 10 m (pg 10-23) is an excellent one as it will allow sampling of more riparian woody habitat and allow better assessments of riparian establishment success.

General Comment: Several figures in the report (e.g., Fig 1, pg 10-26) do not have axes labels. This makes understanding the figures difficult. All figures should be appropriately labeled and those not so should be corrected accordingly.

10.4 California Department of Fish and Wildlife Comments 2012 LORP Report

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bishop Field Office
407 West Line Street
Bishop, CA 93514
www.wildlife.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

January 18, 2012

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

Dr. Robert Harrington
Director
Inyo County Water Department
P. O. Box 337
Independence, CA 93526-0337

Dear Mr. Yannotta and Dr. Harrington:

LOWER OWENS RIVER PROJECT 2012 DRAFT ANNUAL REPORT COMMENTS

The California Department of Fish and Wildlife (Department) is very interested in riparian tree (specifically red willow, Gooding's willow, and cottonwood) recruitment along the Lower Owens River because one goal of the Lower Owens River Project (LORP) is to provide habitat for indicator species and many of the indicator bird species need riparian forest habitat. In accordance with 2011 adaptive management recommendations, the Los Angeles Department of Water and Power (LADWP) collected data targeting woody riparian species recruitment and survival. This data provides a better mechanistic understanding of recruitment within this complex riparian system. The Department would like to see continued data collection of this type so that, in addition to livestock and wildlife grazing, the role of climate and seasonal flows on riparian tree recruitment can also be better understood. Although there are some areas where riparian tree species appear to be recruiting, the great majority of the project area is characterized by shrub (coyote willow) and tule (cattails and bulrush) with little tree recruitment (0-2 plants per river mile based on the rapid assessment survey). The Department would like the consultants to provide adaptive management recommendations that specifically target riparian tree recruitment and, in turn, would like to see LADWP and Inyo County implement these recommendations. The Department does understand that riparian tree recruitment may be hindered by things outside of LADWP's or Inyo County's control (e.g. beaver use or climate).

In general, the process of adopting or rejecting adaptive management recommendations is not clear. This decision process should be made explicit, transparent, and reported to the MOU parties. Understanding why some recommendations are implemented while others are not could help lead to alternative solutions or more acceptable recommendations. For example, it is unclear why the recommendation to release winter time pulse flows to the delta from the intake was not implemented. The Department would like to see this recommendation implemented in addition to the recommendation that seasonal habitat flows are augmented with flow from additional release sites. The Department supports increasing the pumpback station capacity as it will likely result in more 'water neutral' flexibility to implement different flow recommendations. The Department and Inyo County have worked diligently to develop an acceptable MOU amendment to increase pumpback station capacity and encourages LADWP and other MOU parties to continue moving this process forward. However, regardless of pumback station capacity negotiations, the flow guides in the LORP EIR should not limit water flow in the Lower Owens River and should change if LORP goals are not being met.

In addition, we offer the following specific comments:

- Please update the plant code table to include all of the plant codes used in the text and tables.
- Please provide data or a more robust reference to justify why leader browsing intensity of <25% is considered successful recruitment. Explain how this cutoff was derived.
- The Department supports ongoing efforts and encourages further removal of livestock supplements (e.g. salt blocks) from the floodplain.
- One of the LORP goals is to benefit threatened and endangered species (p1-3 2012 LORP Draft Annual Report). Please provide specific examples of how the LORP has benefited Owens pupfish, Owens tui chub, and yellow-billed cuckoo including data or evidence used to support this conclusion.
- The Department requests to receive annual updates on any changes made to LORP monitoring protocols.

Thank you for the opportunity to comment on the 2012 Lower Owens River Project Annual Report. If you have any questions, please contact Ms. Lacey Greene, Environmental Scientist, at 760-872-1128.

Sincerely,

for/ Leslie MacNair
Environmental Program Manager

cc: CHRON
MOU Party Representatives

11.0 ADAPTIVE MANAGEMENT RECOMMENDATIONS

11.0 ADAPTIVE MANAGEMENT RECOMMENDATIONS

11.1. ***Executive Summary***

Responsibilities

The roles and responsibilities of the County, City and MOU Consultants for collecting, analyzing and reporting monitoring data are described in the 2008 LORP Monitoring, Adaptive Management and Reporting Plan (MAMP). The County and the City submit annually to the MOU Parties and the public an Annual Report that display LORP data and management activities. The MOU Consultants reviewed LADWP's and ICWD's 2012 Annual Monitoring Draft Report and developed adaptive management recommendations needed to ensure LORP goals are met in the four Lower Owens River management areas: the Riverine-Riparian Area, Blackrock Waterfowl Management Area, Delta Habitat Area, and Off-River Lakes and Ponds. These recommendations are related to and build upon the adaptive management recommendations made by the MOU Consultants from 2008 to 2011.

The 2012 LORP monitoring included hydrologic monitoring, seasonal habitat flow (including flood extent mapping), rapid assessment survey, land (range) management, Delta Habitat Area landscape mapping, salt cedar control and current conditions, and invasive weed control and current conditions.

Goals

The overall MOU (1997) goal for the LORP is: "*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.*"

Monitoring

Environmental conditions in the LORP can change in response to water and land management activities. The collection, evaluation, and reporting of environmental data is central to the monitoring program and will determine the effectiveness of adaptive management actions in meeting project goals and objectives. The driving tool of adaptive management is environmental monitoring results. Monitoring data is used to measure progress toward a desired management objective over time. Data and analysis provides the necessary information to allow managers to adapt actions and methods to on-the-ground circumstances and unforeseen events. Successful adaptive management is dependent upon a monitoring program that provides a reliable measure if change occurs in ecosystem components.

Adaptive Management

The MOU defines adaptive management as a method for managing the LORP that provides for modifying project management to ensure the project's successful implementation and/or the attainment of the project goals, should ongoing data collection and analysis reveal that such modifications are necessary. The MOU requires that data and information be collected and evaluated so that recommendations and decisions can be made, and changes implemented (adaptive management procedures) to ensure that LORP goals are achieved or, conversely, determine if any LORP goals are not achievable.

Findings

As in 2010 and 2011, monitoring and analysis results indicate that the LORP is attaining many MOU goals. The LORP supports a healthy warmwater fishery in all reaches. Habitat for most indicator species continues to develop. Biodiversity in wetlands and riverine habitats has increased. Some T&E species are using the restored habitat. Grazing, recreation and other land uses are continuing. However, some environmental conditions and management activities need to be addressed. These include: base flows, seasonal habitat flows, tule management, water quality conditions, woody riparian plant development, and the adaptive management process necessary to address these conditions.

Adaptive management recommendations are described in the sections below and are summarized in the Summary of Adaptive Management Recommendations Table. The MOU Consultants also provide recommendations for improving data collection and analysis in future monitoring. Adaptive management is intended to be responsive to new data and information to achieve MOU goals. Thus, monitoring itself is subject to change and improvement, and even elimination of certain variables.

Recommendations Summary

Table 1. Summary of 2012 Adaptive Management Recommendations

Management Area	Recommendation and/or Action to be Taken
Riverine-Riparian Area	• Analyze river flow modeling results. Determine adaptability to inform tule management and needed modifications of flow. A thorough transect by transect analysis be undertaken of the model output. • Seasonal Habitat Flow: in addition to normal requirements evaluate changes in flow timing, flow duration, and flow magnitude that will maintain and improve LORP resources. • Seasonal Habitat Flow Augmentation: flow augmentation be considered when the Owens Basin Runoff is predicted to be over 100% of normal. • Base Flow: improve water quality by releasing some of the Delta Habitat Area habitat flows from the Intake instead of the Pumpback Station. • Lone Pine Sanitary landfill facility clean up from eastern boundary to the river border to keep this corridor area free of debris and trash. • Tule status and needs: actions to manage tules and cattails, including modification of the current flow regime for increased recreational access should be considered. • Pumpback Station: the MOU Parties should resolve, immediately, an effective means for the Pumback Station to increase capacity. The lack of a solution to the Pumpback Station capacity increase is limiting the LORP flow modifications.
Blackrock Waterfowl Management Area	• Thibaut Pond Management: the present management plan for the Thibaut Ponds be voided and revert back to the original plan and management procedures. The ponds must go through the needed annual “dry-out” periods. LADWP should prepare a new Thibaut Ponds management plan that mimics the original plan.
Off-River Lakes and Ponds	• None

Delta Habitat Area	• See Riverine-riparian section for flow recommendations.
Rapid Assessment Survey	• The RAS woody species data be used to inform a targeted riparian woody species analysis that pools the data from all of the available sources within the LORP
Land/Grazing Management	• None
Salt Cedar and Weed Control	• Priority Areas: the top priority of the annual saltcedar control work program is to clear the river corridor annually of all saltcedar plants. • Pepperweed: control of this highly invasive species remain a management priority.
Other	• Monitoring Protocols: All changes or modifications to any protocols be submitted through the adaptive management process for consideration. • Assessment of the LORP data warehouse, its efficacy as an information source, and the ability to redesign the warehouse interface to promote improved access to the LORP information.

Adaptive Management Status and History

The MOU Consultants are responsible for issuing Adaptive Management recommendations, prescriptions and actions to ensure the LORP is succeeding. Each year since 2008 when monitoring was initiated, the MOU Consultants have reviewed the annual reports, discussed project objectives and results with managers, and analyzed conditions and trends in order to form adaptive management actions that need to be taken. These adaptive management recommendations are submitted after careful review to move the project forward in a positive direction and avoid problems.

Adaptive management recommendations and prescriptions should be evaluated and acted upon. The actionable items from each year’s annual report, up to and including this 2012 report, need to be considered and a plan of action implemented. 2012 recommendations should be considered and weighed with the previous year’s recommendations to make the adaptive management process more successful.

11.2. ***RECOMMENDATIONS***

Introduction

The MOU (1997) defines adaptive management as a method for managing the LORP that provides for modifying project management to ensure the projects successful implementation. The process ensures the attainment of project goals by making management changes, should on-going data collection and analysis reveal that such modifications are necessary. The County and the City conduct the LORP monitoring and prepare a draft Annual Report summarizing results. The Annual Report displays monitoring measures and results, LORP achievements and deficiencies, and provides management recommendations. From the analysis of the draft report and in combination with their own findings; the MOU Consultants develop Adaptive Management Recommendations. These recommendations are presented to the County and the City. The Adaptive Management Report becomes a section of the Annual Report.

MOU Parties, through their Advisory Committee, are consulted during the monitoring, evaluation, reporting, and adaptive management process. The Technical Group, the Standing Committee, and the governing boards of the County and the City make the ultimate decision on implementing adaptive management actions. This is done after reviewing the Adaptive Management recommendations submitted by the MOU Consultants and other relevant monitoring data and analysis. The MOU Consultants also monitor the implementation of past Adaptive Management Recommendations and track those recommendations not accepted, but may be worthy of further consideration at a later date. Implemented recommendations are reviewed to determine success.

The MOU Consultants reviewed the County-City 2012 Draft Annual Report and from it developed their Adaptive Management Recommendations. The recommendations that follow are organized by LORP management areas or issues. The 2012 Adaptive Management Recommendations provide guidance as to what changes or additions in LORP management are needed to meet LORP goals as outlined in the MOU (1997) and the EIR (2004).

11.2.1. Base Flow Augmentation

Background

The MOU (1997) Action Plan calls for river flow augmentation in the LORP when it can be justified. The Action Plan also calls for a natural disturbance flow regime consisting of multiple stream flows that emulate natural water year events. The MAMP (2008) calls for river flow augmentation via higher Intake Station flow releases, water additions from spill gates, and/or modifications of river flow duration and ramping rates.

The MOU (1997) requires a minimum base flow of 40 cfs at or near the Intake to the Pumpback Station to be maintained year-around. Therefore, 11.5 months out of the year the river is mainly forced into steady-state flow conditions. During most of the year the river water column and channel are storing and maintaining large amounts of organic biomass. The annual build-up and storage of organic biomass becomes part of the channel with some going into solution. The amount of material stored, transported, moved out of the system, and still un-decomposed is in equilibrium with the required 40 cfs base flow (in fact an average of 52 cfs) resulting stream power potential. Part of this accumulated biomass is dissolved, suspended, and transported causing high BOD and COD when Seasonal Habitat Flows exceed base flow.

The MOU Consultants in their 2011 LORP Adaptive Management Report (LADWP-County 2011) recommended changes in base flow to improve Lower Owens River water quality conditions. Improved conditions were to be accomplished by releasing Delta Habitat Area (DHA) habitat flows from the Intake Control Station instead of the Pumpback Station. LADWP and the County did not accept or put this recommendation into action in 2012.

Problem

The MOU Consultants 2011 LORP base flow augmentation Adaptive Management Recommendation goes into lengthy detail on Lower Owens River water quality conditions. The justification and reasons for changing flow practices to lessen the problem were explained in their comments. This lengthy discussion and details will not be presented here, but can be reviewed in the 2011 Annual Report (LADWP 2011).

Even during the normal summer base flow periods occurring over the past 7-years, the river annually experiences low dissolved oxygen levels (Tables 2 and 3). River dissolved oxygen can run from 11 ppm in winter to as low as 0.1 ppm in summer. Under current river conditions dissolved oxygen decreases rapidly as stream power and water temperature increases. The largest oxygen decreases occur above the Mazourka Bridge downstream to the Pumpback Station. Improved river conditions and a reduction in those factors causing fish stress and possible future fish kills needs to be obtained.

Present Conditions

Short-term, and to a lesser degree long-term water quality conditions during the 2010, 2011, and 2012 seasonal habitat flows caused reductions in dissolved oxygen. This oxygen reduction occurred even when the seasonal habitat peak flow was only 86 cfs in 2012. During the 2010 seasonal habitat flow conditions become so bad that game fish came quite close to having large fish kills (See Table 3). The 2012 seasonal habitat flow was released early in an attempt to beat coming high river water temperatures. The relatively low seasonal habitat peak flow in 2012 (86 cfs) and lower river temperatures resulted in dissolved oxygen staying above 2 ppm during the release period. Game fish and other aquatic life showed no sign of stress. In the future, however, seasonal habitat flows should not necessarily be released early to beat high river water temperatures unless justified. Doing this will cause seasonal habitat flows to miss seed ripe and seed fall periods. Releasing flows too early in the year eliminates the best opportunity available for allowing riparian tree seedlings to develop and maintain a mandated riparian forest habitat.

Table 2. Selected dissolved oxygen concentrations at selected sites compared to corresponding air and river temperatures in 2010.

Air Temperature (F)*		River Temperature (F)	Dissolved Oxygen (ppm)	Date
Max	Min			
59	33	43	8.3	FEB 13-22
64	38	46	5.3	MAR 6-12
64	38	46	5.5	MAR 12-18
64	38	52	3.0	MAR 19-29
72	41	57	2.1	APR 19-29
80	51	60	0.9	MAY 1
92	60	61	1.0	JUN 6
98	62	75	0.1	JUN-JUL**

- Monthly Average Only

** Seasonal Habitat Flow

Table 3. Dissolved oxygen (ppm) by river location during selected past annual seasonal habitat flow periods.

River Site	2008* (210cfs)	2010 (200cfs)	2011 (200cfs)	2012 (86cfs)
Intake	10.3 to 8.8		7.3 to 6.4	8.7
Blackrock	11.3 to 8.5		5.4 to 2.5	6.5
Goose	10.7 to 8.7		4.9 to 2.3	5.4
Culverts	11.7 to 8.7		4.9 to 2.5	4.2
Mazurka Bridge	11.6 to 8.4		4.3 to 2.2	4.7 to 2.5
Manzanar Bridge	10.1 to 7.3	0.5	4.2 to 3.2	4.8 to 2.8
Reinhackle	8.6 to 4.4		4.5 to 3.1	4.9 to 3.5
Alabama Gates	9.8 to 3.9			
Depot Field				
Georges Return		0.1		
Reinhackle Station		1.4		2.6
Depot Field				3.2
Lone Pine Trestle	6.8 to 4.1			3.8 to 3.9
Keeler Station	9.1 to 3.4		1.6	4.6 to 4.3
Pumpback	9.1 to 3.4			5.5, 5.6
LADWP Aqueduct (Mazurka)			8.5	8.7
LADWP Aqueduct (Tinnemaha)				8.9

*Winter release with downstream augmentation

Changes in Point of Flow Release

The Delta Habitat Area (DHA) habitat flows, presently being released from the Pumpback Station in Period 4 (5 flow days at 30 cfs during November-December), Period 1 (10 flow days at 25 cfs during March-April), and Period 3 (5 flow days at 25 cfs during September), with timing and volume modification if released instead at the Intake Control Station have the potential to improve water quality conditions throughout the Lower Owens River. This proposed change in flow can help prepare the river to meet long-term water quality standards to be set for the Lower Owens River in 2015. These new change in point-of-release flows may also allow the annual seasonal habitat flow timing to occur later and be more compatible with meeting annual riparian tree seed fall periods.

Present DHA Released Habitat Flows

Date	Habitat Flow (cfs)	Flow Days	Flow Period
March to Mid-April	25	10	1
Late June to early July	20	10	2
September	25	5	3
November-December	30	5	4

Because increased habitat flow releases from the Intake Station create a block of high-flow water that spreads and lengthens over time, flow volume within a point in this block of water decreases rapidly as the peak flow effect moves downstream. In 2010, a spring Intake Control Station SHF release with a 200 cfs peak flow resulted in a corresponding peak flow reaching the Pumpback Station of only 76 cfs.

Therefore, higher flows released at the Intake Control Structure would result in much lower flows arriving a little over a week later at the Pumpback Station. The much higher flows over most of the river reaches would eliminate some of the muck load the river is presently storing. Upon implementation, the river should gain environmental benefits while the DHA would still receive its required habitat flows. Thus, increased flow volume released at the Intake Station could be managed so the DHA receives the required habitat flows with over-flow to the DHA being minimized. About the same amount of water per DHA flow release would be used, as under the present flow management. The DHA habitat flows would now create dual benefits.

Intake Station Peak Flow Release and Corresponding Peak Flow Reaching the Pumpback Station.
Flow is in cfs.

YEAR	INTAKE PEAK FLOW RELEASE	PEAK REACHING PUMPBACK
2008*	200	200
2009	110	71
2010	200	76
2011	200	78
2012	86	53

*Augmented at Alabama Gates

River Water Loss-Gain

From winter through early spring, the Lower Owens River functions mainly under a neutral down-river flow water loss situation. From December 2008 to March 2009, the river gained an average of 3 cfs flow from the Intake Station to the Pumpback Station. Flows properly released during winter conditions from the Intake, however, could have a small loss by the time these released flows reached the Pumpback Station. Because of very low evapotranspiration during the period, this small water loss would probably show itself later as it re-enters the channel.

MOU Consultants Adaptive Management Recommendation

Prior to the DHA Period 1 habitat flow scheduled for March-April 2013, the City, County and MOU Consultants meet and consider the benefits and feasibility that a new point-of-release of the DHA selected habitat flows could provide. The evaluation should consider that periods 1, 3, and 4 DHA flows would be released from the Intake Station instead of the Pumpback Station. The DHA Period 4 flow release timing would need to be changed from the present September release period to a September-October release period so this habitat flow could be released as soon as cooler river temperatures occur.

11.2.2. Seasonal Habitat Flow Management

Background

MOU Consultants recommend each year to the County and the City, the timing, duration, and magnitude of the Seasonal Habitat Flow (SHF). River flow recommendations are made to maintain and improve LORP resources. Past annual MOU Consultants SHF recommendations have ranged from 110 cfs peak flow to a 200 cfs peak flow. The MOU Consultants recommended that a SHF peak flow of 200 cfs be released during the 2012 seasonal habitat flow. The County and City did not accept the recommendation and approved an 89 cfs seasonal habitat peak flow. This 2012 seasonal habitat peak flow volume was even much less than the highest summer base flow (110 cfs) released by the City. The applied 2012 SHF was so low it was ineffective.

SEASONAL HABITAT PEAK FLOWS (CFS) RELEASED BY YEAR

2008	210
2009	110
2010	200
2011	200
2012	89

Changes in SHF management are needed. Legal requirements and obligations are an obstacle to obtaining needed habitat flows to meet river needs. To address this problem, the issues that need to be discussed and solved by the County and City are:

1. In above normal water years, should peak flow releases during the SHF exceed 200 cfs?
2. Can SHF flow magnitude be increased by using part or all of the additional 928 afy (by Stipulation and Order) that can now flow into the DHA above already approved flow levels?
3. How can the present Pumpback Station pumping volume limitation be increased so it does not constrain future flow management needs?
4. Should all SHF peak flow releases, as already recommended by the MOU Consultants, be a minimum of 200 cfs regardless of the water year by reducing flow duration time?
5. Are more winter flushing flows needed?
6. What changes in flow timing, duration, point releases, and magnitude are needed to better maintain and improve LORP resources?

<u>MOU Consultants Adaptive Management Recommendation</u>

The MOU Consultants recommend that the City, the County, and the MOU Consultants meet and discuss during the winter of 2012-2013, future river flow management needs. The discussion should develop an understanding of the avenues and processes needed to meet MOU (1997) goals. The expected ecological condition of the riverine system at the end of the LORP should be better placed into focus. Once the ecological condition is identified then the planning and process to attain this ecological condition can be developed and implemented.

11.2.3. Seasonal Habitat Flow Augmentation for Water Quality and Habitat Improvement

<u>Background</u>

The river is demonstrating annually that it needs flow management changes to stay healthy and sustain the gains already made in meeting fisheries and habitat goals. To date, seasonal habitat flow (SHF's) are the primary management tool used to promote woody riparian vegetation establishment and riverine-riparian improvement. Higher SHF's in some river reaches are needed to improve water quality, woody tree recruitment, and riparian health by moving deposited solids and exporting these suspended solids. Higher flows are needed to flood and irrigate bordering landforms.

Each year the MOU Consultants are required to make recommendations to the County and the City on the magnitude, duration, and timing of the annual SHF. The flow timing, volume and duration the MOU Consultants can recommend are strongly influenced by the amount of the predicted water year precipitation.

When monitoring shows SHF objectives are not being met or monitoring triggers have been reached, needed flow changes go through the adaptive management process. Changes in river flow management can then be considered for alteration. The main trigger justifying the discussion of needed changes at this time is that all habitat goals are not and may not be attained. Adaptive management recommendations are needed that would improve water quality conditions and increase woody riparian vegetation recruitment. Flow augmentation can help buffer two environmental river conditions of concern that are setting in: serious short-term detrimental water quality conditions and lack of woody tree recruitment needed to maintain and increase bordering riparian habitat quality.

<u>Past and Present Management</u>

Presently SHFs are being applied that stay within the boundaries mandated by legal directives (i.e., flow volume, flow magnitude limitations) and peak flow size dependent on annual yearly precipitation predictions. The recommendations for lower or higher river flows are difficult to make because of limitations set in the MOU (1997), the EIR (2004), and court Stipulation and Orders.

In their 2010 Adaptive Management Recommendation Report the MOU Consultants recommended that future SHF peaks be a minimum of 200 cfs whenever possible. In their 2011 report, MOU Consultants recommended a peak flow of 200 cfs even though the Owens Valley was in a below normal water year. Five SHF's have been applied to date ranging from 89 cfs to 200 cfs peaks with varying degrees of success. To date SHF's are not accomplishing all they were supposed to do.

The first applied SHF in the winter of 2008, (200 cfs peak) was augmented at the Alabama Gates so river flows would be maintained at or near 200 cfs from this location to the Pumpback Station. The complete 2008 SHF period effects covered a 27 day period. A 200 cfs flow from the Alabama Gates to the Pumpback Station was easy to maintain because the river, during winter conditions, has very low, or no, water loss as river flow moves downstream. This is not the case, however, when SHF's are released during late spring or early summer conditions.

Problem

The annual SHFs applied, because of its short duration, low peak flow volumes, and very low flow conditions in downriver river reaches in all years, cannot be used as the sole source for improving water quality and riverine habitat. The SHF, by itself, under present implementation procedures will not maintain the river in a healthy condition. Low river gradient (average about 0.07 percent) does not provide the stream power needed to eliminate deposited inorganic and especially organic channel sediments. Most of the large annual incoming organic biomass that must be eliminated by the river can only be done mainly through solution and water column transport. This is a slow and ineffective process under low flows.

Those SHF flows of 200 cfs, released in 2010 and 2011, by itself, did not accomplish the needed channel scouring and movement of organic material out of the system. A peak released flow of 200 cfs at the Intake Station quickly reduces in volume and is greatly reduced by the time the corresponding peak reaches the Pumpback Station (resulting in only a 78 cfs peak flow). This flow reduction, especially from the Reinhackle Station to the Pumpback Station, dramatically reduces the stream power needed to move and eliminate accumulated detrimental materials over a large reach of the lower river.

EXAMPLES OF PEAK FLOW (CFS) REDUCTIONS AS THE PEAK FLOW MOVES FROM THE INTAKE TO THE PUMPBACK STATION

River Location	Peak Release and Resulting Down Stream Flow Peaks (cfs)			
Year	2008	2009	2010	2012
Intake Station	200	110	200	89
Blackrock		98		
Goose		96		
Culverts		98		
Mazurka	125	82	120	85
Manzanar		84		
Reinhackle	116	89	111	78
Keeler		71		
Pumpback Station	76	69	78	54

RELATIONSHIP BETWEEN INTAKE PEAK FLOW RELEASE AND PEAK FLOW ARRIVAL AT THE PUMPBACK STATION

Year	Intake Release Flow (cfs)	Pumpback Arrival Flow (cfs)
2008	210	+227 (Augmented)
2009	110	69
2010	200	76
2011	200	78
2012	89	54

As the 200 cfs 24 hour peak flow block of water moves down river the flows quickly reduce in volume. This decreases river depths, river velocities, and over-flow into bordering river landforms over what would occur if the peak maintained itself at 200 cfs. Thus, less riparian corridor is inundated and less sediment is removed from the system in these lower reaches. The reduced flow decreases irrigation of riparian vegetation, riverbank soil moisture, deposition of tree seeds above the base flow elevation and adjacent underground aquifer ground water levels.

The lower reaches of the Lower Owens River do, however, exhibit more land inundation with less flow applied from the Island Reach to the Pumpback Reach than occurs from the Intake Reach to the Island Reach. The long river reach from the Island to the Pumpback Station, however, would still benefit from more land inundation. Inundating more area below the Island to Pumpback Reach during the SHF period offers a better opportunity for maintaining riparian vegetation and recruiting riparian trees.

A 200 cfs Peak Release from the Intake Station and Resulting Increase in River Depths as the Peak Flow Passes By

River Location Station	Flow (cfs)	Average Depth Increase Over Base Flow Depth*
Intake	200	4.4 feet
Mazurka	125	1.8 feet
Reinhackle	116	1.5 feet
Keeler	76	1.2 feet

* NHC (2012)

Justification

Changes in river flow dynamics via Adaptive Management Changes will be needed over the next few years to allow the river to meet future water quality regulations and standards. The EIR (2004) threshold trigger for river dissolved oxygen is 1.5 ppm and a downward trend. This is a threshold trigger that has been already exceeded during past SHF's. If monitoring data shows riparian plants are not being recruited within the first 5 years (5 flow release periods have been completed) of flow releases, in areas subject to out-of-channel flows, then SHF's can me modified (Ecosystem Management Plan 2002).

The MAMP (2008) also calls for river flow augmentation if needed and justified. The recent 2010 Lower Owens River Addendum to the EIR (2004) allows increase in flow magnitude and duration if needed. The Addendum states that, "in changing flow management an additional 928 AFY of water can pass into the DHA over flow outlined in the Ecosystem Management Plan (2002)".

Application

The SHF must be of sufficient frequency, duration, and volume that numerous environmental changes take place in the river. In gaining these needed environmental changes, if habitat flow volume has to be reduced, maintaining magnitude is probably more important that maintaining flow duration. In addition to past Adaptive Management Recommendations, the MOU Consultants are now recommending that some future SHF's be augmented. Part of this can be accomplished under present legal and policy mandates by shortening the flow duration period, changing present points of water addition, and using additional water now available under the new 2010 Stipulation and Order. The MOU Parties are making river management much harder and less effective by not working together to modify the Pumpback Station pump-out capacity limitations.

The Pumpback Station is limited by Court order to pumping out no more than 50 cfs of the incoming river flow. Under this limitation it would still take a release of over 86 cfs at the Intake Control Station before any additional flow would be lost to the DHA. A yearly average of 7 cfs is by-passed to the DHA to meet MOU (1997) and EIR (2004) requirements. Therefore, it would take a flow up to 93 cfs before any additional flow would have to be released into the DHA. This provides an additional source of water to increase downriver SHF's volumes to acquire more benefits.

Magnitude, duration, timing, and other information needed for setting the 2013 SHF cannot be recommended at this time. A controlling constraint (water-year precipitation results) used in recommending the SHF will not be known until April 1, 2013. The MOU Consultants can, however, recommend proposed guides to consider when they make their future SHF recommendations to the County and City.

To begin with the Alabama Gates is probably the best release site for flow augmentation. A large decrease in downriver flow volume occurs between the Reinhackle to Pumpback Station reach. Augmentation needs in the river reach between Two Culverts and Mazurka Bridge needs further study.

MOU Consultants Adaptive Management Recommendation

The MOU Consultants recommend that flow augmentation, as exampled below, be considered when the Owens Basin Runoff is predicted to be over 100 % of normal: Augmentation would occur at the Alabama Gates until monitoring and observations show that other sites may be more beneficial.

	Peak Without Augmentation	Peak With Augmentation
Intake Station Release	200	200
Blackrock Station Flow	190	190
Goose Station Flow	180	180
Two Culverts Flow	160	160
Mazurka Bridge Flow	125	125
Manzanar Bridge Flow	120	120
Reinhackle Station Flow	116	116
Keeler Station Flow	80	195
Pumpback Station Arrival Flow	78	192

The additional water needed for flow augmentation could come from a shortened SHF duration period, water saved by increasing the present allowable Pumpback Station 50 cfs limitation, and using part of the additional 928 AFY allowable to bypass to the DHA. This would require the MOU parties to move ahead with solving present Pumpback Station limitations or, if forced to continue under present legal and physical limitations, the MOU Parties agreeing over the short term to a 24 day increase in Pumpback Station pumping rates to 75 cfs. Presently the MOU (1997) requires that any water flowing in the river channel during the SHF period that reaches the Pumpback Station above the allowable pump-out (50 cfs) by stipulation will by-pass into the DHA. The DHA does not need additional water at this time.

The MOU Consultants recommend that during their process of recommending the 2013 seasonal habitat flow they consider increasing down-river reach peak flows by modifying flow curve patterns and/or add augmented water at key sites.

11.2.4.River Flow Modeling

Background

The 2011 Adaptive management report River Flow Modeling section summarizes the overall objective of NHC's Flow Model by stating, "Flow modeling will assist in informing if recommendations need to be made on base and seasonal habitat flow changes." The objectives of the modeling effort will offer data that may help answer the following inquiries:

1. Are there base flow options that can increase open water areas necessary to meet habitat goals for indicator species?
2. Are there feasible base flow patterns that will increase water depths needed to limit tule areas, inhibit future growth and maintain needed open water areas?
3. Can seasonal habitat flows be used to improve river temperature, dissolved oxygen concentrations, and other water quality parameters if necessary?
4. Can base and seasonal habitat flows be managed to meet woody riparian habitat development needs?
5. Are there feasible changes in flow duration and magnitude that would make future seasonal habitat flow more effective?
6. Can river flow management be effectively altered under present management of the Pumpback Station's pump out limitations? And if not, what changes in Pumpback output volumes are needed to effectively manage the Lower Owens River?

NHC's modeling task was difficult because the Lower Owens River lacks vertical streambanks, except for the previously "dry reaches", and flows at such a low velocity that the HEC-RAS model used could not produce precise results. The model output did not address flows over 100cfs in the lower river reaches, specifically reaches below the Islands. With that said the previous six questions need to be addressed and answered if possible using NHC's flow model results. The model summarizes per plot the change in depth and flow area with different flows per 5cfs increments. Corresponding river depths for a series of flows (70, 80, 90 and 100cfs) are given per plot. Modeled flows by NHC were analyzed using a simple linear regression. Two linear regressions models per plot were run: 1. flow and depth and 2. flow and flow area. The results presented below are somewhat redundant as they can be found in the model, but are reproduced here for additional background.

Plot 1

Flows in river plot 1 are very predictable thanks to an incised channel with defined streambanks. The flow/depth regression model was significant ($p<0.00005$) with a very high R-square value (0.89), indicating that flow has a significant effect on depth. Every 5cfs increases the depth within the channel roughly 0.12ft. Thus, it would take roughly 40-45 cfs flow increase to raise the water level 1ft in plot 1. Similar to the flow/depth regression model, the flow/flow area model was significant ($p<0.0005$) with a high R-square value (0.78). Every 5cfs increases the flow area approximately 5.24 sqft. According to the NHC study the channel in Plot 1 can handle upwards of 200cfs before flows crest the adjacent streambanks.

Flow (CFS)	Thlawag Depth (FT)	Flow Area (SQFT)

40	2.80	43.42
70	3.54	74.88
80	3.79	85.37
90	4.03	95.86
100	4.28	106.34

Plot 2

Flows in river plot 2 are predictable like plot 1, as the channel configuration of the two reaches is very similar. The plot 2 flow/depth regression model was significant (p<0.00005) with a moderate R-square value (0.52), indicating that flow has an effect on depth but other factors are also important (e.g. groundwater movement). Every 5cfs increases the depth within the Plot 2 channel roughly 0.13ft. Thus it requires roughly 35-40 cfs flow increase to raise the water level 1ft in plot 2. Similar to the flow/depth regression model, the flow/flow area model was significant (p<0.0005) with a moderate R-square value (0.46). Every 5cfs increases the flow area approximately 9.32 sqft. According to the NHC study the channel in Plot 2 can handle upwards of 180cfs before flows crest the adjacent streambanks.

Flow (CFS)	Thlawag Depth (FT)	Flow Area (SQFT)
40	3.35	76.87
70	4.12	132.79
80	4.38	151.43
90	4.64	170.07
100	4.89	188.71

Plot 3

Flows in plot 3 are not as predictable as plot 1 and 2, as the channel configuration of the reach is much different than the previous 2 plots. The plot 3 flow/depth regression model was significant (p<0.0005) with a low-moderate R-square value (0.42), indicating that flow has an effect on depth but other factors are more important. Most likely tule encroachment in the channel is affecting the flow/depth relationship, as the channel in plot 3 has abundant tules. Every flow increase of 5cfs increases the depth within the Plot 3 channel roughly 0.06ft. Thus, it requires roughly 80 – 85cfs increase in flow to raise the water level 1ft. Similar to the flow/depth regression model, the flow/ area model was significant (p<0.0005) with a relatively high R-square value (0.64). Every 5cfs increase in flow increases the flow area approximately 16.4 sq ft. According to the NHC study the channel in Plot 3 can handle upwards of160cfs before flows crest the adjacent streambanks.

Flow (CFS)	Thlawag Depth (FT)	Flow Area (SQFT)
40	3.18	345.42
70	3.54	443.66
80	3.66	476.41
90	3.79	509.15
100	3.90	541.90

Plot 4

Flows in river plot 4 are not predictable. The plot 4 flow/depth regression model was not significant (p>0.05). The R-square value is (0.11), indicating that flow is not a heavy influencing factor on depth within the reach. The NHC model identified a potential flow restriction at the southern end of the reach that was modeled as a weir. Most likely this restriction is heavily influencing depth in the reach. Like plot 3 tule encroachment in the channel is affecting the flow/depth relationship, as the channel in plot 4 has an abundance of tules. Every 5cfs flow increase raises the depth within the Plot 4 channel roughly 0.05ft. Thus, it requires roughly 100cfs flow increase to raise the water level 1ft. Unlike, the flow/depth regression model, the flow/ area model was significant ($p<0.005$) yet with a relatively low R-square value (0.35). Every 5cfs flow increase spreads the flow area approximately 20.2 sq ft. According to the NHC study the channel in Plot 4 can handle only 80cfs before flows crest the adjacent streambanks.

Flow (CFS)	Thlawag Depth (FT)	Flow Area (SQFT)
40	4.06	217.03
70	4.38	337.94
80	4.49	378.24
90	4.60	418.54
100	4.71	458.84

Plot 5

Flows in river plot 5 are more predictable than plot 4. The plot 5 flow/depth regression model was significant ($p>0.05$) with a low R-square value (0.20), indicating that flow has a small impact on depth changes within the reach. Like plot 4 tule encroachment in the channel is affecting the flow/depth relationship, as much of the channel in plot 5 is choked with tules. Every 5cfs flow increase raises the depth within the Plot 5 channel roughly 0.06ft. Thus, it requires roughly a 80 - 85cfs to raise the water level 1ft. The flow/area regression model was significant ($p<0.005$) yet with a moderate R-square value (0.43). Every 5cfs increase spreads the flow area approximately 9.8sq ft. According to the NHC study the channel in Plot 5 can handle 120cfs before flows crest the adjacent streambanks.

Flow (CFS)	Thlawag Depth (FT)	Flow Area (SQFT)
40	2.53	125.46
70	2.91	184.08
80	3.04	203.62
90	3.16	223.92
100	3.29	242.69

The overall objective of the NHC model was to determine "if recommendations need to be made on base and seasonal habitat flow changes." This objective is difficult to attain as the model had some limitations (inability to model flows over 100cfs in the lower reaches) that make basing recommendations solely on the model untenable. Specific questions that need to be answered are:

1. *Are there base flow options that can increase open water areas necessary to meet habitat goals for indicator species?*

   The model evaluated flows up to 100cfs in several parts of the river, some of which are most infested with tules. Below the islands (Plots 4 and 5), the flow/depth relationship, especially over 100cfs is less distinct and thus other methods to create open water may need to be explored.

2. *Are there feasible base flow patterns that will increase water depths needed to limit tule areas, inhibit future growth and maintain needed open water areas?*

   Due to the variability of the Lower Owens Channel it is difficult to determine a feasible, single flow regime that will limit tule growth. In general, variable flow and deeper water provide a condition for influencing tule abundance. Above the Islands thalwags approach 4ft on average with flows greater than 90 cfs. Below the Islands the depth/flow relationship is vague and may require supplemental flow from Alabama Gates or mechanical intervention to provide a sufficient depth to create open water areas.

3. *Can seasonal habitat flows be used to improve river temperature, dissolved oxygen concentrations, and other water quality parameters if necessary?*

    In theory, based on literature, a winter seasonal habitat flow could be used to improve dissolved oxygen and other water quality parameters through the removal of detritus when water temperatures are cooler. The likelihood of causing a fish kill due to the influence caused by mobilization of detritus is lessened during the winter months.

4. *Can base and seasonal habitat flows be managed to meet woody riparian habitat development needs?*

    Probably not at this time, as the current management limitations, specifically Pumpback capacity, restrict options on what is feasible. Achieving a peak flow during the optimum time of year is important. Thus, the goal of the seasonal habitat flow, even in dry years, should be hit the highest peak with the available water at the appropriate time of year.

5. *Are there feasible changes in flow duration and magnitude that would make future seasonal habitat flow more effective?*

    Yes, but magnitude may be the more important point with this question. Achieving the highest magnitude possible even if it is for a very short duration is important to promoting riparian habitat development in the Lower Owens River - if the habitat flow occurs at the proper time of year. Even in a dry year seasonal habitat flows should be high volume short duration, as the high peak and out of channel flow provided by the peak, provides a greater benefit to the river than a lengthened duration low flow seasonal habitat event.

6. *Can river flow management be effectively altered under present management of the Pumpback Station's pump out limitations? And if not, what changes in Pumpback output volumes are needed to effectively manage the Lower Owens River?*

    There are some options available that can be implemented that do not require increasing the capacity of the Pumpback station. Some of these options are presented in the Adaptive Management annual report. For example, performing the seasonal habitat flow at the appropriate time of year and achieving a peak of 200cfs regardless of the flows duration, would not require a change in Pumpback capacity. With that said increasing the capacity of the Pumpback station would allow for higher seasonal habitat flows and give project managers the ability to explore the benefits of higher flows while remaining water neutral.

Overall, managing expectations from the NHC model is important as the model does not address every aspect of river management. The model is a first step towards understanding what can and cannot be achieved in the Lower Owens through flow management actions alone. One thing that must be reiterated is that tules provide important habitat for fish and wildlife. The Lower Owens is a desert river and as such will always contain tules. However, tules have encroached in many places to the extent that open water habitat necessary for some types of recreation is lacking. The model attempted to determine if open water habitat can be improved by increasing depth with base flow and seasonal habitat flow management, but actually demonstrated that due to many physical factors within the river, flow management alone is not the answer.

MOU Consultants Recommendation

The NHC flow model alone does not answer all questions regarding flow management in the Lower Owens River. One important point that the model acknowledged is the river's physical limitations to manage tule stands through high flows alone, especially in the lower reaches below the Islands. The variability of the channel bed in the lower reaches of the river has an impact on tule colonization but its effect is unclear as some deep sections support tules, while shallow areas do not. Therefore, some questions can still be answered from the model and through further investigation into the model output a clearer picture can emerge about the physical conditions causing tule growth, or inhibiting growth, throughout the Lower Owens River. A thorough transect by transect analysis should be undertaken of the model output. The analysis will examine the physical characteristics of each transect (depth, velocity, tule areas, low-flow areas etc.) and how those characteristics affect tules and riparian habitat development. For example, is there a depth threshold in the Lower Owens that excludes tule growth? What relationships can be derived by overlaying land cover data on the transect HEC-RAS data? Do wider channels promote tule growth? Or, why are some shallow areas not infested by tules, and are there common characteristics amongst these shallow areas that inhibit tule growth? A transect by transect analysis would add to our overall understanding of the Lower Owens River channel's physical characteristics and how those physical characteristics effect tules. The result of the analysis could identify to new management techniques to controlling tule growth in the Lower Owens River.

11.2.5.Tule Status and Needs

Background

Despite the many ecosystem services deep water marshes dominated by cattails and tules provide, their aggressive expansion into many aquatic systems has decreased plant diversity and habitat diversity for many wildlife species (See Tule and Cattail Management paper in Appendix A). The expansion of cattail and tule vegetation in the LORP has been documented in the past and has been a subject of discussion since before project implementation. Although many control methods have been attempted over the years, cattails and tules have provided managers with a management challenge. Localized mechanical cutting at the proper time may provide for recreational benefits (boat passage or fishing access). However, mechanical cutting of the LORP area would require large machinery and a high financial cost, as well as associated impacts on non-target vegetation.

Static and highly regulated low water levels can be conducive to growth and expansion of cattails and tules. Changing the hydrograph of the Lower Owens River to a more natural hydrologic regime could bring multiple ecosystem benefits (Appendix A). Operating the river like a canal with a constant flow is unlike the highly variable streams of the Eastern Sierra and Owens Valley. Specifically, altering water depths at key times of year could have benefits.

Recommendation

The MOU Consultants recommend that LADWP, Inyo County and the MOU Consultants conduct a work session to consider actions to manage tules and cattails, including modification of the current flow regime, to increase LORP resources and values.

11.2.6. Delta Habitat Area Flow

Background

The Delta Habitat Area (DHA) goal is to maintain 755 acres of wetland-riparian areas and surface water suitable for shorebirds, waterfowl, and other animals. Diverse natural habitats are required to be created and maintained through flow and land management, to the extent feasible, consistent with the needs of the "habitat indicator species". These habitats are to be as self-sustaining as possible.

The DHA has been mapped 5 times. These five mapping events provide important data that enables managers to document DHA changes through time and provide adaptive management recommendations for future management. The Land Cover data used in this analysis was cross-walked to the 2012 legend and clipped to the 2012 extent. These two steps were necessary for annual comparison as each mapping event had varying legends and extents. Table 1 presents the data from each mapping year.

Table 1. DHA Land Cover Type per Year (acres)

Land Cover	2000	2005	2008	2010	2012
AlkaliMarsh	186	88	285	293	656
AlkaliMeadow	491	585	318	512	421
Barren	N/A	N/A	11	842	601
Dust Control Area	N/A	N/A	N/A	N/A	46
Eolian	1142	1318	1168	1010	1160
EolianSAVE	N/A	N/A	N/A	17	32
Playa	1141	1063	1269	324	150
RiparianForest(TreeWillow)	13	N/A	N/A	3	3
SUMOScrub	N/A	N/A	N/A	4	4
Water	59	4	3	4	14
WetAlkaliMeadow	132	109	111	156	77
	3165	3165	3165	3165	3165

Notes:
2000 Eolian = Dune and Parry Saltbush Scrub

2000 Water = Brine Pool and Water

2005 Eolian = Eolian complex + Rabbitbush Nevada Saltbush

2005 AlkaliMeadow = Saltgrass+Rabbitbrush Nevada Saltgrass Meadow

2008 Eolian = Eolian complex + Rabbitbush Nevada Saltbush

2008 AlkaliMeadow = Saltgrass+Rabbitbrush Nevada Saltgrass Meadow

2008 Barren = Road

Important features to note in Table 1 are the increase in Alkali Marsh throughout the years, as this habitat type is expanding in the DHA and the decrease in Wet Alkali Meadow since LORP implementation in 2006. These two important wetland habitat types are vital to the shorebird and water bird populations in the Delta.

Figure 1, below, demonstrates the changes per year in selected habitat types. Of note is the dramatic change in Alkali Marsh (green bar) between 2010 and 2012. Alkali Marsh experienced an increase of 362 acres in two years. The only other dramatic increase in a wetland habitat type in the delta occurred between 2005 and 2008 when Alkali Marsh expanded 197 acres. The major difference between these two years (2005 and 2008) was the onset of the Lower Owens River Project in December 2006. Flows were established in earnest in 2007, and the DHA began receiving consistent flow that allowed a significant increase in Alkali Marsh. The significant increase between 2010 and 2012 is the largest jump in wetland acreage since the onset of the project. Field verification indicated that some of the 2012 area mapped as Alkali Marsh is Alkali Wet Meadow, which is a wetland type, but with a different species assemblage.

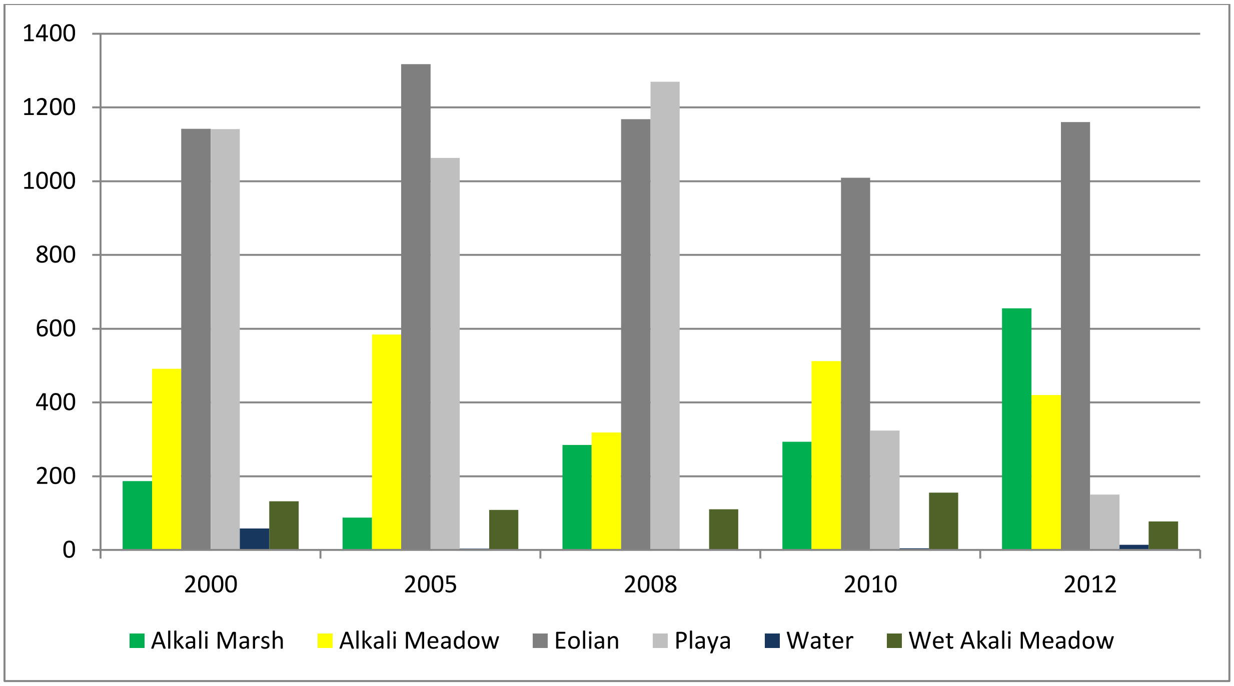

Figure 1. Selected Land Cover Types of the DHA from 2000 to 2012.

Although the DHA has changed through the years the consistent inflow and pulse flows have maintained and enhanced the wetland and riparian habitats of the area. Figure 2 depicts the overall wetland and riparian habitat acreage in the Delta. According to the MOU the project is to maintain and enhance over 755 acres of wetland and riparian habitat. As of 2012, the DHA is roughly 400 acres above that goal.

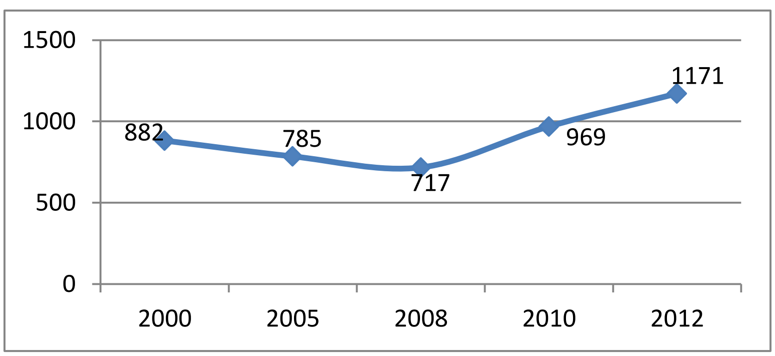

Figure 2. Wetland and Riparian acreage in the DHA over time.

MOU Consultants Recommendation

No major changes need to be made to the overall management of the DHA at this time. Three things to consider which could benefit the overall Lower Owens River are to: 1. implement the base and pulse flow changes requested in 2011 adaptive management recommendation, 2. release DHA flows from the Intake rather than the Pumpback station, 3. increase the capacity of the Pumpback station. The latter recommendation has been made in other parts of this document.

11.2.7. Thibaut Ponds

Present Status

The primary reason for the original Thibaut Ponds (prior to the LORP), was to create open water for wildlife, mainly waterfowl and shorebirds. The Ecosystem Management Plan (2002), the first plan to call for change in pond management, cited the Thibaut Ponds management unit as the highest priority area of the LORP wetland restoration effort. This would be especially true in low water years. Under LORP management the once open surface water habitat has been taken over by emergent vegetation, mainly tules and cattails.

The MOU Consultants, again in their 2010 and 2011 Adaptive Management Report recommended that LADWP complete an analysis of reasonable alternatives to gain back the lost open water. The MOU Consultants spent time in the field and office with LADWP and County staff to discuss management options that would gain the most benefits with a reasonable expenditure of time and money. From these discussions, observations, and consultation with the City and the County, the MOU Consultants have developed a recommendation for the future management of the Thibaut Ponds to meet MOU (1997), EIR (2004) and LORP Management goals.

Past and Present Management

The Thibaut Ponds were successfully developed and maintained by water diverted from the LAA prior to the LORP. No increase in water supply to these ponds, beyond what is already required by the EIR (2004) and the LORP Management Plan, is required. The ponds, under the LORP current management direction, must to be kept full of water year-around. This year-around water requirement was a mistake allowing tule to expand and eliminate most of the valuable surface water habitat.

The EIR (2004) goal for managing the Thibaut Ponds area is to maintain the existing waterfowl habitat area for the establishment of resident and migratory waterfowl populations. The EIR (2004) also states that, “The lake surface areas in off-river lakes and ponds would not increase or decrease and existing shoreline conditions would be maintained under proposed flows”. The EIR (2004) acknowledges that the BRWMA (includes Thibaut Ponds) will not be conducive to promoting suitable habitat for Owens pupfish and Owens tui chub. The primary objective is to create shallow wetland for shorebirds, dabbling ducks, and geese. Both the MOU (1997) and the EIR (2004) call for the Thibaut Ponds to be managed to benefit wildlife. Technical Memorandum 15 called for developing and maintaining conditions to develop a spectrum of fish and wildlife.

The Lower Owens River Ecosystem Management Plan called for the Thibaut Unit to be permanently flooded, unless emergent vegetation begins to fill in the open water areas at which time the Unit would be shifted to a dry phase. The plan called for adaptively managing the wet-dry cycles as the LORP evolves. The plan called for a ratio of open water wetlands to emergent/seasonal wetlands at about 50% each. The EIR (2004) predicted that after the first two flooding seasons, the Thibaut Unit would have 354 acres of open water. Over the long-term the EIR (2004) expected that flooded areas would maintain 177 acres of open water. This did not happen.

Present Conditions

The Thibaut management unit, prior to the LORP, was at one time the most natural wetland in the BRWMA (Ecosystem Management Plan 2002). The area produced the highest bird species richness within the LORP. Water use per unit area was low and the persistence of the winter ponds was high. The original Plan objective called for open water pond areas.

The Thibaut Ponds, under the current LORP water management plan, are now choked with emergent vegetation eliminating most of the surface water. The ponds presently do not contribute 28 surface acres of water because the operating plan did not call for annual “dry out” periods. The LORP EIR (2004) did warn that proposed changes in the Thibaut Unit water timing management would increase the abundance of marsh vegetation and degrade the quality of the ponds for wildlife habitat benefits. This EIR (2004) prediction has come true.

Year-round water delivery caused the present degraded problems. The ponds were just too shallow to control the growth and expansion of tulles with the ponds full of water year-round. Previous successful pond management delivered water during part of the fall, all winter, and part of the spring to provide habitat for migrating and local waterfowl and shorebirds. Thus, the pond area had the opportunity each year to dry out and control the amount of tulles and maintain open water area.

MOU Consultants Recommendation

The MOU Consultants recommend that the present management plan for the Thibaut Ponds be voided and revert back to the original plan and management procedures. The ponds must go through the needed annual "dry-out" periods. LADWP should prepare a new Thibaut Ponds management plan that mimics the original plan. This new plan should be implemented during the fall of 2013 if the on-going rehabilitation has accomplished its goals.

MOU Consultants Reasoning and Follow-Up

Past management of the Thibaut Ponds created and maintained 28 acres of valuable surface water for many years. This management scheme worked and should work again. Thus, once management is reverted back, the ponds will again contribute large benefits to migrating waterfowl, shorebirds, and other wintering wildlife. The Thibaut Ponds are not managed for non-native or native fish so no fishery benefits would be lost under the new recommended management changes. The pond area has recently been burned. LADWP now needs to make sure the "drying out" process has prepared the pond area sufficiently to be ready for the new changes in management.

11.2.8. Rapid Assessment Survey

Background

Revisit Sites
The 2012 Rapid Assessment Survey (RAS) revisited 60 native woody recruitment (willow or cottonwood) sites and 76 salt cedar recruitment sites that were identified in 2011. The 2012 survey found about equal survivorship at both willow recruitment and salt cedar revisit sites; about 71% of both types first detected in 2011 were there in 2012. Not all seedlings persist to establish and grow to mature individuals.

Willow Recruitment
Due to a low snowpack, the 2011-2012 was a low water run-off year and therefore resulted in a smaller seasonal habitat flow event. Therefore fewer sites were available along the river for recruitment during the seasonal habitat flow event than in some past years. Fewer woody recruitment sites were detected in 2012 than some past years. With 69 recorded recruitment sites, 2012 is similar to 2009 (71 sites). After 6 years of RAS data, 2007 (49) and 2010 (31) were lower recruitment years and 2008 (222) and 2011 (144) were higher recruitment years, with 2009 and 2012 falling in between. In 2012, more than ½ of the recruitment was shrub willow. Since the criteria for recording woody recruitment has changed over the years, it is not possible to do a yearly comparison on recruitment counts between years. As would be expected with a low seasonal habitat flow not accessing higher riparian surfaces, the stream bank was the most common recruitment site location in 2012. Few cottonwood recruitment sites have been recorded over recent years, but cottonwood seedlings have been recorded but not reported due to QA/QC protocols (e.g. the seedlings detected were too tall to have been from this year's flow event, and therefore were not recorded).

Saltcedar
Salt cedar remains on ongoing management challenge. Salt cedar is sprouting in treated areas. In 2012, the RAS effort located 163 re-sprout sites. Seedlings are recruiting on the river bank. Controlling salt cedar has posed a challenge to managers all over the west. The LORP is no exception.

Noxious Weeds
Noxious weed invasions continue to be a growing problem. Perennial pepperweed expansion is one of the important management challenges in the LORP. This year's RAS detected 26 new sites. These sites were mostly in the first 3 reaches of the river. The Inyo Mono Agricultural Commission's weed management program continues to treat previously identified populations.

MOU Consultants Recommendation

As stated in the 2011 annual report and adaptive management recommendations, the data and observations made show that some woody recruitment is occurring in the LORP. There is nothing in the 2012 RAS that contradicts this perception. However, if understanding the dynamics and trends in woody recruitment in the LORP is desired, a targeted riparian woody species analysis that pools all available LORP data should be conducted.

Saltcedar control efforts should focus on the riverine-riparian system. Resources are not sufficient to control salt cedar in all areas of the LORP. Efforts made to control salt cedar along the river channel pay a much higher ecological reward than those efforts spent off-river in uplands and spreading basins. Proper control and management of salt cedar will require diligent application of resources. There is an abundant salt cedar seed supply that will not be easily reduced. However, direct cutting of salt cedar along the river provides an opportunity for a native riparian species to establish themselves. The MOU Consultants recommend that the primary focus of the salt cedar control program be on the riverine/riparian corridor above all other areas.

Although the Inyo Mono Agricultural Commission weed management program continues to treat previously identified pepperweed populations and LADWP provides their own control efforts, perennial pepperweed is continuing to spread throughout the LORP. The MOU Consultants recommend that control of this highly invasive species remain a management priority.

11.2.9. Saltcedar Control and Invasive Species Management

Saltcedar

As stated in past year's reports, "The goal of Saltcedar Control Program is to eliminate existing saltcedar stands, to prevent the spread of saltcedar throughout the Lower Owens River and associated wetland environments, and to sustain the ecological restoration that is now occurring in the LORP."

The 2012 effort, aided by a grant from the Wildlife Conservation Board, focused on spreading basins and the North of Mazourka and Homestead 1600-ac ft mitigation sites. Salt cedar along the river was also cut as crews surveyed the river at various points and cut mature plants and pulled seedlings. Altogether, crews cut 45 acres of salt cedar in the spreading basins, cleaned mitigation sites and partially cleaned 89 miles of riverbank.

MOU Consultants Recommendation

It is understood that the purpose for treating the spreading basins was to control the seed source contained in the many mature plants that have established there. However, the number of salt cedar plants establishing and re-sprouting on the river must remain the top priority whenever feasible. The ecological return on the resources expended on the river is higher than any other area. Therefore it is the MOU Consultants recommendation that the river corridor be completely cleared of salt cedar each year as the first priority, and if time and resources are available beyond this effort additional resources may be allocated to other areas.

Perrenial Pepperweed

According to the 2012 LORP Annual Report:

> *Current Inyo and Mono Counties Agricultural Commissioner's Office efforts on LADWP lands focus on the protection of the LORP area during habitat restoration from noxious weed invasion. This is accomplished primarily by efforts to eradicate known weed populations within the LORP area, and also by monitoring the LORP area for pioneer populations. The detection component is critical to the protection of the LORP, as this region is a recovering habitat with many disturbed areas. Disturbed conditions make this area more conducive to weed establishment, as does increasing recreation use.*

This key component of weed control, early detection, is mainly accomplished through the RAS. According to the 2012 RAS report, 26 new pepperweed sites were recorded. The Agriculture Commissioners' office reported only 3 new sites. We understand that this discrepancy is partly due to the method of recording the weed populations (points vs. polygons). However, this is a large discrepancy. Several of the pepperweed sites detected by the RAS were grouped together, but several sites were distributed from the Intake to Blackrock ditch while there was another cluster near Reinhackle. Clearly, proper communication between all participants is essential to maximizing project effectiveness.

Over the course of the LORP project, the weed control efforts have been underfunded. This continues today. Due to funding constraints, it is possible the staff at the Agriculture Commissioner's office will be reduced to one. New populations are establishing and spreading through the LORP, even in the uppermost reaches. It is essential that these sites are quickly located and treated. All sites require multiple treatments and monitoring to effectively achieve control and eradication.

As in prior adaptive management recommendations, the importance of these underfunded efforts must be acknowledged. Not controlling harmful invasive plants would have a ripple effect throughout the ecosystem that can inhibit the attainment of LORP goals.

MOU Consultants Recommendation

The MOU Consultants recommend that managers allocate sufficient funding and resources to properly deal with this important ecosystem threat. If the County Ag. Commission is unable to perform their activities to the extent needed due to funding constraints, LORP managers should provide avenues to maintain pepperweed control efforts.

The MOU Consultants recommend a meeting between Inyo County (to discuss and disseminate RAS data), the Inyo and Mono Counties Agricultural Commissioner's Office (responsible for treatment and tracking of populations) and LADWP (who provide funding, treatment, and tracking) to ensure that data is properly shared and understood and that resources are being efficiently and effectively utilized.

11.2.10. Lone Pine Garbage Dump Clean-up

Background

The Lone Pine sanitary landfill management team is deploying poor housekeeping outside of the sanitation containment boundaries. The Lower Owens River corridor, east of the garbage disposal area, and especially the valley bottom scenic vista area, is marred by large amounts of windblown garbage. The complete eastern border of the disposal facility needs to be patrolled more often and wind delivered garbage cleaned up. Aesthetic and recreational quality called for in the LORP is an important part of project implementation in meeting LORP goals. These resources should not be altered or their value diminished by continuous unsightly conditions.

MOU Consultants Adaptive Management Recommendation

Lone Pine Sanitary landfill personnel patrol the eastern side of their facility to the river border to keep this corridor area clean. This will allow this reach of the Lower Owens River riverine-riparian habitat to better meet the requirements of the LORP.

11.2.11. Monitoring Protocols

As monitoring has progressed since 2008, there has been a growing propensity to make small or seemingly minor changes to the MAMP protocols, or simply not performing all elements of the protocols. This has occurred with the Rapid Assessment Survey, the BWMA surveys; Flood Extent, Quality Assurance/Quality Control (QA/QC) and data management protocols.

The manner in which woody riparian plants are recorded in the RAS protocol has been modified each year; additional indicator species were added to the avian census in the BWMA; QA/QC protocols for the RAS, the BWMA surveys, the Delta and other areas have been dropped; the August 1 deadline for the Flood Extent report is not met; and others. While these changes may have been made to improve the monitoring process and protocols each instance should be documented and codified.

Not all of the modifications cited above have been negative; some have improved a protocol. As described in the MAMP, protocols and methodologies are also subject to adaptive management. Monitoring methods can be modified, terminated or new ones prescribed. However, any changes, additions or deletions, must go through the MOU process. It is not appropriate for an individual to make modifications without soliciting input from ICWD, LADWP, and the MOU Consultants.

MOU Consultants Recommendation

Because the LORP is still early in its monitoring schedule the MOU Consultants recommend that changes or modifications to any protocols be submitted through the adaptive management process for consideration.

According to LADWP and ICWD the LORP data warehouse and common-access to the data as required in protocols has been established at the DWP offices. However, the utilization of this warehouse by anyone is apparently non-existent. This could be due to the fact that interested parties do not know of its existence, or the fact that access can only occur if you go to the DWP offices in person to access the server drives and locate the information. These obstacles may be the reason for a lack of use of the data repository.

ICWD and LADWP should consider the efficacy of the LORP data warehouse in its present state and evaluate its utility. The LORP Data Warehouse design should be reviewed and redesigned to meet contemporary standards, define QA/QC and data management protocols, be based on a spatial/GIS platform, be online and accessible. This would likely increase the access of information by outside parties, and, most importantly, lead to better-informed stakeholders about the LORP and its conditions.

11.2.12. Workshop for Discussing Present and Future River Conditions

Background

The Lower Owens River has been receiving increased flow since December 2006 and annual seasonal habitat flows since February 2008. Over time habitat has developed, the fishery increased, LORP indicator species numbers have increased and livestock grazing has continued. Although several years of monitoring and adaptive management have occurred discussions of what the river has and is to become have not adequately taken place. Discussions will allow each entity to understand each other’s position and hopefully lead to a better understanding of what the river should become.

MOU Consultants Adaptive Management Recommendation

The MOU Consultants recommend, during April 2013, that the County, City and MOU Consultants meet and discuss river condition expectations. This discussion would follow the direction and guidance from the MOU (1997) the EIR (2004) and the LORP Management Plan.

11.2.13. MOU (1997) Needed Changes via Stipulation and Order

Problem

The MOU Consultants recommended several changes in base and seasonal habitat flow management over the past few years. Proper recommendations have been hampered by mandates in the MOU (1997) and following stipulations and orders that stand in the way of good river management. A prime example is the 50cfs Pumpback Station pump out limitation that provides a road-block to feasible flow changes the river now needs.

MOU Consultants Recommendations

The MOU consultants recommend that the MOU parties get their act together and modify these items in the MOU (1997) that are hindering river management prior to the April deadline for recommending and setting of the 2013 seasonal habitat flows. If the MOU parties continue to be ineffective in this process then the MOU consultants will provide a “strawman” solution for the MOU parties to consider.

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11.4. Actions Taken on Adaptive Management Recommendations from 2011

11.4.1. River Flow Modeling

The flow model was completed in 2012. Results were included in the 2012 LORP Report.

11.4.2. Seasonal Habitat Flow Magnitude, Duration and Timing

Until modifications to the LORP pumpstation capacity limits have been made that make these recommendations water neutral, LADWP approve implementation of recommendations that inefficiently use water in a wasteful manner.

11.4.3. Seasonal Habitat Flow Augmentation

Until modifications to the LORP pumpstation have been made that make these recommendations water neutral, LADWP cannot implement them.
Until modifications to the LORP pumpstation capacity limits have been made that make these recommendations water neutral, LADWP approve implementation of recommendations that inefficiently use water in a wasteful manner.

11.4.4. Base Flow Augmentation

Until modifications to the LORP pumpstation capacity limits have been made that make these recommendations water neutral, LADWP approve implementation of recommendations that inefficiently use water in a wasteful manner.

11.4.5. Delta Habitat Area Flow

Until modifications to the LORP pumpstation capacity limits have been made that make these recommendations water neutral, LADWP approve implementation of recommendations that inefficiently use water in a wasteful manner.

11.4.6. Rapid Assessment Survey

These recommendations have been implemented.

11.4.7. Bassia Control

LADWP staff believe that natural successional process will result in the eventual replacement of Bassia.

11.4.8. Saltcedar Control

The saltcedar program has set as one of its ongoing priorities treatment of saltcedar along the river channel.

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11.4.9. Beaver Control

This adaptive management recommendation is being implemented.

11.4.10. Range Belt Transect Monitoring

This adaptive management recommendation is being implemented.

11.4.11. Range Trend Methodology and Timing

This adaptive management recommendation is being implemented.

11.4.12. Monitoring Protocols

These adaptive management recommendations are being implemented.

11.4.13. Blackrock Waterfowl Management Area

These adaptive management recommendations are being implemented.

11.4.14. Blackrock Ditch Maintenance

This adaptive management recommendation is being implemented.

11.4.15. Water Quality

This adaptive management recommendation was implemented.

11.4.16. Thibaut Pond Rehabilitation Progress

This adaptive management recommendation is being implemented.

11.4.17. Annual Report Scheduling

Due to the timing of LADWP's budgeting process this change cannot be implemented.

11.4.18. MOU Changes via Stipulation and Order

Inyo and LADWP continue to work with the MOU Parties to change the capacity of the LORP Pumpstation.

11.5. Thibaut Pond Adaptive Management Recommendation

This is regarding the current Thibaut Pond area (28 acres) within the Thibaut Management Unit of the Blackrock Waterfowl Management Area (BWMA). It is not intended to change or discuss the current management strategy for the overall Thibaut unit when this unit is in a wet cycle as part of the BWMA.

Prior to the LORP, “Thibaut Pond” and the surrounding area was very attractive to waterfowl and shorebirds as precipitation from winter storms filled the alkali playas creating seasonal wetlands that attracted fall and spring migrants and provided winter habitat for geese and ducks. The habitat of the Thibaut Pond area and the Thibaut unit was precipitation-dependent and would shrink and swell depending on the water year. The old maps referred to this as the Tulare swamp. If you look at historical USGS maps there was never a permanent pond in this area and the maps indicated the presence of intermittent alkali playa formations (slicks) that would fill with precipitation. The area was very popular with waterfowl hunting enthusiasts.

With the onset of the LORP, Thibaut Pond (or Thibaut Ponds depending on who you talk to), was designated as an Off-River Lake and Pond component of the LORP. As such, it had to be defined as an area with a concurrent water allotment to maintain pond acreage all year. This is where the current 28 acres of pond maintenance applies to today’s management strategy. It is not designated as a fishery; rather the management is geared towards waterfowl and shorebirds. In retrospect “Thibaut Pond” should not have been designated as an Off River Pond and should have been incorporated into the overall Thibaut management unit of the BWMA.

Because current management of the pond is to maintain a perennial, shallow pond at a constant level (without periodic drying) a homogenous stand of tules has developed that is of little value to either shorebirds or waterfowl as there is no open water available. In order to return the site to its pre-LORP conditions, and achieve the desired habitat benefits, the pre-LORP management approach needs to be reinitiated. This approach consisted of flooding the pond in the late fall through the winter, and allowing the pond to dry during the summer months.

Beginning October 1, each year, the Thibaut East Spillgate will be opened to allow 1 cfs to flow to the Thibaut Pond. The flow will be turned off March 15. This release schedule is designed to avoid water releases during the growing season, thus prevent the situation that led to undesirable habitat conditions. Water releases to the Thibaut Pond during this time period will provide foraging areas for late fall migrant, early spring migrant and wintering waterfowl, shorebirds and wading birds.

11.6. **Appendices**

2012

Ecosystem Sciences

[ADDITIONAL INFORMATION ON TULES AND CATTAILS AS THEY RELATE TO THE LORP]

Research on managing tule and cattail vegetation indicates that water depth is the strongest driver of where they grow. However, there are several other factors, including water nutrient concentrations, hydroperiod, and site and landscape configuration that can determine species distribution. Effective management efforts must include multiple actions including hydrologic modification. Marsh vegetation (tules and cattails) provide multiple ecosystem functions. Although reducing tules to achieve more open water habitat may be desirable, critical functions provided by tules may need to be protected in the process.

Introduction

Marsh vegetation in the Lower Owens River is made up predominantly of cattails (*Typha latifolia* and *T. domingensis*) and common tule or bulrush (*Schoenoplectus acutus*). Cattails are the most common large emergent wetland plant in the Lower Owens. Tules are are also found throughout the LORP. Cattails are flat leaved with the large familiar hairy spike near the top of the plant (Figure 1); common tules are round stemmed with several smaller spikelets emerging from a point near the top of a round bluish-green stem (Figure 2). In the Owens Valley, these three species together are commonly termed "tules."

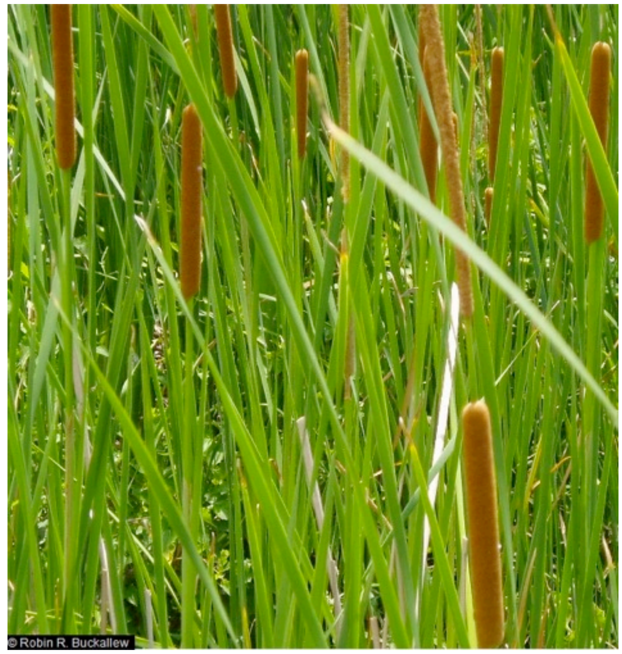

Figure 1. *Typha domingensis*. Photo credit: Robin R. Buckallew @ USDA-NRCS PLANTS Database

Common tule, or hardstem bulrush, has little information available on its control. One paper on controlling tules in the Lower Owens (Groeneveld 1994) is focused on controlling tules and cattails in channel with a combination of velocity and depth. Because the channel is relatively flat, stream flows in the Lower Owens River rarely approach velocities that will control tules. However depths in some of the river reaches are adequate to limit tule growth and maintain a mostly open, although narrow channel. Other areas are completely occluded and have no open channel.

Cattails and rush dominate many of the wetland areas in the Lower Owens. Cattails have been viewed as plants that need to be controlled in the mid-west, western, and southern states for a number of decades. Most of the research on controlling marsh vegetation that exists is focused on the *Typha* genus.

Marsh Species

There are three species of cattail in North America. They all hybridize:

Typha latifoila – common cattail or broad leaf cattail occurs in the LORP area. Abundance is higher in the upper reaches of the LORP and upstream of the Intake.

T. domingensis – southern cattail or tall cattail is the most common marsh vegetation species that occurs in the LORP. It is a species of warm temperate and tropical distribution. Studies have shown that

T. domingensis is outcompeted in shallow conditions by *T. latifolia*, but southern cattail excels in deepwater habitats (Grace 1989). It also occupies lower elevations and warmer habitats. Several attempts to control this species have been made in Florida, Costa Rica, and other areas.

T. angustifoia – Narrow leaf cattail is likely a hybrid of the native and European species which hybridized and are now indistinguishable from each other. They need genetic studies to determine the relation to the European species (Kantrud 2006). This species is the target of several studies, and although exact depths needed to control this species may not be known, the general life history is similar to *T. latifolia* and *T. domingensis*. The hybrid between narrow leaf (TYAN) and common (TYLA) is referred to as *T. Glauca*.

Schoenoplectus (formerly *Scirpus*) *acutus*– common tule or bulrush. Although several other species within this genus appear in the wetland habitats of the LORP, this is the only species of tall emergent vegetation that occupies close to the same niche as the cattail species.

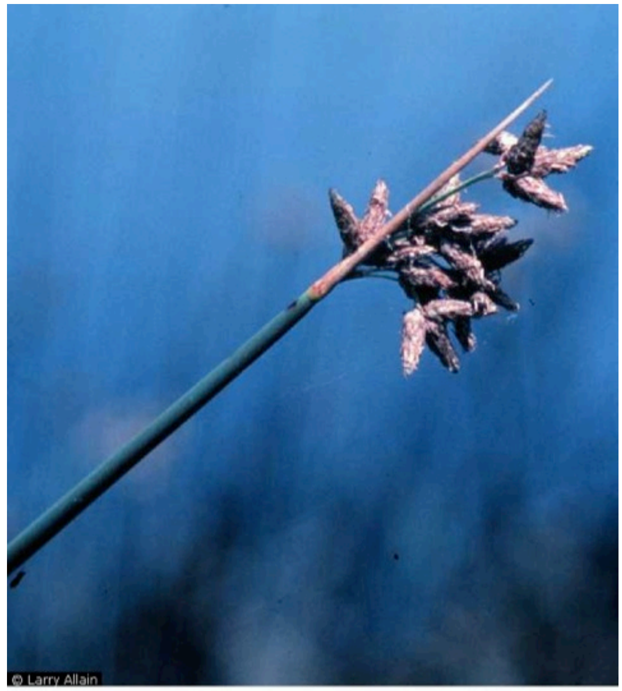

Figure 2. *Scoenoplectus acutus*. Photo credit: Larry Allain @ USDA-NRCS PLANTS Database

Benefits of Cattails and Tules

Cattails and tules provide many important ecological functions. They provide excellent habitat value for many species of wildlife. They provide habitat for large game (e.g. elk), many species of birds including wrens, rails, bitterns, and especially blackbirds, to name a few. Emergent marsh vegetation also provides numerous aquatic species with habitat, including young-of-the-year fish, smaller non-game fish, large game fish, and crustaceans. They provide habitat for the food supply base for many fish, as the insect and crustacean production in these habitats is high.

Tules and cattails also improve water quality by trapping sediments and nutrient uptake. However, they can also degrade water quality by adding large amounts of organic material that may later be mobilized into the system. They have been used to treat contaminated water in many cases, from both organic and heavy metal sources. Tules can have both a positive and negative effect on water quality. Prolific tule growth and consequential die-off, could have an ongoing and deleterious effect on dissolved oxygen, BOD and sediment transport and deposition.

Excessive tule and cattail biomass can be a disadvantage in the development of a flowing and functioning river, but tules can also provide many ecological benefits. Tule growth in the Lower Owens

River provides bank and channel stability, reduces erosion and adds shade and nutrients. High density tule stands are essential habitat for many bird and animal species and provide winter habitat for waterfowl and shorebirds. Dense vegetation stands also provide valuable refuge and early rearing habitat for both native and introduced fish species. Stands of emergent vegetation also filter sediments from stream flow which improves water quality; tules remove nutrients, organics and suspended solids, and can modify low winter and high summer temperatures.

Tules and Fisheries Values

Many studies have shown the importance of aquatic vegetation in providing food and refuge for the juveniles of a number of fish species (e.g., Savino and Stein 1982; Keast 1984; Rozas and Odum 1988; Schramm and Jirka 1989). Human activities that reduce or eliminate aquatic vegetation such as dredging, herbicide application, or mechanical removal, could have severe impacts on the survival of juvenile fishes and thus on their recruitment to adult populations (Hayse and Wissing 1996). Laboratory studies have demonstrated that juvenile bluegills *(Lepomis macrochirus)* are highly vulnerable to predation by largemouth bass *(Micropterus salmoides)* when the stand density of vegetation falls below certain levels (Savino and Stein 1982; Gotceitas and Colgan 1987). These studies also indicate that juvenile bass species discriminate among densities of vegetation and select vegetation densities that are high enough to reduce predation risk (Gotceitas and Colgan 1987).

In addition to reducing predation risk, increases in vegetation density can also decrease the rate at which juvenile bass catch invertebrate prey (Savino et al. 1992). Thus, the selection among densities of vegetation by juvenile bass could depend upon a number of factors, especially the availability of invertebrate prey and the risk of predation in each of the vegetation densities available. Because other studies have suggested that predation risk and food availability may affect the density of artificial vegetation selected by juvenile fish, Hayse and Wissing (1996) conducted experiments to measure how growth rates of age-0 bluegills and predation by largemouth bass were affected by stem density. They found predation rates were significantly lower in medium and high stem densities than in low and zero densities; high-density vegetation offered significantly greater protection than medium density vegetation stands (Hayse and Wissing 1996).

Photo 1. Owens tui chub and other small fish seeking refuge in tule stands (photo: Ecosystem Sciences)

Tules, Cattails and Wildlife Habitat

One of the values of cattail and bulrush to wildlife is the tall robust structure that provides important horizontal and vertical cover. They also provide structural habitat diversity, and micro-sites for other smaller emergent and aquatic plants. Structure provides cover for nesting, protection from predators, habitat for broods, and attachment of nests, and protection from inclement weather (Fredrickson and Laubhan 1994).

Winter resting cover for mallards (*Anas platyrhynchos*) consists of permanent marshes that contain at least 5-15% persistent emergent or woody vegetation (U.S. Fish and Wildlife Service 1986a). Mallard broods use wetlands that have sparse to dense emergent vegetation; wetlands devoid of either emergent vegetation or open water are usually avoided (Berg 1956; Godin and Joyner 1981; Talent et al. 1982; Rumble and Flake 1983). According to the U.S. Fish and Wildlife Service (1986b) habitat value is highest when a minimum of 25% of the wetland has emergent vegetation present (including along the shoreline). Canada geese nest in a variety of sites that include dense marshes, islands, cliffs, elevated platforms in marshes, tundra, mats of bulrush, tops of muskrat houses, tops of haystacks and abandoned heron and osprey nests in trees (Bellrose 1978).

Many species of amphibians, reptiles, mammals and birds directly and indirectly benefit from cattails, bulrush and other emergent vegetation (Zeiner et al. 1988; Zeiner et al. 1990a; Zeiner et al. 1990b). The value of emergent vegetation is related to a complex of factors that include: the plant species composition and species richness; stem density or cover; size and configuration of the vegetation type; vegetation height; relative amount of open water; and surrounding vegetation types. To most species of wildlife the value of cattail and other emergent vegetation decreases in extensive and dense monotypic stands; waterbird and other wildlife species richness and abundance may decrease in these decadent conditions.

Why Control Cattails and Tules

Biologists and managers recognize that a riverine environment consisting of 100% emergent marsh vegetation is not a desired condition in the LORP. Monotypic stands reduce overall habitat value (Sojda and Solberg 1993). Many waterfowl and other birds require a matrix of open water and emergent marsh habitats. Recreation can also be inhibited by excessive growth of marsh vegetation, limiting access from the shoreline and occluding areas that might be desirable floating or boating routes. Water loss through transpiration is another reason to control tules and cattails, as water used by the vegetation is not available for other beneficial uses.

Existing and Desired Conditions in the LORP

The landscape scale vegetation mapping performed on the LORP in 2010 identified 1,085 acres of the marsh cover type (cattail and tule dominated habitats) and 263 acres of the open water cover type (LADWP 2010).

The goal of tule and cattail management in the LORP should not be to eliminate them from the system. They are an important part of the ecosystem. Many researches and managers have identified a 50/50 ratio of open water to vegetation as a management goal. Such areas are often termed hemi-marsh and are considered optimal for warmwater fish and most breeding birds, including most waterfowl, American coots and yellow headed blackbirds, among others.

General Information and Life History

Cattails and tules reproduce by two methods: seed germination and clonal sprouting from rhizomatous root structures. Cattail seeds do not germinate in more than 0.5 inches of water, therefore the growth of cattail in deeper water is expansion from existing plants. Natural shading reduces germination rates. In the LORP, cattails and tules are well established in large stands, and there are few open sites for remaining for germination. For management of these emergent marsh plants to be effective, it is the clonal reproduction that must be understood and managed.

The cattail rhizomes support the plant, stores carbohydrates and allows the plant to reproduce asexually. Treatments must be focused on affecting the rhizomes to be effective. The rhizomes begin to elongate in early summer, and annual growth can be 2 feet or more under beneficial conditions. The next year's stems (the vertical leaves we think of as the plant) begin as shoots in mid-summer. In late winter and early spring, these will begin to grow more rapidly and eventually will become the marsh vegetation we know.

A key structure to controlling cattails and tules is the aerenchyma. The aerenchyma is a structure that provides air passage to the rhizomes from the plant's above water leaves. It can function in dead material as well as in live material, as long as the stems penetrate the water surface. Interrupting the function of the aerenchyma is the key to effective non-chemical means of controlling cattails and other emergent marsh vegetation (Sojda and Solberg 1993).

Management actions to cattails must be timed with the cycle of carbohydrate storage to be effective. During the early spring, the shoots receive their energy for growth from starches stored in the rhizomes. When the rhizomes have access to oxygen (e.g. through the aerenchyma, or when the marsh is dry) the conversion of starches is aerobic, and the growth is fastest. If the rhizome is flooded, the plant must have sufficient energy to penetrate the water surface, or the plant dies. This energy must be accessed by anaerobic means, which is a less efficient process. Eventually, cattails and tules need the above ground stems to deliver oxygen to the roots. However, they are very tough and well adapted to anoxic conditions, so control methods need to be well timed to be effective.

Control Methods

Cattail control often occurs in wildlife management areas to increase wildlife habitat or on canals or other waterways to increase water efficiency and access. Generally, control methods for marsh vegetation are not used in natural areas or preserves. They are a natural part of systems that have habitat and ecosystem value. Care in control is warranted when entering control programs.

In general, a method of cattail control is judged to be effective by managers if it maintains the stature of live and dead cattails stems below water level for a period of 1-3 years. Some researchers and managers have seen control methods last as long as 5-7 years. Long term modification of land and water resources provides more long term success.

No single control method is likely to achieve what stakeholders view as "success" in managing marsh vegetation in the LORP. The best management solution is likely a combination of methods that achieve synergistic effects when implemented in a thoughtfully applied program.

Chemical Control

Glyphosphate (Rodeo) has been shown to be successful at cattail control (Solberg and Higgins 2006). The problem with gyphosphate is that it is a non-discriminatory killer of plants, therefore it would need to be carefully applied. It has been applied with no effect on invertebrate abundance. Depending on the level of herbicide, control lasts 1-2 years. Dalpan, Amitrol and several other herbicides have been used to a limited extent (Timmons et al. 1958). RodeoR, an aquatic version of Rodeo, was shown to be an effective control agent for cattails in North Dakota for only one year at lower application levels, but for 2 years or more at higher levels (Linz et al. 2006).

The USDA began a cattail management program in 1989 to reduce sunflower damage caused by blackbirds in the mid-west. By applying glyphosphate by helicopter in July, they have been able to successfully create open water in tule patches. They found that treatments can last for up to 4 years if water levels are kept more than 1 foot deep (Homan et al. 2001).

Physical Control

Hand or physical pulling results in good control of emergent vegetation. Managers have experienced up to 100% cattail control in some situations when pulled at the right time of year. Pulling plants is very labor intensive and can be impractical in many areas. Clipping is also a commonly used control method that has been effectively employed when coupled with managed water regimes. Managers and researchers have utilized several different approaches to timing of the treatments with various results. The goal of any trimming to cutting treatment is to reduce the vigor or actually kill the plant by decreasing its stores of energy, reduce its access to oxygen through the aerenchyma, and forcing it to utilize more energy to grow its leaves above the water surface to access oxygen and begin photosynthesis.

Successful control has been achieved when the plants were cut twice in late summer/early fall. Then clippings were submerged to at least 3 inch depths for a prolonged period. Clipping too early in the spring can bring an increase in tules (cuttings stimulate more growth). Researchers have reported that it is preferable to cut in the fall, and then submerge the clippings through spring. (Nelson and Dietz 1966, Apfelbaum 1985). The stems and material need to be removed.

In Utah and Montana, cutting shoots below the water line surface 2-3 times before they flower reduced cattail production 90-95% (Stodola 1967). Research from the 1950's showed that cutting the cattail below the water line twice a year, first in early flowering stage and second 4 to 6 weeks later usually kills all or most cattail (Martin 1953, Timmons 1952). In the Palo Verde Marsh, in Palo Verde National Park in Costa Rica, the systematic application of a tractor-based control technique termed "fangueo" to control *T. domingensis* had resulted in increases in open water, avian diversity and plant diversity (Osland et al. 2011).

Fire

Prescribed fire has been found to not control cattails well. It only lasts one season, and they come back vigorously. It may be successfully employed if the timing of the burn is coupled with water regime management that floods the burnt stems for a prolonged period.

Shading

Artificial shading techniques are difficult to implement. In the long term, shading by mature trees will inhibit germination of marsh vegetation on bare substrates.

Nutrients

Research has suggested that *T. domingensis* expansion is tied to the interplay between P (phosphorous) and hydroperiod (King et al. 2004). Using simple correlations, Craft and Richardson (1997) showed that *Typha* was most strongly related to soil P concentrations. Similar results were found in the Everglades, where *T. domingensis* has been expanding into many habitats traditionally occupied by *Cladium* *jamaicense* communities. Researchers in the Everglades had noted that *T. domingensis* had expanded near canals and outlets from canals. Newman et al. (1996) set up an experiment to test the competition between *T. domingensis* and native communities, based on hydroperiod and nutrient concentrations (Figure 5). Their results revealed that *T. domingensis* flourished in areas with high P concentrations and modified water regimes (especially increased and prolonged water depth). They attributed the success of *T. domingensis* under those conditions to the *T. domingensis* life history characteristics that include rapid growth rates, high tissue concentrations of P, tall leaves, and a greater response to contrasting environmental conditions. Their controlled experiment results correlated with field observations, which showed an expansion of *T. domingensis* at higher densities near soil P inputs (e.g. near canal headgates) (Rutchey and Vilchek 1994).

Similar patterns have been observed by other researchers. Both *Typha* and *Schoenoplectu*s (cattail and true tule) responded with increased growth and vigor to N (nitrogen) and P treatments, especially *Typha,* in another controlled wetland experiment (Svengsouk and Mitsch 2001). In a model built to explain riverine marsh vegetation based on fertility and disturbance gradients, ordination of vegetation data indicated two major axis on which the vegetation composition depended: (1) standing crop and litter gradient and (2) a water depth gradient (Day et al. 1988). In the Everglades, Newman et al. (1996) suggest that restoration actions to control *T. domingensis* should include a reduction of nutrient inputs from agriculture runoff and the restoration of a more natural hydroperiod.

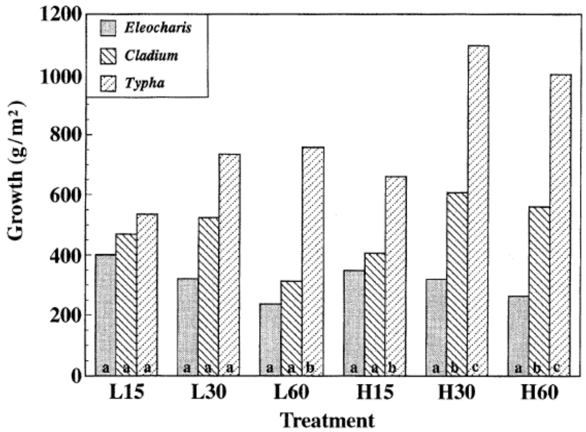

FIG. 4. Growth of plant mixtures grown in outdoor tanks for 2 yr (final − initial biomass). Different symbols within the same treatment demonstrate significant differences at α = 0.05. Treatments are defined in Table 2.

TABLE 2. Experimental treatments applied to plant mixtures grown in outdoor tanks for 2 yr.

Treatment	Water depth (cm)	Concentrations following nutrient adjustment P (μg/L)	Concentrations following nutrient adjustment NO_3 (μg/L)
L15	15†	50	10
L30	30	50	10
L60	60	50	10
H15	15	100	1000
H30	30	100	1000
H60	60	100	1000

† The water depths were maintained from May through November. All tanks had a 5 cm water depth throughout the dry season.

Figure 5. Figure 4 and Table 2 from Newman et al 1996 showing the response of Typha to increased nutrients and water depth.

Water Level Manipulation

Like all plant species, each species of emergent marsh vegetation has a range of environmental conditions between which they may survive (their niche). The strongest environmental gradient that drives the distribution of marsh vegetation is water depth. Marsh vegetation will proliferate and form dense stands at their ideal water depths, and become less vigorous and have decreased density at depths further away from these ideal conditions (at the edge of their niche space). Water depth manipulation is generally thought of as the most cost effective and efficient method if you have good control over water levels.

The depth of water required to kill an emergent plant depends partially on temperatures, the amount of energy stored from the previous year, and the vigor of the plant (Sojda and Solberg 1993). Any shoot that gets above the water level will start pumping oxygen to the root ball through the aerenchyma and increase plant vigor. High water levels for prolonged periods continually stress marsh plants, which may help in the next year's control efforts (due to less stored energy). By inundating the leaves of emergent vegetation, the rate of oxygen uptake is reduced, and this can result in inadequate oxygen delivery to the roots and rhizomes and the eventual death of the below ground structures (Sale and Wetzel 1983, Ball 1990, McKee et al. 1989). Numerous experimental studies have demonstrated that increased water depth negatively affects the growth of emergent vegetation in a number of ways, and will eventually kill them (Lieffers and Shay 1981, Stevenson and Lee 1987, Pip and Stepaniuk 1988, Grace 1989, Waters and Shay 1990, Squires and van der Valk 1992).

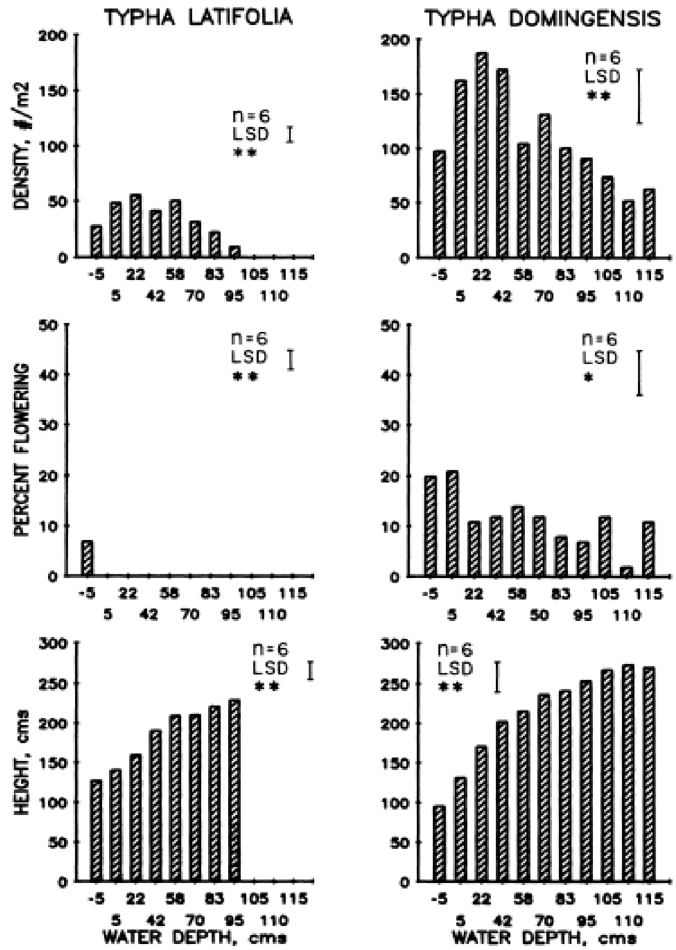

Fig. 2. Changes in shoot density, incidence of flowering, and maximum plant height as a function of water depth for September 1985. Water depths ranged from −5 (5 cm above the water) to 115 cm. The data for density, the incidence of flowering, and the height of plants came from measurements of all shoots in each of the six replicate water-depth gradients. Indicated on each figure is the sample size (number of replicate gradients), a vertical bar showing the Least Significant Difference (LSD) calculated for each parameter-species combination. The results of linear regression analyses for each trait and each species are indicated as follows: * = significant relationship at $P < 0.05$, ** = significant relationship at $P < 0.01$, and ns = no significant relationship.

Figure 3. Density, Percent Flowering and Height of two *Typha* Species in response to increased Depths. (from Grace 1989).

There is no rule as to what depth will achieve control of cattails and tules. Each of the emergent marsh species responds in the same general way to changing environmental conditions, but with different tolerances and parameters. *T. latifolia* is less resistant to deep water then *T. domingensis*. However, the deeper the water, the more stress you put on both species. *T. latifolia* grows better at higher elevations than *T. domingensis*, which flourishes better at lower elevations. *T. latifolia* outcompetes *T. domingensis* in shallow water, while *T. domingensis* excels in deeper water (Grace 1985).

There are several studies that have been performed that can provide information as to the effectiveness of various depths on various species. In a controlled flooding experiment in Manitoba, *Typha* coverage in wetland cells decreased from 22.7% to 9.2% after one year of flooding (+ 1 m depth) and 8.7% after the second year of flooding. However, three cells actually increased their cover of *Typha* in the second year of flooding, indicating the ability of *Typha spp*. to adapt well to water depth, when held static for a period of time. However, after the second year of flooding, 81% of the area originally covered by Typha was open water (van der Valk 1994). In another manipulated experiment, *T. latifolia* grew best in shallow water, but exhibited little growth in water > 1 m deep. *T. domingensis* had peek shoot growth between 0.8 m and 0.9 m of water depth (Grace 1985).

In another manipulated experiment, *T. latifolia* died off almost completely at depths >95cm (37in). *T. domingensis'* depth limit was not reached; its density declined, but it still grew at 115cm (45in). It

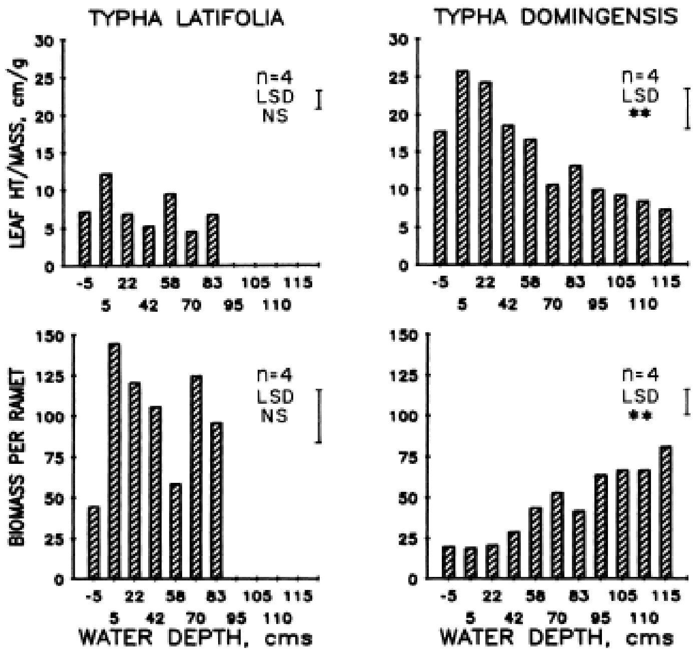

Fig. 3. Leaf height per unit leaf mass and biomass per ramet obtained from harvested plants. Notation is as described in Fig. 2.

Figure 4. Leaf Height/Mass and Biomass per Ramet of Two *Typha* Species in Response to Increased Depths. (from Grace 1989).

responds to deeper depths by growing taller. However, in deeper water, fewer flowers were produced and the stem and leaf density declined. Deeper water stresses both species, but *T. domingensis* is more tolerant. Deeper water reduced *T. domingensis'* density, leaf mass, and percent flowering, while increasing its height and biomass per ramet (Grace 1989 – Figures 3 and 4). However, this research has clearly shown that *T. domingensis* is capable of growing for sustained periods of time at inundation depths >1.2 m (Grace 1987, 1988, 1989). However, this work indicates that deep water will stress the *T. domingensis* and control it to some extent.

In a *T. latifolia* marsh, inundation to 26 inch depth showed a decline in cattail coverage and vigor, but it took two 2 years to see the effects. *T. latifolia* is more susceptible to flooding than *T. domingensis* or *T. angustifoia*, which require above 47 inches (Steenis et al. 1958). Solberg and Higgins (1993) recommend flooding 3-4 feet over the tops of the stems in the spring.

The most common effect of prolonged inundation (one year or more) is the elimination of emergent vegetation (Wallsten and Forsgren 1989). Prolonged inundation can also result in the migration of emergent species, through germination or clonal reproduction to more upslope habitats (van der Valk and Davis 1976). Therefore, prolonged inundation will likely result in marsh vegetation extirpation, migration, or both.

Many researchers have found that not only water depth affects tule and cattail growth, but the hydroperiod as well. In an examination of multiple factors along several environmental gradients in the Everglades, *T. domingensis* abundance was negatively correlated with the ordination vector for water depth (short term inundation) and interquartile range of depth (King et al. 2004). Several researchers have asserted that hydroperiod played a significant role in the expansion of *Typha* species in the Everglades, but feel that *Typha* is highly competitive in deeper, more stable water conditions, and intolerant of drought (Toth 1988, Urban et al. 1993, Newman et al. 1996). King et al. (2004) data support the hypothesis that more stable hydroperiods are conducive to the spread of *T. domingensis*.

Newman et al. (1996) found that increased water depth favored *T. domingensis* over other native aquatic plants in the everglades. However, in that case, the water depths were increased from well below a meter to near a meter, and those changes were coupled with hydroperiod changes that the authors assert contributed to the expansion of *T. domingensis* in that system. Their results are supported by other research that has shown that *Typha* populations are associated with canals and inflow structures (Richardson et al. 1990, Davis 1994 and Jensen et al. 1995).

Drawdowns in summer enhance cattail densities by stimulating germination (Sojda and Solberg 1993). In controlled systems, mimicking the natural hydroperiod, to the extent to which it is possible, is a method to control cattail and tule growth and expansion.

Cutting or burning *Typha* shoots and litter and flooding the stubble so that it remains underwater has been used as an effective management tool to kill or open *Typha* stands (Ball 1990). In a cattail control experiment in Manitoba, both mowing and burning, followed by flooding killed cattail equally well in deeply flooded habitats. However, in shallowly flooded areas, cutting was superior to burning (Ball 1990). Germination was non-existent in treatment areas, even where *Typha* revegetated after treatment.

In a long term study of a marsh system, Seabloom et al. (2001) assessed several parameters and models to predict the establishment of plants along a fluctuating water-depth gradient. Their simplest model, the niche model, used water depth as the sole predictor of the distribution of four plant species of interest within the wetland marsh complex. They used a series of logistic regressions developed by de Swart et al. (1994). Their more complicated models, termed 'spatially explicit models' incorporated life history characteristics (e.g. rhizomatus dispersal, mortality functions, life span, seed bank density) and site history and landscape configuration. They examined the relative importance of (1) current water:depth gradient, (2) landscape geometry (i.e. spatial relationships between suitable habitat), (3) colonization from refugial stands of adults, (4) composition of seed bank, (5) spatial patterning of the seed bank, and (6) differential germination responses to water depth. The research indicated that the more data-rich models were more accurate following flooding and drawdown periods (i.e. periods of change) and the niche model was nearly equally accurate when conditions were stable (following 3 years of stable water conditions). *Typha spp.* and *Schoenoplectus acutus,* declined during the flooding and drawdown periods, and then increased during the stable flooded conditions (Seabloom et al. 2001). This research reinforces the hypothesis that cattails and tules are better adapted to a steady hydrologic regime than to fluctuating water levels (e.g. a natural hydrologic regime).

Constraints on species' ability to colonize suitable habitat created several year's lag-period during which species distributions were more strongly related to historical recruitment events than to the current environmental gradient (Seabloom et al. 2001). Meaning that when mangers enact a management change, the reorganization of species and communities is due to a complex interaction of life history, site specific parameters, site history, and environmental conditions. But, as conditions remain stable, the environmental gradients begin to determine the species composition more strongly; eventually, the communities studied by Seabloom et al. (2001) began to converge on their original distributions relative to water-depth gradient following their flooding/drawdown treatment (predicable using the niche model). The rate at which the original coenocline was reestablished was higher when water levels were increased than when they were decreased, meaning that managers can expect tules and cattails to reestablish in relation to water depth more quickly following a flooding event than a draw-down or drought event. Overall, Seabloom et al. (2001) research found that the following environmental conditions incrementally control marsh vegetation reestablishment following an environmental change: (1) landscape geometry, (2) spatial arrangement of refugia adult stands, (3) the presence of ruderal species in seed bank, (4) the distribution of seed densities in the seed bank, and (5) differential germination and seedling survivorship. However, under stable conditions the strength of the water depth gradient will eventually control species distributions.

Although the niche models described above utilize the strongest drivers of species distribution (e.g. water depth or elevation), the actual observed pattern of colonization and establishment often varied from these models, at least in the initial years following an environmental change (e.g. water depth). For example, in a controlled experiment to test the realized niche models for four emergent species (including *Typha* and *Phragmites*) based on water depth alone did not accurately predict the distribution of species following flooding and then drawdown treatments (de Swart et al. 1994).

Cautions

Some managers have flooded marshes to over 4 feet and saw no decline in *T. domingensis* after 2 years, so there are no guarantees that any treatments will be effective, as nutrient levels, site history and a myriad of other factors influence where vegetation grows on the landscape. Increased water depths can create new shallow inundation in new areas, allowing *Typha* species to expand in those areas. Many of these areas may be wet meadows, which contain some of the highest plant diversity measures of any of the habitat types (Ecosystem Sciences 2010).

Prolonged flooding that is sufficient to kill cattail and tule species will certainly cause mortality to other desirable wetland species (e.g. *Schoenoplectus americanus*). Large numbers of dead cattails and tules may cause water quality issues as the plant material breaks down.

Conclusion and Recommendations

The USFWS has been involved in cattail control for a number of decades in the mid-west. After trying a number of different methods and observing the effectiveness of techniques (treatment effects usually last 3-7 years), in their words:

> *One thing is certain; there are no 100 percent solutions, but with proper application we can manage cattails in a manner that enhances waterfowl and marsh bird habitat, while at the same time maintaining sufficient cover and habitat for the various species that have come to use cattail choked wetlands. There are probably twenty 5% solutions for cattail, waterfowl and blackbird problems.* (McEnroe 2006)

There are a suite of actions available to managers to achieve tule and cattail management in the LORP. Managers and the MOU Consultants should consider the information and management methods presented in this paper at the recommended River Summit.

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12.0 GLOSSARY

BLM – U.S. Department of Interior, Bureau of Land Management

BOD – Biological Oxygen Demand

BWMA – Blackrock Waterfowl Management Area

CDFG – California Department of Fish and Game

CEQA - California Environmental Quality Act

CEQA mitigation – Measures to reduce or avoid impacts identified through the environmental impact analyses performed for an EIR or Negative Declaration

cfs – cubic feet per second

COD – Oxygen Demand

County – Inyo County

CWHR - California Wildlife Habitat Relationship System

Delta conditions - The amount of water and vegetated wetland within the Delta Habitat Area boundary existing at the time of the commencement of flows to the Delta under the LORP

DBH Diameter at Breast Height

ES - Ecosystem Sciences

EIR – Environmental Impact Report

ET – Evaporation transpiration

LAA – Los Angeles Aqueduct

LADWP – Los Angeles Department of Water and Power

LORP – Lower Owens River Project

MOU – Memorandum of Understanding amongst LADWP, the County, California Department of Fish and Game, State Lands Commission, Sierra Club, the Owens Valley Committee, and Carla Scheidlinger. The MOU specifies goals for the LORP, a timeframe for the development and implementation of the project, specific project actions, and requires 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, habitat and species.

RAS – Rapid Assessment Survey

SIP – State Implementation Plan *June 2004 Los Angeles Dept of Water & Power and the U.S. Environmental Protection Agency* 17-3 *Lower Owens River Project Final EIR/EIS*

SLC – California State Lands Commission