Lower Owens River Project
2022 Annual Report

September 2023

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Figures and Tables

ABBREVIATIONS, DEFINITIONS, AND MEMBERSHIP TABLE

1991 EIR	Final Environmental Impact Report regarding water from the Owens Valley to supply the second Los Angeles Aqueduct from 1970-1990, and from 1990 onward pursuant to the Water Agreement.
1997 MOU	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 Owen Valley Committee and Carla Scheidlinger.
2004 EIR	Final Environmental Impact Report & Environmental Impact Statement Lower Owens River Project
ALGA	Alabama Gates Avian Survey Route
AF	Acre-feet
BBBC	*Bassia hyssopifolia* “boom-bust” cycle
BLRS	Blackrock Springs Avian Survey Route
BWMA	Blackrock Waterfowl Management Area
CAC	Inyo-Mono Counties Agricultural Commissioner’s Office
CADFW	California Department of Fish and Wildlife (formerly California Department of Fish and Game)
CDFA	California Department of Food and Agriculture
CEQA	California Environmental Quality Act
cfs	Cubic-feet-per-second
the City	City of Los Angeles
the County	Inyo County
CRRI	Crystal Ridge Avian Survey Route
CWHR	California Wildlife Habitat Relationships System
DHA	Delta habitat area
DSM	Digital surface model
DTM	Digital terrain model
DWR	Dry-weight-rank
Eastern Sierra Runoff	Runoff within Mono Basin, Long Valley, and Owens Valley
EIR	Environmental Impact Report
ET	Evapotranspiration rate

FC1	Flood cycle 1
GIS	Geographic Information System
GOOD	Goodale Creek Avian Survey Route
HIS	Habitat Indicator Species
ICWD	Inyo County Water Department
LAA	Los Angeles Aqueduct
LADWP	City of Los Angeles Department of Water & Power
LiDAR	Light detection and ranging
Long Valley	Area south of Mono Basin, from Owens River headwaters to Long Valley Dam, contained within Mono County
LORP	Lower Owens River Project
MAMP	Lower Owens River Monitoring, Adaptative Management and Reporting Plan
MANZ	Manzanar Avian Survey Route
MCIV	McIver Ditch Avian Survey Route
MOU Parties	Los Angeles Department of Water and Power, Inyo County, California Department of Fish and Wildlife, California State Lands Commission, Sierra Club, Owens Valley Committee and Carla Scheidlinger.
NAD83	North American Datum, 1983
NAGA	Narrow Gauge Avian Survey Route
NRCS	U.S. Department of Agriculture - Natural Resources Conservation Service
ORTI	Owens River North of Tinemaha Creek Avian Survey Route
OVC	Owens Valley Committee
OVLMP	Owens Valley Land Management Plan
Owens River Basin Runoff	Runoff that drains to the Owens River within Long Valley and Owens Valley
ORMC	Owens River North of Mazourka Rd Avian Survey Route
Owens Valley	Area from Round Valley to Haiwee Reservoir, contained within Inyo County
PANG	Pangborn Avian Survey Route
RAS	Rapid Assessment Survey
RY	Runoff year accounts for peak stream flow and occurs from April 1st and ends the following March 31st.
SC	Sierra Club
SLC	California State Lands Commission
Standing Committee	Comprised of elected and appointed officials from the City and County and provide direction to the Inyo/LA Technical Group.
SOMA	South of Mazourka Rd Avian Survey Route
Technical Group	Comprised of Inyo County and City staff who are directed by the Standing Committee.

Water Agreement	Agreement between the County of Inyo and the City of Los Angeles and its Department of Water and Power on a Long-Term Groundwater Management Plan for Owens Valley and Inyo County, administered by the Standing Committee and Technical Group
WY	Water year is a hydrological "year" that starts on October 1st and ends the following September 30th.

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EXECUTIVE SUMMARY

The 2022 Lower Owens River Project (LORP) Annual Report contains the results from the fifteenth year of monitoring for the LORP. Monitoring results contained in this report include hydrologic monitoring, avian surveys, riparian mapping, and habitat modeling for the LORP riverine area, as well as monitoring of range conditions throughout the project area, and managing noxious weed populations. Also included in this report is a summary of adaptive management activities implemented in 2022.

Hydrologic Monitoring

The hydrologic monitoring section describes flow conditions in the LORP regarding attainment with the 2007 Stipulation & Order flow and reporting requirements and 1991 Final Environmental Impact Report (1991 EIR) goals. For the 2021-2022 water year (WY) LADWP was compliant with all the 2007 Stipulation & Order flow and reporting requirements. The mean flow to the Delta Habitat Area (DHA) was 7.3 cubic-feet-per-second (cfs), within the required 6-9 cfs annual flow. Implementation of the Interim Blackrock Waterfowl Management Area (BWMA) Plan continued which involves a seasonal flooding regime of sustained flooding from fall through mid-spring, a complete dry down during late spring, and a fixed waterfowl acreage goal of 500-acres. According to the 2004 LORP Environmental Impact Report (2004 EIR), no flows above the 40-cfs baseflow will be released from the River Intake in years when the runoff is predicted to be 50 percent or less of the annual average (normal) runoff. As the Owens River Basin Runoff Forecast for the 2022-2023 runoff year (RY) was determined to be 47% of normal, no seasonal habitat flow was released in 2022. This section also describes flow measurement issues and includes commentary on flow losses and gains through the different reaches of the Lower Owens River.

LORP Riparian Inventory

Vegetation was mapped by Formation Environmental consultants, using remote sensed products, for LORP and the DHA for 2022 conditions. To assess changes and trends in vegetation, over time, the 2022 conditions of both the LORP and DHA results were compared to conditions in 2000, which pre-date the project and to subsequent years: 2009, 2014, and 2017. For the LORP, differences in vegetation conditions are primarily attributed to fires, changes in hydrology and improvements in the accuracy and precision of mapping techniques. Overall the LORP is aggrading as marsh-vegetation communities continue to expand and permanently occupy open water. Additionally, high flows in the summer of 2017, (which to date, were the highest since the inception of the project), were not effective in maintaining an open river channel as they lacked the energy required to remove the marsh vegetation. Other management activities (e.g., livestock grazing) have had only minor effects on LORP vegetation conditions. Similarly, in the DHA marsh continues to encroach upon open water. In an attempt to slow or reverse this trend, stream discharge, to the DHA, was reduced in 2020 (and subsequent years to date), during the growing season. Initial results of dead marsh vegetation, in dried portions of the delta, support this is a viable management strategy.

Avian Monitoring

In 2022, a third post-LORP avian survey was conducted in the LORP Riverine-Riparian Area. This section summarizes findings of the 2022 surveys, and for the avian monitoring program over the entire 20-year period encompassing pre- and post-LORP surveys. Another related section focuses on how the California Wildlife Habitat Relationships System's (CWHR) Predicted Habitat Models for the Habitat Indicator Species (HIS) relate to the results of the avian monitoring.

Implementation of the LORP has increased breeding bird abundance, but not breeding bird species diversity in the Riverine-Riparian Area. Species diversity was lowest in 2022, though breeding bird abundance was significantly higher than pre-project conditions. Increases in breeding bird abundance are largely attributed to increases in the four most abundant species (Red-winged Blackbird, Common Yellowthroat, Song Sparrow, and Brown-headed Cowbird). Implementation of LORP has resulted in an increase in overall waterbird and landbird abundance and species richness as compared to pre-project.

Weak but significant correlations were found between the avian community of the Riverine-Riparian Area and certain vegetation communities. Trees were the only vegetation community type positively correlated with breeding bird diversity. Breeding bird abundance was positively correlated with trees, water, marsh, and wet meadow habitats. The weak correlations suggest that vegetation community type is not the only factor affecting the distribution and abundance of breeding bird species.

The reestablishment of perennial flow throughout the entire Lower Owens River has resulted in a net increase of hydric vegetation, primarily marsh and wet meadow habitats. The river system is aggrading, further promoting the spread of marsh vegetation. Conversely, there has been no increase in riparian trees or riparian shrubs following implementation of LORP. The current limited tree cover, and lack of recruitment in the LORP Riverine-Riparian Area will limit further increases in species diversity, however bird abundance will likely remain high due to the dominance of marsh and wet meadow habitats in the Riverine-Riparian Area.

Eighteen of the 19 avian HIS have been observed over the entire 20-year monitoring period, and 17 of those post-LORP implementation. Eleven HIS have been confirmed or suspected of breeding in the LORP Riverine-Riparian Area. Wetland-Associated HIS have shown a clear benefit from the LORP. Several of the Riparian Dependent and Riparian Obligate HIS regularly use the LORP Riverine-Riparian Area in migration; however, the amount, distribution, and structure of woody riparian cover is insufficient to support significant breeding populations of these groups.

Indicator Species Habitat Assessment

According to the CWHR Predicted Models, all HIS have some potential habitat in the LORP Riverine-Riparian Area. These models, however may overestimate potential habitat for some HIS as landscape factors influencing suitability such as proximity to other habitat types, or habitat patch size are not accounted for in CWHR. The CWHR System's Predicted Habitat Models further highlight the importance of trees and riparian shrubs for the HIS.

In order to improve and maintain habitat for birds in the LORP Riverine-Riparian Area, we recommend adopting land management practices that protect existing woody riparian vegetation and evaluating the feasibility of localized habitat enhancement.

Land Management

Following the 15th year of land management monitoring under the MAMP, LADWP has synthesized data collected over the life of the project and evaluated general trends as they relate to livestock grazing in the LORP area. We begin by discussing the overriding structure of the project and its pertinent documents. We then discuss the history of utilization on the LORP and the success over time in implementing the utilization standards across the seven LORP leases. We present a summary of the condition of irrigated pastures on the LORP. Next, we provide an overview of four primary vegetation/rangeland management tools used on the LORP: 1) prescribed burns and wildfires 2) fencing 3) stock water developments and 4) supplemental feeding sites. Following this, is a discussion of vegetation monitoring results on grazed range trend transects by river reach, an examination of grazing enclosures and ending with a discussion of rare plant projects.

Adaptation to the grazing management plans by the lessees took approximately four years. From 2008-2012, there were still some elevated utilization rates on the Islands, Delta, and Twin Lakes leases but adjustments to stocking and grazing duration resulted in utilization rates in compliance with standards. Overall, irrigated pastures in the LORP project area have remained in good condition over the past 17 years. The seasonal variations of water availability (drought) was the biggest effect on irrigated pasture condition. After reviewing the trend data in the grazing exclosures and the 20-year dataset for range trend data for moist floodplain sites in Reaches 3-6, no positive responses from decreased utilization were observed. In most cases there were slight downward trends in saltgrass frequency over time. The objective of the rare plant project was to monitor impacts of grazing on Owens Valley checkerbloom (*Sidalcea covillei*) and Inyo County star-tulip (*Calochortus excavatus*) within the LORP. Based on seven years of data, checkerbloom trend in ungrazed plots decreased across all sites.

Both long-term range trend monitoring and utilization monitoring have provided useful information on how the LORP project responded to grazing with the return of flows and the implementation of the grazing management plans. We recommend a continuance of the program on the LORP with a reduction of range trend transects in pastures where information is redundant. However, all riparian pastures will have actively monitored range trend transects visited at least once every three years. Utilization monitoring will continue annually. Future land management reporting for the LORP will be included in LADWP's Annual Owens Valley Report.

Tamarisk Treatment

In 2021-2022 LADWP treated 359-acres of saltcedar (*Tamarix spp.*) across the LORP area, specifically:

- Mechanical treatment in the Goose Lake vicinity (229-acres)
- Hand treated areas immediately adjacent to Lower Owens River, Goose Lake Return Ditch, Blackrock Ditch, and adjacent meadows (130-acres)

LADWP will continue to treat saltcedar re-sprouts in the aforementioned areas in 2023 and the BWMA as conditions allow owing to high-water conditions.

LADWP Weed Report

Significant increases in perennial pepperweed (*Lepidium latifolium)* populations have been detected along the LORP and in the BWMA, over the last 5 years. In 2022, LADWP focused on treating pepperweed within the BWMA, specifically: Winterton, Waggoner and Thibaut units. A total of 400-acres were treated amongst these units. Treatment will continue in 2023 and is dependent on access to these areas as high flows will likely flood significant portions of the LORP.

Inyo/Mono Counties Agricultural Commissioner's Office Weed Report

The Inyo-Mono Counties Agricultural Commissioner's Office (CAC) treated a total of 13-acres of pepperweed along the LORP. These treatments included: initially known sites, retreatment of regrowth and treatment of new sites. Similar to observations of LADWP, there has been a significant increase in pepperweed, in the LORP, since the flooding events of 2017.

2022 LORP Adaptive Management Actions

Following the 2019 LORP Evaluation Report, LADWP and Inyo County Water Department (ICWD) identified a series of adaptive management actions to further improve the project. During the 2021-2022 fiscal year, LADWP and ICWD conducted work on the following: implementation of a five-year interim flow regime in the DHA and related monitoring, implementation of the BWMA Interim Management and Monitoring Plan, a tree recruitment assessment, and noxious species monitoring.

Delta Habitat Area Interim Flow Regime and Related Monitoring
During the 2021-2022 RY, the revised interim flow regime was effective at flooding key seasonal and permanent ponds in the DHA from fall through late spring, and inducing hydrologic stress on cattail stands during the growing period. Use by the HIS were comparable to, or exceeded those observed in previous years. Management techniques such as mowing and/or prescribed fire could be utilized to accelerate habitat improvement goals. Flow effectiveness monitoring should be continued throughout the interim management period and the application of remote sensing techniques further explored.

Blackrock Waterfowl Management Area Interim Management and Monitoring Plan
Implementation of the Interim BWMA Plan continued with the seasonal flooding regime of sustained flooding from fall through mid-spring, a complete dry down during late spring, and a goal of a fixed 500 flooded-acres of the BWMA. The Interim Plan was finalized in April 2021 and is being implemented as adaptive management for a period of 5 years. The first cycle of flooding under the Interim Plan was very effective at creating habitat and attracting BWMA HIS. Habitat was available fall, winter, and spring for migratory waterfowl, shorebirds, wading birds and rails. Increases in the average number of birds per survey was observed for all indicator species groups except wading birds. Observations of waterfowl saw the best response and most increase in numbers as compared to the prior management strategy of year-round flooding. Not only were waterfowl totals higher, but observed bird densities were much higher as compared to all previous years, suggesting improved habitat quality such that more birds per acre could be supported as compared to previous years. The spring drawdown and summer drying maintained open water habitat created during initial site preparation and facilitated a robust and diverse growth of vegetation in the sub-basins.

Vegetation Assessment

Sixteen sub-units inside the three active BWMA Units (Thibaut, Waggoner, and East Winterton) were sampled in August of 2022. The objective was to monitor the vegetation response to early spring draw-downs. Relative vegetation production by weight and plant species cover were evaluated. Early successional plant species occupied the recently drawn down-units and there was little to no colonization of the sub-units by cattails or tules. Spring drawdowns are maintaining open water habitat and generating a forage base for water birds when the units become active in the fall.

Tree Recruitment

To understand mechanisms which have permitted past and current riparian tree recruitment within the LORP riparian area, several adaptive management actions were proposed. Work to-date includes: fieldwork aimed at understanding topographic, hydrologic, edaphic, and biological conditions that allowed tree establishment both prior to and post project initiation, and identifying current processes that could limit tree germination or establishment.

BWMA Interim Plan Remote Sensing

The feasibility of using remote sensing to measure flooded area in the BWMA was evaluated using Sentinel-2 satellite imagery from November 1, 2022 to March 2023, as a means to reduce the field effort. Using remote sensing, 25% of the subbasins, were within 2% of the field mapped measurements; however, large errors were associated with the remaining subbasins. Efforts to increase the accuracy of the remote sensing may not be cost effective relative to the field effort, as it takes just 2-days to complete the survey; compared to weeks that maybe require for remote sensing.

Noxious Species Monitoring

In August 2022, ICWD surveyed the Lower Owens River for perennial pepperweed. No major changes in distribution were noted in the upper portions of the river. However, there has been an incremental downstream spread of pepperweed along the river. These less established populations should be the highest priority for treatment and containment in 2023 and 2024, along with treating new populations that might arise from the high-flows associated with the elevated runoff of 2023.

1.0 INTRODUCTION

The LORP is a large-scale habitat restoration project in Inyo County, California being implemented through a joint effort by the LADWP and Inyo County (the County). The LORP was identified in the 1991 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* (1997 MOU), signed by LADWP, Inyo County, California Department of Fish and Game (CDFG), California State Lands Commission (SLC), Sierra Club (SC), and the Owens Valley Committee (OVC). 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 biological 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*."

The 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 WY forecast in the BWMA, maintenance of several Off-River Lakes and Ponds, modifications to land management practices, and construction of new facilities including a pumpback station to capture a portion of the water released to the river.

The LORP was evaluated under the *California Environmental Quality Act* (CEQA) resulting in the completion of the 2004 EIR.

1.1 Monitoring and Reporting Responsibility

Section 2.10.4 of the 2004 LORP EIR states 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 ICWD, LADWP and the MOU consultants, Mr. Mark Hill and Dr. William Platts, following the methods and schedules described in Section 4 of the Lower Owens River Monitoring, Adaptative Management and Reporting Plan (MAMP) (Ecosystem Sciences 2008). Specific reporting procedures are also described under each monitoring method in the MAMP. The MOU also requires the County and LADWP provide annual reports describing the environmental conditions of the LORP including monitoring data, the results of analyses, and recommendations for any adaptive management. This LORP Annual Report describes monitoring data, analysis, and recommendations for the LORP based on data collected during the 2022 field season (March-October). The development of this LORP Annual Report is a collaborative effort between the ICWD and LADWP. Personnel from these entities participated in different sections of the report writing, data collection, and analysis.

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

> "LADWP and the County will release to the public and to the representatives of the Parties identified in the MOU a draft of the annual report described in Section 2.10.4 of the 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 EIR."

Generally, the LADWP is the lead author for a majority of the document and is responsible for overall layout and content management. For this report, LADWP authored Sections: 1.0 Introduction; 2.0 Hydrologic Monitoring; 3.0 LORP Riverine Riparian Area (riparian mapping conducted by Formation Environmental); 4.0 Avian Monitoring; 5.0 LORP Riverine-Riparian Area Indicator Species Habitat Assessment; 6.0 Land Management; 7.0 LORP Tamarisk Treatment. LADWP and the Inyo/Mono Counties Agricultural Commissioner's Office co-authored Section 8.0 LORP Weed Report. Lastly, LADWP and ICWD co-authored section 9.0 Adaptive Management.

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

This document fulfills the reporting requirements for the LORP Annual Report for 2022.

2.0 HYDROLOGIC MONITORING

2.1 River Flows

On July 12, 2007, a Court Stipulation & Order was issued requiring the LADWP to meet specific flow requirements for the LORP. The flow requirements are listed below:

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

On July 14, 2009, six of the ten 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 the LADWP was in compliance with the Stipulation & Order, from October 2021 through September 2022, for the four in-river stations (see Hydrologic Appendix 2). However, on May 20, 2022, a violation of LORP Intake baseflow requirements described in Section E(1) of the 2007 Stipulation occurred as flow temporarily dropped below 40 cfs for a period of approximately 45 minutes. The violation resulted from issues with gate adjustments in the area, but LADWP staff resolved the gate adjustments and increased flow to above 40 cfs; the daily average flow from LORP Intake on May 20, 2022 was 58 cfs.

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, BWMA wetted acreage, and Off-River Lakes and Ponds depths are posted each day on the Web at <http://www.ladwp.com> under About Us → Los Angeles Aqueduct → LA Aqueduct Conditions Reports → LORP Flow Reports and click on the 'List of LORP Flow Reports' link to access a list of PDFs summarizing the most current daily reports.

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

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

2.2 Measurement Issues

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

The *Sontek* meters measurement accuracy is affected by factors that influence river stage and flow velocity, including vegetation growth and sediment build up. In order to account for these environmental changes, LADWP manually meters flows at all of the stations along the LORP to check the accuracy of the *Sontek* meters at least once per month. Each time current metering is performed, a 'shift' is applied to the station to take into account the difference in flow determined by the current metering. If a fundamental change in the flow curve is observed then a new index is created from the current metering data and downloaded to the meter. To maintain flow measurement accuracy, all of the meters on the LORP are calibrated at least once per month following the 2007 Stipulation & Order.

A commentary on each station along the LORP follows:

Below LORP Intake

Measurement Device: Langemann Gate

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

LORP at Mazourka Canyon Road

Measurement Devices: *Sontek* SW Meter

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

LORP at Reinhackle Springs

Measurement Device: *Sontek* SW Meter

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

LORP at Pumpback Station

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

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

2.3 Flows to the Delta Habitat Area

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

Through adaptive management efforts, a new Delta flow schedule was implemented in April 2020 for a 5-year trial period. This interim schedule incorporates base and pulse flows into one schedule:

- October 1 to October 15 — 11 cfs
- October 16 to October 31 — 8 cfs
- November 1 to November 30 — 7 cfs
- December 1 to February 28 — 6 cfs
- March 1 to March 31 — 10 cfs
- April 1 to May 15 — 13 cfs
- May 16 to August 31 — 3 cfs
- September 1 to September 30 — 11 cfs

The releases for the 2021-22 WY resulted in an average flow of 7.1 cfs to the Delta.

Unintended flows are released to the Delta when rainstorms cause river flows to exceed the maximum allowed flowrate of the Pumpback Station or when pump outages occur at the Pumpback Station. Flows over the weir are generally unintended flows and flows over the Langemann Gate are scheduled flows.

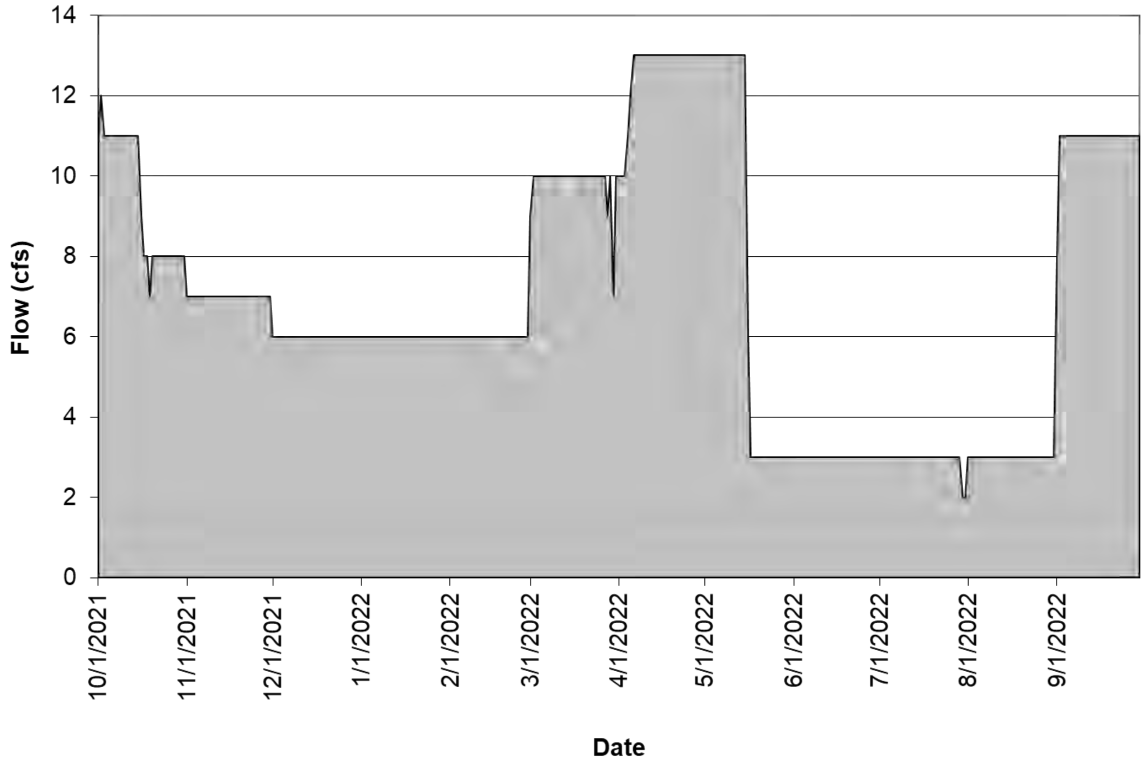


Figure 2-1. Langemann Release to Delta

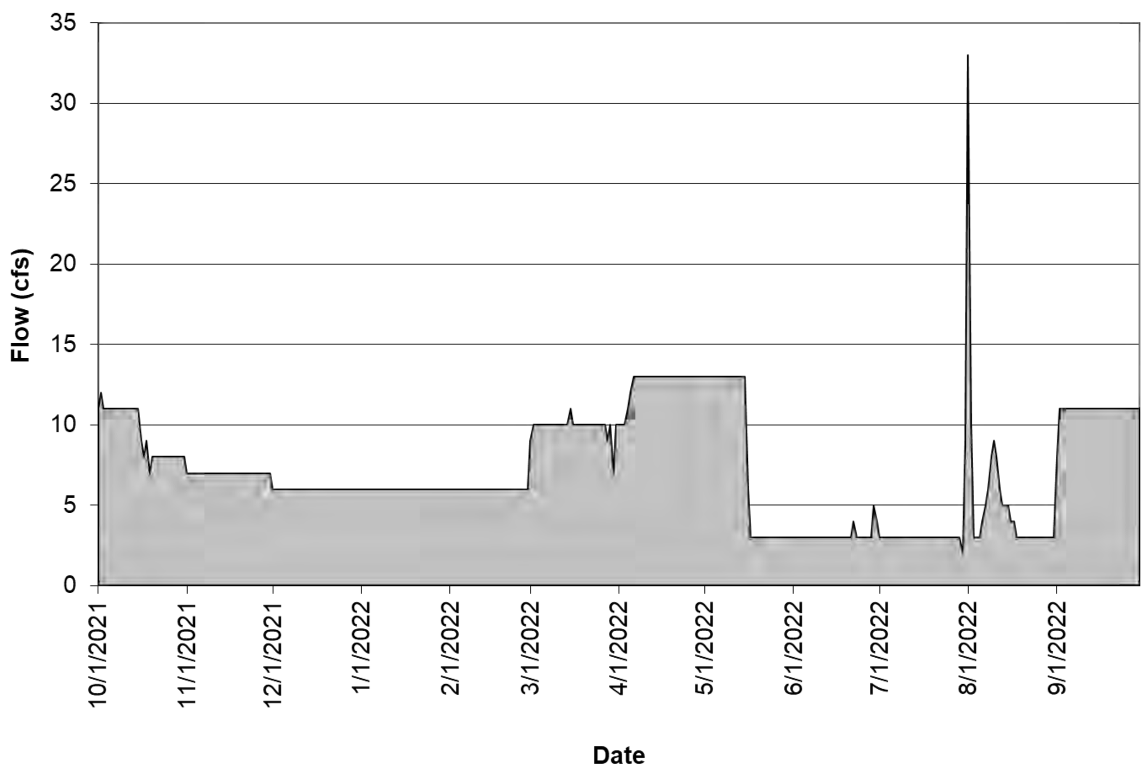


Figure 2-2. Langemann and Weir Release to Delta

Off-River Lakes and Ponds

The BWMA and Off-River Lakes and Ponds Hydrologic Data Reporting Plan requires the Upper Twin Lake, Lower Twin Lake, and Goose Lake to be maintained between 1.5 and 3.0 feet on their respective staff gauges, and for Billy Lake to be maintained full (i.e., at an elevation that maintains outflow from the lake). All of the staff gages measured between 2.0 and 3.0 feet stage height for the 2021-22 WY (Figure 2-3).

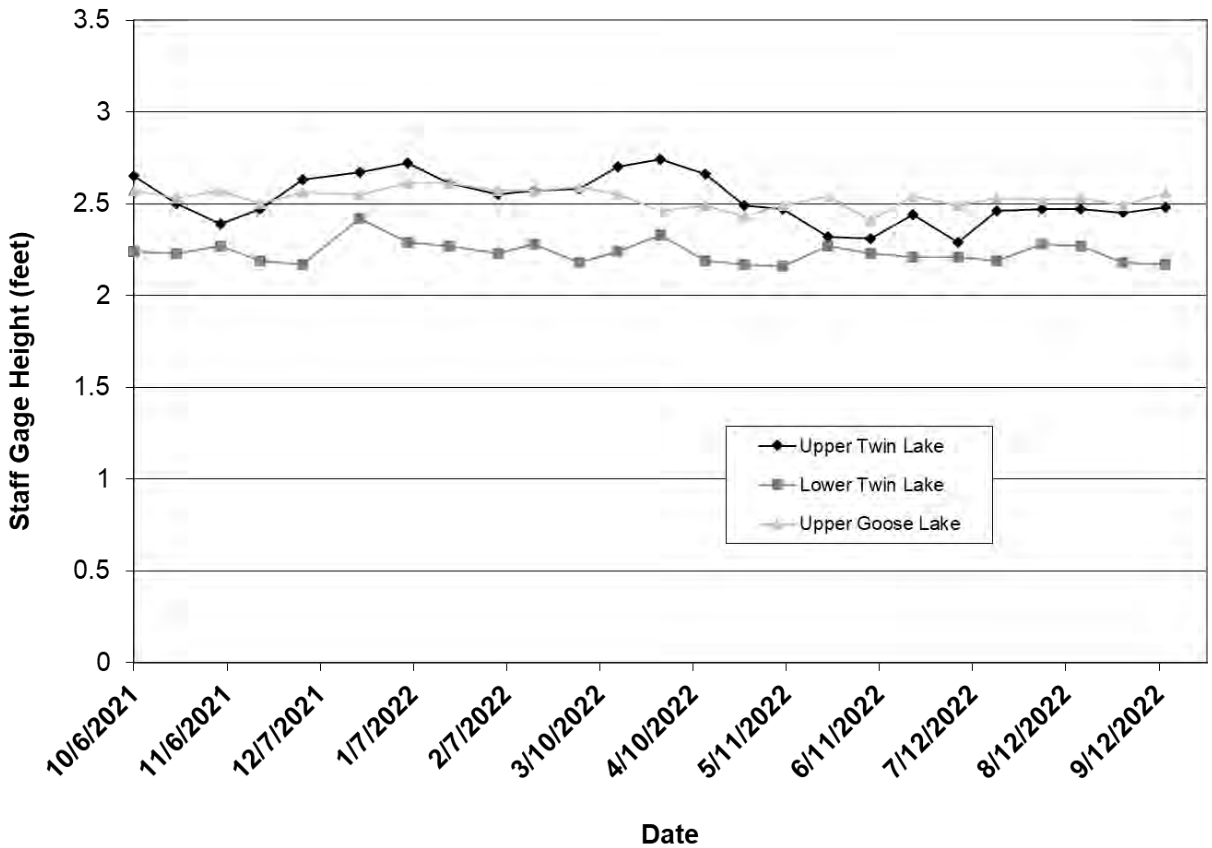


Figure 2-3. Off-River Lakes and Ponds Staff Gages

Billy Lake

Due to the topography of Billy Lake in relation to the Billy Lake Return station, whenever the Billy Lake Return station is showing flow, Billy Lake is full. The LADWP maintains Billy Lake by monitoring the Billy Lake Return station, which had a minimum daily average flow of 1.2 cfs for the year (see Table 2-1, and Hydrologic Appendix 2).

Table 2-1. LORP Flows – WY 2021-22

Station Name	Average Flow (cfs)	Maximum Flow (cfs)	Minimum Flow (cfs)
Below River Intake	57	95	41
Blackrock Return Ditch	1.1	1.6	0.8
Goose Lake Return	0	0	0
Billy Lake Return	1.2	1.5	0.8
Mazourka Canyon Road	53	89	38
Locust Ditch Return	0	0	0
Georges Ditch Return	1	10	0
Reinhackle Springs	51	77	37
Alabama Gates Return	0	16	0
At Pumpback Station	48	57	38
Pump Station	41	48	19
Langemann Gate to Delta	7	13	2
Weir to Delta	0	30	0

Thibaut Pond

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

2.4 Blackrock Waterfowl Management Area

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

The seasons are defined as:

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

Up until the end of the 2012-13 RY, wetted acreage measurements were collected eight times per year, once in the middle of each season and once at the end of each season. Starting with the 2013-14 RY, only the middle of each season measurements have been collected. The end-of-season measurements were discontinued because they added very little information compared to the middle-of-season measurements and required extensive manpower for taking the measurements. Measurements are performed by using GPS and walking the perimeter of the wetted edges of the waterfowl area.

With the adoption of the five-year Interim Management and Monitoring Plan, starting in 2021, measurements are only to be collected for the Fall and Winter seasons when flows occur. No flows are released in the Spring and Summer season.

Table 2-2. BWMA Wetted Acreage

Winterton Unit

ET Season	Read Date	Wetted Acreage	Average Inflow
Fall '21	November 2, 2021	101	5.2
Winter '21-'22	February 25, 2022	49	1.0
Fall '22	November 2, 2022	79	5.7

Thibaut Unit

ET Season	Read Date	Wetted Acreage	Average Inflow
Fall '21	November 3, 2021	189	8.0
Winter '21-'22	March 2, 2022	225	2.0
Fall '22	November 1, 2022	234	8.1

Drew Unit

ET Season	Read Date	Wetted Acreage	Average Inflow
Fall '21	n/a	n/a	OFF
Winter '21-'22	n/a	n/a`	OFF
Fall '22	n/a	n/a	OFF

Waggoner Unit

ET Season	Read Date	Wetted Acreage	Average Inflow
Fall '21	November 1, 2022	212	8.3
Winter '21-'22	March 1, 2022	191	1.3
Fall '22	October 31, 2022	159	7.0

Notes:
No flows are released during the Spring and Summer.
Measurements before 4/1/21 count towards the 2020-21 RY acreage goal.
Measurements after 4/1/21 count towards the 2021-22 RY acreage goal.

2.5 BWMA Results for April 2021 to March 2022

In accordance with the Interim Management and Monitoring Plan, the waterfowl wetted acreage goal was 500 acres.

On April 16, flows to all units were set to 0 cfs.

On September 15, flows for the Fall season were set. Flow to Thibaut Unit was set to 8 cfs. Flow to Winterton Unit was set to 6 cfs. Flow to Waggoner Unit was set to 9 cfs.

Wetted acreage surveys completed for the Fall season measured a total of 502 acres. Thibaut measured 189 acres on November 3, Winterton measured 101 acres on November 2, and Waggoner measured 212 acres on November 1.

On November 10, flows for the Winter season were set. Flow to Thibaut Unit was set to 2 cfs. Flow to Winterton Unit was set to 1.1 cfs. Flow to Waggoner Unit was set to 2 cfs.

On February 25, a Winter season wetted acreage survey was conducted for Winterton, measuring 49 acres.

On March 1 and March 2, Winter season wetted acreage surveys were conducted for Waggoner and Thibaut, measuring 191 acres and 225 acres, respectively. Together with the February 25 survey, the total combined wetted acreage for the Winter season was 465 acres.

On March 3, flows to Thibaut, Winterton, and Waggoner Units were set to 0 cfs.

The average waterfowl wetted acreage for the 2021-22 RY was 484 acres.

2.6 BWMA Results for April 2022 to March 2023

In accordance with the Interim Management and Monitoring Plan, the waterfowl wetted acreage goal was 500 acres.

On April 16, flows to all units were set to 0 cfs.

On September 15, flow to Thibaut Unit was set to 8 cfs, Winterton Unit was set to 6 cfs, and Waggoner Unit was set to 9 cfs.

Wetted acreage surveys completed for the Fall season measured a total of 472 acres. Thibaut measured 234 acres on November 1, Winterton measured 79 acres on November 2, and Waggoner measured 159 acres on October 31.

The Spring wetted acreage measurement will take place in early March 2023; the average totals of the Fall and Spring measurements will be the recorded wetted acreage for the WY.

2.7 Assessment of River Flow Gains and Losses

This section describes river flow gains and losses for all reaches in the Lower Owens River from the LORP Intake to the Pumpback Station during for WY 2022. The reaches referred to in this report indicate areas of river between specified permanent gaging stations. This analysis is an attempt at understanding flow losses and gains in the Lower Owens River so that estimates of future water requirements can be made.

2.8 River Flow Loss or Gain by Month and Year

Flow losses or gains can vary over time as presented in the table below (see Table 2-3). ET rates fall sharply during late fall - winter and increase dramatically during the spring - summer plant growing seasons. Thus, the river can lose water to ET during certain periods of the year and maintain or gain water during other periods of the year. December through March are winter periods with low ET that result in gains from increased flows from water stored in the shallow aquifer where groundwater levels are higher than adjacent river levels. Other incoming winter water sources such as local intermittent runoff from precipitation also result in flow increases.

Table 2-3. Average Monthly River Flow Losses/Gains From the Intake to the Pumpback Station during the 2021-22 WY

River Flows Table 1. Average Monthly River Flow Losses or Gains from Intake to Pumpback Station during 2021/22 Hydro Year

	Month	Flow (cfs)	Acre-Feet-Per-Day
2021	OCT	-4	-7
	NOV	+1	+2
	DEC	+5	+10
2022	JAN	+8	+15
	FEB	+5	+11
	MAR	+1	+3
	APR	-5	-11
	MAY	-16	-32
	JUN	-39	-78
	JUL	-49	-97
	AUG	-26	-52
	SEP	-25	-50
	AVG MONTH	**-12 cfs**	**-24 AcFt**

For the entire river, the overall gain or loss is calculated by subtracting Pumpback Station outflow from inflows at the Intake and augmentation spillgates. Inflows from the Intake were 41,027 acre-feet (AF), inflows from augmentation spillgates were 2,487 AF, and outflows from the Pumpback Station were 34,733 AF. This yields a loss of 8,781 AF for the year, a daily average of approximately 12.1 cfs between the Intake and the Pumpback Station. Water loss during the 2021-22 WY represents about 20% of the total released flow from the Intake and augmentation spillgates into the river channel.

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

From December 2021 to March 2022, an average flow of 43 cfs was released into the Lower Owens River from the Intake. An additional 2 cfs was provided from augmentation ditches, for a total accumulated release of 45 cfs. The average flow reaching the Pumpback Station was 51 cfs, an increase of 6 cfs during the period. During the winter, ET is low and any “make water” coming into the river is additive. Part of the “make water” was likely stored during earlier periods in subsurface aquifers and may also be a result of higher winter season precipitation.

The river reach from the Intake to the Mazourka Canyon Road gaging station lost an average of 3 cfs, Mazourka Canyon Road to the Reinhackle gaging station gained 0 cfs, and Reinhackle to the Pumpback Station gained 8 cfs (see Table 2-4). A water “gaining” reach, during harsh winter conditions, can benefit an ecosystem in many ways. Incoming water, especially if it is subsurface, tends to: increase winter river water temperatures, reduces icing effects, increases dissolved oxygen when water surface ice is melted by increasing the re-aeration rate, and adds nutrients.

Table 2-4. Winter Flow Losses/Gains, December 2021 to March 2022

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	43	N/A	N/A
Mazourka	42	-3	-3
Reinhackle	43	+0	-3
Pumpback	51	+8	+5

Note: All numbers are rounded to the nearest whole value.
Calculations include augmentation and return flows in appropriate reaches, see Appendix 2 for all flows.

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

During the summer period of June 2022 to September 2022, all river reaches lost water. An average flow of 75 cfs was released into the Lower Owens River from the Intake. An additional 5 cfs was provided from augmentation locations throughout the Lower Owens River. The effects of ET are evident from the high total flow loss (-35 cfs) between the Intake and the Pumpback Station. The largest flow losses occurred at the Reinhackle to Pumpback Station reach (-18 cfs) (see Hydrologic Table 5).

Table 2-5. Summer Flow Losses/Gains, June 2022 to September 2022

Recording Station	Average Flow (cfs)	Gain or Loss (cfs)	Accumulative (cfs)
Intake	75	N/A	N/A
Mazourka	67	-10	-10
Reinhackle	62	-7	-17
Pumpback	45	-18	-35

Note: All numbers are rounded to the nearest whole value.
Calculations include augmentation and return flows in appropriate reaches, see Appendix 2 for all flows.

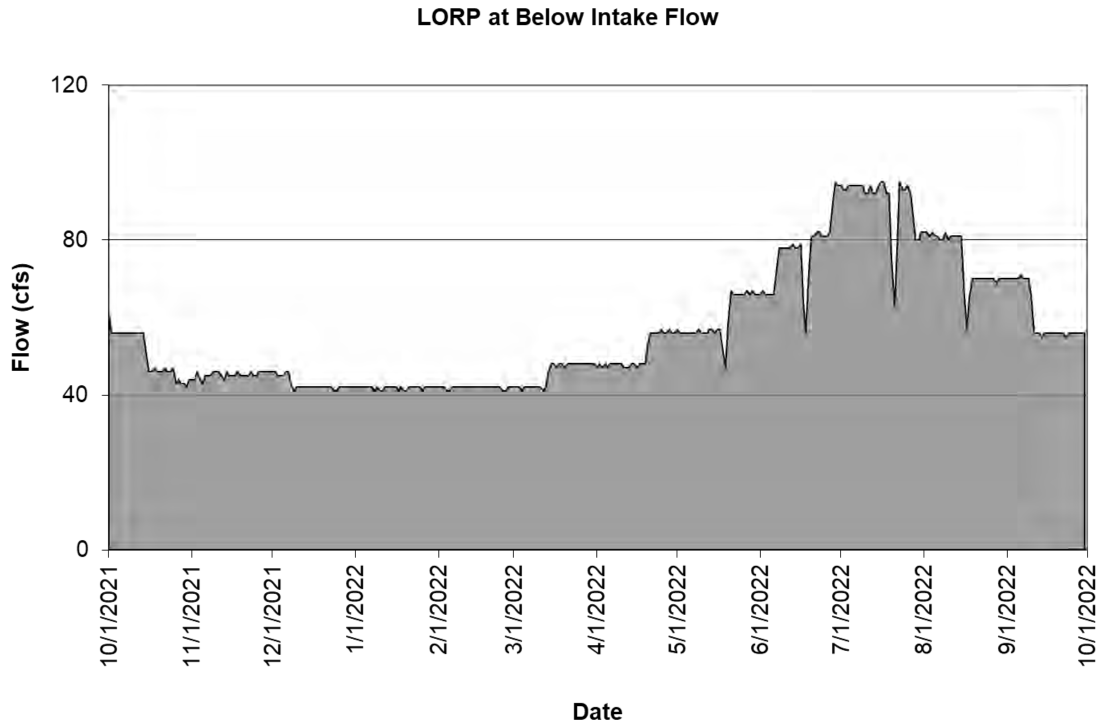
2.11 Seasonal Habitat Flow

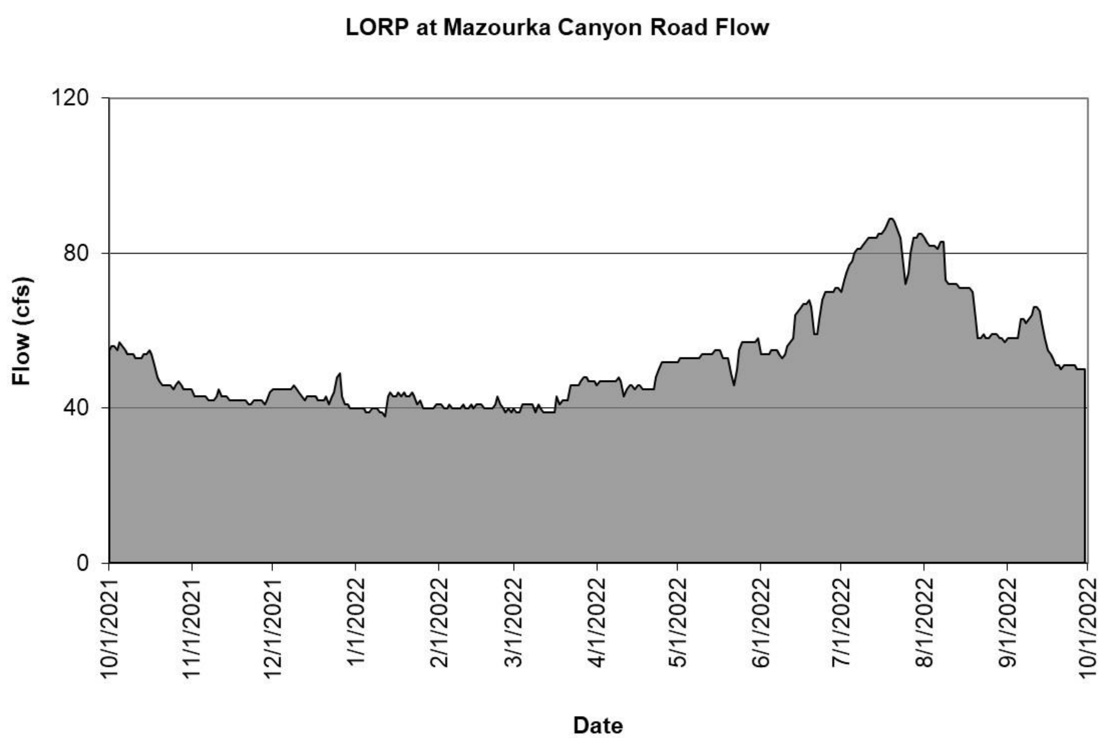
The runoff forecast for RY 2021-22 was 47% of the annual average (normal) runoff. In accordance with the 2004 LORP EIR, Section 2.3.5.3, no flows above the 40-cfs baseflow will be released from the River Intake in years when the runoff is predicted to be 50% or less of the annual average (normal) runoff. As such, a Seasonal Habitat Flow was not released from the LORP Intake.

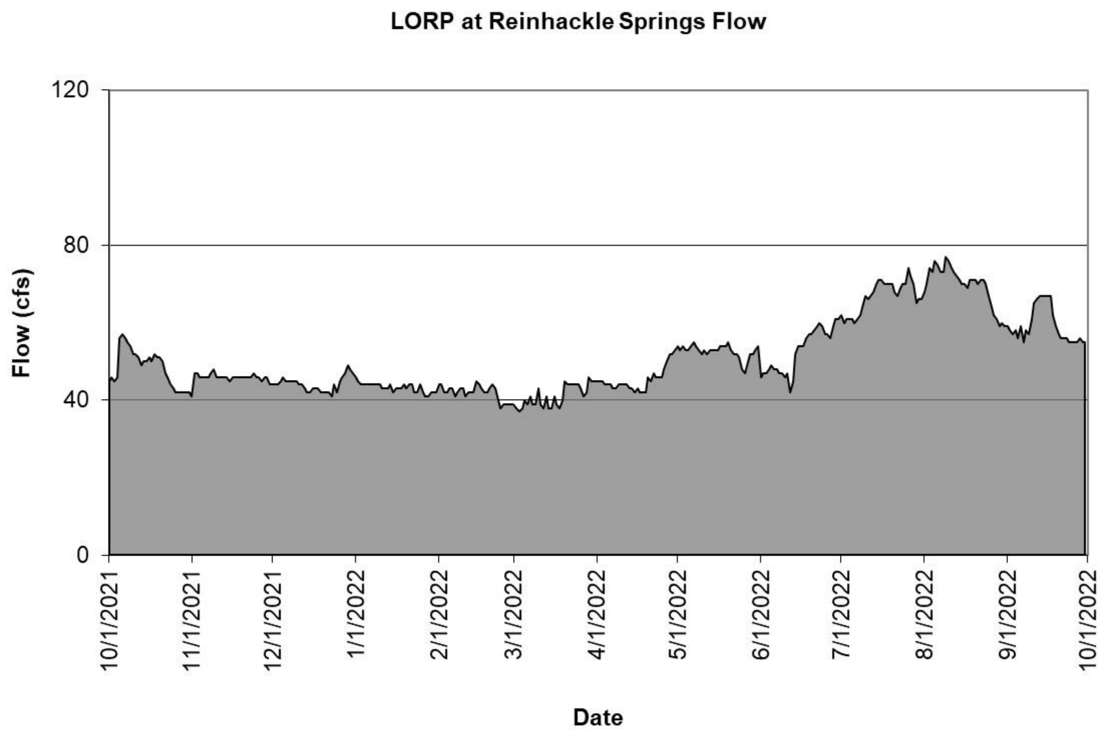
Daily flow rates from the LORP Intake are provided in Appendix 2.

2.12 Appendices

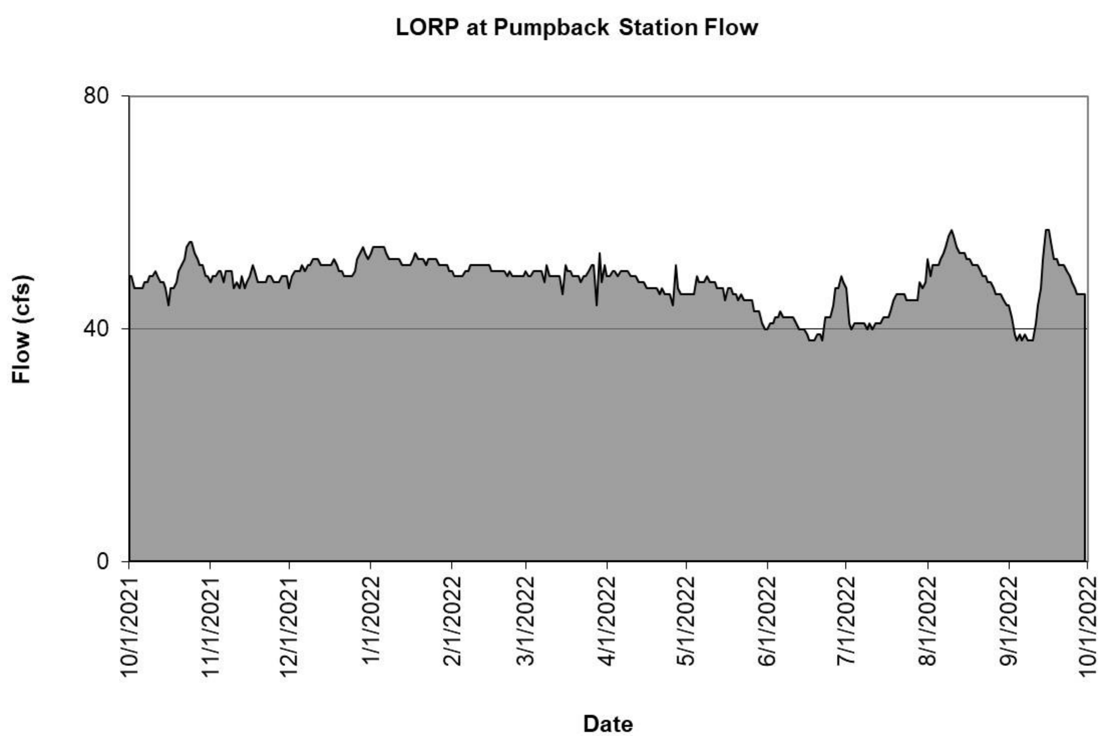
Appendix 1. Hydrologic Monitoring Graphs







LORP at Reinhackle Springs Flow
120
80
40
0
Flow (cfs)
10/1/2021
11/1/2021
12/1/2021
1/1/2022
2/1/2022
3/1/2022
4/1/2022
5/1/2022
6/1/2022
7/1/2022
8/1/2022
9/1/2022
10/1/2022
Date



LORP at Pumpback Station Flow
80
40
0
Flow (cfs)
10/1/2021
11/1/2021
12/1/2021
1/1/2022
2/1/2022
3/1/2022
4/1/2022
5/1/2022
6/1/2022
7/1/2022
8/1/2022
9/1/2022
10/1/2022
Date

Appendix 2. River Flow Tables

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
10/1/2021	61.0	1.1	0.0	1.2	55.0	0.0	0.0	45.0	0.0	49.0	38.0	11.0	0.0	52.5
10/2/2021	56.0	1.1	0.0	1.2	56.0	0.0	0.0	46.0	0.1	49.0	37.0	12.0	0.0	51.8
10/3/2021	56.0	1.1	0.0	1.3	56.0	0.0	0.0	45.0	0.1	47.0	36.0	11.0	0.0	51.0
10/4/2021	56.0	1.1	0.0	1.3	55.0	0.0	0.0	46.0	0.1	47.0	36.0	11.0	0.0	51.0
10/5/2021	56.0	1.1	0.0	1.3	57.0	0.0	0.0	56.0	0.1	47.0	36.0	11.0	0.0	54.0
10/6/2021	56.0	1.1	0.0	1.2	56.0	0.0	0.0	57.0	0.1	47.0	36.0	11.0	0.0	54.0
10/7/2021	56.0	0.8	0.0	1.0	55.0	0.0	0.1	56.0	0.1	48.0	37.0	11.0	0.0	53.8
10/8/2021	56.0	1.2	0.0	1.0	54.0	0.0	0.1	55.0	0.1	48.0	37.0	11.0	0.0	53.3
10/9/2021	56.0	1.2	0.0	1.0	54.0	0.0	0.1	54.0	0.1	49.0	38.0	11.0	0.0	53.3
10/10/2021	56.0	1.2	0.0	1.0	54.0	0.0	0.1	52.0	0.1	49.0	38.0	11.0	0.0	52.8
10/11/2021	56.0	1.2	0.0	1.2	53.0	0.0	0.1	52.0	0.1	50.0	39.0	11.0	0.0	52.8
10/12/2021	56.0	1.2	0.0	1.3	53.0	0.0	0.1	51.0	0.1	49.0	38.0	11.0	0.0	52.3
10/13/2021	56.0	1.1	0.0	1.4	53.0	0.0	0.2	49.0	0.1	48.0	37.0	11.0	0.0	51.5
10/14/2021	56.0	1.1	0.0	1.4	54.0	0.0	0.2	50.0	0.1	48.0	37.0	11.0	0.0	52.0
10/15/2021	50.0	1.1	0.0	1.4	54.0	0.0	0.2	50.0	0.1	47.0	36.0	11.0	0.0	50.3
10/16/2021	46.0	1.2	0.0	1.4	55.0	0.0	0.2	51.0	0.1	44.0	35.0	9.0	0.0	49.0
10/17/2021	46.0	1.2	0.0	1.3	54.0	0.0	0.2	50.0	0.1	47.0	39.0	8.0	0.0	49.3
10/18/2021	47.0	1.2	0.0	1.2	51.0	0.0	0.2	52.0	0.1	47.0	38.0	8.0	1.0	49.3
10/19/2021	46.0	1.1	0.0	1.1	48.0	0.0	0.2	51.0	0.1	48.0	41.0	7.0	0.0	48.3
10/20/2021	46.0	1.2	0.0	1.0	47.0	0.0	0.2	51.0	0.1	50.0	42.0	8.0	0.0	48.5
10/21/2021	46.0	1.2	0.0	1.0	46.0	0.0	0.3	50.0	0.1	51.0	43.0	8.0	0.0	48.3
10/22/2021	47.0	1.2	0.0	1.0	46.0	0.0	0.2	47.0	0.1	52.0	44.0	8.0	0.0	48.0
10/23/2021	46.0	1.2	0.0	1.1	46.0	0.0	0.2	46.0	0.1	54.0	46.0	8.0	0.0	48.0
10/24/2021	46.0	1.1	0.0	1.1	46.0	0.0	0.3	44.0	0.1	55.0	47.0	8.0	0.0	47.8
10/25/2021	47.0	1.1	0.0	1.1	45.0	0.0	0.2	43.0	0.1	55.0	47.0	8.0	0.0	47.5
10/26/2021	43.0	1.1	0.0	1.1	46.0	0.0	0.4	42.0	0.1	53.0	45.0	8.0	0.0	46.0
10/27/2021	44.0	1.1	0.0	1.1	47.0	0.0	0.3	42.0	0.1	52.0	44.0	8.0	0.0	46.3
10/28/2021	43.0	1.1	0.0	1.1	46.0	0.0	0.3	42.0	0.1	51.0	43.0	8.0	0.0	45.5
10/29/2021	43.0	1.2	0.0	1.3	45.0	0.0	0.2	42.0	0.1	51.0	43.0	8.0	0.0	45.3
10/30/2021	42.0	1.0	0.0	1.3	45.0	0.0	0.2	42.0	0.1	49.0	41.0	8.0	0.0	44.5
10/31/2021	44.0	1.1	0.0	1.4	45.0	0.0	0.3	42.0	0.1	49.0	41.0	8.0	0.0	45.0
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
11/1/2021	44.0	1.1	0.0	1.4	45.0	0.0	0.2	41.0	0.1	48.0	41.0	7.0	0.0	44.5
11/2/2021	44.0	1.1	0.0	1.4	43.0	0.0	0.2	47.0	0.1	49.0	42.0	7.0	0.0	45.8
11/3/2021	46.0	1.3	0.0	1.4	43.0	0.0	0.2	47.0	0.1	49.0	42.0	7.0	0.0	46.3
11/4/2021	44.0	1.3	0.0	1.4	43.0	0.0	0.2	46.0	0.1	50.0	43.0	7.0	0.0	45.8
11/5/2021	43.0	1.3	0.0	1.3	43.0	0.0	0.2	46.0	0.1	50.0	43.0	7.0	0.0	45.5
11/6/2021	45.0	1.2	0.0	1.1	43.0	0.0	0.2	46.0	0.1	48.0	41.0	7.0	0.0	45.5
11/7/2021	45.0	1.3	0.0	1.1	42.0	0.0	0.2	46.0	0.1	50.0	43.0	7.0	0.0	45.8
11/8/2021	45.0	1.2	0.0	1.1	42.0	0.0	0.2	47.0	0.1	50.0	43.0	7.0	0.0	46.0
11/9/2021	46.0	1.2	0.0	1.1	42.0	0.0	0.3	48.0	0.1	50.0	43.0	7.0	0.0	46.5
11/10/2021	46.0	1.2	0.0	1.1	43.0	0.0	0.3	46.0	0.1	47.0	40.0	7.0	0.0	45.5
11/11/2021	46.0	0.9	0.0	1.2	45.0	0.0	0.3	46.0	0.1	48.0	41.0	7.0	0.0	46.3
11/12/2021	45.0	1.1	0.0	1.2	43.0	0.0	0.3	46.0	0.1	47.0	40.0	7.0	0.0	45.3
11/13/2021	44.0	1.1	0.0	1.2	43.0	0.0	0.3	46.0	0.1	49.0	42.0	7.0	0.0	45.5
11/14/2021	46.0	1.2	0.0	1.2	43.0	0.0	0.3	46.0	0.1	47.0	40.0	7.0	0.0	45.5
11/15/2021	45.0	1.2	0.0	1.2	42.0	0.0	0.3	45.0	0.1	48.0	41.0	7.0	0.0	45.0
11/16/2021	45.0	1.1	0.0	1.3	42.0	0.0	0.4	46.0	0.1	49.0	42.0	7.0	0.0	45.5
11/17/2021	45.0	1.2	0.0	1.3	42.0	0.0	0.2	46.0	0.1	51.0	44.0	7.0	0.0	46.0
11/18/2021	46.0	1.2	0.0	1.3	42.0	0.0	0.2	46.0	0.1	50.0	43.0	7.0	0.0	46.0
11/19/2021	45.0	1.2	0.0	1.3	42.0	0.0	0.2	46.0	0.1	48.0	41.0	7.0	0.0	45.3
11/20/2021	45.0	1.2	0.0	1.2	42.0	0.0	0.1	46.0	0.1	48.0	41.0	7.0	0.0	45.3
11/21/2021	45.0	1.2	0.0	1.2	42.0	0.0	0.1	46.0	0.1	48.0	41.0	7.0	0.0	45.3
11/22/2021	45.0	1.2	0.0	1.2	41.0	0.0	0.1	46.0	0.1	48.0	41.0	7.0	0.0	45.0
11/23/2021	46.0	1.2	0.0	1.2	41.0	0.0	0.1	46.0	0.1	49.0	42.0	7.0	0.0	45.5
11/24/2021	45.0	1.2	0.0	1.2	42.0	0.0	0.1	47.0	0.1	49.0	42.0	7.0	0.0	45.8
11/25/2021	45.0	1.2	0.0	1.2	42.0	0.0	0.1	46.0	0.1	48.0	41.0	7.0	0.0	45.3
11/26/2021	46.0	1.3	0.0	1.1	42.0	0.0	0.1	46.0	0.1	48.0	41.0	7.0	0.0	45.5
11/27/2021	46.0	1.3	0.0	1.0	42.0	0.0	0.1	45.0	0.1	48.0	41.0	7.0	0.0	45.3
11/28/2021	46.0	1.3	0.0	1.1	41.0	0.0	0.1	46.0	0.1	49.0	42.0	7.0	0.0	45.5
11/29/2021	46.0	1.2	0.0	1.3	42.0	0.0	0.1	46.0	0.1	49.0	42.0	7.0	0.0	45.8
11/30/2021	46.0	1.2	0.0	1.3	44.0	0.0	0.1	44.0	0.1	49.0	42.0	7.0	0.0	45.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
12/1/2021	46.0	1.2	0.0	1.4	45.0	0.0	0.1	44.0	0.1	47.0	41.0	6.0	0.0	45.5
12/2/2021	46.0	1.2	0.0	1.4	45.0	0.0	0.1	44.0	0.1	49.0	43.0	6.0	0.0	46.0
12/3/2021	45.0	1.2	0.0	1.4	45.0	0.0	0.3	44.0	0.1	50.0	44.0	6.0	0.0	46.0
12/4/2021	45.0	1.2	0.0	1.4	45.0	0.0	0.5	45.0	0.1	50.0	44.0	6.0	0.0	46.3
12/5/2021	45.0	1.2	0.0	1.4	45.0	0.0	0.3	46.0	0.1	50.0	44.0	6.0	0.0	46.5
12/6/2021	46.0	1.2	0.0	1.4	45.0	0.0	0.3	45.0	0.1	51.0	45.0	6.0	0.0	46.8
12/7/2021	46.0	1.2	0.0	1.4	45.0	0.0	0.2	45.0	0.1	50.0	44.0	6.0	0.0	46.5
12/8/2021	43.0	1.2	0.0	1.3	45.0	0.0	0.2	45.0	0.1	51.0	45.0	6.0	0.0	46.0
12/9/2021	41.0	1.2	0.0	1.3	46.0	0.0	0.1	45.0	0.1	51.0	45.0	6.0	0.0	45.8
12/10/2021	42.0	1.2	0.0	1.3	45.0	0.0	0.1	45.0	0.1	52.0	46.0	6.0	0.0	46.0
12/11/2021	42.0	1.2	0.0	1.3	44.0	0.0	0.1	44.0	0.1	52.0	46.0	6.0	0.0	45.5
12/12/2021	42.0	1.2	0.0	1.3	43.0	0.0	0.1	44.0	0.1	52.0	46.0	6.0	0.0	45.3
12/13/2021	42.0	1.2	0.0	1.3	42.0	0.0	0.1	43.0	0.1	51.0	45.0	6.0	0.0	44.5
12/14/2021	42.0	1.2	0.0	1.3	43.0	0.0	0.0	42.0	0.1	51.0	45.0	6.0	0.0	44.5
12/15/2021	42.0	1.2	0.0	1.3	43.0	0.0	0.2	42.0	0.1	51.0	45.0	6.0	0.0	44.5
12/16/2021	42.0	1.2	0.0	1.3	43.0	0.0	0.2	43.0	0.1	51.0	45.0	6.0	0.0	44.8
12/17/2021	42.0	1.3	0.0	1.3	43.0	0.0	0.1	43.0	0.1	51.0	45.0	6.0	0.0	44.8
12/18/2021	42.0	1.3	0.0	1.3	42.0	0.0	0.1	43.0	0.1	52.0	46.0	6.0	0.0	44.8
12/19/2021	42.0	1.3	0.0	1.3	42.0	0.0	0.1	42.0	0.1	51.0	45.0	6.0	0.0	44.3
12/20/2021	42.0	1.3	0.0	1.3	42.0	0.0	0.1	42.0	0.1	50.0	44.0	6.0	0.0	44.0
12/21/2021	42.0	1.3	0.0	1.4	43.0	0.0	0.2	42.0	0.1	50.0	44.0	6.0	0.0	44.3
12/22/2021	42.0	1.3	0.0	1.4	41.0	0.0	0.2	42.0	0.1	49.0	43.0	6.0	0.0	43.5
12/23/2021	42.0	1.5	0.0	1.5	43.0	0.0	0.2	41.0	0.1	49.0	43.0	6.0	0.0	43.8
12/24/2021	41.0	1.6	0.0	1.5	44.0	0.0	0.1	44.0	0.1	49.0	43.0	6.0	0.0	44.5
12/25/2021	41.0	1.4	0.0	1.5	48.0	0.0	0.1	42.0	0.1	49.0	43.0	6.0	0.0	45.0
12/26/2021	42.0	1.3	0.0	1.4	49.0	0.0	0.0	45.0	0.1	50.0	44.0	6.0	0.0	46.5
12/27/2021	42.0	1.2	0.0	1.4	43.0	0.0	0.1	46.0	0.1	52.0	46.0	6.0	0.0	45.8
12/28/2021	42.0	1.0	0.0	1.3	41.0	0.0	0.3	47.0	0.1	53.0	47.0	6.0	0.0	45.8
12/29/2021	42.0	1.0	0.0	1.4	41.0	0.0	0.3	49.0	0.1	54.0	48.0	6.0	0.0	46.5
12/30/2021	42.0	1.0	0.0	1.4	40.0	0.0	0.3	48.0	0.1	53.0	47.0	6.0	0.0	45.8
12/31/2021	42.0	1.0	0.0	1.4	40.0	0.0	0.3	47.0	0.1	52.0	46.0	6.0	0.0	45.3

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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
1/1/2022	42.0	1.0	0.0	1.3	40.0	0.0	0.3	46.0	0.1	53.0	47.0	6.0	0.0	45.3
1/2/2022	42.0	1.1	0.0	1.3	40.0	0.0	0.2	45.0	0.1	54.0	48.0	6.0	0.0	45.3
1/3/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.2	44.0	0.1	54.0	48.0	6.0	0.0	45.0
1/4/2022	42.0	1.0	0.0	1.2	40.0	0.0	0.2	44.0	0.1	54.0	48.0	6.0	0.0	45.0
1/5/2022	42.0	1.2	0.0	1.2	39.0	0.0	0.2	44.0	0.1	54.0	48.0	6.0	0.0	44.8
1/6/2022	42.0	1.2	0.0	1.1	39.0	0.0	0.3	44.0	0.1	54.0	48.0	6.0	0.0	44.8
1/7/2022	42.0	1.2	0.0	1.1	40.0	0.0	0.3	44.0	0.1	53.0	47.0	6.0	0.0	44.8
1/8/2022	41.0	1.1	0.0	1.1	40.0	0.0	0.4	44.0	0.1	52.0	46.0	6.0	0.0	44.3
1/9/2022	42.0	1.0	0.0	1.1	40.0	0.0	0.4	44.0	0.1	52.0	46.0	6.0	0.0	44.5
1/10/2022	41.0	1.0	0.0	1.1	39.0	0.0	0.4	44.0	0.1	52.0	46.0	6.0	0.0	44.0
1/11/2022	41.0	1.1	0.0	1.1	39.0	0.0	0.4	43.0	0.1	52.0	46.0	6.0	0.0	43.8
1/12/2022	42.0	1.3	0.0	1.1	38.0	0.0	0.4	43.0	0.1	52.0	46.0	6.0	0.0	43.8
1/13/2022	42.0	1.3	0.0	1.1	43.0	0.0	0.3	43.0	0.1	51.0	45.0	6.0	0.0	44.8
1/14/2022	42.0	1.3	0.0	1.1	44.0	0.0	0.3	44.0	0.1	51.0	45.0	6.0	0.0	45.3
1/15/2022	42.0	1.3	0.0	1.1	43.0	0.0	0.3	42.0	0.1	51.0	45.0	6.0	0.0	44.5
1/16/2022	42.0	1.2	0.0	1.1	43.0	0.0	0.3	43.0	0.1	51.0	45.0	6.0	0.0	44.8
1/17/2022	41.0	1.2	0.0	1.1	44.0	0.0	0.3	43.0	0.1	52.0	46.0	6.0	0.0	45.0
1/18/2022	42.0	1.2	0.0	1.1	43.0	0.0	0.3	43.0	0.1	53.0	47.0	6.0	0.0	45.3
1/19/2022	41.0	1.2	0.0	1.1	44.0	0.0	0.4	44.0	0.0	52.0	46.0	6.0	0.0	45.3
1/20/2022	41.0	1.2	0.0	1.1	43.0	0.0	0.5	43.0	0.0	52.0	46.0	6.0	0.0	44.8
1/21/2022	42.0	1.1	0.0	1.1	43.0	0.0	0.4	44.0	0.0	52.0	46.0	6.0	0.0	45.3
1/22/2022	42.0	1.1	0.0	1.1	44.0	0.0	0.4	44.0	0.0	51.0	45.0	6.0	0.0	45.3
1/23/2022	42.0	1.1	0.0	1.1	43.0	0.0	0.4	42.0	0.0	52.0	46.0	6.0	0.0	44.8
1/24/2022	42.0	1.1	0.0	1.2	41.0	0.0	0.4	42.0	0.0	52.0	46.0	6.0	0.0	44.3
1/25/2022	42.0	1.1	0.0	1.2	42.0	0.0	0.4	44.0	0.0	52.0	46.0	6.0	0.0	45.0
1/26/2022	41.0	1.1	0.0	1.2	40.0	0.0	0.4	42.0	0.0	52.0	46.0	6.0	0.0	43.8
1/27/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.4	41.0	0.0	51.0	45.0	6.0	0.0	43.5
1/28/2022	42.0	1.0	0.0	1.2	40.0	0.0	0.4	41.0	0.0	51.0	45.0	6.0	0.0	43.5
1/29/2022	42.0	1.0	0.0	1.2	40.0	0.0	0.4	42.0	0.0	51.0	45.0	6.0	0.0	43.8
1/30/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.3	42.0	0.0	51.0	45.0	6.0	0.0	43.8
1/31/2022	42.0	1.2	0.0	1.2	41.0	0.0	0.3	42.0	0.0	50.0	44.0	6.0	0.0	43.8

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
2/1/2022	42.0	1.2	0.0	1.2	41.0	0.0	0.5	44.0	0.0	50.0	44.0	6.0	0.0	44.3
2/2/2022	42.0	1.1	0.0	1.2	41.0	0.0	0.4	44.0	0.0	49.0	43.0	6.0	0.0	44.0
2/3/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.4	42.0	0.0	49.0	43.0	6.0	0.0	43.3
2/4/2022	41.0	1.1	0.0	1.2	40.0	0.0	0.4	42.0	0.0	49.0	43.0	6.0	0.0	43.0
2/5/2022	41.0	1.1	0.0	1.2	41.0	0.0	0.3	43.0	0.0	49.0	43.0	6.0	0.0	43.5
2/6/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.3	43.0	0.0	50.0	44.0	6.0	0.0	43.8
2/7/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.3	41.0	0.0	50.0	44.0	6.0	0.0	43.3
2/8/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.3	42.0	0.0	51.0	45.0	6.0	0.0	43.8
2/9/2022	42.0	1.1	0.0	1.2	40.0	0.0	0.3	43.0	0.0	51.0	45.0	6.0	0.0	44.0
2/10/2022	42.0	1.1	0.0	1.2	41.0	0.0	0.3	43.0	0.0	51.0	45.0	6.0	0.0	44.3
2/11/2022	42.0	1.2	0.0	1.2	40.0	0.0	0.3	41.0	0.0	51.0	45.0	6.0	0.0	43.5
2/12/2022	42.0	1.2	0.0	1.1	40.0	0.0	0.3	42.0	0.0	51.0	45.0	6.0	0.0	43.8
2/13/2022	42.0	1.2	0.0	1.1	41.0	0.0	0.4	42.0	0.0	51.0	45.0	6.0	0.0	44.0
2/14/2022	42.0	1.2	0.0	1.2	40.0	0.0	0.4	42.0	0.0	51.0	45.0	6.0	0.0	43.8
2/15/2022	42.0	1.2	0.0	1.2	41.0	0.0	0.4	45.0	0.0	51.0	45.0	6.0	0.0	44.8
2/16/2022	42.0	1.1	0.0	1.1	41.0	0.0	0.4	44.0	0.0	50.0	44.0	6.0	0.0	44.3
2/17/2022	42.0	1.1	0.0	1.1	41.0	0.0	0.3	43.0	0.0	50.0	44.0	6.0	0.0	44.0
2/18/2022	42.0	1.3	0.0	1.1	40.0	0.0	0.3	42.0	0.0	50.0	44.0	6.0	0.0	43.5
2/19/2022	42.0	1.1	0.0	1.1	40.0	0.0	0.3	42.0	0.0	50.0	44.0	6.0	0.0	43.5
2/20/2022	42.0	1.1	0.0	1.1	40.0	0.0	0.3	43.0	0.0	50.0	44.0	6.0	0.0	43.8
2/21/2022	42.0	1.1	0.0	1.1	40.0	0.0	0.5	44.0	0.0	50.0	44.0	6.0	0.0	44.0
2/22/2022	42.0	1.1	0.0	1.1	41.0	0.0	0.4	43.0	0.0	49.0	43.0	6.0	0.0	43.8
2/23/2022	42.0	1.1	0.0	1.1	43.0	0.0	0.4	41.0	0.0	50.0	44.0	6.0	0.0	44.0
2/24/2022	42.0	1.2	0.0	1.1	41.0	0.0	0.4	38.0	0.0	49.0	43.0	6.0	0.0	42.5
2/25/2022	41.0	1.0	0.0	1.1	40.0	0.0	0.4	39.0	0.0	49.0	43.0	6.0	0.0	42.3
2/26/2022	41.0	1.0	0.0	1.1	39.0	0.0	0.4	39.0	0.0	49.0	43.0	6.0	0.0	42.0
2/27/2022	42.0	1.1	0.0	1.1	40.0	0.0	0.5	39.0	0.0	49.0	43.0	6.0	0.0	42.5
2/28/2022	42.0	1.2	0.0	1.1	39.0	0.0	0.5	39.0	0.0	49.0	43.0	6.0	0.0	42.3

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3/1/2022	42.0	1.2	0.0	1.1	40.0	0.0	0.5	39.0	0.0	50.0	41.0	9.0	0.0	42.8
3/2/2022	42.0	1.1	0.0	1.1	39.0	0.0	0.5	38.0	0.0	49.0	39.0	10.0	0.0	42.0
3/3/2022	42.0	1.2	0.0	1.1	39.0	0.0	0.4	37.0	0.0	49.0	39.0	10.0	0.0	41.8
3/4/2022	41.0	1.3	0.0	1.1	41.0	0.0	0.4	38.0	0.0	50.0	40.0	10.0	0.0	42.5
3/5/2022	42.0	1.3	0.0	1.1	41.0	0.0	0.4	40.0	0.0	50.0	40.0	10.0	0.0	43.3
3/6/2022	42.0	1.2	0.0	1.1	41.0	0.0	0.4	39.0	0.0	50.0	40.0	10.0	0.0	43.0
3/7/2022	42.0	1.1	0.0	1.1	41.0	0.0	0.4	41.0	0.0	50.0	40.0	10.0	0.0	43.5
3/8/2022	42.0	1.1	0.0	1.1	41.0	0.0	0.4	39.0	0.0	48.0	38.0	10.0	0.0	42.5
3/9/2022	42.0	1.1	0.0	1.1	39.0	0.0	0.4	39.0	0.0	51.0	41.0	10.0	0.0	42.8
3/10/2022	42.0	1.1	0.0	1.2	41.0	0.0	0.4	43.0	0.0	49.0	39.0	10.0	0.0	43.8
3/11/2022	42.0	1.1	0.0	1.1	40.0	0.0	0.5	39.0	0.0	49.0	39.0	10.0	0.0	42.5
3/12/2022	41.0	1.3	0.0	1.1	39.0	0.0	0.5	38.0	0.0	49.0	39.0	10.0	0.0	41.8
3/13/2022	42.0	1.2	0.0	1.1	39.0	0.0	0.4	41.0	0.0	49.0	39.0	10.0	0.0	42.8
3/14/2022	46.0	1.2	0.0	1.1	39.0	0.0	0.4	38.0	0.0	49.0	39.0	10.0	0.0	43.0
3/15/2022	48.0	1.2	0.0	1.1	39.0	0.0	0.4	38.0	0.0	46.0	35.0	10.0	1.0	42.8
3/16/2022	48.0	1.1	0.0	1.1	39.0	0.0	0.4	41.0	0.0	51.0	41.0	10.0	0.0	44.8
3/17/2022	47.0	1.1	0.0	1.1	43.0	0.0	0.5	39.0	0.0	50.0	40.0	10.0	0.0	44.8
3/18/2022	48.0	1.2	0.0	1.2	41.0	0.0	0.5	38.0	0.0	50.0	40.0	10.0	0.0	44.3
3/19/2022	48.0	1.2	0.0	1.2	42.0	0.0	0.4	40.0	0.0	49.0	39.0	10.0	0.0	44.8
3/20/2022	47.0	1.2	0.0	1.2	42.0	0.0	0.4	45.0	0.0	49.0	39.0	10.0	0.0	45.8
3/21/2022	48.0	1.1	0.0	1.2	42.0	0.0	0.4	44.0	0.0	49.0	39.0	10.0	0.0	45.8
3/22/2022	48.0	1.1	0.0	1.2	46.0	0.0	0.4	44.0	0.0	48.0	38.0	10.0	0.0	46.5
3/23/2022	48.0	1.1	0.0	1.1	46.0	0.0	0.4	44.0	0.0	49.0	39.0	10.0	0.0	46.8
3/24/2022	48.0	1.1	0.0	1.2	46.0	0.0	0.4	44.0	0.0	49.0	39.0	10.0	0.0	46.8
3/25/2022	48.0	1.1	0.0	1.2	46.0	0.0	0.4	44.0	0.0	50.0	40.0	10.0	0.0	47.0
3/26/2022	48.0	1.1	0.0	1.2	47.0	0.0	0.3	43.0	0.0	51.0	41.0	10.0	0.0	47.3
3/27/2022	48.0	1.1	0.0	1.1	48.0	0.0	0.4	41.0	0.0	51.0	41.0	10.0	0.0	47.0
3/28/2022	48.0	1.2	0.0	1.1	48.0	0.0	0.5	42.0	0.0	44.0	35.0	9.0	0.0	45.5
3/29/2022	48.0	1.2	0.0	1.1	47.0	0.0	0.5	46.0	0.0	53.0	43.0	10.0	0.0	48.5
3/30/2022	48.0	1.2	0.0	1.1	47.0	0.0	0.5	45.0	0.0	48.0	41.0	7.0	0.0	47.0
3/31/2022	48.0	1.2	0.0	1.1	47.0	0.0	0.4	45.0	0.0	51.0	41.0	10.0	0.0	47.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
4/1/2022	47.0	1.2	0.0	1.1	46.0	0.0	0.4	45.0	0.0	49.0	39.0	10.0	0.0	46.8
4/2/2022	48.0	1.2	0.0	1.2	47.0	0.0	0.4	45.0	0.0	49.0	39.0	10.0	0.0	47.3
4/3/2022	47.0	1.2	0.0	1.2	47.0	0.0	0.4	45.0	0.0	50.0	40.0	10.0	0.0	47.3
4/4/2022	48.0	1.1	0.0	1.2	47.0	0.0	0.4	44.0	0.0	50.0	39.0	11.0	0.0	47.3
4/5/2022	47.0	1.1	0.0	1.3	47.0	0.0	0.4	44.0	0.0	49.0	37.0	12.0	0.0	46.8
4/6/2022	48.0	1.1	0.0	1.2	47.0	0.0	0.3	44.0	0.0	50.0	37.0	13.0	0.0	47.3
4/7/2022	48.0	1.2	0.0	1.2	47.0	0.0	0.4	43.0	0.0	50.0	37.0	13.0	0.0	47.0
4/8/2022	48.0	1.3	0.0	1.2	47.0	0.0	0.3	43.0	0.0	50.0	37.0	13.0	0.0	47.0
4/9/2022	48.0	1.1	0.0	1.1	48.0	0.0	0.4	44.0	0.0	50.0	37.0	13.0	0.0	47.5
4/10/2022	48.0	1.1	0.0	1.1	47.0	0.0	0.3	44.0	0.0	49.0	36.0	13.0	0.0	47.0
4/11/2022	47.0	1.1	0.0	1.0	43.0	0.0	0.3	44.0	0.0	49.0	36.0	13.0	0.0	45.8
4/12/2022	47.0	1.1	0.0	1.0	45.0	0.0	0.3	44.0	0.0	49.0	36.0	13.0	0.0	46.3
4/13/2022	47.0	1.2	0.0	1.0	46.0	0.0	0.3	43.0	0.0	48.0	35.0	13.0	0.0	46.0
4/14/2022	48.0	1.0	0.0	1.1	46.0	0.0	0.3	43.0	0.0	48.0	35.0	13.0	0.0	46.3
4/15/2022	48.0	1.0	0.0	1.1	45.0	0.0	0.2	42.0	0.0	48.0	35.0	13.0	0.0	45.8
4/16/2022	47.0	1.1	0.0	1.2	46.0	0.0	0.3	43.0	0.0	47.0	34.0	13.0	0.0	45.8
4/17/2022	48.0	1.1	0.0	1.2	46.0	0.0	0.2	42.0	0.0	47.0	34.0	13.0	0.0	45.8
4/18/2022	48.0	1.0	0.0	1.2	45.0	0.0	0.2	42.0	0.0	47.0	34.0	13.0	0.0	45.5
4/19/2022	48.0	0.9	0.0	1.2	45.0	0.0	0.2	42.0	0.0	47.0	34.0	13.0	0.0	45.5
4/20/2022	53.0	1.0	0.0	1.2	45.0	0.0	0.2	46.0	0.0	47.0	34.0	13.0	0.0	47.8
4/21/2022	56.0	1.0	0.0	1.2	45.0	0.0	0.2	45.0	0.0	46.0	33.0	13.0	0.0	48.0
4/22/2022	56.0	1.0	0.0	1.2	45.0	0.0	0.2	47.0	0.0	47.0	34.0	13.0	0.0	48.8
4/23/2022	56.0	1.1	0.0	1.1	48.0	0.0	0.4	46.0	0.0	46.0	33.0	13.0	0.0	49.0
4/24/2022	56.0	1.2	0.0	1.2	50.0	0.0	0.4	46.0	0.0	46.0	33.0	13.0	0.0	49.5
4/25/2022	57.0	1.1	0.0	1.2	52.0	0.0	0.4	46.0	0.0	46.0	33.0	13.0	0.0	50.3
4/26/2022	56.0	1.1	0.0	1.3	52.0	0.0	0.4	48.0	0.0	44.0	31.0	13.0	0.0	50.0
4/27/2022	56.0	1.1	0.0	1.3	52.0	0.0	0.4	50.0	0.0	51.0	38.0	13.0	0.0	52.3
4/28/2022	57.0	1.2	0.0	1.3	52.0	0.0	0.4	52.0	0.0	47.0	34.0	13.0	0.0	52.0
4/29/2022	56.0	1.2	0.0	1.2	52.0	0.0	0.3	52.0	0.0	46.0	33.0	13.0	0.0	51.5
4/30/2022	56.0	1.2	0.0	1.2	52.0	0.0	0.3	53.0	0.0	46.0	33.0	13.0	0.0	51.8

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
5/1/2022	57.0	1.1	0.0	1.0	52.0	0.0	0.2	54.0	0.0	46.0	33.0	13.0	0.0	52.3
5/2/2022	56.0	1.1	0.0	1.0	53.0	0.0	0.2	53.0	0.0	46.0	33.0	13.0	0.0	52.0
5/3/2022	56.0	1.1	0.0	1.2	53.0	0.0	0.3	54.0	0.0	46.0	33.0	13.0	0.0	52.3
5/4/2022	56.0	1.2	0.0	1.3	53.0	0.0	0.6	53.0	0.0	46.0	33.0	13.0	0.0	52.0
5/5/2022	56.0	1.1	0.0	1.3	53.0	0.0	0.4	53.0	0.0	49.0	36.0	13.0	0.0	52.8
5/6/2022	56.0	1.1	0.0	1.4	53.0	0.0	0.3	54.0	0.0	48.0	35.0	13.0	0.0	52.8
5/7/2022	56.0	1.1	0.0	1.4	53.0	0.0	0.3	55.0	0.0	48.0	35.0	13.0	0.0	53.0
5/8/2022	56.0	1.1	0.0	1.4	53.0	0.0	0.2	54.0	0.0	48.0	35.0	13.0	0.0	52.8
5/9/2022	57.0	1.2	0.0	1.2	53.0	0.0	0.2	53.0	0.0	49.0	36.0	13.0	0.0	53.0
5/10/2022	56.0	1.2	0.0	1.0	54.0	0.0	0.2	52.0	0.0	48.0	35.0	13.0	0.0	52.5
5/11/2022	56.0	1.2	0.0	1.0	54.0	0.0	0.2	53.0	0.0	48.0	35.0	13.0	0.0	52.8
5/12/2022	56.0	1.2	0.0	1.0	54.0	0.0	0.2	52.0	0.0	48.0	35.0	13.0	0.0	52.5
5/13/2022	57.0	1.2	0.0	1.1	54.0	0.0	0.2	53.0	0.0	47.0	34.0	13.0	0.0	52.8
5/14/2022	57.0	1.2	0.0	1.1	54.0	0.0	0.2	53.0	0.0	47.0	34.0	13.0	0.0	52.8
5/15/2022	56.0	1.2	0.0	1.1	55.0	0.0	0.3	53.0	0.0	47.0	34.0	13.0	0.0	52.8
5/16/2022	57.0	1.2	0.0	1.1	55.0	0.0	0.3	53.0	0.0	45.0	39.0	6.0	0.0	52.5
5/17/2022	57.0	1.2	0.0	1.1	55.0	0.0	0.3	54.0	0.0	47.0	44.0	3.0	0.0	53.3
5/18/2022	51.0	1.4	0.0	1.1	53.0	0.0	0.3	54.0	0.0	47.0	44.0	3.0	0.0	51.3
5/19/2022	47.0	1.4	0.0	1.2	53.0	0.0	0.2	54.0	0.0	46.0	43.0	3.0	0.0	50.0
5/20/2022	58.0	1.2	0.0	1.2	53.0	0.0	0.2	55.0	0.0	46.0	43.0	3.0	0.0	53.0
5/21/2022	67.0	1.0	0.0	1.1	49.0	0.0	0.5	53.0	0.0	45.0	42.0	3.0	0.0	53.5
5/22/2022	66.0	1.1	0.0	1.1	46.0	0.0	0.5	52.0	0.0	46.0	43.0	3.0	0.0	52.5
5/23/2022	66.0	1.2	0.0	1.1	50.0	0.0	0.5	52.0	0.0	45.0	42.0	3.0	0.0	53.3
5/24/2022	66.0	1.1	0.0	1.1	55.0	0.0	0.4	51.0	0.0	45.0	42.0	3.0	0.0	54.3
5/25/2022	66.0	1.0	0.0	1.1	57.0	0.0	0.4	48.0	0.0	45.0	42.0	3.0	0.0	54.0
5/26/2022	66.0	1.1	0.0	1.1	57.0	0.0	0.3	47.0	0.0	45.0	42.0	3.0	0.0	53.8
5/27/2022	67.0	1.1	0.0	1.1	57.0	0.0	0.2	49.0	0.0	43.0	40.0	3.0	0.0	54.0
5/28/2022	66.0	1.0	0.0	1.1	57.0	0.0	0.2	52.0	0.0	43.0	40.0	3.0	0.0	54.5
5/29/2022	67.0	1.1	0.0	1.0	57.0	0.0	0.2	52.0	0.0	43.0	40.0	3.0	0.0	54.8
5/30/2022	66.0	1.3	0.0	1.0	57.0	0.0	0.2	53.0	0.0	41.0	38.0	3.0	0.0	54.3
5/31/2022	66.0	1.2	0.0	1.0	58.0	0.0	0.3	54.0	0.0	40.0	37.0	3.0	0.0	54.5

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Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman n Gate to Delta	Weir to Delta	In Channel Average Flow
6/1/2022	66.0	1.1	0.0	1.1	54.0	0.0	0.3	46.0	0.0	40.0	37.0	3.0	0.0	51.5
6/2/2022	67.0	1.0	0.0	1.1	54.0	0.0	0.3	47.0	0.0	41.0	38.0	3.0	0.0	52.3
6/3/2022	66.0	1.0	0.0	1.1	54.0	0.0	0.3	47.0	0.0	41.0	38.0	3.0	0.0	52.0
6/4/2022	66.0	1.1	0.0	1.1	54.0	0.0	0.4	48.0	0.0	42.0	39.0	3.0	0.0	52.5
6/5/2022	66.0	1.2	0.0	1.0	55.0	0.0	0.4	49.0	0.0	42.0	39.0	3.0	0.0	53.0
6/6/2022	66.0	1.2	0.0	1.1	55.0	0.0	0.5	48.0	0.0	43.0	40.0	3.0	0.0	53.0
6/7/2022	73.0	1.1	0.0	1.0	55.0	0.0	0.4	48.0	0.0	42.0	39.0	3.0	0.0	54.5
6/8/2022	78.0	1.0	0.0	1.1	54.0	0.0	0.3	47.0	0.0	42.0	39.0	3.0	0.0	55.3
6/9/2022	78.0	1.0	0.0	1.3	53.0	0.0	0.3	47.0	0.0	42.0	39.0	3.0	0.0	55.0
6/10/2022	78.0	1.1	0.0	1.4	54.0	0.0	0.3	46.0	0.0	42.0	39.0	3.0	0.0	55.0
6/11/2022	78.0	1.0	0.0	1.3	56.0	0.0	0.3	47.0	0.0	42.0	39.0	3.0	0.0	55.8
6/12/2022	78.0	1.2	0.0	1.0	57.0	0.0	0.4	42.0	0.0	41.0	38.0	3.0	0.0	54.5
6/13/2022	79.0	1.1	0.0	1.2	58.0	0.0	0.4	45.0	0.0	40.0	37.0	3.0	0.0	55.5
6/14/2022	78.0	1.2	0.0	1.0	64.0	0.0	0.4	52.0	0.0	40.0	37.0	3.0	0.0	58.5
6/15/2022	78.0	1.3	0.0	1.0	65.0	0.0	0.3	54.0	0.0	40.0	37.0	3.0	0.0	59.3
6/16/2022	79.0	1.1	0.0	1.1	66.0	0.0	0.4	54.0	0.0	39.0	36.0	3.0	0.0	59.5
6/17/2022	64.0	1.1	0.0	1.1	67.0	0.0	0.4	54.0	0.0	38.0	35.0	3.0	0.0	55.8
6/18/2022	56.0	1.2	0.0	1.2	67.0	0.0	0.3	56.0	0.0	38.0	35.0	3.0	0.0	54.3
6/19/2022	72.0	1.2	0.0	1.2	68.0	0.0	0.3	57.0	0.0	38.0	35.0	3.0	0.0	58.8
6/20/2022	81.0	1.1	0.0	1.2	66.0	0.0	0.3	57.0	0.0	39.0	36.0	3.0	0.0	60.8
6/21/2022	81.0	1.0	0.0	1.2	59.0	0.0	0.4	58.0	0.0	39.0	36.0	3.0	0.0	59.3
6/22/2022	82.0	1.3	0.0	1.2	59.0	0.0	0.3	59.0	8.5	38.0	34.0	3.0	1.0	59.5
6/23/2022	82.0	1.3	0.0	1.1	63.0	0.0	0.2	60.0	16.3	42.0	39.0	3.0	0.0	61.8
6/24/2022	81.0	1.2	0.0	1.2	68.0	0.0	0.2	59.0	13.6	42.0	39.0	3.0	0.0	62.5
6/25/2022	81.0	1.0	0.0	1.2	70.0	0.0	0.2	57.0	13.7	42.0	39.0	3.0	0.0	62.5
6/26/2022	81.0	1.0	0.0	1.1	70.0	0.0	0.2	57.0	6.4	44.0	41.0	3.0	0.0	63.0
6/27/2022	82.0	1.0	0.0	1.0	70.0	0.0	0.5	56.0	0.0	47.0	44.0	3.0	0.0	63.8
6/28/2022	90.0	1.1	0.0	1.0	70.0	0.0	0.4	59.0	0.0	47.0	44.0	3.0	0.0	66.5
6/29/2022	95.0	1.0	0.0	1.0	71.0	0.0	0.3	61.0	0.0	49.0	44.0	3.0	2.0	69.0
6/30/2022	94.0	0.9	0.0	1.2	71.0	0.0	0.3	61.0	0.0	48.0	44.0	3.0	1.0	68.5

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7/1/2022	94.0	1.0	0.0	1.3	70.0	0.0	0.2	62.0	0.0	47.0	44.0	3.0	0.0	68.3
7/2/2022	93.0	1.0	0.0	1.3	73.0	0.0	0.2	60.0	0.0	41.0	38.0	3.0	0.0	66.8
7/3/2022	93.0	1.3	0.0	1.2	75.0	0.0	0.2	61.0	0.0	40.0	37.0	3.0	0.0	67.3
7/4/2022	94.0	1.3	0.0	0.9	77.0	0.0	0.2	61.0	0.0	41.0	38.0	3.0	0.0	68.3
7/5/2022	94.0	1.0	0.0	0.8	78.0	0.0	0.2	61.0	0.0	41.0	38.0	3.0	0.0	68.5
7/6/2022	94.0	1.0	0.0	0.9	80.0	0.0	0.2	60.0	0.0	41.0	38.0	3.0	0.0	68.8
7/7/2022	94.0	1.1	0.0	1.1	81.0	0.0	0.2	61.0	0.0	41.0	38.0	3.0	0.0	69.3
7/8/2022	94.0	1.0	0.0	1.1	81.0	0.0	0.2	62.0	0.0	41.0	38.0	3.0	0.0	69.5
7/9/2022	94.0	1.0	0.0	1.1	82.0	0.0	0.2	64.0	0.0	40.0	37.0	3.0	0.0	70.0
7/10/2022	92.0	1.0	0.0	1.1	83.0	0.0	0.2	67.0	0.0	41.0	38.0	3.0	0.0	70.8
7/11/2022	92.0	0.9	0.0	1.1	84.0	0.0	0.2	66.0	0.0	40.0	37.0	3.0	0.0	70.5
7/12/2022	94.0	1.2	0.0	1.0	84.0	0.0	0.1	67.0	0.0	41.0	38.0	3.0	0.0	71.5
7/13/2022	92.0	0.8	0.0	1.0	84.0	0.0	0.1	68.0	0.0	41.0	38.0	3.0	0.0	71.3
7/14/2022	92.0	0.9	0.0	1.0	84.0	0.0	0.2	70.0	0.0	41.0	38.0	3.0	0.0	71.8
7/15/2022	94.0	1.6	0.0	1.0	85.0	0.0	0.2	71.0	0.0	42.0	39.0	3.0	0.0	73.0
7/16/2022	95.0	1.5	0.0	1.0	85.0	0.0	0.2	71.0	0.0	42.0	39.0	3.0	0.0	73.3
7/17/2022	95.0	1.5	0.0	1.0	86.0	0.0	0.2	70.0	0.0	42.0	39.0	3.0	0.0	73.3
7/18/2022	92.0	1.3	0.0	1.1	87.0	0.0	0.3	70.0	0.0	43.0	40.0	3.0	0.0	73.0
7/19/2022	92.0	1.2	0.0	1.2	89.0	0.0	0.4	70.0	0.0	45.0	42.0	3.0	0.0	74.0
7/20/2022	75.0	1.2	0.0	1.2	89.0	0.0	0.4	70.0	0.0	46.0	43.0	3.0	0.0	70.0
7/21/2022	63.0	1.1	0.0	1.1	88.0	0.0	0.3	68.0	0.0	46.0	43.0	3.0	0.0	66.3
7/22/2022	78.0	1.1	0.0	1.1	86.0	0.0	0.3	67.0	0.0	46.0	43.0	3.0	0.0	69.3
7/23/2022	95.0	0.9	0.0	0.9	84.0	0.0	0.3	69.0	0.0	46.0	43.0	3.0	0.0	73.5
7/24/2022	93.0	1.0	0.0	0.9	79.0	0.0	0.2	70.0	0.0	45.0	42.0	3.0	0.0	71.8
7/25/2022	93.0	1.2	0.0	1.1	72.0	0.0	0.4	70.0	0.0	45.0	42.0	3.0	0.0	70.0
7/26/2022	94.0	1.2	0.0	1.1	75.0	0.0	0.3	74.0	0.0	45.0	42.0	3.0	0.0	72.0
7/27/2022	92.0	1.0	0.0	1.2	80.0	0.0	0.3	72.0	0.0	45.0	42.0	3.0	0.0	72.3
7/28/2022	86.0	1.0	0.0	1.2	84.0	0.0	0.2	70.0	0.0	45.0	42.0	3.0	0.0	71.3
7/29/2022	80.0	1.1	0.0	1.1	84.0	0.0	0.2	65.0	0.0	48.0	45.0	3.0	0.0	69.3
7/30/2022	80.0	1.3	0.0	1.0	85.0	0.0	0.1	66.0	0.0	47.0	45.0	2.0	0.0	69.5
7/31/2022	82.0	1.3	0.0	1.0	85.0	0.0	0.1	66.0	0.0	48.0	39.0	2.0	7.0	70.3
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8/1/2022	82.0	1.3	0.0	1.0	84.0	0.0	0.1	68.0	0.0	52.0	19.0	3.0	30.0	71.5
8/2/2022	82.0	1.3	0.0	1.0	83.0	0.0	0.1	70.0	0.0	49.0	39.0	3.0	7.0	71.0
8/3/2022	81.0	1.1	0.0	1.0	82.0	0.0	0.1	74.0	0.0	51.0	48.0	3.0	0.0	72.0
8/4/2022	82.0	1.0	0.0	1.2	82.0	0.0	0.0	73.0	0.0	51.0	48.0	3.0	0.0	72.0
8/5/2022	81.0	1.1	0.0	1.4	82.0	0.0	0.1	76.0	0.0	51.0	48.0	3.0	0.0	72.5
8/6/2022	81.0	1.0	0.0	1.4	81.0	0.0	0.1	75.0	0.0	52.0	48.0	3.0	1.0	72.3
8/7/2022	80.0	1.2	0.0	1.4	83.0	0.0	0.1	73.0	0.0	53.0	48.0	3.0	2.0	72.3
8/8/2022	80.0	1.2	0.0	1.1	83.0	0.0	0.1	73.0	0.0	54.0	48.0	3.0	3.0	72.5
8/9/2022	82.0	1.0	0.0	0.9	73.0	0.0	0.0	77.0	0.0	56.0	48.0	3.0	5.0	72.0
8/10/2022	80.0	1.0	0.0	0.9	72.0	0.0	0.1	76.0	0.0	57.0	48.0	3.0	6.0	71.3
8/11/2022	81.0	1.2	0.0	1.1	72.0	0.0	0.1	74.0	0.0	56.0	48.0	3.0	5.0	70.8
8/12/2022	81.0	1.3	0.0	1.2	72.0	0.0	0.1	73.0	0.0	54.0	48.0	3.0	3.0	70.0
8/13/2022	81.0	1.1	0.0	1.4	72.0	0.0	0.0	72.0	0.0	53.0	48.0	3.0	2.0	69.5
8/14/2022	81.0	1.0	0.0	1.4	71.0	0.0	0.0	71.0	0.0	53.0	48.0	3.0	2.0	69.0
8/15/2022	81.0	1.2	0.0	1.4	71.0	0.0	0.0	70.0	0.0	53.0	48.0	3.0	2.0	68.8
8/16/2022	65.0	1.1	0.0	1.4	71.0	0.0	0.0	70.0	0.0	52.0	48.0	3.0	1.0	64.5
8/17/2022	57.0	1.1	0.0	1.4	71.0	0.0	0.0	69.0	0.0	52.0	48.0	3.0	1.0	62.3
8/18/2022	65.0	1.1	0.0	1.4	71.0	0.0	0.2	71.0	0.0	51.0	48.0	3.0	0.0	64.5
8/19/2022	70.0	1.1	0.0	1.3	70.0	0.0	0.4	71.0	0.0	51.0	48.0	3.0	0.0	65.5
8/20/2022	70.0	1.0	0.0	1.1	63.0	0.0	0.2	71.0	0.0	51.0	48.0	3.0	0.0	63.8
8/21/2022	70.0	1.0	0.0	1.1	58.0	0.0	0.1	70.0	0.0	50.0	47.0	3.0	0.0	62.0
8/22/2022	70.0	1.2	0.0	1.1	58.0	0.0	0.1	71.0	0.0	49.0	46.0	3.0	0.0	62.0
8/23/2022	70.0	1.1	0.0	1.1	59.0	0.0	0.1	71.0	0.0	49.0	46.0	3.0	0.0	62.3
8/24/2022	70.0	1.1	0.0	1.1	58.0	0.0	0.2	70.0	0.0	48.0	45.0	3.0	0.0	61.5
8/25/2022	70.0	1.1	0.0	1.1	58.0	0.0	0.1	67.0	0.0	48.0	45.0	3.0	0.0	60.8
8/26/2022	70.0	1.1	0.0	1.2	59.0	0.0	0.1	64.0	0.0	47.0	44.0	3.0	0.0	60.0
8/27/2022	70.0	1.1	0.0	1.1	59.0	0.0	0.1	62.0	0.0	46.0	43.0	3.0	0.0	59.3
8/28/2022	69.0	1.3	0.0	1.1	59.0	0.0	0.1	61.0	0.0	46.0	43.0	3.0	0.0	58.8
8/29/2022	70.0	1.2	0.0	1.1	58.0	0.0	0.0	59.0	0.0	46.0	43.0	3.0	0.0	58.3
8/30/2022	70.0	1.2	0.0	1.0	58.0	0.0	0.0	60.0	0.0	45.0	42.0	3.0	0.0	58.3
8/31/2022	70.0	1.2	0.0	1.0	57.0	0.0	0.0	59.0	0.0	44.0	41.0	3.0	0.0	57.5

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

Flow Gaging Station / Date	Below River Intake	Blackrock Ditch Return	Goose Lake Return	Billy Lake Return	Mazourka Canyon Road	Locust Ditch Return	Georges Ditch Return	Reinhackle Springs	Alabama Gates Return	At Pumpback Station	Pump Station	Langeman Gate to Delta	Weir to Delta	In Channel Average Flow
9/1/2022	70.0	1.2	0.0	0.9	58.0	0.0	0.0	59.0	0.0	44.0	36.0	8.0	0.0	57.8
9/2/2022	70.0	1.2	0.0	1.0	58.0	0.0	0.0	58.0	0.0	42.0	31.0	11.0	0.0	57.0
9/3/2022	70.0	1.1	0.0	1.0	58.0	0.0	0.1	57.0	0.0	39.0	28.0	11.0	0.0	56.0
9/4/2022	70.0	1.1	0.0	1.1	58.0	0.0	0.1	58.0	0.0	38.0	27.0	11.0	0.0	56.0
9/5/2022	70.0	1.0	0.0	1.1	58.0	0.0	0.2	56.0	0.0	39.0	28.0	11.0	0.0	55.8
9/6/2022	71.0	1.0	0.0	1.1	63.0	0.0	0.5	59.0	0.0	38.0	27.0	11.0	0.0	57.8
9/7/2022	70.0	1.1	0.0	1.0	63.0	0.0	3.4	55.0	0.0	39.0	28.0	11.0	0.0	56.8
9/8/2022	70.0	1.1	0.0	1.0	62.0	0.0	2.6	58.0	9.3	38.0	27.0	11.0	0.0	57.0
9/9/2022	70.0	1.1	0.0	1.0	63.0	0.0	4.4	57.0	15.9	38.0	27.0	11.0	0.0	57.0
9/10/2022	66.0	1.2	0.0	1.1	64.0	0.0	8.1	61.0	15.6	38.0	27.0	11.0	0.0	57.3
9/11/2022	56.0	1.2	0.0	1.3	66.0	0.0	8.4	65.0	6.3	41.0	30.0	11.0	0.0	57.0
9/12/2022	56.0	1.2	0.0	1.3	66.0	0.0	8.5	66.0	0.0	44.0	33.0	11.0	0.0	58.0
9/13/2022	56.0	1.3	0.0	1.4	65.0	0.0	8.7	67.0	0.0	47.0	36.0	11.0	0.0	58.8
9/14/2022	55.0	1.3	0.0	1.4	62.0	0.0	9.0	67.0	0.0	52.0	41.0	11.0	0.0	59.0
9/15/2022	56.0	1.3	0.0	1.4	58.0	0.0	8.9	67.0	0.0	57.0	46.0	11.0	0.0	59.5
9/16/2022	56.0	0.9	0.0	1.3	55.0	0.0	10.1	67.0	0.0	57.0	46.0	11.0	0.0	58.8
9/17/2022	56.0	1.1	0.0	1.2	54.0	0.0	10.5	67.0	0.0	55.0	44.0	11.0	0.0	58.0
9/18/2022	56.0	1.2	0.0	1.0	53.0	0.0	7.7	62.0	0.0	52.0	41.0	11.0	0.0	55.8
9/19/2022	56.0	1.0	0.0	1.0	51.0	0.0	8.6	59.0	0.0	52.0	41.0	11.0	0.0	54.5
9/20/2022	56.0	1.1	0.0	1.0	51.0	0.0	9.6	57.0	0.0	51.0	40.0	11.0	0.0	53.8
9/21/2022	56.0	1.2	0.0	1.0	50.0	0.0	9.9	56.0	0.0	51.0	40.0	11.0	0.0	53.3
9/22/2022	56.0	1.3	0.0	1.1	51.0	0.0	10.3	56.0	0.0	51.0	40.0	11.0	0.0	53.5
9/23/2022	55.0	1.3	0.0	1.2	51.0	0.0	9.8	56.0	0.0	50.0	39.0	11.0	0.0	53.0
9/24/2022	56.0	1.2	0.0	1.3	51.0	0.0	9.8	55.0	0.0	49.0	38.0	11.0	0.0	52.8
9/25/2022	56.0	1.2	0.0	1.3	51.0	0.0	9.7	55.0	0.0	48.0	37.0	11.0	0.0	52.5
9/26/2022	56.0	1.1	0.0	1.3	51.0	0.0	9.7	55.0	0.0	47.0	36.0	11.0	0.0	52.3
9/27/2022	56.0	1.1	0.0	1.3	50.0	0.0	9.6	55.0	0.0	46.0	35.0	11.0	0.0	51.8
9/28/2022	56.0	1.2	0.0	1.2	50.0	0.0	9.8	56.0	0.0	46.0	35.0	11.0	0.0	52.0
9/29/2022	56.0	1.2	0.0	1.1	50.0	0.0	9.8	55.0	0.0	46.0	35.0	11.0	0.0	51.8
9/30/2022	56.0	1.1	0.0	1.1	50.0	0.0	9.7	55.0	0.0	46.0	35.0	11.0	0.0	51.8
Notes:	These measurements are not on the main channel of the Owens River, therefore highlighted columns are not included in average calculations.													

3.0 LORP RIVERINE-RIPARIAN AREA

3.1 LORP Riparian Inventory, 2022 Conditions

3.1.1 Introduction

The LORP Monitoring, Adaptive Management and Report Plan (Ecosystems Sciences 2008) stipulates vegetation mapping that measures large-scale vegetation trends and habitat extent be conducted at regular intervals. Vegetation inventories were conducted for the LORP and the DHA for 2022 condition, fifteen years after LORP was implemented. Results were compared with 2000, 2009, 2014, and 2017 conditions of the LORP project area and with 2000, 2009, 2012, and 2017 conditions of the DHA.

3.1.2 LORP Vegetation Mapping

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

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

The LORP project area was first defined for 2000 condition based on the area anticipated to be affected by implementation of the project. This initial project area for 2000 condition was 6,555 acres and included superfluous areas along the west side of the corridor that were functionally unrelated to the LORP. The project area for 2009 condition was increased to 6,570 acres to accommodate expansion of the river corridor in a few areas while including the same superfluous areas, as for 2000 condition. The project area for 2014 condition was again expanded to accommodate a slightly wider river corridor in a few areas, but superfluous areas were clipped and eliminated from further consideration. The project areas for 2022, 2017 and 2014 conditions were reduced to 6,252 acres and used to clip vegetation mapping for 2000 and 2009 conditions to facilitate valid comparisons of mapping.

Differences in 2000, 2009, 2014, 2017, and 2022 LORP conditions are attributed to hydrologic changes associated with rewatering the Owens River, fires, and improvements in the accuracy and precision of mapping. Hydrologic changes are summarized in terms of states. Several major fires have affected large portions of the LORP project area since 2008 (
Figure 3-1). Prescribed burns in 2008, 2010, and 2012 converted scrub/meadow to more productive meadow and invigorated herbaceous

vegetation. A 400-acre wildfire in 2013 was centered on the Owens River corridor east of Lone Pine that burned many trees that have since resprouted. The 1,000-acre Moffat fire burned the Island and 3 miles of the Owens River corridor in 2018. The Moffat fire burned about a thousand dead snags and decadent trees that were engulfed in the marsh; the large stand of trees west of the Island marsh were unaffected. Trees burned in the Moffat fire are not evident on the 2022 imagery.

Figure 3-1. LORP Fires Since 2008

LORP 2000 condition was delineated on 1:6,000 scale plots of high-resolution (2-foot pixels) imagery, and then digitized. The 2000 mapping was refined using heads-up editing at scales greater than 1:1,000 resulting in 3,968 parcels. LORP 2009 condition was mapped using a supervised spectral classification of high-resolution (1-foot pixels) imagery, then refined through a significant field effort of more than 200 person-days, resulting in 6,981 parcels. The 2014 condition (16,601 parcels) was mapped using an unsupervised spectral classification, heads-up editing, and a less significant field effort of about 15 person-days. The 2017 condition was again mapped using an unsupervised spectral classification, LiDAR analyses, heads-up editing, and a field effort of about 5 person-days resulting in about 53,000 parcels. Mapping of 2022 condition entailed using 2017 vegetation types as templates for refining spectral classification of the 2022 image and resulting in about 26,000 parcels. The 2022 mapping was reviewed by LADWP personnel familiar with the LORP/DHA who went to the field to address specific issues. The accuracy and precision of mapping improved with each of these successive applications.

Average discharge to the LORP for the 2021-2022 WY was typical for the period of record, excluding the 2016-2017 WY when eastern Sierra runoff approached record levels. Average discharge to LORP at the intake (**Figure 3-2**) in May, June, and July 2017 was more than double the average discharge for those months since the LORP was implemented; peak discharge in June of 2017 was 244 cfs. Water was diverted from the Owens River to the McIver and Eclipse ditches for water spreading. At the Reinhackle gage just above the Island (**Figure 3-2**), average monthly flow in June and July of 2017 exceeded 100 cfs. On the days 2017 imagery was collected (July 28 through August 2), discharge was on the descending limb, ranging from 131 to 117 cfs. The wet 2017 condition biased mapping towards identification of more hydric classes. Using 2017 vegetation mapping as a template for 2022 spectral analyses likely resulted in inclusion of drier vegetation types that were distinguished through preliminary analyses.

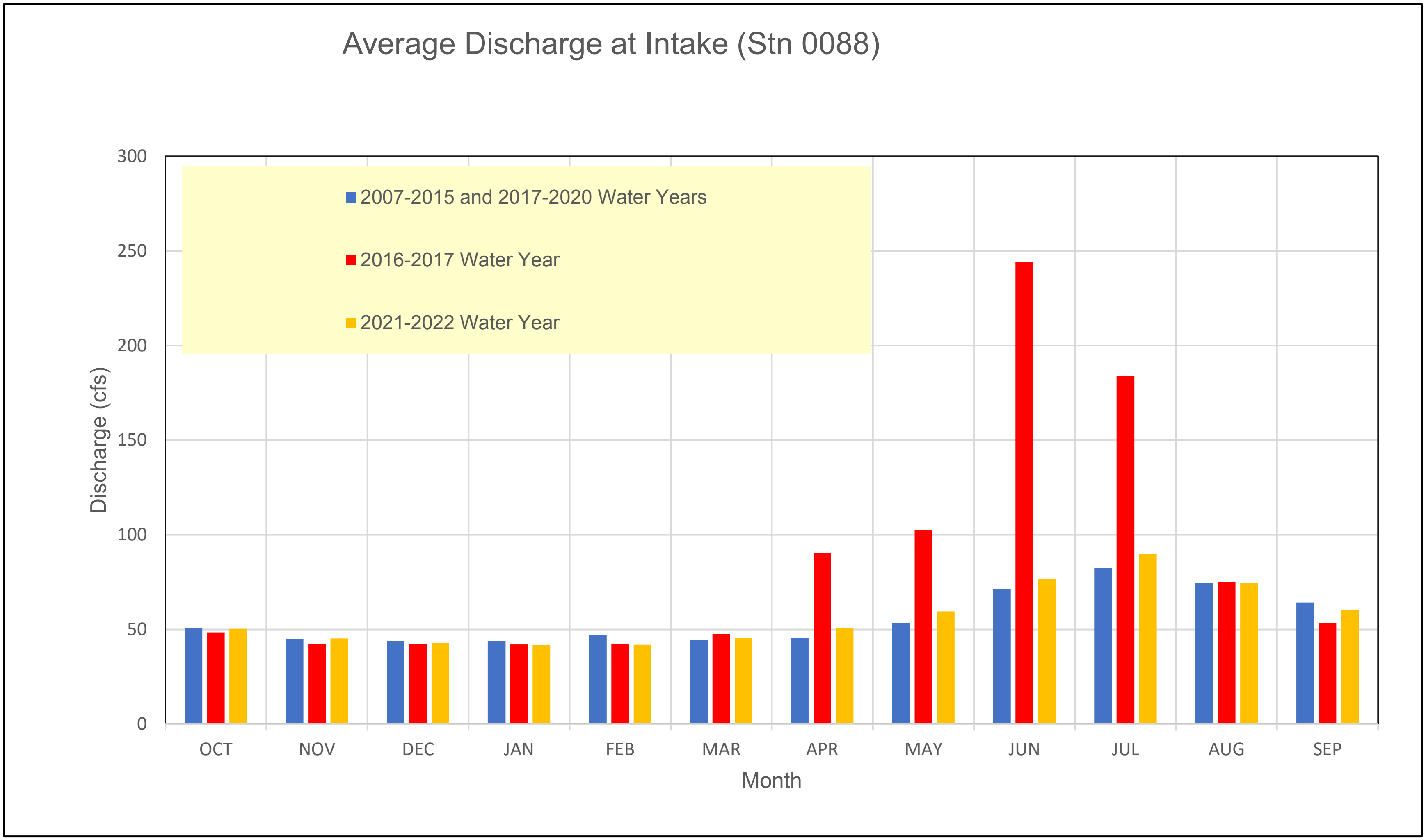


Figure 3-2. Average Discharge at Intake

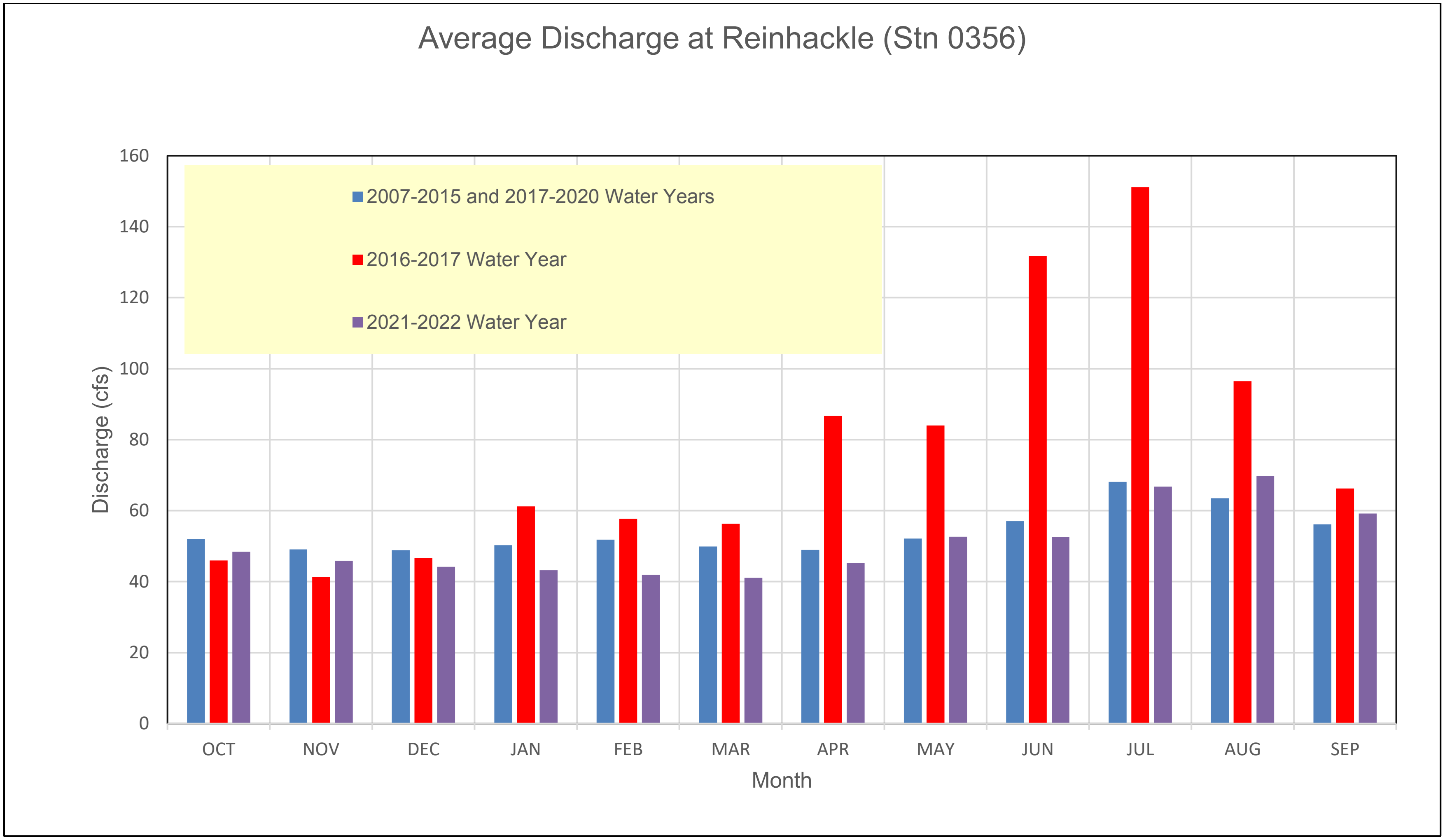


Figure 3-3. Average Discharge at Reinhackle

3.1.3 LORP Approach

The 2022 vegetation mapping is based on a 4 band, high-resolution image captured from aircraft August 21, 2022. Many TIFF image tiles were mosaicked, and then clipped to the LORP project area. The clipped image is comprised of 0.3-meter pixels, each assigned a 16-bit (5 digit) integer for each of 4 color bands. The image can be viewed as either color infrared or natural color, can be viewed at scales greater than 1:1,000, and served as the basis for both spectral analyses and "heads up" editing.
Previous mapping efforts entailed spectral classification across the entire range of LORP vegetation types. A somewhat different approach using the 2017 mapping as templates was applied to mapping of 2022 condition. First, the LORP project area was divided into 8 parts along the river corridor to reduce file size. Next, each of the six major vegetation types mapped in 2017 (water, marsh, wet meadow, meadow, scrub/meadow, and scrub) in each of the 8 parts were exported and used to clip the 2022 image, resulting in 48 images. Each of the images was subjected to unsupervised classification into 8 classes, reclassified into fewer classes corresponding to vegetation types, and generalized using raster simplification tools (majority filter, boundary clean, and nibble). Using the 2017 mapping as a template reduced the number of reclassified spectral classes: areas clipped by 2017 marsh was still mostly marsh in 2022 but included areas of water and wet meadow; areas of 2017 wet meadow were mostly wet meadow in 2022 but included areas of marsh and meadow. In 2017 water was everywhere; consequently, areas clipped by 2017 water included a broader range of vegetation classes. Simplified raster classes for each of the six major vegetation types in the eight parts of the LORP were converted to polygons, resulting in many million parcels.

Each of the 48 polygon files corresponding with six major 2017 vegetation types and eight parts of the LORP were edited "heads-up" in view of the 2022 image at relatively large scale. The goals of this editing were to reduce the complexity, increase the accuracy, and preserve the resolution of the mapping. Mapping for each of the six major vegetation types were dissolved and merged into a single polygon file for each of the eight parts. The merged files were then dissolved by vegetation type and further edited. A few vegetation classes (e.g., water and wet meadow) were exported and subjected to a second (or third) spectral classification. Merged files went through 29 major revisions, each entailing 100s, 1,000s, or 10,000s of discrete edits that entailed more than 300-man hours. Mapping of the 8 parts were then merged into a single file consisting of about 26,000 parcels.

LiDAR data collected in October 2017 was used to refine and enlighten mapping of selected vegetation types (e.g., trees, and scrub/meadow vs. meadow). The technology entails laser measures of elevation including vegetation canopy and the ground at very high (0.2 meter) resolution. A Digital Surface Model (DSM) depicting the vegetation canopy and a Digital Terrain Model (DTM) of the ground surface were subtracted, yielding raster measures of vegetation height (feet). In practice, the LiDAR failed to penetrate dense vegetation (e.g., marsh, reed, and riparian shrub) resulting in surface measures near the top of the canopy and significant underestimates of vegetation height. In 2022 LiDAR was used primarily to distinguish scrub/meadow from meadow vegetation types.

Mapping was evaluated by John Hays and Deborah House (Watershed Resource Specialists/LADWP), both of whom have worked extensively on the LORP for more than a decade. Problem areas were discussed, and field visits were conducted to resolve specific issues. Mapping was revised to address results of the evaluations.

3.1.4 LORP Results

GIS products are documented in Appendix 1. Vegetation types identified for 2000, 2009, 2014, and 2017 conditions are correlated in Table 3-1. Large-scale (1:5,000 and 1:10,000) maps of vegetation for 2022 condition are compiled Appendix 2. Side-by-side maps of vegetation types for 2000, 2009, 2017, and 2022 conditions are compiled in Appendix 2.

The influence of the LORP on the distribution of vegetation types generally corresponds with changes in hydrology and channel morphology associated with states (**Figure 3-4**). Four states were identified for 2000 condition:

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

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

Graded, wet, unconfined floodplain: A wetted channel bordered by floodplain and low terrace. Marsh fills the active channel. Alluvial groundwater is within the rooting depth of hydric vegetation on the floodplain. One reach comprised 12 miles of the LORP in 2000.

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

Reaches defined for 2000 condition (**Figure 3-5**) are based on states prior to implementation of the LORP. With implementation, the dry reach became wet and the length of graded and aggraded states increased slightly, as documented for 2009 condition. In 2014 the length of graded state tripled, and the aggraded state increased 50 percent relative to 2009 condition (**Table 3-2**). In 2017 the length of graded channel increased about 3 miles relative to 2014 and aggraded state increased by about 4 miles. In 2022, two new aggraded reaches identified between river miles 5-9 (**Figure 9-88 – Figure 9-92**) and 12-16 (**Figure 9-95 – Figure 9-99**) are transitioning towards more hydric conditions. The LORP continues to aggrade.

Table 3-1. Map Unit Correlation

2022 Condition		2017 Condition		2014 Condition		2009 Condition		2000 Condition	
Name	**Acres**	**Name**	**Acres**	**Name**	**Acres**	**Name**	**Acres**	**Name**	**Acres**
Water	87	Water	510	Water	154	Water	251	Water	100
Streambar	15	Streambar	3	Streambar	23	Streambar	8	Streambar	23
Marsh	1649	Marsh	1433	Marsh	1310	Marsh	1090	Marsh	765
Reed	63	Reed	51	Reedgrass	51	Reedgrass	24	Reedgrass	25
Wet meadow	821	Wet meadow	1071	Wet meadow	653	Wet alkali meadow	57	Wet alkali meadow	210
				Irrigated meadow	3	Irrigated meadow	3	Irrigated meadow	4
Transitional meadow	180	Weed	0	Bassia	118	Bassia	326	Barren	387
Dead scrub	123					Tamarisk/slash	1		
						Barren	115		
Meadow	1016	Meadow	619	Alkali meadow	513	Dry alkali meadow	1034	Dry alkali meadow	889
Scrub/meadow	823	Scrub/meadow	1433	Scrub/meadow	1484	Scrub/meadow	1132	Scrub/meadow	1237
Riparian shrub	34	Riparian shrub	33	Riparian shrub	32	Riparian shrub	20	Riparian shrub	20
Tree	181	Tree	190	Tamarisk	1	Tamarisk	12	Tamarisk	249
				Cottonwood	3	Cottonwood	5	Cottonwood	5
				Tree willow	162	Tree willow	260	Tree willow	444
Scrub	1132	Scrub	876	Alkali scrub	492	Scrub	1787	Scrub	1728
Barren	90			Upland scrub	1191			Upland	39
Road	34	Road	31	Road	43	--	--	--	--
Misc. feature	4	Misc. feature	1	Misc. feature	19	Structure	22	Structure	3
TOTAL	**6252**	**TOTAL**	**6252**	**TOTAL**	**6252**	**TOTAL**	**6147**	**TOTAL**	**6128**

Table 3-2. Changes in State

State	2000 Condition		2009 Condition		2014 Condition		2017 Condition		2022 Condition	
	Miles	%	Miles	%	Miles	%	Miles	%	Miles	%
Incised, dry, confined floodplain	16.1	29	0.0	0	0.0	0	0.0	0	0	0
Incised, wet, confined floodplain	23.7	42	38.2	68	9.8	18	2.7	5	2.7	5
Graded, wet, unconfined floodplain	12.0	21	12.5	22	38.6	69	42.0	75	30.7	54
Aggraded, wet, unconfined floodplain	4.0	7	5.2	9	7.5	13	11.3	20	23.9	41
TOTAL	**55.9**	**100**	**55.9**	**100**	**55.9**	**100**	**55.9**	**100**	**57.4**	**100**

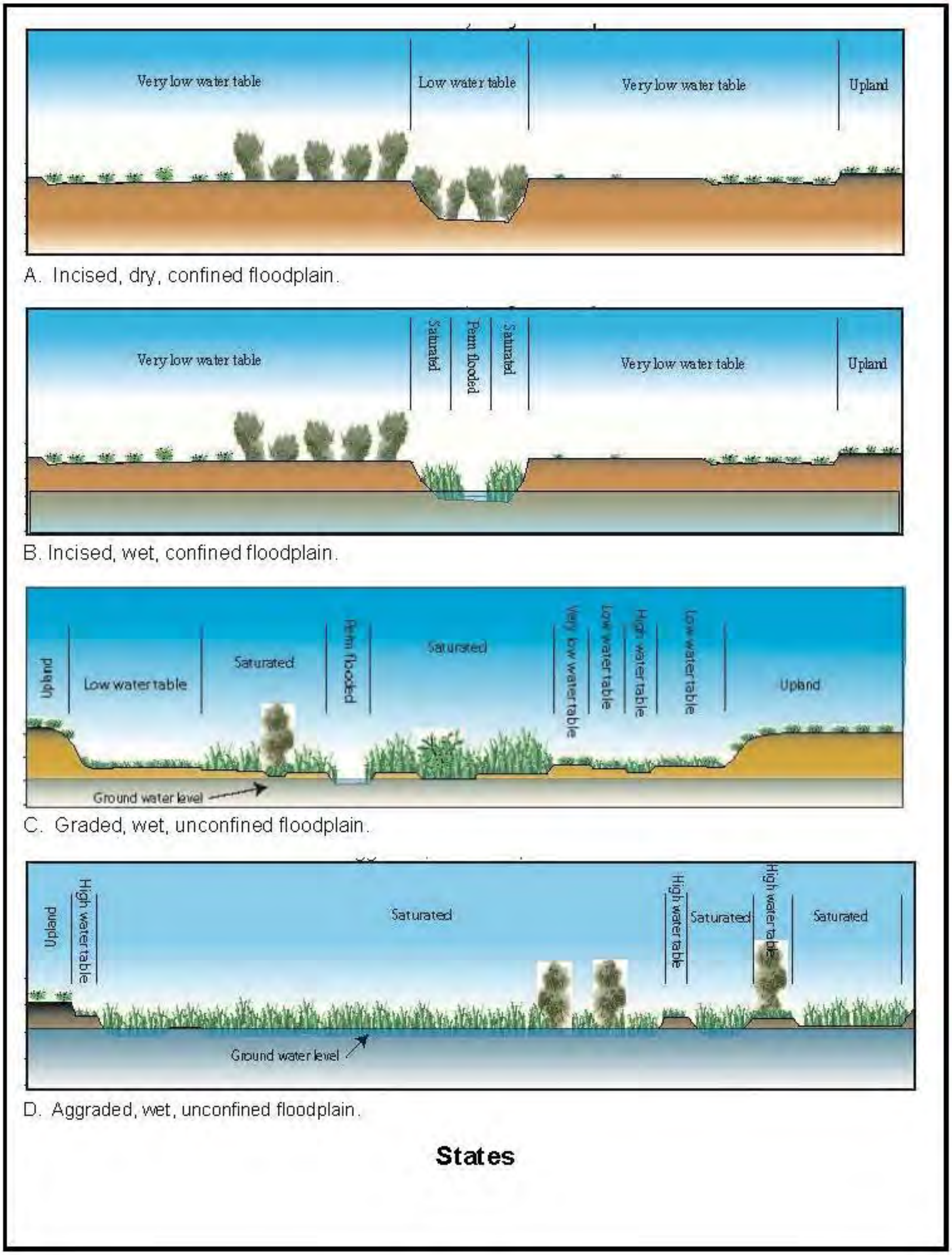


Figure 3-4. Progression of States

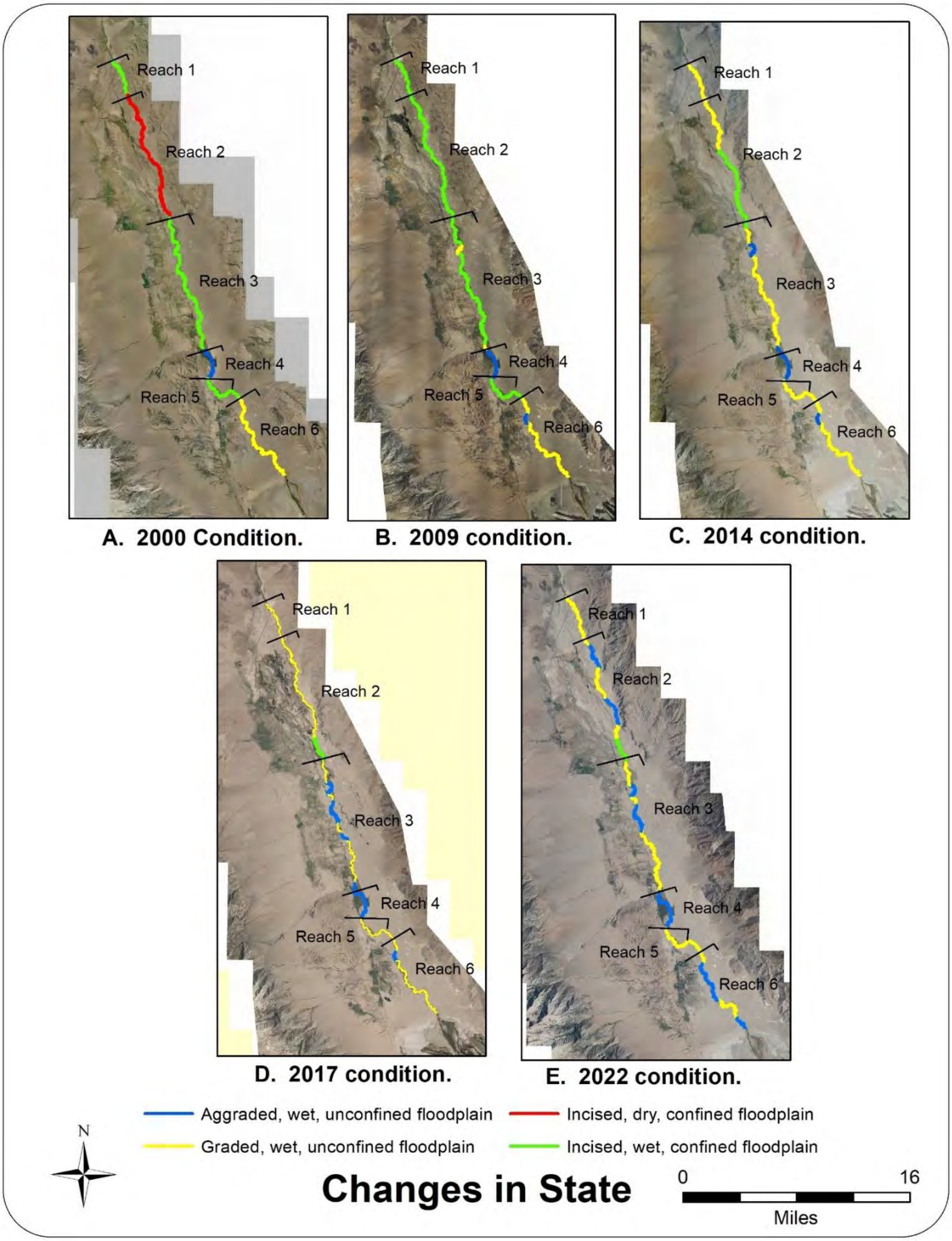


Figure 3-5. Changes in State

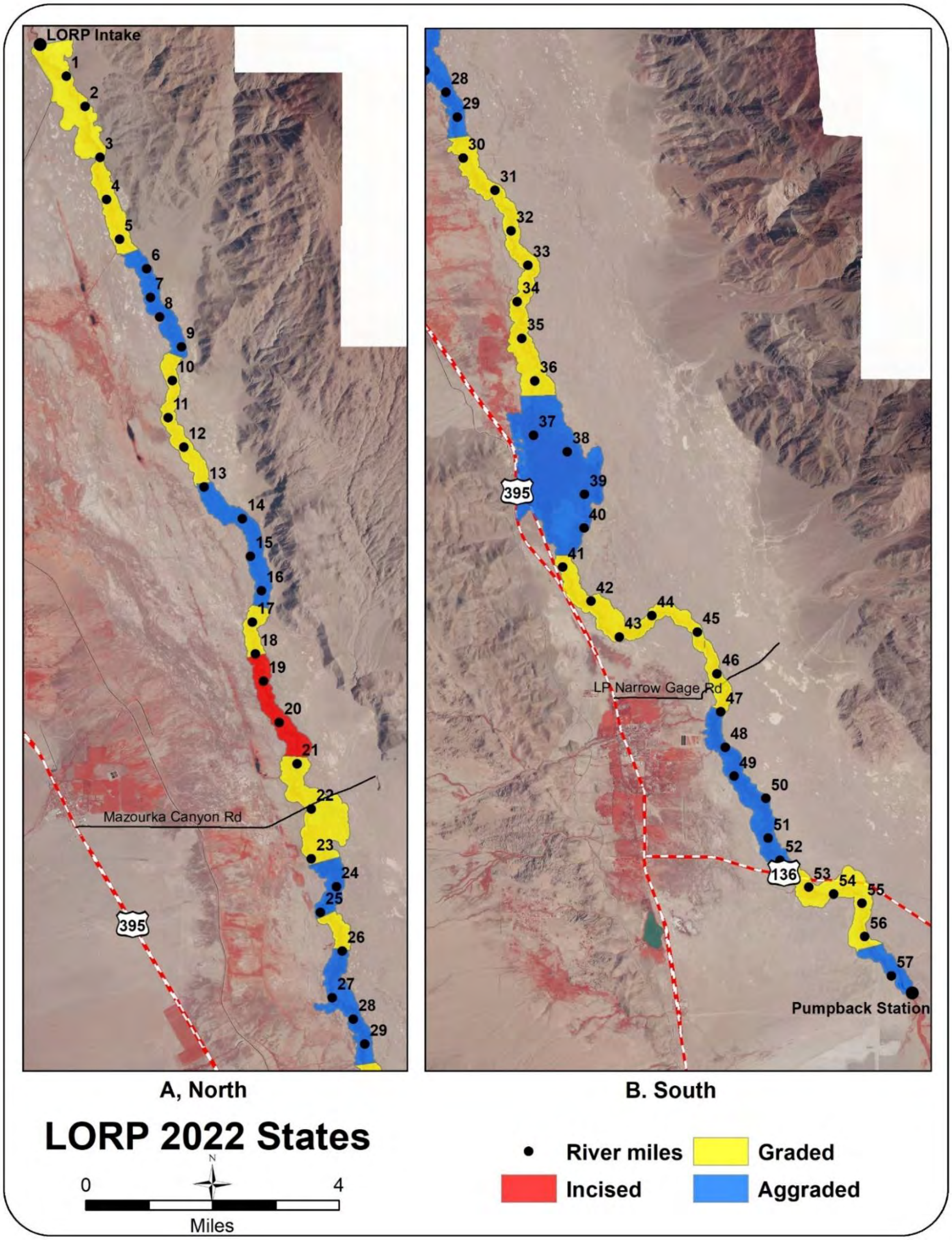


Figure 3-6. LORP 2022 States

Changes in state correspond with changes in the distributions of vegetation (**Table 3-2**) and (**Figure 3-7**). Scrub and barren are prominent in the incised state, comprising almost two-thirds of the river bottom. A more diverse assemblage of vegetation is present in the graded state. Water, marsh, and reed are prominent in the aggraded state, comprising 44 percent of the bottomland.

The extent of hydric vegetation types (water, streambar, marsh, reed, wet meadow, riparian shrub, and tree) increased 761 acres (12 percent) since 2014 and 1,556 acres (24 percent) since 2000 (**Table 3-4**) and (**Figure 3-8**). The somewhat greater extent of hydric vegetation in 2017 is attributed to bias resulting from uncharacteristically wet conditions. The extent of mesic vegetation (scrub/meadow and meadow) has remained relatively consistent since 2000. Arid vegetation (scrub and barren) decreased 578 acres (9 percent) since 2014 and 1,180 acres (19 percent) since 2000. Again, the smaller area of arid vegetation in 2017 is attributed to bias resulting from wet conditions.

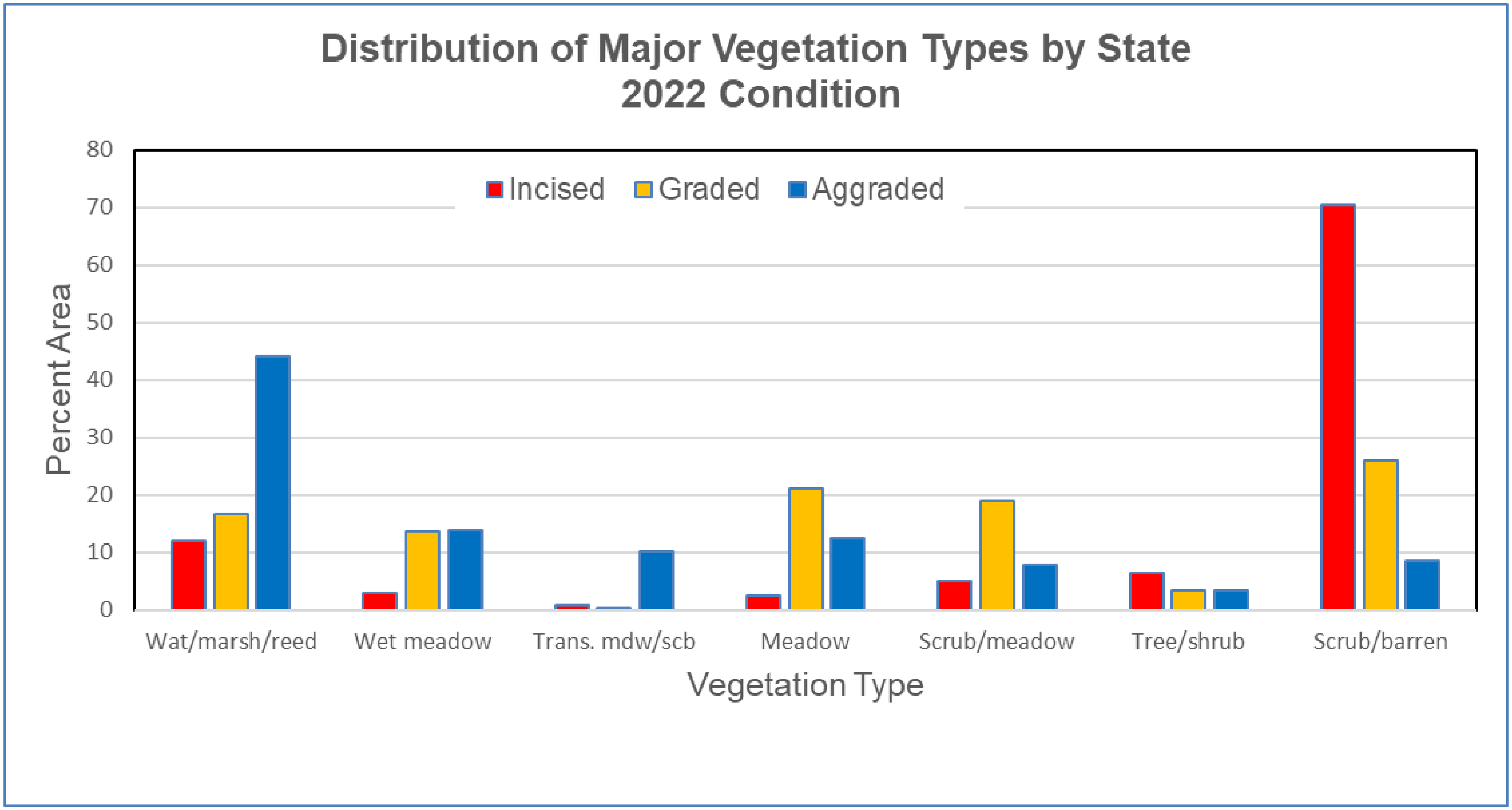


Figure 3-7. Distribution of Major Vegetation Types by State, 2022 Condition

Table 3-3. Distribution of Vegetation Types by State, 2022 Condition

Vegetation Type	Incised		Graded		Aggraded	
	(acres)	(%)	(acres)	(%)	(acres)	(%)
Water	2	1	41	1	43	2
Streambar	4	2	7	0	4	0
Marsh	27	11	447	14	1175	41
Reed	0	0	33	1	30	1
Wet meadow	7	3	422	13	392	14
Trans. Meadow	2	1	10	0	169	6
Dead scrub	0	0	2	0	122	4
Meadow	6	2	658	21	352	12
Scrub/meadow	12	5	592	19	219	8
Riparian shrub	0	0	9	0	24	1
Tree	16	6	93	3	72	3
Scrub	148	60	753	24	231	8
Barren	22	9	59	2	9	0
Road	0	0	27	1	7	0
Misc. feature	0	0	3	0	1	0
TOTAL	**246**	**100**	**3156**	**100**	**2850**	**100**

Table 3-4. Hydric Status, 2000 Through 2022 Conditions

Status	2022 Condition		2017 Condition		2014 Condition		2009 Condition		2000 Condition	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Hydric	3153	50	3239	52	2392	38	1719	28	1597	26
Mesic	1839	29	1899	30	1997	32	2166	35	2126	35
Arid	1223	20	1080	17	1801	29	2241	36	2403	39
Not Considered	38	1	34	1	62	1	22	0	3	0
TOTAL	**6252**	**100**	**6252**	**100**	**6252**	**100**	**6147**	**100**	**6128**	**100**

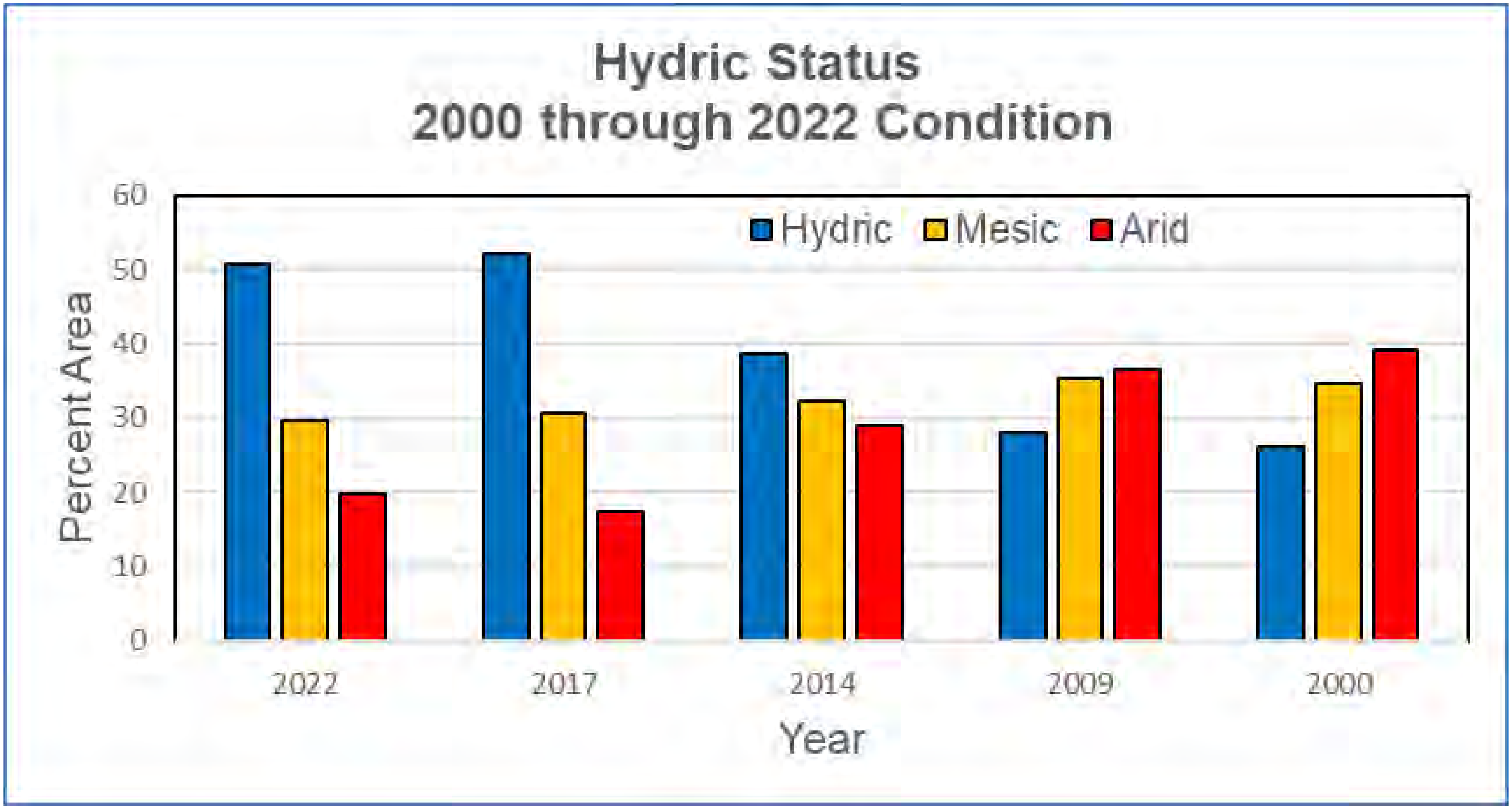
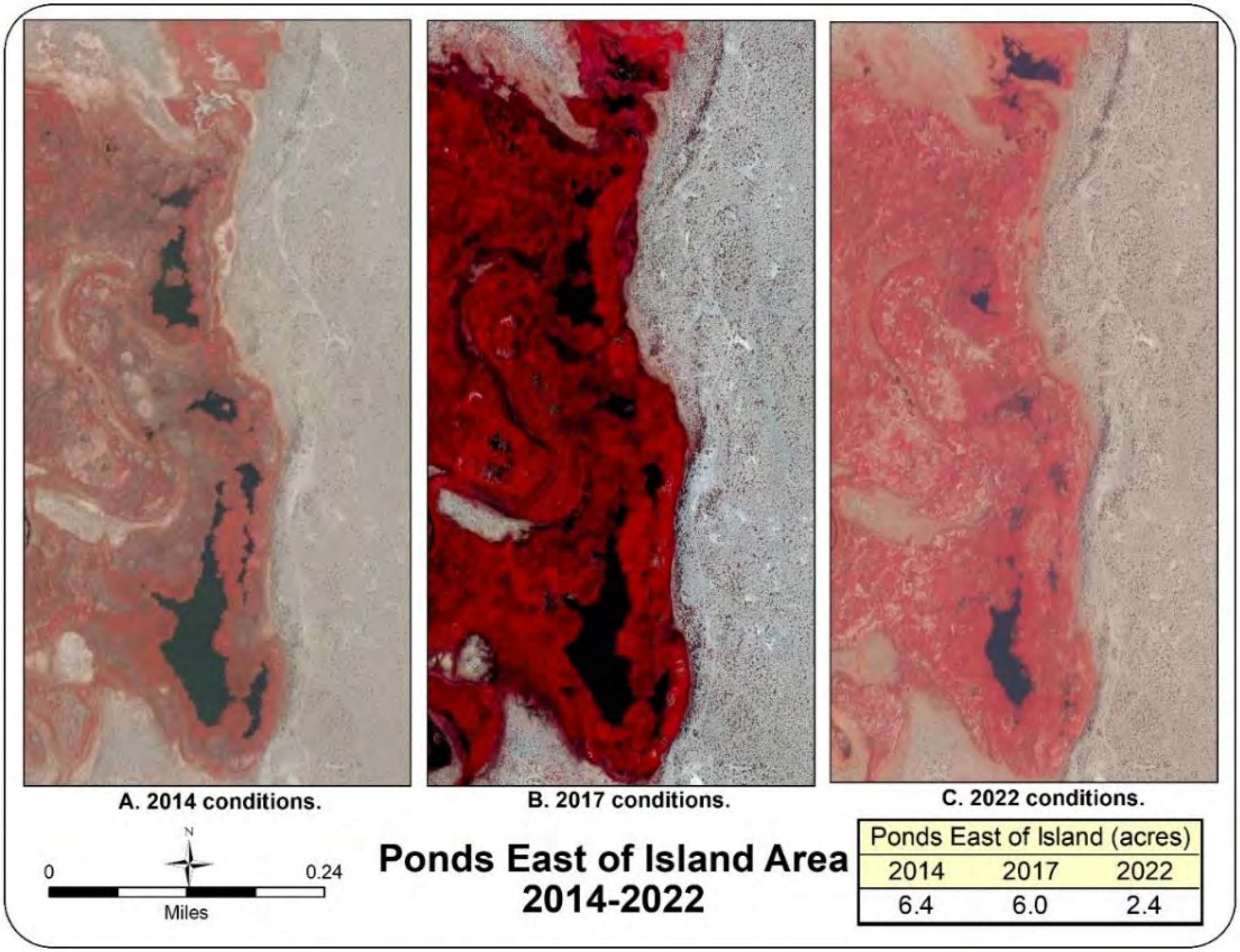


Figure 3-8. Hydric Status, 2000 Through 2022 Conditions

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

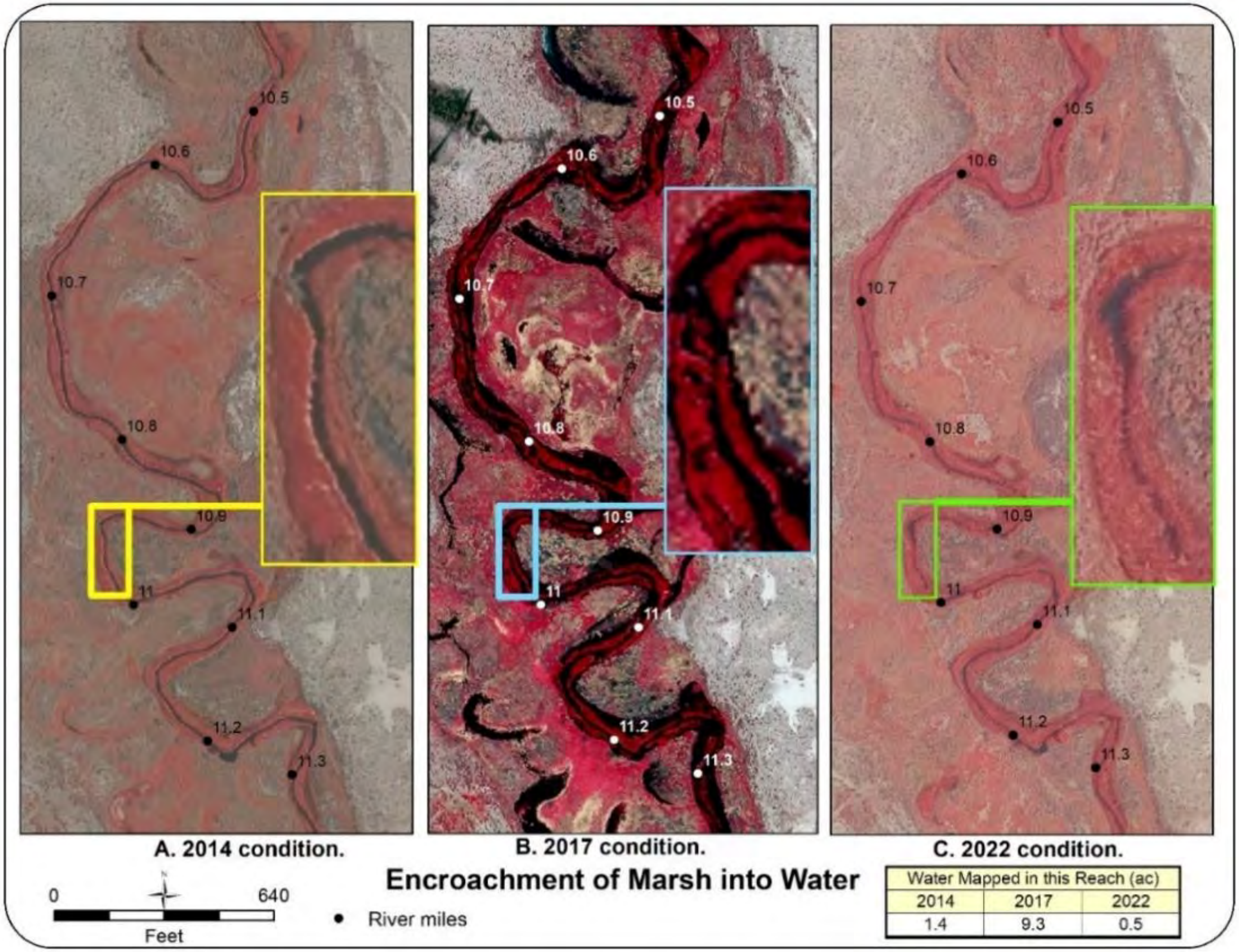
Water: This includes the Owens River, divorced oxbows, and ponds that are open water. The area of water is about 16% of that in 2017 when streamflow was high and water was being actively spread. The extent of water is about half of that in 2014, mostly because of encroachment by marsh. Marsh has filled more than 60 percent of ponds in the eastern part of the Island area (**Figure 3-9**). Similar encroachment of marsh was observed along the river channel relative to 2014 condition (**Figure 3-10**). The half mile reach depicted in Figure 3-10 that was open water in 2014 was encroached by marsh in 2022. It seems that the high flows throughout the summer of 2017 were ineffective in opening the stream channel and slowing the profusion of marsh vegetation.

The spectral signature of water is identical to shadows on the west side of every tree and shrub. Because of the broad extent of water in 2017, the template approach to spectral classification was less effective in simplifying spectral analyses. Water may include shadows of trees immediately adjacent to the river. Areas transitional to marsh are included, especially in parcels that were drawn by hand. Inclusions of similar vegetation types (e.g., marsh and reed) may comprise 10 percent of any parcel. Inclusions of dissimilar vegetation correspond with shadows, are infrequent, but may comprise large portions of a few parcels.



Ponds East of Island (acres)		
2014	2017	2022
6.4	6.0	2.4

Figure 3-9. Ponds East of Island Area



Water Mapped in this Reach (ac)		
2014	2017	2022
1.4	9.3	0.5

Figure 3-10. Encroachment of Marsh into Water

Streambar: These include point bars along the river channel, divorced dry channels, and a large splay of sediment below the Alabama Gate west of the Island. Point bars are sparsely vegetated, sandy deposits suitable for willow (*Salix* spp.,) colonization. Scratchgrass (*Muhlenbergia asperifolia*), saltgrass (*Distichlis spicata*), and sparse marsh plants are also common. Divorced dry channels are mostly barren. The sediment splay below the Alabama Gate is transitioning towards wet meadow.

Streambars are similar in nature and sometimes difficult to distinguish from barren areas associated with scrub. In 2014 mapping 23 acres of streambars were delineated; in 2017 most streambar was inundated by high water and only 3 acres was identified; in 2022, 12 acres of streambar were delineated. Inclusions of adjacent vegetation types may comprise 15 percent of these small parcels.

Marsh: This occurs in the river channel of incised and graded reaches and typically spills onto the floodplain of aggraded reaches. It is dominated by cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acutus*). Three-square bulrush (*Schoenoplectus pungens*), salt marsh bulrush (*Schoenoplectus maritimus*), common reedgrass (*Phragmites australis*), Baltic rush (*Juncus balticus*), Parish spikerush (*Eleocharis parishii*) and yerba-mansa (*Anemopsis californica*) may be present. The vegetation canopy is typically more than 6 feet tall and vegetative cover is very high.

Surfaces are typically permanently or semi-permanently flooded. Many, widely distributed patches of dead marsh comprise about 5 percent of the 1,649 total acres; the reason marsh died is unknown. The area of marsh has steadily increased since 2000 (**Figure 3-11**).

Inclusions of similar types (e.g., water and reed) may comprise up to 5 percent of parcels. Boundary transitions to adjacent wet meadow may be gradual; transitions to more mesic and arid adjacent types are typically abrupt.

Reed: This herbaceous vegetation type occurs in the channel in habitat similar to marsh and on floodplain in habitat similar to wet meadow. Reedgrass (*Phragmites australis*) forms a tall thicket. The extent of reed, while relatively small, has increased since 2000 (**Figure** 3-12) and merits attention due to the aggressive nature of reedgrass.

Reed was difficult to distinguish from riparian shrub (coyote willow), which occupies similar habitat. Inclusions of similar types (riparian shrub) may comprise 15 percent of selected parcels. Boundary transitions to adjacent vegetation types may be diffuse as reedgrass spreads primarily by rhizomes.

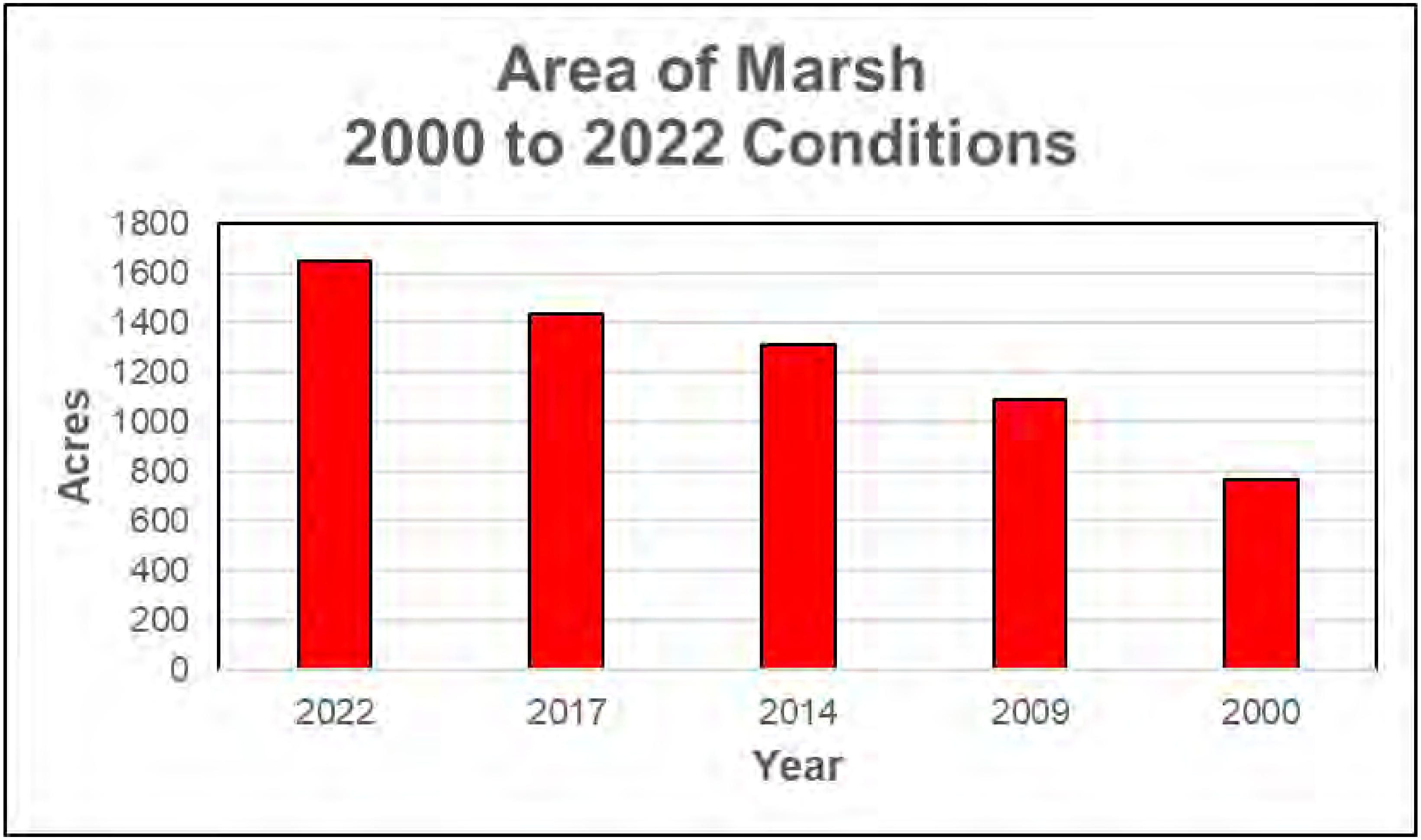


Figure 3-11. Area of Marsh, 2000 to 2022 Conditions

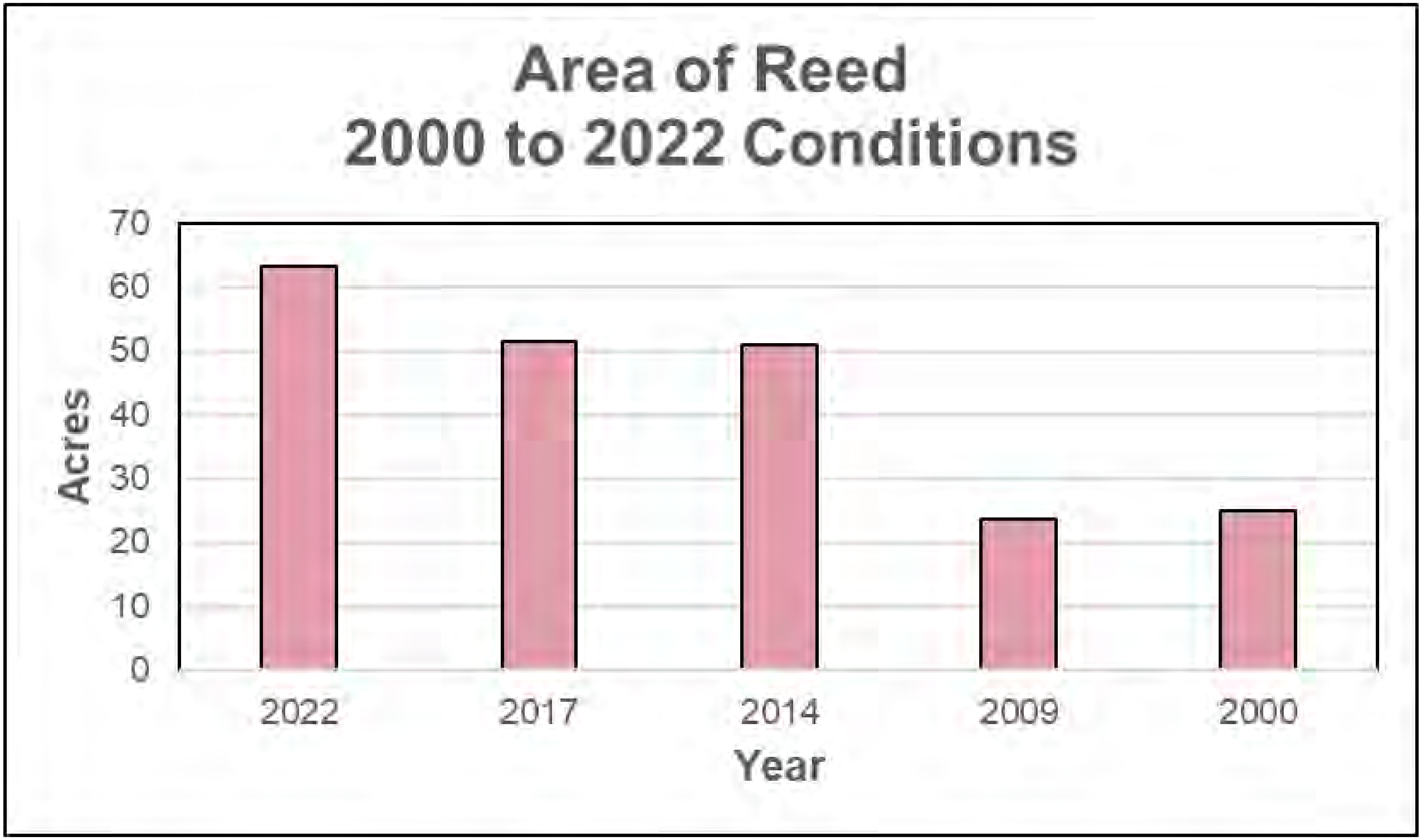


Figure 3-12. Area of Reed, 2000 to 2022 Conditions

Wet meadow: This herbaceous vegetation type occurs on floodplains and in depressions on terraces with high water table. The key criteria distinguishing wet meadow from meadow is that wet meadow does not support scrub. Dominant plants included saltgrass (*Distichlis spicata*), creeping wildrye (*Leymus triticoides*), Baltic rush (*Juncus balticus*), beaked spikerush (*Juncus rostellata*), three-square bulrush (*Schoenoplectus pungens*), sunflower (*Helianthus* sp.), and clustered field sedge (*Carex praegracilis*). Decadent Nevada saltbush (*Artriplex lentiformis, torreyi*) and rubber rabbitbrush (*Ericameria nauseosus*) may be present in parcels that have transitioned from scrub/meadow to wet meadow. Total vegetative cover is typically higher than for meadow. Inclusions of similar types (e.g., meadow and scrub/meadow) are common and may comprise up to 15 percent of parcels.

Most of the 210 acres of wet meadow present in 2000 converted to marsh in 2009 **(Figure** 3-13**)**. Wet meadow increased to 653 acres in 2014. The increase in wet meadow in 2017 is both a result of burning shrubs that became decadent in response to wetness and to mapping error resulting from the uncharacteristically wet conditions. The area of wet meadow increased about 165 acres since 2014.

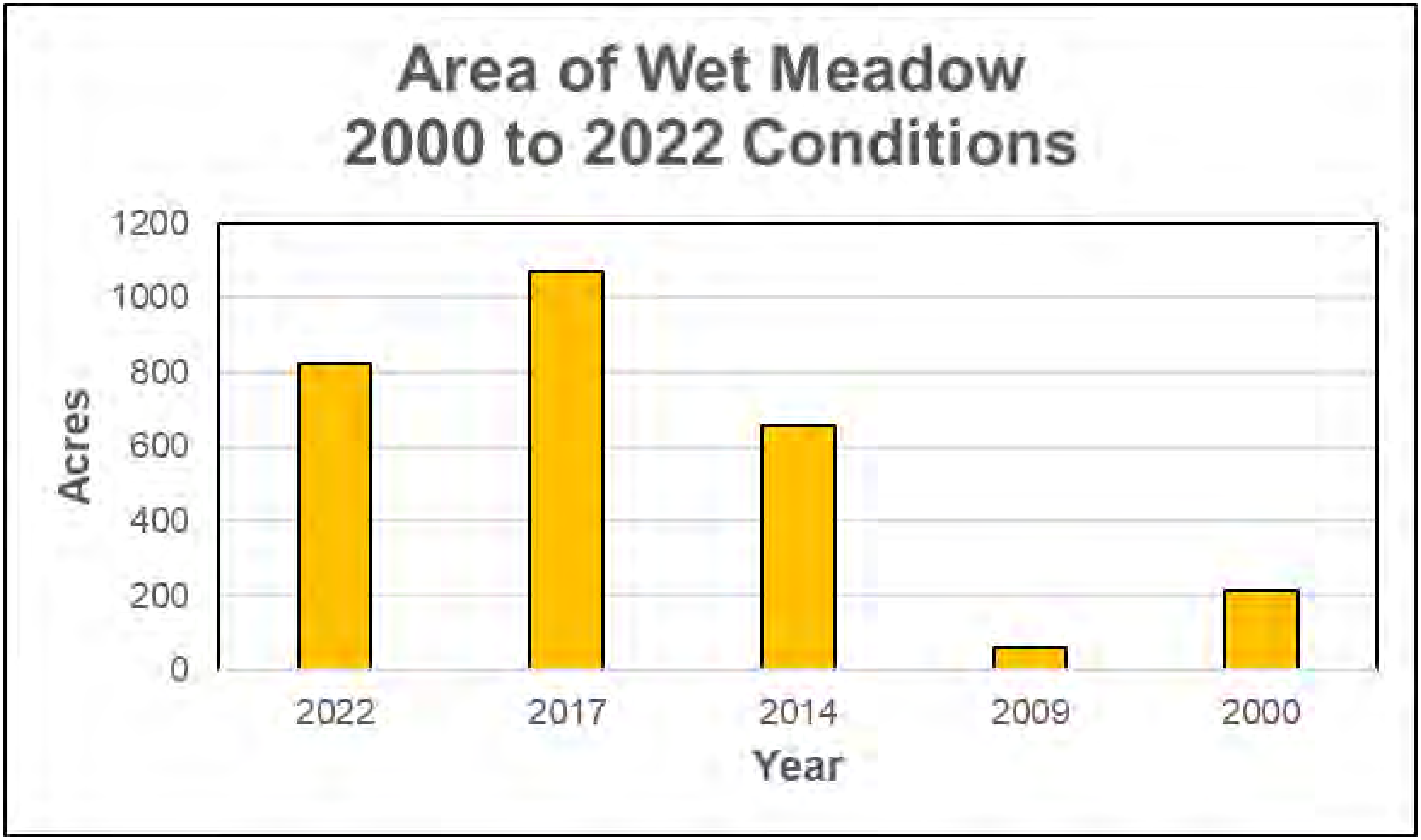


Figure 3-13. Area of Wet Meadow, 2000 to 2022 Conditions

Transitional meadow: This herbaceous vegetation type is transitional in response to rising groundwater level. It was identified primarily in two reaches that are approaching aggraded state between river miles 5-9 and 12-16. Prominent vegetation includes fivehorn smotherweed (*Bassia hyssopifolia*), alkali mallow (*Malvella leprosa*), salt heliotrope (*Heliotropium curassavicum*), and saltgrass (*Distichlis spicata*). Perennial pepperweed (*Lepidium latifolium*) and milkweed (*Asclepias sp.*) may be present.

Transitional meadow is commonly associated with subsequently described "dead scrub" that may comprise 30 to 40 percent of some parcels **(Figure 3-14**). Also included are areas of scrub/meadow and scrub vegetation types. The pattern of occurrence of transitional meadow is complex. As the river continues to aggrade and conditions become wetter, these areas are expected to become wet meadow and marsh.

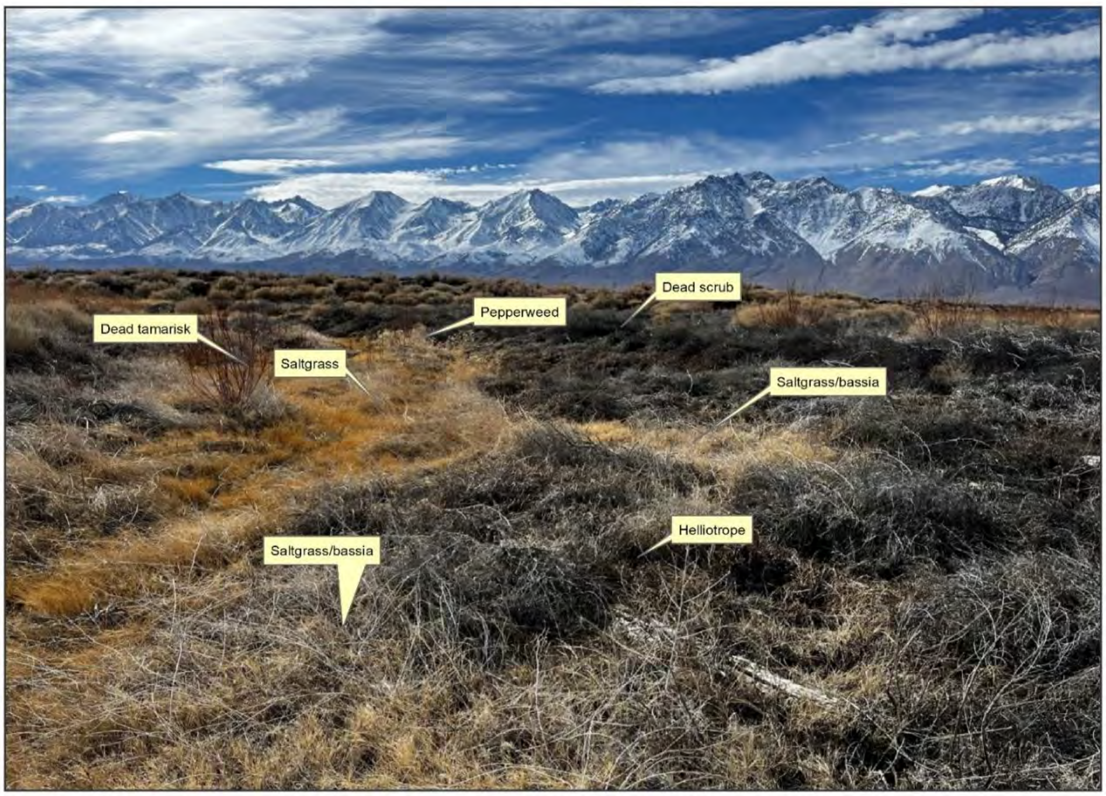


Figure 3-14. A Complex Transitional Meadow Near River Mile 6.4

Dead scrub: This was identified in in the newly aggrading reaches between river miles 5-9 and 12-16. It is a thicket of dead saltbush (*Atriplex spp.*) and rubber rabbitbrush (*Ericameria nauseosa*). Fivehorn smotherweed (*Bassia hyssopifolia*), alkali mallow (*Malvella leprosa*), salt heliotrope (*Heliotropium curassavicum*), perennial pepperweed (*Lepidium latifolium*), and saltgrass (*Distichlis spicata*) may be present. Dead scrub occurs in complex arrangement with transitional meadow which may comprise 30-40 percent of some parcels.[1] Also included are smaller areas of scrub/meadow, scrub, and wet meadow.

Meadow: This herbaceous vegetation type occurs mostly on low terraces with low water table. Scrub/meadow and meadow are broadly overlapping habitat. If you burn scrub/meadow, you get meadow.[2] Saltgrass (*Distichlis spicata*) is dominant; alkali sacaton (*Sporobolus airoides*) and Baltic rush (*Juncus balticus*) may also be present. Meadow is distinguished from wet meadow by having a lower water table that allows encroachment of scrub and with having lower total herbaceous cover. Inclusions of similar vegetation (e.g., scrub/meadow) may comprise 20 percent of parcels. Areas transitional to wet meadow and to scrub may also be present.

Between 2017 and 2009 there was a net loss of more than 400 acres of meadow (**Figure 3-15**), but an increase of over 1,000 acres of wet meadow. The area of meadow has since increased in response to the 2018 Moffat fire (see
Figure 3-1) that burned extensive marsh in the Island area and scrub/meadow in the bottom 4 miles upstream. The sum of meadow and wet meadow has increased over 700 acres since 2000 and 2009, primarily a response to fire and rising water table.

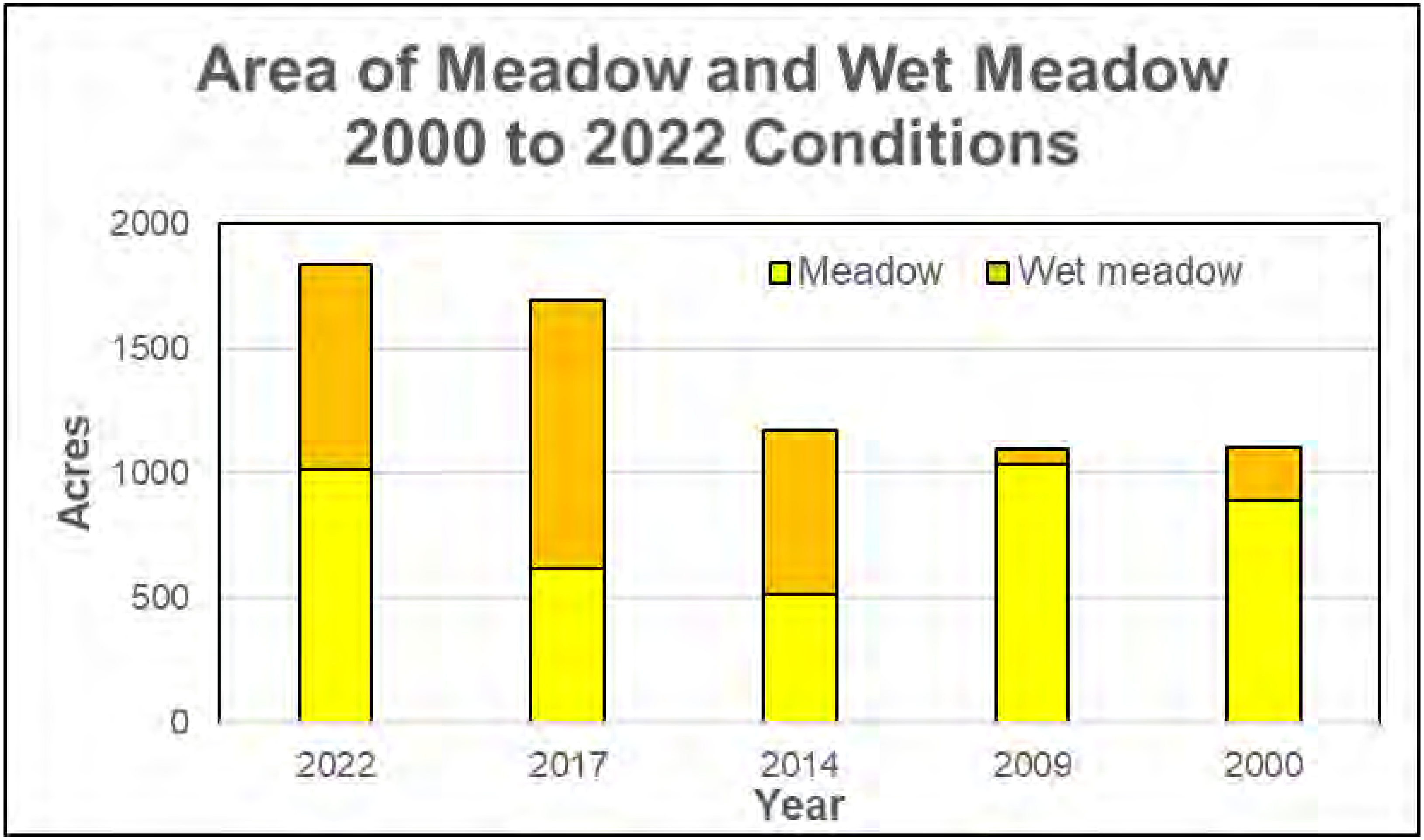


Figure 3-15. Area of Meadow and Wet Meadow, 2000 to 2022 Conditions

[1] We considered grouping dead scrub with transitional meadow because they occur in such complex arrangement, they are difficult to distinguish spectrally.
[1] If scrub is decadent in response to wetness, burning leaves wet meadow.

Scrub/meadow: This low scrub vegetation type occurs primarily on low terraces with low water table. Scrub/meadow and meadow are similar habitat. When you burn scrub/meadow you get meadow. Where the scrub is dead or decadent in response to wetness, burning may leave wet meadow. The dominant scrub are Nevada saltbush (*Atriplex lentiformis, torreyi*) and rubber rabbitbrush (*Ericameria nauseosus*); greasewood (*Sarcobatus vermiculatus*) is sometimes present, but more typical in scrub.

Total scrub cover is variable, but typically greater than 25 percent. Saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), Torrey seepweed (*Sueda moquinii*), and creeping wildrye (*Leymus triticoides*) are prominent in the understory. Inclusions of meadow with sparse scrub and inclusions of scrub with sparse understory are common and may comprise up to about 30 percent of some parcels.

Despite the extensive fires that converted scrub meadow to meadow and rising groundwater tables resulting in conversion to wet meadow and marsh, the area of scrub/meadow increased about 300 acres between 2017 and 2009 (**Figure 3-16**). It seems likely that areas of scrub were identified as scrub/meadow due to the wet conditions in 2017. The total area of scrub/meadow and scrub have decreased by about 1,000 acres since 2000.

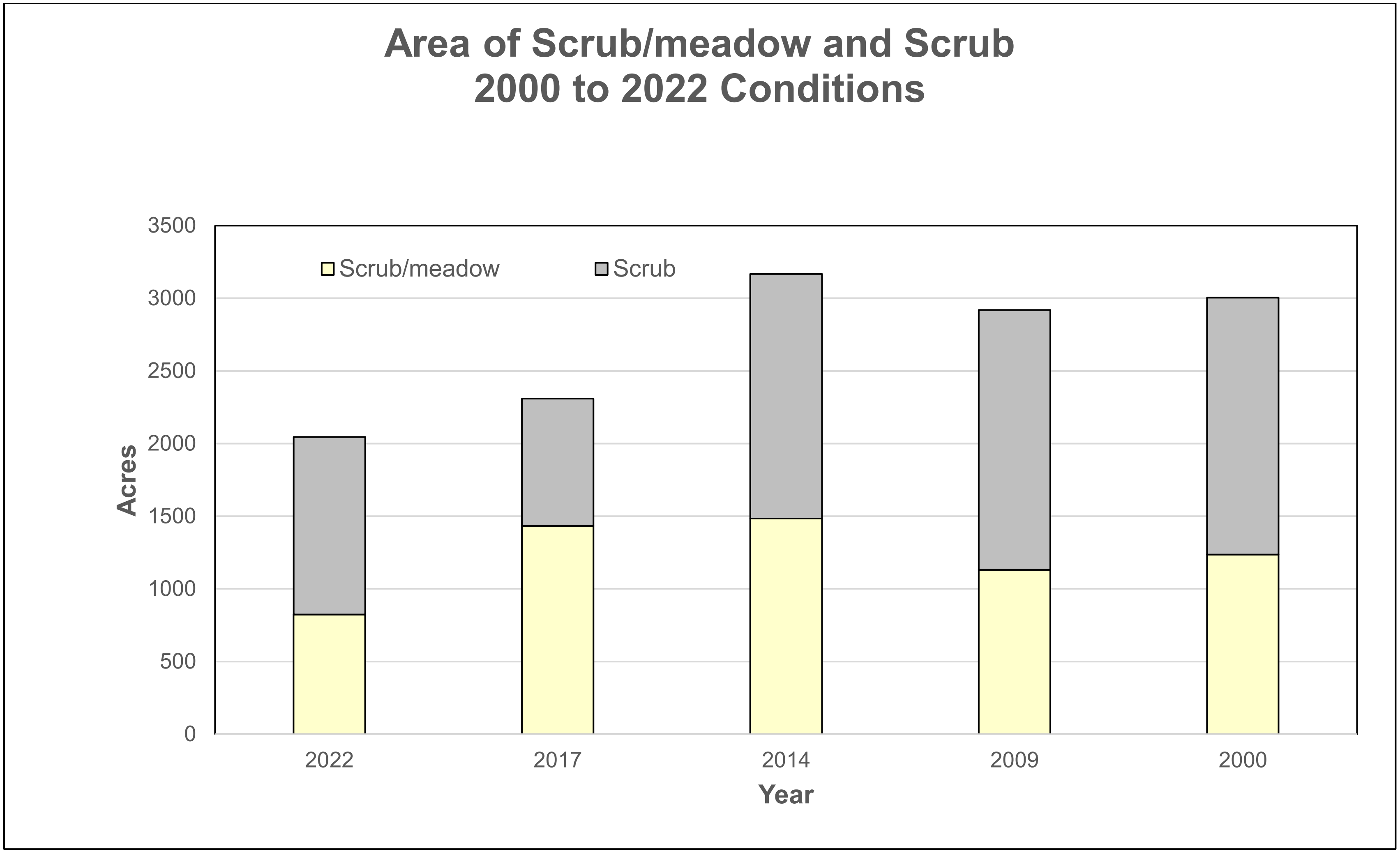


Figure 3-16. Area of Scrub/Meadow and Scrub, 2000 to 2022 Conditions

Riparian shrub: This tall shrub vegetation type occurs primarily on floodplains and low terraces with intermittently high water table. Riparian shrub is commonly associated with tributary drainages, the likely source of propagules. A dense thicket of coyote willow (*Salix exigua*) dominates the overstory; small patches of Woods rose (*Rosa woodsii*) were grouped with riparian shrub. Creeping wildrye (*Leymus triticoides*) and saltgrass (*Distichlis spicata*) are prominent in the sparse understory. Riparian shrub was difficult to distinguish from reed, which occupies similar habitat and forms a tall, thick stand. A few parcels were noted to include both coyote willow and reedgrass.

The area of riparian shrub increased from 20 acres in 2000 and 2009, to just over 30 acres since 2014 (**Figure 3-17**). New riparian shrub communities are also getting started on point streambars.

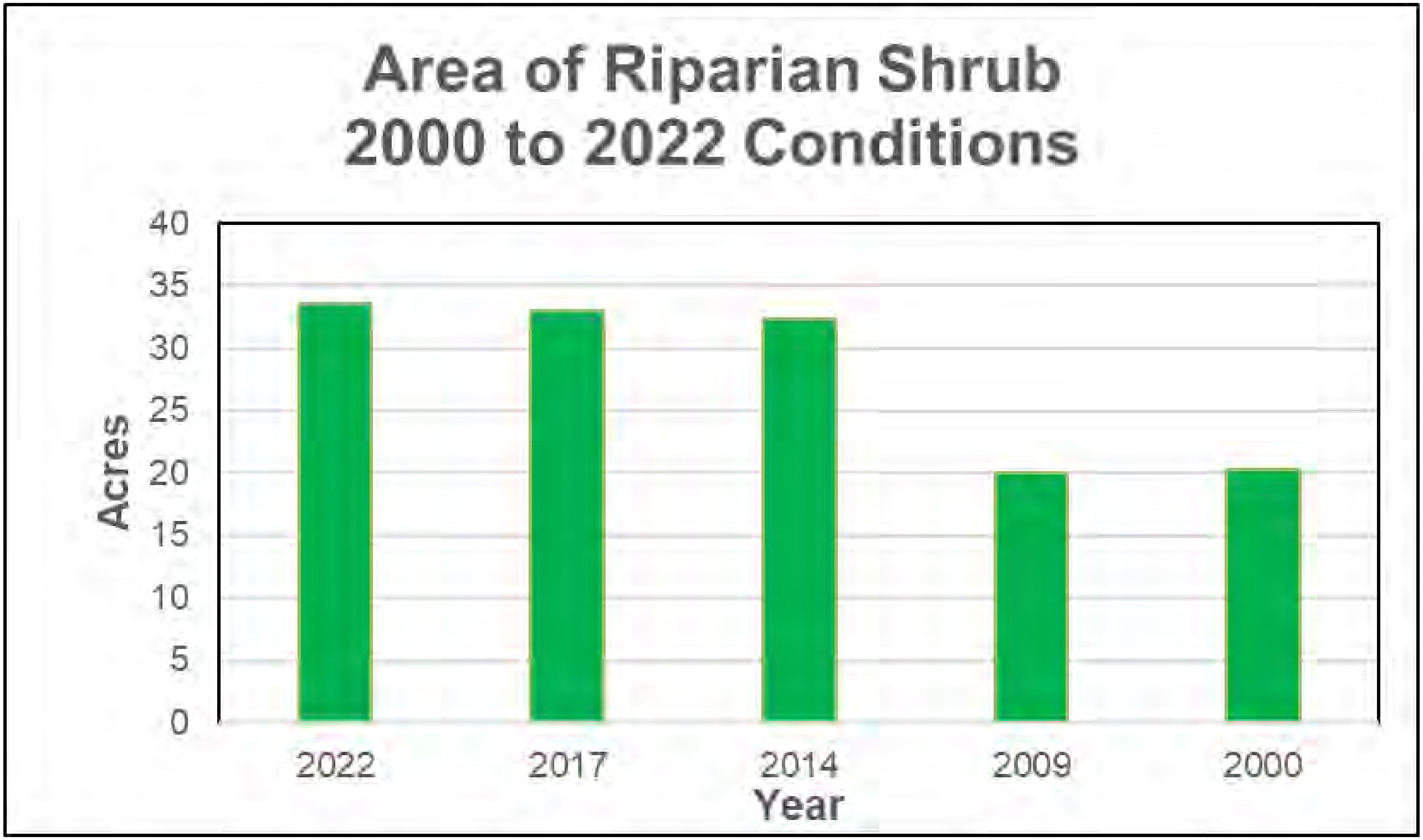


Figure 3-17. Area of Riparian Shrub, 2000 to 2022 Conditions

Tree: This forested vegetation type occurs on all landtypes and in all water regimes. The prominent overstory is Goodding willow (*Salix Gooddingii*) and red willow (*Salix laevigata*). Russian olive (*Elaeagnus angustifolia*), tamarisk (*Tamarix ramosissima*), and Fremont cottonwood (*Populus fremontii*) are also included. The understory may be marsh, wet meadow, meadow, scrub/meadow or scrub. Once established, trees seem indifferent to drought and flooding, and re-sprout after fire. Trees in the Island area endured prolonged inundation while they are also common survivors in dry scrub habitat. Most of the trees burned in the Lone Pine fire (2013) have re-sprouted and appear vigorous in 2022. About 36 acres of trees identified in 2017, including a thousand dead and decadent trees embedded in the Island marsh, burned in the 2018 Moffat fire and have not yet reappeared. The large stand of trees immediately west of the Island marsh was spared.

The mapped area of tree decreased from 449 acres in 2000 (including tamarisk), to 260 acres in 2009, and to 162 acres in 2014, primarily in response to more precise mapping of tree canopy and to tamarisk removal. A still more precise approach in 2017 identified 190 acres of trees (**Figure 3-18**) as a 2-meter buffer on LiDAR measures of vegetation height greater than 10 feet. The LiDAR mapping included some dead and decadent trees but missed many “short” trees that had previously burned and resprouted. New trees mapped in 2022 almost made up for the 36 acres of trees lost in the 2018 Moffat fire.

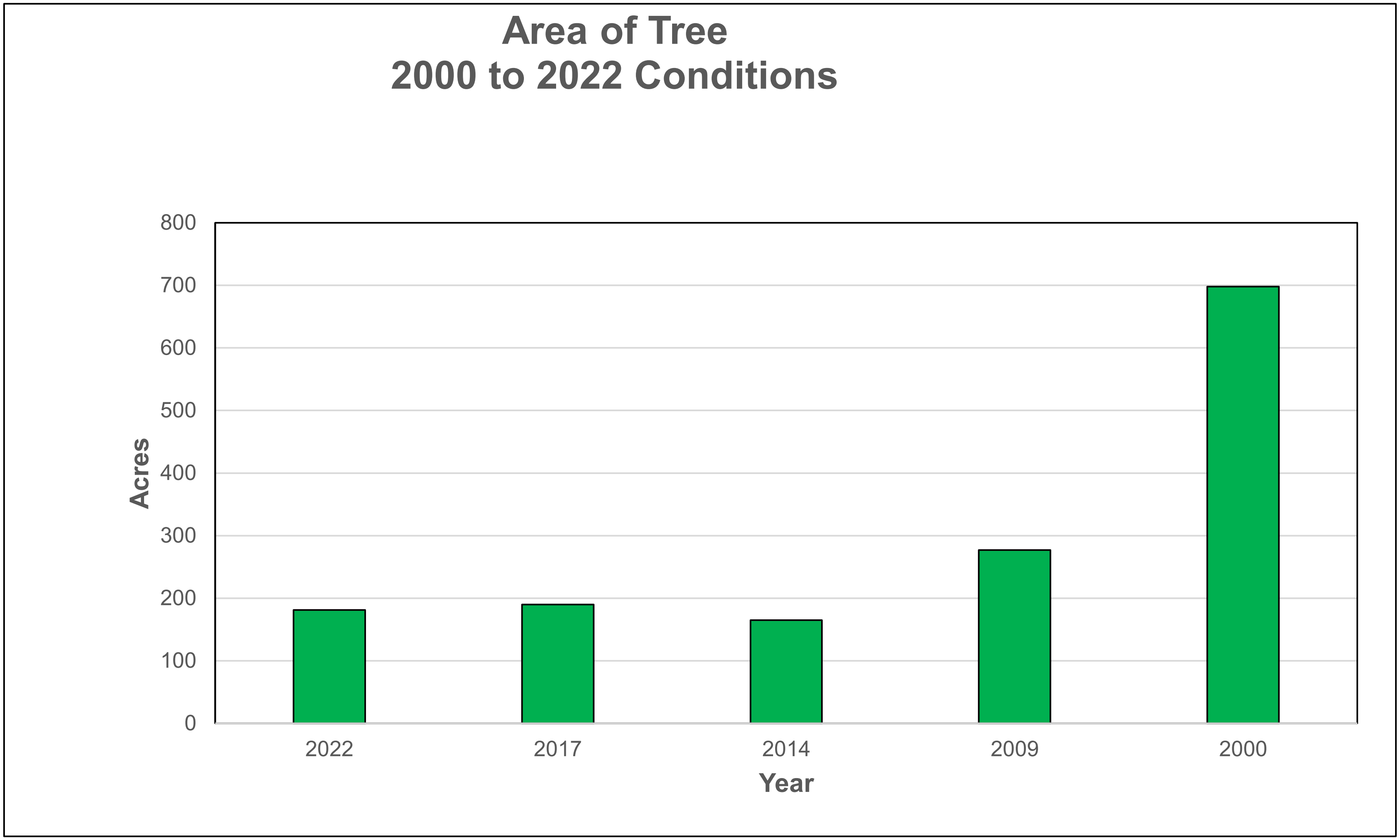


Figure 3-18. Area of Tree, 2000 to 2022 Conditions

Scrub: Scrub includes Nevada saltbush (*Atriplex lentiformis* ssp. *torreyi*) and rubber rabbitbrush (*Ericameria nauseosus)* with sparse understory. It is prevalent on terraces of incised reaches where the water table is very low and along the distant flanks of the Owens River corridor. With channel aggradation and rise in alluvial groundwater table, scrub may change to scrub/meadow. Scrub cover varies and understory is sparse. Inclusions of similar scrub/meadow and barren may each comprise up to about 10 percent of parcels.

The extent of scrub was relatively consistent (about 1,775 acres) in 2000 and 2009, decreased only about a hundred acres in 2014, then decreased about 600 acres in 2017 (**Figure 3-19**). Most of the decrease in 2017 changed to scrub/meadow. Subsequent analyses indicate that about 200-300 acres of scrub was called scrub/meadow in 2017 because of the uncharacteristically wet conditions. The area of scrub and associated barren decreased about 460 acres in 2022 relative to 2014 condition. This is believed to be a response to rising groundwater level.

Barren: Relatively unvegetated alkali soil associated with scrub. In 2022 about 7 percent of the area mapped as scrub was barren. Inclusions of scrub are common.

Roads and Miscellaneous Features: Road polygons were generated as a 16 feet wide buffer centered on an existing line file of roads. Roads comprise about 35 acres of the LORP. Miscellaneous features include the LORP intake structures, streamflow measuring stations, spoil areas, and other structural features total about 4 acres.

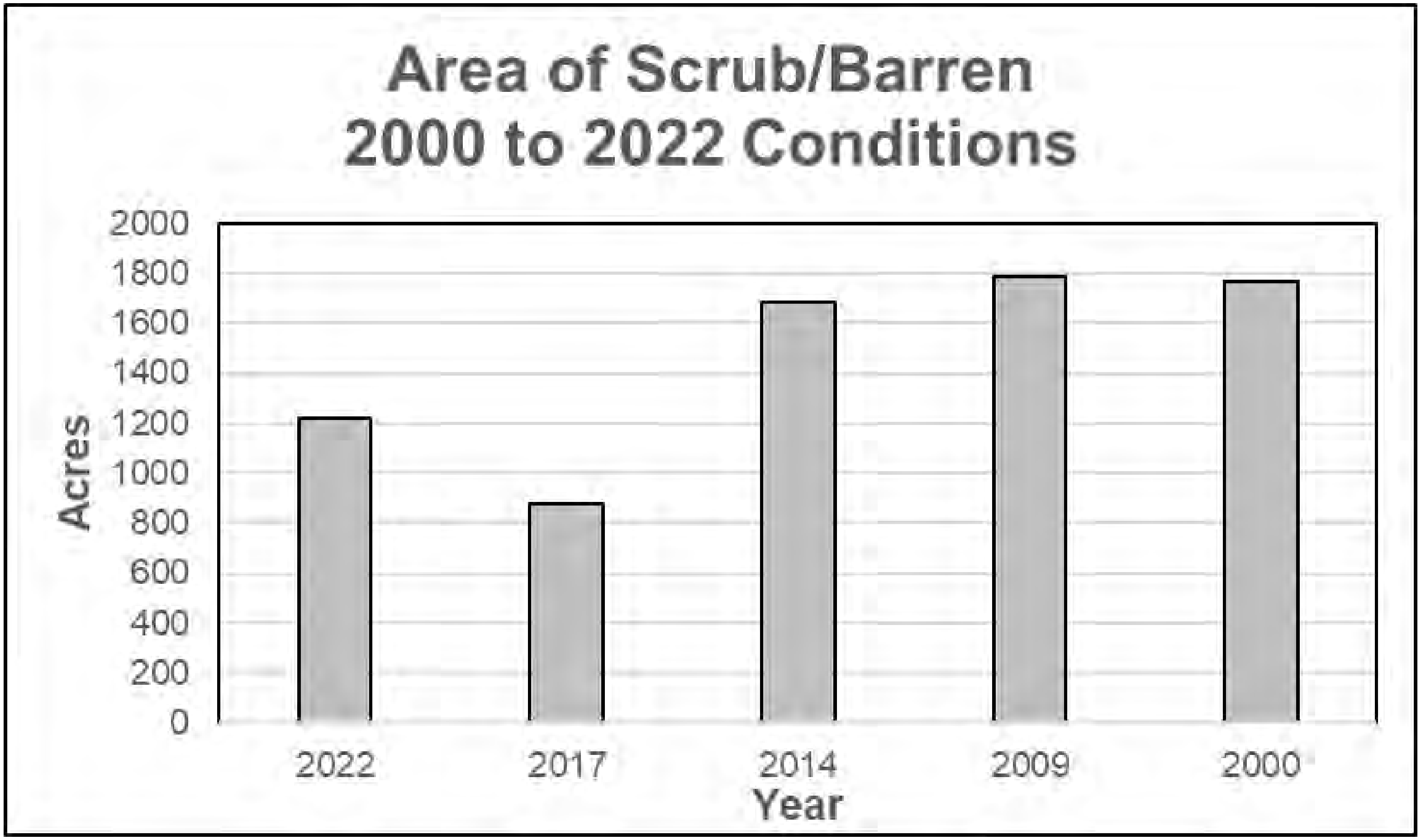


Figure 3-19. Area of Scrub/Barren, 2000 to 2022 Conditions

3.1.5 LORP *Summary*

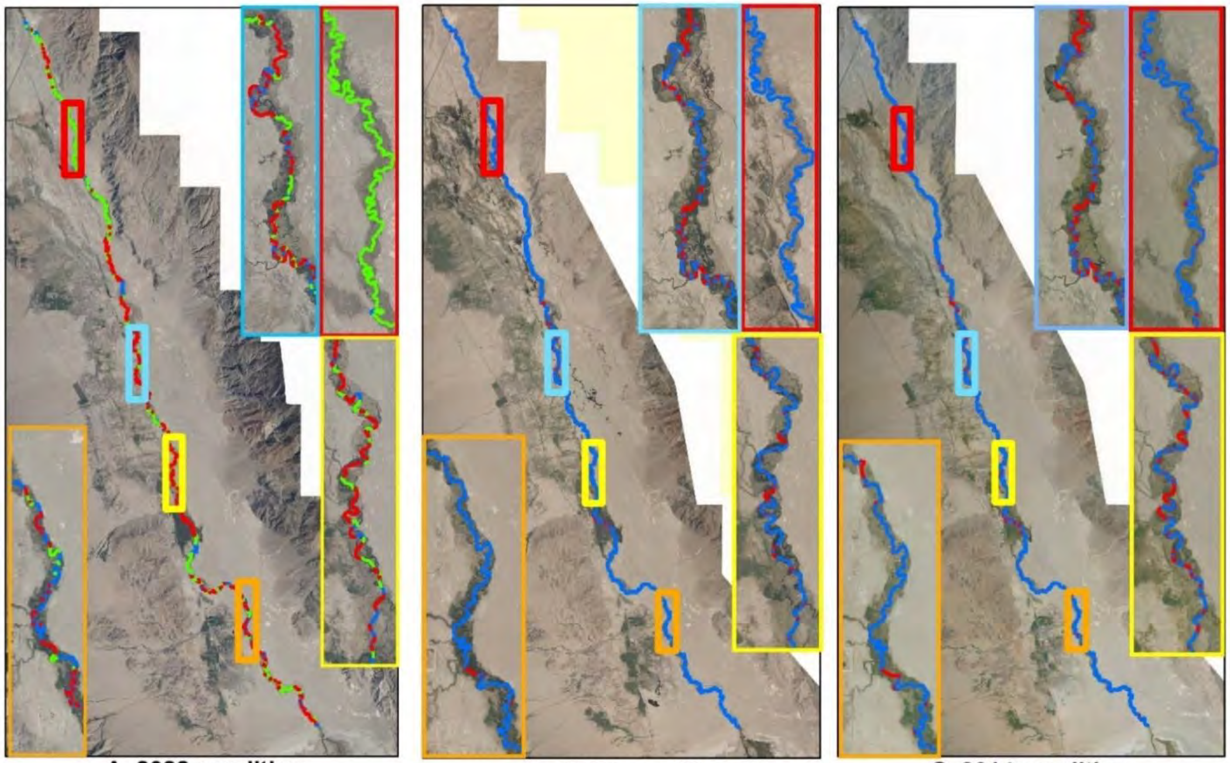
Prior to implementation of the LORP in 2007 conditions were already established that promoted aggradation (WHA 2004). A relatively consistent 15 cfs base flow since 1987 below Reach 2 (which was dry) coupled with very low stream gradient (0.08 percent) nurtured marsh in the wetted channel bottom throughout most of the LORP. After the LORP was implemented, the pre-existing marsh slowed and spread the water, encouraging more marsh. These observations led to the prediction:

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

For 2000 condition, six reaches were identified based on channel morphology, hydrology, and degree of confinement (**Figure 3-5**). Changes in the distributions of states are primarily responsible for an increase in hydric vegetation. Since 2000, the length of incised state decreased about 37 miles; the length of graded state increased 18 miles; and the aggraded state increased 19 miles. The LORP is clearly aggrading.

Hydric vegetation was predicted to increase 1,032 acres in response to the LORP (WHA 2004b). Short-term future conditions were predicted in response to two mechanisms: 1) changes to herbaceous strata in response to changes in state from establishment of base flow; and 2) changes to overstory in response to flooding from seasonal habitat flows. In practice, hydric herbaceous vegetation has increased 1,556 acres since 2000 primarily in response to changes in state. The predicted increase in overstory canopy has not yet been realized, probably because of the very limited extent of barren substrate suitable for new willow colonization in the seasonally flooded zone. Riparian shrub communities are becoming established around the mouths of tributary streams that probably serve as a source of propagules but less commonly along the Owens River. While new trees are rare, most of those present in 2000 have survived drought, inundation, fire, and appear healthy today.

In 2017 open water increased by about 3-fold in response to 250 cfs release to the LORP. The length of occluded channel in 2017 decreased 11 miles and open channel increased the same amount (**Figure 3-20**). In 2022 the length of occluded channel was about half that in 2014, but nearly half the total channel length had narrowed significantly relative to 2014 **(Figure 3-20**). The area of water in 2022 was about half that in 2014. The river channel is expected to become more occluded and marsh will continue to encroach upon open channels.



A. 2022 condition. B. 2017 condition. C. 2014 condition.

Open, Confined, and Occluded Channel

Note: Confined channel was not identified in 2014 or 2017. It probably occured but was less extensive than in 2022.

Condition	2022		2017		2014	
	(mi)	(%)	(mi)	(%)	(mi)	(%)
Open	17	29	40	69	29	50
Confined	26	45	--	--	--	--
Occluded	15	26	18	31	29	50
TOTAL	**58**	**100**	**58**	**100**	**58**	**100**

Figure 3-20. Changes in Channel Occlusion Marsh and wet meadow have continued to expand. The area of scrub/meadow and scrub has decreased. Riparian shrub has not changed much since 2014. Other than the 36 acres of trees burned by the Moffat fire in 2018 that have not (yet) reappeared, differences in the areas of trees since 2000 are primarily in response to more precise mapping and LiDAR.

As predicted in 2014, parts of the “incised reach will become graded; the floodplain of graded reaches will become wetter; and aggraded reaches will continue to slowly expand.” Since 2017 about 12 miles of graded channel is approaching an aggraded state – transitional meadows and dead scrub are a response to the higher groundwater table.

Alternative streamflow scenarios have been suggested for changing the direction of the LORP. Record flows of relatively long duration in 2017 were a good test of whether more open channel conditions will be maintained with the onset of prolonged high flows. Previously, seasonal habitat flows of somewhat lower magnitude and much shorter duration were ineffective in maintaining an open channel. In 2017 average monthly discharge exceeded 80 cfs throughout the summer and approached 150 cfs in July. Marsh has further encroached on open water in 2022 relative to 2014 condition – the high flows in 2017 were ineffective in opening the stream channel or slowing the profusion of marsh. The LORP continues to aggrade!

3.2 Delta Habitat Area Vegetation Mapping

As specified in the LORP-FEIR:

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

Baseline condition for the DHA was mapped from a 2005 Ikonos image. Conditions were again mapped in 2009, 2012, and 2017. Average monthly discharge to the DHA in July 2017 (**Figure 3-21**) was 100 cfs, ten times the average July discharge from 2007-2016. Mapping of 2017 condition was biased towards more hydric classes.

Discharge to the DHA was modified beginning in summer 2020. The 4 "pulse flows" were eliminated and discharge from May to mid-September were reduced to 3 cfs. Discharge throughout the rest of the year was increased to maintain outflow to the brine pool September through May. The intent of the revised flow regime was to reduce the expansion of marsh at the expense of wet meadow or to cause retraction of the extent of marsh. These conditions were intended to benefit birds and wildlife.

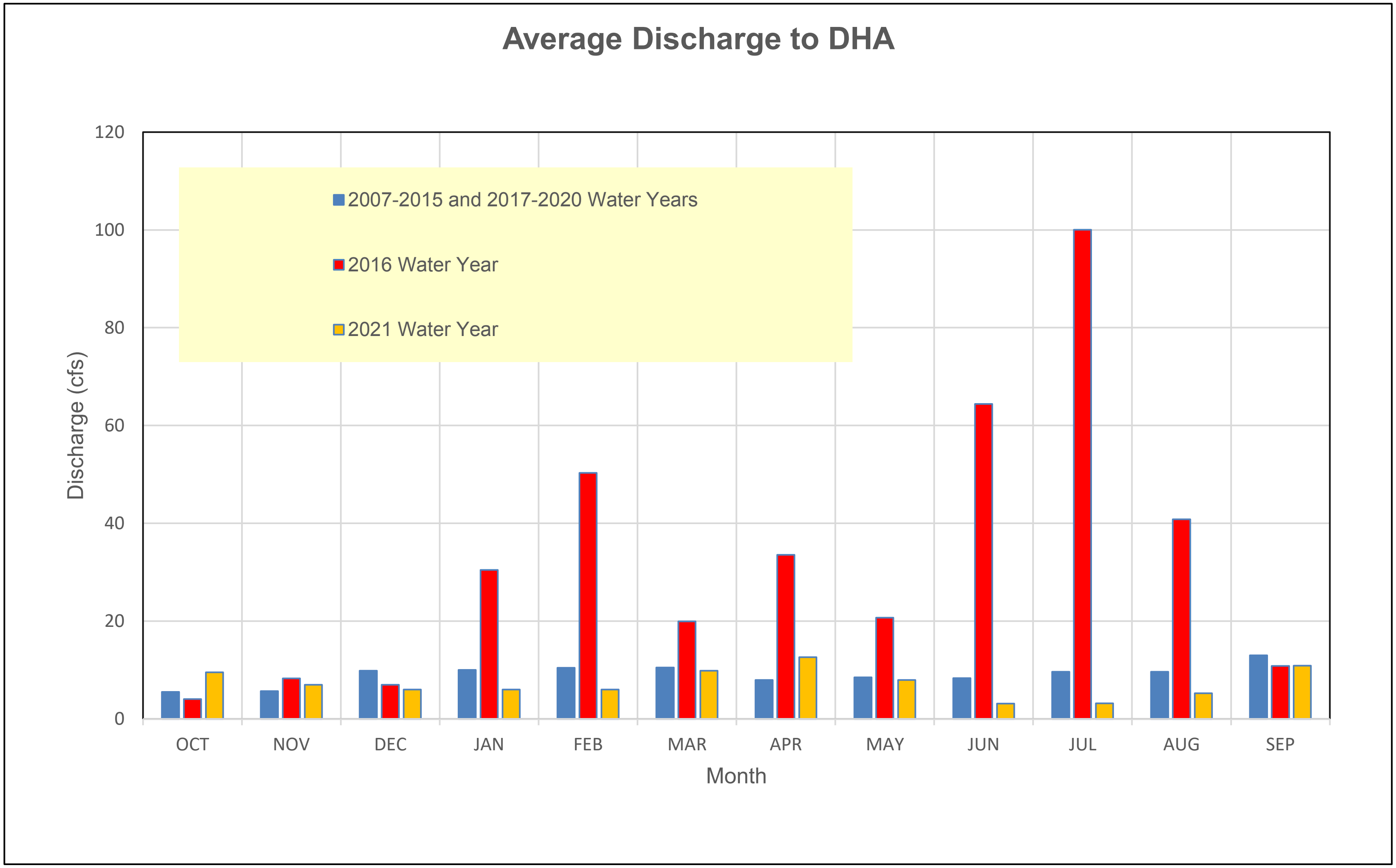


Figure 3-21. Average Discharge to the DHA

3.2.1 DHA Approach

DHA mapping of 2020 condition served as a template for spectral analysis of the 2022 image. The 2022 image was first clipped by the areas mapped as water, marsh, wet meadow, meadow, eolian, and playa in 2020. The clipped images were then treated to unsupervised classification (8 classes). The 8 raster classes for each clipped image were reclassified into fewer classes corresponding with vegetation types and generalized using raster simplification tools (majority filter, boundary clean, and nibble). Rasters were converted to polygons and edited (heads-up). Edited parcels of clipped imagery were then merged, dissolved by vegetation class, and further edited.

Marsh (tall) and wet meadow (short) were difficult to distinguish spectrally. Vegetation height derived from 2017 LiDAR was evaluated for distinguishing tall marsh from short wet meadow. Vegetation height was estimated as the difference between the LiDAR Digital Surface Model (DSM) denoting the top of the vegetation canopy and the Digital Terrain Model (DTM) denoting the water/ground surface. Resulting estimates of vegetation height were incorrect for marsh and reed because the DTM failed to penetrate to the ground surface. Alternatively, cross-section profiles of the DSM of canopy elevation relative to adjacent playa were found useful for distinguishing (tall) marsh from (short) wet meadow (
Figure 3-22).

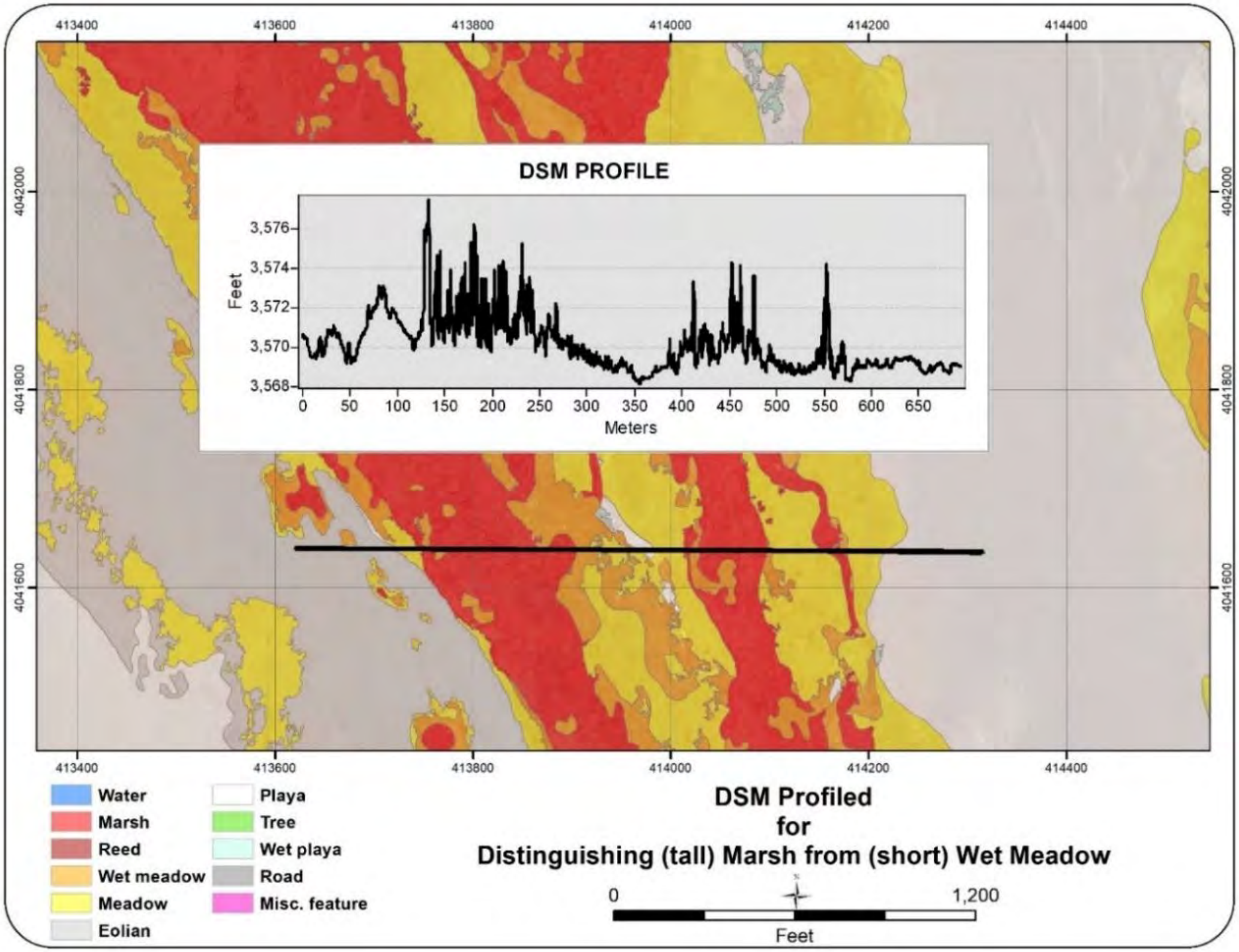


Figure 3-22. DSM Profile for Distinguishing Marsh from Wet Meadow

Deborah House (Watershed Resource Specialist/LADWP) reviewed draft DHA mapping and suggested revisions that were incorporated into final vegetation mapping.

3.2.2 DHA Results

Results of the 2022 inventory of the DHA are depicted in **Figure 3-23.** Map units are correlated in **Table 3-5.** DHA Map Unit Correlation The expansion of prominent hydric vegetation types is evident from 2005 through 2022 conditions (**Figure 3-24 and Figure 3-25**). Large-scale (1:5,000 and 1:10,000) maps of 2022 condition are compiled in Appendix 2. Large-scale comparisons of 2005, 2009, 2012, 2017, and 2022 conditions are presented Appendix 2.

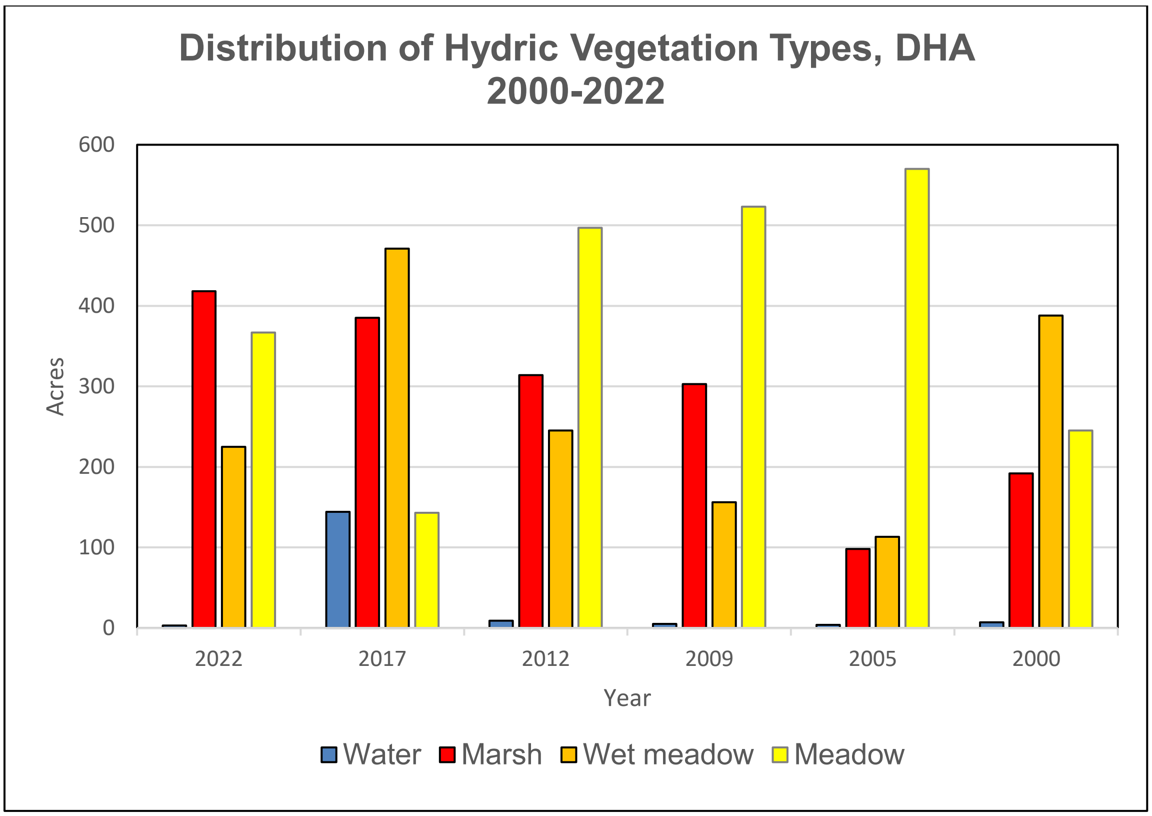


Figure 3-23. Distribution of Hydric Vegetation Types, 2005-2022

Vegetation types specific to the DHA are:

Water: Small ponds, some of which were disguised by aquatic vegetation and typically surrounded by marsh comprise only 3 acres of the DHA. This is a stark contrast to 2017 when open water covered 144 acres and diminished relative to 2012 when 9 acres was identified.

Marsh: This occurs in permanently and semi-permanently flooded habitat in the lowest parts of the lakebed, typically confined by eolian sediments. Cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acut*us) are dominant. Three-square bulrush (*Schoenoplectus pungens*), salt marsh bulrush (*Schoenoplectus maritimus*), common reedgrass (*Phragmites australis*), Parish spikerush (*Eleocharis parishii*) and yerba-mansa (*Anemopsis californica*) may be present.

The vegetation canopy is typically more than 6 feet tall and vegetative cover is very high. Marsh was distinguished from spectrally similar wet meadow using LiDAR DSM (**Figure 3-22**). Inclusions of similar wet meadow are common; minor inclusions of open water may be present but are uncommon. Also included are small areas of dead marsh that may be a response to altered flow regime to the DHA in 2020. The area of marsh has steadily increased since 2005 (**Figure 3-23**).

Wet Meadow (Short Marsh): This typically occurs along the expanding front of marsh and appears to be a successional stage towards (tall) marsh. Prominent species include prairie rush (*Schoenoplectus maritimus*), chairmakers bulrush (*Schoenoplectus americanus*), spikerush (*Eleocharis spp*.), and saltgrass (*Distichlis spicata*). It was distinguished from (tall) marsh using a LiDAR DSM. Inclusions of similar marsh are common; inclusions of meadow are less frequent. The area of wet meadow has remained relatively consistent except for 2017 when wet conditions probably resulted in large areas of meadow being mistaken for wet meadow.

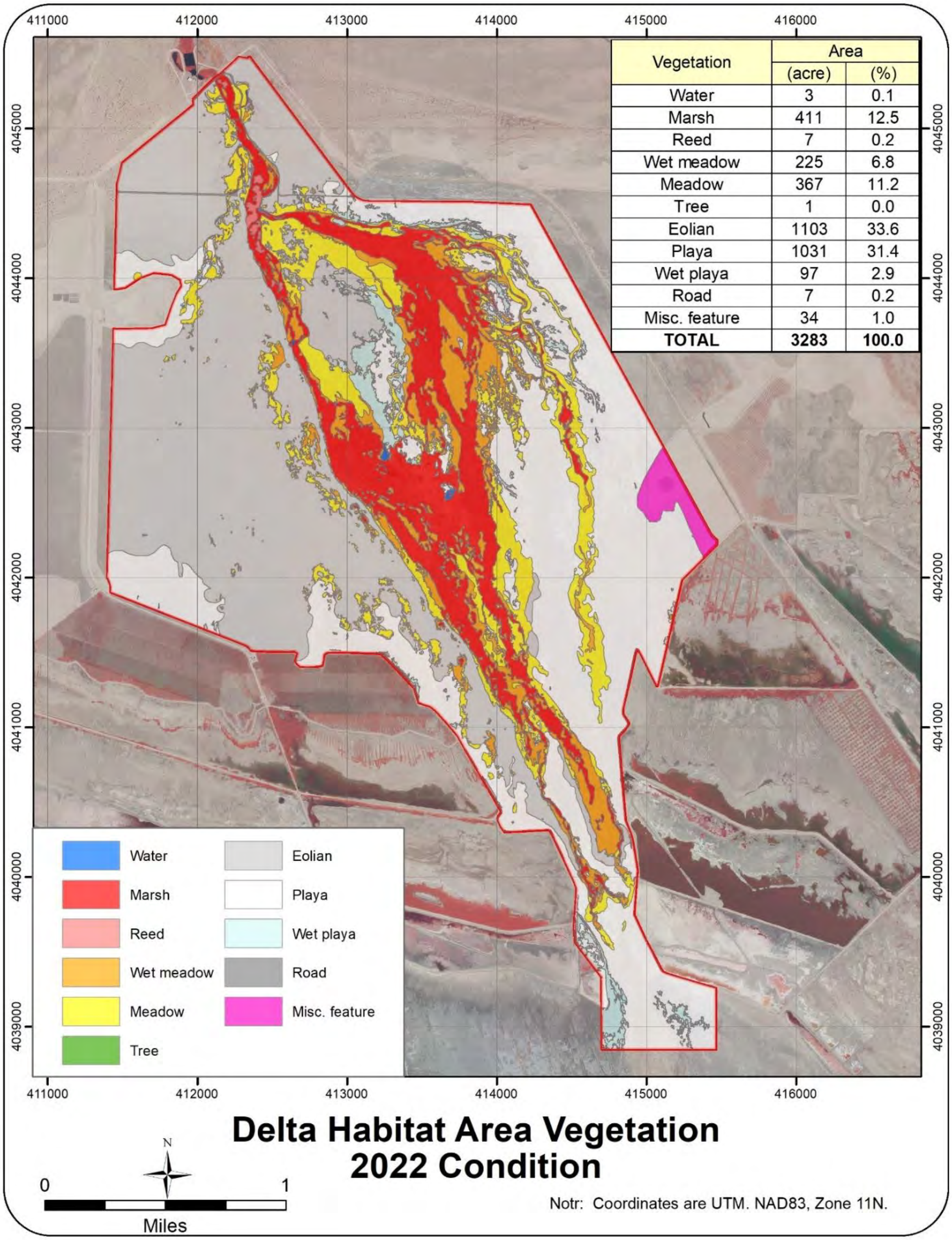
Meadow: This typically occurs on the periphery of the hydric vegetation on sandy eolian substrate. The prominent species is saltgrass (*Distichlis spicata*), typically with relatively low cover. Boundaries with eolian are diffuse. The area of meadow was underestimated in 2017 due to wet conditions. The area of meadow decreased more than 100 acres since 2012.

Tree: A few solitary trees are present on shallow dunes west of the wetted area and in the marsh. Trees have been more precisely delineated in recent surveys, but do not appear to have changed much.

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

Playa: Unvegetated lake deposit. Wet playa and (dry) playa were distinguished.

Road and Miscellaneous Feature: A gravel dust control treatment area was added along the east flank of the DHA comprises 34 acres and roads comprise 7 acres.



Vegetation	Area (acre)	Area (%)
Water	3	0.1
Marsh	411	12.5
Reed	7	0.2
Wet meadow	225	6.8
Meadow	367	11.2
Tree	1	0.0
Eolian	1103	33.6
Playa	1031	31.4
Wet playa	97	2.9
Road	7	0.2
Misc. feature	34	1.0
TOTAL	**3283**	**100.0**

Figure 3-24. DHA Vegetation, 2022 Condition

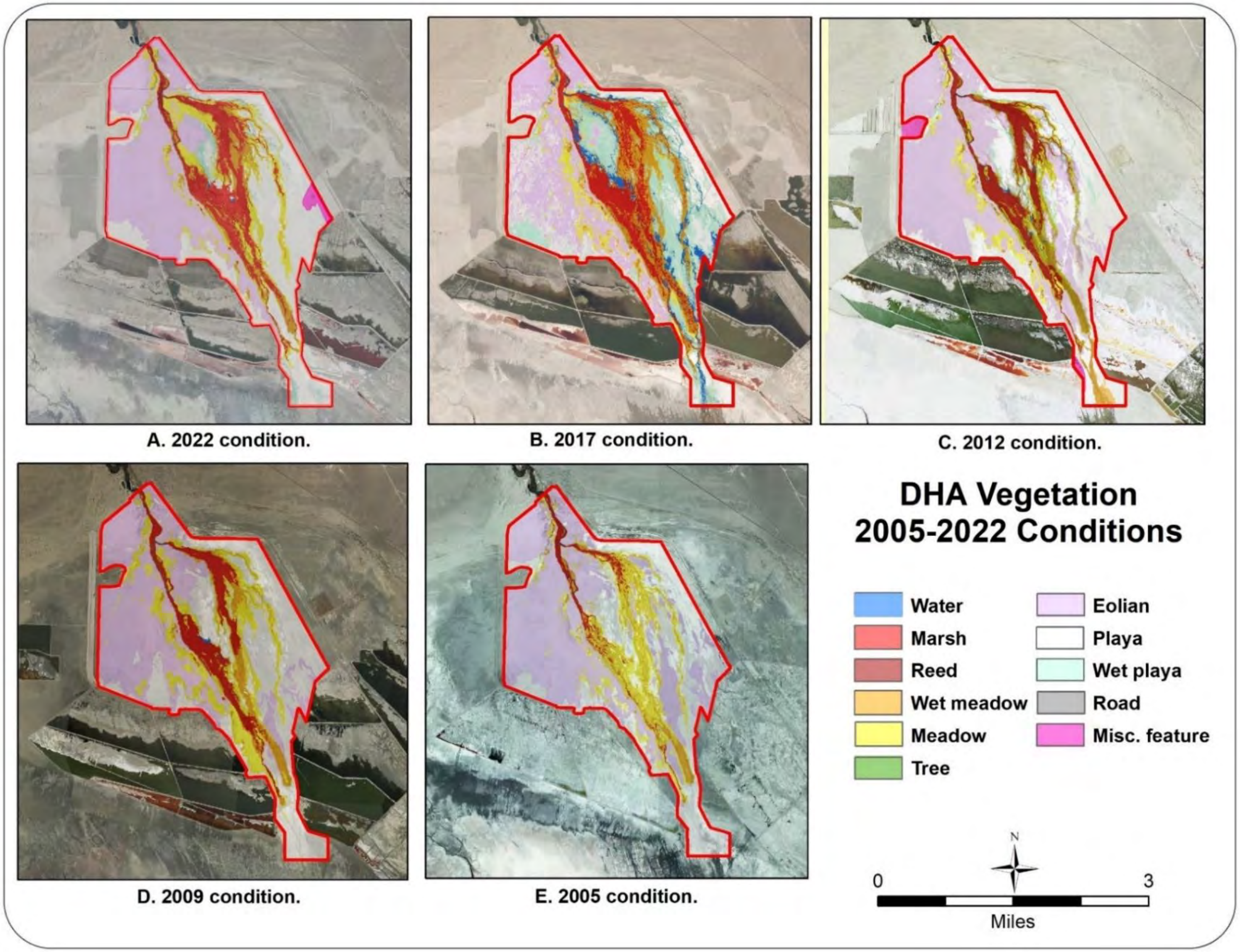


Figure 3-25. DHA Vegetation, 2005-2022 Conditions

Table 3-5. DHA Map Unit Correlation

<table>
<tr><th colspan="2">2022 Condition</th><th colspan="2">2017 Condition</th><th colspan="2">2012 Condition</th><th colspan="2">2009 Condition</th><th colspan="2">2005 Condition</th><th colspan="2">2000 Condition</th></tr>
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<tr><td>Reed</td><td>7</td></tr>
<tr><td rowspan="2">Wet meadow</td><td rowspan="2">225</td><td>Short marsh</td><td>217</td><td>Short marsh</td><td>51</td></tr>
<tr><td>Wet meadow</td><td>254</td><td>Wet alkali meadow</td><td>194</td><td>Saltgrass-rush</td><td>156</td><td>Saltgrass-rush</td><td>113</td><td>Wet alkali meadow</td><td>388</td></tr>
<tr><td rowspan="2">Meadow</td><td rowspan="2">367</td><td rowspan="2">Meadow</td><td rowspan="2">143</td><td>Alkali meadow</td><td>282</td><td rowspan="2">Saltgrass</td><td rowspan="2">523</td><td rowspan="2">Saltgrass</td><td rowspan="2">570</td><td rowspan="2">Saltgrass</td><td rowspan="2">245</td></tr>
<tr><td>Eolian DISP</td><td>215</td></tr>
<tr><td>Tree</td><td>1</td><td>Tree</td><td>1</td><td>Riparian forest</td><td>2</td><td>Goodding-red willow</td><td>4</td><td>--</td><td>--</td><td>Goodding-red willow</td><td>18</td></tr>
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<tr><td rowspan="3">Eolian</td><td rowspan="3">735</td><td>Eolian</td><td>178</td><td>Parry saltbush</td><td>1087</td><td rowspan="3">Eolian complex</td><td rowspan="3">1398</td><td rowspan="2">Parry saltbush-seepweed</td><td rowspan="2">1190</td></tr>
<tr><td>Eolian scrub</td><td>897</td><td>Seepweed</td><td>31</td></tr>
<tr><td>Eolian SAVE</td><td>129</td><td>Greasewood</td><td>17</td><td>Dune</td><td>50</td></tr>
<tr><td>Wet playa</td><td>97</td><td>Wet playa</td><td>728</td><td>Wet playa</td><td>123</td><td rowspan="2">Playa</td><td rowspan="2">1151</td><td rowspan="2">Playa</td><td rowspan="2">1039</td><td rowspan="2">Playa</td><td rowspan="2">1180</td></tr>
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3.3 Associated Literature

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

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3.4 Appendices

3.4.1 Appendix B.

APPENDIX B
LORP Vegetation
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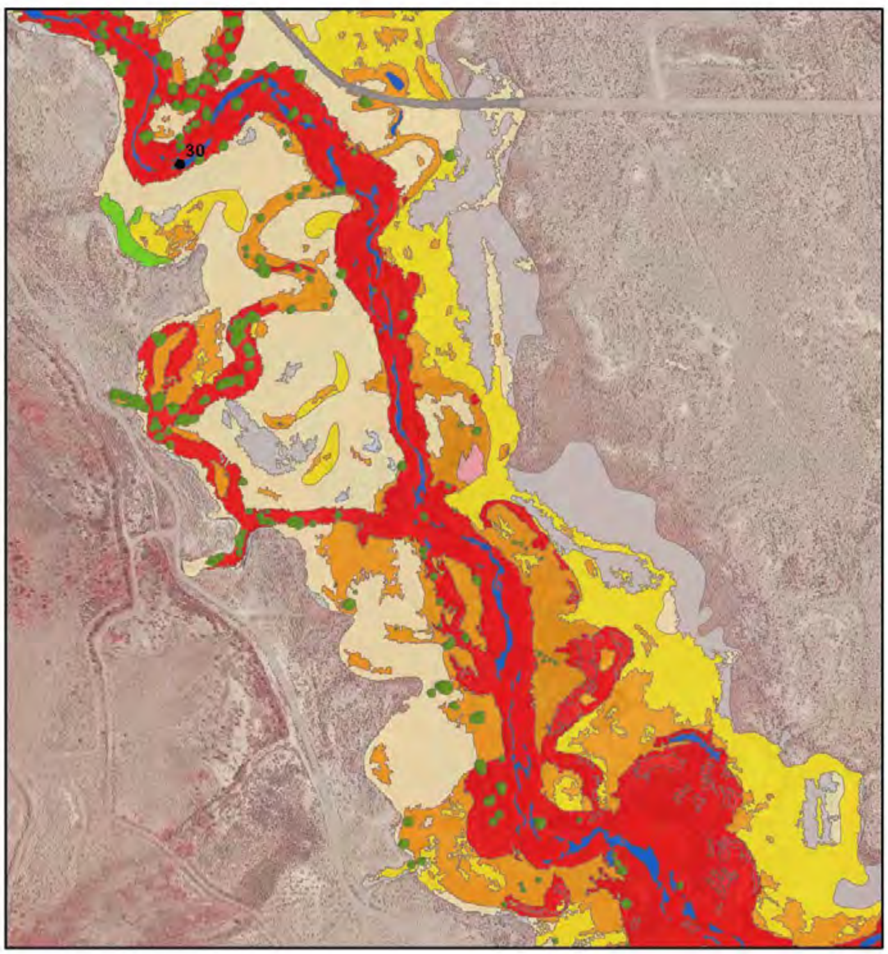

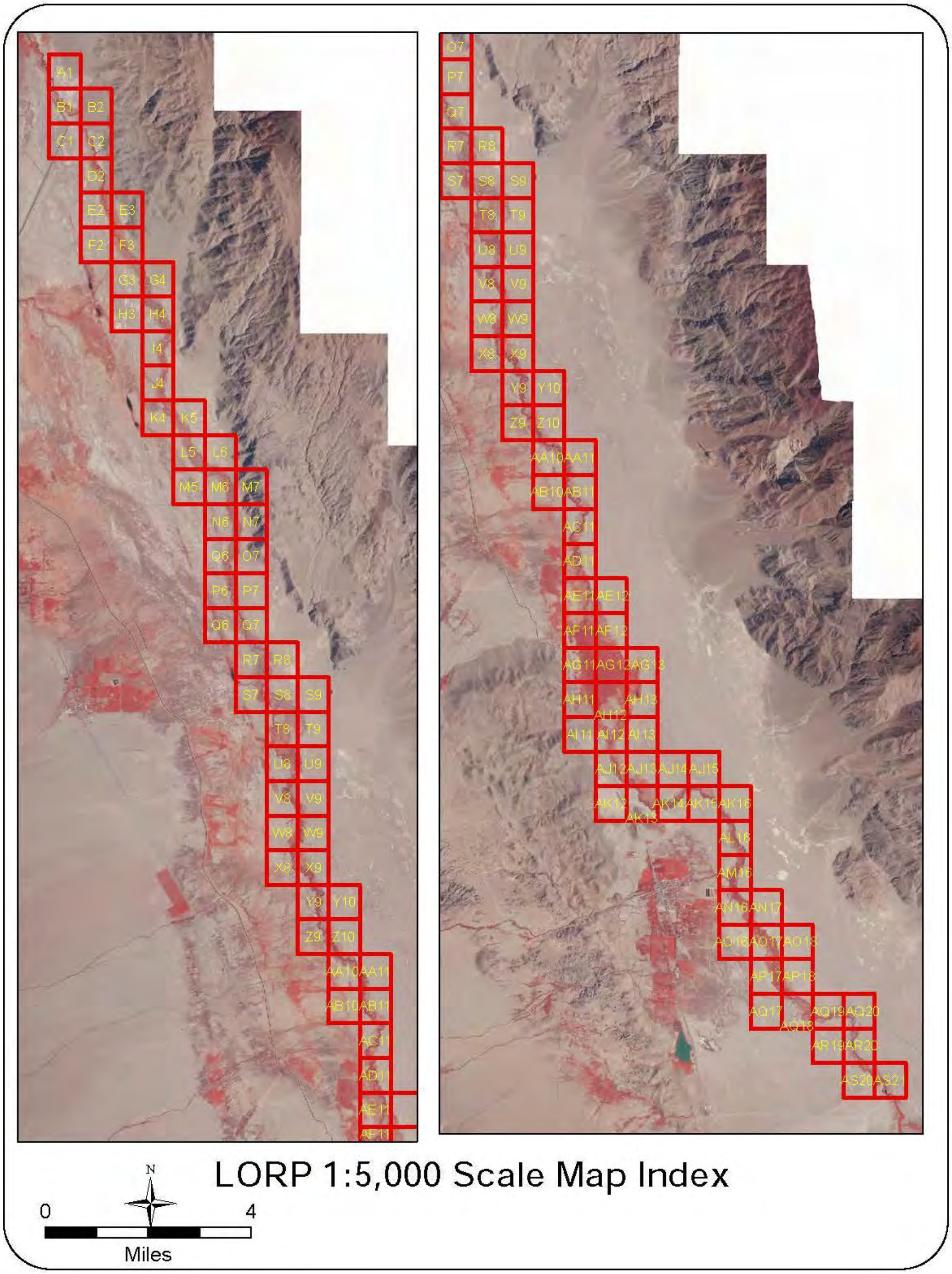
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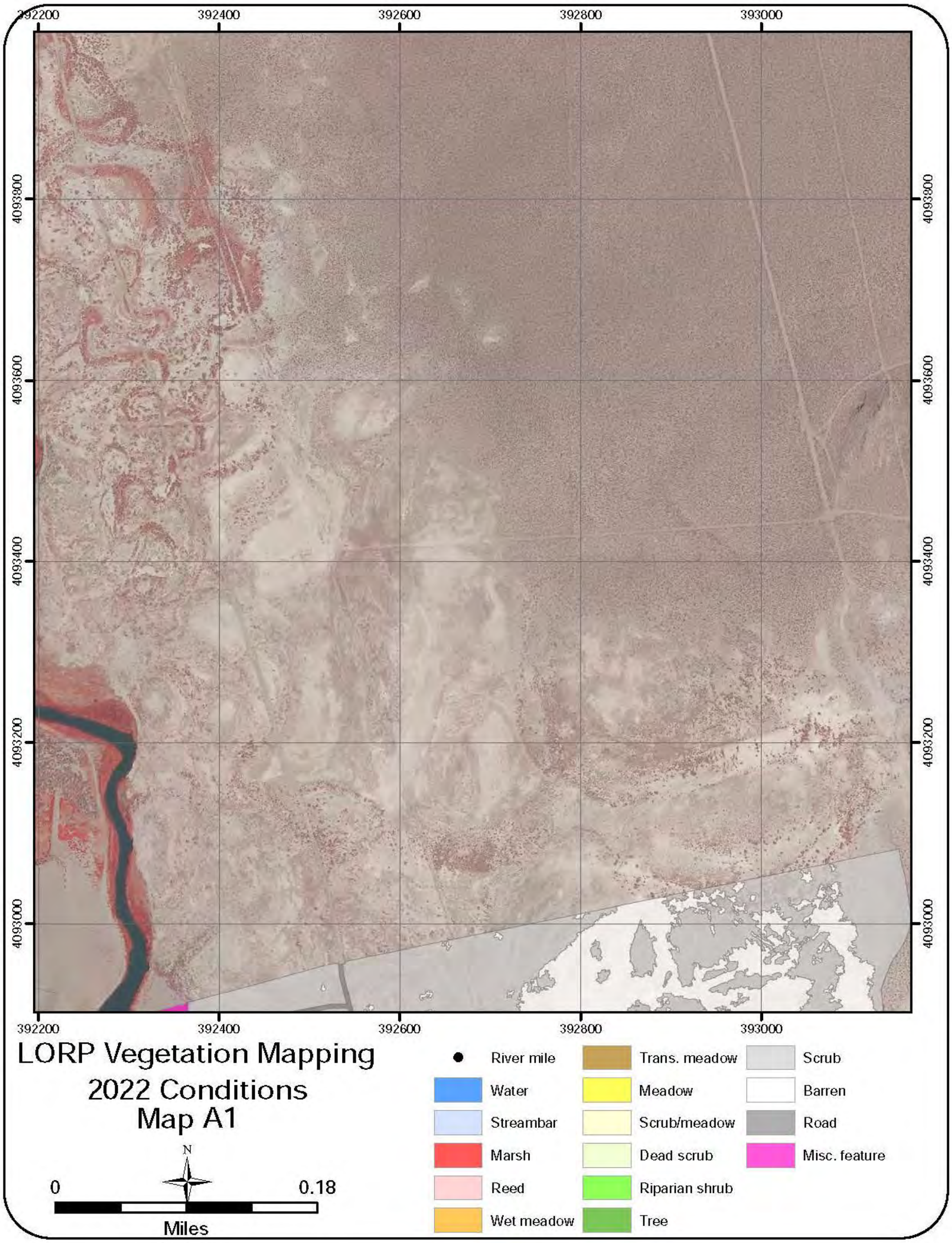

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Road
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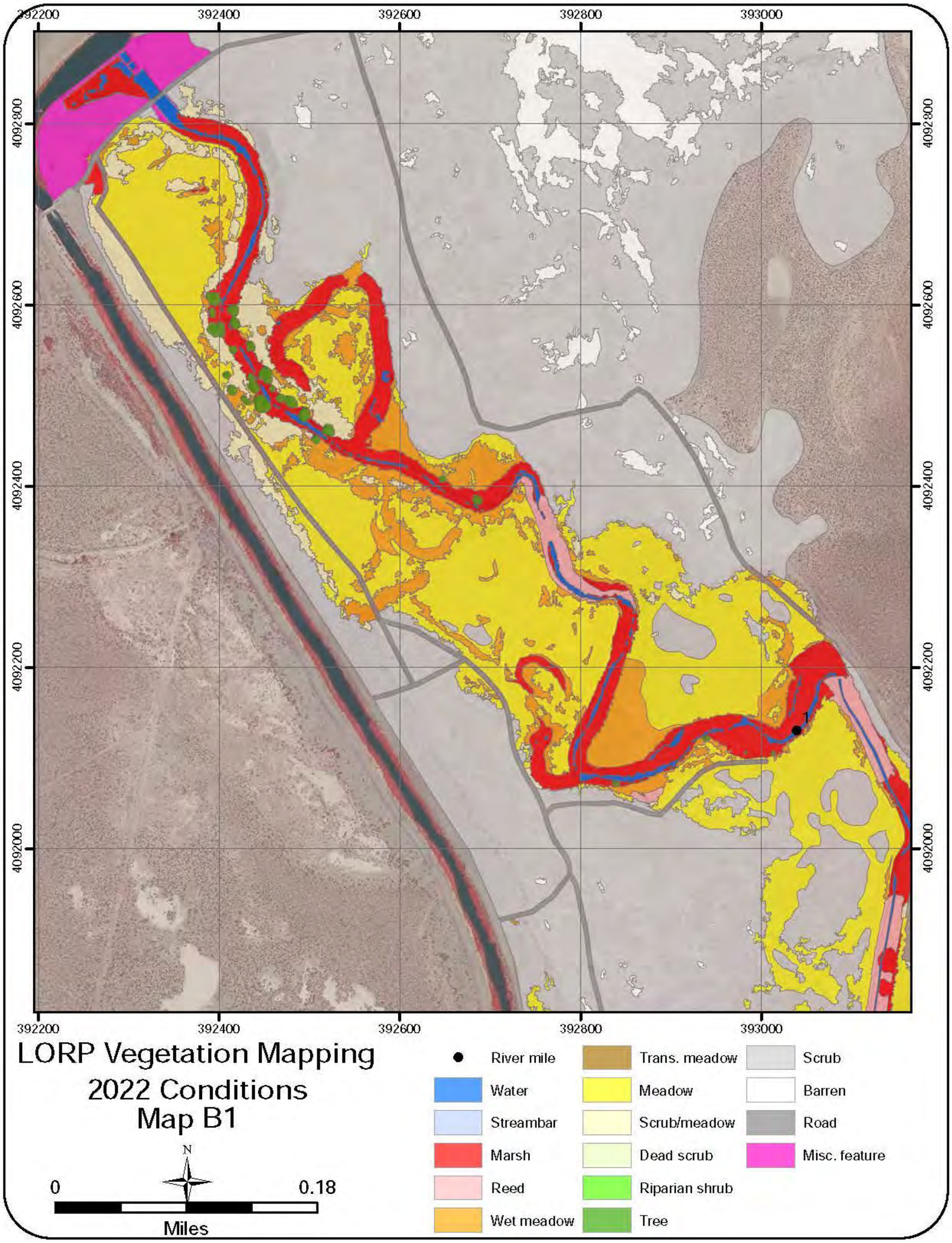
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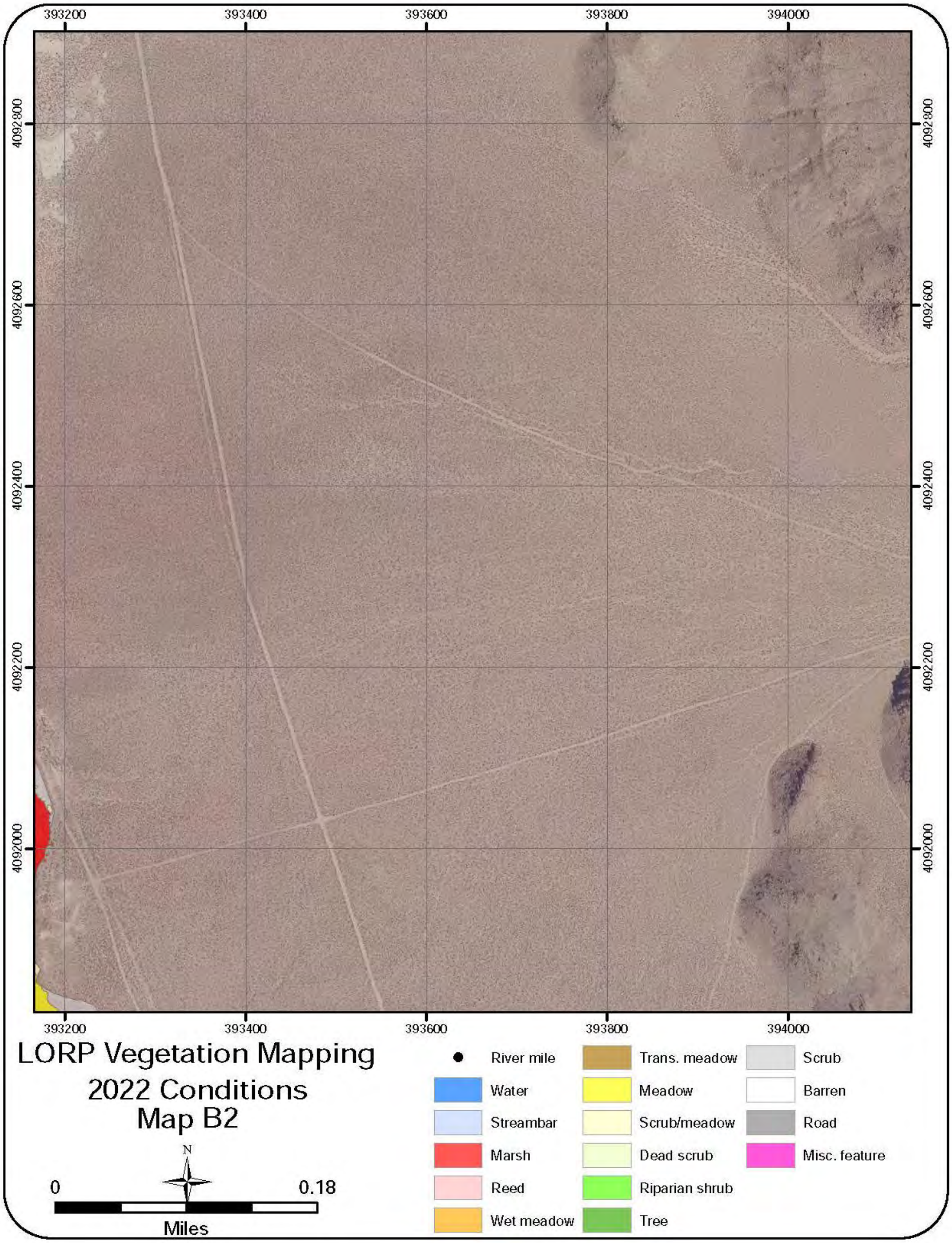
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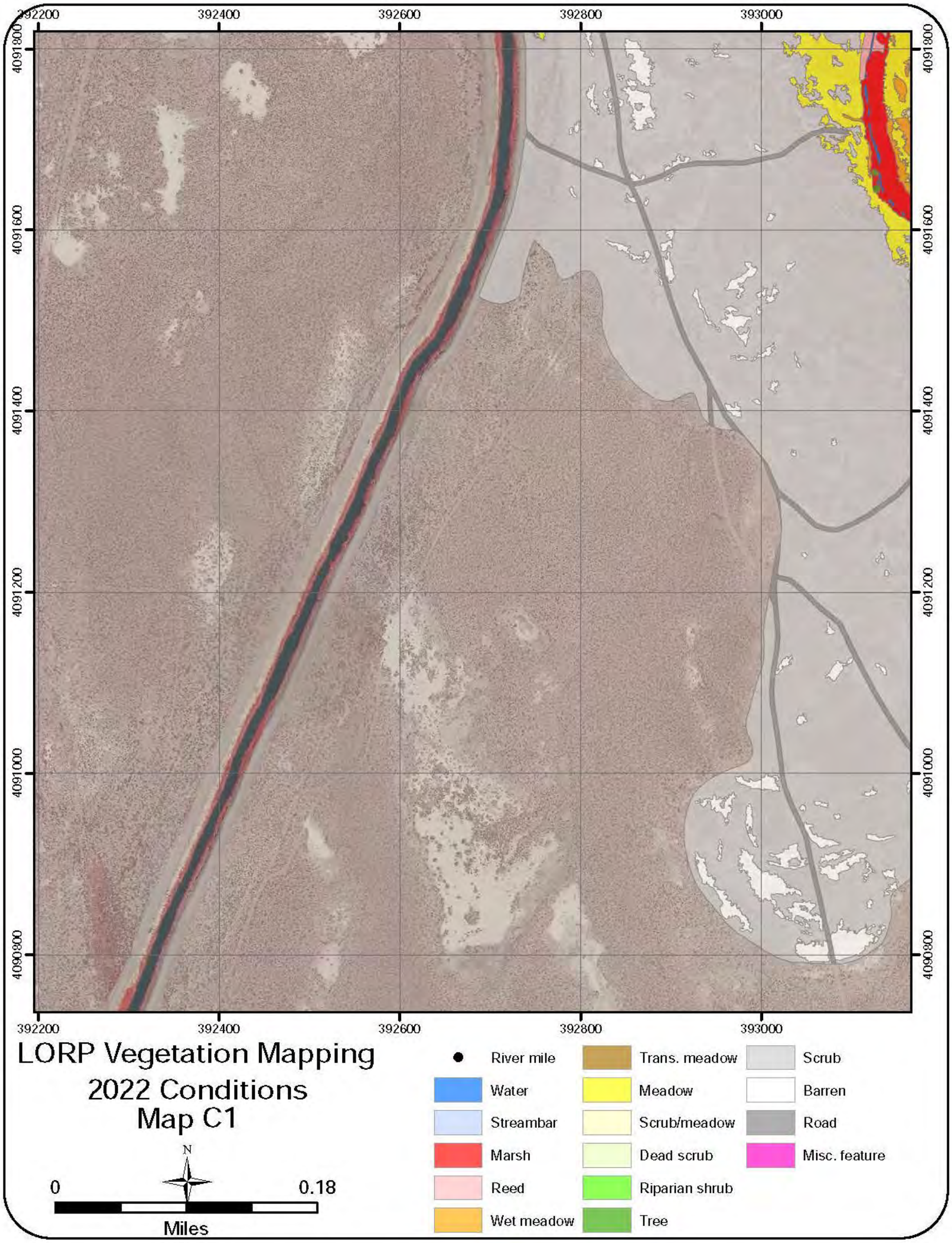
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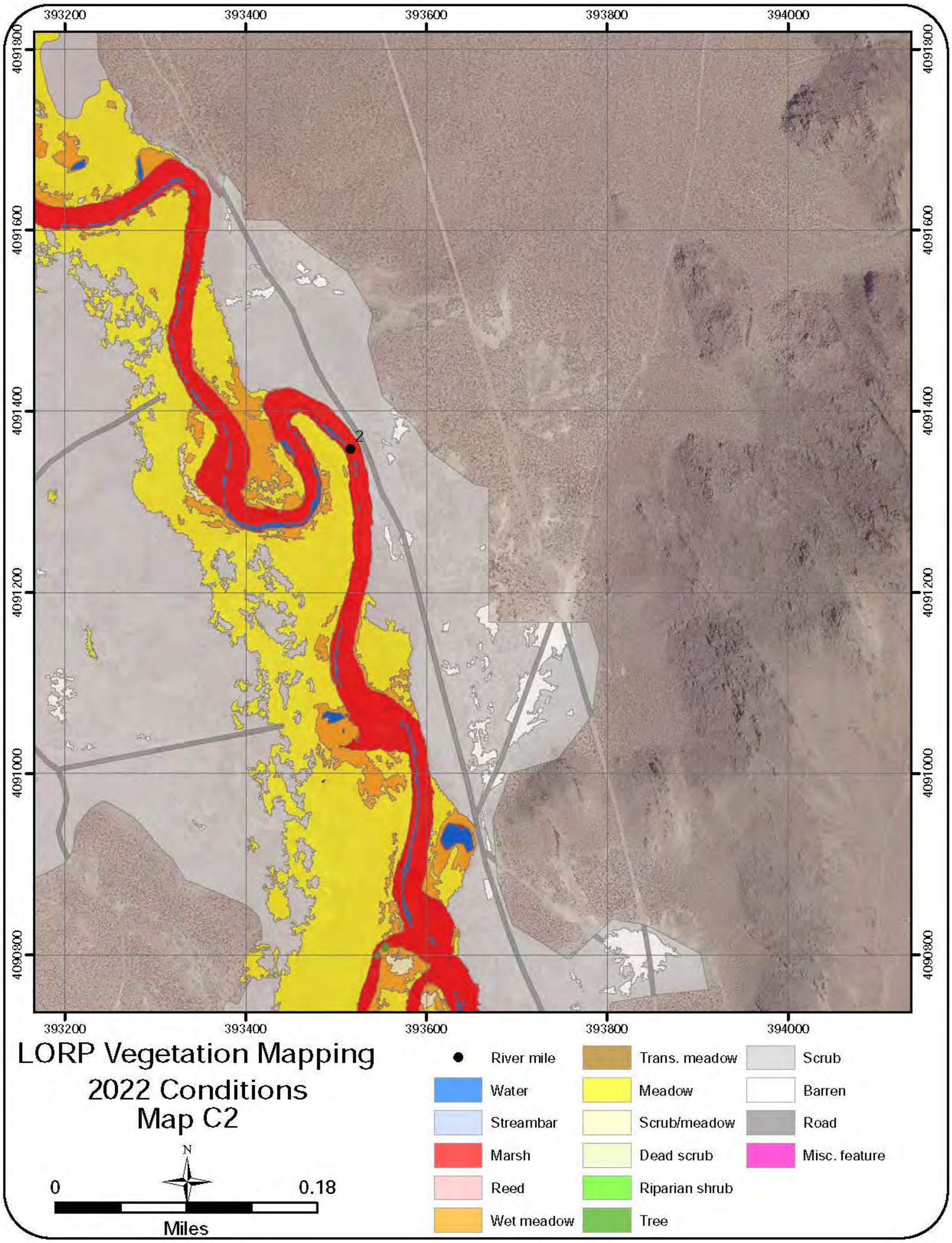
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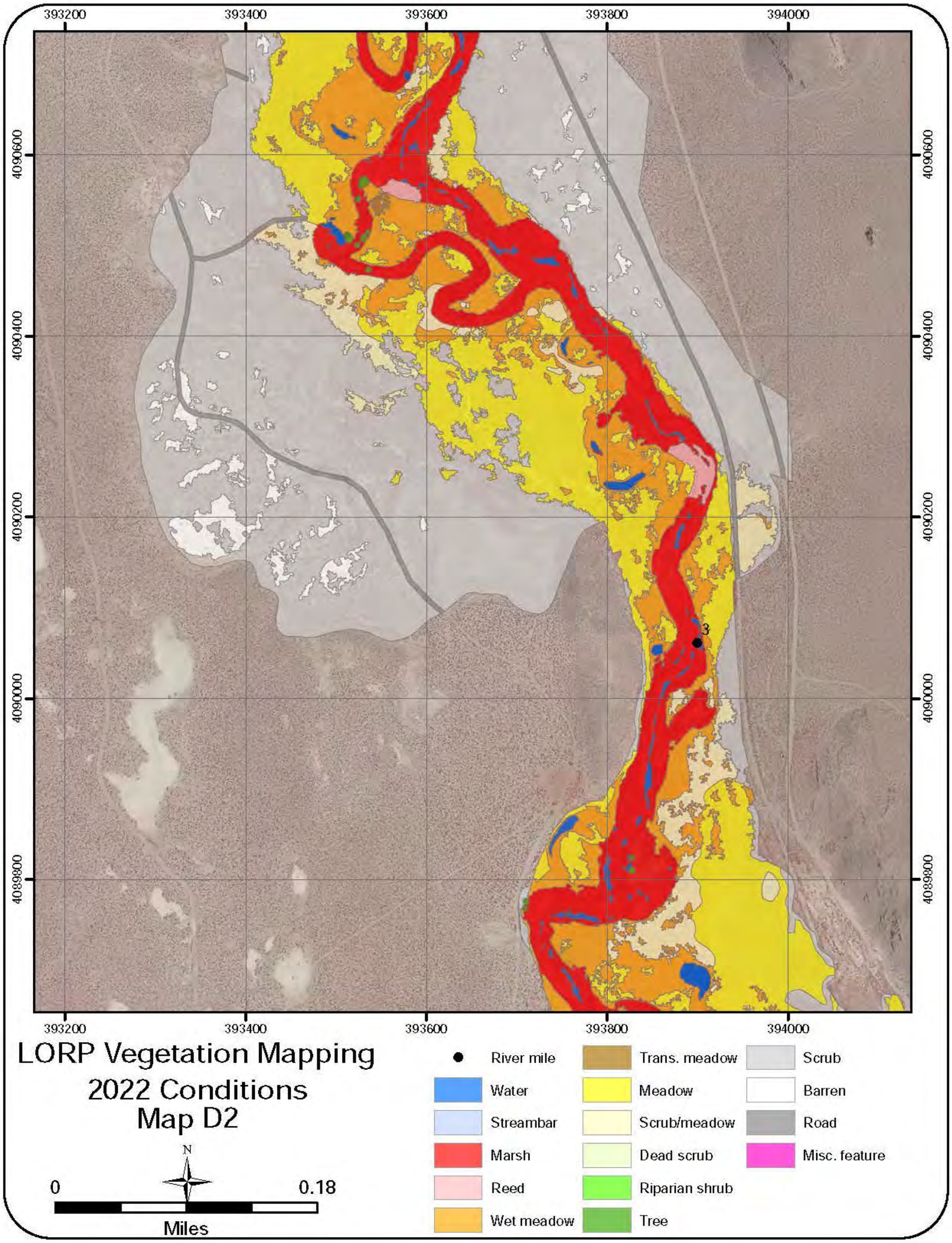
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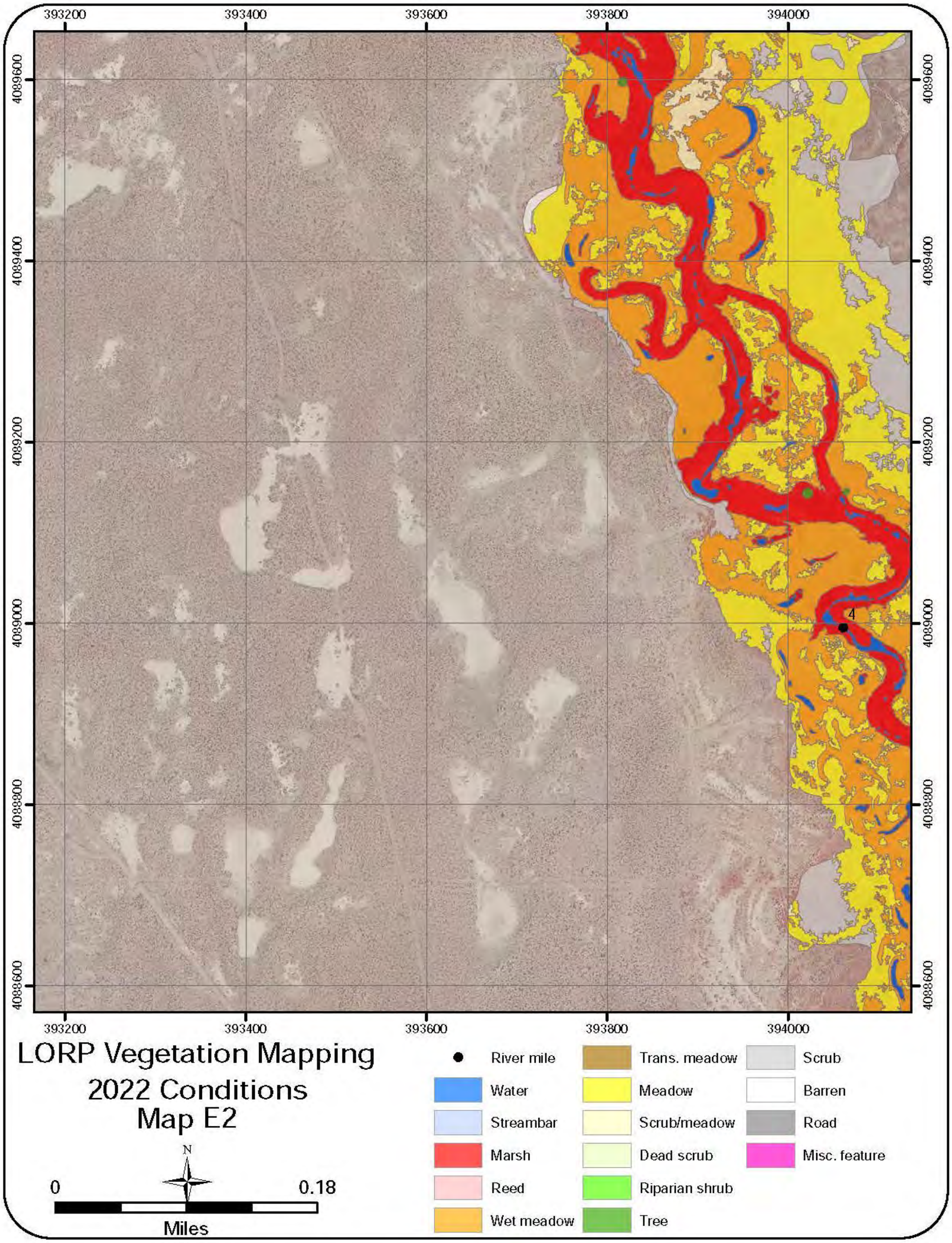
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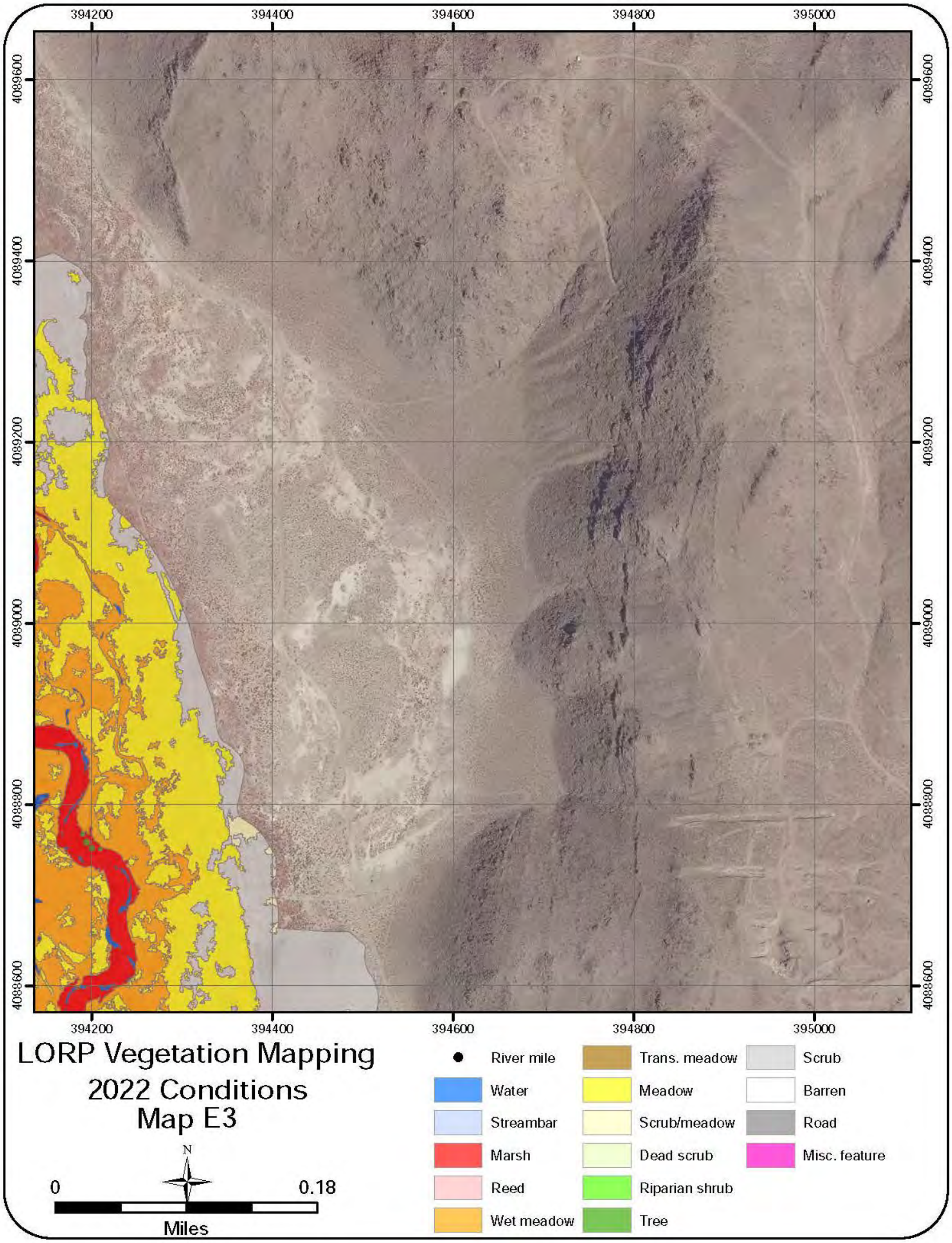
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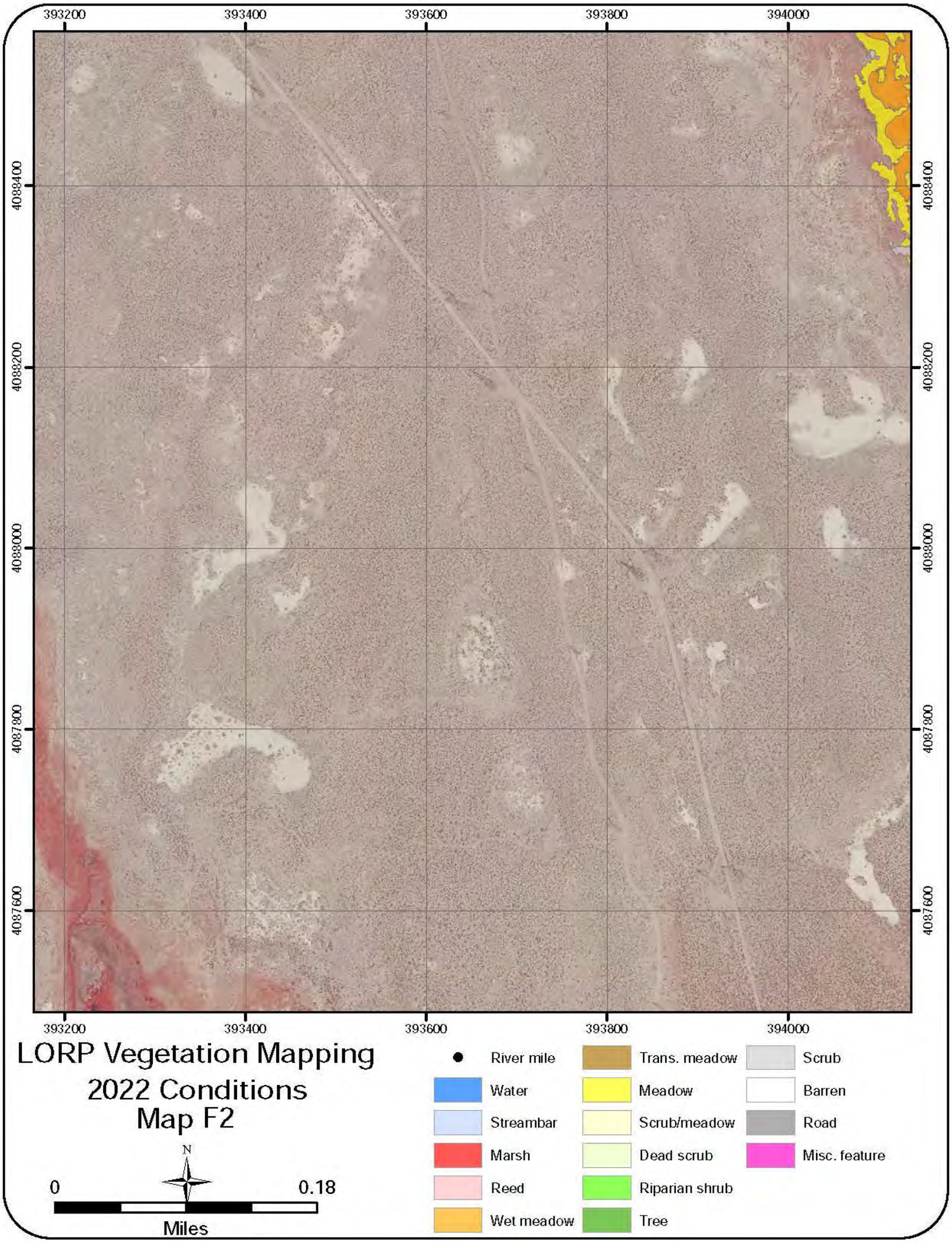
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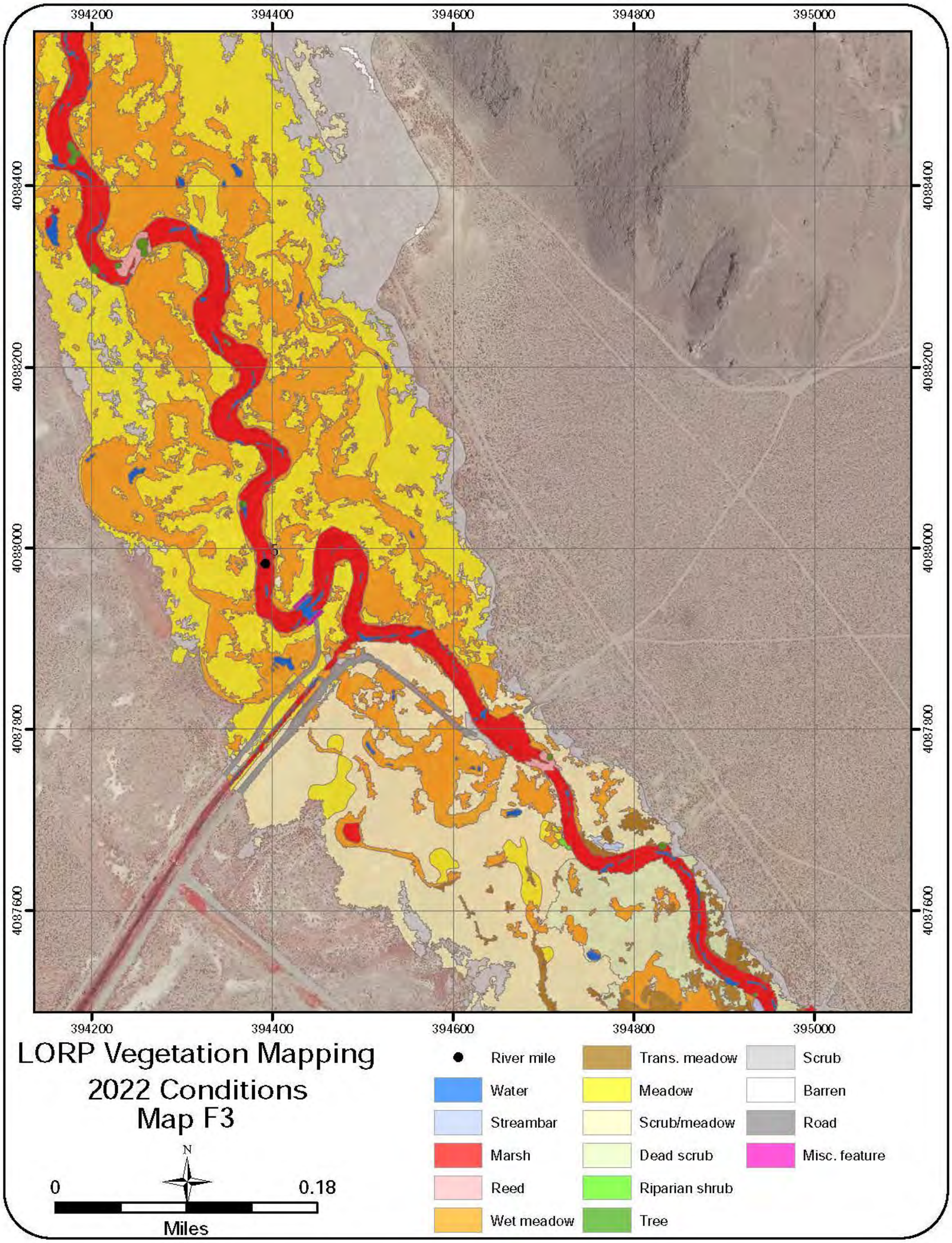
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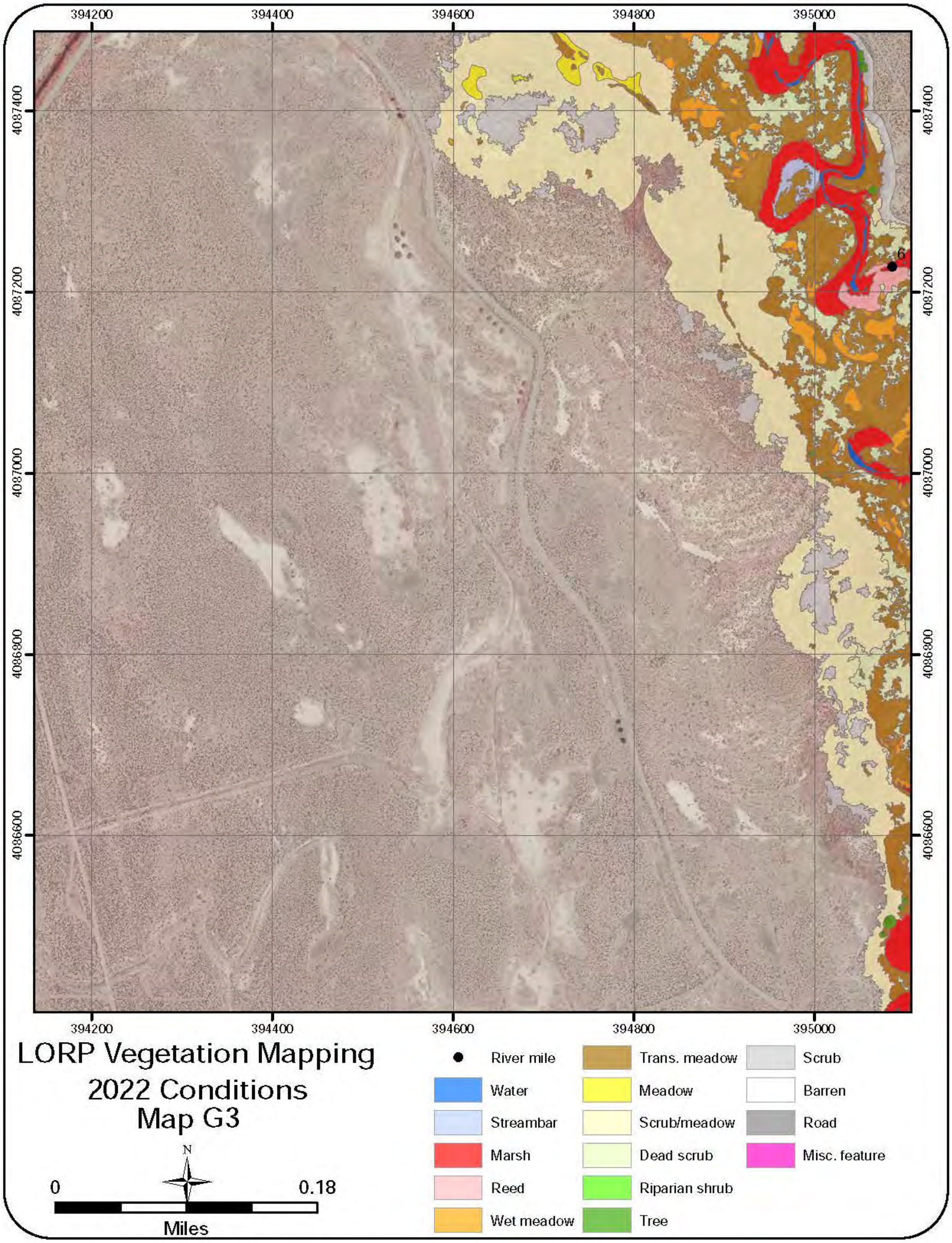
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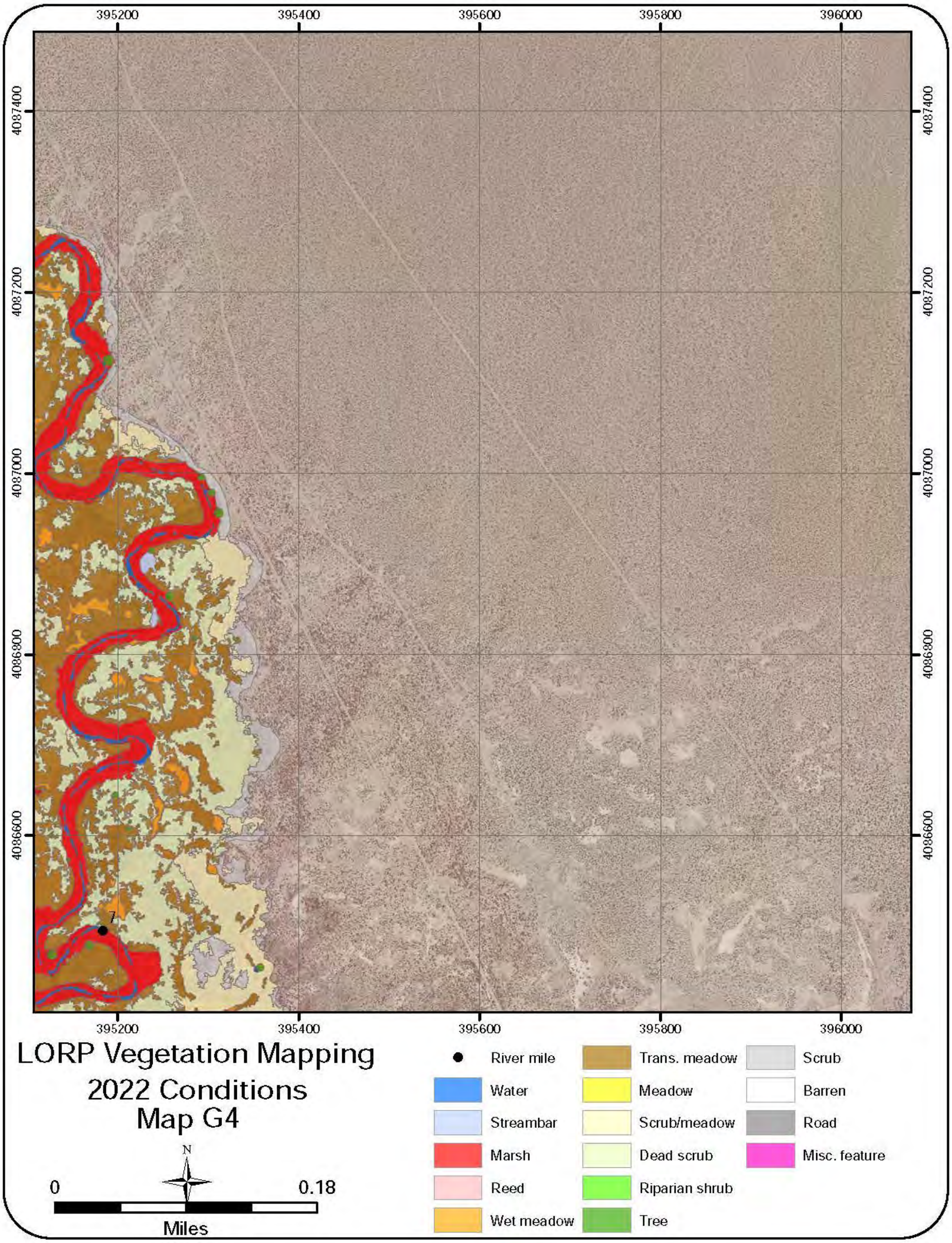
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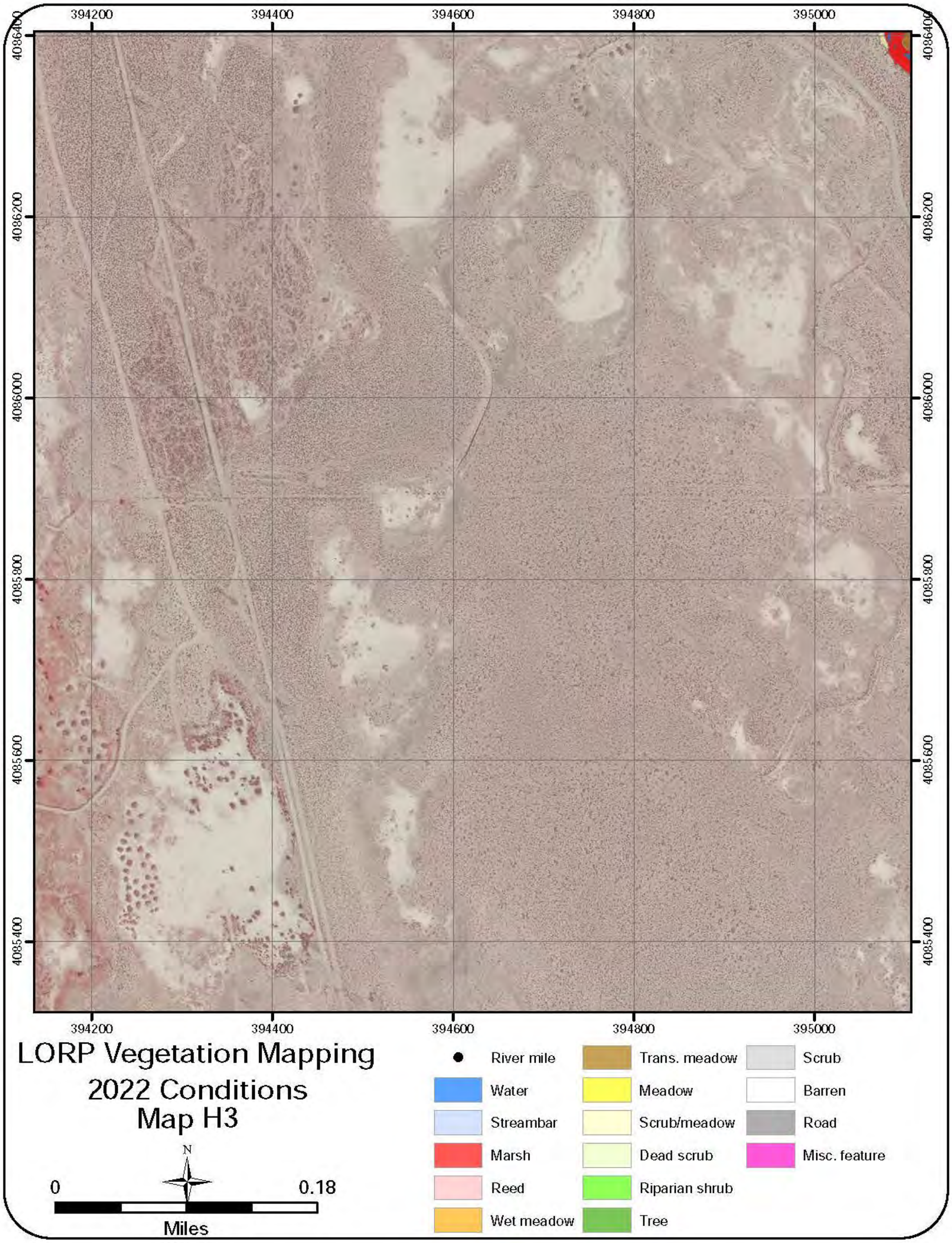
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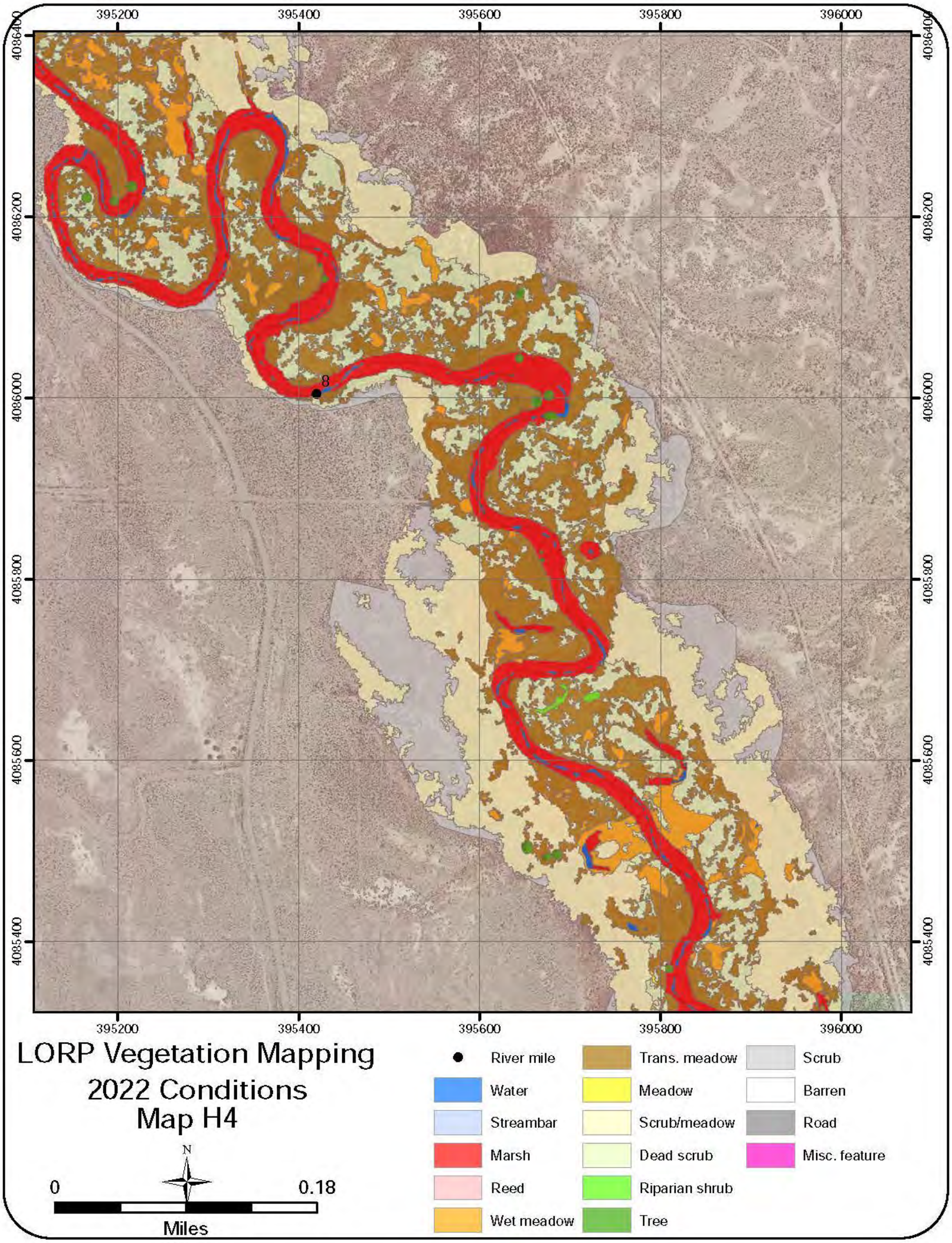
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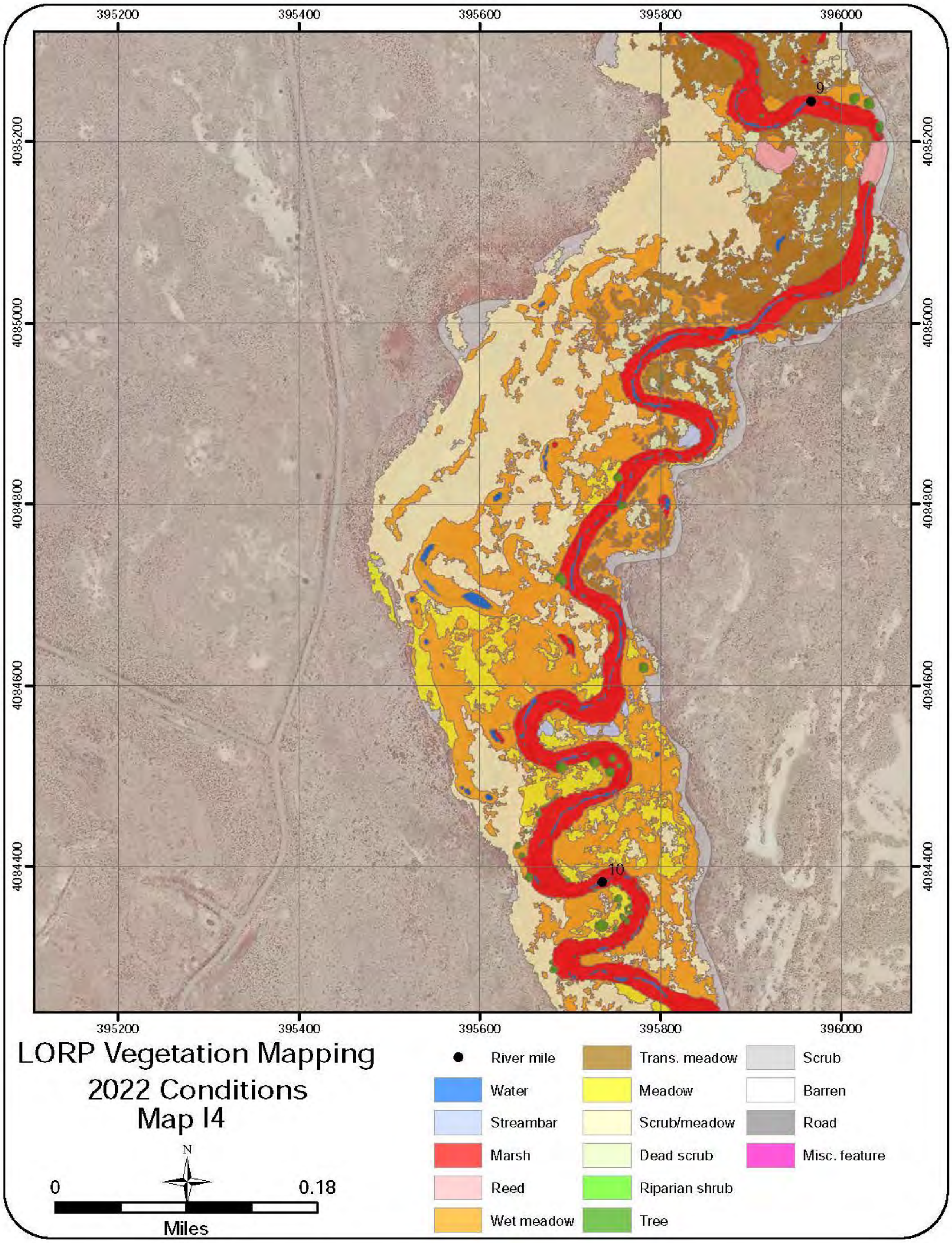
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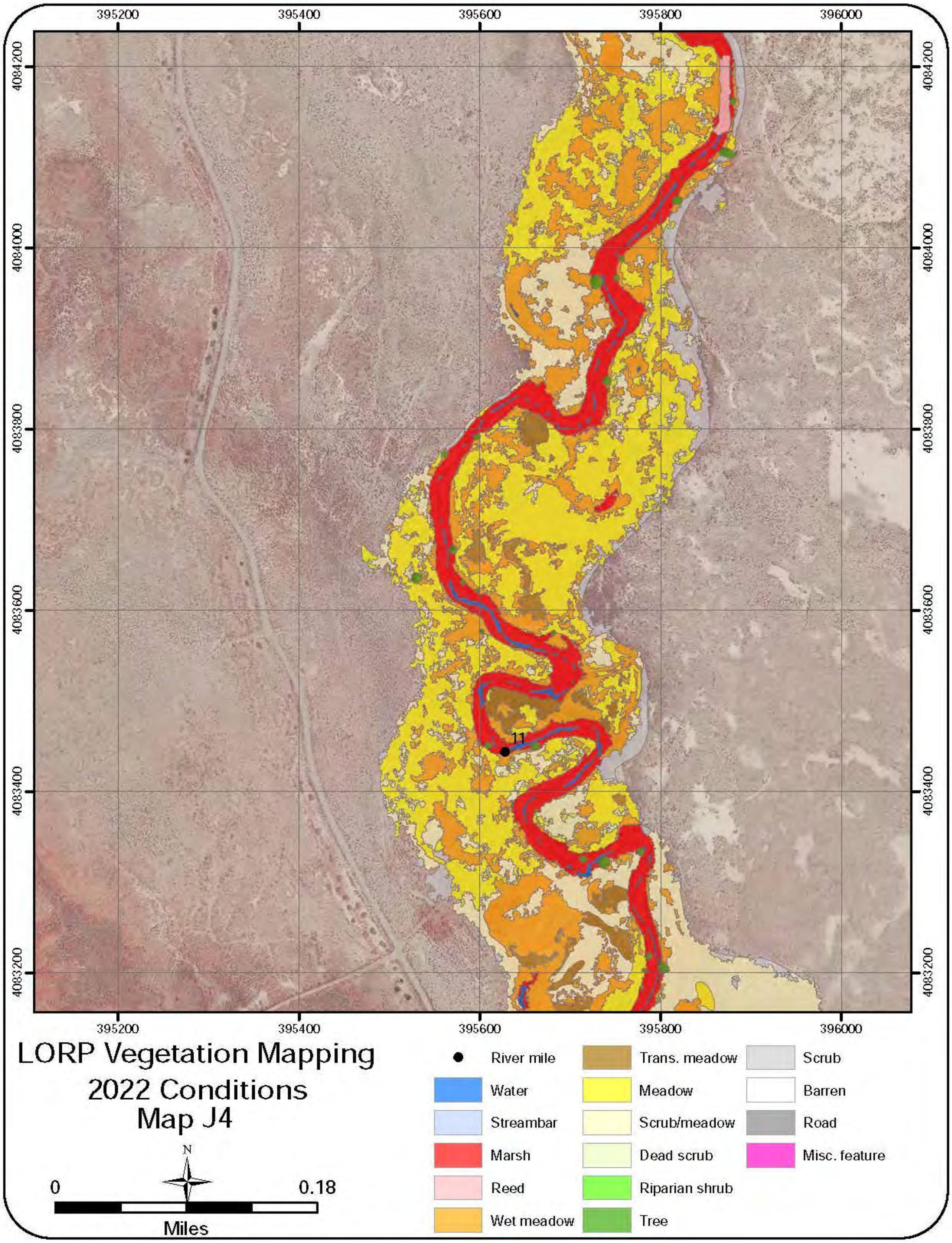
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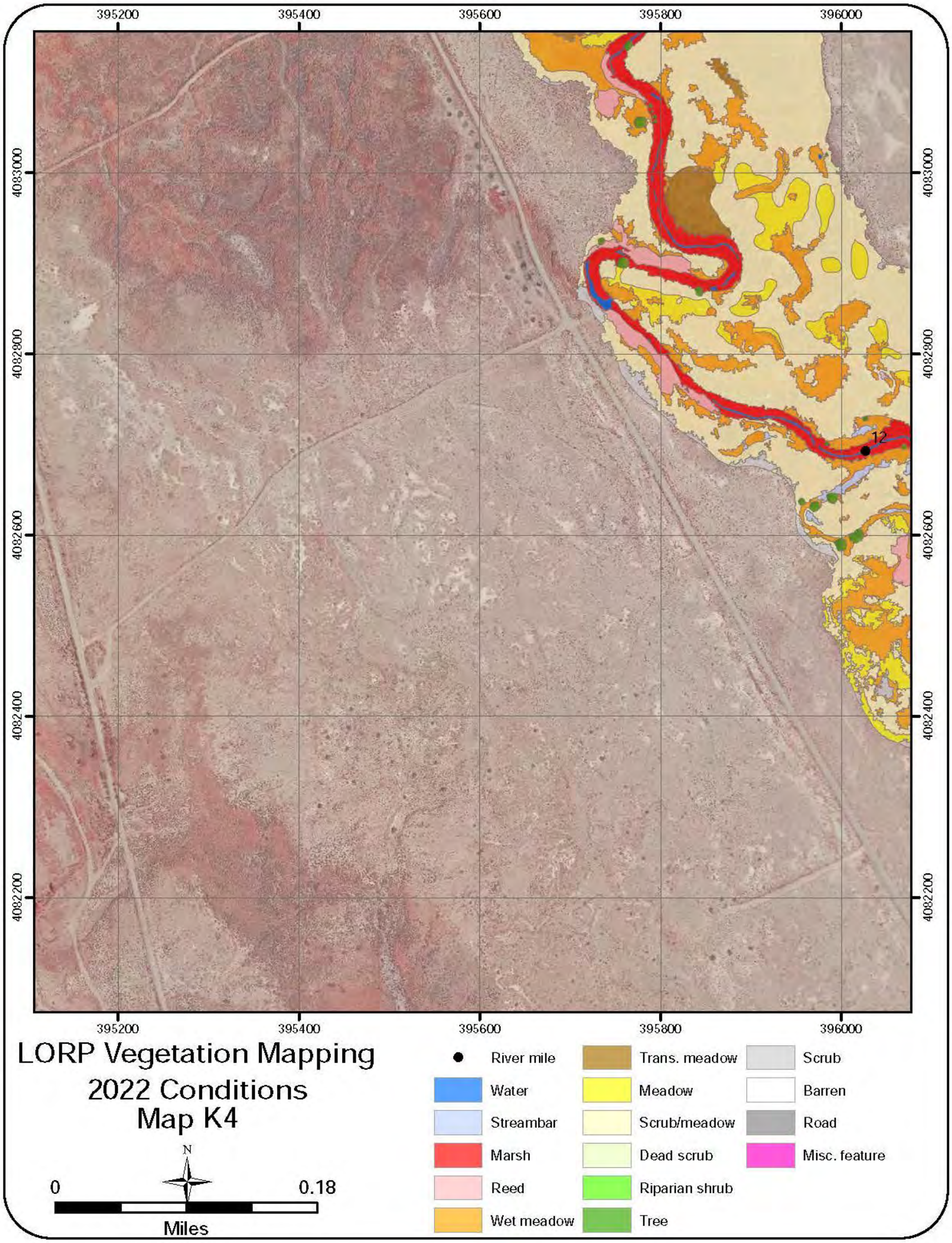
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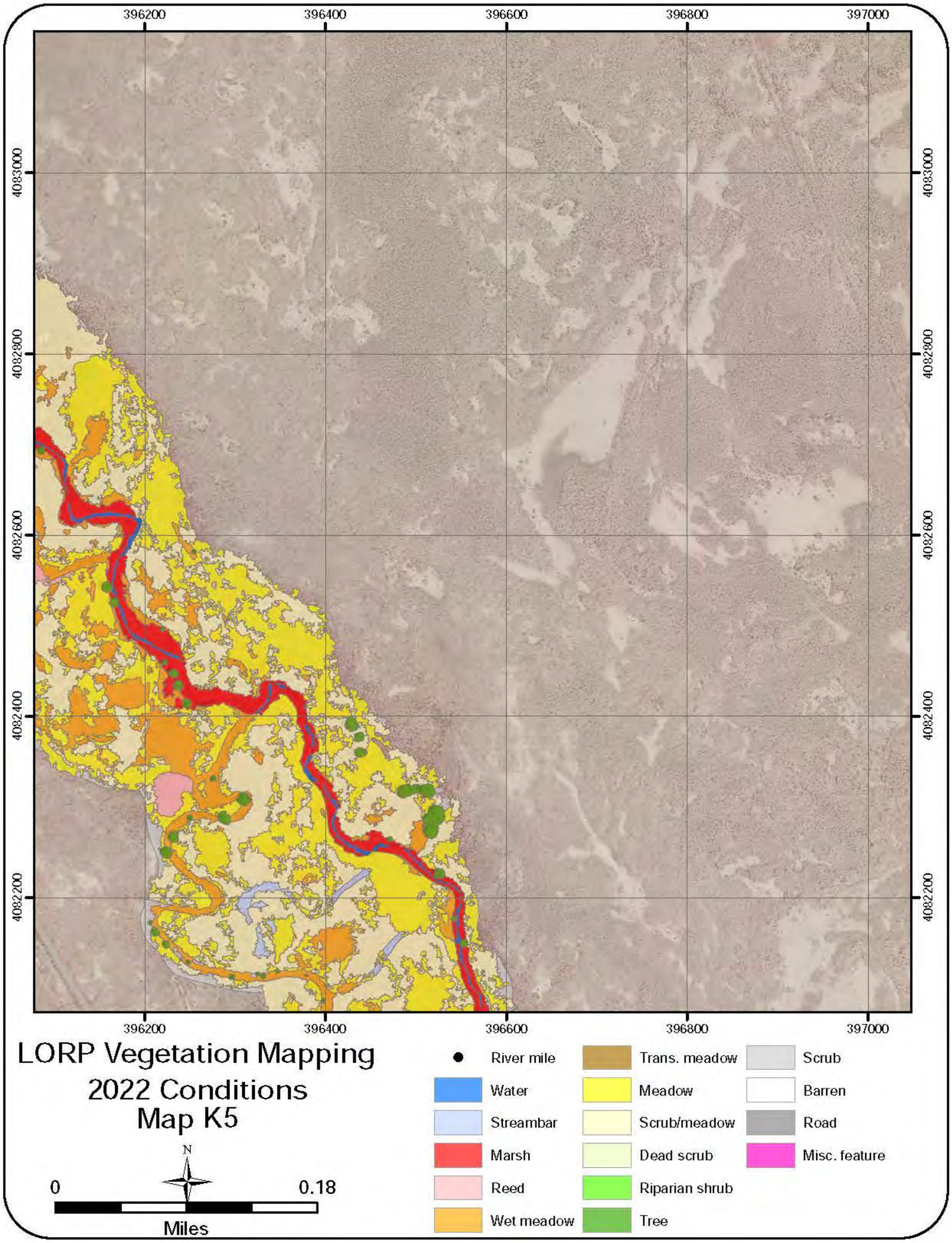
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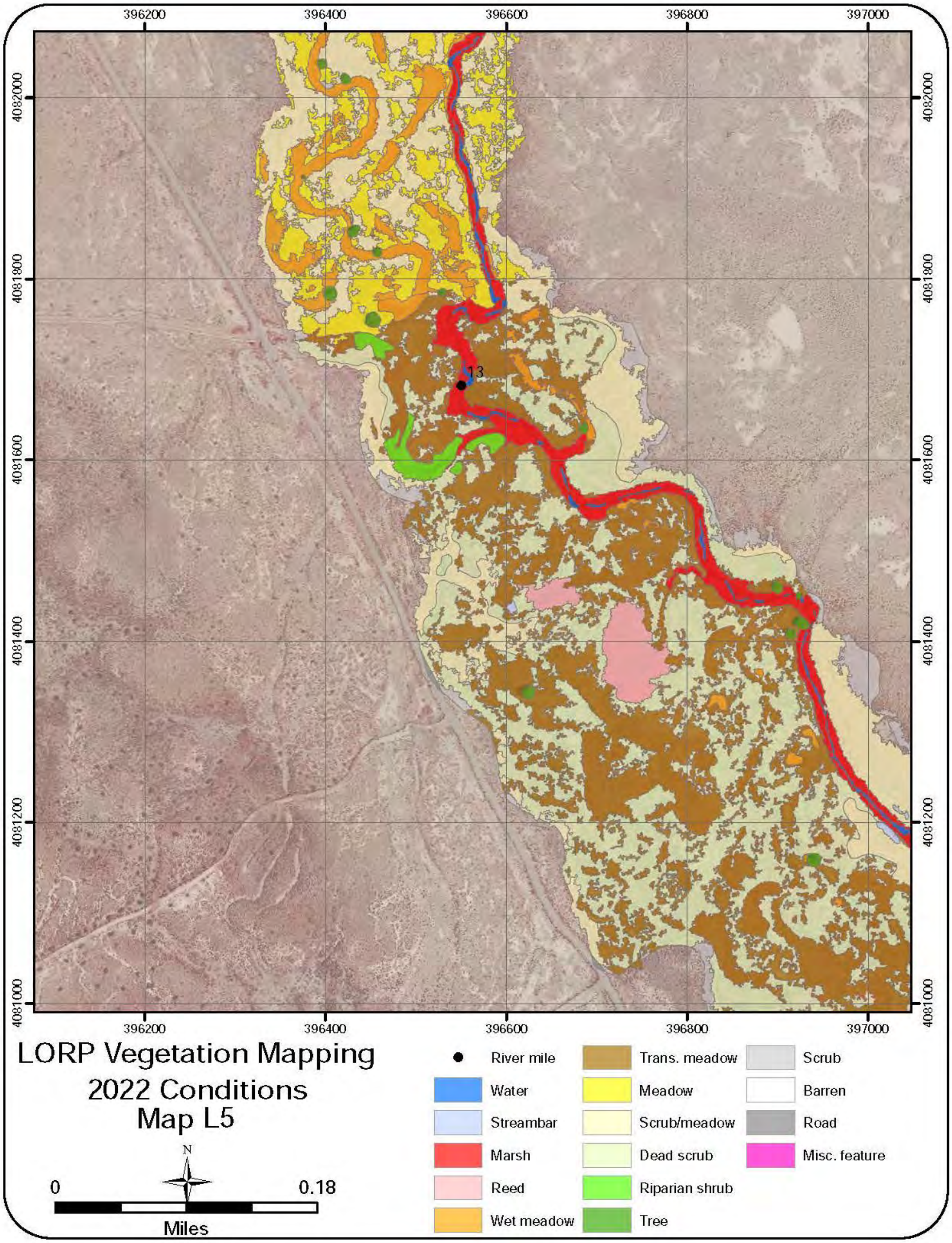
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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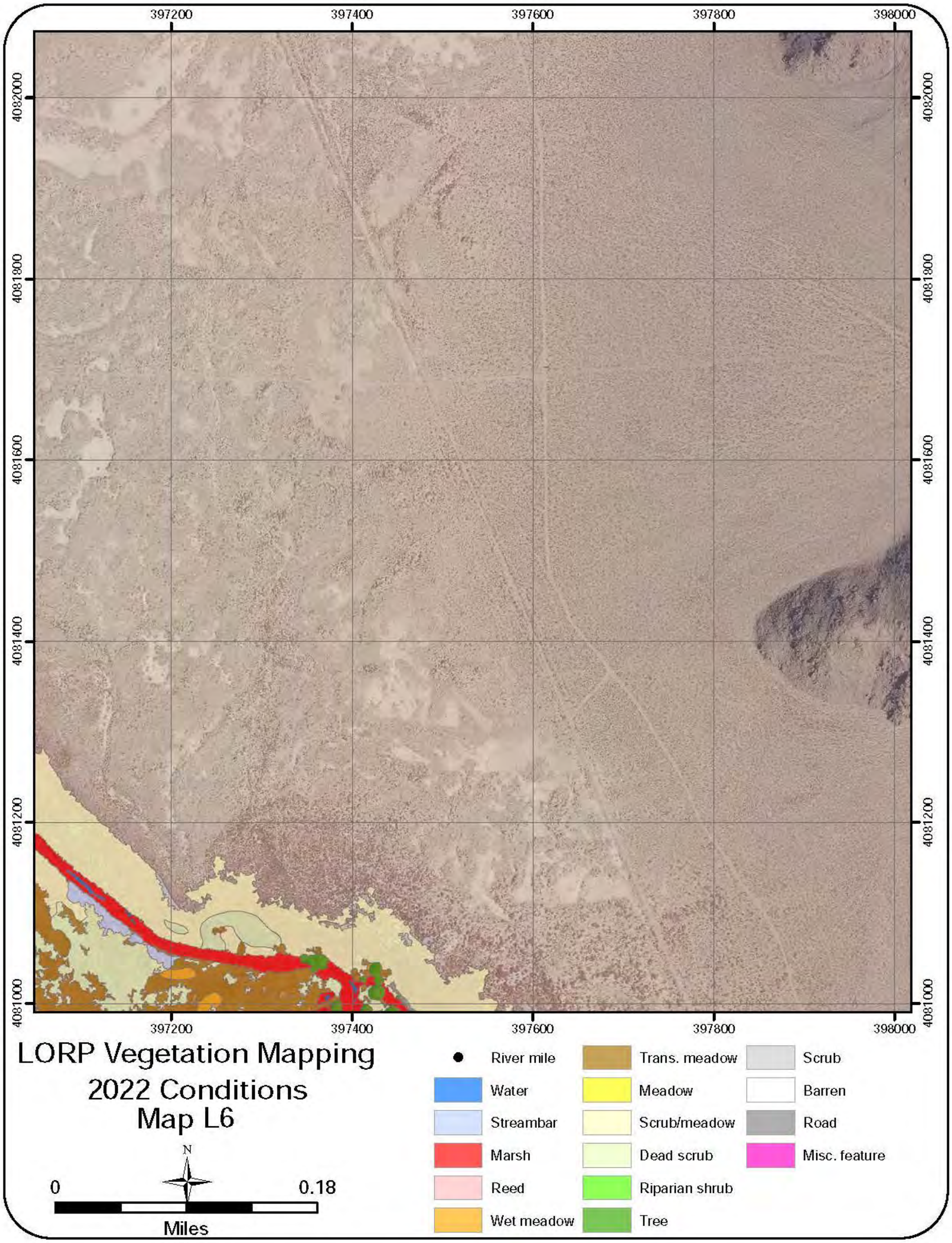
LORP Vegetation Mapping
2022 Conditions
Map L5
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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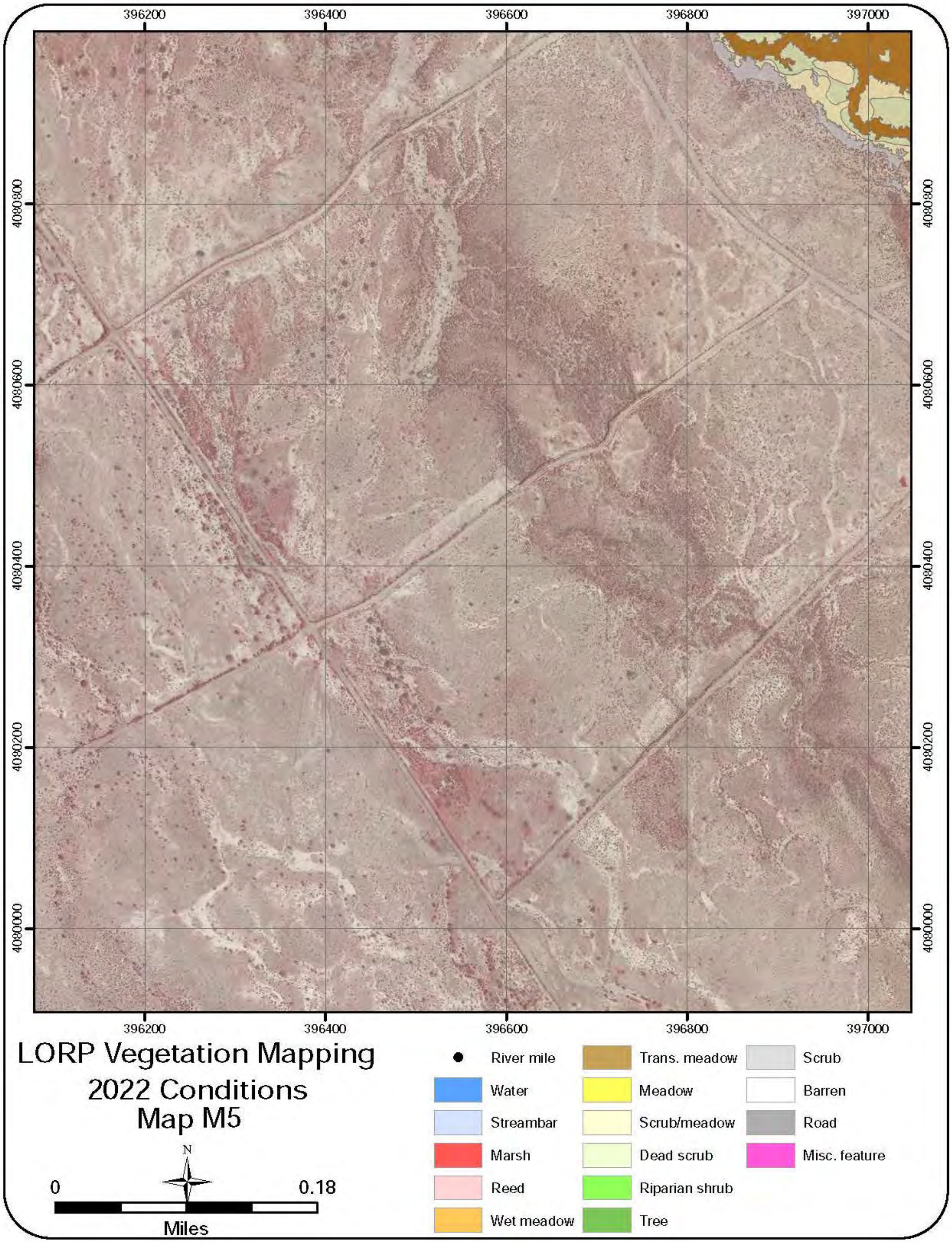
2022 Conditions
Map L6
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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2022 Conditions
Map M5
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Miles
River mile
Water
Streambar
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Scrub/meadow
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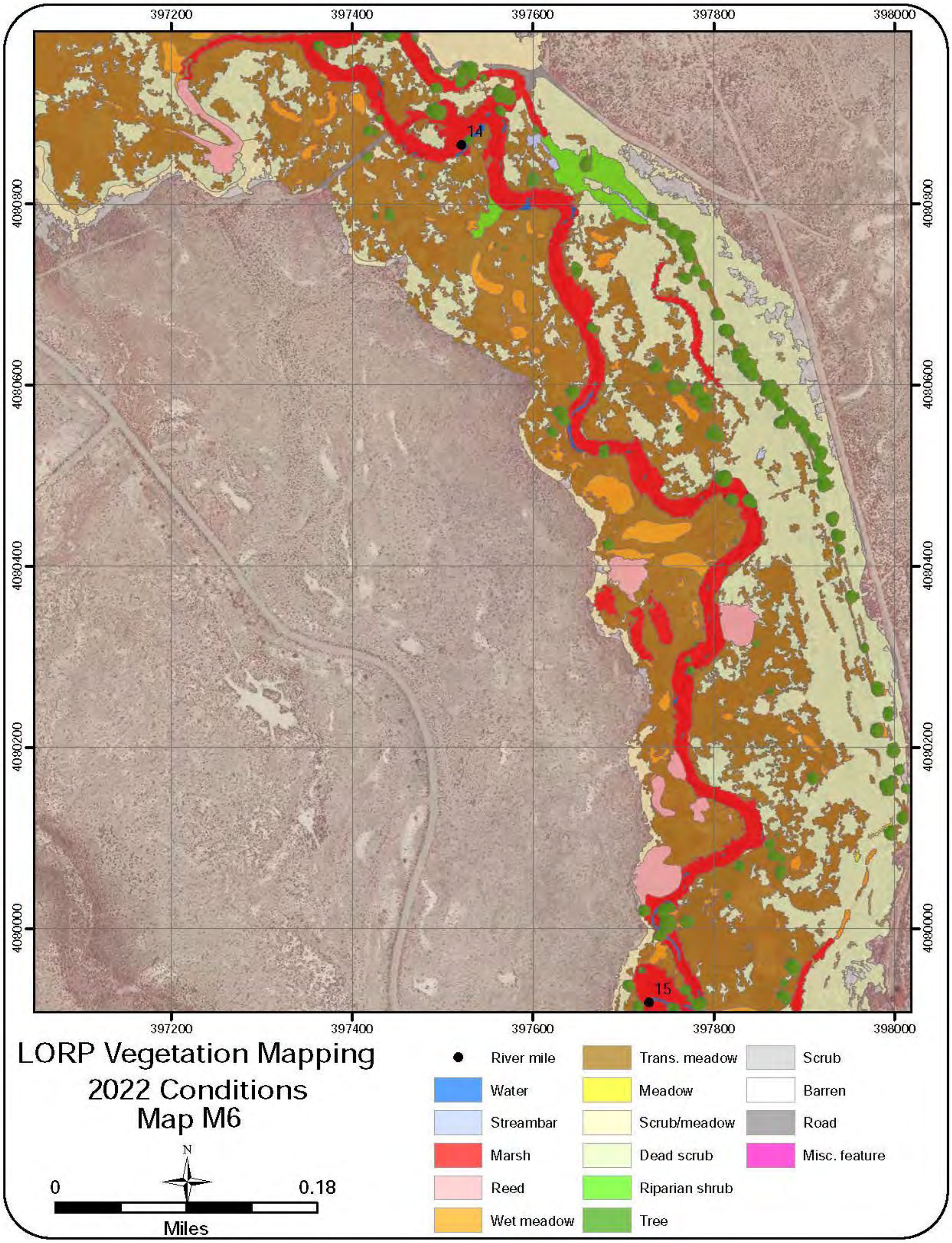
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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2022 Conditions
Map M6
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0.18
Miles
River mile
Water
Streambar
Marsh
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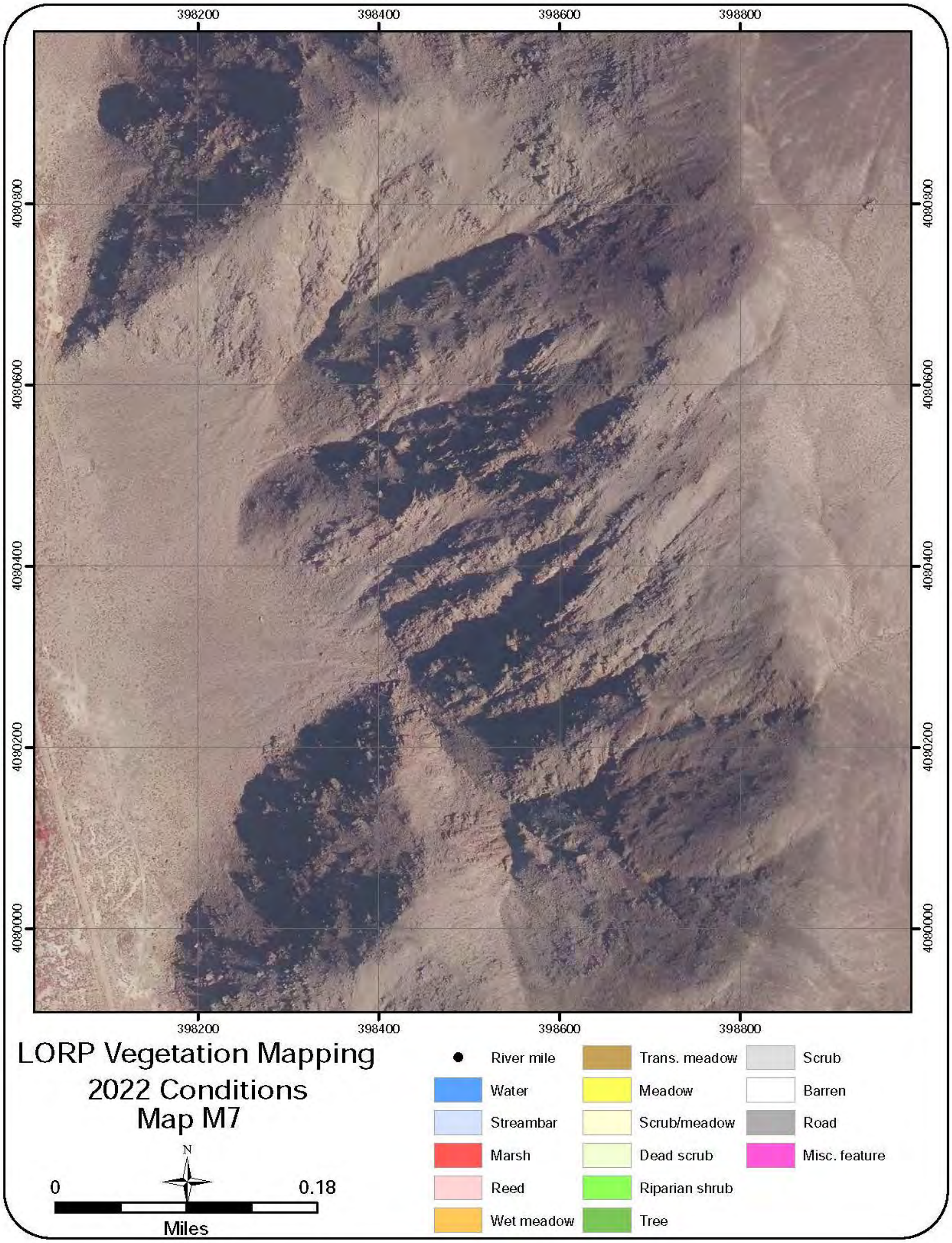
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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2022 Conditions
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Miles
River mile
Water
Streambar
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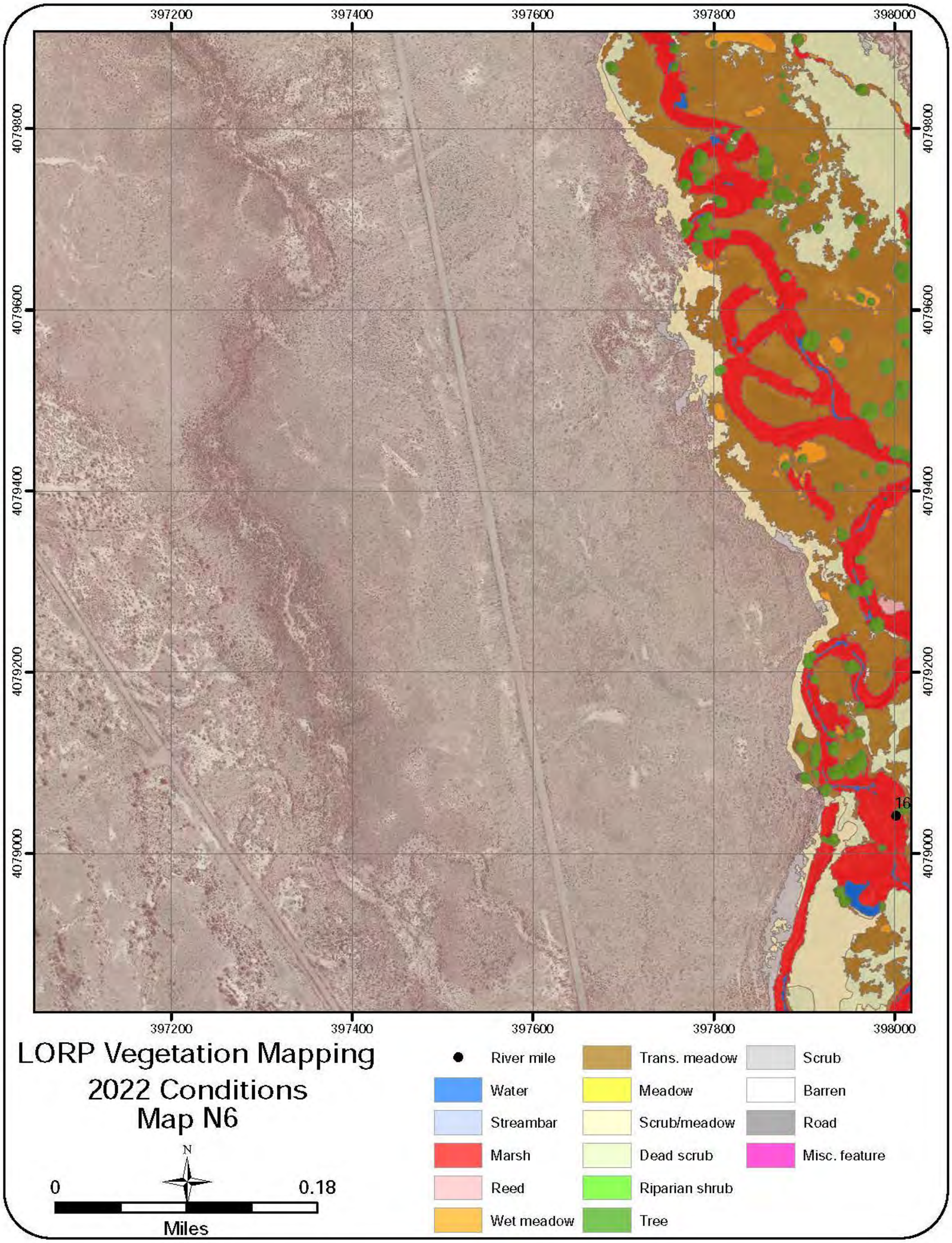
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LORP Vegetation Mapping
2022 Conditions
Map N6
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
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Riparian shrub
Tree
Scrub
Barren
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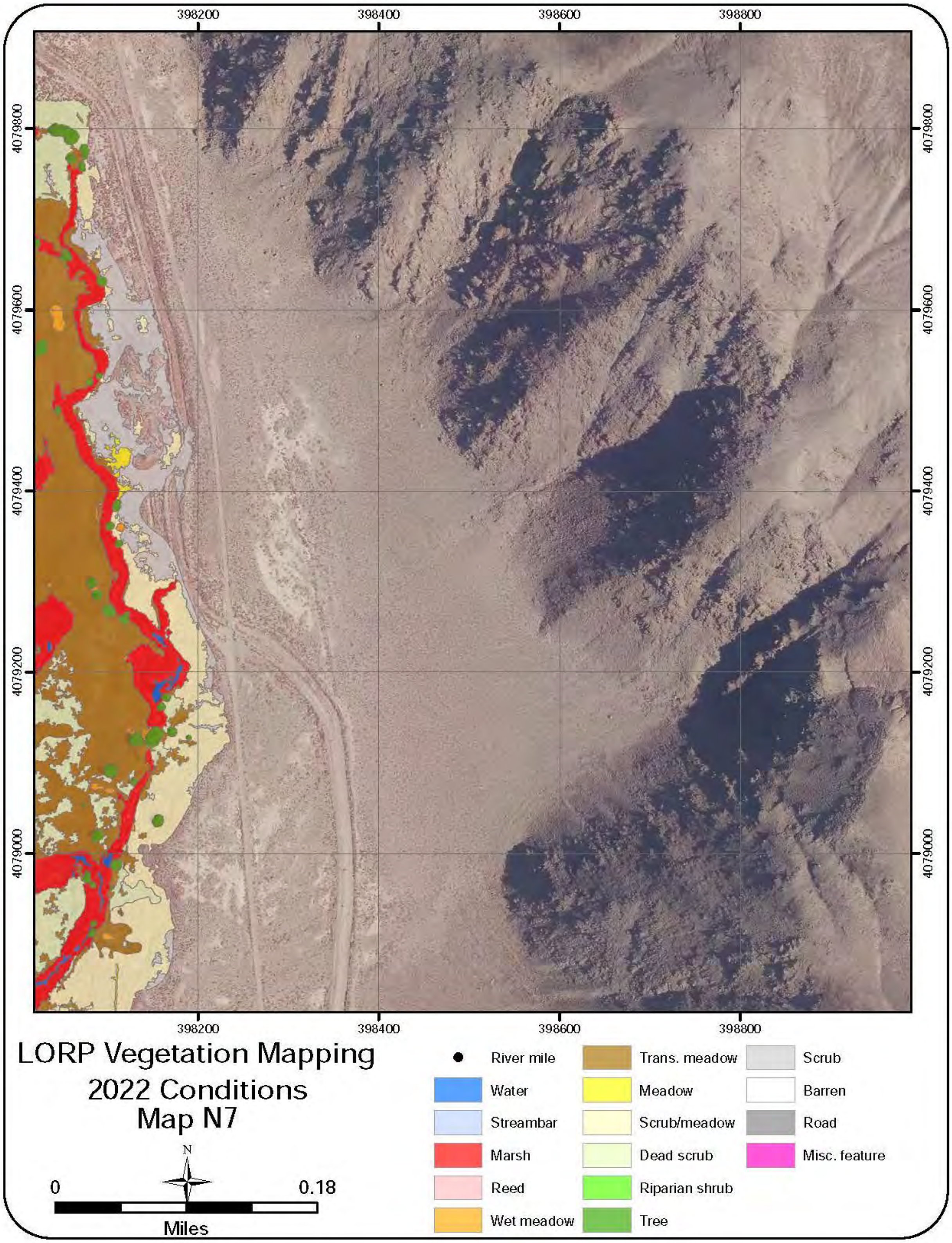
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
Riparian shrub
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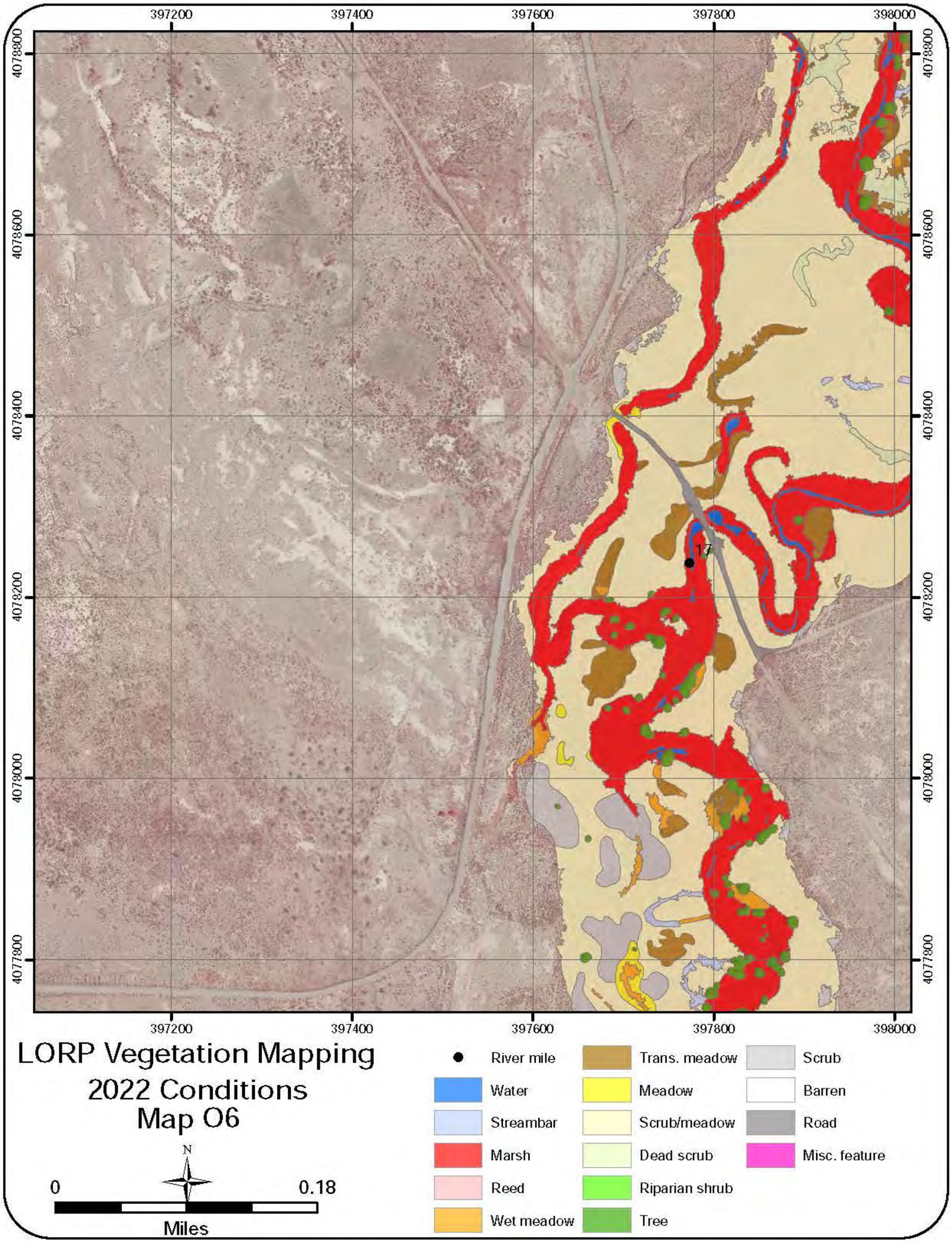
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map O6
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Miles
River mile
Water
Streambar
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Riparian shrub
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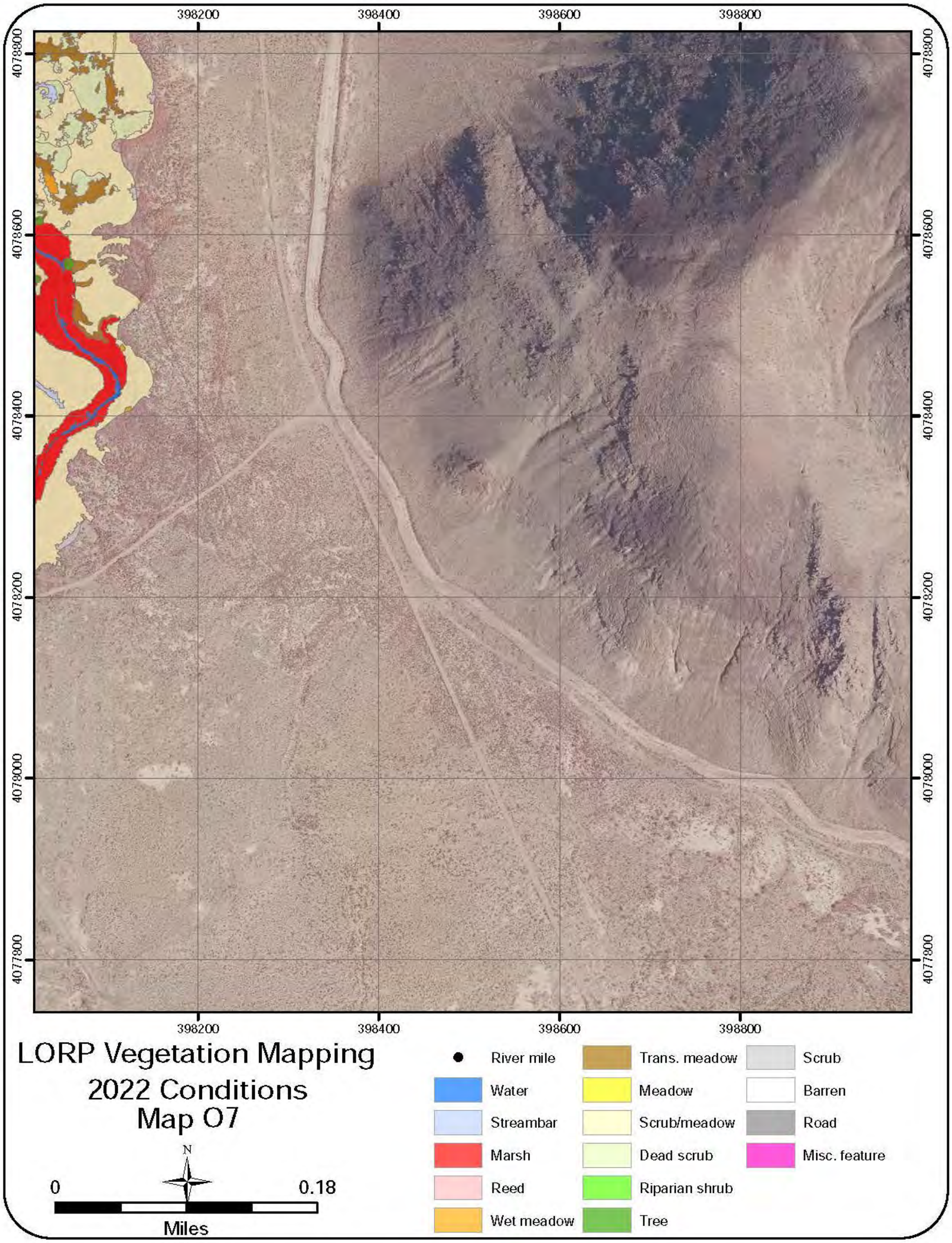
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LORP Vegetation Mapping
2022 Conditions
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Miles
River mile
Water
Streambar
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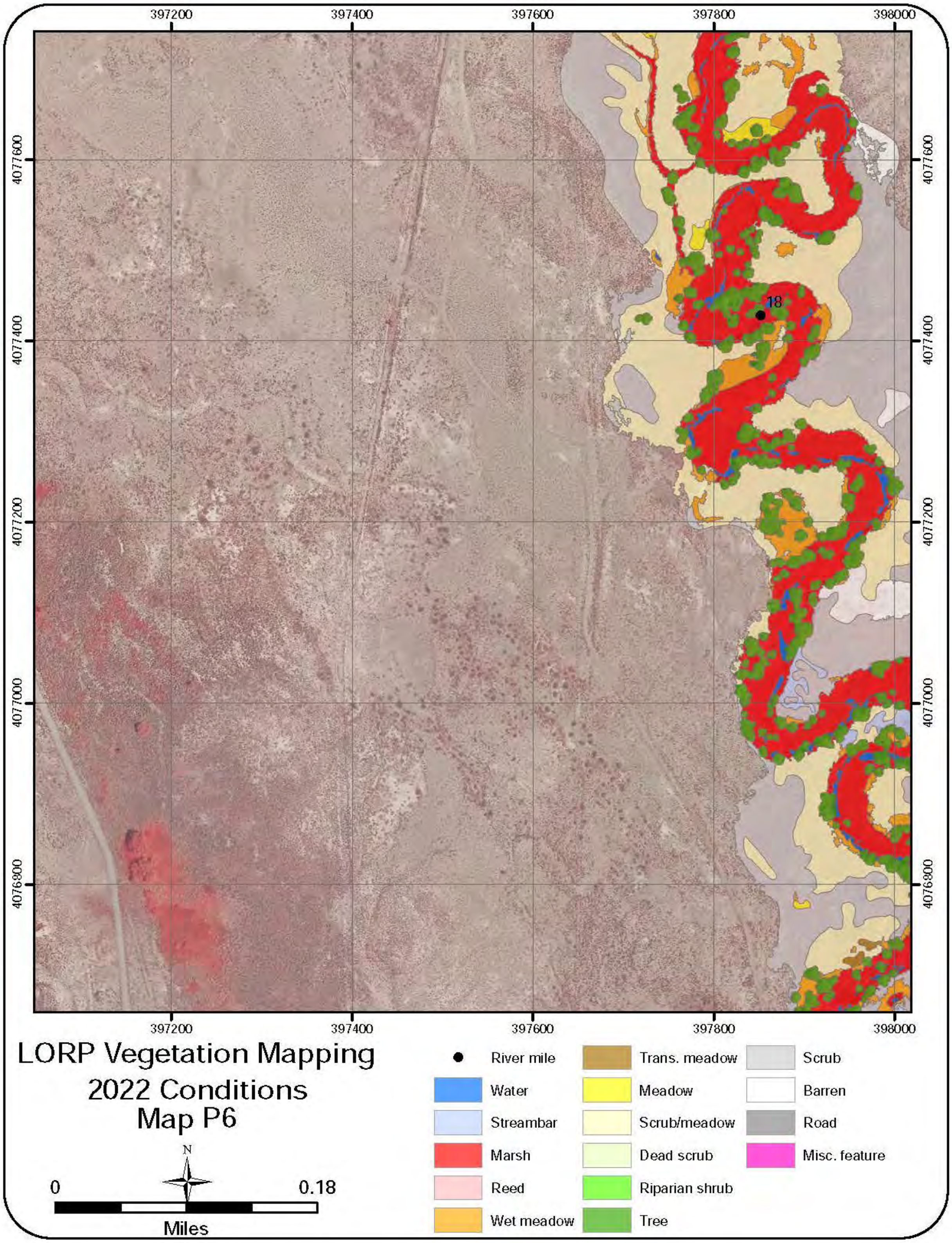
Misc. feature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2022 Conditions
Map P6
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
Riparian shrub
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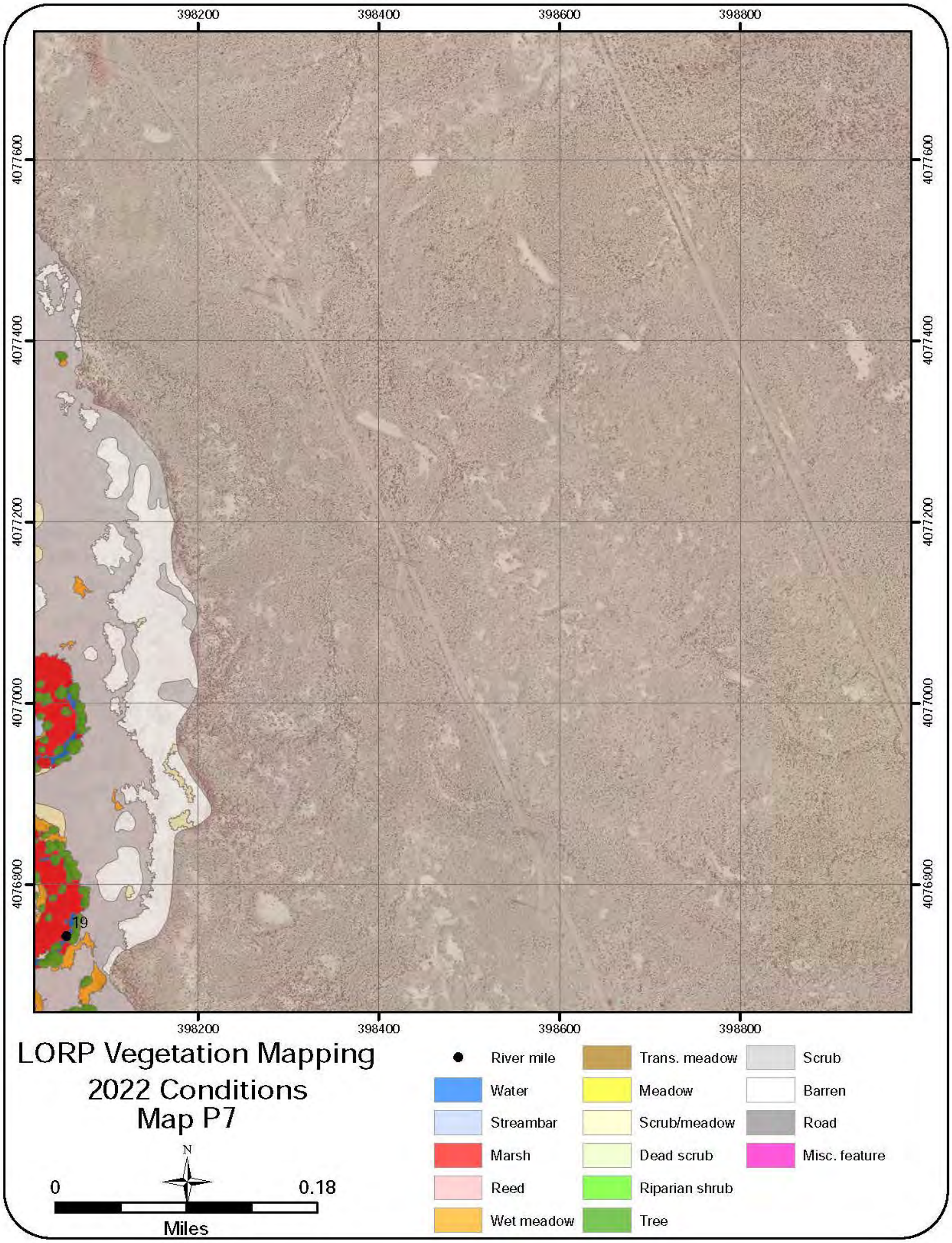
Misc. feature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2022 Conditions
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Miles
River mile
Water
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Scrub/meadow
Dead scrub
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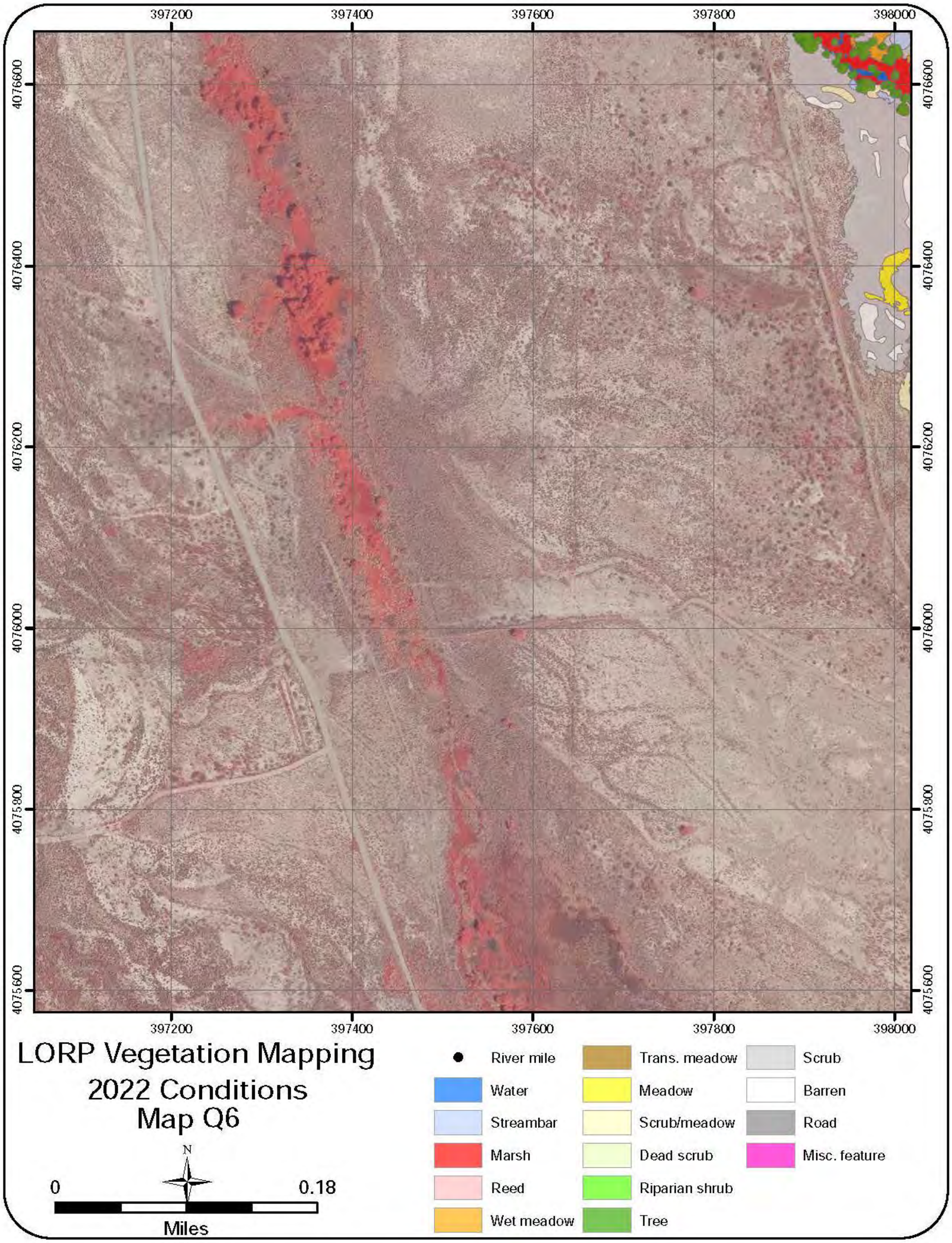
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map Q6
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Miles
River mile
Water
Streambar
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Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
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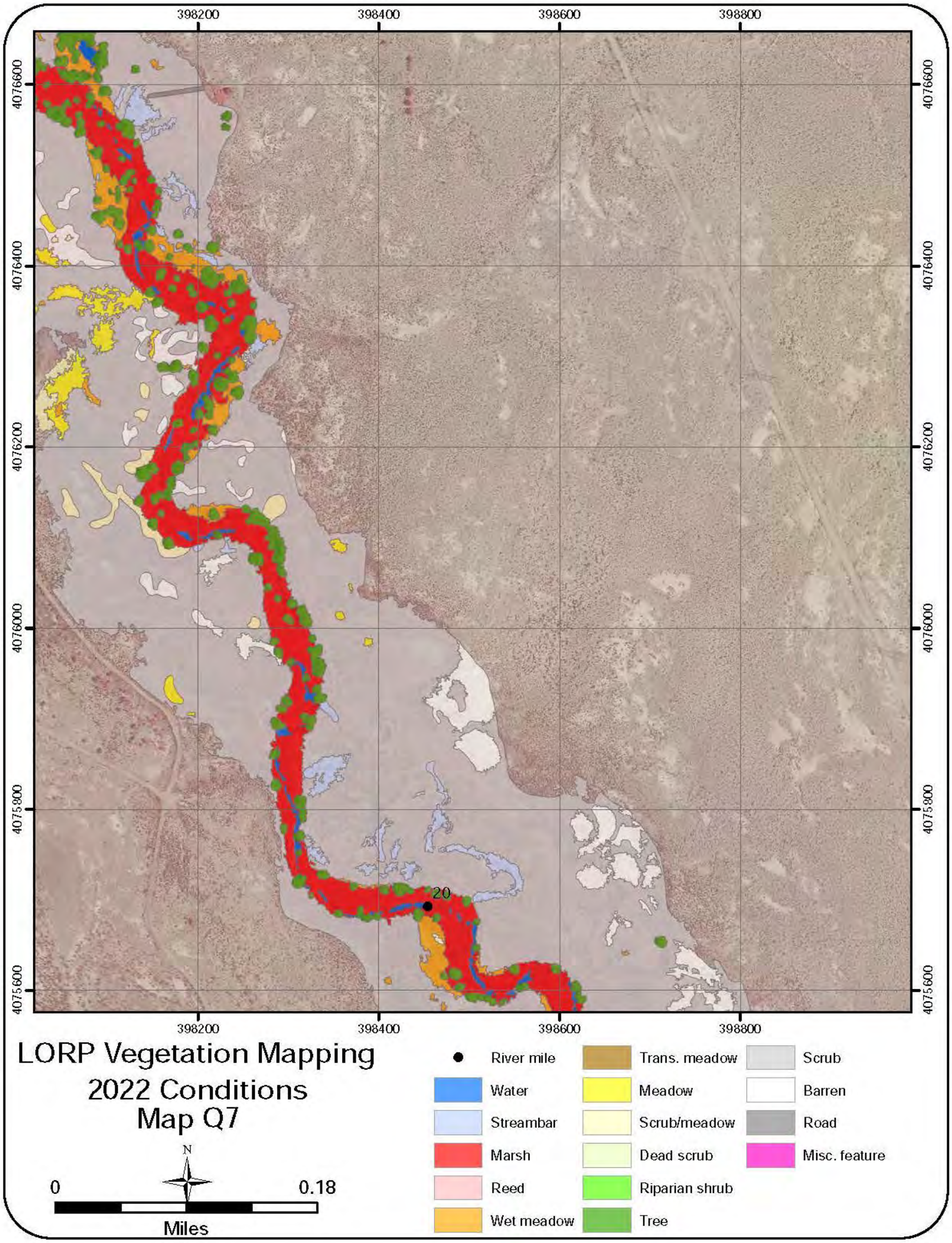
Barren
Road
Misc. feature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2022 Conditions
Map Q7
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Miles
River mile
Water
Streambar
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Scrub/meadow
Dead scrub
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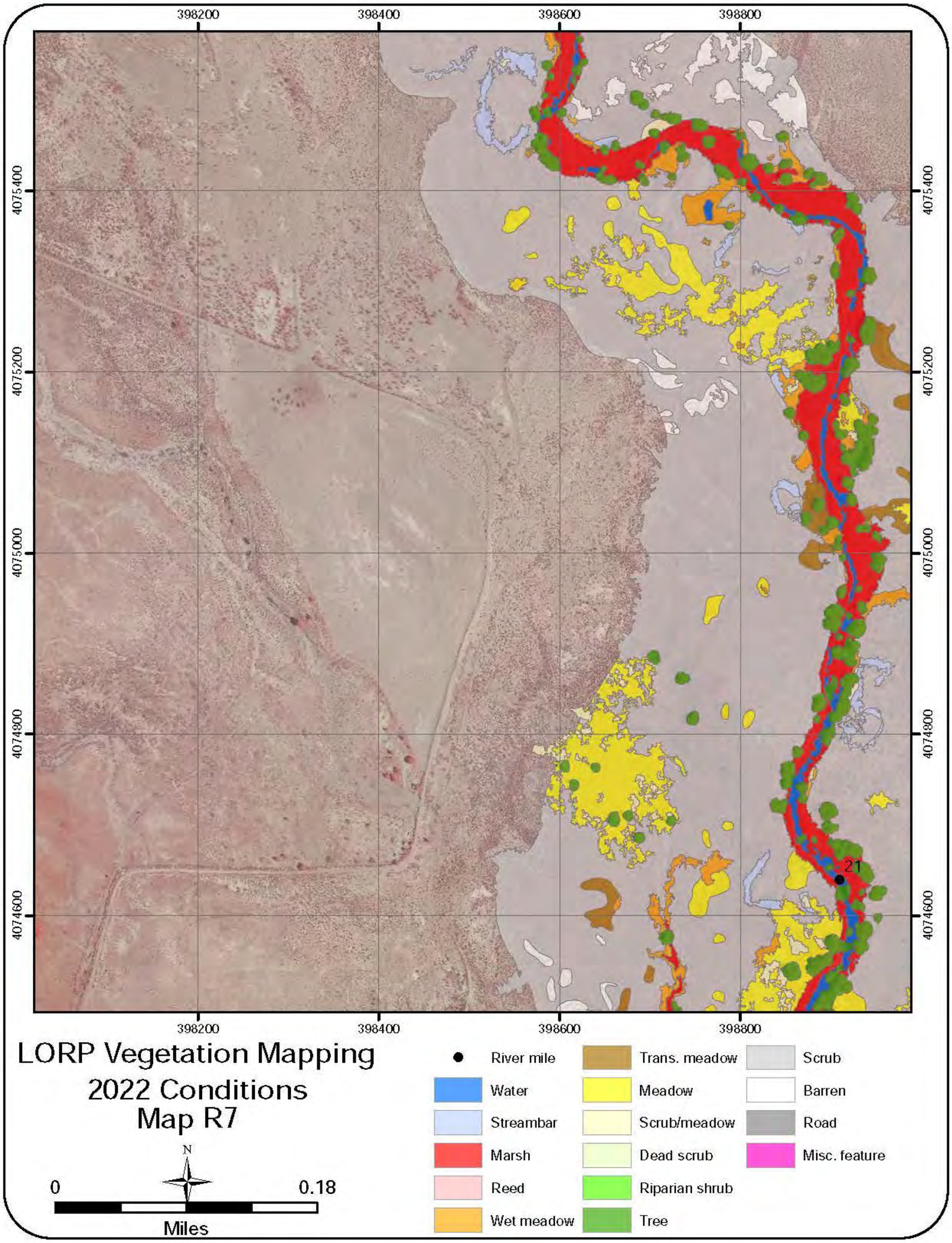
Misc. feature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2022 Conditions
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
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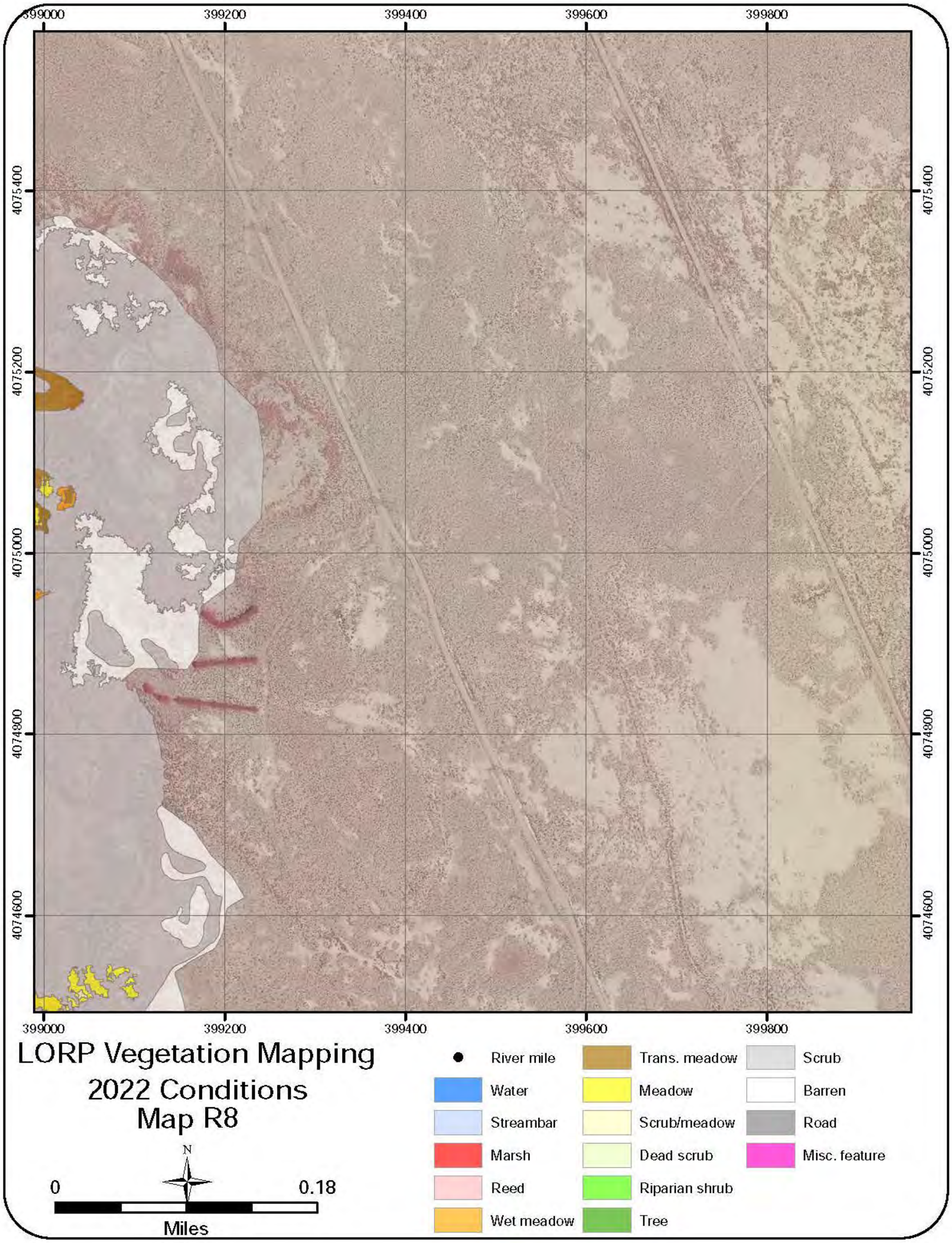
Misc. feature



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LORP Vegetation Mapping
2022 Conditions
Map R8
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0.18
Miles
River mile
Water
Streambar
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Trans. meadow
Meadow
Scrub/meadow
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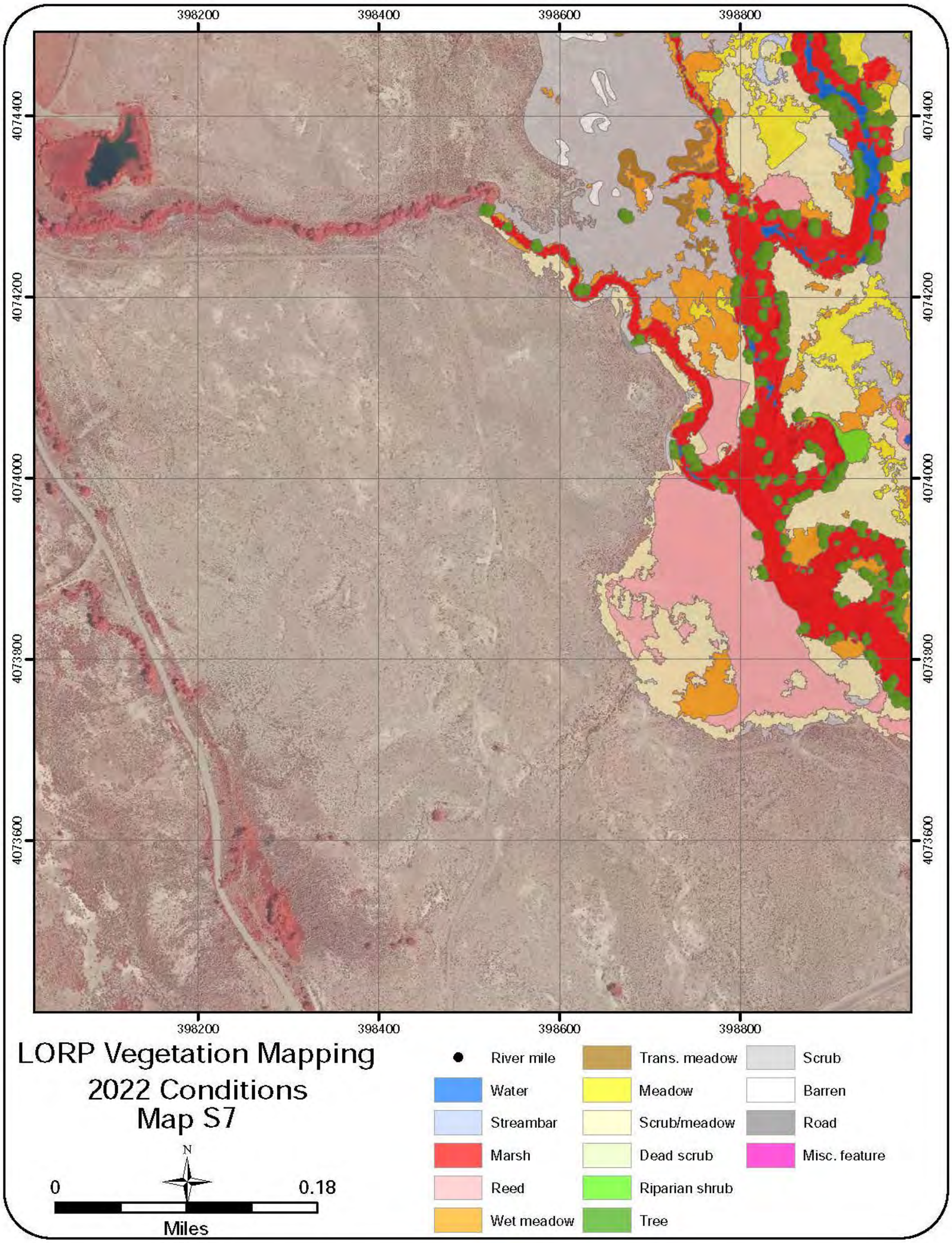
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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Miles
River mile
Water
Streambar
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Scrub/meadow
Dead scrub
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Barren
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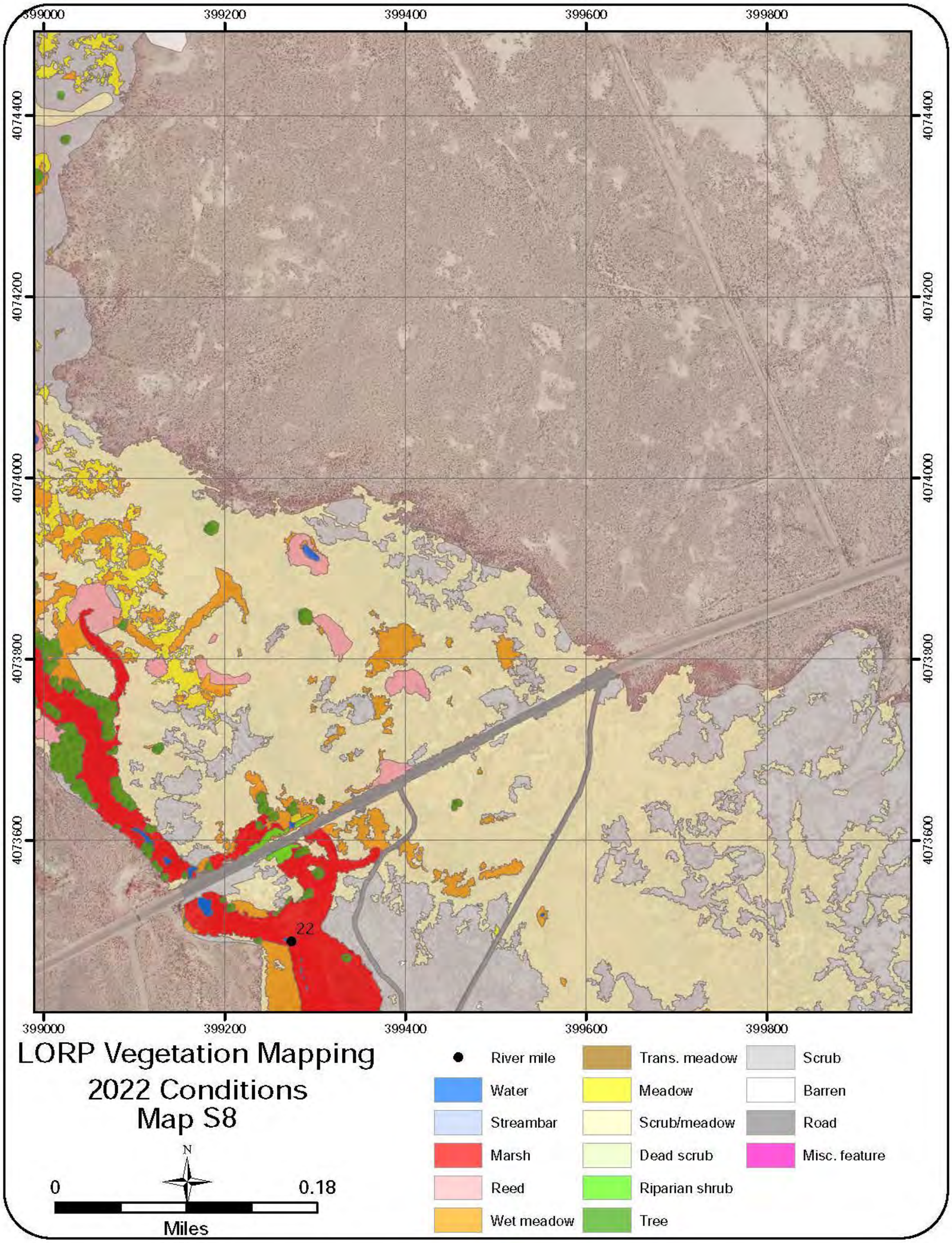
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map S8
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Miles
River mile
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Streambar
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Scrub/meadow
Dead scrub
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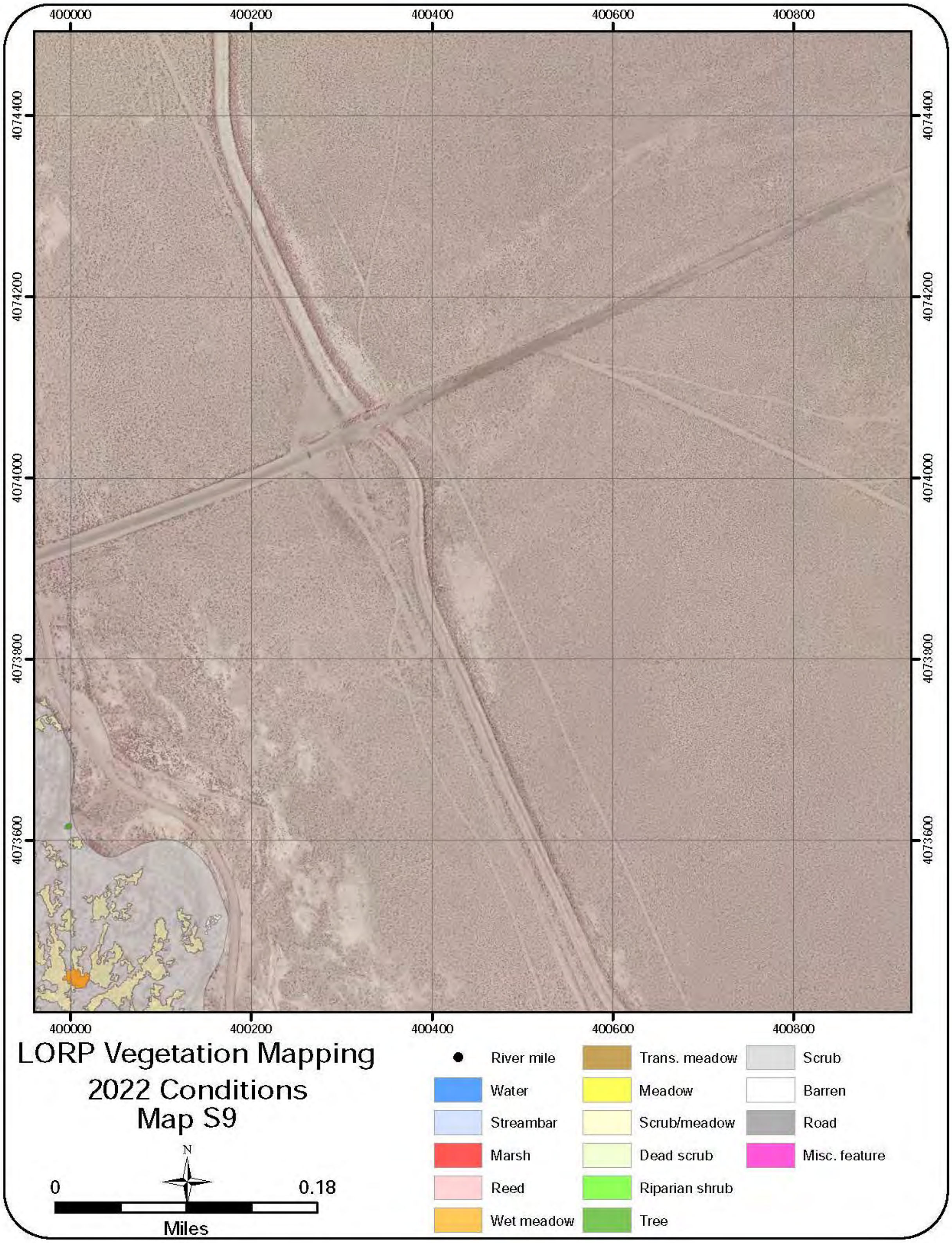
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map S9
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Miles
River mile
Water
Streambar
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Scrub/meadow
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Scrub
Barren
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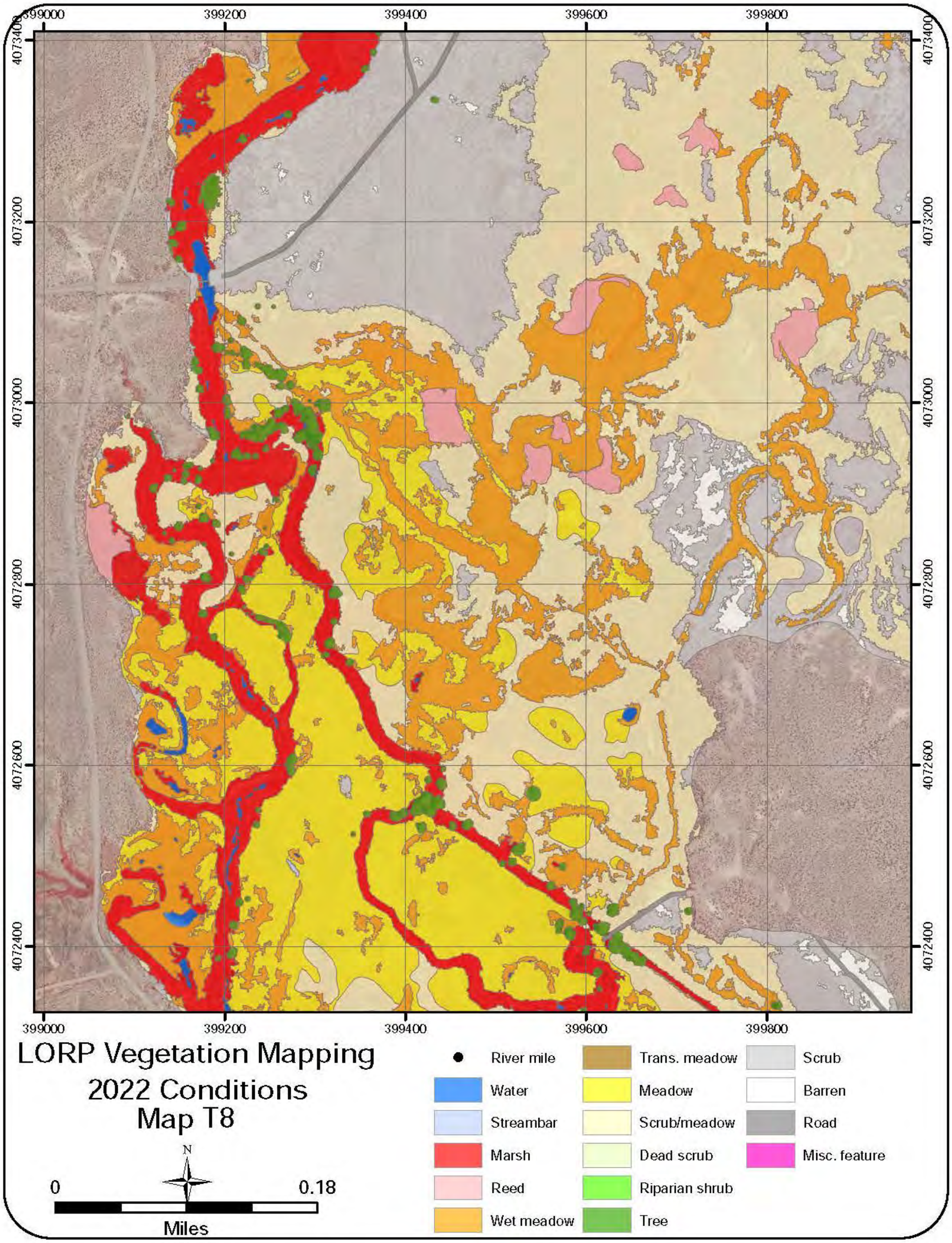
Misc. feature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2022 Conditions
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Miles
River mile
Water
Streambar
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Scrub/meadow
Dead scrub
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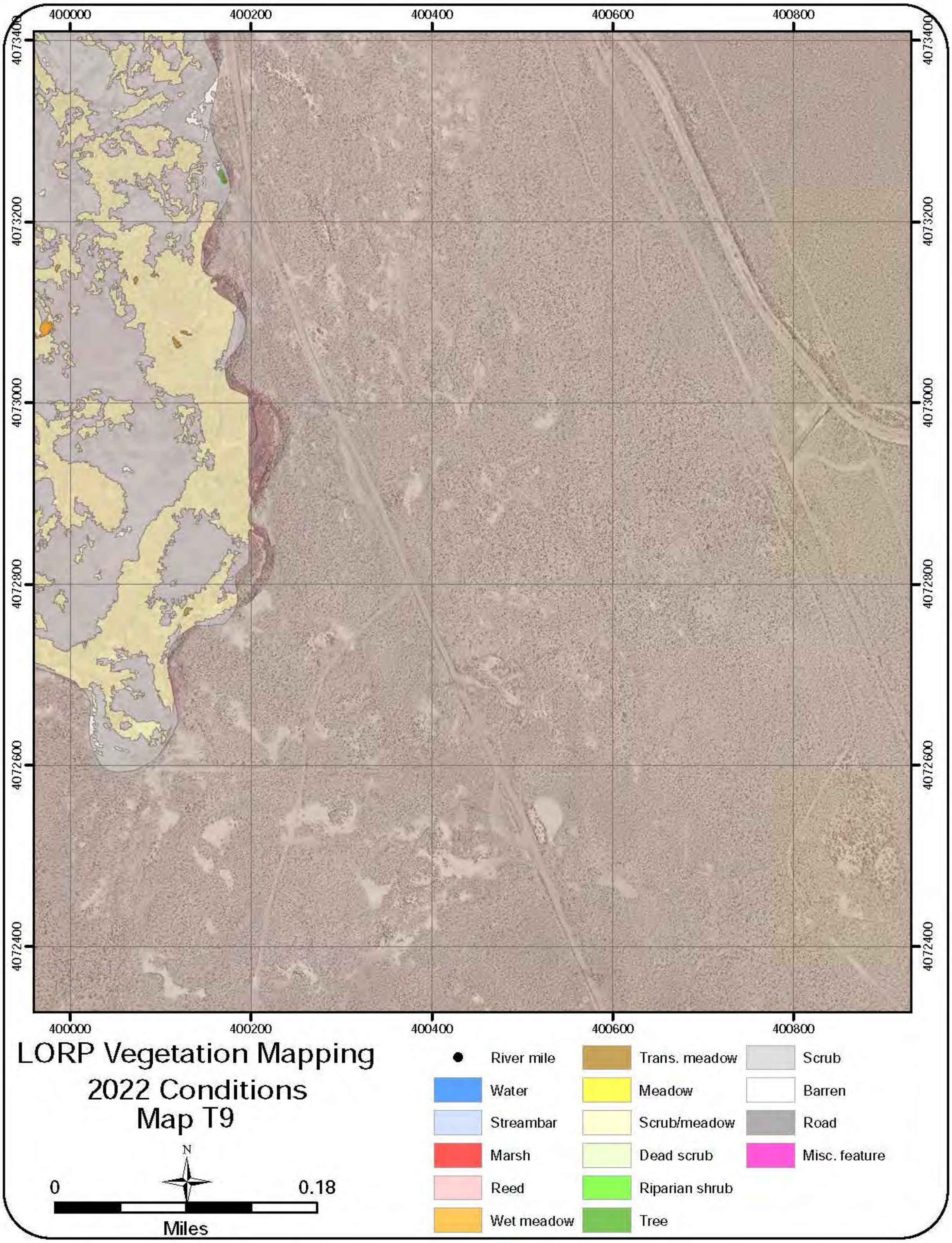
Misc. feature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2022 Conditions
Map T9
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Scrub/meadow
Dead scrub
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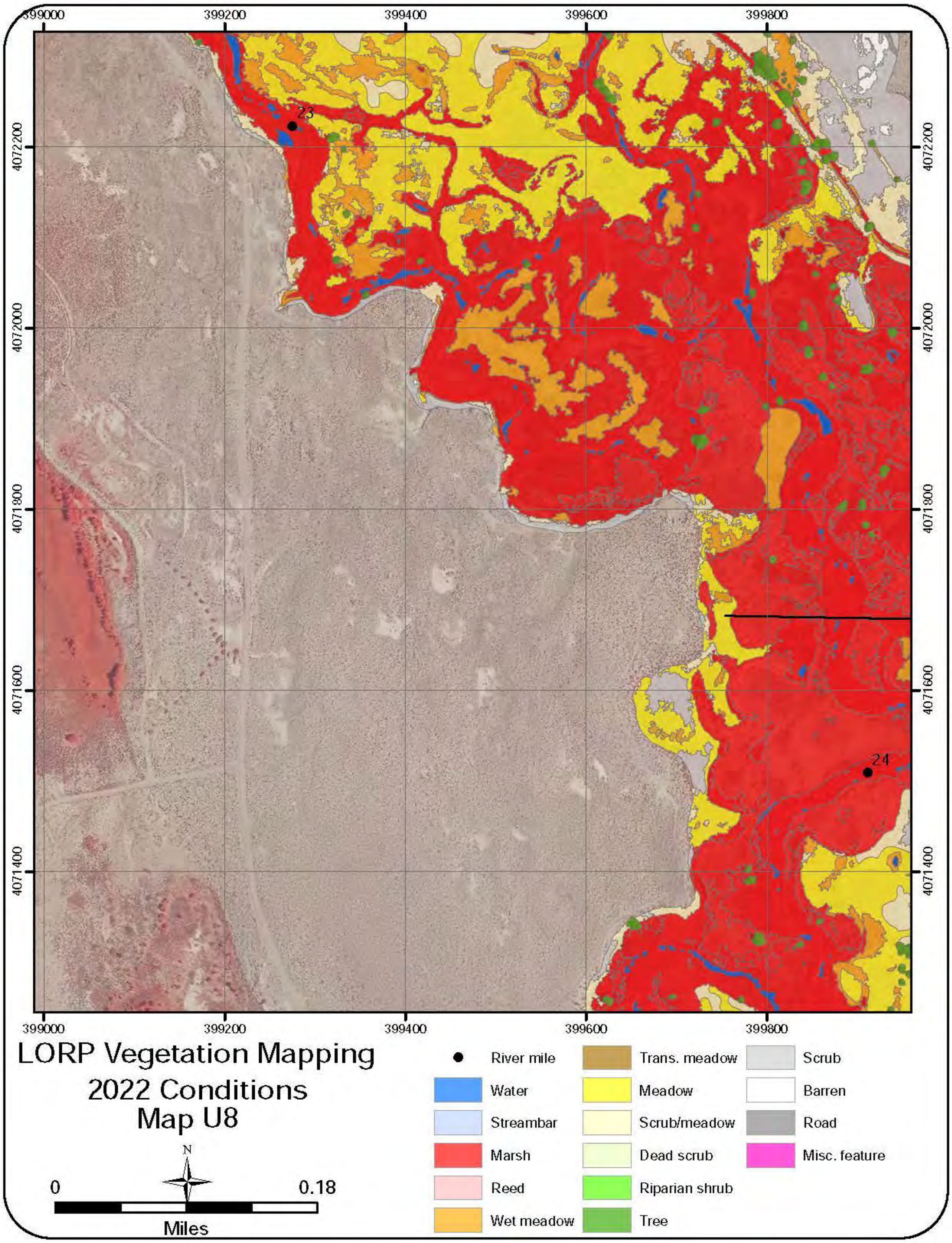
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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Miles
River mile
Water
Streambar
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Scrub/meadow
Dead scrub
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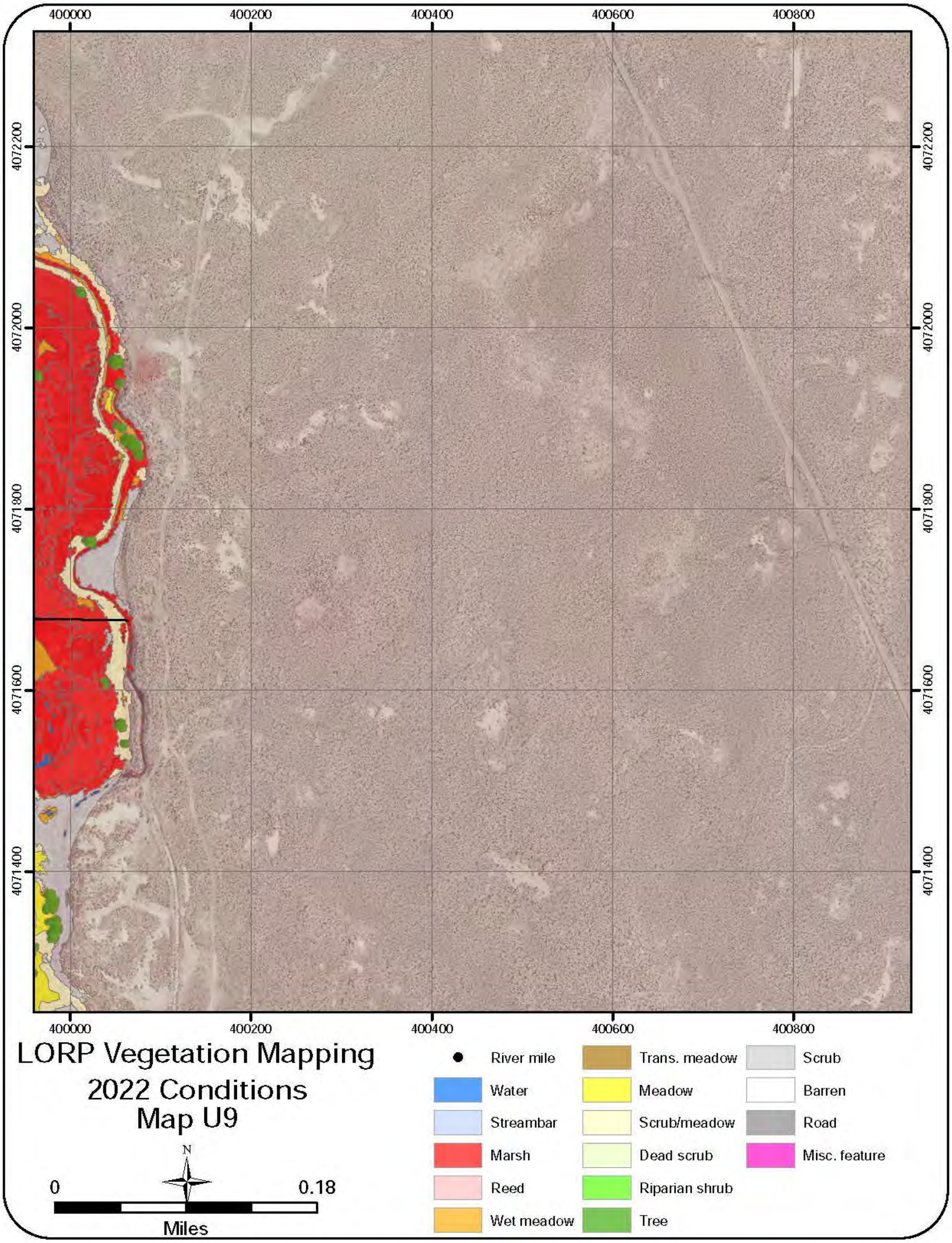
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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Miles
River mile
Water
Streambar
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Scrub/meadow
Dead scrub
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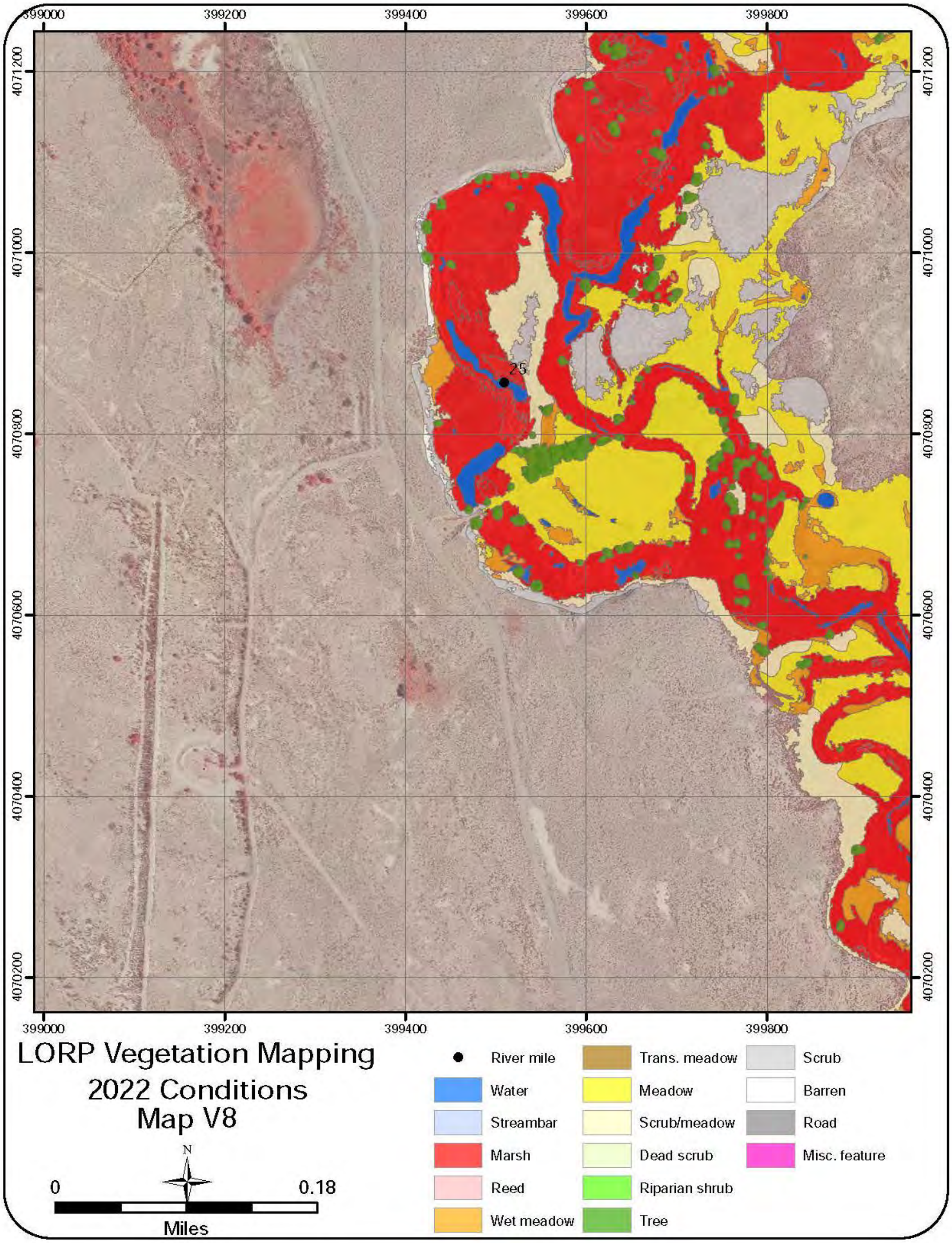
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map V8
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0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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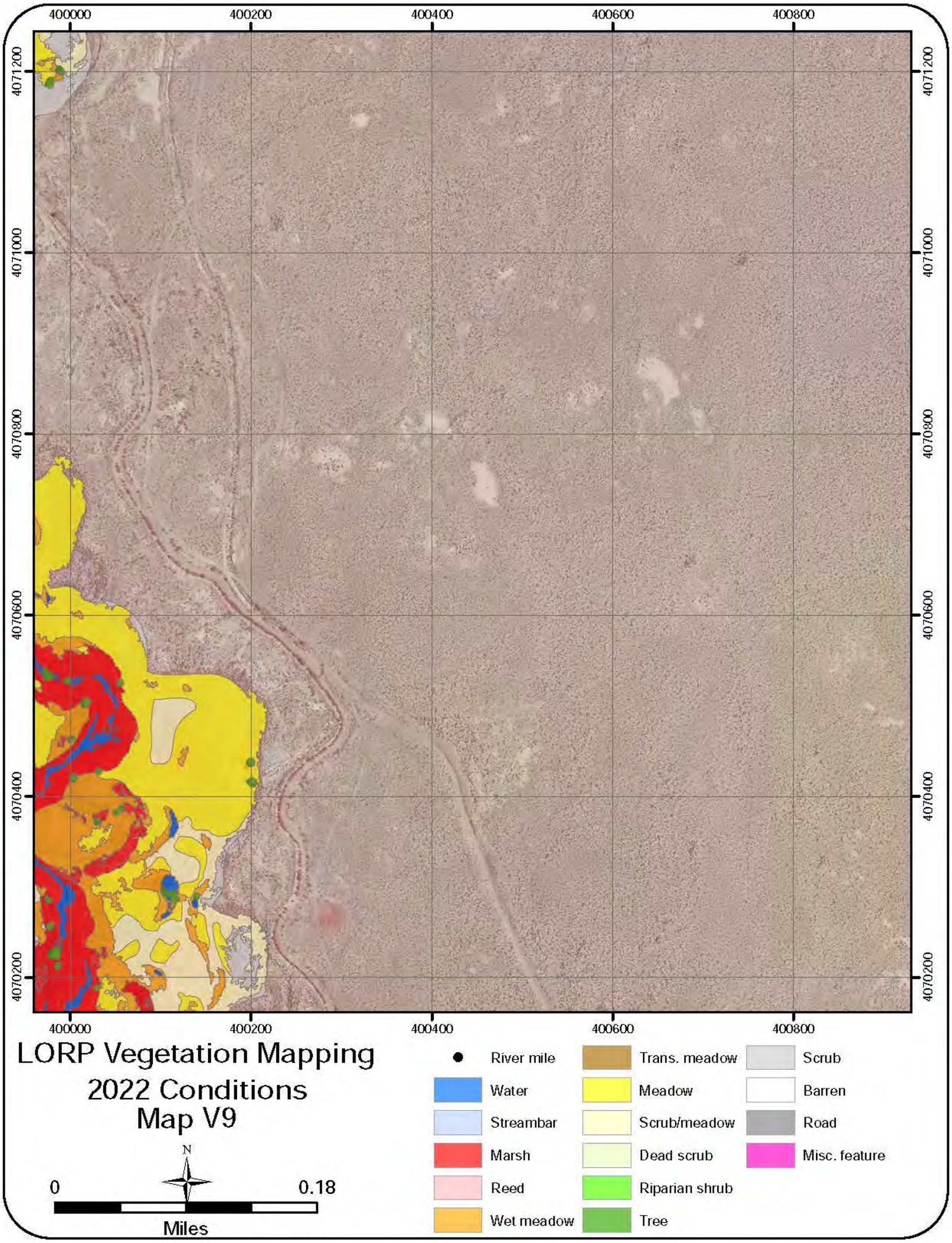
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map V9
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Miles
River mile
Water
Streambar
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Reed
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Scrub/meadow
Dead scrub
Riparian shrub
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Scrub
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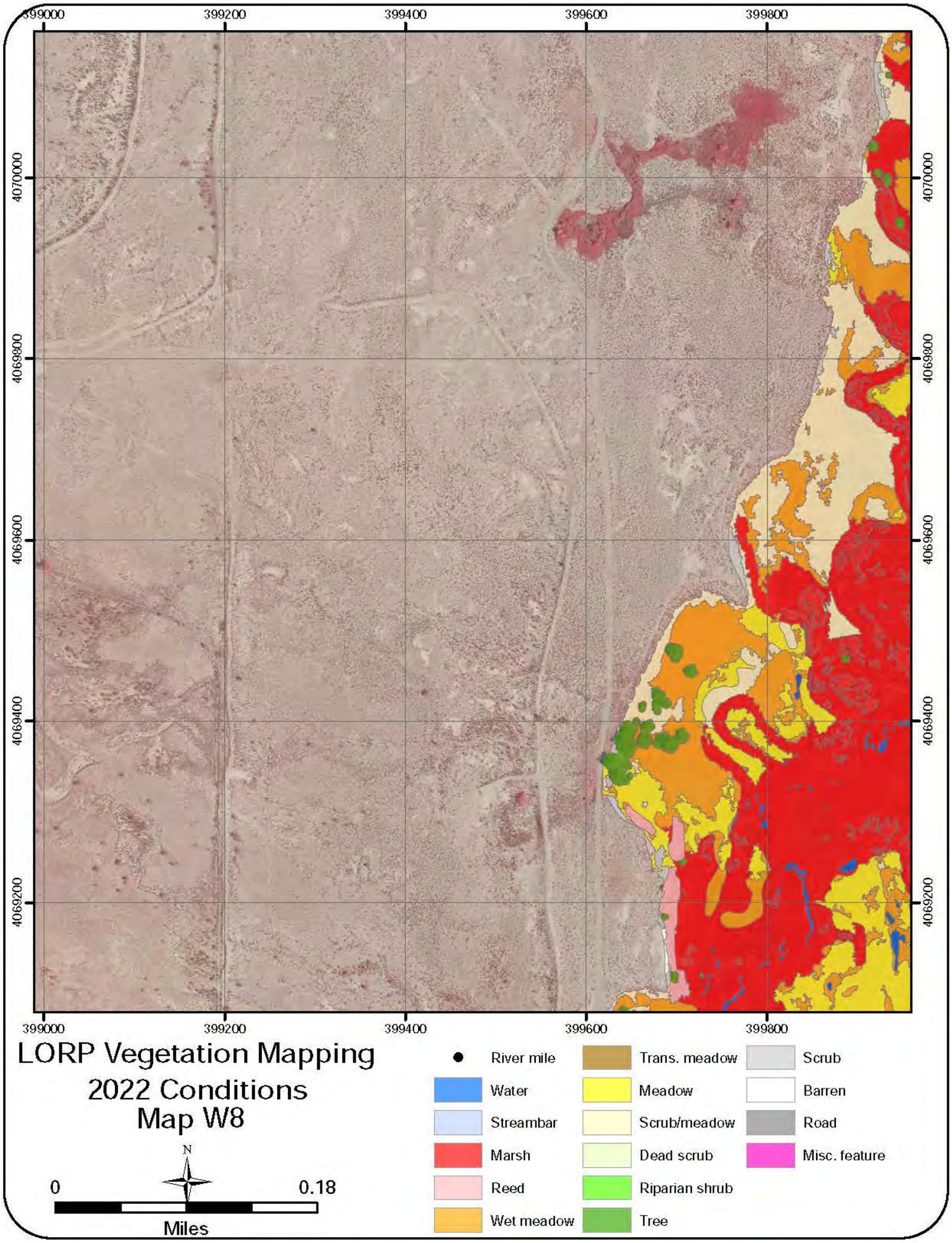
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map W8
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
Riparian shrub
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Scrub
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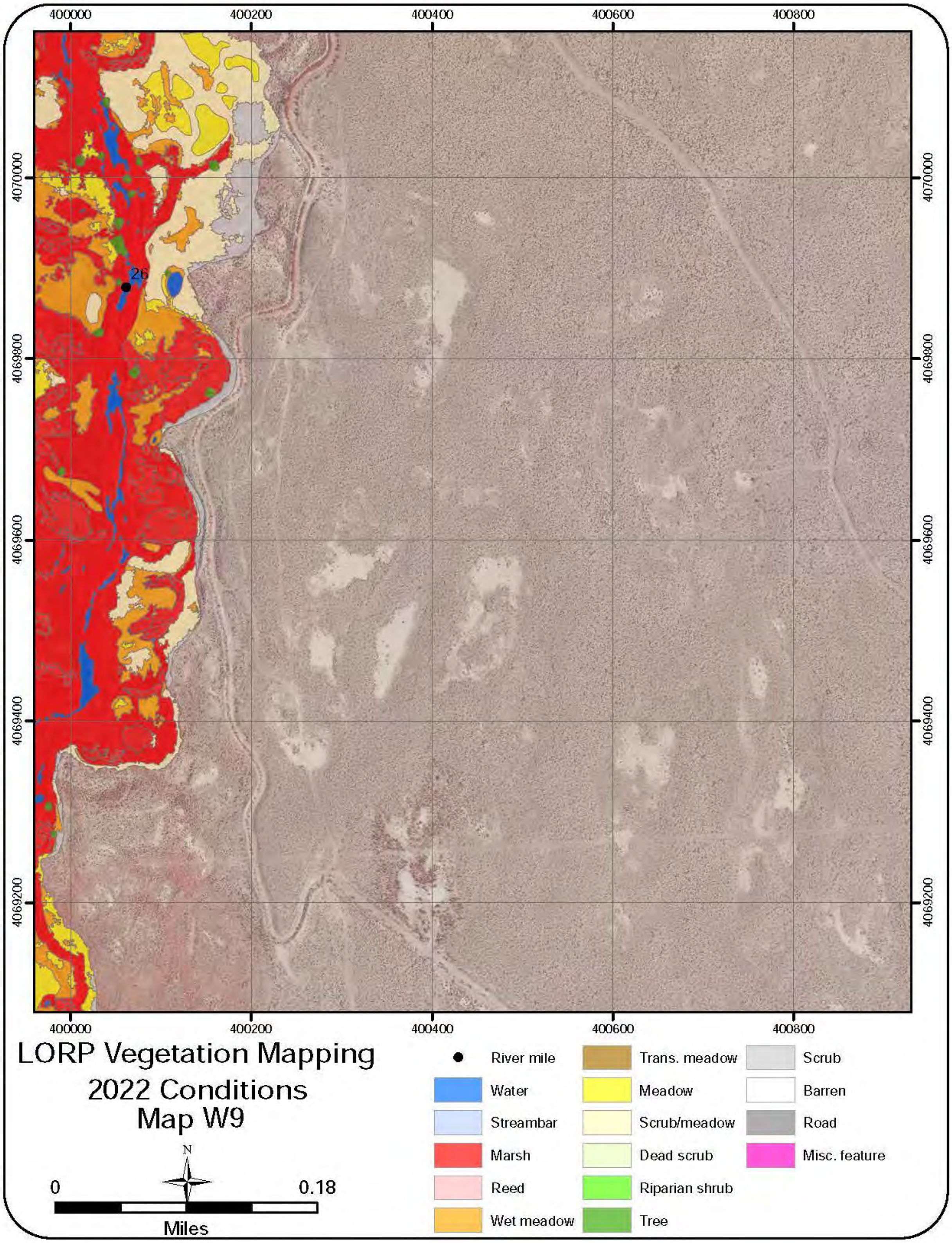
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map W9
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
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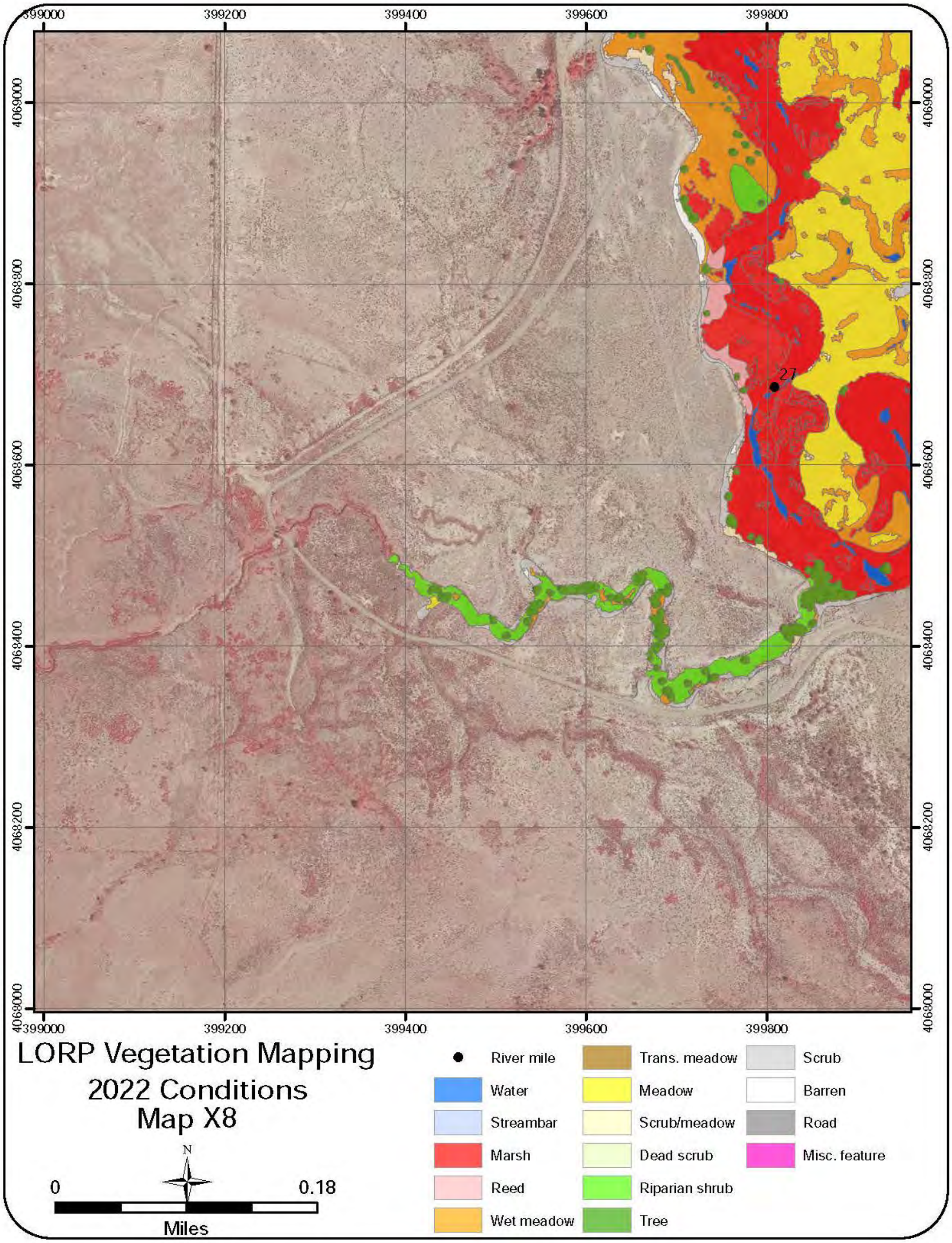
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map X8
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
Riparian shrub
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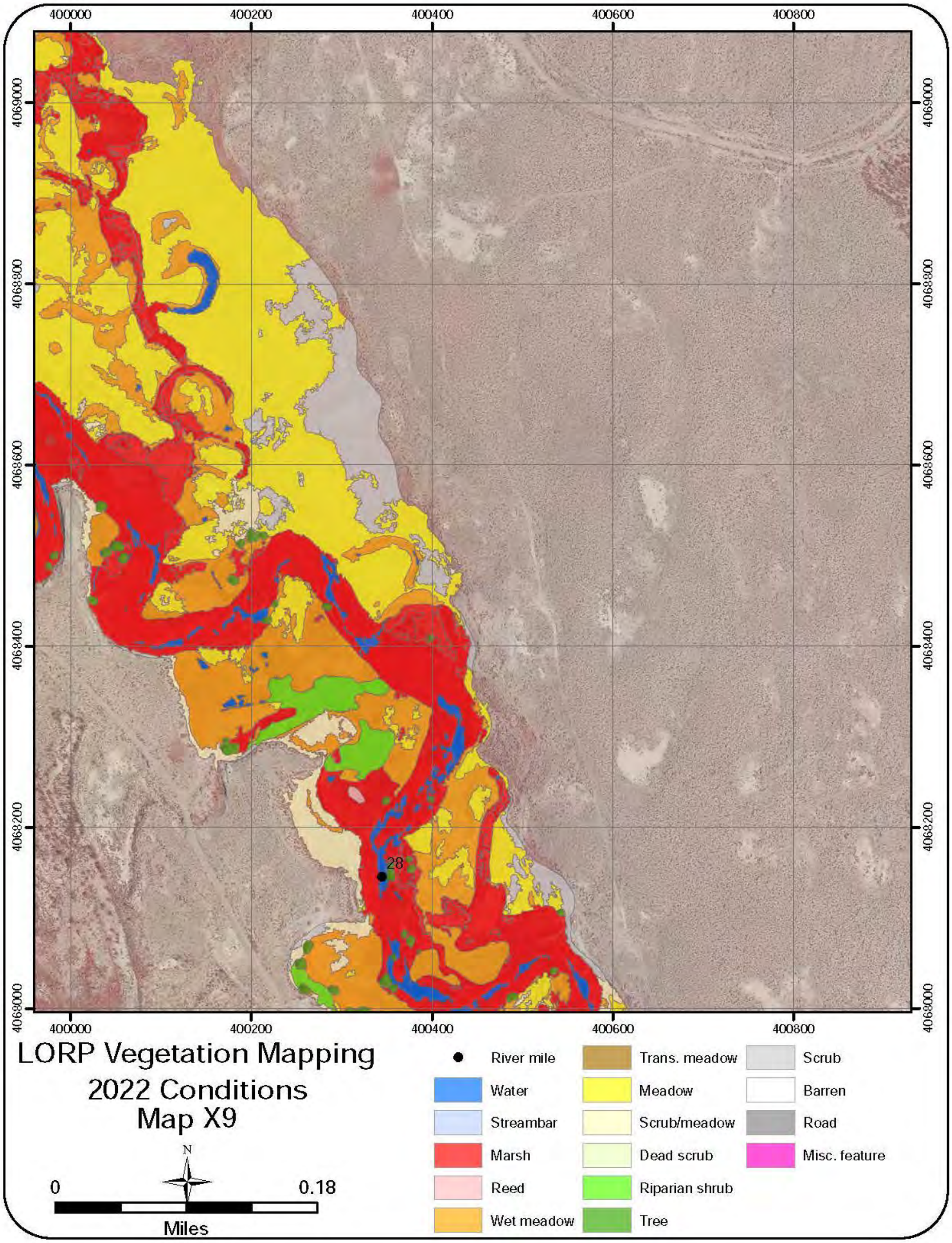
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map X9
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
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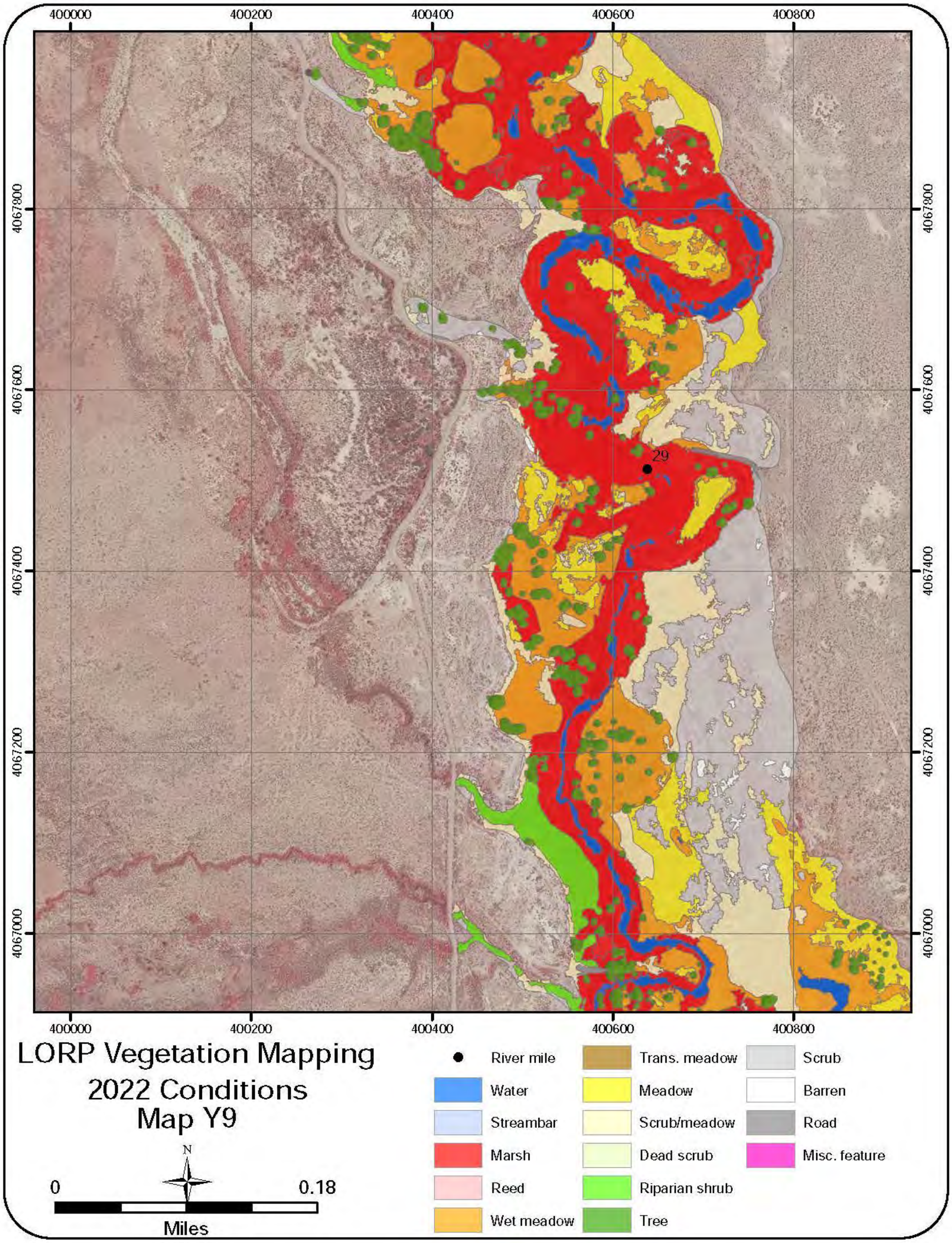
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map Y9
N
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0.18
Miles
River mile
Water
Streambar
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Reed
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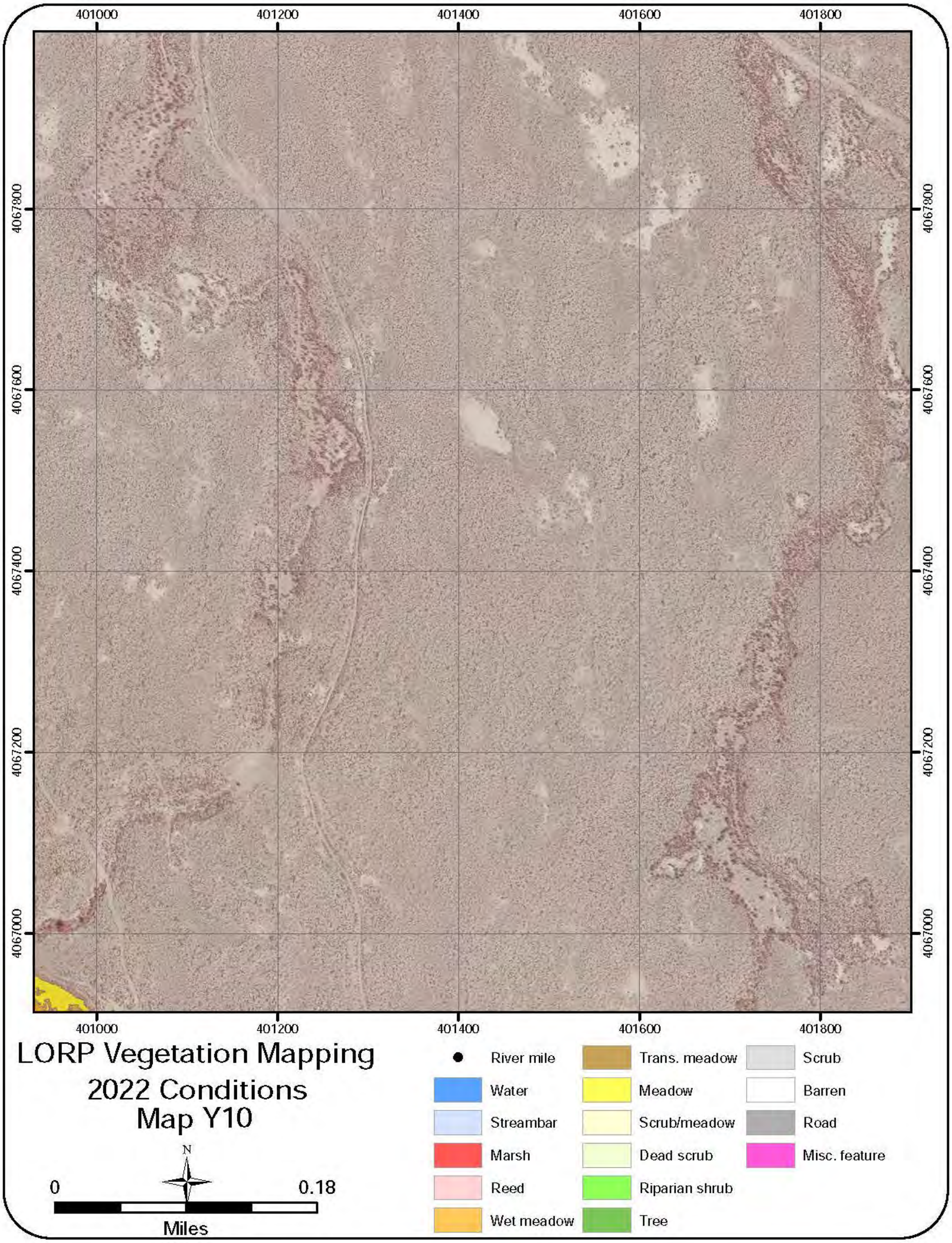
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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Miles
River mile
Water
Streambar
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Scrub/meadow
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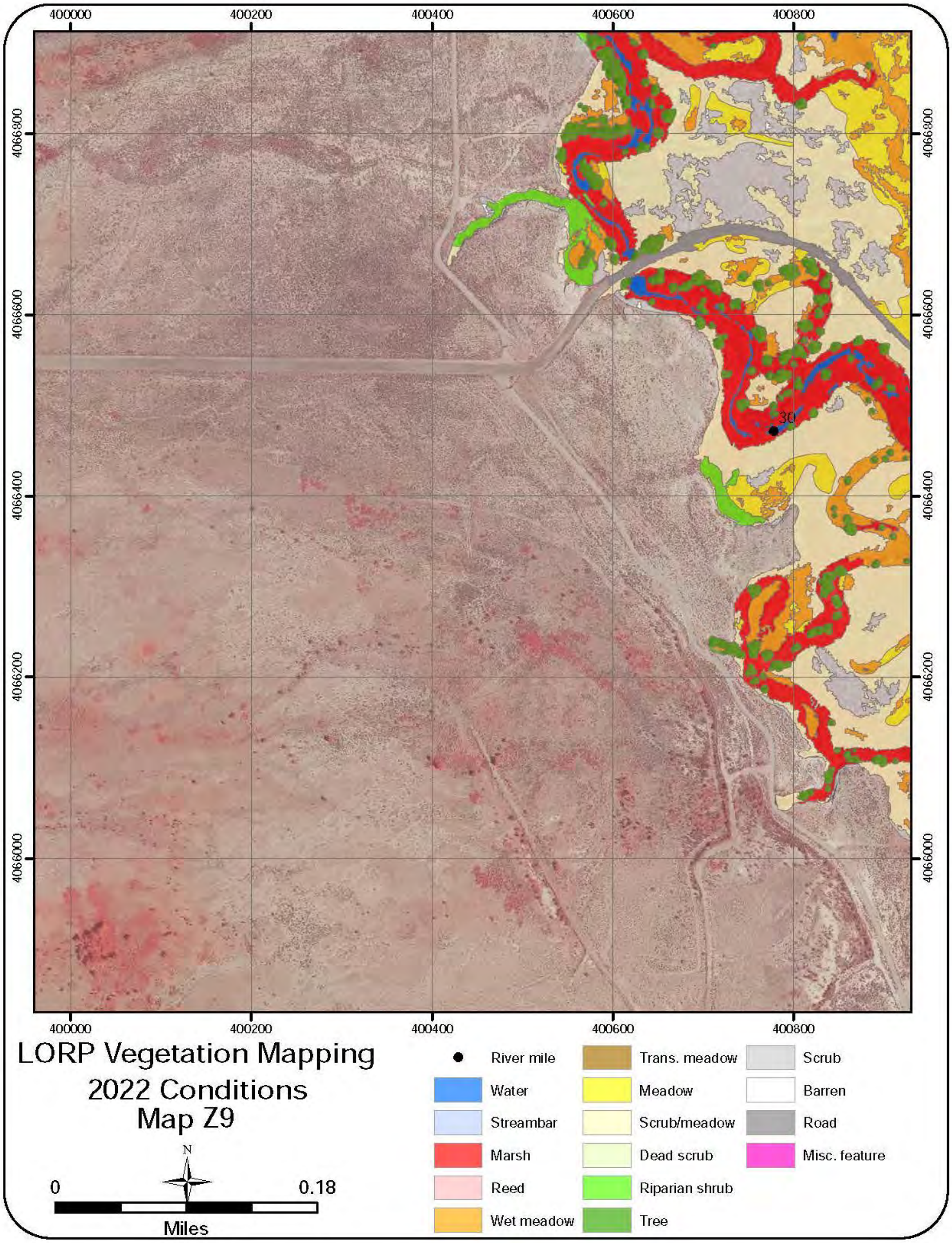
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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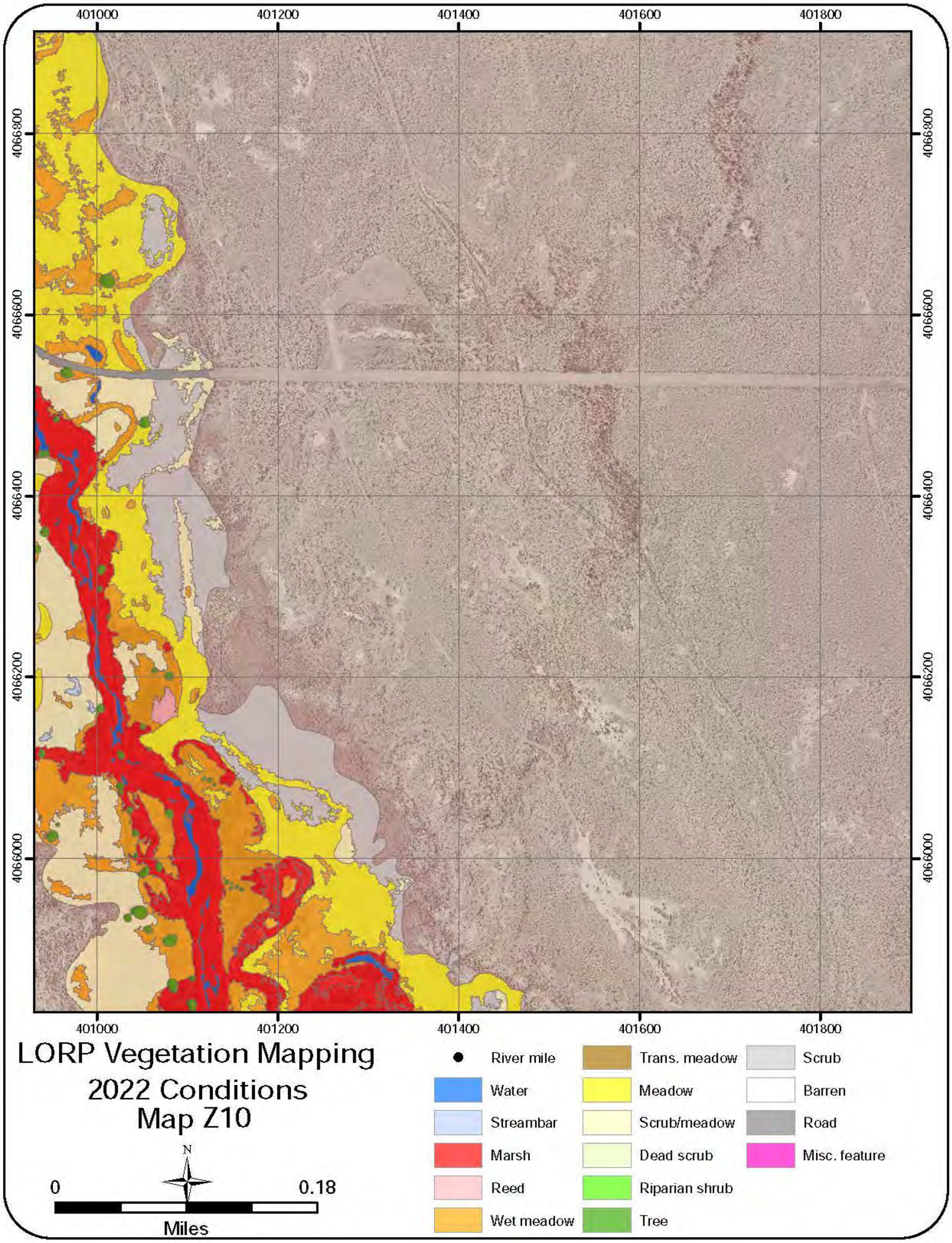
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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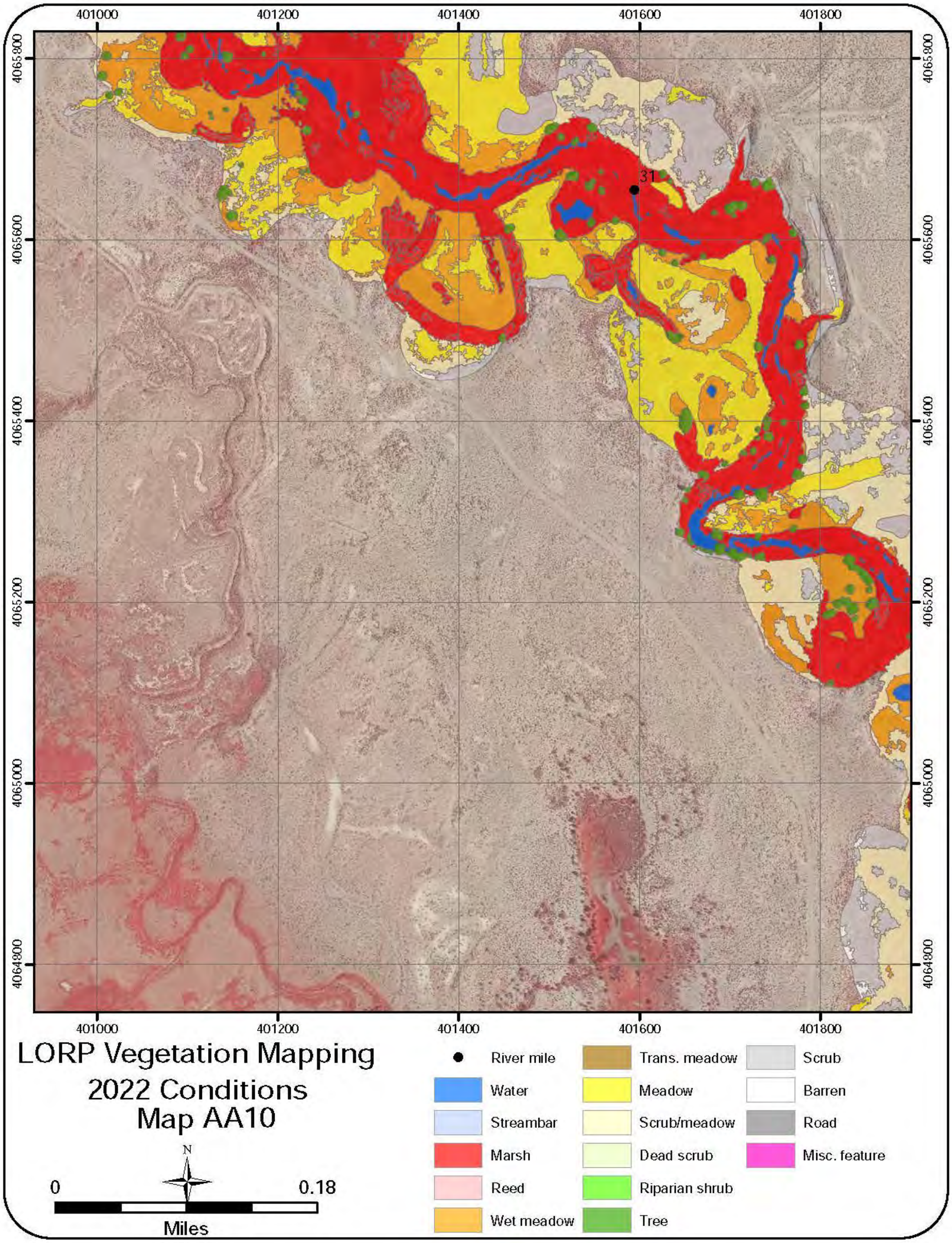
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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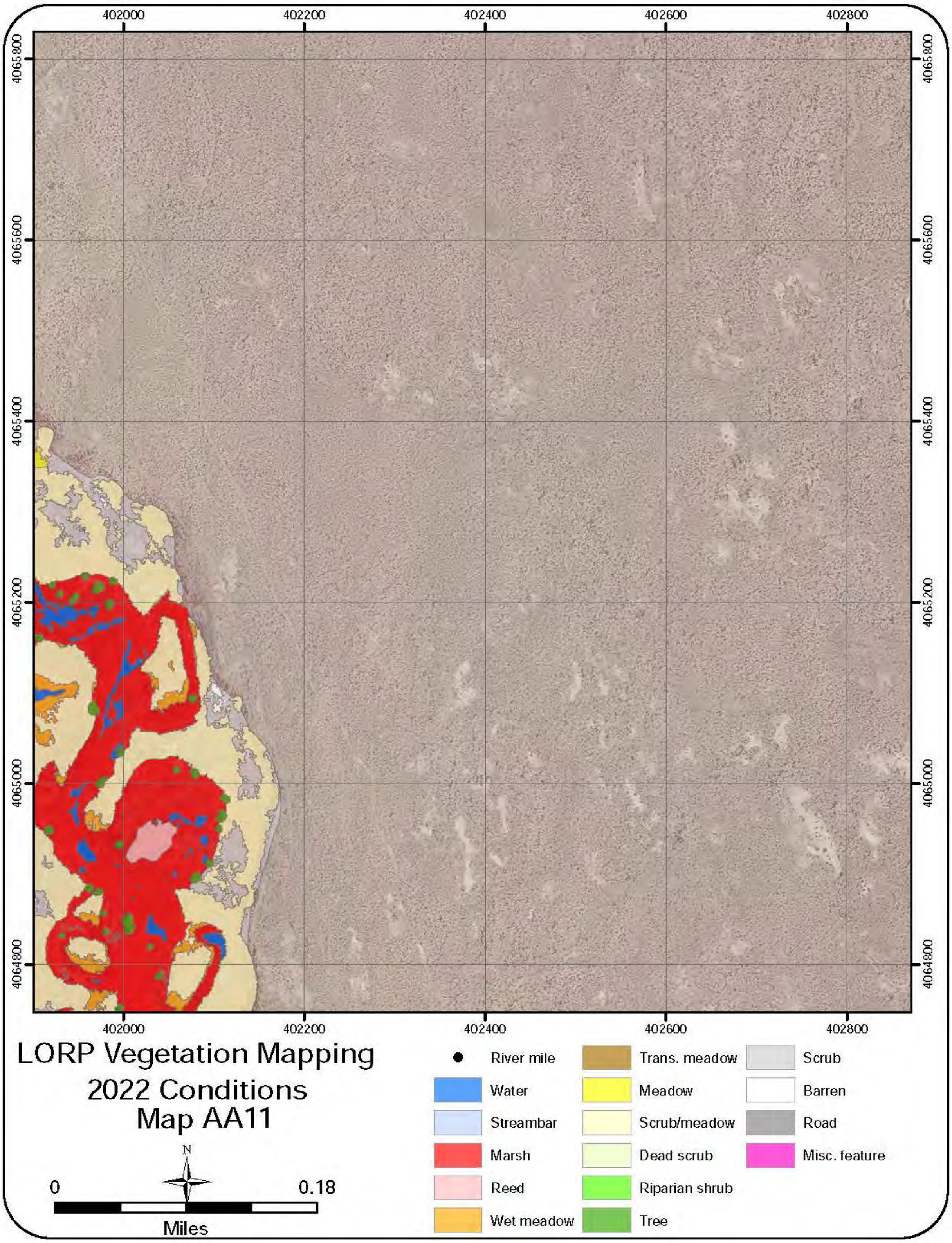
LORP Vegetation Mapping
2022 Conditions
Map AA10
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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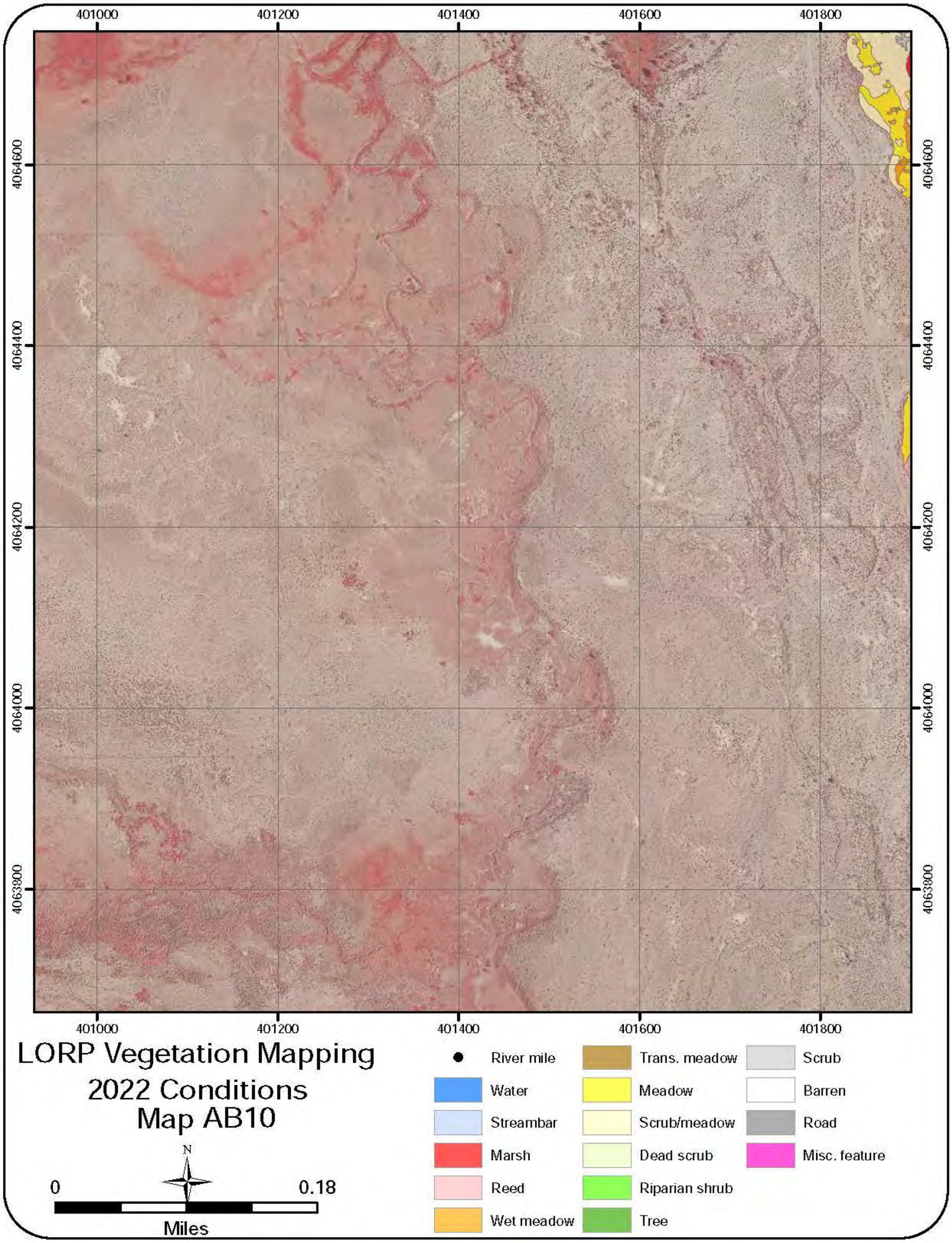
LORP Vegetation Mapping
2022 Conditions
Map AA11
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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2022 Conditions
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0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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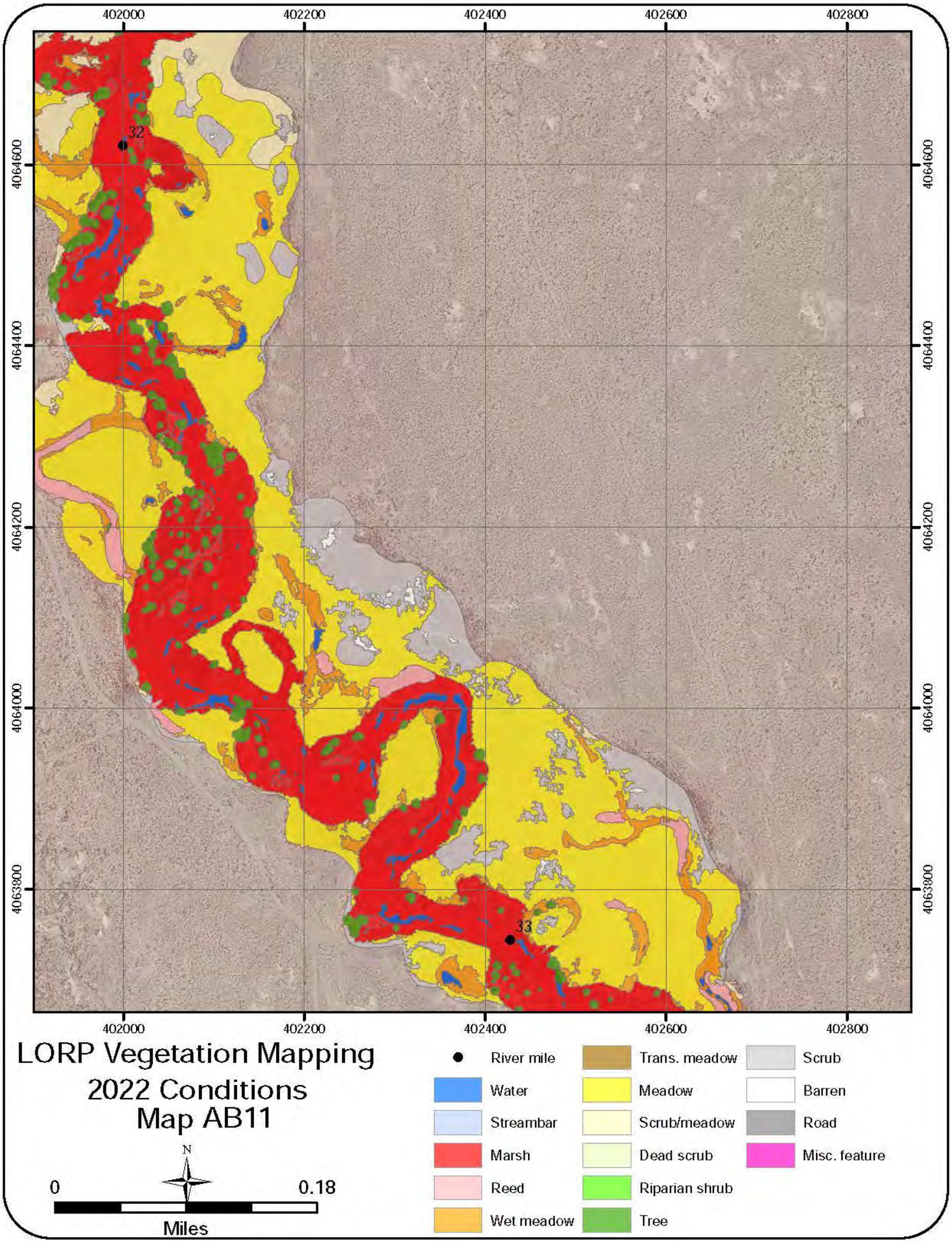
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AB11
N
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0.18
Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
Riparian shrub
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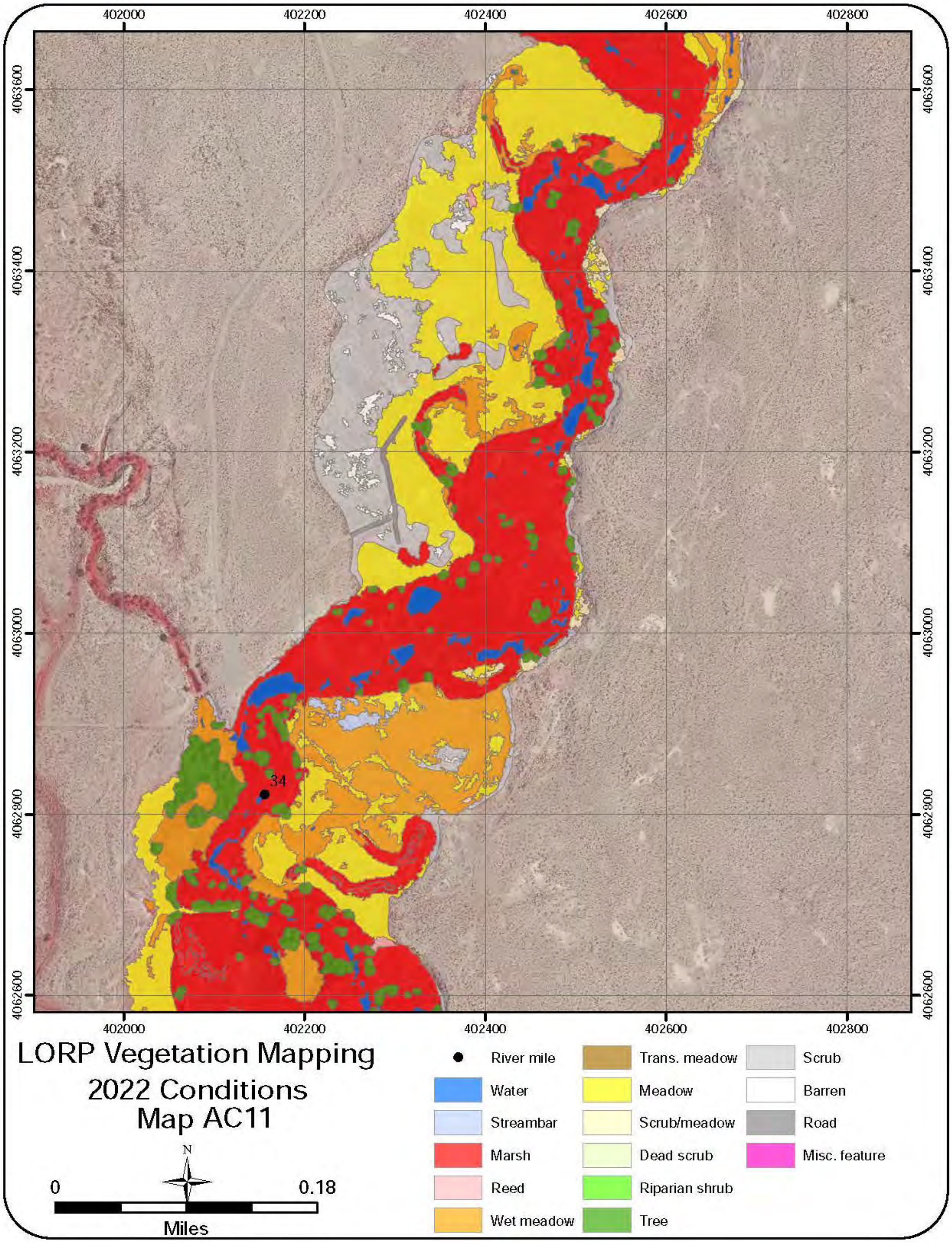
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AC11
N
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Miles
River mile
Water
Streambar
Marsh
Reed
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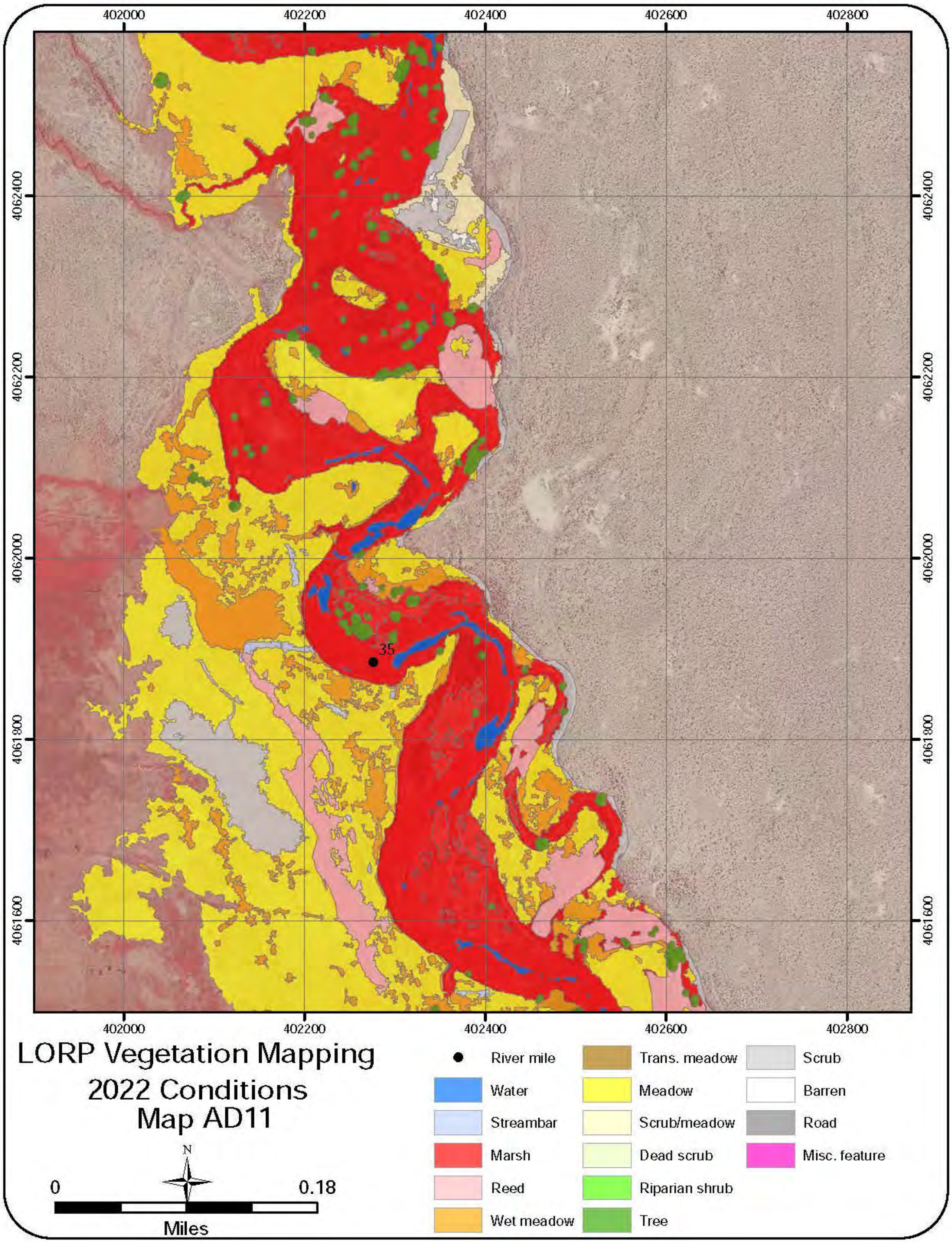
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AD11
N
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0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
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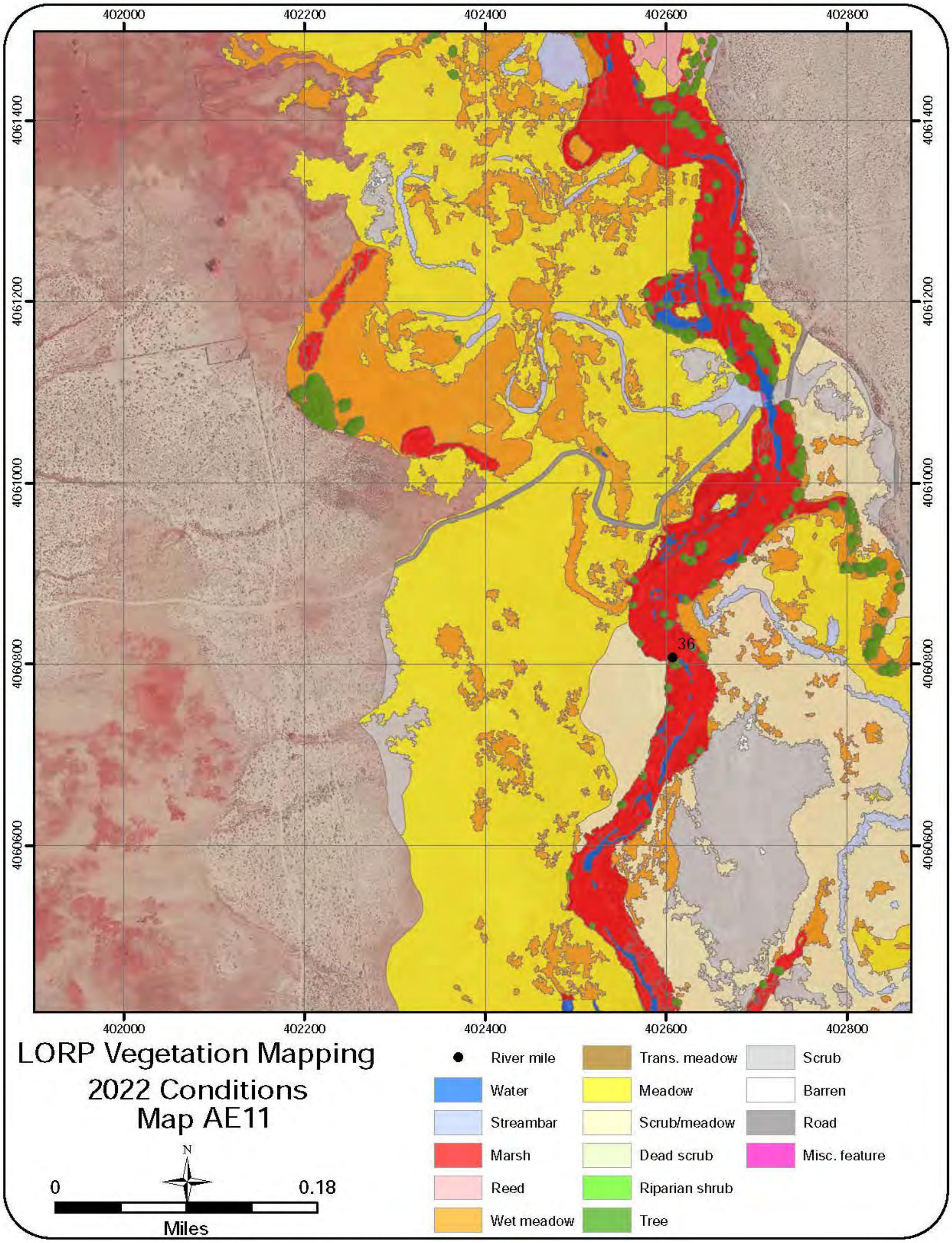
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AE11
N
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0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
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Meadow
Scrub/meadow
Dead scrub
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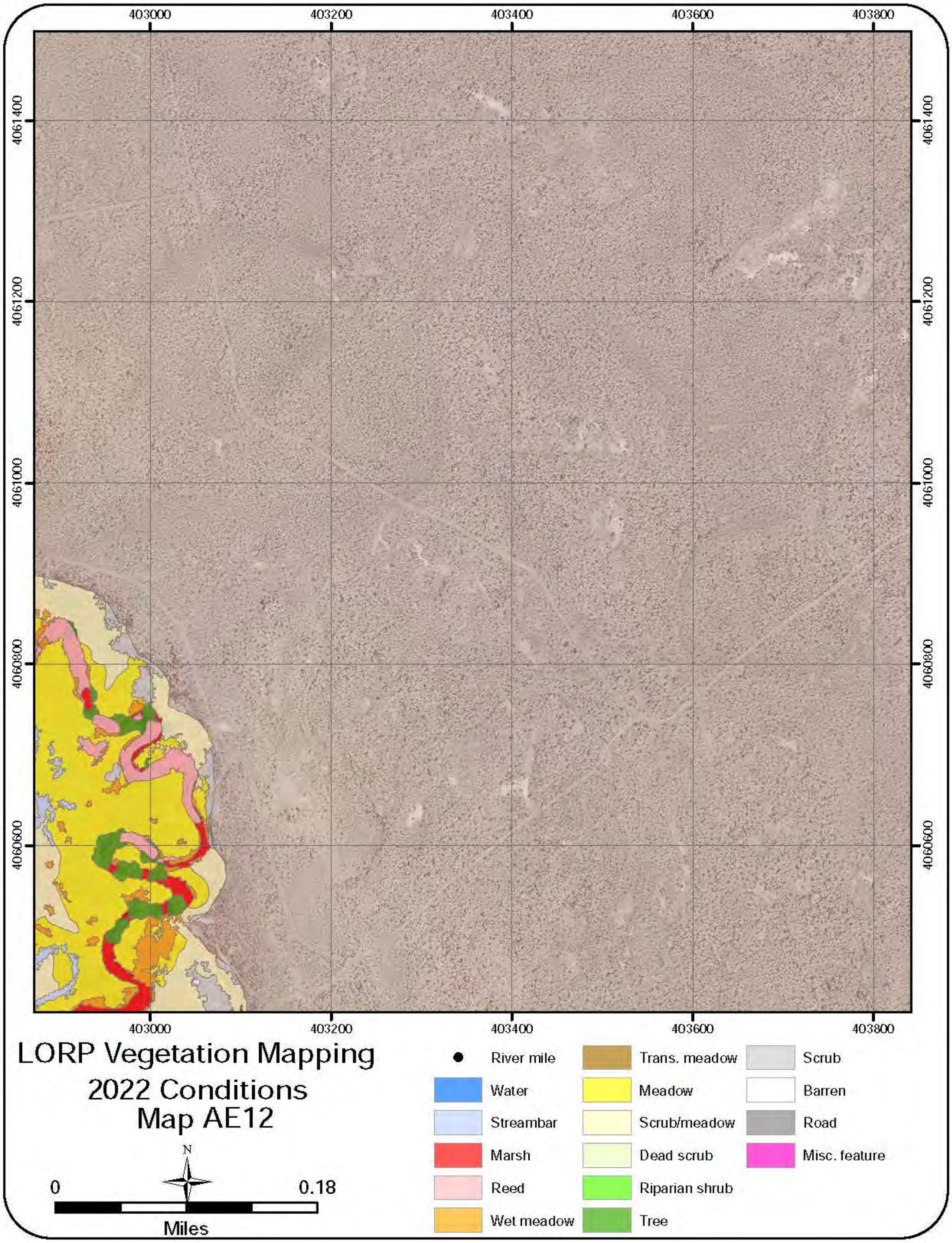
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AE12
N
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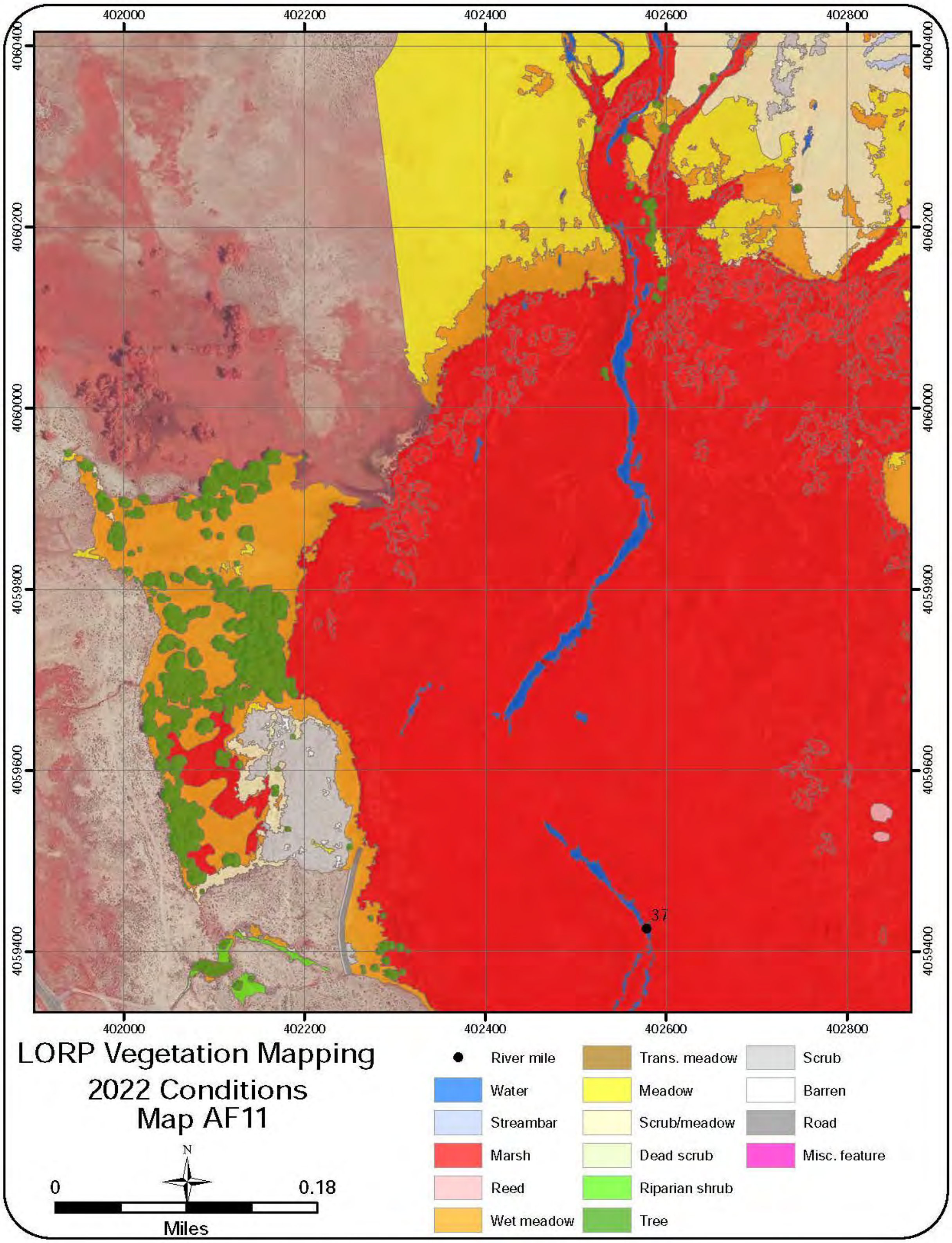
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AF11
N
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0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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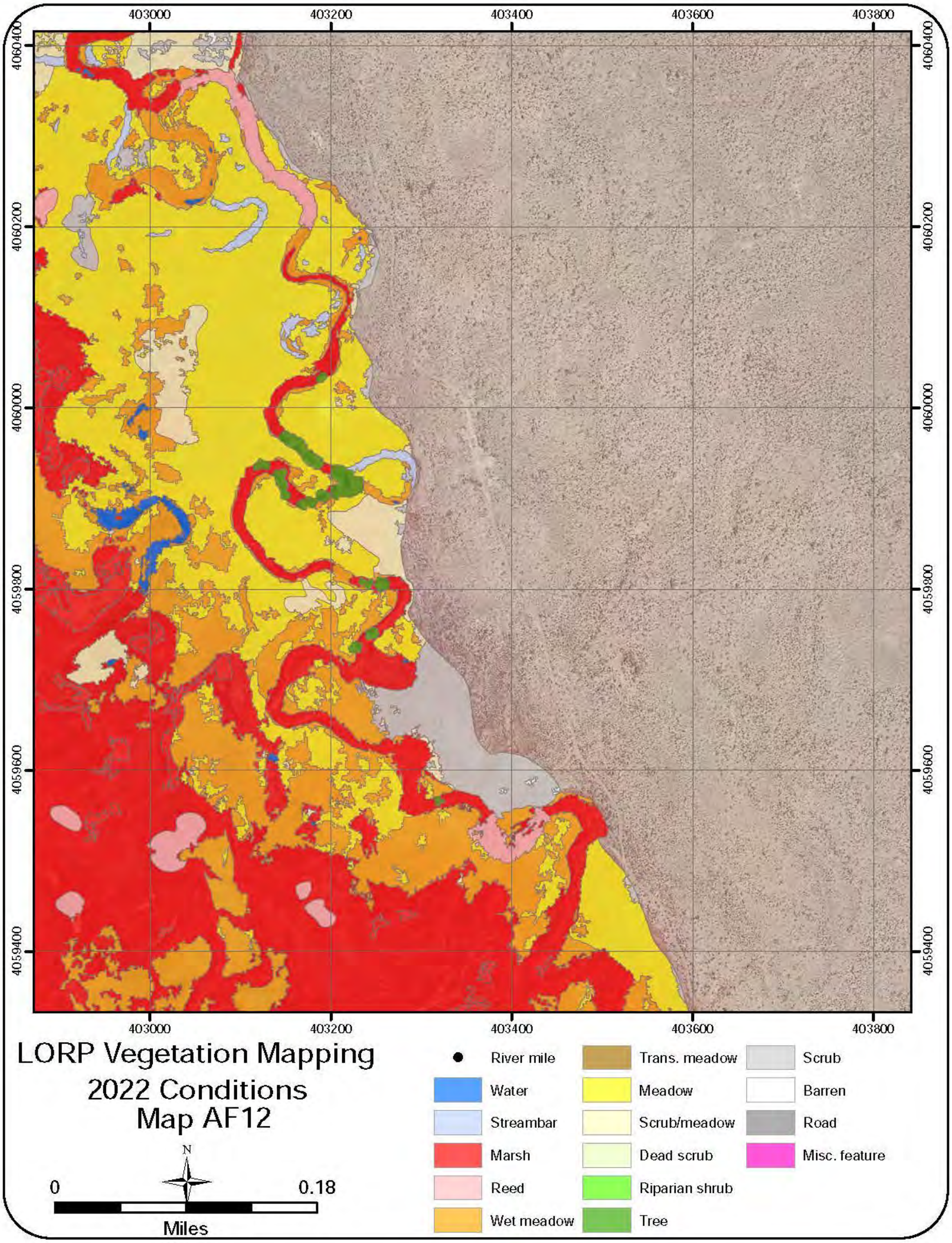
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AF12
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Miles
River mile
Water
Streambar
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Scrub/meadow
Dead scrub
Riparian shrub
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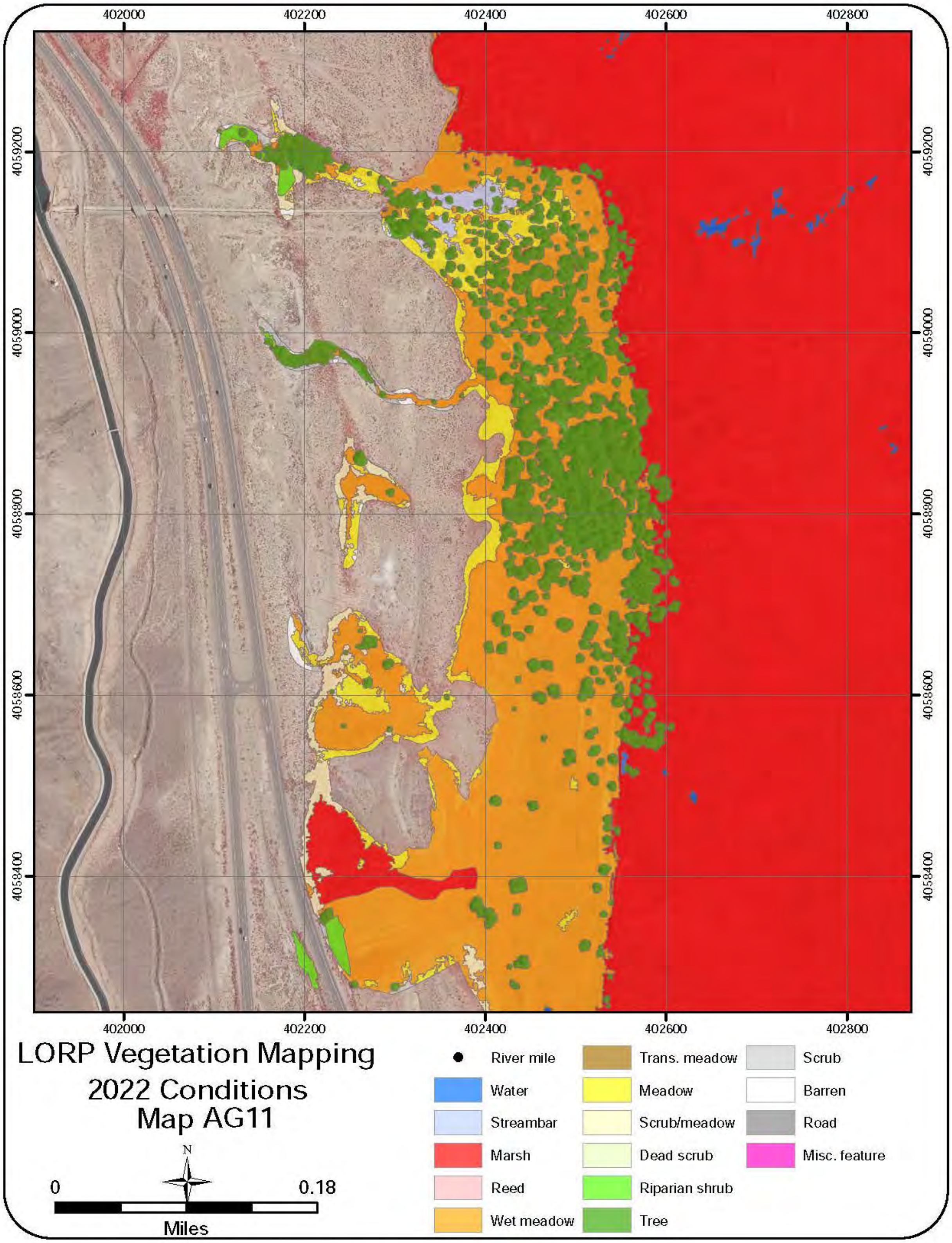
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AG11
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
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Meadow
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Dead scrub
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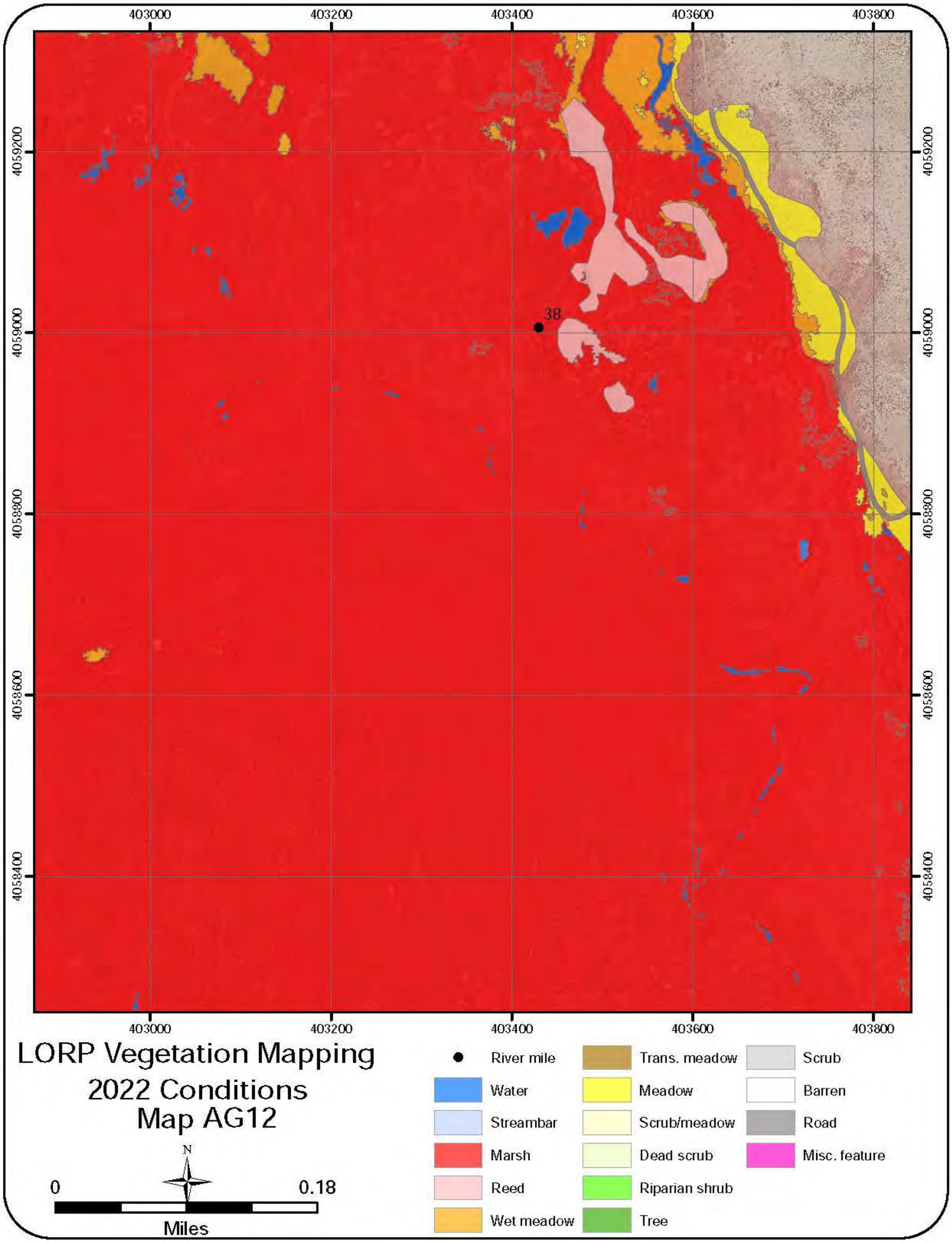
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AG12
N
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Miles
River mile
Water
Streambar
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Reed
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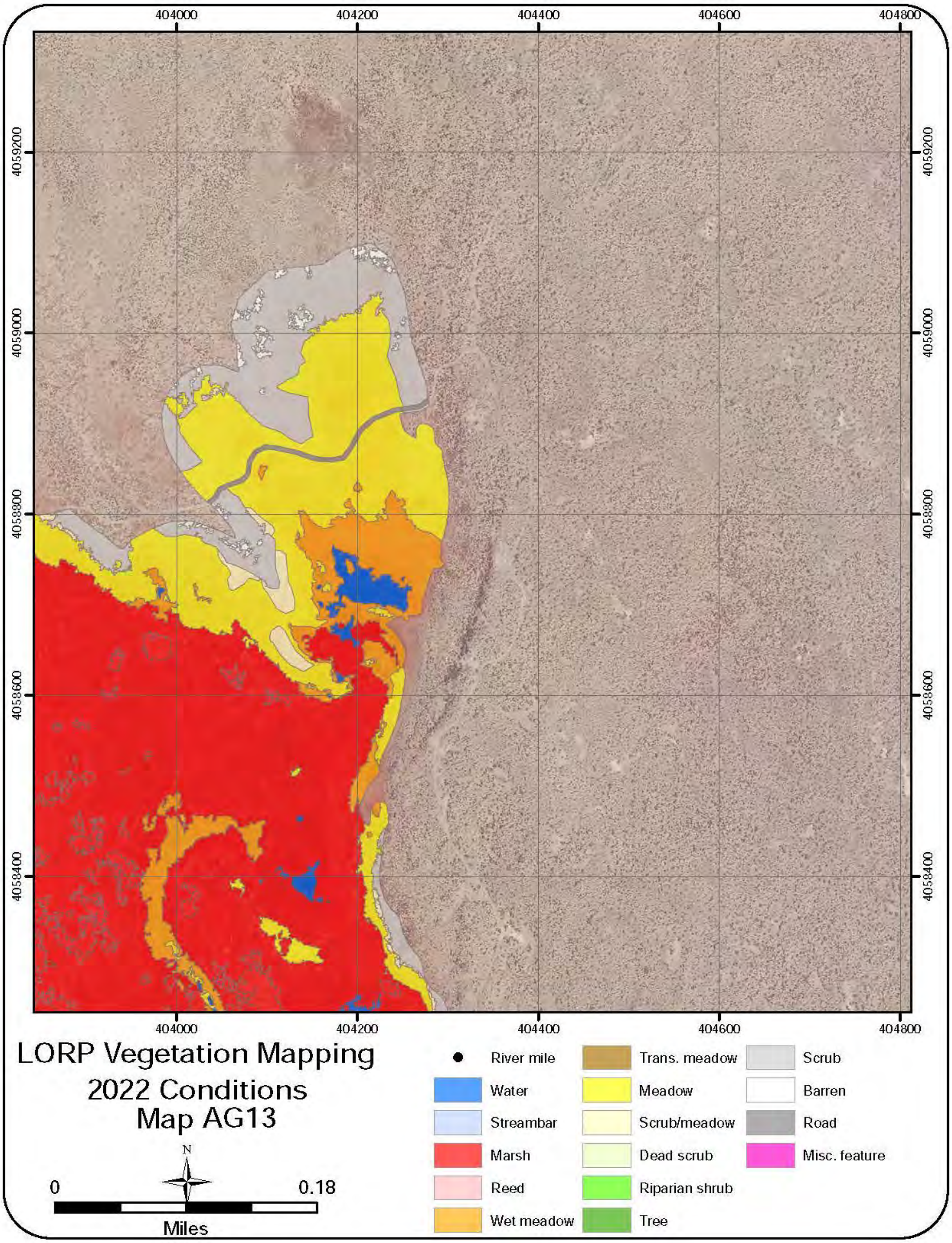
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LORP Vegetation Mapping
2022 Conditions
Map AG13
N
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0.18
Miles
River mile
Water
Streambar
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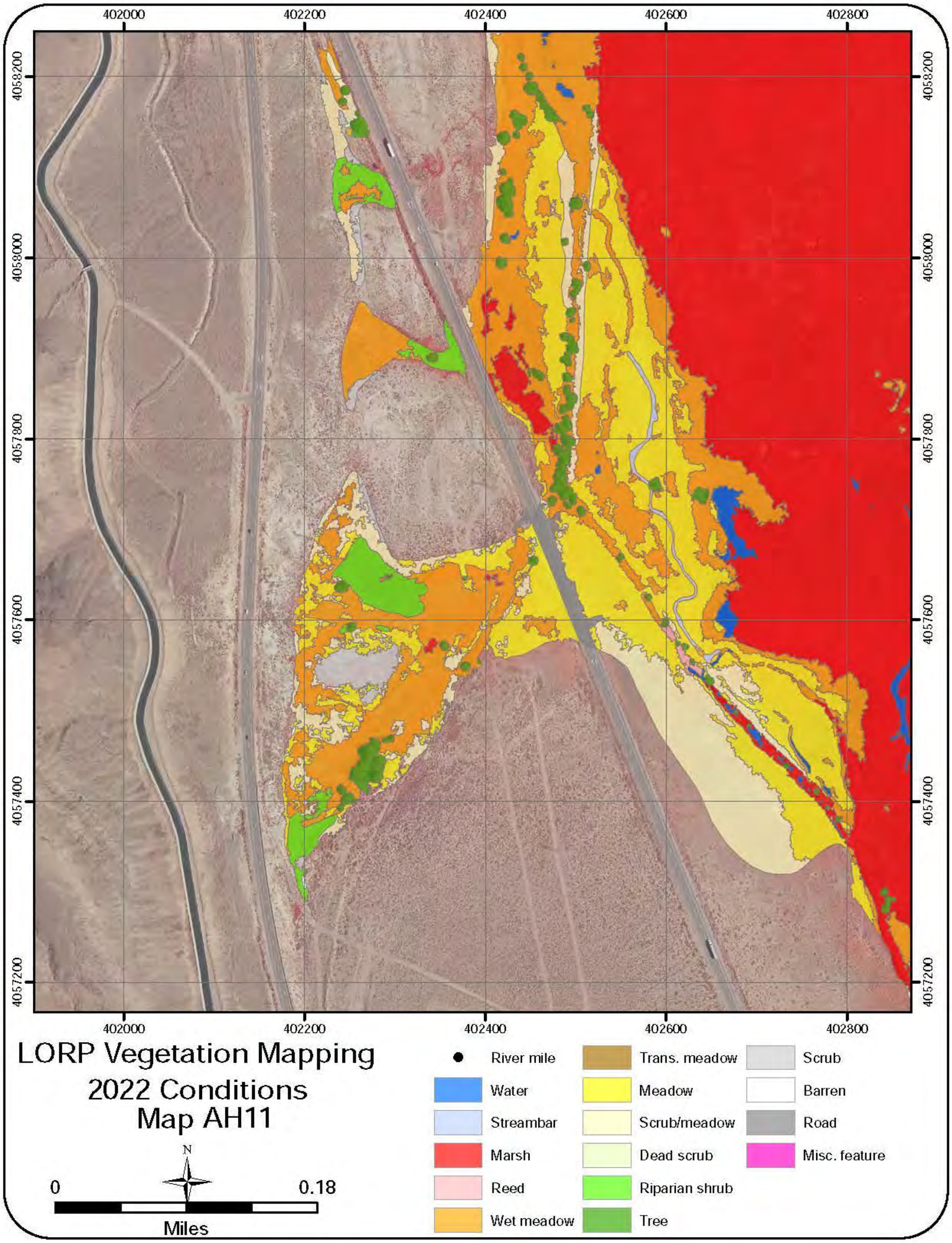
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LORP Vegetation Mapping
2022 Conditions
Map AH11
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Miles
River mile
Water
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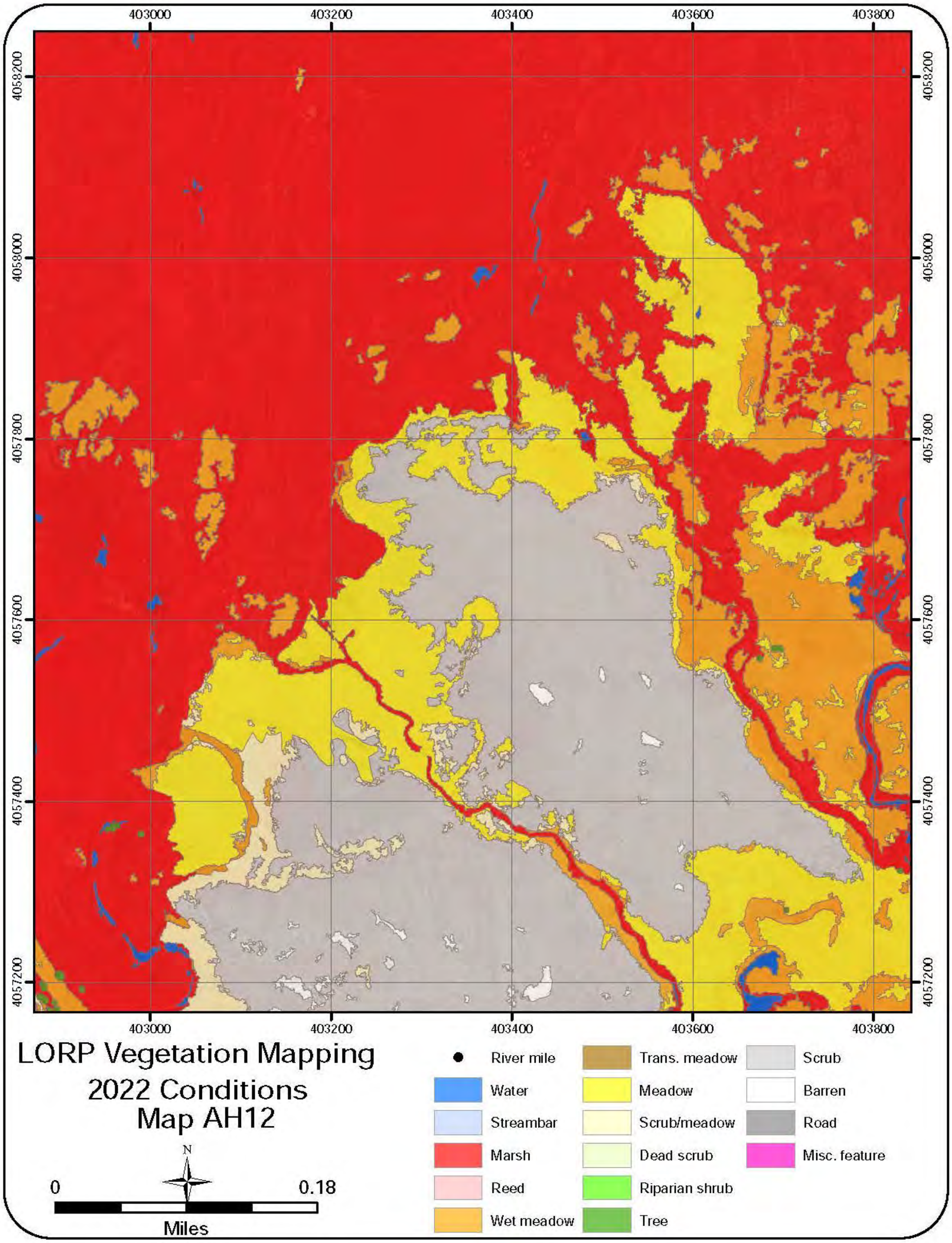
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LORP Vegetation Mapping
2022 Conditions
Map AH12
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Miles
River mile
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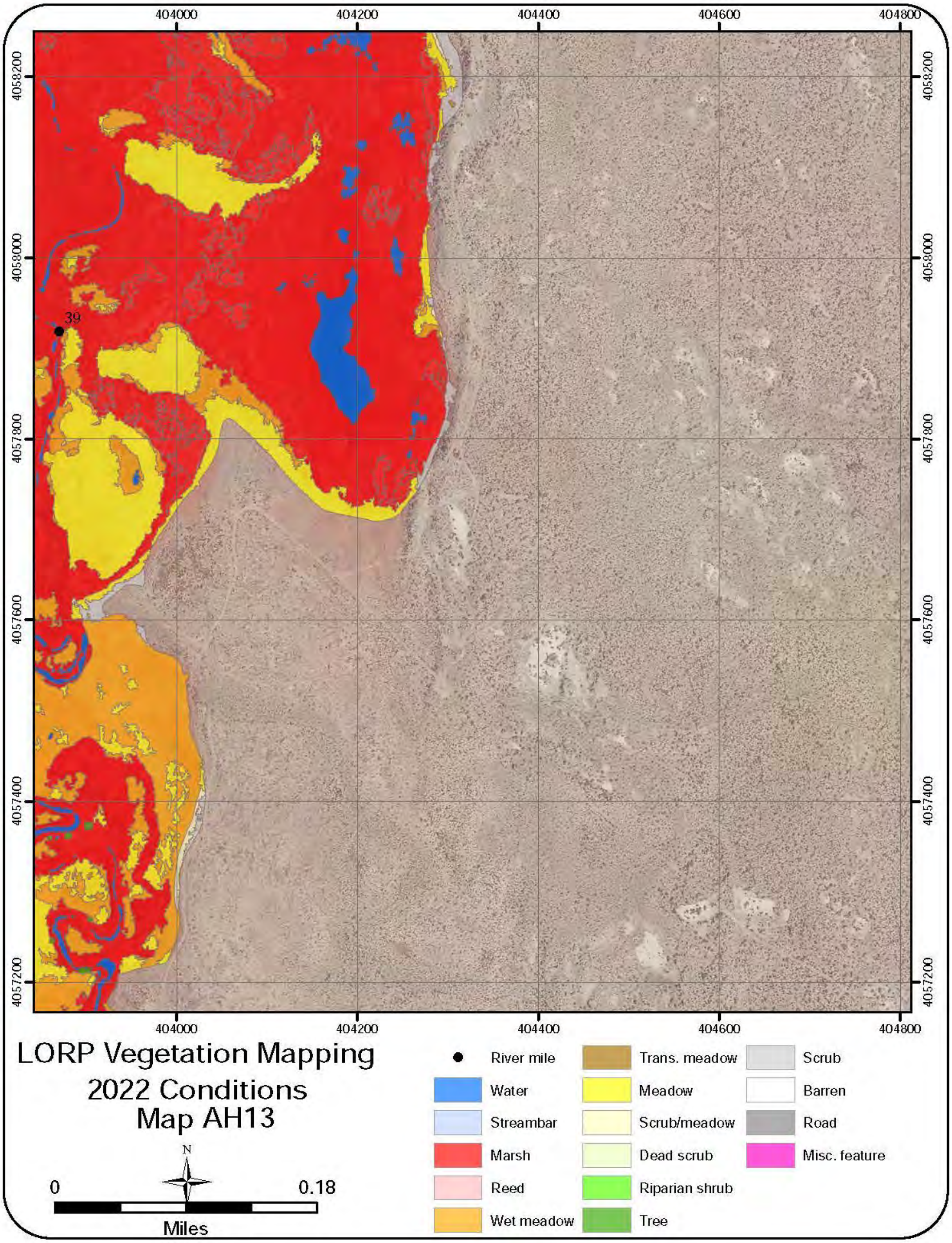
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LORP Vegetation Mapping
2022 Conditions
Map AH13
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Miles
River mile
Water
Streambar
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Trans. meadow
Meadow
Scrub/meadow
Dead scrub
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Scrub
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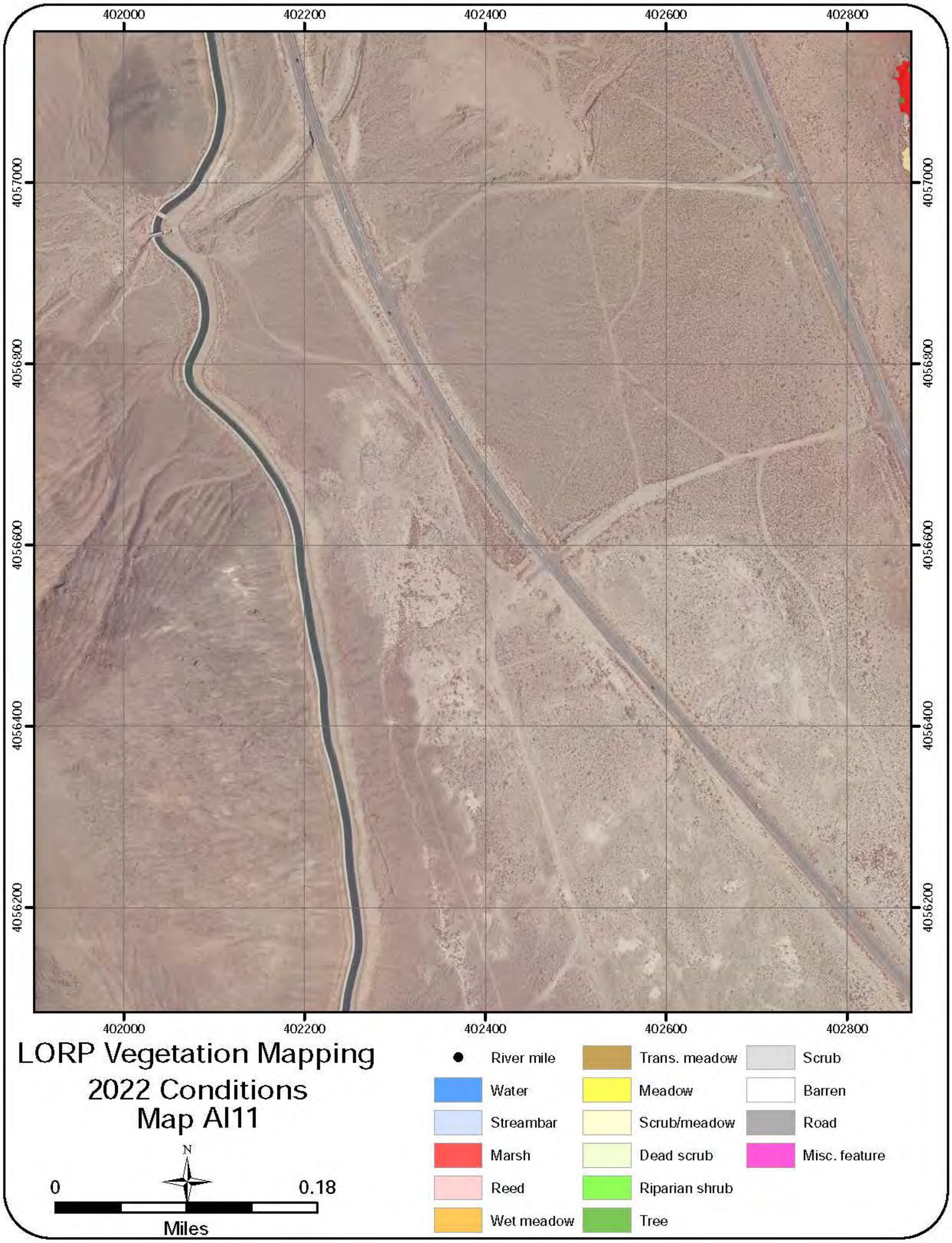
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AI11
N
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Miles
River mile
Water
Streambar
Marsh
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Trans. meadow
Meadow
Scrub/meadow
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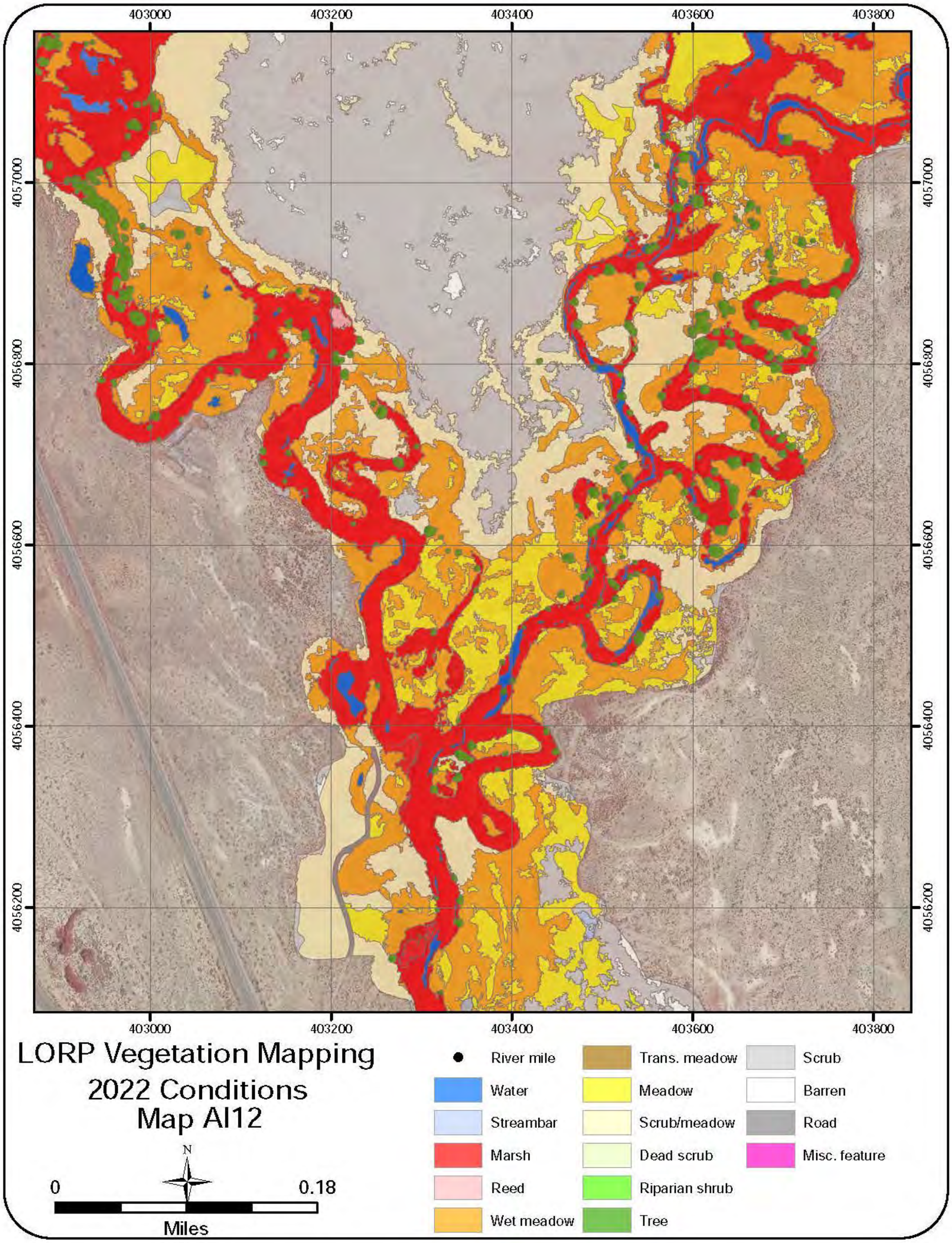
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LORP Vegetation Mapping
2022 Conditions
Map AI12
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
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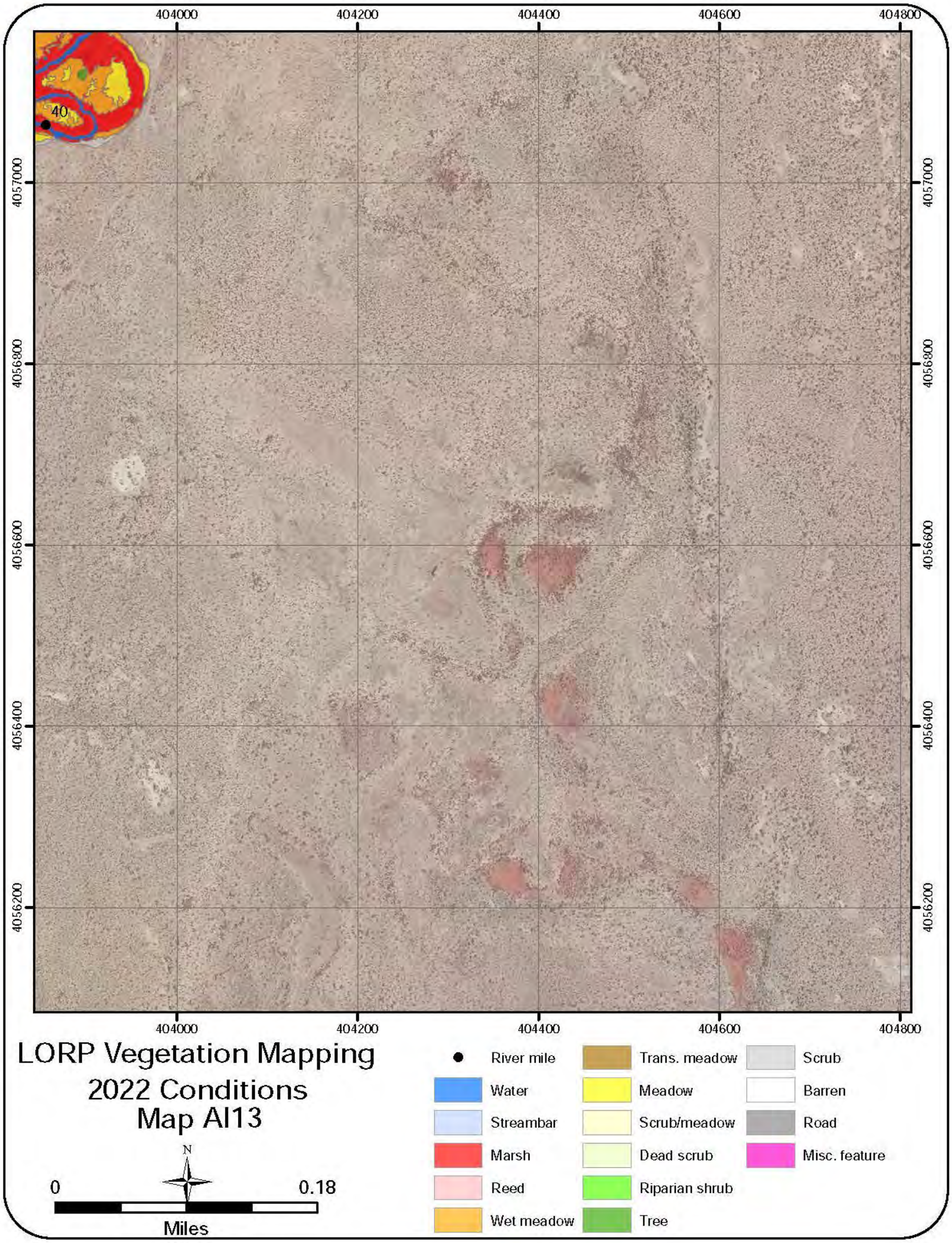
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AI13
N
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
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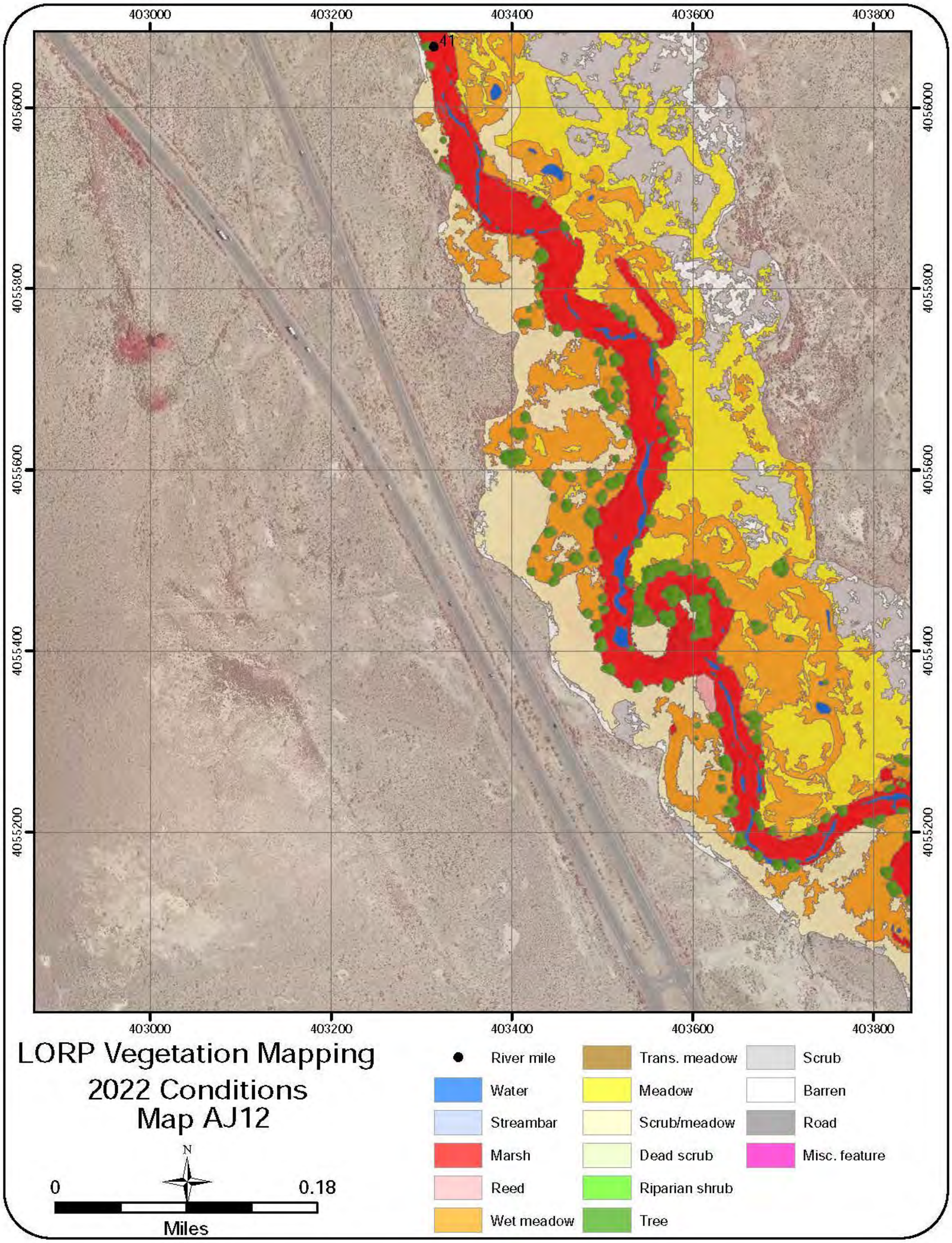
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AJ12
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
Dead scrub
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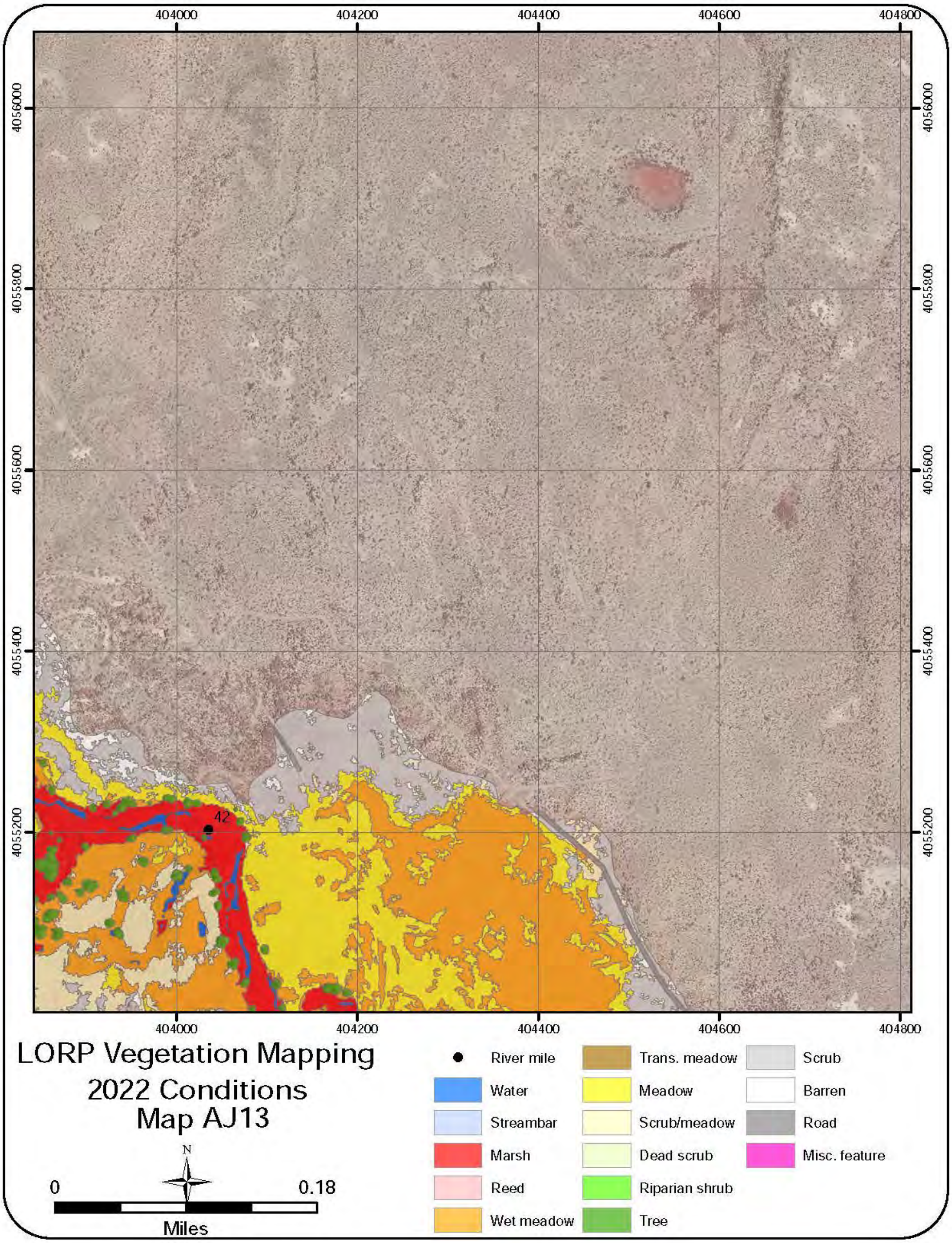
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AJ13
N
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0.18
Miles
River mile
Water
Streambar
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Reed
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Meadow
Scrub/meadow
Dead scrub
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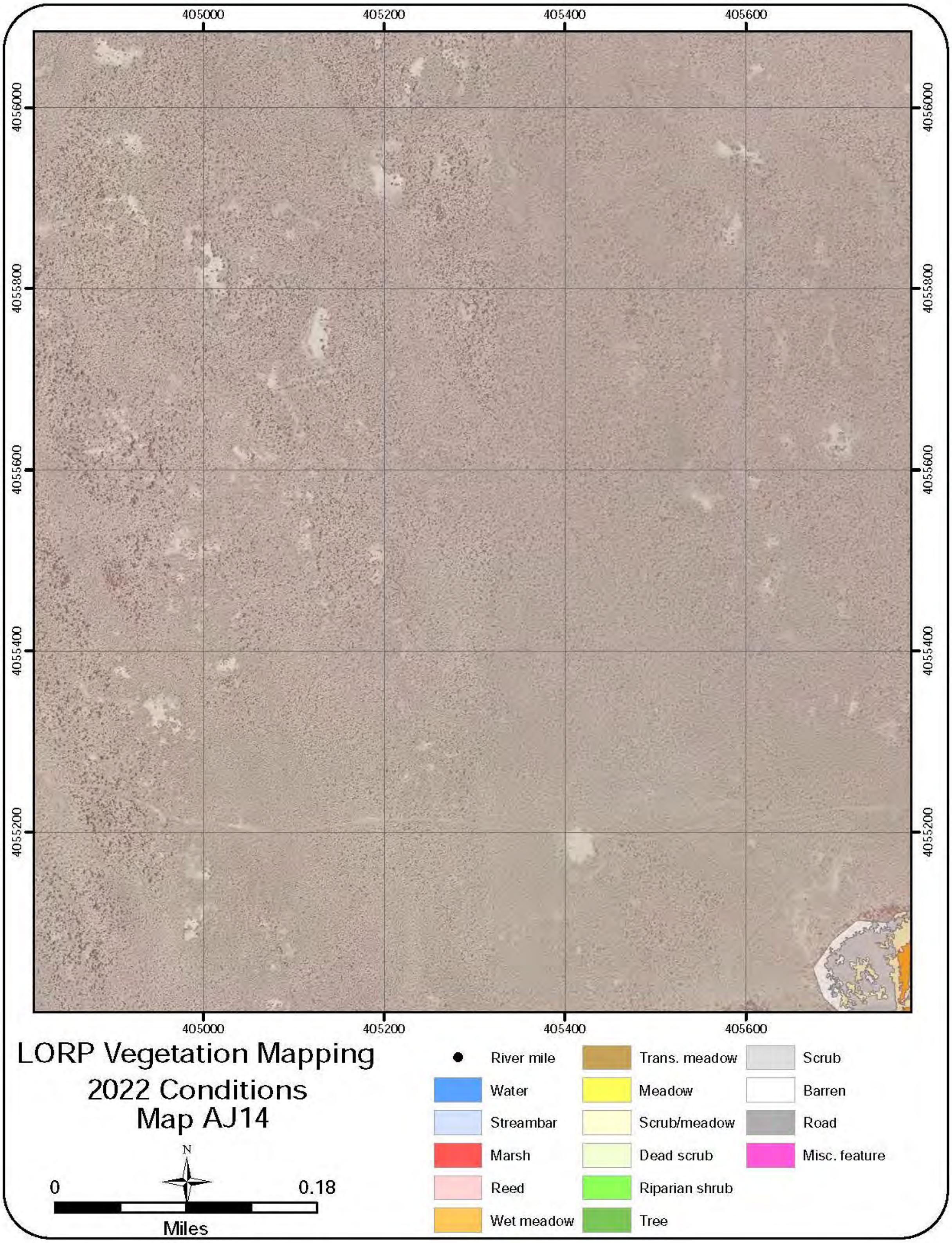
Misc. feature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LORP Vegetation Mapping
2022 Conditions
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Miles
River mile
Water
Streambar
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Meadow
Scrub/meadow
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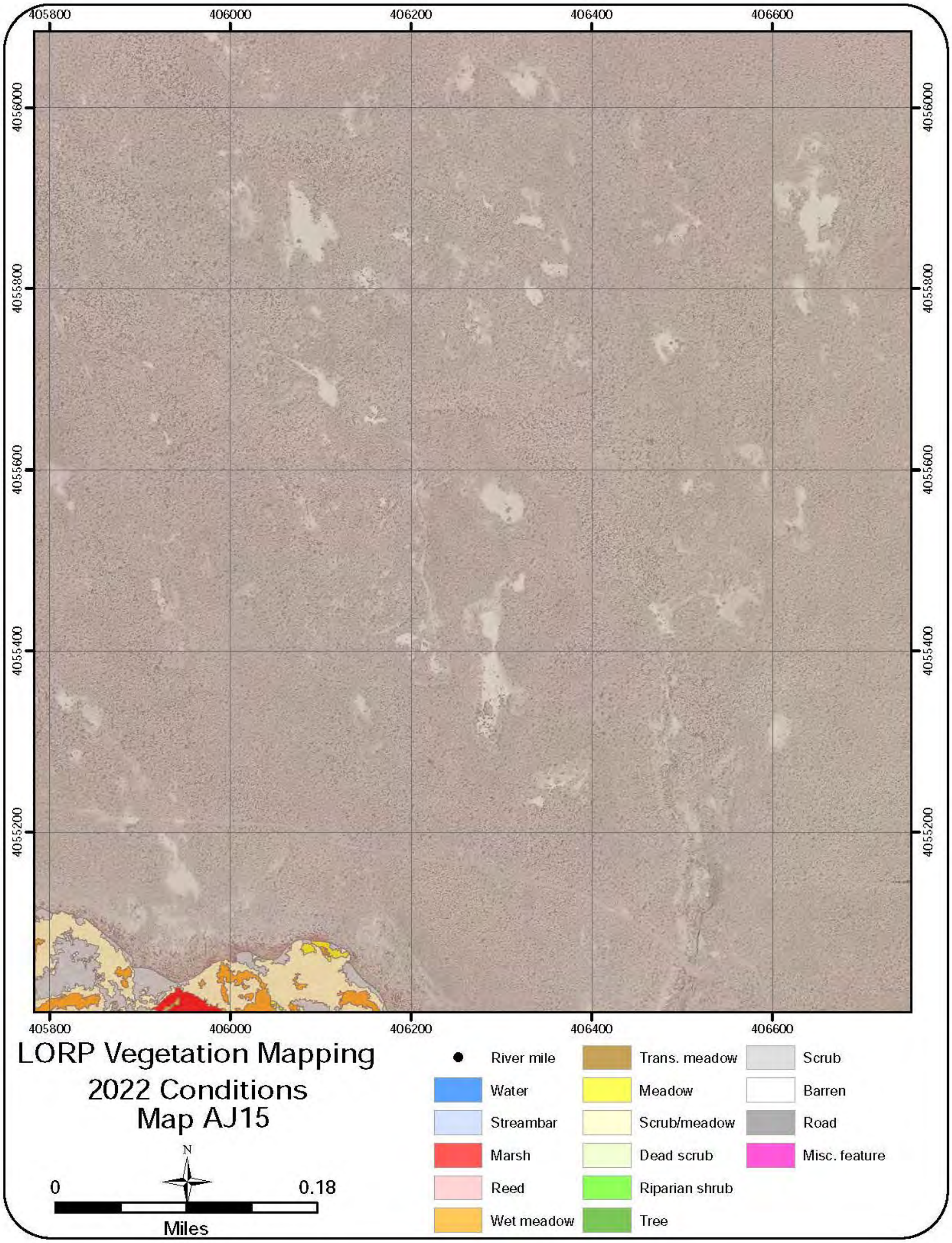
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AJ15
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Miles
River mile
Water
Streambar
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Scrub/meadow
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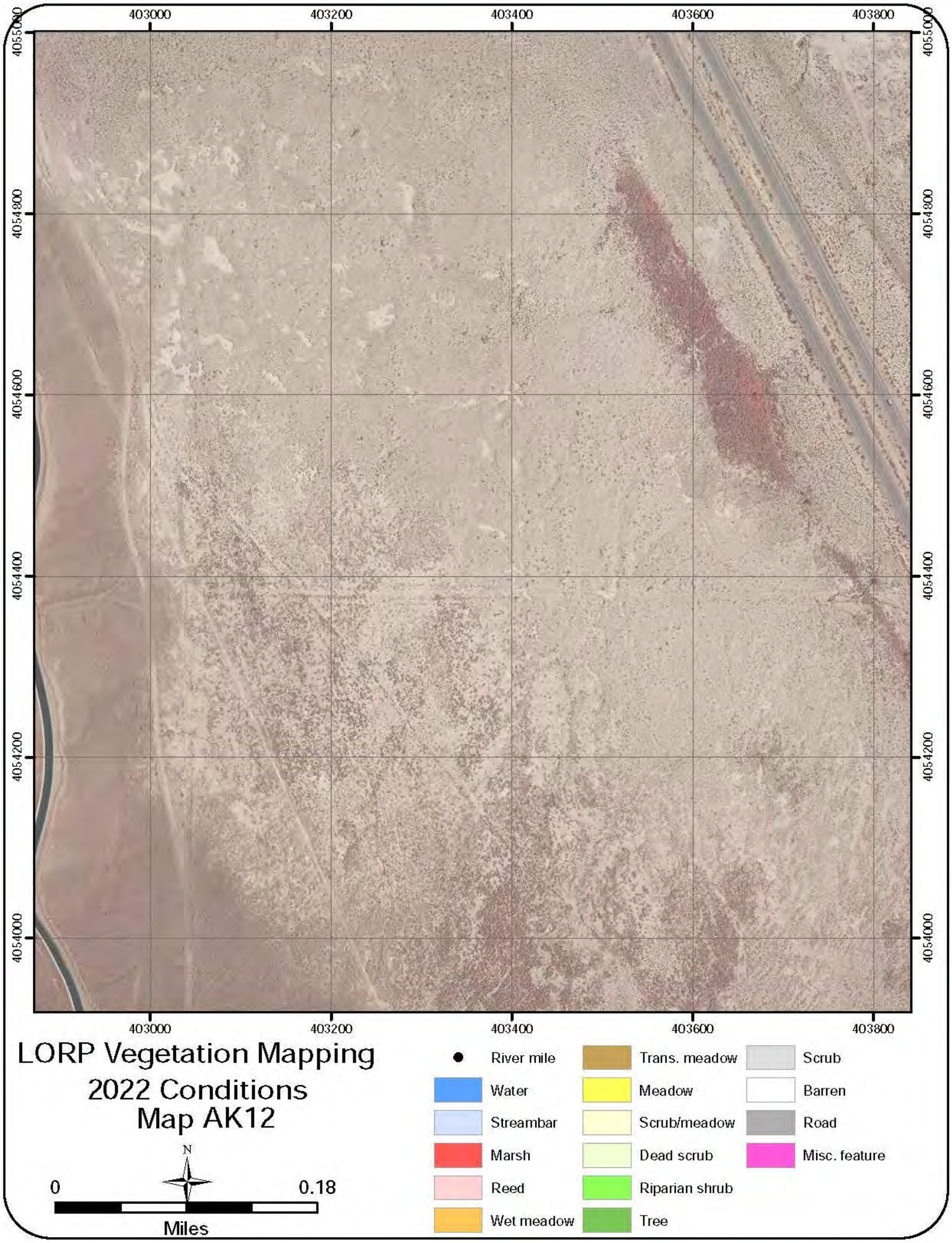
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AK12
N
0
0.18
Miles
River mile
Water
Streambar
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Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
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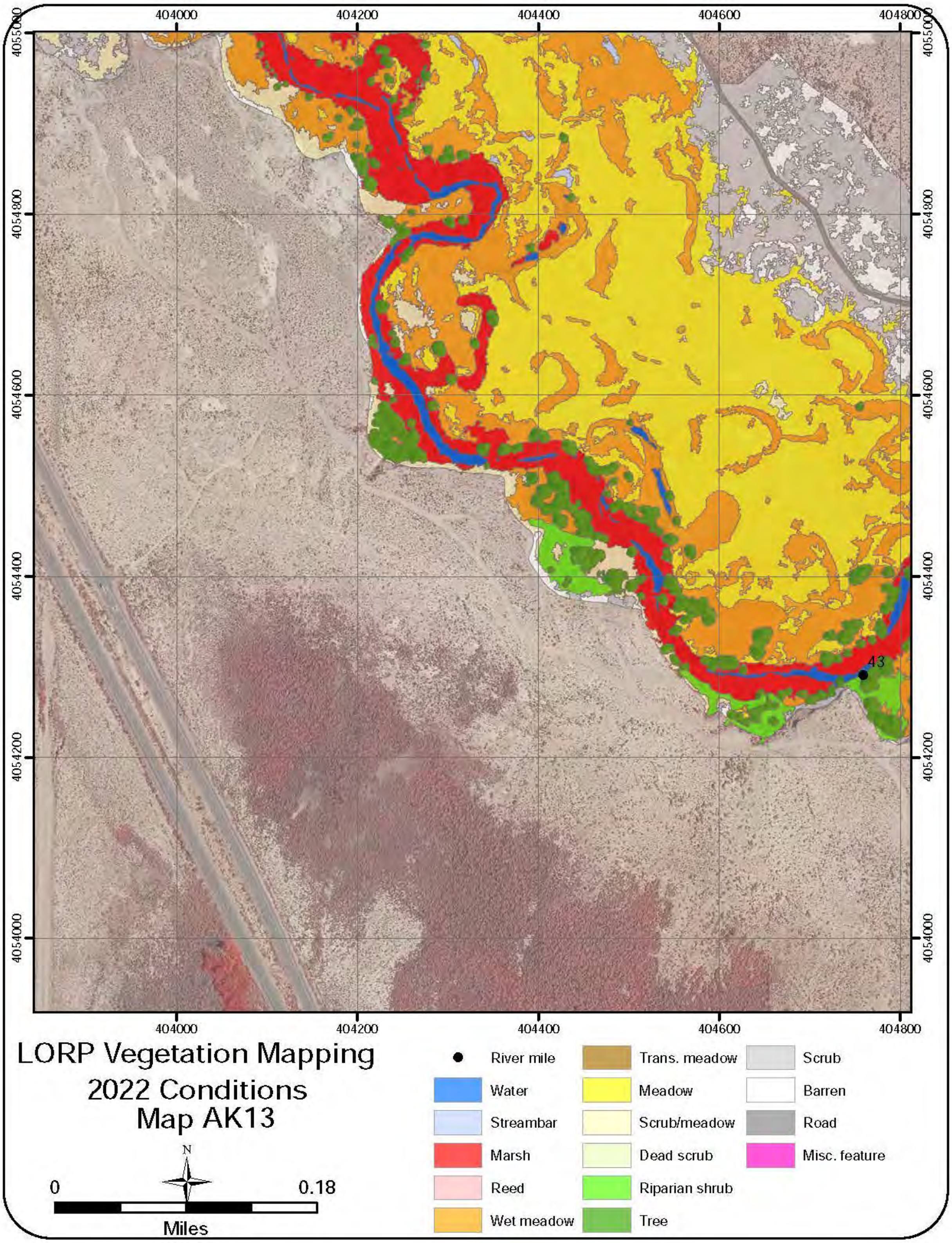
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AK13
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
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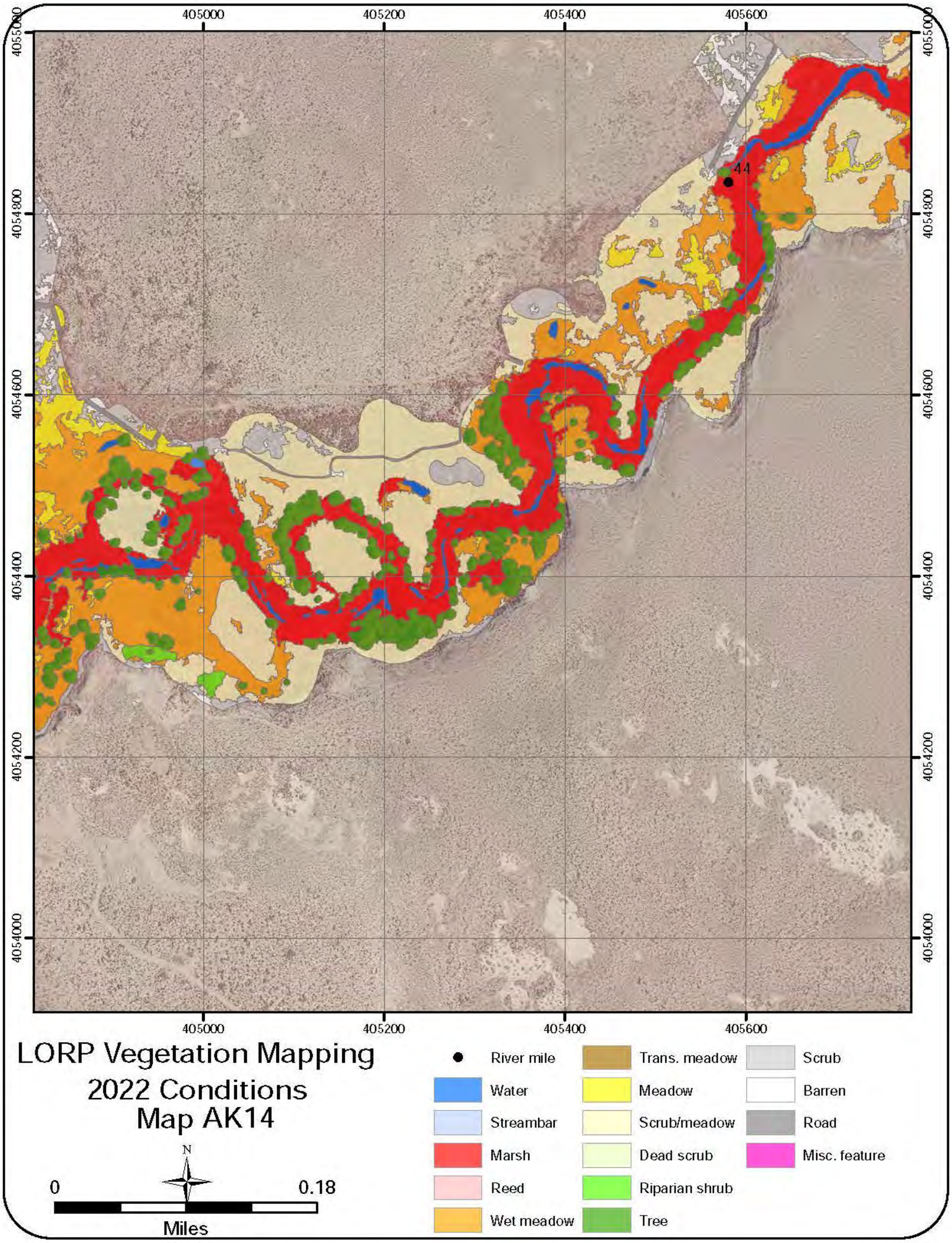
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AK14
N
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0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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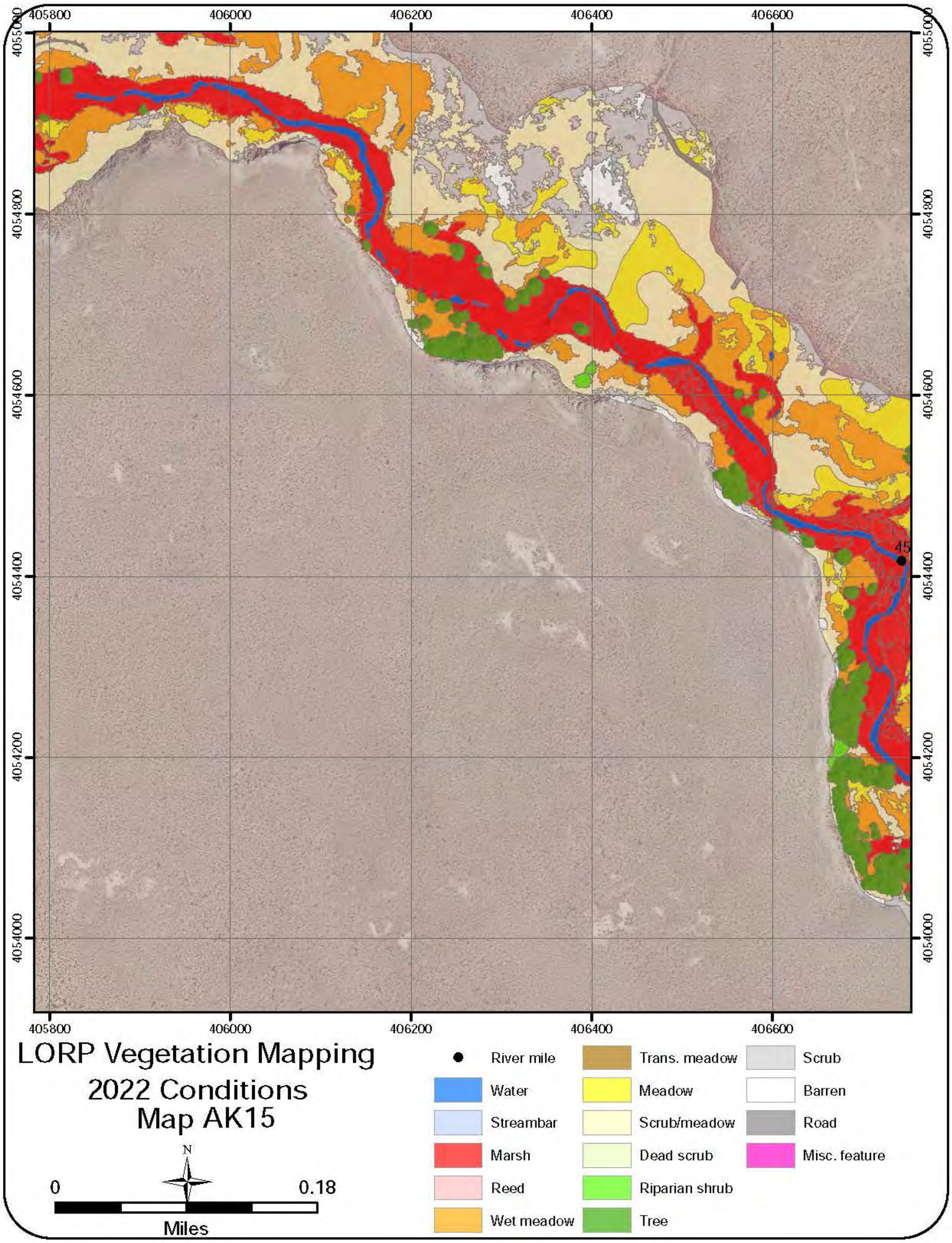
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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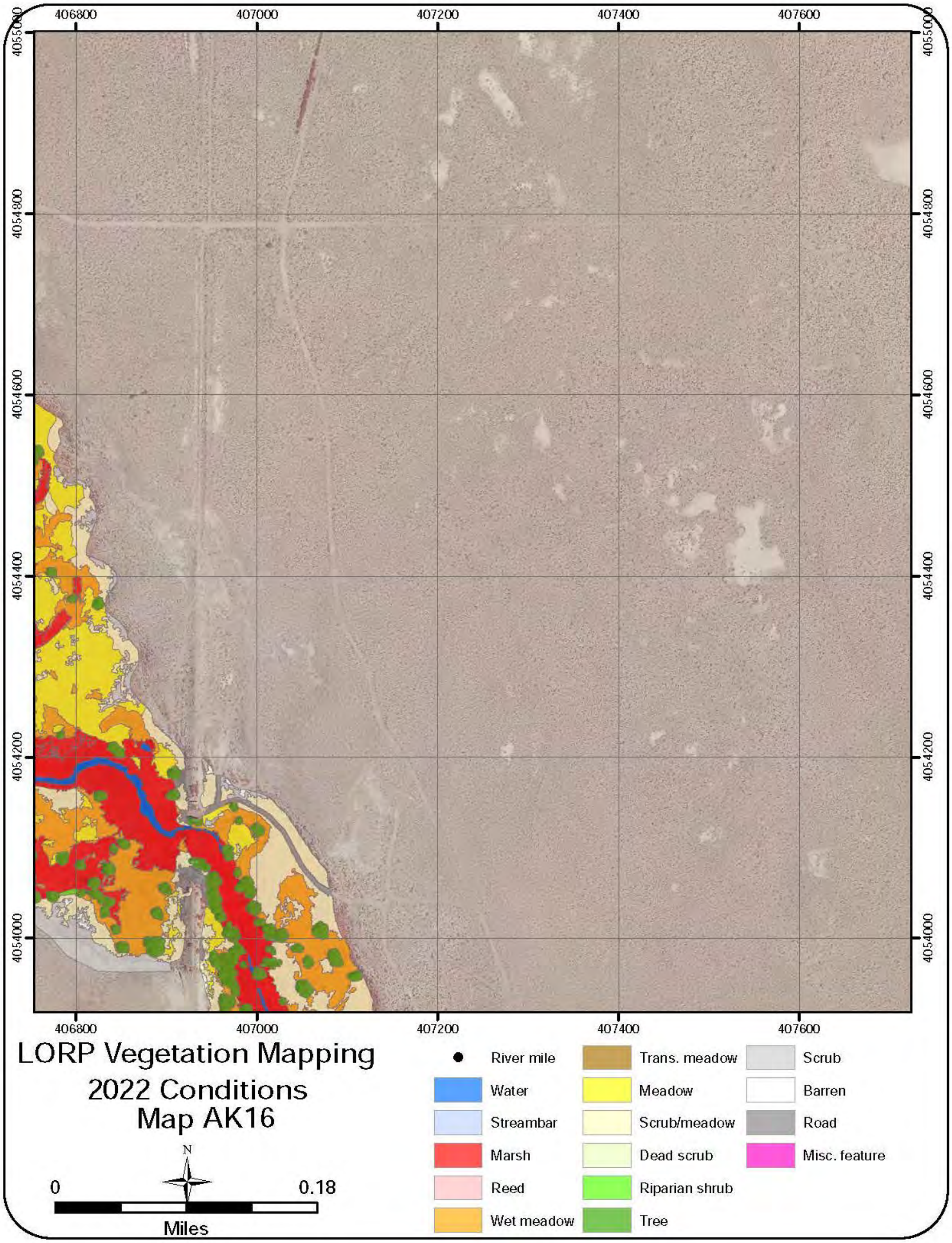
LORP Vegetation Mapping
2022 Conditions
Map AK15
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AK16
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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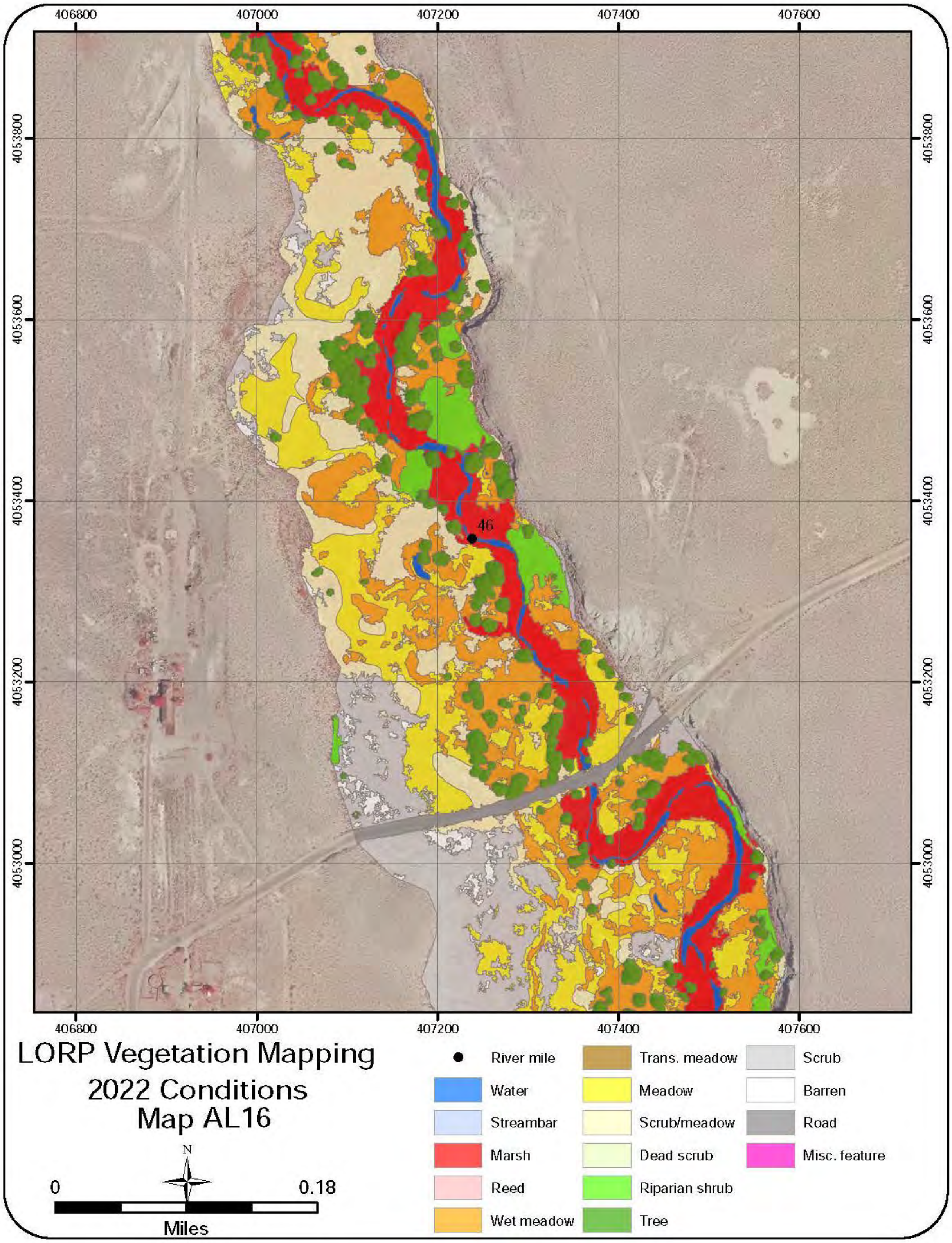
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AL16
N
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0.18
Miles
River mile
Water
Streambar
Marsh
Reed
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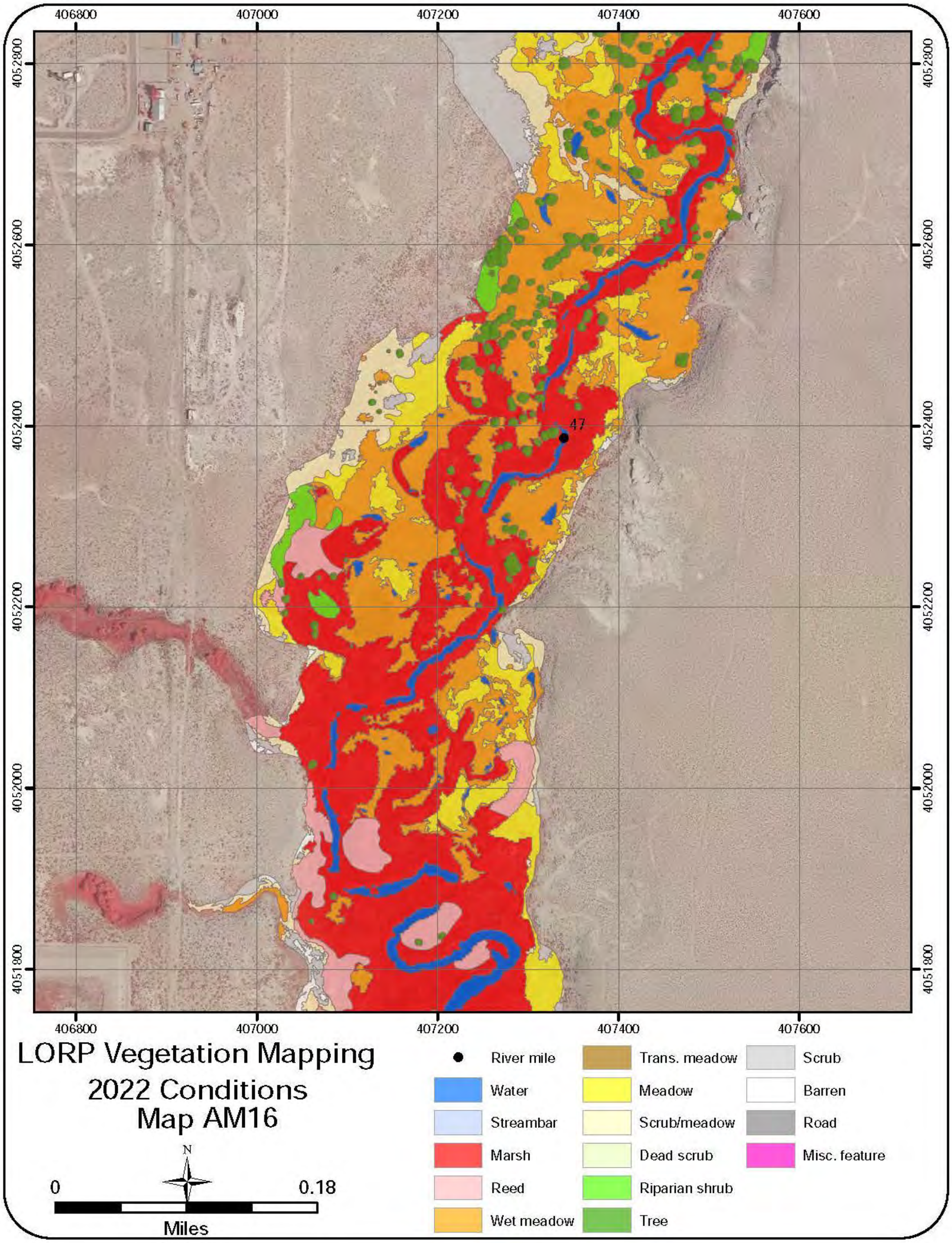
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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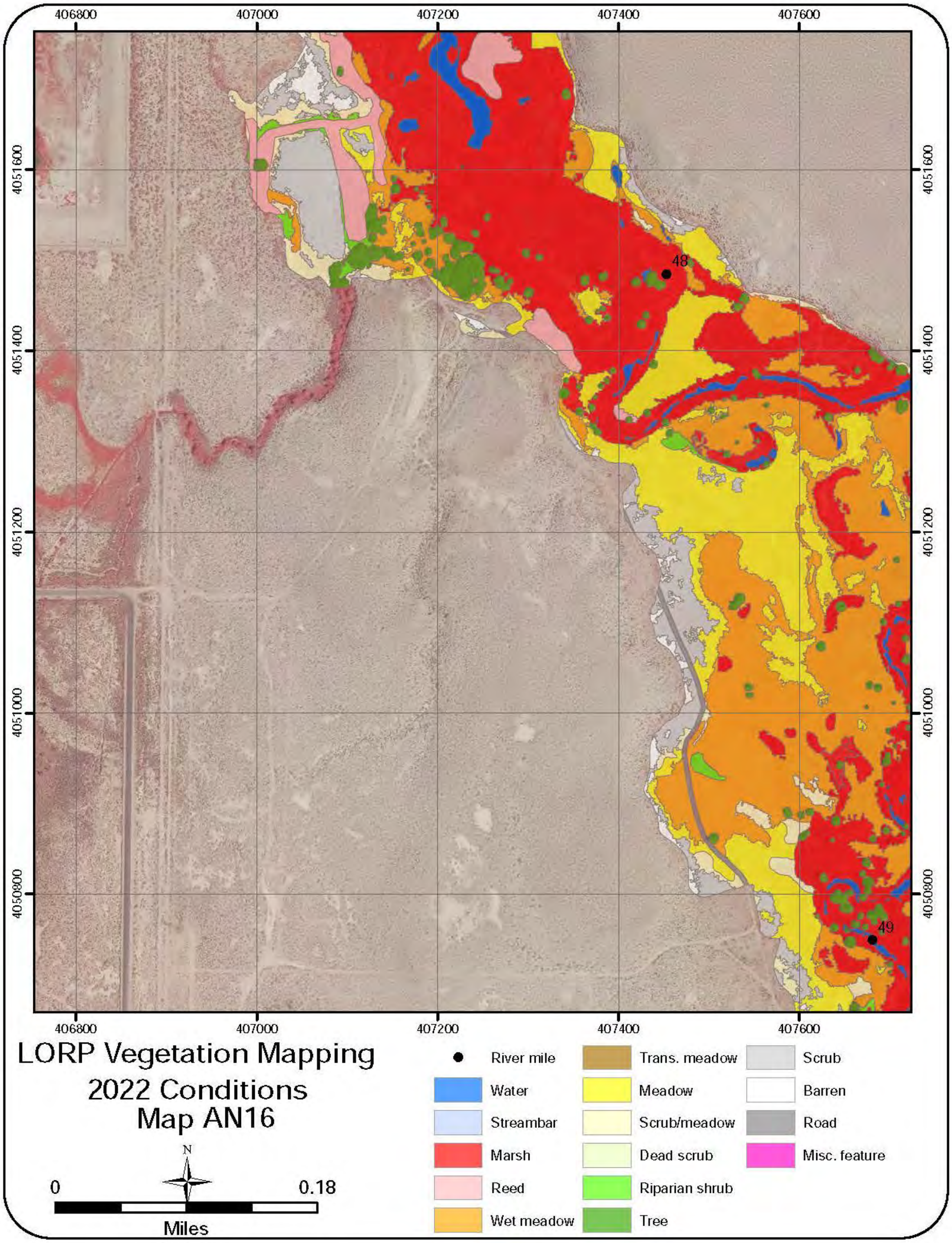
LORP Vegetation Mapping
2022 Conditions
Map AM16
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AN16
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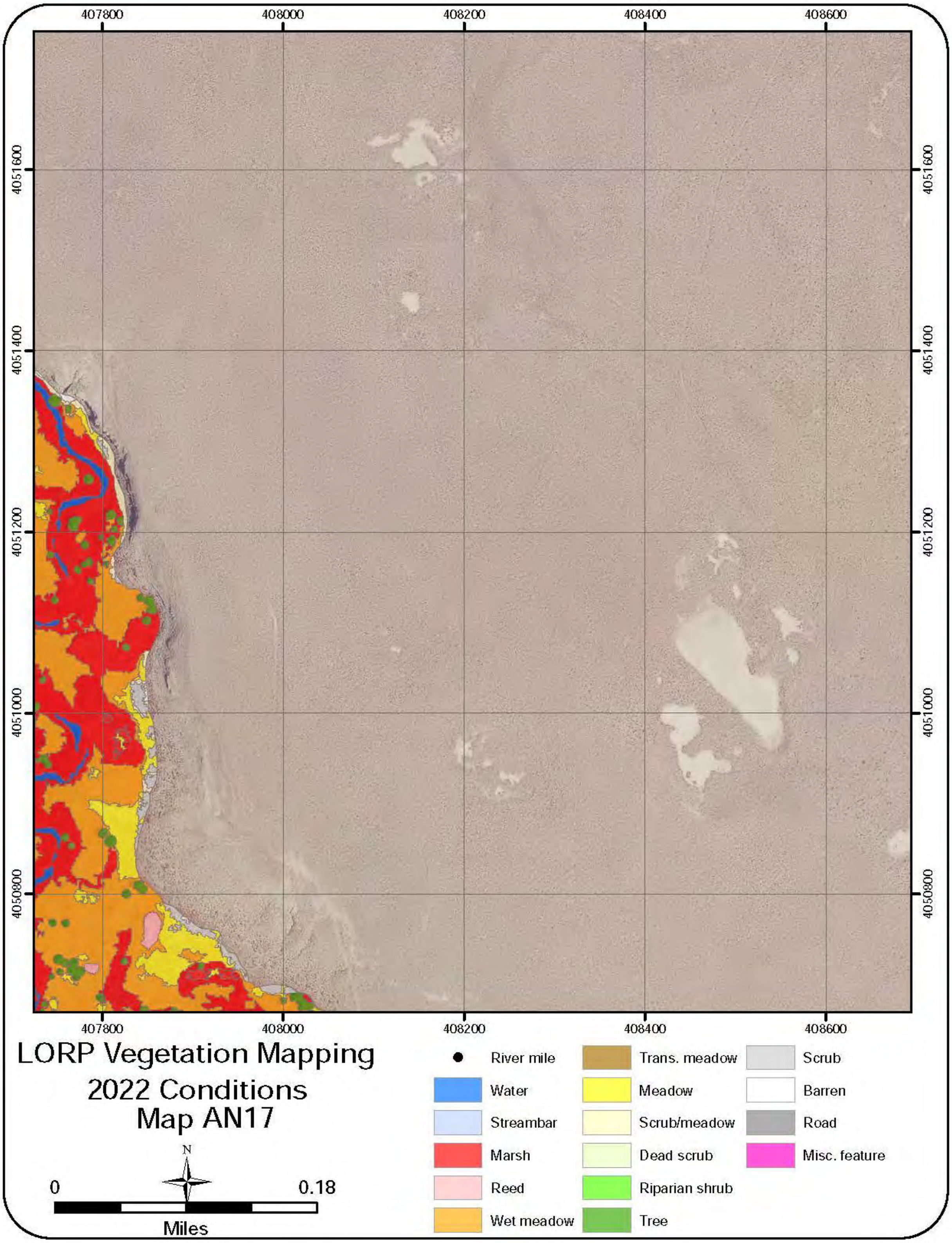
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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4051000
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LORP Vegetation Mapping
2022 Conditions
Map AN17
N
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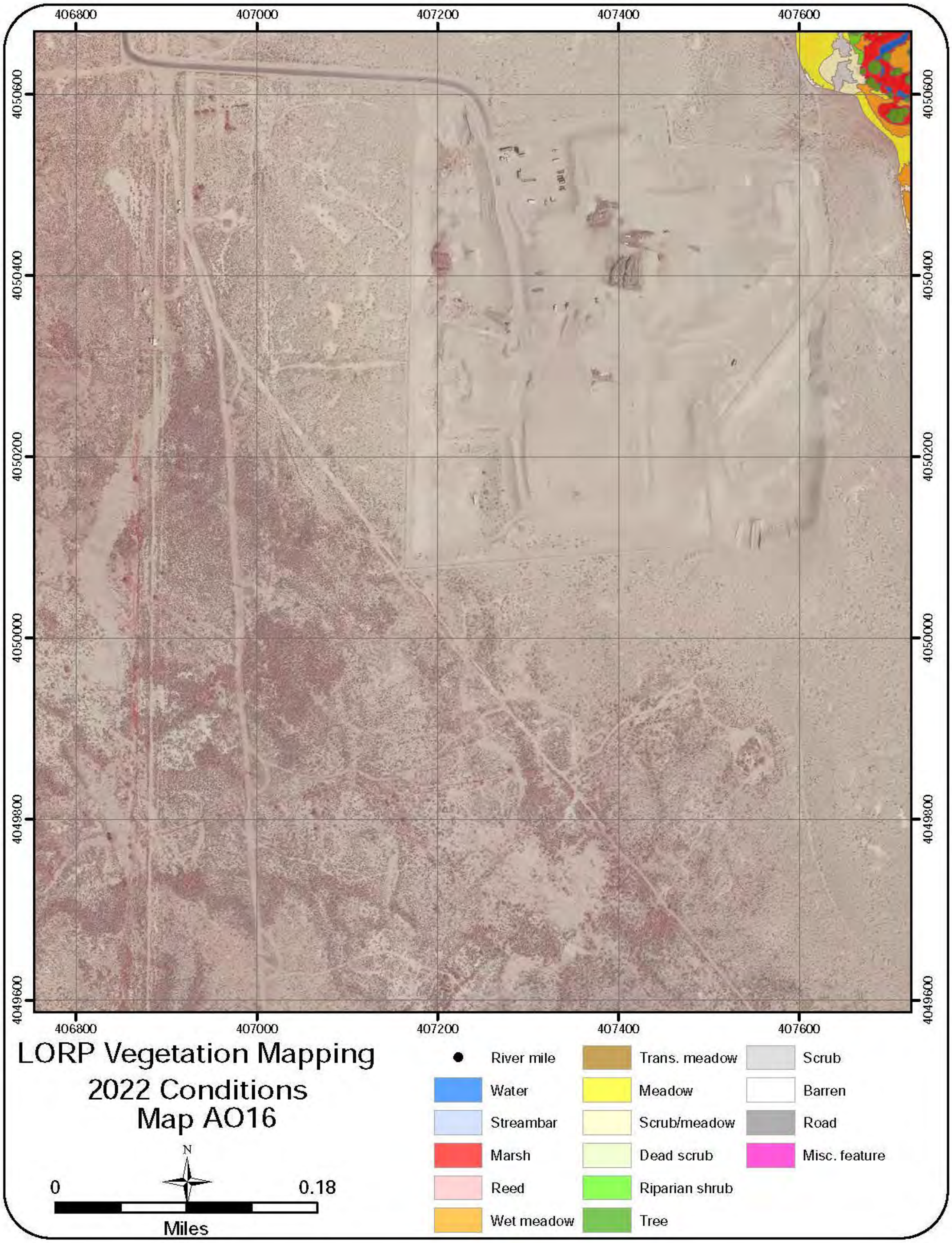
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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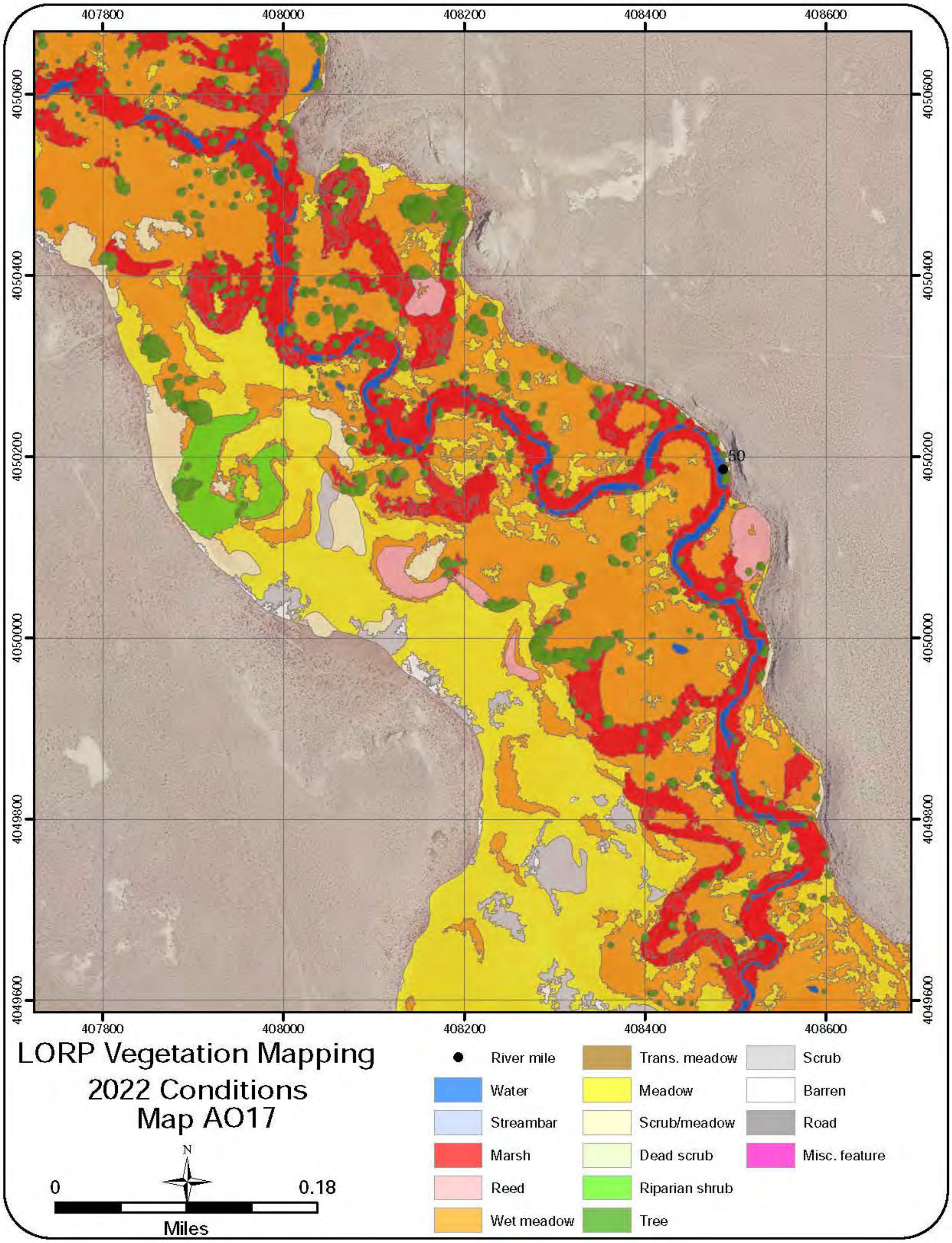
LORP Vegetation Mapping
2022 Conditions
Map AO16
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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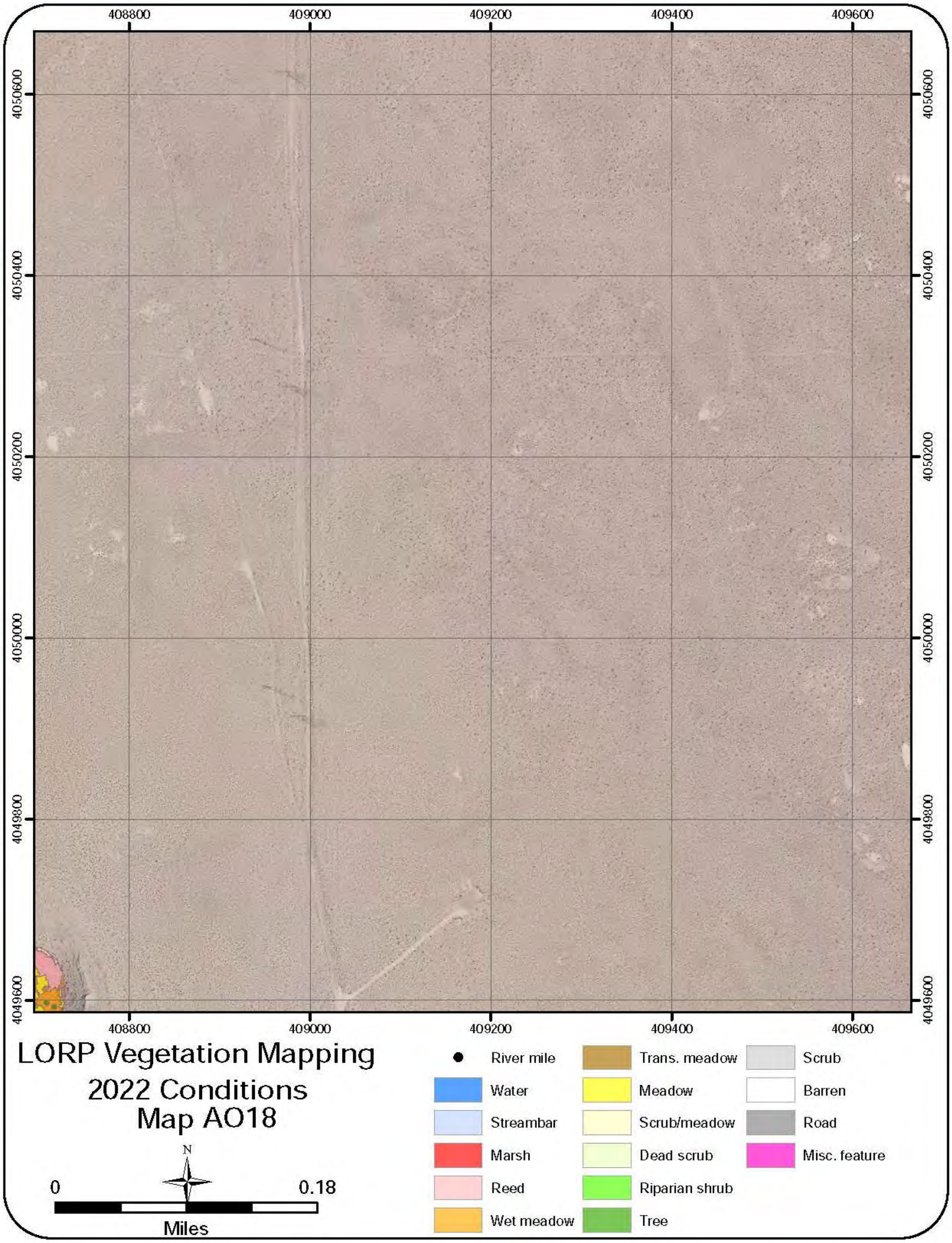
LORP Vegetation Mapping
2022 Conditions
Map AO17
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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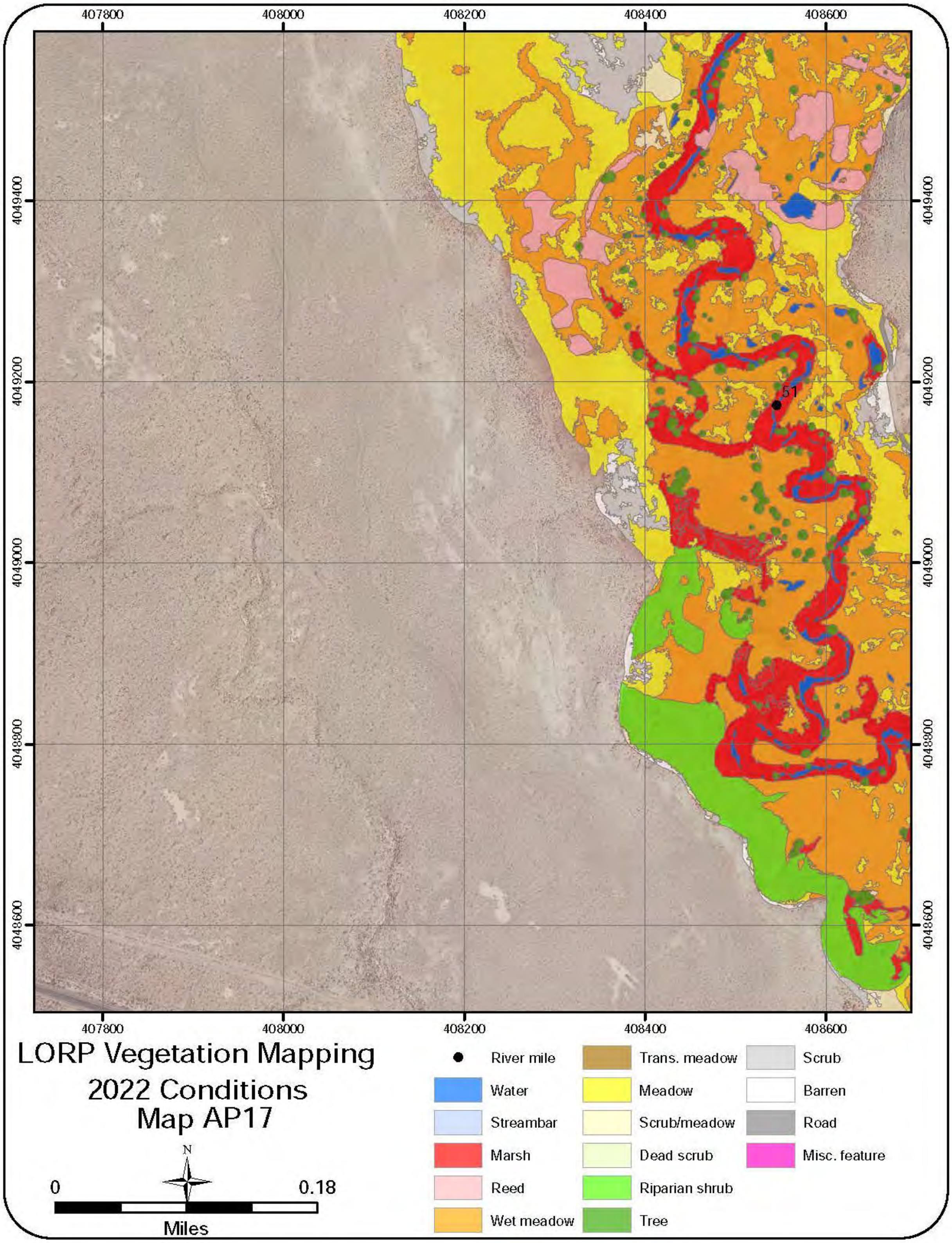
2022 Conditions
Map AO18
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map AP17
N
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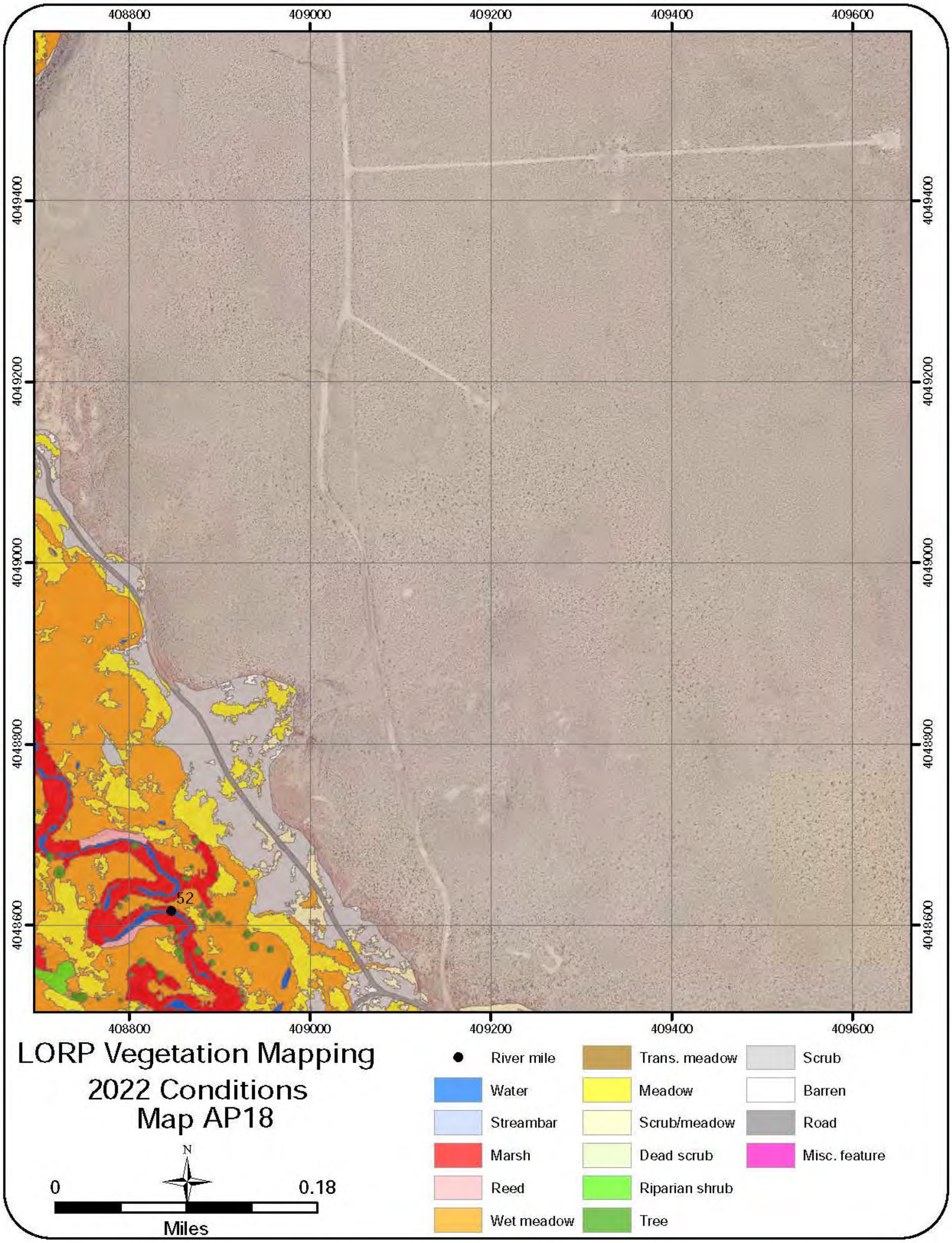
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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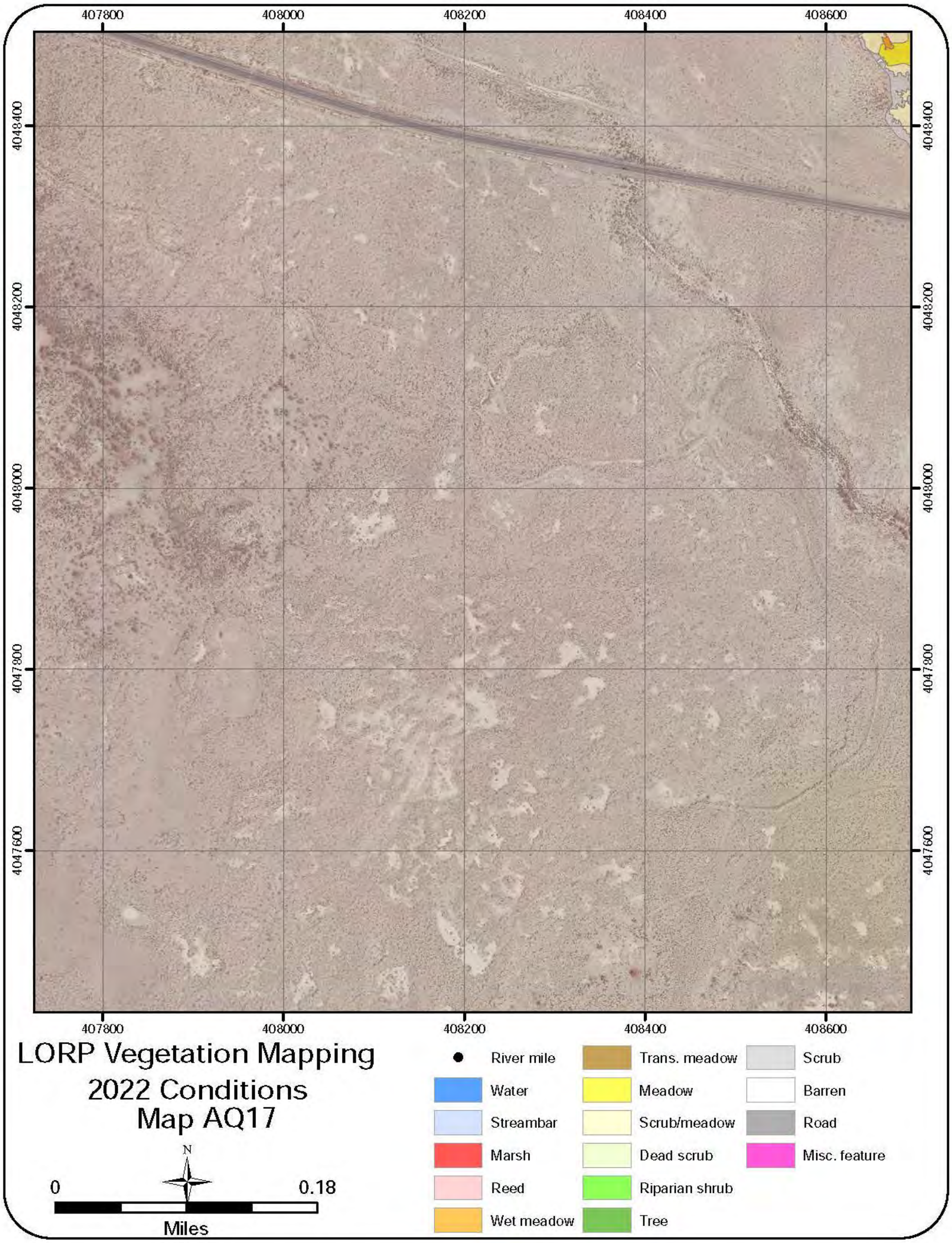
4048600
52
LORP Vegetation Mapping
2022 Conditions
Map AP18
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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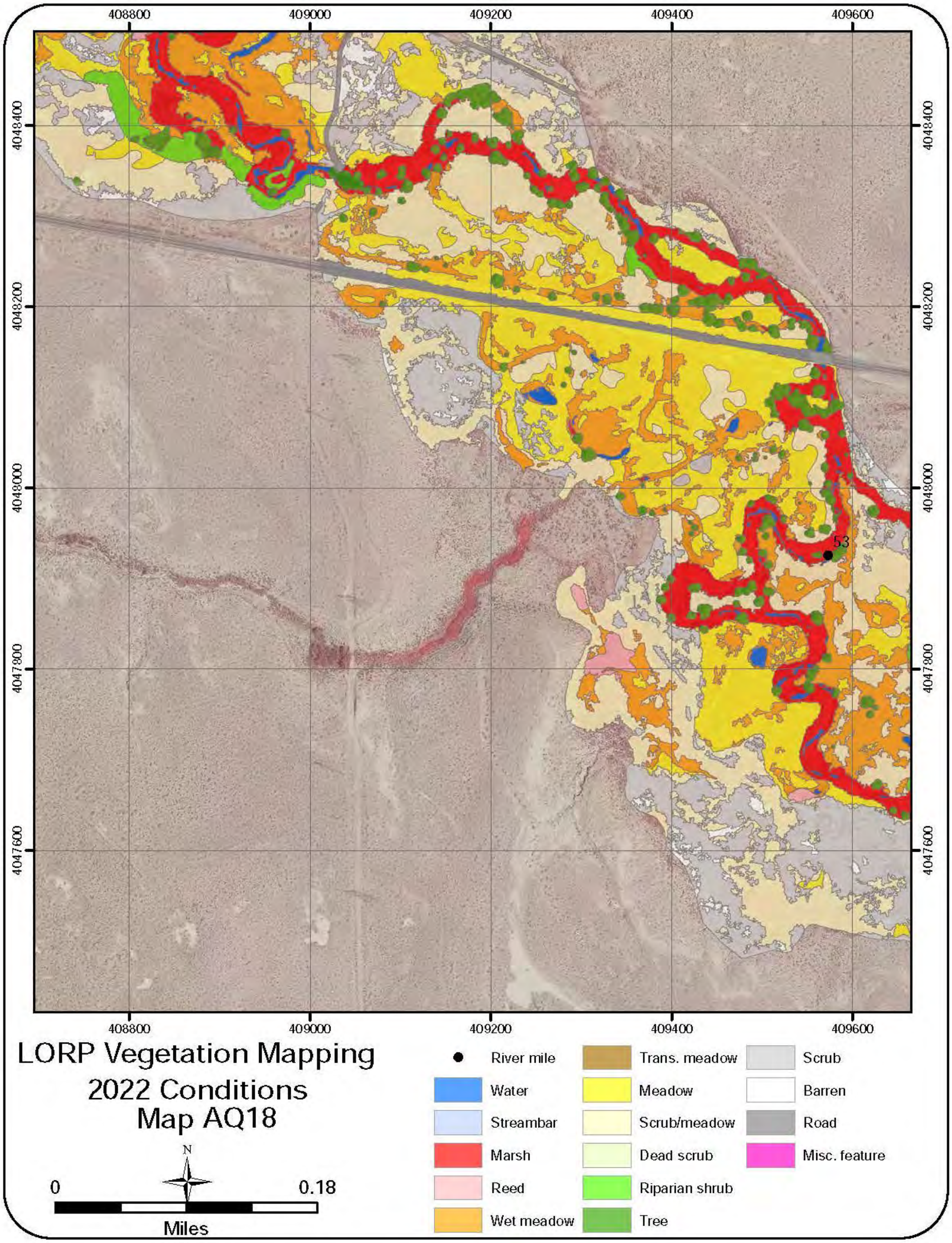
LORP Vegetation Mapping
2022 Conditions
Map AQ17
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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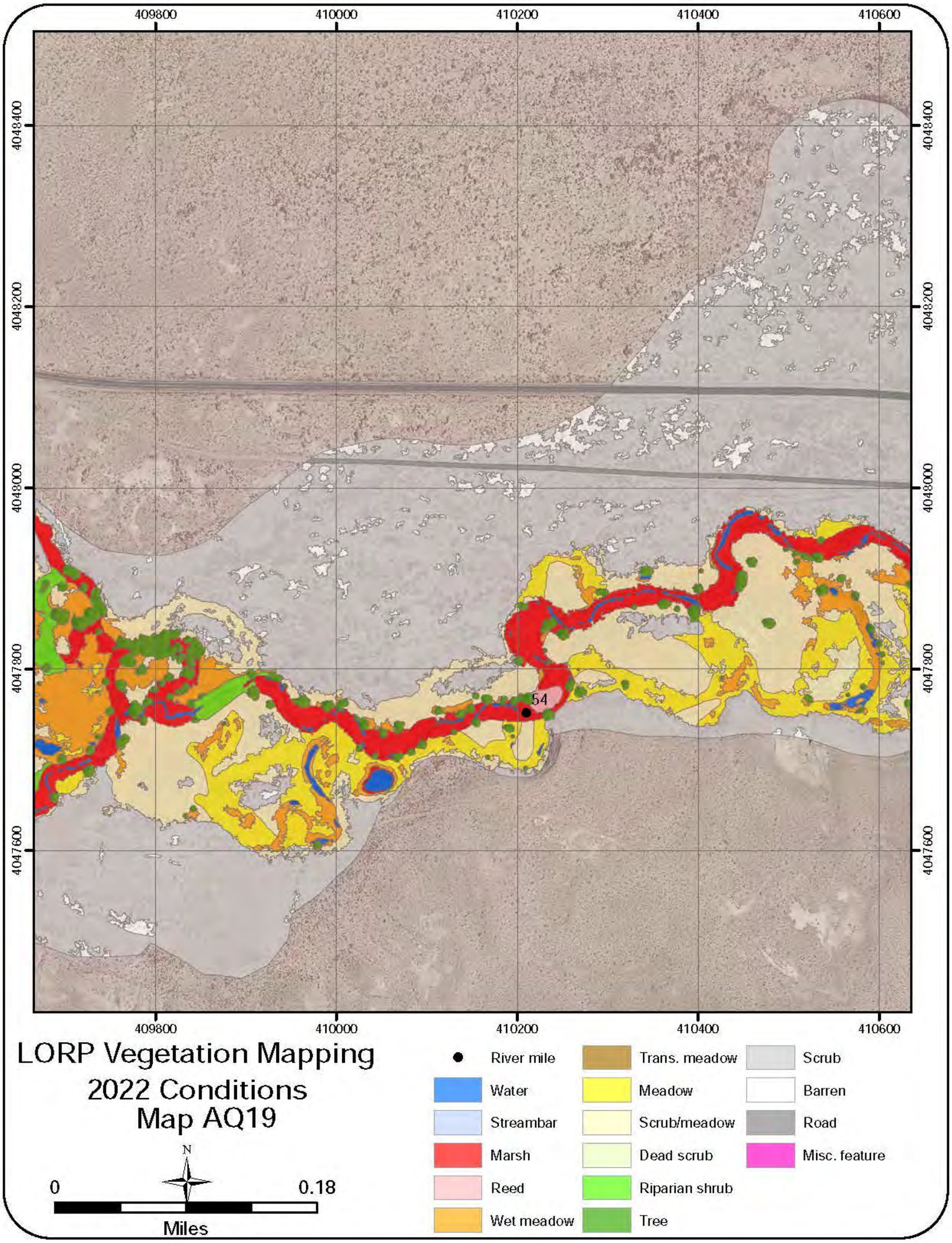
4048000
4047800
4047600
53
LORP Vegetation Mapping
2022 Conditions
Map AQ18
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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410400
410600
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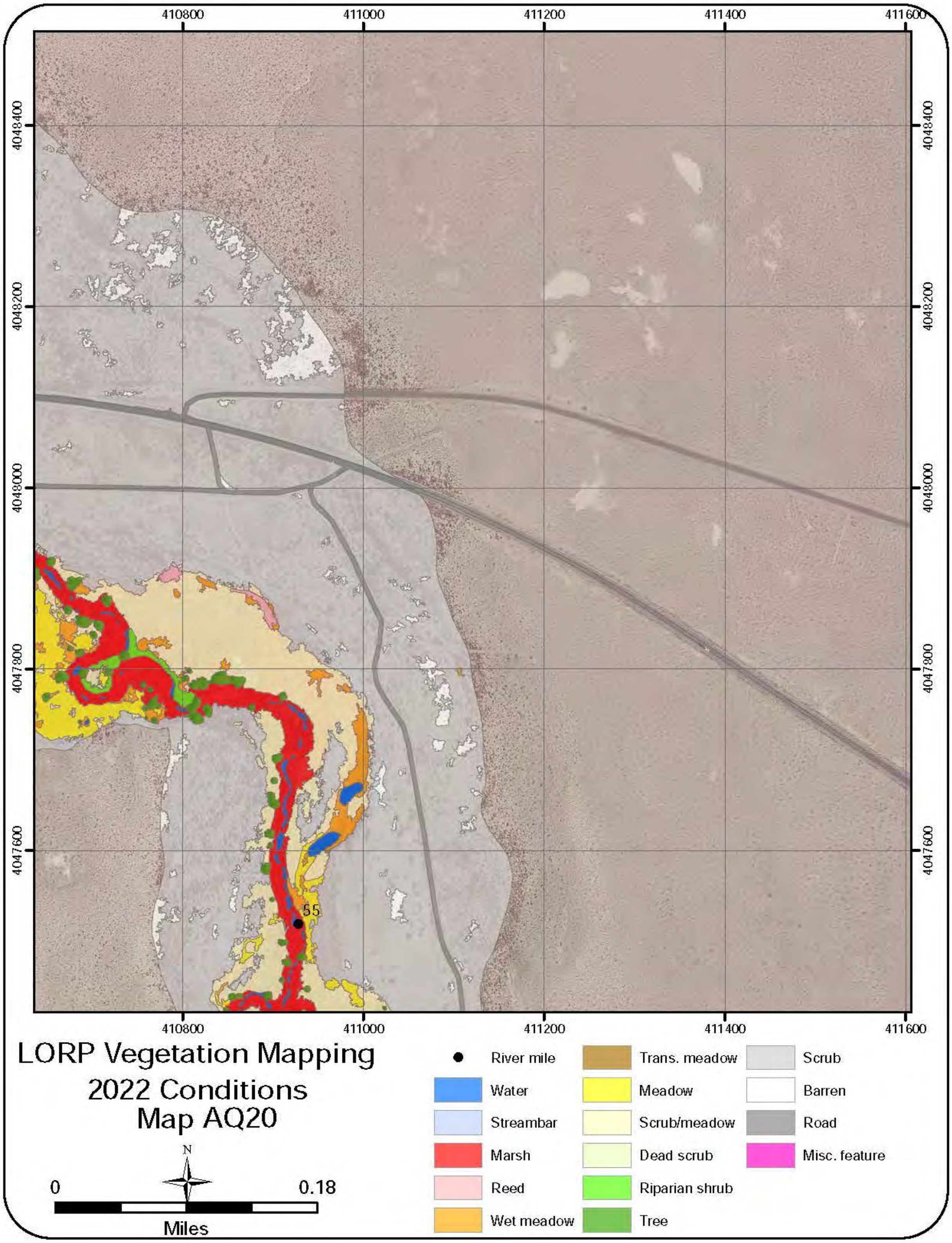
4048200
4048000
4047800
4047600
54
LORP Vegetation Mapping
2022 Conditions
Map AQ19
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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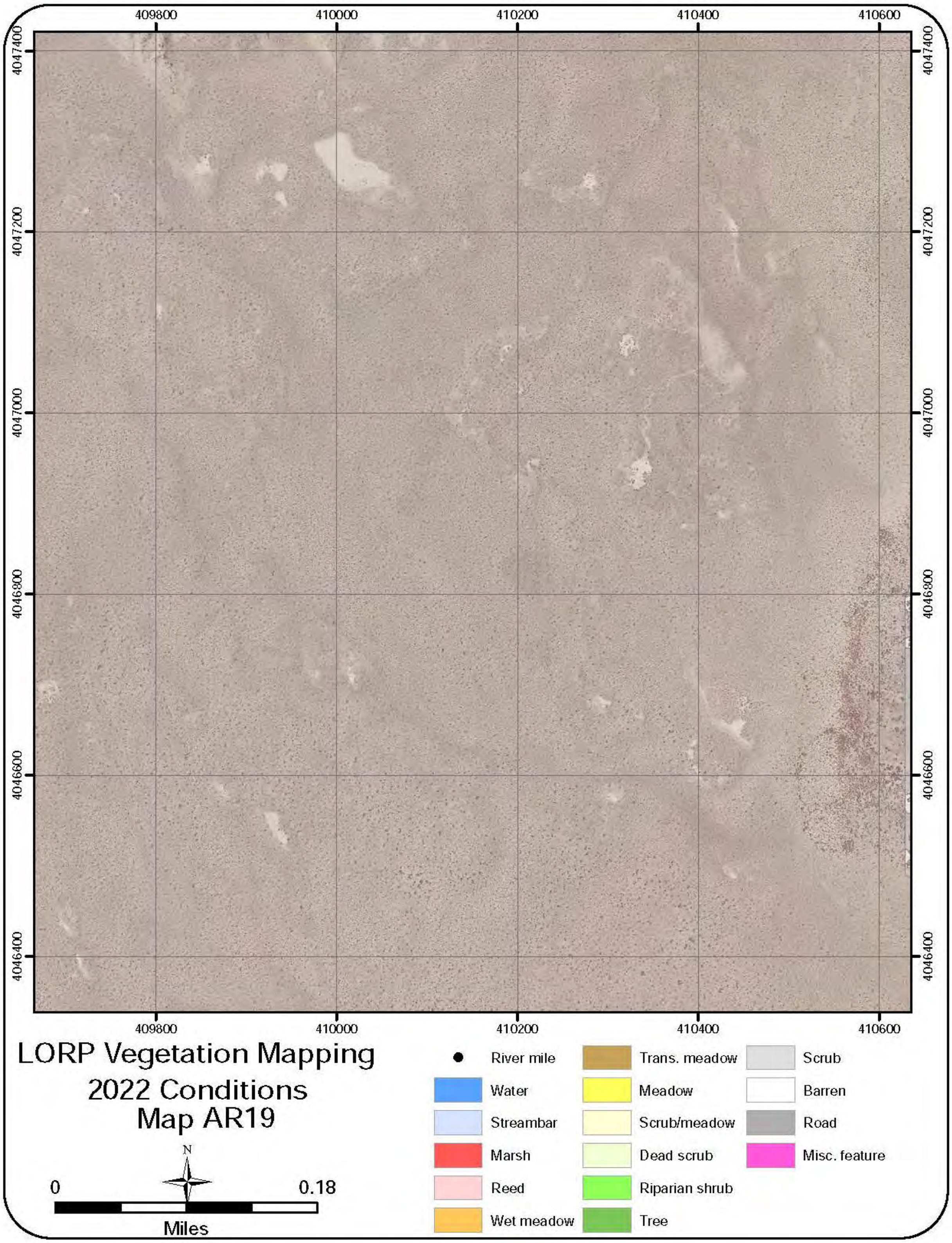
4047800
4047600
55
LORP Vegetation Mapping
2022 Conditions
Map AQ20
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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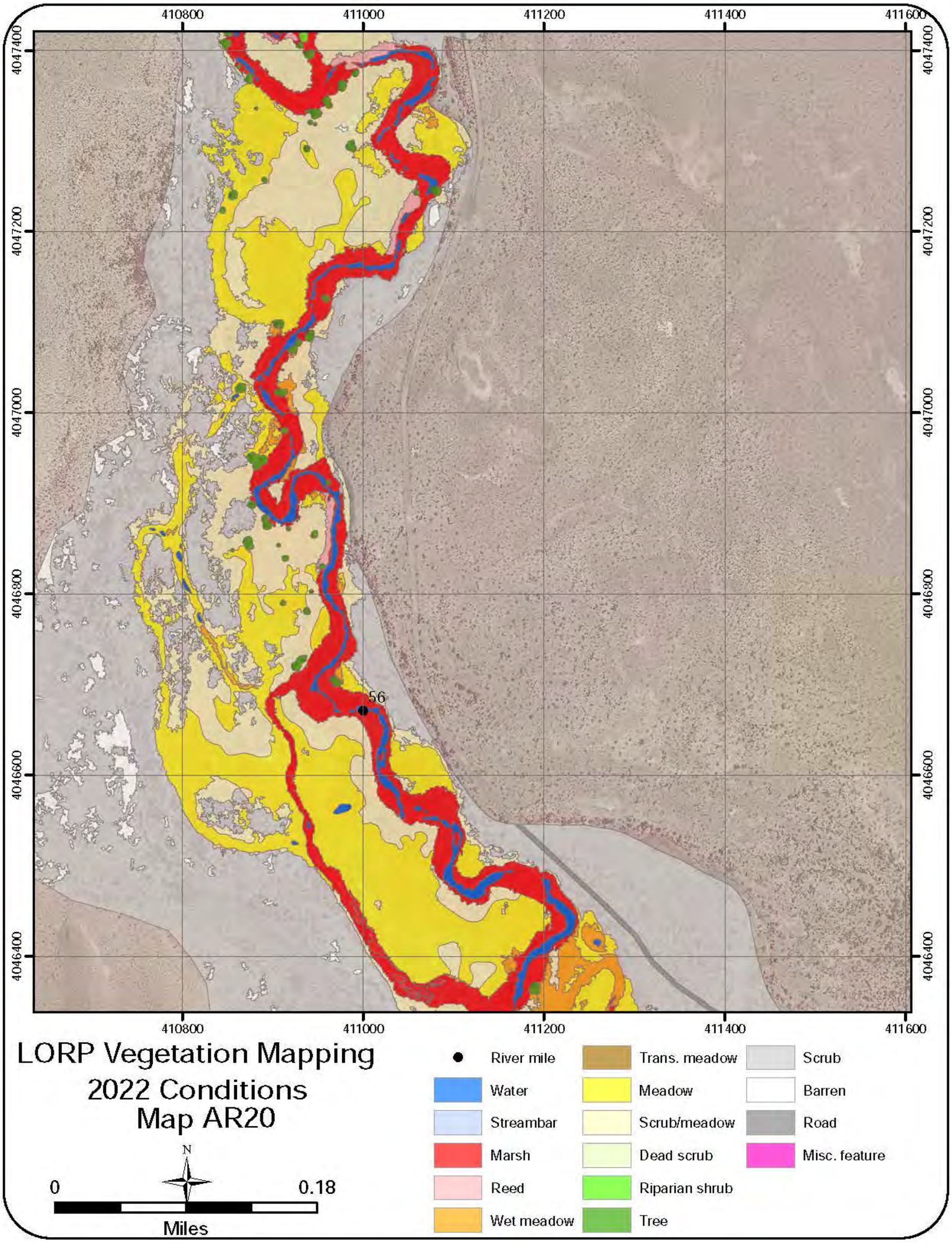
4046400
LORP Vegetation Mapping
2022 Conditions
Map AR19
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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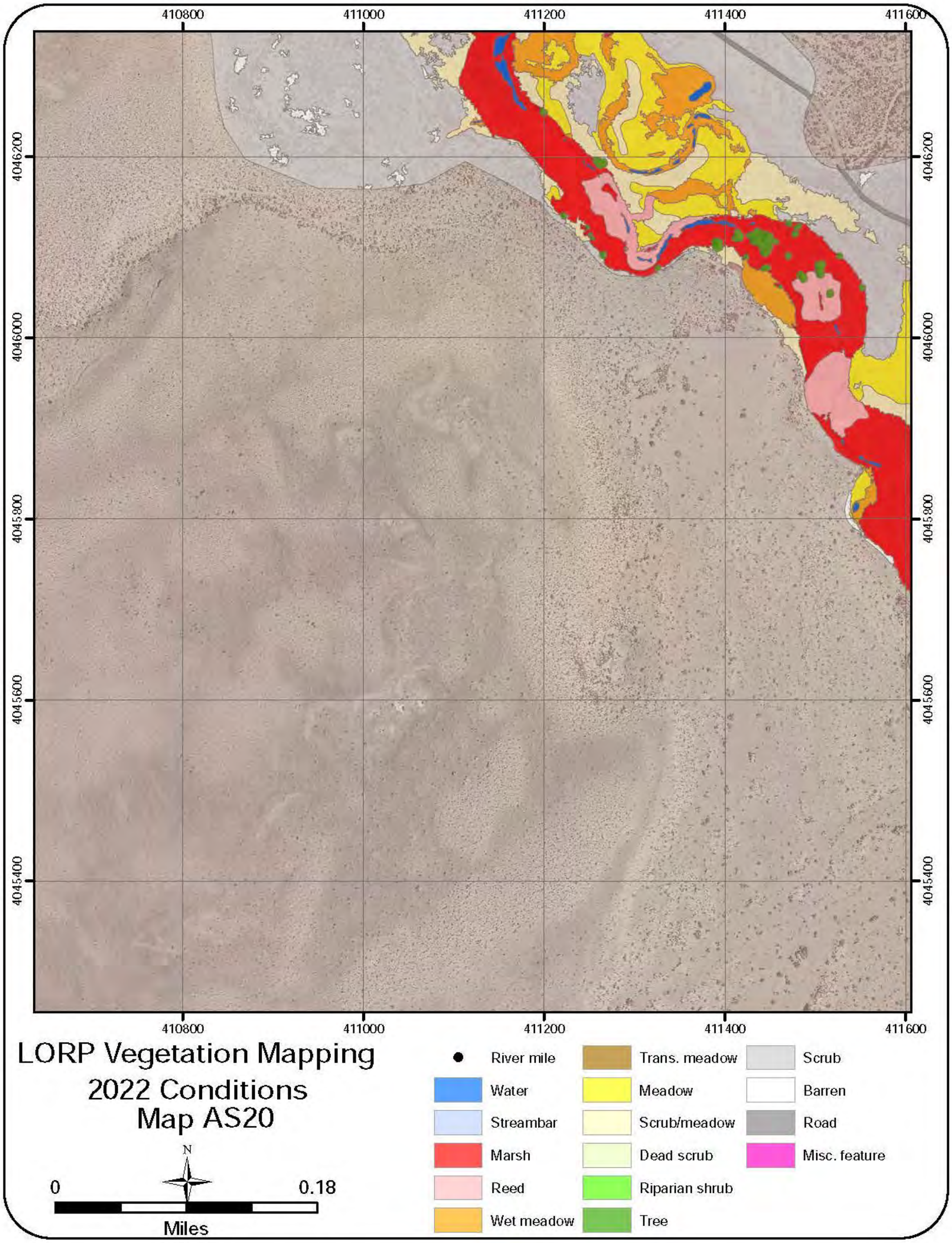
4046600
4046400
56
LORP Vegetation Mapping
2022 Conditions
Map AR20
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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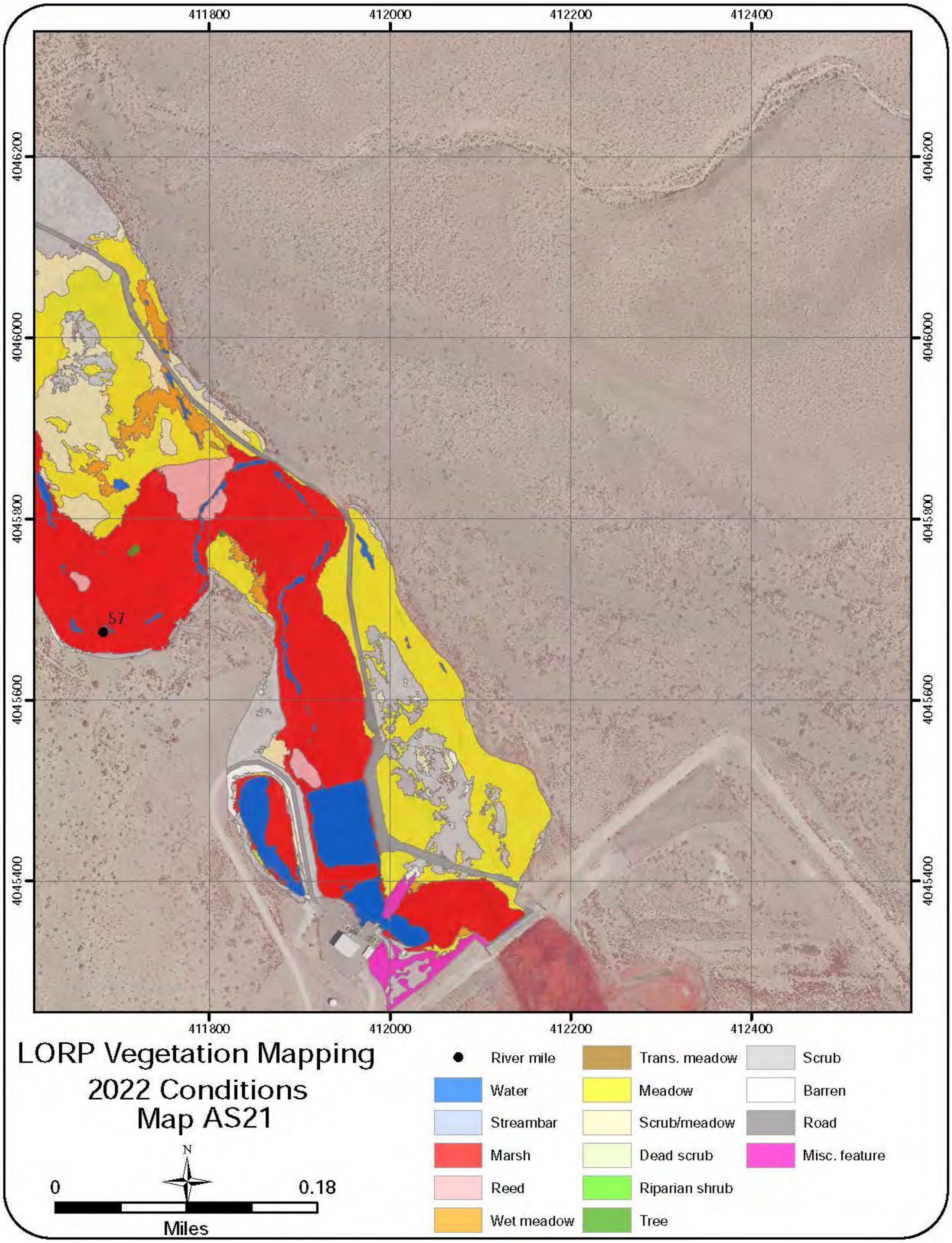
LORP Vegetation Mapping
2022 Conditions
Map AS20
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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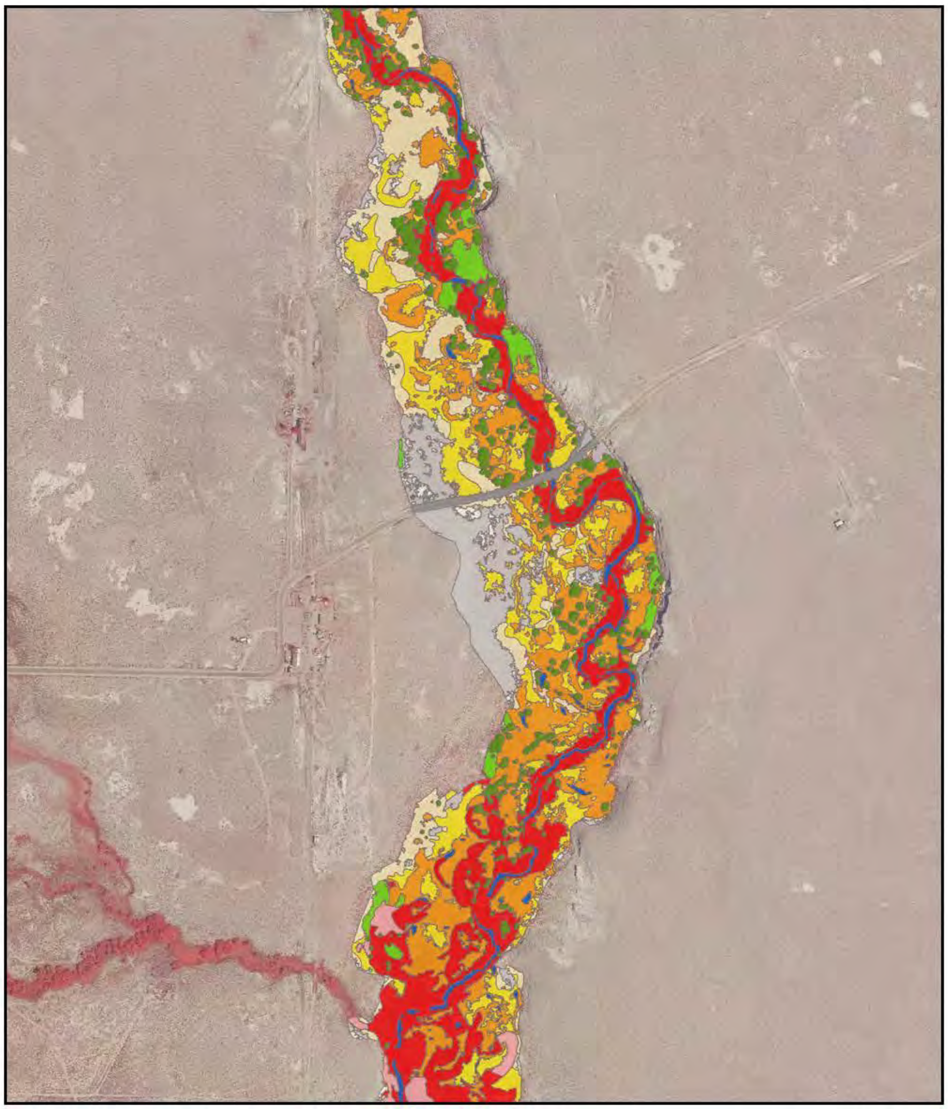
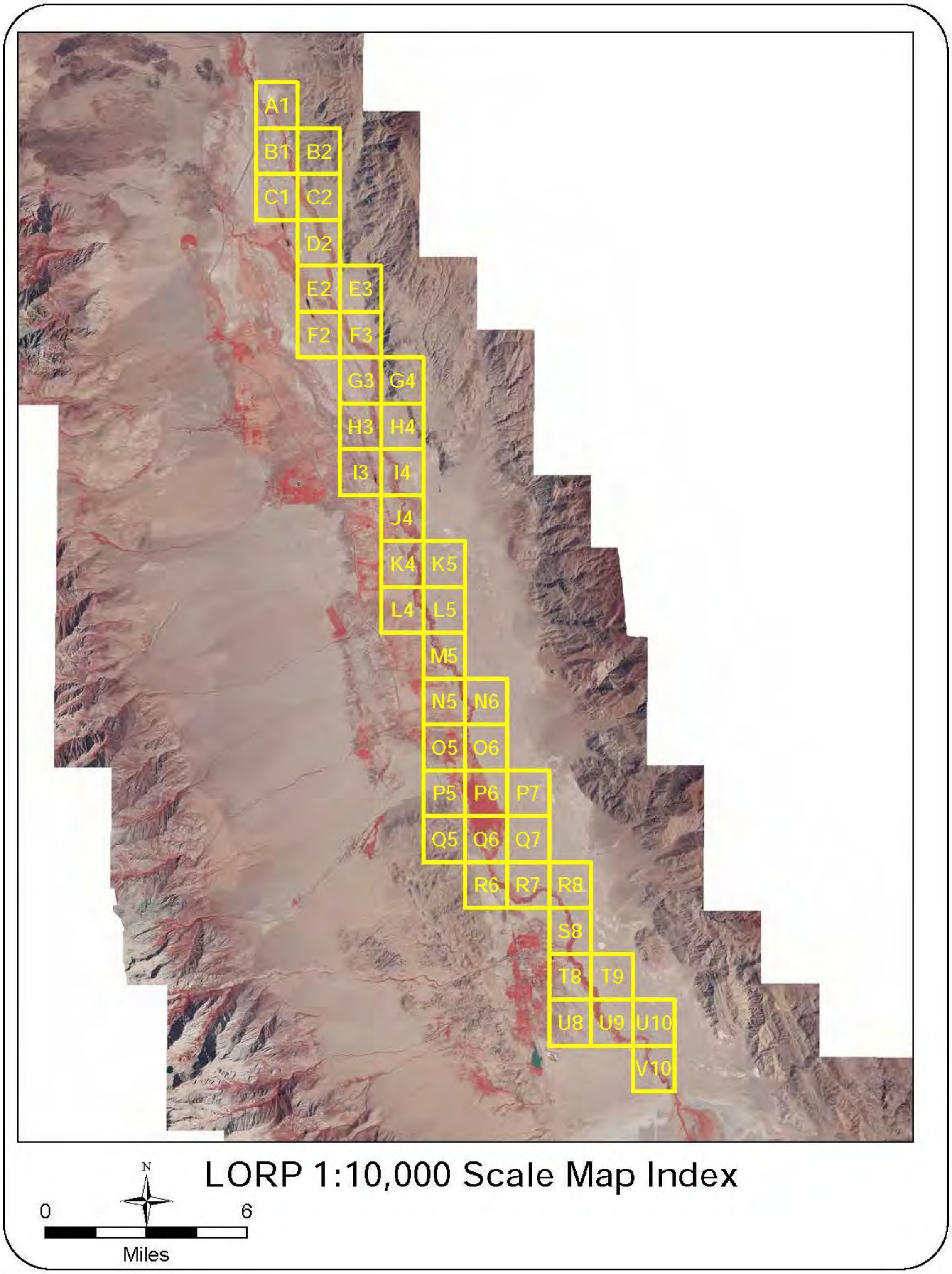
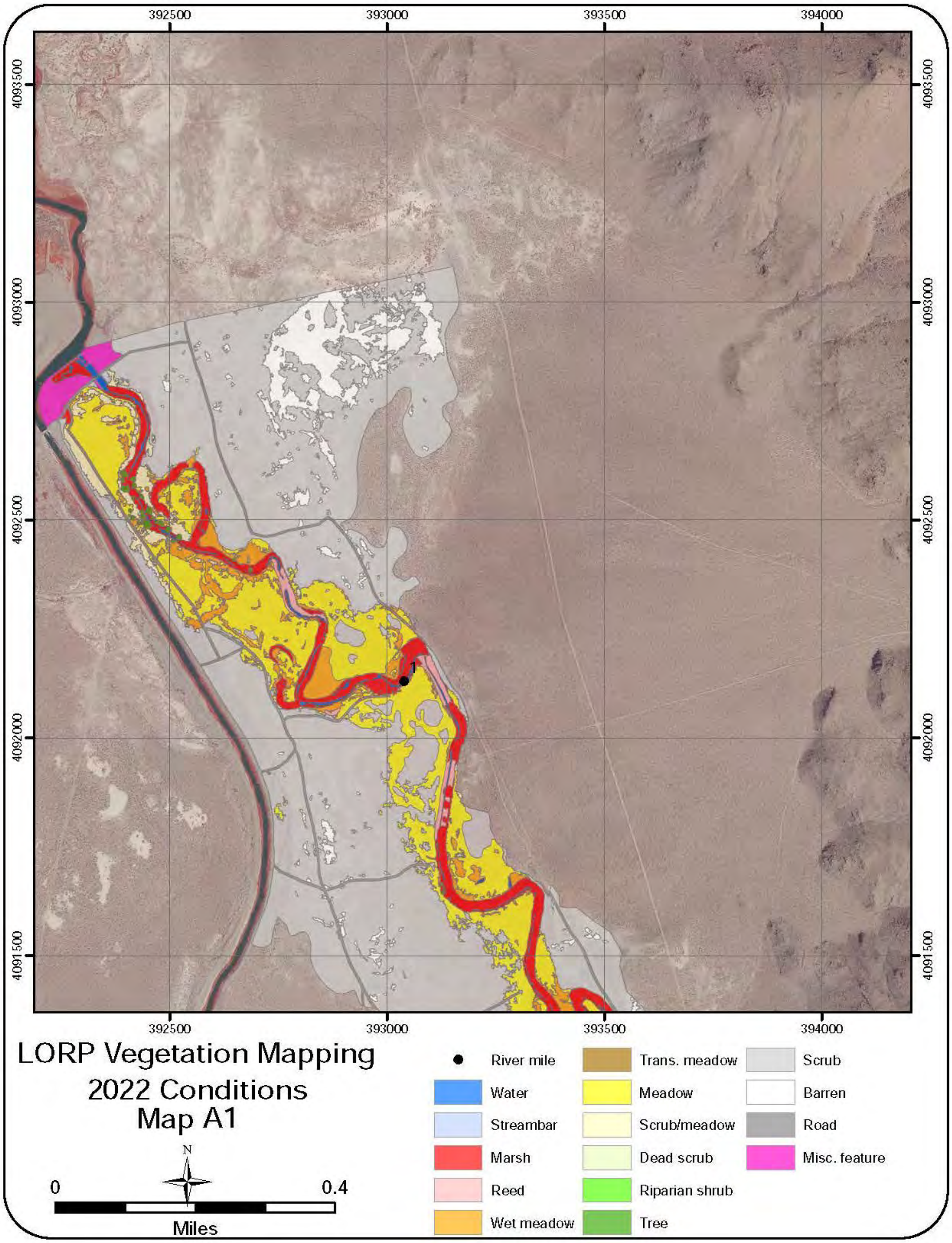
LORP Vegetation Mapping
2022 Conditions
Map AS21
N
0
0.18
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature

3.4.2 Appendix C.

APPENDIX C
LORP Vegetation
2022 Conditions
1:10,000 Scale




A1
B1
B2
C1
C2
D2
E2
E3
F2
F3
G3
G4
H3
H4
I3
I4
J4
K4
K5
L4
L5
M5
N5
N6
O5
O6
P5
P6
P7
Q5
Q6
Q7
R6
R7
R8
S8
T8
T9
U8
U9
U10
V10
LORP 1:10,000 Scale Map Index
N
0
6
Miles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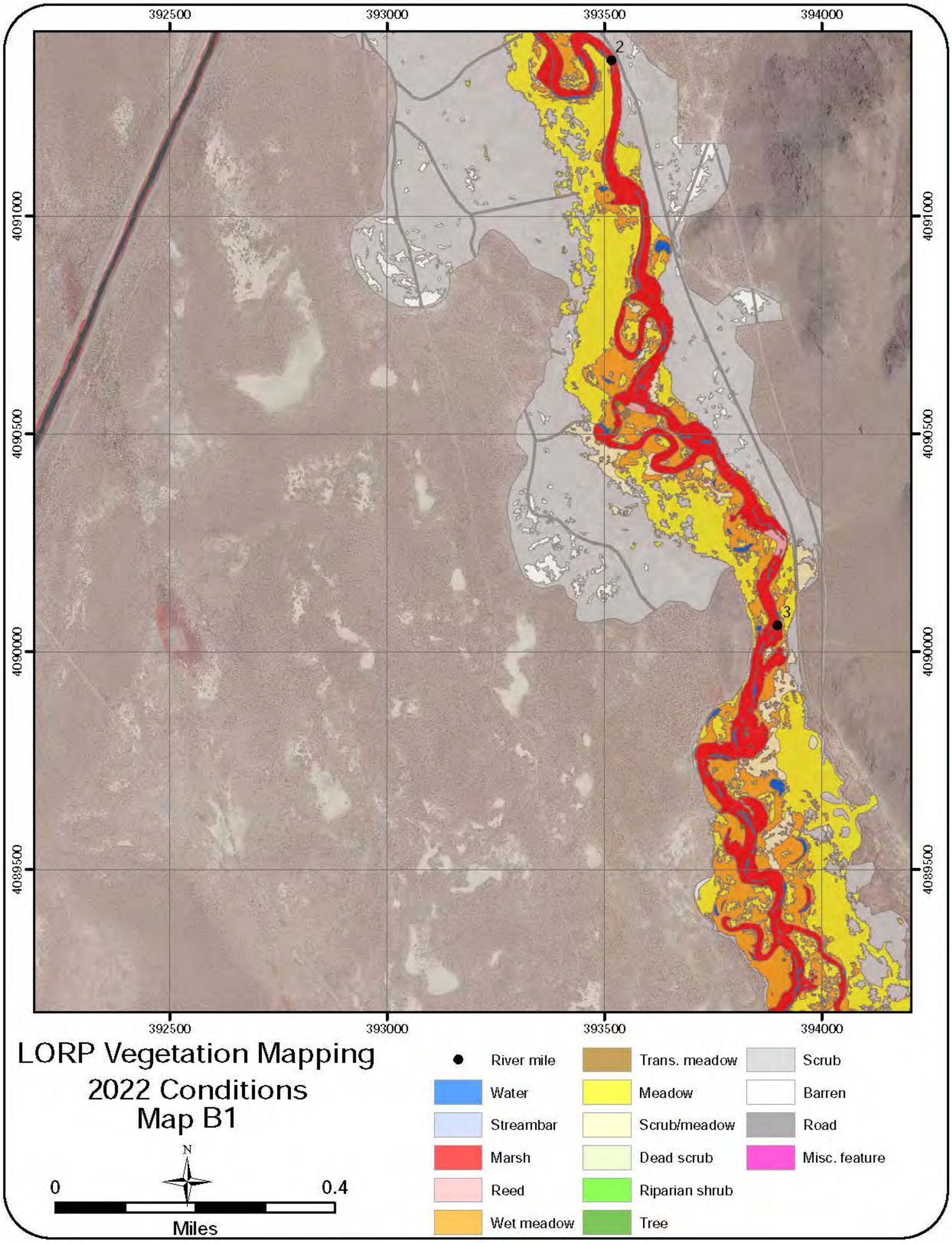
4092000
4091500
1
LORP Vegetation Mapping
2022 Conditions
Map A1
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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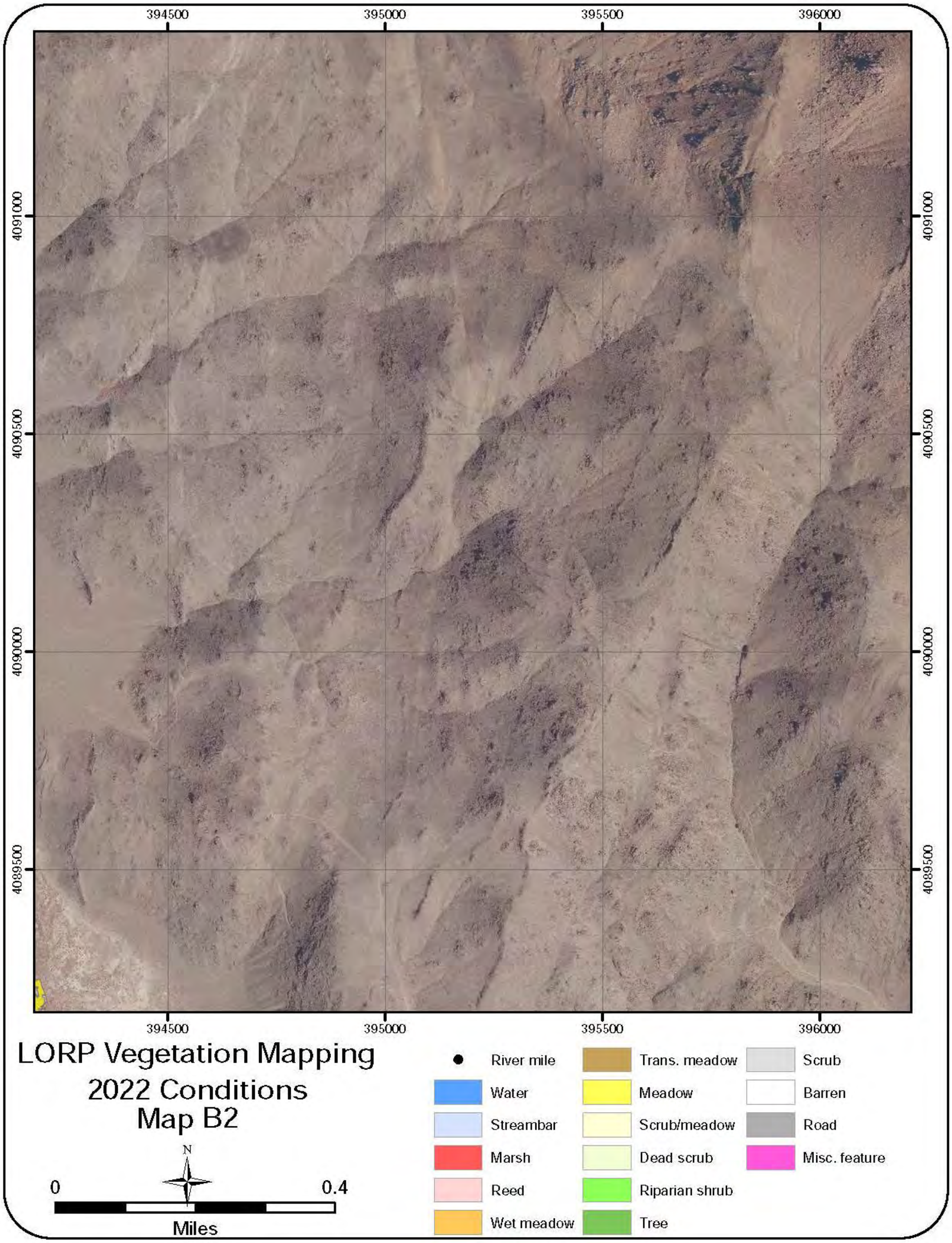
3
LORP Vegetation Mapping
2022 Conditions
Map B1
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map B2
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0.4
Miles
River mile
Water
Streambar
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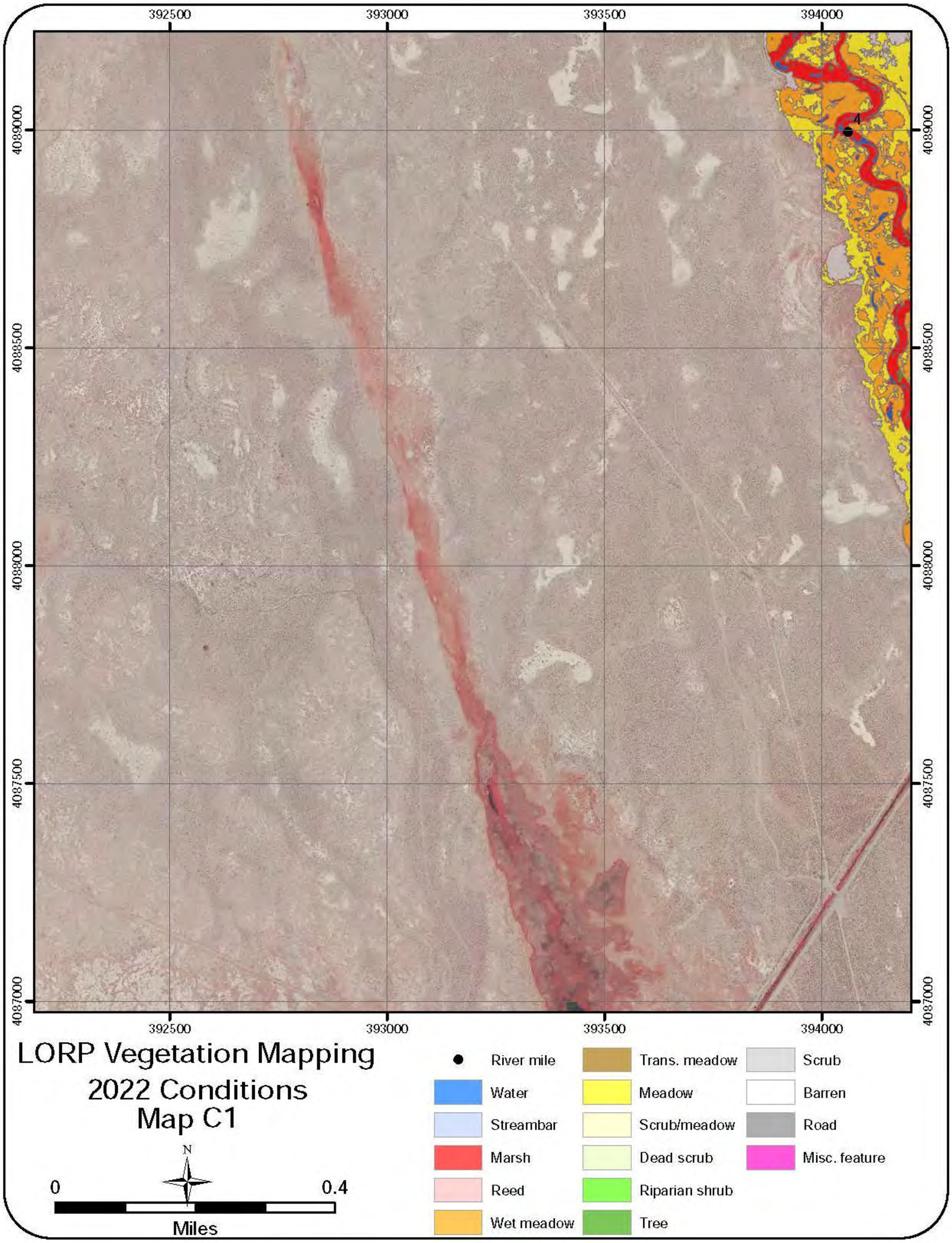
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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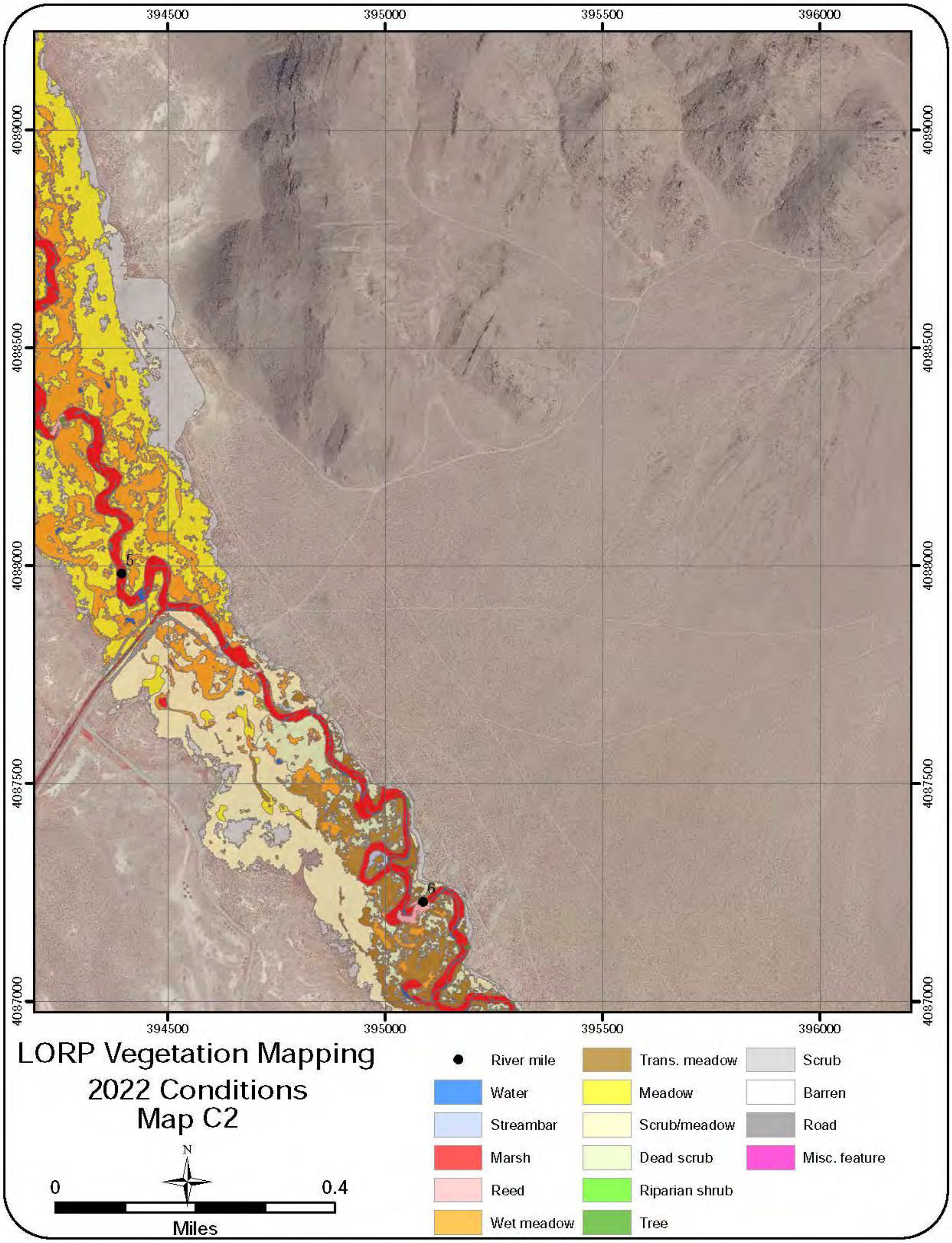
LORP Vegetation Mapping
2022 Conditions
Map C1
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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4087000
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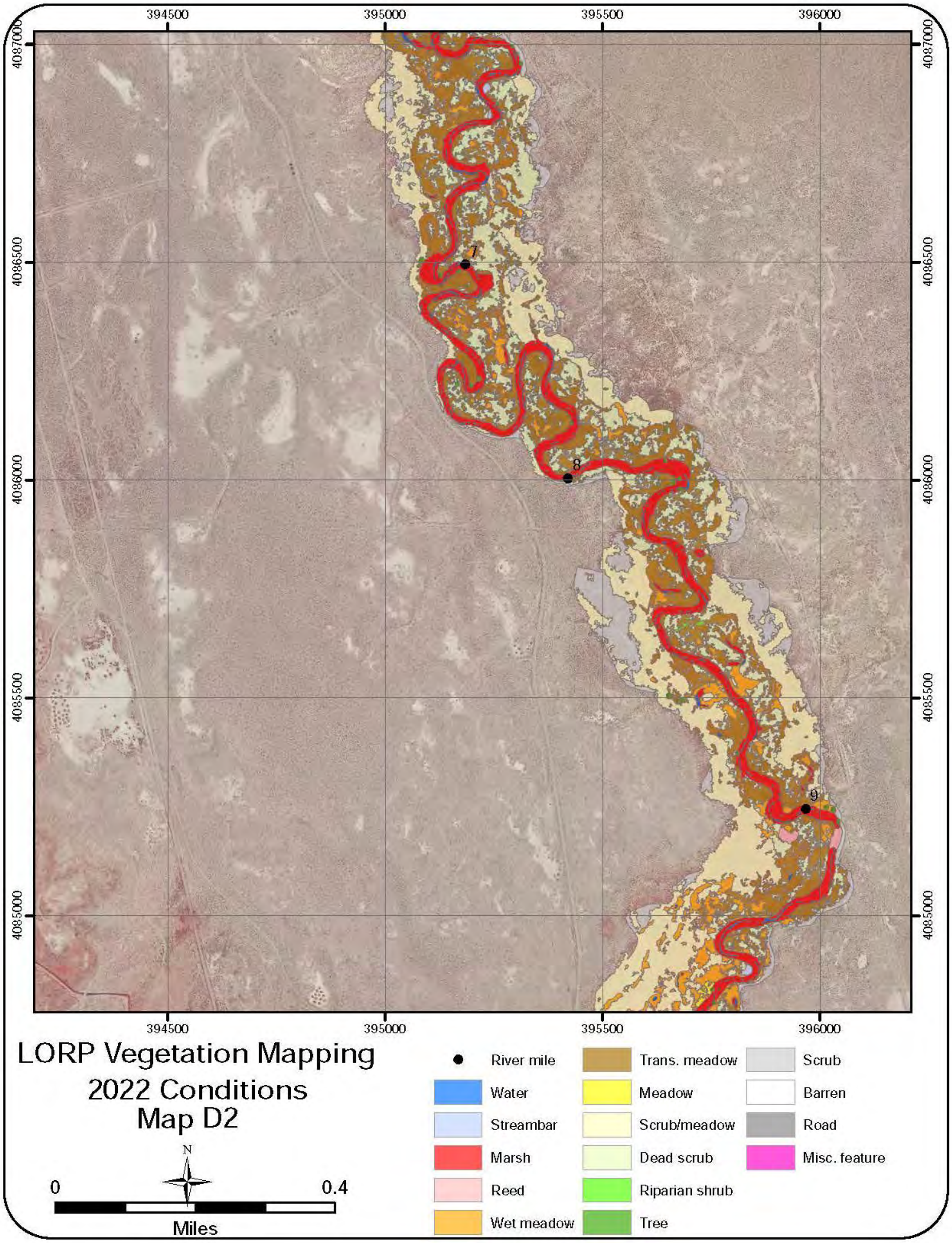
6
LORP Vegetation Mapping
2022 Conditions
Map C2
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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4085000
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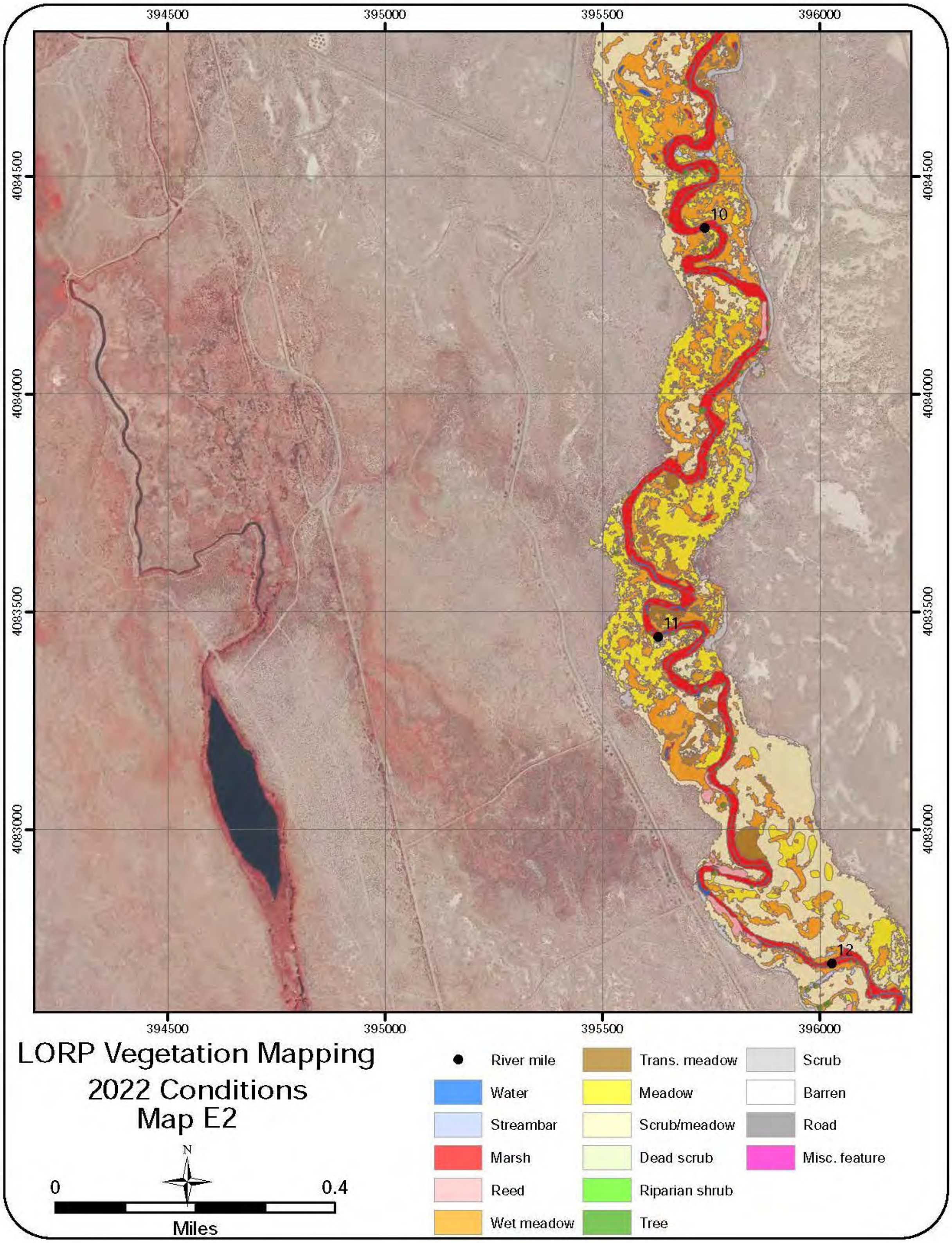
8
9
LORP Vegetation Mapping
2022 Conditions
Map D2
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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10
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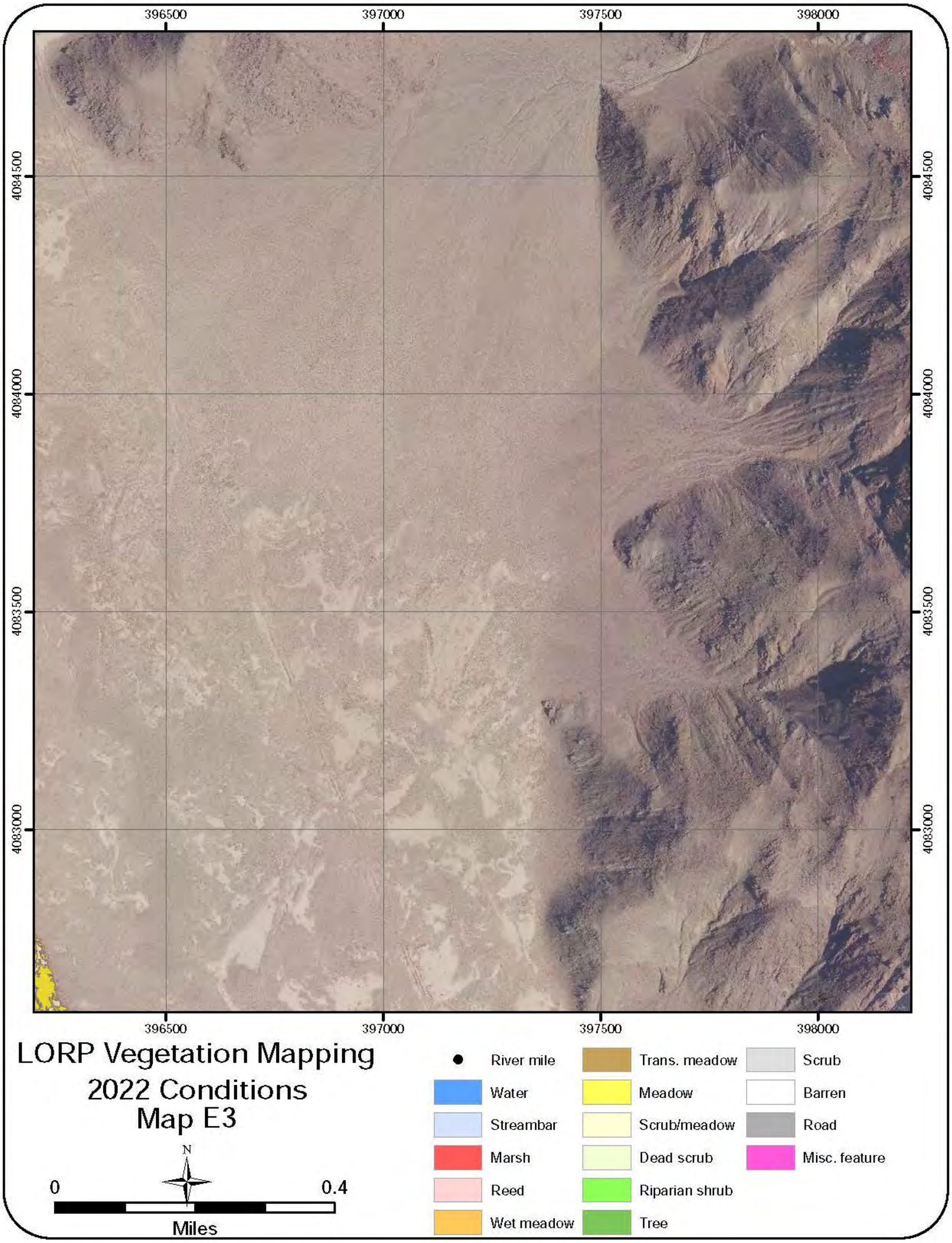
12
LORP Vegetation Mapping
2022 Conditions
Map E2
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map E3
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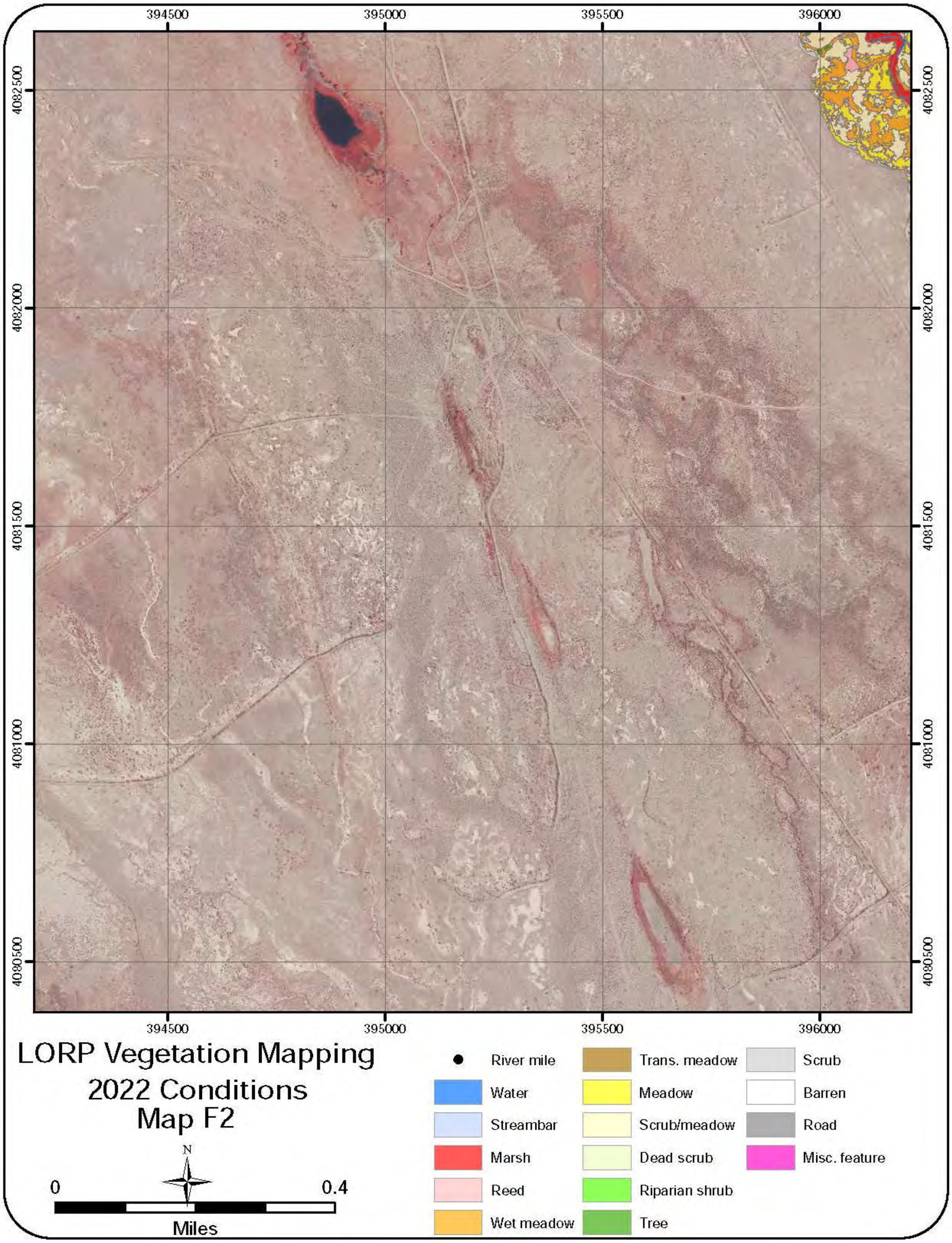
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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396000
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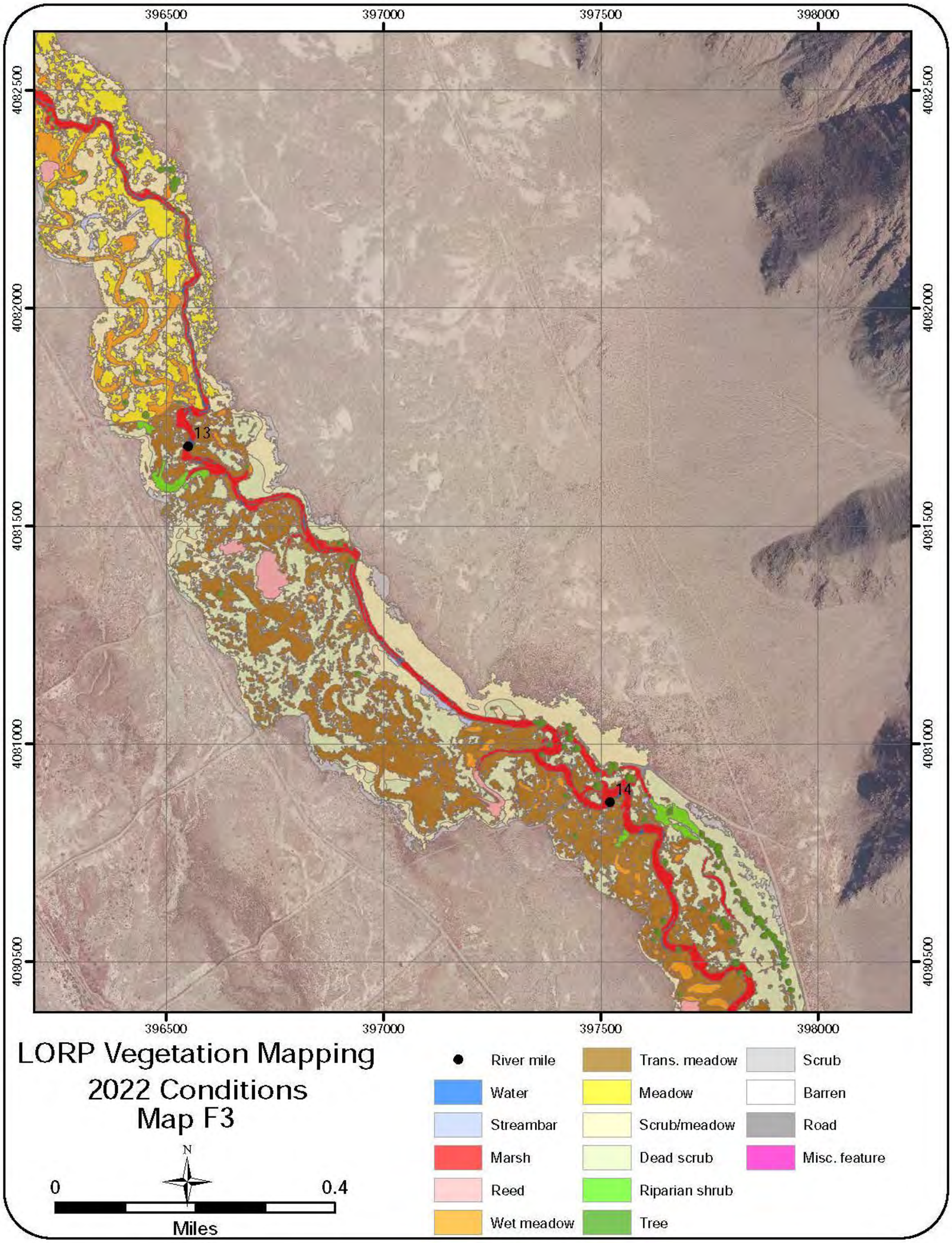
4081000
4080500
LORP Vegetation Mapping
2022 Conditions
Map F2
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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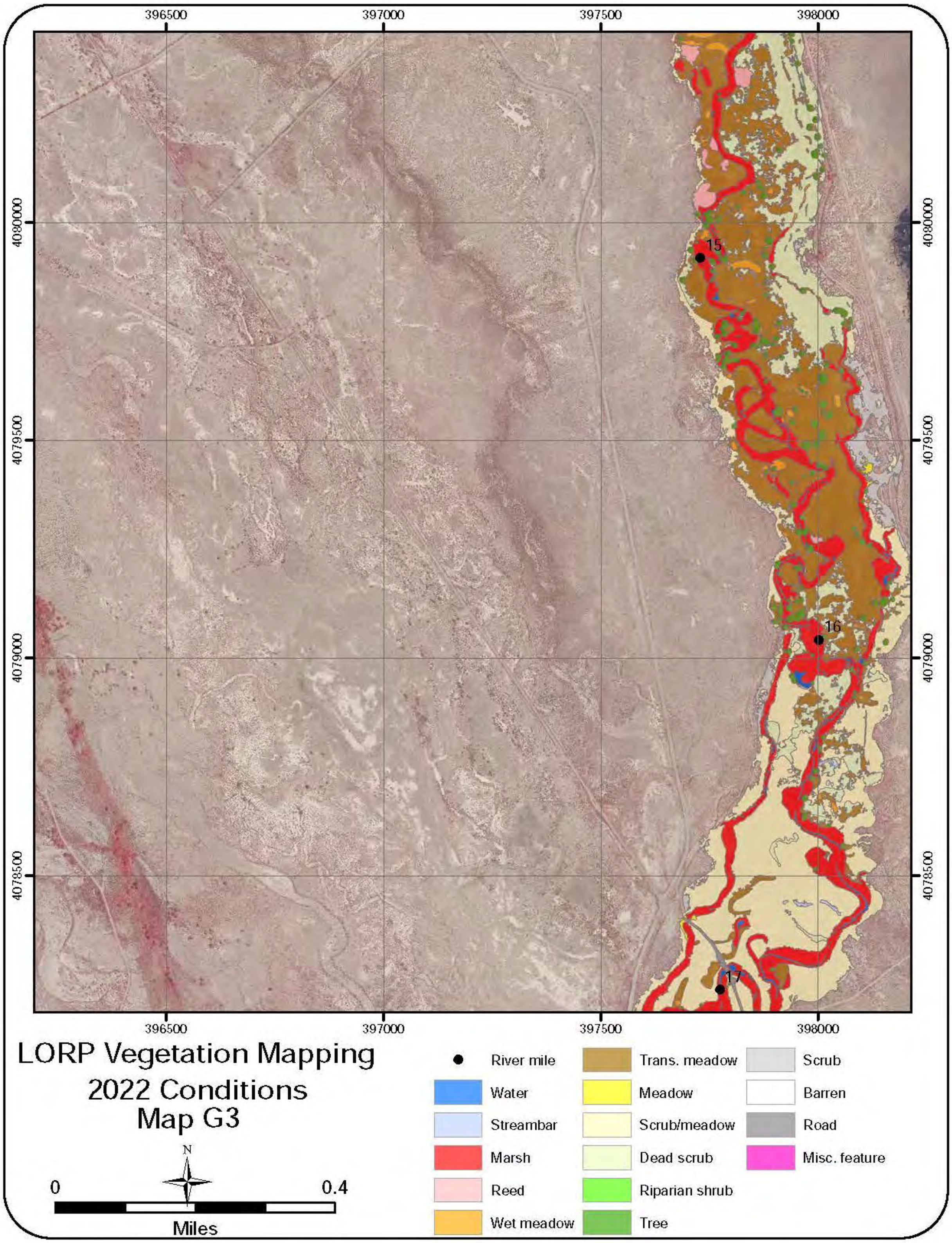
4081000
4080500
13
14
LORP Vegetation Mapping
2022 Conditions
Map F3
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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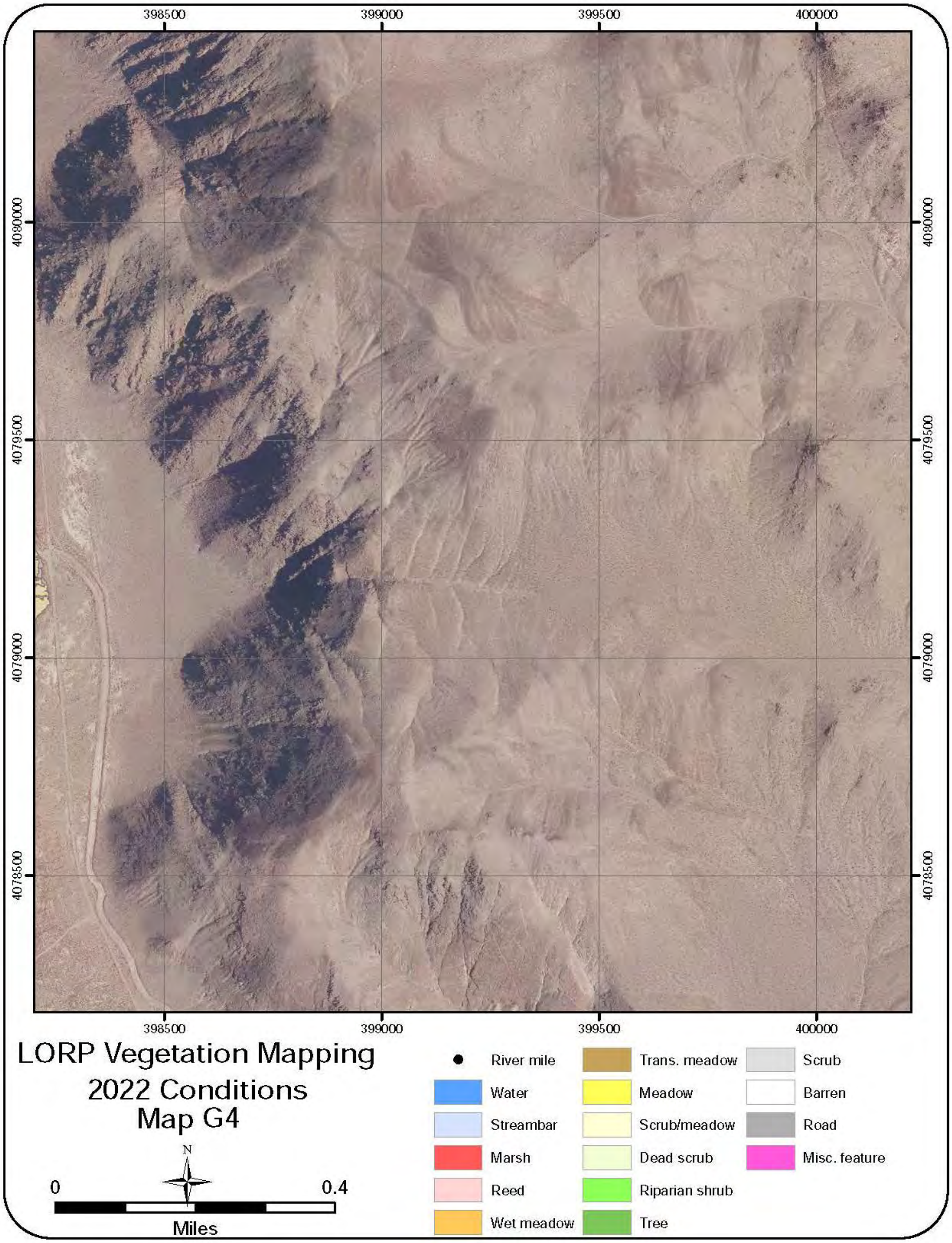
4079000
4078500
15
16
17
LORP Vegetation Mapping
2022 Conditions
Map G3
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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LORP Vegetation Mapping
2022 Conditions
Map G4
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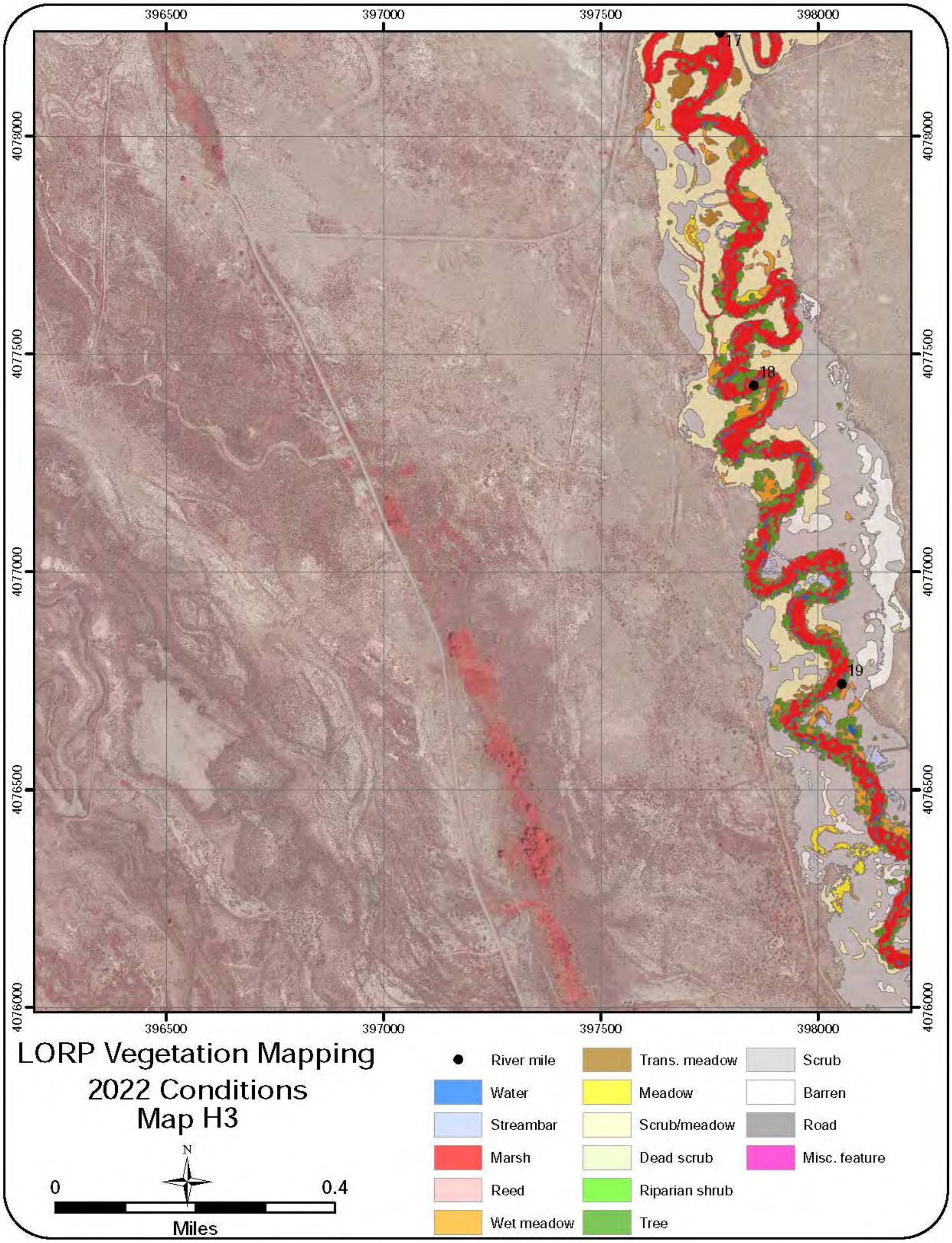
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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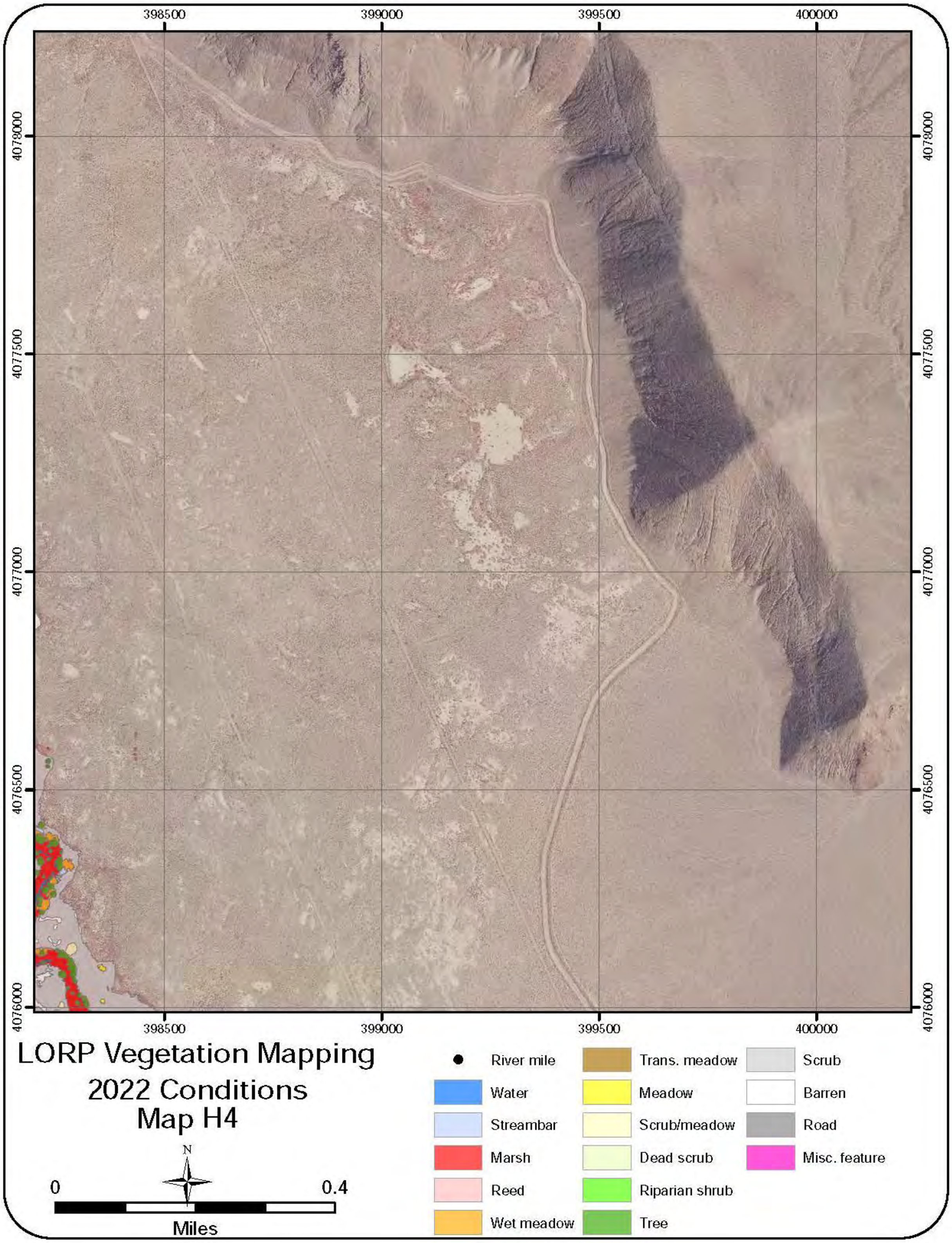
18
19
LORP Vegetation Mapping
2022 Conditions
Map H3
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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400000
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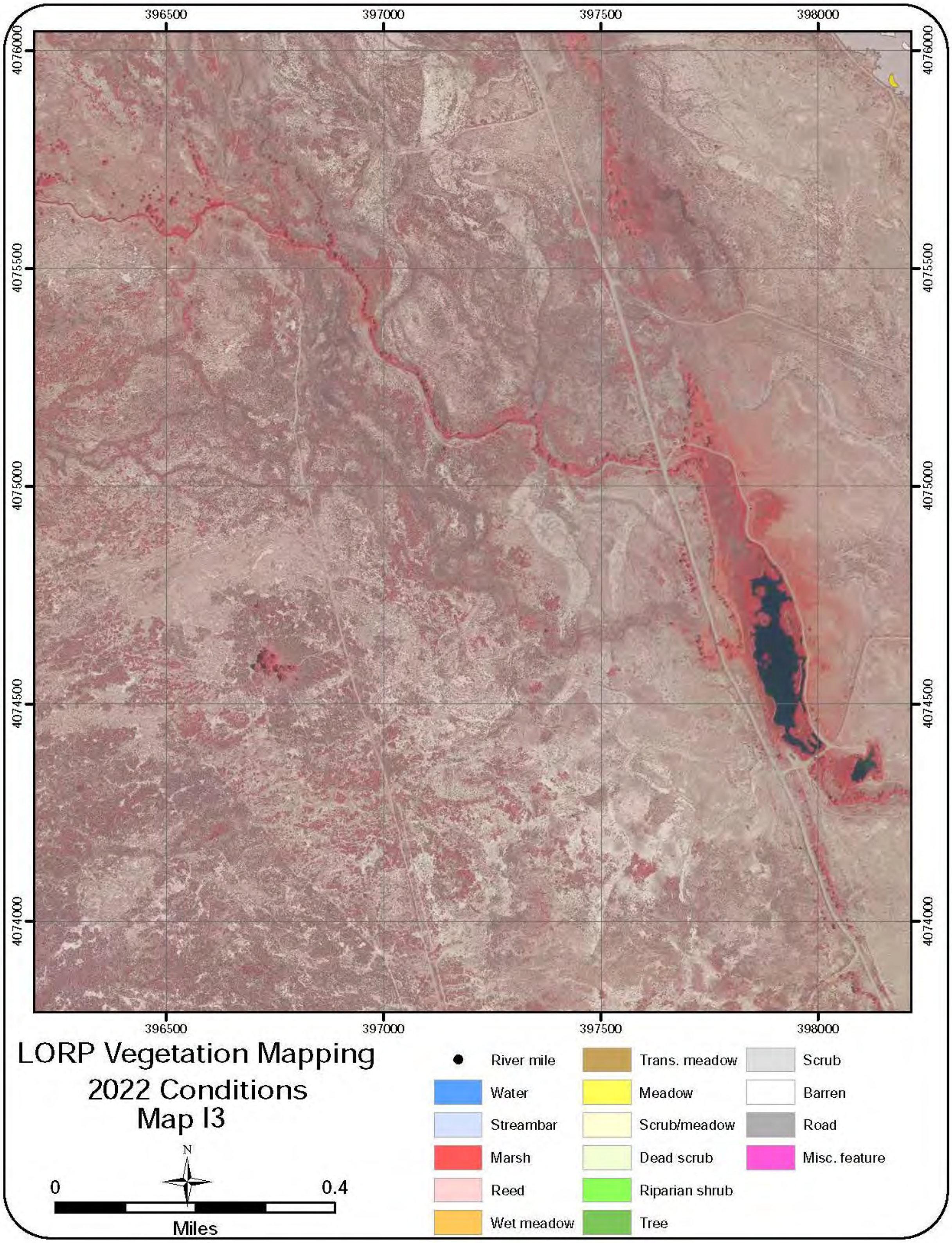
4077000
4076500
4076000
LORP Vegetation Mapping
2022 Conditions
Map H4
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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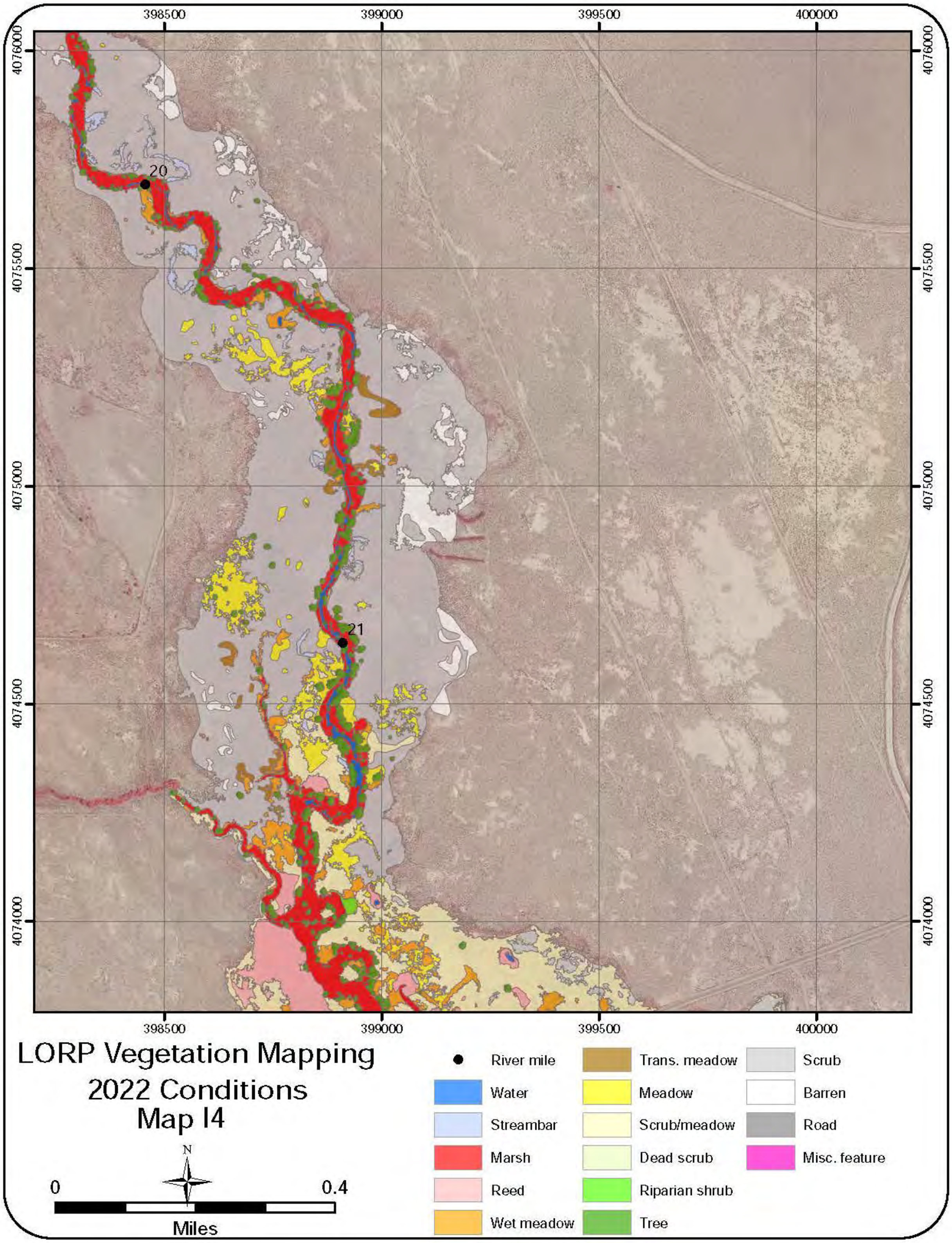
4074500
4074000
LORP Vegetation Mapping
2022 Conditions
Map I3
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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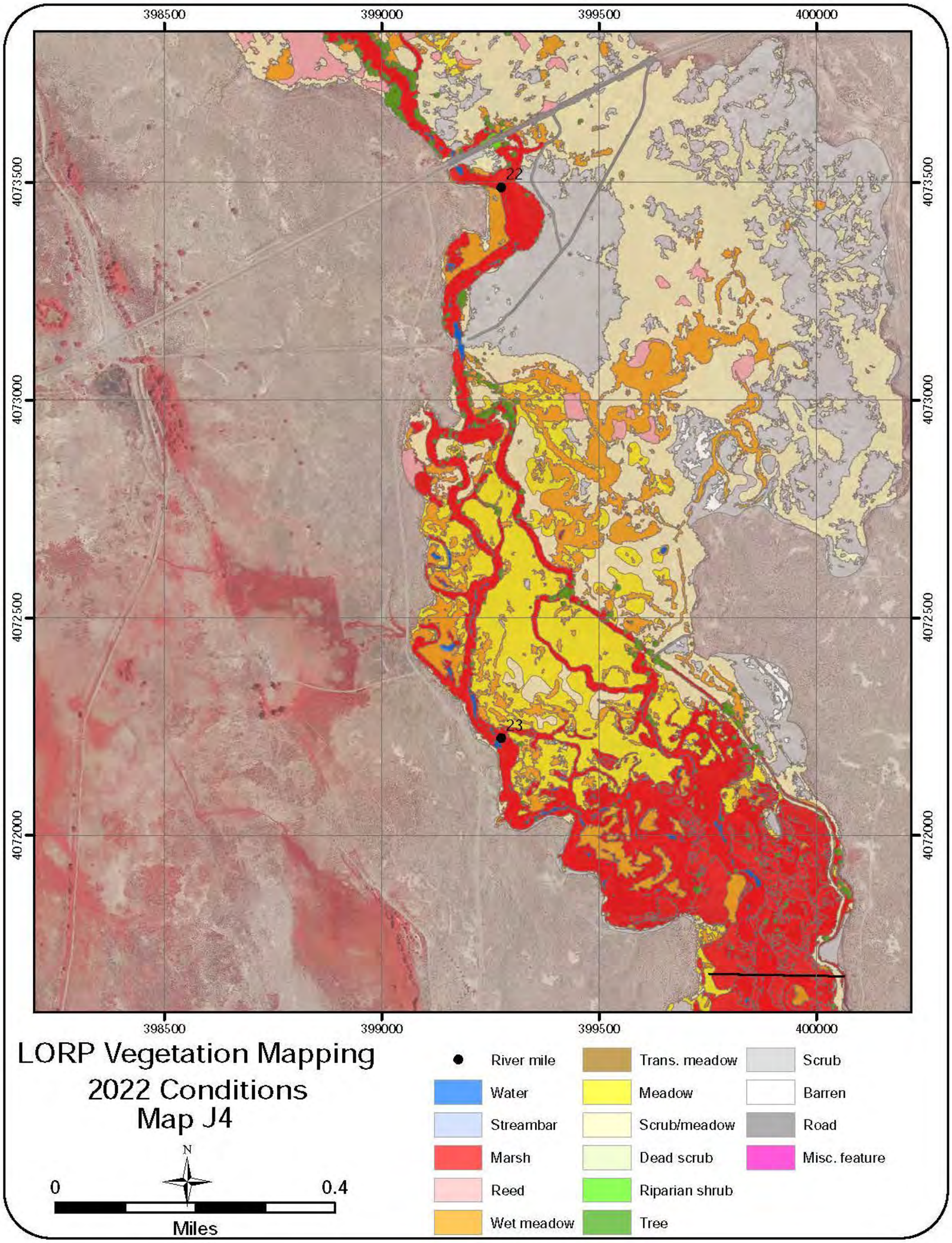
4075500
4075000
4074500
4074000
20
21
LORP Vegetation Mapping
2022 Conditions
Map I4
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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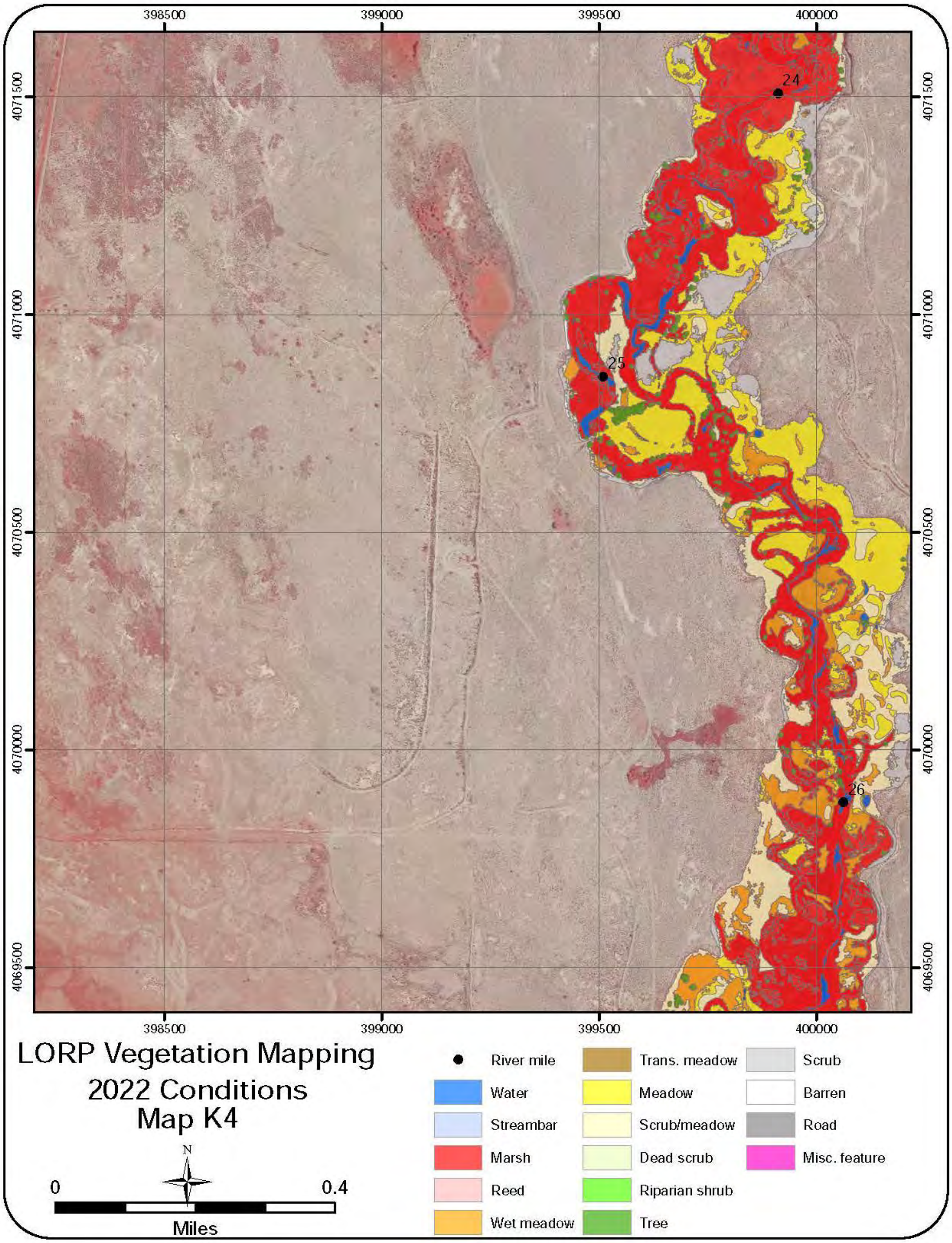
4072000
22
23
LORP Vegetation Mapping
2022 Conditions
Map J4
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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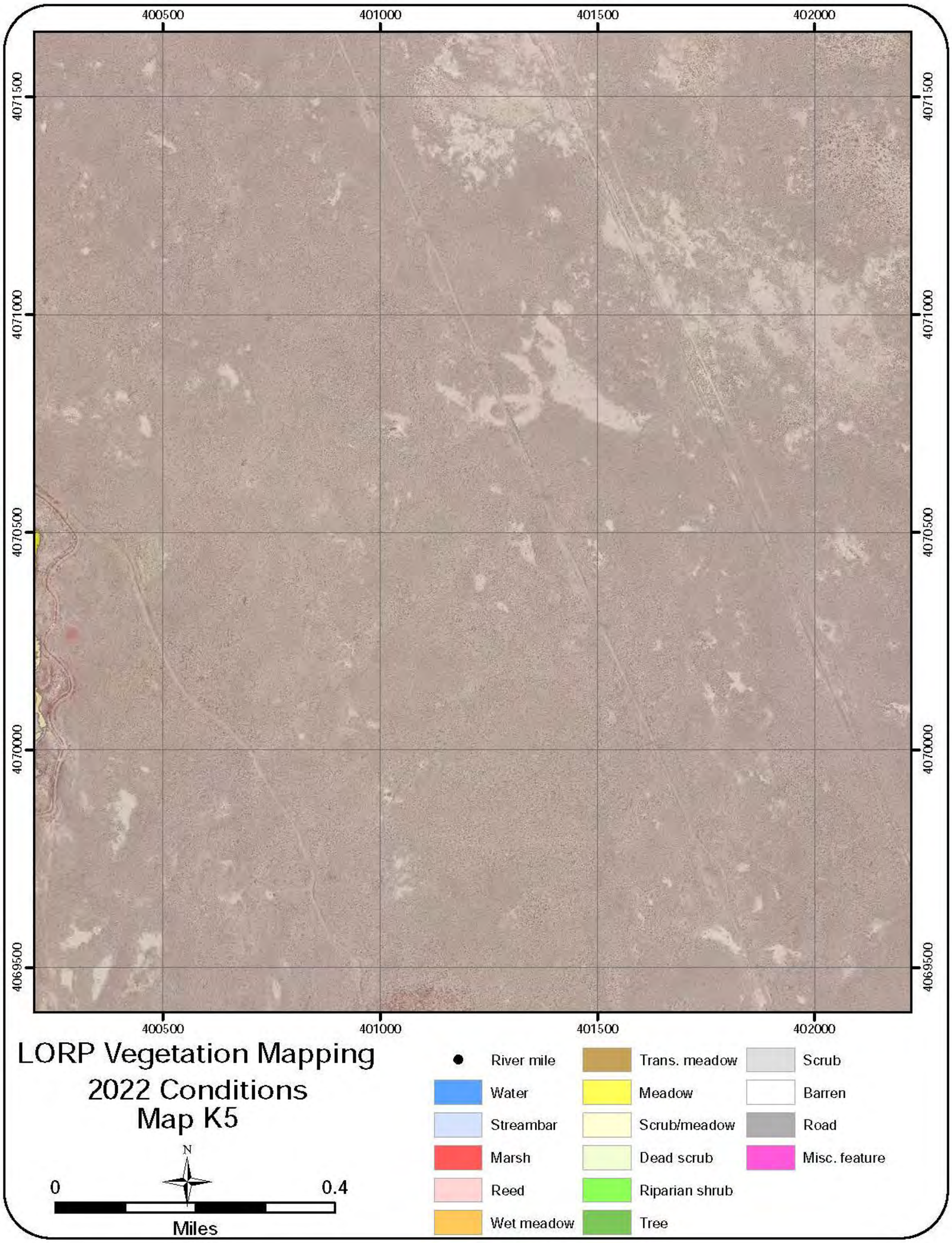
4069500
24
25
26
LORP Vegetation Mapping
2022 Conditions
Map K4
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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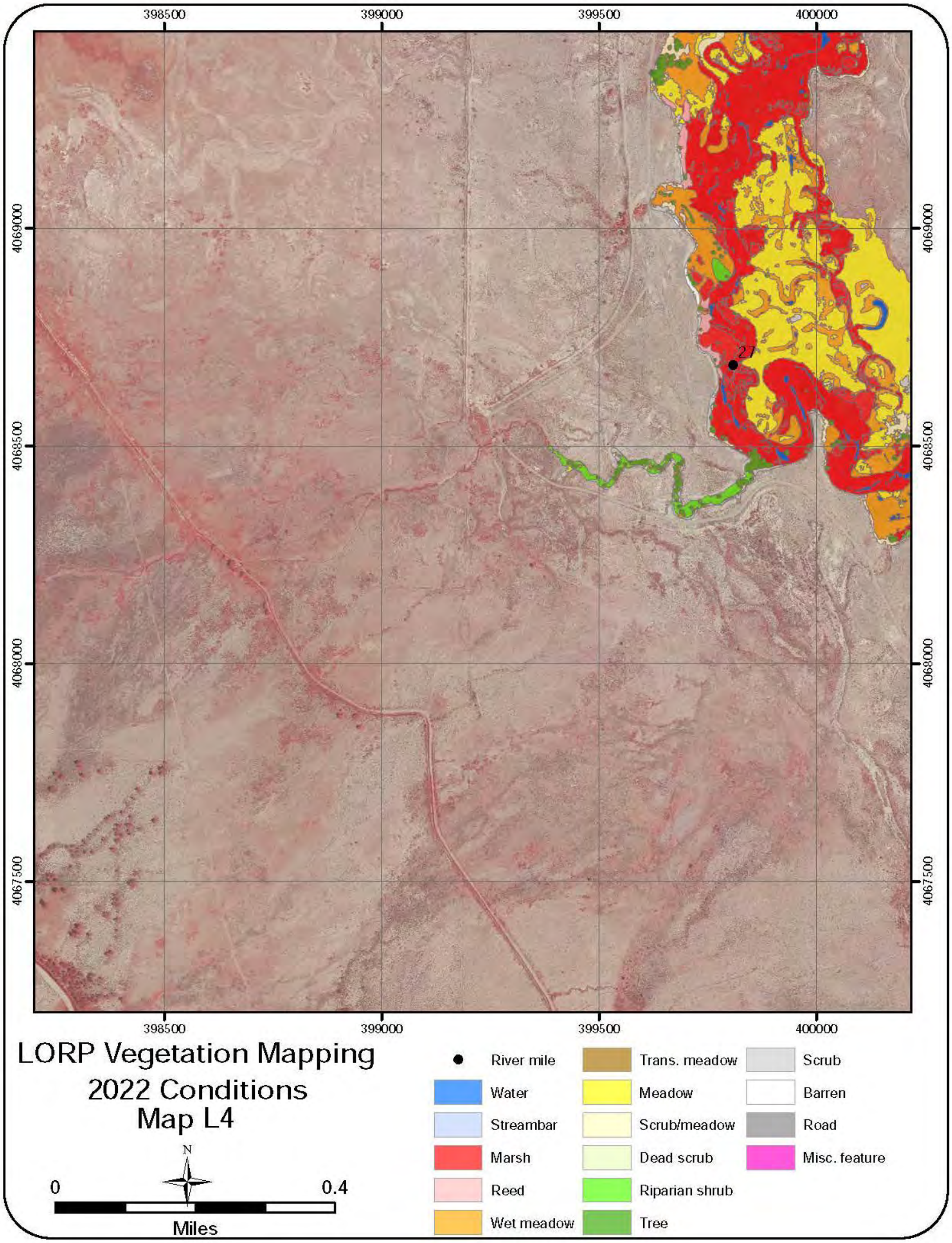
4070500
4070000
4069500
LORP Vegetation Mapping
2022 Conditions
Map K5
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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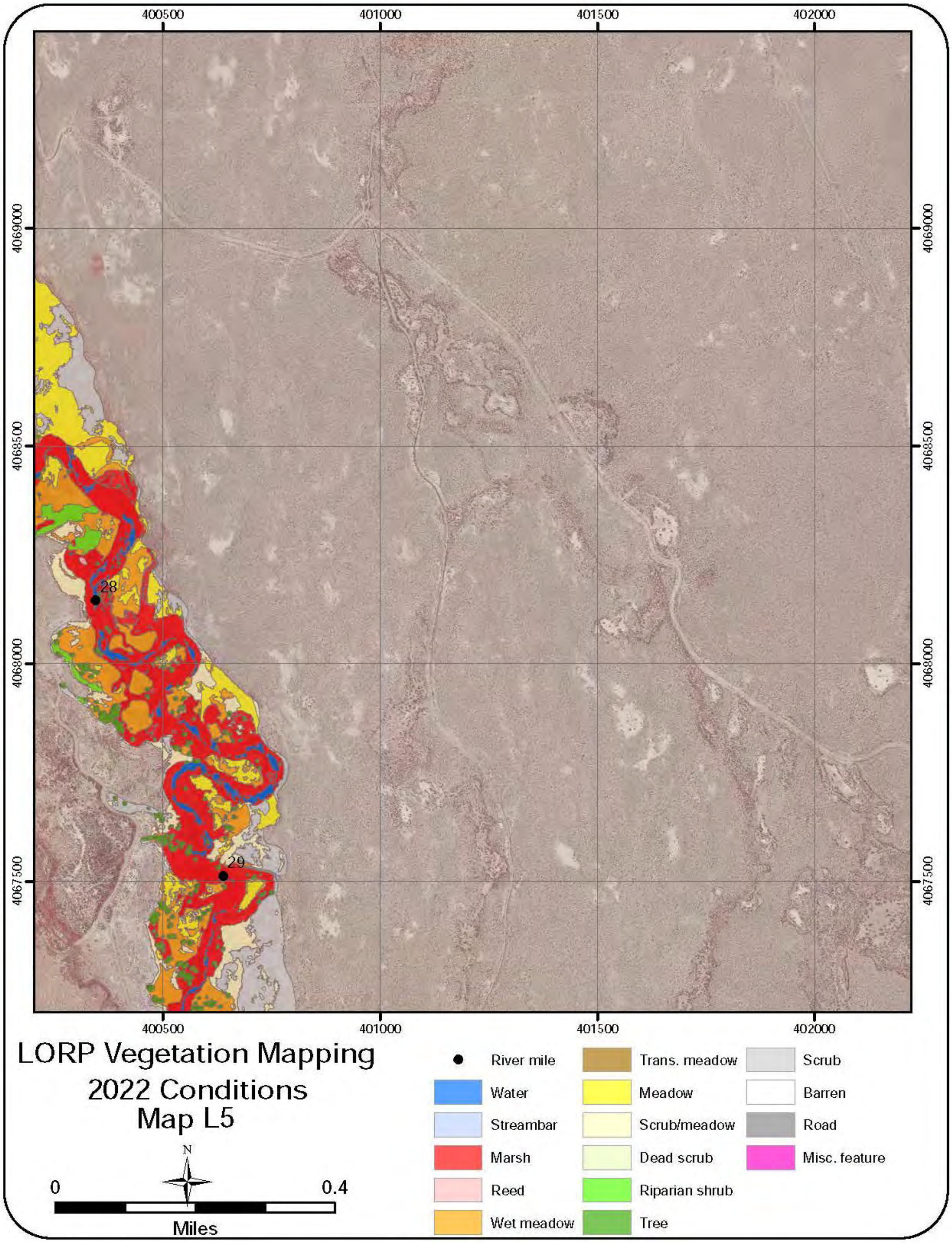
4067500
27
LORP Vegetation Mapping
2022 Conditions
Map L4
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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401500
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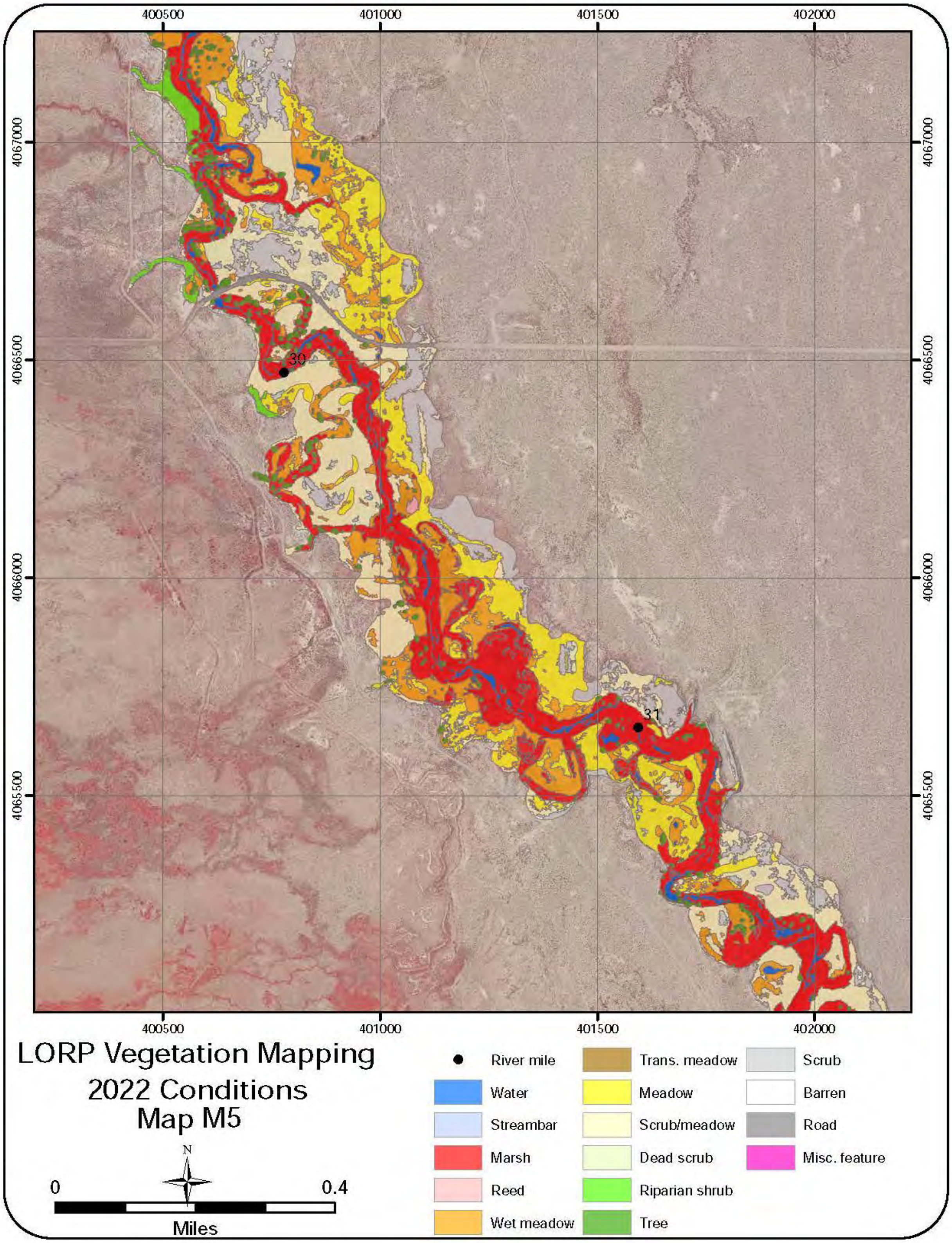
4068000
4067500
28
29
LORP Vegetation Mapping
2022 Conditions
Map L5
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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401500
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4067000
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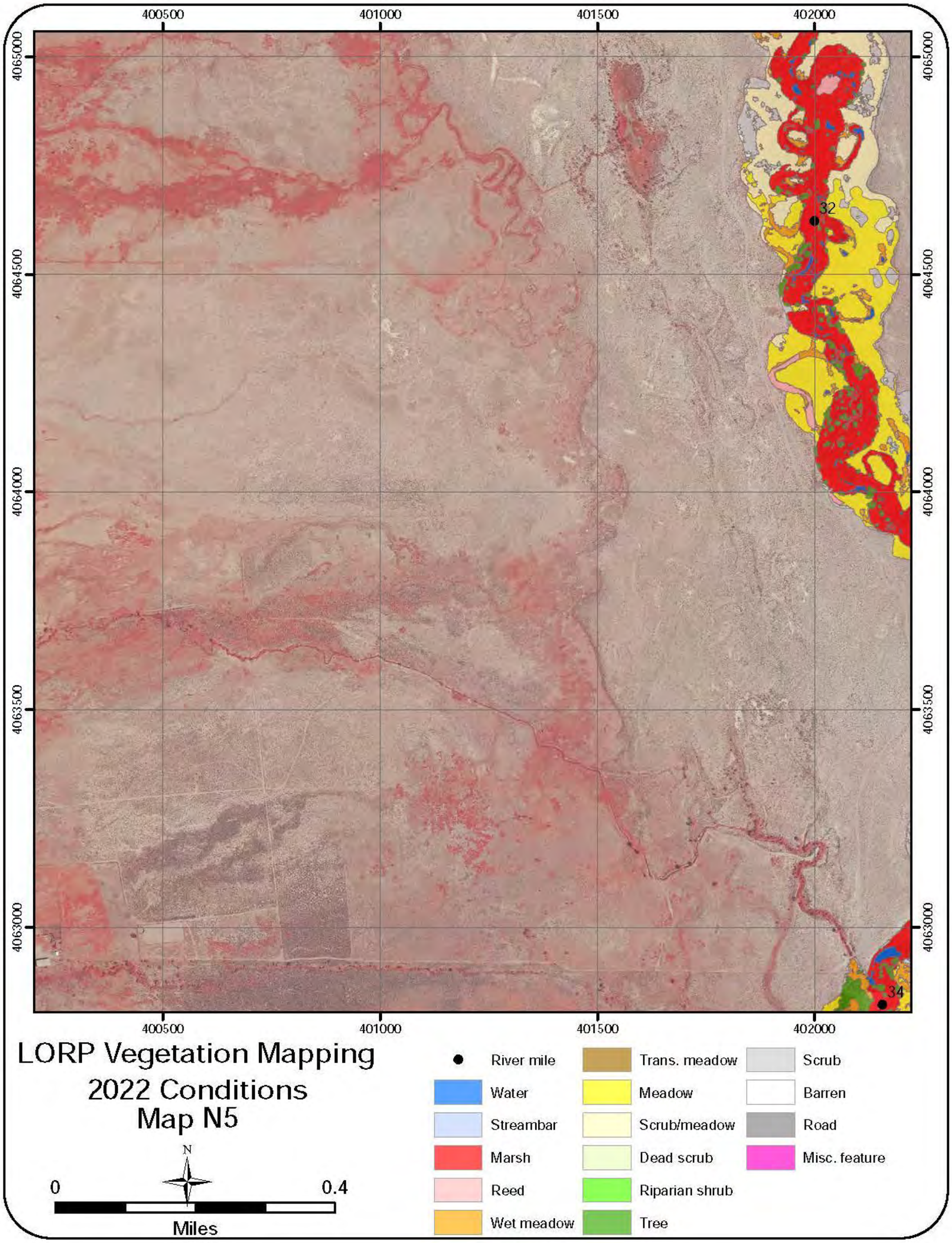
4066000
4065500
30
31
LORP Vegetation Mapping
2022 Conditions
Map M5
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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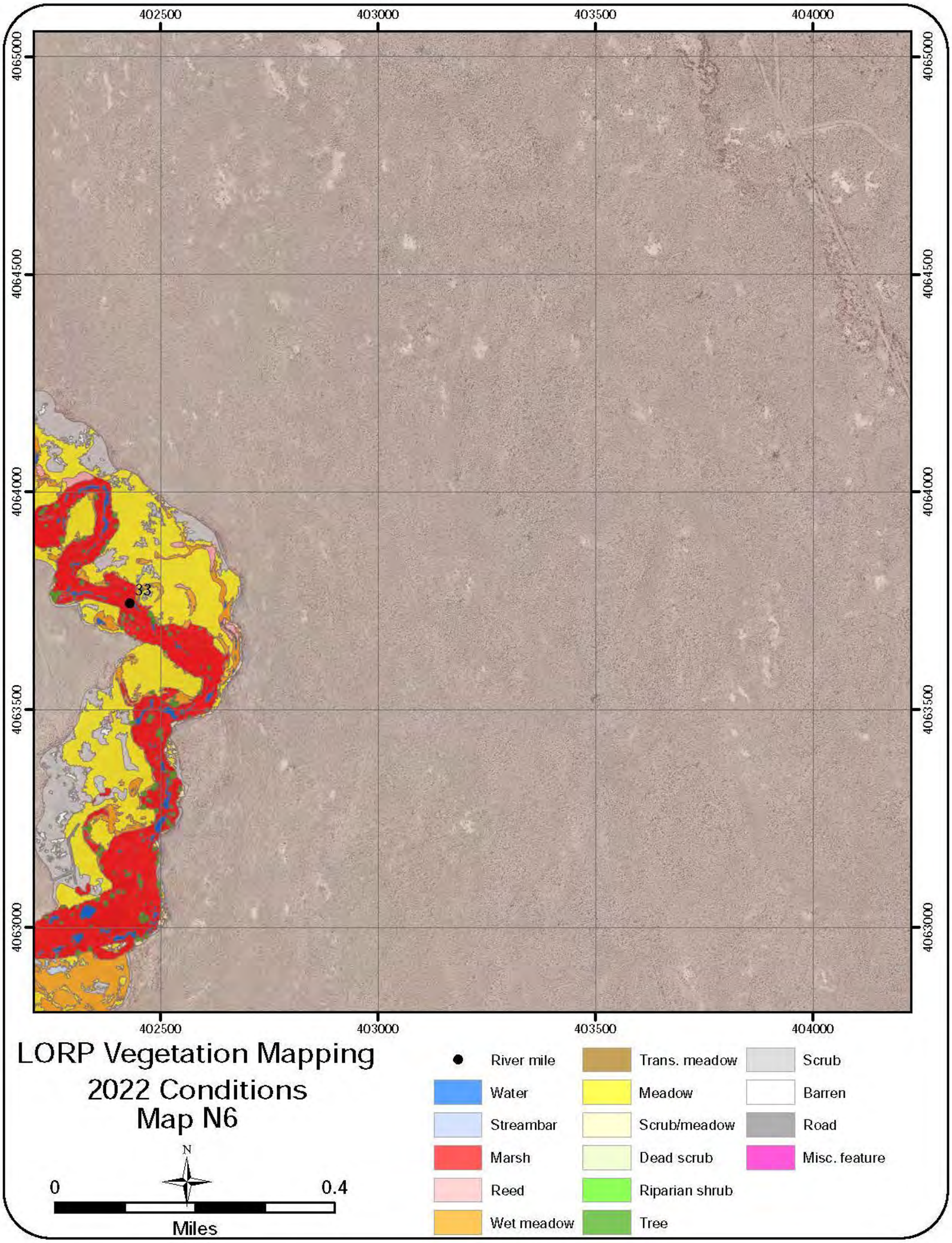
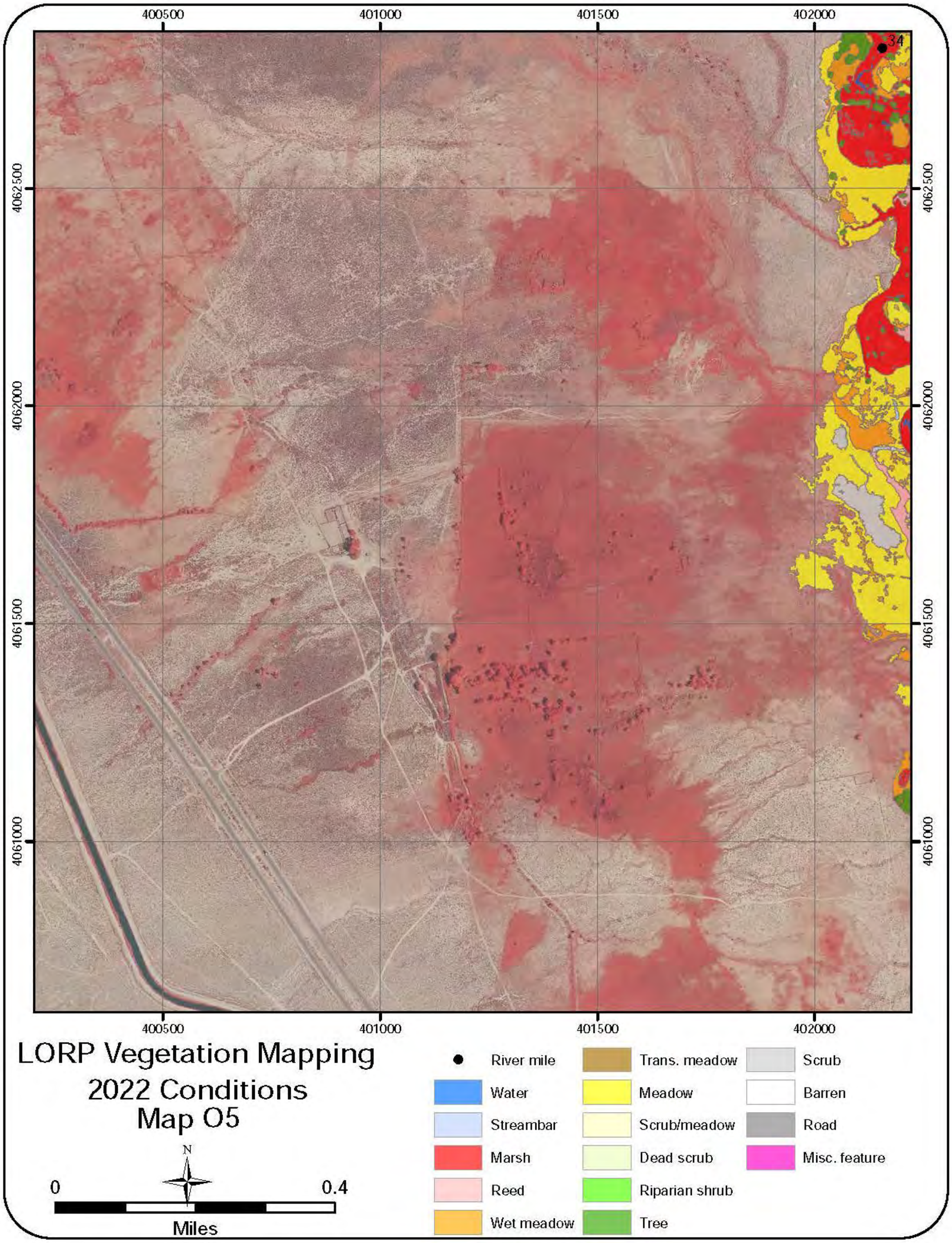
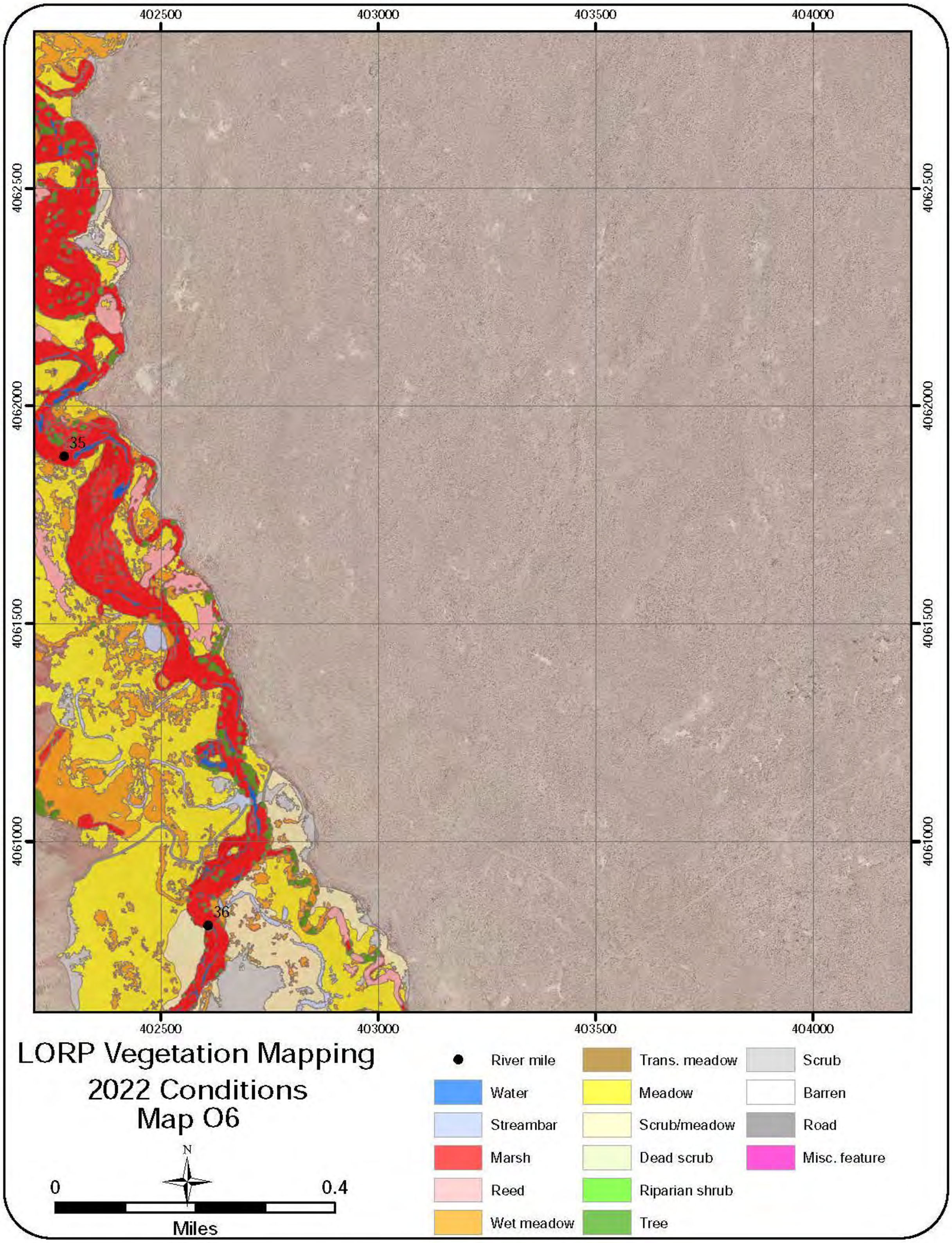
401000
401500
402000
4065000
4064500
4064000
4063500
4063000
32
34
LORP Vegetation Mapping
2022 Conditions
Map N5
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature


402500
403000
403500
404000
4065000
4064500
4064000
4063500
4063000
33
LORP Vegetation Mapping
2022 Conditions
Map N6
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature


400500
401000
401500
402000
4062500
4062000
4061500
4061000
34
LORP Vegetation Mapping
2022 Conditions
Map O5
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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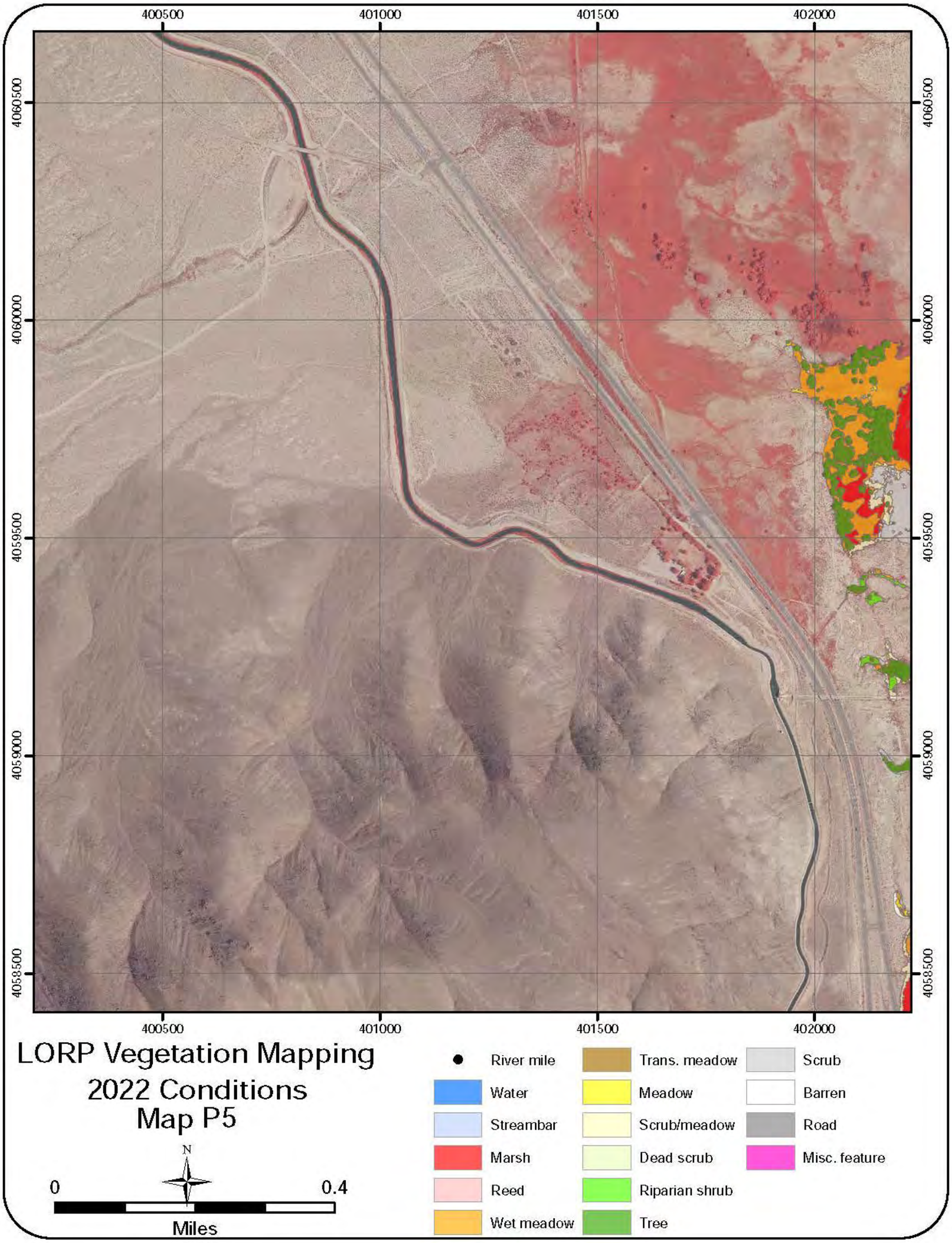
403500
404000
4062500
4062000
4061500
4061000
35
36
LORP Vegetation Mapping
2022 Conditions
Map O6
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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401000
401500
402000
4060500
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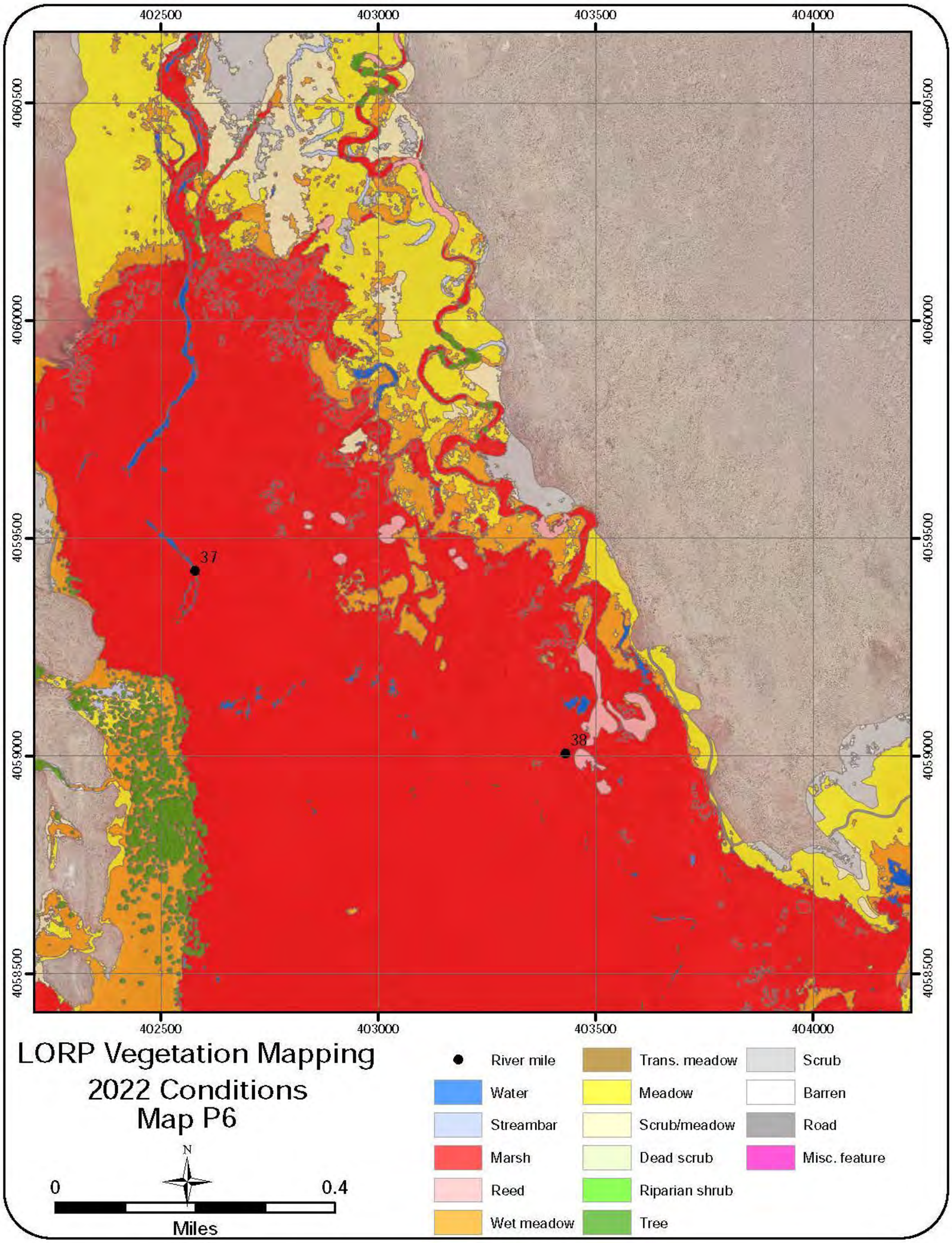
4059500
4059000
4058500
LORP Vegetation Mapping
2022 Conditions
Map P5
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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403500
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4060500
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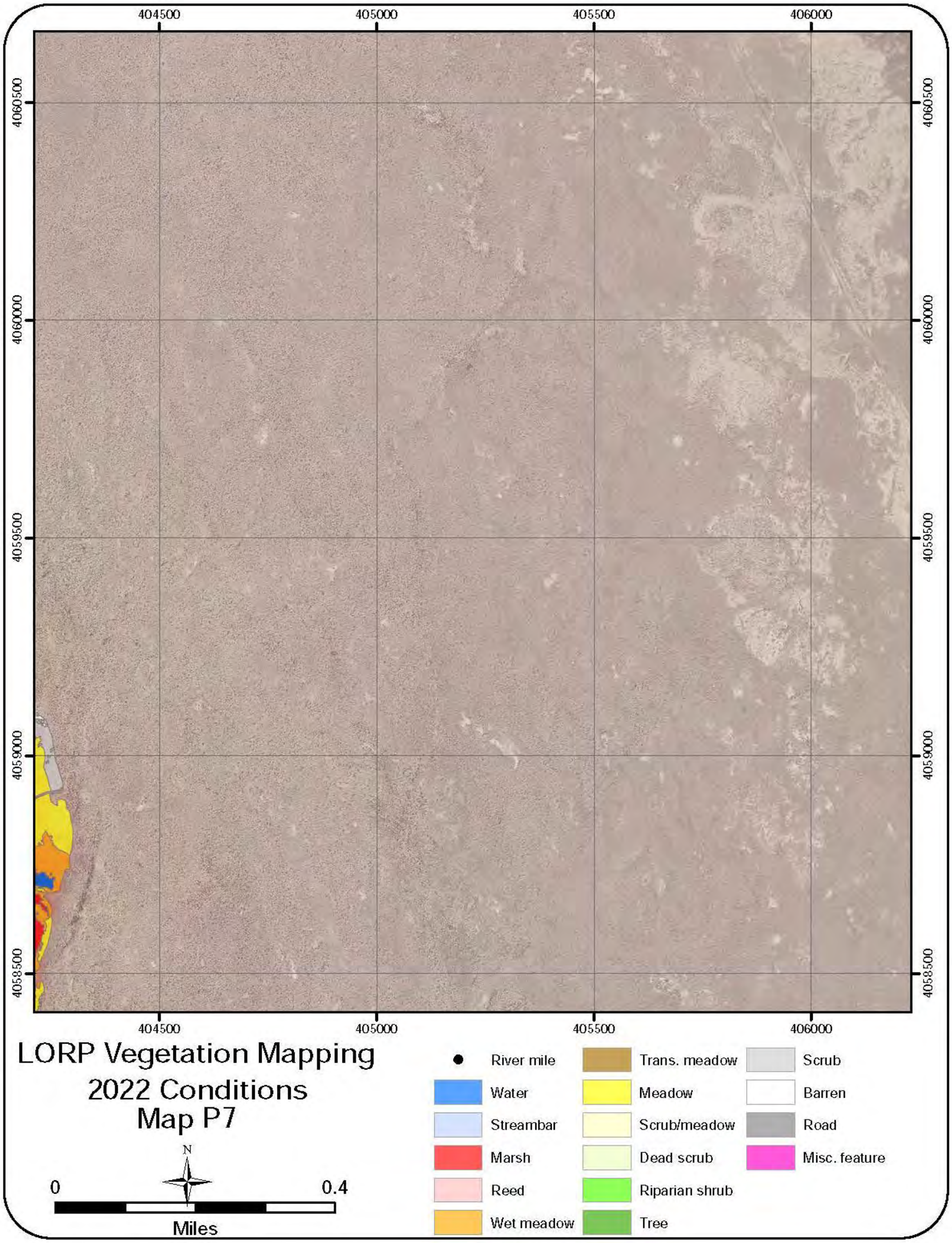
4059500
4059000
4058500
37
38
LORP Vegetation Mapping
2022 Conditions
Map P6
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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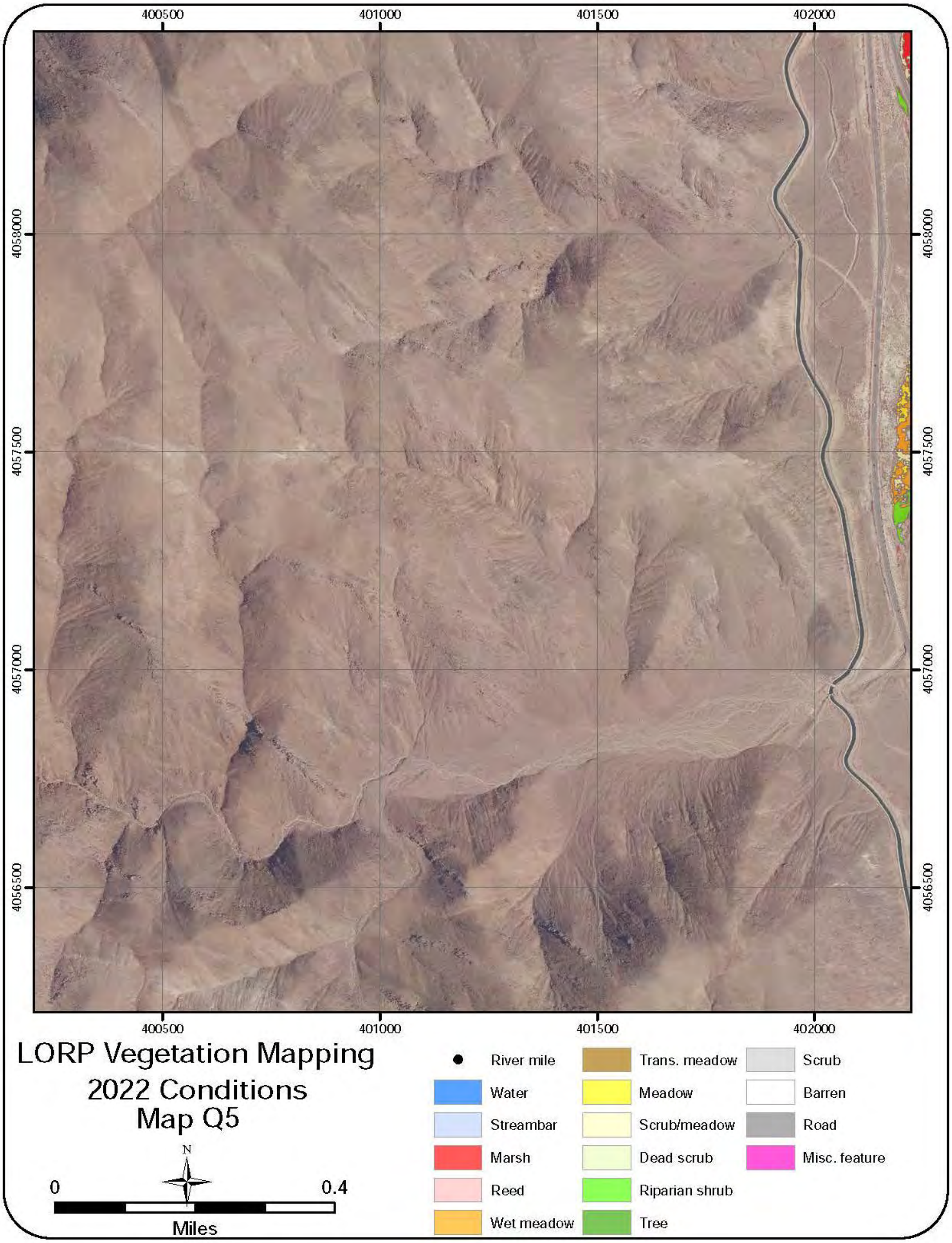
405500
406000
4060500
4060000
4059500
4059000
4058500
LORP Vegetation Mapping
2022 Conditions
Map P7
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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401500
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4058000
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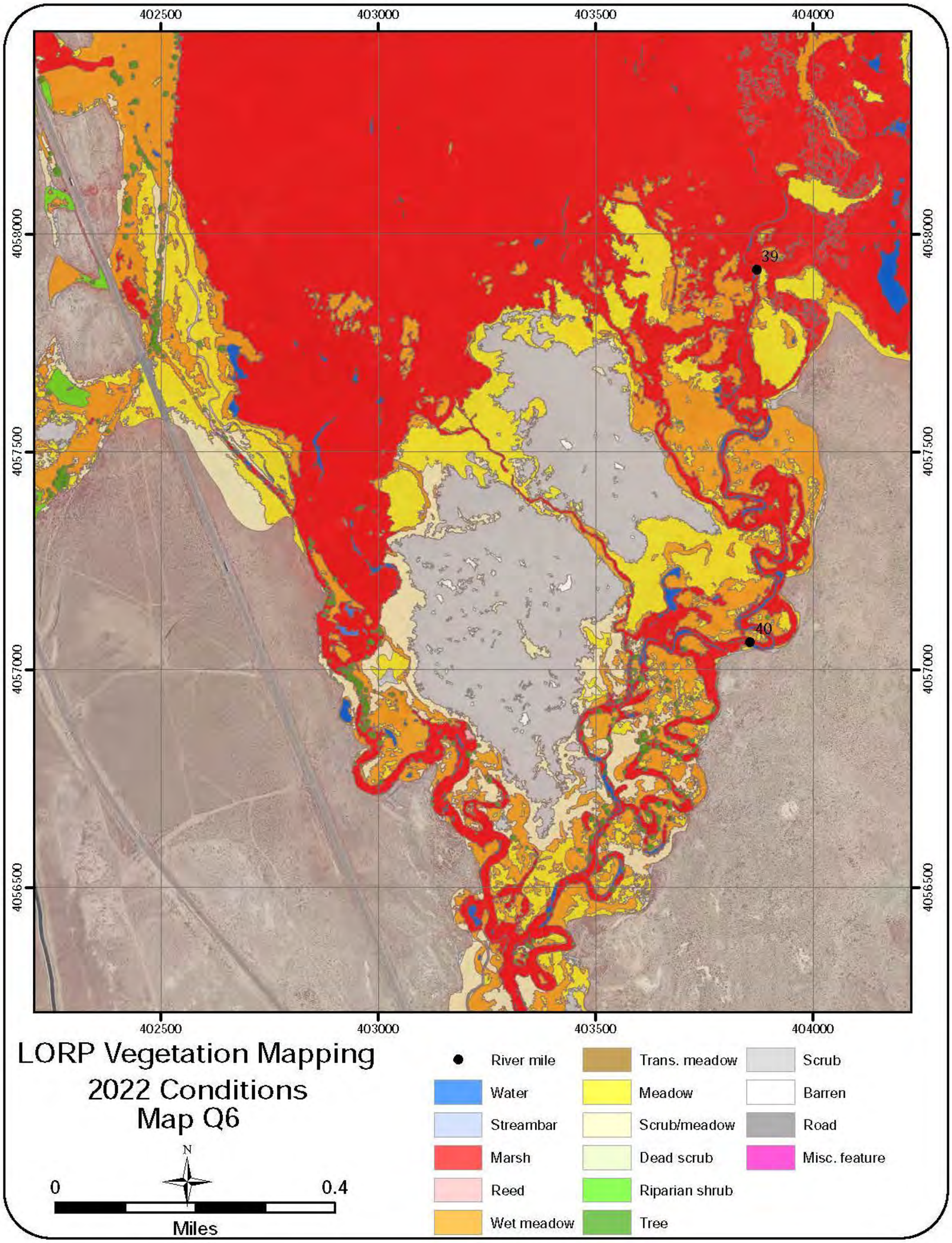
4057000
4056500
LORP Vegetation Mapping
2022 Conditions
Map Q5
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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403500
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4058000
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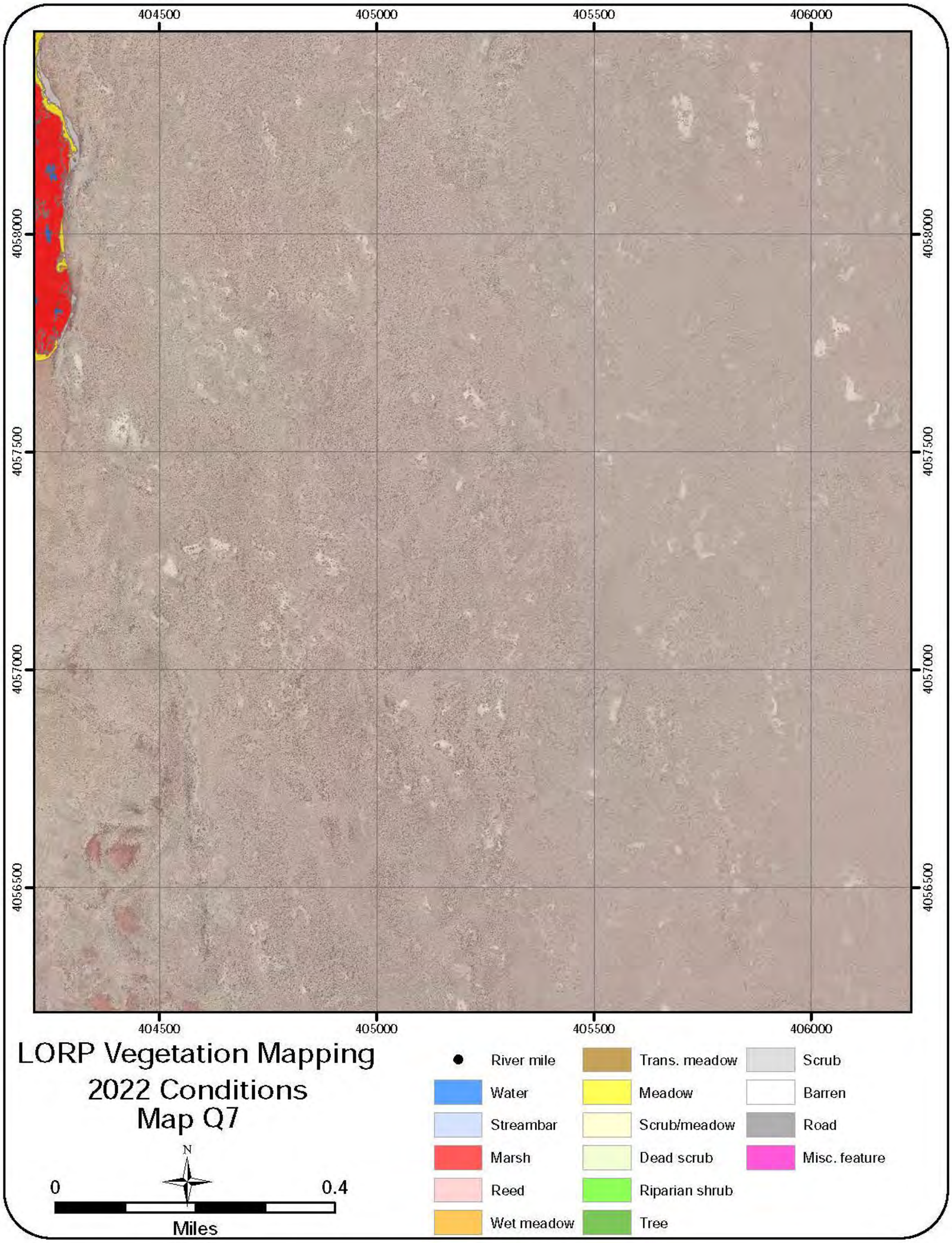
4057000
4056500
39
40
LORP Vegetation Mapping
2022 Conditions
Map Q6
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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405500
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4058000
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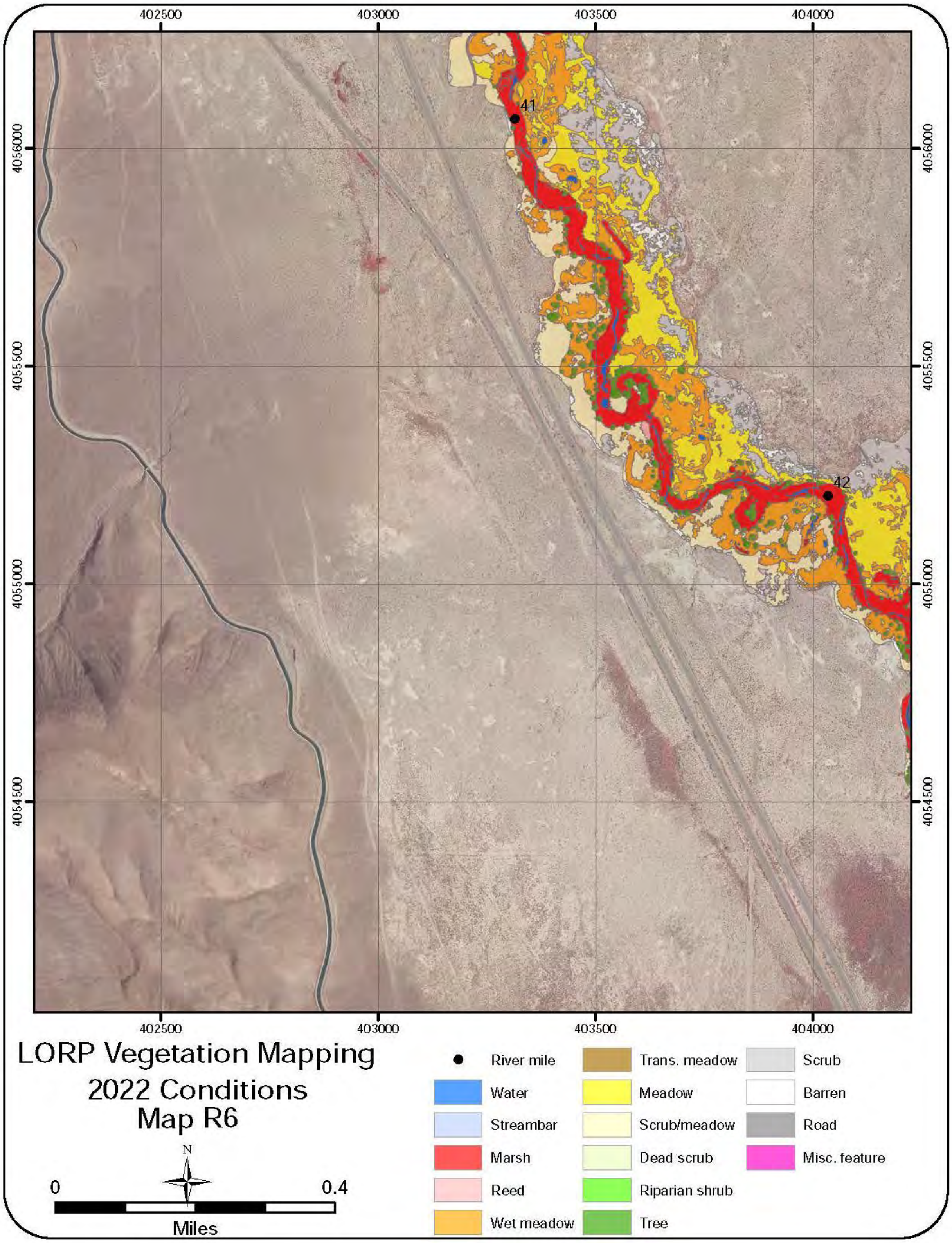
4057000
4056500
LORP Vegetation Mapping
2022 Conditions
Map Q7
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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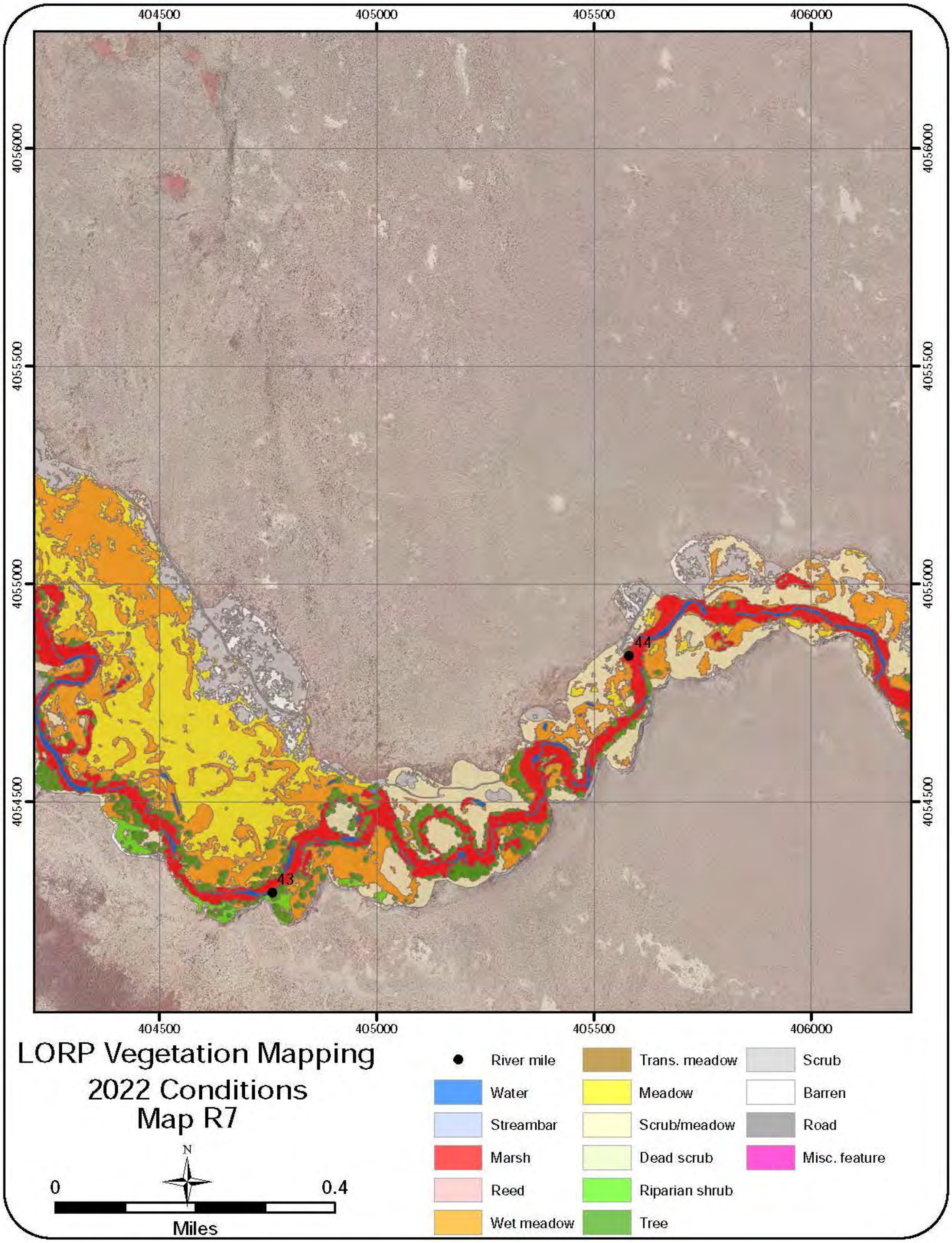
4055500
4055000
4054500
41
42
LORP Vegetation Mapping
2022 Conditions
Map R6
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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405500
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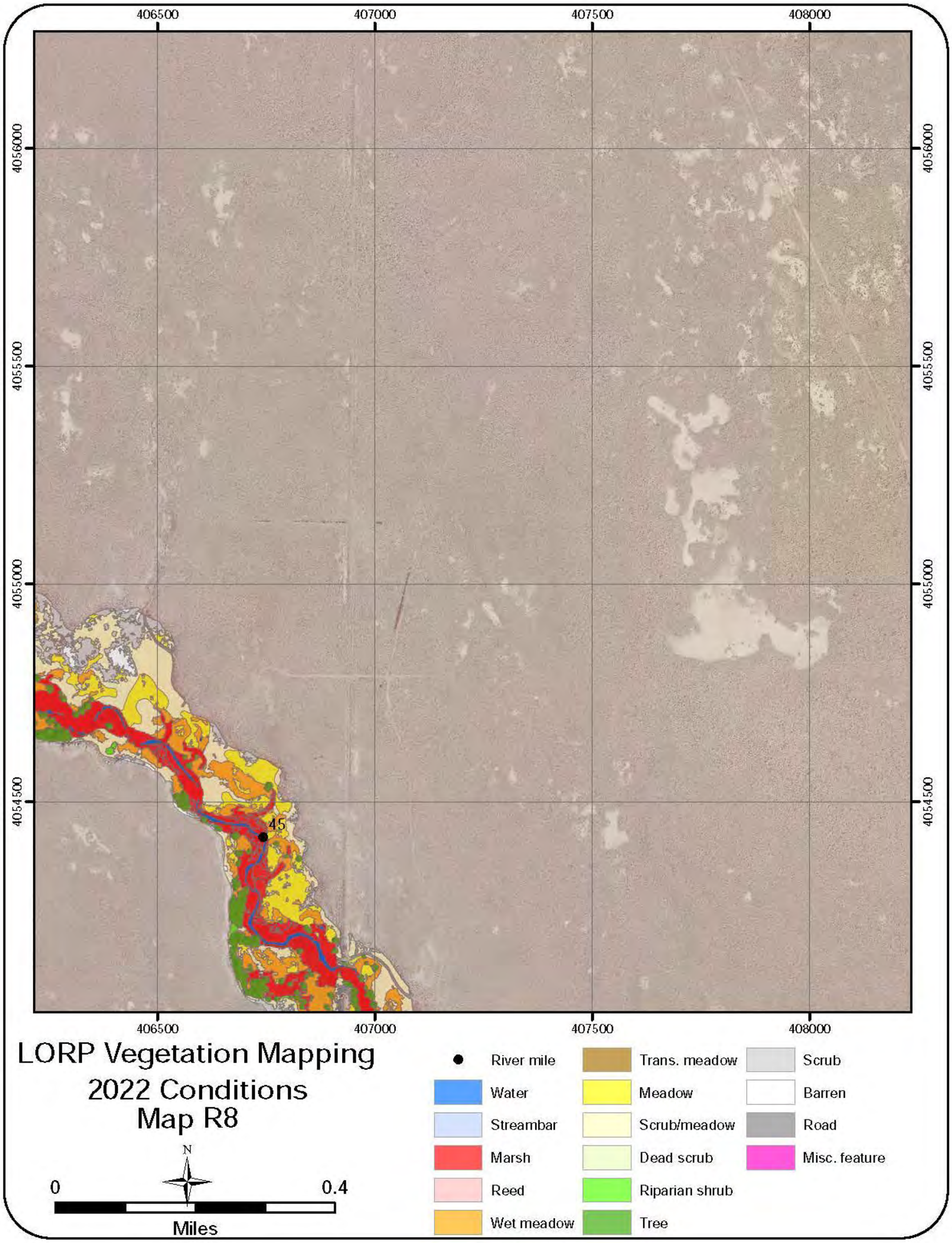
4055000
4054500
43
44
LORP Vegetation Mapping
2022 Conditions
Map R7
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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407500
408000
4056000
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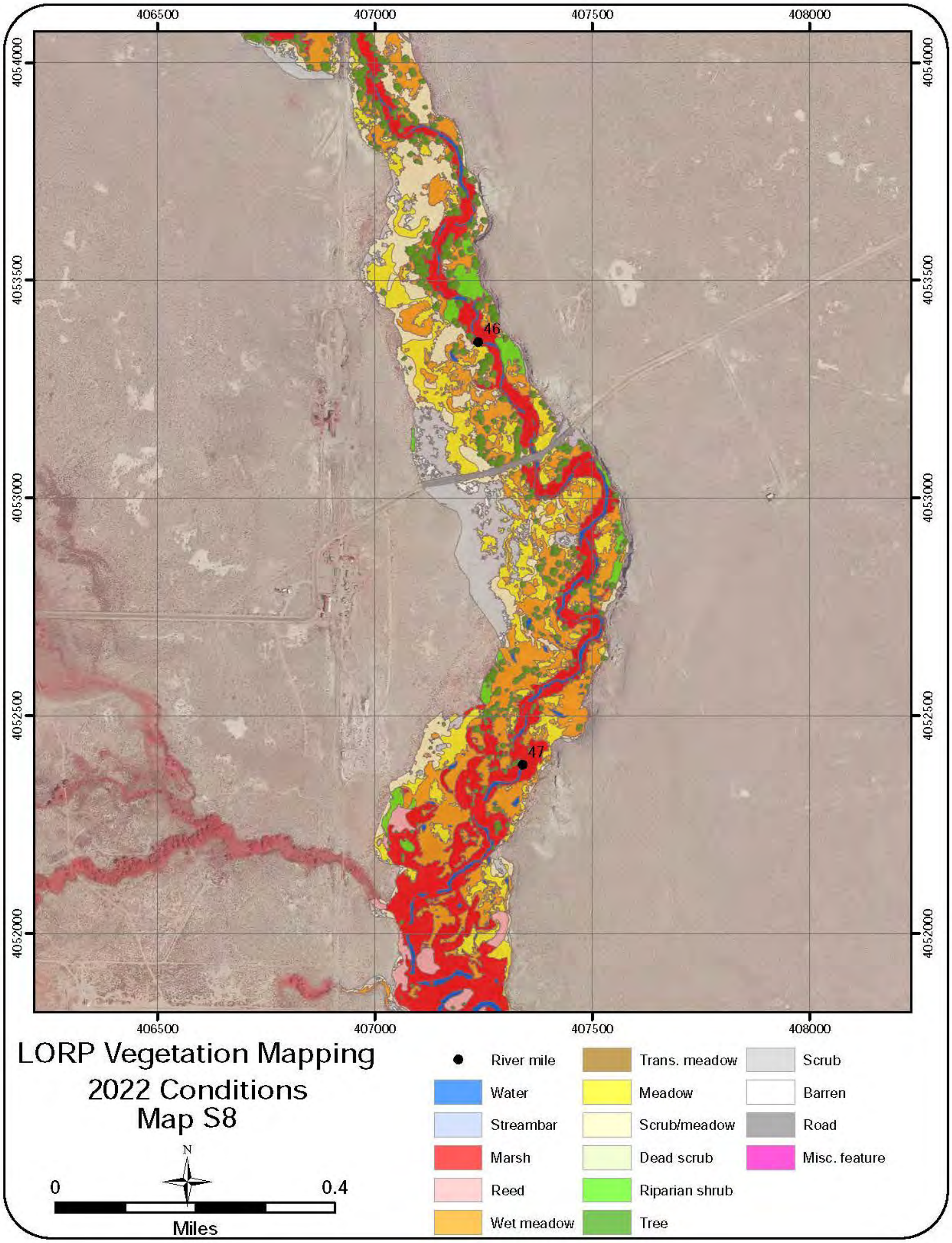
4055000
4054500
45
LORP Vegetation Mapping
2022 Conditions
Map R8
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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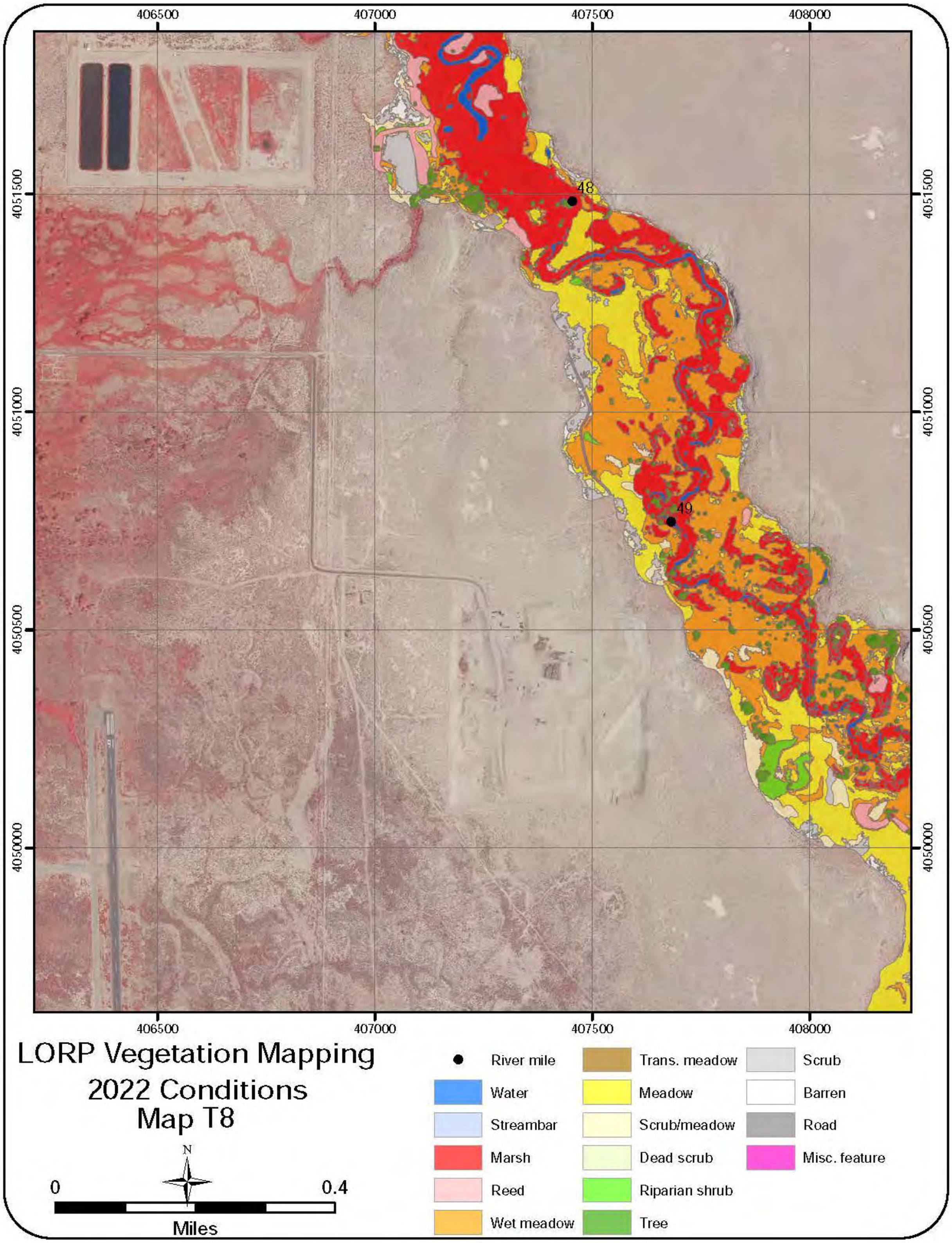
4053500
4053000
4052500
4052000
46
47
LORP Vegetation Mapping
2022 Conditions
Map S8
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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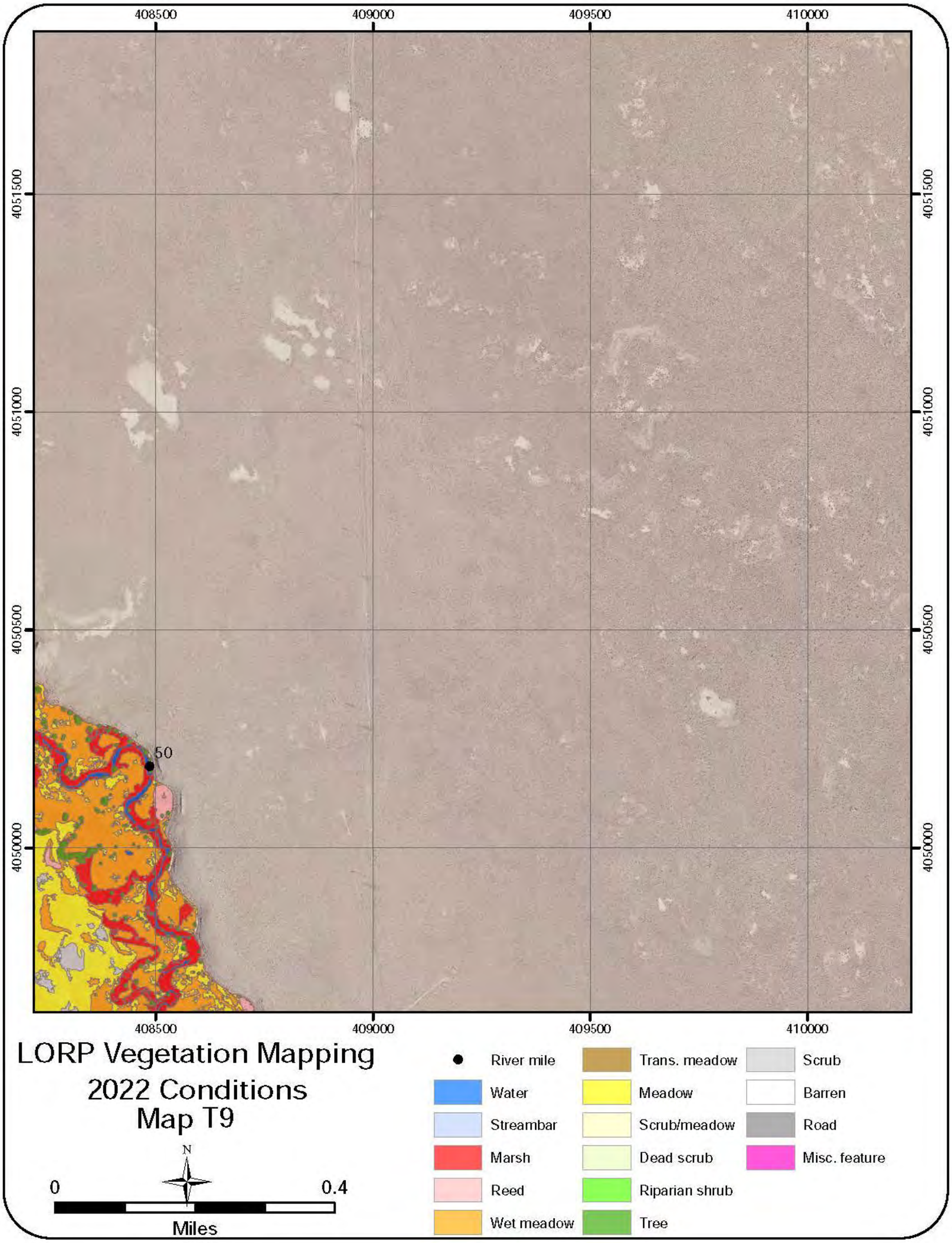
4050000
48
49
LORP Vegetation Mapping
2022 Conditions
Map T8
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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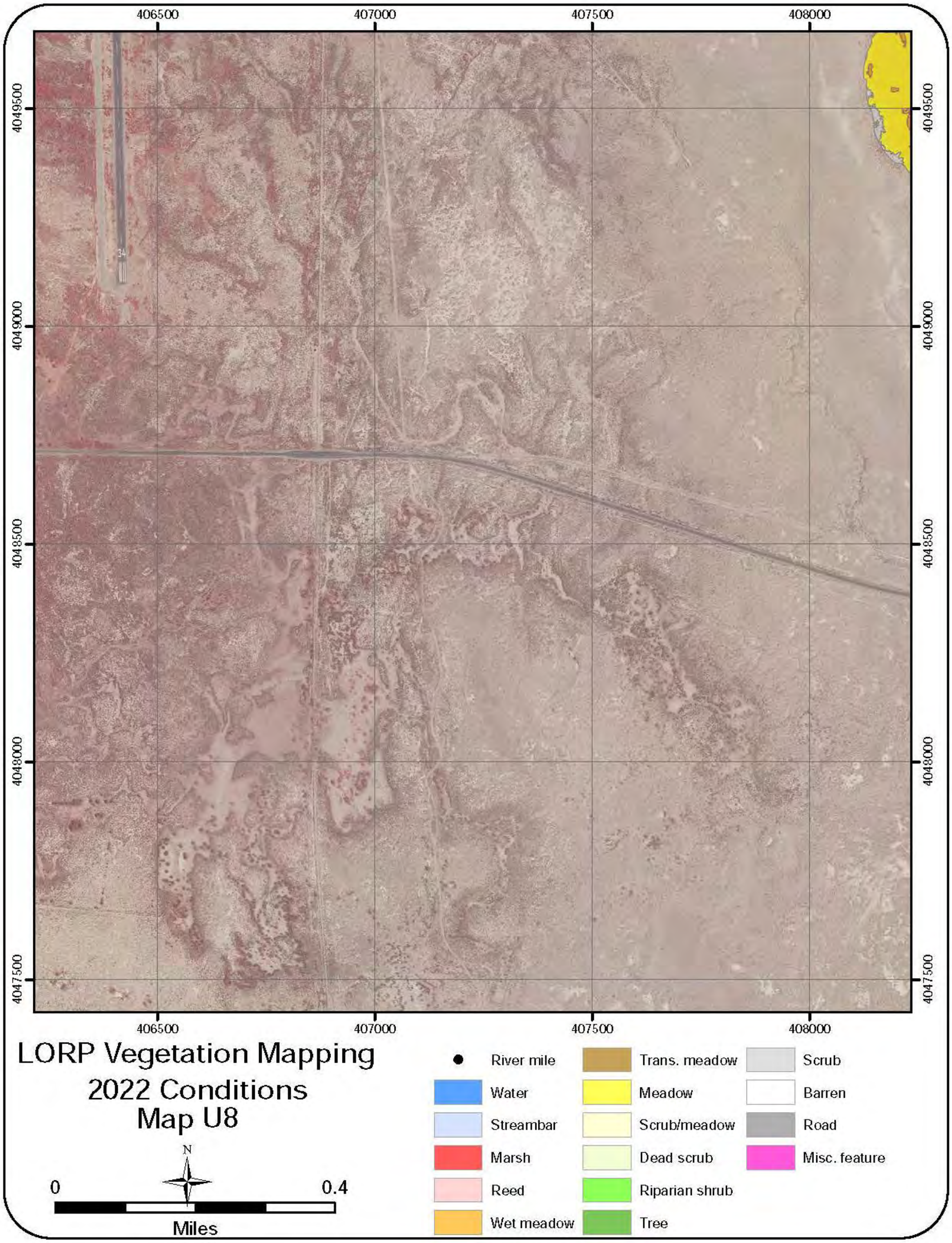
4050500
4050000
50
LORP Vegetation Mapping
2022 Conditions
Map T9
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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4049500
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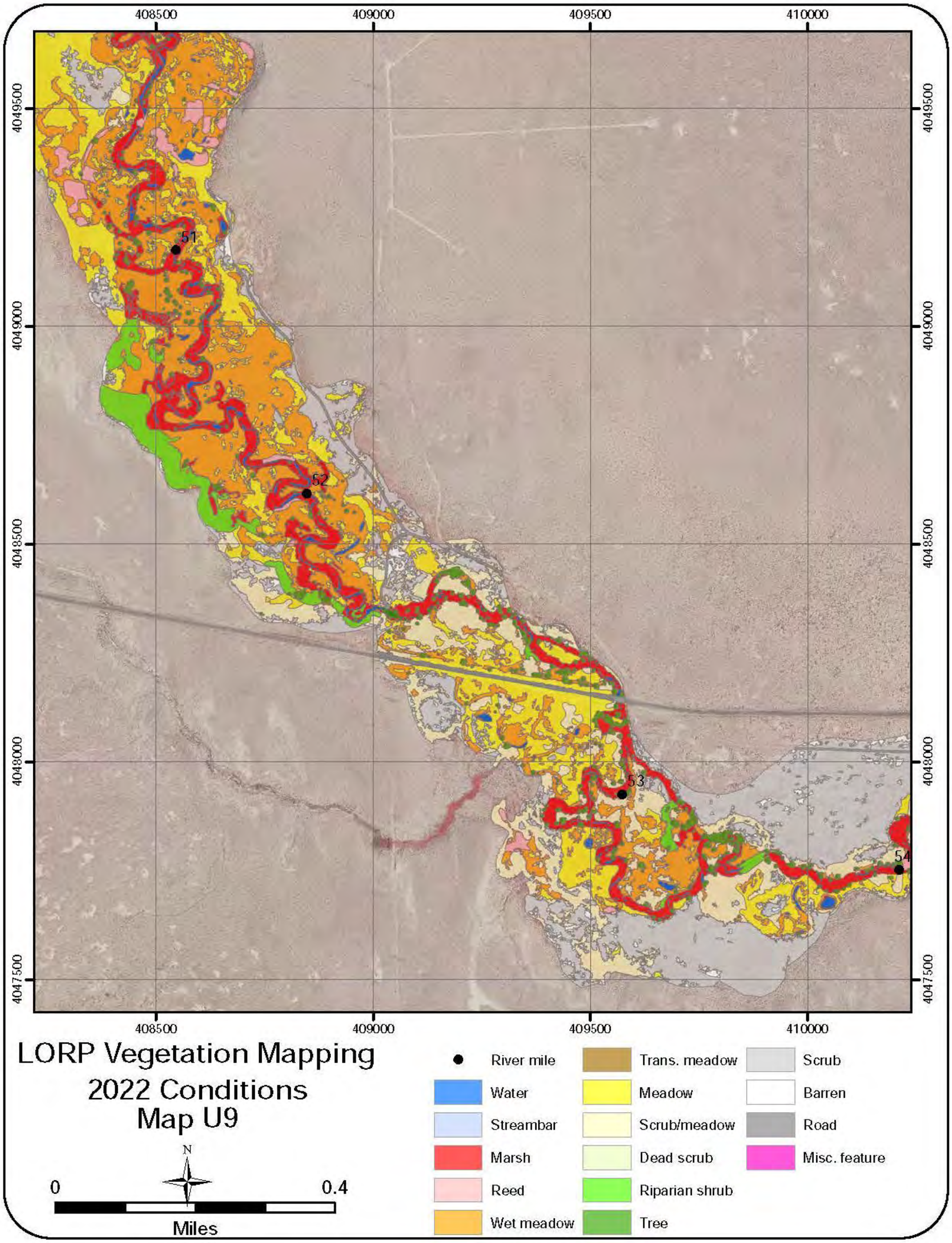
4048500
4048000
4047500
LORP Vegetation Mapping
2022 Conditions
Map U8
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature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4049500
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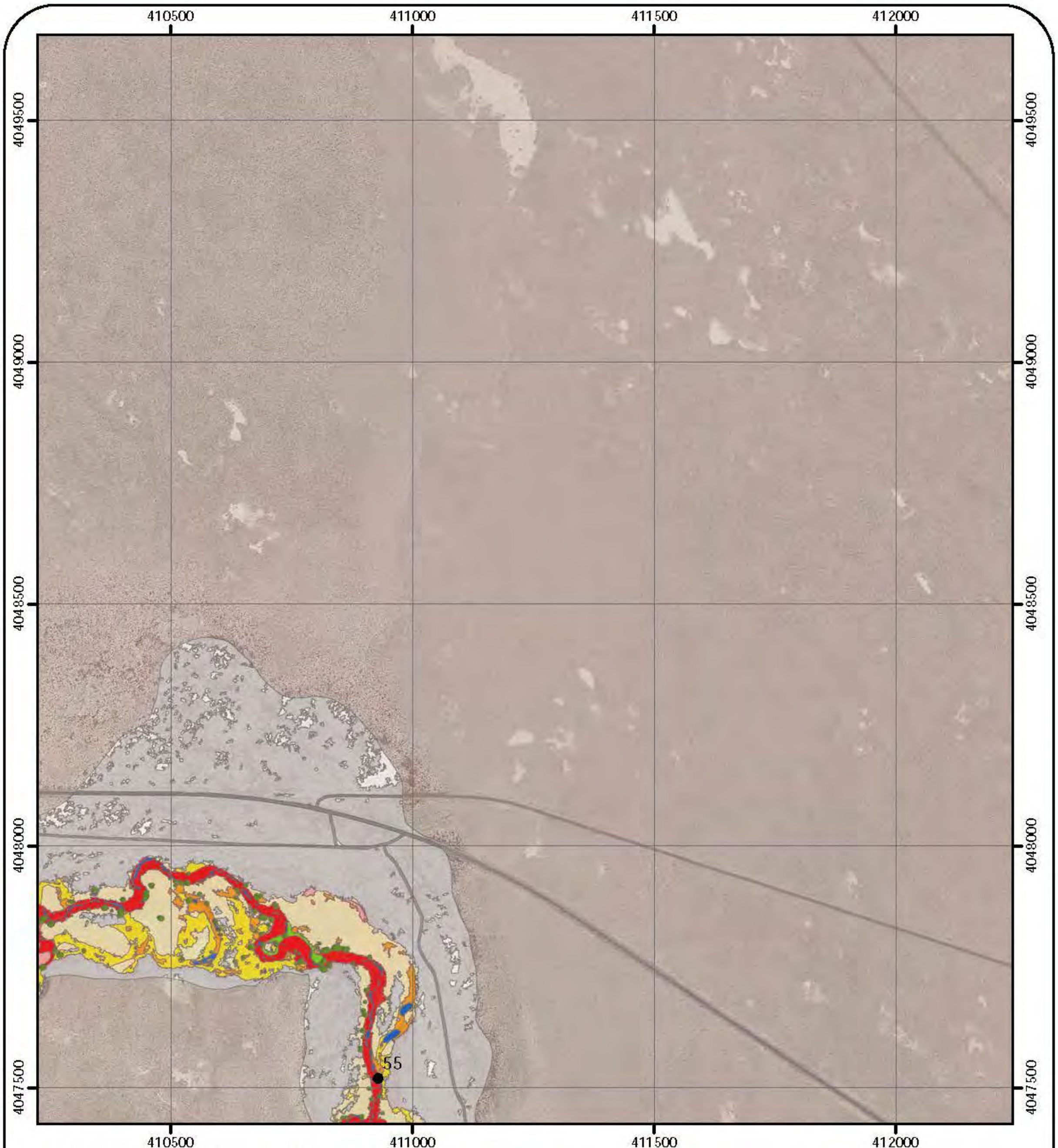
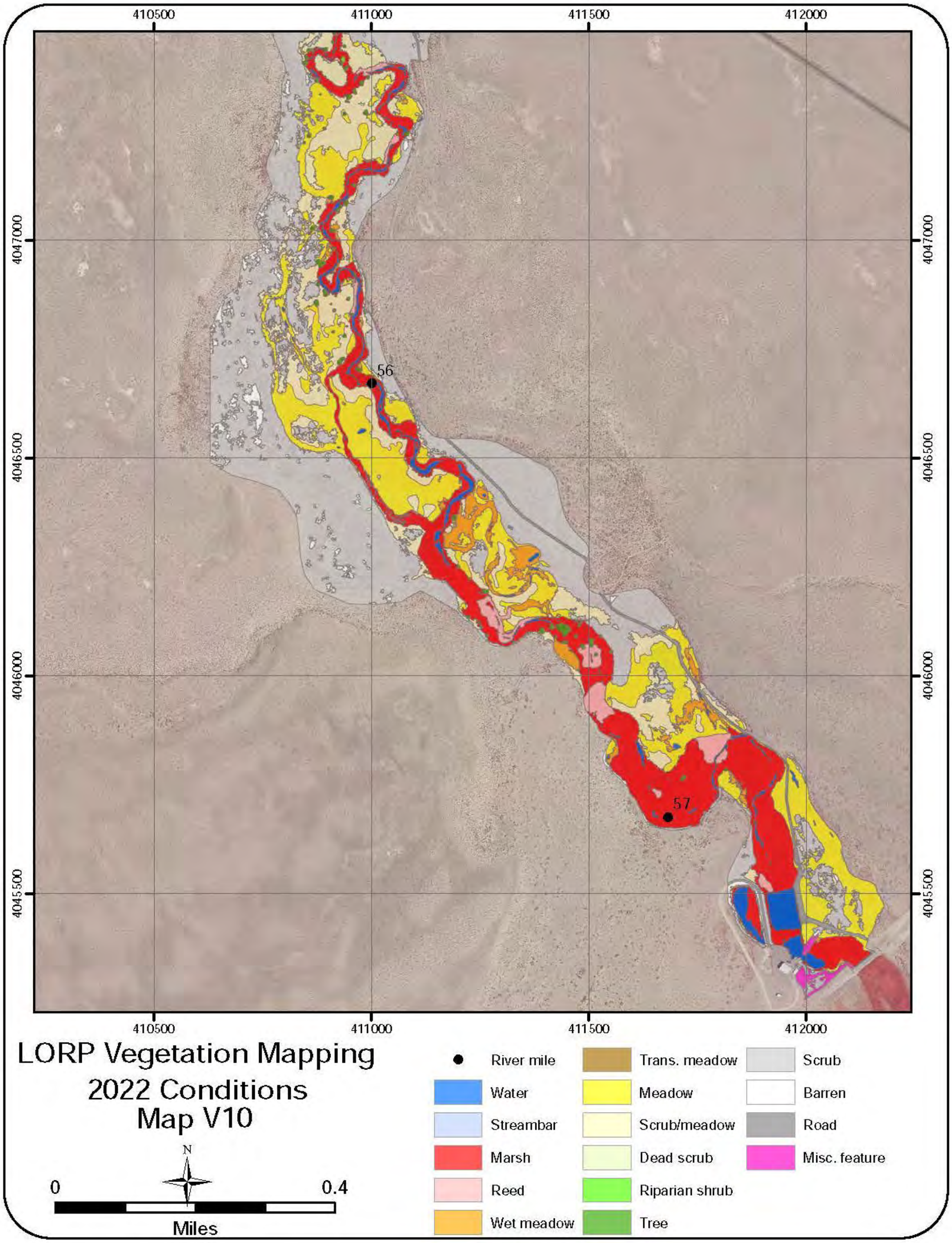
4048500
4048000
4047500
51
52
53
54
LORP Vegetation Mapping
2022 Conditions
Map U9
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature



LORP Vegetation Mapping
2022 Conditions
Map U10


410500
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411500
412000
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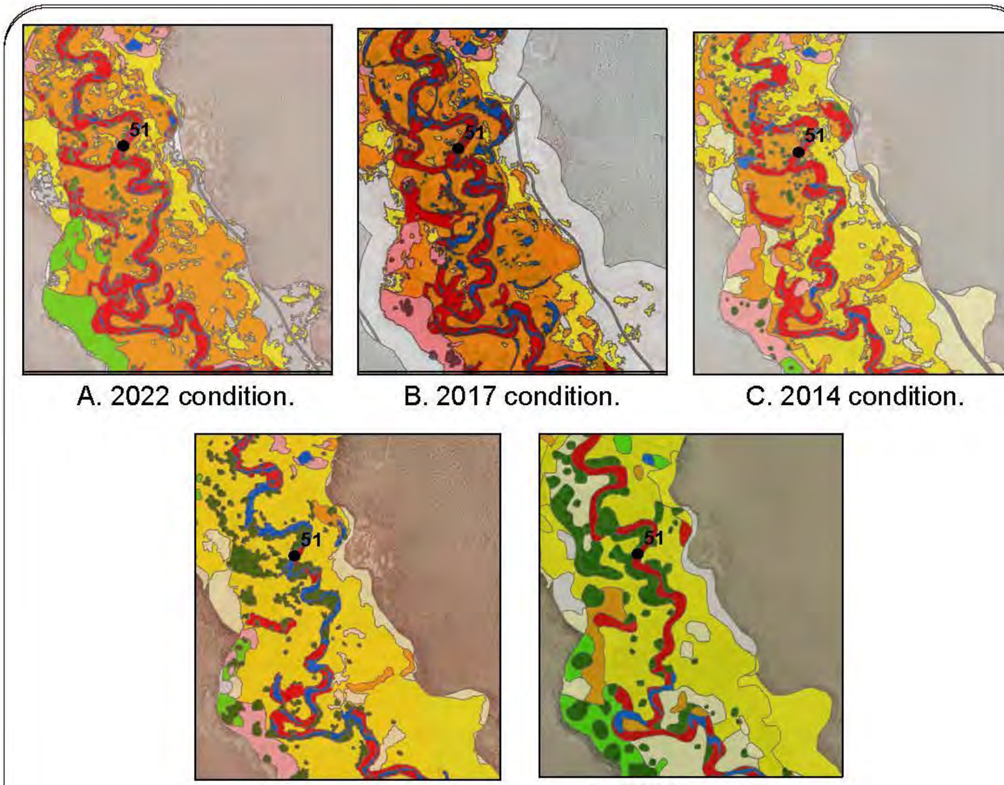
4046500
4046000
4045500
56
57
LORP Vegetation Mapping
2022 Conditions
Map V10
N
0
0.4
Miles
River mile
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Dead scrub
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature

3.4.3 Appendix D.

APPENDIX D
LORP Vegetation
2000 through 2022 Condiition



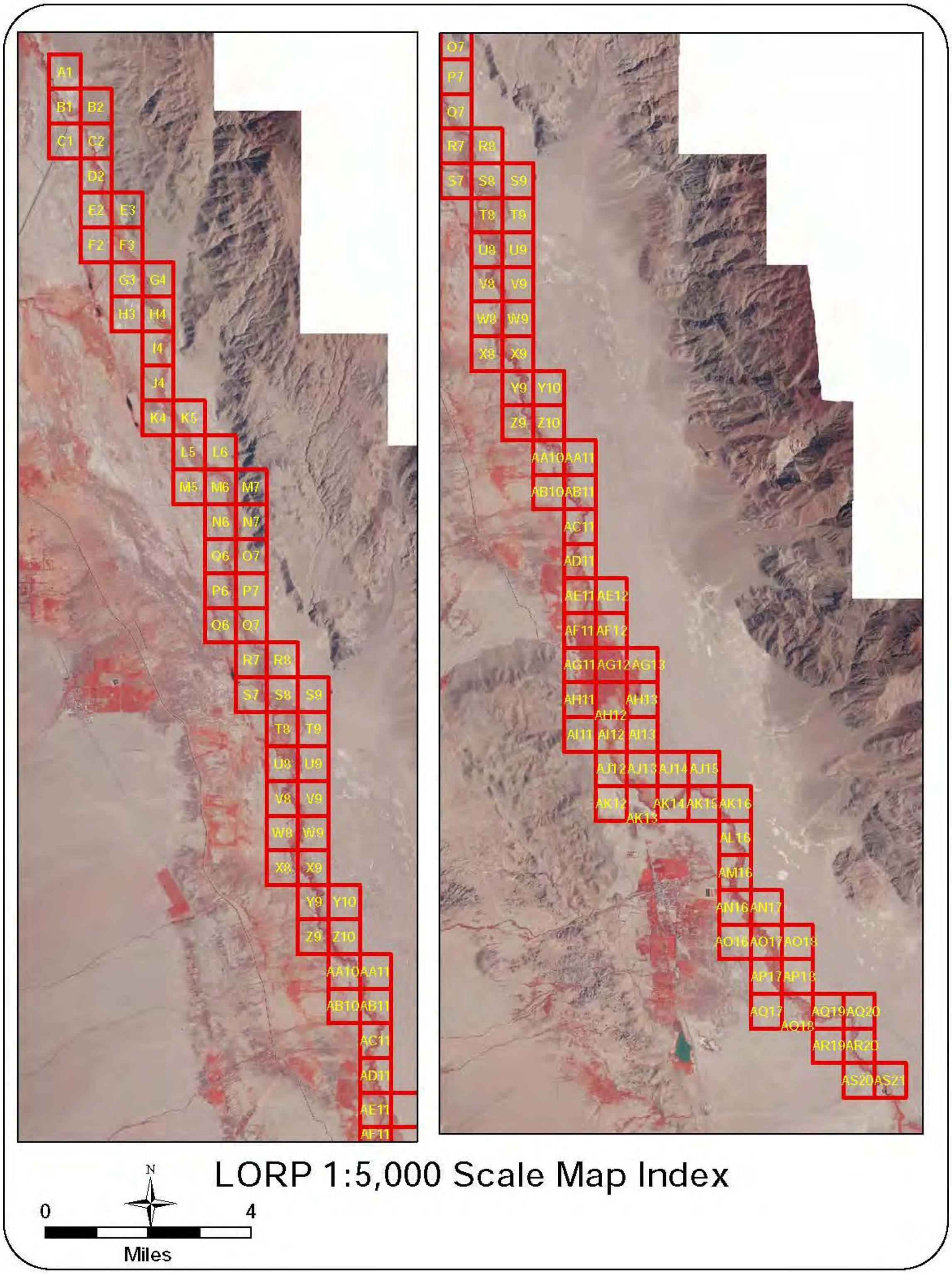
A. 2022 condition.

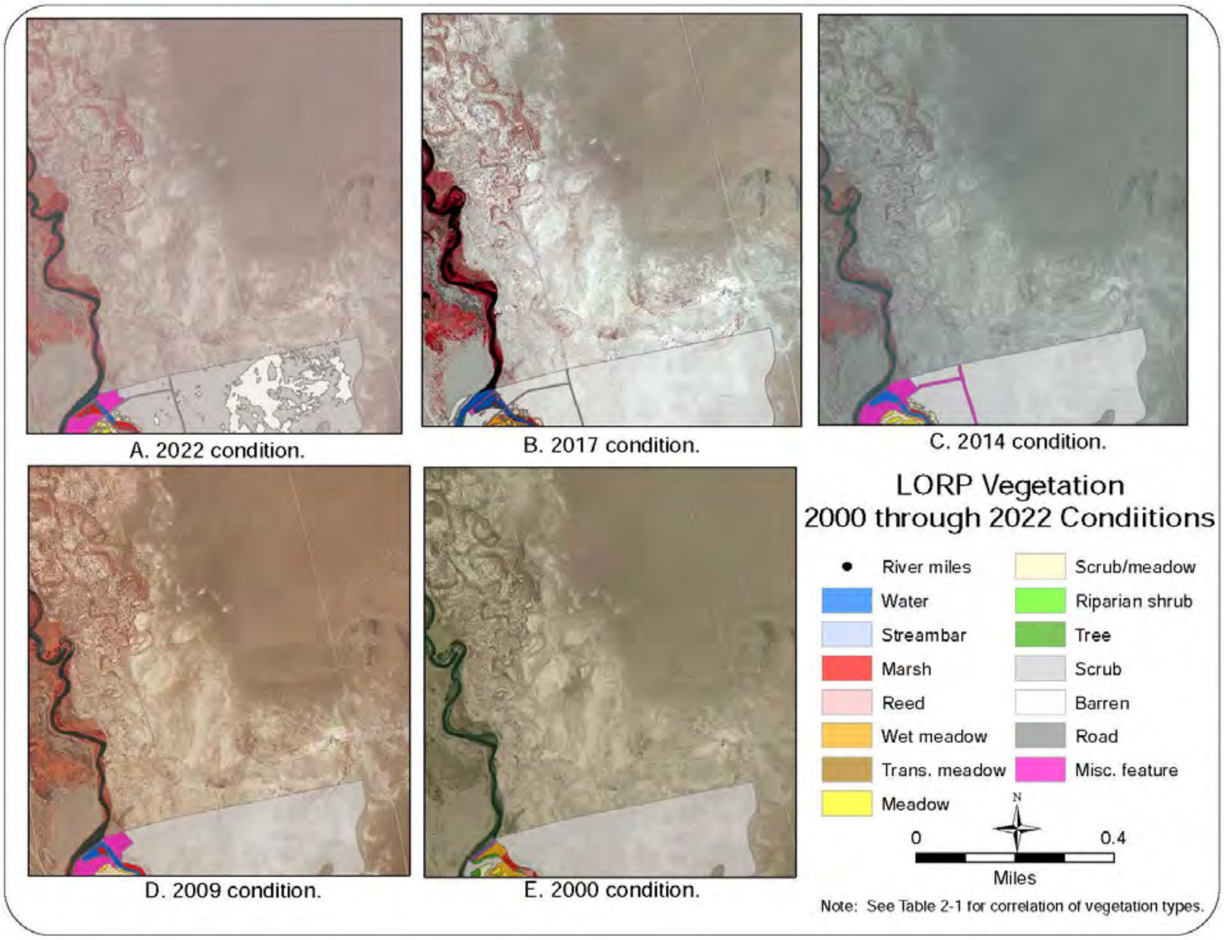
B. 2017 condition.

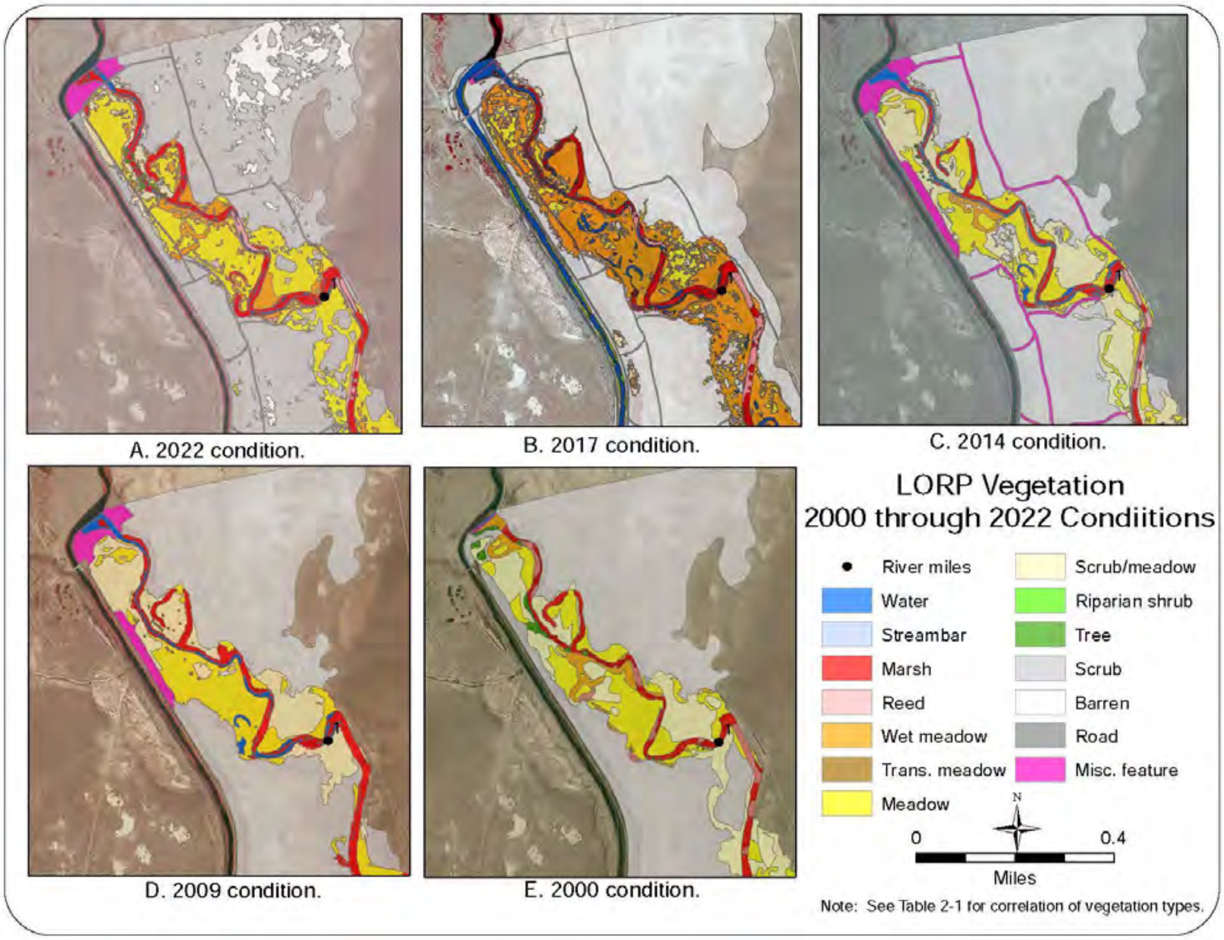
C. 2014 condition.

D. 2009 condition.

E. 2000 condition.


A1
B1 B2
C1 C2
D2
E2 E3
F2 F3
G3 G4
H3 H4
I4
J4
K4 K5
L5 L6
M5 M6 M7
N6 N7
O6 O7
P6 P7
Q6 Q7
R7 R8
S7 S8 S9
T8 T9
U8 U9
V8 V9
W8 W9
X8 X9
Y9 Y10
Z9 Z10
AA10 AA11
AB10 AB11
AC11
AD11
AE11
AF11
O7
P7
Q7
R7 R8
S7 S8 S9
T8 T9
U8 U9
V8 V9
W8 W9
X8 X9
Y9 Y10
Z9 Z10
AA10 AA11
AB10 AB11
AC11
AD11
AE11 AE12
AF11 AF12
AG11 AG12 AG13
AH11 AH13
AH12
AI11 AI12 AI13
AJ12 AJ13 AJ14 AJ15
AK12 AK14 AK15 AK16
AK13
AL16
AM16
AN16 AN17
AO16 AO17 AO18
AP17 AP18
AQ17 AQ19 AQ20
AQ18
AR19 AR20
AS20 AS21
LORP 1:5,000 Scale Map Index
N
0
4
Miles


A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
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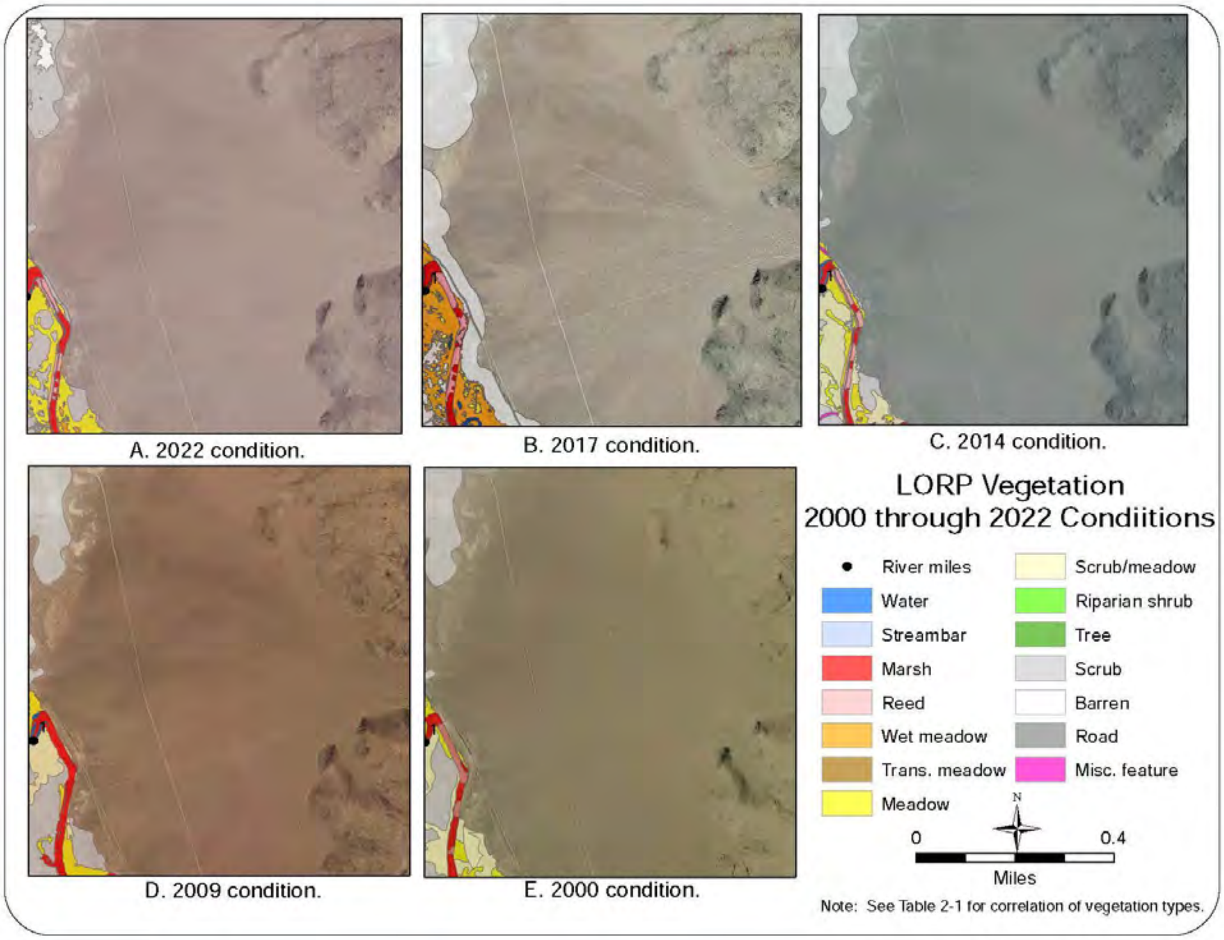
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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B. 2017 condition.
C. 2014 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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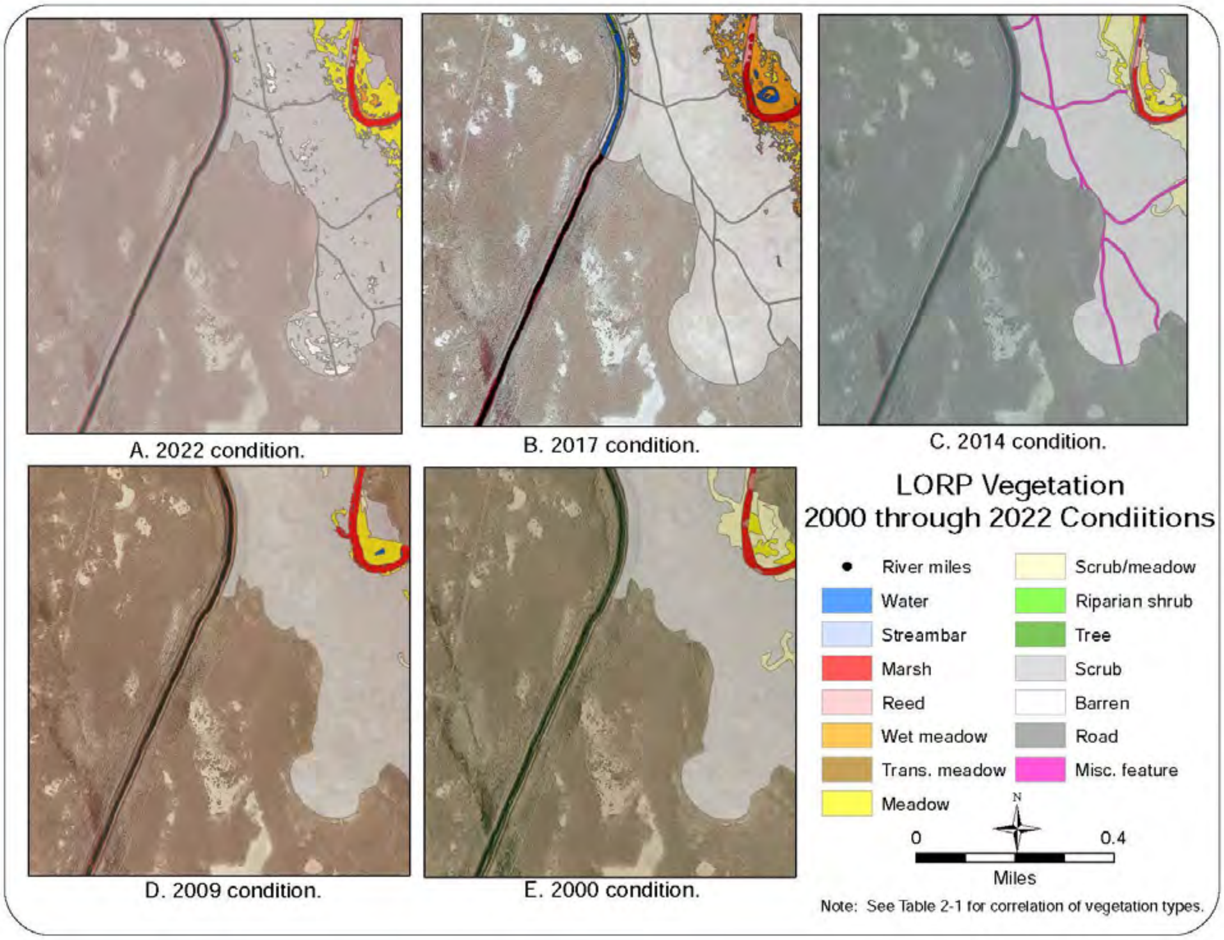
0.4
Miles
D. 2009 condition.
E. 2000 condition.
Note: See Table 2-1 for correlation of vegetation types.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B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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0.4
Miles
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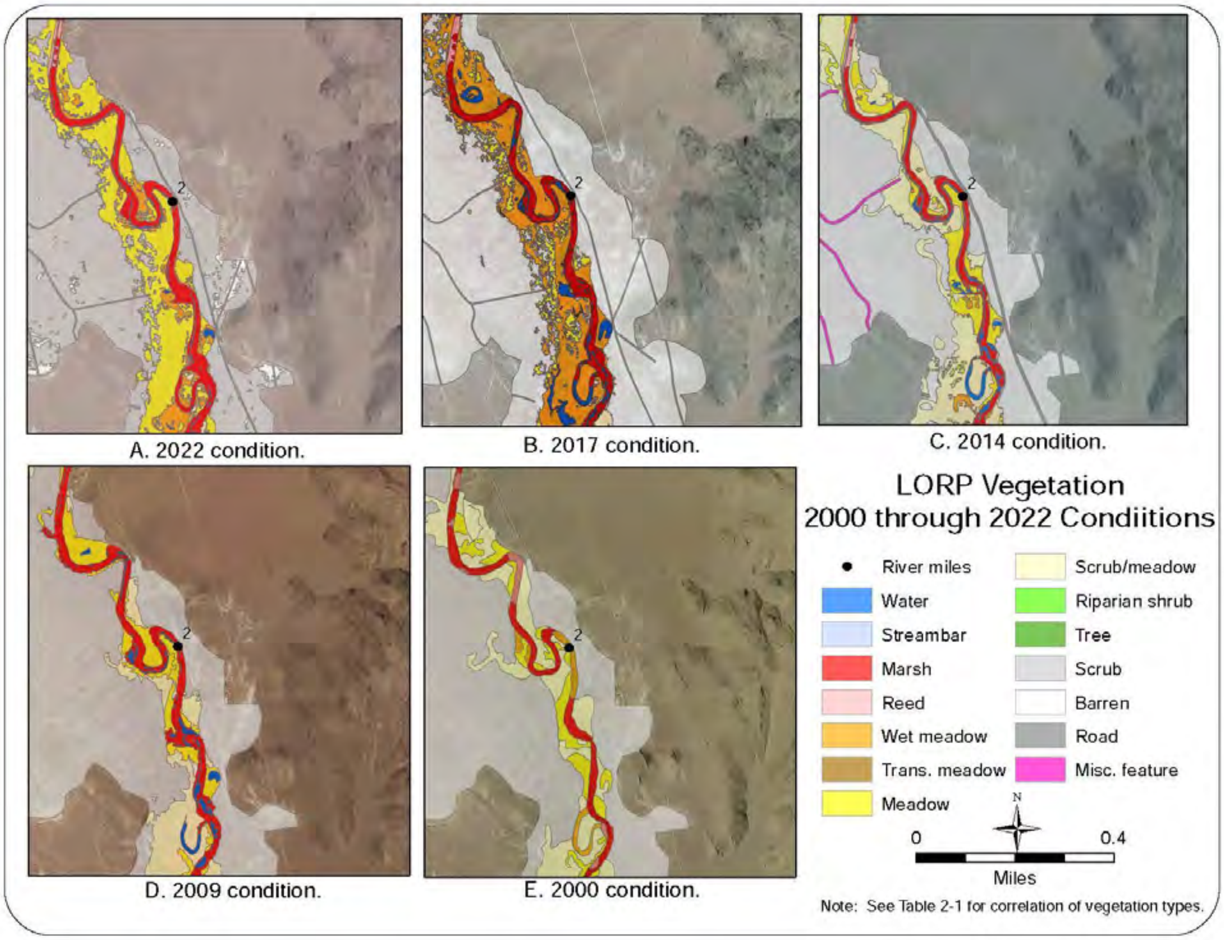
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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0.4
Miles
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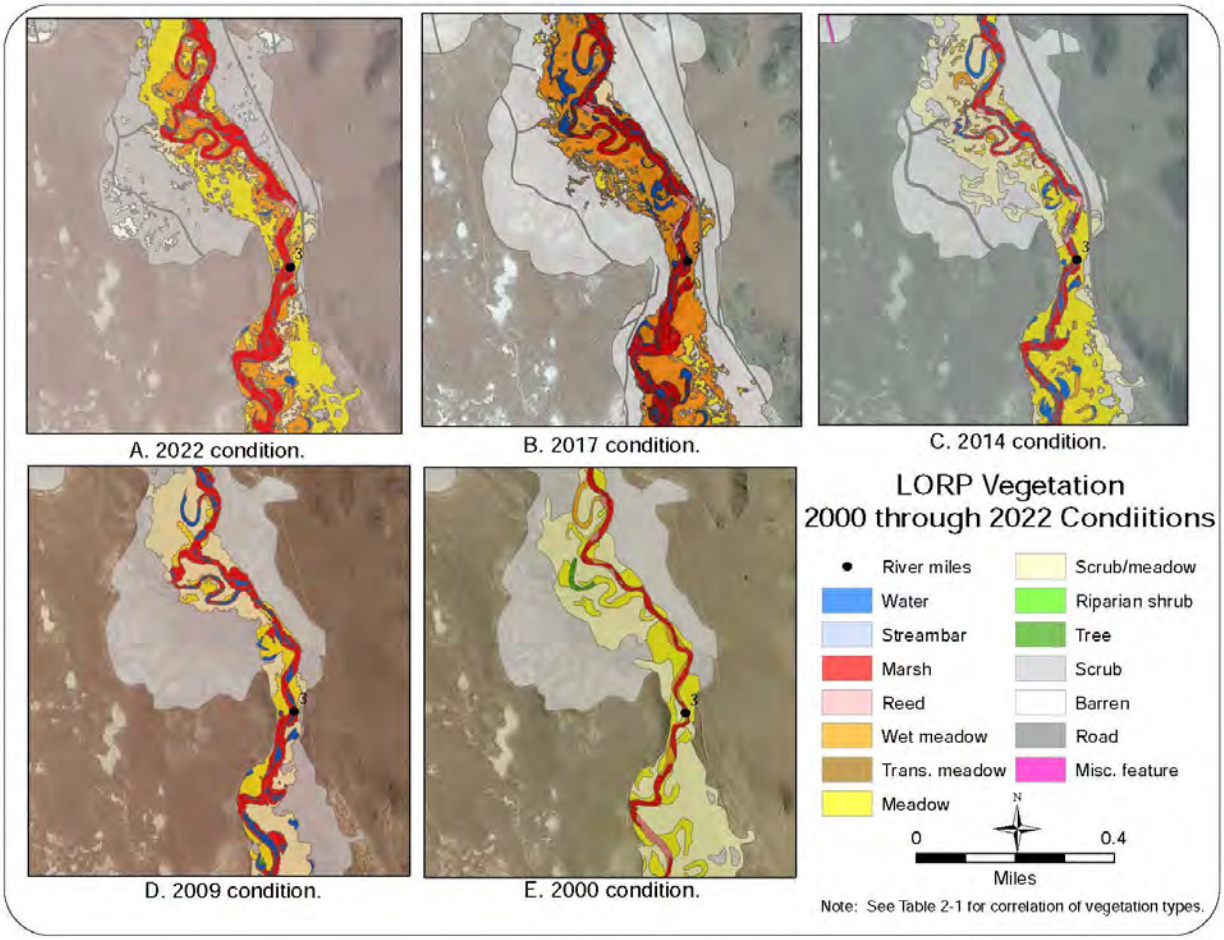
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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0.4
Miles
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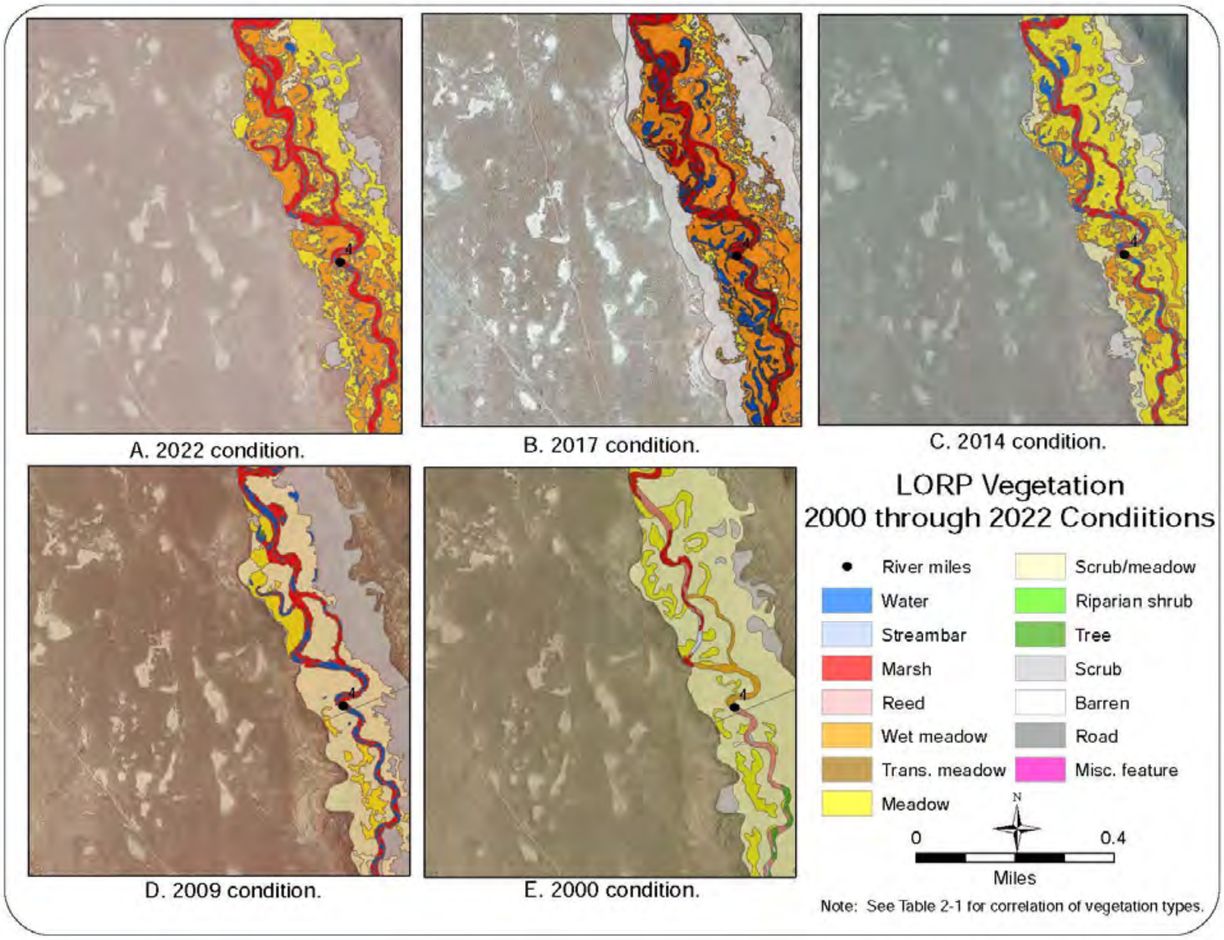
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Streambar
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Meadow
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Riparian shrub
Tree
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Misc. feature
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Miles
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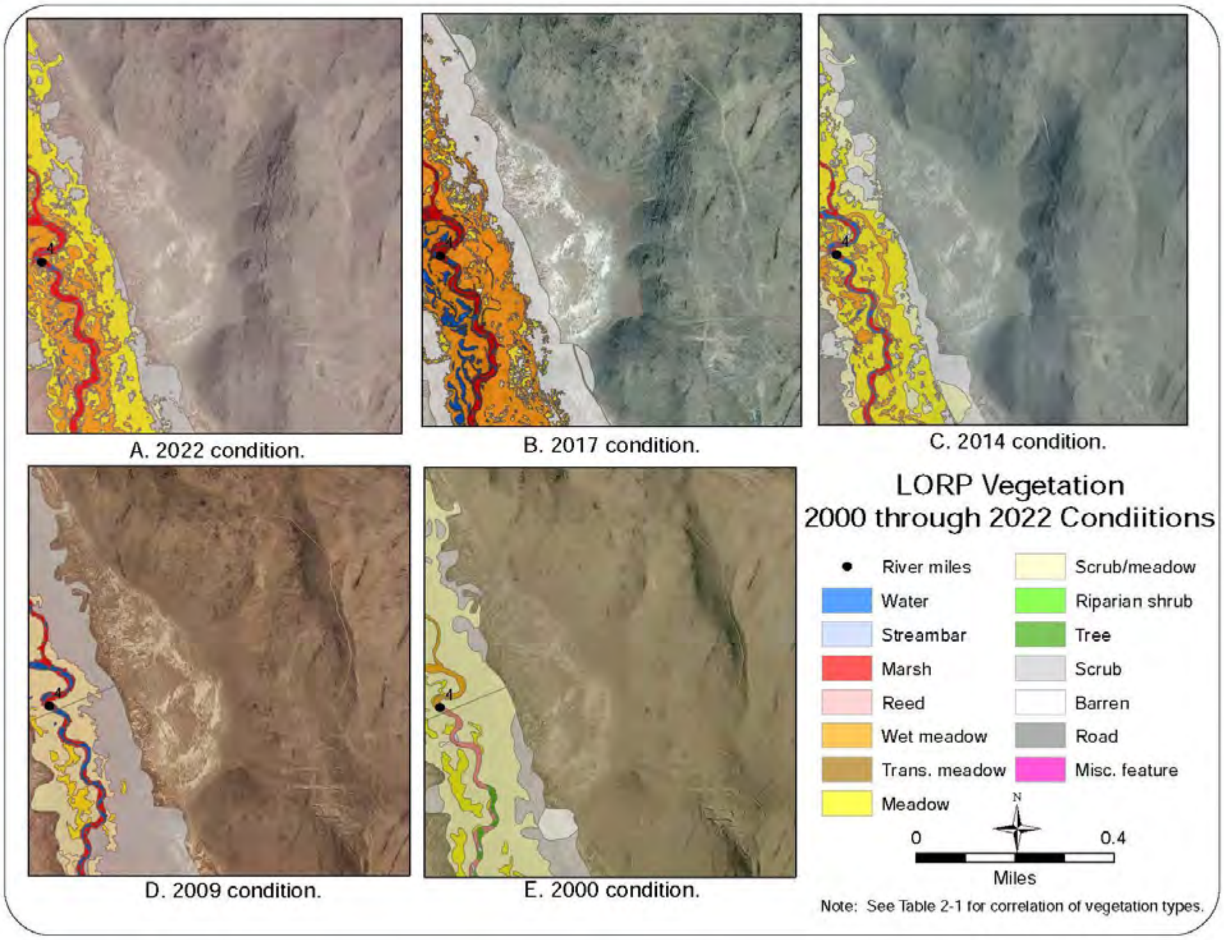
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Streambar
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Meadow
Scrub/meadow
Riparian shrub
Tree
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Barren
Road
Misc. feature
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Miles
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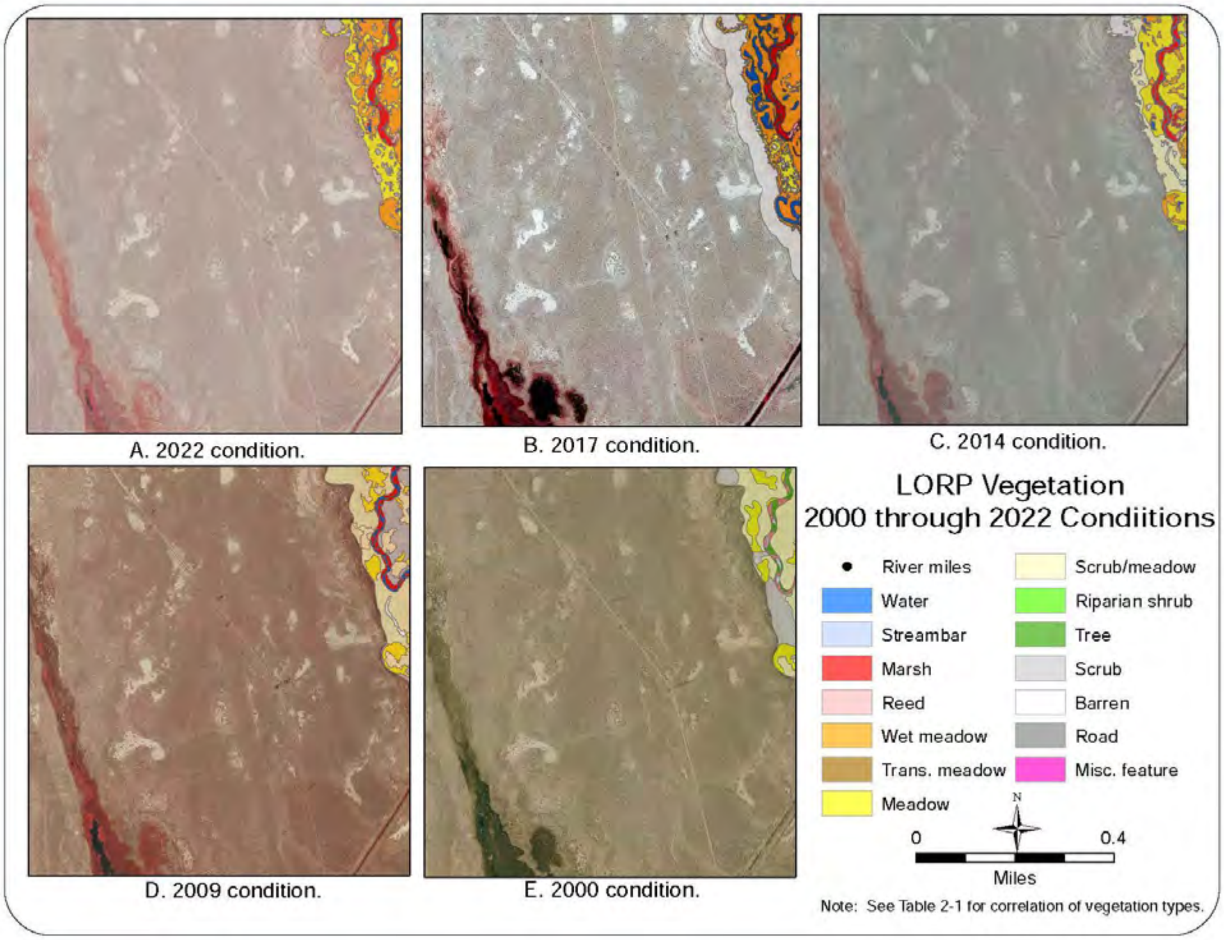
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Streambar
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Riparian shrub
Tree
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Barren
Road
Misc. feature
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0.4
Miles
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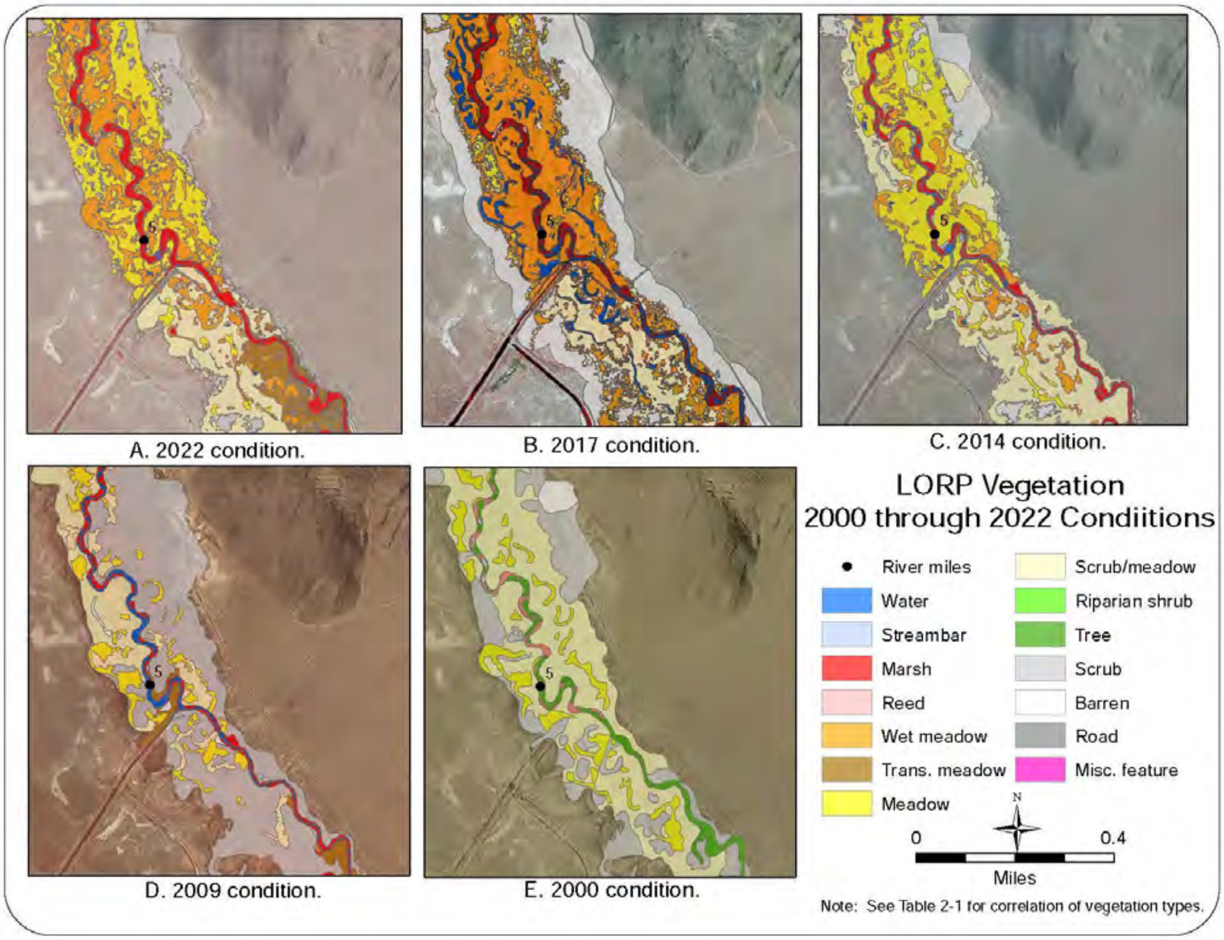
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B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Streambar
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Trans. meadow
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Scrub/meadow
Riparian shrub
Tree
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Barren
Road
Misc. feature
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Miles
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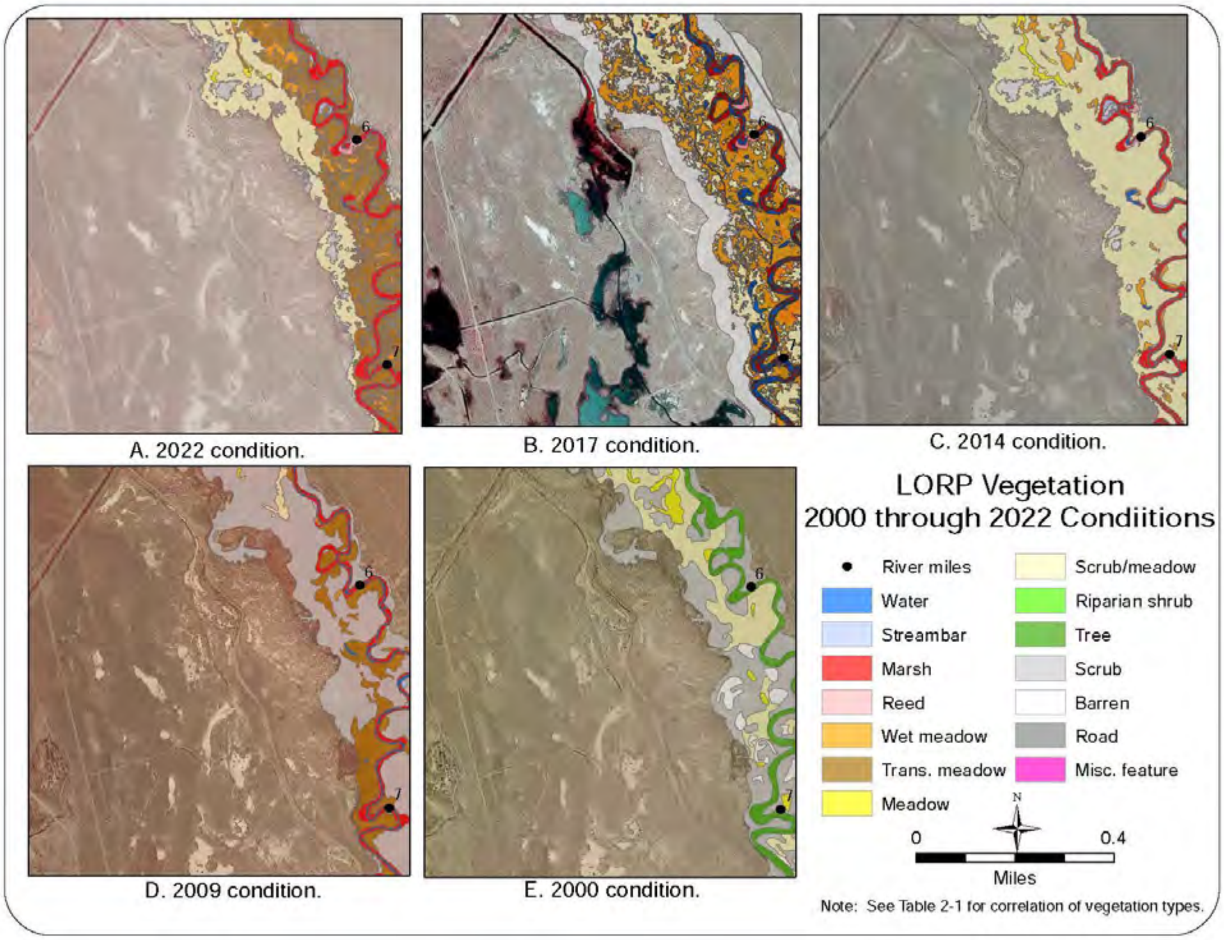
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B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Riparian shrub
Tree
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Barren
Road
Misc. feature
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Miles
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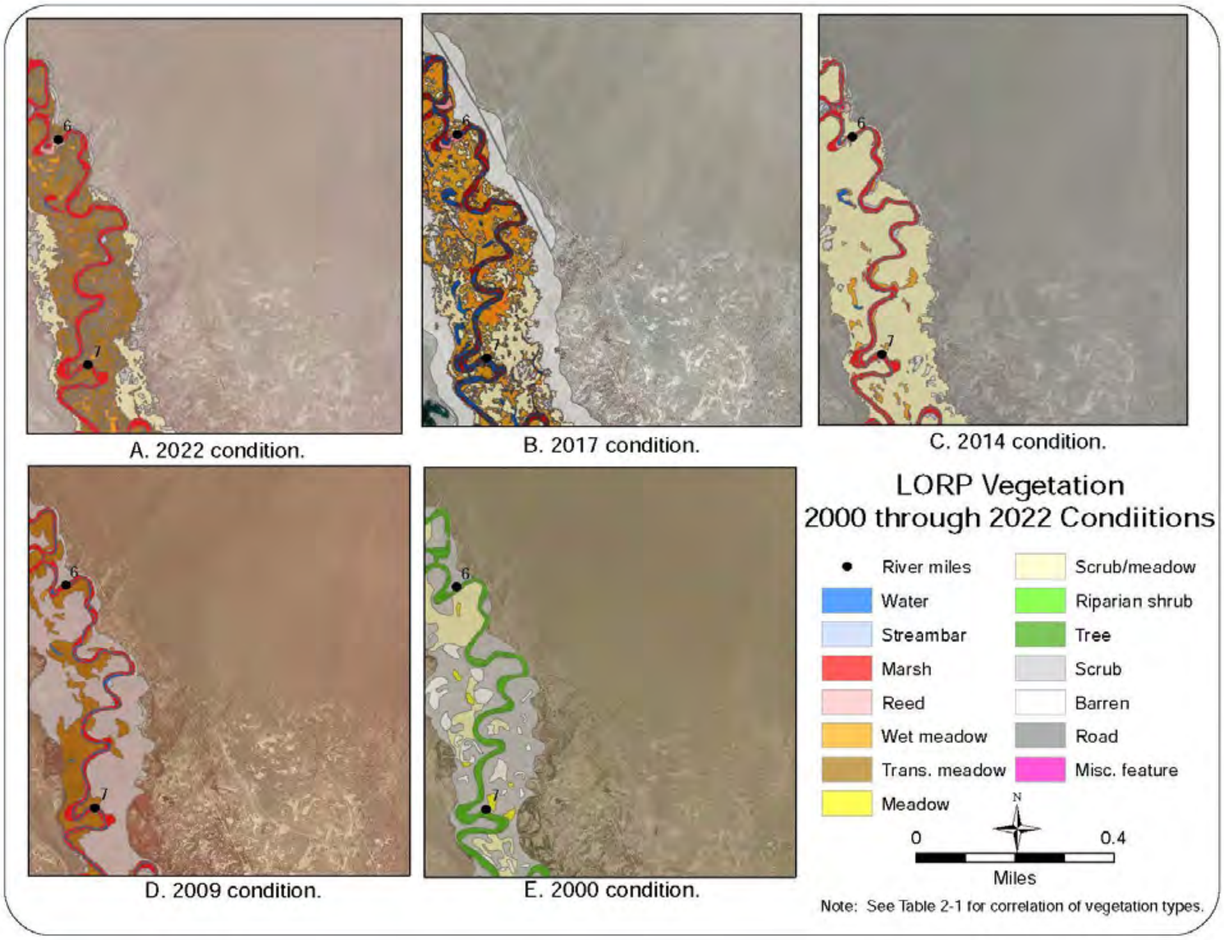
6
7
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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Miles
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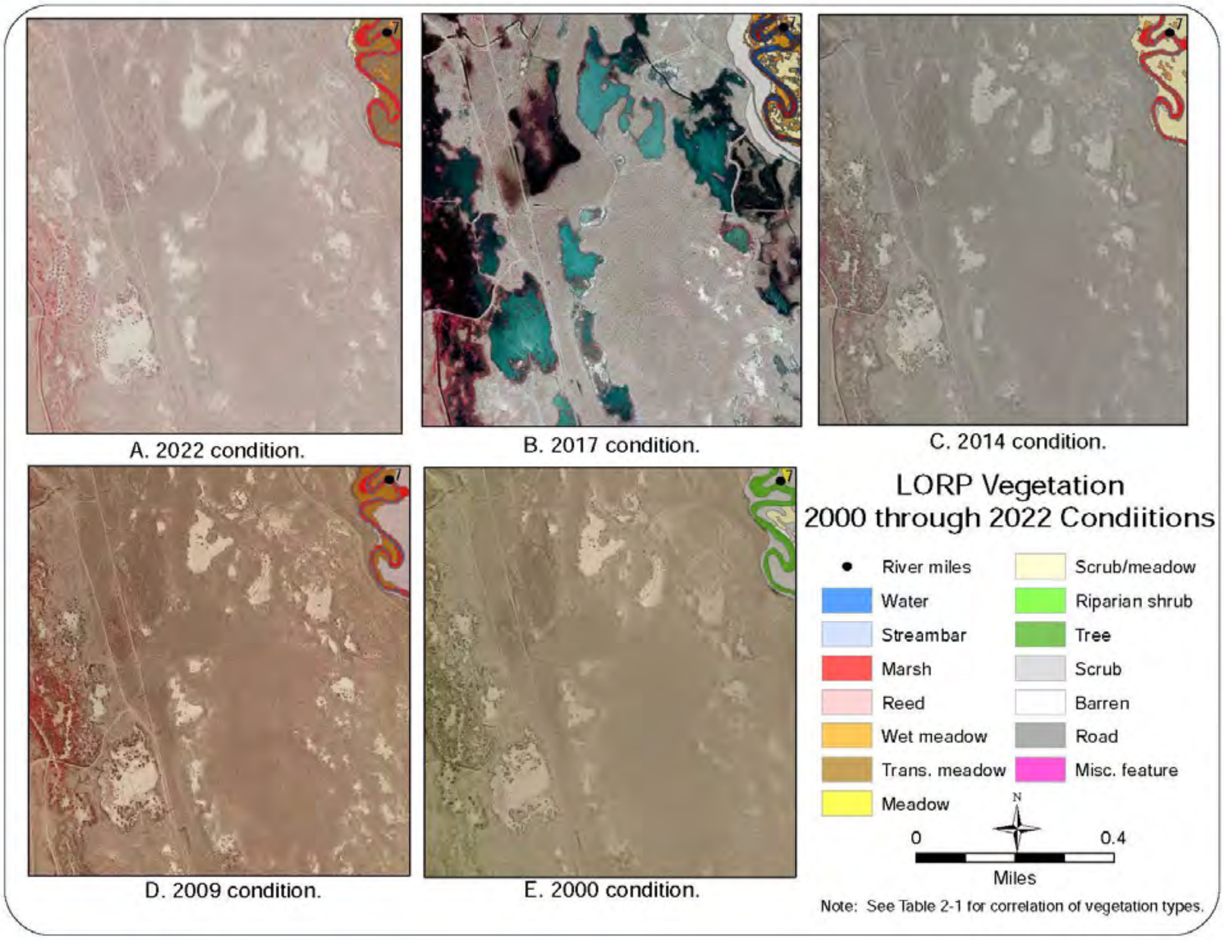
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B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
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Misc. feature
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Miles
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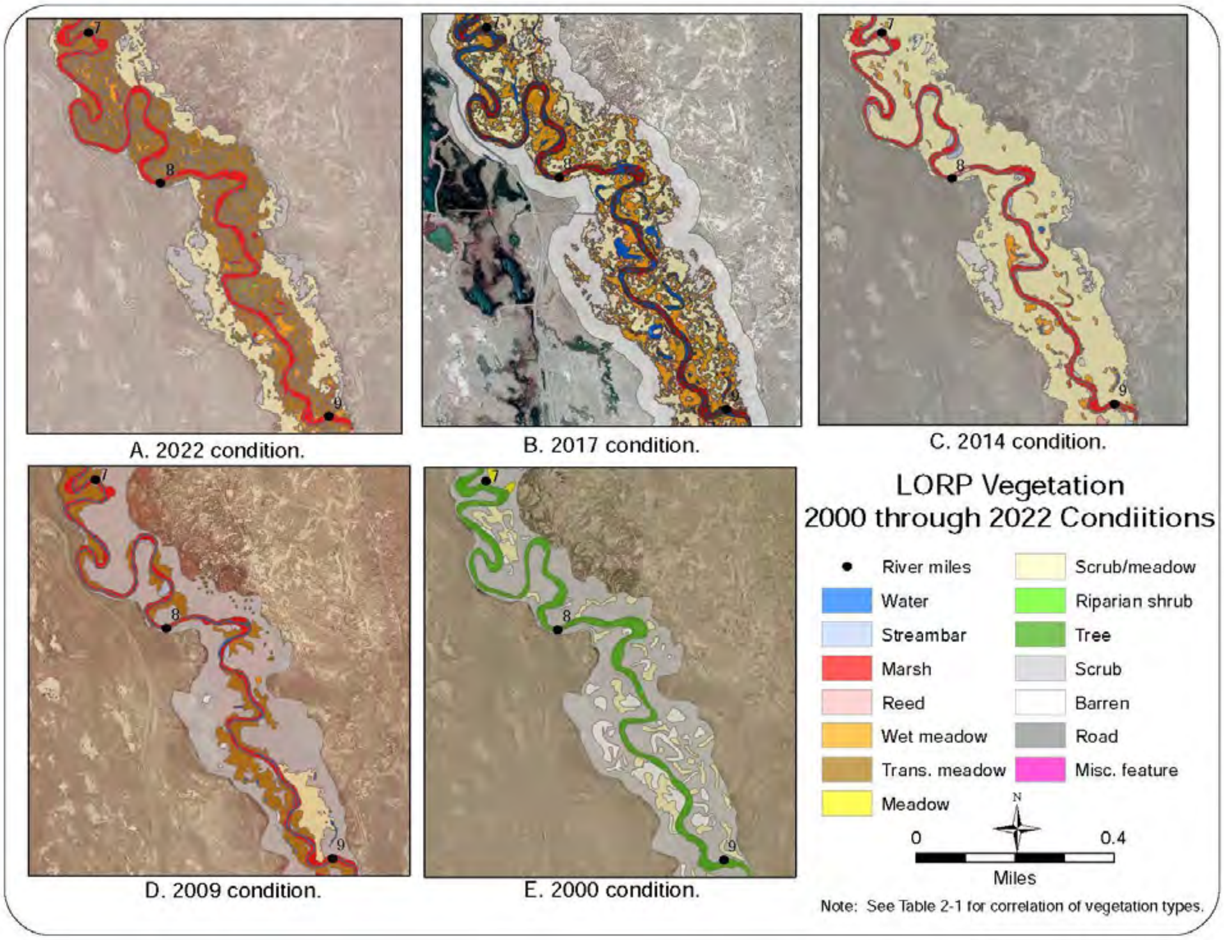
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B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Misc. feature
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Miles
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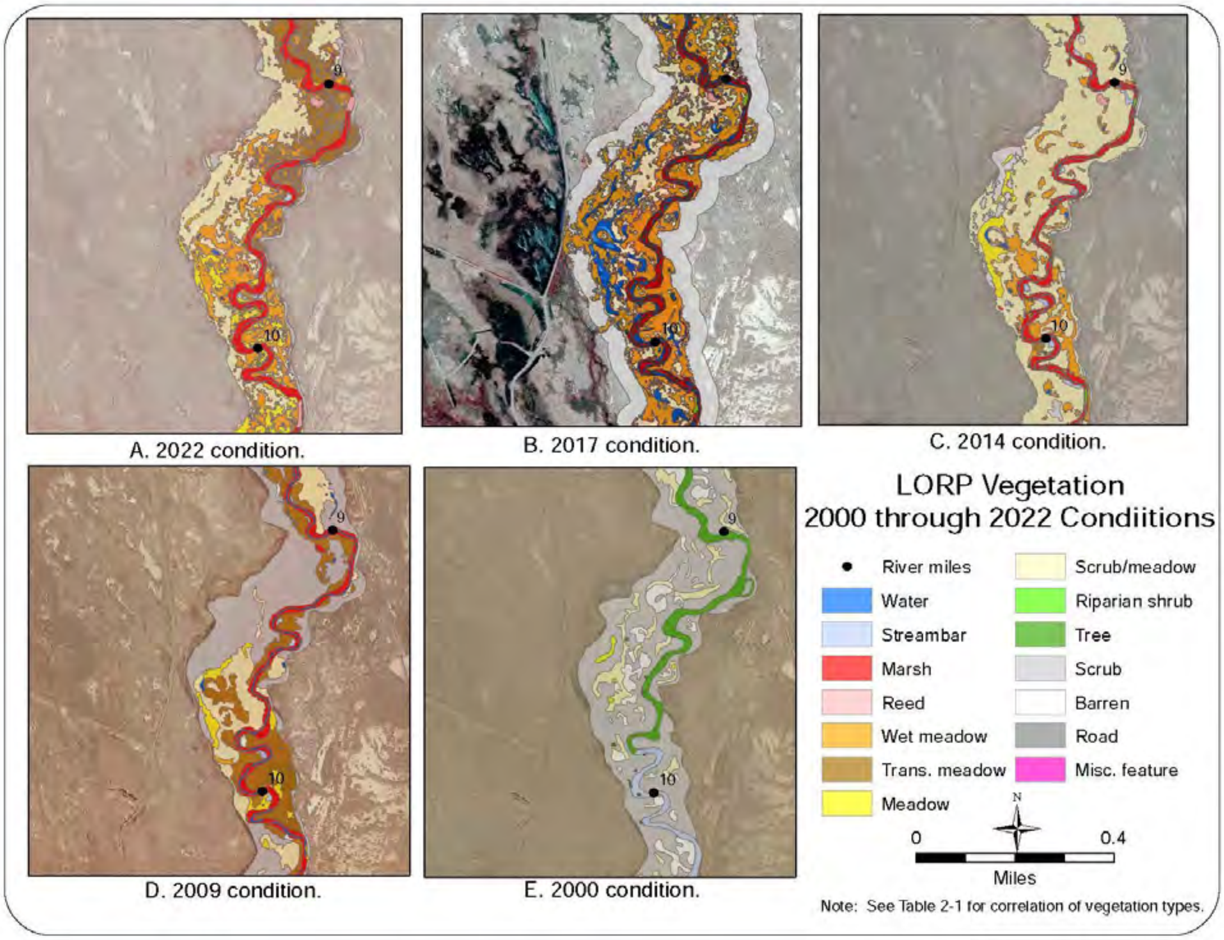
9
10
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Riparian shrub
Tree
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Barren
Road
Misc. feature
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0.4
Miles
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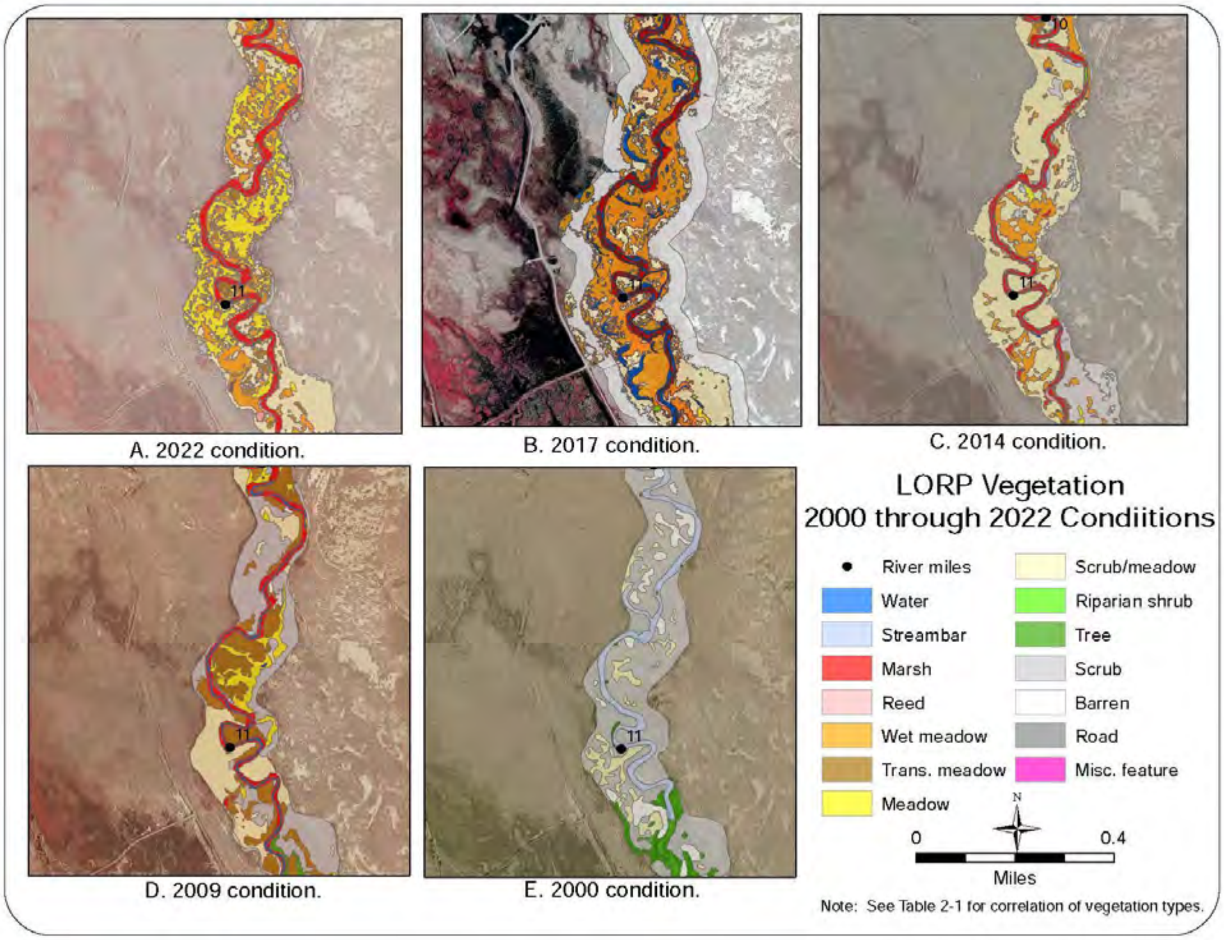
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
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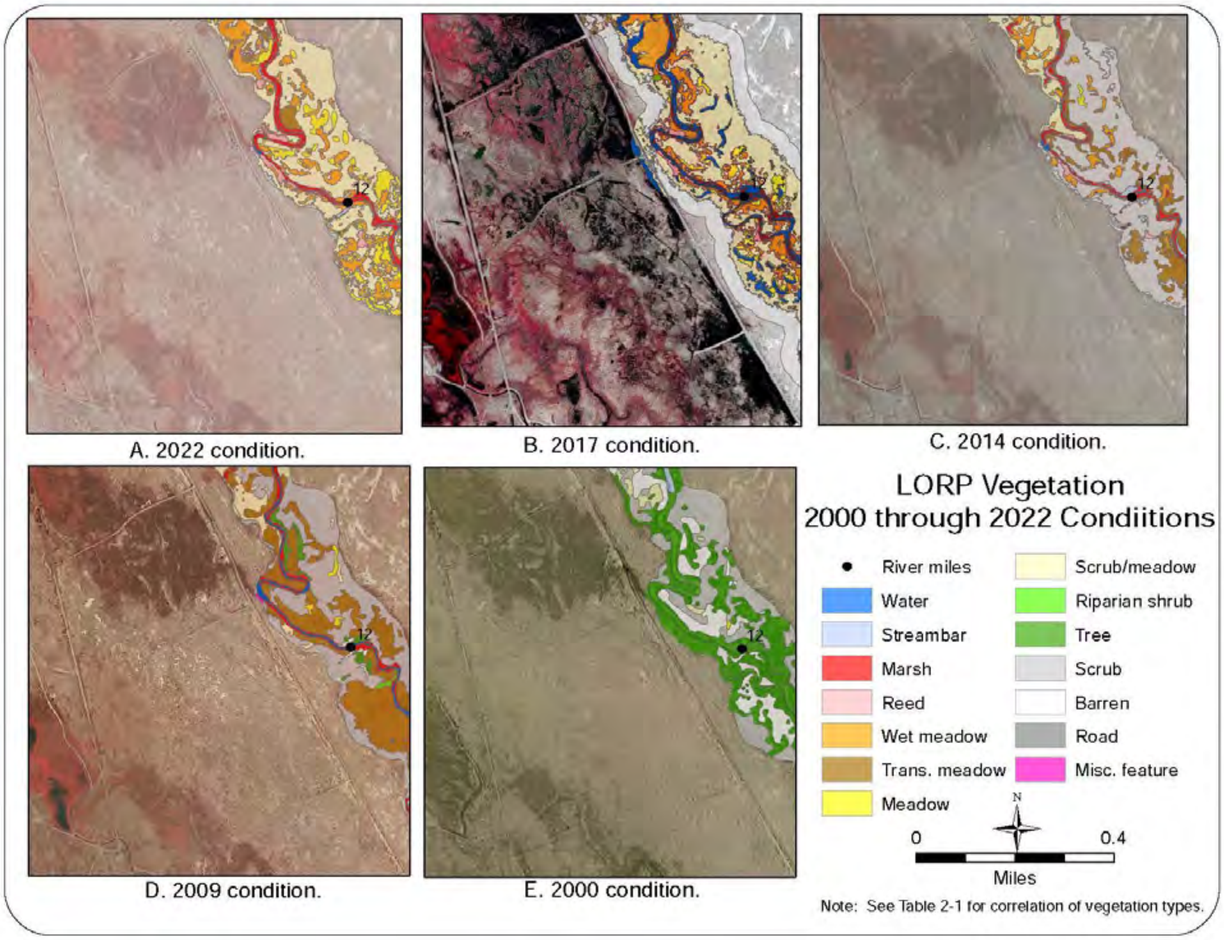
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A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Scrub/meadow
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Misc. feature
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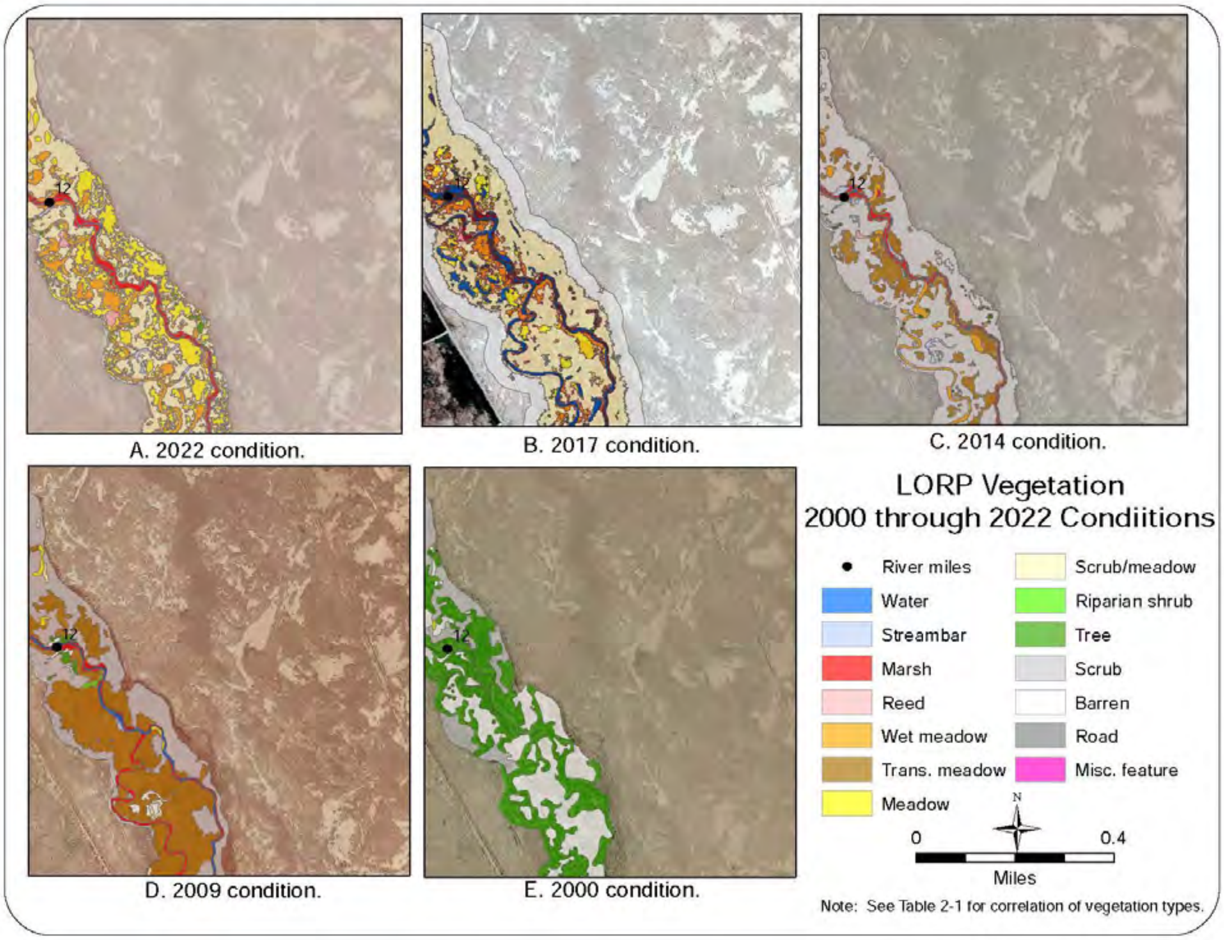
Miles
Note: See Table 2-1 for correlation of vegetation types.


12
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Misc. feature
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Miles
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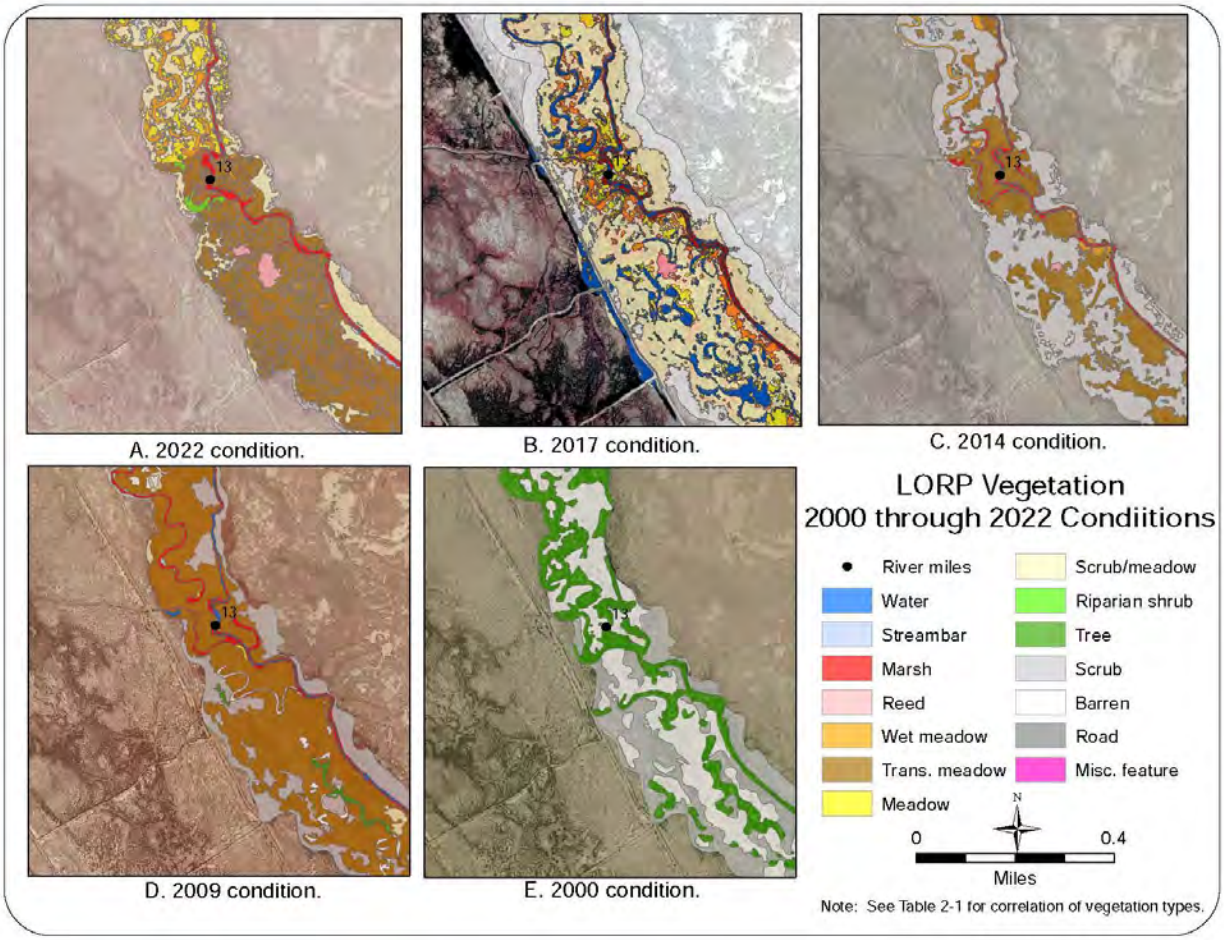
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C. 2014 condition.
D. 2009 condition.
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LORP Vegetation
2000 through 2022 Condiitions
River miles
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Misc. feature
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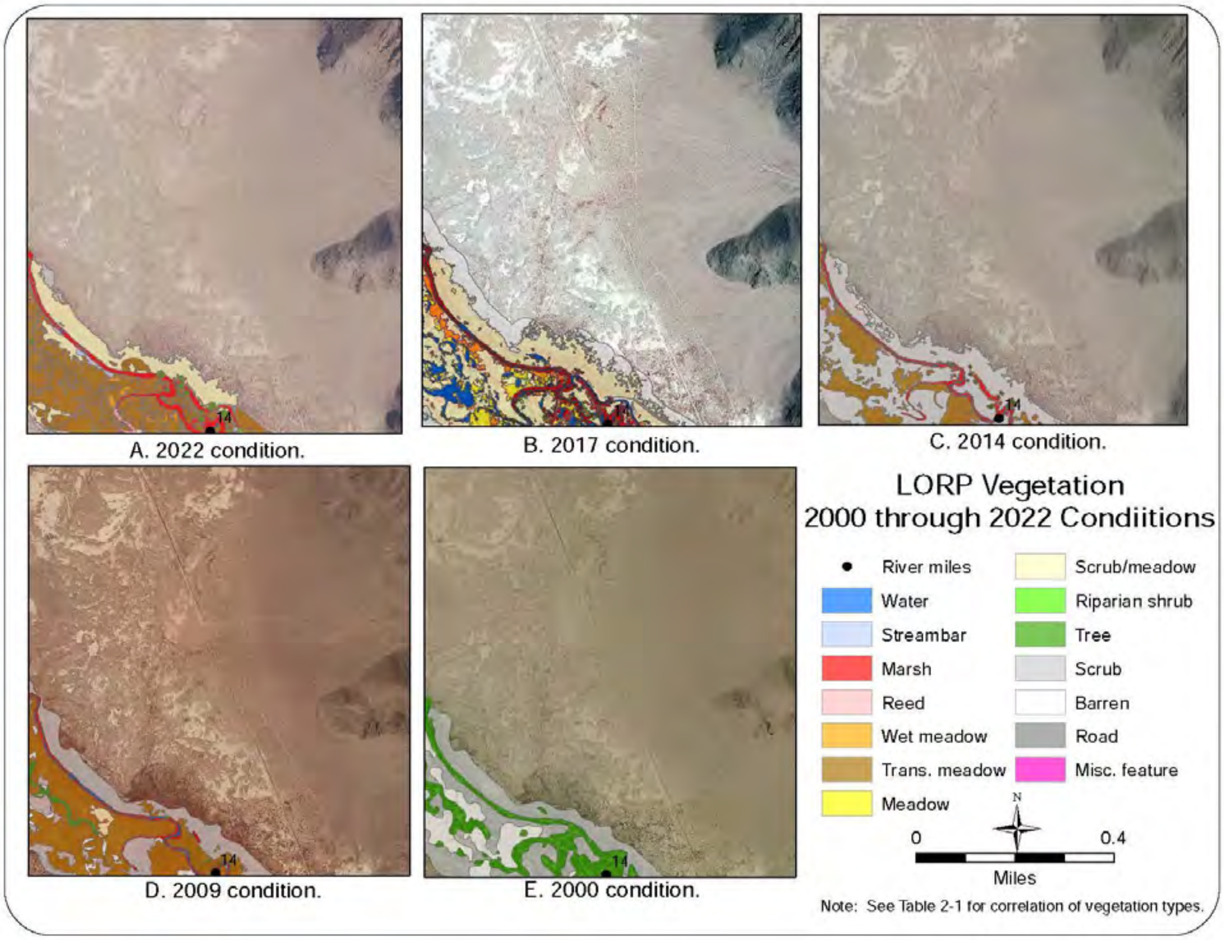
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LORP Vegetation
2000 through 2022 Condiitions
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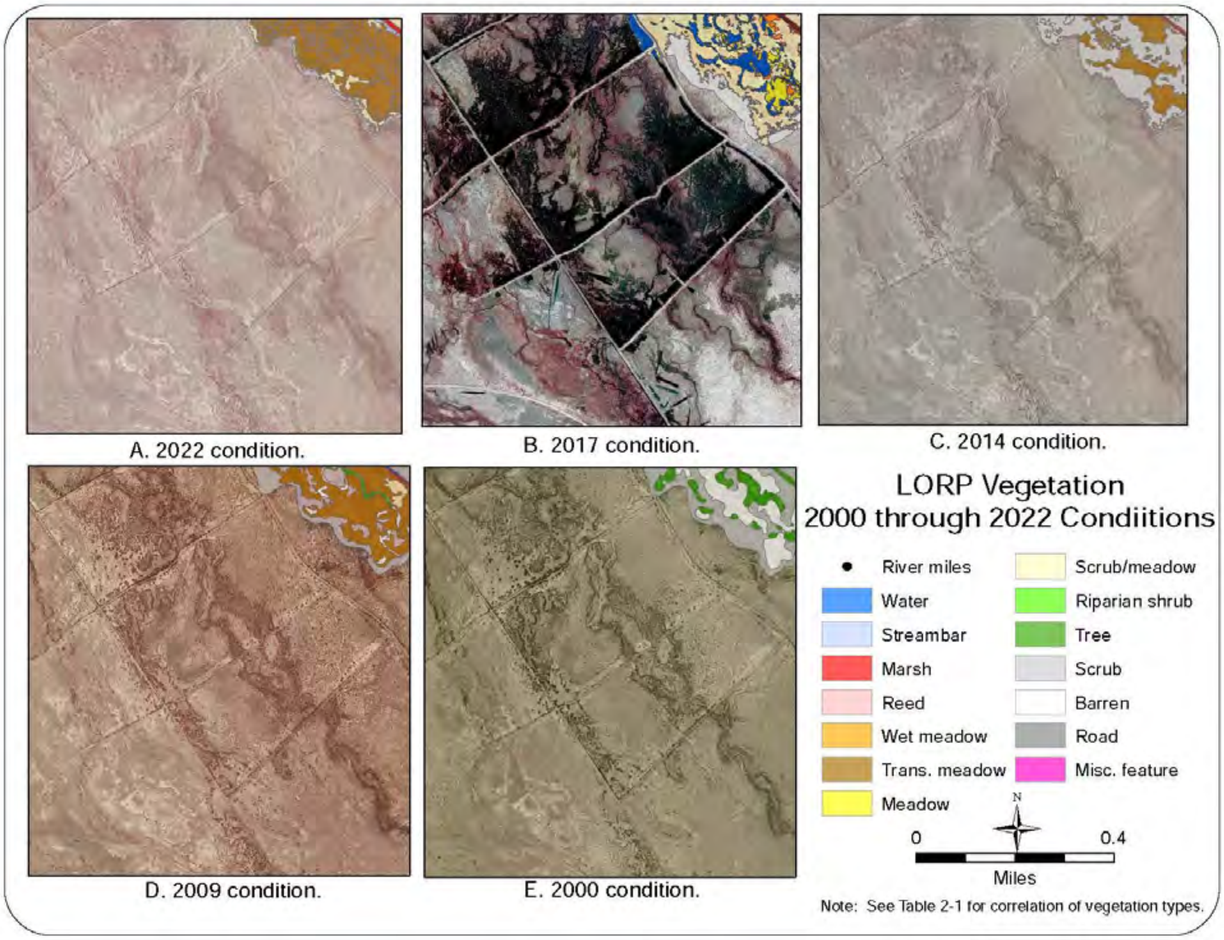
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B. 2017 condition.
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D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
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Misc. feature
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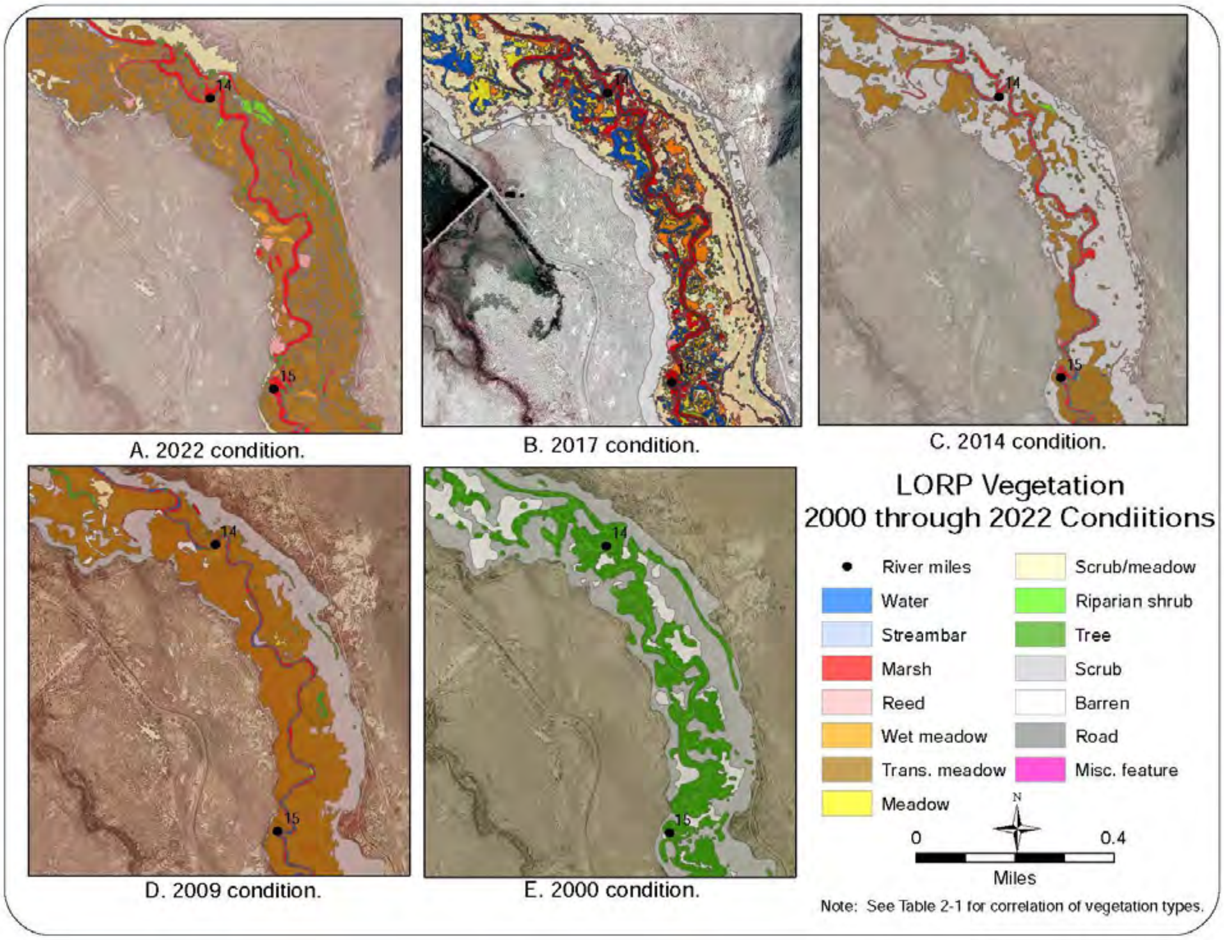
14
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A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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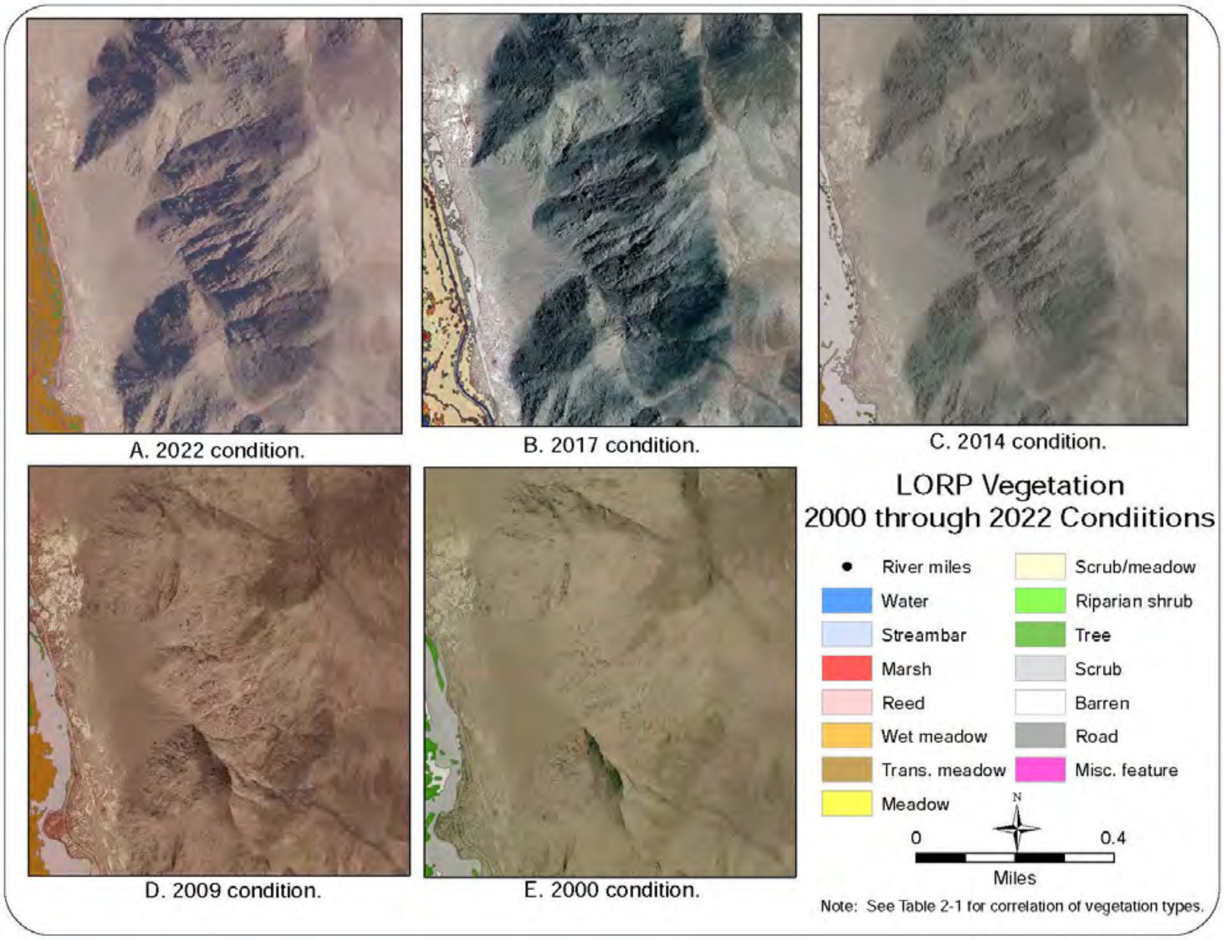
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LORP Vegetation
2000 through 2022 Condiitions
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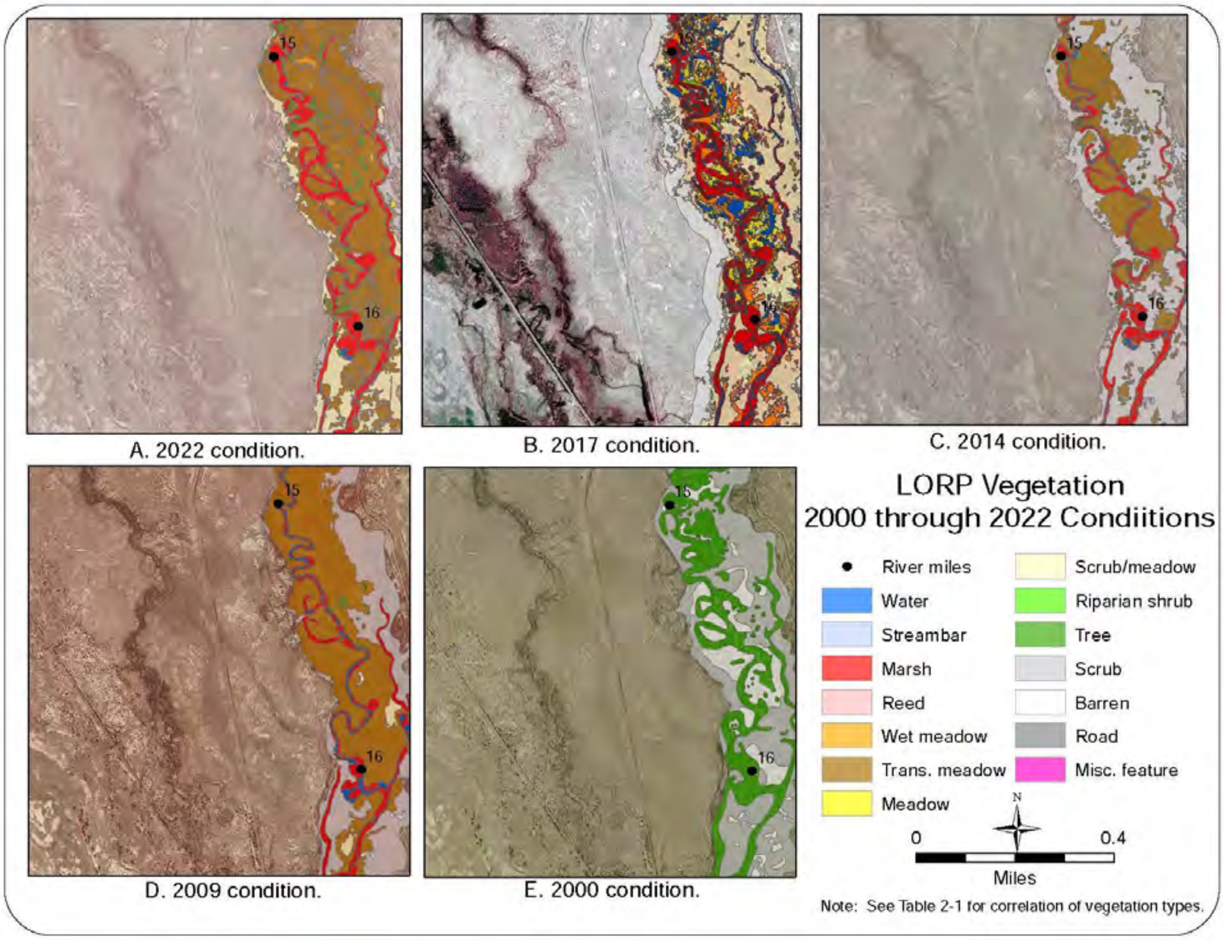
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A. 2022 condition.
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E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Misc. feature
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0.4
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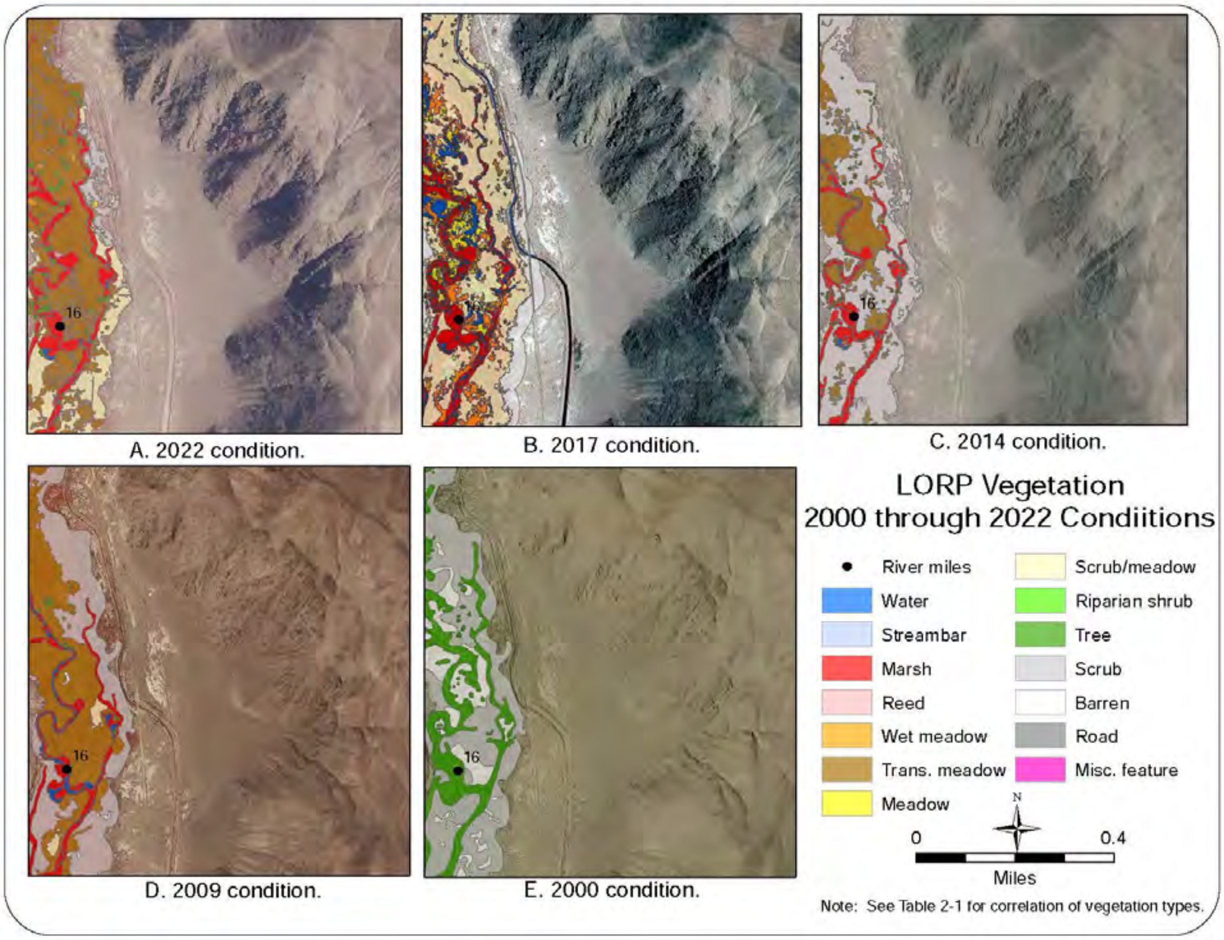
16
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A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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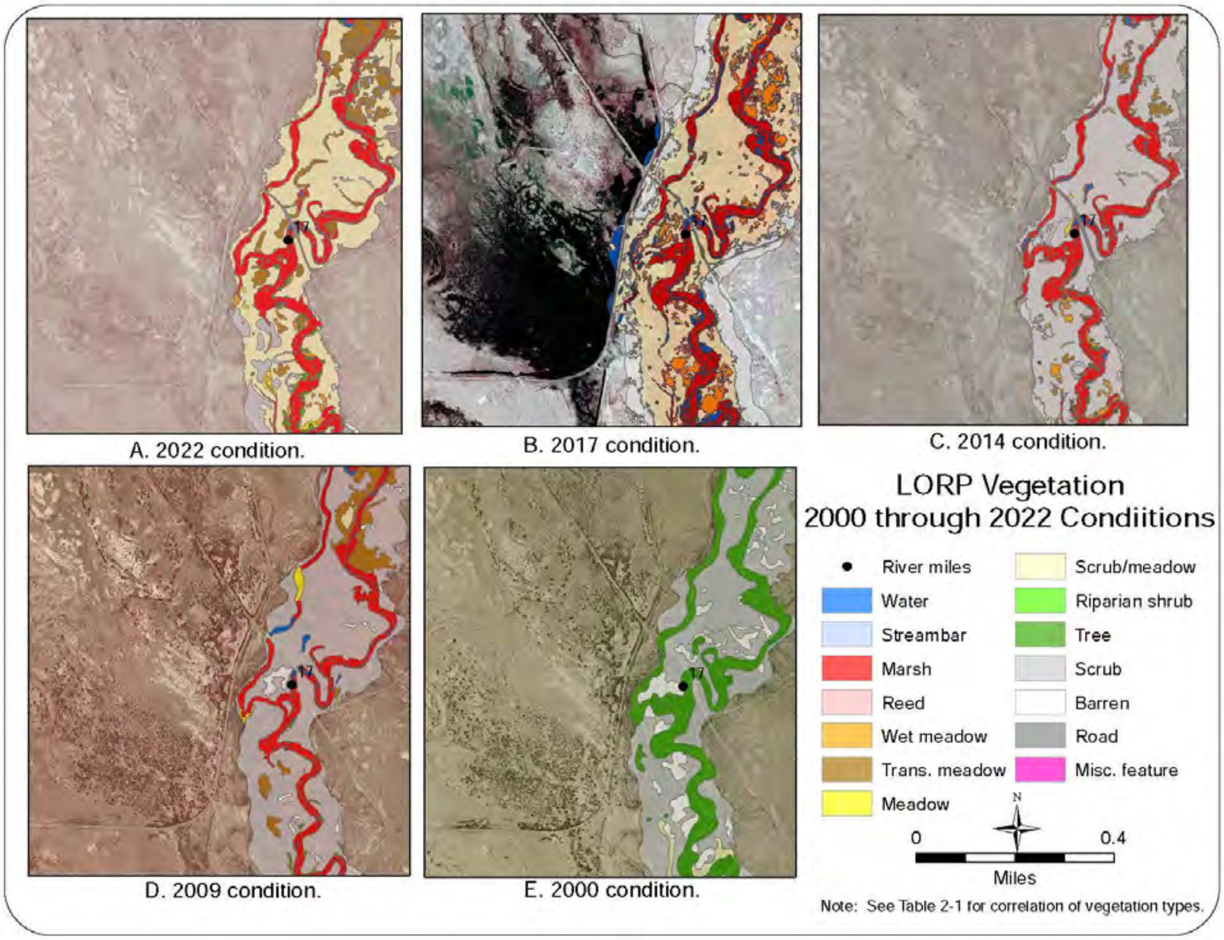
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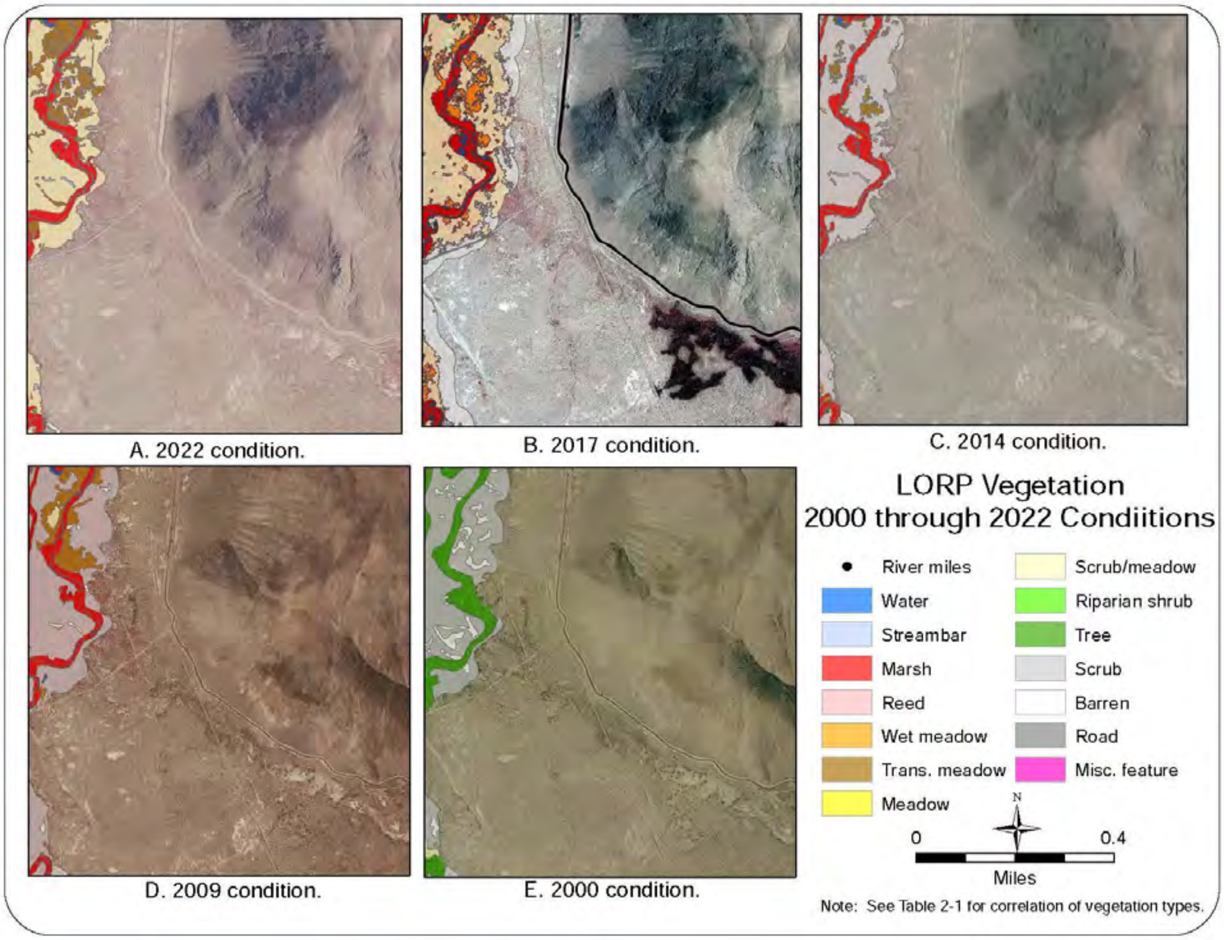
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E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
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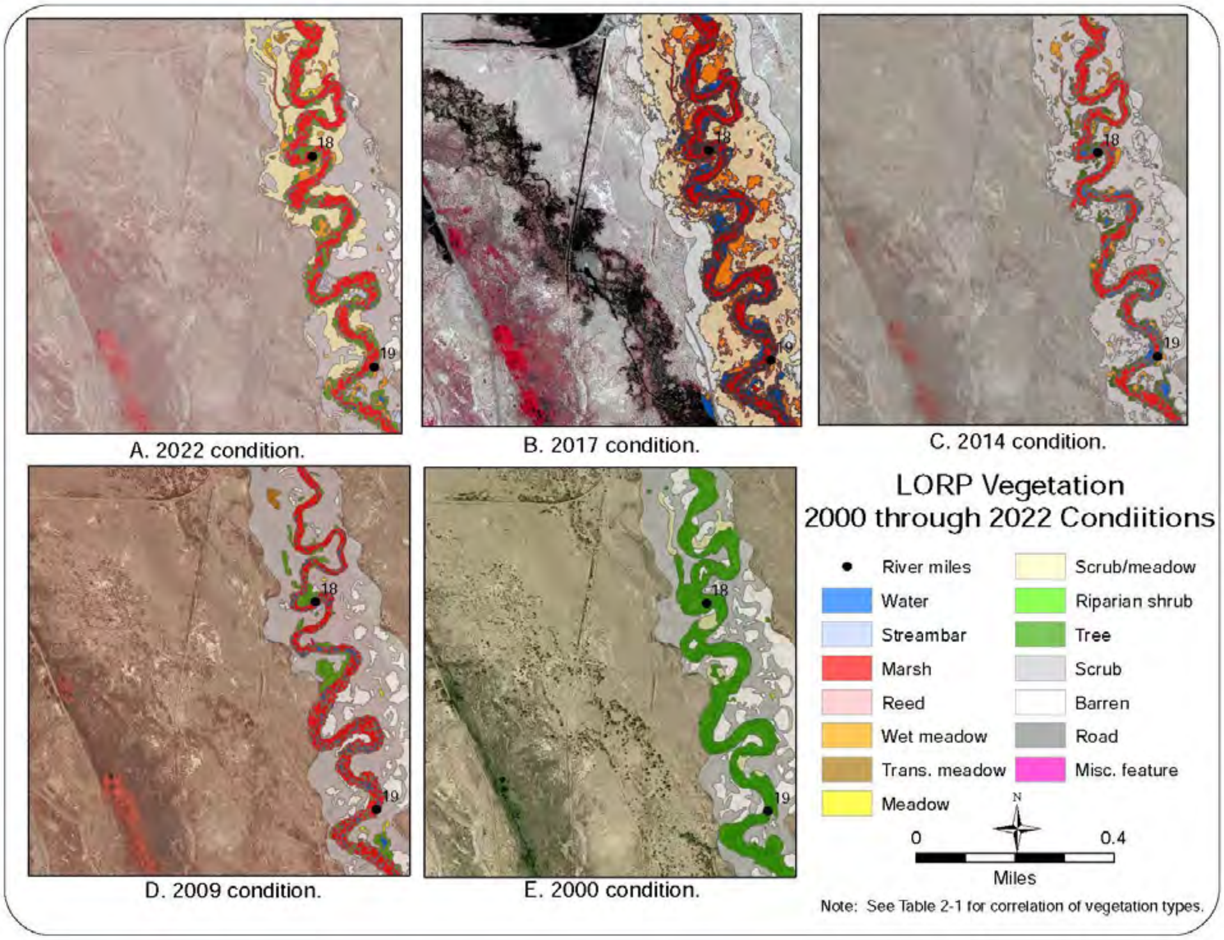
18
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A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
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E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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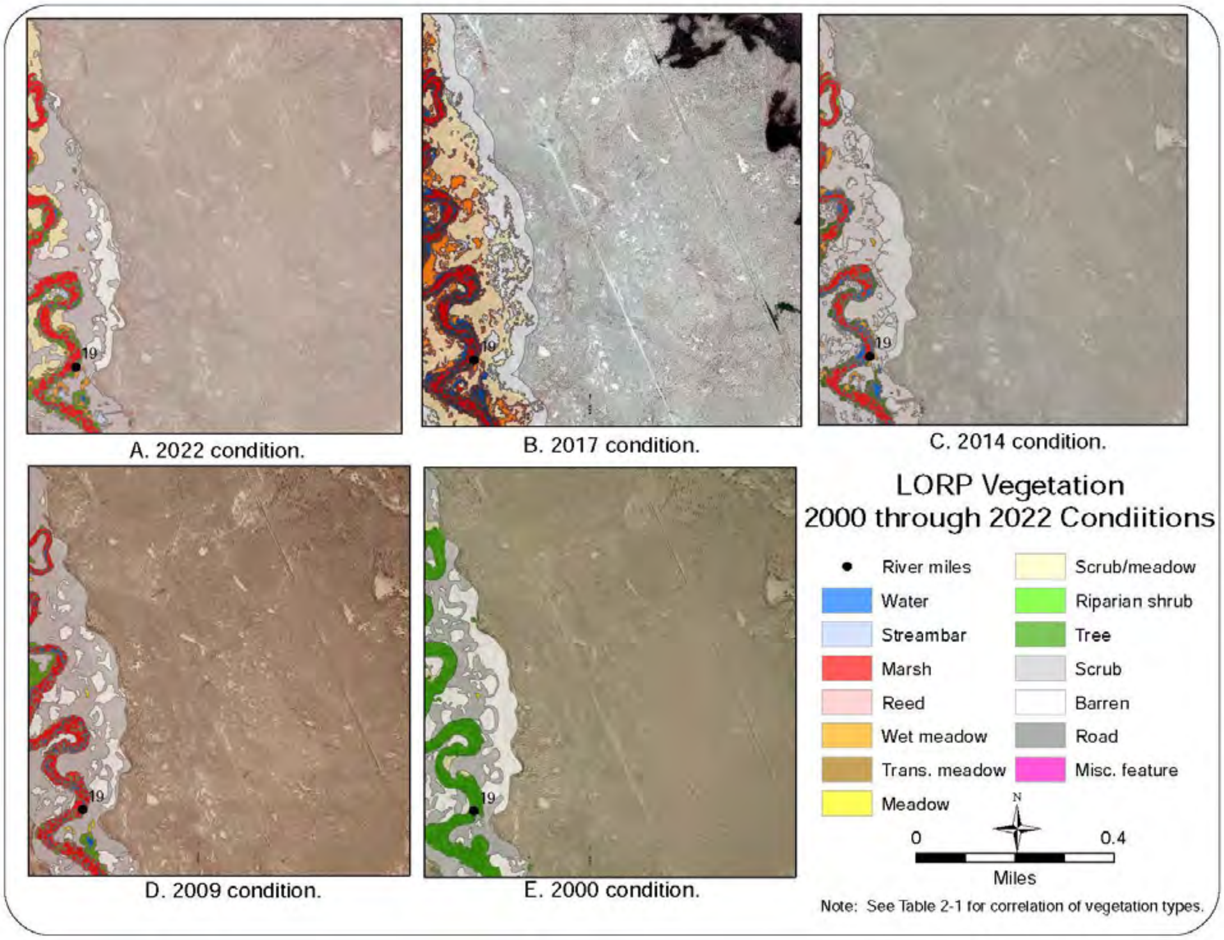
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A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Streambar
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Meadow
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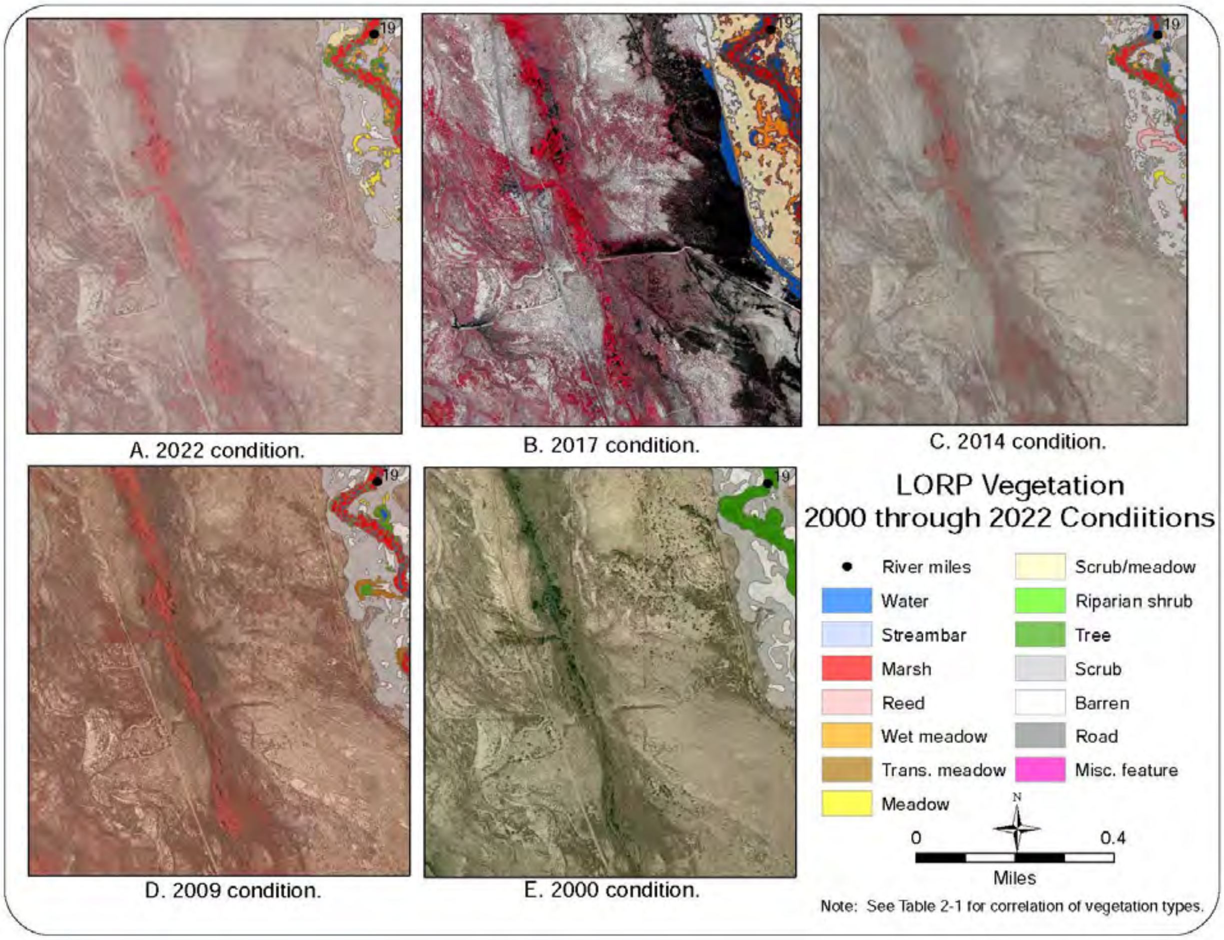
19
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B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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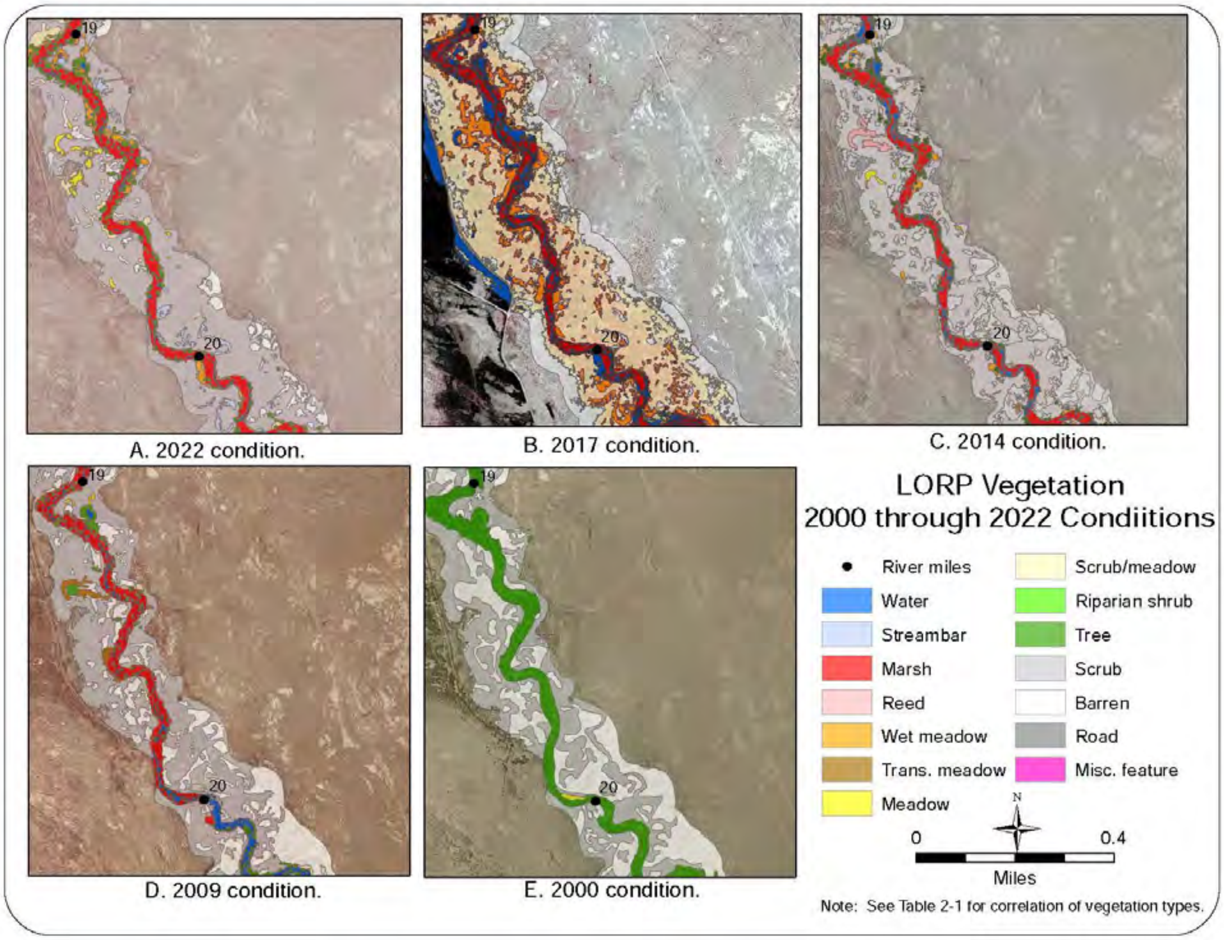
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
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LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
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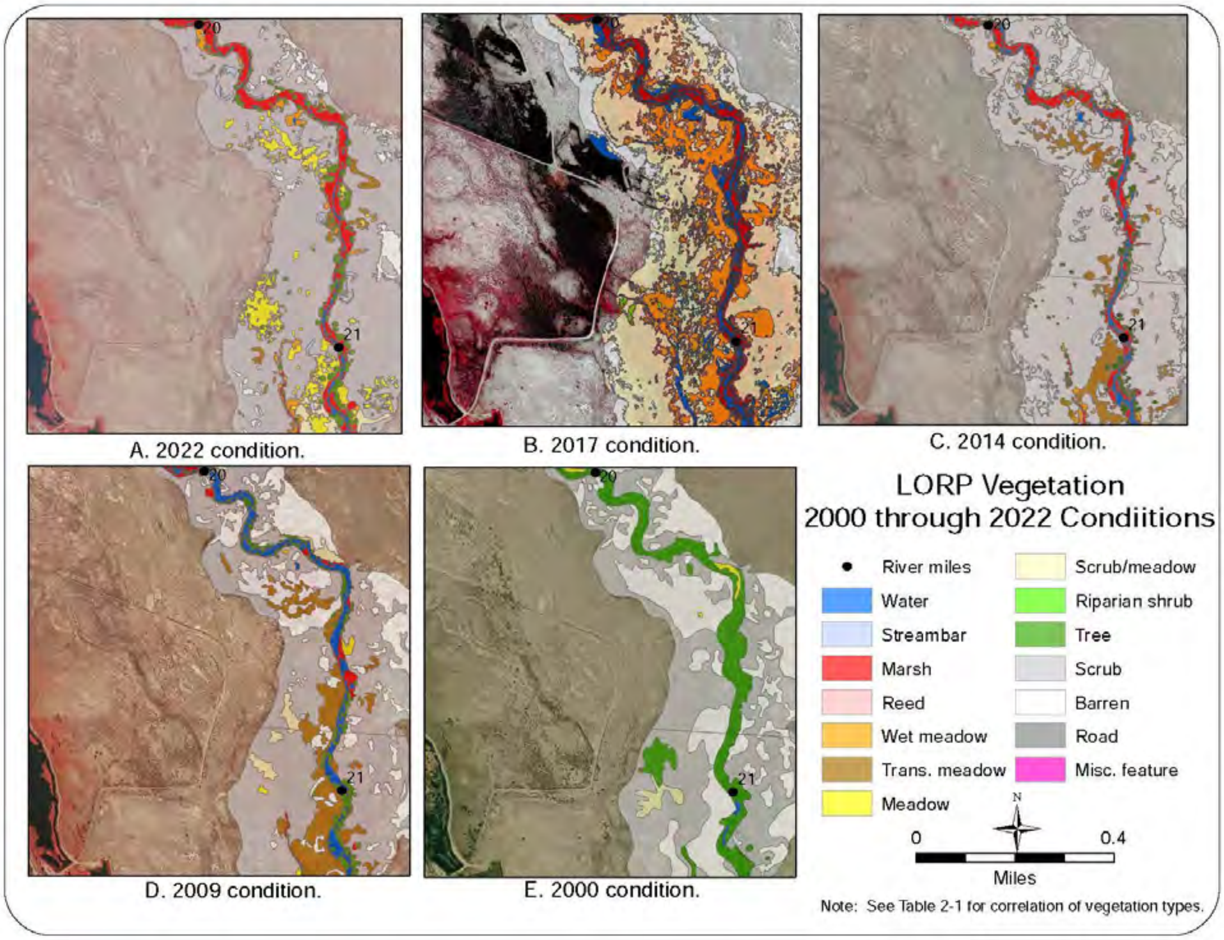
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B. 2017 condition.
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D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
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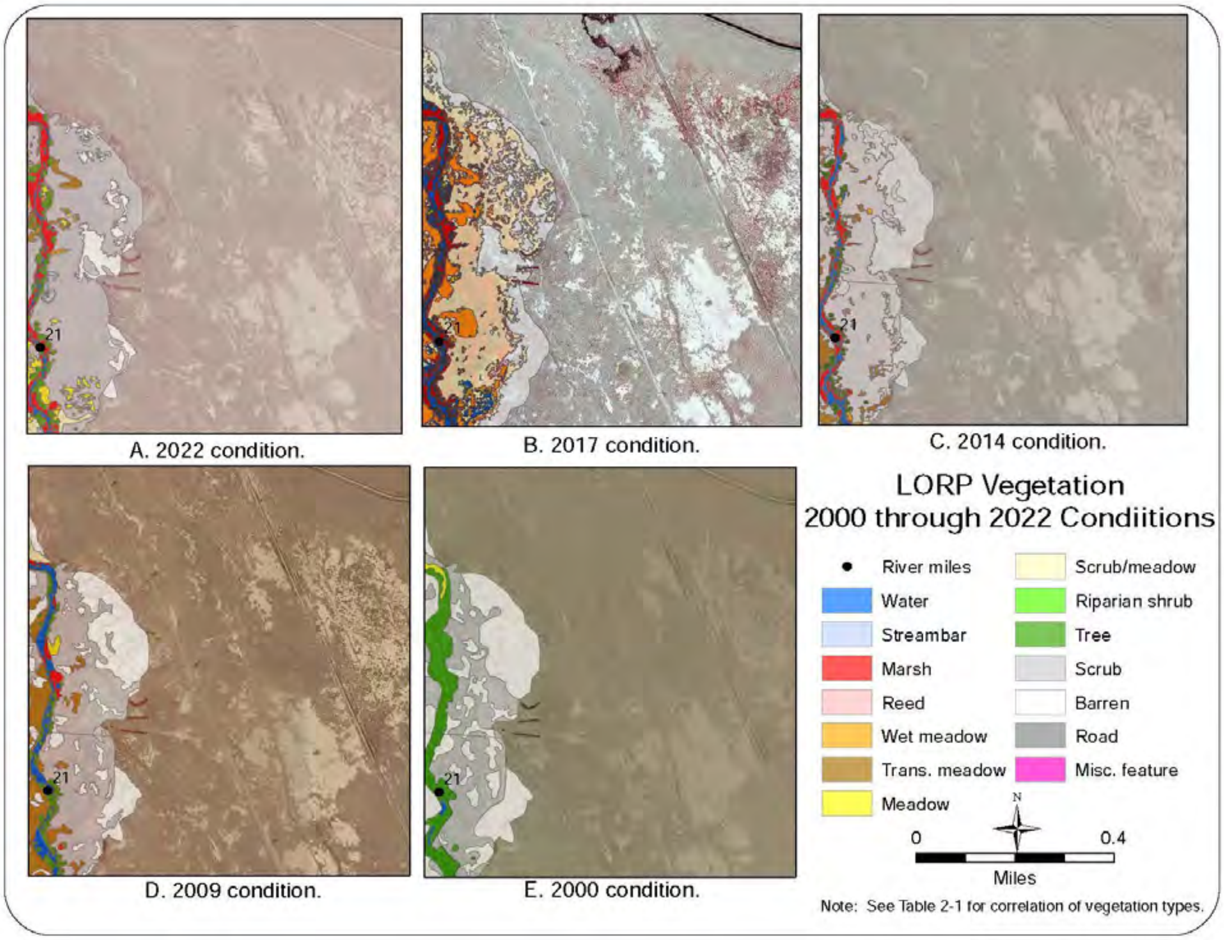
21
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Meadow
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Misc. feature
N
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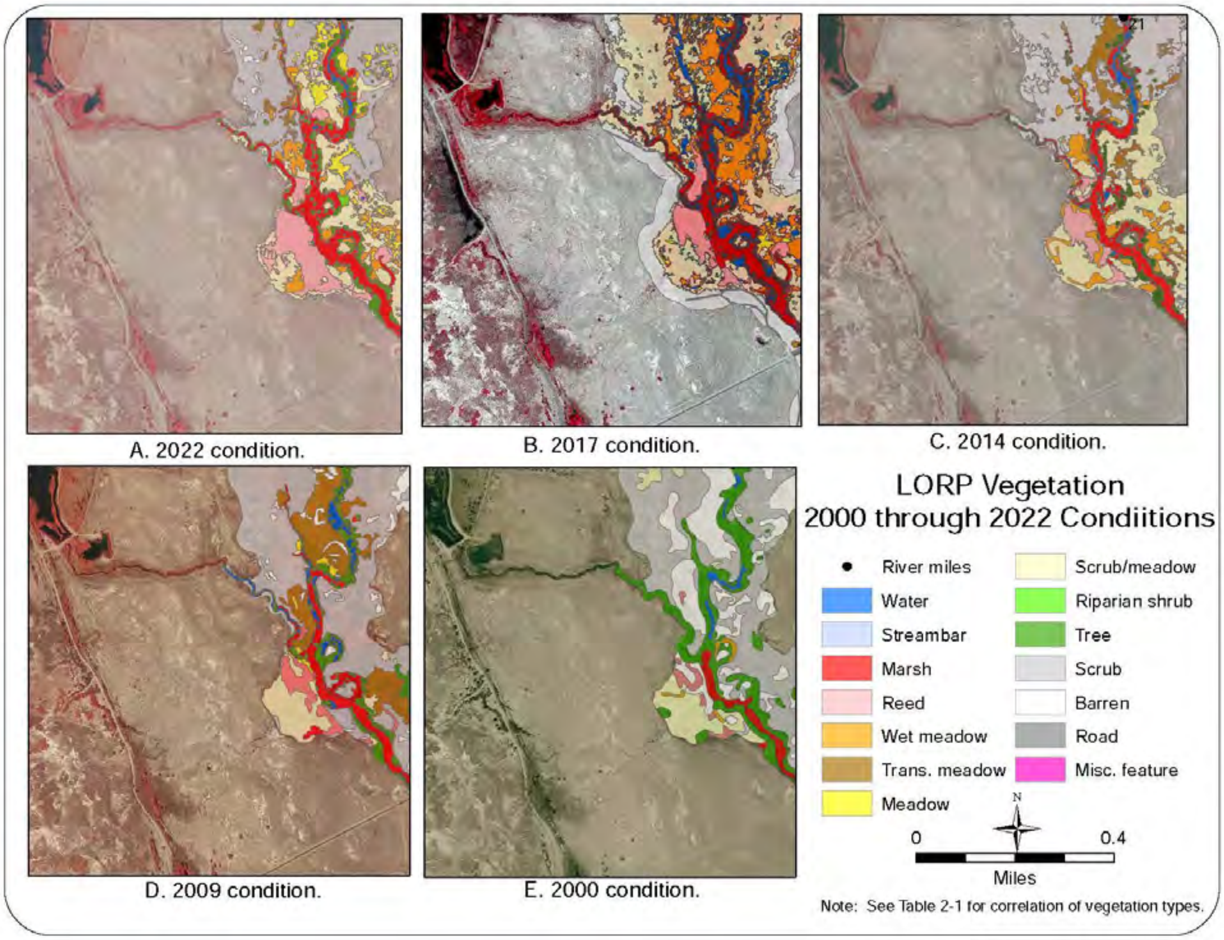
Miles
Note: See Table 2-1 for correlation of vegetation types.


A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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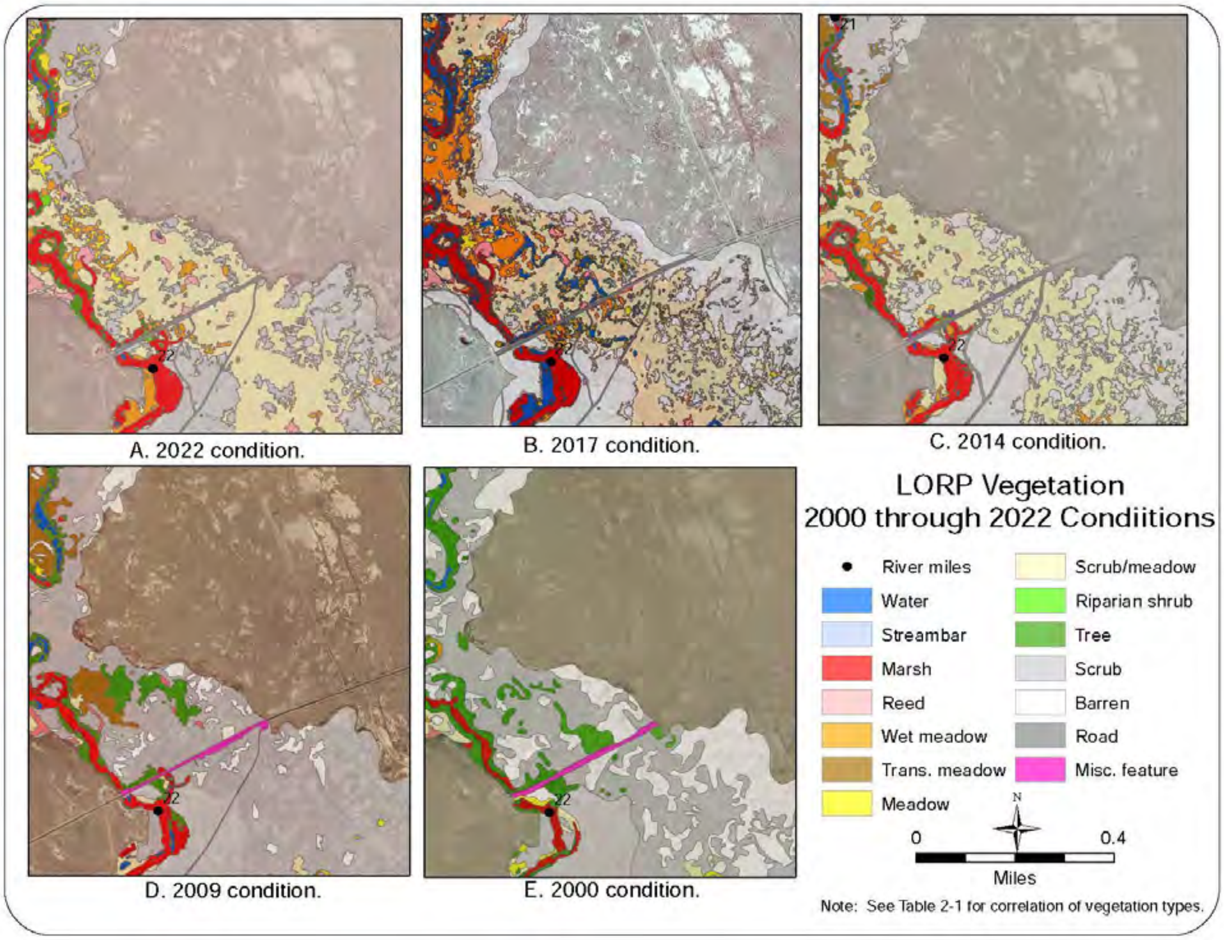
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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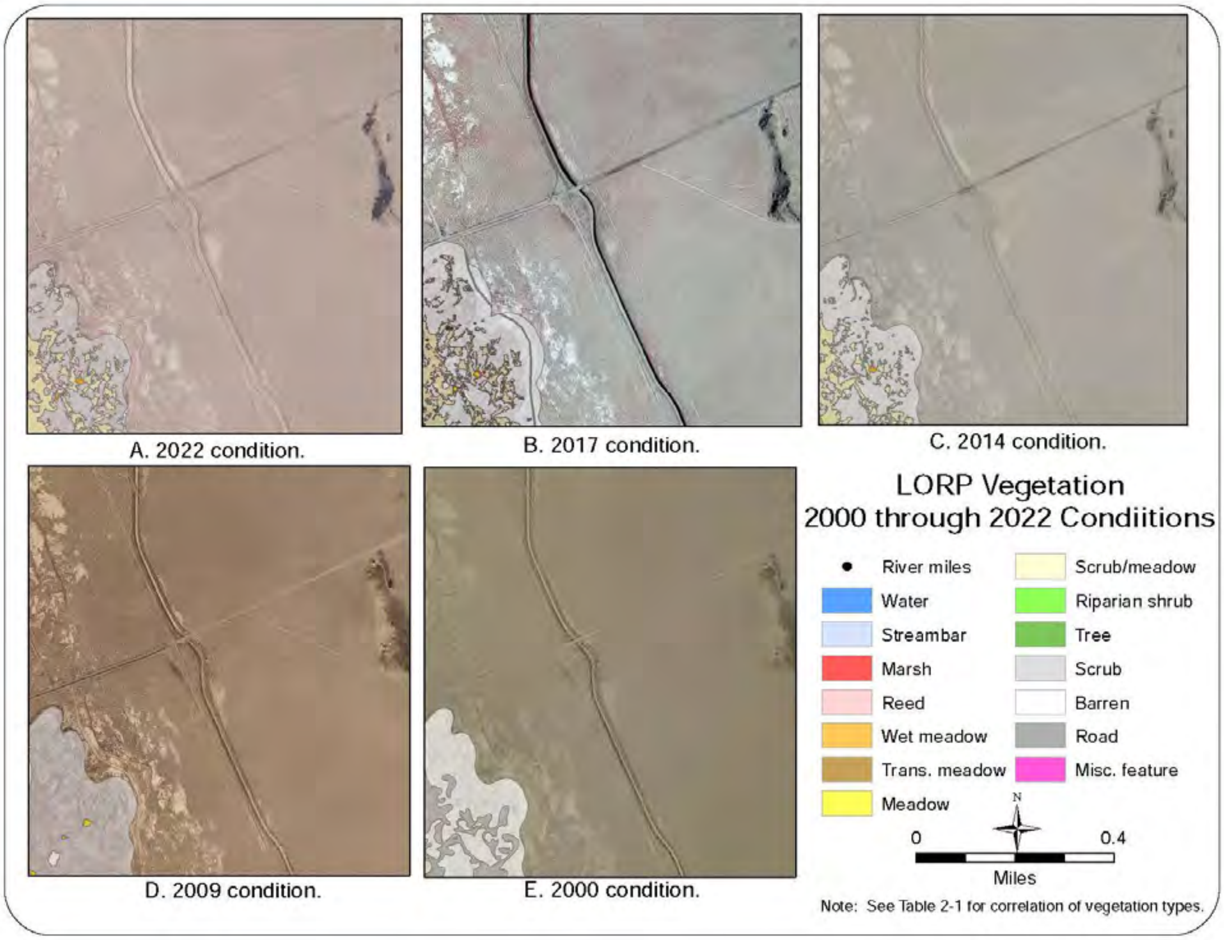
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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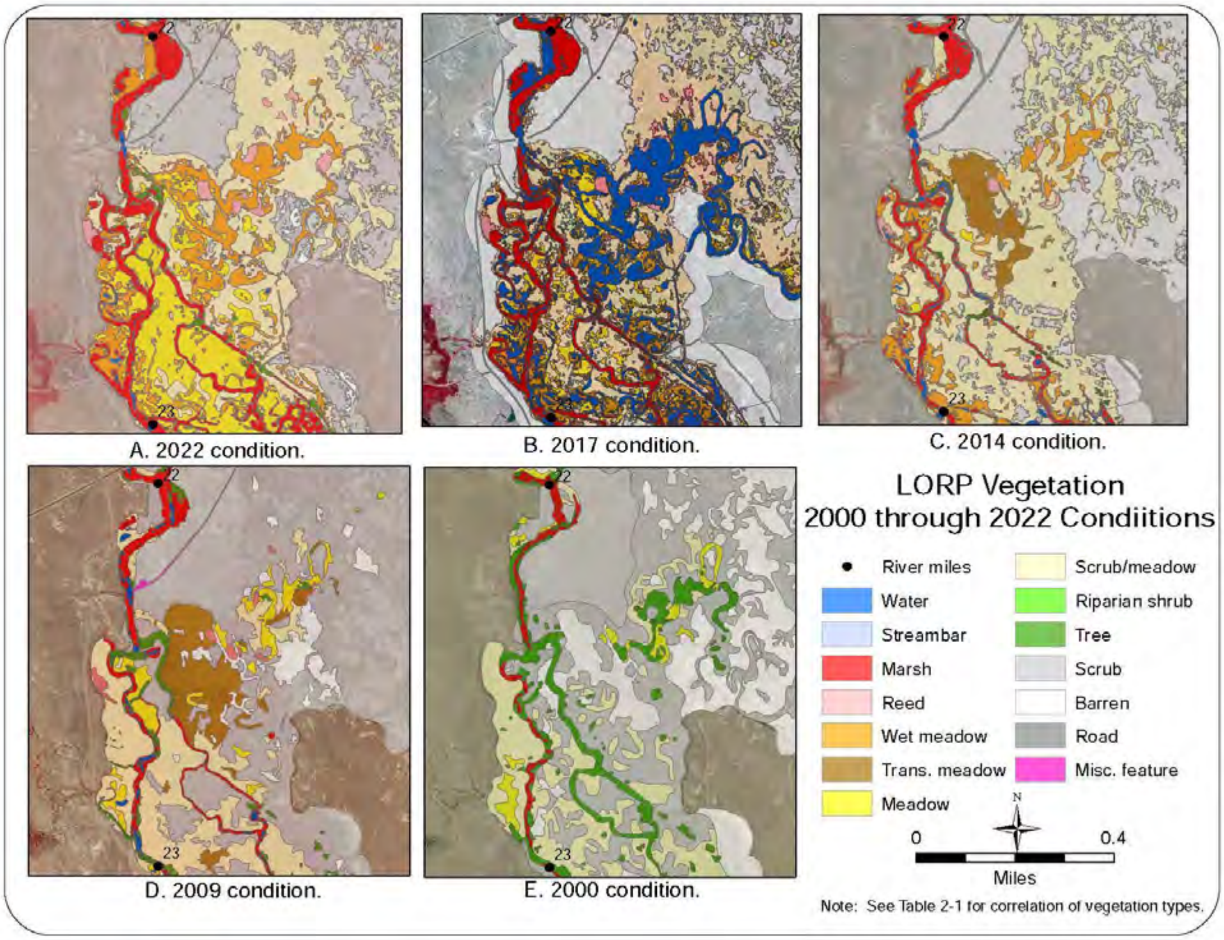
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


22
23
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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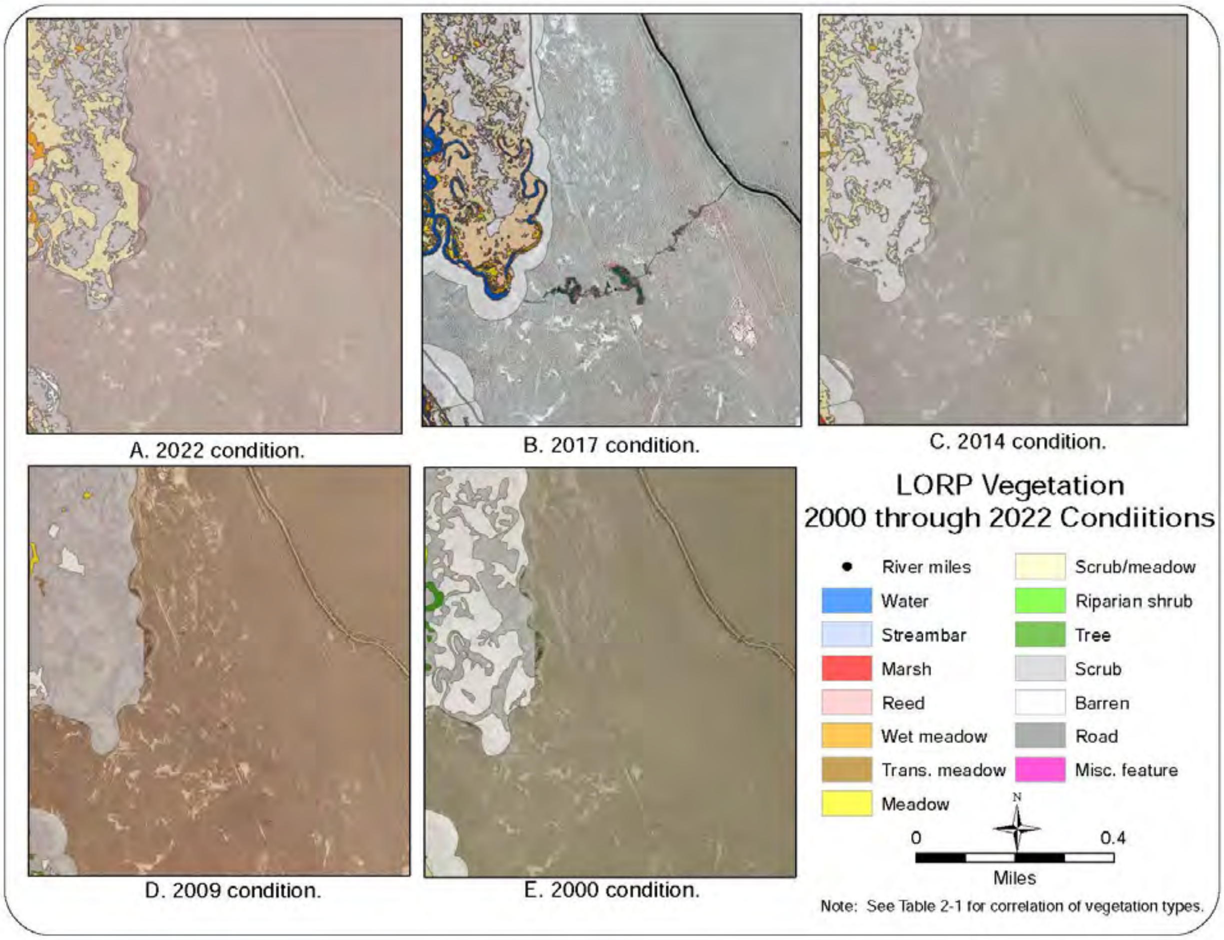
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
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Wet meadow
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Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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0.4
Miles
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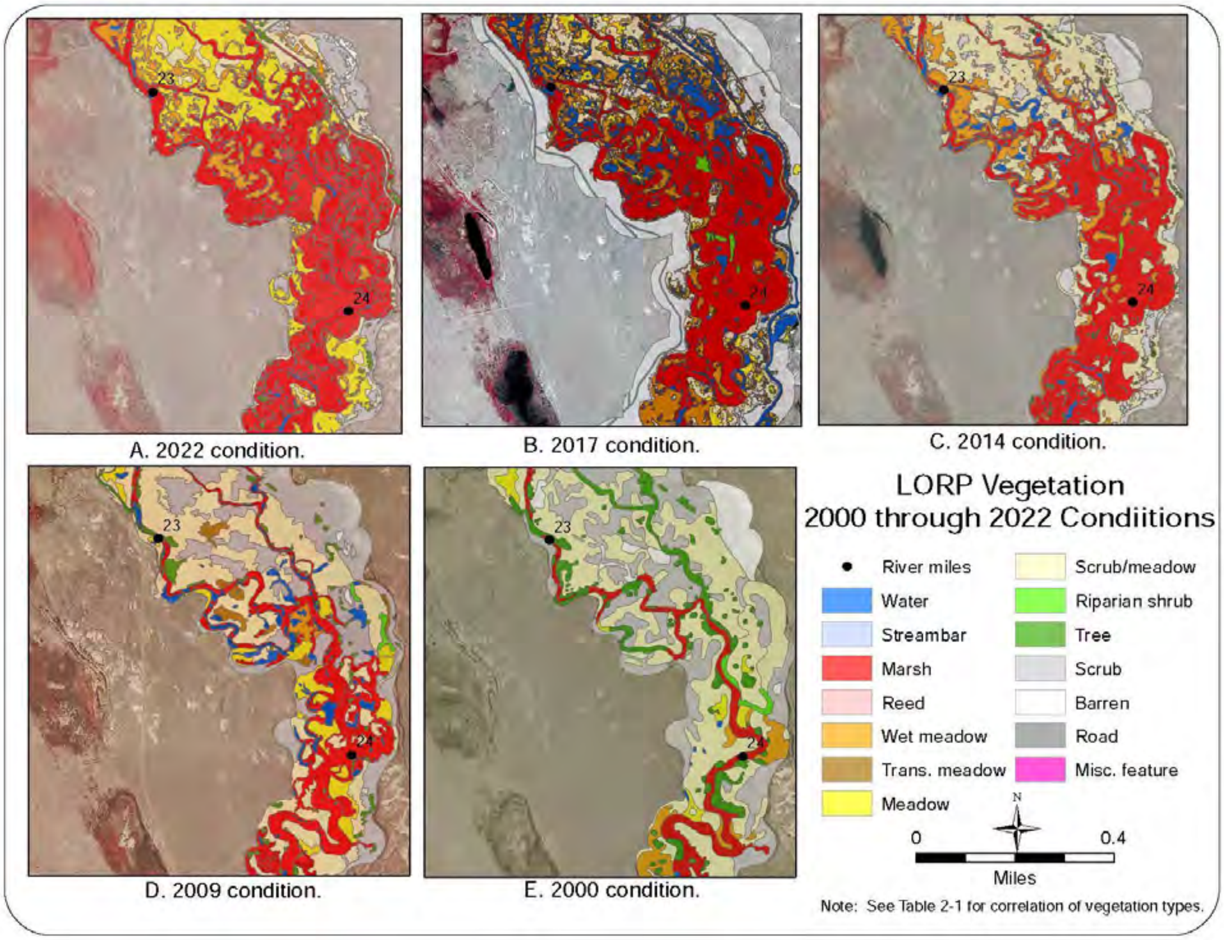
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B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
23
24
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
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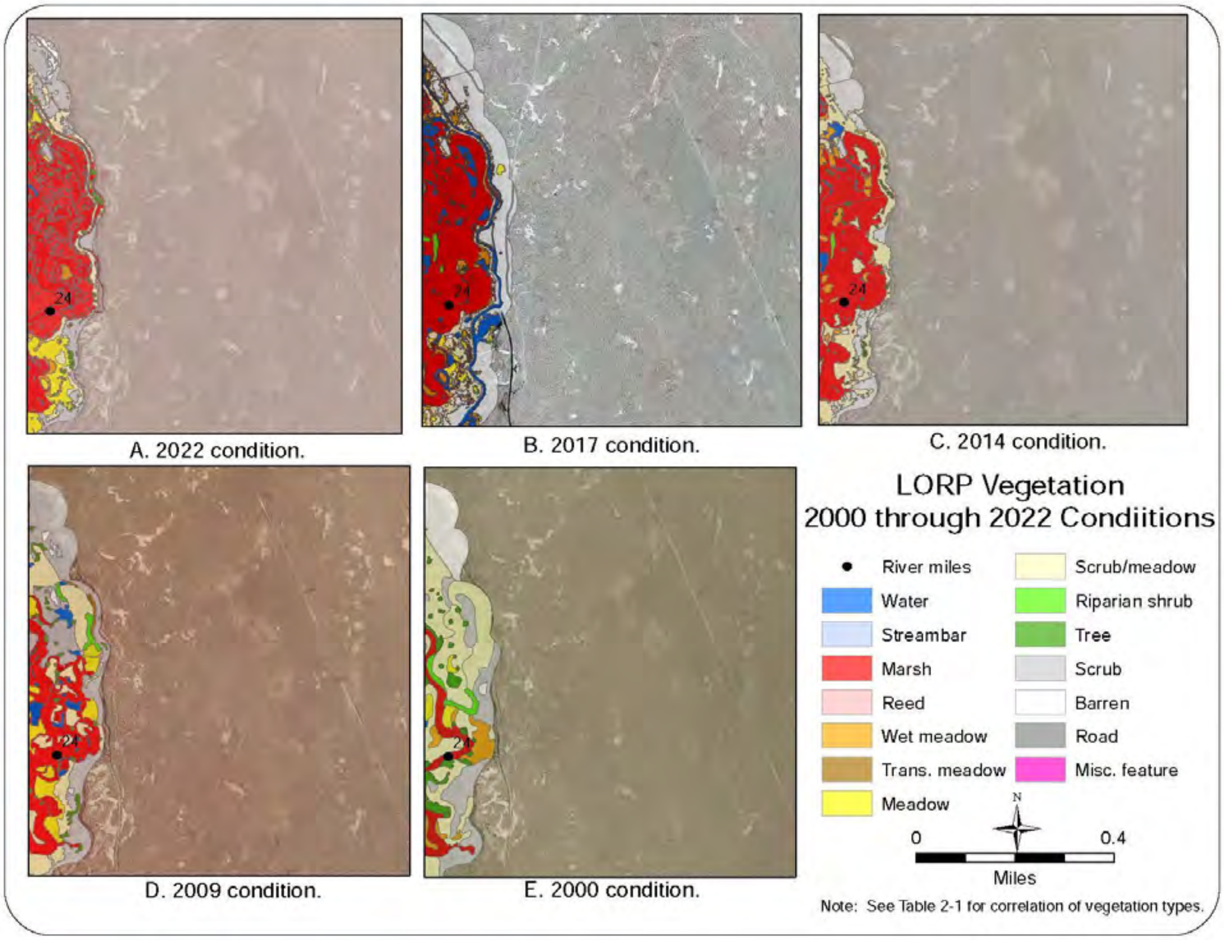
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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B. 2017 condition.
C. 2014 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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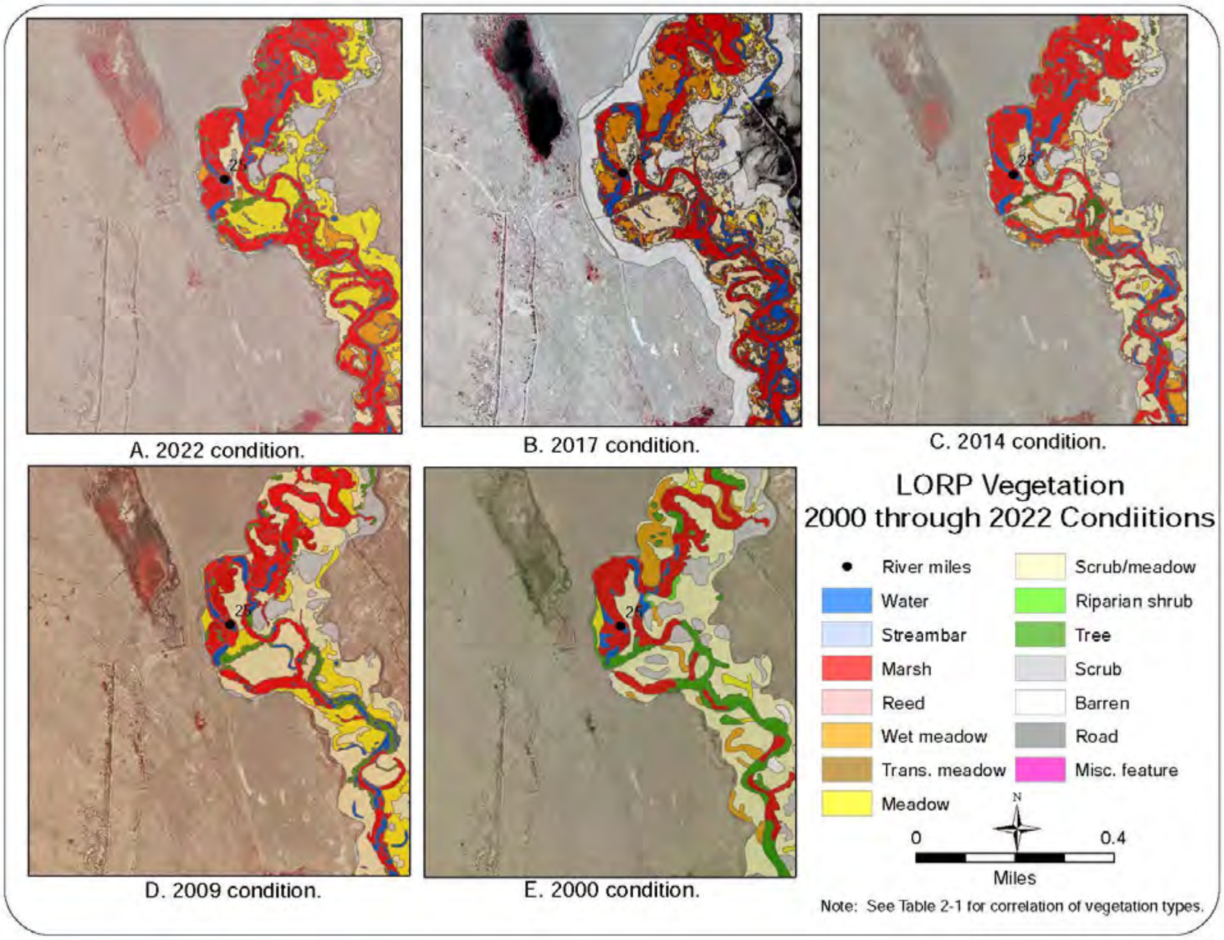
0.4
Miles
D. 2009 condition.
E. 2000 condition.
Note: See Table 2-1 for correlation of vegetation types.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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
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Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
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0.4
Miles
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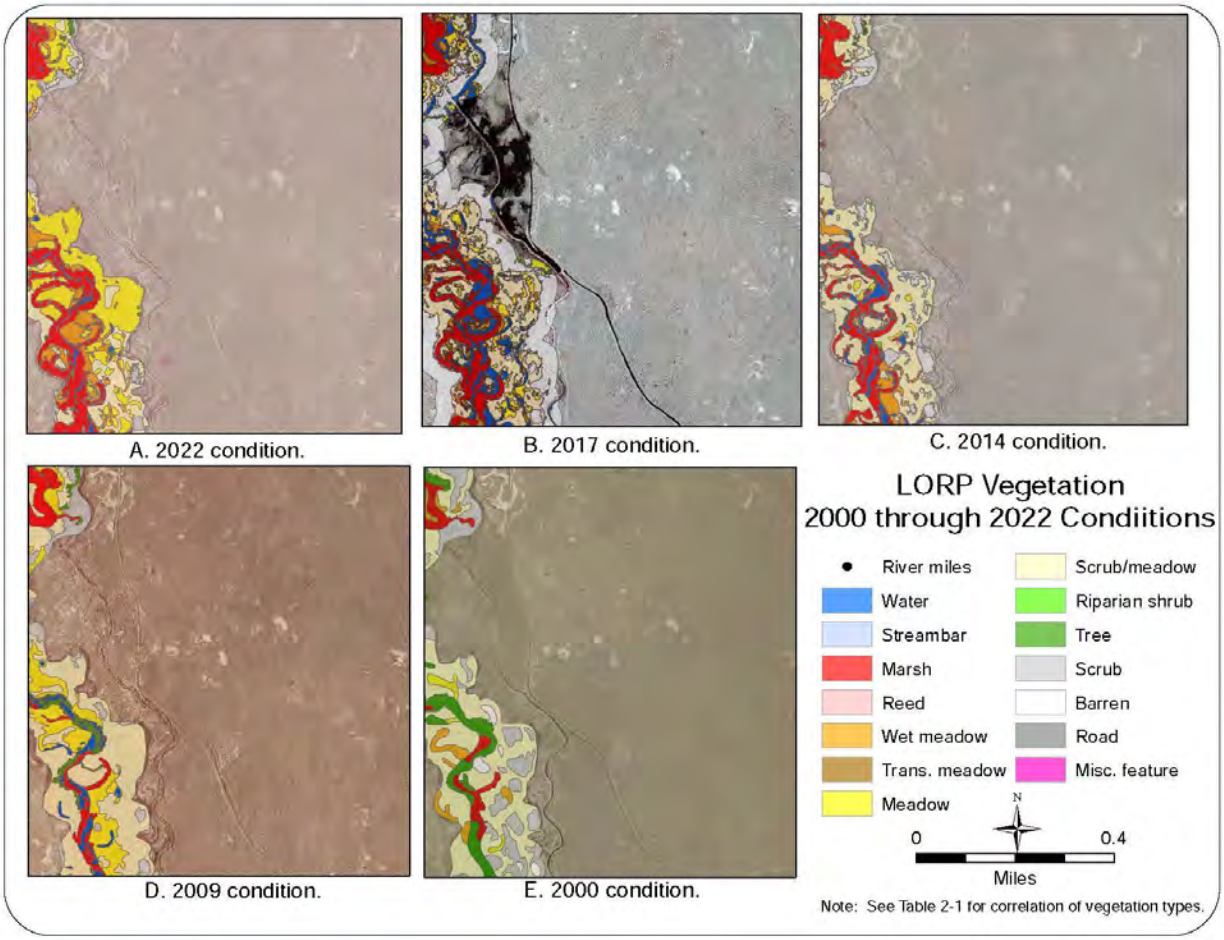
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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0.4
Miles
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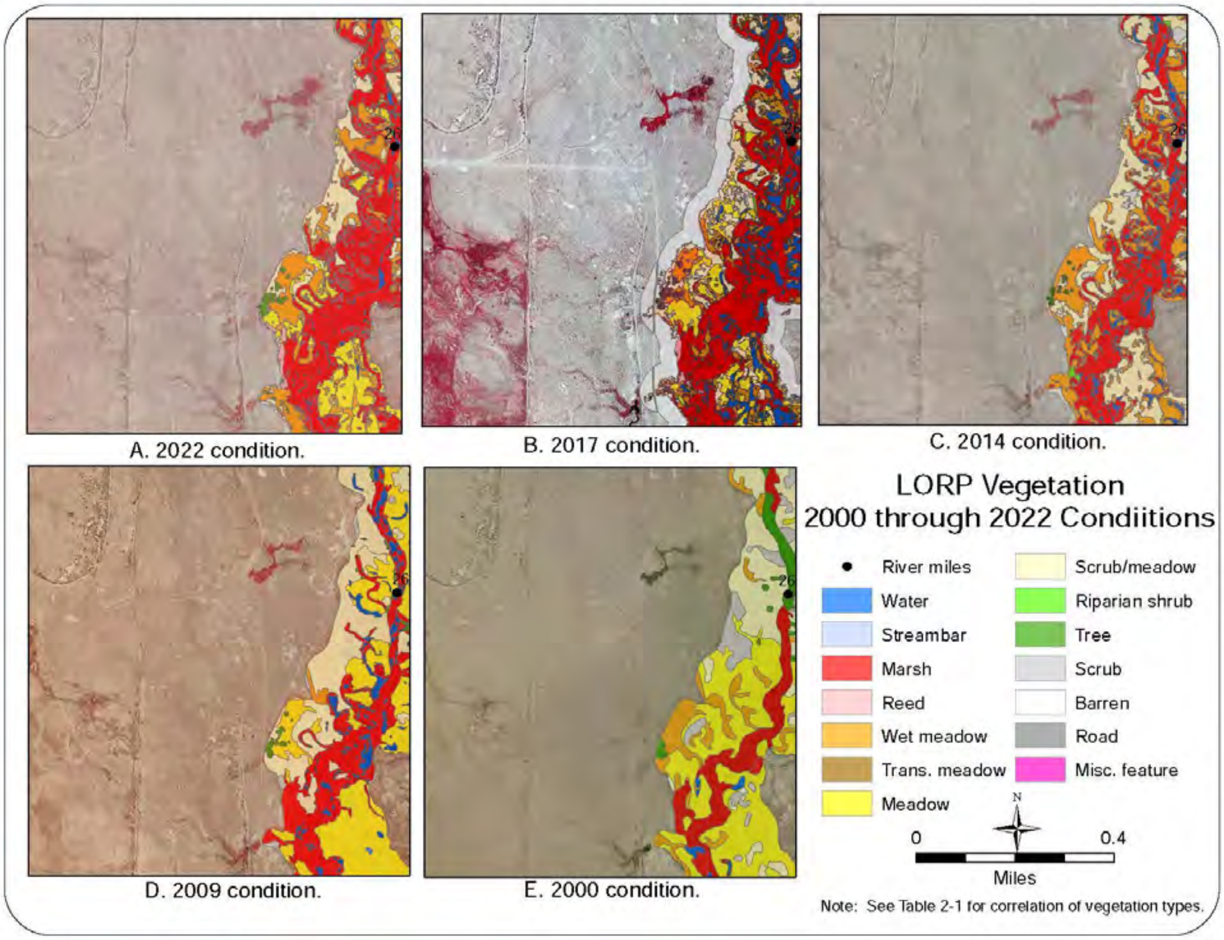
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Riparian shrub
Tree
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Misc. feature
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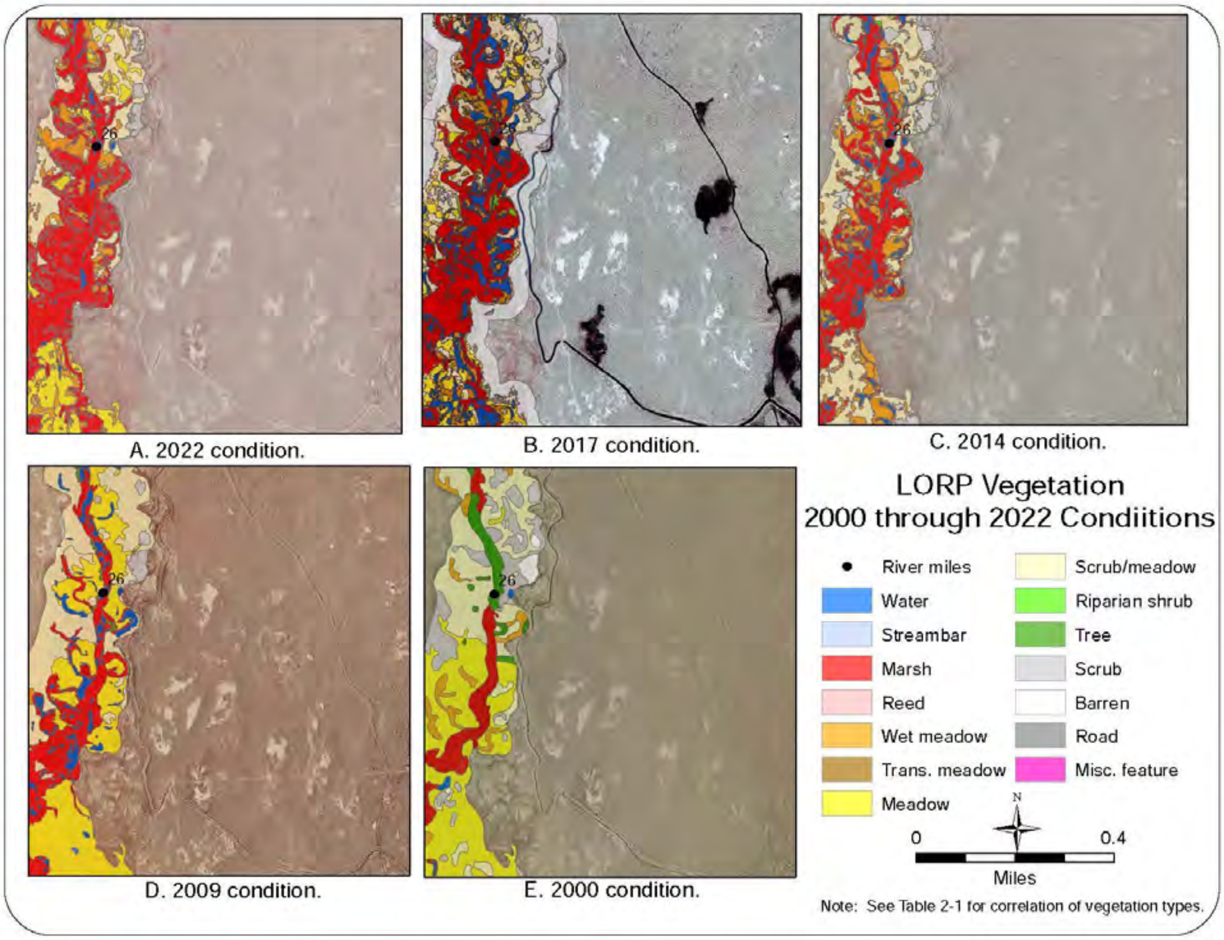
26
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
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Meadow
Scrub/meadow
Riparian shrub
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Misc. feature
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Miles
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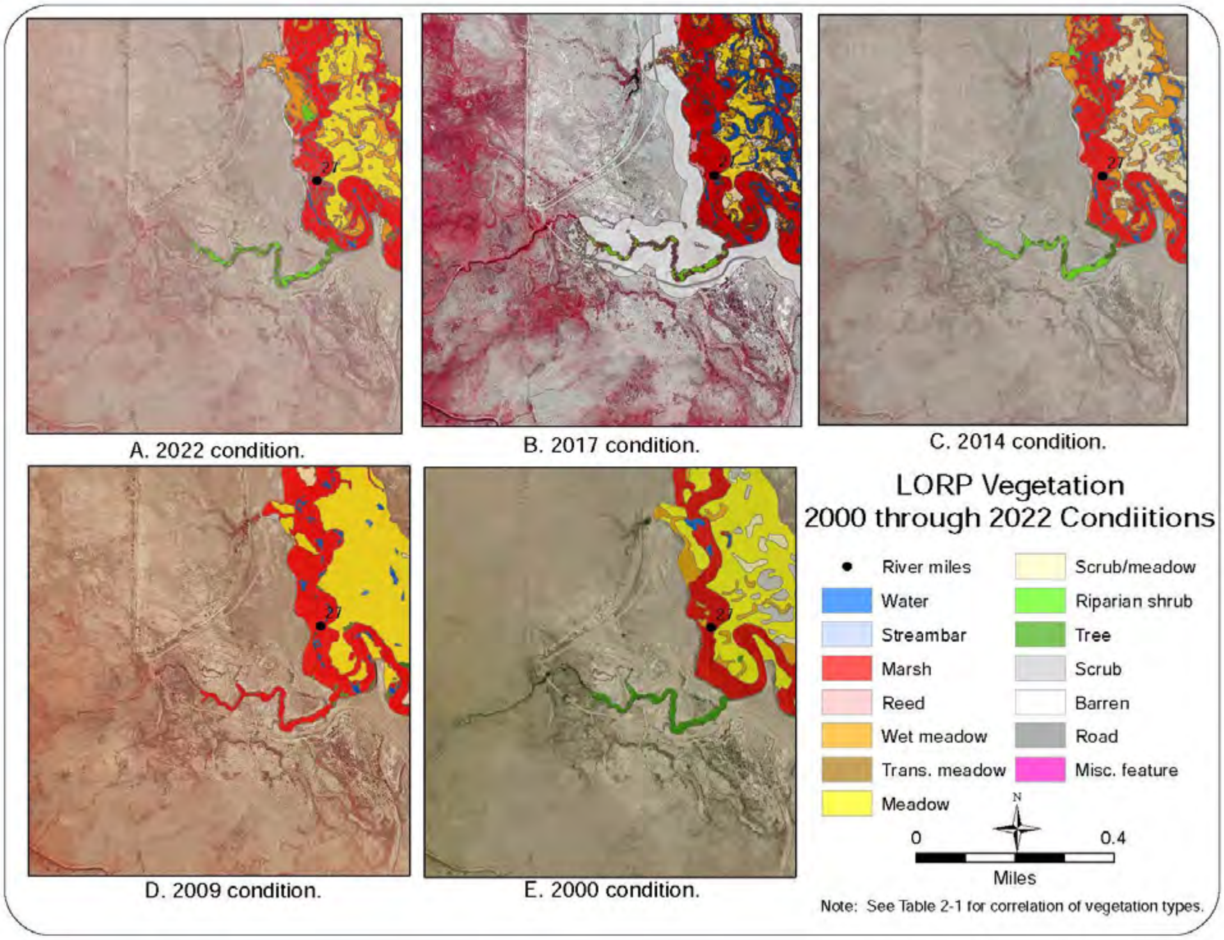
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C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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Streambar
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Misc. feature
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0.4
Miles
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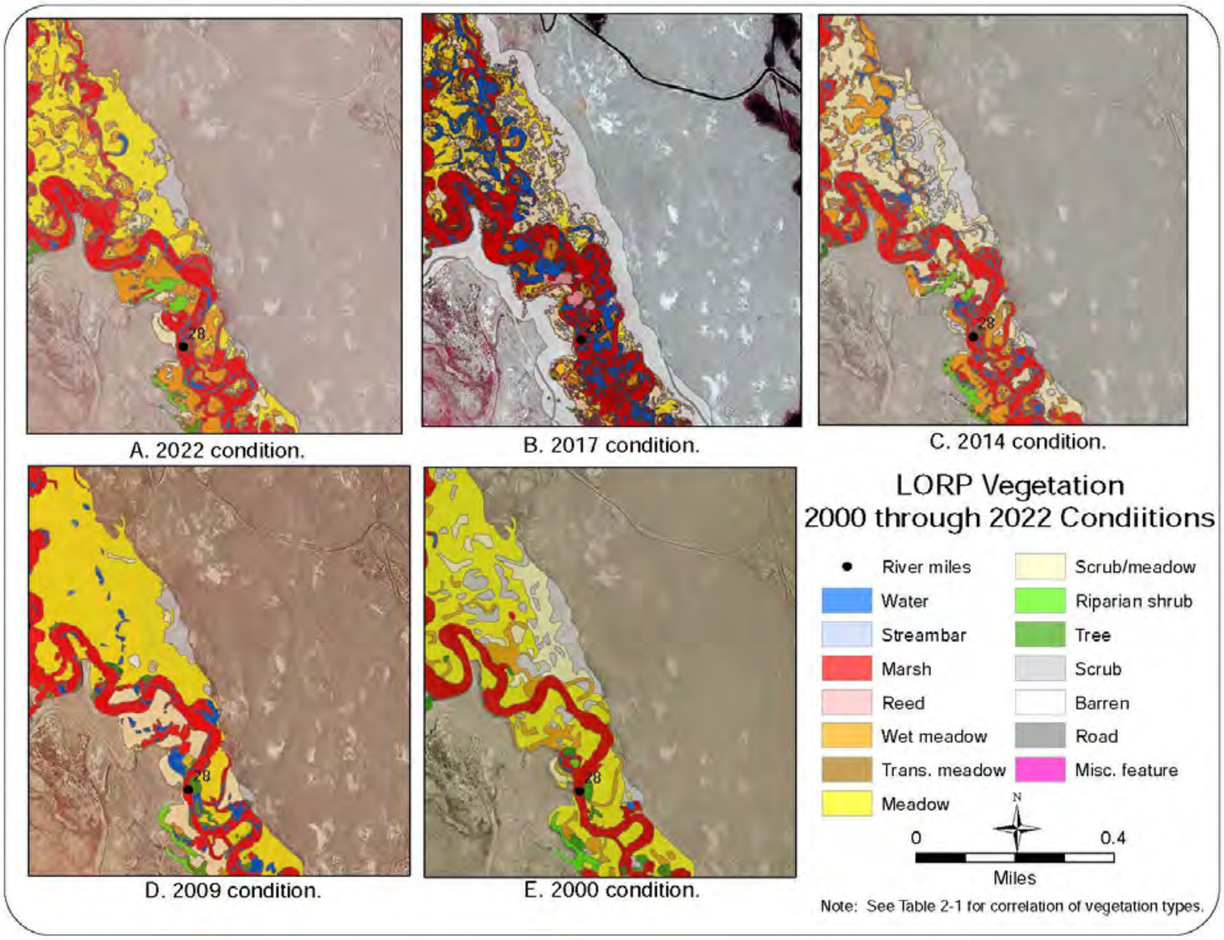
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
28
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
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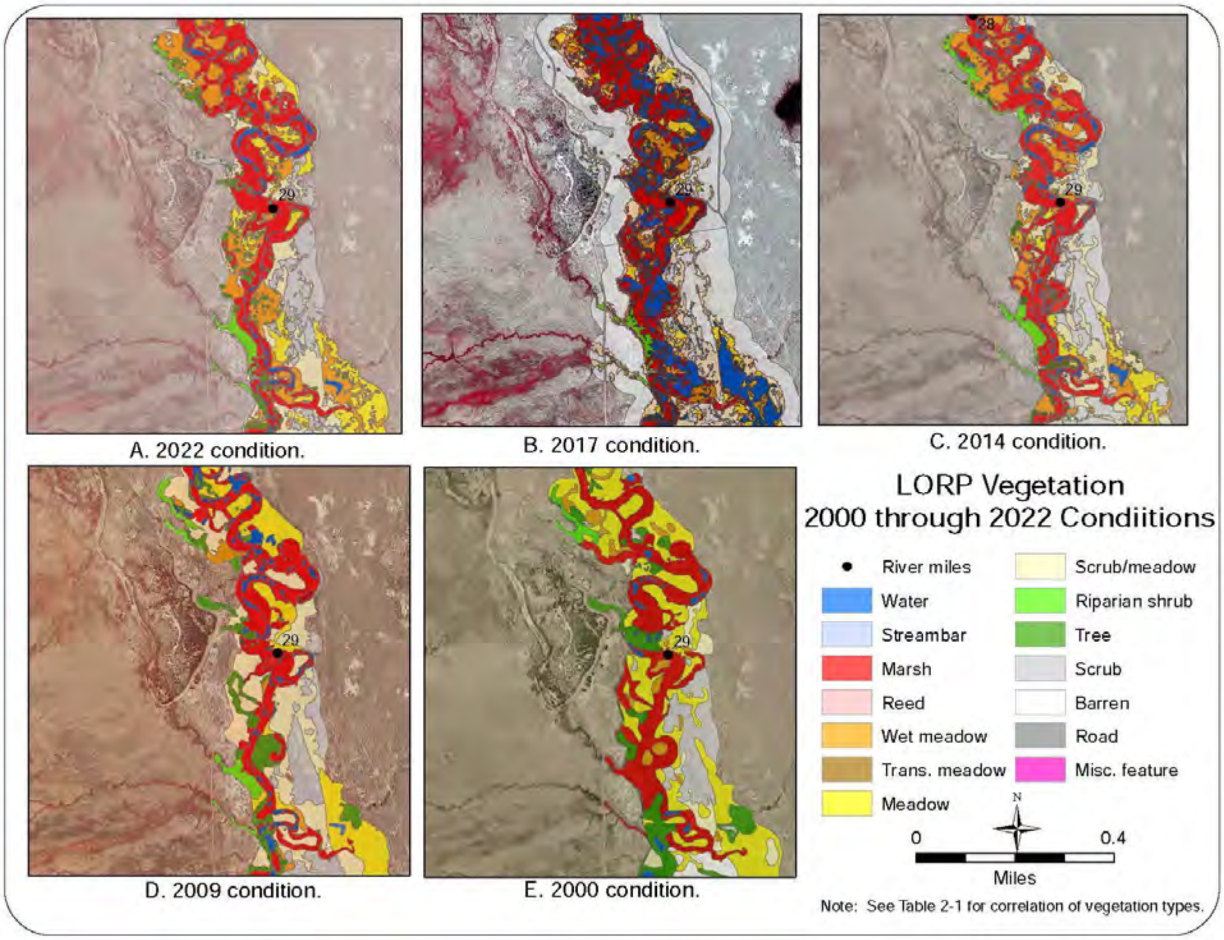
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


29
28
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Miles
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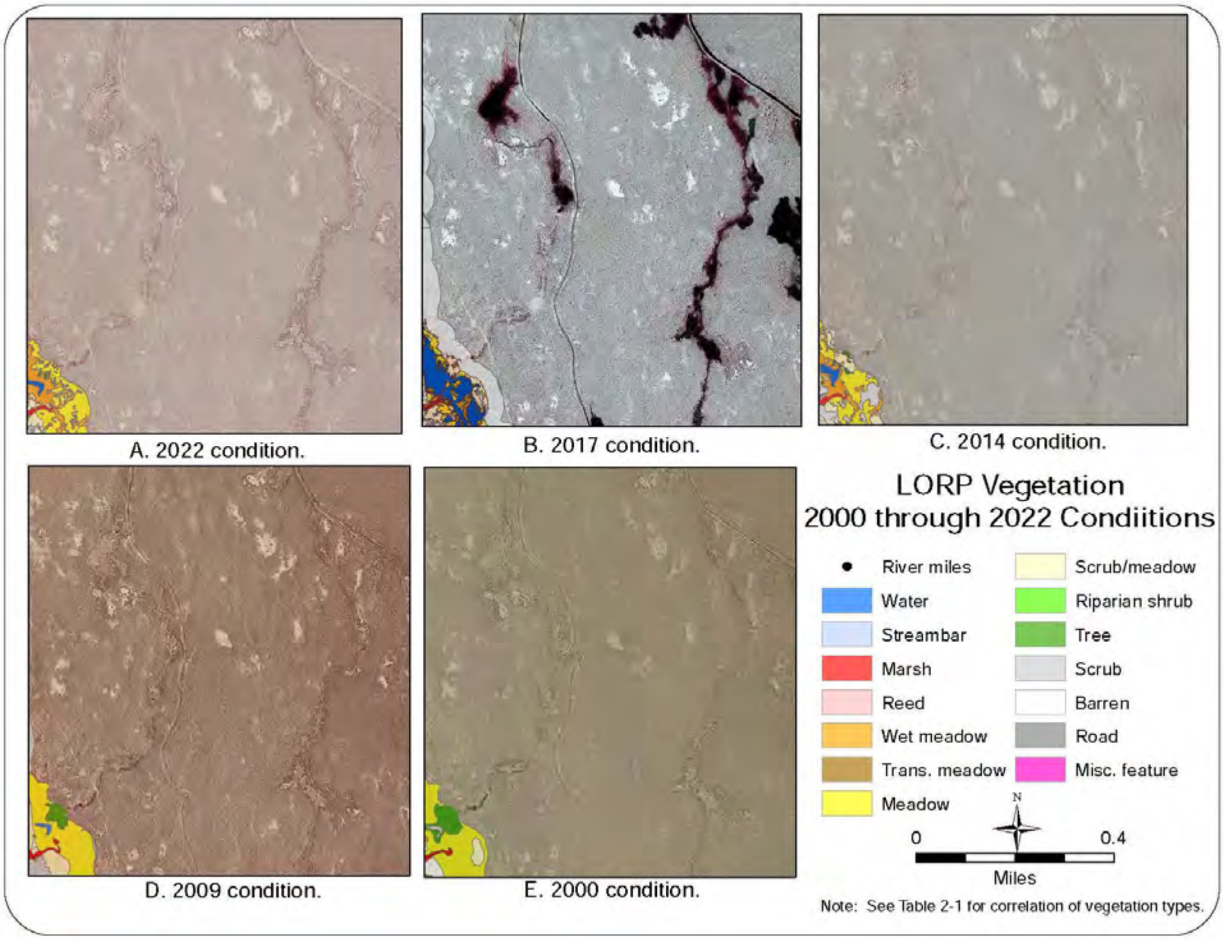
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2000 through 2022 Condiitions
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Misc. feature
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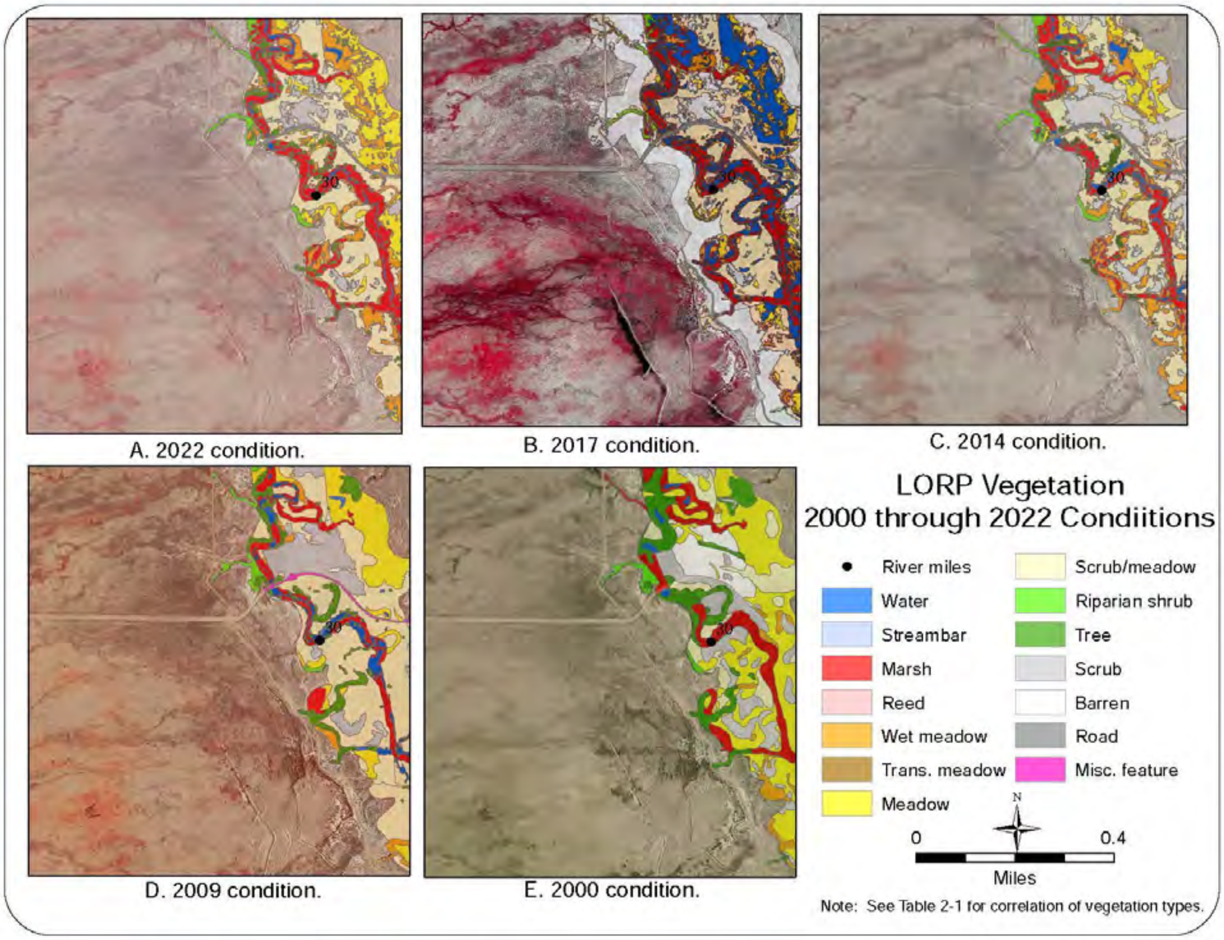
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LORP Vegetation
2000 through 2022 Condiitions
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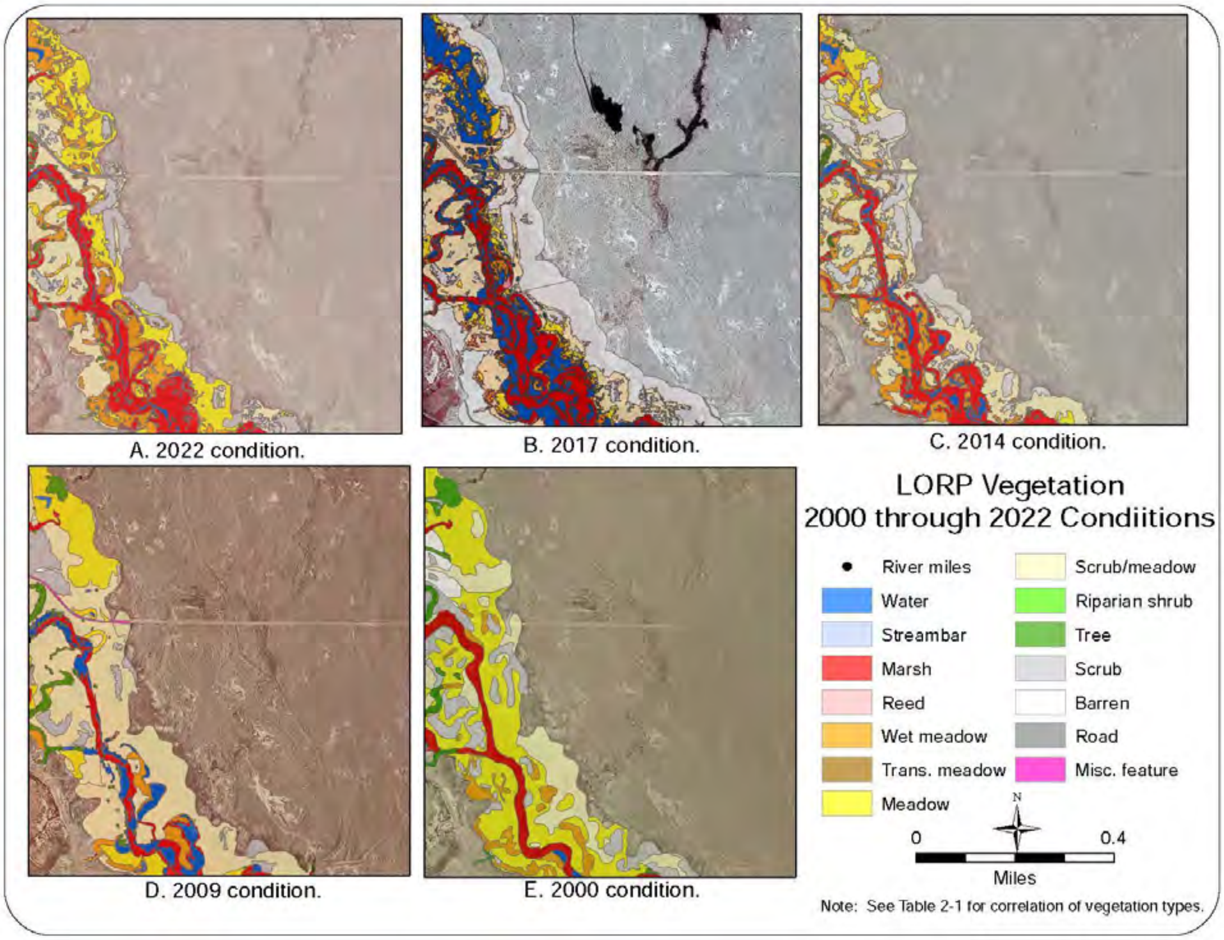
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E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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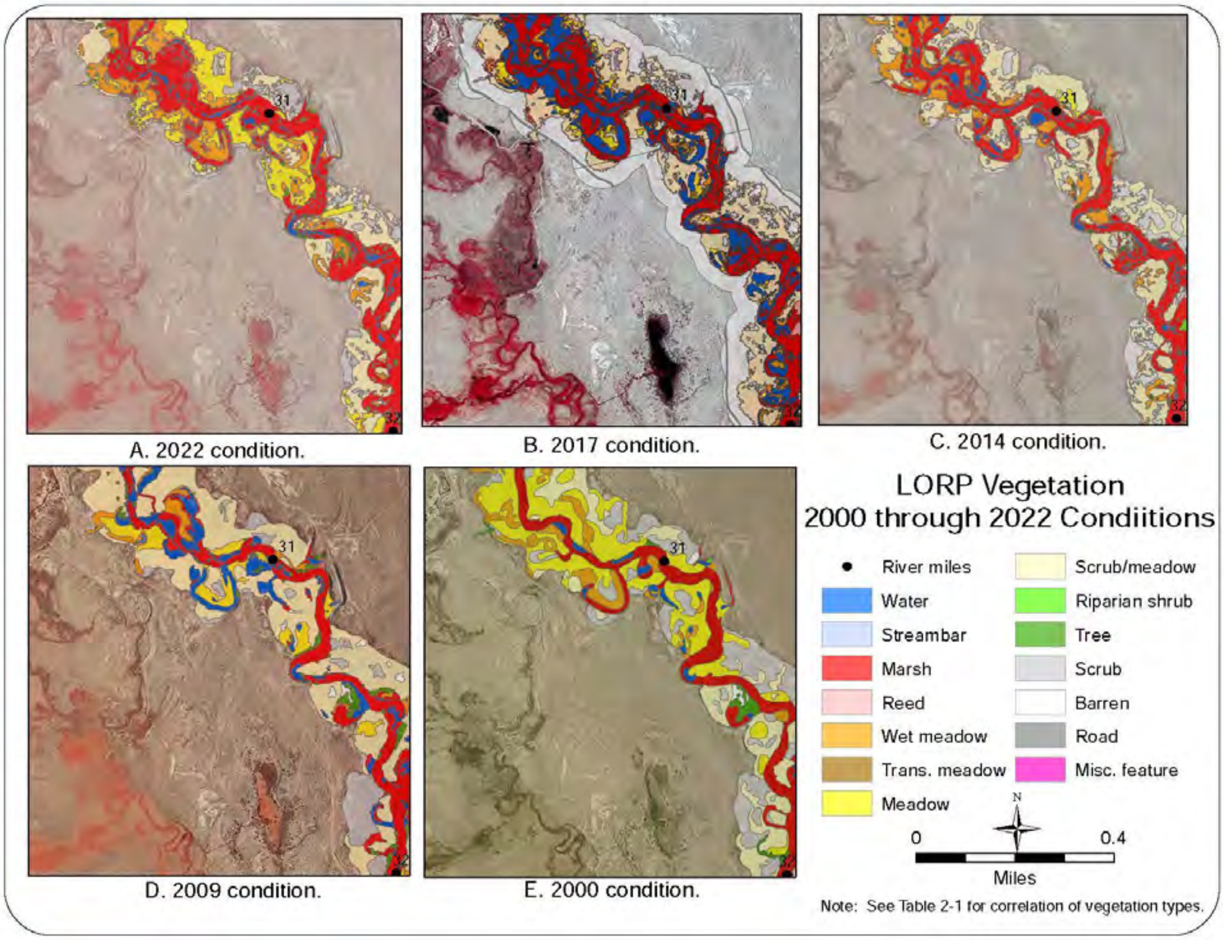
31
32
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Misc. feature
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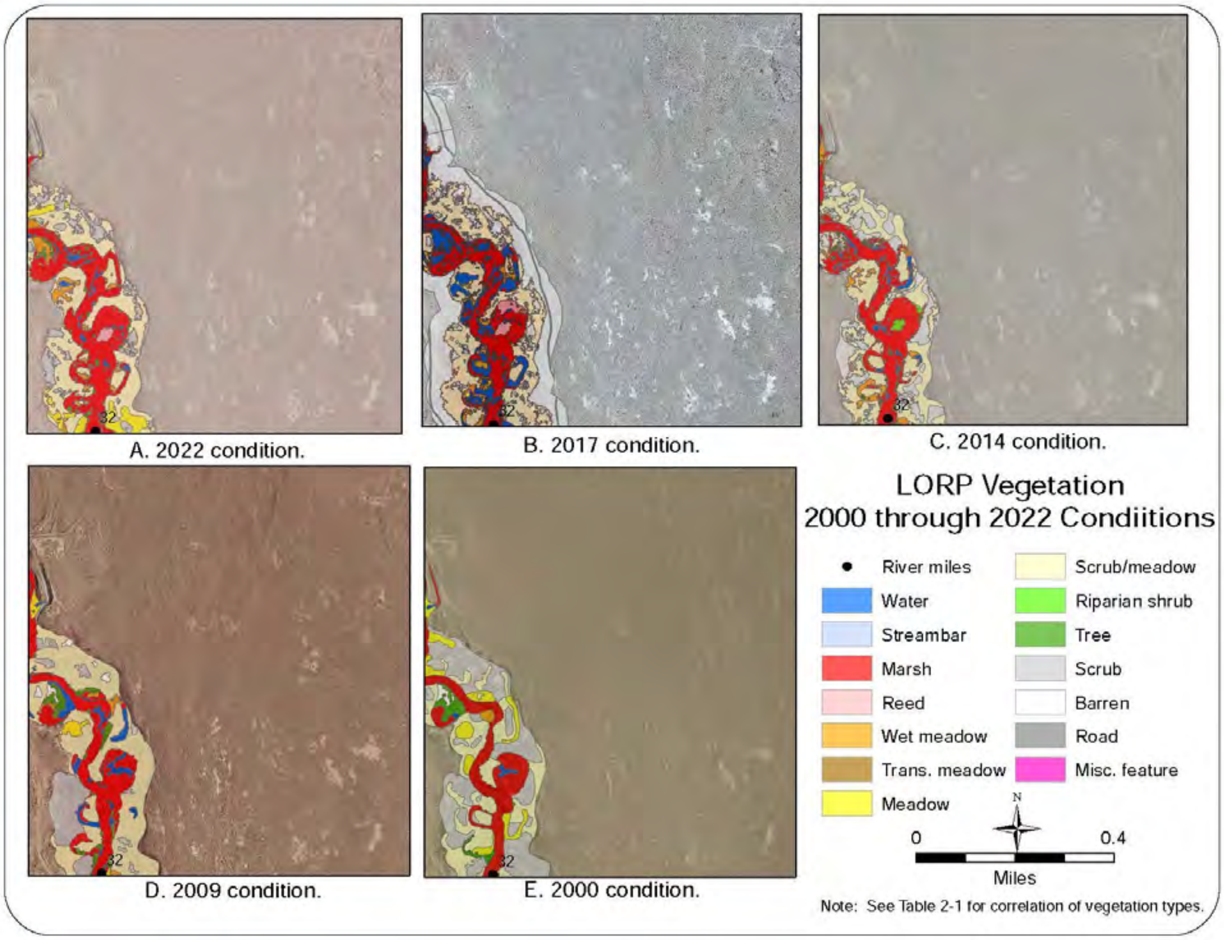
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LORP Vegetation
2000 through 2022 Condiitions
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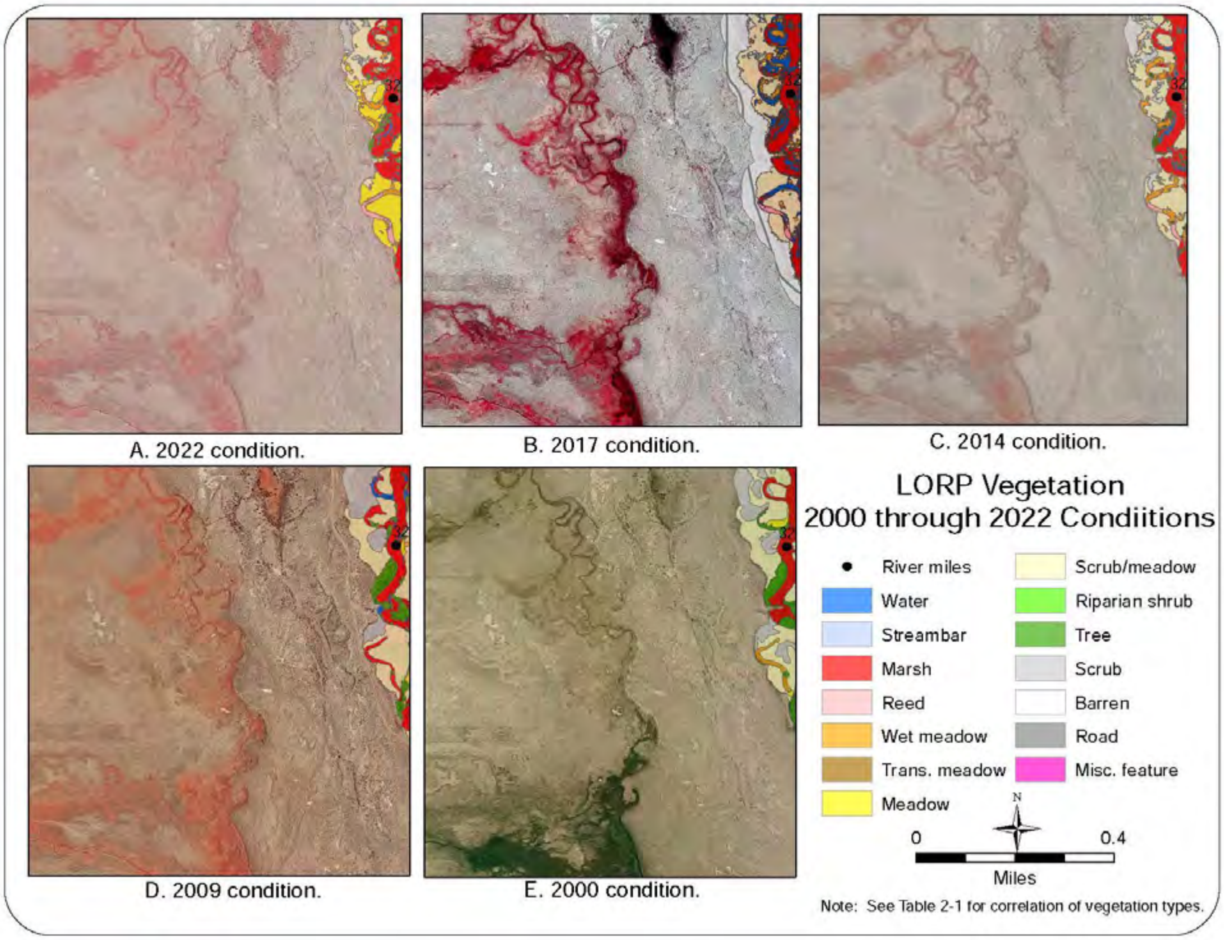
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LORP Vegetation
2000 through 2022 Condiitions
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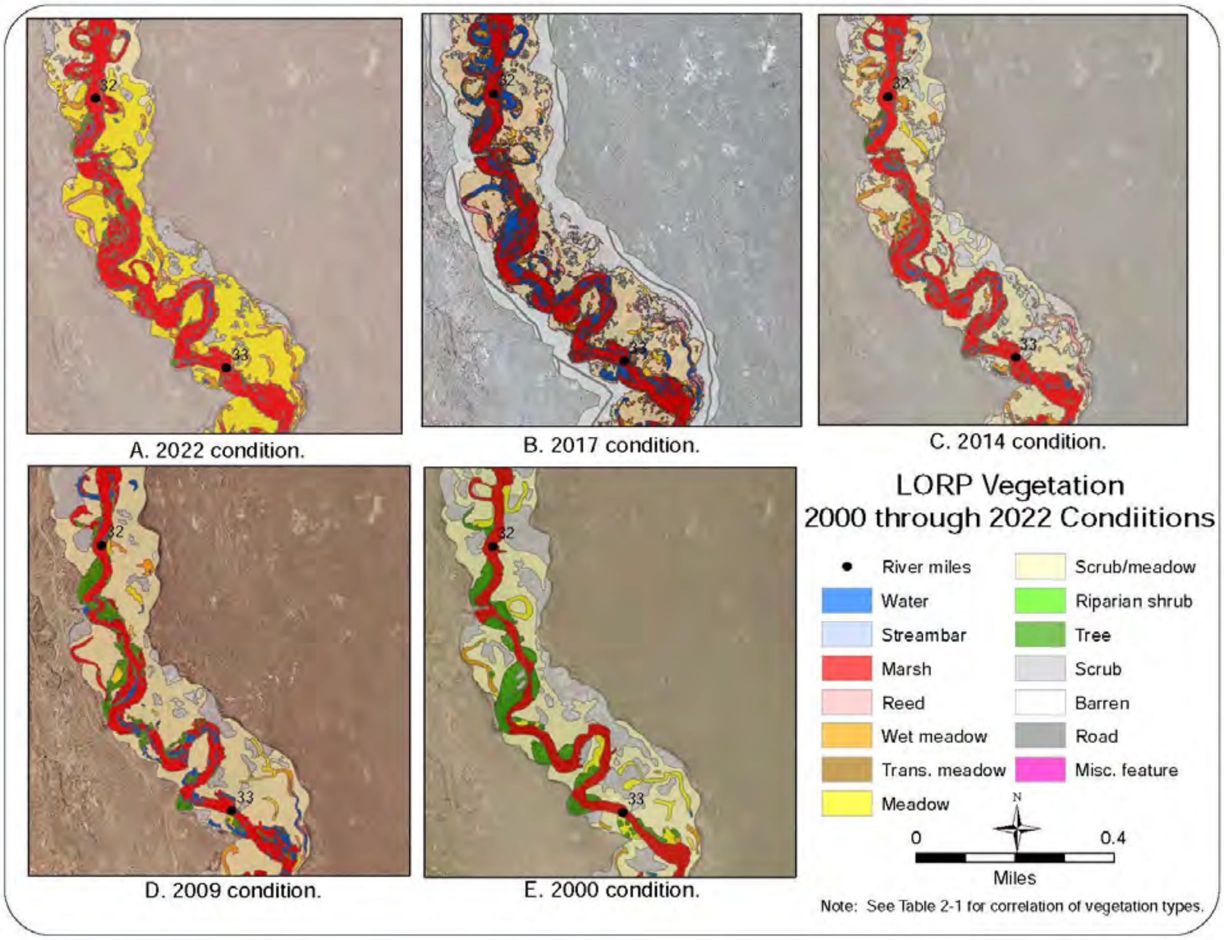
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A. 2022 condition.
B. 2017 condition.
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E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
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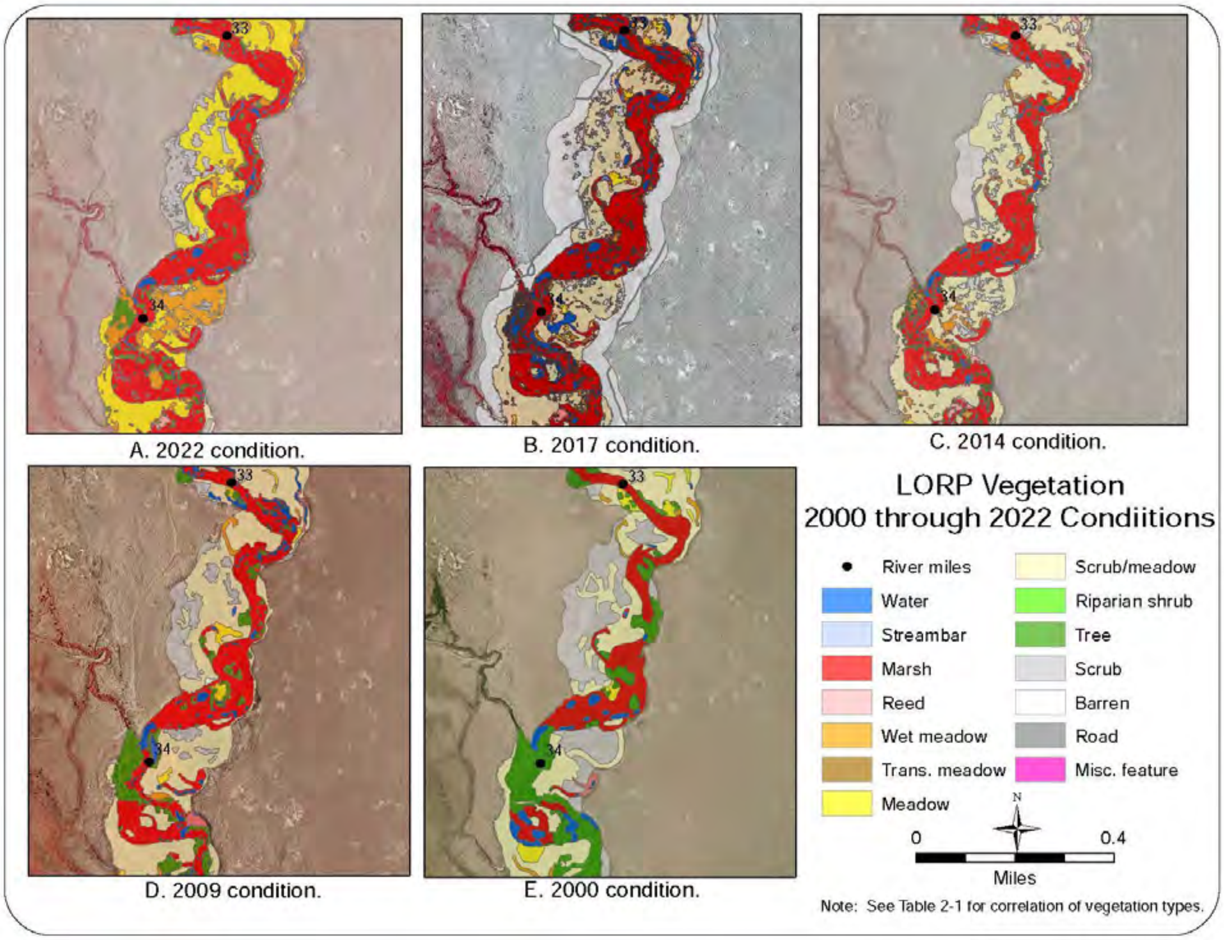
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A. 2022 condition.
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E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
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Misc. feature
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0.4
Miles
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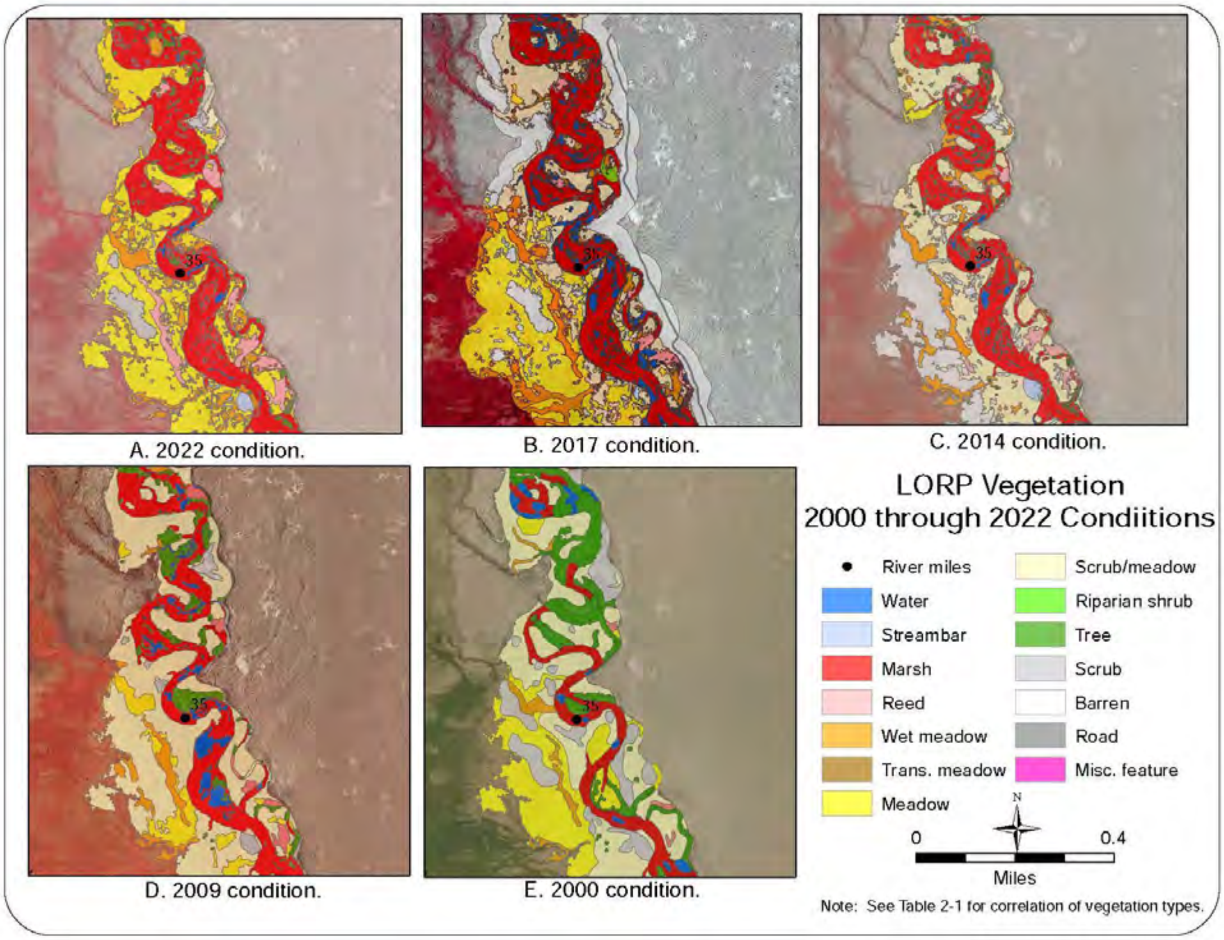
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LORP Vegetation
2000 through 2022 Condiitions
River miles
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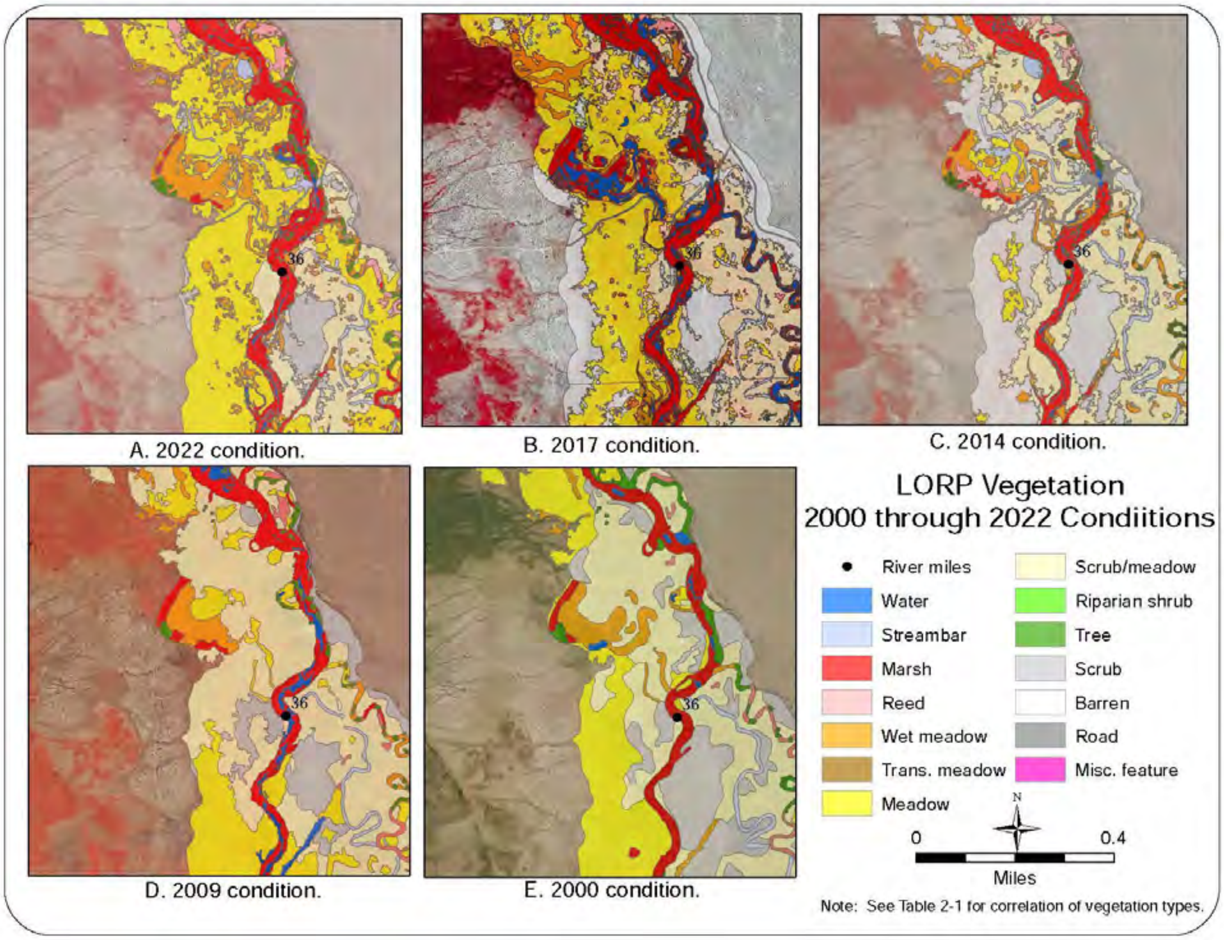
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LORP Vegetation
2000 through 2022 Condiitions
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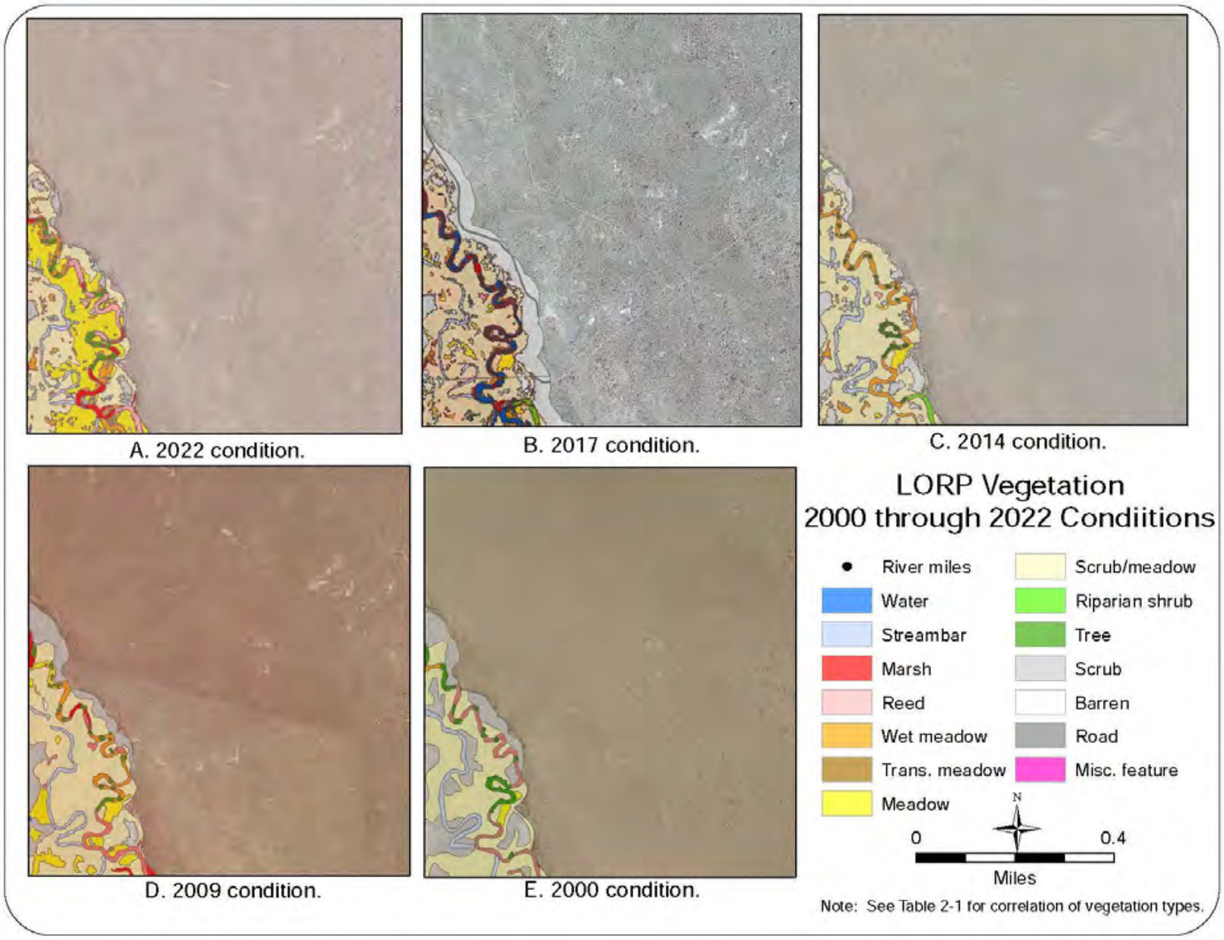
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LORP Vegetation
2000 through 2022 Condiitions
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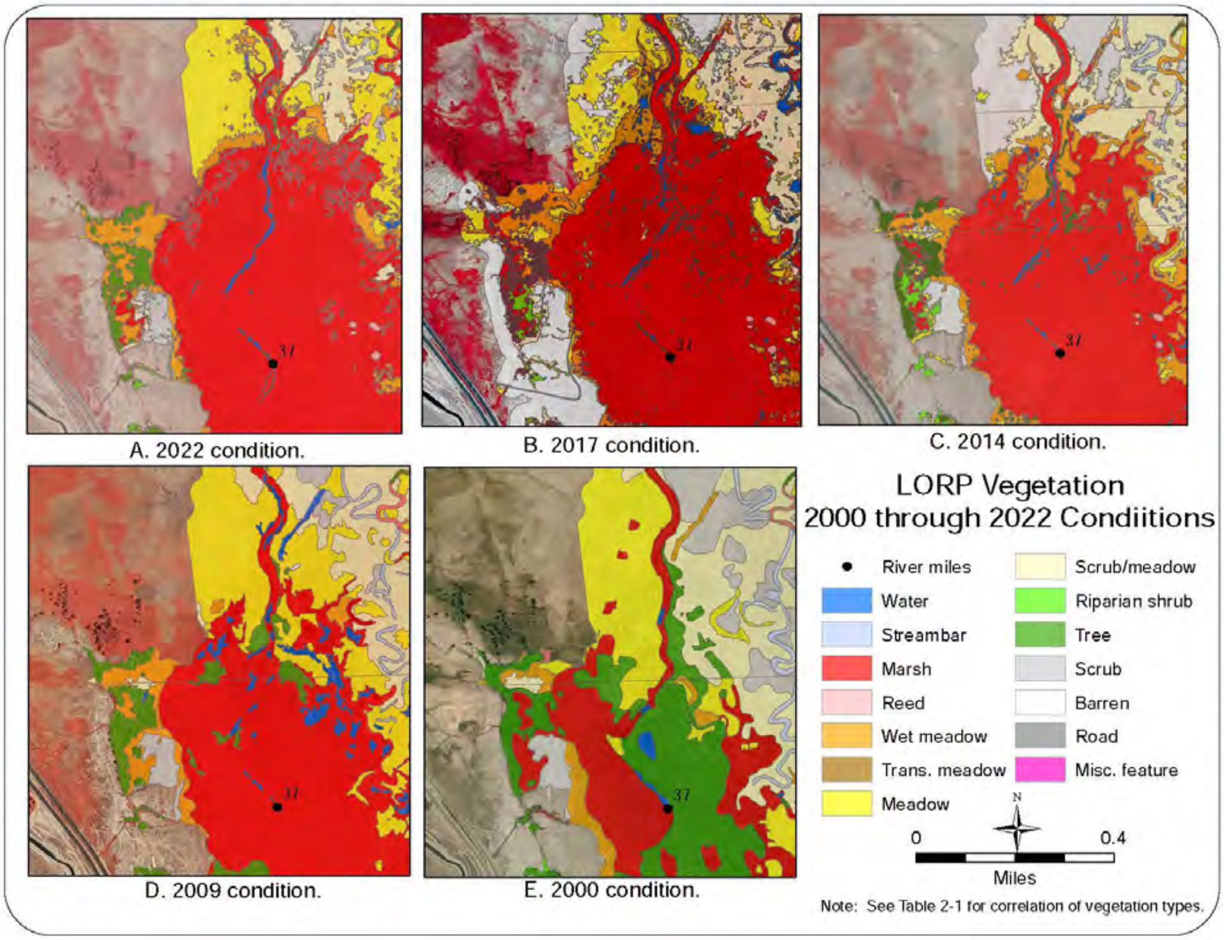
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LORP Vegetation
2000 through 2022 Condiitions
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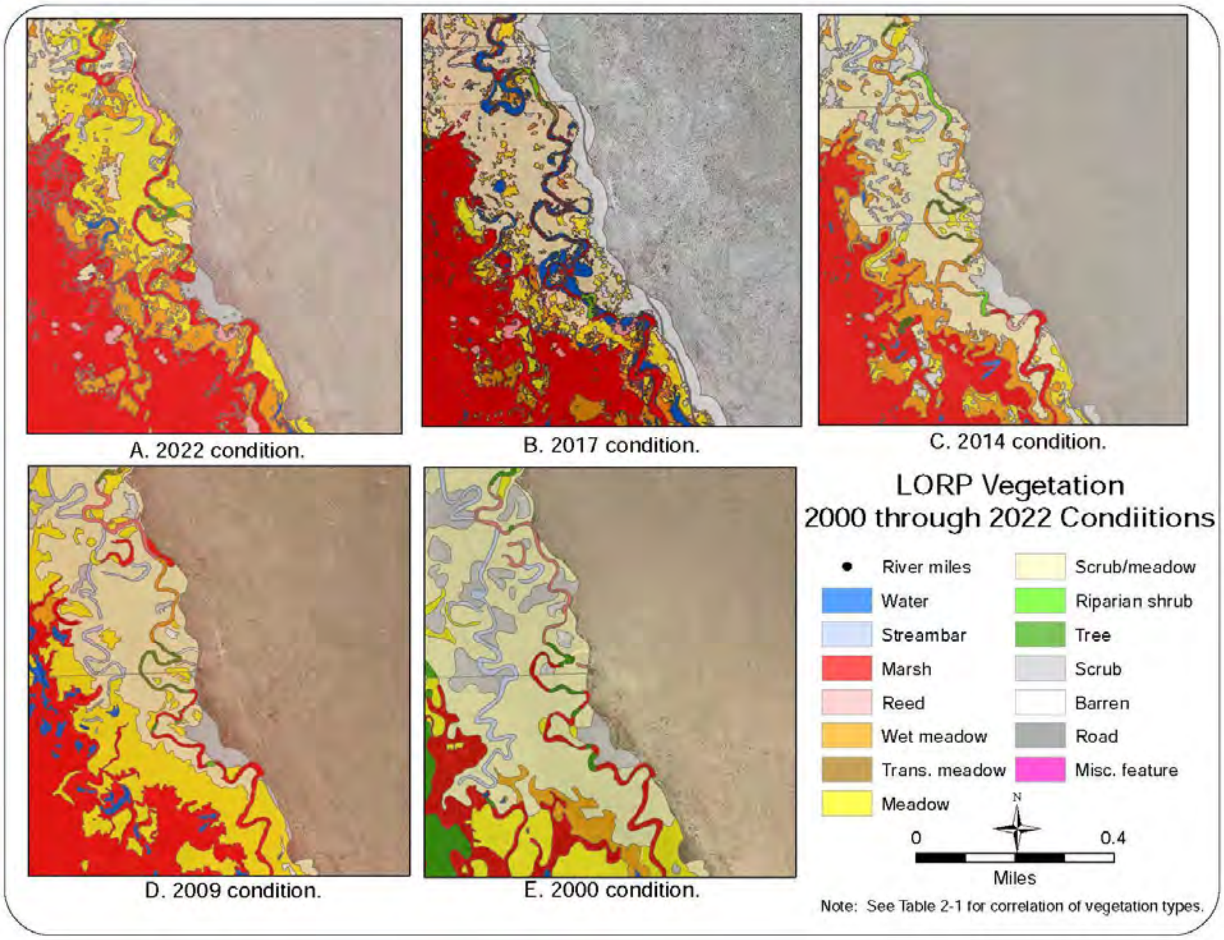
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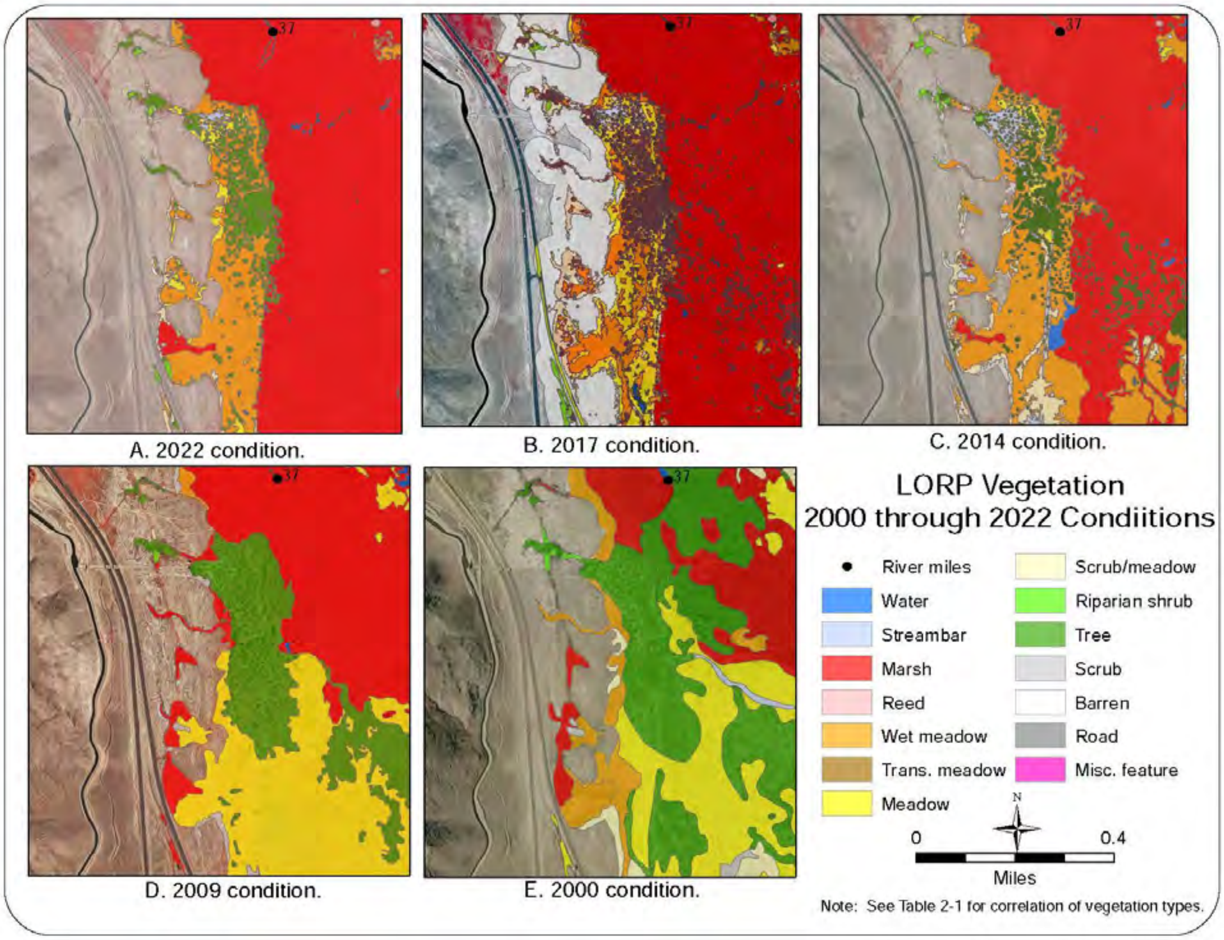
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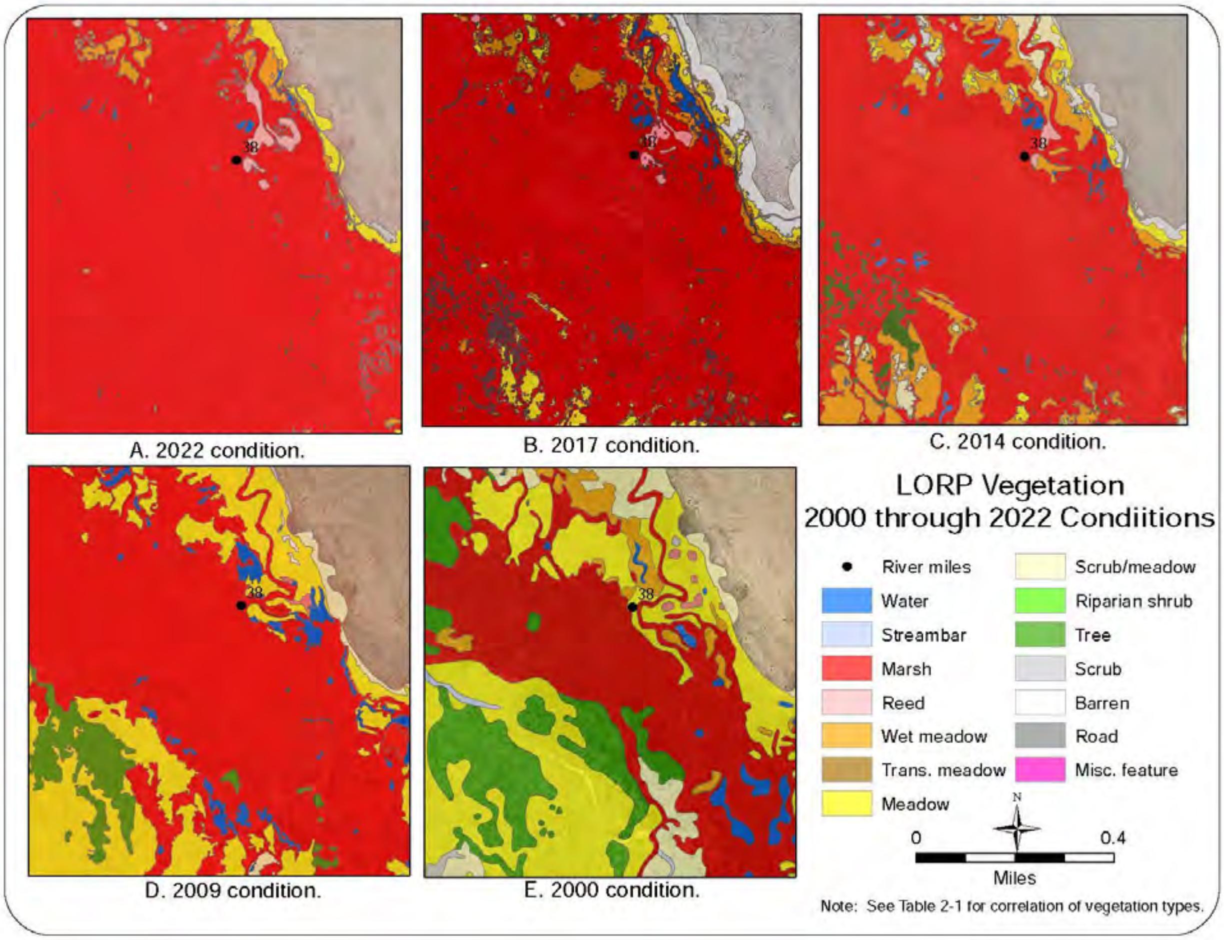
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C. 2014 condition.
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E. 2000 condition.
LORP Vegetation
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Tree
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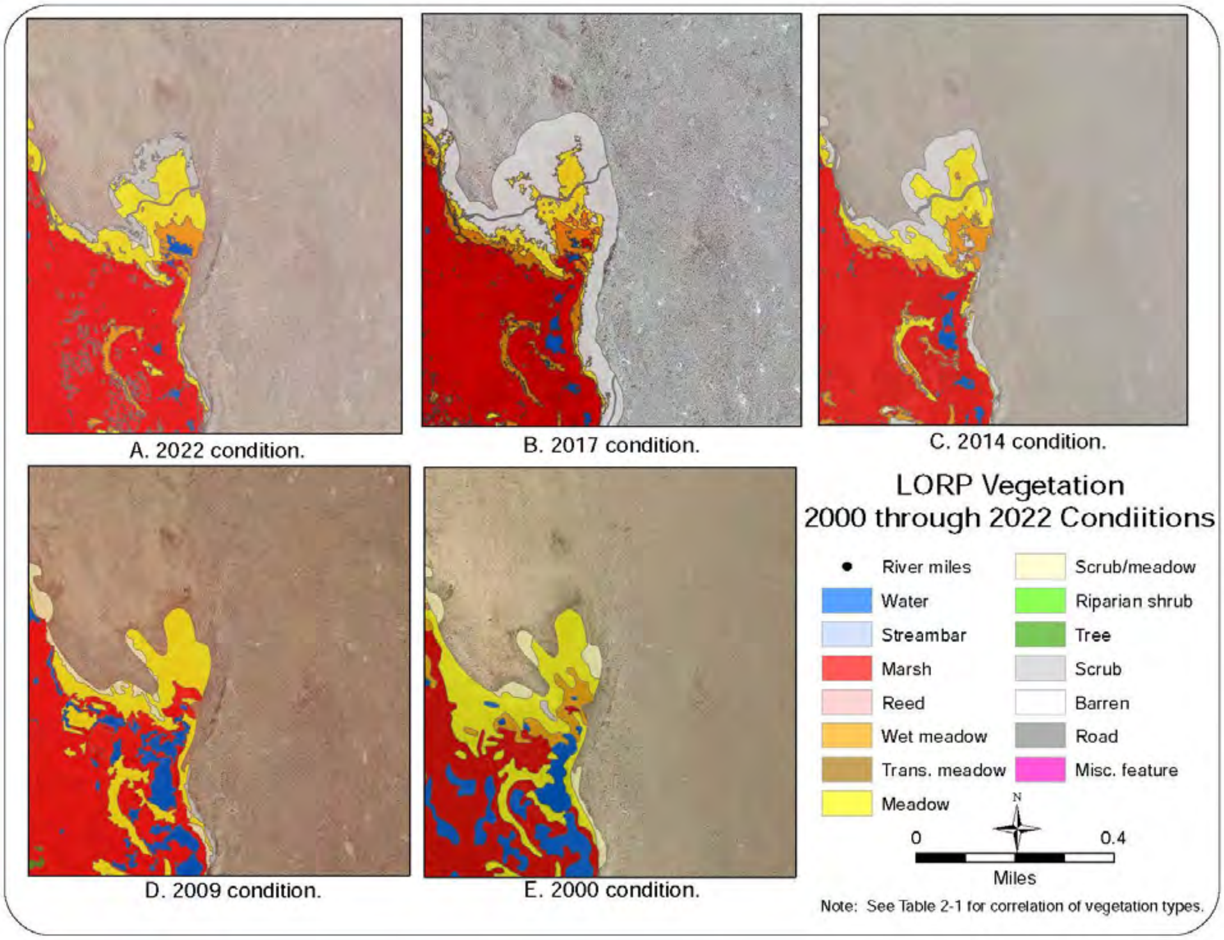
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C. 2014 condition.
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LORP Vegetation
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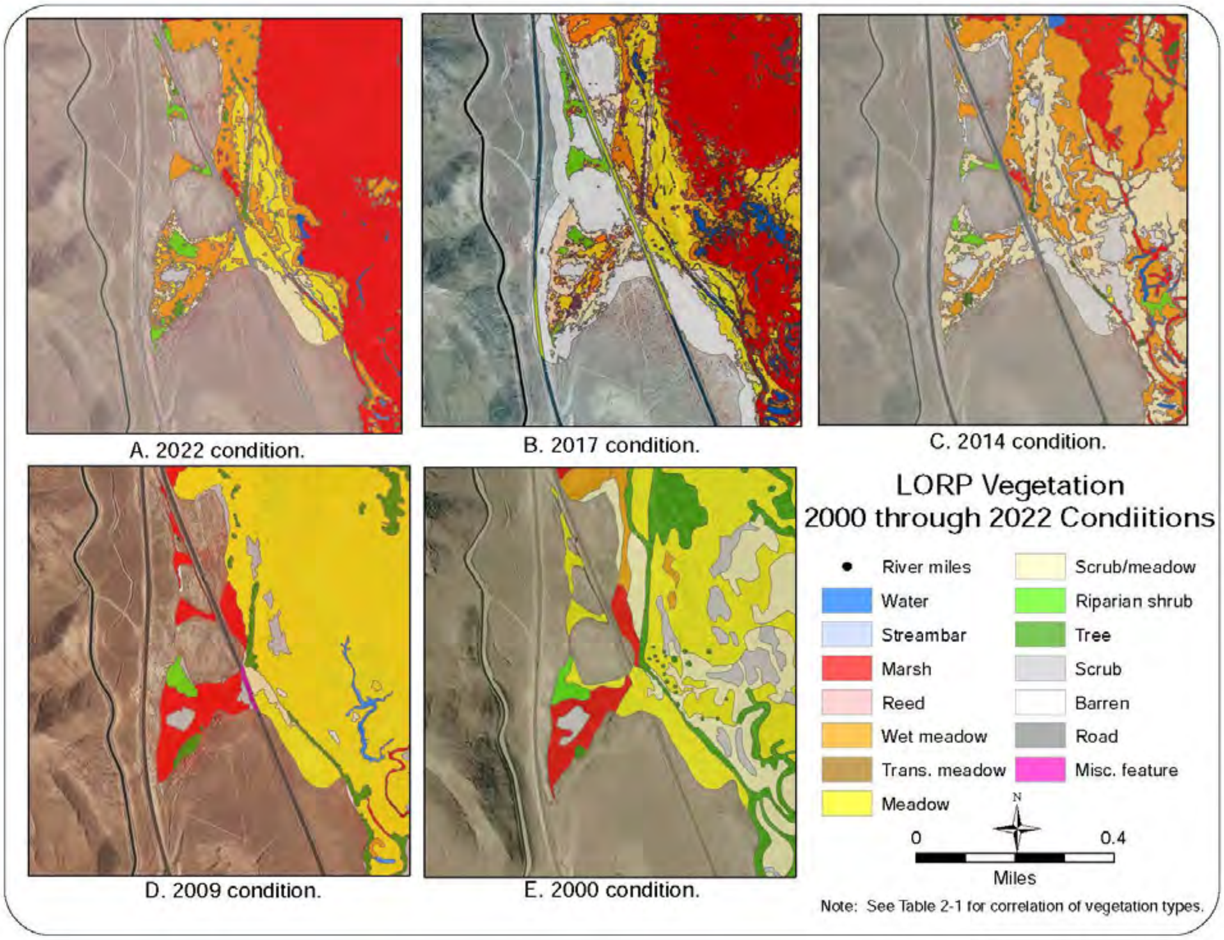
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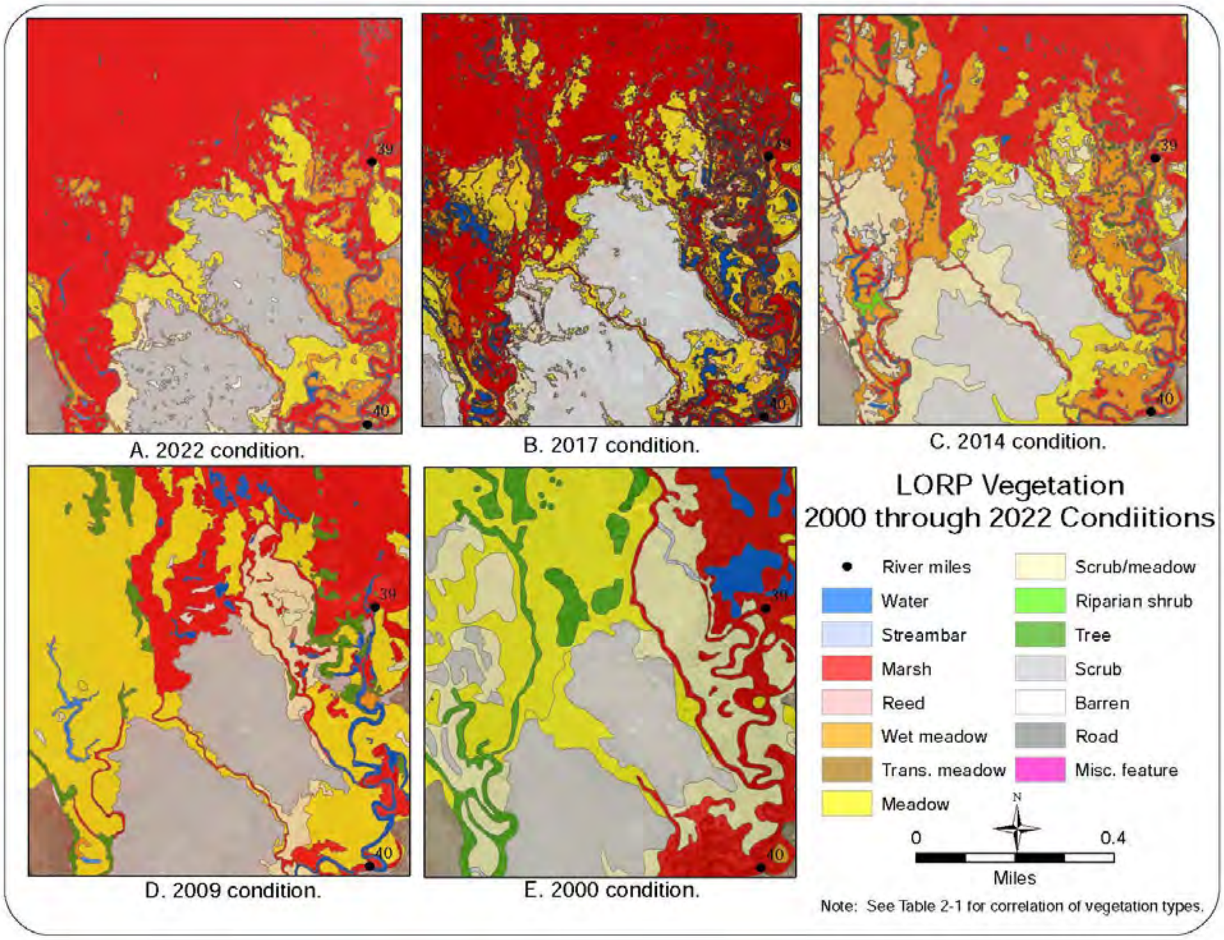
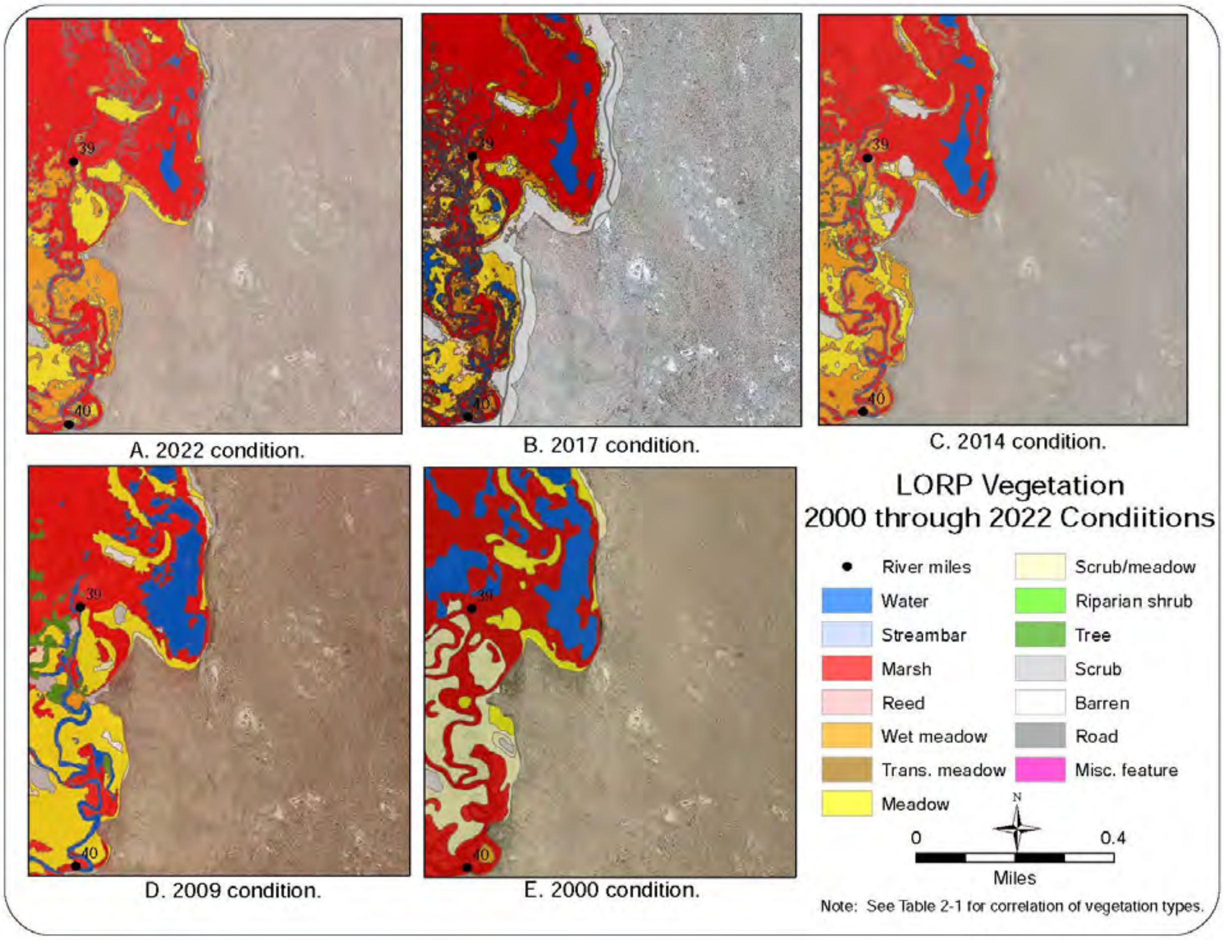
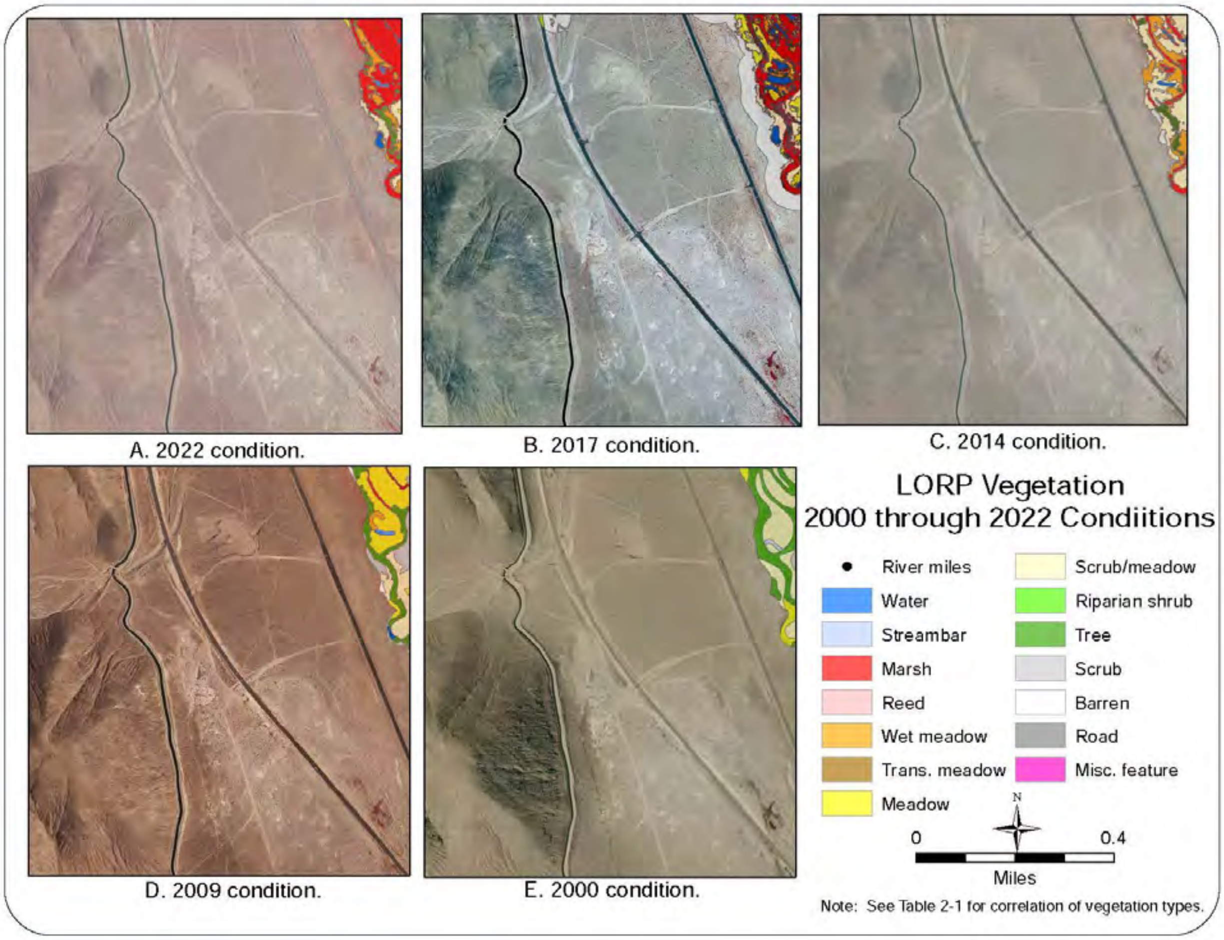
Miles
Note: See Table 2-1 for correlation of vegetation types.


A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
39
40
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


39
40
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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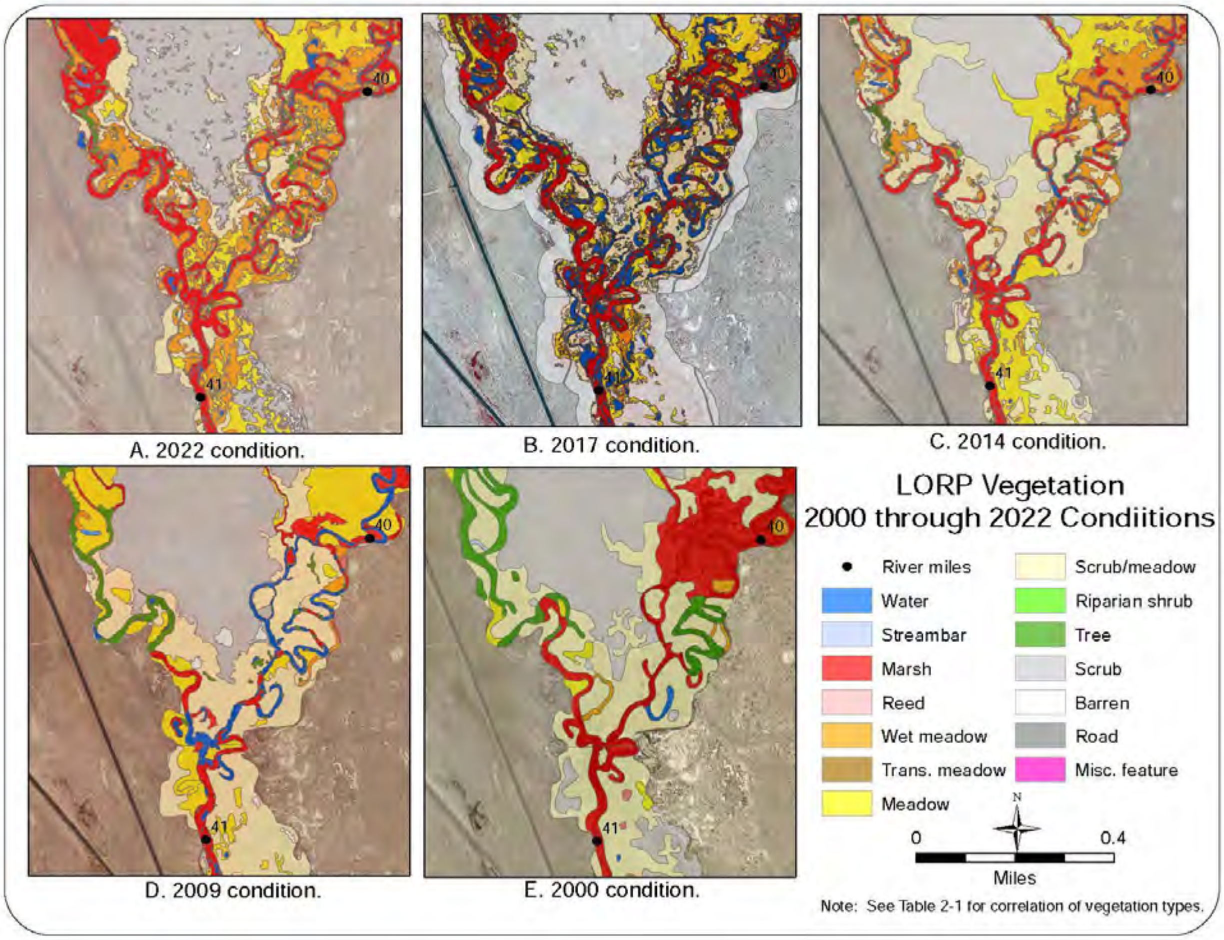
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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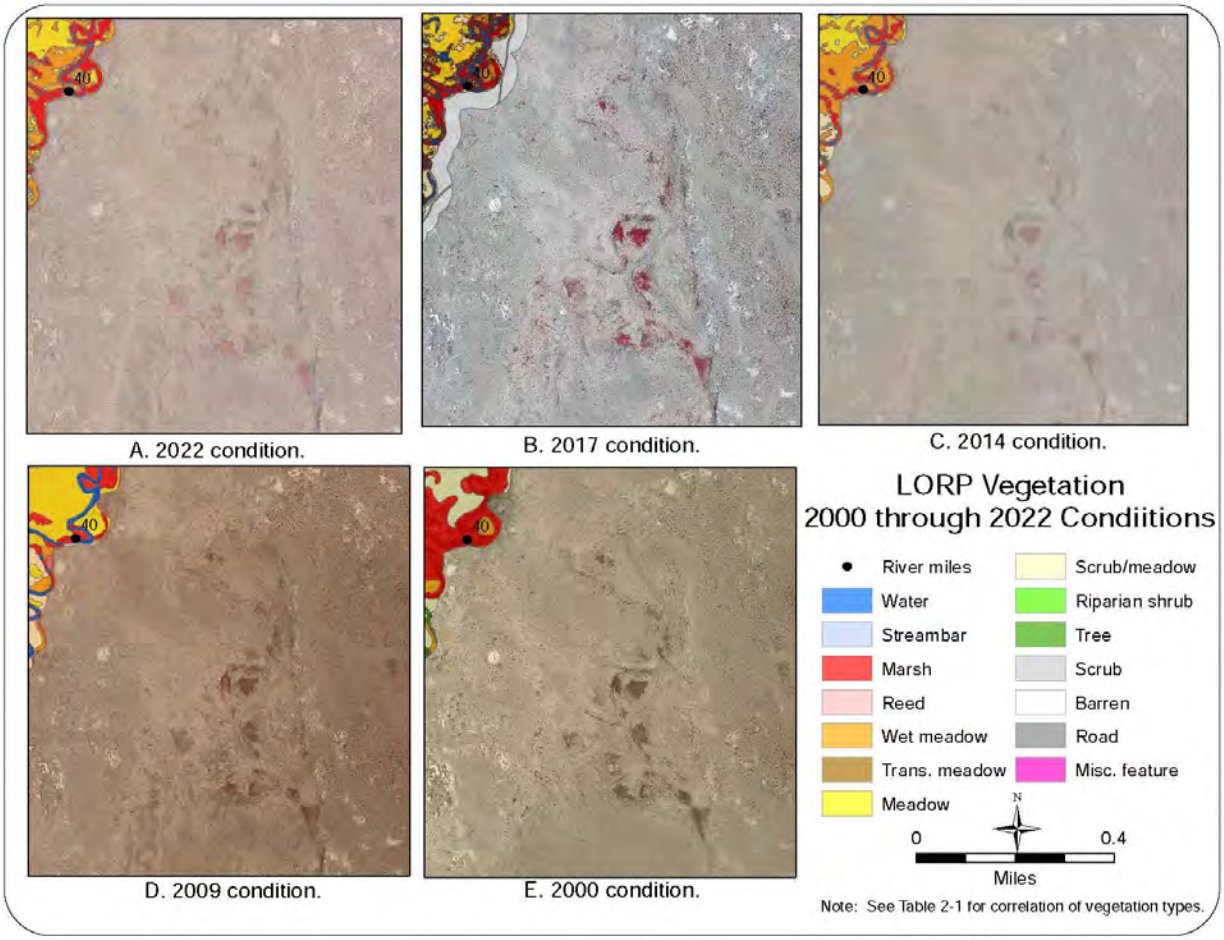
41
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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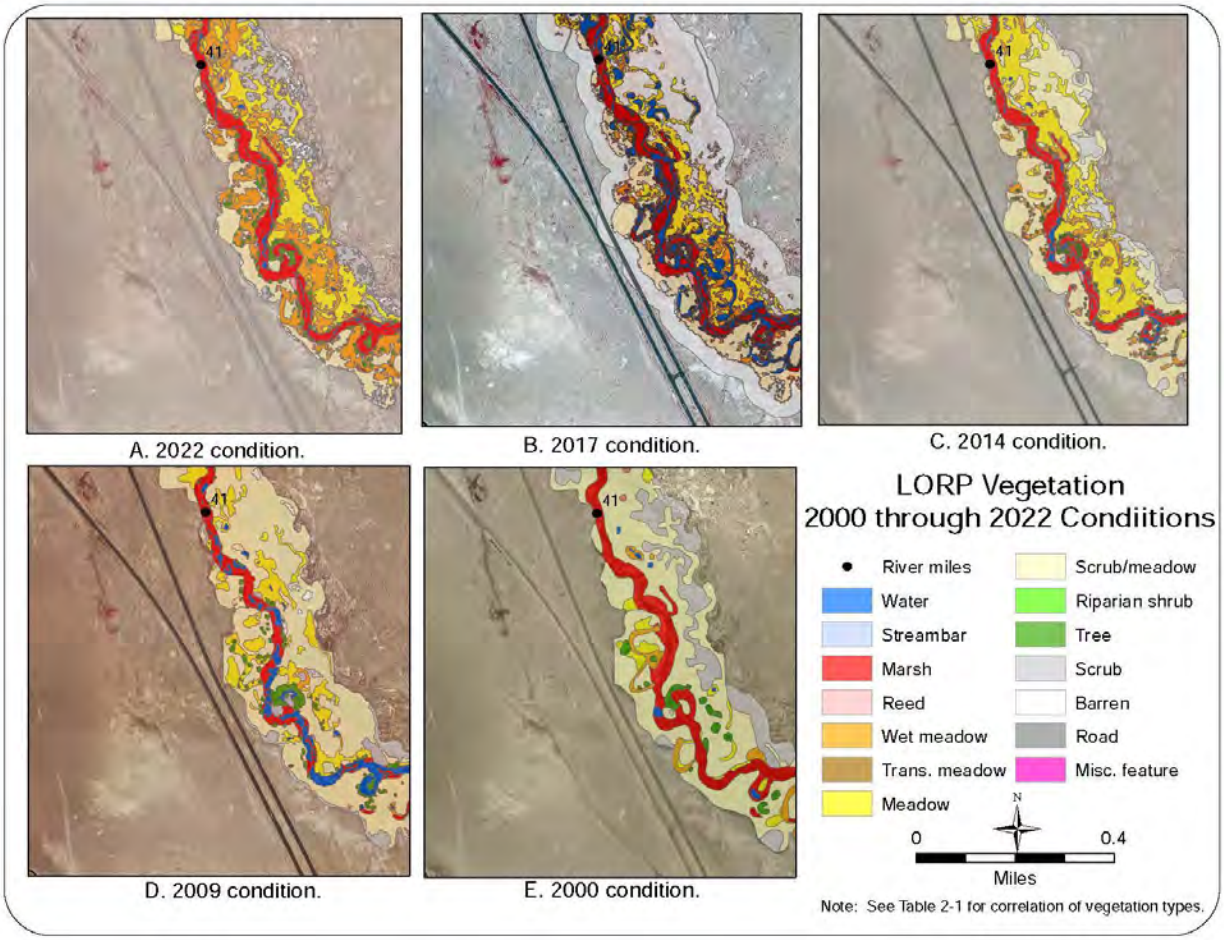
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.
40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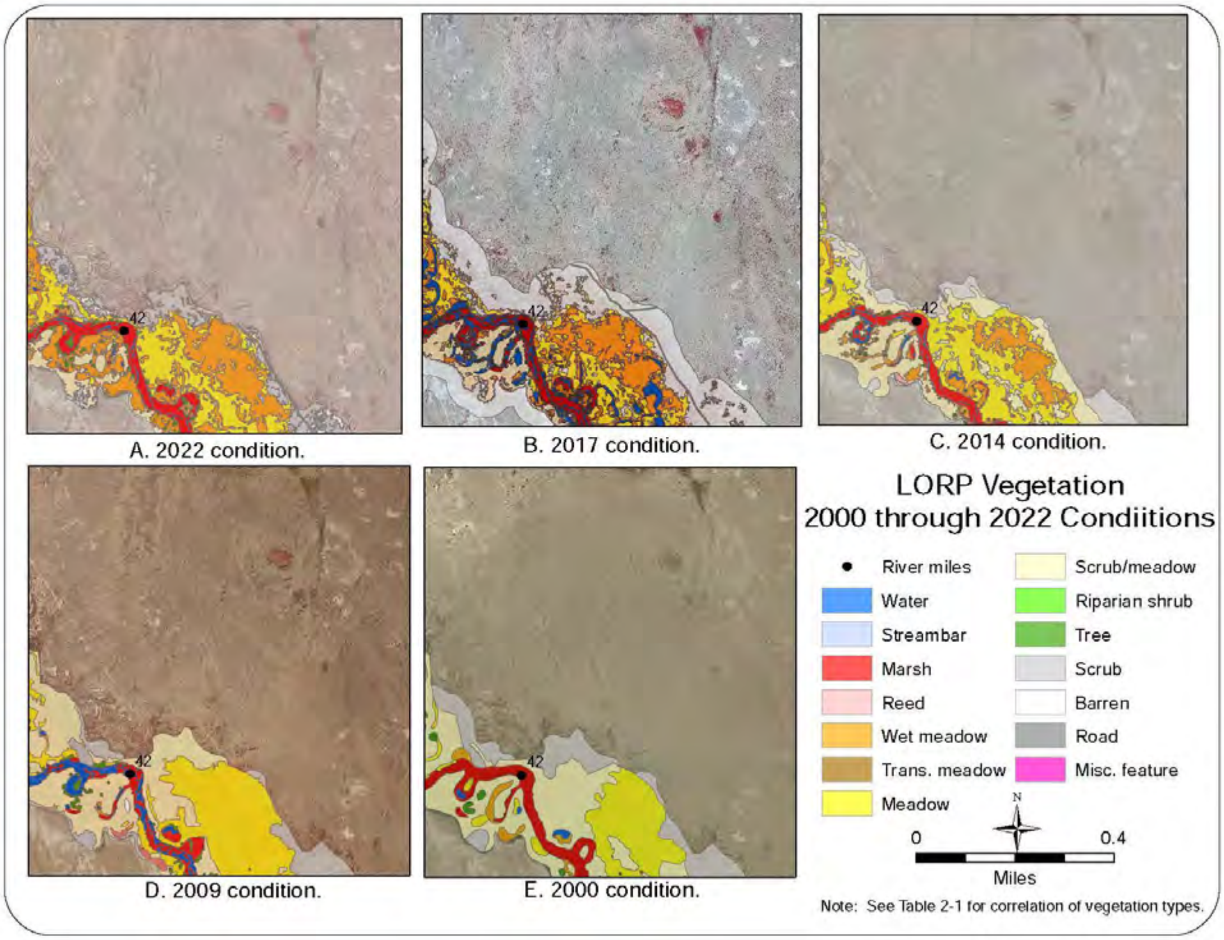
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


42
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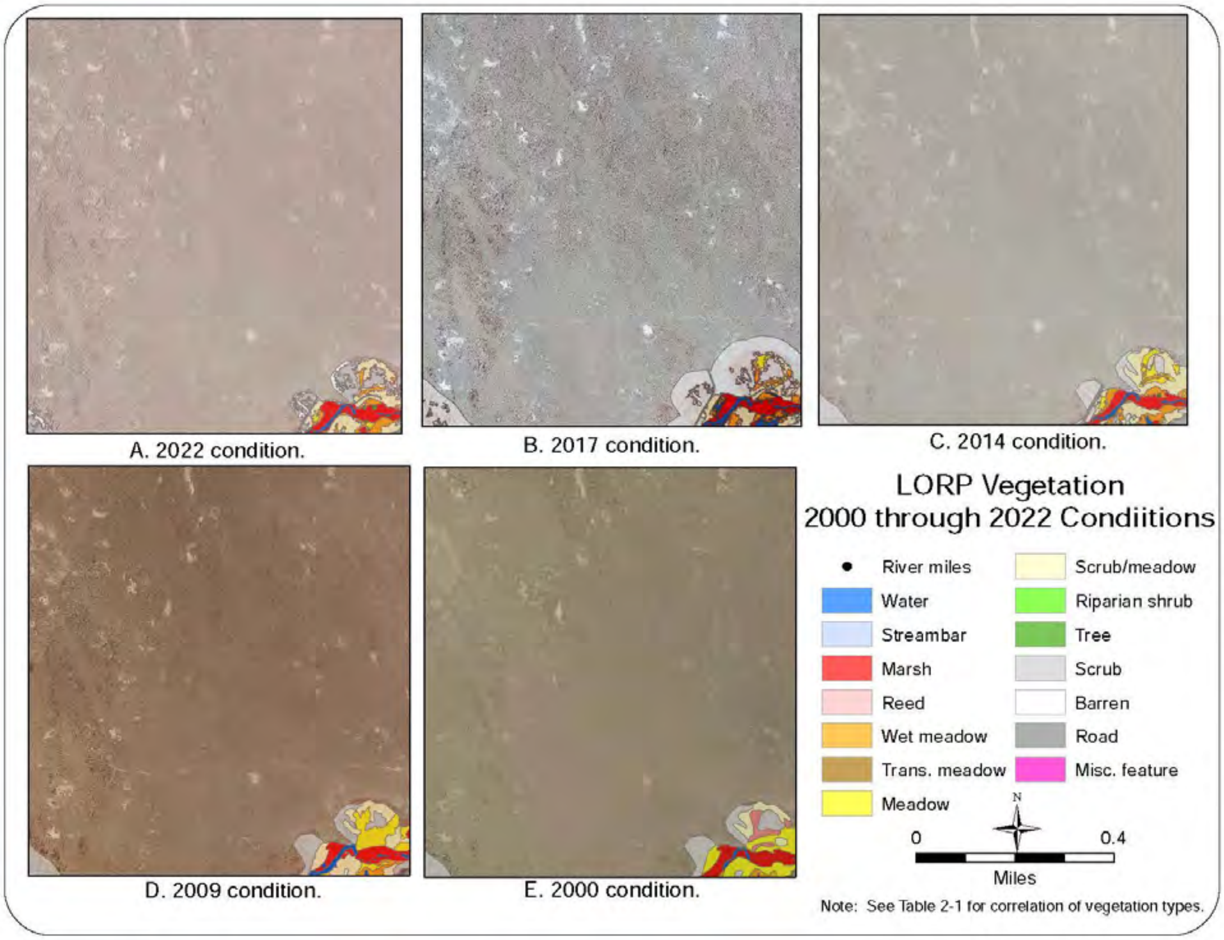
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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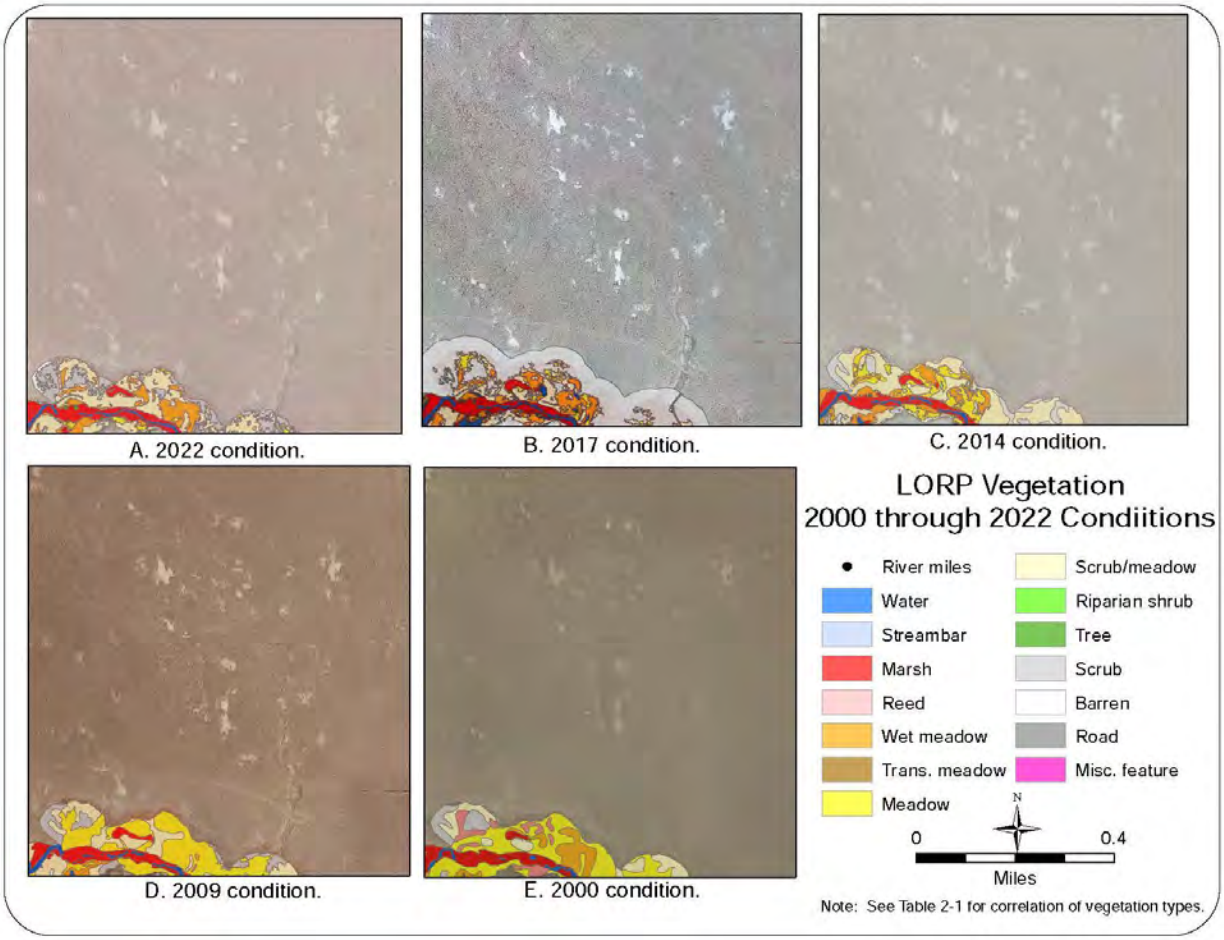
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.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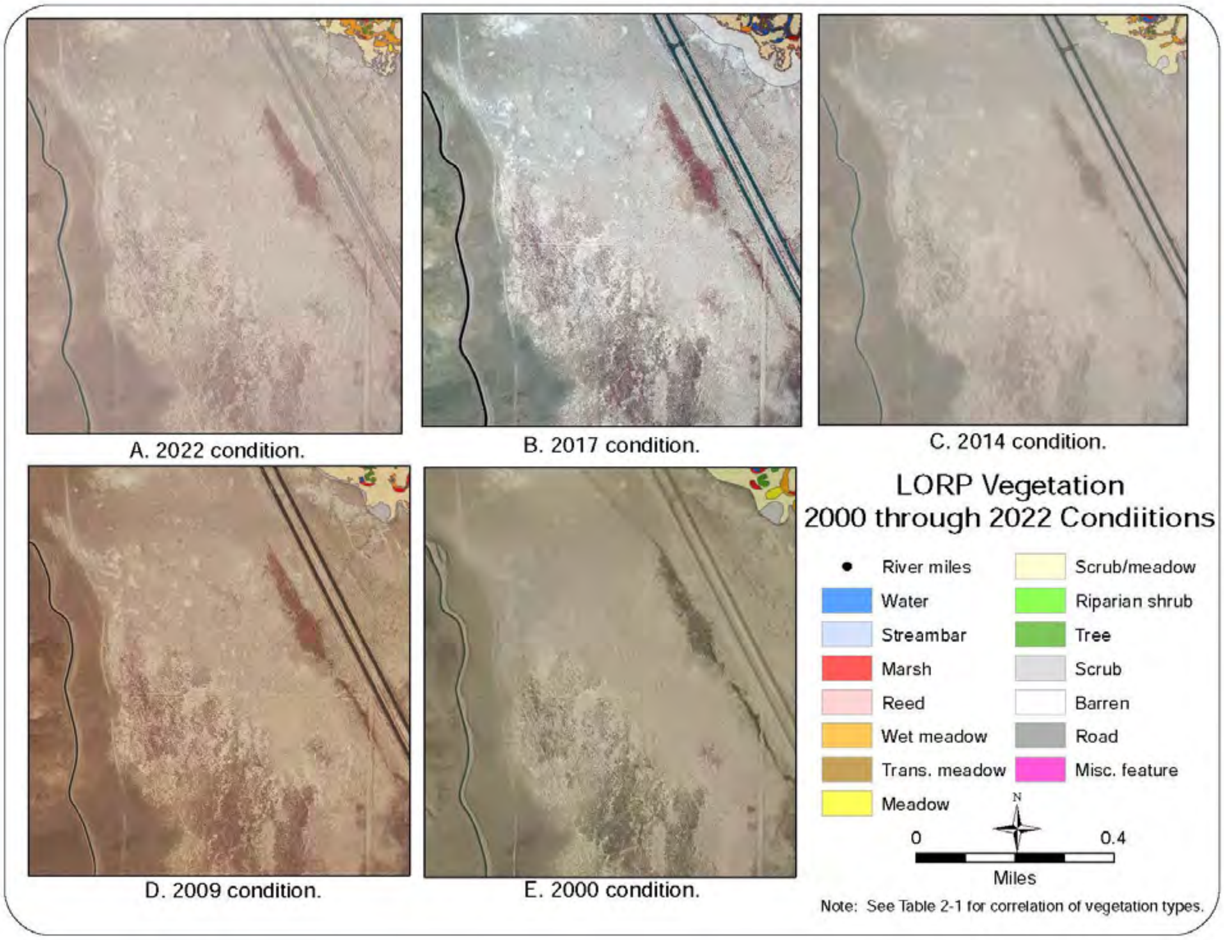
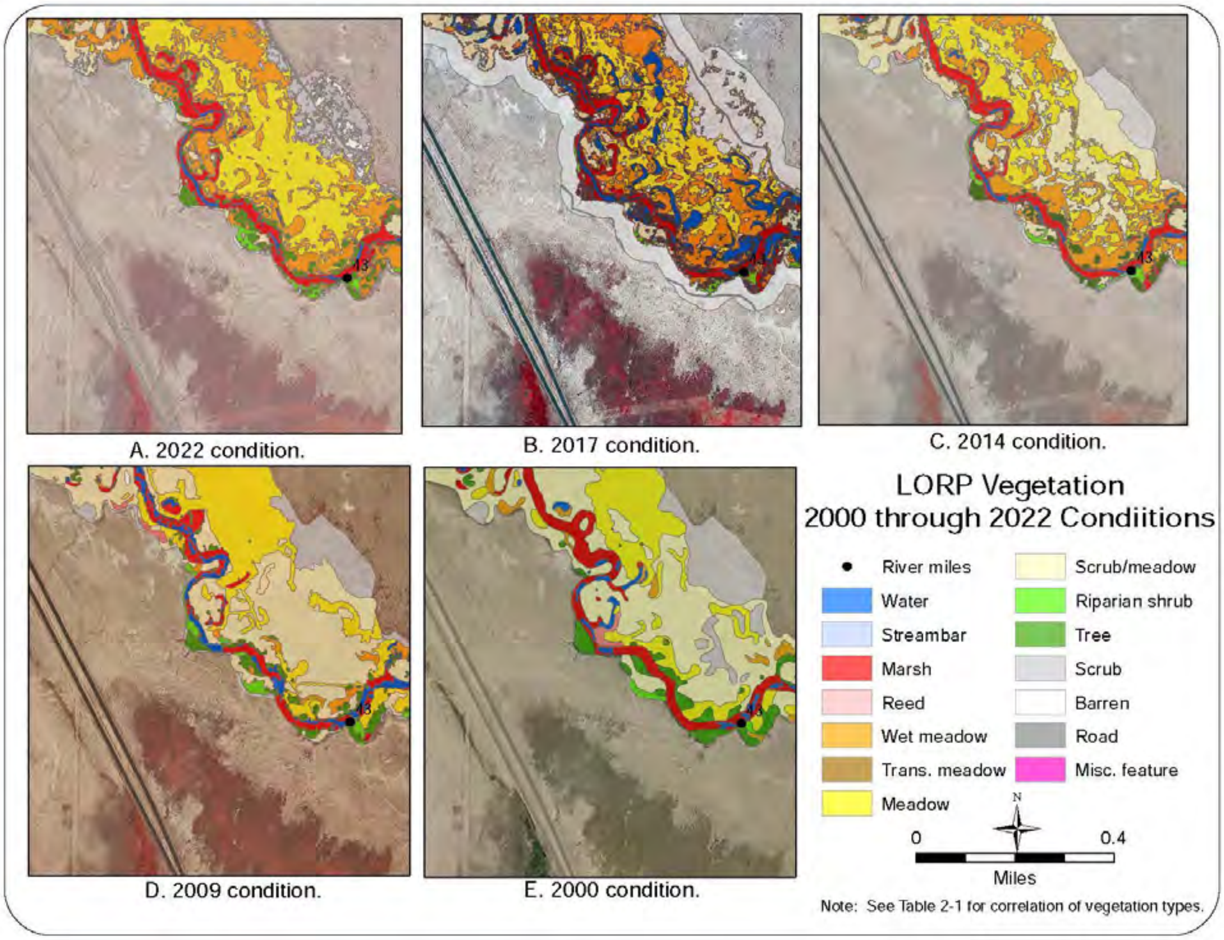
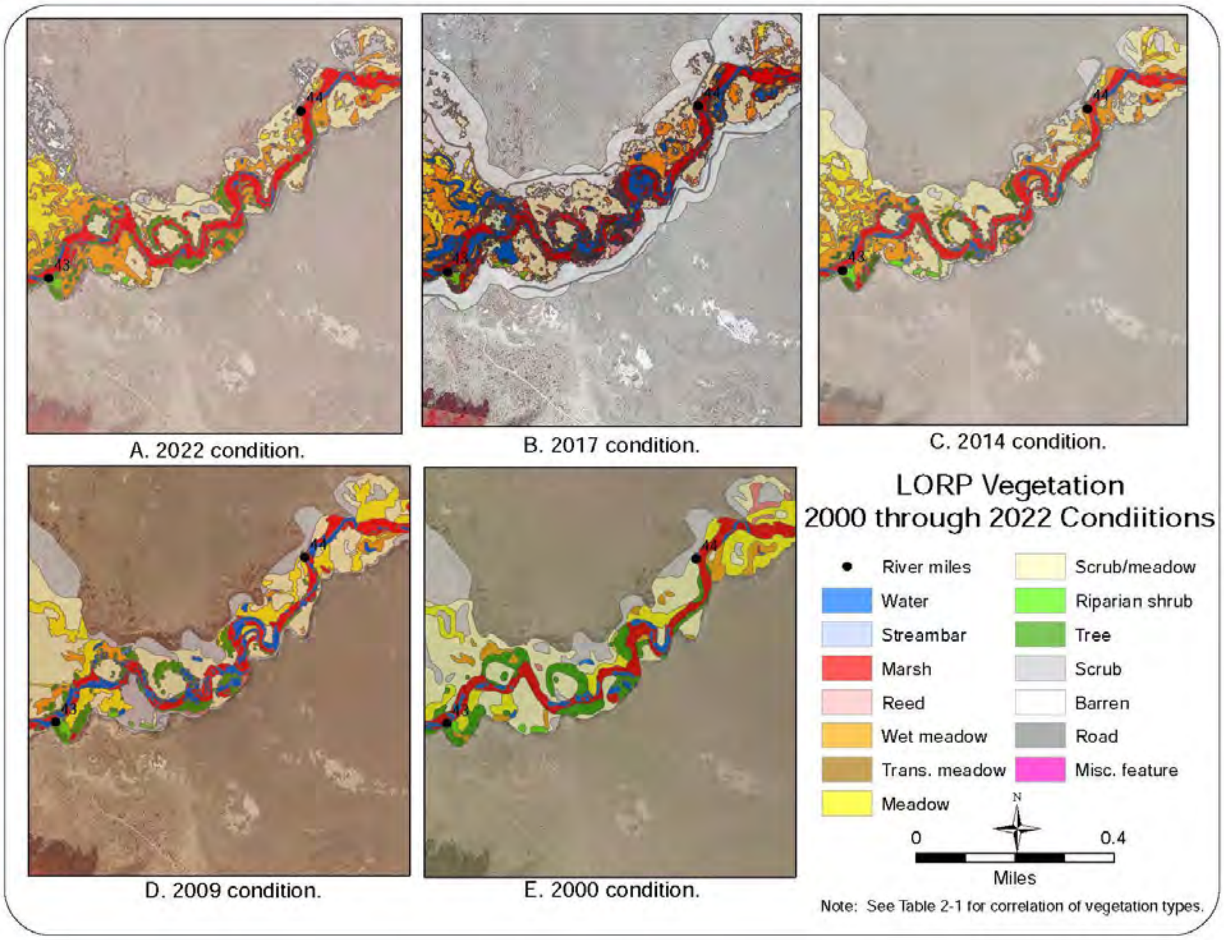
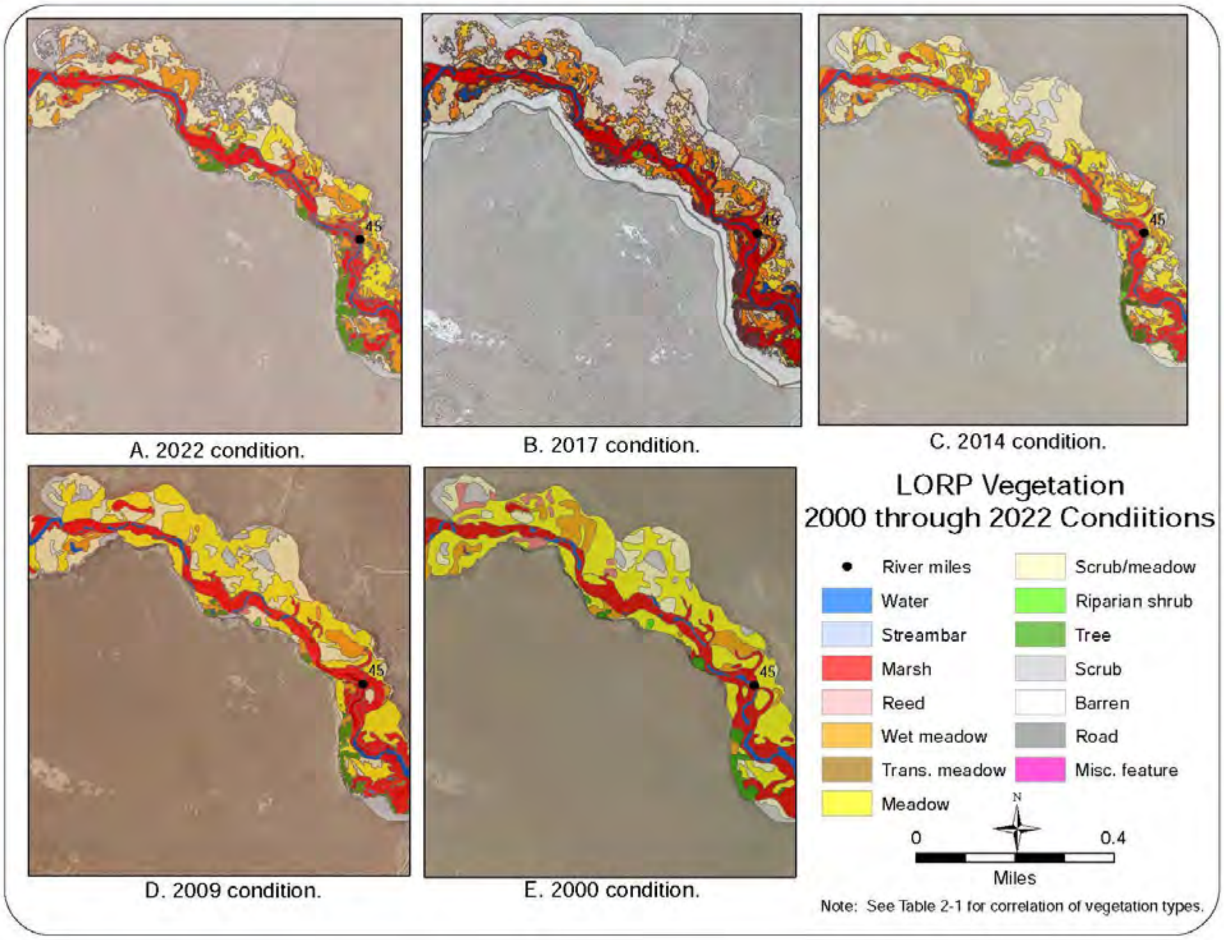
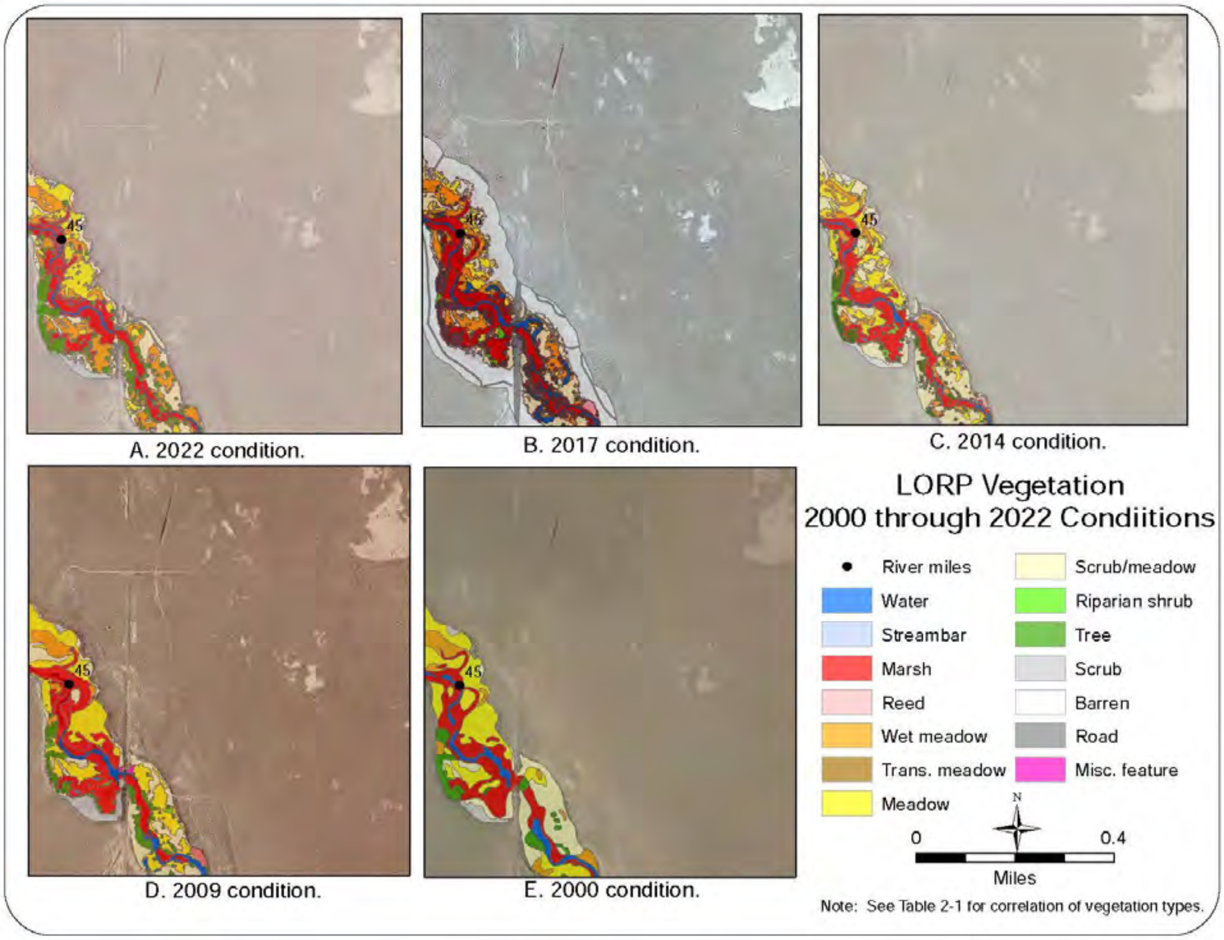
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

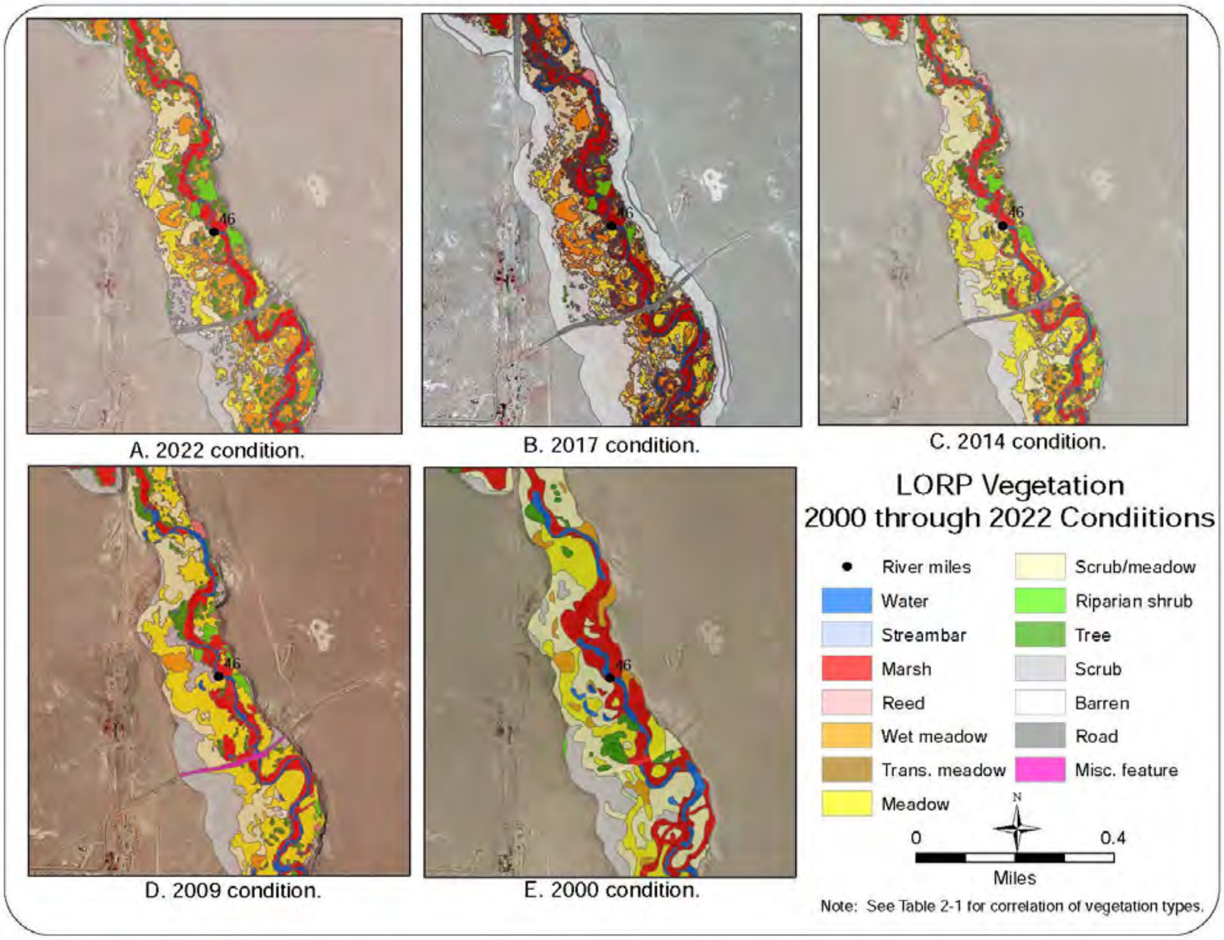

A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

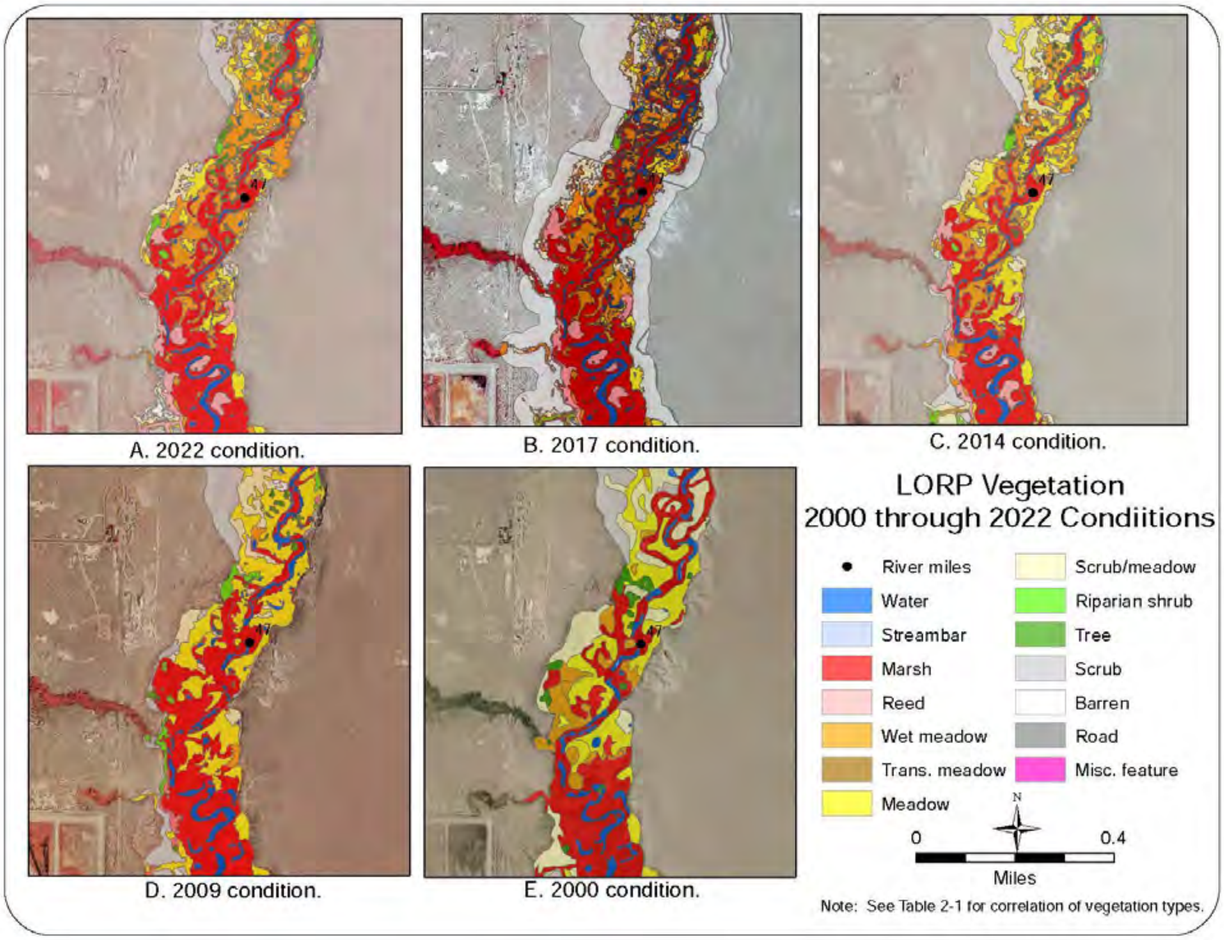

A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

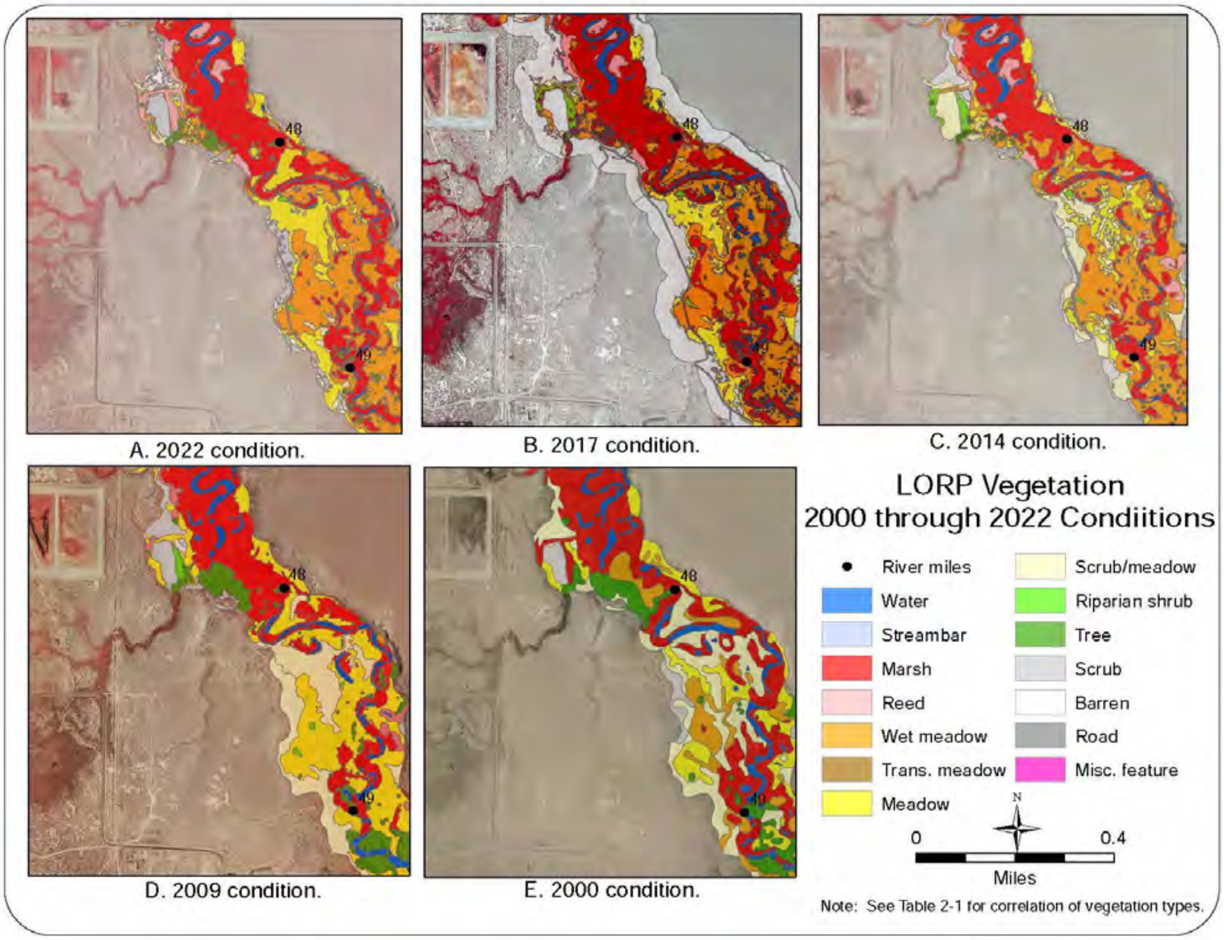

44
43
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

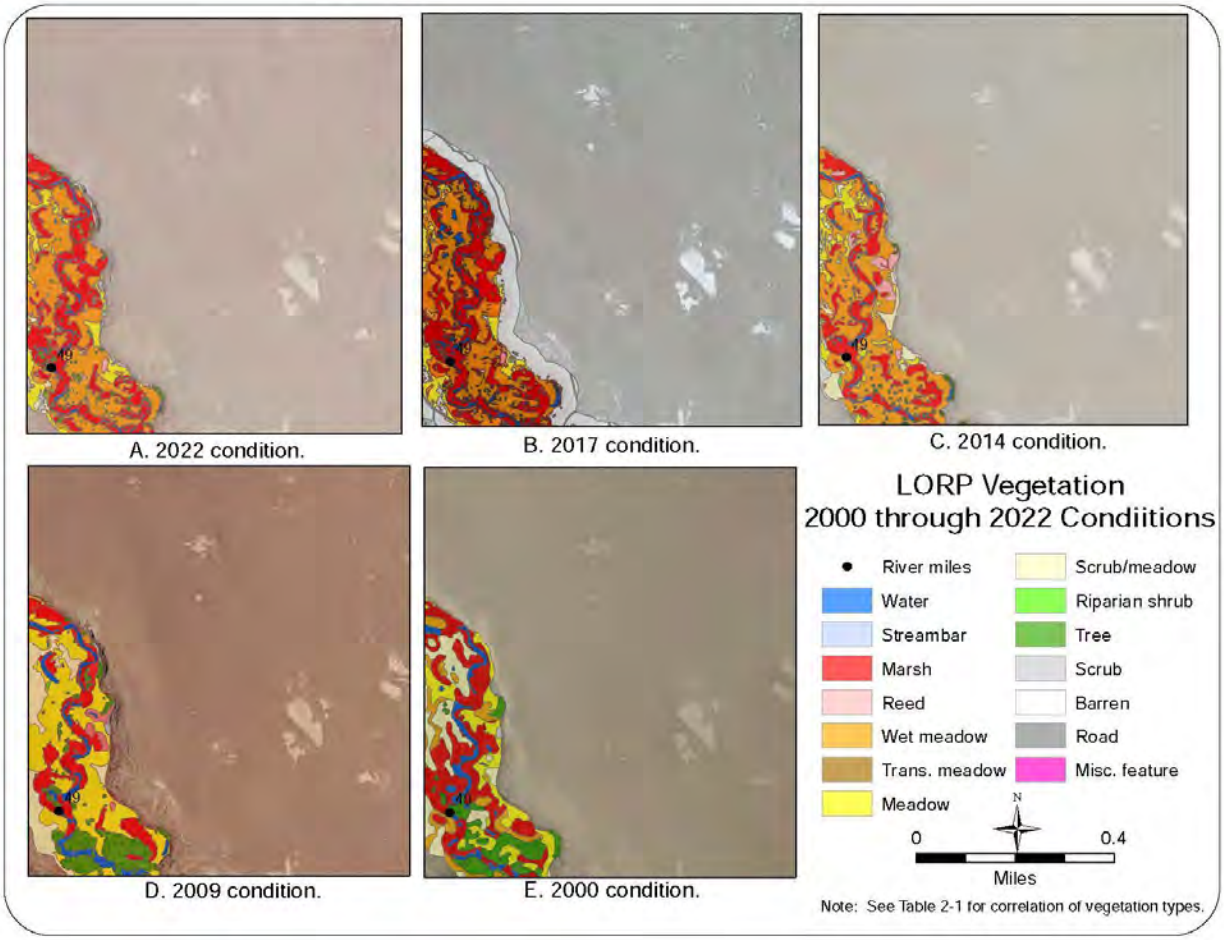

45
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

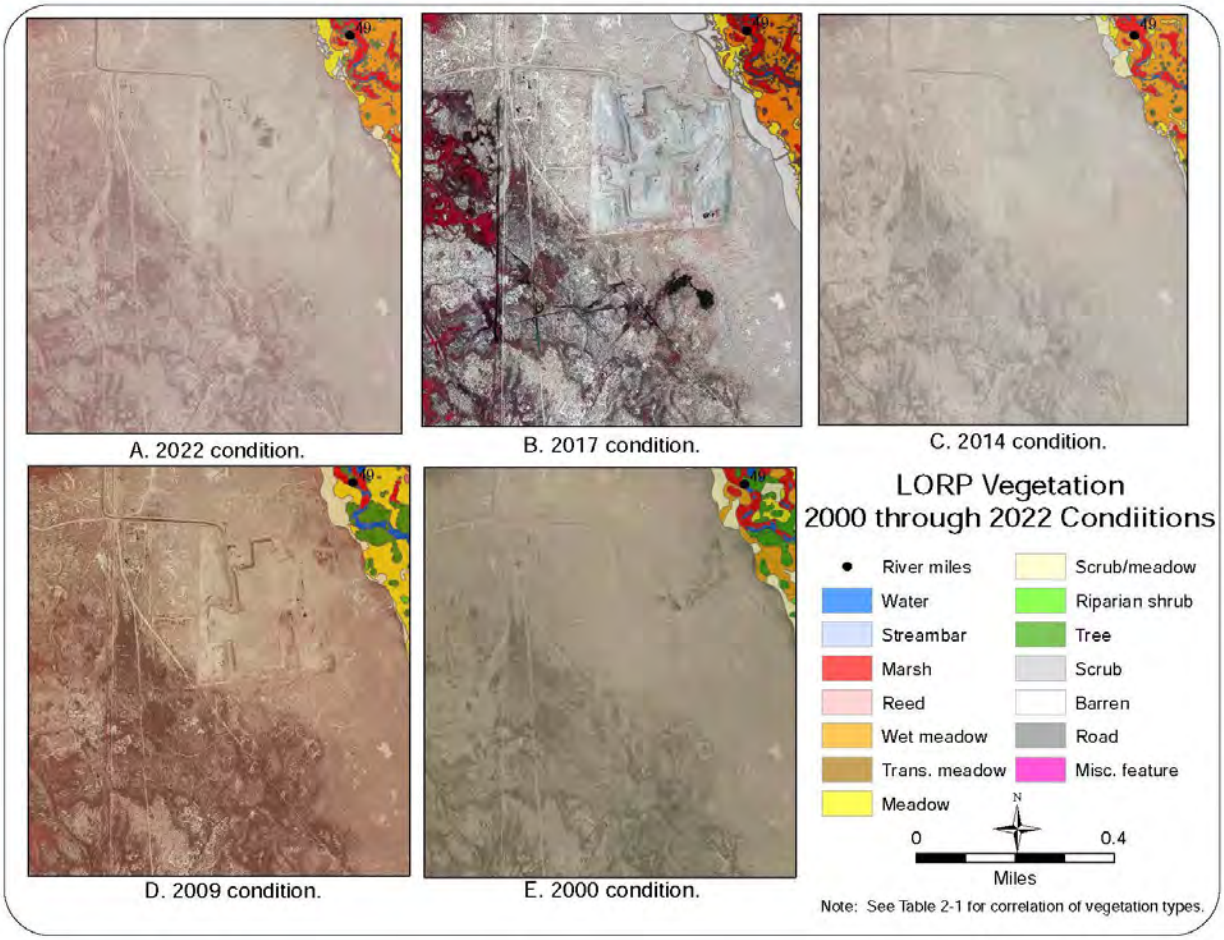

45
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


46
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


48
49
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


49
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
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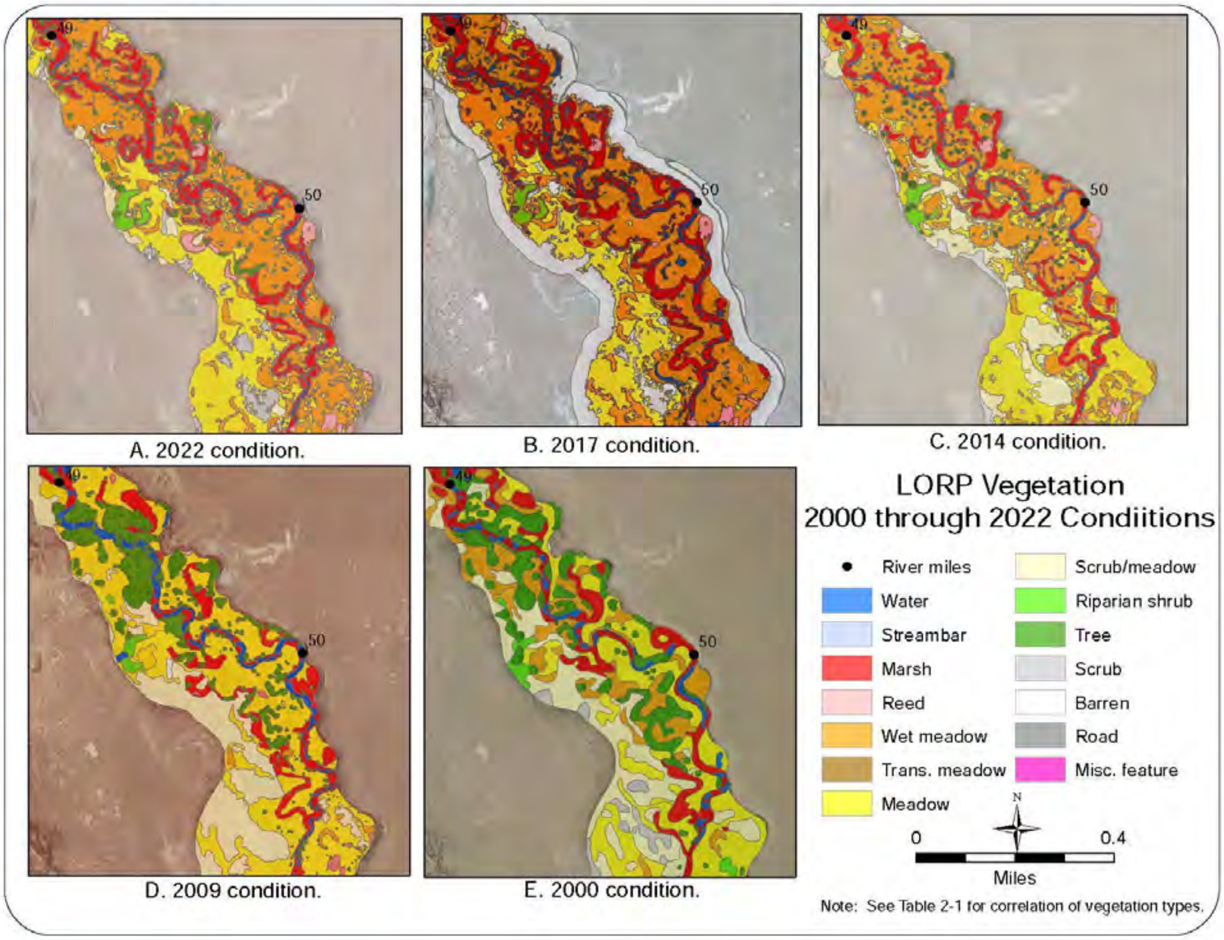
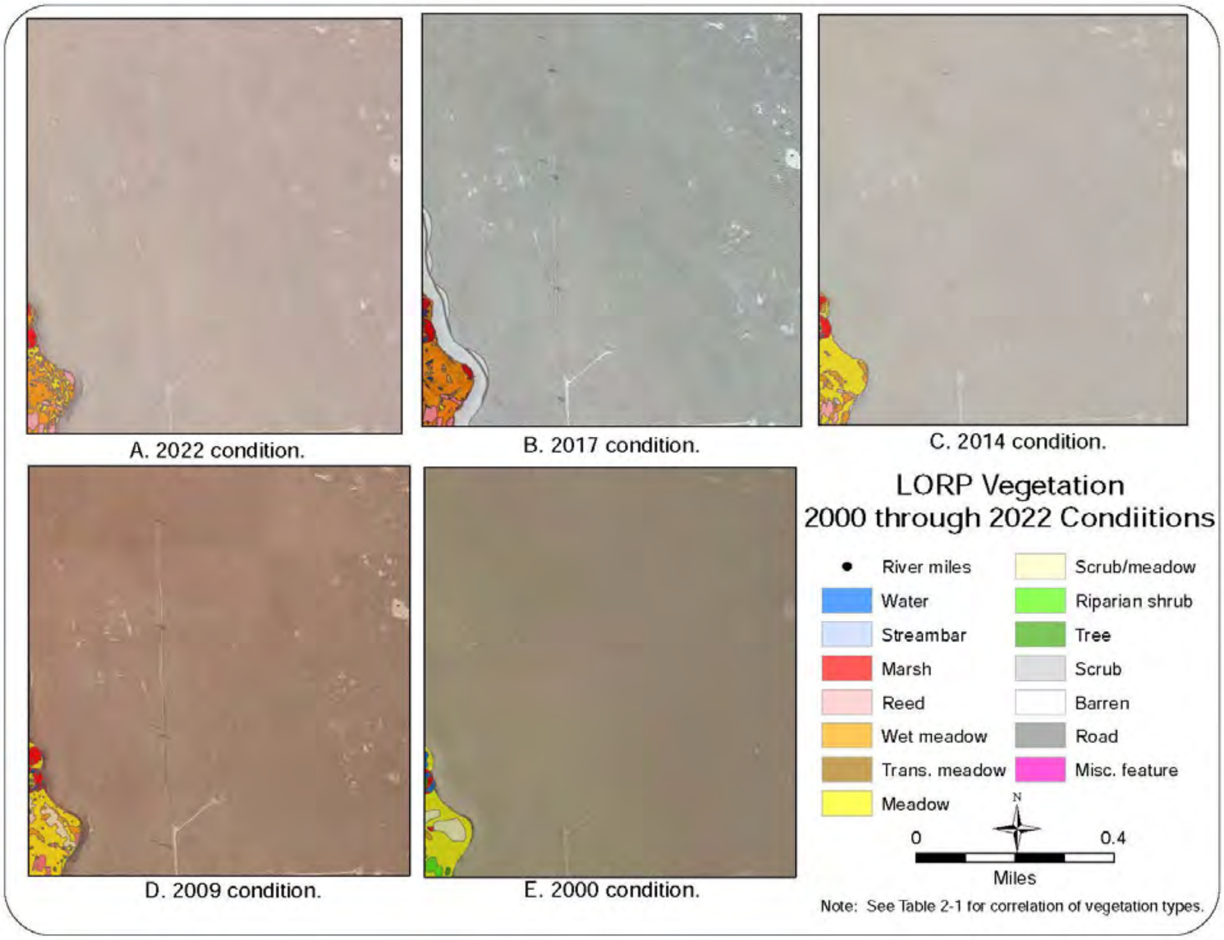
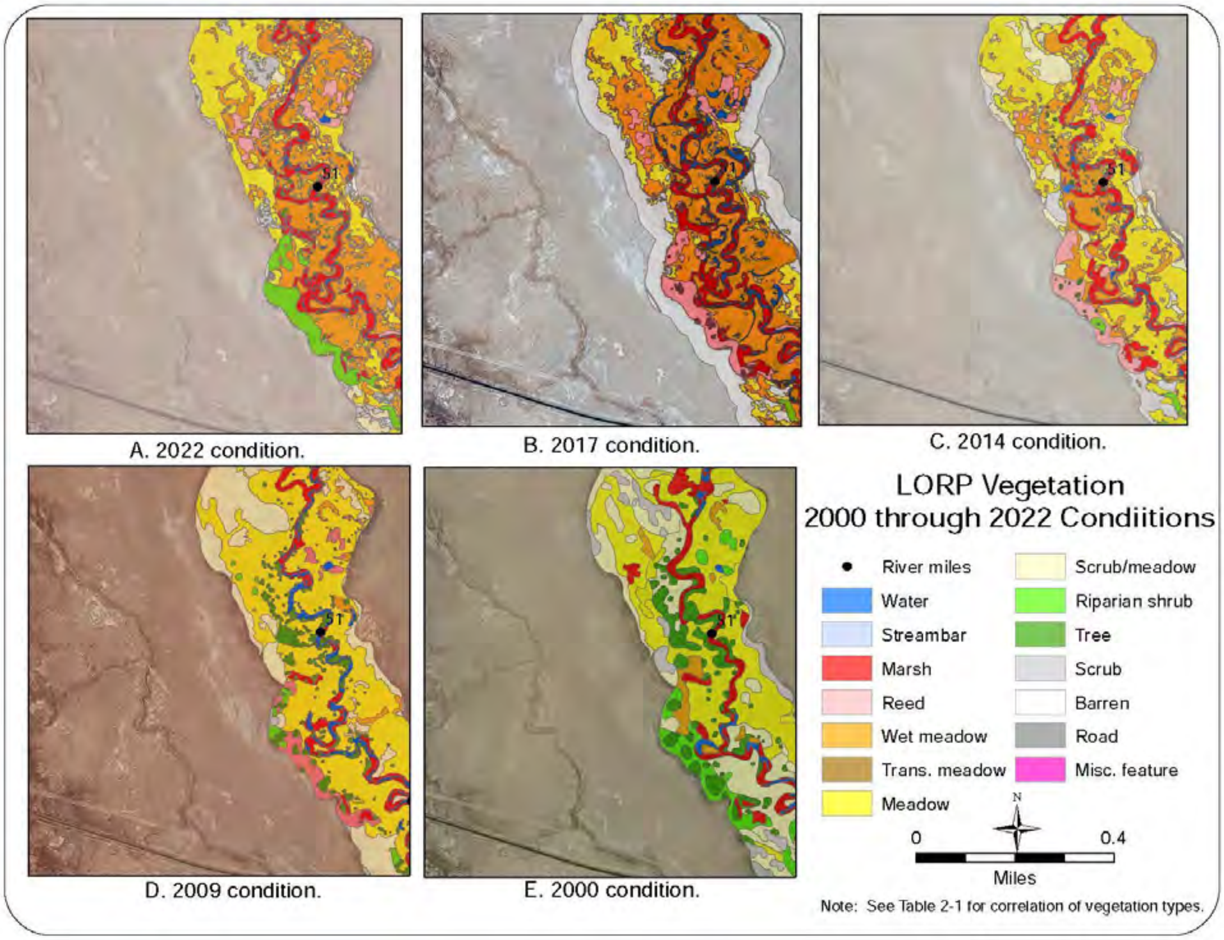
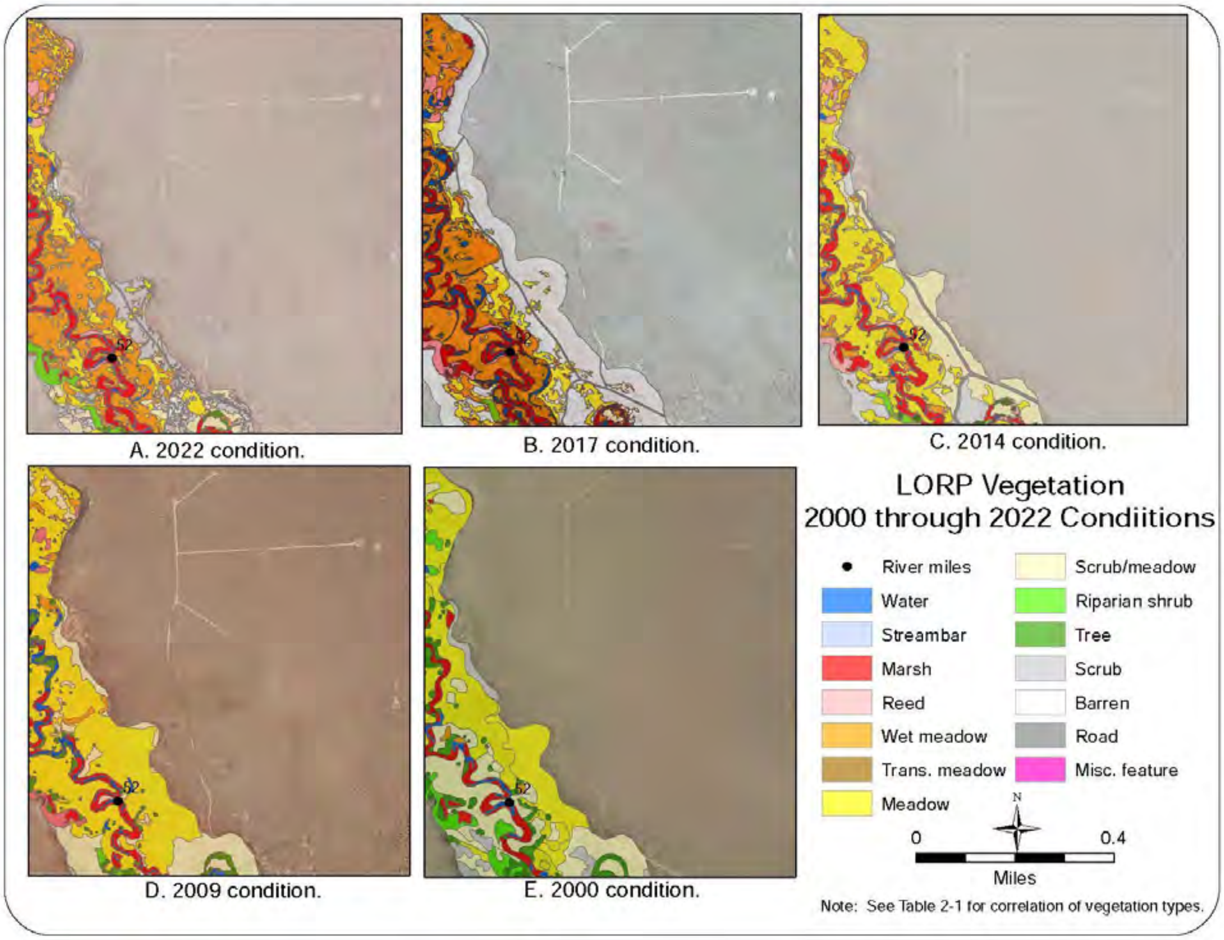
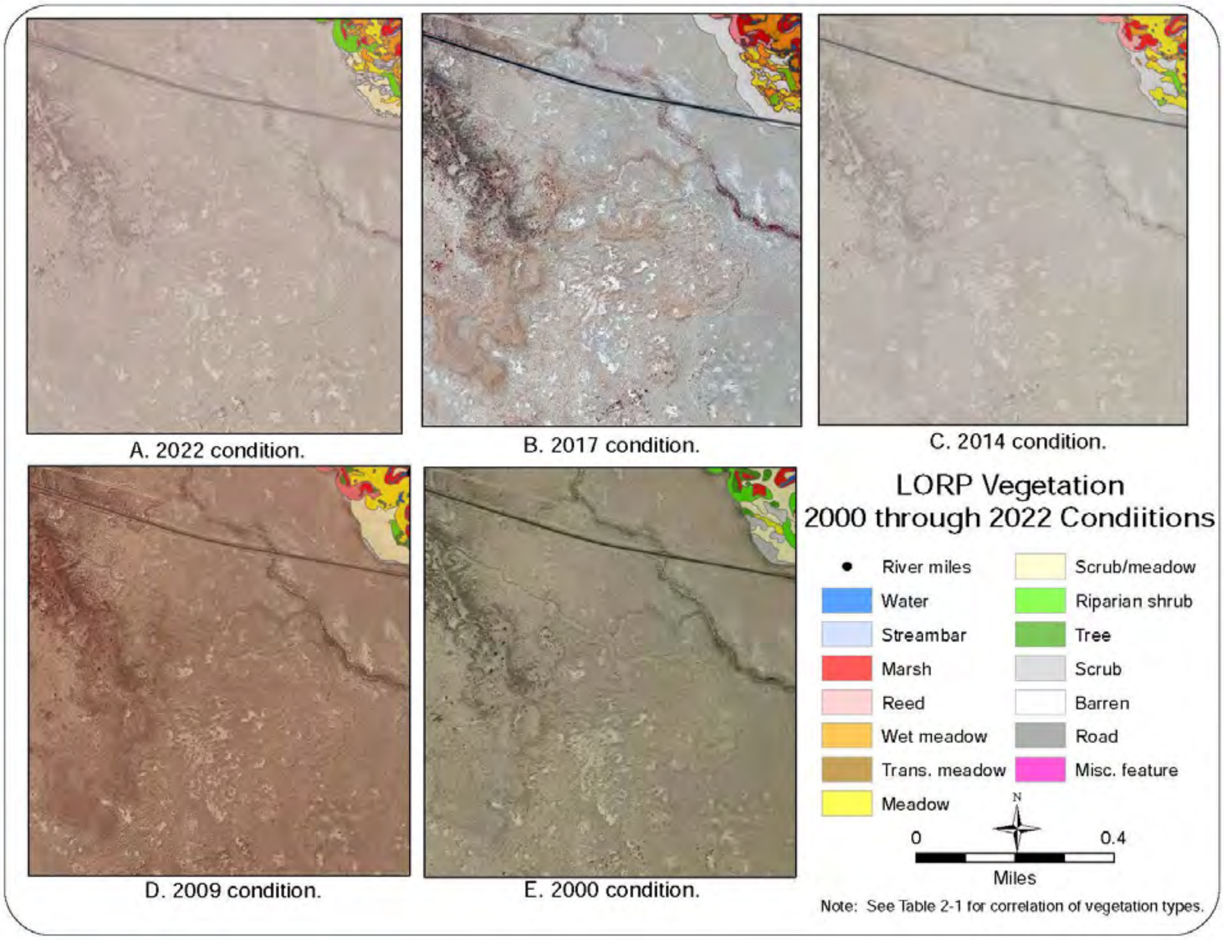
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

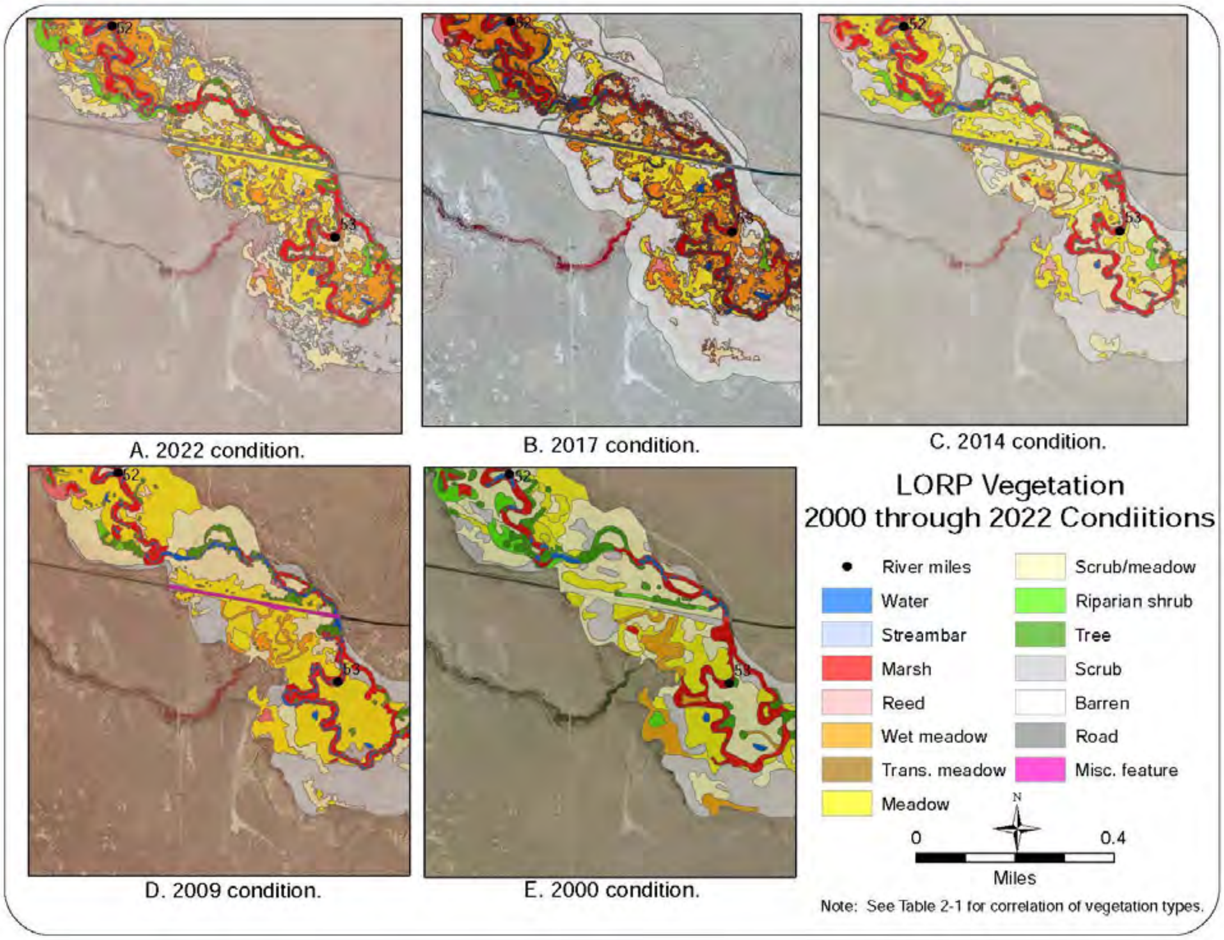

49
50
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

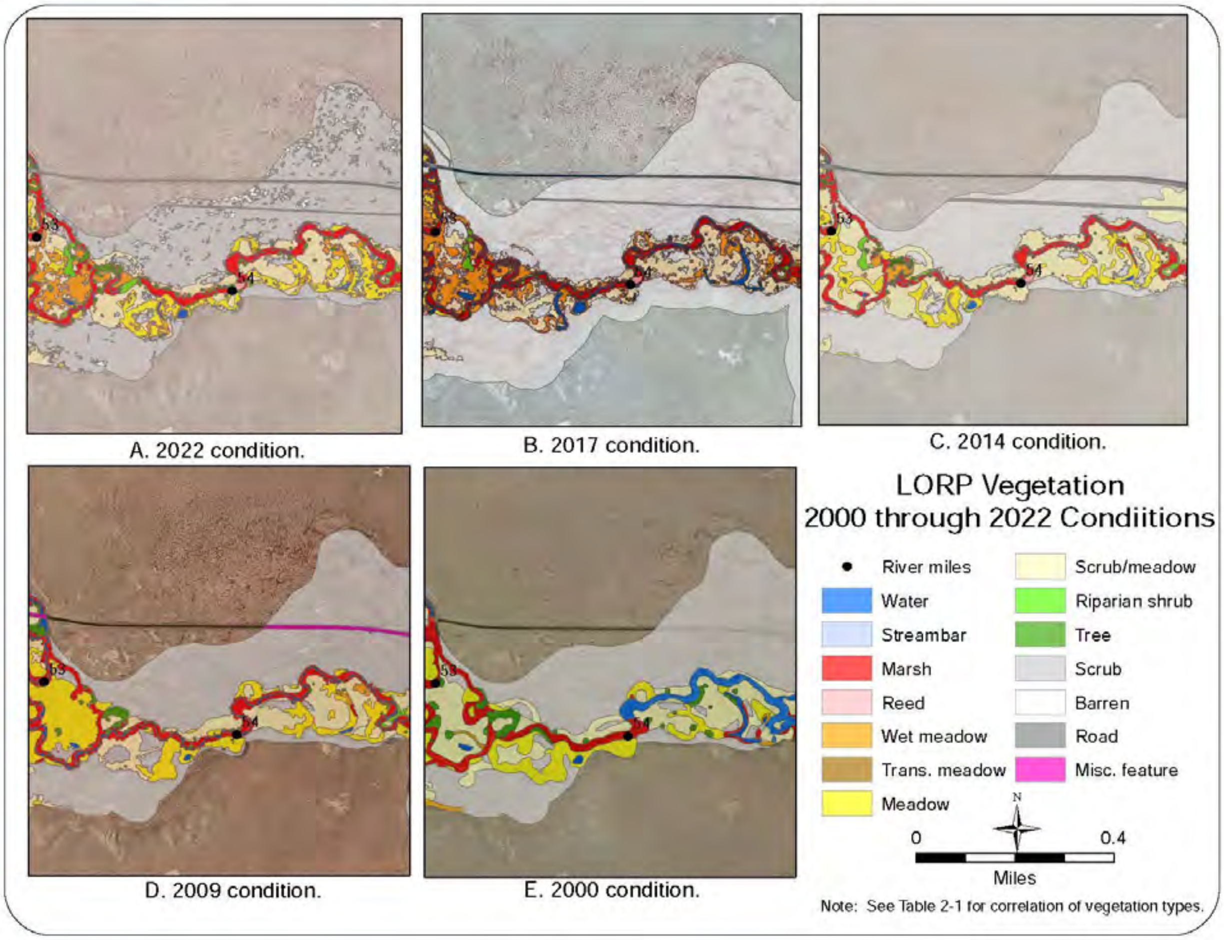

A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

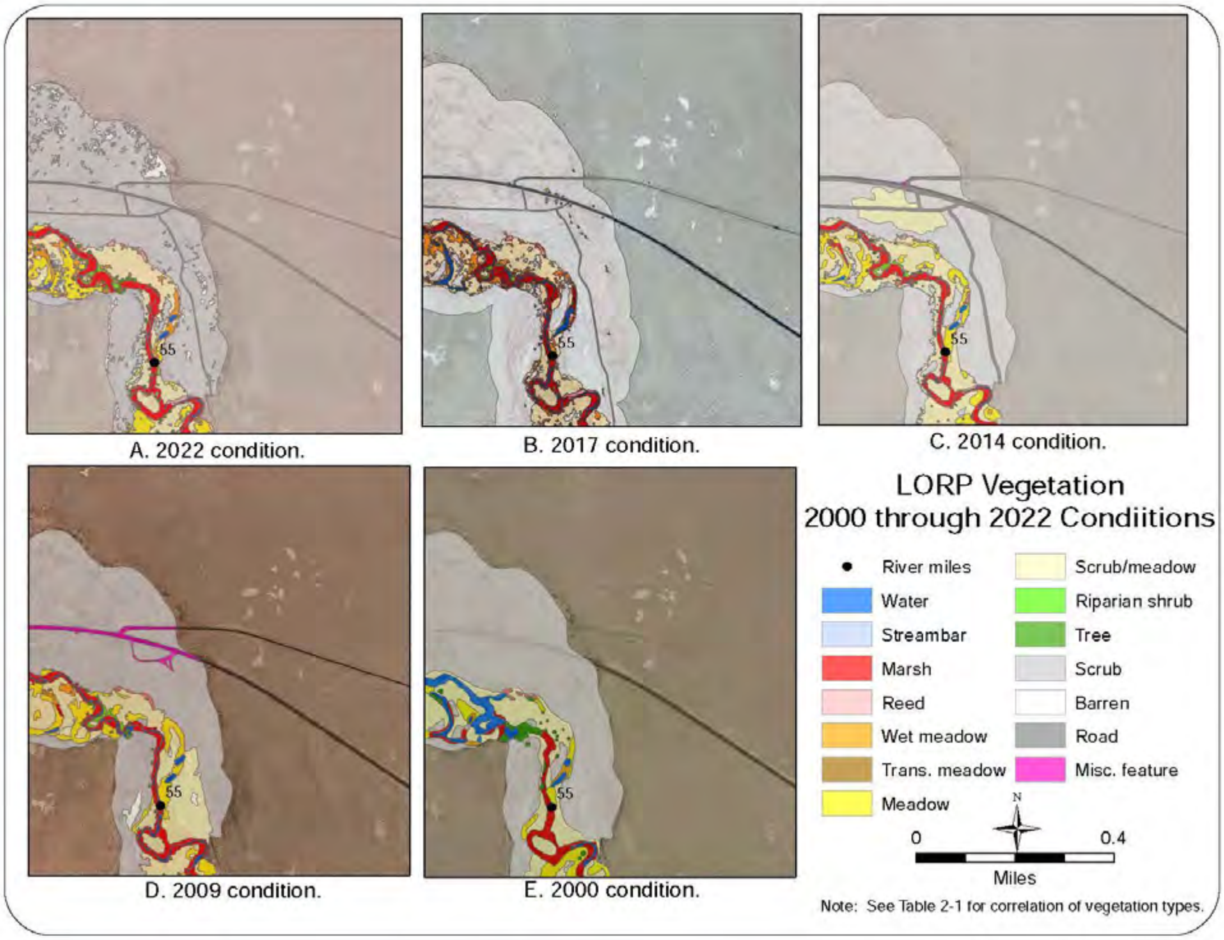

A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
51
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

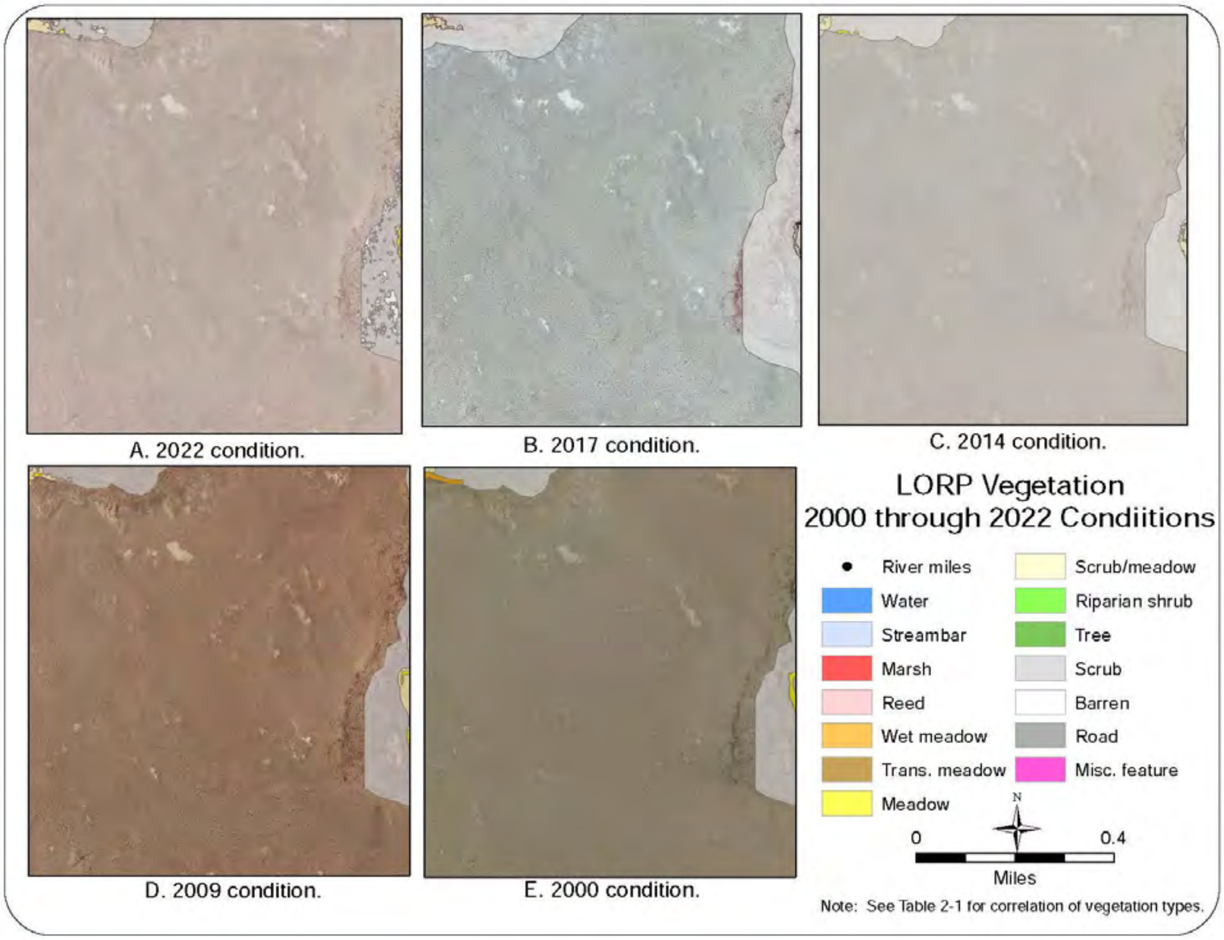

52
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

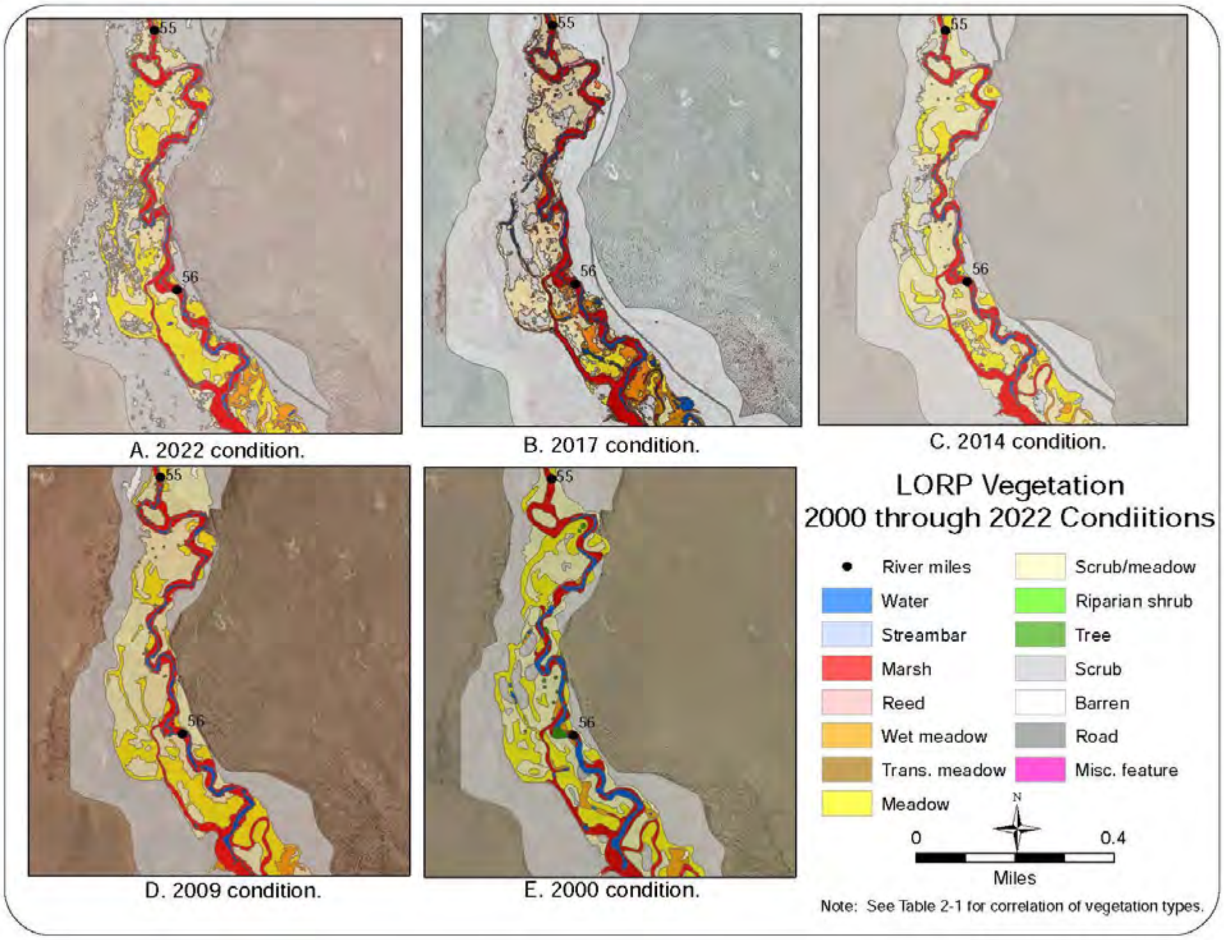

A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

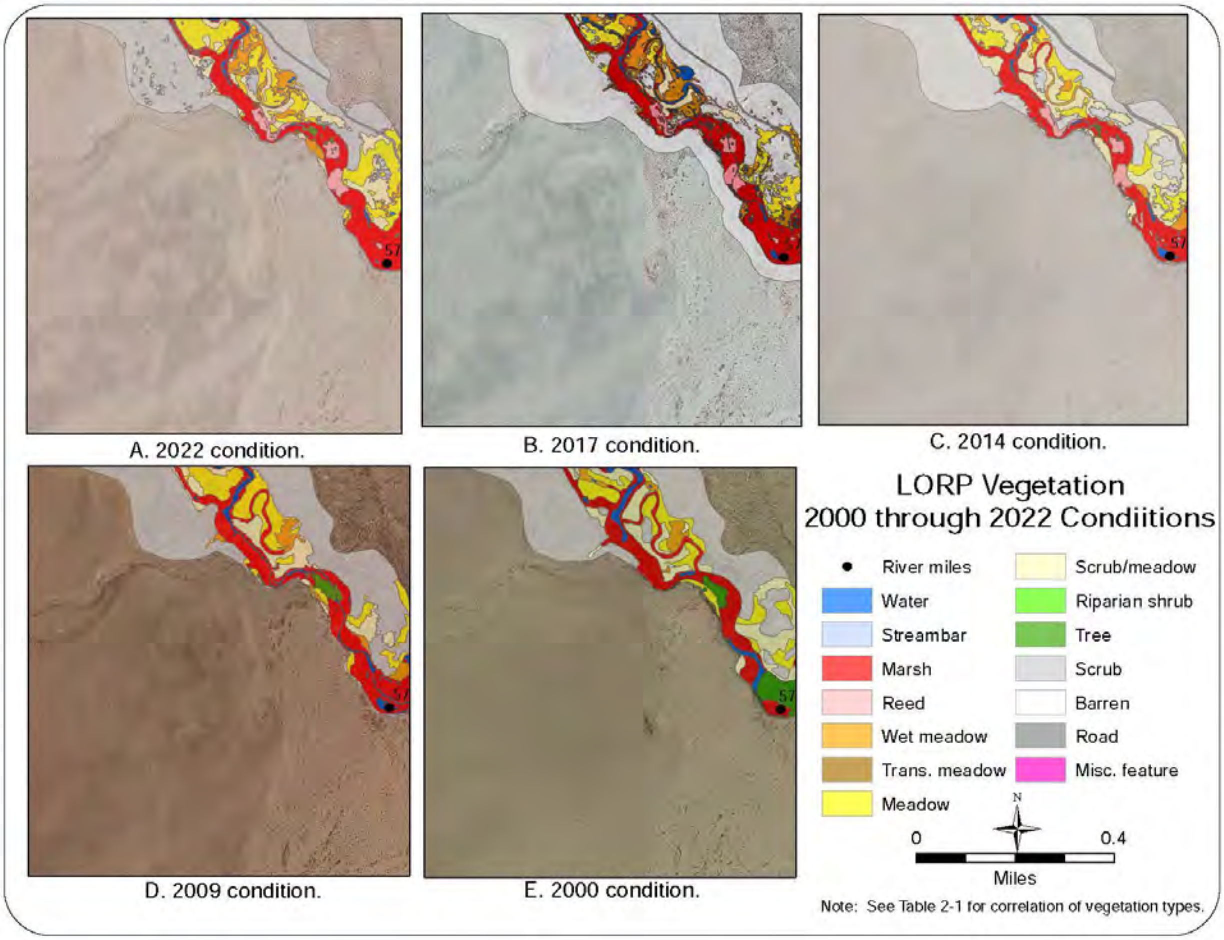

52
53
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

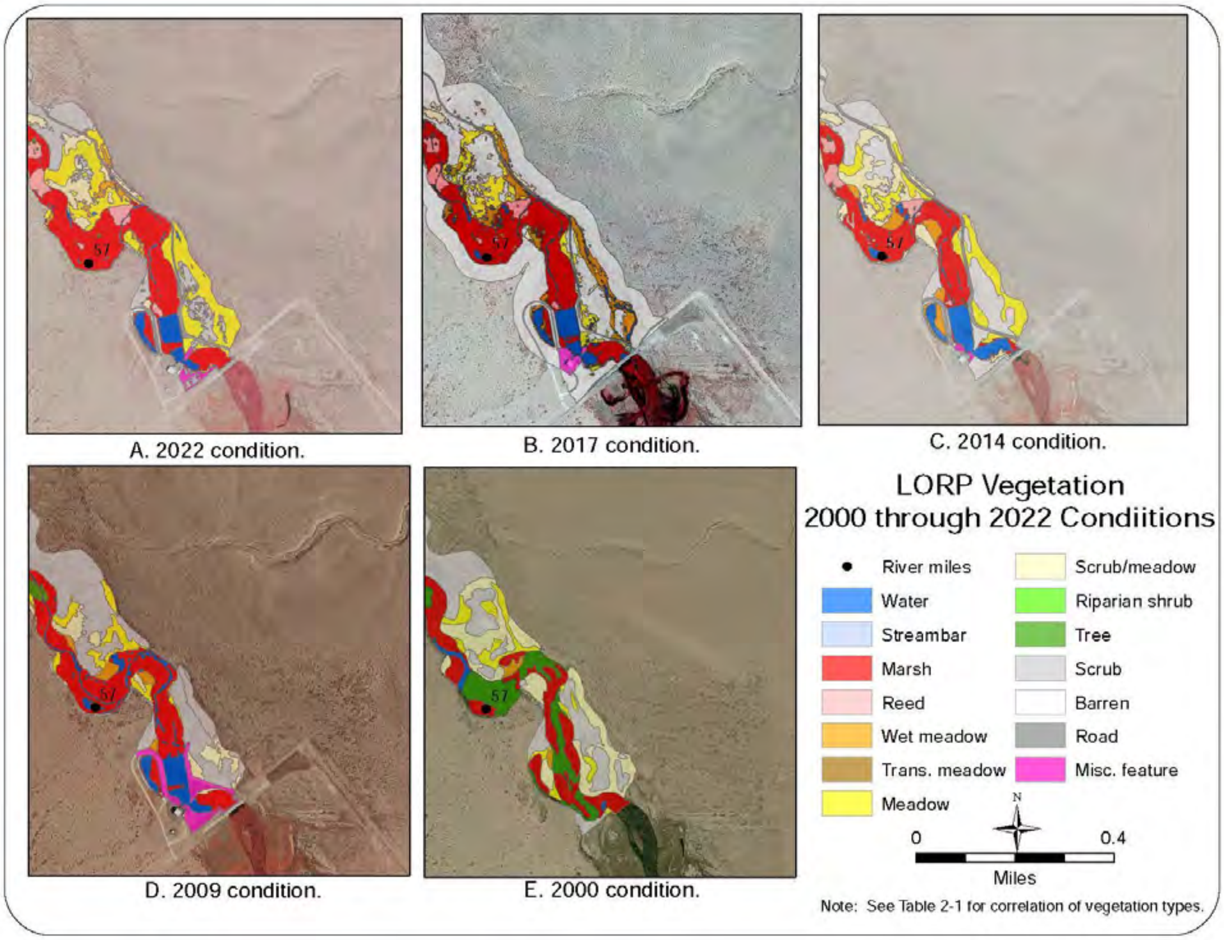

53
54
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


55
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

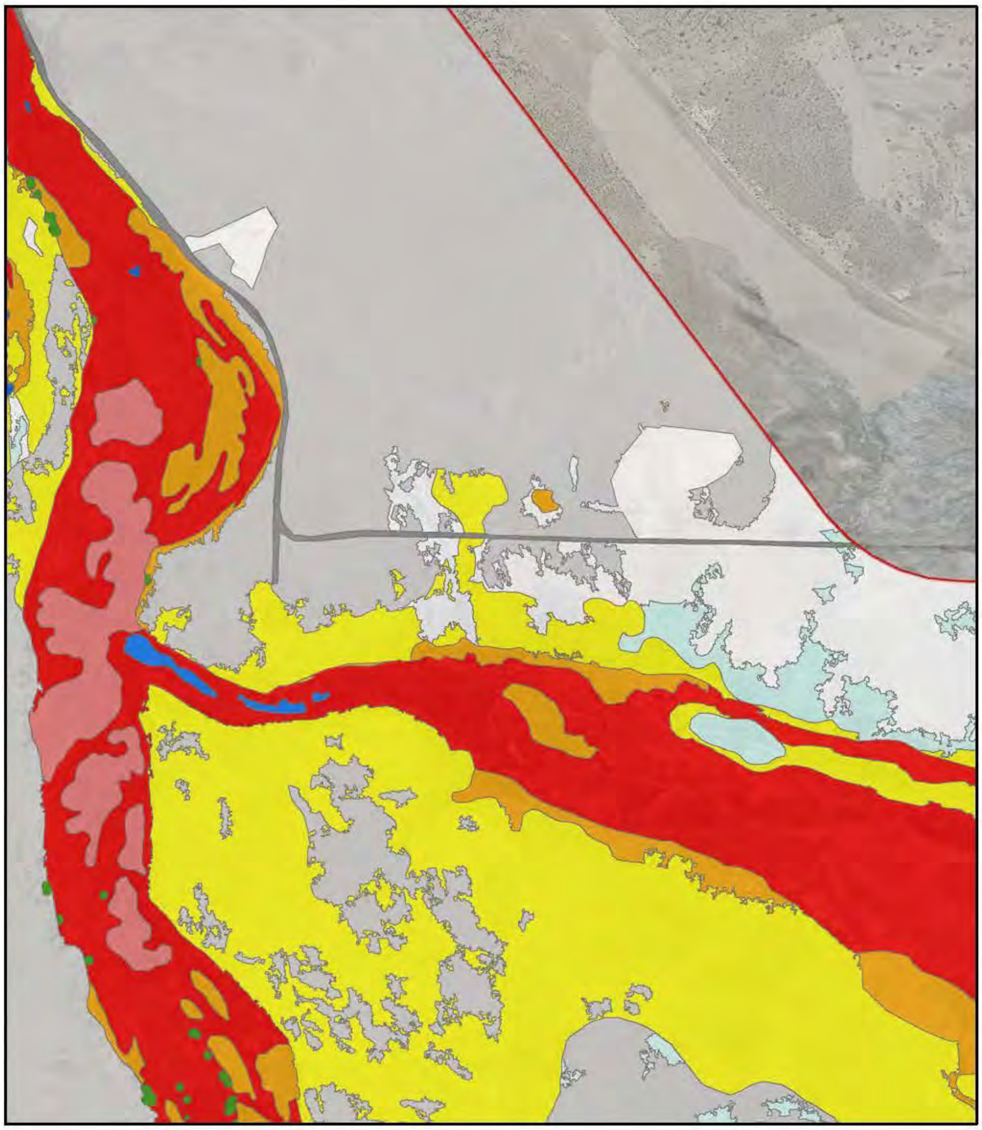

55
56
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

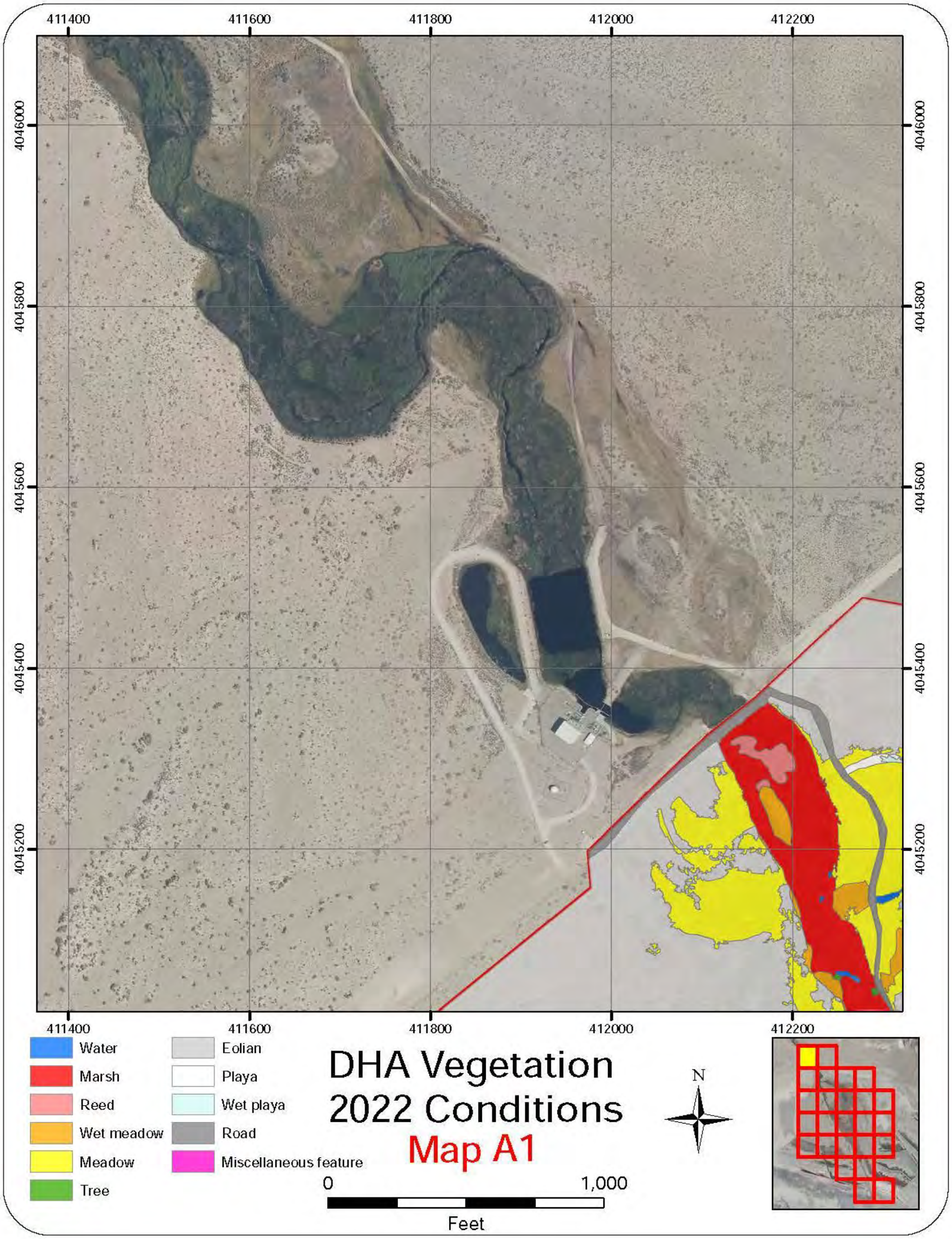

57
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.


57
A. 2022 condition.
B. 2017 condition.
C. 2014 condition.
D. 2009 condition.
E. 2000 condition.
LORP Vegetation
2000 through 2022 Condiitions
River miles
Water
Streambar
Marsh
Reed
Wet meadow
Trans. meadow
Meadow
Scrub/meadow
Riparian shrub
Tree
Scrub
Barren
Road
Misc. feature
N
0
0.4
Miles
Note: See Table 2-1 for correlation of vegetation types.

3.4.4 Appendix E.

APPENDIX E
DHA Vegetation
2022 Conditions
1:5,000 Scale

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Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map A1
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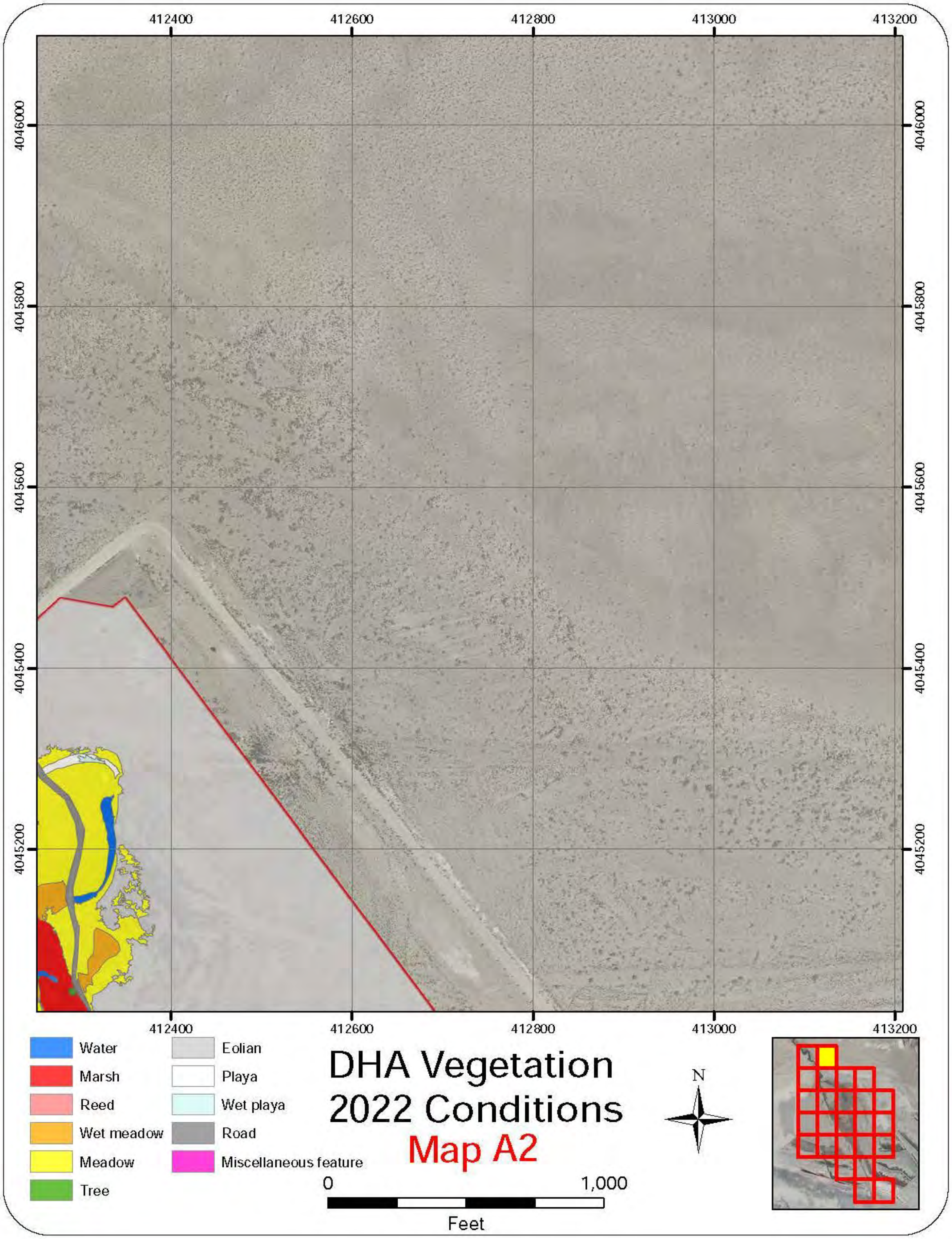
Feet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Reed
Wet meadow
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Tree
Eolian
Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
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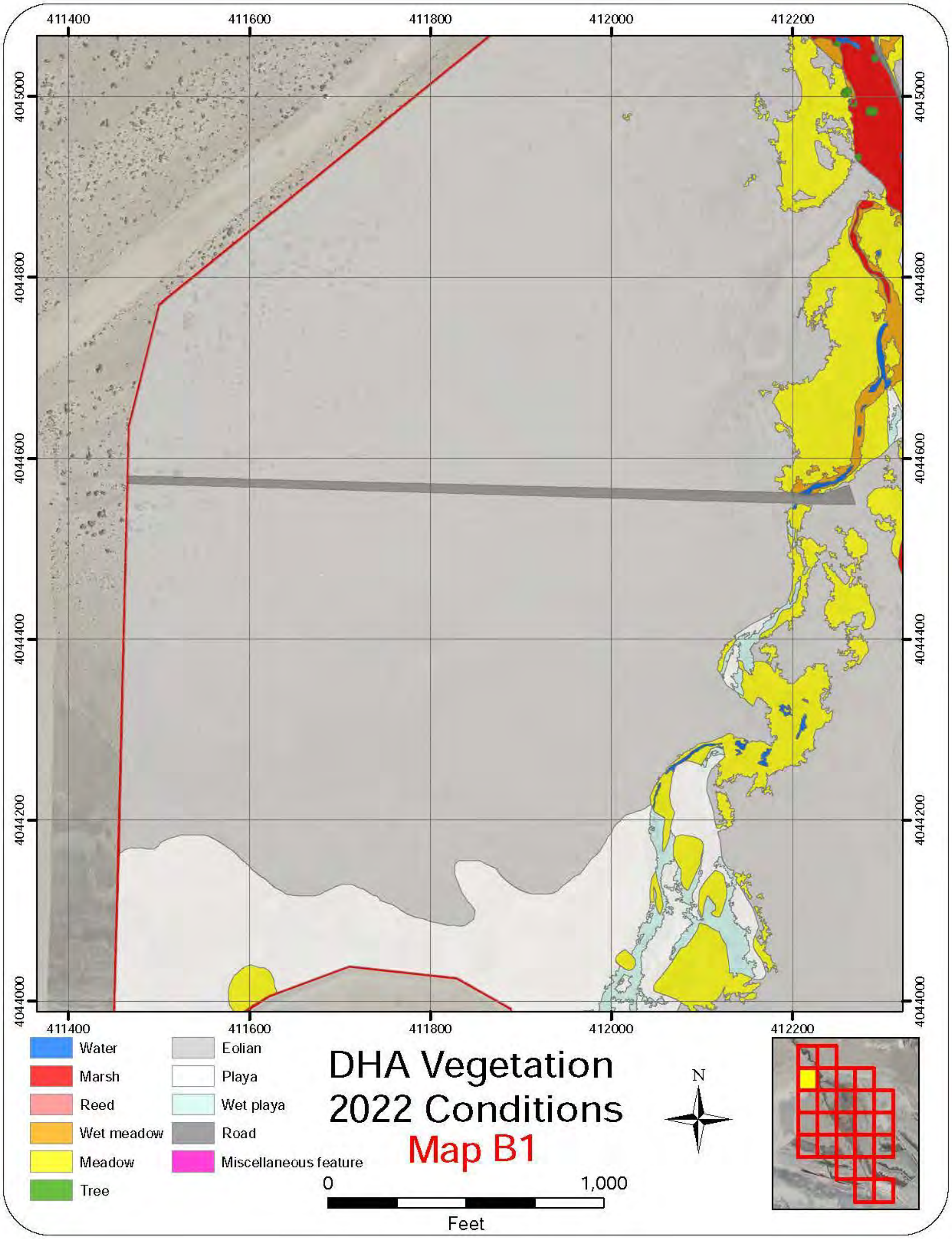
Feet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Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
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Feet
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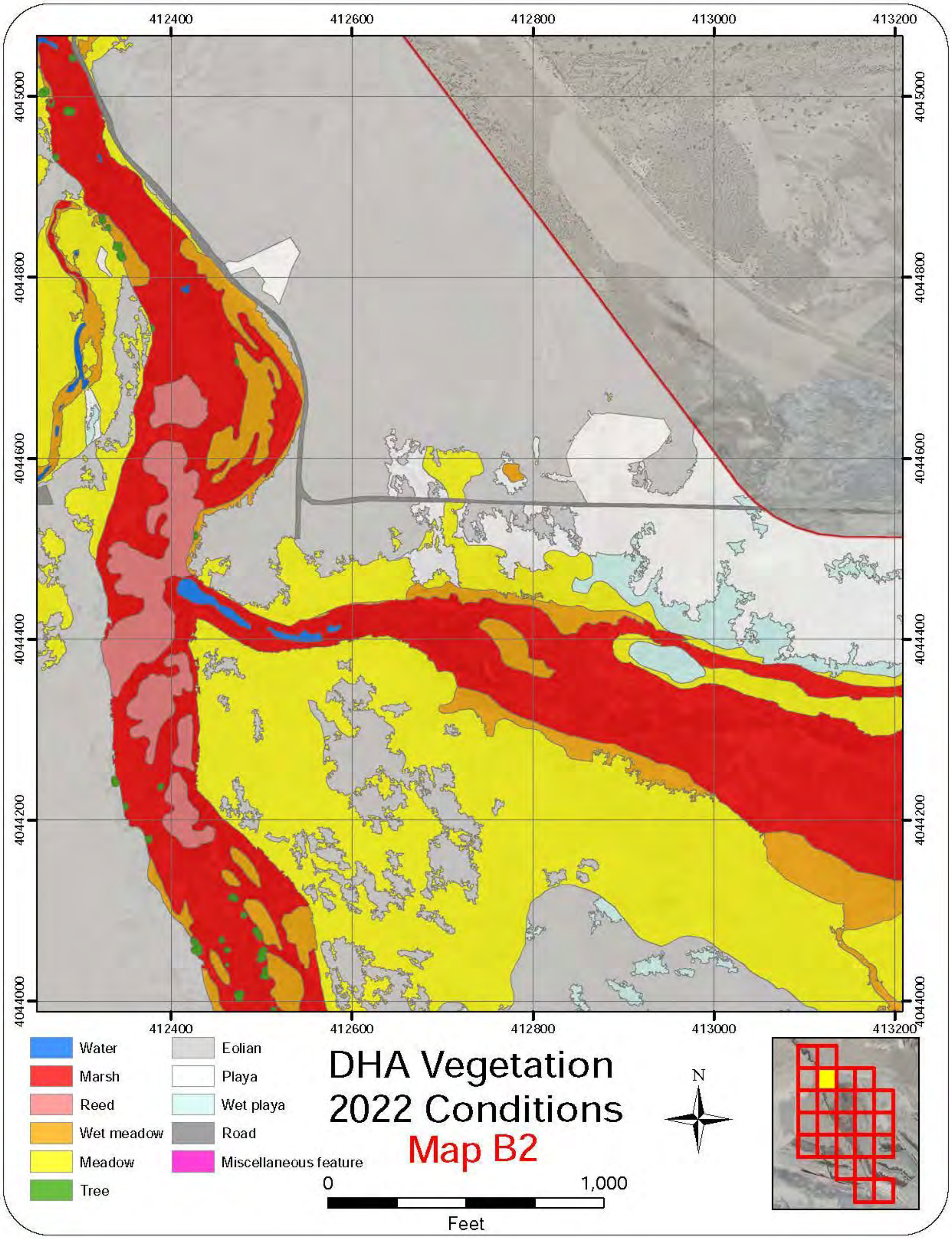
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Meadow
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Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map B2
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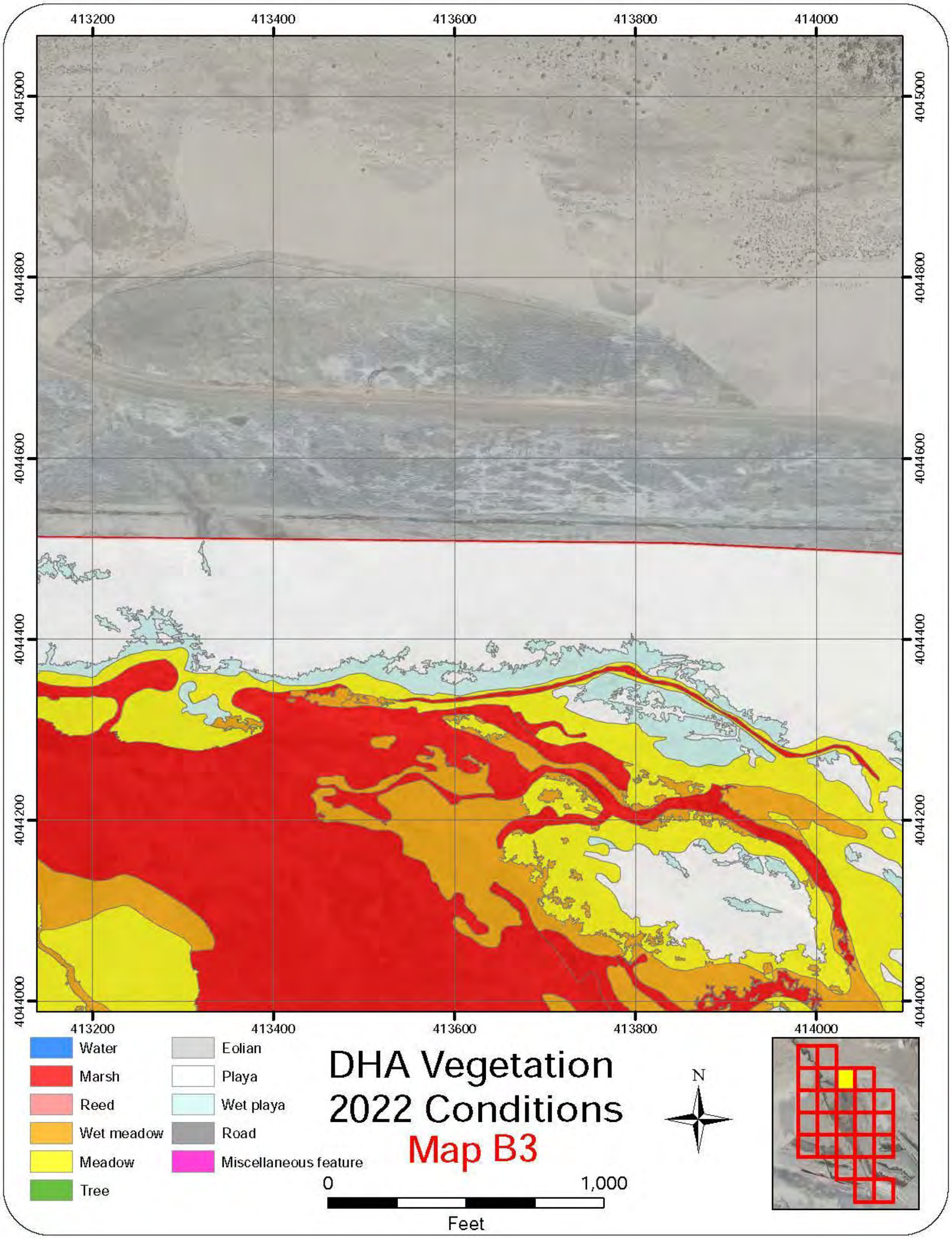
Feet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Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map B3
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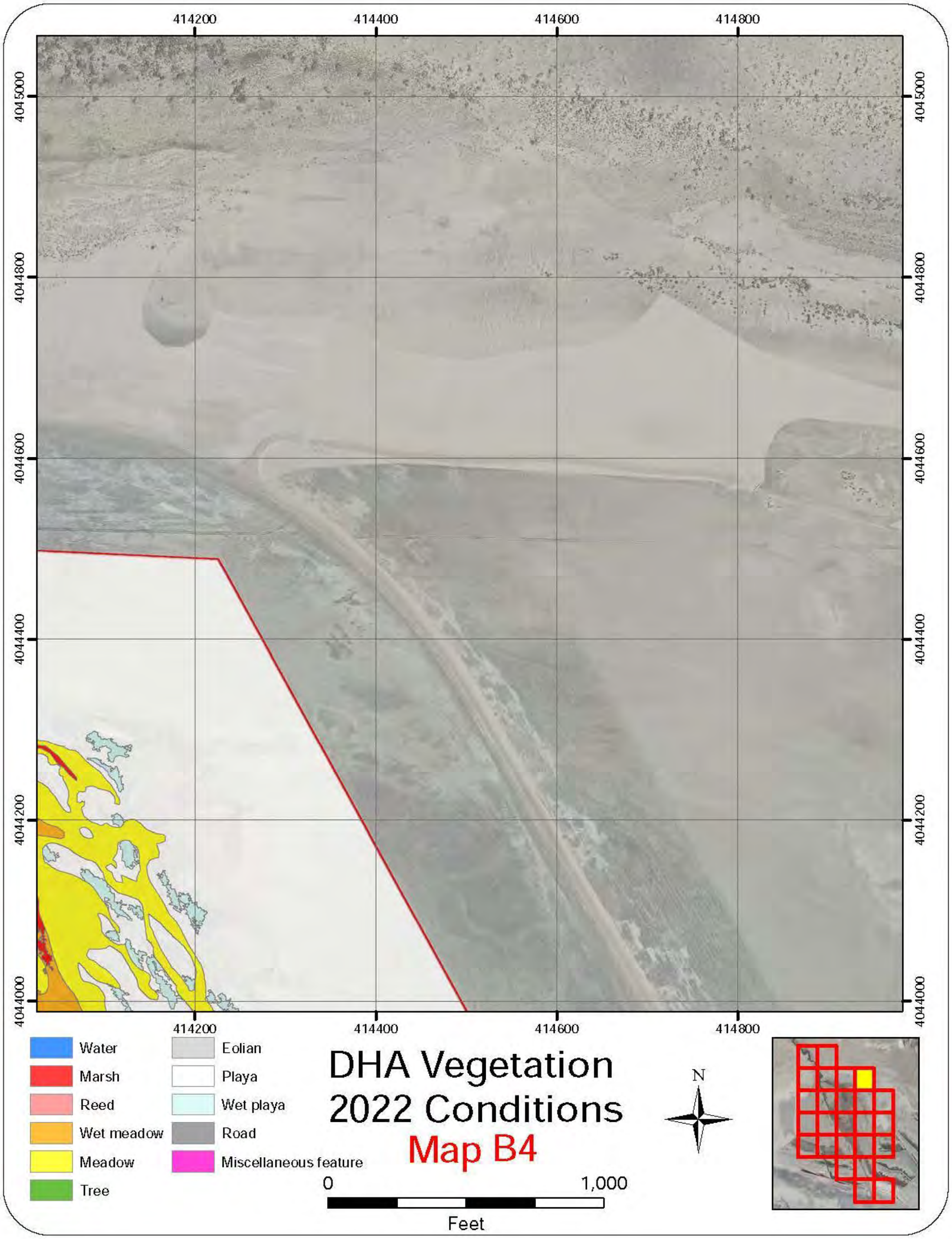
1,000
Feet
N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Reed
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Playa
Wet playa
Road
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DHA Vegetation
2022 Conditions
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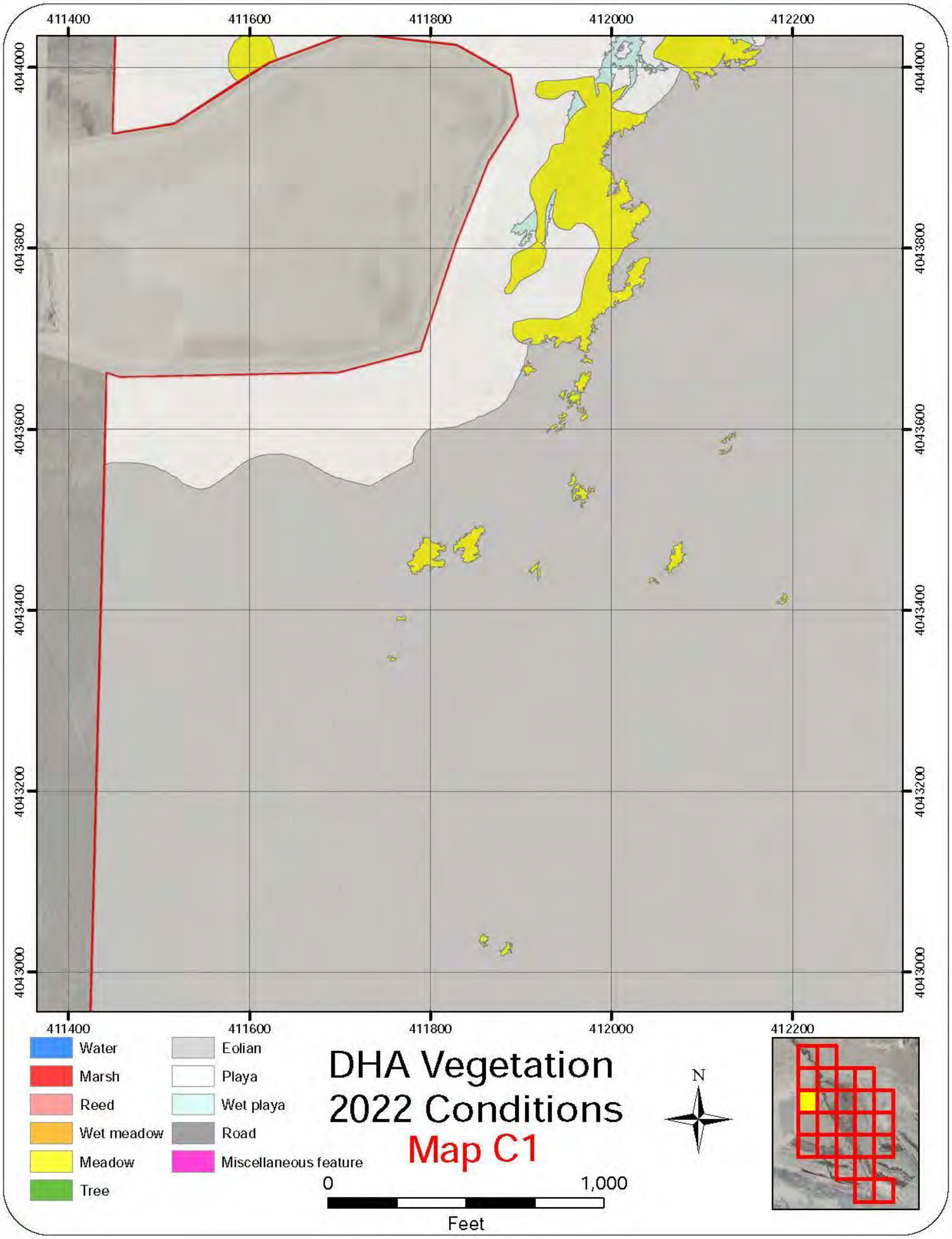
Feet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Wet meadow
Meadow
Tree
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Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map C1
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Feet
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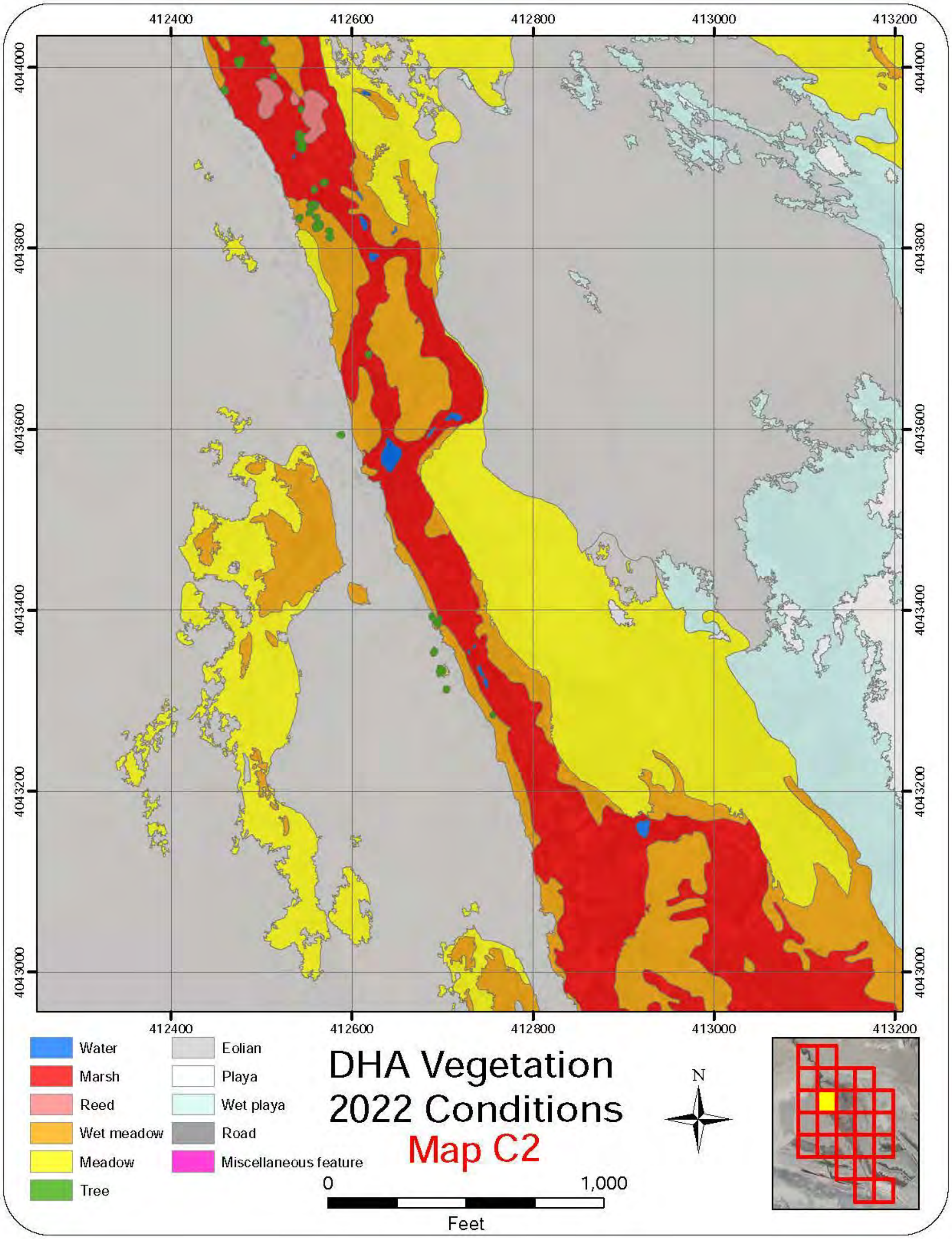
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Reed
Wet meadow
Meadow
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Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map C2
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0
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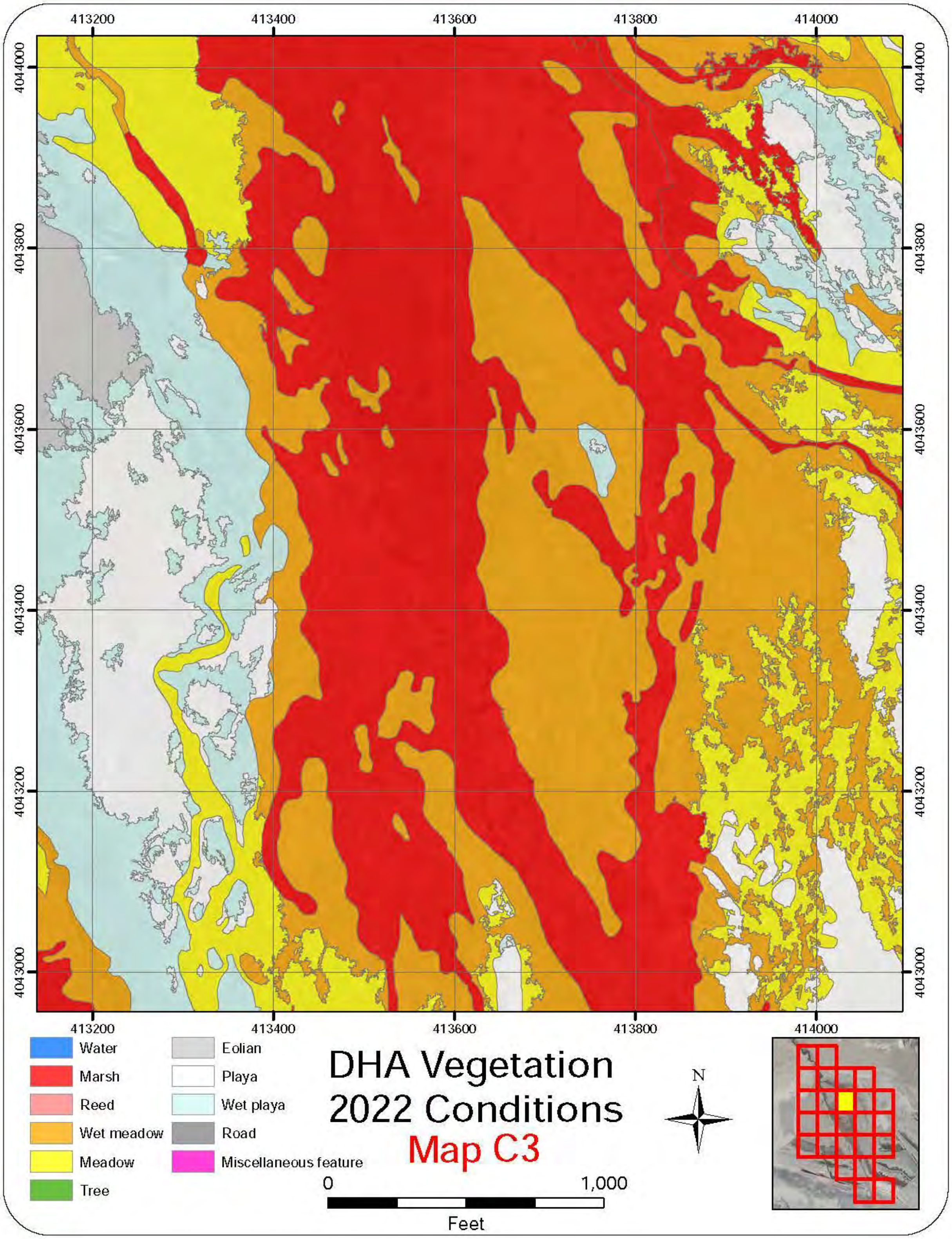
Feet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Meadow
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Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map C3
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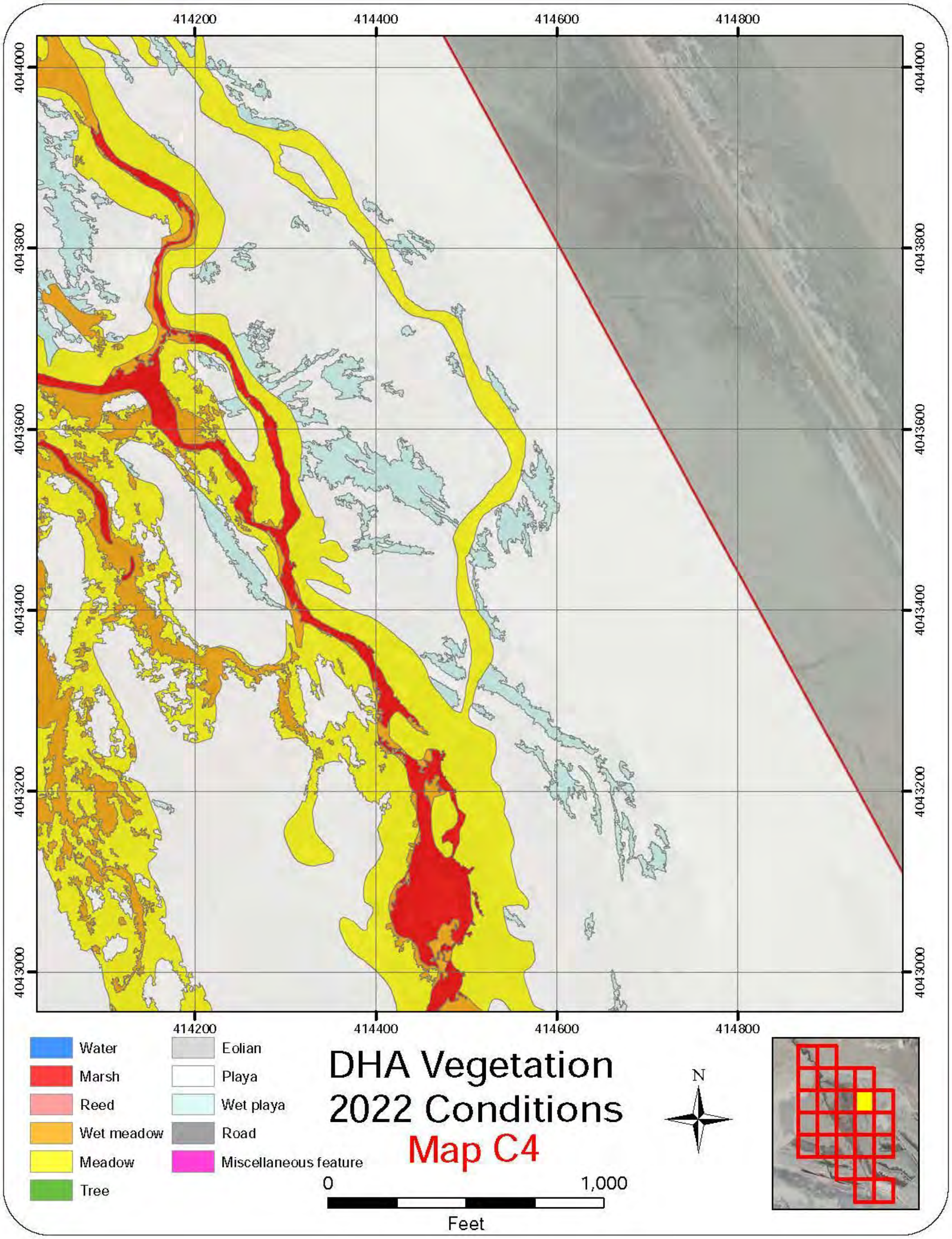
Feet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Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
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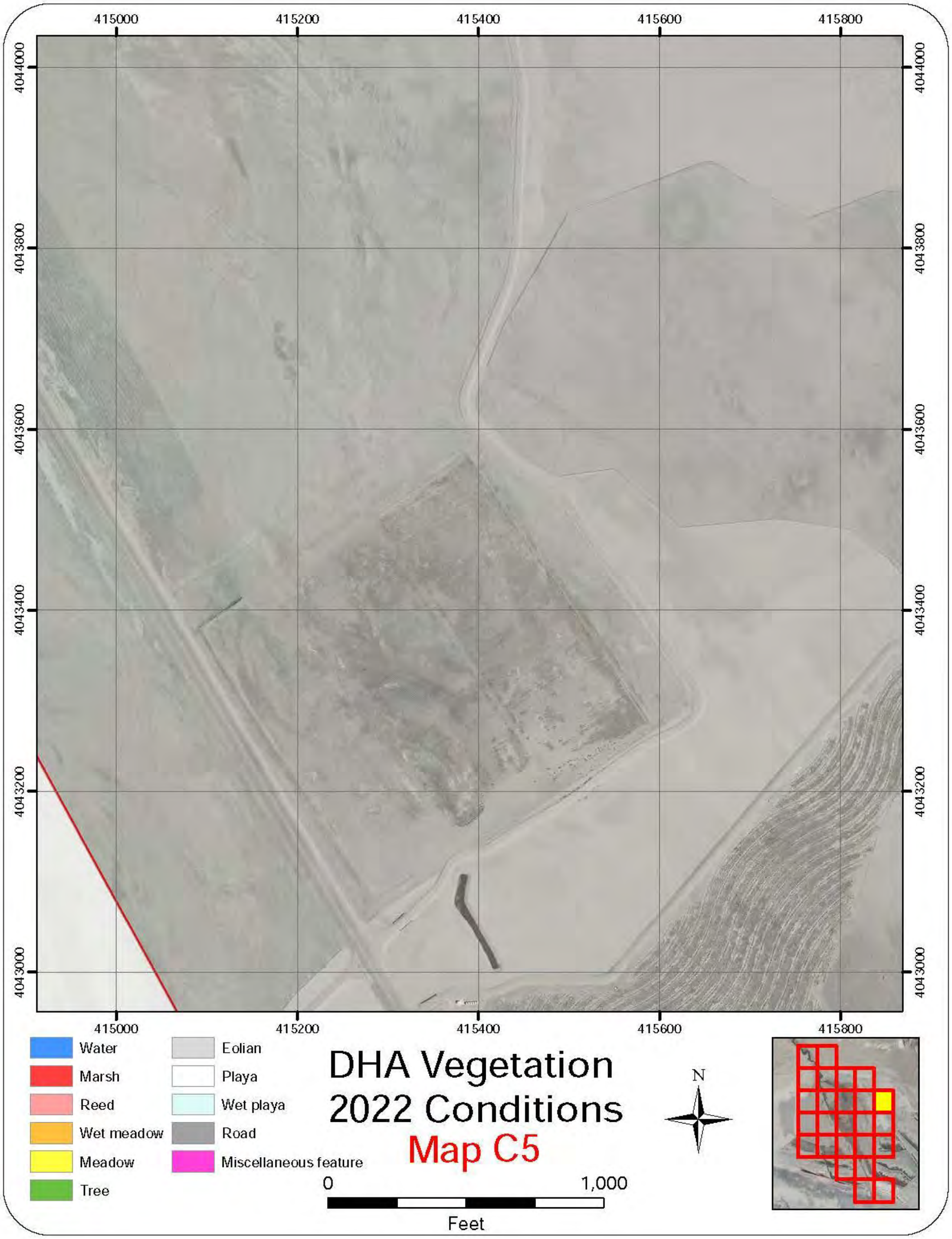
0
1,000
Feet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Wet meadow
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Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map C5
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1,000
Feet
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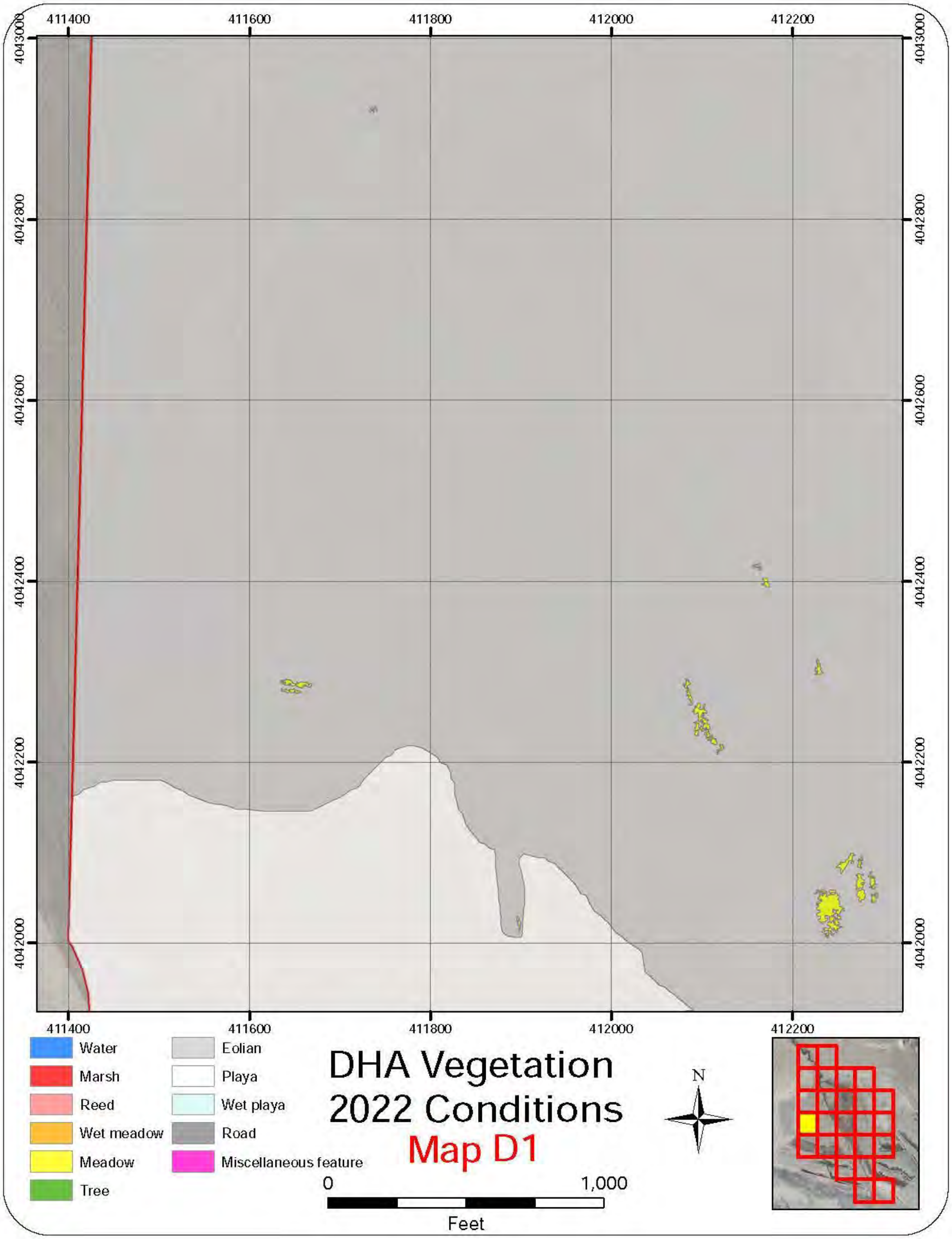
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Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map D1
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1,000
Feet
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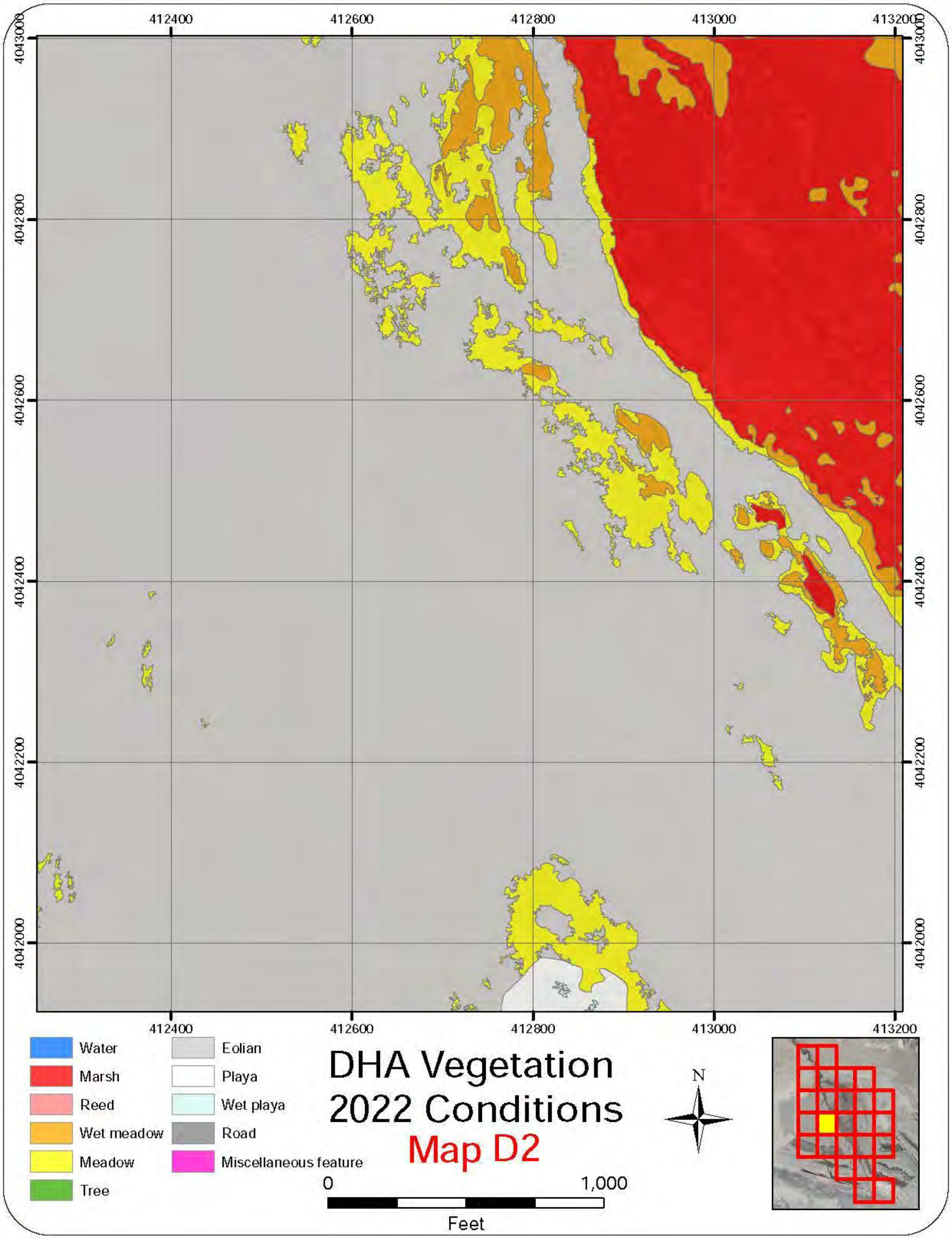
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Reed
Wet meadow
Meadow
Tree
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Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
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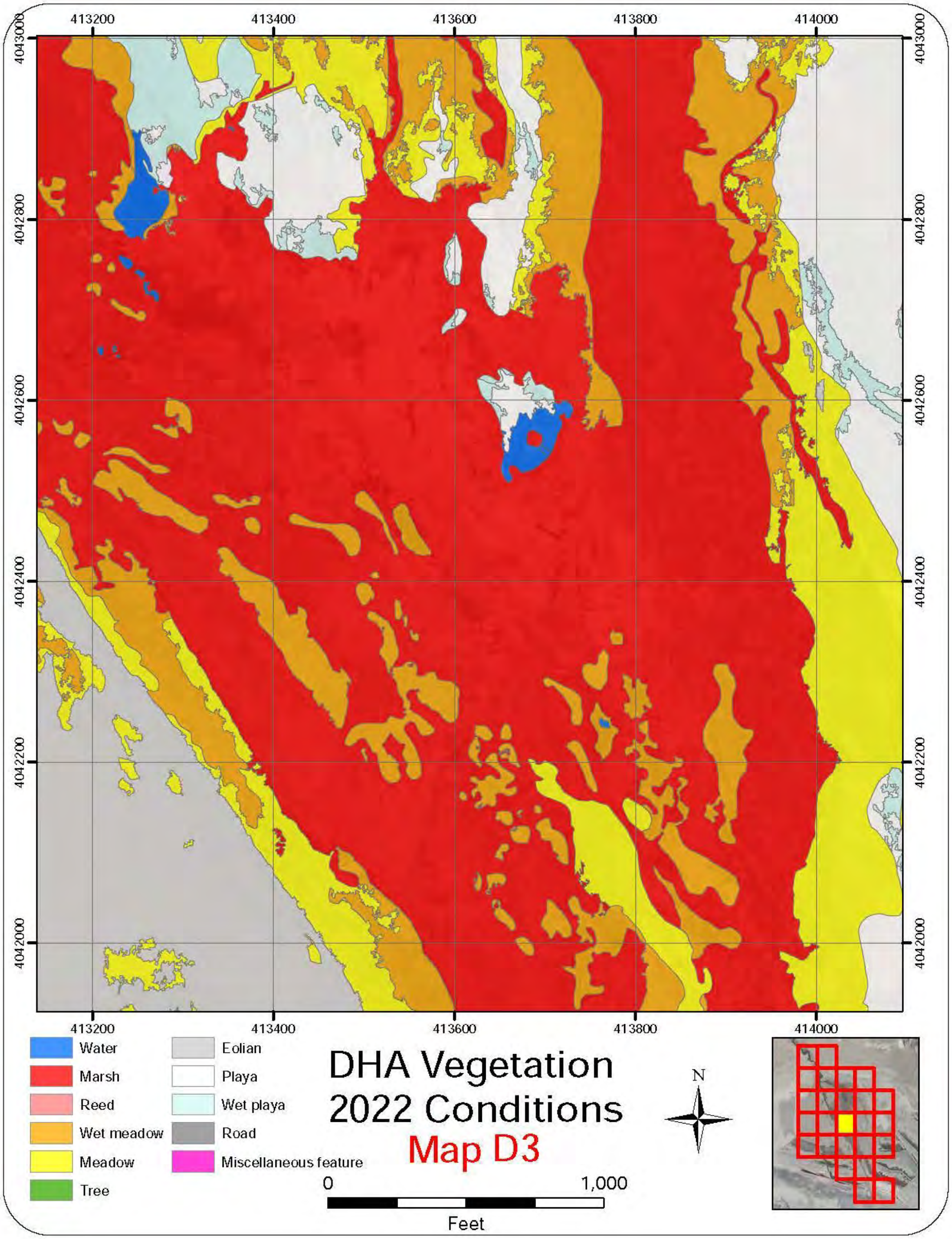
0
1,000
Feet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Reed
Wet meadow
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Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
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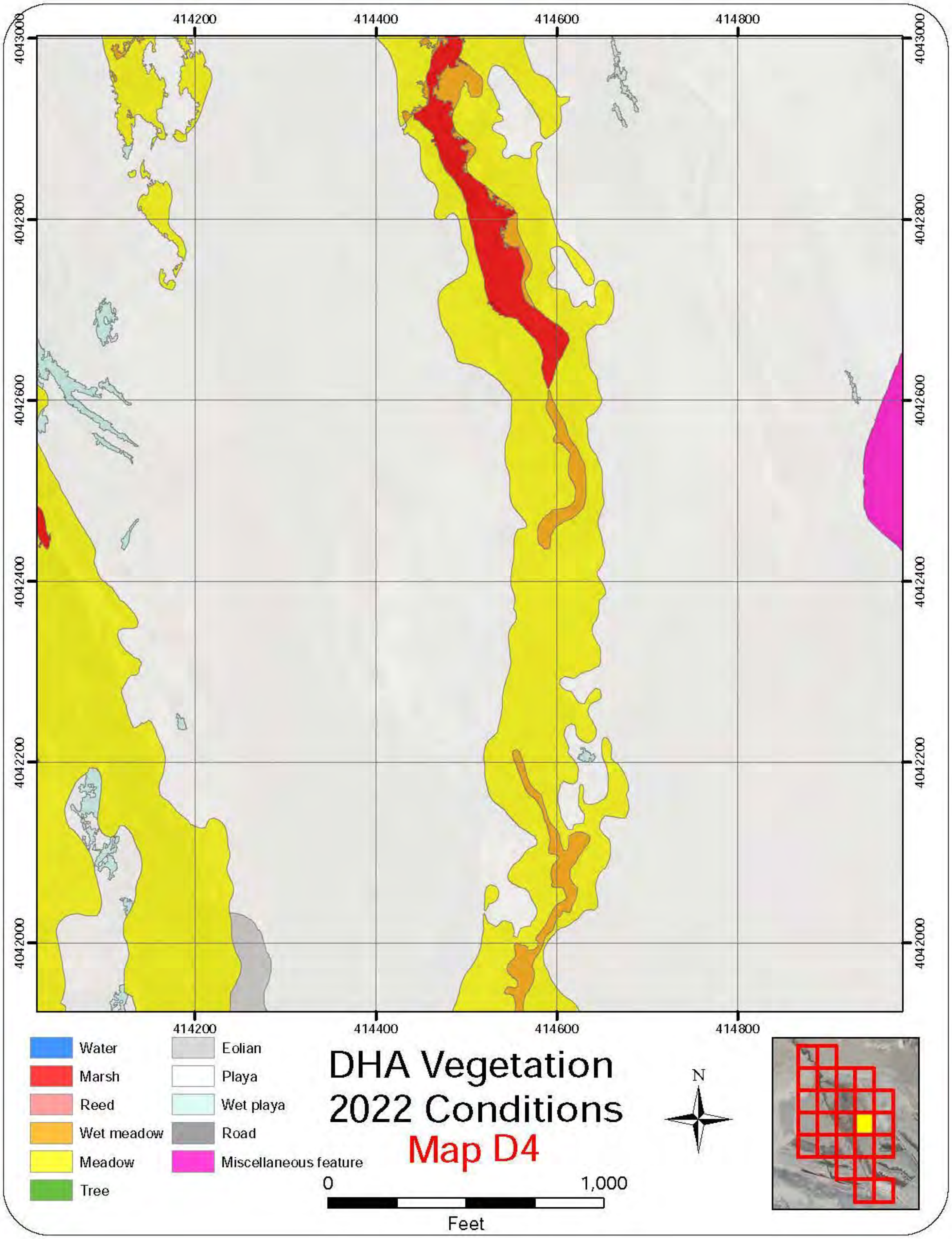
Feet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Reed
Wet meadow
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Tree
Eolian
Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map D4
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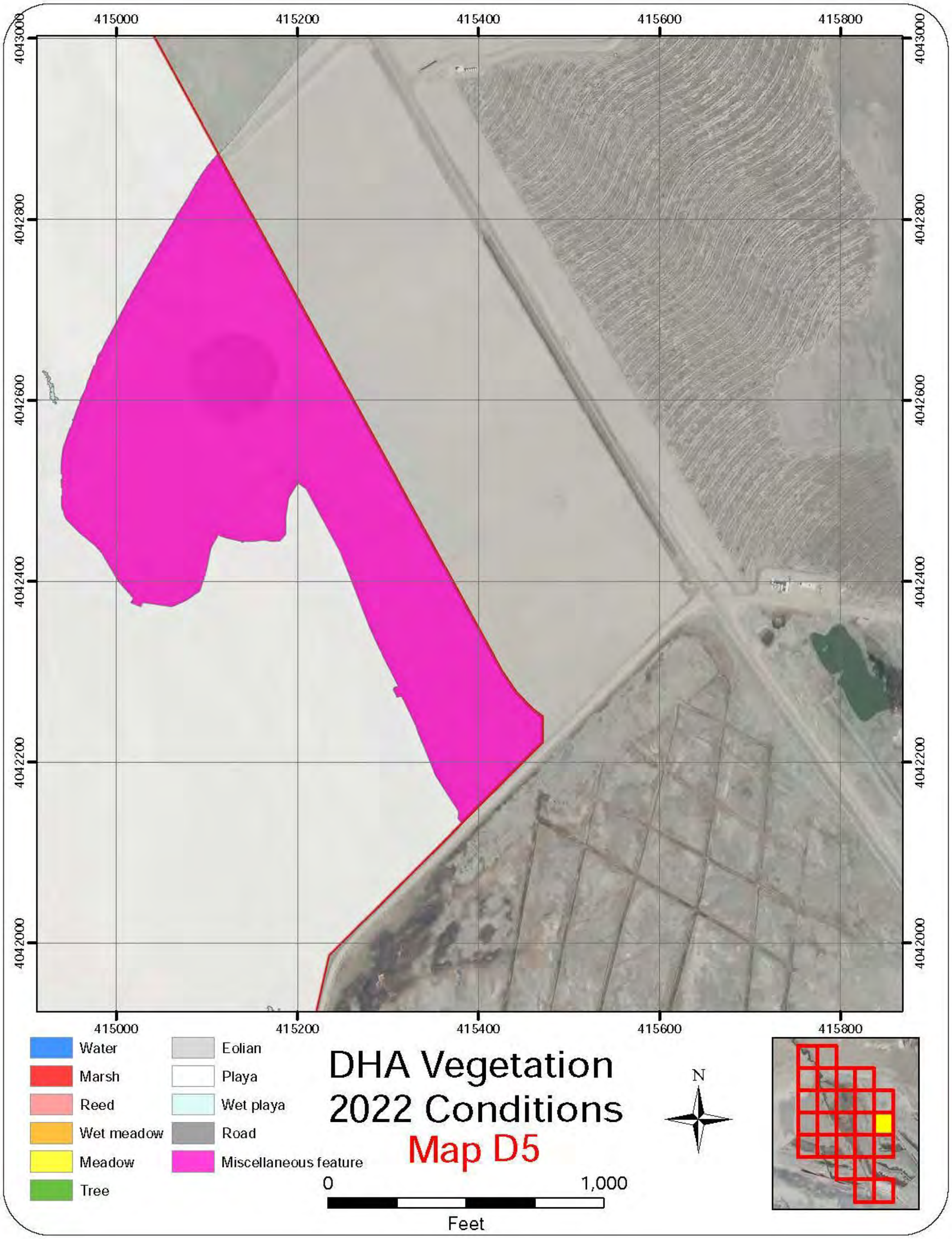
0
1,000
Feet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Playa
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Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
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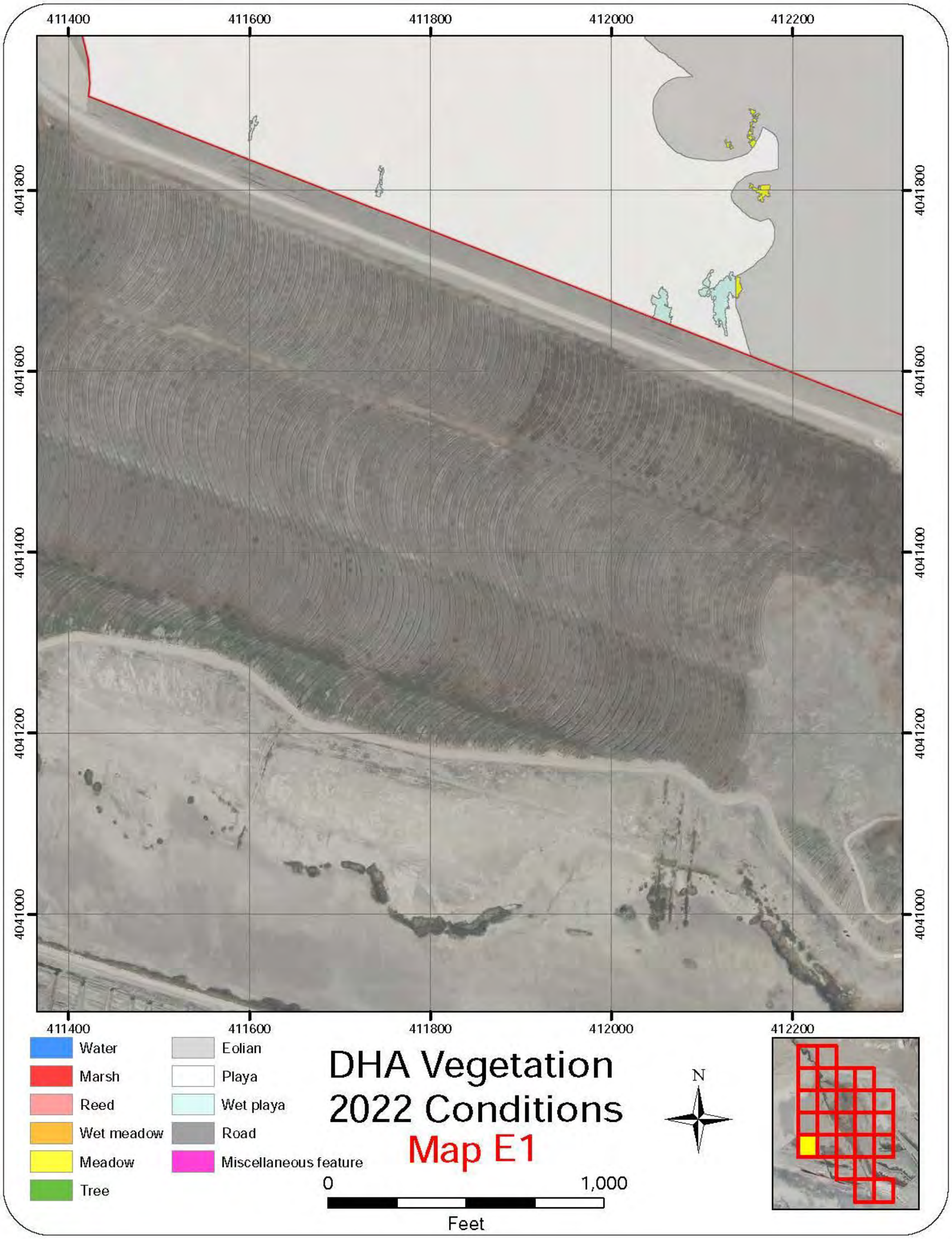
Feet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Playa
Wet playa
Road
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DHA Vegetation
2022 Conditions
Map E1
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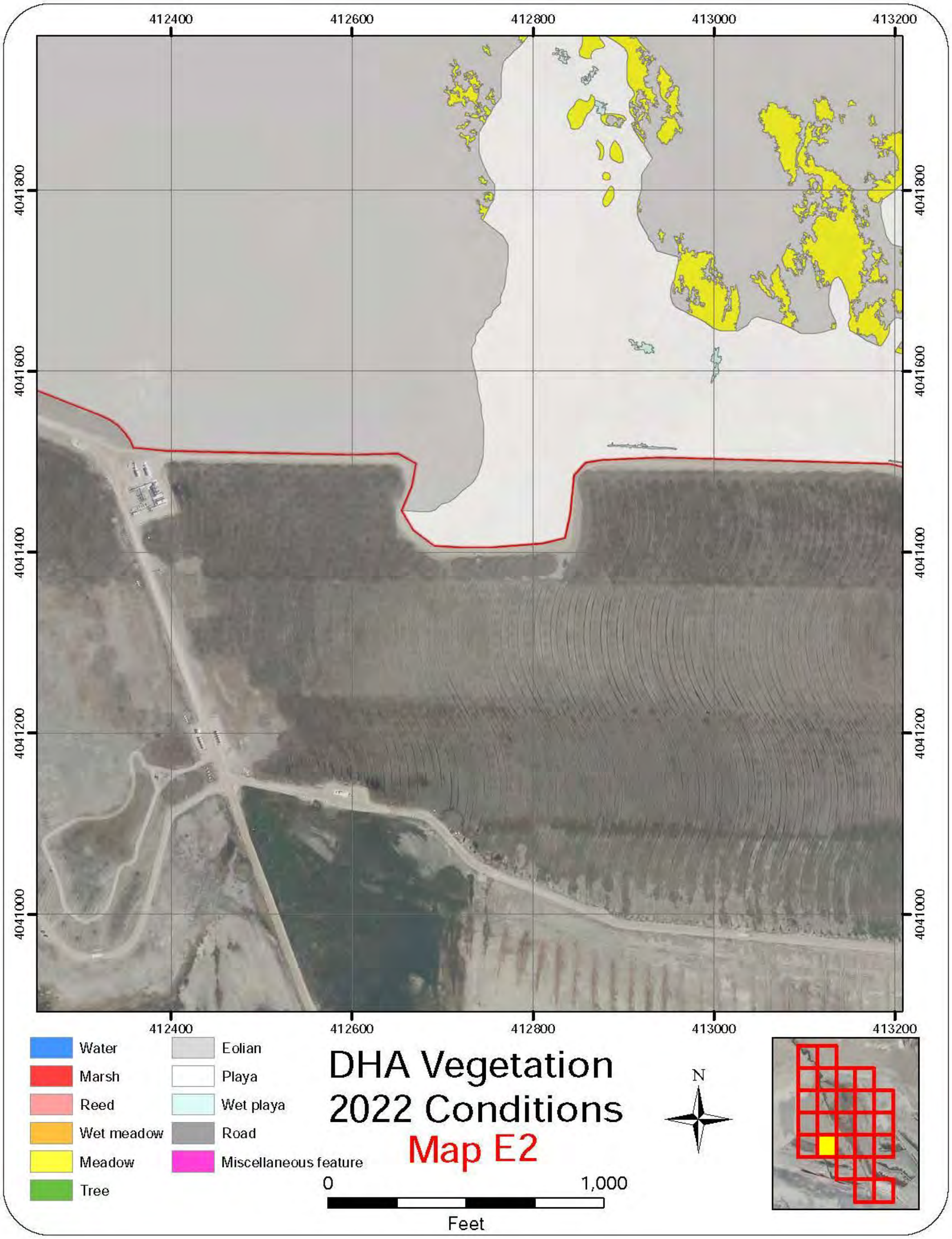
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Reed
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Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map E2
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1,000
Feet
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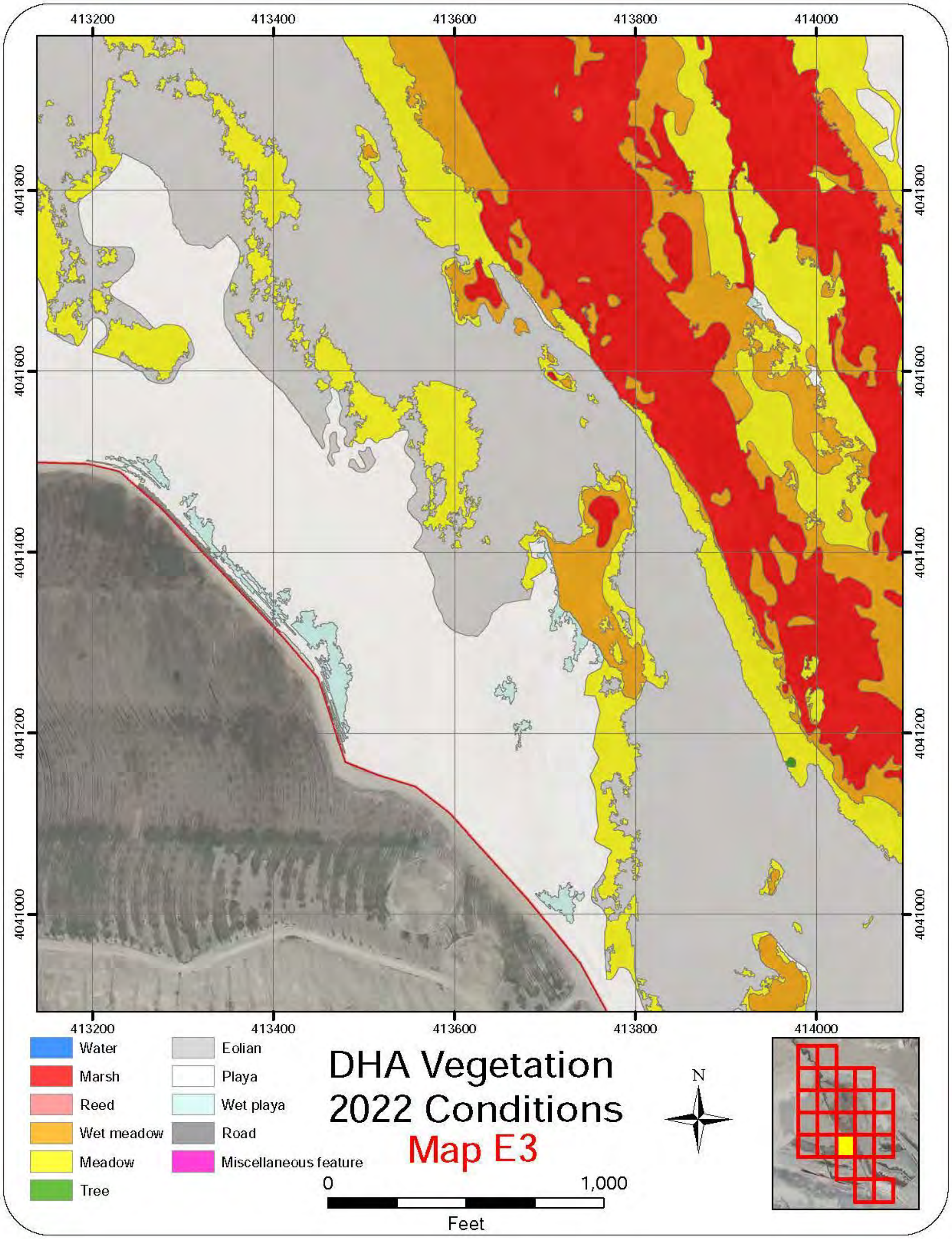
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Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
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Feet
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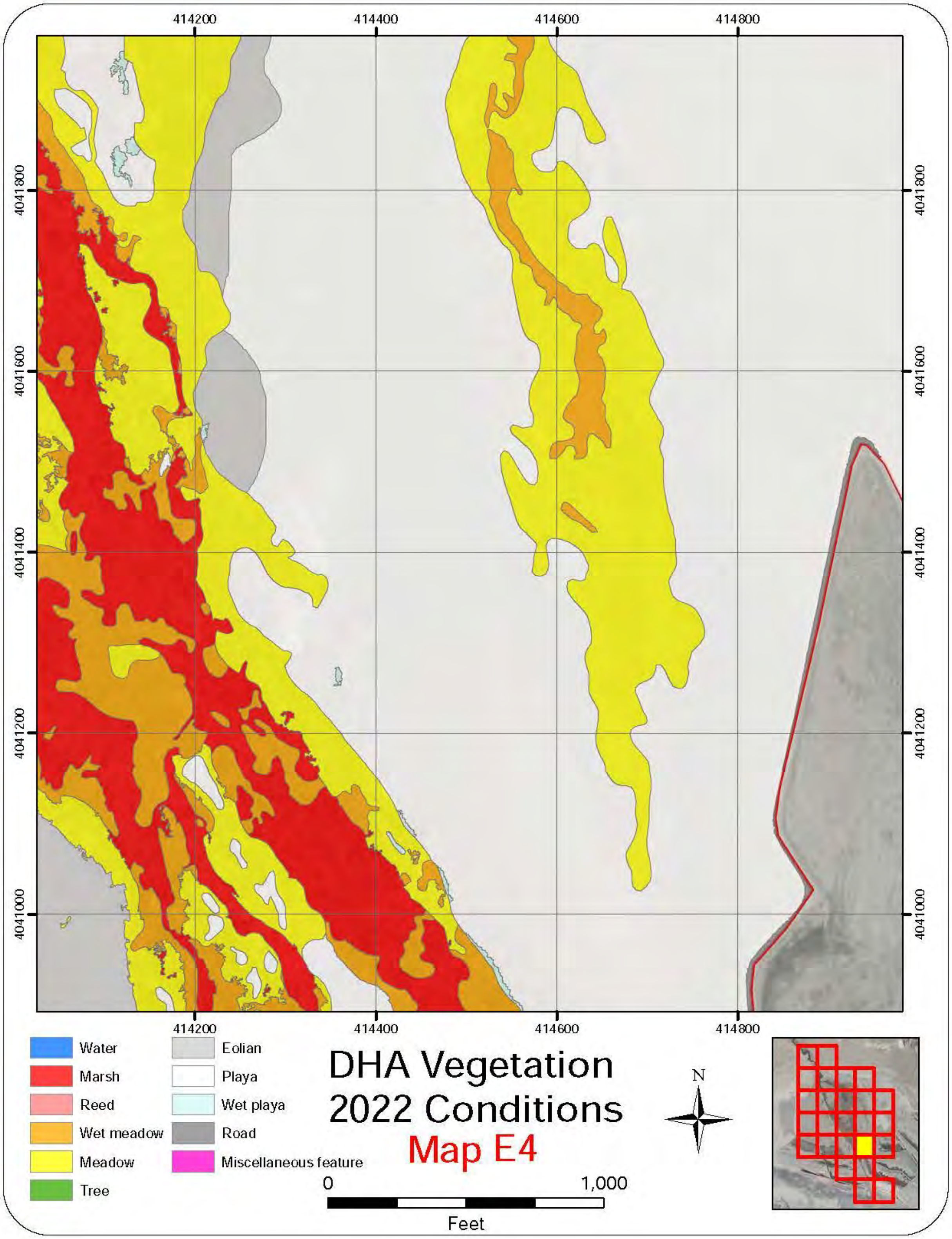

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Miscellaneous feature
DHA Vegetation
2022 Conditions
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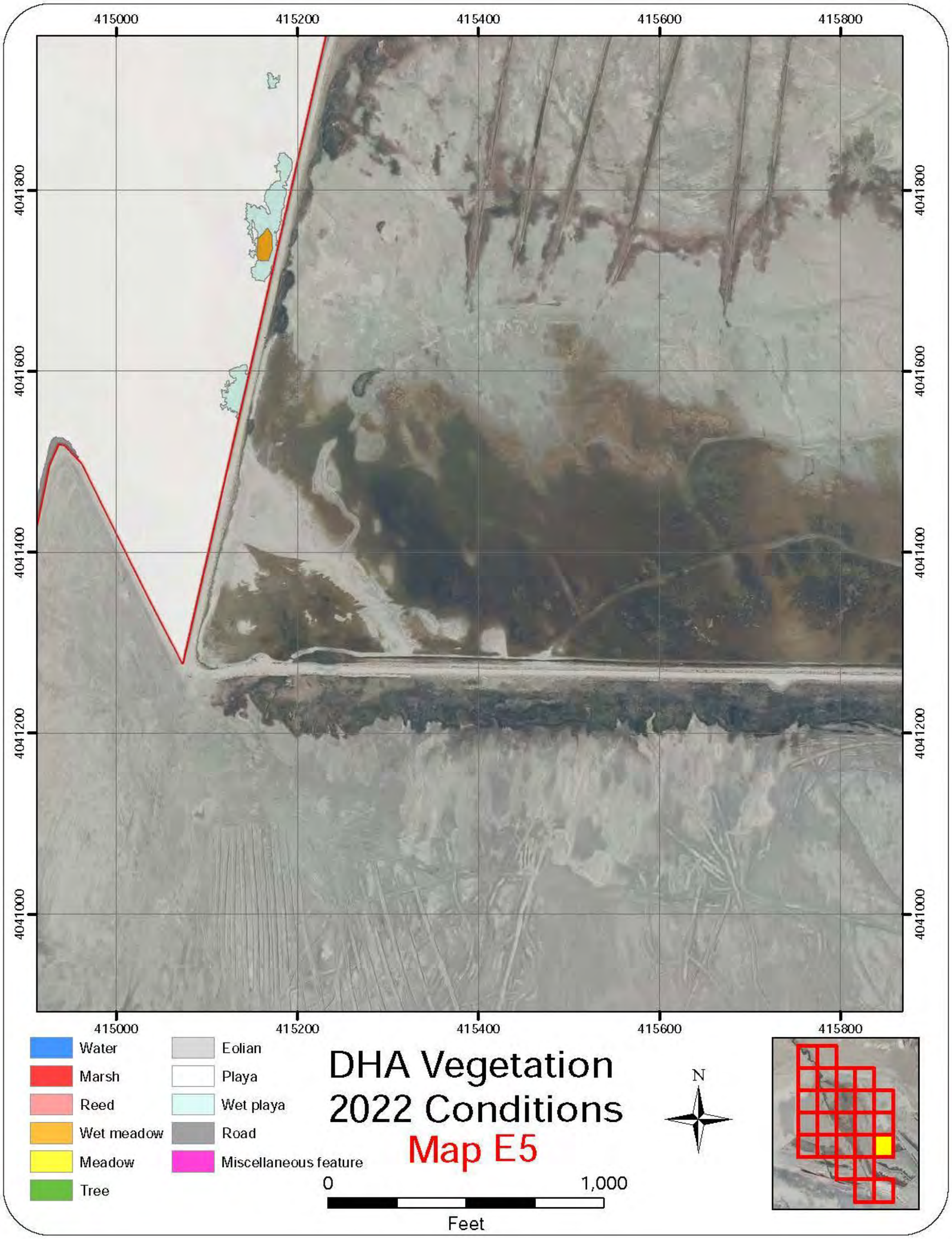
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Miscellaneous feature
DHA Vegetation
2022 Conditions
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1,000
Feet
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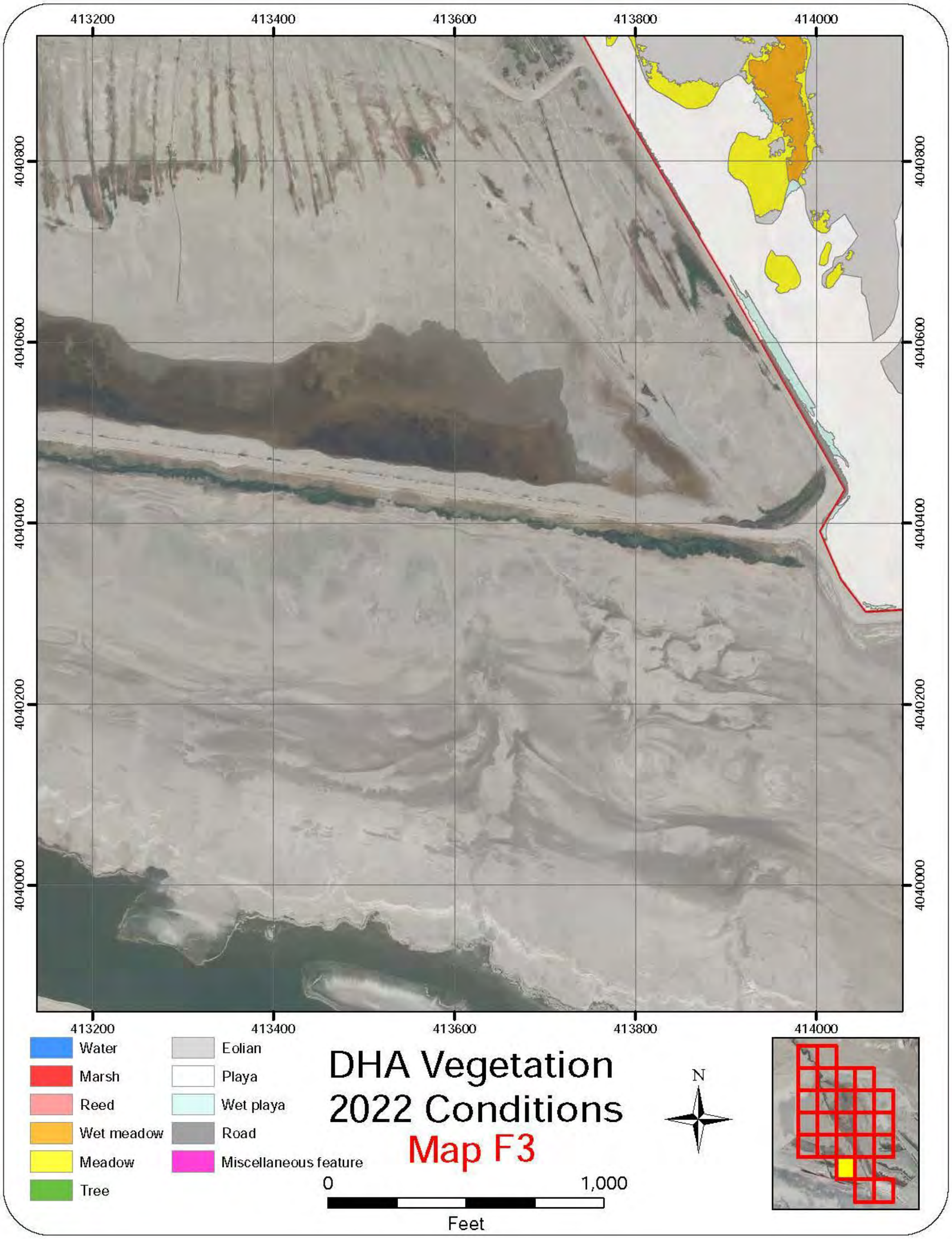
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Miscellaneous feature
DHA Vegetation
2022 Conditions
Map F3
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1,000
Feet
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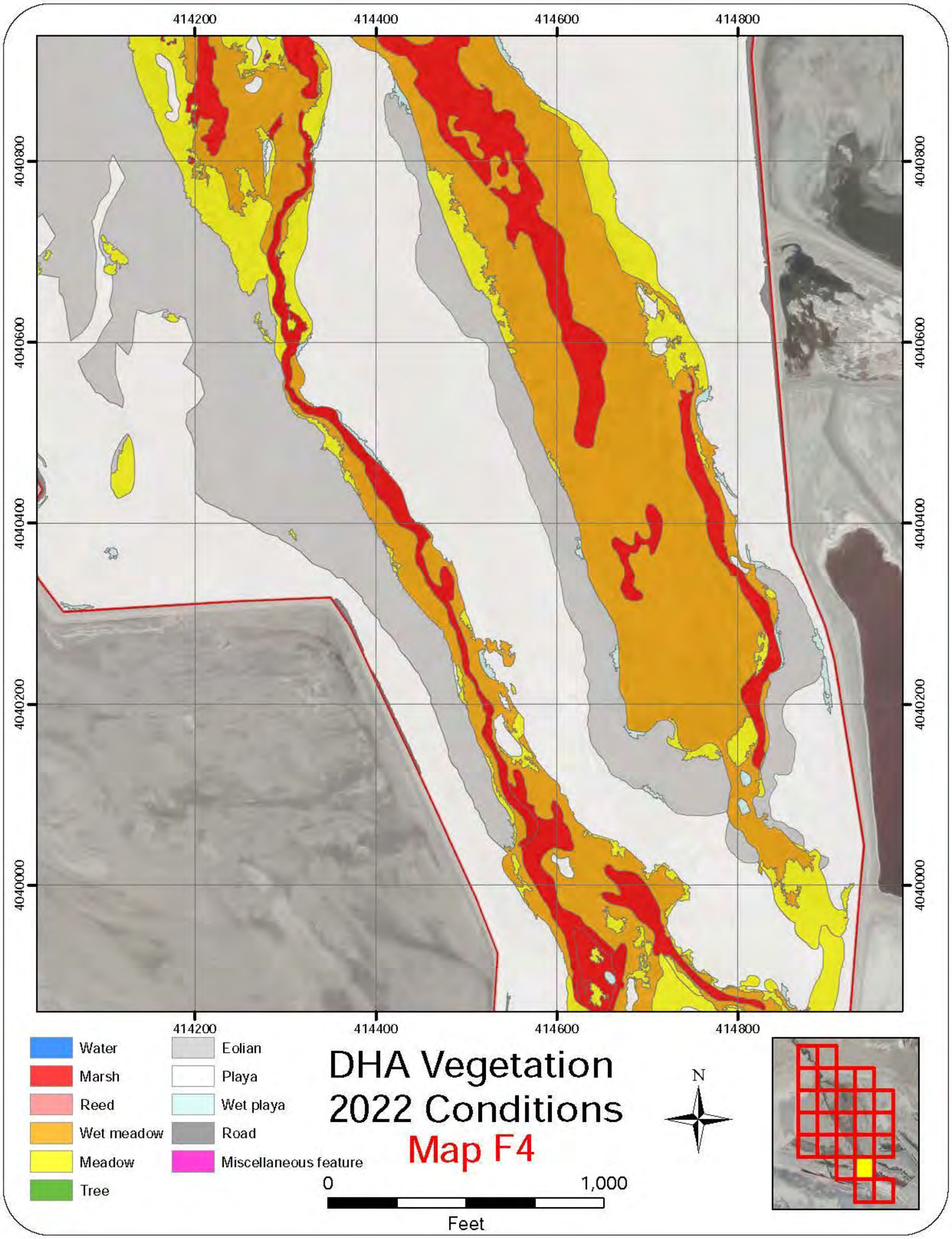
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DHA Vegetation
2022 Conditions
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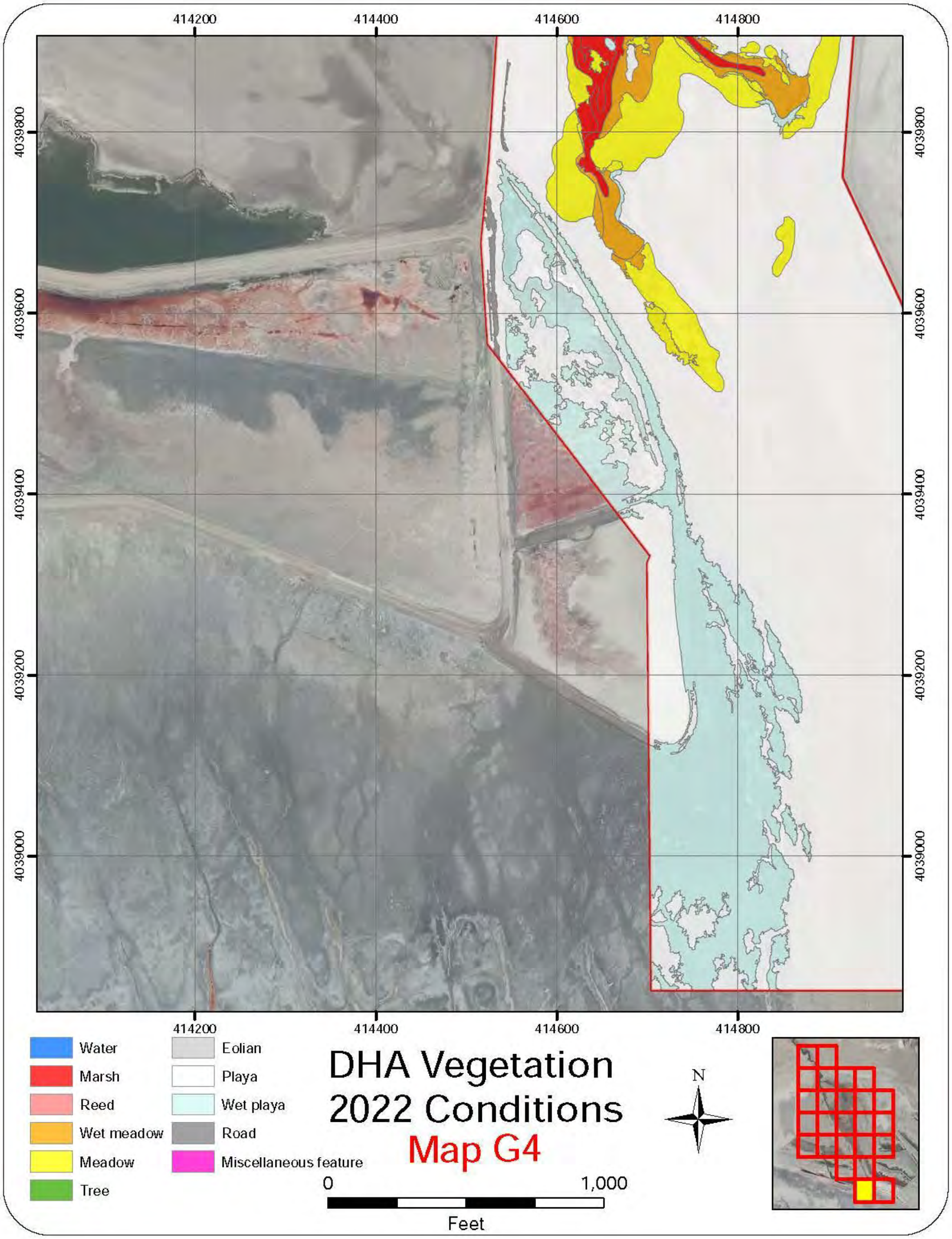
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Road
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DHA Vegetation
2022 Conditions
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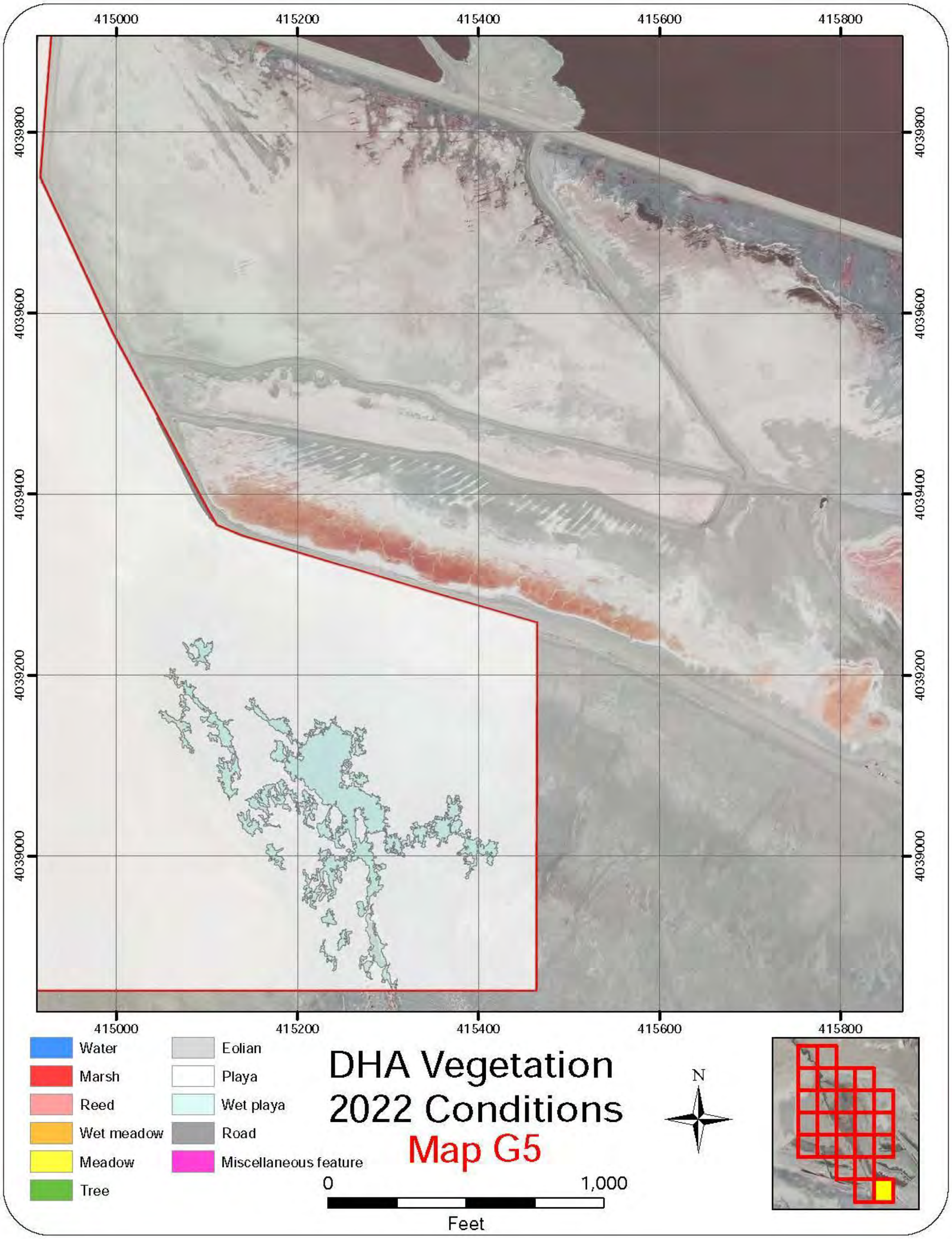
Feet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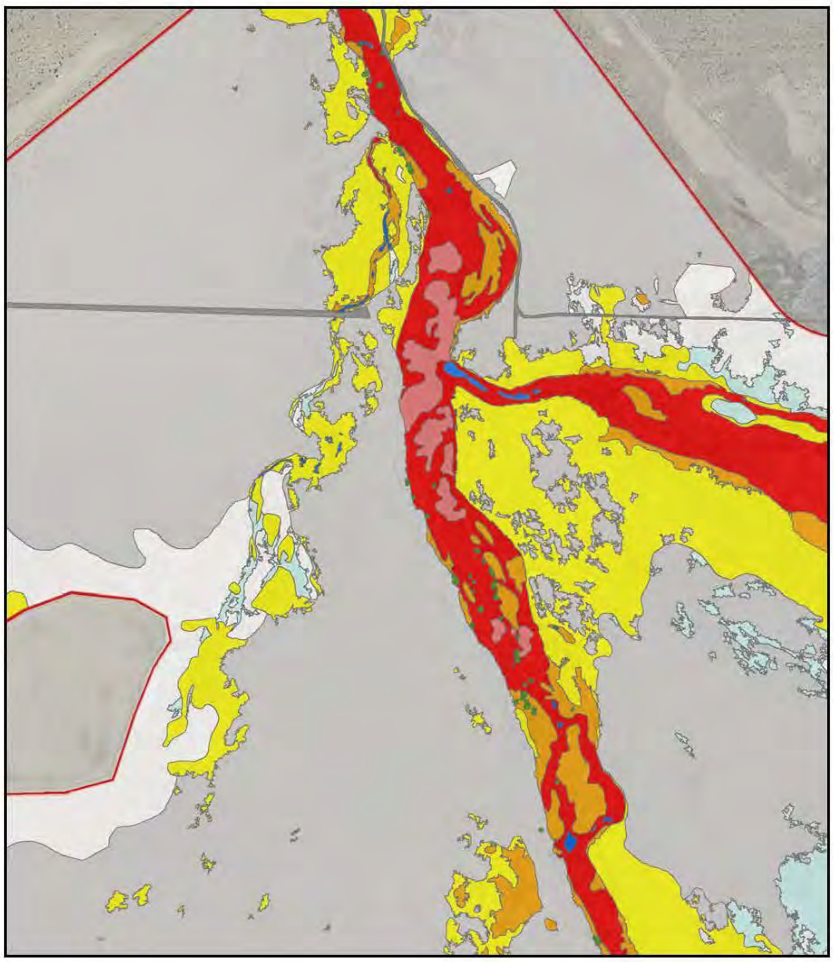
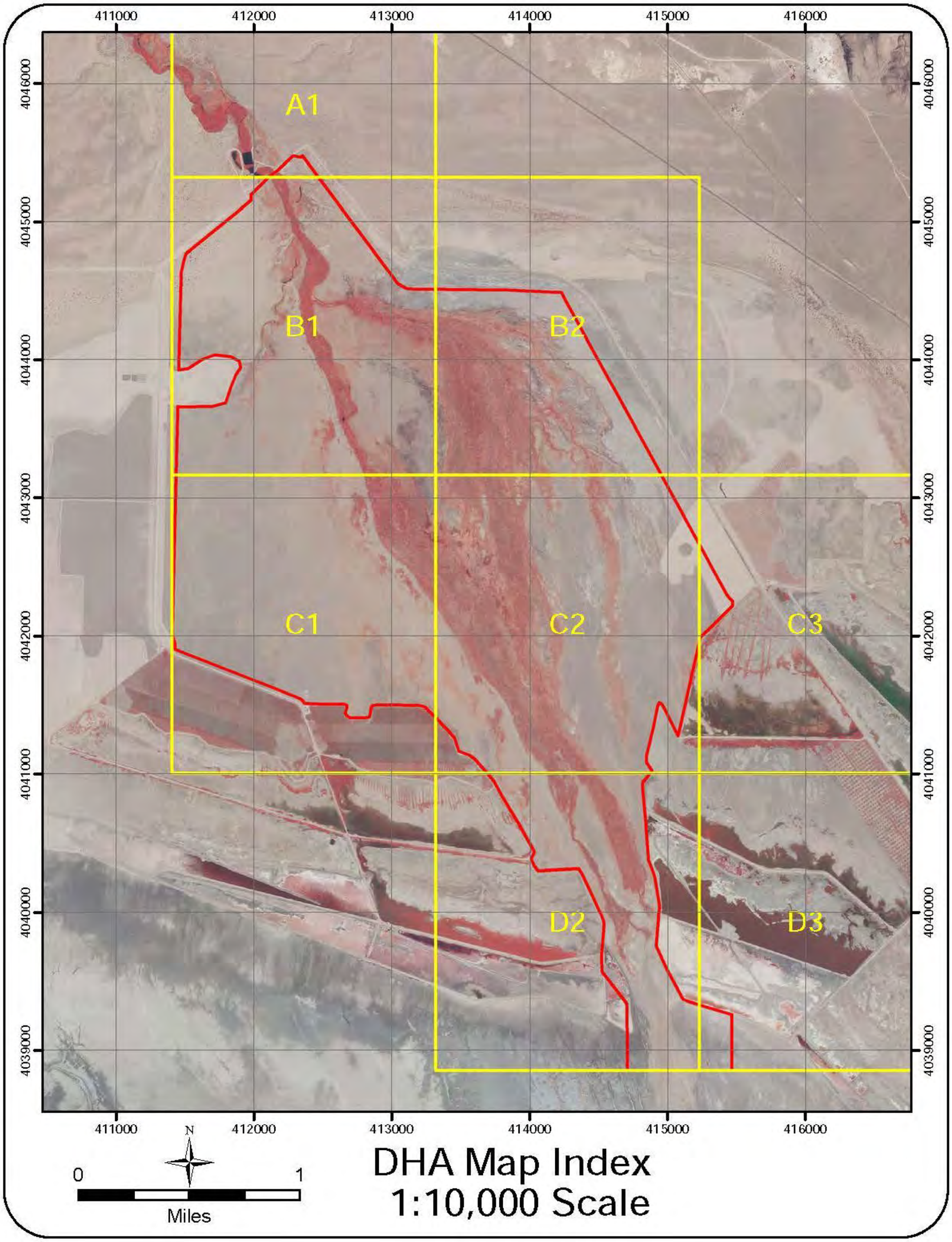
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Miscellaneous feature
DHA Vegetation
2022 Conditions
Map G5
0
1,000
Feet
N

3.4.5 Appendix F.

APPENDIX F
DHA Vegetation
2022 Conditions
1:10,000 Scale

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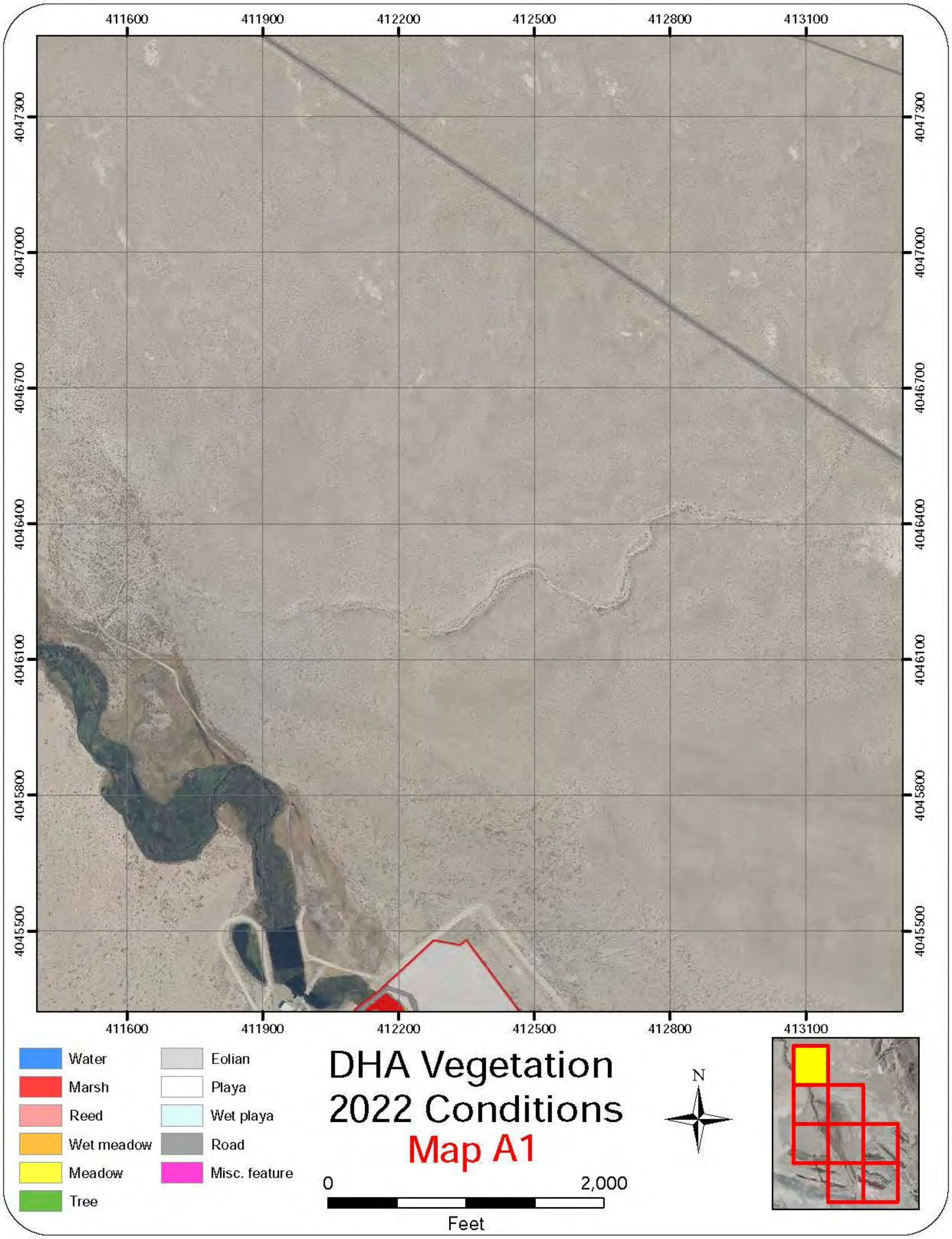
A1
B1
B2
C1
C2
C3
D2
D3
N
0
1
Miles
DHA Map Index
1:10,000 Scale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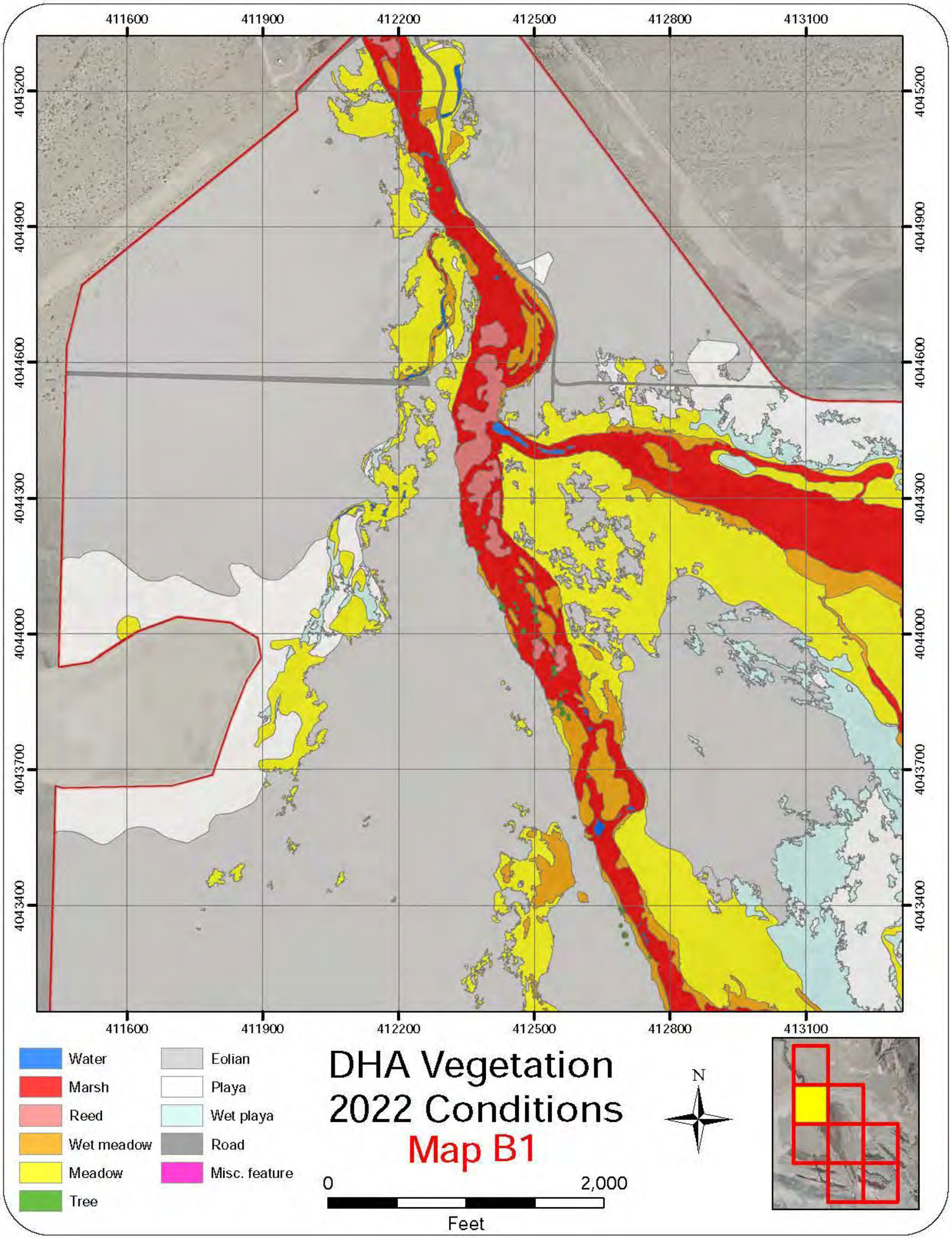
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
DHA Vegetation
2022 Conditions
Map A1
0
2,000
Feet
N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Reed
Wet meadow
Meadow
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Road
Misc. feature
DHA Vegetation
2022 Conditions
Map B1
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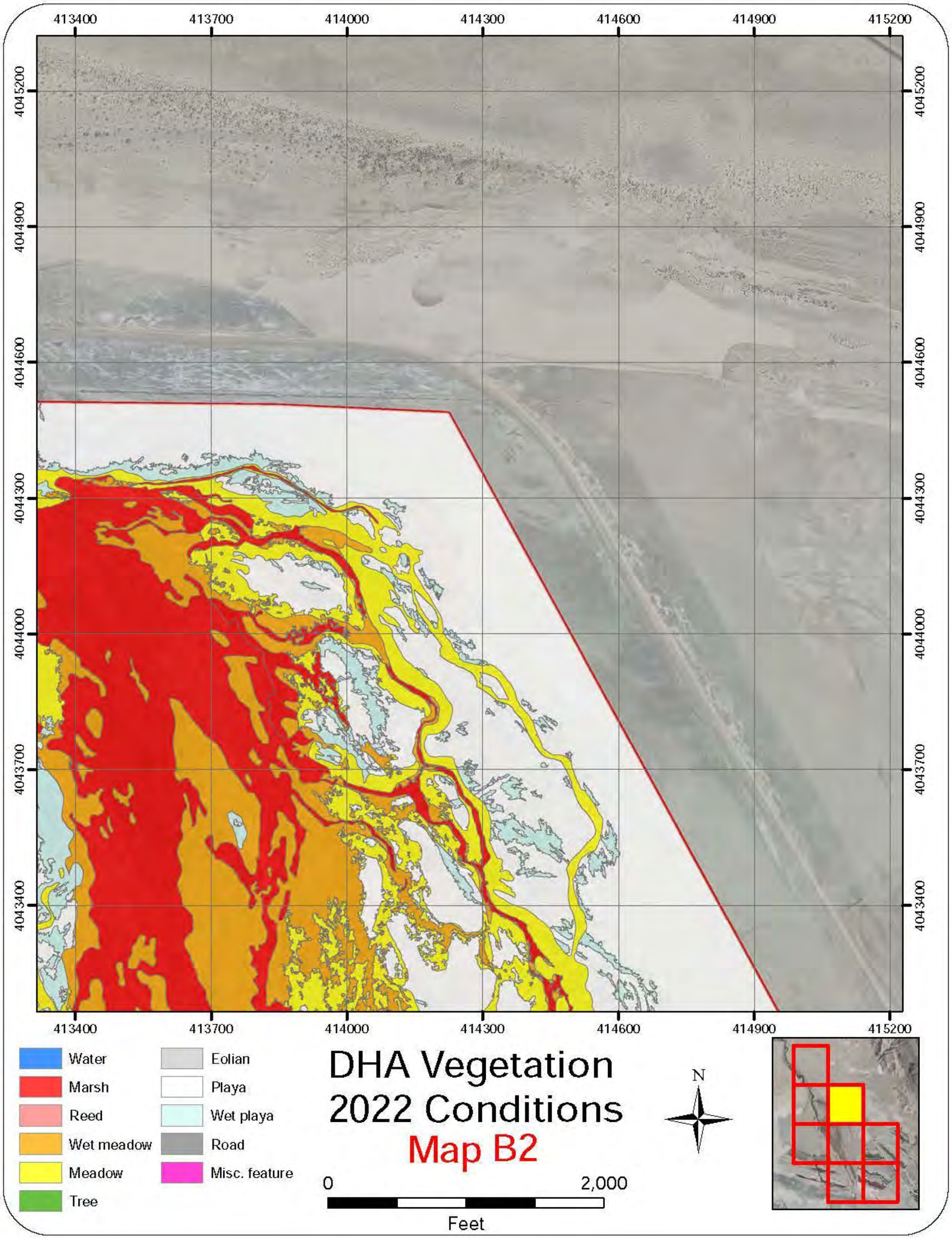
2,000
Feet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Reed
Wet meadow
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Road
Misc. feature
DHA Vegetation
2022 Conditions
Map B2
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2,000
Feet
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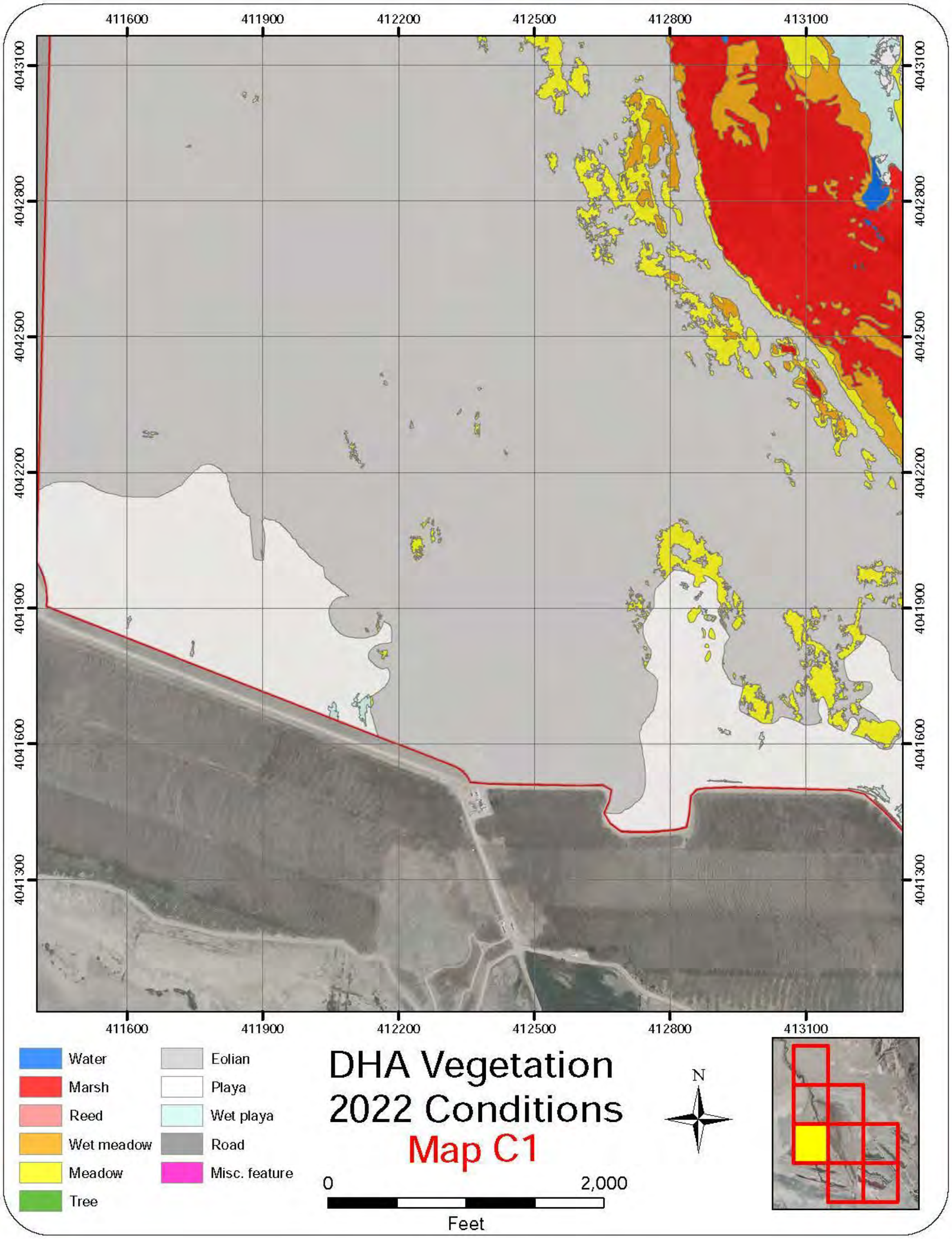
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Road
Misc. feature
DHA Vegetation
2022 Conditions
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Feet
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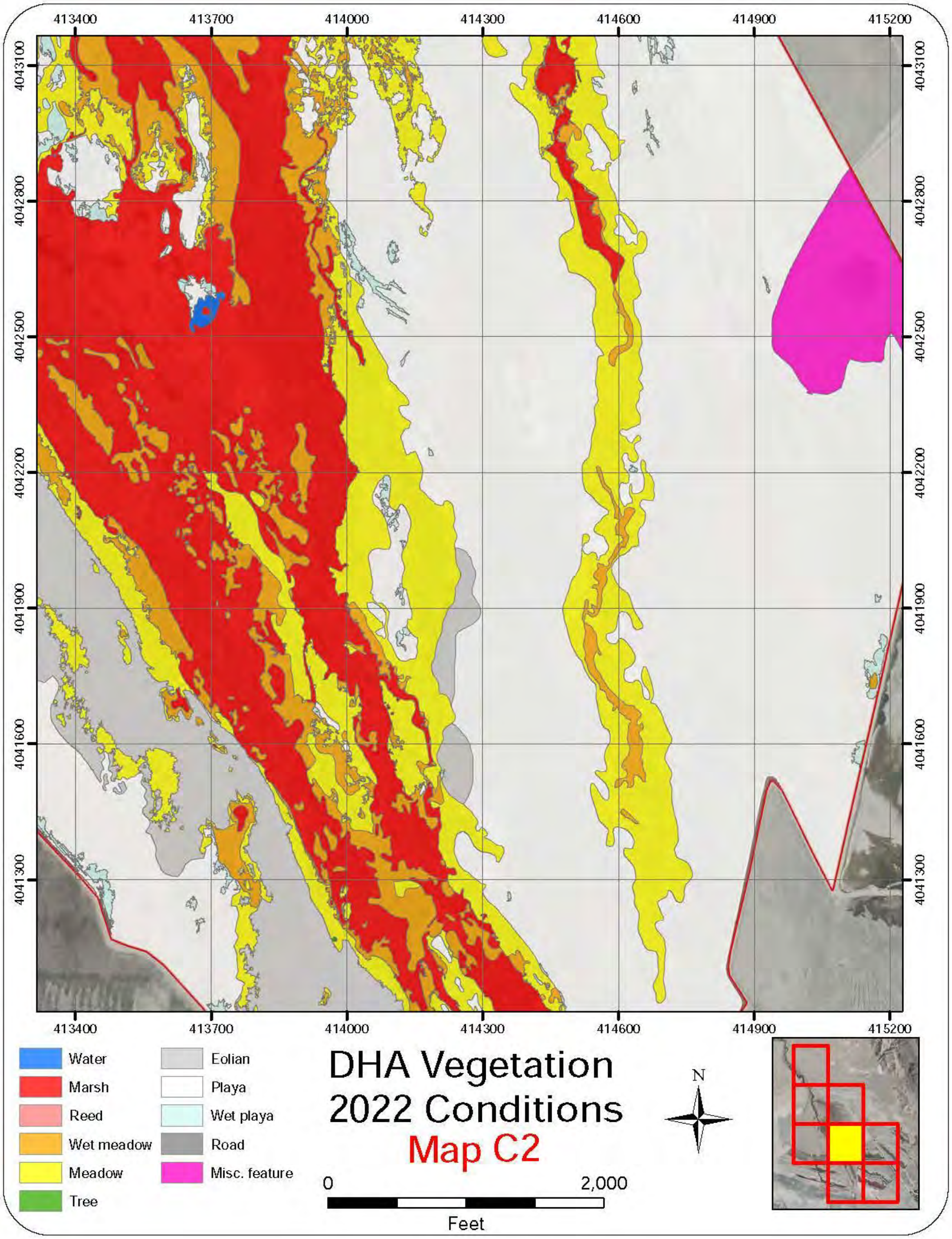
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Reed
Wet meadow
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Tree
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Wet playa
Road
Misc. feature
DHA Vegetation
2022 Conditions
Map C2
0
2,000
Feet
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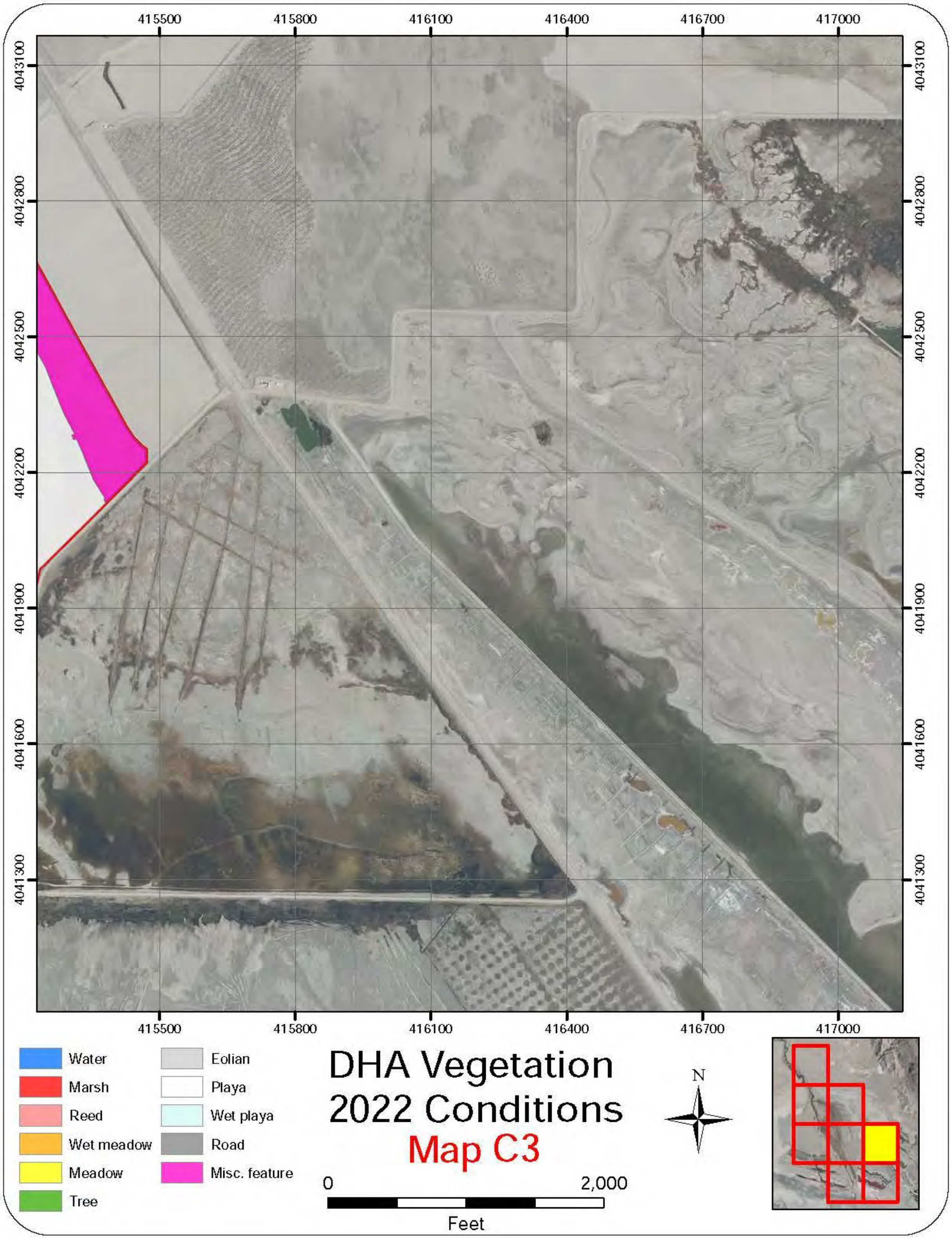
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Reed
Wet meadow
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Road
Misc. feature
DHA Vegetation
2022 Conditions
Map C3
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2,000
Feet
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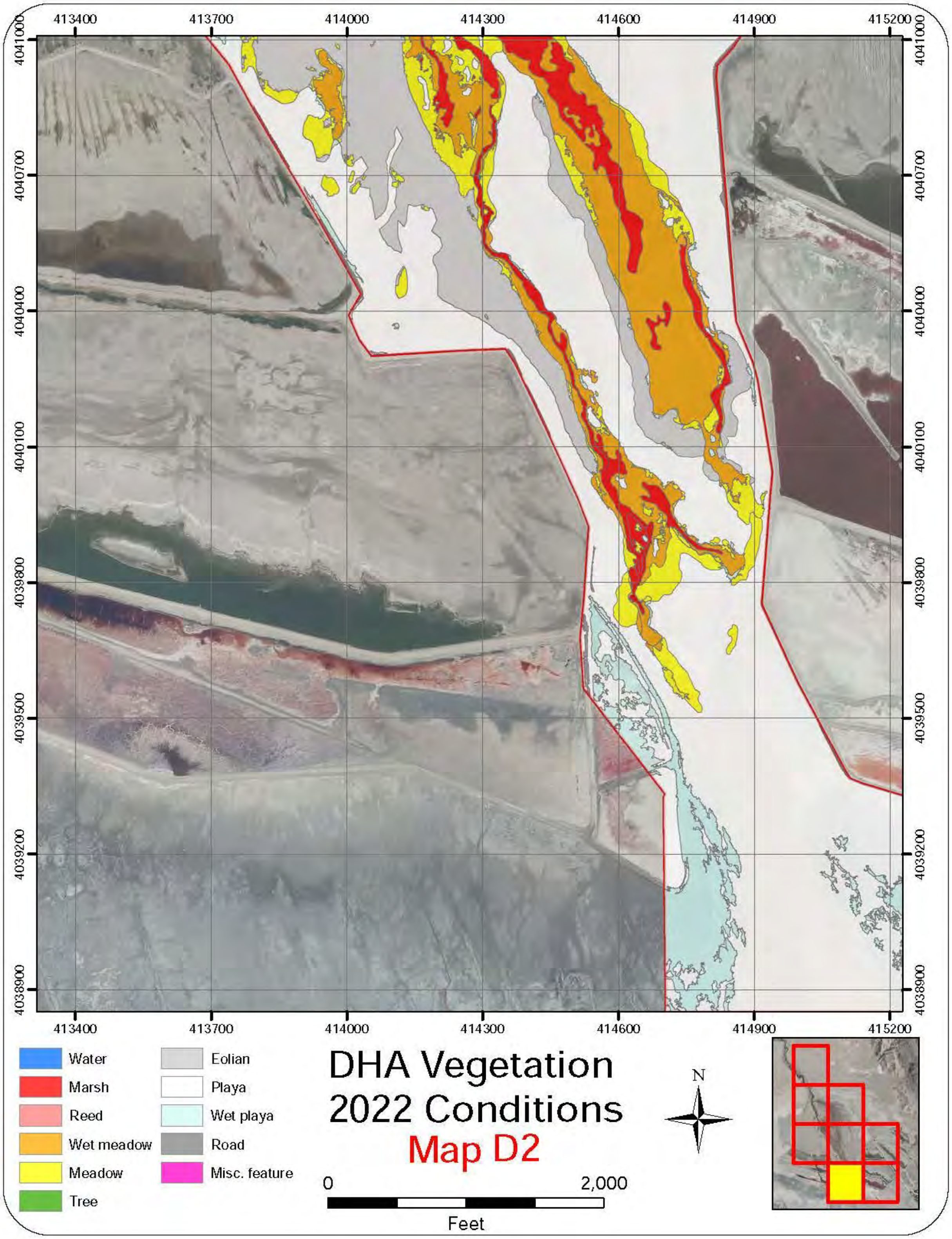
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Reed
Wet meadow
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Misc. feature
DHA Vegetation
2022 Conditions
Map D2
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Feet
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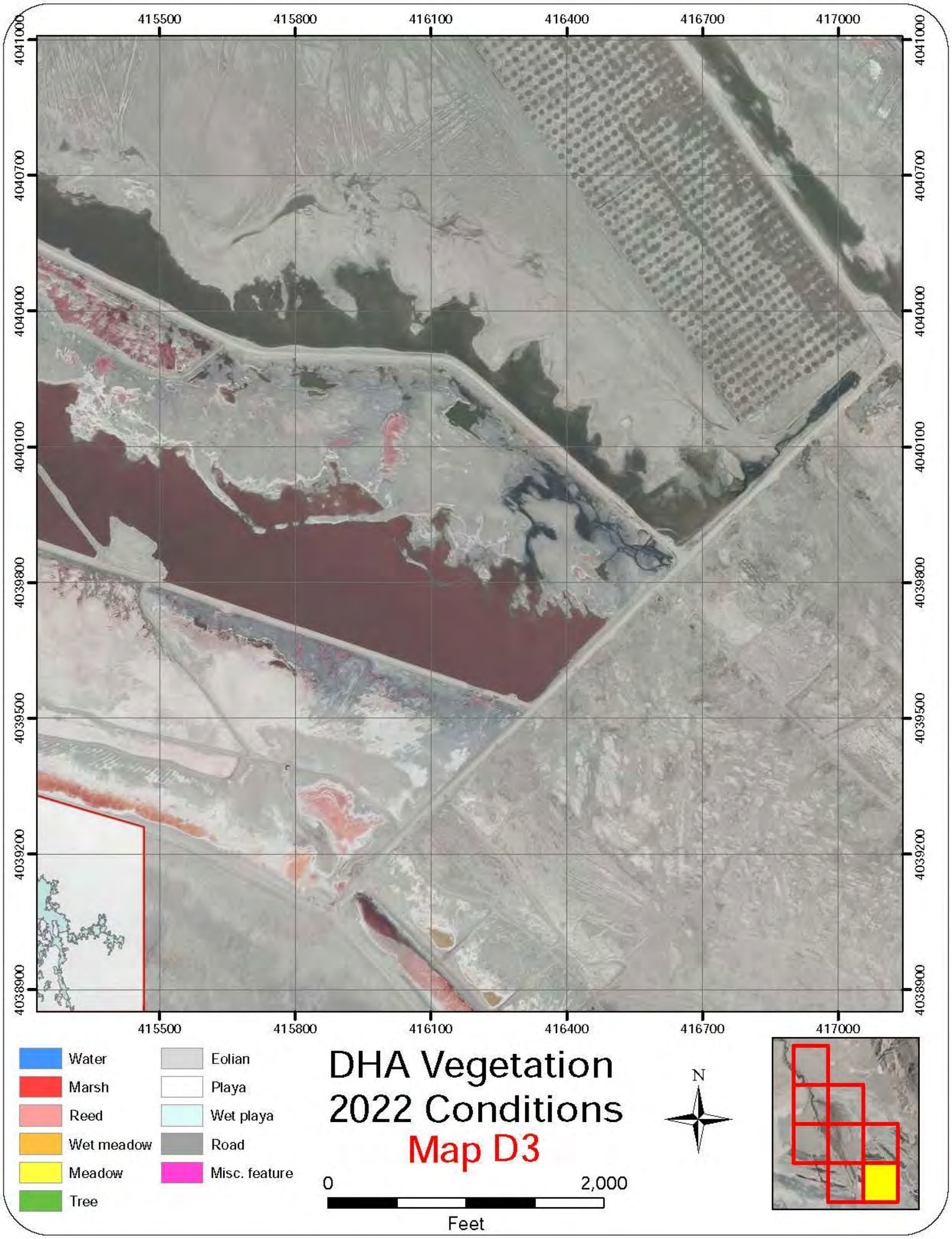
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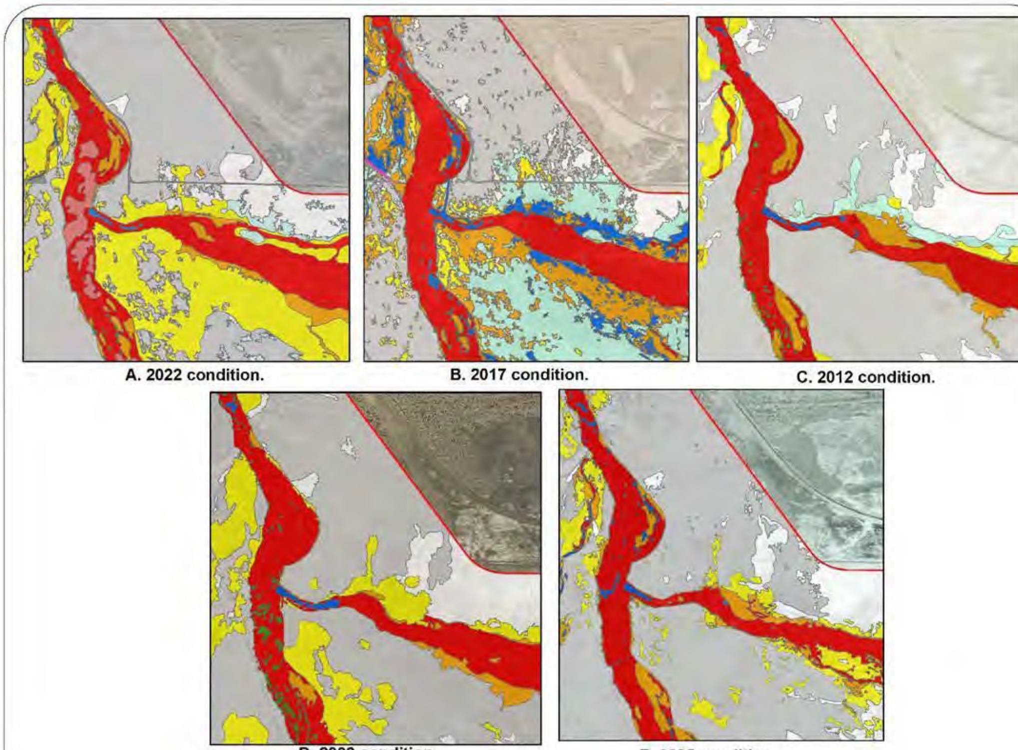
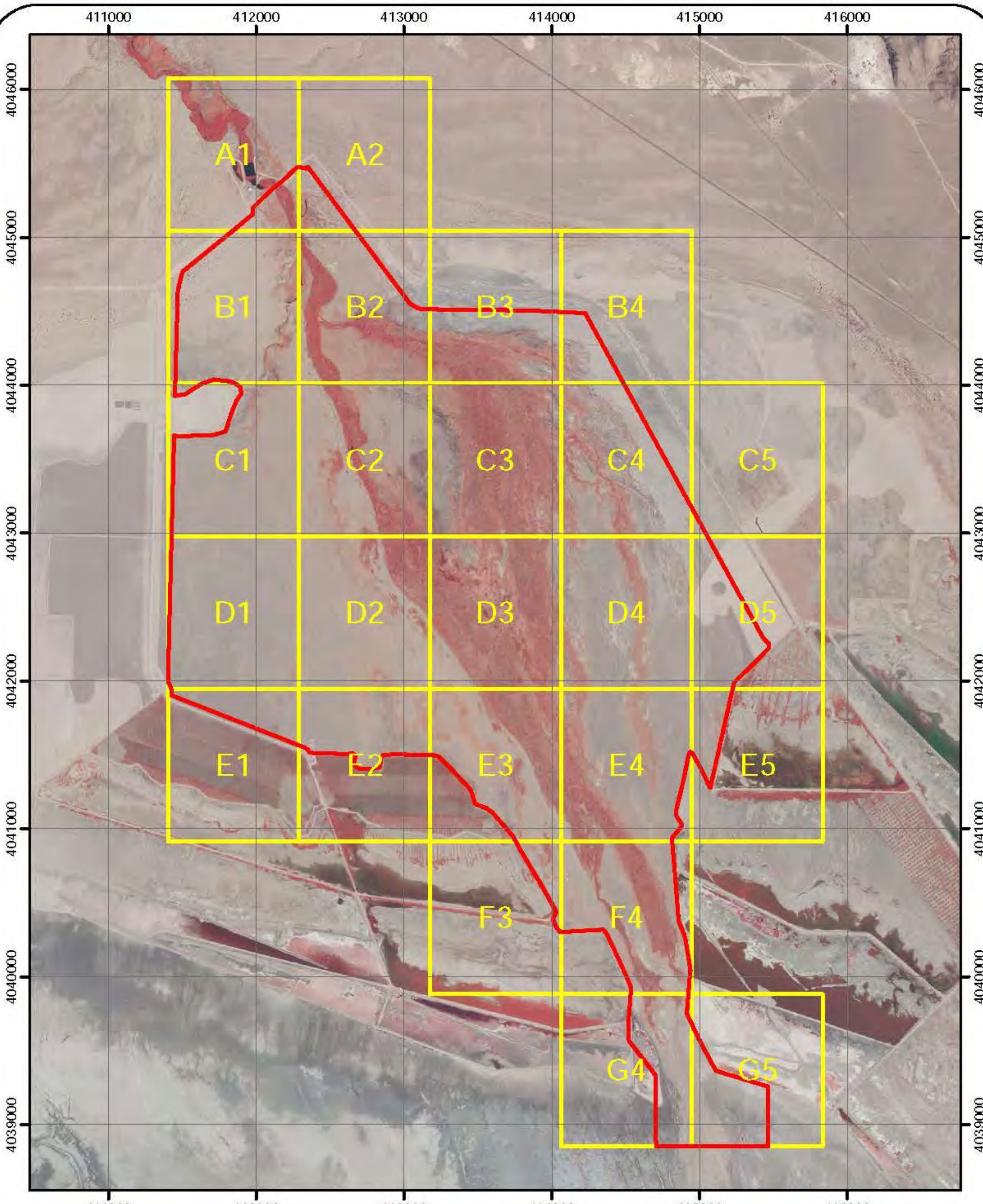
Playa
Wet playa
Road
Misc. feature
DHA Vegetation
2022 Conditions
Map D3
0
2,000
Feet
N

3.4.6 Appendix G.

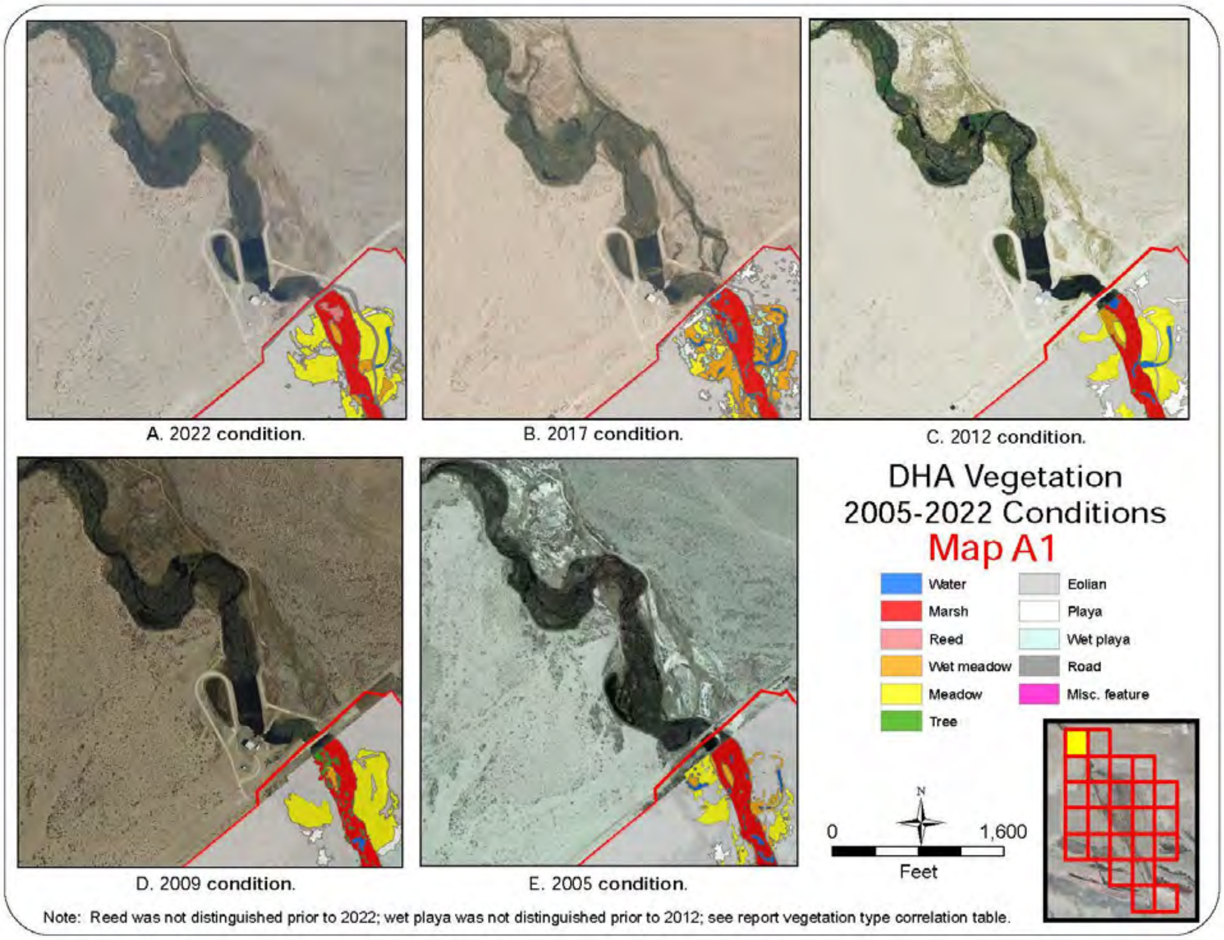
APPENDIX G
DHA VEGETATION
2005 THROUGH 2022 CONDITION

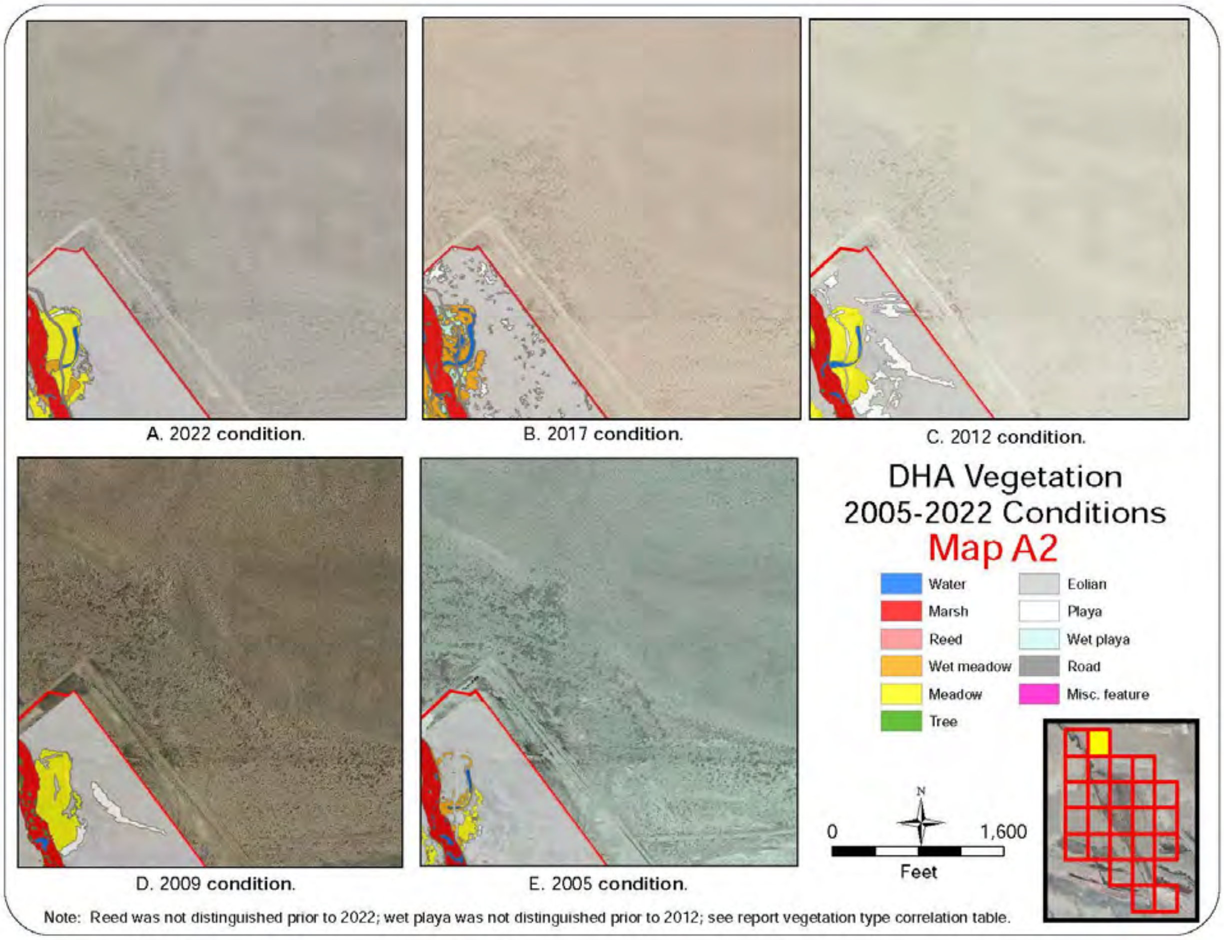


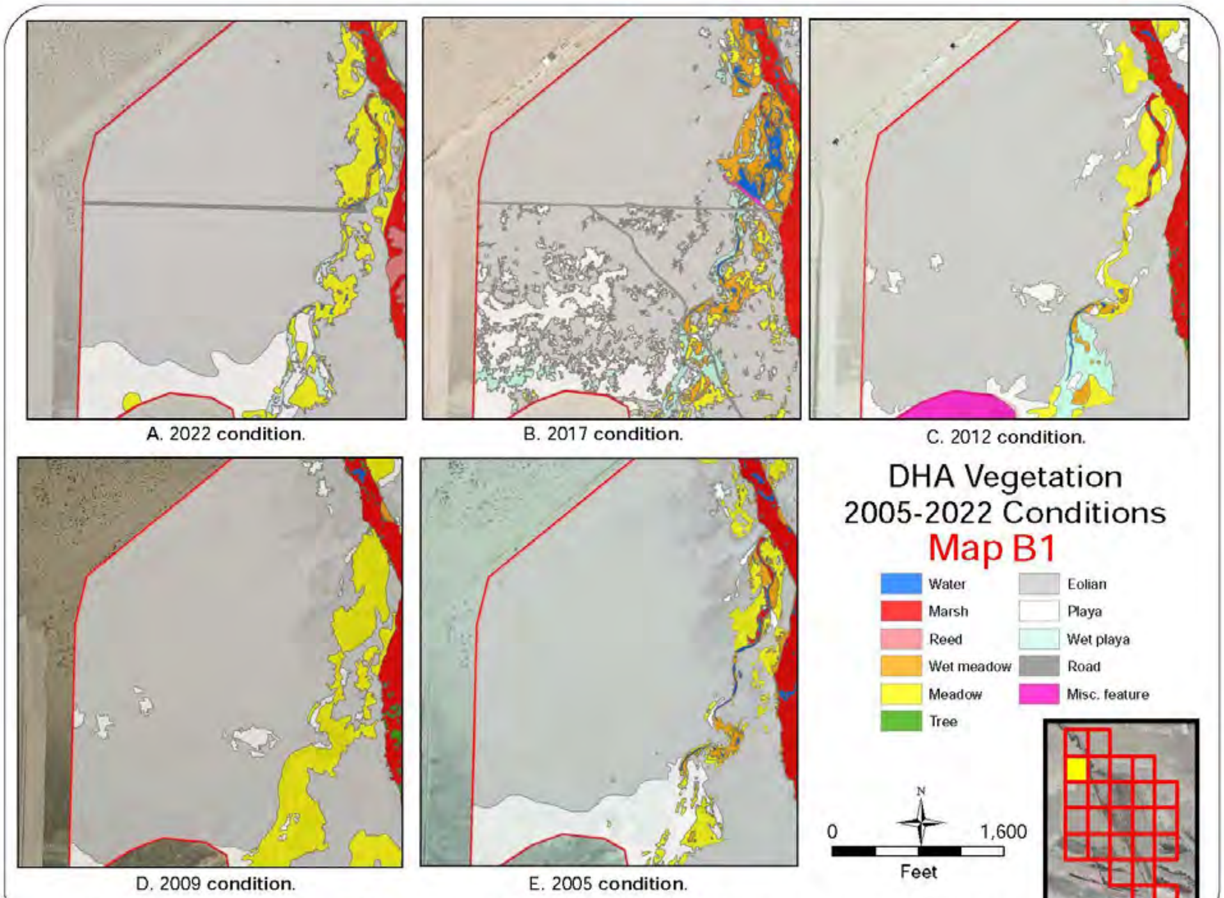
A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.



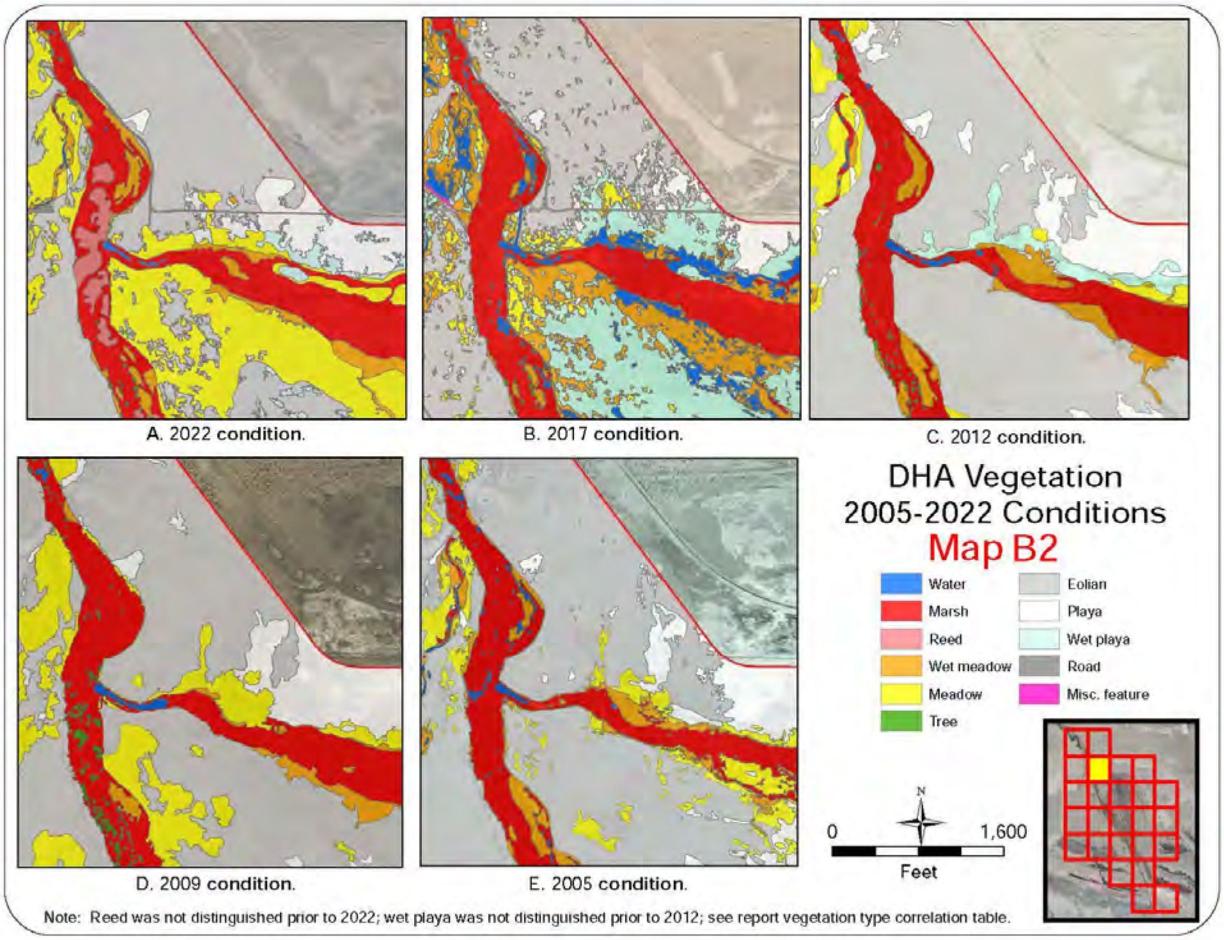
DHA Map Index
1:5,000 Scale

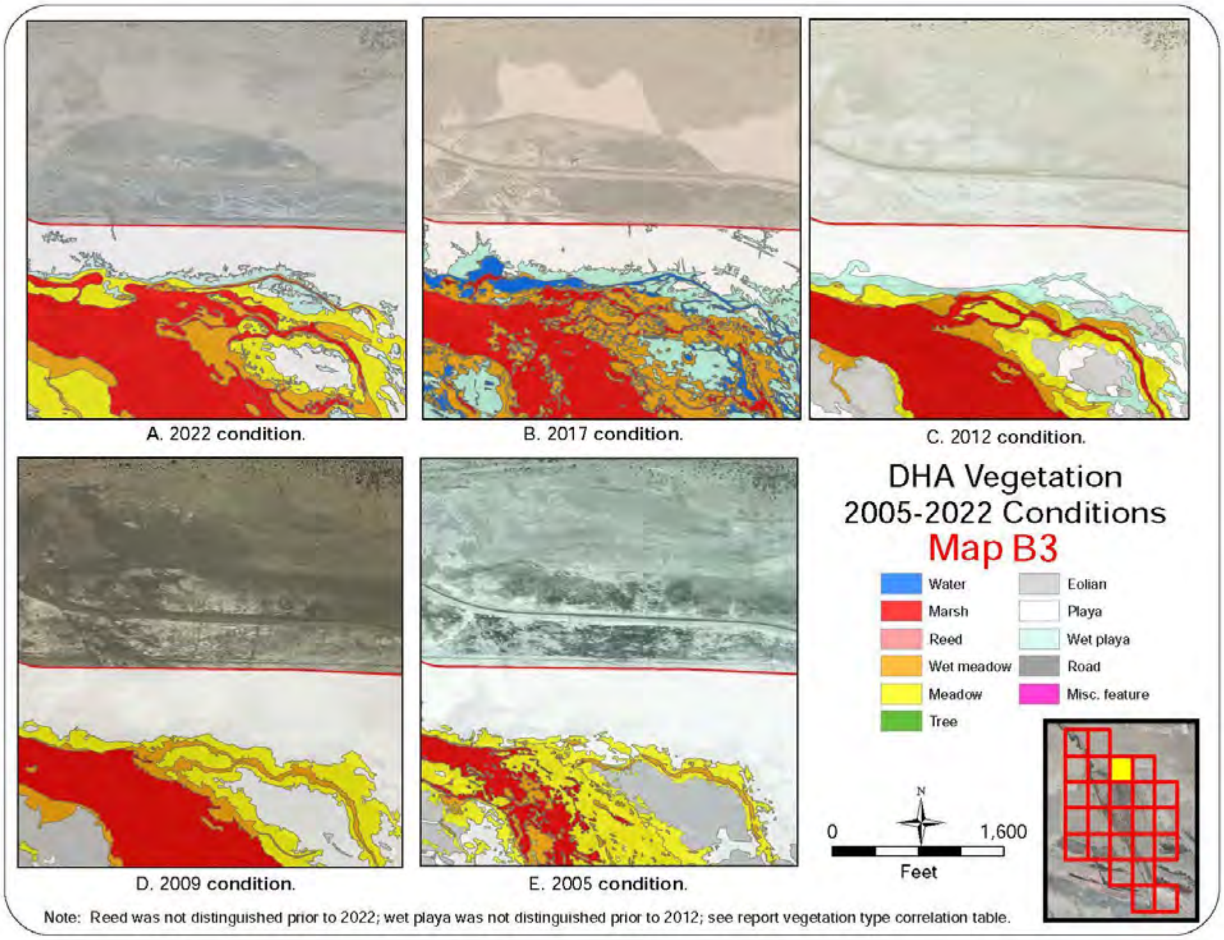

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map A1
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
D. 2009 condition.
E. 2005 condition.
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

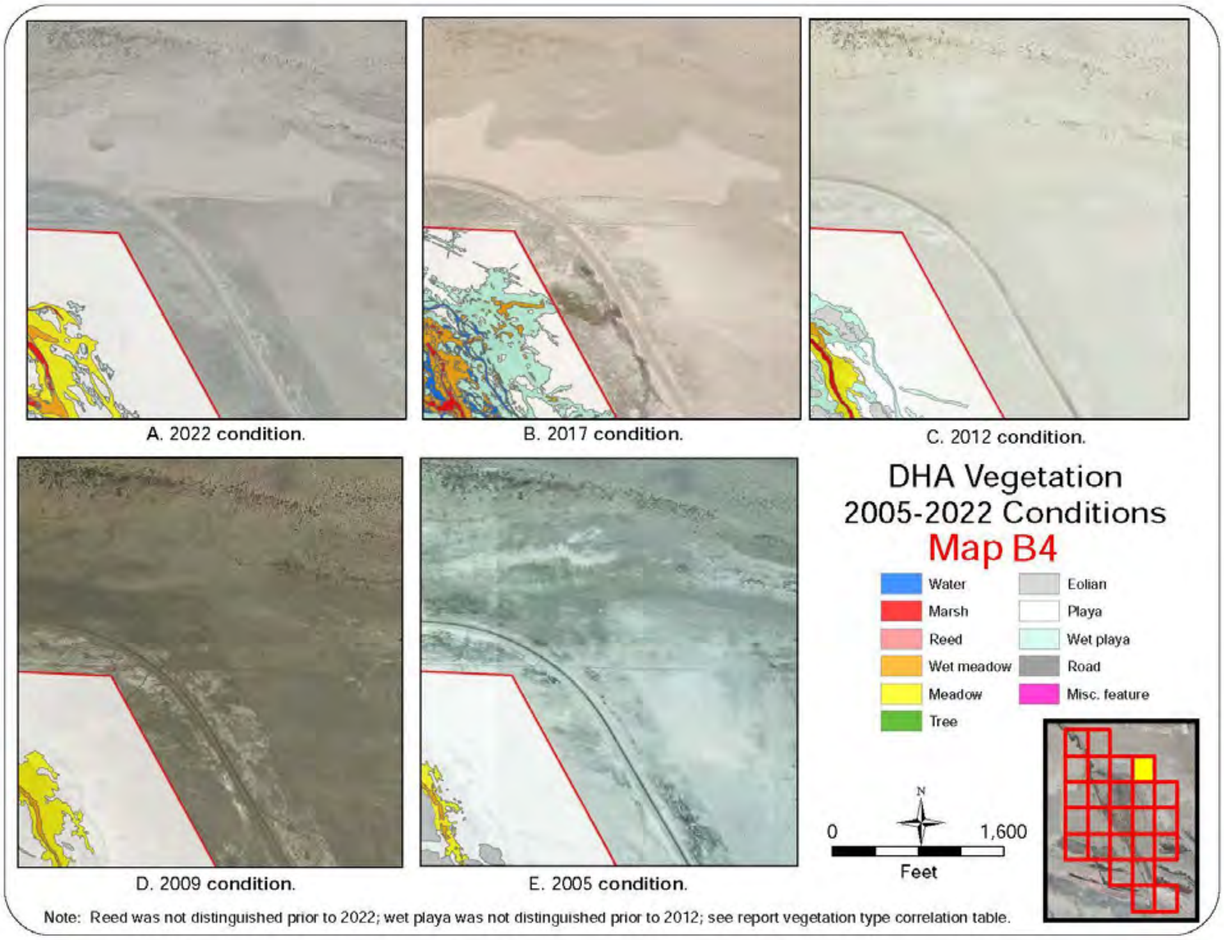

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map A2
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
D. 2009 condition.
E. 2005 condition.
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

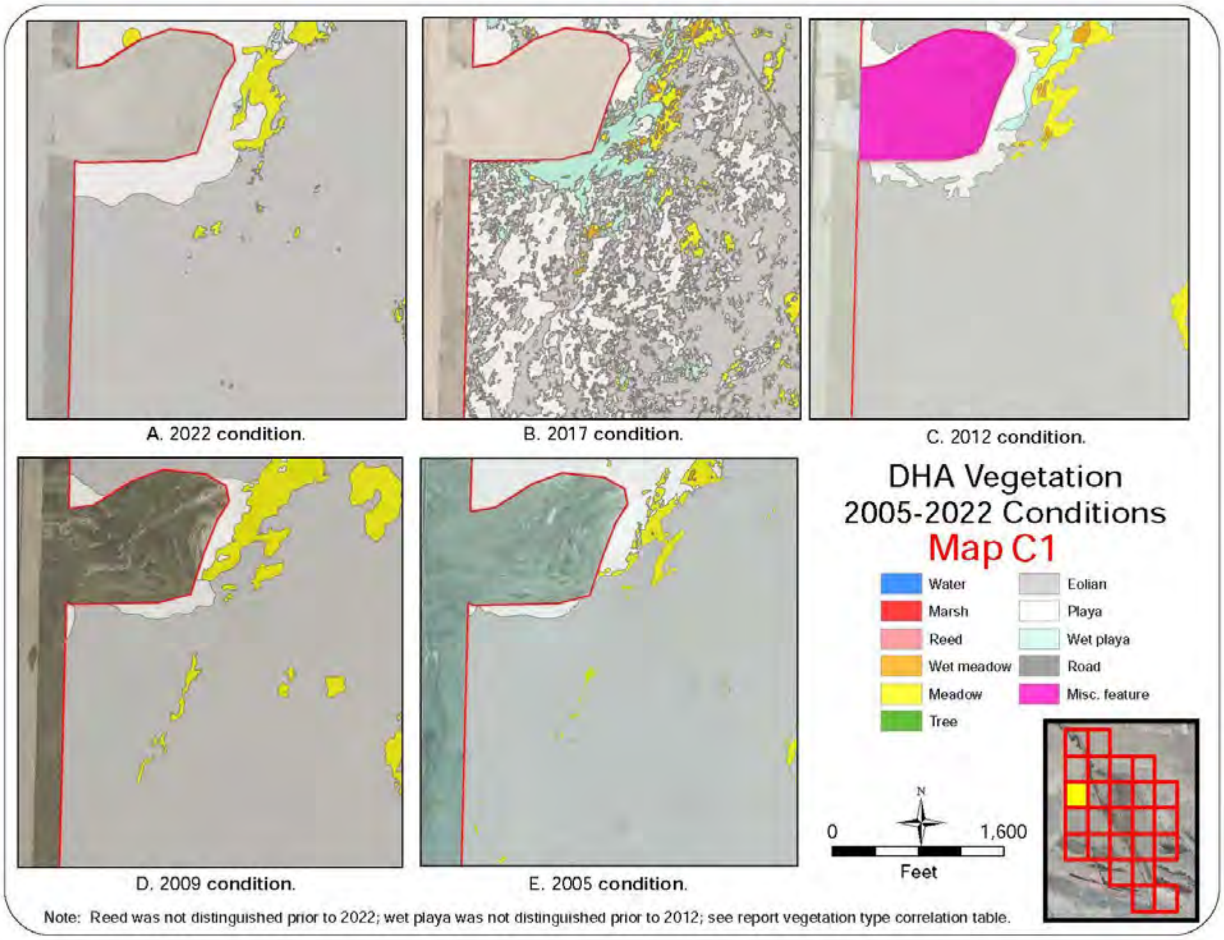


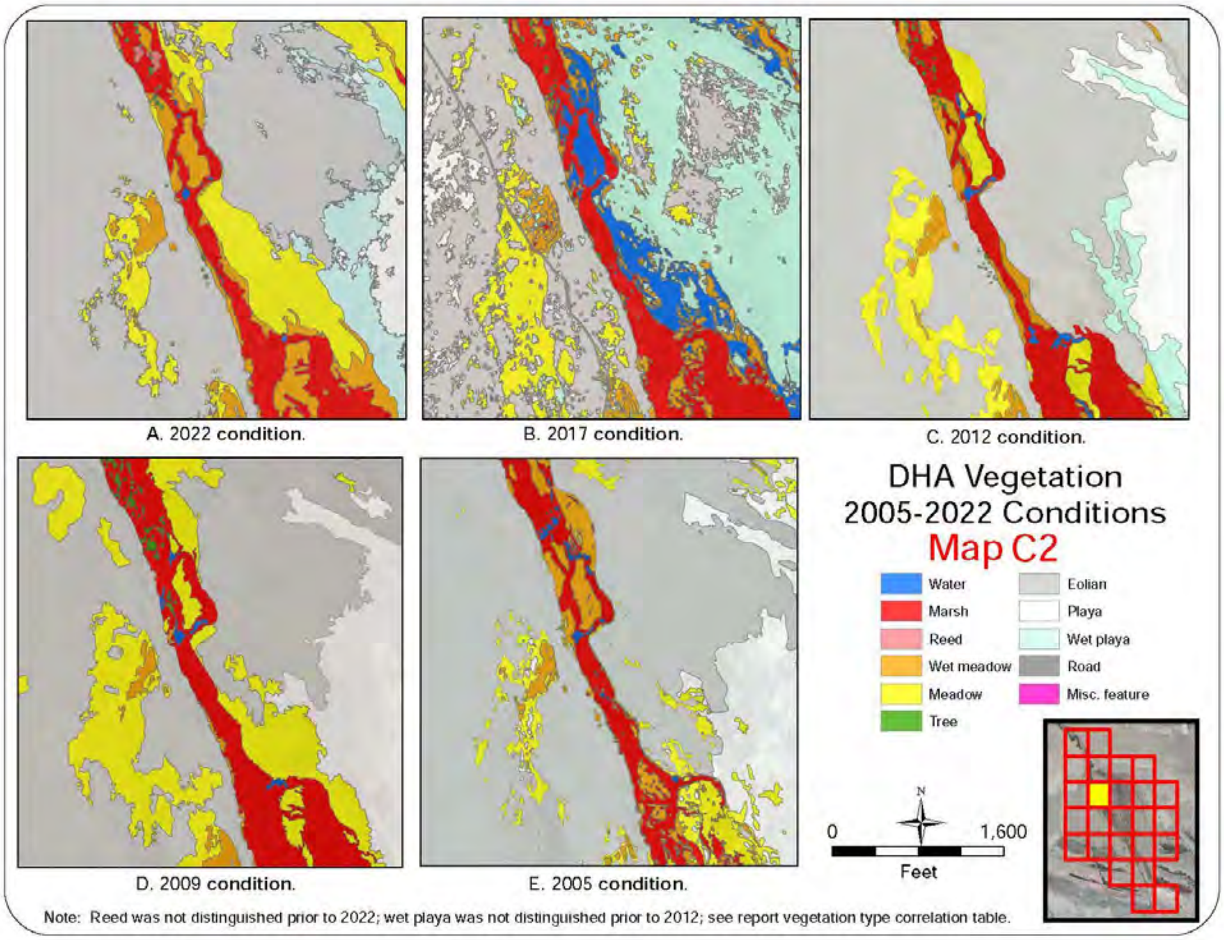
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

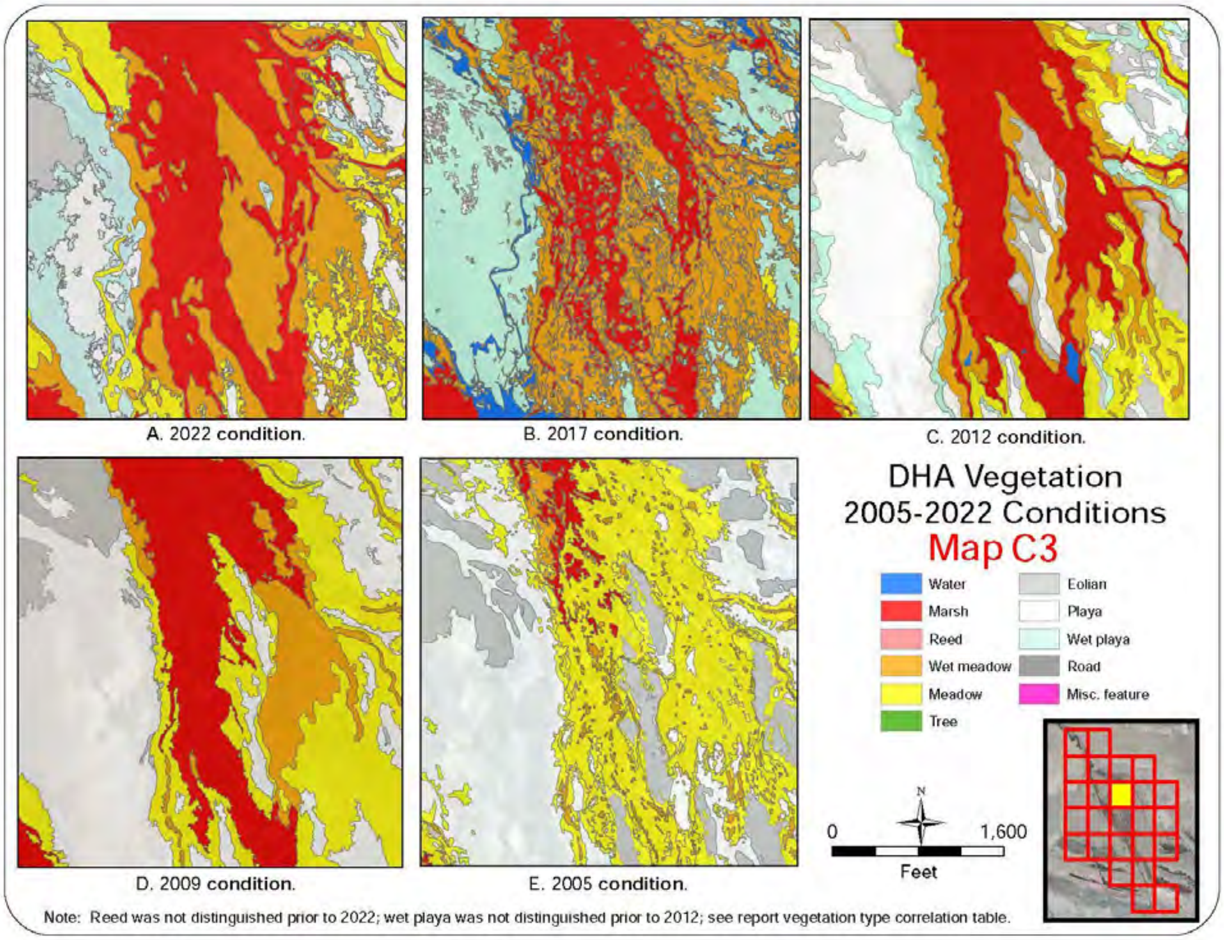

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map B2
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

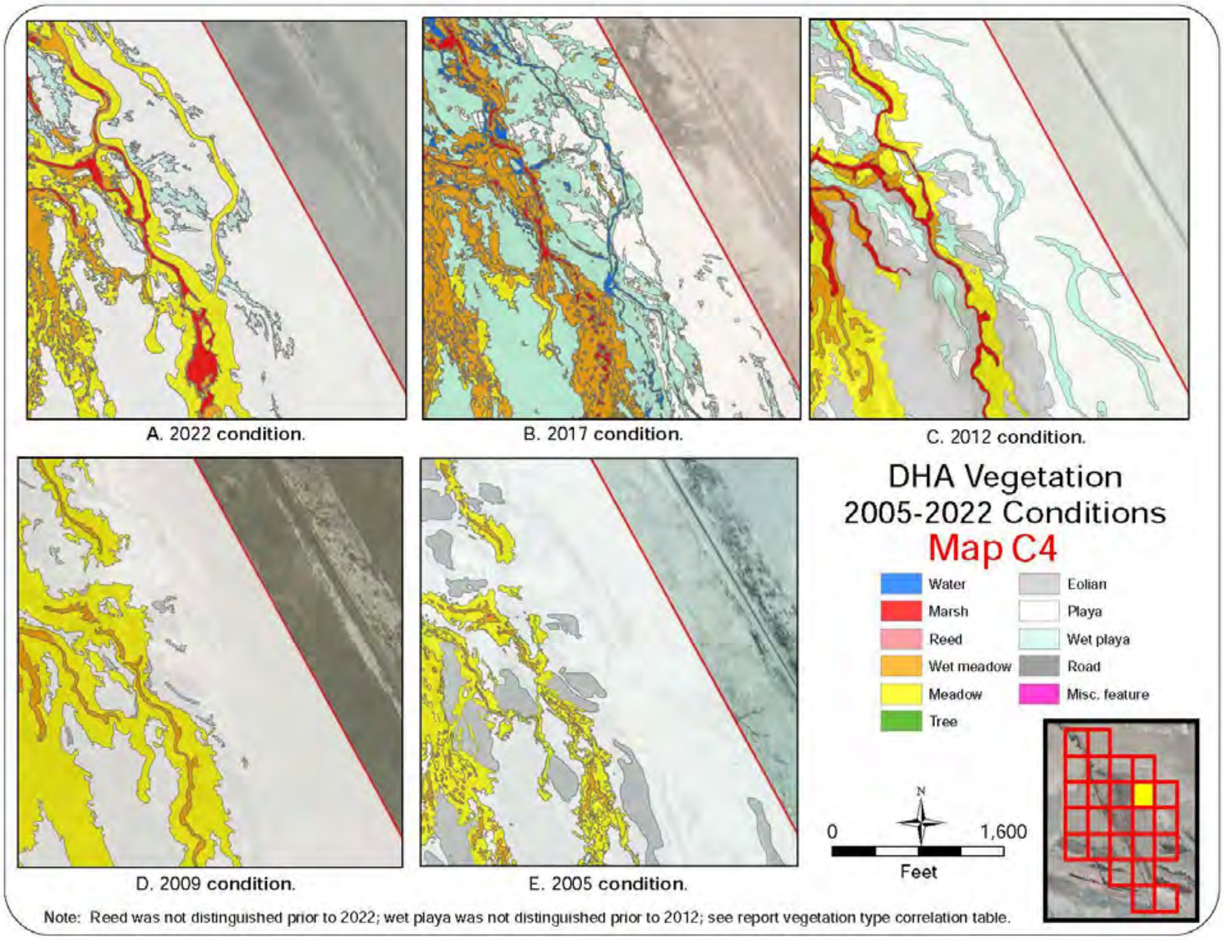

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map B3
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

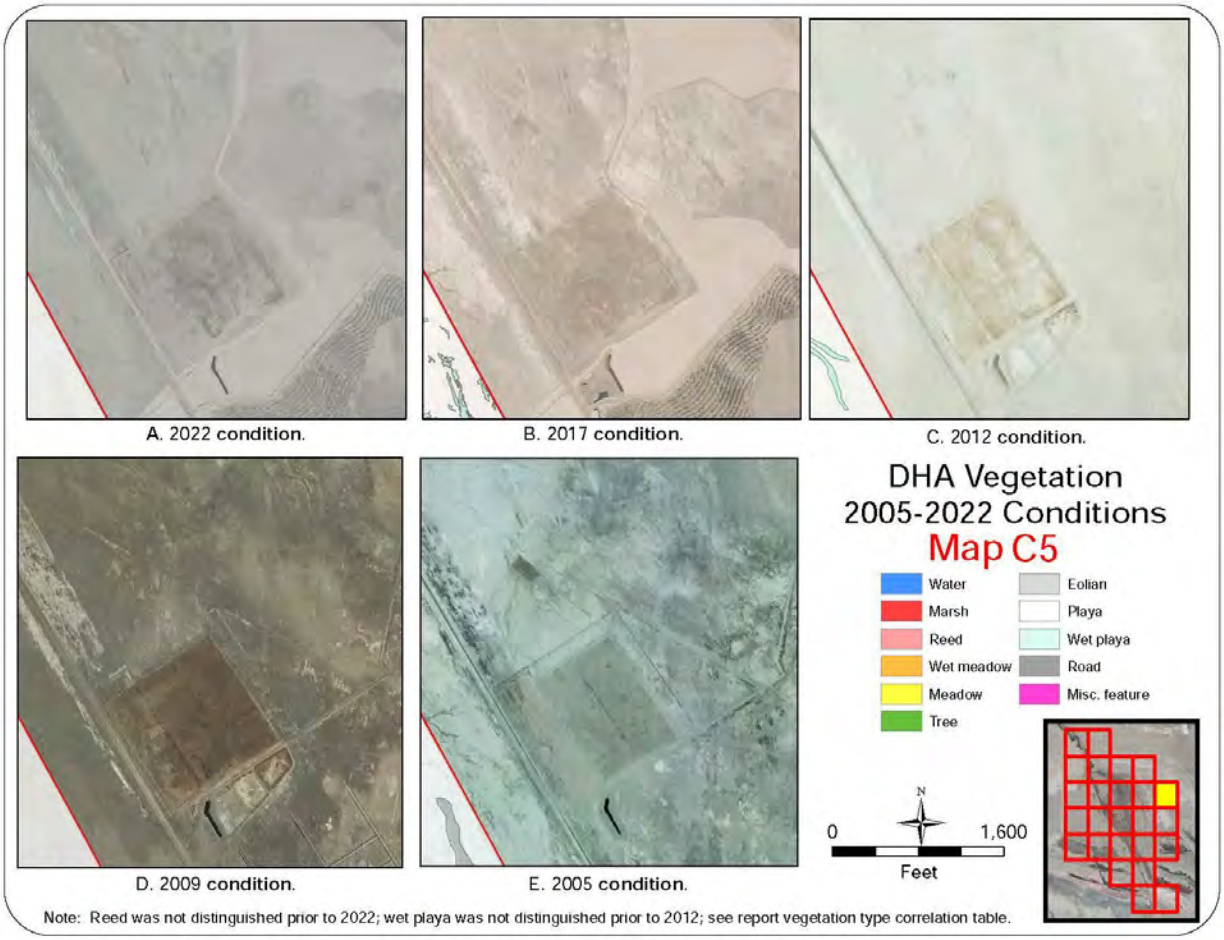

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map B4
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

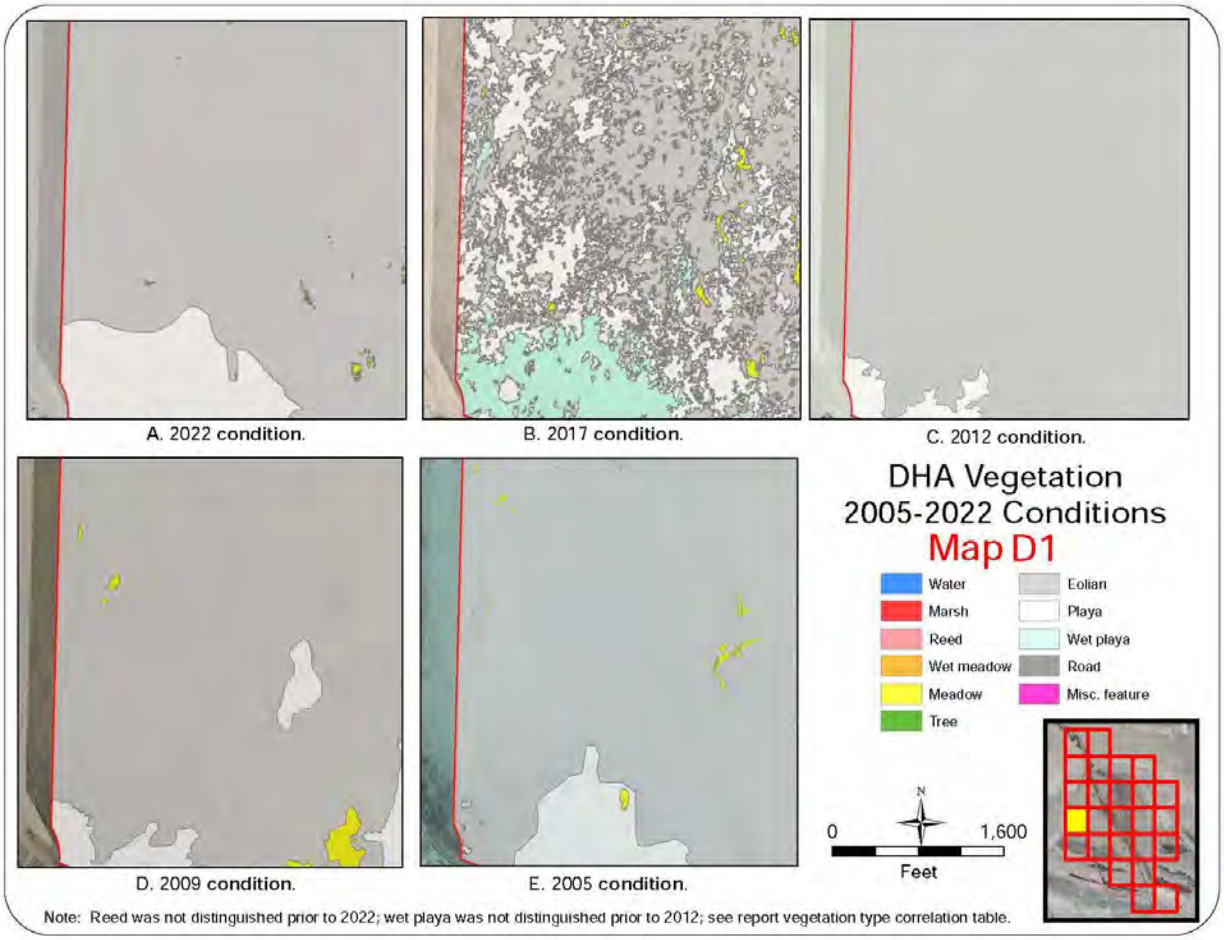

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map C1
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

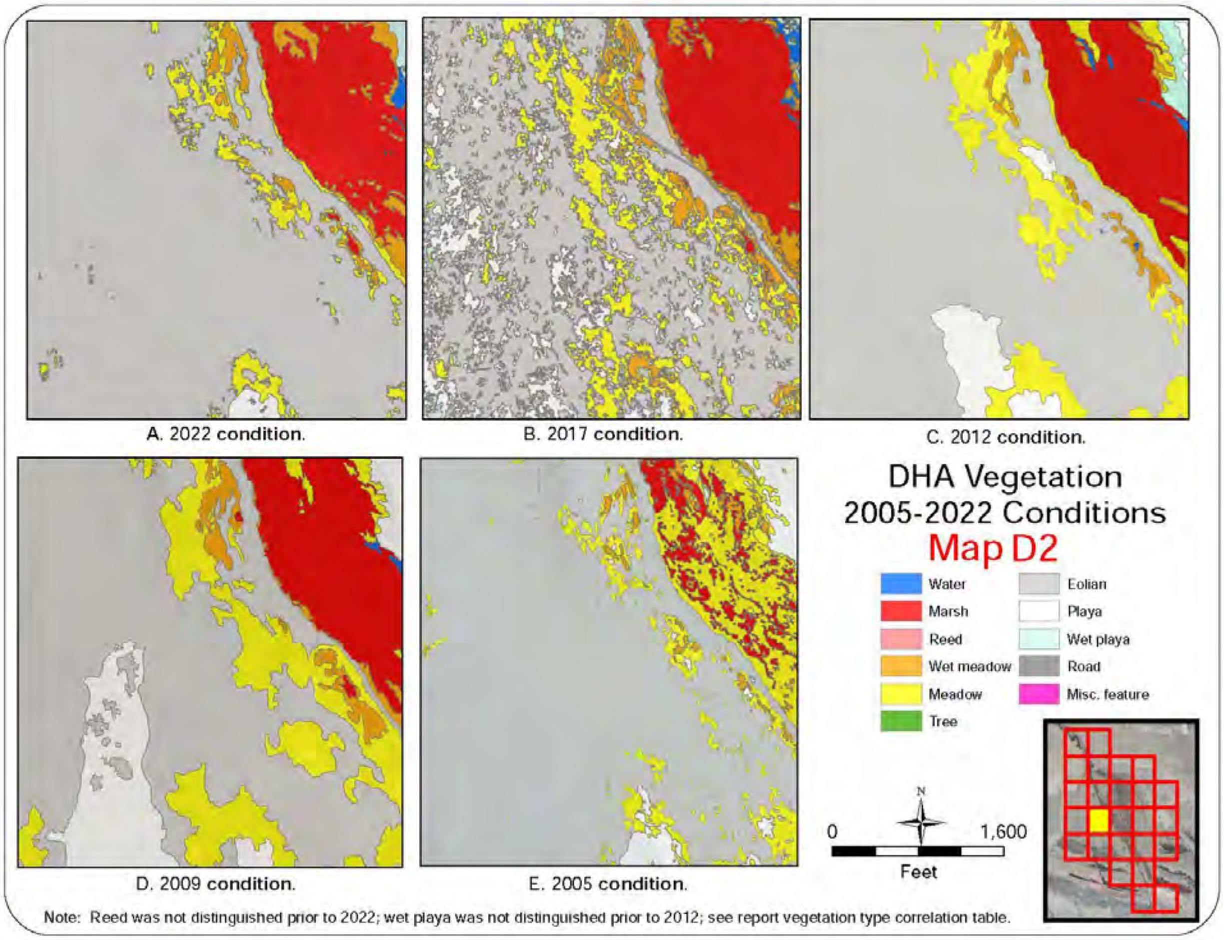

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map C2
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

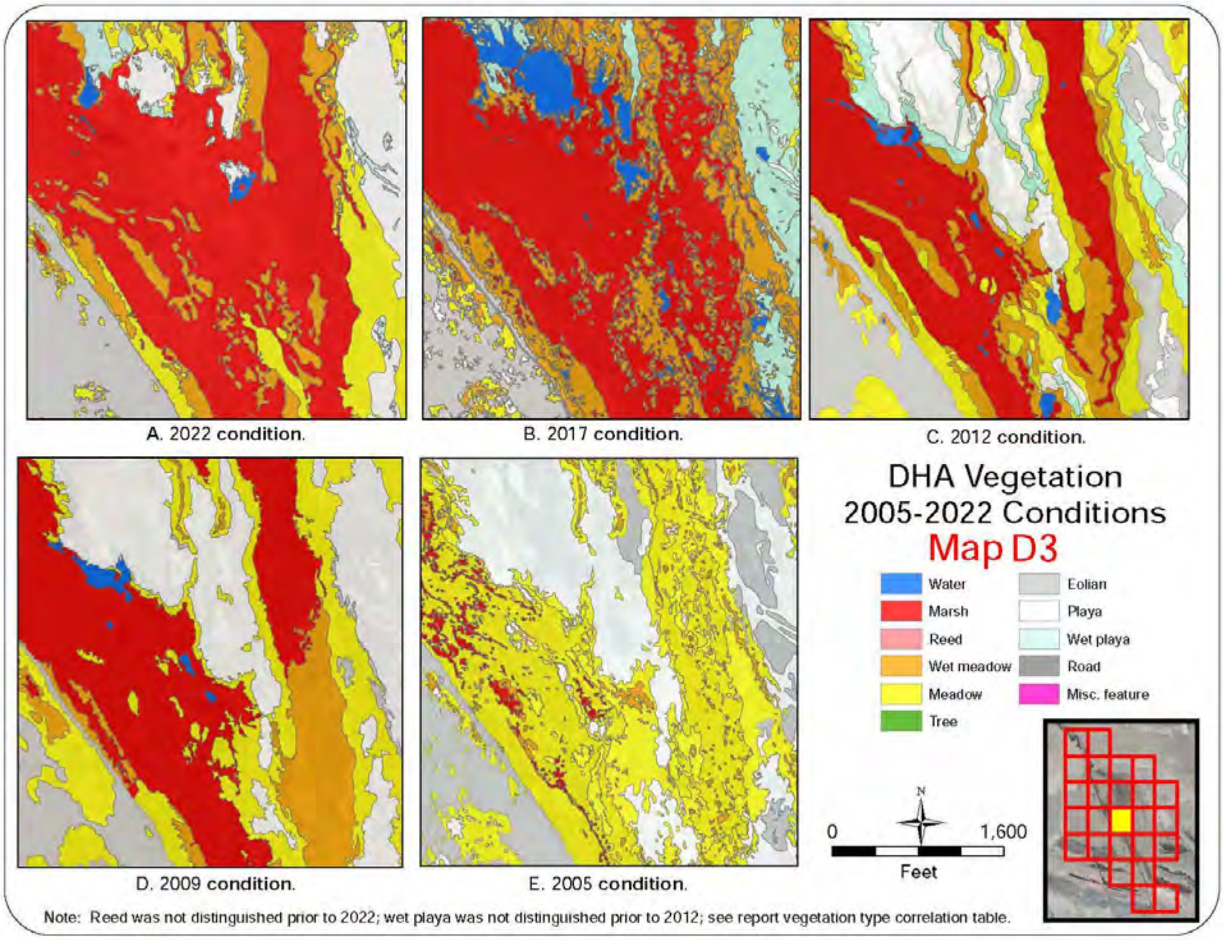

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map C3
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

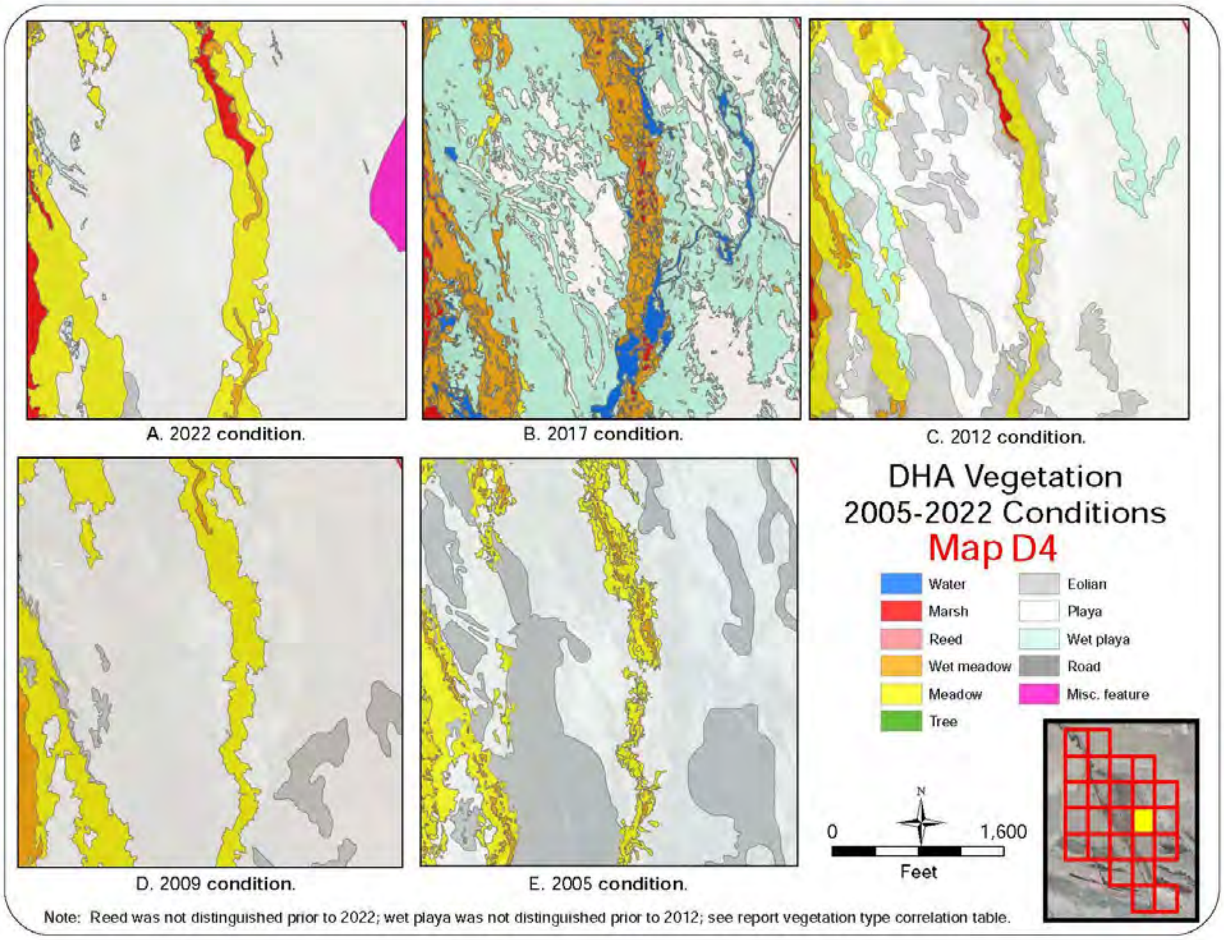

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map C4
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

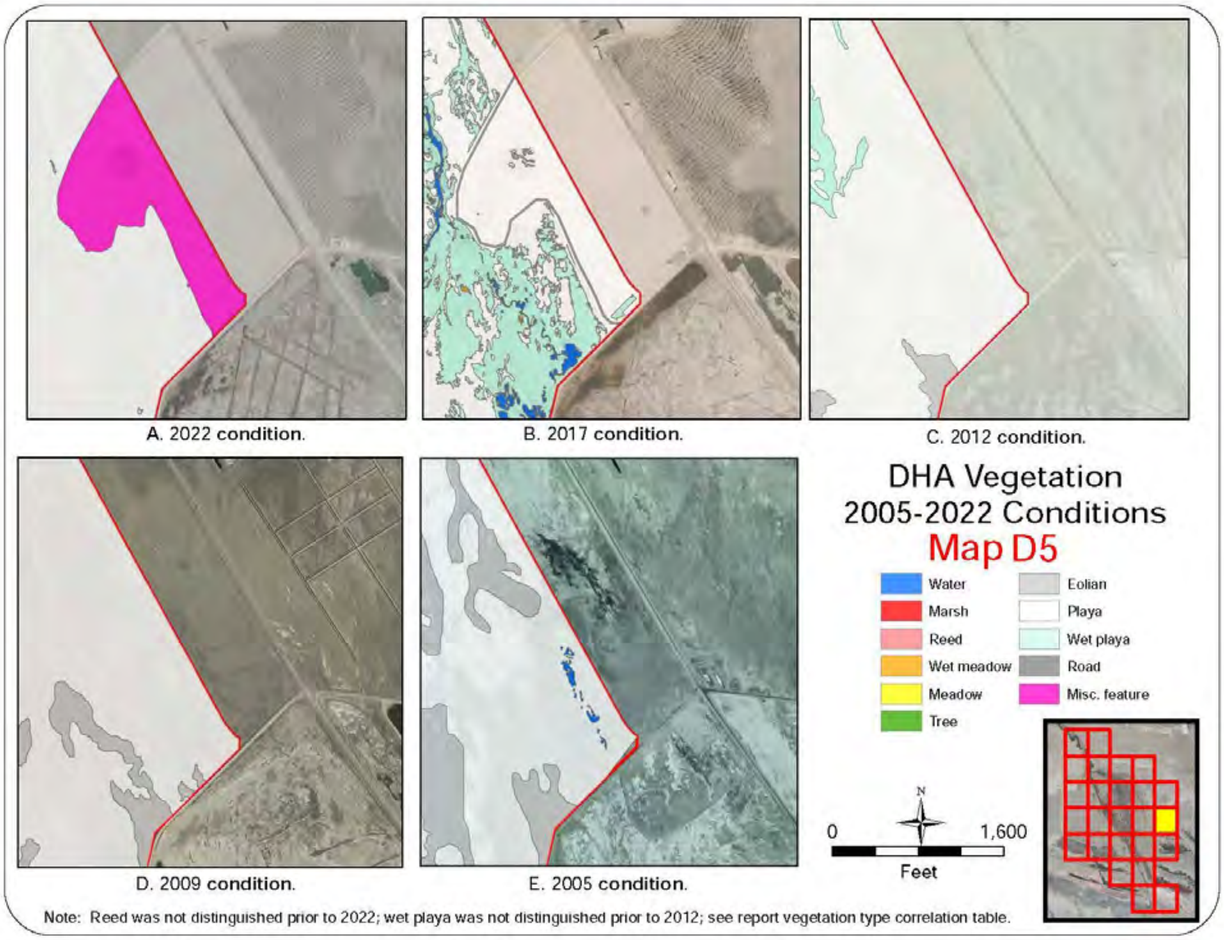

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map C5
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

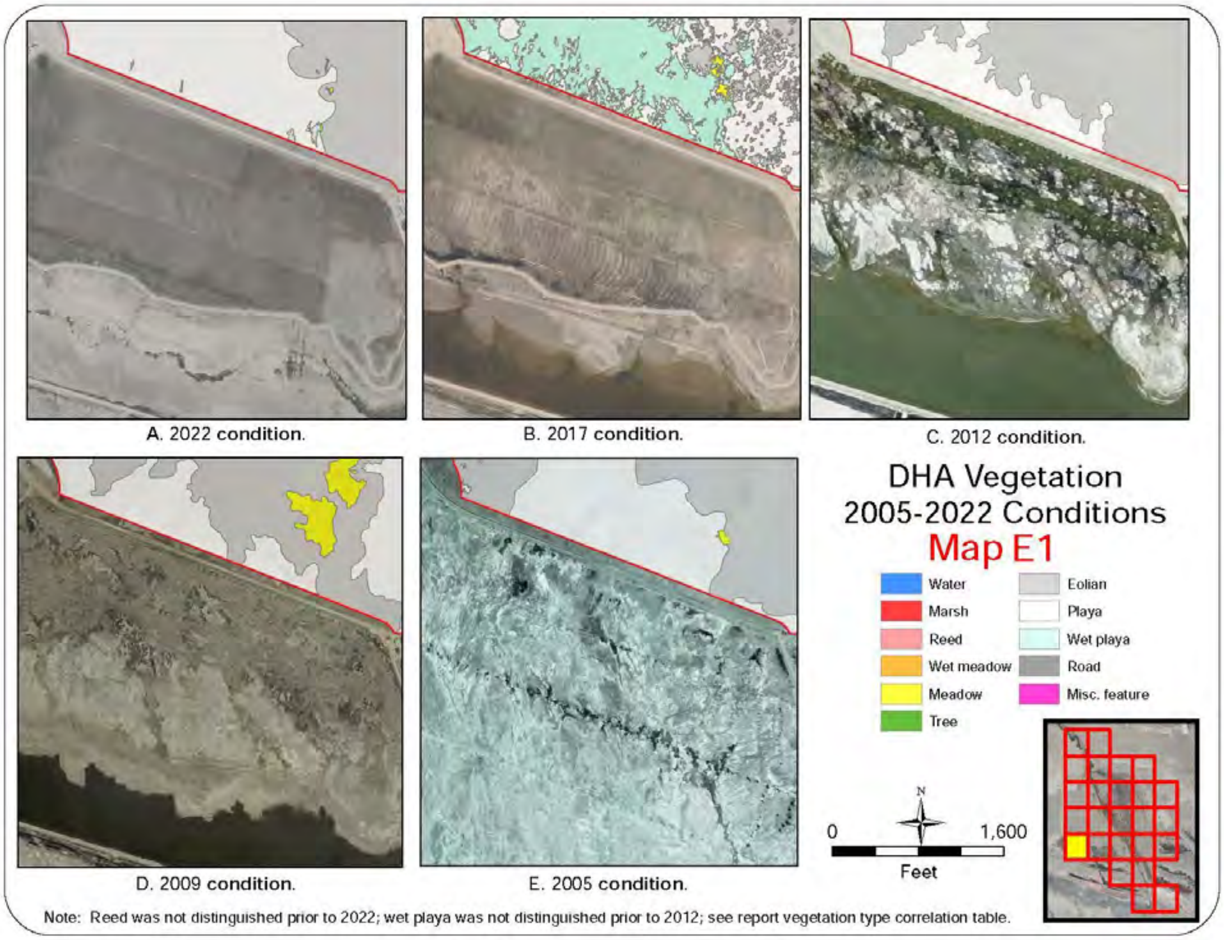

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map D1
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

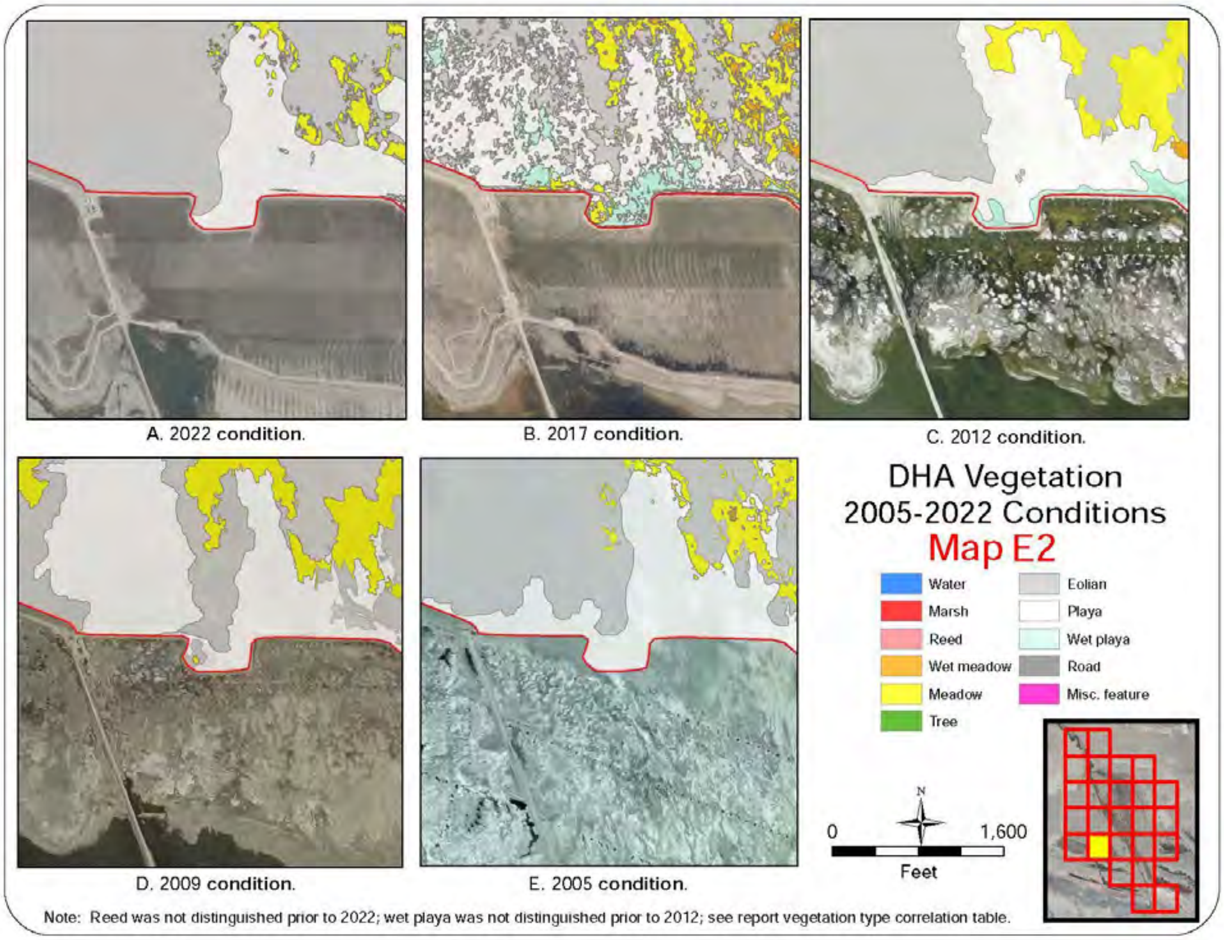

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map D2
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

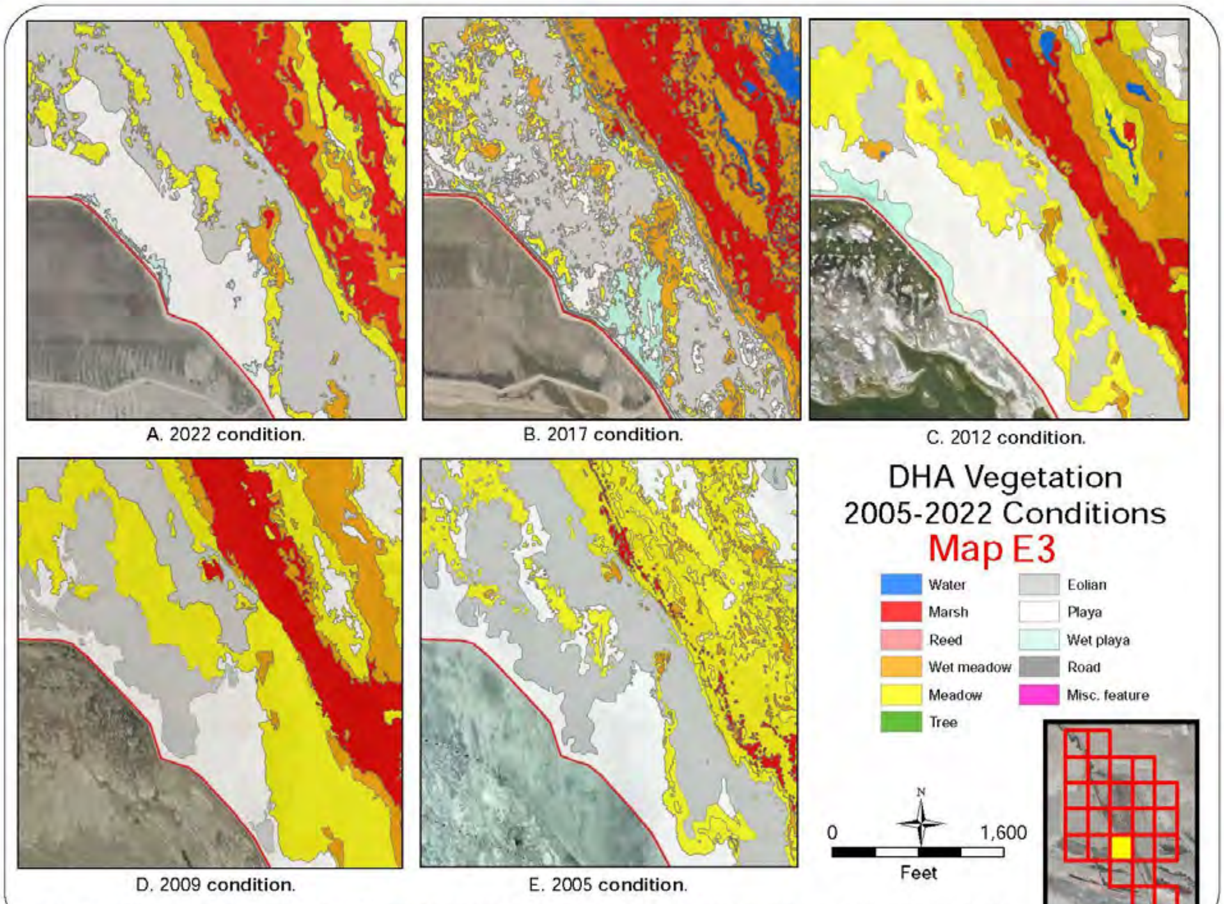

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map D3
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.


A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map D4
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

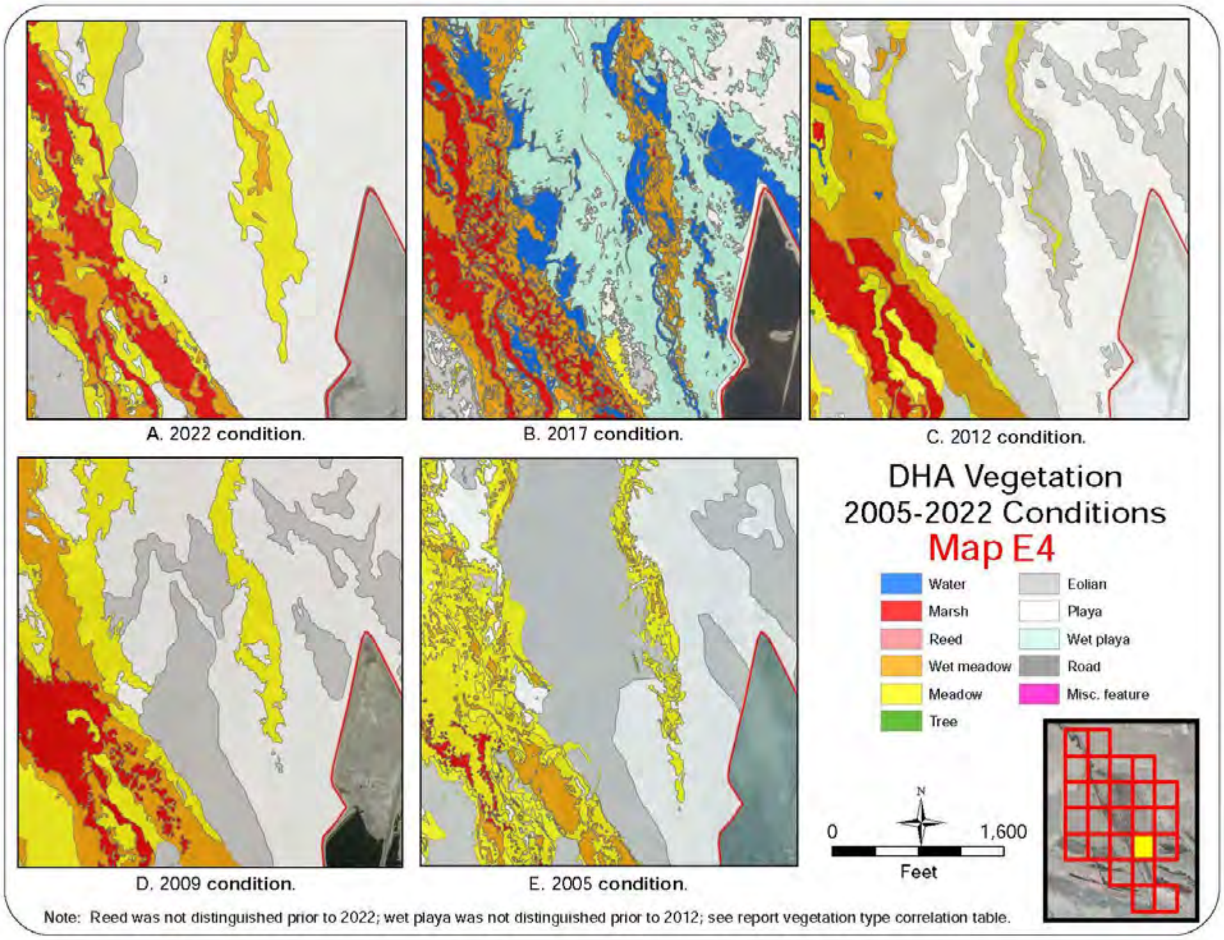

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map D5
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

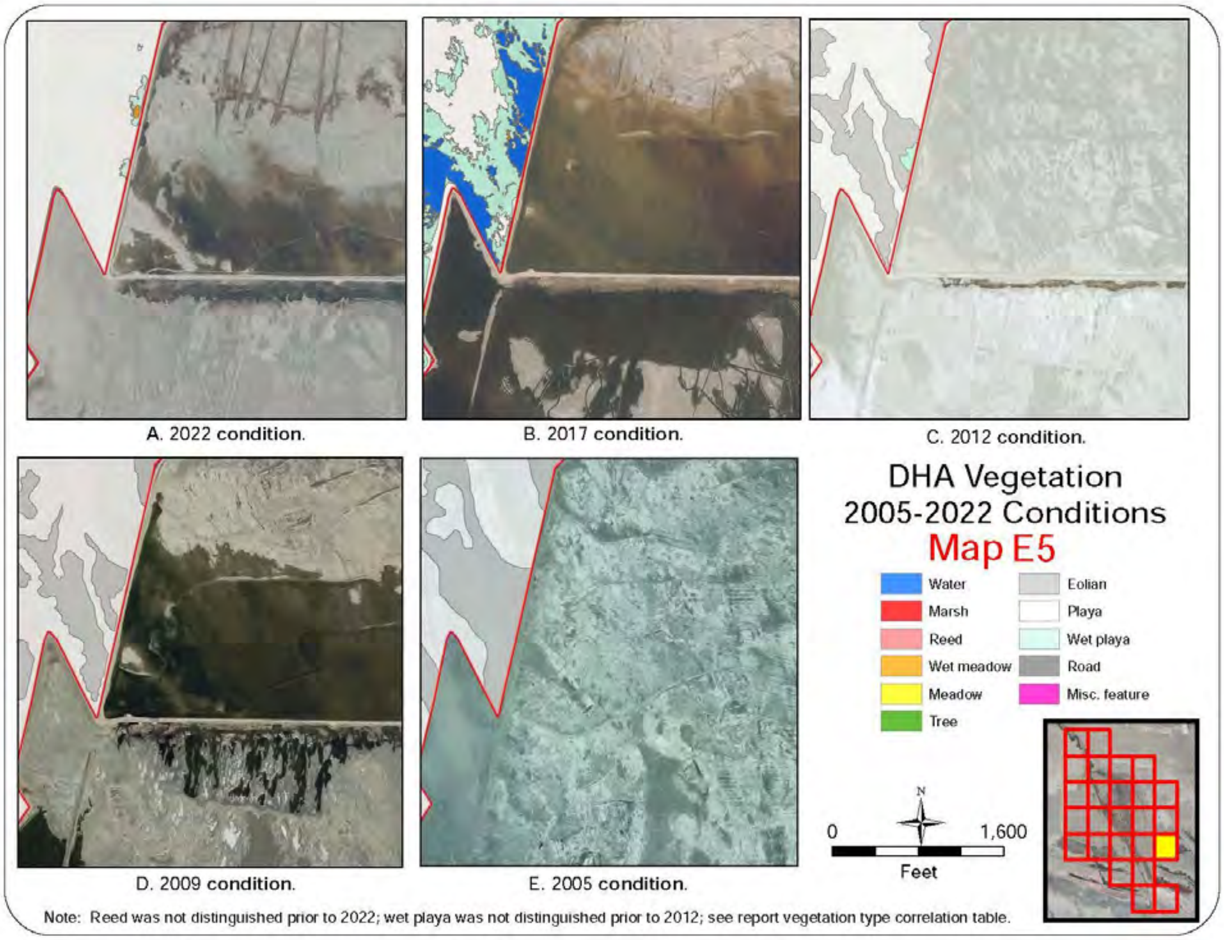

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map E1
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

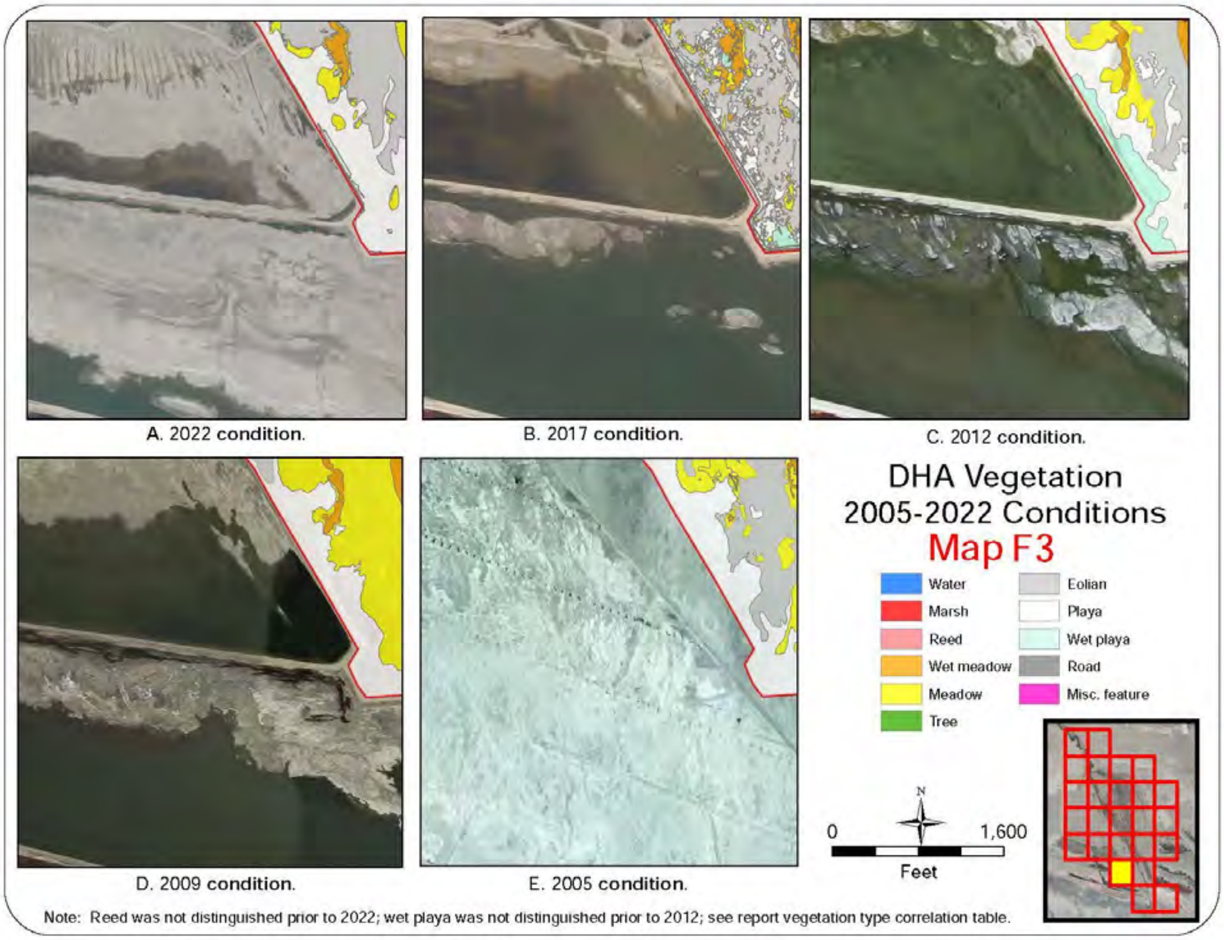

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map E2
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

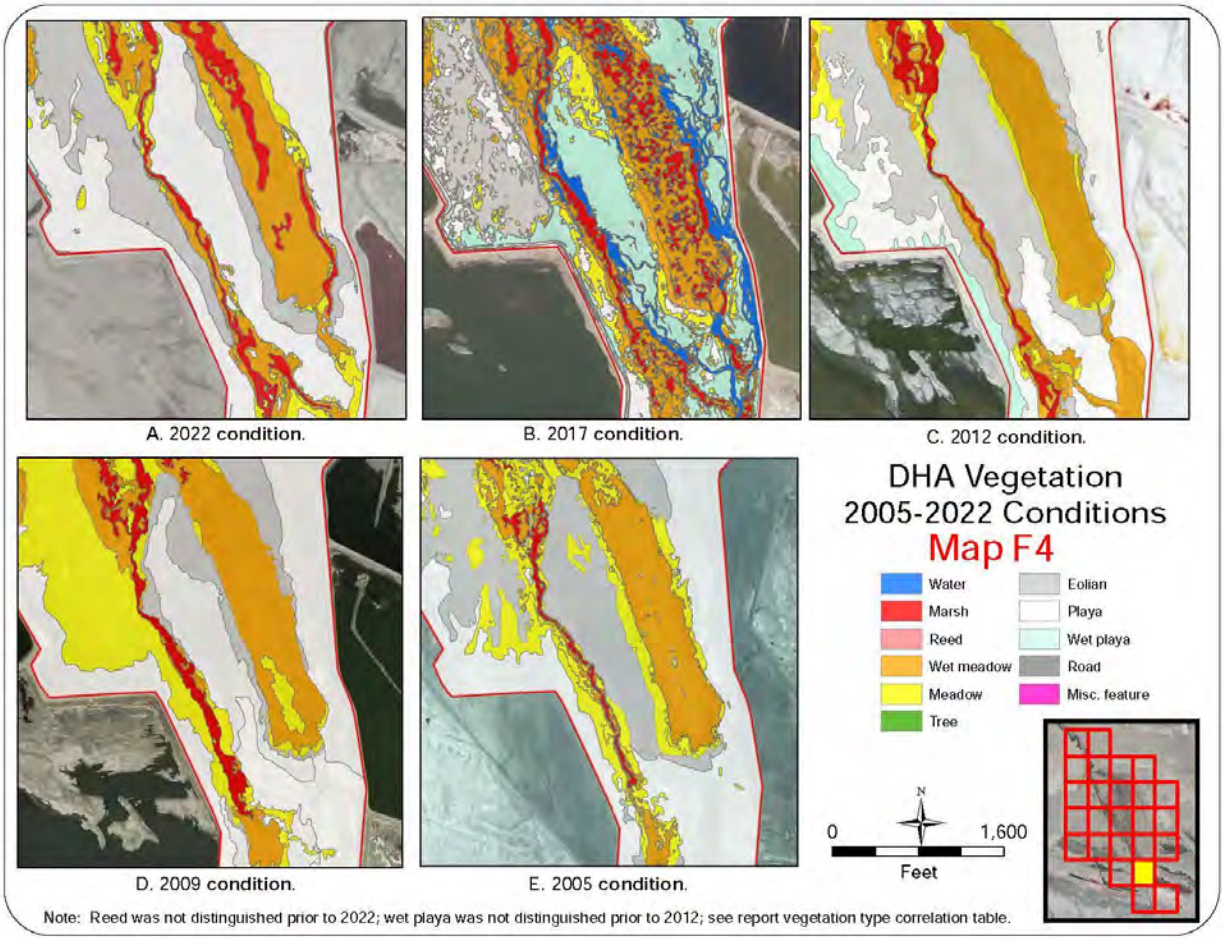


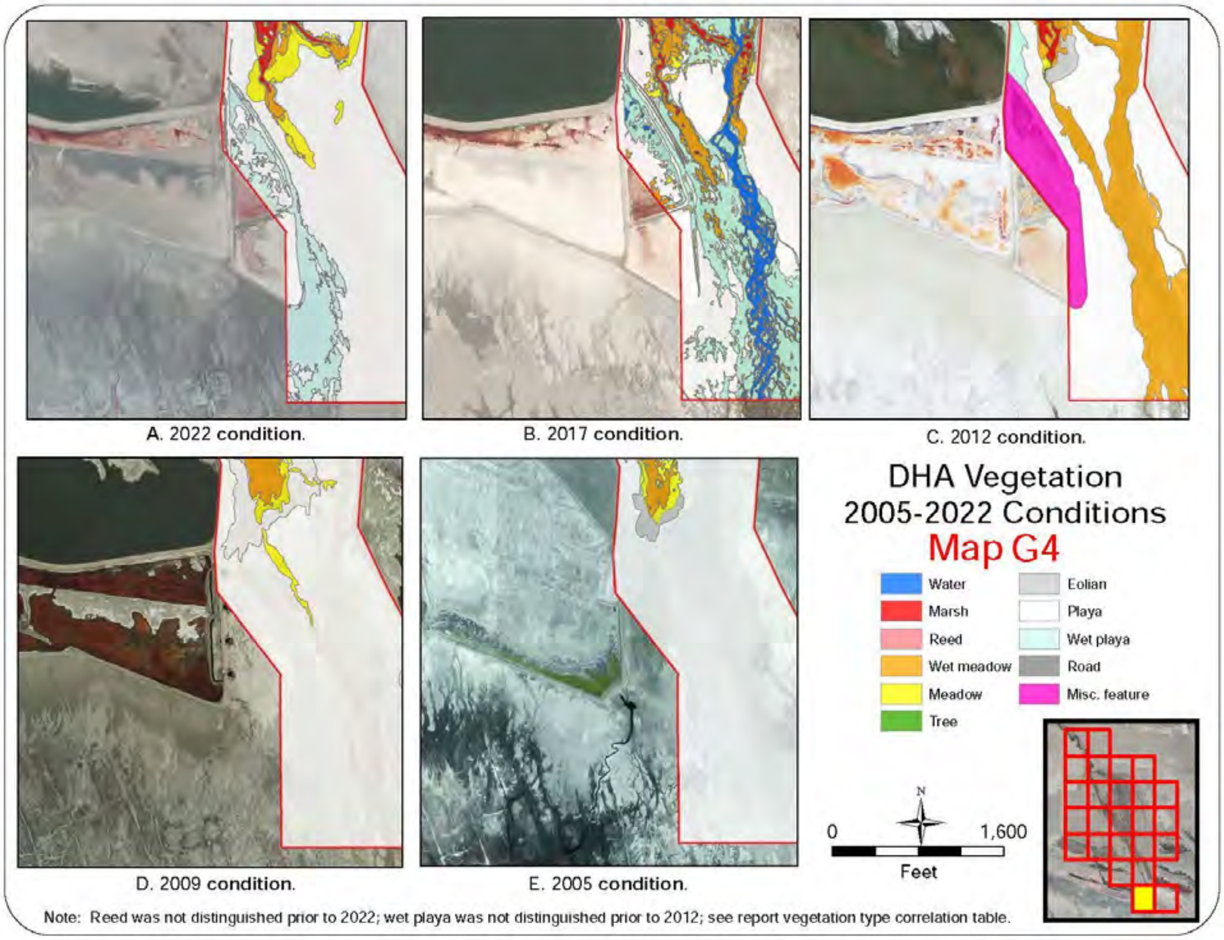
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

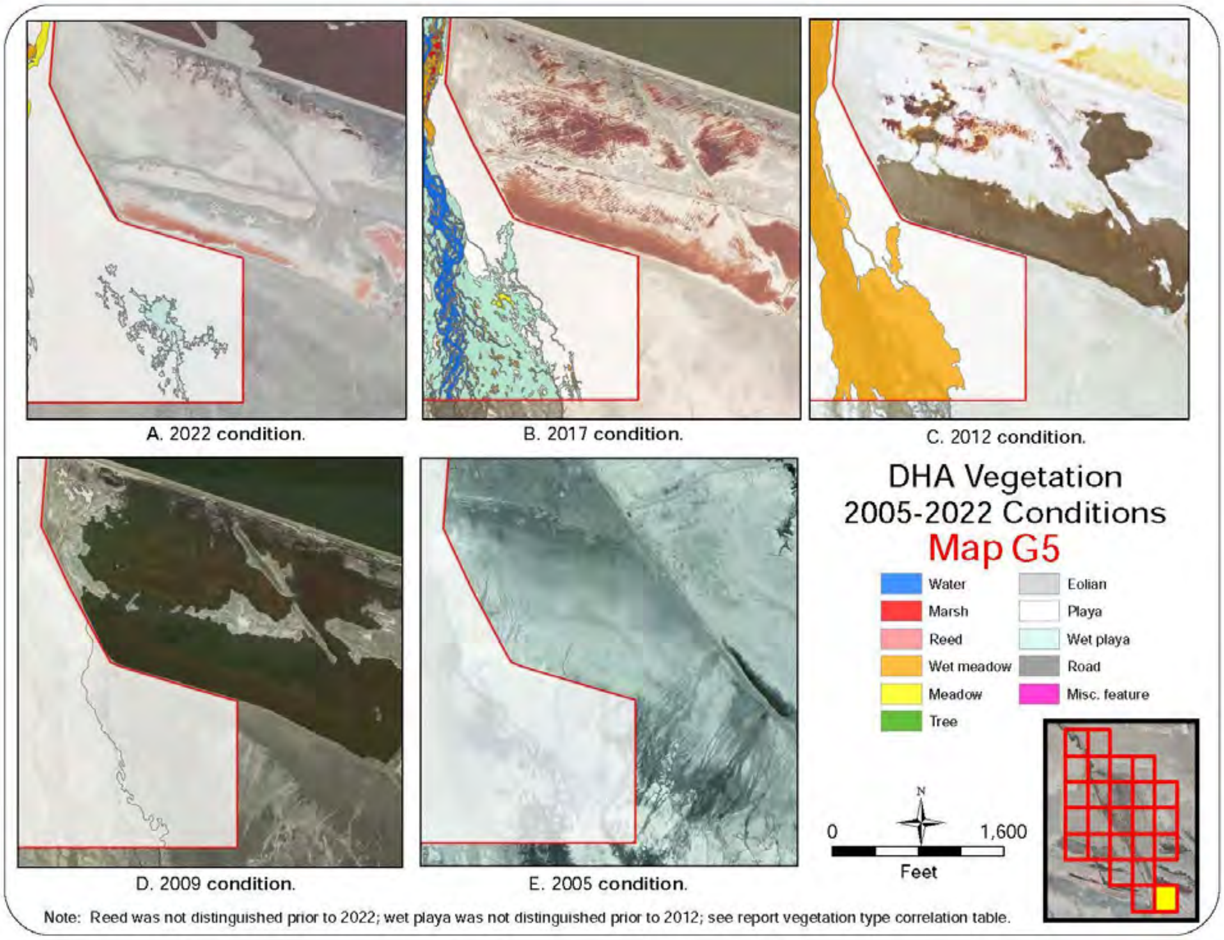

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map E4
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.


A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map E5
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.


A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map F3
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
D. 2009 condition.
E. 2005 condition.
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

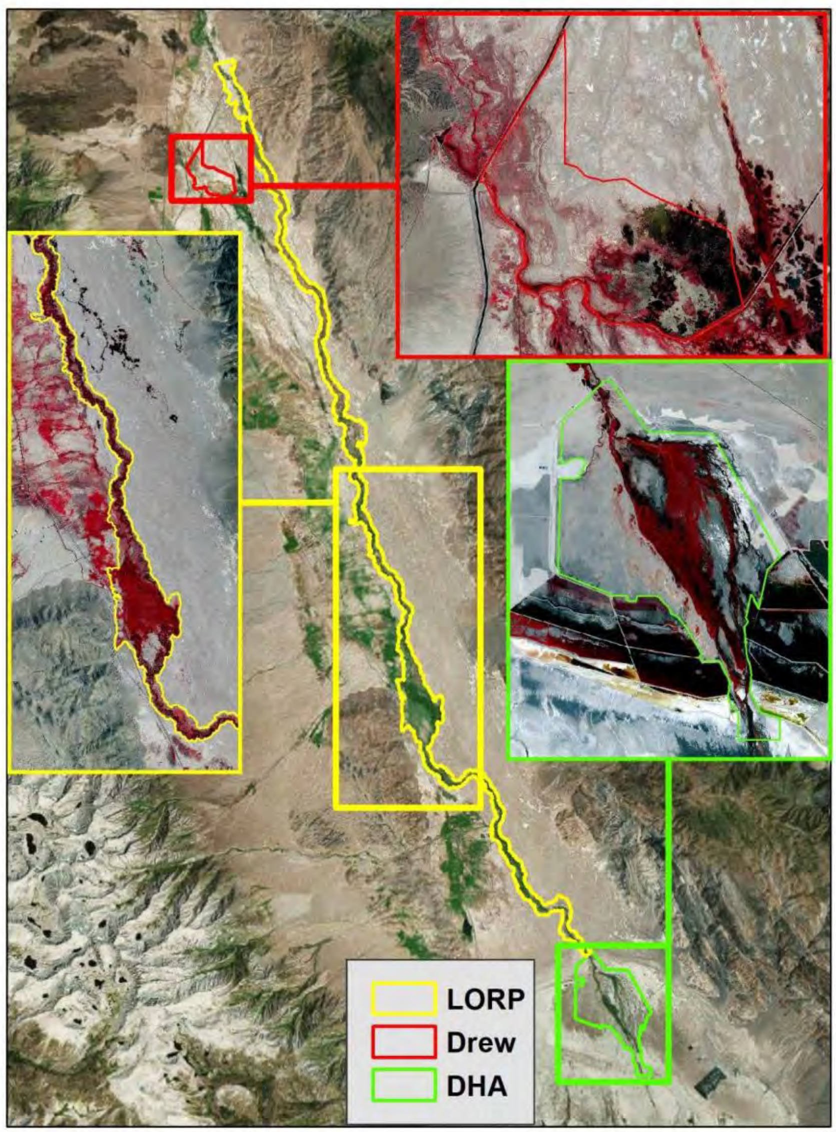

A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
DHA Vegetation
2005-2022 Conditions
Map F4
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
D. 2009 condition.
E. 2005 condition.
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.


A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map G4
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.


A. 2022 condition.
B. 2017 condition.
C. 2012 condition.
D. 2009 condition.
E. 2005 condition.
DHA Vegetation
2005-2022 Conditions
Map G5
Water
Marsh
Reed
Wet meadow
Meadow
Tree
Eolian
Playa
Wet playa
Road
Misc. feature
N
0
1,600
Feet
Note: Reed was not distinguished prior to 2022; wet playa was not distinguished prior to 2012; see report vegetation type correlation table.

3.4.7 Appendix H.

VEGETATION MAPPING
LORP, DHA, AND DREW SLOUGH
2017 CONDITIONS



Revised February 2023

PREFACE

Errors were discovered in areas of vegetation types reported in the 2018 report. The errors did not arise from the mapping, but rather from the correction for the 50-meter buffer on the LORP project area. In previous years the entire buffer (1,901 acres) was "scrub" that was subtracted from the area of scrub in the LORP project area. Extremely wet conditions in 2017 resulted in extensive water spilling into the buffer; assuming the entire buffer was "scrub" resulted in reporting more water than was present in the LORP project area. Corrected and reported areas (acres) are listed below.

Veg Type	Corrected	Reported
	(acres)	
Water	488	510
Streambar	3	3
Marsh	1433	1433
Reed	51	51
Wet meadow	1049	1071
Meadow	580	619
Scrub/meadow	1319	1433
Riparian shrub	27	33
Tree	188	190
Scrub	1080	876
Road	31	31
Misc feature	1	1
TOTAL	**6252**	**6252**

Tables 2-1, 2-3, and 2-4 and text referring to the area of vegetation types were corrected in this revised report.

EXECUTIVE SUMMARY

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

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

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

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

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

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

TABLE OF CONTENTS

1.0 INTRODUCTION

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

2.0 LORP VEGETATION MAPPING

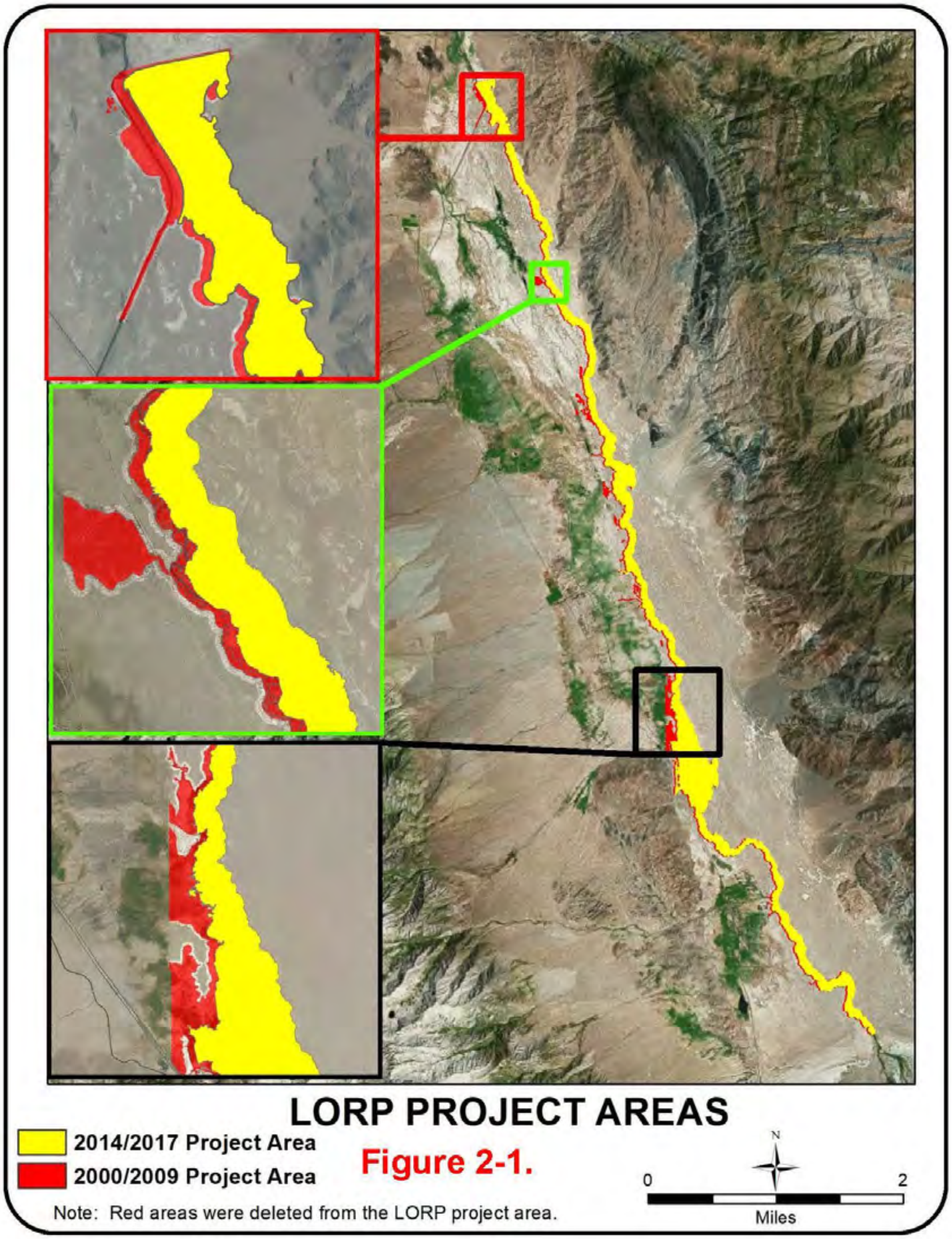
The overall goal of the LORP, as stated in the 1997 MOU, is:

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

The LORP project area was first defined for 2000 conditions based on the area anticipated to be affected by implementation of the project. This initial project area for 2000 conditions was 6,555 acres and included superfluous areas along the west side of the corridor that were functionally unrelated to the LORP (Figure 2-1). The project area for 2009 conditions was increased to 6,570 acres to accommodate expansion of the river corridor in a few areas while including the same superfluous areas, as for 2000 conditions. The project area for 2014 conditions was again expanded to accommodate a slightly wider river corridor in a few areas, but superfluous areas were clipped and eliminated from further consideration. The project area for 2017 and 2014 conditions was reduced to 6,252 acres and was used to clip vegetation mapping for 2000 and 2009 conditions to facilitate valid comparisons of mapping.

Differences in 2000, 2009, 2014, and 2017 LORP conditions are attributed to hydrologic changes associated with rewatering the Owens River, fires, and improvements in the accuracy and precision of mapping. Hydrologic changes are summarized in terms of states. Several major fires have affected large portions of the LORP project area since 2008 (Figure 2-2). Prescribed burns in 2008, 2010, and 2012 converted scrub/meadow to more productive meadow and invigorated herbaceous vegetation. A 400 acre wildfire centered on the Owens River corridor east of Lone Pine reduced the stature and killed some trees in 2013. The 1,000 acre Moffat fire burned the Island and 3 miles of the Owens River corridor in 2018, subsequent to the 2017 inventory.

Vegetation Mapping, 2017 Conditions



1

LORP Fires Since 2008

Figure 2-2

Vegetation Mapping, 2017 Conditions

LORP 2000 conditions were delineated on 1:6,000 scale plots of high-resolution (2 foot pixels) imagery, and then digitized. The 2000 mapping was refined using heads-up editing at scales greater than 1:1,000 resulting in 3,968 parcels. LORP 2009 conditions were mapped using a supervised spectral classification of high-resolution (1 foot pixels) imagery, then refined through a significant field effort of more than 200 person-days, resulting in 6,981 parcels. The 2014 conditions (16,601 parcels) were mapped using an unsupervised spectral classification, heads-up editing, and a less significant field effort of about 15 person-days. The 2017 conditions were again mapped using an unsupervised spectral classification, LiDAR analyses, more limited heads-up editing, and a minimal field effort of about 5 person-days resulting in about 46,000 parcels. The accuracy and precision of mapping have improved with each successive application.

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

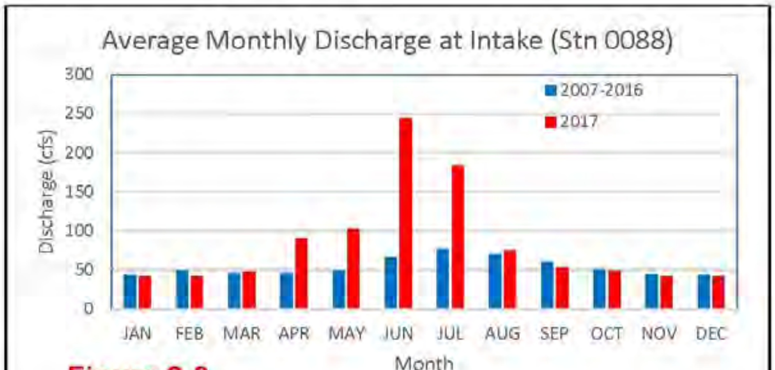


Figure 2-3

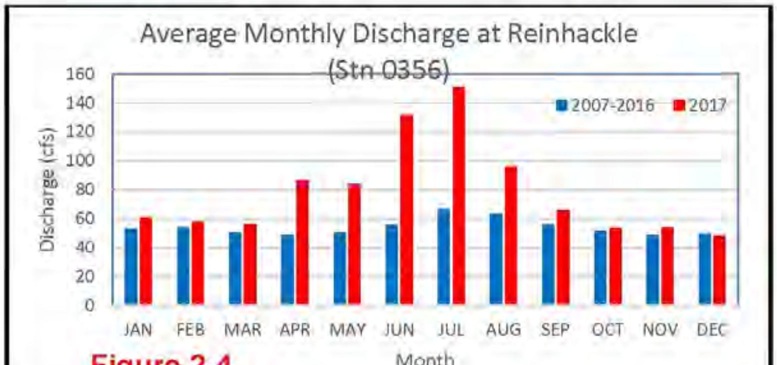


Figure 2-4

3

2.1 LORP Approach

The 2017 vegetation mapping is based on a 4 band, high-resolution image captured from aircraft July 27-28 and August 1-2, 2017. Many TIFF image tiles were mosaicked, and then clipped to the LORP project area boundary with a 50 m buffer to accommodate potential expansion. The clipped image is comprised of 1 foot pixels, each assigned a 16 bit (5 digit) integer for each of 4 color bands. The image can be viewed as either color infrared (CIR) or natural color (Figure 2-5). This full resolution image can be viewed at scales greater than 1:1,000 and served as the basis for both successive spectral classifications and "heads up" editing.

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

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

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

Vegetation Mapping, 2017 Conditions

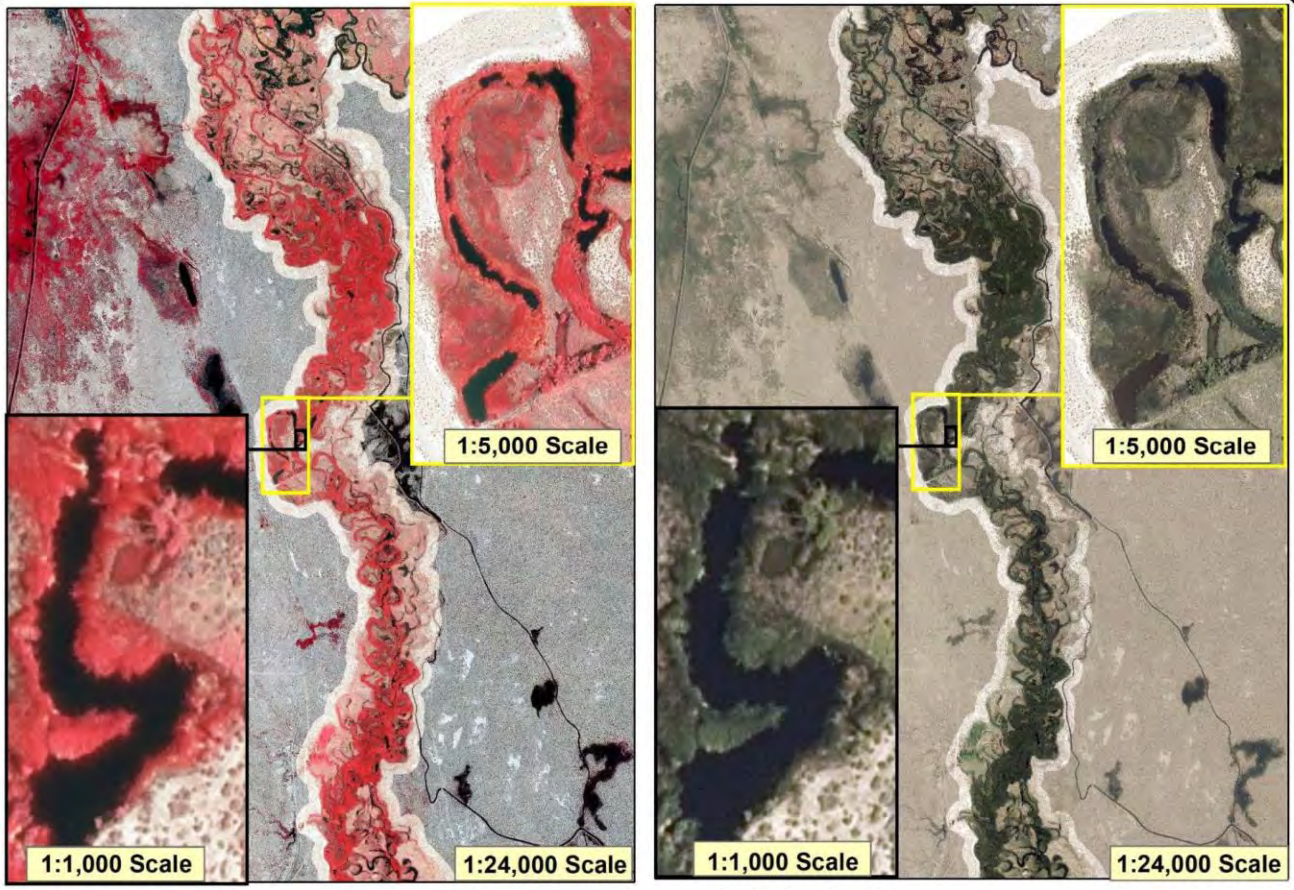


Figure 2-5 **2017 Imagery**

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

2.2 LORP Results

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

The influence of LORP on the distribution of vegetation types generally corresponds with changes in hydrology and channel morphology associated with states (Figure 2-6). Four states were identified for 2000 conditions:

> **Incised, dry channel:** A deep, dry channel bordered by high terrace with upland vegetation. Alluvial water table is well below the rooting depth of vegetation. Hydric vegetation is mostly absent. This state made up 16.1 miles of the LORP in 2000.
>
> **Incised, wet, confined floodplain:** A deep, wetted channel bordered by high and low terraces. Hydric vegetation is confined to the incised channel. Alluvial water table is mostly below the rooting depth of vegetation on adjacent terraces with upland vegetation. Three reaches totaled 23.7 miles of the LORP in 2000.
>
> **Graded, wet, unconfined floodplain:** A wetted channel bordered by floodplain and low terrace. Marsh fills the active channel. Alluvial groundwater is within the rooting depth of hydric vegetation on the floodplain. One reach comprised 12 miles of the LORP in 2000.
>
> **Aggraded, wet, unconfined floodplain:** Saturated conditions extend across a broad floodplain and a channel may not be evident. Alluvial groundwater is at or near the surface. One reach (Island) comprised 4.0 miles of the LORP in 2000.

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

Table 2-2. Changes in state.

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

Table 2-1. Map unit correlation.

2017 Conditions		2014 Conditions		2009 Conditions		2000 Conditions	
Name	Acres	Name	Acres	Name	Acres	Name	Acres
Water	488	Water	154	Water	251	Water	100
Streambar	3	Streambar	23	Streambar	8	Streambar	23
Marsh	1433	Marsh	1310	Marsh	1090	Marsh	765
Reed	51	Reedgrass	51	Reedgrass	24	Reedgrass	25
Wet meadow	1049	Wet meadow	653	Wet Alkali Meadow	57	Wet Alkali Meadow	210
		Irrigated meadow	3	Irrigated Meadow	3	Irrigated meadow	4
Riparian shrub	27	Riparian shrub	32	Riparian Shrub (willow)	20	Riparian Shrub (willow)	20
		Tamarisk	1	Tamarisk	12	Tamarisk	249
Tree	188	Riparian forest (cottonwood)	3	Riparian Forest (cottonwood)	5	Riparian Forest (cottonwood)	5
		Riparian forest (tree willow)	162	Riparian Forest (tree willow)	260	Riparian Forest (tree willow)	444
Meadow	580	Alkali meadow	513	Dry Alkali Meadow	1034	Dry Alkali Meadow	889
Scrub/meadow	1319	Alkali scrub/meadow	1484	Rabbitbrush-NV saltbush scrub/meadow	1132	Rabbitbrush-NV saltbush scrub/meadow	1237
Scrub	1080	Alkali scrub	492	Rabbitbrush-NV saltbush scrub	1787	Rabbitbrush-NV saltbush scrub	1728
		Upland scrub	1191			Undifferentiated upland	39
Weed	0	Bassia (weeds)	118	Bassia	326	Barren	387
				Tamarisk / Slash	1		
				Barren	115		
Road	31	Road	6	---	---	---	---
		Road	37				
Misc feature	1	Miscellaneous feature	19	Structure	22	Structure	3
TOTAL	**6252**	**TOTAL**	**6252**	**TOTAL**	**6147**	**TOTAL**	**6128**

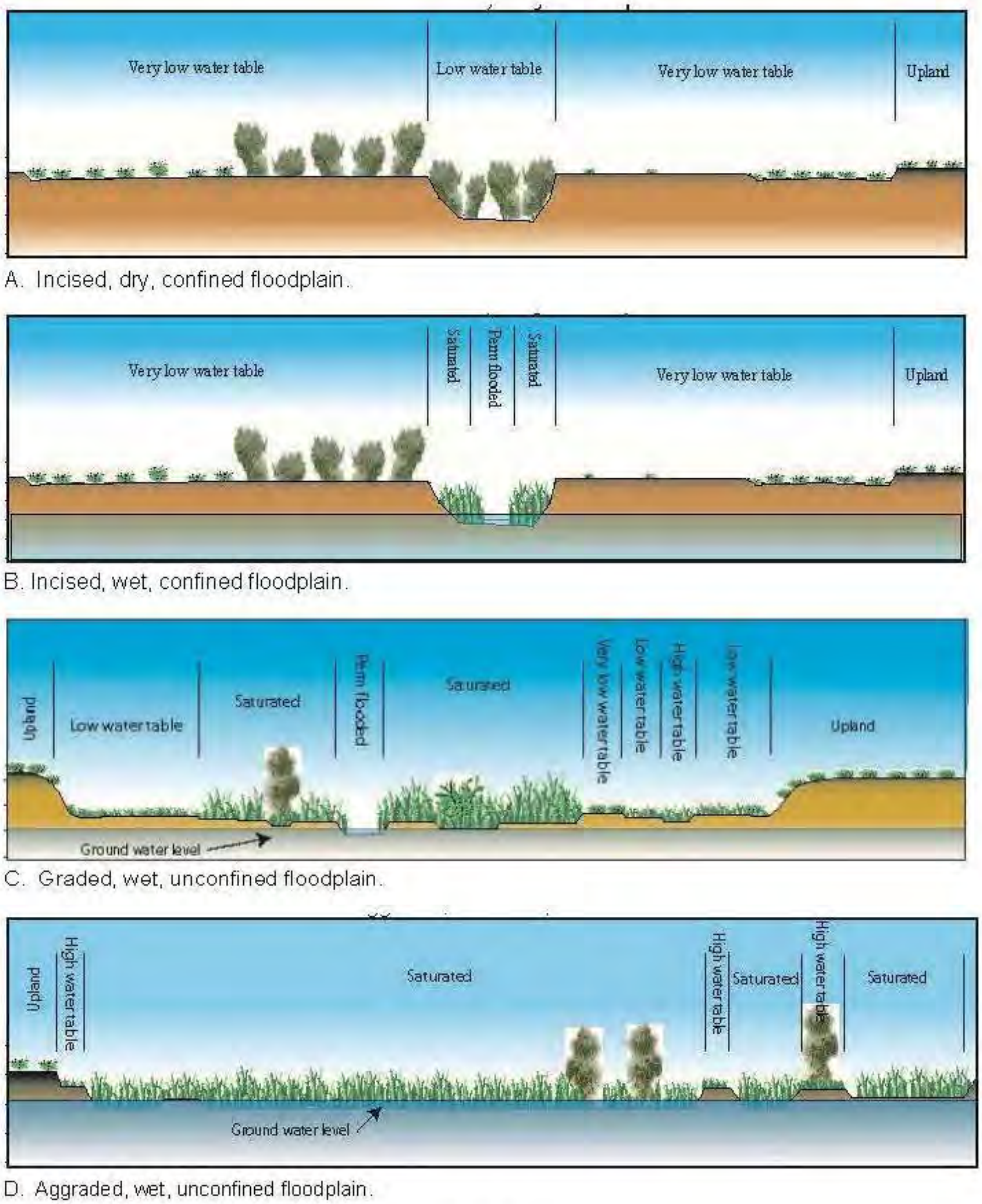


Figure 2-6 **States**

8

Vegetation Mapping, 2017 Conditions

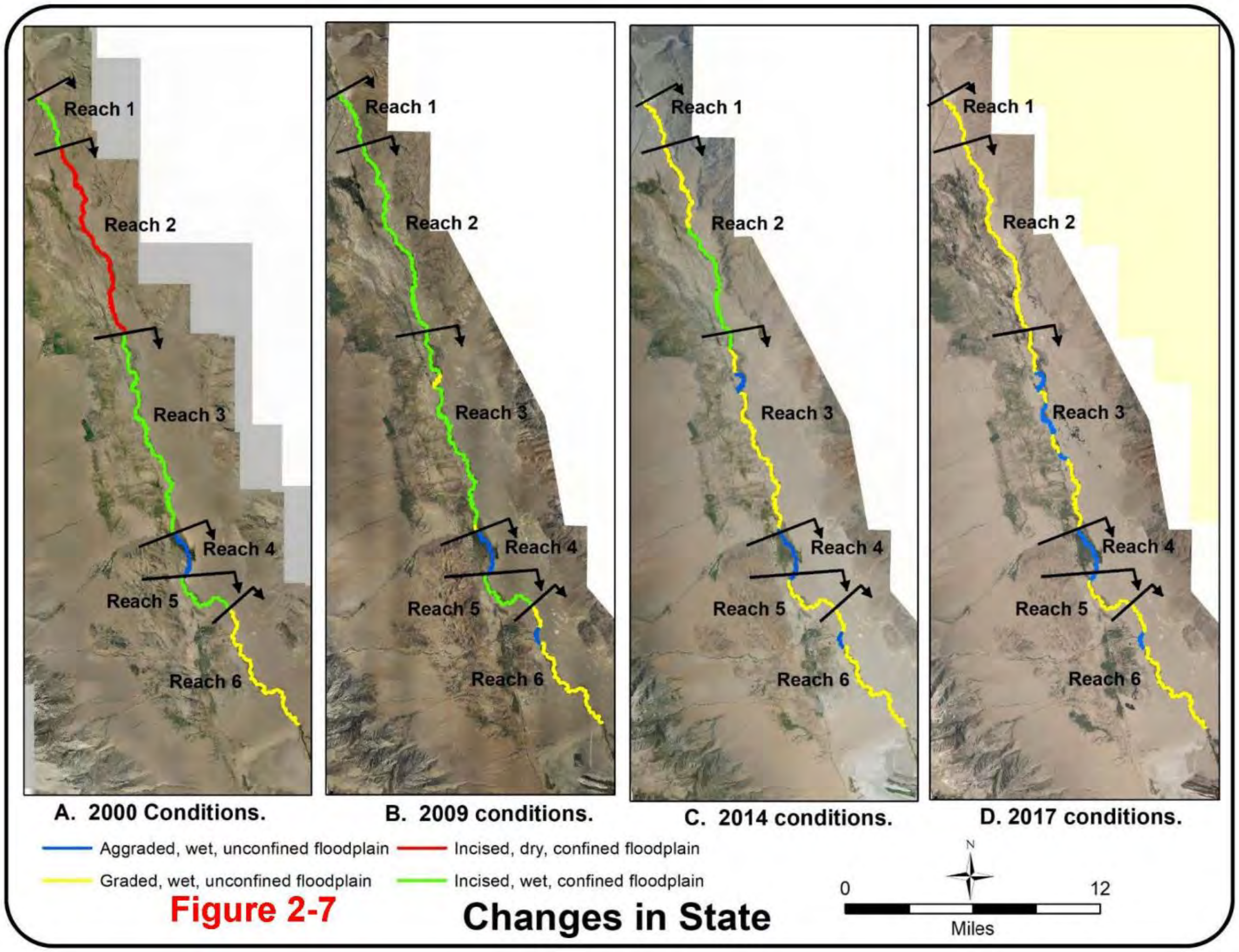


Figure 2-7 Changes in State

9

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

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

Conditions predicted from long-term (5-25 years) aggradation have been achieved in only 10 years. The LORP is aggrading faster than anticipated. The direction of changes toward more aggraded conditions is expected to continue for the foreseeable future.

Changes in state correspond with changes in the distributions of vegetation (Table 2-3 and Figure 2-8). Marsh is prominent in the aggraded state, comprising almost half of the river bottom. A more diverse assemblage of vegetation is present in the graded state, with marsh more restricted to the active river channel. The extent of hydric vegetation types (water, marsh, reed, wet meadow, riparian shrub, and riparian forest) increased 847 acres (14 percent) since 2014 and 1,642 acres (26 percent) since 2000 (Table 2-4). The extent of mesic vegetation (scrub/meadow and meadow) has remained relatively consistent since 2000. Arid vegetation (scrub) declined 721 acres (12 percent) since 2014 and 1,323 acres (22 percent) since 2000. Aggrading conditions throughout the LORP correspond with changes towards more hydric vegetation types.

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

Class	Aggraded		Graded	
	(acres)	(%)	(acres)	(%)
Water	124	6	364	8
Streambar	1	0	2	0
Marsh	904	47	529	12
Reed	13	1	38	1
Wet meadow	193	10	856	20
Meadow	227	12	353	8
Scrub/meadow	189	10	1130	26
Tree	69	4	119	3
Riparian shrub	13	1	14	0
Scrub	183	10	897	21
Road	1	0	30	1
Misc feature	0	0	1	0
TOTAL	**1917**	**100**	**4335**	**100**

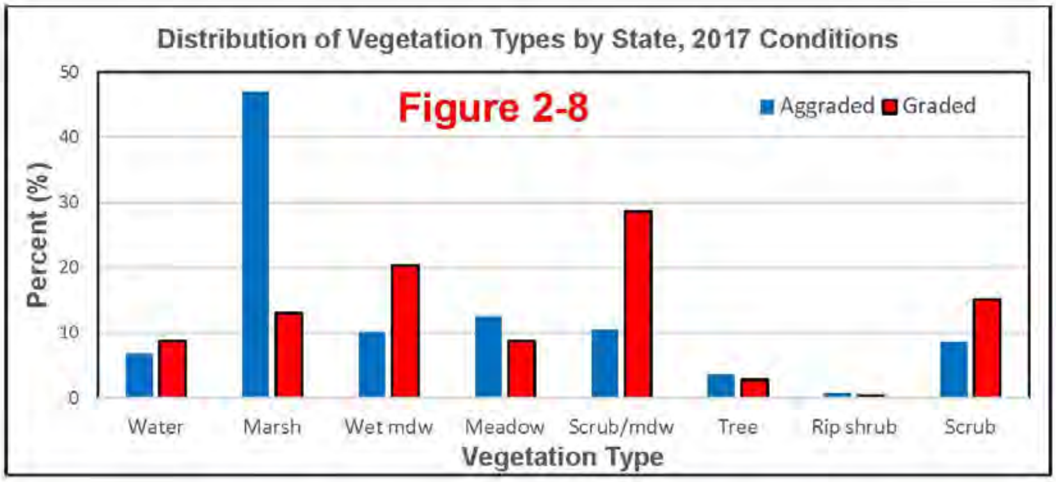
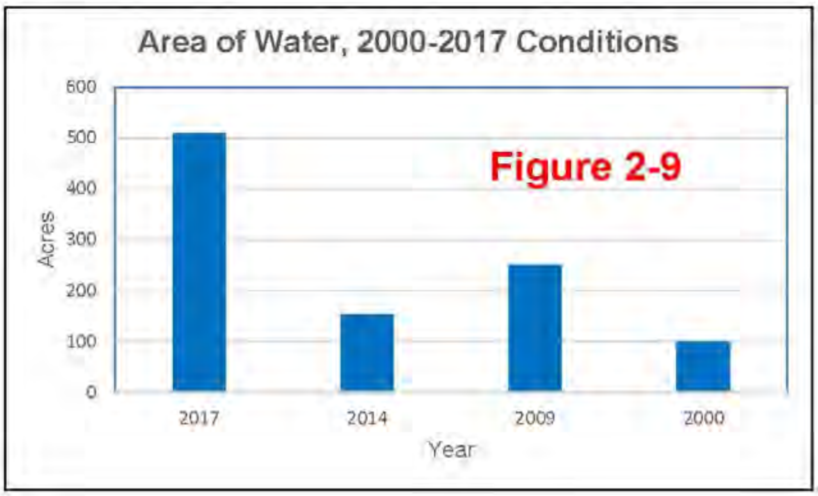


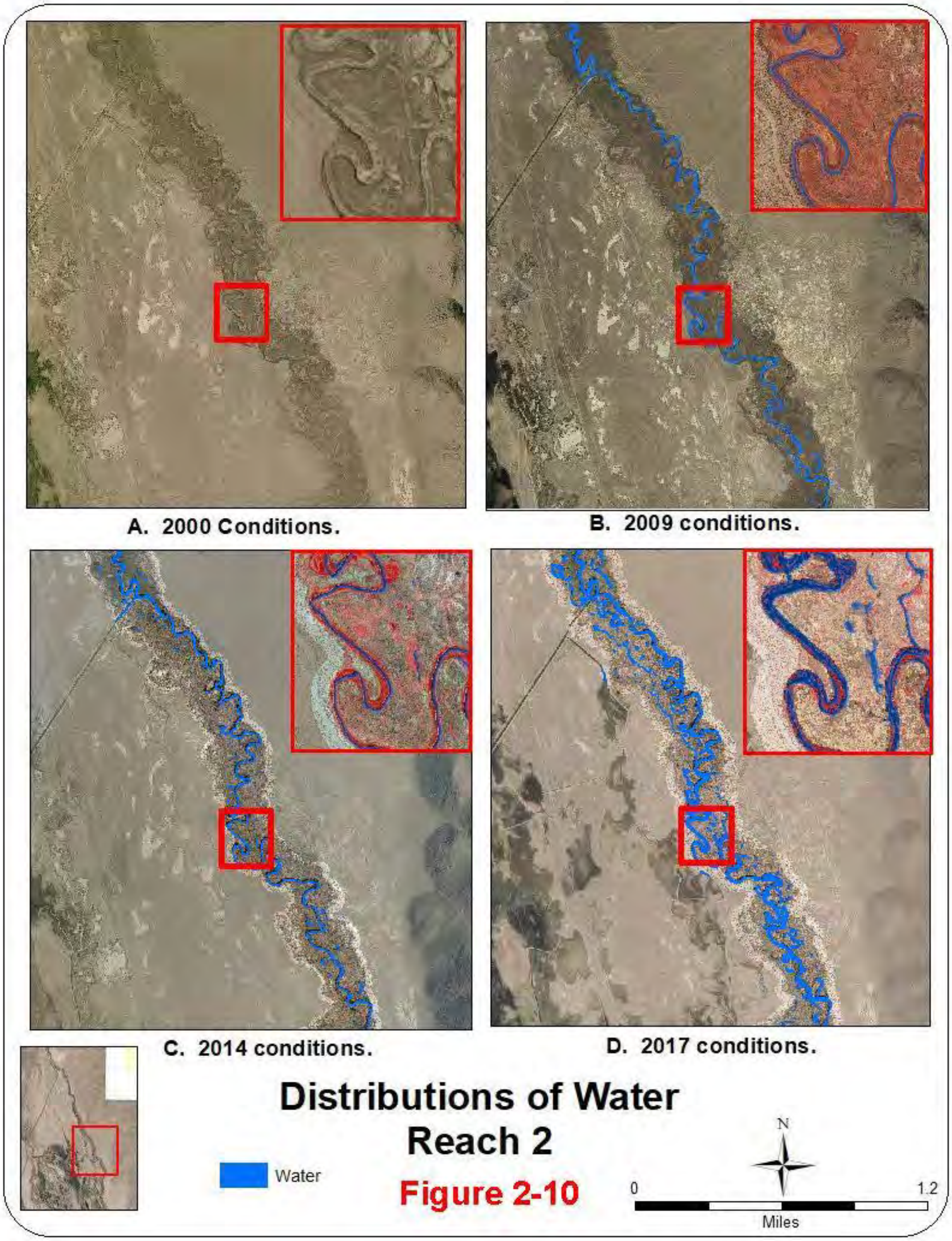
Table 2-4. Hydric status, 2000 through 2017 conditions.								
Status	2017 Conditions		2014 Conditions		2009 Conditions		2000 Conditions	
	Acres	%	Acres	%	Acres	%	Acres	%
Hydric	3239	52	2392	38	1719	28	1597	26
Mesic	1899	30	1997	32	2166	35	2126	35
Arid	1080	17	1801	29	2241	36	2403	39
Not considered	34	1	62	1	22	0	3	0
TOTAL	**6252**	**100**	**6252**	**100**	**6147**	**100**	**6128**	**100**

Vegetation types are subsequently described.

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



Vegetation Mapping, 2017 Conditions



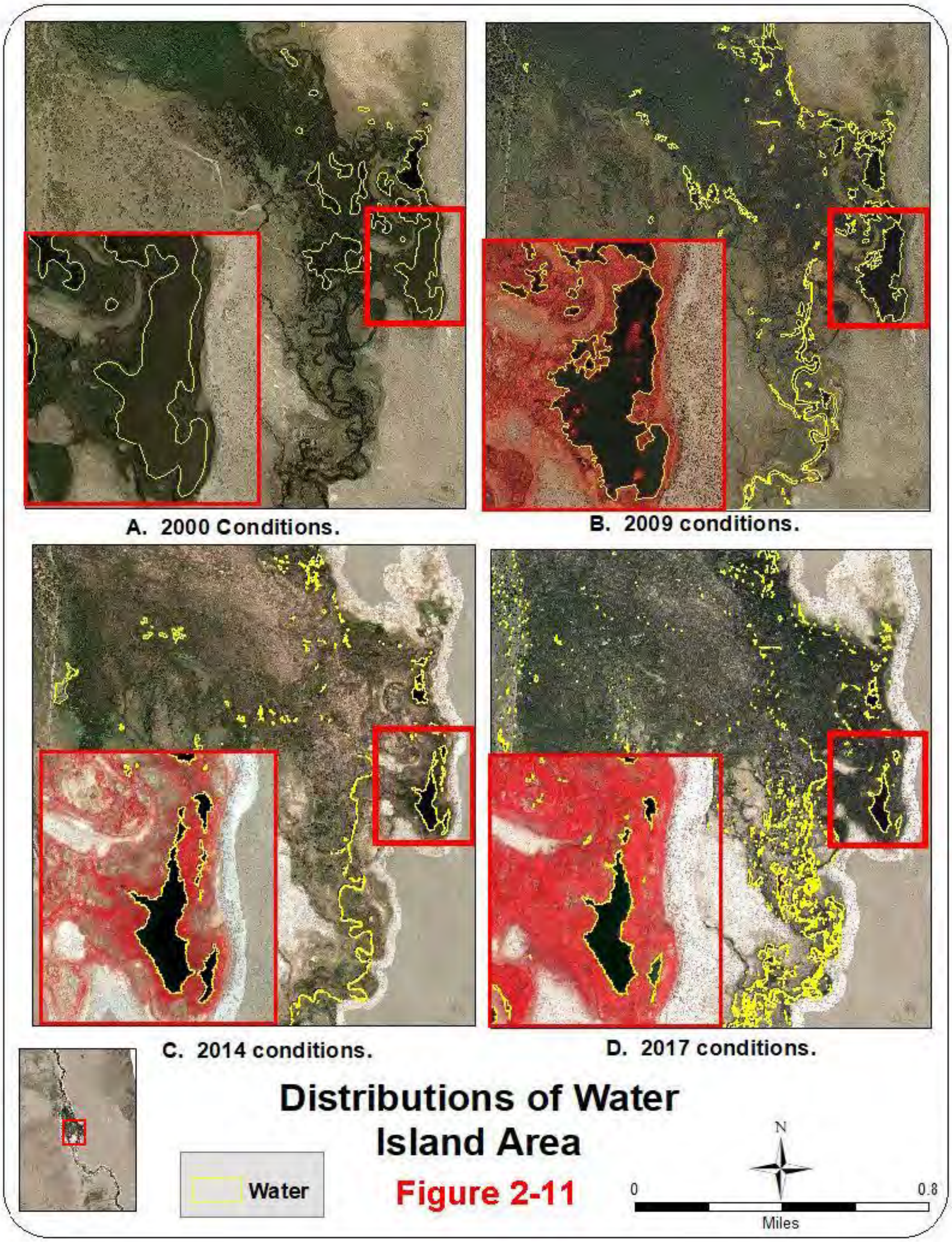
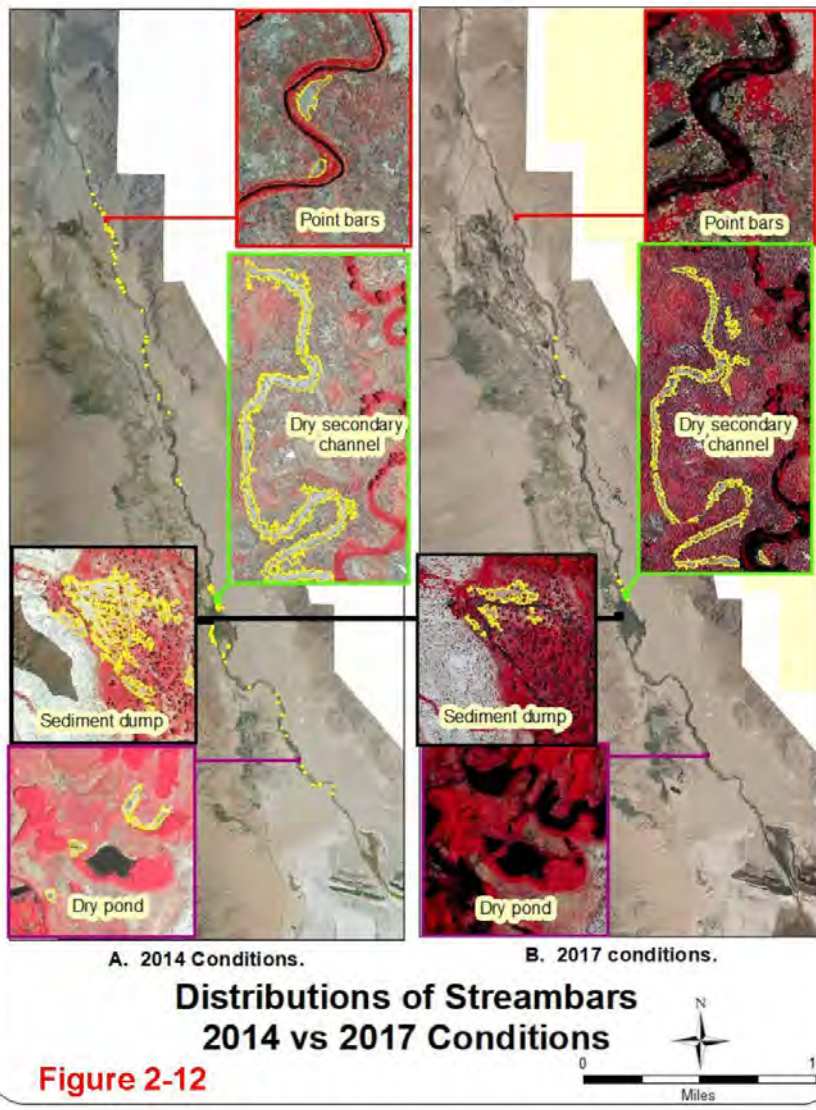

A. 2000 Conditions.
B. 2009 conditions.
C. 2014 conditions.
D. 2017 conditions.
Distributions of Water
Island Area
Water
N
0
0.8
Miles

Figure 2-11

Streambar: In 2000, 23 acres of streambars included the bottom of a dry, incised river channel and dry secondary channels (Figure 2-12). In 2014, mapping of 23 acres of streambars included point bars, secondary channels, a large sediment deposit at the mouth of the Alabama Gates, and several dry ponds. Point bar deposits are sparsely vegetated, sandy habitats are suitable for willow colonization. Most of the new willow colonization in reach 2 occurred on streambars. Scratchgrass (*Muhlenbergia asperifolia*) and saltgrass (*Distichlis spicata*) and sparse marsh plants are common. The large sediment deposit near the Alabama Gates is sediment sluiced from the Los Angeles Aqueduct. In 2017, only 3 acres of streambar was identified as streambar vegetated or was inundated by high water.



Distributions of Streambars 2014 vs 2017 Conditions

Figure 2-12

Marsh: Occurs in the river channel of graded reaches and extends across broad floodplains of aggraded reaches. The area of marsh increased from 765 acres in 2000 to 1,090 acres in 2009, to 1,310 acres in 2014, to 1,433 acres in 2017 (Figure 2-13). Dominant plants include cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acutus*). Three-square bulrush (*Schoenoplectus pungens*), salt marsh bulrush (*Schoenoplectus maritimus*), common reedgrass (*Phragmites australis*), Baltic rush (*Juncus balticus*), Parish spikerush (*Eleocharis parishii*) and yerba-mansa (*Anemopsis californica*) may also be present. Widely scattered, decadent Goodding willow (*Salix Gooddingii var. variabilis*) and red willow (*Salix laevigata*) were present in some parcels. Total vegetative cover exceeds 85 percent. Surfaces are typically semi-permanently flooded. The expansion of marsh is evident in the Island area (Figure 2-14). Inclusions of water and reed are common.

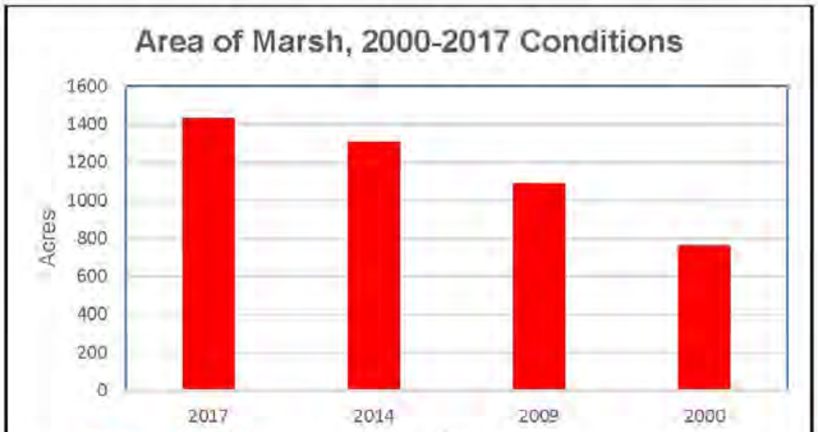
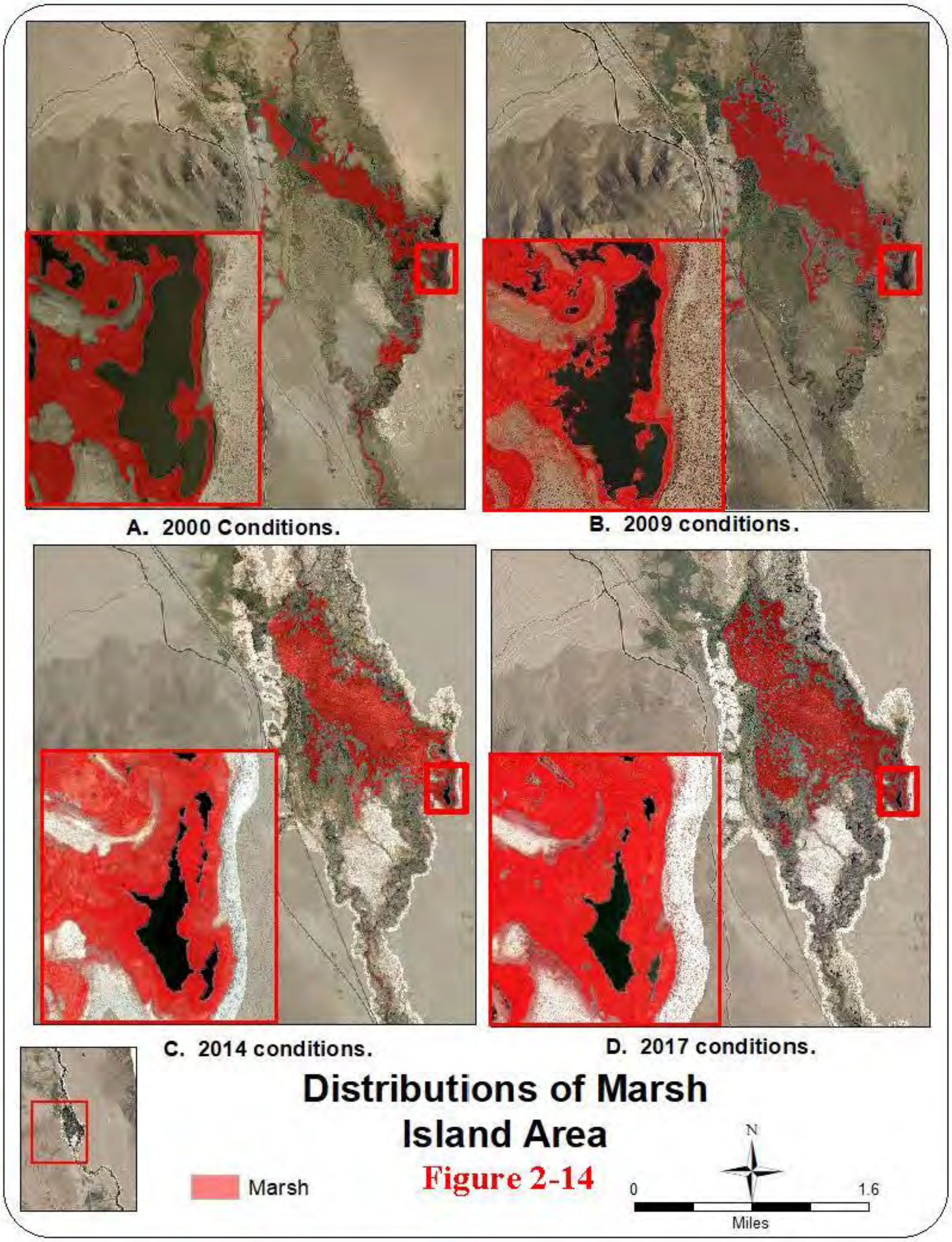
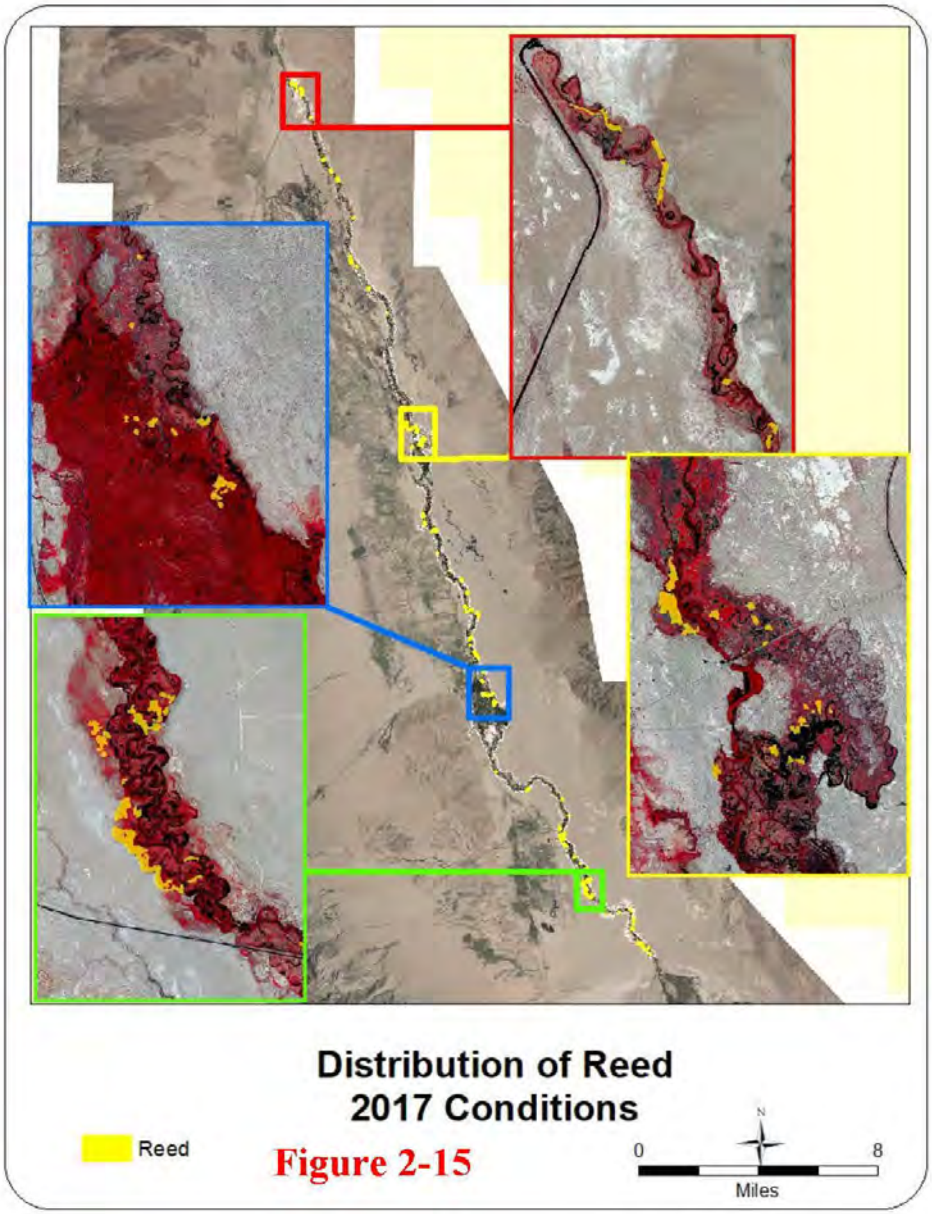


Figure 2-13


A. 2000 Conditions.
B. 2009 conditions.
C. 2014 conditions.
D. 2017 conditions.
Distributions of Marsh Island Area
Marsh
N
0
1.6
Miles
Figure 2-14

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

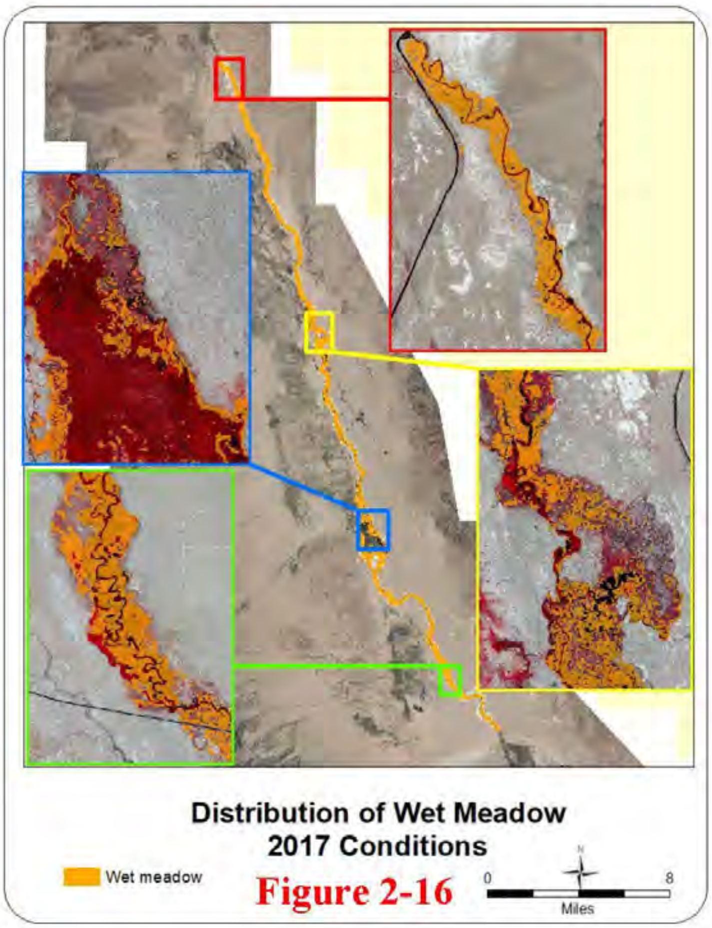


Distribution of Reed
2017 Conditions

Figure 2-15

Wet meadow: This herbaceous vegetation type occurs on floodplains and in depressions on terraces with high water tables (Figure 2-16). The key criteria distinguishing wet meadow from alkali meadow is that wet meadow does not support alkali scrub. Dominant plants included saltgrass (*Distichlis spicata*), creeping wildrye (*Leymus triticoides*), Baltic rush (*Juncus balticus*), beaked spikerush (*Juncus rostellata*), three-square bulrush (*Schoenoplectus pungens*), sunflower (*Helianthus* sp.), and clustered field sedge (*Carex praegracilis*). Decadent Nevada saltbush (*Artriplex lentiformis, torreyi*) and rubber rabbitbrush (*Ericameria nauseosus*) may be present in parcels transitioning from scrub/meadow to wet meadow. Total vegetative cover was typically greater than 75 percent.

Most of the 210 acres of wet meadow present in 2000 had converted to marsh in 2009. Wet meadow increased to 653 acres in 2014 and to 1,049 acres in 2017, mostly in response to burning of shrubs that became decadent in response to wetness. Also, about 116 acres of scrub meadow burned in the 2018 Moffat fire, leaving additional meadow and wet meadow not counted in the 2017 inventory.



Distribution of Wet Meadow
2017 Conditions

Figure 2-16

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

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

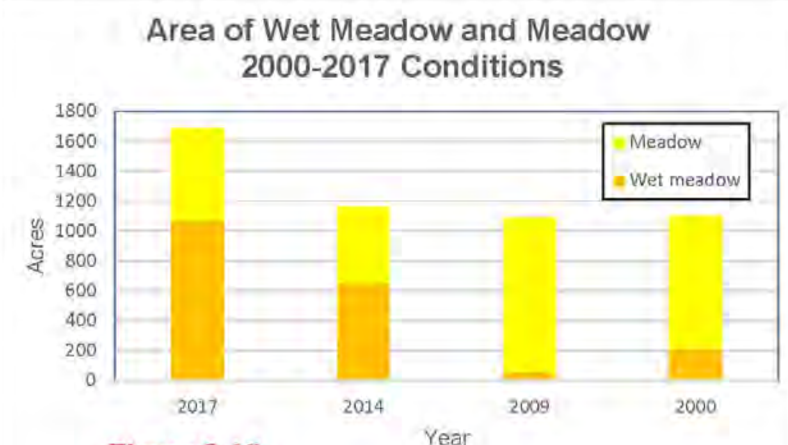


Figure 2-18

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

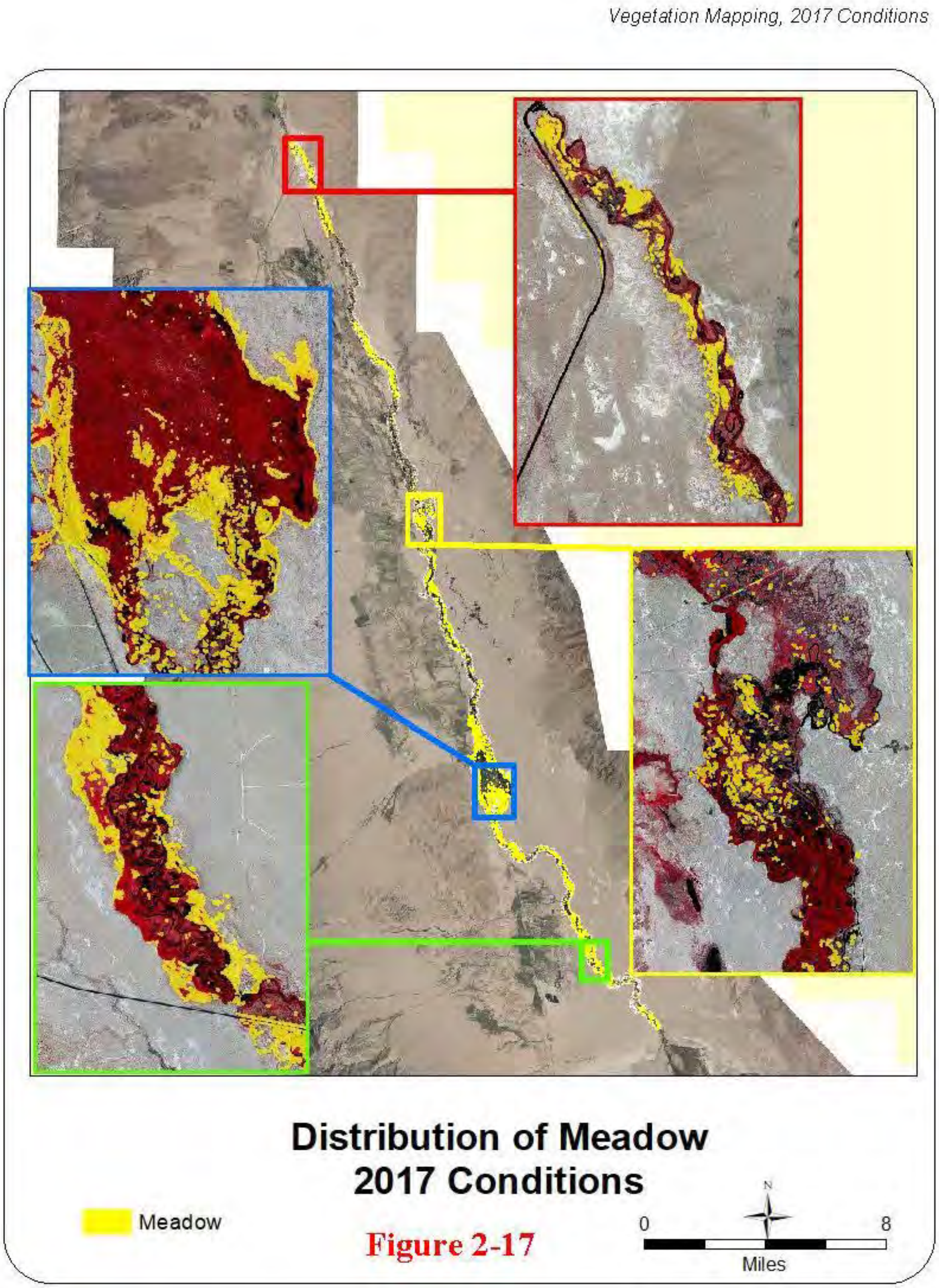
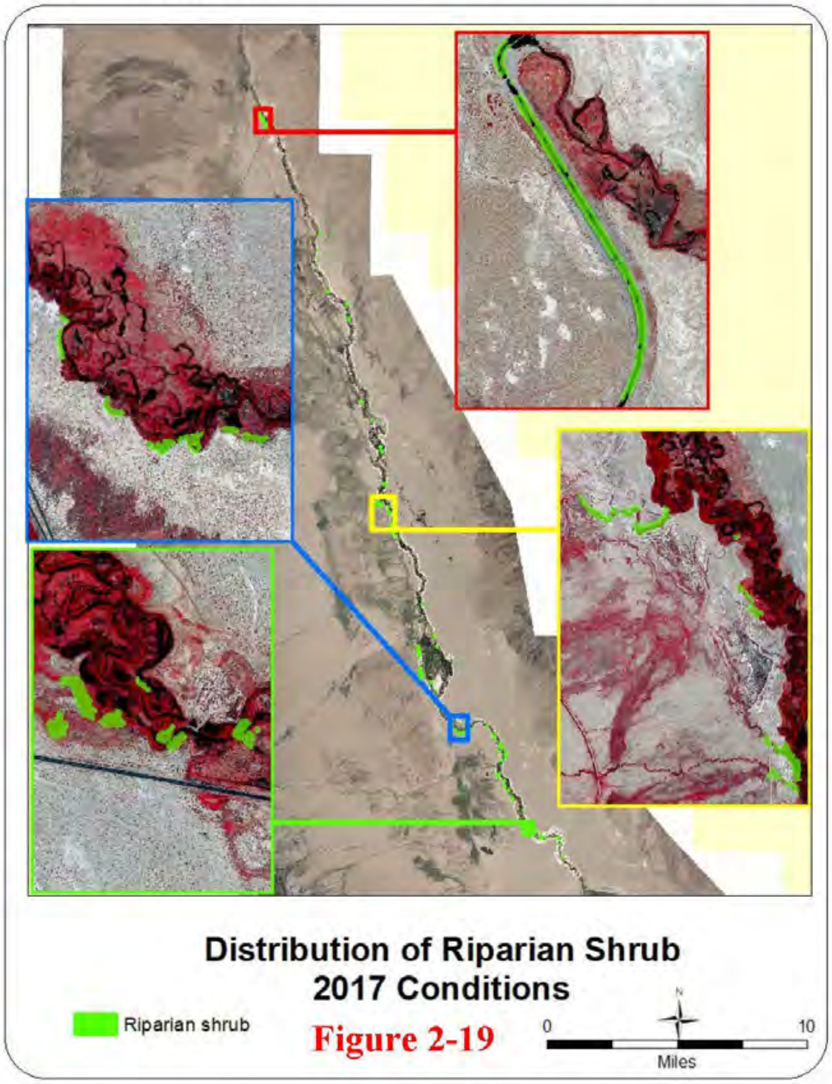

Vegetation Mapping, 2017 Conditions
Distribution of Meadow
2017 Conditions
Meadow
0
8
Miles
N

Figure 2-17

Riparian shrub: This tall shrub vegetation type occurs primarily on floodplain and low terrace landtypes with high water table. Riparian shrub is commonly associated with tributary drainages (Figure 2-19). A dense thicket of coyote willow (*Salix exigua*) dominates the overstory; Woods rose (*Rosa woodsii*) may be present. Creeping wildrye (*Leymus triticoides*) and saltgrass (*Distichlis spicata*) are prominent in the understory.

The area of riparian shrub increased from 20 acres in 2000 and 2009, to 32 acres in 2014, and to 27 acres in 2017. New riparian shrub communities are also getting started on point streambars in reach 2.

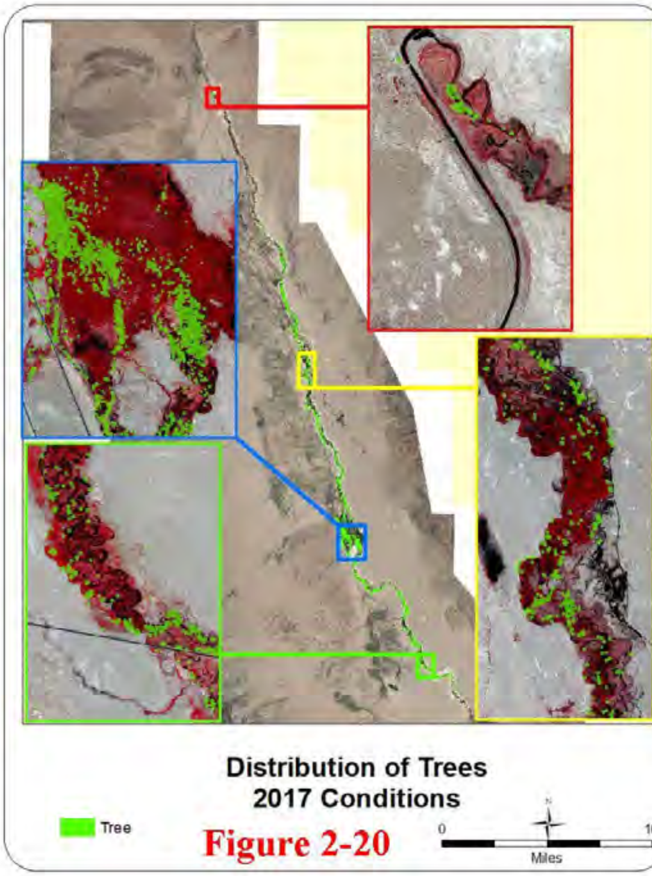


Distribution of Riparian Shrub 2017 Conditions

Figure 2-19

Tree: This forested vegetation type occurs on all landtypes and in all water regimes. The prominent overstory is Goodding willow (*Salix Gooddingii*) and red willow (*Salix laevigata*). Russian olive (*Elaeagnus angustifolia*), tamarisk (*Tamarix ramosissima*), and Fremont cottonwood (*Populus fremontii*) may be present in some parcels. The understory may be marsh, wet meadow, meadow, scrub/meadow or scrub. Once established, trees seem indifferent to drought and flooding and re-sprout after fire. Trees in the Island area have endured prolonged inundation while they are also common survivors in dry scrub habitat. Most of the trees burned in the Lone Pine fire (2013) have re-sprouted.

The mapped area of tree decreased from 449 acres in 2000, to 260 acres in 2009, and to 162 acres in 2014, probably in response to more precise mapping of tree canopy. A still more precise approach in 2017 identified 188 acres of trees (Figure 2-20) as a 2 meter buffer on LiDAR measures of vegetation height greater than 10 feet. The LiDAR mapping likely included dead and decadent trees. The Moffat fire in 2018 burned 36 acres of trees identified in 2017.



Distribution of Trees
2017 Conditions

Figure 2-20

Scrub/meadow: This low scrub vegetation type occurs primarily on low terraces with low water table (Figure 2-21). Scrub/meadow and meadow are overlapping habitats. When you burn scrub/meadow you get meadow. Where the scrub is dead or decadent in response to wetness, burning may leave wet meadow. The dominant scrub are Nevada saltbush (*Atriplex lentiformis, torreyi*) and rubber rabbitbrush (*Ericameria nauseosus*); greasewood (*Sarcobatus vermiculatus*) is sometimes present, but more typical in upland scrub. Total scrub cover is variable, but typically greater than 25 percent. Saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), Torrey seepweed (*Sueda moquinii*), and creeping wildrye (*Leymus triticoides*) are prominent herbaceous plants; total herbaceous cover is typically greater than 50 percent. Inclusions of meadow with sparse scrub and inclusions of scrub with sparse understory are common and may comprise up to about 30 percent of some parcels.

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

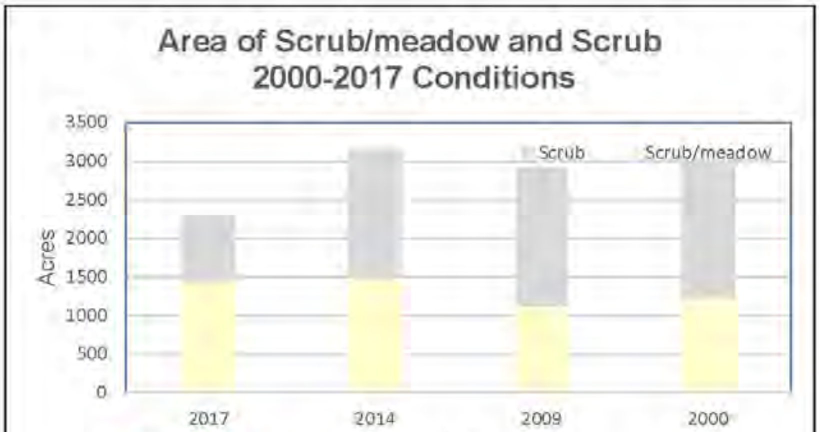


Figure 2-22

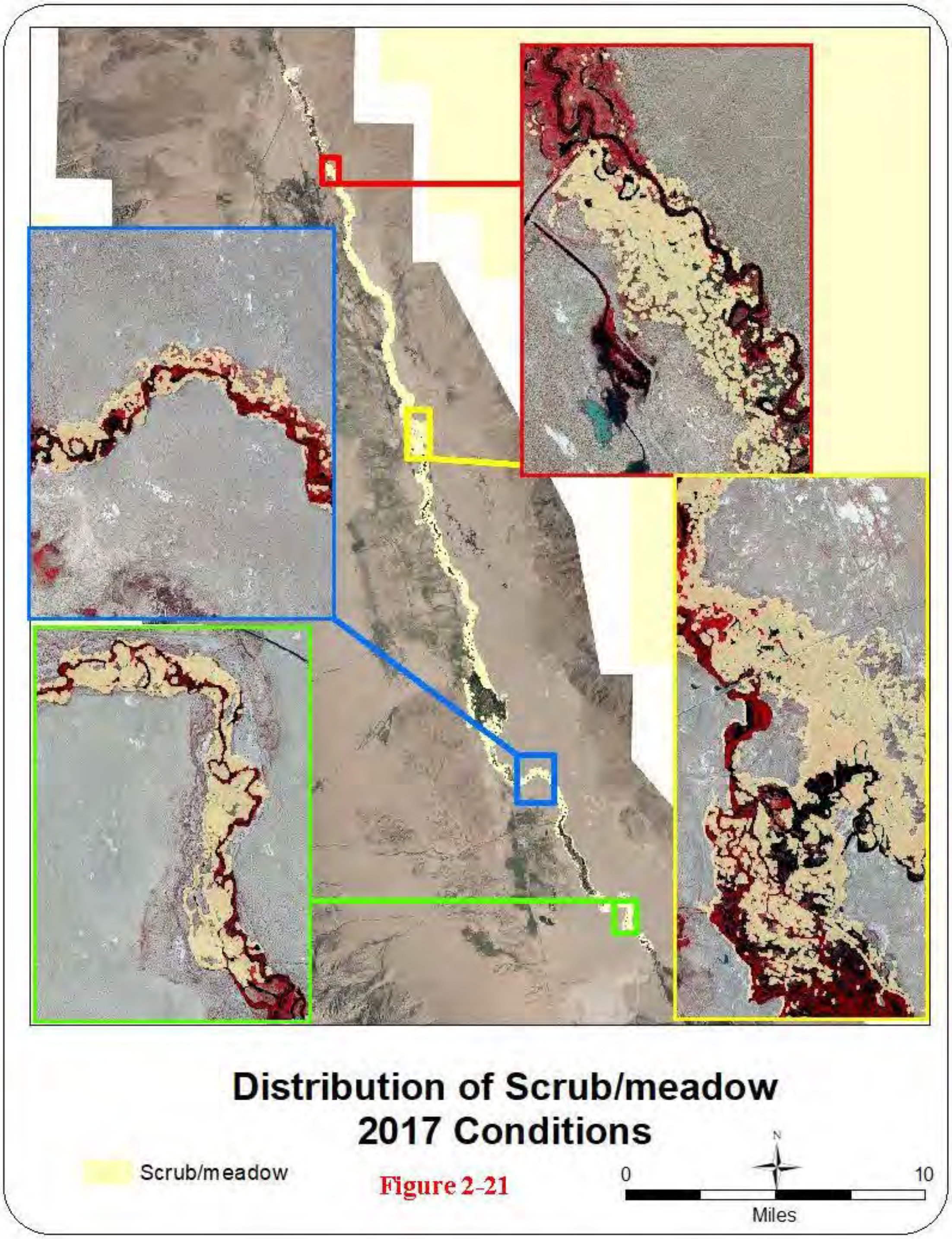
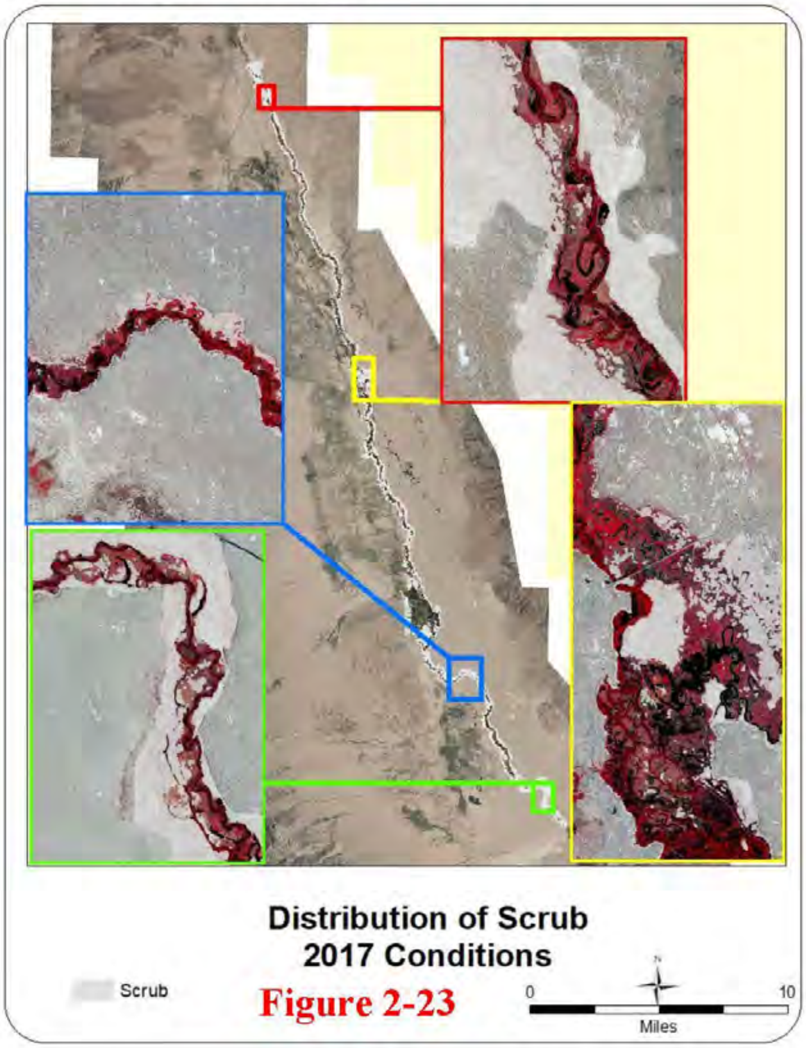

Distribution of Scrub/meadow
2017 Conditions
Scrub/meadow
N
0
10
Miles

Figure 2-21

Scrub: Scrub consists of a thicket of Nevada saltbush (*Atriplex lentiformis* ssp. *torreyi*) and rubber rabbitbrush (*Ericameria nauseosus)* with sparse understory that occurs on terrace with very low water table, mostly along the flanks of the Owens River corridor (Figure 2-23). With channel aggradation and rise in alluvial groundwater table, scrub may change to scrub/meadow. Scrub cover is typically greater than 75 percent and understory is mostly absent. The extent of scrub was relatively consistent (about 1,775 acres) in 2000 and 2009, decreased only about a hundred acres in 2014, then decreased about 600 acres in 2017, most of which changed to scrub/meadow in response to channel aggradation and rising groundwater level[2].



Distribution of Scrub
2017 Conditions
Figure 2-23

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

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

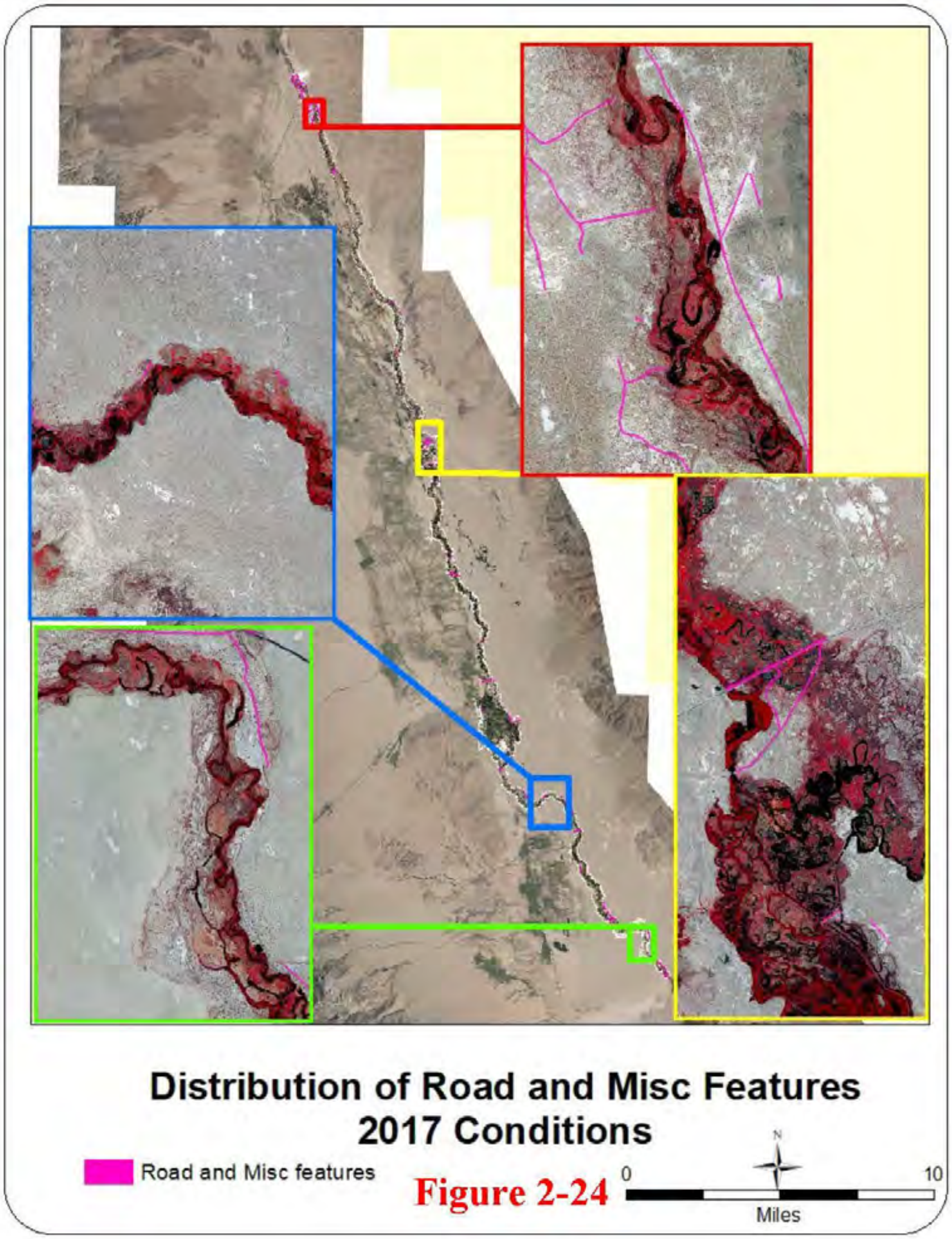


Figure 2-24

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

2.3 LORP Summary

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

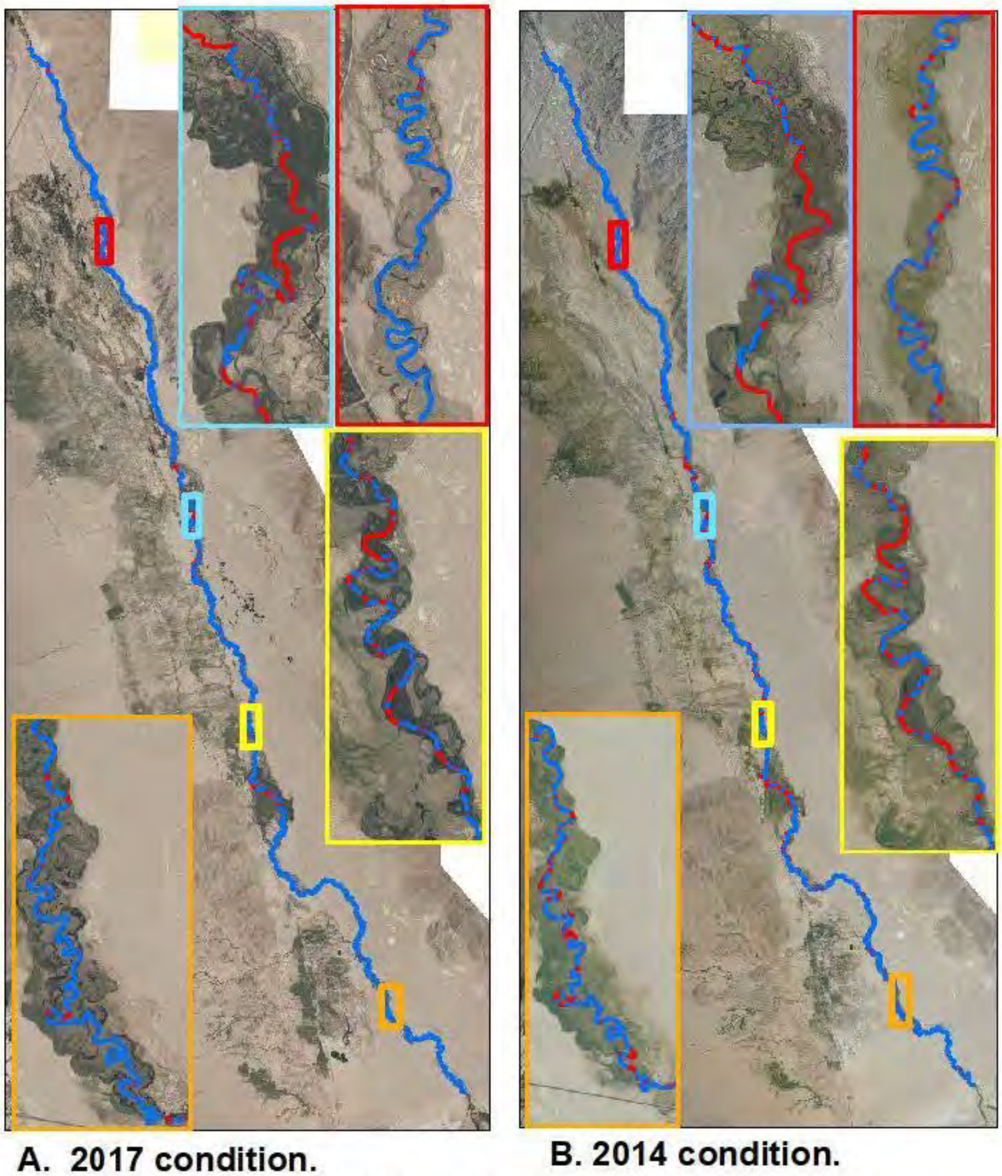
Hydric vegetation was predicted to increase 1,032 acres in response to the LORP (WHA 2004b). Short-term future conditions were predicted in response to two mechanisms: 1) changes to herbaceous strata in response to changes in state from establishment of base flow; and 2) changes to overstory in response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

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

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

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

Vegetation Mapping, 2017 Conditions



Open verus Occluded River Channel

Figure 2-25

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

Alternative streamflow scenarios have been suggested for changing the direction of the LORP. Record flows of relatively long duration in 2017 will be a good test of whether more open channel conditions will be maintained with the return of more normal flows. In the past, seasonal habitat flows of somewhat lower magnitude and duration have been found to be ineffective in maintaining an open channel. Reducing base flows below 40 cfs has also been considered as a means of reducing the extent of marsh, but low flows in the Los Angeles Aqueduct in 2015 have only resulted in an "inset marsh" that further occludes the channel (Figure 2-26). Alternative streamflow scenarios may not be effective in changing the direction of the LORP.

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

3.0 DELTA HABITAT AREA (DHA) VEGETATION MAPPING

As specified in the LORP-FEIR:

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

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

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

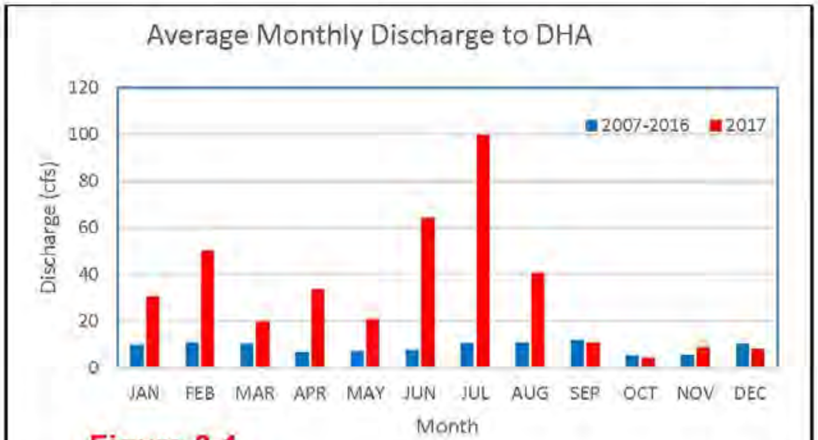


Figure 3-1

3.1 DHA Approach

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

3.2 DHA Results

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

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

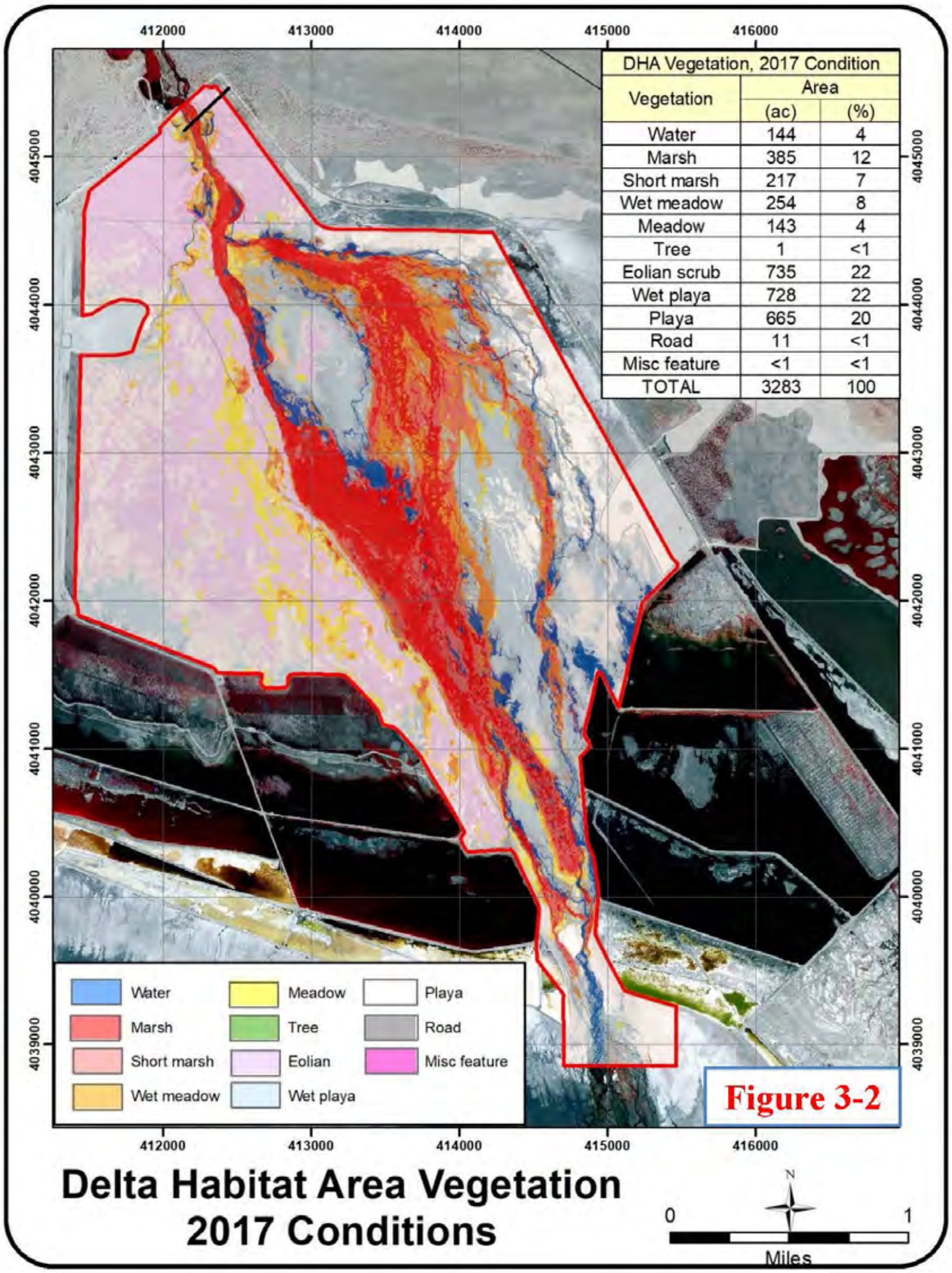
Short marsh: Typically occurs along the expanding front of marsh and appears to be a successional stage towards (tall) marsh. Prominent species include prairie rush (*Schoenoplectus maritimus*), chairmakers bulrush (*Schoenoplectus americanus*), and spikerush (*Eleocharis spp.*). It was distinguished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

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

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

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

Vegetation Mapping, 2017 Conditions



DHA Vegetation, 2017 Condition		
Vegetation	Area	
	(ac)	(%)
Water	144	4
Marsh	385	12
Short marsh	217	7
Wet meadow	254	8
Meadow	143	4
Tree	1	<1
Eolian scrub	735	22
Wet playa	728	22
Playa	665	20
Road	11	<1
Misc feature	<1	<1
TOTAL	3283	100

Delta Habitat Area Vegetation 2017 Conditions

Vegetation Mapping, 2017 Conditions

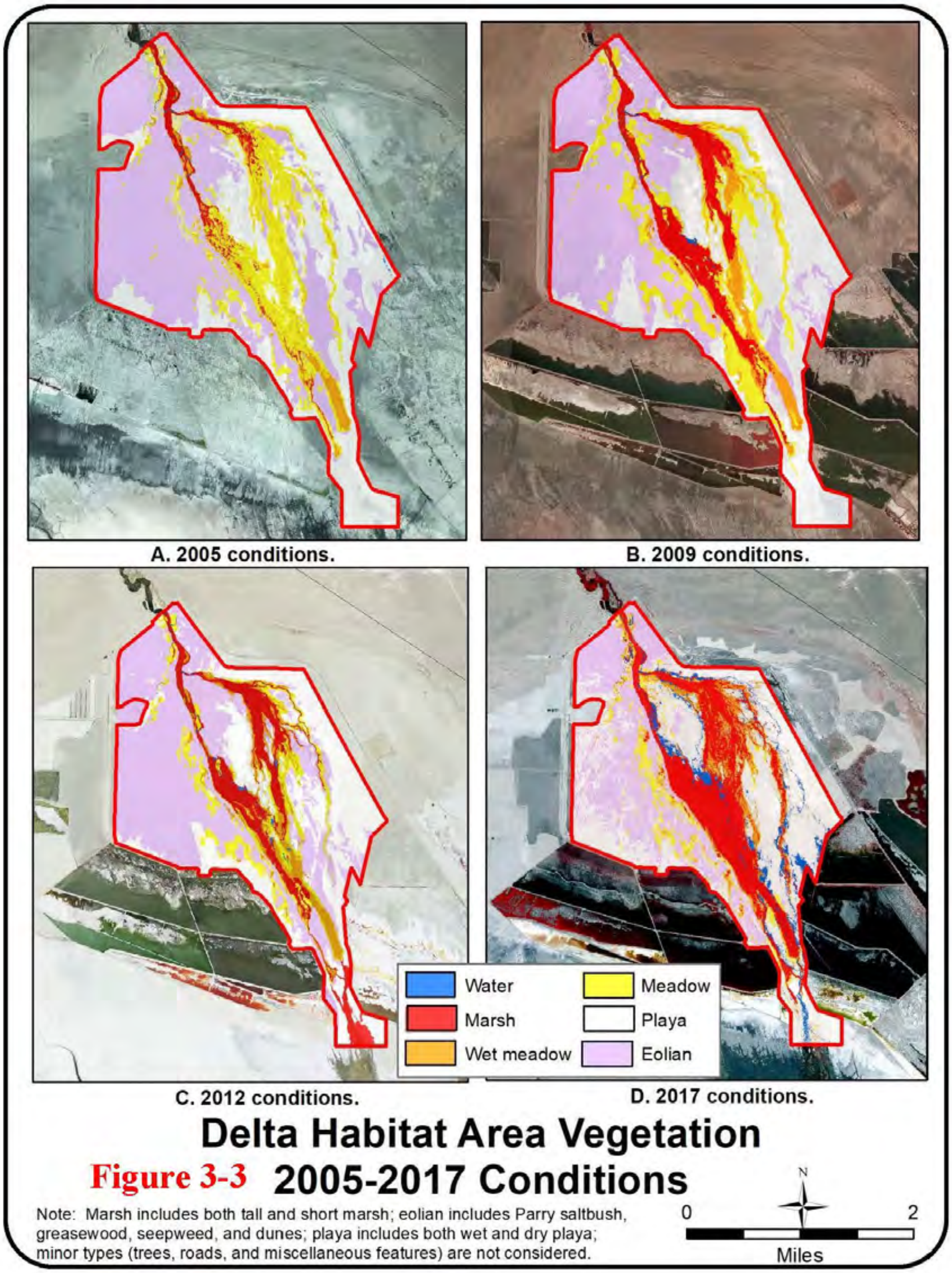


Figure 3-3 Delta Habitat Area Vegetation 2005-2017 Conditions

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

Vegetation Mapping, 2017 Conditions

Table 3-1. DHA map unit correlation

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

4.0 BWMA VEGETATION MAPPING

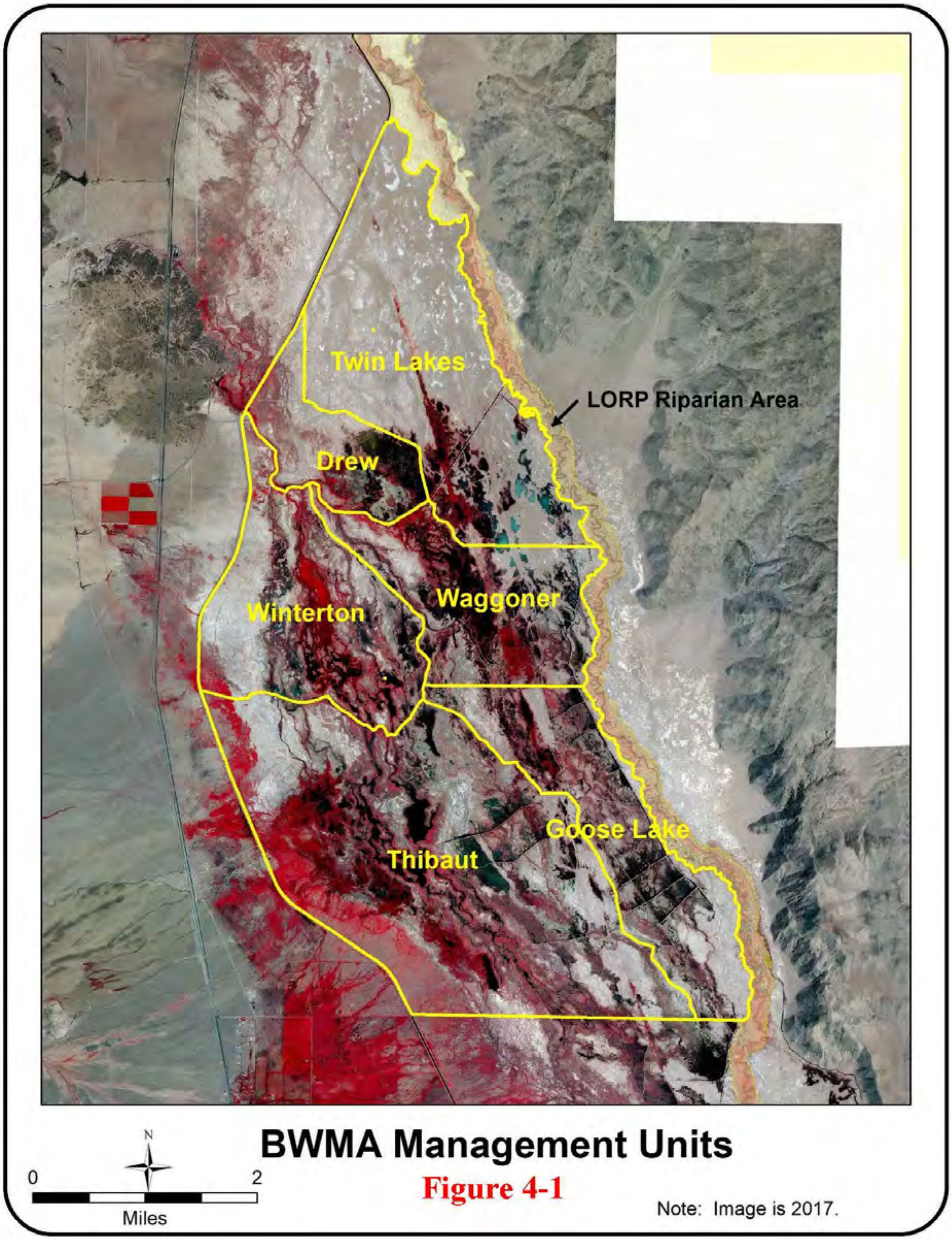
The BWMA consists of the Drew, Waggoner, Winterton, and Thibaut management units (Figure 4-1; Table 4-1). Two off river lakes and pond management units (Twin Lakes and Goose Lake) have traditionally been included with the BWMA vegetation inventory, as reported for 2000 and 2009 conditions. The BWMA vegetation inventory for 2017 conditions includes only the Drew management unit.

Table 4-1. BWMA management units.

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

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

Vegetation Mapping, 2017 Conditions



BWMA Management Units

Figure 4-1

Vegetation Mapping, 2017 Conditions

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

		Drew	Thibaut	Waggoner	Winterton
2007	Summer		Flooded		Flooded
2007	Fall		Flooded		Flooded
2007	Winter		Flooded		Flooded
2008	Spring		Flooded		Flooded
2008	Summer		Flooded		Flooded
2008	Fall		Flooded		Flooded
2008	Winter		Flooded		Flooded
2009	Spring	Flooded	Flooded	Flooded	Flooded
2009	Summer	Flooded	Flooded	Flooded	Flooded
2009	Fall	Flooded	Flooded	Flooded	
2009	Winter	Flooded	Flooded	Flooded	
2010	Spring	Flooded	Flooded	Flooded	
2010	Summer	Flooded	Flooded	Flooded	
2010	Fall	Flooded	Flooded	Flooded	
2010	Winter	Flooded	Flooded	Flooded	
2011	Spring	Flooded			Flooded
2011	Summer	Flooded			Flooded
2011	Fall	Flooded			Flooded
2011	Winter	Flooded			Flooded
2012	Spring	Flooded			
2012	Summer	Flooded			
2012	Fall	Flooded			
2012	Winter	Flooded			
2013	Spring	Flooded			
2013	Summer	Flooded			
2013	Fall	Flooded			
2013	Winter	Flooded			
2014	Spring	Flooded			
2014	Summer	Flooded			
2014	Fall	Flooded			
2014	Winter	Flooded			
2015	Spring				Flooded
2015	Summer				Flooded
2015	Fall				Flooded
2015	Winter				Flooded
2016	Spring		Flooded		Flooded
2016	Summer		Flooded		Flooded
2016	Fall		Flooded		Flooded
2016	Winter		Flooded		Flooded
2017	Spring	Additional water spreading	Flooded	Additional water spreading	Flooded
2017	Summer	Additional water spreading	Flooded	Additional water spreading	Flooded
2017	Fall		Flooded		Flooded
2017	Winter		Flooded		Flooded

(Blue) = Flooded (Red) = Additional water spreading

4.1 BWMA Approach

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

4.2 BWMA Results

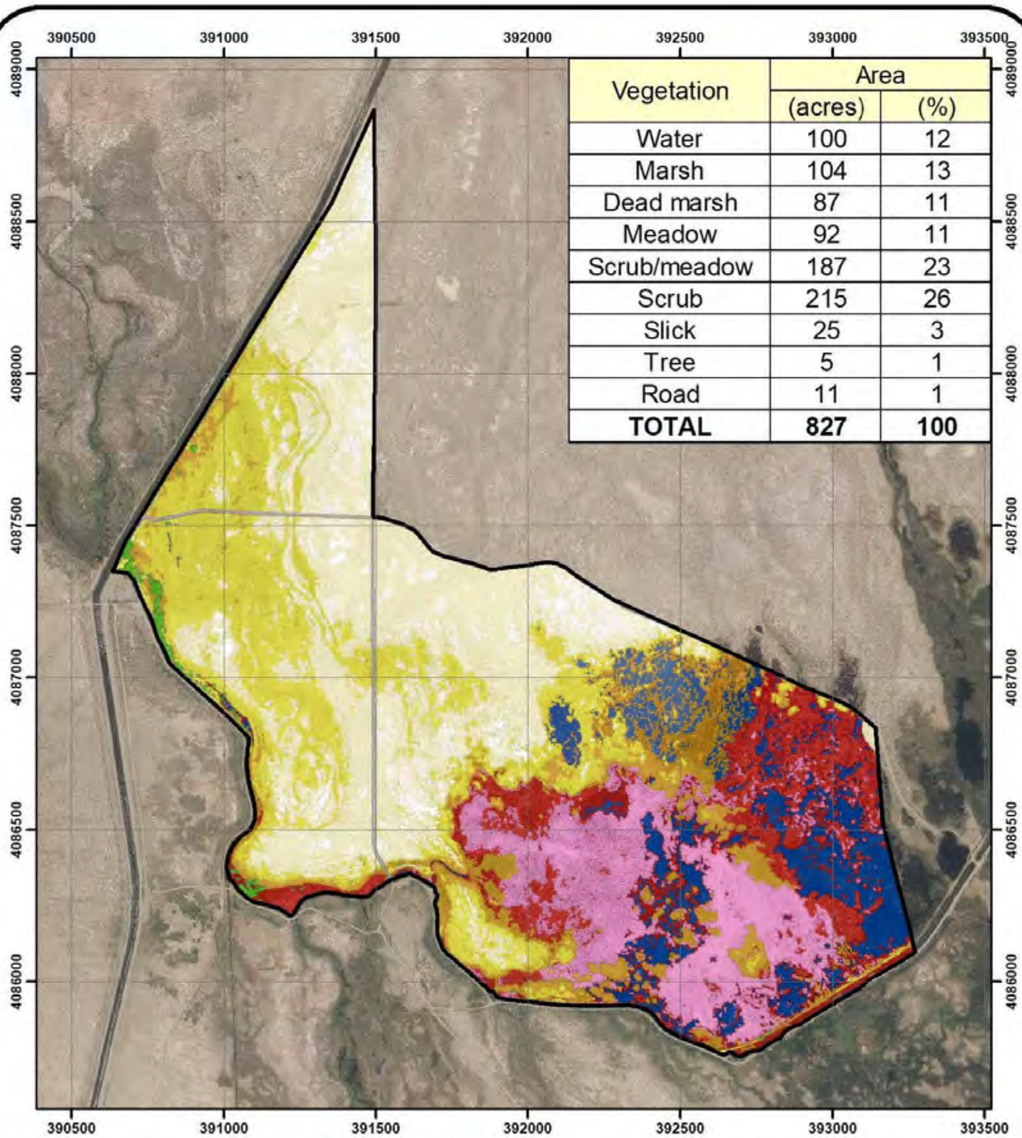
Vegetation types for 2017 conditions are presented as Figure 4-3. Vegetation types identified for 2000, 2009, 2014, and 2017 conditions of Drew Slough are listed in Table 4-3 and illustrated in Figure 4-4.

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

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

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

Vegetation Mapping, 2017 Conditions



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

Water
Marsh
Dead marsh
Meadow
Scrub/meadow
Scrub
Slick
Tree
Road

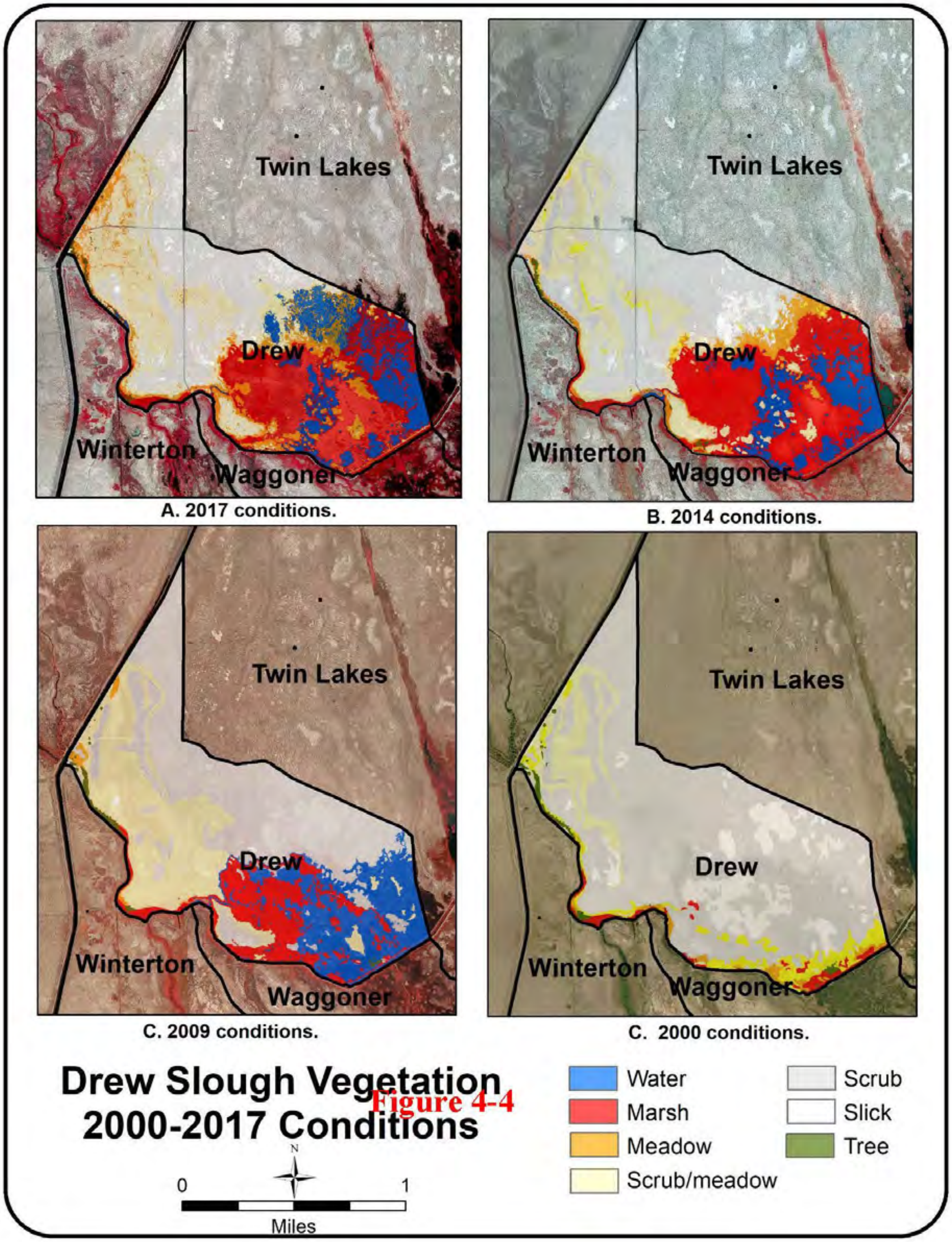
0 — 1 Miles

Figure 4-3

BWMA DREW UNIT
Vegetation, 2017 Conditions

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

Vegetation Mapping, 2017 Conditions



5.0 LITERATURE CITED

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

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

4.0 AVIAN MONITORING

4.1 Introduction

The Riverine-Riparian component of the LORP has focused on the rewatering and reestablishment of perennial flow in the Lower Owens River. Flows in the Lower Owens River have been diverted to the Los Angeles Aqueduct (LAA) since 1913, leaving much of the channel dry. Perennial flow throughout the entire 62-mile length of the Lower Owens River was reestablished in December of 2006, and 2022 marked the end of a scheduled 15-year post-project monitoring period.

Ecological goals for the LORP, as they appear in the 1997 MOU, were based on a principle of "holistic management of natural resources", and meant to consider human, financial, and biological aspects (MOU 1997). Somewhat paraphrased, the overarching goal for the Riverine-Riparian Area was to establish a healthy, functioning riverine-riparian ecosystem for the benefit of biodiversity and Threatened and Endangered Species (defined in the 1997 MOU as native plant and animal species listed under federal or state laws and regulations adopted pursuant to such federal or state laws), while allowing for the continuation of other sustainable uses. Secondarily, a list of HIS was identified, with an additional goal of creating and maintaining, through flow and land management, to the extent feasible, diverse natural habitats consistent with the needs of these "HIS" and to ensure these habitats are as self-sustaining as possible.

Breeding bird surveys have been conducted periodically in the Riverine-Riparian Area in both pre-project and post-project periods to provide a metric for evaluating achievement of these ecological goals. No specific objectives have ever been defined regarding bird populations, or more specifically, the HIS. This approach provides much flexibility for the interpretation of whether certain goals have been met, but also a lack of clarity. Given this context, we present the bird data, discuss the response of the bird community to implementation of LORP, and provide recommendations we feel are feasible, self-sustaining, and will support diversity of bird communities, given the various constraints of the project environment. This report presents the results of the 2022 avian surveys of the LORP Riverine-Riparian Area. It also synthesizes avian monitoring conducted over a 20-year period. Results are compared to pre-project (2002 and 2003) and post-project monitoring data (2010, 2015, and 2022).

LADWP Watershed Resources Specialists, Deborah House and Erin Nordin, and ICWD personnel, Zach Nelson, and Jerry Zatorski, conducted bird surveys in 2022. Data analysis and reporting was completed by Debbie House, Erin Nordin, and Zach Nelson.

4.2 Survey Area Description

4.2.1 Survey Area

Bird surveys were conducted in the Riverine-Riparian Area of the LORP, which includes the river corridor and adjacent floodplain of the Lower Owens River (**Figure 4-1).** The Lower Owens River is a meandering low-gradient river system in a hydrologically-closed basin (Hollett et al. 1991). The Lower Owens River corridor, from the LAA Intake, north of the town of Independence, downstream to the Pumpback Station located just upstream of the DHA, constitutes the Riverine-Riparian Area of the LORP.

The LAA, completed in 1913, diverted all water from the Lower Owens River, leaving much of the channel essentially dry. Downstream areas of the river channel (i.e., south of Independence) remained wetted due to spring flow and limited releases; however, the upstream portion of the Lower Owens River only received water in extremely wet years through intermittent releases from the LAA. The LORP, with flows first initiated in December of 2006, reestablished perennial flow throughout the entire 62 miles of the Lower Owens River.

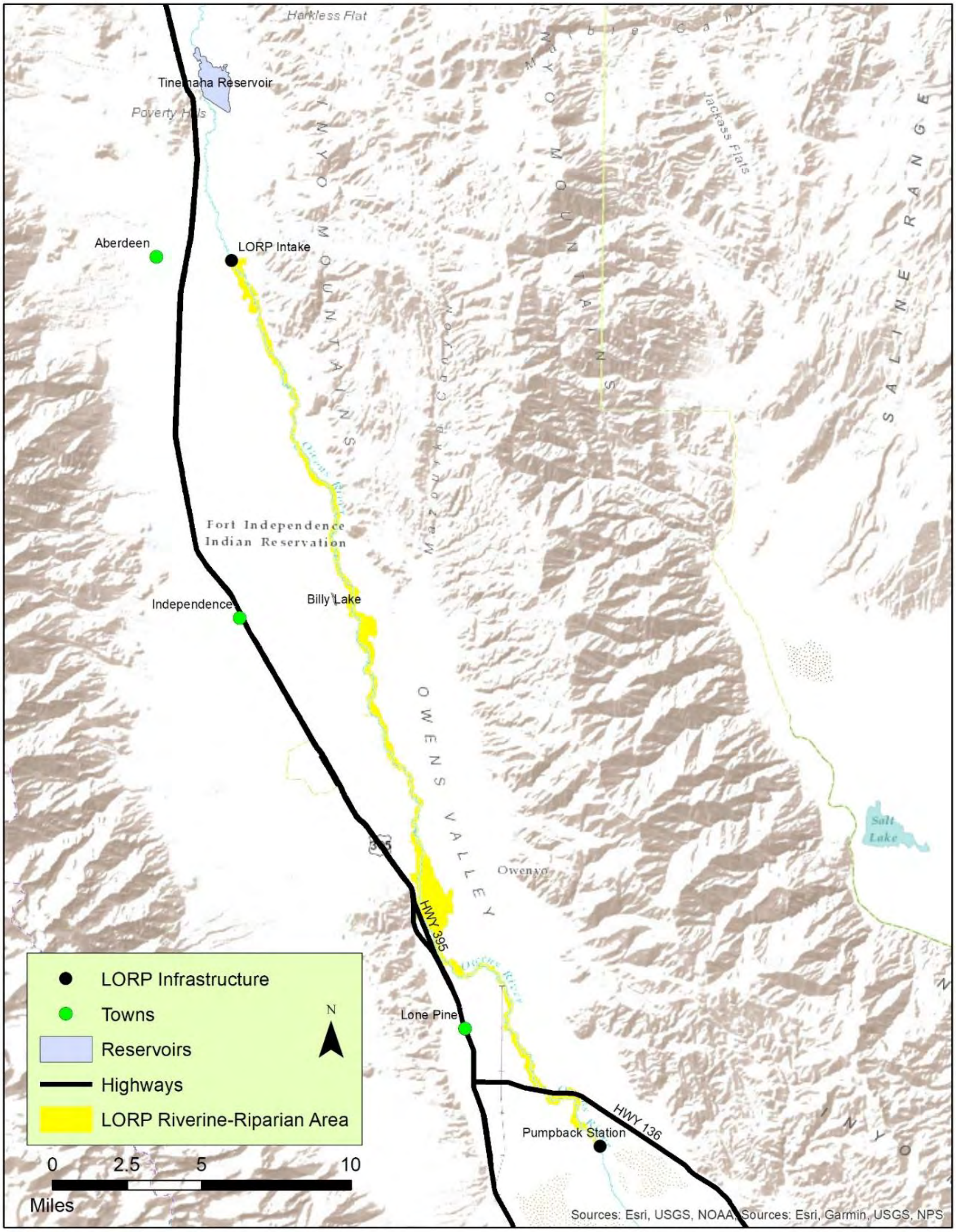

Figure 4-1. **Location of the LORP Riverine-Riparian Area.**

4.2.2 Channel Morphology, Hydrology, and River Reaches

Prior to implementation of the LORP, the entire 62-mile river channel was divided into six discrete reaches of varying lengths of four hydrogeomorphic river “states”. The hydrogeomorphic state is a function of the combination of channel morphology and hydrology. River state affects the vegetation of the floodplain by influencing the water table and the degree of saturation of the floodplain, and thus the development and maintenance of wetland habitats.

The LORP has resulted in changes to the hydrology and channel morphology; consequently, the river states have changed. Initially, avian data were analyzed by reach; however, due to changes to within-reach river states, the reach descriptions no longer reflect current conditions. In this report, avian data was analyzed across all sample sites to evaluate bird response to overall ecological changes in the LORP Riverine-Riparian Area.

The four distinct hydrogeomorphic states identified in the LORP Riverine-Riparian Area are:

1) **Incised, dry channel.** A deep, dry channel bordered by high terrace with upland vegetation. Alluvial water table is well below the rooting depth of vegetation. Hydric vegetation is mostly absent. This state was present pre-project, comprising 29% of the river channel (see Section 3.2), but no longer occurs in the LORP Riverine-Riparian Area due to the establishment of perennial flow.
2) **Incised, wet, confined floodplain:** A deep, wetted channel bordered by high and low terraces. Hydric vegetation is confined to the incised channel. Alluvial water table is mostly below the rooting depth of vegetation of adjacent terraces with upland vegetation. This state currently comprises 5% of the LORP Riverine-Riparian Area.
3) **Graded, wet, unconfined floodplain:** A wetted channel bordered by floodplain and low terrace. Marsh fills the active channel. Alluvial groundwater is within the rooting depth of hydric vegetation on the floodplain. This state currently comprises 54% of the LORP Riverine-Riparian Area.
4) **Aggraded, wet, unconfined floodplain:** Wet conditions extend across most of the floodplain and a channel may not be evident. Alluvial groundwater is at or near the surface. This state currently comprises 41% of the LORP Riverine-Riparian Area.

4.2.3 LORP Vegetation Communities

The vegetation communities of the Lower Owens River, upon which the avian community relies, are directly influenced by hydrology and channel morphology corresponding with the hydrogeomorphic state. Due to ecological succession, there have been slight modifications to the vegetation categories used over time, but in 2022, the following vegetation communities were recognized in the LORP Riverine-Riparian Area:

Water: Open water areas of the Owens River, divorced oxbows, and open water off-river ponds.

Streambar: Sparsely vegetated deposits including point bars in the river, and dry, divorced channels.

Marsh: Marsh habitat on the Owens River is typically over six feet tall and dense. Dominant plants included cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acutus*).

Reedgrass: Reedgrass (*Phragmites australis*) forms tall, thick monotypic stands in the river channel and adjacent floodplain.

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

Transitional Meadow: A predominantly herbaceous community as in a transitional state in response to rising groundwater level.

Dead Scrub: Found in association with transitional meadow, and in response to rising groundwater level**.**

Meadow: This herbaceous vegetation type occurred on the low terraces with low-water table. Saltgrass is dominant; alkali sacaton (*Sporobolus airoides*) and Baltic rush may also be present.

Scrub/meadow: This low shrub vegetation type occurs primarily on low terraces with low-water table. Scrub/meadow and meadow are overlapping habitats. The dominant shrubs are Nevada saltbush (*Atriplex lentiformis* ssp. *torreyi*) and rubber rabbitbrush (*Ericameria nauseosa*) and sometimes greasewood (*Sarcobatus vermiculatus*). Total shrub cover is variable, but typically greater than 25%.

Riparian Shrub: This tall shrub vegetation type occurs primarily on floodplain and low terraces with intermittently high-water table. Riparian shrub is commonly associated with tributary drainages and is primarily composed of dense thickets of coyote willow (*Salix exigua*). Woods' rose (*Rosa woodsii*) is present in some areas.

Tree: Areas mapped as tree are primarily composed of Goodding's willow (*Salix gooddingii*) and red willow (*S. laevigata*). Russian olive (*Elaeagnus angustifolia*), tamarisk (*Tamarix ramosissima*), and Fremont cottonwood (*Populus fremontii*) may be present in some parcels. The understory may be marsh, wet meadow, alkali meadow, or alkali scrub.

Scrub: Scrub is primarily dominated by Nevada saltbush and rubber rabbitbrush with sparse understory.

Barren: Relatively unvegetated sites of alkali soil within scrub.

Roads and Miscellaneous Features: Includes roads, intake structures, measuring stations, and spoil areas.

4.3 Methodology

4.3.1 Quantification of Vegetation at the Bird Point Count Stations

Vegetation communities in the LORP have been mapped five times (2000, 2009, 2014, 2017, and 2022). The 2000 vegetation mapping data represents pre-project conditions, up to December 2006. Mapping of 2022 conditions was completed using aerial imagery taken August 21, 2022 (see Section 3.1).

The total acreage of each vegetation community within a 50-meter radius from each avian point-count station was determined for each mapping year using *ArcGIS* 10.6. The 50-m buffer was used to match the buffer used when calculating the breeding bird indices. The map unit correlation cross-walk in Jensen (2023) was used to standardize vegetation classifications across monitoring years to those used in 2022.

4.3.2 Avian Surveys

Monitoring of avian species in the LORP Riverine-Riparian Area has been conducted preceding and following implementation of the LORP. The avian monitoring program established by Point Blue Conservation Science (formerly known as Point Reyes Bird Observatory) is a scientifically-robust breeding bird survey program to track breeding songbird communities (Heath and Gates 2002). Point Blue Conservation Science conducted baseline surveys in 2002 and 2003 and the monitoring program was adopted for the LORP. It is important to note that the adopted avian monitoring program was not designed for, nor has it specifically targeted, the HIS. However, LADWP and ICWD have continued to implement this monitoring strategy to provide bird data that are comparable across pre-LORP and post-LORP years.

Survey Routes

There are 11 avian survey routes in the LORP Riverine-Riparian Area and from north to south they are: Goodale (GOOD), Blackrock Springs (BLRS), Crystal Ridge (CRRI), McIver (MCIV), North of Mazourka Canyon (ORMC), South of Mazourka Canyon (SOMA), Manzanar (MANZ), Alabama Gates (ALGA), Pangborn (PANG), Narrow Gauge (NAGA), and Delta (DELT). One additional route outside the LORP boundary, Owens River North of Tinemaha (ORTI), was established by Point Blue Conservation Science as a reference area (Heath and Gates 2002).

Point Blue Conservation Science determined that 11 transects with 15 points each would be enough to detect a 2 to 5 percent change in songbird numbers with 90 to 100 percent confidence (Heath and Gates 2002). Starting points for each survey route were selected randomly during establishment of the project. Each survey route consists of 15 point-count stations for a total of 165 point-count stations. The reference site, ORTI, has eight stations. Point-count stations are located approximately 250 m apart in the floodplain, on an adjacent bluff, or close to the active river channel.

During the 2022 surveys, some point-count stations were moved due to the expansion of marsh and the development of deep channels preventing access to previously established point-count stations. Point-count stations were relocated as close as possible to the previous points while maintaining the appropriate distance from each other (250 m), and placed adjacent to comparable vegetation types (**Figure 4-2**). Avian Monitoring Appendix 1 provides the coordinates and reach assignment for each point-count station and Avian Monitoring Appendix 3 provides a brief description, and representative photos of each survey route, including the reference site.

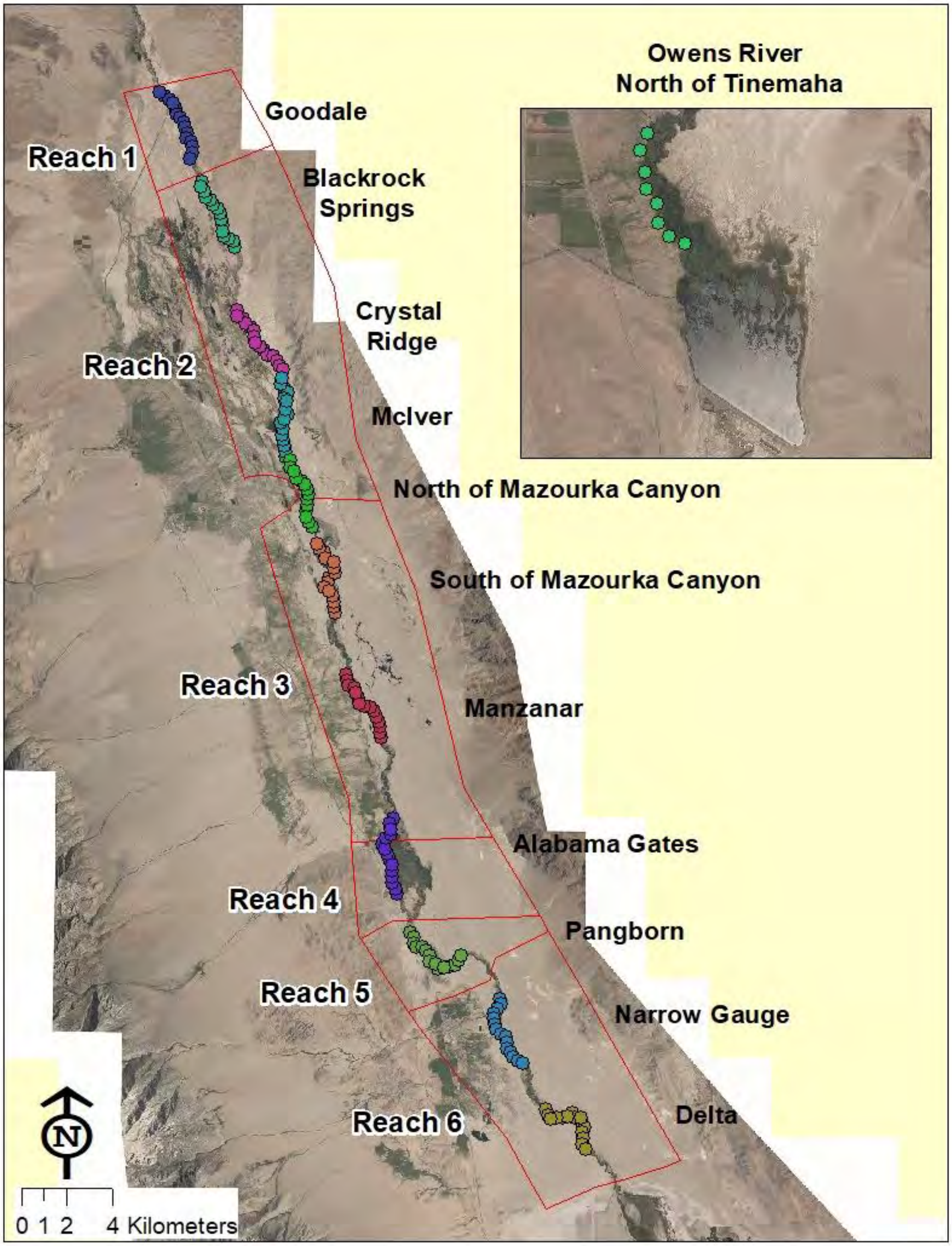

Figure 4-2. **LORP reaches and survey routes, and one reference site (inset).**

Point-Count Surveys

Routes were surveyed three times between May 16 and June 23, 2022, at approximately two-week intervals (**Table 4-1.** Survey Dates for Each Route.). The surveys began at the southernmost route (DELT) and continued north for each survey period. Surveys began within 30 minutes of local sunrise, and all point-count stations in a route were surveyed within 4 to 5 hours. Every effort was made to conduct surveys when weather conditions (e.g., wind speed) were optimal and detection rates were high. To minimize the effect of time of day on detection rates, the order in which a route was conducted was alternated between visits. Upon arrival at a point-count station, the observer waited approximately one minute before commencing the five-minute count period. This allowed birds to resume their activity after potentially being disrupted by the presence of the observer. Finally, to minimize observer bias, observers were rotated on the survey routes.

Table 4-1. Survey Dates for Each Route.

		SURVEY PERIOD		
		1	2	3
SURVEY ROUTES	**CODE**	**Date**	**Date**	**Date**
Owens River North of Tinemaha Reservoir	ORTI	23-May	9-Jun	23-Jun
Goodale	GOOD	20-May	8-Jun	22-Jun
Blackrock Springs	BLRS	19-May	7-Jun	21-Jun
Crystal Ridge	CRRI	19-May	6-Jun	17-Jun
McIver	MCIV	18-May	3-Jun	16-Jun
Owens River North of Mazourka Canyon	ORMC	18-May	3-Jun	16-Jun
South of Mazourka Canyon	SOMA	17-May	2-Jun	15-Jun
Manzanar	MANZ	17-May	2-Jun	15-Jun
Alabama Gates	ALGA	17-May	1-Jun	14-Jun
Pangborn Lane	PANG	16-May	1-Jun	14-Jun
Narrow Gauge	NAGA	16-May	31-May	13-Jun
Delta	DELT	16-May	31-May	13-Jun

Bird species were recorded using the variable-circular plot method, employing the following distance bands: <50 m, 50-75 m, 75-100 m and >100 m. Habitat use was documented by recording the vegetation community the bird was observed in when detected. The vegetation communities are the same as those used for vegetation mapping of the LORP Riverine-Riparian Area as described in Section 3.1. Bird activity was recorded using one of the following categories: foraging, perching, calling, locomotion, flying over (not using habitat), flushed, unknown and reproductive. If reproductive activity was noted, the specific evidence of breeding was also noted to determine breeding status.

4.4 Data Summary and Analysis

4.4.1 Vegetation analysis and habitat diversity

To describe the vegetation conditions during the 2022 surveys, and compare with the breeding bird analysis, the total acreage of each vegetation community within a 50-m buffer around each point was summed by point, route, and for all 165 point-count stations. The proportion of each community was calculated for all 165 point-count stations, and by route.

Habitat diversity was calculated using a transformation of the Shannon's diversity index (denoted N1) as described in Heath and Gates (2002).

$$N_1 = e^{H'} \text{ and } H' = \sum_{i=1}^{i=S} (pi)(\ln pi)(-1)$$

Where S is the total number of vegetation communities and p_i is the proportion of the total acreage in 50-m radius circle around each point count station. Differences in habitat diversity between river hydrogeomorphic states were examined for 2022 data using one-way ANOVA and the Tukey test (Jamovi 2.3.21).

4.4.2 Point Count Data Analysis

LORP Riverine-Riparian Bird Community

Use of the LORP Riverine-Riparian Area by all bird species was compiled as a general index to the diversity of avian life present, as "biodiversity" is an objective of the LORP. The totality of birds observed using the LORP Riverine-Riparian Area was evaluated using all detections within a 100-m radius of each point-count station (excluding flyovers). This distance was more inclusive, and less restrictive than the 50-m radius used for breeding birds, and allowed the inclusion of species with larger territories or that are more mobile. This metric of "all bird species" was used to provide an overall description of birds observed using the LORP Riverine-Riparian Area.

Waterbird and Landbird Species Richness and Abundance

The categories of waterbirds and landbirds were created to assess the diversity and functioning of the riverine-riparian ecosystem under the general habitat objective for the LORP Riverine-Riparian Area of creating and sustaining healthy and diverse riparian and aquatic habitats. Waterbirds were considered a general index to how the wetland and aquatic habitats are functioning, while landbirds were considered as a general index to the functioning of the riparian habitat.

Waterbirds included all species in the orders Anseriformes (ducks, geese, and swans), Podicipediformes (grebes), Gruiformes (rails), Charadriiformes (shorebirds, gulls, and terns), Gaviiiformes (loons) and Pelecaniformes (wading birds). For waterbirds, the total number of individuals observed within 100 m of each point-count station over all three surveys was summed for the entire LORP Riverine-Riparian Area.

Landbirds included all species in the orders Galliformes (quail), Columbiformes (doves), Cuculiformes (cuckoos), Caprimulgiformes (nightjars), Apodiformes (swifts and hummingbirds), Strigiformes (owls), Coraciiformes (kingfishers), Piciformes (woodpeckers), Falconiformes (falcons), and Passeriformes (perching birds). For landbirds, species richness was calculated by summing the total number of species observed at each point-count station within 100 m for the entire LORP Riverine-Riparian Area, as was done for all birds.

For landbirds and waterbirds, any unidentified species or hybrids were removed from further analysis. The spatial distribution of waterbird and landbird species is presented with a map of species richness per survey point.

Breeding Bird Diversity and Abundance

Data summary and analysis followed that described in Heath and Gates (2002) to allow for a comparison of the breeding bird indices over time, with some exceptions. We calculated breeding bird species richness, diversity, and abundance, but to improve the brevity and clarity of the report, are not presenting species richness. Species diversity is closely correlated with changes in species richness (Tramer 1969); consequently, we used the single index of species diversity for the breeding bird analysis.

Species eliminated from the breeding bird analysis included non-breeding migrant or transient species; species whose territories are typically large and where independence of observations between points cannot be assured; waterfowl (Anatidae), grebes (Podicipedidae), wading birds (Ardeidae), hawks (Accipitridae), shorebirds (Charadriidae and Scolopacidae), falcons (Falconidae), swallows (Hirundinidae), swifts (Apodidae) and Common Raven (Corvidae); and species that do not routinely vocalize including rails (Rallidae), owls (Strigidae and Tytonidae) and nightjars (Caprimulgidae). In addition, only individuals detected within 50 m from the observer were included in the analysis to eliminate double-counting, and flyovers were excluded since these birds did not appear to be using the habitat. All data were subsetted based on these criteria.

Determination of Breeding Status

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

> **Confirmed breeding**: Birds singing on territory all three surveys; nest material carry, nest found; fecal sac carry; distraction display; food carry; feeding fledglings; and independent juveniles with adults (family groups).
>
> **Probable breeding**: Territorial behavior more than once at same location; singing noted on two or more visits; courtship behavior; agitated behavior or distraction display; visiting nest site (such as cavity); and pair in suitable habitat.
>
> **Possible breeding**: Territorial behavior or singing noted only during one survey; also included species known to breed in Owens Valley and observed in appropriate habitat during the breeding season.
>
> **No evidence of breeding**: Includes seasonal migrants, species not known to breed in the Owens Valley, or species in the LORP Riverine-Riparian Area for which no breeding activity has been observed.

Breeding bird species diversity was calculated from the summed detections using a transformation of the Shannon's diversity index (denoted N1) as described in Heath and Gates (2002).

$$N_1 = e^{H'} \text{ and } H' = \sum_{i=1}^{i=S}(pi)(\ln pi)(-1)$$

Where S is total species richness and p_i is the proportion of the total numbers of individuals of each species (Nur et al. 1999). The species diversity index incorporates species richness (total number of species) and evenness (relative abundance). A high diversity index score indicates both high species richness and a more equal distribution of individuals among species. Bird communities dominated by a few very abundant species will have a lower diversity index than those in which the relative abundance of individual species is more even.

Mean breeding species diversity and abundance were calculated for each route, averaged across all point-count stations within the route. Differences in the means of each index were compared among the survey routes using one-way ANOVA, and the Tukey test (Jamovi 2.3.21).

Riverine-Riparian Habitat Indicator Species Analysis

There are 19 avian HIS for the LORP Riverine-Riparian Area (**Table 4-2**). These species are generally associated with riparian or wetland habitats. The presence of these species was thought to indicate whether the desired range of habitat conditions was being achieved (Ecosystem Sciences 2008). The list includes several special-status species including five California State Species of Special Concern, and three Federally- and/or State-listed species.

The occurrence and breeding status of HIS in the LORP Riverine-Riparian Area was determined using the breeding point-count survey data. HIS richness was calculated by summing the total number of species observed over the three surveys. This analysis was limited to detections <100 m from each point-count station to limit double-counting. However, it also allows detections of larger or non-territorial HIS such as Great Blue Heron. The breeding status of each HIS was assessed, following protocols used above.

Most of the HIS were found in low abundance, limiting any statistical inference. To better assess patterns of use, the avian HIS for the LORP Riverine-Riparian Area were placed into one of three categories: Riparian Obligate, Riparian Dependent, or Wetland-Associated (**Table 4-2**) based on Rich (2002) and expert opinion regarding local species habitat associations (LADWP and ICWD 2020). Riparian Obligate species are those that place >90% of their nests in riparian vegetation or for which >90% of their abundance in the breeding season occurs in riparian vegetation (Rich 2002). Riparian Dependent species are those that place 60-90% of their nests in riparian vegetation or 60-90% of their abundance is in riparian vegetation (Rich 2002). Wetland-Associated bird species are those whose distribution and abundance is expected to be more closely tied to wet meadow, marsh or swamp-like areas, which include a mix of wet meadow, marsh, and woody riparian vegetation.

Riverine-Riparian Bird Community Habitat Use

The vegetation communities in which bird species were observed were analyzed to characterize habitat use and associations. The number of birds observed in each vegetation community was totaled over the three surveys in 2022. These totals were limited to birds observed within a 50-m radius around each point-count station, and excluded flyovers. To determine habitat “availability”, the acreage of each vegetation community was totaled across all 165 point-count stations. Chi-squared goodness-of-fit along with the Bonferroni test were used to determine which vegetation communities were used more or less than expected, based on their availability.

Table 4-2. Habitat Indicator Species and Habitat Association.

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

4.5 Results

4.5.1 Vegetation analysis and habitat diversity

The LORP Riverine-Riparian Area is now a marsh- and meadow-dominated system. In 2022, the dominant vegetation communities within 50 m of all point-count stations were marsh, and meadow habitats including scrub-meadow, wet meadow, and meadow vegetation types (**Figure 4-3**). Woody riparian cover including trees and riparian scrub was a small component, averaging about 8% of the entire cover at all point-count stations combined. Open water averaged only 2.5% of the area sampled.

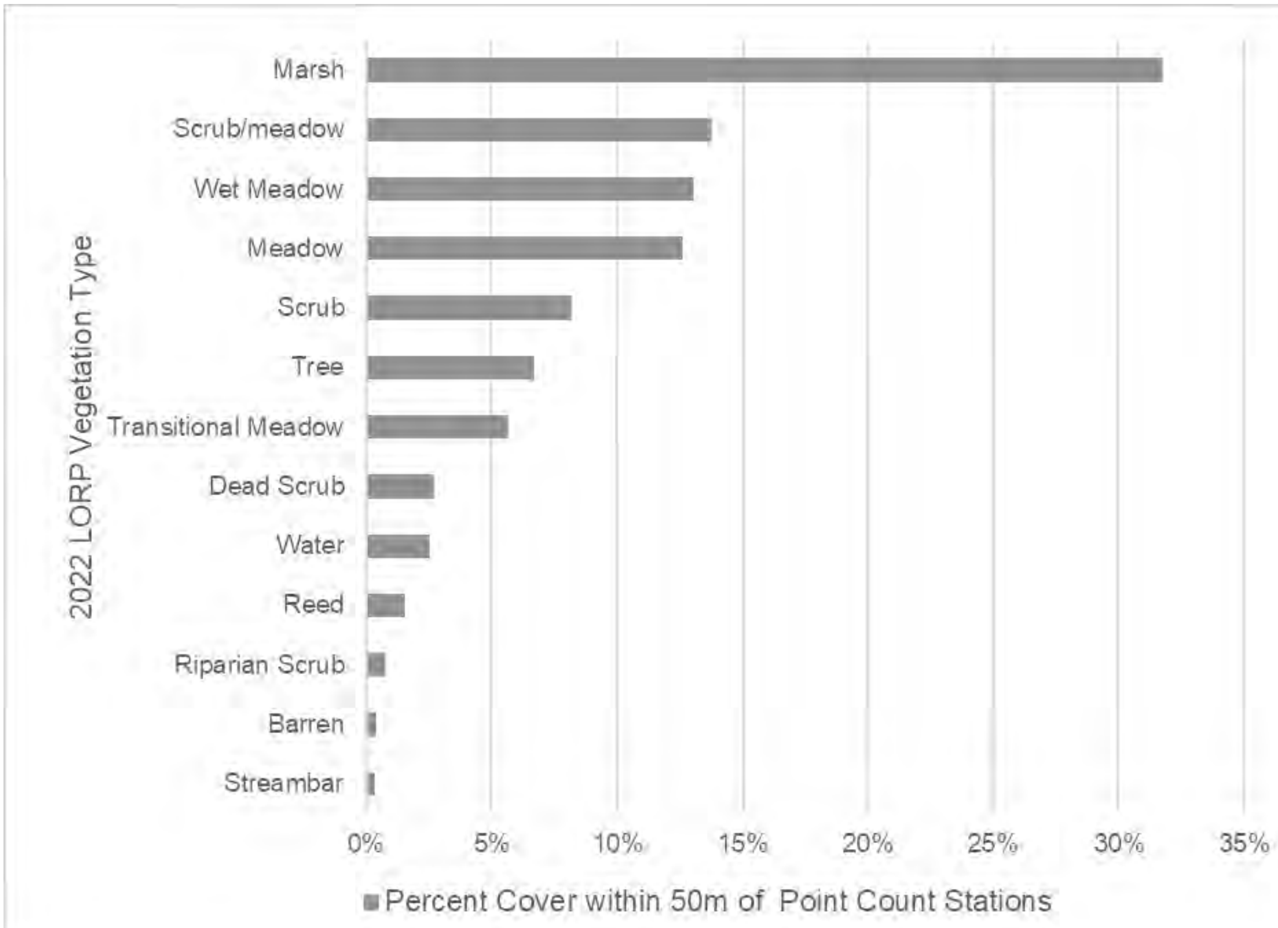

Figure 4-3. Vegetation Composition within a 50-m Buffer of All Point-counts Stations in the LORP Riverine-Riparian Area.

Marsh was the dominant wetland vegetation type along most routes, but lowest was on the CRRI, NAGA, and DELT Routes (**Figure 4-4**). Trees were most abundant on the PANG, ORMC, and ALGA Routes, and least numerous on the GOOD, BLRS, and CRRI Routes. Wet meadow habitats were most numerous from the ALGA, downstream to the PANG and NAGA Routes, but also in the upper reaches on the GOOD and BLRS Routes. Open water averaged 2.5% across all routes, and was highest on the MANZ Route at 4.2%.

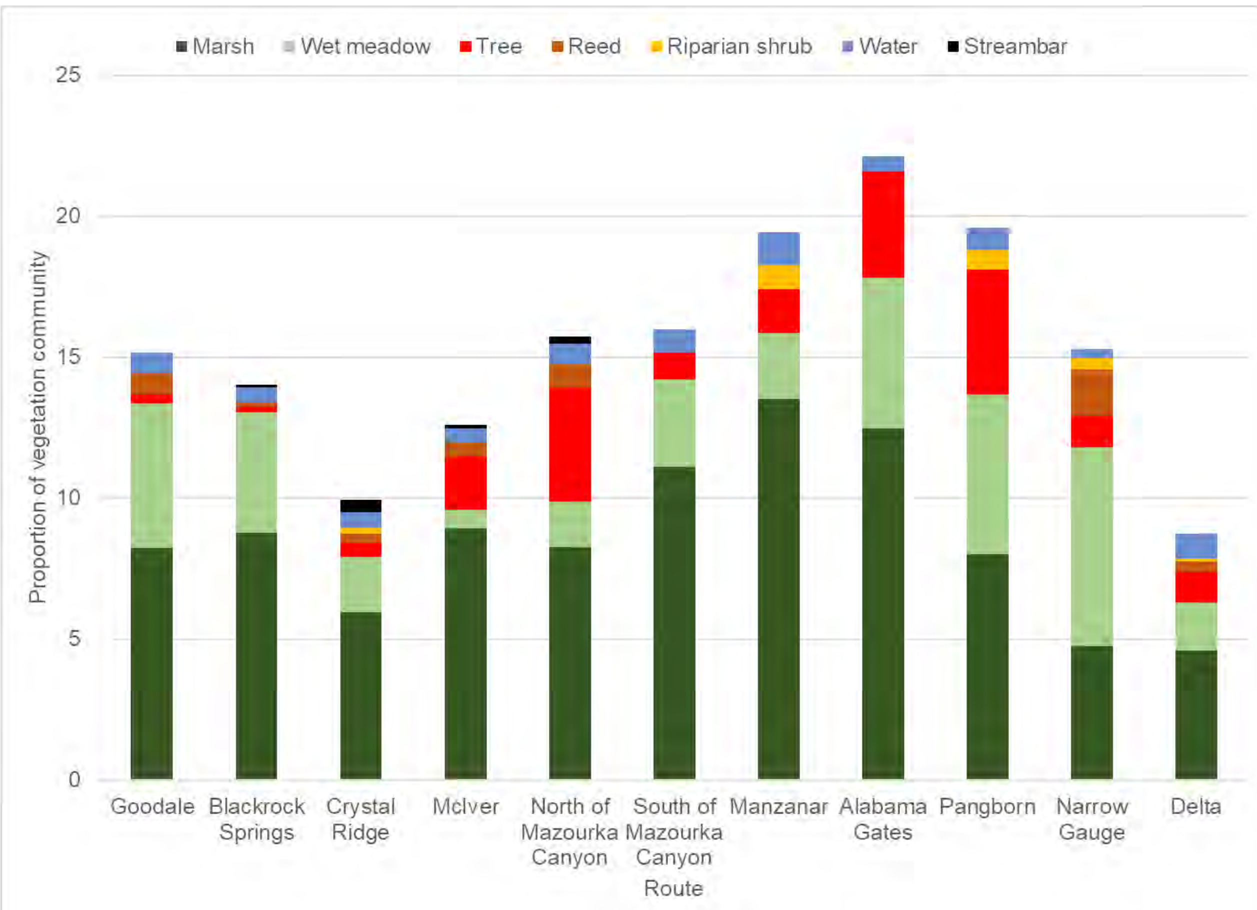

Figure 4-4. The Composition of Wetland Community Types Along Each Route, within a 50-m Buffer Around Point-count Stations. (Non-wetland types are not displayed, thus the bars representing proportion do not sum to 100.)

Habitat Diversity

The three most dominant vegetation types of incised, wet sites were scrub, marsh, and tree. Graded sites were dominated by marsh, meadow, and scrub/meadow. Aggraded sites were primarily marsh, wet meadow, and meadow (**Table 4-3**). The diversity of vegetation types differed among the three river states currently present in the LORP Riverine-Riparian Area (F=5.36, p=0.01). Aggraded sites had significantly lower habitat diversity than both incised, wet and graded sites (**Figure 4-5**). There was no significant difference in the vegetation diversity of incised, wet and graded sites.

Table 4-3. Vegetation Community Percentage for Each River State in the LORP.

Vegetation Community	INCISED WET	GRADED	AGGRADED
Barren	2.0%	0.7%	0.5%
Dead scrub	0.0%	0.0%	13.4%
Marsh	55.0%	56.1%	59.6%
Meadow	2.1%	30.9%	14.2%
Reed	0.0%	2.4%	3.8%
Riparian shrub	0.0%	0.9%	2.5%
Road	0.0%	0.5%	0.2%
Scrub	59.1%	14.2%	6.7%
Scrub/meadow	18.5%	34.3%	11.3%
Streambar	2.2%	0.3%	0.7%
Transitional meadow	2.1%	1.1%	25.9%
Tree	27.6%	11.4%	10.1%
Water	4.5%	5.5%	3.1%
Wet meadow	12.2%	26.0%	21.9%

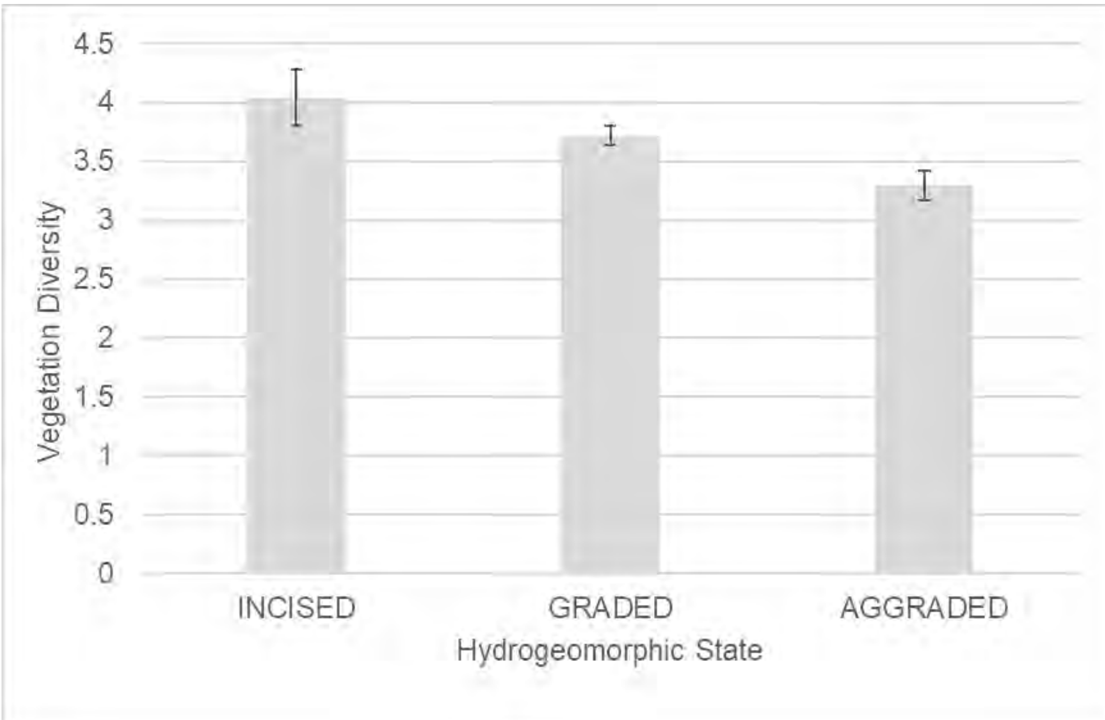

Figure 4-5. Vegetation Diversity (+/- SE) within 50-m of Point-count Stations by River State.

4.5.1 LORP Riverine-Riparian Bird Community

We recorded 5,442 individuals of 89 species in the LORP Riverine-Riparian Area in 2022. Up to 61 bird species were determined to breed in the LORP Riverine-Riparian Area including 27 confirmed, 17 probable, and 17 possible (Avian Monitoring Appendix 2). Twenty-eight of the 89 species detected were migrant or transient species, or those not known to breed in the LORP Riverine-Riparian Area. In addition to songbird breeding populations (analyzed below in “Breeding Bird Analysis”), the LORP Riverine-Riparian Area also supports breeding populations of waterbirds including waterfowl, bitterns, rails, and a few shorebird species.

4.5.2 Waterbird and Landbird Species Richness and Abundance

A total of 156 waterbirds of 15 species were observed. The most waterbirds and waterbird species were observed along the section of the river extending from the SOMA to NAGA Routes, and the fewest on the section of the river extending from the CRRI to ORMC Routes (**Table 4-4**). The most frequently encountered waterbird species (between 10 and 40 individuals) were (in descending order): Mallard, Killdeer, Gadwall, Virginia Rail, Great Egret, and Great Blue Heron. Mallard were primarily observed on four survey routes: ALGA, MANZ, NAGA, and PANG. Killdeer were mostly observed on the ALGA and DELT survey routes.

A total of 5,077 landbirds of 68 species were observed (**Table 4-5**). Of all routes, ALGA had the highest landbird abundance, largely influenced by the number of Red-winged Blackbird and Common Yellowthroat on this survey route (Avian Monitoring Table 4-6). This route, along with MANZ, also supported the most marsh. The PANG Route, which had the highest acreage of trees, supported the highest species richness. Landbird abundance and landbird species richness were lowest on the BLRS Route, which had the lowest tree acreage of any route.

The most abundant landbird species (between 800-1,200 individuals) were Red-winged Blackbird and Common Yellowthroat (**Table 4-5**). Other frequently encountered landbirds (between 100-400 individuals) included (in descending order): Song Sparrow, Brown-headed Cowbird, Western Meadowlark, Northern Mockingbird, Ash-throated Flycatcher, and Western Kingbird. Red-winged Blackbird had the highest abundance on the ALGA, MANZ, SOMA, NAGA, PANG, and ORMC survey routes. Common Yellowthroat had a similar abundance across all survey routes, except for DELT.

Table 4-4. Total Waterbirds and Waterbird Species per Survey Route.

	Route Code											No. of Each Species
Waterbird Species	**GOOD**	**BLRS**	**CRRI**	**MCIV**	**ORMC**	**SOMA**	**MANZ**	**ALGA**	**PANG**	**NAGA**	**DELT**	
Wood Duck						1						1
Cinnamon Teal								3				3
Gadwall		2			1	3	7	3	2			18
Mallard	4	1	2		1	3	8	6	6	6	1	38
Unidentified dabbling duck*											1	1
Pied-billed Grebe							2					2
Virginia Rail	1	1	2	4		2	1		4	3		18
Sora	2					1	2	1		2		8
American Coot										2		2
Black-necked Stilt											2	2
Killdeer	5					1	1	10	7	1	8	33
Least Bittern		1										1
Great Blue Heron	1				2	1	2	2	1	1		10
Great Egret						9				8		17
Snowy Egret										1		1
Black-crowned Night-Heron									1			1
Total Individuals per Route	*13*	*5*	*4*	*4*	*4*	*21*	*23*	*25*	*21*	*24*	*12*	156
Total Species per Route	*5*	*4*	*2*	*1*	*3*	*8*	*7*	*6*	*6*	*8*	*3*	*15*

*Unidentified dabbling duck not included in species count.

Table 4-5. Total Landbirds and Landbird Species per Survey Route.

	Survey Route Code											No. of Each Species
Landbird Species	GOOD	BLRS	CRRI	MCIV	ORMC	SOMA	MANZ	ALGA	PANG	NAGA	DELT	
California Quail			3		2			1	1			7
Eurasian Collared-Dove				1	1		3	7	18	13		43
White-winged Dove										2		2
Mourning Dove	7	3	11	9	14	3	31		2	8	6	94
Lesser Nighthawk			2	1	7	1	4	3	8	4		30
Common Nighthawk					1							1
White-throated Swift						4	2	1			1	8
Black-chinned Hummingbird									3			3
Costa's Hummingbird						1						1
Great Horned Owl						2	2	1				5
Downy Woodpecker							1					1
Hairy Woodpecker					8	2	1	1	2	1		15
Northern Flicker				6	8	4	9	5	12	4		48
American Kestrel				1	2		1	3	4	3	2	16
Ash-throated Flycatcher		1	11	16	25	12	13	14	29	28	19	168
Western Kingbird	2	1	2	4	6	9	28	8	22	21	15	118
Olive-sided Flycatcher										1		1
Western Wood-Pewee	1			1			1	2	1	2	3	11
Willow Flycatcher					1				2			3
Dusky Flycatcher						1		1				2
Black Phoebe	1			1	1	2	2	1	5			13
Say's Phoebe	1		4	1	1	3	1		1	3	2	17
Loggerhead Shrike	11	10	6	3	2	6	6	2	9	8	3	66
Black-billed Magpie					4		1	8			2	15
American Crow					1							1
Common Raven	1		3		1	1		2	6	17	3	34
Mountain Chickadee				1								1
Horned Lark	1							4				5
Tree Swallow						1						1
Violet-green Swallow			25						1		1	27
Northern Rough-winged Swallow	1					1		7	7			16
Barn Swallow	11			3				6			3	23
Cliff Swallow			1				3	15	9	20	5	53
Phainopepla								2				2
Blue-gray Gnatcatcher			1									1
Bewick's Wren	1	1	9	13	31		3		7	1	5	71
House Wren								9	9	9	1	28
Marsh Wren		5	2	7	3	2	15	42	2	6	4	88
LeConte's Thrasher	1		1		1		1		2	1		7
Sage Thrasher			1									1
Northern Mockingbird	13	13	7	7	9	17	33	3	27	11	31	171
European Starling					5	6		10	5		3	29
American Robin				2					4	1		7
House Sparrow										1		1
House Finch	9		2	1	5	3	2	5	14	3	5	49
Lesser Goldfinch						1		1	1			3
Black-throated Sparrow		2										2
Dark-eyed Junco			1	1	1							3
Bell's Sparrow		1			3			1				5
Savannah Sparrow		1						6				7
Song Sparrow	15	14	8	37	38	43	48	28	60	56	41	388
Spotted Towhee			10	4	5				1			20
Yellow-breasted Chat				2			1	5	1	1		10
Yellow-headed Blackbird		1									1	2
Western Meadowlark	47	25	30	3	4	27	14	20	14	22	17	223
Bullock's Oriole	5			4	4	1	6		9	1	2	32
Red-winged Blackbird	95	71	58	99	127	271	287	310	162	206	87	1773
Brown-headed Cowbird	23	7	37	31	38	40	23	32	60	51	28	370
Brewer's Blackbird						2				1		3
Orange-crowned Warbler					1							1
Common Yellowthroat	92	95	91	75	77	79	73	100	84	70	51	887
Yellow Warbler	1				1				1	1	4	8
Yellow-rumped Warbler											1	1
Wilson's Warbler	2	5		4	2		2	3	2		3	23
Western Tanager		2						1	1		2	6
Black-headed Grosbeak									1			1
Blue Grosbeak					3				1	1		5
Total Individuals per Route	*341*	*258*	*326*	*338*	*443*	*545*	*617*	*670*	*610*	*578*	*351*	*5077*
Total Species per Route	*22*	*18*	*24*	*28*	*36*	*28*	*30*	*37*	*41*	*33*	*30*	*67*

Breeding Bird Diversity and Abundance

Thirty-five of the 61 breeding species fit the criteria for inclusion into the analysis of long-term trends in breeding birds (**Figure 4-6**). Restricting the analysis to birds recorded within 50 m of the observer for these 35 species accounted for 2,564 individuals in the LORP Riverine-Riparian Area in 2022.

Across all 165 points, breeding bird diversity averaged 3.77 (**Figure 4-6**). Within each survey route, the mean breeding bird species diversity per point-count station ranged from 3.0 to 5.2. Mean breeding bird diversity was fairly uniform between routes, with the exception of PANG, which was notably higher (**Figure 4-6**). As was the case with landbird species richness, breeding bird diversity was highest on the PANG Route and was significantly higher than several routes including BLRS, CRRI, SOMA, MANZ, ALGA, and DELT (**Figure 4-7**). BLRS had the lowest species diversity in 2022, but was significantly different only from PANG. Species diversity did not differ significantly in pairwise comparisons between the other survey routes. The breeding bird community is currently dominated by four species that are primarily associated with marsh habitats: Red-winged Blackbird (32%), Common Yellowthroat (19%), Song Sparrow (7%), and Brown-headed Cowbird (9%). These four species comprised 67% of all breeding birds in 2022.

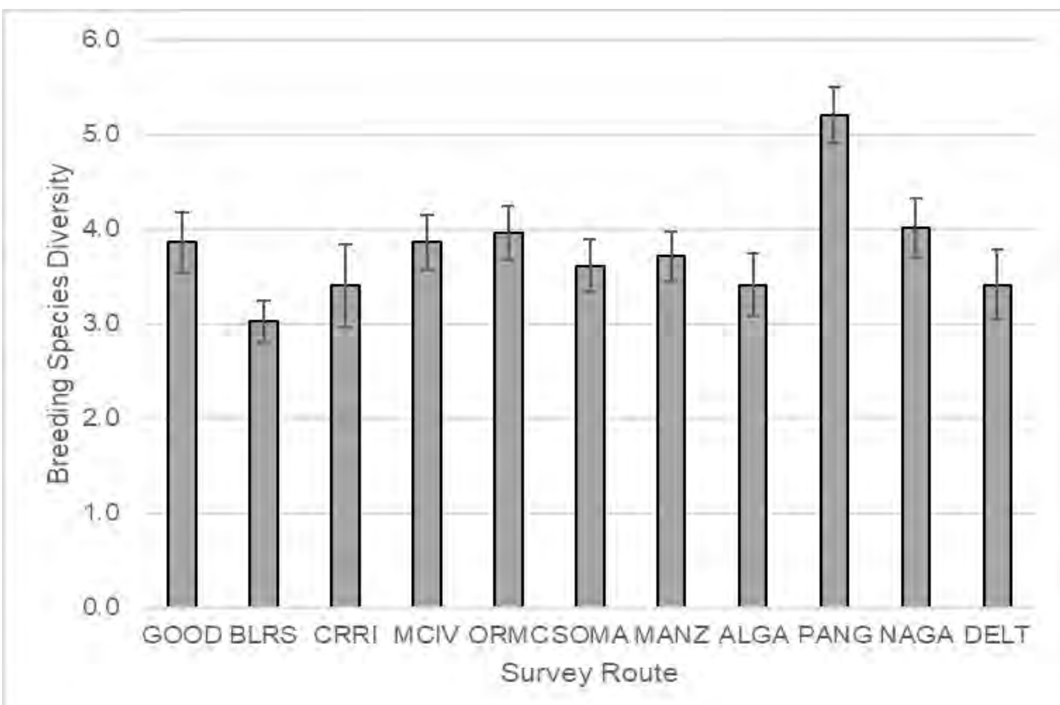

Figure 4-6. Mean Breeding Bird Species Diversity per Point-Count Station by Route.

Breeding bird abundance showed more variation among routes than diversity. On a per survey route basis, the mean breeding bird species abundance per point-count station ranged from 3.0 to 8.4. Breeding bird abundance was highest at ALGA and lowest at BLRS (**Figure 4-7**). Breeding bird abundance at ALGA was significantly higher than that found on several routes: GOOD, BLRS, CRRI, MCIV, ORMC, and DELT. Breeding bird abundance at the three lowest routes: BLRS, CRRI, and DELT were significantly lower than SOMA, MANZ, and PANG.

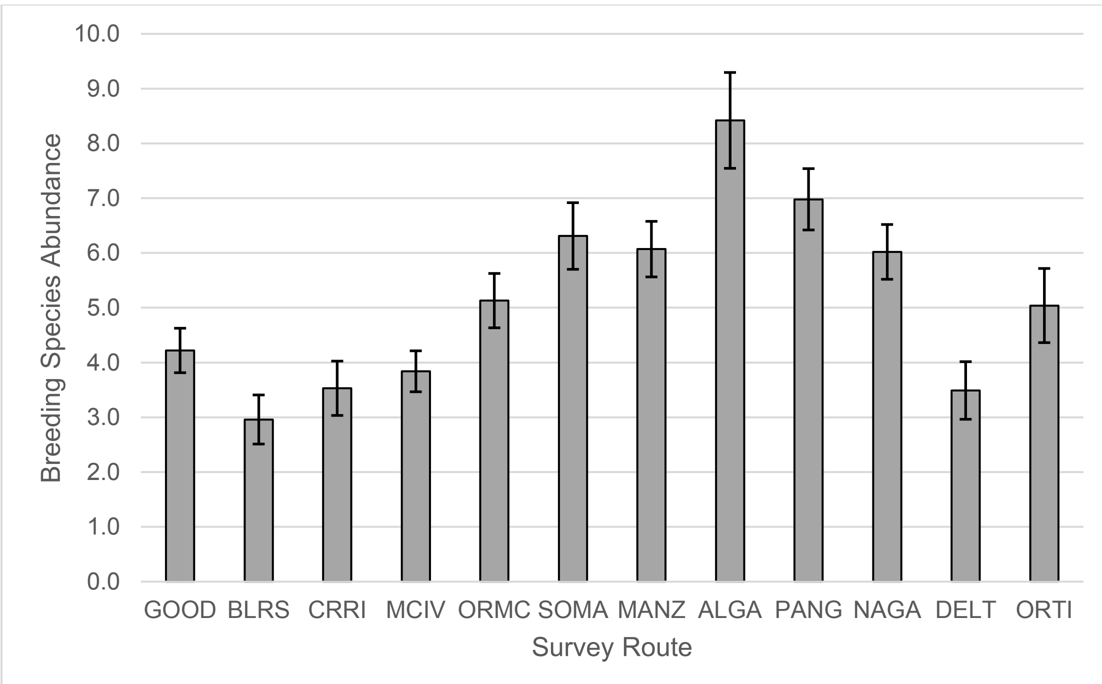

Figure 4-7. Mean Breeding Bird Species Abundance per Point-Count Station.

4.5.3 Riverine-Riparian HIS Abundance and Distribution

We observed 13 of the 19 avian HIS during 2022 surveys, and breeding activity was documented for 10 of these (**Table 4-6**). HIS were observed on all routes, with the most individuals seen on MANZ, MCIV, and NAGA. HIS richness varied from a low of two species seen on the DELT route, to seven species seen on both the PANG and NAGA routes.

Marsh Wren was the most abundant and widespread HIS, with 88 observed, and seen on all routes except GOOD. Marsh Wren was most abundant on the ALGA route, and seen in low numbers along all other routes, as compared to the number seen in ALGA. The next most abundant HIS were Virginia Rail (18 individuals), Great Blue Heron (12), and Yellow-breasted Chat (10). All other HIS were recorded in low numbers, totaling fewer than 10 individuals in 2022.

Table 4-6. **HIS Abundance and Richness by Survey Route.**

Habitat Indicator Species	**GOOD**	**BLRS**	**CRRI**	**MCIV**	**ORMC**	**SOMA**	**MANZ**	**ALGA**	**PANG**	**NAGA**	**DELT**	**TOTAL**
Wood Duck						1						1
Virginia Rail	1	1	2	4		2	1		4	3		18
Sora	2					1	2	1		2		8
Least Bittern		1										1
Great Blue Heron	3				2	1	2	2	1	1		12
Northern Harrier				4	1							5
Swainson's Hawk			*1*									*1*
Willow Flycatcher*					*1*				*2*			*3*
Tree Swallow*						*1*						*1*
Marsh Wren		5	2	7	3	2	15	42	2	6	4	88
Yellow-breasted Chat				2			1	5	1	1		10
Yellow Warbler*	*1*				*1*				*1*	*1*	*4*	*8*
Blue Grosbeak					3				1	1		5
Total Individuals By Route	**7**	**7**	**5**	**17**	**11**	**8**	**21**	**50**	**12**	**15**	**8**	**161**
Total Species	**4**	**3**	**3**	**4**	**6**	**6**	**5**	**4**	**7**	**7**	**2**	**13**

* No breeding activity observed for this species in 2022.

Of the three habitat association groups of the LORP Riverine-Riparian Area HIS, the Wetland-Associated species were by far most abundant (**Table 4-7).** Wetland-Associated species were present on all survey routes, and most numerous on ALGA. Riparian Obligate species were much less abundant, and absent on BLRS, CRRI, and SOMA survey routes. Only two Riparian Dependent species were observed in 2022. Section 4.5.4. discusses bird response to the vegetation communities.

Table 4-7. Total HIS by Habitat Association and Survey Route.

Survey Route	Riparian Dependent	Riparian Obligate	Wetland Associated
Goodale (GOOD)		1	6
Blackrock Springs (BLRS)			7
Crystal Ridge (CRRI)	1		4
McIver (MCIV)		2	15
Owens River North of Mazourka (ORMC)		5	6
South of Mazourka (SOMA)	1		7
Manzanar (MANZ)		1	2
Alabama Gates (ALGA)		5	45
Pangborn (PANG)		5	7
Narrow Gauge (NAGA)		3	12
Delta (DELT)		4	4
Total by Group	**2**	**26**	**133**

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Habitat Use in the Riverine-Riparian Area

The vegetation communities used most frequently by birds in the LORP Riverine-Riparian Area were “Marsh” and “Tree” (**Figure 4-8**). These vegetation community types were also used significantly more than expected based on the vegetation composition within the 50-m radius around each point-count station. The difference between the availability on the landscape and use by birds was particularly pronounced for trees.

Although “Riparian Scrub” was used slightly more, and “Water” water slightly less than expected, the differences were not statistically significant. All other habitats were used significantly less than expected.

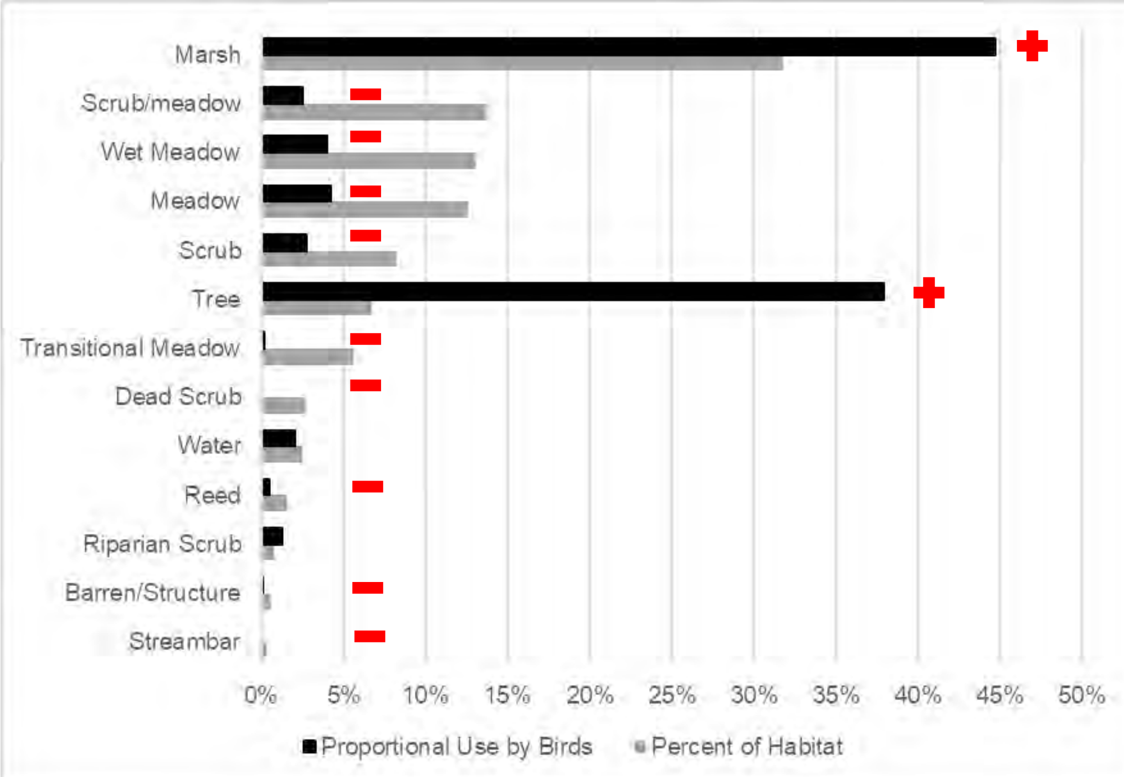

Figure 4-8. Habitat Use of Birds Observed in the LORP Riverine-Riparian Area in Comparison to Habitat Availability. The "+" or "-"indicate habitats used more than, or less than expected, based on available acreage.

4.5.4 Summary of Vegetation and Bird Response to Implementation of LORP

Vegetation Composition

The composition of the vegetation within 50 m of all point-count stations has changed in response to implementation of LORP, and other factors such as fire and increased precision of mapping products. The most obvious and consistent trend has been the steady increase in marsh over time (**Figure 4-9**). Wet meadow habitats have also increased notably in response to the establishment of perennial flow. Meadow habitats have remained essentially unchanged. Although there has undoubtedly been some loss of riparian tree cover due to fires, the loss is not as large as indicated in **Figure 4-9**; much of this reduction is presumably due to increased mapping precision. Water was much higher in 2010, due to a wet winter and cool spring. Open water was lower in 2015 and 2022 than 2010. The acreage of riparian scrub has increased slightly as compared to pre-project; however, no significant increase in riparian scrub has occurred in response to the establishment of perennial flow.

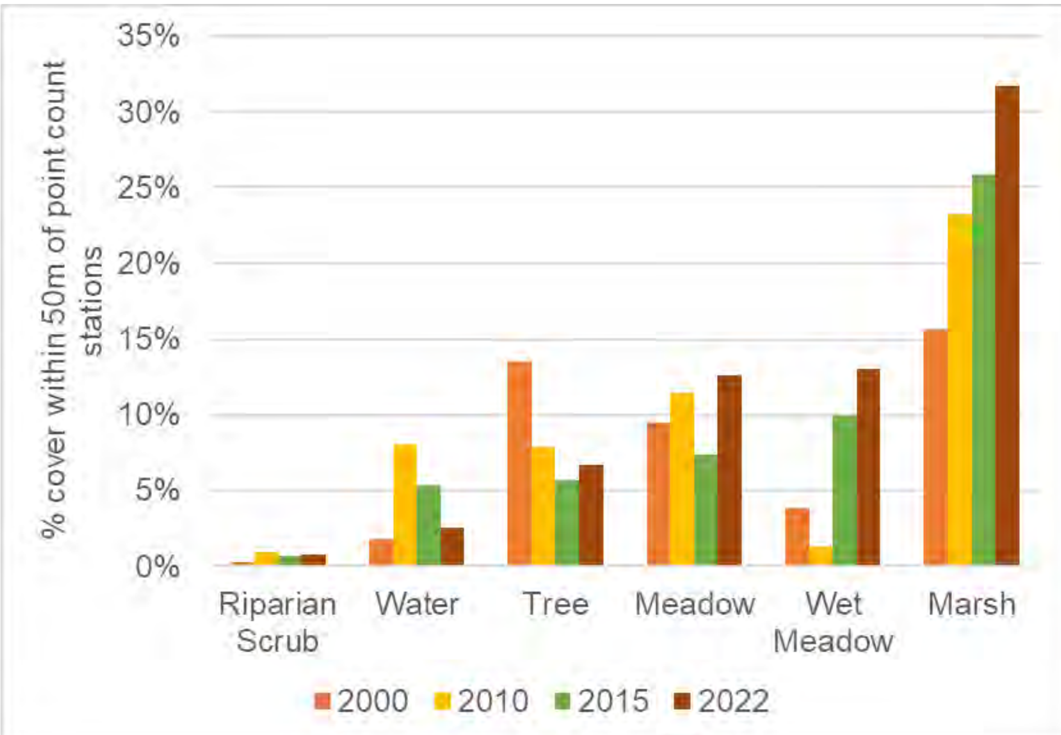

Figure 4-9. The Percent Cover of Wetland Community Types Within a 50-m Buffer of All Point-counts Stations in the LORP Riverine-Riparian Area, by Year of Mapping.

Point Count Data

The five seasons of breeding bird survey data collected over a 20-year period were evaluated by examining data pooled across all the LORP Riverine-Riparian Area survey routes. Trends in the LORP Riverine-Riparian Area were compared to those observed in the reference site (ORTI). However, it is important to note that the habitat conditions along the reference route of ORTI (Sanger Slough) are not only very different than those across the LORP Riverine-Riparian Area, but unique in the Owens Valley. Compared to the LORP survey routes, the ORTI site is structurally quite different than the LORP Riverine-Riparian Area as it is a very wide riparian woodland interspersed with marsh dominated by cattails, hard-stem bulrush, and wet meadows. The location just upstream of Tinemaha Reservoir is subjected to periodic flooding of the riparian woodlands with changing reservoir levels. A description of each survey route, and representative photos are provided in Avian Monitoring Appendix 2. Given the current management and trajectory of ecological succession, habitat on the LORP Riverine-Riparian Area is not expected to yield that observed at ORTI. Additionally, the limited number of point-count stations at ORTI (8), may limit statistical inference.

Waterbird and Landbird Species Richness and Abundance

Implementation of the LORP has resulted in an increase in both the number of waterbird species, and in waterbird abundance in the Riverine-Riparian Area (**Figure 4-10)**. Pre-project, the total number of waterbird species observed ranged from 12 to 13, and post-project between 15 and 19 species have been observed each monitoring period. As compared to species richness, larger increases have been seen in waterbird abundance. Pre-project, waterbird abundance ranged from 54 to 75 individuals, but waterbird abundance has ranged from 156 to 373 waterbirds since implementation of the LORP.

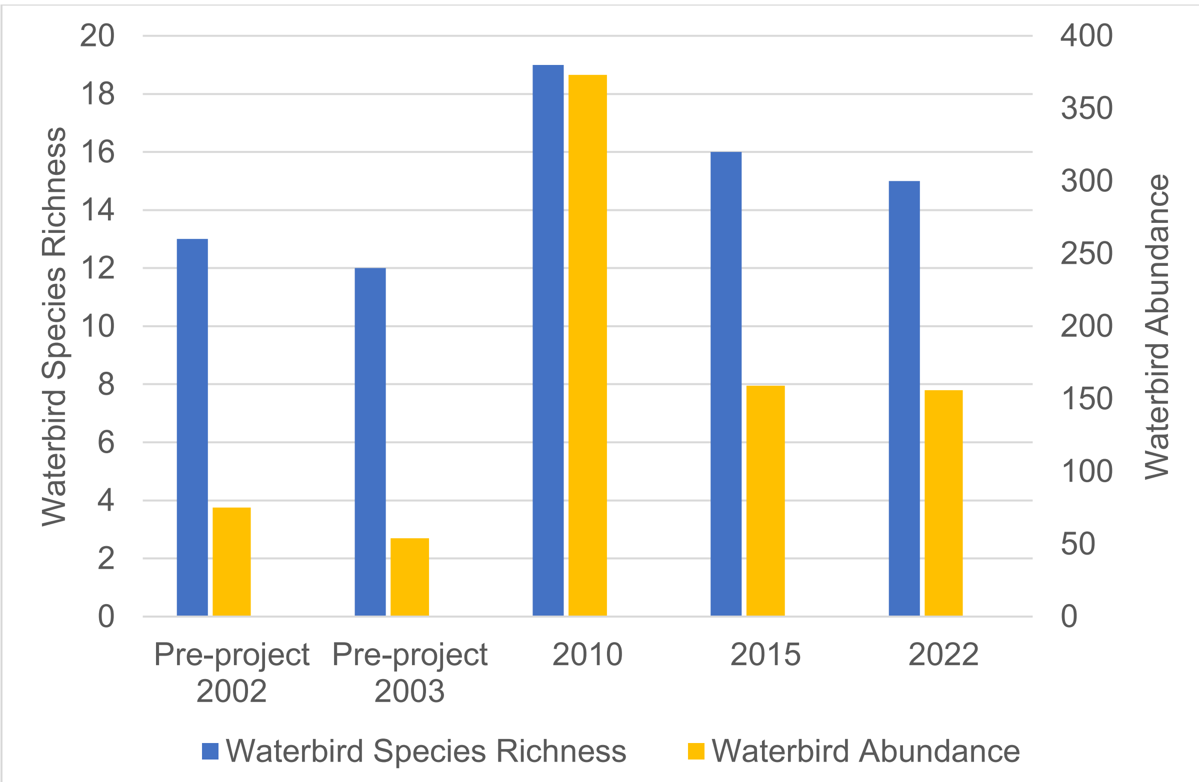

Figure 4-10 . Waterbird Species Richness and Abundance per Monitoring Period.

Implementation of the LORP has also increased both the number of landbird species, and landbird abundance in the Riverine-Riparian Area (**Figure 4-11**). Pre-project, the total number of landbird species observed was 61, and post-project between 69 and 81 species have been observed each monitoring period. Landbird abundance has increased more notably, ranging from 2,254 to 2,923 individuals per year (all three surveys combined) pre-project, to between 5,068 and 6,433 since implementation of the LORP.

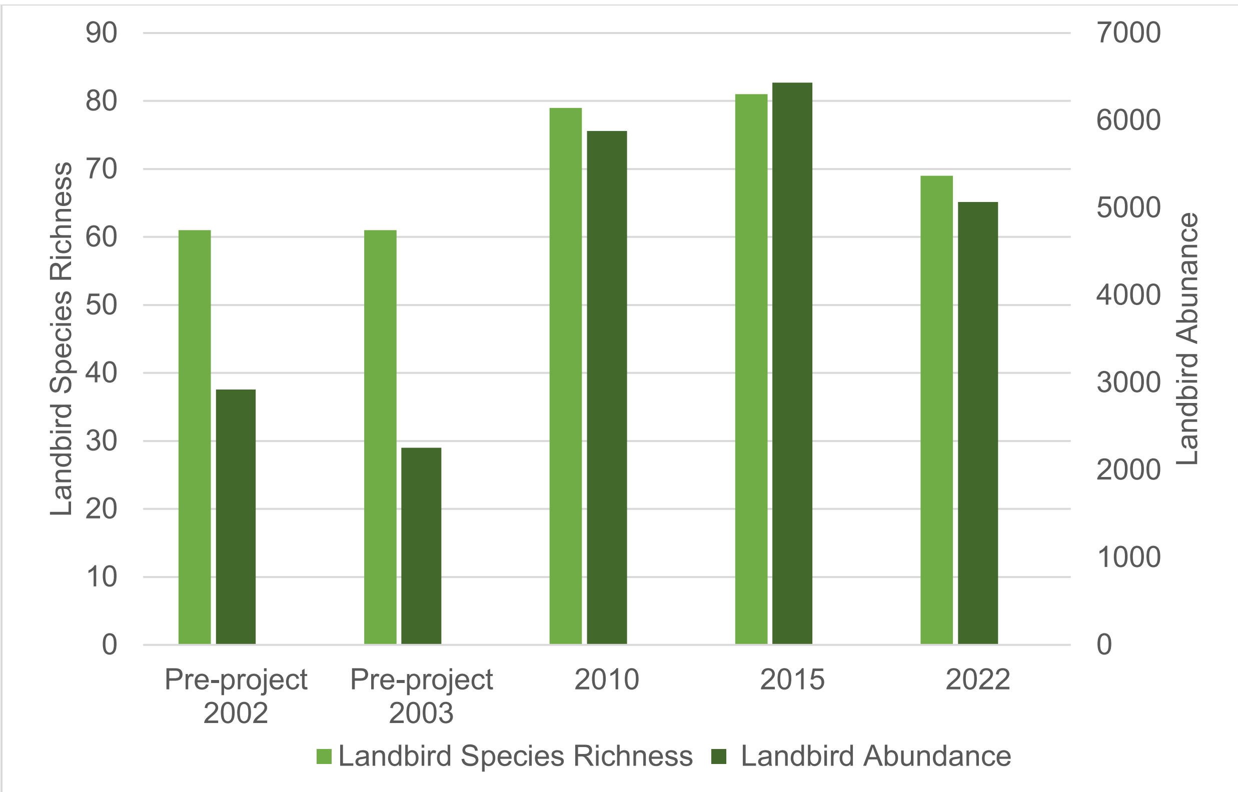

Figure 4-11. Total Landbird Species Richness and Abundance per Monitoring Period.

Breeding Bird Diversity and Abundance

Implementation of the LORP has increased breeding bird abundance, but not breeding bird species diversity in the Riverine-Riparian Area. Species diversity was lowest in 2022, although statistically not differing from 2003 (**Figure 4-12**). Breeding bird abundance post-LORP has been significantly higher than pre-project conditions.

Increases in breeding bird abundance are largely attributed to increases in the four most abundant species in the LORP Riverine-Riparian Area (**Figure 4-13**): Red-winged Blackbird (RWBL), Common Yellowthroat (COYE), Song Sparrow (SOSP), and Brown-headed Cowbird (BHCO). Over the entire monitoring period, Western Kingbird (WEKI) has been the fifth most abundant species. This species has been trending downward, and in 2022, numbers were significantly lower than all other years. Marsh Wren (MAWR) numbers have been higher the last two survey periods (2015 and 2022), but no consistent trend was detected.

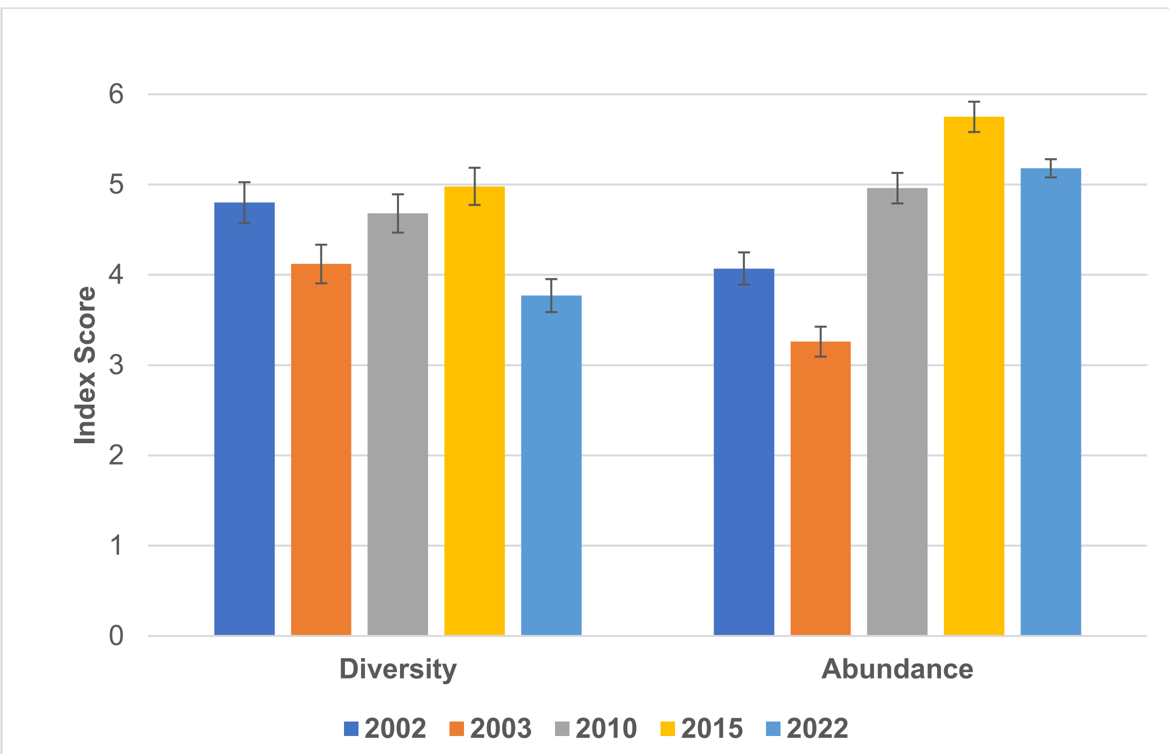

Figure 4-12. Mean Breeding Bird Species Diversity and Abundance in the LORP Riverine-Riparian Area Across the Monitoring Period (2002-2022).

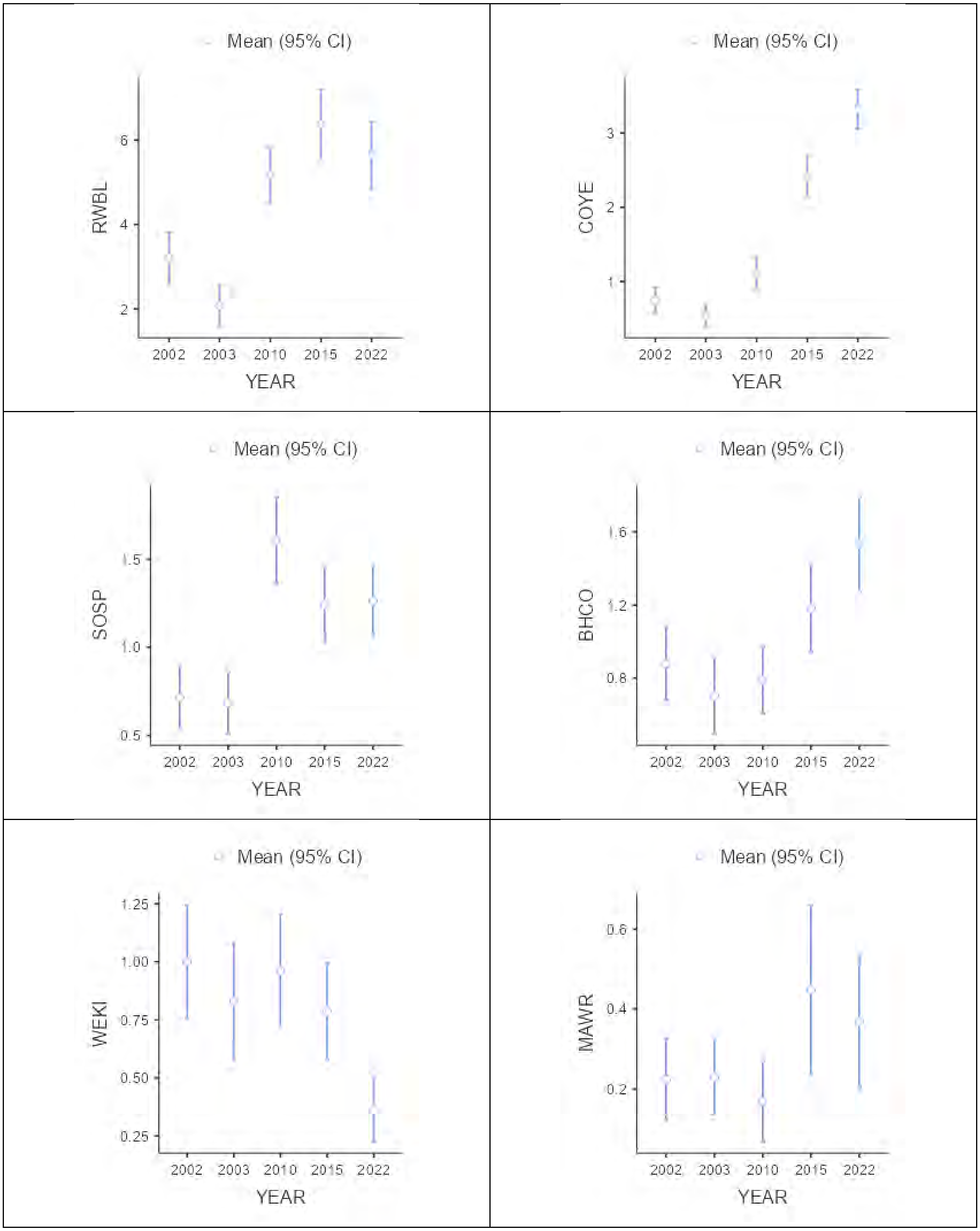

Figure 4-13. Trends in the Five Most Abundant Breeding Species, Plus Marsh Wren. Bird Codes are Displayed on the Y-Axis.

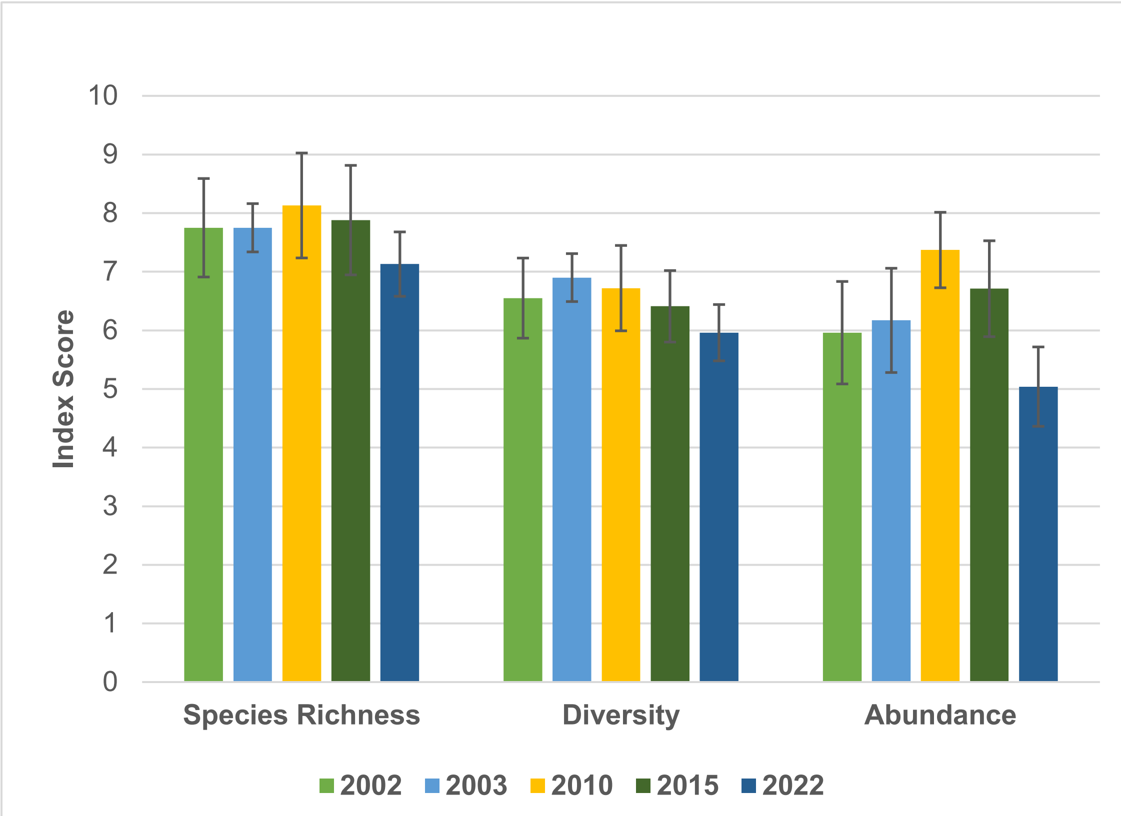

Figure 4-14. Mean Breeding Bird Species Diversity and Abundance on ORTI Across the Monitoring Period (2002-2022).

At the reference site (ORTI), there has been no significant difference across years in breeding bird species diversity (F=0.514, p=0.723), or abundance (F=1.49, p=0.247) (

Figure 4-14**)**. However, a failure to detect any difference among years could be attributed to the small sample size (i.e., 8 point-count stations).

Riverine-Riparian Habitat Indicator Species

Sixteen of the 19 avian LORP Riverine-Riparian Area HIS have been observed during breeding bird surveys over the 20-year monitoring period (**Table 4-8**). Two other HIS (Yellow-billed Cuckoo and Red-shouldered Hawk) have been observed during other surveys or via personal observation. Thus, in total, 18 of the 19 HIS have been observed in the LORP Riverine-Riparian Area. Of these, 11 have been confirmed or suspected to breed in the LORP Riverine-Riparian Area.

Since the implementation of the LORP, breeding habitat has been created for two HIS, Wood Duck and Yellow-breasted Chat. Prior to implementation of LORP, these two species were not recorded as breeding species in the LORP Riverine-Riparian Area. Breeding was suspected or confirmed for the two species in 2010, 2015, and 2022, but not in the pre-project years of 2002 and 2003. Although documented as a breeding species in all other years, Nuttall's Woodpecker was not detected in 2022. The species is likely still present in the project area, but the lack of any detections suggests lower numbers or a shift in distribution.

Table 4-8. Habitat Indicator Species Presence and Breeding Status in the LORP Riverine-Riparian Area During the Monitoring Period (2002-2022).

Habitat Indicator Species	2002	2003	2010	2015	2022
Wood Duck			Y	Y	Y
Yellow-billed Cuckoo					
Virginia Rail	Y	Y	Y	Y	Y
Sora	Y	Y	Y	Y	Y
Least Bittern			N		Y
Great Blue Heron	Y	Y	Y	Y	Y
Northern Harrier	Y	Y	Y	Y	Y
Red-shouldered Hawk					
Swainson's Hawk	Y		N		N
Long-eared Owl					
Belted Kingfisher	N				
Nuttall's Woodpecker	Y	Y	Y	Y	
Willow Flycatcher	N	N	N	N	N
Warbling Vireo	N		N	N	
Tree Swallow			N	N	N
Marsh Wren	Y	Y	Y	Y	Y
Yellow-breasted Chat			Y	Y	Y
Yellow Warbler	N	N	N	N	N
Blue Grosbeak	Y	Y	Y	Y	Y

* Species confirmed or suspected to breed are indicated by "Y", and those for which no evidence of breeding was observed are indicated by "N".

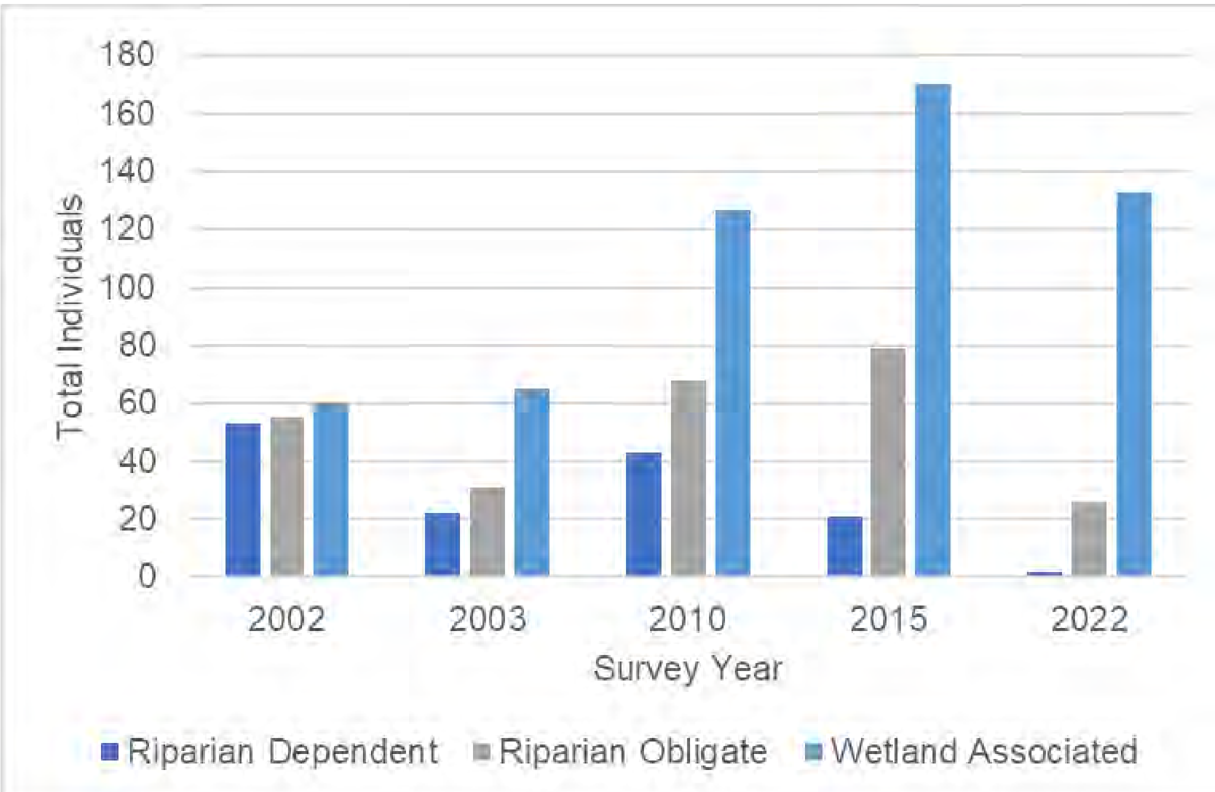

Figure 4-15. Total HIS by Group During the Monitoring Period (2002-2022).

The LORP has provided clear benefits to some HIS groups. Wetland-Associated HIS have increased in abundance since implementation of the LORP (**Figure 4-15**). No such response has been seen among the Riparian Dependent and Riparian Obligate HIS. Riparian Dependent species were less abundant in 2022 than any prior year. After slight increases in Riparian Obligates in 2010 and 2015, numbers in 2022 were similar to those observed in the pre-project year of 2003.

Variables Influencing the Avian Community of the Riverine-Riparian Area

Weak but significant correlations were found between the avian community of the LORP Riverine-Riparian Area and certain vegetation communities (**Table 4-9**). Trees were the only vegetation community that positively influenced both breeding bird diversity and breeding bird abundance. Breeding bird abundance was also influenced by water, marsh, and wet meadow habitats. Many of the drier communities including scrub and meadow showed weak, negative correlations with the indices.

These weak correlations suggest that vegetation community is not the only factor that may be affecting the distribution and abundance of breeding bird species. However, it is clear that trees play an important role, and positively influence the indices. In addition, the wetland habitats of water, marsh, and wet meadow contribute positively to breeding bird abundance. In contrast, meadow habitats (i.e., saltgrass dominated) and scrub habitats were associated with decreased breeding bird abundance.

Table 4-9. Correlations Between Breeding Bird Indices and Vegetation Communities. Positive correlations noted by green and negative correlations by yellow highlighting.

	Bird Community Index			
	Diversity		Abundance	
Vegetation Community	Pearson's r	p-value	Pearson's r	p-value
Water	0.065	0.147	*****0.189**	**< .001**
Marsh	0.021	0.647	*****0.278**	**< .001**
Wet meadow	0.070	0.118	*****0.266**	**< .001**
Tree	*****0.304**	**< .001**	*****0.226**	**< .001**
Riparian shrub	0.049	0.274	-0.019	0.679
Reed	-0.041	0.360	-0.045	0.314
Streambar	-0.083	0.064	****-0.139**	**0.002**
Meadow	-0.080	0.074	***-0.113**	**0.012**
Scrub/meadow	0.007	0.873	-0.012	0.791
Transitional meadow	***-0.098**	**0.029**	*****-0.187**	**< .001**
Scrub	-0.064	0.152	*****-0.198**	**< .001**
Dead scrub	****-0.147**	**0.001**	*****-0.173**	**< .001**
Barren	0.016	0.720	-0.033	0.468

* p < .05, ** p < .01, *** p < .001

Correlation analysis for the LORP Riverine-Riparian Area HIS showed a few weak relationships (**Table 4-10**), possibly due to the low numbers of individuals present. Riparian Obligates were weakly associated with the acreage of trees in the riparian corridor. Wetland-Associated species were weakly, but positively associated with marsh and wet meadow.

Table 4-10. Correlations Between LORP Riverine-Riparian Area HIS Groups and Vegetation Communities. Positive correlations noted by green and negative correlations by yellow highlighting.

	Habitat Indicator Species Group					
	Riparian Obligate		Riparian Dependent		Wetland Associated	
Vegetation Community	Pearson's r	p-value	Pearson's r	p-value	Pearson's r	p-value
Water	-0.013	0.775	-0.042	0.352	0.050	0.271
Marsh	0.022	0.628	0.062	0.171	*****0.211**	**< .001**
Wet meadow	0.041	0.367	0.044	0.327	*****0.31**	**< .001**
Tree	*****0.163**	**< .001**	0.021	0.641	-0.063	0.159
Riparian shrub	0.076	0.089	0.038	0.400	0.023	0.614
Reed	0.041	0.363	-0.048	0.282	-0.009	0.837
Streambar	-0.027	0.550	-0.041	0.360	0.005	0.911
Meadow	-0.033	0.467	-0.031	0.490	-0.052	0.246
Scrub/meadow	-0.065	0.148	-0.016	0.725	-0.072	0.110
Transitional meadow	-0.031	0.493	-0.047	0.302	-0.060	0.180
Scrub	-0.010	0.819	0.042	0.347	****-0.122**	**0.007**
Dead scrub	-0.073	0.105	-0.046	0.310	-0.059	0.193
Barren	0.027	0.555	-0.030	0.505	-0.047	0.294
Vegetation Diversity	****0.144**	**0.001**	0.012	0.783	*****-0.176**	**< .001**

* $p < .05$, ** $p < .01$, *** $p < .001$

Bird Communities vs. River State

The hydrogeomorphic river state influences bird communities in the LORP Riverine-Riparian Area. Breeding bird communities of the dry, incised channel (that comprised almost 30% of the LORP Riverine-Riparian Area pre-project) had significantly lower species diversity and abundance than all other hydrogeomorphic river states (**Figure 4-16.** Breeding Bird Indices Versus River State.). Thus, implementation of the LORP and the conversion of dry, incised channel to other states increased bird diversity and abundance, at least initially.

Diversity has shown a declining trend with river aggradation, such that breeding bird diversity is significantly lower in areas where the channel is aggraded than in areas where the channel is wet, but incised.

Breeding bird abundance has shown the opposite pattern, as abundance increases with river aggradation, and abundance has been significantly higher in aggraded areas than all other river states. Aggraded areas are dominated by marsh, which is a structurally simple and homogeneous habitat. While marsh habitat has increased over time because aggradation leads to increases in marsh, this habitat supports only a few bird species such as, Red-winged Blackbird and Common Yellowthroat. Consequently, with only a few species benefiting from an increase in marsh habitat, there has not been a significant increase in avian species diversity.

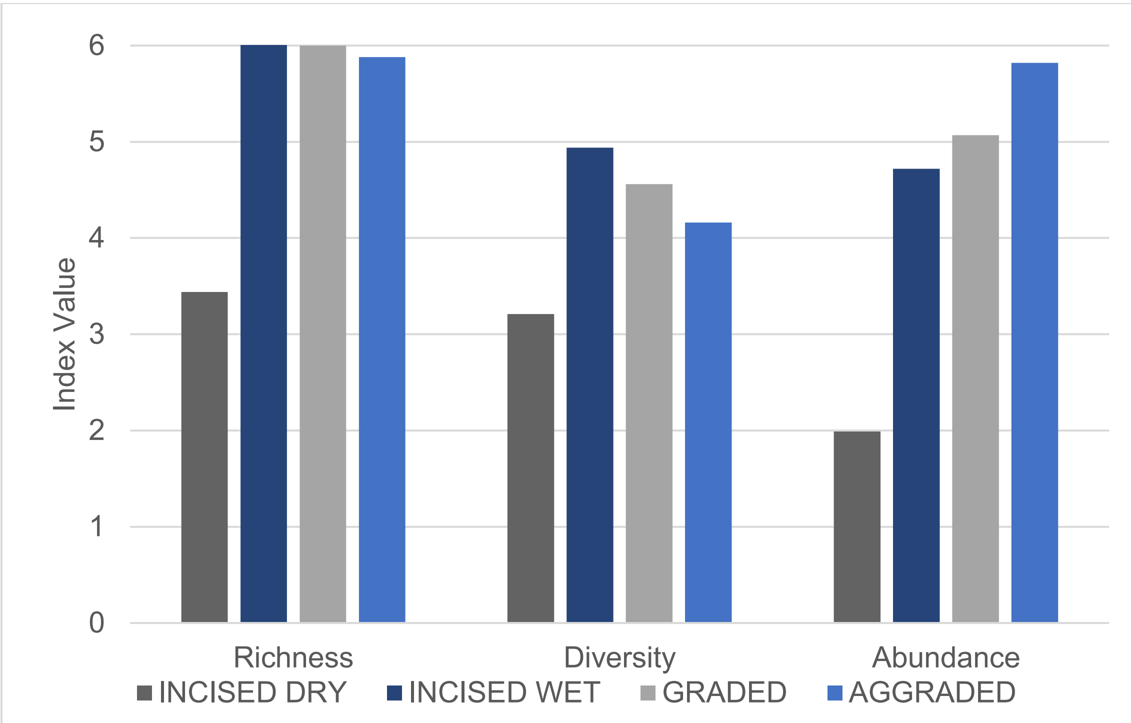

Figure 4-16. **Breeding Bird Indices Versus River State.**

Wetland-Associated species have been very responsive to river state (**Figure 4-17**). Not unexpectedly, the number of Wetland-Associated birds in incised, dry channel was significantly lower than all other river states. The number of Wetland-Associated HIS seen in incised, dry and graded river areas has been similar. Aggraded areas of the river have supported significantly more Wetland-Associated HIS than other river states.

The number of Riparian Obligate and Riparian Dependent LORP Riverine-Riparian Area HIS has not been influenced by river state, although a slight numerical decline may be occurring among the Riparian Obligates. These two species groups require tree cover, and if anything, tree cover is decreasing slightly over time. Because tree cover is low to begin with, and no large changes in tree cover have occurred, it is not surprising that the Riparian Obligate and Riparian Dependent species numbers have remained low, despite LORP implementation.

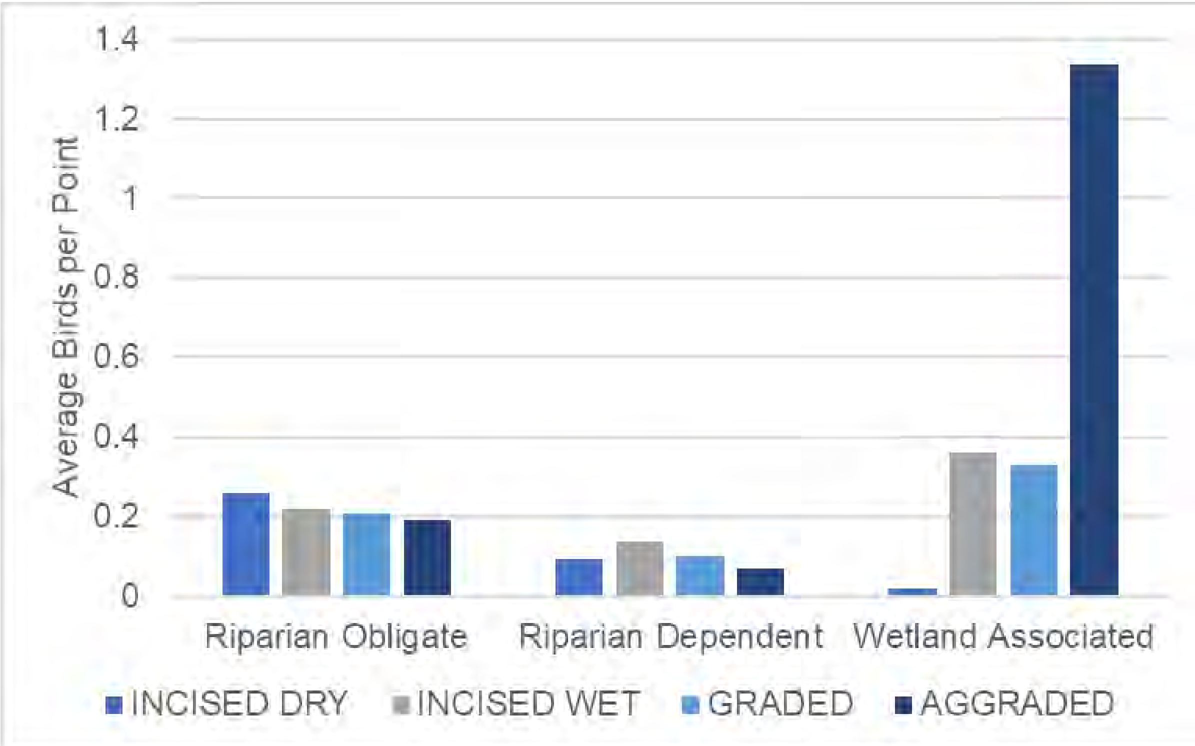

Figure 4-17. HIS Group Abundance Versus River State.

4.6 Discussion

The avian monitoring program for the LORP Riverine-Riparian Area has allowed us to evaluate the relationship between bird species and project-related changes in habitat. One of the overarching goals for the LORP Riverine-Riparian Area included establishing a self-sustaining riverine-riparian ecosystem that is healthy, functioning, and benefits biodiversity, and Threatened and Endangered Species. Another goal was to create and maintain diverse natural habitats consistent with the needs of "HIS". These goals were to consider human, financial, and biological aspects (MOU 1997). The 1997 MOU did not, however, identify quantitative habitat or population goals for the LORP HIS. Consequently, the focus was to create "desirable" habitat for the HIS (LADWP et al. 2004). Below we discuss the findings of the avian monitoring program, and how they relate to the goals described above.

Over the 20-year monitoring period, 134 bird species have been recorded in the LORP Riverine-Riparian Area during the breeding bird surveys. This number represents almost 1/3 of the 434 species recorded in Inyo County (https://ebird.org/region/US-CA-027?yr=all). A combined total of 74 species have been documented to have bred. Breeding bird diversity is at least comparable to some other riparian sites in Inyo County based on our review of other local studies. Point Blue Conservation Science conducted breeding bird surveys at several other riparian sites in Inyo County and documented an average breeding diversity of 3.93 (range 2.18-10.51). The mean breeding bird diversity for all 165 point-count stations in the LORP Riverine-Riparian Area in 2022 was 3.77. So, while at the low end of the scale, breeding bird diversity is in the range observed at other riparian sites in Inyo County (Heath et al. 2001). Reflective of the current habitat conditions, the breeding bird community is currently dominated by four species that are primarily associated with marsh habitats: Red-winged Blackbird, Common Yellowthroat, Song Sparrow and Brown-headed Cowbird.

The average per point-count station breeding bird abundance in the LORP Riverine-Riparian Area of 5.18 is, on average, higher than that observed at other riparian sites in Inyo County of 2.78.

General trends in indices were compared to the ORTI reference site; however, comparisons of avian response to the LORP to the reference site were challenging due to an insufficient number of points (8) on the ORTI survey route, and the differences in the habitat at ORTI versus the LORP Riverine-Riparian area sites. Point Blue Conservation Science selected the ORTI reference site for comparison purposes; however, it did not provide an explanation as to why ORTI was chosen as a reference site, or why the number of point-count stations on this route were so few compared to all LORP routes. It is possible ORTI was chosen as a reference site because it was assumed, with implementation of the LORP, habitat would be similar to that at the reference site; however, as noted before, the ORTI site is not only very different from most habitats on LORP, but also a unique habitat area in the Owens Valley. Data from the eight points on the reference route had enough variability that statistical tests were unable to detect differences between sampling periods for some indices. Species diversity appeared to decrease slightly at the reference site as was seen in the LORP Riverine-Riparian Area. In contrast to that observed in the LORP Riverine-Riparian Area, however, abundance decreased slightly at the reference site, although statistical differences could not be detected between years for ORTI. It is unknown to what extent changes in the LORP Riverine-Riparian Area bird community (such as decreases in diversity), are influenced by larger scale factors such as regional drought or population fluctuations.

Since project implementation, and the reestablishment of perennial flow throughout the entire Lower Owens River, there has been a net increase of 1,500 acres (24%) of hydric vegetation (Jensen 2023), primarily marsh and wet meadow habitats. The river system is aggrading, and consequently, marsh continues to spread, encouraging further aggradation of the channel, as the marsh vegetation slows and spreads the flow (Jensen 2023). Although wet meadow habitats have increased, the increases in hydric vegetation have not included significant increases in vegetation important to bird diversity including riparian trees (*Salix gooddingii*, *S. laevigata*, and *Populus fremontii)* and riparian shrubs (e.g., *S. exigua*, *Rosa woodsii*, *Forestiera pubescens*). Given the current management of the LORP Riverine-Riparian Area, the marsh system appears to be self-sustaining, as evidenced by the continued increase in acreage. In contrast, there has been very limited recruitment of woody riparian vegetation (e.g., trees and shrubs), and some loss through fire and flooding. Therefore, the riparian habitat does not appear to be self-sustaining because, without recruitment, tree cover in particular will decline over time. The limited tree cover in the LORP Riverine-Riparian Area will limit species diversity, but the high bird abundance, at least in marsh and wet meadow habitats, suggests that these habitats are healthy and productive.

As reflected in our results, habitat diversity decreases with aggradation as homogeneous stands of *Typha* spp., and/or *Schoenoplectus* spp. become dominant. The trend in bird indices are also reflective of habitat and vegetation changes in the LORP Riverine-Riparian Area. The addition of water and resulting substantial increase in acreage of hydric vegetation has increased foraging and nesting opportunities for bird species that use marsh and meadow systems, such as Red-Winged Blackbird, Common Yellowthroat, and Song Sparrow. Habitat changes in the LORP Riverine-Riparian Area have increased bird abundance in these species, but the loss of habitat diversity may be causing reduced species and diversity.

Riparian trees appear to be a preferentially-used vegetation type in the LORP Riverine-Riparian Area, and add significantly to the species diversity, and abundance of the bird community. For example, the PANG survey route, which supported the highest tree cover, also had the highest breeding species diversity. Trees add structure and habitat complexity not afforded by marsh or meadow habitats. In the LORP Riverine-Riparian Area, birds regularly use isolated or small patches of trees as singing perches, for territorial surveillance, and for nest placement. Breeding bird species forage in these trees, and migrant songbirds are regularly seen stopping at trees in migration to rest and feed. Tree cover, however, is limited in the LORP Riverine-Riparian Area, and generally consists of small stands or isolated trees. Based on a review of vegetation mapping polygons of the entire LORP Riverine-Riparian Area (Jensen 2023), the average polygon size for the tree community type is 0.038 acres (single isolated trees), and the largest polygon, representing continuous cover by a patch of trees, is only 8.5 acres.

In relation to the goal of establishing a riverine-riparian ecosystem that is healthy, functioning, and benefits biodiversity and Threatened and Endangered Species, the LORP has resulted in an increase in breeding bird abundance, and the establishment of a breeding bird community with a diversity comparable to other riparian sites in Inyo County. However, abundance is largely dominated by four common bird species that rely on marsh habitat. At present, marsh habitat is expanding due to aggradation. Aggraded river reaches have less vegetation diversity, and consequently, less bird diversity. Under current management of the LORP, we expect this trend to continue. Conversely, woody riparian vegetation has not increased in the LORP Riverine-Riparian Area, and in the absence of recruitment, we expect there will be a gradual loss of this vegetation type over time. This will also result in a decrease in bird diversity over time.

It is a challenge determining whether the goals of the LORP Riverine-Riparian Area have been met regarding HIS, because there is a lack of specifics regarding the expectations or objectives. As mentioned above, the 1997 MOU did not quantify acres of habitat or number of HIS needed to meet the goals of the LORP. The HIS were supposed to “represent the range of habitat conditions” that were “desired to be achieved” for the LORP Riverine-Riparian Area (Hill and Platts 1997).

The response of the 19 avian HIS to implementation of the LORP has been mixed. Of the avian HIS, 18 have been observed in the LORP Riverine-Riparian Area. The only HIS not observed during the surveys is the Long-Eared Owl. It is likely that Long-eared Owl also uses the area, as the species occurs in in similar habitats throughout the Owens Valley (D. House, pers. obs.). Based solely on confirmed and suspected presence, one could conclude that the LORP Riverine-Riparian Area is “meeting the habitat needs” of the HIS. Although if the intent of meeting the needs of the HIS includes providing habitat for breeding, or to increase local populations, then the LORP Riverine-Riparian Area is only meeting that goal for some of the HIS.

Over the monitoring period, 11 HIS have been confirmed or suspected of breeding in the LORP Riverine-Riparian Area. As mentioned above, Wetland-Associated bird species have shown a clear benefit from the LORP, with significantly higher numbers in all survey years as compared to pre-project surveys. In 2022, Riparian Dependent and Riparian Obligate HIS were detected in the lowest numbers of all survey periods. Several of the Riparian Dependent and Riparian Obligate HIS regularly use the LORP Riverine-Riparian Area in migration; however, the amount, distribution, and structure of woody riparian cover is insufficient to support significant breeding populations of these groups.

In summary, it was anticipated that the goals of the LORP, which focus on habitat, would be met primarily through flow and land management. The avian monitoring program has demonstrated that the LORP has resulted in an increase in bird diversity and abundance, but suggests that bird diversity will decline over time with the expansion of marsh and loss of woody riparian vegetation. The avian monitoring program has also documented that HIS are, or are likely to be, using habitat in the LORP Riverine-Riparian Area. Current management is such that it clearly provides a benefit for those HIS that rely on marsh or are considered Wetland-Associated Species. HIS considered Riparian Obligates or Riparian Dependent have a limited amount of habitat as the only existing habitat is single trees, or small patches of trees and little to no woody vegetation recruitment. It is our conclusion that the LORP Riverine-Riparian Area goals have not been met because current management of the LORP is not likely to sustain habitat that will support both bird diversity and abundance, or the HIS.

4.7 Recommendations

Adopt Land Management Practices That Protect Existing Woody Riparian Vegetation
Based on the trajectory of the LORP system, it does not appear that significant increases in woody riparian cover should be expected. Natural recruitment has also been limited. Due to the importance of riparian vegetation to wildlife, we recommend ensuring land management practices protect existing riparian trees (*Salix gooddingii*, *S. laevigata*, and *Populus fremontii)* and riparian shrubs (e.g., *S. exigua*, *Rosa woodsii*, *Forestiera pubescens*) because of their value for foraging, nesting, and cover.

Evaluate the Feasibility of Localized Habitat Enhancement
There may exist opportunities to make local enhancements of woody riparian species to help support wildlife, even if large stands of riparian vegetation needed to support some species are not anticipated. Since little tree recruitment has occurred, it should be acknowledged that even if planting trees is feasible, the habitats may not be self-sustaining. Still, creating larger stands of trees along the LORP Riverine-Riparian Area would result in localized habitat enhancement for wildlife.

We suggest investigating whether suitable areas exist for establishing pole plantings of riparian trees and shrubs such as old oxbows or streambars. Also, it would be instructive to investigate whether *Salix exigua* could be encouraged to expand, or be established in more areas of the river. *Salix exigua* provides excellent foraging habitat and cover for wildlife, and is generally resilient once established, will spread clonally, thus may be more self-sustaining than trees. Although existing small patches of *S. exigua* appear to be slowly expanding (D. House, pers. obs), surprisingly, this species has not colonized new areas with implementation of LORP, especially in upper reaches. It is not clear why this is case.

Suspend the Riverine-Riparian Avian Monitoring Program
The 2022 season marked the end of the planned 15-year MAMP for the Lower Owens River Project (Ecosystem Sciences 2008). Unless an adaptive management component is implemented in the LORP Riverine-Riparian Area, for which the response of bird species is needed or desired, we do not see a need to continue this monitoring program. Although the project has been informative with respect to bird response to the reestablishment of perennial flow in the Lower Owens River, and associated ecological changes, the staff time and level of skill required to conduct the work may not be justifiable, if the information does not lead to, or support adaptive management. Additionally, the breeding bird point-count survey is an appropriate population monitoring program only for a few of the HIS, but not for the majority. If it is decided the monitoring program should continue, then not only should modifications to the program be considered to better track use by HIS, but also include clarification on how the

information might best inform future adaptive management decisions. For example, if local habitat enhancement is adopted, existing bird data could be used to determine how “riparian patch size” influences bird diversity, and help guide decisions on plantings. Bird monitoring in these enhanced areas would be of use for effectiveness monitoring.

Finally, while there are some weak correlations between habitat types and the bird indices, the clearest connection appears to be with river state. The river state affects the vegetation community so vegetation mapping, which has greatly improved over time, may be the simplest means of tracking progress towards the LORP Riverine-Riparian Area goals. Bird populations are influenced by various factors both on and away from their breeding areas in the LORP Riverine-Riparian Area including drought, predation, disease, or ecological changes to wintering or migratory habitats. These factors will lead to variability in bird indices over time that cannot be captured or explained by the data from five surveys over a 20-year period. While vegetation may be affected by local events (e.g., drought, fire), it is much easier to detect and interpret long-term trends.

Vegetation mapping could also be used to target areas along the LORP for monitoring. Specifically, areas that show a change or increase in woody riparian vegetation. Our data indicates bird diversity shows the greatest response to trees and riparian shrub; therefore, these habitat types would be the most important to monitor over time. A short-term monitoring study could be conducted at these sites to assess the response of the HIS to localized changes on the ground rather than surveying the entire LORP, or areas that do not exhibit habitat changes or contain marsh habitat that benefits only a few bird species.

Despite Their Abundance, Brown-headed Cowbird Control is Not Recommended as a Means to Achieve the Goals of the LORP

Brown-headed Cowbirds are one of four abundant species found in the LORP Riverine-Riparian Area. It is a brood parasite, meaning it does not build its own nest, but instead, lays its eggs in the nest of other species, primarily songbirds. The LORP plan does not include a Brown-headed Cowbird trapping program, but the need for it was considered in the 2004 EIR (LADWP et al. 2004). At that time, it was not considered a necessary management action, and we do not think it is needed now. Riparian Obligate and Riparian Dependent HIS are clearly habitat-limited in the Riverine-Riparian Area, and cowbird control will not address this limitation.

For one, the impact of Brown-headed Cowbird parasitism in the LORP Riverine-Riparian Area is unknown. The presence or abundance of Brown-headed Cowbirds in a particular area is not necessarily an indication of local parasitism rates. Thus, the mere presence of Brown-headed Cowbirds in the LORP Riverine-Riparian Area is no indication of whether cowbird parasitism is a factor limiting bird populations in the project area. Brown-headed Cowbird parasitism rates vary temporally, spatially, and with the identity of the host species. Many species are able to avoid reproductive losses from parasitism by abandoning parasitized nests and renesting, or by producing a successful nest at another time during the season (Smith et al. 2000).

Second, Brown-headed Cowbird trapping programs are not an effective long-term management solution (Riparian Habitat Joint Venture 2004). Brown-headed Cowbird control programs spanning multiple years indicate that, based on the number of birds trapped each year, cowbird removal has no impact on cowbird populations (DeCapita 2000 Griffith and Griffith 2000). Although Brown-headed Cowbird control may result in improved nest success of some species, the open-ended nature of cowbird control programs are undesirable from a management standpoint (Rothstein and Cook 2000). In addition, without knowledge of local parasitism rates, control programs may be trying to “fix” a nonexistent problem, and wasting resources that could be better spent elsewhere (Rothstein and Cook 2000).

Lastly, although Brown-headed Cowbird parasitism reduces the nest success of some host species, it is only one factor that limits songbird populations. Nest parasitism and losses due to predation interact to reduce nest success (Grzybowski and Pease 2000). Many studies have shown that both parasitism and predation rates are influenced by increasing habitat fragmentation and degradation. Predation, not Brown-headed Cowbird parasitism, is the usually the main cause of nest failure. A better option would be the habitat improvements described above to improve both habitat quality and extent, which would benefit bird populations by decreasing the likelihood of both predation and Brown-headed Cowbird parasitism.

4.8 Appendices

4.8.1 Appendix 1. 2022 Avian Point Count Stations GPS Locations and Reach Assignments, (NAD 83).

Name	POINT	REACH	EASTING	NORTHING		POINT	REACH	EASTING	NORTHING		POINT	REACH	EASTING	NORTHING
Goodale	GOOD01*	1	392397	4092547	North of Mazourka Canyon	ORMC15	2	397930	4076614	Pangborn	PANG01	5	403386	4055843
(GOOD)	GOOD02	1	392598	4092409	(ORMC)	ORMC14*	2	398118	4076457	(PANG)	PANG02	5	403510	4055628
	GOOD03	1	392805	4092271		ORMC13*	2	398135	4076135		PANG03	5	403496	4055378
	GOOD04*	1	392997	4092103		ORMC12*	2	398283	4075989		PANG04	5	403654	4055179
	GOOD05	1	393112	4091887		ORMC11	2	398397	4075677		PANG05	5	403903	4055191
	GOOD06	1	393120	4091636		ORMC10	2	398588	4075574		PANG06	5	404069	4055016
	GOOD07	1	393302	4091470		ORMC09	2	398747	4075441		PANG07	5	404220	4054826
	GOOD08	1	393446	4091272		ORMC08	2	398877	4075205		PANG08	5	404233	4054574
	GOOD09	1	393536	4091030		ORMC07	2	398898	4074990		PANG09*	5	404450	4054455
	GOOD10	1	393599	4090789		ORMC06	3	398846	4074776		PANG10	5	404604	4054263
	GOOD11	1	393553	4090562		ORMC05	3	398873	4074536		PANG11*	5	404848	4054310
	GOOD12	1	393761	4090408		ORMC04	3	398786	4074246		PANG12	5	405101	4054329
	GOOD13	1	393842	4090165		ORMC03*	3	398784	4074003		PANG13	5	405332	4054413
	GOOD14	1	393818	4089907		ORMC02	3	398938	4073801		PANG14	5	405500	4054610
	GOOD15	1	393739	4089673		ORMC01	3	399099	4073582		PANG15	5	405606	4054837
Blackrock Springs	BLRS01	2	394237	4088677	South of Mazourka Canyon	SOMA01*	3	399287	4072846	Narrow Gauge	NAGA01	6	407276	4052928
(BLRS)	BLRS02*	2	394188	4088436	(SOMA)	SOMA02*	3	399404	4072618	(NAGA)	NAGA02	6	407333	4052689
	BLRS03*	2	394345	4088242		SOMA03*	3	399596	4072454		NAGA03	6	407197	4052470
	BLRS04*	2	394402	4087993		SOMA04*	3	399644	4072212		NAGA04	6	407017	4052301
	BLRS05*	2	394611	4087876		SOMA05*	3	400022	4072038		NAGA05	6	407030	4052053
	BLRS06*	2	394753	4087665		SOMA06*	3	400054	4071780		NAGA06	6	407054	4051805
	BLRS07*	2	394960	4087484		SOMA07*	3	400067	4071554		NAGA07	6	407143	4051580
	BLRS08*	2	395060	4087256		SOMA08	3	399842	4071365		NAGA08	6	407319	4051400
	BLRS09*	2	395122	4087016		SOMA09	3	399788	4071130		NAGA09	6	407531	4051270
	BLRS10*	2	395155	4086770		SOMA10	3	399623	4070931		NAGA10	6	407613	4051030
	BLRS11*	2	395146	4086510		SOMA11*	3	399811	4070757		NAGA11	6	407603	4050769
	BLRS12*	2	395218	4086285		SOMA12*	3	399965	4070564		NAGA12	6	407767	4050587
	BLRS13*	2	395447	4086155		SOMA13*	3	400007	4070304		NAGA13	6	407886	4050362
	BLRS14*	2	395656	4086045		SOMA14*	3	400048	4070063		NAGA14	6	408068	4050203
	BLRS15*	2	395706	4085780		SOMA15*	3	400066	4069813		NAGA15	6	408303	4050133
Crystal Ridge	CRRI01	2	395790	4083028	Manzanar	MANZ01	3	400532	4067102	Delta	DELT01	6	409273	4048086
(CRRI)	CRRI02*	2	395788	4082768	(MANZ)	MANZ02	3	400597	4066860	(DELT)	DELT02	6	409382	4047856
	CRRI03	2	396047	4082691		MANZ03	3	400684	4066630		DELT03*	6	409528	4047662
	CRRI04	2	396189	4082481		MANZ04*	3	400922	4066541		DELT04*	6	409767	4047741
	CRRI05	2	396387	4082327		MANZ05*	3	400996	4066299		DELT05	6	410012	4047706
	CRRI06	2	396548	4082131		MANZ06	3	401097	4066083		DELT06*	6	410258	4047779
	CRRI07	2	396559	4081879		MANZ07*	3	401146	4065841		DELT07	6	410436	4047949
	CRRI08*	2	396607	4081619		MANZ08*	3	401345	4065710		DELT08	6	410573	4047740
	CRRI09	2	396815	4081473		MANZ09*	3	401592	4065697		DELT09*	6	410821	4047751
	CRRI10	2	396947	4081270		MANZ10*	3	401765	4065506		DELT10	6	410895	4047519
	CRRI11	2	397130	4081100		MANZ11*	3	401859	4065271		DELT11	6	411005	4047292
	CRRI12	2	397370	4081030		MANZ12*	3	402006	4065044		DELT12	6	410878	4047076
	CRRI13	2	397538	4080831		MANZ13*	3	402055	4064809		DELT13	6	410935	4046831
	CRRI14	2	397636	4080597		MANZ14*	3	402023	4064570		DELT14	6	410906	4046585
	CRRI15	2	397824	4080445		MANZ15*	3	402081	4064337		DELT15	6	411023	4046360
McIver	MCIV01*	2	397764	4080067	Alabama Gates	ALGA01	3	402599	4060790	Owens River North of Tinema	ORTI01	N/A	390328	4104156
(MCIV)	MCIV02*	2	397710	4079792	(ALGA)	ALGA02	3	402479	4060577	(ORTI)	ORTI02*	N/A	390173	4104357
	MCIV03	2	397849	4079595		ALGA03*	3	402522	4060326		ORTI03	N/A	390157	4104582
	MCIV04	2	398004	4079419		ALGA04*	3	402533	4060100		ORTI04	N/A	390101	4104867
	MCIV05	2	397882	4079200		ALGA05*	3	402298	4059950		ORTI05	N/A	390191	4105106
	MCIV06*	2	397945	4079059		ALGA06	4	402168	4059685		ORTI06	N/A	390338	4103898
	MCIV07*	2	397936	4078711		ALGA07*	4	402256	4059464		ORTI07	N/A	390491	4103716
	MCIV08	2	398034	4078483		ALGA08*	4	402361	4059251		ORTI08	N/A	390693	4103616
	MCIV09*	2	397846	4078300		ALGA09	4	402480	4059003					
	MCIV10*	2	397700	4078095		ALGA10*	4	402565	4058799					
	MCIV11*	2	397802	4077841		ALGA11*	4	402546	4058520					
	MCIV12*	2	397771	4077600		ALGA12*	4	402548	4058272					
	MCIV13*	2	397809	4077351		ALGA13*	4	402593	4057975					
	MCIV14*	2	397862	4077120		ALGA14*	4	402707	4057745					
	MCIV15	2	397925	4076858		ALGA15*	4	402803	4057539					

*Location of point changed due to accessibility issues.

4.8.2 Appendix 2. Route descriptions and photos. All aerial view photos were taken from a helicopter on August 3, 2022.

GOOD: The survey route starts just downstream of the Los Angeles Aqueduct Intake on the west side of the river, and covers river miles 0.3 to 3.3. The channel is narrow and lined with cattail, hard-stem bulrush, and reedgrass, and bordered by meadow. Only a few trees are present, primarily clustered at the north end of the route near the intake. There are small, open-water depressions scattered throughout the floodplain**.**

Aerial view of the LORP along the GOOD survey route, looking north.

The GOOD survey route looking east from point-count station GOOD03.

BLRS: This route covers river miles 4.3 to 8.4. It straddles the area just upstream and downstream of the Blackrock Ditch, on the east side of the river. The channel is highly sinuous, yet narrow and confined and is dominated by narrow bands of marsh with limited open water. There are a very limited number of trees located along this survey route, although several young tree willows are present. The floodplain is brushy in many areas, and largely dominated by shrub meadow, or ruderal transitional meadow.

Aerial view of the LORP along the BLRS survey route, looking north.

The BLRS survey route looking north from point-count station BLRS11.

CRRI: This survey route is located in the middle of reach 2, just upstream and downstream of Goose Lake Return Ditch on the west side of the Lower Owens River, covering river miles 11.5 to 14.5. The channel is a narrow, confined, marsh-covered and less sinuous than along the BLRS survey route. The CRRI survey route supports more trees than the two upstream survey routes, particularly towards the southern end.

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Aerial view of the LORP along the CRRI survey route, looking northwest.

The CRRI survey route looking north from point-count station CRRI05.

MCIV: This survey route straddles the Two Culverts crossing), and on the west side of the river, covering river miles 14.9 to 18.9. As compared to the more upstream routes, the complexity of the floodplain increases in this area, with numerous oxbows and side channels, and increased tree cover. Away from the channel, the floodplain is dominated by either transitional meadow communities with decadent stands of smotherweed (*Bassia hyssopifolia*), or covered in dense saltbush (*Atriplex* spp.).

Aerial view of the LORP along the MCIV survey route, looking northwest.

The MCIV survey route facing east from point-count station MCIV02.

ORMC: This is on the west side of the river, starting upstream of Billy Lake Return Ditch, and ends at Mazourka Canyon Road to the south. The route covers river miles 19.1-21.9. Riparian trees and shrubs are continuing to increase as compared to the upstream routes, and the channel appears more open. This route formerly had many Russian olive trees; however, most have since died due to continual inundation following implementation of the LORP.

Aerial view of the ORMC route from Mazourka Canyon Road, looking northwest.

The ORMC survey route looking north from point-count station ORMC15.

SOMA: This survey route is located at the northern end of reach 3. It is on the east side of the river, starting at Mazourka Canyon and heading south, covering river miles 22.5 to 26.1. The floodplain is noticeably wetter with more extensive stands of marsh than survey routes upstream. Trees are widely scattered. Several small, open-water ponds were present on the river channel and in the floodplain.

Aerial view of the LORP along the SOMA survey route, looking northwest.

The SOMA survey route looking south from point-count station SOMA14.

MANZ: This survey route is in the middle of reach 3, covering river miles 29.3 to 32.2, and is fairly similar to SOMA. The route starts just north of Manzanar Reward Road on the west side of the river; however, most of the points are on the east side of the river, south of Manzanar Reward Road. The survey route consists of extensive marsh, some off-river and in-channel ponds, and scattered trees.

Aerial view of the LORP along the MANZ survey route, looking northwest.

The MANZ survey route looking east from point-count station MANZ06.

ALGA: This survey route, on the west side of the river, starts just east of Reinhackle Spring, extending south past the Alabama Gates, covering river miles 36.0 to 39.2. The most obvious feature of this route is the extensive marsh system which has expanded with implementation of the LORP. This survey route also supports small ponds, wet meadow, springs, and woodlands.

Aerial view of the LORP along the ALGA survey route, looking northwest.

The ALGA survey route looking south from point-count station ALGA04.

PANG: This is the only survey route located in reach 5, covering river miles 41.2 to 44.0, and downstream of the confluence of the east and west channels south of the Alabama Gates, and where the Lower Owens River swings eastward away from Highway 395. The survey route supports a diverse mix of marsh, in channel and off-river ponds, riparian trees and shrubs, and meadow systems. This survey route is one of the most well-treed parts of the LORP.

Aerial view of the LORP along the PANG survey route, looking west.

The PANG survey route looking north from point-count station PANG10.

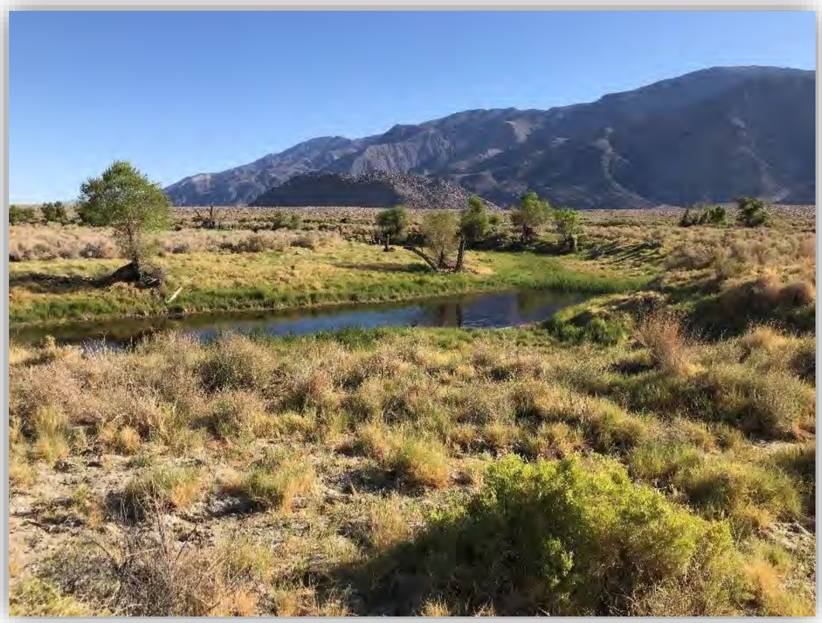
NAGA: This survey route is located east of Lone Pine, and covers the area from Lone Pine Depot Road to the Keeler Bridge near Highway 136, or river miles 46.3 to 49.9. Much of the area was impacted from the River Fire in February of 2013. Although there was some loss of tree canopy, many trees resprouted. Reedgrass is more extensive on this survey route than other areas of the river. The survey route supports expansive meadows, marsh, and open-canopy woodlands.

Aerial view of the LORP along the NAGA survey route, looking northwest.

The NAGA survey route looking east from point-count station NAGO08.

DELT: This survey route is located on the southern end of reach 6, extending from Highway 136 south, covering river miles 52.9 to 56.3. In the upper portions of the survey route near Highway 136, there are several off-river open-water ponds and extensive riparian trees and shrubs. After the southward bend in the Lower Owens River, the channel becomes increasingly narrowed, confined, and the meadows increasingly saline.

Aerial view of the DELT survey route, looking west at Highway 136.



The DELT survey route looking north from point-count station DELT08.

ORTI: The reference site is structurally very different than the LORP Riverine-Riparian Area as it is a very wide riparian woodland interspersed with marsh dominated by cattails, hard-stem bulrush, and wet meadows. The location just upstream of Tinemaha Reservoir is subjected to periodic flooding of the riparian woodlands with changing reservoir levels.

The Owens River, North of the Tinemaha Reservoir, looking west from point-count station ORTI02.

4.8.3 Appendix 3. LORP Riverine-Riparian Area Avian HIS

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

4.8.4 Appendix 4. All Bird Species Detected in the LORP Riverine-Riparian Area in 2022 and Their Breeding Status.

English Name	Scientific Name	2022 Breeding Status
Wood Duck	*Aix sponsa*	Possible
Cinnamon Teal	*Spatula cyanoptera*	Possible
Gadwall	*Mareca strepera*	Probable
Mallard	*Anas platyrhynchos*	Probable
California Quail	*Callipepla californica*	Probable
Pied-billed Grebe	*Podilymbus podiceps*	Possible
Eurasian Collared-Dove	*Streptopelia decaocto*	Confirmed
White-winged Dove	*Zenaida asiatica*	No Evidence
Mourning Dove	*Zenaida macroura*	Confirmed
Greater Roadrunner	*Geococcyx californianus*	Possible
Lesser Nighthawk	*Chordeiles acutipennis*	Probable
Common Nighthawk	*Chordeiles minor*	Possible
White-throated Swift	*Aeronautes saxatalis*	No Evidence
Black-chinned Hummingbird	*Archilochus alexandri*	Probable
Costa's Hummingbird	*Calypte costae*	Possible
Virginia Rail	*Rallus limicola*	Confirmed
Sora	*Porzana carolina*	Possible
American Coot	*Fulica americana*	Possible
Black-necked Stilt	*Himantopus mexicanus*	No Evidence
Killdeer	*Charadrius vociferus*	Confirmed
California Gull	*Larus californicus*	No Evidence
Caspian Tern	*Hydroprogne caspia*	No Evidence
Least Bittern	*Ixobrychus exilis*	Possible
Great Blue Heron	*Ardea herodias*	Probable
Great Egret	*Ardea alba*	No Evidence
Snowy Egret	*Egretta thula*	No Evidence
Black-crowned Night-Heron	*Nycticorax nycticorax*	No Evidence
Turkey Vulture	*Cathartes aura*	No Evidence
Northern Harrier	*Circus hudsonius*	Probable
Swainson's Hawk	*Buteo swainsoni*	Possible
Red-tailed Hawk	*Buteo jamaicensis*	Probable
Great Horned Owl	*Bubo virginianus*	Probable
Downy Woodpecker	*Dryobates pubescens*	Possible
Hairy Woodpecker	*Dryobates villosus*	Confirmed
Northern Flicker	*Colaptes auratus*	Confirmed
American Kestrel	*Falco sparverius*	Confirmed
Ash-throated Flycatcher	*Myiarchus cinerascens*	Confirmed
Western Kingbird	*Tyrannus verticalis*	Confirmed
Olive-sided Flycatcher	*Contopus cooperi*	No Evidence
Western Wood-Pewee	*Contopus sordidulus*	No Evidence
Willow Flycatcher	*Empidonax traillii*	No Evidence
Dusky Flycatcher	*Empidonax oberholseri*	No Evidence
Black Phoebe	*Sayornis nigricans*	Probable

Appendix 4 Continued. All Bird Species and Breeding Status, 2022.

Say's Phoebe	*Sayornis saya*	Possible
Loggerhead Shrike	*Lanius ludovicianus*	Confirmed
Black-billed Magpie	*Pica hudsonia*	Confirmed
American Crow	*Corvus brachyrhynchos*	No Evidence
Common Raven	*Corvus corax*	Probable
Mountain Chickadee	*Poecile gambeli*	No Evidence
Horned Lark	*Eremophila alpestris*	Possible
Tree Swallow	*Tachycineta bicolor*	No Evidence
Violet-green Swallow	*Tachycineta thalassina*	No Evidence
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Probable
Barn Swallow	*Hirundo rustica*	Probable
Cliff Swallow	*Petrochelidon pyrrhonota*	Probable
Phainopepla	*Phainopepla nitens*	No Evidence
Blue-gray Gnatcatcher	*Polioptila caerulea*	No Evidence
Bewick's Wren	*Thryomanes bewickii*	Confirmed
House Wren	*Troglodytes aedon*	Confirmed
Marsh Wren	*Cistothorus palustris*	Confirmed
LeConte's Thrasher	*Toxostoma lecontei*	Probable
Sage Thrasher	*Oreoscoptes montanus*	No Evidence
Northern Mockingbird	*Mimus polyglottos*	Confirmed
European Starling	*Sturnus vulgaris*	Confirmed
American Robin	*Turdus migratorius*	Probable
House Sparrow	*Passer domesticus*	No Evidence
House Finch	*Haemorhous mexicanus*	Confirmed
Lesser Goldfinch	*Spinus psaltria*	Possible
Black-throated Sparrow	*Amphispiza bilineata*	Possible
Dark-eyed Junco	*Junco hyemalis*	No Evidence
Bell's Sparrow	*Artemisiospiza belli*	Confirmed
Savannah Sparrow	*Passerculus sandwichensis*	Possible
Song Sparrow	*Melospiza melodia*	Confirmed
Spotted Towhee	*Pipilo maculatus*	Confirmed
Yellow-breasted Chat	*Icteria virens*	Confirmed
Yellow-headed Blackbird	*Xanthocephalus xanthocepha*	Possible
Western Meadowlark	*Sturnella neglecta*	Confirmed
Bullock's Oriole	*Icterus bullockii*	Confirmed
Red-winged Blackbird	*Agelaius phoeniceus*	Confirmed
Brown-headed Cowbird	*Molothrus ater*	Confirmed
Brewer's Blackbird	*Euphagus cyanocephalus*	Confirmed
Orange-crowned Warbler	*Leiothlypis celata*	No Evidence
Common Yellowthroat	*Geothlypis trichas*	Confirmed
Yellow Warbler	*Setophaga petechia*	No Evidence
Yellow-rumped Warbler	*Setophaga coronata*	No Evidence
Wilson's Warbler	*Cardellina pusilla*	No Evidence
Western Tanager	*Piranga ludoviciana*	No Evidence
Black-headed Grosbeak	*Pheucticus melanocephalus*	No Evidence
Blue Grosbeak	*Passerina caerulea*	Probable

4.8.5 Appendix 5. The 35 Species Included in the Analysis of Breeding Bird Indices

English Name	Scientific Name
California Quail	*Callipepla californica*
Eurasian Collared-Dove	*Streptopelia decaocto*
Mourning Dove	*Zenaida macroura*
Black-chinned Hummingbird	*Archilochus alexandri*
Costa's Hummingbird	*Calypte costae*
Downy Woodpecker	*Dryobates pubescens*
Hairy Woodpecker	*Dryobates villosus*
Northern Flicker	*Colaptes auratus*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Western Kingbird	*Tyrannus verticalis*
Black Phoebe	*Sayornis nigricans*
Say's Phoebe	*Sayornis saya*
Loggerhead Shrike	*Lanius ludovicianus*
Black-billed Magpie	*Pica hudsonia*
Bewick's Wren	*Thryomanes bewickii*
House Wren	*Troglodytes aedon*
Marsh Wren	*Cistothorus palustris*
LeConte's Thrasher	*Toxostoma lecontei*
Northern Mockingbird	*Mimus polyglottos*
European Starling	*Sturnus vulgaris*
American Robin	*Turdus migratorius*
House Finch	*Haemorhous mexicanus*
Lesser Goldfinch	*Spinus psaltria*
Bell's Sparrow	*Artemisiospiza belli*
Savannah Sparrow	*Passerculus sandwichensis*
Song Sparrow	*Melospiza melodia*
Spotted Towhee	*Pipilo maculatus*
Yellow-breasted Chat	*Icteria virens*
Western Meadowlark	*Sturnella neglecta*
Bullock's Oriole	*Icterus bullockii*
Red-winged Blackbird	*Agelaius phoeniceus*
Brown-headed Cowbird	*Molothrus ater*
Brewer's Blackbird	*Euphagus cyanocephalus*
Common Yellowthroat	*Geothlypis trichas*
Blue Grosbeak	*Passerina caerulea*

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5.0 LORP RIVERINE-RIPARIAN AREA INDICATOR SPECIES HABITAT ASSESSMENT

5.1 California Wildlife Habitat Relationship System Analysis of Potential Habitat – Riverine-Riparian HIS

In the absence of species-specific habitat models, the California Wildlife Habitat Relationship System (CWHR) (Version 10.0) was used to estimate the amount of potential habitat in the Lower Owens River Project (LORP) Riverine-Riparian Area for each HIS, and compare the results of the model to on-the-ground observations. The Owens Valley Vole, the one mammalian HIS, is included in this analysis as there is no specific section discussing this species. The CWHR, operated and maintained by the California Department of Fish and Wildlife (CADFW), is a community-level model of 59 habitats and structural classes. The CWHR rates the suitability of each habitat and class for reproduction, cover, and feeding for wildlife species, and has a model available for each of the HIS.

As with all models, there is a simplification of complex ecological processes. The CWHR system itself is based on several general and specific assumptions. The general assumptions are that: (1) wildlife species occurrence and abundance are strongly influenced by habitat conditions; (2) wildlife habitat can be described by a set of environmental characteristics; (3) relative suitability values of habitats and the relative importance of special habitat elements may be determined for each species; and (4) habitat suitability value is uniform for a species throughout its range in California for the specified habitat. The specific assumptions are: (1) habitat ratings reflect values only for that species; (2) habitats for the species that require juxtaposition of two or more habitats are individually rated as if the other habitats are available in the proper mix; (3) ratings assume that all special habitat elements are present in adequate amounts if they are typical components of the habitat; and (4) ratings assume that adequate habitat amounts and patch sizes exist. For our purposes, we are using the CWHR system to estimate the acreage of predicted habitat available for the HIS in the LORP Riverine-Riparian Area, and compare it to the results of avian surveys.

5.2 CWHR Model Application and Data Summary

5.2.1 CWHR Habitat Variables

In order to estimate potential habitat for each HIS, the vegetation mapping layer of the LORP Riverine-Riparian Area 2022 conditions was translated into information used by the CWHR (**Table 5-1** and **Table 5-2**). The three variables required for the CWHR are habitat code, size, and cover.

1. **Habitat Code:** Each vegetation community within the LORP Riverine-Riparian Area was classified using an equivalent CWHR habitat type. The CWHR habitat type code was then added as an attribute to each polygon representing this vegetation community within ArcGIS.

2. **Size:** The size field contains information on tree size (i.e., diameter at breast height (DBH)), shrub age, or height of herb vegetation. A size class was assigned to each polygon using 2022 high-resolution images, habitat photos, and other attributes such as plant height, age, vigor, and canopy diameter as references. Canopy diameter was used to classify the size of trees because DBH was not measured in the field. The Minimum Bounding Geometry tool was used to create circles around each polygon classified as “tree” to estimate the diameter (i.e., canopy) and thus, assign a size class to each polygon. This process worked well when identifying the size class of individual trees. However, polygons including more than one tree, trees with open canopies, or containing a significant portion of non-forested cover had to be evaluated individually to determine if the size classification was correct.

3. **Cover:** The cover field refers to canopy cover or crown closure. The rankings referring to percent canopy closure are sparse, open, moderate, and dense. A cover class was assigned to each polygon based on: standard classification system for some communities, heads-up cover category assignment of all riparian forest polygons using the 2022 high-resolution images, and reviewing habitat photos.

Table 5-1 . The CWHR Habitat Classification and Crosswalk to LORP Vegetation Mapping.

Herbaceous habitats		
CHWR Habitat Code	**Habitat Description**	**2022 LORP Vegetation Classification**
AGS	Annual Grassland	Transitional meadow
PGS	Perennial Grassland	Meadow
PGS	Perennial Grassland	Scrub/meadow
WTM	Wet Meadow	Wet Meadow
FEW	Fresh Emergent Wetland	Marsh
FEW	Fresh Emergent Wetland	Reed
Size Classes		
Code	**Descriptor**	**Description**
1	Short herb	< 12" tall at maturity
2	Tall herb	> 12.1" tall at maturity
Cover		
Code	**Descriptor**	**Average Cover**
S	Sparse	2 - 9.9%
P	Open	10 - 39.9%
M	Moderate	40 - 59.9
D	Dense	> 60%
Shrub Habitats		
CHWR Habitat Code	**Habitat Description**	**2022 LORP Vegetation Classification**
ASC	Alkali Desert Scrub	Scrub
ASC	Alkali Desert Scrub	Dead Scrub
Size Classes		
Code	**Descriptor**	**Description**
1	Seedling Shrubs	Seedlings
2	Young shrub	< 1% crown decadence
3	Mature shrub	1 - 24.9 % crown decadence
4	Decadent shrub	> 25 % crown decadence
Cover		
Code	**Descriptor**	**Average Cover**
S	Sparse	10 - 24.9%
P	Open	25 - 39.9%
M	Moderate	40 - 59.9%
D	Dense	> 60%
Riparian Woody Vegetation		
CHWR Habitat Code	**Habitat Description**	**2022 LORP Vegetation Classification**
DRI	Desert Riparian	Tree
DRI	Desert Riparian	Riparian shrub
Size Classes		
Code	**Descriptor**	**Crown Diameter/DBH**
1	Seeding tree	DBH < 1"
2	Sapling tree	canopy is < 15 feet diameter; DBH 1 - 5.9"
3	Pole tree	Canopy is 15 - 29.9 feet; DBH 6 - 10.9"
4	Small tree	Canopy is 30 - 44.9 feet; DBH 11 - 23.9"
5	Med/large tree	Canopy is > 45 feet diameter; DBH > 24"
6	Multilayer tree	A distinct layer of size class 5 trees over a distinct layer of size 4 and/or 3 trees, and total tree canopy of layers >/=60%
NOTE:	*Riparian shrub habitats will either be size class 1 or 2 only*	
Cover		
Code	**Descriptor**	**Average Cover**
S	Sparse	10 - 24.9%
P	Open	25 - 39.9%
M	Moderate	40 - 59.9%
D	Dense	> 60%

Table 5-1, cont. CWHR Habitat Classification and Crosswalk

Off-River Water Features		
CHWR Habitat Code	**Habitat Description**	**2022 LORP Vegetation Classification**
LAC	Lacustrine	Water
Size Classes		
Code	**Descriptor**	**Description**
1	Limnetic	Deep water beyond light penetration (no stage code)
2	Submerged	Ponds that are shallow enough to allow light penetration
3	Periodically Flooded	Unvegetaed areas that are periodically flooded
4	Shore	Water's edge with less than 2% vegetation
Cover		
Code	**Descriptor**	**Substrate**
O	Organic	Algae, duckweed or plant material present
M	Mud	Mud substrate
S	Sand	Sandy substrate
G	Gravel/cobble	Substrate of gravel or cobble
R	Rubble/boulders	Substrate of rubble or boulders
B	Bedrock	Not on the LORP
River Channel		
CHWR Habitat Code	**Habitat Description**	**2022 LORP Vegetation Classification**
RIV	Riverine	Water (in channel)
RIV	Riverine	Streambar
Size Classes		
Code	**Descriptor**	**Description**
1	Open Water	Water greater than 2 meters in depth
2	Submerged	Area of permanent water between "open water" and shore
3	Periodically Flooded	Unvegetated areas that are periodically flooded
4	Shore	Seldom-flooded areas with <10% vegetative cover
Cover		
Code	**Descriptor**	**Substrate**
O	Organic	Algae, duckweed, or plant material present
M	Mud	Mud substrate
S	Sand	Sandy substrate
G	Gravel/cobble	Substrate of gravel or cobble
R	Rubble/boulders	Substrate of rubble or boulders
B	Bedrock	Not on the LORP
CHWR Habitat Code	**Habitat Description**	**2022 LORP Vegetation Classification**
BAR	Barren	Relatively unvegetated alkali soil associated with scrub
BAR	Road	16-foot wide buffer on centered on existing line file of roads
BAR	Miscellaneous Features	Structures, streamflow measuring stations, spoil areas, etc.
Size Classes		
Code	**No Size Class**	**Description: None**
Cover		
Code	**No Stage**	**Substrate: None**

Table 5-2. Decision Tree Used to Classify the 2022 LORP Vegetation Mapping into the CWHR Categories.

2022 LORP Vegetation Classification	Habitat Code	Biological Description & Vegetation Assessment	Size	Cover
Water	LAC	Off-river sites/oxbows. The aerial images will be reviewed for presence of visible floating aquatic vegetation or algae for cover assignment.	2	O, M
Water	RIV	Active river channel with muddy bottom; limited aquatic vegetation.	2	M
Streambar	RIV	Point bars along the channel that are inundated under seasonal releases.	3	M
Marsh	FEW	Dominated by cattail (*Typha* spp.) and hard-stem bulrush (*Schoenoplectus acutus*).	2	D
Reed	FEW	Reedgrass (*Phragmites australis*) that forms thick monotypic stands.	2	D
Wet Meadow	WTM	Wet meadow sites are dense (>75% cover) and support species >12" tall.	2	D
Transitional Meadow	AGS	Herbaceous areas transitiioning to meadow or wet meadow due to rising water table.	2	P, M, D
Dead Scrub	ACS	Shrubs dying due to rising water table.	4	S, P, M, D
Meadow	PGS	Distinguished from WTM by having a lower water table that allows shrub encroachment; low-growing salt grass (*Distichlis spicata*) is dominant; may have some shrubs	1, 2	M, D
Scrub Meadow	PGS	Evaluated as a grassland habitat as it is similar to meadow; supports grassland-associated wildlife species	1, 2	M, D
Riparian Shrub	DRI	Dominant riparian shrub is coyote willow (*Salix exigua*). Polygons will be evaluated and assigned to the appropriate "size" class. Most will fall in size 1 class.	1, 2	D
Tree	DRI	Precision of mapping is such that "cover" is usually "D". A "size" class will be defined by measuring the diameter of the canopy. Most of the trees will be in the size 2-5 class.	2, 3, 4, 5, 6	D
Barren	BAR	The tree or shurb cover <10% and <2% in herbaceous cover.	None	None
Scrub	ASC	Desert scrub with sparse understory. Polygons will be evaulated and assignd to the appropriate "cover" class.	3, 4	S, P, M, D
Road	BAR		None	None
Miscellaneous Features	BAR	Measuring stations, structures	None	None

5.2.2 Application of CWHR to the LORP Riverine-Riparian Area Habitat Types

The CWHR has Predicted Habitat Models for each HIS; these were used to estimate potential habitat in the LORP Riverine-Riparian Area. The Predicted Habitat Models are raster files showing the distribution of predicted suitable habitat within a species' range based on a mean habitat suitability score. A mean habitat suitability score was assigned to each habitat type, based on size and cover, and is the average of the reproduction, cover, and feeding scores for each HIS. If suitable habitat exists for any one of these three-life history needs, the habitat would be considered suitable. The mean habitat suitability scores are ranked on a scale of 0 to 1, and are defined as follows: low (<0.34), medium (0.34-0.66), and high (>0.66) suitability. A value of "0" is defined as "no suitability".

The CWHR defines habitat suitability based on its ability to meet the life history needs of the species and support a high, moderate, or low population density. For example, a habitat suitability ranking score that falls within the "medium" category would meet the life history need such that it supports a relatively moderate population density (CDFW California Interagency Wildlife Task Group 2014).

After assigning equivalent CWHR values (i.e., habitat type, size, and cover) to all 2022 vegetation mapping polygons within the LORP Riverine-Riparian Area, the attribute table for each CWHR HIS raster file was queried to find the associated mean habitat suitability score, based on the attributes assigned to polygons. The Predicted Habitat Models provided a single mean habitat suitability score for annual grassland (AGS), alkali scrub (ASC), barren (BAR), freshwater emergent (FEW), lacustrine (LAC), perennial grassland (PGS), riverine (RIV), and wet meadow (WTM) vegetation communities. In other words, size and cover were ultimately not factored into the mean habitat suitability score for these vegetation communities. The desert riparian (DRI) habitat was the only vegetation community for which mean habitat suitability scores accounted for differences in size and cover. For example, as shown in **Table 5-1** , the 2022 LORP Riverine-Riparian Area vegetation mapping of "tree" is equivalent to the CWHR's DRI habitat code. For Northern Harrier, a tree assigned a size class of 2 and cover of "S" results in a mean habitat suitability score of 0.22, whereas a size class of 3 and cover of "S" results in a score of 0.11. In contrast, all size and covers classes of PGS, were assigned a mean habitat suitability score of 0.94.

The following adjustments were made to the mean habitat suitability scores based on assessment of the classifications made by the CWHR Predicted Habitat Models. For Belted Kingfisher, the CWHR Predicted Habitat Model assigned a high suitability score to the BAR habitat code; however, this is only true for unvegetated banks that can be used for nesting. In the 2022 LORP Riverine-Riparian Area vegetation mapping, "barren" areas were defined as upland sites. Thus, for Belted Kingfisher, the BAR mean habitat suitability score was assigned a value of "0", indicating "no suitability". Additionally, the Predicted Habitat Models did not list DRI as suitable habitat for Wood Duck, Red-shouldered Hawk, Swainson's Hawk, or Nuttall's Woodpecker. The Predicted Habitat Models do not work well for these HIS because the Owens Valley is at the edge of their core ranges. All four of these HIS use riparian habitats in the Owens Valley, however, and have occurred in the LORP Riverine-Riparian Area in small numbers. To better represent the availability of potential habitat for these species, a surrogate vegetation community was selected from the CWHR System. For Wood

Duck, Red-shouldered Hawk, and Nuttall's Woodpecker, DRI polygons were coded using the mean habitat suitability scores for riparian shrubs and trees in the equivalent size and cover class categories in the "Montane Riparian" habitat code. For Swainson's Hawk, DRI polygons were coded using the mean habitat suitability scores for riparian shrubs and trees in the equivalent size and cover class categories in the "Valley Foothill Riparian" habitat code. The "Valley Foothill Riparian" habitat code is the only riparian community Swainson's Hawk is associated with in the Predicted Habitat Model.

5.2.3 2022 Data Summary and Evaluation of Changes to Indicator Species Habitat Availability

The mean habitat suitability scores were appended to each 2022 vegetation polygon for each HIS. The "Select by Attributes" feature in ArcGIS was used to query each HIS and the CWHR habitat types they are predicted to use, excluding 0 values (i.e., not suitable habitat). The "Statistics" feature was then used to find the sum of the acres for each CWHR habitat type. Total acreages of each CWHR habitat type was also compared across all monitoring years. The percent change in the amount of CWHR habitat types between pre-LORP implementation in 2000, and post-LORP implementation in 2022 was calculated. These values were compared to baseline conditions in 2002 to evaluate how the CWHR habitat types have changed over time. Finally, we compared the availability of potential habitat to the avian monitoring results.

5.3 Results

5.3.1 2022 CWHR Habitat in the LORP Riverine-Riparian Area

Table 5-3 shows the amount of potential habitat for each HIS in the LORP Riverine-Riparian Area as estimated by the CWHR Predicted Habitat Models. Northern Harrier is the HIS with the greatest amount of potential habitat in the LORP Riverine-Riparian Area. This was followed by Tree Swallow, Red-shouldered Hawk, Great Blue Heron, and Owens Valley Vole. Yellow-billed Cuckoo had the least amount of potential habitat.

Despite the high amount of potential habitat for Red-shouldered Hawk, it is important to consider how CWHR ranks each habitat type. In this case, there is a large amount of FEW, but it has a mean suitability score of 0.33, or low suitability. In contrast, the DRI habitat type has mean suitability scores ranging primarily from 0.44 to 1 (medium to high suitability). This indicates DRI is a valuable habitat type, and because it is limited in the LORP Riverine-Riparian Area, it is unlikely that Red-shouldered Hawks would be found frequently.

Table 5-3. Potential Habitat for Each HIS in the LORP Riverine-Riparian Area, 2022.

	Acres per CWHR Habitat Code									Total Acres per Species
Habitat Indicator Species	**AGS**	**ASC**	**BAR**	**DRI**	**FEW**	**LAC**	**PGS**	**RIV**	**WTM**	
Wood Duck				88	1712	19		82		1902
Least Bittern				92	1712	19		82		1905
Great Blue Heron	180			88	1712	19	1839	82	821	4742
Northern Harrier	180	1256	128	0.12	1712	19	1839	82	821	6038
Red-shouldered Hawk	180			214	1712		1839		821	4767
Swainson's Hawk	180		128	178			1839		821	3146
Virginia Rail				36	1712				821	2570
Sora					1712				821	2533
Yellow-billed Cuckoo				79						79
Long-eared Owl	180			180			1839		821	3020
Belted Kingfisher				178	1712	19		82	821	2813
Nuttall's Woodpecker				214						214
Willow Flycatcher				180					821	1001
Warbling Vireo				180						180
Tree Swallow	180			177	1712	19	1839	82	821	4831
Marsh Wren					1712				821	2533
Yellow Warbler				171						171
Yellow-breasted Chat				92						92
Blue Grosbeak	180			92						272
Owens Valley Vole	180				1712		1839		821	4553
HIS with Predicted Suitable Habitat	8	1	2	17	11	6	7	6	12	

5.3.2 Evaluation of Changes to Indicator Species Habitat Availability

Figure 5-1 shows the acreage of each CWHR habitat type per vegetation mapping period (2000, 2009, 2015, and 2022). The vegetation mapping conducted in 2000 represents baseline conditions prior to the implementation of the LORP in 2006. In previous years (2000, 2009, 2014), vegetation mapping included irrigated meadow. The "Pasture" (PAS) habitat code in CWHR was used to label "irrigated meadow." However, improved mapping refined the boundaries of the LORP, and the "irrigated meadow" designation was removed because it does not exist within the boundaries of the Riverine-Riparian Area. Therefore, this habitat code was removed to compare the habitat types that truly occur on the LORP.

Since implementation of the LORP, the CWHR habitat types have changed in response to the establishment of perennial flow throughout the length of the Lower Owens River. The ASC vegetation community shows a clear downward trend since 2000, while hydric vegetation types of FEW and WTM show upward trends. As discussed below, these changes are the result of transitions from one habitat type to another.

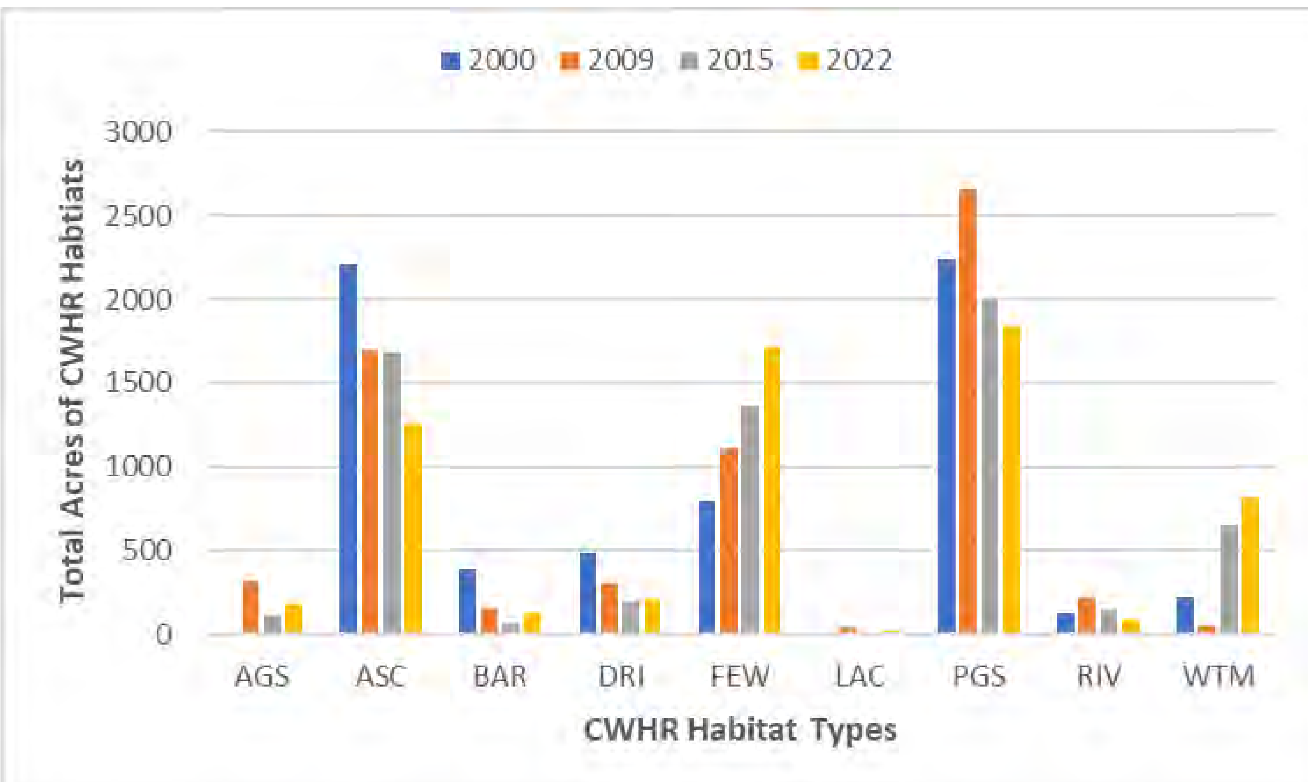

Figure 5-1. Total Acreages of CWHR Habitat Types by Mapping Year.

Figure 5-2 shows the percent change in the amount of CWHR habitat types between pre-LORP implementation in 2000, and post-LORP implementation in 2022. As mentioned above, in 2000 “pasture” was incorrectly mapped on the LORP and this classification when comparing between years.

The CWHR habitat types that have decreased since 2000 are: ASC, BAR, DRI, PGS, and RIV (**Figure 5-2**). The reason for the decline in ASC, BAR, and PGS is due to a transition to another habitat type as vegetation responds (positively or negatively) to the rising groundwater table and fires (both prescribed and natural). A rising groundwater table will negatively impact ASC and convert it to a more mesic community such as PGS, WTM, or FEW, depending on how wet, and or flooded conditions become. For example, if conditions in PGS become wetter, it will transition into WTM, thus increasing the amount of WTM and decreasing PGS. A decline in RIV can be attributed to encroaching marsh that reduces open-water channels.

Habitat types that have increased over time include WTM, AGS, FEW, and LAC. The largest increases were in WTM and FEW. As shown in **Figure 5-2**, the FEW habitat type has steadily increased over time since 2000. Some WTM has converted to FEW as the river has aggraded, but hydric vegetation types such as WTM have also increased due to local increases in groundwater in the floodplain. LAC has shown an increase since 2000, likely due to increases in groundwater levels along the river corridor flooding off-channel depressions. AGS was applied to formerly barren areas that are still in a state of transition from being dominated by annual weeds, to meadow or wet meadow habitats.

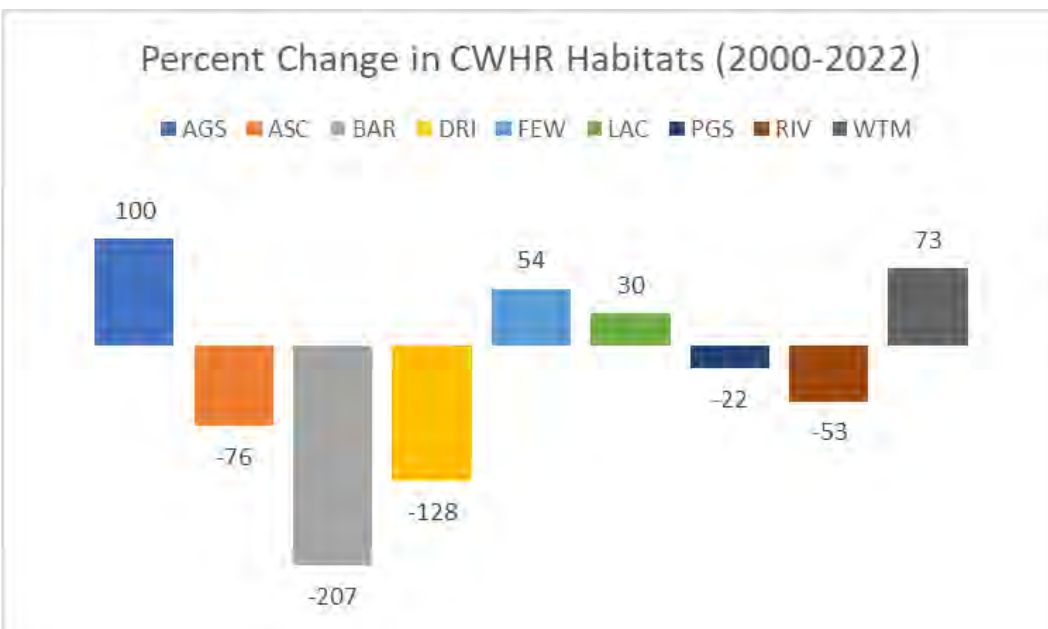

Figure 5-2. Percent Change in CWHR Habitat Types Between 2000 and 2022.

Table 5-4. Pre-LORP Versus Post-LORP Results for Each HIS in the LORP Riverine-Riparian Area.

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	Pre-LORP		**Post-LORP**	
HIS	*Observed*	*Breeding*	*Observed*	*Breeding*
Wood Duck			Y	Y
Yellow-billed Cuckoo			Y	
Virginia Rail	Y	Y	Y	Y
Sora	Y	Y	Y	Y
Least Bittern			Y	Y
Great Blue Heron	Y	Y	Y	Y
Northern Harrier	Y	Y	Y	Y
Red-shouldered Hawk			Y	
Swainson's Hawk	Y	Y	Y	
Long-eared Owl				
Belted Kingfisher	Y			
Nuttall's Woodpecker	Y	Y	Y	Y
Willow Flycatcher	Y		Y	
Warbling Vireo	Y		Y	
Tree Swallow			Y	
Marsh Wren	Y	Y	Y	Y
Yellow-breasted Chat			Y	Y
Yellow Warbler	Y		Y	
Blue Grosbeak	Y	Y	Y	Y

*HIS observed, and confirmed or suspected of breeding is indicated by a "Y".

Based on the results of the avian monitoring program, since implementation of the LORP, 17 of the HIS have been observed, and breeding has been confirmed or suspected for 10 HIS (**Table 5-4**). Those HIS that have not been observed during post-LORP monitoring are Long-eared Owl and Belted Kingfisher. HIS that have not been confirmed or suspected of breeding are: Yellow-billed Cuckoo, Red-shouldered Hawk, Swainson's Hawk, Belted Kingfisher, Long-eared Owl, Willow Flycatcher, Warbling Vireo, Tree Swallow, and Yellow Warbler. All of these HIS are considered Riparian Obligate or Riparian Dependent species, and given the limited DRI habitat in the LORP Riverine-Riparian Area, it is not surprising that they have not been observed or are not breeding here. As shown in **Figure** 5-1 and **Figure 5-2**, there has been a decline in DRI over the monitoring period. This decline has mostly been due to improved mapping (discussed below), but is clear that DRI habitat does not make up a large portion of the LORP Riverine-Riparian Area.

5.4 Discussion and Recommendations

Changes in CWHR habitat availability have occurred since 2000 due to the shifts from one habitat type to another in response to the reestablishment of perennial flow throughout the river. Jensen (2023) reports a net increase of over 1,500 acres of hydric vegetation in the LORP Riverine-Riparian Area since project implementation. This is equivalent to a 97% increase in hydric vegetation since 2000. An obvious increase in FEW has occurred, as wet meadow and open water areas have been converted to this habitat type. Also, a new CWHR habitat type, AGS, has evolved that was non-existent under baseline conditions. However, the addition of the AGS habitat type in the LORP Riverine-Riparian Area may be temporary, as these sites are best described as being in a state of transition from one type to another.

A change in the DRI habitat type can be attributed increases in the accuracy and precision of vegetation mapping, particularly with respect to trees (Jensen 2023). Over time, as aerial imagery and mapping tools have improved, there has been an apparent decrease in the acres of trees. Some trees have indeed been lost to fire and possibly inundation; but, many have resprouted from the fire and survived inundation. However, the DRI habitat type is important to many of the HIS because it provides not only forage, but cover and nesting habitat.

According to the CWHR Predicted Models, all HIS have some potential habitat in the LORP Riverine-Riparian Area. However, our experiences in applying the model to LORP Riverine-Riparian Area suggests that the CWHR Predicted Habitat Models may overestimate potential habitat for some HIS, and underestimate it for others. For example, in 2015, the ability of the CWHR to predict potential habitat for Marsh Wren (a HIS for which there is sufficient abundance data) was analyzed (LADWP and Inyo County 2016) and it was found that abundance of Marsh Wren was not predicted by the total CWHR habitat per point count station. Marsh Wren abundance was positively correlated with WTM, but there was no correlation with FEW. In the case of other species such as Nuttall's Woodpecker, the Predicted Habitat Model had to be adjusted based on expert knowledge of the area and the species status and distribution. Other landscape factors will influence the relative suitability of individual habitat patches such as proximity to other habitat types, or habitat patch size. These factors are not accounted for in CWHR, but should be considered when interpreting results.

Additionally, it is difficult to compare the CWHR habitat rankings over time; therefore, we did not include it in this report. This is because the CWHR mean habitat suitability score may change as the model is updated, shifting potential habitat from one category to another. For example, for Least Bittern, the mean habitat suitability score of FEW changed from a value of 1 ("high suitability") to 0.56 ("medium suitability"). This could be viewed as a loss of "high suitability" habitat when in actuality the modeling parameters changed. The CWHR habitat suitability ranks were also developed based on habitat patch sizes >40 acres in size, and are best interpreted for habitat patches >200 acres in size (CDFW, Biogegraphic Data Branch 2021). This point is very important to consider when evaluating habitat for species requiring DRI. Based on a review of vegetation mapping polygons of the entire LORP Riverine-Riparian Area (Jensen 2023), the average polygon size for tree stands is 0.038 acres, and the largest patch of trees is only 8.5 acres. Thus, existing tree patches, although important, may have a lower suitability value due to the small patch size. Therefore, any comparison in trends in the categorization of potential habitat over time should be viewed with caution.

With the collection of five years of avian point-count data, and increasingly precise landscape mapping, it would be worthwhile to construct data-driven occupancy and abundance models that can be applied to generate predictive maps of wildlife habitat suitability in response to the changing vegetation communities in the LORP Riverine-Riparian Area. These models would provide greater insight about the range of riparian and aquatic habitat features in the LORP Riverine-Riparian Area, the response of the avian community, and whether the current HIS represent the full range of conditions envisioned in the MOU when the list was originally developed.

5.5 References

California Department of Fish and Wildlife California, Interagency Wildlife Task Group. 2014. Standards and Guidelines for Species Models California Wildlife Habitat Relationships System. 40 pp.

California Department of Fish and Wildlife, Biogegraphic Data Branch. 2021. California Wildlife Habitat Relationship System, Version 10.1.23. Sacramento, CA.

Jensen, S. 2023. Vegetation mapping LORP and DHA. 2022 Condition. Prepared for LADWP and Inyo County. February 2023.

Los Angeles Department of Water and Power and Inyo County. 2016. Lower Owens River Project Annual Report. Dated March 8. 418 pp.

6.0 LAND MANAGEMENT

6.1 Introduction

This section of the 2022 LORP Annual Report looks at nearly 20 years of data and project implementation as it relates to land management. We begin by discussing the overriding structure of the project and its pertinent documents. We then discuss the history of utilization on the LORP and the success over time in implementing the utilization standards across the seven LORP leases. We present a summary of the condition of irrigated pastures on the LORP. Next, we provide an overview of four primary vegetation/rangeland management tools used on the LORP: 1) prescribed burns and wildfires, 2) fencing ,3) stock water developments, and 4) supplemental feeding sites. Following this is a discussion of vegetation monitoring results on grazed range trend transects by river reach and an examination of grazing exclosures, ending with a brief discussion of rare plant projects. The section concludes with a summary of key findings and recommendations.

6.1.1 Framework for Land Management on the LORP

The LORP is first described in the 1991 EIR and was further refined in the 1997 MOU. The MOU required the development of land management plans to address livestock management issues and develop livestock management guidelines to support LORP goals and objectives. LADWP's Owen Valley Land Management Plan (OVLMP) (LADWP and Ecosystem Sciences, 2010) contains grazing prescriptions for LADWP leases within the LORP area. Lease-specific grazing management plans were designed to achieve the MOU goal of continuing and managing livestock grazing use in a manner sustainable and consistent with establishing and maintaining a healthy ecosystem. The LORP MAMP (2008), serves as the guiding document describing the management objectives, background, baseline data, analysis, and adaptive management methods. The document also emphasizes that the project should be operated for a minimum 15-20 years before any large-scale deviations from the original plan occurs. According to the MAMP, a project this large will take many years before the ecosystem has stabilized. The MAMP also states that monitoring will occur for 15 years.

Following the 15th year of land management monitoring under the MAMP, LADWP has synthesized data collected over the life of the project and evaluated general trends as they relate to livestock grazing in the LORP area. Both the 1991 EIR and the 1997 MOU assigned the highest priority for intervention and changes in livestock grazing for the riparian areas, irrigated meadows, and sensitive plant or animal habitats. The LORP Grazing Management Plans, finalized in 2006, were written to support the goals outlined in the MOU:

- Improve water quality
- Improve water-use efficiency
- Ensure that the plans are compatible with water gathering activities
- Plans are in sync with LADWP's goal of developing a cost-effective aqueduct operation
- Establish healthy, functioning ecosystems in support of biodiversity and special status plants and animals
- Maintain sustainable livestock grazing and other agricultural activities occurring on City lands in Inyo County
- Ensure continued recreational opportunities on City lands

6.2 Land Management

There are seven grazing leases inside the LORP boundary (**Table 6-1**). Before 2002, livestock grazing in the LORP area was left largely up to the discretion of the lessees. The Grazing Management Plans for the LORP, in adherence to the LORP MOU goals mentioned above, were developed in consultation with each lessee, MOU Consultants, and LADWP staff. Additional consultation occurred with MOU Parties and other special interest groups. Grazing Management Plans were integrated into the LORP. Plan summaries are available in the Appendices of the LORP MAMP (Ecosystems, 2008). Complete plans are available in the OVLMP (2010).

Table 6-1 Acreages for the seven LORP Leases

Lease	Acreage	Reach
Intake	284	1
Twin Lakes	5,021	1-2
Blackrock	32,674	2-3
Thibaut	5,259	2
Island	18,970	4-5
Lone Pine	8,274	6
Delta	7,110	6

In addition to addressing the LORP goals described in the MOU, the MAMP, and grazing management plans' goals were to enhance native habitat diversity while allowing for sustainable grazing. To meet these goals, the plans called for utilization limits in riparian and upland areas, construction of riparian fencing, modifications in fencing to facilitate elk passage as well as recreational access to both the river and the BWMA, development of off river stock water, maintenance of irrigated pastures in good condition, and fencing rare plant populations. The plans also included an intensive monitoring and reporting schedule for utilization and rangeland vegetation trends.

6.2.1 Utilization Introduction

The LORP land management plans were designed to achieve the MOU goal of continuing and managing livestock grazing and recreational use in a manner sustainable and consistent with the primary goal of establishing and maintaining a healthy ecosystem (LORP EIR, 2004). Seven leases occur in the LORP planning area: Intake (RLI-475), Twin Lakes (RLI-491), Blackrock (RLI-428), Thibaut (RLI-430), Islands (RLI-489), Lone Pine (RLI-456), and Delta (RLI-490). Lease maps within the LORP project area are depicted in **Figures 6-1 – Figure 6-7**.

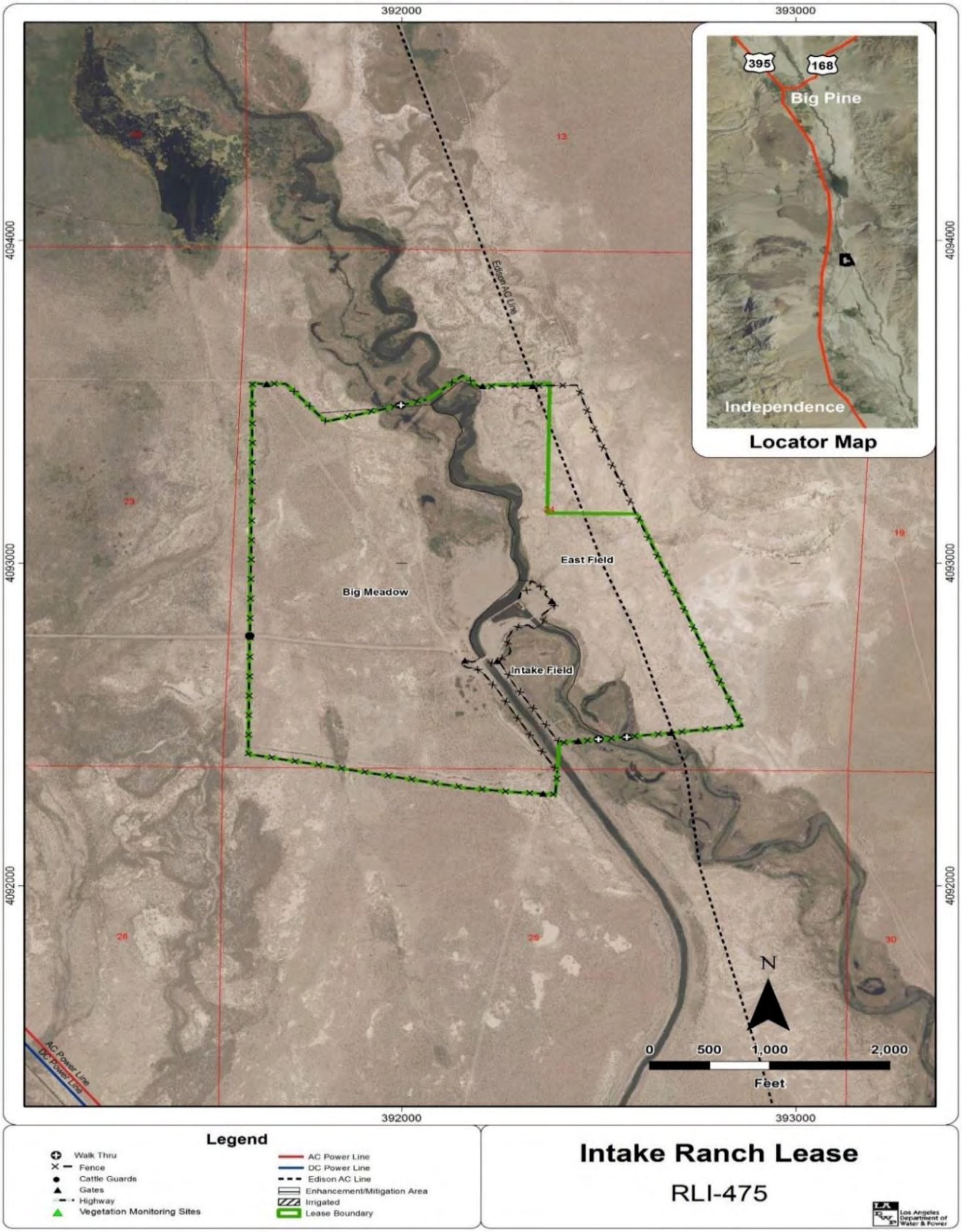

Figure 6-1 Intake Ranch Lease RLI-475

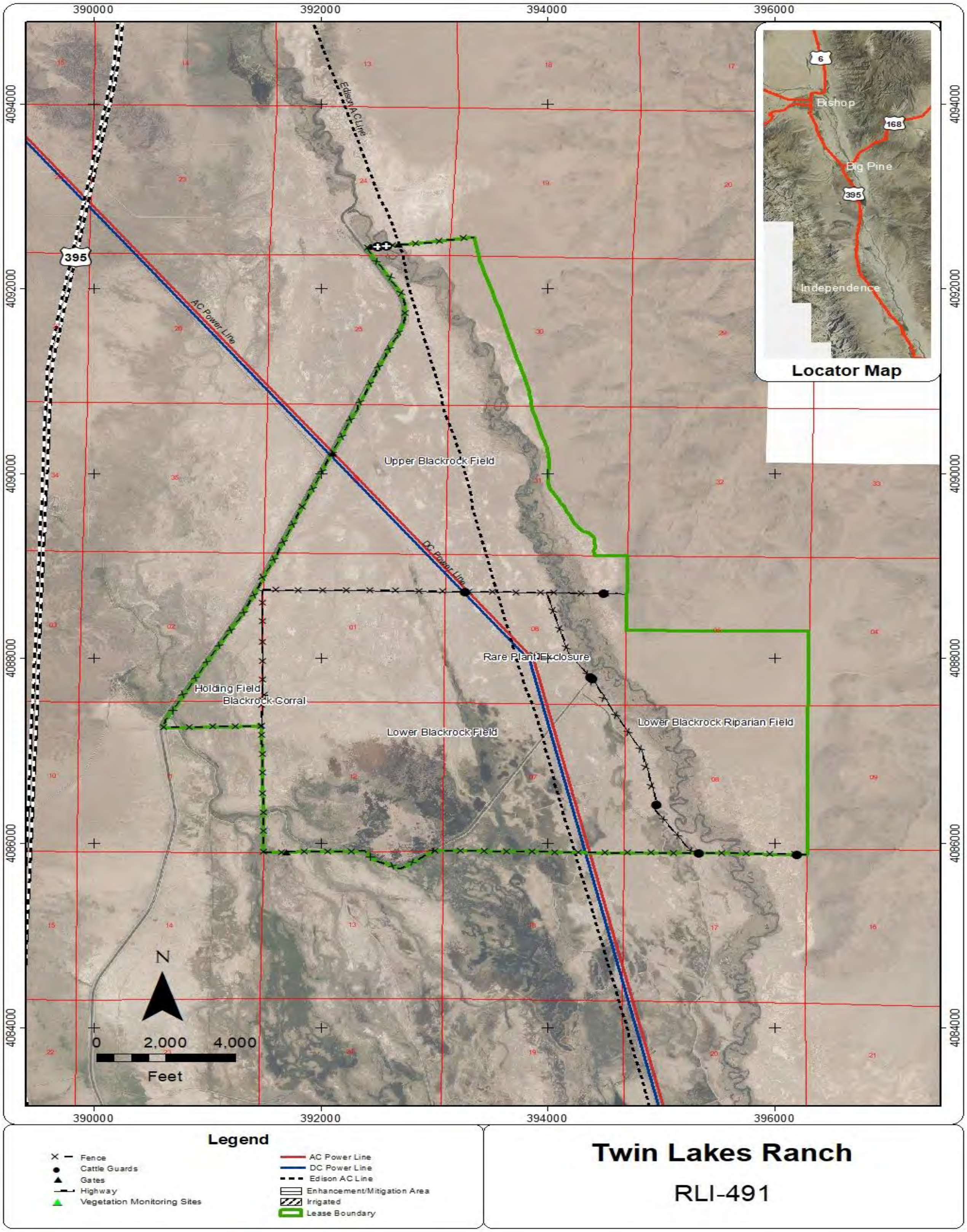

Figure 6-2. Twin Lakes Ranch RLI-491

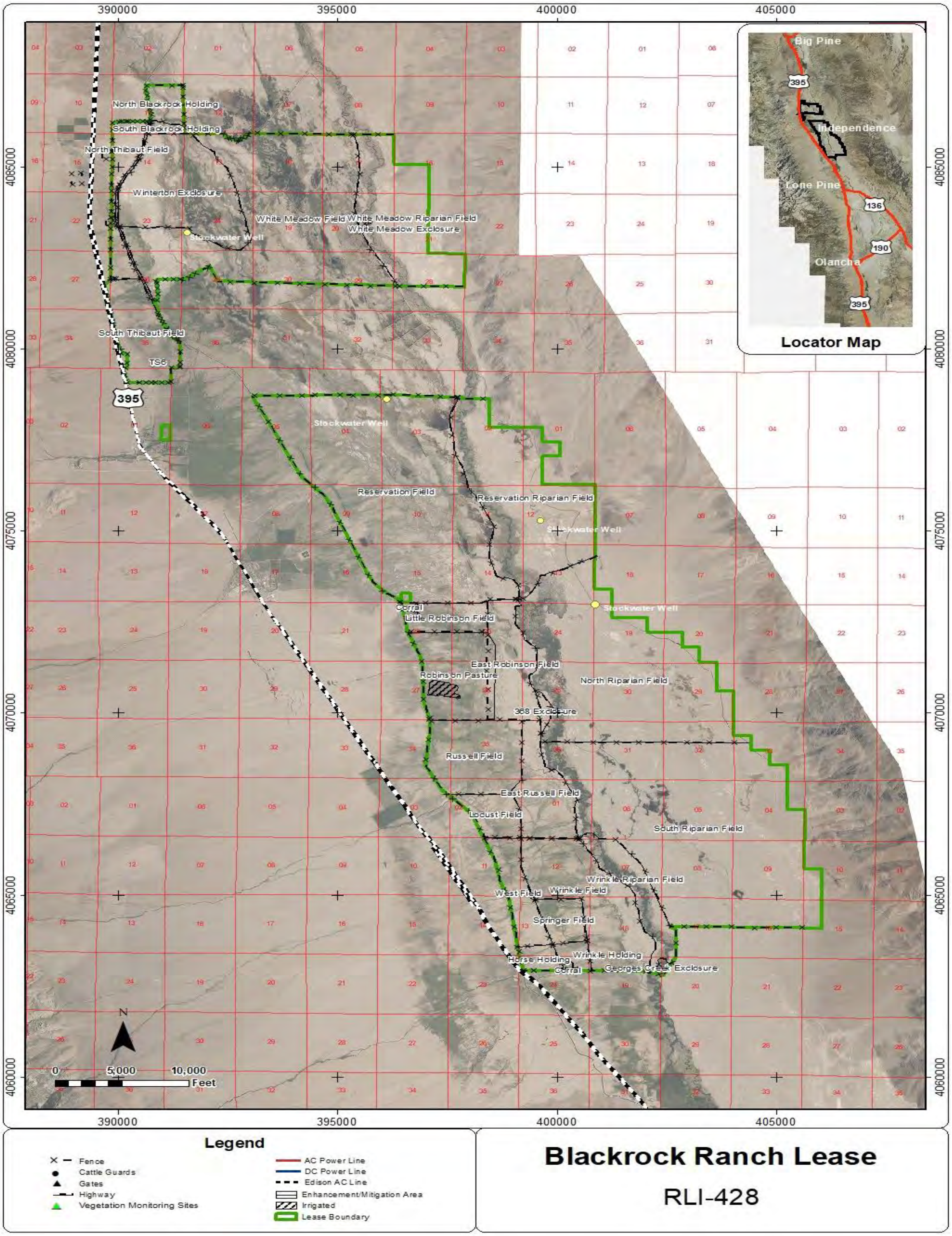

Figure 6-3. Blackrock Ranch Lease RLI-428

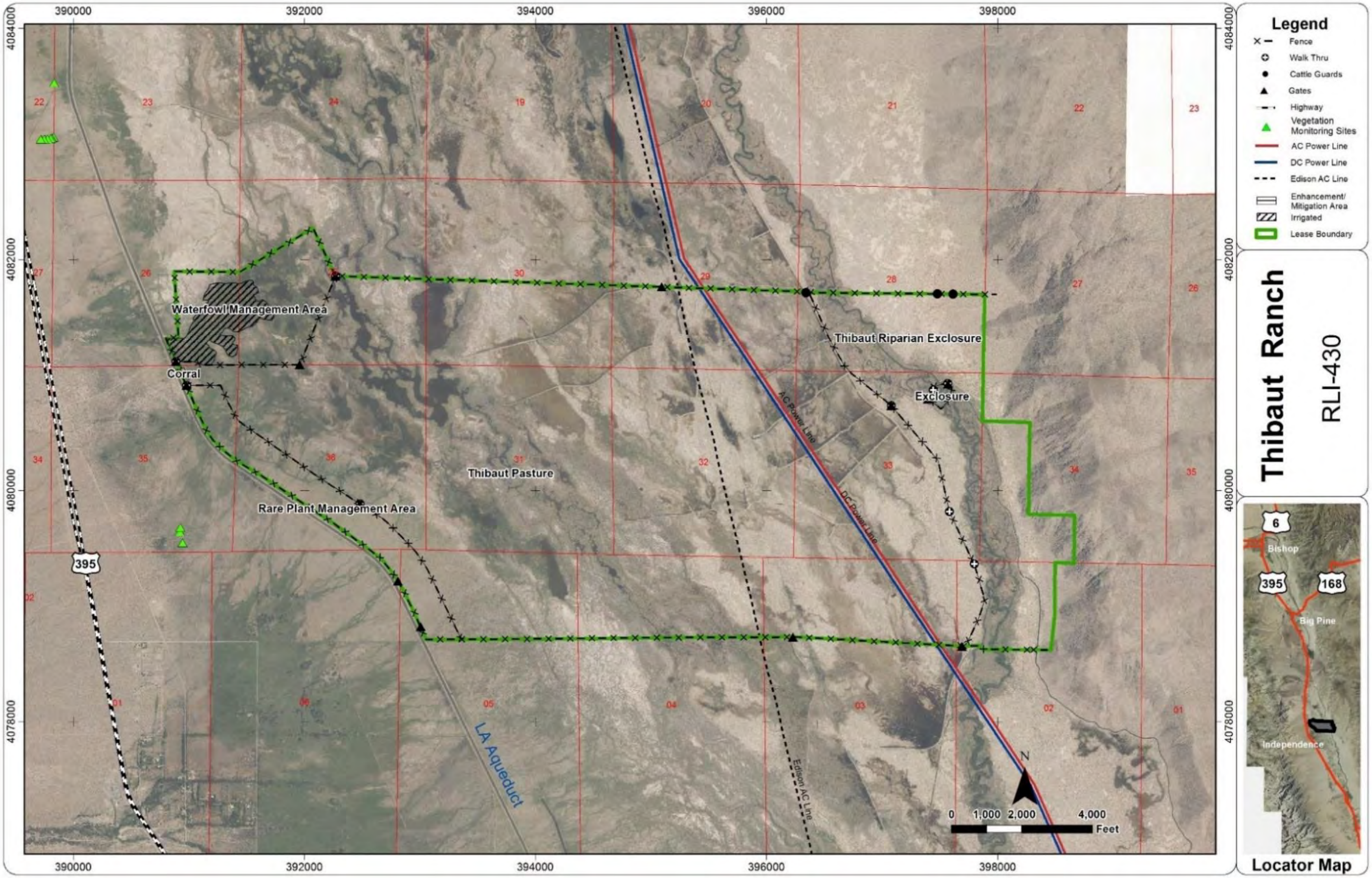

Figure 6-4. Thibaut Ranch Lease RLI-430

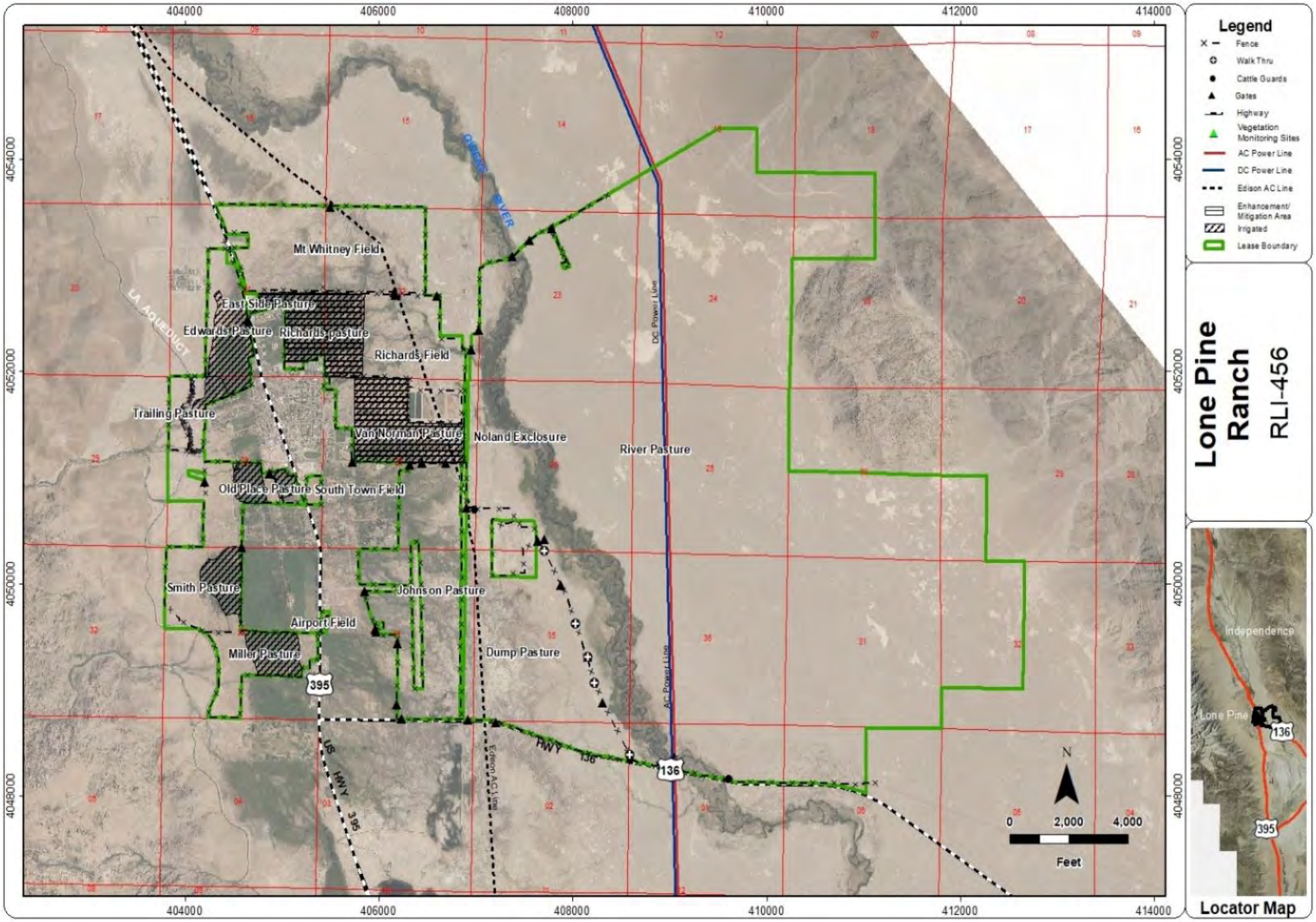

Figure 6-5. Lone Pine Ranch Lease RLI-456

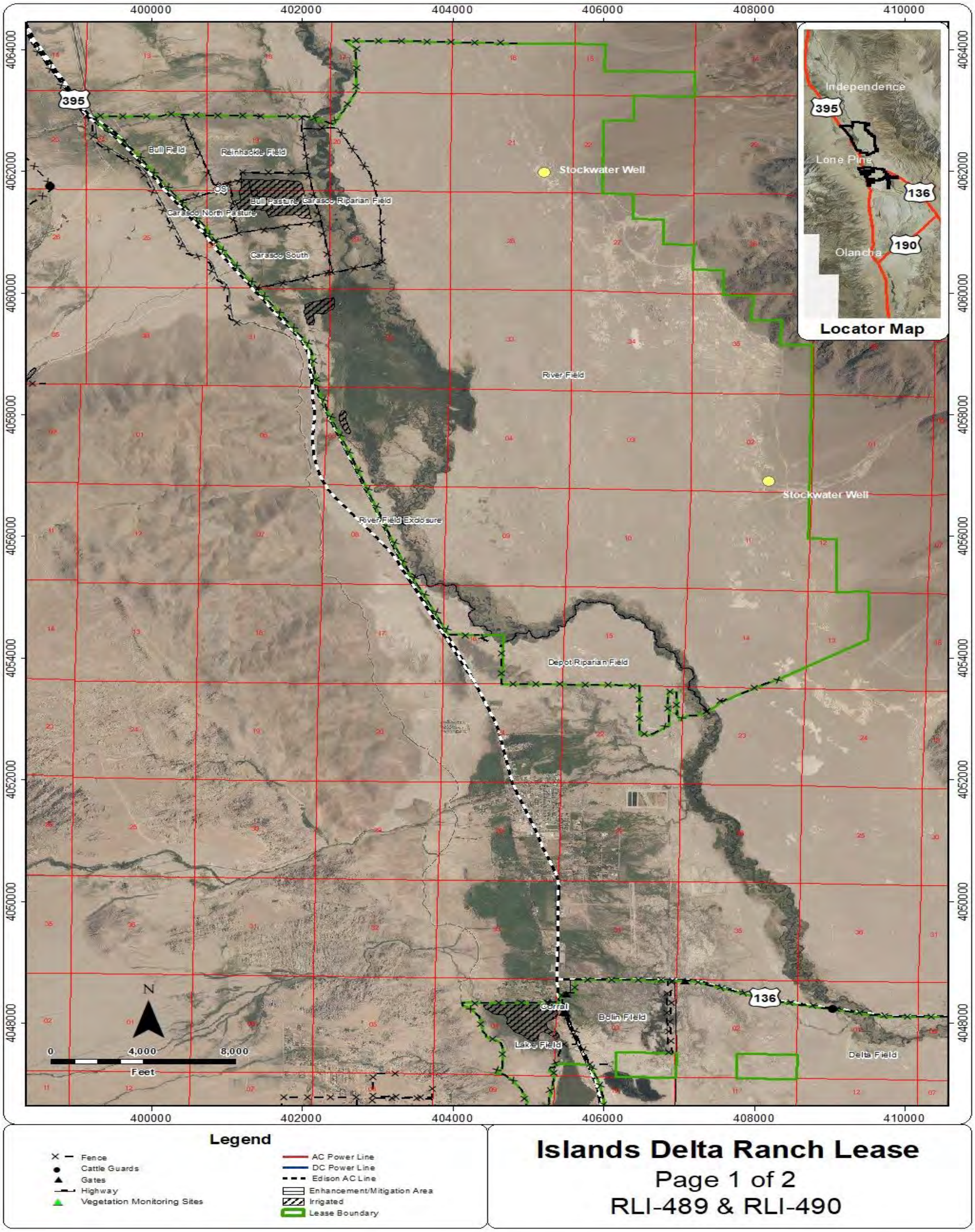

Figure 6-6. Islands Delta Ranch Lease RLI-489 & 490, 1 of 2

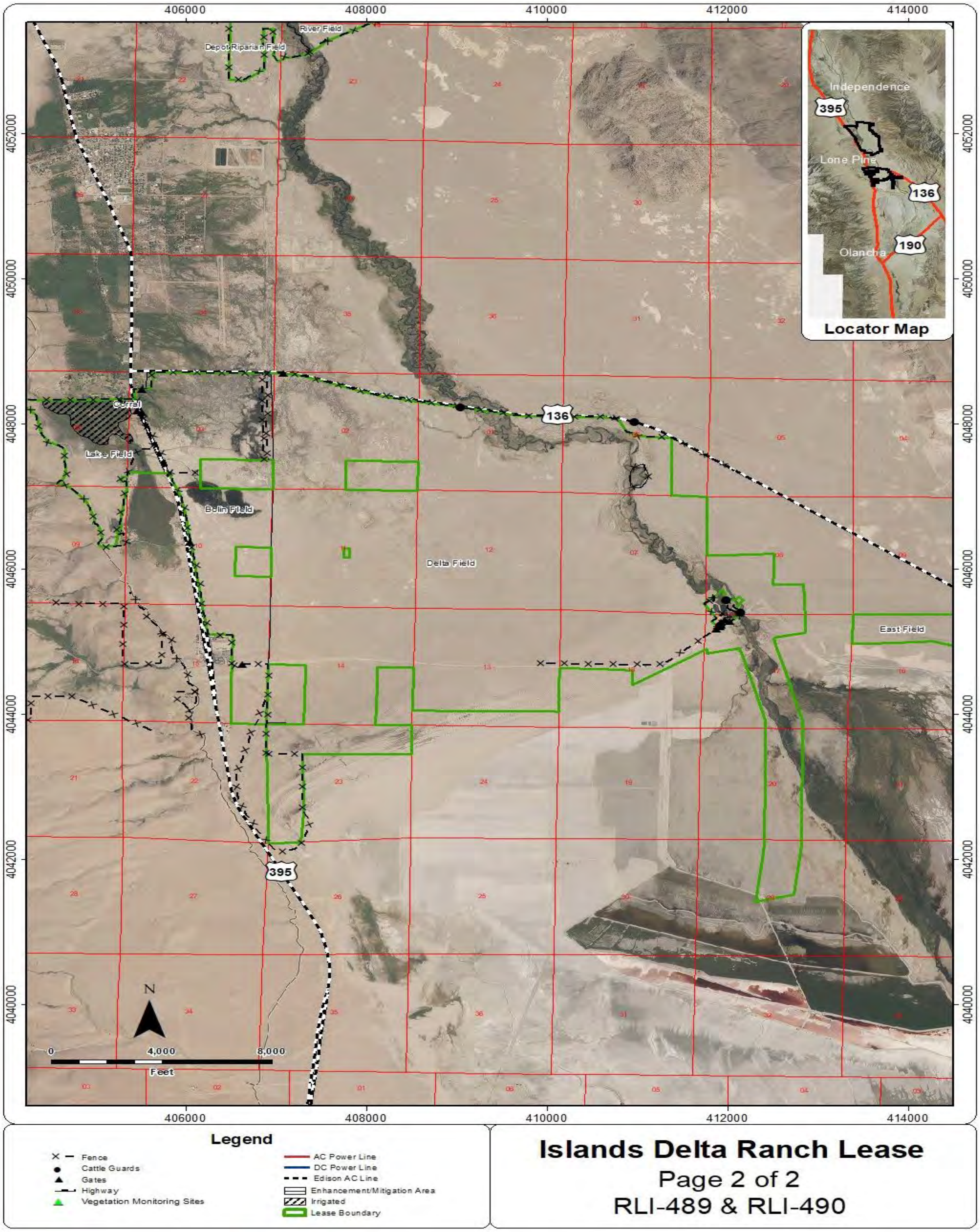

Figure 6-7. Islands Delta Ranch Lease RLI-489 & 490, 2 of 2

Prior to the LORP, with the exception of rare plant and post-fire management areas, few restrictions related to grazing management existed (MAMP, 2008). Grazing management activities were left primarily to the discretion of the lessees with grazing typically occurring from October to May-June. In both riparian and upland settings, spring forage production and duration of grazing was closely linked to annual precipitation. With average or above average precipitation, livestock could graze the uplands and alluvial fans in the spring, reducing grazing pressure in riparian areas and extending the grazing season. In the spring cattle were moved to high elevation irrigated ranches in Long Valley or the Kern Plateau for the summer through fall. Afterwards, cattle returned to the Owens Valley to begin the rotation again.

The new plans set specific on/off dates for each pasture. Because the plans were developed in consultation with the lessees, the on/off dates for each pasture largely reflected the historical management practices described above. The greater challenge to implementing the plans was managing grazing intensity (utilization restrictions) which took about four-years for lessees to fully implement. The grazing management plans make no mention of animal units, animal unit months, stocking rates, or carrying capacities for any of the pastures or leases. Instead, a 40% use limit in riparian pastures and a 65% limit in upland pastures served as a proxy for reduced stocking rates. One advantage to this landscape condition approach is it allows lessees flexibility in aligning stocking rates with forage abundance and seasonality from year to year. To aid the lessees in plan implementation, more than 44 miles of riparian fencing were created separating uplands from the Lower Owens River. Initial management changes focused on implementing the utilization standards as pasture on/off dates were already in practice by most of the lessees. An exception to this were the on/off dates set for the Rare Plant Pasture on the Thibaut Lease.

Beginning in 2003, end of season pasture utilization was estimated annually on each lease. Additionally, long-term range trend monitoring on key areas began in earnest in 2003 with some sites being monitored in 2002. Utilization and range trend monitoring were conducted both in the uplands and in the moist flood plains. Monitoring transects have been added as needed over the years.

6.2.2 Utilization Methodology

The initial methodology for measuring utilization was implemented in 2002. It consisted of using ocular evaluations associated with 1.5-meter by 1.5-meter utilization cages containing key native forage species. These cages were located in grazing locations within the riparian and upland pastures/fields throughout the LORP. Site locations were selected by Watershed Resources Staff in consultation with each lessee to reflect historic grazing use patterns. The cages were moved on an annual basis in order to capture seasonal vegetation growth so biomass could be compared inside to outside of the cage. This comparison provided a utilization value for each cage location within each pasture/field. The utilization standards were set at 40% for riparian areas and 65% for upland areas. Grazing utilization was reduced to 50% in the uplands if it occurred during the peak of the growing season. These standards will be discussed in further detail below.

Once the grazing management plans were implemented, it was apparent utilization cages were not providing an accurate evaluation of utilization across each pasture/field on the LORP leases. In 2006, Watershed Resources Staff determined that more spatially dispersed monitoring locations would provide a better estimate of use related to variations in cattle movement across each pasture/field. It was also decided that a more accurate methodology of estimating utilization would be required since ocular estimates can be inconsistent. The new methodology relied on utilization height-weight curves based on key native forage species which converted the average height of a grazed species into percent of biomass removed. These height-weight curves were developed on a species-specific basis within the LORP. Key species were collected and a mathematical relationship between the height and biomass of each was determined using dried weight (Bureau of Land Management, 1996). Utilization transects were paired with range trend monitoring locations throughout the LORP and additional transects were added in each pasture/field as needed to accurately estimate use. This methodology became the primary means of measuring utilization for the past 17 years.

Since 2006, utilization monitoring has been conducted annually beginning in August by collecting ungrazed samples of key forage species for each pasture/field. In mid-season (January or February), all pasture/fields were again visited by Watershed Resources Staff. Utilization evaluations were conducted if utilization seemed close to the applicable utilization standard. At the end of the grazing season, all transects were measured and final utilization estimates were calculated. All lessees were initially shown how the methodology was applied to their leases and within a few years all of them could equate a stubble height with utilization standard. The end of season estimate is always performed by LADWP staff in late April, however utilization can be checked at any time of the year at the request of the lessee. Typically, this is the only time lessees would accompany Watershed Resource Staff while monitoring. In these situations, the more accurate estimate would allow the lessee to optimize forage use without incurring management penalties for overgrazing. In the event that utilization was exceeded, the lessee was contacted and an adjustment in management was implemented. These management adjustments included grazing deferment or reducing the utilization standard by a percentage for the next grazing season, moving the locations of supplemental feed sites, adjusting livestock numbers, and/or adjusting livestock grazing duration.

6.2.3 Riparian Pastures/Fields

In riparian pastures/fields, a utilization standard of 40% was implemented to facilitate the recruitment and establishment of riparian shrubs and trees while leaving enough vegetative structure to facilitate suitable habitat for wildlife. Forty percent was selected by the Ecosystem Sciences rangeland management specialist as the initial utilization rate, since livestock were not likely to graze woody species if herbaceous forage utilization stayed below 40% (LORP EIR 1994; Clary, 1989).

6.2.4 Riparian Utilization

Adaptation to the grazing management plans by the lessees took approximately four years. Beginning in 2008, utilization on the majority of riparian transects became stable at or under the riparian utilization standard of 40%. From 2008-2012, there were still some elevated utilization rates on the Islands, Delta, and Twin Lakes leases but further adjustments to stocking and grazing duration resulted in utilization rates in compliance with the 40% standard **(**
Figure 6-8**)**. The newly constructed riparian fencing allowed the lessees to choose the time of year they would use riparian pastures. Most lessees, especially in Twin Lakes and Blackrock, tended to graze the riparian pastures towards the end of winter. This allows the lessee to optimize spring grazing of the alluvial fans if precipitation conditions allow. If there was no spring green up on the alluvial fans, livestock were then moved early in April or when utilization was met. Riparian grazing on the Islands and Lone Pine leases was similar in pressure and timing east of the river since the leases had a much smaller amount of adjacent upland grazing to the west. These reaches rely on irrigated pastures to supplement riparian grazing during the winter. Because of this, utilization on these leases tended to be close to or above the riparian utilization standard annually.

Prior to project implementation, the Islands lease had one of the largest riparian meadow habitat areas in the LORP with established mature shrub and tree willow (LORP Annual Monitoring Report, 2015). As the project progressed, this reach began to aggrade into a wetland habitat dominated by tules and cattails due to lack of a defined river channel, consistent 40 cfs flows, and the wide flat topography of the reach. As of 2022, only one of five riparian grazing monitoring locations was accessible in this reach because of habitat transformation. The lessee has reduced his herd to adjust to the loss of forage base. As the LORP has progressed, these conditions are also becoming more prevalent and increasing in the North and South Riparian Fields on the Blackrock lease.

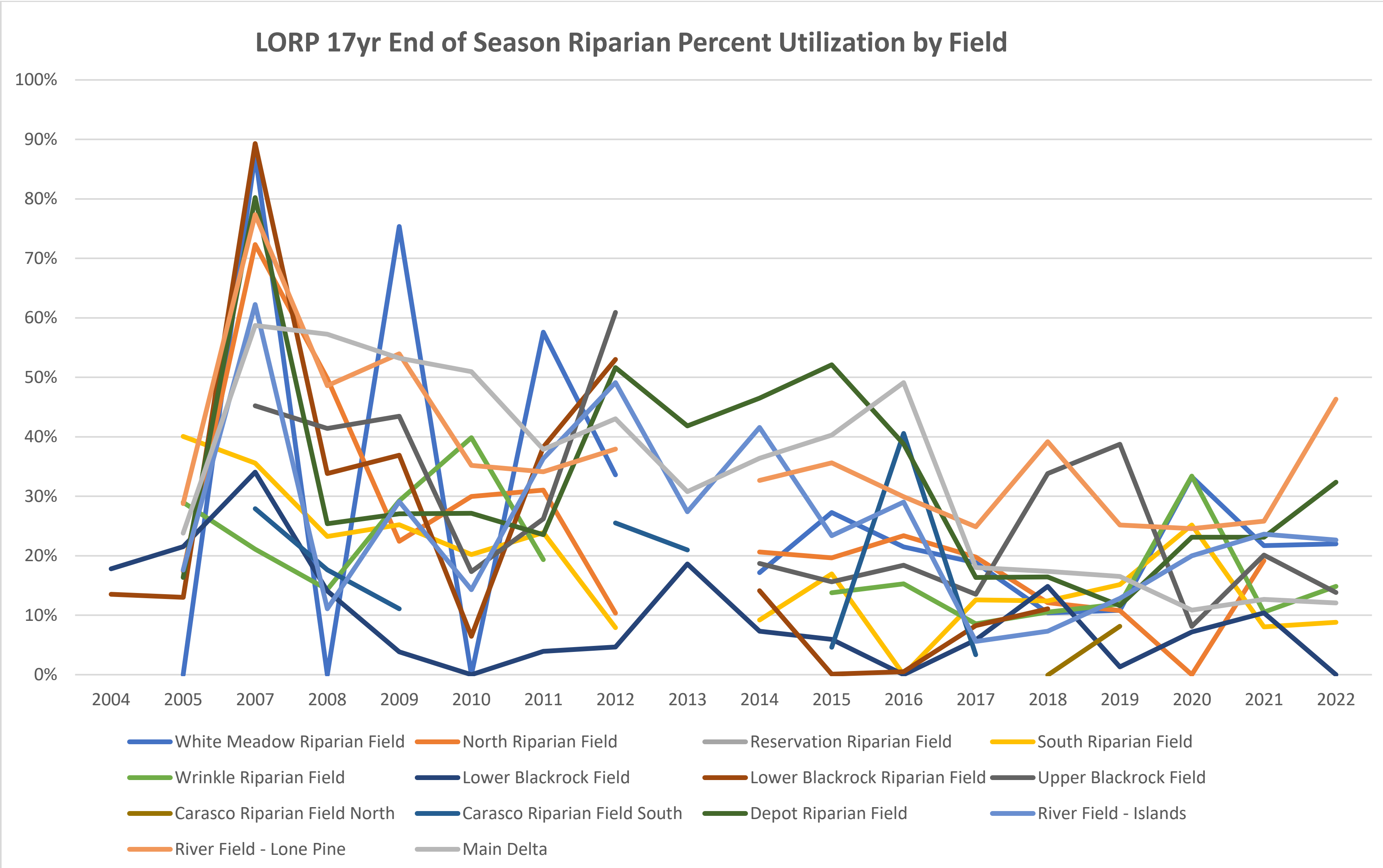

Figure 6-8. LORP Project Area (All Leases) Riparian Pastures/Fields End of Season Utilization, 2004-2022.

6.2.5 Upland Utilization

In upland pastures/fields, grazing occurs October to April with a utilization standard of 65%. Given the larger geographical expanse for livestock to graze, it was deemed that a heavier grazing intensity could be sustained given the absence of riparian obligate species. Upland pastures/fields are comprised of shrubs such as rubber rabbitbrush (*Ericameria nauseosus*) ([ERNA)], Nevada saltbush (*Atryplex torreyi*, [ATTO]) and perennial grasses such as alkali sacaton (*Sporobolus airoides*, [SPAI]) and saltgrass (*Distchlis spicata,* [DISP]). Maximum annual average herbaceous utilization allowed in upland areas is 65% if grazing occurs only during the plant dormancy period. Utilization allowed in upland areas is 50% if livestock grazing occurs during the active plant growing period; however, if no livestock grazing occurs during the latter part of the active plant growing period (the period when plants are "active" in putting on green growth) or the pasture or field is completely rested for a minimum of 60 continuous days during the latter part of this "active stage" to allow seed set, allowable forage utilization can be increased from 50 to 65%. If pastures contain both upland and riparian rangeland types, cattle are removed from the entire pasture when use reaches or exceeds the riparian or upland limit, whichever occurs first.

Implementation of the upland utilization standard of 65% did not restrict grazing beyond historical grazing practices in the upland portions of the leases. However, as a result utilization data in upland pastures/fields did show an increase in grazing intensity between 2005-2008 (
Figure 6-9). This was due to the implementation of the riparian grazing standard of 40% which decreased the historical grazing duration in riparian pastures/fields and increased the grazing duration in the uplands. The lessees adjusted livestock management and utilization soon stabilized. There had been no significant management changes required since 2008. Water spreading activities following record runoff levels in the aqueduct system in 2017 helped improve upland fields mainly on the western side of the LORP project area. These spreading activities occurred throughout the Owens Valley in 2017.

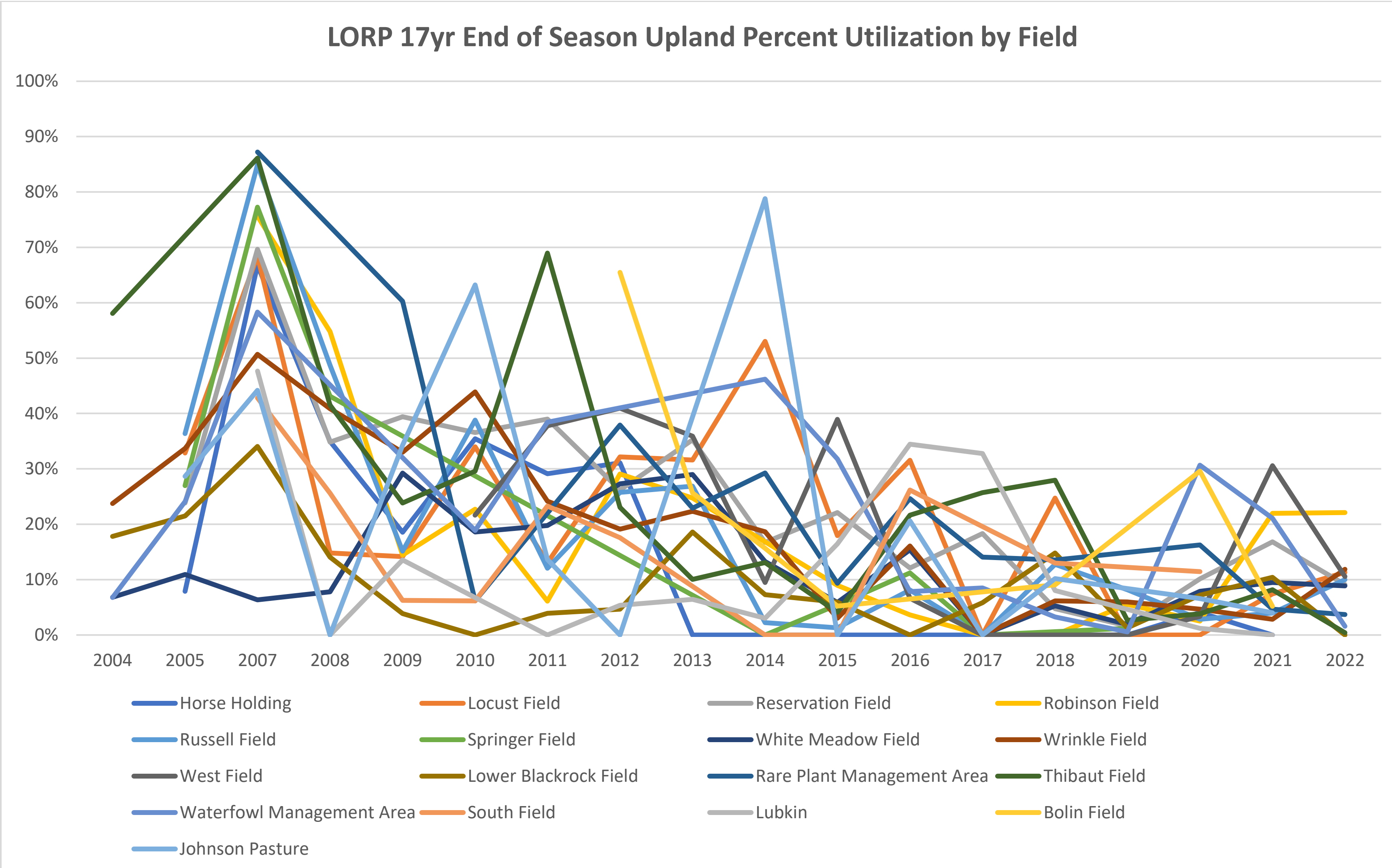

Figure 6-9. LORP Project Area (All Leases) Upland Pasture End of Season Utilization Average, 2004-2022.

Future utilization monitoring protocols should remain the same since the current protocols have proven to be effective to ascertain grazing utilization in an efficient and timely manner across all leases. It also allows for adaptive management by adjusting what transects are used based on seasonal changes in grazing activity in pasture/fields.

Other land management practices like burning, mowing, and grazing treatments should be considered and implemented on a site-specific basis. These land management practices will help improve range conditions and further enhance LORP project goals. This will be discussed in more detail below.

6.2.6 Irrigated Pastures

There are four leases within the LORP area that contain irrigated pastures: Thibaut, Islands, Delta, and Lone Pine **(Figure 6-4 - Figure 6-7)**. The Blackrock lease has acreage mapped as irrigated pasture in the Robinson Field however; due to topography and plant association, this location is managed more as a wildland flood area as opposed to a graded pasture with defined edges. The irrigation water conveyance also serves as a stock water source. This location is not monitored under the guidelines of irrigated pasture evaluation. Irrigated pastures do not directly affect the LORP project goals but they do offset grazing utilization in riparian and upland pastures/fields in the LORP by allowing the lessees to have greater operational flexibility with the additional grazing provided by irrigated pastures.

Irrigated areas are classified as any portion of the lease where the lessee receives an irrigation allotment based on Type-E vegetation classification. LADWP and the lessee jointly determine irrigated pasture conditions using the Natural Resource Conservation Service (NRCS) Guide to Pasture Condition Scoring (2001). This protocol was designed to optimize plant and livestock productivity while minimizing detrimental effects to soil or water resources. Irrigated pastures do not have a utilization standard.

Pasture condition scoring involves the visual evaluation of 10 indicators each having five environmental conditions (Cosgrove et al., 1991). Each indicator is rated separately and the scores are combined into an overall score for the pasture. The overall score for a pasture can then be divided by the total possible score to give a percent rating (overall score ÷ total possible score x 100 = percent rating). Not all 10 indicators may be appropriate for use in every pasture. In this case, using less than 10 indicators will reduce the possible score, but the percent rating will still be comparable.

All irrigated pastures within the Owens Valley are monitored using the same protocols and timing interval. Prior to project implementation, the LORP EIR (2004) recommended annual monitoring of pastures scoring below 80%, biannual monitoring of pastures scoring between 80% and 90%, and a five-year interval for those scoring 90% or greater. However, prior to initial monitoring the five-year period was felt to be too long to effectively apply management intervention in the event of declining pasture conditions. To reduce the interval without increasing the overall monitoring commitment the initial methods were changed in 2004. All pastures were to be monitored every three years and those scoring below 80% were to be monitored annually until scoring met or exceeded 80%. These intervals have not changed since monitoring began in 2004.

All irrigated pastures that scored 80 percent or greater were considered to be in good to excellent vegetation condition and were not subject to any changes in grazing management. Any irrigated field or pasture scoring less than 80 percent received changes in management prescriptions (i.e., changes in forage utilization, livestock numbers, season, or duration of use) and were monitored annually until pasture scoring met or exceeded 80%. Necessary management changes were determined by LADWP in consultation with the lessees.
All irrigated pastures/fields receive an annual irrigation allotment. The main driver of irrigated pasture condition health is water availability. The irrigated pastures located in the LORP are supplied by perennial creek flows, groundwater wells, or diversions from the aqueduct. In years where monitoring coincides with drought conditions and insufficient irrigation water delivery, monitoring can be postponed until the following year. If drought conditions persist, carrying capacity for the entire lease is reduced. This necessitates a reduction in stocking rates to prevent overgrazing and damage to forage species. This occurred in 2022, when creek flows were insufficient to provide irrigation water to the leases in the LORP. Scheduled monitoring in 2022, was then deferred to 2023.

Irrigated pasture evaluations were first implemented in 2004. Irrigation and pasture management was left up to the discretion of the lessees so long as scores remained above 80%. Pasture condition on each lease has remained stable with most averaging above 80% for the last 15 years. However, the Thibaut lease has scored below the allowable irrigated pasture evaluation standard of 80% throughout the years. Average pasture condition scores (2004-present) are displayed in **Table 6-2**.

The Thibaut lease scored between 68% and 80% seven out of 11 monitoring years between 2004 and present. These low scores were primarily due to poor irrigation practices and grazing in the early spring and summer. All pastures on the lease are grazed during the winter months with variable stocking rates. In early spring livestock are moved closer to the corrals in the Thibaut Field to begin preparations to leave for the packing season. This management practice increases grazing pressure on the irrigated portion of the field. In addition, often times the lessee cannot move the pack stock into the Eastern Sierras until late June or until winter snows have melted adequately to access the pack stations. This adds extra grazing pressure in the spring when forage species are breaking dormancy and mobilizing stored energy in their roots. In order to improve irrigated pasture condition scores, supplemental feeding during the winter months has been used to move grazing activity to the east and south portions of the Thibaut Field. This management change has increased pasture condition in some years by relieving grazing pressure on the irrigated portion of the field during the winter months. This allows for more residual cover in the spring which helps alleviate grazing pressure on the sensitive springtime growth. However, both poor irrigation practices and late season grazing contributes to low pasture condition scores, hovering around 80% most years.

Table 6-2. Irrigated Pasture Condition, LORP Land Management Area 17 Year Average

Lease	RLI	Location	Pasture/Field	17yr/Avg
Thibaut	**RLI- 430**	Corrals	Thibaut Fileld	78%
Lone Pine	**RLI- 456**	Lone Pine	Edwards	86%
			Richards	85%
			Van Norman	82%
			Old Place	86%
			Smith	89%
			Miller	88%
Islands	**RLI-489**	Reinhackle	B Pasture D Pasture	90%
			Carasco North Pasture	88%
Delta	**RLI- 490**	Lone Pine	Lake	86%

Overall, irrigated pastures in the LORP project area have remained in good condition over the past 17 years. The seasonal variations of water availability (drought) is the only factor that can't be predicted and has the biggest effect on irrigated pasture condition. However, adherence to the irrigated pasture monitoring protocols and pasture management by the lessee have proven to mitigate for drought affects. When water is available normal irrigation allotments must be supplied to the irrigated pastures; water is always the limiting factor for healthy irrigated pastures. The use of NRCS irrigated pasture monitoring protocols should continue to be used in future. Using the ten indicators allows for a repeatable method that encompasses conditions that occur on LORP irrigated pastures. Monitoring practices for irrigated pastures in the future will remain the same.

6.2.7 Fires Prescribed and Wild

There have been prescribed burns and wildfires throughout the project since the implementation of the LORP **(Figure 6-10)**. Prescribed fires were used to improve range condition and habitat by removing shrub encroachment and decadent forage. It was also used in preparation for flooding units in the BWMA. There was a total of 11 range burns within the LORP project area since implementation. Overall prescribed burning has had a positive effect on forage production and habitat within the LORP. Post-fire outcomes throughout project implementation have shown that site potential and vegetative cover must be assessed prior to prescribed burns. Riparian sites or uplands that were meeting potential but were being encroached by shrubs have had good results. In areas that were burned that also contained shrub dominated stands with little herbaceous forage or bare ground understory, burn recovery was mixed with results including no vegetative recovery, or a monoculture of fivehorn smotherweed (*Bassia hyssopifolia*). Although these areas were limited in size, they provided visuals in otherwise successful burns of what a negative response would look like and to avoid.

There were three wildfires on the LORP. Each resulted in having a positive effect on vegetation. Two of the wildfires occurred within the riparian corridor, the largest being the Lone Pine River fire. This fire consumed all of the riparian vegetation in the River Field on the Lone Pine lease. Prior to the fire the riparian corridor was high functioning with a strong forage base. The resulting response was very good, there was some loss of mature trees but most re-sprouted and the associated pastures rebounded quickly and vigorously. The Moffat fire had a similar response since this location was also in good functioning condition prior to burning. The third wildfire began as a prescribed fire on the Blackrock Canal but became a wildfire when it reignited the following night during a wind event. The fire spread north and south into the Drew and Wagoner Waterfowl areas before being contained the following day. This fire served to remove cattails and tules regularly burned under prescription. Some of the burned uplands responded with smotherweed growth but overall the wildfire resulted in positive vegetation response.

Prescribed fire will continue to be an essential tool within the LORP project area for land management. The number of burn events prescribed or wild are shown **(Table 6-3)** below.

Table 6-3. LORP Land Management Area 17 year Burn Acreages

LORP 17yr Burn Acreages				
Year	**Lease**	**Type**	**Burns**	**Acres**
2006	RLI-489	Prescribed	Islands	107
2008	RLI_491-428	Prescribed	Drew Slough & Waggoner	849
2008	RLI-428/430	Prescribed	Slash pile	70
2009	RLI-491/428	Wild Fire	Fort/Drew/Waggoner	940
2010	RLI-489	Prescribed	Lone Pine North/Islands	476
2011	RLI-428	Prescribed	Winterton	908
2011	RLI-489	Prescribed	Islands South	154
2012	RLI-491	Prescribed	Telegraph	195
2013	RLI-428	Prescribed	Homestead	366
2013	RLI-456	Wild Fire	Lone Pine River	525
2014	RLI-428	Prescribed	Thibaut/Blackrock	224
2018	RLI-428	Prescribed	Winterton South	336
2018	RLI-428	Prescribed	Long Pond	308
2018	RLI-428	Wild Fire	Moffat	990
			Total	**6448**

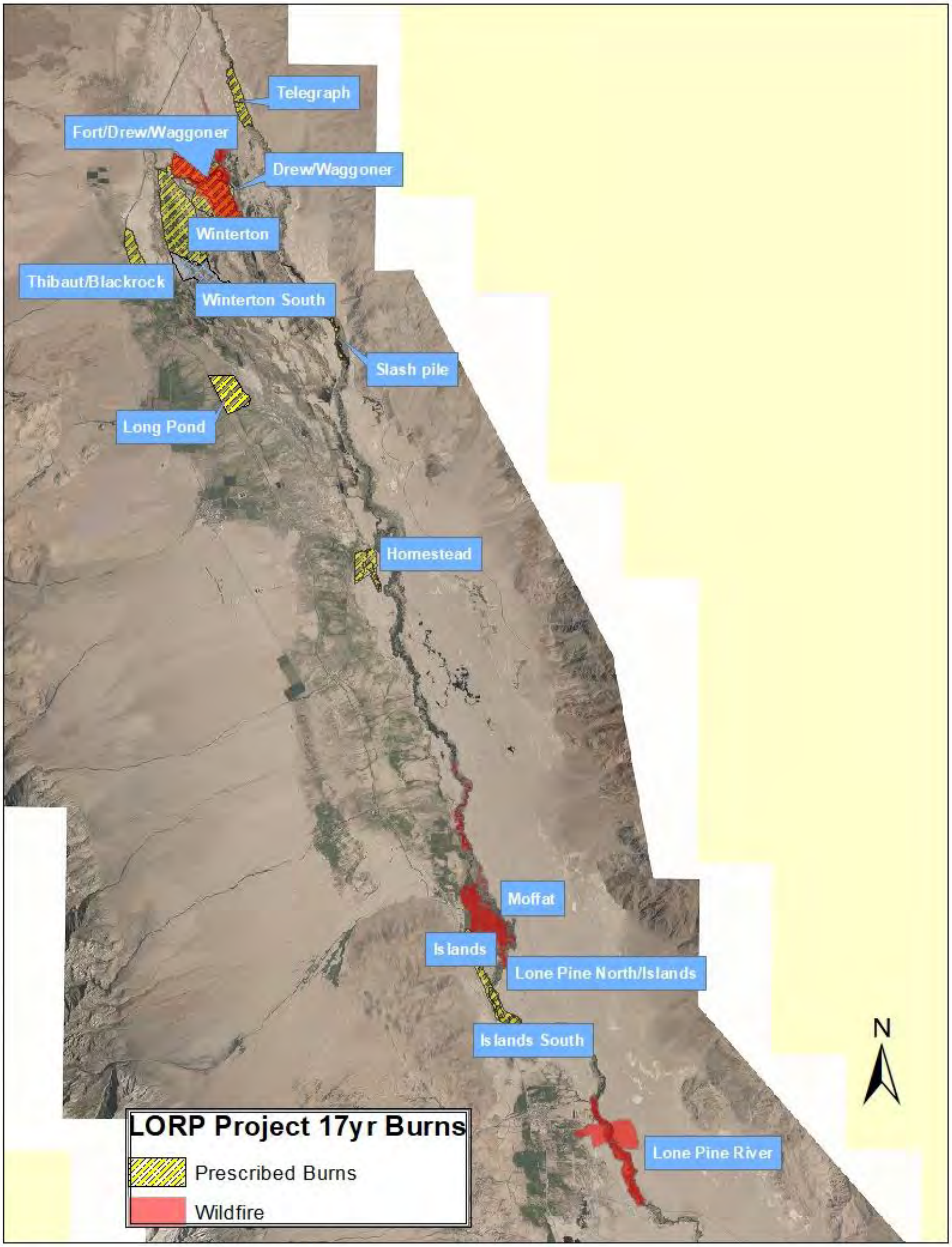

Figure 6-10. Location of Prescribed Burns and Wildfires within LORP.

6.2.8 Fencing

LADWP installed 44 miles of new riparian fence, 22 miles of cross-fencing, and fencing for rare plant and riparian exclosures by 2010 (**Figure 6-1 – Figure 6-7**). The riparian pastures provided lessees the flexibility to adhere to riparian utilization standards by moving animals from one pasture to the next before limits were exceeded. With the exception of the Wrinkle and Carasco riparian fields (Blackrock and Islands leases) which are fenced entirely, all riparian fencing was constructed on the western side of the Lower Owens River. This was done to allow livestock the ability to utilize spring grazing on the eastern uplands and foothills of the Inyo Mountains while still having access to water. Use in these areas occurs in the spring months when precipitation is average or above.

The new riparian fencing consisted of a northern and southern section. The northern section began on the middle portion of the Twin Lakes lease and extended south on the west side of the Lower Owens River riparian corridor. It terminated north of the Islands as part of the Carasco riparian field. The remainder of the Islands lease to the south was left without a riparian fence at the request of the lessee. The riparian portion of this lease (River Field) was the largest within the LORP with adjacent uplands that extended several miles to the base of the Inyo Mountains. In years of average or above normal precipitation spring forage in the uplands are a valuable source for livestock on the lease. Since no riparian fencing was constructed the entire River Field was managed as riparian. Riparian fence construction began again on the north west end of the Lone Pine lease. This stretch of fence was located between Lone Pine Narrow Gauge Rd and Highway 136. No riparian fences were constructed south of the highway on the Delta lease since the entire field was managed as riparian.

There were two types exclosures constructed within the LORP project area: riparian and rare plant. Rare plant exclosures targeted Owens Valley checkerbloom (*Sidalcea covillei*) and Inyo County star-tulip (*Calochortus excavatus*) species and were generally less-than-acre in size. The riparian exclosures were built to compare grazed vs ungrazed areas on the LORP following returned flows to the river. Discussion about the exclosure studies can be found further below in this document.

Redesigned H-braces fashioned to serve as elk crossings between pastures were built in numerous locations on the LORP. No formal study had evaluated the impacts from LADWP's efforts but anecdotally it has appeared that elk have not used the crossings.

There are no current recommendations for additional fencing by LADWP. Fence maintenance is ongoing and will continue to be performed by either the lessees or LADWP dependent upon the specifics of a given project.

6.2.9 Stock Water Wells

The goal of additional stock water locations in the LORP was to improve livestock distribution outside the river corridor and reduce grazing pressure on riparian pastures. Water gaps were also to be installed as part of the riparian fence construction. However, managing livestock movement between the river and the adjacent alluvial fans to the east made water gaps not practical since there was very little fencing constructed on the east side of the river. The use of stock-water tanks offered more opportunity for animal movement between riparian grazing and eastern uplands. Normal operation of the stock water wells is March-June, except the Thibaut well which may run into the summer depending on the movement of pack stock to the mountains. The remainder of the year they are turned off.

There was a total of eight stock water well locations proposed for the LORP project area, and as of 2020 seven had been installed (**Figure 6-3 – Figure 6-6**). Of the seven LORP leases Thibaut, Blackrock, Islands, and Lone Pine received stock water wells. Some of the wells have established troughs (**Figure 6-11**) and some flow out on adjacent playa (**Figure 6-12**). One advantage to using natural playa is that it provides good wildlife watering locations. Troughs tend to be problematic for small fur bearers and birds to drink and require bird ladders. These allow wildlife to utilize the water source without drowning.

The remaining stock water well was planned to be installed on the Lone Pine lease east of the Owens River near Owens Road. The well was drilled twice unsuccessfully. The first attempt resulted in multiple pumps burning up due to continued siltation of the well. The second attempt resulted in producing water accompanied with methane gas. This well is currently being reengineered to safely vent the flammable gas.

Figure 6-11. Stock water Well with Trough, Islands Lease.

Figure 6-12. Stock water Well with no Trough (used Playa), Blackrock Lease.

Given climatic variability, precipitation conditions do not always allow for spring grazing on the alluvial fans. In drier years, livestock tend to stay in the riparian corridor until utilization is met or they are gathered for branding or shipping. During these conditions, livestock use of these watering locations is intermittent. The reliability and maintenance issues such as freezing pipes, bad solar panels, and malfunctioning control boards have also made the stock water wells unreliable over the years. Because of this, the lessee's livestock management does not rely on these stock water locations. However, given the right year they still can be a benefit for livestock grazing if operational.

The remaining well on the Lone Pine lease should be completed to further reduce grazing pressure on the river. In addition, the lessee hauls water to temporary troughs in wet years to take advantage of springtime grazing in the uplands. Lastly, the stock water well will promote animal distribution as cattle on the Lone Pine lease use the adjacent alluvial fan every year to some extent. Further assessments for more stock water locations in the future will be evaluated as needed. Currently there is no recommendation for any new stock water wells.

6.2.10 Supplemental Feeding

The LORP land management grazing plans also address the use of supplemental feeding and stock water by lease in order to improve livestock grazing distribution. The typical grazing season for the LORP is during the dormant and spring months of the growing season (November – April). During this time period, the nutritional value of forage species, specifically protein content, is significantly lower than the growing season. For this reason, the LORP lessees use supplement livestock feed. Proper supplementation will maintain an adequate body condition score and improve the health of livestock. The typical supplemental feed used by the lessees in the LORP consists of round liquid molasses feeders and hay. The molasses feeders contain extra protein, vitamins, and minerals. Supplemental feeding was used prior to 2002 by the LORP lessees with feeding locations being selected at their discretion. The LORP grazing management plans removed all supplemental feeding sites from riparian meadow pasture/fields, and relocated them to prior disturbed upland locations. The intent was to protect water quality in areas where supplement was located directly adjacent to the Lower Owens River. Supplemental feeding in riparian pasture/ fields was one of the theorized causes of impeded woody recruitment through trampling and browsing by livestock (Ecosystem Sciences Field Communication, 2009). By moving these supplemental sites and implementing a utilization standard of 40%, it was also hoped to improve riparian meadow habitat in the LORP. Supplementation is used widely throughout the LORP by all the lessees.

Currently there is no data to substantiate the movement of supplemental feeding sites in regards to decreasing riparian grazing pressure. However, field staff have noticed livestock spending less time in the riparian areas when supplement is available on the adjacent uplands. Supplement will continue to be utilized by the lessees to improve livestock health. The management of the feeding locations will continue as outlined in the LORP grazing management plans for the future.

6.3 Range Trend Introduction

The intent of this section is to discuss the results of nearly 20 years of monitoring utilization and plant community trends (range trend) on the moist floodplain sites on the LORP. The goal of range trend monitoring was to "provide vegetation data necessary to evaluate the response of range condition and trend to changes in livestock management practices" (Ecosystem Sciences, 2008). A description of monitoring methods, data compilation, and analysis techniques can be found in the MAMP. More detailed discussions regarding range trend methods and considerations for interpretation are located in the 2010 LORP Annual Monitoring Report (LADWP and Inyo County, 2010). Descriptions of the range trend monitoring sites, their locations on the leases, individual transect narratives and maps can be found in LADWP and Inyo County's LORP Annual Reports (2008-2021).

The original range trend protocols recommended in the MAMP were nested frequency sampling, line intercept sampling for shrub cover, shrub age classification, visual obstruction, and photo documentation. Visual obstruction data were closely linked to seasonal variability where fluctuations in precipitation and growing periods translated into changes in herbaceous structure. This sensitivity created too much noise to evaluate longer period trends in plant communities. There were also greater observer bias and repeatability issues associated with the method compared to frequency. Because of these reasons visual obstruction was discontinued by 2007. Line intercept described overall shrub communities. Shrub age classifications were not relevant to management objectives that considered overall shrub cover adequate for land management needs. Though the data were interesting, given staffing limitations and LADWP's commitment to a time intensive monitoring schedule, the protocol for measuring shrub age classes was discontinued in 2012. Of all of the methodologies used to sample over the last 19 years, nested frequency and shrub cover (line intercept) have proven to be the most repeatable amongst users, invited minimal bias when performing the protocol, and generated the most reliable data relating to the influences of livestock grazing and flow management on vegetation trend and range condition. Influences of climate, fire, and flow management on moist floodplain sites in the LORP are also detectable in the frequency and shrub cover data.

The intent of range trend monitoring was to document the anticipated positive effects from limiting livestock grazing (utilization) on vegetation communities in the LORP. One of the objectives stated in the MAMP was "Grazing strategies will lead to the establishment of healthy riparian pastures and exhibit an upward trend in range conditions" (Ecosystem Sciences, 2008). No further refinement of what appropriate range condition/indicators should be used to evaluate moist floodplain sites were presented in the MAMP, the LORP EIR, or the 1997 MOU. Based on the assumption that post-2008 changes in management would improve conditions (Ecosystem Sciences, 2008), we will compare general conditions from years prior to 2009 up to the present. General conditions are defined here as long-term trends in plant frequencies and shrub cover. Stable to upward trends in desirable plant frequencies (e.g. saltgrass or other native perennial grasses) which are also key forage species for livestock will be interpreted as a positive response to livestock grazing. Understanding that responses from changes in grazing management can be slow, general trends rather than simply comparing between pre and post implementation are also discussed. Vegetation conditions inside five grazing exclosures to comparable conditions immediately outside of them will also be presented. Range trend data were collected for up to five years before implementation. Utilization data was collected for two-three years prior to flows returning to the Lower Owens River in 2007 on most sites. Range trend monitoring began on the LORP in 2002. Since 2009, monitoring results have been reported annually. A total of 81 transects are in the LORP **(Figure 6-13)**, and all transects have been read at least five times while the majority have been read nine times or more. Sampling years have varied over time among all transects, some transects have been discontinued as they became inaccessible by the river, and others were shelved due to static trends. Currently, LADWP leases are monitored every three years, with a minimum of two leases being monitored each year in the LORP area.

The following discussion begins with a brief examination of upland sites then focuses on range trend sites located along Reaches 1-2 in areas that have not historically been grazed for extended periods of time each year. These areas are still changing in response to returned flows to the Lower Owens River (**Figure 6-14**). The sites in Reach 1-2 are further differentiated into graded and incised sites. The third portion will focus on Reaches 3-6 on sites that are located on more developed and stable riparian meadows which receive greater grazing pressure during the winter months each year (**Figure 6-19**).

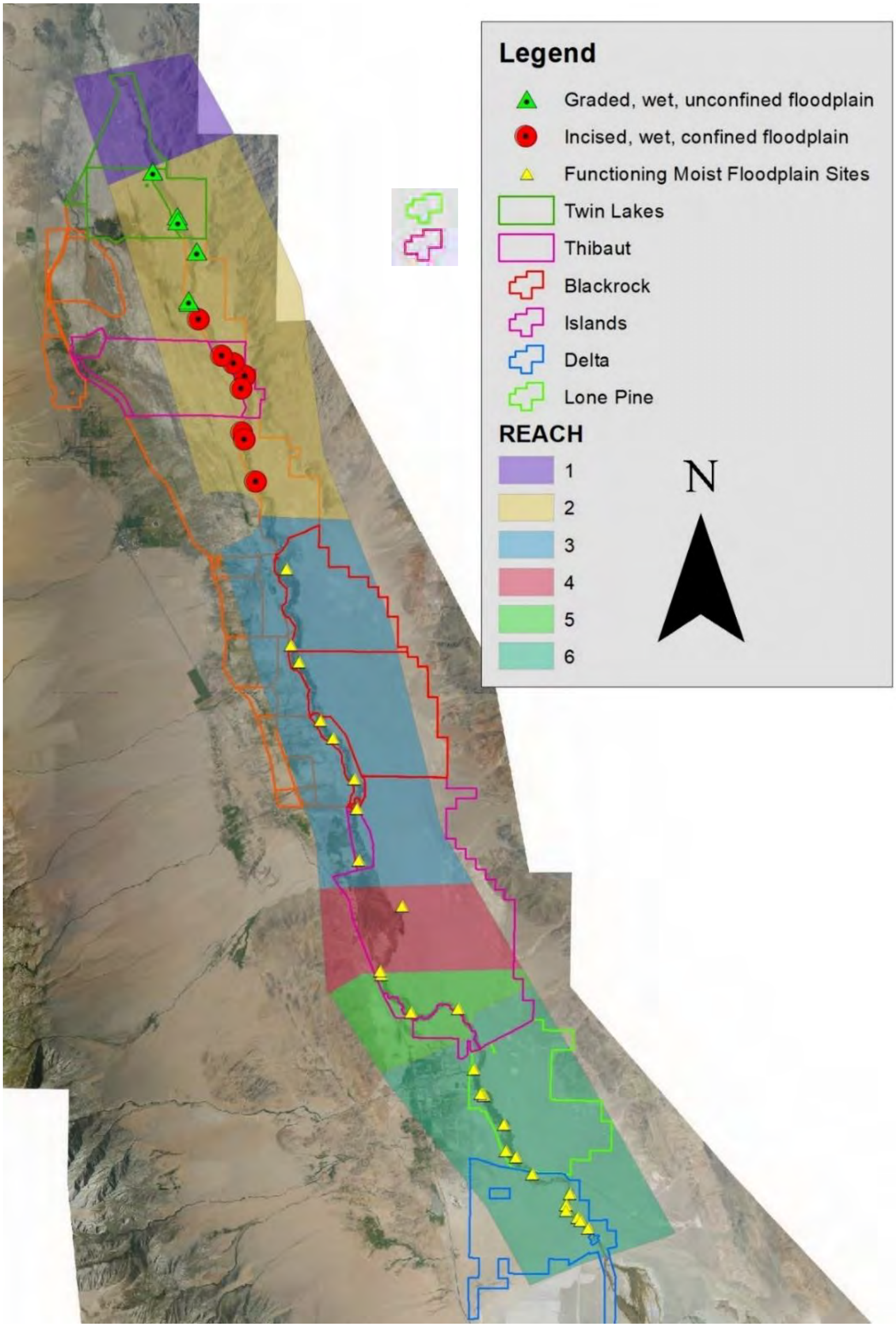

Figure 6-13. Locations of all Range Trend transects in the riparian zone of the LORP. Sites are further broken down by river reach and state.

These 26 sites are referred to as functioning moist floodplain sites. Finally, there will be a discussion examining similarities and differences between grazed transects and adjacent conditions inside grazing exclosures.

6.3.1 Upland Range Trend Sites

Range trend monitoring transects are established in all upland pastures in the LORP Project area where livestock grazing occurs regularly and the pasture is fenced off from the Lower Owens River. There are no upland transects on the Lone Pine Lease east of the river because it is unfenced. The upland Johnson Pasture (Lone Pine Lease) west of the river near the Lone Pine Airport does have a transect but receives tailwater from irrigation off of the Lone Pine Paiute Shoshone Reservation on some years, significantly altering the plant composition in the area. Utilization is still read on the site every year, however making inferences about the larger area from the transect LONEPINE_05 is confounded because the tailwater does not reach the majority of the pasture. The Delta Lease lacks upland range trend transects as does the Islands Lease, both these areas are either not regularly grazed (Bolin Field-Delta Lease) or lack fencing between the riparian corridor and uplands (Islands Lease). A utilization limit of 65% was set for all upland transects. Utilization rarely has reached this level over the past 15 years. In general, utilization in the upland transects rarely exceeds 20% and many areas will go several years without grazing. Upland transect trends have remained static over the course of the LORP Project. Fluctuations in plant frequency and shrub cover will vary slightly in response to annual precipitation and more so to wildfire. Many transects have been archived because of their static nature and will only be read if significant impacts are occurring such as an episodic event of extreme grazing, wildfire, or water spreading. For a more detailed look at upland transects for each of the leases please refer to the LORP Annual Reports. For the most current summary of upland conditions for Twin Lakes refer to the 2021 LORP Annual Report. The most current upland summary for the Blackrock Lease is in the 2019 LORP Annual Report. The Islands Lease, Delta Lease, and Lone Pine Lease do not have upland transects inside the LORP Project area.

6.3.2 Reaches 1-2

Reaches 1-2 contain 14 transects in the riparian corridor. In Reach 1, there are two transects, INTAKE_01 and TWINLAKES_03 on the Twin Lakes Lease. INTAKE_01 is outside the moist floodplain area in an upland site (Saline Bottom Ecological Site) and will not be discussed as part of the riparian transects in Reach 1-2. The fourteen riparian sites can be further separated into graded, wet, unconfined floodplain or incised, wet, confined floodplain (LADWP and County of Inyo, 2015). The elevated water table associated with the implementation of LORP flows, prescribed fire, and mechanical trampling of shrubs by livestock have increased the relative proportion of perennial grasses to shrubs, and has led to a general expansion of the graded, wet, unconfined floodplains in the Blackrock and Twin Lake leases (**Table 6-4**). The graded, wet, unconfined floodplain sites are essentially alkali meadows whose water table is directly connected to LORP flows. The incised, wet, confined floodplain have also responded to the re-watering of the Lower Owens river but these responses have varied. When salt cedar slash was removed from the channel and burned on the banks prior to returning flows, or where dense monocultures of salt cedar groves were removed on the stream terraces leaving open, uncolonized disturbed areas, these locations quickly became locked into a Bassia boom-bust cycle (BBBC) dictated by wet and dry winters. This cycle, coined by LADWP Watershed Resources Specialists is further explained below and depicted in Figure **6-14**).

Other incised, confined areas where the original saltbush understory was left intact have exhibited large swings in shrub cover. Line intercept was the most effective sampling protocol for the transects on the incised wet, confined floodplain as herbaceous cover has remained minimal. Because of the paucity of perennial grasses and associated lack of use by livestock in these same areas, no utilization estimates were collected. However, utilization, frequency, and line intercept have all generated useful data on the graded, wet, unconfined floodplain sites.

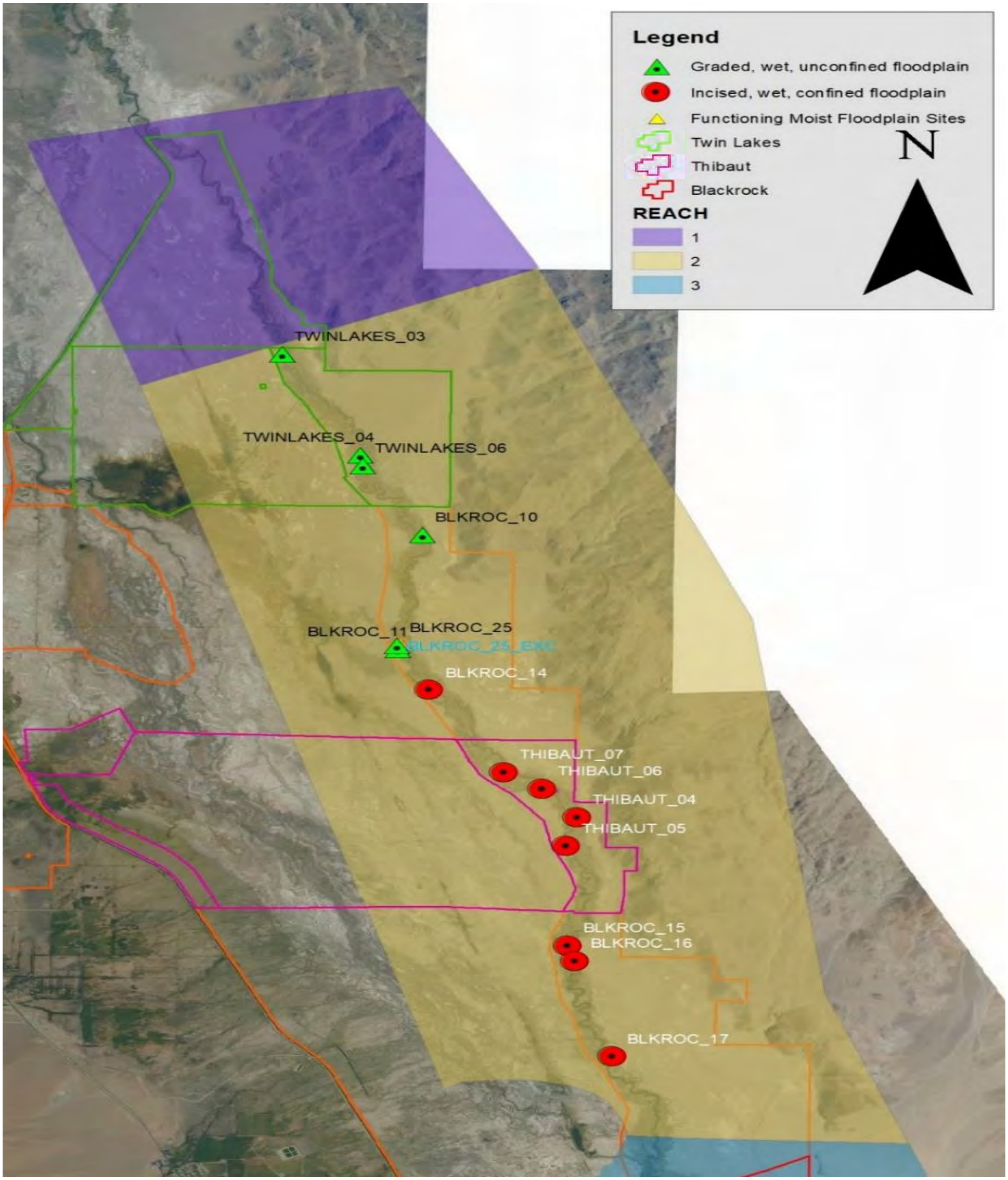

Figure 6-14.Map of both graded, wet, unconfined and incised, wet, confined floodplain sites in Reaches 1-2.

6.3.3 Graded, wet, unconfined sites

Shrub cover trend varied on the six sites located on the graded, wet, unconfined reach until 2017 **(Figure 6-15)**. Runoff in the summer of 2017 was the only event that appeared to affect five out of the six transects. Large scale flooding across the unconfined floodplains caused widespread mortality for Nevada saltbush, a species that is intolerant to prolonged inundation. TWINLAKES_06 and BLACKROCK_10 both spiked in shrub cover with the return of flows in 2007 and declined after 2017 in a pattern more similar to the incised sites discussed below. Shrub cover flatlined to zero on TWINLAKES_03 from 2013 forward, the site was burned over in a prescribed burn in 2013.

Saltgrass frequency on the graded, wet, unconfined floodplains varied between sites with frequencies ranging from 0% to 100% depending on site and year (**Figure 6-16**). Frequency within each site exhibited small changes from year to year, however. The greatest change was on BLKROC_25. This site is discussed in greater detail in the section below covering grazing exclosures. BLKROC_10 is slowly transitioning to a site with some perennial grasses. The grass community is beginning to occupy the voids created by shrub mortality caused by the 2017 flooding (**Photo 1**).

Table 6-4. Expansion of river length by state from 2000-2014, taken from LORP Annual Report 2015 (LADWP and County of Inyo 2015).

Vegetation Mapping Table 1. River Length by State						
State	2000 Conditions		2009 Conditions		2014 Conditions	
	Miles	%	Miles	%	Miles	%
Incised, dry, confined floodplain	16.1	28.9	0.0	0.0	0.0	0.0
Incised, wet, confined floodplain	23.7	42.5	38.2	68.3	9.8	17.6
Graded, wet, unconfined floodplain	12.0	21.4	12.5	22.4	38.6	69.1
Aggraded, wet, unconfined floodplain	4.0	7.2	5.2	9.3	7.5	13.4
TOTAL	**55.9**	**100.0**	**55.9**	**100.0**	**55.9**	**100.0**

**Preliminary mapping results from 2022 highlight a continuance of this trend for Reach 2.*

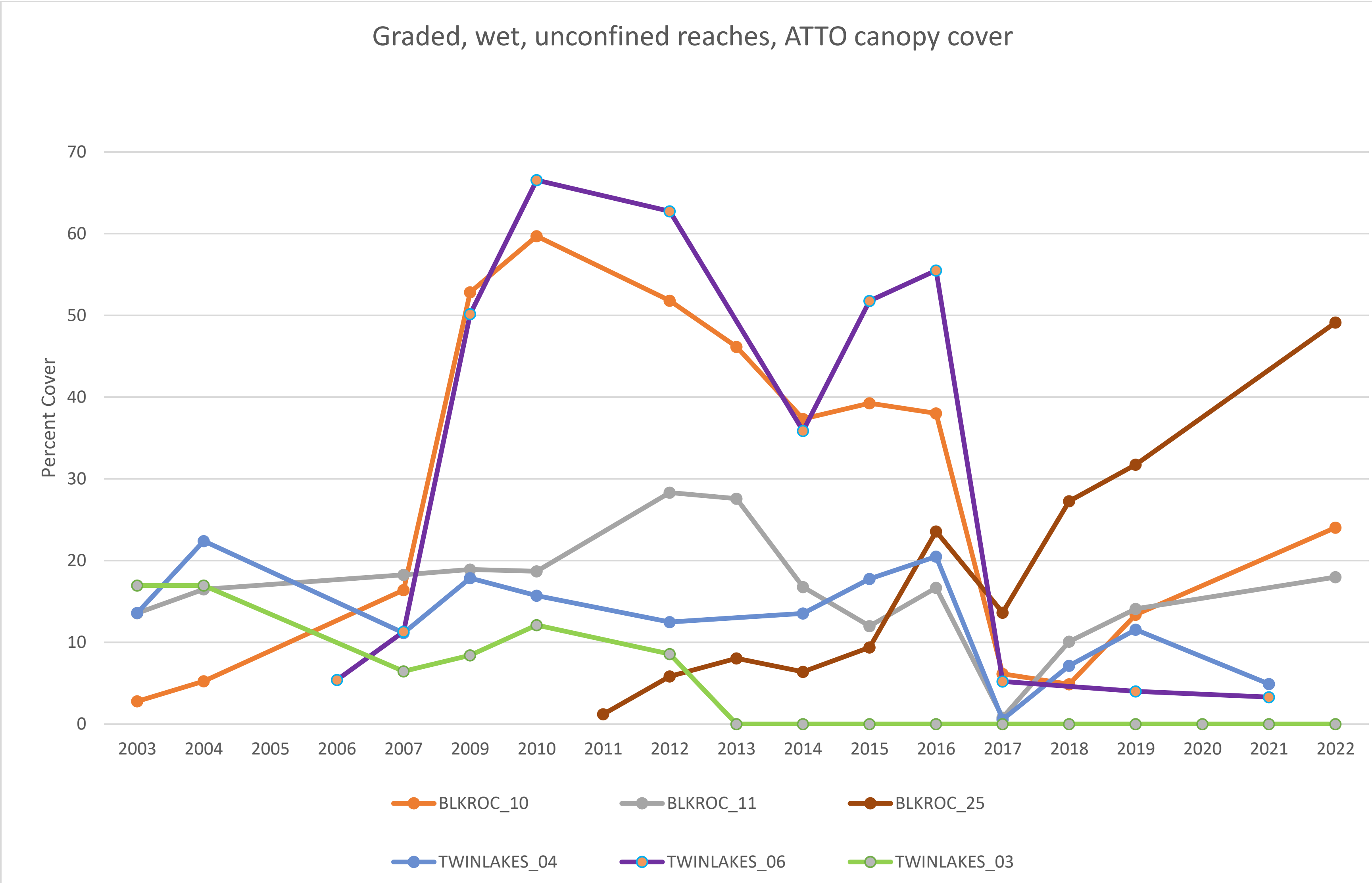

Figure 6-15. ATTO cover (line intercept) for transects located on graded, wet, unconfined reaches

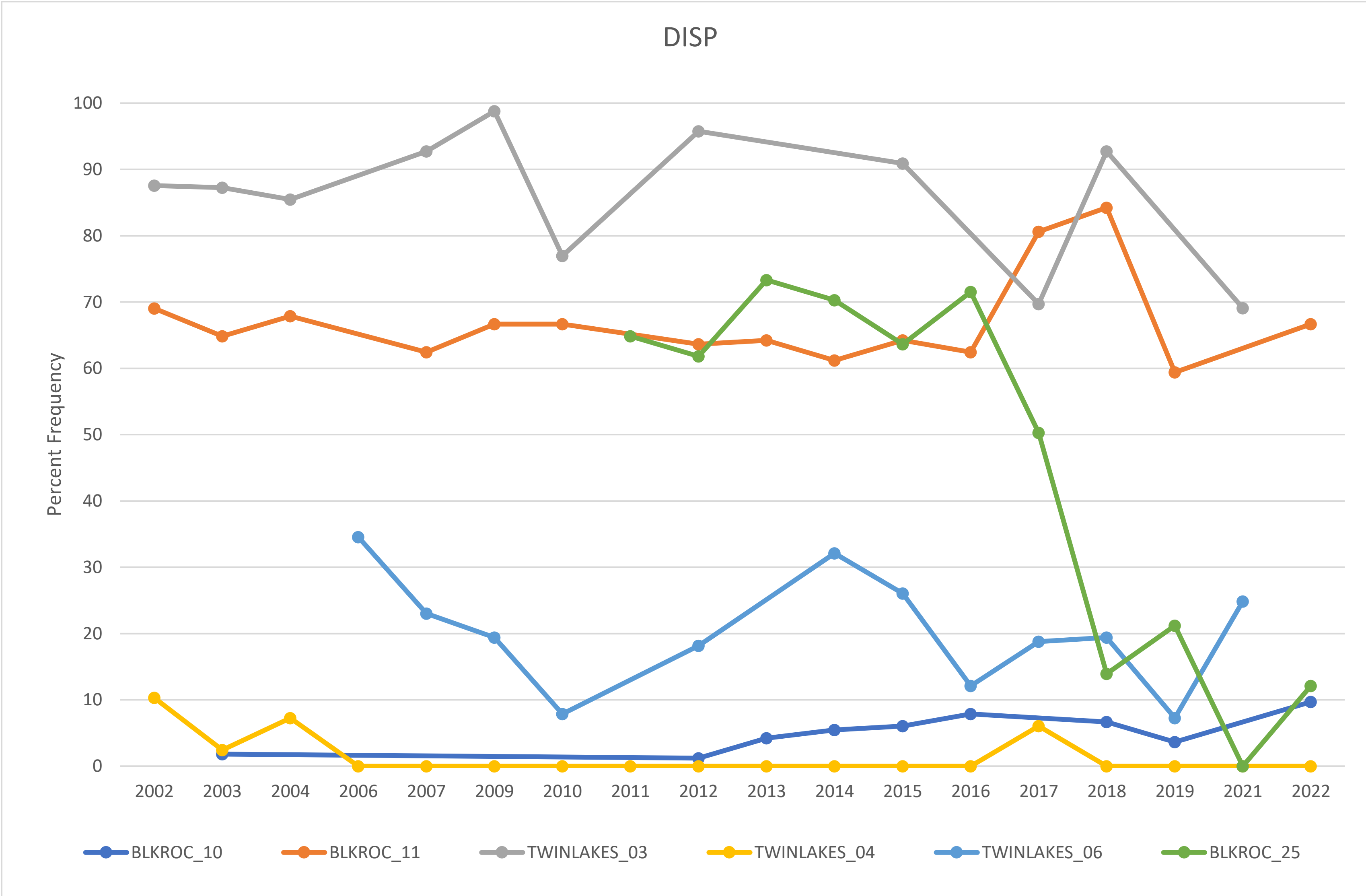

Figure 6-16. Frequency for saltgrass (DISP) on graded, wet, unconfined sites on Reaches 1-2.

6.3.4 Reach 2- Incised, wet, confined floodplain sites

There are eight range trend sites located on the incised, wet, confined floodplain sites in Reach 2. Livestock grazing has been nominal at best on these sites. There are few large perennial grass stands in these areas and livestock tend to concentrate on more productive regions either upstream on the graded, wet, unconfined sites or downstream on the functioning moist floodplain sites discussed later in this document. Prior to LORP implementation, with the exception of isolated seeps in Reach 2, the water table was below the rooting depth of perennial grasses, with water accessible only to shrubs and trees- primarily Nevada saltbush and salt cedar. With a rising water table, line intercept cover for shrubs increased markedly beginning in 2007 when compared to earlier periods.

Photo 1 BLKROC_10, August 2017, note high mortality of Nevada saltbush as a result of flooding.

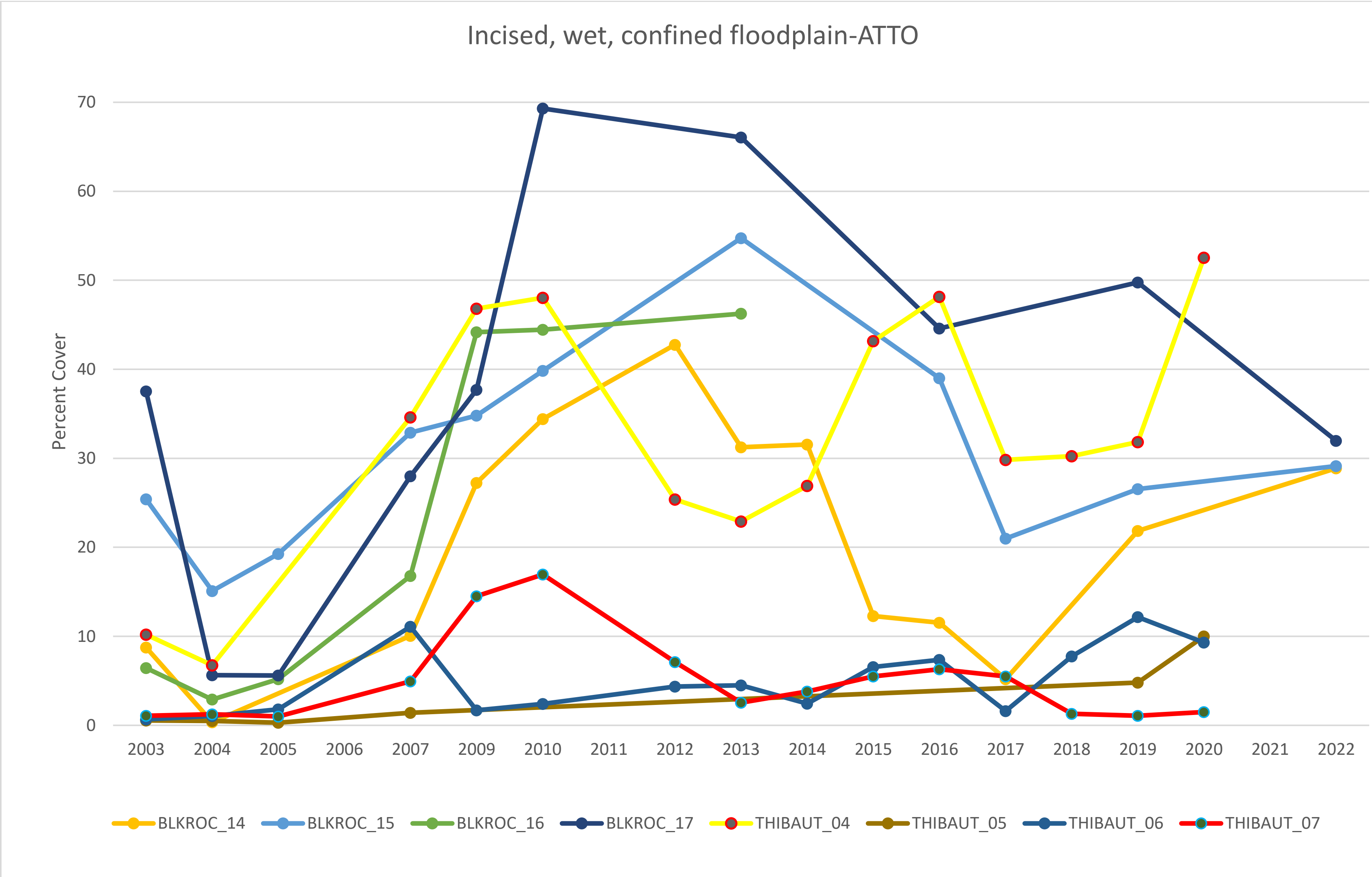

Figure 6-17. ATTO Cover (Line Intercept) for Transects Located on Incised, Wet, Confined Floodplain.

Increased shrub cover in response to returned flows did not immediately occur on THIBAUT_05 or THIBAUT_06 (**Figure 6-17**). These two sites became dominated by Bassia (**Photo 2 – Photo 5**). The large accumulations of cleared salt cedar slash in these areas were either burned as in the case of THIBAUT_05 in preparation for flows, or channel slash was placed onto banks but left in place, unburned as was the case forTHIBAUT_06. Disturbance associated with salt cedar removal was intense enough to either eliminate associated Nevada saltbush or there were no understory shrubs prior to salt cedar removal. Regardless, these bare areas were now available for colonization by smotherweed.

Photo 2 THIBAUT_05, 2005

Photo 3 THIBAUT_06, 2004

Photo 4 THIBAUT_05, 2018

Photo 5 THIBAUT_06, 2018

The cycle described in **Figure 6-18** continues today for many locations on the incised, wet, confined region in Reach 2. There are some locations where sun heliotrope (*Heliotropium curassavicum)* is slowly replacing Bassia stands (THIBAUT_04) but in general the boom-bust Bassia cycle (BBBC) appears to continue unabated.

The remaining six transects located on the confined, wet incised reaches had native shrubs (Nevada saltbush) onsite when flows were returned to the Lower Owens River. Though not simultaneous, these transects have all shown a similar pattern (**Figure 6-17**) where shrub cover rapidly increased between 2007-2010 and then eventually began to decline around 2012 with the lowest point in 2017. Subsequent cover has increased but not to the levels observed immediately after 2010. The initial rise in cover was in response to the rising water table. The rapid crash in cover is likely explained by high shrub mortality from the continued rise in the water table and prolonged inundation of the root zone. The high flow releases in 2017 served as the tipping point to an already stressed shrub community from surplus water, resulting in further declines in shrub cover. Subsequent upticks in shrub cover indicate there were shrubs that did survive. Field observations along transects in 2019 also noted large germination events in 2017 Valley wide.

As evidenced from vegetation mapping results discussed in the 2015 LORP Report, graded, wet, unconfined sites are expanding. Results and discussion found in the Vegetation Mapping section of the 2018 LORP Report further confirms the expansion in Reach 2.

Range trend monitoring on Reach 2 has been able to document several distinct plant community responses to the return flows into a channel that was once dry and incised. On the graded, wet, unconfined sites, alkali meadows continue to develop and expand. The range trend transects do not capture the spatial expansion in the plant communities but they do confirm that the plant communities have remained stable, with the exception of BLACKROC_25. With regard to management interventions, the graded, unconfined sites respond favorably to prescribed fires. This section of the river benefitted from the 2013 prescribed Telegraph Burn (**Figure 6-10**), further accelerating the establishment of moist floodplains and alkali meadows.

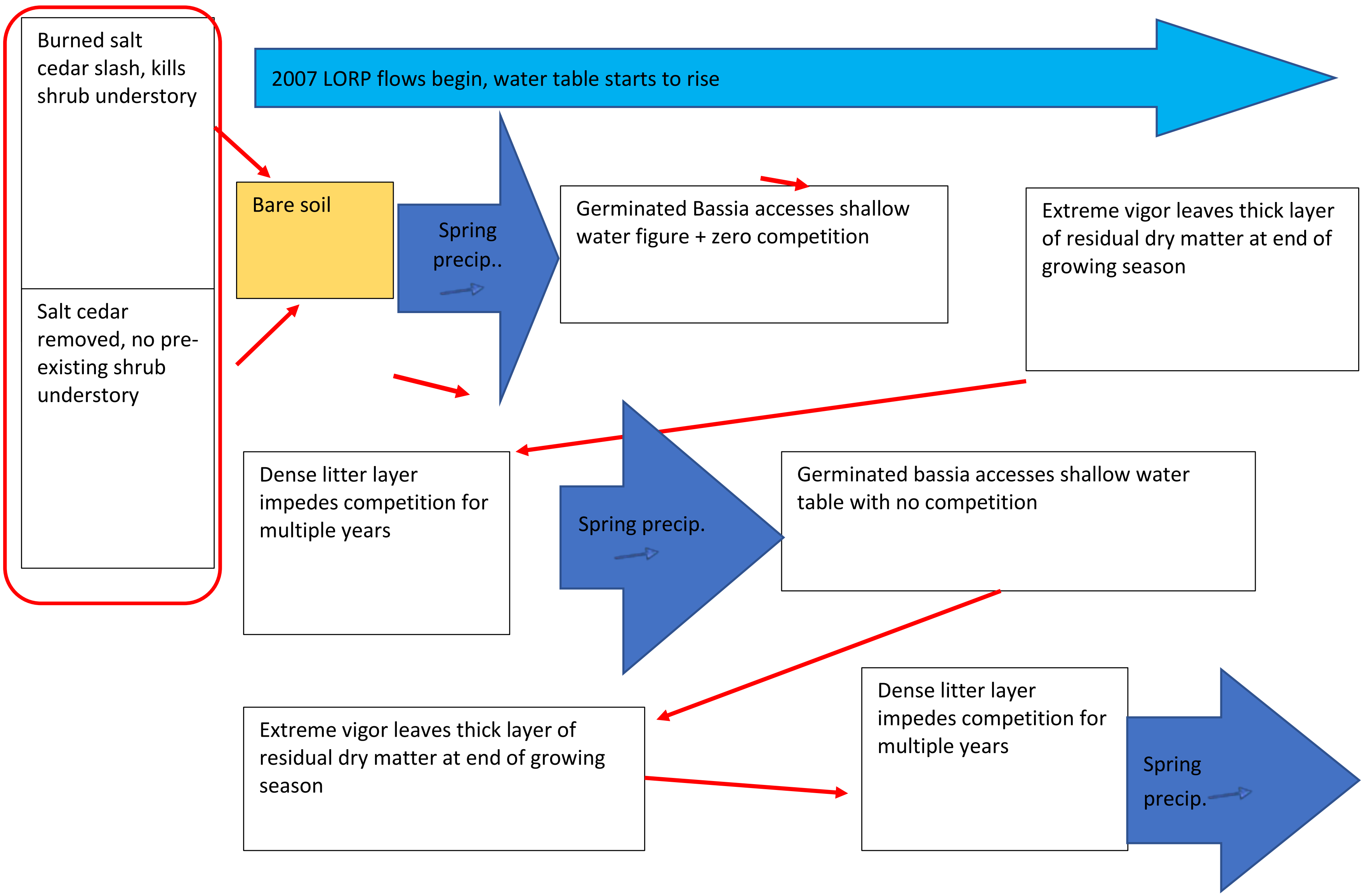

Figure 6-18. Conceptual BBBC model on disturbed, wet, confined, incised areas on Reach 2.

The wet, confined, incised areas in Reach 2 are also dynamic. Depending upon a site's initial condition when water was returned to the river, sites have taken different trajectories. Some areas appear to be fully ensconced in the BBBC while others appear to show early signs of a transition away from Bassia to sun heliotrope (*Heliotropium curassavicum*) and/or alkali mallow (*Malvella leprosa*). Other sites which were less disturbed at the onset of the LORP project, exhibited explosive growth early on then precipitously declined with current trends pointing towards a rebound in cover, though not to the original levels. Shallow rooting saltgrass, which can tolerate wetter soils better than Nevada saltbush, where present, will likely thrive under these conditions which helps to explain why these areas respond positively from fires. It also explains the 'pockets' or satellite meadows identified from Vegetation Mapping (**Table 6-4**) in Reach 2.

When considering future management interventions in Reaches 1-2, managers need to further determine what state a project is located in. Prescribed burns may be successful on graded, wet, unconfined flood plains while a similar burn on an incised, wet, confined floodplain could trigger a BBBC. Similarly, when planning salt cedar control efforts, a post-removal plan should also be developed to occupy the created niches with desirable species.

6.3.5 Reaches 3-6, Moist Floodplain sites

This section of the report concentrates on livestock/vegetation interactions on moist floodplain (MFP) sites adjacent to the Lower Owens River. More specifically moist floodplain sites are considered to be functioning and in fair to good condition. Although named differently due to functionality, the moist floodplain sites are also located on graded, wet, unconfined floodplains. These areas are located inside Reaches 3-6 or below Mazourka Canyon Rd to the Pumpback Station (**Figure 6-19**). Transects in these areas were in fair to good range condition when flows were returned to the Lower Owens River in 2006 (LORP Annual Monitoring Report, 2009). Range conditions in these areas were maintained due in part to continual 15 cfs maintenance flows released from Billy Lake at the river starting in 1987. The moist floodplains along these lower reaches are characterized by a shallow water table and a less incised river channel as compared to Reaches 1 and 2. In Reaches 3-6 there are eight riverine riparian pastures across four leases (Blackrock, Islands, Lone Pine, and Delta Lease). These riparian pastures are dominated by saltgrass and to a lesser extent, alkali sacaton. They are very productive and as such are critical components to each lessee's livestock operation. There are 28 long term range trend transects located on the functioning moist floodplain sites on Reaches 3-6. Saltgrass was the key species monitored for frequency in the range trend program and quadrat sizes were adjusted to capture percentage occurrence on transects within a 20%-80% range. For the following discussions, DISP will be the primary perennial grass species discussed in relation to plant trends. Utilization at the pasture level, averaged from individual transects has been at or below 40% utilization for the majority of the monitoring years. Utilization on each individual transect was more varied compared to pasture averages. For ease of discussing the 28 transects, we will break out transects by leases within each reach, beginning from the north.

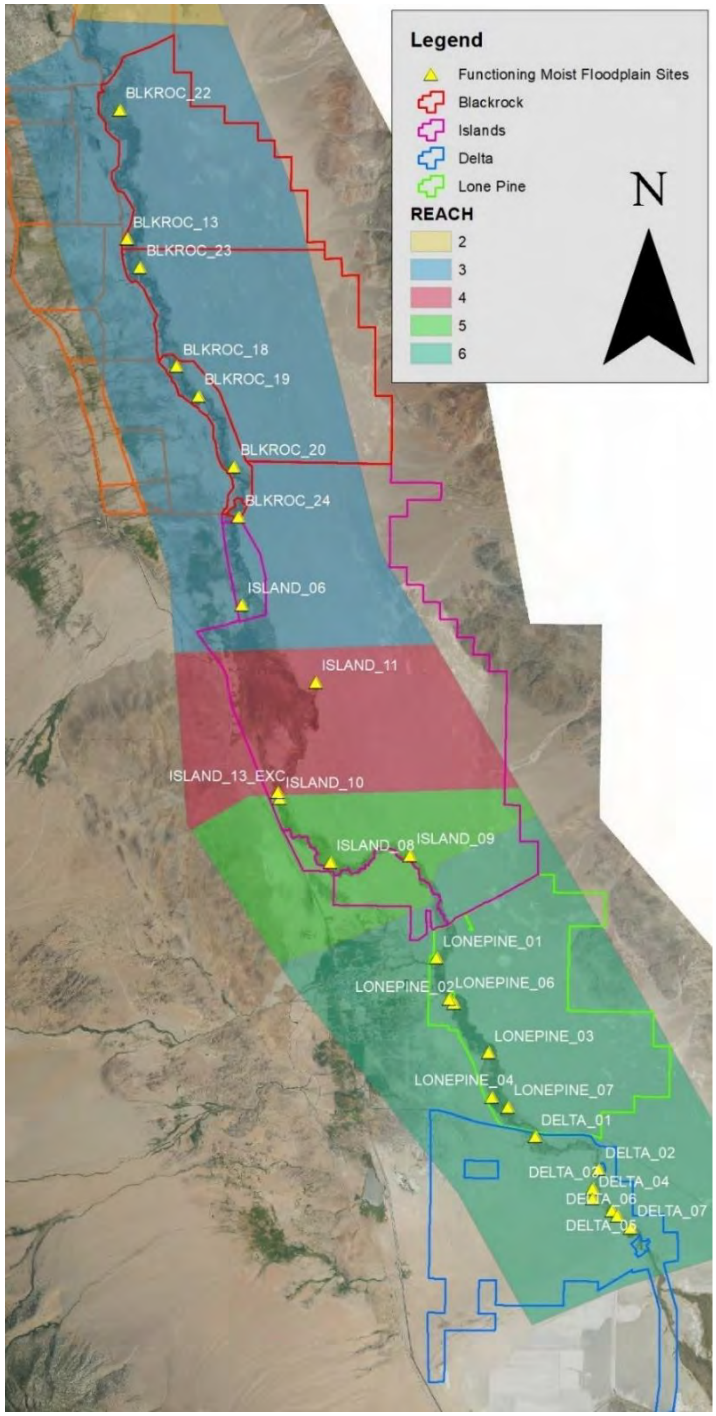

Figure 6-19 .Functioning Moist Floodplain Sites, Reaches 3-6.

6.3.6 Reach 3 (Blackrock Lease, RLI-428)

Six moist floodplain range trend transects were monitored in Reach 3. All of the sites were annually grazed by livestock during the winter months. **Figure 6-20** provides information for 20 years of saltgrass frequency monitoring and 16 years of grazing utilization. By 2012, grazing pressure dropped below 40% use for all six transects. Based on pre-2007 utilization estimates at the pasture level (**Figure 6-8**) where most transects generally exceeded 40% on all transects, it's assumed historical use in these areas were >40%. Despite successfully implementing utilization standards to <40% on the six moist floodplain sites for eleven straight years, there were no realized increases in saltgrass abundance.

In some instances (BLKROC_20 and BLKROC_22) trends decreased significantly (**Figure 6-20**). The decrease in DISP on transect BLKROC_20 was supplanted by a significant increase in beardless wildrye (*Leymus triticoides*). As the river aggraded, portions of this transect became increasingly mesic, supporting more wildrye at the expense of saltgrass. The increase in this more palatable forage species was attributed to flow management however, and not to the implementation of utilization rates. At BLKROC_22 declines in DISP were caused in part from large scale flooding that occurred in 2017. Salt heliotrope colonized bare spots created by the flooding and displaced saltgrass in many areas along the transect. The large increase of fivehorn smotherweed on the site since 2019 also has had a negative effect on saltgrass.

Though much less abundant compared to saltgrass, trends in alkali sacaton on the same transects on the Blackrock lease were relatively static over the past 20 years (**Figure 6-21**). No discernable improvements in alkali sacaton frequencies occurred following the onset of reduced dormant season livestock grazing initiated in 2007 and fully implemented by 2011-2012. The implemented changes in grazing strategies described in the MAMP and the Blackrock Grazing Management Plan did not generate upward trends in range condition predicted in the MAMP document. This suggests that the moist floodplains on the Blackrock Lease were functioning at or near potential prior to plan implementation.

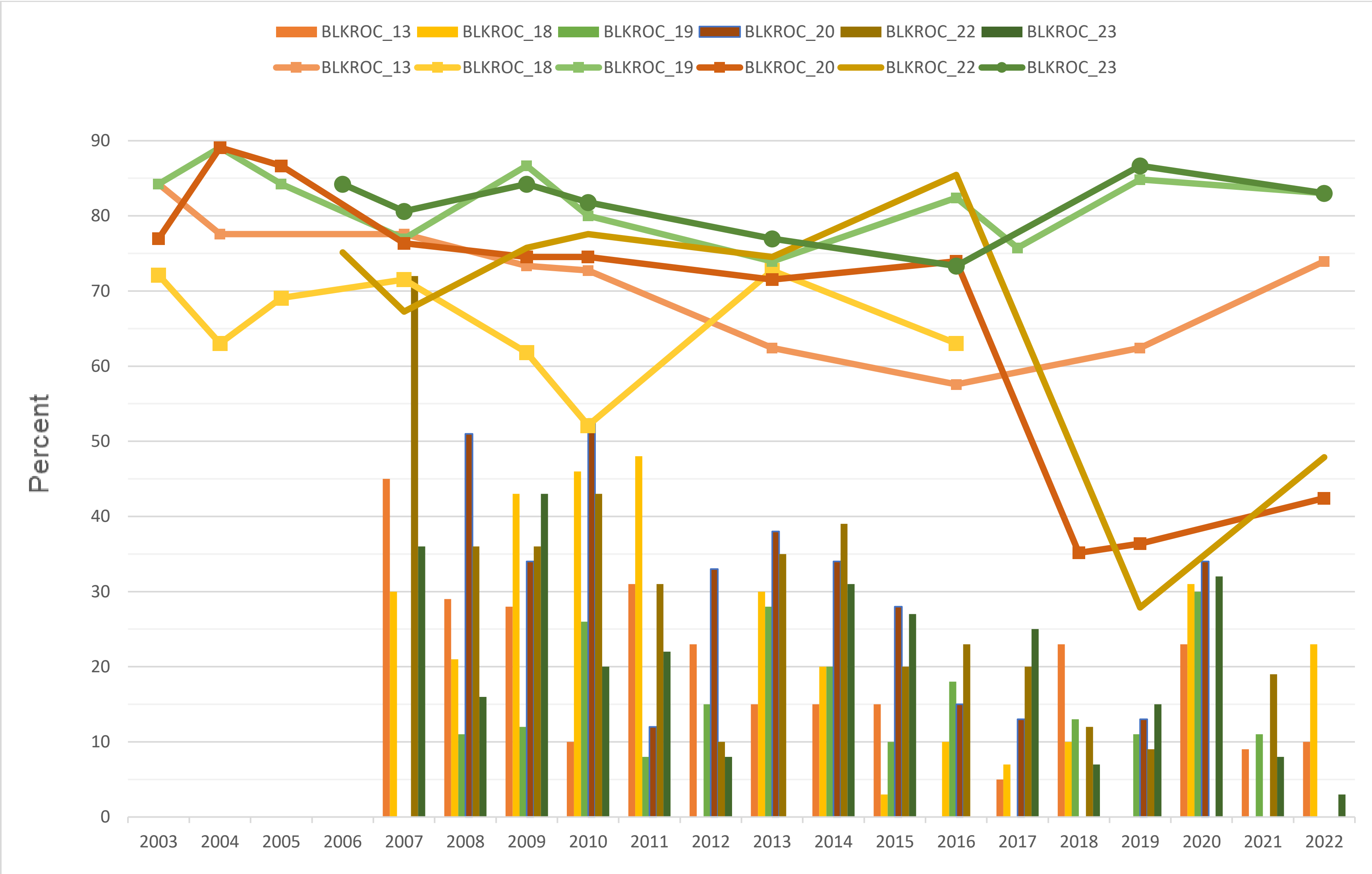

Figure 6-20. Percent frequency (line) for saltgrass and percent utilization (bar) on functioning moist floodplain sites on the Blackrock Lease on Reach 3.

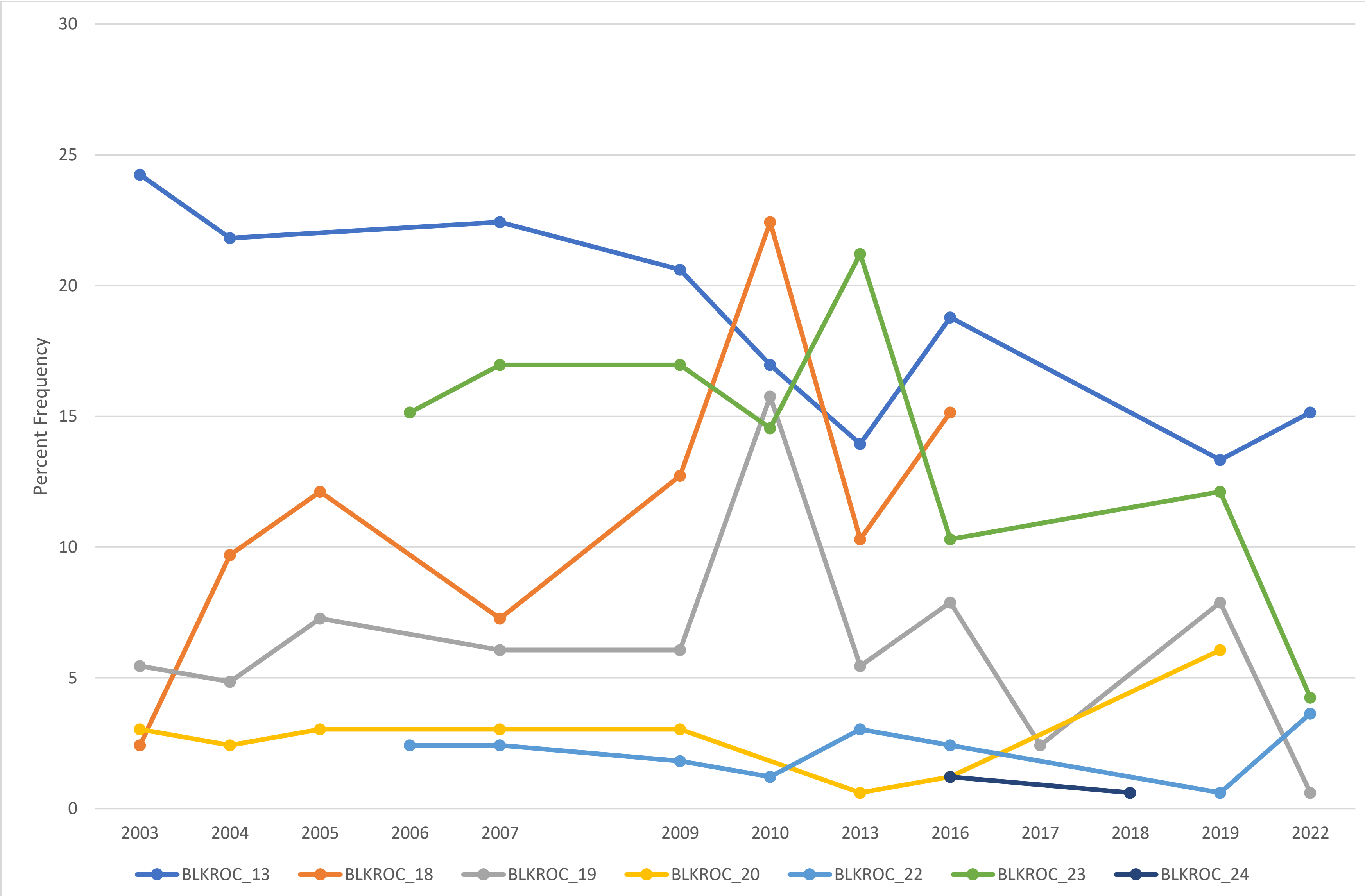

Figure 6-21. Alkali sacaton frequencies for moist floodplain sites on Reach 3.

6.3.7 Reach 3-5 (Islands Lease, RLI-489)

Five range trend transects were monitored in Reaches 4-5. Adherence to the <40% utilization standard was not as consistent across these transects as compared to the RLI-428 lease **(Figures 6-20 & 6-22)**. The only marked increase in DISP frequency was observed at Island_06 and Island_08 **(Figure 6-22)**.

DISP frequency at Island_09, and Island_10 declined slightly over the past 15 years of sampling. However, they are both highly productive areas and had likely reached their potential well before the project was implemented.

Island_08 saltgrass frequency increased significantly from 2010 to 2014 in response to the Islands South 154-acre prescribed burn in 2011 **(Table 6-3)** which included Island_08. With the exception of 2007 and 2012, utilization has consistently been below 40%. Shrub cover was 32% in 2010, after the burn, cover was at 0% until 2020 when cover was 1%. Island_06 **(Figure 6-22)** exhibited a substantial increase in saltgrass frequency. There are two factors that can explain the increase of frequency on the site: 1) groundwater and soil salinity-related. As depth to the water table decreased in part to LORP flow releases in 2007 and subsequent aggradation of the Islands tule complex (LORP Annual Report, 2018), salt levels decreased and allowed for an increase in saltgrass. 2) Changes were wildfire-related. Following the Moffat fire in 2017, DISP frequency increased to 87%. Returned flows to the LORP and prescribed burns resulted in positive changes in saltgrass. There was no correlation between changes in utilization rates and DISP frequency at this site.

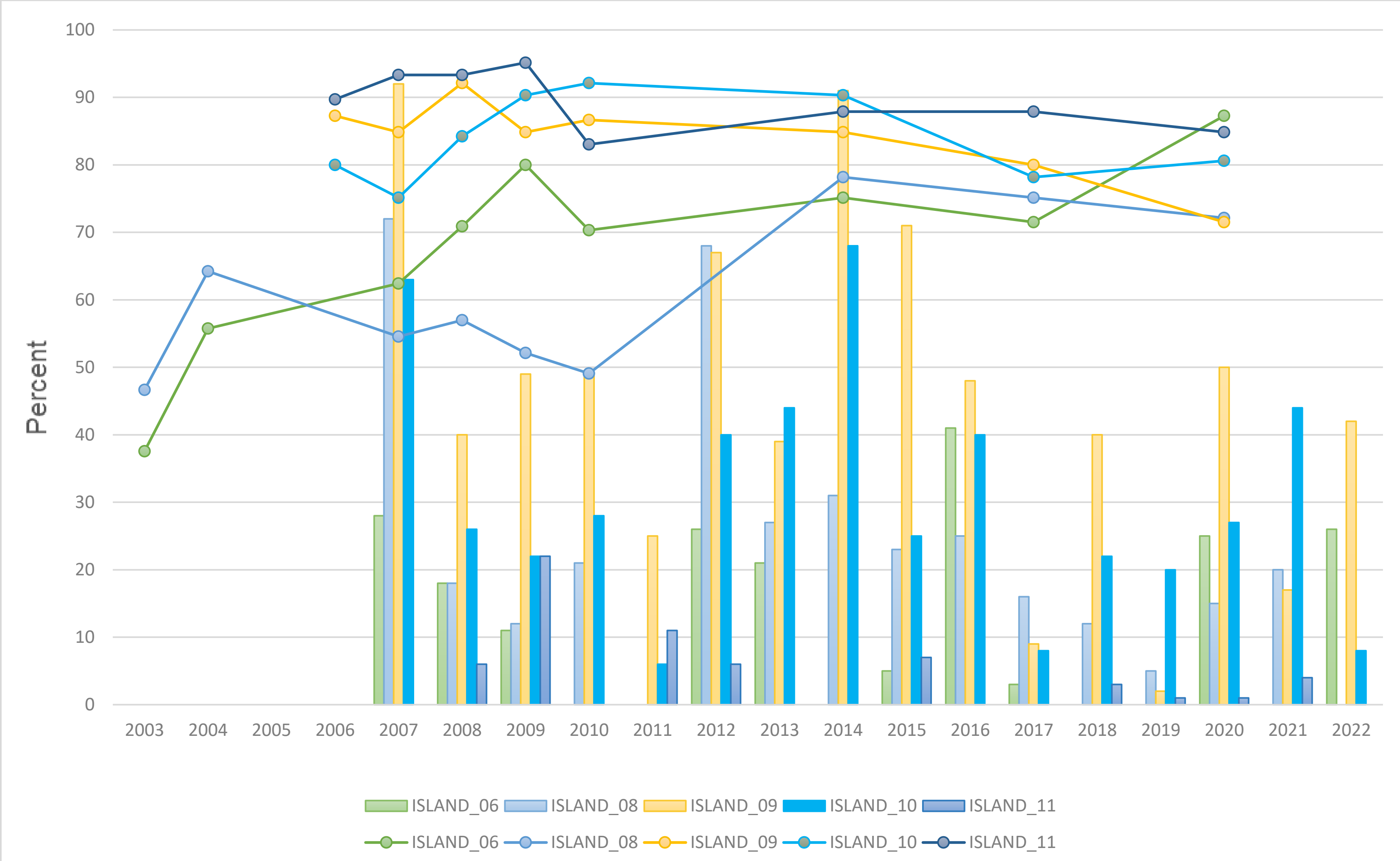

Figure 6-22. Percent frequency (line) for saltgrass and percent utilization (bar) on functioning moist floodplain sites on the Island Lease on Reaches 3-5.

6.3.8 Reach 6 (Lone Pine Lease, RLI-456 and Delta Lease, RLI-490)

Lone Pine Lease, RLI-456

Utilization at the Lone Pine lease was very heavy and from 2007 to 2009 ranging between ≈50% to ≈80% **(Figure 6-23)**. Despite heavy early use and later general adherence to the 40% utilization standard, there was no clear upward or downward trend in saltgrass frequency over time **(Figure 6-23)** for most transects. Only LONEPINE_04 and LONEPINE_07 have shown some volatility. LONEPINE_04 exhibited a general decline in DISP from earlier years despite utilization being heaviest on the transect during five of the first six years. Utilization was not estimated in 2013 due to a late February wildfire that burned over all of the transects on the river. There was sufficient regrowth the following summer to monitor range trend. Although a slight dip in frequency was observed across all transects, no significant declines occurred. This highlighted that our frequency monitoring was sensitive enough to detect the burn impacts.

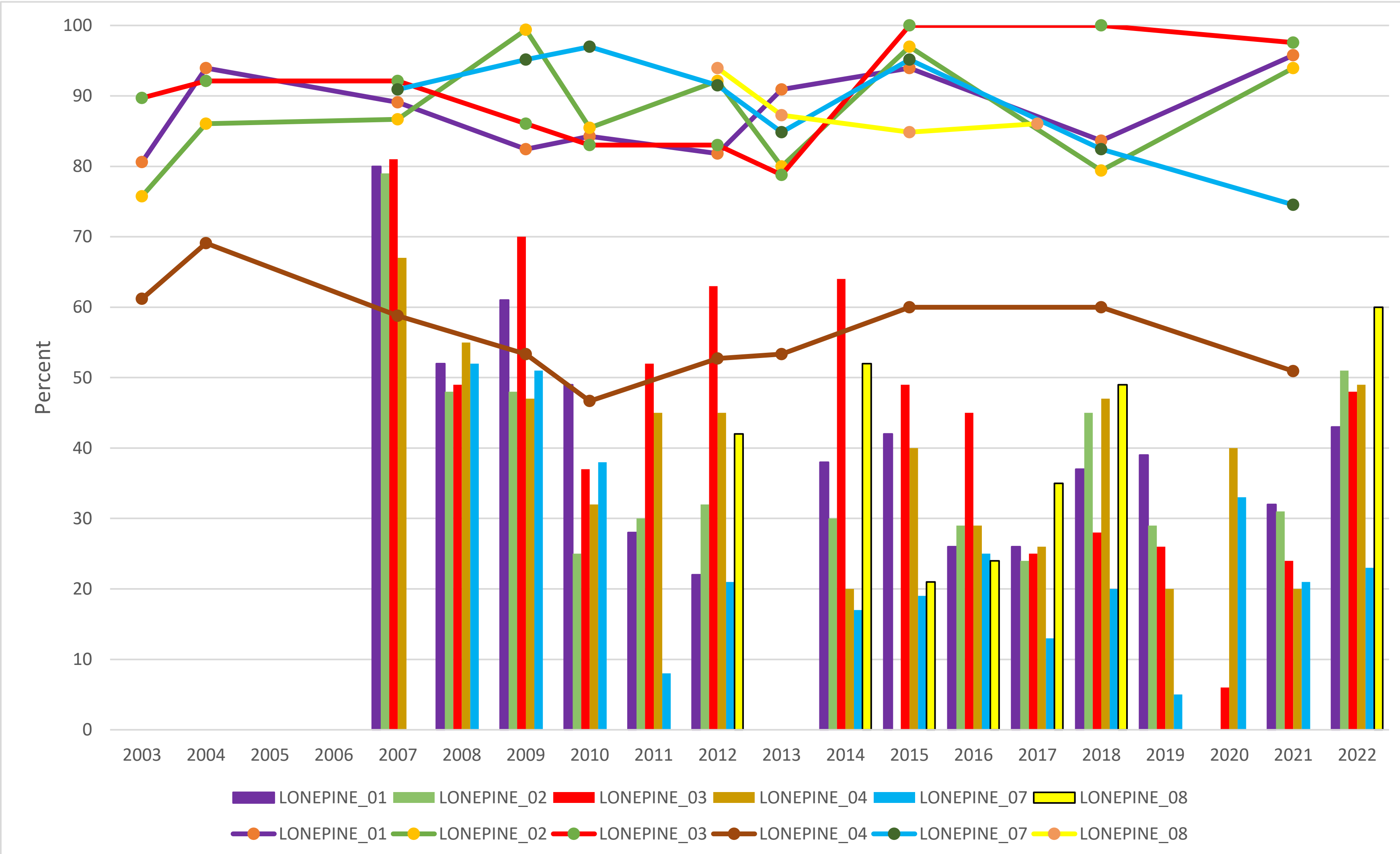

Figure 6-23. Percent frequency (line) for saltgrass and percent utilization (bar) on functioning moist floodplain sites on the Lone Pine Lease, Reach 5.

LONEPINE_07, a saltgrass monoculture, steadily declined from 95% to 75% since 2015 despite grazing pressure only reaching 33% for one year during that time. During the remaining years, grazing pressure could be described as very little to light. For the lease in general, frequency data did not display a response to changes in grazing strategies described in the LORP Grazing Management Plans.

One trend to highlight on the Lone Pine Lease that also occurred on the Islands Lease was the inverse relationship between winter/spring precipitation and use on the river. Years with average to above average winter/spring precipitation create annual green up and stem/leaf development on cool season desert shrubs in the uplands. When this occurs, livestock opportunistically move east towards the Inyo Mountains to graze reducing grazing pressure on the river. This occurs during a critical period on the riparian corridor where the last of the previous year's forage is being depleted.

Delta Lease, RLI-490

Soils on the Delta Lease are saline, Delta_01 immediately below Keeler Bridge is the only transect that had trace amounts of alkali sacaton and beardless wildrye. Saltgrass is the only perennial grass on the remaining Delta transects. Utilization for the first four years of LORP implementation was much higher than the target limit of 40% identified in the MAMP and the Delta Grazing Management Plan (**Figure 6-24**). Delta_03 in 2008 reached 93% use, the highest use observed on any site in the LORP Project. Beginning in 2017, no transects exceeded 40%.

Although the magnitude was slight, the frequency of DISP exhibited a downward trend on all transects throughout the entire monitoring period.

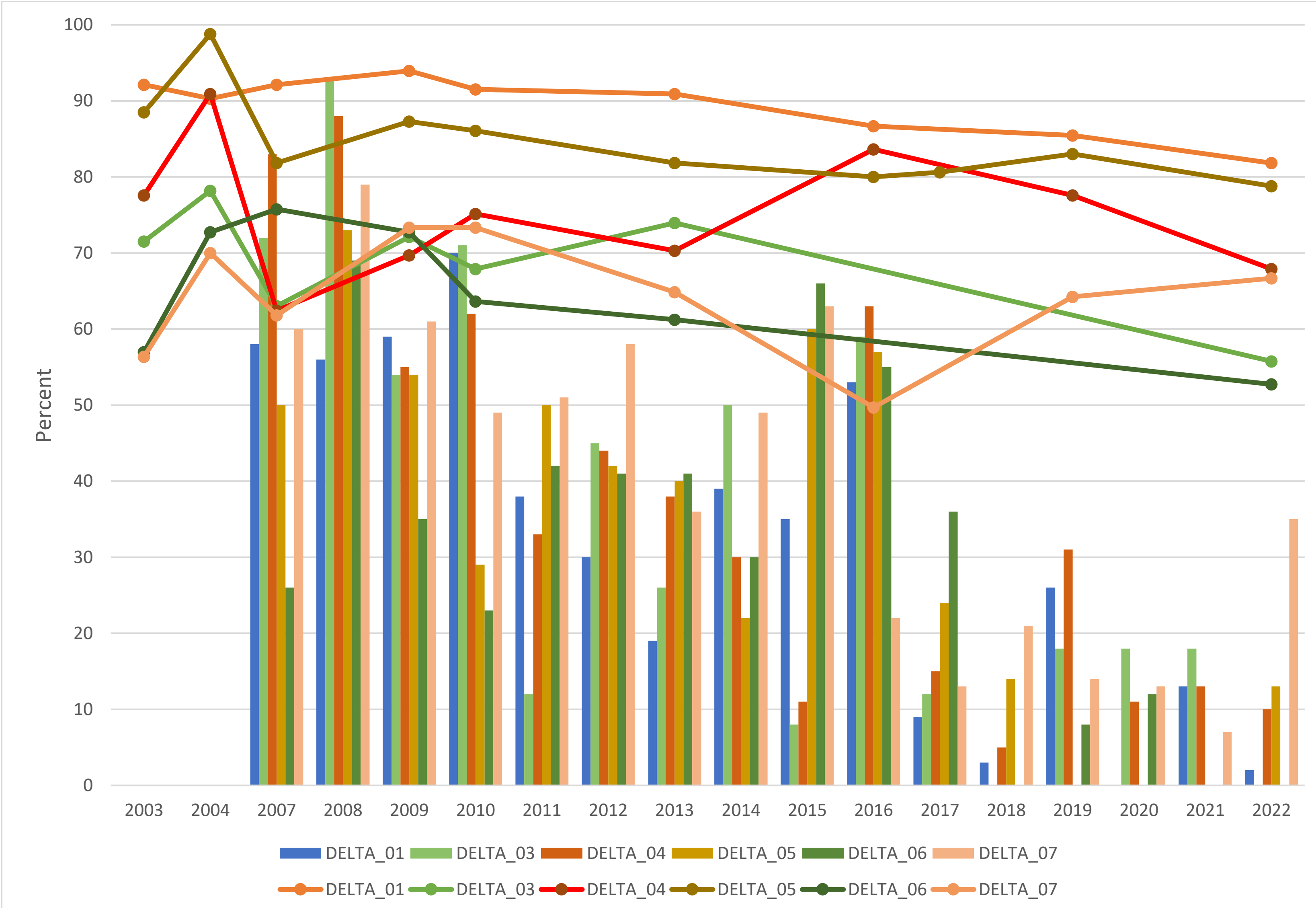

Figure 6-24.Percent frequency (line) for saltgrass and percent utilization (bar) on functioning moist floodplain sites on the Delta Lease, Reach 5.

After 18 years of utilization and frequency monitoring on the moist floodplain sites on the Blackrock, Islands, Lone Pine, and Delta leases, there was no indication in the trend data that: "*Grazing strategies will lead to the establishment of healthy riparian pastures and exhibit an upward trend in range conditions*" (Ecosystems, 2008). Oftentimes the highest grass frequencies occurred at the onset of project implementation when lessees were just beginning to recalibrate their herd numbers to adapt to the new utilization standards. This was the period when utilization was often highest.

6.4 Grazing Exclosures

The construction of reference areas was identified in the LORP EIR (FEIR 9.2.2.1.). The intent was to evaluate the vegetation response to the return/increase of flows to the Lower Owens without the additional disturbance from livestock grazing. The exclosures were also helpful in understanding the role of livestock grazing and the establishment of woody riparian vegetation.

Five exclosures ranging in size from two to 31 acres were constructed on the LORP (**Table 6-5**). In addition, the 732-acre Thibaut Riparian pasture was excluded from grazing from 2008 to 2018. When the Thibaut pasture was returned to the lessee for grazing, a smaller 8-acre exclosure was constructed around transect Thibaut_06. Due to the lack of grazed adjacent transects, paired transect comparisons (grazed vs. ungrazed transects) were not conducted in the Thibaut exclosures.

Table 6-5. Grazing exclosures and acreages within the LORP Project area.

Table 6.5	
Blackrock Lease	
Blkroc_25	3 ac.
Blkroc_24	31 ac.
Thibaut Lease	
Thibaut Riparian Pasture	732 ac (2008-2018)
Thibaut_06	8 ac.
Island Lease	
Island_13	2 ac.
Lone Pine Lease	
Lonepine_06	4 ac.
Delta Lease	
Delta_02	13 ac.
TOTAL:	793

6.4.1 Reach 2

Blackrock_25 was located inside a 3-acre exclosure on the Lower Owens River (**Figure 6-25**). The exclosure was constructed during the winter of 2011 and was designed to encapsulate two meanders on the river. The meanders were selected to increase the opportunity of documenting woody recruitment without the added pressure of livestock grazing. Range trend monitoring for this transect began the following growing season. The paired grazed transect, BLKROC_11, was located immediately outside the exclosure to the west. Range trend monitoring for this transect began in 2003 and utilization monitoring began in 2009 (**Figure 6-26**).

Figure 6-25. BLKROC_25. Blue line represents BLKROC_11, red line represents BLKROC_25

The frequency of saltgrass was similar between the grazed and ungrazed transects from 2011 to 2016. In 2017, saltgrass frequency on BLKROC_25 inside the exclosure began to significantly depart from a high of 73% in 2013 to 21% in 2018 and 12% in 2022. Common to grazing exclosures, this site accumulated litter at a much faster rate than in grazed areas. This extended build up in thatch likely prevented the recruitment of seedlings and eventually lead to overall declines in the abundance of sod forming grasses.

The general area experienced relatively high flows in June and July, 2017, due to record snowpack and subsequent runoff. Old oxbows nearby were completely submerged but neither of the two transects submerged. Spring moisture preceding these flows facilitated the establishment of Bassia in March with a significantly greater amount inside the exclosure based on frequency results collected that summer. This surge in Bassia, its growth habit of growing rapidly and upwards above both live saltgrass and the accumulated thatch enabled the plant to outcompete the lower growing saltgrass. Dead Bassia the following year (2018) further shaded saltgrass stymying production and contributing to greater declines in 2018. In 2019, another above average RY facilitated a second germination event of Bassia, again with larger numbers of the annual inside the exclosure as compared to outside, which lead to further shading and decrease in DISP frequency.

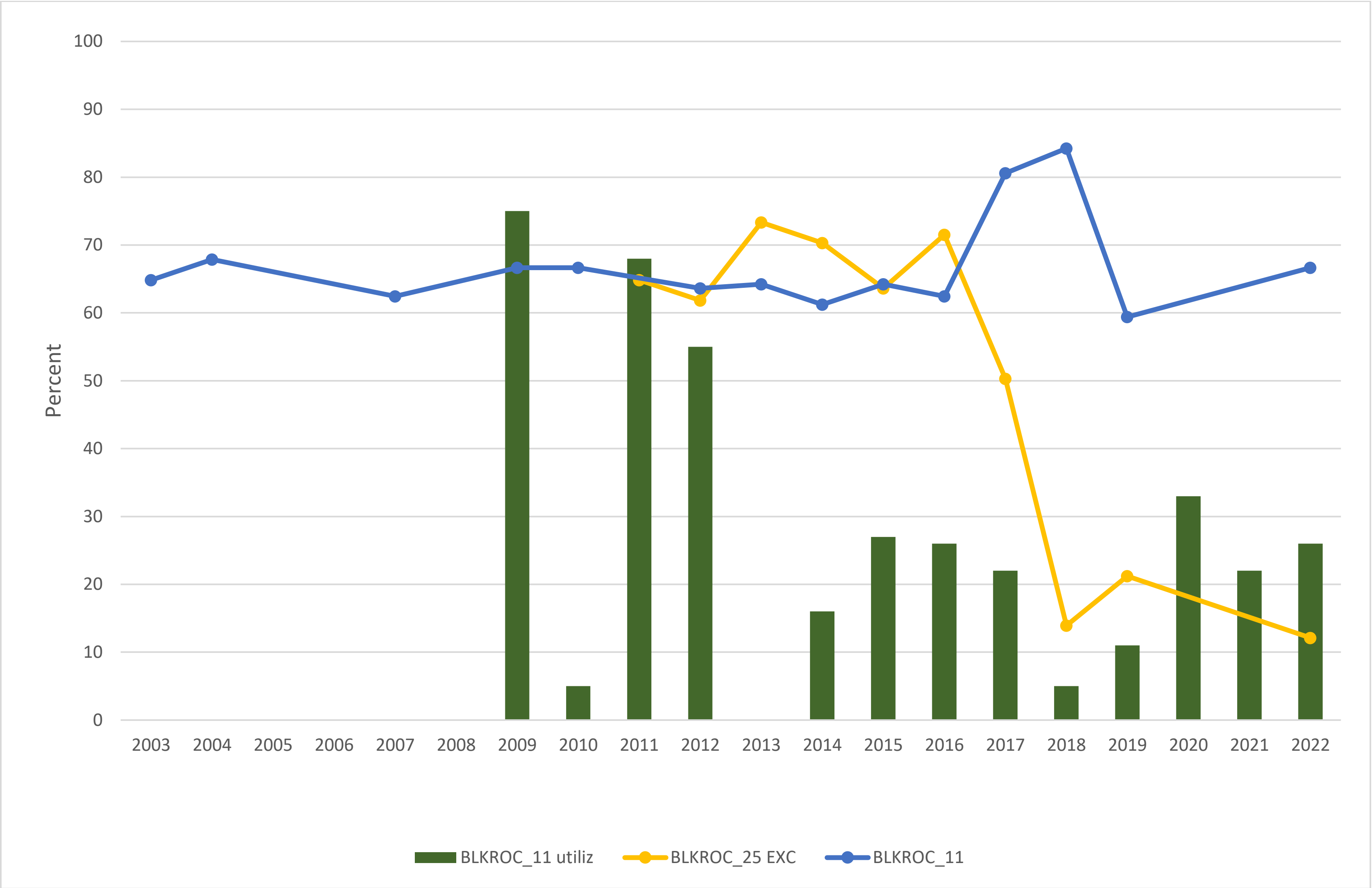

Figure 6-26.Frequency values for saltgrass (DISP) for BLKROC_25 (excluded from grazing) compared to adjacent grazed transect BLKROC_11. Green bars indicate grazing utilization levels on BLKROC_11.

Shrub cover (line intercept) data at this site also exhibited different trends between the grazed and ungrazed areas (**Figure 6-27**). Shrub cover inside the exclosure was 1% when the structure was built but had steadily increased to 49% by 2022. At the same period, shrub cover was steady around 20-25% outside the exclosure and then began to decrease in 2014 to less than one percent in 2017. The large decline in 2017 was seen at both transects however, likely caused by high river flows and groundwater that submerged the root zone of ATTO for five months. Five years afterwards shrub cover increased on both sites with 50% cover in the exclosure and 18% outside. A large pulse of shrub seedlings emerged in 2017 across many sites on the LORP. Mechanical disturbance (hoof action) from livestock outside the exclosure in 2017-2018 had slowed the increase in shrub cover through seedling trampling.

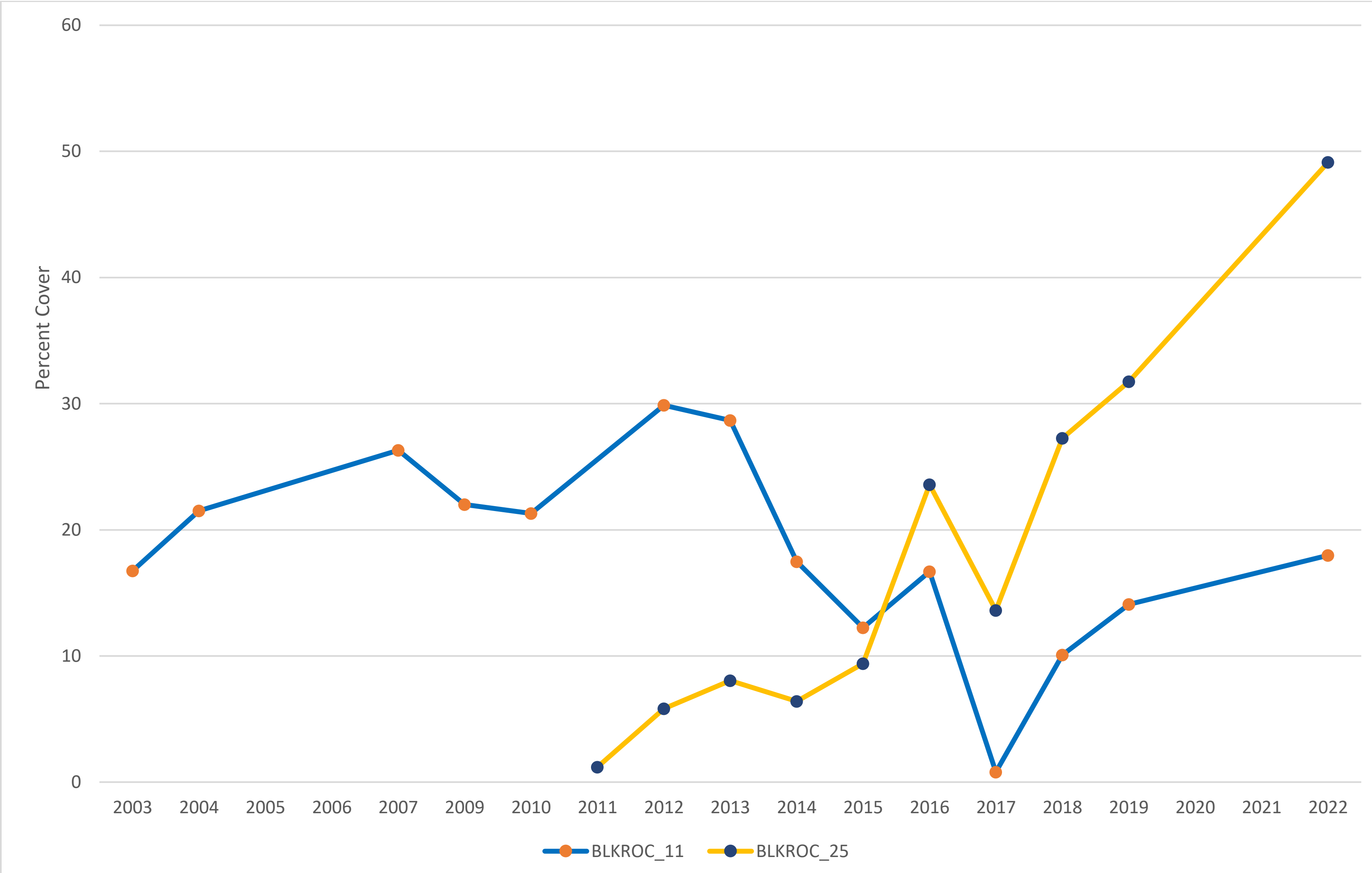

Figure 6-27. Shrub cover (line intercept) changes for BLKROC_25 (excluded from grazing) compared to adjacent grazed transect BLKROC_11. Dominant species for both transects was Nevada saltbush (Atriplex torreyi, ATTO).

6.4.2 Reach 3

BLKROC_24 was located in Reach 4 of the LORP. The BLKROC_21 transect north of the exclosure was the nearest grazed transect used for comparison. Exclosure construction and monitoring began in 2011 for BLKROC_24. BLKROC_21 has been monitored for range trend since 2003 and utilization beginning in 2008 **(Figure 6-28)**.

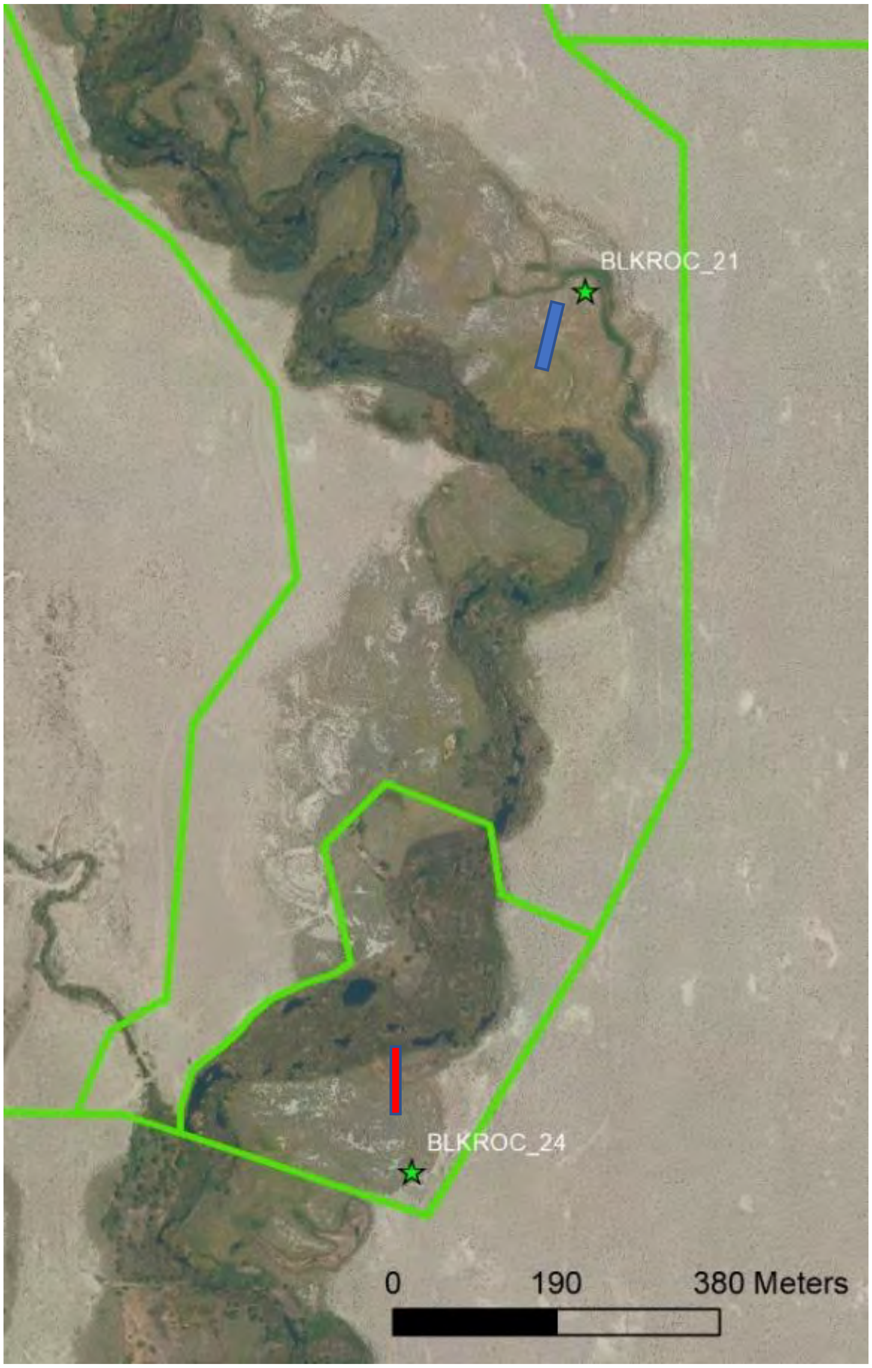

Figure 6-28. BLKROC_24 inside ungrazed exclosure, BLKROC_21, grazed

Grazing intensity on BLKROC_21 has been moderate to light. Saltgrass frequency values have increased each year inside the exclosure to those similar outside the exclosure in 2022 (**Figure 6-29**). Saltgrass abundance on both transects was high and both locations are very productive. Both sites responded favorably to wildfire that occurred in 2018 (**Photos 6-9**).

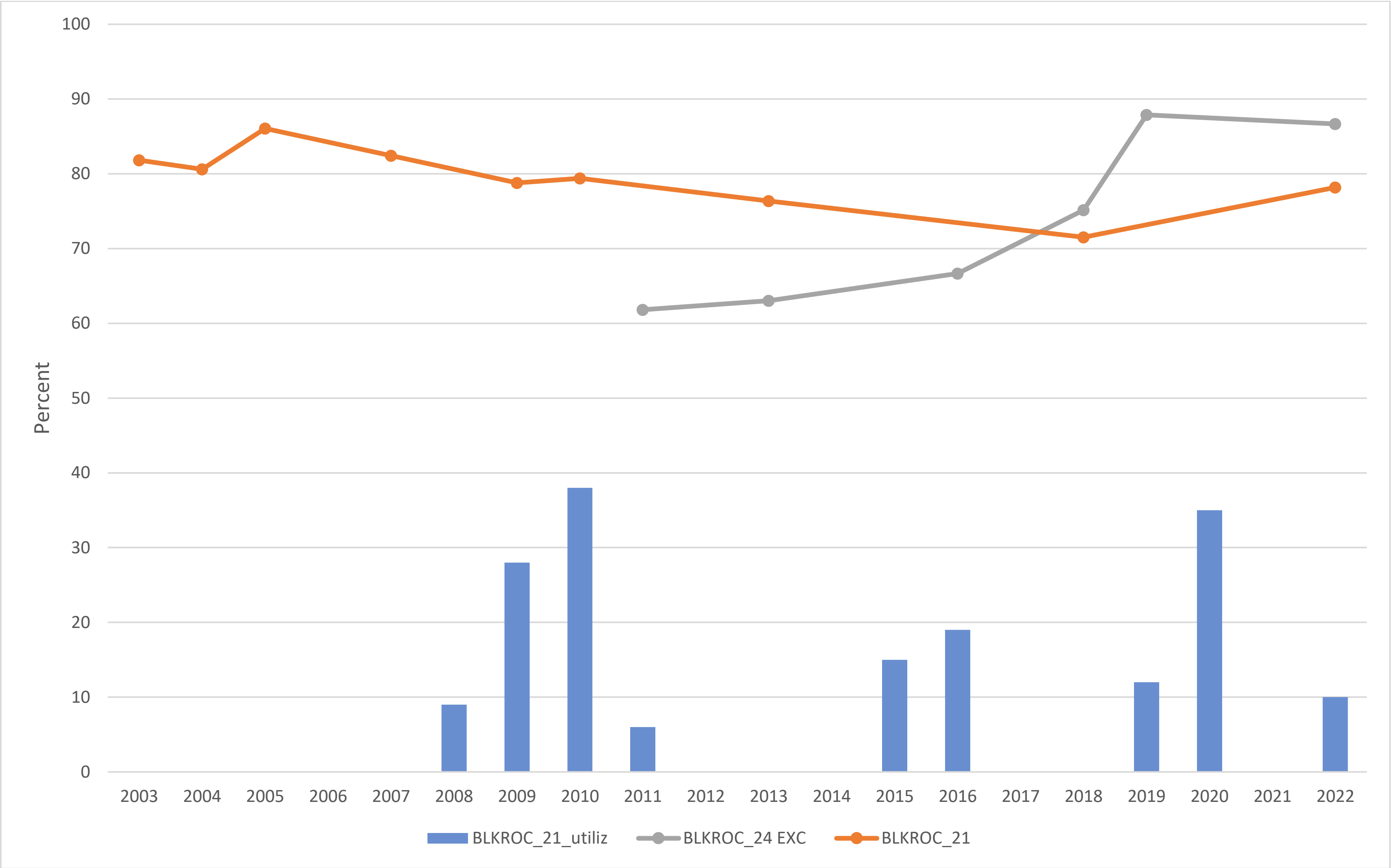

Figure 6-29.Saltgrass frequency for BLKROC_21, orange line and BLKROC_24 (exclosure), grey line. Percent utilization is represented by blue columns.

Photo 6 BLKROC_21, 2007

Photo 7 BLKROC_21, 2018, August. The area burned in mid-March of the same year.

Photo 8 BLKROC_24, 2013

Photo 9 BLKROC_24, 2018, after burn.

As expected, shrub cover on both sites dropped to 0% in 2018 after the Moffat Fire (**Figure 6-30**). Following the release of LORP flows in 2008, shrub mortality began to increase on BLKROC_21. As the water table began to rise, total cover declined from 32% in 2007 to 13% before the fire in 2018. The post flow effects on the adjacent flood plain shrubs also resulted in rapid mortality at several sites on Reach 2. In regards to saltgrass frequency both transects appeared to be very stable over time. In addition, there were no noteworthy distinctions between the two areas regarding the removal of grazing from BLKROC_24.

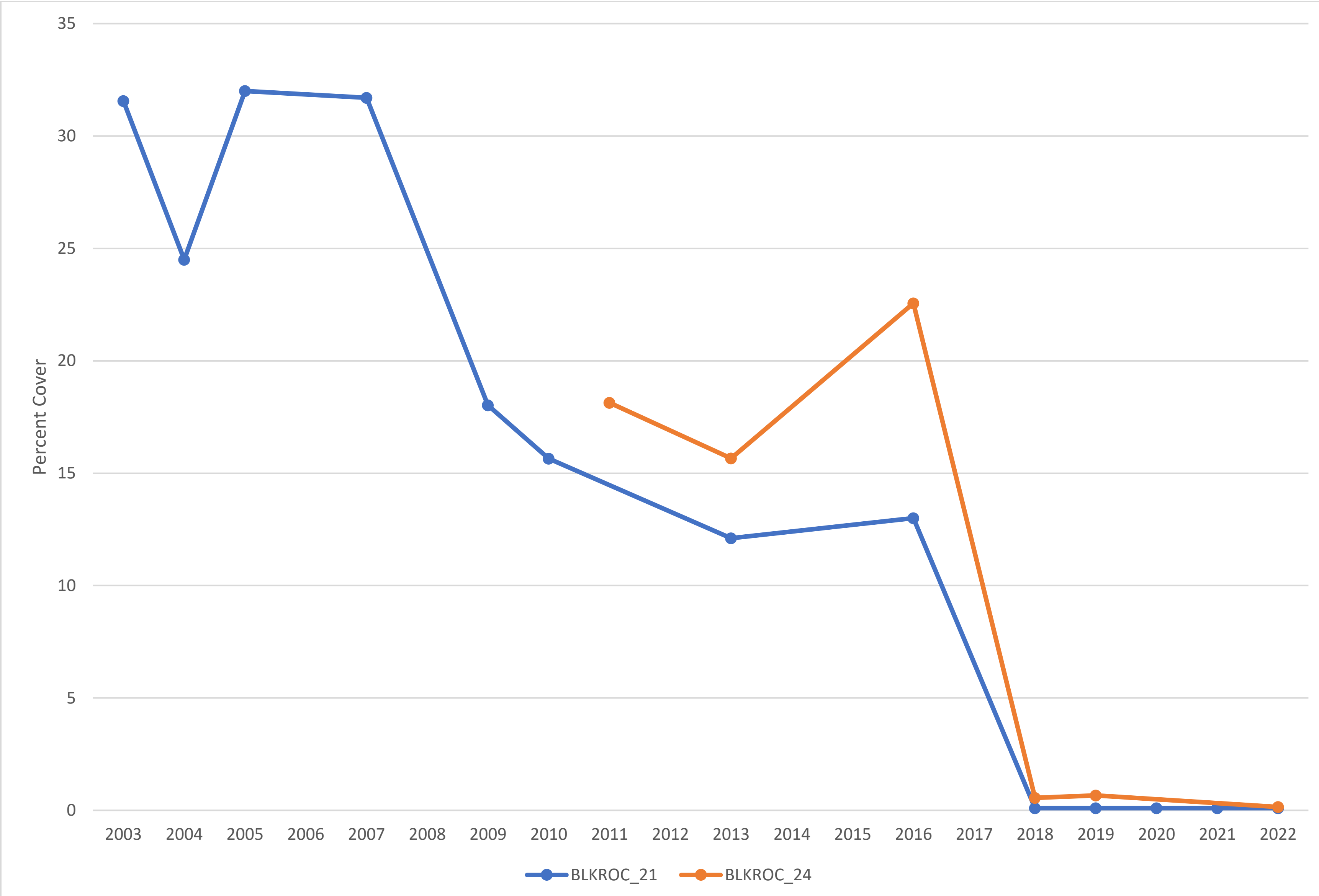

Figure 6-30. Shrub cover (line intercept) for BLKROC_21 and BLKROC_24 (exclosure).

6.4.3 Reach 5

The Island 13 exclosure was located in the Islands River Field. The exclosure was built in 2011 directly north of the pre-existing ISLAND_10 transect (**Figure 6-31**). Grazing intensity on the transect started high in 2007 at >60% then fluctuated between moderate and light over the years (**Figure 6-32**). Saltgrass frequency, though lower inside the exclosure compared to outside, tracked a similar pattern to the grazed ISLAND_10 for the first six years. When last read in 2020, saltgrass all but disappeared inside the exclosure, primarily due to plant decadence and a general buildup of thatch. Despite not having burned, shrub cover inside the exclosure was only 12% in 2020.

The Moffat fire burned through the area in the spring of 2018, burning ISLAND_10 but not the exclosure. ISLAND_10 was also burned during the prescribed burn of 2011. The exclosure was not constructed at this time. Because of the requirement that the exclosure encapsulate two meanders they make themselves extremely difficult to become part of a prescribed fire plan because of the heightened risk of burning the river or losing the fire. This is unfortunate because it’s preferred to overlay identical treatments across both locations, save livestock grazing. Both fires have eliminated shrub cover on the ISLAND_10 transect (**Figure 6-33 and Photos 10-13**).

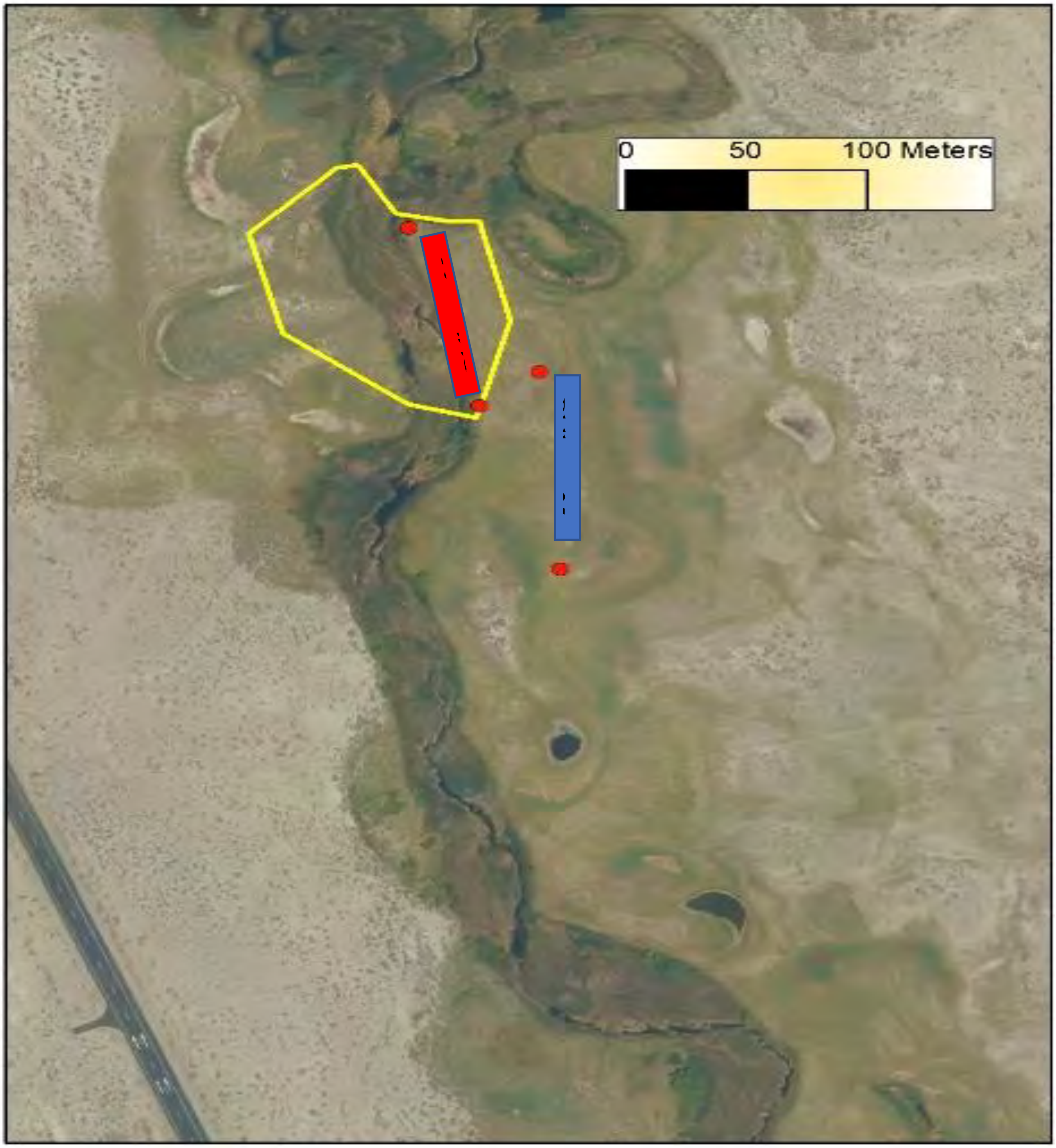

Figure 6-31.Map of transect layout inside Islands Exclosure (red rectangle) and outside (blue rectangle).

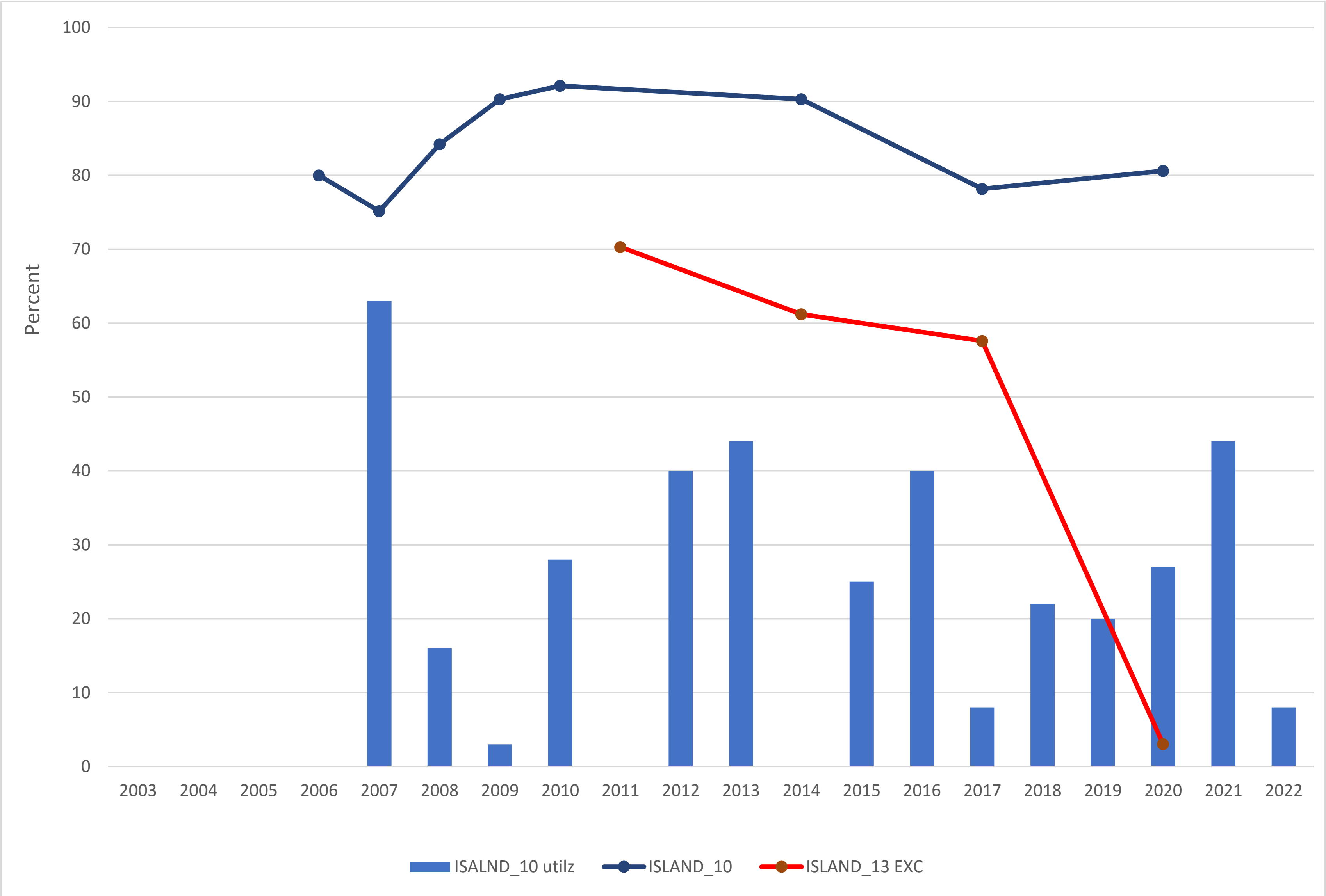

Figure 6-32. Saltgrass frequency for ISLAND_10, and ISLAND_13 (exclosure). Percent utilization is represented by blue columns.

Photo 10 ISLAND_10 range trend transect, grazed, directly south of exclosure (ISLAND_13), 2006.

Photo 11 ISLAND_10, 2017

Photo 12 Grazing exclosure, ISLAND_13, 2011

Photo 13 Grazing exclosure, ISLAND_13, 2020.

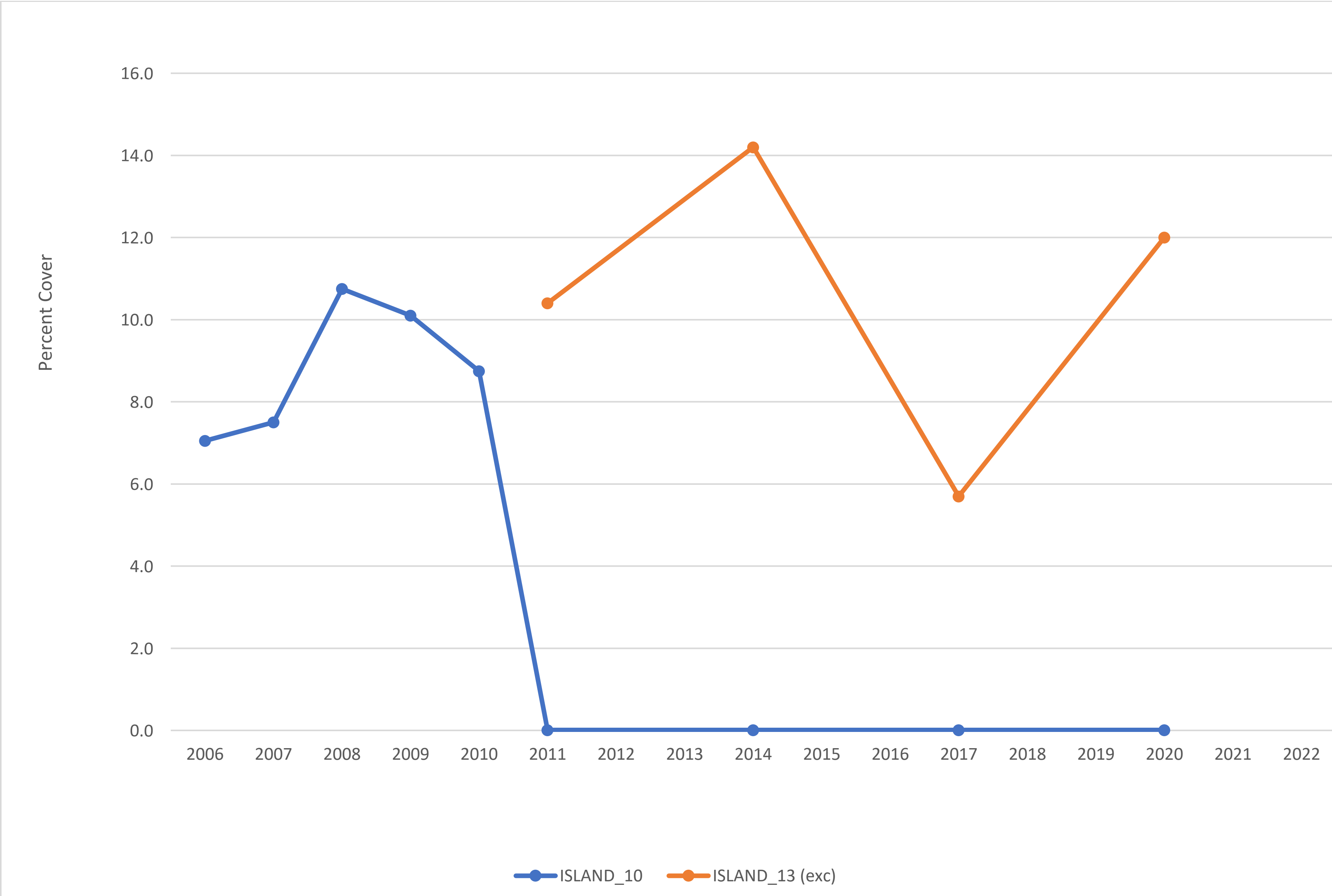

Figure 6-33. Shrub cover (line intercept) for ISLAND_10 and ISLAND_13 (exclosure).

6.4.4 Reach 6

There are two grazing exclosures on Reach 6. The first is LONEPINE_06, which was constructed in 2009 (**Figure 6-34**). The second is DELTA_02 which will be discussed later. LONEPINE_06 was established in 2003 and was monitored four occasions prior to becoming a livestock exclosure. Tule elk can enter the exclosure and have grazed the area. There have also been breaches by livestock into the exclosure caused by changes in the river allowing livestock to gain entry where fencing meets the river. LADWP continued to adjust the fencing to ensure livestock remained excluded. Shrub cover has been minimal on both sites. Both LONEPINE_06 and its grazed counterpart LONEPINE_02 were completely burned over in a wildfire in late February of 2013. Saltgrass frequency remained unchanged for both sites and essentially both transects followed the same general trend over time (**Figure 6-35**). The exclusion of livestock beginning in 2009 resulted in little influence on general plant trends.

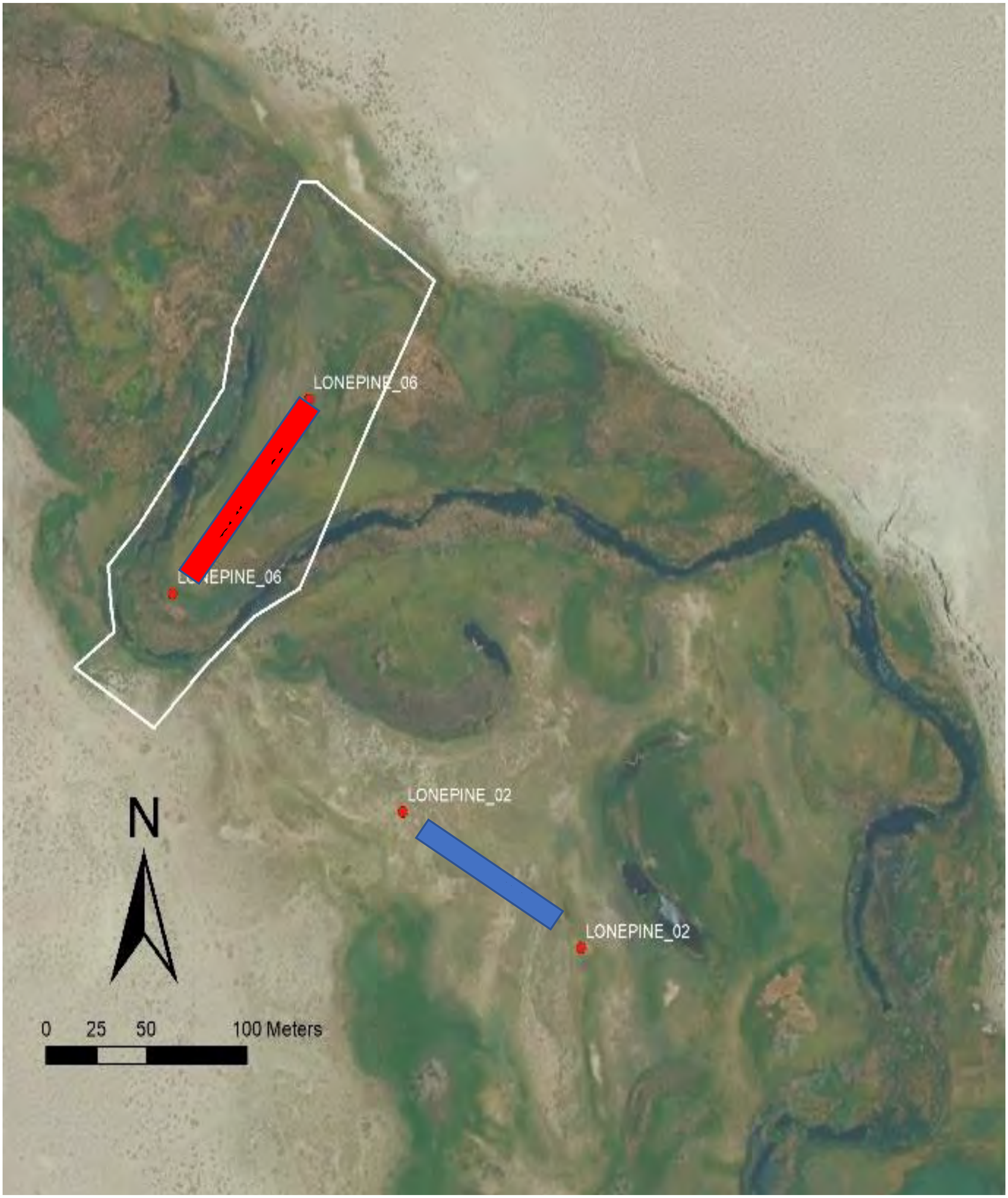

Figure 6-34. Location of LONEPINE_06 (exclosure, red rectangle) and LONEPINE_02 (blue rectangle).

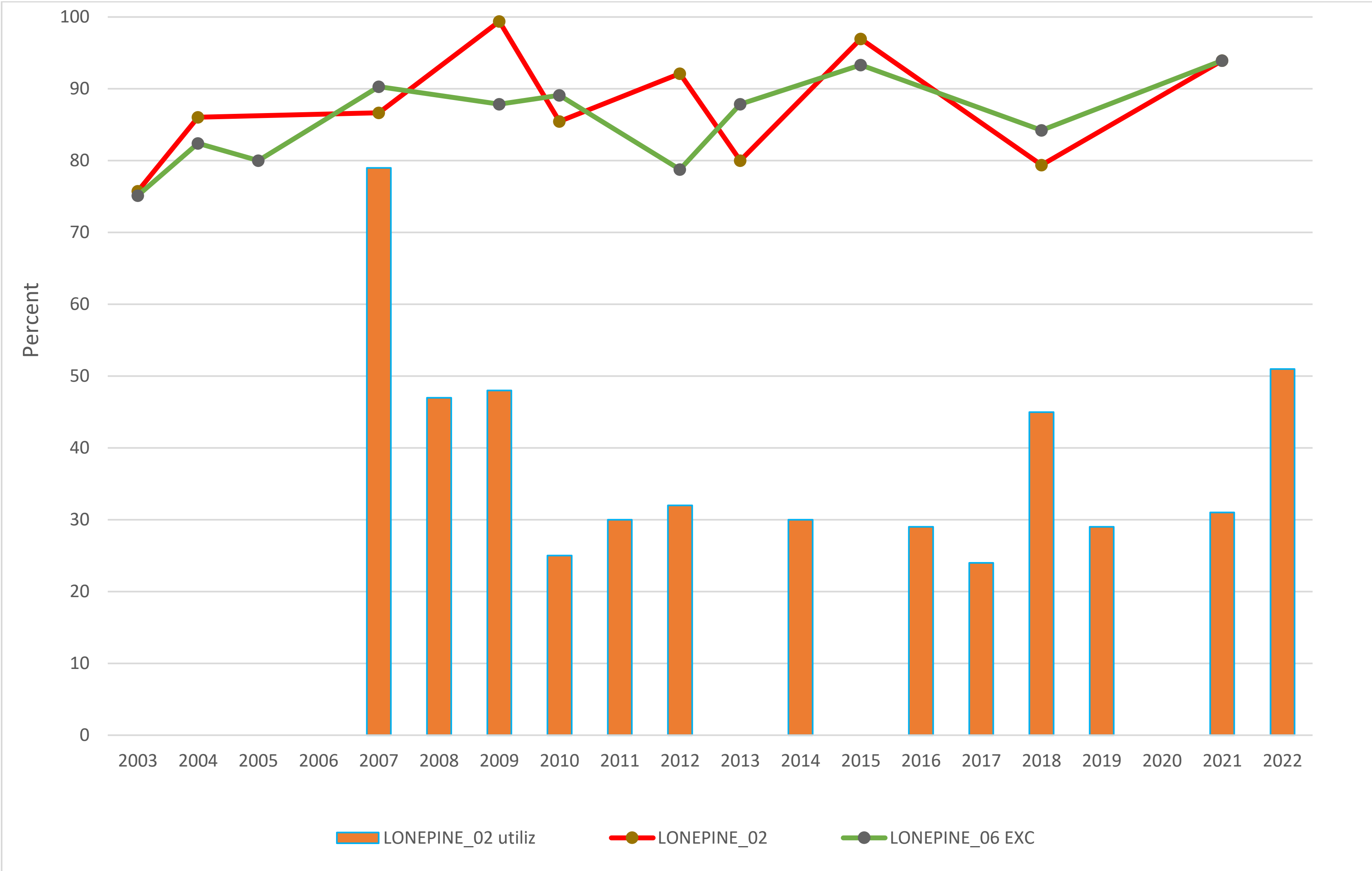

Figure 6-35. Comparison between saltgrass frequency trends inside exclosure (LONEPINE_06) and adjacent grazed transect (LONEPINE_02). Columns represent utilization rates for LONEPINE_02. Exclosure was constructed the winter of 2009.

The second grazing exclosure in Reach 6 is the DELTA_02 exclosure which was constructed in 2009 on the Delta Lease (**Figure 6-36**). Prior to becoming an exclosure the transect was monitored in 2003, 2004, and again in 2007. Following the exclusion of livestock, DELTA_02 saltgrass frequency declined when compared to the outside transect, DELTA_04 (**Figure 6-38**). Only in 2022 did values coalesce. From 2009 to 2022 shrub cover declined inside the exclosure (**Figure 6-37**). No fires have occurred on the Delta lease. The removal **of** livestock grazing appears to have had no long-term effect on the abundance of saltgrass on the DELTA_02 transect.

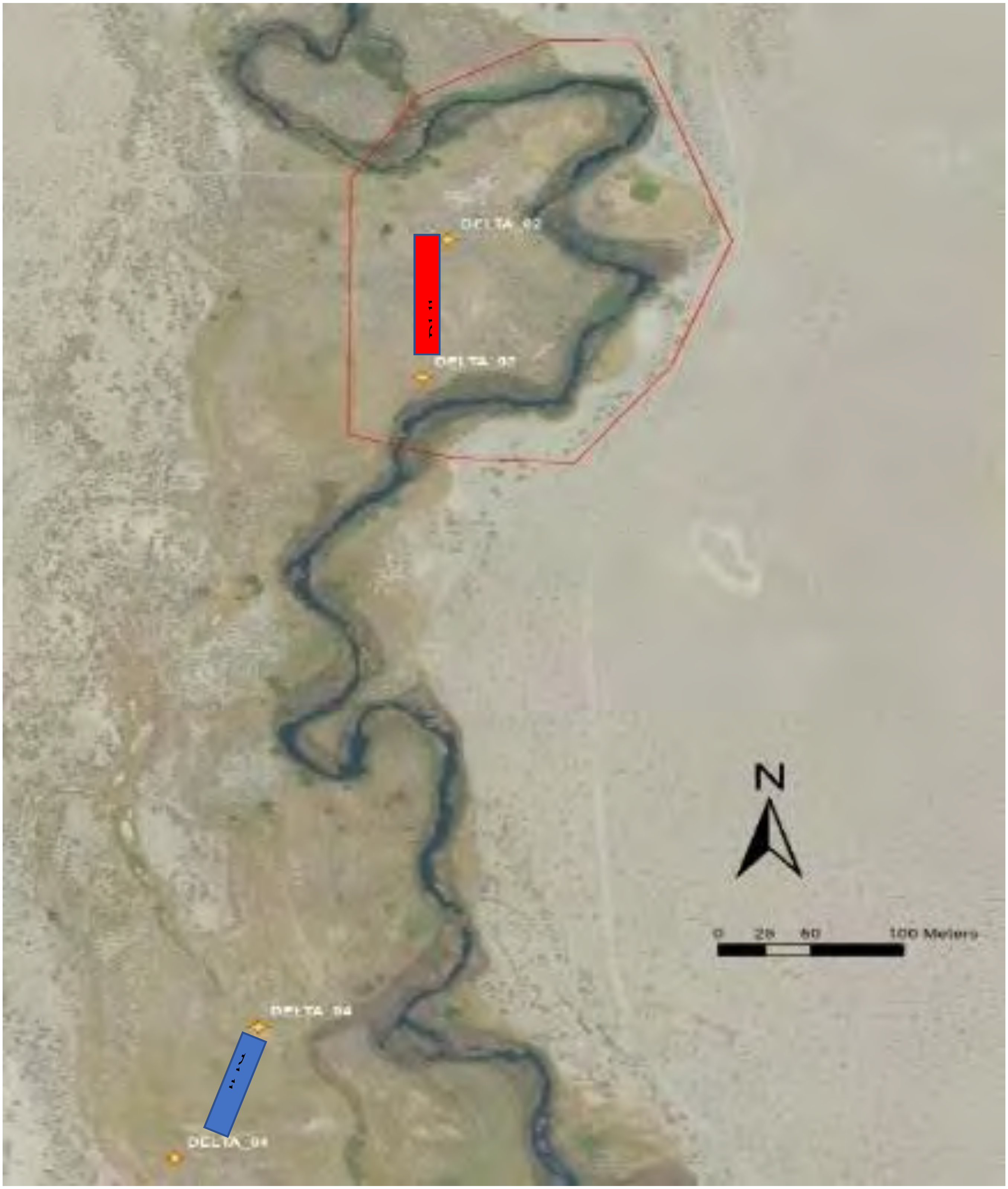

Figure 6-36. DELTA_02 location inside exclosure (red rectangle), DELTA_04 outside (blue rectangle)

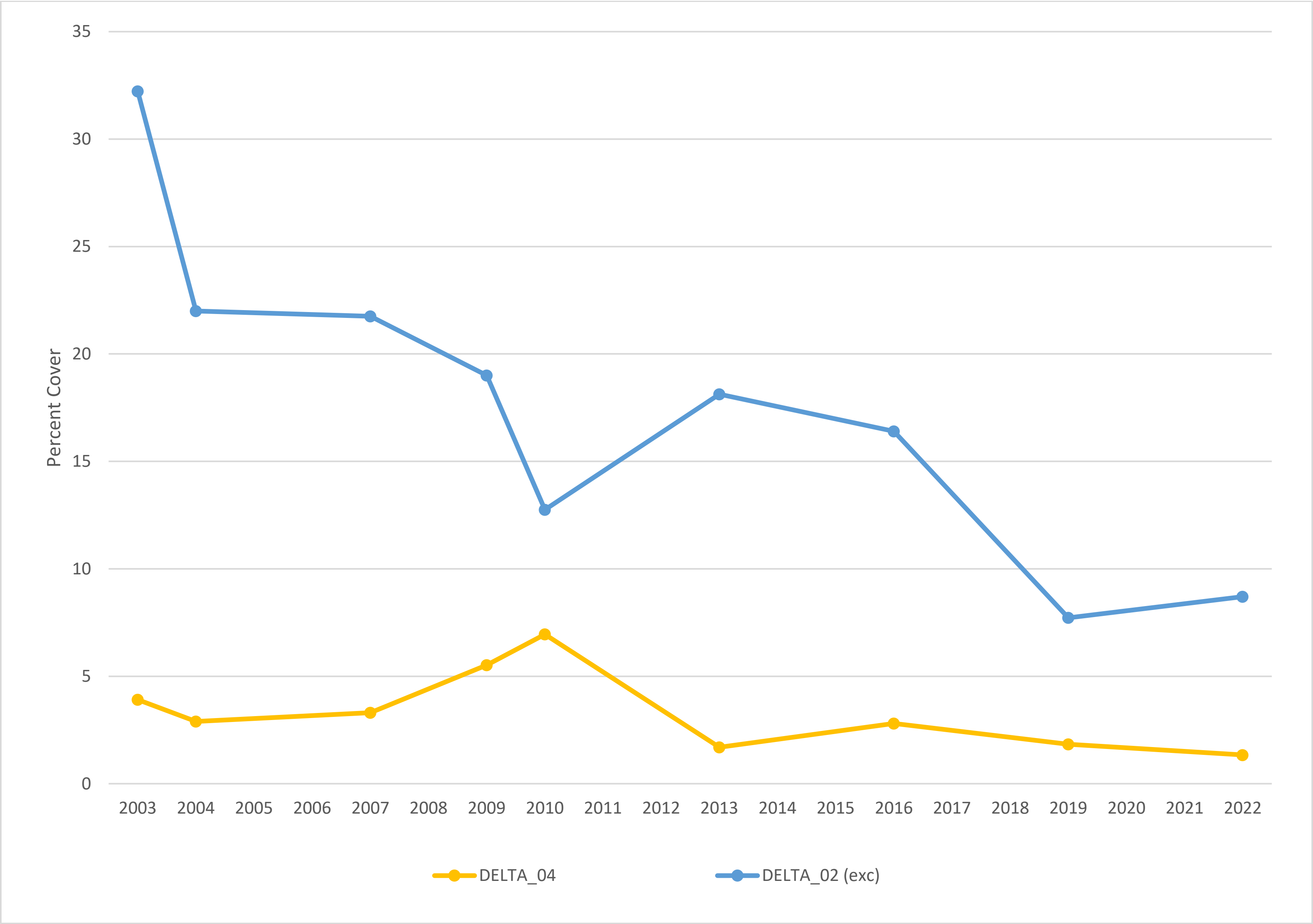

Figure 6-37. Shrub cover (line intercept) for DELTA_02 (exclosure) and adjacent grazed DELTA_04 transect.

Figure 6-38. Frequency for DISP inside grazing exclosure (DELTA_02) compared to grazed transect outside (DELTA_04). Columns represent utilization. Note-DELTA_02 was grazed until 2009.

6.5 Rare Plants

Seven rare plant exclosures were constructed per the direction of the MAMP and the LORP EIR. The Rare Plant Pasture (210 ac.) on the Thibaut Lease, immediately north of the Los Angeles Aqueduct was also constructed with grazing only permitted from October 1st to March 1st. The objective of the Rare Plant project was to monitor impacts of grazing on Owens Valley checkerbloom and Inyo County star-tulip within the LORP. Based on seven years of data, checkerbloom trend in ungrazed plots decreased across all sites. A primary conclusion drawn from the study was that controlled grazing and stable water management contributed to the maintenance of rare plant populations in the LORP project area. Grazing exclosures generate plant decadence over time which in the case of checkerbloom (a prostrate, broad-leaf plant) results in lost competitive advantage due to excessive shading. Unlike bladed grass leaves, the plant is unable to break through the accumulating thatch layer. It was recommended in 2015 to remove the grazing exclosures, lift the timing restrictions on the Thibaut Rare Plant pasture, and discontinue the study (LADWP and County of Inyo, 2016). Exclosures were removed in 2016.

6.6 Conclusion

Utilization rates and long-term plant trends

During the 1980's through the 1990's, research on grazed riparian areas in the western U.S. identified uncontrolled livestock grazing as a primary cause of deteriorating riparian systems (Belsky et. al, 1999). Prior to the LORP, there were no formalized riparian grazing management strategies developed for moist floodplain sites on the Lower Owens River. Recognizing the problems with riparian grazing on a regional level and the absence of a formalized grazing strategy, under the guidance of the LORP EIR and the MAMP, the MOU Consultants and LADWP in consultation with the lessees incorporated proven management approaches taken from other riparian ecosystems in the inter-mountain West to create the LORP Grazing Management Plans. The adaptive management approach was also included to evaluate the new grazing program through monitoring and if warranted, adjust the initial approach.

As directed in the 2004 EIR, approximately 24,700 acres of riparian pastures were fenced in order to facilitate the new changes in grazing management. Livestock would be grazed under prescribed grazing periods and utilization rates to "promote a healthy riparian ecosystem" (2004 EIR Vol. 1 9-3). These activities were intended to reduce "current grazing impacts to existing biological resources" (2004 EIR Vol. 1 9-3). The lessees either reduced their overall stocking rates or offset the decreased amount of time on the river by securing additional forage elsewhere to maintain herds before they were moved to summer pastures. LADWP and the MOU consultants, guided by directives in the LORP EIR and the MAMP, developed monitoring protocols and implemented a rigorous monitoring schedule, where all LORP leases were monitored for five years to establish a baseline and afterwards all leases were monitored every third year with a minimum of two leases monitored each year. Both LADWP and the lessees invested heavily in the project and successfully implemented the grazing management plans.

After reviewing the trend data in the grazing exclosures presented above and the 20-year dataset for range trend data for the moist floodplain sites in Reaches 3-6, no positive responses from decreased utilization were observed. In most cases there were slight downward trends in saltgrass frequency over time. Trends in grass frequencies during the pre-implementation period on the initial range trend transects (2002-2008), when utilization was greater than the 40% benchmark, were either the same as current trends or slightly elevated. When range trend data were compared to trends inside grazing exclosures, conditions inside the exclosures declined in some instances (BLKROC_25 and ISLANDS_13) while other exclosure transects showed virtually identical trends to those that were grazed (BLKROC_24, LONEPINE_06, and DELTA_02). Prescribed fire and wildfires did improve saltgrass frequencies on numerous transects (BLKROC_21, BLKROC_24, ISLAND_08, LONEPINE_2, LONEPINE_ 3, LONEPINE_4, LONEPINE_6, LONEPINE_7, and

LONEPINE_8). Changes in flows appeared to have improved conditions on BLKROC_20 and ISLAND_06 although when examined from a landscape level vs the 100m transect there were significant losses (on the order of hundreds of acres) of moist-flood plain meadows on the Islands, and to a lesser scale, on several areas on Reach 3 on the Blackrock Lease as a result from aggradation. Vegetation mapping analysis also identified aggradation (flow management) and both prescribed fire and wildfire as the primary drivers for vegetation changes on the LORP (LADWP and County of Inyo, 2009; LADWP and County of Inyo, 2016).

So why did the riparian floodplains not respond to reduced grazing on the LORP when reductions in livestock grazing in riparian areas elsewhere in the western U.S. have generated favorable changes in vegetation condition?

1. The utilization limit of 40% is not an unreasonable threshold and is typical for riparian grazing prescriptions in the western U.S. This approach has generated favorable results in many areas and is widely adopted into USFS and BLM management plans for riparian areas. These prescriptions are designed to allow for grazing during the growing season but they also require some rest during the same period. Riparian areas on the Lower Owens River are grazed during the winter (dormant season) and the entire riparian corridor is rested every year from April/May through October. This extended rest period is in contrast to summer grazed riparian areas where managers try to balance grazing with a reasonable amount of rest/recovery period during the same growing season. Under normal conditions this is not the case with the current grazing strategies on the LORP. The riparian corridor along the LORP is essentially left ungrazed by livestock for the entire growing season.

2. Another key objective in limiting grazing intensity along streambanks is to reduce bank trampling/chiseling. A critical difference in the LORP system as mentioned above is that grazing primarily occurs in the dormant season (winter). Vegetation along the wetted edge of the Lower Owens is almost entirely composed of cattails, tules, and *Scirpus sp.* None of these plants are palatable to livestock when senescent. Livestock grazing in the winter is concentrated away from the banks and in the saltgrass meadows. Furthermore, the aggradation on the river is enveloping what streambanks may have existed. The greenline (Winward, 2000) on the LORP is largely a hemi-marsh, attractive to livestock in the winter, primarily as a water source.

3. The intent specified in the MAMP was to prevent woody species browsing by cattle based on research where grazing occurred during the growing season (Clary, 1989). Recognizing that there is no single approach to manage livestock grazing in riparian systems and that each location carries its own suite of unique characteristics and

conditions (Kauffman and Krueger, 1984; Kovalchik and Elmore, 1992), LADWP and the MOU Consultants engaged in a four-year study examining the interaction between livestock and juvenile woody riparian trees on the LORP. Results showed that winter and early spring grazing by livestock had little to no impact on young trees (LADWP and County of Inyo, 2014).

4. The MAMP's grazing management objectives were only described as: "Grazing strategies will lead to the establishment of healthy riparian pastures and exhibit an upward trend in range conditions" (Ecosystems, 2008). There were no clearly defined targets to manage for beyond healthy and an upward trend. For this discussion, we focused on the key forage species on the LORP: saltgrass and alkali sacaton. Both species are hardy and very resistant to grazing, in particular dormant season grazing (Franklin and Dyrnes, 1973; NRCS, 2022). Because of the hardiness of the key forage species, the lack of grazing during the growing season, and the presence of a stable, shallow water table on the moist flood plains since the 1980s; moist floodplain sites appear to have already been in good to excellent range condition prior to project implementation. This would explain why no upward trends occurred after implementing grazing management changes and why upward trends in grazing exclosures when compared to grazed areas had not occurred.

6.7 Adaptive Management

Guidelines from the MAMP state: *As part of the LORP adaptive management approach, the initial allowable maximum riparian and upland utilization rates and grazing periods described below may be increased or decreased on a case-by-case basis depending on the changes in rangeland conditions as indicated by monitoring of rangeland "trend"* (Ecosystems, 2008. Page: 2-139). The MAMP also states: *Evaluation and monitoring of riverine-riparian habitat is a critical component of the monitoring plan. If habitat conditions are below expectations or proposed management actions do not result in the expected responses then management actions will be reevaluated through adaptive management, and plans will be reconsidered* (Ecosystems, 2008).

Nearly 20 years of monitoring and exclusion studies suggested no relationship between reduced utilization and improved rangeland conditions under the current grazing system. Considering these results, under the direction of the MAMP, the 40% utilization limit on dormant season grazing may not be as effective as originally identified in achieving desired landscape outcomes across all LORP locations. Independent of grazing, reaches 3-6 were found to be functioning at site potential throughout the entire study period while reaches 1-2 are still transitioning after 17 years of returned flows. The latter group is where there may be utility in altering utilization levels to advance riparian development. Given the limited number of tools to manipulate the LORP river system, managed livestock grazing should be viewed as a tool rather than a threat. We recommend the flexibility to increase utilization on a case by case basis at the pasture level by at least 10%. This increase would be dependent upon identified management objectives for a given area. Any additional increases in utilization would be accompanied with both range trend monitoring and utilization monitoring and assessed for effectiveness over time. Other monitoring may be implemented based on the objectives of the project.

Vegetation Management

Over the course of the LORP, we have identified three primary tools for vegetation management: grazing, fire, and mechanical treatment.

Targeted Grazing

The impacts from grazing disturbances (trampling and tunneling) on the graded, wet, unconfined state on Reach 2 (**Figure 6-39**) has accelerated the transition from alkali scrub to alkali scrub meadows. A release from the 40% utilization threshold and an increase in utilization on pastures in Reach 2 during the dormant season may permit further meadow development while also providing the operational flexibility needed by the Lessee to stock at a higher rate. We also recommend to have the ability to alter the timing of grazing at the pasture level. Grazing the same locations, with the same number of animals at the same time of year is not always the best approach to grazing management. There may be opportunities available to increase certain grass species or decrease the proliferation of shrub/herb species if grazing were to occur at different times of the year. All of these changes would be accompanied with continued monitoring of existing range trend transects, utilization, and any other additional monitoring as necessary.

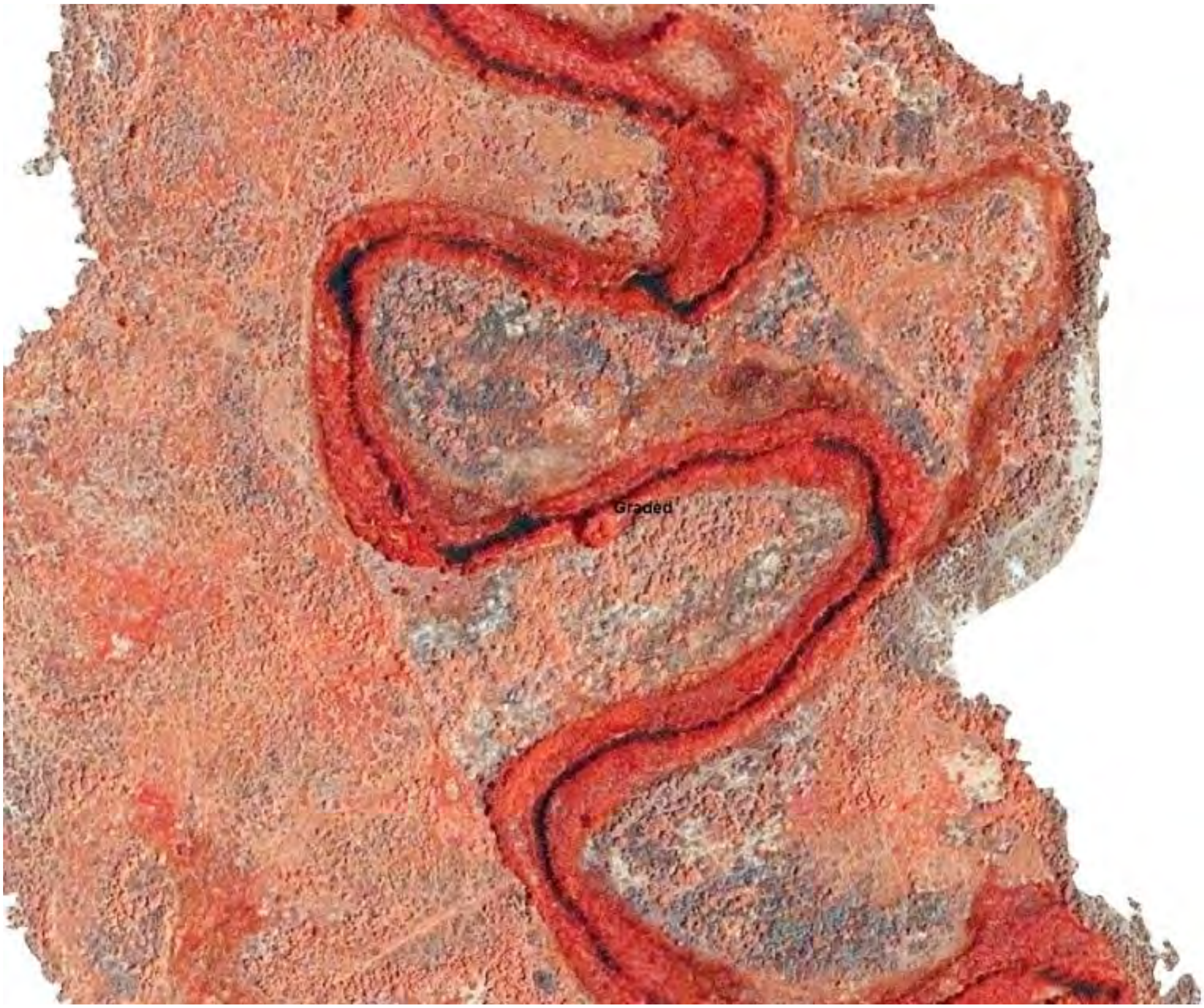

Figure 6-39. Blackrock_25 grazing exclosure, August 2022. Note the fence line contrast between the ungrazed areas and the developing meadows outside of the exclosure, a result from livestock disturbance.

Fire

Prescribed fire and wildfires along the river corridor have accelerated the transition into alkali meadows from shrub dominated plant communities. Fires in the wrong locations have triggered the BBBC scenario discussed earlier. Extensive field experience accompanied with monitoring and vegetation mapping has allowed watershed staff to identify areas that are ideal sites for burning as well as areas that would result in undesirable conditions. We would like to continue using fire where appropriate and feasible. If prescribed fires are used in riparian or upland areas they should be site specific and applied in community types with a strong grass component and shallow groundwater table. Locations that are at site potential in regards to range condition but, have shrub encroachment have better results post prescribed burns. Locations below site potential or are shrub dominated with no herbaceous understory should be allowed to develop naturally unless anticipated community structure and composition creates conditions inconsistent with LORP goals. In this event these sites should be evaluated for different treatments i.e. mowing or grazing.

Mechanical Treatment

Protecting the few existing willow communities on the river is of high importance. Because of this, site preparation for a prescribed burn can become difficult if not impossible in areas interspersed with riparian trees, particularly in smaller areas on the river. Another hinderance associated with burning is the limited amount of burn days and heavy time and financial investments in launching a prescribed burn. An alternative is to identify Nevada saltbush communities (this shrub will not re-sprout if mowed) that have the potential to convert to alkali meadows in locations where burning would be particularly onerous. In these areas discing, dragging, or mowing may be a viable alternative for meadow conversion without jeopardizing existing trees. We recommend the ability to apply these tests in small areas <20 acres and follow up these treatments with monitoring.

Future Monitoring

Both long term range trend monitoring and utilization monitoring have provided useful information on how the LORP project responded to grazing with the return of flows and the implementation of the grazing management plans. We recommend a continuance of the program on the LORP with a reduction of range trend transects in pastures where information is redundant. That said, all riparian pastures will have actively monitored range trend transects visited at least once every three years. Utilization monitoring will continue annually. We do not anticipate an increase in utilization or range trend monitoring beyond current levels.

Lastly, with the cessation of the MAMP, future range monitoring results for areas within the LORP Area will be presented in LADWP's Annual Owens Valley Report.

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7.0 LORP TAMARISK TREATMENT

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

Starting in 1997 the ICWD administered the Saltcedar Control Program for treatment on City of Los Angeles lands in the Owens Valley. The program was funded by the LADWP under the County of Inyo-Los Angeles Water Agreement and was supplemented with grant funding. Additionally, the LADWP provided funds to Inyo County as required in the 2004 Stipulation and Order, the LORP EIR, and LORP Post Implementation Funding Agreement for tamarisk treatment in the LORP. In 2017 ICWD suspended their tamarisk program owning to the retirement of their Saltcedar Program Manager and loss of grant funding. Subsequently, LADWP assumed control of treating tamarisk on City property, including the LORP. In fall of 2019, ICWD created a position to assist the LADWP in saltcedar control, which created a mutually beneficial relationship between the ICWD and LADWP. The ICWD and LADWP saltcedar partnership is planned to continue through 2022-2023.

During the 2021-2022 tamarisk treatment season, LADWP treated 359 acres in the LORP area (**Figure 7-1**), including:

- Mechanical treatment in Goose Lake vicinity (229 treated acres).
- Hand treated areas immediately adjacent to lower Owens River, Goose Lake Return Ditch, Blackrock Ditch and adjacent meadows (130 treated acres).

During the 2021-2022 season, 229 acres of saltcedar were treated at the Goose lake site. Saltcedar at this site consisted of dense stands of various sizes from seedlings to mature trees with 10-inch diameter trunks. This required higher intensity mowing and sawing per unit area, which resulted in lower treatment acres as compared to prior years' efforts. However, total biomass per acre was significant resulting in numerous piles of saltcedar slash having to be moved to appropriate locations for subsequent burning.

With respect to both Blackrock Ditch and along the lower Owens River 130-acres were treated. This treatment included seedlings and saplings along the wetted edges of both the ditch and the river and large stands in the flood plain and oxbow cutoffs. Treatment of these patched focused on cut stump methods using hand tools as these areas were not accessible by heavy equipment because of rough and uneven terrain.

The 2021-2022 control efforts consisted of: cut stump treatment of larger diameter trees using a skid steer mounted turbo saw attachment, mowing of smaller diameter trees including saplings and seedlings and hand cutting using chainsaws and pruners. Garlon 4-Ultra herbicide was applied to cut stumps using the turbo saw attachment and spray equipment mounted on side by side utility vehicles.

A skid steer mounted turbo saw and grapple rake attachment was utilized to cut, gather and consolidate substantial volumes of slash into piles for burning. Approximately 100 piles measuring 10 ft. in diameter and 6 ft. tall were stacked in locations to be burned by CAL Fire. A CAL Fire Vegetation Management Plan (VMP) will be utilized to permit and coordinate burning activities. Pile burning is planned for the winter of 2022-2023.

The Tamarisk leaf beetle (*Diorhabda spp*.), a natural insect herbivore of tamarisk leaves that has been used for tamarisk control along many southwest riparian corridors, appears to have become established within the LORP area (per LADWP Watershed Resources Staff). However, the long-term effect of the beetle on LORP tamarisk populations is unknown. The landscape-level control of tamarisk through this biocontrol agent is a worthwhile area of study and monitoring. Biological control of tamarisk through sustained colonization could reduce the amount of resources currently allocated to mechanical control. Staff are currently monitoring the effects of the beetle at various locations.

Tamarisk will continue to be treated within the LADWP spreading grounds from October 2022 through March 2023 using methods described above or similar. Treated acres are expected to be similar during the 2021-2022 tamarisk control season.

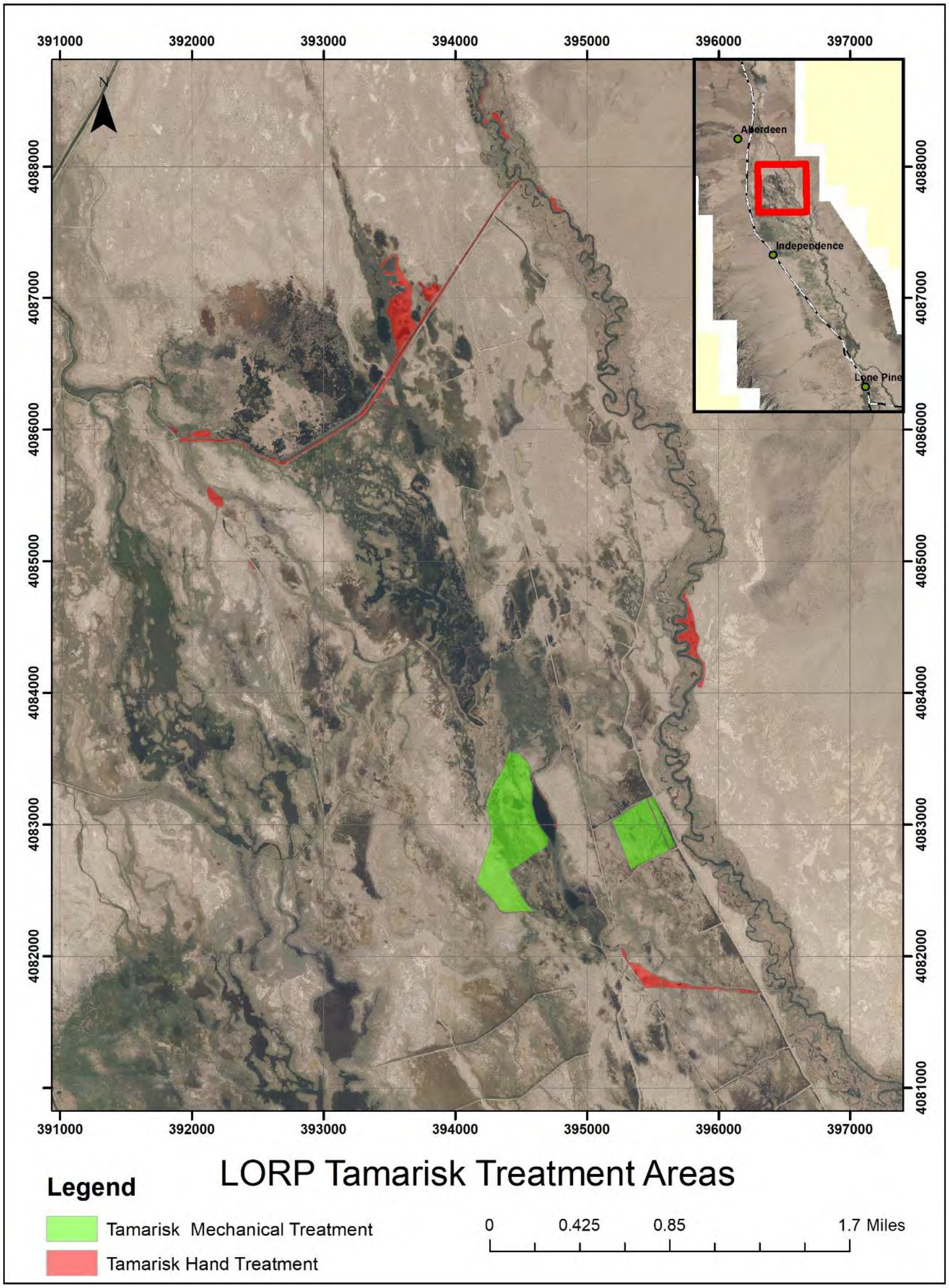


Figure 7-1. LORP Treatment Areas

8.0 LORP WEED REPORT

8.1 LADWP and Inyo/Mono Counties Agricultural Commissioner's Office Weed Treatment Activities

LADWP Weed Treatment

Broadleaved perennial pepperweed (*Lepidium latifolium*) (
Figure 8-1) was an ongoing species prioritized for weed treatment in the LORP by the LADWP personnel in 2022. A total of 400 acres within the LORP project boundaries were canvased in the search for pepperweed (**Figure 8-2**). All pepperweed populations were herbicide treated using broadcast applications from spray equipment mounted on side-by-side utility vehicles.

Pepperweed typically flourishes and displaces native vegetation in irrigated meadows and around the wetted extent of irrigation ditches, creeks, sloughs, rivers, water spreading basins, and some alkali meadows. On occasion pepperweed is found to exist, although in lower densities, in drier upland shrub communities. In areas occupied by cattle, the LADWP personnel have noted persistent grazing of younger pepperweed plants has reduced larger stands from developing, thus reducing seed production capabilities. To capitalize on this observation, modified grazing strategies and targeted mowing will be integrated with future strategic herbicide applications.

To gain control over observed increases in pepperweed within the BWMA, crews focused their 2022 LORP treatment efforts in the Winterton, Waggoner, and Thibaut Waterfowl Units treating 400 acres. It is anticipated these areas will be treated annually for the foreseeable future.

Figure 8-1. Pepperweed (late season with seed)

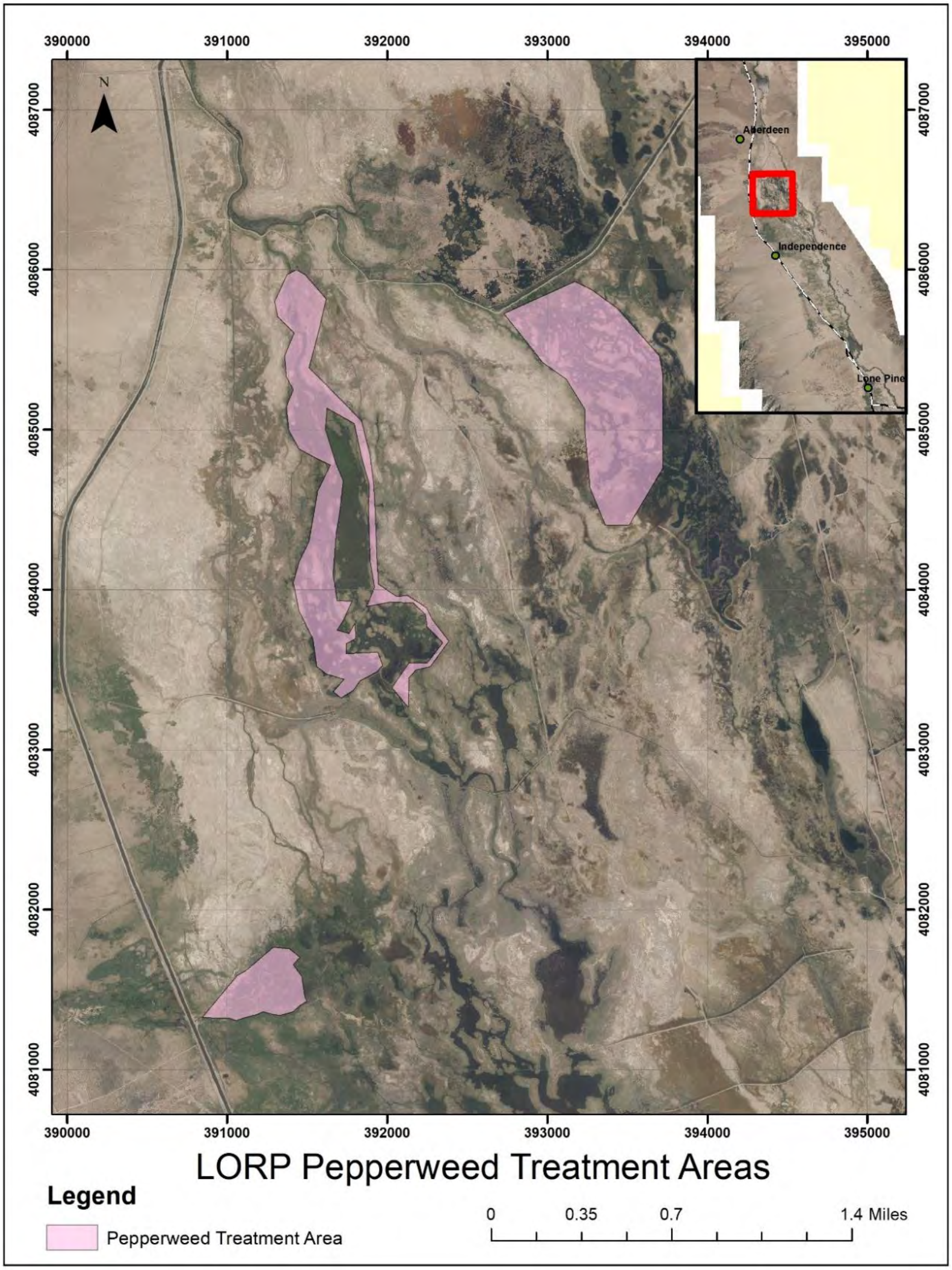


Figure 8-2. Weed treatment areas LORP 2022

8.2 Inyo/Mono Counties Agricultural Commissioner's Office Weed Report

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

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

While eradication of all known weed populations in the LORP is the long-term goal of the program, new populations will continue to establish due to distribution of seeds and root fragments from upstream populations. This issue is exacerbated on sites where disturbance occurs such as wildfire, flooding, or construction. Thus, the detection component of the program is critical to the protection of the LORP's habitat; early detection is critical to limit the spread of weeds and to minimize habitat damage and long-term control costs as it is far less costly to find and treat newly established infestations then to do so once establish.

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

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

In 2022 CAC staffing that contributed to invasive plant work on the LORP included two Agricultural Biologists and two seasonal field assistants. CAC staff began surveillance activities in April and treatment in June. A total of 11.21 net acres were treated this season. Weed treatment means some sort of intervention (chemical or mechanical) has been applied to a weed population. Net acreage treated can be calculated by physically measuring the treated area or by calculating the amount of dilute herbicide applied by calibrated spray equipment.

The 2022 runoff season set a record low and was the second season in a row with below average annual runoff (**Figure 8-3**). Years with low runoff result in more of the project area accessible and treatable. In high seasonal water RYs CAC crews cannot physically access pepperweed populations and even if the populations are accessible, often herbicides cannot be applied due to proximity to standing water or overly wet soil. In high seasonal water RYs, this artificially lowers treatment acreage and provides time for inaccessible pepperweed populations to recover. The result in a low seasonal water RY is that acreage of treatment increases.

In April 2022 the CAC began treatment activities of all known pepperweed sites and new populations discovered during the 2022 season. Low-volume, directed spot treatments using the selective herbicide *Telar XP* were employed. Applications were made from all-terrain vehicles where terrain allowed and on foot with backpack sprayers in more challenging terrain. Care was taken to minimize damage to native plant communities within the LORP. By the middle of July, CAC staff had treated all known sites that were accessible and treatable for a total net treated acreage of 11.21 acres.

A second treatment of the project area was conducted in August. CAC staff returned to all known pepperweed sites and retreated any regrowth. This second treatment also included new sites identified by the 2022 ICWD Rapid Assessment Survey (RAS). A total of 1.93 total acres were treated during the second treatment.

Total net treated acreage, including initial treatment of known sites, retreatment of regrowth, and treatment of new sites identified by the RAS was 13.14 acres. **Figure 8-3** depicts the net weed acreage trend from 2006 to 2022 and total runoff for the Owens River below Long Valley Dam. A significant increase in treated acreage of pepperweed is apparent since the flooding events of 2017 and subsequent drought years.

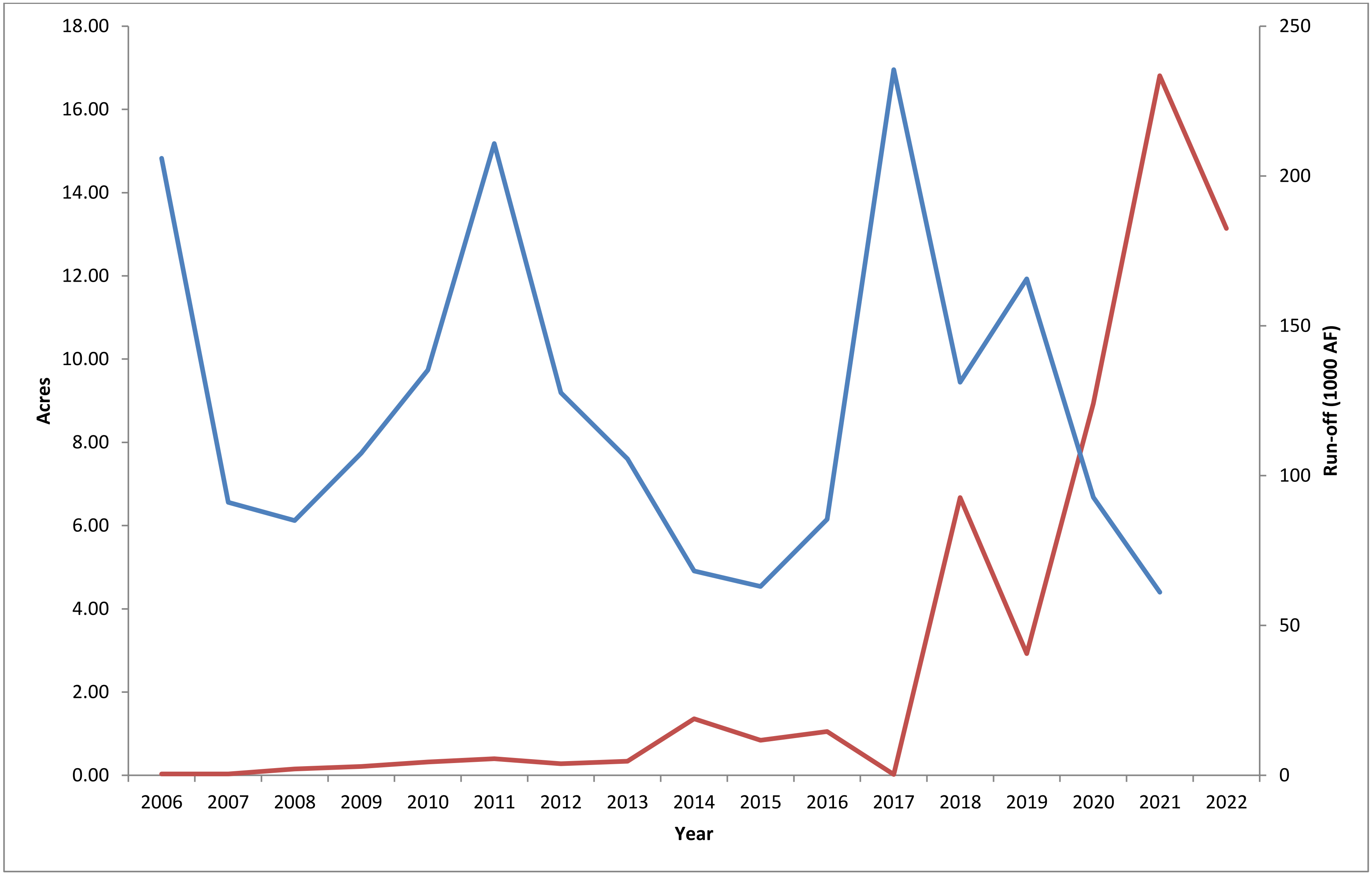


Figure 8-3. Acres of treated pepperweed within the LORP project area from 2006 to 2022 (red line) and total seasonal runoff (April 1 to March 31) of the Owens River below Long Valley Dam for RYs for 2006 to 2021(blue line).

9.0 ADAPTIVE MANAGEMENT

The LORP was implemented in 2006 by the LADWP and is presently managed jointly by the LADWP and the County. Nearing the end of the LORP's prescribed 15-year monitoring program, the LADWP and the County conducted a comprehensive evaluation of the project in 2019 to assess its status with respect to the goals and requirements defined by the guiding legal documents. Through this evaluation, a series of adaptive management actions were identified and are being pursued. In 2022, the LADWP and the County conducted the following:

- Implementation of a 5-year interim flow regime in the DHA and related monitoring,
- Implementation of a 5-year interim flow regime in the BWMA and related monitoring,
- Continuation of a tree recruitment assessment,
- Continuation of a noxious species survey and treatment.

A summary of these efforts is provided below. No new adaptive management was proposed for 2022, as the above items are multi-year commitments.

9.1 DHA Interim Flow Regime and Related Monitoring

On April 1, 2020, the LADWP initiated implementation of a revised interim flow regime in the DHA. The intent of the interim flow regime is to further improve habitat conditions for migrating and wintering waterfowl and shorebirds by increasing the availability of open flooded habitats in the fall, winter and spring.

There are two important differences between the original flow releases under the LORP EIR, and the revised interim flow regime. The first is that summer releases were decreased to a minimum flow of 3 cfs in order to induce hydrological stress on marsh vegetation. The intent of this change is to limit the further expansion of marsh and subsequent decreases in open water and meadow vegetation communities occurring under prior flow releases due to extensive flooding during the growing season. The second difference is lengthening and flattening of seasonal pulse flow releases. This was done to extend the period of flooding of the DHA to better match seasonal migratory patterns of HIS.

In the fiscal year 2021-2022 the LADWP and the County assessed the effectiveness of the new flows in terms of flooding Delta habitats from fall through late spring, and invoking hydrologic stress on cattail stands during the growing season. Land type mapping will be completed at the end of the interim flow study period to evaluate longer term changes in the vegetation community.

During the 2021-2022 RY, and 2022 calendar year, monitoring associated with the revised interim flow regime included flow monitoring and flow effectiveness monitoring.

9.1.1 Methodology

Flow Monitoring

Releases to the DHA were monitored following methods described in the Hydrologic Monitoring section of this report. The scheduled interim flows to the Delta are released through a Langemann gate. Additional water may flow to the Delta over a weir above and beyond the scheduled interim flows. These additional flows occur when flows in the Owens River exceed the capacity of the Pumpback Station, such as during rain events, seasonal habitat flow events for the river, or during power outages of the Pumpback station.

Daily flow data (cfs) were compiled for RY 2021-2022. These data were graphed to allow a visual comparison of how the interim flows in RY 2021-2022 compared with prescribed interim flows.

Effectiveness of Adaptive Management Flows

The effectiveness of the interim flows in maintaining, and eventually improving habitat for DHA indicator species will be assessed both short-term and long-term. Short-term monitoring will be done annually and include an evaluation of the timing and extent of flooding. Long-term, the desired effect of the interim flow schedule is to halt the expansion of cattails, and over time, return the DHA to a seasonally flooded meadow-dominated system with open water ponds.

In the interest of maintaining current habitat values, and creating conditions to improve future habitat values, the following were considered when evaluating the effectiveness of the interim flows:

1) Did the summer minimum baseflow result in drying and hydrologic stress of cattails in the DHA?
2) Did the minimum summer base flow maintain water in permanent ponds serving as “control points”?
3) Did the interim flows produce flooding of existing, seasonal ponds serving as “control points” from September through early May?

During the first year of implementation of the interim flows, various methods were evaluated to determine how to monitor the short-term effectiveness of achieving the desired conditions. The following data sources were evaluated: weekly to twice weekly photographs of the DHA taken from a helicopter during surveillance flights of the Owens Lake Dust Control Program, and remote sensing products used for the Owens Lake Dust Control Program to determine wetness compliance.

Due to the heavily vegetated nature of the DHA, and the small size of permanent and seasonal ponds, the available remote sensing products did not reliably detect the extent of flooding, nor consistently detect small open water areas. Based on a comparison of helicopter photos, in many cases, areas classified as “wet soil” were actually flooded. The Owens Lake remote sensing products do appear to be useful in evaluating criterion 3 above, especially in combination with the aerial photos.

Criteria 1 and 2 above were assessed using the photos taken from the helicopter and at photo points. The condition of cattails was helpful in determining whether the interim flows were inducing hydrologic stress. For criterion 2, the small permanent ponds are visible in the helicopter photos, and thus these photos were reviewed to document the continuing presence during the summer drying period of minimum flow conditions.

9.1.2 Results

Flow Monitoring

Interim flows commenced April 1, 2020 and have continued through WY 2021-2022. The interim flows have resulted in an overall more stable pattern of releases to DHA as compared to the previous release schedule that had more daily variability and four shorter, higher seasonal pulse flows. The minimum summer base flow of 3 cfs was applied May 15 to August 31. Several small increases in summer base flows in 2022 above the prescribed flows (**Figure 9-1**) were the result of precipitation events.

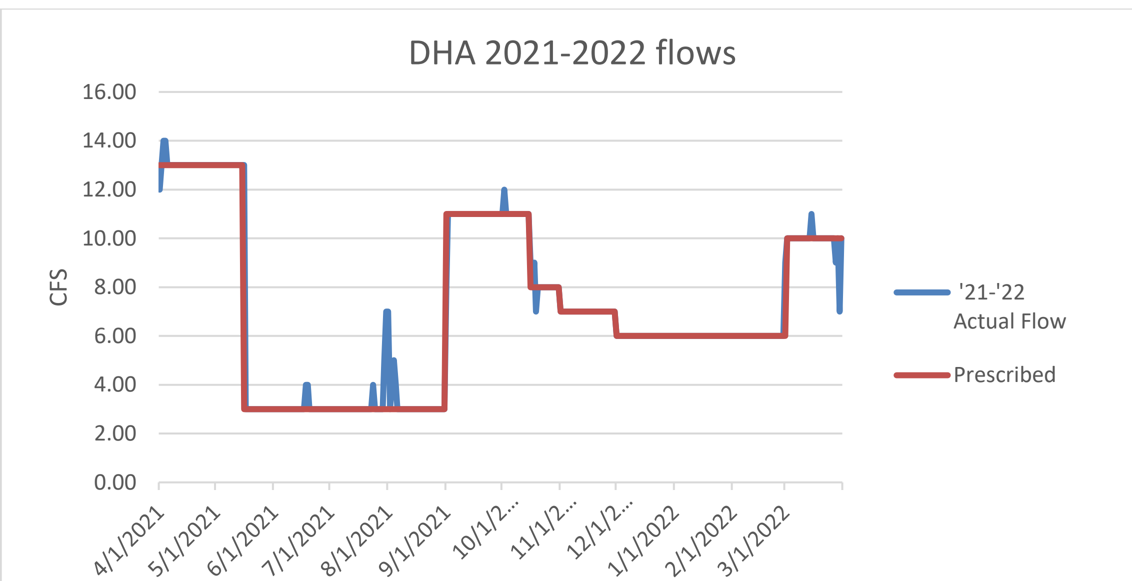


Figure 9-1. Comparison of flow to the DHA in RY 2021-2022 vs. prescribed interim adaptive management flows

Effectiveness of Adaptive Management Flow Regime

Habitat conditions were evaluated to determine if the interim flows were effective at meeting the three habitat and management criteria described above.

> *Criterion 1: Did the summer minimum baseflow result in drying and hydrologic stress of cattails in the DHA?*

Figure 9-2 and **Figure 9-3** are aerial photos taken in August of the DHA. **Figure 9-2** is August 2019, prior to implementation of the interim flows. **Figure 9-3** is August 2021, in the second year of interim flows, with the application of a minimum base flow of 3 cfs. As compared to the August 2019 photo, the August 2021 image shows extensive areas of brown cattails, particularly along the east and south side of the DHA. This shows two consecutive years of hydrologic stress to cattails. The cattails at the northern end of the DHA remained green through the summer as they continued to receive water throughout the growing season, and thus re-sprouted in early summer of 2021.
Figure 9-4 shows extensive areas of brown cattails from a different angle, also from August 6, 2021.

Figure 9-2. Photo taken August 16, 2019 show that all cattail stands are green due to the continuous supply of water during the growing season.

Figure 9-3. Photo taken August 6, 2021 show cattail stands at the edges and the southern end of the DHA are brown due to lack of regrowth.

Figure 9-4. Extensive area of brown cattails looking southwest.

Criteria 2: Did the minimum summer base flow maintain water in permanent ponds serving as “control points”?

Figure 9-5 shows the permanent ponds that were monitored during the period of reduced summer flows to evaluate whether the ponds remained flooded. Not all of the ponds were always captured during flights due to visibility or lighting condition, but biweekly helicopter photos taken during the reduced summer flow period were evaluated. Representative photos from a mid-summer date of August 21, 2021, shows that permanent Pond 1 and Pond 2 remained flooded in summer (**Figure 9-6**), thus Criterion 2 was met.

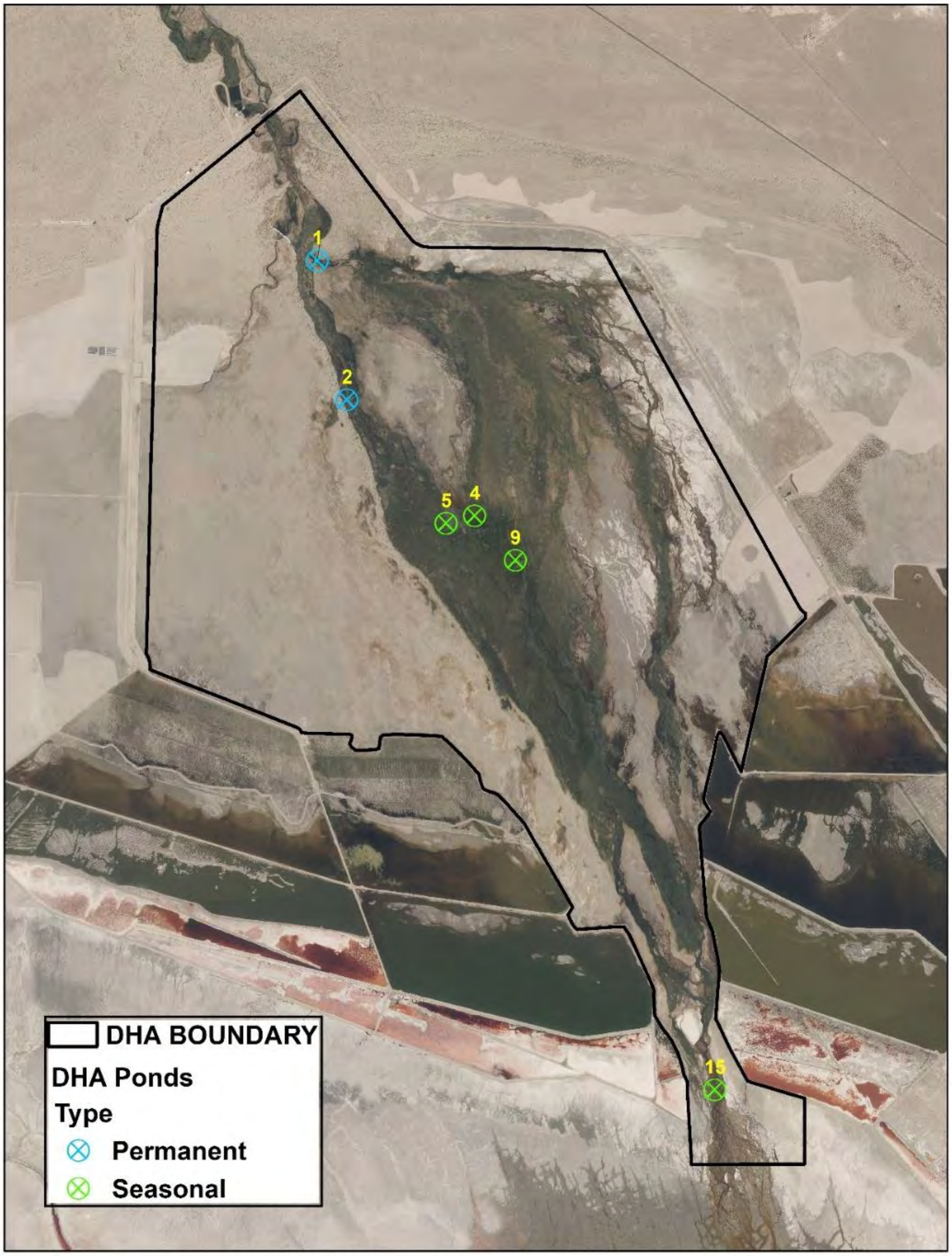


Figure 9-5. Permanent and seasonal ponds in DHA. Not all ponds are mapped, but those typically visible on photos taken from the helicopter are shown.

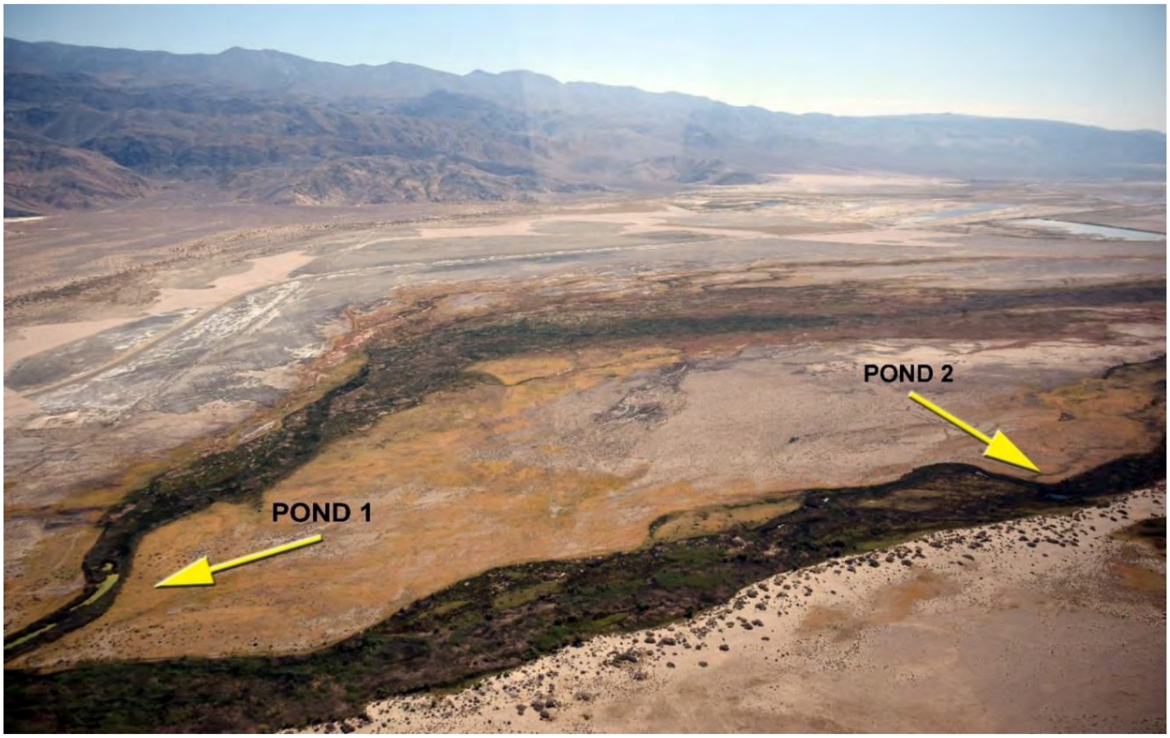


Figure 9-6. Helicopter photo from August 21, 2021 shows that the Permanent Ponds 1 and 2 remained flooded during reduced summer flows.

Criterion 3: Did the interim flows produce flooding of existing, seasonal ponds serving as "control points" from September through early May?

The interim flow management schedule was continued from the 2020-2021 WY with flows continuing from April 1, 2021 until May 14, 2022, when they were reduced to the minimum summer flow of 3 cfs. Helicopter photos from May 24, 2022 show water remaining in 4, 5, and 9, and some outflow into 15. Some water still appears present in the brine pool.

On September 1, 2022, the summer minimum base flow of 3 cfs was increased to 11 cfs. The September 14, 2022 helicopter photos showed that seasonal ponds 4, 5 and 9 were flooded, but that water had not yet reached the brine pool transition area, or seasonal pond 15, thus there was not yet outflow. By September 29, 2022, water was flowing into the brine pool transition area (seasonal pond 15) based on a review of helicopter photos. These are very similar results to 2020 and 2021 seasonal releases.

A review of helicopter photos indicates that all seasonal ponds remained flooded throughout the remainder of fall and winter (October through April), therefore Criterion 3 has been met.

9.1.3 Discussion and Recommendations

Effectiveness of Adaptive Management Flow Regime

The adaptive management flow regime was effective at meeting the three assessment criteria used for the 2021-2022 RY. Cattail stands, including most of the new areas of expansion observed since LORP implementation, experienced drying and hydrologic stress during the growing season and failed to resprout in spring.

With time, the standing dead cattails will break down through the combined effects of biological decay and mechanical action by the local elk herd and livestock; and a more open, meadow system is anticipated in the long-term. The minimum summer base flow of 3 cfs was sufficient, however, to maintain flooding of permanent ponds in the DHA. This is desirable in order to provide a sustained summer water resource for resident wildlife including game fish. Seasonal open water areas were also flooded during the fall through late spring period this first year of interim flows. Open water areas are critical for attracting HIS in the DHA.

Recommendations

Overall, the second year of monitoring indicates that the interim flows continued to be effective for two consecutive years at meeting short-term habitat and management objectives; and suggests they will support the long-term goal of increasing the habitat diversity of DHA by converting existing stands of cattails to meadow habitats, and creating and maintaining open water areas for HIS.

It is unknown how long it will take to achieve this desired state, but it could be multiple years, and small-scale changes may be subtle even at the end of the five-year adaptive management monitoring period.

1) Mowing to create open water areas

   We recommend investigating a short-term pilot project to achieve habitat improvements more quickly, and thus improve resource use efficiency. This short-term project would involve the mowing of vegetation in and around depressions that collect water fall through spring in order to create open settings that would provide waterfowl, shorebirds and wading birds additional habitat for feeding and resting. Increasing visibility and decreasing vegetation height in the immediate vicinty of ponds may enchance and attract more wildlife use in the short term, as we wait for natural succession and ecological process to occur. Areas best to mow would be depressions in the southern and or eastern part of the delta that dry seasonaly under the adaptive management flows, and thus very limited regrowth of vegetation is anticipated. This mowing would be done in late summer or early fall prior to fall water releases, preferably August or early September, when the southern and eastern portions of the delta are dry, and the bird nesting season is over. Since areas to be mowed are administered by the State Lands Commission, coordination with and approval by this agency will need to be obtained.

   Prescribed fire is another management tool which could be utilized in order to achieve dead vegetation removal and create more open ponded areas. However, implementing prescribed fire is a much more involved, lengthy, and invasive process.

2) Conduct mid-summer qualitative habitat assessment August 2023

   We recommend visiting the DHA on-the-ground in August 2023 to retake all photopoints, and to further evaluate the extent of dry down during the summer months. Although we note that high runoff conditions will mean that dry down conditions are unlikely to happen.

3) Further investigate the use of remote sensing to assess habitat conditions and flow effectiveness

   The use of remote sensing tools could be valuable and efficient means of monitoring flow effectiveness. The presence of large amounts of dense vegetation in the DHA resulted in seemingly inconsistent results using the methods used for evaluating Owens Lake wetted compliance. We recommend that the use of remote sensing be further evaluated as a tool to track changes in the extent of flooding, the amount of open-water habitat available, and the size and availability of seasonal and permanent ponds over time to allow a more quantitative approach to evaluating habitat conditions and flow effectiveness.

4) Continue flow effectiveness monitoring through the interim management period to determine if the results observed during the first two years of implementation are representative of what is expected long-term.

9.2 Blackrock Waterfowl Management Area Interim Management and Monitoring

Since the LORP implementation in 2006, the BWMA has been managed in accordance with guidance in the 1997 MOU, with up to 500 acres flooded year-round proportional to the annual runoff forecast. Since implementation, management of BWMA under this legal direction created and maintained habitat for BWMA indicator species, but also resulted in considerable cattail and bulrush encroachment, reducing open water in the units. These changes resulted in subsequent declines in habitat quality following the first year of flooding each waterfowl unit.

Following an evaluation of the effectiveness of the year-round flooding approach defined in the 1997 MOU, LADWP and the County jointly recommended implementing a seasonal flooding regime in BWMA (LADWP and ICWD 2020). LADWP and the County worked together to develop a 5-year Interim Management and Monitoring Plan for the BWMA (Interim Plan) in 2020 to further improve conditions for the BWMA HIS, which are waterfowl, shorebirds, wading birds, Northern Harrier and Marsh Wren. The Interim Plan proposed a seasonal flooding regime to flood a fixed 500 acres of the BWMA each year from fall to mid-spring, with full dry down in the summer months, and to enhance forage for indicator species through moist soil management.

LADWP and the County finalized the Interim Plan in April 2021, following consultation with the MOU Parties. The Inyo/Los Angeles Standing Committee set the BWMA flooded acreage for 2021-2022 in accordance with the Interim Plan at their May 26, 2021 meeting. The Interim Plan will be implemented as adaptive management for a period of 5 years, with a sunset of April 15, 2026. The Interim Plan is included as Adaptive Management Appendix 1.

LADWP and the County began implementation of the Interim Plan shortly thereafter, drying down the units beginning May 2021, and conducting all necessary preparatory work in the Waggoner and Thibaut Units, and the East Winterton Subunit by August 31, 2021. This preparatory work included weed treatment, disking of cattails and bulrush, reinforcement of berms, and upgrading flow measuring stations. Flooding of these units commenced September 15, 2021, on schedule with the Interim Plan. Water was released to BWMA throughout the winter to maintain 500 acres of flooded habitats, and then water was shut off on March 3, 2022 to allow for spring drawdown and summer drying.

Here we report on the results of the effectiveness monitoring conducted during Flooding Cycle 1 (FC1) implementation of the Interim Plan (Fall 2021 to Spring 2022), which included documenting the flooded acreage, vegetation assessments to evaluate forage species availability, and avian surveys to determine use by HIS. In addition to the ground-based wetted extent monitoring conducted by LADWP and Inyo County staff, the County also explored the use of remote sensing to monitor flooding of the units. We used the data to compare the effectiveness of the new management approach against past practices.

9.2.1 Overview of BWMA Interim Plan Effectiveness Monitoring

Active Units, Subunits, and Subbasins in Flooding Cycle 1

In accordance with FC1 of the Interim Plan, the Waggoner unit, Thibaut Unit, and the East Winterton Subunit of the Winterton Unit were flooded. Although portions of the East Winterton Subunit have had some flooding in previous years, this is the first time the subunit has been intentionally flooded.

The BWMA units have been further divided into “subbasins” to allow increased spatial resolution of the monitoring data. Subbasin boundaries were drawn based on topography, the presence of water control structures, and the physical boundaries visible in the field. In this section of the report, flooded extent, and bird and vegetation data will be presented both at the level of subbasin and unit. **Table 9-1** shows the flooded subbasins in which bird and vegetation monitoring were conducted in FC1, and **Figure 9-7,** showing the subbasins by BWMA Unit.

Table 9-1. Subbasins Monitored in FC1 and their Associated Unit and Subunit Designation

Subbasin	Unit	Subunit
WAG1	Waggoner	
WAG2	Waggoner	
WAG3	Waggoner	
WAG4	Waggoner	
WAG5	Waggoner	
WAG6	Waggoner	
WAG7	Waggoner	
TH5	Thibaut	
TH6	Thibaut	
TH7	Thibaut	
TH8	Thibaut	
TH9	Thibaut	
TH10	Thibaut	
TH11	Thibaut	
SW2	Thibaut	South Winterton
W9	Winterton	East Winterton
W11	Winterton	East Winterton
W12	Winterton	East Winterton
W13	Winterton	East Winterton
W14	Winterton	East Winterton

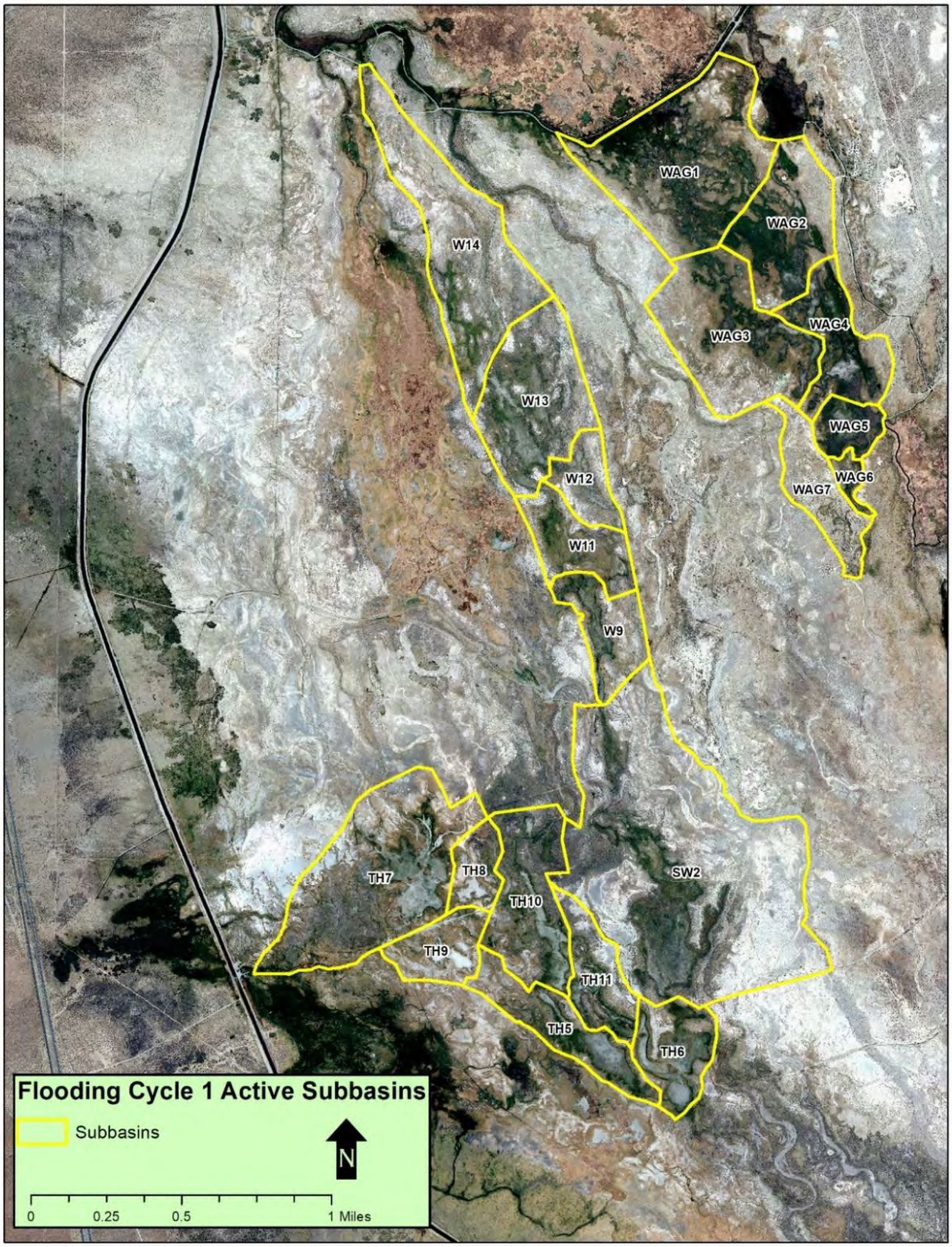


Figure 9-7. Map of the active subbasins monitored in 2021-2022

9.2.2 Flooded Extent Monitoring

Methodology

Flooded extent monitoring was conducted in November 2021 and March 2022 (Section 2.6) by walking the water's edge and creating a GPS track. This monitoring was used to both confirm compliance with the Interim Plan, and to help describe the effectiveness of seasonal filling.

Data Summary

The ArcView flooded extent shapefiles for November and March were clipped by unit and subunits in order to extract flooded acreage values. The flooded acre value was calculated by averaging the flooded acreage values for November and March by subunit and unit.

Results

The results presented in **Table 9-2** are the flooded acreage for the subbasins monitored for bird activity. The total flooded acreage in this table will differ slightly from the total flooded acreage in Section 2.4 of this report as there was some flooding outside of the boundaries of the monitored subbasins.

Table 9-2. Flooded acreage of subbasins monitored during avian surveys

Subbasin	Unit	Subunit	November	March	Average
WAG1	Waggoner		15.6	9.5	12.6
WAG2	Waggoner		51.9	46.1	49.0
WAG3	Waggoner		60.5	53.5	57.0
WAG4	Waggoner		49.3	46.1	47.7
WAG5	Waggoner		22.5	21.8	22.1
WAG6	Waggoner		8.4	8.0	8.2
WAG7	Waggoner		3.5	5.7	4.6
TH5	Thibaut		27.0	22.9	24.9
TH6	Thibaut		29.1	28.6	28.9
TH7	Thibaut		39.8	54.3	47.0
TH8	Thibaut		9.2	12.4	10.8
TH9	Thibaut		1.5	1.5	1.5
TH10	Thibaut		34.1	30.4	32.3
TH11	Thibaut		14.8	14.4	14.6
SW2	Thibaut	South Winterton	30.6	58.2	44.4
W9	Winterton	East Winterton	10.5	0.1	5.3
W11	Winterton	East Winterton	23.8	16.1	19.9
W12	Winterton	East Winterton	5.5	0.0	2.7
W13	Winterton	East Winterton	30.1	23.4	26.8
W14	Winterton	East Winterton	25.8	9.0	17.4

9.2.3 Vegetation Monitoring

Introduction

One of the goals of seasonal drawdowns on the BWMA Units is to create moist soil conditions on the active units to support early seral vegetation. Moist soil conditions resulting from spring drawdowns would support early seral vegetation, when submerged in the fall would become a forage source for water birds. To gain a better understanding of the plant composition in each of the basins, vegetation sampling on winter flooded sub-units in the BWMA was conducted in August 2022. The objective was to capture the dominant plant communities that emerged following the drawdown of the active units beginning in March of the same year. Once the 2022-23 avian surveys are completed for the fall, winter and spring we will look for any patterns that may indicate a preferred plant association in relation to avian use in a given basin/unit.

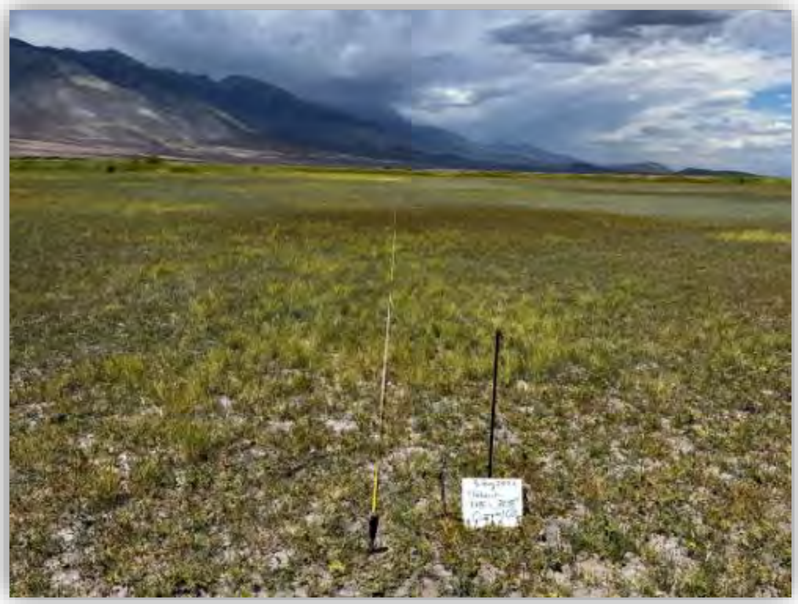


Figure 9-8. Vegetation transect BWMA, 2022

Methodology

Sixteen transects were established across the three active units (**Table 9-3**). **Figure 9-7** depicts all the subbasins in the active BWMA project area from 2021-2023. Sampling was conducted in August of 2022. At least one transect was placed in each basin associated with the larger three units.

Methodology consisted of photo points at the 0m to the 100m and back from the 100m point to the 0m. Site selection was determined by field staff as to best represent the general plant communities in each basin. The Dry-Weight-Rank (DWR) sampling method was applied inside a 40cm by 40cm quadrat frame, placed every meter along a 100m tape, a total of 100 quadrats were sampled at each transect. The DWR requires the observer to assign ranks for the three heaviest plant species in each quadrat (Bureau of Land Management 1996). This method can generate a rapid assessment of estimated of production based on species composition. This method does not generate an estimate of pounds/acre of plant material but can provide a general depiction of which species contribute the largest amount of biomass across a given area (Friedel et al. 1988).

Line point intercept was also used to estimate cover along the same tape. The first live cover hit at each meter was recorded. If no cover was intercepted then the ground cover hit was recorded as soil, litter, or rock. These actual cover results will help interpret the DWR results which are based on the relative contribution by species to the total given weight in each quadrat.

Table 9-3. Vegetation transects (16) associated with active units in 2021-2023

Unit	Basin	Transect
Thibaut	SW2	SW2-2
	SW2	SW2-1
	TH5	TH5-1
	TH6	TH6-1
	TH7	TH7-1
	TH8	TH8-1
	TH10	TH10-1
	TH11	TH11-1
	Subtotal	8
Winterton	W 9	W9-1
	W 11	W11-1
	W 13	W13-1
	Subtotal	3
Waggoner	Wag_3	Wag 3-1
	Wag_2	Wag 2-1
	Wag_4	Wag 4-1
	Wag_5	Wag 5-1
	Wag_6	Wag 6-1
	Subtotal	5

Results

Live cover
Sampling for live cover in the five Waggoner subbasins ranged between 53%-86%. The three subbasins sampled in the East Winterton subunit ranged between 8%-24%, and 14%-89% in the eight Thibaut subbasins.

Species Composition
Species composition by weight (DWR) varied widely between units and among basins within the same unit (**Table 9-4**). Averaged across all units *Malvella leprosa* was the largest contributor to relative species composition by weight (27%), with *Atriplex prostrata* (11%), *Atriplex truncata* (11%), *Cressa truxillensis* (11%) another third of the total composition.

Table 9-4. Species composition for plants by weight, averaged across all basins from three active units (Thibaut, Waggoner, and East Winterton) flooded in 2021-2022.

COMMON NAME	SPECIES	CODE	Relative Composition by weight
triangle orache	*Atriplex prostrata*	ATPR	11%
tumbling saltweed	*Atriplex rosea*	ATRO	1%
wedgescale saltbush	*Atriplex truncata*	ATTR	11%
fivehorn smotherweed	*Bassia hyssopifolia*	BAHY	4%
Sedge	*Carex spp.*	CAREX	1%
Canadian horseweed	*Conyza canadensis*	COCA5	1%
swamp timothy	*Crypsis schoenoides*	CRSC	4%
spreading alkaliweed	*Cressa truxillensis*	CRTR5	11%
Saltgrass	*Distichlis spicata*	DISP	10%
common sunflower	*Helianthus annuus*	HEAN3	9%
salt heliotrope	*Heliotropium curassavicum*	HECU3	3%
beardless wildrye	*Leymus triticoides*	LETR5	2%
alkali mallow	*Malvella leprosa*	MALE3	27%
Scratchgrass	*Muhlenbergia asperifolia*	MUAS	1%
annual rabbitsfoot grass	*Polypogon monspeliensis*	POMO5	1%
willow dock	*Rumex salicifolius*	RUSA	1%
hardstem bulrush	*Schoenoplectus acutus*	SCAC3	1%
verrucose seapurslane	*Sesuvium verrucosum*	SEVE2	1%

Species presented were contributing at least a cumulative 1% of total composition (trace species are not presented).

Smartweed [*Polygonum sp*. (POLY)] was only observed on TH7-1 with 2% relative species composition. The emergence of *Crypsis schoenoides* (CRSC) on four Thibaut basins with a range between 4%-30% was encouraging. The seeds from this annual grass provide excellent foraging opportunities for waterbirds. This was also the first time this grass has been identified in the LORP project area. The grass likely was introduced by migrating water birds.

Bassia was abundant (30%) on WAG 6-1, Waggoner; (19%) on W 14-1, East Winterton; and 27% on SW2-1, South Winterton (Thibaut Unit).

Results for each transect on each subbasin, in the three active units beginning with the Waggoner Unit are presented in **Figure 9-10**.

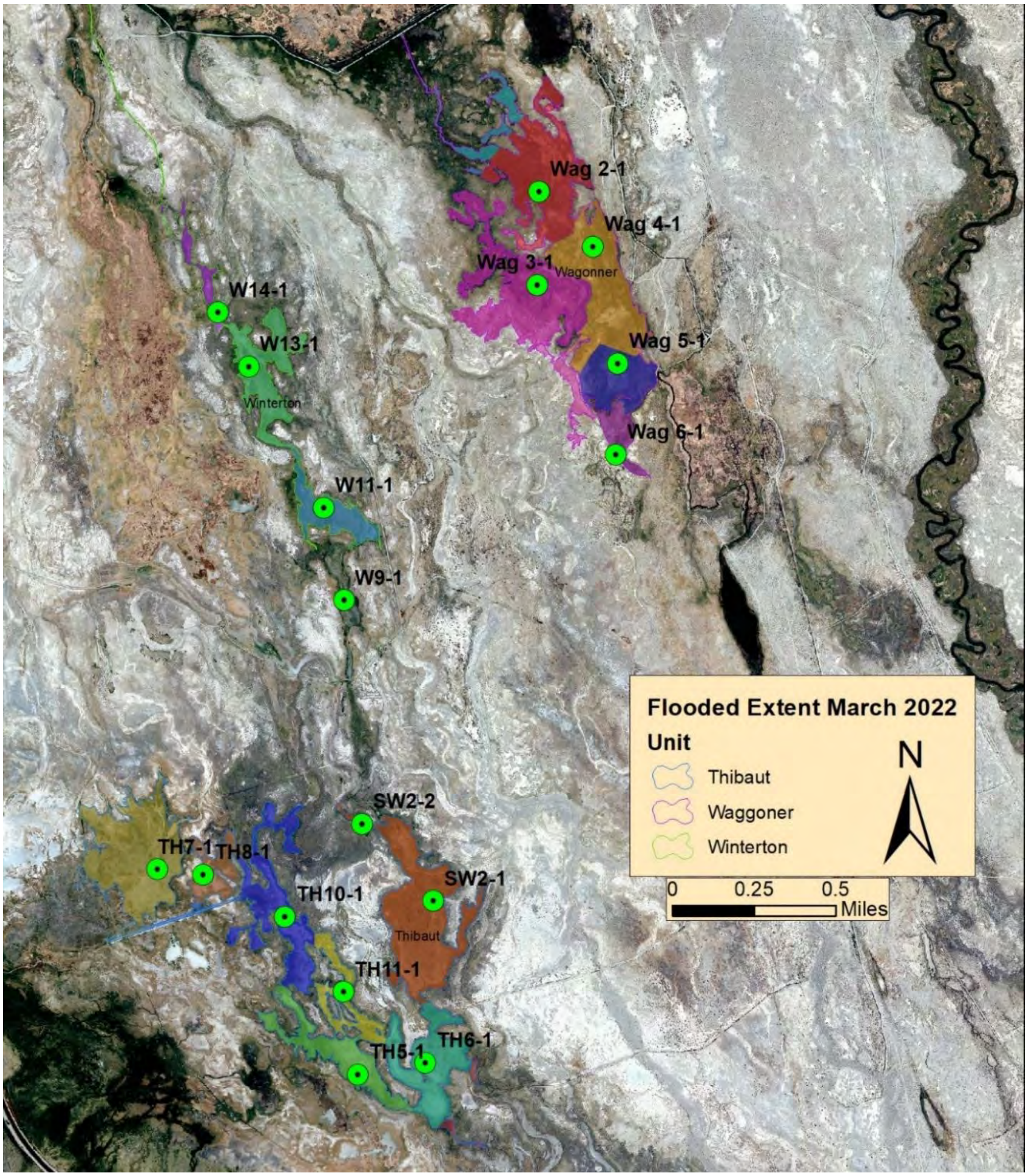


Figure 9-9. Locations of transects sampled in August 2022.

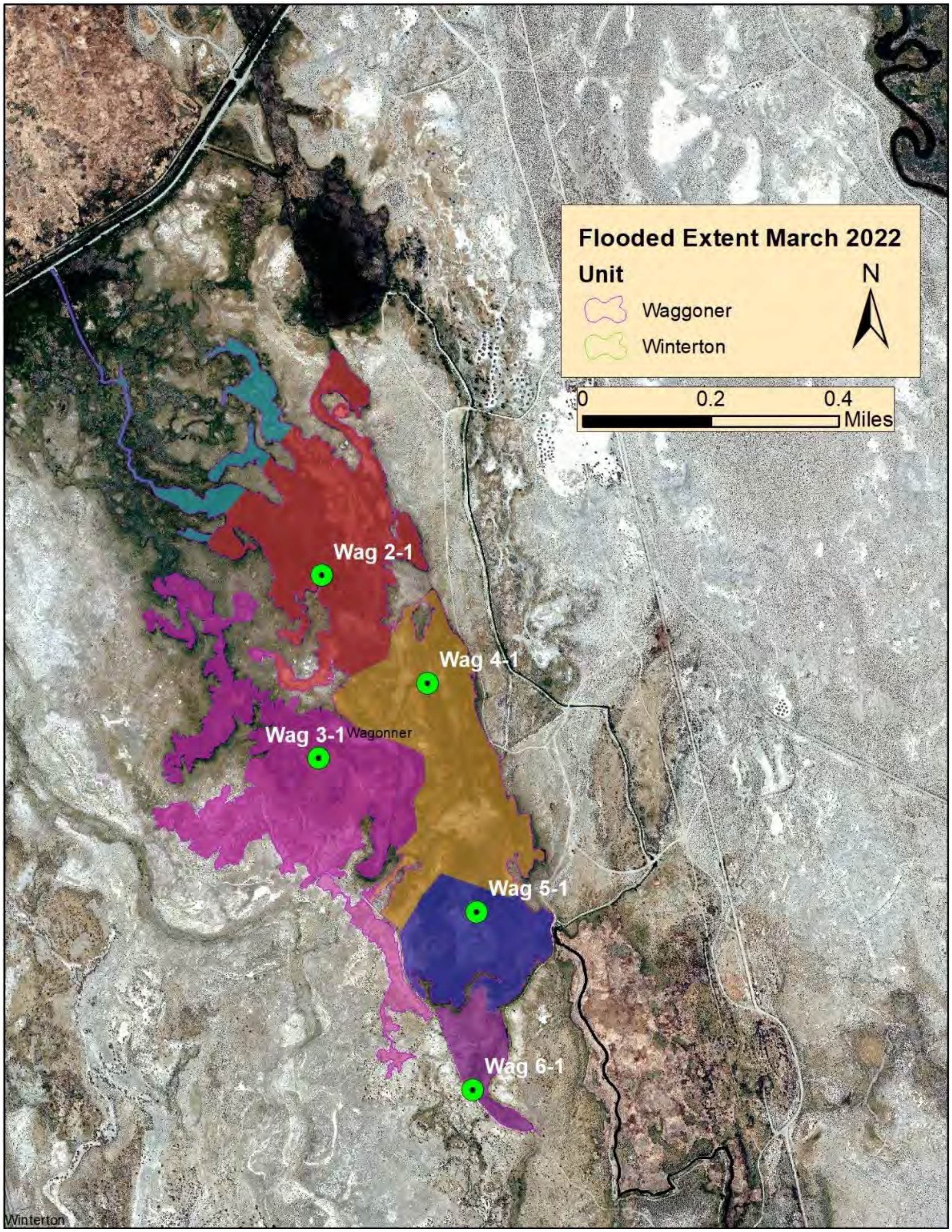
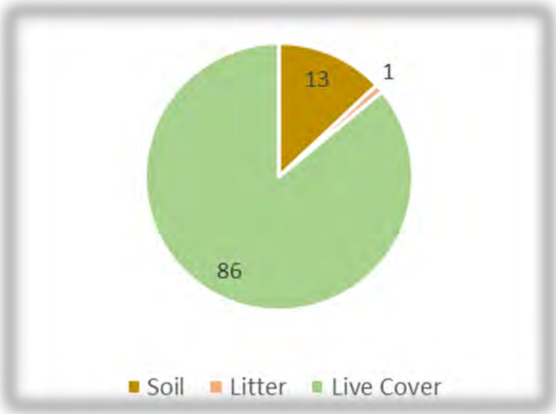


Figure 9-10. Waggoner Unit and location of sample plots

WAG 2-1

*Species codes can be cross-referenced on Table 7-4

Cover



Relative species composition by weight

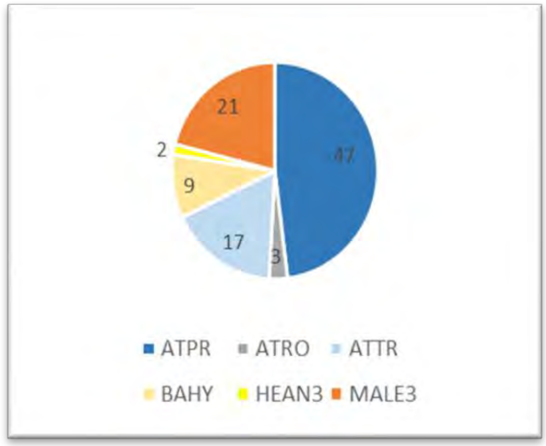
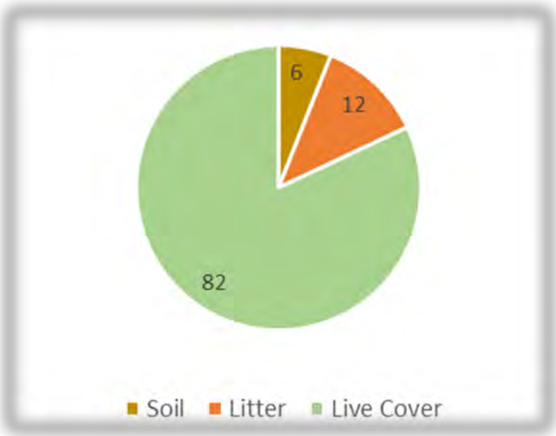


Figure 9-11. WAG 2-1.

WAG 3-1

Cover



Relative species composition by weight

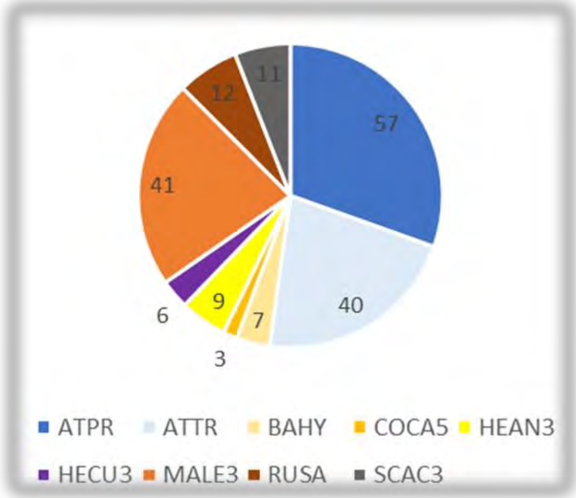


Figure 9-12. WAG 3-1

WAG 4-1

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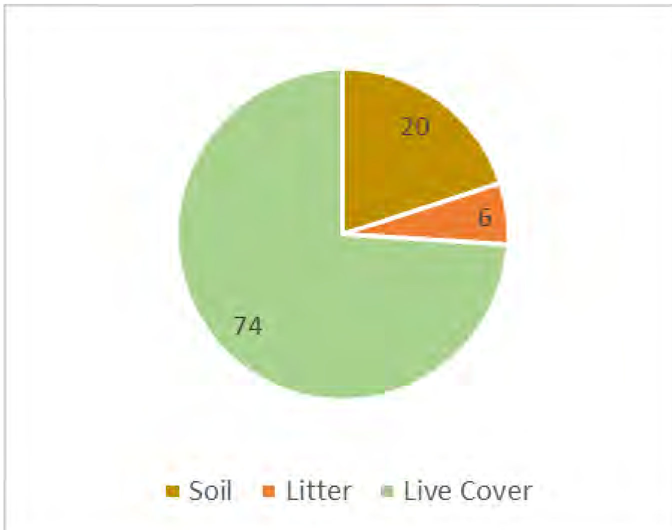


Relative species composition by weight

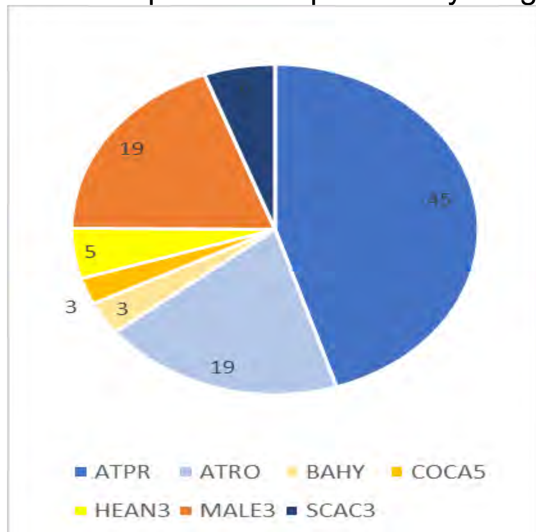
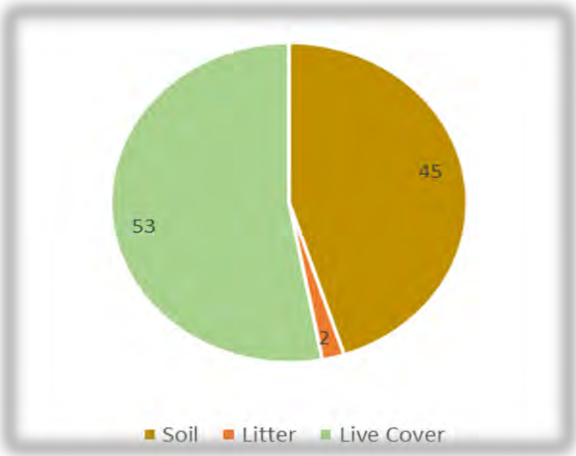


Figure 9-13. WAG 4-1

WAG 5-1

Cover



Relative species composition by weight

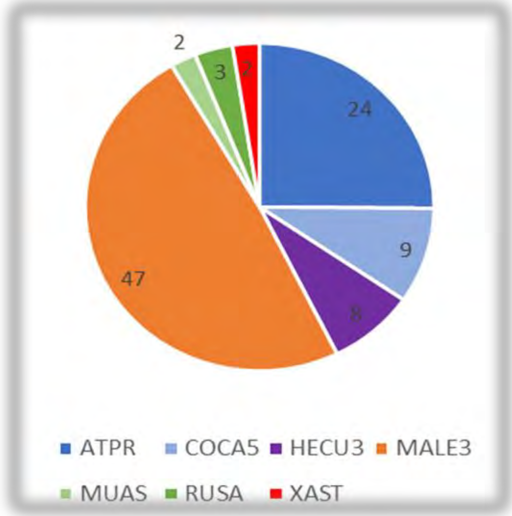
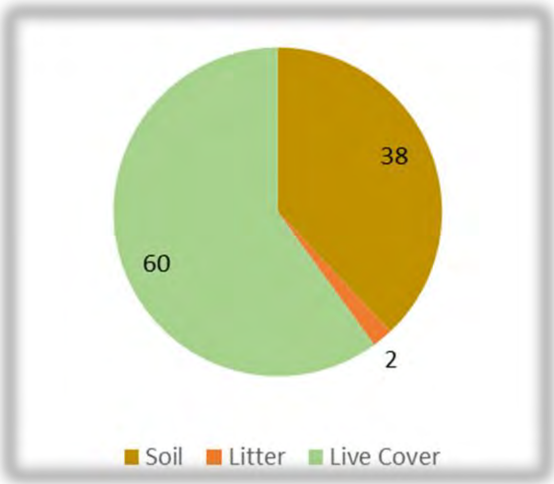


Figure 9-14. WAG 5-1

WAG 6-1

Cover



Relative species composition by weight

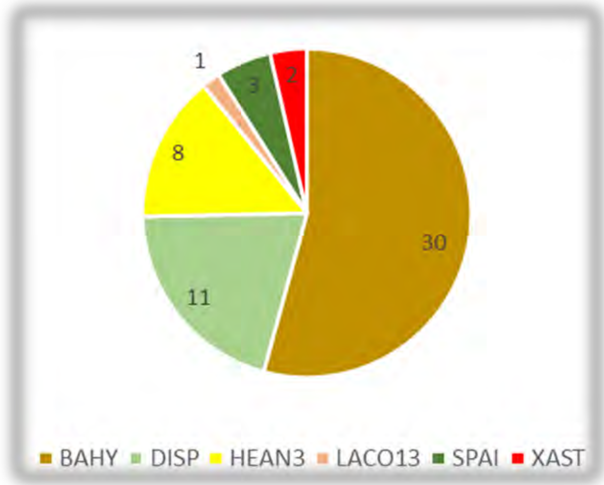


Figure 9-15. WAG 6-1

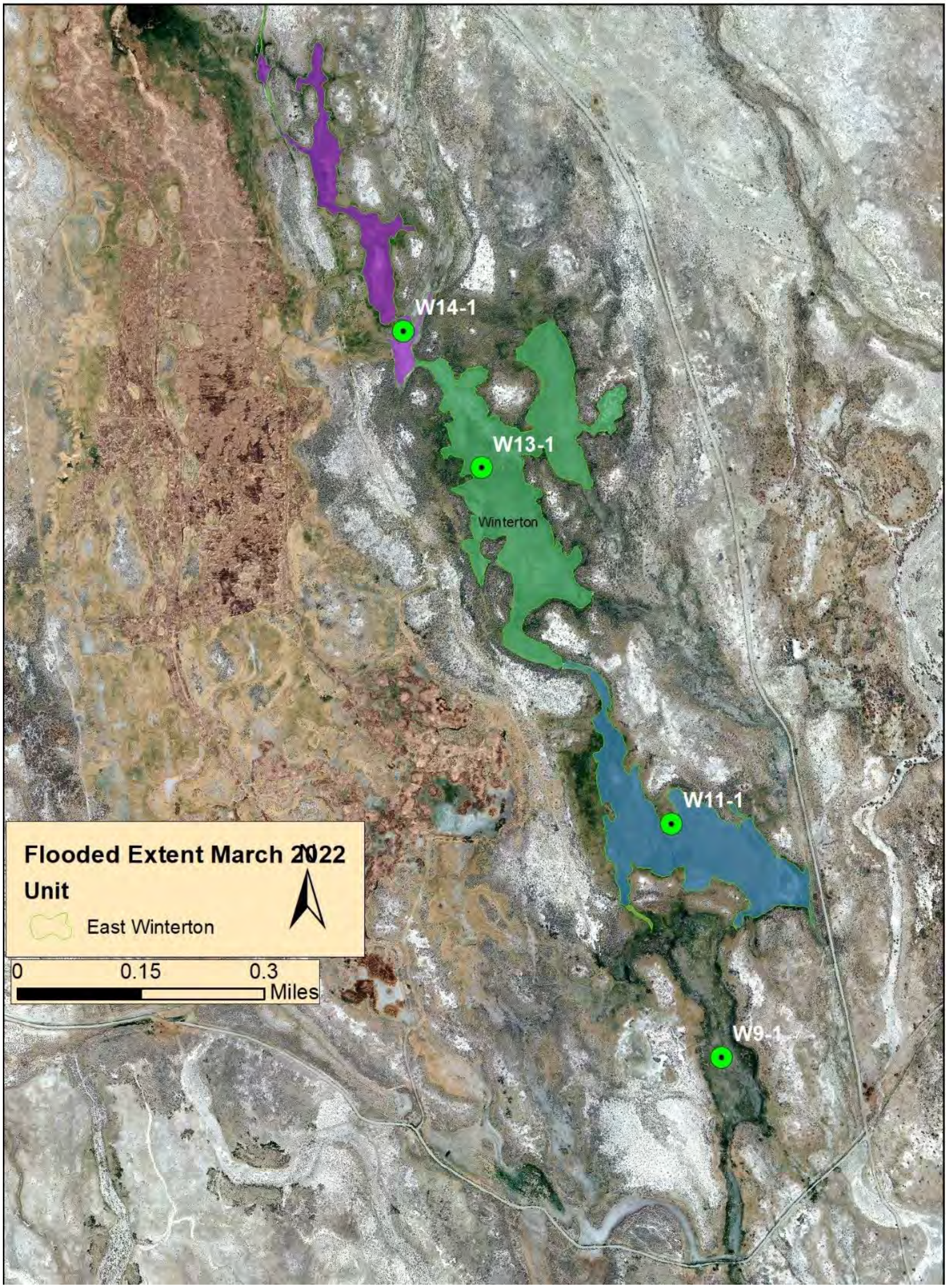
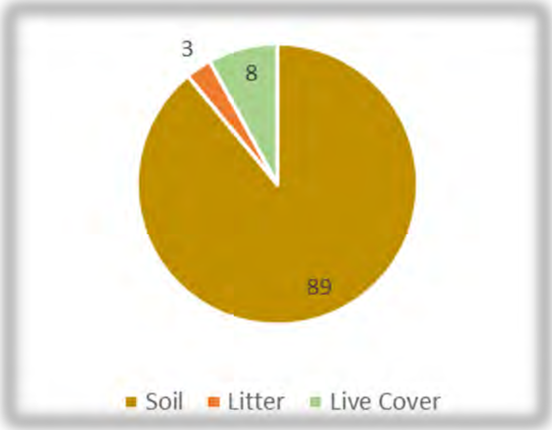


Figure 9-16. East Winterton

WAG 14-1

Cover



Relative species composition by weight

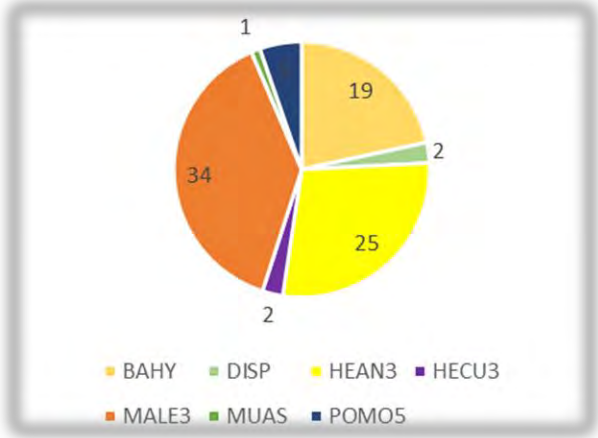


Figure 9-17. WAG 14-1

WAG 13-1

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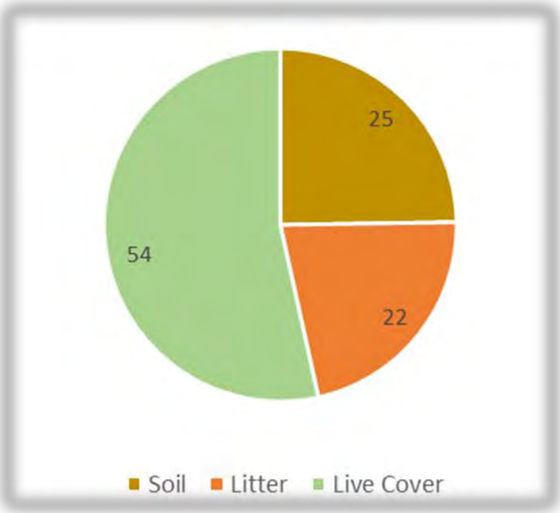


Relative species composition by weight

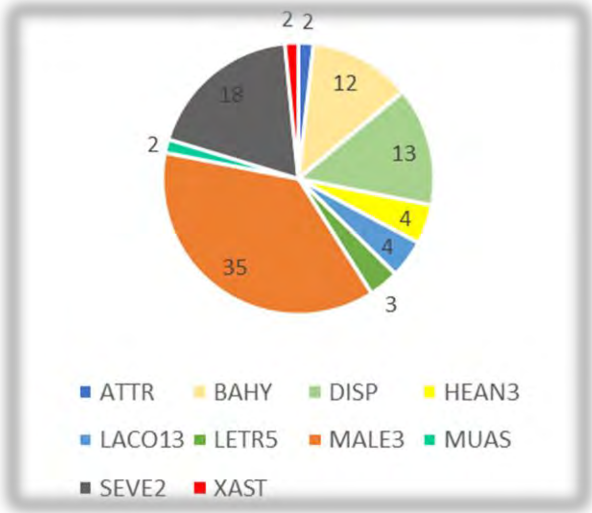
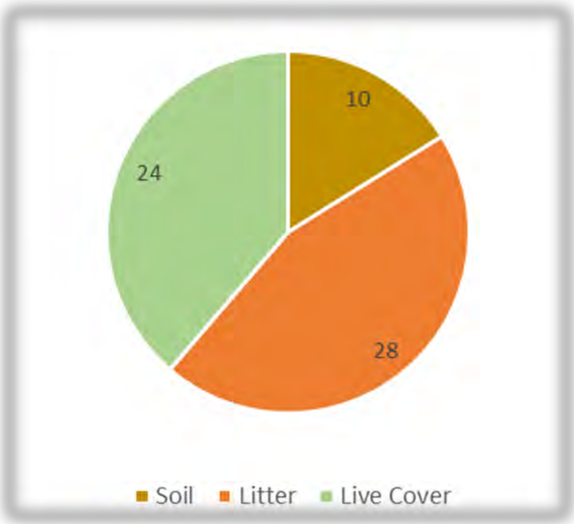


Figure 9-18. WAG 13-1

WAG 11-1

Cover



Relative species composition by weight

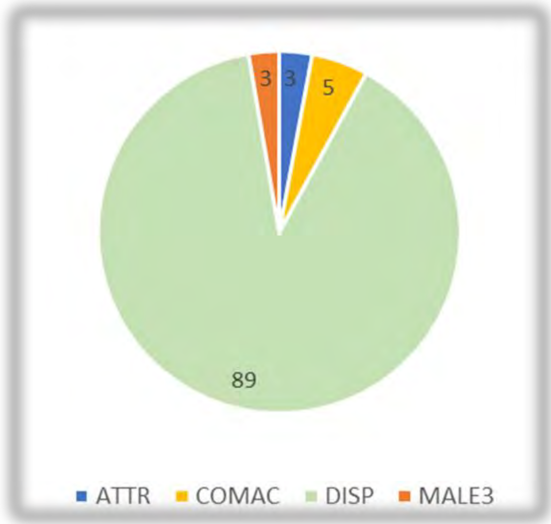


Figure 9-19. WAG 11-1

WAG 9-1

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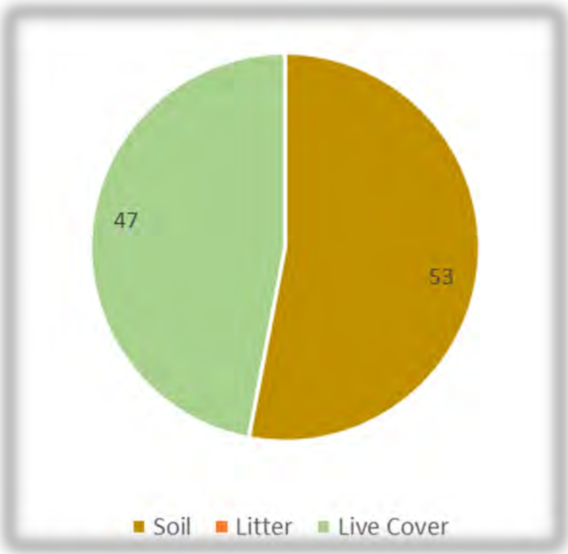


Relative species composition by weight

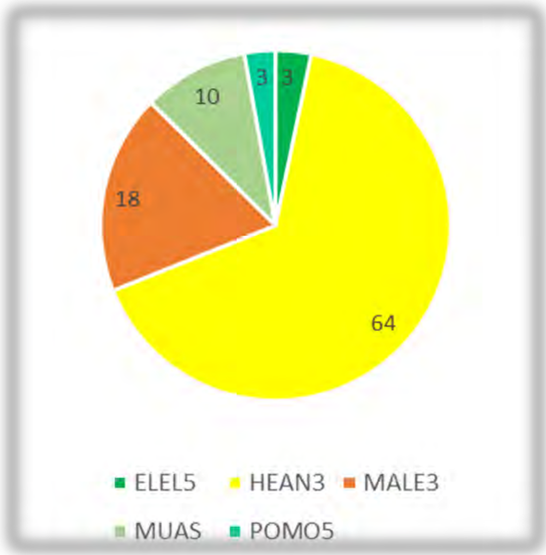


Figure 9-20. WAG 9-1

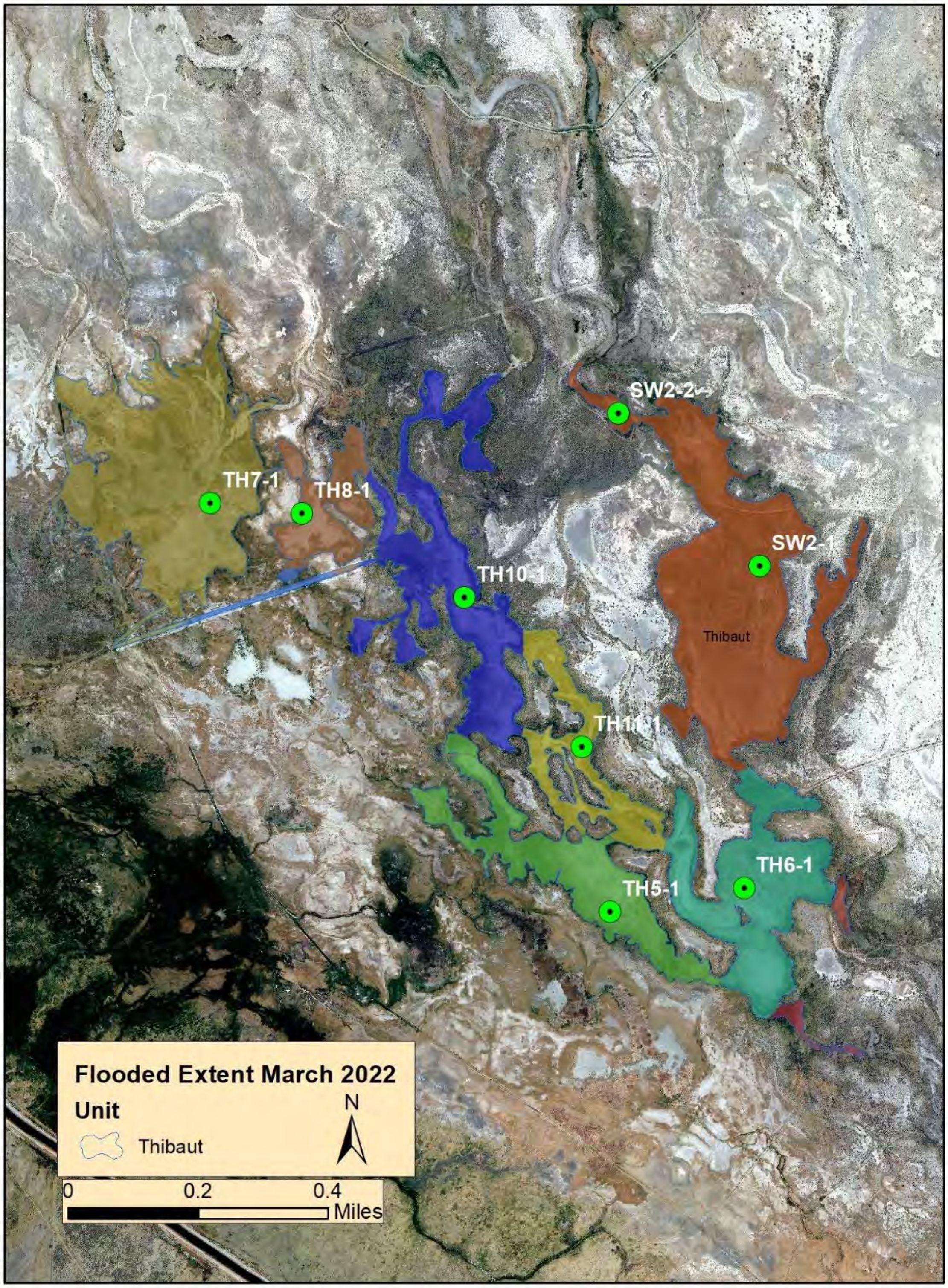
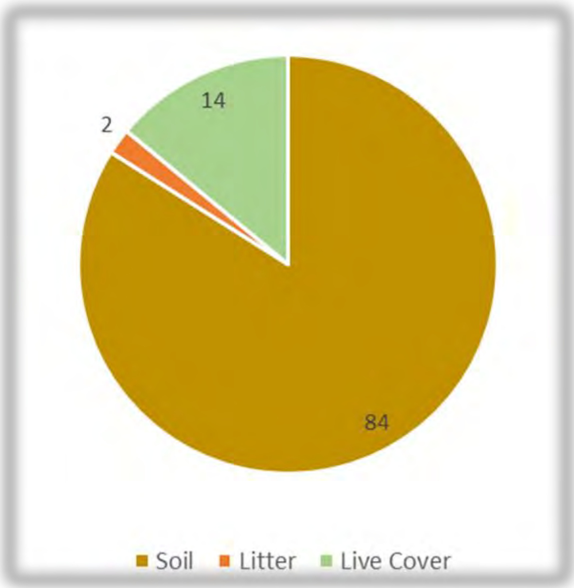


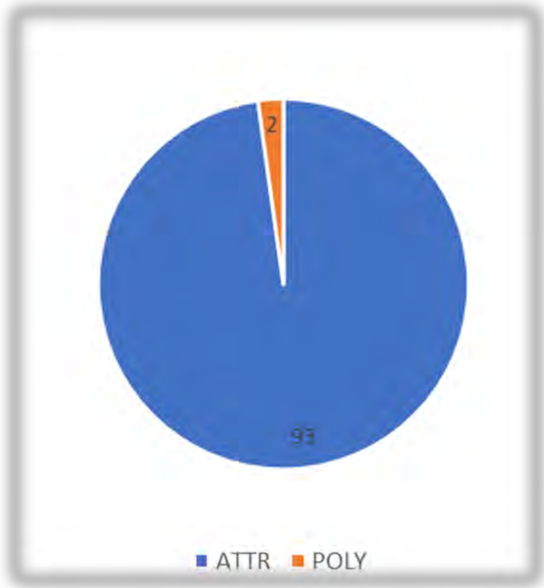
Figure 9-21. Thibaut and South Winterton

TH 7-1

Cover



Relative species composition by weight



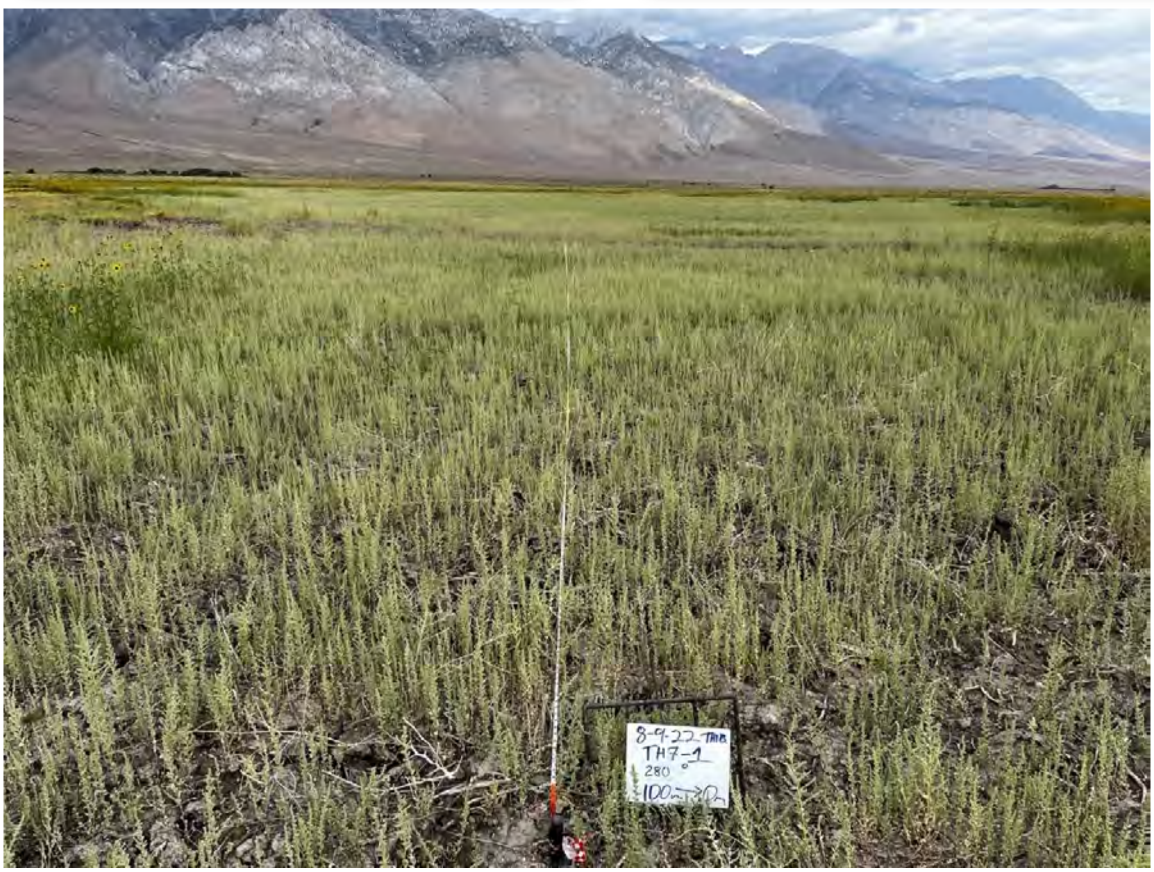
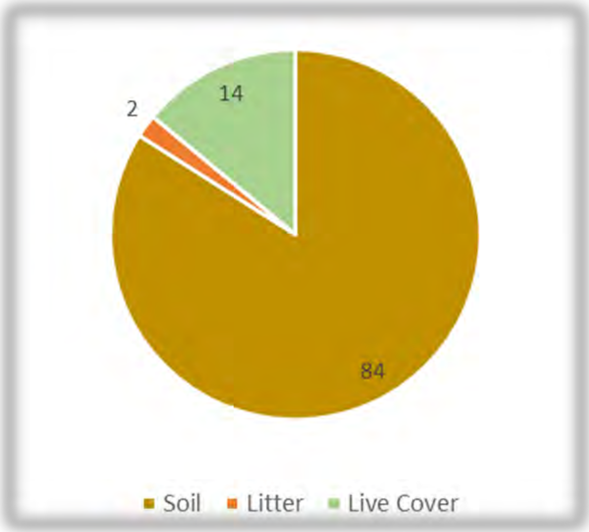


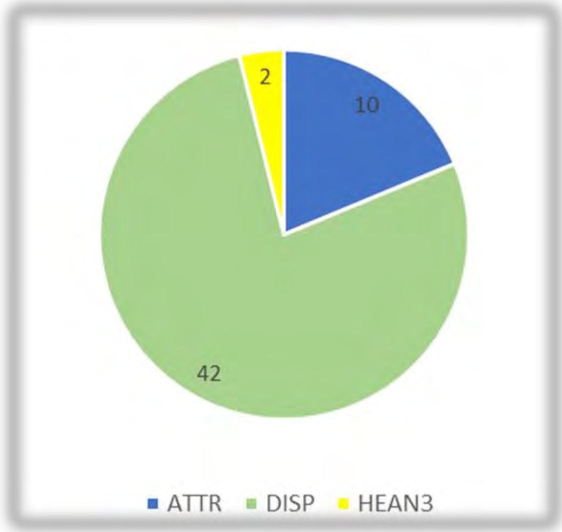
Figure 9-22.TH 7-1

TH 8-1

Cover



Relative species composition by weight



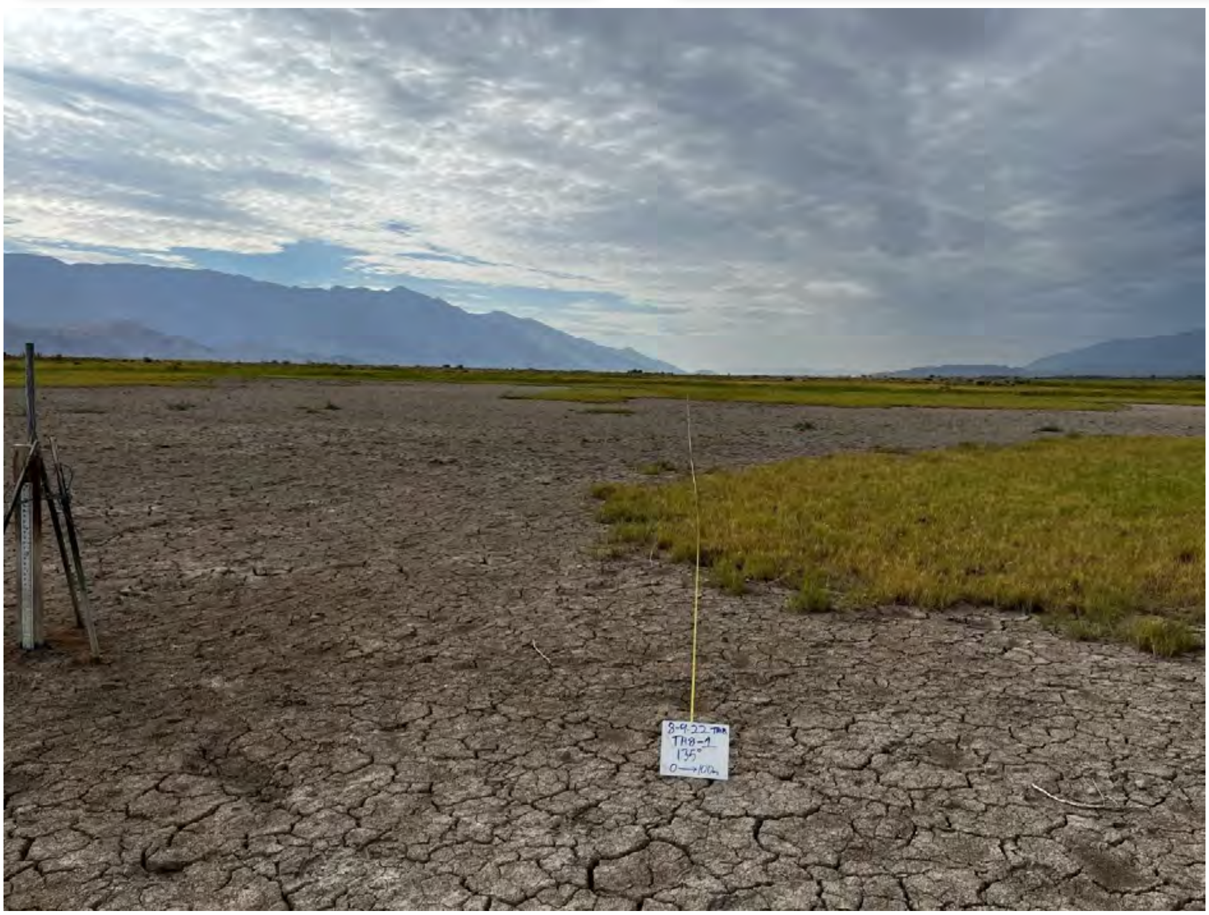
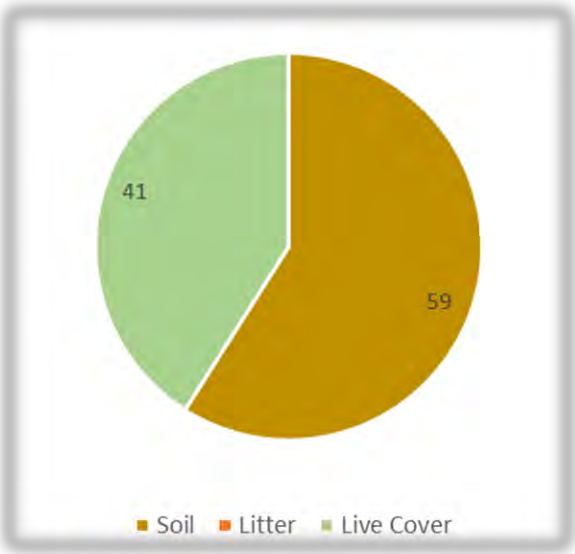


Figure 9-23. TH 8-1

TH 10-1

Cover



Relative species composition by weight

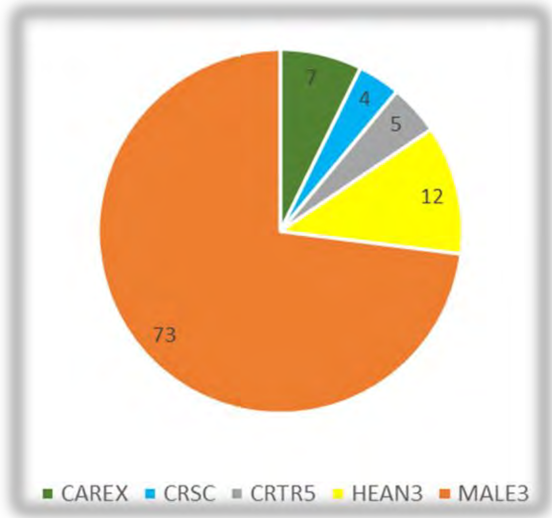
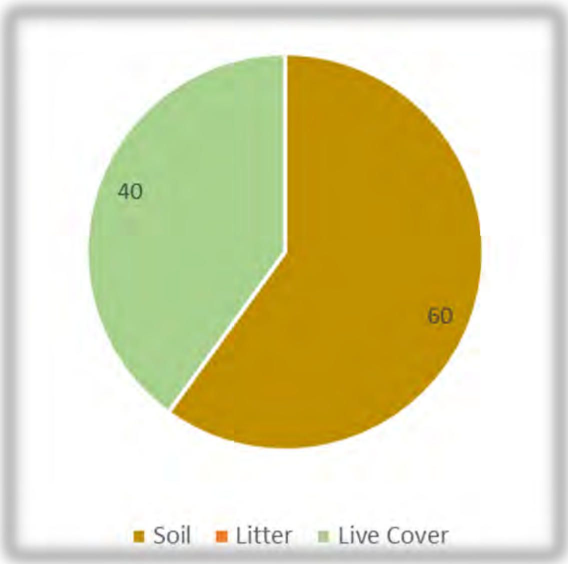


Figure 9-24. TH 10-1

TH 11-1

Cover



Relative species composition by weight

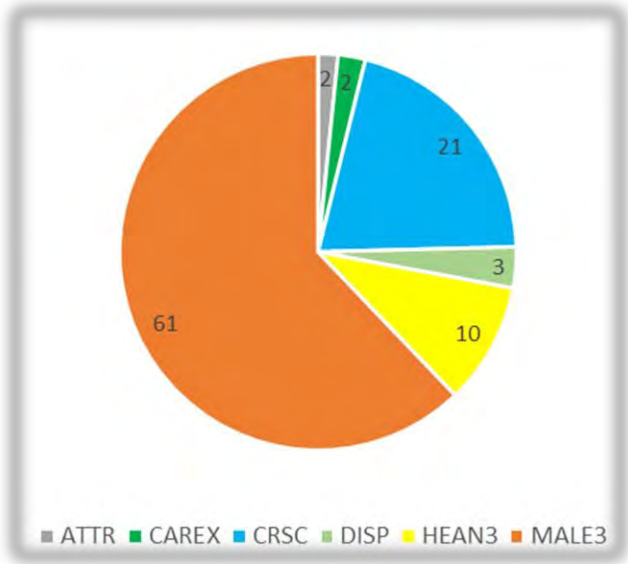
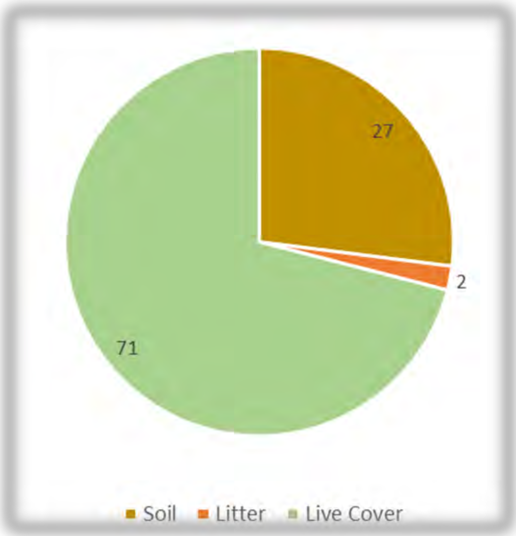


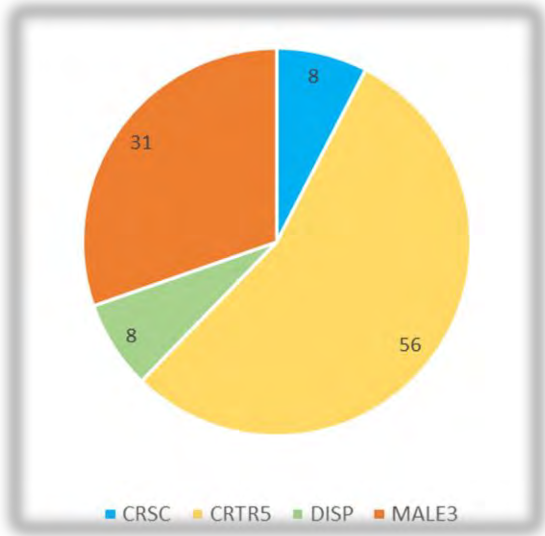
Figure 9-25. TH 11-1

TH 5-1

Cover



Relative species composition by weight



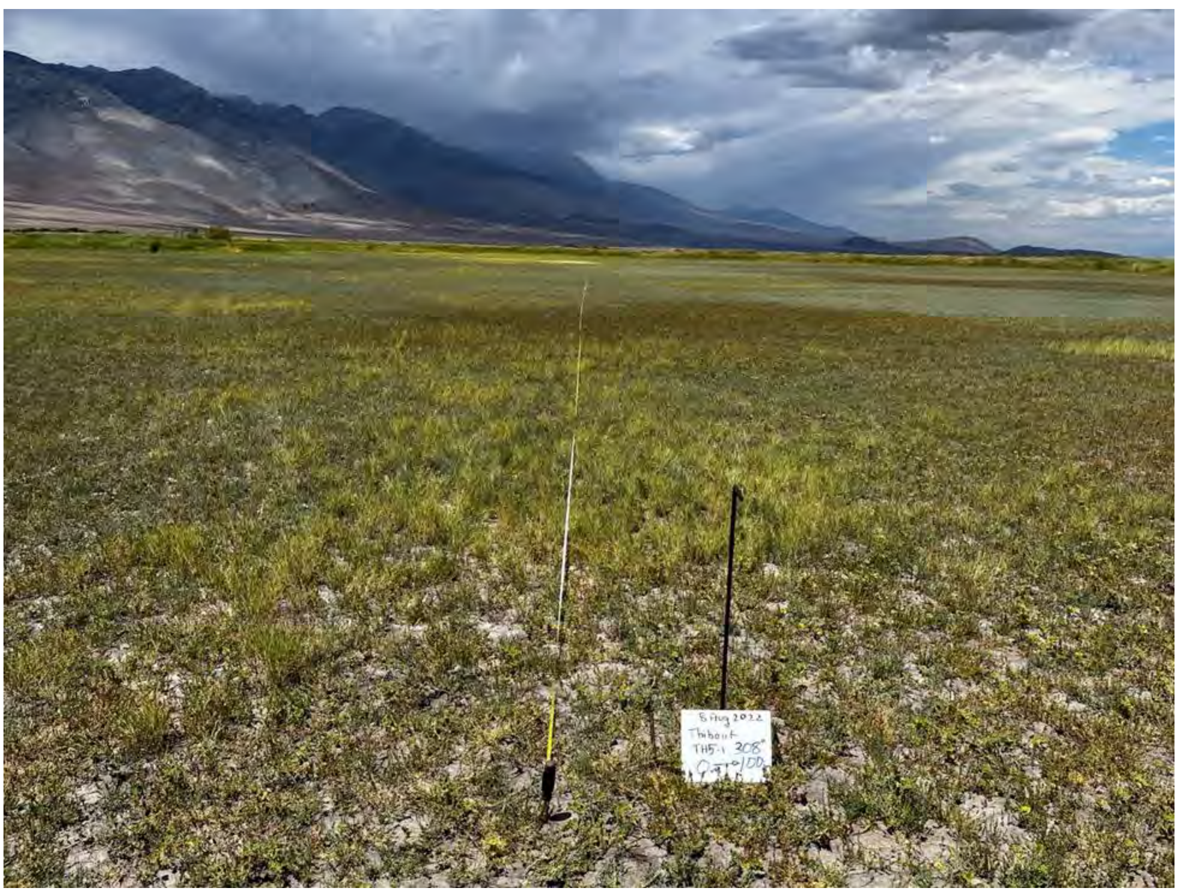
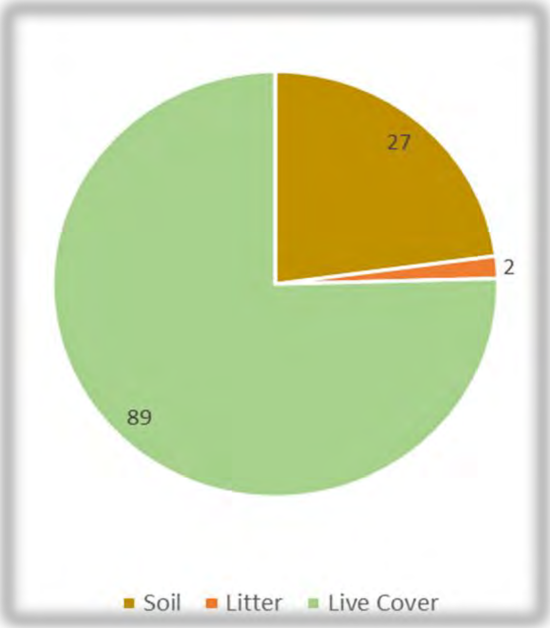


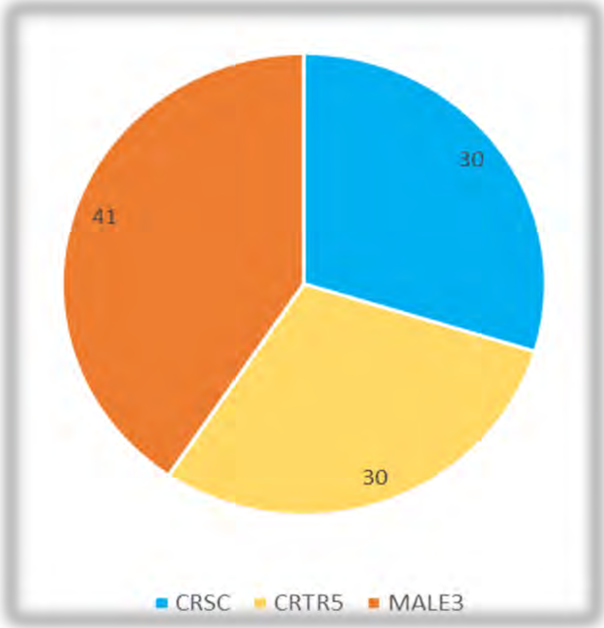
Figure 9-26. TH 5-1

TH 6-1

Cover



Relative species composition by weight



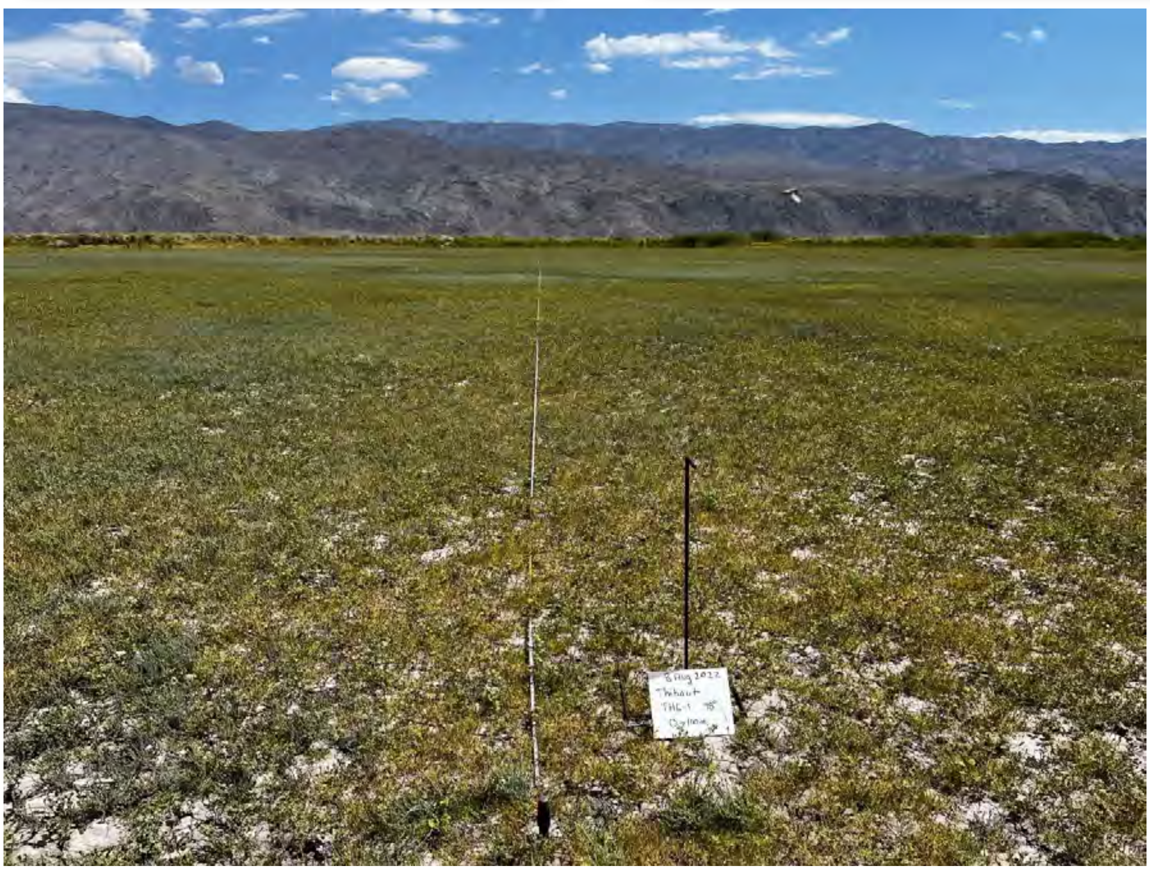
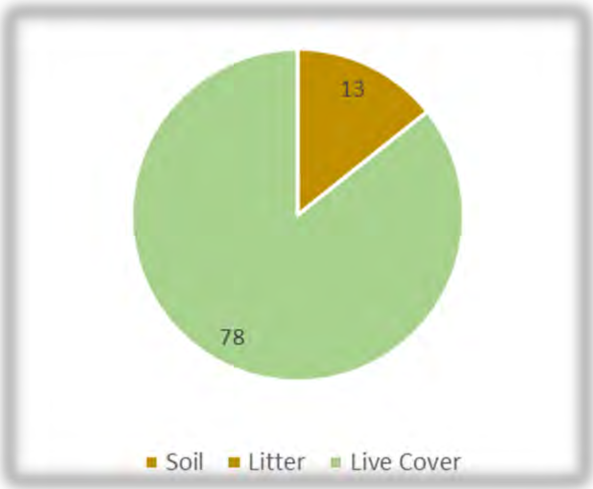


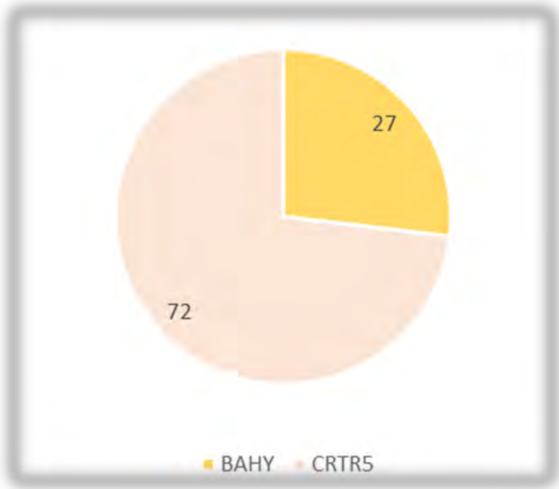
Figure 9-27. TH 6-1

SW 2-1

Cover



Relative species composition by weight



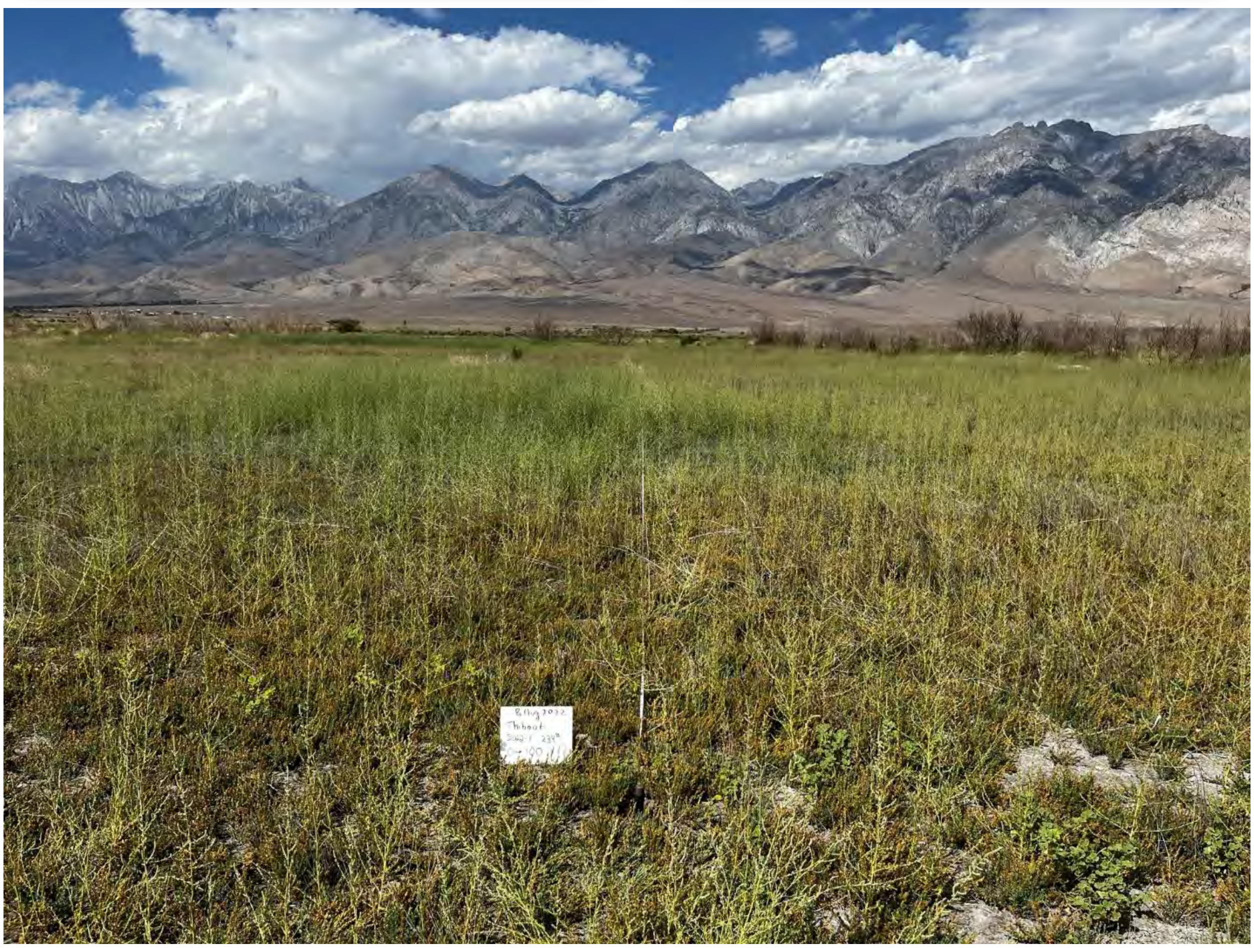
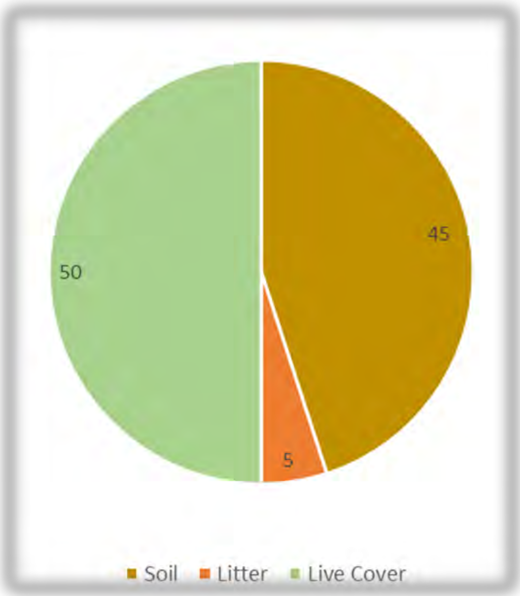


Figure 9-28. SW 2-1

SW 2-2

Cover



Relative species composition by weight

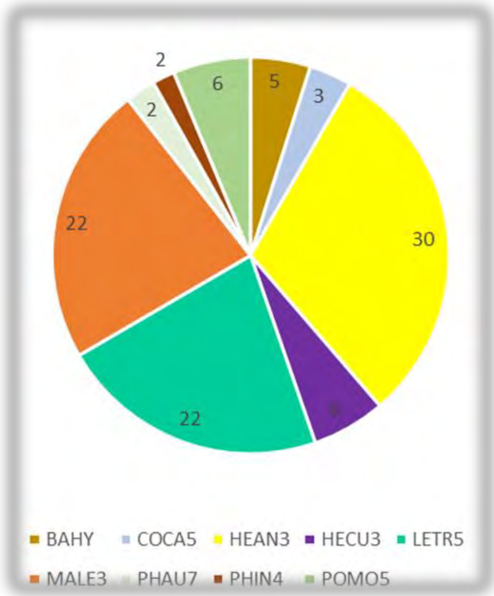


Figure 9-29. SW 2-2

9.2.4 Discussion

One of the major problems with management of the BWMA while implementing the flooding schedule presented in the LORP EIR (LADWP, 2004) was a rapid increase in cattails and hardstem bulrush in the actively flooded units. This problem is described extensively in the BWMA Management plan. One of the goals of the five-year interim plan was to seasonally flood the units in order to maintain open water and control cattail and bulrush from occupying the units over time. The relative composition by weight for hardstem bulrush (SCAC3) only occurred on two of the 16 transects, W3-1 (11%, DWR) and W4-1 (6%, DWR). Actual line point cover recorded hardstem bulrush at 1% on WAG5-1 and TH11-1. No cattail were recorded on the cover transects or the DWR quadrats. The small amount present on transects helps confirm field observations by staff that the seasonal flooding of the units is an effective means of controlling cattail and bulrush. No saltcedar seedlings were detected on the transects.

The actual use in each basin by water birds is still pending for the fall-spring season of 2022-23 so we are not able to examine possible correlations of use in association with a given plant community/basin. Monitoring results indicate we were able to produce a diverse array of early native, early seral plant communities in response to spring drawdowns and prevent a reduction in open water for the following year.

Considering the current 2023 snowpack there exists a strong possibility that all three units will be flooded this summer. This will result in significant changes from what was observed in the summer of 2022.

Table 9-5. List of all species observed during monitoring, August 2022.

COMMON NAME	SPECIES	CODE
yerba mansa	*Anemopsis californica*	ANCA10
western pearly everlasting	*Anaphalis margaritacea*	ANMA
triangle orache	*Atriplex prostrata*	ATPR
tumbling saltweed	*Atriplex rosea*	ATRO
Torrey's saltbush	*Atriplex torreyi*	ATTO
wedgescale saltbush	*Atriplex truncata*	ATTR
fivehorn smotherweed	*Bassia hyssopifolia*	BAHY
sedge	*Carex spp.*	CAREX
hians goosefoot	*Chenopodium hians*	CHHI
Canadian horseweed	*Conyza canadensis*	COCA5
saltmarsh bird’s beak	*Cordylanthus maritimus ssp. canescens*	COMAC
swamp timothy	*Crypsis schoenoides*	CRSC
spreading alkaliweed	*Cressa truxillensis*	CRTR5

Table 9-5. Continued

COMMON NAME	SPECIES	CODE
dodder	*Cuscuta sp.*	CUSCU
Durango roots	*Datisca glomerata*	DAGL2
saltgrass	*Distichlis spicata*	DISP
squirreltail	*Elymus elymmoides*	ELEL5
rubber rabbitbrush	*Ericameria nauseosa*	ERNA10
American licorice	*Glycyrrhiza lepidota*	GLLE3
curlycup gumweed	*Grindelia squarrosa*	GRSQ
common sunflower	*Helianthus annuus*	HEAN3
salt heliotrope	*Heliotropium curassavicum*	HECU3
foxtail barley	*Hordeum jubatum*	HOJU
arctic rush	*Juncus arcticus*	JUAR2
Coulter's horseweed	*Laennecia coulteri*	LACO13
broadleaved pepperweed	*Lepidium latifolium*	LELA2
beardless wildrye	*Leymus triticoides*	LETR5
birdsfoot treefoil	*Lotus corniculatus*	LOCO6
alkali mallow	*Malvella leprosa*	MALE3
sweetclover	*Melilotus officinalis*	MEOF
scratchgrass	*Muhlenbergia asperifolia*	MUAS
witchgrass	*Panicum capillare*	PACA6
common reed	*Phragmites australis*	PHAU7
Inyo phacelia	*Phacelia inyoensis*	PHIN4
oval-leaf knotweed	*Polygonum arenastrum*	POAR11
Smartweed	*Polygonum sp*	POLY
annual rabbitsfoot grass	*Polypogon monspeliensis*	POMO5
Jersey cudweed	*Pseudognaphalium luteoalbum*	PSLU6
willow dock	*Rumex salicifolius*	RUSA
hardstem bulrush	*Schoenoplectus acutus*	SCAC3
verrucose seapurslane	*Sesuvium verrucosum*	SEVE2
eastern annual saltmarsh aster	*Symphyotrichum subulatum*	SYSU5
saltcedar	*Tamarix ramosissima*	TARA
rough cocklebur	*Xanthium strumarium*	XAST

References

Bureau of Land Management. 1996. Sampling vegetation attributes. Interagency Technical Reference, BLM/RS/ST-96/002+1730. pp. 50-54.

Friedel, M.H., Chewings, V.H., and G.N. Bastin. 1988. The use of comparative yield and dry-weight rank techniques for monitoring arid rangelands. Journal of Range Management 41:430-434. (pdf)

Los Angeles Department of Water and Power. 2004. Final Environmental Impact Report and Environmental Impact Statement – Lower Owen River Project. June 23, 2004.

9.2.5 BWMA Avian Surveys

Methodology

Photopoint Monitoring

Photopoints were established in each subbasin, and generally consisted of a minimum of two points per subbasin; however, some small basins only have one photopoint. One photo was taken at each photopoint during avian surveys.

Avian Surveys

The BWMA units were surveyed nine times between October 2021 and April 2022 to evaluate the use of BWMA by the HIS. Five survey routes were established: East Waggoner, West Waggoner, East Winterton, Thibaut, and South Winterton. Completing each round of surveys required 4-5-person days. The East and West Waggoner surveys were conducted simultaneously by two surveyors - one on each route. One-person day was required to complete the East Winterton Subunit route. One to two persons were required to complete the Thibaut and South Winterton areas, depending on the amount of flooding present and bird activity.

Each survey was assigned to a specific “Seasonal Survey” period corresponding to the survey periods and the coding used for all prior BWMA avian data (Table 9-6). For example, under prior management, flooding of the units was year round, and “Fall” surveys started the first week of August. Under the Interim Plan, water releases are not initiated until mid-September, “Fall 1” and “Fall 2” surveys are not conducted since these are prior to flooding, so the first survey conducted in 2021 was equivalent to “Fall 3”.

Under the Interim Plan, eight seasonal surveys were scheduled, however in FC1, a total of nine were conducted (Table 9-6), as an early spring survey in mid-March was added. In early 2022, project staff recommended adding the mid-March survey since water would be turned off to the units on March 1, and it was uncertain how long the water would remain in each area. The East Winterton Subbunit had dried down by the Spring 2 survey at the end of March, and thus surveys were discontinued for the season. The South Winterton Subunit was not flooded in fall, and thus the first survey conducted was the Winter 1 survey in mid-December.

Surveys were conducted as area counts with observers walking the edge of flooded areas in a manner that would allow complete viewing of each subbasin within the unit or subunit being surveyed. Surveys began within 30 minutes of local sunrise, and were generally completed within 4-5 hours. Bird numbers and activities were recorded at the level of subbasin.

All bird species encountered were recorded, with an emphasis on the HIS. Creating and maintaining diverse natural habitats is an overarching objective of LORP, and keeping track of all bird species during surveys helps in describing the overall bird diversity and use of BWMA. Analysis will focus on BWMA HIS which include all waterfowl, wading birds, shorebirds, plus Northern Harrier, Least Bittern, rails, and Marsh Wren. The resident, migratory and wintering waterfowl indicator group includes all species in the Family Anatidae including geese, swans, and ducks. Wading birds includes species in the Family Ardeidae (egrets and herons), and Threskiornithidae (i.e., White-faced Ibis). The shorebird group includes all species in the Order Charadriiformes, exclusive of gulls and terns (Family Laridae). The MOU also identified Least Bittern and Northern Harrier, both California Species of Special Concern, as HIS. The rail species expected to occur at BWMA are Virginia Rail, Sora and American Coot. Marsh Wren is the only songbird species that is designated as HIS. For all bird species encountered, behaviors were documented as well including foraging, perching, calling, locomotion, flying over (not using habitat), and flushing. Waterbird locations were mapped in the field using ArcCollector in order to document the spatial distribution of birds within subbasins.

Table 9-6. Dates of BWMA seasonal avian surveys by survey route

Seasonal Survey	Survey Dates	East Winterton Subunit	South Winterton Subunit	Thibaut Unit	Waggoner Unit
Fall 3	5-6 October 2021	X		X	X
Fall 4	19-21 October 2021	X		X	X
Fall 5	1-2 November 2021	X		X	X
Winter 1	15-17 December 2021	X	X	X	X
Winter 2	11-13 January 2022	X	X	X	X
Spring 1	14-16 March 2022	X	X	X	X
Spring 2	29-31 March 2022	X	X	X	X
Spring 3	13-15 April 2022		X	X	X
Spring 4	26-27 April 2022		X	X	X

Data Summary

Photopoint Monitoring

One photo from each photopoint was selected and included in this report to support qualitative descriptions of the subbasins and units. Most of the photos were taken during the Fall 5 bird survey the first week of November, coinciding with when the first flooded extent monitoring was conducted. In cases where a photo was not available for early November, another photo was selected from either late-October or mid-January, depending on what was available.

Avian Surveys

Species Composition

The total number of bird species and individuals encountered over the nine surveys was summed for the entire BWMA and by unit or subunit surveyed. BWMA HIS totals were also calculated and compared across units. Individuals unidentified to species (e.g., unidentified dabbling duck, or unidentified swallow) were not included in the species count, but were included in total individual counts.

Seasonal Patterns of Abundance

HIS were totaled for all units for each of the nine seasonal surveys to describe the seasonal use patterns of BWMA.

Spatial Distribution

The spatial distribution of HIS was evaluated by looking at indicator species density and the proportion of indicator species observed in each subbasin. HIS density was calculated as the total birds observed over the season divided by the average flooded acreage to allow a comparison of unit and subbasin productivity.

Comparison to Previous Years

In order to allow comparison of data with previous year, all existing BWMA avian data were filtered by Unit, Subunit, and Seasonal Survey. As the spring seasonal surveys have typically started the last week of March, there are no prior mid-March (Spring 1) survey data at BWMA. In addition, since this is the first time the East Winterton Subunit has been flooded, there are no prior data available for comparison. Surveys included in the analysis were those from the Waggoner Unit, Thibaut Unit, and East Winterton Subunit. Seasonal surveys included were Fall 3, Fall 4, Fall 5, Winter 1, Winter 2, and Spring 2, Spring 3, and Spring 4. Data were categorized into three time periods: Pre-LORP (encompassing data from years 2002-2004), LORP (years 2009-2017), and FC1 Interim Plan implementation (FC1 2021-2022).

There are two ways in which data from FC1 were compared with prior survey data. The first comparison involved calculating the average number of birds per survey for each of the three time periods. Taking the average standardized for differing survey effort over the different time periods.

The second comparison involved comparing HIS density in terms of birds per average flooded acre by unit since implementation of LORP and under the Interim Plan. Bird data were standardized to density to account for differences in the prescribed flooded acreage over the years. This analysis was only done for the Waggoner and Thibaut Units. This analysis was not done for East Winterton since this subunit of Winterton had never been flooded, and thus it was felt comparable data were not available.

Results

Photopoint Monitoring
One photo from each monitored subbasin is presented below. Please refer to the referenced maps for photopoint locations Table 9-2. For the total flooded acreage of each subbasin.

Waggoner Unit
Seven subbasins were monitored in the Waggoner Unit (**Figure 9-30**).

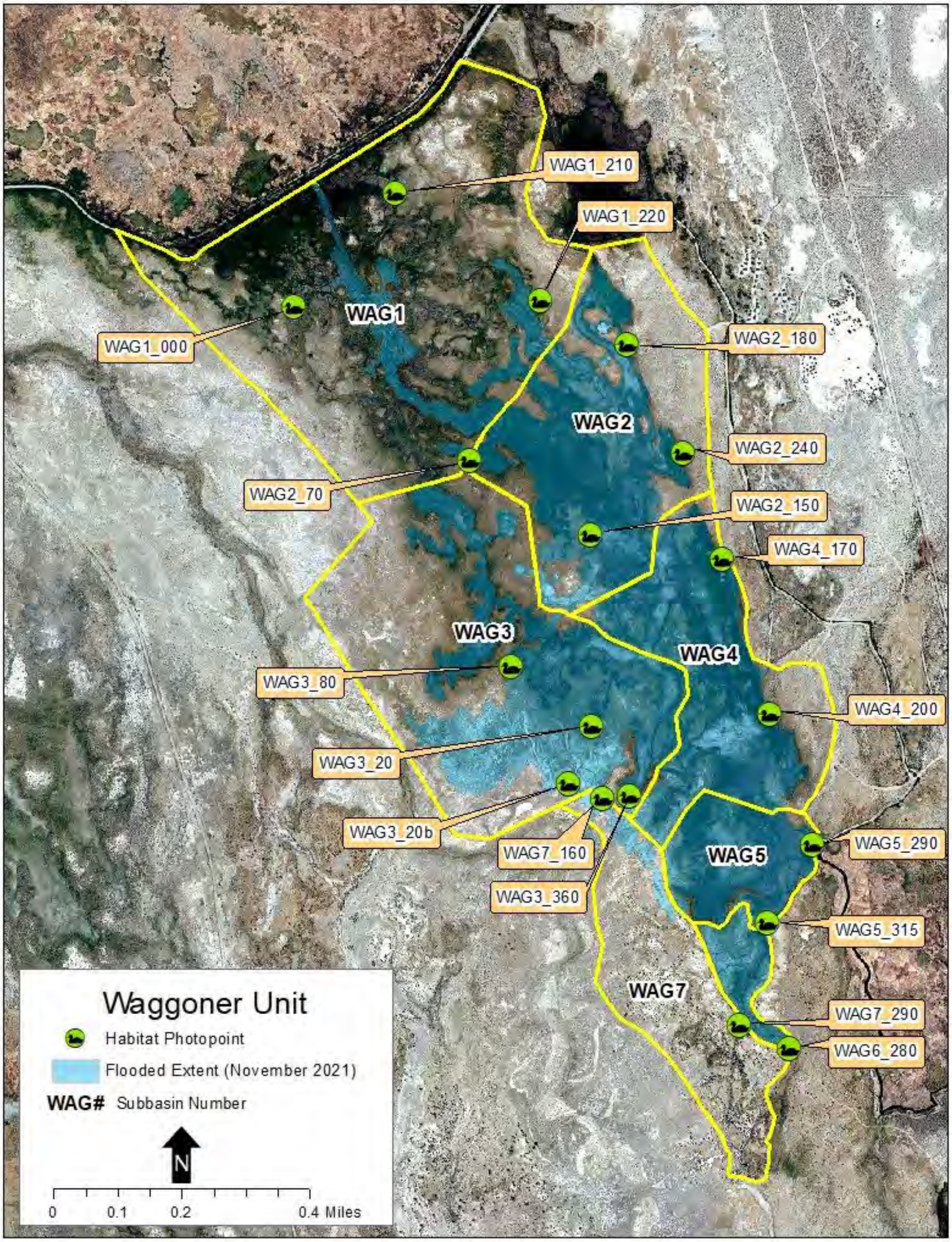


Figure 9-30. Waggoner Unit subbasins and photopoints

Subbasin WAG1 (2 November 2021)

WAG1 borders the Blackrock Ditch. The subunit supports a number of willow trees along the Blackrock Ditch, attracting a variety of songbirds. This subbasin is relatively small, averaging 12.6 flooded acres, and only supported small areas of open water when flooded.

Figure 9-31. WAG1_000

Figure 9-32. WAG1_210

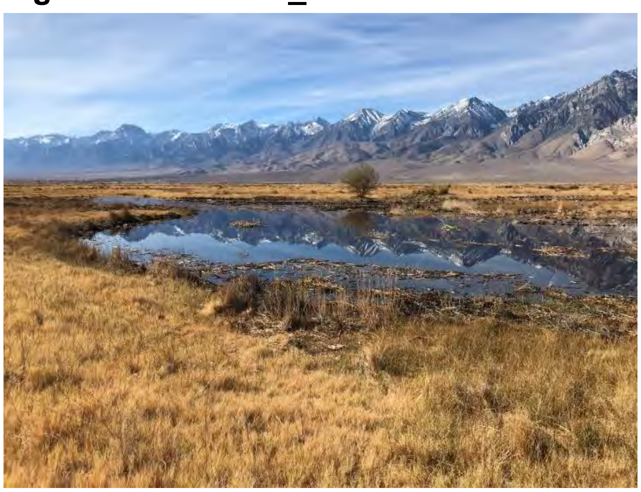


Figure 9-33. WAG1_220

Subbasin WAG2 (2 November 2021)

WAG2 was a large subbasin averaging 49 flooded acres. WAG2 supported a central large, open water pond (Figure 9-34, Figure 9-36) and some smaller side ponds (Figure 9-35) connected by flooded channels.

Figure 9-34. WAG2_70

Figure 9-35. WAG2_180

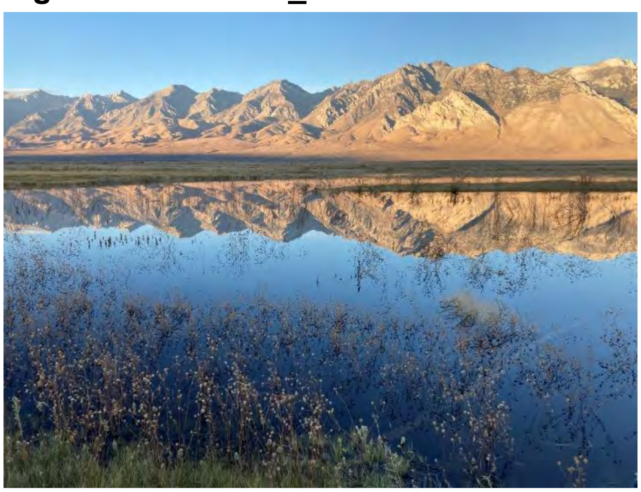


Figure 9-36. WAG2_240

Subbasin WAG3 (2 November 2021)

Although WAG3 had the largest average flooded acreage in the unit, there was no single large pond, but a complex series of small shallow ponds and small “fingers” of flooding.

Figure 9-37. WAG3_20B (taken Dec 15, 2021)

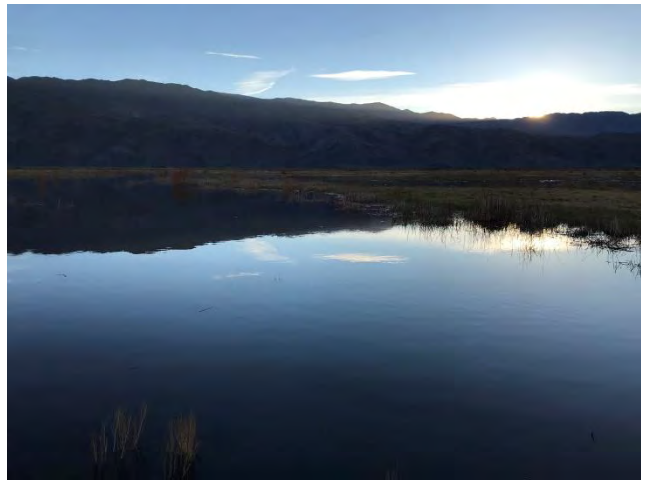


Figure 9-38. WAG3_80

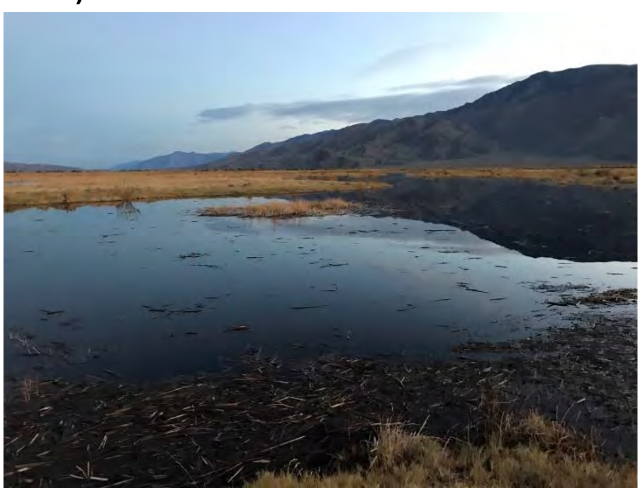


Figure 9-39. WAG3_360

Subbasin WAG4 (2 November 2021)

WAG4 was similar to WAG2 in that it supported a relatively large and deep open water pond, and average 47.7 flooded acres.

Figure 9-40. WAG4_170

Figure 9-41. WAG4_200

Subbasin WAG5 (2 November 2021)

WAG5 supported a moderately-sized open water pond averaging 22.1 flooded acres and was deepest along the western edge.

Figure 9-42. WAG5_290

Figure 9-43. WAG5_315

Subbasin WAG6 (2 November 2021)

WAG6 is a very small subbasin at the south end of Waggoner averaging 8.2 flooded acres of small, narrow and shallow ponds.

Figure 9-44. WAG6_280

Subbasin WAG7 (11 January 2022)

WAG7 is a small, intermittently-flooded area averaging 4.6 acres that is not being “actively” managed, but receives water from WAG3 when water levels are high, and some subsurface water from adjacent subbasins. WAG7 was not flooded until early 2022.

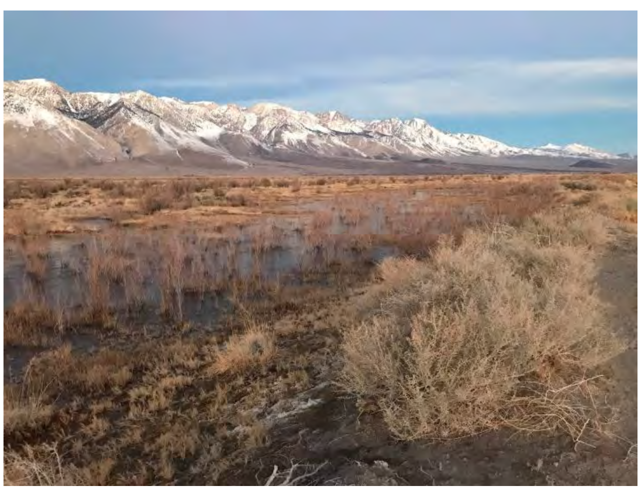


Figure 9-45. WAG7_290

Thibaut Unit

Six subbasins were monitored in the Thibaut Unit, including the South Winterton Subunit (
Figure 9-466).

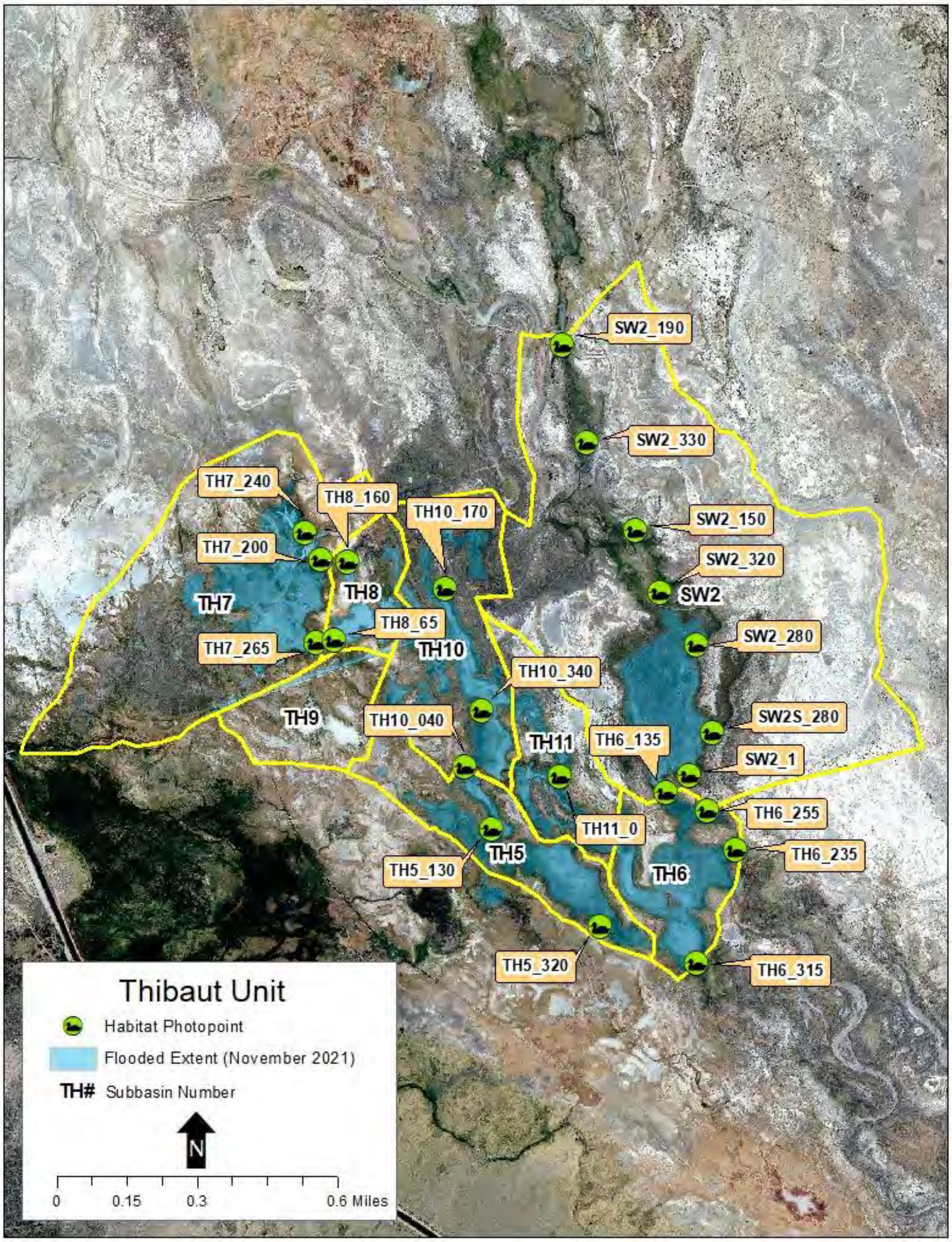


Figure 9-46. Thibaut Unit subbasins and photopoints

Subbasin TH5 (19 October 2021)

TH5 was a moderately-sized open water pond, averaging 24.9 flooded acres. A small stand of *Phragmites* was present at the south end.

Figure 9-47. TH5_130 (Oct 19, 2021)

Figure 9-48. TH5_320 (Oct 19, 2021)

Subbasin TH6 (19 October 2021)

TH6 is a moderately sized subbasin averaging 28.9 flooded acres and likely supports the deepest pond in the BWMA (Figure 9-51). TH6 supports an island used by waterbirds for sleeping and loafing. At the north end of the pond are old tamarisk plants and stumps where waterfowl are often seen sleeping and loafing. There are some small, shallow ponds physically connected to the main pond as well (Figure 9-49).

Figure 9-49. TH6_135

Figure 9-50. TH6_235

Figure 9-51. TH6_315

Subbasin TH7 (19 October 2021)

TH7 is part of the “Thibaut Pond” management area that has been seasonally flooded (October to March) since 2013.TH7 is a large, shallow pond averaging 47.0 flooded acres. The pond supported a notable amount of annual and perennial vegetation, including large numbers of sunflowers (Figure 9-54).

Figure 9-52. TH7_200

Figure 9-53. TH7_240

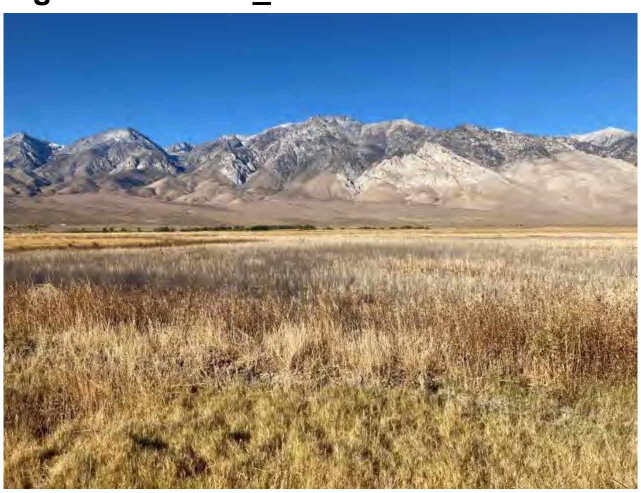


Figure 9-54. TH7_265

Subbasin TH8 (19 October 2021)

TH8 is also part of the “Thibaut Pond” management area that has been seasonally flooded (October to March) since 2013. TH8 includes two small and shallow ponds averaging 10.8 flooded acres.

Figure 9-55. TH8_65

Figure 9-56. TH8_160

Subbasin TH10 (19 October 2021)

TH10 is a long, linear pond surrounded by dense saltbush scrub on the banks. It is moderately size at 32.3 average flooded acres.

Figure 9-57. TH10_040 (5 October 2021)

Figure 9-58. TH10_170

Figure 9-59. TH10_340

Subbasin SW2 (20 December 2021)

SW2 is a large subbasin that includes a large, moderately deep pond (Figure 9-63) and a second small shallow pond to the north (Figure 9-60). The large main pond was densely covered with *Bassia* prior to flooding (Figure 9-62). The total average flooded acreage for SW2 was 44.4.

Figure 9-60. SW2_150

Figure 9-61. SW2_190

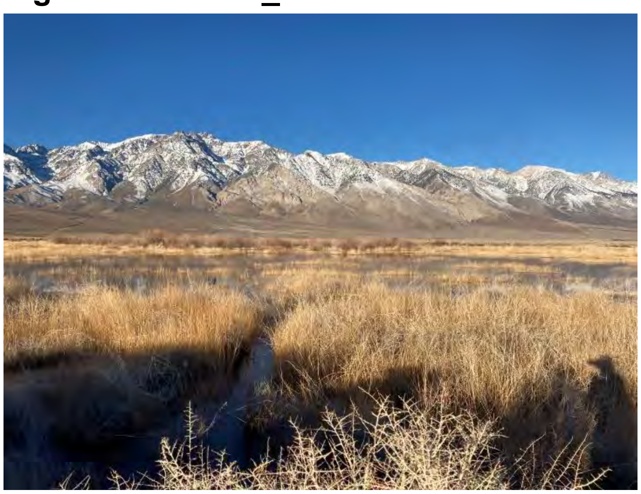


Figure 9-62. SW2_280

Figure 9-63. SW2_320

East Winterton Subunit

Five subbasins were monitored in the East Winterton Subunit (Figure 9-64).

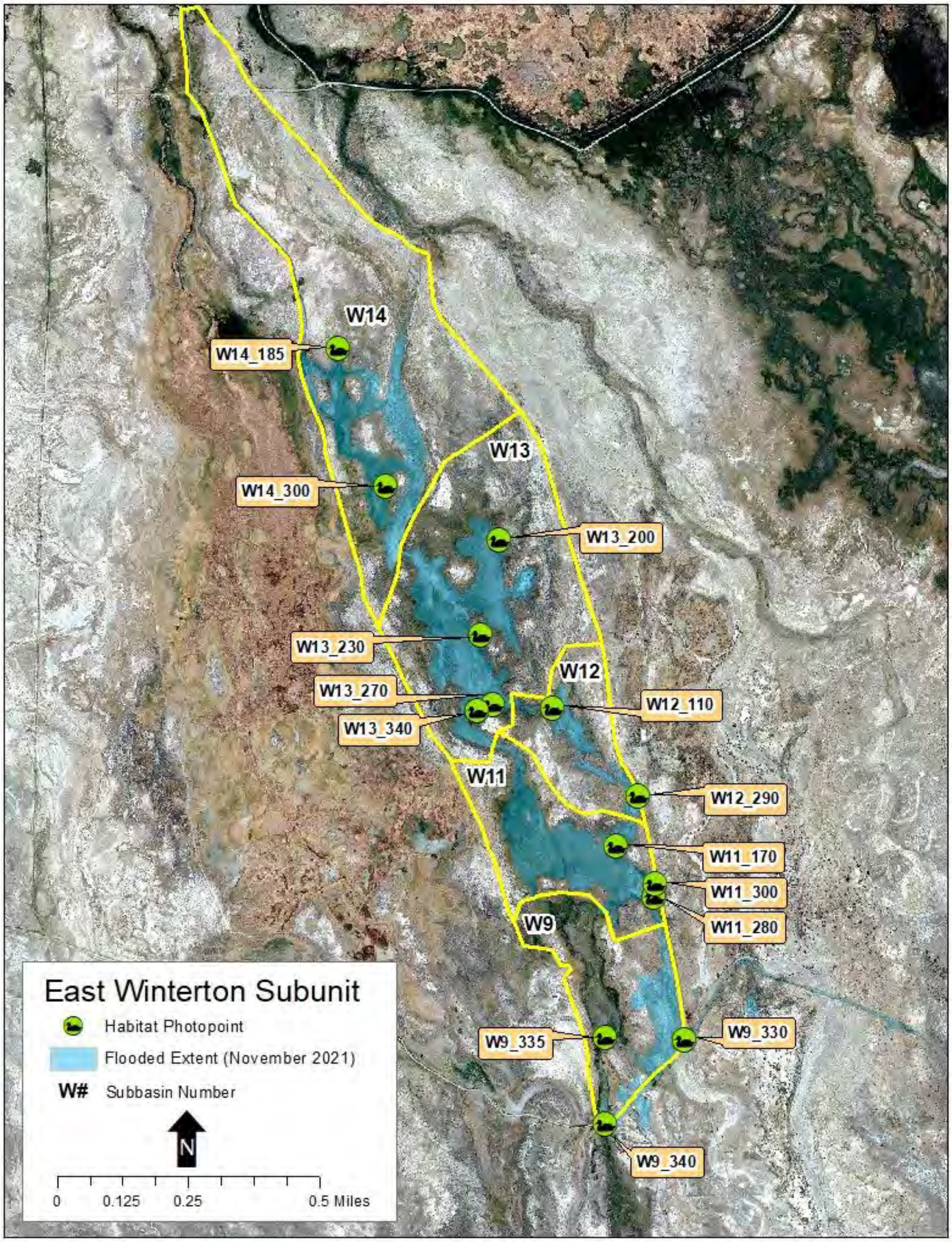


Figure 9-64. East Winterton Subbasins and Photopoints

Subbasin W9 (1 November 2021)

W9 is a relatively shallow subbasin that was intermittently-flooded in FY1. In November, the acreage was 10.5, but the subbasin was essentially dry by early March.

Figure 9-65. W9_330

Figure 9-66. W9_335 (Jan 11, 2022)

Subbasin W11 (1 November 2021)

W11 supported a moderately-sized open water pond, with an average of 19.9 flooded acres. Prior to flooding, the basin was highly vegetated with saltgrass.

Figure 9-67. W11_170

Figure 9-68. W11_300

Subbasin W12 (1 November 2021)

W12 was a small shallow shrubby subbasin, and little open water area. In November this subbasin was 5.5 acres, but it was dry in March.

Figure 9-69. W12_110

Figure 9-70. W12_290

Subbasin W13 (1 November 2021)

W13 supported the largest open water area in East Winterton, and supported the most HIS. W13 was moderately-sized at 26.8 average flooded acres. The subbasin was surrounded by dense stands of saltbrush and rabbitbrush.

Figure 9-71. W13_200

Figure 9-72. W13_230 (Oct 19, 2021)

Figure 9-73. W13_270 (Oct 19, 2021)

Figure 9-74. W13_340

<u>Subbasin W14 (1 November 2021)</u>

W14 contained a mix of small, shallow, grassy ponds, and shrubby areas, and average 17.4 flooded acres. There was no single pond of any significant size, but instead, the habitat was relatively braided and broken up.

Figure 9-75. W14_185

Figure 9-76. W14_300

Avian Survey Results

General Habitat Conditions

The fall surveys were initiated while units and subbasins were still in the process of filling. Maximum flooding had been achieved by the time the Fall 5 survey took place the first week of November. Persistent cold temperatures in December and January resulted in significant ice cover of ponds, particularly during the Winter 1 survey in mid-December. Most all of the small or shallow ponds were ~75-100% iced over, while the larger and deeper ponds generally maintained a variable amount of open water. The first spring survey in mid-March was approximately two weeks after releases ceased. The East Winterton Subunit retracted rapidly, and significant water retraction left only a few, small ponds and mudflats. This subunit was surveyed only one more time at the end of March, and, lacking standing water at that time, was not revisited. In contrast, only small areas of water retraction were noted in the Thibaut and Waggoner Units by mid-March. Water continued to retract through the end of April, and the habitat evolved from large, open water ponds, to progressively smaller and shallower ponds, and mudflats. As anticipated, shorebirds were observed feeding on the mudflats, and drawdown coincided with spring shorebird migration. Water was still present in both Thibaut and Waggoner Units at the conclusion of spring surveys at the end of April. Field observations suggest a healthy invertebrate population had colonized the units as large numbers of midges and water fleas (*Daphnia* sp.) were seen in spring.

BWMA Avian Species Composition

At total of 114 species of birds and 32,840 individuals were detected in the BWMA during the 2021-2022 surveys (**Table 9-7**). The total number of species detected at Thibaut (92) and Waggoner (90) was similar. Substantially fewer were seen at East Winterton (52) and South Winterton (57).

A total of 18,068 of birds observed were HIS, comprising 55% of all bird species recorded (**Table 9-8**). The Thibaut Unit supported the highest number of HIS (8,724) and East Winterton the fewest (537). Waterfowl were the most abundant HIS group using BWMA comprising 67% of all HIS (12,146/18,068), followed by rails (25%, dominated by American Coot) and shorebirds (7%).

Over the entire survey period, BWMA supported 18 waterfowl species, and overall totals were highest for Green-winged Teal, Cinnamon Teal, Gadwall, Ruddy Duck and Mallard (**Table 9-7**). The Thibaut and Waggoner Units were fairly similar to each other in terms of total waterfowl use in FC1. A total of 14 shorebird species were found, and again, the Thibaut and Waggoner Units were similar in totals observed, and South and East Winterton supported much fewer. The BWMA attracted an additional 70 species not designated as habitat indicators species, including large numbers of migrating swallows, and migrating and overwintering blackbirds and sparrows.

Table 9-7. Bird Species Totals by Unit for the 2021-2022 Flooding Cycle. HIS are Bold-Typed.

English Name	Scientific Name	East Winterton	South Winterton	Thibaut	Waggoner	Total
Greater White-fronted Goose	***Anser albifrons***	**17**		**17**	**34**	**68**
Cackling Goose	***Branta hutchinsii***			**10**		**10**
Canada Goose	***Branta canadensis***	**10**	**6**	**14**	**10**	**40**
Tundra Swan	***Cygnus columbianus***			**9**		**9**
Cinnamon Teal	***Spatula cyanoptera***	**3**	**676**	**707**	**866**	**2252**
Northern Shoveler	***Spatula clypeata***		**217**	**293**	**383**	**893**
Gadwall	***Mareca strepera***	**43**	**28**	**1012**	**305**	**1388**
American Wigeon	***Mareca americana***	**31**		**351**	**143**	**525**
Mallard	***Anas platyrhynchos***	**199**	**34**	**502**	**404**	**1139**
Northern Pintail	***Anas acuta***	**37**	**32**	**194**	**272**	**535**
Green-winged Teal	***Anas crecca***	**52**	**329**	**897**	**1846**	**3124**
Unidentified Dabbling Duck	***Anas sp. Etc.***			**54**		**54**
Canvasback	***Aythya valisineria***			**1**		**1**
Redhead	***Aythya americana***	**15**	**12**	**14**	**14**	**55**
Ring-necked Duck	***Aythya collaris***		**12**	**144**	**41**	**197**
Lesser Scaup	***Aythya affinis***			**77**	**11**	**88**
Bufflehead	***Bucephala albeola***	**6**	**110**	**119**	**367**	**602**
Common Merganser	***Mergus merganser***			**24**	**6**	**30**
Ruddy Duck	***Oxyura jamaicensis***		**195**	**613**	**328**	**1136**
California Quail	*Callipepla californica*				1	1
Pied-billed Grebe	*Podilymbus podiceps*	2		7	11	20
Eared Grebe	*Podiceps nigricollis*		2	35	80	117
Mourning Dove	*Zenaida macroura*	2	1	5	9	17
Vaux's Swift	*Chaetura vauxi*		9			9
Virginia Rail	***Rallus limicola***		**2**	**3**		**5**
Sora	***Porzana carolina***		**13**	**5**		**18**
American Coot	***Fulica americana***	**9**	**204**	**3065**	**1183**	**4461**
Black-necked Stilt	***Himantopus mexicanus***		**7**	**17**	**1**	**25**
American Avocet	***Recurvirostra americana***		**7**	**9**	**39**	**55**
Killdeer	***Charadrius vociferus***	**19**	**11**	**38**	**44**	**112**
Semipalmated Plover	***Charadrius semipalmatus***			**53**	**29**	**82**
Long-billed Curlew	***Numenius americanus***			**4**		**4**
Dunlin	***Calidris alpina***			**1**		**1**
Least Sandpiper	***Calidris minutilla***		**82**	**247**	**232**	**561**
Western Sandpiper	***Calidris mauri***		**6**	**11**		**17**
Short-billed Dowitcher	***Limnodromus griseus***			**4**	**4**	**8**
Long-billed Dowitcher	***Limnodromus scolopaceus***	**1**	**71**	**59**	**18**	**149**
Wilson's Snipe	***Gallinago delicata***	**30**	**3**	**15**	**35**	**83**
Spotted Sandpiper	***Actitis macularius***		**3**	**1**	**16**	**20**
Lesser Yellowlegs	***Tringa flavipes***			**12**	**4**	**16**
Greater Yellowlegs	***Tringa melanoleuca***	**36**	**3**	**67**	**31**	**137**
Wilson's Phalarope	***Phalaropus tricolor***			**8**	**1**	**9**
California Gull	*Larus californicus*		6	98	6	110
Caspian Tern	*Hydroprogne caspia*				9	9
Double-crested Cormorant	*Nannopterum auritum*			1	12	13
American Bittern	***Botaurus lentiginosus***				**1**	**1**
Great Blue Heron	***Ardea herodias***	**1**	**1**	**4**	**3**	**9**
Great Egret	***Ardea alba***		**5**	**2**		**7**
Black-crowned Night-Heron	***Nycticorax nycticorax***			**1**		**1**
White-faced Ibis	***Plegadis chihi***		**2**	**1**		**3**
Turkey Vulture	*Cathartes aura*			1		1
Golden Eagle	*Aquila chrysaetos*			2		2
Northern Harrier	***Circus hudsonius***	**17**	**4**	**12**	**23**	**56**
Sharp-shinned Hawk	*Accipiter striatus*			1		1
Bald Eagle	*Haliaeetus leucocephalus*				2	2
Red-shouldered Hawk	*Buteo lineatus*				1	1
Red-tailed Hawk	*Buteo jamaicensis*	2	1	3	2	8
Rough-legged Hawk	*Buteo lagopus*	1		1	2	4
Ferruginous Hawk	*Buteo regalis*			1		1

Table. 9-7 cont.

English Name	Scientific Name	East Winterton	South Winterton	Thibaut	Waggoner	Total
Great Horned Owl	*Bubo virginianus*				5	5
Burrowing Owl	*Athene cunicularia*			1		1
Long-eared Owl	*Asio otus*				1	1
Belted Kingfisher	*Megaceryle alcyon*		1	1	1	3
Northern Flicker	*Colaptes auratus*	17		1	25	43
American Kestrel	*Falco sparverius*	2		6	3	11
Merlin	*Falco columbarius*	1		1	4	6
Peregrine Falcon	*Falco peregrinus*			2		2
Prairie Falcon	*Falco mexicanus*			1	2	3
Western Kingbird	*Tyrannus verticalis*				1	1
Black Phoebe	*Sayornis nigricans*	1		8	8	17
Say's Phoebe	*Sayornis saya*			3	8	11
Loggerhead Shrike	*Lanius ludovicianus*	6		7	9	22
Black-billed Magpie	*Pica hudsonia*	1		1	13	15
Common Raven	*Corvus corax*	46	7	21	52	126
Horned Lark	*Eremophila alpestris*	46	11	76	129	262
Bank Swallow	*Riparia riparia*		1	1	2	4
Tree Swallow	*Tachycineta bicolor*	13	5702	805	368	6888
Violet-green Swallow	*Tachycineta thalassina*		11	16	1	28
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*			5	3	8
Barn Swallow	*Hirundo rustica*	296	125	836	509	1766
Cliff Swallow	*Petrochelidon pyrrhonota*	1	8	86	32	127
Ruby-crowned Kinglet	*Corthylio calendula*				4	4
Blue-gray Gnatcatcher	*Polioptila caerulea*		1		2	3
Bewick's Wren	*Thryomanes bewickii*	24	2	5	7	38
Marsh Wren	***Cistothorus palustris***	**11**	**2**	**33**	**36**	**82**
LeConte's Thrasher	*Toxostoma lecontei*	9	9	3		21
Northern Mockingbird	*Mimus polyglottos*	1	1	6	2	10
European Starling	*Sturnus vulgaris*	15		1	24	40
Mountain Bluebird	*Sialia currucoides*	4		12	16	32
American Robin	*Turdus migratorius*	1				1
American Pipit	*Anthus rubescens*	58	6	83	268	415
House Finch	*Haemorhous mexicanus*	20		2	14	36
Lesser Goldfinch	*Spinus psaltria*			1	79	80
Lawrence's Goldfinch	*Spinus lawrencei*				2	2
American Goldfinch	*Spinus tristis*	2			16	18
Chipping Sparrow	*Spizella passerina*	2				2
Clay-colored Sparrow	*Spizella pallida*				1	1
Brewer's Sparrow	*Spizella breweri*		6			6
Dark-eyed Junco	*Junco hyemalis*				1	1
White-crowned Sparrow	*Zonotrichia leucophrys*	80	18	69	247	414
Bell's Sparrow	*Artemisiospiza belli*	11	16	9		36
unidentified Sage Sparrow	*Artemisiospiza nevadensis/belli*		6			6
Vesper Sparrow	*Pooecetes gramineus*				2	2
Savannah Sparrow	*Passerculus sandwichensis*	83	73	330	182	668
Song Sparrow	*Melospiza melodia*	27	1	39	113	180
Lincoln's Sparrow	*Melospiza lincolnii*	1		2	29	32
Spotted Towhee	*Pipilo maculatus*			3		3
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*		54	29	11	94
Western Meadowlark	*Sturnella neglecta*	107	11	144	222	484
Red-winged Blackbird	*Agelaius phoeniceus*	297	171	566	1135	2169
Brewer's Blackbird	*Euphagus cyanocephalus*	28	1	3	85	117
Great-tailed Grackle	*Quiscalus mexicanus*				1	1
Common Yellowthroat	*Geothlypis trichas*		2	12	9	23
Yellow-rumped Warbler	*Setophaga coronata*	15	4	29	117	165
Townsend's Warbler	*Setophaga townsendi*				1	1
Wilson's Warbler	*Cardellina pusilla*				1	1
Total Birds Recorded		**1759**	**8344**	**12105**	**10632**	**32840**
Species Richness		**52**	**57**	**92**	**90**	**114**

Table 9-8. Bird totals by Species Group and Unit

Species Group	East Winterton	South Winterton	Thibaut	Waggoner	BWMA Totals
Waterfowl	413	1651	5052	5030	12146
Shorebirds	86	193	546	454	1279
Rails	9	219	3073	1183	4484
Wading Birds	1	8	8	4	21
Northern Harrier	17	4	12	23	56
Marsh Wren	11	2	33	36	82
Total Indicator Species	**537**	**2077**	**8724**	**6730**	**18068**
Non-HIS	1222	6267	3381	3902	14772
Total All Bird Species	**1759**	**8344**	**12105**	**10632**	**32840**

Seasonal Patterns of Abundance

HIS were observed using BWMA throughout the flooding period (**Figure 9-77**). The initial fall survey in early October was the highest count for the fall period, and numbers declined through early November. Numbers increased again by mid-December (Winter 1), yet were lower in mid-January. Spring migration brought an influx of birds, and HIS use was generally higher during spring migration than in fall and winter. The highest single survey period total for FC1 (4,099) was observed on the mid-March survey. After mid-March, totals were observed to gradually decrease through the end of April.

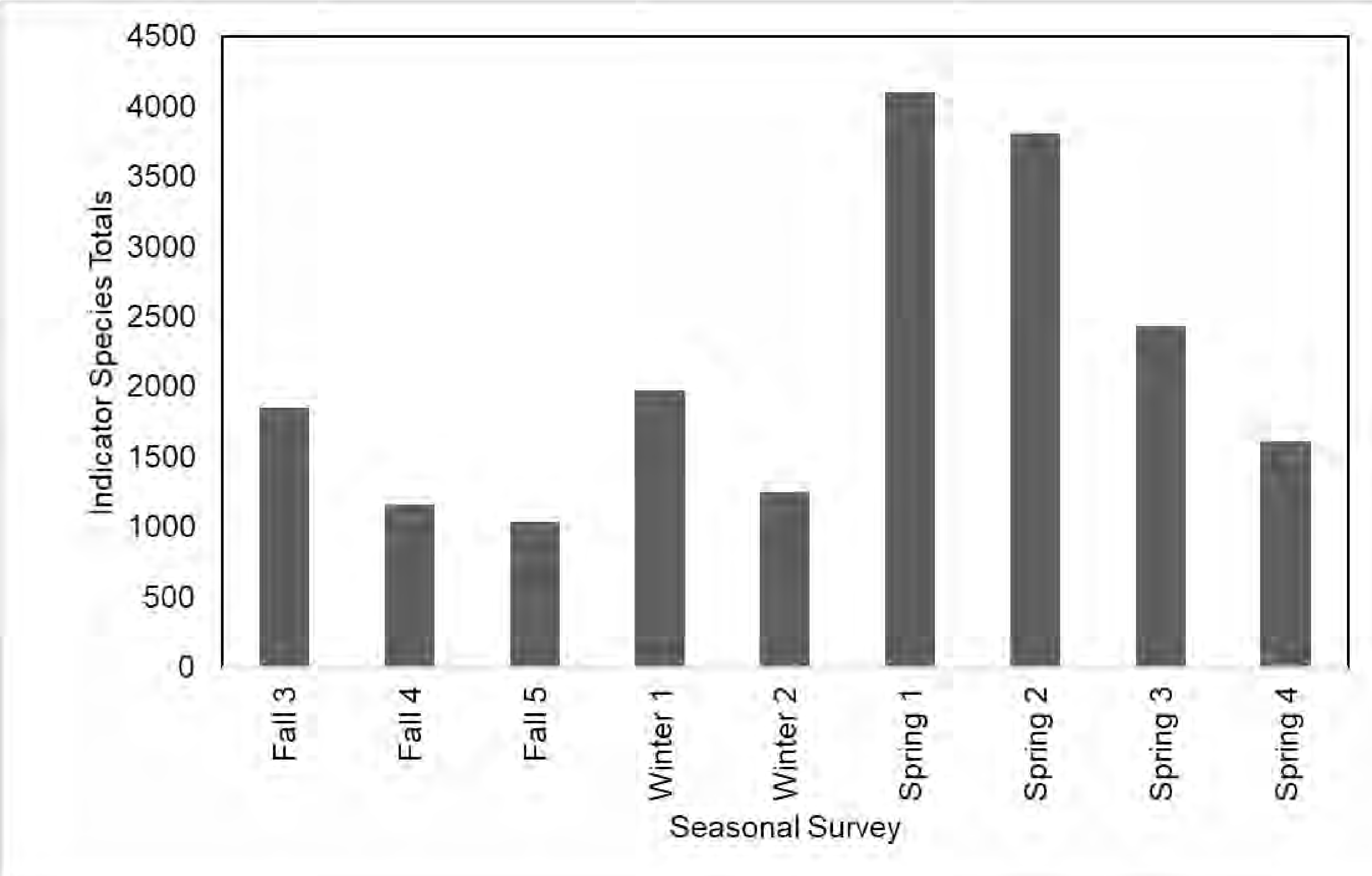


Figure 9-77. Abundance of Habitat Indicator Species Totals for All Units, 2021-2022

Spatial Distribution
Overall, the Thibaut Unit supported 48% of all HIS detections (see Table 9-8), and the highest density of the three units at over 70 birds/flooded acre. Within each unit, individual subbasins varied in terms of their attractiveness (i.e., use) to birds, and based on their size, the overall proportion of HIS they supported. The most productive subbasin overall was TH6 in the Thibaut Unit (
Figure 9-78**)**. Other productive subbasins in Thibaut were TH10 and SW2.

The Waggoner Unit supported 37% of all HIS detections, and 30 birds/flooded acre. Within the Waggoner Unit, WAG2, WAG4 and WAG5 supported the highest proportion of HIS.

Bird density in the East Winterton Subunits was very low, averaging 5 birds/flooded acre and 3% of all HIS detected in BWMA. The main area of use in the East Winterton Subunit was W13.

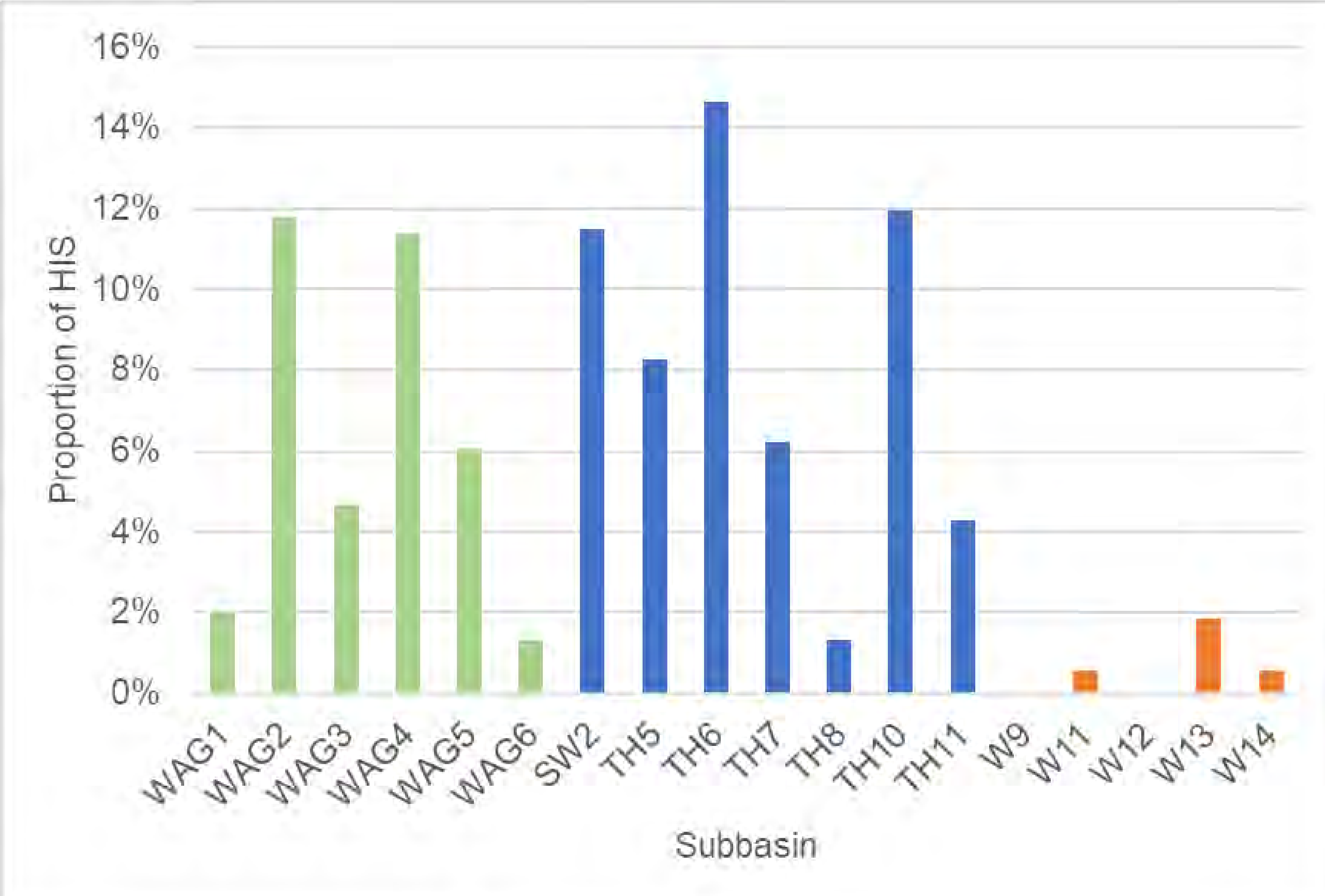


Figure 9-78. The Spatial Distribution of HIS by Subbasin in Terms of the Proportion of Total HIS Observed

Comparison to Previous Years
During FC1, the HIS groups showed differing responses to implementation of the Interim Plan, with waterfowl showing the most significant positive response (
Figure 9-79). The average number of waterfowl observed per survey during FC1 was almost double that seen over the 2010-2017 period of LORP implementation. Shorebird and rail use was above pre-project conditions, but comparable to the 2010-2017 time period. Marsh Wren and Northern Harrier only occur at BWMA in small numbers, and no major change has been observed in these groups over time. The only group showing a decline in use as compared to the 2010-2017 time period was wading birds.

The Waggoner Unit was last active 2009-2010 and avian surveys were conducted in 2010. In FC1 implementation of the Interim Plan, the observed density of both waterfowl and shorebirds was approximately six times higher than observed in 2010, and rail density doubled (**Figure 9-80**).

The Thibaut Unit has been active for more years and time periods than Waggoner, allowing for more comparisons of HIS density under LORP management with FC1 of adaptive management (**Figure 9-81**). As seen in Waggoner, the observed density of waterfowl, shorebirds, and rails was higher in FC1 than in three other survey years for which we have survey data. Waterfowl density in FC1 was 2-5 times higher than, shorebird density up to 3 times higher, and rail density up to 30 times higher than previous years, with increases in waterfowl the most substantial. Wading birds have always been a small component of the bird community, and no increased density of this HIS group was seen in FC1.

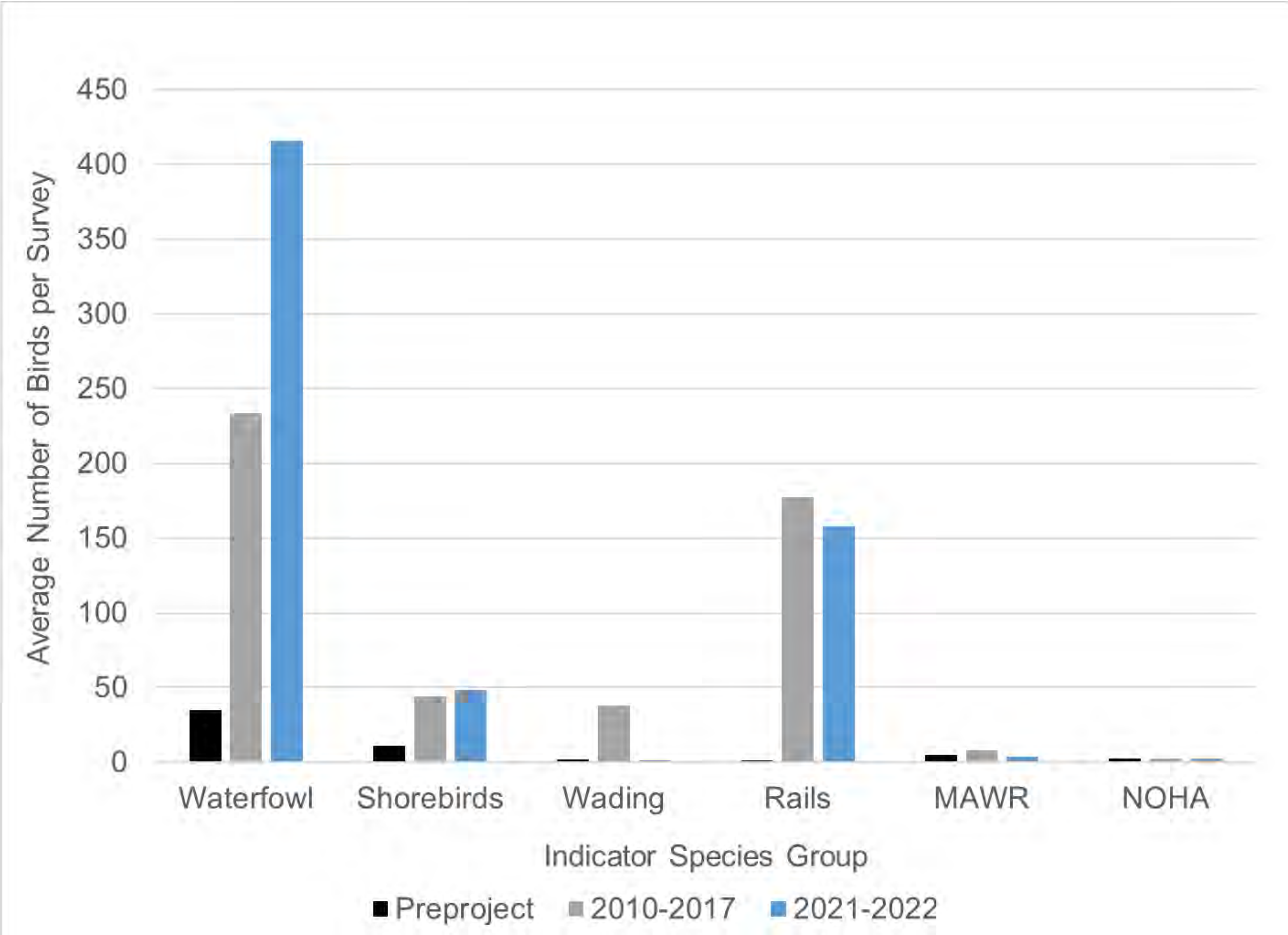


Figure 9-79. BWMA HIS Groups Totals by Time Period, Standardized by Averaging Total HIS per Survey (MAWR = Marsh Wren, NOHA = Northern Harrier)

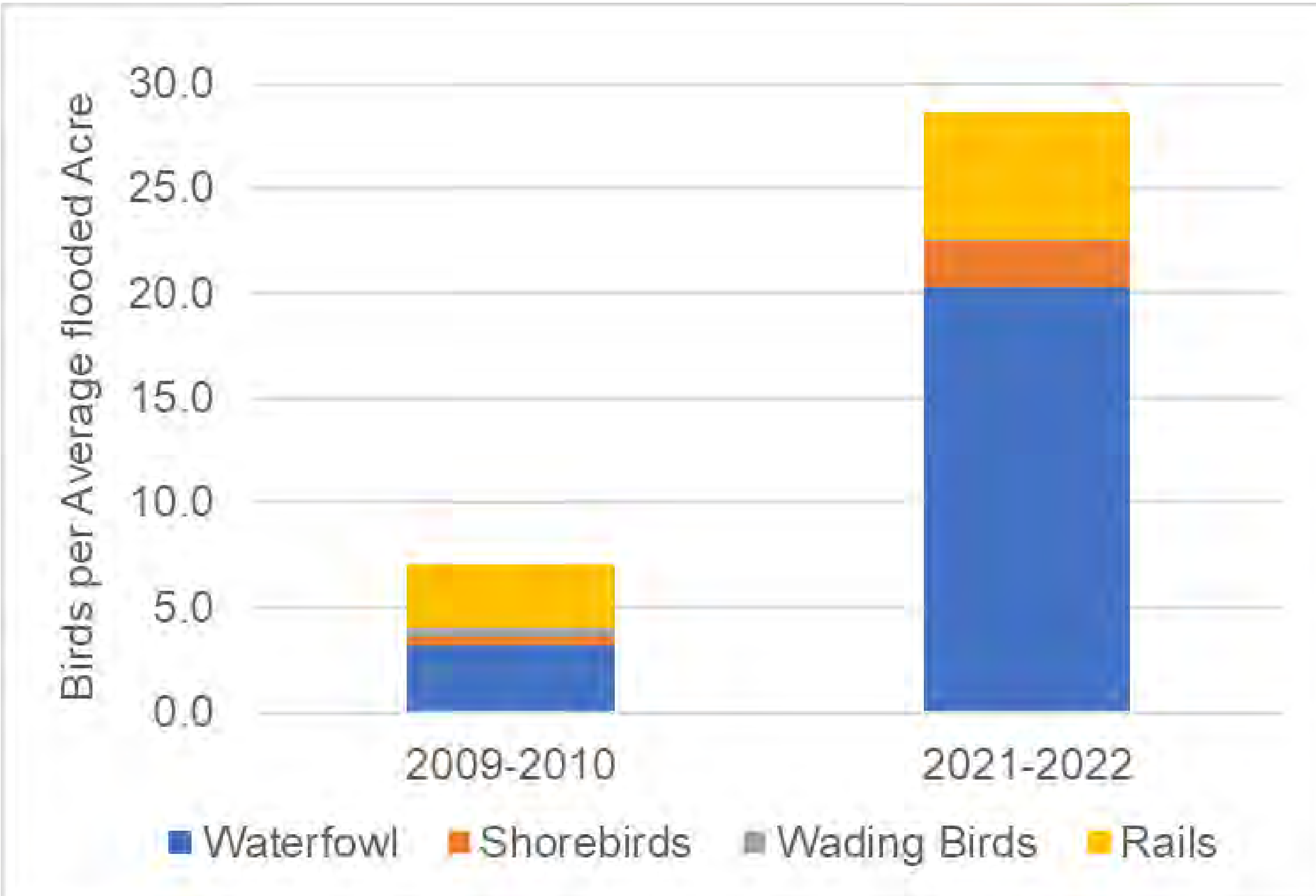


Figure 9-80. A Comparison of Bird Density in the Waggoner Unit Under LORP Management (2009-2010), and FC1 Interim Plan (2021-2022)

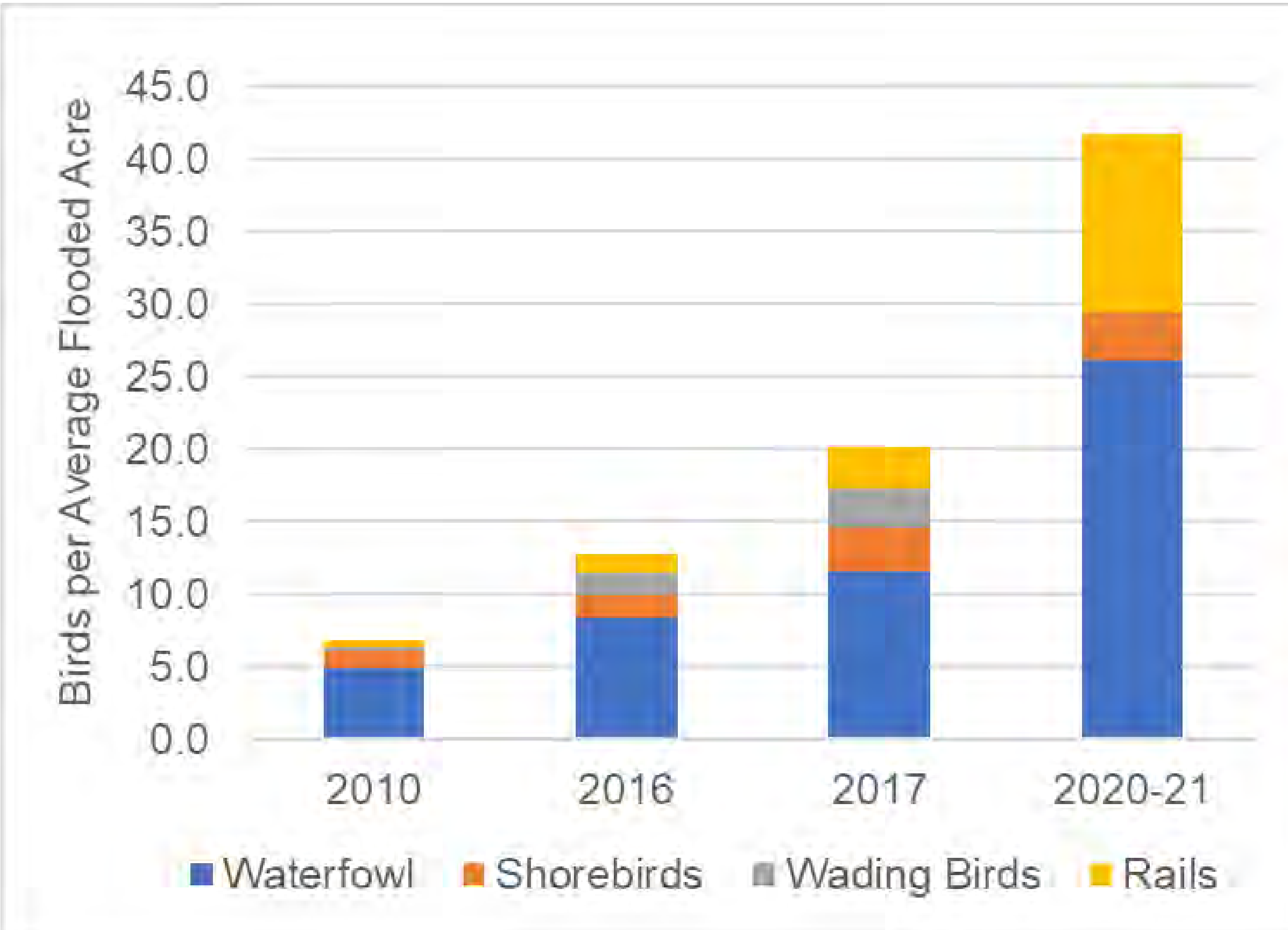


Figure 9-81. A Comparison of Bird Density in the Thibaut Unit Each Survey Year Under LORP Management (2010, 2016, and 2017), and FC1 Interim Plan (2021-2022).

Discussion and Recommendations

The first cycle of flooding under the Interim Plan was very effective at creating habitat and attracting BWMA Habitat Indictor Species. The initial flood-up of the units went as planned, and the objective of 500 acres of flooded habitat by early November was achieved. HIS were seen at BWMA on every survey, and standing water remained in at least some subbasins through the end of spring migration, so habitat was available fall, winter and spring for migratory waterfowl, shorebirds, wading birds and rails.

Increases in the average number of birds per survey was observed for all indicator species groups except wading birds, which have always been a small component of the overall bird community. Waterfowl were the indicator species group for which we saw the best response and most increase in numbers as compared to the prior management strategy of year-round flooding. Not only were waterfowl totals higher, but observed bird densities were much higher as compared to all previous years, suggesting improved habitat quality such that more birds per acre could be supported as compared to previous years.

The spring drawdown and summer drying maintained open water habitat created during initial site preparation and facilitated a robust and diverse growth of vegetation in the subbasins. Several plant species observed during vegetation monitoring produce seeds consumed by waterfowl (Martin and Uhler 1939) including sedges (*Carex* spp.), swamp Timothy (*Crypsis schoenoides*), willow dock (*Rumex salicifolius*), Arctic rush (*Juncus arcticus*), hardstem bulrush (*Schoenoplectus acutus*) and smartweed (*Polygonum* spp.). The nutritional value of many of the native plant species occurring in the subbasins of BWMA is not known. Even if these plant species do not produce seeds or vegetative parts directly consumed by species such as waterfowl, their presence will support various invertebrate communities. Casual observations during bird surveys suggest that aquatic invertebrate species consumed by waterfowl and shorebirds such as water fleas (*Daphnia* sp.), copepods, and midges have also successfully colonized the seasonally flooded ponds of BWMA.

We recommend continuing the avian survey program as implemented in FC1, including the mid-March “Spring 1” survey that was added this year. The 2022-2023 monitoring year will provide bird data to evaluate indicator species response following the first year of full implementation of one complete drawdown and reflood sequence. Successive monitoring will allow improved understanding of the response of the indicator species to the management change, and factors influencing the seasonal and spatial distribution of indicator species as a function of flooding regimes and subbasin habitat conditions and characteristics.

9.2.6 BWMA Interim Plan Remote Sensing

The flooded-extent goal of the interim plan is 500 flooded-acres between November 1 and March 1; currently this is quantified by walking the wetted extent with a GPS tracklog. One of the studies identified in the workplan, was to evaluate whether a simple satellite-based method could provide flooded acreage estimates that are comparable to the tracklog estimates - thus eliminating that laborious effort. Sentinel 2 Operational Land Imagery (OLI) (nearest cloud-free date to tracklogs November 1 and March 1) was downloaded from earth engine and the near-infra-red (NIR) band was used to globally threshold each 20-m pixel, with water classified as digital number less than 2400.

For brevity, the simple thresholding conducted here produces large over and underestimates of flooded extent at the entire BWMA scale (e.g. +/- 100 acres) or roughly 20% of the total flooded acreage and the direction of error changed from November to March. On the promising side, remote sensing estimates in 25% of subbasins were within 2% of the field mapped estimate. But some outlier subbasins make the generalized thresholding approach insufficient. This suggests that NIR thresholding can be a quick way to segment flood maps, but as an automatic acreage calculator at this scale, there is further refinement required for automation.

NIR thresholding overestimated the tracklog acreage in the fall while underestimating it in the spring, though the slopes for subsets of the subbasins appeared to behave linearly save the outliers. Future investigations might evaluate the particular subunits with high error and determine whether dynamic thresholding might improve the estimator. For instance, the "Otsu method" uses dynamic thresholding using a moving window and local histograms (Donchyts et al 2016). If it's known that 80% of subbasins can be accurately mapped with Sentinel but 20% are producing 90% of the acreage estimate error for vegetation related reasons, there could be manual mapping for some subbasins but remote sensing for the majority. Because the manual mapping only takes a few days for two people, it doesn't make sense to spend weeks doing remote sensing and writing python code to replace it unless that led to an automated remote sensing flooded acreage calculator that would be generally useful beyond that year and project.

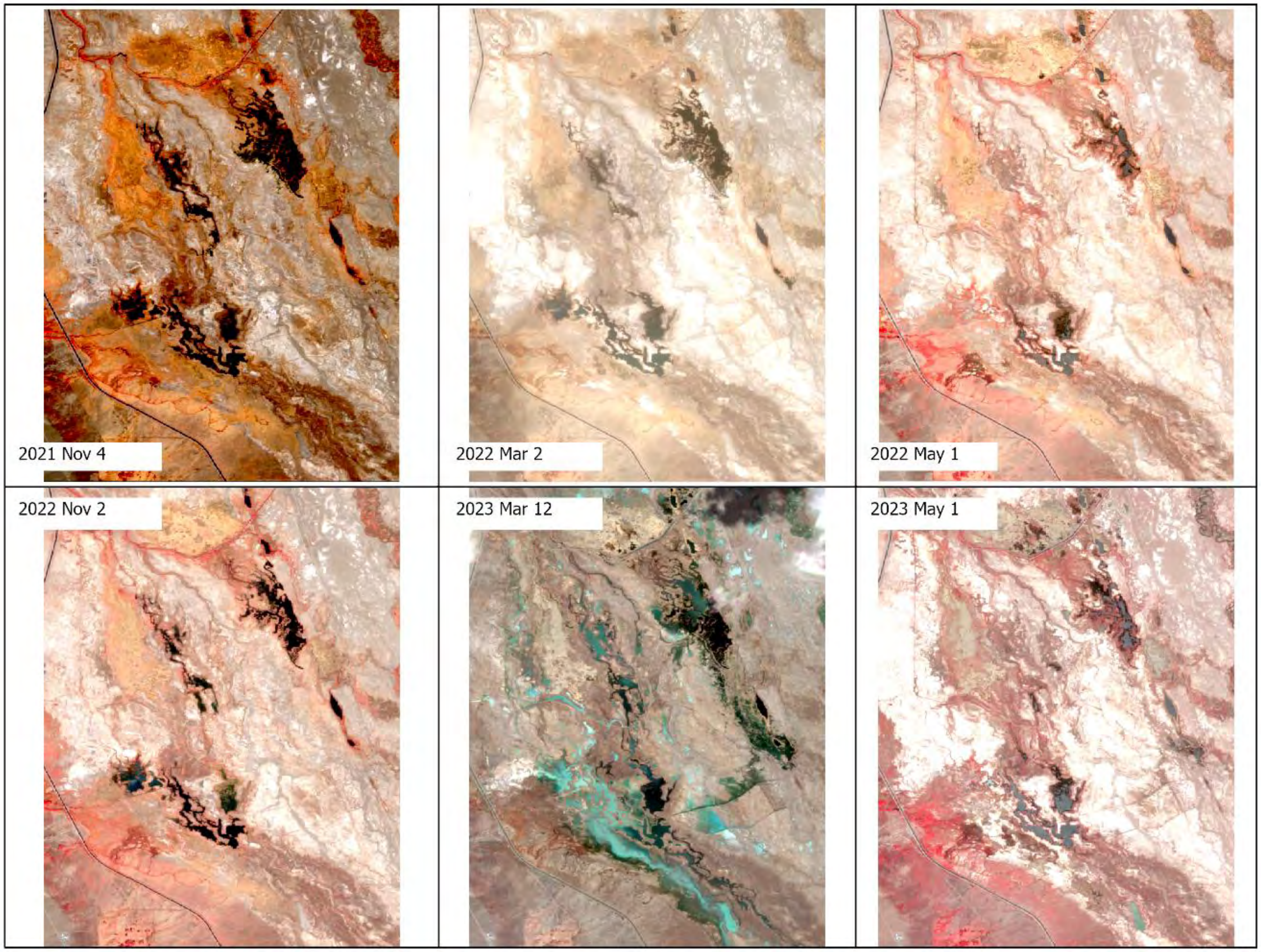


Figure 9-82. Example of Sentinel-2 near-infrared false color composite shows water as dark bodies (low near-infrared wavelength reflectance) in November, March and May. Presence of ice in March 2023 has a bluish tint on ponds and introducing some omission errors in flooded extent segmenting.

9.2.7 Tree Recruitment

Spring - Summer 2022

Three adaptive management actions were proposed in the 2020 LORP Annual Report (LADWP and ICWD, 2020) and 2020-2021 LORP Workplan (LADWP and ICWD, 2021) to understand past and current riparian tree recruitment within the project area. These included: 1) describing conditions that allowed tree establishment under pre-project settings (prior to re-watering), 2) assessing conditions that have permitted limited recruitment since project initiation (post re-watering), and 3) identifying current biological processes that could limit tree germination or establishment. This review summarizes work to-date (as of October 2022) on the LORP project area for items 1 and 2; the third item requires a substantial habitat flow (during a 100% of normal RY) to trial a removal experiment.

The first adaptive management recommendation, understanding historic tree recruitment, was initiated during summer 2020 and continued in 2021 and 2022 with Type D, or riparian, vegetation transects located within LORP reaches 2, 3, 5, and 6. The islands have been excluded from the study at present because of confounding factors altering the hydrologic regime. Methods are described in detail in the 2020 and 2021 annual reports, please see: Type D – Riparian Vegetation Monitoring Annual Status Report 2021, Appendix 1: Type D Monitoring Program and studies for the Water Agreement (ICWD 2020, 2021). This project is ongoing into summer 2023; data will be analyzed when the field component of the project is complete. A more comprehensive analysis will be presented in the 2023 or 2024 LORP Annual Report.

The second adaptive management item involved surveying successful tree recruitment locations post-LORP implementation. To understand the relevant conditions during recent recruitment events (2008 - 2020) that permitted riparian tree germination and establishment, recruitment sites identified during the LORP Rapid Assessment Survey (RAS) were re-visited. To date, 35 sites have been revisited (Figure1). At these locations, the number of tree recruits (Salix laevigata, Salix gooddingii, and Populus fremontii) and their size (basal diameter and height), presence of co-occurring vegetation species, and ground substrate (e.g. bare soil, litter) were recorded along one (or several) line-point transect(s). Local environmental conditions such as: landform, tree topographic elevation relative to water surface, soil substrate, soil salinity, and patch size were also assessed (as identified in the LORP Work Plan 2020-2021).

Finally, assessing the impact of plant competition on successful tree recruitment or survival was a study topic suggested in the 2020-2021 LORP Work Plan. This item is still incomplete due to low spring 2021 and 2022 runoff (approximately 45 and 47% RYs) so the seasonal habitat flow was not substantial enough to wet soils into the floodplain where most successful tree recruitment has been observed during the RAS. This adaptive management recommendation was therefore again not applied.

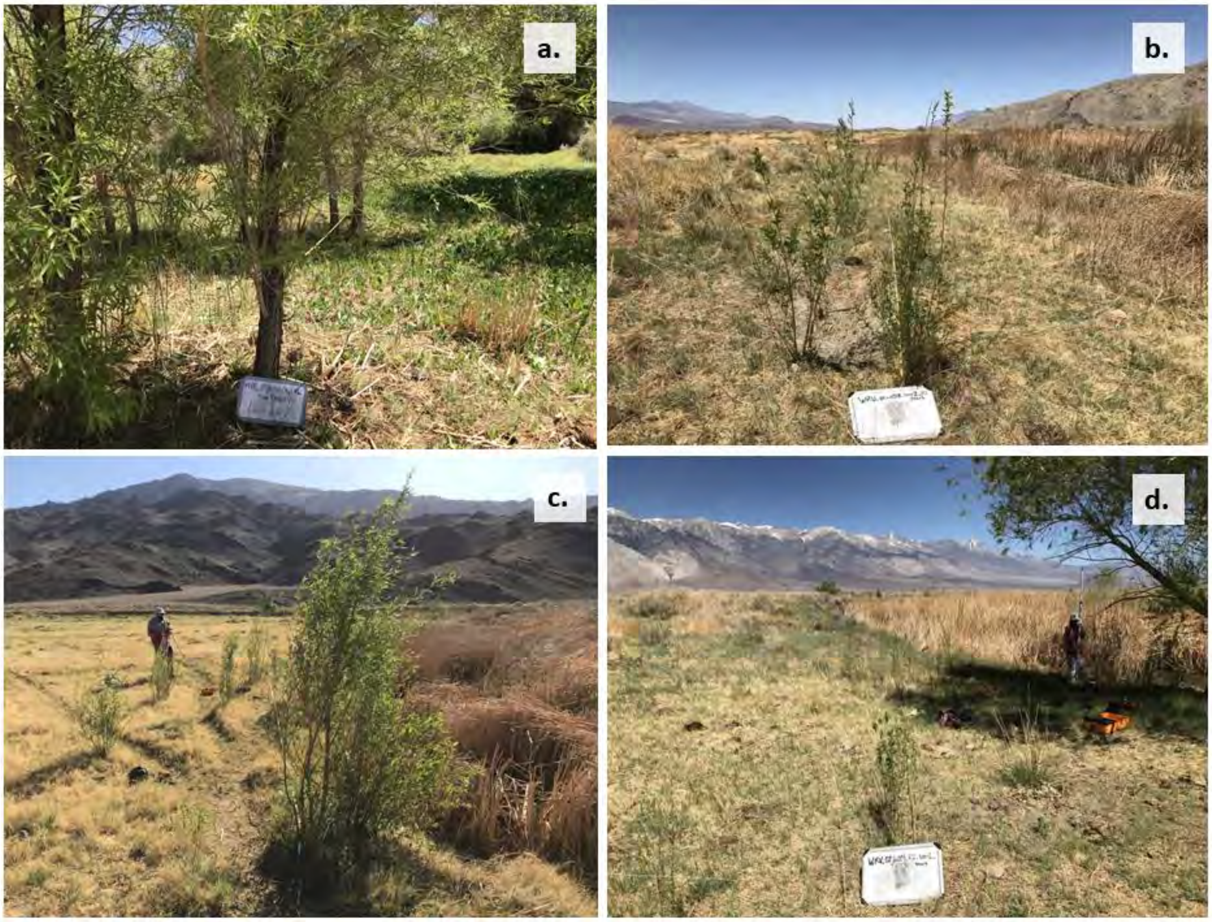


Figure 9-83. **Riparian tree recruitment locations revisited on the LORP in 2021 and 2022. Images a) and b) depict various ages of riparian trees following recruitment events; c) and d) show sampling for topographic elevation relative to river stage.**

In spring and summer 2023 we will continue environmental and biological assessments of known recruitment locations, and riparian transects along the LORP. Competition assessment via vegetation removals will occur given an adequate seasonal habitat flow (100% RY). It is expected that a more thorough analysis of findings from riparian tree recruitment work will be presented in a subsequent (2023 or 2024) annual report.

References

ICWD 2020. Type D - Riparian Vegetation Monitoring Annual Status Report 2020. County of Inyo, Independence, CA, 22 p https://www.inyowater.org/wp-content/uploads/2021/08/TypeD_AnnualReport_2020_08242021_FINAL.pdf

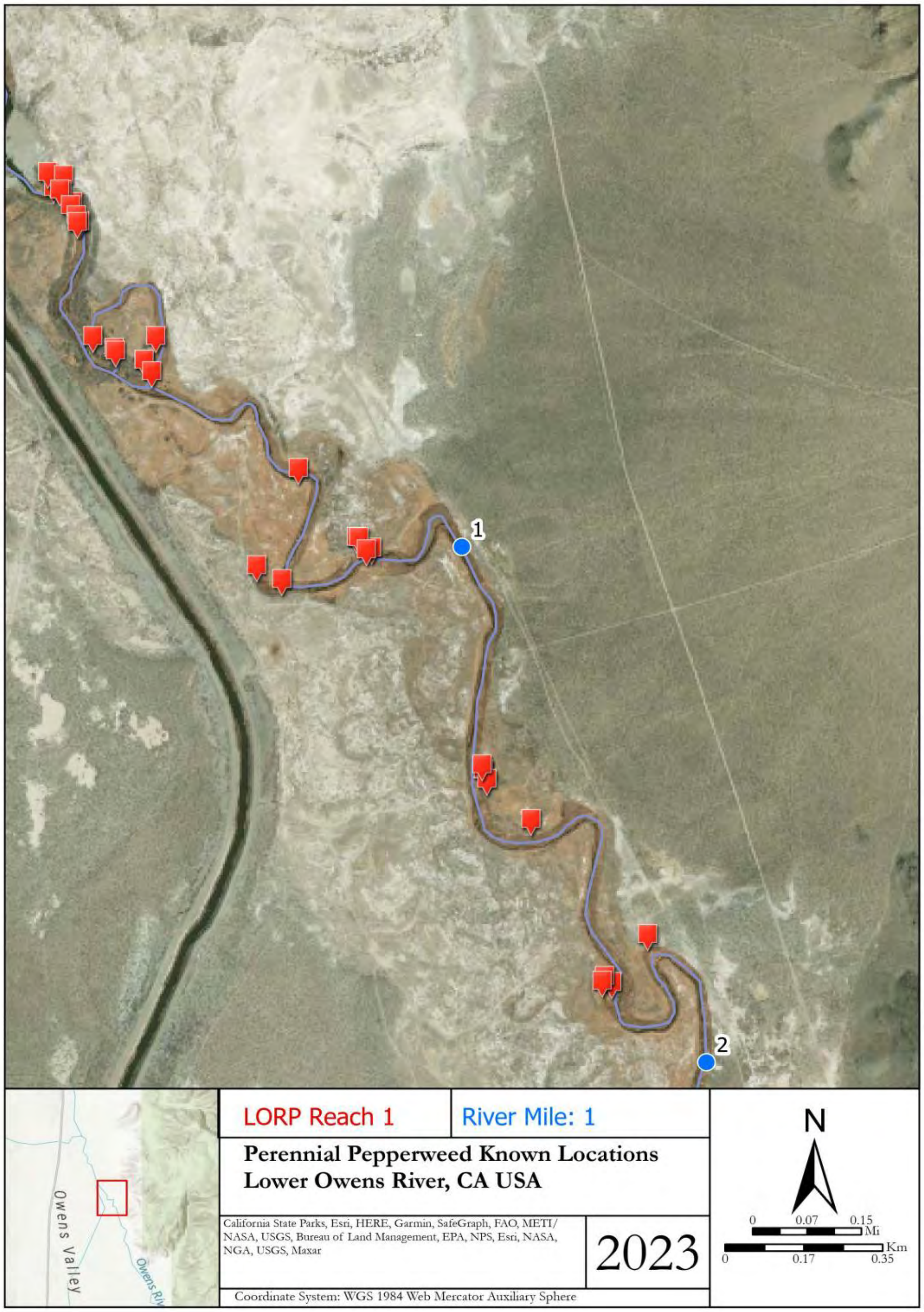
ICWD 2021. Type D - Riparian Vegetation Monitoring Annual Status Report 2021. County of Inyo, Independence, CA, 24 p https://www.inyowater.org/wp-content/uploads/2022/07/TypeD_AnnualReport_2021_Final.pdf

LADWP and County of Inyo. 2020. Lower Owens River Project 2020 Annual Report. Los Angeles Department of Water and Power, Bishop, CA & Inyo County Water Department, Independence, CA. 155 p https://www.inyowater.org/wp-content/uploads/2021/02/2020-FINAL-LORP-ANNUAL-REPORT-rev02.22.21.pdf

LADWP and County of Inyo. 2021. Lower Owens River Project Work Plan, Budget, and Schedule 2020-2021 Fiscal Year. Los Angeles Department of Water and Power, Bishop, CA & Inyo County Water Department, Independence, CA. 19 p https://www.inyowater.org/wp-content/uploads/2020/06/2020-21-LORP-Work-Plan-FINAL-FINAL-20200602-_IC_LA-2.pdf

9.2.8 Noxious Species Survey

In August 2022, ICWD surveyed the Lower Owens River for Perennial Pepperweed (*Lepidium latifolium*). No major changes in distribution were noted compared to previous years with the exception of incremental downstream spread in reach 4 on the eastern channel of the islands. Pepperweed is well established along river mile 0 to 8 from the Los Angeles Aqueduct Intake to three miles south of the Blackrock Ditch Return, east of Twin Lakes (River Miles 1 -8). Downstream, a few detections have occurred east of Goose Lake from rm 8 to just south of rm 12 (River Miles 9-12). Rm 13-16 was free of pepperweed in 2021, but rm 13-14, 14-15 had detections in 2022 (River Miles13-15). Two pepperweed locations between rm 16 and 17 on the west side of the river were detected in 2020 and 2021 and still persisted in 2022 (River Miles 16-17). Rm 17-20 was free of pepperweed. One new location south of rm 20 was recorded in 2021 (River Mile 20) and persisted in 2022. The next downstream pepperweed location is between rm 25 and 26 on the east side of the river and one detection just downstream of Rm 26 (River Miles 25-26). Downstream from this detection to rm 28 was free of pepperweed. The last primary infestation occurs south of Manzanar Reward Rd at rm 28 to rm 33 just upstream from Reinhackle Gauging Station Rd (River Miles 28-33); recent spread has been noted downstream to rm 33 in 2020 and rm 35 in 2021 and half way to rm 36 in 2022, along the east channel of the northern portion of the islands in reach 4. This area as mentioned in the last year should be the highest priority for treatment and containment (River Miles 28-36) in 2023 and 2024, especially after the high flows spread propagules into new areas throughout the islands. Control methods are carried out by Inyo-Mono Counties Agricultural Commissioner's Office (CAC) and LADWP.



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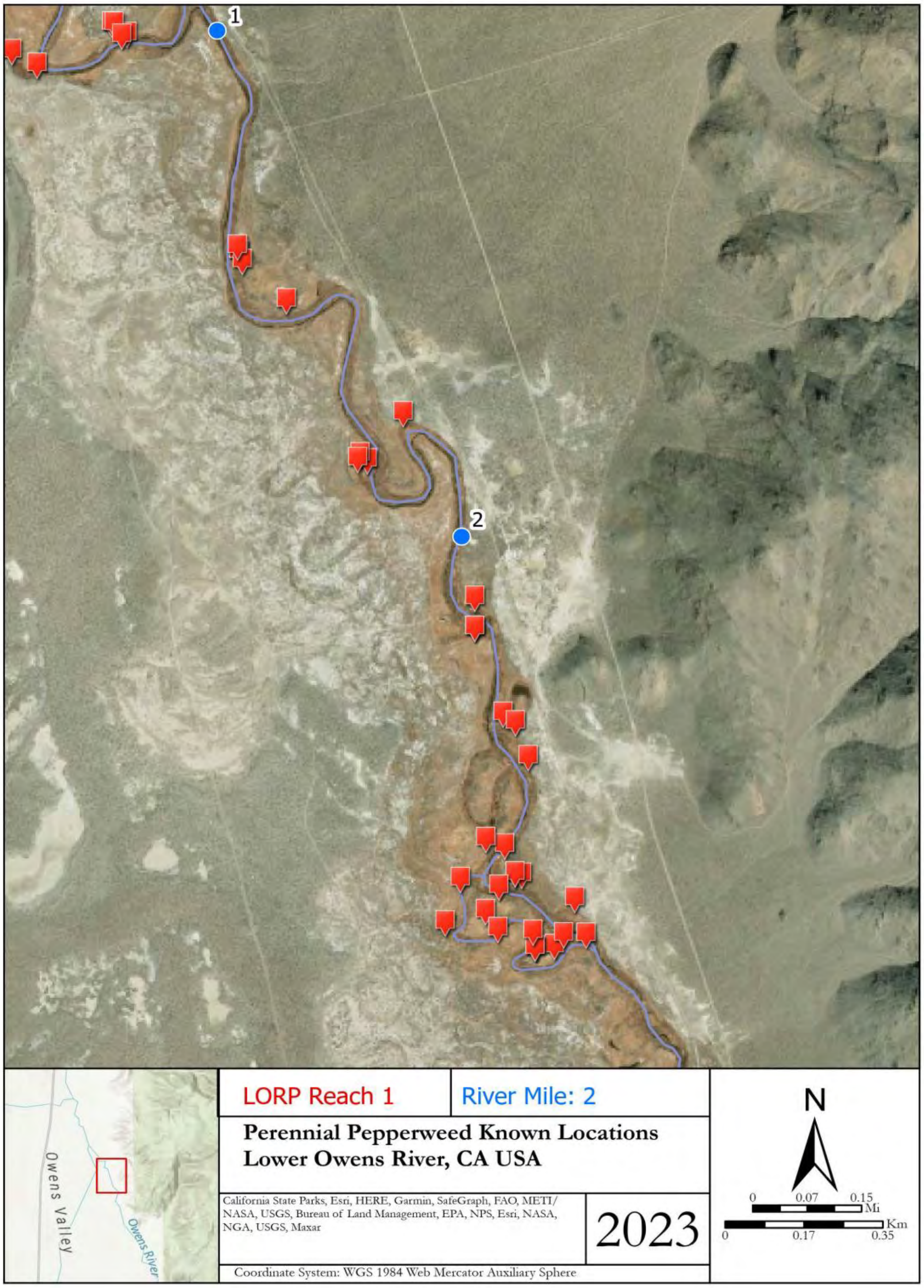

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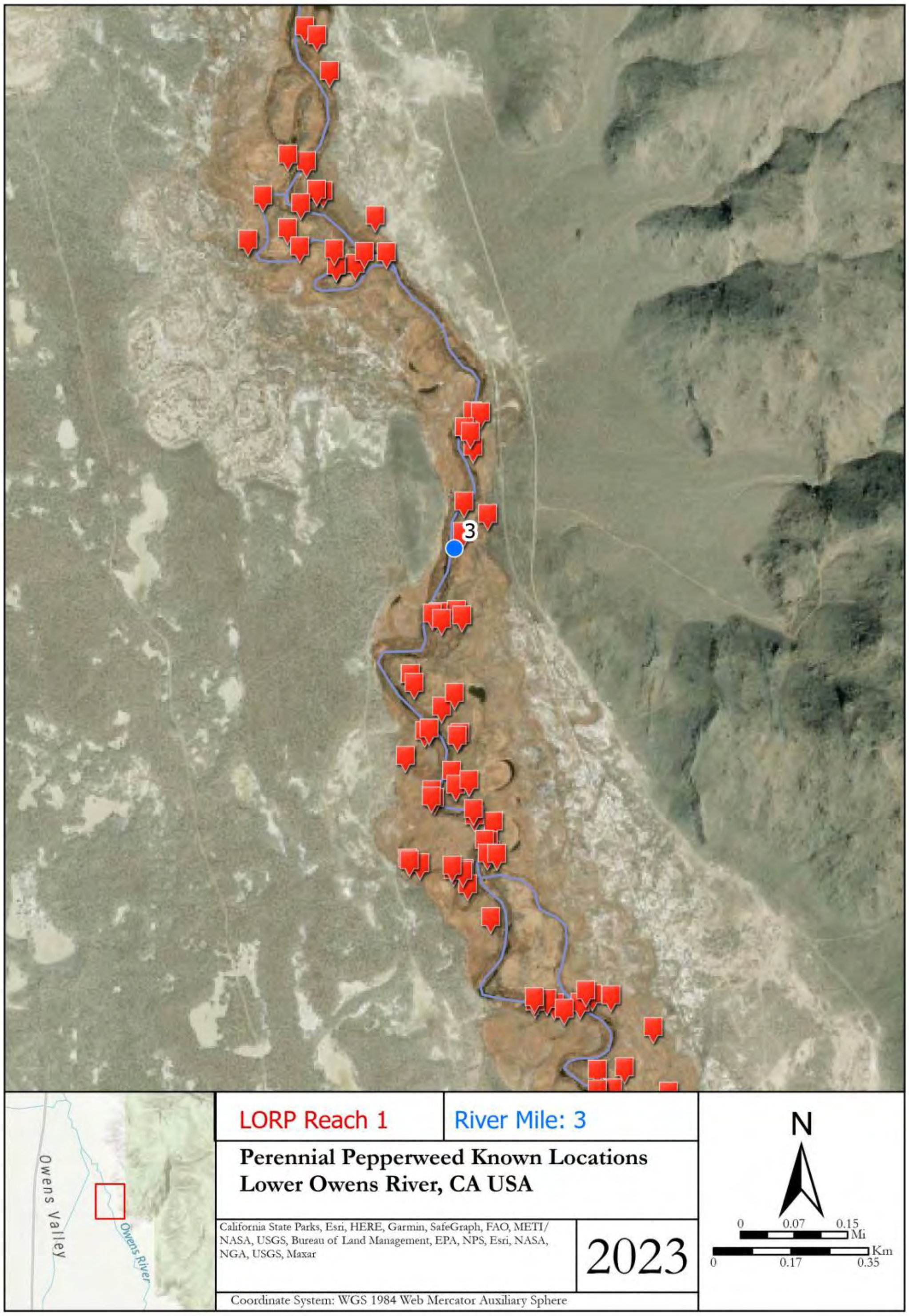

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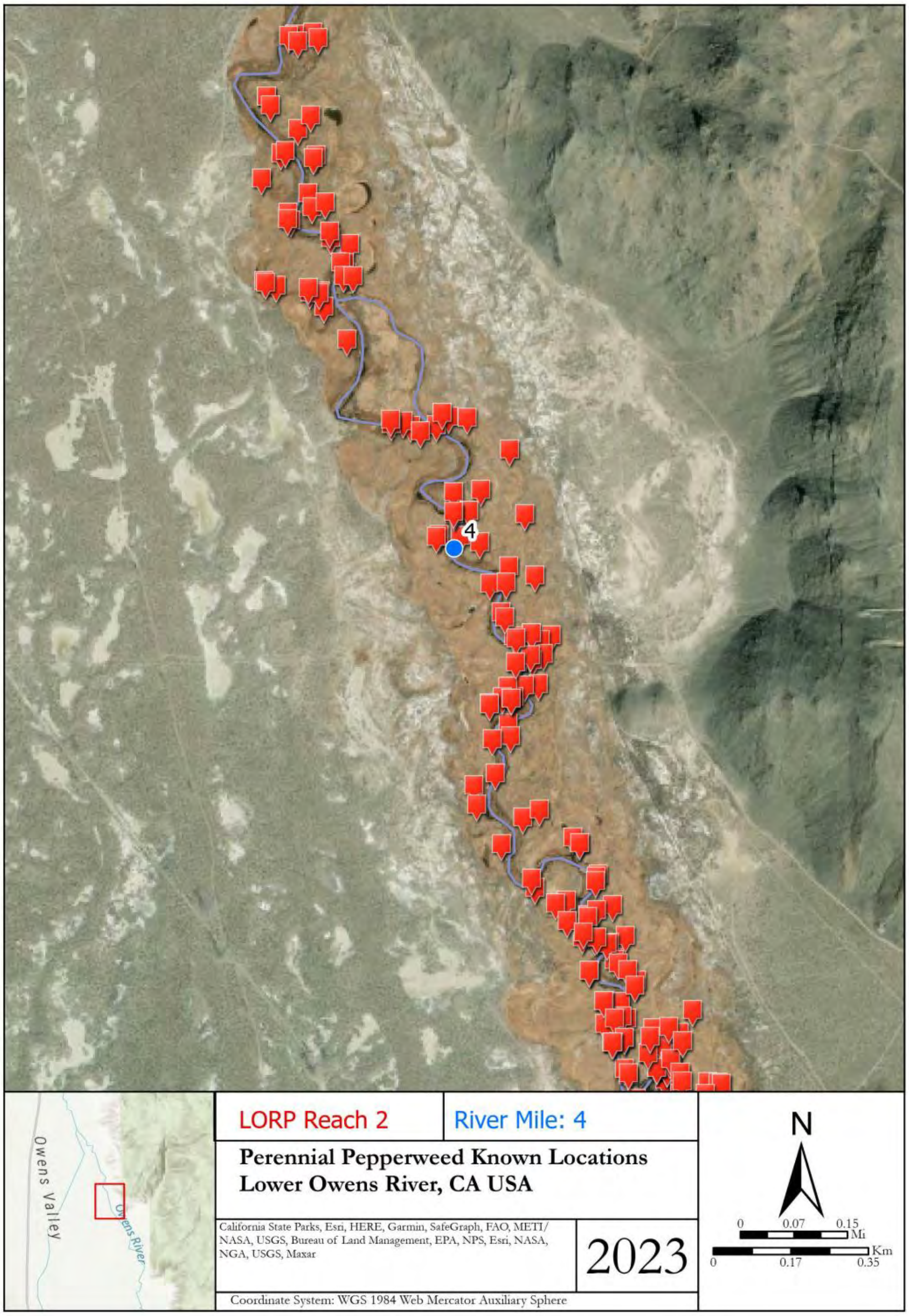

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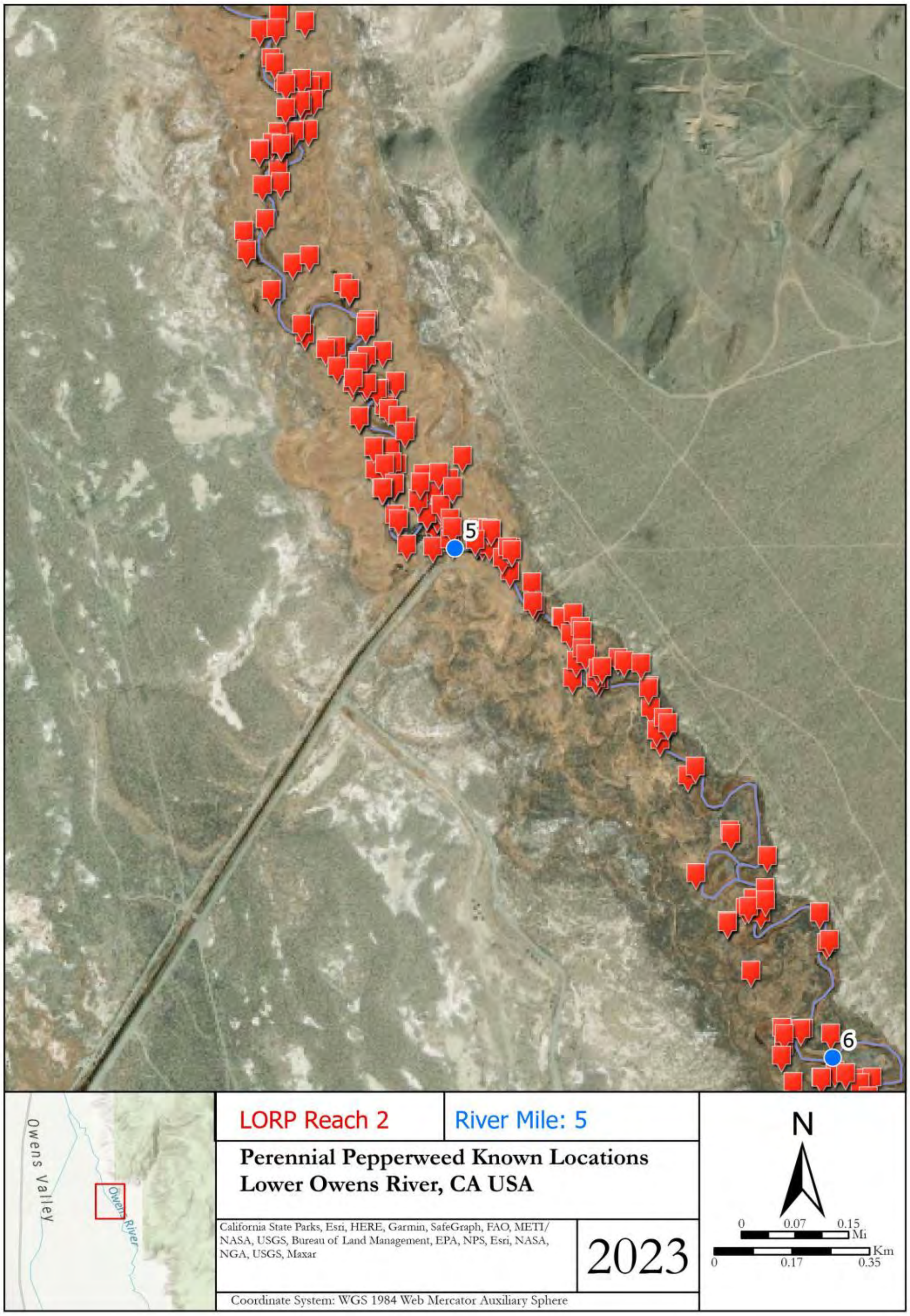

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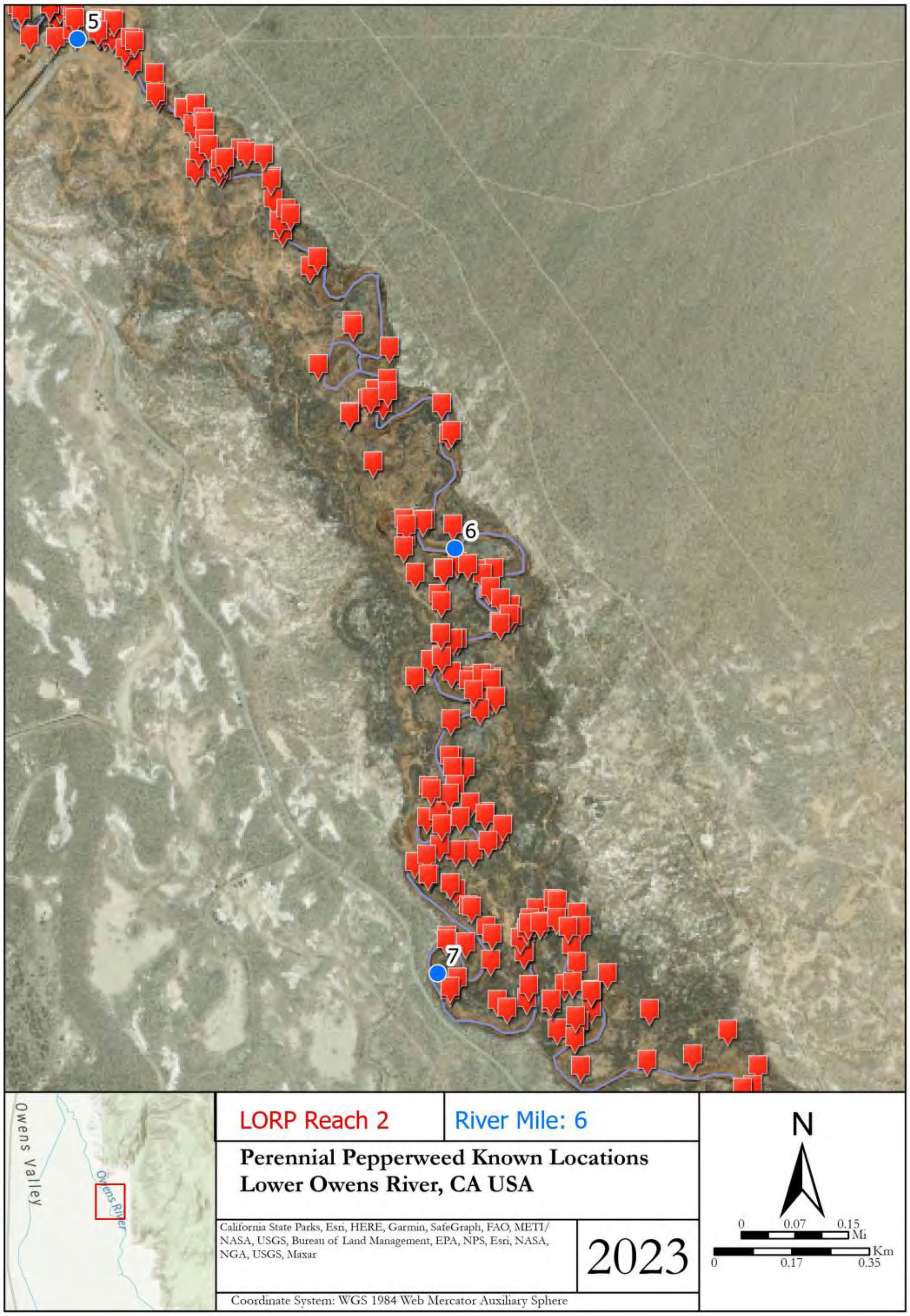

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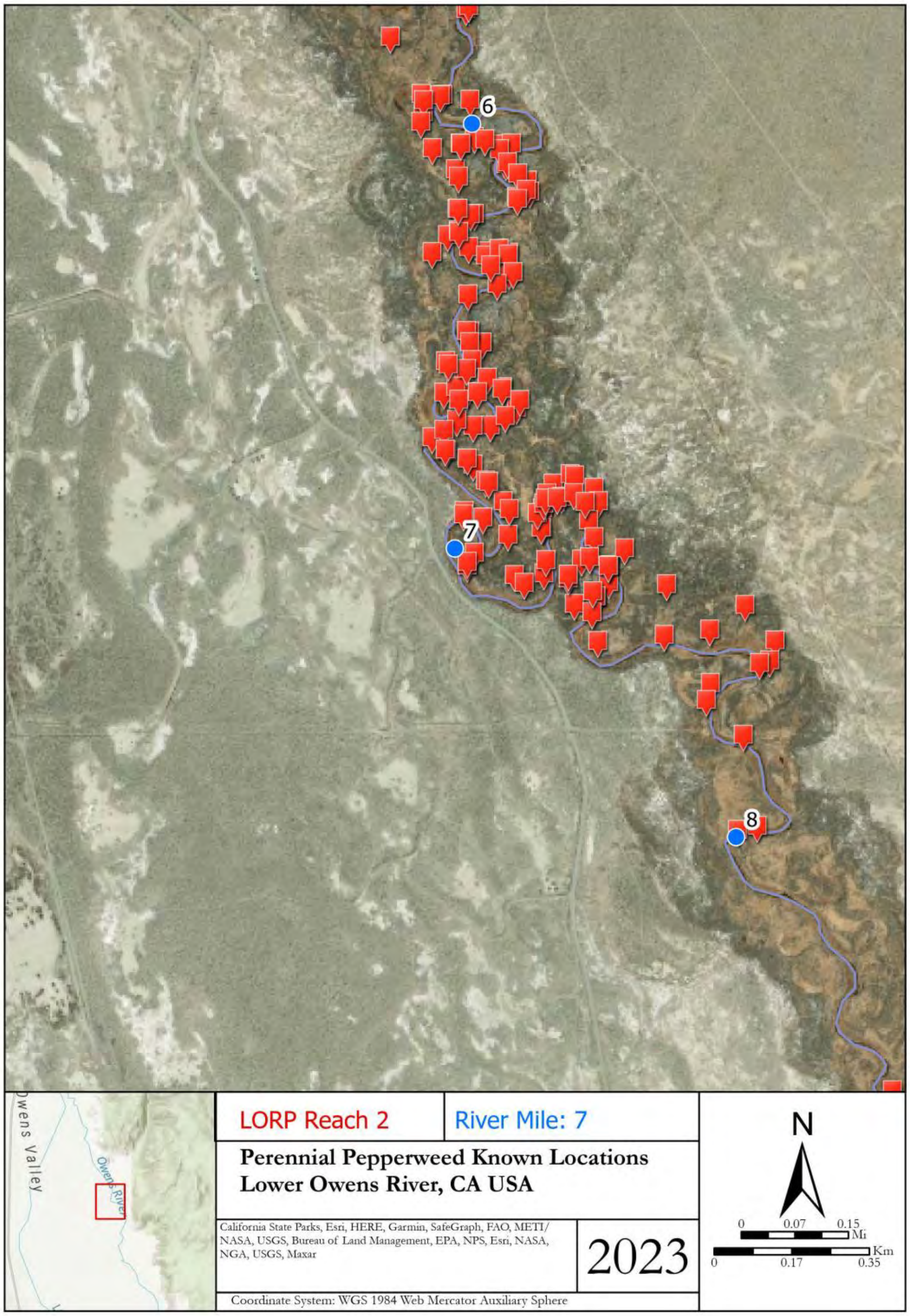

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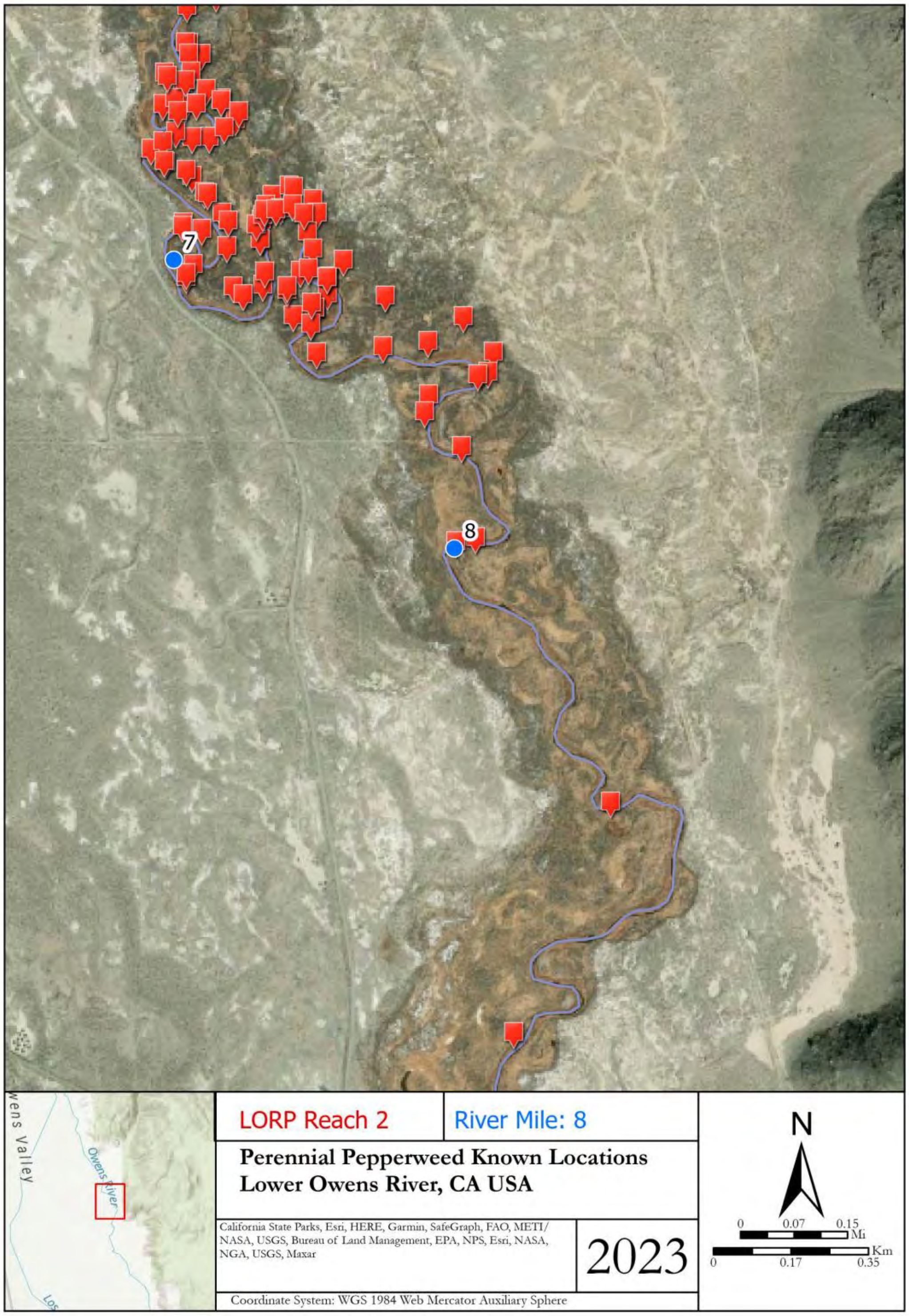

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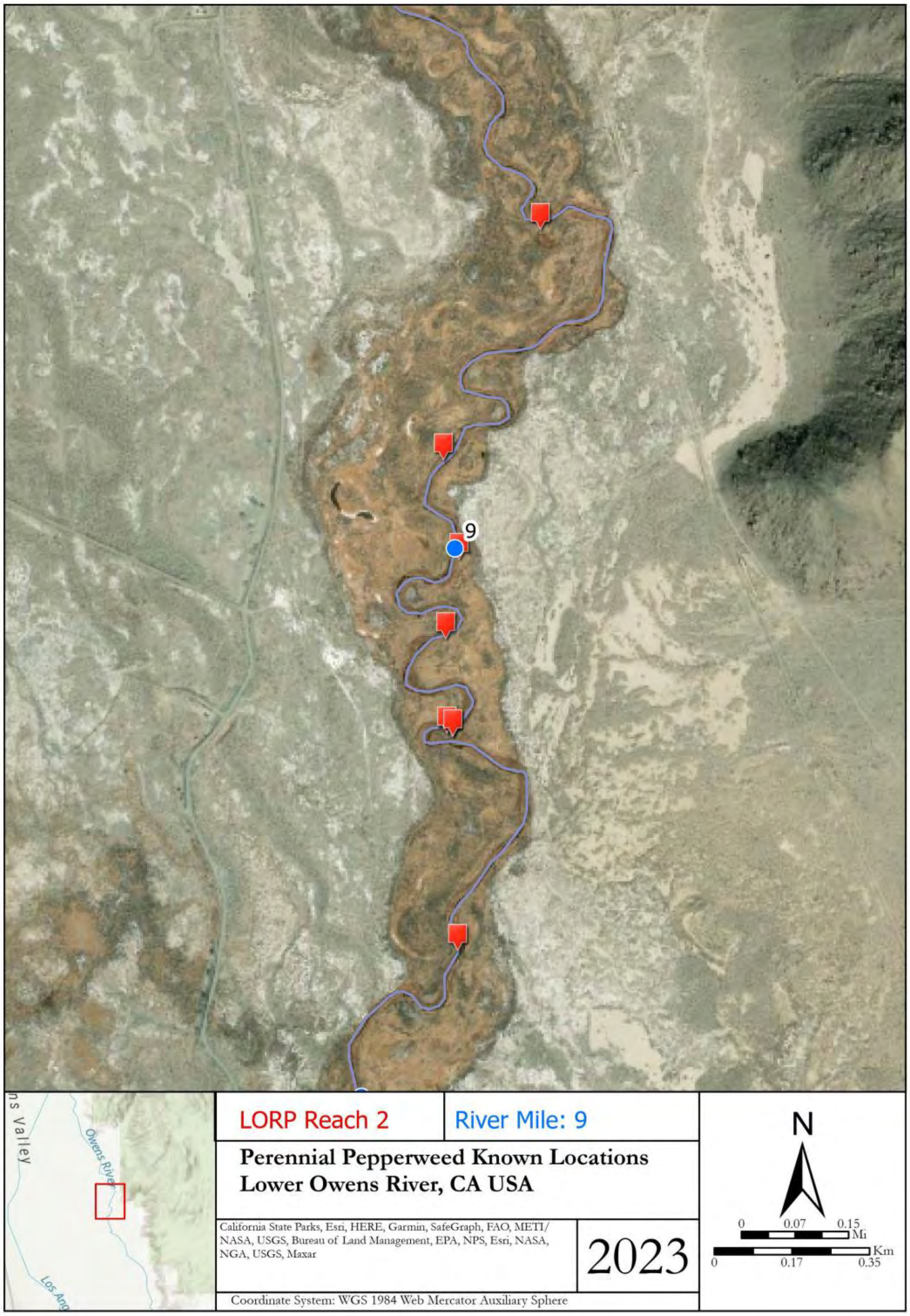

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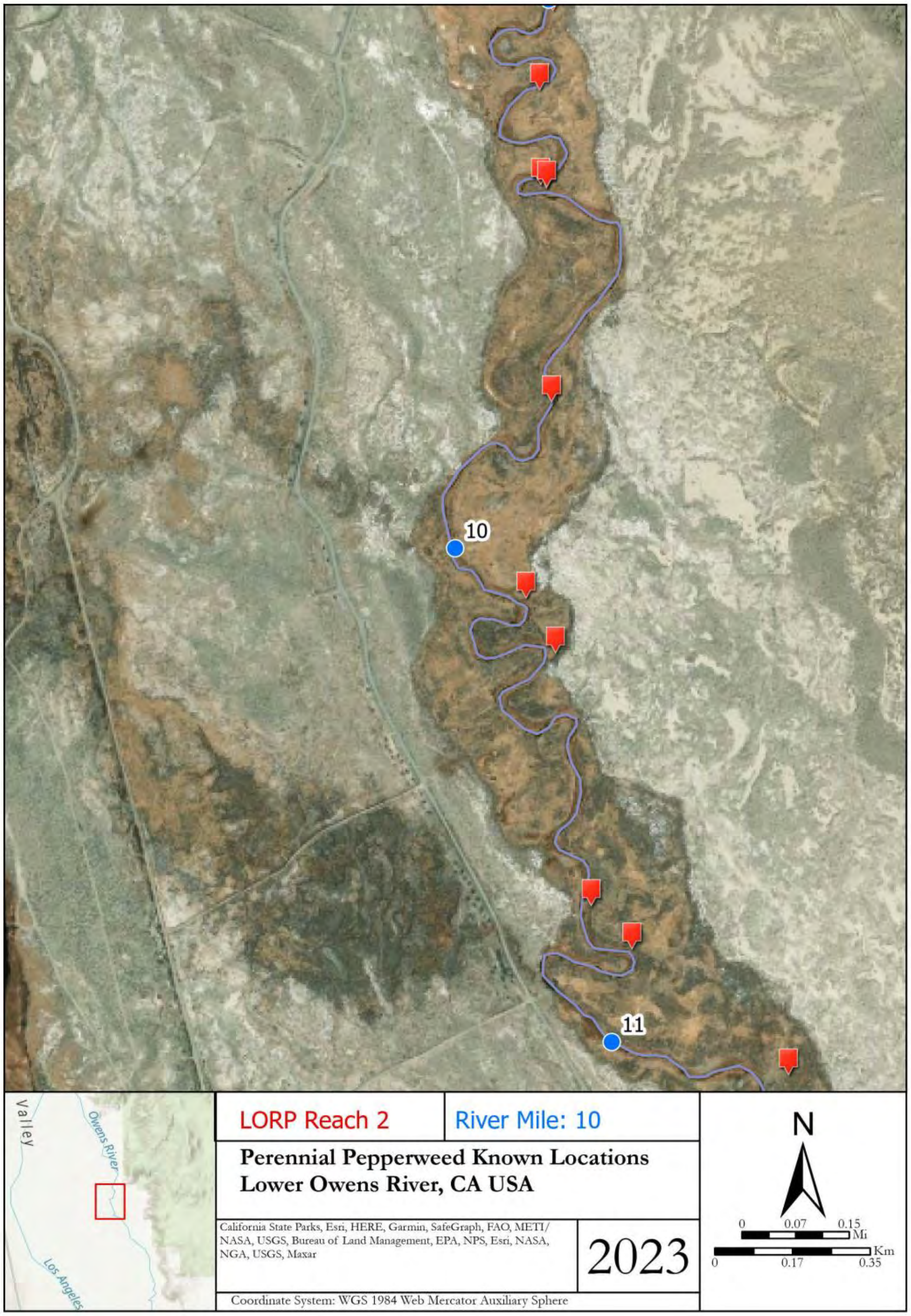

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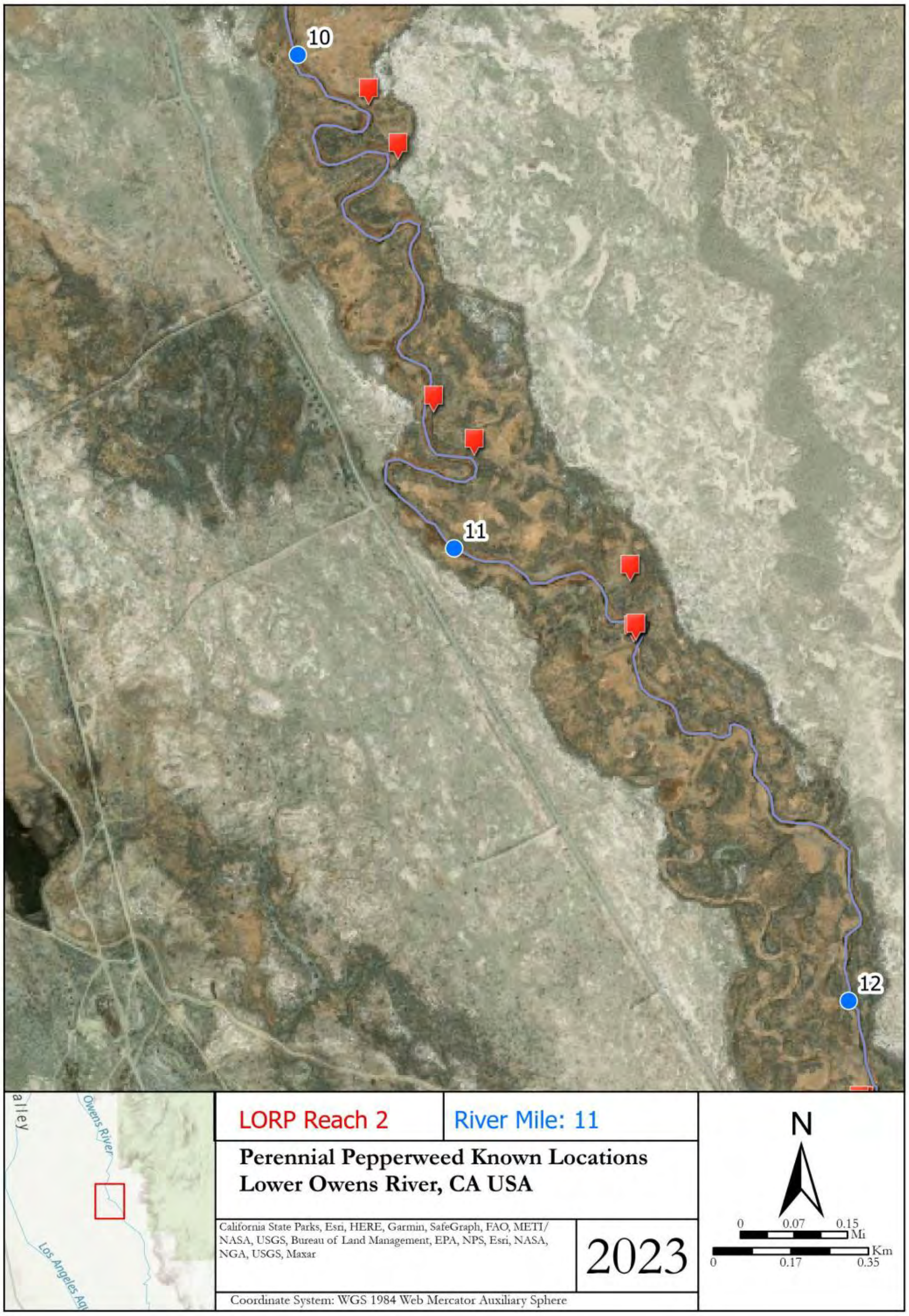

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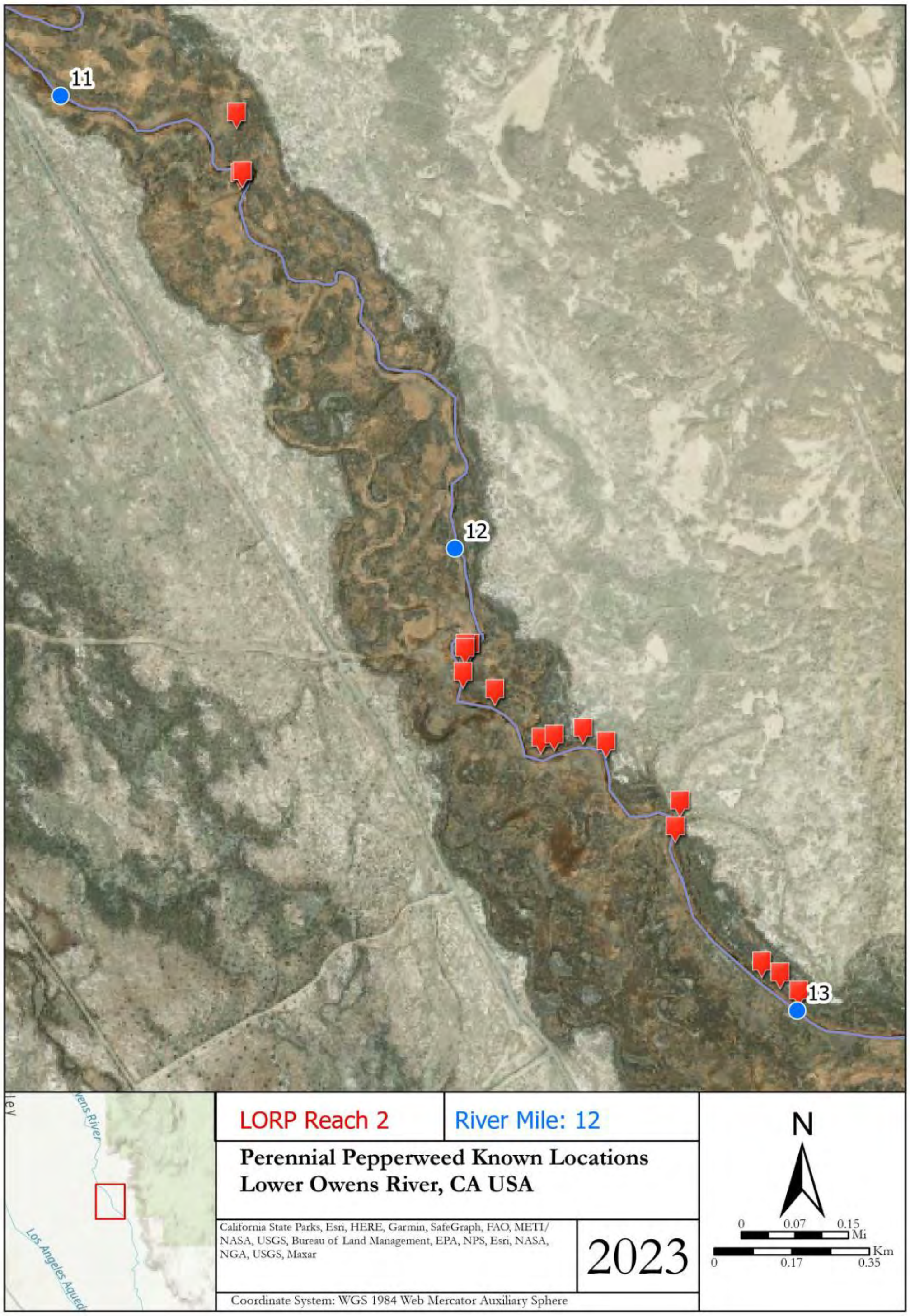

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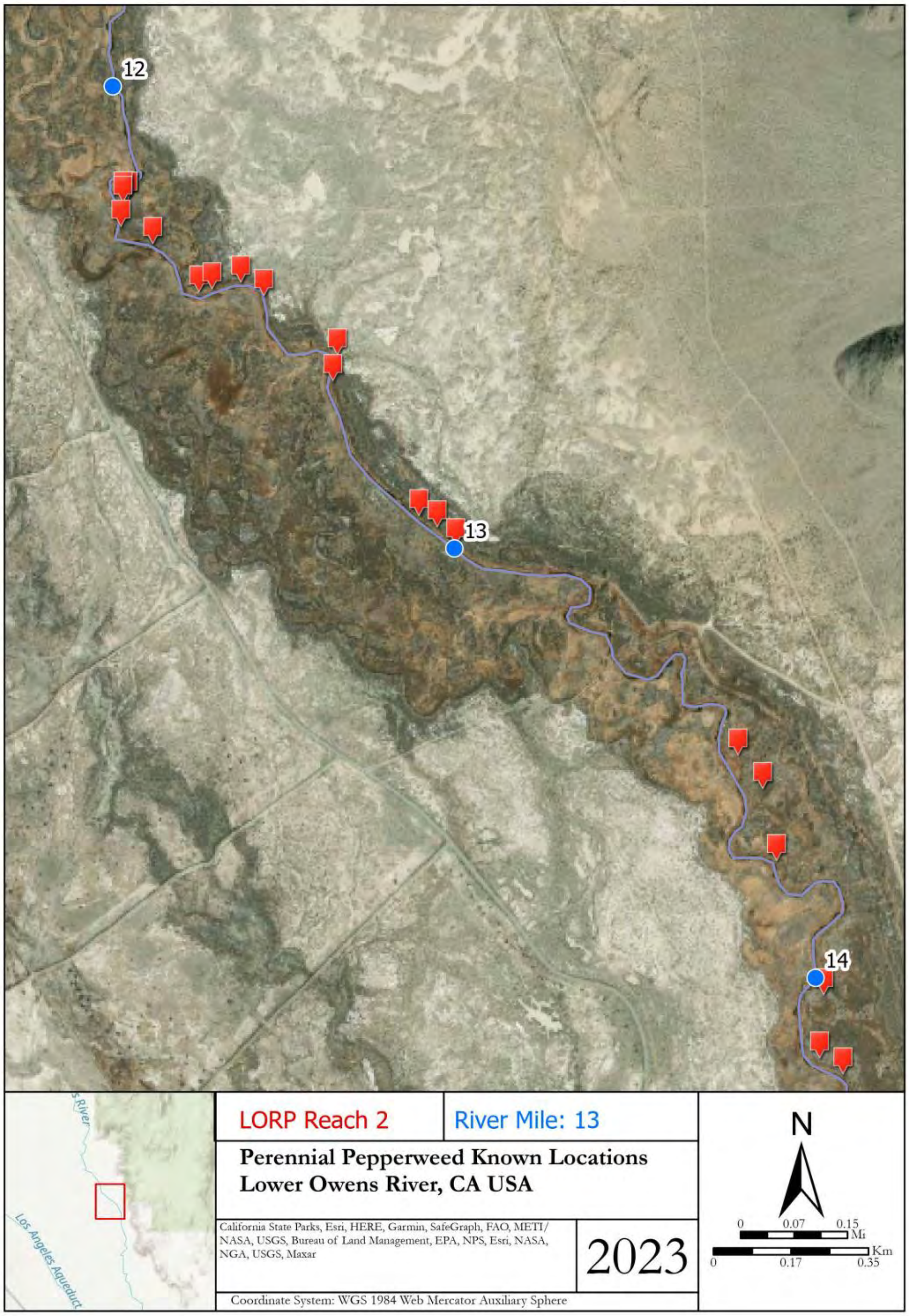

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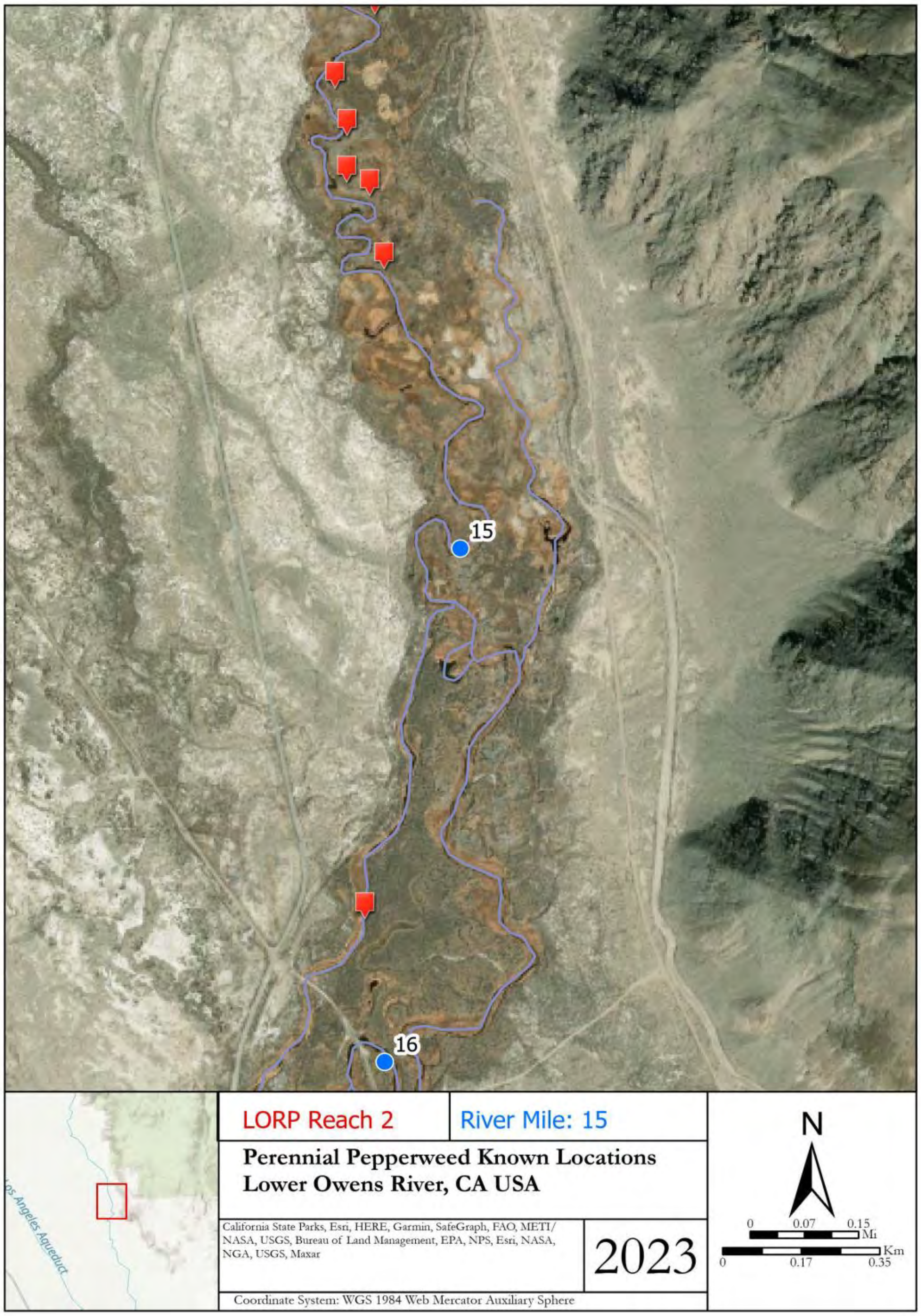
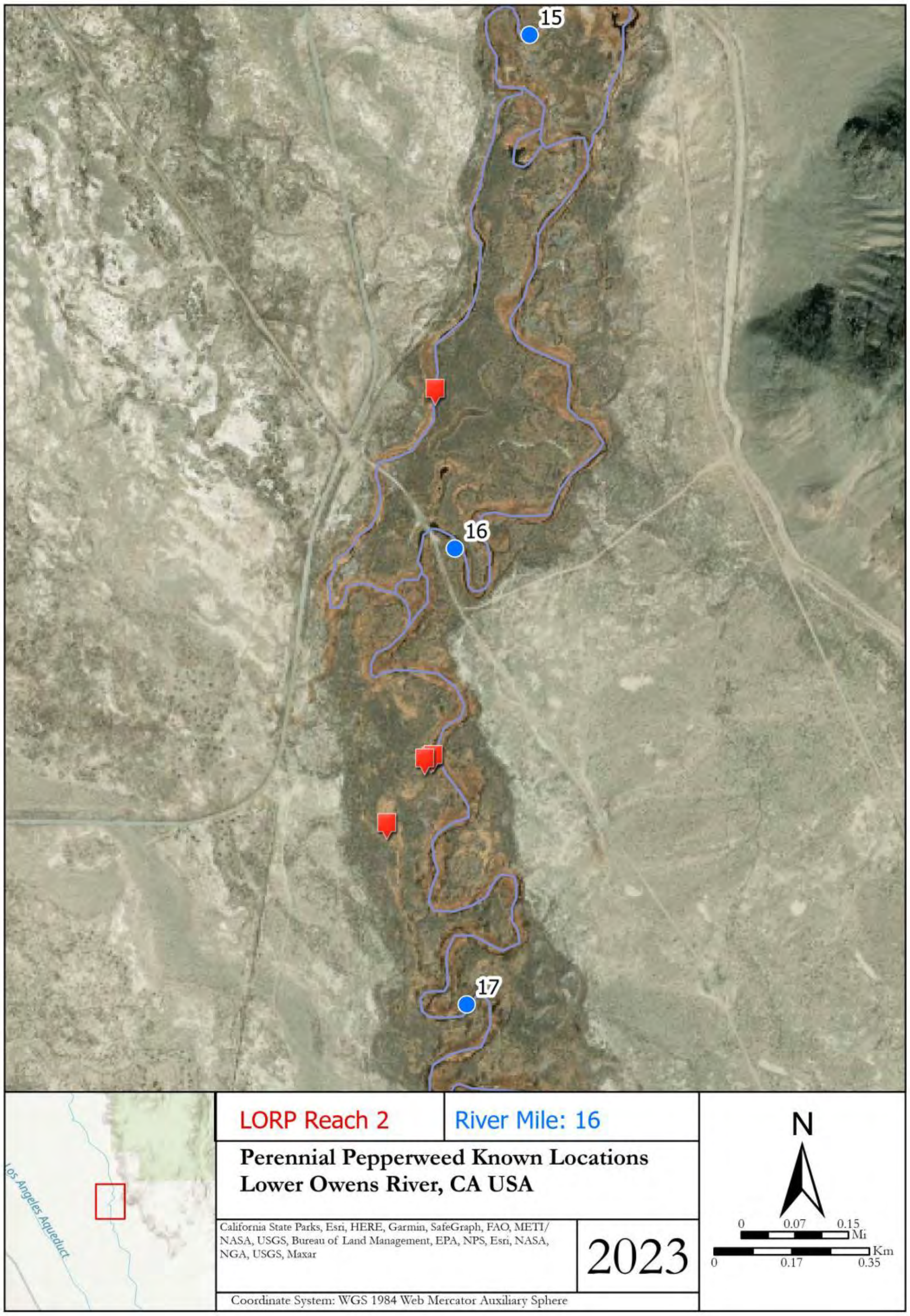


Figure 9-97. River Mile:14.

Figure 9-98. River Mile:15.



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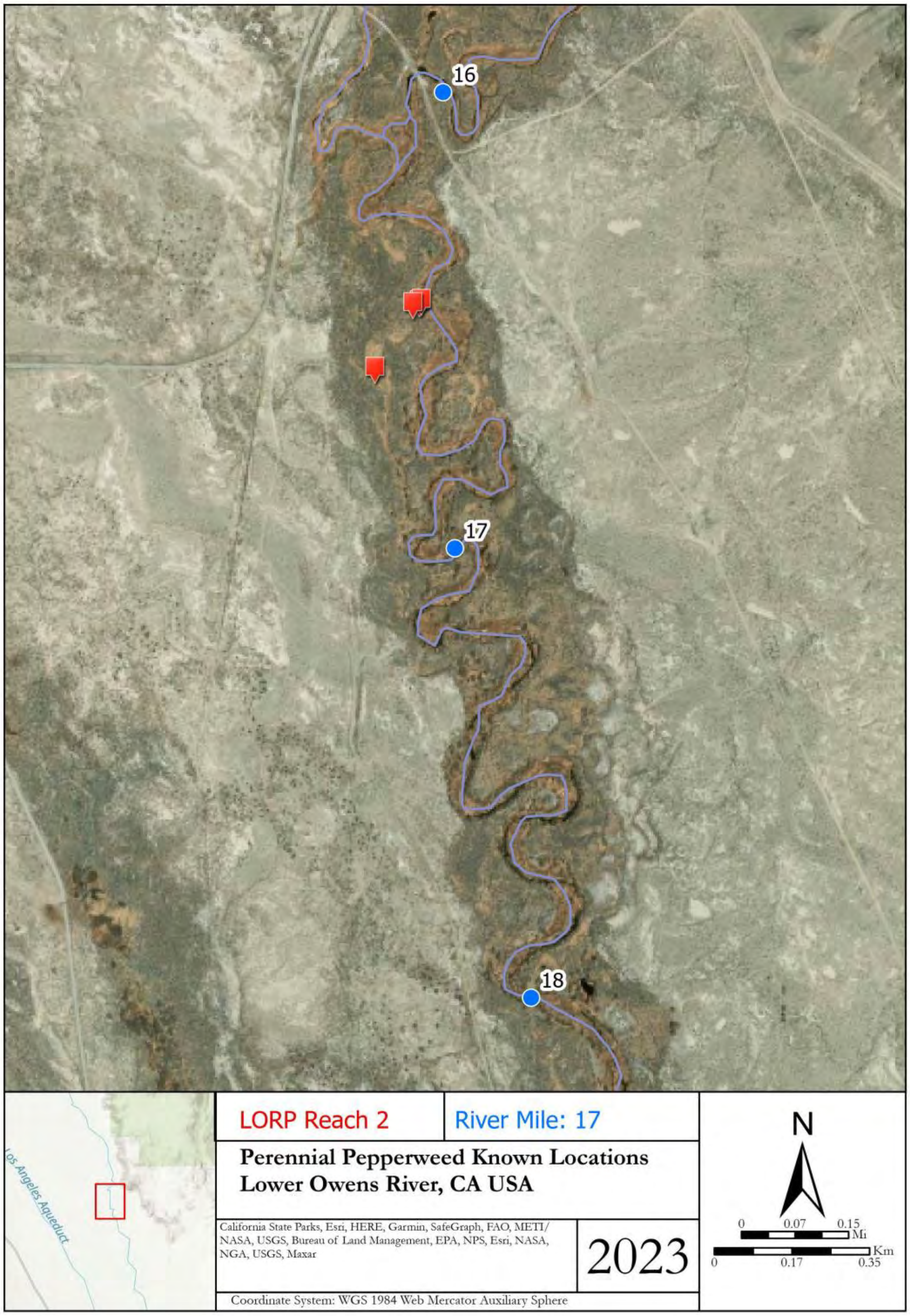
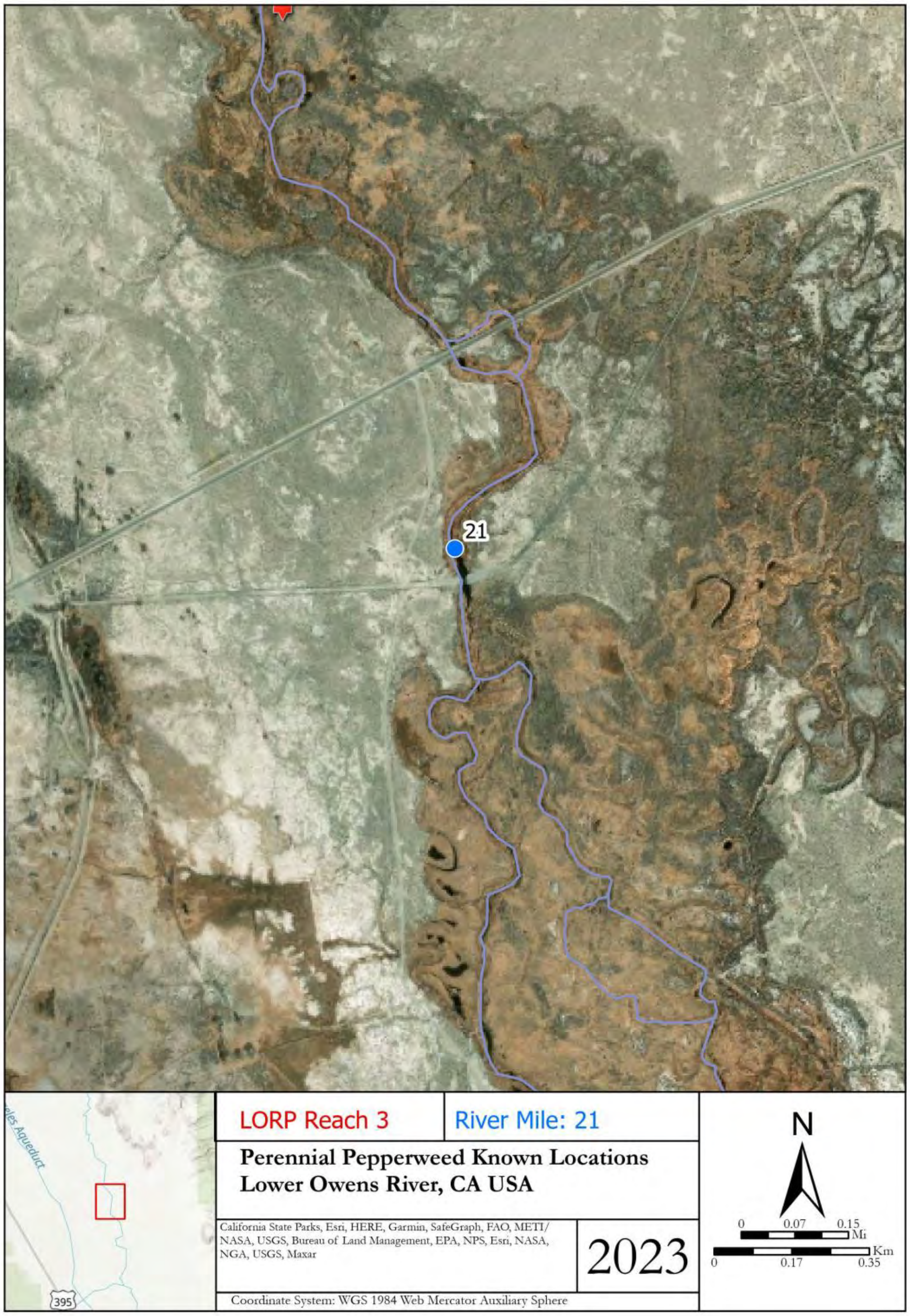


Figure 9-100. River Mile:17.

Figure 9-101. River Mile:18.

Figure 9-102. Rive Mile:19.

Figure 9-103. River Mile:20.



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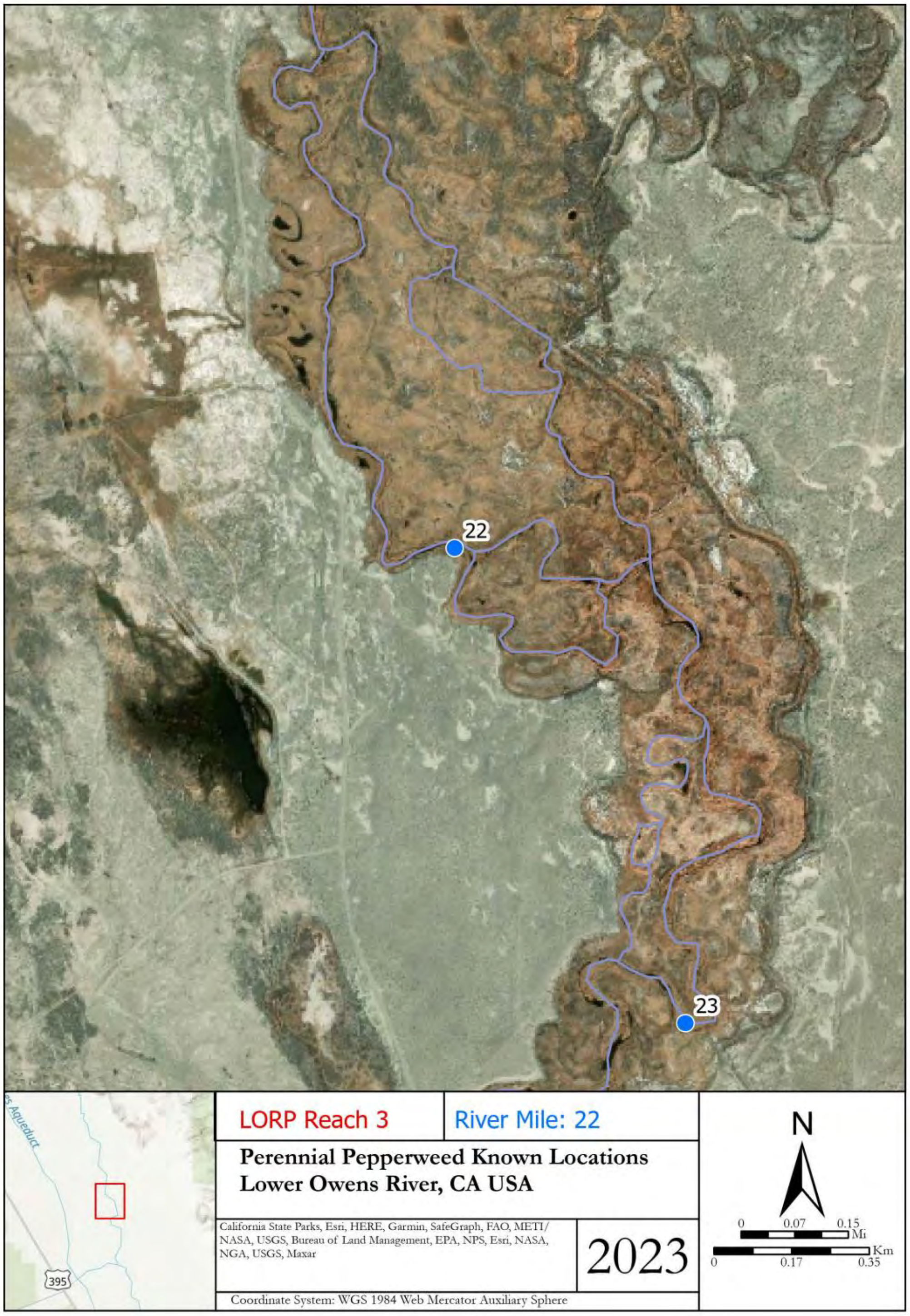

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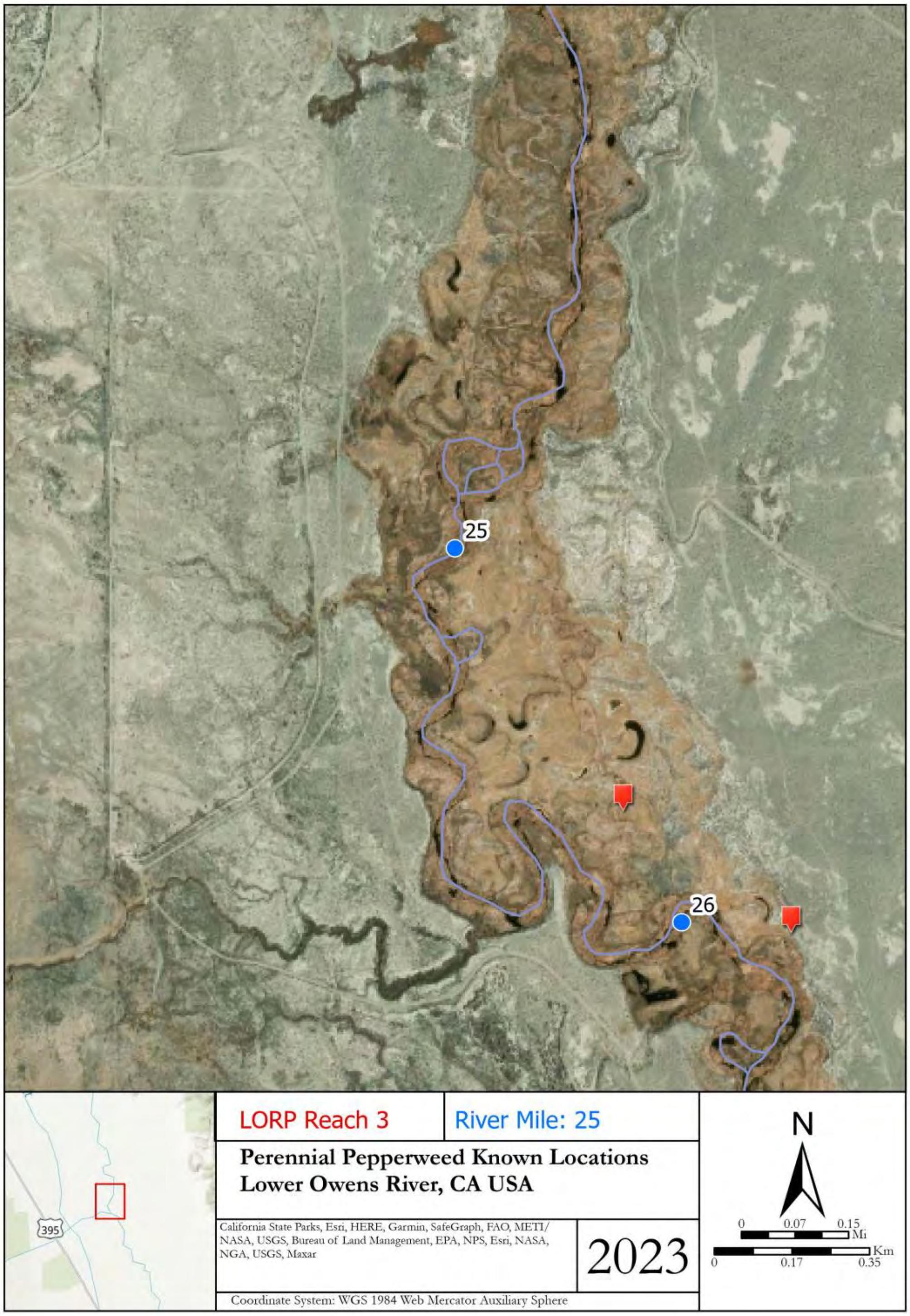
Figure 9-106. River Mile:23.

Figure 9-107. River Mile:24.



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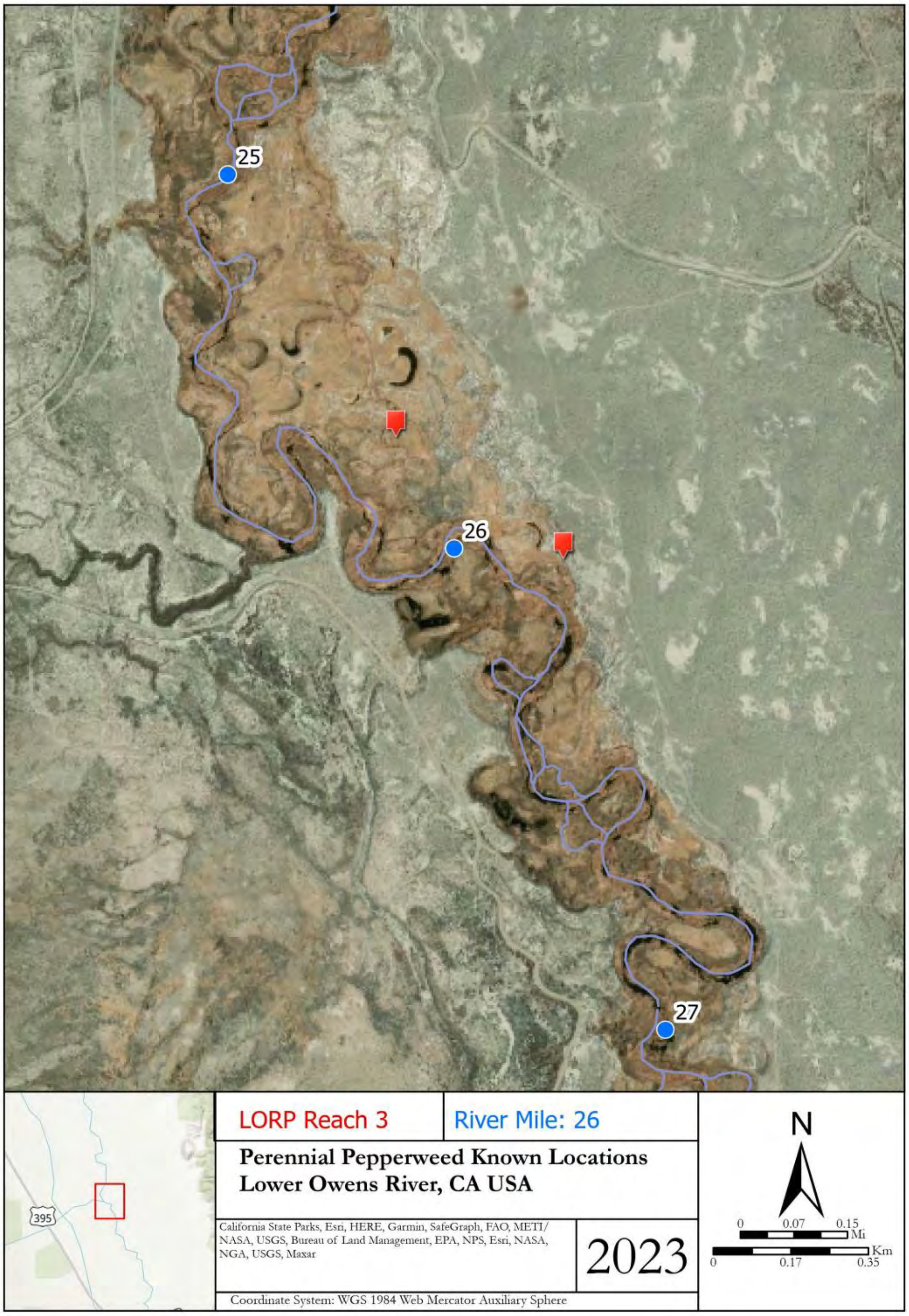

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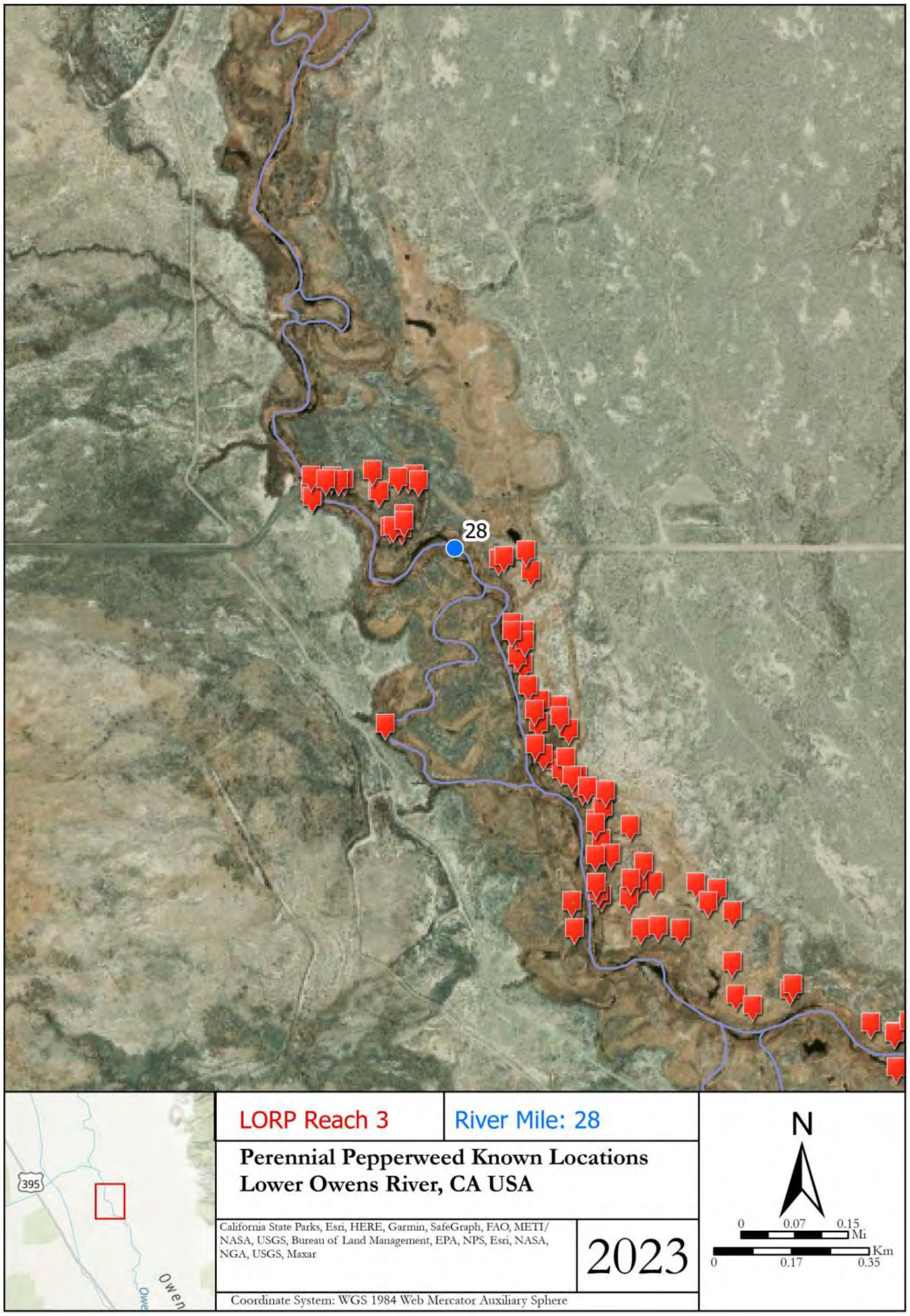
Figure 9-110. River Mile:27.



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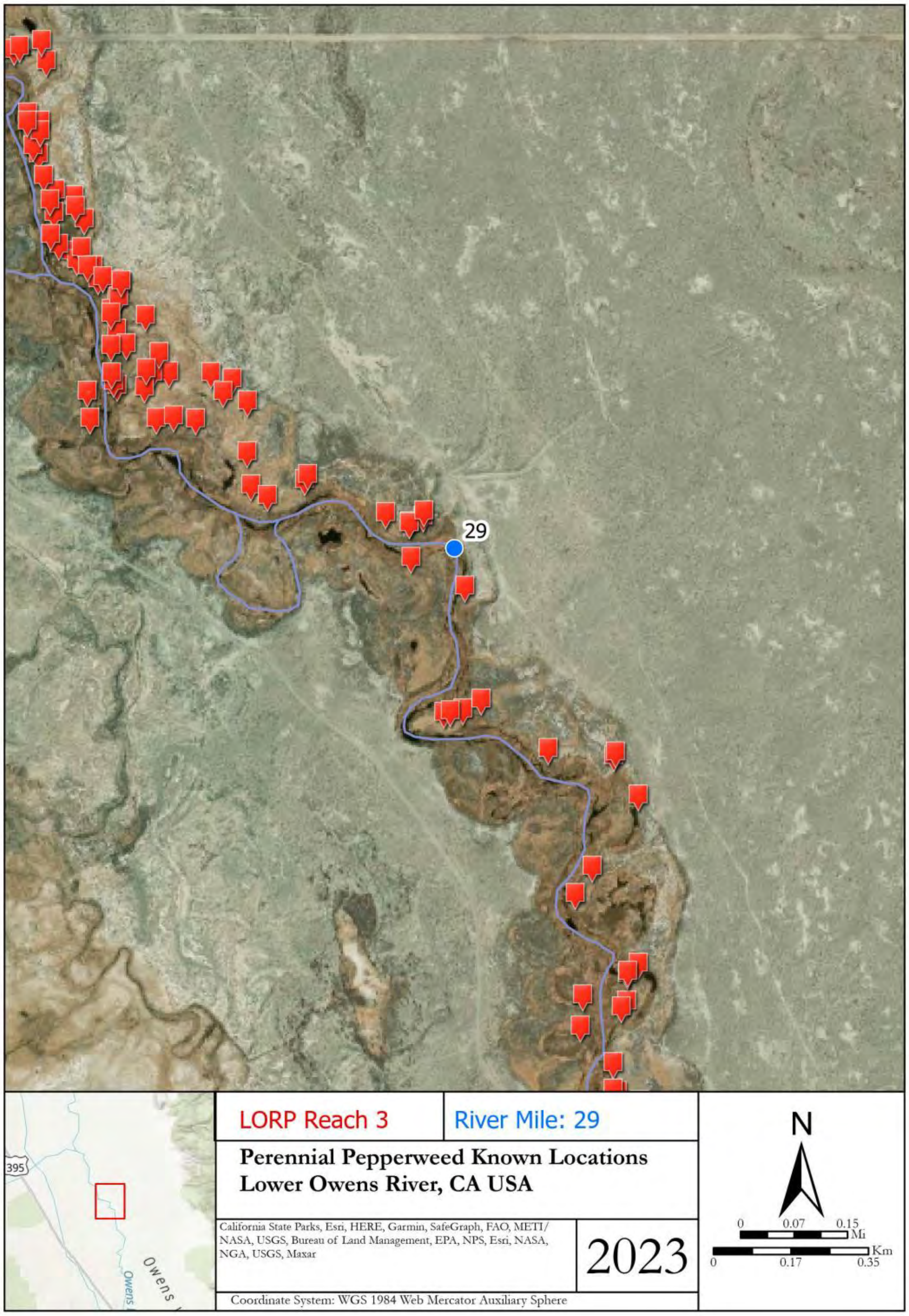

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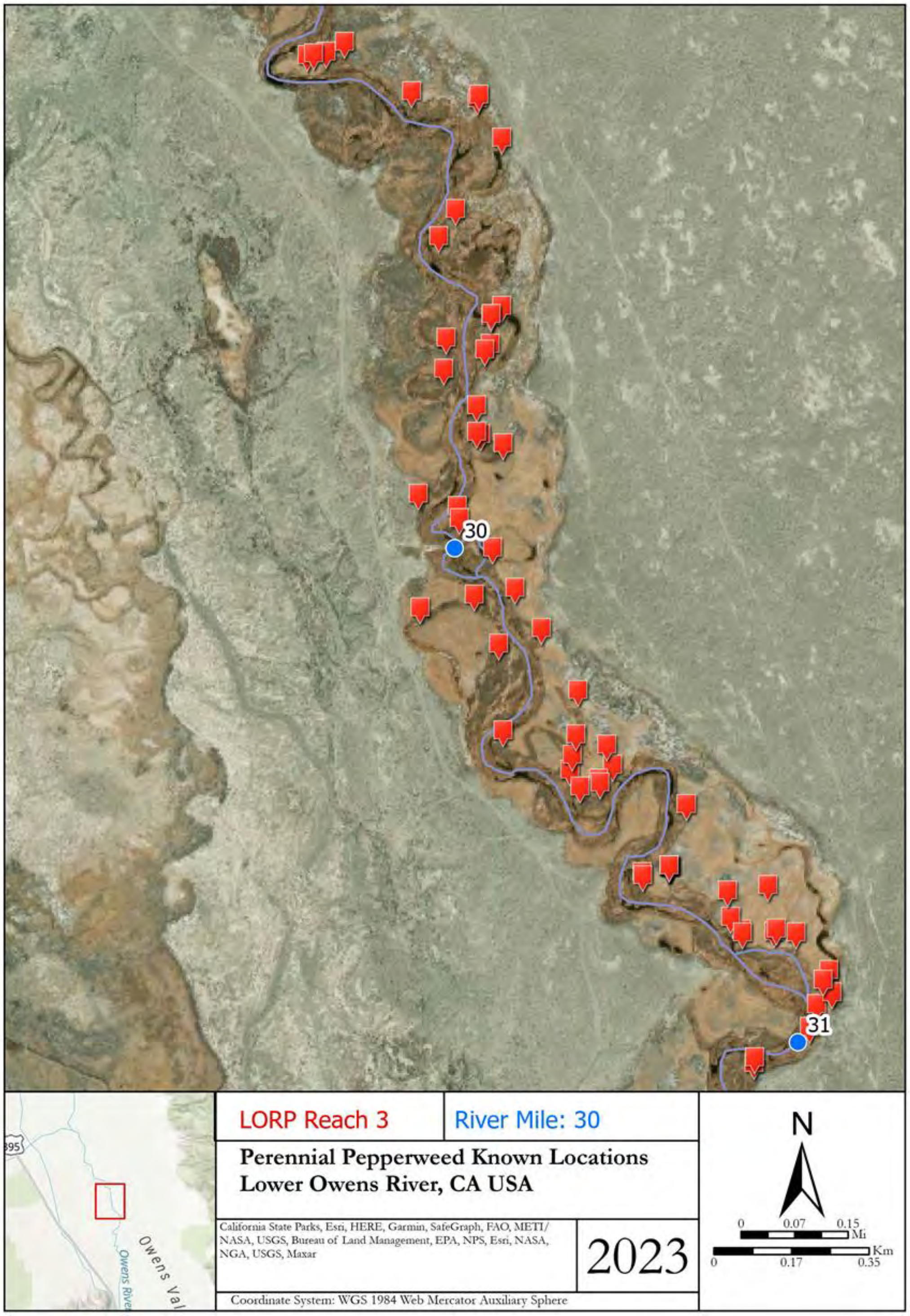

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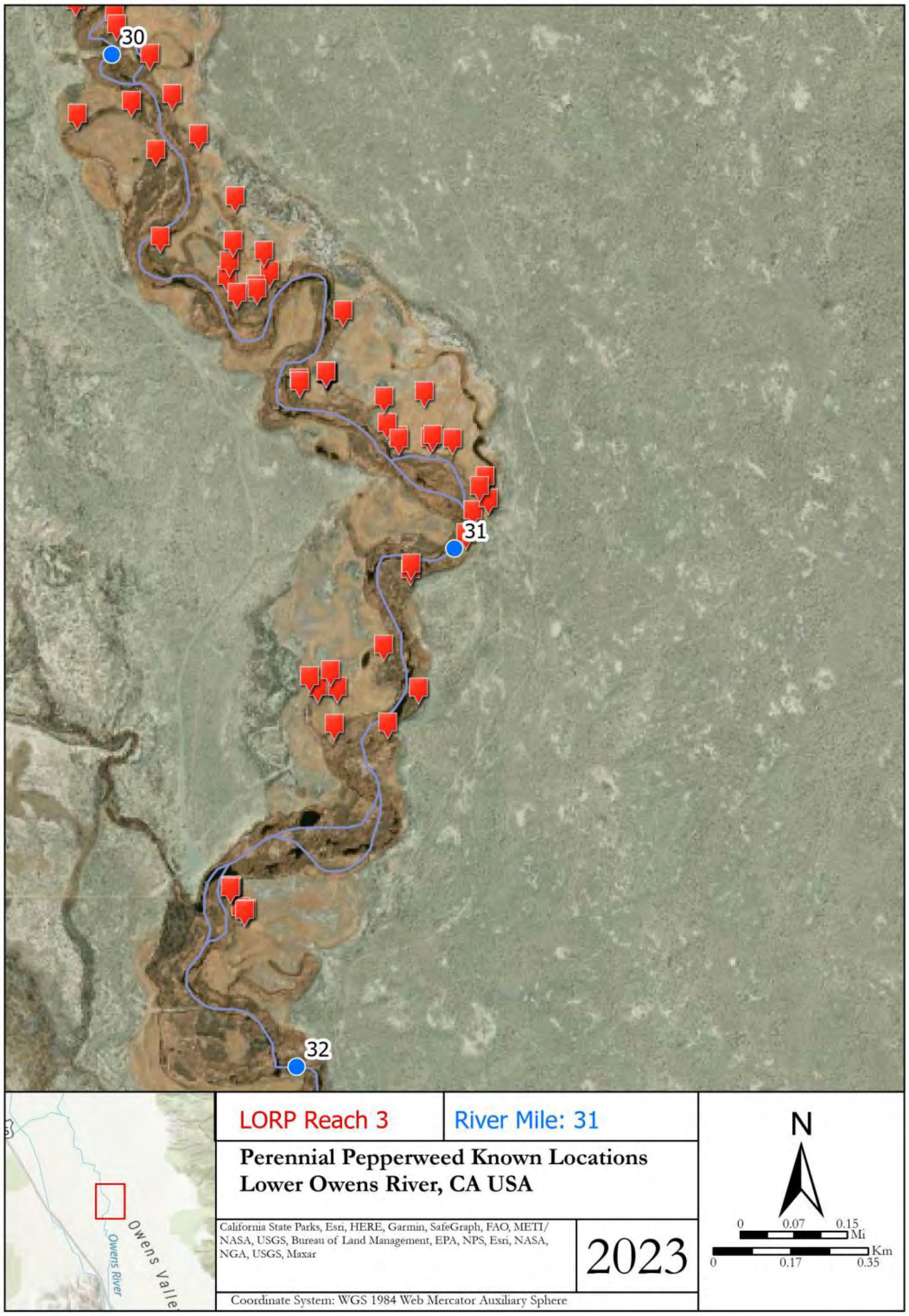

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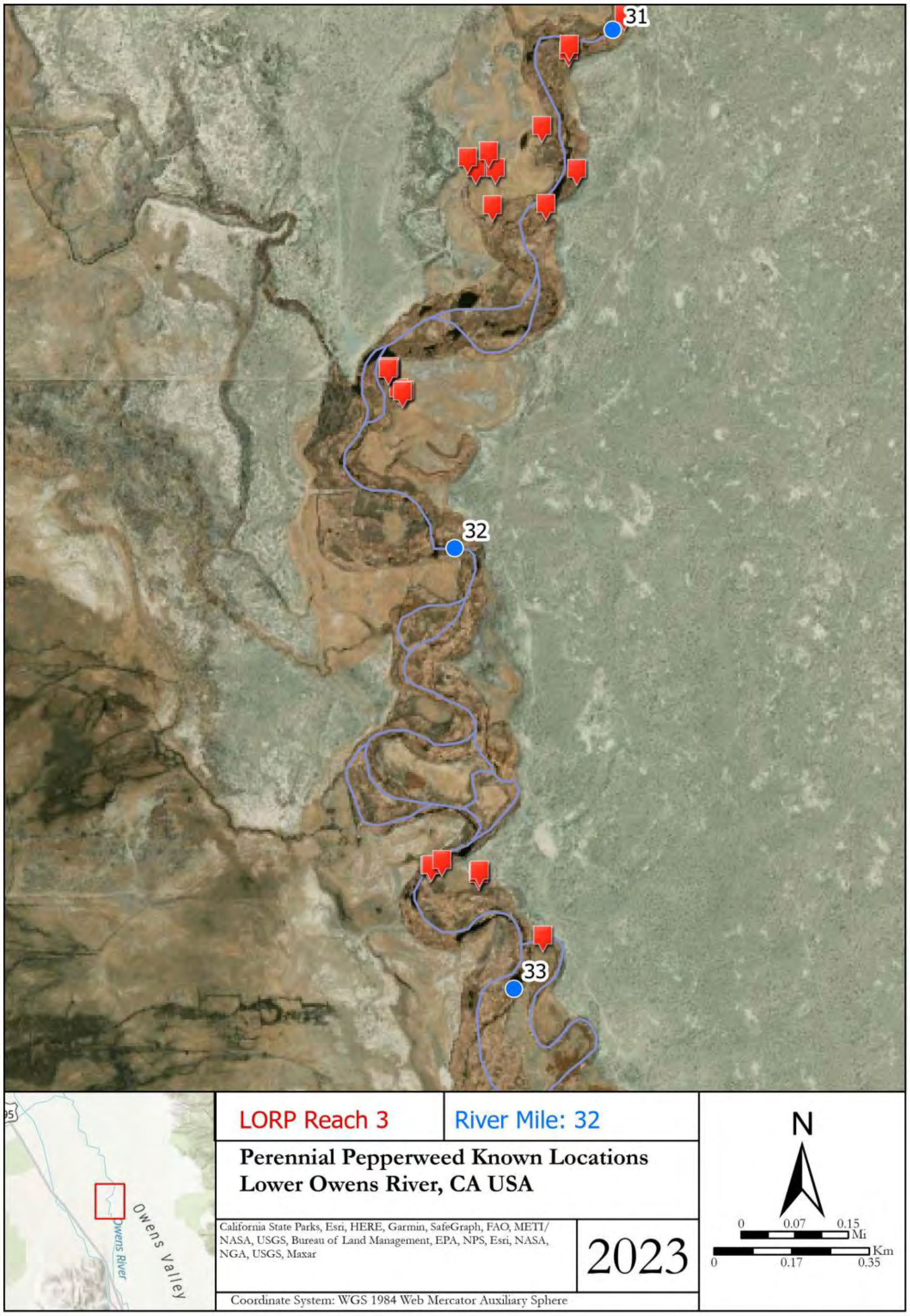

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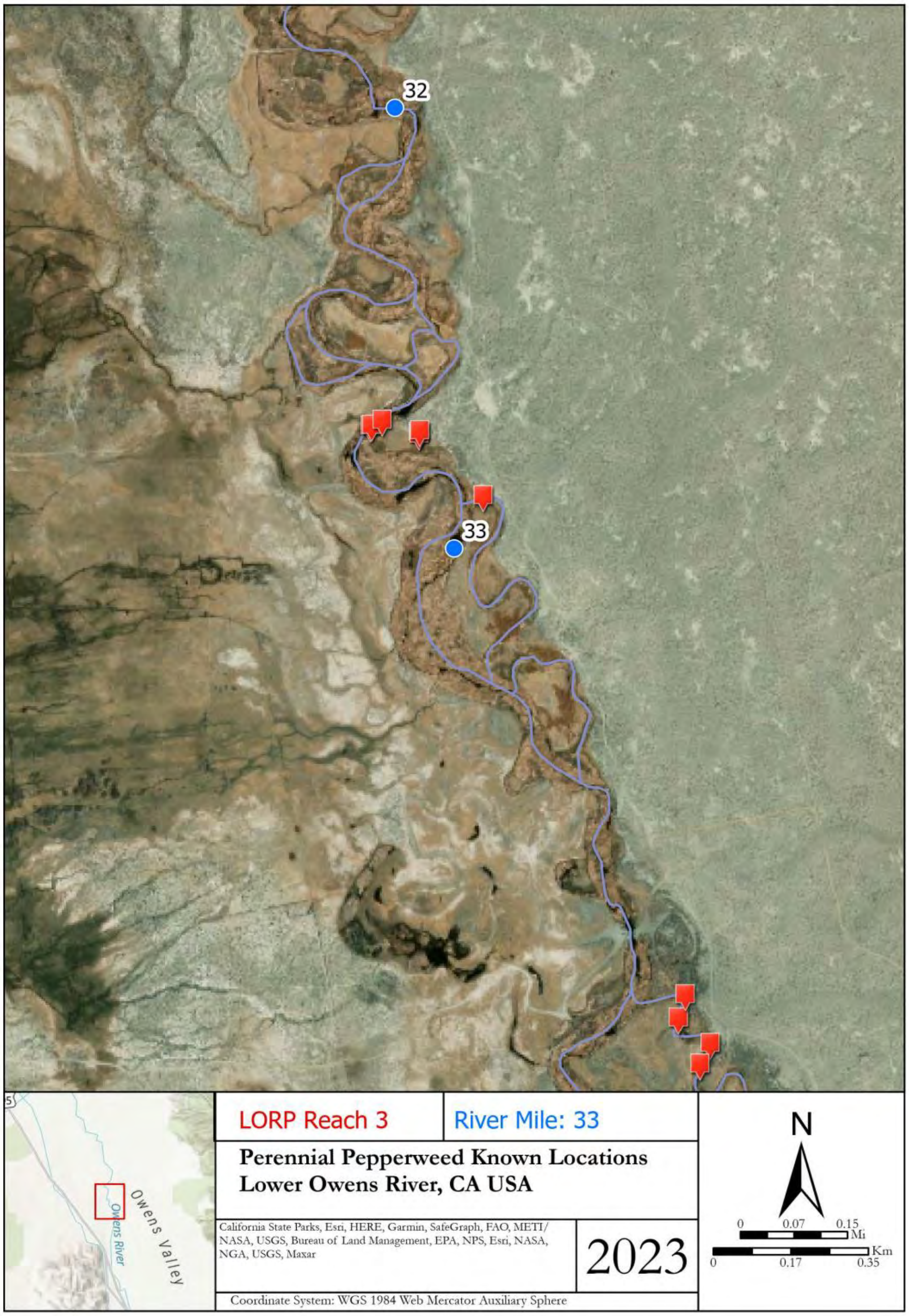

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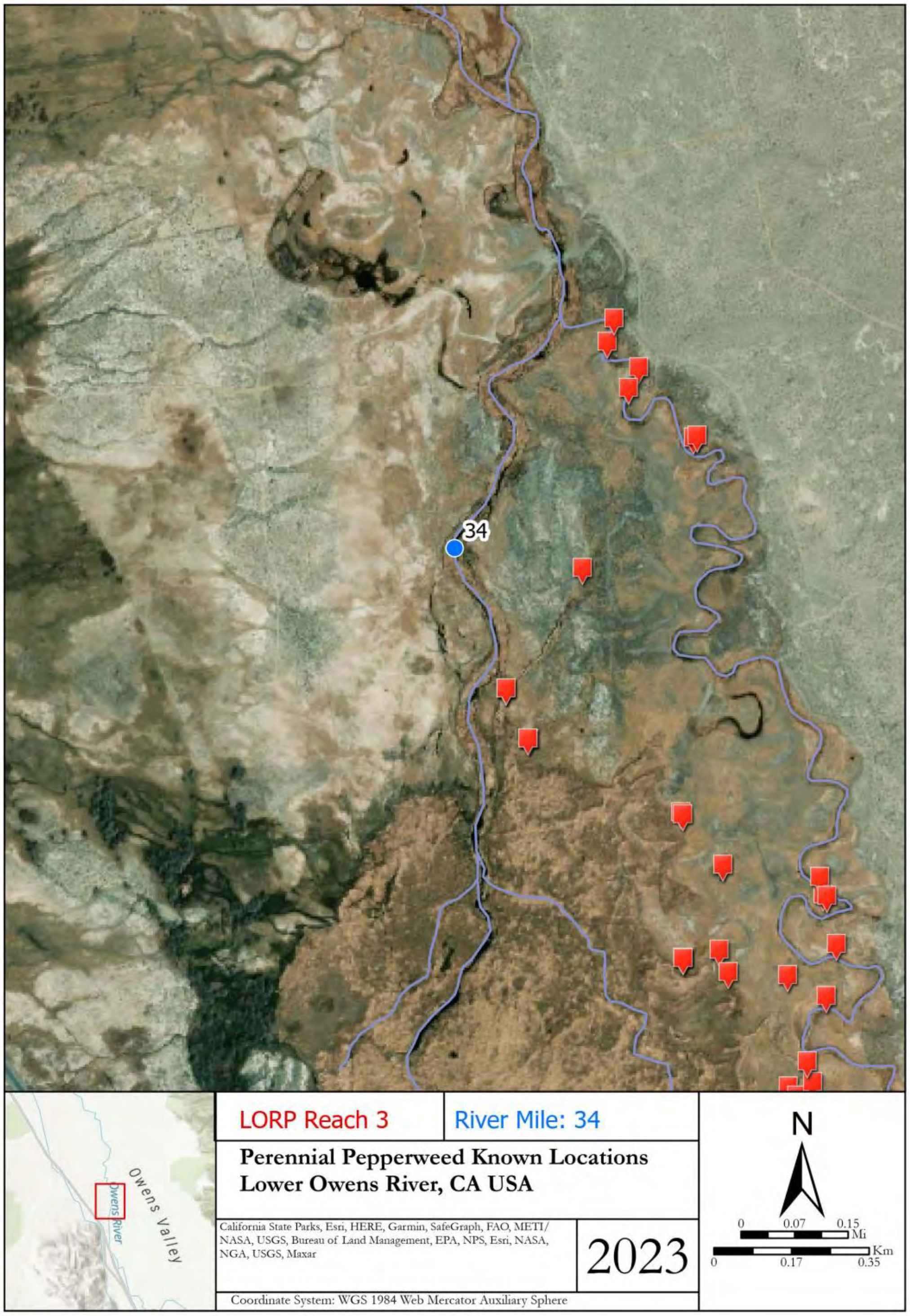

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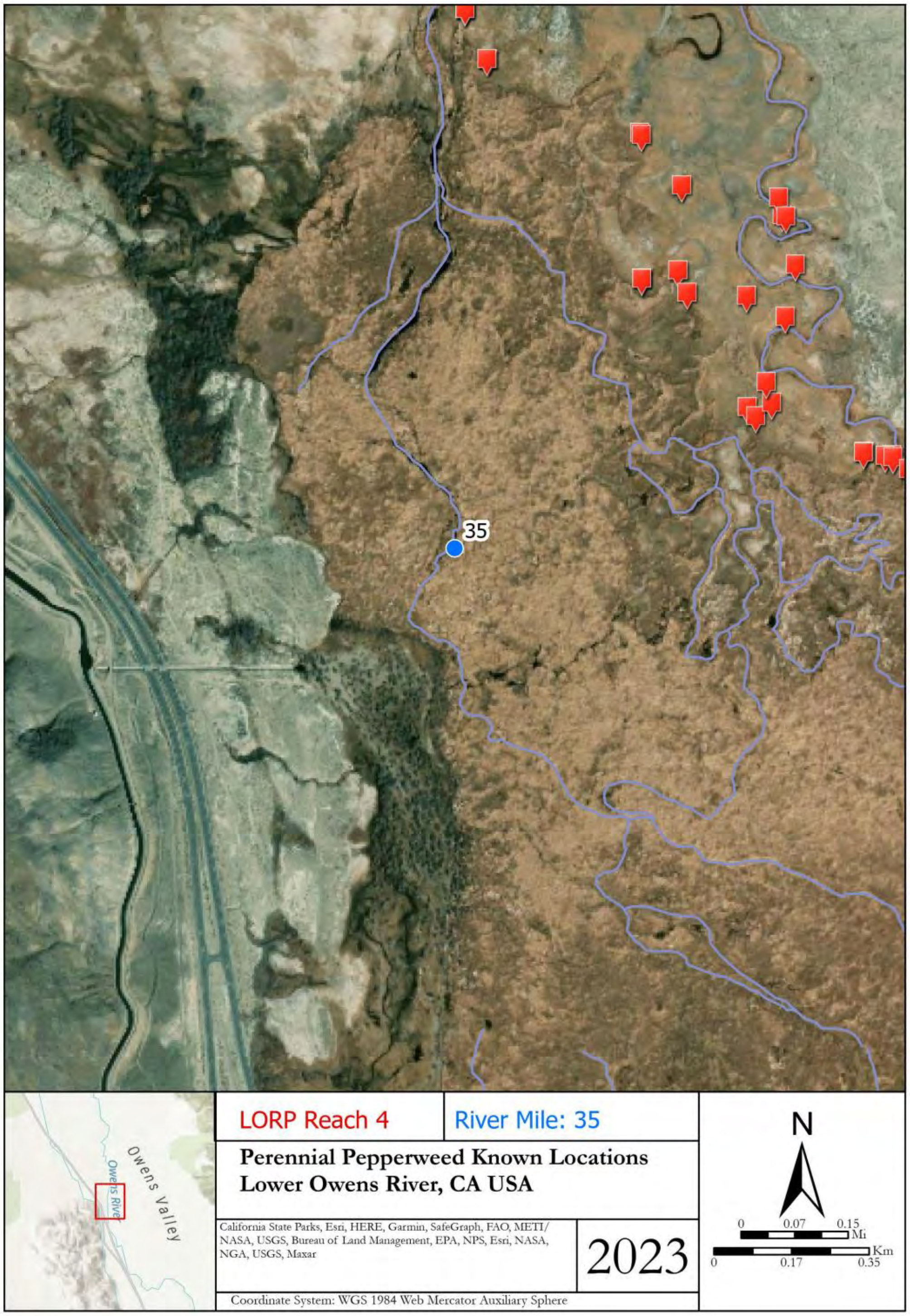
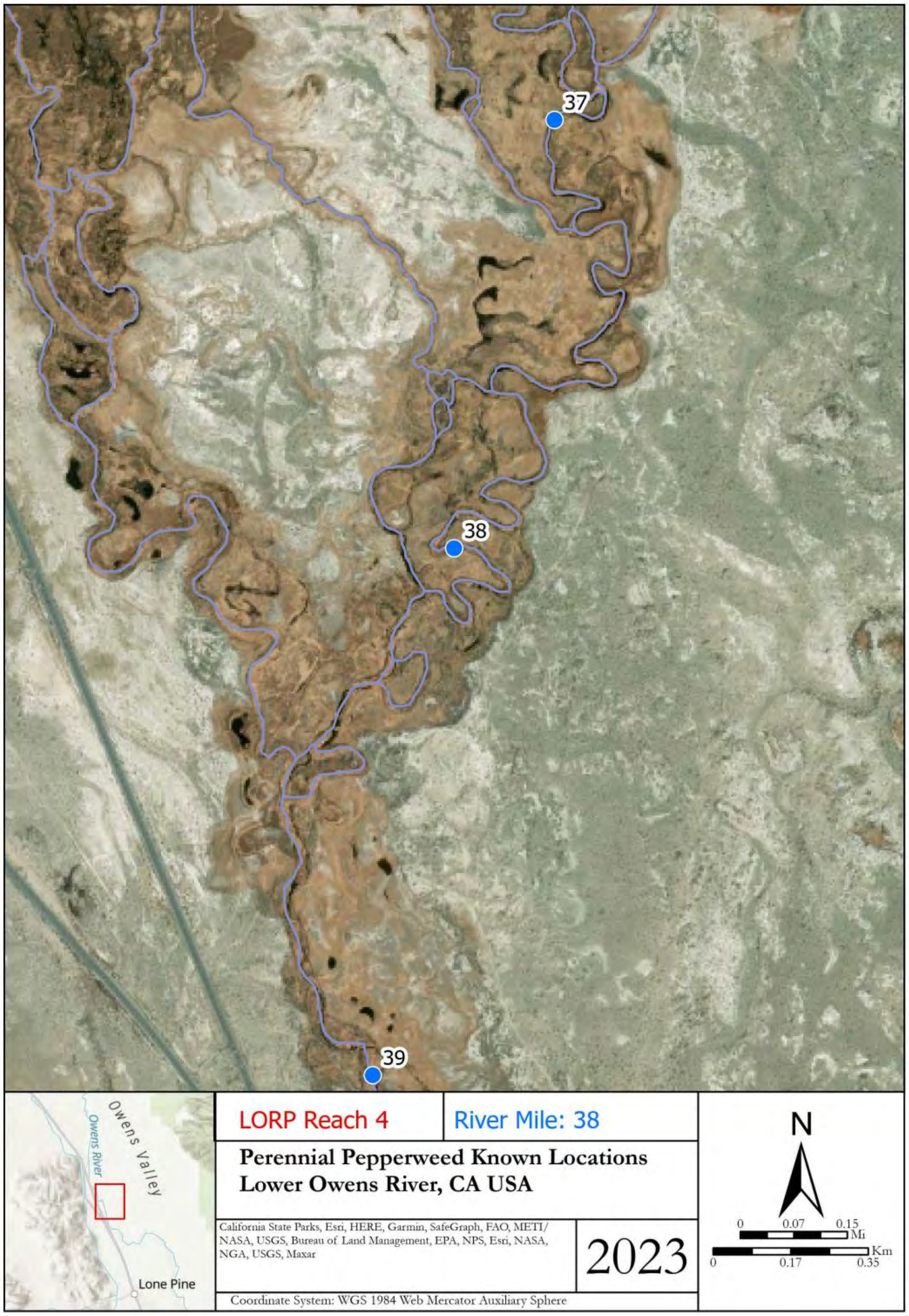


Figure 9-118. River Mile:35.

Figure 9-119. River Mile:36.

Figure 9-120. River Mile 37.



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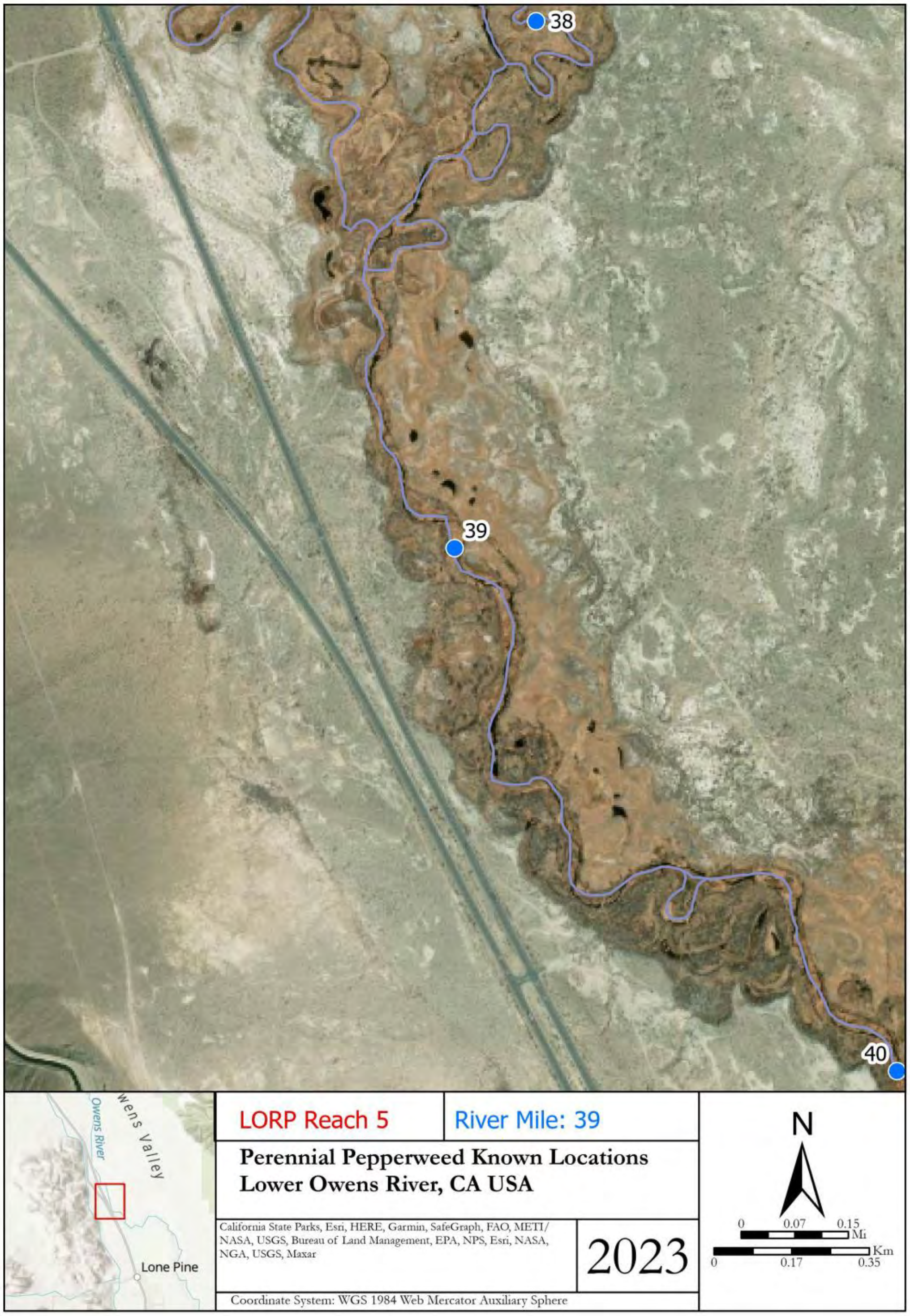

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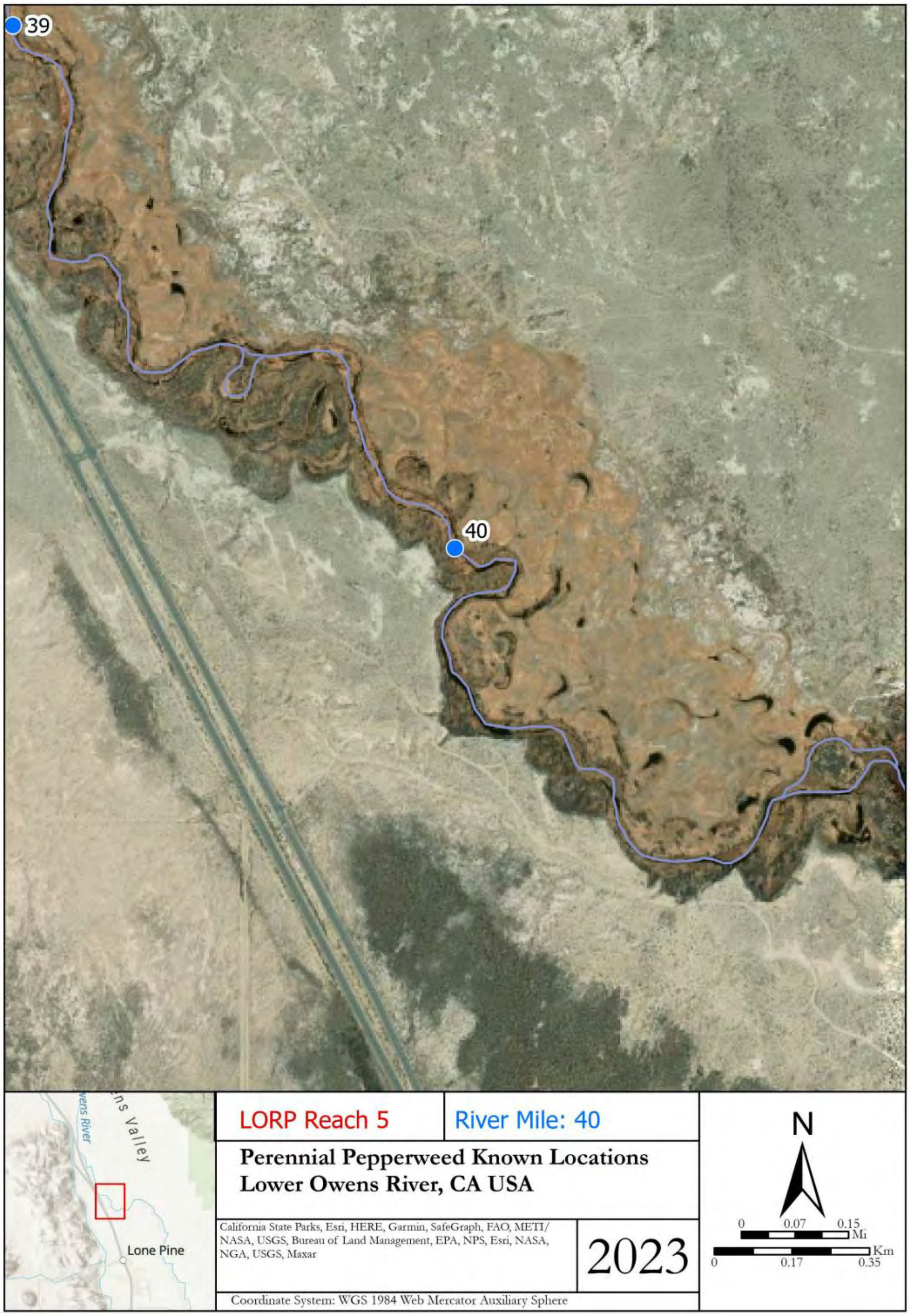


Figure 9-123. River Mile:40.

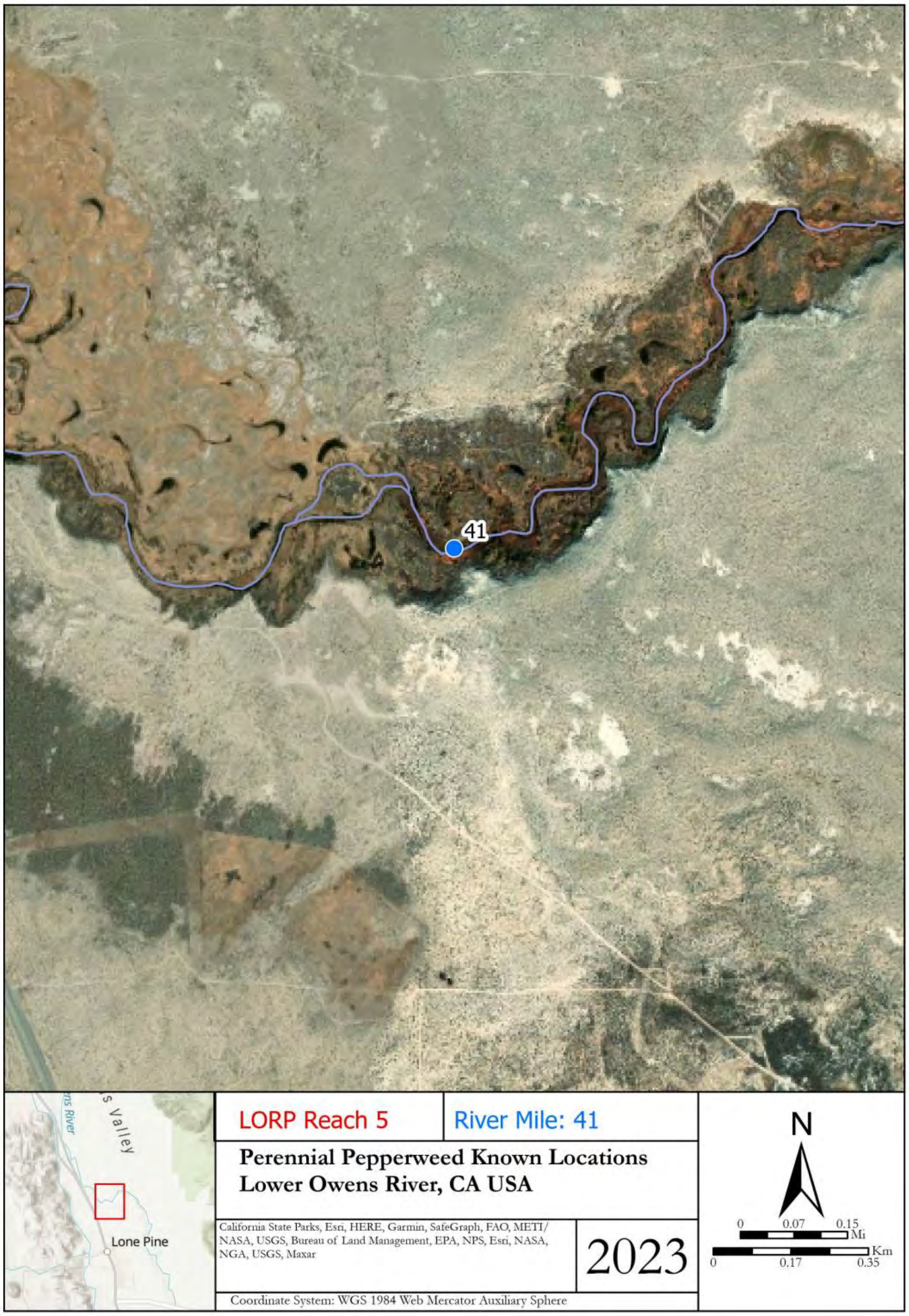
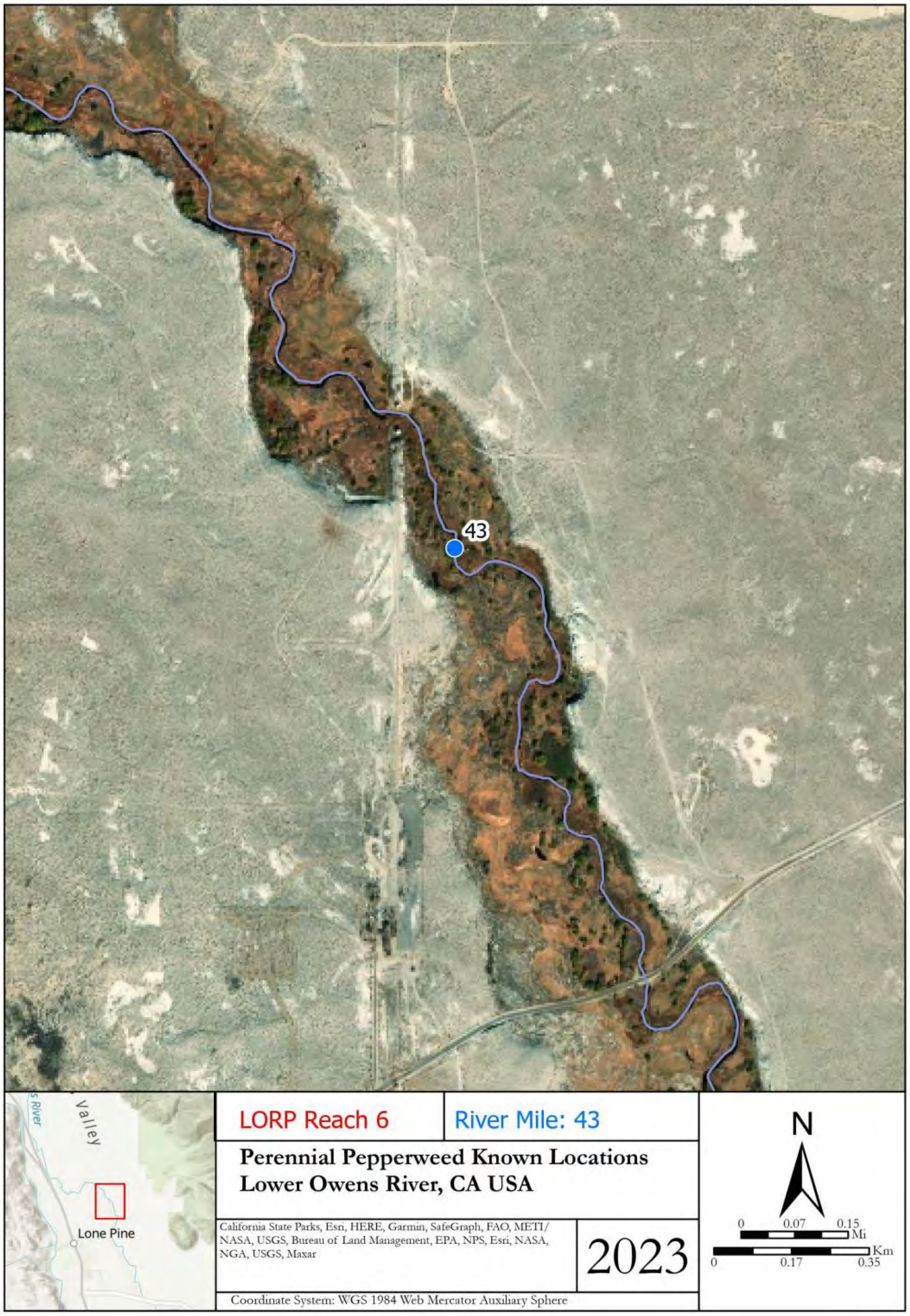


Figure 9-124. River Mile:41.

Figure 9-125. River Mile:42.



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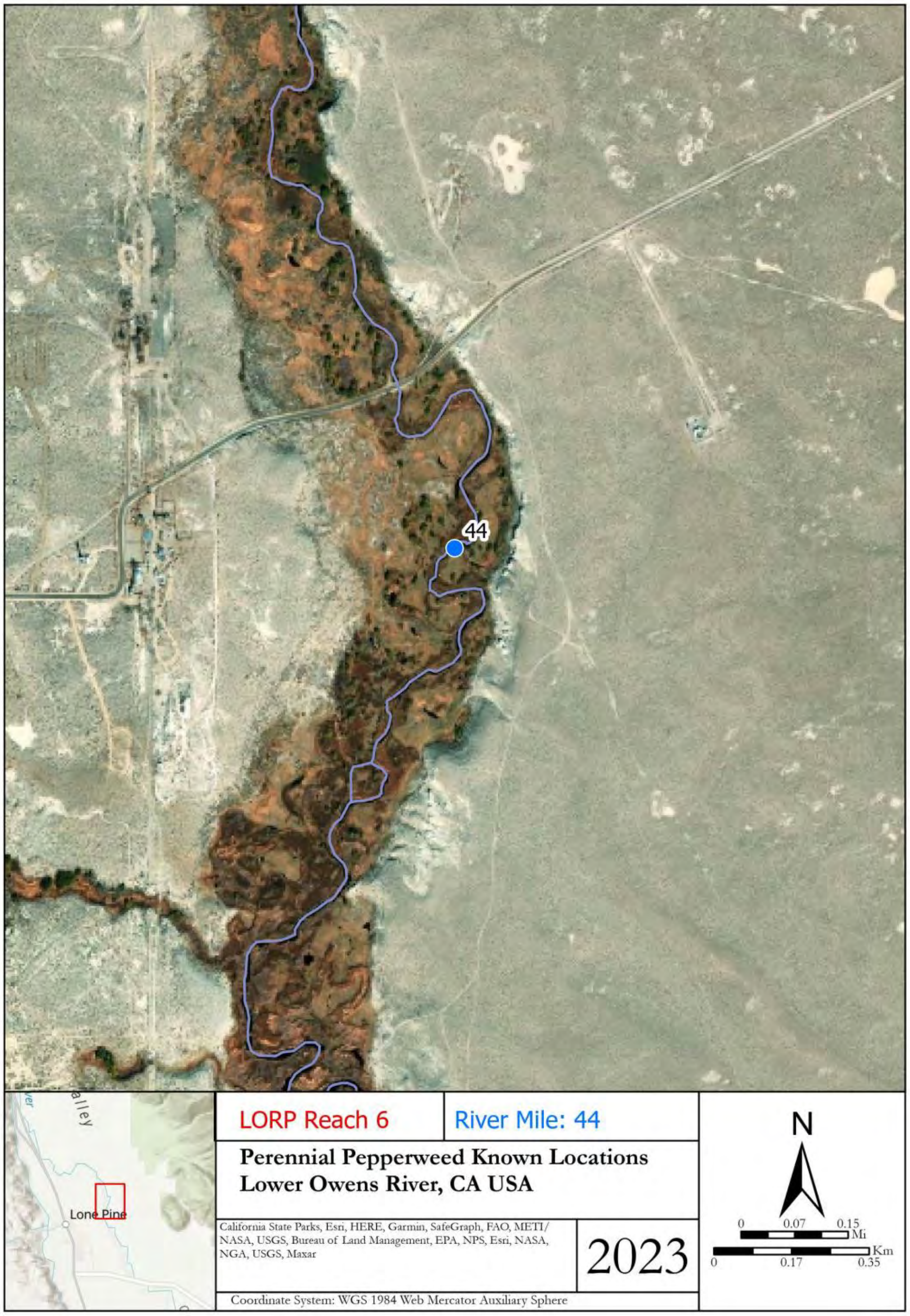

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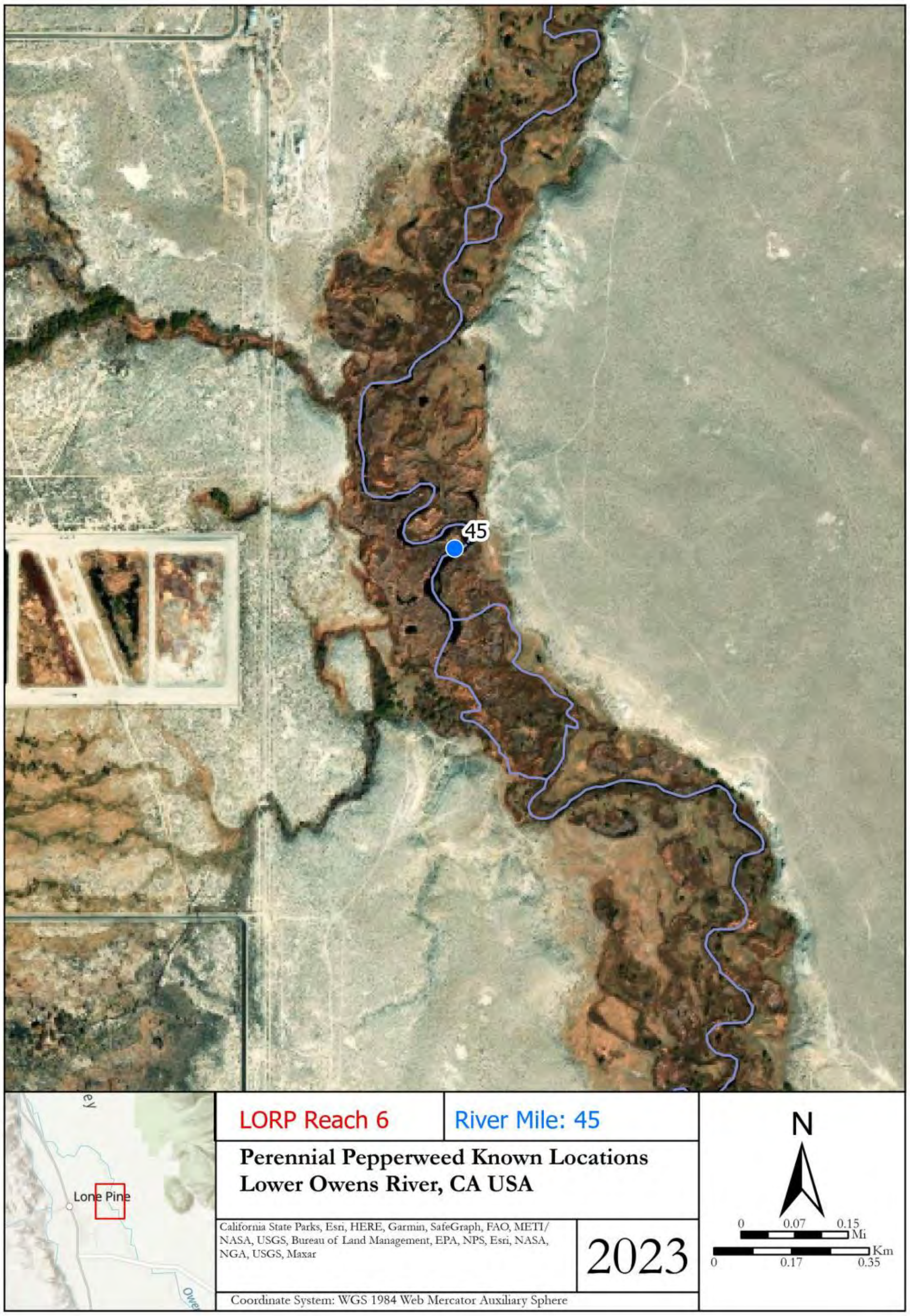


Figure 9-128. River Mile:45.

Figure 9-129. River Mile:46.

Figure 9-130. River Mile:47.

Figure 9-131. River Mile:48.

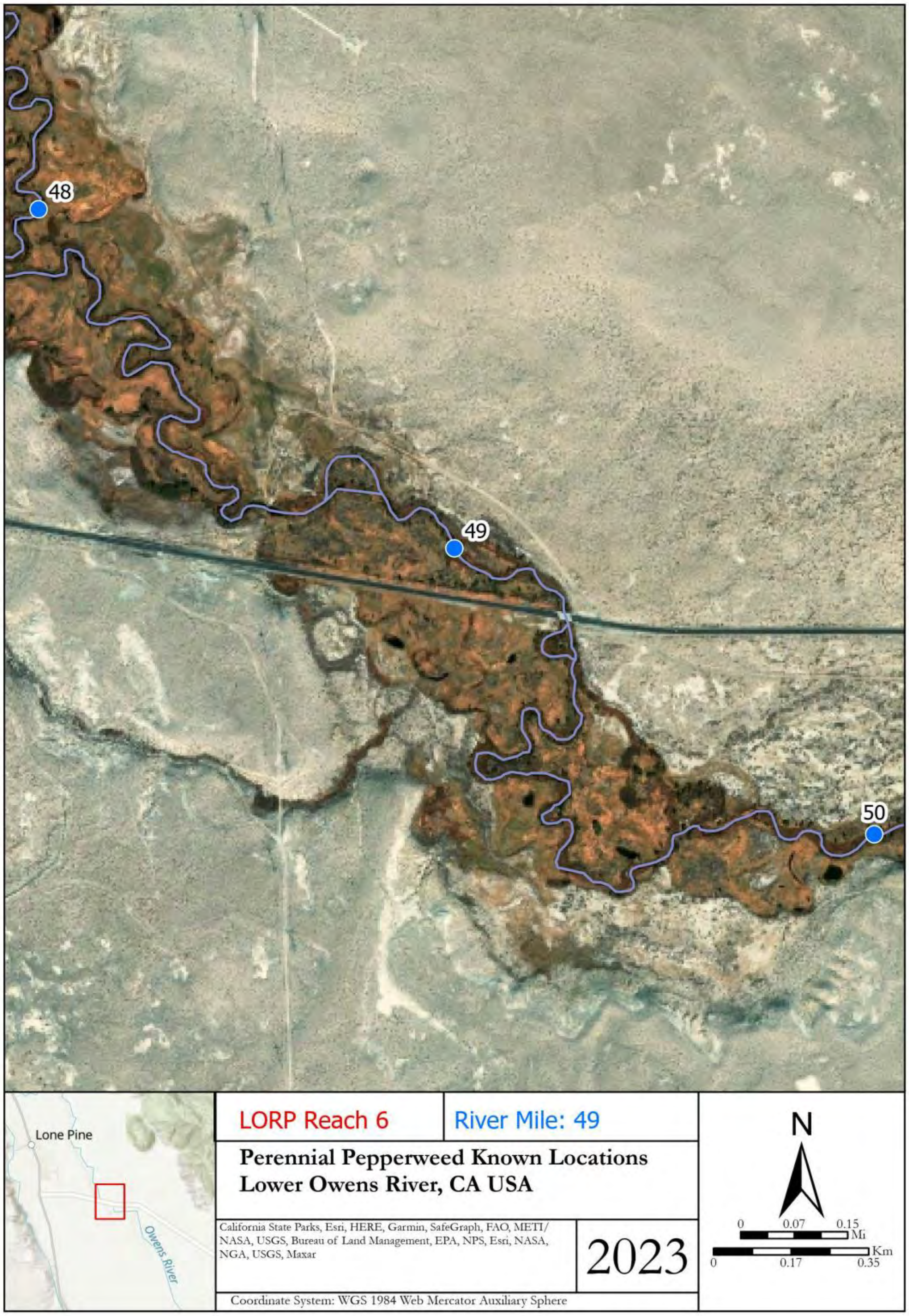


Figure 9-132. River Mile:49.

Figure 9-133. River Mile:50.

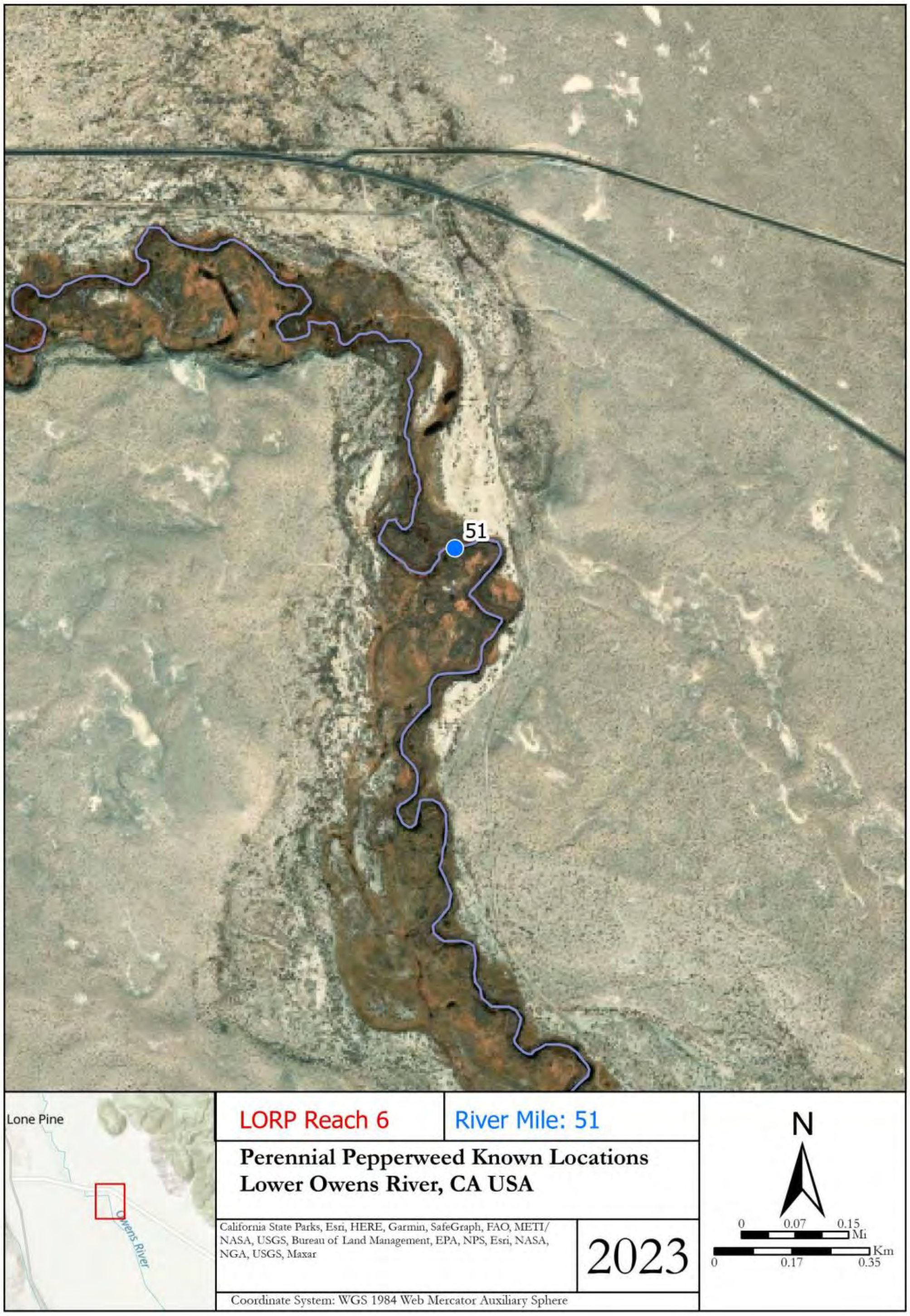


Figure 9-134. River Mile:51.

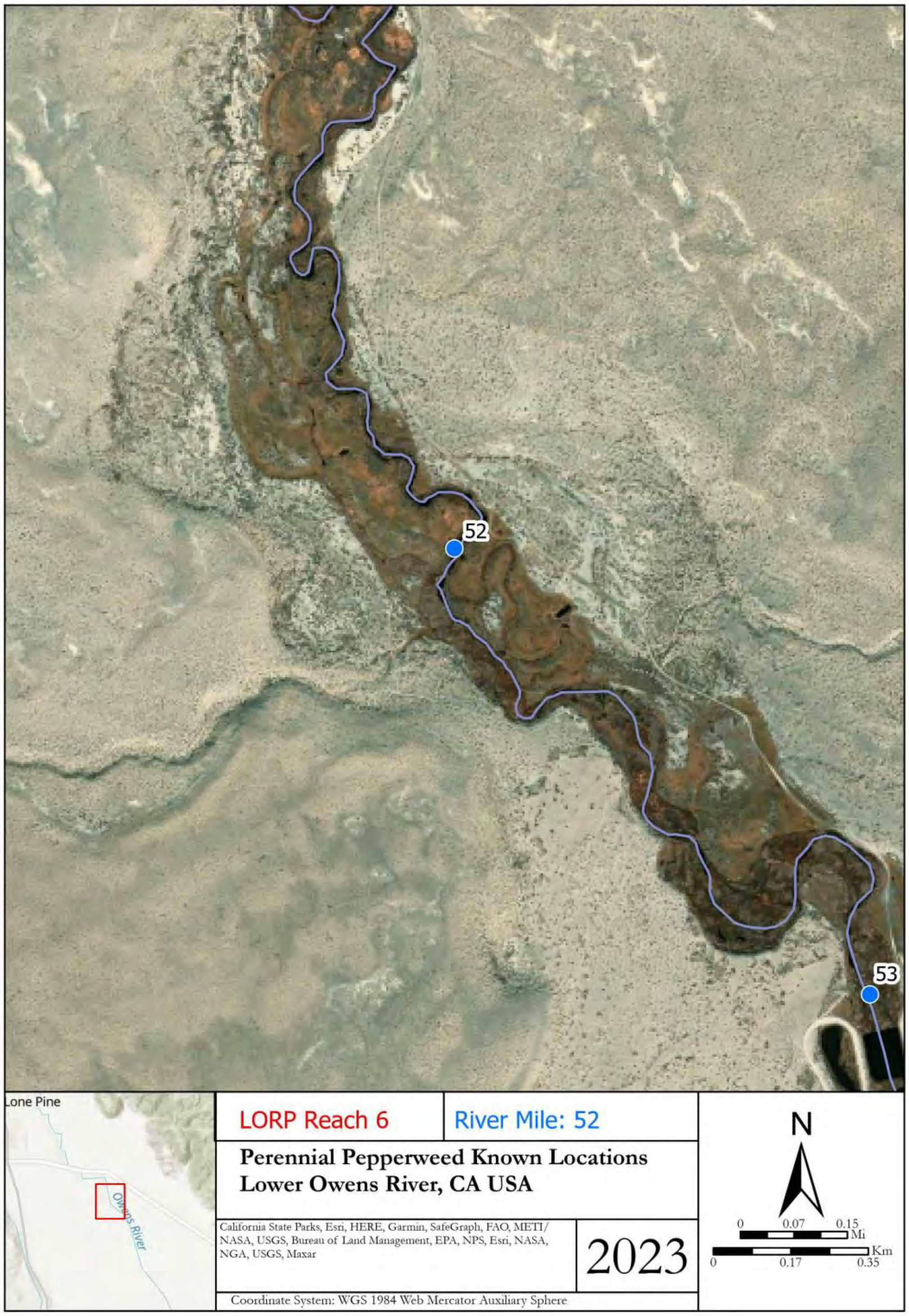
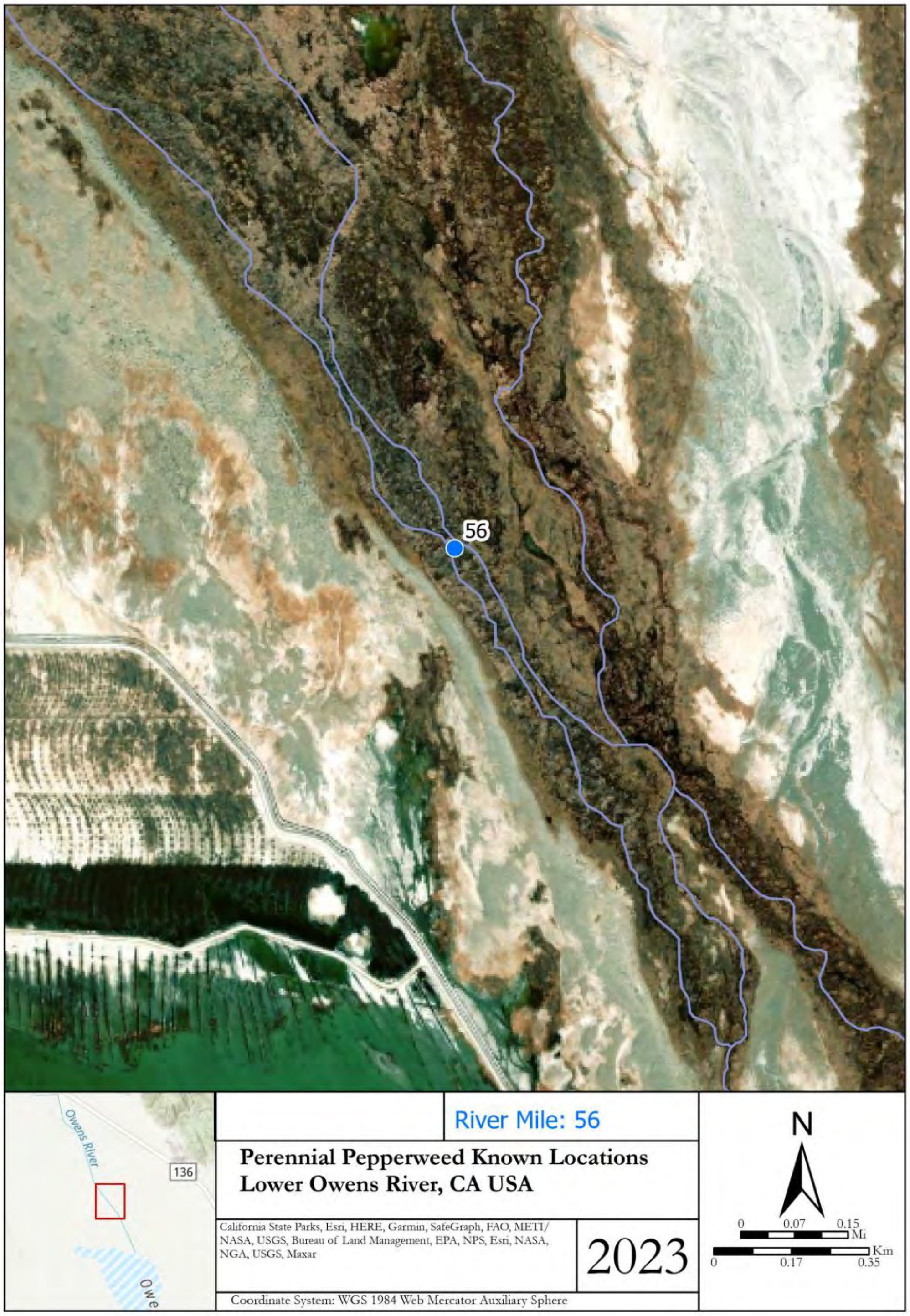


Figure 9-135. River Mile:52.

Figure 9-136. River Mile:53.

Figure 9-137. River Mile:54.

Figure 9-138. River Mile:55.



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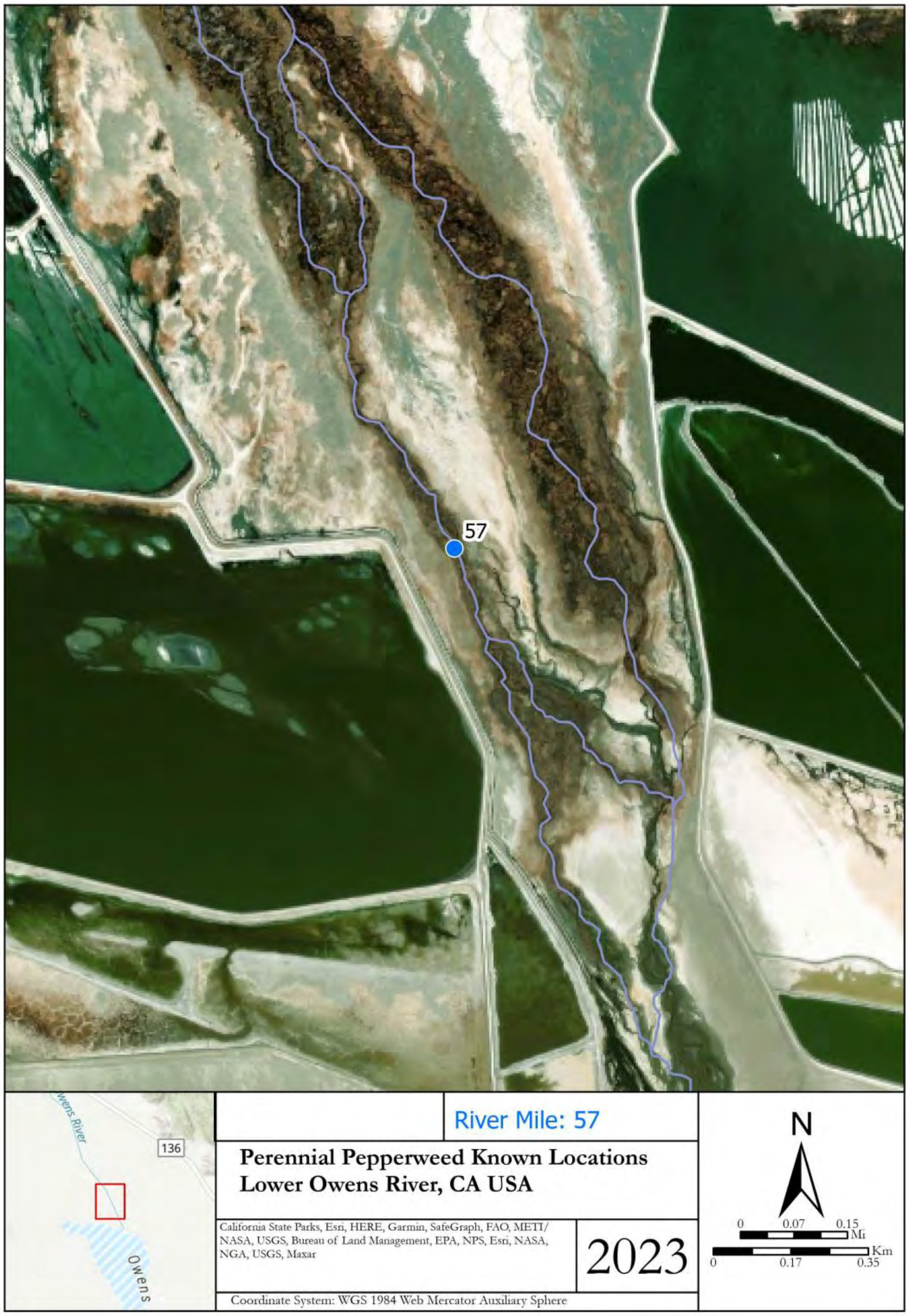

Figure 9-140. River Mile:57.

10.0 Public Meeting and Comments

10.1 LORP Annual Public Meeting

The LORP 2022 Draft Annual Report public meeting was held on June 22, 2023 in person and via WebEx at the Los Angeles Department of Water and Power's Bishop Administrative Office Multipurpose room at 10 a.m. An audio recording of the meeting can be made available upon request. The 2022 LORP Annual Report presentations given by both LADWP and ICWD staff are provided in the LORP Public Meeting Appendix 2.

10.2 LORP 2022 Draft Annual Report Comments

The comment period for the LORP 2022 Draft Annual Report was from June 22, 2023 to July 7, 2023. CDFW requested an extension for comments and was granted through Adam Perez. Comment letters were received from the Sierra Club and CDFW and are provided in Appendix 1. Both LADWP and ICWD did not provide responses to the letters, as they are awaiting the findings of the 2023 field season, which will be presented in the forthcoming 2023 LORP Annual Report.

10.3 Appendices

10.3.1 Appendix 1. Comment Letters from the MOU Parties

Range of Light Group
Toiyabe Chapter, Sierra Club
Counties of Inyo and Mono, California
P.O. Box 1973, Mammoth Lakes, CA, 93546
RangeofLight.sc@gmail.com

SIERRA CLUB

July 7, 2023

Holly Alpert, Ph.D., Director
Inyo County Water Department
PO Box 337
Independence, CA 93526

Adam Perez, LA Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, CA 93515-3449

Subject: Draft Lower Owens River Project 2022 Annual Report Comments

Dear Dr. Alpert and Mr. Perez:

The Sierra Club is submitting comments on the 2022 Lower Owens River Project Annual Report. The riverine-riparian system is not a healthy, functioning ecosystem that provides the benefits to biodiversity and Threatened and Endangered Species as provided in the goals set forth for the project in the 1997 MOU (p. 8). This is not the first time we have raised this issue and the problems still need to be addressed. We are requesting a meeting of the MOU parties this summer or fall to discuss possible adaptive management actions for the riverine-riparian habitat in the hope that changes to how it is managed can improve the situation. We asked for a meeting in 2021 and in 2019 and we request it again this year. Our concerns are listed below.

Riverine-Riparian Ecosystem
There are three main issues with the riverine-riparian ecosystem where we believe the goals are not being met and that need to be addressed: 1) the expanding marshland, at the expense of alkali meadows, riparian forest and riparian scrub habitats, especially in the islands reach; 2) the decline in riparian trees and shrub willows and lack of recruitment of same; and 3) the expansive tule encroachment on the banks and in the channel that limits biodiversity.

In consideration of adaptive management measures, such as a change to the flow regime, we would support the removal of restrictions on the pumpback system, with some limitations, to do this either on a temporary basis or on a permanent basis.

We would also like to discuss and see what can be done about improving populations of T&E species and habitat indicator species such as the Owens Valley checkerbloom, Inyo County star-tulip, Owens Valley vole, Owens pupfish, Owens tui chub, and Owens speckled dace, in the riverine-riparian ecosystem and any other riparian areas, wetlands, marshes, meadows and springs and seeps within the Planning Area as set forth in the 1997 MOU (p. 7).

Until there is an adaptive management plan in place to address issues with the riverine ecosystem, then the goal of vegetation mapping should be limited to measuring how much the marsh areas along the river are expanding and what habitat type was lost. We support the research regarding recruitment, establishment and persistence of willow and cottonwood that Meredith Jabis of the ICWD is conducting.

BWMA
We supported the development of the five-year interim plan to improve conditions in the Blackrock Waterfowl Management Area. The monitoring results presented are promising. However, because of the very unusually wet year this year and LADWP's need to spread water wherever possible, the BWMA will not dry out this summer per the plan. Since the interim plan protocols are not being followed this year, the 2023-2024 year should not count as one of the five years in the five-year interim plan.

Regarding the vegetation monitoring, the variability between subbasins shown in the data, the fact only one transect was sampled in each subbasin, and our sense that there is significant variability within a subbasin, lead us to think that the vegetation data does not very precisely reflect conditions. We do not believe that it needs to be very precise and if it can be done more efficiently, we would support changes to the method.

Owens pupfish and Owens tui chub are among the habitat indicator species for the BWMA. How does the interim plan address protect habitat for these species?

DHA
We supported the five-year interim plan to modify flows into the Delta Habitat Area. The monitoring results presented are promising. We think it would be very beneficial to burn areas where cattails and bulrushes appear to have died due to the modified flows. This would remove the dead biomass that is likely to otherwise persist for many years and inhibit vegetation type conversion.

However, because of the very unusually wet year this year and LADWP's desire to drastically increase flows into the Lower Owens River and the DHA, the interim plan protocols are not being followed this year. Therefore the 2023-2024 year should not count as one of the five years in the five-year interim plan.

Invasive Species
Anticipating an explosion of growth of native habitat and invasive species due to the increase this year in water everywhere, the work plan for this year and the next should include more funding for invasive species control and removal. Pepperweed and tamarisk are very likely to grow and expand where they are known to grow now and will show up in new places. Going forward, we believe it is necessary to continue treatment of invasive species throughout the Owens Valley.

Thank you for your consideration of our comments.

Sincerely,

Mark Bagley
Sierra Club MOU Representative

cc: Trish Moyer, California Department of Fish and Wildlife, Bishop
Nancy Masters, OVC President
Lynn Boulton, Chair Sierra Club Range of Light Group
Don Mooney, OVC Attorney
Larry Silver, Sierra Club Attorney

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Inland Deserts Region 6
3602 Inland Empire Boulevard, Suite C-220
Ontario, CA 91764
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

Via email

July 13, 2023

Mr. Adam Perez, Los Angeles Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, CA 93514
Adam.Perez@ladwp.com

Dr. Holly Alpert, Director
Inyo County Water Department
P.O. Box 337
Independence, CA 93526-0337
Halpert@inyocounty.us

Subject: California Department of Fish and Wildlife Comments on the Lower Owens River Project 2022 Annual Report

Mr. Perez and Dr. Alpert:

The California Department of Fish and Wildlife (CDFW) appreciates the opportunity to provide comments on the Lower Owens River Project (LORP) 2022 Draft Annual Report (Report). Stemming from the 1997 Memorandum of Understanding (MOU) between the City of Los Angeles Department of Water and Power (LADWP), the Inyo County Water Department (ICWD), CDFW, the California State Lands Commission, the Sierra Club and the Owens Valley Committee (MOU Parties), the MOU Parties have a collective interest and duty in restoring the Lower Owens River.

CDFW, as a MOU party, and in its capacity as a Trustee Agency, provides comments on the 2022 status of the LORP and encourages the MOU Parties to jointly determine the management actions needed now to meet the goals of the LORP set forth in the 1991 EIR, 2004 EIR and the 1997 MOU (MOU, Section II.B.):

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

After 15 years of implementation of the LORP it is evident that the Project has not met the goals stated in the 1997 MOU. Specifically, the Lower Owens River is not on track

Conserving California's Wildlife Since 1870

Mr. Adam Perez, Los Angeles Aqueduct Manager
Dr. Holly Alpert, Director
July 13, 2023
Page 2

to establish a healthy, functioning riverine-riparian ecosystem, for the benefit of biodiversity and threatened and endangered species. The LORP currently does not provide sufficient riparian forest development needed to benefit biodiversity and threatened and endangered species as specified in the MOU.

CDFW is concerned about three findings of the Report that are closely related to the timing, duration and magnitude of the Seasonal Habitat Flows (SHF) prescribed by the 2004 EIR: 1) the area of tule marsh associated with the Lower Owens River has doubled in area since 2000, now occupying areas that were once open water (p. 3-20), 2) the area of riparian trees associated with the Lower Owens River has declined by approximately 520 acres (p. 3-26), and 3) the avian species diversity along the Lower Owens River in 2022 is the lowest to yet be recorded (p. xv).

Seasonal Habit Flows

CDFW continues to be concerned that the LORP objectives have not been met and continue to not be met by following the 2004 EIR hydrograph (Chart 2-2 & Chart 2-1). As stated in CDFW comments in previous years, even when implementing a maximum SHF release of 200 cubic feet per second (cfs), this SHF magnitude and schedule does not provide adequate stream flows to achieve the intended LORP seasonal habitat goals. The LORP goals include creation of sufficient disturbance to establish and maintain native riparian vegetation and channel morphology (CDFW 2017 mobilization study; 2017 & 2021 LORP Seasonal Habitat Flow and Blackrock Waterfowl Are Flooded Acreage Letters). Reliance on the hydrograph as described in the 2004 LORP EIR to inform SHF magnitude, timing, and duration is less effective now that tule density in the channel has increased to the point where the river system needs SHF's above 200 cfs to yield the flushing flow benefits that 200 cfs SHF was intended to provide based on 2004 stream conditions. As a threshold matter, a thorough analysis of flow changes and predicted results is needed to validate such a change to the existing flow regime; and thus, a revision to the 2004 EIR hydrograph may be appropriate.

The timing of SHF was intended to "roughly coincide with the spring run-off and to facilitate dispersal and germination of riparian plant species" (LORP Monitoring Adaptive Management Plan [MAMP], Section 4.2.3 Seasonal Habitat Flows). Record-high precipitation in 2023 has created unprecedented runoff conditions in 2023 that will result in previously unseen LORP flows from late May through early August 2023. SHF in the spring were intended to disperse and germinate riverine-riparian tree seeds. Since excess flows will continue until the fall, outside of the growing season, the SHF's goal to establish native riparian vegetation may not be supported by the extreme conditions of 2023, and any previous riparian vegetation gains may indeed be lost due to prolonged flooding.

Pre-LORP modeling predicted that after rewatering the Lower Owens River, tule marsh would occupy over 50% of riverine landforms, totaling 350 acres of tule marsh within the

LORP planning area (Technical Memorandum No. 9). However, according to the Report, in 2022, the tule marsh in the LORP has expanded to over 1600 acres (*Figure 3-11*). As described above, this expansion is due to the LORP's prescribed flow regime (40 cfs base flows and limited SHF of up to 200 cfs in wet years, no SHF in drought years) creating ideal conditions for tule marsh proliferation and expansion.

In turn, the tule marsh expansion has prevented the establishment of a functioning, healthy riverine-riparian ecosystem along the LORP. According to the Report, the riparian tree area along the LORP has declined from 260 acres in 2009 to 180 acres in 2022. Additionally, the 2022 mapped tree area includes invasive species such as tamarisk (*Tamarix ramosissima*) and Russian olive (*Elaeagnus angustifolia*); such species are actively being treated and eradicated as a part of the LORP and should not be counted towards a functioning, healthy riverine-riparian ecosystem. Thus, it is imperative that ICWD and LADWP map riparian forest separately from tamarisk and Russian olive.

Establishment of riparian trees requires, among other factors, availability of water in the form of substantially wet floodplain soils. The SHF have not been sufficient in duration and amount to provide these basic criteria for riparian tree recruitment. Despite repeated calls of the MOU parties for adaptive management of the LORP, the Project's failure to establish a healthy riverine-riparian ecosystem has not been addressed.

A functioning, healthy riverine-riparian ecosystem would consist of a mixed, multi-story canopy of willows (*Salix* sp.), cottonwoods (*Populus fremontii*), wild rose (*Rosa* sp.) and other riparian species. In a healthy riverine-riparian system, larger woody trees provide shading, thus controlling tule growth and expansion. As identified in the MOU, a functioning, healthy riverine-riparian ecosystem would also support a diversity and abundance of avian fauna, including threatened and endangered species.

The Report states that 2022 marked the lowest diversity of avian species recorded since monitoring of the LORP began. The Report concludes that a combination of limited riparian tree cover and increases in tule marsh area have inhibited the LORP from creating breeding bird diversity for 19 habitat indicator species (HIS)[1] associated with the LORP. HIS are used as a measure to determine whether or not the LORP has improved habitat for species that are state listed as threatened or endangered under the California Endangered Species Act (CESA), as well as common avian species. Currently, according to the findings of the Report, the predominant breeding bird

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[1] HIS: wood duck, yellow-billed cuckoo, Virginia rail, sora, least bittern, great blue heron, northern harrier, red-shouldered hawk, Swainson's hawk, long-eared owl, belted kingfisher, Nuttall's woodpecker, willow flycatcher, Warbling vireo, tree swallow, marsh wren, yellow-breasted chat, yellow warbler, and blue grosbeak

community of the LORP consists of non-HIS and non CESA listed species associated with marsh habitat.

Recommendations:

As in previous years (CDFW's 2014 Annual Report Comment letter), CDFW again emphasizes that the avian HIS require diverse habitat types including riparian forest canopy for the Swainson's hawk (*Buteo swainsoni*), a CESA-listed threatened species, and riparian understory vegetation (such as willow stands) for the southwestern willow flycatcher (*Empidonax traillii extimus*), a CESA-listed endangered species (CDFW, 2014). To continue to measure the LORP vegetation's ability to support wildlife, including threatened and endangered avian species such as the Swainson's hawk and the southwestern willow flycatcher, CDFW recommends continued avian monitoring of the LORP.

During the LORP Public Meeting on June 22, 2023, LADWP staff estimated that the largest contiguous patch of riparian trees in the LORP area only covers approximately eight acres. Page 4-42 of the Report further elaborates that the amount of woody recruitment anticipated at the onset of the Project, has not been realized and is not expected to self-sustain.

CDFW encourages continued efforts to establish new natural woody recruits along the LORP, while also supporting adaptive management recommendations to manage land in a way that protects existing riparian trees and to perform localized habitat enhancement for certain reaches of the LORP. Reattempting tree tubing, for example, could help establish woody recruit seedlings, increasing their survival rate as they establish to weather the effects of prolonged periods of drought and extreme wet years evident in the Owens Valley.

LADWP proposed, and CDFW agrees, that exploring the clonal reproductive potential of the riparian shrub sandbar willow (*Salix exigua*) could be an effective and sustainable means of establishing dense understory in oxbows or stream bars along the LORP. To maximize survival, pole planting clones to colonize new areas should consider placement location that resembles the parent stem's location on the bank. Pole plantings should be monitored regularly and consistently, with established and agreed upon success criteria that can be measured and tracked over time to predict the long-term survival and area coverage of the plantings.

Establishing riparian shrub cover however, does not replace riparian trees' ecosystem functions for the Lower Owens River. Rather, propagating riparian shrub cover creates an opportunity to increase foraging and nesting habitat in areas low in cover and habitat quality that may otherwise be dominated by tule or alkali meadow, which already comprise the majority of the LORP. Establishing riparian shrub cover may also support riparian woody tree recruitment and establishment.

CDFW strongly urges ICWD and LADWP to reevaluate the relevance and application of the hydrograph in the 2004 EIR, in the context of prevailing conditions such as climate change, extreme precipitation events, and extended periods of drought that were not comprehended during the LORP planning phases and preparation of the 2004 LORP EIR. Without even considering these climate variables, the hydrograph outlined in the 2004 LORP EIR has been implemented for over ten years and has not been successful at achieving the LORP goals and objectives. Through the adaptive management process, ICWD and LADWP are to "make adjustments to the initially proposed flow regimes and other management actions" to conform with the LORP goal of enhancing native fisheries and riparian habitats along 62 miles of the LORP (2004 LORP EIR, Section 2.10.5 Adaptive Management). In light of the current poor performance of the LORP in achieving its riparian habitat goals, such adaptive management appears warranted.

To this end, CDFW also recommends establishing a panel of river restoration experts in 2023 to scientifically analyze and determine appropriate flow regimes for the LORP to better support the longstanding-and currently unmet-goals of the LORP. The high flows of over 1600 cfs the LORP has experienced in 2023, and the continued elevated flows the LORP is currently experiencing, provide an opportunity to study the effects of flows above 200 cfs on the hydrograph and vegetation communities associated with the LORP, as well as on County and Caltrans infrastructure capacity along the LORP.

Additionally, CDFW supports experimenting with potential alternative release points for the SHF to inundate riparian surfaces in need of riparian tree recruitment and establishment.

Considering the LORP's goals of restoring riparian habitat for ecosystem health and biodiversity, and for threatened and endangered species habitat in the Lower Owens River watershed, CDFW encourages ICWD and LADWP to apply for state-funded *Watershed Restoration Grant Programs*.

To proactively address increases in perennial pepperweed (*Lepidium latifolium*) (LELA) colonization of the LORP, CDFW recommends that LADWP and ICWD consider implementing a specific LELA monitoring treatment plan to prevent and treat the significant increase in LELA that is expected to establish this summer due to flooding conditions in the LORP.

CDFW appreciates the opportunity to provide comments on the status of the LORP. CDFW strives to engage and work with the MOU Parties to bring about change in the Lower Owens River through LORP progress and a continued commitment to achieve the goals agreed upon by all parties in the MOU.

If you have any questions regarding this letter, please contact Trisha Moyer at (760) 835-4304 or at Patricia.Moyer@wildlife.ca.gov.

Mr. Adam Perez, Los Angeles Aqueduct Manager
Dr. Holly Alpert, Director
July 13, 2023
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Sincerely,

DocuSigned by:
Magdalena Rodriguez

For Alisa Ellsworth
Environmental Program Manager

cc: California Department of Fish and Wildlife
Trisha Moyer, Senior Environmental Scientist Supervisor, Inland Deserts Region
Patricia.Moyer@wildlife.ca.gov

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Drew Simpkin, Public Land Management Specialist
Drew.Simpkin@slc.ca.gov

Mr. Adam Perez, Los Angeles Aqueduct Manager
Dr. Holly Alpert, Director
July 13, 2023
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10.3.2 Appendix 2. 2022 LORP Annual Report Meeting Presentations

2022 LORP Annual Report Public Meeting

10 a.m.

Thursday, June 22,2023

Agenda Overview

10:00 am	Welcome and Introduction – D. Livingston (LADWP)
10:05 am	Hydrology – T. Tillemans (LADWP)
10:15 am	Riparian & Delta Habitat Vegetation Inventory – D. Livingston (LADWP)
10:25 am	Riverine Avian Monitoring/Indicator Species Habitat Assessment – E. Nordin (LADWP)
10:35 am	Land Management – G. Peek (LADWP)
10:45 am	Weed Treatment & Survey – B. Stange (LADWP) & L. Freilich (Inyo Co.)
10:55 am	Adaptive Management - Delta Habitat – D. House (LADWP)
11:05 am	Adaptive Management – BWMA – D. House/J. Hays (LADWP)
11:15 am	Adaptive Management – Tree Recruitment – M. Jabis (Inyo Co.)
11:30 am	Adjournment

Written comments related to the Lower Owens River Project 2022 Draft Annual Report may be sent to the following by Friday, July 7th:

Dr. Holly Alpert
Director
Inyo County Water Department
135 South Street
P.O. Box 337
Independence, CA 93526

Mr. Adam Perez
Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, CA 93514

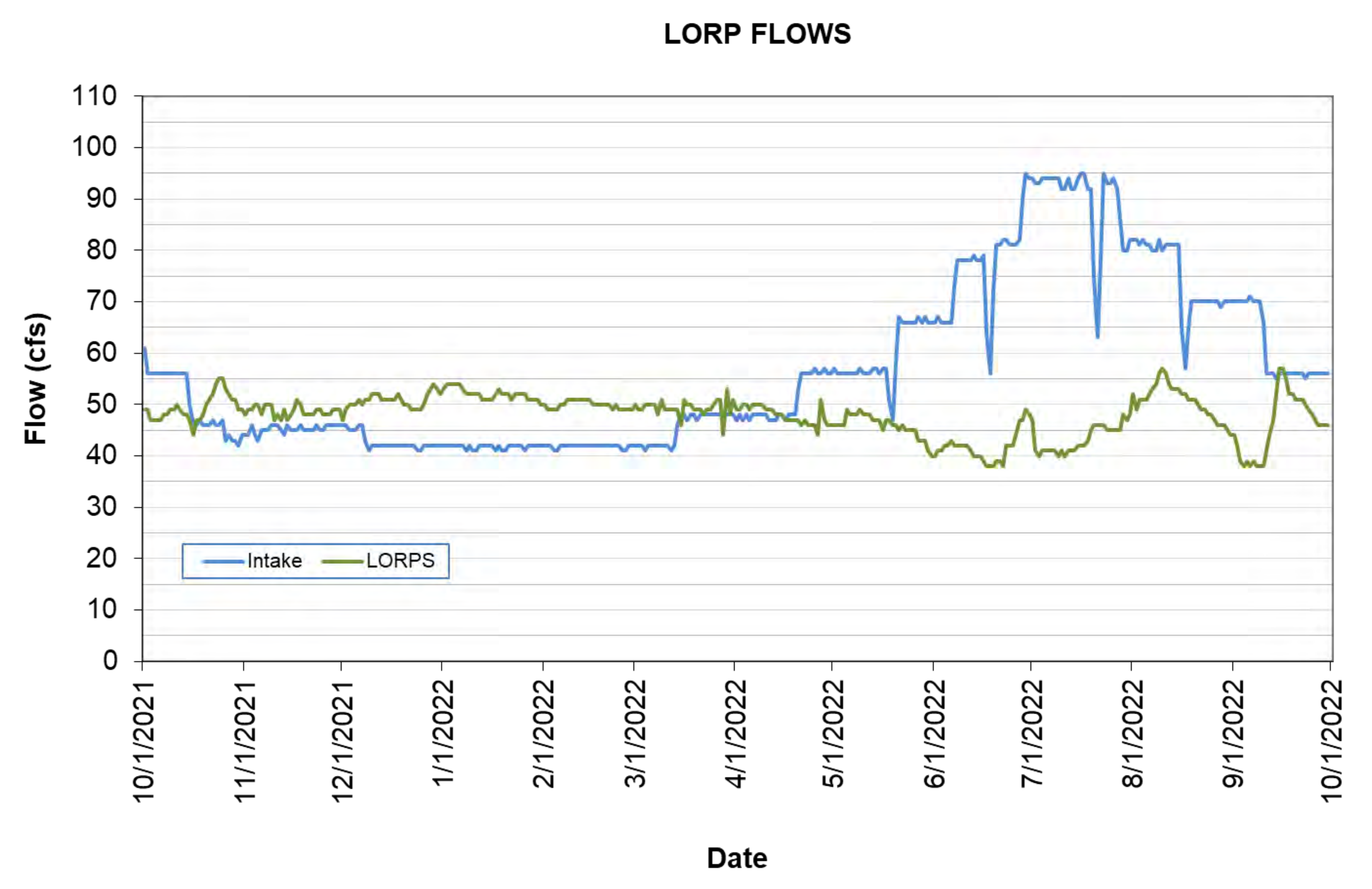
Hydrology

Presented by:

Tony Tillemans (LADWP)

Hydrologic Monitoring

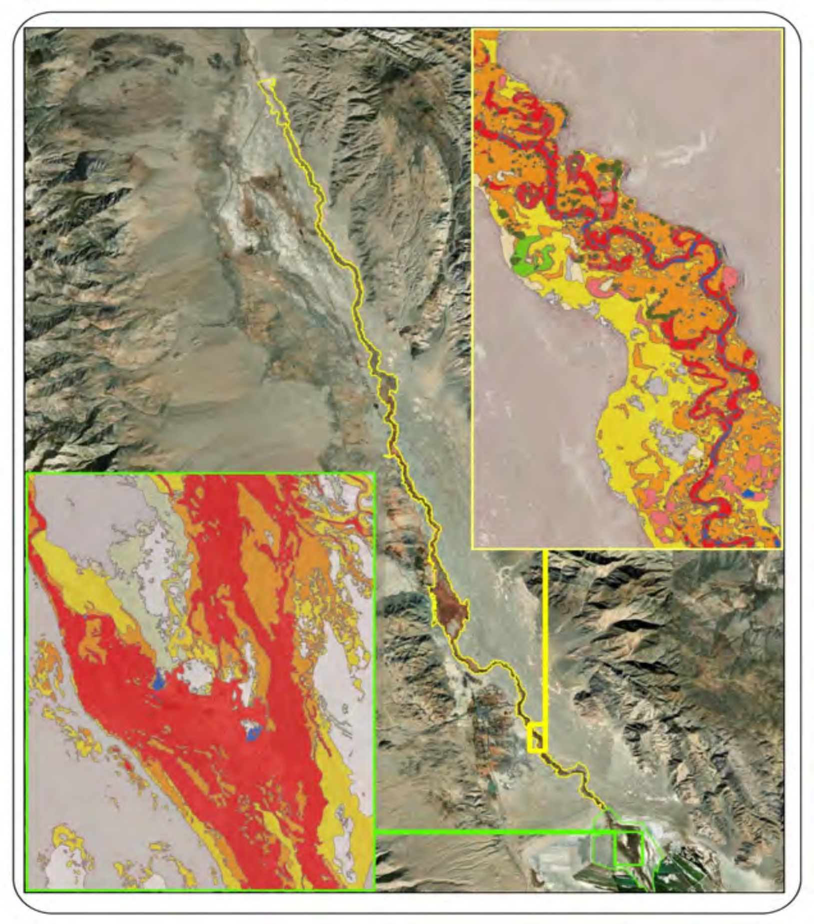
- Mean flow to the Delta was 7.3 cfs.
- Continued implementation of the Interim BWMA
- Average wetted acreage for the 2021-22 RY was 484 acres.
- No seasonal habitat flow was released in 2022 per the 2004 EIR.
- See Chapter 2 and Appendices for full set of graphs and tables.



LORP FLOWS
Flow (cfs)
110
100
90
80
70
60
50
40
30
20
10
0
Intake
LORPS
10/1/2021
11/1/2021
12/1/2021
1/1/2022
2/1/2022
3/1/2022
4/1/2022
5/1/2022
6/1/2022
7/1/2022
8/1/2022
9/1/2022
10/1/2022
Date

QUESTIONS

Vegetation Mapping
Lower Owens River and Delta Habitat Area
2022 Condition



Prepared by:

Sherman Jensen, Formation Environmental, LLC

Goals- River

- How has riparian vegetation communities changed?
- Trend(s)
- What's driving the changes?

Methods - River

- Time-series analysis
- Aerial imagery: 2000, 2009, 2014, 2017 & 2022
- GIS and Remote sensing
- Field evaluation

Results/Discussion - River

FIGURE 2-4. PROGRESSION OF STATES

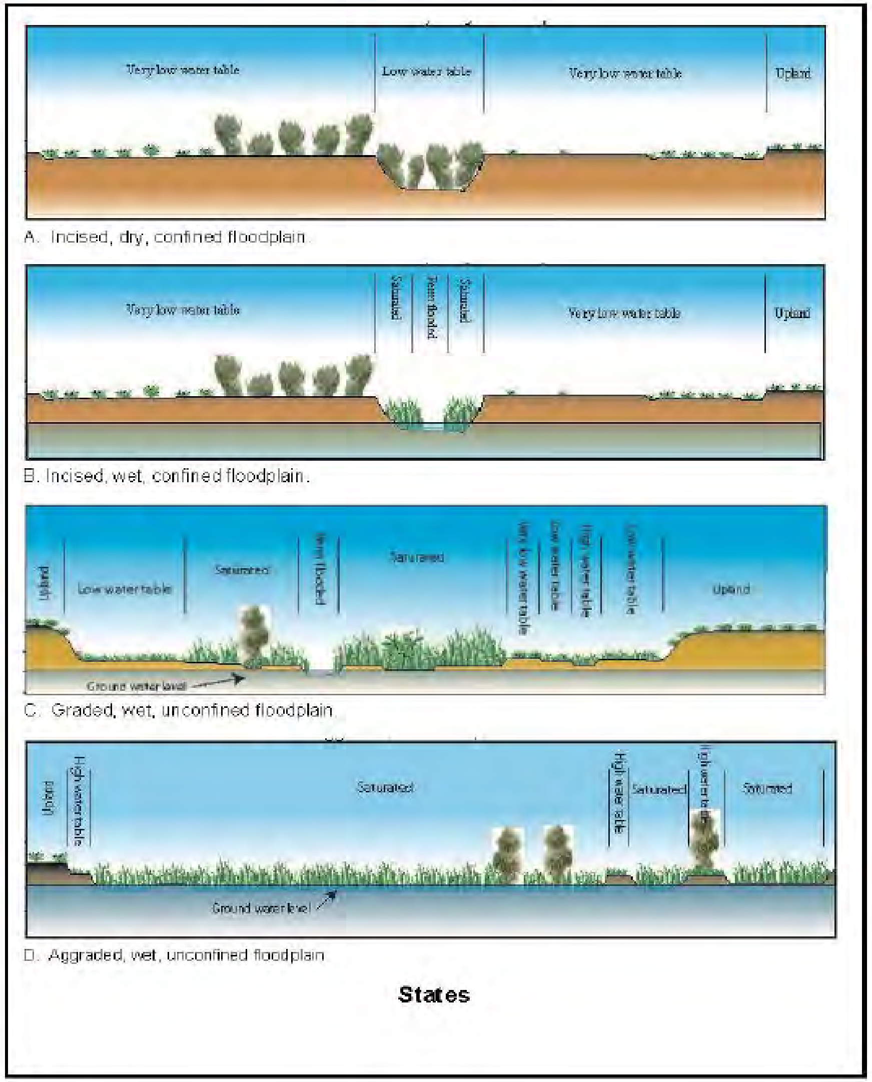
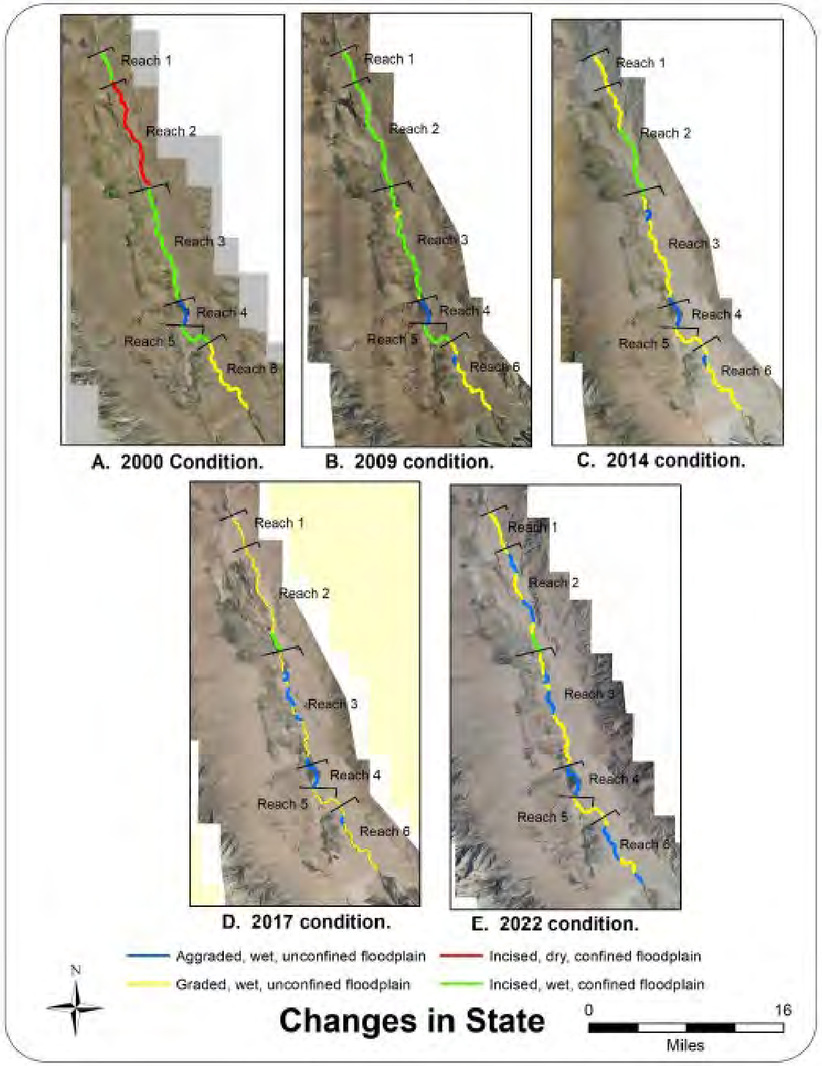
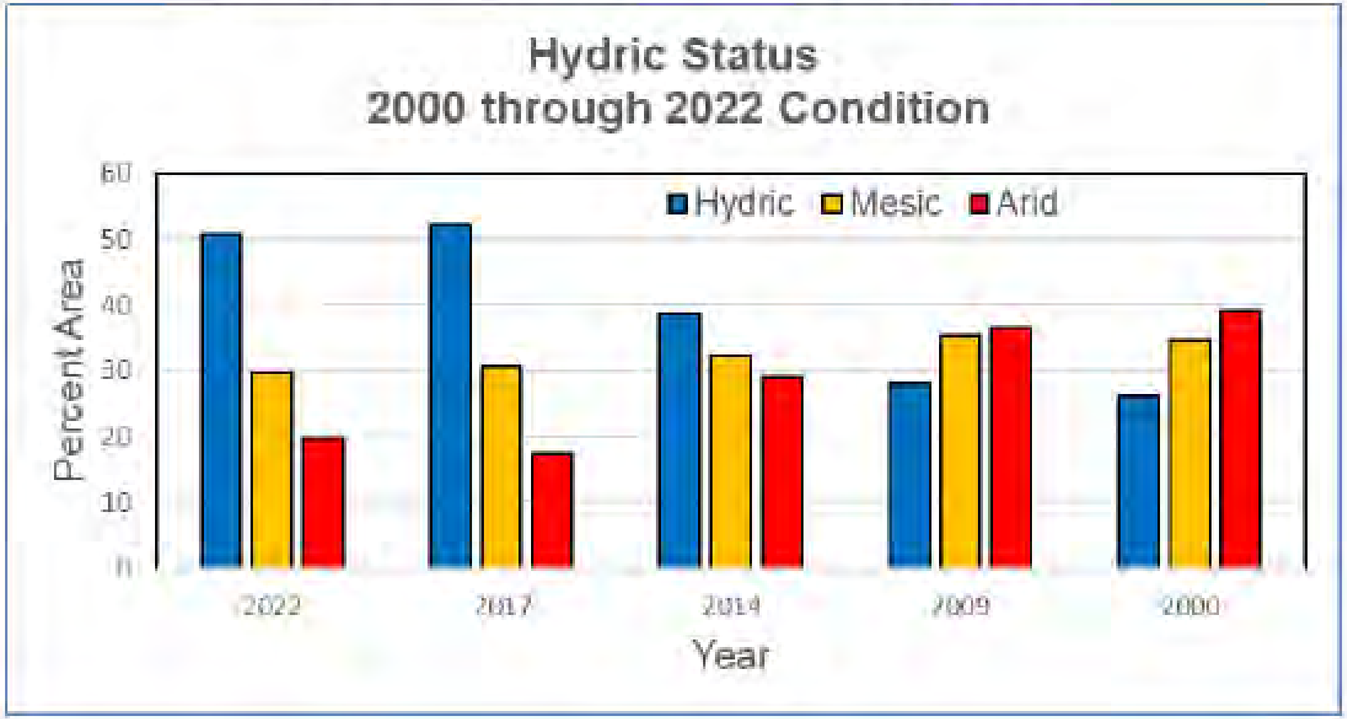


FIGURE 2-5. CHANGES IN STATE

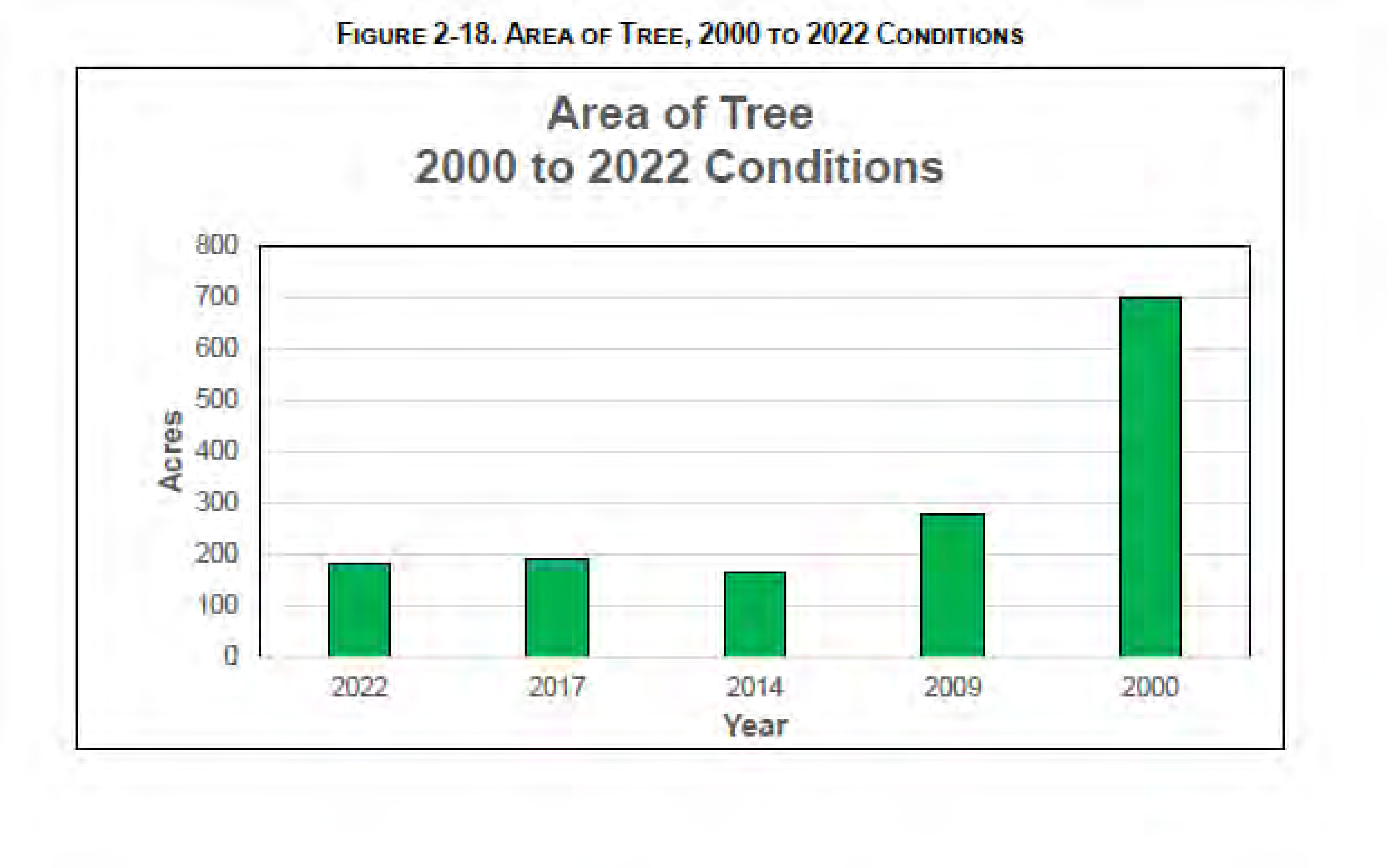


Results/Discussion - River

FIGURE 2-8. HYDRIC STATUS, 2000 THROUGH 2022 CONDITIONS



Results/Discussion - River



Conclusions - River

- Riparian vegetation = Current >>> Baseline
- Emergent vegetation
- Equilibrium with channel/floodplain structure and hydrology
- Mature riparian trees likely stabilizing
- Future recruitment?

Goals-Delta

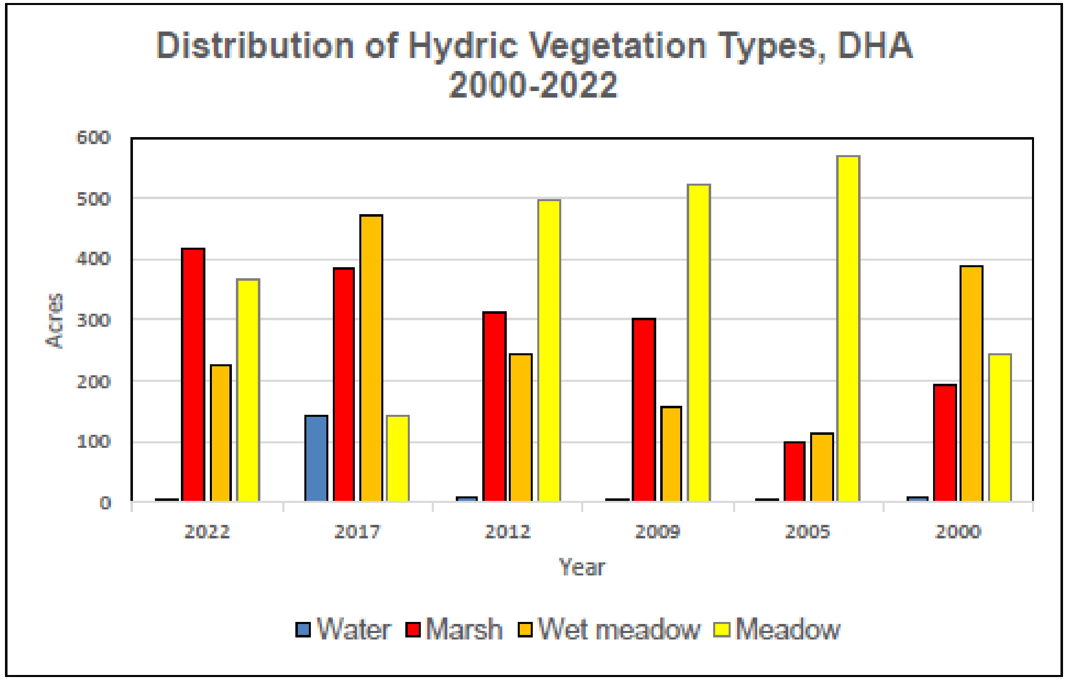
- How has riparian vegetation communities changed?
- Trend(s)
- What's driving the changes?

Methods - Delta

- Time-series analysis
- Aerial imagery: 2000, 2005, 2009, 2012, 2017 & 2022
- GIS and Remote sensing
- Field evaluation

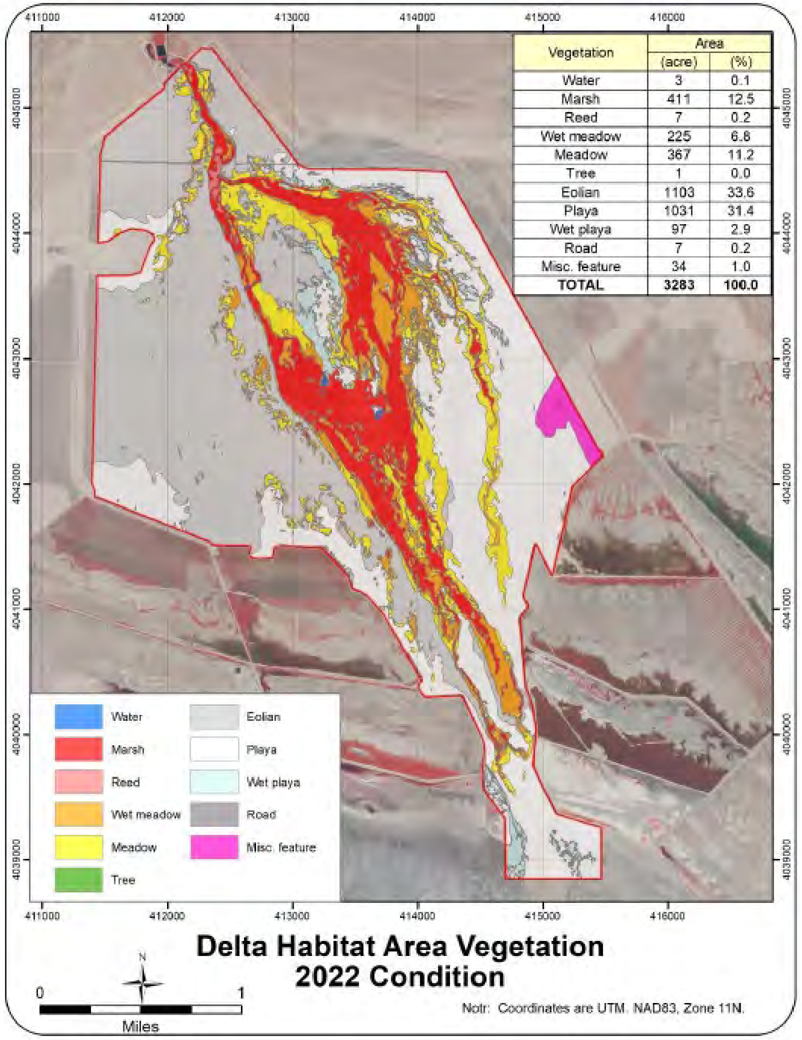
Results/Discussion - Delta

FIGURE 3-3. DISTRIBUTION OF HYDRIC VEGETATION TYPES, 2005-2022



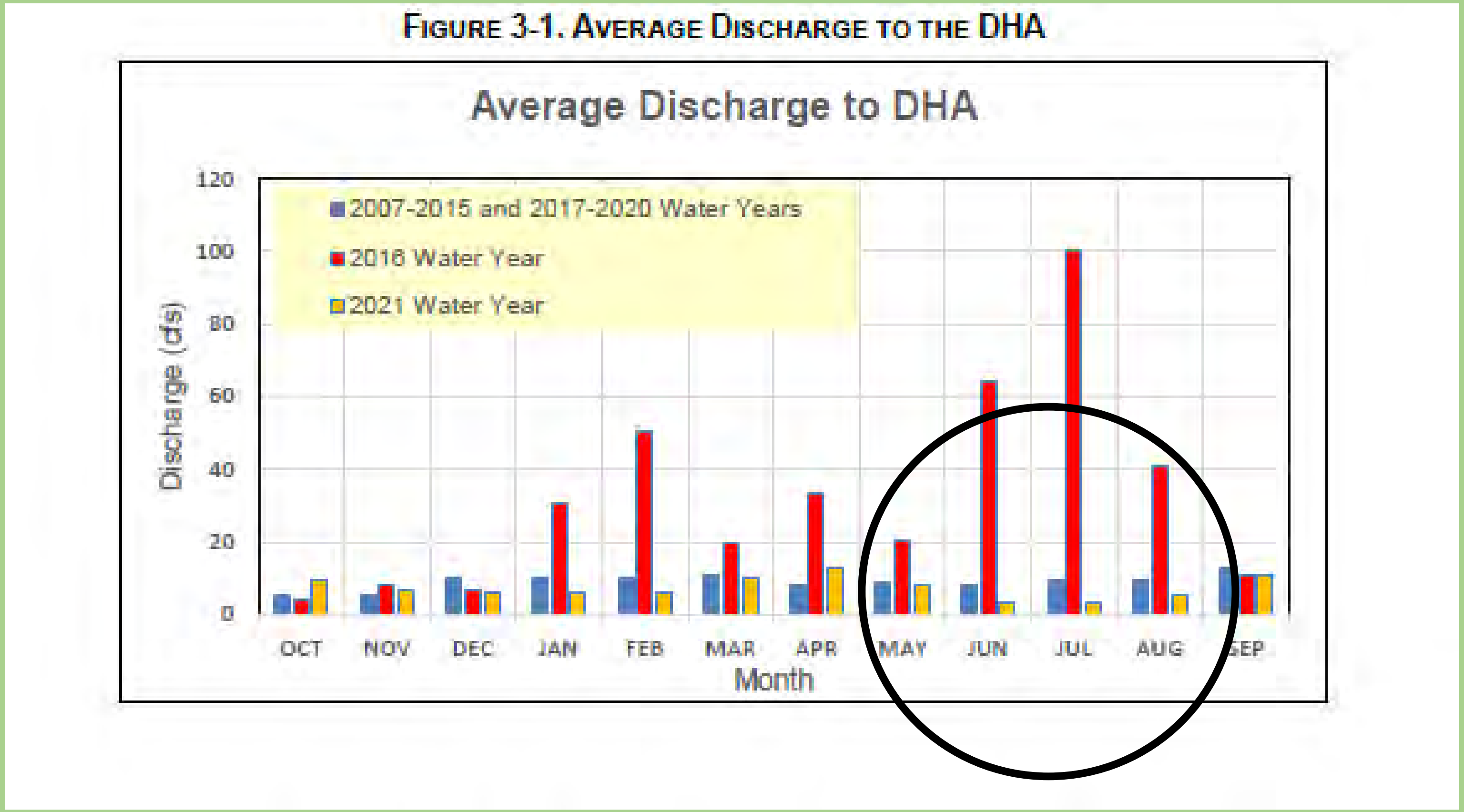
Results/Discussion - Delta

FIGURE 3-4. DHA VEGETATION, 2022 CONDITION



Vegetation	Area (acre)	Area (%)
Water	3	0.1
Marsh	411	12.5
Reed	7	0.2
Wet meadow	225	6.8
Meadow	367	11.2
Tree	1	0.0
Eolian	1103	33.6
Playa	1031	31.4
Wet playa	97	2.9
Road	7	0.2
Misc. feature	34	1.0
TOTAL	**3283**	**100.0**

Results/Discussion - Delta



Conclusions - Delta

- Marsh dominated
- Flow management

QUESTIONS

Avian Monitoring & Modeling Riverine-Riparian Area

2023 Annual LORP Meeting

June 22, 2023

Deborah House & Erin Nordin, Los Angeles Department of Water & Power

Zack Nelson & Jerry Zatorski, Inyo County Water Department

1997 Memorandum of Understanding

"The goal of the LORP is the establishment of a healthy, functioning Lower Owens River riverine-riparian ecosystem, […], for the benefit of biodiversity and Threatened and Endangered Species […] "

"Establishment and maintenance of diverse riverine, riparian and wetland habitats in a healthy ecological condition."

"…the goal is to create and maintain through flow and land management, to the extent feasible, diverse natural habitats consistent with the needs of the "habitat indicator species." These habitats will be as self-sustaining as possible."

1997 Memorandum of Understanding

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“Establishment and maintenance of diverse riverine, riparian and wetland habitats in a healthy ecological condition.”

“…the goal is to create and maintain through flow and land management, to the extent feasible, diverse natural habitats consistent with the needs of the “habitat indicator species.” These habitats will be as self-sustaining as possible.”

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"Establishment and maintenance of diverse riverine, riparian and wetland habitats in a healthy ecological condition."

"…the goal is to create and maintain through flow and land management, to the extent feasible, diverse natural habitats consistent with the needs of the "habitat indicator species.""

Avian Monitoring

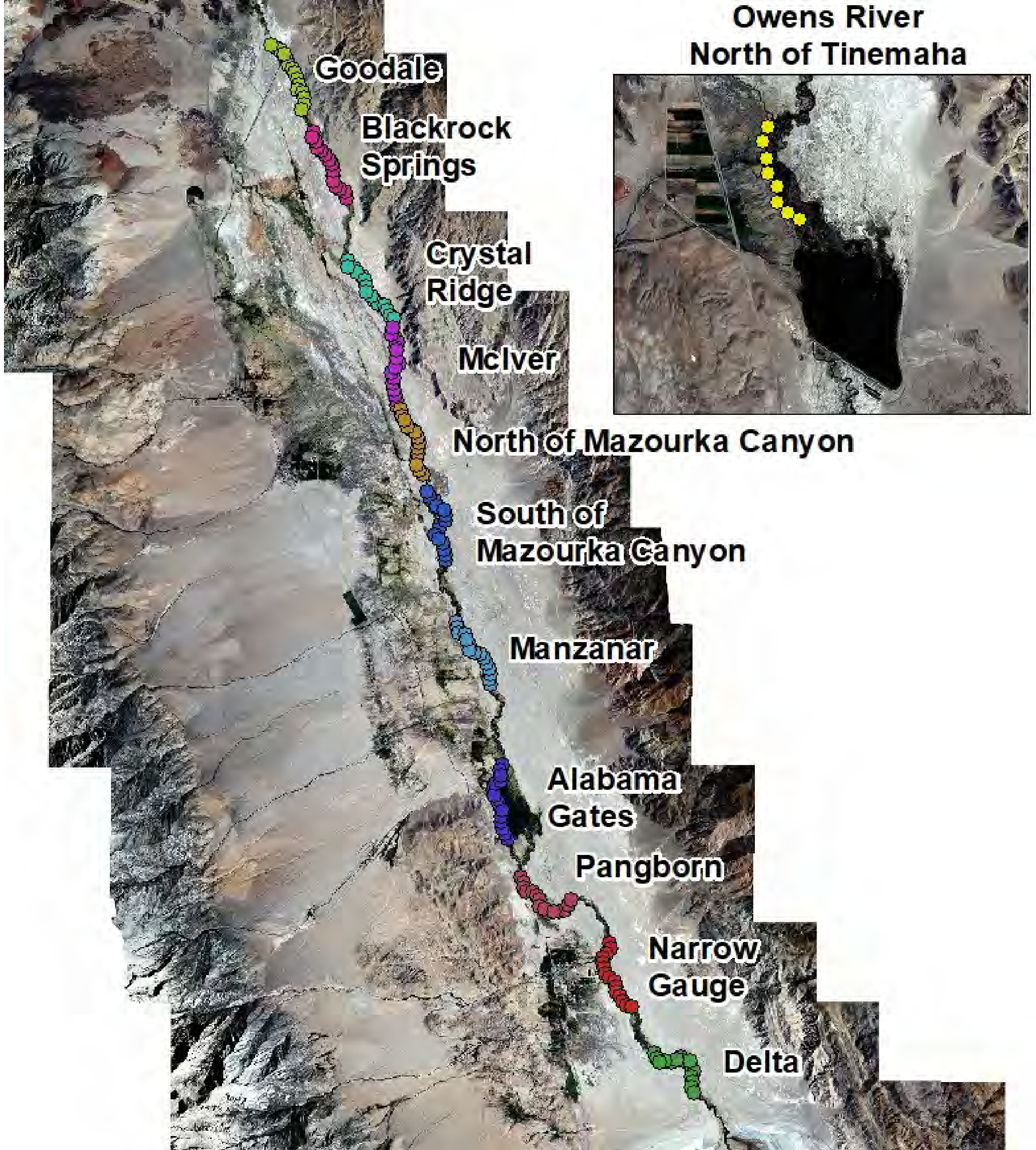
Developed by Point Blue Conservation Science (Point Blue)

3 Surveys in May & June
- Two-week intervals

11 Survey Routes
- 15 Point-Count Stations (165 total)

1 Reference Site
- 8 Point-Count Stations

2 periods
- Pre-LORP (Baseline): 2002, 2003
- Post-LORP: 2010, 2015, 2022



Avian Monitoring Analysis

Waterbirds
Landbirds

- Wetland
- Riverine
- Riparian

Breeding Birds — Biodiversity

Habitat Indicator Species — MOU

Vegetation

- 2022
- 2000-2022
- Breeding Birds

River State — Breeding Birds

Avian Monitoring Analysis

Mallard
Killdeer

Waterbirds

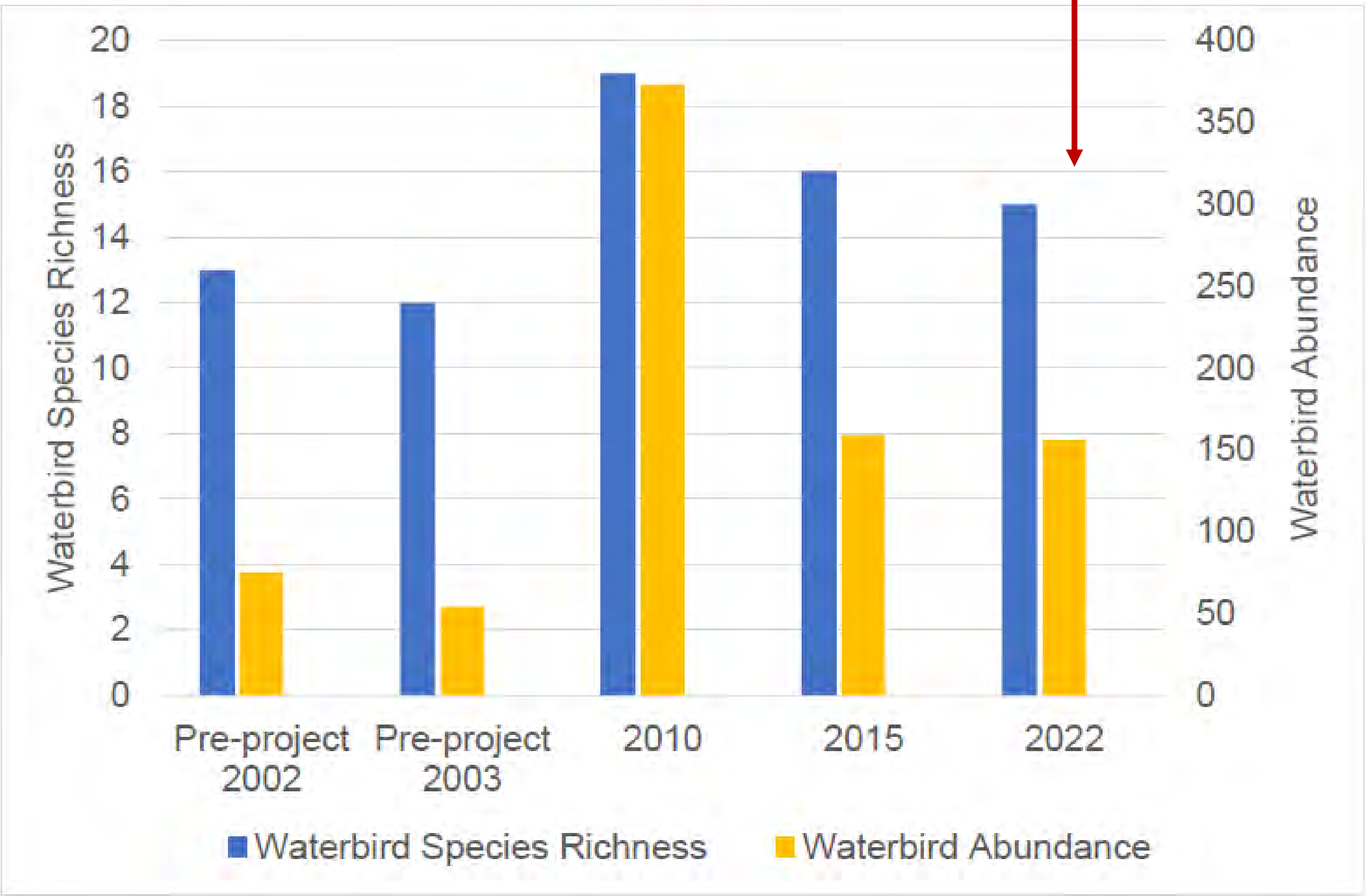
Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State



Avian Monitoring Analysis

Red-winged Blackbird
Common Yellowthroat
Song Sparrow
Brown-headed Cowbird

Waterbirds

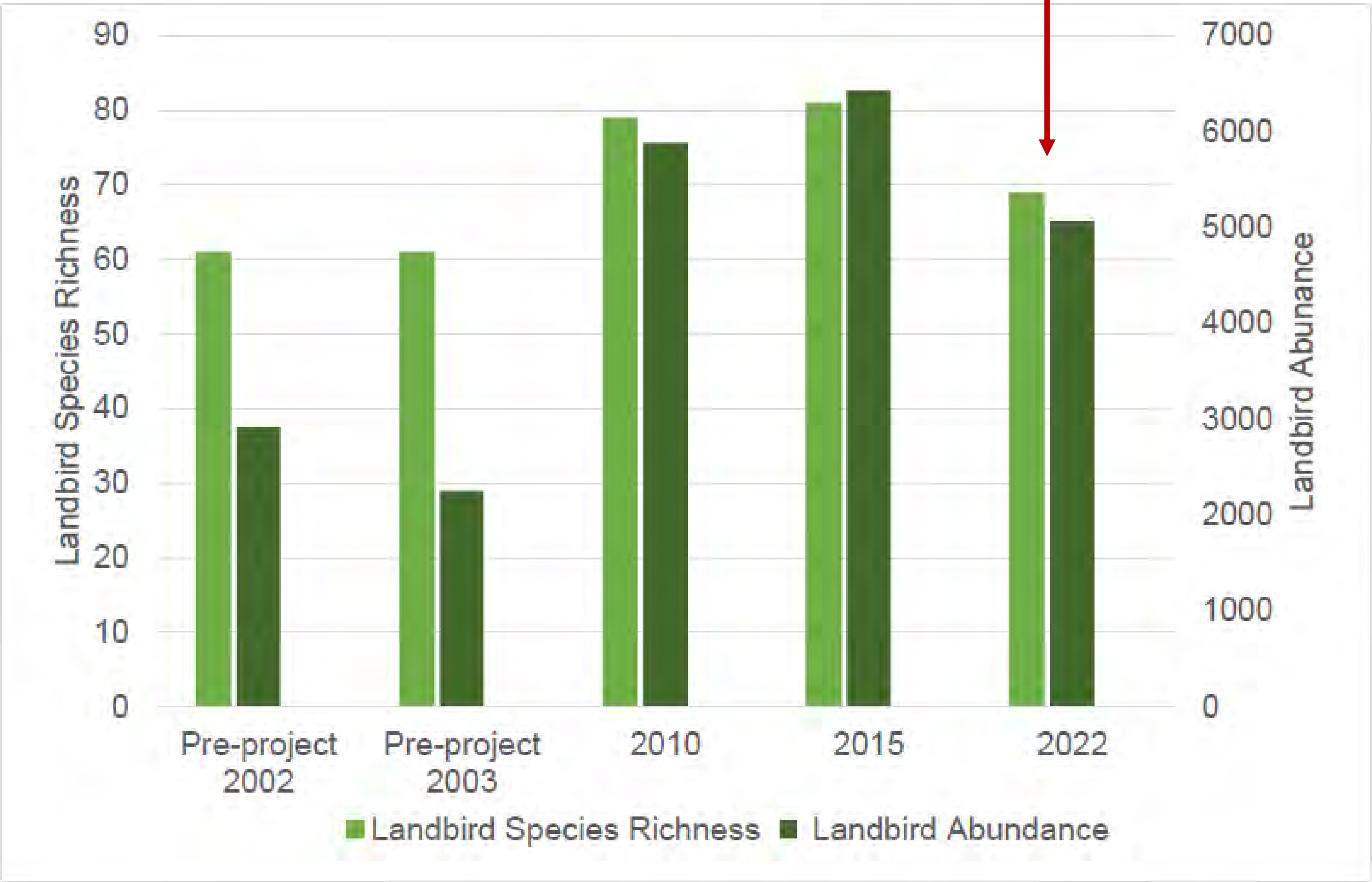
Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State



Red-winged Blackbird
Common Yellowthroat
Song Sparrow
Brown-headed Cowbird

Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

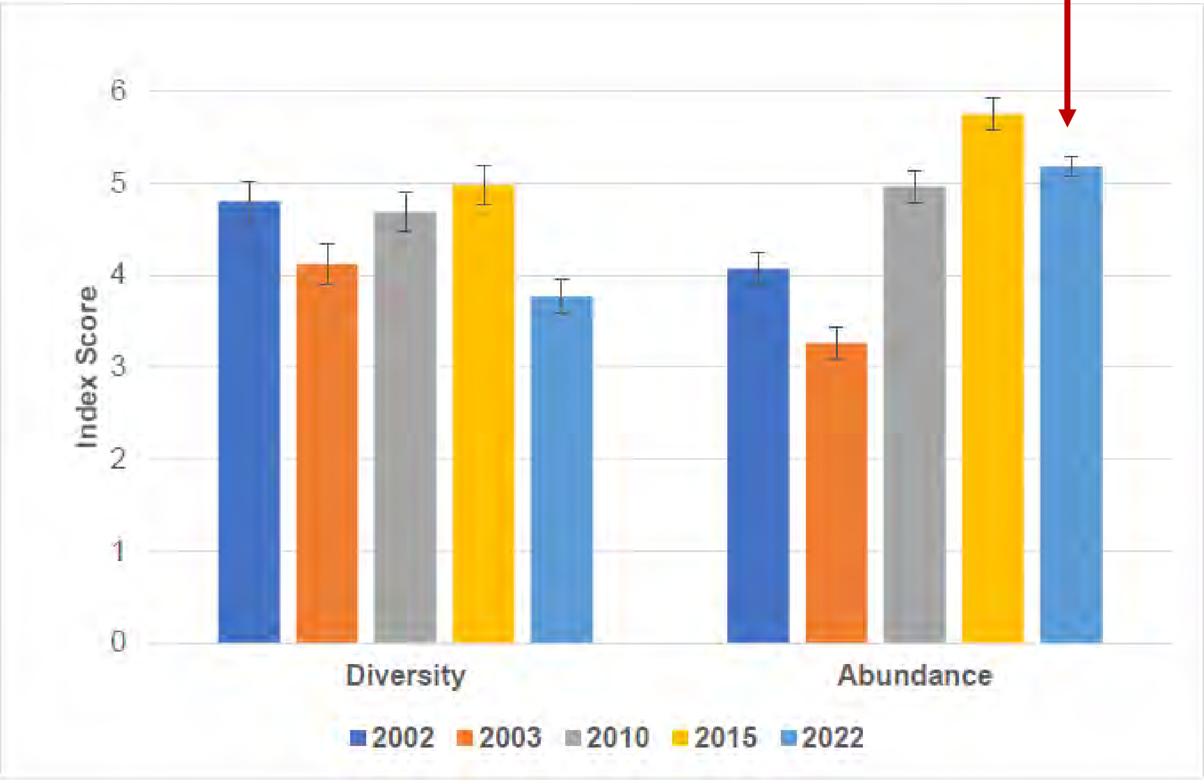


Figure 4-12. Mean Breeding Bird Species Diversity and Abundance in the LORP Riverine-Riparian Area Across the Monitoring Period (2002-2022).

Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

	12	15
Habitat Indicator Species	**Pre-LORP (2002-2003)**	**Post-LORP (2010-2022)**
Wood Duck		X
Yellow-billed Cuckoo		
Virginia Rail	X	X
Sora	X	X
Least Bittern		X
Great Blue Heron	X	X
Northern Harrier	X	X
Red-shouldered Hawk		
Swainson's Hawk	X	X
Long-eared Owl		
Belted Kingfisher	X	
Nuttall's Woodpecker	X	X
Willow Flycatcher	X	X
Warbling Vireo	X	X
Tree Swallow		X
Marsh Wren	X	X
Yellow-breasted Chat		X
Yellow Warbler	X	X
Blue Grosbeak	X	X

Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

Habitat Indicator Species	Pre-LORP (2002-2003)	Post-LORP (2010-2022)
Wood Duck		X
Yellow-billed Cuckoo		
Virginia Rail	X	X
Sora	X	X
Least Bittern		X
Great Blue Heron	X	X
Northern Harrier	X	X
Red-shouldered Hawk		
Swainson's Hawk	X	X
Long-eared Owl		
Belted Kingfisher	X	
Nuttall's Woodpecker	X	X
Willow Flycatcher	X	X
Warbling Vireo	X	X
Tree Swallow		X
Marsh Wren	X	X
Yellow-breasted Chat		X
Yellow Warbler	X	X
Blue Grosbeak	X	X

Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

Habitat Indicator Species	Pre-LORP (2002-2003)	Post-LORP (2010-2022)
Wood Duck		X
Yellow-billed Cuckoo		
Virginia Rail	X	X
Sora	X	X
Least Bittern		X
Great Blue Heron	X	X
Northern Harrier	X	X
Red-shouldered Hawk		
Swainson's Hawk	X	X
Long-eared Owl		
Belted Kingfisher	X	
Nuttall's Woodpecker	X	X
Willow Flycatcher	X	X
Warbling Vireo	X	X
Tree Swallow		X
Marsh Wren	X	X
Yellow-breasted Chat		X
Yellow Warbler	X	X
Blue Grosbeak	X	X

Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

3

Habitat Indicator Species	Pre-LORP (2002-2003)	Post-LORP (2010-2022)
Wood Duck		X
Yellow-billed Cuckoo		
Virginia Rail	X	X
Sora	X	X
Least Bittern		X
Great Blue Heron	X	X
Northern Harrier	X	X
Red-shouldered Hawk		
Swainson's Hawk	X	X
Long-eared Owl		
Belted Kingfisher	X	
Nuttall's Woodpecker	X	X
Willow Flycatcher	X	X
Warbling Vireo	X	X
Tree Swallow		X
Marsh Wren	X	X
Yellow-breasted Chat		X
Yellow Warbler	X	X
Blue Grosbeak	X	X

Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

10

Habitat Indicator Species	Pre-LORP (2002-2003)	Post-LORP (2010-2022)
Wood Duck		X
Yellow-billed Cuckoo		
Virginia Rail	X	X
Sora	X	X
Least Bittern		X
Great Blue Heron	X	X
Northern Harrier	X	X
Red-shouldered Hawk		
Swainson's Hawk	X	X
Long-eared Owl		
Belted Kingfisher	X	
Nuttall's Woodpecker	X	X
Willow Flycatcher	X	X
Warbling Vireo	X	X
Tree Swallow		X
Marsh Wren	X	X
Yellow-breasted Chat		X
Yellow Warbler	X	X
Blue Grosbeak	X	X

Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

Table 4-2. Habitat Indicator Species and Habitat Association.

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

Avian Monitoring Analysis

Waterbirds

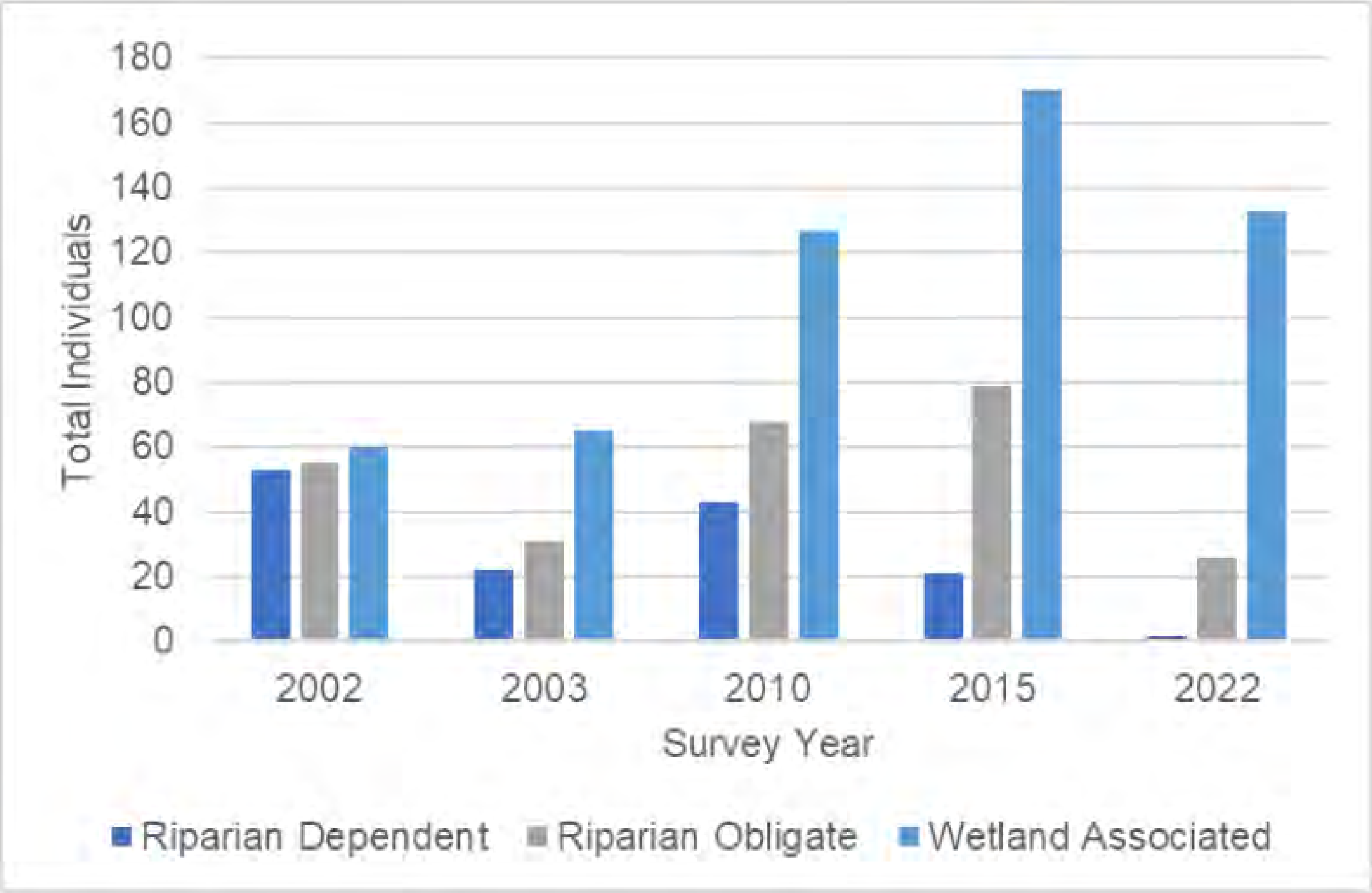
Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State



California Wildlife Habitat Relationship System

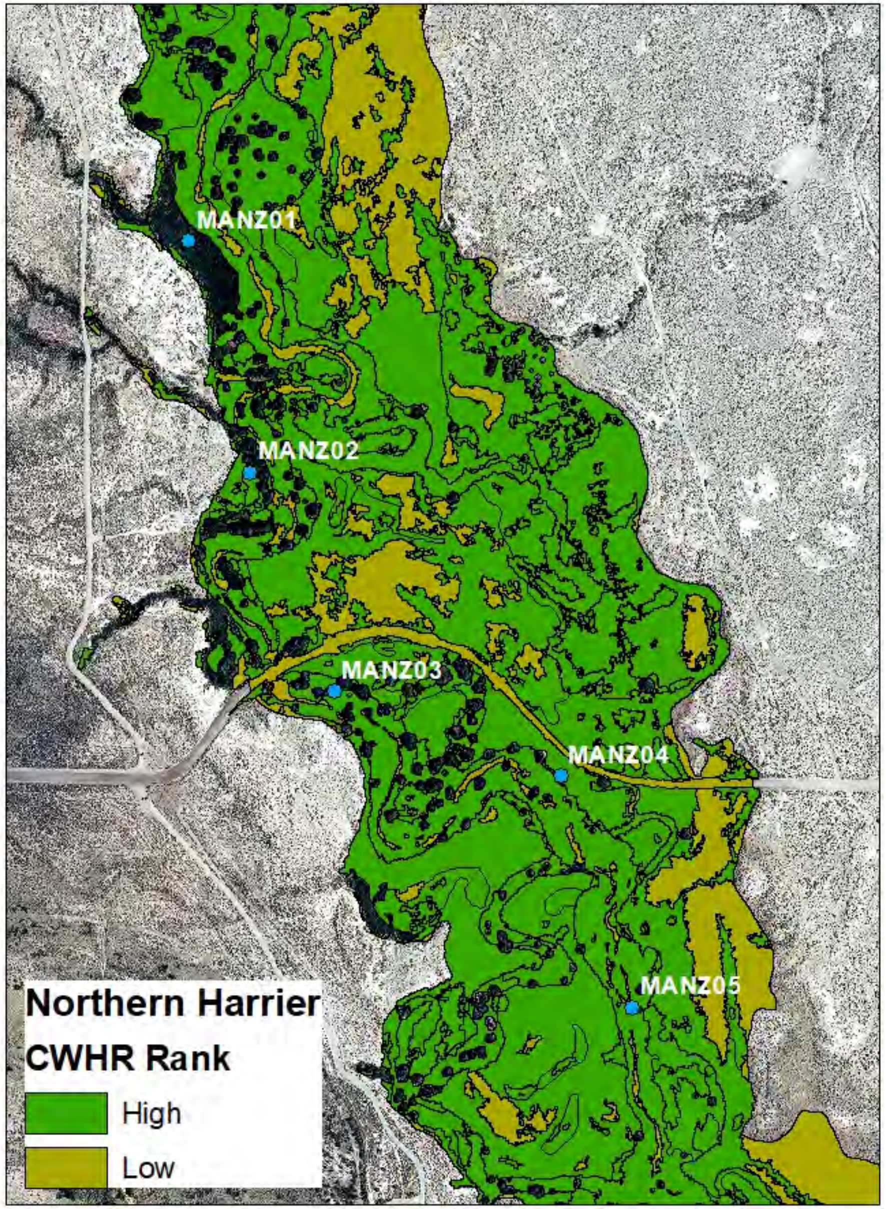
Operated and maintained by California Department of Fish and Wildlife

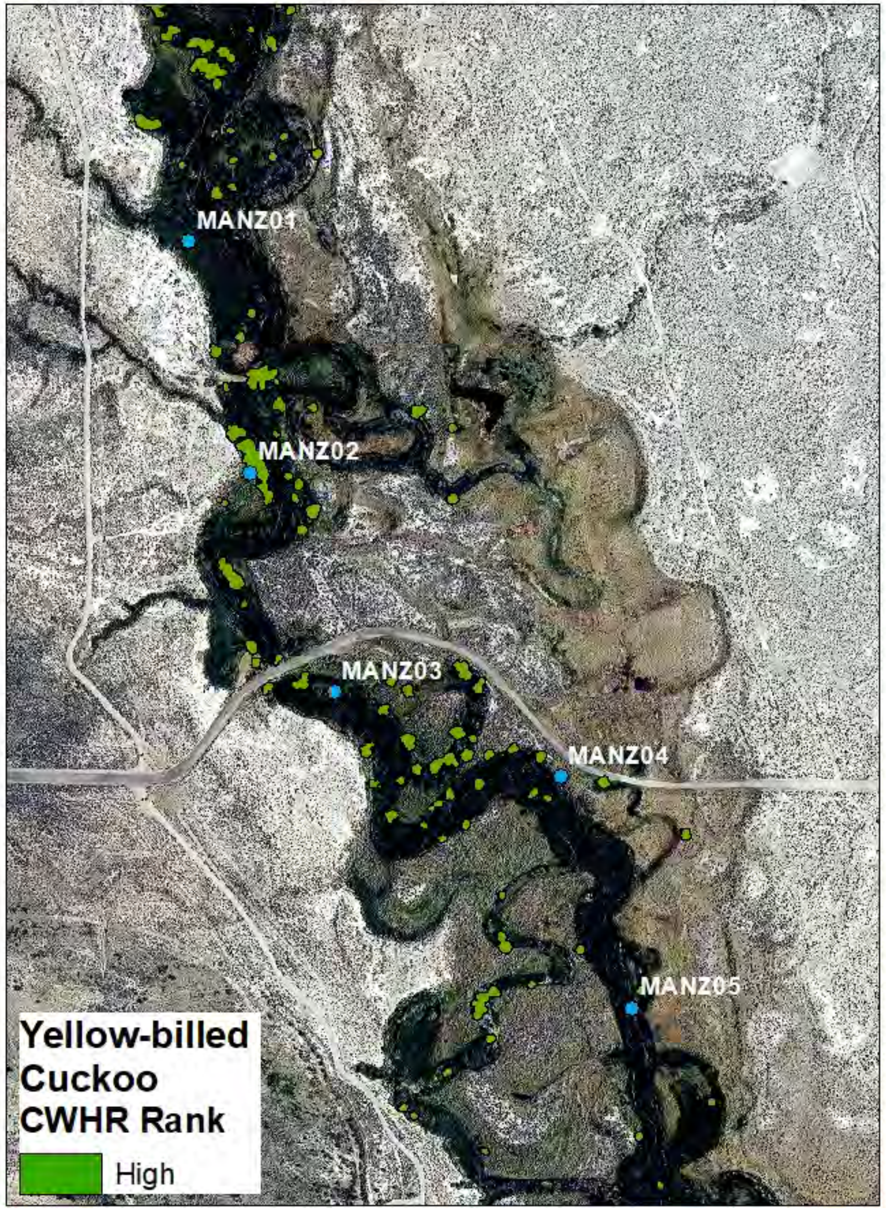
Used Predicted Habitat Models for each HIS

Show predicted suitable habitat within species range

Mean suitability score = reproduction, cover, and feeding scores

Ranked on 0 to 1 scale → low, medium, high suitability


MANZ01
MANZ02
MANZ03
MANZ04
MANZ05
Northern Harrier
CWHR Rank
High
Low


MANZ01
MANZ02
MANZ03
MANZ04
MANZ05
Yellow-billed
Cuckoo
CWHR Rank
High

California Wildlife Habitat Relationship System

Predicted habitat varies for each HIS

- *Yellow-billed Cuckoo has the least*
- *Northern Harrier has the most*

Top three habitat types

- *Desert Riparian – 17*
- *Wet Meadow – 12*
- *Freshwater Emergent Wetland - 11*

Avian Monitoring Analysis

Waterbirds

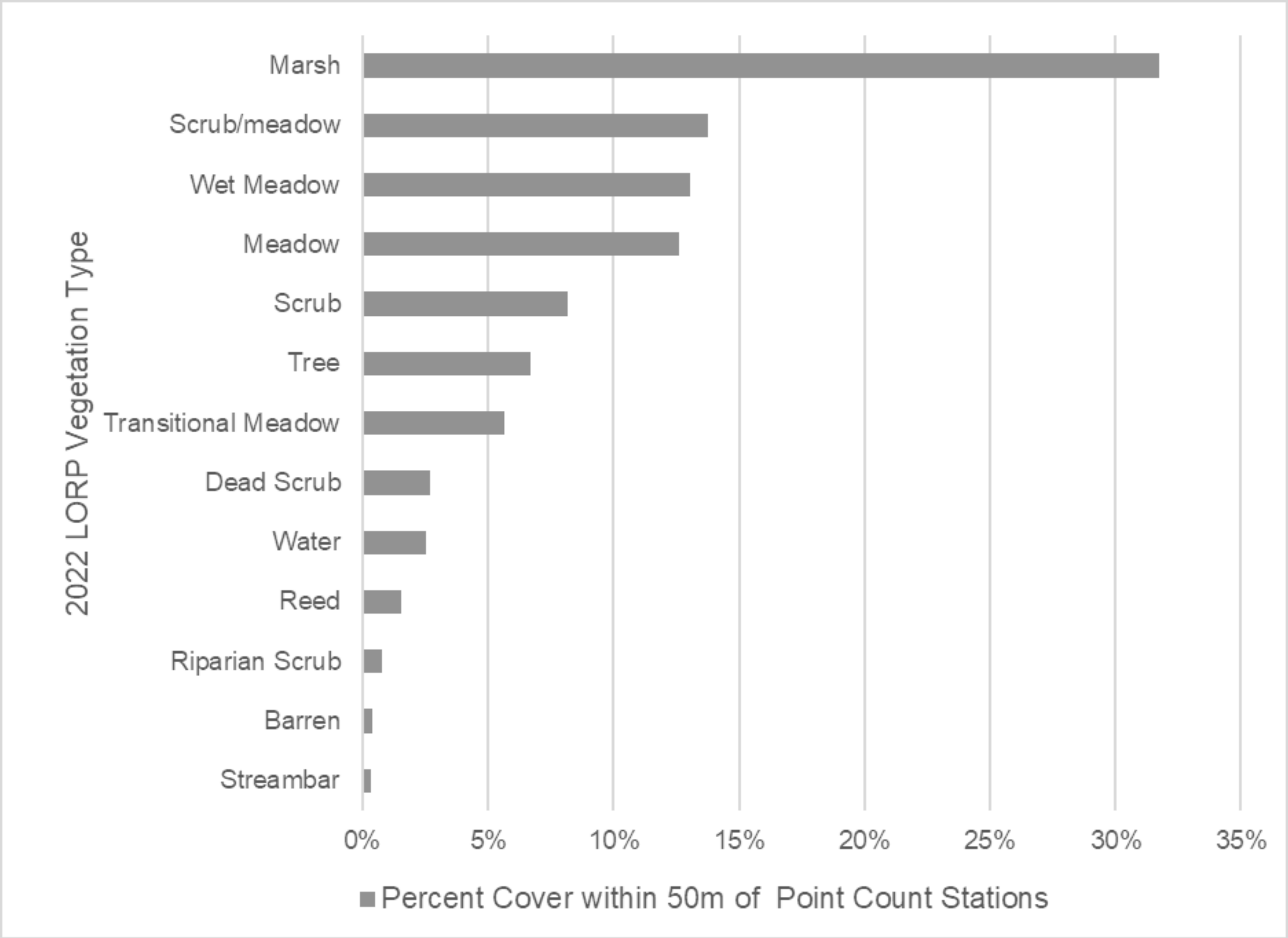
Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State



Avian Monitoring Analysis

Waterbirds

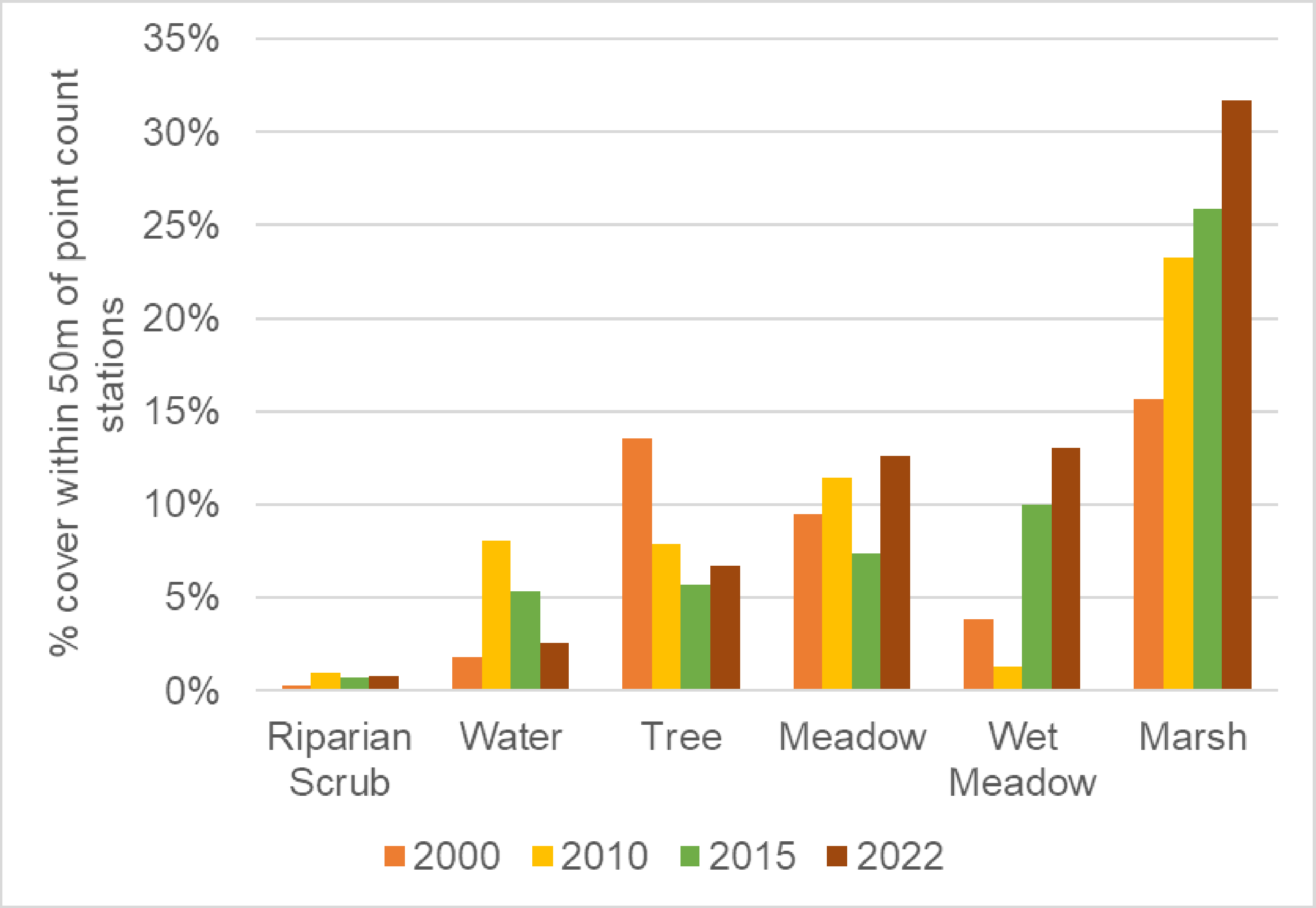
Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State



Avian Monitoring Analysis

Waterbirds

Landbirds

Breeding Birds

Habitat Indicator Species

Vegetation

River State

nit sis

	Bird Community Index			
	Diversity		Abundance	
Vegetation Community	Pearson's r	p-value	Pearson's r	p-value
Water	0.065	0.147	*****0.189**	**< .001**
Marsh	0.021	0.647	*****0.278**	**< .001**
Wet meadow	0.070	0.118	*****0.266**	**< .001**
Tree	*****0.304**	**< .001**	*****0.226**	**< .001**
Riparian shrub	0.049	0.274	-0.019	0.679
Reed	-0.041	0.360	-0.045	0.314
Streambar	-0.083	0.064	****-0.139**	**0.002**
Meadow	-0.080	0.074	***-0.113**	**0.012**
Scrub/meadow	0.007	0.873	-0.012	0.791
Transitional meadow	***-0.098**	**0.029**	*****-0.187**	**< .001**
Scrub	-0.064	0.152	*****-0.198**	**< .001**
Dead scrub	****-0.147**	**0.001**	*****-0.173**	**< .001**
Barren	0.016	0.720	-0.033	0.468

* p < .05, ** p < .01, *** p < .001

Avian Monitoring Analysis

	Bird Community Index			
	Diversity		Abundance	
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* p < .05, ** p < .01, *** p < .001

Avian Monitoring Analysis

- Waterbirds
- Landbirds
- Breeding Birds
- Habitat Indicator Species
- Vegetation
- River State

Avian Monitoring Analysis

Pre-LORP Conditions
- 29% Incised, dry channel (1/3)

Post-LORP Conditions
- Increase in the amount of aggraded channel
- 7% → 41%

2022 Conditions
- 41% of river is aggraded
- Dominated by marsh
- Benefits a few, abundant species

Aggraded → High abundance, low diversity

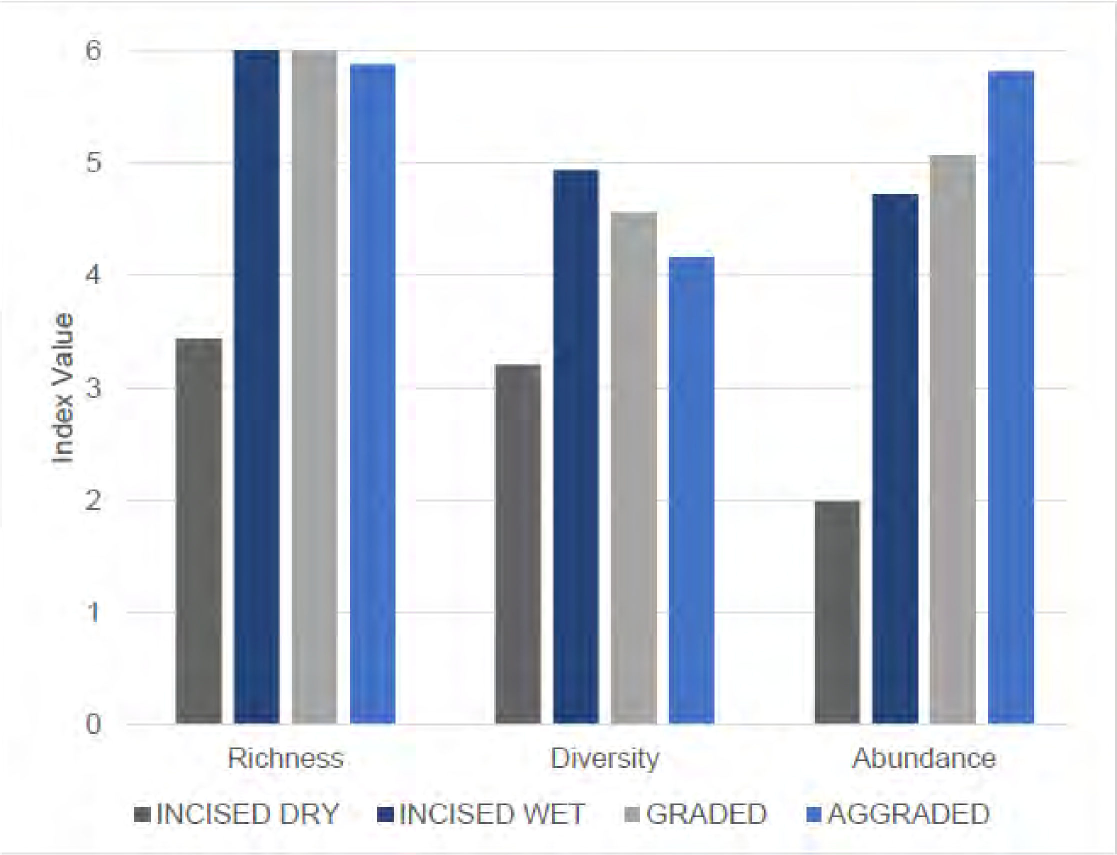

Figure 4-16. Breeding Bird Indices Versus River State.

Key Points

Waterbird and landbird species richness and abundance have increased

Breeding bird diversity has decreased while abundance has increased

Habitat Indicator Species have increased

15 observed

10 confirmed or suspected of breeding

Key Points

The river is aggrading and dominated by marsh

This benefits Wetland Associated HIS and common landbird and breeding birds

There is a lack of recruitment of riparian trees

Trees positively influence breeding bird diversity and abundance

Recommendations

Protect existing woody riparian vegetation

Evaluate the feasibility of localized habitat enhancement

Discontinue the current scale of monitoring

Future monitoring should be a targeted approach

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QUESTIONS

LORP Land Management
2022

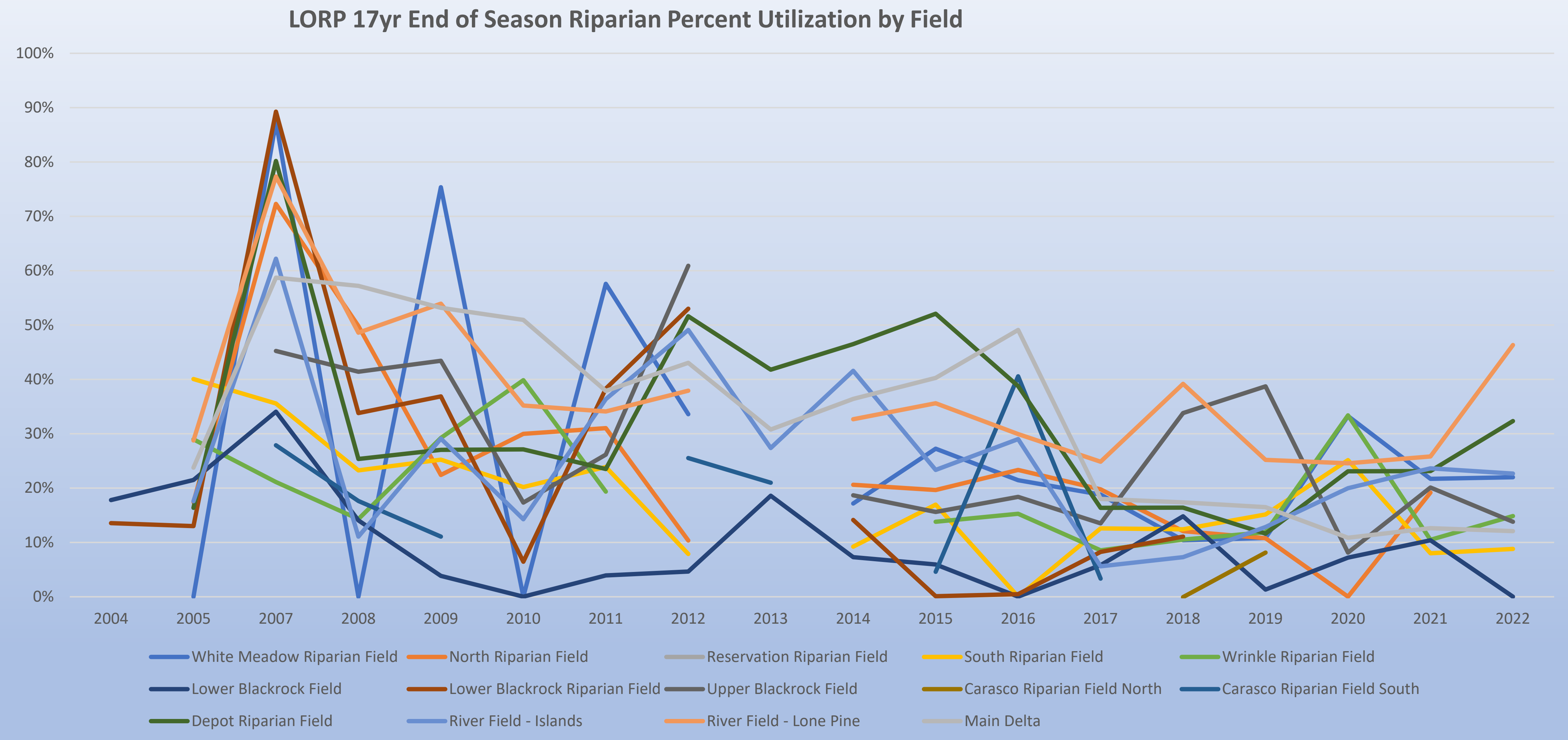
Presented by:
Gary Peek (LADWP)

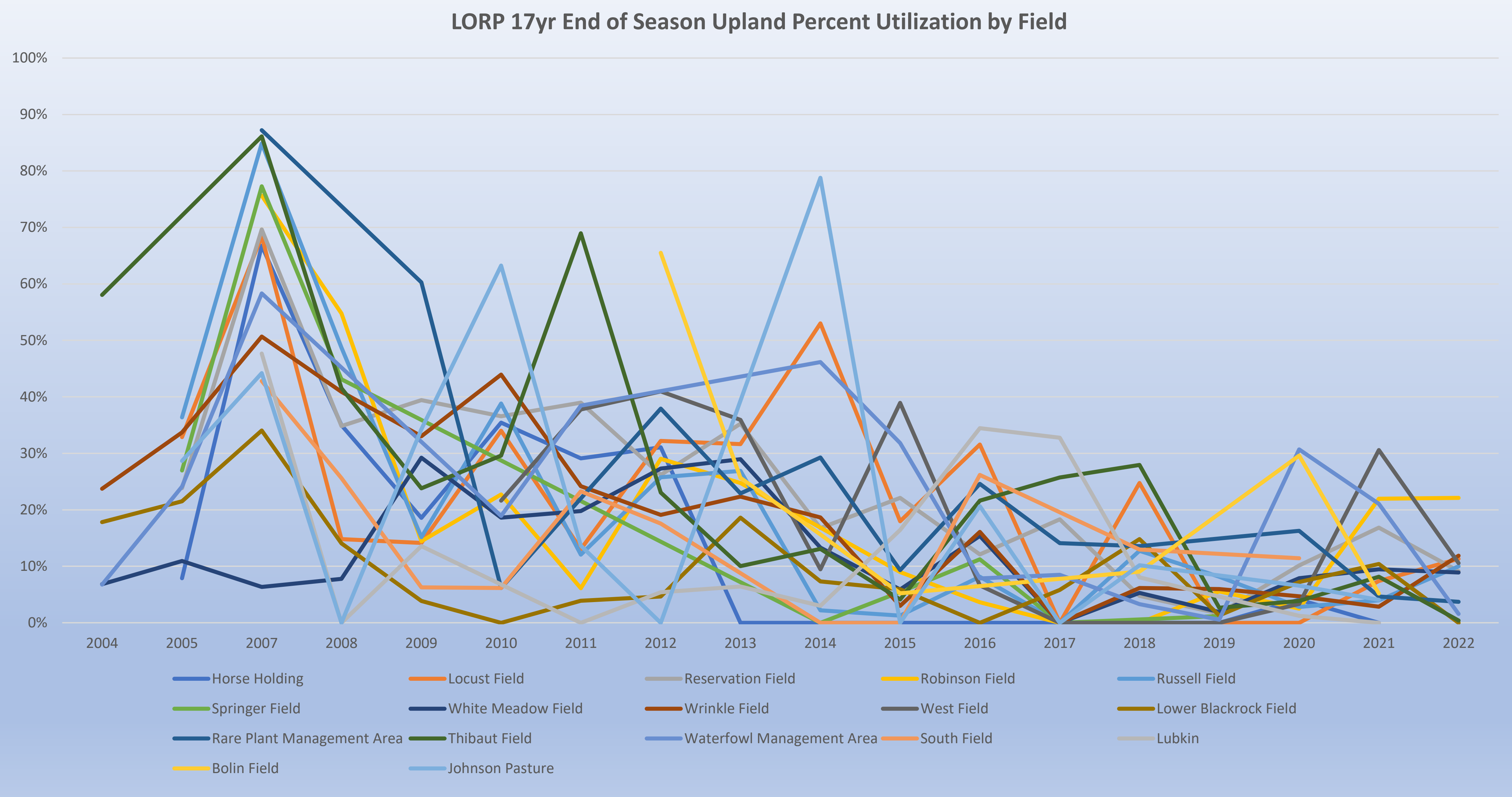
Land Management Through Grazing

- There are seven grazing leases located inside LORP boundary.
- Prior to 2002 grazing management on the LORP was conducted at the discretion of the lessee.
- Under the guidance of the LORP EIR and the MAMP, the MOU Consultants, LADWP, and LORP Lessee's grazing management plans were developed.
- Grazing management plans outline the basic operational plan used by lessees to meet LORP goals while maintaining a viable livestock operation.
- The basis of the management plans consists on the relationship between utilization and range trend.

Utilization

- The 40% riparian utilization rate was developed to promote a healthy riparian ecosystem. Approximately 24,700 acres of riparian pastures were fenced (66 miles) in order to facilitates the riparian pasture management. The upland utilization rate was set at 65%.
- Height-weight curves were developed on a species-specific basis within the LORP for key forage species (Inland Saltgrass/Alkali Sacaton).
- Monitoring has been conducted annually since 2002.
- It took 5 years for the lessees to adapt to the utilization grazing standards.

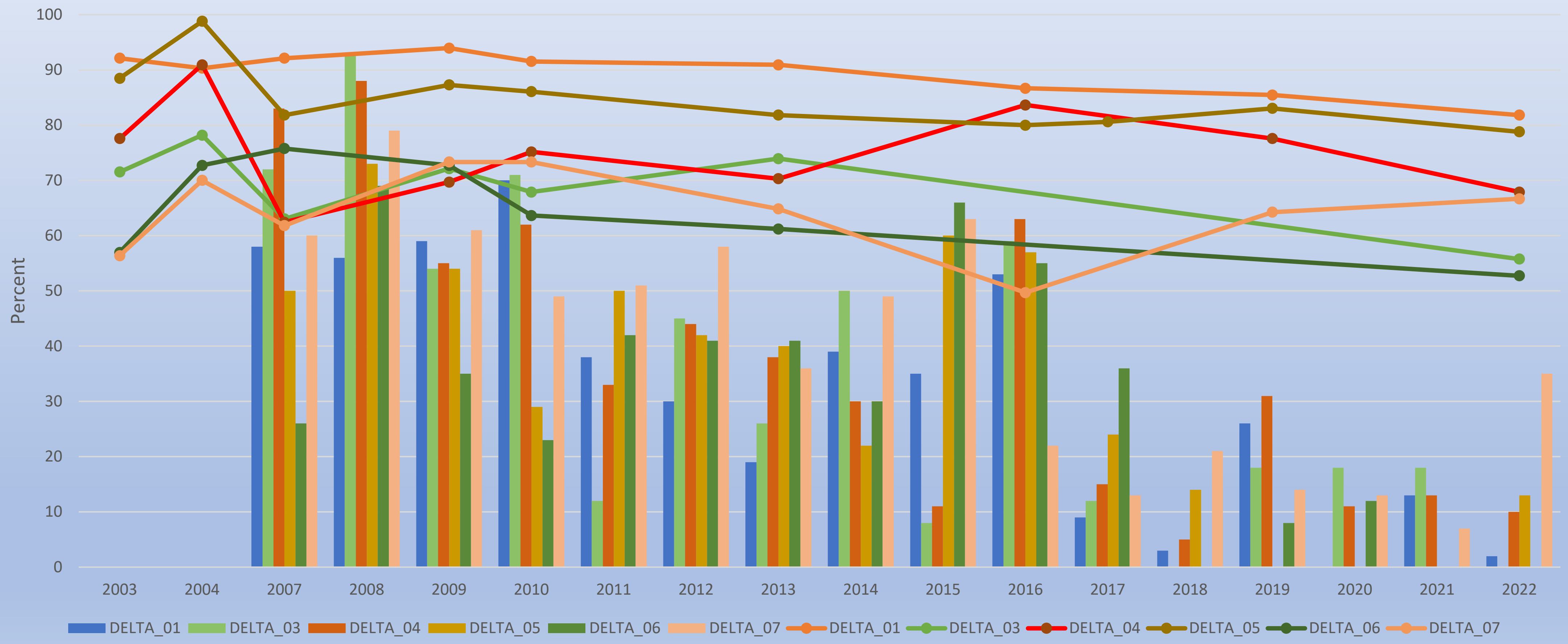

LORP 17yr End of Season Riparian Percent Utilization by Field
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2004
2005
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
White Meadow Riparian Field
North Riparian Field
Reservation Riparian Field
South Riparian Field
Wrinkle Riparian Field
Lower Blackrock Field
Lower Blackrock Riparian Field
Upper Blackrock Field
Carasco Riparian Field North
Carasco Riparian Field South
Depot Riparian Field
River Field - Islands
River Field - Lone Pine
Main Delta


LORP 17yr End of Season Upland Percent Utilization by Field
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2004
2005
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Horse Holding
Locust Field
Reservation Field
Robinson Field
Russell Field
Springer Field
White Meadow Field
Wrinkle Field
West Field
Lower Blackrock Field
Rare Plant Management Area
Thibaut Field
Waterfowl Management Area
South Field
Lubkin
Bolin Field
Johnson Pasture

Range Trend

- The intent of range trend monitoring was to document the anticipated positive effects from limiting livestock grazing (utilization) on key forage species in the LORP.
- Nested frequency (percent cover) and shrub cover (line intercept) are used for monitoring range trend.
- The data relates to the influences of livestock grazing and flow management on vegetation trend and range condition.
- Range trend is conducted in uplands, moist flood plains, and enclosures.
- Range trend monitoring began on the LORP in 2002. Since 2009, monitoring results have been reported annually.

Percent frequency (line) for saltgrass and percent utilization (bar) on functioning moist floodplain sites on the Delta Lease, Reach 5.



Utilization rates and long-term plant trends

- Nearly 20 years of monitoring and exclusion studies suggested no relationship between reduced utilization and improved rangeland conditions under the current grazing system.
- Considering these results, under the direction of the MAMP, the 40% utilization limit on dormant season grazing may not be as effective as originally identified in achieving desired landscape outcomes across all LORP locations.
- Independent of grazing, reaches 3-6 were found to be functioning at site potential prior to and throughout the entire study period. While reaches 1-2 are still transitioning after 17 years of returned flows.

Adaptive Management/Conclusion

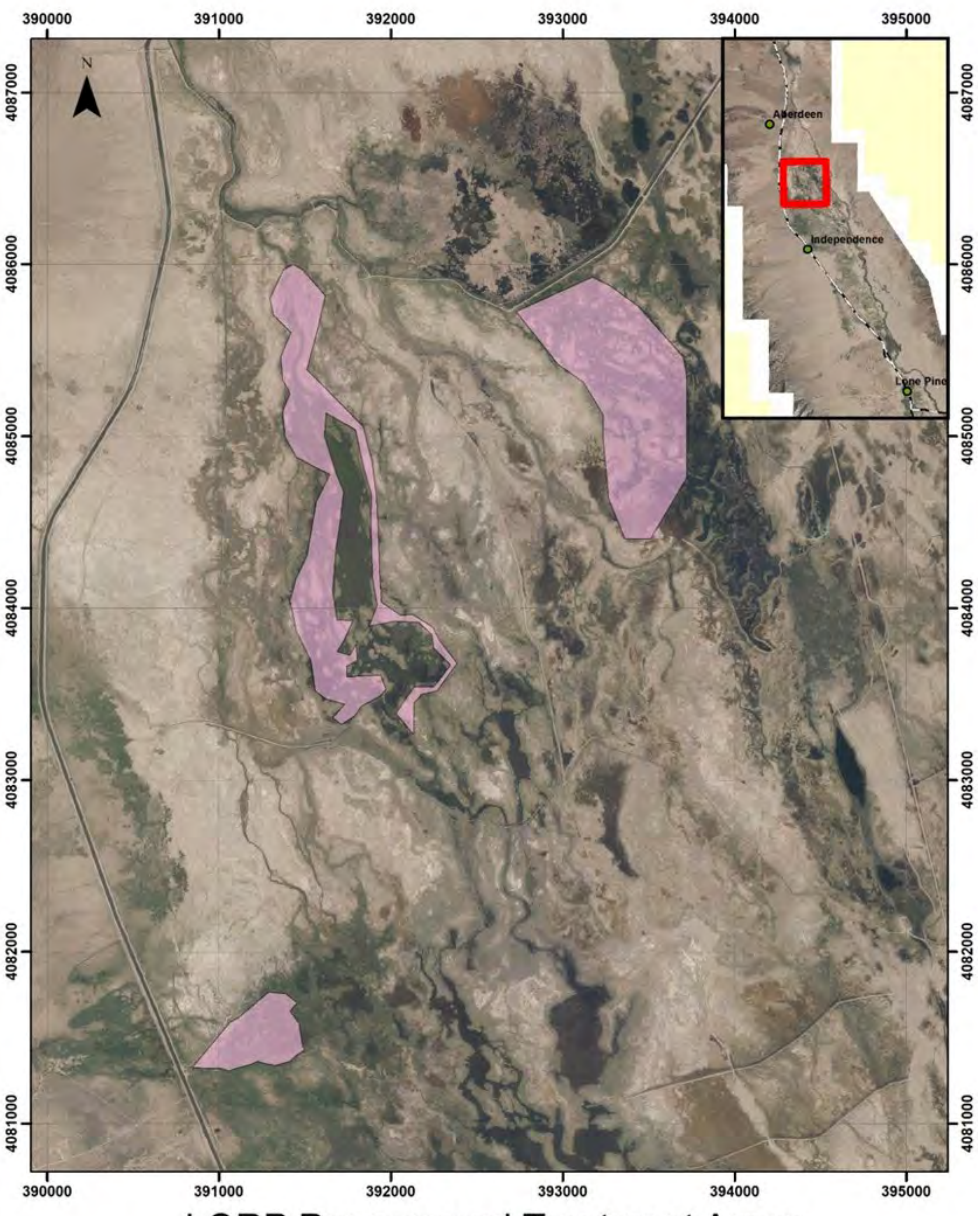
- Over the course of the project we have identified three primary tools for land management that can help facilitate the improvement of riparian and upland habitats.
- These tools are grazing, controlled burns, and mechanical treatments.
- LADWP recommends the implementation of these management tools for future adaptive management, to improve habitat conditions.
- LADWP also recommends continued utilization and range trend monitoring at the current levels.


Questions

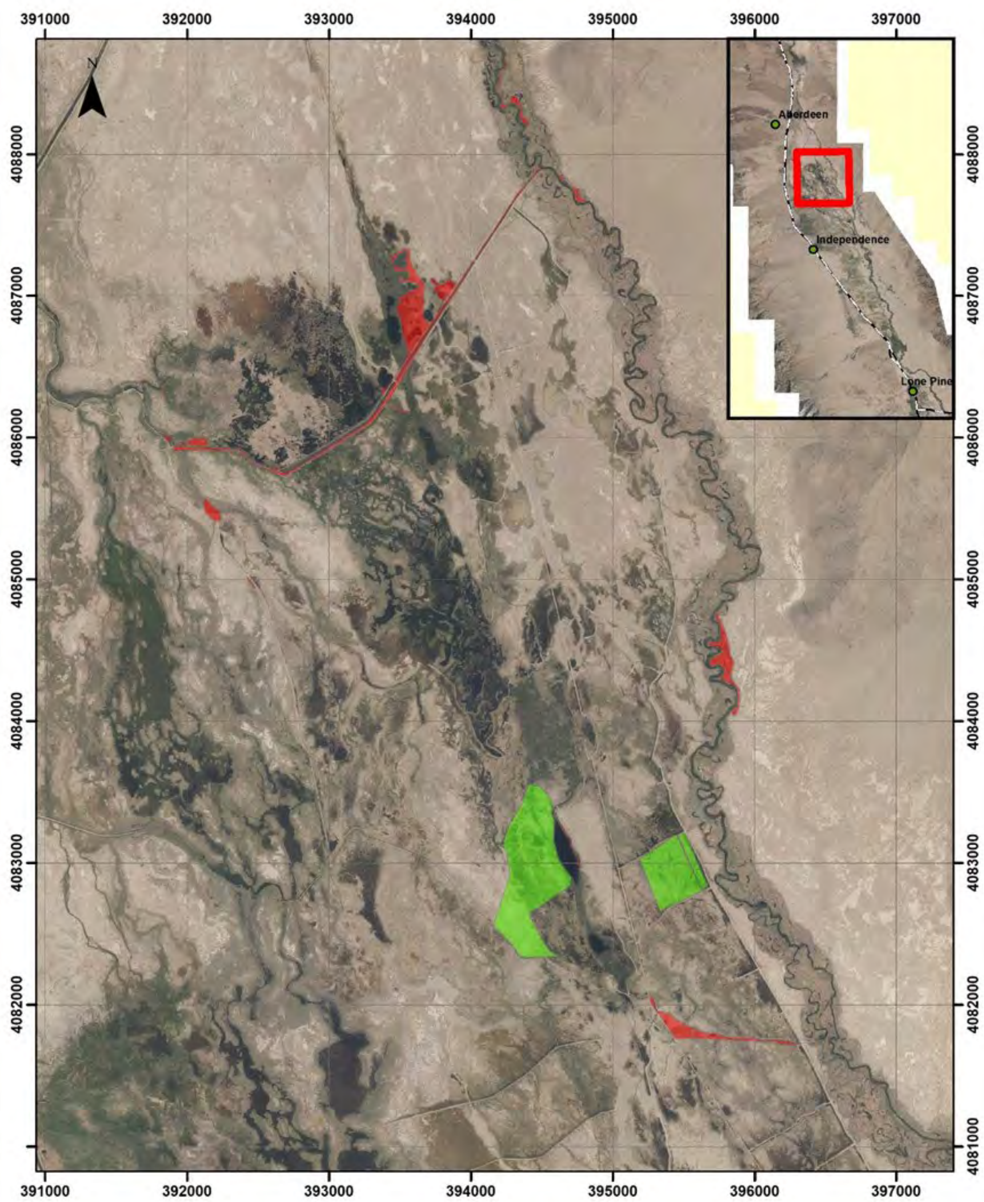
2022 LADWP LORP Weed Treatment

Presented by:

Brian Stange (LADWP)



LORP Pepperweed Treatment Areas



LORP Tamarisk Treatment Areas

Legend

Tamarisk Mechanical Treatment

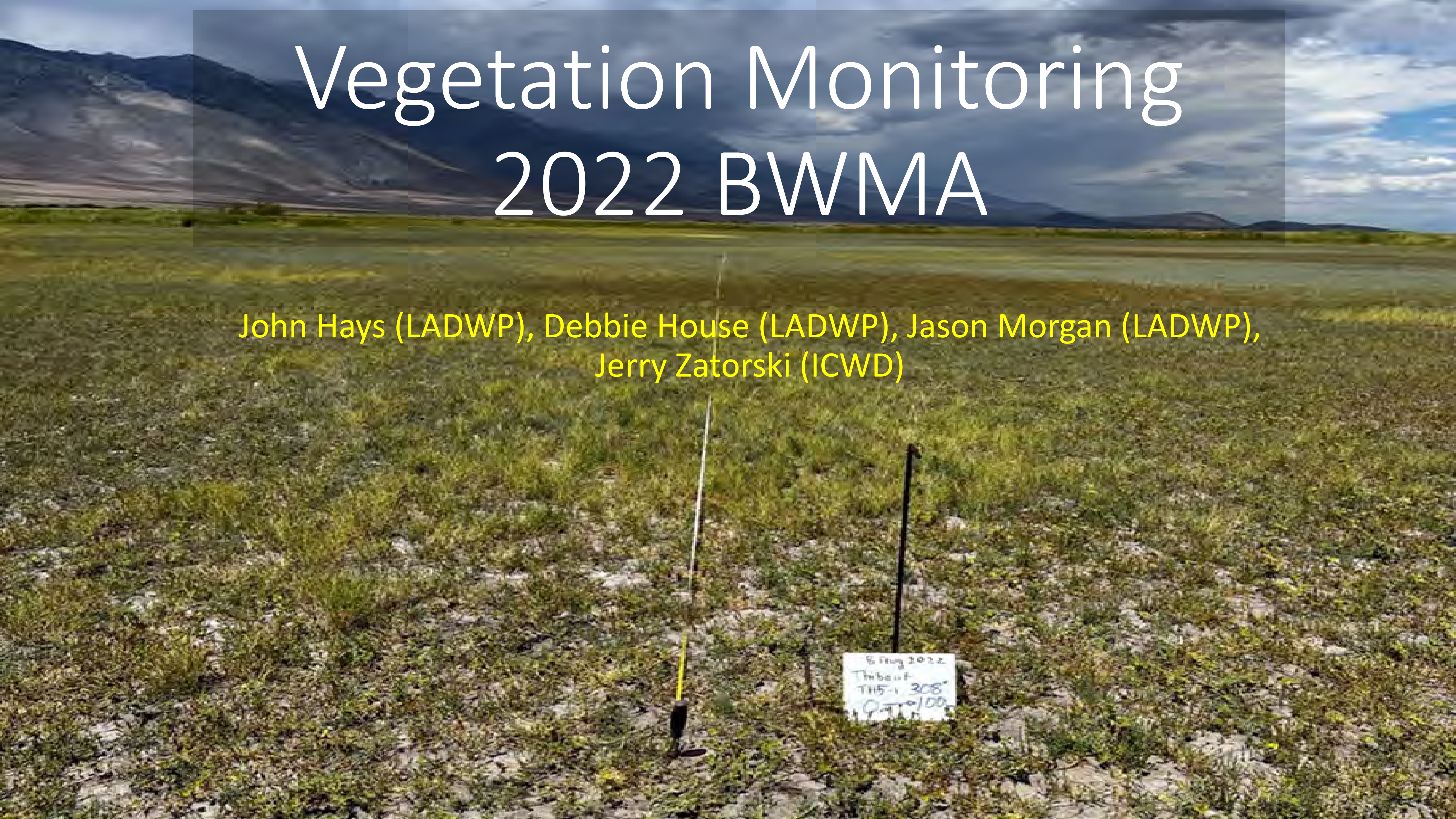
Tamarisk Hand Treatment

0 0.425 0.85 1.7 Miles

QUESTIONS

Vegetation Monitoring 2022 BWMA

John Hays (LADWP), Debbie House (LADWP), Jason Morgan (LADWP), Jerry Zatorski (ICWD)



BWMA Adaptive Management Project

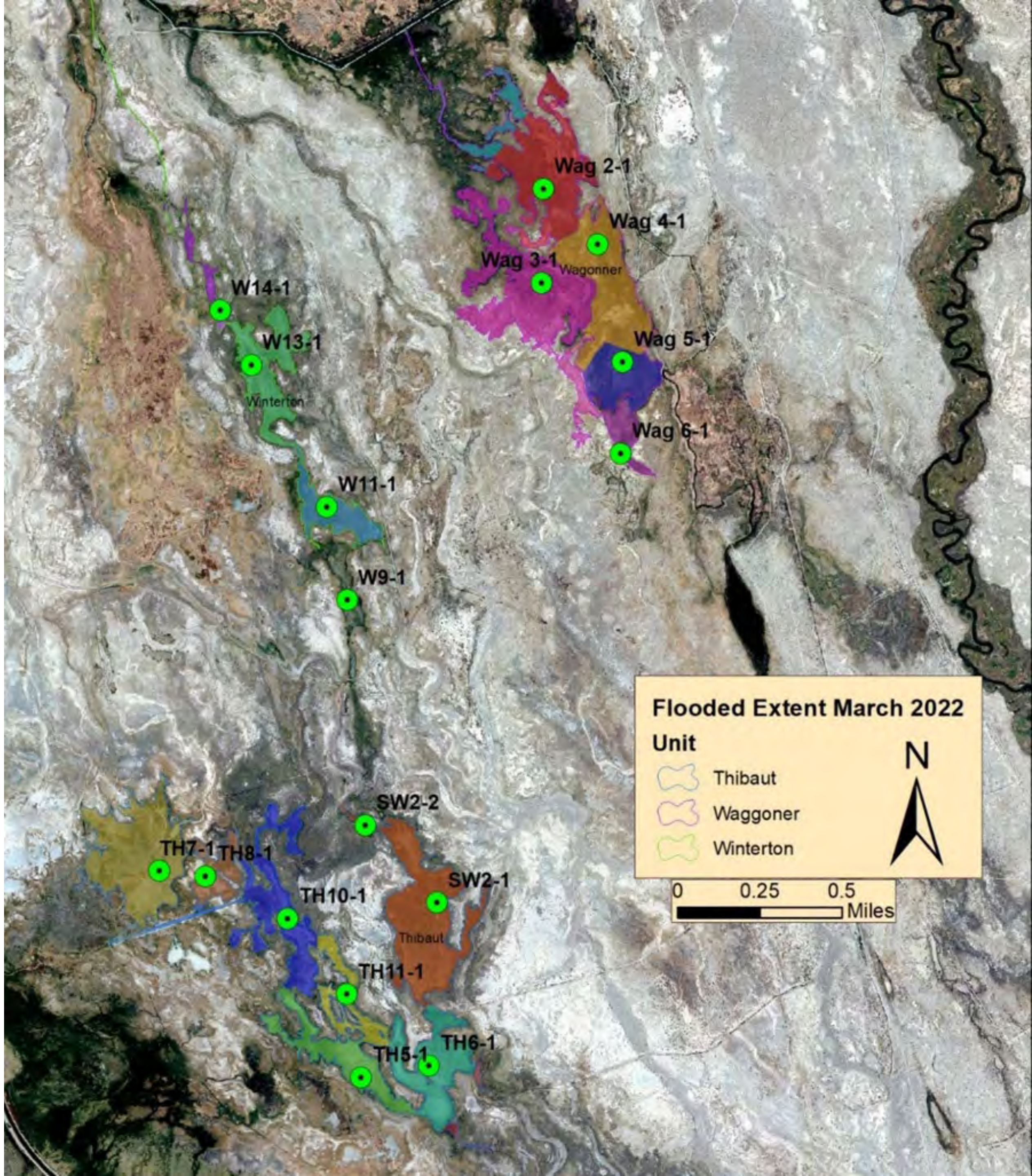
Goal: Improve habitat conditions using outside framework described in the LORP EIR

- Change from a year long flooding period with acreages dependent upon each water year to a seasonal cycle with a fixed 500 acres between Nov 1st-March 1st.
- Focus on vegetation manipulation/management using site prep and drying periods during the summer (Moist Soil Management)

AMP Vegetation Management Objectives

- Significantly reduce encroachment of hardstem bulrush and cattail (maintain open water)
- Determine if draw down period did not facilitate salt cedar germination
- Create conditions for early seral vegetation to be utilized as a forage base when flooded next fall

Sixteen, 100m transects were placed in flooded sub-units on Waggoner, East Winterton, and Thibaut.

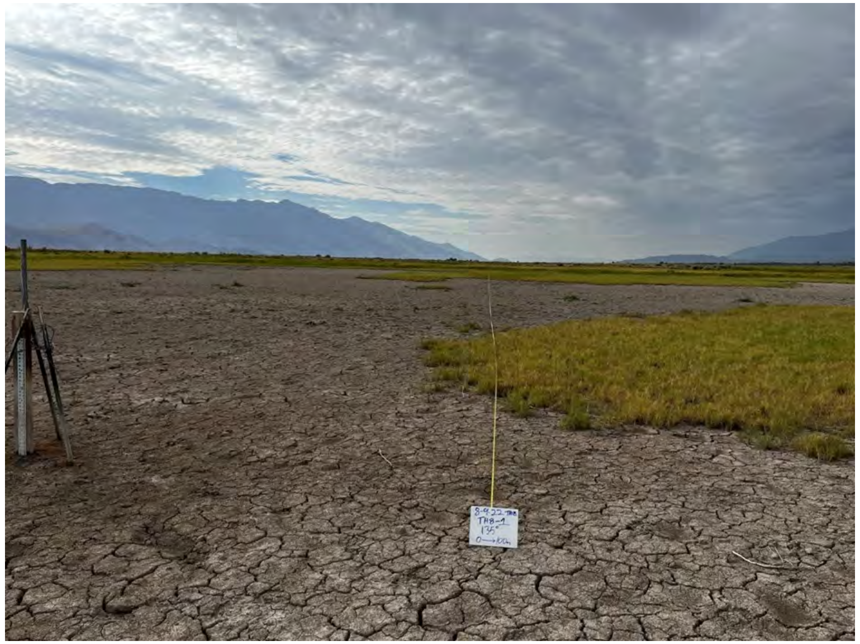


Determining Effectiveness = vegetation monitoring

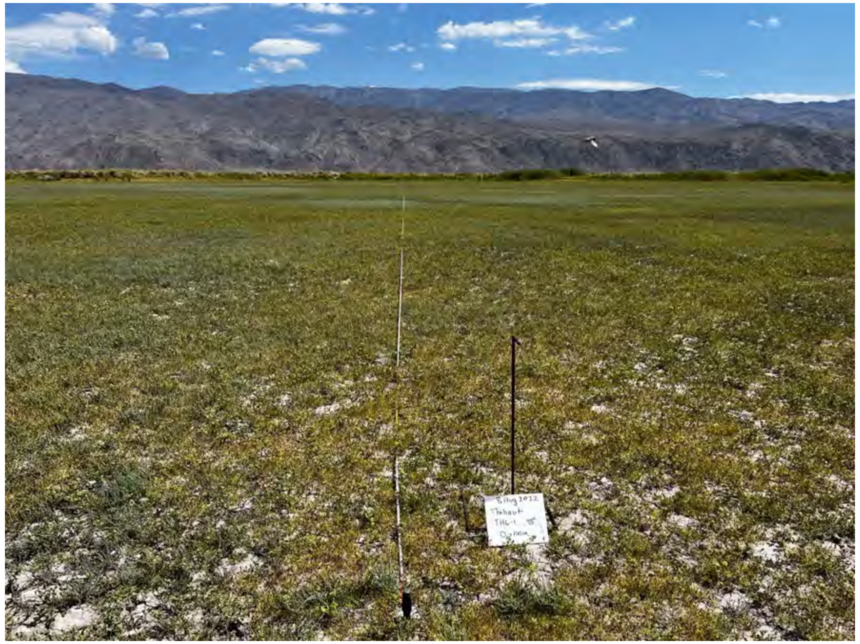
- Dry-weight-rank method = rapid estimate of relative plant production
- Point intercept = total plant cover
- Photo point = qualitive evaluation of change at landscape level, appropriate filler for dull power point slides

Results- Total Live Cover

- Waggoner (n=5) = 71% (53%-86%)
- East Winterton (n=4) = 33% (8%-24%)
- Thibaut (n=8) = 53% (14%-89%)



TH 8-1 (Thibaut) 14% TLC



TH-6 (Thibaut) 89% TLC

Results- Species composition by weight

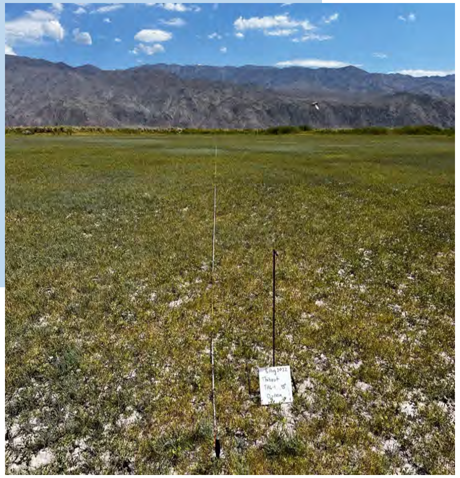
triangle orache	**Atriplex prostrata**	**11%**
tumbling saltweed	Atriplex rosea	1%
wedgescale saltbush	**Atriplex truncata**	11%
fivehorn smotherweed	Bassia hyssopifolia	4%
Sedge	Carex spp.	1%
Canadian horseweed	Conyza canadensis	1%
swamp timothy	Crypsis schoenoides	4%
spreading alkaliweed	**Cressa truxillensis**	11%
Saltgrass	Distichlis spicata	10%
common sunflower	Helianthus annuus	9%
salt heliotrope	Heliotropium curassavicum	3%
beardless wildrye	Leymus triticoides	2%
alkali mallow	**Malvella leprosa**	27%
Scratchgrass	Muhlenbergia asperifolia	1%
annual rabbitsfoot grass	Polypogon monspeliensis	1%
willow dock	Rumex salicifolius	1%
hardstem bulrush	Schoenoplectus acutus	1%
verrucose seapurslane	Sesuvium verrucosum	1%

Seasonal Draw Downs:

- Maintain open water
- Support ruderal species= 44 species found on transects, 18 species contributed ≥ 1% total estimated dry weight (14 species = R)
- Draw down schedule does NOT influence salt cedar germination
- Swamp timothy
- High diversity between sub-units

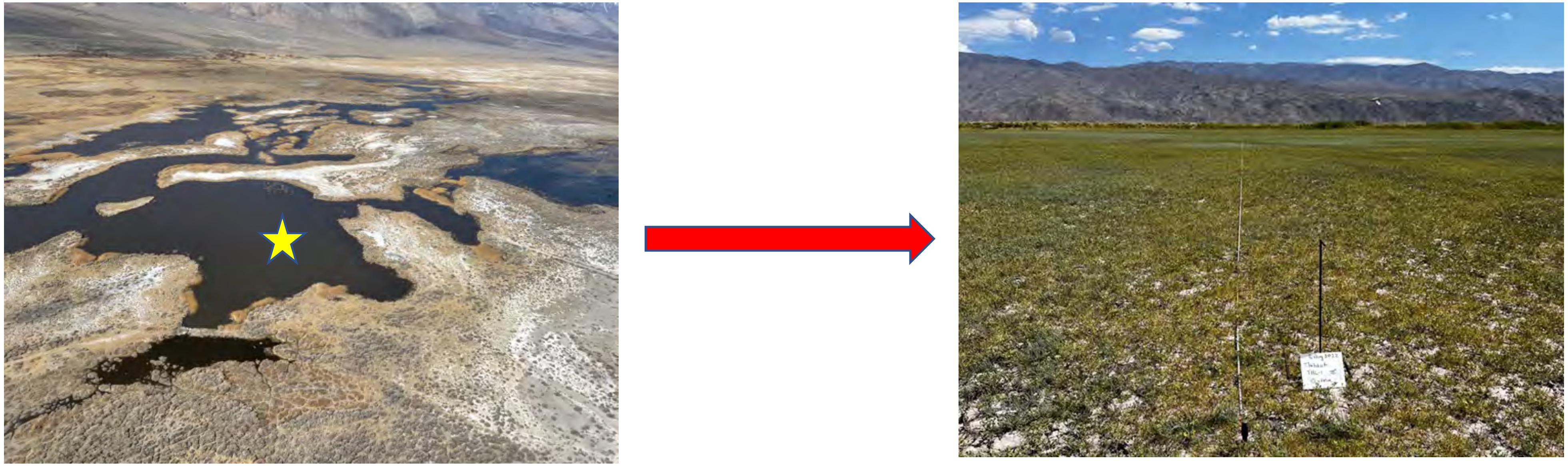






Next steps…

- Overlay avian monitoring results at sub-unit level with vegetation results
- Continue monitoring after next wet dry cycle (summer 2024)
- Understand influence of timing, soil conditions, and site prep have on R plant communities



Questions???

Delta Habitat Area

Interim Adaptive Management

Report on Year 2 Observations:

Runoff Year April 1, 2021-March 31, 2022

LORP Public Meeting

June 22, 2023

Deborah House
LADWP Watershed Resources Specialist

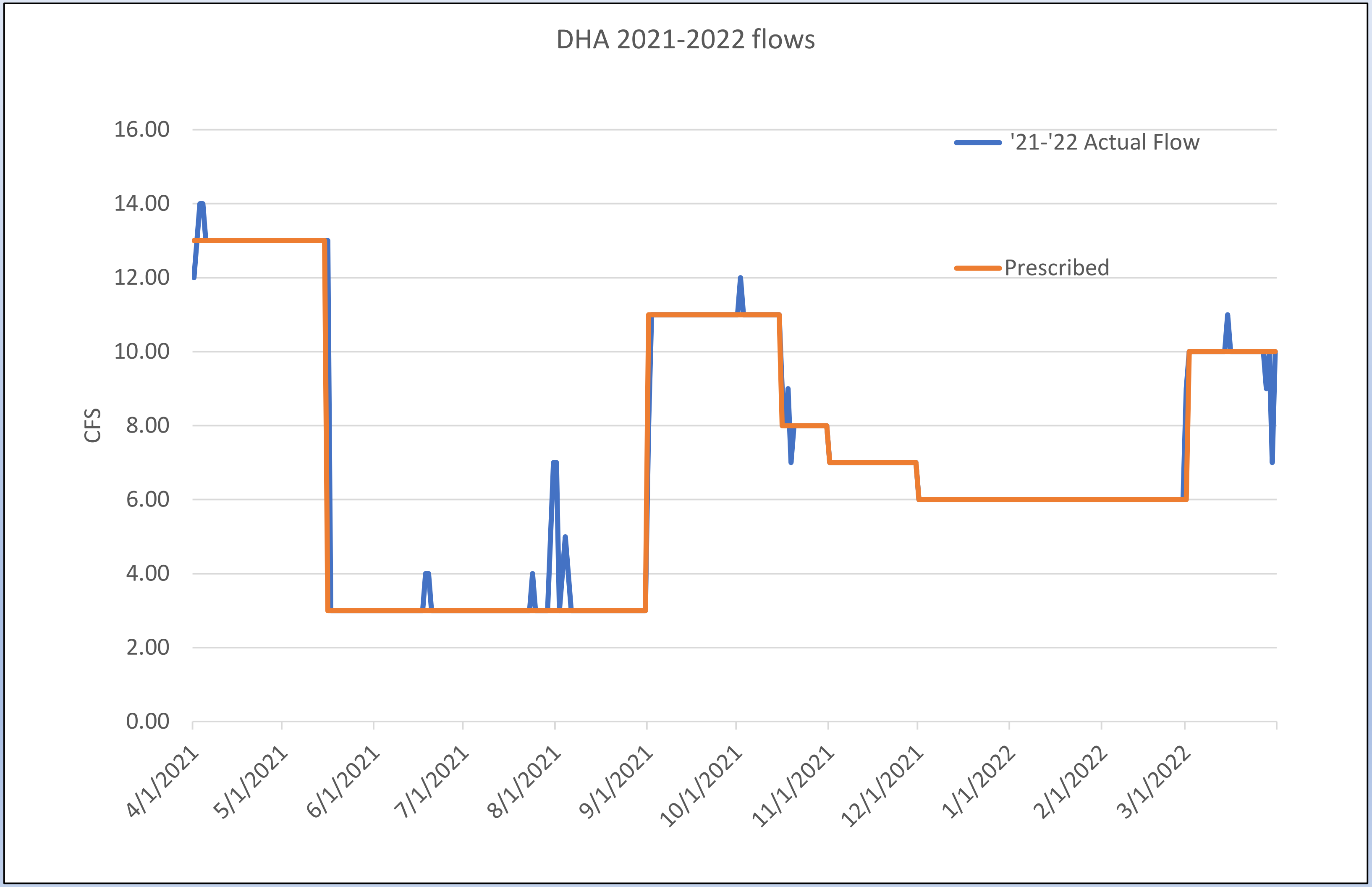
Delta Habitat Area – Interim Adaptive Management Plan

- 5-year plan
- Redistribution of flows to better match seasonal abundance of indicator species and arrest the expansion of marsh
- Habitat objectives:
  - Maintain and improve habitat for indicator species
  - Reduce marsh, increase meadow habitats and open water
  - Maintain flooding of key habitats fall through spring

2021-2022 Monitoring

- Flow Monitoring
- Effectiveness of Adaptive Management Flows

Prescribed Interim vs. Actual Flows to DHA



Effectiveness of Adaptive Management Flows

Criteria 1: Did the summer minimum baseflow result in drying and hydrologic stress of cattails in the DHA?

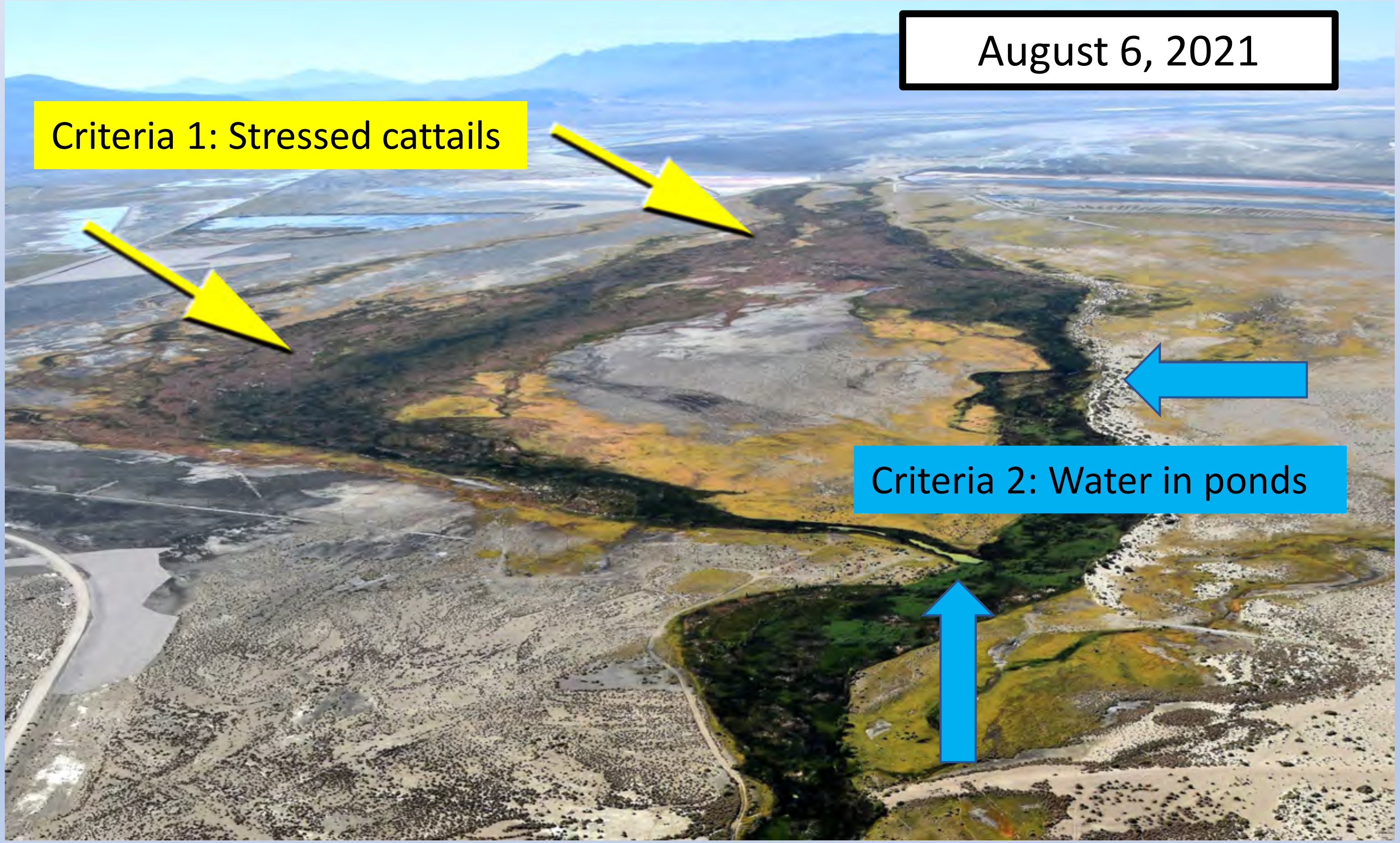
Criteria 2: Did the minimum summer base flow maintain water in permanent ponds serving as “control points”?

Criteria 3: Did the interim flows produce flooding of existing, seasonal ponds serving as “control points” from September through early May?

Flow Effectiveness Monitoring

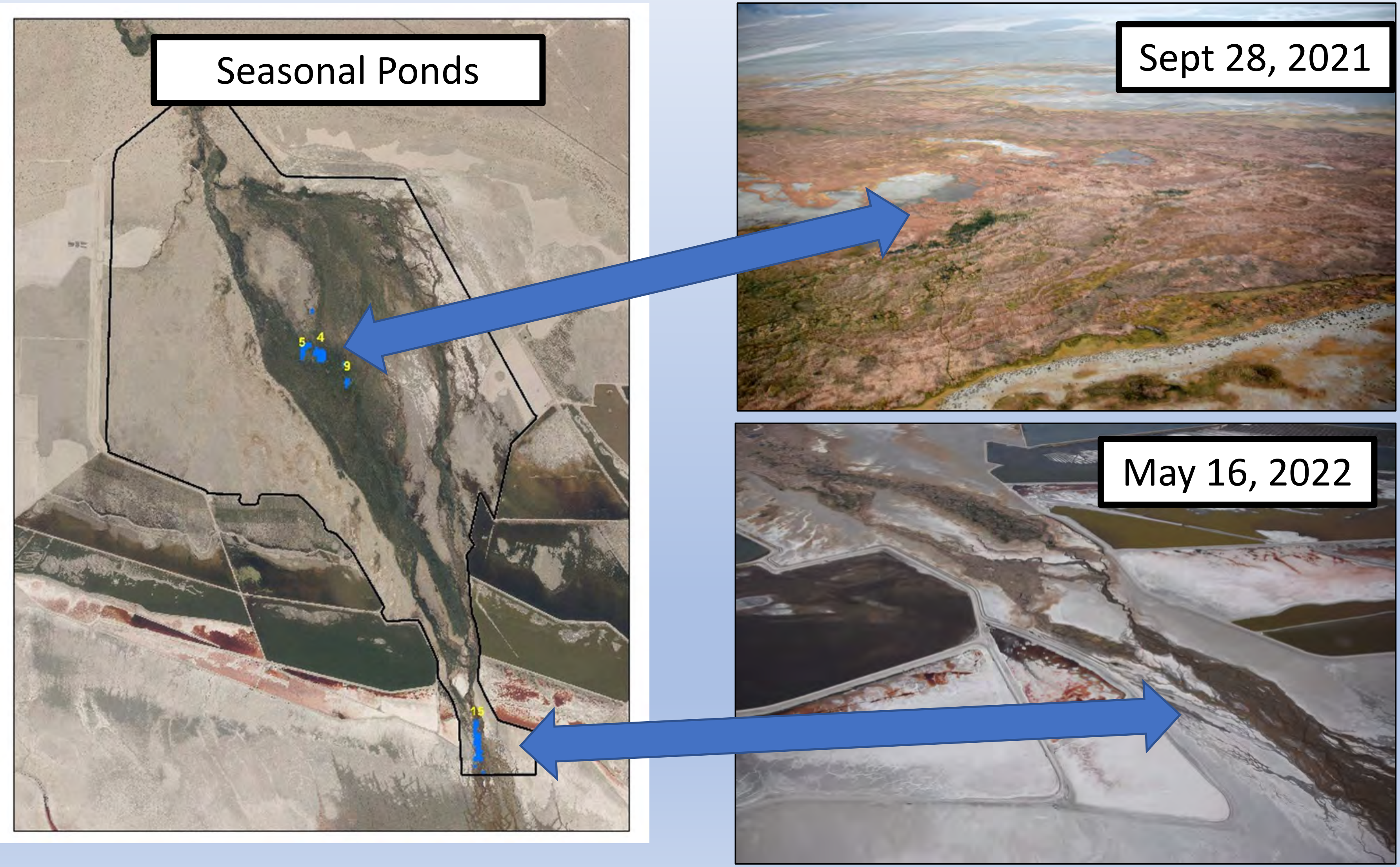
Criteria 1: Did the summer minimum baseflow result in drying and hydrologic stress of cattails? YES

Criteria 2*:* Did the minimum summer base flow maintain water in permanent ponds serving as "control points"? YES



Flow Effectiveness Monitoring

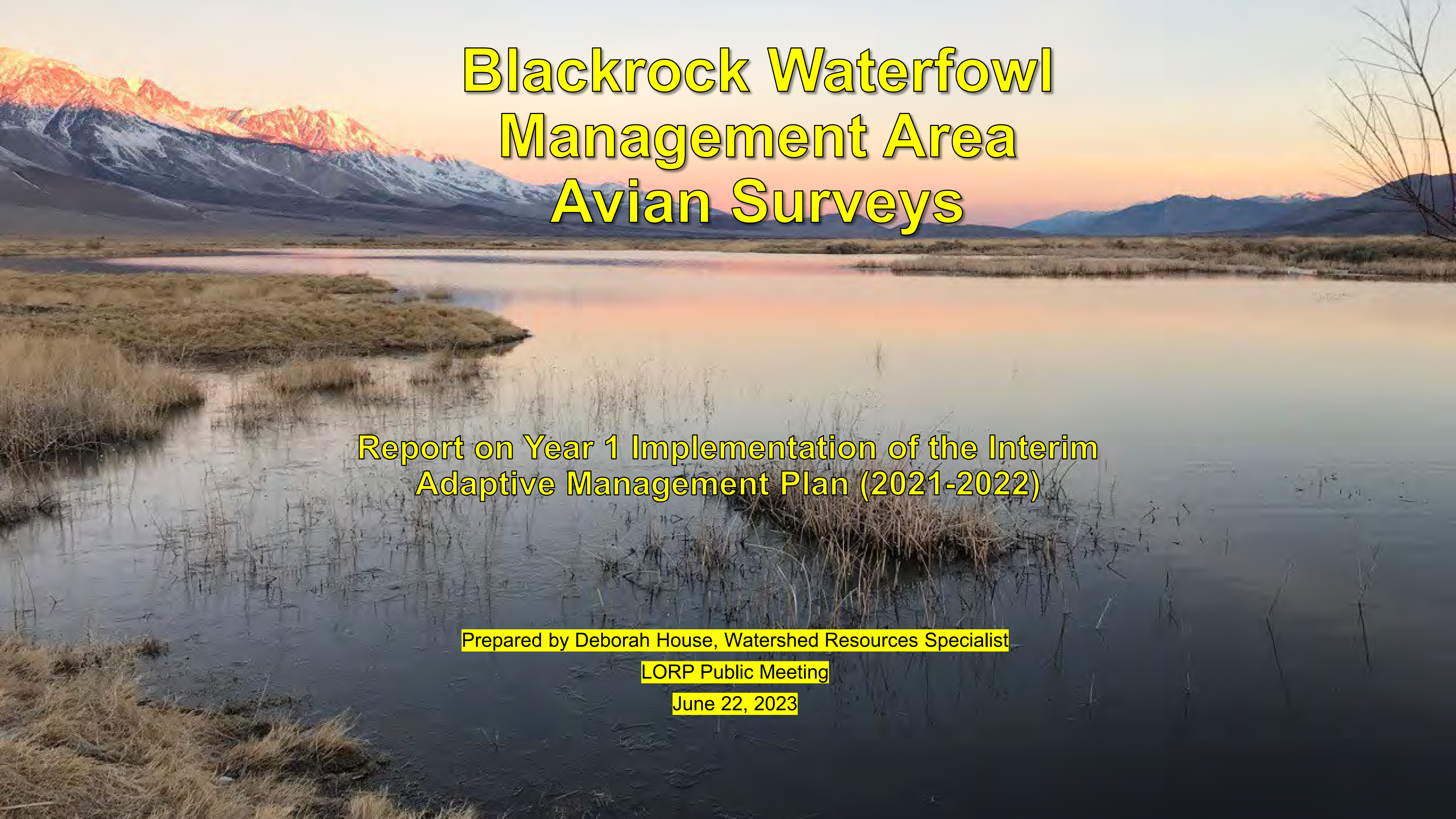
Criteria 3: Did the interim flows produce flooding of existing, seasonal ponds serving as “control points” from September through early May? YES



Summary of Year 2 Adaptive Management Flows

- ❑ Interim flow regime was effective at meeting assessment criteria in Year 2
- ❑ Habitat conversion will be slow without intervention
- ❑ Recommendation: selective mowing in and around natural depressions

QUESTIONS



Blackrock Waterfowl Management Area Avian Surveys

Report on Year 1 Implementation of the Interim Adaptive Management Plan (2021-2022)

Prepared by Deborah House, Watershed Resources Specialist

LORP Public Meeting

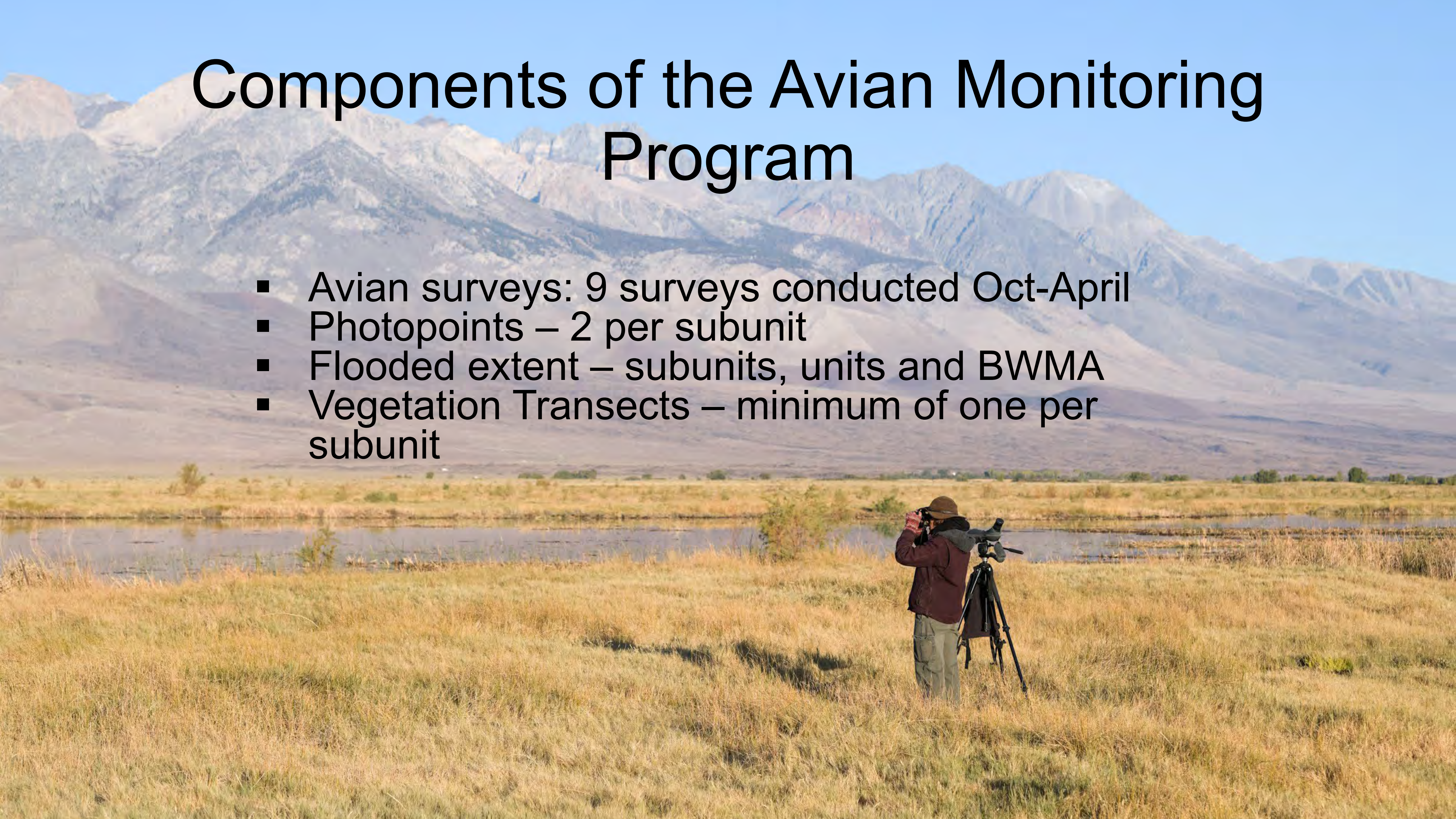
June 22, 2023

BWMA Interim Adaptive Management Plan

- 5-year plan
- Plan jointly-developed and implemented by LADWP and ICWD
- Seasonal flooding of 500 acres of wetlands
- Habitat improvement objectives:
  - Maintain open water habitat
  - Maintain a forage base for waterbirds

Components of the Avian Monitoring Program

- Avian surveys: 9 surveys conducted Oct-April
- Photopoints – 2 per subunit
- Flooded extent – subunits, units and BWMA
- Vegetation Transects – minimum of one per subunit

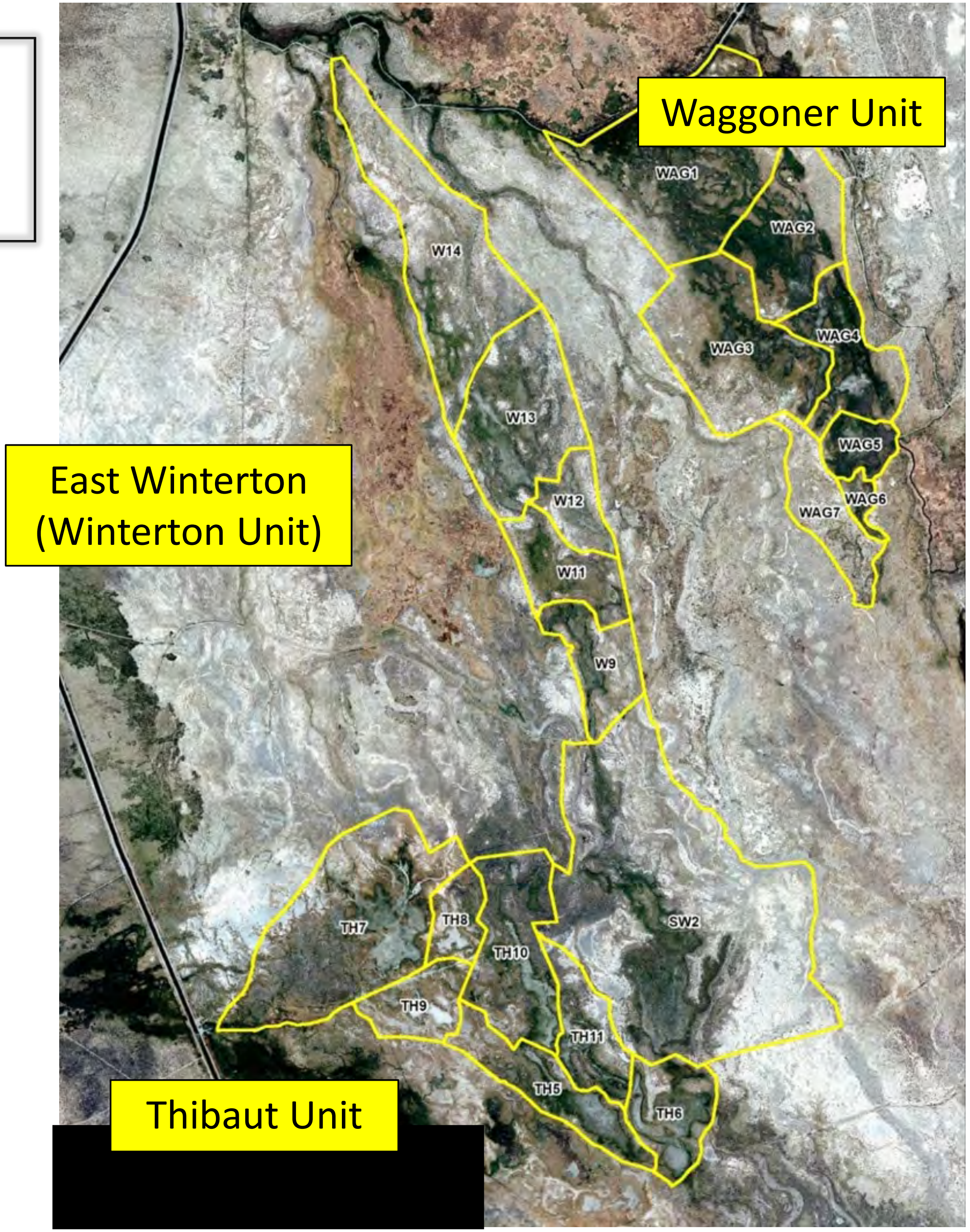


Evaluation of Avian Response at Three Spatial Scales:

1) All active BWMA Units combined

2) Individual Units

3) Subbasins within Units

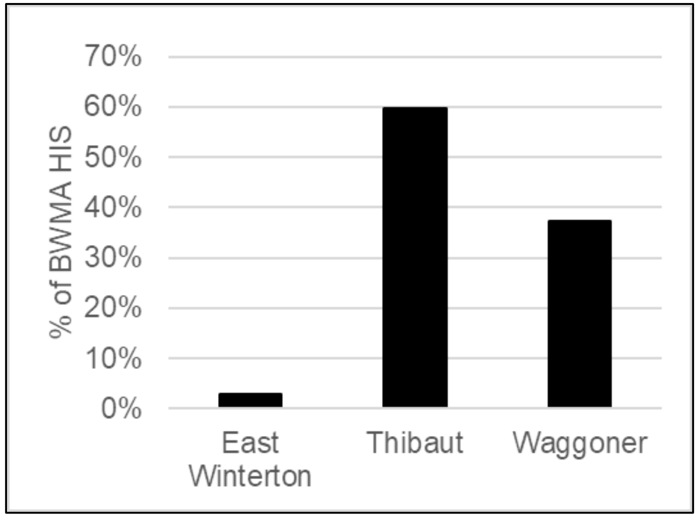


Seasonal Survey Periods and Survey Dates

Seasonal Survey	Survey Dates	East Winterton Subunit	Thibaut Unit	Waggoner Unit
Fall 3	5-6 October 2021	X	X	X
Fall 4	19-21 October 2021	X	X	X
Fall 5	1-2 November 2021	X	X	X
Winter 1	15-17 December 2021	X	X	X
Winter 2	11-13 January 2022	X	X	X
Spring 1	14-16 March 2022	X	X	X
Spring 2	29-31 March 2022	X	X	X
Spring 3	13-15 April 2022		X	X
Spring 4	26-27 April 2022		X	X

2021-2022 Bird Data Summary

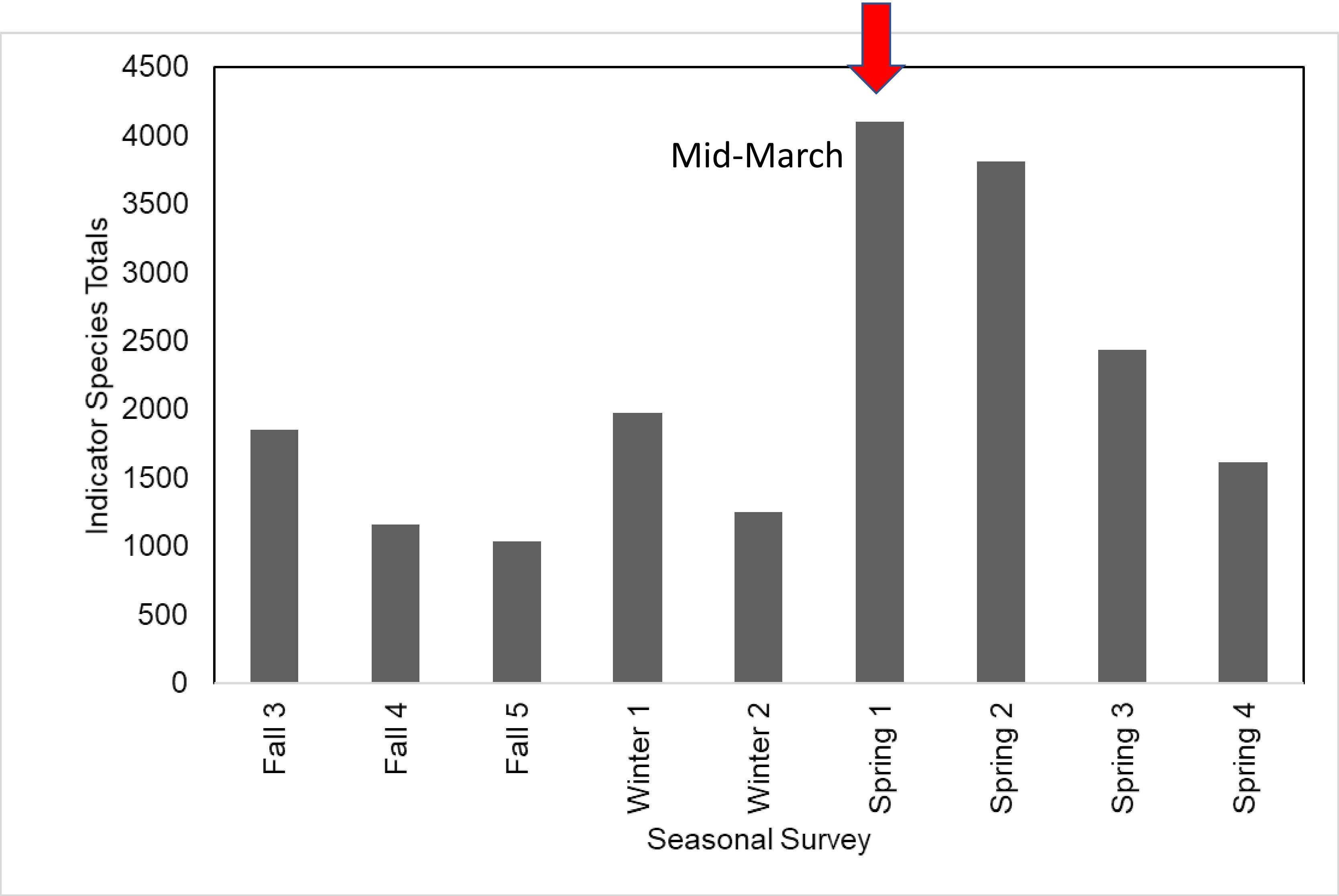
Species Group	East Winterton	Thibaut	Waggoner	BWMA Total	% all birds
Waterfowl	413	6703	5030	**12146**	37.0%
Shorebirds	86	739	454	**1279**	3.9%
Rails	9	3292	1183	**4484**	13.7%
Wading Birds	1	16	4	**21**	0.1%
Northern Harrier	17	16	23	**56**	0.2%
Marsh Wren	11	35	36	**82**	0.2%
Total Indicator Species	**537**	**10801**	**6730**	**18068**	**55.0%**
All Bird Species	**1759**	**20449**	**10632**	**32840**	



Key Points for Year 1 FC:

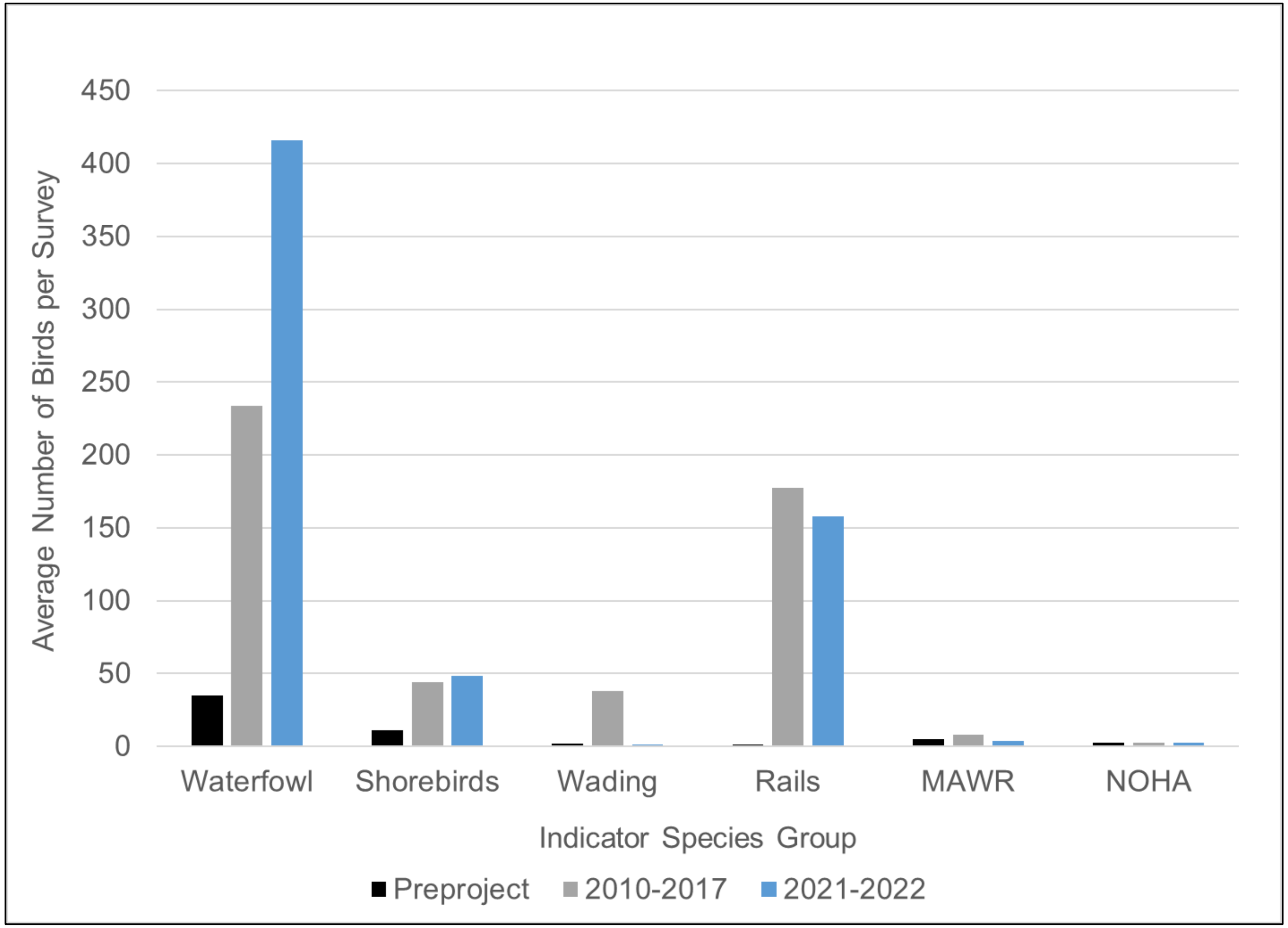
- Habitat Indicator Species comprised the majority of birds in the project area
- All Habitat Indicator Species groups were detected

Indicator Species Use Highest in Spring



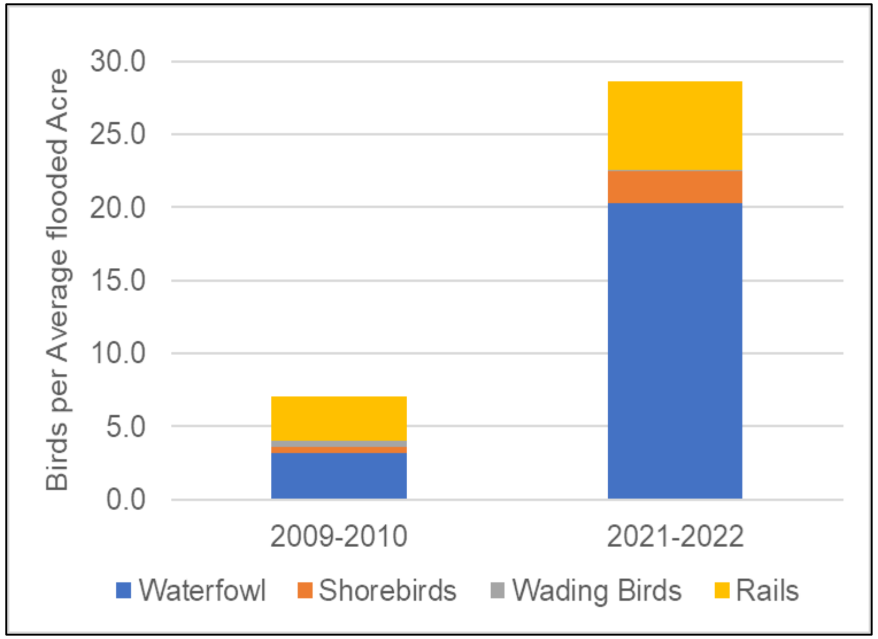
Comparisons with previous data

Average Number of Habitat Indicator Species Observed per Survey and Project Phase

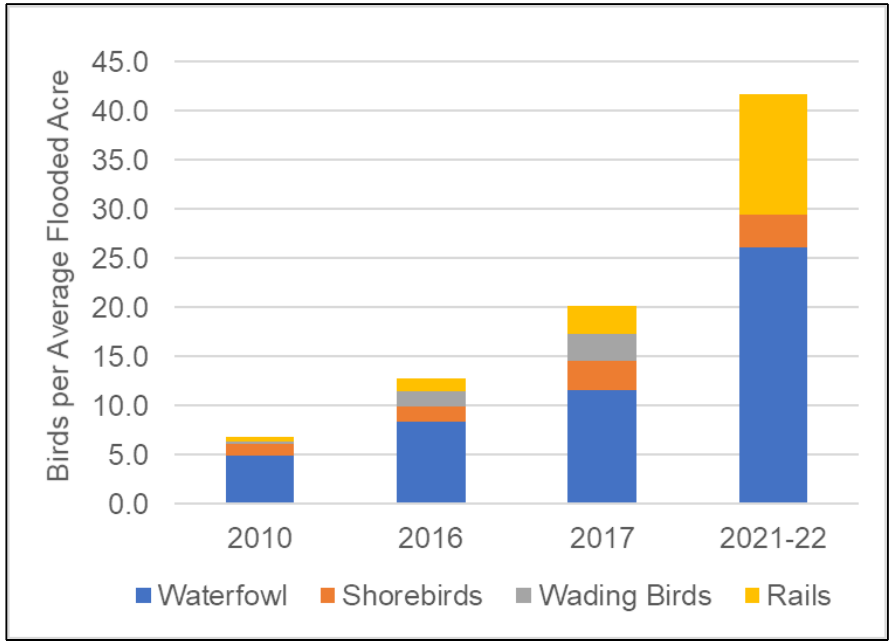


Comparison of Indicator Species Density – Year-round Flooding vs. Year 1 Adaptive Management

Waggoner Unit



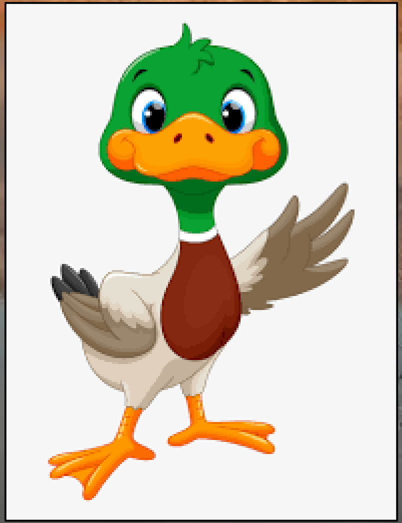
Thibaut Unit



<u>Key Points for Year 1 FC</u>:

- Habitat Indicator Species density, “birds per flooded acre” was well above that observed in prior years
- Increase highest among Waterfowl
- Higher density suggests “better habitat”

Thank You!



Acknowledgements:
- -LORP MOU Parties
- -ICWD biological staff Jerry Zatorski and Zach Nelson
- -LADWP biological staff Debbie House, Bill Deane and Erin Nordin

Adjournment

Written comments related to the Lower Owens River Project 2022 Draft Annual Report may be sent to the following by Friday, July 7th:

Dr. Holly Alpert
Director
Inyo County Water Department
135 South Street
P.O. Box 337
Independence, CA 93526

Mr. Adam Perez
Aqueduct Manager
Los Angeles Department of Water and Power
300 Mandich Street
Bishop, CA 93514