APPENDIX H

2020 AVIAN MONITORING REPORT FOR THE SAN ELIJO LAGOON RESTORATION PROJECT; 2021 AVIAN MONITORING REPORT FOR THE SAN ELIJO LAGOON RESTORATION PROJECT

2020 AVIAN MONITORING REPORT
FOR THE
SAN ELIJO LAGOON RESTORATION PROJECT

Prepared for:

Nature Collective

Prepared by:

AECOM
and
Moffatt & Nichol

June 2022

TABLE OF CONTENTS

Section **Page**

LIST OF APPENDICES

LIST OF FIGURES

Figure **Page**

LIST OF TABLES

Table **Page**

LIST OF ACRONYMS AND ABBREVIATIONS

AOU	American Ornithologists' Union
CDFW	California Department of Fish and Wildlife
CBM	Coastal Brackish Marsh
CI	confidence interval
CSM	Coastal Salt Marsh
I-5	Interstate 5
LCL	lower confidence limit
LFRR	light-footed Ridgway's rail
SELRP	San Elijo Lagoon Restoration Project
UCL	upper confidence limit
USFWS	U.S. Fish and Wildlife Service

This page intentionally left blank.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

San Elijo Lagoon is a coastal wetland formed at the drainage of the Escondido and La Orilla Creeks into the Pacific Ocean and is located in Encinitas, San Diego County, California. The lagoon provides habitat for sensitive, threatened, and endangered plants and animals, including resident and migratory wildlife. The San Elijo Lagoon Ecological Reserve is owned and managed by the California Department of Fish and Wildlife (CDFW), County of San Diego Parks and Recreation Department, and the Nature Collective (formerly the San Elijo Lagoon Conservancy). Lagoon functions became compromised over time, as development and infrastructure constraints have affected the ecosystem and the gradient of habitats within the lagoon (e.g., between unvegetated and vegetated intertidal habitats). The San Elijo Lagoon Restoration Project (SELRP) is an effort to restore lagoon functions and services to the extent practicable given the current constraints of surrounding development and activities.

The SELRP is being implemented by the Nature Collective and California Department of Transportation to enhance and restore the physical and biological functions and services of San Elijo Lagoon by increasing hydraulic efficiency in the lagoon, addressing existing water quality impairments, and halting ongoing conversion of unvegetated wetland habitats to support a more connected gradient of balanced habitat types. Success of the restoration effort is being measured through the implementation of a monitoring program developed in coordination with various permitting and approval agencies, including the California Coastal Commission, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service (USFWS), and Regional Water Quality Control Board.

Construction for the SELRP began in December 2017 and was substantively completed in July 2020 with focused activities continuing to occur in discrete areas of the lagoon. Environmentally sensitive area fence (ESA) installation and vegetation clearing occurred in the central and east basins December 2017 through early March 2018, to avoid the light-footed Ridgway's rail (*Rallus obsoletus levipes*; LFRR) breeding season. Vegetation clearing in the west basin occurred in December 2018. Throughout 2018 and 2019, the overdredge pit was dredged, followed by excavation of channel side slopes and mudflat areas and channel dredging with disposal to the overdredge pit occurred. Grading of transitional areas and the nest site also occurred, along with pedestrian bridge installation, construction of the inlet revetment, trail installation, and planting and irrigation. Demobilization was initiated, with final site cleanup, staging area/access/dike removal, and demobilization completed in mid-2020; some minor remedial grading also occurred within the main channel and nest site to complete the project through late 2020. Planting within restoration areas and substantive construction activities were completed in July 2020, and the 240-working day plant establishment period initiated in June 2020.

To assess the responses of select avian taxa to the construction activities and changes to the habitat in San Elijo Lagoon, "construction phase" avian monitoring began in 2018 and continued through July of 2020. These data will provide complementary information related to performance standards and construction/post-construction monitoring results documented as part of the monitoring program as defined in *Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project* (Monitoring Plan) (Nature Collective 2020). Table 1-1 provides a summary of each report associated with work conducted for the SELRP.

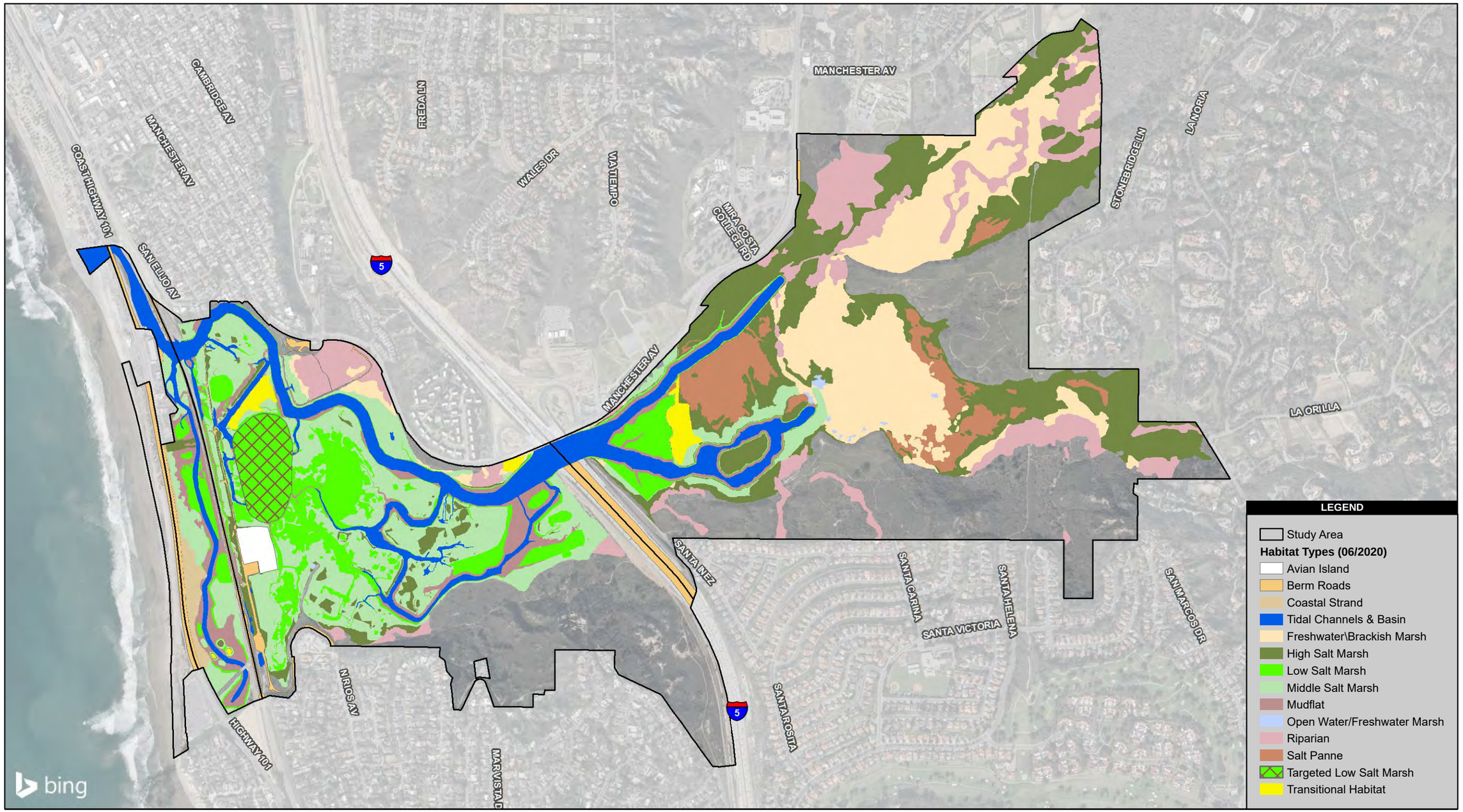
Table 1-1. SELRP Report Summary

Report	Description of Report
Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project (Monitoring Plan)	Overarching document that establishes the criteria for determining success (performance standards) of the restoration project for the biological and physical parameters being evaluated.
Wetland Habitat and Hydrology Baseline Monitoring Report for the San Elijo Lagoon Restoration Project (Baseline Monitoring Report)	Document that summarizes data collected during the pre-construction (baseline) period (2016–2017) against which absolute performance standard metrics will be compared.
2018-2019 Avian Monitoring Report for the San Elijo Lagoon Restoration Project (2018-2019 Avian Monitoring Report)	Document that summarizes the avian data collected during the 2018–2019 construction period.
2020 Construction Monitoring Report for the San Elijo Lagoon Restoration Project (2020 Construction Monitoring Report)	Document that summarizes data collected during 2020 and across the 3 construction phase years of 2018–2020.
Annual Reports	Documents that summarize the data collected in each year post-construction, beginning in 2021.

1.2 REPORTING REQUIREMENTS

This report documents the results of avian surveys for the year 2020 when SELRP construction was ongoing. The results provide a useful reference point for avian survey results relative to the baseline levels reported in the SELRP Baseline Monitoring Report (AECOM 2020a). Ultimately, these results will be reviewed with post-construction results from avian surveys in post-construction annual monitoring reports and may be informative for adaptive management decisions should the trajectory of avian numbers not be trending towards achieving performance standards, as defined in the Monitoring Plan (Nature Collective 2020).

This 2020 Avian Monitoring Report is based on the framework set forth in Chapter 11 of the SELRP Baseline Monitoring Report (AECOM 2020a). Post-construction annual monitoring reports in upcoming years will include results for these avian survey metrics; the results will identify whether the key variables have met performance standards and whether the project is on a trajectory to meet success requirements. Reports will be submitted to agencies as required and will also identify recommendations for remedial activities or adaptive management strategies that may be required over the year following the reporting period.



Source: SANDAG 2012; MoffattNichol 2020; AECOM 2020.

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 1-1
Proposed Habitat Distribution

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\Proposed Habitat Distribution_2020_Avian_Report.mxd, 9/23/2021, paul.moreno

This page intentionally left blank.

This report is framed to be consistent with the Monitoring Plan (Nature Collective 2020) to facilitate reference between documents, including future annual reports. Table 1-2 summarizes the specific variables discussed in this report and the corresponding performance standards for each variable. Per the Monitoring Plan (Nature Collective 2020), annual reports will be completed as needed until Year 10 post-construction, after which a final monitoring report will be prepared and submitted. Monitoring and reporting beyond 10 years post-construction for the life of the project (defined as a minimum of 50 years) will be detailed in a Long-Term Management Plan. Detailed methods, including data collection, monitoring frequency, analysis, and performance standards, are discussed in the Monitoring Plan (Nature Collective 2020); specifically, Chapter 12 of that document includes information as it pertains to avian species.

Table 1-2. Avian Variable Summary

Chapter	Variable	Variable Type	Performance Standard
2.1	Breeding Marsh Birds with focus on Light-footed Ridgway's Rail	Pre-Restoration Absolute	Within 95% or greater of pre-construction survey data (2016, 2017)
2.2	Western Snowy Plover, California Least Tern, and Waterbird Species	Pre-Restoration Absolute	Within 95% or greater of pre-construction survey data (2016, 2017)
2.3	Belding's Savannah Sparrow	Pre-Restoration Absolute	Within 95% or greater of pre-construction survey data (2016, 2017)

This page intentionally left blank.

2. BIRDS

2.1 BREEDING MARSH BIRDS

The monitoring of breeding marsh birds is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. Additionally, the specialized surveys required to adequately estimate abundance of secretive marsh bird species are not being conducted at reference wetlands, thereby making comparison impossible. A standardized monitoring protocol (Conway 2011) recommends focused monitoring for the following secretive marsh bird species: LFRR (federally and state endangered), Virginia rail (*Rallus limicola*), least bittern (*Ixobrychus exilis*) (CDFW Species of Special Concern), American bittern (*Botaurus lentiginosus*), common gallinule (*Gallinula galeata*), and pied-billed grebe (*Podilymbus podiceps*).

2.1.1 Performance Standards

Success for breeding marsh birds will be measured by comparing project-specific pre-construction data ("baseline data" herein defined as those data collected in 2016 and 2017, as summarized in the SELRP Baseline Monitoring Report [AECOM 2020a]) and construction (herein defined as data collected in 2018–2020)/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Performance standards are included below.

> **Interim standard**: Construction/post-construction 4-year running average density and number of individuals 75% or greater than that of pre-construction survey data (2016, 2017) by year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average density and number of individuals 95% or greater than that of pre-construction survey data (2016, 2017) by year 10 post-construction

Running averages will be used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan).

2.1.2 Approach

The focus of these surveys is to estimate density and abundance for the federally and state endangered LFRR. The objective of the LFRR surveys is to provide a replicable survey method that can act as a reliable abundance index to monitor for changes in the LFRR population size within San Elijo Lagoon over time. An additional five "focal" marsh bird species that are generally

considered wetland specialists were also recorded, if present: Virginia rail, least bittern, American bittern, common gallinule, and pied-billed grebe. The focal bird species results are intended to provide an index of relative abundance of key marsh bird species other than LFRR. These other focal bird species have utility as indicator species for assessing wetland ecosystem quality (Conway 2011) and their continued presence will be another gauge of project success.

Breeding marsh bird surveys were conducted from March 20 through June 3, 2020. LFRR data were collected within a 200-meter radius of survey points using independent double-observer methods (Nichols et al. 2000). As described in the 2018-2019 Avian Monitoring Report (AECOM 2020b), survey points 9, 10, 11, and 18 were moved slightly because the original locations were no longer accessible without disturbance to enhanced areas after restoration activities were completed in winter 2018–2019. Configuration of the proposed habitat distribution (Figure 1-1) was also slightly modified because the survey points were established in 2016, which further necessitated some minor relocation of survey points. These changes are reflected in figures in this report and in calculations regarding suitable LFRR habitat within the survey area.

2.1.2.1 Light-footed Ridgway's Rail

An independent double-observer survey approach was used for surveys, meaning two ornithologists were present for each survey (Nichols et al. 2000) and the two ornithologists each recorded data independently of the other ornithologist. The double-observer approach allows for estimation of detection probabilities between observers and improves overall detection probabilities to yield more precise estimates of abundance than if a single observer were used. Detection probabilities were estimated from each of the six surveys conducted from mid-March through early June in 2020 to derive LFRR estimates and abundance values. LFRR abundance and the associated 95% upper and lower confidence limits (UCL and LCL, respectively) were calculated separately for each of the six surveys using a closed mark-recapture model (Huggins 1991). Model-averaging was used to generate LFRR estimates and confidence intervals (CIs) for 2018 through 2020 in this report.

Annual LFRR survey area density estimates were calculated by dividing the model-generated estimate of LFRR abundance within the survey area by the total acreage of "preferred" habitat within the survey area for each year. For this analysis, LFRR preferred habitat was considered Coastal Brackish Marsh (CBM), Coastal Salt Marsh – Low (CSM – Low), and Coastal Salt Marsh – Mid (CSM – Mid), based on habitat types described by Oberbauer et al. (2008). These three habitat types most closely resemble the breeding habitat of LFRR as described by Massey et al. (1984), and coincide with habitat types most consistently associated with LFRR presence during surveys. Observations of LFRR in other habitat types that may be considered "suitable" (e.g., Coastal Salt Marsh – High [CSM – High], or others where detection occurred) were generally restricted to areas immediately adjacent to one of the preferred habitat types. During 2018, there were approximately 149.4 acres of LFRR preferred habitat in the survey area, in 2019 there were

approximately 147.5 acres, and in 2020 there were approximately 154.8 acres. The amount of preferred habitat decreased from 2018 to 2019, both within the survey area and across the lagoon, because vegetation removal was completed in phases. Vegetation was removed in the east and central basins before the 2018 breeding season, and additional acreage was cleared during the winter of 2018–2019 in the west basin, thereby decreasing the amount of preferred habitat. Regrowth of vegetation and plantings was still in the early stages in 2020, which resulted in a modest increase in the amount of preferred habitat from 2019 to 2020. For reference to baseline conditions, there were approximately 192.5 acres of preferred habitat within the survey area in 2016 and 2017.

To estimate the LFRR population size for the entire lagoon (i.e., lagoon-wide abundance estimate), including both surveyed and unsurveyed areas, LFRR density estimates and associated confidence intervals were multiplied by the total acreage of preferred habitat across the entire lagoon. Total preferred habitat acreages are as follows for each respective year: 244.1 acres in 2018, 241.2 acres in 2019, and 251.1 acres in 2020. For reference to baseline conditions, there were approximately 301.2 acres of preferred habitat across the entire lagoon in 2016 and 2017.

2.1.2.2 Other Focal Marsh Bird Species

In addition to LFRR, results for five other species of marsh birds are provided as the average number of individuals detected per survey. There was an insufficient number of detections for these other species to generate modeled estimates of abundance. For this reason, raw numbers of detected individuals are presented as an index reflecting relative abundance.

2.1.3 Results

A detailed summary of the survey dates, survey times, survey personnel, and weather conditions, is provided in Appendix A.

2.1.3.1 Light-footed Ridgway's Rail

Survey Area Density Estimates

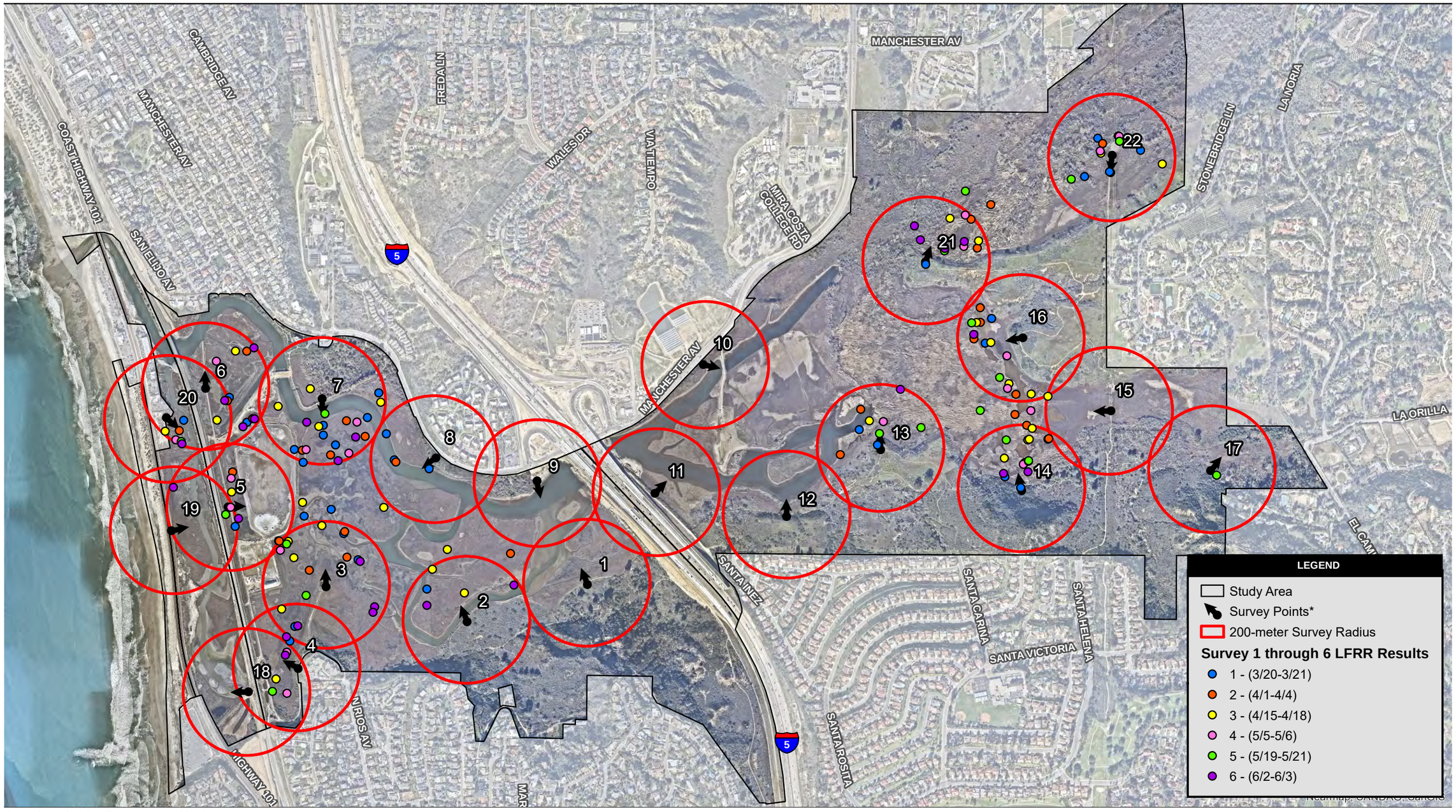
LFRR were detected predominantly in areas dominated by CBM, CSM – Low, and CSM – Mid. Locations of LFRR detections from 2020 surveys are depicted in Figure 2-1. Based on results from the Huggins (1991) model, LFRR survey area density estimates for each of the six surveys conducted in 2020 are presented in Table 2-1 with associated model-generated 95% confidence intervals. Values represent the estimated number of individuals per acre of preferred habitat within the survey area. LFRR density estimates are presented for 2020, the 3 construction phase years combined (2018–2020), as well as the baseline LFRR density estimates (2016 and 2017 combined).

Table 2-1. Summary of Survey Area Density Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Survey Area Density Estimates; # Individuals/Acre		
	2020 Estimate (95% CI)[1]	2018–2020 Construction Phase Estimate[2]	2016–2017 Baseline Estimate[3]
1	0.33 (0.31-0.35)	0.26	0.25
2	0.22 (0.22-0.22)	0.24	0.22
3	0.22 (0.21-0.23)	0.23	0.23
4	0.12 (0.11-0.12)	0.18	0.21
5	0.12 (0.12-0.12)	0.14	0.17
6	0.25 (0.24-0.26)	0.16	0.18
Overall Mean (95% CI)[4]	0.21 (0.14-0.28)	**0.20 (0.15 – 0.26)**	**0.21 (0.18 – 0.23)**

[1] Density estimates and 95% confidence intervals (CIs) for Surveys 1 through 6 in 2020 were calculated by dividing the model-generated LFRR abundance estimates (and associated confidence limits) within the survey area by the amount of preferred habitat within the survey area (154.8 acres).
[2] The six survey-specific density estimates in these columns were calculated as the mean of 2018 through 2020 density estimates and lack model-generated confidence limits.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a)
[4] Overall Mean Estimates in this row for 2020, 2018–2020 combined, and the baseline data were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% confidence intervals calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Survey area density estimates varied considerably among the six surveys conducted in 2020, ranging from a low of 0.12 individuals/acre during Surveys 4 and 5, to a high of 0.33 individuals/acre during Survey 1 (mean=0.21 individuals/acre). Across the 5 surveyed years (2016–2020), LFRR density estimates tended to be greater in surveys conducted earlier in the season as compared to surveys completed later in the season, with the exception of Survey 6 in 2020 (Table 2-1), which was second only to Survey 1. The inter-survey variation was significant in many cases, with non-overlapping 95% confidence intervals for most estimates from different surveys during the same survey season. The overall mean for 2020 was 0.01 individuals/acre higher than the overall mean for the construction phase period, and the same as the baseline overall mean (Table 2-1).



Source: SANDAG 2012; MoffattNichol 2020; AECOM 2020.

1,000 500 0 1,000 Feet

Scale: 1:12,000; 1 inch = 1,000 feet

* arrows depict direction of broadcast call

Figure 2-1
2020 Light-footed Ridgway's Rail Observations

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\LFRR_Species_Survey_Overview_2020_v2.mxd, 9/23/2021, paul.moreno

This page intentionally left blank.

Figure 2-2. Survey Area Estimates of Light-footed Ridgway's Rail Density during the Construction Phase (2018–2020)

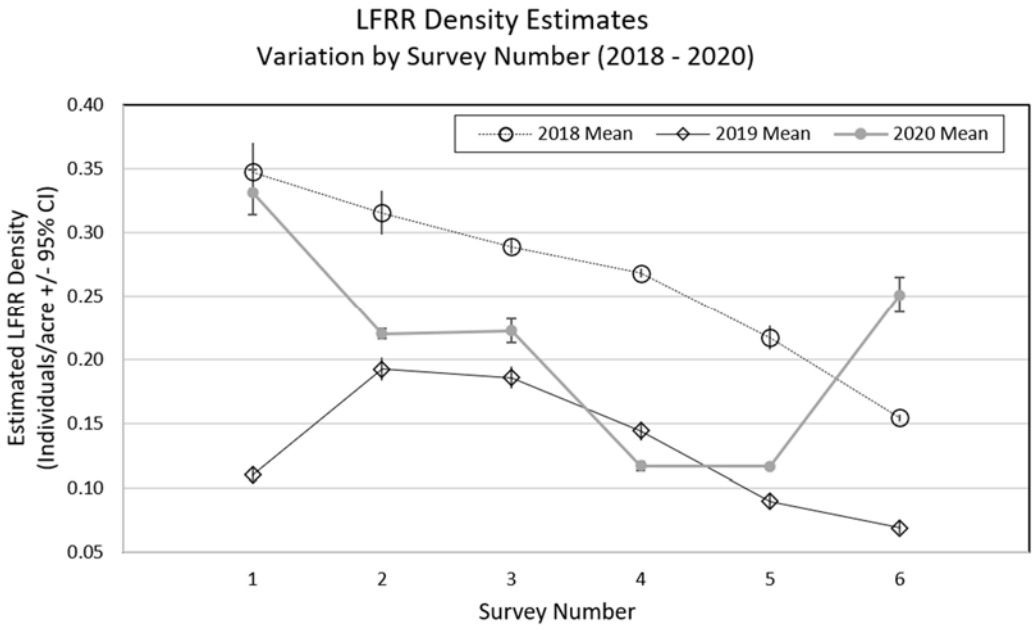


Figure 2-2: Model-generated lower and upper 95% confidence limits (LCL and UCL, respectively) are indicated by vertical lines.

Lagoon-wide Abundance Estimates

The lagoon-wide LFRR abundance estimate in 2020 was 52.66 individuals (95% CI: 36.05–69.28) (Table 2-2; Figure 2-3), which was slightly higher than the construction phase lagoon-wide abundance estimate of 49.73 individuals (95% CI: 39.83–59.63). Both the 2020 and the construction phase abundance estimates are increases over the 2019 estimate of 31.78 individuals, but were lower than the 2018 abundance estimate of 64.75 individuals (2018-2019 Avian Monitoring Report [AECOM 2020b]), and the baseline abundance estimate of 62.98 individuals (Baseline Monitoring Report [AECOM 2020a]).

Table 2-2. Summary of Lagoon-wide Abundance Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Lagoon-wide Abundance Estimates		
	2020 Estimate (95% CI)[1]	2018–2020 Construction Phase Estimate[2]	2016–2017 Baseline Estimate[3]
1	83.24 (78.87-87.62)	64.86	75.06
2	55.28 (54.32-56.25)	59.58	66.38
3	55.87 (53.48-58.27)	57.06	68.79
4	29.31 (28.44-30.18)	43.20	63.13
5	29.21 (28.92-29.50)	34.57	49.91
6	63.05 (59.56-66.54)	39.09	54.60
Overall Mean (95% CI)[4]	**52.66 (36.05-69.28)**	**49.73 (39.83-59.63)**	**62.98 (55.54-70.42)**

[1] Lagoon-wide abundance estimates and 95% confidence intervals (CIs) for Surveys 1 through 6 were calculated by multiplying the model-generated LFRR density estimates for each year/survey (and associated confidence limits) by the amount of suitable preferred habitat across the lagoon that year (see Section 2.1.2 for acreage for each year).
[2] The six survey-specific density estimates in these columns were calculated as the mean of 2018 through 2020 density estimates and lack model-generated confidence limits.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a).
[4]Overall Mean Estimates in this row were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% CIs calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Figure 2-3. Lagoon-wide Abundance Estimates of Light-footed Ridgway's Rails during the Pre-Construction and Construction Phases (2016–2020)

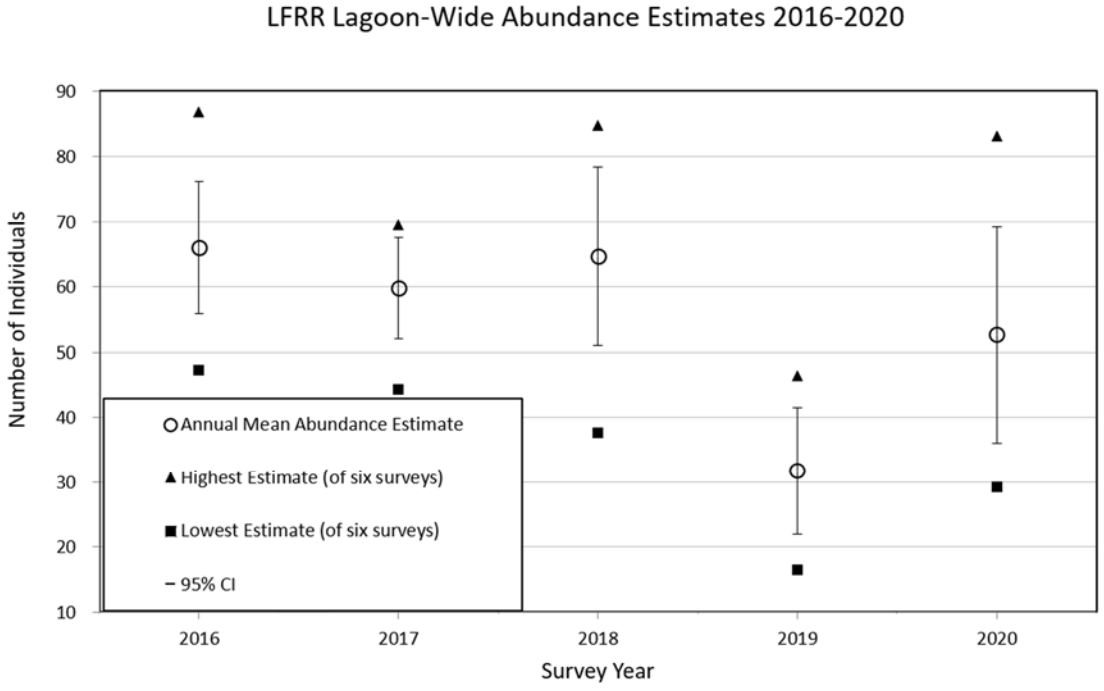


Figure 2-3: Lower and Upper confidence limits (LCL and UCL, respectively) are indicated by vertical bars.

2.1.3.2 Other Focal Marsh Bird Species

As stated above, the focal marsh bird data represent the number of detections within the survey area and are not adjusted for the amount of suitable habitat or extrapolated to provide an estimate of the lagoon-wide abundance. Detections of focal marsh bird species recorded during survey efforts are included in Table 2-3. On average, Virginia rails were the most commonly detected of the focal marsh bird species during the 2020 survey, whereas no common gallinules were detected. Aside from Virginia rails, the numbers were relatively low for focal marsh bird species. American bitterns showed a moderate uptick in 2020 compared to previous years, and this increase contributed to a higher overall average number of birds per survey relative to previous years. Other than the increase in American bitterns in 2020, the number of detections for focal marsh bird species combined from 2018 through 2020 was similar to the baseline numbers observed in 2016 through 2017 (10.67 individuals/survey, and 10.00 individuals/survey, respectively).

Table 2-3. Survey Detections of Other Focal Marsh Bird Species

Focal Species		Average Number Detected per Survey (Standard Error)		
Common Name	**Scientific Name**	**2020[1]**	**2018–2020 Construction Phase[2]**	**2016–2017 Baseline[3]**
Virginia Rail	*Rallus limicola*	6.83 (1.58)	6.94 (1.04)	6.00 (1.41)
Least Bittern	*Ixobrychus exilis*	0.17 (0.17)	0.33 (0.17)	0.33 (0.17)
American Bittern	*Botaurus lentiginosus*	2.33 (0.71)	1.22 (0.24)	0.75 (0.48)
Common Gallinule	*Gallinula galeata*	0.00 (0.00)	0.00 (0.00)	0.08 (0.08)
Pied-billed Grebe	*Podilymbus podiceps*	1.83 (0.70)	2.11 (0.53)	1.75 (0.38)
All Species[4]	-----	**11.17 (2.80)**	**10.67 (1.48)**	**10.00 (2.49)**

[1] Mean and standard error for 2020 averages calculated from number of individuals detected during the six surveys.
[2] Averages and standard error values calculated from the 3-year average (2018–2020, "construction phase") number of individuals detected during each of the six surveys each year.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a)
[4] Values are based on the survey-specific totals (number of individuals of all focal species) detected for surveys 1 through 6 in each year or combination of years.

2.1.4 Discussion

As marsh bird surveys continue to be conducted during the post-construction phase of the project, a running average will be calculated for the 4 most recent years of construction/post-construction surveys and compared to the baseline abundance levels to evaluate performance standards as described in the Monitoring Plan (Nature Collective 2020). Data comparisons between pre-construction and construction/post-construction periods will be summarized and discussed in the annual SELRP monitoring reports.

2.1.4.1 Light-footed Ridgway's Rail

While the average estimated LFRR density for the 2018–2020 construction phase period was only slightly lower than that observed during the baseline period of 2016–2017 (0.20 individuals/acre for the construction phase period and 0.21 for the baseline period), the lagoon-wide abundance estimate for the construction phase was markedly lower than the baseline period (49.73 individuals and 62.98 individuals, respectively) due to a reduction in the amount of preferred habitat available during the construction phase. In addition, there was much more variability among years during the construction phase than during the baseline period. The estimated number of LFRR within the survey area was 0.22 individuals/acre in 2016, and 0.20/acre in 2017, which translated to lagoon-wide estimates of 66.11 and 59.85 individuals in 2016 and 2017, respectively (Baseline Monitoring Report [AECOM 2020a]). In 2018, the estimated number of LFRR within the survey area increased to 0.27 individuals/acre, but because of the decrease in suitable habitat during 2017 and 2018 (see Section 2.1.2.1 for details) the lagoon-wide abundance estimate remained similar to 2016 and 2017 at 64.75 individuals (2018-2019 Avian Monitoring Report [AECOM 2020b]). The higher survey area density in 2018 as compared to 2016 or 2017 could be the result of a similar number of birds residing in the lagoon in a smaller area of available habitat. Indeed, LFRR are relatively sedentary and are year-round resident in the lagoon. Therefore, it seems possible that those birds that were flushed from their territories due to restoration activities remained in the lagoon, at least for a few months.

In 2019, estimated LFRR numbers declined to 0.15 individuals/acre (2018-2019 Avian Monitoring Report [AECOM 2020b]), with a lagoon-wide abundance estimate of 36.74 individuals (Figure 2-3). Whether this decline was due primarily to emigration of displaced individuals during 2018 and 2019, reduced reproductive success in 2018, or some other environmental variables is unclear, but it is plausible that multiple factors could have played a role in the decline. Indeed, LFRR censuses throughout Southern California conducted by Zembal et al. documented the lowest numbers of the decade in 2019 (Zembal et al. 2019), suggesting that regional factors could have contributed to the low estimates for San Elijo Lagoon. In 2020, LFRR surveys in San Elijo Lagoon as part of the SELRP indicated that LFRR numbers had rebounded to an estimated 0.21 individuals/acre, and a lagoon-wide abundance estimate of 52.66 individuals. Despite the high per acre estimate, the lagoon-wide abundance estimate remains lower than the pre-construction estimates because of the smaller amount of preferred habitat available in 2020 compared to the baseline period.

For a number of years, Zembal et al. have conducted LFRR surveys within San Elijo Lagoon and other nearby lagoons to provide a census of LFRR numbers throughout San Diego County. These lagoon-wide LFRR censuses tend to be higher than the estimates generated as part of the SELRP breeding marsh bird survey efforts, although it is important to note that the results from the two studies are not directly comparable. Methods in this study were designed to provide metrics of LFRR density and abundance during the breeding season rather than a census of individuals and/or

documentation of nesting activity. The average of six surveys is used because it provides a standardized index for comparisons among survey years. This average remains unbiasedbecause surveys are conducted at approximately the same time throughout the year. As illustrated in Figure 2-2, LFRR detections generally decrease over the course of the six survey periods, with the exception of 2020, in which Survey 6 had the second highest estimate of the year. The general trend for delining estimates can likely be attributed to differences in detectability of birds throughout the breeding season. For example, LFRR in Southern California have been documented to give "clapper" and "kek" calls less frequently during May and June, after a peak in the early spring (Zembal and Massey 1987). LFRR in Arizona were also shown to be less responsive to playback during May and June compared to March and April (Conway et al. 1993). LFRR may also be more difficult to detect after most pairs have begun incubation, which generally occurs by late April or early May in Southern California (Eddleman and Conway 2018). Although Zembal et al. conduct their surveys from February through June (similar to this study), they try to target peak breeding activity when possible.

Despite the lack of direct comparability between this study and Zembal et al.'s work, the catalog of data provided by Zembal et al.'s monitoring data provides useful background information of the LFRR population at San Elijo Lagoon. General trends are presented herein for reference. From 2016 through 2019, Zembal et al. (2019) reported 70, 68, 54, and 46 pairs of LFRR during each of those respective years. The population size recorded by Zembal et al. and the estimates generated from surveys conducted for the SELRP showed generally similar patterns with regard to a reduction in the San Elijo Lagoon LFRR population size from 2016 through 2019. In 2020, however, Zembal et al. (2019) reported 42 pairs, which continued the downward trajectory documented over the previous 4 years, whereas LFRR survey results for the SELRP showed an increase from a lagoon-wide abundance estimate of 36.74 individuals in 2019 to a lagoon-wide abundance estimate of 52.66 individuals in 2020.

The increase in estimated LFRR numbers in 2020 could be the result of a few factors: normal population cycling, recruitment of adults into the lagoon due to available breeding habitat, or increased recruitment of previous years' young due to reduced nest-predation pressure. Predator control efforts from 2018 through 2020 have targeted potential LFRR nest-predators in the lagoon, including racoons, Virgina opossums, and non-native rats, among others. These efforts may have resulted in higher nest and young survival in 2018 and 2019, which could have led to higher LFRR estimates in 2020.

2.1.4.2 Other Focal Marsh Bird Species

Observations of the other focal species are presented as the average number of individuals per survey for the survey year (2020) as well as the construction and baseline years, as shown in Table 2-3. In general, the overall number of focal marsh species detections remained relatively constant or increased slightly over the 5-year period from 2016 through 2020, at approximately 10–11

detections per survey. Survey results from the construction phase (2018–2020) averaged 10.66 individuals/survey, compared to an average of 10.00 individuals/survey during the baseline period of 2016 through2017. In 2020, there was an average 11.17 individuals/survey, which was the highest average of the 5-year survey period. Generally, individual focal marsh bird species did not exhibit dramatic changes in the number of detections across years with the exception of the American bittern, which exhibited a relatively large increase in 2020 to an average of 2.33 birds/survey. This number was more than three times the baseline average of 0.75 birds/survey, and almost 3.5 times the 2018–2019 average of 0.67 birds/survey (2018-2019 Avian Monitoring Report [AECOM 2020b]).

Due to the low number of detections for each of these species, survey estimates were not corrected for detection probabilities, so the reported numbers probably underestimate true abundance of focal marsh bird species. Thus, abundance estimates are not directly comparable to the modeled abundance estimates of LFRR.

2.2 WATERBIRD SURVEYS, INCLUDING WESTERN SNOWY PLOVER AND CALIFORNIA LEAST TERN

The monitoring of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in the SELRP study area is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. In the process of monitoring waterbirds, these avian surveys generate specific information about western snowy plovers (*Charadrius nivosus nivosus*) and California least terns (*Sternula antillarum browni*).

2.2.1 Performance Standards

Success for western snowy plovers, California least terns, and other waterbird species will be measured by comparing project-specific pre-construction data ("baseline data" defined as those data collected in 2016 and 2017, as summarized in the Baseline Monitoring Report [AECOM 2020a]) and construction/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Performance standards are included below.

> **Interim standard**: Construction/post-construction 4-year running average number of individuals 75% or greater than that of pre-construction survey data (2016, 2017) by year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average number of individuals 95% or greater than that of pre-construction survey data (2016, 2017) by year 10 post-construction

Running averages will be used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan [Nature Collective 2020]).

2.2.2 Approach

Waterbird surveys focused on birds that utilize open water, mudflat, and sand habitat, including western snowy plovers and California least terns. A complete description of survey methodology for waterbird surveys can be found in the Monitoring Plan (Nature Collective 2020). Each survey yielded a census of waterbirds observed in the west, central, and east basins of the lagoon. Abundances of two species, western snowy plover and California least tern, were calculated as the lagoon-wide average of individuals observed per survey by month, as well as the average number observed per survey within each basin. These values were then used to calculate an overall per-survey average for 2020. Observations of other target waterbird species were grouped into specific taxonomic orders and summarized as both the number of individuals in each cohort observed per survey by month for each basin, and an overall per-survey average for 2020. A list of the species associated with each taxonomic order detected during surveys can be found in Appendix B.

Surveys were conducted from January through December with one survey conducted per month during January, February, October, November, and December, and at least two surveys conducted per month during March through September. Because California least terns overwinter in Central and South America and breed in Southern California during May and July, results for California least terns are provided for the months of April through September because the species is generally not present at the lagoon outside of these months.

2.2.3 Results

Survey results are summarized by month in the subsections for western snowy plover, California least tern, and waterbirds. Detailed summaries of the survey dates, survey times, survey personnel, and weather conditions are provided in Appendix C. When multiple surveys were conducted in a month for a given year, the mean number of individuals detected across surveys conducted within that month was calculated. The mean number of individuals detected per survey during each month was then used to evaluate temporal variation in abundance (across seasons and years). These values, along with the baseline data, are presented in Tables 2-4, 2-6, and 2-8.

2.2.3.1 Western Snowy Plover

Survey results for western snowy plovers from 2020, the 3-year construction phase average of 2018 through 2020, and baseline values from 2016 and 2017 combined are summarized in Table 2-4. In 2020, western snowy plovers were detected within the lagoon in six of the 19 surveys, with

a monthly average of 4.54 individuals/survey. High counts of this species were recorded during both January and December with 18 birds detected per survey in those months. No western snowy plovers were detected in the lagoon from February through June. The mean number of detections per survey in 2020 was higher than the baseline average and the 3-year construction phase average by 4.27 and 2.53 individuals/survey, respectively.

The mean number of western snowy plovers detected in each lagoon basin is shown in Table 2-5 and Figure 2-4. The majority of western snowy plovers were detected in the west basin (4.46 individuals/survey), with small numbers detected in the central basin (0.08 individuals/survey) and none detected in the east basin. Western snowy plovers detected in the west and central basins were generally observed foraging on open mudflat habitat.

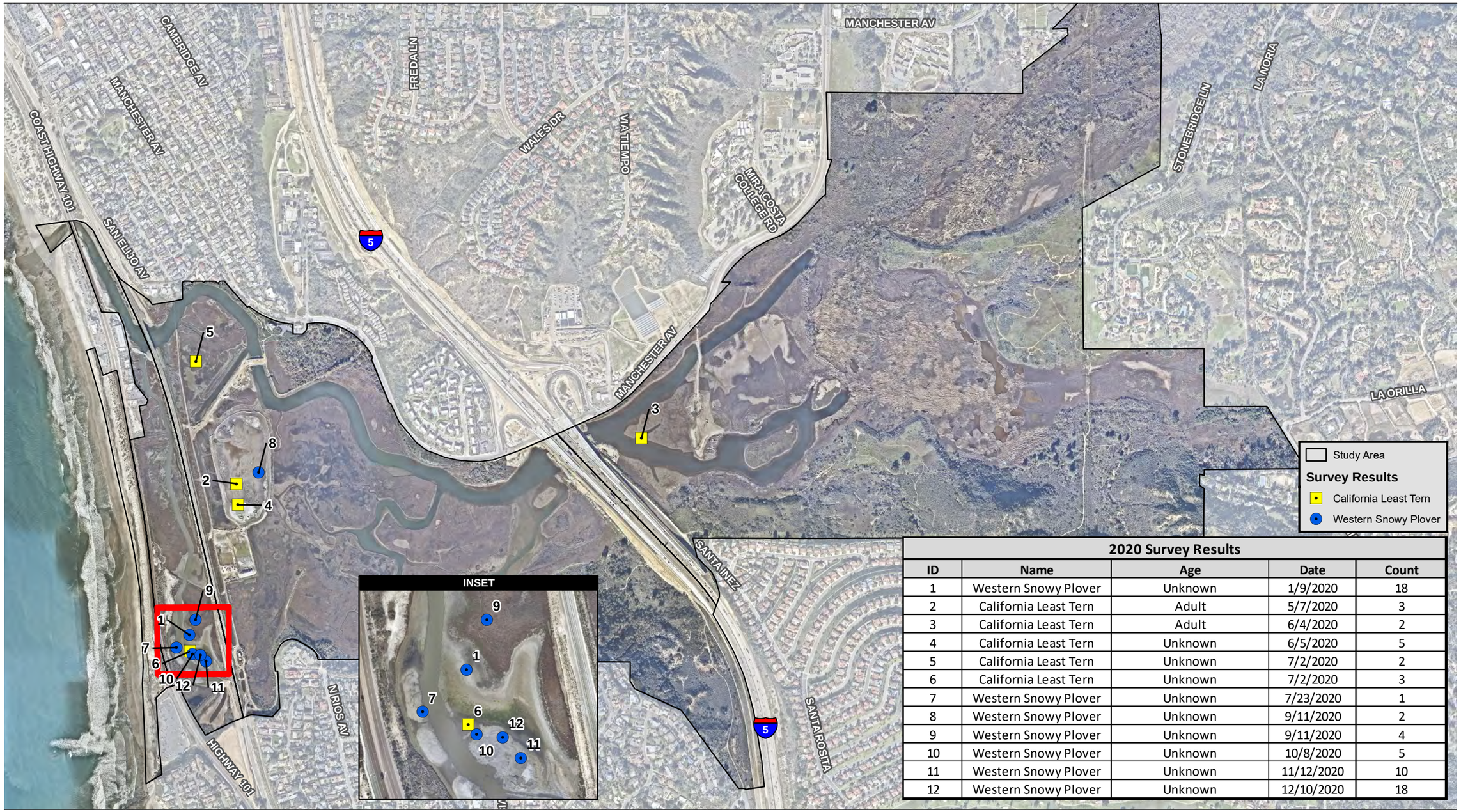
Table 2-4. Summary of Western Snowy Plover Results by Survey Number and Month

Month	2020 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Survey #	# Individuals	2020	2018–2020 Construction Phase	2016–2017 Baseline
Jan	1	18	18.00	6.00	0.00
Feb	2	0	0.00	0.00	0.00
Mar	3	0	0.00	0.00	0.00
	4	0			
Apr	5	0	0.00	0.00	0.00
	6	0			
May	7	0	0.00	0.00	0.00
	8	0			
Jun	9	0	0.00	0.00	0.00
	10	0			
Jul	11	0	0.50	0.17	0.00
	12	1			
Aug	13	0	0.00	0.33	0.00
	14	0			
Sep	15	6	3.00	1.00	1.25
	16	0			
Oct	17	5	5.00	1.67	2.00
Nov	18	10	10.00	3.67	0.00
Dec	19	18	18.00	6.00	0.00
Overall Average (Standard Error)			**4.54 (2.01)**	**1.57 (0.57)**	**0.27 (0.19)**

Table 2-5. Mean Number of Western Snowy Plovers/Survey by Lagoon Basin

Lagoon Basin	Mean # Individuals/Survey (Standard Error)
	2020; 19 surveys[1]
Central	0.08 (0.08)
East	0.00 (0.00)
West	4.46 (2.02)

[1] Mean and standard error values for each basin calculated from 12 monthly values (averaged among surveys when multiple surveys conducted in a month).



2020 Survey Results

ID	Name	Age	Date	Count
1	Western Snowy Plover	Unknown	1/9/2020	18
2	California Least Tern	Adult	5/7/2020	3
3	California Least Tern	Adult	6/4/2020	2
4	California Least Tern	Unknown	6/5/2020	5
5	California Least Tern	Unknown	7/2/2020	2
6	California Least Tern	Unknown	7/2/2020	3
7	Western Snowy Plover	Unknown	7/23/2020	1
8	Western Snowy Plover	Unknown	9/11/2020	2
9	Western Snowy Plover	Unknown	9/11/2020	4
10	Western Snowy Plover	Unknown	10/8/2020	5
11	Western Snowy Plover	Unknown	11/12/2020	10
12	Western Snowy Plover	Unknown	12/10/2020	18

Source: SANDAG 2012; MoffattNichol 2020; AECOM 2020.

1,000 500 0 1,000 Feet

Scale: 1:12,000; 1 inch = 1000 feet

Figure 2-4
2020 California Least Tern and Western Snowy Plover Survey Results

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\LeastTern_Plover_2020_Survey_Results.mxd, 9/23/2021, paul.moreno

This page intentionally left blank.

2.2.3.2 California Least Tern

Survey results for California least terns from 2020, the 3-year construction phase average of 2018 through 2020, and baseline values from 2016 and 2017 combined are summarized in Table 2-6. During 2020, California least terns were detected in three of the 12 "California least tern surveys" from April through September; one survey each in May, June, and July. The number of individuals observed ranged from 0 to 7 birds, and the mean number of individuals detected per survey in 2020 was 1.25 individuals. Overall, survey results in 2020 were higher than the baseline average and the 3-year construction phase average by 0.40 and 0.28 individuals/survey, respectively.

Table 2-6. Summary of California Least Tern Results by Survey Number and Month

Month	2020 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Survey #	# Individuals	2020	2018–2020 Construction Phase	2016–2017 Baseline
Apr	5	0	0.00	0.00	0.00
	6	0			
May	7	3	1.50	1.40	1.40
	8	0			
Jun	9	7	3.50	3.17	3.40
	10	0			
Jul	11	5	2.50	1.83	0.40
	12	0			
Aug	13	0	0.00	0.00	0.00
	14	0			
Sep	15	0	0.00	0.00	0.00
	16	0			
Overall Average (Standard Error)			**1.25 (0.62)**	**0.97 (0.53)**	**0.85 (0.55)**

During 2020 surveys, the species was detected most frequently in the central basin of the lagoon (0.83 individuals/survey), and less frequently in the east and west basins (0.17 and 0.25 individuals/survey, respectively) (Table 2-7). When present within the lagoon, individuals were observed engaging in aerial foraging over open water or were actively flying. The locations of California least tern observations from 2020 surveys are displayed in Figure 2-4.

Table 2-7. Mean Number of California Least Terns/Survey by Lagoon Basin

Lagoon Basin	Mean # Individuals/Survey (Standard Error)
	2020; 12 surveys[1]
Central	0.83 (0.42)
East	0.17 (0.17)
West	0.25 (0.25)

[1] Mean and standard error values for each basin calculated from six monthly values (averaged across the two surveys conducted each month).

2.2.3.3 Other Waterbird Species

Waterbird survey results from 2020, the 3-year construction phase average of 2018 through 2020, and baseline values from 2016 and 2017 combined are summarized in Table 2-8. Averaged across the three lagoon basins, the mean number of waterbirds detected in 2020 was 853.71 individuals/survey. Detections were markedly higher in 2020 than the 3-year construction phase average (660.39 individuals/survey) and more than two times higher than the baseline average of 355.8 individuals/survey.

Table 2-8. Summary of Waterbird Results by Survey Number and Month

Month	2020 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Survey #	# Individuals	2020	2018–2020 Construction Phase	2016–2017 Baseline
Jan	1	1,275	1,275.0	906.0	509.5
Feb	2	1,310	1,310.0	989.7	857.0
Mar	3	653	690.0	717.5	458.5
	4	727			
Apr	5	507	501.0	434.0	328.8
	6	495			
May	7	408	412.0	321.2	181.3
	8	416			
Jun	9	331	258.5	181.7	148.9
	10	186			
Jul	11	897	595.5	390.8	154.8
	12	294			
Aug	13	436	424.5	365.8	262.0
	14	413			
Sep	15	666	621.0	478.3	286.8
	16	576			
Oct	17	868	868.0	705.0	186.5
Nov	18	1,717	1,717.0	1,106.3	549.8
Dec	19	1,572	1,572.0	1,328.3	682.8
Overall Average (Standard Error)			**853.71 (141.76)**	**660.39 (103.25)**	**355.8 (72.7)**

Taxonomic groups observed within each basin during waterbird surveys are included in Table 2-9. The two orders of birds most frequently observed during waterbird surveys were the Anseriformes (waterfowl) and Charadriiformes (shorebirds, gulls, and terns). In 2020, Anseriformes were detected in the greatest numbers in the east basin (178.46 individuals/survey) and in the lowest numbers in the west basin (15.42 individuals/survey), with intermediate abundances in the central basin (74.75 individuals/survey). Charadriiformes were detected at similarly high levels in the central and west basins (196.42 and 191.75 individuals/survey, respectively), and at the lowest levels in the east basin (81.00 individuals/survey).

Overall, waterbird numbers tended to be lower during the spring and summer months because this coincides with the time most migrants are away at breeding grounds farther north, and highest during the fall and winter months, which is consistent with the period of time these birds winter in Southern California.

Table 2-9. Summary of Waterbird Results by Taxonomic Group and Lagoon Basin

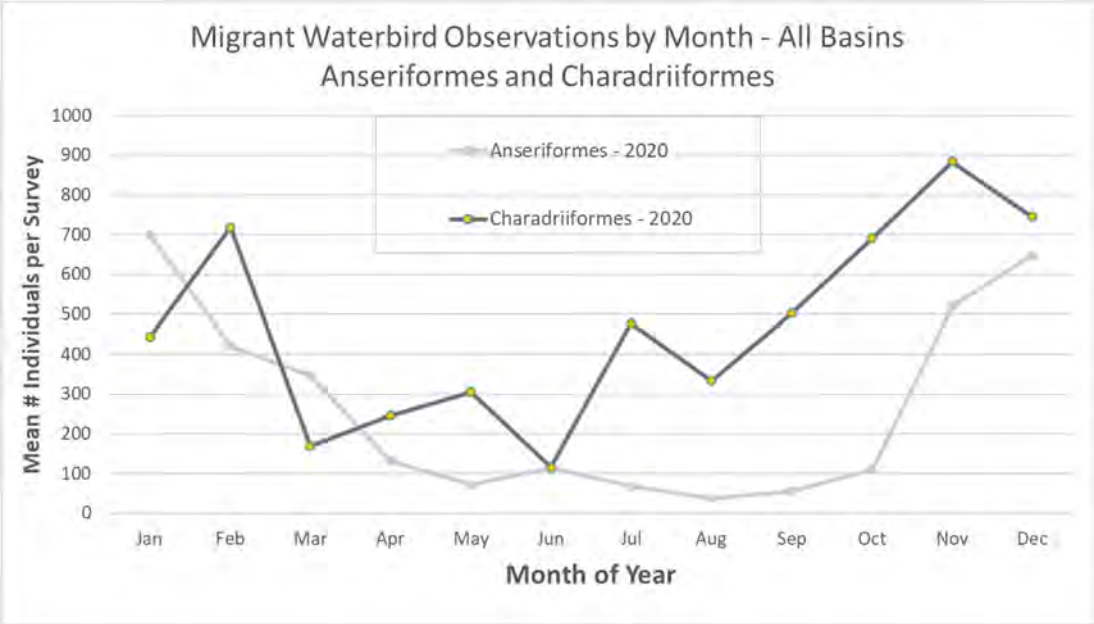
Lagoon Basin	Taxonomic Order	Mean # of Individuals Detected per Survey (Standard Error)
		2020; 19 surveys[1]
Central	**Total (all species)**	**300.13 (52.27)**
	Anseriformes (Waterfowl)	74.75 (32.54)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	196.42 (36.96)
	Gruiformes (Rails, Coots)	9.25 (4.23)
	Pelecaniformes (Pelicans, Wading birds)	9.25 (1.50)
	Podicipediformes (Grebes)	1.25 (0.55)
	Suliformes (Cormorants)	9.21 (0.95)
East	**Total (all species)**	**340.96 (73.79)**
	Anseriformes (Waterfowl)	178.46 (50.84)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	81.00 (10.75)
	Gruiformes (Rails and Coots)	62.83 (21.54)
	Pelecaniformes (Pelicans and Wading birds)	11.46 (1.45)
	Podicipediformes (Grebes)	3.25 (0.82)
	Suliformes (Cormorants)	3.96 (0.68)
West	**Total (all species)**	**212.63 (43.88)**
	Anseriformes (Waterfowl)	15.42 (8.83)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	191.75 (42.39)
	Gruiformes (Rails and Coots)	0.38 (0.33)
	Pelecaniformes (Pelicans and Wading birds)	3.71 (0.60)
	Podicipediformes (Grebes)	0.13 (0.07)
	Suliformes (Cormorants)	1.25 (0.56)

[1] Mean and standard error values for each basin calculated from 12 monthly values (averaged among surveys when multiple surveys conducted in a month).

After the Anseriformes and Charadriiformes, the next most abundant groups were birds in the orders Gruiformes (primarily American coots and LFRR), Pelecaniformes (primarily herons and egrets), and, to a lesser extent, Suliformes (cormorants). In the central and west basins, these three orders were present in roughly equal numbers; however, in the east basin, Gruiformes were the most abundant. Numbers were generally the lowest in the west basin with birds in the order Pelecaniformes detected at slightly higher levels than the other groups.

Waterbirds belonging to the taxonomic orders Anseriformes and Charadriiformes comprised more than 85.0% of observations during 2020, although this varied by basin. Together they comprised 90.4% of observations in the central basin, 76.1% of observations in the east basin, and 97.4% of observations in the west basin. Because both groups consist largely of migrant species that overwinter in the area or pass through when traveling between winter and breeding grounds, seasonal variation in overall waterbird numbers are largely driven by differences in the abundance of these two groups throughout the year. The average number of Anseriformes and Charadriiformes detected per survey, across the basins combined, is displayed below for each month of the year (Figure 2-5). As a group, Anseriformes were present in the lagoon in lower numbers from April through October, while peak numbers were observed during the winter months of December and January (Figure 2-5). Charadriiformes displayed variable peaks in abundance with the highest numbers detected in October through December and in February, while the lowest numbers were documented in June (Figure 2-5).

Figure 2-5. Mean Number of Waterfowl, Shorebirds, Gulls, and Terns (2020)



2.2.4 Discussion

Similar to marsh bird surveys, as waterbird surveys continue to be conducted during the post-construction phase of the project, a running average of western snowy plovers, California least terns, and waterbirds will be calculated for the 4 most recent years of construction/post-construction surveys and compared to the baseline abundance levels described herein to evaluate performance standards as described in the Monitoring Plan (Nature Collective 2020). Data comparisons between baseline and construction/post-construction periods will be summarized and discussed in the annual SELRP monitoring reports.

2.2.4.1 Western Snowy Plover

During 2020, western snowy plovers were observed within the lagoon in much higher numbers than previous years and at almost 17 times the levels observed during the baseline period (Table 2-4). Counts were highest in fall and winter, with two surveys (Surveys 1 and 19) documenting 18 birds each. In 2020, two western snowy plover observations were in the central basin with the remaining 56 observations in the west basin. As in each preceeding year, western snowy plovers were not detected in the east basin. The west basin is immediately adjacent to the coastal habitat, which is dominated by open sandy areas and the intertidal zone, and where the species is most commonly found due to the presence of abundant foraging and roosting habitat. Construction-related dedging activities have resulted in an increase in the amount of open mudflat foraging habitat in the central basin. While this habitat type is available immediately post-construction, some of this may dissipate over time as restored vegetation takes hold. The east basin is dominated by vegetative cover and channels, neither of which is preferred by the western snowy plover.

The first year in which more than 20 western snowy plovers in total were detected during waterbird surveys was 2020. Western snowy plovers will forage on exposed mudflats but typically prefer open sandy substrate. Thus, it is not yet clear if the increases documented in 2020 are indicative of changes to the lagoon that are favorable to the plovers immediately post-construction (i.e., large mudflat expanses), or are a result of some other factors.

2.2.4.2 California Least Tern

California least terns were present in low numbers during the months of May through July in 2020. Overall, the number of California least tern detections during 2020 was 1.25 individuals/survey which was identical to the 2018 average and almost three times the 2019 average of 0.42 individuals/survey (2018-2019 Avian Monitoring Report [AECOM 2020b]). The 3-year construction phase average of 0.97 individuals/survey is slightly higher than the baseline average of 0.85 individuals/survey (Table 2-6). California least terns were observed in all three lagoon basins in 2020, with the highest numbers in the central basin (Table 2-7). During surveys,

California least terns were observed engaging in aerial foraging over open water (central and east basins) or simply flying over (west basin).

Although the 2020 California least tern numbers are higher than the baseline average and the 3-year construction average, their numbers in the lagoon have been low for the past several years. Based on monthly counts conducted at the lagoon from 1973–1983, and again from 2002–2017, California least tern numbers were substantially higher 10–20 years ago, with monthly counts as high as 69 and 78 individuals in 2004 and 2007, respectively (Nature Collective 2020). In 2019, there were a total of five California least tern detections in the lagoon (2018-2019 Avian Monitoring Report [AECOM 2020b]). Increased tidal flow due to restoration work may improve foraging, and 4 acres of protected sand dunes should provide safe nesting habitat, both of which could bolster California least terns numbers in the lagoon.

2.2.4.3 Other Species

Waterbird surveys were designed to assess the abundance of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in San Elijo Lagoon. The 2020 survey results continue the trend of increasing waterbird abundance in each year following the baseline period; the baseline monthly survey mean was 355.8 individuals/survey, 2018 was 453.92 individuals/survey, 2019 was 664.54 individuals/survey (2018-2019 Avian Monitoring Report [AECOM 2020b]), and 2020 was 853.71 individuals/survey. The 2020 monthly mean was substantially higher than the overall construction phase average of 660.39 individuals/survey and more than twice as high as the baseline monthly survey mean of 355.8 individuals/survey (Table 2-8). Six orders of waterbird were recorded in the 2020 surveys with more than 85% of the observations consisting of birds in the orders Anseriformes (waterfowl) and Charadriiformes (shorebirds, gulls, and terns). This distribution is primarily a result of these two orders having more species than the other four orders. Additionally, Anseriformes and Charadriiformes species tend to be gregarious during the non-breeding season, which is when they are most abundant in the lagoon.

The abundance of birds in the different taxonomic orders varied among the three surveyed basins and showed both seasonal and annual variation (Table 2-9 and Figure 2-5). Spatial variation in abundance of waterbirds is most likely driven by differences in habitat between basins, relative to the habitat preferences of those groups. Among the three basins, overall waterbird numbers were highest in the east basin, which averaged 340.96 individuals/survey during 2020. Waterbird abundance was intermediate in the central basin (300.13 individuals/survey) and lowest in the west basin (212.63 individuals/survey).

Anseriformes (waterfowl) were least prevalent in the west basin, comprising only 7.3% of waterbirds observations there during 2020, compared to the east and central basins, where Anseriformes comprised 52.3% and 24.9% of waterbird observations, respectively. Both the

central and east basins are larger than the west basin, but the greater prevalence of waterfowl in those two basins appears driven mainly by the presence of significant areas of open water which is preferred by waterfowl.

Charadriiformes (shorebirds, gulls, and terns) had very similar numbers in the central and west basins (196.42 and 191.75 individuals/survey, respectively), with much lower numbers in the east basin (81.00 individuals/survey). Charadriiformes comprised 90.2% of waterbird observations in the west basin, 65.4% of observations in the central basin, and 23.8% of observations in the east basin. Shorebirds, which generally made up a high proportion of the Charadriiformes observations, prefer exposed mudflat and open sandy areas for foraging, habitats, which are more common in the west and central basins.

Patterns in the general waterbird data are more complex to interpret than the other datasets involving a single species, such as western snowy plover or California least tern, due to the diversity of species within each group and the variability in the presence of these species across different basins in the lagoon and different seasons of the year. For example, 35 species of birds were observed within the order Charadriiformes, and 19 were observed within the order Anseriformes (Appendix B). Despite this variability, overall waterbird numbers increased relative to the previous 4 years. This increase is likely due to changes in habitat associated with restoration construction activities. For example, waterfowl (order Anseriformes) numbers increased from an average of 50.42 individuals/survey during the baseline period to an average of 73.27 individuals/survey in 2018, 90.12 individuals/survey in 2019 (2018-2019 Avian Monitoring Report [AECOM 2020b]), and 89.54 individuals/survey in 2020. The increase in waterfowl numbers is correlated with an increase in the amount of open water associated with restoration activities. Similarly, the abundance of birds in the order Charadriiformes (especially shorebirds) in the the lagoon has increased from a low of 53.61 individuals/survey in the baseline period to 55.56 individuals/survey in 2018, 111.97 individuals/survey in 2019 (2018-2019 Avian Monitoring Report [AECOM 2020b]), and 156.39 individuals/survey in 2020. This increase in shorebirds could represent a response to the increased mudflat habitat created by dredging activities during the construction phase, although this may dissipate over time as vegetation establishes. In addition, improved hydrological function has resulted in more pronounced tidal fluctuations, especially in the east basin, and this has resulted in more foraging habitat for shorebirds at low tide.

2.3 BELDING'S SAVANNAH SPARROW SURVEYS

The monitoring of Belding's savannah sparrows (*Passerculus sandwichensis beldingi*) is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. Additionally, the specialized surveys required to adequately estimate abundance of Belding's savannah sparrows are not being conducted in at a reference wetland, thereby making comparison impossible. Belding's savannah sparrow, a

California endangered species, occurs in the salt marsh habitat present in the SELRP area. This species is endemic to the coastal salt marshes of Southern California and northern Baja California (AOU 1983).

2.3.1 Performance Standards

Success for Belding's savannah sparrow will be measured by comparing pre-construction data and construction/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Performance standards are included below.

> **Interim standard**: Construction/post-construction 4-year running average density 75% or greater than that of pre-construction survey data (2016, 2017) by year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average density 95% or greater than that of pre-construction survey data (2016, 2017) by year 10 post-construction

Running averages will be used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan [Nature Collective 2020]).

2.3.2 Approach

The focus of these surveys was to estimate density for the state endangered Belding's savannah sparrow. Baseline surveys (2016 and 2017) were conducted during the breeding season for the species, from April 11 through May 20, 2016 (six surveys) and March 20 through May 19, 2017 (four surveys). In 2018 and 2019, surveys were conducted from February 25 through May 14 (four surveys each year), and in 2020, surveys were conducted from March through May (four surveys).

Survey results are summarized according to the following four "survey periods" designed to enable grouping of survey results across four roughly equal time periods and to minimize the effects temporal variation may have on analysis results:

- Late February to Mid-March
- Late March to Early April
- Mid- to Late April
- Early to Mid-May

When multiple surveys were conducted in a survey period for a given year, the mean number of individuals detected across surveys was calculated. The mean number of individuals detected per survey during each survey period was then used to evaluate temporal variation in abundance (across seasons and between years), and to calculate the overall average abundance metrics.

Belding's savannah sparrow detections were recorded at all distances from 19 survey transects measuring 100 meters long located within suitable habitat and spread throughout the lagoon, following methods described in the Monitoring Plan (Nature Collective 2020). Transects 1 through 4, 6, 9, and 11 through 15 were surveyed only on one side due to the lack of sufficient suitable habitat on the other side. In 2019 and 2020, transects 16 and 17 could not be surveyed due to safety issues. Detailed summaries of the survey dates, survey times, survey personnel and weather conditions are provided in Appendix D.

Survey data were analyzed using a distance sampling approach (Buckland et al. 2001), which applied the distances between the observer and each detected bird to control for differences in detectability. Based on results from the distance sampling model approach and data collected in previous years, detections beyond 75 meters perpendicular distance from the transect were omitted from the analysis. An estimate of the density of Belding's savannah sparrow individuals was calculated for each survey as the number of individuals per acre across the survey area as a whole. The model selection process was revised following the 2020 season to better fit the distribution of the data. To ensure appropriate comparisons across years, this change was also applied to the previous years' data, resulting in modest changes to the annual estimates for 2016 through 2019 (Appendix E). These changes are reflected in the results presented below.

2.3.3 Results

Belding's savannah sparrows were detected during 2020 surveys primarily in areas dominated by CSM – Low, CSM – Mid, and CSM – High, as shown in Figure 2-6. Based on results from the distance sampling model approach (Buckland et al. 2001), detections within 75 meters perpendicular distance from the transect were included in the analysis. Belding's savannah sparrow density within the survey area was lower in 2020 (0.66 individuals/acre) than the 3-year average from 2018–2020 (1.29 individuals/acre), and was substantially lower than the 2016–2017 baseline average (2.11 individuals/acre) (Table 2-10). It should be noted that the high baseline value appears heavily influenced by the high density estimate of 04.03 individuals/acre detected in the 2017 Late-February to Mid-March period (Baseline Monitoring Report [AECOM 2020a]; Appendix E). In 2020, the density estimates ranged from 0.38 individuals/acre in the second survey period (late March to early April) to 0.89 individuals/acre in the first survey period (mid to late April) (Table 2-10).

Table 2-10. Summary of Belding's Savannah Sparrow Results by Survey Period, 2016–2020

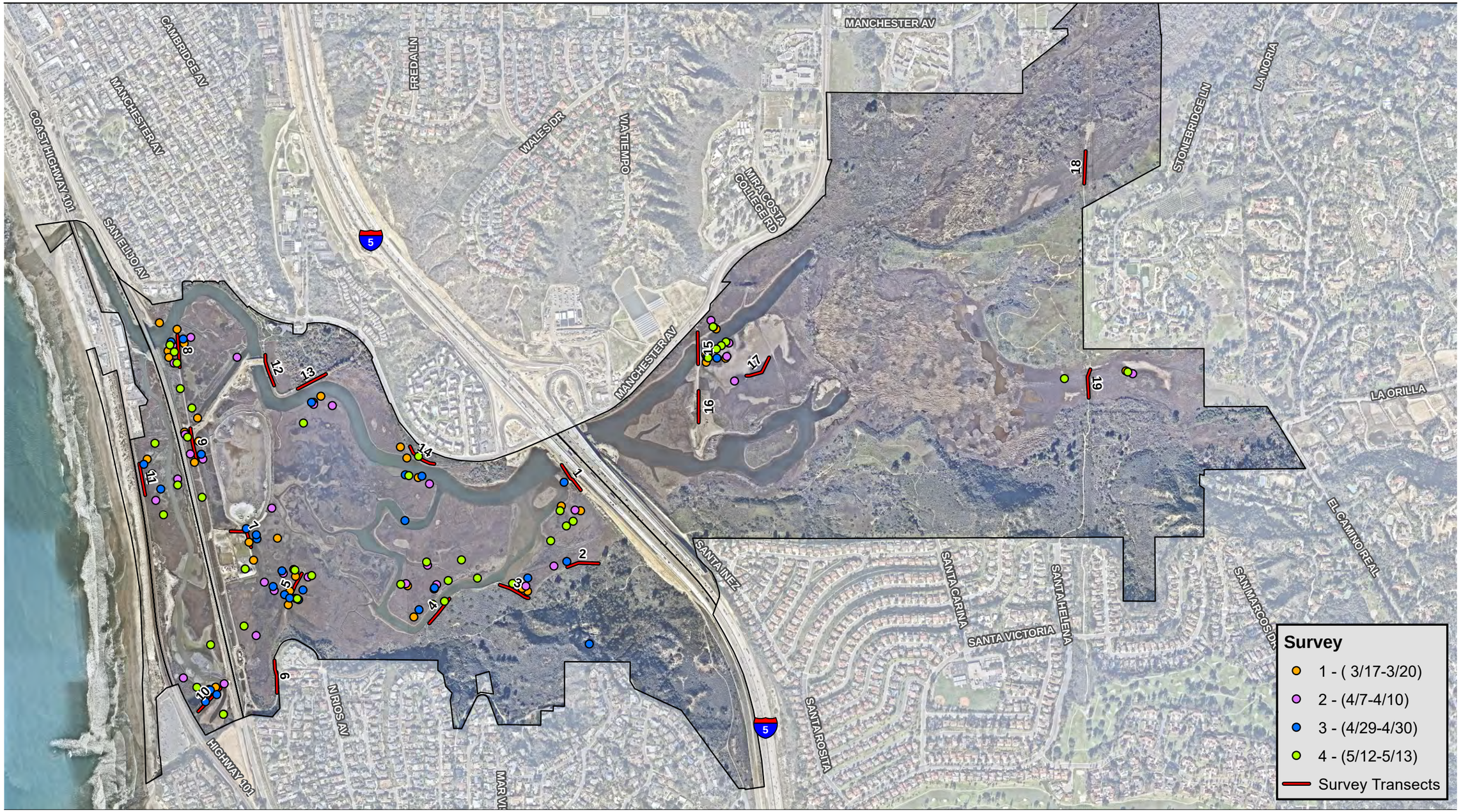
Survey Period	Survey Period Averages; Density defined as Mean # Individuals/acre		
	2020	2018–2020 Construction Phase*	2016–2017 Baseline*
Late February to Mid-March	0.89	1.49	04.03
Late March to Early April	0.38	1.22	1.61
Mid- to Late April	0.76	1.21	1.45
Early to Mid-May	0.59	1.25	1.36
Overall Average (Standard Error)	**0.66 (0.12)**	**1.29 (0.07)**	**2.11 (0.64)**

*Values reflect changes to the density estimates based on revision to the model selection process. See Appendix E for revised density estimates for years 2016-2019.

2.3.4 Discussion

As Belding's savannah sparrow surveys continue to be conducted during the post-construction phase of the project, running averages will be calculated for the species' density within the survey area for the 4 most recent years of construction/post-construction surveys. These estimates will be compared to the baseline abundance levels described herein to evaluate performance standards as described in the Monitoring Plan (Nature Collective 2020). Data comparisons between pre-construction and construction/post-construction periods will be summarized and discussed in the annual SELRP monitoring reports.

The estimated Belding's savannah sparrow density within the survey area was lower in 2020 (0.66 individuals/acre) compared to the 2018 and 2019 averages of 1.57 individuals/acre and 1.65 individuals/acre, respectively (2018-2019 Avian Monitoring Report [AECOM 2020b]; Appendix E). The combined construction phase average was also lower than the baseline average (1.29 individuals/acre and 2.11 individuals/acre, respectively). The higher estimated density in the baseline period was partly driven by one unusually high estimate from the first survey in 2017 (see Baseline Monitoring Report [AECOM 2020a] and Appendix E). Aside from that high count, density estimates were relatively similar across survey periods and years from 2016 through 2019. However, the counts in each survey period in 2020 were consistently lower than corresponding counts from the previous years, both during the construction and baseline phases. The reduced density estimates in 2020 and likely reflect losses in Belding's savannah sparrow preferred habitat due to channel widening and changes in vegetation composition. However, some areas of mudflat are transitioning to CSM – Low and Belding's savannah sparrow numbers may gradually increase as this transition occurs.



Source: SANDAG 2012; MoffattNichol 2020; AECOM 2020.

1,000 500 0 1,000 Feet

Scale: 1:12,000; 1 inch = 1000 feet

Figure 2-6
2020 Belding's Savannah Sparrow Survey Results

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\BSSP_Survey_Areas_2020_Survey_Results.mxd, 9/23/2021, paul.moreno

This page intentionally left blank.

3. SUMMARY

Changes in bird abundances or density estimates from the baseline period to the construction phase varied by species or group, as shown in Table 3-1 below. Some species/groups increased (e.g., waterbirds), while some declined (e.g., Belding's savannah sparrow), and others remained relatively constant (e.g., LFRR and other marsh birds).

Table 3-1. Summary of Bird Estimates during the Baseline Period and the Construction Phase

Species	Density/Acre			Lagoon-wide Abundance			Detections/Survey		
	Baseline[1]	Construction Phase[2]	2020	Baseline[1]	Construction Phase[2]	2020	Baseline[1]	Construction Phase[2]	2020
Light-footed Ridgway's Rails*	0.21	0.20	0.21	62.98	49.73	52.66	--	--	--
Other Focal Marsh Birds	--	--	--	--	--	--	10.00	10.67	11.17
Western Snowy Plovers*	--	--	--	--	--	--	0.27	1.57	4.54
California Least Terns*	--	--	--	--	--	--	0.85	0.97	1.25
Waterbirds	--	--	--	--	--	--	355.8	563.73	853.71
Belding's Savannah Sparrows[3]*	2.11	1.29	0.66	--	--	--	--	--	--

[1] Baseline is 2016–2017.
[2] Construction Phase is 2018–2020.
[3]Values reflect changes to the model selection process for density estimates for years 2016-2019 (Appendix E).
* Species subject to interim and final performance standards based on 4-year running averages equivalent to 75% and 95% of baseline levels by year 7 and year 10, respectively.

LFRR numbers declined in 2019 relative to previous years; however, in 2020, the numbers rebounded to levels similar to those of the baseline period. Potential reasons for this recovery may be increases in native vegetation cover and ongoing predator control efforts. These efforts will continue to be evaluated and adaptively managed, and monitored for their influence in stabilizing the LFRR population post-construction within the lagoon. Some species-level variation occurred among other focal marsh bird species (Table 2-3), but the overall average was similar between the baseline period and construction phase, with moderately higher numbers in 2020 (Table 3-1). Western snowy plovers and California least terns both exhibited increases in 2020 compared to the baseline period as well as the previous 2 years. Western snowy plovers in particular exhibited a large increase in numbers in 2020, with a total of 58 detections. Waterbirds also exhibited an increase in 2020 compared to numbers from the baseline period as well as the previous 2 years. Much of this change was driven by increases in the number of waterfowl (order Anseriformes) and

shorebirds (order Charadriiformes). Because the amount of open water increased as part of the proposed habitat distribution, this likely attracted greater numbers of waterfowl to the lagoon especially in the east basin (Table 2-9). Similarly, dredging activities increased the amount of mudflat habitat, as did increased tidal fluctuations due to improved hydrological function, and together these changes likely attracted greater numbers of shorebirds. Belding's savannah sparrows declined in 2020 compared to the baseline period and the previous 2 years. The cause of this decline is unclear but may be related to loss or changes in Belding's savannah sparrow habitat near transects as part of restoration work. It is anticipated that with vegetation establishment following post-restoration activities, preferred habitat by the Belding's savannah sparrow will establish, providing additional areas for foraging and breeding.

4. LIST OF PREPARERS

Table 4-1 includes a list of persons and organizations that participated in the monitoring program and/or preparation of this report.

Table 4-1. List of Preparers

Chapter/Section	Variable	Lead Author	Organization
1 and 2	General Report Preparation	Cindy Kinkade (Project Manager) Michael Anguiano	AECOM
2.1	Breeding Marsh Birds with Focus on Light-footed Ridgway's Rail	Loren Merrill	AECOM
2.2	Western Snowy Plover, California Least Tern, and Waterbird Species	Loren Merrill	AECOM
2.3	Belding's Savannah Sparrow	Loren Merrill	AECOM

This page intentionally left blank.

5. REFERENCES

AECOM. 2020a. *Wetland Habitat and Hydrology Baseline Monitoring Report for the San Elijo Lagoon Restoration Project*. Prepared for the Nature Collective. March.

---------- 2020b. *2018-2019 Avian Monitoring Report for the San Elijo Lagoon Restoration Project*. Prepared for the Nature Collective. September.

American Ornithologists' Union (AOU). 1983. *Check-list of North American Birds*, 6th edition. Allen Press, Inc., Lawrence, Kansas.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. *Introduction to Distance Sampling – Estimating Abundance of Biological Populations*. Oxford University Press, Oxford.

Conway, C. J. 2011. Standardized North American Marsh Bird Monitoring Protocol. *Waterbirds* 34(3):319–346.

Conway, C. J., W. R. Eddleman, S. H. Anderson and L. R. Hanebury. 1993. Seasonal Changes in Yuma Clapper Rail Vocalization Rate and Habitat Use. *Journal of Wildlife Management* 56:282–290.

Eddleman, W. R., and C. J. Conway. 2018. Ridgway's Rail (*Rallus obsoletus*), version 2.1. In *The Birds of North America* (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. Available at https://doi.org/10.2173/bna.ridrai1.02.1.

Huggins, R. M. 1991. Some Practical Aspects of a Conditional Likelihood Approach to Capture Experiments. *Biometrics* 47.

Massey, B. W., R. Zembal, and P. D. Jorgensen. 1984. Nesting Habitat of the Light-footed Clapper Rail in Southern California. *Journal of Field Ornithology* 55:67–80.

Nature Collective. 2020. *Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project*. Prepared by AECOM, Nordby Biological Consulting, and Moffatt & Nichol.

Nichols, J. D., J. E. Hines, J. R. Sauer, F. W. Fallon, J. E. Fallon, and P. J. Heglund. 2000. A Double-Observer Approach for Estimating Detection Probability and Abundance from Point Counts. *Auk* 117:393–408.

Oberbauer, T., M. Kelly, and J. Buegge. March 2008. *Draft Vegetation Communities of San Diego County*. Based on "Preliminary Descriptions of the Terrestrial Natural Communities of California," Robert F. Holland, Ph.D., October 1986.

U.S. Fish and Wildlife Service (USFWS). 2017. Formal Section 7 Consultation for the San Elijo Lagoon Restoration Project, San Diego County, California.

Zembal, R., S. M. Hoffman, J. Konecny, and B. Sabiston. 2019. *Light-footed Ridgway's (Clapper) Rail in California, 2019 Season*. Final Report to US Fish and Wildlife Service and California Department of Fish and Wildlife. 49 pp.

Zembal, R., and B. W. Massey. 1987. Seasonality of vocalizations by Light-footed Clapper Rails. *Journal of Field Ornithology* 58:41–48.

Appendix A

2020 Marsh Bird Surveys and Weather

Appendix A
2020 Light-footed Ridgeway's Rail Surveys and Weather

Table A-1. Weather conditions and survey times for each AM and PM Light-footed Ridgeway's Rail survey[1].

Survey Number	Date	AM/PM Survey Session	Time	Average Temperature (°F)	Average Sky Condition Rating[2]	Average Wind Speed (mph)	Average Background Noise Rating[3]
1	3/20/2020	AM	06:22 - 08:03	53.4	1.3	1.1	1.5
		PM	17:06 - 18:56	62.3	1.0	1.7	1.5
	3/21/2020	AM	06:25 - 07:40	52.0	1.3	1.7	1.1
2	4/1/2020	AM	06:20 - 07:53	50.3	1.5	0.5	1.0
		PM	17:34 - 18:27	63.0	0.0	3.0	2.0
	4/2/2020	AM	06:13 - 07:10	59.3	2.0	1.2	1.5
		PM	17:23 - 18:18	62.7	0.5	3.0	1.0
	4/3/2020	AM	06:05 - 07:36	51.0	1.3	1.0	1.4
	4/4/2020	AM	06:21 - 07:21	56.3	1.5	1.5	1.0
3	4/15/2020	AM	06:03 - 07:37	51.0	0.0	0.8	1.0
		PM	17:55 - 18:43	70.3	0.0	1.0	1.0
	4/16/2020	AM	05:51 - 07:19	50.4	0.5	1.4	1.4
		PM	17:54 - 18:49	65.0	0.0	1.3	1.0
	4/17/2020	AM	05:50 - 07:05	54.0	1.0	1.0	1.0
	4/18/2020	AM	05:56 - 06:51	57.3	3.0	1.0	1.3
4	5/5/2020	AM	05:30 - 07:02	56.8	0.0	0.7	1.9
		PM	17:30 - 18:35	74.9	0.0	1.7	1.2
	5/6/2020	AM	05:36 - 06:39	57.1	0.0	2.0	1.6
5	5/19/2020	AM	05:31 - 06:59	60.3	1.0	1.0	1.0
		PM	18:06 - 18:53	65.0	1.0	3.0	1.0
	5/21/2020	AM	05:18 - 06:46	54.3	0.4	1.2	1.6
		PM	17:46 - 18:31	74.0	0.5	2.3	1.0
	5/22/2020	AM	05:26 - 06:20	64.0	2.0	0.3	1.8
6	6/2/2020	AM	05:12 - 06:43	57.3	0.6	0.4	1.4
		PM	17:53 - 18:56	70.1	1.0	1.4	1.3
	6/3/2020	AM	05:12 - 06:36	64.9	1.0	1.0	1.4

°F = degrees Fahrenheit; mph = miles per hour

[1] Surveys 1 through 6 were conducted by the same four ornithologists: Ian Maunsell (TE 42833A-3, Blackhawk Environmental); Antonette Gutierrez (TE-50992B-0, Blackhawk Environmental); James McMorran (AECOM); and Brennan Mulrooney (AECOM).

[2] Sky Condition Ratings: 0 = clear or a few clouds; 1 = partly cloudy or variable sky; 2 = cloudy or overcast; 3 = fog; 4 = drizzle

[3] Background Noise Ratings: 0 = no noise; 1 = faint noise; 2 = moderate noise (probably can't hear some birds beyond 100 meters); 3 = loud noise (probably can't hear some birds beyond 50 meters); 4 = intense noise (probably can't hear some birds beyond 25 meters)

Appendix B

2020 Waterbird Surveys Species List

Appendix B – 2020 Waterbird Survey Species List

Table B-1. List of bird species observed during 2020 waterbird surveys, sorted by taxonomic order.

Order	Common Name	Scientific Name
Anseriformes (Waterfowl)	American Wigeon	*Mareca americana*
	Blue-winged Teal	*Spatula discors*
	Brant	*Branta bernicla*
	Bufflehead	*Bucephala albeola*
	Canada Goose	*Branta canadensis*
	Canvasback	*Aythya valisineria*
	Cinnamon Teal	*Spatula cyanoptera*
	Eurasian Wigeon	*Mareca penelope*
	Gadwall	*Mareca strepera*
	Greater Scaup	*Aythya marila*
	Green-winged Teal	*Anas crecca*
	Hooded Merganser	*Lophodytes cucullatus*
	Lesser Scaup	*Aythya affinis*
	Mallard	*Anas platyrhynchos*
	Northern Pintail	*Anas acuta*
	Northern Shoveler	*Spatula clypeata*
	Red-breasted Merganser	*Mergus serrator*
	Redhead	*Aythya americana*
	Ruddy Duck	*Oxyura jamaicensis*
Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	American Avocet	*Recurvirostra americana*
	Baird's Sandpiper	*Calidris bairdii*
	Black Turnstone	*Arenaria melanocephala*
	Black-bellied Plover	*Pluvialis squatarola*
	Black-necked Stilt	*Himantopus mexicanus*
	Bonaparte's Gull	*Chroicocephalus philadelphia*
	California Gull	*Larus californicus*
	California Least Tern	*Sternula antillarum browni*
	Caspian Tern	*Hydroprogne caspia*
	Dowitcher sp.	*Limnodromus* spp.
	Dunlin	*Calidris alpina*
	Elegant Tern	*Thalasseus elegans*
	Forster's Tern	*Sterna forsteri*
	Greater Yellowlegs	*Tringa melanoleuca*
	Heermann's Gull	*Larus heermanni*
	Herring Gull	*Larus argentatus*
	Killdeer	*Charadrius vociferus*
	Least Sandpiper	*Calidris minutilla*

Order	Common Name	Scientific Name
Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	Lesser Yellowlegs	*Tringa flavipes*
	Long-billed Curlew	*Numenius americanus*
	Long-billed Dowitcher	*Limnodromus scolopaceus*
	Marbled Godwit	*Limosa fedoa*
	Red-necked Phalarope	*Phalaropus lobatus*
	Ring-billed Gull	*Larus delawarensis*
	Royal Tern	*Thalasseus maximus*
	Ruddy Turnstone	*Arenaria interpres*
	Sanderling	*Calidris alba*
	Semipalmated Plover	*Charadrius semipalmatus*
	Short-billed Dowitcher	*Limnodromus griseus*
	Spotted Sandpiper	*Actitis macularius*
	Western Gull	*Larus occidentalis*
	Western Sandpiper	*Calidris mauri*
	Western Snowy Plover	*Charadrius nivosus nivosus*
	Whimbrel	*Numenius phaeopus*
	Willet	*Tringa semipalmata*
	Wilson's Phalarope	*Phalaropus tricolor*
Gruiformes (Rails, Coots, Gallinules)	American Coot	*Fulica americana*
	Common Gallinule	*Gallinula galeata*
	Light-footed Ridgeway's Rail	*Rallus obsoletus levipes*
	Sora	*Porzana carolina*
	Virginia Rail	*Rallus limicola*
Pelecaniformes (Pelicans, Wading birds)	American Bittern	*Botaurus lentiginosus*
	Black-crowned Night-Heron	*Nycticorax nycticorax*
	Great Blue Heron	*Ardea herodias*
	Great Egret	*Ardea alba*
	Green Heron	*Butorides virescens*
	Least Bittern	*Ixobrychus exilis*
	Reddish Egret	*Egretta rufescens*
	Snowy Egret	*Egretta thula*
	White-faced Ibis	*Plegadis chihi*
	Yellow-crowned Night-Heron	*Nyctanassa violacea*
Podicipediformes (Grebes)	Clark's Grebe	*Aechmophorus clarkii*
	Eared Grebe	*Podiceps nigricollis*
	Pied-billed Grebe	*Podilymbus podiceps*
	Western Grebe	*Aechmophorus occidentalis*
Suliformes (Cormorants)	Double-crested Cormorant	*Phalacrocorax auritus*

Appendix C

2020 Waterbird Surveys

Appendix C

Table C-1: Waterbird Surveys (2020) Survey Dates and Personnel

Survey Number	Date	Survey Personnel	Start Time	End Time
1	1/9/2020	James McMorran, Brennan Mulrooney	07:34 AM	02:02 PM
1	1/9/2020	Brennan Mulrooney, James McMorran	10:14 AM	12:05 PM
1	1/10/2020	Brennan Mulrooney, James McMorran	09:07 AM	01:41 PM
2	2/11/2020	Brennan Mulrooney, James McMorran	10:29 AM	02:01 PM
2	2/11/2020	Brennan Mulrooney, James McMorran	09:14 AM	10:28 AM
2	2/13/2020	James McMorran, Brennan Mulrooney	07:52 AM	02:10 PM
3	3/13/2020	Brennan Mulrooney, James McMorran	10:23 AM	02:31 PM
3	3/14/2020	James McMorran, Brennan Mulrooney	12:33 PM	03:46 AM
3	3/14/2020	James McMorran, Brennan Mulrooney	08:16 AM	02:32 PM
4	3/24/2020	Brennan Mulrooney, Madeline Bailey	12:30 PM	03:28 PM
4	3/25/2020	Brennan Mulrooney, Ayoola Folarin	09:32 AM	11:01 AM
4	3/25/2020	Brennan Mulrooney, Ayoola Folarin	10:13 AM	12:42 PM
5	4/9/2020	Brennan Mulrooney, Madeline Bailey	08:28 AM	11:30 AM
5	4/10/2020	Brennan Mulrooney, Ayoola Folarin	09:33 AM	12:30 PM
5	4/10/2020	Brennan Mulrooney, Ayoola Folarin	11:42 AM	01:19 PM
6	4/23/2020	Brennan Mulrooney, Madeline Bailey	08:22 AM	10:06 AM
6	4/23/2020	Brennan Mulrooney, Madeline Bailey	10:00 AM	12:14 PM
6	4/24/2020	Brennan Mulrooney, Madeline Bailey	09:35 AM	12:00 PM
7	5/7/2020	Brennan Mulrooney, James McMorran	09:12 AM	12:45 PM
7	5/7/2020	Brennan Mulrooney, James McMorran	10:48 AM	12:03 PM
7	5/8/2020	Brennan Mulrooney, Madeline Bailey	09:05 AM	11:00 AM
8	5/21/2020	Brennan Mulrooney, Kalli Kilmer	08:02 AM	11:04 AM
8	5/21/2020	Brennan Mulrooney, Kalli Kilmer	07:38 AM	09:09 AM
8	5/22/2020	James McMorran, Brennan Mulrooney	06:54 AM	10:52 AM
9	6/4/2020	Brennan Mulrooney, Kalli Kilmer	09:04 AM	01:49 PM
9	6/5/2020	Brennan Mulrooney, James McMorran	09:04 AM	10:43 AM
9	6/5/2020	James McMorran, Brennan Mulrooney	07:11 AM	12:38 PM
10	6/18/2020	James McMorran, Kalli Kilmer	09:21 AM	10:59 AM
10	6/18/2020	James McMorran, Kalli Kilmer	07:30 AM	12:30 PM
10	6/19/2020	James McMorran, Kalli Kilmer	06:45 AM	12:30 PM
11	7/2/2020	James McMorran, Ayoola Folarin	08:23 AM	11:03 AM
11	7/2/2020	James McMorran, Ayoola Folarin	06:13 AM	11:39 AM
11	7/3/2020	Brennan Mulrooney, Madeline Bailey	08:05 AM	10:00 AM
12	7/23/2020	James McMorran, Madeline Bailey	06:29 AM	11:55 AM
12	7/23/2020	James McMorran, Madeline Bailey	09:25 AM	11:30 AM

Survey Number	Date	Survey Personnel	Start Time	End Time
12	7/24/2020	James McMorran, Ayoola Folarin	07:01 AM	11:39 AM
13	8/6/2020	James McMorran, Brennan Mulrooney	07:22 AM	09:43 AM
13	8/6/2020	James McMorran, Brennan Mulrooney	06:28 AM	12:56 PM
13	8/7/2020	James McMorran, Brennan Mulrooney	06:23 AM	10:42 AM
14	8/20/2020	James McMorran, Madeline Bailey	08:45 AM	11:00 AM
14	8/20/2020	James McMorran, Madeline Bailey	06:22 AM	12:18 PM
14	8/21/2020	James McMorran, Ayoola Folarin	06:31 AM	12:54 PM
15	9/10/2020	James McMorran, Brennan Mulrooney	06:20 AM	12:54 PM
15	9/11/2020	Brennan Mulrooney, James McMorran	08:39 AM	10:50 AM
15	9/11/2020	James McMorran, Brennan Mulrooney	06:29 AM	11:54 AM
16	9/17/2020	Brennan Mulrooney, James McMorran	08:06 AM	09:34 AM
16	9/17/2020	James McMorran, Brennan Mulrooney	06:09 AM	12:42 PM
16	9/18/2020	James McMorran, Brennan Mulrooney	06:44 AM	11:07 AM
17	10/8/2020	Brennan Mulrooney, James McMorran	08:02 AM	10:36 AM
17	10/8/2020	James McMorran, Brennan Mulrooney	06:59 AM	12:22 PM
17	10/9/2020	James McMorran, Brennan Mulrooney	06:50 AM	12:55 AM
18	11/12/2020	Brennan Mulrooney, James McMorran	08:28 AM	10:49 AM
18	11/12/2020	James McMorran, Brennan Mulrooney	06:33 AM	12:09 PM
18	11/13/2020	James McMorran, Brennan Mulrooney	06:41 AM	01:19 PM
19	12/10/2020	Brennan Mulrooney, James McMorran	10:25 AM	11:40 AM
19	12/10/2020	James McMorran, Brennan Mulrooney	06:33 AM	12:55 PM
19	12/11/2020	James McMorran, Brennan Mulrooney	06:43 AM	01:36 PM

Table C-2: Waterbird Surveys (2020) Weather Conditions

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
1	01/09/2020	02:19:03 PM	Mostly cloudy	61	90	11.6
1	01/09/2020	09:35:03 AM	Mostly cloudy	55	90	5.1
1	01/09/2020	10:14:48 AM	Mostly cloudy	56	78	5.4
1	01/09/2020	12:05:11 PM	Mostly cloudy	59	90	8.8
1	01/10/2020	01:41:23 PM	Sunny	63	10	4
1	01/10/2020	11:07:41 AM	Sunny	56	6	3.3
2	02/11/2020	02:01:16 PM	Sunny	70	10	9.8
2	02/11/2020	09:15:20 AM		59	0	3
2	02/11/2020	10:28:55 AM	Sunny	58	0	5.3
2	02/11/2020	10:29:39 AM	Sunny	58	0	5.3
2	02/13/2020	09:53:20 AM	Sunny	56	10	1.3
3	03/13/2020	01:31:41 PM	Light rain	61	95	7.7

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
3	03/13/2020	10:23:43 AM	Cloudy	59	91	5.3
3	03/14/2020	10:17:23 AM	Cloudy	61	97	1.5
3	03/14/2020	12:33:04 PM	Cloudy	62	100	2.9
3	03/14/2020	12:34:03 PM	Cloudy	62	100	2.9
4	03/24/2020	02:18:53 PM	Partly sunny	63	50	7.7
4	03/24/2020	12:32:30 PM	Partly sunny	63	50	4.9
4	03/25/2020	09:34:41 AM	Cloudy	58	97	3.1
4	03/25/2020	10:01:32 AM	Mostly cloudy	57	90	3.1
4	03/25/2020	10:14:21 AM	Mostly cloudy	57	90	3.1
4	03/25/2020	12:42:34 PM	Mostly cloudy	62	90	6.8
5	04/09/2020	09:29:09 AM	Light rain	54	100	4.9
5	04/10/2020	10:45:52 AM	Light rain	54	100	4.3
5	04/10/2020	11:42:57 AM	Light rain	56	100	4.5
5	04/10/2020	12:06:32 PM	Light rain	55	100	4.5
5	04/10/2020	12:30:20 PM	Light rain	55	100	4.3
6	04/23/2020	08:24:46 AM	Sunny	62	5	1.1
6	04/23/2020	10:06:59 AM	Sunny	73	4	2.2
6	04/23/2020	10:08:06 AM	Sunny	73	4	2.2
6	04/23/2020	12:14:17 PM	Sunny	72	0	3.3
6	04/24/2020	09:36:02 AM	Sunny	69	5	1.8
6	04/24/2020	11:45:51 AM	Sunny	77	0	3.9
7	05/07/2020	09:14:45 AM	Mostly sunny	66	27	1.9
7	05/07/2020	10:49:04 AM	Mostly sunny	68	14	3.5
7	05/07/2020	12:02:32 PM	Mostly sunny	74	12	4.4
7	05/08/2020	09:06:33 AM	Mostly cloudy	66	77	2.4
7	05/08/2020	10:39:34 AM	Mostly sunny	72	23	3.9
8	05/21/2020	07:39:08 AM	Mostly cloudy	59	76	1.2
8	05/21/2020	08:04:52 AM	Mostly cloudy	59	76	1.3
8	05/21/2020	09:09:16 AM	Mostly cloudy	64	76	1.9
8	05/21/2020	10:04:36 AM	Mostly sunny	64	24	3
8	05/22/2020	07:19:20 AM	Cloudy	61	93	1.8
9	06/04/2020	09:06:15 AM	Drizzle	64	100	2.9
9	06/04/2020	11:49:00 AM	Cloudy	66	100	5
9	06/05/2020	08:12:34 AM	Rain	64	100	2.8
9	06/05/2020	09:05:25 AM	Rain	64	100	3.4
9	06/05/2020	10:43:07 AM	Cloudy	68	98	3.4
9	06/05/2020	12:54:16 PM	Cloudy	69	100	5.7
10	06/18/2020	09:19:55 AM	Cloudy	65	100	1.9
10	06/18/2020	12:59:18 PM	Mostly sunny	70	29	5.5

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
10	06/19/2020	09:16:24 AM	Cloudy	65	100	3
11	07/02/2020	08:11:10 AM	Cloudy	66	100	1.8
11	07/02/2020	09:03:12 AM	Cloudy	66	100	2.4
11	07/03/2020	08:06:27 AM	Mostly sunny	64	19	1.3
11	07/03/2020	09:42:30 AM	Mostly sunny	67	11	2.9
12	07/23/2020	08:51:29 AM	Cloudy	66	100	2.4
12	07/23/2020	09:26:47 AM	Cloudy	68	100	2.4
12	07/23/2020	10:08:29 AM	Cloudy	69	100	2.9
12	07/23/2020	11:33:26 AM	Cloudy	70	91	3.9
12	07/24/2020	08:38:49 AM	Cloudy	66	100	1.9
12	07/24/2020	11:09:10 AM	Mostly cloudy	70	76	8.1

°F = degrees Fahrenheit; mph = miles per hour

Appendix D

2020 Belding's Savannah Sparrow Surveys

Appendix D

Table D-1: Belding's Savannah Sparrow Surveys (2020) Survey Dates, Personnel, Weather Conditions and Observations

Survey Number	Date	Survey Personnel	Time	Weather Conditions
1[a]	3/17/2020	Brennan Mulrooney	0635-1011	Start: 55 °F; wind 3 mph; 91 % cloud cover End: 51 °F; wind 3 mph; 90 % cloud cover
1[b]	3/20/2020	Brennan Mulrooney	0847-1054	Start: 53 °F; wind 5 mph; 94 % cloud cover End: 58 °F; wind 4 mph; 90 % cloud cover
2[a]	4/07/2020	Brennan Mulrooney	0645–0951	Start: 52 °F; wind 2 mph; 98 % cloud cover End: 54 °F; wind 2 mph; 100 % cloud cover
2[b]	4/09/2020	Brennan Mulrooney	0710–0955	Start: 48 °F; wind 4 mph; 98 % cloud cover End: 59 °F; wind 7 mph; 100 % cloud cover
2[C]	4/10/2020	Brennan Mulrooney	0935-0959	Start: 54 °F; wind 5 mph; 100 % cloud cover End: 54 °F; wind 5 mph; 100 % cloud cover
3[a]	4/29/2020	James McMorran	0557-1038	Start: 62 °F; wind 2 mph; 100 % cloud cover End: 65 °F; wind 3 mph; 100 % cloud cover
3[b]	4/30/2020	James McMorran	0636-0707	Start: 64 °F; wind 2 mph; 100 % cloud cover End: 64 °F; wind 2 mph; 100 % cloud cover
4[a]	5/12/2020	Brennan Mulrooney	0602-0838	Start: 53 °F; wind 2 mph; 9 % cloud cover End: 62 °F; wind 2 mph; 16 % cloud cover
4[b]	5/13/2020	Brennan Mulrooney	0609-0923	Start: 60 °F; wind 2 mph; 39 % cloud cover End: 64 °F; wind 3 mph; 48 % cloud cover

°F = degrees Fahrenheit; mph = miles per hour

Appendix E

Revised Belding's Savannah Sparrow Data 2016–2019

Appendix E
Revised Belding's Savannah Sparrow Data 2016–2019

Table E-1. Summary of Revised Belding's Savannah Sparrow Results by Survey Number and Survey Period for the Baseline data (2016–2017)

Month	Survey #		Density (# Individuals/ acre)		Survey Period Averages (Density [Mean # Individuals/acre])			
	2016	2017	2016	2017	Survey Period	2016	2017	2016–2017 Baseline
Mar (early)	-	1	-	4.03	Late Feb to Mid-Mar	-	4.03	4.03
Mar (mid)	-	-	-	-				
Mar (late)	-	-	-	-	Late March to Early Apr	1.76	1.47	1.61
Apr (early)	1	2	1.76	1.47				
Apr (mid)	-	-	-	-	Mid-Apr to Late Apr	1.40	1.49	1.45
Apr (late)	2	3	1.63	1.49				
Apr (late)	3	-	1.18	-				
May (early)	4	-	1.14	-	Early May to Mid-May	1.25	1.47	1.36
May (mid)	5	4	1.78	1.47				
May (mid)	6		0.84	-				
Overall Average (Standard Error)						**1.47 (0.15)**	**2.12 (0.64)**	**2.11 (0.64)**

Table E-2. Summary of Revised Belding's Savannah Sparrow Results by Survey Period, 2018–2019

Survey Period	Survey Period Averages; Density defined as Mean # Individuals/acre	
	2018	**2019**
Late February to Mid-March	2.01	1.57
Late March to Early April	1.64	1.63
Mid- to Late April	1.16	1.70
Early to Mid-May	1.46	1.70
Overall Average (Standard Error)	**1.57 (0.18)**	**1.65 (0.03)**

2021 AVIAN MONITORING REPORT
FOR THE
SAN ELIJO LAGOON RESTORATION PROJECT

Prepared for:

Nature Collective

Prepared by:

AECOM
and
Moffatt & Nichol

June 2022

TABLE OF CONTENTS

Section **Page**

LIST OF APPENDICES

LIST OF FIGURES

Figure **Page**

LIST OF TABLES

Table **Page**

LIST OF ACRONYMS AND ABBREVIATIONS

AOU	American Ornithologists' Union
CDFW	California Department of Fish and Wildlife
CBM	Coastal Brackish Marsh
CI	confidence interval
CSM	Coastal Salt Marsh
I-5	Interstate 5
LCL	lower confidence limit
LFRR	light-footed Ridgway's rail
SELRP	San Elijo Lagoon Restoration Project
UCL	upper confidence limit
USFWS	U.S. Fish and Wildlife Service

This page intentionally left blank.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

San Elijo Lagoon is a coastal wetland formed at the drainage of the Escondido and La Orilla Creeks into the Pacific Ocean and is located in Encinitas, San Diego County, California. The lagoon provides habitat for sensitive, threatened, and endangered plants and animals, including resident and migratory wildlife. The San Elijo Lagoon Ecological Reserve is owned and managed by the California Department of Fish and Wildlife (CDFW), County of San Diego Parks and Recreation Department, and the Nature Collective (formerly the San Elijo Lagoon Conservancy). Lagoon functions became compromised over time, as development and infrastructure constraints have affected the ecosystem and the gradient of habitats within the lagoon (e.g., between unvegetated and vegetated intertidal habitats). The San Elijo Lagoon Restoration Project (SELRP) is an effort to restore lagoon functions and services to the extent practicable given the current constraints of surrounding development and activities.

The SELRP is being implemented by the Nature Collective, San Diego Association of Governments, and California Department of Transportation to enhance and restore the physical and biological functions and services of San Elijo Lagoon by increasing hydraulic efficiency in the lagoon, addressing existing water quality impairments, and halting ongoing conversion of unvegetated wetland habitats to support a more connected gradient of balanced habitat types. Success of the restoration effort is being measured through the implementation of a monitoring program developed in coordination with various permitting and approval agencies, including the California Coastal Commission, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service (USFWS), and Regional Water Quality Control Board.

Construction for the SELRP began in December 2017 and was substantively completed in July 2020 with focused activities continuing to occur in discrete areas of the lagoon. Environmentally sensitive area fence (ESA) installation and vegetation clearing occurred in the central and east basins December 2017 through early March 2018, to avoid the light-footed Ridgway's rail (*Rallus obsoletus levipes*; LFRR) breeding season. Vegetation clearing in the west basin occurred in December 2018. Throughout 2018 and 2019, the overdredge pit was dredged, followed by excavation of channel side slopes and mudflat areas and channel dredging with disposal to the overdredge pit occurred. Grading of transitional areas and the nest site also occurred, along with pedestrian bridge installation, construction of the inlet revetment, trail installation, and planting and irrigation. Demobilization was initiated, with final site cleanup, staging area/access/dike removal, and demobilization completed in mid-2020; some minor remedial grading also occurred within the main channel and nest site to complete the project through late 2020. Planting within restoration areas and substantive construction activities were completed in July 2020, and the 240-working day plant establishment period initiated in June 2020.

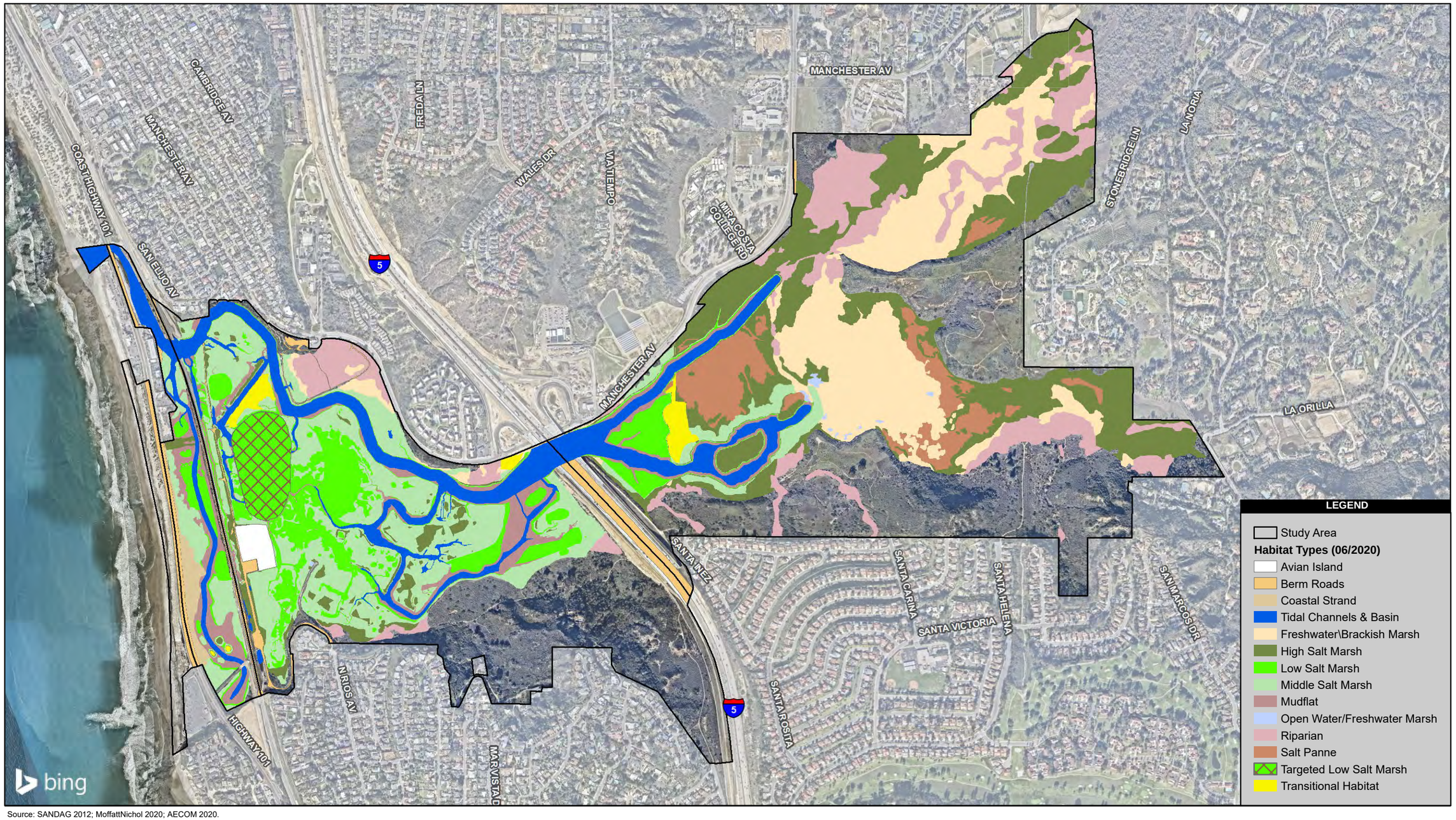
Data collection was designed to assess the responses of select avian taxa to the construction activities and associated changes to the habitat in San Elijo Lagoon. Specifically, data collection periods for avian monitoring were grouped into the following three discrete periods: the "baseline" or "pre-construction period" from 2016 through 2017, a "construction period" from 2018 through July of 2020, and a "post-construction period" starting with August 2020. Because much of the avian monitoring occurs in the spring and was conducted prior to completion of the construction activities in 2020, 2021 represents the first year post-construction for the avian metrics. For the purposes of reporting a 4-year running average herein, the construction and post-construction years have been combined into a "construction/post-construction period" which includes the years 2018 through 2021. These data will provide complementary information related to performance standards and construction/post-construction monitoring results documented as part of the monitoring program as defined in *Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project* (Monitoring Plan) (Nature Collective 2020). Table 1-1 provides a summary of each report associated with work conducted for the SELRP.

Table 1-1. SELRP Report Summary

Report	Description of Report
Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project (Monitoring Plan)	Overarching document that establishes the criteria for determining success (performance standards) of the restoration project for the biological and physical parameters being evaluated.
Wetland Habitat and Hydrology Baseline Monitoring Report for the San Elijo Lagoon Restoration Project (Baseline Monitoring Report)	Document that summarizes data collected during the pre-construction (baseline) period (2016–2017) against which absolute performance standard metrics will be compared.
2018-2019 Avian Monitoring Report for the San Elijo Lagoon Restoration Project (2018-2019 Avian Monitoring Report)	Document that summarizes the avian data collected during the 2018–2019 construction period.
2020 Construction Monitoring Report for the San Elijo Lagoon Restoration Project (2020 Construction Monitoring Report)	Document that summarizes data collected during 2020 and across the 3 construction phase years of 2018–2020.
Annual Reports	Documents that summarize the data collected in each year post-construction, beginning in 2021.

1.2 REPORTING REQUIREMENTS

This report documents the results of avian surveys for the year 2021, which is the first year of data collection for the post-construction period. Data for these annual reports provide a useful reference point for avian survey results relative to the baseline levels reported in the SELRP Baseline Monitoring Report (AECOM 2020a). Results from the contruction and early post-construction years may be informative for adaptive management decisions should the trajectory of avian numbers not be trending towards achieving performance standards, as defined in the Monitoring Plan (Nature Collective 2020).



Source: SANDAG 2012; MoffattNichol 2020; AECOM 2020.

1,100 550 0 1,100 Feet

Scale: 1:13,200; 1 inch = 1,100 feet

Figure 1-1
Proposed Habitat Distribution

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\2021_Avian_Report\Proposed Habitat Distribution_2021_Avian_Report.mxd, 2/7/2022, paul.moreno

This page intentionally left blank.

This 2021 Avian Monitoring Report is based on the framework set forth in Chapter 11 of the SELRP Baseline Monitoring Report (AECOM 2020a). Post-construction annual monitoring include results for these avian survey metrics; the results will identify whether the key variables have met performance standards and whether the project is on a trajectory to meet success requirements. Reports will be submitted to agencies as required and will also identify recommendations for remedial activities or adaptive management strategies that may be required over the year following the reporting period.

This report is framed to be consistent with the Monitoring Plan (Nature Collective 2020) to facilitate reference between documents, including future annual reports. Table 1-2 summarizes the specific variables discussed in this report and the corresponding performance standards for each variable. Per the Monitoring Plan (Nature Collective 2020), annual reports will be completed as needed until year 10 post-construction, after which a final monitoring report will be prepared and submitted. Monitoring and reporting beyond 10 years post-construction for the life of the project (defined as a minimum of 50 years) will be detailed in a Long-Term Management Plan. Detailed methods, including data collection, monitoring frequency, analysis, and performance standards, are discussed in the Monitoring Plan (Nature Collective 2020); specifically, Chapter 12 of that document includes information as it pertains to avian species.

Table 1-2. Avian Variable Summary

Chapter	Variable	Variable Type	Performance Standard
2.1	Breeding Marsh Birds with focus on Light-footed Ridgway's Rail	Pre-Restoration Absolute	Within 95% or greater of pre-construction survey data (2016–2017)
2.2	Western Snowy Plover, California Least Tern, and Waterbird Species	Pre-Restoration Absolute	Within 95% or greater of pre-construction survey data (2016–2017)
2.3	Belding's Savannah Sparrow	Pre-Restoration Absolute	Within 95% or greater of pre-construction survey data (2016–2017)

This page intentionally left blank.

2. BIRDS

2.1 BREEDING MARSH BIRDS

The monitoring of breeding marsh birds is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. Additionally, the specialized surveys required to adequately estimate abundance of secretive marsh bird species are not being conducted at reference wetlands, thereby making comparison impossible. A standardized monitoring protocol (Conway 2011) recommends focused monitoring for the following secretive marsh bird species: LFRR (federally and state endangered), Virginia rail (*Rallus limicola*), least bittern (*Ixobrychus exilis*) (CDFW Species of Special Concern), American bittern (*Botaurus lentiginosus*), common gallinule (*Gallinula galeata*), and pied-billed grebe (*Podilymbus podiceps*).

2.1.1 Performance Standards

Success for breeding marsh birds is measured by comparing project-specific pre-construction data ("baseline data" herein defined as those data collected in 2016 and 2017, as summarized in the SELRP Baseline Monitoring Report [AECOM 2020a]) and construction (herein defined as data collected in 2018–2020)/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Performance standards are included below.

> **Interim standard**: Construction/post-construction 4-year running average density and number of individuals 75% or greater than that of pre-construction survey data (2016–2017) by year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average density and number of individuals 95% or greater than that of pre-construction survey data (2016–2017) by year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan).

2.1.2 Approach

The focus of these surveys is to estimate density and abundance for the federally and state endangered LFRR. The objective of the LFRR surveys is to provide a replicable survey method that can act as a reliable abundance index to monitor for changes in the LFRR population size within San Elijo Lagoon over time. An additional five "focal" marsh bird species that are generally

considered wetland specialists were also recorded, if present: Virginia rail, least bittern, American bittern, common gallinule, and pied-billed grebe. The focal bird species results are intended to provide an index of relative abundance of key marsh bird species other than LFRR. These other focal bird species have utility as indicator species for assessing wetland ecosystem quality (Conway 2011) and their continued presence will be another gauge of project success.

Breeding marsh bird surveys were conducted from March 22 through June 10, 2021. LFRR data were collected within a 200-meter radius of survey points using independent double-observer methods (Nichols et al. 2000). As described in the 2018-2019 Avian Monitoring Report (AECOM 2020b), survey points 9, 10, 11, and 18 were moved slightly because the original locations were no longer accessible without disturbance to enhanced areas after restoration activities were completed in winter 2018–2019. Configuration of the proposed habitat distribution (Figure 1-1) was also slightly modified because the survey points were established in 2016, which further necessitated some minor relocation of survey points. These changes are reflected in figures in this report and in calculations regarding suitable LFRR habitat within the survey area.

2.1.2.1 Light-footed Ridgway's Rail

An independent double-observer survey approach was used for surveys, meaning two ornithologists were present for each survey (Nichols et al. 2000) and the two ornithologists each recorded data independently of the other ornithologist. The double-observer approach allows for estimation of detection probabilities between observers and improves overall detection probabilities to yield more precise estimates of abundance than if a single observer were used. Detection probabilities were estimated from each of the six surveys conducted from mid-March through early June in 2021 to derive LFRR estimates and abundance values. LFRR abundance and the associated 95% upper and lower confidence limits (UCL and LCL, respectively) were calculated separately for each of the six surveys using a closed mark-recapture model (Huggins 1991). Model-averaging was used to generate LFRR estimates and confidence intervals (CIs) for 2016 through 2021 in this report.

Survey Area Density Estimates

Annual LFRR survey area density estimates were calculated by dividing the model-generated estimate of LFRR abundance within the survey area by the total acreage of "preferred" habitat within the survey area for each year. For this analysis, LFRR preferred habitat was considered Coastal Brackish Marsh (CBM), Coastal Salt Marsh – Low (CSM – Low), and Coastal Salt Marsh – Mid (CSM – Mid), based on habitat types described by Oberbauer et al. (2008). These three habitat types most closely resemble the breeding habitat of LFRR as described by Massey et al. (1984) and coincide with habitat types most consistently associated with LFRR presence during surveys. Observations of LFRR in other habitat types that may be considered "suitable" (e.g., Coastal Salt Marsh – High [CSM – High], or others where detection occurred) were generally

restricted to areas immediately adjacent to one of the preferred habitat types. Prior to construction there were approximately 192.5 acres of preferred habitat within the survey area in 2016 and 2017 (Baseline levels). As a result of construction activities, that amount of LFRR preferred habitat within the survey area declined to 149.4 acres in 2018 and to 147.5 acres in 2019. The amount of LFRR preferred habitat within the survey area increased in 2020 to 154.8 acres and increased again in 2021 to 159.3 acres.

Lagoon-wide Abundance Estimates

To estimate the LFRR population size for the entire lagoon (i.e., lagoon-wide abundance estimate), including both surveyed and unsurveyed areas, LFRR density estimates and associated CIs were multiplied by the total acreage of preferred habitat across the entire lagoon. Total preferred habitat acreages are as follows for each respective year: 301.2 acres during the baseline period (2016-2017), 244.1 acres in 2018, 241.2 acres in 2019, 251.1 acres in 2020, and 257.1 acres in 2021.

2.1.2.2 Other Focal Marsh Bird Species

In addition to LFRR, results for five other species of marsh birds are provided as the average number of individuals detected per survey. There was an insufficient number of detections for these other species to generate modeled estimates of abundance. For this reason, raw numbers of detected individuals are presented as an index reflecting relative abundance.

2.1.3 Results

A detailed summary of the survey dates, survey times, survey personnel, and weather conditions is provided in Appendix A.

2.1.3.1 Light-footed Ridgway's Rail

Survey Area Density Estimates

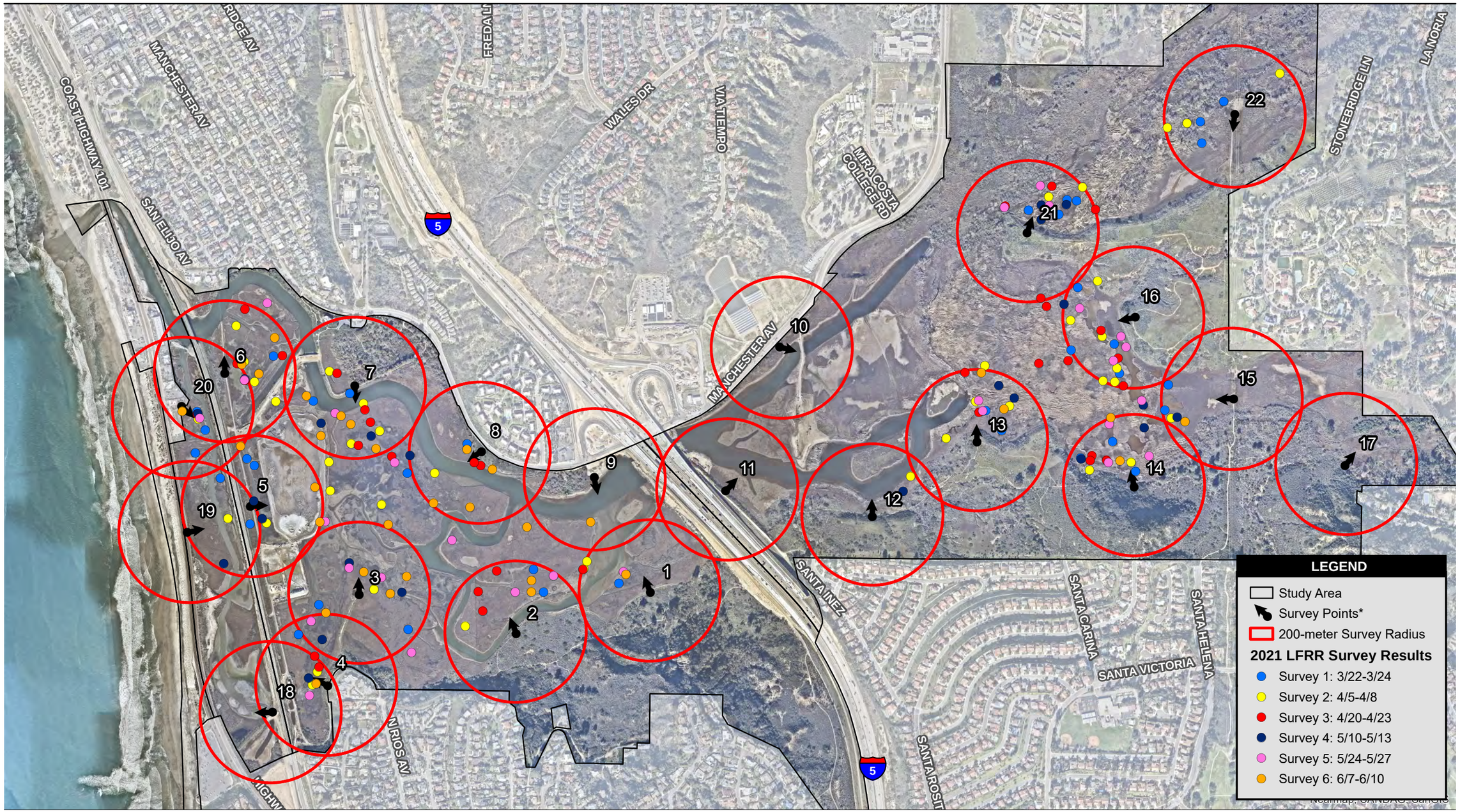
LFRR were detected predominantly in areas dominated by CBM, CSM – Low, and CSM – Mid. Locations of LFRR detections from 2021 surveys are depicted in Figure 2-1. Based on results from the Huggins (1991) model, LFRR survey area density estimates for each of the six surveys conducted in 2021 are presented in Table 2-1 with associated model-generated 95% CIs. Values represent the estimated number of individuals per acre of preferred habitat within the survey area. LFRR density estimates are presented for 2021, the 4-year average of the construction/ post-construction period (2018–2021), as well as the baseline period (2016–2017).

Table 2-1. Summary of Survey Area Density Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Survey Area Density Estimates; # Individuals/Acre		
	2021 Estimate (95% CI)[1]	2018–2021 Construction/Post-construction Estimate[2]	2016–2017 Baseline Estimate[3]
1	0.28 (0.27-0.29)	0.27	0.25
2	0.29 (0.27-0.30)	0.25	0.22
3	0.25 (0.25-0.26)	0.24	0.23
4	0.17 (0.16-0.18)	0.18	0.21
5	0.23 (0.23-0.24)	0.16	0.17
6	0.27 (0.26-0.28)	0.19	0.18
Overall Mean (95% CI)[4]	**0.25 (0.22-0.28)**	**0.21 (0.18 – 0.25)**	**0.21 (0.18 – 0.23)**

[1] Density estimates and 95% confidence intervals (CIs) for Surveys 1 through 6 in 2021 were calculated by dividing the model-generated LFRR abundance estimates (and associated confidence limits) within the survey area by the amount of preferred habitat within the survey area (159.3 acres in 2021).
[2] The six survey-specific density estimates in these columns were calculated as the mean of 2018 through 2021 density estimates and lack model-generated confidence limits.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a).
[4] Overall Mean Estimates in this row for 2021, 2018–2021 combined, and the baseline data were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% CIs calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Survey area density estimates varied considerably among the six surveys conducted in 2021, ranging from a low of 0.17 individuals/acre during Survey 4, to a high of 0.29 individuals/acre during Survey 2 (overall mean=0.25 individuals/acre). LFRR density estimates were highest in the first two surveys, and then dropped during the middle surveys before increasing again later in the season. This pattern occurs in both 2020 and 2021 (Figure 2-2), while prior years (2016–2019) generally showed a decline across the survey period (Baseline Monitoring Report [AECOM 2020a], Figure 2-2). The inter-survey variation in 2021 was significant in many cases, with non-overlapping 95% CIs for most estimates from the different surveys. The overall mean for 2021 was 0.04 individuals/acre higher than the overall means for both the baseline and 4-year construction/post-construction periods (Table 2-1).



Source: SANDAG 2012; MoffattNichol; AECOM General Veg 2015.

900 450 0 900 Feet

Scale: 1:10,800; 1 inch = 900 feet

* arrows depict direction of broadcast call

Figure 2-1
2021 Light-footed Ridgway's Rail Observations

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\LFRR_Species_Survey_Overview_2021.mxd, 3/24/2022, paul.moreno

This page intentionally left blank.

Figure 2-2. Survey Area Estimates of Light-footed Ridgway's Rail Density 2018-2021

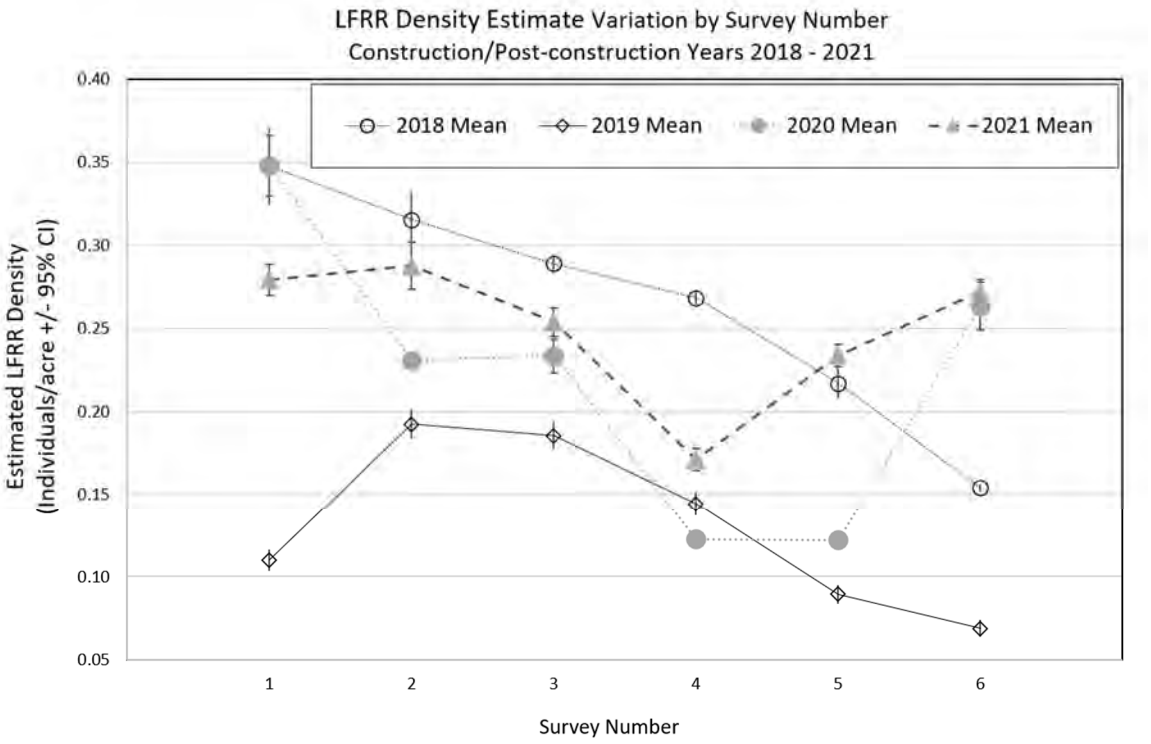


Figure 2-2: Data from 2018–2021, which represent the four construction/post-construction years. Model-generated lower and upper 95% confidence limits (LCL and UCL, respectively) are indicated by vertical lines.

Lagoon-wide Abundance Estimates

The lagoon-wide LFRR abundance estimate in 2021 was 64.19 individuals (95% CI: 55.34–73.03), which was markedly higher than the construction/post-construction mean lagoon-wide abundance estimate of 53.34 individuals (95% CI: 44.58–62.11) and slightly higher than the baseline mean lagoon-wide abundance estimate of 62.98 individuals (95% CI: 55.54–70.42) (Table 2-2). The 2021 lagoon-wide abundance estimate continues the upward trend from the low of 31.77 individuals in 2019 to 52.66 individuals in 2020 and 64.19 individuals in 2021, and is similar to the pre-construction years (2016 and 2017), and the first contruction year (2018) (Figure 2-3).

Table 2-2. Summary of Lagoon-wide Abundance Estimates for the Light-Footed Ridgway's Rail

Survey Number	LFRR Lagoon-wide Abundance Estimates		
	2021 Estimate (95% CI)[1]	2018–2021 Construction/Post-construction Estimate[2]	2016–2017 Baseline Estimate[3]
1	71.79 (69.44-74.15)	66.60	75.06
2	73.97 (70.28-77.66)	63.18	66.38
3	65.25 (63.04-67.47)	59.11	68.79
4	44.02 (42.28-45.76)	43.41	63.13
5	60.14 (58.41-61.88)	40.97	49.91
6	69.94 (68.00-71.89)	46.80	54.60
Overall Mean (95% CI)[4]	**64.19 (55.34-73.03)**	**53.34 (44.58-62.11)**	**62.98 (55.54-70.42)**

[1] Lagoon-wide abundance estimates and 95% confidence intervals (CIs) for Surveys 1 through 6 were calculated by multiplying the model-generated LFRR density estimates for each year/survey (and associated confidence limits) by the amount of suitable preferred habitat across the lagoon that year (see Section 2.1.2 for acreage for each year).
[2] The six survey-specific density estimates in these columns were calculated as the mean of 2018 through 2021 density estimates and lack model-generated confidence limits.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a).
[4]Overall Mean Estimates in this row were calculated as the mean of the six survey-specific estimates. Confidence limits for 95% CIs calculated as mean estimate +/- 1.96 x standard error of the six estimates.

Figure 2-3. Lagoon-wide Abundance Estimates of Light-footed Ridgway's Rails 2016–2021

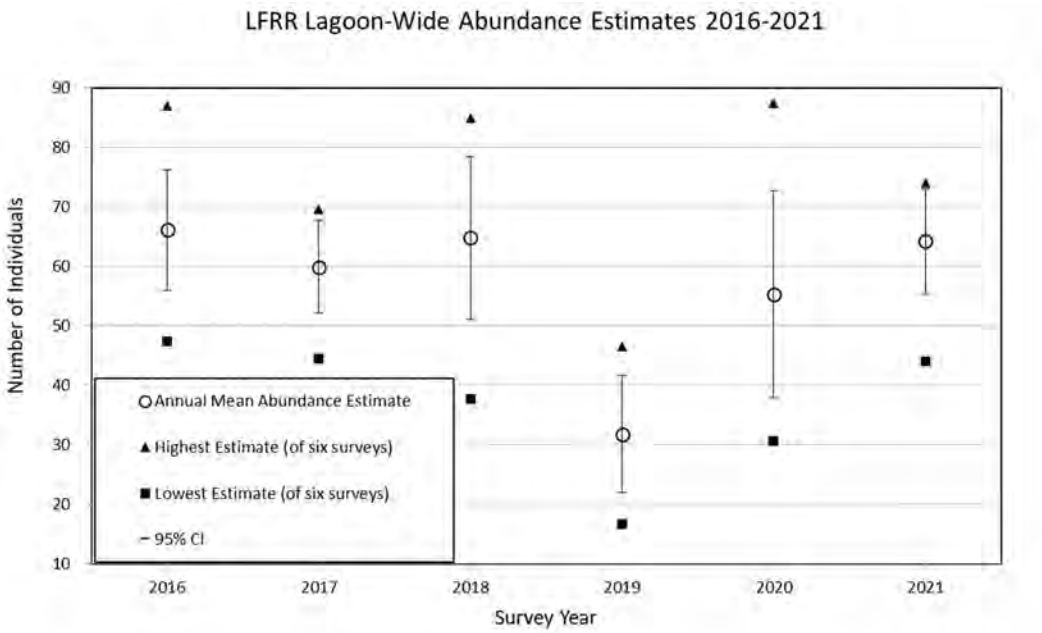


Figure 2-3: Mean abundance estimate for the number of LFRR across the lagoon by year. The first 2 years (2016 and 2017) represent the baseline period and the subsequent 4 years (2018 through 2021) represent the first 4 years of the construction/post-construction period. Lower and Upper confidence limits (LCL and UCL, respectively) are indicated by vertical bars. Triangles and squares reflect mean highest (triangle) and lowest (square) estimates for a survey period.

2.1.3.2 Other Focal Marsh Bird Species

As stated above, the focal marsh bird data represent the number of detections within the survey area and are not adjusted for the amount of suitable habitat or extrapolated to provide an estimate of the lagoon-wide abundance. Detections of focal marsh bird species recorded during survey efforts are included in Table 2-3. On average, Virginia rails were the most commonly detected of the focal marsh bird species during the 2021 surveys, whereas no common gallinules or least bitterns were detected. Aside from Virginia rails, the numbers were relatively low for focal marsh bird species. Pied-billed grebes showed a modest increase in 2021 compared to the previous years, but Virginia rails and both American and least bitterns showed declines in 2021. These declines contributed to an overall average that is lower than both the construction/post-construction period and baseline period (8.67 individuals/survey in 2021 compared to 10.17 individuals/survey and 10.00 individuals/survey for the construction/post-construction and baseline periods, respectively) (Table 2-3).

Table 2-3. Survey Detections of Other Focal Marsh Bird Species

Focal Species		Average Number Detected per Survey (Standard Error)		
Common Name	**Scientific Name**	**2021[1]**	**2018–2021 Construction/ Post-construction[2]**	**2016–2017 Baseline[3]**
Virginia Rail	*Rallus limicola*	5.50 (1.82)	6.58 (1.13)	6.00 (1.41)
Least Bittern	*Ixobrychus exilis*	0.00 (0.00)	0.25 (0.13)	0.33 (0.17)
American Bittern	*Botaurus lentiginosus*	0.83 (0.48)	1.13 (0.28)	0.75 (0.48)
Common Gallinule	*Gallinula galeata*	0.00 (0.00)	0.00 (0.00)	0.08 (0.08)
Pied-billed Grebe	*Podilymbus podiceps*	2.33 (0.42)	2.17 (0.37)	1.75 (0.38)
All Species[4]	**-----**	**8.67 (1.65)**	**10.17 (1.38)**	**10.00 (2.49)**

[1] Mean and standard error for 2021 averages calculated from number of individuals detected during the six surveys.
[2] Averages and standard error values calculated from the 4-year average (2018–2021 "construction/ post-construction period") number of individuals detected during each of the six surveys each year.
[3] 2016 and 2017 baseline averages from SELRP Baseline Monitoring Report (AECOM 2020a)
[4] Values are based on the survey-specific totals (number of individuals of all focal species) detected for surveys 1 through 6 in each year or combination of years.

2.1.4 Discussion

As marsh bird surveys continue to be conducted during the post-construction phase of the project, a new running average will be calculated annually for the 4 most recent years of construction/ post-construction surveys and compared to the baseline abundance levels to evaluate interim and final performance standards as described in the Monitoring Plan (Nature Collective 2020).

Statistical comparisons between the baseline and construction/post-construction period survey results presented above will be made in the annual SELRP monitoring reports.

2.1.4.1 Light-footed Ridgway's Rail

The 2021 LFRR data yielded the second highest survey area density estimate of the 6-year survey period at 0.25 individuals/acre, which is 0.04 individuals/acre higher than both the baseline and the construction/post-construction periods. This density estimate resulted in a lagoon-wide abundance estimate of 64.19 individuals, which was slightly higher than the baseline lagoon-wide abundance estimate of 62.98 individuals. This lagoon-wide abundance estimate is comparable to the baseline value despite the total amount of preferred habitat occupying only 85% of the pre-construction acreage. Similarly, although the average estimated LFRR density for the 2018–2021 construction/post-construction period was the same as that observed during the baseline period of 2016–2017 (0.21 individuals/acre), the lagoon-wide abundance estimate for the construction/post-construction period was lower than the baseline period (53.34 individuals and 62.98 individuals, respectively) due to less total acreage of preferred habitat available during the construction/post-construction period relative to the baseline period. However, the amount of preferred habitat in both the survey area and lagoon-wide increased in 2020 and 2021 relative to the amount present in 2019, and this trend is expected to continue as the restored vegetation establishes and matures.

The relatively high lagoon-wide abundance estimates generated by AECOM for 2021 corroborate data collected by Zembal and Hoffman, in which they reported a record 78 breeding pairs in the lagoon (Zembal and Hoffman 2021). This number is the highest they have recorded at San Elijo Lagoon since Zembal began censusing LFRR at San Elijo Lagoon in 1981. For a number of years, Zembal and colleagues have conducted LFRR surveys within San Elijo Lagoon and other nearby lagoons to provide a census of LFRR numbers throughout San Diego County. These lagoon-wide LFRR censuses tend to be higher than the estimates generated as part of the SELRP breeding marsh bird survey efforts, although it is important to note that the results from the two studies are not directly comparable. Methods in this study were designed to provide metrics of LFRR density and abundance during the breeding season rather than a census of individuals and/or documentation of nesting activity. The average of six surveys is used because it provides a standardized index for comparisons among survey years. This average remains unbiased because surveys are conducted at approximately the same time throughout the year. As illustrated in Figure 2-2, LFRR detections generally decrease over the course of the six survey periods, with the exceptions of 2020 and 2021. The general trend for delining estimates can likely be attributed to differences in detectability of birds throughout the breeding season. For example, LFRR in Southern California have been documented to give "clapper" and "kek" calls less frequently during May and June, after a peak in the early spring (Zembal and Massey 1987). LFRR in Arizona were also shown to be less responsive to playback during May and June compared to March and April (Conway et al. 1993). LFRR may also be more difficult to detect after most pairs have begun incubation, which generally occurs by late April or early May in Southern California (Eddleman and Conway 2018). Although

Zembal and colleagues conduct their surveys from February through June (similar to this study), they try to target peak breeding activity when possible. Despite the lack of direct comparability between this study and Zembal et al.'s work, the catalog of data provided by Zembal and colleagues' monitoring data provides useful background information of the LFRR population at San Elijo Lagoon.

The increase in estimated LFRR numbers in 2020 and 2021 could be the result of a few factors: normal population cycling, recruitment of adults into the lagoon due to available breeding habitat, or increased recruitment of previous years' young due to reduced nest-predation pressure. Predator control efforts from 2018 through 2021 have targeted potential LFRR nest-predators in the lagoon, including racoons, Virgina opossums, and non-native rats, among others. These efforts may have resulted in higher nest and young survival during those years, which could be contributing to higher LFRR estimates.

2.1.4.2 Other Focal Marsh Bird Species

Observations of the other focal species are presented as the average number of individuals per survey for the survey year 2021, as well as the construction/post-construction and baseline periods, as shown in Table 2-3. Due to the low number of detections for each of these species, survey estimates were not corrected for detection probabilities, so the reported numbers probably underestimate true abundance of focal marsh bird species. Thus, abundance estimates are not directly comparable to the modeled abundance estimates of LFRR.

The overall average of 8.67 focal marsh bird individuals/survey in 2021 was a marked decline relative to the construction/post-construction and baseline averages. Virginia rail, American bittern, and least bittern all exhibited declines in 2021, whereas pied-billed grebes showed a slight increase. No common gallinules were detected in 2021 similar to the other constuction/ post-construction years. Despite the low numbers of focal marsh birds for 2021, the construction/post-construction period average remains higher than the baseline period average (10.17 individuals/survey and 10.00 individuals/survey, respectively). Post-construction surveys will continue to monitor numbers of these birds moving forward.

2.2 WATERBIRD SURVEYS, INCLUDING WESTERN SNOWY PLOVER AND CALIFORNIA LEAST TERN

The monitoring of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in the SELRP study area is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. In the process of monitoring waterbirds, these avian surveys generate specific information about western snowy plovers (*Charadrius nivosus nivosus*) and California least terns (*Sternula antillarum browni*).

2.2.1 Performance Standards

Success for western snowy plovers, California least terns, and other waterbird species is measured by comparing project-specific pre-construction data ("baseline data" defined as those data collected in 2016 and 2017, as summarized in the Baseline Monitoring Report [AECOM 2020a]) and construction/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Performance standards are included below.

> **Interim standard**: Construction/post-construction 4-year running average number of individuals 75% or greater than that of pre-construction survey data (2016–2017) by year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average number of individuals 95% or greater than that of pre-construction survey data (2016–2017) by year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan [Nature Collective 2020]).

2.2.2 Approach

Waterbird surveys focused on birds that utilize open water, mudflat, and sand habitat, including western snowy plovers and California least terns. A complete description of survey methodology for waterbird surveys can be found in the Monitoring Plan (Nature Collective 2020). Each survey yielded a census of waterbirds observed in the west, central, and east basins of the lagoon. Abundances of two species, western snowy plover and California least tern, were calculated as the lagoon-wide average of individuals observed per survey by month, as well as the average number observed per survey within each basin. These values were then used to calculate an overall per-survey average for 2021. Observations of other target waterbird species were grouped into specific taxonomic orders and summarized as both the number of individuals in each cohort observed per survey by month for each basin, and an overall per-survey average for 2021. A list of the species associated with each taxonomic order detected during surveys is provided in Appendix B.

Surveys were conducted January through December with one survey conducted per month during January, February, October, November, and December, and at least two surveys conducted per month during March through September. Because California least terns overwinter in Central and South America and breed in Southern California during May and July, results for California least

terns are provided for the months of April through September because the species is generally not present at the lagoon outside of these months.

2.2.3 Results

Survey results are summarized by month in the subsections for western snowy plover, California least tern, and waterbirds. Detailed summaries of the survey dates, survey times, survey personnel, and weather conditions are provided in Appendix C. When multiple surveys were conducted in a month for a given year, the mean number of individuals detected across surveys conducted within that month was calculated. The mean number of individuals detected per survey during each month was then used to evaluate temporal variation in abundance (across seasons and years). These values, along with the baseline data, are presented in Tables 2-4, 2-6, and 2-8.

2.2.3.1 Western Snowy Plover

Survey results for western snowy plovers from 2021, the 4-year average of the construction/ post-construction period (2018–2021), as well as the baseline period (2016–2017) are summarized in Table 2-4. In 2021, western snowy plovers were detected within the lagoon in four of the 19 surveys, with a monthly average of 2.00 individuals/survey. High counts of this species were recorded during both July and December with 15 birds detected in those months. No western snowy plovers were detected in the lagoon from January through June. The mean number of detections per survey in 2021 was higher than the baseline average and the 4-year construction/post-construction average by 1.73 and 0.32 individuals/survey, respectively. The mean number of western snowy plovers detected in each lagoon basin is shown in Table 2-5 and Figure 2-4. In 2021, all western snowy plovers were detected in the central basin.

Table 2-4. Summary of Western Snowy Plover Results by Survey Number and Month

Month	2021 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Waterbird Survey #	# Individuals	2021	2018–2021 Construction/ Post-construction	2016–2017 Baseline
Jan	1	0	0.00	4.50	0.00
Feb	2	0	0.00	0.00	0.00
Mar	3	0	0.00	0.00	0.00
	4	0			
Apr	5	0	0.00	0.00	0.00
	6	0			
May	7	0	0.00	0.00	0.00
	8	0			
Jun	9	0	0.00	0.00	0.00
	10	0			
Jul	11	0	7.50	2.00	0.00
	12	15			
Aug	13	1	0.50	0.38	0.00
	14	0			
Sep	15	2	1.00	1.00	1.25
	16	0			
Oct	17	0	0.00	1.25	2.00
Nov	18	0	0.00	2.75	0.00
Dec	19	15	15.00	8.25	0.00
Overall Average (Standard Error)			**2.00 (1.33)**	**1.68 (0.72)**	**0.27 (0.19)**

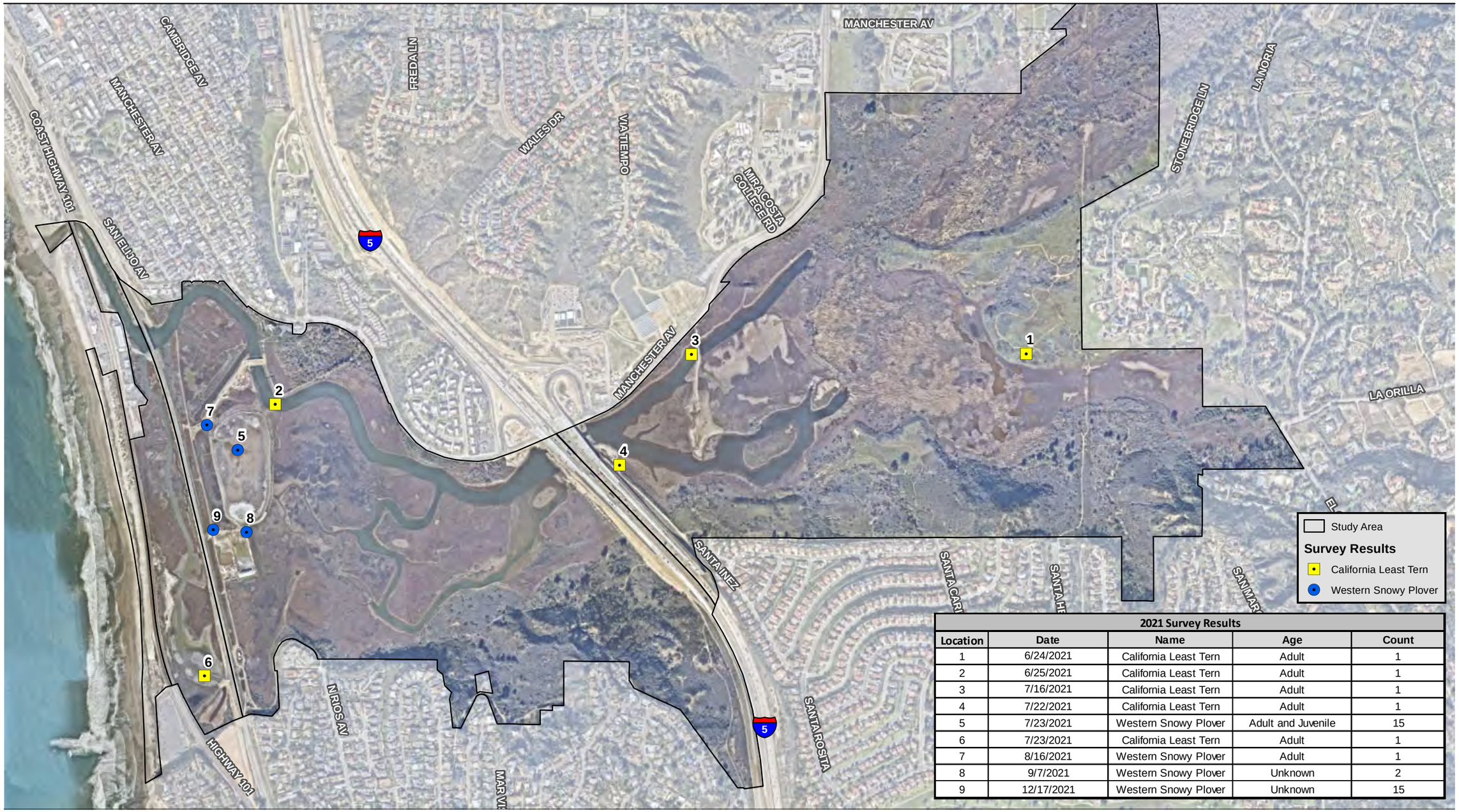
Table 2-5. Mean Number of Western Snowy Plovers/Survey by Lagoon Basin

Lagoon Basin	Mean # Individuals/Survey (Standard Error)
	2021; 19 surveys[1]
Central	2.00 (1.33)
East	0.00 (0.00)
West	0.00 (0.00)

[1] Mean and standard error values for each basin calculated from 12 monthly values (averaged among surveys when multiple surveys conducted in a month).

2.2.3.2 California Least Tern

Survey results for California least terns from 2021, the 4-year average of the construction/ post-construction period (2018–2021), as well as the baseline period (2016–2017) are summarized in Table 2-6. During 2021, California least terns were detected in three of the 12 "California least tern surveys" from April through September; one survey in June and both surveys in July. The number of individuals observed ranged from 1 to 2 birds, and the mean number of birds detected per survey in 2021 was 0.42 individuals. Overall, survey results in 2021 were lower than the baseline average and the 4-year construction/post-construction average by 0.44 and 0.41 individuals/survey, respectively.



2021 Survey Results

Location	Date	Name	Age	Count
1	6/24/2021	California Least Tern	Adult	1
2	6/25/2021	California Least Tern	Adult	1
3	7/16/2021	California Least Tern	Adult	1
4	7/22/2021	California Least Tern	Adult	1
5	7/23/2021	Western Snowy Plover	Adult and Juvenile	15
6	7/23/2021	California Least Tern	Adult	1
7	8/16/2021	Western Snowy Plover	Adult	1
8	9/7/2021	Western Snowy Plover	Unknown	2
9	12/17/2021	Western Snowy Plover	Unknown	15

Source: SANDAG 2012; MoffattNichol 2020; AECOM 2020.

1,000 500 0 1,000 Feet

Scale: 1:12,000; 1 inch = 1000 feet

Figure 2-4
2021 California Least Tern and Western Snowy Plover Survey Results

Path: \\na.aecomnet.com\lfs\AMER\SanDiego-USSDG1\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\2021_Avian_Report\LeastTern_Plover_2021_Survey_Results.mxd, 3/16/2022, daniel.arellano

This page intentionally left blank.

Table 2-6. Summary of California Least Tern Results by Survey Number and Month

Month	2021 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Waterbird Survey #	# Individuals	2021	2018–2021 Construction/ Post-construction	2016–2017 Baseline
Apr	5	0	0.00	0.00	0.00
	6	0			
May	7	0	0.00	0.83	1.40
	8	0			
Jun	9	0	1.00	3.17	3.35
	10	2			
Jul	11	1	1.50	1.83	0.40
	12	2			
Aug	13	0	0.00	0.00	0.00
	14	0			
Sep	15	0	0.00	0.00	0.00
	16	0			
Overall Average (Standard Error)			**0.42 (0.27)**	**0.83 (0.45)**	**0.86 (0.55)**

During 2021 surveys, the species was detected more frequently in the east basin of the lagoon (0.25 individuals/survey) than in the central and west basins (0.08 individuals/survey in both basins) (Table 2-7). When present within the lagoon, individuals were observed engaging in aerial foraging over open water or were actively flying. The locations of California least tern observations from 2021 surveys are displayed in Figure 2-4.

Table 2-7. Mean Number of California Least Terns/Survey by Lagoon Basin

Lagoon Basin	Mean # Individuals/Survey (Standard Error)
	2021; 12 surveys[1]
Central	0.08 (0.08)
East	0.25 (0.17)
West	0.08 (0.08)

[1] Mean and standard error values for each basin calculated from six monthly values (averaged across the two surveys conducted each month).

2.2.3.3 Other Waterbird Species

Waterbird survey results from 2021, the 4-year average of the construction/post-construction period (2018–2021), as well as the baseline period (2016–2017) are summarized in Table 2-8. Averaged across the three lagoon basins, the mean number of waterbirds detected in 2021 was 663.58 individuals/survey. Detections in 2021 were very close to the 4-year construction/post-construction average of 661.19 individuals/survey, and approximately 85% higher than the baseline average of 355.8 individuals/survey.

Taxonomic groups observed within each basin during waterbird surveys are included in Table 2-9. The two orders of birds most frequently observed during waterbird surveys were the Anseriformes (waterfowl) and Charadriiformes (shorebirds, gulls, and terns). In 2021, Anseriformes were detected in the greatest numbers in the east basin (132.58 individuals/survey) and in the lowest numbers in the west basin (13.50 individuals/survey), with intermediate abundances in the central basin (76.00 individuals/survey). Charadriiformes were detected in the greatest numbers in the central basin (272.46 individuals/survey), and at the lowest levels in the east basin (31.42 individuals/survey), with intermediate abundances in the west basin (76.00 individuals/survey).

Overall, waterbird numbers tended to be lower during the spring and summer months because this coincides with the time most migrants are away at breeding grounds farther north, and highest during the fall and winter months, which is consistent with the period of time these birds winter in Southern California.

Table 2-8. Summary of Waterbird Results by Survey Number and Month

Month	2021 Survey Data		Monthly Averages; Mean # Individuals/Survey		
	Waterbird Survey #	# Individuals	2021	2018–2021 Construction/ Post-construction	2016–2017 Baseline
Jan	1	1,284	1,284.0	1,000.5	509.5
Feb	2	1,476	1,476.0	1,111.3	857.0
Mar	3	918	729.5	720.5	458.5
	4	541			
Apr	5	393	349.5	412.9	328.8
	6	306			
May	7	142	143.0	276.6	181.3
	8	144			
Jun	9	95	88.0	158.3	148.9
	10	81			
Jul	11	325	316.0	372.1	154.8
	12	307			
Aug	13	417	446.5	386.0	262.0
	14	476			
Sep	15	550	471.5	476.6	286.8
	16	393			
Oct	17	821	821.0	734.0	186.5
Nov	18	692	692.0	1,002.8	549.8
Dec	19	1,146	1,146.0	1,282.8	682.8
Overall Average (Standard Error)			**663.58 (129.49)**	**661.19 (106.08)**	**355.8 (72.7)**

After the Anseriformes and Charadriiformes, the next most abundant groups were birds in the orders Gruiformes (primarily American coots and LFRR), Pelecaniformes (primarily herons and egrets), and, to a lesser extent, Suliformes (cormorants). In the central and west basins, these three orders were present in roughly similar numbers, with Pelecaniformes being the most abundant; however, in the east basin, Gruiformes were the most abundant. Abundances were lowest in the west basin for all orders except Charadriiformes.

Waterbirds belonging to the taxonomic orders Anseriformes and Charadriiformes comprised more than 90.0% of observations during 2021, although this varied by basin. Together they comprised 93.8% of observations in the central basin, 83.5% of observations in the east basin, and 93.4% of observations in the west basin. Because both groups consist largely of migrant species that overwinter in the area or pass through when traveling between winter and breeding grounds, seasonal variation in overall waterbird numbers are largely driven by differences in the abundance of these two groups throughout the year. The average number of Anseriformes and Charadriiformes detected per survey, across the basins combined, is displayed below for each

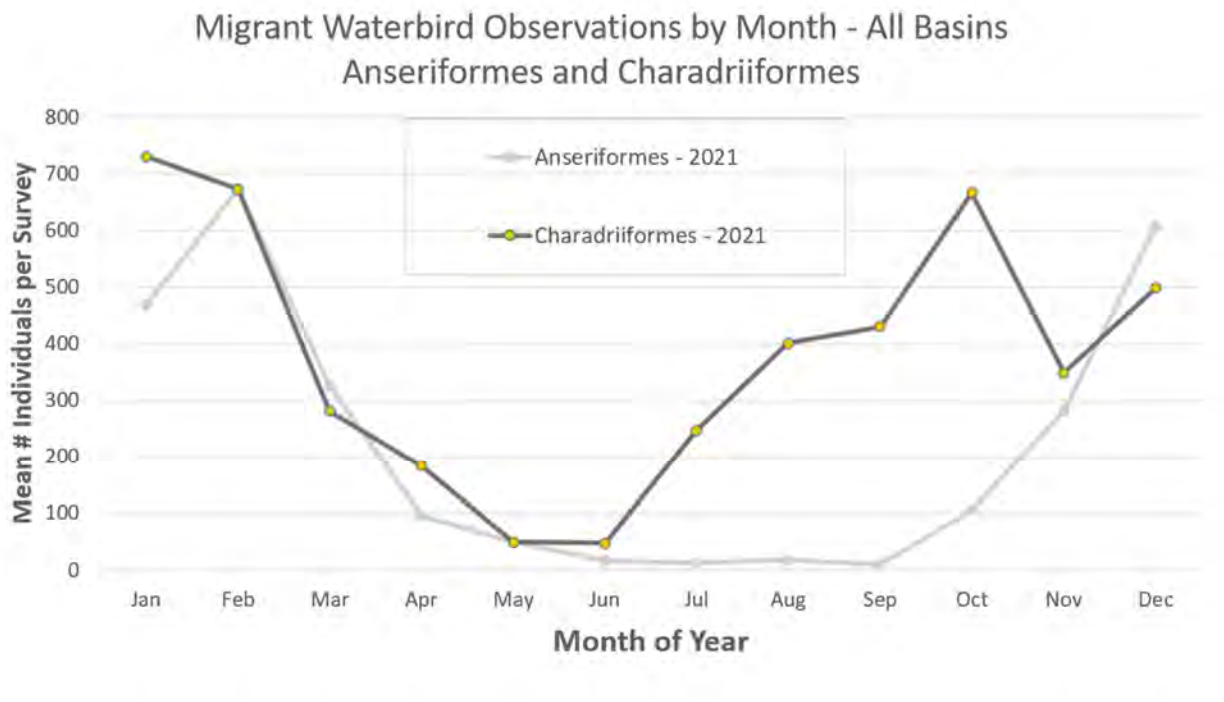
Table 2-9. Summary of Waterbird Results by Taxonomic Group and Lagoon Basin

Lagoon Basin	Taxonomic Order	Mean # of Individuals Detected per Survey (Standard Error)
		2021; 19 surveys[1]
Central	**Total (all species)**	**371.38 (86.72)**
	Anseriformes (Waterfowl)	76.00 (32.11)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	272.46 (61.16)
	Gruiformes (Rails, Coots)	7.38 (3.35)
	Pelecaniformes (Pelicans, Wading birds)	9.92 (1.22)
	Podicipediformes (Grebes)	1.96 (0.51)
	Suliformes (Cormorants)	3.67 (0.86)
East	**Total (all species)**	**196.38 (49.09)**
	Anseriformes (Waterfowl)	132.58 (40.28)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	31.42 (7.74)
	Gruiformes (Rails and Coots)	21.92 (6.18)
	Pelecaniformes (Pelicans and Wading birds)	5.83 (0.75)
	Podicipediformes (Grebes)	3.21 (0.80)
	Suliformes (Cormorants)	1.42 (0.48)
West	**Total (all species)**	**95.83 (19.41)**
	Anseriformes (Waterfowl)	13.50 (5.02)
	Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	76.00 (19.77)
	Gruiformes (Rails and Coots)	0.04 (0.04)
	Pelecaniformes (Pelicans and Wading birds)	4.29 (0.86)
	Podicipediformes (Grebes)	1.08 (0.50)
	Suliformes (Cormorants)	0.92 (0.36)

[1] Mean and standard error values for each basin calculated from 12 monthly values (averaged among surveys when multiple surveys conducted in a month).

month of the year (Figure 2-5). As a group, Anseriformes were present in the lagoon in lower numbers from April through October, while peak numbers were observed during the winter months of December and January (Figure 2-5). Charadriiformes displayed variable peaks in abundance, with high numbers detected in January and February, and again in October and December, while the lowest numbers were documented in May and June (Figure 2-5).

Figure 2-5. Mean Number of Waterfowl, Shorebirds, Gulls, and Terns (2021)



2.2.4 Discussion

Similar to marsh bird surveys, as waterbird surveys continue to be conducted during the post-construction phase of the project, a new running average of western snowy plovers, California least terns, and waterbirds will continue to be calculated annually for the 4 most recent years of construction/post-construction surveys and compared to the baseline abundance levels described herein to evaluate interim and final performance standards as described in the Monitoring Plan (Nature Collective 2020). Statistical comparisons between the baseline and construction/ post-construction period survey data presented above will be made in the annual SELRP monitoring reports.

2.2.4.1 Western Snowy Plover

During 2021, western snowy plovers were observed within the lagoon in modest numbers (Table 2-4). Counts were highest in summer and winter, with two surveys (Surveys 12 and 19) documenting 15 birds each. In 2021, all 33 western snowy plover detections were in the central basin, which represents a change from 2020, in which there were 56 detections in the west basin and only two detections in the central basin (2020 Avian Monitoring Report [AECOM 2022]). Over the course of the project, western snowy plovers have been detected most consistently in the west basin, except for 2017 and 2018 when no western snowy plovers were detected in any basin.

Construction-related dedging activities have resulted in an increase in the amount of open mudflat foraging habitat in the central basin, and it appears that the western snowy plovers have begun utilizing that area for foraging in greater numbers. While this habitat type is abundant and available immediately post-construction, some of this may dissipate over time as restored vegetation takes hold.

The west basin is immediately adjacent to the coastal habitat, which is dominated by open sandy areas and the intertidal zone, and where the species is traditionally most commonly found due to the presence of abundant foraging and roosting habitat. It is important to note that surveys conducted once a month for 5 months and twice a month for 7 months may simply miss bird activity in a given area. To confirm that western snowy plovers were still present in the west basin, eBird records from 2021 were examined, and they indicated that western snowy plovers were still using exposed mudflat habitat in the west basin. As in each prior year, there were no western snowy plover detections in the east basin, which is dominated by vegetative cover and channels, neither of which is preferred by the western snowy plover.

Despite the reduction in western snowy plover detections in 2021 relative to 2020 (33 individuals vs. 58 individuals, respectively) (2020 Avian Monitoring Report [AECOM 2022]), the 2.00 individuals/survey average in 2021 remained higher than the 4-year construction/post-construction average (1.68 individuals/survey), and much higher than the baseline average (0.27 individuals/survey). Western snowy plovers generally favor sandy substrate for foraging, but they will readily forage on mudflats as well. In addition, the establishment of the overdredge pit area at the western end of the central basin has produced habitat that western snowy plovers will forage on and roost on. Trends for western snowy plover habitat usage in the lagoon should become more clear as additional data are collected.

2.2.4.2 California Least Tern

California least terns were present in low numbers during the months of June and July in 2021. Overall, the number of California least tern detections during 2021 was 0.42 individuals/survey which was approximately one-third of the 2020 numbers (1.25 individuals/survey) (2020 Avian Monitoring Report [AECOM 2022]) and identical to the 2019 average (2018-2019 Avian Monitoring Report [AECOM 2020b]). The 2021 average was about half the 4-year construction/ post-construction average, as well as the baseline average (0.83 individuals/survey and 0.86 individuals/survey, respectively). California least terns were observed in all three lagoon basins in 2021, with the highest numbers in the east basin (Table 2-7). During surveys, California least terns were observed engaging in aerial foraging over open water or simply flying over.

California least terns have not been abundant in the lagoon for the past several years. Based on monthly counts conducted at the lagoon 1973–1983, and again from 2002–2017, California least tern numbers were substantially higher 10–20 years ago, with monthly counts as high as 69 and

78 individuals in 2004 and 2007, respectively (Nature Collective 2020). In 2020, 15 California least terns were detected in the lagoon (2020 Avian Monitoring Report [AECOM 2022]), but the 2021 count of five birds is the same as that of 2019 (2018-2019 Avian Monitoring Report [AECOM 2020b]). These data suggest that California least terns are still relatively uncommon lagoon users, and that interannual variation in survey detections may be more reflective of sampling error than actual trends in habitat usage. As with the western snowy plovers, eBird records from 2021 were examined and they corroborated the trends presented herein. Increased tidal flow due to restoration work may improve foraging conditions, and 4 acres of protected sand dunes should provide safe nesting habitat, both of which could bolster California least tern numbers in the lagoon moving forward.

2.2.4.3 Other Waterbird Species

Waterbird surveys were designed to assess the abundance of waterbird species (e.g., seabirds, waterfowl, shorebirds, wading birds) that use open water and mudflat habitats in San Elijo Lagoon. The 2021 survey numbers (663.58 individuals/survey) remained much higher than baseline levels (355.8 individuals/survey), but showed a drop-off relative to 2020 (853.71 individuals/survey) (2020 Avian Monitoring Report [AECOM 2022]) and were very close to the 4-year construction/ post-construction average (661.19 individuals/survey). Six orders of waterbird were recorded in the 2021 surveys with more than 90% of the observations consisting of birds in the orders Anseriformes (waterfowl) and Charadriiformes (shorebirds, gulls, and terns). This distribution is primarily a result of these two orders having more species than the other four orders. Additionally, Anseriformes and Charadriiformes species tend to be gregarious during the non-breeding season, which is when they are most abundant in the lagoon.

The abundance of birds in the different taxonomic orders varied among the three surveyed basins and showed both seasonal and annual variation (Table 2-9 and Figure 2-5). Spatial variation in abundance of waterbirds is most likely driven by differences in habitat between basins relative to the habitat preferences of those groups. Among the three basins, overall waterbird numbers were highest in the central basin, which averaged 371.38 individuals/survey during 2021. Waterbird abundance was intermediate in the central basin (196.38 individuals/survey) and lowest in the west basin (95.83 individuals/survey).

Anseriformes (waterfowl) were detected in the highest numbers in the east basin (132.58 individuals/survey), followed by the central basin (76.00 individuals/survey) and then the west basin with only 13.50 individuals/survey. Anseriformes were also least prevalent in the west basin, comprising 14.1% of waterbird observations there, compared to the east and central basins, where Anseriformes comprised 67.5% and 20.5% of waterbird observations, respectively. Both the central and east basins are larger than the west basin, but the greater prevalence of waterfowl in the east and central basins appears to be driven mainly by the presence of significant areas of open water, which is preferred by waterfowl.

Charadriiformes (shorebirds, gulls, and terns) had the highest numbers in the central basin (272.46 individuals/survey), intermediate numbers in the west basin (76.00 individuals/survey) and the lowest numbers in the east basin (31.42 individuals/survey). Charadriiformes comprised 79.3% of waterbird observations in the west basin, 73.4% of waterbird observations in the central basin, and 16.0% of waterbird observations in the east basin. Shorebirds, which make up a high proportion of the Charadriiformes observations, typically prefer exposed mudflat and open sandy areas for foraging, and these habitats are more common in the west and central basins.

Patterns in the general waterbird data are more complex to interpret than the other datasets involving a single species, such as western snowy plover or California least tern, due to the diversity of species within each group and the variability in the presence of these species across different basins in the lagoon and different seasons of the year. For example, 29 species of birds were observed within the order Charadriiformes, and 21 were observed within the order Anseriformes (Appendix B). The overall waterbird numbers in 2021 were lower than 2020 by approximately 23% (663.58 individuals/survey and 853.71 individual/survey, respectively). These declines were similarly represented in the two most abundant orders, with both Anseriformes and Charadriiformes exhibiting an approximate 20% reduction in 2021 relative to 2020. Despite the lower numbers relative to 2020, the 2021 average was almost identical to the 4-year construction/post-construction average of 661.19 individuals/survey. Restoration activities have improved foraging habitat for both Anseriformes and Charadriiformes in the lagoon. These changes are especially apparent in the central and east basins where dredging of the channels and basins has improved the depth and amount of open water habitat for waterfowl. In addition, dredging activities have improved hydrological function, which in turn has led to more pronounced tidal fluctuations, especially in the east basin, and this has resulted in more foraging habitat for shorebirds at low tide. Moreover, the overdredge pit that was established from dredging activities has been heavily utilized by foraging shorebirds.

Both Anseriformes and Charadriiformes exhibit large seasonal variation in their numbers, with peak levels occuring in the fall and winter months. Charadriiformes begin to increase a bit earlier in the summer than Anseriformes because shorebird migration typically starts earlier than waterfowl migration. Both orders are present in the lagoon in small numbers during the late spring and early summer, but the vast majority of individuals detected during the surveys are those that have come to the lagoon to winter there. Post-construction surveys will continue to monitor numbers of these birds moving forward.

2.3 BELDING'S SAVANNAH SPARROW SURVEYS

The monitoring of Belding's savannah sparrows (*Passerculus sandwichensis beldingi*) is a "pre-restoration absolute" monitoring variable and will not be compared to reference wetlands for purposes of determining success of the SELRP. Additionally, the specialized surveys required to adequately estimate abundance of Belding's savannah sparrows are not being conducted at a

reference wetland, thereby making comparison impossible. Belding's savannah sparrow, a California endangered species, occurs in the salt marsh habitat present in the SELRP area. This species is endemic to the coastal salt marshes of Southern California and northern Baja California (AOU 1983).

2.3.1 Performance Standards

Success for Belding's savannah sparrow is measured by comparing pre-construction data and construction/post-construction data metrics using the "floating alpha" method described in Sections 2.1.2 and 2.2.2 of the Monitoring Plan (Nature Collective 2020). Performance standards are included below.

> **Interim standard**: Construction/post-construction 4-year running average density 75% or greater than that of pre-construction survey data (2016–2017) by year 7 post-construction
>
> **Final standard**: Construction/post-construction 4-year running average density 95% or greater than that of pre-construction survey data (2016–2017) by year 10 post-construction

Running averages are used to account for annual population variability. Standards will not be considered met until performance standards are met for 3 consecutive years (see Section 2.3 of the Monitoring Plan [Nature Collective 2020]).

2.3.2 Approach

The focus of these surveys was to estimate density for the state endangered Belding's savannah sparrow. Baseline surveys (2016 and 2017) were conducted during the breeding season for the species, from April 11 through May 20, 2016 (six surveys) and March 20 through May 19, 2017 (four surveys). In 2018 and 2019, surveys were conducted from February 25 through May 14 (four surveys each year), and in 2020 and 2021, surveys were conducted from March through May (four surveys).

Survey results are summarized according to the following four "survey periods" designed to enable grouping of survey results across four roughly equal time periods and to minimize the effects temporal variation may have on analysis results:

- Late February to Mid-March
- Late March to Early April
- Mid- to Late April
- Early to Mid-May

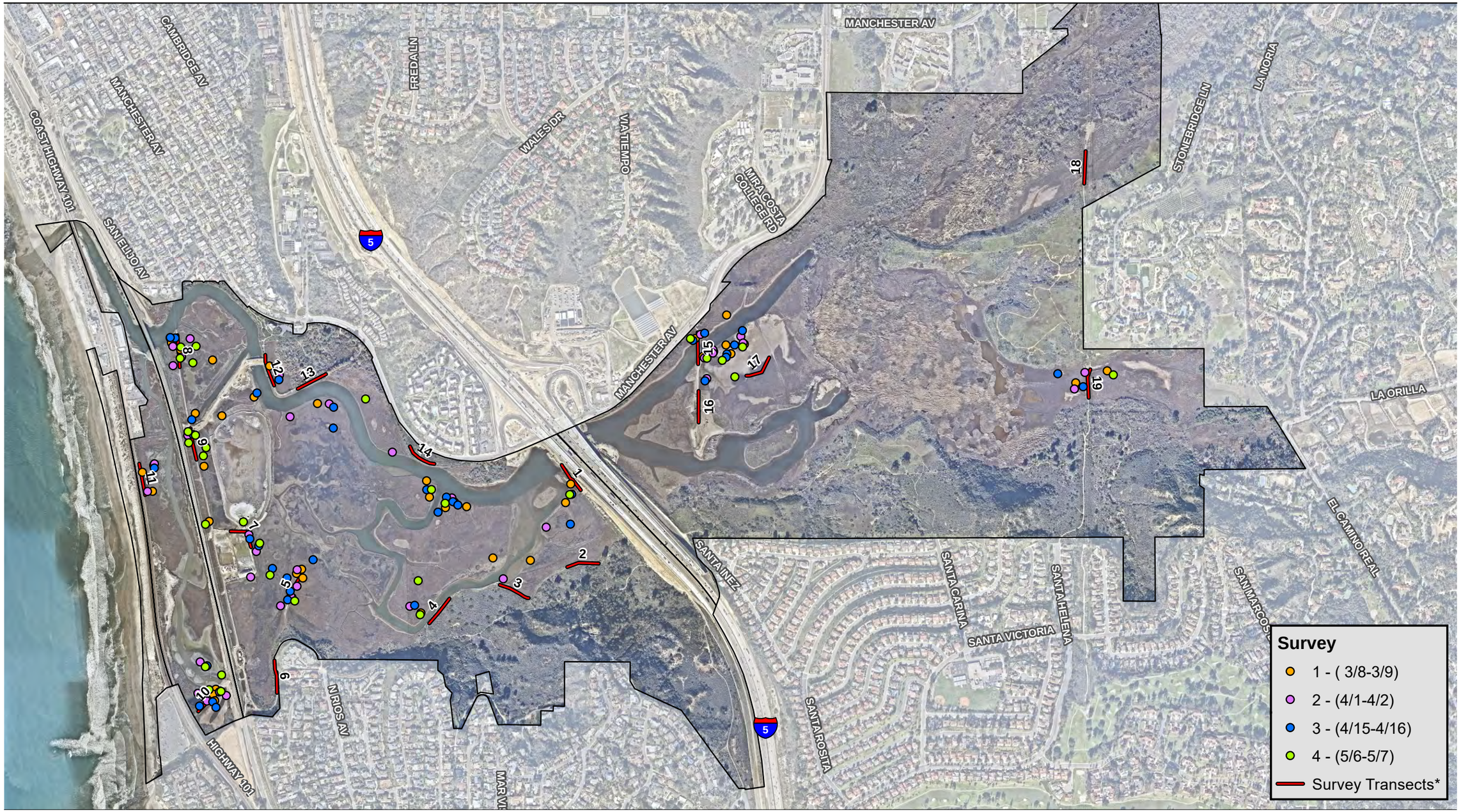
When multiple surveys were conducted in a survey period for a given year, the mean number of individuals detected across surveys was calculated. The mean number of individuals detected per survey during each survey period was then used to evaluate temporal variation in abundance (across seasons and between years), and to calculate the overall average abundance metrics.

Belding's savannah sparrow detections were recorded at all distances from the survey transects measuring 100 meters long located within suitable habitat and spread throughout the lagoon, following methods described in the Monitoring Plan (Nature Collective 2020). Initially, there were 19 transects (i.e., transects 1 through 19), with transects 1 through 4, 6, 9, and 11 through 15 surveyed only on one side due to the lack of sufficient suitable habitat on the other side. Starting in 2019, transects 16 and 17 could no longer be surveyed due to safety issues. Detailed summaries of the survey dates, survey times, survey personnel and weather conditions are provided in Appendix D.

Survey data were analyzed using a distance sampling approach (Buckland et al. 2001), which applied the distances between the observer and each detected bird to control for differences in detectability. Based on results from the distance sampling model approach (Buckland et al. 2001) and data collected in previous years, detections beyond 75 meters perpendicular distance from the transect were omitted from the analysis. An estimate of the density of Belding's savannah sparrow individuals was calculated for each survey as the number of individuals per acre across the survey area as a whole. The model selection process was revised following the 2020 season to better fit the distribution of the data. To ensure appropriate comparisons across years, this change was also applied to the previous years' data, resulting in modest changes to the annual estimates for the baseline and construction year periods (2020 Avian Monitoring Report [AECOM 2022]).

2.3.3 Results

Belding's savannah sparrows were detected during 2021 surveys primarily in areas dominated by CSM – Low, CSM – Mid, and CSM – High, as shown in Figure 2-6. Belding's savannah sparrow density within the survey area was higher in 2021 (0.98 individuals/acre) than the 2020 average (0.66 individuals/acre) (2020 Avian Monitoring Report [AECOM 2022]) but was lower than the 4-year construction/post-construction average from 2018–2021 (1.21 individuals/acre), and was substantially lower than the 2016–2017 baseline average (2.11 individuals/acre) (Table 2-10). In 2021, the density estimates ranged from 0.82 individuals/acre in the fourth survey period (early to mid May) to 1.18 individuals/acre in the second survey period (late March to early April).



Source: SANDAG 2014; MoffattNichol; AECOM 2013

1,000 500 0 1,000 Feet

Scale: 1:12,000; 1 inch = 1000 feet

*Transects 16 and 17 were not surveyed due to inaccessibility post-restoration

Figure 2-6
2021 Belding's Savannah Sparrow Survey Results

Path: L:\DCS\Projects_6058\60582908_SELRP_ConPh2\900-CAD-GIS\920 GIS\map_docs\mxd\Report\Avian_Report\BSSP_Survey_Areas_2021_Survey_Results.mxd, 3/24/2022, paul.moreno

This page intentionally left blank.

Table 2-10. Summary of Belding's Savannah Sparrow Results by Survey Period, 2016–2021

Survey Period	Survey Period Averages; Density defined as Mean # Individuals/acre		
	2021	2018–2021 Construction/ Post-construction	2016–2017 Baseline*
Late February to Mid-March	1.07	1.38	4.03
Late March to Early April	1.18	1.21	1.61
Mid- to Late April	0.87	1.12	1.45
Early to Mid-May	0.82	1.14	1.36
Overall Average (Standard Error)	**0.98 (0.08)**	**1.21 (0.06)**	**2.11 (0.64)**

*Baseline values differ from those reported in the Baseline Report due to revised model selection approach in estimating survey area densities (see Section 2.3.2 and 2020 Avian Monitoring Report [AECOM 2022]).

2.3.4 Discussion

As Belding's savannah sparrow surveys continue to be conducted during the post-construction phase of the project, running averages will continue to be calculated annually for the species' density within the survey area for the 4 most recent years of construction/post-construction surveys and compared to the baseline density levels to evaluate interim and final performance standards as described in the Monitoring Plan (Nature Collective 2020). Statistical comparisons between the baseline and construction/post-construction period survey data presented above will be made in the annual SELRP monitoring reports.

The estimated Belding's savannah sparrow density within the survey area was higher in 2021 than in 2020 (0.98 individuals/acre and 0.66 individuals/acre, respectively) (2020 Avian Monitoring Report [AECOM 2022]), but lower than the 4-year construction/post-construction average of 1.21 individuals/acre and markedly lower than the baseline average of 2.11 individuals/acre. The higher estimated density in the baseline period was heavily driven by one unusually high estimate from the first survey in 2017 (see Baseline Monitoring Report [AECOM 2020a] and 2020 Avian Monitoring Report [AECOM 2022]). Aside from that high count, density estimates for each survey period have fallen between 1.00 and 2.01 individuals/acre with the exception of all survey periods in 2020 and the last two surveys in 2021, when density estimates were lower than 1.00 individuals/acre (AECOM 2020a,b; 2022). The reduced density estimates in 2020 and 2021 likely reflect losses in Belding's savannah sparrow preferred habitat due to channel widening and changes in vegetation composition. However, some areas of mudflat are transitioning to CSM – Low and Belding's savannah sparrow numbers may increase as this transition occurs.

This page intentionally left blank.

3. SUMMARY

Changes in bird abundances or density estimates from the baseline period to the construction/ post-construction period varied by species or group, as shown in Table 3-1 below. Some species/groups have shown increases from baseline to construction/post-construction (e.g., waterbirds), while some have declined (e.g., Belding's savannah sparrow), and others have remained relatively constant (e.g., LFRR and other marsh birds).

Table 3-1. Summary of Bird Estimates during the Baseline Period and the Construction/Post-construction Period

Species	Density/Acre			Lagoon-wide Abundance			Detections/Survey		
	Baseline[1]	Construction/ Post-construction[2]	2021	Baseline[1]	Construction/ Post-construction[2]	2021	Baseline[1]	Construction/ Post-construction[2]	2021
Light-footed Ridgway's Rails*	0.21	0.21	0.25	62.98	53.34	64.19	--	--	--
Other Focal Marsh Birds	--	--	--	--	--	--	10.00	10.17	8.67
Western Snowy Plovers*	--	--	--	--	--	--	0.27	1.68	2.00
California Least Terns*	--	--	--	--	--	--	0.86	0.83	0.42
Waterbirds	--	--	--	--	--	--	355.8	661.19	663.58
Belding's Savannah Sparrows*	2.11	1.21	0.98	--	--	--	--	--	--

[1] Baseline is 2016–2017.
[2] Construction/post-construction period is 2018–2021.
* Species subject to interim and final performance standards based on 4-year running averages equivalent to 75% and 95% of baseline levels by year 7 and year 10, respectively.

LFRR numbers for the construction/post-construction 4-year average are lower than the baseline period, but much of this is a result of the low density and abundance estimates in 2019. The number of LFRR increased in 2020 relative to 2019, and this trend continued in 2021. Potential reasons for this recovery may be increases in native vegetation cover and ongoing predator control efforts. These efforts will continue to be evaluated and adaptively managed, and monitored for their influence in stabilizing the LFRR population post-construction within the lagoon. Some species-level variation occurred among other focal marsh bird species (Table 2-3), but the overall average was similar between the baseline period and construction/post-construction period, with moderately lower numbers in 2021 (Table 3-1).

Western snowy plover numbers in 2021 were higher than both the baseline and the 4-year construction/post-construction averages, although they were lower than the 2020 numbers. The improved foraging conditions and the establishment of the overdredge pit area may lead to more

consistent usage of the lagoon by western snowy plovers moving forward. California least tern numbers also declined in 2021 and were about half of the baseline period and the construction/ post-construction period averages. California least terns have not been common in the lagoon since before the project began, and small changes in detections due to random chance can result in proportionally large variations from year to year. Waterbirds also exhibited a decrease in 2021 compared to 2020, but the 2021 numbers were similar to the 4-year construction/post-construction average, and were much higher than the baseline values. Much of this change from baseline to construction/post-construction was driven by increases in the number of waterfowl (order Anseriformes) and shorebirds (order Charadriiformes). Because the amount of open water increased as part of the proposed habitat distribution, this likely attracted greater numbers of waterfowl to the lagoon especially in the east basin (Table 2-9). Similarly, dredging activities increased the amount of mudflat habitat, as did increased tidal fluctuations due to improved hydrological function, and together these changes likely attracted greater numbers of shorebirds.

Belding's savannah sparrows increased slightly in 2021 compared to 2020, but remained lower than the 4-year construction/post-construction average and the baseline period. The cause of the construction/post-construction decline is unclear but may be related to loss or changes in Belding's savannah sparrow habitat near transects as part of restoration work. It is anticipated that with vegetation establishment following post-restoration activities, preferred habitat by the Belding's savannah sparrow will establish, providing additional areas for foraging and breeding.

4. LIST OF PREPARERS

Table 4-1 includes a list of persons and organizations that participated in the monitoring program and/or preparation of this report.

Table 4-1. List of Preparers

Chapter/Section	Variable	Lead Author	Organization
1 and 2	General Report Preparation	Cindy Kinkade (Project Manager) Michael Anguiano	AECOM
2.1	Breeding Marsh Birds with Focus on Light-footed Ridgway's Rail	Loren Merrill	AECOM
2.2	Western Snowy Plover, California Least Tern, and Waterbird Species	Loren Merrill	AECOM
2.3	Belding's Savannah Sparrow	Loren Merrill	AECOM

This page intentionally left blank.

5. REFERENCES

AECOM. 2020a. *Wetland Habitat and Hydrology Baseline Monitoring Report for the San Elijo Lagoon Restoration Project*. Prepared for the Nature Collective. March.

---------- 2020b. *2018-2019 Avian Monitoring Report for the San Elijo Lagoon Restoration Project*. Prepared for the Nature Collective. September.

---------- 2022. *2020 Avian Monitoring Report for the San Elijo Lagoon Restoration Project*. Prepared for the Nature Collective. June.

American Ornithologists' Union (AOU). 1983. *Check-list of North American Birds*, 6th edition. Allen Press, Inc., Lawrence, Kansas.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. *Introduction to Distance Sampling – Estimating Abundance of Biological Populations*. Oxford University Press, Oxford.

Conway, C. J. 2011. Standardized North American Marsh Bird Monitoring Protocol. *Waterbirds* 34(3):319–346.

Conway, C. J., W. R. Eddleman, S. H. Anderson and L. R. Hanebury. 1993. Seasonal Changes in Yuma Clapper Rail Vocalization Rate and Habitat Use. *Journal of Wildlife Management* 56:282–290.

Eddleman, W. R., and C. J. Conway. 2018. Ridgway's Rail (*Rallus obsoletus*), version 2.1. In *The Birds of North America* (P. G. Rodewald, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA. Available at https://doi.org/10.2173/bna.ridrai1.02.1.

Huggins, R. M. 1991. Some Practical Aspects of a Conditional Likelihood Approach to Capture Experiments. *Biometrics* 47.

Massey, B. W., R. Zembal, and P. D. Jorgensen. 1984. Nesting Habitat of the Light-footed Clapper Rail in Southern California. *Journal of Field Ornithology* 55:67–80.

Nature Collective. 2020. *Wetland Habitat and Hydrology Monitoring Plan for the San Elijo Lagoon Restoration Project*. Prepared by AECOM, Nordby Biological Consulting, and Moffatt & Nichol.

Nichols, J. D., J. E. Hines, J. R. Sauer, F. W. Fallon, J. E. Fallon, and P. J. Heglund. 2000. A Double-Observer Approach for Estimating Detection Probability and Abundance from Point Counts. *Auk* 117:393–408.

Oberbauer, T., M. Kelly, and J. Buegge. March 2008. *Draft Vegetation Communities of San Diego County*. Based on "Preliminary Descriptions of the Terrestrial Natural Communities of California," Robert F. Holland, Ph.D., October 1986.

U.S. Fish and Wildlife Service (USFWS). 2017. Formal Section 7 Consultation for the San Elijo Lagoon Restoration Project, San Diego County, California.

Zembal, R., and S. M. Hoffman. 2021. *Light-footed Ridgway's (Clapper) Rail in California, 2021 Season*. Final Report to US Fish and Wildlife Service and California Department of Fish and Wildlife. 32 pp.

Zembal, R., and B. W. Massey. 1987. Seasonality of Vocalizations by Light-footed Clapper Rails. *Journal of Field Ornithology* 58:41–48.

Appendix A

2021 Marsh Bird Surveys and Weather

Appendix A – 2021 Marsh Bird Surveys and Weather

Table A-1. Weather Conditions and Survey Times for Each AM and PM Marsh Bird Survey[1]

Survey Number	Date	AM/PM Survey Session	Time	Average Temperature (ºF)	Average Sky Condition Rating[2]	Average Wind Speed (mph)	Average Background Noise Rating[3]
1	3/22/2021	AM	06:15 - 07:59	50.0	0.0	0.0	1.0
		PM	17:24 - 18:16	62.0	0.0	2.7	1.0
	3/23/2021	AM	06:17 - 07:44	57.0	2.0	1.6	2.6
		PM	18:15 - 19:00	62.7	1.0	1.0	1.3
	3/24/2021	AM	06:21 - 07:30	50.0	0.0	1.0	1.3
	3/25/2021	AM	06:30 - 07:42	52.0	2.0	1.8	1.0
2	4/5/2021	AM	06:10 - 07:50	59.3	2.0	0.0	1.0
		PM	17:34 - 18:36	60.3	1.7	2.7	1.0
	4/6/2021	AM	06:02 - 07:34	54.8	0.4	0.2	1.8
		PM	18:35 - 19:19	61.0	1.7	1.0	2.0
	4/7/2021	AM	06:02 - 07:05	52.0	0.7	1.0	1.3
	4/8/2021	AM	06:08 - 07:23	55.0	2.0	2.0	1.0
3	4/20/2021	AM	05:45 - 07:36	59.8	2.0	0.8	0.8
		PM	17:39 - 18:28	65.0	0.0	2.0	1.3
	4/21/2021	AM	05:49 - 07:22	59.0	2.0	2.0	2.4
		PM	17:46 - 18:29	58.0	2.0	1.3	1.0
	4/22/2021	AM	05:50 - 06:50	55.3	2.0	0.7	1.3
	4/23/2021	AM	05:48 - 06:59	58.5	2.0	1.0	1.0
4	5/10/2021	AM	05:44 - 07:05	61.5	1.0	1.0	1.0
		PM	18:06 - 18:59	65.0	0.0	1.7	1.0
	5/11/2021	AM	05:30 - 06:48	59.0	1.0	1.0	2.8
	5/12/2021	AM	05:27 - 06:17	62.0	2.0	0.0	1.3
		PM	17:40 - 18:20	67.0	2.0	2.0	1.7
	5/13/2021	AM	05:20 - 06:25	65.0	2.0	1.8	1.0
5	5/24/2021	AM	05:26 - 06:52	52.0	0.0	0.0	0.5
		PM	17:48 - 18:41	66.3	0.0	2.3	1.3
	5/25/2021	AM	05:22 - 06:41	59.2	3.2	0.6	2.6
		PM	17:50 - 18:30	73.3	0.0	1.0	2.0
	5/26/2021	AM	05:23 - 06:21	59.0	1.0	0.3	1.3
	5/27/2021	AM	05:26 - 06:31	60.5	2.0	0.0	1.0
6	6/7/2021	AM	05:18 - 06:37	63.0	2.0	0.0	1.0
		PM	18:03 - 18:47	63.0	2.0	2.0	1.0
	6/8/2021	AM	05:07 - 06:42	61.4	1.0	0.0	2.2
		PM	17:47 - 18:28	69.7	0.0	2.0	1.7
	6/9/2021	AM	05:09 - 06:05	58.3	1.0	0.7	1.7
	6/10/2021	AM	05:11 - 06:18	52.5	1.0	2.0	1.3

°F = degrees Fahrenheit; mph = miles per hour

[1] Surveys were conducted by the same four ornithologists: Ian Maunsell (TE 42833A-3, Blackhawk Environmental [Blackhawk]); Antonette Gutierrez (TE-50992B-0, Blackhawk); James McMorran (AECOM); and Ryan Quilley (Blackhawk).

[2] Sky Condition Ratings: 0 = clear or a few clouds; 1 = partly cloudy or variable sky; 2 = cloudy or overcast; 3 = fog; 4 = drizzle

[3] Background Noise Ratings: 0 = no noise; 1 = faint noise; 2 = moderate noise (probably can't hear some birds beyond 100 meters); 3 = loud noise (probably can't hear some birds beyond 50 meters); 4 = intense noise (probably can't hear some birds beyond 25 meters)

Appendix B

2021 Waterbird Surveys Species List

Appendix B – 2021 Waterbird Surveys Species List

Table B-1. List of Bird Species Observed during 2021 Waterbird Surveys, Sorted by Taxonomic Order

Order	Common Name	Scientific Name
Anseriformes (Waterfowl)	American Wigeon	*Mareca americana*
	Blue-winged Teal	*Spatula discors*
	Brant	*Branta bernicla*
	Bufflehead	*Bucephala albeola*
	Canada Goose	*Branta canadensis*
	Canvasback	*Aythya valisineria*
	Cinnamon Teal	*Spatula cyanoptera*
	Common Goldeneye	*Bucephala clangula*
	Eurasian Wigeon	*Mareca penelope*
	Gadwall	*Mareca strepera*
	Greater Scaup	*Aythya marila*
	Green-winged Teal	*Anas crecca*
	Hooded Merganser	*Lophodytes cucullatus*
	Lesser Scaup	*Aythya affinis*
	Mallard	*Anas platyrhynchos*
	Northern Pintail	*Anas acuta*
	Northern Shoveler	*Spatula clypeata*
	Red-breasted Merganser	*Mergus serrator*
	Redhead	*Aythya americana*
	Ruddy Duck	*Oxyura jamaicensis*
Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	American Avocet	*Recurvirostra americana*
	Black-bellied Plover	*Pluvialis squatarola*
	Black-necked Stilt	*Himantopus mexicanus*
	Bonaparte's Gull	*Chroicocephalus philadelphia*
	California Gull	*Larus californicus*
	California Least Tern	*Sternula antillarum browni*
	Caspian Tern	*Hydroprogne caspia*
	Dowitcher sp.	*Limnodromus* spp.
	Dunlin	*Calidris alpina*
	Forster's Tern	*Sterna forsteri*
	Greater Yellowlegs	*Tringa melanoleuca*
	Killdeer	*Charadrius vociferus*
	Least Sandpiper	*Calidris minutilla*
	Long-billed Curlew	*Numenius americanus*
	Long-billed Dowitcher	*Limnodromus scolopaceus*
	Marbled Godwit	*Limosa fedoa*
	Red-necked Phalarope	*Phalaropus lobatus*

Order	Common Name	Scientific Name
Charadriiformes (Shorebirds, Sandpipers, Gulls, Terns)	Ring-billed Gull	*Larus delawarensis*
	Royal Tern	*Thalasseus maximus*
	Ruddy Turnstone	*Arenaria interpres*
	Semipalmated Plover	*Charadrius semipalmatus*
	Short-billed Dowitcher	*Limnodromus griseus*
	Spotted Sandpiper	*Actitis macularius*
	Western Gull	*Larus occidentalis*
	Western Sandpiper	*Calidris mauri*
	Western Snowy Plover	*Charadrius nivosus*
	Whimbrel	*Numenius phaeopus*
	Willet	*Tringa semipalmata*
	Wilson's Phalarope	*Phalaropus tricolor*
	Wilson's Snipe	*Gallinago delicata*
Gruiformes (Rails, Coots, Gallinules)	American Coot	*Fulica americana*
	Light-footed Ridgway's Rail	*Rallus obsoletus levipes*
	Sora	*Porzana carolina*
	Virginia Rail	*Rallus limicola*
Pelecaniformes (Pelicans, Wading birds)	American Bittern	*Botaurus lentiginosus*
	Black-crowned Night-Heron	*Nycticorax nycticorax*
	Great Blue Heron	*Ardea herodias*
	Great Egret	*Ardea alba*
	Green Heron	*Butorides virescens*
	Reddish Egret	*Egretta rufescens*
	Snowy Egret	*Egretta thula*
	White-faced Ibis	*Plegadis chihi*
Podicipediformes (Grebes)	Clark's Grebe	*Aechmophorus clarkii*
	Eared Grebe	*Podiceps nigricollis*
	Pied-billed Grebe	*Podilymbus podiceps*
Suliformes (Cormorants)	Double-crested Cormorant	*Phalacrocorax auritus*

Appendix C

2021 Waterbird Surveys and Weather

Appendix C – 2021 Waterbird Surveys and Weather

Table C-1: Waterbird Surveys (2021) Survey Dates and Personnel

Survey Number	Date	Survey Personnel	Start Time	End Time
1	1/14/2021	Brennan Mulrooney, James McMorran	07:04 AM	11:34 AM
1	1/14/2021	James McMorran, Brennan Mulrooney	08:57 AM	01:02 PM
1	1/15/2021	James McMorran, Brennan Mulrooney	07:05 AM	01:08 PM
2	2/16/2021	James McMorran, Heather Hughes	07:30 AM	02:30 PM
2	2/16/2021	James McMorran, Heather Hughes	11:01 AM	12:46 PM
2	2/17/2021	James McMorran, Heather Hughes	07:05 AM	01:20 PM
3	3/11/2021	James McMorran, Heather Hughes	06:30 AM	01:30 PM
3	3/11/2021	James McMorran, Heather Hughes	09:22 AM	11:35 AM
3	3/12/2021	James McMorran, Heather Hughes	06:45 AM	12:37 PM
4	3/29/2021	James McMorran, Heather Hughes	07:04 AM	12:33 PM
4	3/30/2021	James McMorran, Heather Hughes	08:13 AM	01:04 PM
4	3/30/2021	James McMorran, Heather Hughes	10:10 AM	11:59 AM
5	4/12/2021	James McMorran	07:03 AM	01:42 PM
5	4/13/2021	James McMorran	09:42 AM	11:36 AM
5	4/13/2021	James McMorran	09:08 AM	02:06 PM
6	4/28/2021	James McMorran	08:30 AM	01:38 PM
6	4/28/2021	James McMorran	08:57 AM	10:30 AM
6	4/29/2021	James McMorran, Dawn Bailey	06:28 AM	01:07 PM
7	5/17/2021	James McMorran, Heather Hughes	08:42 AM	01:37 PM
7	5/18/2021	James McMorran	08:54 AM	11:01 AM
7	5/18/2021	James McMorran, Heather Hughes	08:30 AM	12:38 PM
8	5/27/2021	James McMorran, Heather Hughes	07:02 AM	09:37 AM
8	5/27/2021	Heather Hughes, James McMorran	05:25 AM	12:35 PM
8	5/28/2021	James McMorran, Heather Hughes	08:01 AM	12:28 PM
9	6/14/2021	James McMorran	07:04 AM	12:48 PM
9	6/15/2021	James McMorran	09:22 AM	10:52 AM
9	6/15/2021	James McMorran	08:17 AM	02:34 PM
10	6/24/2021	Heather Hughes	10:28 AM	11:57 AM
10	6/25/2021	Heather Hughes, Ayoola Folarin	12:11 PM	01:45 PM
10	6/25/2021	Heather Hughes, Ayoola Folarin	11:04 AM	01:39 PM
11	7/15/2021	James McMorran	08:41 AM	02:50 PM
11	7/15/2021	James McMorran	10:40 AM	12:49 PM
11	7/16/2021	James McMorran	08:08 AM	12:52 PM
12	7/22/2021	Heather Hughes	09:45 AM	01:15 PM
12	7/23/2021	James McMorran	06:16 AM	12:42 PM

Survey Number	Date	Survey Personnel	Start Time	End Time
12	7/23/2021	James McMorran	07:01 AM	08:45 AM
13	8/16/2021	James McMorran, Heather Hughes	06:23 AM	12:47 PM
13	8/16/2021	James McMorran	07:20 AM	09:19 AM
13	8/17/2021	James McMorran	07:41 AM	01:58 PM
14	8/26/2021	James McMorran	08:37 AM	10:34 AM
14	8/26/2021	James McMorran	06:55 AM	01:02 PM
14	8/27/2021	James McMorran	06:24 AM	12:38 PM
15	9/7/2021	James McMorran, Heather Hughes	09:14 AM	11:37 AM
15	9/7/2021	James McMorran, Heather Hughes	07:43 AM	01:09 PM
15	9/8/2021	Emma Fraser, Madeline Bailey	06:54 AM	10:00 AM
16	9/22/2021	James McMorran, Heather Hughes	07:34 AM	12:42 PM
16	9/24/2021	James McMorran, Madeline Bailey	07:42 AM	10:11 AM
16	9/24/2021	James McMorran, Madeline Bailey	08:00 AM	01:00 PM
17	10/14/2021	James McMorran, Heather Hughes	07:13 AM	12:45 PM
17	10/15/2021	James McMorran	07:05 AM	03:16 PM
17	10/15/2021	James McMorran, Heather Hughes	07:41 AM	09:41 AM
18	11/18/2021	James McMorran, Madeline Bailey	06:24 AM	02:13 PM
18	11/19/2021	James McMorran, Ayoola Folarin	06:24 AM	11:02 AM
18	11/19/2021	James McMorran, Ayoola Folarin	07:45 AM	09:51 AM
19	12/16/2021	James McMorran	06:43 AM	11:16 AM
19	12/17/2021	James McMorran, Ayoola Folarin	06:34 AM	01:15 PM
19	12/17/2021	James McMorran, Ayoola Folarin	08:24 AM	09:36 AM

Table C-2: Waterbird Surveys (2021) Weather Conditions

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
1	01/14/2021	08:05:10 AM	Sunny	50	5	2.1
1	01/14/2021	08:58:47 AM	Mostly sunny	58	16	1.7
1	01/14/2021	01:02:36 PM	Sunny	75	3	3.3
1	01/14/2021	02:34:16 PM	Sunny	70	0	3
1	01/15/2021	08:06:04 AM	Mostly sunny	63	11	3.2
1	01/15/2021	11:10:09 AM	Sunny	69	6	4.8
2	02/16/2021	09:22:57 AM	Cloudy	55	91	2.8
2	02/16/2021	11:37:56 AM	Partly sunny	59	39	4.4
2	02/16/2021	12:10:30 PM	Partly sunny	59	44	5
2	02/16/2021	12:33:37 PM	Mostly cloudy	60	76	5.5
2	02/17/2021	07:47:55 AM	Mostly cloudy	47	77	2.2
2	02/17/2021	02:31:58 PM	Partly sunny	63	35	10.4

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
3	03/11/2021	07:36:25 AM	Mostly cloudy	46	88	2.2
3	03/11/2021	09:41:22 AM	Mostly cloudy	51	88	2.8
3	03/11/2021	10:43:34 AM	Mostly cloudy	54	76	2.4
3	03/11/2021	11:00:07 AM	Mostly cloudy	54	76	2.7
3	03/12/2021	07:09:17 AM	Cloudy	43	99	1.6
3	03/12/2021	10:26:24 AM	Mostly cloudy	53	76	2.9
4	03/29/2021	08:08:55 AM	Mostly sunny	48	28	1.7
4	03/29/2021	05:16:17 PM	Mostly sunny	62	5	3
4	03/30/2021	09:24:10 AM	Partly sunny	57	49	2.4
4	03/30/2021	10:11:09 AM	Mostly sunny	62	26	2.3
4	03/30/2021	11:27:03 AM	Sunny	63	9	3.8
4	03/30/2021	12:04:50 PM	Sunny	61	6	4.4
5	04/12/2021	08:04:27 AM	Cloudy	57	100	2.2
5	04/12/2021	01:41:20 PM	Mostly cloudy	64	76	4.9
5	04/13/2021	09:09:02 AM	Cloudy	58	99	3.1
5	04/13/2021	10:17:07 AM	Cloudy	59	95	5.5
5	04/13/2021	11:36:32 AM	Cloudy	56	100	3.3
5	04/13/2021	02:07:11 PM	Overcast	59	100	5
6	04/28/2021	08:31:45 AM	Sunny	56	0	1.2
6	04/28/2021	08:58:22 AM	Sunny	58	0	1.8
6	04/28/2021	09:14:31 AM	Sunny	61	0	1.8
6	04/28/2021	01:22:34 PM	Sunny	68	4	5.6
6	04/29/2021	07:07:26 AM	Sunny	49	0	2.2
6	04/29/2021	01:08:11 PM	Sunny	78	0	5
7	05/17/2021	10:16:00 AM	Cloudy	59	100	2.2
7	05/18/2021	08:33:43 AM	Cloudy	60	100	1.8
7	05/18/2021	09:20:44 AM	Cloudy	60	100	2.4
7	05/18/2021	09:46:19 AM	Sunny	63	23	2.9
7	05/18/2021	12:19:58 PM	Cloudy	63	95	4.4
7	05/18/2021	12:36:35 PM	Sunny	69	35	3
8	05/27/2021	05:14:21 AM	Cloudy	57	100	1.1
8	05/27/2021	07:03:26 AM	Cloudy	58	99	1.2
8	05/27/2021	09:37:38 AM	Mostly cloudy	63	76	1.8
8	05/27/2021	12:35:30 PM	Mostly sunny	67	25	9.2
8	05/28/2021	08:10:03 AM	Cloudy	62	100	1.3
8	05/28/2021	02:28:58 PM	Sunny	68	4	5.5
9	06/14/2021	09:05:12 AM	Mostly cloudy	65	76	1.7
9	06/14/2021	06:34:01 PM	Mostly sunny	70	17	4.2
9	06/15/2021	08:18:36 AM	Mostly cloudy	61	76	1.7

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
9	06/15/2021	09:22:24 AM	Mostly cloudy	65	78	1.7
9	06/15/2021	11:03:23 AM	Mostly cloudy	65	82	2.2
9	06/15/2021	04:12:03 PM	Sunny	77	5	4.9
10	06/24/2021	10:29:00 AM	Cloudy	64	98	3.5
10	06/24/2021	11:57:51 AM	Partly sunny	68	44	4.5
10	06/25/2021	11:05:12 AM	Partly sunny	65	42	3.2
10	06/25/2021	12:12:42 PM	Mostly sunny	67	12	4
10	06/25/2021	01:39:16 PM	Mostly sunny	68	18	5.4
10	06/25/2021	01:40:13 PM	Mostly sunny	68	13	5.4
11	07/15/2021	08:41:52 AM	Mostly cloudy	70	77	1.8
11	07/15/2021	10:42:37 AM	Mostly sunny	71	30	3.4
11	07/15/2021	11:42:28 AM	Mostly sunny	74	15	4.3
11	07/15/2021	08:00:07 PM	Partly cloudy	74	30	5
11	07/16/2021	08:09:20 AM	Mostly sunny	68	13	1.1
11	07/16/2021	12:52:37 PM	Sunny	76	3	5.4
12	07/22/2021	10:13:14 AM	Cloudy	72	99	3.9
12	07/22/2021	11:23:52 AM	Mostly sunny	72	18	4.5
12	07/23/2021	06:17:07 AM	Cloudy	64	97	1.1
12	07/23/2021	07:02:24 AM	Mostly cloudy	65	85	1.1
12	07/23/2021	08:45:29 AM	Cloudy	67	99	1.2
12	07/23/2021	12:42:52 PM	Mostly cloudy	74	76	4.9
13	08/16/2021	07:03:49 AM	Mostly sunny	66	20	1.2
13	08/16/2021	07:22:02 AM	Mostly sunny	67	26	1.2
13	08/16/2021	09:19:50 AM	Mostly sunny	71	12	1.8
13	08/16/2021	06:49:39 PM	Mostly Sunny	76	12	4.2
13	08/17/2021	08:27:36 AM	Cloudy	72	100	1.7
13	08/18/2021	06:23:38 AM	Partly cloudy	77	26	5.1
14	08/26/2021	08:26:39 AM	Mostly sunny	67	18	1.8
14	08/26/2021	08:37:48 AM	Sunny	68	8	1.3
14	08/26/2021	10:34:43 AM	Sunny	74	4	2.9
14	08/26/2021	02:44:04 PM	Sunny	78	0	6
14	08/27/2021	07:29:35 AM	Fog	63	20	1.2
14	08/27/2021	02:34:35 PM	Sunny	76	5	5.4
15	09/07/2021	09:17:02 AM	Cloudy	69	100	1.3
15	09/07/2021	09:49:52 AM	Cloudy	70	100	1.2
15	09/07/2021	11:37:09 AM	Mostly cloudy	73	76	2.3
15	09/07/2021	11:05:10 AM	Partly cloudy	77	25	4.1
15	09/08/2021	06:55:55 AM	Cloudy	67	99	1.1
15	09/08/2021	09:27:30 AM	Mostly sunny	72	29	1.7

Survey Number	Date	Time	Weather Summary	Temp. (°F)	Cloud Cover (%)	Average Wind Speed (mph)
16	09/22/2021	09:09:34 AM	Sunny	70	0	1.9
16	09/22/2021	08:22:01 PM	Sunny	75	2	3
16	09/24/2021	08:47:27 AM	Cloudy	65	94	1.3
16	09/24/2021	08:55:25 AM	Mostly cloudy	65	90	1.3
16	09/24/2021	10:10:44 AM	Mostly cloudy	66	76	1.9
16	09/24/2021	11:07:07 AM	Sunny	76	5	3.1
17	10/14/2021	08:14:22 AM	Mostly sunny	51	23	2.1
17	10/15/2021	07:59:50 AM	Sunny	59	1	4
17	10/15/2021	09:41:33 AM	Sunny	74	4	5.3
17	10/15/2021	12:57:21 PM	Sunny	74	1	2.7
17	10/15/2021	02:58:12 PM	Sunny	59	43	2
17	10/25/2021	11:08:48 AM	Sunny	76	12	5.2
18	11/18/2021	07:44:59 AM	Cloudy	56	100	1.6
18	11/18/2021	02:12:46 PM	Mostly cloudy	61	88	3.8
18	11/19/2021	07:46:27 AM	Cloudy	57	99	1.6
18	11/19/2021	07:01:12 PM	Cloudy	61	98	2.1
18	11/19/2021	07:02:06 PM	Clear	64	24	2.6
18	11/30/2021	08:48:47 AM	Partly cloudy	60	54	1.5
19	12/16/2021	09:02:55 AM	Mostly sunny	39	11	2.8
19	12/16/2021	11:16:22 AM	Mostly sunny	58	12	2.3
19	12/17/2021	07:35:03 AM	Mostly sunny	47	17	2.1
19	12/17/2021	08:25:29 AM	Sunny	50	8	2.2
19	12/17/2021	09:36:40 AM	Mostly sunny	54	11	2.2
19	12/17/2021	01:01:24 PM	Sunny	64	7	3.9

°F = degrees Fahrenheit; mph = miles per hour

Appendix D

2021 Belding's Savannah Sparrow Surveys and Weather

Appendix D – 2021 Belding's Savannah Sparrow Surveys and Weather

Table D-1: Belding's Savannah Sparrow Surveys (2021) Survey Dates, Personnel, and Weather Conditions

Survey Number	Date	Survey Personnel	Time	Weather Conditions
1[a]	3/08/2021	James McMorran	05:53 – 09:53	Start: 55 °F; wind 2 mph; 100 % cloud cover End: 61 °F; wind 7 mph; 68 % cloud cover
1[b]	3/09/2021	James McMorran	06:08 – 10:17	Start: 45 °F; wind 1 mph; 50 % cloud cover End: 56 °F; wind 7 mph; 50 % cloud cover
2[a]	4/01/2021	James McMorran	06:30 – 09:37	Start: 52 °F; wind 2 mph; 0 % cloud cover End: 73 °F; wind 3 mph; 40 % cloud cover
2[b]	4/02/2021	James McMorran	06:30 – 10:02	Start: 55 °F; wind 2 mph; 100 % cloud cover End: 63 °F; wind 2 mph; 98 % cloud cover
3[a]	4/15/2021	James McMorran	06:43 – 10:16	Start: 46 °F; wind 2 mph; 49 % cloud cover End: 64 °F; wind 6 mph; 82 % cloud cover
3[b]	4/16/2021	James McMorran	07:02 – 10:10	Start: 55 °F; wind 2 mph; 94 % cloud cover End: 62 °F; wind 1 mph; 100 % cloud cover
4[a]	5/06/2021	James McMorran	05:58 – 09:38	Start: 58 °F; wind 1 mph; 100 % cloud cover End: 64 °F; wind 4 mph; 100 % cloud cover
4[b]	5/07/2021	James McMorran	06:02 – 09:51	Start: 57 °F; wind 1 mph; 100 % cloud cover End: 62 °F; wind 2 mph; 76 % cloud cover

°F = degrees Fahrenheit; mph = miles per hour