2023 Annual Habitat Monitoring Report
Salt River Ecosystem Restoration Project
Humboldt County, California

Prepared for the Humboldt County Resource Conservation District
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Summary

In the summer of 2023, J.B. Lovelace & Associates conducted the annual habitat monitoring effort for the Salt River Ecosystem Restoration Project (SRERP). This phased habitat restoration project was initiated in 2013 and is being implemented throughout the Salt River watershed in the Eel River delta of coastal Humboldt County, California, to achieve the following goals: restoration of historically impaired beneficial hydrological and ecological functions of the Salt River (a tributary to the lower Eel River), creation and enhancement of historically more abundant estuarine and freshwater coastal wetland habitats, and reduction of flooding in the surrounding community during high-flow events.

Following completion of each project sub-phase, a suite of environmental parameters is being assessed over the course of respective 10-year monitoring periods to evaluate progress toward the realization of targeted restoration design criteria and to identify potential problems that may compromise the successful realization of identified goals. Our most recent 2023 habitat monitoring effort addressed specific potions of both Phase 1 — Riverside Ranch Tidal Marsh and Phase 2 — Salt River Corridor Restoration Areas and consisted of the mapping and areal analysis of restored habitats, as well as the application of quantitative vegetation sampling methods to characterize the community composition and structural development of vegetation within specific habitats for evaluation against respective restoration success criteria.

Corresponding results from our 2023 habitat mapping and areal analysis indicate that the Phase 1 “tidal salt and brackish marsh” habitat complex does satisfy the respective final minimum area success threshold in what is scheduled to be the final monitoring year for that specific SRERP habitat. Riparian planting zones of the Phase 2B (Middle) restoration reach, while comprising only one-third of the area projected for such habitats in that specific portion of the SRERP footprint, have changed little in their area and extent since previously assessed, and additional supplemental revegetation of other Phase 2 habitats with riparian species in anticipation of such shortfalls in the Phase 2B (Middle) subphase are expected to compensate for the aforementioned acreage deficit.

That expectation is, however, contingent on the successful establishment and development of actual riparian forested habitat in zones planted with such species. Vegetation percent cover and basal area sampling efforts performed in 2023 indicate continued poor establishment and survival of woody riparian vegetation throughout habitats of the Phase 2B (Middle) restoration area replanted with riparian trees and shrubs, and without additional dedicated replanting and irrigation efforts in these areas, drought-related conditions experienced during original revegetation efforts are likely to have prevented their successful future development into truly forested riparian habitats, at least within the temporal context of the SRERP monitoring time frame.

Recent quantitative vegetation sampling results also reflect the continued invasion of all Phase 1 and Phase 2B (Middle) habitats sampled in 2023 by invasive plants. Two invasive species in particular are disproportionately influencing SRERP plant communities and preventing the successful achievement of vegetation compositional goals established in the development of the Salt River Ecosystem Restoration Project: *Spartina densiflora* ("dense-flowered cord grass") in estuarine habitats of the Phase 1 — Riverside Ranch Tidal Marsh Restoration Area and *Phalaris arundinacea* ("reed canary grass") in the palustrine habitats of the Phase 2B (Middle) reach of the Salt River Corridor Restoration Area.

In all but a single SRERP sampling region evaluated in 2023, the prevalence of either of these two invasive grasses (independently) resulted in both the failure to maintain levels of abundance of invasive vegetation below the respective final *maximum* cover success threshold, as well as the failure of co-occurring native vegetation to reach or exceed respective *minimum* cover thresholds. Such failures to satisfy final vegetation success criteria include those four sampling regions for which 2023 represents the final year when vegetation percent cover sampling is scheduled to occur: Phase 1 salt marsh *sensu stricto* and high marsh ecotone habitats, and both Phase 2B (Middle) Salt River "channel wetland" sampling regions (i.e., active bench and active channel). The single exception was the high marsh ecotone of the Phase 1 restoration area, where the abundance of native vegetation did exceed the respective final minimum cover threshold.

Results presented herein for the 2023 habitat monitoring effort provide evidence of continued successful progress towards the attainment of some of the long-term restoration goals for the Salt River Ecosystem Restoration Project, while simultaneously indicating the need for additional revegetation efforts for woody riparian vegetation in the Phase 2B (Middle) restoration reach, and reinforcing the need for continued and proportionate invasive vegetation management actions throughout SRERP habitats addressed in 2023 to ensure that the Project's habitat restoration goals are ultimately achieved.

With the application of dedicated and proportionate invasive vegetation management actions, as well as additional supplemental revegetation and/or irrigation efforts where needed, we anticipate continued successful development of projected restoration habitats and the eventual realization of targeted native-species-dominated plant communities throughout regions of the SRERP footprint addressed during our 2023 effort. To further inform and guide this process, we recommend the continued implementation of the SRERP monitoring program.
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1.0 Project Description

The Salt River Ecosystem Restoration Project (SRERP) is a phased habitat restoration project being implemented throughout the Salt River watershed in the Eel River delta of coastal Humboldt County, California (Figure 1). The project was first initiated in 2013 and is an on-going collaborative effort involving numerous stakeholders and project partners, and is being coordinated by the Humboldt County Resource Conservation District (HCRCD).

The main focus of the watershed-scale restoration effort is to reduce periodic flooding of the adjacent agricultural community during high-flow events and restore beneficial fluvial, hydrological, and ecological functions to this significant tributary to the Eel River estuary whose watershed functions have been impaired due to historic channel alteration and excess sediment accretion.

Project goals include the reduction and management of upstream sediment sources; facilitation of sediment transport through the system; and the creation and enhancement of adjacent ecologically important coastal habitats that were historically more abundant throughout the region such as tidal salt marsh, brackish estuarine, and freshwater wetlands.

In order to ensure the overall success of the Salt River Ecosystem Restoration Project, a suite of monitoring programs was developed to periodically evaluate progress towards the realization of various identified restoration objectives. One such habitat monitoring program consists of periodic quantitative assessments of the development of targeted projected habitat types and associated vegetation characteristics. During the summer and autumn of 2023, J.B. Lovelace & Associates continued to assist the HCRCD in its fulfillment of Salt River Ecosystem Restoration Project monitoring requirements by conducting such quantitative assessments. That effort is the focus of this annual habitat monitoring report and our associated findings from 2023 are presented herein.

1.1 Regulatory Context & Monitoring Directives

An extensive planning and permitting process preceded the initiation of the SRERP and included the preparation of the *Salt River Ecosystem Restoration Habitat Mitigation and Monitoring Plan* (HMMP) (H.T. Harvey & Associates with Winzler & Kelly 2012). The HMMP was developed to help guide the restoration effort and to provide an assessment framework with which to gauge its efficacy. Among other elements, this framework includes directives for implementing a 10-year, post-restoration monitoring program upon completion of each phase and sub-phase with periodic quantitative assessments of specific habitat and vegetation parameters, to be compared against established success criteria, that track progress towards achieving specific restoration goals, as well as to identify and address any potential problems that could prevent the realization of such goals. Implementation of this monitoring program is also a requirement of the following project-related permits, certifications, and agreements:

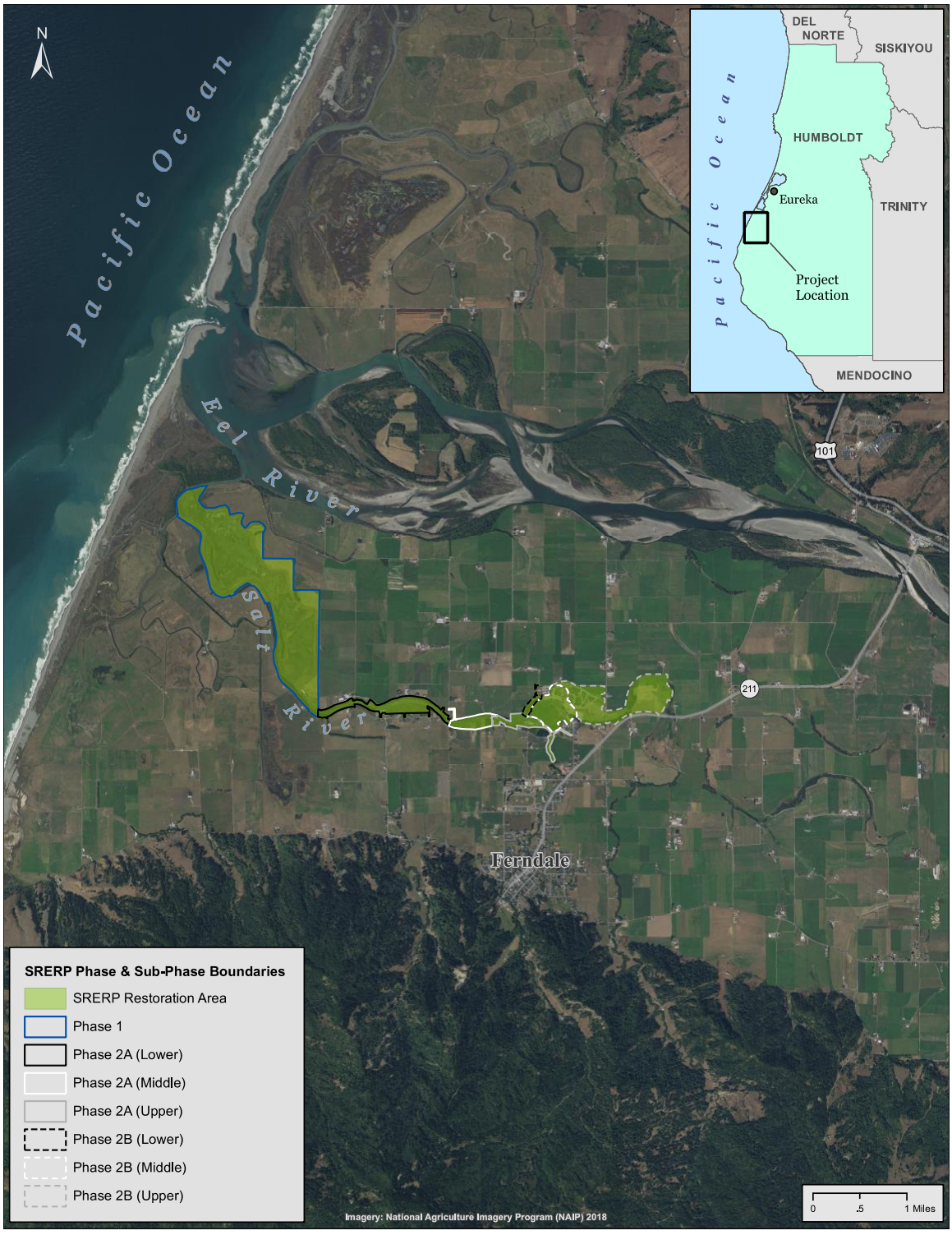

Figure 1. Salt River Ecosystem Restoration Project (SRERP) Location and Vicinity.

- *Biological Opinion and Formal Consultation on the Salt River Ecosystem Restoration Project, Humboldt County, California: File No. AFWO-11B0097-11F0249* (U.S. Department of Interior—U.S. Fish & Wildlife Service 2011);
- *Section 404 General Permit for the Salt River Ecosystem Restoration Project No. 2010-00282N* (U.S. Army Corps of Engineers 2012);
- *Water Quality Certification for the Humboldt County RCD — Salt River Ecosystem Restoration Project, WDID No. 1B10106NHU* (North Coast Regional Water Quality Control Board 2011);
- *Streambed Alteration Agreement Notification No. 1600-2011-0107-R1 Salt River, Francis Creek, Williams Creek, and Reas Creek* (California Department of Fish & Game 2012);
- *Humboldt County Resource Conservation District Conditional Use Permit Modification Case No. C-10-05M* for the Salt River Ecosystem Restoration Project (Humboldt County Department of Community Development Services 2011); and
- *Coastal Development Permit No. CDP-1-10-032* for the Salt River Ecosystem Restoration Project (California Coastal Commission 2012).

1.2 Monitoring & Reporting History & Context

The habitat monitoring schedule provided in the HMMP prescribes specific monitoring requirements for the various combinations of restored habitats, vegetation parameters, and monitoring years (Table 1). Habitat monitoring efforts conducted during the first two monitoring years (i.e., 2014 and 2015) were performed by H.T. Harvey & Associates and are documented in *Salt River Ecosystem Restoration Project (Phase 1): Vegetation Monitoring for the High Marsh Ecotone (Year 1) Final Report* (H.T. Harvey & Associates 2014) and *2015 Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project Final Report* (H.T. Harvey & Associates 2015). Habitat monitoring conducted during 2016–2022 was performed by J.B. Lovelace & Associates, and those efforts are described in respective annual habitat monitoring reports (J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b, 2022c, 2023; respectively). This report provides documentation of the most recent habitat monitoring effort for the Salt River Ecosystem Restoration Project in 2023, and addresses the following specific tasks identified (Table 1) for the current monitoring year:

A. Habitat Area Analysis & Mapping

1. Phase 1 — Riverside Ranch Tidal Marsh Restoration Area:
    a. “Tidal Salt & Brackish Marsh”
2. Phase 2B (Middle) — Salt River Corridor Restoration Area:
    a. Riparian Planting Zones

B. Vegetation Percent Cover Sampling

1. Phase 1 — Riverside Ranch Tidal Marsh Restoration Area:
    a. High Marsh Ecotone
    b. “Tidal Salt & Brackish Marsh”
2. Phase 2B (Middle) — Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones

C. Replanted Woody Riparian Vegetation Basal Area Assessment

1. Phase 2B (Middle) — Salt River Corridor Restoration Area:
    a. Riparian Planting Zones

2.0 Project Description

The first phase of the SRERP (i.e., Phase 1 — Riverside Ranch Tidal Marsh Ecosystem Restoration Project) was initiated in 2013 in the lower portion of the watershed near the Salt River’s confluence with the Eel River estuary. Since that time, construction of multiple consecutive sub-phases of Phase 2 (the Salt River Corridor Restoration Project) has progressed upstream along the Salt River riparian corridor to a point just downstream (north) of California State Route 211. As originally designed, the entire project area consists of approximately 7.7 miles of the Salt River channel and more than 800 acres of adjacent habitat. As of the 2023 habitat monitoring effort, restoration construction has been completed throughout the Phase 1, Phase 2A (Lower, Middle, and Upper), and Phase 2B (Lower, Middle, and Upper) restoration areas (Figure 1; Table 2).

Implementation of the SRERP involved extensive structural modifications to the Salt River channel system and adjacent floodplain wetland habitats in order to facilitate the enhancement of identified fluvial, hydrological, and ecological characteristics and functions. Extensive revegetation efforts followed completion of restoration construction activities in each phase and sub-phase of the project to stabilize disturbed soils and to re-establish suitable vegetative cover in the affected habitats. These efforts incorporate specific prescriptions for herbaceous and woody riparian species assemblages developed during the design phase of the project for each restoration area, which are presented in Tables 5–7 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) where a more encompassing project description for the entire SRERP can be found.

Table 1. SRERP Habitat Monitoring Schedule[1] for Phase 1 & Phase 2. Bold text indicates the current monitoring year (2023).

Phase	SRERP Habitat Type	Monitoring Period & Schedule of Tasks[2]																	
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**	2024	2025	2026	2027	2028	2029	2030
Phase 1	(Monitoring Year)		1	2	3	4	5	6	7	8	9	**10**							
	High Marsh Ecotone[3]		BC	BC	BC	C	C	C	BC	C	C	**BC**							
	"Tidal Salt & Brackish Marsh"[4]		AC	C	ABC	C	ABC	C	ABC	C	C	**ABC**							
	(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
	Replanted Riparian Forest[5]			AC	BC	ABCD	C	ABCD	C	ABC	C	**C**	ABCD						
Phase 2A (Lower)	(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
	"Salt River Channel Wetlands"[6,7]			BC	BC	BC	C	BC	C	BC	C	**C**	BC						
	Riparian Planting Zones[8]			AC	BC	ABCD	C	ABCD	C	ABC	C	**C**	ABCD						
Phase 2A (Middle)	(Monitoring Year)				1	2	3	4	5	6	7	**8**	9	10					
	"Salt River Channel Wetlands"[6]				BC	BC	BC	C	BC	C	BC	**C**	C	BC					
	Riparian Planting Zones[8]				AC	BC	ABCD	C	ABCD	C	ABC	**C**	C	ABCD					
Phase 2A (Upper)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
	"Salt River Channel Wetlands" [6,9]						ABC	BC	BC	C	BC	**C**	BC	C	C	BC			
	Riparian Planting Zones[8,10]						ABC	BC	ABCD	C	ABCD	**C**	ABC	C	C	ABCD			
Phase 2B (Lower)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
	"Salt River Channel Wetlands" [6,9]						ABC	BC	BC	C	BC	**C**	BC	C	C	BC			
	Riparian Planting Zones[8,10]						ABC	BC	ABCD	C	ABCD	**C**	ABC	C	C	ABCD			
Phase 2B (Middle)	(Monitoring Year)							1	2	3	4	**5**	6	7	8	9	10		
	"Salt River Channel Wetlands" [6,9]							ABC	BC	BC	C	**BC**	C	C	C	C	C		
	Riparian Planting Zones[8,10]							ABC	BC	ABCD	C	**ABCD**	C	ABC	C	C	ABCD		
Phase 2B (Upper)	(Monitoring Year)								1	2	3	**4**	5	6	7	8	9	10	
	"Salt River Channel Wetlands" [6,9]								ABC	BC	BC	**C**	BC	C	C	C	C	C	
	Riparian Planting Zones[8,10]								ABC	BC	ABCD	**C**	ABCD	C	ABC	C	C	ABCD	

[1] Adapted from Table 11 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] A = Habitat area (acreage) assessment
B = Percent vegetative cover assessment
C = Non-native invasive vegetation assessment
D = Basal area assessment of replanted woody riparian vegetation
[3] Percent cover sampling in High Marsh Ecotone was not required in 2018 as suggested in J.B. Lovelace & Associates 2017 (HCRCD 2016c.)
[4] Percent cover sampling in "Tidal Salt & Brackish Marsh" is required specifically in salt marsh *sensu stricto* habitat only (HCRCD 2016c.)
[5] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions in the winter of 2013/2014 (HCRCD 2015a).
[6] Includes both elements (i.e., active channel and active bench) of both brackish and freshwater channel wetlands.
[7] Additional quantitative sampling suggested (J.B. Lovelace & Associates 2020, 2022a–c) to continue to assess the abundance of invasive vegetation in regions of the SRERP footprint where such vegetation exceeded the final maximum threshold (i.e., <5%) in respective 5th monitoring years.
[8] Includes both replanted riparian forest areas and active riparian berms.
[9] Habitat area assessment is warranted in Salt River Channel Wetlands, given subsequent supplemental planting of these areas with woody species.
[10] Percent cover assessment is warranted in Riparian Planting Zones, given that some areas recently planted with woody species also occur in historically designated Salt River Channel Wetlands.

Table 2. SRERP Phases & Sub-Phases Completed Prior to Initiation of 2023 Habitat Monitoring Fieldwork.

SRERP Phase & Sub-Phase	Year Completed
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area	2013
Woody Riparian Revegetation*	2015
Phase 2A — Salt River Corridor Restoration Area	
Phase 2A (Lower)	2014
Phase 2A (Middle)	2015
Phase 2A (Upper)	2017
Phase 2B — Salt River Corridor Restoration Area	
Phase 2B (Lower)	2017
Phase 2B (Middle)	2018
Phase 2B (Upper)	2019

* Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions during the winter of 2013–2014 (HCRCD 2015a).

Herbaceous revegetation methods, which varied based on site conditions and desired species composition, included transplantation of propagated plant "plugs" as well as "hydroseeding," seed-drilling, and broadcast seed applications. In restoration areas originally designated for the re-establishment of woody riparian vegetation, young shrubs, tree saplings, and live cuttings were planted during the dormant season following restoration construction. Additional, supplemental planting of woody riparian vegetation also occurred in 2018 and 2019 in some Phase 2 restoration area locations originally replanted with only herbaceous species. This latter revegetation effort was conducted in anticipation of reductions in the availability of portions of the project area where replanting of woody riparian vegetation could occur (HCRCD pers. com.).

Phase- and sub-phase-specific methodologies and technical specifications for the aforementioned revegetation efforts are described in:

- *Humboldt County Resource Conservation District Salt River Ecosystem Project Riverside Ranch (Phase 1) Tidal Marsh Restoration Seed Application Plan* (GHD 2012a);
- *Seed and Mulch Application Plans and Technical Specifications Riverside Ranch (Phase 1) Tidal Marsh Restoration Salt River Ecosystem Restoration Project* (GHD 2012b);
- *Salt River Ecosystem Restoration Project Salt River Channel & Riparian Floodplain Corridor — Lower Phase 2A Restoration Planting Plans* (GHD with H.T. Harvey & Associates October 2014);
- *Memorandum: Salt River Ecosystem Restoration Project Phase Lower 2A Revegetation As-built Documentation* (GHD 2015);
- *Salt River Ecosystem Restoration Project Phase 1 Revegetation As-Built Documentation* (HCRCD 2015a);

- *Humboldt County Resource Conservation District Salt River Ecosystem Project Revegetation: Wetland Plug Planting Plans Phase Middle 2A* (HCRCD 2015b);
- *Humboldt County Resource Conservation District Salt River Ecosystem Project Phase Middle 2A Riparian Planting Plans* (HCRCD 2015c);
- *Humboldt County Resource Conservation District Salt River Ecosystem Project Revegetation: Riparian Tree/Shrub Planting Plans Phase Middle 2A-R3* (HCRCD 2016a);
- *Salt River Ecosystem Restoration Project Phase 2018 Revegetation As-Built Documentation* (HCRCD 2019a); and
- *Salt River Ecosystem Restoration Project Phase 2019 Revegetation As-Built Documentation* (HCRCD 2019b).

Descriptions of the implementation of each project phase/sub-phase, respective revegetation efforts, restoration goals, and targeted or "projected" habitats have been addressed in detail in previous annual monitoring reports (J.B. Lovelace & Associates 2022a–2022c; etc.). In the interest of streamlining the annual habitat monitoring reporting process, we present herein brief descriptions of those SRERP habitat components relevant to evaluating the goals of the 2023 annual habitat monitoring effort (i.e., certain portions of the Phase 1 — Riverside Ranch Tidal Marsh and Phase 2 — Salt River Corridor Restoration Project areas). Readers are encouraged to refer to J.B. Lovelace & Associates (2022a–2022c; etc.) for additional detail and context.

2.1 Phase 1 — Riverside Ranch Tidal Marsh Restoration

The first phase of the SRERP (Phase 1 — "Riverside Ranch Tidal Marsh Restoration Project") was implemented in 2013 on property acquired by the California Department of Fish and Wildlife, historically known as "Riverside Ranch." This ~440-acre Phase 1 restoration area, extends south (upstream) from its northern boundary near Salt River's confluence with Cutoff Slough and the Eel River, to the approximate location of the confluence between the Salt River and Reas Creek (Appendix A, Figures 1 and 2).

2.1.1 Phase 1 Projected Habitats and Associated Habitat Components

One of the primary goals of the SRERP is the creation and/or enhancement of specific targeted habitat types projected to be established by the completion of the restoration-monitoring period. These "projected habitat types" are described in the HMMP and depictions of those projected habitats that are relevant to the current effort have been reproduced here in Appendix A (Figure 1).

The single most extensive habitat type projected for the majority of the Phase 1 restoration area is variously referred to in the HMMP as either "tidal salt & brackish marsh" or "tidal salt marsh." The remainder of the Riverside Ranch restoration area is partitioned into less extensive projected habitat types also central to the goals of the SRERP (i.e., aquatic, high marsh ecotone, and riparian forest), as well as some adjunct retained (e.g., "agricultural," "developed," etc.) and created (i.e., setback levees) features.

Subsequent investigations (H.T. Harvey & Associates 2014, 2015; J.B. Lovelace & Associates 2017–2022c) of the region of the Phase 1 restoration area projected to become “tidal salt & brackish marsh”/“tidal salt marsh” have revealed substantial habitat complexity throughout this area, not reflected at the level of resolution invoked in the general assignment of “tidal salt & brackish marsh”/“tidal salt marsh” in the HMMP. Though much of this area does represent “true” salt marsh *sensu stricto* habitat, a complex system of aquatic tidal slough channels, unvegetated mudflats, and brackish wetlands also co-occur. This scenario presents potential confusion when attempting to evaluate restoration success using a comparison between observed salt marsh *sensu stricto* and a success criterion for the inconsistently labeled “tidal salt & brackish marsh” or “tidal salt marsh” area which actually represents a mosaic of different habitats (including salt marsh *sensu stricto*).

In an attempt to avoid further ambiguity and confusion, we use the slightly more inclusive habitat title, “tidal salt & brackish marsh,” (from the HMMP’s *Table 1. Land Use and Habitat Projections*) when referring to this original, projected aggregate habitat. We limit the use of more specific terms (e.g., “salt marsh *sensu stricto*,” “brackish marsh *sensu stricto*,“ etc.) to subordinate portions of the project area actually found to reflect characteristics typically associated with such habitat classifications. Below, we briefly describe projected habitat types and relevant subordinate habitat components that directly relate to, or provide context for, the 2023 habitat monitoring goals using this described approach to the organization of these habitat types. Other associated retained and/or created habitat features lacking monitoring requirements for 2023 are not addressed.

Phase 1: “Tidal Salt & Brackish Marsh”

As described above, this habitat complex actually consists of a mosaic of distinct habitat types. For the purposes of conducting the appropriate annual habitat monitoring tasks for the Phase 1 restoration area, the habitat types identified and addressed include salt marsh *sensu stricto*, brackish marsh *sensu stricto*, aquatic, and unvegetated mudflats.

Salt Marsh *Sensu Stricto*

Extensive excavation and grading restored tidal influence throughout the majority of the Phase 1 area, with the intent of facilitating the re-establishment of tidal salt marsh habitat in this area. No reseeding efforts were conducted in these portions of the Phase 1 area subject to regular tidal inundation. It was anticipated that these areas would respond sufficiently with natural recruitment of native salt marsh species, whose propagules are predominantly dispersed by means of tidal mechanisms. In the context of the SRERP, salt marsh *sensu stricto* is considered to consist primarily of estuarine intertidal emergent wetland habitats as described in *Classification of Wetlands and Deepwater Habitats of the United States, Second Edition* (FGDC 2013).

Brackish Marsh *Sensu Stricto*

Substantial geomorphological modifications were not undertaken in portions of the Phase 1 restoration area that were already within an elevation range expected to experience regular tidal influence following adjacent excavation and grading activities. Over time, these predominantly palustrine emergent wetland (FGDC 2013) habitats are expected to undergo gradual conversion to either brackish marsh or salt marsh habitat in response to increased tidal influence resulting from restoration efforts. Phase 1 habitat types designated as "brackish marsh" are those habitats that have not been converted to salt marsh *sensu stricto*, but that are exposed to intermediate water chemistry with increased salinity, determined in the field based on observations of their ability to support vegetation tolerant of such conditions. Brackish marsh *sensu stricto* habitats were not reseeded following the completion of construction based on the same rationale described for salt marsh *s.s*. habitats. Being subject to increased tidal influence, it is anticipated that the plant species composition in these areas will naturally transition during the conversion process.

Aquatic & Mudflat Habitat

"Aquatic" habitats consist of unvegetated and wetted portions of the active Salt River channel between its confluences with Reas Creek and Cutoff Slough, and all similar associated tidal slough tributary channels within the Phase 1 area. These "aquatic" habitats variously consist of unconsolidated bottom, aquatic bed, and streambed subtidal; or unconsolidated shore intertidal; estuarine wetland habitats as described in FGDC (2013). Mudflats consist of predominantly unvegetated (i.e., <5% vegetative cover) areas subject to regular and periodic tidal inundation and ponding, and are considered to be unconsolidated shore intertidal estuarine wetland habitats (FGDC 2013).

Phase 1: High Marsh Ecotone

The "high marsh ecotone" is an ecologically valuable habitat feature incorporated into the Phase 1 restoration design, and consists of a gradual incline constructed along the entire tidal slope of the new setback levee to create a broad transitional zone between the salt and/or brackish marsh *sensu stricto* wetland habitat and the (upland) setback levee itself. This transition zone was hydroseeded in September and October of 2013, following completion of Phase 1 construction with a seed prescription composed of native plant species considered suitable for such transitional conditions (H.T. Harvey & Associates with Winzler & Kelly 2012) and a sterile "wheatgrass" hybrid (*Elymus x Triticum*) to facilitate rapid stabilization of the reseeded areas.

Phase 1: Riparian Habitats

Implementation of Phase 1 necessitated the removal of some stands of pre-existing willow (*Salix* spp.)-dominated riparian forest, though portions of this existing habitat type were retained wherever possible. Following completion of construction, woody riparian species were replanted throughout suitable "riparian planting zones" of the Phase 1 project area to achieve identified restoration goals and to compensate for the project-related loss of this valuable habitat

component. Suitable riparian planting zones (i.e., “replanted riparian forest” areas) consisted primarily of areas adjacent to the Salt River channel, and were typically contiguous with retained portions of pre-existing riparian forest. Due to exceptionally dry conditions occurring during the dormant planting season immediately following completion of construction (winter 2013/2014), replanting of Phase 1 woody riparian vegetation was instead delayed until the subsequent planting season in early 2015 (HCRCD 2015a). Riparian planting zones were also revegetated with suitable herbaceous species, following specifications provided in the aforementioned revegetation guidance documents.

2.2 Phase 2 — Salt River Corridor Restoration

Following completion of Phase 1 in 2013, the second phase of the SRERP was initiated in 2014, and has progressed upstream along the Salt River corridor as a sequential series of sub-phases. As of the 2023 habitat monitoring effort, all three sub-phase reaches (i.e., lower, middle, and upper) in both the Phase 2A and Phase 2B restoration areas have been completed. The distinction between “lower,” “middle,” and “upper” reaches of each sub-phase reflects the progression of completion of respective restoration efforts over the course of multiple construction seasons (Table 2). The restoration goals and approach were consistent throughout.

2.2.1 Phase 2 Projected Habitats and Associated Habitat Components

“Salt River Channel Wetlands”

The Salt River “channel wetland” system associated with the Phase 2 — Salt River Corridor Restoration Area consists of estuarine, riverine, and palustrine emergent wetland habitats designed to support plant communities initially dominated by herbaceous species, though the eventual recruitment of a woody riparian vegetation component in these habitats as a result of natural successional processes was anticipated in the restoration design process (H.T. Harvey & Associates with Winzler & Kelly 2012).

Specific restoration design features of these Salt River channel wetland habitats addressed in the SRERP habitat monitoring effort consist of “active channel” and “active bench” habitat components. The “active channel” refers to the primary wetted channel and immediately adjoining vegetated banks of both the Salt River and its tributary, Francis Creek, both of which consistently convey streamflow throughout normal water years. The “active bench” is a dynamic alluvial geomorphological feature extending from the edges of the active channel, out to the upper extent of the Salt River corridor and adjacent Eel River floodplain.

“Seasonal (Non-Channel) Wetlands”

Seasonal (non-channel) wetlands within the SRERP footprint that extend beyond the immediately modified Salt River riparian corridor, or which lack obvious above-ground hydrological connectivity to the Salt River channel throughout most of the year, are identified in the HMMP as being predominantly herbaceous vegetation-dominated palustrine emergent wetland habitats.

"Sediment Management Areas"

"Sediment management areas were designed as discrete portions of active bench habitats where reduced streamflow velocity during high-flow events is expected to facilitate the deposition of transported sediments. Periodic removal of sediment from some of these areas is expected to address anticipated aggradation and to prevent channel occlusion. Given the anticipated periodic burial- and sediment removal-related disturbances in these sediment management areas, habitat-monitoring efforts have not been required in these portions of the restoration area.

Riparian Habitats

Existing riparian forest was retained where possible during Phase 2 restoration construction, but some removal was required. To compensate for the temporary loss of removed portions of such habitat, woody riparian vegetation was subsequently replanted throughout identified "riparian planting zones."

Phase 2 riparian planting zones include both "replanted riparian forest" areas and "active riparian berms." Areas of "replanted riparian forest" primarily occur along the upper riparian channel banks, contiguous with retained patches of pre-existing riparian forest. "Active riparian berms" consist of linear, elevated channel edge design features that were constructed along specific portions of the interface between the edge of the active channel and the immediately adjacent active bench habitats. These active riparian berms serve to direct streamflow, provide bank stabilization, and are anticipated to eventually provide shading of the channel as well as underwater refugia for fish and other aquatic species.

In addition to the designed revegetation of aforementioned riparian planting zones, unanticipated reductions in the availability of portions of the middle and upper Phase 2B restoration reach where woody riparian revegetation efforts could occur prompted the subsequent supplemental planting of woody riparian species in some freshwater active bench and passive sediment management areas throughout the Phase 2 restoration area in 2018 and 2019.

Given that these subsequent woody species revegetation efforts will likely result in the eventual conversion of some restoration areas originally designed as herbaceous-vegetation-dominated wetland habitats or sediment management areas, we continue to treat all such areas as originally designated (i.e., active bench or sediment management area), while also separately quantifying supplemental woody vegetation replanting areas (Section 4.1; Appendix A, Figure 3) for evaluation in the context of respective relevant success criteria.

3.0 Methods

Consistent with the schedule of monitoring requirements (Table 1) provided in the HMMP, the 2023 SRERP habitat monitoring effort consisted of three general tasks: field verification and mapping of the distribution and extent of specific habitats within respective portions of the SRERP project area, quantitative

sampling within specific habitats to characterize the composition and structural development of the associated vegetation, and the documentation of invasive vegetation encountered during these efforts. Methods used to accomplish each of these tasks are described below. Fieldwork was performed by J.B. Lovelace & Associates' principal environmental scientist and plant ecologist, Brett Lovelace. All botanical taxonomic nomenclature presented in this effort is consistent with *The Jepson Manual: Vascular Plants of California, Second Edition* (Baldwin et al. 2012) or the *Jepson eFlora* (Jepson Flora Project 2023) in instances where updated taxonomic classification is applicable.

3.1 Habitat Mapping & Area Analysis

In 2023, our habitat mapping and area analysis efforts focused on "tidal salt & brackish marsh" habitats within the Phase 1 restoration area and riparian habitats in the Phase 2B (Middle) restoration area, as required in the HMMP schedule of monitoring tasks (Table 1). However, where changes to riparian habitat boundaries proportionately affected adjoining non-riparian habitats, such effects were also documented and are addressed herein where relevant. Additional opportunistic observations of changes in the extent of other adjoining SRERP habitat types were also documented where encountered.

Existing SRERP habitat geographic information system (GIS) data, originally provided by the HCRCD and subsequently updated during the 2016–2022 monitoring efforts (J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b, 2022c, 2023), were refined as necessary in 2023 to develop updated habitat maps reflecting current site conditions. Geographic field data were collected during fieldwork performed throughout July 19–21 and August 2, 2023 using Environmental Systems Research Institute's (ESRI) ArcGIS® Field Maps application operating on handheld iOS mobile devices paired with external Bad Elf Flex® or Surveyor® Global Navigation Satellite System (GNSS) receivers capable of ≤1 m accuracy (Bad Elf 2023). Updated habitat maps and resulting area (acreage) quantifications were then developed using recently collected geographic data, the most recent available satellite imagery (i.e., ESRI's World Imagery 2023, National Agriculture Imagery Program [NAIP] 2018, Google Earth 2023), and a combination of ESRI's ArcGIS® Online web application, and the following desktop software: ESRI's ArcGIS® and ArcMap™, and Google Earth (2023).

It is important to note that habitat area (acreage) success criteria provided in the HMMP represent total "phase-wide" acreage thresholds, inclusive of upstream areas where restoration has not yet occurred. The success thresholds provided therein do not reflect any partitioning into "sub-phase" quantities corresponding to the actual progression in which Phase 2A (Lower, Middle, and Upper) and/or Phase 2B (Lower, Middle, and Upper) restoration efforts were ultimately implemented.

In the absence of explicit sub-phase-specific success criteria, original "projected habitat" GIS data created during the development of the HMMP (H.T. Harvey &

Associates with Winzler & Kelly 2012) were appropriately partitioned along sub-phase boundaries to derive proportionately-scaled respective area success thresholds for each relevant Phase 2 sub-phase habitat using ArcMap desktop software. These scaled habitat area success thresholds are presented alongside corresponding 2023 habitat area analysis results in Section 4.1 for purposes of evaluating the development of this component of the SRERP.

3.2 Quantitative Vegetation Analysis

Two distinct quantitative sampling efforts were conducted in 2023 to characterize the composition and structural development of the vegetation associated with specific habitats within the SRERP restoration area: percent cover sampling and basal area sampling of arborescent vegetation in riparian planting zones. Both sampling efforts are described in detail below.

3.2.1 Vegetation Percent Cover Sampling

Vegetative percent cover data were collected from July 19–21, 2023 to characterize the composition and structural development of the vegetation within habitats where this task was scheduled to occur during the current monitoring year. Specific habitat sampling regions where vegetation percent cover sampling occurred in 2023 consisted of:

Phase 1 — Riverside Ranch Tidal Marsh Restoration Area
- High Marsh Ecotone
- "Tidal Salt & Brackish Marsh"

Phase 2 — Salt River Corridor Restoration Area

Phase 2B (Middle)

Salt River Channel Wetlands
- Active Channel
- Active Bench

Riparian Planting Zones
- Replanted Riparian Forest
- Active Riparian Berm

Sampling Design & Data Collection

We used a stratified, randomized sampling approach to characterize the abundance, composition, and structural developmental stage of existing vegetation within each sampling region. Sampling region-specific sample sizes were determined based on power analyses performed on the most recent preceding SRERP vegetation sampling data for respective habitat types (J.B. Lovelace & Associates 2022b, 2022c; see also Section 3.2.1. *Data Analysis: Power Analyses*, herein).

Using updated SRERP habitat GIS data and ArcMap desktop software, each phase and sub-phase of the restoration area was partitioned into ecologically distinct vegetation sampling regions of perceived relative homogeneity based on currently mapped restoration habitat design components. ArcMap desktop

software was then used to randomly distribute sampling plots throughout each of these sampling areas. Given that most sampling regions are composed of multiple, geographically separated polygons, sample plots were randomly allocated throughout each sampling area, in quantities proportionate to the size (i.e., area) of each polygon.

Geographic coordinates for each randomly assigned sample plot center were then appropriately corrected and uploaded to a task-specific ArcGIS Online webmap, which was made accessible to survey personnel in the field for sample plot location using ESRI's ArcGIS Field Maps application loaded on handheld mobile iOS devices paired with external Bad Elf GNSS receivers. Once sample plots were located in the field, a 1-m^2 sampling frame, or "quadrat," constructed from ¼-inch diameter PVC was then used to visually estimate:

- (total) percent vegetative cover, and
- (absolute) percent cover of each species present.

In order to evaluate these field data against respective success criteria for specific vegetative parameters, each observed plant species was subsequently categorized as:

- native,
- "non-native non-invasive"[*], or
- invasive

as well as being:

- herbaceous (an herb),
- arborescent (a tree),
- a shrub, or
- a vine.

In an attempt to minimize observer-related variation between monitoring efforts, we continued to use the same modified Braun-Blanquet (1928) cover-abundance scale (Table 3) used in previous monitoring efforts (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b, 2022c, 2023) during the 2023 sampling fieldwork to assign a "cover class" to the visually estimated absolute percent cover for each species observed during sampling. Median percent cover values for the range associated with each cover class were then used in subsequent analyses.

[*] The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*), addressed independently in previous SRERP monitoring efforts, was categorized as "non-native non-invasive" beginning in 2022 given that the abundance of this plant has been demonstrated to be both negligible and decreasing (where present) throughout SRERP sampled habitats and monitoring events (J.B. Lovelace & Associates 2022c).

Table 3. Modified Braun-Blanquet (1928) Plant-Cover Abundance Scale.[1]

Cover Class	Range of Percent Cover	Median (%)
r	<1 (single individual)	0.1
+	<1 (sporadic or few)	0.5
1	1–5	3.0
2	>5–25	15.0
3	>25–50	37.5
4	>50–75	62.5
5	>75–95	85.5
6	>95–100	97.5

[1] Source: H.T. Harvey & Associates (2015).

The aforementioned vegetation data were collected using plot-specific field data forms created using ESRI's ArcGIS Survey123Connect desktop software, which were made accessible to survey personnel in the field using mobile devices equipped with ESRI's Survey123 for ArcGIS mobile application, via links embedded in respective vegetation survey plot layers accessed from ESRI's Field Maps mobile application. Completed data forms were then uploaded to ESRI's ArcGIS Survey123 web application for subsequent export, management, and analysis.

Plant Species Categorization

We continue to recognize encountered plant species as being native or non-native, following designations assigned in *The Jepson Manual: Vascular Plants of California, Second Edition* (Baldwin et al. 2012). Therein, they define native plants as those "occurring naturally in an area, as neither a direct nor indirect consequence of human activity." Non-native species are those introduced as a direct or indirect result of human activity.

Non-native invasive plants are defined by the California Invasive Plant Council (Cal-IPC) (2022) as non-native species threatening "wildlands" by displacing and/or hybridizing with native species and/or likely to "alter biological communities, or alter ecosystem processes." It is also understood that certain native plants have the potential to displace pre-existing biological communities and/or adversely alter ecosystem processes when introduced from other regions. Within the context of the SRERP monitoring effort, we recognize "invasive" plants as being inclusive of a select subset of native plants (i.e., *Phalaris arundinacea* ["reed canary grass"] and *Typha latifolia* ["broad-leaved cattail"] based on those species' potential for ecosystem-altering effects in this nascent, large-scale restoration project.

Except as noted elsewhere herein, we recognize non-native plant species encountered in the current habitat monitoring effort as being "invasive" if they are classified as:

- "highly invasive" by Cal-IPC (2023);
- "noxious weeds" by the California Department of Food & Agriculture (CDFA) (2023);
- "federal noxious weeds" by the U.S. Department of Agriculture (USDA) 2023);
- "Red Alert" or "High Priority" by the Humboldt County Weed Management Area (WMA) (2010);
- *Both* "moderately invasive" by Cal-IPC (2023) *and* "Moderate Priority" by the Humboldt County Weed Management Area (WMA) (2010); or
- otherwise warrant concern based on known or perceived potential for preventing the establishment of intended vegetation in the SRERP restoration area.

It is important to note that, following the 2021 SRERP habitat monitoring effort, our classification of invasive species changed slightly in light of seven consecutive years of quantitative and qualitative vegetation assessments within the SRERP footprint and additional experience throughout the region. Beginning in 2022 we refined our classification of invasive vegetation to consist of a more conservative cohort of ecologically problematic plant species. In that process, certain plants previously recognized as "invasive" due to their designation by Cal-IPC (2016–2021) as having "moderate" or "limited" invasive potential have been "down-graded" to "non-native non-invasive" status based on local observations (pers. obs.) indicating that they pose a low threat to the SRERP success. These changes are reflected in Appendix B. Otherwise, our plant species categorization generally conforms to that used in previous SRERP habitat monitoring efforts (H.T. Harvey & Associates 2014, 2015; J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b, 2022c).

Data Analysis

Statistical methods used to analyze percent cover data collected during the 2023 habitat monitoring effort consisted of: 1) non-parametric bootstrap analyses to evaluate the precision of mean percent cover estimates for the various combinations of sampling region and vegetation categories of interest, and 2) power analyses to assess the adequacy of the sample size for each vegetation sampling area, as well as to provide sample size recommendations for the subsequent vegetation sampling event.

At the sample plot level, absolute percent cover values for the various categories of interest (i.e., native, non-native non-invasive, and invasive) were calculated from summed Braun-Blanquet cover class median percent cover values for each. These sample plot category totals were then pro-rated with respect to corresponding sample plot "total vegetative cover" values to yield a set of mean

cover values ranging from 0−100%, which summed to equal the total vegetative cover percentage. These pro-rated sample plot means for the various categories were then used to calculate respective mean estimates for each sampling area.

The same procedure was also used to produce mean percent cover estimates for vegetative structural categories (i.e., herb, shrub, tree, and vine), as well as to evaluate the individual contribution of *Phalaris arundinacea* ("reed canary grass") to the invasive component of vegetative cover throughout sampled habitats, as requested by HCRCD staff (Hansen pers. comm.). All statistical analyses were performed using the statistical software program "R" (The R Foundation for Statistical Computing 2023) and specific methods used in the 2023 analyses of percent cover data are described below.

Nonparametric Bootstrap Analysis

Nonparametric bootstrap methods (Efron & Tibshirani 1993) were used to calculate 95% confidence intervals for observed mean percent cover estimates for each vegetative category of interest by applying the "BCa" approach (Efron 1987) to the pro-rated data described above. "Bootstrapping" provides a method of quantifying the uncertainty of an estimator (e.g., a sample mean, etc.) by repeatedly resampling (with replacement) the collected data at random. Each resampling event produces a corresponding sample mean, and the variability of these "bootstrap means" can be used to assess the uncertainty of the actual sample mean. In the present case, the BCa bootstrap was used to calculate confidence intervals for reported sample means. In this effort, we resampled each data set 100,000 times to produce 95% confidence intervals for each combination of vegetative category of interest and sampled area.

Power Analyses

Power analyses were performed retrospectively to evaluate the adequacy of the most recent prior sample sizes for each combination of sampling region where vegetation sampling was conducted and vegetation category for which success criteria are provided in the HMMP. They also serve to provide recommended initial sample sizes for subsequent vegetation sampling efforts in these same habitats. Power analysis calculations were performed using a two-sided *t*-test, assuming 80% statistical power ($\beta = 0.8$) and a significance level of 95% ($\alpha = 0.05$) to be able to detect both a "medium" effect size of 0.5 standard deviations (SD) (following Cohen 1988) and/or a difference of 20% between observed sample means and their respective success criteria.

Vegetation Percent Cover Success Criteria

Vegetation percent cover success criteria established in the HMMP consist of *minimum* percent cover thresholds for native species and *maximum* percent cover thresholds for both non-native non-invasive and invasive species. Minimum percent cover criteria for native vegetation vary according to the different combinations of habitat type and monitoring year, and are summarized in Table 4. Maximum percent cover criteria for both non-native non-invasive and invasive species consist of singular, final maximum percent cover thresholds applicable in

respective final monitoring years. These latter two final maximum thresholds are summarized in Tables 5–6.

Although no such percent cover success criteria are provided in the HMMP for vegetative structural types (e.g., herb, shrub, tree, etc.), a characterization of the structural type of sampled vegetation was requested during a meeting with project partners and the California Coastal Commission staff (HCRCD 2016c). During this same meeting it was also determined that quantitative vegetation sampling was not required within retained existing riparian habitat patches. This clarification does not alter the requirements established in the HMMP for monitoring the extent (acreage) of riparian habitat throughout the duration of the monitoring period.

3.2.2 Arborescent Riparian Vegetation Basal Area Assessment

Consistent with the schedule of monitoring requirements provided in the HMMP (Table 1), arborescent basal area sampling was conducted on August 2, 2023 in order to further assess the structural development of vegetation within specific replanted portions of the Phase 2 — Salt River Corridor restoration Area. During this period, we resampled previously established basal area sampling plots within the Phase 2B (Middle) restoration area replanted with woody riparian plant species to evaluate the extent of change that may have occurred since the previous sampling effort in 2021 (J.B. Lovelace & Associates 2022c). Specific habitat sampling regions where basal area sampling was performed in 2023 consisted of:

Phase 2B (Middle) — Salt River Corridor Restoration Area:

Riparian Planting Zones

- Replanted Riparian Forest (n = 10)
- Active Riparian Berm (n = 5)
- Active Bench (n = 5)

As in the 2022 habitat monitoring effort, basal area sampling was not performed within the Phase 2B (Upper) restoration area in 2023 at the direction of the HCRCD (pers. com.).

Sampling Design & Data Collection

In 2023 we resampled the same randomly located circular (r = 10 m) basal area sampling plots that were originally established and sampled in 2021 (J.B. Lovelace & Associates 2022c). Relocation of basal area sampling plots in the field was accomplished by accessing a previously-created ArcGIS Online webmap using the same mobile device, software, and GNSS technology previously described herein. Basal-area-specific field data forms were created using ESRI's ArcGIS Survey123Connect desktop software, which were then accessed in the field, as described previously for percent cover data collection, and completed basal area data forms were uploaded to ESRI's ArcGIS Survey123 web application for subsequent export, management, and analysis.

Table 4. SRERP Native Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2023). Missing values indicate monitoring years for which no habitat monitoring tasks are required for respective habitats.

Phase		SRERP Habitat Type	Percent Cover Native Plant Species Success Criteria (≥)																	
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**	2024	2025	2026	2027	2028	2029	2030
Phase 1		(Monitoring Year)		1	2	3	4	5	6	7	8	9	**10**							
		High Marsh Ecotone		5%	15%	30%	–	40%	–	50%	–	–	**60%**							
		Salt Marsh *Sensu Stricto*[2]		–	–	10%	–	30%	–	50%	–	–	**60%**							
		(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
		Replanted Riparian Forest[3]			–	15%	30%	–	40%	–	60%	–	**–**	80%						
Phase 2A	(Lower)	(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
		"Salt River Channel Wetlands"[4]			10%	20%	30%	–	50%											
		Riparian Planting Zones			–	15%	30%	–	40%	–	60%	–	**–**	80%						
	(Middle)	(Monitoring Year)				1	2	3	4	5	6	7	**8**	9	10					
		"Salt River Channel Wetlands"[4]				10%	20%	30%	–	50%										
		Riparian Planting Zones				**–**	15%	30%	–	40%	–	60%	**–**	**–**	80%					
	(Upper)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
		"Salt River Channel Wetlands"[4]						10%	20%	30%	–	50%								
		Riparian Planting Zones						–	15%	30%	–	40%	**–**	60%	–	–	80%			
Phase 2B	(Lower)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
		"Salt River Channel Wetlands"[4]						10%	20%	30%	–	50%								
		Riparian Planting Zones						–	15%	30%	–	40%	**–**	60%	**–**	**–**	80%			
	(Middle)	(Monitoring Year)							1	2	3	4	**5**	6	7	8	9	10		
		"Salt River Channel Wetlands"[4]							10%	20%	30%	–	**50%**							
		Riparian Planting Zones							–	15%	30%	–	**40%**	–	60%	**–**	**–**	80%		
	(Upper)	(Monitoring Year)								1	2	3	**4**	5	6	7	8	9	10	
		"Salt River Channel Wetlands"[4]								10%	20%	30%	**–**	50%						
		Riparian Planting Zones								–	15%	30%	**–**	40%	–	60%	–	–	80%	

[1] Adapted from Tables 8–10 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] As per guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[3] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions in the winter of 2013/2014 (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish marsh and freshwater channel wetlands.

Table 5. SRERP Non-Native Non-Invasive Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2023). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

Phase		SRERP Habitat Type	Percent Cover Non-Native Non-Invasive Plant Species Success Criteria																	
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**	2024	2025	2026	2027	2028	2029	2030
Phase 1		(Monitoring Year)		1	2	3	4	5	6	7	8	9	**10**							
		High Marsh Ecotone		–	–	–	–	–	–	–	–	–	–	**<15%**						
		Salt Marsh *Sensu Stricto*[2]		–	–	–	–	–	–	–	–	–	–	**<15%**						
		(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
		Replanted Riparian Forest[3]			–	–	–	–	–	–	–	–	–	<15%						
Phase 2A	(Lower)	(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
		"Salt River Channel Wetlands"[4,5]			–	–	–	–	<15%											
		Riparian Planting Zones			–	–	–	–	–	–	–	–	–	<15%						
	(Middle)	(Monitoring Year)				1	2	3	4	5	6	7	**8**	9	10					
		"Salt River Channel Wetlands"[4,5]				–	–	–	–	<15%										
		Riparian Planting Zones				–	–	–	–	–	–	–	–	–	<15%					
	(Upper)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
		"Salt River Channel Wetlands"[4,5]						–	–	–	–	<15%								
		Riparian Planting Zones						–	–	–	–	–	–	–	–	–	<15%			
Phase 2B	(Lower)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
		"Salt River Channel Wetlands"[4,5]						–	–	–	–	<15%								
		Riparian Planting Zones						–	–	–	–	–	–	–	–	–	<15%			
	(Middle)	(Monitoring Year)							1	2	3	4	**5**	6	7	8	9	10		
		"Salt River Channel Wetlands"[4,5]							–	–	–	–	**<15%**							
		Riparian Planting Zones							–	–	–	–	–	–	–	–	–	<15%		
	(Upper)	(Monitoring Year)								1	2	3	**4**	5	6	7	8	9	10	
		"Salt River Channel Wetlands"[4,5]								–	–	–	–	<15%						
		Riparian Planting Zones								–	–	–	–	–	–	–	–	–	<15%	

[1] Adapted from the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] As per guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[3] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions in the winter of 2013/2014 (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish marsh and freshwater channel wetlands.
[5] Although not explicitly specified in the HMMP, it is assumed that these criteria for non-native vegetation are intended for "Salt River channel wetlands," as they are for all other habitats where vegetation percent cover sampling is a requirement.

Table 6. SRERP Invasive Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2023). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

Phase		SRERP Habitat Type	Percent Cover Non-Native Invasive Plant Species Success Criteria																	
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**	2024	2025	2026	2027	2028	2029	2030
Phase 1		(Monitoring Year)		1	2	3	4	5	6	7	8	9	**10**							
		High Marsh Ecotone		–	–	–	–	–	–	–	–	–	–	**<5%**						
		Salt Marsh *Sensu Stricto*[2]		–	–	–	–	–	–	–	–	–	–	**<5%**						
		(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
		Replanted Riparian Forest[3]			–	–	–	–	–	–	–	–	–	<5%						
Phase 2A	(Lower)	(Monitoring Year)			1	2	3	4	5	6	7	8	**9**	10						
		"Salt River Channel Wetlands"[4,5]			–	–	–	–	<5%											
		Riparian Planting Zones			–	–	–	–	–	–	–	–	–	<5%						
	(Middle)	(Monitoring Year)				1	2	3	4	5	6	7	**8**	9	10					
		"Salt River Channel Wetlands"[4,5]				–	–	–	–	<5%										
		Riparian Planting Zones				–	–	–	–	–	–	–	–	–	<5%					
	(Upper)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
		"Salt River Channel Wetlands"[4,5]						–	–	–	–	<5%								
		Riparian Planting Zones						–	–	–	–	–	–	–	–	–	<5%			
Phase 2B	(Lower)	(Monitoring Year)						1	2	3	4	5	**6**	7	8	9	10			
		"Salt River Channel Wetlands"[4,5]						–	–	–	–	<5%								
		Riparian Planting Zones						–	–	–	–	–	–	–	–	–	<5%			
	(Middle)	(Monitoring Year)							1	2	3	4	**5**	6	7	8	9	10		
		"Salt River Channel Wetlands"[4,5]							–	–	–	–	**<5%**							
		Riparian Planting Zones							–	–	–	–	–	–	–	–	–	<5%		
	(Upper)	(Monitoring Year)								1	2	3	**4**	5	6	7	8	9	10	
		"Salt River Channel Wetlands"[4,5]								–	–	–	–	<5%						
		Riparian Planting Zones								–	–	–	–	–	–	–	–	–	<5%	

[1] Adapted from the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] As per guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[3] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions in the winter of 2013/2014 (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish marsh and freshwater channel wetlands.
[5] Although not explicitly specified in the HMMP, it is assumed that these criteria for non-native vegetation are intended for "Salt River channel wetlands," as they are for all other habitats where vegetation percent cover sampling is a requirement.

Each customized data form allowed for the collection of the following data for all trees located within each plot that were ≥4.5 feet ("breast height") tall: diameter-at-breast-height (DBH), species, and geographic coordinates. Diameter measurements (in millimeters) were obtained for all tree stems at 4.5 feet above ground level (on the uphill side, where relevant) using either metric calipers or a metric "diameter tape" depending on the size of the measured stem.

As in previous such sampling efforts, in instances where the circular basal area sampling plots extended outside of the boundaries of the targeted sampling regions, the aforementioned data were only collected for trees within the area of overlap between the sampling plot and target habitat; all trees outside of the combined area of overlap were ignored. (This is common in the narrow and sinuous habitat sampling areas throughout the riparian corridor of the Phase 2 — Salt River Corridor Restoration Area.)

In instances where basal area sampling plots extended into adjacent, retained "Existing Riparian Forest" habitat areas, no data were collected from trees in those retained habitats. For each sampling plot, the actual coinciding sampled area (in acres) of overlap between the sampling plot and target habitat was subsequently calculated using ArcMap to derive relativized tree-basal-area-per-unit-area-sampled ("BAPA") values for use in generating summary statistics and performing comparative analyses.

Individual plants were considered to be a "tree" if they were a species whose vegetative "habit" is described in relevant botanical literature (e.g., Baldwin et al. 2012; etc.) as being a tree at maturity. This criterion included young flexible saplings and excluded some woody species whose habit is described as being a "shrub" at maturity (even if such woody individuals encountered were robust and tall enough to have a diameter-at-breast-height).

Data Analysis

All DBH measurements collected during fieldwork were subsequently converted to values of basal area (measured in square-feet) by converting metric measurements into inches, which were then squared and multiplied by 0.005454 ("the forester's constant"), otherwise expressed as:

$$\text{Basal area} = DBH^2 \times 0.005454$$

Basal area measurements were then summed for each tree species within each sampling plot and divided by respective actual-plot-area-sampled to derive standardized values of basal-area-per-unit-area-sampled ("BAPA") (ft^2/acre) for each species at the sample plot, sampling region, and sub-phase level. Respective BAPA values were then used to characterize the species composition and basal area contributions of arborescent vegetation in habitats sampled in 2023. Summed raw basal area measurements are also provided in Appendix E.

Hypothesis Tests

The single success criterion identified in the HMMP for evaluation of basal area sampling results states that replanted riparian vegetation basal area must demonstrate a "statistically significant increasing trend" (H.T. Harvey & Associates with Winzler & Kelly 2012). To address this measure of restoration success, we performed hypothesis tests to assess the extent of change in the structural development of woody vegetation (i.e., change in BAPA) that may have occurred within the riparian planting zones of the Phase 2B (Middle) restoration area since the previous corresponding sampling effort in 2021 (J.B. Lovelace & Associates 2022c).

Initial analysis revealed that the 2023 BAPA data were highly skewed and a Shapiro-Wilks test for normality was significant (Shapiro-Wilks = 0.53, p = 0.0000058), suggesting that hypothesis testing methods that assume normality — such as a paired *t*-test — were not appropriate (Shapiro-Wilks 1965). For this reason, no paired *t*-test was performed in 2023, and we instead proceeded to use permutation tests as in previous SRERP habitat monitoring years to analyze the 2023 replanted riparian forest BAPA results in the Phase 2B (Middle) restoration reach.

As in the past, we applied the standard permutation testing reasoning that if there was no interannual change in BAPA, the year (i.e., 2021 or 2023) associated with each data point can be viewed as a meaningless label and can be permuted to form a null distribution for testing statistical hypotheses related to change. Note that random year-swapping was done only within pairs (i.e., for each plot, the same two BAPA measurements were retained and the only potential change was which value was labeled with which year).

We used 10,000 permutation data sets to derive (one-sided) *p*-values, each of which equals the proportion of permutations for which the mean difference in BAPA (i.e., the mean of the differences, 2023 minus 2021) equaled or exceeded respective actual observed values. P-values less than 0.05 were determined to indicate a statistically significant increase in BAPA over the period: 2021–2023.

While the aforementioned methods provide valid statistical hypothesis tests of the current trajectory at the level of "sampling region" and "sub-phase," they are less informative about the response of individual sampling plots, and could potentially fail to reveal patterns of success or failure at that more detailed level (e.g., sampling plots with exceptionally abundant saplings in some sampling regions could potentially mask significant tree mortality in others, etc.). In an attempt to reveal such patterns and to address the skewed nature of our 2023 basal area sampling data, we also performed a third exercise.

In this third procedure, we scored each sampling plot as being a "success" if BAPA increased from 2021 to 2023 or a "failure" if BAPA either decreased or exhibited no change during that same period. We then computed the proportion

of “successful” plots observed in 2023 for each sampling region and phase of the SRERP project area addressed during that monitoring year. We then derived 95% confidence intervals for each estimated proportion, which reflect the level of uncertainty inherent in estimating the true “success” frequency (over the entire area) from the limited set of sampled sites. Confidence intervals were computed using the Wilson method (Agresti & Coull 1998), except in cases where the proportion of successful plots approached 1.0, where we followed the recommendation of Brown et al. (2001), applying instead a modified Wilson method, which is believed to perform better than the standard method in such cases.

4.0 Results

4.1 Results of Habitat Mapping & Area Analysis

In this 10th monitoring year for the Phase 1 — Riverside Ranch Tidal Marsh Restoration Area, “tidal salt and brackish marsh” habitat continues to exceed the respective final minimum acreage success threshold established in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012). In contrast, riparian habitats of the middle Phase 2B restoration area fall well short of both the proportionately-scaled projected restored area for that specific habitat type in this 5th monitoring year for the Phase 2B (Middle) restoration reach, as well as its respective final minimum acreage success threshold.

Salient observations from the 2023 mapping effort and analysis follow. Observed habitat area (acreage) totals and respective eventual final success criteria for all relevant SRERP habitats addressed in 2023 are summarized in Tables 7–10, and the mapped distribution and extent of each habitat type and relevant associated restoration design components are depicted in Appendix A (Figures 2–3). (Figures presented in Appendix A depict both habitats of interest in 2023 as well as those adjoining, given that the mapping of any one habitat boundary affects all adjoining habitat boundaries and corresponding areas).

4.1.1 Phase 1 — Riverside Ranch Tidal Marsh Restoration Area Habitats

Habitat mapping and areal assessments of high marsh ecotone and Phase 1 riparian habitats were not required in 2023 (Table 1) and are, therefore, not addressed further in this report.

No significant change has occurred in the total area of the broadly inclusive projected Phase 1 habitat complex, “tidal salt and brackish marsh” since this habitat complex was previously addressed in detail in 2020 (J.B. Lovelace & Associates 2022b). Collectively, “tidal salt and brackish marsh” covers 303.93 acres of the Phase 1 project area in 2023, slightly less (~95%) than the projected extent (321.7 acres) of this habitat complex, yet still 14.43 acres greater than the final minimum success threshold (i.e., 289.50 acres) established in the HMMP for this final year of restoration monitoring for this Phase 1 habitat complex (Table 7; Appendix A, Figures 1–2).

Table 7. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area: Summary of habitats addressed during the 2023 SRERP habitat monitoring effort and their respective success criteria.

	Area (Acres)[1,2]			
			2023	
Habitats & Restoration Design Components	Projected[3]	Final Success Criteria[4]	Observed	% of Projected
"Tidal Salt & Brackish Marsh"[5]				
Salt Marsh Sensu Stricto	–	–	*210.30*	–
Mudflat[6]	*20.81*	*≥18.73*	*25.23*	*278%*
Aquatic[6]			*32.69*	
Brackish Marsh	–	–	*15.71*	–
Upland	–	–	*20.00*	–
"Tidal Salt & Brackish Marsh"[4] Total	**321.67**	**≥289.50**	**303.93**	**95%**

[1] Values presented here do not include other Phase 1 habitats that were not addressed in the 2023 SRERP habitat monitoring effort.
[2] Missing values reflect "projected habitat" acreages, which were not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly defined habitat components identified during the 2023 habitat monitoring effort.
[3] "Projected Habitat" acreage quantities for those habitats either not recognized as discrete areas in H.T. Harvey & Associates with Winzler & Kelly (2012), or for partial portions of habitats which extend beyond phase and/or sub-phase boundaries, were proportionately scaled from "Projected Habitat" GIS data used in the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), and which are depicted in (Appendix A, Figure 1).
[4] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5–10.
[5] Acreage analysis of Phase 1 "Tidal Salt & Brackish Marsh" assumes the inclusion of all associated and more narrowly described habitats following guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[6] Aquatic and mudflat habitats are treated collectively ("Aquatic/Mudflat") in (H.T. Harvey & Associates with Winzler & Kelly 2012).

Noteworthy changes within this habitat complex between 2020–2023 include the continued conversion of unvegetated mudflat and aquatic habitat to vegetated "true" salt marsh *sensu stricto*. During the aforementioned period, salt marsh *s.s.* increased from 204.76 acres in 2020 to 210.30 acres in 2023 (Δ +5.54 acres). During this same period, unvegetated mudflat and aquatic habitats combined decreased from 63.06 acres in 2020 to 57.92 acres in 2023 (Δ -5.14 acres [Δ –5.09 and Δ –0.05 acres, respectively]).

4.1.2 Phase 2 — Salt River Corridor Restoration Area Riparian Habitats

Habitat mapping and areal assessments of SRERP riparian forest habitats were only required for the Phase 2B (Middle) restoration reach in 2023 (Table 1). Other riparian forest restoration areas within the SRERP footprint are, therefore, not addressed further in this report (however, refer to Section 5.1).

The extent and total area of riparian habitats distributed throughout the Phase 2B (Middle) restoration reach has not changed substantially since our relevant previous habitat mapping fieldwork in 2021 (J.B. Lovelace & Associates 2022c). Substantive—but minor—changes that have occurred since 2021 include a 0.21-acre decrease (from 2.55 to 2.34 acres) in retained existing riparian forest, which is largely attributable to senescence and mortality associated with discrete and isolated patches of mature riparian trees in adjacent agricultural pastureland

within the mapped SRERP footprint (Appendix A, Figure 3). Slight mapping refinements to the additional supplemental riparian planting area associated with the active bench habitat along the southern boundary of the middle Phase 2B restoration reach (Appendix A, Figure 3) also resulted in a negligible increase (Δ +0.02 acres) in the contribution of supplemental riparian planting area towards replanted riparian habitats in this portion of the SRERP footprint.

As of the 2023 habitat monitoring effort, 6.58 acres of the Phase 2B (Middle) restoration area consist of either retained existing riparian forest or have been replanted with woody riparian vegetation (Table 8). This total represents only 51% of the proportionately-scaled projected restored area (i.e., 12.86 acres) for this Phase 2B (Middle) habitat type, and 4.99 acres less than the respective proportionately-scaled final minimum success threshold (i.e., 11.57 acres) established in the HMMP (Table 8; Appendix A, Figures 1 and 3).

Of the combined areas contributing to the aforementioned Phase 2B (Middle) riparian habitat acreage total, 2.34 acres consist of retained existing riparian forest (Table 9), and the remaining 4.24 acres are made up of 1.96 acres of initially revegetated riparian planting zones (Table 9) and 2.28 acres of additional supplemental riparian planting areas replanted more recently (Table 10).

Table 8. SRERP Phase 2 — Salt River Corridor Restoration Area: Summary of retained existing and replanted riparian area contributions to the total acreage of Phase 2 riparian forest habitats addressed in the 2023 SRERP habitat monitoring effort.

	Habitat Area (Acres)[1]			
Habitats & Restoration Design Components	**Projected[2]**	**Final Success Criteria[3]**	**Observed**	**% of Projected**
Phase 2B (Middle)				
Existing Riparian Forest & Riparian Planting Zones	12.86	≥11.57	4.30	33%
Supplemental Riparian Planting Areas[4]	–	–	2.28	–
Total	**12.86**	**≥11.57**	**6.58**	**51%**

[1] Values presented here do not include other Phase 2 riparian forest habitats that were not addressed in the 2023 SRERP habitat monitoring effort.

[2] "Projected Habitat" acreage quantities for those habitats either not recognized as discrete areas in H.T. Harvey & Associates with Winzler & Kelly (2012), or for partial portions of habitats which extend beyond phase and/or sub-phase boundaries, were proportionately scaled from "Projected Habitat" GIS data used in the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), and which are depicted in Appendix A (Figure 1).

[3] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5–10.

[4] Missing values reflect "projected habitat" acreages, which were not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly defined habitat components documented during the 2023 habitat monitoring effort.

Initially revegetated riparian planting zones include 0.73 acres of replanted riparian forest and 1.23 acres of replanted active riparian berm habitats (Table 9). The 2.28 acres of supplemental riparian planting areas (Table 10) consist of replanted freshwater active bench Salt River channel wetland habitat† which was replanted with woody riparian vegetation in 2018–2019 to compensate for reductions in the availability of other portions of the Phase 2B (Middle) restoration reach where replanting of woody riparian vegetation could occur.

4.2 Results of Quantitative Vegetation Analyses

4.2.1 Vegetation Percent Cover Sampling Results

Findings presented below address the adequacy of sample sizes used in our 2023 vegetation percent cover sampling effort, provide a current quantitative characterization of both the structural composition and native status of vegetation throughout sampling regions visited in 2023, and evaluate the abundance of specific categories of vegetation (i.e., native, non-native non-invasive, and invasive) as they relate to various relevant restoration success thresholds (Tables 4–6) established in the HMMP.

Table 9. SRERP Phase 2 — Salt River Corridor Restoration Area: Riparian Forest Habitats. Summary of riparian habitat areas addressed during the 2023 SRERP habitat monitoring effort and their respective success criteria.

	Habitat Area (Acres)[1,2]			
			2023	
Habitats & Restoration Design Components	**Projected[3]**	**Final Success Criteria[4]**	**Observed**	**% of Projected**
Phase 2B (Middle)				
Existing Riparian Forest	–	–	2.34	–
Riparian Planting Zones				
Replanted Riparian Forest	–	–	*0.73*	–
Active Riparian Berms	–	–	*1.23*	–
Riparian Planting Zone Total	–	–	1.96	–
Riparian Forest Habitat Total	**12.86**	**≥11.57**	**4.30**	**33%**

[1] Values presented here do not include other Phase 2 riparian forest habitats that were not addressed in the 2023 SRERP habitat monitoring effort.
[2] Missing values reflect "projected habitat" acreages not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly defined habitat components documented during the 2023 habitat monitoring effort.
[3] "Projected Habitat" acreage quantities for those habitats either not recognized as discrete areas in H.T. Harvey & Associates with Winzler & Kelly (2012), or for partial portions of habitats which extend beyond phase and/or sub-phase boundaries, were extrapolated from "Projected Habitat" GIS data used in the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), and which are depicted in Appendix A (Figure 1).
[4] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5–10.

† It is worth noting that the 2.28 acres of Phase 2B (Middle) freshwater active bench habitat subsequently replanted with woody riparian vegetation are being applied towards satisfaction of minimum areal success thresholds for both Salt River channel wetland and riparian forest habitats.

Table 10. SRERP Phase 2 — Salt River Corridor Restoration Area: Supplemental Riparian Forest Planting Areas. Quantitative summary of previously restored SRERP areas subsequently supplemented with woody riparian plants. Restoration design components and respective areas presented here consist only of those addressed during the 2023 SRERP habitat monitoring effort. Other such subsequently replanted Phase 2 areas are not included.

Habitats & Restoration Design Components	Replanted Area (Acres)
Phase 2B (Middle)	
Sediment Management Areas	N/A
Replanted Freshwater Active Bench	2.28
Total	**2.28**

Herein, we also specifically address the 2023 results for salt marsh *sensu stricto* and high marsh ecotone within the Phase 1 restoration area, as well as the Salt River channel wetlands within the Phase 2B (Middle) restoration area given that 2023 represents the "final" monitoring year wherein vegetation percent cover sampling is scheduled to occur in these portions of the SRERP (Table 1), as originally anticipated in the HMMP. Additional independent analysis of the 2023 abundance of the prevalent invasive grass, *Phalaris arundinacea* ("reed canary grass"), is also included at the request of the Humboldt County Resource Conservation District. A complete list of all plant species detected during our 2023 vegetation sampling fieldwork, along with their corresponding original (untransformed) absolute mean percent cover and frequency-of-occurrence values is provided in Appendix B.

Sample Size

Results from power analyses performed as part of the current effort yielded minimum sample sizes varying across the different combinations of sampling region and vegetation category, but confirmed that those used in the 2023 SRERP vegetation sampling effort do satisfy our pre-determined criteria (refer to Section 3.2.1) in all relevant instances (Table 11).

Structural Composition

Total vegetative cover continues to remain fairly stable throughout portions of the SRERP area sampled in 2023, with all mean cover estimates exceeding 92% (Table 12; Appendix C, Figure 1). The lowest total vegetative cover estimate recorded in 2023 was observed in the active channel sampling region of the Phase 2B (Middle) restoration area ($\overline{x} = 92.8\%$, 95% CI [86.0, 96.6]). This represents a slight decrease (Δ = –3.3%) since the previous sampling event for that project reach in 2021 (Table 12; Appendix C, Figure 1), but is neither surprising nor concerning given the dynamic nature of that sampling region.

Table 11 Power Analysis Results Associated with the 2023 SRERP Vegetation Cover Sampling Effort. All 2023 sample sizes were demonstrated to be sufficient to satisfy pre-determined criteria.*

Relevant SRERP Habitat Sampling Areas	Most Recent Previous Post-Hoc Power Analysis Results (n)	2023 Sample Size Used (n)	2023 Post-Hoc Power Analysis Results*	2023 Difference
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area†				
High Marsh Ecotone	14	20	11	9
"Tidal Salt & Brackish Marsh"	30	35	21	14
Phase 2B (Middle) — Salt River Corridor Restoration Area‡				
Active Channel	19	25	16	9
Active Bench	20	25	21	4
Active Riparian Berm	14	20	18	2
Replanted Riparian Forest	15	20	20	0

* Where α=0.05 and β=0.80 to detect a medium effect size (i.e., 0.5 SD) between sample means and respective success criteria using a two-sided *t*-test.
† Most recent post-hoc power analysis was performed in 2020 (J.B. Lovelace & Associates 2022b).
‡ Most recent post-hoc power analysis was performed in 2021 (J.B. Lovelace & Associates 2022c).

Herbaceous Vegetation

The vast majority of SRERP plant communities sampled in 2023 were dominated by, or consisted entirely of, herbaceous vegetation (Table 12; Appendix C, Figures 2–3). Mean percent cover estimates for herbaceous vegetation in 2023 ranged from 98.1% (95% CI [96.0, 99.2]) in the Phase 1 salt marsh *sensu stricto* sampling region—reflecting continued colonization of mudflat and aquatic habitats by herbaceous salt marsh vegetation (primarily the invasive Spartina densiflora, "dense-flowered cord grass")—to 87.7% (95% CI [80.9, 92.8]) in the Phase 2B (Middle) active channel sampling region, where regular fluvial disturbance maintains some exposed substrate and a slowly developing arborescent vegetation component may be beginning to compete with co-occurring herbaceous plants (Table 12; Appendix C, Figures 1–3).

Woody Riparian Vegetation

As expected, woody riparian vegetation is almost entirely absent from salt marsh *sensu stricto* and high marsh ecotone habitats within the Phase 1 restoration area, with the limited exception ($\overline{x}$ = 0.6%, 95% CI [0, 1.8]) of an establishing component of *Rubus ursinus* ("California blackberry") along the upland fringe of the latter sampling region (Table 12; Appendix B; Appendix C, Figure 2). In the Phase 2B (Middle) restoration reach, four years after post-restoration replanting occurred in this subphase, woody vegetation continues to struggle to establish throughout all sampling regions addressed in 2023 (Table 12; Appendix C, Figure 3).

Table 12. Structural Composition of Vegetation within 2023 Sampled Habitats. Mean percent cover estimates are in bold and associated 95% confidence intervals follow in brackets. No specific success criteria exist for vegetative structural categories (H.T. Harvey & Associates with Winzler & Kelly 2012).

	Mean Percent Cover for Vegetation Categories of Interest				
SRERP Habitat Sampling Areas	**Total**	**Herb**	**Shrub**	**Tree**	**Vine**
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area					
Salt Marsh *Sensu Stricto* (n=35)	**98.1** [96.0, 99.2]	**98.1** [96.0, 99.2]	**0** [N/A]	**0** [N/A]	**0** [N/A]
High Marsh Ecotone (n=20)	**96.3** [91.5, 98.3]	**95.7** [91.2, 98.0]	**0.6** [0, 1.8]	**0** [N/A]	**0** [N/A]
Phase 2 — Salt River Corridor Restoration Area Channel Wetlands					
Phase 2B (Middle) — Salt River Channel Wetlands					
Active Channel (n=25)	**92.8** [86.0, 96.6]	**87.7** [80.9, 92.8]	**0** [N/A]	**5.1** [2.1, 10.1]	**0** [N/A]
Active Bench (n=25)	**94.4** [90.4, 97.0]	**92.0** [87.4, 95.4]	**0.4** [0, 1.3]	**2.0** [0.1, 7.6]	**0** [N/A]
Phase 2B (Middle) — Riparian Planting Zones					
Replanted Riparian Forest (n=20)	**100.0** [N/A]	**94.0** [85.9, 98.3]	**2.4** [0.1, 7.5]	**3.6** [0, 10.7]	**0** [N/A]
Active Riparian Berm (n=20)	**100.0** [N/A]	**96.9** [89.3, 99.3]	**3.1** [0.4, 9.7]	**0** [N/A]	**0** [N/A]

The greatest mean estimate of arborescent vegetation in the middle Phase 2B restoration reach in 2023 was only 5.1% (95% CI [2.1, 10.1]), which was observed within the active channel sampling region (Table 12 ; Appendix C, Figure 3). Tree species were only otherwise encountered during our 2023 vegetation percent cover sampling in Phase 2B (Middle) replanted riparian forest and active bench sampling regions (but refer to Section 4.2.2, below), with mean cover estimates of 3.6% (95% CI [0, 10.7]) and 2.0% (95% CI [0.1, 7.6]), respectively (Table 12; Appendix C, Figure 3). Despite being revegetated with woody riparian plants in 2018–2019, no tree species were encountered in Phase 2B (Middle) active riparian berm sample plots during our 2023 vegetation percent cover sampling effort (Table 12; Appendix C, Figure 3) (but refer to Section 4.2.2, below).

Estimated mean cover of shrub species encountered in the middle Phase 2B restoration reach during our 2023 vegetation percent cover sampling effort was greatest in the active riparian berm sampling region ($\overline{x}$ = 3.1%, 95% CI [0.4, 9.7]), followed—in decreasing order—by replanted riparian forest ($\overline{x}$ = 2.4%, 95% CI [0.1, 7.5]) and the active bench ($\overline{x}$ = 0.4%, 95% CI [0, 1.3]) (Table 12; Appendix C, Figure 3).

Community Composition

Native Vegetation

Mean estimated cover of native vegetation fell short of respective minimum success thresholds (Table 4) in all regions sampled in 2023 except the high marsh ecotone of the Phase 1 restoration area (Table 13; Appendix D, Figure 1). In this latter sampling region, native vegetative cover ($\overline{x}$ = 72.2%, 95% CI [61.0, 79.8]) did successfully exceed the final respective minimum cover threshold (i.e., ≥60%) in this final monitoring year for that specific SRERP habitat (Table 13; Appendix D, Figure 1).

The two most abundant plant species encountered in the high marsh ecotone during our most recent sampling effort were the native *Deschampsia cespitosa*, “tufted hair grass” ($\overline{x}$ = 43.4% absolute cover, *s* = 31.6; frequency of occurrence = 90%) and *Salicornia pacifica*, “pickleweed” ($\overline{x}$ = 19.3% absolute cover, *s* = 19.5; frequency of occurrence = 60%) (Appendix B). Other native plants known to inhabit such transitional tidally-influenced habitats were also detected to lesser degrees (Appendix B). One such native plant encountered in our high marsh ecotone sample plots in 2023—though in limited abundance—was the rare *Castilleja ambigua* ssp. *humboldtiensis* (“Humboldt Bay owl’s-clover”). This rare species was detected in 5% of our sample plots in this region, with a mean estimated absolute cover value of 0.15% (*s* = 0.67) (Appendix B).

Included among those restoration areas where the abundance of native vegetation was found to be deficient in this most recent sampling effort were the Phase 1 salt marsh *sensu stricto* and Phase 2B (Middle) Salt River channel wetland (i.e., active channel and active bench) sampling regions, for which 2023 also represents the “final” monitoring year wherein vegetation percent cover

Table 13. Summary of 2023 SRERP Quantitative Vegetation Percent Cover Sampling Results & Respective Success Criteria. Mean percent cover estimates are in bold and associated 95% confidence intervals follow in brackets.

	Mean Percent Cover for Vegetation Categories of Interest							
	Total Vegetation[1]	Native Vegetation		Non-Native Non-Invasive Vegetation		Invasive Vegetation		
SRERP Habitat Sampling Area	Observed	Observed	2023 Success Criteria[2]	Observed	Final Success Criteria[3]	Observed	Final Success Criteria[3]	
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area								
Salt Marsh *Sensu Stricto* (n=35)	**98.1** [96.0, 99.2]	**47.0** [37.4, 56.6]	≥60%	**6.4** [3.7, 10.5]	<15%	**44.7** [35.0, 55.1]	<5%	
High Marsh Ecotone (n=20)	**96.3** [91.5, 98.3]	**72.2** [61.0, 79.8]	≥60%	**6.8** [3.8, 10.5]	<15%	**17.3** [9.7, 28.1]	<5%	
Phase 2 — Salt River Corridor Restoration Area								
Phase 2B (Middle) — Salt River Channel Wetlands								
Active Channel (n=25)	**92.8** [86.0, 96.6]	**40.6** [32.1, 50.2]	≥50%	**6.2** [3.6, 9.6]	<15%	**46.0** [36.9, 54.8]	<5%	
Active Bench (n=25)	**94.4** [90.4, 97.0]	**20.6** [11.1, 33.8]	≥50%	**19.9** [12.9, 29.0]	<15%	**53.9** [41.9, 65.7]	<5%	
Phase 2B (Middle) — Riparian Planting Zones								
Replanted Riparian Forest (n=20)	**100.0** [N/A]	**37.0** [26.3, 51.3]	≥40%	**10.5** [5.3, 19.6]	<15%	**52.4** [39.3, 64.5]	<5%	
Active Riparian Berm (n=20)	**100.0** [N/A]	**22.6** [12.2, 36.4]	≥40%	**10.1** [5.7, 16.0]	<15%	**67.3** [54.1, 78.4]	<5%	

[1] No specific success criteria are indicated in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] Adapted from Tables 8–10 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[3] Must be achieved by the final monitoring year for each respective habitat sampling area (i.e., Year 5 for Salt River Channel Wetlands or Year 10 for all others) (H.T. Harvey & Associates with Winzler & Kelly 2012).

sampling is scheduled to occur (Table 1). In the salt marsh *sensu stricto* sampling region of the Phase 1 restoration area, the estimated cover of native vegetation ($\overline{x}$ = 47.0%, 95% CI [37.4, 56.6]) fell well short of the respective final minimum cover threshold of 60% (Table 13; Appendix D, Figure 1).

The two most abundant native plant species encountered in the salt marsh *sensu stricto* sampling region during our most recent sampling effort were *Distichlis spicata*, "salt grass" ($\overline{x}$ = 19.7% absolute cover, *s* = 25.2; frequency of occurrence = 51%) and *Salicornia pacifica*, "pickleweed" ($\overline{x}$ = 17.9% absolute cover, *s* = 25.7; frequency of occurrence = 60%) (Appendix B). Other native salt marsh plants were also detected to lesser degrees, including the rare *Carex lyngbyei* ("Lyngbye's sedge") (Appendix B). This rare species was detected in 3% of our sample plots in this region, with a mean estimated absolute cover value of 2.8% (*s* = 16.5) (Appendix B). It is also worth noting that, while not detected within any of our salt marsh *sensu stricto* sample plots, the previously mentioned rare plant, *Castilleja ambigua* ssp. *humboldtiensis* ("Humboldt Bay owl's-clover") was also incidentally encountered elsewhere within this Phase 1 habitat in multiple instances in 2023, typically occurring along the upper margin of salt marsh habitats and other similar higher elevation locations.

In the Phase 2B (Middle) Salt River channel wetlands, the mean estimated cover of native vegetation in the active channel sampling region ($\overline{x}$ = 40.6%, 95% CI [32.1, 50.2]) failed to reach or exceed the respective final minimum cover threshold of 50% (Table 13; Appendix D, Figure 1) in what is scheduled to be the final year wherein vegetation percent cover sampling is scheduled to occur (Table 1). The most abundant native plants encountered in Phase 2B (Middle) active channel sample plots included *Eleocharis macrostachya*, "spikerush" ($\overline{x}$ = 11.3% absolute cover, *s* = 22.1; frequency of occurrence = 32%), *Deschampsia cespitosa*, "tufted hair grass" ($\overline{x}$ = 10.9% absolute cover, *s* = 17.6; frequency of occurrence = 36%), *Potentilla anserina* ssp. *pacifica*, "Pacific silverweed" ($\overline{x}$ = 10.5% absolute cover, *s* = 15.5; frequency of occurrence = 52%), *Oenanthe sarmentosa*, "water parsley" ($\overline{x}$ = 5.9% absolute cover, *s* = 9.4; frequency of occurrence = 40%), and others (Appendix B). Native willow saplings were also encountered in Phase 2B (Middle) active channel sample plots, including *Salix sitchensis*, "Sitka willow" ($\overline{x}$ = 5.4% absolute cover, *s* = 11.2; frequency of occurrence = 24%), and to a lesser degree, *Salix lasiandra* ssp. *lasiandra* ("Pacific willow") and *Salix hookeriana* ("coastal willow") (Appendix B).

Mean estimated cover of native vegetation in the Phase 2B (Middle) active bench sampling region ($\overline{x}$ = 20.6%, 95% CI [11.1, 33.8]) also failed to reach or exceed the respective final minimum cover threshold of 50% (Table 13; Appendix D, Figure 1) in what is scheduled to be the final year wherein vegetation percent cover sampling is scheduled to occur (Table 1). The most abundant native plants encountered in Phase 2B (Middle) active bench sample plots included *Deschampsia cespitosa*, "tufted hair grass" ($\overline{x}$ = 5.8% absolute cover, *s* = 14.6; frequency of occurrence = 20%), *Scirpus microcarpus*, "small fruited bulrush"

($\overline{x} = 5.0\%$ absolute cover, *s* = 18.4; frequency of occurrence = 12%), *Alopecurus geniculatus*, "water foxtail" ($\overline{x} = 3.7\%$ absolute cover, *s* = 10.6; frequency of occurrence = 16%), and others in lesser abundance, including a few *Salix hookeriana* ("coastal willow") and *Salix lasiandra* ssp. *lasiandra* ("Pacific willow") saplings detected in a small number of sample plots (Appendix B).

Vegetation percent cover sampling is scheduled to continue occur in riparian planting zones in the Phase 2B (Middle) restoration reach through 2028 (i.e., the 10th monitoring year for that reach) (H.T. Harvey & Associates with Winzler & Kelly 2012). Although 2023 was not the final monitoring year for Phase 2B (Middle) active riparian berm and replanted riparian forest sampling regions, mean estimated cover of native vegetation did still fail to reach or exceed the respective final minimum cover threshold of 40% in both (Table 13; Appendix D, Figure 1).

In the Phase 2B (Middle) active riparian berm sampling region, mean estimated cover of native vegetation ($\overline{x} = 22.6\%$, 95% CI [12.2, 36.4]) fell well short of the 40% minimum cover threshold for 2023 (Table 13; Appendix D, Figure 1). The most abundant native plants encountered in Phase 2B (Middle) active riparian berm sample plots included *Deschampsia cespitosa*, "tufted hair grass" ($\overline{x} = 8.8\%$ absolute cover, *s* = 13.7; frequency of occurrence = 45%), *Equisetum telmateia* ssp. *braunii*, "giant horsetail" ($\overline{x} = 5.6\%$ absolute cover, *s* = 11.8; frequency of occurrence = 30%), *Juncus patens*, "spreading rush" ($\overline{x} = 2.3\%$ absolute cover, *s* = 5.5; frequency of occurrence = 16%), and the native shrub, *Lonicera involucrata* ssp. *ledebourii* , "twinberry" ($\overline{x} = 3.9\%$ absolute cover, *s* = 14.2; frequency of occurrence = 10%) (Appendix B).

In the Phase 2B (Middle) replanted riparian forest sampling region, the mean estimate for native vegetation cover was only slightly less than the 40% minimum cover threshold for 2023 ($\overline{x} = 37.0\%$, 95% CI [26.3, 51.3]), and said threshold was well within the associated 95% confidence interval Table 13; Appendix D, Figure 1). These recent results also represent a notable increase in the abundance of native vegetation within this specific habitat since the relevant previous sampling effort occurred in 2021 (Appendix D, Figure 1).

The most abundant native plants encountered in Phase 2B (Middle) replanted riparian forest sample plots included *Equisetum telmateia* ssp. *braunii*, "giant horsetail" ($\overline{x} = 10.6\%$ absolute cover, *s* = 19.6; frequency of occurrence = 25%), *Potentilla anserina* ssp. *pacifica*, "Pacific silverweed" ($\overline{x} = 5.2\%$ absolute cover, *s* = 9.7; frequency of occurrence = 36%), *Eleocharis macrostachya*, "spikerush" ($\overline{x} = 7.4\%$ absolute cover, *s* = 23.1; frequency of occurrence = 10%), *Deschampsia cespitosa*, "tufted hair grass" ($\overline{x} = 4.3\%$ absolute cover, *s* = 9.5; frequency of occurrence = 25%), and the woody species, *Salix lasiolepis*, "arroyo willow" ($\overline{x} = 4.3\%$ absolute cover, *s* = 19.1; frequency of occurrence = 5%), *Salix sitchensis*, "Sitka willow" ($\overline{x} = 1.9\%$ absolute cover, *s* = 8.4; frequency of

occurrence = 5%), *Lonicera involucrata* ssp. *ledebourii*, “twinberry” ($\overline{x} = 1.9\%$ absolute cover, *s* = 8.4; frequency of occurrence = 5%) (Appendix B).

Non-Native Non-Invasive Vegetation

The abundance of non-native non-invasive vegetation remains below the final maximum threshold for this vegetation category (i.e., <15% cover) throughout all sampling regions addressed in 2023, except for the active bench of the Phase 2B (Middle) restoration reach (Table 13; Appendix D, Figure 2). This includes Phase 1 salt marsh *sensu stricto* ($\overline{x} = 6.4\%$, 95% CI [3.7, 10.5]) and high marsh ecotone ($\overline{x} = 6.8\%$, 95% CI [3.8, 10.5]), reflecting achievement of the final success criterion for this category of vegetation in these two sampling regions in this last year wherein vegetation percent cover sampling is scheduled to occur in both habitats (Table 1).

2023 is also the last scheduled year for such sampling in the active bench habitat of the Phase 2B (Middle) restoration reach. In this latter sampling region, non-native non-invasive vegetative cover ($\overline{x} = 19.9\%$, 95% CI [12.9, 29.0]) was in excess of the final respective maximum cover threshold of <15% (Table 13; Appendix D, Figure 2). The most abundant non-native non-invasive plants encountered in Phase 2B (Middle) active bench sample plots included *Trifolium repens*, “white clover” ($\overline{x} = 7.1\%$ absolute cover, *s* = 12.7; frequency of occurrence = 36%), *Festuca perennis*, “rye grass” ($\overline{x} = 6.8\%$ absolute cover, *s* = 14.6; frequency of occurrence = 36%), and *Ranunculus repens*, “creeping buttercup” ($\overline{x} = 2.5\%$ absolute cover, *s* = 7.9; frequency of occurrence = 20%), among others of lesser abundance (Appendix B).

Other mean percent cover sampling estimates for this category of vegetation obtained in 2023 ranged from 6.2 [95% CI = 3.6, 9.6] in the Phase 2B (Middle) active channel sampling region to 10.5 [95% CI = 5.3, 19.6] in the Phase 2B (Middle) replanted riparian forest (Table 13; Appendix D, Figure 2). The non-native non-invasive species composition documented in these and all other sampling regions addressed in 2023 can be found in Appendix B.

Invasive Vegetation

Mean estimated cover of invasive vegetation far exceeds the final maximum threshold for this vegetation category (i.e., <5% cover) in all sampling regions addressed in 2023 (Table 13; Appendix D, Figure 3). These include those four sampling regions for which 2023 represents the “final” monitoring year wherein vegetation percent cover sampling is scheduled to occur: salt marsh *sensu stricto* and high marsh ecotone within the Phase 1 restoration area, as well as the Salt River channel wetlands (i.e., active channel and active bench) within the Phase 2B (Middle) restoration area (Table 1).

The least mean estimated cover of invasive vegetation observed in SRERP sampling regions in 2023 was in the high marsh ecotone of the Phase 1 restoration area ($\overline{x} = 17.3\%$, 95% CI [9.7, 28.1]) (Table 13; Appendix D, Figure 3).

The next lowest was in the Phase 1 salt marsh *sensu stricto* sampling region. ($\overline{x} = 44.7\%$, 95% CI [35.0, 55.1]) (Table 13; Appendix D, Figure 3). In the Phase 2B (Middle) restoration reach, mean estimated cover of invasive vegetation ranged from 46.0% (95% CI [36.9, 54.8]) in the active channel sampling region to 67.3% (95% CI [54.1, 78.4]) in the active riparian berm, with replanted riparian forest and active bench sampling regions exhibiting elevated estimates of invasive vegetative cover intermediate between those: $\overline{x} = 52.4\%$ (95% CI [39.3, 64.5]) and $\overline{x} = 53.9\%$ (95% CI [41.9, 65.7]) , respectively (Table 13; Appendix D, Figure 3).

Two apparent "suites" of invasive vegetation continue to be dominant throughout all Phase 1 and Phase 2B (Middle) sampling regions addressed in 2023. These suites variously include some plants common to both, but otherwise segregate in association with one of two specific dominant invasive species, representative of either the estuarine habitats of the Phase 1 — Riverside Ranch Tidal Marsh Restoration Area or those of the predominantly palustrine (freshwater) Phase 2 — Salt River Corridor Restoration Area: *Spartina densiflora* ("dense-flowered cord grass") or *Phalaris arundinacea* ("reed canary grass"), respectively.

Spartina densiflora ("dense-flowered cord grass") continues to be, far and away, the most abundant plant in the salt marsh *sensu stricto* habitats of the Phase 1 restoration area ($\overline{x} = 44.5\%$ absolute cover, *s* = 35.8; frequency of occurrence = 86%) (Appendix B). Other invasive plant species detected in our salt marsh sample plots in 2023 included *Parapholis strigosa*, "hairy sickle grass" ($\overline{x} = 4.1\%$ absolute cover, *s* = 11.0; frequency of occurrence = 14%) and *Agrostis stolonifera*, "creeping bent" ($\overline{x} = 0.5\%$ absolute cover, *s* = 2.6; frequency of occurrence = 9%) (Appendix B).

Spartina densiflora ("dense-flowered cord grass") was also commonly encountered in high marsh ecotone sample plots of the Phase 1 restoration area as well ($\overline{x} = 6.7\%$ absolute cover, *s* = 16.0; frequency of occurrence = 25%), though *Agrostis stolonifera* ("creeping bent") was the most abundant invasive plant in that transitional habitat type ($\overline{x} = 9.6\%$ absolute cover, *s* = 17.2; frequency of occurrence = 45%). *Helminthotheca echioides* ("bristly ox-tongue") was also encountered in high marsh ecotone sample plots in 2023 ($\overline{x} = 2.0\%$ absolute cover, *s* = 4.6; frequency of occurrence = 25%), but to a lesser degree (Appendix B).

Throughout the Phase 2B (Middle) restoration reach, our 2023 vegetation sampling results reflect that the invasive vegetation component was comprised of the same four invasive plants: *Phalaris arundinacea* ("reed canary grass"), *Holcus lanatus* ("common velvet grass"), *Agrostis stolonifera* ("creeping bent"), and *Helminthotheca echioides* ("bristly ox-tongue"); with 2–3 additional species also being present in riparian planting zones: *Conium maculatum* ("poison hemlock") and *Cirsium vulgare* ("bull thistle") in both active riparian berm and replanted riparian forest sampling regions, as well as *Dipsacus fullonum* ("wild

teasel") in the latter sampling region (Appendix B). The abundance of *Phalaris arundinacea* ("reed canary grass") is treated (independently) in greater detail below, but its general contribution to the invasive vegetation assemblage is also included here, in the context of other co-occurring plant species.

Across all Phase 2B (Middle) sampling regions in 2023, *Phalaris arundinacea* ("reed canary grass") was by far the most abundant plant—as well as being the most abundant invasive plant—encountered (Appendix B). In both sampling regions within the Phase 2B (Middle) Salt River channel wetlands, the estimated mean absolute cover of *P*. *arundinacea* was at least four times that of the next most abundant plant (Appendix B).

In Phase 2B (Middle) riparian planting zones, *P*. *arundinacea* was still clearly the most abundant plant in our 2023 sample plots, though *Holcus lanatus* ("common velvet grass") was also disproportionately well-represented in these two sampling regions (Appendix B). In the Phase 2B (Middle) active riparian berm, mean estimated absolute cover of *H. lanatus* was 29.7% (*s* = 29.4) and was encountered in 70% of respective sample plots in 2023 (Appendix B). In the replanted riparian forest sampling region of the Phase 2B (Middle) reach, mean estimated absolute cover of *H. lanatus* was 21.4% (*s* = 22.4) and that invasive grass species was encountered in 65% of respective sample plots in 2023 (Appendix B). Additional quantitative metrics of the abundance of the other aforementioned invasive plants detected during our 2023 vegetation sampling effort can be found in Appendix B.

Species-Specific Analysis: *Phalaris arundinacea* ('Reed Canary Grass")
As indicated above, the invasive grass, *Phalaris arundinacea* ("reed canary grass"), continues to be the most prevalent plant throughout the middle Phase 2B restoration reach (Appendix B). *P. arundinacea* was observed incidentally in both salt marsh *sensu stricto* and high marsh ecotone habitats of the Phase 1 restoration area, but sporadically enough that it was not encountered in any of our 2023 sample plots (Table 14; Appendix B). In the Phase 2B (Middle) restoration reach, *P*. *arundinacea* was found to be least abundant in the riparian planting zones during this most recent sampling effort, where it is subject to competitive pressures from the co-occurring invasive grass, *Holcus lanatus* ("common velvet grass") (Appendix B).

Mean estimated cover of *Phalaris arundinacea* ("reed canary grass") was 31.4% (95% CI [18.0, 48.6]) in the Phase 2B (Middle) replanted riparian forest sampling region in 2023, where it occurred in 50% of respective sample plots and represented 47% of the total invasive vegetative cover of that region (Table 14). In the Phase 2B (Middle) active riparian berm, mean estimated cover of *Phalaris arundinacea* ("reed canary grass") was 32.0% (95% CI [14.5, 45.8]), where it occurred in 65% of active berm sample plots and represented 53% of the total invasive vegetative cover of that habitat component (Table 14).

Table 14. Abundance of *Phalaris arundinacea* (reed canary grass) in 2023 SRERP Quantitative Vegetation Sampling Plots.

SRERP Habitat Sampling Areas	Abundance of *Phalaris arundinacea* (reed canary grass)			
	Mean Percent Cover[1]		Frequency of Occurrence[2]	% of Total Invasive Vegetative Cover[3]
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area				
Salt Marsh *Sensu Stricto* (n = 35)	**0**	[NA]	0%	0%
High Marsh Ecotone (n = 20)	**0**	[NA]	0%	0%
Phase 2 — Salt River Corridor Restoration Area				
Phase 2B (Middle) — Salt River Channel Wetlands				
Active Channel (n = 25)	**36.8**	[27.0, 47.1]	96%	80%
Active Bench (n = 25)	**44.3**	[31.4, 58.2]	88%	82%
Phase 2B (Middle) — Riparian Planting Zones				
Replanted Riparian Forest (n = 20)	**31.4**	[18.0, 48.6]	50%	53%
Active Riparian Berm (n = 20)	**32.0**	[14.5, 45.8]	65%	47%

[1] Relativized mean percent cover estimates are in bold and associated 95% confidence intervals follow in brackets.
[2] Calculated as the number of sampling plots where *Phalaris arundinacea* occurred, divided by the total number of sampling plots in respective sampling regions.
[3] Calculated as the (relativized) mean percent cover of *Phalaris arundinacea* divided by the (relativized) mean cover of invasive vegetation in respective sampling regions.

Phalaris arundinacea (“reed canary grass”) reached its greatest abundance in the Salt River channel wetlands of the middle Phase 2B restoration reach in 2023 (Table 14). In the active channel, mean estimated cover of *P. arundinacea* was 36.8% (95% CI [27.0, 47.1]), where it occurred in 96% of active channel sample plots and represented 80% of the total invasive vegetative cover of that habitat component (Table 14). Finally, in the active bench, mean estimated cover of *P. arundinacea* reached 44.3% (95% CI [31.4, 58.2]), where it occurred in 88% of active channel sample plots and represented 82% of the total invasive vegetative cover of that sampling region (Table 14).

4.2.2 Arborescent Riparian Vegetation Basal Area Sampling Results

We resampled 12% (0.67 acres) of the total combined (5.6 acres) Phase 2B (Middle) replanted riparian forest, active riparian berm, and active bench sampling regions in 2023 to complete the second of three basal area sampling events scheduled for this portion of the SRERP (Table 1). Corresponding results further corroborate some of our aforementioned findings, reflecting continued poor establishment of woody riparian vegetation throughout sampled portions of the Phase 2B (Middle) restoration area. (It is worth noting that minor inconsistencies in vegetation percent cover sampling results previously addressed herein [Section 4.2.1] and basal area sampling results which follow are attributable to variations owing to the differing location of random sampling points between the two efforts. Minor inconsistencies notwithstanding, overall conclusions are substantiated by the quantitative results of both efforts.)

Changes in Basal Area Over Time: 2021–2023

Basal-area-per-unit-area-sampled ("BAPA") has increased in each of the three Phase 2B (Middle) sampling regions during the two-year period from 2021–2023, however, observed increases have been slight, and are statistically significant only at the combined level ($\overline{x}\Delta$ = 0.38 ft^2/acre, p = 0.0023) (Table 15). The greatest increase in BAPA during the 2021–2023 period was observed in the Phase 2B (Middle) replanted riparian forest ($\overline{x}\Delta$ = 0.81 ft^2/acre, p = 0.1233), followed by the active riparian berm ($\overline{x}\Delta$ = 0.26 ft^2/acre, p = 0.1188), and only a 0.08 ft^2/acre increase (p = 0.1203) in BAPA was observed in the Phase 2B (Middle) active bench sampling region (Table 15).

At the level of individual basal area sample plots, only 9 of 15 (0.60, 95% CI [0.35, 0.81]) exhibited "successful" increases in BAPA during the period 2021–2023 (Tables 16 and 17), as defined in our methodologies (Section 3.2.2). Of the remaining six sample plots distributed evenly across all three Phase 2B (Middle) sampling regions, four continue to reflect no establishment of woody riparian vegetation, and the remaining two plots exhibiting decreases in BAPA indicate that the few saplings that were initially detected in 2021 no longer survive, as no woody riparian vegetation was encountered in either plot in 2023 (Table 17). Although 60% of Phase 2B (Middle) sample plots did exhibit increases in BAPA in 2023, it is worth noting that most of those increases were quite small, with only two instances exceeding 1 ft^2/acre (Table 17).

Basal Area Species Composition

Arborescent species diversity was also observed to be relatively low in the Phase 2B (Middle) restoration reach, with the exception of the active riparian berm where six tree species were detected in basal area sample plots (Figure 2). The greatest contributions of basal area throughout this restoration subphase were from *Salix sitchensis* ("Sitka willow"), *Alnus rubra* ("red alder"), and *Salix*

Table 15. Changes in Basal Area-per-Unit-Area-Sampled ("BAPA") of Arborescent Riparian Vegetation During the Period: 2021–2023. The Greek symbol, delta (Δ), indicates change.

2021 & 2023 SRERP Basal Area Sampling Regions	Mean Δ BAPA (ft^2/acre)	*P*†	*P*‡
Phase 2 — Salt River Corridor Restoration Area			
Phase 2B (Middle) — Riparian Planting Zones			
Replanted Riparian Forest (n = 5)	0.81	N/A	0.1233
Active Riparian Berm (n = 5)	0.26	N/A	0.1188
Active Bench (n = 5)	0.08	N/A	0.1203
Total	0.38	N/A	0.0023*

* *P-values* < 0.05 indicate statistically significant changes in BAPA during this period
† Paired *t*-test
‡ Permutation test (*p*-values represent the proportion of permutation data sets [n = 10,000] for which the mean difference in BAPA between 2021–2023 equaled or exceeded actual observed values)

Table 16. Proportion of "Successful" Basal Area Sample Plots Observed in 2023. Sampling plots were determined to be "successful" if the basal area of arborescent-riparian-vegetation-per-unit-area-sampled ("BAPA") increased during the period: 2021–2023. Ninety-five percent confidence intervals reflect the degree of uncertainty inherent in estimating the true "success" frequency throughout respective sampling regions from the limited set of sampled locations.

2021 & 2023 SRERP Basal Area Sampling Regions	Proportion of Successful Sample Plots	95% CI
Phase 2 — Salt River Corridor Restoration Area		
Phase 2B (Middle) — Riparian Planting Zones		
Replanted Riparian Forest (n = 5)	0.60	[0.23, 0.93]
Active Riparian Berm (n = 5)	0.60	[0.23, 0.93]
Active Bench (n = 5)	0.60	[0.23, 0.93]
Total	0.60	[0.35, 0.81]

lasiandra ssp. *lasiandra* ("Pacific willow") (Figure 2). Below, we characterize the species composition and associated estimates of basal area contributions for arborescent vegetation within each Phase 2B (Middle) sampling region (Figure 2). Summed raw basal area measurements are provided in Appendix E.

Table 17. Sample Plot-Level Changes in Basal Area-per-Unit-Area-Sampled ("BAPA") in Phase 2B (Middle) Sampling Regions During the Period from 2021–2023. The Greek symbol, delta (Δ), indicates change.

Phase 2B (Middle) Basal Area Sample Plots	BAPA (ft^2/acre) 2021	2023	Δ
Replanted Riparian Forest			
P2BMRForest01	0.8009	3.9863	3.1854
P2BMRForest02	0	0	0
P2BMRForest03	0	0.6301	0.6301
P2BMRForest04	0.0035	0	–0.0035
P2BMRForest05	0.0746	0.3274	0.2528
Active Riparian Berm			
P2BMBerm01	0	0	0
P2BMBerm02	0.0179	0.0608	0.0429
P2BMBerm03	0.0078	0	–0.0078
P2BMBerm04	0.0755	0.3712	0.2957
P2BMBerm05	0.0784	1.0380	0.9596
Active Bench			
P2BMBench01	0.0170	0.0553	0.0383
P2BMBench02	0	0	0
P2BMBench03	0.0301	0.3042	0.2741
P2BMBench04	0	0.0745	0.0745
P2BMBench05	0	0	0

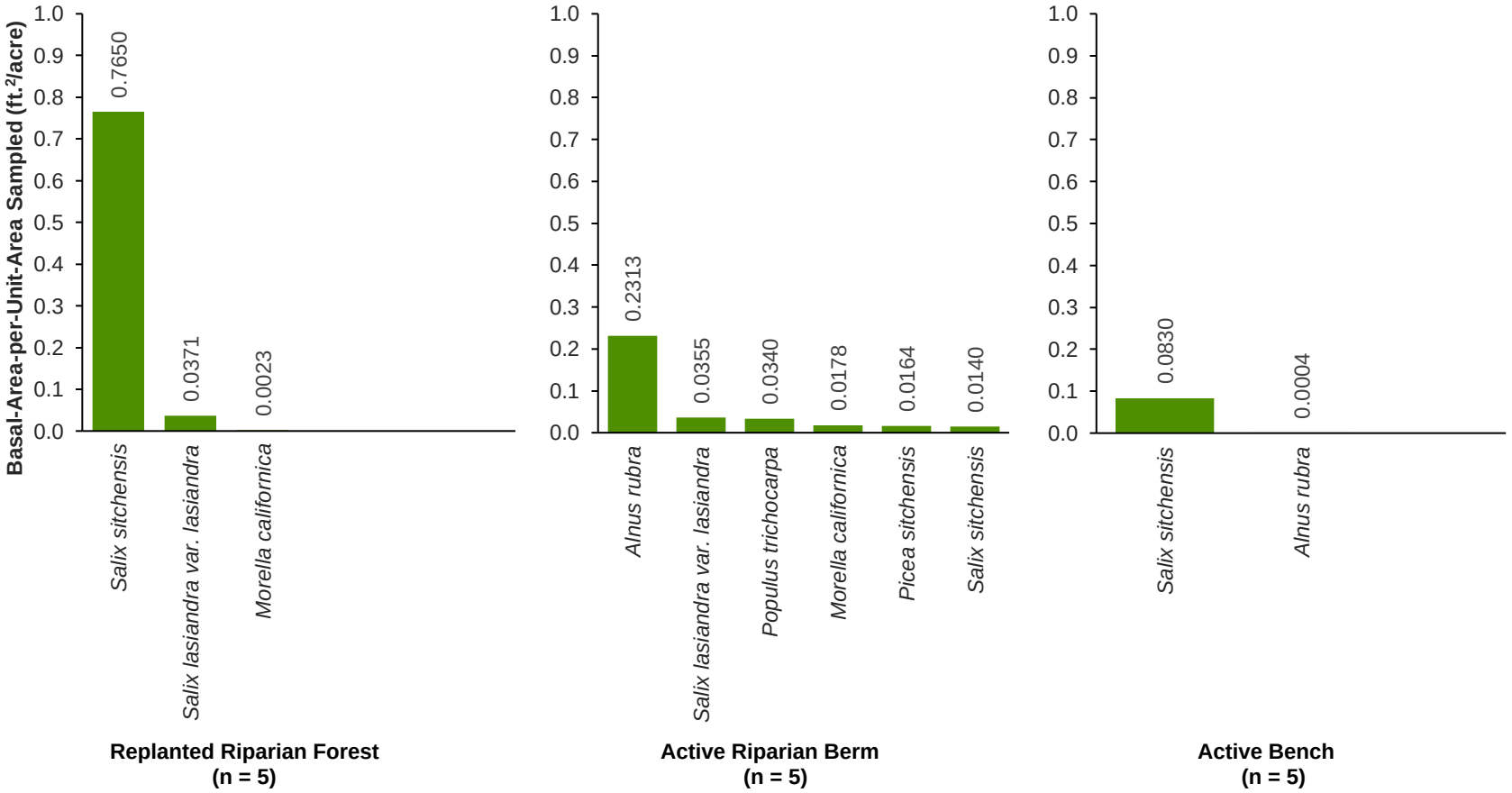

Figure 2. Basal area contributions of arborescent vegetation encountered in 2023 Phase 2B (Middle) basal area sample plots.

Replanted Riparian Forest

We resampled (n = 5) approximately 18% (0.13 acres) of the total (0.73 acres) Phase 2B (Middle) replanted riparian forest sampling region again in 2023. The greatest contributions of woody riparian basal area to the Phase 2B (Middle) replanted riparian forest in 2023 are from *Salix sitchensis* ("Sitka willow"), with lesser amounts of *Salix lasiandra* var. *lasiandra* ("Pacific willow") and *Morella californica* ("wax-myrtle") (Figure 2; Appendix E).

Active Riparian Berm

We resampled (n = 5) approximately 18% (0.22 acres) of the total (1.23 acres) Phase 2B (Middle) active riparian berm sampling region again in 2023. The majority of the active riparian berm basal area consists of *Alnus rubra* ("red alder), followed by *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Populus trichocarpa* ("black cottonwood"), *Morella californica* ("wax-myrtle"), *Picea sitchensis* ("Sitka spruce"), and *Salix sitchensis* ("Sitka willow") (Figure 2; Appendix E).

Active Bench

In the active bench habitat of the Phase 2B (Middle) restoration reach, we resampled (n = 5) approximately 9% (0.32 acres) of the total area (3.61 acres) of this habitat design component in 2023. Woody riparian basal area in this sampling region was comprised of two species: *Salix sitchensis* ("Sitka willow") and *Alnus rubra* ("red alder) (Figure 2; Appendix E).

5.0 Discussion & Recommendations

Results presented herein for the 2023 habitat monitoring effort provide evidence of continued successful progress towards the attainment of some of the long-term restoration goals for the Salt River Ecosystem Restoration Project, while simultaneously indicating the need for additional revegetation efforts for woody riparian vegetation in the Phase 2B (Middle) restoration reach, and reinforcing the need for continued and proportionate invasive vegetation management actions throughout SRERP habitats addressed in 2023 to ensure that the Project's habitat restoration goals are ultimately achieved. Specific considerations apparent from the 2023 habitat monitoring effort follow.

5.1 Phase 1 — Riverside Ranch Tidal Marsh Restoration Area: "Tidal Salt and Brackish Marsh" and High Marsh Ecotone Habitats

Our findings from 2023 confirm the continued development of Phase 1 "tidal salt and brackish marsh" habitat and substantiate that this habitat complex does satisfy the respective final minimum area success threshold in what is scheduled to be the final monitoring year for that specific SRERP habitat.

Detracting from this success is the continued establishment and development of the aggressive invasive salt marsh grass, *Spartina densiflora* ("dense-flowered cord grass"), throughout the associated salt marsh *sensu stricto* plant community. *Spartina densiflora* is, far and away, the most dominant plant

throughout the Phase 1 salt marsh *sensu stricto* habitats and its abundance and associated competitive influence on the surrounding vegetation is the primary cause for the observed failure of this sampling region to satisfy two of three vegetation success criteria in what is scheduled to be the final monitoring year for that specific SRERP habitat.

Although our 2023 percent cover sampling results indicate that the non-native non-invasive component of Phase 1 salt marsh *sensu stricto* vegetation continues to maintain a level of abundance well below the respective final maximum cover threshold for that vegetation category, the prevalence of *Spartina densiflora* in this habitat has resulted in our interrelated 2023 observations whereby the abundance of invasive vegetation well exceeds its respective final *maximum* cover threshold and native vegetative cover falls well short of its respective final *minimum* cover threshold.

The presence of *Spartina densiflora* ("dense-flowered cord grass")—along with other invasive plants—in the Phase 1 high marsh ecotone habitat in 2023 also contributes to the failure of vegetation in this SRERP sampling region to satisfy the respective final *maximum* invasive vegetation cover threshold in what is scheduled to be the final monitoring year for that specific SRERP habitat. High marsh ecotone vegetation otherwise does satisfy respective final abundance thresholds for both native and non-native non-invasive vegetation categories in 2023.

Some of the resulting likely effects of the on-going invasion of salt marsh and high marsh ecotone habitats by *Spartina densiflora* include decreased native plant biodiversity; reduction of otherwise suitable habitat for regionally important and rare native plant species observed within both sampling regions such as *Castilleja ambigua* ssp. *humboldtiensis* ("Humboldt Bay owl's-clover"), *Carex lyngbyei* ("Lyngbye's sedge"), and others; as well as other adverse ecosystem impacts to estuarine habitats associated with the introduction of *S. densiflora* (SFEISP 2020). We encourage additional future efforts to attempt to reduce, manage, and/or eradicate *S. densiflora* throughout estuarine habitats within the SRERP footprint.

5.2 Phase 2 — Salt River Corridor Restoration Area: Phase 2B (Middle) Channel Wetlands and Riparian Planting Zones

Somewhat similar vegetation phenomena are evident within the Phase 2B (Middle) restoration reach where the aggressive invasive plant, *Phalaris arundinacea* ("reed canary grass")—among others—is suppressing and/or displacing native vegetation throughout. Native vegetation failed to reach or exceed the respective minimum cover thresholds in all four Phase 2B (Middle) sampling regions in 2023, including in the active channel and active bench habitats in what is scheduled to be the final year wherein vegetation percent cover sampling is scheduled to occur. Relatedly, invasive vegetation far exceeded the respective maximum cover thresholds in all four Phase 2B (Middle) sampling regions in 2023, including in the active channel and active bench

habitats in what is scheduled to be the final year wherein vegetation percent cover sampling is scheduled to occur. Consistent with our previous recommendations, we encourage additional future efforts to attempt to reduce, manage, and/or eradicate *P. arundinacea* and other associated invasive vegetation throughout Phase 2 — Salt River Corridor Restoration Area habitats.

When considered only at the subphase level, riparian habitats of the Phase 2B (Middle) restoration reach constitute only approximately one-third of such habitats projected for that specific portion of the SRERP footprint, some 7.27 acres less than the final minimum area success threshold for that specific subphase. However, in anticipation of such originally-unexpected shortfalls of Phase 2B (Middle) area available for replanting with woody riparian vegetation, additional supplemental replanting areas were revegetated with woody species elsewhere throughout the Phase 2 — Salt River Corridor Restoration area in 2018–2019 to compensate for any such deficits in restored riparian forest habitat.

Consideration of other such Phase 2 restoration reaches was outside of the scope of the 2023 habitat monitoring effort. However, comparisons of habitat mapping and area analysis results for Phase 2B (Middle) riparian planting zones in 2023 and prior monitoring years (J.B. Lovelace & Associates 2022c, 2023) reflect little change. We therefore interpret our most recent Phase 2B (Middle) habitat area results as being consistent with prior conclusions that SRERP-wide, riparian habitats are on track to meet or exceed respective minimum area thresholds.

Successful restoration of such mapped riparian planting zones, however, is contingent on the successful establishment and development of the targeted vegetation type therein. Unfortunately, both our 2023 vegetation percent cover and basal area sampling results indicate that continued poor establishment and survival of woody riparian vegetation throughout habitats of the Phase 2B (Middle) restoration area replanted with riparian trees and shrubs appears to be preventing their successful development into truly forested riparian habitats.

Sufficient passive recruitment of volunteer woody riparian vegetation from onsite sources may ultimately occur within these portions of the project area, but likely only at a protracted time scale. To address the as-of-yet unsuccessful establishment and development of woody riparian vegetation in Phase 2B (Middle) riparian planting zones, additional supplemental revegetation and irrigation efforts are recommended in order to accelerate the process if these areas are to indeed develop into “riparian forest” habitat within the temporal context of the SRERP—and thereby satisfy respective success thresholds. Particularly if additional replanting efforts occur during low-rainfall years and/or periods of regional drought, supplemental irrigation will likely prove critical during the establishment phase of replanted vegetation (as is common practice in inland

restoration efforts). Supplemental irrigation would also be likely to encourage establishment of *in situ* propagules already present in the seedbank, further facilitating establishment of the targeted vegetation component in these habitats.

5.3 Additional Recommendations

In addition to recommendations provided elsewhere herein, we also recommend the continued performance of scheduled periodic quantitative percent cover and basal area sampling efforts throughout the duration of the respective monitoring periods. These will continue to serve to track and evaluate the development of structural and community vegetation attributes within restored habitats, and thereby, the relative progress towards the attainment of core restoration goals for the Salt River Ecosystem Restoration Project. Where it appears that success thresholds may not be met, supplemental planting and irrigation of native species should occur, concurrent with invasive vegetation management actions.

5.3.1 Recommended Sample Sizes

Finally, any subsequent vegetation cover sampling efforts in SRERP restoration areas addressed in 2023 would be safe to use respective sample sizes successfully applied in 2023 (at least initially), and we refer the reader to Section 4.2.1 and Table 11 herein for additional context. As the Salt River Ecosystem Restoration Project plant communities continue to develop; on-going vegetation community dynamics, inter-annual seasonal variation, stochastic events, and/or other factors are expected to continue to influence future vegetation sample variation and, as a result, respective sample sizes. For these reasons we recommend continuing to perform power analyses to guide any subsequent vegetation sampling efforts to address these on-going changes, to evaluate the adequacy of sample sizes, and to increase the efficiency of such efforts where possible.

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Salt River Ecosystem Restoration Project Figures

Figure 1. SRERP Projected Habitat Types

Figure 2. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area Habitats

Figure 3. SRERP Phase 2B (Middle) — Salt River Corridor Restoration Area Habitats

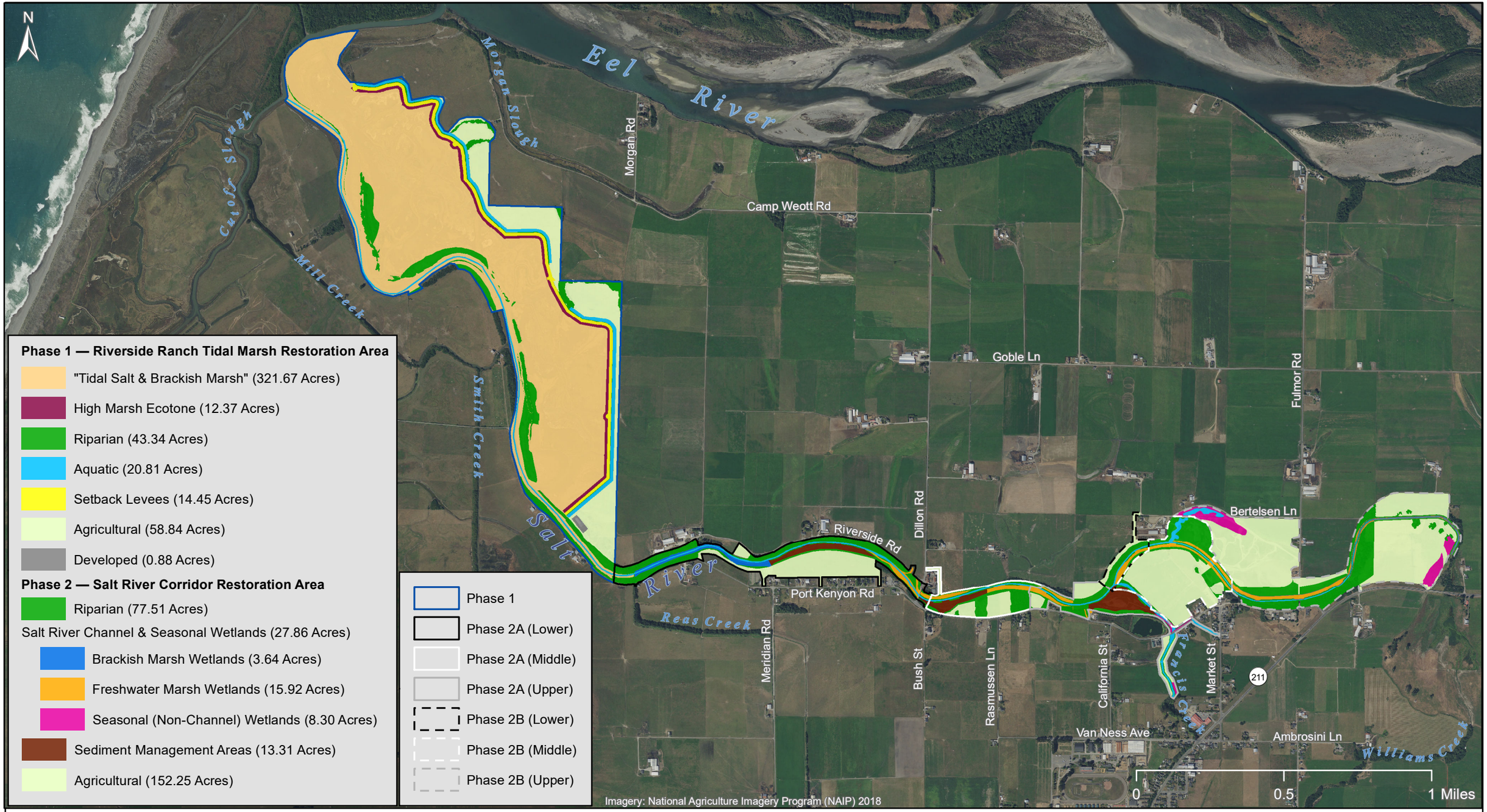

Figure 1. SRERP Projected Habitat Types (Adapted from: H.T. Harvey & Associates and Winzler & Kelly 2012)
2023 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

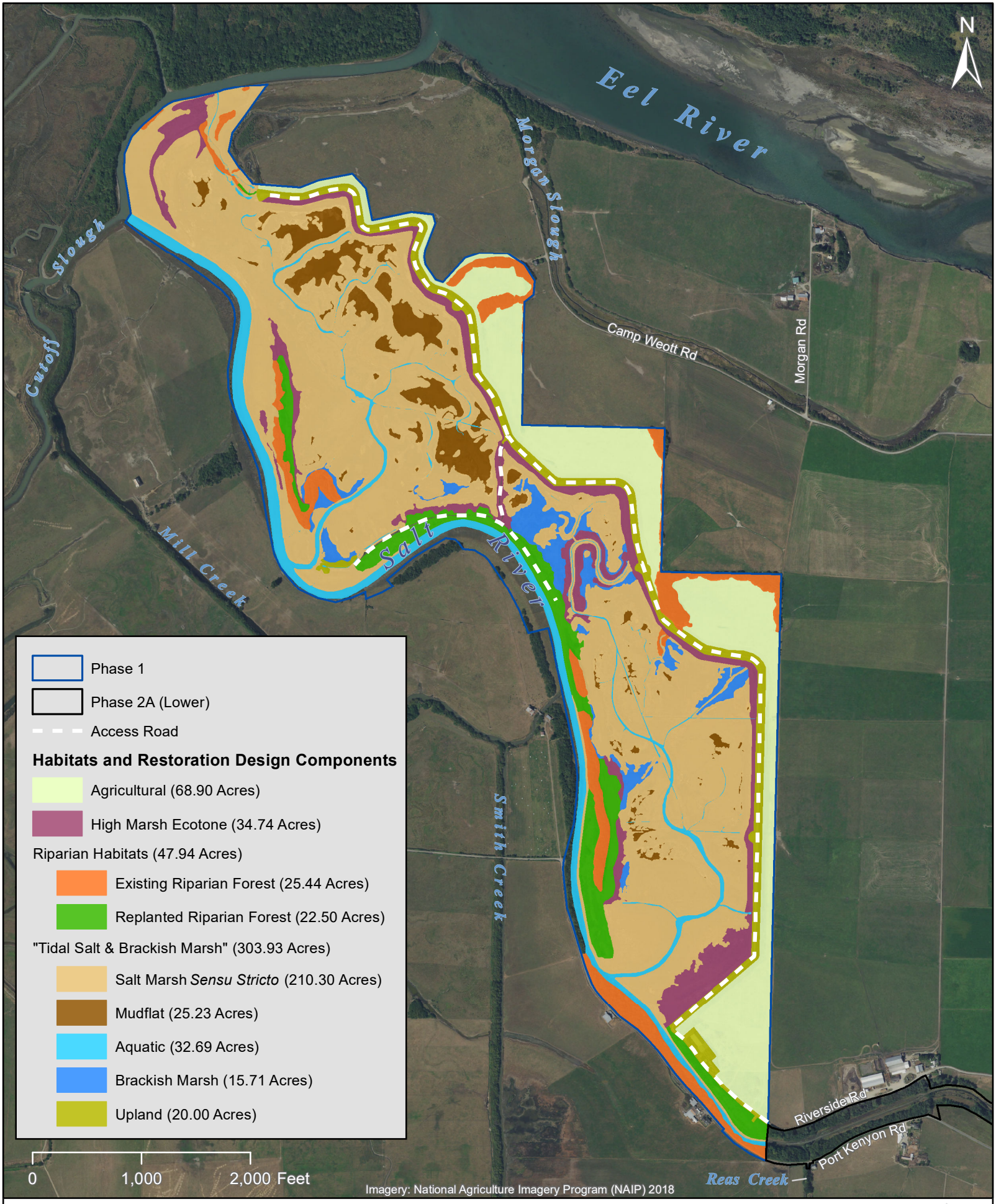

Figure 2. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area Habitats
2023 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

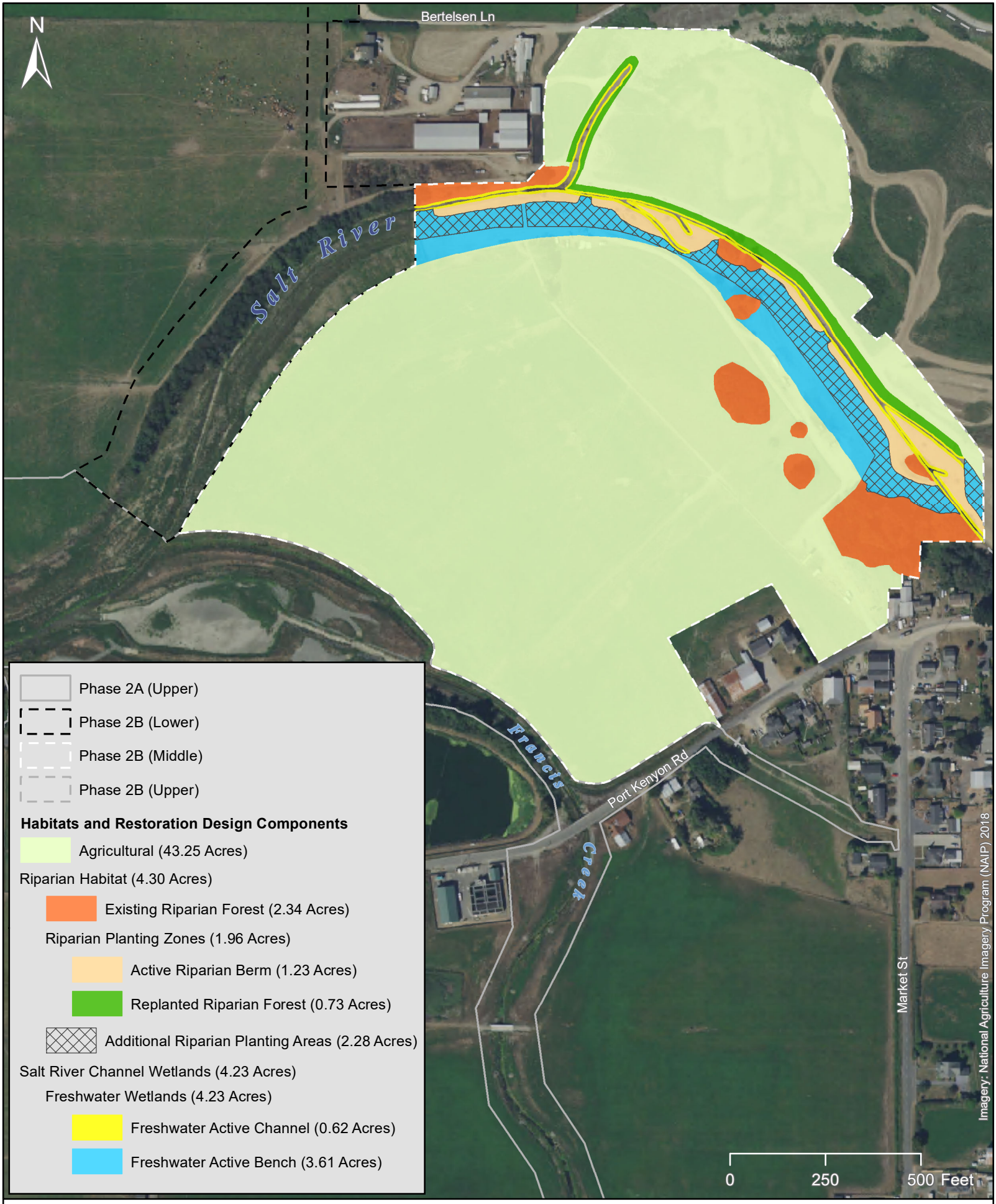

Figure 3. SRERP Phase 2B (Middle) — Salt River Corridor Restoration Area Habitats
2023 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

2023 SRERP Vegetation Cover Sampling Results

Phase 1 — Riverside Ranch Tidal Marsh Restoration Area:
Salt Marsh *Sensu Stricto* (n = 35)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Native Species			
Herbaceous Species			
Salicornia pacifica	0.60	17.91	25.68
Distichlis spicata	0.51	19.74	25.23
Potentilla anserina ssp. *pacifica*	0.14	3.81	14.84
Deschampsia cespitosa	0.14	1.39	4.26
Triglochin maritima	0.11	1.29	4.26
Bolboschoenus maritimus ssp. *paludosus*	0.09	1.59	6.76
Juncus mexicanus	0.09	1.29	4.26
Cuscuta pacifica var. *pacifica*	0.09	0.87	3.53
Eleocharis macrostachya	0.06	1.50	6.76
Carex lyngbyei	0.03	2.79	16.48
Hordeum brachyantherum	0.03	1.07	6.34
Jaumea carnosa	0.03	0.43	2.54
Triglochin striata	0.03	0.09	0.51
Non-Native Non-Invasive Species			
Herbaceous Species			
Atriplex prostrata	0.54	5.07	8.33
Cynosurus cristatus	0.06	1.16	6.34
Trifolium resupinatum	0.06	0.51	2.57
Cotula coronopifolia	0.03	0.09	0.51
Polypogon monspeliensis	0.03	0.09	0.51
Rumex crispus	0.03	0.09	0.51
Invasive Species			
Herbaceous Species			
Spartina densiflora	0.86	44.49	35.80
Parapholis strigosa	0.14	4.07	10.97
Agrostis stolonifera	0.09	0.53	2.57

Phase 1 — Riverside Ranch Tidal Marsh Restoration Area: High Marsh Ecotone (n = 20)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.90	43.38	31.61
Salicornia pacifica	0.60	19.25	19.52
Symphyotrichum chilense	0.15	2.25	5.50
Potentilla anserina ssp. *pacifica*	0.10	6.15	20.47
Distichlis spicata	0.10	3.28	13.96
Grindelia stricta	0.10	2.63	8.87
Eleocharis macrostachya	0.05	4.28	19.12
Juncus bolanderi	0.05	0.75	3.35
Castilleja ambigua ssp. *humboldtiensis*	0.05	0.15	0.67
Isolepis cernua	0.05	0.15	0.67
Oenanthe sarmentosa	0.05	0.15	0.67
Shrub Species			
Rubus ursinus	0.05	0.75	3.35
Non-Native Non-Invasive Species			
Herbaceous Species			
Atriplex prostrata	0.35	2.85	5.37
Lotus corniculatus	0.20	1.55	4.60
Rumex conglomeratus	0.10	0.30	0.92
Cynosurus cristatus	0.05	0.75	3.35
Raphanus sativus	0.05	0.75	3.35
Trifolium resupinatum	0.05	0.75	3.35
Lepidium didymum	0.05	0.15	0.67
Ranunculus repens	0.05	0.15	0.67
Rumex crispus	0.05	0.15	0.67
Sonchus asper ssp. *asper*	0.05	0.03	0.11
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.45	9.58	17.15
Spartina densiflora	0.25	6.65	16.04
Helminthotheca echioides	0.25	1.95	4.59

Phase 2B (Middle) — Salt River Corridor Restoration Area: Active Channel (n = 25)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Potentilla anserina ssp. *pacifica*	0.52	10.54	15.49
Oenanthe sarmentosa	0.40	5.94	9.39
Deschampsia cespitosa	0.36	10.90	17.63
Eleocharis macrostachya	0.32	11.32	22.10
Hordeum brachyantherum	0.20	0.60	1.22
Juncus effusus ssp. *pacificus*	0.16	2.34	7.94
Equisetum telmateia ssp. *braunii*	0.08	1.20	4.15
Equisetum arvense	0.08	0.72	3.03
Tree Species			
Salix sitchensis	0.24	5.40	11.15
Salix lasiandra var. *lasiandra*	0.16	0.96	3.09
Salix hookeriana	0.04	0.12	0.60
Non-Native Non-Invasive Species			
Herbaceous Species			
Rumex conglomeratus	0.20	1.56	4.16
Raphanus sativus	0.16	1.82	4.97
Ranunculus repens	0.16	1.44	4.16
Alisma lanceolatum	0.12	1.32	4.16
Festuca perennis	0.08	0.72	3.03
Medicago polymorpha	0.04	0.60	3.00
Plantago major	0.04	0.12	0.60
Senecio glomeratus	0.04	0.12	0.60
Trifolium repens	0.04	0.12	0.60
Atriplex prostrata	0.04	0.02	0.10
Lotus corniculatus	0.04	0.02	0.10
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.96	43.94	30.66
Helminthotheca echioides	0.44	7.18	12.66
Agrostis stolonifera	0.12	3.60	10.63
Holcus lanatus	0.04	0.60	3.00

Phase 2B (Middle) — Salt River Corridor Restoration Area: Active Bench (n = 25)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.20	5.80	14.64
Alopecurus geniculatus	0.16	3.72	10.61
Scirpus microcarpus	0.12	5.04	18.36
Oenanthe sarmentosa	0.12	1.80	4.97
Hordeum brachyantherum	0.12	0.84	3.06
Potentilla anserina ssp. *pacifica*	0.12	0.84	3.06
Juncus patens	0.08	3.10	12.73
Equisetum arvense	0.04	0.12	0.60
Equisetum telmateia ssp. *braunii*	0.04	0.12	0.60
Shrub Species			
Rubus ursinus	0.04	0.60	3.00
Tree Species			
Salix hookeriana	0.04	0.60	3.00
Salix lasiandra var. *lasiandra*	0.04	0.12	0.60
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium repens	0.36	7.14	12.69
Festuca perennis	0.36	6.76	14.57
Ranunculus repens	0.20	2.46	7.92
Rumex conglomeratus	0.12	0.84	3.06
Lotus corniculatus	0.12	0.74	3.03
Raphanus sativus	0.08	0.24	0.83
Festuca arundinacea	0.04	0.60	3.00
Trifolium fragiferum	0.04	0.60	3.00
Atriplex prostrata	0.04	0.12	0.60
Plantago major	0.04	0.12	0.60
Polypogon monspeliensis	0.00	0.00	0.00
Tree Species			
Salix babylonica	0.04	2.50	12.50
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.88	50.92	38.98
Agrostis stolonifera	0.36	6.24	11.15
Holcus lanatus	0.12	2.70	8.35
Helminthotheca echioides	0.04	0.60	3.00

Phase 2B (Middle) — Salt River Corridor Restoration Area:
Active Riparian Berm (n = 20)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.45	8.80	13.73
Equisetum telmateia ssp. *braunii*	0.30	5.55	11.84
Hordeum brachyantherum	0.20	1.20	3.43
Juncus patens	0.15	2.25	5.50
Potentilla anserina ssp. *pacifica*	0.10	1.50	4.62
Stachys ajugoides	0.10	1.50	4.62
Juncus effusus ssp. *pacificus*	0.05	1.88	8.39
Stachys mexicana	0.05	0.75	3.35
Vicia americana ssp. *americana*	0.05	0.15	0.67
Shrub Species			
Lonicera involucrata var. *ledebourii*	0.10	3.88	14.20
Rubus parviflorus	0.05	0.75	3.35
Physocarpus capitatus	0.05	0.15	0.67
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.40	4.80	6.91
Raphanus sativus	0.30	3.30	6.07
Lotus corniculatus	0.15	2.65	8.86
Rumex conglomeratus	0.10	0.30	0.92
Festuca arundinacea	0.05	0.75	3.35
Aira caryophyllea	0.05	0.15	0.67
Avena barbata	0.05	0.15	0.67
Vicia hirsuta	0.05	0.15	0.67
Invasive Species			
Herbaceous Species			
Holcus lanatus	0.70	29.70	29.39
Phalaris arundinacea	0.65	38.05	41.44
Helminthotheca echioides	0.50	6.63	14.43
Agrostis stolonifera	0.35	6.90	12.07
Conium maculatum	0.25	1.95	4.59
Cirsium vulgare	0.10	0.90	3.39

Phase 2B (Middle) — Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 20)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Potentilla anserina ssp. *pacifica*	0.35	5.18	9.70
Equisetum telmateia ssp. *braunii*	0.25	10.63	19.57
Deschampsia cespitosa	0.25	4.28	9.53
Stachys mexicana	0.15	2.78	8.84
Stachys ajugoides	0.15	2.25	5.50
Vicia americana ssp. *americana*	0.15	1.65	4.61
Eleocharis macrostachya	0.10	7.40	23.08
Alopecurus geniculatus	0.10	2.03	8.38
Elymus glaucus ssp. *virescens*	0.10	0.90	3.39
Festuca rubra	0.10	0.90	3.39
Scirpus microcarpus	0.10	0.30	0.92
Cyperus eragrostis	0.05	0.75	3.35
Juncus effusus ssp. *pacificus*	0.05	0.75	3.35
Shrub Species			
Lonicera involucrata var. *ledebourii*	0.05	1.88	8.39
Rubus ursinus	0.05	0.75	3.35
Rubus parviflorus	0.05	0.15	0.67
Tree Species			
Salix lasiolepis	0.05	4.28	19.12
Salix sitchensis	0.05	1.88	8.39
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.20	3.00	6.16
Rumex conglomeratus	0.20	1.80	4.61
Vicia hirsuta	0.15	4.50	11.77
Raphanus sativus	0.15	1.05	3.41
Brassica nigra	0.15	0.45	1.10
Trifolium repens	0.10	0.90	3.39
Ranunculus repens	0.05	0.75	3.35
Geranium dissectum	0.05	0.15	0.67
Hypochaeris radicata	0.05	0.15	0.67
Invasive Species			
Herbaceous Species			
Holcus lanatus	0.65	21.38	22.43
Phalaris arundinacea	0.50	32.68	39.83
Helminthotheca echioides	0.30	3.83	9.15
Agrostis stolonifera	0.25	4.28	9.53
Conium maculatum	0.10	0.90	3.39
Cirsium vulgare	0.05	0.75	3.35
Dipsacus fullonum	0.05	0.75	3.35

Summary of the Abundance of Vegetation Structural Categories throughout Relevant Salt River Ecosystem Restoration Project Sampling Regions: 2014–2023

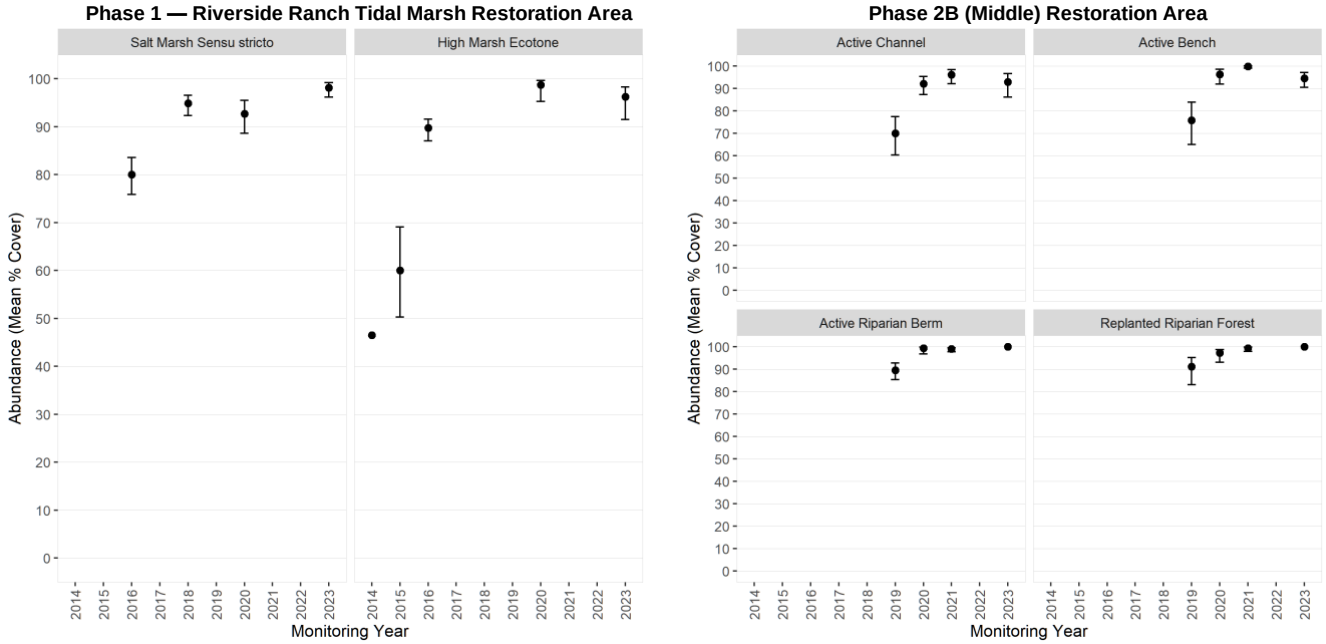

Figure 1. Estimated Total Vegetative Cover throughout the Salt River Ecosystem Restoration Project (SRERP) Sampling Regions Addressed in the 2023 Annual Habitat Monitoring Effort: 2014–2023. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. Missing values indicate years when vegetation percent cover sampling was not prescribed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for respective portions of the SRERP project area.

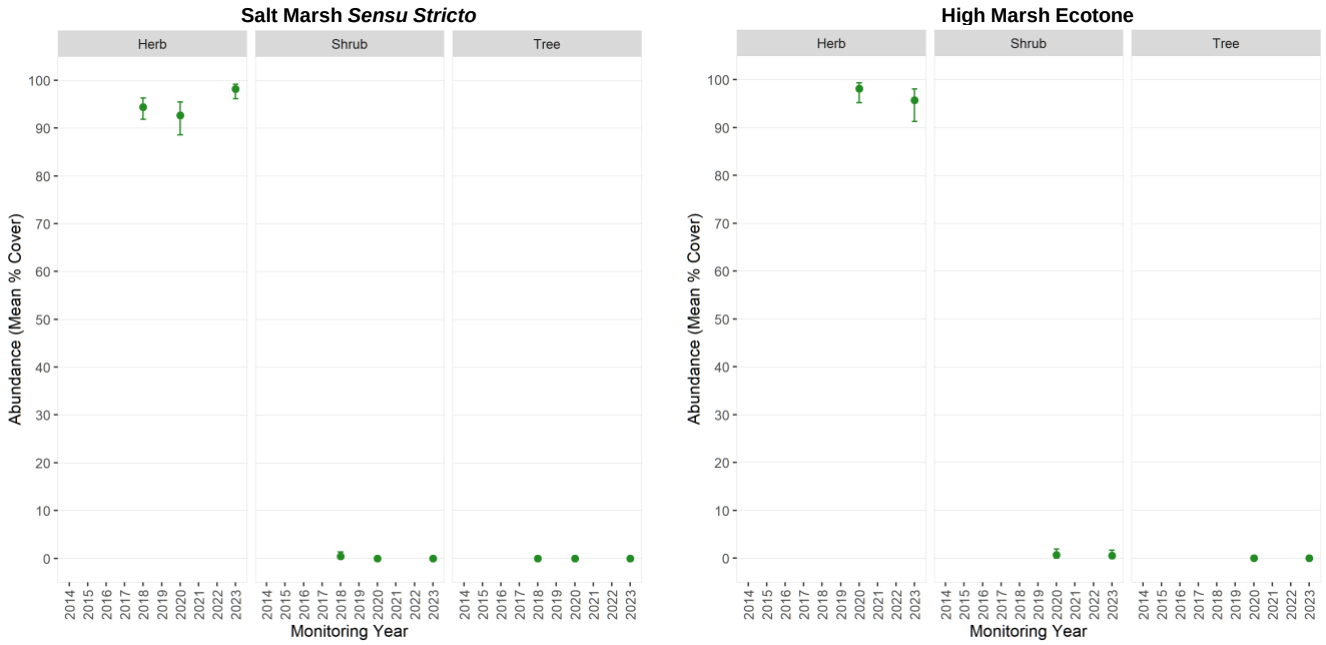

Figure 2. Vegetation Structural Composition within regions of the Salt River Ecosystem Restoration Project (SRERP) Phase 1 — Riverside Ranch Tidal Marsh Restoration Area sampled in 2023: 2014–2023. Points indicate mean percent cover estimates and error bars reflect respective 95% confidence intervals (where such values were greater than zero and less than 100). Missing values indicate years where vegetation percent cover sampling was not prescribed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the Phase 1 — Riverside Ranch Tidal Marsh Restoration Area sampled in 2023 and/or when vegetation habit was not being addressed as part of the percent cover sampling effort.

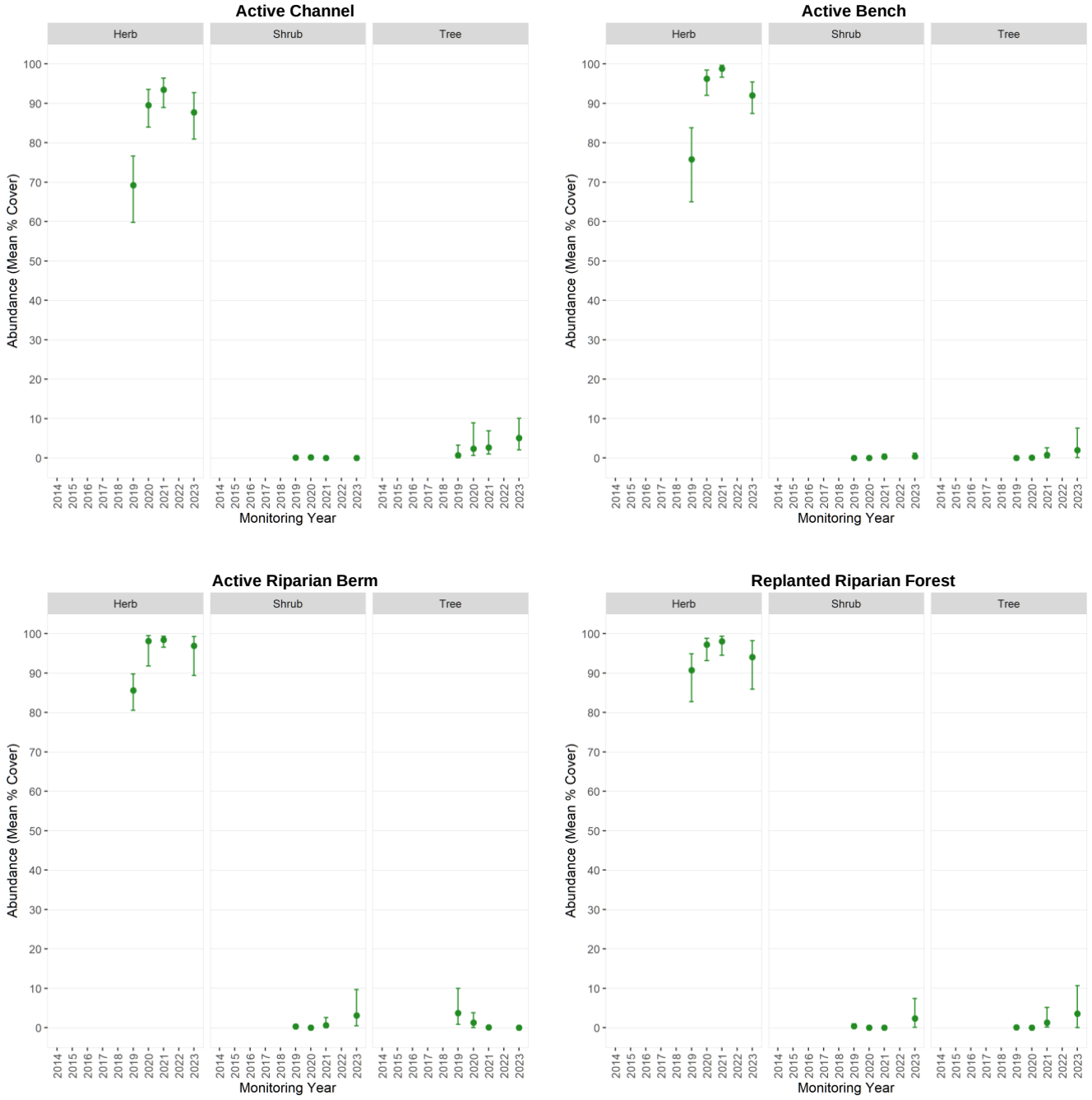

Figure 3. Vegetation Structural Composition within the Salt River Ecosystem Restoration Project (SRERP) Phase 2B (Middle) Restoration Area: 2014–2023. Points indicate mean percent cover estimates and error bars reflect respective 95% confidence intervals (where such values were greater than zero and less than 100). Missing values indicate years where vegetation percent cover sampling was not prescribed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the Phase 2B (Middle) restoration area and/or when vegetation habit was not being addressed as part of the percent cover sampling effort.

Summary of the Abundance of Monitored Vegetation Categories throughout Relevant Salt River Ecosystem Restoration Project Sampling Regions: 2014–2023

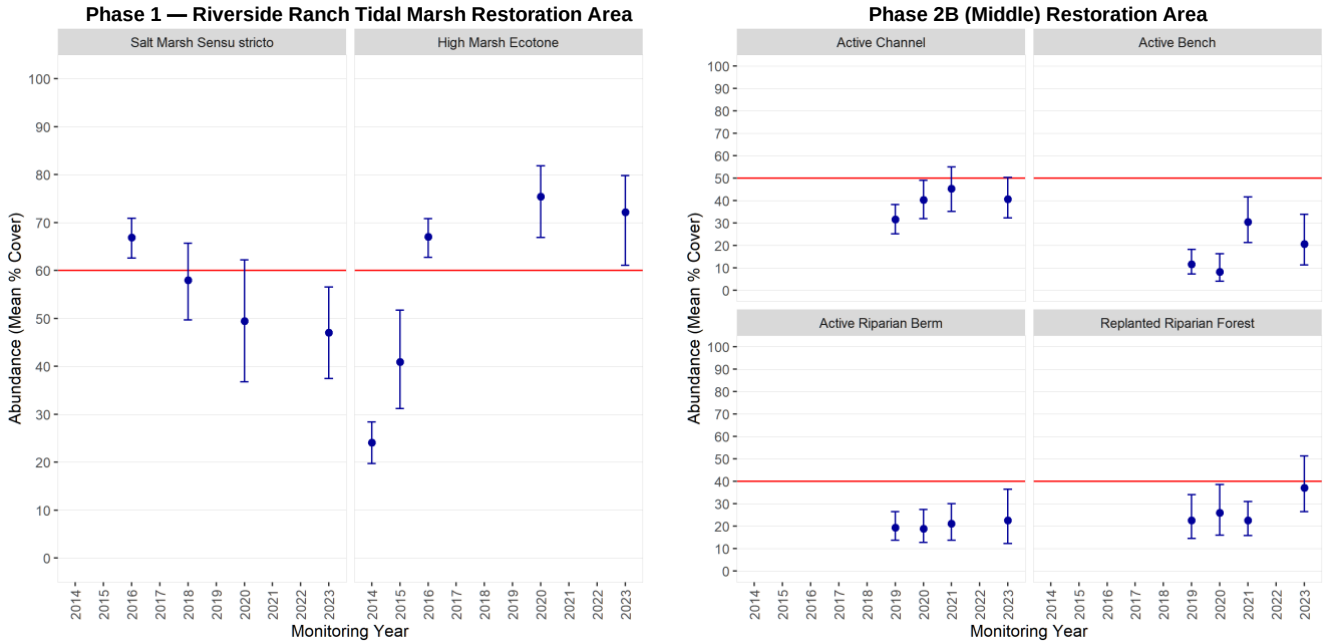

Figure 1. Estimated Abundance of Native Vegetation throughout the Salt River Ecosystem Restoration Project (SRERP) Sampling Regions Addressed in the 2023 Annual Habitat Monitoring Effort: 2014–2023. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. Horizontal red lines indicate respective *minimum* percent cover success thresholds for native vegetation in each sampling region during the 2023 vegetation sampling effort. Missing values indicate years when vegetation percent cover sampling was not prescribed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for respective portions of the SRERP project area.

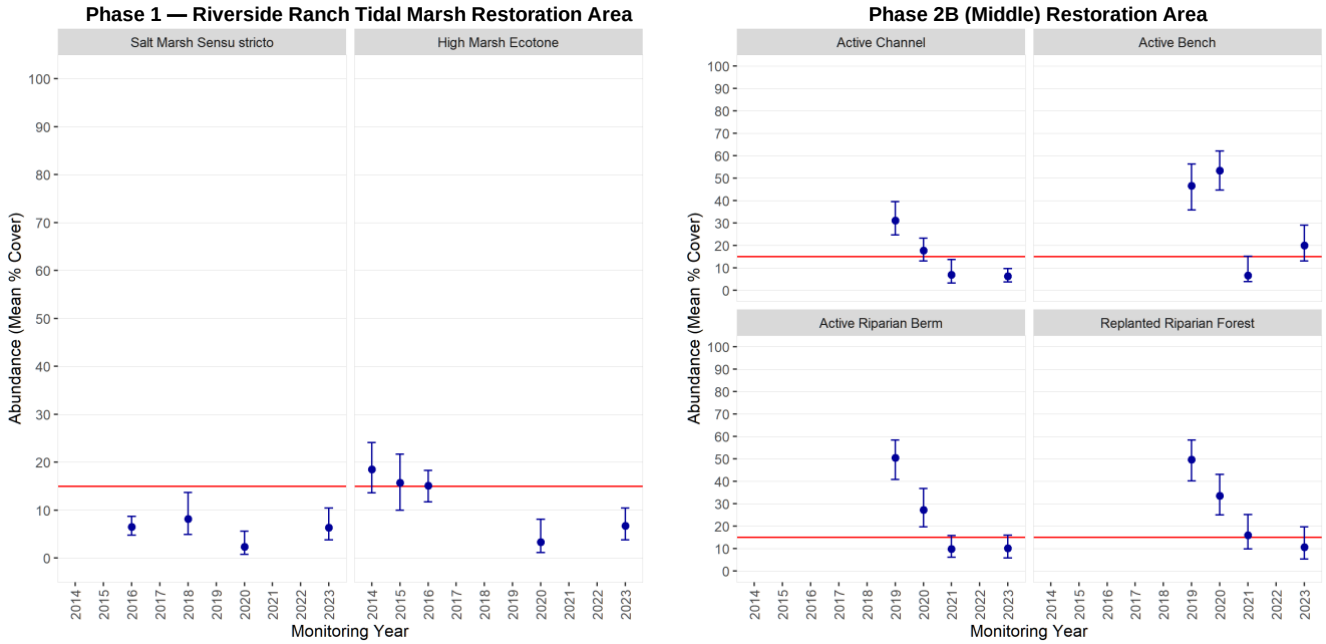

Figure 2. Estimated Abundance of Non-Native Non-Invasive Vegetation throughout the Salt River Ecosystem Restoration Project (SRERP) Sampling Regions Addressed in the 2023 Annual Habitat Monitoring Effort: 2014–2023. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. Horizontal red lines indicate the final *maximum* percent cover success threshold for non-native non-invasive vegetation (i.e., < 15%) throughout the Salt River Ecosystem Restoration Project area. Missing values indicate years when vegetation percent cover sampling was not prescribed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for respective portions of the SRERP project area

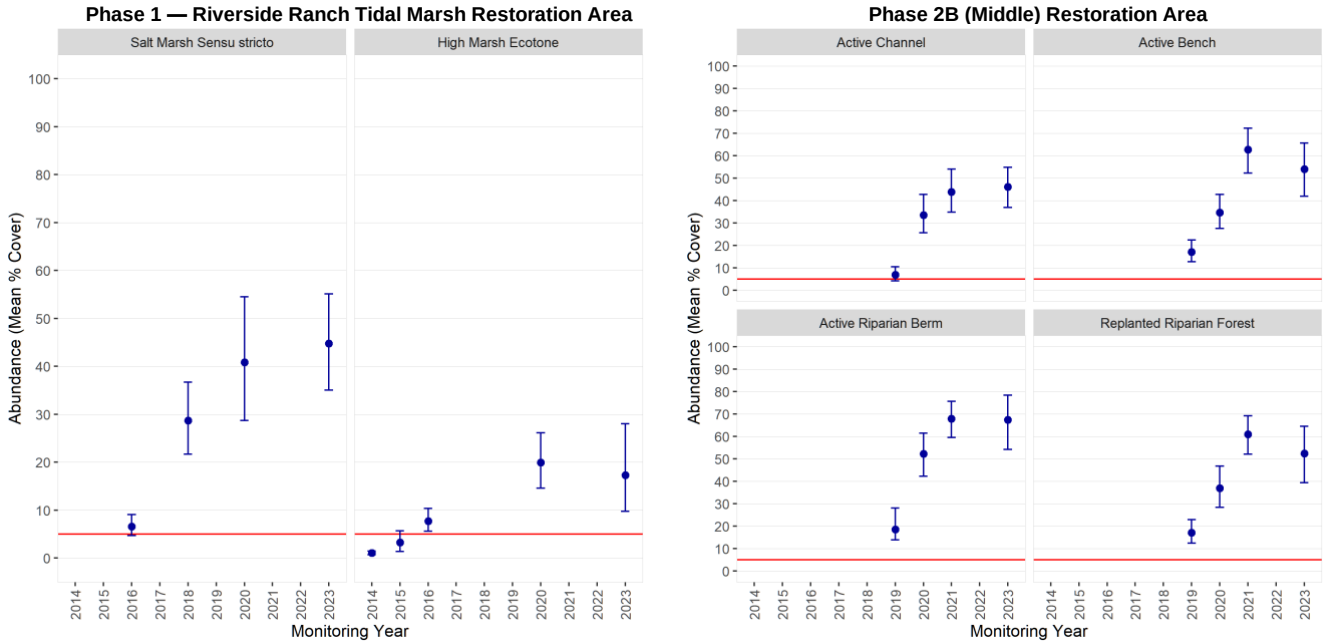

Figure 3. Estimated Abundance of Invasive Vegetation throughout Salt River Ecosystem Restoration Project (SRERP) Sampling Regions Addressed in the 2023 Annual Habitat Monitoring Effort: 2014–2023. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. Horizontal red lines indicate the final *maximum* percent cover success threshold for invasive vegetation (i.e., < 5%) throughout the Salt River Ecosystem Restoration Project area. Missing values indicate years when vegetation percent cover sampling was not prescribed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for respective portions of the SRERP project area.

Summary Table of Arborescent Riparian Vegetation

Basal Area Sampling Measurements in 2023

Appendix E

Summary Table of 2023 SRERP Replanted Woody Riparian Vegetation Basal Area Sampling Measurements. Basal area values represent summed total basal area measurements for each tree species observed in each habitat sampled in 2023. Acreage values reflect summed sampling plot area within respective sampling regions.

	Measured Basal Area (ft^2)			
	Phase 2B (Middle) — Salt River Corridor Restoration Area			
Tree Species	**Replanted Riparian Forest (0.13 acres) (n = 5)**	**Active Riparian Berm (0.22 acres) (n = 5)**	**Active Bench (0.32 acres) (n = 5)**	**Total (0.67 acres)**
Salix sitchensis (Sitka willow)	0.1004	0.0031	0.0268	0.1303
Alnus rubra (red alder)	0	0.0503	0.0001	0.0504
Salix lasiandra var. *lasiandra* (Pacific willow)	0.0049	0.0077	0	0.0126
Populus trichocarpa (black cottonwood)	0	0.0074	0	0.0074
Morella californica (California wax-myrtle)	0.0003	0.0039	0	0.0042
Picea sitchensis (Sitka spruce)	0	0.0036	0	0.0036
Total	**0.1056**	**0.0760**	**0.0269**	**0.2085**