2019 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 and fall of 2019, J.B. Lovelace & Associates conducted the annual habitat monitoring effort for the Humboldt County Resource Conservation District's Salt River Ecosystem Restoration Project (SRERP) near the Eel River estuary in Humboldt County, California. This watershed-scale habitat restoration project was initiated in 2013 and continues to be carried out in a sequential series of phases throughout the Salt River corridor over the course of several years. Implementation of the SRERP is expected to restore beneficial hydrological and ecological functions to the Salt River (a tributary to the Eel River) as well as to restore historically more abundant tidal and freshwater wetland habitats within the restoration area. Following completion of each project sub-phase, a suite of environmental parameters is assessed over the course of respective 10-year monitoring periods to evaluate progress toward the development of targeted conditions and to anticipate and address potential problems that may compromise the successful attainment of restoration goals. This 2019 annual habitat monitoring effort focused on all restoration areas completed prior to the 2019 monitoring period (i.e., Phase 1, Phase 2A, and the lower and middle reaches of Phase 2B) and involved the mapping and analysis of restored habitats, quantitative vegetation sampling to characterize developing herbaceous and woody riparian vegetation within specific habitats, and an assessment of the extent of invasive vegetation occurring throughout the SRERP area.

Results from our 2019 fieldwork demonstrate that the Salt River Ecosystem Restoration Project has outperformed the respective success criteria for this monitoring year in all regions of the project area addressed, with the exception of the Salt River channel wetland habitats in the Phase 2A (Lower) restoration area. In this fifth and theoretical "final" year for which vegetation percent cover sampling was originally required in this specific portion of the SRERP restoration area, the abundance of invasive plants ranges from 3 to 6 times greater than the *maximum* final success threshold (i.e., 5%) for this category of vegetation. For this reason, we recommend continuing to perform periodic vegetation percent cover sampling in these locations until it can be demonstrated that the abundance of invasive vegetation has been reduced to the extent required.

Mapping and analysis of restored habitats in the Phase 1 and Phase 2 restoration areas reflect only minor changes in the sizes and distributions of habitats previously addressed during respective preceding monitoring efforts, and have verified the additions of freshwater Salt River channel wetland and riparian habitats in the recently completed Phase 2B (Middle) reach. Although specific minimum area (acreage) success thresholds only exist for final monitoring years, the habitat types assessed in the 2019 habitat monitoring effort currently meet or exceed those final thresholds.

Quantitative vegetation sampling results reflect the continued establishment and development of native vegetation in all habitats sampled in 2019, and relevant

success thresholds for minimum cover of native vegetation were exceeded in every case. Included among those native plants encountered in 2019 were two special status plants, *Carex lyngbyei* (“Lyngbye’s sedge”) and *Angelica lucida* (“sea-watch”), both of which were documented in both the Phase 1 and Phase 2A (Lower) restoration areas.

Recent results also demonstrate the continued establishment and development of woody riparian vegetation throughout replanted riparian habitats in the Phase 1 and Phase 2A (Lower) restoration areas, though supplemental revegetation efforts should be considered in Phase 1 riparian planting zones where both current estimates, and observed increases in arborescent basal area during the period 2017-2019, were disproportionately low. Woody vegetation is also establishing in Salt River channel wetland habitats as well as in sediment management areas throughout the Phase 2 – Salt River Corridor Restoration Area due to stochastic recruitment from *in situ* propagule sources, as well as supplemental revegetation efforts conducted in 2018 and 2019 to compensate for anticipated shortfalls in this vegetation type in the Phase 2B (Middle) restoration reach. It is expected that these areas will experience an accelerated conversion of associated vegetation communities, which will likely confound and complicate evaluation of the “performance” of affected habitats when compared against success criteria that did not anticipate such processes to occur within the span of respective restoration monitoring periods. Re-evaluation of relevant success criteria should be considered to determine whether more appropriate alternative thresholds should be developed, which accommodate such successional dynamics while still remaining consistent with the fundamental restoration goals of the SRERP.

Despite the continued favorable trajectory with respect to the development of projected habitats and native vegetation thus far, sustained and proportionate efforts are warranted to reduce and/or eradicate invasive vegetation documented during our 2019 fieldwork throughout the SRERP restoration area. If not adequately addressed, the continued establishment and development of such undesirable vegetation is likely to prevent the achievement of final success thresholds, thereby jeopardizing some of the long-term restoration goals for the project. We remain confident that if sufficient effort is dedicated to addressing invasive plant species occurrences in a timely manner, all respective success thresholds can be met, thereby achieving the various goals of this ambitious restoration project.

1.0 Introduction

The Salt River Ecosystem Restoration Project (SRERP) is a phased watershed-scale habitat restoration project being implemented in the vicinity of the Eel River delta in coastal Humboldt County, California (Figure 1). Initiated in 2013, this collaborative effort is being coordinated by the Humboldt County Resource Conservation District (HCRCD) and involves numerous project partners. The primary focus of this restoration project is to restore beneficial fluvial, hydrological, and ecological functions to the Salt River (a tributary to the lower Eel River), as well as to restore historically more abundant adjacent coastal and floodplain wetland habitats. The project attempts to address compromised watershed functions resulting from historic channel alteration and excess sediment accretion throughout the Salt River watershed. Specific restoration goals include the reduction and management of upstream sediment sources, the facilitation of sediment transport through the system, and the creation of suitable conditions for the development and enhancement of ecologically important habitats such as tidal salt marsh, estuarine brackish, and freshwater wetlands. Accomplishing these goals is helping to reduce periodic flooding in the adjacent agricultural community during high-flow events, while simultaneously restoring regionally important coastal wetland habitats. During the summer of 2019 J.B. Lovelace & Associates participated in the restoration effort by assisting the HCRCD in the performance of required annual habitat monitoring tasks.

1.1 Regulatory Context & Monitoring Directives

Preparation for the SRERP involved an extensive planning and permitting process. As part of this process, the *Salt River Ecosystem Restoration Habitat Mitigation and Monitoring Plan* (HMMP) (H.T. Harvey & Associates with Winzler & Kelly 2012) was developed to guide the restoration effort and to provide an assessment framework with which to gauge its efficacy. This framework includes directives for implementing a 10-year, post-installation monitoring program, during which time various environmental parameters are to be measured and compared against success criteria to track progress towards achieving specific restoration goals for each phase, and to identify and address any problems that could prevent the realization of such goals. Implementation of this monitoring program is also a requirement included in the following project-related permits, certifications, and agreements:

- *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);

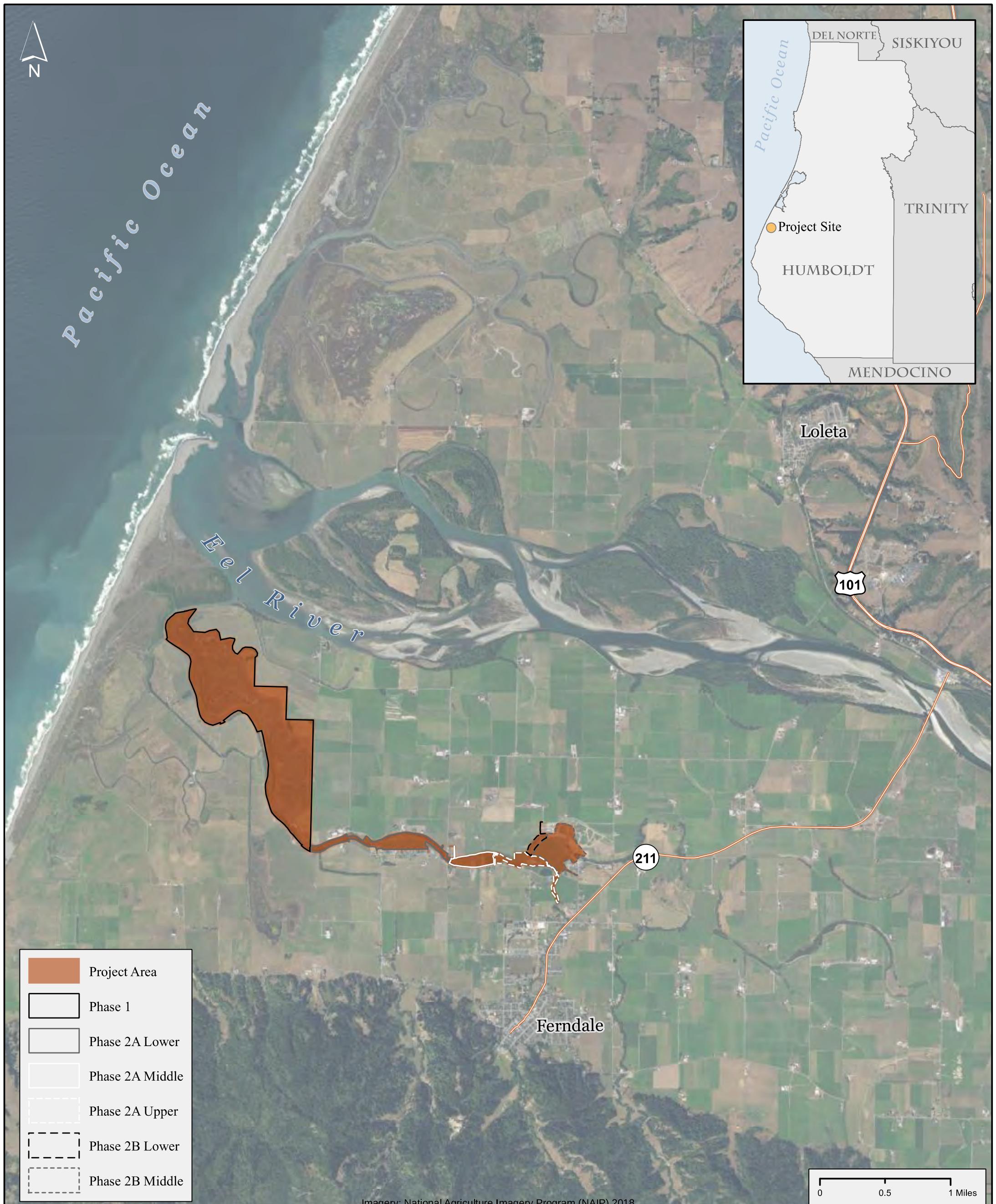


Figure 1. Salt River Ecosystem Restoration Project (SRERP) Vicinity
2019 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

- *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).

A quantitative assessment of the development of restored habitats and associated vegetation is an important component of this monitoring program, and is the focus of this annual habitat monitoring report.

1.2 Previous Monitoring & Reporting

The 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 in 2016, 2017, and 2018 was performed by J.B. Lovelace & Associates, and those efforts are described in *2016 Annual Habitat Monitoring Report for the Salt River Ecosystem Restoration Project*, *2017 Annual Habitat Monitoring Report for the Salt River Ecosystem Restoration Project*, and *2018 Annual Habitat Monitoring Report for the Salt River Ecosystem Restoration Project* (J.B. Lovelace & Associates 2017, 2018, 2019; respectively). This current report provides documentation of the most recent (2019) habitat monitoring effort for the Salt River Ecosystem Restoration Project, and addresses the specific tasks (Table 1) identified for the current monitoring year, which consist of the following:

A. Habitat Area Analysis & Mapping

1. Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
    a. Riparian Habitats
2. Phase 2A (Lower) – Salt River Corridor Restoration Area:
    a. Riparian Habitats
3. Phase 2B (Middle) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Habitats

Table 1. SRERP Habitat Monitoring Schedule[1] for Phases 1 & Phase 2. Bold text indicates the current monitoring year (2019).

		Monitoring Period & Schedule of Tasks[2]																	
Phase	**SRERP Habitat Type**	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	BC	**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]			BC	BC	BC	C	**BC**	C	C	C	C	C						
	Riparian Planting Zones[7]			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	C	C	C	C					
	Riparian Planting Zones[7]				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" [6,8]						ABC	**BC**	BC	C	BC	C	C	C	C	C			
	Riparian Planting Zones[7,9]						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" [6,8]						ABC	**BC**	BC	C	BC	C	C	C	C	C			
	Riparian Planting Zones[7,9]						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" [6,8]							**ABC**	BC	BC	C	BC	C	C	C	C	C		
	Riparian Planting Zones[7,9]							**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] Includes both replanted riparian forest areas and active riparian berms.
[8] Habitat area assessment is warranted in Salt River Channel Wetlands, given recent planting of these areas with woody species.
[9] 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.

B. Vegetation Percent Cover Sampling

1. Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
    a. Replanted Riparian Forest
2. Phase 2A (Lower) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones
3. Phase 2A (Upper) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones
4. Phase 2B (Lower) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones
5. Phase 2B (Middle) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones

C. Invasive Vegetation Assessment

1. SRERP Restoration Area-Wide

D. Replanted Woody Riparian Vegetation Basal Area Assessment

1. Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
    a. Replanted Riparian Forest
2. Phase 2A (Lower) – 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 and is anticipated to continue until eventual completion of the SRERP near the toe of the coast range slope in the vicinity of the Salt River's confluence with Perry Slough. The entire project area consists of approximately 7.7 miles of the Salt River channel and more than 800 acres of adjacent habitat. At the initiation of the 2019 habitat monitoring effort, restoration construction had been completed throughout the Phase 1, Phase 2A (Lower, Middle, and Upper), and the lower and middle sub-phases of the Phase 2B restoration areas (Table 2).

Implementation of the SRERP involves 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 follow completion of restoration construction activities in each phase and sub-phase of the project to

Table 2. SRERP Phases & Sub-Phases Completed Prior to Initiation of 2019 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

* 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).

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 for each restoration area, which were developed during the design phase of the project and are provided in Tables 5-7 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

Herbaceous revegetation methods, which vary based on site conditions and desired species composition, include transplantation of propagated plant "plugs" as well as "hydroseeding," seed-drilling, and broadcast seed applications. Additionally, in restoration areas designated for the re-establishment of woody riparian vegetation, young shrubs, tree saplings, and live cuttings are planted during the dormant season following restoration construction. Specific methodologies and technical specifications for these 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);
- *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); and
- *Salt River Ecosystem Restoration Project Phase 2018 Revegetation As-Built Documentation* (HCRCD 2019).

A general description of each of the project phases, respective revegetation efforts, restoration goals, and targeted or "projected" habitats for which 2019 monitoring requirements apply, is introduced here to provide supportive context for the 2019 habitat monitoring effort. A more encompassing project description for the entire SRERP can be found in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

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 & 2).

Phase 1 restoration increased the capacity of the Salt River channel through excavation and widening of much of its lower reach, and restored tidal connectivity throughout ~300 acres of the adjacent diked former tidelands by removing existing levees, excavating and grading reclaimed dairy pastureland, and developing a system of tributary channels throughout the Riverside Ranch restoration area. As part of Phase 1, a new 2.2 mile-long "setback levee" was also constructed around much of the eastern perimeter of the restored tidal habitat to prevent tidal inundation from extending beyond the restoration area, into adjacent agricultural pasturelands.

Approximately 2.5 miles of the Salt River channel and 2.8 miles of new and existing internal tributary channels were excavated and widened, and ~170,000 cubic yards of fill material were removed from reclaimed pastureland to achieve suitable topography, restoring tidal connectivity to these diked former tidelands. Restoration of tidal influence throughout this area has facilitated the development of important estuarine habitats historically more abundant throughout the region, such as tidal salt marsh and brackish wetlands, tidally influenced mudflats, and open water habitats, as well as associated and ecologically significant transitional zones or "ecotones."

2.1.1 Phase 1 Projected Habitats

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. Some ambiguities inherent in the originally conceived habitat descriptions have been found to complicate assessments of restoration “success.” In this current (2019) effort, we carry forward the approach towards classification of the different projected habitat types and regions of the SRERP restoration area introduced during the 2016 habitat monitoring period (J.B. Lovelace & Associates 2017), which was proposed in an attempt to facilitate more appropriate comparisons of observed results against success criteria. Explanations for this approach are incorporated into our treatment of projected SRERP habitats relevant to the 2019 habitat monitoring effort, below.

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, 2018, 2019) 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 such as “salt marsh” and “brackish marsh” to subordinate portions of the project area actually found to reflect characteristics typically associated with such habitat classifications (i.e., *sensu stricto*). Below, we briefly describe projected habitat types and relevant subordinate habitat components that directly relate to, or provide context for, the 2019 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 2019 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*). Sterile hybrid seed is commonly used to achieve rapid soil stabilization in restoration of disturbed habitats due to its relatively vigorous germination and growth rates as well as its limited potential for reproduction. This seed blend was selected to quickly stabilize disturbed soils initially, while simultaneously encouraging the establishment of a native flora consistent with similar native ecotonal communities in the region.

Phase 1: Riparian Habitats

In the context of vegetation, the term "riparian" is traditionally understood to be inclusive of all types of plant species associated with rivers or streams, regardless of a species' growth form or "habit" (e.g., herbaceous plants, woody shrubs, woody vines, trees, etc.). Use of this adjective in project-related documents for the SRERP, however, appears to refer only to the woody component (trees, shrubs, and/or woody vines) of riparian vegetation under consideration. In an attempt to avoid potential confusion, we maintain such usage; hereafter, "riparian" is used to indicate habitats generally recognized as being classified as "forested wetlands" and/or "scrub-shrub wetlands" (FGDC 2013).

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 also 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" 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

The second phase of the SRERP was initiated in 2014 following completion of Phase 1, and has progressed upstream from the Phase 1 – Riverside Ranch restoration area along the Salt River corridor as a sequential series of sub-phases. As of the 2019 habitat monitoring effort, all three reaches (i.e., lower, middle, and upper) of Phase 2A and the lower and middle reach of Phase 2B 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. The restoration goals and approach were consistent throughout.

Phase 2A (Lower) was implemented in 2014. This restoration reach extends along the Salt River corridor, upstream from the southern-most limit of the Phase 1 project area, to a location approximately 200 feet upstream from the Dillon Road bridge crossing of the Salt River channel (Appendix A, Figures 1 & 3). The following year (2015), Phase 2A (Middle) restoration proceeded from the upstream terminus of the Phase 2A (Lower) project reach, to a location approximately 0.4 linear miles upstream from the Dillon Road bridge, and ~1,000 feet northwest of the City of Ferndale's wastewater treatment facility (Appendix A, Figures 1 & 4).

In 2017, restoration of the combined Phase 2A (Upper) & Phase 2B (Lower) restoration reaches resumed from the upstream limit of Phase 2A (Middle) to locations approximately 0.5 miles further up the Salt River channel, as well as ~0.5 miles up Francis Creek from its confluence with the Salt River. Specifically, Phase 2A (Upper) consists of the reach extending ~ 0.25 miles up the Salt River channel from the upstream limit of Phase 2A (Middle), and includes the entirety of the restored portion of Francis Creek. The Phase 2B (Lower) portion of restoration completed in 2017 consists of a ~0.25-mile section of restored Salt River channel, extending upstream from the upstream limit of Phase 2A (Upper) (Appendix A, Figures 1 & 5). Given that both Phase 2A (Upper) and Phase 2B (Lower) restoration reaches were completed during the same construction season in 2017, they are addressed together, in aggregate, for the purposes of our habitat monitoring efforts.

In 2018, Phase 2B (Middle) restoration proceeded upstream ~0.3 miles from the upstream extent of the Phase 2B (Lower) area to reconnect the restored lower portions of the Salt River channel with an isolated segment of its historic channel in the vicinity of "Arlynda Corners" near the junction of Port Kenyon Road and Market Street (Appendix A, Figures 1 & 6). With completion of Phase 2A (Upper), and the lower and middle sub-phases of Phase 2B, historic channel connectivity and streamflow conveyance has been restored to both the Salt River and Francis Creek (within the SRERP footprint), both of which had become occluded, resulting in deviation from their respective original channels and flooding of the agricultural pastureland along Bertelsen Lane.

Restoration activities associated with these initial Phase 2 efforts focus on Salt River channel modifications and restoration of immediately adjacent habitat within the riparian corridor. Future design elements proposed for subsequent SRERP efforts further upstream include restoration of adjacent seasonal freshwater wetland habitats extending beyond the immediate riparian corridor (H.T. Harvey & Associates with Winzler & Kelly 2012). Salt River channel modifications involve excavation, widening, and recontouring to increase channel capacity, encourage conveyance of sediment through the system, and facilitate the development and maintenance of identified hydrologic and ecologic riparian habitat functions. Backwater alcoves, engineered log-jams, coarse woody debris, and other design features are also being incorporated into the channel during recontouring to increase channel morphological complexity and provide important habitat features for fish and other native aquatic species.

All disturbed portions of the Phase 2 project areas restored thus far were revegetated with appropriate species blends that correspond to six designated planting zones (i.e., brackish marsh, freshwater marsh, brackish active riparian berm, freshwater active riparian berm, brackish riparian forest, and freshwater riparian forest) following completion of construction (GHD 2015; HCRCD 2016b, 2018, 2019). Revegetation efforts were consistent with the aforementioned guidance documents and involved hydroseeding and broadcast application methods for seed blends, which were conducted in autumn of 2014, 2015, 2017, and 2018 for the Phase 2A (Lower), Phase 2A (Middle), the combined Phase 2A (Upper)/Phase 2B (Lower), and Phase 2B (Middle) restoration reaches, respectively.

Revegetation of designated areas with woody species and “wetland plugs” occurred in winter and early spring of 2014/2015 for Phase 2A (Lower), 2015/2016 for Phase 2A (Middle), 2017/2018 for the combined Phase 2A (Upper)/Phase 2B (Lower), and 2018/2019 for Phase 2B (Middle) restoration reaches. Supplemental planting of woody riparian vegetation was also conducted in locations originally replanted with only herbaceous species throughout the Phase 2 restoration area in 2018 and 2019 in anticipation of the need to compensate for potential insufficiencies in the amount of total area planted with this vegetation component following unanticipated reductions in the availability of portions of the project area where replanting of woody riparian vegetation could occur (HCRCD pers. com.).

2.2.1 Phase 2 Projected Habitats & Associated Habitat Components

Consistent with the first phase of the SRERP, Phase 2 restoration areas were designed, constructed, and revegetated with the intent to establish identified geomorphological and hydrological functions, and/or specific targeted or “projected” habitats. Different plant species assemblages were prescribed (H.T. Harvey & Associates with Winzler & Kelly 2012; GHD with H.T. Harvey & Associates October 2014; HCRCD 2015b, 2015c, 2016a, 2019) for various restoration “habitat components” throughout respective reaches. These species compositions were developed based on a combination of restoration goals, various hydrological regimes, edaphic conditions, and/or other site-specific factors.

Projected habitat types within the Phase 2 Salt River restoration corridor identified in the HMMP include existing and replanted riparian habitats, "sediment management areas," and two distinct types of wetland systems contiguous with the wetted Salt River channel: "brackish marsh" and "freshwater channel" wetlands. For the purposes of the 2019 habitat monitoring effort (and consistent with the approach used in preceding habitat monitoring efforts [J.B. Lovelace & Associates 2017, 2018, 2019]), we refer to portions of the Phase 2 Salt River corridor restoration area that are contiguous with the wetted Salt River channel, and are not otherwise classified as existing riparian forest/scrub, "riparian planting zones," or "sediment management areas" to be part of the "Salt River channel wetland" system, having both "brackish marsh" and "freshwater channel" wetland components. Each of these habitats and relevant design components addressed in the 2019 habitat monitoring effort are identified and briefly described below.

Phase 2: "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 (FGDC 2013), which support plant communities currently dominated by herbaceous species. Collectively, this system incorporates geomorphological diversity that beneficially influences the movement of sediment throughout the Salt River watershed, facilitates the establishment of wetland vegetation, and provides low-velocity refugia for aquatic organisms during high-flow events, in addition to foraging and breeding habitat for terrestrial wildlife and avian species during other times of the year.

Specific 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 Francis Creek, which consistently convey streamflow throughout the year. 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.

The active bench was designed to provide an interface between the active channel of the Salt River and the adjacent landscape, which receives flows exceeding bankfull channel capacity during high-flow events and facilitates deposition of sediments transported from upstream sources. Active bench areas were treated in the HMMP as emergent (i.e., herbaceous plant-dominated) wetland habitats and revegetation prescriptions for such areas did not include woody perennial plant species, though the eventual recruitment of a woody riparian component in these habitats as a result of natural successional processes was anticipated in the development of the HMMP.

Tidal influx and upstream freshwater contributions combine in the Phase 2A restoration area resulting in brackish hydrological conditions, particularly in the lower Phase 2A reach. Plant species tolerant of such intermediate water chemistry have become established along the edges of the active Salt River channel and in adjacent active bench habitats exposed to tidal influence. With increasing distance upstream, and/or away from the active channel edge, the vegetation transitions into a plant community composed of species more typically adapted to freshwater conditions in response to this water chemistry gradient.

Tidal influence extends upstream in the Salt River active channel to a point approximately 600 feet upstream of the Dillon Road bridge (GHD with H.T. Harvey & Associates 2014), or ~400 feet upstream of the boundary between the "lower" and "middle" reaches of the Phase 2A restoration area. Beyond this point, the Salt River hydrological regime is understood to be a predominantly freshwater system. The actual transition between brackish and freshwater conditions of the adjacent active bench habitat is both gradual and variable due to variations in the geomorphology of the reconstructed channel, the dynamic nature of the associated hydrology, and the fact that the restored habitats are still developing. Findings from the 2019 effort reflecting the current distribution of brackish and freshwater habitats are presented in Section 4.0 (below) and Appendix A, Figures 3 & 4.

<u>Disambiguation of "Brackish Marsh"</u>
The term "Brackish Marsh" has been used in the planning context of Phase 2 of the SRERP to refer to estuarine emergent wetland habitats expected to develop in the Salt River channel wetland system in the lower reach of the Phase 2A restoration area. Consistent with that understanding, we apply the term "brackish marsh wetlands" to all estuarine emergent wetland habitats subject to brackish hydrological conditions, (whether in reference to such habitats in the Phase 1 restoration area or to Phase 2A Salt River channel wetlands, not just the active channel edge of Phase 2A (as presented in H.T. Harvey & Associates [2015]). For purposes of any comparisons of habitat monitoring results across monitoring years, H.T. Harvey & Associates' (2015) use of "brackish marsh" corresponds specifically to the Phase 2A (Lower) "brackish active channel" recognized in J.B Lovelace & Associates (2017, 2018, 2019) and in this current report.

Phase 2: Sediment Management Areas
"Sediment management areas" are 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 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.

Phase 2: Riparian Habitats

Phase 2 restoration construction efforts necessitated the removal of some portions of pre-existing riparian forest, as had also occurred during Phase 1. This existing habitat was retained where possible, and woody riparian vegetation was replanted in suitable "riparian planting zones" during the subsequent dormant seasons for each project sub-phase to compensate for the loss of this habitat component as well as to achieve identified restoration goals. Riparian planting zones were also revegetated with suitable herbaceous species, following specifications provided in the aforementioned revegetation guidance documents.

Suitable Phase 2 riparian planting zones included both areas of "replanted riparian forest" along the upper riparian channel banks, contiguous with retained pre-existing riparian forest, as well as along the "active riparian berms." "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 as "natural" levees, 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 revegetation of aforementioned riparian planting zones, in 2018 and 2019 unanticipated reductions in the availability of portions of the Phase 2B (Middle) restoration reach where replanting of woody riparian vegetation could occur prompted the subsequent supplemental planting of such vegetation in some freshwater active bench and passive sediment management areas throughout the Phase 2 restoration reach. Given this subsequent "conversion" of some areas historically treated either as herbaceous-vegetation-dominated wetland habitats of the "Salt River Channel Wetland System" or as sediment management areas, in this current annual monitoring report, all such supplemental riparian planting areas continue to be addressed as originally designated (i.e., active bench or sediment management area), though the extent of these additional areas revegetated with woody species are quantified for evaluation in Section 4.1.2, and are depicted in Appendix A, Figures 3-6.

3.0 Methods

Consistent with the schedule of monitoring requirements (Table 1) provided in the HMMP, the 2019 SRERP habitat monitoring effort consisted of three general tasks: verification of habitat conditions to update maps of the distribution of specific habitats within respective portions of the SRERP project area, quantitative sampling within specific habitats to characterize 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 2019) where updated taxonomical classification was warranted.

3.1 Habitat Mapping & Area Analysis

Existing SRERP habitat GIS data originally provided by the HCRCD and revised during the 2016, 2017, and 2018 monitoring efforts (J.B. Lovelace & Associates 2017, 2018, 2019; respectively), were refined as necessary in 2019 to develop updated habitat maps reflecting current site conditions. These refinements were made using ArcMap® (ESRI) geographic information system (GIS) desktop software and the most recent satellite imagery (Google Earth 2019 and National Agriculture Imagery Program [NAIP] 2018), and were based on observations made during fieldwork performed from July 16-August 5 and November 19-23, 2019. Geographic field data were collected using a Trimble® Juno® global positioning system (GPS) device with ArcPad® software (ESRI). Habitat area (acreage) totals were calculated as part of this process, and the resulting maps are included in Appendix A as Figures 2-6.

The HMMP schedule of monitoring tasks (Table 1) only explicitly requires the analysis of habitat area (acreage) for Phase 1 “riparian planting zones,” Phase 2A (Lower) “riparian planting zones,” and both “Salt River channel wetland” and “riparian planting zones” in the Phase 2B (Middle) restoration areas in 2019. Although the 2019 habitat mapping & area analysis effort focused on these specific habitat types, additional opportunistic observations of changes in the extent of other SRERP habitat types were also recorded where encountered. Habitat area success criteria established in the HMMP are presented alongside respective 2019 habitat area analysis results in Section 4.1 for evaluation purposes. It is important to note that habitat area (acreage) success criteria provided in the HMMP for Phase 2 represent total “phase-wide” acreage thresholds (including upstream areas where restoration has not yet occurred), and do not reflect any partitioning into “sub-phase” quantities corresponding to the actual progression in which Phase 2A (Lower, Middle, and Upper) or Phase 2B (Lower and Middle) restoration efforts were implemented. In the absence of sub-phase-specific success criteria, respective thresholds were proportionately scaled for each relevant Phase 2 sub-phase habitat using ArcMap® and appropriately truncated “projected habitat” GIS data created during the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

3.2 Quantitative Vegetation Analysis

Two distinct quantitative sampling efforts were conducted in 2019 to analyze and characterize different aspects of the vegetation associated with specific habitats within the SRERP restoration area: vegetation percent cover sampling and replanted woody riparian vegetation basal area sampling. Both sampling efforts are described in detail below. Because some SRERP habitats (and associated monitoring task schedules) are partitioned due to project phasing (i.e., brackish active channel and freshwater active bench habitats that extends across both Phase 2A [Lower] and Phase 2A [Middle] project areas), we adopt the convention of referring to partial, project phase-specific portions of a given habitat as their respective habitat type “sampling region” (e.g., Phase 2A [Lower] active bench sampling area, Phase 2A [Middle] active bench sampling area, etc.). This allows for phase-specific portions of sampled habitats to be treated independently, to be tracked and evaluated based on respective monitoring schedules and success criteria, while attempting to minimize the complexity associated with addressing various combinations of habitat types and monitoring schedule requirements. The primary drawback in this approach is reduced resolution when attempting to draw conclusions from results at the level of habitat variants (e.g., brackish vs. freshwater active berm habitat in the Phase 2A [Lower] restoration area, brackish vs. freshwater active channel habitat in the Phase 2A [Middle] reach, etc.). However, in light of the additional level of complexity inherent in tracking and evaluating each such iteration through “monitoring space,” the aforementioned convention was determined to achieve the best compromise between simplicity and being most informative.

3.2.1 Vegetation Percent Cover Sampling

Vegetative percent cover data were collected from July 17-August 5, 2019 to characterize the vegetation within habitats where this task was scheduled to occur during the current monitoring year. Specific habitat “sampling areas” where vegetation percent cover sampling was performed in 2019 consisted of:

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area

- Replanted Riparian Forest

Phase 2 – Salt River Corridor Restoration Area

Phase 2A (Lower)

Salt River Channel Wetlands

- Active Channel
- Active Bench

Riparian Planting Zones

- Replanted Riparian Forest
- Active Riparian Berm

Phase 2A (Upper)/Phase 2B (Lower)

Salt River Channel Wetlands

- Active Channel
- Active Bench

Riparian Planting Zones

- Replanted Riparian Forest
- Active Riparian Berm

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, species composition, and structural composition of existing vegetation in each vegetation sampling area. The goal of such a sampling approach is to sufficiently distribute the collection of vegetation data throughout sampling areas to provide the most accurate, quantitative characterization of the vegetative categories of interest throughout the site, while minimizing any pre-conceived bias on the part of the observer. Based on power analyses of 2018 SRERP vegetation sampling data (J.B. Lovelace & Associates 2019), we used a minimum sample size (n = 32) that was determined to be sufficient to detect a "medium" effect size of 0.5 standard deviations (following Cohen 1988) between the observed sample means and their respective success criteria using a two-sided *t*-test, and assuming both 95% confidence and a statistical power of 80%.

Using updated SRERP habitat GIS data and ArcMap® software, each phase and sub-phase of the restoration area was partitioned into ecologically distinct vegetation sampling areas of perceived relative homogeneity based on project reach, restoration habitat design components, revegetation prescriptions, and elevation strata. ArcMap® software was then used to randomly distribute 32 sampling plots throughout each of these sampling areas (Appendix A, Figures 7-10). Given that each sampling area is composed of multiple, geographically separated polygons, the 32 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 location were then appropriately corrected and uploaded to the aforementioned GPS unit for location during fieldwork. Once sample plots were located in the field, a 1m^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 data against the success criteria for specific vegetative parameters, each observed plant species was categorized as:

- native,
- non-native non-invasive,
- non-native invasive, or
- sterile "wheatgrass" hybrid (*Elymus* x *Triticum*);

as well as being:

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

Percent cover data collected for each species reflected that species' *absolute* cover, which is distinct from *relative* cover. *Absolute* cover quantifies the entire aerial projection of each species (or any other vegetative category of interest) within the sample frame, regardless of any canopy overlap between different species. When measuring absolute cover, resulting cumulative cover values for sampled locations that exceed 100% for a given sample are not uncommon (Barbour et al. 1998, etc.). Absolute cover data are generally considered to allow for a broader range of analytical applications. In contrast, *relative* cover values always represent a proportion ranging from 0-100%, and can be less informative due to reduced precision in addressing areas of overlapping vegetative canopy.

In an attempt to minimize any observer-related variation between monitoring efforts, 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) was also used during the 2019 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. Although some precision is lost when using such a method, plant-cover abundance scales can be useful in long-term monitoring projects as they serve to reduce observer-based variation between observation periods.

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 vegetation success criteria specified in the HMMP consist of minimum percent cover thresholds for native species and maximum percent cover thresholds for both non-native non-invasive and non-native invasive species for the various combinations of habitat type and monitoring year. These criteria are summarized below in Tables 4-6. Although no such "percent cover" success criteria are specified for vegetative structural composition (other than related criteria for riparian habitat acreage), a characterization of the structural type of

Table 4. SRERP Native Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2019). Missing values indicate monitoring years for which no habitat monitoring tasks are required for respective habitats.

		Percent Cover Native Plant Species Success Criteria (≥)																	
Phase	**SRERP Habitat Type**	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%						
Phase 2A (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%					
Phase 2A (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%			
Phase 2B (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%		

[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 (2019). 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	2013	2014	2015	2016	2017	2018	**2019**	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			Percent Cover Non-Native Non-Invasive Plant Species Success Criteria																	
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%		

[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 Non-Native Invasive Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2019). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

		Percent Cover Non-Native Invasive Plant Species Success Criteria																	
Phase	**SRERP Habitat Type**	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%						
Phase 2A (Middle)	(Monitoring Year)				1	2	3	**4**	5	6	7	8	9	10					
	"Salt River Channel Wetlands"[4,5]				–	–	–	**–**	<5%										
	Riparian Planting Zones				–	–	–	**–**	–	–	–	–	–	<5%					
Phase 2A (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%			
Phase 2B (Middle)	(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.

sampled vegetation in riparian planting zones 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 areas. This does not change the requirements established in the HMMP for monitoring the extent (acreage) of this habitat throughout the duration of the monitoring period.

Data Analysis

Statistical methods used to analyze percent cover data collected in the 2019 habitat monitoring effort consisted of: 1) non-parametric bootstrap analyses to evaluate the precision of mean percent cover estimates for the various vegetation categories of interest, and 2) power analyses to assess the adequacy of the sample size for each vegetation sampling area and to provide sample size recommendations for the subsequent monitoring year. To the extent possible, we attempted to maintain consistency with methods employed in previous monitoring efforts (H.T. Harvey & Associates 2014, 2015; J.B. Lovelace & Associates 2017, 2018, 2019) to minimize any investigator-related discrepancies introduced in comparisons between results from different monitoring years.

At the sample plot level, absolute cover values for the various categories of interest (i.e., native, non-native non-invasive, invasive, and hybrid) 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, tree, and shrub) in riparian planting zones, as well as to address 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 2016) and specific methods used in the 2019 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.

<u>Power Analyses</u>
Power analyses were performed retrospectively to evaluate the adequacy of the 2019 sample size (n = 32) for each habitat area where vegetation sampling was conducted. They also serve to provide recommendations for initial sample sizes in subsequent vegetation sampling efforts in these habitats. Initial calculations revealed that the sample sizes used in the 2019 vegetation percent cover sampling efforts continue to be sufficient to detect both an effect size of 0.5 standard deviations and/or a difference of 20% between the observed estimated means and respective success criteria.

Based on these initial calculations, we ultimately performed power analysis calculations, assuming a two-sided *t*-test with 80% statistical power and a significance level of 0.05 (95% confidence) to be able to detect the more conservative effect size of a 20% difference between observed sample means and respective success criteria. In every instance, sample sizes associated with the 2019 sampling efforts for each sampled habitat type were determined to have exceeded the minimum quantities necessary to detect the aforementioned significant (and meaningful) differences between observed mean estimates of percent cover for the various vegetative categories of interest and their respective monitoring year success criteria.

3.2.2 Replanted Woody Riparian Vegetation Basal Area Assessment
From November 20-23, 2019 we resumed basal area sampling in habitats replanted with woody riparian vegetation within the Phase 1 and Phase 2A (Lower) restoration areas to assess the structural development of arborescent vegetation in these habitats since the previous sampling effort occurred in 2017 (J.B. Lovelace & Associates 2018). Specific habitat sampling regions where basal area sampling was performed in 2019 consisted of:

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
Riparian Planting Zones
- Replanted Riparian Forest (n = 30)

Phase 2A (Lower) – Salt River Corridor Restoration Area:
Riparian Planting Zones
- Replanted Riparian Forest (n = 21)
- Active Riparian Berm (n = 10)

Sampling Design & Data Collection

In 2019 we resampled the same randomly located circular (r = 10 m) basal area sampling plots (Appendix A, Figures 11-14) that were originally established and sampled in 2017 (J.B. Lovelace & Associates 2018). We elected to resample the same plots instead of randomly selecting new plots in order to minimize potential variation attributable to inter-plot variability alone, which was perceived to be appreciable based on experience and familiarity with the SRERP project area (pers. obs.).

Upon relocating basal area sampling plots in the field using a handheld Trimble GPS device, the diameter-at-breast-height (DBH) (in millimeters), species, and geographic coordinates were recorded for all trees located within the plot that were ≥4.5 feet ("breast height") tall. Diameter measurements 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.

In instances where the circular plots extended outside of the boundaries of the targeted sampling habitats, 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 was common in the more narrow and sinuous habitat sampling areas along the riparian corridor in 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® GIS software to derive relativized tree basal-area-per-unit-area-sampled 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:

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

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 within each sample plot as well as to obtain sampling plot BAPA totals. Respective BAPA values were then extrapolated to produce projected estimates of total sampling region- and phase-wide basal area for each species using respective habitat area (acreage) measurements obtained from current SRERP GIS data. Tabulated values for the resulting projected basal area estimates are provided in Section 4.0 to characterize the current developmental status of this vegetation type in habitats sampled in 2019. Raw basal area measurements (not extrapolated to sampling region- and/or phase-wide estimates) are also provided in Appendix C.

Hypothesis Test

Individual sample plot values of total BAPA for both 2017 and 2019 were then used to conduct a hypothesis test in order to determine if recent results reflect sufficient progress towards satisfaction of the single relevant success criterion set forth in the HMMP of demonstrating a “statistically significant increasing trend” in basal area of arborescent vegetation. Given the extent of inter-plot variability (both in terms of observed BAPA as well as the change in BAPA over time) and the non-normal distribution of recently obtained sampling data, we performed a permutation test rather than a paired *t*-test to evaluate the degree of change in (total) observed BAPA from 2017 to 2019.

We applied the standard permutation testing reasoning that if there was no interannual change in BAPA, the year (i.e., 2017 or 2019) 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, 2019 minus 2017) 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: 2017-2019.

While such a method provides a valid statistical hypothesis test of the current trend at each level of the analysis, we also performed an additional analysis to address the skewed nature of our 2019 sampling data and attempt to tease out more granular information about the response of individual sampling plots. In this second analysis, we scored each sampling plot as being a “success” if BAPA increased from 2017 to 2019 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 2019 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.

3.3 Invasive Plant Species Assessment

Throughout the performance of habitat mapping and quantitative vegetation sampling fieldwork (i.e., July 16-August 5 and November 19-23, 2019), all encountered occurrences of invasive vegetation were documented using the aforementioned GPS device. The resulting geographic data were subsequently uploaded, appropriately corrected, and used to update relevant maps developed over the course of the 2016, 2017 and 2018 habitat monitoring efforts (J.B. Lovelace & Associates 2017, 2018, 2019; respectively) using ArcMap® software and the most recent satellite imagery (NAIP 2018) to reflect the most current knowledge of the distribution and extent of invasive species occurring throughout the SRERP area. The resulting maps are included in Appendix A (Figures 15-21).

Where feasible, the distributions of discrete invasive species were mapped separately, and in the case of the highly invasive salt marsh species, *Spartina densiflora* (“dense-flowered cord grass”), *Spartina*-specific figures were created to clearly depict updated observations of the distribution of this species throughout the SRERP restoration area (Appendix A, Figures 15 & 16). In some instances, the distributions of multiple co-occurring species overlapped to produce such complex mosaics that mapping separate species was not practical in the context of this effort. In such instances, the resulting combined species distribution mosaics were mapped as species “complexes.” These “complexes” were assigned titles referencing the most dominant invasive species genera represented. These species complexes are included in respective figures (Appendix A), and the most well represented species associated with each complex are also indicated.

Our categorization of plant species as being native, non-native non-invasive, and invasive generally conforms to that used in previous SRERP habitat monitoring efforts (H.T. Harvey & Associates 2014, 2015; J.B. Lovelace & Associates 2017, 2018, 2019) in an attempt to maintain consistency throughout the duration of the entire SRERP monitoring period. Native plants are considered to be those “occurring naturally in an area, as neither a direct nor indirect consequence of human activity” (Baldwin et al. 2012). 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) (2019) 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.”

Except as noted otherwise, our classification regards plant species encountered in the current habitat monitoring effort as being “invasive” if they are assigned a “high” invasive rating by Cal-IPC (2019), are listed as “noxious weeds” by the California Department of Food & Agriculture (CDFA 2019), are listed as “federal noxious weeds” (USDA 2019), are considered invasive in 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. Although some non-native plants detected in the current monitoring fieldwork regarded by the Cal-IPC (2019) as having “moderate” or “limited” invasive potential were considered invasive in the context of the SRERP restoration goals, other species classified similarly were not considered problematic in the context of the current effort, based on local species observations.

We also include two native plant species in our treatment of invasive vegetation in this effort based on their potential for ecosystem-altering effects in this nascent, large-scale restoration project: *Phalaris arundinacea* (“reed canary grass”) and *Typha latifolia* (“broad-leaved cattail”), although neither is listed as invasive by Cal-IPC (2019), CDFA (2019), or the Humboldt County Weed Management Area (2010). Although there is some ambiguity with respect to variation in the invasive potential of different populations of *P. arundinacea* (and the ability to distinguish between them in the field), both *P. arundinacea* and *Typha latifolia* are currently considered to be native in California. However, up until relatively recently, *Phalaris arundinacea* was not regarded as being native to California, and was considered invasive in previous SRERP habitat monitoring efforts (H.T. Harvey and Associates 2014, 2015; J.B. Lovelace & Associates 2017, 2018, 2019). Both species are considered by some sources (USDA 2019; etc.) to be invasive elsewhere due to their potential to alter ecosystem processes by becoming rapidly established and developing dense, monotypic stands which aggressively outcompete other species, and can result in sediment accretion and eventual channel occlusion and/or habitat conversion in some aquatic habitats.

4.0 Results

Recent results indicate a continued favorable trajectory throughout the SRERP restoration area with respect to the development of projected habitats and native vegetation thus far. However, immediate and proportionate efforts are warranted to reduce and/or eradicate non-native and invasive vegetation also documented during our recent fieldwork. Indeed, in this fifth, and what was intended to be final, year of vegetation percent cover sampling in the Phase 2A (Lower) Salt River channel wetland habitats, the abundance of invasive vegetation exceeds the final maximum success threshold (i.e., 5%) established in the HMMP for that vegetation category. If not adequately addressed, the continued establishment and development of such undesirable vegetation is likely to prevent the achievement of final success criteria in additional regions of the SRERP restoration area, thereby jeopardizing long-term restoration goals identified for the project. Specific results for the habitat mapping and area analysis, quantitative vegetation sampling, and invasive vegetation assessment aspects of the 2019 monitoring effort are provided in respective sections below.

4.1 Results of Habitat Mapping & Area Analysis

Results from the 2019 mapping and area analysis of restored habitats in the Phase 1 and Phase 2 restoration areas (Tables 7, 8, 10) reflect no changes in the sizes and/or distributions of habitats previously addressed in respective preceding monitoring efforts (J.B. Lovelace & Associates 2017, 2018, 2019), with the single exception of the active bench in Phase 2B (Lower) restoration area. Mapping of recently restored habitats in the Phase 2B (Middle) restoration reach also occurred in 2019 and those results contribute to the increasing habitat acreage totals for the SRERP. All habitat types for which final success criteria were specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) currently exceed their respective final (minimum) acreage thresholds. Project-wide habitat area (acreage) totals and respective eventual final success criteria are summarized in Tables 7, 8 and 10; and the observed distribution and extent of each habitat type, and relevant associated restoration design components, are depicted in Appendix A, Figures 2-6. Salient observations from the 2019 mapping effort and analysis are described below.

4.1.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration Area

During the 2019 habitat monitoring fieldwork, no changes were detected in the size and/or distribution of any of the Phase 1 habitats (Table 7; Appendix A, Figure 2) addressed during our preceding 2018 habitat monitoring effort (J.B. Lovelace & Associates 2019) and each exceeds respective minimum area success thresholds established in the HMMP. Replanted riparian forest was the only Phase 1 restoration area habitat that required focused habitat mapping and area analysis during the 2019 habitat monitoring effort (Table 1). However, given that the mapping of any one habitat boundary affects all adjoining habitat boundaries and corresponding areas, we include relevant information for all Phase 1 habitats for which this task is required throughout the SREP monitoring effort in Table 7 (below).

4.1.2 Phase 2 – Salt River Corridor Restoration Area

Phase 2: Salt River Channel Wetlands

As of the 2019 habitat monitoring effort, the current total area of Salt River channel wetlands is 21.41 acres, 51% (7.25 acres) greater than the extrapolated projected extent of this habitat category (14.16 acres) for this point in the implementation of the SRERP (Table 8; Appendix A [Figures 1, 3-6]). Recent mapping fieldwork in the Phase 2B (Middle) restoration area documented the addition of 4.15 acres of freshwater wetland habitat (0.63 acres of freshwater active channel and 3.52 acres of freshwater active bench) to the Phase 2 Salt

Table 7. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area: Summary of 2019 Observed Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2019	
Habitats & Restoration Design Components	**Projected[2]**	**Final Success Criteria[3]**	**Observed**	**% of Projected**
High Marsh Ecotone	**12.38**	**≥11.14**	**36.07**	**291%**
"Tidal Salt & Brackish Marsh"[4]				
Salt Marsh sensu stricto	–	–	*185.79*	–
Mudflat[5]	*20.80*	*≥18.72*	*44.24*	*390%*
Aquatic[5]			37.07	
Brackish Marsh	–	–	*16.69*	–
Upland	–	–	*20.16*	–
"Tidal Salt & Brackish Marsh"[4] Total	**321.70**	**≥289.53**	**303.95**	**95%**
Riparian Habitat				
Existing Riparian Forest	–	–	*20.46*	–
Replanted Riparian Forest	–	–	*22.91*	–
Riparian Habitat Total	**43.40**	**≥39.06**	**43.36**	**99%**

[1] 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 2019 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 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).

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

[4] 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).

[5] Aquatic and mudflat habitats are treated collectively ("Aquatic/Mudflat") in (H.T. Harvey & Associates with Winzler & Kelly 2012).

River channel wetland habitat total (Table 8; Appendix A, Figures 3-6). Brackish marsh wetland habitat does not occur upstream of the Phase 2A (Middle) restoration area and, therefore, no further contributions of this habitat type have been documented since the 2016 habitat monitoring effort (J.B. Lovelace & Associates 2017).

No actual changes have occurred to the extent of Salt River channel wetland habitats throughout the Phase 2A and the Phase 2B (Lower) restoration areas since preceding habitat mapping efforts were conducted in 2018 (J.B. Lovelace & Associates 2019). Mapping of the Phase 2B (Lower) freshwater active bench habitat was, however, revised slightly in 2019 to extend the eastern limit of that habitat component to more accurately reflect the true extent of active bench in that area. This mapping revision increased the total acreage of freshwater active bench habitat in the combined Phase 2A (Upper)/Phase 2B (Lower) restoration

Table 8. SRERP Phase 2 – Salt River Corridor Restoration Area: Salt River Channel Wetlands. Summary of 2019 Observed Habitat Areas & Respective Success Criteria.

Habitats & Restoration Design Components	Area (Acres)[1] Projected[2]	Final Success Criteria[3]	2019 Observed	2019 % of Projected
Brackish Marsh Wetlands				
Brackish Active Channel				
Phase 2A (Lower)	–	–	*2.07*	–
Phase 2A (Middle)	–	–	*0.12*	–
Phase 2A (Upper)/2B (Lower)	–	–	*0.00*	–
Phase 2B (Middle)	–	–	*0.00*	–
Brackish Marsh Active Channel Total	–	–	2.19	–
Brackish Active Bench				
Phase 2A (Lower)	–	–	*1.58*	–
Phase 2A (Middle)	–	–	*0.00*	–
Phase 2A (Upper)/2B (Lower)	–	–	*0.00*	–
Phase 2B (Middle)	–	–	*0.00*	–
Brackish Marsh Active Bench Total	–	–	1.58	–
Brackish Marsh Wetlands Total	**3.65**	**≥3.29**	**3.77**	**103%**
Freshwater Wetlands				
Freshwater Active Channel				
Phase 2A (Lower)	–	–	*0.00*	–
Phase 2A (Middle)	–	–	*0.26*	–
Phase 2A (Upper)/2B (Lower)	–	–	*1.16*	–
Phase 2B (Middle)	–	–	*0.63*	–
Freshwater Active Channel Total	–	–	2.05	–
Freshwater Active Bench				
Phase 2A (Lower)	–	–	*3.69*	–
Phase 2A (Middle)	–	–	*2.71*	–
Phase 2A (Upper)/2B (Lower)	–	–	*5.67*	–
Phase 2B (Middle)	–	–	*3.52*	–
Freshwater Active Bench Total	–	–	15.59	–
Freshwater Wetlands Total	**10.51**	**≥9.46**	**17.64**	**168%**
Salt River Channel Wetlands Total	**14.16**	**≥12.75**	**21.41**	**151%**

[1] 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 2019 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 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).

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

area by 0.83 acres from the 4.84 acres reported for the 2018 monitoring effort (J.B. Lovelace & Associates 2019) to 5.67 acres (Table 8; Appendix A, Figures 3-6).

Phase 2: Riparian Habitats

For those portions of the Phase 2 restoration area completed as of the 2019 monitoring effort, riparian habitats collectively total 46.70 acres, representing 91% of the (extrapolated) projected extent of this habitat (51.22 acres) at this point in the implementation of the SRERP (Table 9; Appendix A, Figures 3-6). The total area of existing riparian forest and riparian planting zone habitats distributed throughout the Phase 2A and the Phase 2B (Lower) restoration areas has not changed (Table 9; Appendix A, Figures 3-6) since our preceding habitat mapping fieldwork in 2018 (J.B. Lovelace & Associates 2019). Results from our 2019 habitat mapping efforts in the recently completed Phase 2B (Middle) restoration area reveal the addition of 4.54 acres of riparian habitat to the SRERP total, consisting of 2.58 acres of retained existing riparian forest, 0.74 acres of replanted riparian forest, and 1.22 acres of replanted active riparian berm habitat (Table 9; Appendix A, Figures 3-6).

Additional supplemental planting of woody riparian vegetation in Salt River channel freshwater wetland habitats (i.e., freshwater active bench) and sediment management areas throughout the Phase 2 restoration area totaled 15.87 acres (Table 10; Appendix A, Figures 3-6). All but 2.14 acres of this supplemental planting area occurred in freshwater active bench habitats, with the remainder occurring in passive sediment management areas (Table 10; Appendix A, Figures 3-6). These supplemental plantings were carried out in 2018 and 2019 to compensate for reductions in the availability of portions of the Phase 2B (Middle) restoration reach where replanting of woody riparian vegetation could occur. However, given that these subsequent revegetation efforts occurred within, and will eventually convert, herbaceous-vegetation-dominated habitat areas (i.e., freshwater active bench) already included elsewhere in the habitat mapping and area analysis of the SRERP, their acreage contributions are provided here, distinct from the originally-designated woody riparian revegetation results already introduced at the beginning of this section for purposes of providing clarity and appropriate evaluation of the areal contributions of these confounded revegetation areas.

4.2 Results of Quantitative Vegetation Analyses

4.2.1 Vegetation Percent Cover Sampling Results

Results from the 2019 vegetation percent cover sampling effort indicate that replanted (and volunteer) vegetation continues to establish and develop throughout sampled SRERP habitats. Our recently collected data also confirm the initiation and continuation of expected vegetation successional processes within these habitats. Findings presented here provide a current quantitative characterization of both the structural composition and native status of vegetation throughout sampling regions visited in 2019.

Table 9. SRERP Phase 2 – Salt River Corridor Restoration Area: Riparian Habitats. Summary of 2019 Observed Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2019	
Habitats & Restoration Design Components	**Projected[2]**	**Final Success Criteria[3]**	**Observed**	**% of Projected**
Existing Riparian Forest				
Phase 2A (Lower)	–	–	*11.52*	–
Phase 2A (Middle)	–	–	*6.89*	–
Phase 2A (Upper)/2B (Lower)	–	–	*3.26*	–
Phase 2B (Middle)	–	–	*2.58*	–
Existing Riparian Forest Total	**–**	**–**	**24.25**	**–**
Riparian Planting Zones				
Replanted Riparian Forest				
Phase 2A (Lower)	–	–	*8.22*	–
Phase 2A (Middle)	–	–	*3.47*	–
Phase 2A (Upper)/2B (Lower)	–	–	*2.86*	–
Phase 2B (Middle)	–	–	*0.74*	–
Replanted Riparian Forest Total	–	–	15.29	–
Active Riparian Berms				
Phase 2A (Lower)	–	–	*2.50*	–
Phase 2A (Middle)	–	–	*1.12*	–
Phase 2A (Upper)/2B (Lower)	–	–	*2.32*	–
Phase 2B (Middle)	–	–	*1.22*	–
Active Riparian Berm Total	–	–	7.16	–
Riparian Planting Zone Total	–	–	**22.45**	–
Riparian Habitat Total	**51.22**	**≥46.10**	**46.70**	**91%**

[1] 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 2019 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 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).
[3] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5-10.

Herein, we also address the relative abundance (i.e., percent cover) of native, non-native non-invasive, invasive, and sterile hybrid (erosion-control) categories of vegetation as they relate to the various success thresholds (Tables 4-6) established in the HMMP. We include specific mention of the current state of vegetation in the Salt River channel wetlands of the Phase 2A (Lower) restoration area, given that 2019 represents the fifth and theoretical final monitoring year for which vegetation percent cover sampling was expected in that specific area. The distribution of individual vegetation sampling

Table 10. SRERP Phase 2 – Salt River Corridor Restoration Area: Supplemental Riparian Planting Areas. Summary of previously restored SRERP areas recently supplemented with woody riparian plants.

Habitats & Restoration Design Components	**Replanted Area (Acres)**
Phase 2A (Lower)	
Replanted Sediment Management Area	*1.90*
Replanted Freshwater Active Bench	*2.23*
Total	4.13
Phase 2A (Middle)	
Replanted Sediment Management Area	*0.24*
Replanted Freshwater Active Bench	*2.67*
Total	2.91
Phase 2A (Upper)	
Replanted Freshwater Active Bench	*2.88*
Total	2.88
Phase 2B (Lower)	
Replanted Freshwater Active Bench	*2.45*
Total	2.45
Phase 2B (Middle)	
Replanted Freshwater Active Bench	*3.51*
Total	3.51
Phase 2 Total	
Replanted Sediment Management Area	***2.14***
Replanted Freshwater Active Bench	***13.73***
Total	**15.87**

plots are depicted in Appendix A (Figures 7-10) for each vegetation percent cover sampling region visited during the 2019 habitat monitoring effort, and a complete list of all detected plant species, along with their corresponding original (untransformed) absolute mean cover and frequency-of-occurrence values is provided in Appendix B.

Structural Composition

Total mean plant cover ranged from 70.0% (95% CI [60.3, 77.3]) to 100%, with the lowest observed mean values occurring in the most recently restored Salt River channel wetland habitats in the Phase 2B (Middle) restoration area (Table 11). Estimated mean cover of herbaceous vegetation ranged from 60.7% (95% CI [51.7, 69.4]) to 90.7% (95% CI [82.7, 94.9]) (Table 11). The lowest mean percent cover values of herbaceous vegetation were observed either in active channel habitats subject to regular fluvial disturbance or in more well-developed riparian replanting zones (e.g., Phase 2A [Lower], etc.) where the developing shrub and tree canopies are exerting an increasingly competitive influence and are beginning to "shade out" the associated herbaceous stratum (Table 11).

Woody riparian shrubs and trees are established and developing in all riparian planting zones sampled in 2019, with increasing vegetative cover of both being directly related to the age of restoration sub-phases (i.e., older restoration areas exhibit greater cover of woody vegetation) (Table 11). Across all Phase 2 riparian planting zone sampling regions, least mean cover values for both shrubs and

Table 11. Structural Composition of Vegetation within 2019 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).

SRERP Habitat Sampling Areas	Mean Percent Cover of Vegetation Categories of Interest: Total	Herb	Shrub	Tree	Vine
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area					
Replanted Riparian Forest (n=32)	**100.0** NA	**85.4** [74.5, 91.6]	**11.5** [6.0, 22.5]	**1.6** [0.3, 3.9]	**1.6** [0.0, 4.7]
Phase 2 – Salt River Corridor Restoration Area					
Phase 2A (Lower) – Salt River Channel Wetlands					
Active Channel (n=32)	**82.0** [74.3, 87.5]	**75.3** [67.7, 81.7]	**0.3** [0.0, 0.9]	**6.4** [2.8, 13.3]	**0.0** NA
Active Bench (n=32)	**94.4** [90.4, 97.0]	**89.6** [83.6, 93.6]	**0.7** [0.0, 2.1]	**4.0** [1.0, 11.2]	**0.0** NA
Phase 2A (Lower) – Riparian Planting Zones					
Replanted Riparian Forest (n=32)	**100.0** NA	**60.7** [51.7, 69.4]	**9.3** [5.8, 14.0]	**29.7** [22.3, 37.8]	**0.4** [0.0, 1.2]
Active Riparian Berm (n=32)	**97.0** [94.5, 98.4]	**72.9** [64.1, 79.4]	**4.0** [1.3, 9.5]	**20.2** [13.3, 29.7]	**0.0** NA
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands					
Active Channel (n=32)	**90.5** [84.6, 94.4]	**76.0** [68.9, 82.8]	**0.0** NA	**14.5** [8.4, 22.0]	**0.0** NA
Active Bench (n=32)	**92.3** [87.6, 95.5]	**86.3** [80.0, 91.1]	**0.0** NA	**6.0** [2.7, 11.9]	**0.0** NA
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones					
Replanted Riparian Forest (n=32)	**98.8** [96.4, 99.7]	**86.5** [79.8, 91.8]	**2.4** [0.6, 5.9]	**9.9** [5.1, 16.6]	**0.0** NA
Active Riparian Berm (n=32)	**85.3** [75.7, 91.4]	**78.7** [68.2, 86.2]	**0.4** [0.0, 1.6]	**6.2** [3.3, 10.8]	**0.0** NA
Phase 2B (Middle) – Salt River Channel Wetlands					
Active Channel (n=32)	**70.0** [60.3, 77.3]	**69.2** [59.8, 76.6]	**0.1** [0.0, 0.2]	**0.7** [0.0, 3.3]	**0.0** NA
Active Bench (n=32)	**75.8** [65.0, 83.8]	**75.8** [65.0, 83.8]	**0.0** NA	**0.0** NA	**0.0** NA
Phase 2B (Middle) – Riparian Planting Zones					
Replanted Riparian Forest (n=32)	**91.1** [83.1, 95.2]	**90.7** [82.7, 94.9]	**0.4** [0.08, 1.0]	**0.1** [0.0, 0.2]	**0.0** NA
Active Riparian Berm (n=32)	**89.5** [85.3, 92.7]	**85.6** [80.5, 89.7]	**0.3** [0.0, 0.8]	**3.7** [0.9, 10.0]	**0.0** NA

trees were recorded in the most recently restored Phase 2B (Middle) restoration area and greatest mean cover values were observed in the Phase 2A (Lower) reach (Table 11).

Mean tree cover in Phase 2 replanted riparian forest sampling regions ranged from 0.1% (95% CI [0.0, 0.2]) in Phase 2B (Middle) to 29.7% (95% CI [6.0, 22.5]) in the Phase 2A (Lower) reach (Table 11). In active riparian berm sampling regions, mean tree cover ranged from 3.7% (95% CI [0.9, 10.0]) in Phase 2B (Middle) to 20.2% (95% CI [13.3, 29.7]) in the Phase 2A (Lower) reach (Table 11). Consistent with this pattern described for arborescent riparian vegetation, mean cover of shrubs in Phase 2 replanted riparian forest sampling regions ranged from 0.4% (95% CI [0.06, 1.0]) in Phase 2B (Middle) to 9.3% (95% CI [5.8, 14.0]) in the Phase 2A (Lower) restoration area, and 0.3% (95% CI [0.0, 0.8]) in Phase 2B (Middle) to 4.0% (95% CI [1.3, 9.5]) in the Phase 2A (Lower) active riparian berm sampling region (Table 11).

Recent observations of woody riparian vegetation in the Phase 1 replanted riparian forest sampling region reflect an exception to the previously described relationship between percent cover of woody vegetation and the age-of-restoration-reach. Although shrub cover ($\overline{x} = 11.5\%$, 95% CI [6.0, 22.5]) in this Phase 1 sampling region was the greatest of any habitat sampled in 2019, this sampling region exhibited one of the lowest mean cover values for trees ($\overline{x} = 1.6\%$, 95% CI [0.3, 3.9]), less than some habitats replanted more recently, and less than some areas not initially replanted with woody species to begin with (Table 11).

Outside of riparian replanting zones, woody vegetation is also establishing in some Salt River channel wetland habitats. Mean cover of establishing trees in active channel sampling regions ranged from 0.7% (95% CI [0.0, 3.3]) in Phase 2B (Middle) to 14.5% (95% CI [8.4, 22.0]) in the Phase 2A (Upper)/Phase 2B (Lower) reach. The greatest tree cover ($\overline{x} = 6.0\%$, 95% CI [2.7, 11.9]) in active bench sampling regions was observed in the Phase 2A (Upper)/Phase 2B (Lower) restoration area. Mean cover of shrubs is much less in Salt River channel wetland habitats, peaking in the active bench sampling region in the Phase 2A (Upper)/Phase 2B (Lower) reach at 0.7% (95% CI [0.0, 2.1]), and at 0.3% (95% CI [0.0, 0.9]) in the active channel of the Phase 2A (Lower) reach (Table 11).

Native Status

Native Vegetation

Mean percent cover of native vegetation exceeds respective minimum success thresholds for 2019 in all sampling regions addressed during the current monitoring year (Table 12), demonstrating the achievement of respective success criteria for this vegetation category thus far, including for the Salt River wetland sampling regions (i.e., active channel and active bench) of the Phase 2A (Lower) restoration area. However, it is worth noting that of the thirteen habitats

Table 12. Summary of 2019 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		Sterile Hybrid Wheatgrass[1]
SRERP Habitat Sampling Area	Observed	Observed	2019 Success Criteria[2]	Observed	Final Success Criteria[3]	Observed	Final Success Criteria[3]	Observed
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area								
Replanted Riparian Forest (n=32)	**100.0** NA	**47.5** [38.2, 57.2]	≥40%	**8.8** [6.2, 12.1]	<15%	**43.7** [34.8, 52.3]	<5%	**0.0** NA
Phase 2 – Salt River Corridor Restoration Area								
Phase 2A (Lower) – Salt River Channel Wetlands								
Active Channel (n=32)	**82.0** [74.3, 87.5]	**59.9** [51.9, 67.8]	≥50%	**3.9** [1.9, 7.1]	<15%	**18.3** [14.1, 22.9]	<5%	**0.0** NA
Active Bench (n=32)	**94.4** [90.4, 97.0]	**62.5** [54.4, 70.0]	≥50%	**1.2** [0.4, 2.9]	<15%	**30.6** [23.0, 38.9]	<5%	**0.0** NA
Phase 2A (Lower) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**100.0** NA	**66.6** [53.8, 77.1]	≥40%	**0.9** [0.0, 2.4]	<15%	**32.6** [21.8, 45.4]	<5%	**0.0** NA
Active Riparian Berm (n=32)	**97.0** [94.5, 98.4]	**72.0** [62.1, 79.4]	≥40%	**1.2** [0.4, 2.7]	<15%	**23.9** [16.3, 34.5]	<5%	**0.0** NA
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands								
Active Channel (n=32)	**90.5** [84.6, 94.4]	**62.2** [53.3, 70.2]	≥20%	**7.1** [3.7, 13.6]	<15%	**21.2** [15.3, 29.7]	<5%	**0.01** [0.0, 0.03]
Active Bench (n=32)	**92.3** [87.6, 95.5]	**44.5** [35.6, 54.1]	≥20%	**20.8** [13.7, 29.4]	<15%	**26.7** [18.8, 37.2]	<5%	**0.3** [0.0, 1.0]
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**98.8** [96.4, 99.7]	**43.8** [34.4, 54.0]	≥15%	**19.7** [14.0, 27.0]	<15%	**33.4** [25.3, 43.2]	<5%	**1.5** [0.5, 3.0]
Active Riparian Berm (n=32)	**85.3** [75.7, 91.4]	**32.7** [26.5, 40.9]	≥15%	**26.5** [18.9, 35.1]	<15%	**24.7** [18.0, 33.1]	<5%	**1.8** [0.8, 3.1]
Phase 2B (Middle) – Salt River Channel Wetlands								
Active Channel (n=32)	**70.0** [60.3, 77.3]	**31.6** [25.1, 38.1]	≥10%	**31.0** [24.6, 39.5]	<15%	**6.8** [4.1, 10.4]	<5%	**0.6** [0.1, 1.9]
Active Bench (n=32)	**75.8** [65.0, 83.8]	**11.5** [7.2, 18.1]	≥10%	**46.5** [35.8, 56.3]	<15%	**17.0** [12.6, 22.3]	<5%	**0.8** [0.2, 2.8]
Phase 2B (Middle) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**91.1** [83.1, 95.1]	**22.5** [14.5, 34.0]	≥10%	**49.6** [40.2, 58.3]	<15%	**17.1** [12.3, 22.9]	<5%	**1.9** [0.8, 3.5]
Active Riparian Berm (n=32)	**89.5** [85.3, 92.7]	**19.3** [13.7, 26.4]	≥10%	**50.5** [40.7, 58.4]	<15%	**18.5** [13.8, 28.1]	<5%	**1.2** [0.5, 3.5]

[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).

recently sampled, 95% confidence intervals calculated for mean cover of native vegetation in Phase 1 replanted riparian forest ($\bar{x} = 47.5\%$, 95% CI [38.2, 57.2]) and Phase 2B (Middle) active bench ($\bar{x} = 11.5\%$, 95% CI [7.2, 18.1]) sampling regions included values below current minimum success threshold values (i.e., 40% and 10%, respectively) (Table 12). Mean percent cover of this vegetation category ranged from the lowest value reported above for the Phase 2B (Middle) active bench to a maximum of 72.0% (95% CI [62.1, 79.4]) in the Phase 2A (Lower) replanted riparian forest sampling region (Table 12).

<u>Non-Native Non-Invasive Vegetation</u>
Observed mean percent cover of non-native non-invasive vegetation is well below the (maximum) final success threshold (i.e., 15%) for this originally-proposed final year of percent cover sampling for the Phase 2A (Lower) Salt River channel wetland habitats (Table 12), thereby satisfying the relevant final success criterion for this specific sampling region. Mean percent cover of this category of vegetation ranges from a maximum of 50.5% (95% CI [40.7, 58.4]) in the recently constructed Phase 2B (Middle) active riparian berm sampling region to only 0.9% (95% CI [0.0, 2.4]) in the Phase 2A (Lower) replanted riparian forest habitat (Table 12), which was restored five years prior to our 2019 fieldwork (Table 2). Indeed, within each habitat type sampled, cover of non-native non-invasive vegetation appears to exhibit a consistently decreasing trend corresponding to increasing age of restoration sub-phase (Table 12).

<u>Invasive Vegetation</u>
Invasive vegetation exceeds the eventual final maximum success threshold of 5% (by monitoring year 5 for Salt River channel wetlands, and monitoring year 10 for all other habitats [Table 6]), in all thirteen of the SRERP habitats sampled in 2019 (Table 12). This includes the Phase 2A (Lower) Salt River channel wetland habitats, for which 2019 was originally scheduled to be the final year requiring percent cover vegetation sampling. Here, mean percent cover of invasive plants was 18.3% (95% CI [14.1, 22.9]) in the active channel sampling region and 30.6% (95% CI [23.0, 38.9]) in the active bench (Table 12).

The lowest mean cover of invasive vegetation observed during the 2019 habitat monitoring effort was in the recently restored Phase 2B (Middle) active channel sampling region ($\bar{x} = 6.8\%$, 95% CI [4.1, 10.4]) where vegetation is just becoming established. Elsewhere, mean percent cover of this category of vegetation ranged from 17.0% (95% CI [12.6, 22.3]) in the Phase 2B (Middle) active bench to 43.7% (95% CI [34.8, 52.3]) in the Phase 1 replanted riparian forest. Further analysis of the species composition of invasive vegetation observed during the 2019 vegetation sampling effort is provided in Section 4.3 (below).

<u>Sterile Erosion-Control “Wheatgrass” Hybrid</u>
The sterile “wheatgrass” hybrid (*Elymus* x *Triticum*) was encountered in each sampling region of both the Phase 2A (Upper)/Phase 2B (Lower) and the more

recently completed Phase 2B (Middle) restoration areas, but in relatively low abundance (Table 12). Mean percent cover of this hybrid grass ranged from 0.01% (95% CI [0, 0.03]) in the Phase 2A (Upper)/Phase 2B (Lower) active channel sampling region to a maximum of 1.9% (95% CI [0.8, 3.5]) in the Phase 2B (Middle) replanted riparian forest sampling region (Table 12).

4.2.2 Replanted Woody Riparian Vegetation Basal Area Sampling Results

Results from our 2019 woody riparian vegetation basal area sampling fieldwork further corroborate some of our aforementioned findings, reflecting the continued growth and development of woody riparian vegetation throughout much of the Phase 1 and lower Phase 2A restoration areas. Below, we provide projected estimates (extrapolated from recent sample data) of sampling region- and phase-wide basal area for each tree species encountered in each habitat sampled in 2019. Raw basal area measurements (not extrapolated to sampling region- and/or phase-wide estimates) are provided in Appendix C and the distribution of trees encountered during the 2019 sampling effort are depicted in Appendix A, Figures 11-14.

We also assess the magnitude of change in basal-area-per-unit-area ("BAPA") since previous basal area sampling was performed in the Phase 1 and Phase 2A (Lower) restoration areas in 2017 (J.B. Lovelace & Associates 2018). This assessment is made for the total combined Phase 1 and Phase 2A (Lower) restoration areas addressed in 2019 to determine if the relevant success criterion established in the HMMP (i.e., that basal area of arborescent vegetation demonstrates a "statistically significant increasing trend" over time) is currently being met. We further address the extent of change in BAPA at the level of restoration area, phase, sub-phase, sampling region, and individual basal area sample plots to allow for greater resolution in evaluating the performance of woody riparian vegetation within the portion of the SRERP project area addressed during the 2019 habitat monitoring effort.

Projected Basal Area Estimates

<u>Phase 1 – Riverside Ranch Tidal Marsh Restoration Area</u>

Replanted Riparian Forest

We sampled (n = 30) approximately 10% (2.2 acres) of the Phase 1 replanted riparian forest habitat (22.7 acres) again in 2019. Total projected basal area for this sampling region is 19.25 ft^2, which represents ~13% of the total projected basal area (150.11 ft^2) of all SRERP habitats addressed in the 2019 basal area sampling effort (Table 13). The most significant basal area contributions in this sampling region are from *Salix hookeriana* ("coastal willow") and *Alnus rubra* ("red alder), with lesser amounts of *Picea sitchensis* ("Sitka spruce"), *Pinus contorta* ssp. *contorta* ("shore pine"), and *Salix lasiandra* var. *lasiandra* ("Pacific willow").

Table 13. Summary of 2019 SRERP Replanted Woody Riparian Vegetation Basal Area Sampling Results. Basal area values represent projected totals for each tree species observed in each habitat sampled in 2019.

	(Projected*) Basal Area (ft²)				
	Phase 1 – Riverside Ranch Tidal Marsh Restoration Area	Phase 2A (Lower) – Salt River Corridor Restoration Area			
Tree Species	**Replanted Riparian Forest (22.71 acres) (n = 30)**	**Replanted Riparian Forest (8.05 acres) (n = 21)**	**Active Riparian Berm (2.44 acres) (n = 10)**	**Total Phase 2A (Lower) (10.49 acres)**	**Total[§] SRERP (33.2 acres)**
Alnus rubra (red alder)	5.6557	59.3262	31.0823	90.4084	96.0641
Salix hookeriana (coastal willow)	12.1919	17.5238	0.2395	17.7634	29.9553
Salix lasiolepis (arroyo willow)	0	14.2699	0.1494	14.4193	14.4193
Salix lasiandra (Pacific willow)	0.1632	6.0213	0.1911	6.2122	6.3753
Salix sitchensis (Sitka willow)	0	0.2386	1.4370	1.6755	1.6755
Picea sitchensis (Sitka spruce)	0.8962	0.1829	0.1986	0.3815	1.2777
Pinus contorta (shore pine)	0.3435	0	0	0	0.3435
Total	**19.2505**	**97.5624**	**33.2978**	**130.8602**	**150.1108**

* Projected total basal area values were derived from basal-area-per-unit-area-sampled measurements collected during 2019 quantitative vegetation sampling efforts, extrapolated to habitat- and phase-wide estimates based on respective habitat areas (acreages) obtained from current SRERP GIS data.

§ All SRERP restoration areas addressed during the 2019 basal area sampling effort

Phase 2A (Lower) – Salt River Corridor Restoration Area

Replanted Riparian Forest
In the Phase 2A (Lower) replanted riparian forest sampling area, we sampled (n = 21) approximately 13% (1.03 acres) of the total habitat area (8.05 acres) again in 2019. In contrast to the results described for its Phase 1 counterpart sampling region, the projected total basal area for the replanted riparian forest in the Phase 2A (Lower) restoration area is 97.56 ft^2, representing ~65% of the total projected basal area (150.11 ft^2) of all SRERP habitats addressed in 2019 (Table 13). This is greater than five times the basal area observed in the Riverside Ranch restoration area, despite being only ~35% of the size. The greatest contributions to woody riparian basal area in the Phase 2A (Lower) replanted riparian forest are from *Alnus rubra* ("red alder), *Salix hookeriana* ("coastal willow"), and *Salix lasiolepis* ("arroyo willow"), though *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Salix sitchensis* ("Sitka willow"), and *Picea sitchensis* ("Sitka spruce") also contributed to a lesser extent.

Active Riparian Berm
In the active riparian berm habitat of the Phase 2A (Lower) restoration area, we again sampled (n = 10) approximately 21% (0.51 acres) of the total habitat area (2.44 acres) in 2019. The projected basal area in this restoration design feature is 33.30 ft^2, which represents ~22% of the total projected basal area (150.11 ft^2) of all SRERP habitats addressed in 2019 (Table 13). Most of this basal area is attributable to *Alnus rubra* ("red alder), though lesser contributions from *Salix sitchensis* ("Sitka willow"), *Salix hookeriana* ("coastal willow"), *Picea sitchensis* ("Sitka spruce"), *Salix lasiandra* var. *lasiandra* ("Pacific willow"), and *Salix lasiolepis* ("arroyo willow") were also recorded.

Changes in Measured Basal Area Over Time
The results of our permutation test reveal that mean basal-area-per-unit-area-sampled ("BAPA") showed statistically significant increases throughout all Phase 1 and Phase 2A (Lower) basal area sampling regions during the two-year period from 2017 to 2019 (Table 14). The total increase in BAPA across all sampling regions was 4.73 ft^2/acre ($p = 0.0001$) and ranged from the weakest observed increase of 0.56 ft^2/acre ($p = 0.0312$) in the Phase 1 replanted riparian forest sampling region to the most vigorous increase of 11.49 ft^2/acre ($p = 0.0017$) in active riparian berm habitats in the Phase 2A (Lower) restoration area (Table 14). These results provide strong evidence against the null hypothesis that the mean change in BAPA was zero or decreasing, in favor of the alternative: that BAPA has indeed increased since 2017. The outcomes of individual sample plots were, however, highly variable, both in terms of basal area contributions as well as changes in basal area from 2017 to 2019, with several sample plots accounting for most of the basal area observed (Figure 2; Appendix A, Figures 11-14), as well as most of the increase (Table 14; Figure 2).

Table 14. Changes in Basal Area of Arborescent-Riparian-Vegetation-per-Unit-Area-Sampled ("BAPA") During the Period: 2017-2019. *P*-values represent the proportion of permutation data sets (n = 10,000) for which the mean difference in BAPA between 2017-2019 equaled or exceeded actual observed values. The Greek symbol, delta (Δ), indicates change.

2017 & 2019 SRERP Basal Area Sampling Regions	**Mean Δ BA/Area Sampled (ft^2/acre)**	***P***
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area		
Replanted Riparian Forest (n = 30)	0.56	0.0312*
Phase 2 – Salt River Corridor Restoration Area		
Phase 2A (Lower) – Riparian Planting Zones		
Replanted Riparian Forest (n = 21)	7.47	0.0001*
Active Riparian Berm (n = 10)	11.49	0.0017*
Phase 2 – Salt River Corridor Restoration Area Total	8.77	0.0001*
SRERP Total	4.73	0.0001*

* *P-values* < 0.05 indicate statistically significant changes in BAPA during this period.

Eighty-five percent (95% CI [0.74, 0.93]) of all basal area plots (n = 61) sampled during this effort exhibited an increase in BAPA (i.e., considered "successful" sample plots in the context of this analysis) during the period from 2017 to 2019, including all those in the Phase 2A (Lower) active riparian berm sampling region (Table 15; Figure 2). "Unsuccessful" sample plots are those which either exhibited no change in, or decreasing, BAPA during this two-year period. Decreases in BAPA were only observed in three sample plots (Figure 2), each from replanted riparian forest sampling regions: one in the Phase 1 restoration area and two in the Phase 2A (Lower) restoration area. The remaining six "unsuccessful" sample plots occur in the Phase 1 replanted riparian forest sampling region where no change in BAPA occurred between 2017 and 2019 (Figure 2; Appendix A, Figures 11-14). These latter six instances actually reflect randomly positioned sampling plots within replanted riparian forest sampling areas where no trees were encountered during either our 2017 or 2019 sampling fieldwork (or at least none that had yet reached a height of 4.5 feet [i.e., "breast height"]).

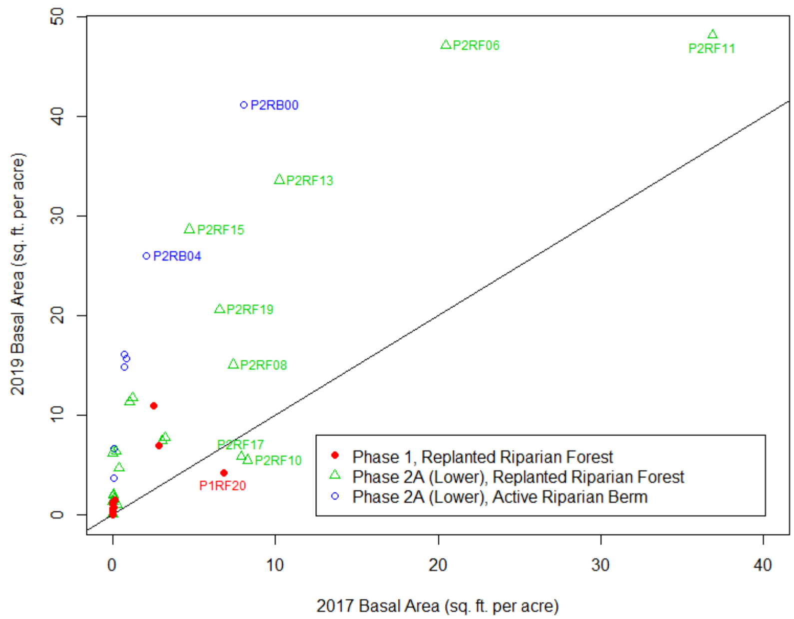


Figure 2. Pairwise Scatterplot of Basal-Area-per-Unit-Area Sampled ("BAPA") for 2017 and 2019. Each point represents one of 61 basal area sample plots, with horizontal and vertical axes reflecting the range of observed BAPA in 2017 and 2019, respectively. The diagonal line indicates the theoretical plane, along which, BAPA in 2017 and 2019 are equal (i.e., no change). Points above the diagonal line are instances where BAPA increased from 2017 to 2019 and points below the line are cases where BAPA decreased during that period.

Table 15. Proportion of "Successful" Basal Area Sampling Plots Observed in 2019. Sampling plots were determined to be "successful" if the basal area of arborescent-riparian-vegetation-per-unit-area-sampled ("BAPA") increased during the period: 2017-2019. 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.

2017 & 2019 SRERP Basal Area Sampling Regions	**Proportion of Successful Sampling Plots**	**95% CI**
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area		
Replanted Riparian Forest (n = 30)	0.77	[0.59, 0.89]
Phase 2 – Salt River Corridor Restoration Area		
Phase 2A (Lower) – Riparian Planting Zones		
Replanted Riparian Forest (n = 21)	0.90	[0.71, 0.99]
Active Riparian Berm (n = 10)	1.00	[0.72, 1.00]
Phase 2 – Salt River Corridor Restoration Area Total	0.94	[0.79, 0.99]
SRERP Total	0.85	[0.74, 0.93]

4.3 Invasive Plant Species Assessment

Results from the 2019 percent cover vegetation sampling effort discussed in Section 4.2.1 provide quantitative estimates (Table 12) of the current abundance of invasive vegetation in SRERP habitats sampled during 2019, and reveal that this class of vegetation exceeds the *eventual* final (maximum) success threshold (i.e., 5%) in all thirteen of the SRERP sampling regions addressed in 2019. This includes the Phase 2A (Lower) Salt River channel wetland habitats, for which, 2019 was originally scheduled to be the final year requiring percent cover vegetation sampling (Table 1). Additional incidental observations (Appendix A, Figures 15-21) made during our recent habitat mapping analysis and basal area sampling fieldwork support these findings and also indicate the persistence and development of substantial occurrences of invasive vegetation in regions of the SRERP project area where percent cover vegetation sampling did not occur in 2019 (e.g., salt marsh *sensu stricto* and "high marsh ecotone" in the Phase 1 restoration area, Phase 2A [Middle] Salt River channel wetlands and riparian planting zones, etc.).

In this section, we present invasive-plant-species-related findings from our 2019 habitat monitoring effort in greater detail in order to facilitate strategic vegetation maintenance and eradication efforts targeting this problematic category of vegetation. Specifically, we report on the recently observed species composition and abundance of invasive vegetation at the level of restoration reach and associated sampling regions. Herein, stated measures of abundance include both non-prorated absolute mean percent cover estimates and computed percent frequency of occurrence values. Conclusions drawn from these data should incorporate consideration of associated measures of sample variability (i.e., sample standard deviations [*s*], indicated as error bars in respective figures presented herein). The current distribution of invasive vegetation throughout the SRERP area is depicted in Appendix A, Figures 15-21. Where feasible, the distributions of individual species were mapped discretely. Where the distributions of multiple co-occurring invasive species overlap, the resulting mosaics are indicated as species "complexes."

It is important to note that findings presented in this current annual monitoring report (Appendix A, Figures 15, 17, 19) specific to portions of the SRERP project area where no habitat monitoring tasks were scheduled for 2019 (Table 1), rely heavily on results from the previous habitat monitoring effort in 2018 (J.B. Lovelace & Associates 2019) when such areas did receive focused attention. Though such locations are not specifically addressed in this narrative, relevant incidental observations documented in 2019 were used to update respective figures in Appendix A where applicable.

4.3.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration Area

Vegetation percent cover sampling results from the single Phase 1 sampling region addressed in 2019 (i.e., replanted riparian forest) show an increase in both the abundance and species diversity of invasive vegetation since the previous sampling effort was performed in 2017. Mean percent cover in this

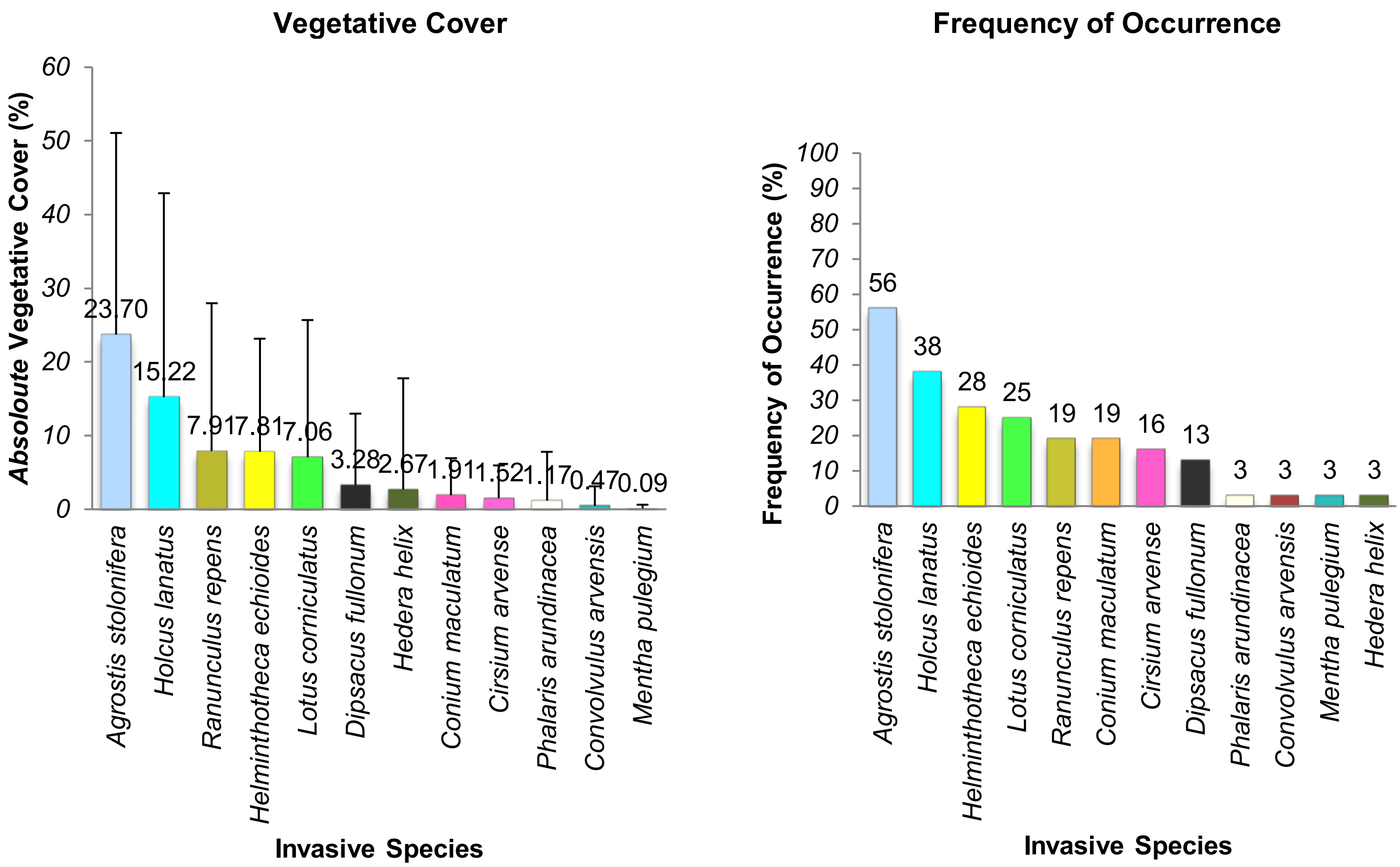


Figure 3. Invasive Plant Species Abundance. Phase 1 – Riverside Ranch Tidal Marsh Restoration Area: Replanted Riparian Forest. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

sampling region increased from 37.2% (95% CI [27.8, 47.3]) in 2017 (J.B. Lovelace & Associates 2018) to 43.7% (95% CI [34.8, 52.3]) in 2019 (Table 12) and slight changes in the invasive species composition have resulted in the net addition of one species, increasing the total number of invasive plant species encountered in this habitat to twelve (Figure 3).

The two most abundant invasive species documented in the Phase 1 replanted riparian forest during recent percent cover sampling fieldwork (Figure 3) reflect contrasting changes in abundance since 2017. During this time period, *Agrostis stolonifera* ("creeping bent") has decreased in both percent cover and frequency of occurrence, while *Holcus lanatus* ("common velvet grass") exhibited the opposite pattern and has increased by both measures. *Helminthotheca echioides* ("bristly ox-tongue") and *Conium maculatum* ("poison hemlock") have also increased in both frequency of occurrence and mean percent cover in the Phase 1 replanted riparian forest sampling region since 2017. Other, less substantial, and in some instances paradoxical, changes (i.e., increased frequency of occurrence and decreased percent cover, or vice versa) exhibited by less abundant invasive species have also occurred to a lesser extent between 2017 and 2019. One additional noteworthy new occurrence in the Phase 1 replanted riparian forest consists of the invasive vine, *Hedera helix* ("English ivy"), which was observed growing from near the base of woody vegetation installed as part of the replanting efforts in 2015. Both plants appeared to be of similar ages and it is believed that this invasive vine became established at this location as the result of planting of contaminated nursery stock.

Outside of percent cover sampling plots, both *Helminthotheca echioides* ("bristly ox-tongue") and *Dipsacus fullonum* ("wild teasel") are increasingly becoming established along the sheltered leeward edges of developing replanted riparian forest habitats (Appendix A, Figure 17). Additionally, new occurrences of *Rubus armeniacus* ("Himalayan blackberry") and *Senecio jacobaea* ("tansy ragwort") were also documented in graminoid-dominated portions of both replanted riparian forest and brackish marsh habitats within the Phase 1 restoration area (Appendix A, Figure 17). Elsewhere, in portions of brackish marsh habitat previously mapped as supporting pure stands of *Phalaris arundinacea* ("reed canary grass"), both *Agrostis stolonifera* ("creeping bent") and *Holcus lanatus* ("common velvet grass") were recently found to be infiltrating some these areas, resulting in changes in the classification of said areas from pure *P. arundinacea* to the "*Phalaris-Agrostis-Holcus* Complex" (Appendix A, Figure 17).

In the southern portion of the Phase 1 restoration area, along the leeward edge of the developing replanted riparian forest where it transitions into "high marsh ecotone," the expanding occurrence of low-density *Phalaris arundinacea* has merged with a similarly-expanding occurrence of the *Agrostis-Holcus-Ranunculus* Complex, to create a larger area most appropriately identified as supporting the combined *Phalaris-Agrostis-Holcus* Complex (Appendix A, Figure 17). In the southeastern portion of the Phase 1 restoration area, in the vicinity of the historic dairy infrastructure and restoration construction materials staging area, the Mixed Herbaceous Invasive Complex was also found to have expanded slightly since our previous habitat monitoring effort in 2018 (Appendix A, Figure 17).

Extensive regions of the "noxious" (CDFA 2019) and highly invasive salt marsh species, *Spartina densiflora* ("dense-flowered cord grass") continue to expand and increase in density throughout the majority of the tidal wetland and brackish riparian habitats in the Riverside Ranch restoration area (Appendix A, Figure 15). The coarse abundance classification of a small portion of the distribution of this species has been reduced from "moderate" to "low" in the southern-most portion of the Phase 1 (and adjacent Phase 2A [Lower]) restoration area(s) (Appendix A, Figure 15) in light of recent field observations made of the previously inaccurate designation, which overstated this species' abundance in this location. Both invasive grass species, *Polypogon monspeliensis* ("rabbitfoot grass") and *Parapholis strigosa* ("hairy sickle grass"), also continue to persist in relatively higher elevations in salt marsh *sensu stricto* habitat, as well as in portions of "high marsh ecotone" (Appendix A, Figure 15). Finally, the "noxious" (CDFA 2019) invasive plant, *Cortaderia jubata* ("pampas grass"), still occurs in previously documented (J.B. Lovelace & Associates 2019) locations, and at least three new occurrences of this species have recently become established along the setback berm and associated access road, as well as on the western edge of retained existing riparian forest along the Salt River channel (Appendix A, Figure 17).

4.3.2 Phase 2 – Salt River Corridor Restoration Area

Invasive plant species previously documented throughout the Phase 2 restoration area (J.B. Lovelace & Associates 2017, 2018, 2019) continue to persist in 2019, with some observed changes in their occurrence and distribution (Appendix A; Figures 16, 18-21) since previous respective habitat monitoring efforts. One new species not previously encountered in the SRERP project area, was also documented in the recently restored Phase 2B (Middle) restoration area during our 2019 fieldwork: the highly invasive (Cal-IPC 2019) grass, *Bromus tectorum* ("cheat grass") (Appendix A, Figure 21).

Consistent associations between habitat components and invasive species documented in the Phase 2A and lower Phase 2B portions of the Salt River corridor restoration area also extend upstream into the recently constructed Phase 2B (Middle) restoration reach. The majority of the invasive vegetation throughout the Phase 2 – Salt River Corridor Restoration Area continues to consist of a mixed assemblage of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), and *Holcus lanatus* ("velvet grass"), which extends throughout the active channel, active bench, and riparian berm habitats, as well as along the adjacent woody riparian fringe and in contiguous canopy gaps (Appendix A, Figures 18-21). This invasive species complex has continued to expand throughout all Salt River channel and riparian planting zone habitats in the Phase 2A and Phase 2B (Lower) restoration areas and is also becoming established in the recently restored Phase 2B (Middle) restoration area (Appendix A, Figures 18- 21). However, of these three species, *H. lanatus* was notably either absent (Figures 4, 5) or less abundant (Figures 6, 7) in vegetation sample plots within the lower Phase 2A habitats in 2019.

The most notable recent observations of invasive vegetation occurrences in the Phase 2 restoration area are described below, organized by restoration habitat component (though areas of overlap are indicated where relevant). Measures of abundance of individual invasive species associated with these habitat components are presented in Figures 4-15 for respective vegetation sampling regions where sampling was conducted in 2019 (i.e., salt river channel wetland habitats and riparian planting zones in the Phase 2A [Lower], Phase 2A [Upper]/ Phase2B [Lower], and Phase 2B [Middle] restoration reaches). Species which

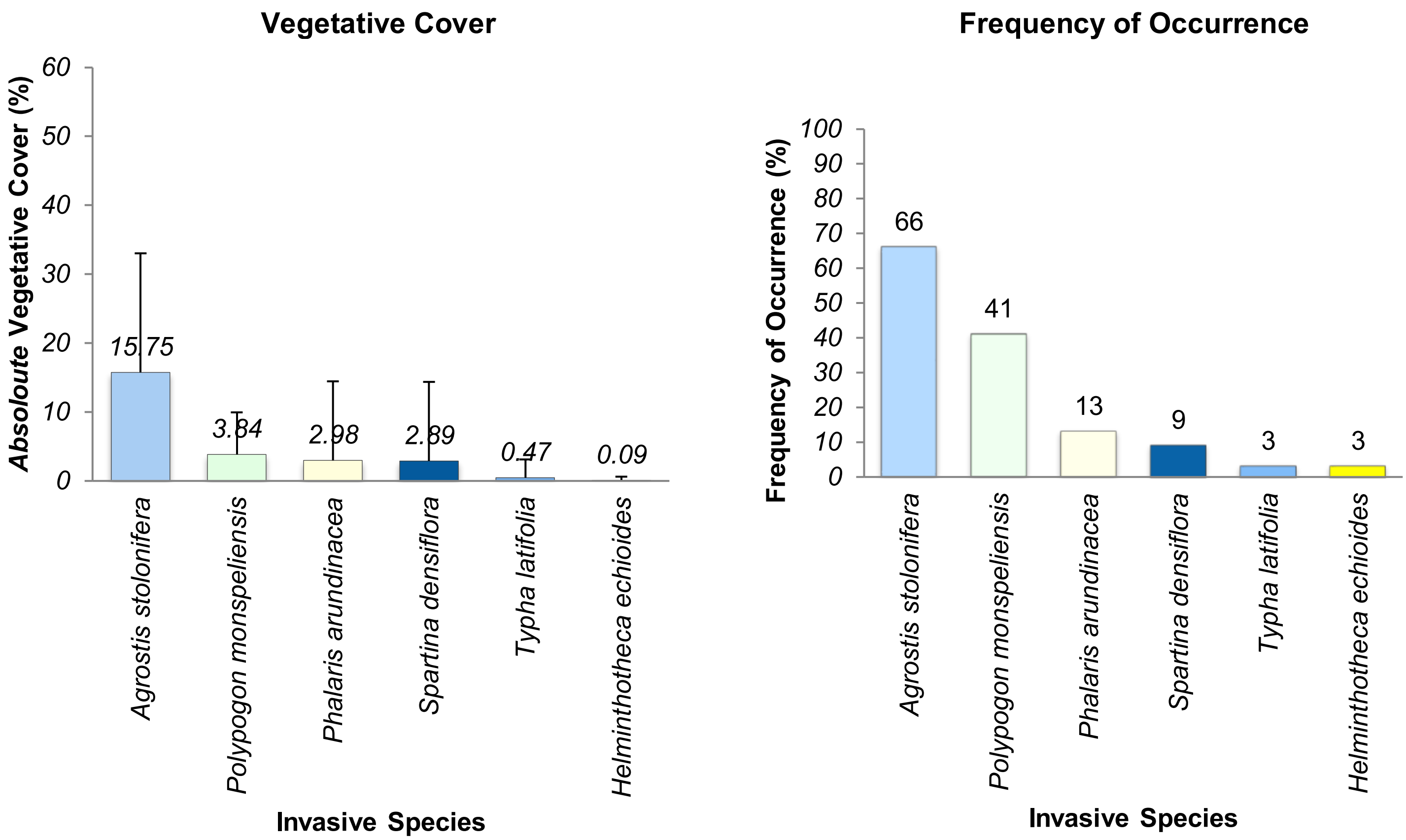


Figure 4. Invasive Vegetation Species Abundance. Phase 2A (Lower) – Salt River Corridor Restoration Area: Active Channel. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

were not encountered in vegetation sampling plots (and are, therefore, not represented in Figures 4-15), but were observed during the performance of other habitat monitoring tasks, are included among the invasive vegetation distributions depicted in Appendix A (Figures 16, 18-21).

Salt River Channel Wetlands

In the downstream portions of the Phase 2A (Lower) restoration area more directly subject to tidal influx and brackish water chemistry, *Polypogon monspeliensis* ("rabbitfoot grass") and the highly invasive *Spartina densiflora* ("dense-flowered cord grass") continue to become established and increase in abundance in brackish Salt River channel wetland habitats (Appendix A, Figures 16 & 18). Since our 2018 habitat monitoring effort, *S. densiflora* has further dispersed to a point ~250 feet "upstream" of its previously documented (J.B. Lovelace & Associates 2019) extent in historically uncolonized active channel

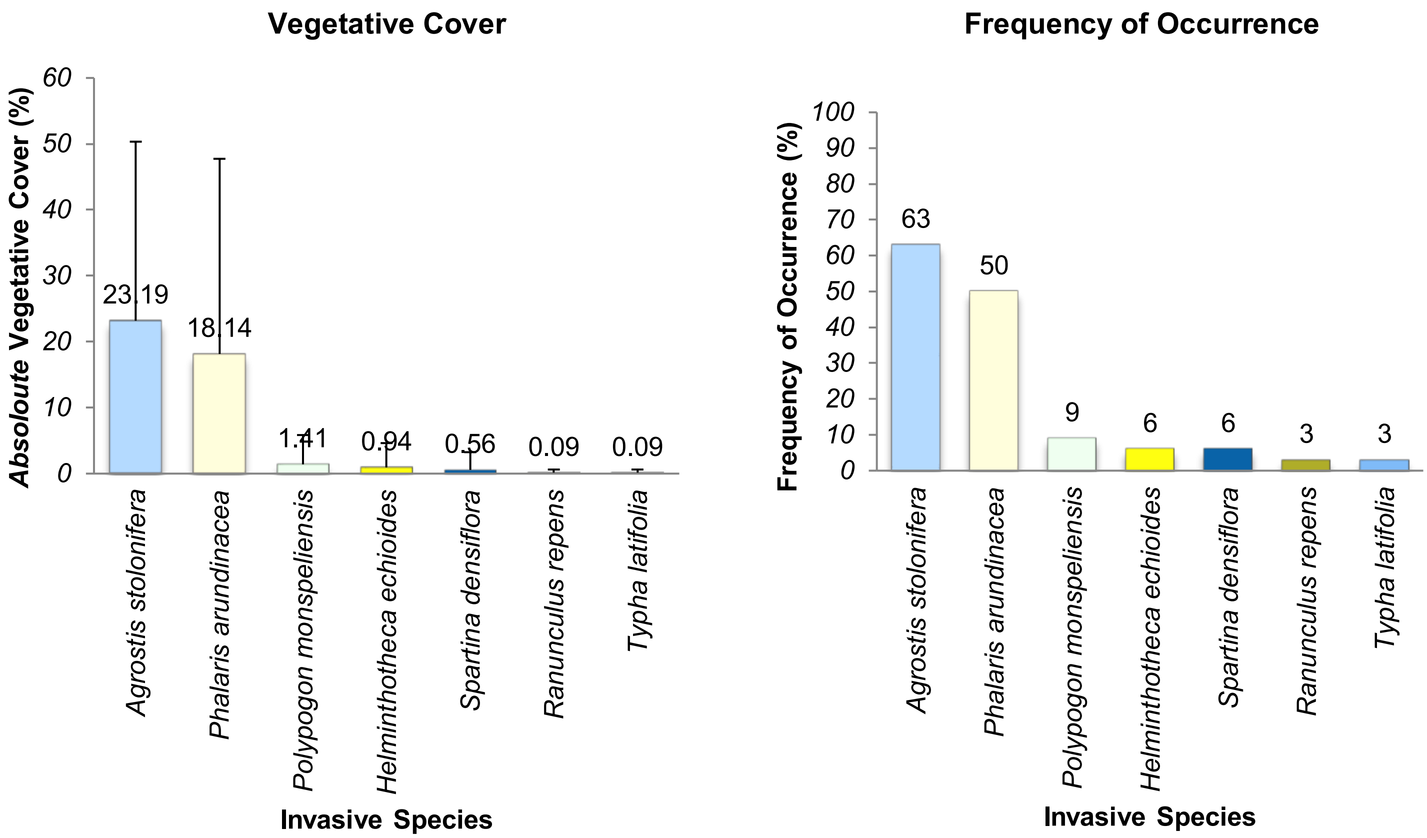


Figure 5. Invasive Vegetation Species Abundance. Phase 2A (Lower) – Salt River Corridor Restoration Area: Active Bench. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

and active bench habitats (Appendix A, Figure 16). This increase in distribution is also reflected when comparing recently obtained measures of abundance of *S. densiflora* in Salt River channel wetland habitats (Figures 4, 5) with comparable results (J.B. Lovelace & Associates 2018) obtained during the previous percent cover sampling effort in 2017. Since 2017, the frequency of occurrence of *S. densiflora* in both the active bench and active channel sampling regions of the Phase 2A (Lower) restoration area has increased by 3%. During this same time period, in this same restoration reach, estimated mean percent cover of *S. densiflora* increased by 2.3% in the active channel sampling region and appears to have remained constant in the active bench sampling region.

Polypogon monspeliensis (“rabbitfoot grass”) continues to establish and disperse along the active channel in the brackish region of the Phase 2A (Lower)

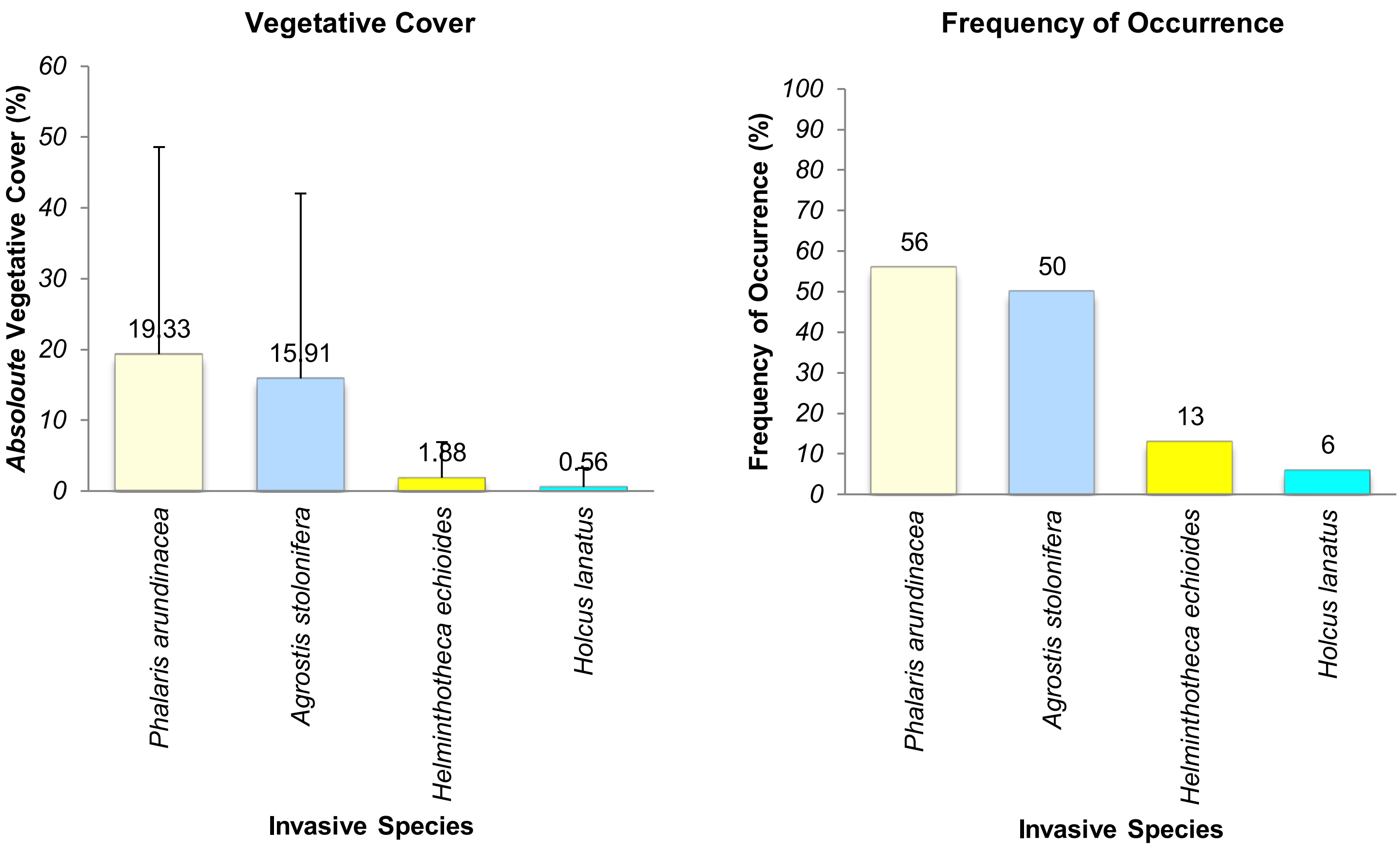


Figure 6. Invasive Vegetation Species Abundance. Phase 2A (Lower) – Salt River Corridor Restoration Area: Active Riparian Berm. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

restoration area (Figure 4; Appendix A, Figure 18), showing an increase both in frequency of occurrence in vegetation sampling plots and an increase in mean percent cover since 2017 (Figure 4; J.B. Lovelace & Associates 2018). Away from the active channel, however, *P. monspeliensis* is being outcompeted by co-occurring invasive (e.g., *Phalaris arundinacea*, *Agrostis stolonifera*, etc.), and to some extent, native (e.g., *Deschampsia cespitosa*, etc.) vegetation in the Phase 2A (Lower) active bench habitats (Figure 5). In this latter sampling region, mean percent cover of *P. monspeliensis* has decreased from 2.8% (J.B. Lovelace & Associates 2018) to 1.4% (Figure 5) since 2017 and it was detected in only three sampling plots in 2019 (Figure 5), as opposed to eight in 2017 (J.B. Lovelace & Associates 2018).

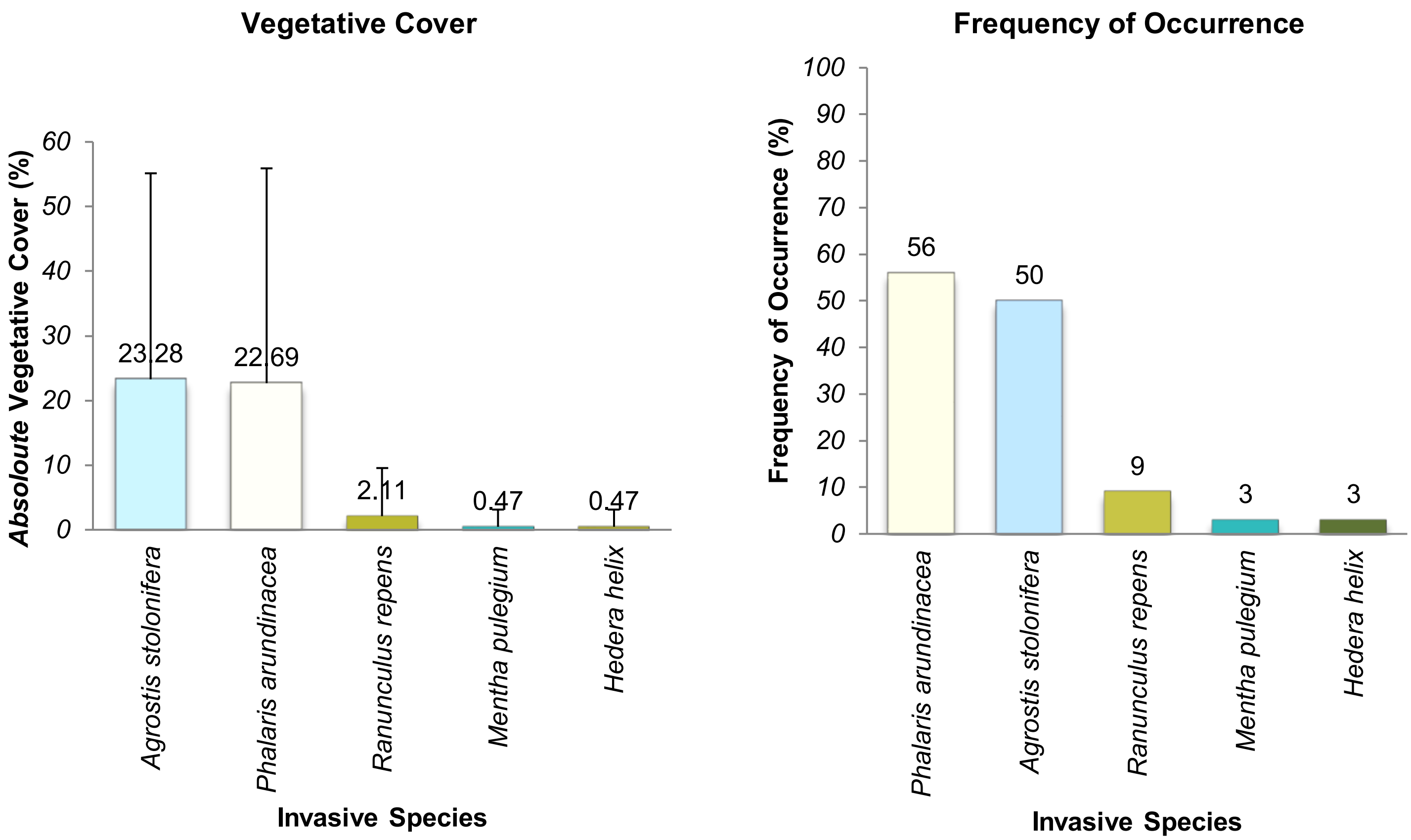


Figure 7. Invasive Vegetation Species Abundance. Phase 2A (Lower) – Salt River Corridor Restoration Area: Replanted Riparian Forest. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

Indeed, vegetation successional processes are well underway throughout the five-year-old Phase 2A (Lower) restoration reach, with the exclusion of some invasive species occurring along the active channel resulting in a net decrease (n = –3) in invasive species diversity since 2017. Conversely, increased establishment in the more stable active bench habitat resulted in a net increase (n = +2) of invasives during the same two-year interval.

With increasing distance upstream, away from the active channel edge, and/or where other freshwater contributions sufficiently reduce saline hydrochemistry, invasive vegetation in the freshwater Salt River channel wetland habitats continue to be dominated by either extensive pure stands of *Phalaris arundinacea* (“reed canary grass”) or variously-mixed stands of *P. arundinacea*,

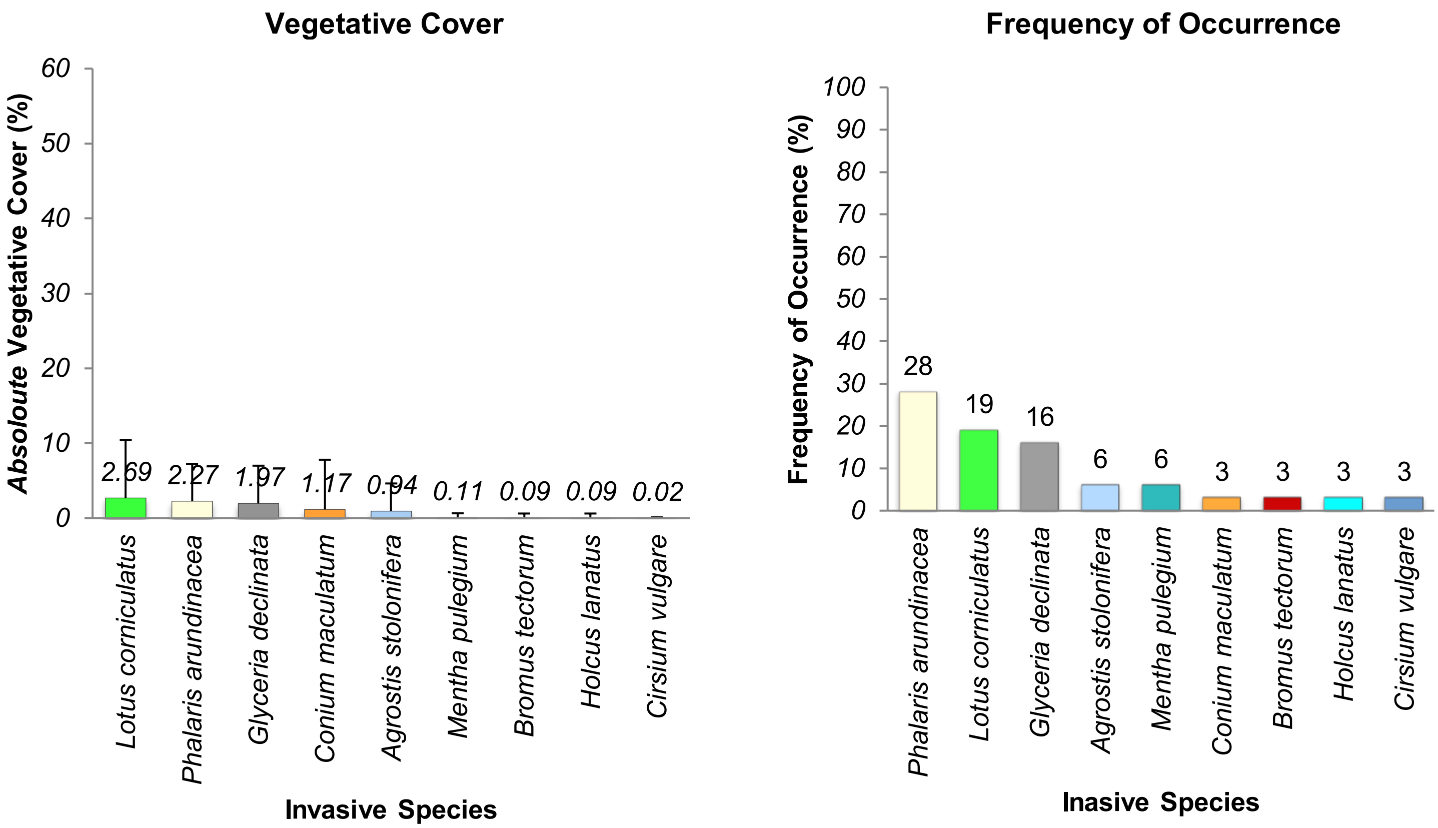


Figure 8. Invasive Vegetation Species Abundance. Phase 2B (Middle) – Salt River Corridor Restoration Area: Active Channel. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

Agrostis stolonifera ("creeping bent"), *Holcus lanatus* ("velvet grass"), and/or *Glyceria declinata* ("low manna grass") (Appendix A, Figures 18-21). At least within the context of the Phase 2 Salt River channel restoration corridor, the consistently observed patterns of establishment and development of the invasive grass, *Glyceria declinata* ("low manna grass"), continue to indicate that it is an early-successional species readily dispersed by fluvial activity and that establishes quickly, but is readily excluded when subject to competitive pressure from more aggressive species. This grass has already become widely established throughout the recently constructed Phase 2B (Middle) restoration reach, where it occurs (in decreasing abundance) in the active channel (Figure 8), active bench (Figure 9), active riparian berm (Figure 10), and replanted riparian forest habitats (Figure 11).

Although *G. declinata* is still widely distributed throughout the Phase 2A (Upper)/Phase 2B (Lower) restoration area (Appendix A, Figure 20), a

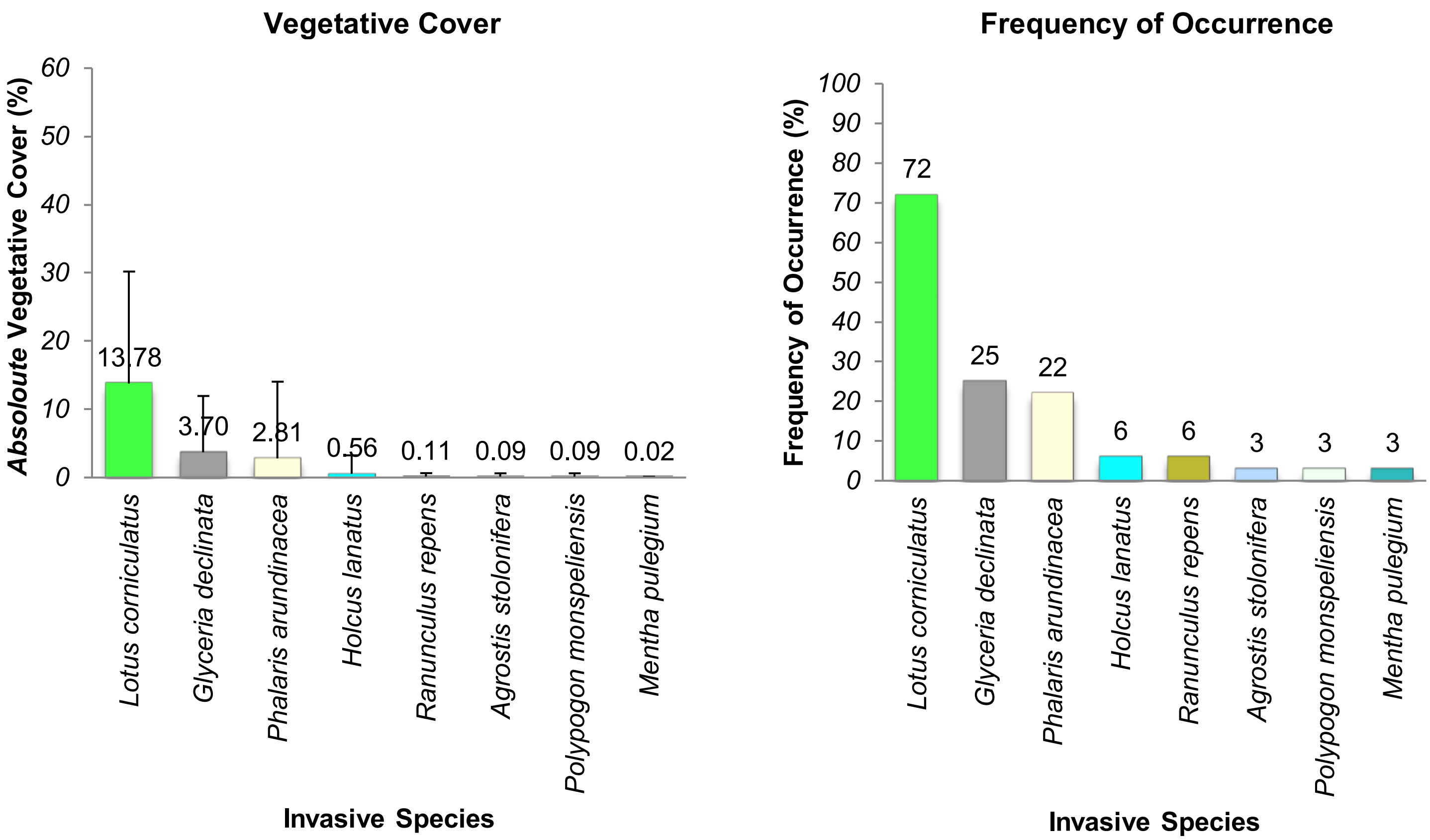
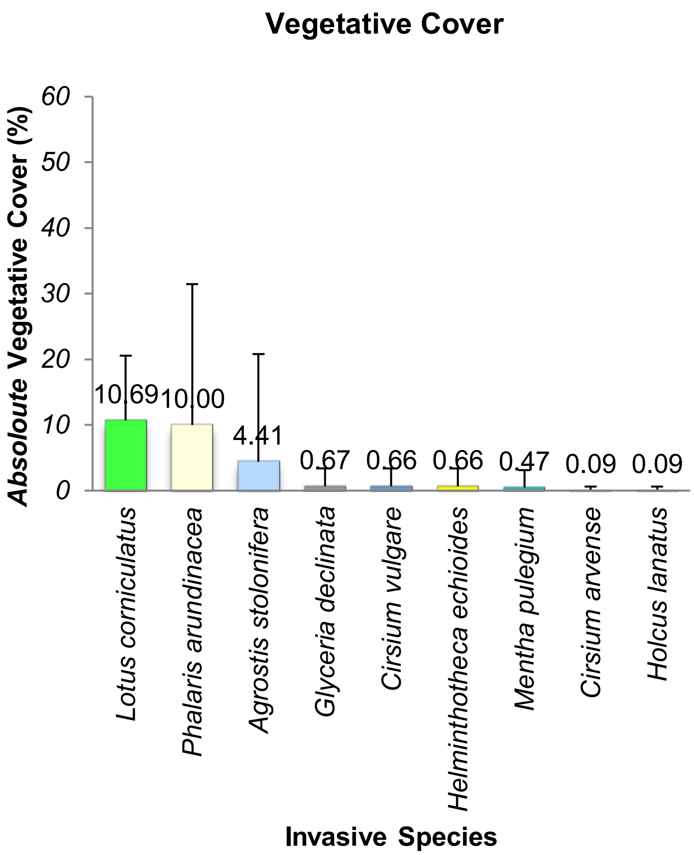


Figure 9. Invasive Vegetation Species Abundance. Phase 2B (Middle) – Salt River Corridor Restoration Area: Active Bench. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

comparison of vegetation percent cover sampling results from 2019 (Figures 12, 13) with comparable data from 2018 (J.B. Lovelace & Associates 2019) show marked reductions in both mean percent cover and frequency of occurrence of this species over the past year in Salt River channel wetland habitats within this restoration reach. These recent observations parallel similar decreases in the abundance of *G. declinata* over time observed in the Phase 2A (Middle) reach between 2017–2018 and 2016–2017 (J.B. Lovelace & Associates 2019, 2018; respectively). Such decreases are attributable in large part to displacement by more aggressive co-occurring invasive species such as those comprising the *Phalaris*-*Agrostis*-*Holcus* Complex, which continues to increase in abundance and distribution throughout the Phase 2 restoration area (Appendix A, Figures 18-21).



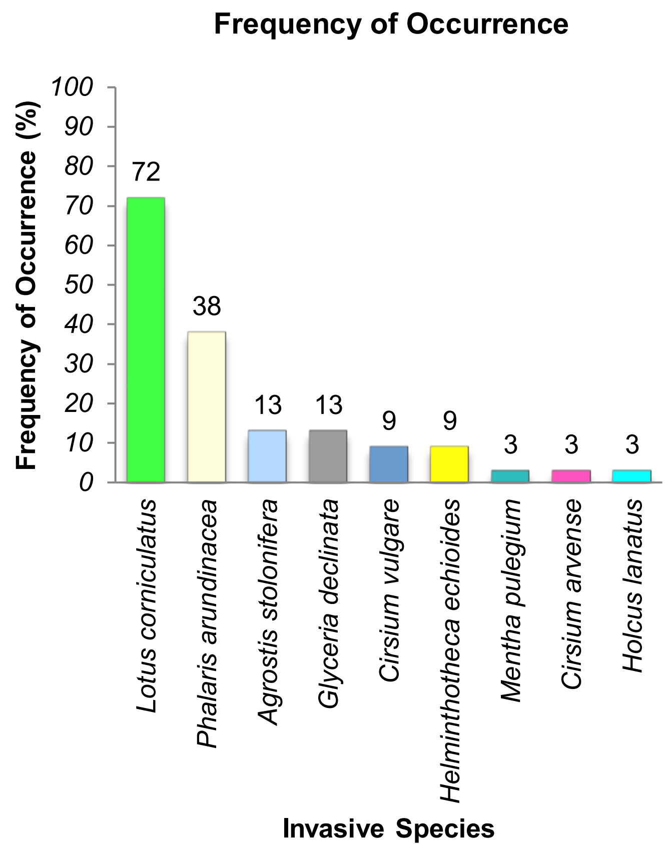


Figure 10. Invasive Vegetation Species Abundance. Phase 2B (Middle) – Salt River Corridor Restoration Area: Active Riparian Berm. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

Other invasive species previously reported within Phase 2 Salt River channel wetlands in varying proportions include *Helminthotheca echioides* (“bristly ox-tongue”), *Typha latifolia* (“broad-leaved cattail”), *Cirsium vulgare* (“bull thistle”), *Ranunculus repens* (“creeping buttercup”), *Mentha pulegium* (“pennyroyal”) (Figures 4, 5, 8, 9, 12, 13; Appendix A, Figures 18-21). Invasive species recently documented for the first time in Phase 2 Salt River channel wetlands consist of three additional occurrences of *Cortaderia jubata* (“pampas grass”) in active bench habitats of both the Phase 2A (Lower) and Phase 2A (Upper) restoration areas (Appendix A, Figures 18 & 20; respectively), *Rubus armeniacus* (“Himalayan blackberry”) in the active bench habitat of the Phase 2A (Lower) restoration area (Appendix A, Figure 18), and *Bromus tectorum* (“cheat grass”), recently discovered along the interface of active channel and active riparian berm habitat elements in the recently constructed Phase 2B (Middle) restoration area (Appendix A, Figure 21).

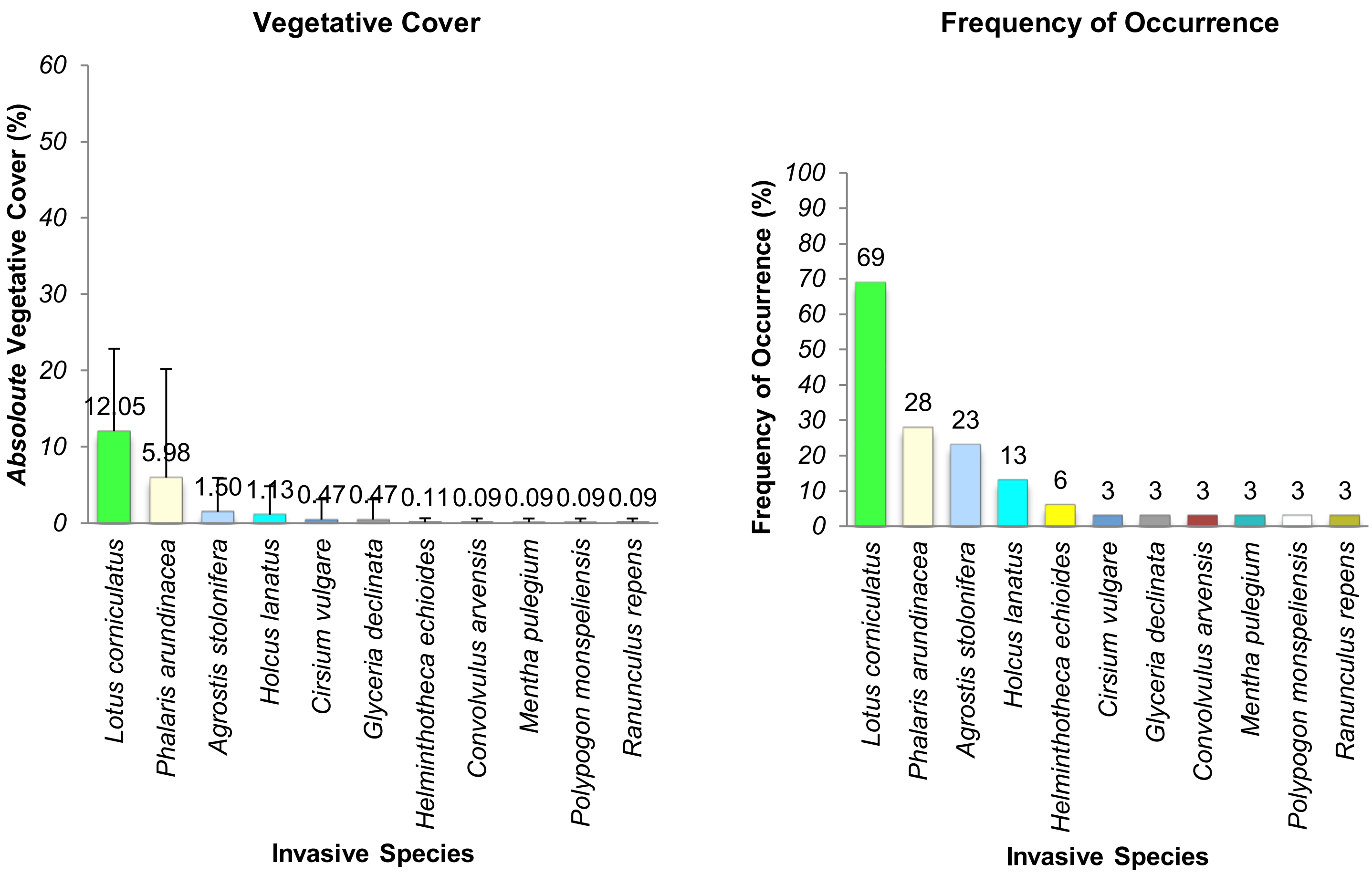


Figure 11. Invasive Vegetation Species Abundance. Phase 2B (Middle) – Salt River Corridor Restoration Area: Replanted Riparian Forest. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

Other invasive plants recently encountered in Salt River channel wetland habitats in the most recently restored Phase 2B (Middle) restoration area were (in order of decreasing abundance): *Lotus corniculatus* ("bird's-foot trefoil"), *Phalaris arundinacea* ("reed canary grass"), and *Glyceria declinata* ("low manna grass"), followed by less abundant *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), *Conium maculatum* ("poison hemlock"), *Mentha pulegium* ("pennyroyal"), *Cirsium vulgare* ("bull thistle"), *Polypogon monspeliensis* ("rabbitfoot grass"), and *Ranunculus repens* ("creeping buttercup") (Figures 8, 9).

Riparian Planting Zones

Much of the invasive vegetation occurring in the Phase 2 Salt River channel wetland habitats also extend into the adjacent, and often interdigitating, active riparian berm and replanted riparian forest areas along transitional gradients

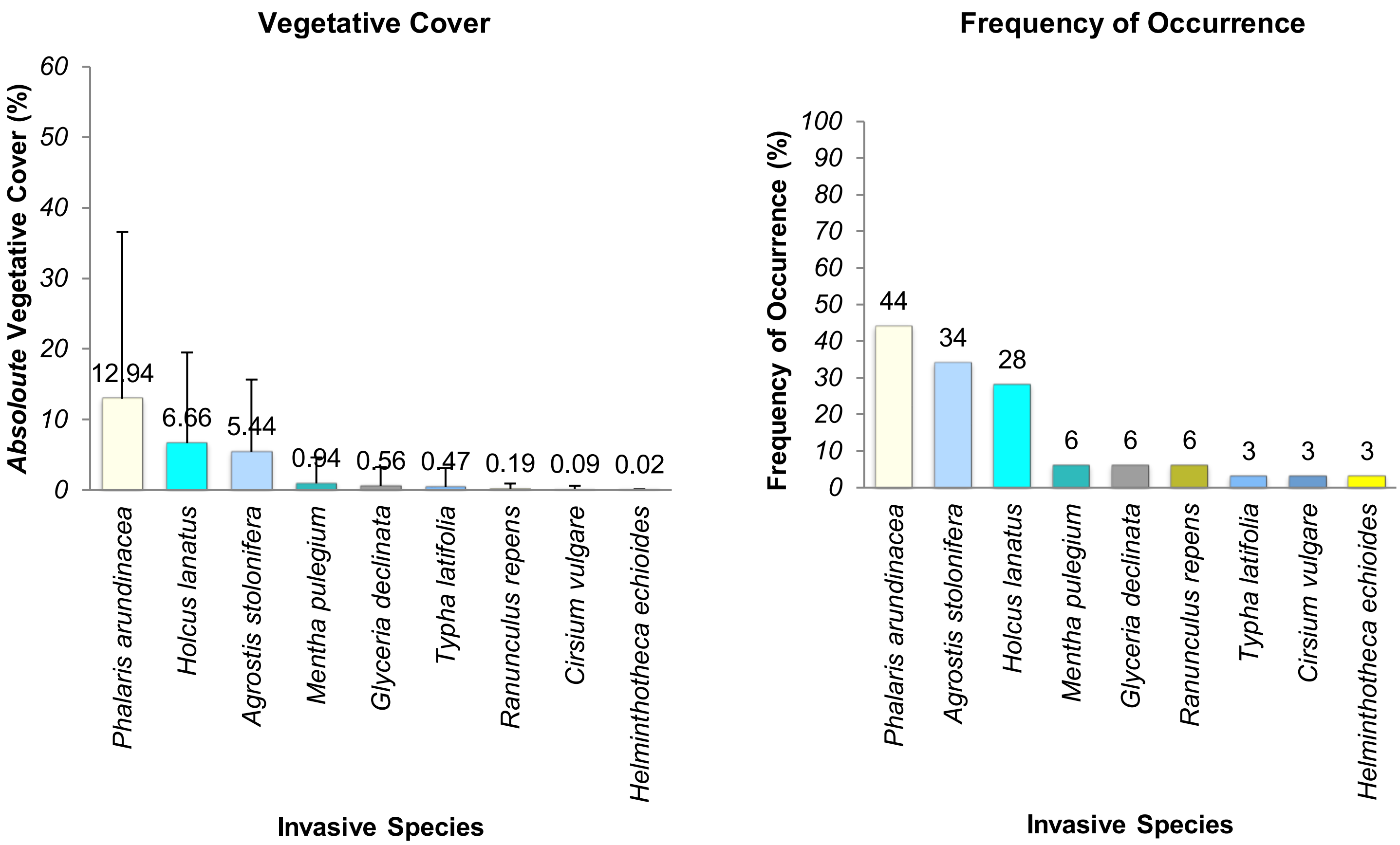


Figure 12. Invasive Vegetation Species Abundance. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Active Channel. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

between these habitat components (Appendix A, Figures 18-21). Otherwise, these riparian planting zone habitats support a slightly different suite of invasive vegetation, being situated at slightly higher elevations with marginally better drainage. In the more mature restoration areas (e.g., Phase 2A [Lower], etc.) where shrub and tree canopies are developing and where co-occurring shade-tolerant invasive herbaceous species are exerting substantial competitive influence over the associated herbaceous vegetation, invasive species diversity has decreased since previous percent cover sampling efforts were performed in 2017 and 2018 (J.B. Lovelace & Associates 2018, 2019; respectively).

Phalaris arundinacea ("reed canary grass") and *Agrostis stolonifera* ("creeping bent") are well established (Figures 6, 7, 10, 11, 14, 15; Appendix A, Figures 18-21) and increasing in percent cover throughout all Phase 2 riparian sampling regions, especially in active riparian berm habitats. Both species were, however,

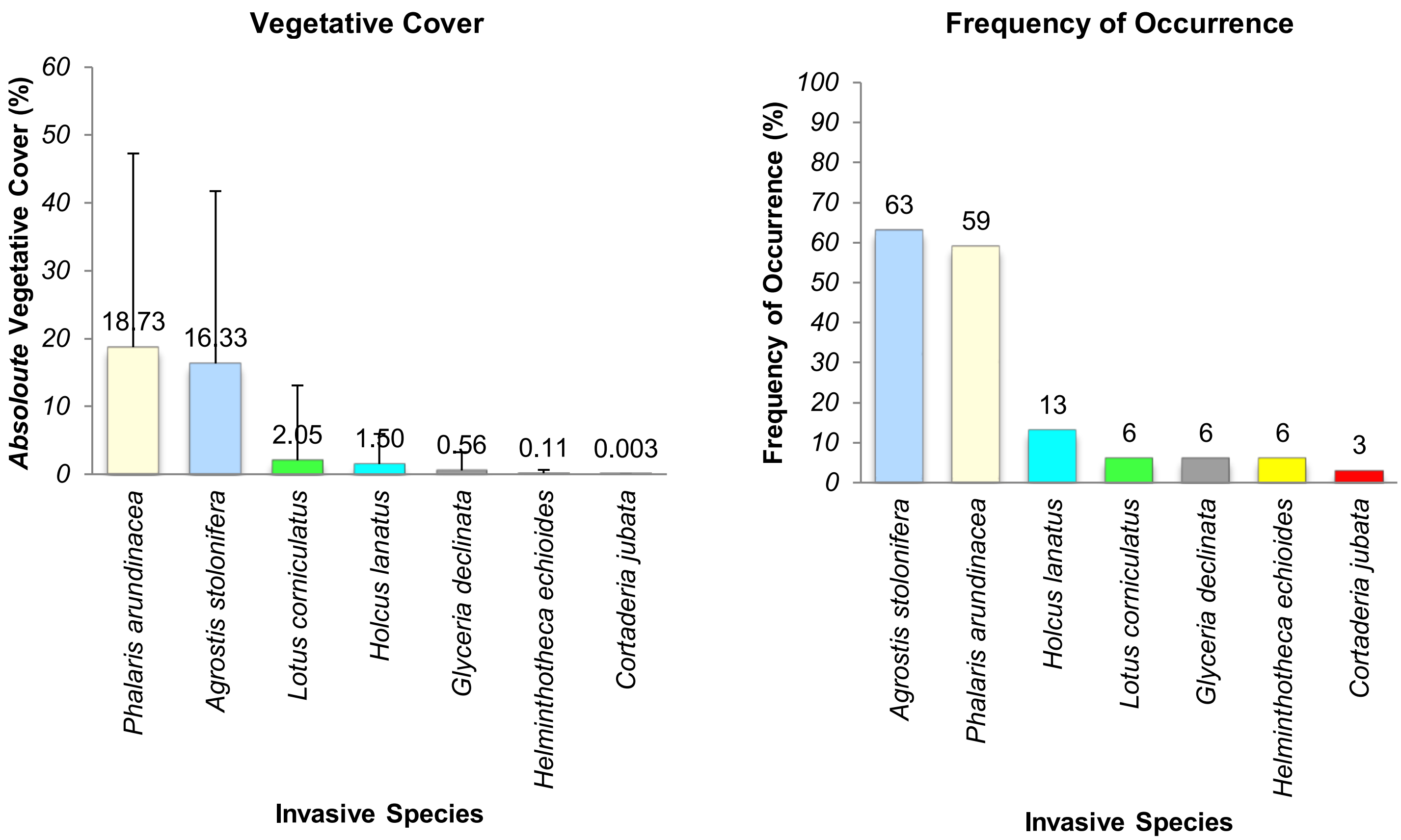
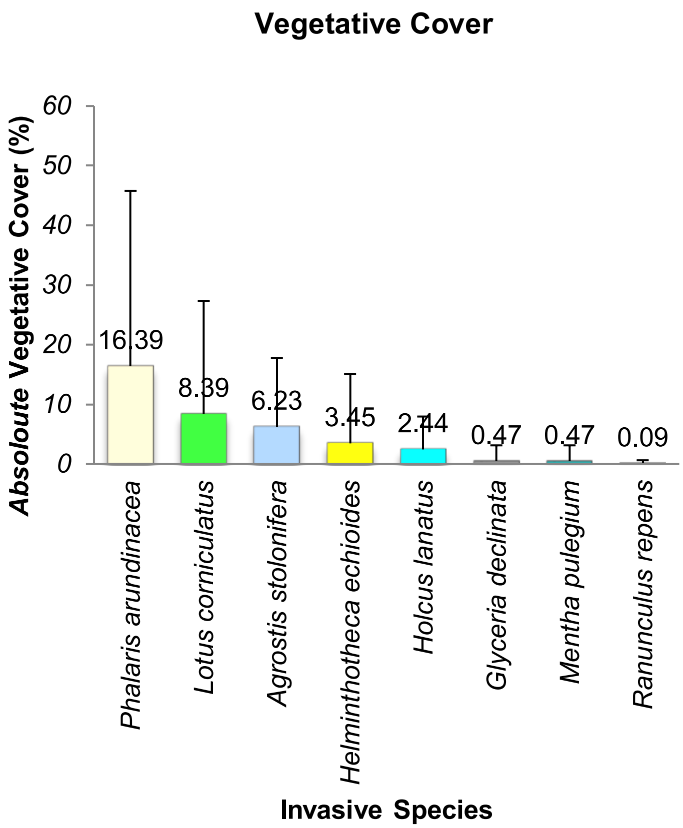


Figure 13. Invasive Vegetation Species Abundance. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Active Bench. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

detected in two fewer replanted riparian forest vegetation sample plots in the Phase 2A (Upper)/Phase 2B (Lower) restoration area in 2019 (Figure 15) than in 2018 (J.B. Lovelace & Associates 2019), possibly due to competition from developing replanted woody vegetation in these habitats. In this latter location, where *P. arundinacea* and *A. stolonifera* decreased in frequency of occurrence, *Holcus lanatus* ("velvet grass") and *Lotus corniculatus* ("bird's-foot trefoil") displayed substantial increases in both measures of abundance during the same period (Figure 15; J.B. Lovelace & Associates 2019).

Holcus lanatus is present throughout Phase 2 riparian planting zones (Figures 6, 7, 10, 11, 14, 15; Appendix A, Figures 18-21), especially in replanted riparian forest areas. In the older Phase 2A (Lower) restoration area, however, *H. lanatus* was found to have decreased in mean percent cover in the active riparian berm



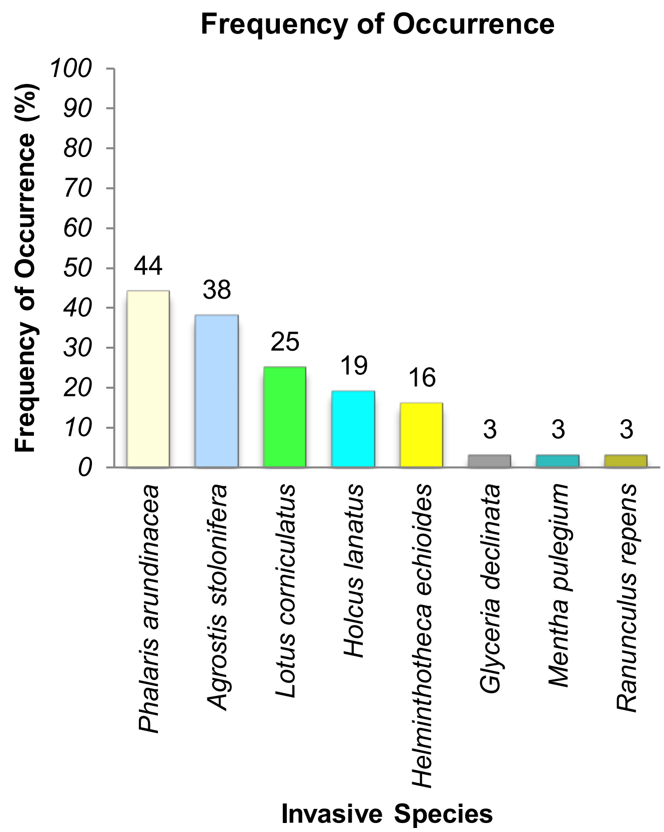
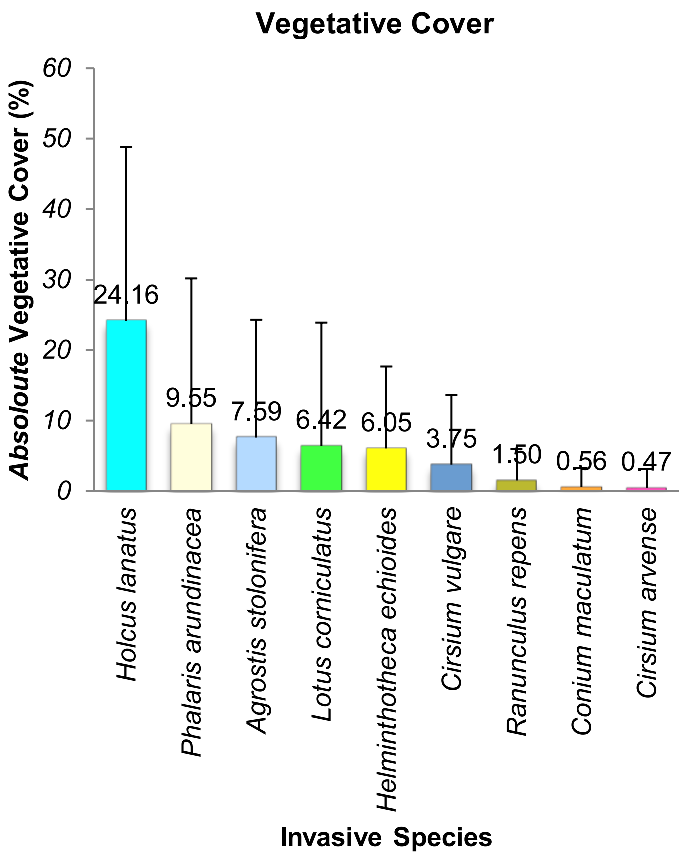


Figure 14. Invasive Vegetation Species Abundance. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Active Riparian Berm. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

(Figure 6) since 2018 (J.B. Lovelace & Associates 2019) and was not detected in any replanted riparian forest vegetation sample plots in 2019 (Figure 7). *Lotus corniculatus* ("bird's-foot trefoil") has become a more well represented invasive species in upstream freshwater wetland habitats where it was found to be the most abundant invasive in both riparian planting zones in the recently restored Phase 2B (Middle) restoration area in 2019 (Figures 10, 11), and where it was also documented to be increasing in all such habitats in the Phase 2A (Upper)/Phase 2B (Lower) reach as well (Figures 14, 15).

The previously described pattern of establishment and development of *Glyceria declinata* ("low manna grass") in Salt River channel wetland habitats appears to also be operative in Phase 2 riparian planting zones. This species is becoming



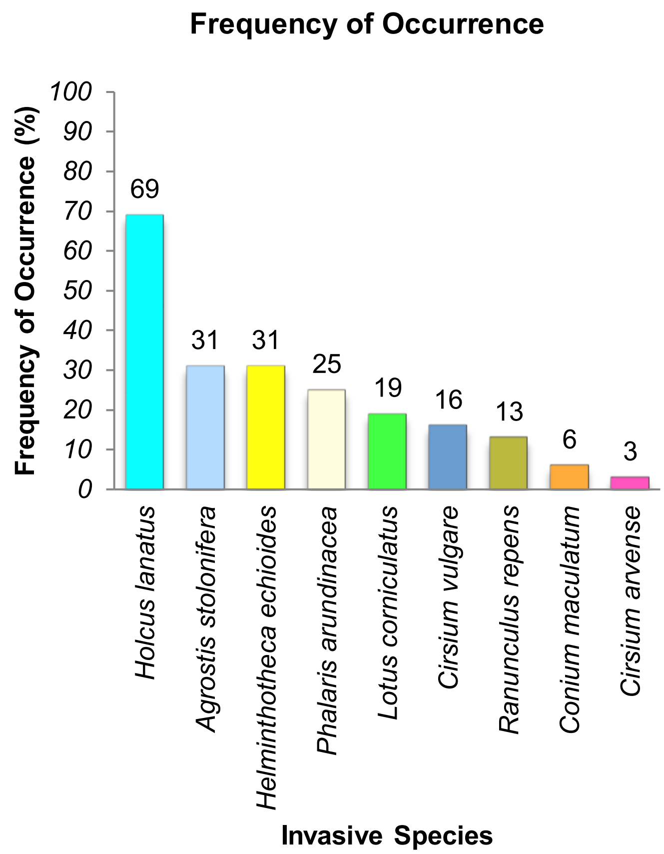


Figure 15. Invasive Vegetation Species Abundance. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Replanted Riparian Forest. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Error bars represent associated sample standard deviations (*s*). Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

established in the active riparian berm and replanted riparian forest areas of the recently restored Phase 2B (Middle) reach (Figures 10, 11; respectively), but elsewhere in Phase 2 vegetation sampling plots, it has decreased both in frequency of occurrence and mean percent cover to the extent that it was not detected at all within riparian planting zone vegetation sample plots in either the Phase 2A (Lower) or Phase 2A (Upper)/Phase 2B (Lower) restoration areas (Figures 6, 7 & 14, 15, respectively). While these results would appear to indicate the absence of this species in these areas, it was, however, detected in low abundance in these habitats, outside of vegetation sample plots (Appendix A, Figures 18 & 20).

Recent vegetation percent cover sampling results (Figures 4, 5, 8, 9, 12, 13) indicate that *Helminthotheca echioides* ("bristly ox-tongue") and *Ranunculus repens* ("creeping buttercup") were less abundant throughout sampled Phase 2 riparian planting zone sampling regions in 2019. However, outside of vegetation sample plots, *H. echioides* was documented to be establishing readily within active riparian berm and riparian forest habitats, along with *Cirsium vulgare* ("bull thistle") and *Dipsacus fullonum* ("wild teasel"), especially in the middle and upper Phase 2A restoration reaches (Appendix A, Figures 18-21). *Bromus tectorum* ("cheat grass"), documented for the first time in 2019 along the active channel in the Phase 2B (Middle) restoration reach, was also encountered in two locations in adjacent active riparian berm habitats as well (Appendix A, Figure 21).

A new occurrence of the invasive vine, *Hedera helix* ("English ivy") was also observed in the replanted riparian forest habitat of the Phase 2A (Lower) restoration area (Appendix A, Figure 18). This observation was also significant because this individual represented the second observed occurrence of likely contamination of revegetation stock with the invasive *H. helix* during our 2019 habitat monitoring fieldwork (see also Section 4.3.1). This individual was found to be originating at the base of a replanted native shrub, *Physocarpus capitatus* ("ninebark") of similar age. Finally, new occurrences of the "noxious" (CDFA 2019) *Senecio jacobaea* ("tansy ragwort") and *Cortaderia jubata* ("pampas grass") continue to become established in active riparian berm (and replanted riparian forest) habitats throughout the Phase 2 restoration area (Appendix A, Figures 18-21).

4.3.3 Species-Specific Analysis: *Phalaris arundinacea* (Reed Canary Grass)

The invasive grass, *Phalaris arundinacea* ("reed canary grass"), was encountered in every sampling region we visited during our recent vegetation percent cover sampling efforts (Table 16), in addition to being observed incidentally elsewhere in the SRERP project area while performing other tasks associated with the 2019 habitat monitoring effort (Appendix A, Figures 17-21). This invasive species was least abundant, both in terms of frequency of occurrence (3%) and mean percent cover ($\overline{x} = 0.9\%$, 95% CI [0.0, 2.6]) in the replanted riparian forest of the Phase 1 restoration area (Table 16).

In the Phase 2 restoration area, *P. arundinacea* was detected in vegetation sampling plots with frequencies of occurrence varying between 13% in the Phase 2A (Lower) active channel sampling region to 59% in active bench of the Phase 2A (Upper)/Phase 2B (Lower) restoration area (Table 16). Estimated mean cover of *P. arundinacea* within the Phase 2 restoration area ranges from 1.5% (95% CI [0.6, 2.9]) in the recently restored Phase 2B (Middle) active channel sampling region to 14.2% (95% CI [8.2, 22.9]) in the replanted riparian forest of the lower Phase 2A restoration reach (Table 16).

Table 16. Abundance of *Phalaris arundinacea* (reed canary grass) in 2019 SRERP Quantitative Vegetation Sampling Plots.

SRERP Habitat Sampling Areas	Varying Measures of 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			
Replanted Riparian Forest (n = 32)	**0.9** [0.0, 2.6]	3%	7%
Phase 2 – Salt River Corridor Restoration Area			
Phase 2A (Lower) – Salt River Channel Wetlands			
Active Channel (n = 32)	**1.9** [0.3, 6.9]	13%	10%
Active Bench (n = 32)	**11.4** [6.4, 18.5]	15%	37%
Phase 2A (Lower) – Riparian Planting Zones			
Replanted Riparian Forest (n = 32)	**14.2** [8.2, 22.9]	56%	44%
Active Riparian Berm (n = 32)	**12.8** [7.3, 20.2]	56%	54%
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands			
Active Channel (n = 32)	**11.1** [5.7, 19.7]	44%	52%
Active Bench (n = 32)	**13.4** [7.7, 23.0]	59%	50%
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones			
Replanted Riparian Forest (n = 32)	**5.2** [2.3, 9.9]	25%	16%
Active Riparian Berm (n = 32)	**11.9** [6.0, 22.0]	44%	48%
Phase 2B (Middle) – Salt River Channel Wetlands			
Active Channel (n = 32)	**1.5** [0.6, 2.9]	28%	22%
Active Bench (n = 32)	**2.5** [0.5, 9.8]	22%	15%
Phase 2B (Middle) – Riparian Planting Zones			
Replanted Riparian Forest (n = 32)	**4.4** [1.8, 9.4]	28%	26%
Active Riparian Berm (n = 32)	**5.8** [2.7, 11.5]	38%	31%

[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 (n = 32) 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.

When calculated as a percentage of mean total invasive vegetative cover recorded in respective sampling regions, *P. arundinacea* comprised as little as 7% of invasive vegetative cover in the Phase 1 replanted riparian forest sampling region, and ranged from 10% of the invasive vegetation component in the Phase 2A (Lower) active channel to as much as 54% in the Phase 2A (Lower) active riparian berm (Table 16).

5.0 Special Status Plant Species

During the course of our 2019 habitat monitoring fieldwork, multiple incidental observations were made of two special status plant species (Table 17) in both the Phase 1 – Riverside Ranch and the lower Phase 2A – Salt River Corridor Restoration Areas: *Carex lyngbyei* (“Lyngbye’s sedge”) and *Angelica lucida* (“sea-watch”). Both species were previously known to occur within the vicinity of the SRERP restoration area (CalFlora 2019; CNDDB 2019; CNPS 2019) and are establishing in restored wetland habitats. *Carex lyngbyei* was encountered in regularly flooded portions of salt marsh *sensu stricto* and high marsh ecotone habitats in the Phase 1 restoration area (Appendix A, Figure 22) and in similar water regimes in brackish Salt River channel wetlands (both active channel and active bench) in the Phase 2A (Lower) restoration area (Appendix A, Figure 23). *Angelica lucida* was found in the Phase 1 restoration area in graminoid-dominated portions of replanted riparian forest habitat as well as at higher elevations within the high marsh ecotone (Appendix A, Figure 22). In the Phase 2A (Lower) restoration area, *A. lucida* was encountered in a few instances at

Table 17. Special Status Botanical Species Observed Incidentally within the SRERP Restoration Area in 2019.

	***Carex lyngbyei* (“Lyngbye’s sedge”)**	***Angelica lucida* (“sea-watch”)**
Family	Cyperaceae (“sedge family”)	Apiaceae (“carrot family”)
Federal Listing Status (ESA)[1]	None	None
State Listing Status (CESA)[2]	None	None
California Rare Plant Rank[3] (& Rank Description)	2B.2 (Rare or endangered in California, common elsewhere; fairly endangered in California)	4.2 Limited distribution in California; fairly endangered in California)
State Rank[3]	S3 (Vulnerable)	S3 (Vulnerable)
Global Rank[3]	G5 (Secure, considering populations outside of California)	G5 (Secure, considering populations outside of California)
Published[3] Known Threats	(Possibly) grazing, non-native plants, habitat disturbance	(Possibly) non-native plants
Observed Threats[4]	Grazing (domesticated goats & dairy cattle), Exclusion related to encroachment of *Spartina densiflora*	Grazing (domesticated goats)

[1] 50 CFR §17.12
[2] CCR, Title 14, §670.5
[3] CNPS (2019)
[4] Personal observation (2019), from within the SRERP restoration area

higher elevations (i.e., less saline conditions) in brackish Salt River channel wetlands, as well as in both active riparian berms and in the graminoid-dominated understory along the periphery of replanted riparian forest habitats (Appendix A, Figure 23).

While some grazing of *Carex lyngbyei* (by dairy cattle) was observed on the opposite side of the Salt River from the Riverside Ranch restoration area, the primary threat to this species identified within the SRERP project footprint is exclusion due to the continued establishment and spread of the invasive *Spartina densiflora* (“dense-flowered cord grass”). The other special status species, *Angelica lucida*, was primarily observed in habitats dominated by grasses such as *Deschampsia cespitosa* (“tufted hair grass”), and often along the peripheries of riparian planting zones. Gradual conversion of some of these areas to shaded riparian forests may lead to the eventual exclusion of some observed occurrences of *A. lucida*, though the only immediate threat to this species observed during our 2019 fieldwork was potential grazing by goats along the northern bank of the Salt River in the lower Phase 2A restoration area.

It is important to emphasize that the distributions of these two species depicted in Appendix A reflect incidental observations made during the performance of various habitat monitoring tasks. Focused, species-specific botanical surveys were not performed throughout the SRERP project area, and it is possible that additional occurrences of both aforementioned species, as well as possibly other special status species, may also occur elsewhere within the SRERP restoration area footprint.

6.0 Discussion & Recommendations

Results presented herein for the 2019 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 reinforcing the pressing need for continued and proportionate invasive vegetation management actions to ensure that those goals are ultimately achieved. All habitats addressed during the 2019 habitat monitoring effort satisfied respective success criteria identified for the current monitoring year with respect to: the areal extent of projected habitat types, the abundance (i.e., percent cover) of established native vegetation, and the continued development of replanted woody riparian vegetation. In contrast, all SRERP habitats in which fieldwork occurred in 2019 also currently support invasive vegetation at levels that will, in most cases, be difficult to reduce to the extent required in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) by respective “final” monitoring years unless immediate and proportionate management efforts are initiated and sustained.

One such area consists of the Phase 2A (Lower) Salt River channel wetlands (i.e. both active channel and active bench), for which 2019 was intended to be the fifth and final year during which vegetation percent cover sampling would be required. Findings presented in Section 4.2.1 and 4.3.2, however, indicate that the abundance of invasive plants in these Salt River channel wetlands ranges from 3 to 6 times greater than the *maximum* final success threshold (i.e., 5%) for this category of vegetation, resulting in the failure to satisfy this specific success criterion within the Phase 2A (Lower) Salt River channel wetland habitats. While there is reason to be optimistic that the various final success criteria will ultimately be achieved throughout the SRERP restoration area, we continue to recommend escalating and augmenting strategies and methods to manage the increasing populations of invasive vegetation as soon as possible to ensure that relevant restoration goals of the SRERP are eventually realized. Additional treatment of specific elements of the 2019 annual SRERP habitat monitoring effort and associated recommendations follows.

6.1 Habitat

Our findings from 2019 confirm the continued development of projected habitats restored thus far, reflecting a demonstrable trajectory toward their ultimate achievement of the minimum area success thresholds stipulated in the HMMP. Native vegetation appears to be establishing successfully throughout completed portions of the SRERP restoration area suggesting reasonable potential for the eventual realization of targeted conditions envisioned during the planning of the SRERP. However, a preponderance of established and increasingly abundant invasive vegetation throughout much of the SRERP restoration area has the potential to exclude co-occurring native plants and substantially compromise the ecological value of some of these habitats despite their otherwise continuing to exhibit abiotic (and some biotic) characteristics, which still accurately support their respective habitat designations.

One such example is the increasing colonization of salt and brackish marsh habitats in the Phase 1 and lower Phase 2A restoration areas by the invasive *Spartina densiflora* (“dense-flowered cord grass”). While such tidally-influenced (vegetated) wetland habitats are subject to a marine-derived salinity regime exceeding 0.5 parts per thousand (ppt) and are, therefore, accurately designated and mapped as salt marsh *sensu stricto* or brackish marsh *sensu stricto* (Appendix A, Figures 2 & 3), extensive and expanding stands of *S. densiflora* in these restoration areas will likely result in the exclusion of a large part of the native salt marsh flora if the establishment and spread of this invasive species goes unchecked.

Dense monotypic stands of *S. densiflora* will not only likely force reductions in both native species diversity (see Ayres et al. 2004; Kittleson & Boyd 1997) and the availability of suitable habitat for special status species such as *Castilleja ambigua* ssp. *humboldtiensis* (“Humboldt Bay owl’s-clover”), *Chloropyron maritimum* ssp. *palustre* (“Point Reyes salty bird’s-beak”), *Carex lyngbyei* (“Lyngbye’s sedge”), etc., but they also have the potential adverse effect of impeding tidal flow, which can result in increased sediment deposition leading to the elevation and eventual conversion of affected habitats (California Coastal Conservancy 2001). Analogous scenarios with different invasive plant species (e.g., *Phalaris arundinacea*, *Agrostis stolonifera*, etc.) also exist throughout freshwater wetland habitats of the Phase 2 restoration area. Such potential outcomes would be inconsistent with both near- and long-term goals of the SRERP.

The replanting of Phase 2 active bench habitats and passive sediment management areas with woody riparian vegetation in 2018 and 2019 as compensation for reductions in actual area revegetated with such species in the Phase 2B (Middle) restoration reach has somewhat confounded the future evaluation of the areal extent of associated habitats. Within the context of the Phase 2 – Salt River Corridor Restoration Area, discrete minimum area (acreage) success thresholds were established in the HMMP for (brackish and freshwater) Salt River channel wetland habitats and for riparian forest/scrub habitats to ensure the creation of both as real products of the restoration project. Implicit in this dichotomy is the assumption that both habitat types would remain recognizably distinct throughout the respective habitat monitoring periods to the extent that each would be able to be evaluated against their respective success criteria.

While the designation, "riparian forest/scrub" clearly indicates a predominantly woody plant community, the targeted structural vegetation type, or "habit," of the plant communities envisioned for the Phase 2 Salt River channel wetland habitats (i.e., active bench and active channel) was not explicitly characterized in the HMMP. It does, however, appear to be implicit in the respective planting plans and prescriptions for these habitats (Tables 5 & 6 of the HMMP) that they were assumed to be emergent wetland habitats (dominated by herbaceous plant species), at least within the span of respective 10-year monitoring periods.

The recent replanting of woody vegetation in Phase 2 active bench habitats and sediment management areas represents a departure from these aforementioned revegetation prescriptions. As intended, these subsequent revegetation efforts, will undoubtedly accelerate the recruitment of woody species in these areas, resulting in a more rapid conversion from herbaceous vegetation-dominated plant communities to shrub- and/or tree-dominated riparian habitats than would otherwise occur. During this process, the distinction between "Salt River channel wetland" and "riparian forest/scrub" habitats conceived of in the development of the HMMP will become increasingly ambiguous with time, despite the quantitative success criteria established for each remaining both discrete and constant.

As vegetation successional processes (either stochastic or accelerated by supplemental planting of woody species) convert herbaceous vegetation-dominated sediment management areas and active bench habitats to scrub-shrub and/or riparian forested habitats, these areas will, at some point, become more appropriately identified and quantified as such. In the context of evaluating observed acreages against respective success criteria, the result of this process will likely produce a “surplus” of riparian habitat and a potential “deficit” of Salt River channel wetland habitat.

Such successional conversion of these Phase 2 habitats (at least as a result of recruitment of volunteer individuals from adjacent existing propagule sources) was anticipated in the planning of the SRERP and potential vegetation “maintenance” actions to facilitate desirable channel conveyance and management of sediment deposition areas are a component of the *Salt River Ecosystem Restoration Project Adaptive Management Plan* (H.T. Harvey & Associates et al. 2012). Though such conversion would not be inconsistent with the long-term restoration goals of the project, the advanced timeframe during which it may now occur does not appear to have been anticipated during the development of relevant success criteria set forth in the guiding HMMP and may well substantially skew the respective outcomes resulting in the inability to achieve established success criteria. Given this situation, it is advisable to reevaluate the relative applicability of these specific success criteria to assess whether more appropriate alternative thresholds should be developed, which accommodate such anticipated successional dynamics while still remaining consistent with the fundamental restoration goals of the SRERP.

Alternatively, locations within the SRERP footprint would need to be identified and restored to create additional Salt River channel wetland habitat to compensate for any deficit resulting from the aforementioned conversion of habitats. Moving forward, we recommend the continued future performance of habitat mapping and area (acreage) analysis in respective monitoring years, consistent with the schedule of monitoring tasks described in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

6.2 Vegetation

The development of vegetation throughout the SRERP restoration area appears to favor both native and invasive species, whereas non-native non-invasive vegetation generally seems to be declining. Where a comparative analysis of quantitative sampling data (Appendix D) obtained during scheduled monitoring efforts from 2014 to 2019 was possible for those sampling regions addressed in 2019, results indicate a sustained increase in the abundance (i.e., absolute percent cover) of both total and native vegetation throughout. Overall changes in the abundance of non-native non-invasive and invasive vegetation exhibit contrasting trajectories, with the general patterns reflecting substantial increases in the abundance of invasive vegetation at the proportionate expense of non-native non-invasive species. Two exceptions to this pattern include the active channel sampling regions of both the Phase 2A (Lower) and Phase 2A (Upper)/Phase 2B (Lower) restoration areas where both non-native non-invasive and invasive vegetative cover decreased in 2019, which is likely attributable to regular fluvial disturbances associated with these dynamic channel habitats.

Some disturbance to developing vegetation from domestic herbivores (i.e., goats) entering the restoration area from adjacent properties continues to occur in the lower Phase 2A restoration area. Associated vegetative impacts observed in 2019 are primarily restricted to browsing of riparian and understory vegetation within existing and replanted riparian forest habitats, though this is also occurring in close proximity to observed occurrences of the special status plant species, *Angelica lucida* ("sea-watch") (Appendix A, Figure 23). Impacts to establishing vegetation from livestock continue to have the potential to preclude the realization of final vegetation-related success criteria throughout the SRERP restoration area if they are not effectively prevented from entering the restoration area. Appropriate livestock management practices and maintenance of effective perimeter fencing around private agricultural properties adjacent to the restoration area will continue to help prevent impacts to vegetation from domesticated herbivores.

Woody riparian vegetation continues to establish and develop throughout riparian planting zones in the Phase 1 and Phase 2A (Lower) restoration area. Our 2019 field observations also reflect continued establishment of volunteer woody riparian vegetation in both active channel and active bench habitats (i.e., "Salt River Channel Wetlands") throughout the Phase 2 restoration area as well. While the majority of the riparian vegetation encountered during habitat monitoring fieldwork is the result of extensive revegetation efforts following restoration habitat modification, it was also apparent that volunteer recruitment from *in situ* propagule sources continues to occur, and contributes to results reported herein.

Quantitative vegetation percent cover and basal area sampling data from the Phase 1 and Phase 2 (Lower) restoration areas during the period from 2017-2019 (J.B. Lovelace & Associates 2018, current effort) demonstrate a statistically (and ecologically) significant increase in the abundance and structural development of native riparian vegetation throughout all habitats sampled in 2019. Based on these findings, it is anticipated that continued growth and development of observed woody vegetation will result in the successful attainment of projected structural characteristics throughout the Phase 2 – Salt River Corridor Restoration Area.

A similar outcome is possible for Phase 1 replanted riparian habitats as well, though sample data from this sampling region reflect less consistent and less vigorous development of this vegetation component. The possibility exists that, due to a combination of increased edaphic variability, greater area, and the randomized placement of sampling plots throughout this sampling region that our sampling design is not accurately characterizing the real response of the revegetation efforts in the Phase1 replanted riparian forest. However, incidental observations of the relative vigor of replanted trees throughout this habitat suggests a combination of inconsistent establishment and relatively slow growth in some areas. Where poor establishment is operative, the realization of targeted vegetative conditions will be reliant upon native recruitment of woody species from adjacent *in situ* propagule sources, which may not occur within the 10-year monitoring period.

Where woody species saplings are exhibiting relatively slow development, their attainment of heights sufficient for measurement during basal area sampling (“breast height”, or ≥4.5 feet) will be protracted and may or may not occur prior to the third and final sampling event for this area, scheduled to occur in 2024 (the tenth and theoretical final monitoring year for this sampling region) (Table 1). As stated, in the absence of any actions taken, the development of woody vegetation in the Phase 1 replanted riparian forest may prove sufficient to maintain a demonstrable increasing trend. However, to increase the likelihood of such an outcome and address the observed mediocre establishment of previously replanted individuals, supplemental planting efforts in this restoration area should be considered.

Finally, the continued development of vegetation throughout the SRERP restoration footprint will continue to increase the amount of time and effort required to remove browse-protection materials (e.g., wire cages, etc.) that are no longer necessary from the restoration area. Removal of these materials should be scheduled for the Phase 1 and Phase 2A (Lower) restoration areas as soon as is feasible.

6.2.1 Recommended Sample Size

We recommend continuing to use a sample size (n) of 32 in the subsequent vegetation percent cover sampling effort. This sample size appears to have adequately addressed the variability in the vegetation encountered thus far in the 2016, 2017, 2018, and 2019 quantitative sampling efforts, both when relying on the assumptions proposed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), as well as when applying a common “burden of proof” (i.e., Cohen’s [1988] “medium” effect size, as described in J.B. Lovelace & Associates 2017) and more stringent level of confidence (i.e., 95%, rather than 80%). It is important to recognize, however, that our suggested sample size is a “starting point,” and its adequacy to address variability in future data sets should continue to be assessed retrospectively, during each habitat monitoring endeavor to ensure collection of adequate sample data.

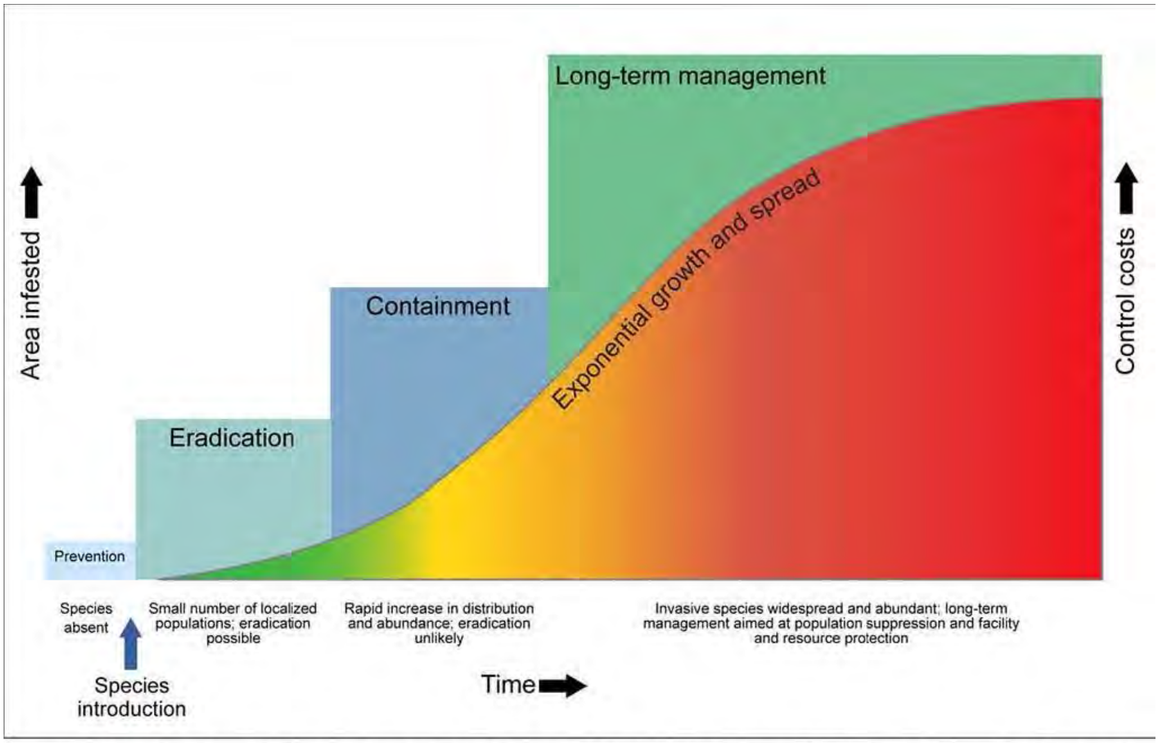
6.3 Invasive Plant Species

Results from scheduled vegetation sampling efforts within the five-year period since habitat monitoring was initiated (i.e., 2015-2019) continue to overwhelmingly reflect increasing trends in the abundance of invasive vegetation throughout the Salt River Ecosystem Restoration Project footprint (Appendix D). Indeed, in this fifth and theoretical “final” year for which vegetation percent cover sampling was originally required for Salt River channel wetland habitats in the Phase 2A (Lower) restoration area (Tables 1, 4-6), the abundance of invasive plants ranges from 3 to 6 times greater than the *maximum* final success threshold (i.e., 5%) for this category of vegetation as stipulated in the HMMP. For this reason, we recommend continuing to perform periodic vegetation percent cover sampling in these habitats until it can be demonstrated that the abundance of invasive vegetation has been reduced to the extent required by the HMMP. The continuation of this monitoring task in these specific SRERP habitats would most conveniently coincide with already scheduled similar vegetation sampling efforts for riparian planting zones in this same restoration reach (Table 1).

As discussed previously in this annual monitoring report, invasive plant species pose real threats to the near- and long-term success of the Salt River Ecosystem Restoration Project given the extent to which such unfavorable vegetation continues to become established. Although eventual overstory shading by a developing riparian forest canopy is hoped to provide some degree of passive management of invasive and undesirable vegetation in riparian planting zone habitats, given the protracted period over which this is predicted to occur, substantial production and dispersal of invasive species propagules is likely during such a time period.

Such successional phenomena may be a contributing factor in recently observed decreases in non-native-non-invasive vegetation, but our results show no clear indication that such vegetation community dynamics are decreasing the abundance of invasive vegetation. On the contrary, the abundance of invasive plants is increasing in every habitat sampled in 2019 (whether revegetated with woody species or not) for which data from two or more years are available for comparison, with the single exception of the Phase 2A (Upper)/Phase 2B (Lower) active riparian berm. In this latter sampling region, no real change between 2018-2019 (the only two years for which data has yet been collected in this sampling region) is apparent. Failure to implement adequate management efforts during the initial years of establishment and development of invasive species may allow for invasive vegetation to outcompete native and/or planted vegetation, preventing the ultimate realization of this restoration goal and requiring significant additional effort and expense, as has occurred in other long-term riparian habitat restoration projects in inland regions of California (Silveira pers. comm.).

Significant off-site source populations of non-native and invasive species occur within the vicinity of the SRERP restoration area, and will continue to complicate non-native and invasive vegetation management efforts at the site through continued contribution of propagules unless these occurrences are also managed effectively. The most obvious of these include an extensive occurrence of *Spartina densiflora* (“dense-flowered cord grass”) on the western bank of the lower Salt River channel that is part of a larger population found throughout the Eel River estuary (Grazul & Rowland 2011) and the large occurrence of the *Agrostis-Phalaris-Holcus* invasive species complex, which extends along the northeastern edge of the setback levee in the Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. Fortunately, the initiation of a managed grazing regime to provide short-grass habitat for Aleutian Cackling Goose (*Branta hutchinsii leucopareia*) in the latter area has been ongoing since 2018 and is expected to help reduce the development and spread of the invasive grass species associated with that location.



Sources: National Invasive Species Council; U.S. Department of Agriculture; National Park Service; U.S. Fish and Wildlife Service; Rodgers, L, South Florida Water Management District; Department of Primary Industries, State of Victoria, Australia; and GAO. | GAO-16-49

Figure 16. "The Invasion Curve."

The rate of plant reproduction is often exponential, particularly for successfully invasive "pioneering" species, and many reproduce both by sexual (e.g., seeds, etc.) and asexual methods (e.g., spreading by rhizomes, fragmentation, clonal reproduction, etc.). With every successful reproductive cycle, the invasive plant population potential increases by orders of magnitude. Coinciding with such increases, a proportionate level of effort and expense are required to adequately address such invasive vegetation. Figure 16 provides an informative graphic illustration of this context.

For these reasons, adequate invasive species management responses should be initiated as early as possible following detection, and should be appropriately implemented to manage the species being addressed. In order to be successful, management actions typically need to be repeated (i.e., multiple times each year, for successive years), sustained, and monitored to ensure that they are effective. Ill-conceived or incomplete attempts are frequently ineffective and ultimately do not result in a reduced need for continued efforts. Most often, early and comprehensive responses result in more effective outcomes at reduced long-term expense to land managers, despite the extent of costs initially.

Where substantial occurrences of invasive species exist within the SRERP restoration area, efforts should continue despite the reduction and/or cessation of on-site propagule production, as *in situ* seed bank material continues to emerge and propagules from external sources arrive and establish. It is unlikely that all latent invasive species propagules in the existing seed bank will be exhausted by the end of the respective 10-year monitoring periods. However, with sustained and dedicated effort, invasive vegetation development, flower production, seed maturation, and subsequent dispersal can be greatly reduced to minimize both the establishment of new individuals and minimize further contributions to the seed bank at the site and in the surrounding landscape. Indeed, however much progress is made towards successful eradication of invasive vegetation in the Phase 1 and Phase 2 portions of the SRERP restoration area will likely ultimately translate into a reduced need (and expense) of future invasive vegetation management attention in upstream regions of the SRERP restoration area.

With continued time and the reduction in significant (restoration-related) soil disturbance events, there will also be fewer favorable opportunities for invasive seed germination and establishment. This reduction in disturbance regimes that favor invasive plant establishment, coupled with dedicated invasive species management efforts should contribute to reducing invasive species abundance throughout the SRERP area to below the final maximum success thresholds. The next theoretical “final” assessment interval for invasive vegetation in the SRERP occurs in the Phase 2A (Middle) restoration area in 2020. Given the amount of effort and time required to implement management strategies and gauge the resulting effects, any such efforts should be initiated as soon as possible in order to achieve the desired results within the required time periods.

Effective invasive species management efforts require proper planning and must address various seasonal considerations. The typical phenology and reproductive biology for each targeted species should be evaluated to identify the best time(s) of year to implement appropriate management methods, as well as the number of repetitions during the species’ development that management tasks should be performed to produce the desired results. Planning for management efforts should also take into consideration their potential impacts on other associated sensitive biological resources.

Invasive species management efforts should target specific species and minimize impacts to co-occurring native vegetation. Care should be taken in areas where special status plant species are known (i.e.; *Angelica lucida*, “sea-watch;” *Carex lyngbyei*, “Lyngbye’s sedge”), or have the potential (e.g.; *Castilleja ambigua* ssp. *humboldtiensis*, “Humboldt Bay owl’s-clover;” *Chlorophyron maritimum* ssp. *palustre*, “Point Reyes salty bird’s-beak”; etc.), to occur in order to avoid causing adverse impacts to such species as a result of eradication efforts. Management efforts targeting *Spartina densiflora* (“dense-flowered cord grass”) in the Phase 1 salt marsh and Phase 2A (Lower) brackish marsh habitats is a relevant examples of such an instance.

Invasive species management efforts should also incorporate a strategy to avoid causing adverse impacts to breeding birds. There is often substantial overlap between the optimum timing for invasive vegetation management efforts and the breeding season of resident and migratory bird species. Included among these are species with protective conservation status, for which suitable breeding habitat exists within the SRERP restoration area (pers. obs.). Appropriate planning can help minimize and/or avoid invasive vegetation management-related impacts to breeding birds.

In closing, we continue to recommend performance of scheduled annual percent cover sampling efforts and invasive vegetation assessments throughout the duration of the respective monitoring periods to track and evaluate the abundance of this category of vegetation, and thereby, the relative progress towards the attainment of core restoration goals for the Salt River Ecosystem Restoration Project. Should it appear that success thresholds will not be met, supplemental planting of native species should also be considered, concurrent with invasive vegetation management actions.

7.0 References & Literature Cited

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Appendix A

Salt River Ecosystem Restoration Project Figures

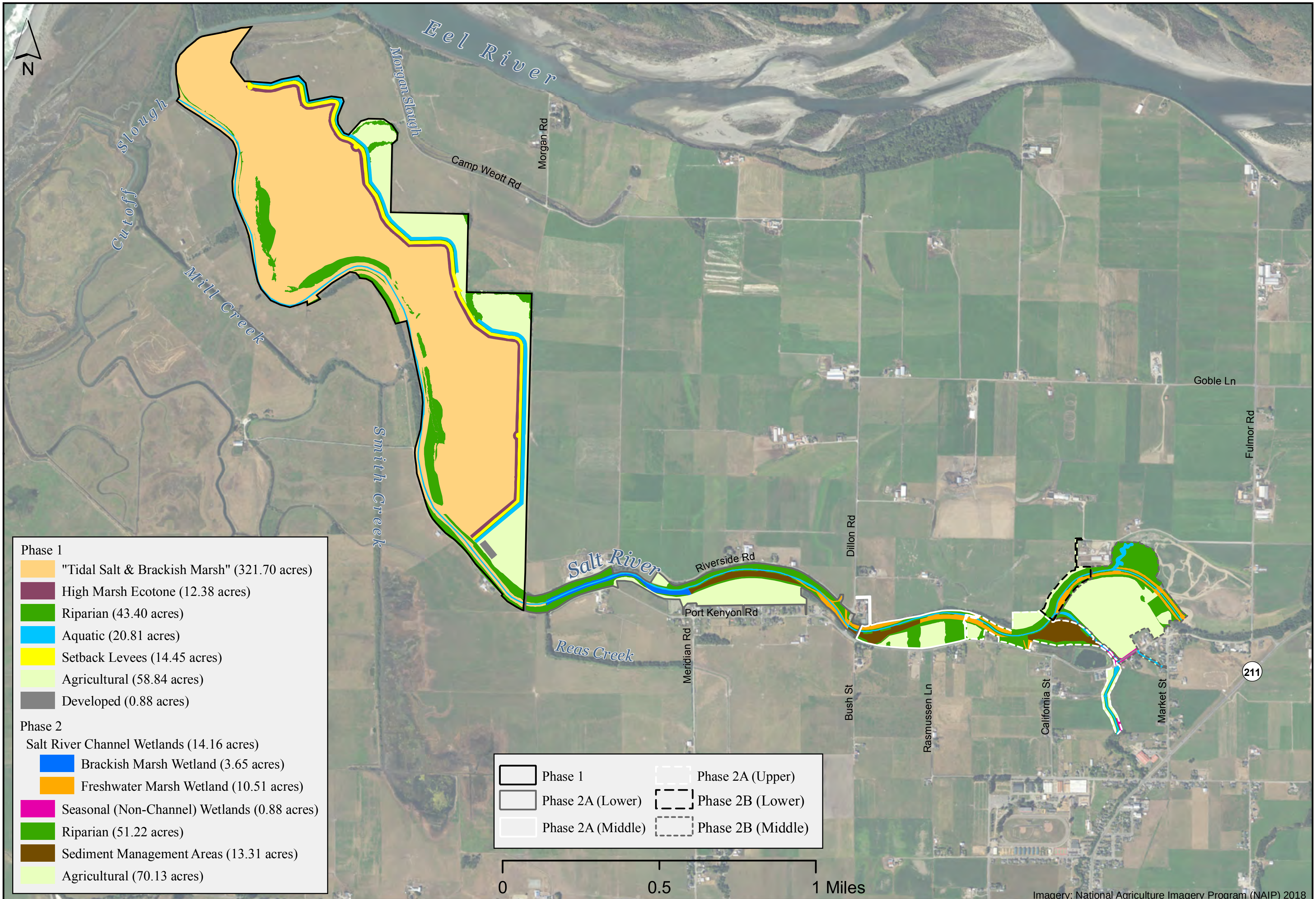

Figure 1. SRERP Projected Habitat Types (Adapted From: H.T. Harvey & Associates and Winzler & Kelly 2012)
2019 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

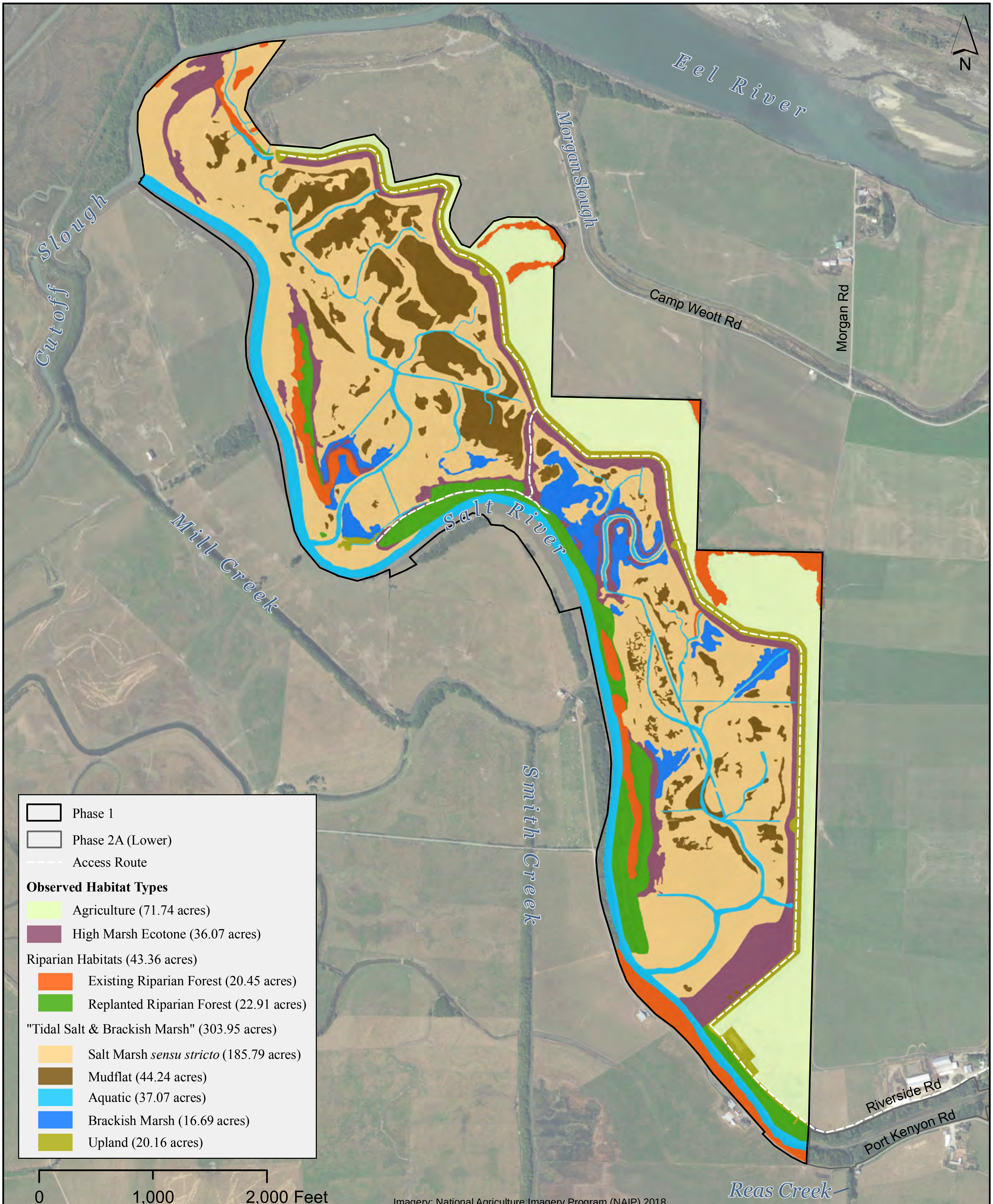

Figure 2. SRERP Phase 1 - Riverside Ranch Tidal Marsh Restoration Area Habitats

2019 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

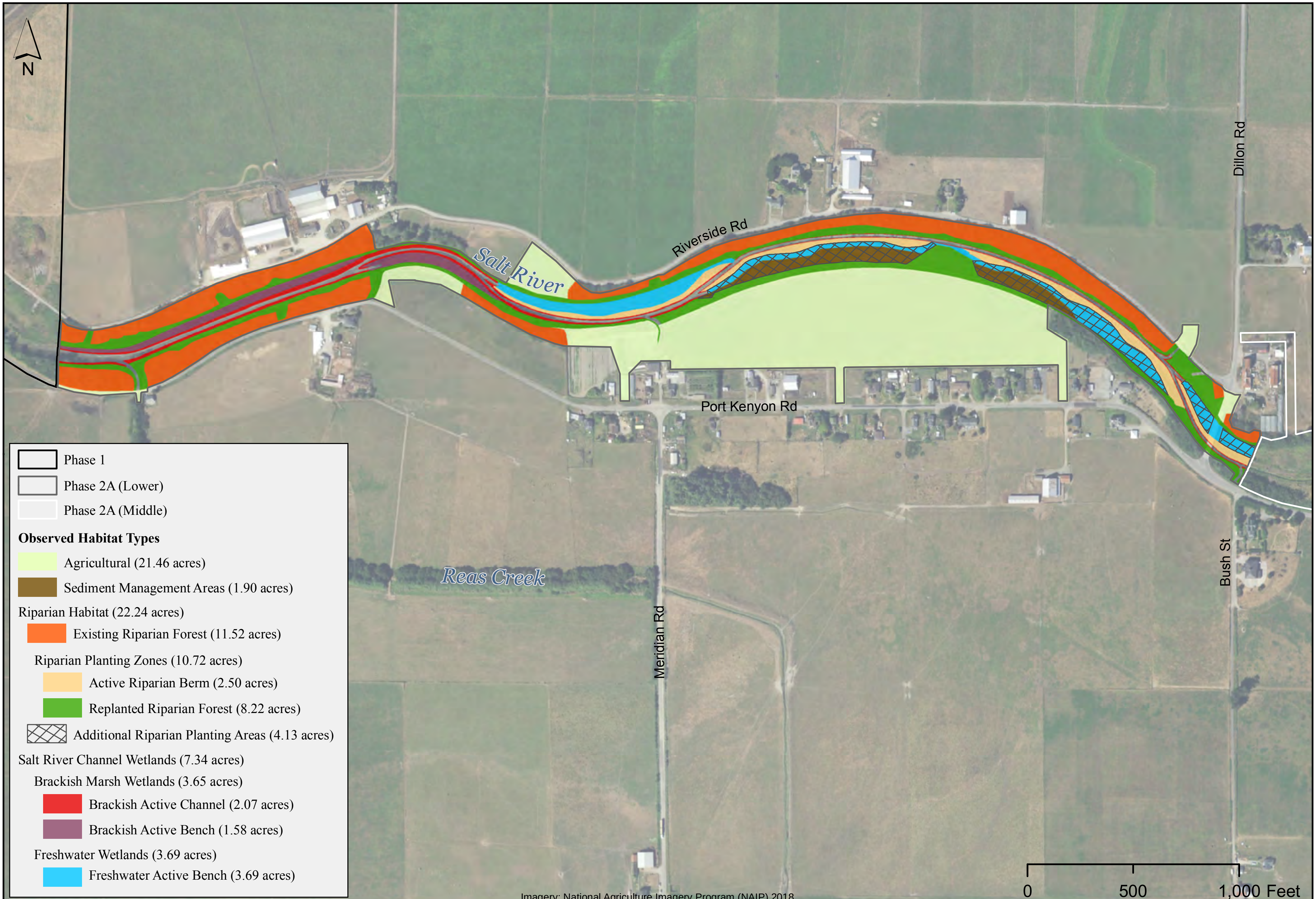

Figure 3. SRERP Phase 2A (Lower) - Salt River Corridor Restoration Area Habitats

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Salt River Ecosystem Restoration Project

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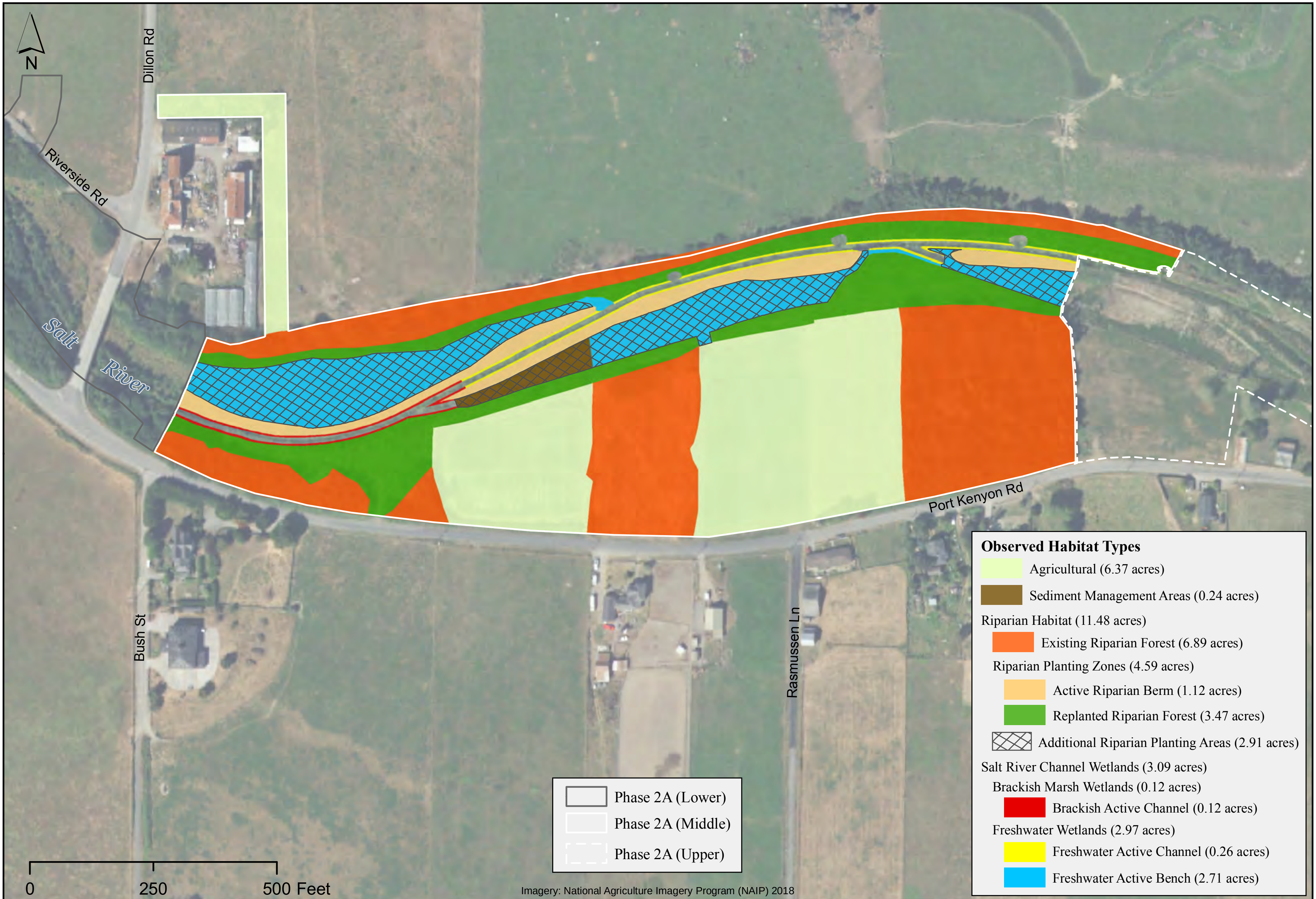

Figure 4. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Habitats

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Salt River Ecosystem Restoration Project

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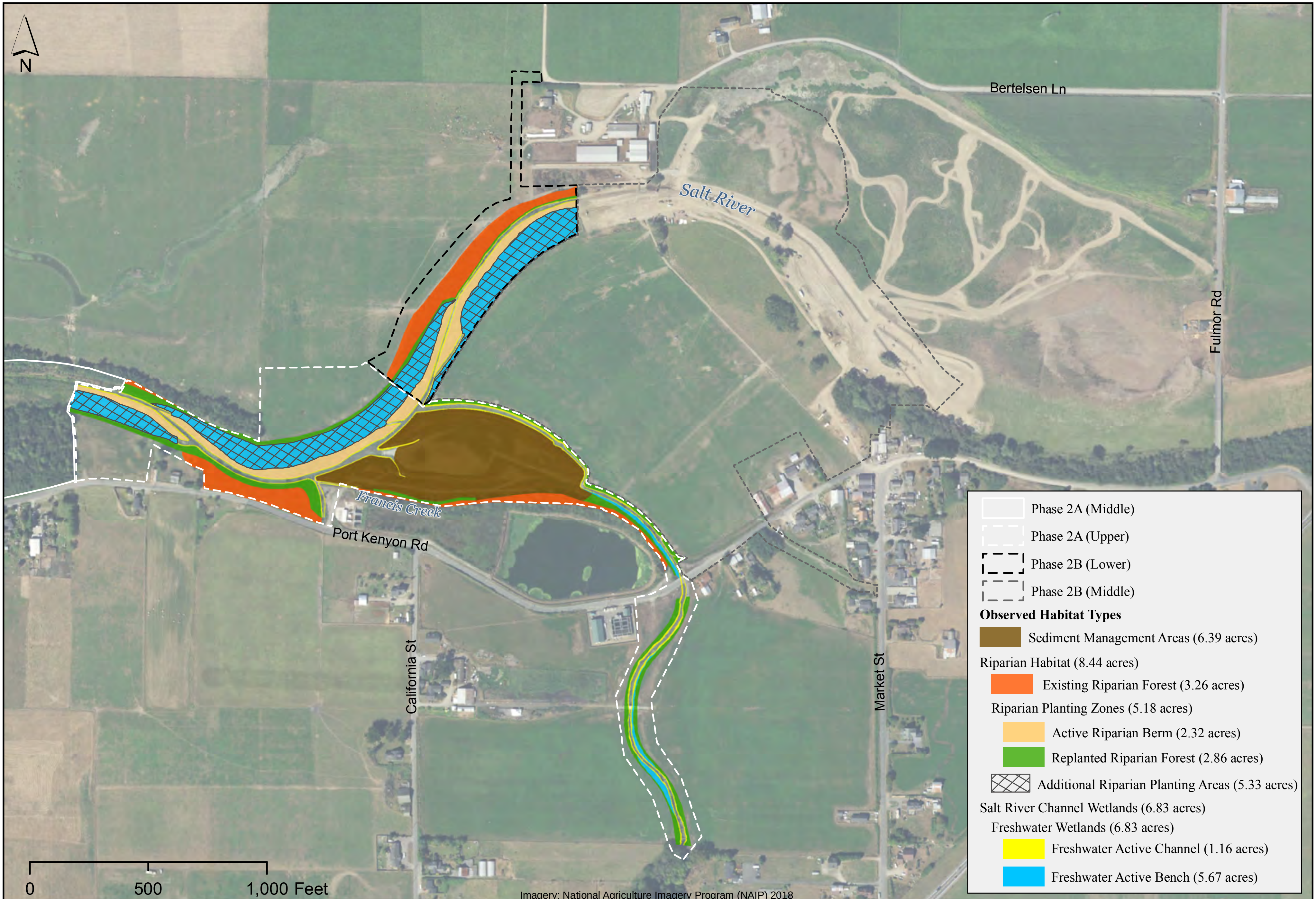

Figure 5. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Habitats
2019 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

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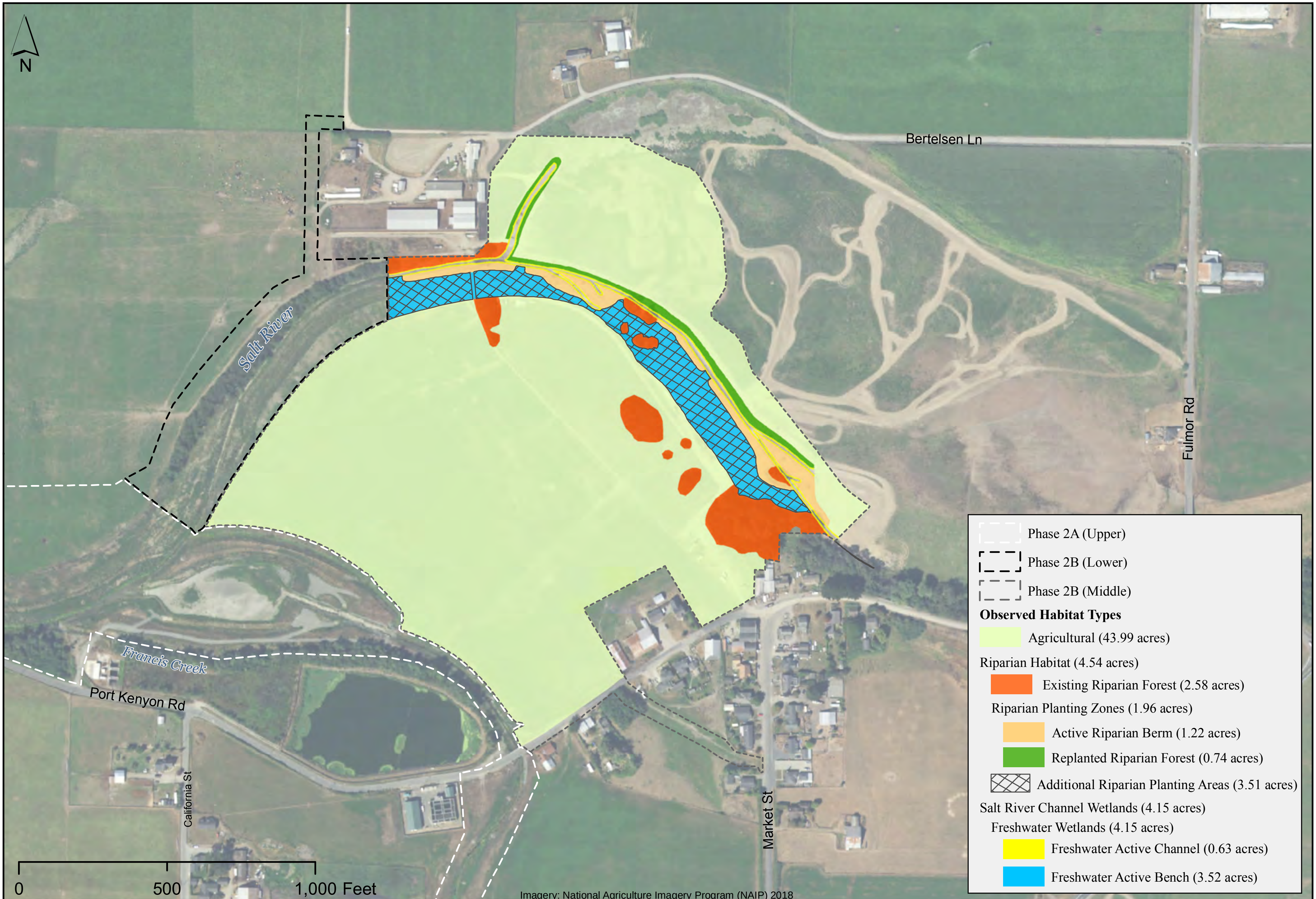

Figure 6. SRERP Phase 2B (Middle) – Salt River Corridor Restoration Area Habitats

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Salt River Ecosystem Restoration Project

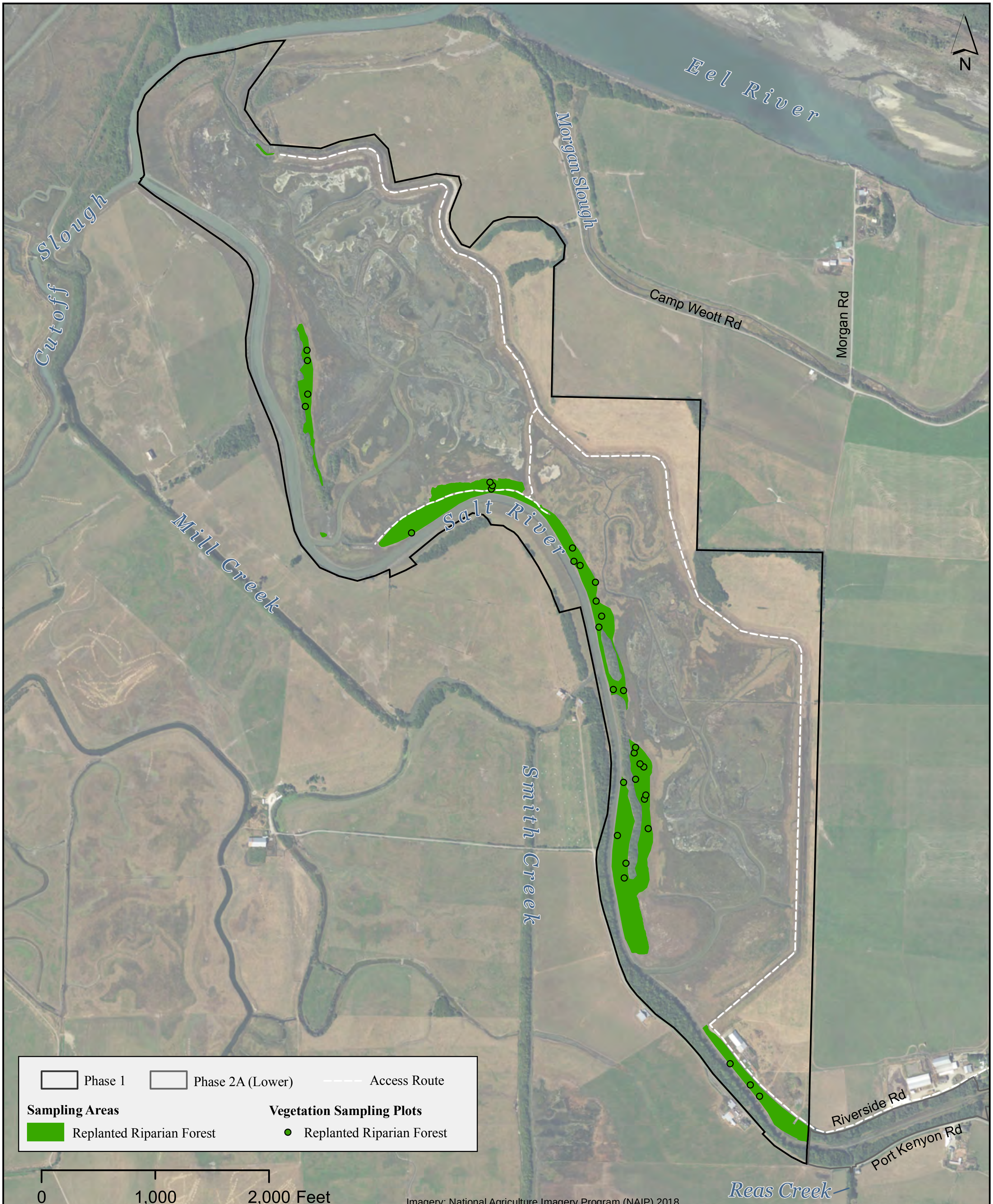

Figure 7. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Quantitative Vegetation Sampling Plots

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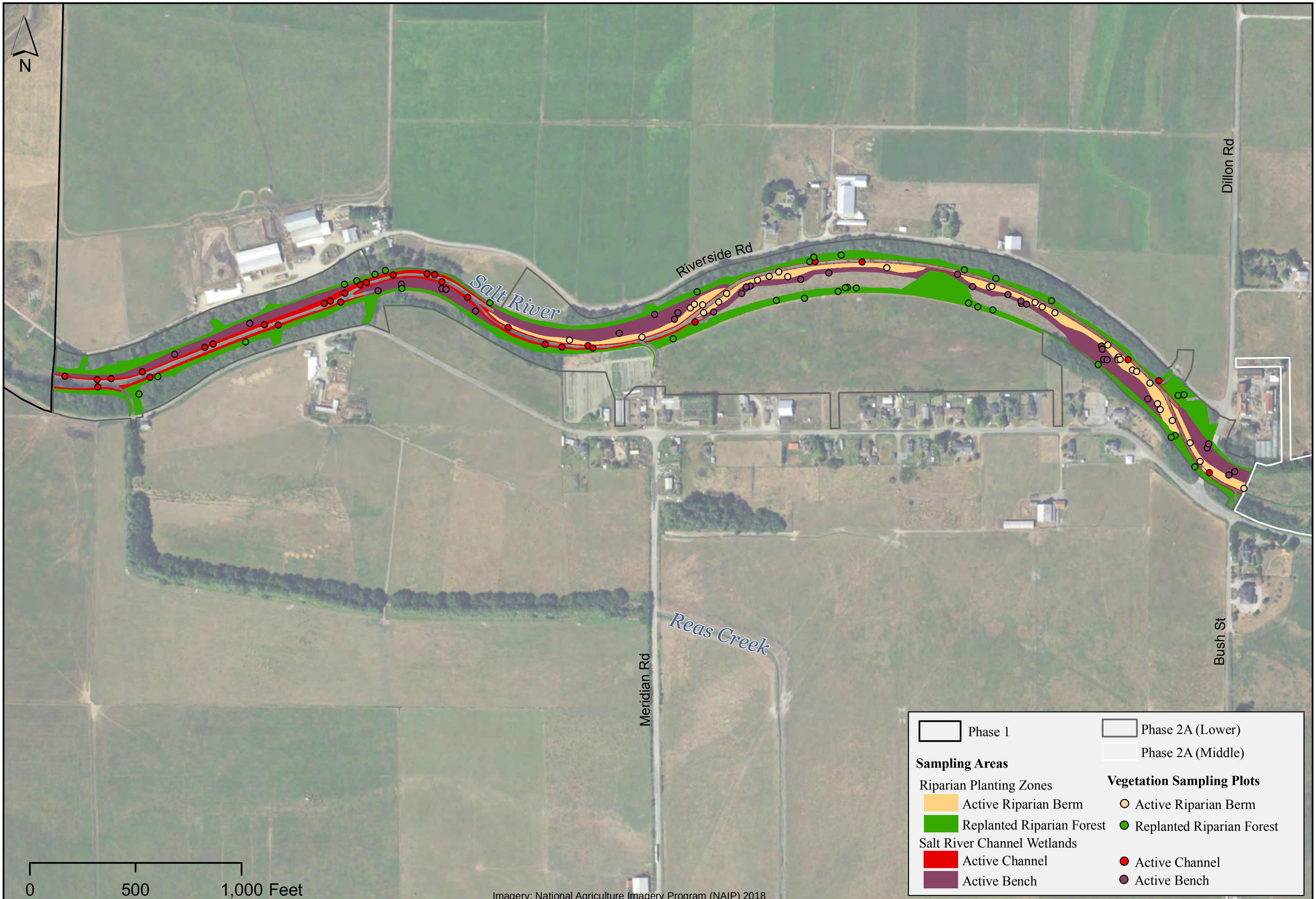

Figure 8. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots

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Salt River Ecosystem Restoration Project

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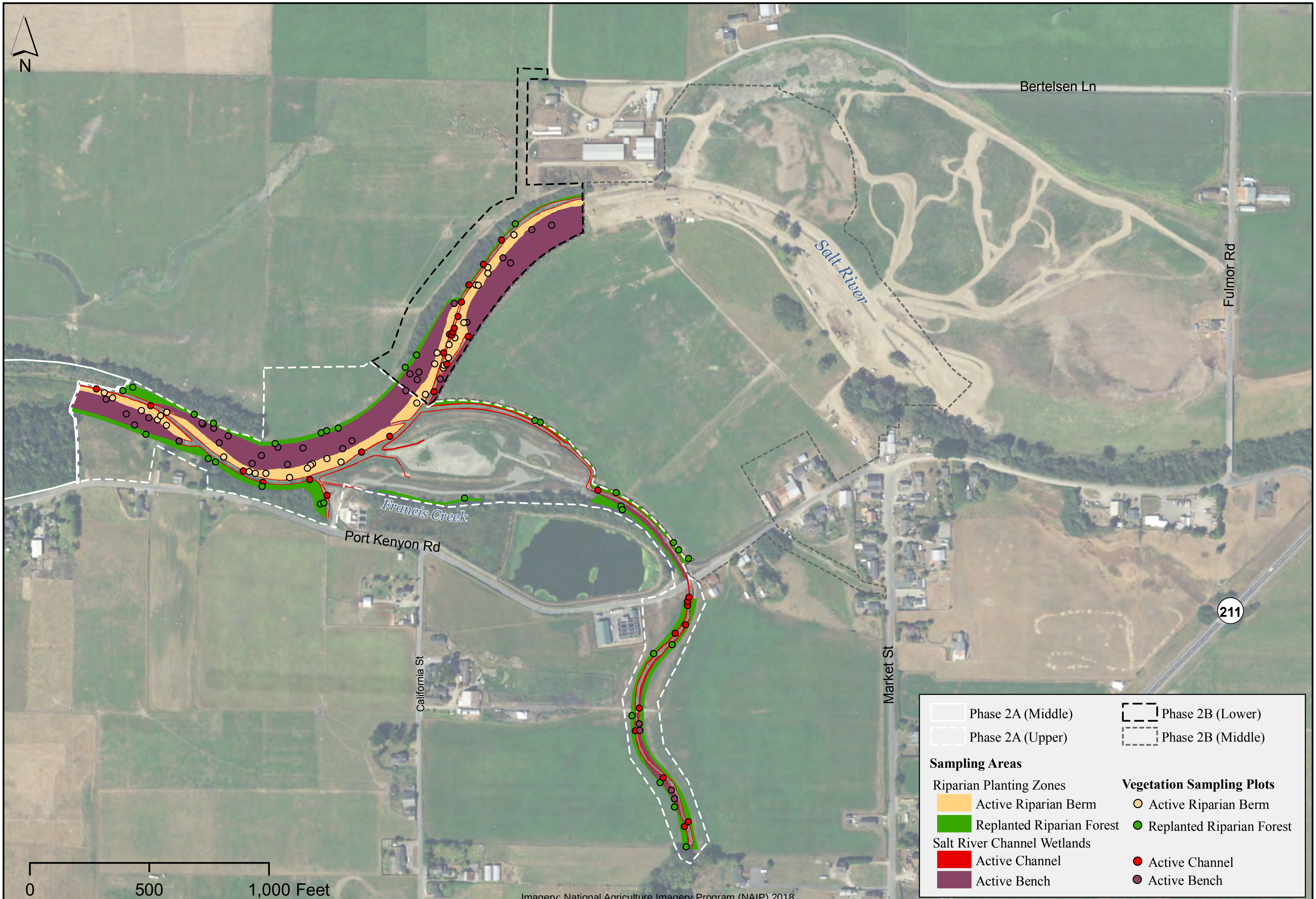

Figure 9. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots

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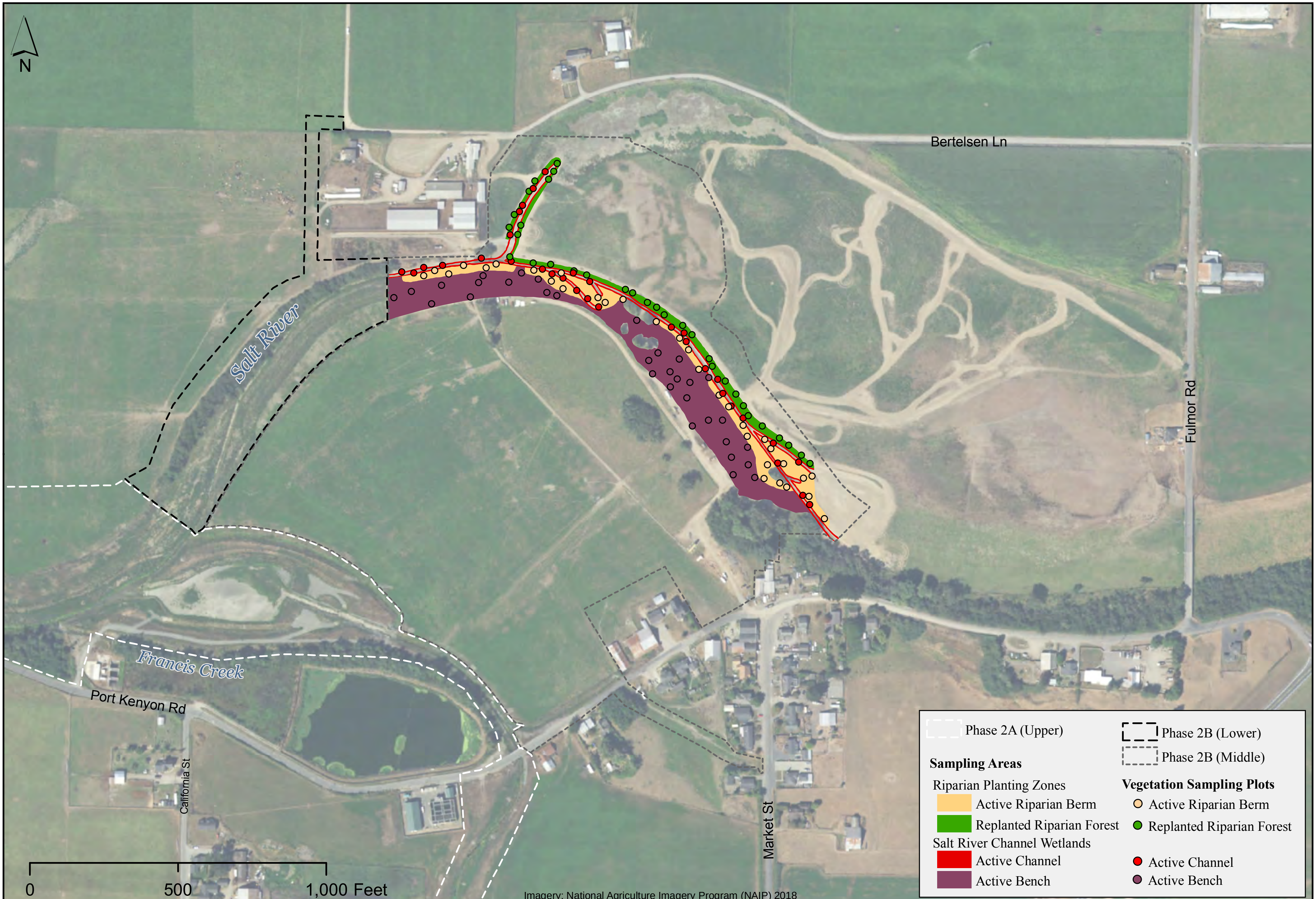

Figure 10. SRERP Phase 2B (Middle) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots

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Figure 11. SRERP Phase 1 ─ Riverside Ranch Tidal Marsh Restoration Area (North) Replanted Woody Riparian Vegetation Basal Area Sampling Plots

2019 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

Figure 12. SRERP Phase 1 ─ Riverside Ranch Tidal Marsh Restoration Area (South) Replanted Woody Riparian Vegetation Basal Area Sampling Plots

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Figure 13. SRERP Phase 2A (Lower) ─ Salt River Corridor Restoration Area (West)
Replanted Woody Riparian Vegetation Basal Area Sampling Plots

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Figure 14. SRERP Phase 2A (Lower) ─ Salt River Corridor Restoration Area (East) Replanted Woody Riparian Vegetation Basal Area Sampling Plots

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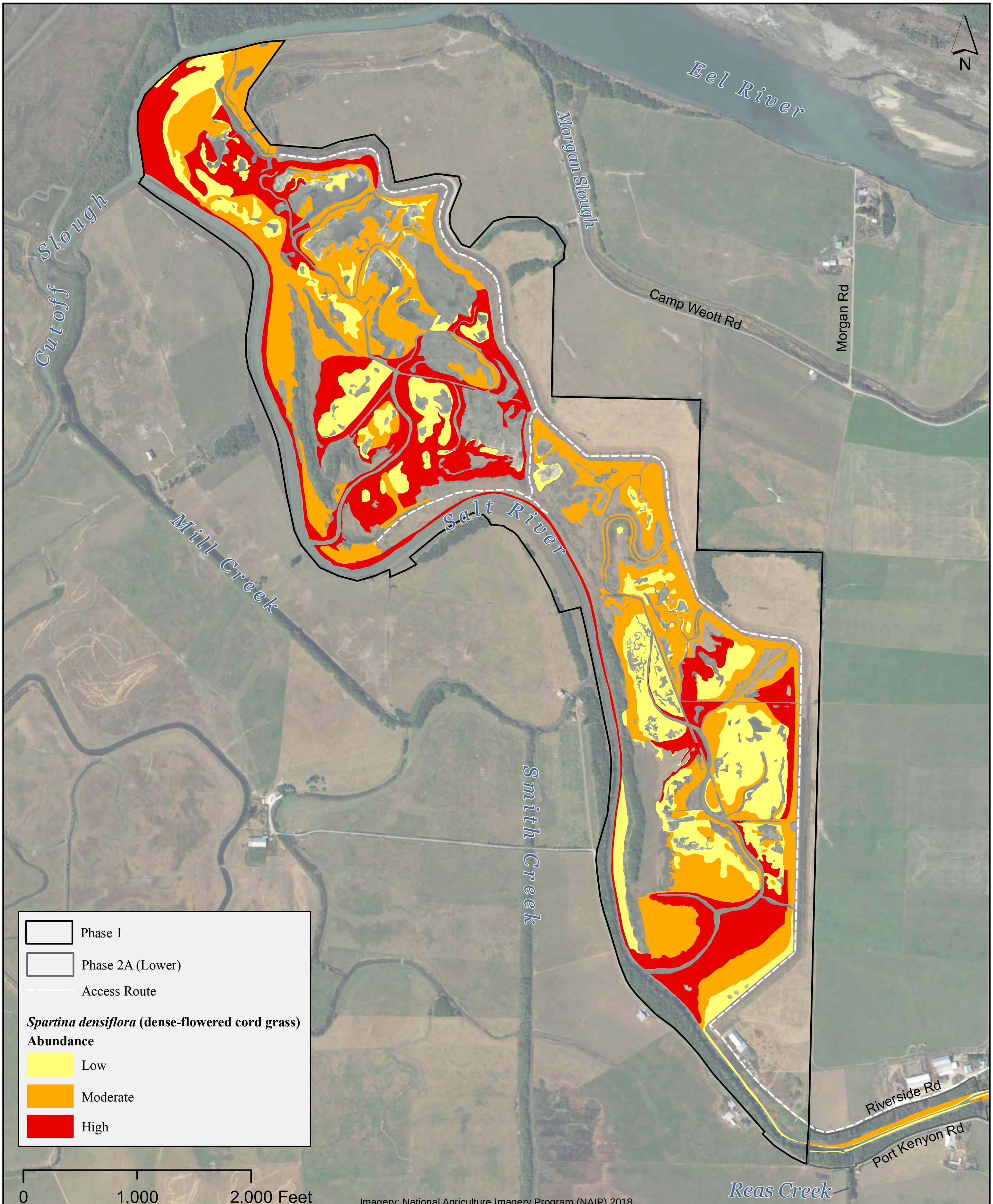

Figure 15. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive *Spartina densiflora* ("dense-flowered cord grass")

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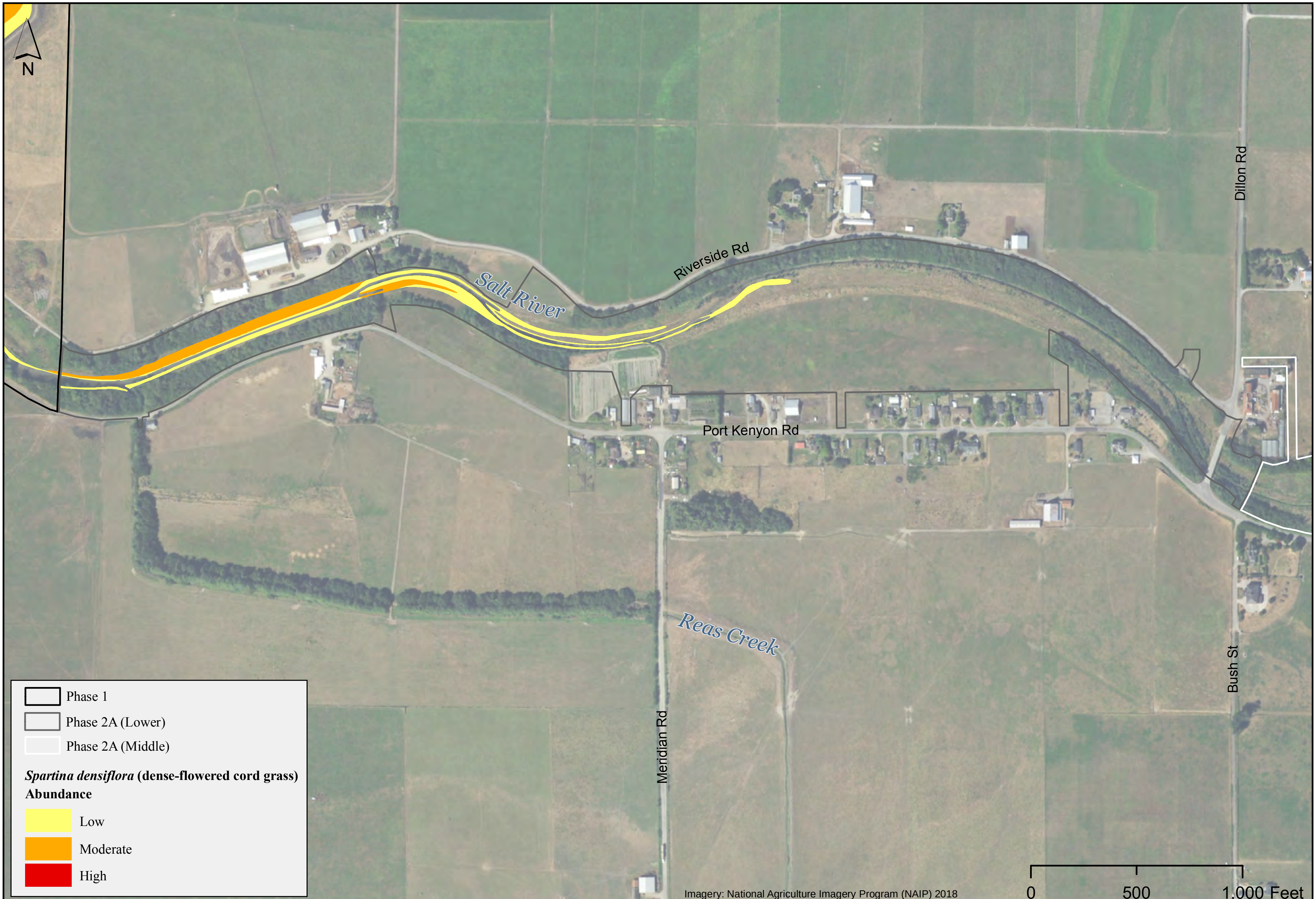

Figure 16. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area
Invasive *Spartina densiflora* ("dense-flowered cord grass")
2019 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

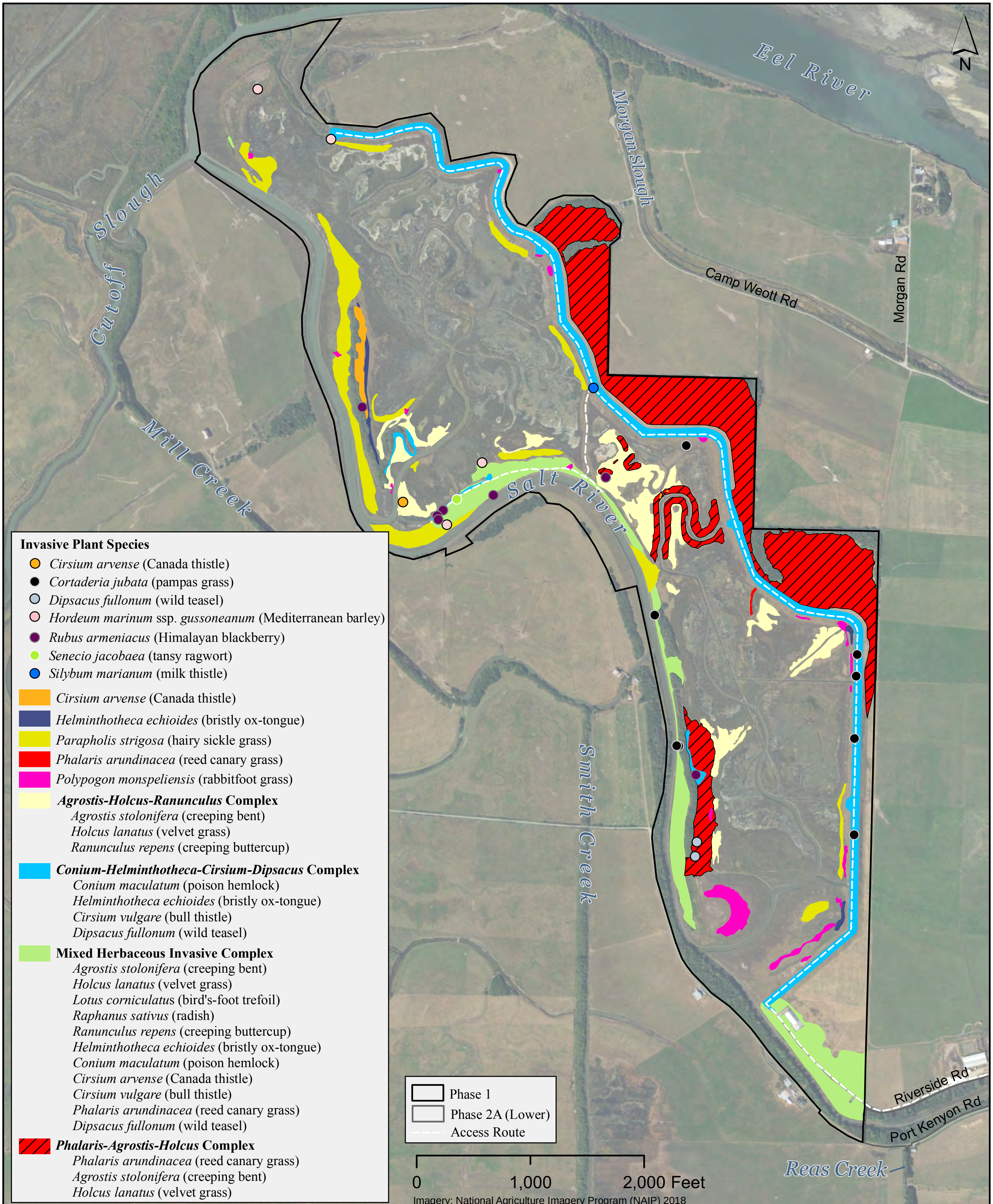

Figure 17. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive Plant Species

2019 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

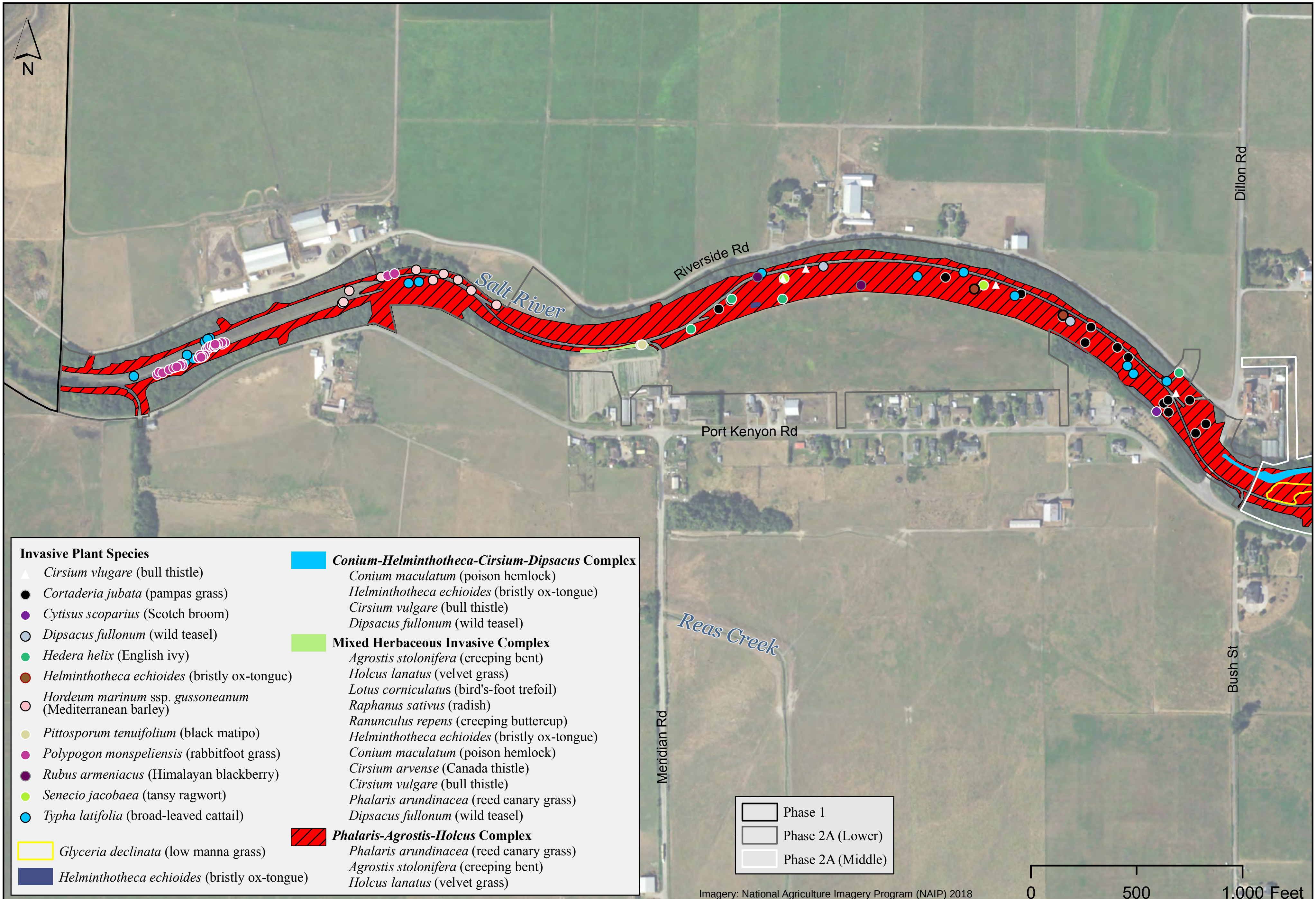

Figure 18. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

2019 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

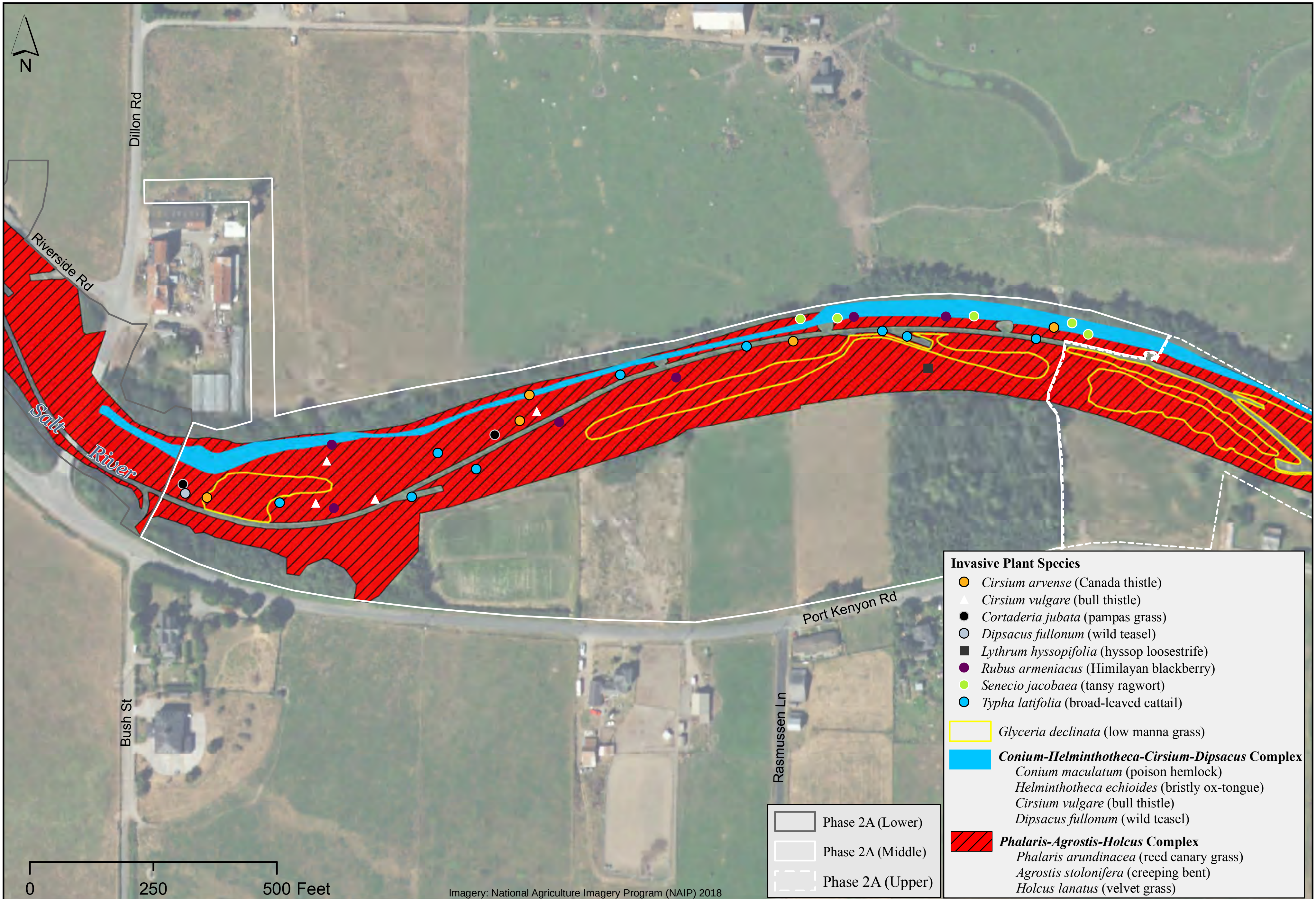

Figure 19. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Invasive Plant Species

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Salt River Ecosystem Restoration Project

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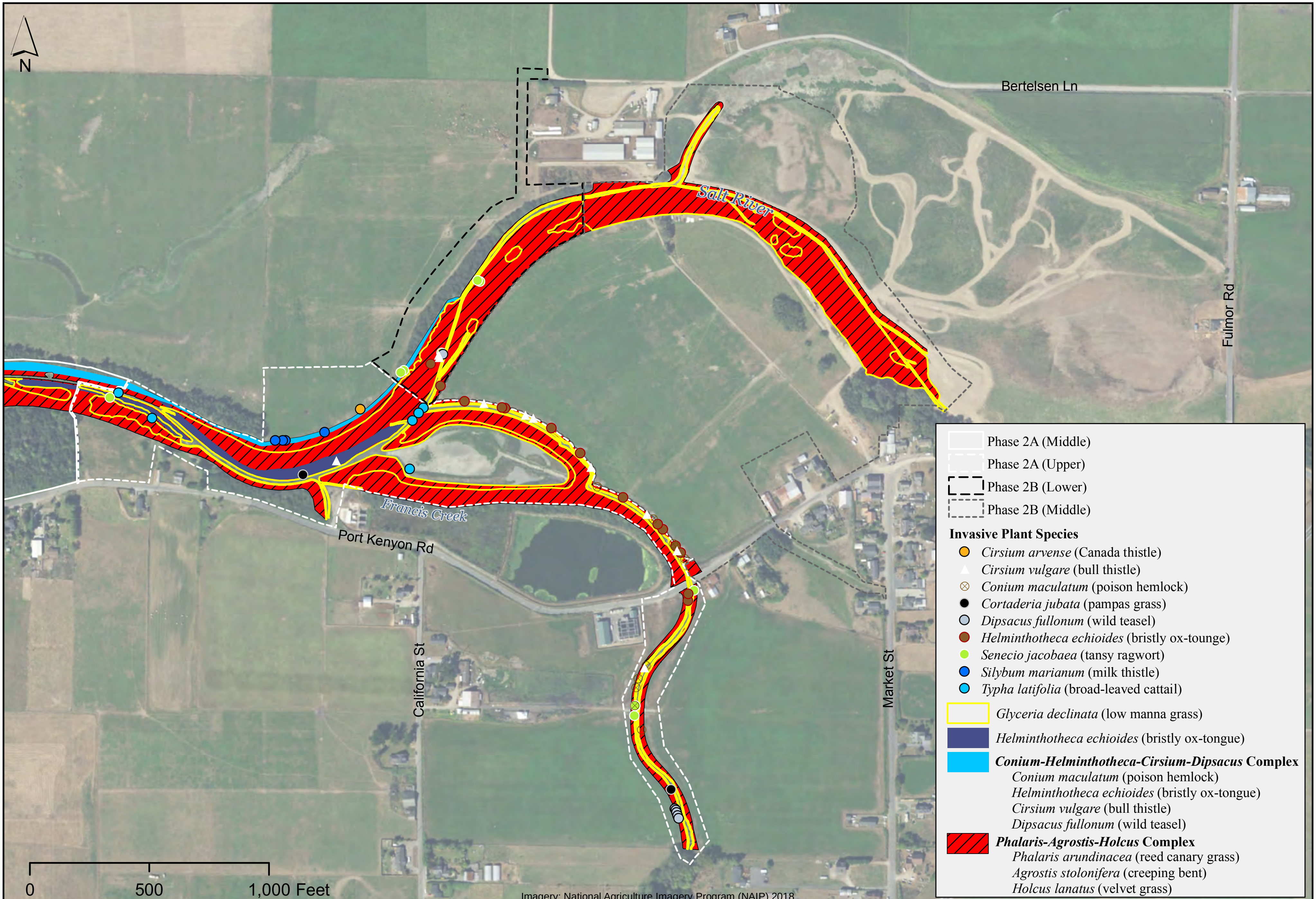

Figure 20. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

2019 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

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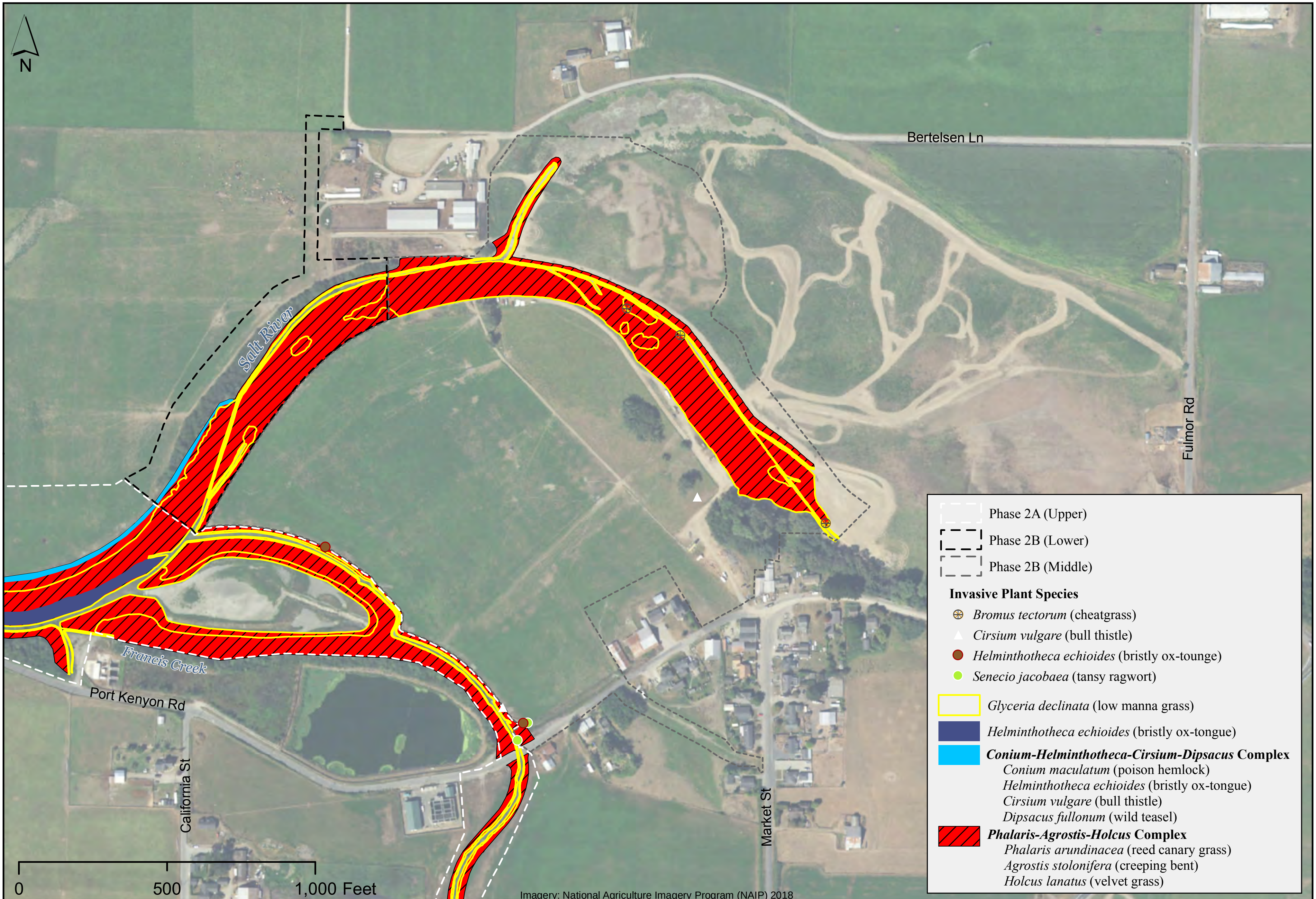

Figure 21. SRERP Phase 2B (Middle) – Salt River Corridor Restoration Area Invasive Plant Species

2019 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

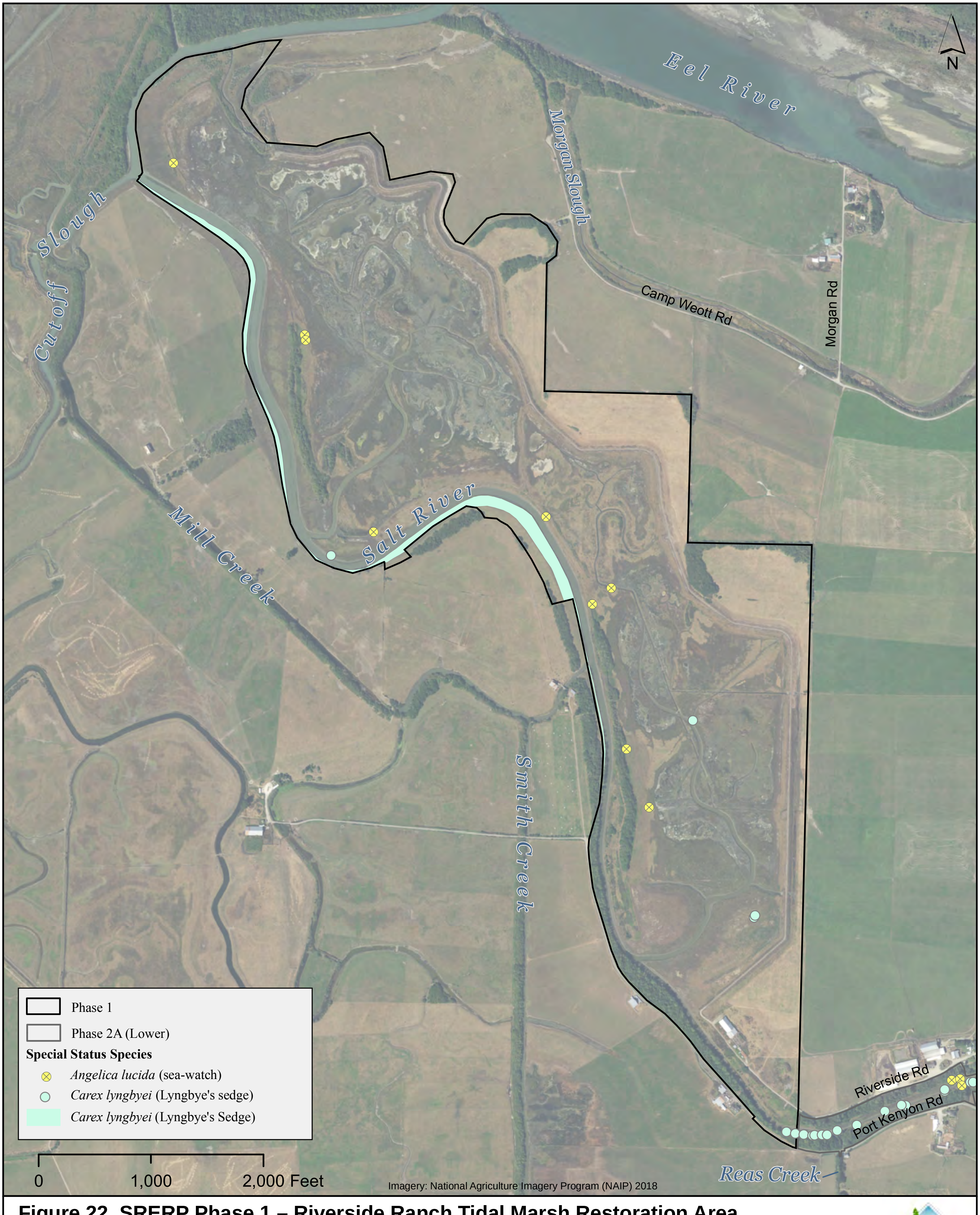

Figure 22. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Special Status Plant Species (Incidental observations)

2019 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

Figure 23. SRERP Phase 2A (Lower) – Riverside Ranch Tidal Marsh Restoration Area Special Status Plant Species (Incidental Observations)

2019 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

Appendix B

2019 SRERP Quantitative Vegetation Sampling Results

Phase 1 - Riverside Ranch Tidal Marsh Restoration Area:
Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.56	30.45	36.60
Symphiotrichum chilense	0.25	4.41	10.01
Hordeum brachyantherum	0.25	3.70	8.25
Equisetum telmateia ssp. *braunii*	0.16	5.63	18.47
Oenanthe sarmentosa	0.13	3.98	11.27
Potentilla anserina ssp. *pacifica*	0.09	2.11	7.44
Grindelia stricta	0.03	1.17	6.63
Equisetum arvense	0.03	0.47	2.65
Epilobium ciliatum ssp. *watsonii*	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.41	14.89	27.78
Baccharis pilularis	0.06	1.64	7.06
Morella californica	0.03	0.47	2.65
Lonicera involucrata var. *ledebourii*	0.03	0.09	0.53
Tree Species			
Salix hookeriana	0.03	1.17	6.63
Alnus rubra	0.03	0.47	2.65
Picea sitchensis	0.03	0.47	2.65
Pinus contorta	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Raphanus sativus	0.19	3.52	8.30
Festuca perennis	0.19	2.44	5.52
Vicia sativa ssp. *nigra*	0.13	1.13	3.71
Plantago lanceolata	0.09	1.41	4.44
Rumex conglomeratus	0.09	1.41	4.44
Vicia hirsuta	0.03	1.95	11.05
Medicago polymorpha	0.03	1.17	6.63
Trifolium repens	0.03	1.17	6.63
Trifolium fragiferum	0.03	0.47	2.65
Geranium dissectum	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.56	23.70	27.38
Holcus lanatus	0.38	15.22	27.68
Helminthotheca echioides	0.28	7.81	15.34
Lotus corniculatus	0.25	7.06	18.63
Ranunculus repens	0.19	7.91	20.06
Conium maculatum	0.19	1.91	5.03
Cirsium arvense	0.16	1.52	4.44
Dipsacus fullonum	0.13	3.28	9.70
Phalaris arundinacea	0.03	1.17	6.63
Convolvulus arvensis	0.03	0.47	2.65
Mentha pulegium	0.03	0.09	0.53

Phase 1 - Riverside Ranch Tidal Marsh Restoration Area:
Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Vine Species			
Hedera helix	0.03	2.67	15.11

Phase 2A (Lower) - Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.56	14.94	20.00
Grindelia stricta	0.44	10.50	17.99
Triglochin striata	0.41	17.38	28.47
Salicornia pacifica	0.31	7.50	12.92
Scirpus microcarpus	0.22	4.69	10.21
Potentilla anserina ssp. *pacifica*	0.22	4.02	11.79
Carex lyngbyei	0.19	3.55	11.64
Bolboschoenus maritimus ssp. *paludosus*	0.19	3.09	9.43
Oenanthe sarmentosa	0.13	1.88	5.04
Schoenoplectus pungens var. *longispicatus*	0.06	3.84	16.31
Juncus hesperius	0.06	0.94	3.69
Cyperus eragrostis	0.03	0.47	2.65
Alopecurus geniculatus	0.03	0.09	0.53
Veronica americana	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.03	0.47	2.65
Tree Species			
Alnus rubra	0.22	8.38	21.58
Salix lasiolepis	0.06	1.64	7.06
Salix lasiandra var. *lasiandra*	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Cotula coronopifolia	0.28	4.17	8.46
Festuca perennis	0.09	0.28	0.89
Rumex conglomeratus	0.03	0.47	2.65
Atriplex prostrata	0.03	0.09	0.53
Barbarea verna	0.03	0.09	0.53
Sonchus oleraceus	0.03	0.09	0.53
Cotula coronopifolia	0.28	4.17	8.46
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.66	15.75	17.28
Polypogon monspeliensis	0.41	3.84	6.11
Phalaris arundinacea	0.13	2.98	11.47
Spartina densiflora	0.09	2.89	11.48
Typha latifolia	0.03	0.47	2.65
Helminthotheca echioides	0.03	0.09	0.53

Phase 2A (Lower) - Salt River Corridor Restoration Area: Active Bench (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.59	22.00	27.42
Scirpus microcarpus	0.38	13.59	21.05
Schoenoplectus pungens var. *longispicatus*	0.25	8.47	20.01
Bolboschoenus maritimus ssp. *paludosus*	0.22	7.30	19.35
Oenanthe sarmentosa	0.19	7.81	17.02
Juncus hesperius	0.19	3.52	8.30
Triglochin striata	0.16	7.11	20.98
Grindelia stricta	0.09	3.23	15.25
Potentilla anserina ssp. *pacifica*	0.09	1.03	3.70
Carex lyngbyei	0.06	3.14	15.26
Carex obnupta	0.06	0.94	3.69
Cyperus eragrostis	0.03	0.47	2.65
Juncus patens	0.03	0.47	2.65
Hordeum brachyantherum	0.03	0.09	0.53
Shrub Species			
Baccharis pilularis	0.03	0.47	2.65
Rubus ursinus	0.03	0.47	2.65
Tree Species			
Salix lasiandra var. *lasiandra*	0.09	3.59	12.86
Alnus rubra	0.06	2.05	11.04
Salix lasiolepis	0.03	1.17	6.63
Non-Native Non-Invasive Species			
Herbaceous Species			
Mentha spicata	0.06	0.94	3.69
Cotula coronopifolia	0.06	0.56	2.69
Rumex conglomeratus	0.06	0.19	0.74
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.63	23.19	27.15
Phalaris arundinacea	0.50	18.14	29.60
Polypogon monspeliensis	0.09	1.41	4.44
Helminthotheca echioides	0.06	0.94	3.69
Spartina densiflora	0.06	0.56	2.69
Ranunculus repens	0.03	0.09	0.53
Typha latifolia	0.03	0.09	0.53

Phase 2A (Lower) - Salt River Corridor Restoration Area: Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.66	37.00	35.72
Scirpus microcarpus	0.28	7.83	17.52
Juncus hesperius	0.25	3.75	6.60
Oenanthe sarmentosa	0.16	6.03	18.60
Equisetum telmateia ssp. *braunii*	0.16	2.30	7.42
Stachys ajugoides	0.13	2.58	7.76
Potentilla anserina ssp. *pacifica*	0.13	1.50	4.44
Grindelia stricta	0.06	3.84	16.31
Carex lyngbyei	0.06	2.77	15.11
Epilobium ciliatum ssp. *watsonii*	0.06	0.94	3.69
Carex obnupta	0.03	1.17	6.63
Hordeum brachyantherum	0.03	0.47	2.65
Juncus patens	0.03	0.47	2.65
Elymus glaucus	0.03	0.09	0.53
Schoenoplectus pungens var. *longispicatus*	0.03	0.09	0.53
Shrub Species			
Baccharis pilularis	0.06	2.42	11.28
Rubus spectabilis	0.06	2.42	11.28
Physocarpus capitatus	0.03	0.47	2.65
Rosa californica	0.03	0.47	2.65
Rubus ursinus	0.03	0.47	2.65
Tree Species			
Alnus rubra	0.47	27.94	33.96
Salix sitchensis	0.09	2.89	11.48
Picea sitchensis	0.06	0.94	3.69
Salix lasiolepis	0.06	0.56	2.69
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.09	0.66	2.72
Plantago major	0.03	0.47	2.65
Raphanus sativus	0.03	0.47	2.65
Calystegia silvatica ssp. *disjuncta*	0.03	0.09	0.53
Rumex crispus	0.03	0.09	0.53
Trifolium repens	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.56	19.33	29.27
Agrostis stolonifera	0.50	15.91	26.13
Helminthotheca echioides	0.13	1.88	5.04
Holcus lanatus	0.06	0.56	2.69

Phase 2A (Lower) - Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.59	17.69	24.20
Scirpus microcarpus	0.41	13.61	21.64
Juncus hesperius	0.28	3.84	6.57
Oenanthe sarmentosa	0.22	3.98	8.52
Equisetum telmateia ssp. *braunii*	0.19	3.52	8.30
Grindelia stricta	0.09	2.89	11.48
Potentilla anserina ssp. *pacifica*	0.09	0.66	2.72
Juncus effusus ssp. pacificus	0.06	0.94	3.69
Stachys ajugoides	0.03	1.17	6.63
Anaphalis margaritacea	0.03	0.47	2.65
Angelica lucida	0.03	0.47	2.65
Equisetum arvense	0.03	0.47	2.65
Shrub Species			
Rubus ursinus	0.47	15.80	23.46
Rubus parviflorus	0.06	0.94	3.69
Lonicera involucrata var. *ledebourii*	0.03	0.47	2.65
Rosa californica	0.03	0.47	2.65
Tree Species			
Salix lasiolepis	0.38	22.94	34.07
Alnus rubra	0.31	20.48	34.62
Picea sitchensis	0.16	3.45	11.65
Salix lasiandra var. *lasiandra*	0.09	4.00	15.36
Salix hookeriana	0.06	3.91	15.37
Salix sitchensis	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Calystegia silvatica ssp. *disjuncta*	0.03	1.17	6.63
Senecio minimus	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.56	22.69	33.22
Agrostis stolonifera	0.50	23.28	31.86
Ranunculus repens	0.09	2.11	7.44
Mentha pulegium	0.03	0.47	2.65
Vine Species			
Hedera helix	0.03	0.47	2.65

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Scirpus microcarpus	0.50	21.36	31.18
Deschampsia cespitosa	0.44	7.58	14.23
Hordeum brachyantherum	0.44	5.64	10.14
Equisetum arvense	0.31	4.22	11.74
Juncus hesperius	0.25	4.78	10.18
Potentilla anserina ssp. *pacifica*	0.22	1.33	3.72
Alopecurus geniculatus	0.19	4.64	15.59
Oenanthe sarmentosa	0.09	3.22	12.69
Equisetum telmateia ssp. *braunii*	0.09	2.89	11.48
Eleocharis macrostachya	0.06	1.64	7.06
Cyperus eragrostis	0.06	0.94	3.69
Elymus glaucus	0.06	0.56	2.69
Callitriche heterophylla	0.03	0.47	2.65
Carex obnupta	0.03	0.47	2.65
Epilobium ciliatum ssp. *watsonii*	0.03	0.47	2.65
Juncus effusus ssp. *pacificus*	0.03	0.47	2.65
Alisma triviale	0.03	0.09	0.53
Juncus bolanderi	0.03	0.09	0.53
Tree Species			
Alnus rubra	0.34	18.80	30.26
Salix sitchensis	0.09	0.28	0.89
Salix lasiandra var. *lasiandra*	0.09	0.20	0.74
Salix lasiolepis	0.06	3.84	16.31
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.28	8.48	18.92
Atriplex prostrata	0.16	1.13	3.71
Hypochaeris radicata	0.03	0.09	0.53
Juncus bufonius var. *congestus*	0.03	0.09	0.53
Calystegia silvatica ssp. *disjuncta*	0.03	0.00	0.02
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.44	12.94	23.63
Agrostis stolonifera	0.34	5.44	10.23
Holcus lanatus	0.28	6.66	12.85
Mentha pulegium	0.06	0.94	3.69
Glyceria declinata	0.06	0.56	2.69
Ranunculus repens	0.06	0.19	0.74
Typha latifolia	0.03	0.47	2.65
Cirsium vulgare	0.03	0.09	0.53
Helminthotheca echioides	0.03	0.02	0.09
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.03	0.02	0.09

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Active Bench (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.75	14.80	14.33
Deschampsia cespitosa	0.53	15.84	23.15
Alopecurus geniculatus	0.44	7.17	11.62
Equisetum arvense	0.22	6.88	15.33
Scirpus microcarpus	0.19	6.83	20.92
Juncus hesperius	0.09	1.41	4.44
Epilobium ciliatum ssp. *watsonii*	0.06	0.11	0.53
Oenanthe sarmentosa	0.03	0.47	2.65
Tree Species			
Alnus rubra	0.22	8.08	21.04
Salix lasiandra var. *lasiandra*	0.09	0.66	2.72
Salix sitchensis	0.06	0.56	2.69
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.59	14.81	17.71
Trifolium fragiferum	0.31	7.91	15.30
Rumex conglomeratus	0.19	2.06	5.02
Trifolium repens	0.13	4.47	15.46
Cotula coronopifolia	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.63	16.33	25.41
Phalaris arundinacea	0.59	18.73	28.55
Holcus lanatus	0.13	1.50	4.44
Lotus corniculatus	0.06	2.05	11.04
Glyceria declinata	0.06	0.56	2.69
Helminthotheca echioides	0.06	0.11	0.53
Cortaderia jubata	0.03	0.00	0.02
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.03	0.47	2.65

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area:
Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.75	11.78	10.82
Deschampsia cespitosa	0.34	5.44	10.23
Elymus glaucus	0.25	3.38	6.27
Bromus maritimus	0.16	2.34	5.53
Alopecurus geniculatus	0.16	1.97	5.03
Festuca rubra	0.13	3.28	9.70
Equisetum telmateia ssp. *braunii*	0.13	1.83	7.05
Cyperus eragrostis	0.09	1.03	3.70
Potentilla anserina ssp. *pacifica*	0.09	0.58	2.69
Scirpus microcarpus	0.06	3.52	17.35
Juncus effusus ssp. *pacificus*	0.06	0.94	3.69
Equisetum arvense	0.03	0.47	2.65
Oenanthe sarmentosa	0.03	0.47	2.65
Stachys ajugoides	0.03	0.47	2.65
Shrub Species			
Lonicera involucrata var. *ledebourii*	0.06	0.19	0.74
Ceonothus thyrsiflorus	0.03	0.47	2.65
Tree Species			
Alnus rubra	0.28	6.73	14.37
Thuja plicata	0.09	0.28	0.89
Sequoia sempervirens	0.06	0.56	2.69
Salix sitchensis	0.06	0.19	0.74
Populus trichocarpa	0.03	0.47	2.65
Salix lasiolepis	0.03	0.47	2.65
Picea sitchensis	0.03	0.09	0.53
Salix lasiandra var. *lasiandra*	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.66	15.59	19.68
Trifolium repens	0.34	14.23	25.88
Trifolium fragiferum	0.19	6.48	16.61
Rumex conglomeratus	0.19	2.81	5.95
Trifolium pratense	0.06	0.56	2.69
Senecio minimus	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.44	16.39	29.39
Agrostis stolonifera	0.38	6.23	11.55
Lotus corniculatus	0.25	8.39	18.96
Holcus lanatus	0.19	2.44	5.52
Helminthotheca echioides	0.16	3.45	11.65
Glyceria declinata	0.03	0.47	2.65
Mentha pulegium	0.03	0.47	2.65
Ranunculus repens	0.03	0.09	0.53

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area:
Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.25	2.25	5.00

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Native Species			
Herbaceous Species			
Bromus maritimus	0.38	4.50	6.73
Hordeum brachyantherum	0.31	3.19	5.85
Elymus glaucus	0.28	2.34	4.98
Equisetum telmateia ssp. *braunii*	0.25	13.95	27.85
Deschampsia cespitosa	0.19	4.22	10.07
Equisetum arvense	0.19	3.92	11.81
Scirpus microcarpus	0.16	4.16	12.97
Stachys ajugoides	0.16	1.97	5.03
Vicia americana ssp. *americana*	0.13	4.84	15.57
Festuca rubra	0.09	3.59	12.86
Potentilla anserina ssp. *pacifica*	0.09	1.03	3.70
Oenanthe sarmentosa	0.06	3.84	16.31
Lupinus rivularis	0.06	0.94	3.69
Achillea millefolium	0.03	0.47	2.65
Epilobium ciliatum ssp. *watsonii*	0.03	0.47	2.65
Petasites frigidus var. *palmatus*	0.03	0.47	2.65
Stachys mexicana	0.03	0.47	2.65
Shrub Species			
Rubus ursinus	0.06	1.64	7.06
Morella californica	0.03	1.17	6.63
Lonicera involucrata var. *ledebourii*	0.03	0.47	2.65
Physocarpus capitatus	0.03	0.47	2.65
Tree Species			
Alnus rubra	0.22	8.02	21.74
Salix lasiandra var. *lasiandra*	0.06	3.14	15.26
Salix lasiolepis	0.06	2.77	15.11
Salix sitchensis	0.06	1.27	6.63
Picea sitchensis	0.06	0.56	2.69
Salix hookeriana	0.03	2.67	15.11
Acer macrophyllum	0.03	0.47	2.65
Populus trichocarpa	0.03	0.09	0.53
Thuja plicata	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.47	8.02	11.66
Rumex conglomeratus	0.25	4.78	10.18
Trifolium repens	0.22	7.30	19.35
Plantago lanceolata	0.19	3.84	9.88
Vicia hirsuta	0.09	2.89	11.48
Raphanus sativus	0.09	2.78	15.10
Solanum nigrum	0.06	1.27	6.63
Trifolium fragiferum	0.06	0.48	2.65
Aira caryophyllea	0.03	0.47	2.65

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Anthoxanthum odoratum	0.03	0.47	2.65
Atriplex prostrata	0.03	0.47	2.65
Calystegia silvatica ssp. *disjuncta*	0.03	0.47	2.65
Rumex crispus	0.03	0.47	2.65
Senecio minimus	0.03	0.47	2.65
Sonchus asper ssp. *asper*	0.03	0.47	2.65
Trifolium pratense	0.03	0.47	2.65
Vicia sativa ssp. *nigra*	0.03	0.47	2.65
Geranium dissectum	0.03	0.09	0.53
Avena fatua	0.03	0.00	0.02
Invasive Species			
Herbaceous Species			
Holcus lanatus	0.69	24.16	24.66
Agrostis stolonifera	0.31	7.59	16.72
Helminthotheca echioides	0.31	6.05	11.63
Phalaris arundinacea	0.25	9.55	20.63
Lotus corniculatus	0.19	6.42	17.49
Cirsium vulgare	0.16	3.75	9.90
Ranunculus repens	0.13	1.50	4.44
Conium maculatum	0.06	0.56	2.69
Cirsium arvense	0.03	0.47	2.65
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.34	3.28	5.82

Phase 2B (Middle) - Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.63	13.70	17.01
Gamochaeta ustulata	0.38	6.45	11.70
Potentilla anserina ssp. *pacifica*	0.31	0.77	2.70
Persicaria lapathifolia	0.25	4.78	10.18
Deschampsia cespitosa	0.16	2.34	5.53
Oenanthe sarmentosa	0.13	0.30	0.89
Eleocharis macrostachya	0.09	6.58	21.05
Alopecurus geniculatus	0.09	1.41	4.44
Alisma triviale	0.09	1.03	3.70
Cyperus eragrostis	0.09	0.95	3.69
Elymus glaucus	0.06	0.19	0.74
Epilobium ciliatum ssp. *watsonii*	0.06	0.19	0.74
Juncus effusus ssp. *pacificus*	0.06	0.11	0.53
Gnaphalium palustre	0.03	0.47	2.65
Stachys ajugoides	0.03	0.47	2.65
Equisetum arvense	0.03	0.09	0.53
Juncus patens	0.03	0.09	0.53
Juncus bufonius var. *occidentalis*	0.03	0.02	0.09
Shrub Species			
Lonicera involucrata var. *ledebourii*	0.03	0.09	0.53
Tree Species			
Salix hookeriana	0.06	1.27	6.63
Non-Native Non-Invasive Species			
Herbaceous Species			
Atriplex prostrata	0.78	18.92	23.55
Festuca perennis	0.50	8.56	13.28
Plantago major	0.19	1.16	3.71
Barbarea verna	0.19	0.78	2.74
Trifolium repens	0.13	2.98	11.47
Rumex conglomeratus	0.13	1.88	5.04
Polygonum aviculare ssp. *depressum*	0.09	0.66	2.72
Raphanus sativus	0.06	2.05	11.04
Trifolium fragiferum	0.06	1.27	6.63
Senecio minimus	0.06	0.19	0.74
Trifolium dubium	0.06	0.19	0.74
Juncus bufonius var. *congestus*	0.06	0.11	0.53
Trifolium pratense	0.03	0.47	2.65
Matricaria chamomilla	0.03	0.09	0.53
Taraxacum officinale	0.03	0.09	0.53
Vicia hirsuta	0.03	0.09	0.53
Rumex crispus	0.03	0.02	0.09
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.28	2.27	4.99
Lotus corniculatus	0.19	2.69	7.74

Phase 2B (Middle) - Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Glyceria declinata	0.16	1.97	5.03
Agrostis stolonifera	0.06	0.94	3.69
Mentha pulegium	0.06	0.11	0.53
Conium maculatum	0.03	1.17	6.63
Bromus tectorum	0.03	0.09	0.53
Holcus lanatus	0.03	0.09	0.53
Cirsium vulgare	0.03	0.02	0.09
Cirsium vulgare	0.03	0.02	0.09
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.19	0.78	2.74

Phase 2B (Middle) - Salt River Corridor Restoration Area: Active Bench (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.53	9.36	14.14
Juncus bufonius var. *occidentalis*	0.16	1.44	4.43
Alopecurus geniculatus	0.09	1.36	6.64
Deschampsia cespitosa	0.06	0.56	2.69
Cyperus eragrostis	0.03	0.09	0.53
Gnaphalium palustre	0.03	0.09	0.53
Potentilla anserina ssp. *pacifica*	0.03	0.02	0.09
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.84	22.41	25.16
Trifolium repens	0.69	13.91	16.48
Trifolium pratense	0.41	13.45	23.03
Trifolium hybridum	0.34	5.86	9.08
Trifolium fragiferum	0.19	2.81	5.95
Polygonum aviculare ssp. *depressum*	0.13	0.22	0.74
Trifolium dubium	0.06	0.11	0.53
Plantago major	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Lotus corniculatus	0.72	13.78	16.41
Glyceria declinata	0.25	3.70	8.25
Phalaris arundinacea	0.22	2.81	11.24
Holcus lanatus	0.06	0.56	2.69
Ranunculus repens	0.06	0.11	0.53
Agrostis stolonifera	0.03	0.09	0.53
Polypogon monspeliensis	0.03	0.09	0.53
Mentha pulegium	0.03	0.02	0.09
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.19	0.78	2.74

Phase 2B (Middle) - Salt River Corridor Restoration Area: Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.72	12.50	14.28
Potentilla anserina ssp. *pacifica*	0.16	3.05	8.05
Equisetum arvense	0.13	1.50	4.44
Alopecurus geniculatus	0.09	1.03	3.70
Deschampsia cespitosa	0.06	0.56	2.69
Elymus glaucus	0.06	0.19	0.74
Epilobium ciliatum ssp. *watsonii*	0.03	0.09	0.53
Gamochaeta ustulata	0.03	0.09	0.53
Persicaria lapathifolia	0.03	0.09	0.53
Stachys ajugoides	0.03	0.09	0.53
Juncus patens	0.03	0.02	0.09
Shrub Species			
Lonicera involucrata var. *ledebourii*	0.03	0.47	2.65
Tree Species			
Salix hookeriana	0.03	3.05	17.24
Populus trichocarpa	0.03	2.67	15.11
Salix sitchensis	0.03	1.17	6.63
Acer macrophyllum	0.03	0.09	0.53
Picea sitchensis	0.03	0.09	0.53
Salix lasiandra var. *lasiandra*	0.03	0.09	0.53
Thuja plicata	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.72	24.66	25.63
Trifolium repens	0.53	23.78	31.08
Trifolium pratense	0.34	8.64	18.21
Trifolium hybridum	0.28	4.17	8.46
Trifolium fragiferum	0.25	3.63	8.27
Polygonum aviculare ssp. *depressum*	0.13	1.13	3.71
Trifolium dubium	0.09	1.41	4.44
Juncus bufonius var. *congestus*	0.03	0.47	2.65
Tree Species			
Salix babylonica	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Lotus corniculatus	0.72	10.69	9.87
Phalaris arundinacea	0.38	10.00	21.45
Agrostis stolonifera	0.13	4.41	16.39
Glyceria declinata	0.13	0.67	2.72
Cirsium vulgare	0.09	0.66	2.72
Helminthotheca echioides	0.09	0.66	2.72
Mentha pulegium	0.03	0.47	2.65
Cirsium arvense	0.03	0.09	0.53
Holcus lanatus	0.03	0.09	0.53

Phase 2B (Middle) - Salt River Corridor Restoration Area: Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.28	1.59	3.73

Phase 2B (Middle) - Salt River Corridor Restoration Area:
Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.50	7.45	9.11
Eleocharis macrostachya	0.22	11.38	29.14
Deschampsia cespitosa	0.13	1.50	4.44
Equisetum telmateia ssp. *braunii*	0.09	1.73	7.06
Alisma triviale	0.09	0.66	2.72
Alopecurus geniculatus	0.09	0.28	0.89
Persicaria lapathifolia	0.06	1.64	7.06
Scirpus microcarpus	0.06	0.94	3.69
Paspalum distichum	0.03	1.17	6.63
Linum bienne	0.03	0.47	2.65
Shrub Species			
Lonicera involucrata var. *ledebourii*	0.06	0.19	0.74
Sambucus racemosa	0.06	0.19	0.74
Morella californica	0.03	0.09	0.53
Tree Species			
Populus trichocarpa	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.78	18.19	20.03
Trifolium repens	0.50	15.19	23.07
Trifolium pratense	0.50	15.02	19.51
Trifolium fragiferum	0.28	3.80	8.22
Atriplex prostrata	0.25	6.64	14.40
Trifolium hybridum	0.16	2.34	5.53
Raphanus sativus	0.13	0.67	2.72
Hypochaeris radicata	0.09	0.28	0.89
Cotula coronopifolia	0.03	0.47	2.65
Barbarea verna	0.03	0.09	0.53
Rumex conglomeratus	0.03	0.09	0.53
Rumex crispus	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Lotus corniculatus	0.69	12.05	10.83
Phalaris arundinacea	0.28	5.98	14.23
Agrostis stolonifera	0.13	1.50	4.44
Holcus lanatus	0.13	1.13	3.71
Helminthotheca echioides	0.06	0.11	0.53
Cirsium vulgare	0.03	0.47	2.65
Glyceria declinata	0.03	0.47	2.65
Convolvulus arvensis	0.03	0.09	0.53
Mentha pulegium	0.03	0.09	0.53
Polypogon monspeliensis	0.03	0.09	0.53
Ranunculus repens	0.03	0.09	0.53

Phase 2B (Middle) - Salt River Corridor Restoration Area:
Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.28	2.72	5.46

Appendix C

Summary Table of 2019 Replanted Woody Riparian Vegetation

Basal Area Sampling Measurements

Summary Table of 2019 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 2019. Sampling region area values reflect actual area sampled.

	Measured Basal Area (ft^2)				
	Phase 1 – Riverside Ranch Tidal Marsh Restoration Area	**Phase 2A (Lower) – Salt River Corridor Restoration Area**			
Tree Species	**Replanted Riparian Forest (2.20 acres) (n = 30)**	**Replanted Riparian Forest (1.03 acres) (n = 21)**	**Active Riparian Berm (0.51 acres) (n = 10)**	**Total Phase 2A (Lower) (1.54 acres)**	**Total[§] SRERP (3.74 acres)**
Alnus rubra (red alder)	0.5485	7.5682	6.5162	14.0844	14.6330
Salix hookeriana (coastal willow)	1.1825	2.2355	0.0502	2.2857	3.4682
Salix lasiolepis (arroyo willow)	0	1.8204	0.0313	1.8517	1.8517
Salix lasiandra (Pacific willow)	0.0158	0.7681	0.0401	0.8082	0.8240
Salix sitchensis (Sitka willow)	0	0.0304	0.3012	0.3317	0.3317
Picea sitchensis (Sitka spruce)	0.0869	0.0233	0.0416	0.0650	0.1519
Pinus contorta (shore pine)	0.0333	0	0	0	0.0333
Total	**1.8671**	**12.4460**	**6.9807**	**19.4267**	**21.2938**

[§] All SRERP restoration areas addressed during the 2019 basal area sampling effort

Salt River Ecosystem Restoration Project

Vegetation Percent Cover Sampling Results: 2015-2019

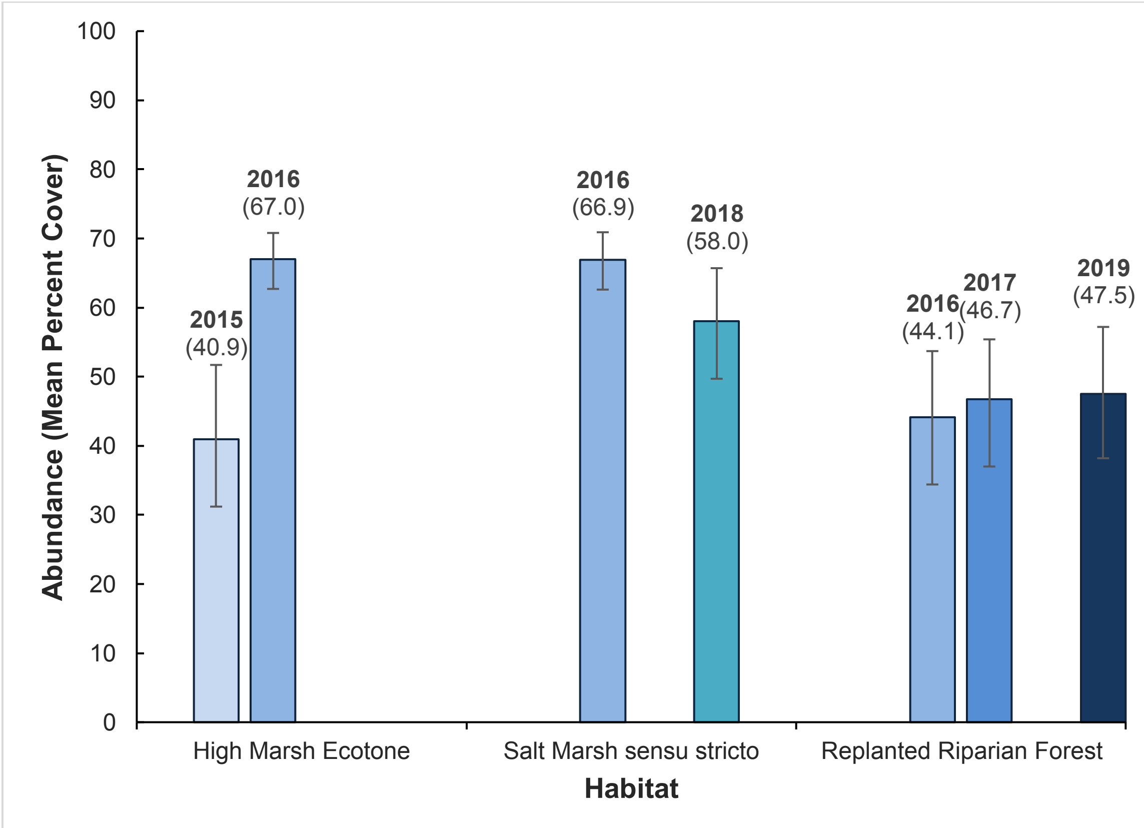

Figure 1. Abundance of **native** vegetation in the Phase 1 Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (H.T. Harvey & Associates 2015; J.B. Lovelace & Associates 2016, 2017, 2018, 2019, this report). Error bars reflect respective 95% confidence intervals.

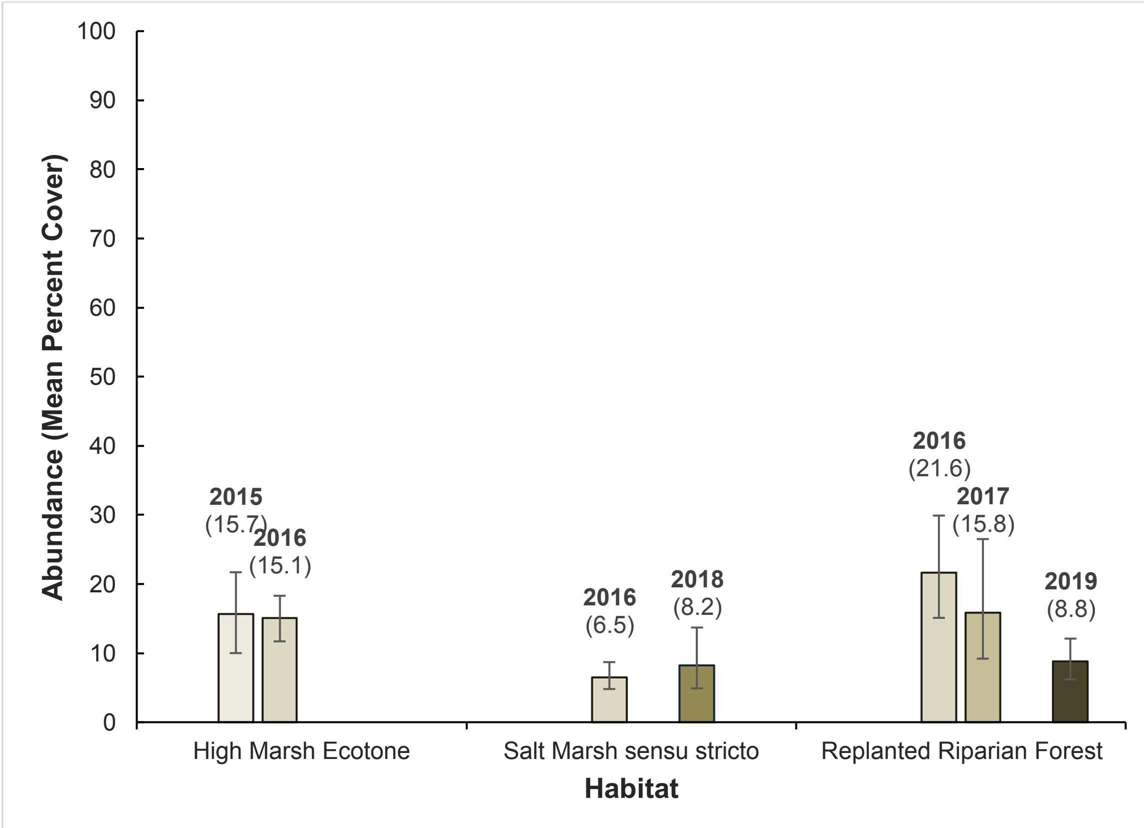

Figure 2. Abundance of **non-native non-invasive** vegetation in the Phase 1 Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (H.T. Harvey & Associates 2015; J.B. Lovelace & Associates 2016, 2017, 2018, 2019, this report). Error bars reflect respective 95% confidence intervals.

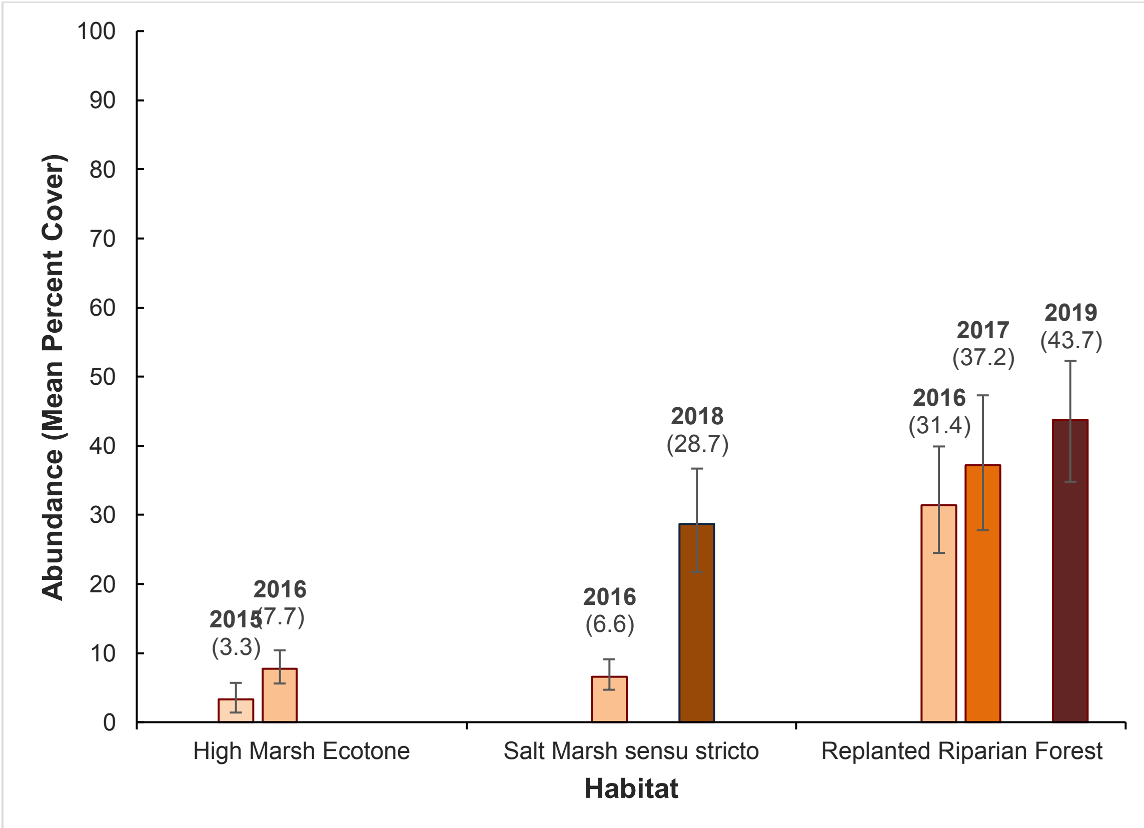

Figure 3. Abundance of **invasive** vegetation in the Phase 1 Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (H.T. Harvey & Associates 2015; J.B. Lovelace & Associates 2016, 2017, 2018, 2019, this report). Error bars reflect respective 95% confidence intervals.

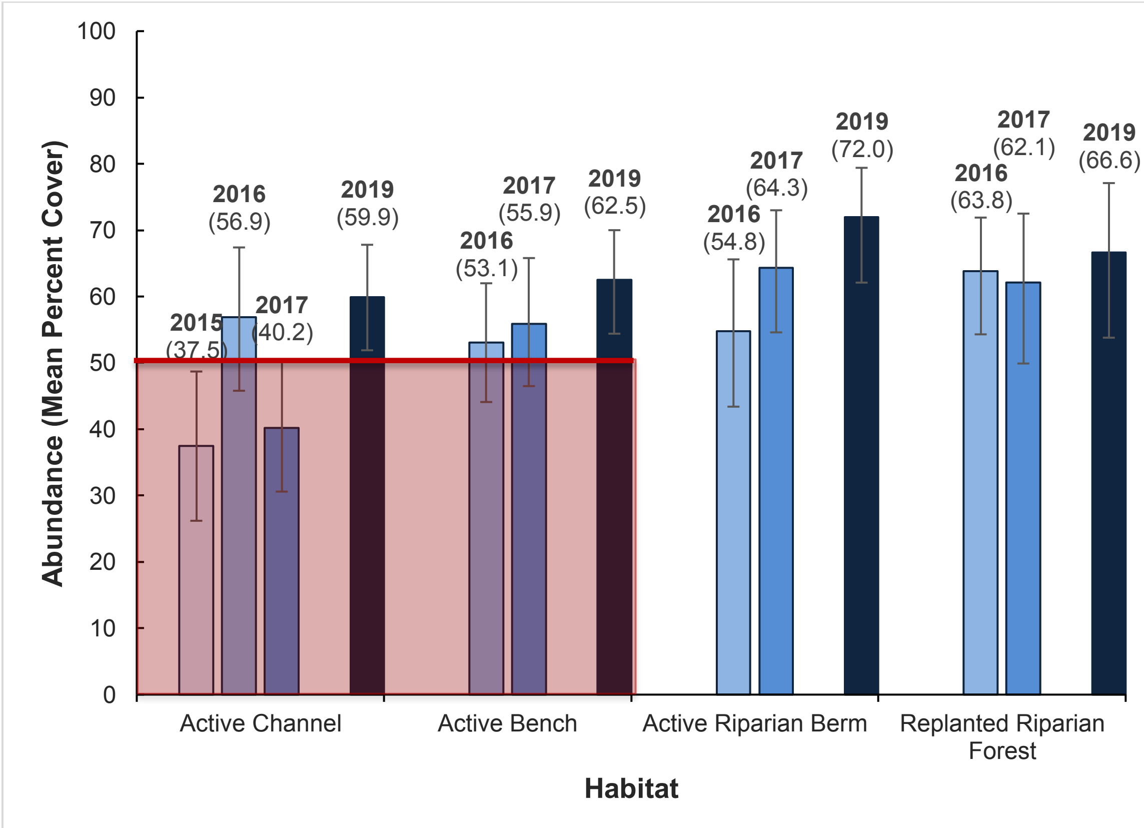

Figure 4. Abundance of **native** vegetation in the Phase 2A (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (H.T. Harvey & Associates 2015; J.B. Lovelace & Associates 2016, 2017, 2018, this report). Error bars reflect respective 95% confidence intervals. The final minimum success threshold (i.e., 50%) applied in 2019 for native species abundance in Salt River channel wetlands is indicated by the horizontal red line. The associated red-shaded area indicates the range of unacceptable percent cover values.

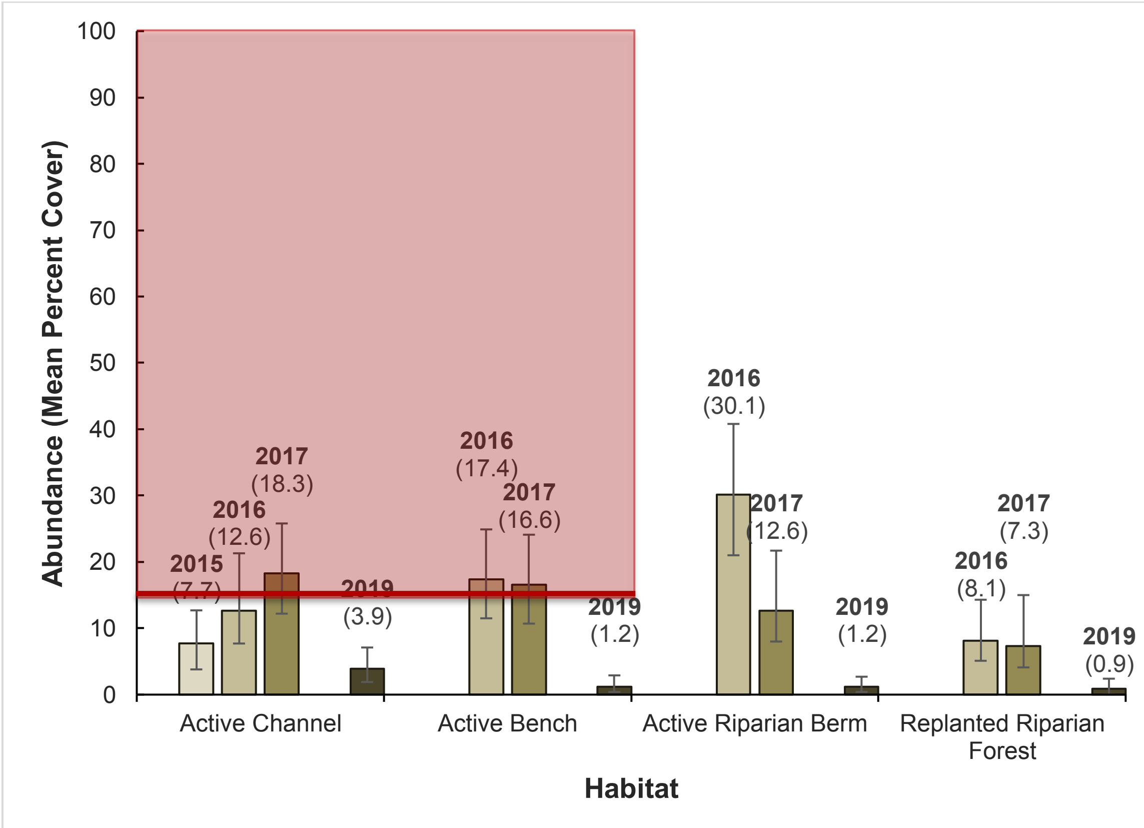

Figure 5. Abundance of **non-native non-invasive** vegetation in the Phase 2A (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (H.T. Harvey & Associates 2015; J.B. Lovelace & Associates 2016, 2017, 2018, this report). Error bars reflect respective 95% confidence intervals. The final maximum success threshold (i.e., 15%) applied in 2019 for non-native non-invasive species abundance in Salt River channel wetlands is indicated by the horizontal red line. The associated red-shaded area indicates the range of unacceptable percent cover values.

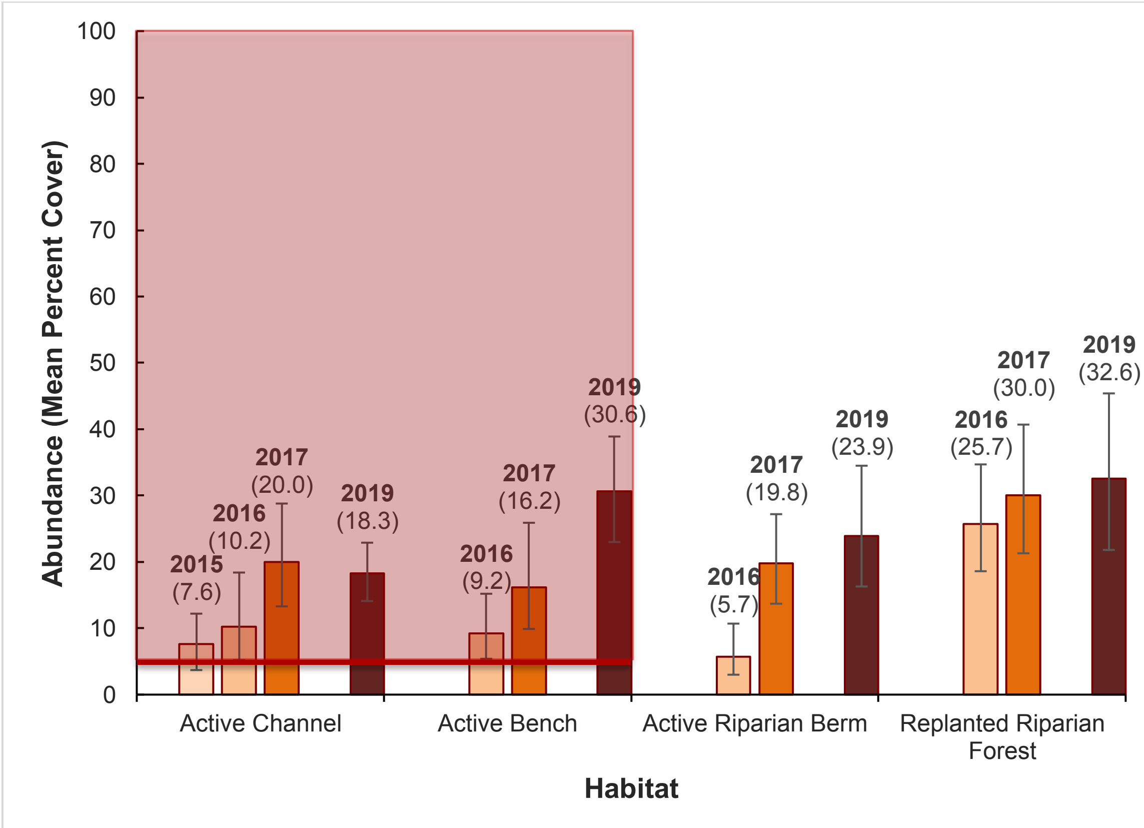

Figure 6. Abundance of **invasive** vegetation in the Phase 2A (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (H.T. Harvey & Associates 2015; J.B. Lovelace & Associates 2016, 2017, 2018, this report). Error bars reflect respective 95% confidence intervals. The final maximum success threshold (i.e., 5%) applied in 2019 for invasive species abundance in Salt River channel wetlands is indicated by the horizontal red line. The associated red-shaded area indicates the range of unacceptable percent cover values.

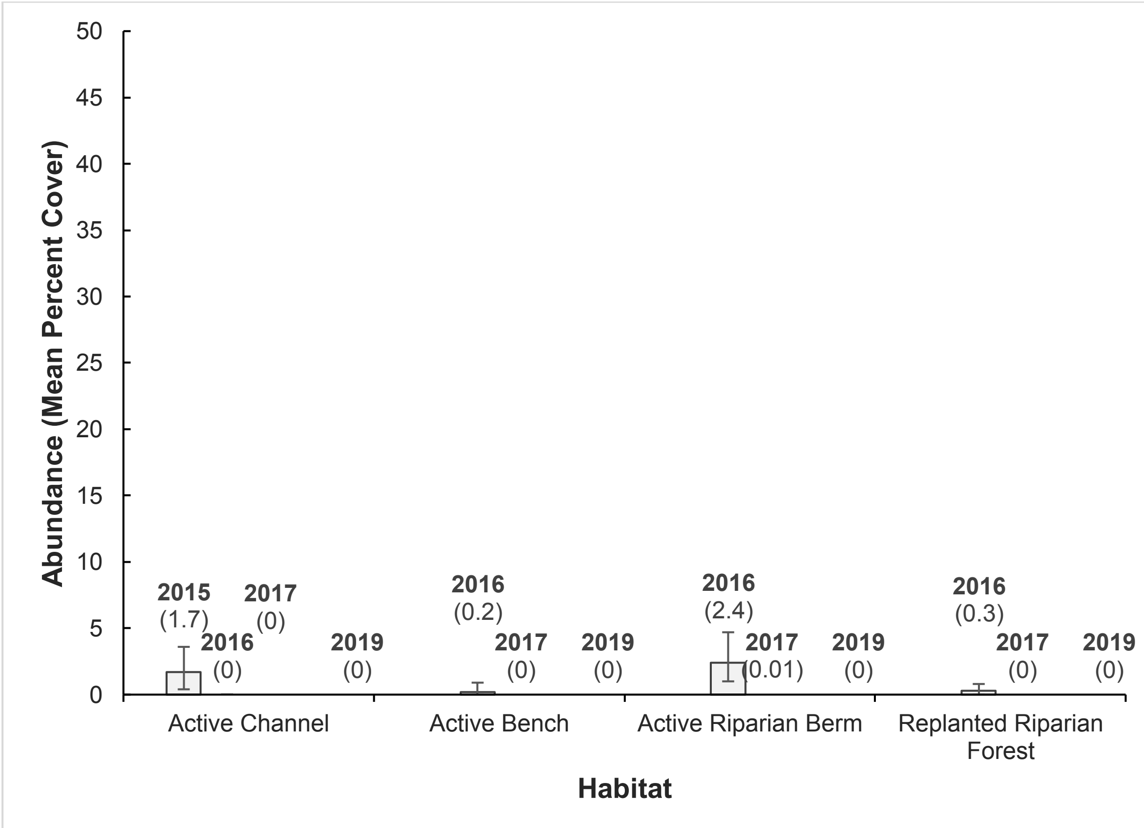

Figure 7. Abundance of **erosion control hybrid** vegetation in the Phase 2A (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (H.T. Harvey & Associates 2015; J.B. Lovelace & Associates 2016, 2017, 2018, this report). Error bars reflect respective 95% confidence intervals.

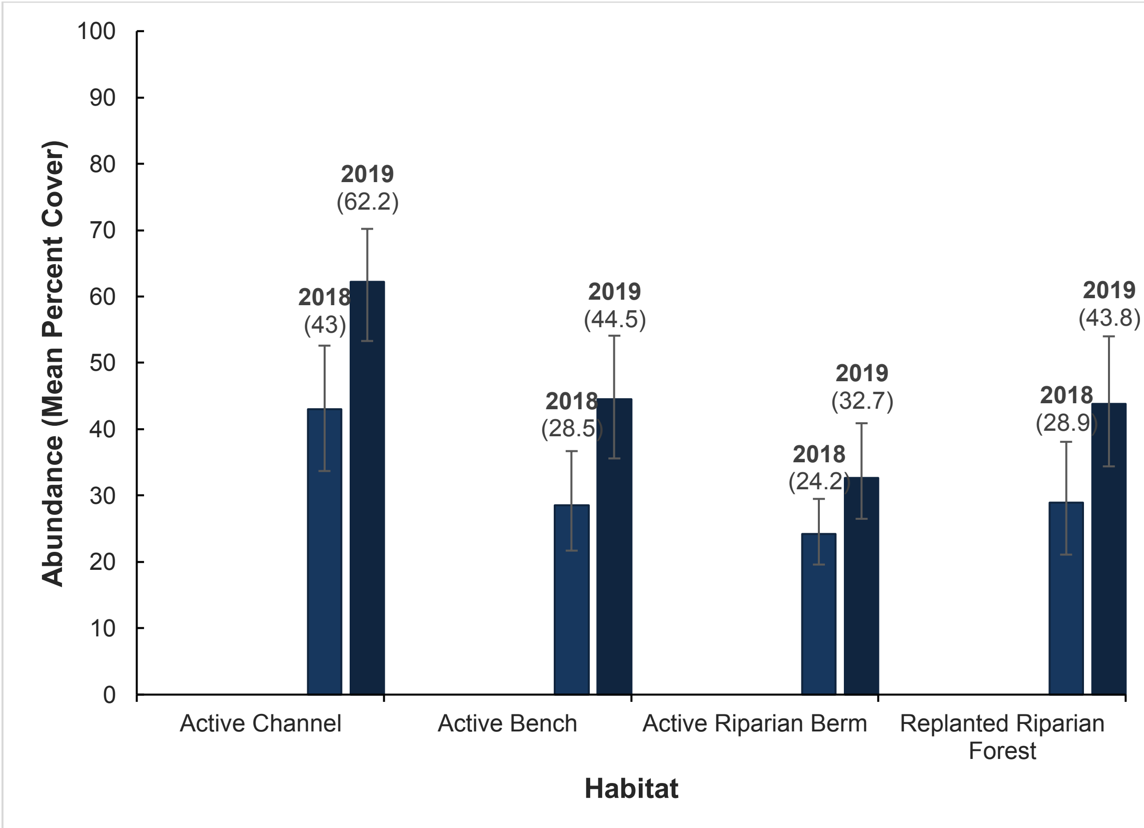

Figure 8. Abundance of **native** vegetation in the Phase 2A (Upper)/2B (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (J.B. Lovelace & Associates 2019, this report). Error bars reflect respective 95% confidence intervals.

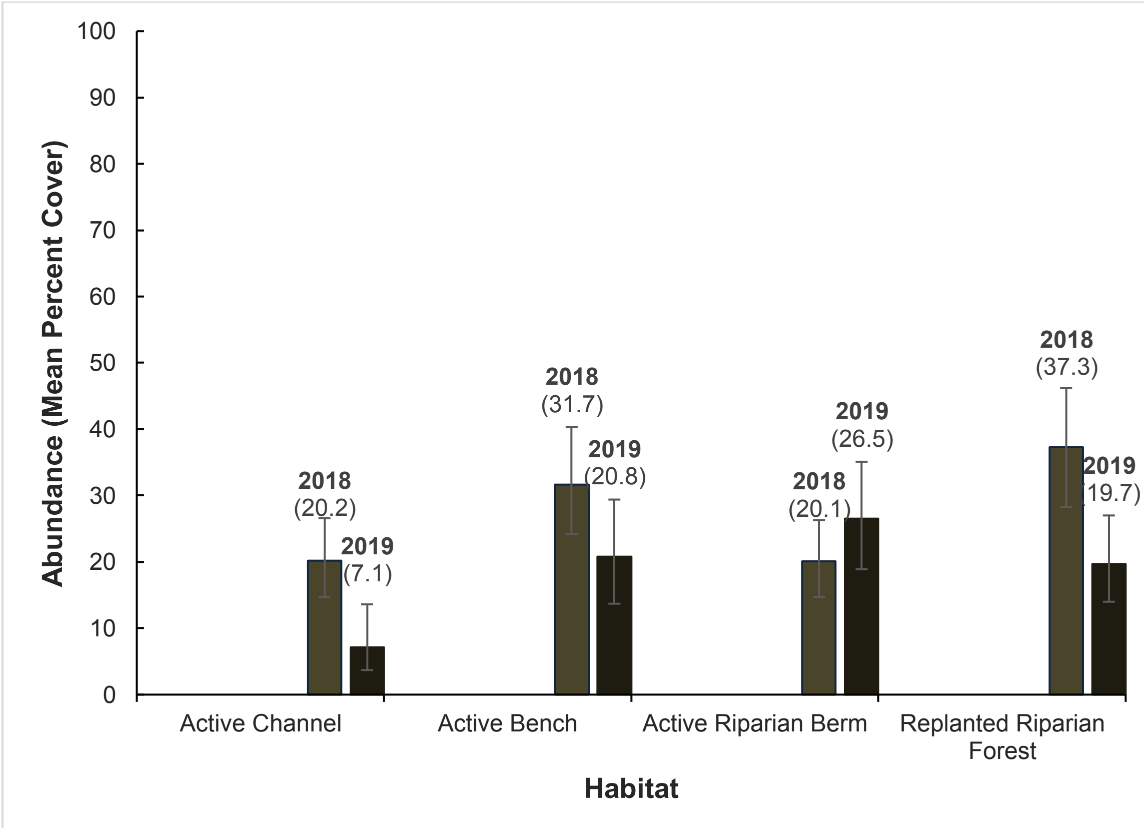

Figure 9. Abundance of **non-native non-invasive** vegetation in the Phase 2A (Upper)/2B (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (J.B. Lovelace & Associates 2019, this report). Error bars reflect respective 95% confidence intervals.

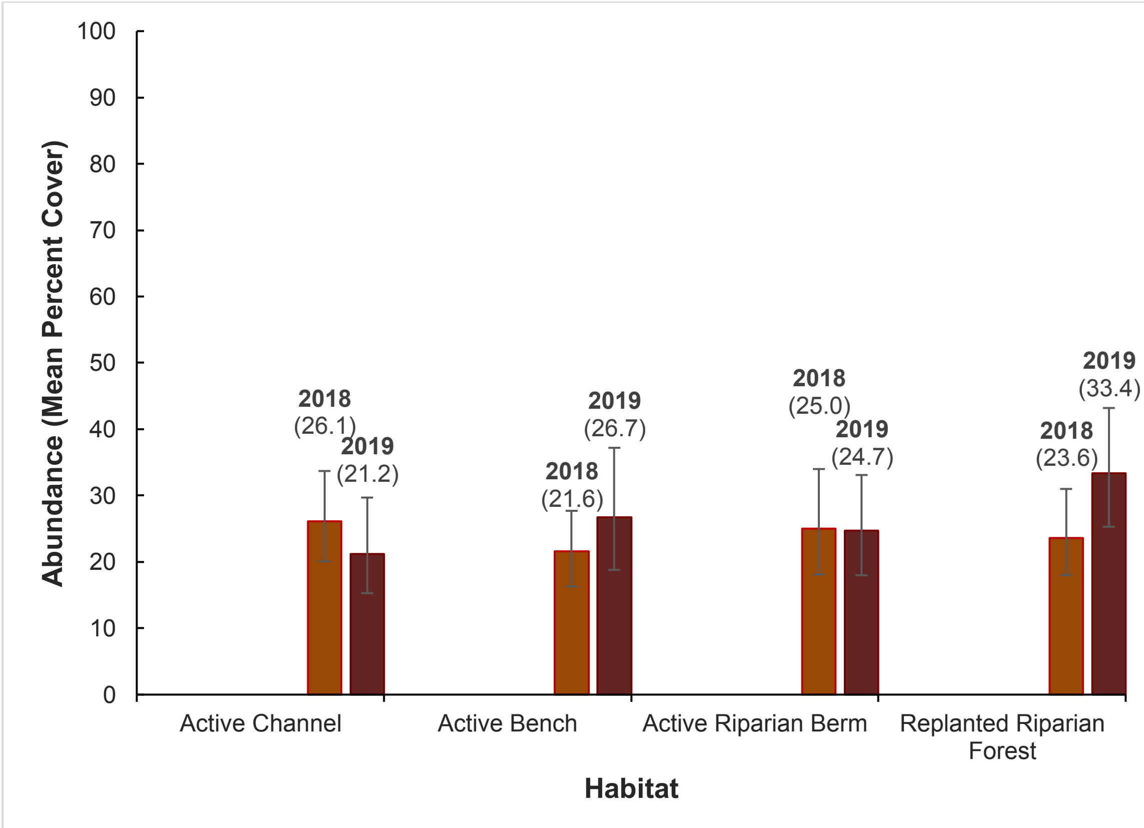

Figure 10. Abundance of **invasive** vegetation in the Phase 2A (Upper)/2B (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (J.B. Lovelace & Associates 2019, this report). Error bars reflect respective 95% confidence intervals.

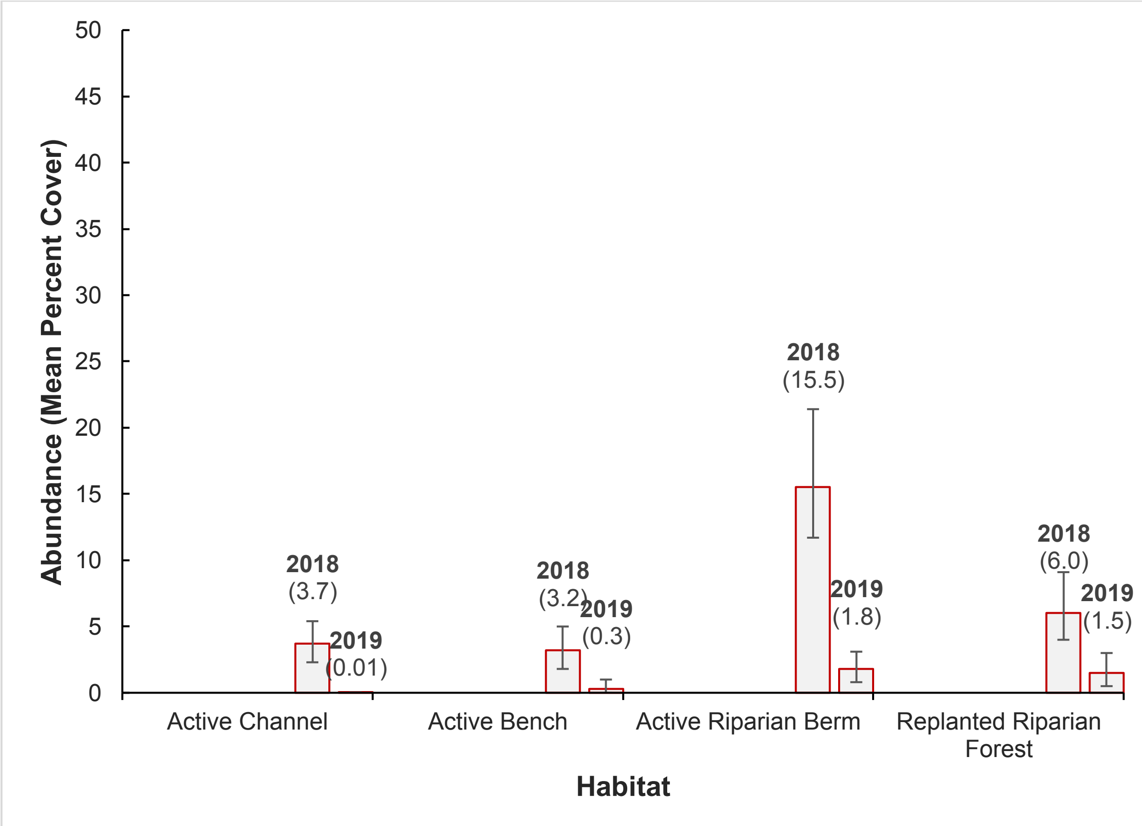

Figure 11. Abundance of **erosion control hybrid** vegetation in the Phase 2A (Upper)/2B (Lower) Restoration Area during monitoring years in which quantitative sampling of respective habitats have occurred (J.B. Lovelace & Associates 2019, this report). Error bars reflect respective 95% confidence intervals.

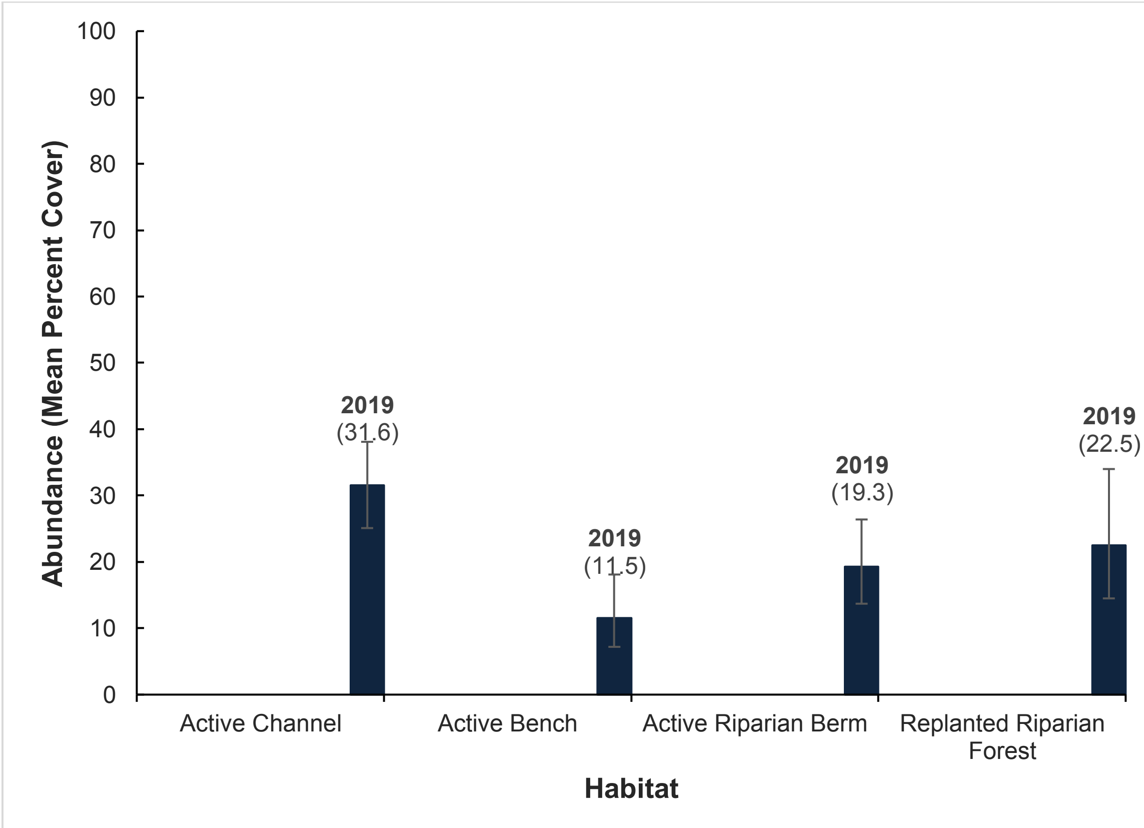

Figure 12. Abundance of **native** vegetation in the 2B (Middle) Restoration Area during the 2019 habitat monitoring effort. Error bars reflect respective 95% confidence intervals.

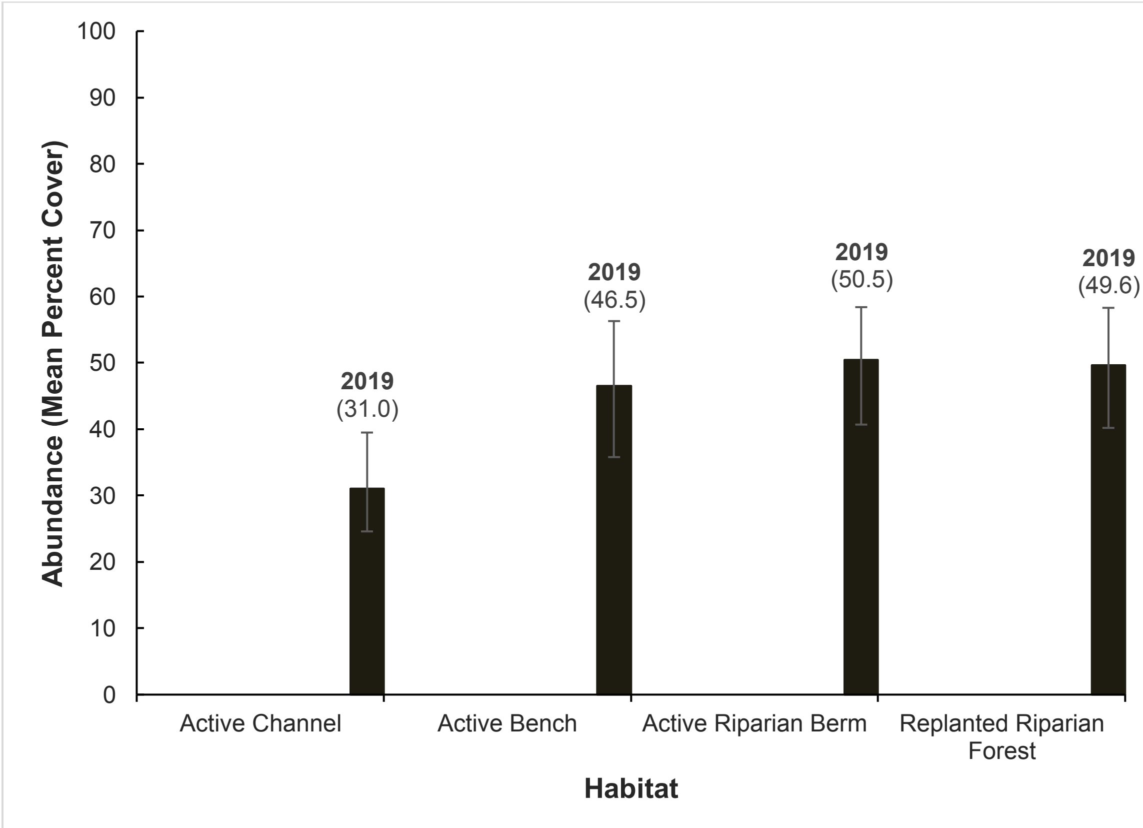

Figure 13. Abundance of **non-native non-invasive** vegetation in the 2B (Middle) Restoration Area during the 2019 habitat monitoring effort. Error bars reflect respective 95% confidence intervals.

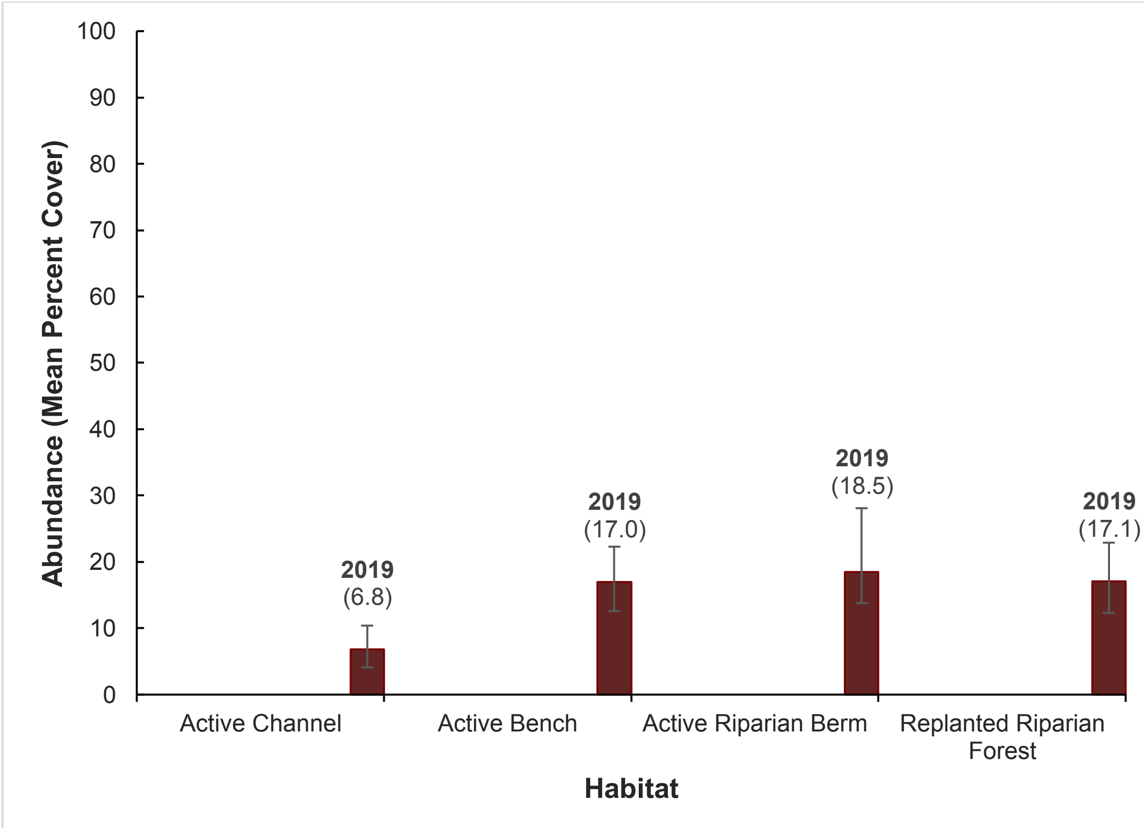

Figure 14. Abundance of **invasive** vegetation in the 2B (Middle) Restoration Area during the 2019 habitat monitoring effort. Error bars reflect respective 95% confidence intervals.

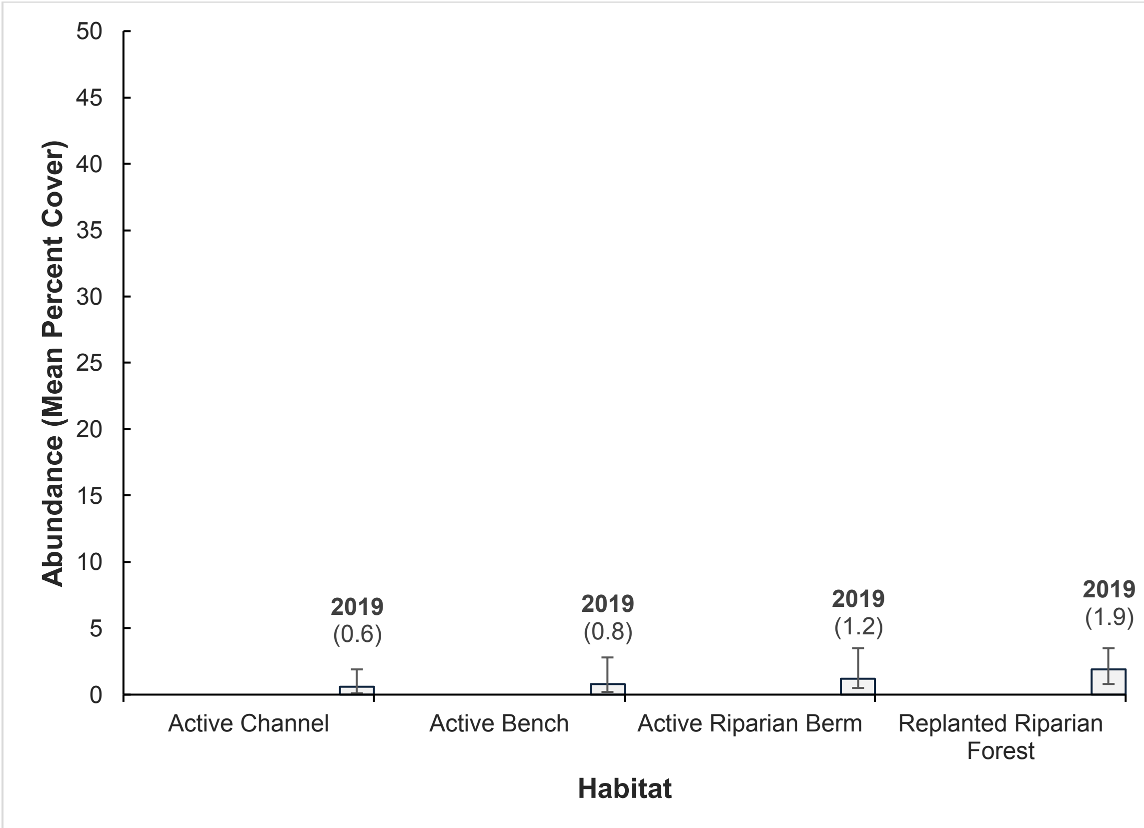

Figure 15. Abundance of **erosion control hybrid** vegetation in the 2B (Middle) Restoration Area during the 2019 habitat monitoring effort. Error bars reflect respective 95% confidence intervals.