Las Vegas Wash Vegetation Monitoring Report, 2019

May 2020

SOUTHERN NEVADA WATER AUTHORITY®

Las Vegas Wash Coordination Committee

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Las Vegas Wash
Vegetation Monitoring Report, 2019

SOUTHERN NEVADA WATER AUTHORITY
Las Vegas Wash Project Coordination Team

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Las Vegas Wash Coordination Committee

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ABSTRACT

Revegetation projects have been conducted along the Las Vegas Wash for over 19 years to meet the goals of the Las Vegas Wash Coordination Committee. In late summer and early fall of 2019, when monitoring for this report took place, nearly 515 acres of revegetation across 137 sites were established. These sites were broken up into 226 monitoring areas. Sites ranging in age from 1 to 19 growing seasons had total cover, noxious species cover, species richness, and Wetland Prevalence Index documented. Three new sites were monitored in 2018. These were all sites at the Tropicana Weir including two volunteer planting sites and the emergent vegetation that lines the banks upstream and downstream of the weir that was completed in 2018. Overall, most revegetation sites either increased in cover or remained the same as in 2018; approximately 8% of the sites decreased in cover. Most older sites have matured to a point that vegetative cover does not change much between growing seasons.

ACKNOWLEDGEMENTS

Many people have helped to make monitoring of the Las Vegas Wash revegetation program a success and even more have contributed to the success of the revegetation and restoration program in general. Specifically, we would like to thank the following people for their assistance in monitoring and management of revegetation sites: Nick Rice, Nathan Harper, Tim Ricks, Julia Mueller, and Debbie Van Dooremolen. Keiba Crear has been a central figure in advocating for rigorous monitoring and proper maintenance, and we thank you. Additional appreciation goes to the many people who reviewed this document and provided valuable comments. Finally, I would like to thank the 28 members of the Las Vegas Wash Coordination Committee and the members of the Research and Environmental Monitoring Study Team for continuing to support this program and the implementation of the Las Vegas Wash Comprehensive Adaptive Management Plan.

Las Vegas Wash Vegetation Monitoring Report, 2019

Table of Contents

Page No.

List of Tables

Page No.

List of Figures

Page No.

Page No.

1.0 INTRODUCTION

1.1 Background

In 1997, the Southern Nevada Water Authority (SNWA) assembled a citizen's advisory committee to evaluate water quality issues in the Las Vegas Wash (Wash), Las Vegas Bay, and Lake Mead. These efforts resulted in the establishment of the Las Vegas Wash Coordination Committee (LVWCC), now a 28-member multi-stakeholder group consisting of federal, state, and local agencies, the university, private businesses, environmental groups, and citizens. In 2000, the LVWCC drafted a long-term management plan, the Las Vegas Wash Comprehensive Adaptive Management Plan (CAMP), to facilitate stabilization and enhancement activities along the Wash (LVWCC 2000; Figure 1). On-the-ground activities have been carried out since then to implement the goals of the CAMP, including constructing erosion control structures (weirs) in the stream channel and armoring the banks with rock. After erosion control facilities are built, wetland, riparian, and upland vegetation is planted to help further protect the Wash from erosion, as well as to improve the functional attributes of the ecosystem.

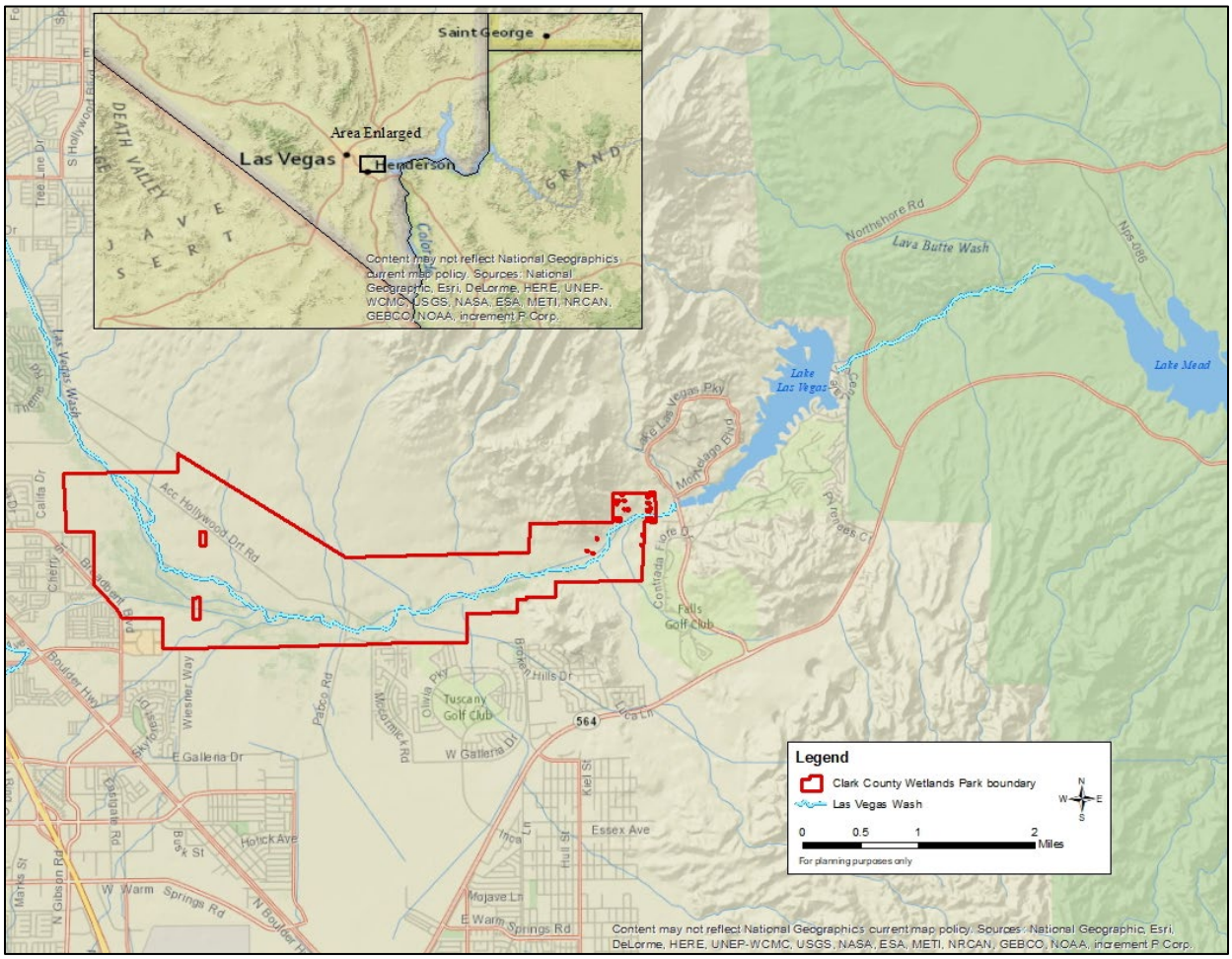

Figure 1. Las Vegas Wash location and general study area map.

The revegetation program is a critical component of the overall plan to stabilize and enhance the Wash. Erosion control is enhanced by plants binding their roots to soil particles on the surface, subsurface and in deep subsurface horizons, thereby acting as soil anchors during scouring events (i.e., floods). In addition, a variety of wildlife species benefit from revegetation efforts (GBBO 2019, Van Dooremolen 2019, Lantow 2020). At the time when the erosion control project began along the Wash, there were very few native plants found along its banks, especially wetland and riparian species (LVWCC 2000). Moreover, as flows increased and began to incise the channel, exotic species such as salt cedar (*Tamarix ramosissima*) successfully established in the area and became the dominant species. As a result, the plants used to restore the Wash to a natural-type condition include a variety of species native to upland, wetland, and riparian areas in the region.

1.2 Purpose and Scope

The primary purpose of this report is to document the status of SNWA's revegetation efforts along the Wash by reporting 2019 data as part of a comprehensive vegetation monitoring program. Vegetation monitoring results from 2002 through 2018 have been previously documented (SNWA 2005, Eckberg and Shanahan 2008, Eckberg 2019a); therefore, they are not described in detail in this report. Since 2003, monitoring activities have been conducted on progressively larger land areas. Approximately 38 acres were monitored in 2003 and approximately 514 acres were monitored in 2019. The majority of these activities have been conducted on revegetation project sites located within the boundaries of the Clark County Wetlands Park (CCWP; Figure 2). An additional revegetation area is located at the Clark County Water Reclamation District (CCWRD), which is located just north of the CCWP (Figure 2).

1.3 Need for Revegetation and Vegetation Monitoring

Revegetation projects along the Wash are conducted for multiple reasons. Clean Water Act (CWA) Section 404 permits issued by the U.S. Army Corps of Engineers (Corps) to SNWA for erosion control projects occurring in jurisdictional waters of the U.S. require revegetation as compensatory mitigation for wetlands impacted. Section 404 of the CWA established a program to regulate the discharge of dredged or fill material into waters of the U.S. This includes wetlands associated with Wash erosion control projects. Section 404 permits required that revegetation projects are monitored for success; consequently, several performance indicators are monitored so performance criteria can be achieved. The primary criterion is that mitigation areas provide the functional attributes of a natural wetland system.

The Nevada Division of Environmental Protection (NDEP), which derives duties through state and federal implementing regulations (i.e., Chapter 445A of the Nevada Revised Statutes and Section 402 of the CWA), also requires revegetation to occur for Wash erosion control projects. NDEP issues general stormwater permits for Wash construction activities and permits require that final site stabilization is achieved. Vegetation cover serves as a form of final stabilization, defined by NDEP as "…perennial vegetative cover with a density of 70% of the native background vegetative cover…establishing at least 70% of the natural cover of the native vegetation…e.g., if the native vegetation covers 50% of the ground, 70% of 50% would require 35% total cover."

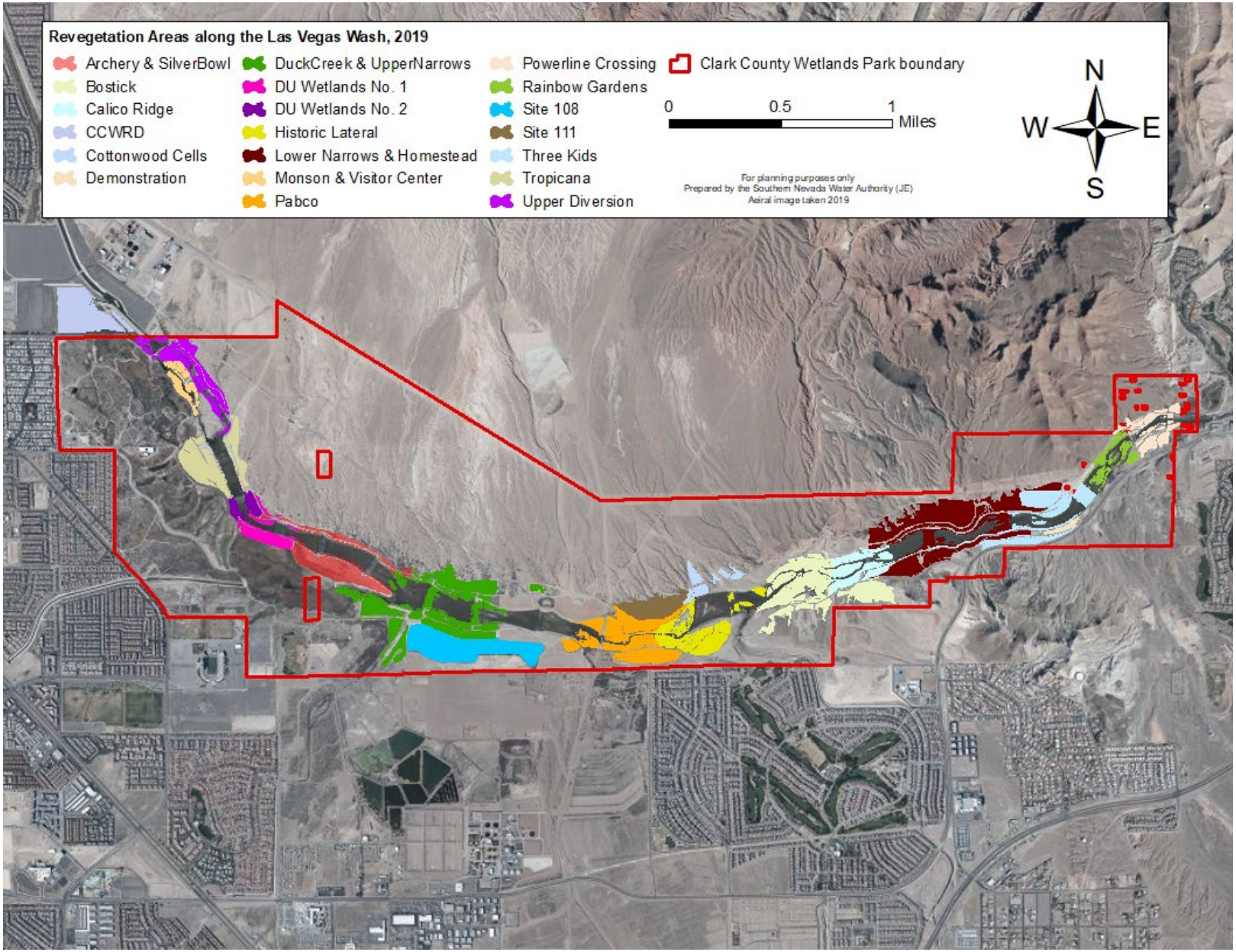

Figure 2. Location of the 2019 Las Vegas Wash revegetation sites.

In addition to permit-required revegetation, SNWA has received multiple federal, state, and local grants to help fund the erosion control program as well as ecological enhancement along the Wash. Granting agencies, such as the Bureau of Reclamation (BOR), require that revegetation projects are successful; therefore, specific criteria are measured during monitoring to ensure compliance with these requirements. For program consistency, all revegetation sites are monitored annually and with the same general methodology.

Finally, members of the LVWCC are interested to know the status and progression of projects along the Wash including the revegetation program. Many stakeholder meetings were held to establish goals of the Wash program and providing regular updates is a vital component of ensuring the members of the committee are informed on these activities. In addition, funding members of the committee need to know how their funds are spent and that their efforts are successful.

1.4 Program Funding

Major sources of funding for revegetation projects along the Wash are the Las Vegas Wash Capital Improvements Plan (Wash CIP), state and federal grants, Clark County (primarily for specific projects related to the CCWP), and the LVWCC operating budget. Wash CIP funds revegetation activities stipulated in federal or state permits obtained by SNWA as part of weir construction. Grant funds have been used to supplement the majority of revegetation projects implemented along the Wash, typically areas adjacent to but not directly influenced by weir construction. Grants have been obtained from a variety of sources for revegetation including the Clark County Multiple Species Habitat Conservation Plan, NDEP, Nevada Division of State Parks (NDSP), and three rounds of the Southern Nevada Public Land Management Act (SNPLMA IV, SNPLMA V, and SNPLMA VI). Once revegetation sites are initially established, funding for ensuring the success of these sites has been grants provided by the BOR and the LVWCC operating budget.

1.5 Typical Revegetation Establishment Activities

1.5.1 Planning

The majority of revegetation sites along the Wash are in association with the construction of erosion control structures. This results in most site revegetation efforts being planned in conjunction with those construction activities. Once designs are complete on the structures including temporary and permanent footprints, design of revegetation areas begins. This includes plant selection and irrigation design. Once substantial completion has been reached on the structures, on-site soil testing may alter final plant selection and layout. Included in the design of these structures are species and procedures for hydroseeding. Hydroseeding doubles as the final step in the construction process and the initial step in most revegetation projects.

1.5.2 Plant Procurement

After plant selection has been completed, procurement activities must take place in order to have material in time for planting at the sizes needed to have a successful restoration site. Plants are either ordered from government or commercial nurseries or grown by the Las Vegas Wash Project Coordination Team (Wash Team). Plants grown by the Wash Team involve collecting seed or

cuttings, establishing the seedlings, transplanting into larger containers, irrigating, and delivery back to the Wash for final planting. With revegetation activities taking place along the Wash since 2000, there are now sufficient native species established to procure seeds and cuttings without looking to surrogate areas. Plant propagation for the Wash Team takes place at the SNWA owned and operated Warm Springs Natural Area propagation facility in Moapa, NV.

1.5.3 Invasive and Other Undesirable Species Removal

The majority of the sites described in this report were previously covered in part or entirely by salt cedar, an invasive species that is prolific and spreads easily and can encroach on revegetation sites if removal does not take place. Some of the other invasive species that are found on sites and require constant monitoring are tall whitetop (*Lepidium latifolium*), silverleaf nightshade (*Solanum elaegnifolium*), giant reed (*Arundo donax*), Malta starthistle (*Centaurea melitensis*) and Johnsongrass (*Sorghum halepense*). Without removal, the native species would not be able to grow, germinate, and become self-sustaining. Considerable effort, therefore, is given to continually surveying sites for encroachment, identifying the invasive species, and planning for their removal as soon as possible.

In addition to invasive species, there are other undesirable species that are closely monitored for their presence. Common reed (*Phragmites australis*) and quailbush (*Atriplex lentiformis*) can grow so vigorously that they outcompete native species that are trying to establish. The Wash has native and non-native common reed as well as hybrids of the two (Saltonstall et al. 2016). The goal with these is not to completely remove them, since this is likely unattainable, but to selectively thin them so that other vegetation can have time to establish and create a species-rich environment.

1.5.4 Irrigation

Non-wetland revegetation sites along the Wash require irrigation for the first 1-3 growing seasons in order to become established. Sites are irrigated with infrastructure components that are easily moved to new sites as they are planted. Irrigation water is pumped out of the Wash using gasoline or bio-diesel powered pumps to a single mainline and then to multiple lateral lines that are fitted with sprinkler heads and/or drip irrigation tubing.

The sizes of the sites that are irrigated have ranged from under 10 acres to almost 60 acres. Maintenance on irrigation system components is critical to ensure that plant material is given the proper amount of water. This is particularly true in Southern Nevada where the average rainfall is less than five inches of rainfall annually. Irrigation maintenance includes fixing leaks, tightening connections, and fixing or replacing broken pipes or heads.

1.5.5 Trash Removal

Furniture, landscape waste, and many other types of trash have been found on revegetation sites. On newly created sites, successful establishment can be hindered by trash and other debris collecting on the site. The revegetation program is reducing the amount of illegal dumping that is observed by making the Wash a more scenic location, involving the public in its revegetation

activities, and continually removing trash. Without large amounts of visible trash, people are not encouraged to dump there; however, some trash does get into the Wash from wind or water runoff.

1.5.6 Herbivore Control

On revegetation sites, fences are installed to reduce the damage caused by rabbits and beavers to newly planted material. Some sites have had a single fence placed around the entire site while others have had smaller fences around the plants themselves. Both must be continually inspected for damage, have repairs made, and have adjustments made to the spacing of the fences to reduce plant damage.

2.0 MATERIALS AND METHODS

Monitoring was conducted between August and October 2019, and the methods followed the same guidelines as previous years (Eckberg and Shanahan 2009). As of August 2019, there were 68 wetland and 65 non-wetland revegetation sites. Many of the non-wetland sites were broken up into multiple monitoring areas (Table 1).

ArcGIS was used to monitor 64 of the 133 total revegetation sites in 2019 for total cover; these sites did not have data collected regarding species richness, individual species cover, or Wetland Prevalence Index (WPI). Sites are only monitored using ArcGIS if they meet specific criteria as laid out in the 2008 Las Vegas Wash Vegetation Monitoring Report (Eckberg and Shanahan 2009).

3.0 RESULTS AND DISCUSSION

The following subsections describe monitoring results for each site and for groupings of sites. From 2018 to 2019, the number of areas monitored decreased by 7 and the acreage increased by just over 18 acres (Table 1). The total areas and acreage include sites monitored in the field as well as with ArcGIS.

Cumulatively, there have been 91.38 acres of wetlands created above those required by mitigation permits (Table 2), including 3.17 acres associated with the Cottonwood Cells, which were fully funded by grants from the BOR, and the 5.99 acres created at CCWRD, which had its permit held by the property owners. Federally funded projects are not eligible for use as mitigation of wetlands impacted in accordance with permits issued by the Corps.

3.1 Archery and Silver Bowl Weirs

The Archery and Silver Bowl weirs were simultaneously completed in 2015 and their project boundaries are adjacent to each other (Figure 3). The revegetation for these weirs was also done simultaneously. In 2019, the seven actively revegetated sites were in their third growing season (Table 3). Final weir modification projects removed the vegetation off these two weirs, as well as others. Therefore, there was no vegetation and the two passive wetland sites, AW and SBW, were not monitored. Their information is retained in tables within this annual report because there will likely be some regrowth in future years.

	Acreage		No. of Monitoring Areas	
Major Site	**2018**	**2019**	**2018**	**2019**
Archery and Silver Bowl Weirs	33.3	31.5	9	7
Bostick Weir	48.4	48.2	15	14
Calico Ridge Weir	17.0	17.6	9	9
CCWRD	27.4	27.4	1	1
Cottonwood Cells	8.1	8.2	9	9
Demonstration Weir	2.2	2.2	2	2
Duck Creek Confluence and Upper Narrows Weirs	62.3	62.5	13	13
DU Wetlands No. 1 Weir	12.2	11.4	5	4
DU Wetlands No. 2 Weir	7.5	6.3	5	5
Historic Lateral Weir	26.7	26.4	11	11
Lower Narrows and Homestead Weirs	67.4	68.2	9	9
Monson and Visitor Center Weirs	8.2	8.2	4	4
Pabco Road Weir	39.6	40.7	19	16
Powerline Crossing Weir	13.6	14.2	17	17
Rainbow Gardens Weir	9.9	10.3	8	8
Site 108	38.0	38.6	63	59
Site 111	14.9	14.9	1	1
Three Kids Weir	28.7	30.7	8	8
Tropicana Weir	7.3	25.2	1	5
Upper Diversion Weir	23.3	21.9	24	24
TOTAL	496.0	514.6	233	226

Table 1. Change in cumulative acreage monitored and number of monitoring areas from 2018 to 2019.

A small number of screwbean mesquite (*Prosopis pubescens*) were planted at Archery Silver Bowl 1 (ASBS1) in 2018 and required supplemental irrigation that continued through 2019. These trees were all planted in a single location on the northern end of the site. The remainder of this site and all other sites have not received any irrigation for two growing seasons. Screwbean mesquite had 1-5% cover in 2019, equal to quailbush and bassia (*Bassia hyssopifolia*). The dominant species remained desert saltbush (*Atriplex polycarpa*) which had 75-100% cover.

With the exception of the two passive wetland sites that formed on the weirs, all other sites either increased in total cover or remained the same as in 2018. All but one site, Archery Silver Bowl North Upper Bank (ASBNUB), had the maximum cover range of 75-100%. ASBS1 and Archery Silver Bowl South 2 (ASBS2) both increased from 50-75% to 75-100%. Both sites had the maximum cover value in 2017 but decreased in 2018. This was likely due to the termination of irrigation on the sites which led to a reduction in size of desert saltbush, the dominant plant on both sites (Figure 4). The recovery and growth of the species highlights that this species was an

appropriate species for the site and that the site will be sustainable in the future without supplemental irrigation.

Mitigation Project	Mitigation Permit Number	Mitigation Required (acres)	Wetland Area Created (acres)
Archery and Silver Bowl Weirs	SPK-2011-00796-SG	0[c]	4.68
Bostick Weir	200125114	7.88	19.65
Calico Ridge Weir	200450004	3.80	9.42
Clark County Water Reclamation District	SPK-2009-00227-SG	6.79	5.99[a]
Cottonwood Cells	N/A	—	3.17[b]
Demonstration Weir	199825148	0.90	0.48
Duck Creek Confluence and Upper Narrows Weirs	SPK-2009-00042	1.33	14.89
DU Wetlands No. 1 Weir	SPK-2010-00285-SG	1.22	2.31
DU Wetlands No. 2 Weir	2007-1961-SG	0.05	1.75
Historic Lateral Weir	199825148	4.90	7.00
Lower Narrows and Homestead Weirs	SPK-2008-01417-SG	6.25	11.27
Monson and Visitor Center Weirs	200250111	4.81	1.6
Pabco Road Weir	199725375	2.20	13.28
Powerline Crossing Weir	200450454	4.87	3.46
Rainbow Gardens Weir	200250054	1.00	6.76
Three Kids Weir	SPK-2012-01138-SG	0[c]	14.35
Tropicana Weir		0[c]	18.3
Upper Diversion Weir	200550514	0.01	6.09
Bank Protection Projects	—	7.06	—
TOTAL		53.07	144.45

[a] Permit held by Clark County Water Reclamation District and not eligible for Wash wetland mitigation
[b] Federally funded revegetation not eligible for wetland mitigation
[c] Permits authorized under nationwide Permit Number #27 after 2012 have no mitigation requirement

Table 2. Mitigation requirements and wetland areas established as of October 2019.

The two wetland sites that were actively planted, Archery Silver Bowl North Bank (ASBNB) and Archery Silver Bowl South Bank (ASBSB), have both had the maximum cover value of 75-100% for the past three growing seasons. In 2019, both sites also had their highest species richness with ASBNB having 28 species and ASBSB had 22. The dominant species on ASBNB was southern cattail (*Typha domingensis*) which is a native species but established on its own on this site. ASBSB's dominant species was California bulrush (*Schoenoplectus californicus*) which was established on the site using harvested plugs from other Wash locations.

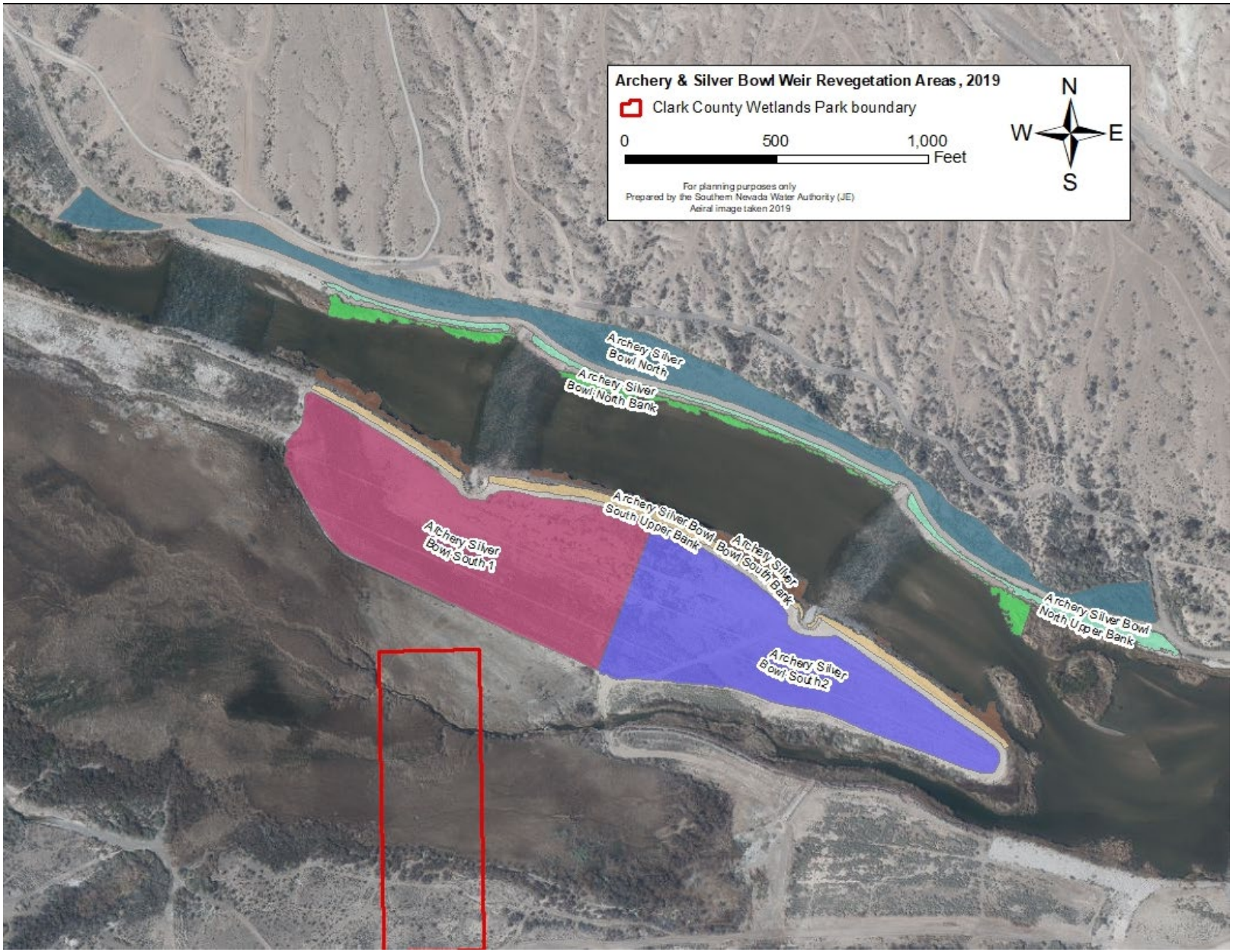

Figure 3. Aerial photograph of 2019 delineated Archery and Silver Bowl Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
ASBN	4	6.33	non-wet	75-100%	0.5%	20	3.65
ASBNB	4	1.18	wet	75-100%	1.1%	28	1.46
ASBNUB	4	1.38	non-wet	50-75%	0.1%	10	3.69
ASBS1	4	11.40	non-wet	75-100%	0.5%	6	3.94
ASBS2	4	8.60	non-wet	75-100%	0.1%	6	3.99
ASBSB	4	1.16	wet	75-100%	15.1%	22	1.64
ASBSUB	4	1.45	non-wet	75-100%	0.0%	4	3.91
AW	3	0.00	wet	0%	nm	nm	nm
SBW	3	0.00	wet	0%	nm	nm	nm

[1]ASBN= Archery Silver Bowl North, ASBNB= Archery Silver Bowl North Bank, ASBNUB= Archery Silver Bowl North Upper Bank, ASBS-1= Archery Silver Bowl South 1, ASBS-2= Archery Silver Bowl South 2, ASBSB= Archery Silver Bowl South Bank, ASBSUB= Archery Silver Bowl South Upper Bank, AW=Archery Weir, SBW=Silver Bowl Weir

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 3. Vegetation monitoring results for Archery and Silver Bowl Weirs revegetation sites in 2019.

Figure 4. Both non-wetland revegetation sites on the south side of Archery and Silver Bowl Weirs were dominated by desert saltbush in 2019.

3.2 Bostick Weir

The number of revegetation sites at the Bostick Weir remained the same as the previous monitoring season at 14 (Table 4; Figure 5). Most sites here are in their 15th or 16th growing season in 2019 and therefore have mature vegetation with not many attributes changing from year to year. Of the nine sites that were field monitored in 2019, only one was less than 15 growing seasons old; Bostick South Tamarisk (BST). BST was 4 growing seasons old during 2019 monitoring and is the largest revegetation site in the Bostick area. The total vegetative cover for this site reached the maximum 75-100% range for the first time in 2019. Individual plant cover ranges didn't have many changes between 2018 and 2019 and species richness decreased by eight. The increase total cover can be explained in a couple ways. First, this site is very large and more difficult than many to accurately estimate the total cover in the field. Second, the dominant species, creosote bush (*Larrea tridentata*), had the same cover both years; 25-50%. It could have been at the lower end of the range in 2018 and the higher end of the range in 2019.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
B	16	8.03	wet	75-100%	nm	nm	nm
BI	16	4.96	wet	75-100%	nm	nm	nm
BN	16	0.84	non-wet	50-75%	0.0%	6	4.50
BS	15	1.20	non-wet	75-100%	0.1%	17	3.81
BST	4	21.03	non-wet	75-100%	0.5%	26	4.29
DBN	16	0.48	non-wet	25-50%	0.0%	4	4.72
DBS	15	0.22	non-wet	50-75%	0.0%	4	4.63
DBSE	15	0.79	wet	75-100%	nm	nm	nm
UBN	16	0.55	non-wet	75-100%	nm	nm	nm
UBNB	15	2.00	wet	75-100%	nm	nm	nm
UBNE	15	1.79	wet	75-100%	0.5%	7	2.01
UBS	16	2.51	non-wet	75-100%	2.5%	8	3.22
UBS	16	2.08	wet	75-100%	2.5%	9	1.88
UBSB	15	1.71	non-wet	75-100%	0.0%	7	3.59

[1]B=Bostick, BI=Bostick Islands, BN=Bostick North, BS=Bostick South, BST=Bostick South Tamarisk, DBN=Downstream Bostick North, DBS=Downstream Bostick South, DBSE=Downstream Bostick South Emergent, UBN=Upstream Bostick North, UBNB=Upstream Bostick North Bank, UBNE=Upstream Bostick North Emergent, UBS=Upstream Bostick South, UBSB=Upstream Bostick South Bank

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 4. Vegetation monitoring results for Bostick Weir revegetation sites in 2019.

Upstream Bostick South Bank is one of the older sites at the Bostick Weir, which was in its 15th growing season in 2019. This mature site borders the Clark County Wetlands Park bike trail (Figure 6). This site has had the maximum 75-100% total cover every year since 2010 including

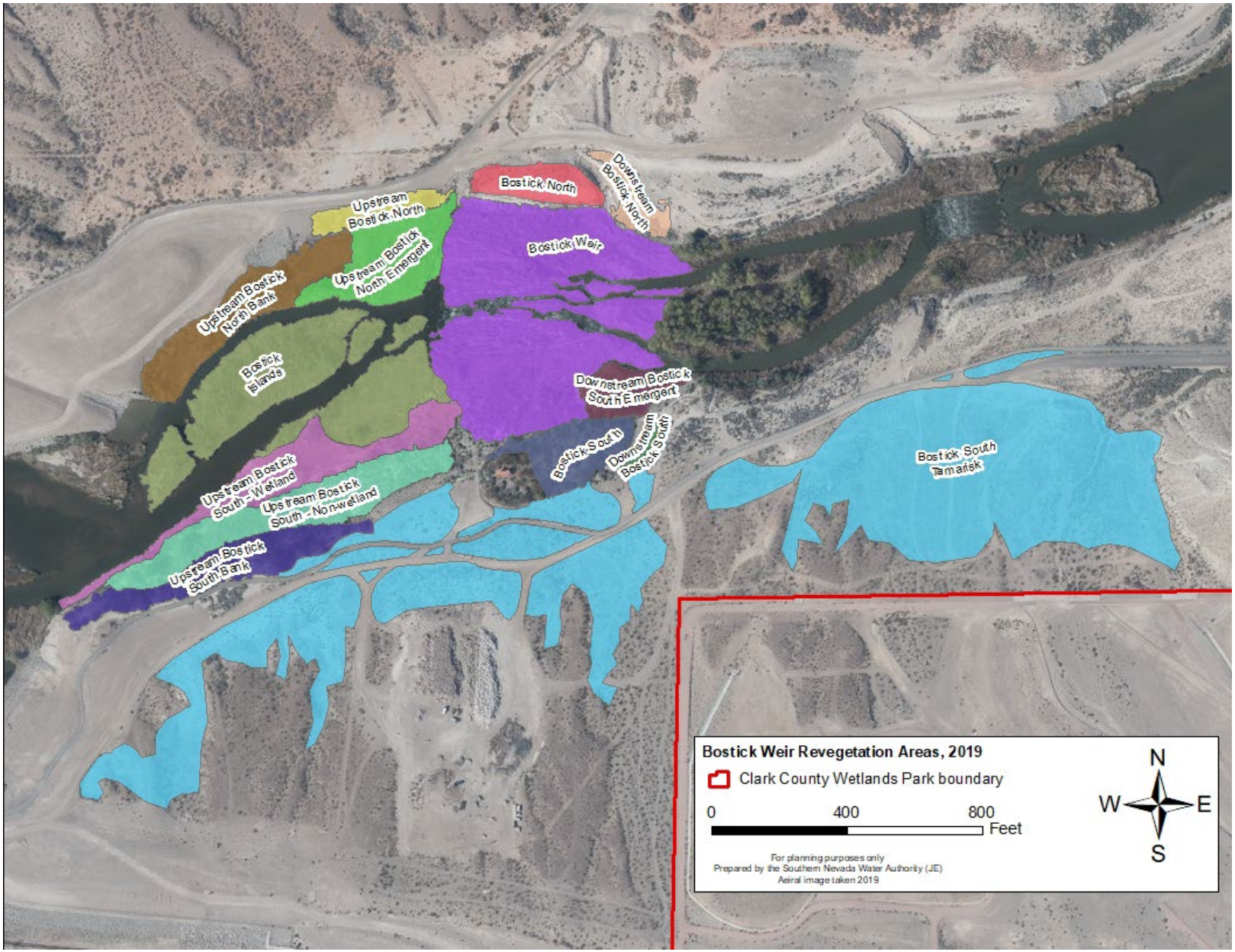

Figure 5. Aerial photograph of 2019 delineated Bostick Weir revegetation sites.

2019. The co-dominant plants on the site in 2019 were honey mesquite (*Prosopis glandulosa*) and screwbean mesquite. One or both of these species have been the dominant species on the site every monitoring year since 2006. There were no noxious species found on the site in 2019.

Figure 6. Vegetation at the Upstream Bostick South Bank is adjacent to the Clark County Wetlands Park bike trail.

3.3 Calico Ridge Weir

Only one of the nine revegetation sites were monitored in the field in 2019 at the Calico Ridge Weir (Figure 7; Table 5). The other eight revegetation sites were monitored for total cover using ArcGIS. Planted in 2005, Downstream Calico North (DCN) was the lone field monitored site. DCN had 25-50% total cover in 2019 which is the same as most of the past monitoring seasons going back to 2009 with the exception of 2017 and 2011 when it had 5-25% cover. The co-dominant plants on the site in 2019 were honey mesquite and fourwing saltbush (*Atriplex canescens* var. *canescens*) where both had 5-25% cover. There were no noxious weeds documented on the site this year. Due to this site's relatively low total cover after 15 growing seasons, this site is a good candidate for additional plantings and/or seeding under long-term operations. Specifically, some drought tolerant trees such cat-claw acacia (*Senegalia greggii*) could be planted which require less water than the currently established mesquites.

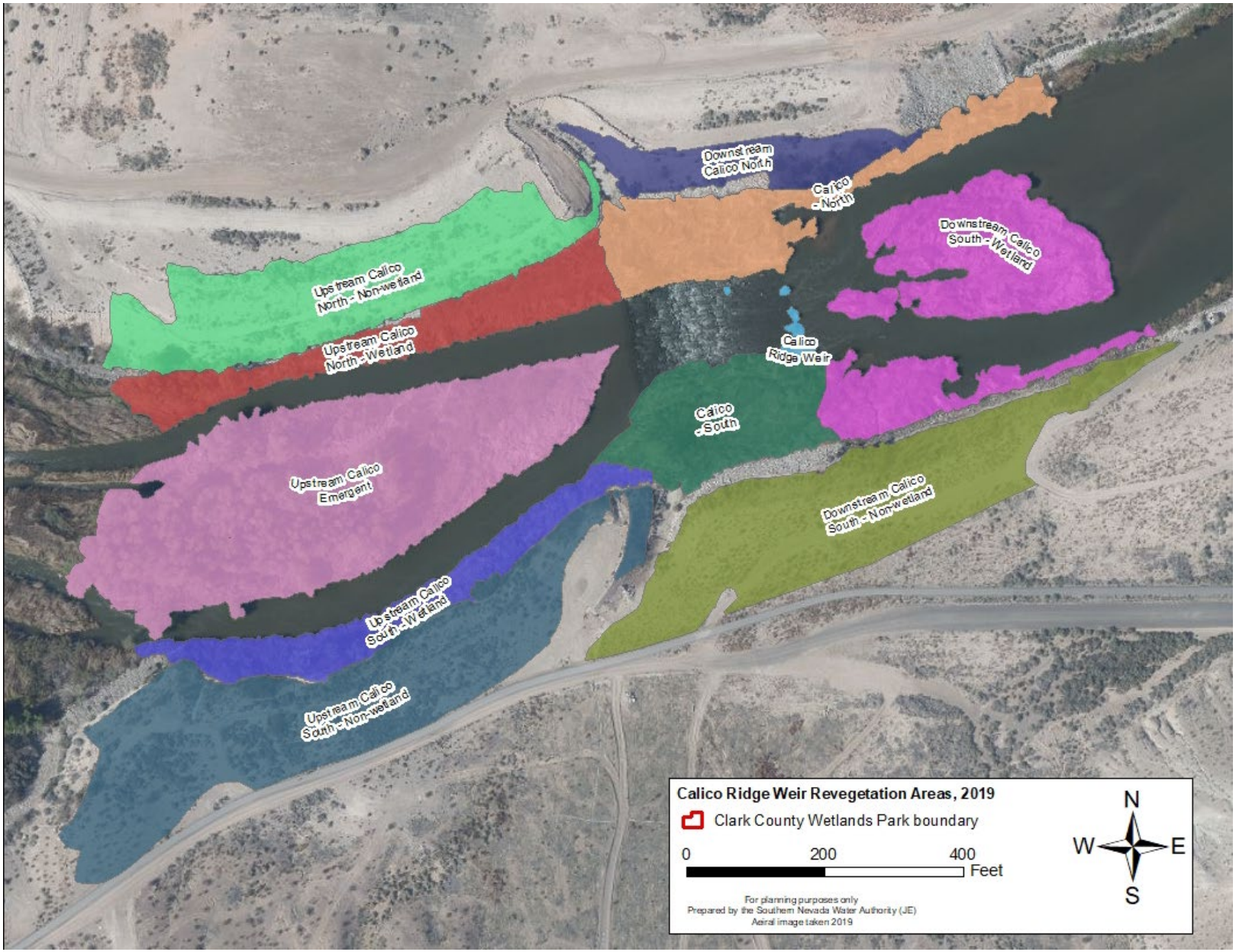

Figure 7. Aerial photograph of 2019 delineated Calico Ridge Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
C	15	2.11	wet	75-100%	nm	nm	nm
DCN	15	1.11	non-wet	25-50%	0.0%	8	4.36
DCS	15	2.27	non-wet	25-50%	nm	nm	nm
DCS	15	1.84	wet	75-100%	nm	nm	nm
UCE	15	3.61	wet	75-100%	nm	nm	nm
UCN	15	1.89	non-wet	25-50%	nm	nm	nm
UCN	15	1.01	wet	75-100%	nm	nm	nm
UCS	15	2.86	non-wet	50-75%	nm	nm	nm
UCS	15	0.85	wet	75-100%	nm	nm	nm

[1]C=Calico, DCN=Downstream Calico North, DCS=Downstream Calico South, UCE=Upstream Calico Emergent, UCN=Upstream Calico North, UCS=Upstream Calico South

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 5. Vegetation monitoring results for Calico Ridge Weir revegetation sites in 2019.

3.4 Clark County Water Reclamation District

The CCWRD revegetation site was not monitored in the field in 2019 after being field monitored in the previous year (Table 6, Figure 8). The total cover of the CCWRD site in 2019 was 75-100%, the same as it has been the previous two monitoring years. Starting in 2018 due to the density of the vegetation of the site, the monitoring protocol was changes to no longer separate the site into multiple monitoring areas. Individual areas within the site are difficult to access and therefore comparisons to previous year's data may not be valid. Although using ArcGIS would allow for continued usage of this method, it is desired to be able to compare this data to future years in which field monitoring of the site will resume.

Site Code	Growing Season	Acreage	Wetland Status[1]	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
CCWRD	10	27.44	both	75-100%	nm	nm	nm

[1]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet"= non-wetland

[2]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 6. Monitoring results for the Clark County Water Reclamation District revegetation site in 2019.

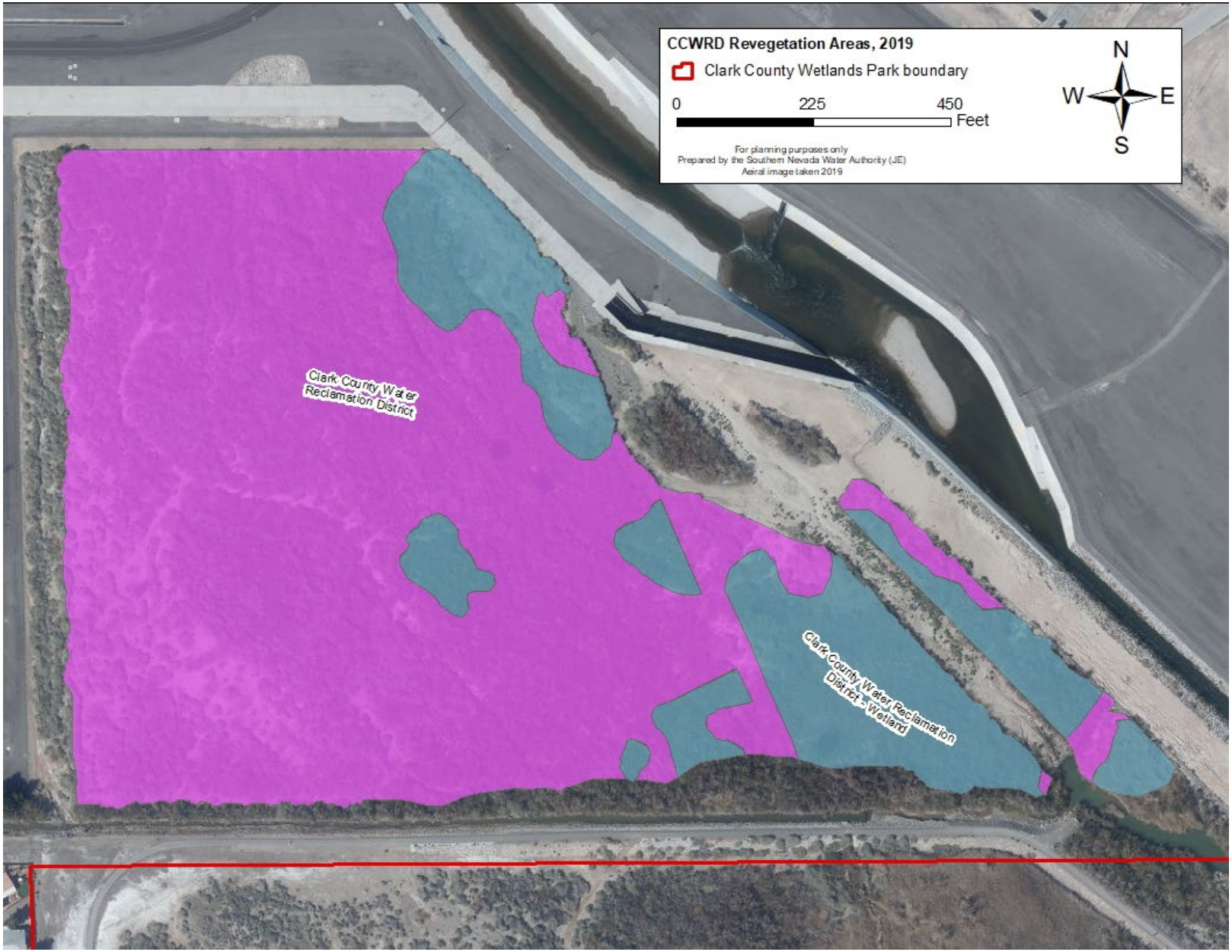

Figure 8. Aerial photograph of 2019 delineated Clark County Water Reclamation District revegetation sites.

3.5 Cottonwood Cells

All seven of the revegetation sites at the Cottonwood Cells were monitored in the field in 2019 after using ArcGIS for the 2018 monitoring year (Table 7, Figure 9). The Historic Lateral Weir expansion was completed in December 2018. This year's monitoring is the first full year of plant growth after a major change to the surrounding environment including earth moving, an increased backwater, as well as disturbance to previously existing vegetation. The expansion project required the removal of portions of four different revegetation sites; Cottonwood Cell North (CCN), Cottonwood Cell North Stockpiles (CCNS), Cottonwood Cell Bank (CCB), and Cottonwood Cell 3 (CC3). It is theorized that these changes will have impacts on the remaining vegetation. For example, the larger backwater behind the weir could allow for increased water infiltration to revegetation sites increasing growth of existing plants. A potential negative impact would come from the land disturbance which allows for weed encroachment into the area. This first year's monitoring is not expected to have complete results of how these changes impacted the Cottonwood Cell sites but will be important first data point for evaluating the changes in the future.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
CC1	18	0.98	wet	75-100%	15.1%	12	2.18
CC2	15	0.53	wet	75-100%	2.5%	6	2.05
CC3	8	1.15	wet	75-100%	2.6%	21	3.26
CC3-2	7	0.40	wet	75-100%	2.5	9	4.12
CCB	7	0.11	wet	75-100%	nm	nm	nm
CCN	8	4.23	non-wet	50-75%	0.0%	18	2.62

[1]CC1=Cottonwood Cell 1, CC2=Cottonwood Cell 2, CC3=Cottonwood Cell 3, CC3-2=Cottonwood Cell 3-2, CCB=Cottonwood Cell Bank, CCN=Cottonwood Cell North

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 7. Vegetation monitoring results for Cottonwood Cell revegetation sites in 2019.

The two sites expected to potentially benefit from an expanded backwater behind the Historic Lateral Weir are Cottonwood Cell 1 (CC1) and Cottonwood Cell 2 (CC2). CC1 and CC2 were planted exclusively with cottonwood (*Populus fremontii*) poles in 2002 and 2005 respectively. These sites are only a few feet away from the edge of the Wash. CC1 has declined in the cover of its namesake plant from 75-100% in 2010 to 25-50% in each field monitoring year since 2014 including the most recent year (Figure 10). This is believed to be a combination of disease and beaver herbivory. Cottonwoods were replaced by other species including state listed noxious weeds (johnsongrass, Malta starthistle, and tamarisk) as well as native species such as desert broom (*Baccharis sarothroides*). CC2 in contrast has had cottonwoods measure at 75-100% cover in every field monitoring season since 2007. The cottonwood poles that were planted at this

Figure 9. Aerial photograph of 2019 delineated Cottonwood Cell revegetation sites.

location remain at a much higher density than those at CC1. This is also potentially problematic in that the trees are not reaching their full growth potential and the Long-Term Management Plan specifically mentions this site as one that should be thinned to allow for greater growth as well as reduce the potential for disease.

Figure 10. Sparse cottonwood trees at Cottonwood Cell 1 in 2019.

3.6 Demonstration Weir

The two sites at the Demonstration Weir were not monitored in the field in 2019 (Table 8, Figure 11). ArcGIS monitoring in 2019 showed that UDS-N had the same total cover as it has had since 2015, 25-50%. This site has not changed much in terms species composition or cover in many years except for a decline in the cover of the dominant species, creosote bush. In 2018, this species had a cover of 1-5% which was down from 25-50% two years earlier. Monitoring in 2020 will show if this is a long-term trend or a single year anomaly. UDS-W had the maximum cover in 2019 at 75-100%. This is the same cover that was measured the last time cover was calculated using ArcGIS. The last two times UDS-W was monitored in the field, it was calculated to be 50-75%. This may be a result of the inherent biases related to ocular estimation of vegetative cover in the field.

Figure 11. Aerial photograph of 2019 delineated Demonstration Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
UDS	17	1.69	non-wet	25-50%	nm	nm	nm
UDS	17	0.48	wet	75-100%	nm	nm	nm

[1]UDS=Upstream Demonstration South

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland
nm = this attribute was not monitored

Table 8. Vegetation monitoring results for Demonstration Weir revegetation sites in 2019.

3.7 Duck Creek Confluence and Upper Narrows Weirs

In 2019, four of the 12 revegetation sites at the Duck Creek Confluence and Upper Narrows weirs were monitored in the field. The other eight sites had their total cover monitored using ArcGIS (Table 9, Figure 12). Three of the four field monitored sites include areas planted by volunteers during our semi-annual Green-Up events in the fall of 2014 and spring of 2015. Duck Creek Upper Narrows South 2 (DCUNS-2) and Duck Creek Upper Narrows South Riparian (DCUNSR) were both planted at the fall 2014 Green-Up while Duck Creek Upper Narrows South 3 (DCUNS-3) was planted at the spring 2015 event. The fourth site monitored in the field in 2019, Duck Creek Upper Narrows Emergent (DCUNE), was planted in 2013 by contractors.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DCUNE	7	6.97	wet	75-100%	2.5%	19	1.55
DCUNN	6	13.76	non-wet	75-100%	nm	nm	nm
DCUNNR	6	1.43	non-wet	75-100%	nm	nm	nm
DCUNNS	6	1.31	non-wet	5-25%	nm	nm	nm
DCUNS-1	6	7.96	non-wet	75-100%	nm	nm	nm
DCUNS-2	5	10.66	non-wet	50-75%	0.0%	14	4.15
DCUNS-3	5	9.54	non-wet	75-100%	2.5%	10	3.58
DCUNSR	5	2.94	non-wet	75-100%	0.0%	11	4.14
DCCS	5	1.14	wet	75-100%	nm	nm	nm
DCCW	6	2.93	wet	75-100%	nm	nm	nm
UDCCI	6	1.47	wet	75-100%	nm	nm	nm
UNW	6	2.38	wet	75-100%	nm	nm	nm

[1] DCUNE=Duck Creek Upper Narrows Emergent, DCUNN=Duck Creek Upper Narrows North, DCUNNR=Duck Creek Upper Narrows North Riparian, DCUNNS=Duck Creek Upper Narrows North Stockpile, DCUNS-1=Duck Creek Upper Narrows South 1, DCUNS-2=Duck Creek Upper Narrows South 2, DCUNS-3=Duck Creek Upper Narrows South 3, DCUNSR= Duck Creek Upper Narrows South Riparian, DCCS= Duck Creek Channel South, DCCW=Duck Creek Confluence Weir, UDCCI=Upstream Duck Creek Confluence Channel, UNW=Upper Narrows Weir

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland
nm = this attribute was not monitored

Table 9. Vegetation monitoring results for Duck Creek Confluence and Upper Narrows Weirs revegetation sites in 2019.

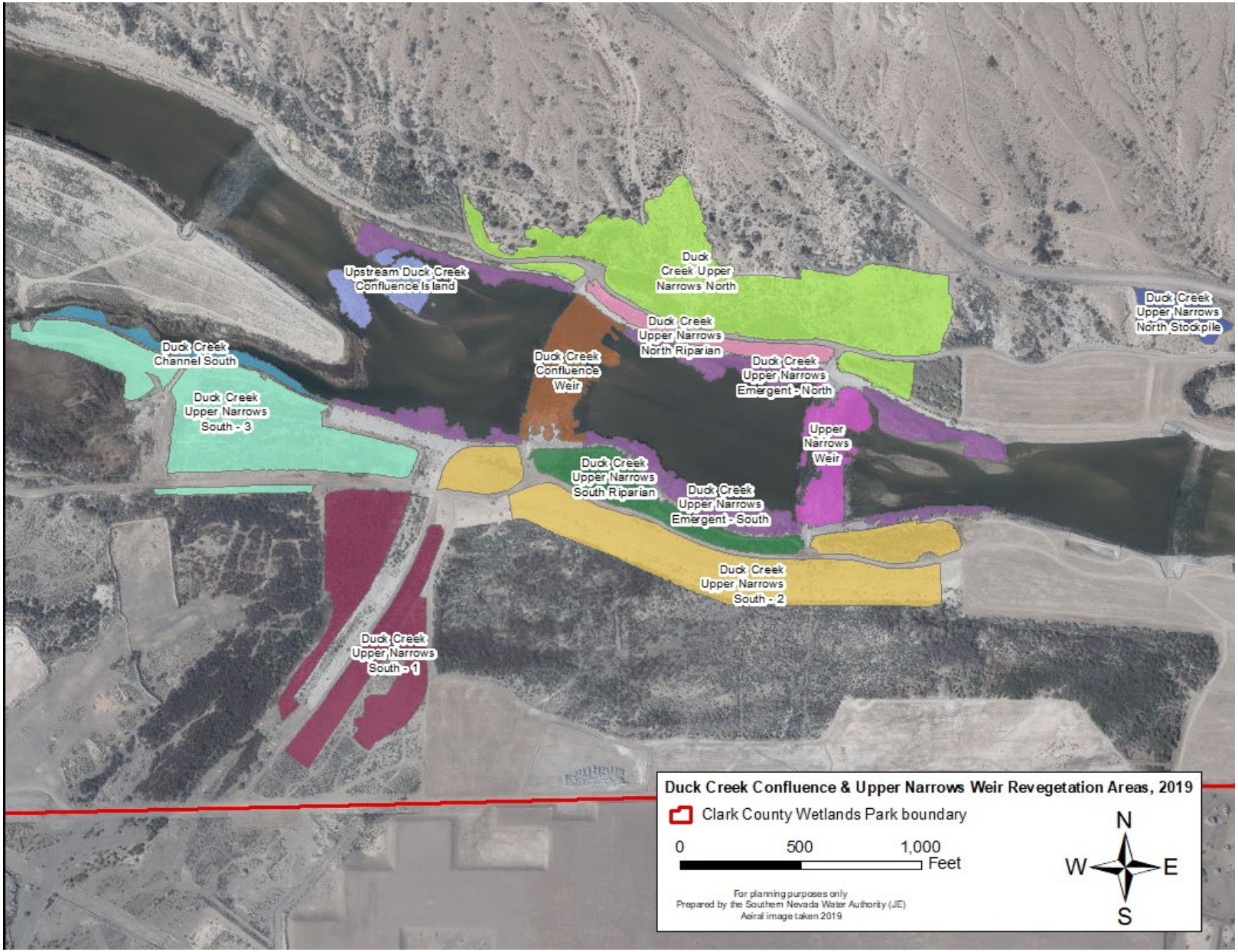

Figure 12. Aerial photograph of 2019 delineated Duck Creek Confluence and Upper Narrows Weir revegetation sites.

The two sites planted in the fall of 2014, DCUNS-2 and DCUNSR were planted simultaneously at the fall 2014 Green-Up event. However, there were different species planted on each area and therefore separated for monitoring purposes. DCUNSR was thought to be able to support riparian vegetation which is why it had riparian included in its name. The WPI for this site was 4.14 in 2019 putting it in the range for being an upland site (a riparian site would be expected to be in the range of 0 to 3.5). The two dominant plants on the site were desert saltbush and fourwing saltbush, both with 25-50% cover making up over half of the total 75-100% vegetative cover of the site. In contrast, DCUNS-2 was always designed to be an upland site. WPI values have varied from a low of 3.70 in 2015 to 4.21 in 2016 with a value of 4.15 in 2019. All of these values are within categories labeled as "not likely a wetland" or "upland." The dominant plant on this site was desert saltbush with fourwing saltbush also making up a large component of the vegetative cover. Honey mesquite on this site has seen an increase reaching 5-25% cover in 2019 up from 1-5% in 2018. This would be a great compliment to the large mesquite stands at Site 108 to the south.

The site for the spring 2015 Green-Up was DCUNS-3. This site is the most upstream site in this area and mainly runs along the Duck Creek Channel, an urban tributary, rather than the Wash. It is located at a slightly lower elevation than most of the other non-wetland sites at the Duck Creek Confluence and Upper Narrow Weirs. While the dominant plant is desert saltbush, just like the other non-wetland sites on the south side of the Wash, three other species also make up substantial portions of the vegetative cover. Desert saltbush had 25-50% cover in 2019 while desert broom, honey mesquite, and alkali sacaton (*Sporobolus airoides*) all had 5-25% cover (Figure 13).

Figure 13. An alkali sacaton stand with a variety of other vegetation at DCUNS-3 in 2019.

3.8 DU Wetlands No. 1 Weir

The DU Wetlands No. 1 Weir (DU1W) passive wetland site was the only revegetation site not monitored in the field at the DU Wetlands No. 1 Weir in 2019 (Table 10). The weir was cleared of vegetation earlier in 2019 and reduced to 0 acres but is still included in monitoring due to knowing subsurface vegetation as well as new plant establishment will result in some replacement of the removed vegetation in upcoming years. The lone wetland site at DU Wetlands No.1 Weir, DU1E, has had the highest possible cover value each year since monitoring began in 2013. In 2019, however, it had its lowest species richness recorded at 27. The highest number of species at this site was in 2013 when there were 40 species. This is likely explained by the growth of the two dominant species on the site. Common reed, the dominant species on the site, had 2.5% cover in 2013 and 46.5% cover in 2019. The second most dominant species, Goodding's willow, had 1.2% cover in 2013 and 29.9% in 2019. The expansive growth of these species is likely outcompeting other species for space and resources. One new species on the site is the non-native Siberian Elm (*Ulmus pumila*; Figure 14)

Figure 14. A non-native Siberian Elm at DU1E in 2019.

The remaining three sites include DU Wetlands No. 1 Tamarisk (DU1T) which was cleared of salt cedar but not actively planted, DU Wetlands No. 1 South (DU1S) which was the site of the spring 2013 Green-Up, and DU Wetlands No. 1 Emergent (DU1E) which is the wetland areas on the banks of the Wash made up of planted emergents and riparian tree poles as well as passively established vegetation (Figure 15).

3.9 DU Wetlands No. 2 Weir

For the past three growing seasons, all four of the revegetation sites at the DU Wetlands No. 2 Weir have had the maximum total cover for vegetation, 75-100% (Table 11, Figure 16). This data comes from two of the sites being monitored in the field with the other two being monitored using ArcGIS. The two sites monitored in the field were DU Wetlands No. 2 Emergent (DU2E) and DU Wetlands No. 2 North (DU2N). Both of these sites have had the maximum cover value since the first monitoring year in 2010.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DU1E	7	2.31	wet	75-100%	2.8%	27	1.87
DU1S	7	7.88	non-wet	50-75%	2.6%	18	3.55
DU1T	4	1.17	non-wet	75-100%	37.5%	10	3.26
DU1W	7	0.00	wet	0.0%	nm	nm	nm

[1] DU1S=DU Wetlands No. 1 South, DU1E=DU Wetlands No. 1 Emergent, DU1T=DU Wetlands No. 1 Tamarisk, DU1W=DU Wetlands No. 1 Weir

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 10. Vegetation monitoring results for DU Wetlands No. 1 Weir revegetation sites in 2019.

Now in its tenth growing season, DU2E had 29 species identified on the site. This is equal to the second highest species richness recorded there which was in 2011. In 2010, there were 41 species. There were three new species in 2019 that had not been recorded on the site before; prickly lettuce (*Lactuca serriola*), Spanish false fleabane (*Pulicaria paludosa*), and Russian thistle (*Salsola tragus*). All of these species are non-natives but covered less than 0.1% of the site each so should not be considered a problem for overall success of the site.

Work was conducted on multiples weir in 2019 including the DU Wetlands No. 2 Weir to bring the structures back into the configuration that they were originally constructed. This also included removing much of the vegetation that had passively established on the structures to allow water to pass over without being diverted or blocked by trunks of trees or groups of other plants (Figure 27). As a result, the revegetation site DU Wetlands No. 2 Weir (DU2W) was reduced from 0.87 acres in 2018 to 0.13 in 2019. It expected that this site will now continue to fluctuate with vegetation establishing on the weir and subsequent maintenance activities removing it.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DU2E	10	1.62	wet	75-100%	2.8%	29	1.83
DU2N	10	2.98	non-wet	75-100%	2.5%	14	3.75
DU2S	10	1.53	non-wet	75-100%	nm	nm	nm
DU2W	10	0.13	wet	75-100%	nm	nm	nm

[1]DU2N=DU Wetlands No. 2 North, DU2S=DU Wetlands No. 2 South, DU2E=DU Wetlands No. 2 Emergent, DU2W=DU Wetlands No. 2 Weir

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

Table 11. Vegetation monitoring results for DU Wetlands No. 2 Weir revegetation sites in 2019.

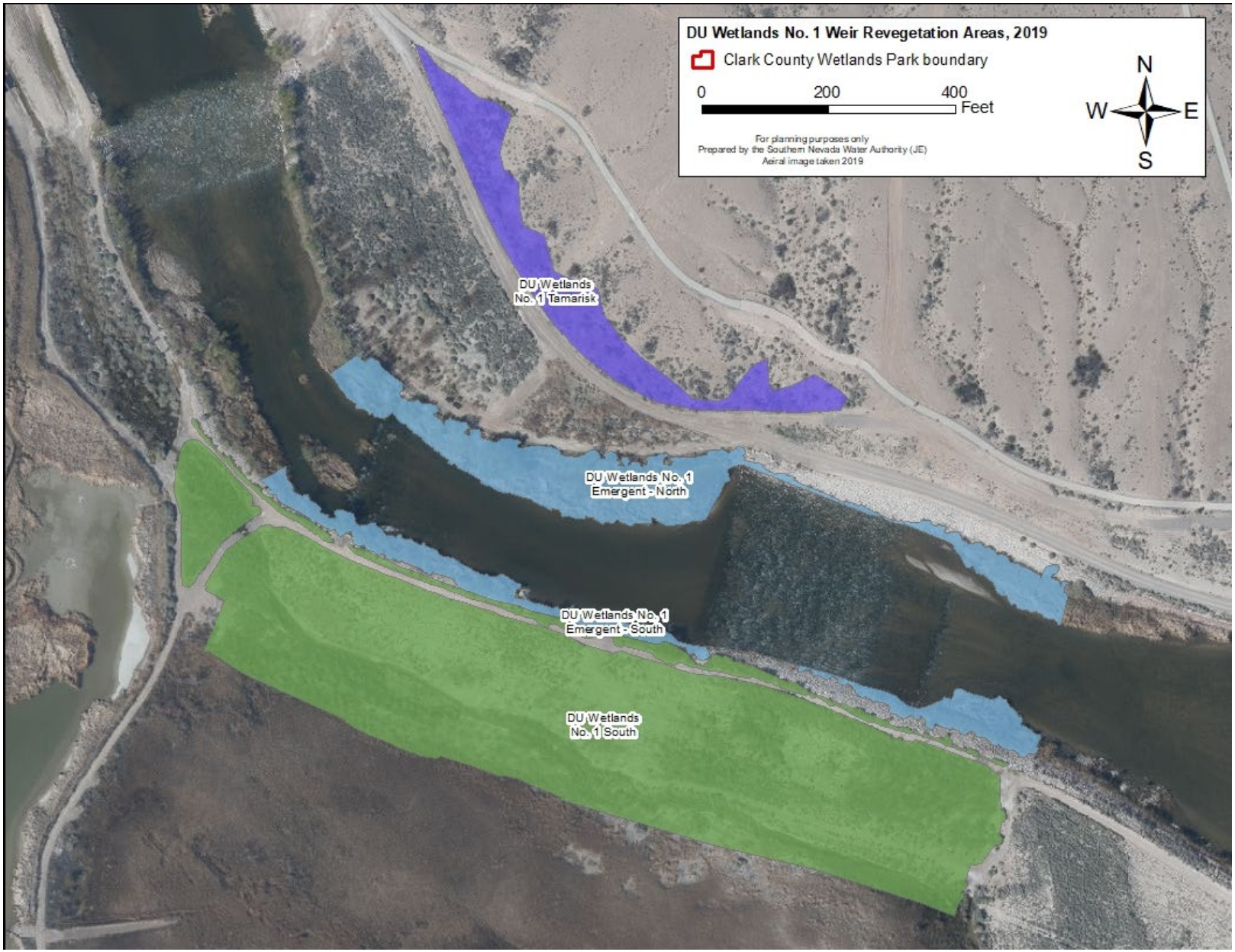

Figure 15. Aerial photograph of 2019 delineated DU Wetlands No. 1 Weir revegetation sites.

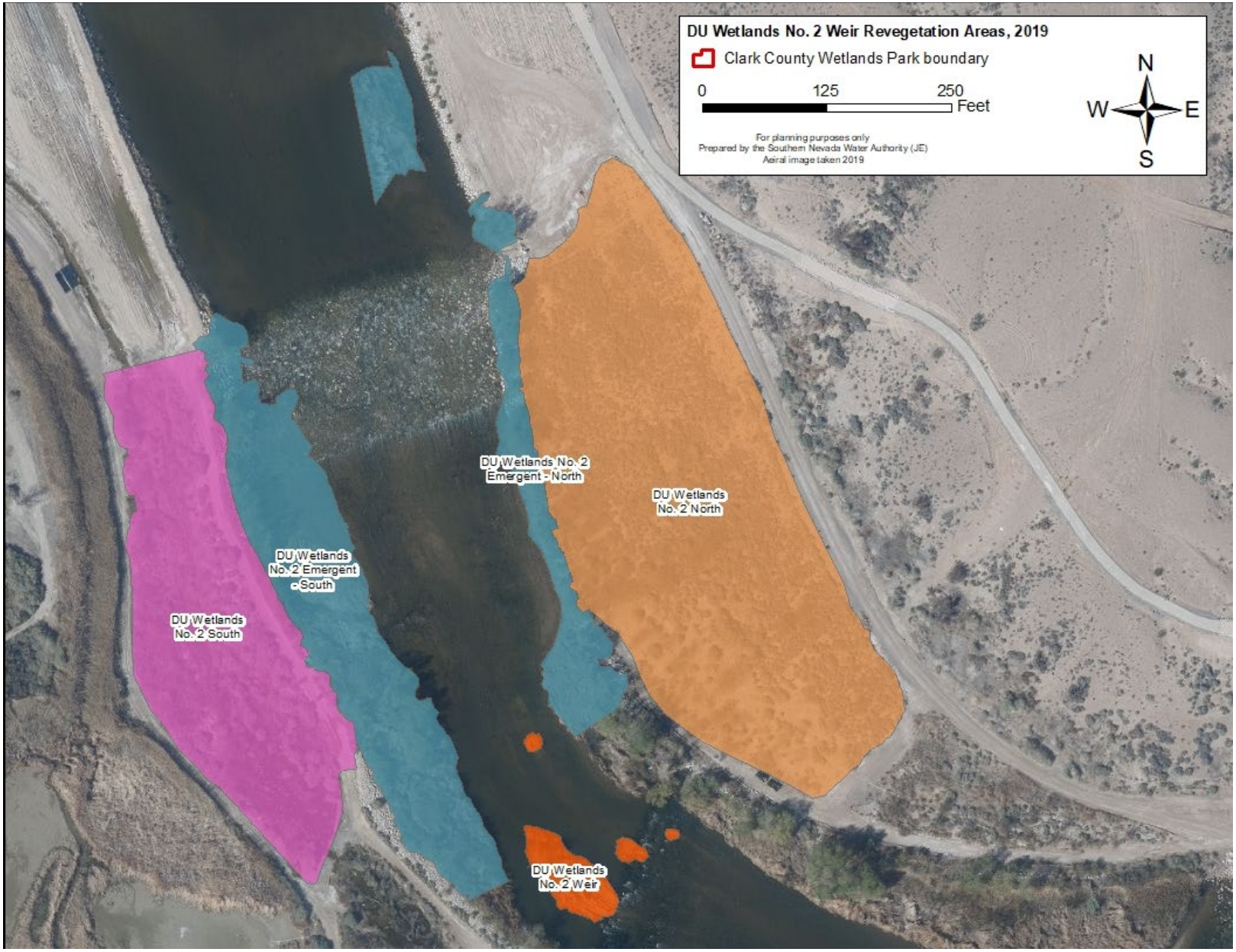

Figure 16. Aerial photograph of 2019 delineated DU Wetlands No. 2 Weir revegetation sites.

Figure 17. Vegetation was cleared from the DU Wetlands No. 2 Weir in 2019.

3.10 Historic Lateral Weir

All of the actively planted revegetation sites at the Historic Lateral Weir were monitored in the field in 2019 (Table 12, Figure 18). Only the two passively created sites; Historic Lateral Weir (HLW) and Downstream Historic Lateral Passive Wetland (DHLPW) were not field monitoring and maintain their 75-100% vegetative cover using ArcGIS which they have had every monitoring year. This is the first monitoring year after the completion of the Historic Lateral Weir expansion project. This expansion more than doubled the width of the weir and greatly expanded the size of the backwater behind the weir. Two full revegetation sites were removed from the area to make room for the large backwater while many others had their size decreased.

The three wetland sites upstream of the Historic Lateral Weir all increased in species richness from the last field monitoring in 2017 compared to 2019. This may be an effect of the increased backwater area by increasing water infiltration into the sites. While there is always fluctuation with species, more so on wetland sites, having an increase on all three of these mature sites in their 19th growing season does not appear to be associated with normal fluctuations. Upstream Historic Lateral North – Wetland (UHLN-W) increased from 21 species to 31 species. One of the new species on this site in 2019 was bulrush (*Bolboschoenus maritimus*) which is relatively common native species in wetland areas but mostly due to being planted. It was unusual to see self-

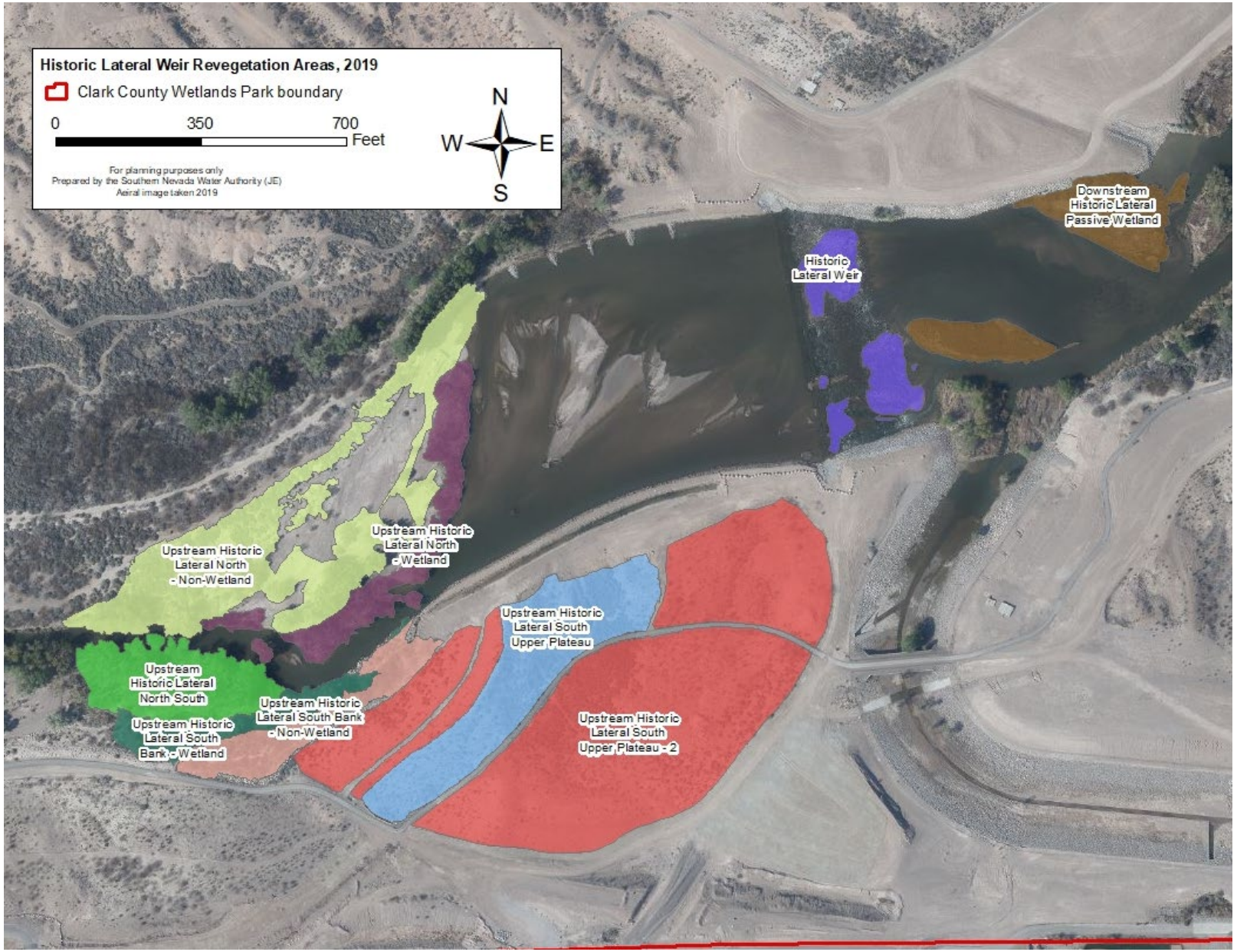

Figure 18. Aerial photograph of 2019 delineated Historic Lateral Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DHLPW	19	1.78	wet	75-100%	nm	nm	nm
HLW	19	1.07	wet	75-100%	nm	nm	nm
UHLN	19	4.55	non-wet	75-100%	15.0%	19	2.63
UHLN	19	1.52	wet	75-100%	15.0%	31	2.20
UHLNS	19	1.76	wet	75-100%	2.6%	18	2.21
UHLSB	19	1.20	non-wet	75-100%	0.5%	13	3.71
UHLSB	19	0.87	wet	75-100%	0.1%	20	2.12
UHLSUP	12	2.93	non-wet	50-75%	2.5%	10	4.40
UHLSUP2	9	10.72	non-wet	58.8%	1.8%	16	4.52

[1]DHLPW=Downstream Historic Lateral Passive Wetlands, HLW=Historic Lateral Weir, UHLN=Upstream Historic Lateral North, UHLNS=Upstream Historic Lateral North South, UHLPW=Upstream Historic Lateral Passive Wetlands, UHLS=Upstream Historic Lateral South, UHLSB=Upstream Historic Lateral South Bank, UHLSS=Upstream Historic Lateral South Stockpile, UHLSUP=Upstream Historic Lateral South Upper Plateau, UHLSUP2=Upstream Historic Lateral South Upper Plateau 2

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 12. Vegetation monitoring results for Historic Lateral Weir revegetation sites in 2019.

established populations, but many were observed in 2019. Upstream Historic Lateral North South (UHLNS; Figure 19) increased from 11 species to 18. Seven of the 18 species identified in 2019 were never documented on the site before, although the remaining 11 species identified weren't the exact same 11 species identified in 2017. One of these new species was tree tobacco (*Nicotiana glauca*). This exotic plant is becoming very common along the Wash. Although not listed on the Nevada state list of noxious weeds, it is treated as one in many other restoration sites in the southwest as it outcompetes many desirable native species. The third wetland site, Upstream Historic Lateral South Bank – Wetland (UHLSB-W), increased from nine species to 20. Only four of these 11 additional species were not recorded on the site in prior monitoring years. Many of these species have cover values less than 1% which makes them susceptible to being absent in subsequent years but changing conditions either lead to establishment or reestablishment on the site or germination of seeds previously deposited on the site. An exception this year was the identification of false daisy (*Eclipta prostrata*) which had a 1-5% cover in 2019 after never being documented on the site before. So, in approximately two years, this species established over the site and now covers over 1% of the 0.87-acre site.

3.11 Lower Narrows and Homestead Weirs

Only one of the seven revegetation sites at the Lower Narrows and Homestead Weirs was monitored in the field in 2019 (Table 13, Figure 20). Lower Narrows Homestead North (LNHN) is one of the larger sites along the Wash at just over 40 acres. Site is very high up off of the Wash and vegetation probably doesn't reach the groundwater. As a result, there are not many changes. Results from 2019 monitoring are similar to 2017. In 2019, there were 13 species compared to 12

Figure 19. Species richness increased at UHLNS in 2019.

in 2017. The total cover was also the same at 50-75%. In the alternate years where the site is monitored for total cover using ArcGIS the total cover has been lower at 25-50% in both 2016 and 2018. This could be a result of one or many factors. First, it is a very large site and difficult to accurately estimate the cover in the field. Second, because the desert shrubs found here are light in color, they may not show up clearly in aerial imagery and may be undercounted using ArcGIS. Combining both methods, it is likely that the site is near the 50% cover mark for the past few years. A reptile survey conducted in 2019 included LNHN as a representative upland site (Figure 21).

3.12 Monson and Visitor Center Weirs

The criteria for whether or not a site is field monitored or has its total cover measured with ArcGIS has led to two of the four revegetation sites at the Monson and Visitor Center Weirs being monitored in the field each year and then alternating the following year. In 2019, the two Downstream Monson North sites (wetland and non-wetland) were field monitored. All four sites had the maximum total cover of 75-100%, something they have had for many years (Table 14, Figure 22)

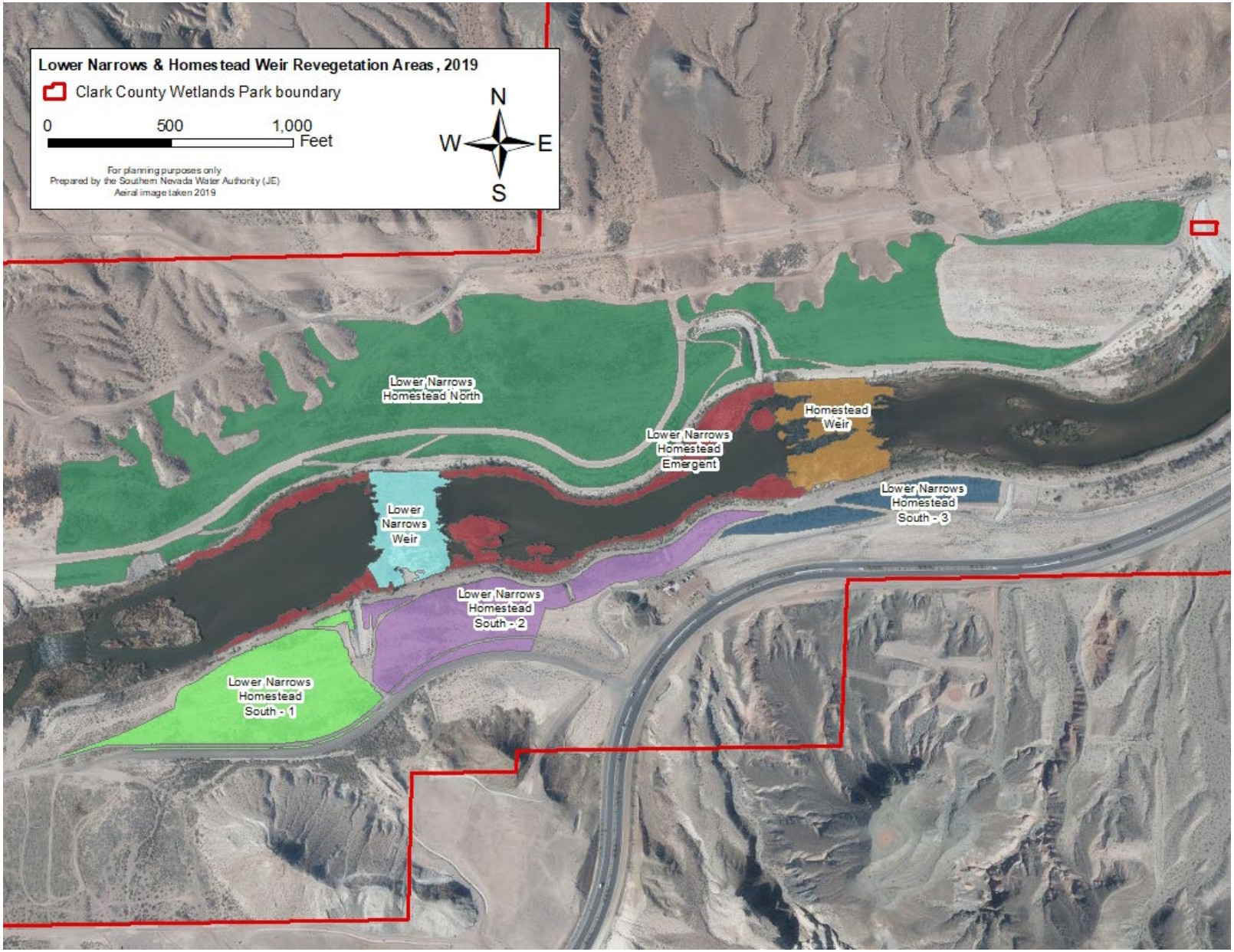

Figure 20. Aerial photograph of 2019 delineated Lower Narrows and Homestead Weir revegetation sites.

Figure 21. A reptile survey array was erected on the LNHN site in 2019.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
HW	8	3.27	wet	75-100%	nm	nm	nm
LNW	8	2.83	wet	75-100%	nm	nm	nm
LNHE	8	5.17	wet	75-100%	nm	nm	nm
LNHN	8	40.75	non-wet	50-75%	0.5%	13	3.92
LNHS1	8	7.38	non-wet	25-50%	nm	nm	nm
LNHS2	7	6.60	non-wet	25-50%	nm	nm	nm
LNHS3	8	2.22	non-wet	50-75%	nm	nm	nm

[1]HW=Homestead Weir, LNW=Lower Narrows Weir, LNHE=Lower Narrows Homestead Emergent, LNHN=Lower Narrows Homestead North, LNHS1=Lower Narrows Homestead South 1, LNHS2=Lower Narrows Homestead South 2, LNHS3=Lower Narrows Homestead South 3
[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland
[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland
nm = this attribute was not monitored

Table 13. Vegetation monitoring results for Lower Narrows and Homestead Weirs revegetation sites in 2019.

Downstream Monson North - non-wetland (DMN-N) had the same six species identified as were recorded in 2017. Downstream Monson North – wetland (DMN-W) had a much larger change. In 2018, the Visitor Center Weir was almost completely rebuilt. The length of the weir was expanded up and downstream, some portions were expanded in terms of width as well. All of the vegetation along the banks was removed to make room for this new weir. Fortunately, most of this vegetation was salt cedar and the site is still dominated by Goodding's willow (*Salix gooddingii*; Figure 23). As with most disturbance, the result was an influx of new plants establishing on the bare soil left behind after construction was completed. Species richness increased from eight species in 2017 to 32 species in 2019. Some new species have established and grown very quickly in the year and a half since construction was completed. Both bulrush and desert broom had 5-25% cover in 2019 after not being identified on the site ever before.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DMN	17	3.73	non-wet	75-100%	15.0%	6	3.75
DMN	17	1.00	wet	75-100%	20.5%	32	2.37
DMS	17	2.89	non-wet	75-100%	nm	nm	nm
DMS	17	0.60	wet	75-100%	nm	nm	nm

[1]DMN=Downstream Monson North, DMS=Downstream Monson South

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 14. Vegetation monitoring results for Monson and Visitor Center Weirs revegetation sites in 2019.

3.13 Pabco Road Weir

Six of the 15 revegetation sites associated with the Pabco Road Weir were monitored in the field in 2019 (Table 15, Figure 24). These sites include many of the oldest revegetation sites along the Wash with seven sites being in their 19th growing season in 2019. One of those sites is Downstream Pabco South (DPS) which was similar in metrics in 2019 as it was in 2017 after being monitored for total cover using ArcGIS in 2018. The site has had 75-100% cover every year since 2011. There were 30 species identified on the site in 2019 compared to 32 in 2017. The dominant species is cottonwood which has seen some older trees die in recent years, but new trees are also establishing on the site (Figure 25). The only species identified in 2019 that had not been recorded for many years was tree tobacco. Tree tobacco was found on the site in 2006 when it had 0.1% cover and not again until 2019 when it had 0.5% cover. As mentioned previously, this non-native species is becoming common along the Wash. Crews from the Lake Mead Exotic Plant Management Team, which SNWA has contracted to control noxious weeds along the Wash, treat and remove this species to preemptively fight the spread of this species.

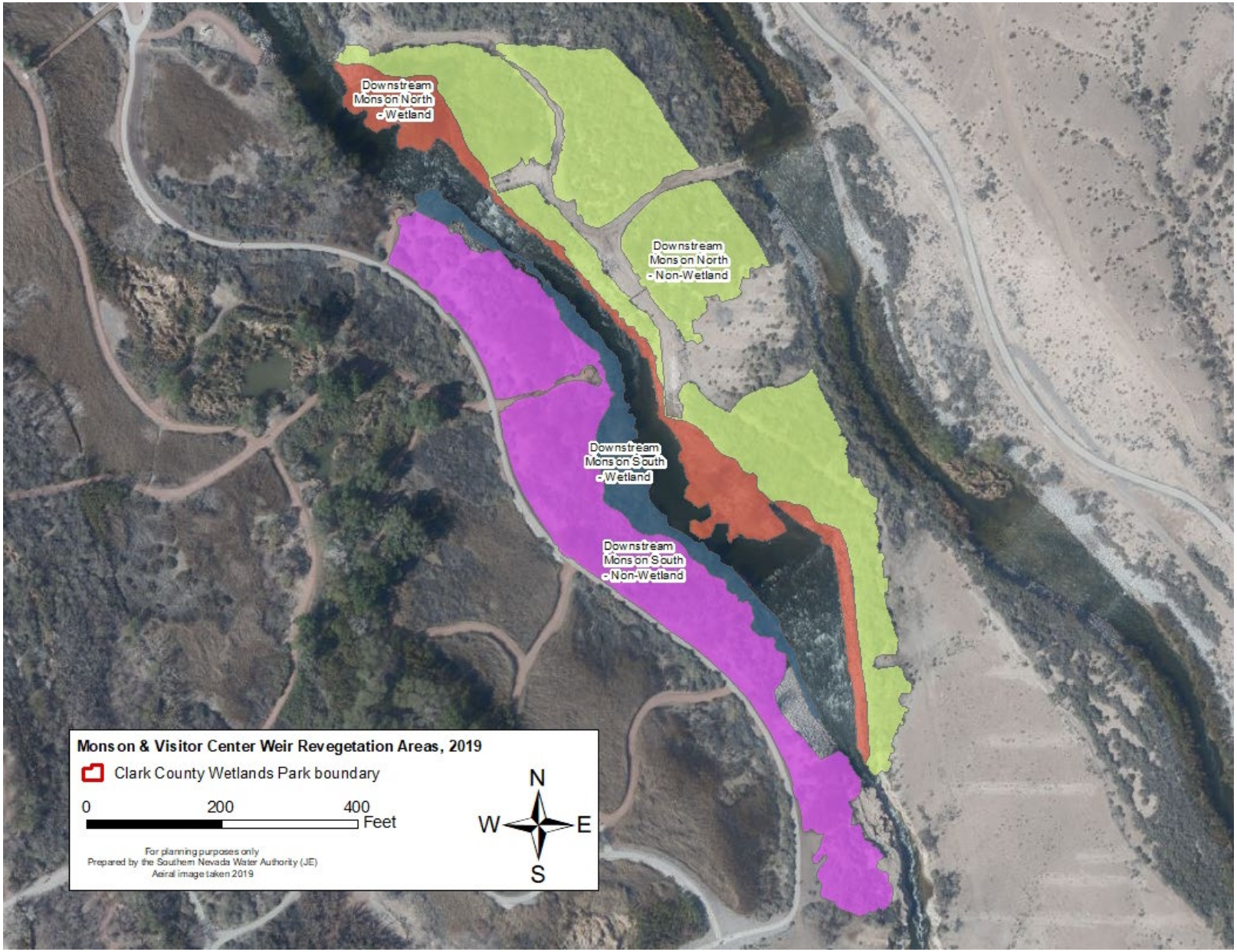

Figure 22. Aerial photograph of 2019 delineated Monson and Visitor Center Weir revegetation sites.

Figure 23. Goodding's willow stand tall across DMN-W in 2019.

Another site at Pabco that is older than most along the Wash was Upstream Pabco North (UPN) which was in its 14th growing season in 2019. This site was removed in early 2020, so 2019 marks its last monitoring. Because the Pabco Road Weir was the first permanent weir on the Wash, it continued to have large amounts of sediment deposition while the other weirs were being constructed. UPN had a lot of sediment deposited on it in its 14 years being on the upstream side of the weir. It also had large Goodding's willows which provided habitat but also caught sediment, debris, and trash as it flowed during storm events. It was determined that in order for the weir to continue functioning properly, the entire site needed to be removed.

Similar to UPN, on the other side of the Wash, Upstream Pabco South (UPS) was also cleared of vegetation and reduced in size by removing sediment in 2020. While there was also a need for vegetation removal to improve the functioning of the weir, there were additional reasons. The Clark County Flood Control District has a gauge at this site which the increasing sediment and vegetation were blocking the inlet. Also, the site was dominated by salt cedar and traditional removal methods had not been very successful. Unlike UPN, the land under most of the vegetation at UPS was left intact in order to replant in the future. Because it is near water level, it should support some riparian and wetland plants that are not as common along the Wash. To avoid having to be removed again, trees will not be planted, and noxious weeds will be treated regularly.

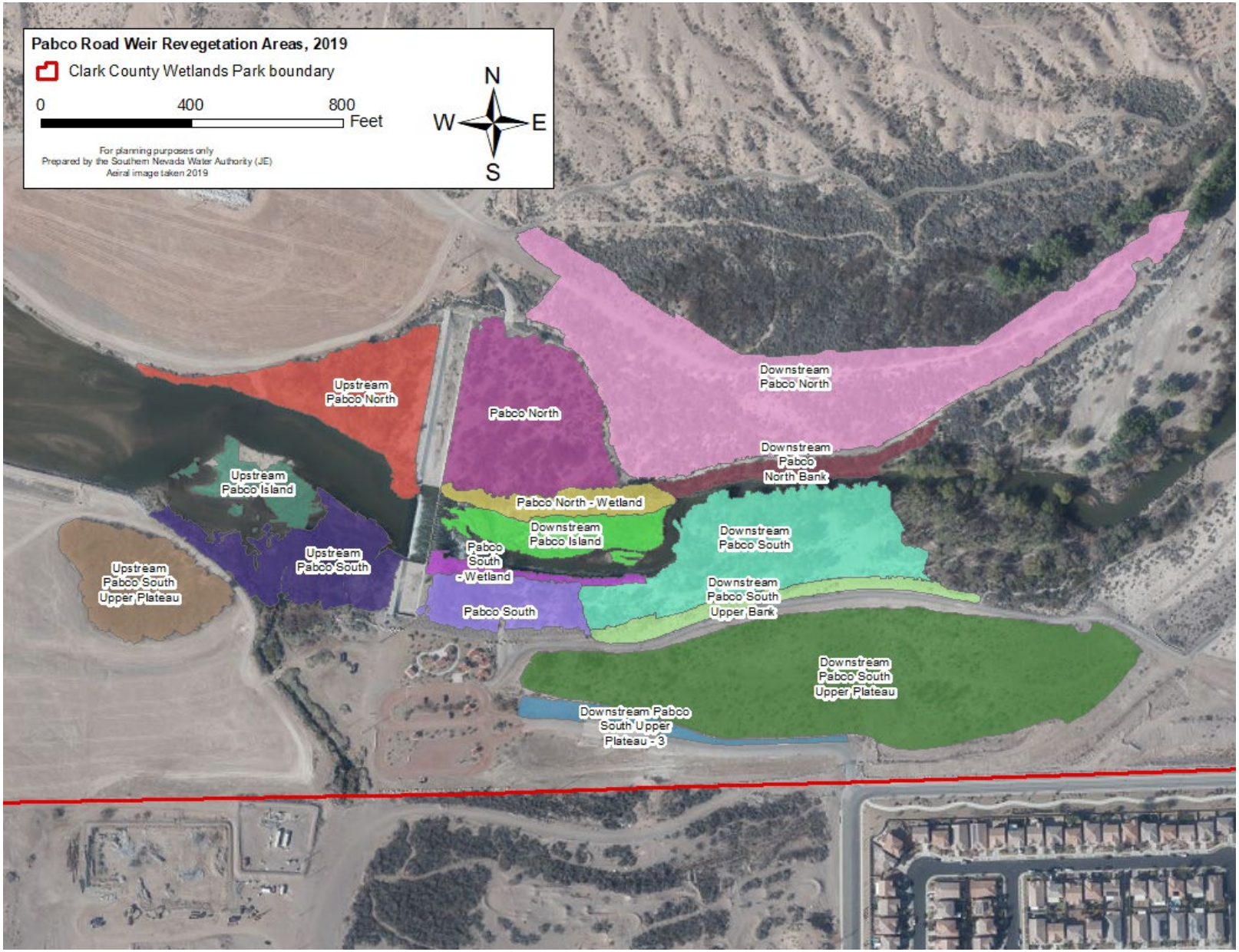

Figure 24. Aerial photograph of 2019 delineated Pabco Road Weir revegetation sites.

Figure 25. A fallen cottonwood tree and a sapling on DPS in 2019.

3.14 Powerline Crossing Weir

All of the revegetation sites at the Powerline Crossing Weir were monitored in the field in 2019 except for the site on the weir itself (Table 16, Figure 26). All ten revegetation sites were in their 13th growing season at the time of 2019 monitoring. There are typically not many changes on sites that are this old without some disturbance on the site either natural or man-made. The two sites planted at the spring 2007 Green-Up were Upstream Powerline North Plateau (UPLNP; Figure 27) and Upstream Powerline South Plateau (UPLSP). Both of these sites are very high off of the water and it is unlikely the plants reach the groundwater table. As a result, the plant growth is slow, and the species richness is lower than many sites since only those species that can survive the dry saline conditions could survive and thrive on the site. However, there has been steady increase in total cover on both of these sites. Both sites recorded their highest total cover in 2019 with UPLNP having 72.1% cover and UPLSP having 71.9% cover. Both sites are made up of multiple monitoring areas which have their total cover measured individually and then a weighted average is used for the site as a whole. The dominant plant species on UPLNP was fourwing saltbush while quailbush was the dominant species on UPLSP. Due to the dry saline conditions on these sites, these species are two of the few that could thrive on these sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DPI	19	1.25	wet	75-100%	nm	nm	nm
DPN	11	9.45	non-wet	75-100%	nm	nm	nm
DPNB	8	0.81	wet	75-100%	nm	nm	nm
DPS	19	4.22	wet	75-100%	1.0%	30	2.20
DPSUB	9	0.89	non-wet	5-25%	nm	nm	nm
DPSUP	9	9.51	non-wet	50-75%	nm	nm	nm
DPSUP-3	2	0.58	non-wet	25-50%	15.0%	16	2.78
PN	19	3.57	non-wet	75-100%	nm	nm	nm
PN	19	0.84	wet	75-100%	nm	nm	nm
PS	19	1.23	non-wet	75-100%	0.0%	10	3.75
PS	19	0.39	wet	75-100%	0.5%	21	2.15
UPI	19	0.82	wet	75-100%	nm	nm	nm
UPN	14	2.65	wet	75-100%	2.6%	22	3.03
UPS*	18	2.30	wet	75-100%	15.0%	22	2.53
UPSUP	18	2.19	non-wet	75-100%	nm	nm	nm

[1]DPI=Downstream Pabco Island, DPN=Downstream Pabco North, DPNB=Downstream Pabco North Bank, DPS=Downstream Pabco South, DPSUB=Downstream Pabco South Upper Bank, DPSUP=Downstream Pabco South Upper Plateau, PN=Pabco North, PS=Pabco South, UPI=Upstream Pabco Island, UPN=Upstream Pabco North, UPS=Upstream Pabco South, UPSUP=Upstream Pabco South Upper Plateau

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

* UPS includes Upstream Pabco South Lower Plateau

nm = this attribute was not monitored

Table 15. Vegetation monitoring results for Pabco Road Weir revegetation sites in 2019.

The only site at Powerline Crossing Weir that had less than 70% cover was Upstream Powerline North Bank (UPLNB) which had 25-50% cover in 2019. Saline and dry like UPLNP and UPLSP, this small site (0.65 acres) had just four species recorded and has never had more than 50% cover. This is likely due to this site having an additional environmental variable that makes it difficult for plants to establish and grow, it is on a slope. So, any rainfall that does occur on the site is lost and doesn't become available for the plants.

3.15 Rainbow Gardens Weir

Only one of the eight revegetation sites associated with the Rainbow Gardens Weir were monitored in the field in 2019 (Figure 28; Table 17). Upstream Rainbow North Bank (URNB) was in its 10th growing season in 2019. This site is along the slopes on the north side of the Wash upstream of the Rainbow Weir. The area was identified as a suitable location for hydroseeding as direct planting was not feasible given the extreme slope. There has been limited success, likely also due to the slope. The site is very dry, and rainfall is quickly washed away. However, there are some signs of success after the 2019 monitoring. The site had its highest species richness with 12 species, up from just 6 in 2017. Also, the dominant species, desert saltbush increased from 1-5% cover in

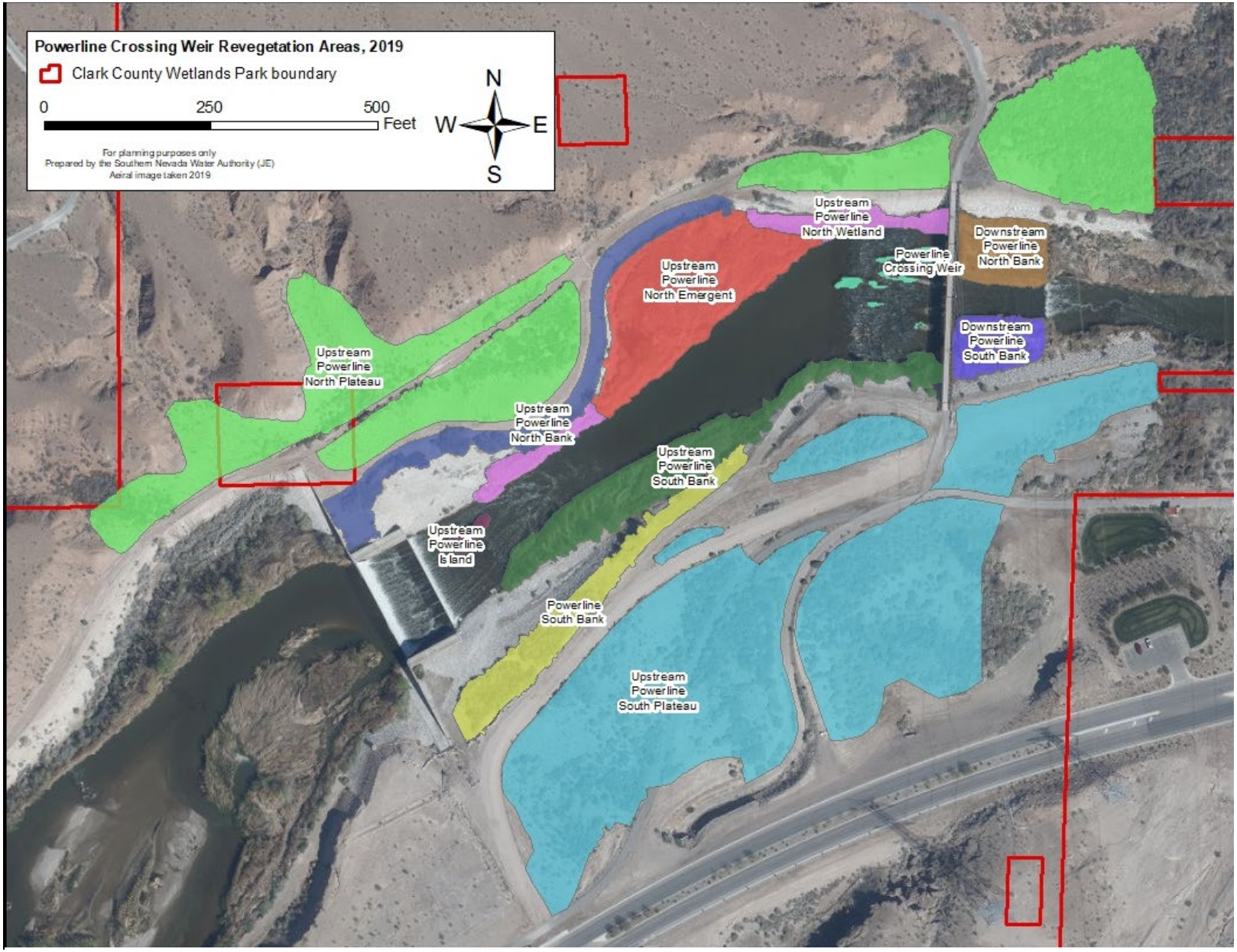

Figure 26. Aerial photograph of 2019 delineated Powerline Crossing Weir revegetation sites.

2017 to 5-25% cover in 2019.While increasing in richness and cover slower than most planted sites, this pace may be the best that could be expected given the sites environment.

Figure 27. Saltbush are the dominant species on UPLNP in 2019.

3.16 Site 108

Site 108 was monitored for total cover using ArcGIS in 2018, therefore it was measured in the field in 2019 (Table 18, Figure 29). This is still the largest contiguous revegetation site along the Wash, even though the site decreased by over 20 acres of its initial size due to construction. Cleared areas (Figure 30) will be replanted as part of the Sunrise Mountain Weir project, currently scheduled for 2021.

From 2016 to 2019, cover slightly increased for honey mesquite from 11.3% to 14.3% and quailbush from 15.2% to 16.5%. However, the site condition was poor, and the plants in many of the areas were exhibiting signs of stress—discolored leaves, branch die-off, and plant death—which led to total reduced cover. Cover decreased the most for fourwing saltbush from 5.7% to 4.1%, desert willow from 0.01% to 0.0004%, screwbean mesquite from 5.9% to 4.0%, and alkali sacaton 9.7% to 3.5%. The dramatic reduction in total cover between 2018 at 82.1% and 2019 at 52.9% could be due to the lack of rain during the summer monsoon season combined with average monthly highs of over 100°F between June and September. Subsequent monitoring will reveal if the site health will recover or if further actions need to be taken to improve the health of the site.

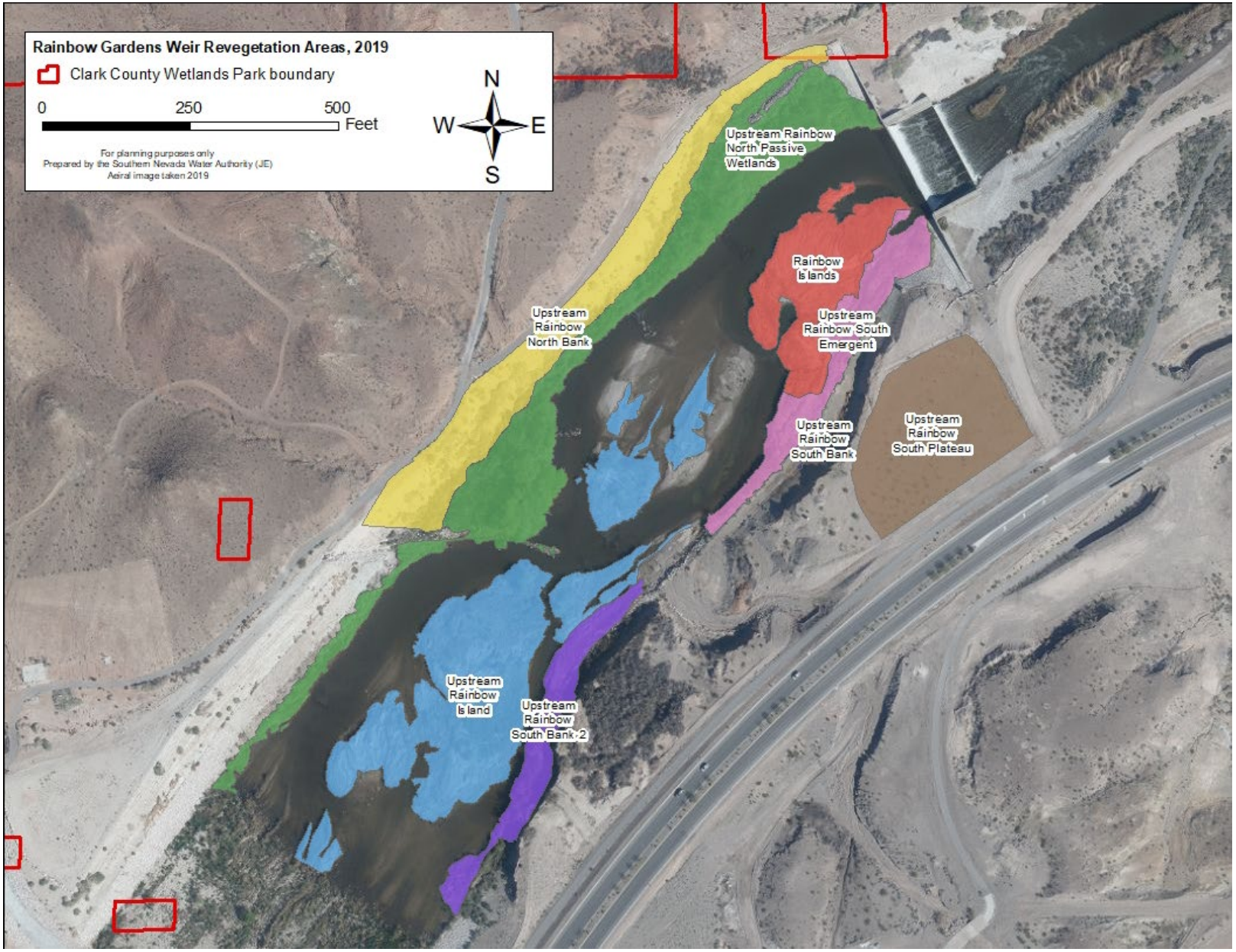

Figure 28. Aerial photograph of 2019 delineated Rainbow Gardens Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DPLNB	13	0.31	wet	75-100%	15.0%	8	2.15
DPLSB	13	0.81	wet	75-100%	37.5	4	2.41
PCW	13	0.08	wet	75-100%	nm	nm	nm
PLSB	13	0.57	non-wet	75-100%	0.0%	3	2.58
UPLNB	13	0.65	non-wet	25-50%	0.0%	4	3.13
UPLNE	13	1.09	wet	75-100%	2.5%	10	2.26
UPLNP	13	3.83	non-wet	72.1%	0.1%	10	3.39
UPLNW	13	0.36	wet	75-100%	2.5%	11	2.06
UPLSB	13	0.81	wet	75-100%	15.0%	6	2.18
UPLSP	13	5.67	non-wet	71.9	0.2%	8	4.03

[1]DPLNB=Downstream Powerline North Bank, DPLSB=Downstream Powerline South Bank, PCW=Powerline Crossing Weir, PLSB=Powerline South Bank, UPLNB=Upstream Powerline North Bank, UPLNE=Upstream Powerline North Emergent, UPLNP=Upstream Powerline North Plateau, UPLNW=Upstream Powerline North Wetland, UPLSB=Upstream Powerline South Bank, UPLSP=Upstream Powerline South Plateau

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 16. Vegetation monitoring results for Powerline Crossing Weir revegetation sites in 2019.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
RI	15	0.98	wet	75-100%	nm	nm	nm
URI	15	2.75	wet	75-100%	nm	nm	nm
URNB	10	1.58	non-wet	5-25%	0.5%	12	3.88
URNPW	15	2.34	wet	75-100%	nm	nm	nm
URSB1	14	0.02	non-wet	75-100%	nm	nm	nm
URSB2	12	0.58	non-wet	75-100%	nm	nm	nm
URSE	15	0.69	wet	75-100%	nm	nm	nm
URSP	14	1.39	non-wet	5-25%	nm	nm	nm

[1]RI=Rainbow Islands, URI=Upstream Rainbow Island, URNB=Upstream Rainbow North Bank, URNPW=Upstream Rainbow North Passive Wetlands, URSB1=Upstream Rainbow South Bank 1, URSB2=Upstream Rainbow South Bank 2, URSE=Upstream Rainbow South Emergent, URSP=Upstream Rainbow South Plateau

[2]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[3]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 17. Vegetation monitoring results for Rainbow Gardens Weir revegetation sites in 2019.

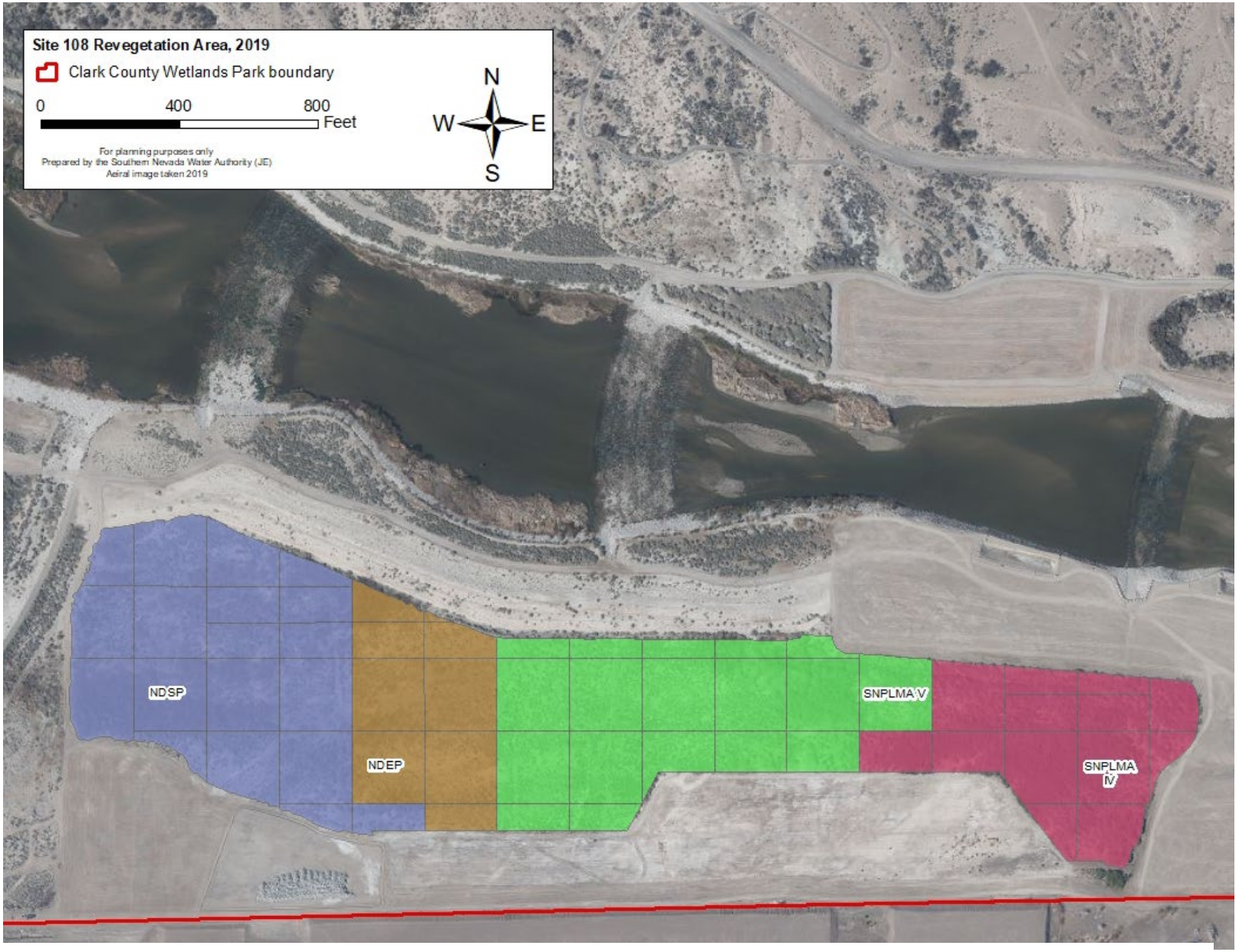

Figure 29. Aerial photograph of Site 108 with 2019 delineations based on funding source.

Figure 30. Portions of Site 108 were removed for the Sunrise Mountain Weir.

Funding Areas	Growing Season[3]	Acreage	Wetland Status[1]	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
NDEP	13	5.72	non-wet	31.9%	0.5%	11	3.78
NDSP	13	13.15	non-wet	57.8%	0.7%	9	3.63
SNPLMA IV	13	7.89	non-wet	64.0%	0.2%	9	2.31
SNPLMA V	13	11.80	non-wet	48.4%	0.6%	8	3.33
TOTAL	13	38.56	non-wet	52.9%	0.5%	14	3.23

[1]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[2]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

[3]Portions of funding areas SNPLMA IV and SNPLMA V were planted in the spring of 2006 and others in the fall of 2006

nm = this attribute was not monitored

Table 18. Vegetation monitoring results for the Site 108 revegetation site in 2019.

The total project was funded through four different grants from the NDEP, NDSP, and the fourth and fifth rounds of the SNPLMA administered by the BLM. To monitor this large site, it was broken up into smaller areas and each area has all of the attributes calculated and then a weighted average of all of them is used to determine the total site information. The exception is species richness which is the sum of all the unique species found through all of the monitoring areas. Total cover is calculated using a weighted average of the 59 monitoring areas across the site.

3.17 Site 111

Site 111 is one of the larger revegetation sites along the Wash (Table 19, Figure 31). It was monitored for total cover using ArcGIS in 2019 after being field monitored in 2018. The total cover in both years was 75-100%. Prior to 2018, this site was broken up into 26 monitoring areas and a weighted average was used for the total cover of the site. The past two years, however, the site was monitored as a single monitoring area. This was done due to substantial growth of shrubs such as quailbush, fourwing saltbush, desert saltbush as well as honey and screwbean mesquites have made it impossible to enter some of the monitoring areas. Although when using ArcGIS to measure plant cover, the monitoring areas can be used again to both provide more detailed data, it is was decided to stay consistent with methods as it is not anticipated conditions will change in the future to allow for individual monitoring areas to accessed in the field.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
S111	13	14.93	non-wet	75-100%	nm	nm	nm

[1]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[2]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 19. Vegetation monitoring results for Site 111 revegetation site in 2019.

3.18 Three Kids Weir

There are eight revegetation sites at the Three Kids Weir (Figure 32, Table 20). The two passively created wetland sites (Three Kids Weir [3KW] and Upstream Three Kids Island [UKI]) were monitored using ArcGIS, the remaining six sites were monitored in the field in 2019. All of the sites were either in their third or fourth growing season. UKI has steadily increased in size as sedimentation continues to increase the size of these naturally formed islands upstream of the weir. In 2019, they measured 0.67 acres, up from 0.58 acres in 2018 and 0.43 acres in 2017. While the increase in wetland vegetation that is establishing on them is ecologically beneficial, their continued growth will likely result in the need for removal to ensure the proper function of the weir to continue.

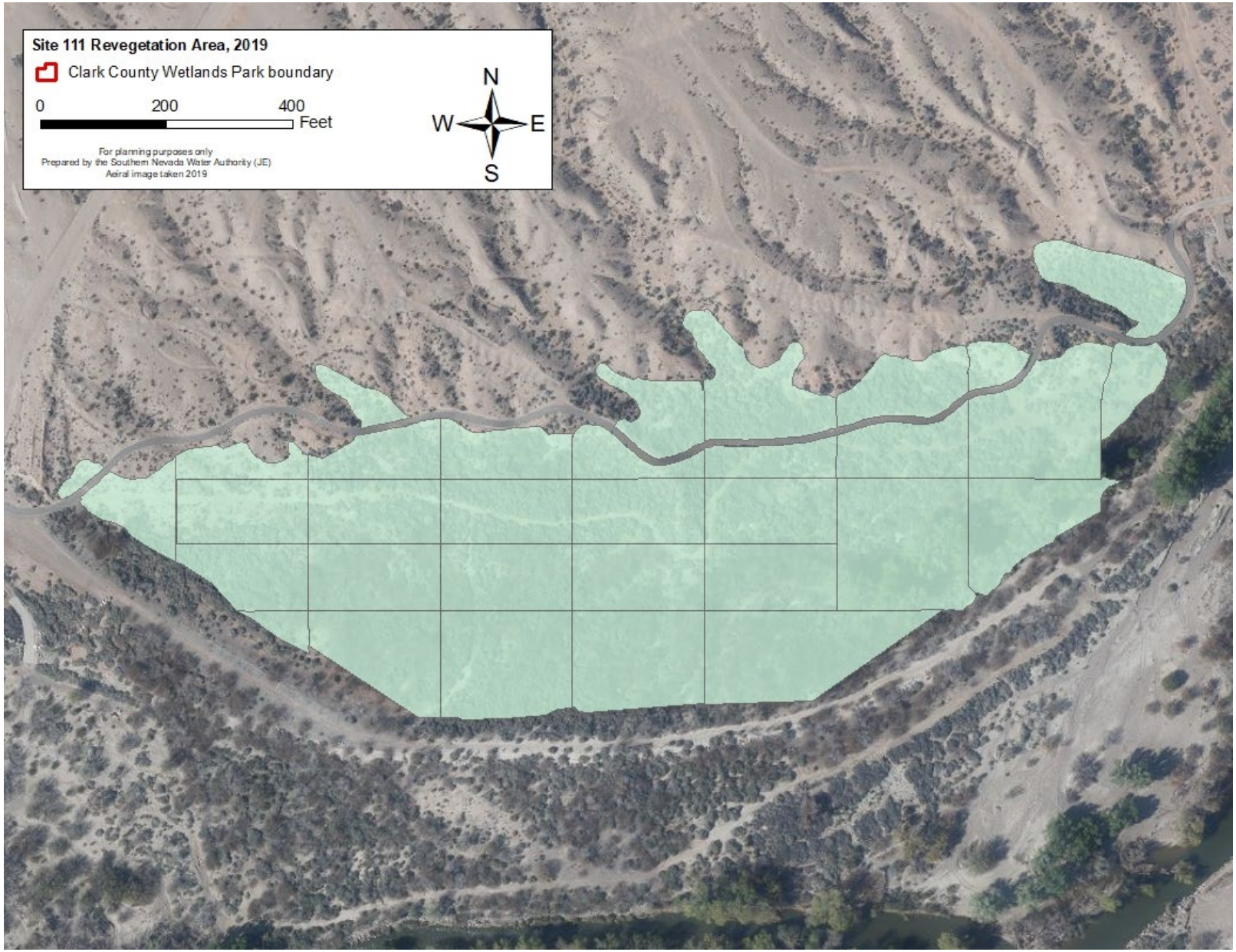

Figure 31. Aerial photograph of the 2019 delineated Site 111 revegetation site.

The lone Green-Up site at the Three Kids Weir is Upstream Three Kids South (U3KS). This site was planted on March 4, 2017 and was in its third growing season at the time of 2019 vegetation monitoring. U3KS had 75-100% cover for the past two years. An additional 100 cat-claw trees were planted in the spring of 2019 by the Hilton corporation celebrating their 100th anniversary. Cat-claw had the same cover in 2019 as it did in 2018, 1-5%. These trees are relatively slow growing, and the impact of these additional trees may not be seen for a few years. One new species in 2019 was paper bag bush (*Salazaria mexicana*). There were a few of these native plants planted at the Green-Up but were not identified in the first two years of monitoring. This is a good sign of the health of the vegetation on the site. Another new species on the site was saltlover (*Halogeton glomeratus*; Figure 33). This species has likely been at the Wash in the past but resembles both young salt cedar and bush seepweed (*Suaeda nigra*) and was probably misidentified. However, the large increase in saltlover population throughout the Wash made identification easier. At U3KS it had 5-25% cover and formed large monoculture clusters. While not listed as a state noxious weed in Nevada, it is in Arizona, California, and four other states and therefore its status on the Wash will be monitored closely.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
LNHB-N	4	1.76	wet	50-75%	0.5%	16	3.15
LNHB-S	4	3.25	wet	50-75%	2.5%	18	2.47
LNHN2	3	9.46	non-wet	50-75%	0.0%	5	4.17
3KW	3	4.02	wet	75-100%	nm	nm	nm
U3KI	3	0.67	wet	75-100%	nm	nm	nm
U3KNB	4	3.56	wet	50-75%	0.1%	18	3.01
U3KS	3	6.89	non-wet	75-100%	0.1%	23	3.23
U3KSB	4	1.08	wet	75-100%	2.5%	9	2.00

[1]LNHB-N=Lower Narrows Homestead Bank North, LNHB-S=Lower Homestead Bank South, LNHN2=Lower Narrows Homestead North 2, 3KW=Three Kids Weir, U3KI=Upstream Three Kids Island, U3KNB= Upstream Three Kids North Bank (North=N, South=S), U3KS=Upstream Three Kids South, U3KSB= Upstream Three Kids South Bank,

[1]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[2]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 20. Vegetation monitoring results for Three Kids Weir revegetation sites in 2019.

3.19 Tropicana Weir

The four newest revegetation sites at the Las Vegas Wash are located at the Tropicana Weir which was completed at the end of 2018 (Figure 34, Table 21). One site, Tropicana West 1 (TW1) was monitored in 2018. The other three sites had their first monitoring in 2019. Tropicana West 2 (TW2) and Tropicana East (TE) were both planted as Green-Up events in the fall of 2018 and spring of 2019 respectively. TW1 was also a Green-Up site in the spring of 2018. Tropicana Weir

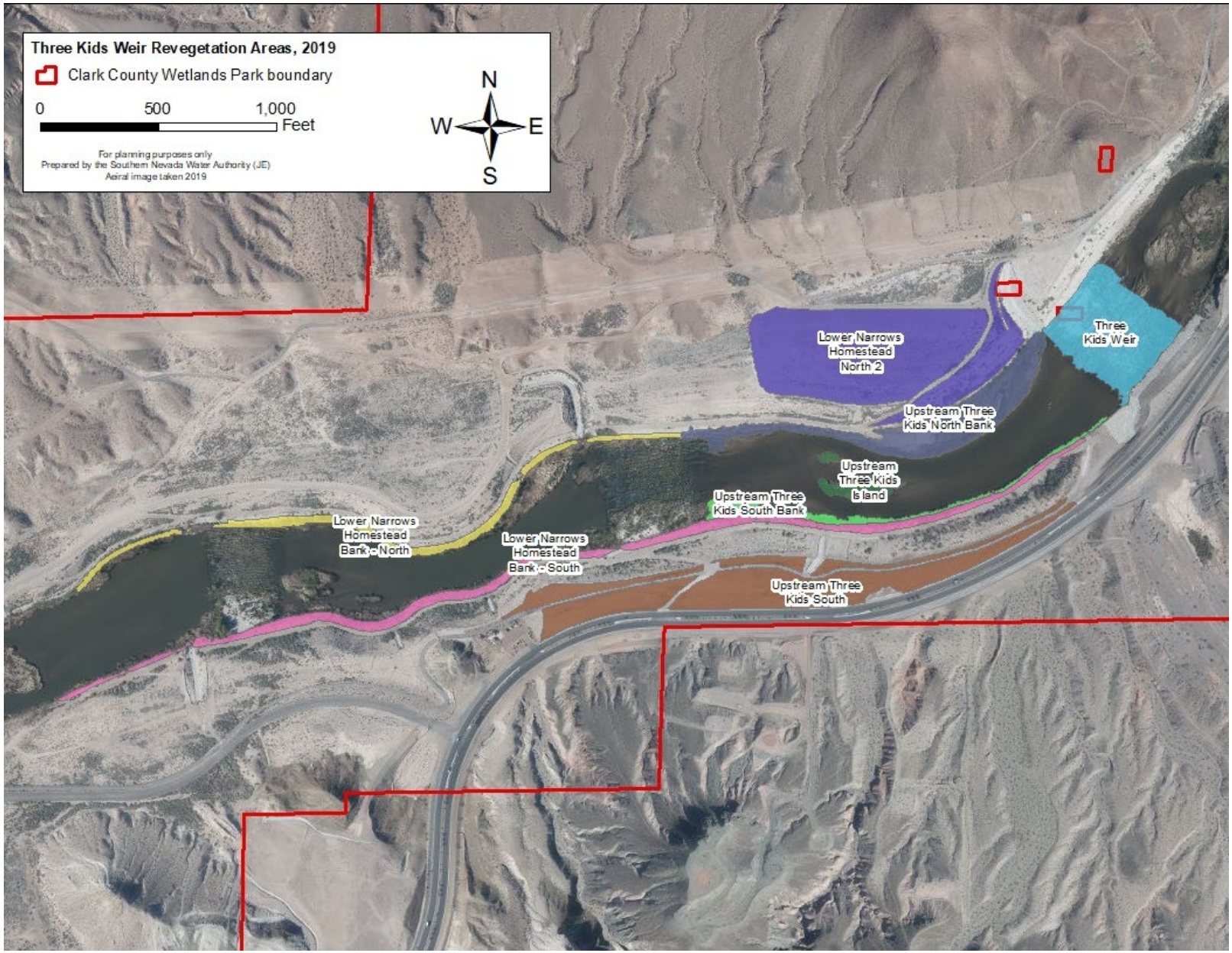

Figure 32. Aerial photograph of 2019 delineated Three Kids Weir revegetation sites.

Figure 33. Saltlover at U3KS in 2019

Emergent (TWE) includes the passively established wetlands on the two banks upstream and downstream of the weir.

The oldest site at the Tropicana Weir, TW1, remained at the 75-100% total cover range in 2019 as it had in 2018 (Figure 35). The species richness decreased from 37 species to 26 species between the two years. The total cover remained high due to the growth of the remaining species. The dominant species bassia which had 50-75% cover which is the highest cover this exotic weed had on any site along the Wash. In 2018, this species had only 1-5% cover. This substantial increase can be attributed to continued irrigation of the site, the shallow depth to groundwater, and a large source population at nearby sites. Contractors were asked to work on removal after the 2019 monitoring concluded and most were removed. Monitoring in 2020 will show if this is a recurring issue or if these removal efforts along with growth of native plants will successfully decrease the spread of this weed.

The second site planted, as well as the second Green-Up, at the Tropicana Weir was TW2. The 2019 monitoring was the first year it was monitored. At 10.29 acres, it was difficult to monitor all

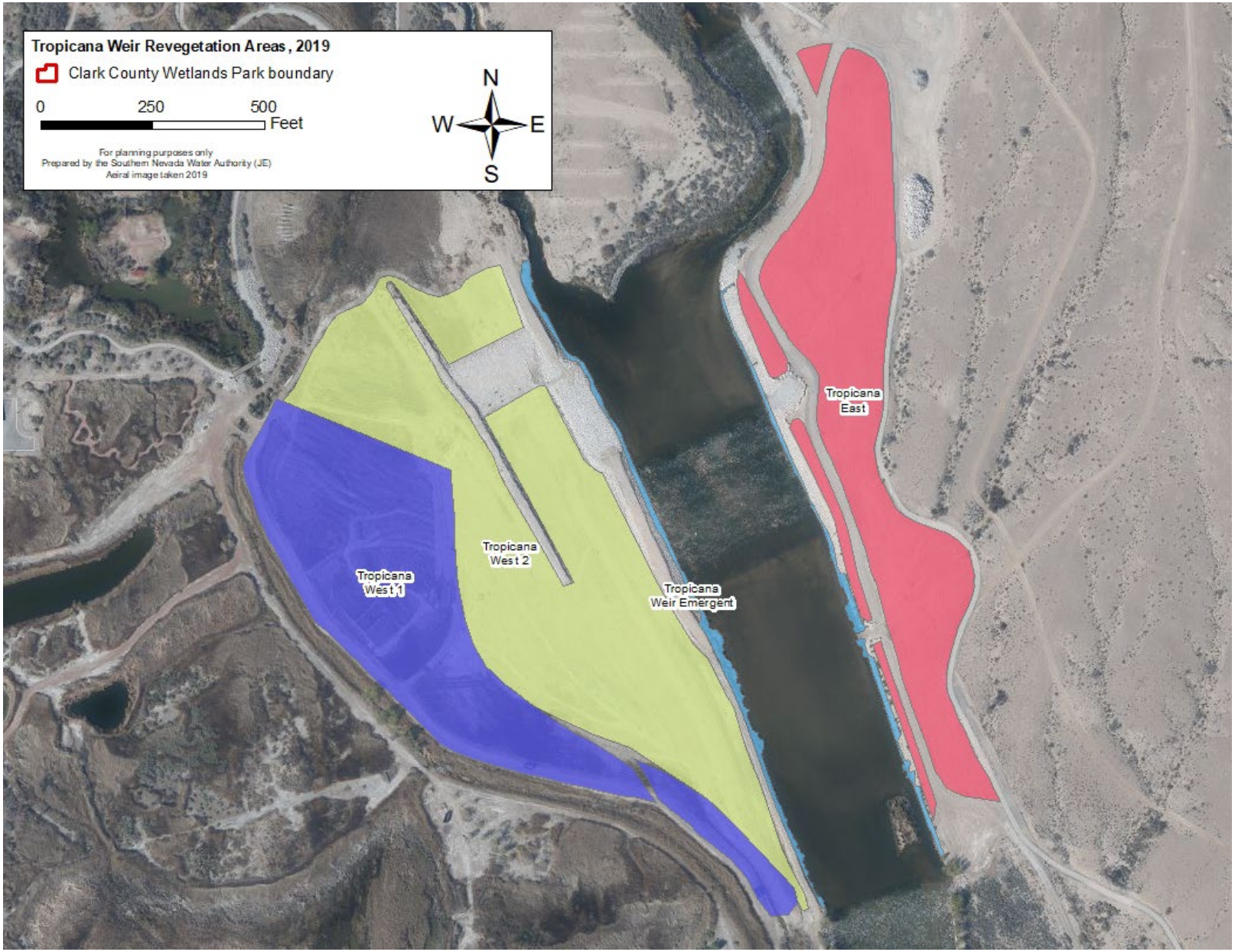

Figure 34. Aerial photograph of 2019 delineated Tropicana Weir revegetation site.

at once. In addition, there were three distinct areas where different plant types were planted. As a result, the site was separated into three monitoring areas and a weighted average was used to calculate the total cover of the site. The area downstream of the lateral weir associated with the Tropicana Weir was primarily planted with alkali sacaton to reduce impact from woody vegetation on flows. The area directly west of this area had shrubs and mesquite trees added to the same sacaton grass. The third area was upstream of the lateral weir and had a shallower depth to groundwater which allowed for the planting of riparian vegetation. The dominant species the monitoring area closest to the Wash was alkali sacaton. The dominant or co-dominant species on the other two areas, as well as the site as a whole, was bassia. Just like with TW1, substantial management took place to remove these non-native weeds after monitoring took place in the fall of 2019.

Figure 35. Dense and Diverse vegetation at Tropicana West 1 in 2019.

The newest site planted along the Wash prior to 2019 monitoring was TE which was a Green-Up event in the spring of 2019. In the approximately six months since planting, the site had 25-50% vegetative cover across its 6.92 acres. The two dominant plants on this site were planted at the Green-Up; brittle bush (*Encelia farinosa*) and four-wing saltbush. Both species had 5-25% cover and were the only species over 5% cover out of all of the 30 species identified on the site.

There are plans for active planting of the TWE site as has been done with other bank lines near newly completed weirs but at the time of 2019 monitoring only passively established vegetation was present (Figure 36). At nearly one year old, these areas had grown to 0.73 acres. The monitoring area is established by mapping the location of the vegetation and as a result is 75-100% cover. The dominant species on both the east and west side of the channel was southern cattail. The second most prevalent species in terms of cover was bassia. Due to the difficulty accessing portions of the site, limited removal took place. It is presumed that the removal of bassia on TW1 and TW2 will reduce the future establishment, future monitoring will show if true.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
TE	1	6.92	non-wet	25-50%	0.5%	30	2.35
TW1	2	7.28	wet	75-100%	0.6%	26	2.85
TW2	1	10.29	wet	81.2%	0.8%	25	3.27
TWE	1	0.73	wet	75-100%	2.9%	37	2.23

[1]TE=Tropicana East, TW1=Tropicana West 1, TW2=Tropicana West 2, TWE=Tropicana Weir Emergent

[1]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[2]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland
nm = this attribute was not monitored

Table 21. Vegetation monitoring results for the Tropicana Weir revegetation site in 2018.

Figure 36. Looking from the east side of the Wash upstream of the Tropicana Weir in 2019.

3.20 Upper Diversion Weir

Only one of the eight revegetation sites at the Upper Diversion Weir were monitored in the field in 2019 (Table 22, Figure 37), Upper Diversion Island (UDI). The remaining seven sites were monitored using ArcGIS. This 5.05-acre site was planted as part of a Green-Up event in the fall of 2008. Now in its 11th growing season, the site has 75-100% plant cover and had its highest species richness of 17 species recorded in both 2017 and 2019. It is highly unusual for non-wetland sites to increase in cover after becoming relatively mature. New species in 2019, including castorbean (*Ricinus communis*; Figure 38), may explain some of the reason. Overflow from under the Upper Diversion Weir / bridge creates cuts and pools on the UDI site. This disturbance brings in seeds and creates a substrate ideal for plants to establish i.e. scouring existing plants and bringing in water.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
DUDE	11	2.38	wet	75-100%	nm	nm	nm
DUDN	11	9.76	non-wet	50-75%	nm	nm	nm
DUDS	11	1.43	wet	75-100%	nm	nm	nm
UDI	11	5.05	non-wet	75-100%	1.3%	18	3.77
UDIE	11	0.35	wet	50-75%	nm	nm	nm
UDIS	11	0.22	non-wet	75-100%	nm	nm	nm
UUDE	11	1.93	wet	75-100%	nm	nm	nm
UUDS	11	0.77	non-wet	75-100%	nm	nm	nm

[1]DUDE=Downstream Upper Diversion Emergent, DUDN=Downstream Upper Diversion North, DUDS=Downstream Upper Diversion Shelves, UDI=Upper Diversion Island, UDIE=Upper Diversion Island Emergent, UUDE=Upstream Upper Diversion Emergent, UUDS=Upstream Upper Diversion South, UDIS=Upstream Upper Diversion Island South

[1]Wetland status resulting from a JD (i.e., jurisdictional determination) conducted according to the Corps' 1987 Wetland Delineation Manual. "wet" = wetland and "non-wet" = non-wetland

[2]Wetland Prevalence Index (WPI) value. WPI≤2.0 =wetland, 2.0<WPI<2.5 = likely wetland, 2.5≤WPI<3.5 = may be wetland, 3.5≤WPI<4.0 = not likely a wetland, and WPI≥4.0 = upland

nm = this attribute was not monitored

Table 22. Vegetation monitoring results for Upper Diversion Weir revegetation sites in 2019.

4.0 CONCLUSIONS

For comprehensive environmental programs such as what is being done along the Wash there are various goals and multiple facets of each goal. This monitoring report is designed to describe how the Wash program is doing in relation to some of the quantitative measurements of native plant restoration. In simple terms, the revegetation program as a whole and on individual sites, success is when there is an increase in native plant cover up to a level that is sustainable absent of management, survivorship of planted plants, and an ongoing control or reduction of noxious weeds. More difficult to measure goals include providing wildlife habitat and that the overall ecological health of the system is increasing. However, wildlife surveys plus the summation of the other measurements should give managers and stakeholders an idea of the health of the system.

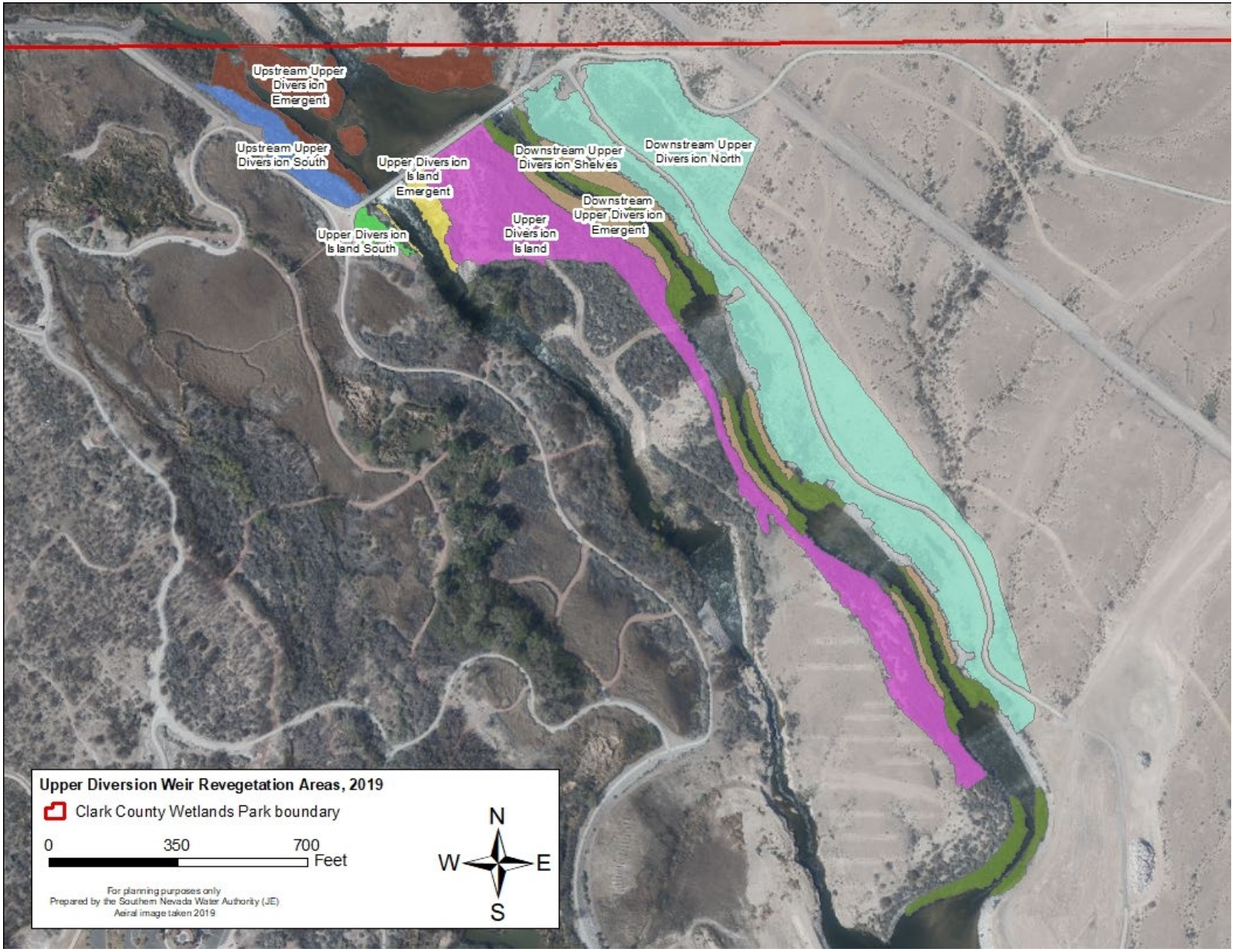

Figure 37. Aerial photograph of 2019 delineated Upper Diversion Weir revegetation sites.

Of the 137 total sites monitored, (S108, S111, and CCWRD are considered one site each), 100 (73.0%) had the same cover as they did in 2018, 23 (16.8%) increased in cover, and 11 (8.0%) decreased in cover. The remaining 3 sites (2.2%) were first monitored in 2019. These sites were all located at the Tropicana Weir; TW2, TE, and TWE. ArcGIS was used to measure the total cover for 67 (48.9%) of the sites.

5.0 RECOMENDATIONS

Annual monitoring for the vegetation provides many years of data to compare and contrast. As a result, there are only a few sites where declines in total plant cover are a concern. As with individual sites and even individual species, single year increases or declines are not of major concern to a large restoration project such as that occurring along the Wash. Sites that need to have closer examination in future years include CC1 which had 75-100% cover but over 15% were noxious weeds and cottonwoods are declining in cover. While the cottonwoods may not need to be replaced entirely, a combination of weed treatment and replacement of native plants needs to take place to keep this site successful. Two sites not monitored in 2019 that need close examination in 2020 are Lower Narrows Homestead North 1 and Lower Narrows Homestead North 2. These two Green-Up sites had just 25-50% cover which is a declining trend for both sites. Supplemental planting is likely necessary.

Figure 38. A new species for the Wash, castor bean, was found at Upper Diversion Island in 2019.

Site 108 had its lowest total cover in many years. Each of the four areas broken down by funding source also had their lowest total cover in many years. Some of this can be attributed to the removal of areas with denser vegetation as part of the construction of the Sunrise Mountain Weir which was completed at the end of 2018. Current plans call for planting the south side of the Sunrise Mountain Weir in 2021. This may be a good opportunity to do supplemental planting or seeding across Site 108 which is located just to the west.

The three non-emergent sites at the Tropicana Weir all had high amounts of the exotic weed bassia in 2019. While substantial removal has already taken place, regular monitoring and weeding must take place in order to prevent larger infestations which would make it harder to control. The

emergent site at the Tropicana Weir, TWE, needs to be planted with native vegetation to both control the spread of less desirable species as well as create additional wildlife habitat.

The final weirs had their construction completed in 2018. First was the Historic Lateral Weir expansion, which had the north side planted as a Green-Up in the fall of 2019 and the south side is planned to be planted by a variety of Girl Scout Gold Star Award projects. The Sunrise Mountain Weir has one of the largest combined planting areas of any weir with over 20 acres on each of the north and south sides. These areas are planned to be planted through a series of four Green-Up events. The first event, on the north side of the weir, was scheduled for the spring of 2019 but was canceled. It is currently scheduled for the fall of 2019. The weir should be completed with revegetation activities in the spring of 2022. Additional planting needs to be done on both of these weirs along the banks with pole plantings and emergents to create wildlife habitat and compete fewer desirable species including noxious weeds.

For the existing sites, a long-term management plan has been developed to address wildlife habitat improvements, additional planting needs, noxious weed removal, trash removal and more (Eckberg 2019b). This plan should be utilized as a guide for how the Wash revegetation program will be move forward after the initial plantings have concluded at the Historic Lateral and Sunrise Mountain Weirs. However, some steps laid out in the plan can be incorporated concurrently with these projects if time and funding are available.

6.0 LITERATURE CITED

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