



Las Vegas Wash Vegetation Monitoring Report, 2021

December 2023



SOUTHERN NEVADA
WATER AUTHORITY®

Las Vegas Wash
Coordination
Committee



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**Las Vegas Wash
Vegetation Monitoring Report, 2021**

**SOUTHERN NEVADA WATER AUTHORITY
Las Vegas Wash Project Coordination Team**

Prepared for:

Las Vegas Wash Coordination Committee

Prepared by:

**Julia Lantow
Southern Nevada Water Authority
100 City Parkway, Suite 700
Las Vegas, Nevada 89106**

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ABSTRACT

For more than 20 years, revegetation efforts along the Las Vegas Wash have been a primary component in helping to meet the goals of the Las Vegas Wash Coordination Committee. From August through October of 2021 monitoring for this report took place. During surveys, approximately 306 acres of revegetation across 78 sites were monitored. These sites were broken up into 95 monitoring areas. The remaining 76 sites were monitored for total cover using ArcGIS.

Sites ranging in age from 1 to 21 growing seasons had total cover, noxious species cover, species richness, and Wetland Prevalence Index documented. Of the 78 sites monitored in the field, 49 (62.8%) had the same cover as they did in the previous field monitoring season, 12 (15.4%) increased in cover, and 12 (15.4%) decreased in cover. The remaining 5 sites (6.4%) were first monitored in the field in 2021. These sites were all located at the Historic Lateral and Sunrise Mountain weirs. ArcGIS was used to measure the total cover for the remaining 76 (49.4%) sites. Most older sites have matured to a point that vegetative cover does not change much between growing seasons.

ACKNOWLEDGMENTS

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, I would like to thank David Syzdek and Linda Shapiro for their assistance in monitoring of revegetation sites. I thank Nick Rice for creating the maps and all of his work he has done on this report. A special thank you for Jason Eckberg for his guidance, expertise and help throughout the monitoring season and especially while writing this report. Thank you, Keiba Crear, for being a central figure in advocating for rigorous monitoring and proper maintenance. 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.

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1.0 INTRODUCTION

1.1 Background

A citizens advisory committee was assembled in 1997 by the Southern Nevada Water Authority (SNWA) to evaluate water quality issues in the Las Vegas Wash (Wash), Las Vegas Bay, and Lake Mead. From this, the Las Vegas Wash Coordination Committee (LVWCC), a 28-member stakeholder group consisting of federal, state, and local agencies; the University of Nevada, Las Vegas; private businesses; environmental groups; and citizens, was formed. The LVWCC created the Las Vegas Wash Comprehensive Adaptive Management Plan (CAMP) (LVWCC 2000; Figure 1) to help guide stabilization and enhancement activities along the Wash. 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. Wetland, riparian, and upland vegetation has been planted to help further protect the Wash from erosion, as well as to improve the functional attributes of the ecosystem.

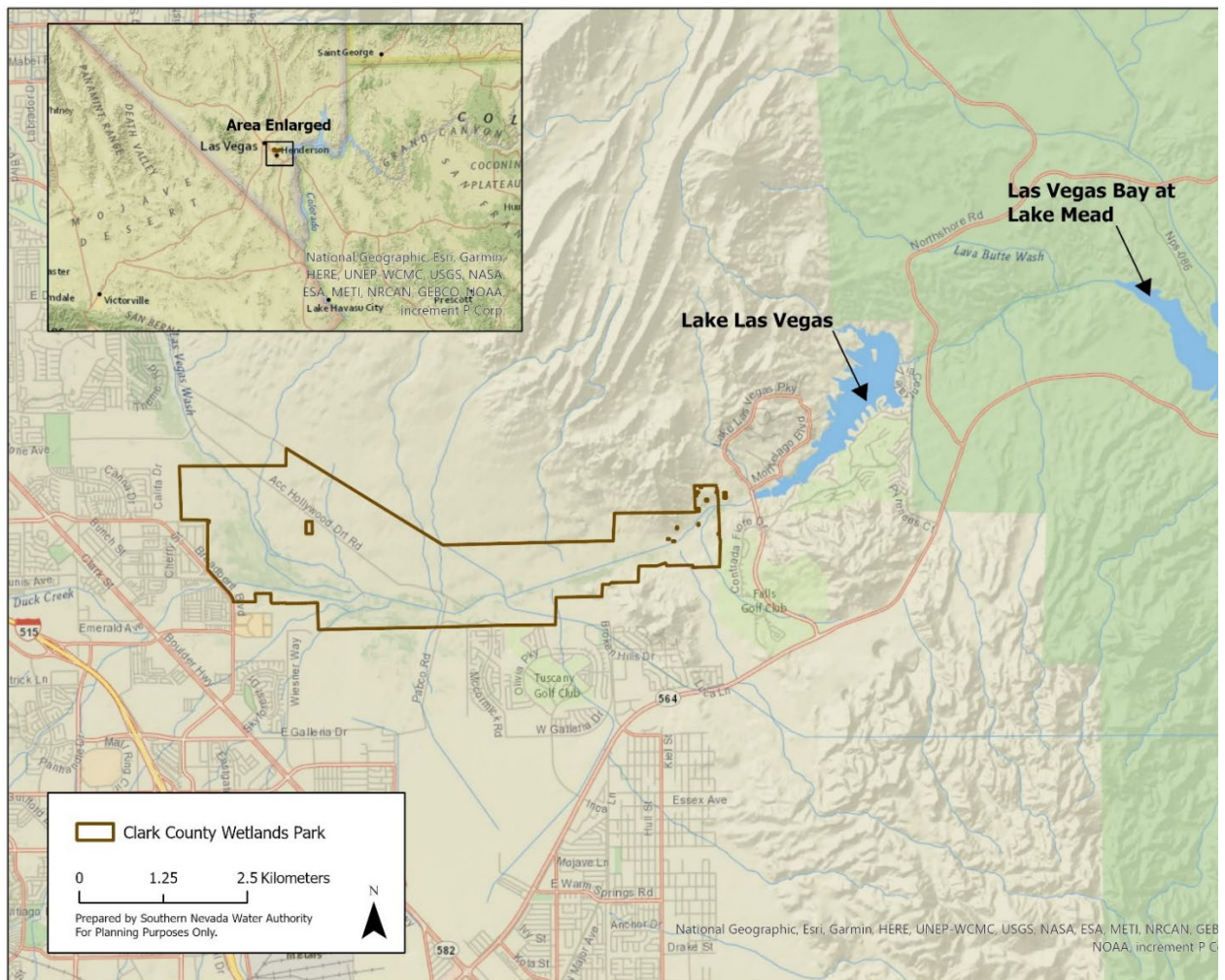


Figure 1. Las Vegas Wash location and general study area map.

The revegetation program plays a critical role in the overall plan to stabilize and enhance the Wash. Plants act as soil anchors during flood events by binding their roots to soil particles on the surface, subsurface and in deep subsurface horizons. It has been documented that a variety of wildlife species benefit from these revegetation efforts (Great Basin Bird Observatory 2020, Van Dooremolen 2021, Lantow 2020). At the time when the erosion control project began along the Wash, there were few native plants found along its banks, especially wetland and riparian species (LVWCC 2000). Salt Cedar (*Tamarix ramosissima*; a.k.a., tamarisk) and exotic species successfully established in the area and became the dominant species. At its peak, salt cedar covered approximately 1,500 acres along the Wash. 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 2021 data as part of a comprehensive vegetation monitoring program. Vegetation monitoring results from 2002 through 2020 have been previously documented (SNWA 2005, Eckberg and Shanahan 2008, Eckberg 2022); 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 619 acres were monitored in 2021. All of these revegetation project sites are located within the boundaries of the Clark County Wetlands Park (Wetlands Park; Figure 2).

1.3 Need for Revegetation and Vegetation Monitoring

Revegetation projects along the Wash are not only conducted because of their environmental benefits but are also required for permitting purposes. 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 require revegetation to occur for Wash erosion control projects. NDEP issued general stormwater permits for Wash construction activities and permits require that final site stabilization is achieved. Vegetative 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.”

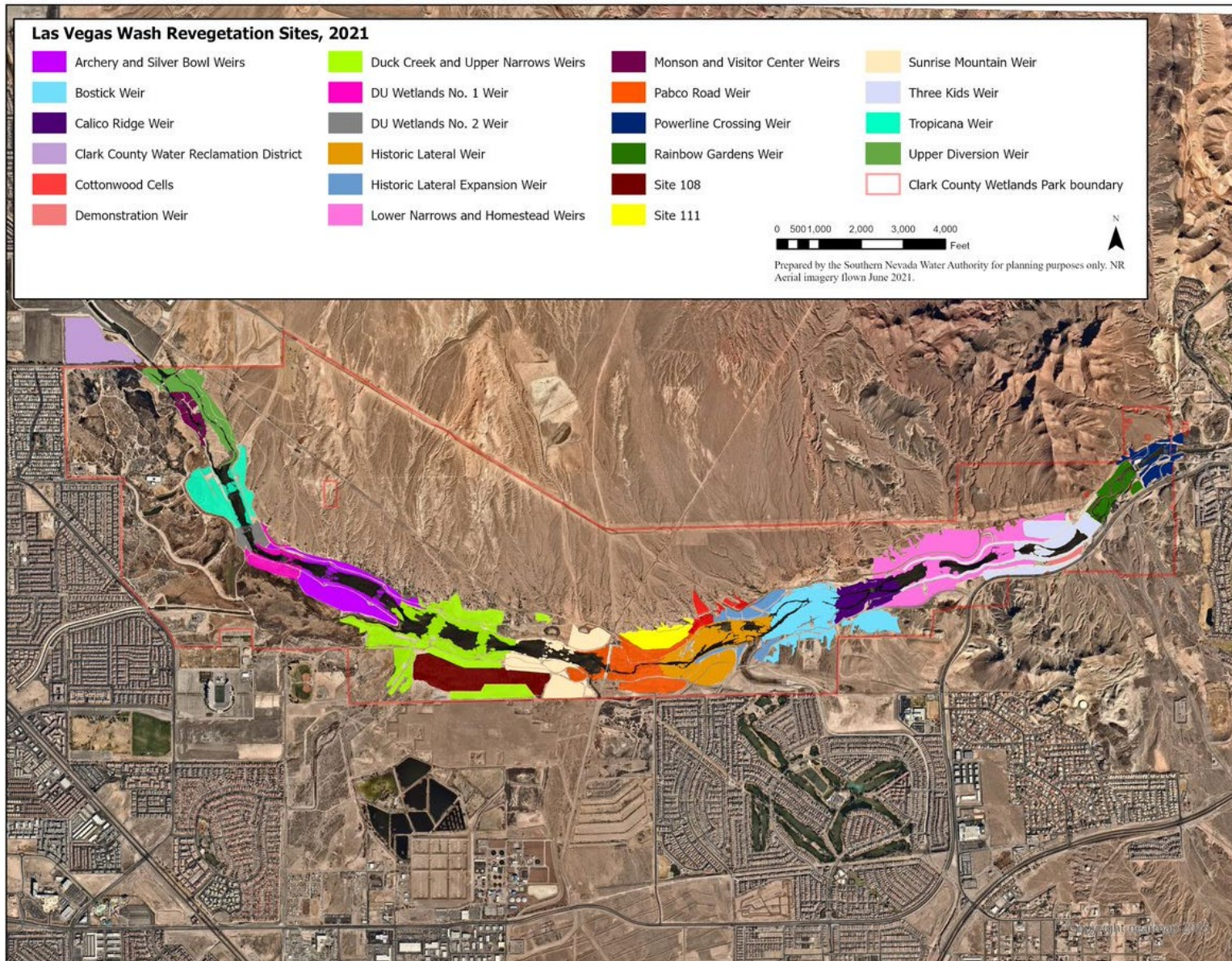


Figure 2. Location of the 2021 Las Vegas Wash revegetation sites.

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 for the same criteria and with the same general methodology.

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.

Finally, data from past revegetation efforts along the Wash inform future decisions. Knowledge of which species are regularly successful and those that rarely survive without substantial human interventions provides information on which species should be used in future restoration efforts. This both allows for the most successful revegetation projects possible and ensures the funds being used in these efforts is done so responsibly.

1.4 Program Funding

Major sources of funding for revegetation projects along the Wash have been the Las Vegas Wash Capital Improvements Plan (Wash CIP), state and federal grants, Clark County (primarily for specific projects related to the Wetlands Park), and the LVWCC operating budget. The Wash CIP has funded 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 BOR, 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, V, and VI). Once revegetation sites are initially established, funding for ensuring their success has been provided by BOR grants and the LVWCC operating budget.

This report marks the final year of funding from the Wash CIP and moving forward revegetation efforts along the Wash will be funded by the Wash long term operations budget, as well as state and federal grants. Funding through the long-term operations budget will begin in July of 2022, this will also be when long-term management activities begin. You can read more about this in section 1.5.7.

1.5 Typical Revegetation Establishment Activities

1.5.1 Planning

Most revegetation sites along the Wash were established in association with the construction of erosion control structures. Plant selection and irrigation design were done in conjunction with the

engineering plans for the site. Hydroseed was included in the construction of the erosion control structures. Hydroseeding represented the final step in the construction process and the initial step in most revegetation projects. Species were specifically selected to be most successful on each weir site. Procedures were described in construction plans to include tackifier, mulch, and fertilizer along with the seeds themselves.

1.5.2 Plant Procurement

After plants are selected, procurement activities 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). Local nurseries, such as Mountain State Wholesale Nursery and the Nevada Division of Forestry have provided most plants for this work. Plants grown by the Wash Team involve collecting seed or cuttings, establishing the seedlings, transplanting them into larger containers, irrigating, and delivering them back to the Wash for final planting. With revegetation activities taking place for more than 20 years, there are now sufficient native species established along the Wash to procure seeds and cuttings and going to surrogate areas are no longer needed. 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

Prior to revegetation efforts, most 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 other invasive species that are found on sites and require constant monitoring are tall whitetop (*Lepidium latifolium*), silverleaf nightshade (*Solanum elaeagnifolium*), giant reed (*Arundo donax*), Malta starthistle (*Centaurea melitensis*), and Johnsongrass (*Sorghum halepense*). Without removal, the native species used in revegetation efforts 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.

Other species that are closely monitored because of their ability to grow vigorously and outcompete revegetated plants are common reed (*Phragmites australis*) and quailbush (*Atriplex lentiformis*). Quailbush is a native species, while the Wash has both native and non-native common reed as well as hybrids of the two (Saltonstall et al. 2016). The goal with these species 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 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 biodiesel powered pumps to a single mainline and then to multiple lateral lines that are fitted with or drip irrigation tubing. Past efforts also included spray irrigation.

Over the years, the sizes of the sites that are irrigated have ranged from under 1 acre to almost 60 acres. Regular checks and maintenance on irrigation system components is critical to ensure the water is reaching the plants. On average, southern Nevada gets less than five inches of rain annually, so a break in the irrigation system could be detrimental to the plants health and the overall successful of the site. Irrigation maintenance includes fixing leaks, tightening connections, and fixing or replacing broken pipes or heads.

1.5.5 Trash Removal

Trash along the Wash is prevalent and caused by flood events, wind, and illegal dumping. Although illegal dumping has decreased over the years, its presence is still there. If this trash ends up at a newly established revegetation site, it can hinder the site's success. The Clark County Wetlands Park (CCWP), which encompasses the Wash, has grown in popularity over the years which may be a reason for the decrease in illegal dumping. Or perhaps in part due to the revegetation program making the Wash a more scenic location. In addition, the public outreach program has helped educate the community about the Wash, its importance, and why we should keep it clean.

1.5.6 Herbivore Control

Fencing was installed on some revegetation sites to help reduce the damage caused by beavers and rabbits. Some sites have a single fence that goes around the sites entirety while other sites have individual fences for each plant. Both situations require continual inspection for damage, have repairs made, and have adjustments made to the spacing of the fences to reduce plant damage. Once a site is considered fully established, the fencing is typically removed. Only a few locations at the Wash still have fencing, these sites should be inspected and if deemed appropriate all fencing should be removed.

1.5.7 Long-Term Management

In 2019, the Las Vegas Wash Long-Term Revegetation Plan (Eckberg 2019) was created to help identify activities that would improve revegetation sites along the Wash after their initial establishment is completed. Initial establishment activities are scheduled to be completed in the spring of 2022 and this report will be the final report of these initial efforts. Moving forward, our annual reports will focus on the long-term revegetation efforts that occur along the Wash.

In general, the long-term revegetation plan focuses on how to improve the ecological function of revegetation sites including diversifying plant structure types and plant species, increasing wildlife benefits in the form of food and shelter, and removing undesirable species and trash from the sites.

2.0 MATERIALS AND METHODS

Monitoring was conducted between August and October 2021, following the same guidelines as previous years (Eckberg and Shanahan 2009). As of August 2021, there were 82 wetland and 72 non-wetland revegetation sites. Many larger sites were broken up into multiple monitoring areas

(Table 1). These smaller monitoring areas have their information combined using a weighted average, with acreage as the weight, of cover statistics to properly combine sites of different sizes.

ArcGIS was used to monitor 76 of the 154 total revegetation sites in 2021 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 Eckberg and Shanahan (2009) or if on the ground obstacles prevent in person monitoring.

3.0 RESULTS AND DISCUSSION

The following subsections describe monitoring results for each site and for groupings of sites. From 2020 to 2021, the number of areas monitored increased by 9 and the acreage increased by just over 39 acres (Table 1). The total areas and acreage include sites monitored in the field as well as with ArcGIS.

Cumulatively, there have been 134.46 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. In the table below, some individual project results show the wetlands created does not meet the required acreage. For these instances, multiple projects were combined to meet the required acreage. 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 (Figure 3, Table 3). The revegetation for these weirs was also done simultaneously and there is no separation between the two weirs for revegetation sites (Figure 3). In 2021, all revegetation sites were monitored in field except for both weirs. The two weir sites, Archery Weir (AW) and Silver Bowl Weir (SBW), include the passively established wetland vegetation on the weirs themselves, have only been monitored using ArcGIS.

2020 Survey Year

Major Site	Acreage	No. of Monitoring Areas
Archery and Silver Bowl Weirs	37	9
Bostick Weir	50.2	15
Calico Ridge Weir	18	11
CCWRD	28.4	1
Cottonwood Cells	8.3	9
Demonstration Weir	2.3	2
Duck Creek Confluence and Upper Narrows Weirs	85.1	13
DU Wetlands No. 1 Weir	13.5	5
DU Wetlands No. 2 Weir	6.3	5
Historic Lateral Weir	38.2	14
Historic Lateral Expansion	13.1	6
Lower Narrows and Homestead Weirs	70.8	8
Monson and Visitor Center Weirs	8.6	4
Pabco Road Weir	39.2	18
Powerline Crossing Weir	14	17
Rainbow Gardens Weir	12.8	8
Site 108	38.9	59
Site 111	14.9	26
Sunrise Mountain Weir	23.1	7
Three Kids Weir	34	8
Tropicana Weir	28.2	6
Upper Diversion Weir	24.8	24
TOTAL	609.16	275

2021 Survey Year

Major Site	Acreage	No. of Monitoring Areas
Archery and Silver Bowl Weirs	37.1	9
Bostick Weir	49.6	15
Calico Ridge Weir	18.1	12
CCWRD	27.9	1
Cottonwood Cells	8.2	9
Demonstration Weir	2.3	2
Duck Creek Confluence and Upper Narrows Weirs	70.8	13
DU Wetlands No. 1 Weir	13.2	5
DU Wetlands No. 2 Weir	6.3	5
Historic Lateral Weir	36.8	14
Historic Lateral Expansion	11.1	6
Lower Narrows and Homestead Weirs	70.8	8
Monson and Visitor Center Weirs	8.5	4
Pabco Road Weir	38.7	18
Powerline Crossing Weir	14.0	17
Rainbow Gardens Weir	13.1	8
Site 108	38.2	59
Site 111	14.9	18
Sunrise Mountain Weir	4.5	5
Three Kids Weir	33.9	8
Tropicana Weir	27.7	6
Upper Diversion Weir	24.1	24
TOTAL	569.7	266

Table 1. Change in cumulative acreage monitored and number of monitoring areas from 2020 to 2021.

Mitigation Project	Mitigation Permit Number	Mitigation Required (acres)	Wetland Area Created (acres)
Archery and Silver Bowl Weirs	SPK-2011-00796-SG	0 ^c	7.28
Bostick Weir	200125114	7.88	20.99
Calico Ridge Weir	200450004	3.80	10.29
Clark County Water Reclamation District	SPK-2009-00227-SG	6.79	5.99^a
Cottonwood Cells	N/A	—	3.16^b
Demonstration Weir	199825148	0.90	0.54
Duck Creek Confluence and Upper Narrows Weirs	SPK-2009-00042	1.33	22.97
DU Wetlands No. 1 Weir	SPK-2010-00285-SG	1.22	4.21
DU Wetlands No. 2 Weir	2007-1961-SG	0.05	1.72
Historic Lateral Weir	199825148	4.90	18.59
Historic Lateral Expansion	SPK-2014-01108	0 ^c	0.42
Lower Narrows and Homestead Weirs	SPK-2008-01417-SG	6.25	13.66
Monson and Visitor Center Weirs	200250111	4.81	1.90
Pabco Road Weir	199725375	2.20	12.37
Powerline Crossing Weir	200450454	4.87	2.99
Rainbow Gardens Weir	200250054	1.00	9.09
Sunrise Mountain Weir	SPK-2014-01108	0 ^c	4.05
Three Kids Weir	SPK-2012-01138-SG	0 ^c	17.4
Tropicana Weir	SPK-2016-00293	0 ^c	21.25
Upper Diversion Weir	200550514	0.01	8.66
Bank Protection Projects	—	7.06	—
TOTAL		53.07	187.53

^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 2021.

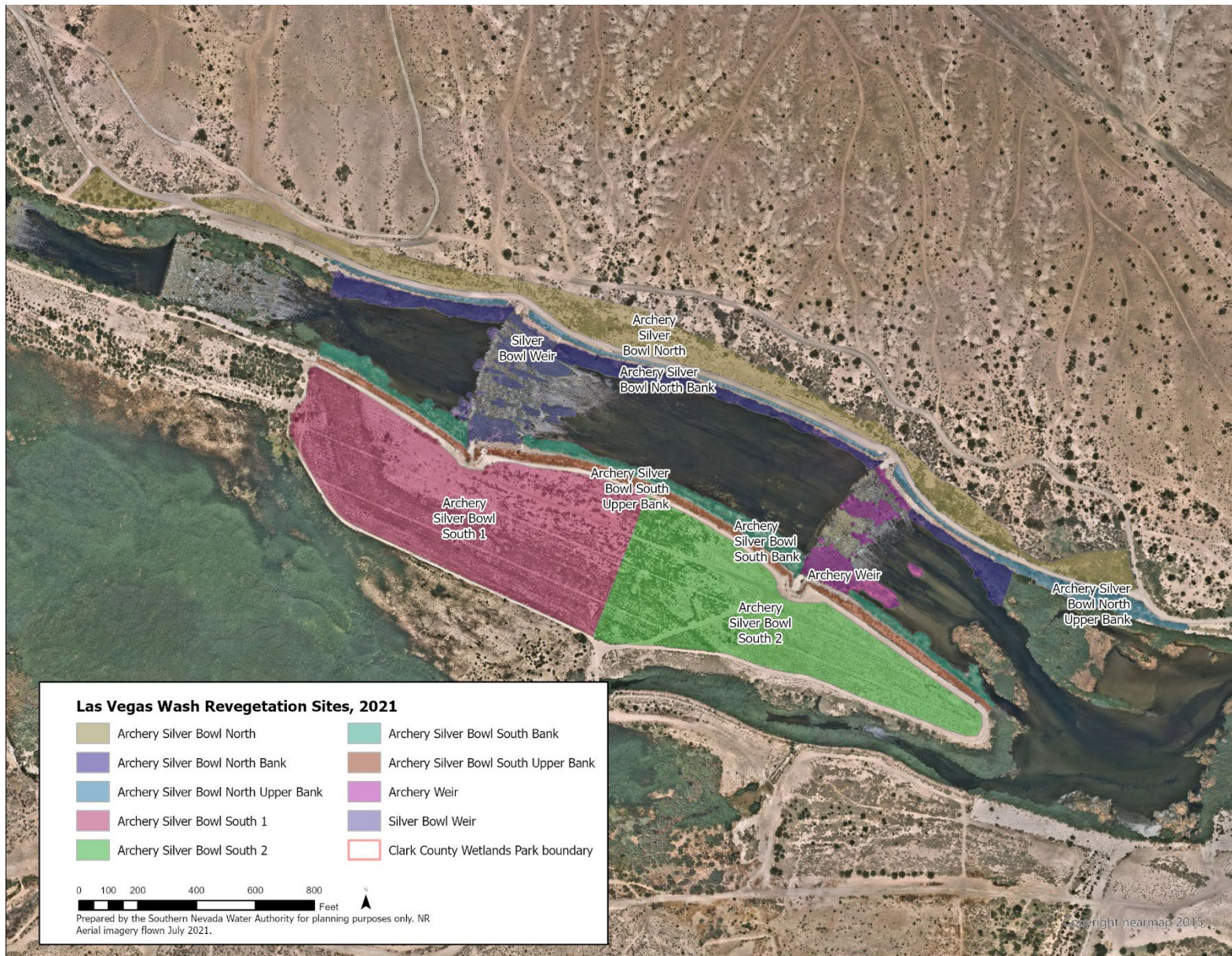


Figure 3. Aerial photograph of 2021 delineated Archery and Silver Bowl weirs revegetation sites.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
ASBN	6	6.48	non-wet	75-100%	0.5%	20	4.06
ASBNB	6	2.53	wet	75-100%	0.7%	20	1.69
ASBNUB	6	1.59	non-wet	50-75%	0.5%	8	3.80
ASBS1	6	11.41	non-wet	75-100%	0.5%	5	3.86
ASBS2	6	8.60	non-wet	75-100%	0.5%	5	3.85
ASBSB	6	2.29	wet	75-100%	15.1%	18	2.22
ASBSUB	6	1.59	non-wet	75-100%	0.0%	5	3.84
AW	5	1.11	wet	75-100%	nm	nm	nm
SBW	5	1.36	wet	75-100%	nm	nm	nm

¹ASBN= Archery Silver Bowl North, ASBNB= Archery Silver Bowl North Bank, ASBNUB= Archery Silver Bowl North Upper Bank, ASBS1= Archery Silver Bowl South 1, ASBS2= 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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

nm = this attribute was not monitored

Table 3. Vegetation monitoring results for Archery and Silver Bowl weirs revegetation sites in 2021.

The total cover from 2020 to 2021 drastically improved at Archery Silver Bowl North (ASBN) and Archery Silver Bowl South 2 (ASBS-2) sites. These sites were previously monitored using ArcGIS in 2020 and were likely mislabeled due to the inability to identify the main species present, desert saltbush (*Atriplex polycarpa*) with aerial imagery. At these sites, desert saltbush made up 62.5% and 87.5% total cover, respectively.

The two weir sites, AW and SBW, had all of the vegetation removed from the face of the weirs in 2019 as part of final configurations of the weirs. Therefore, both sites had no vegetation identified on the aerial imagery in 2019, then in 2020, the acres of vegetation of both sites were greater than any previous year. In 2021, both sites saw a very small reduction in acreage. AW had 1.16 acres of wetland vegetation in 2020 and 1.11 in 2021. SBW had 1.47 acres in 2020 and 1.36 acres in 2021. This demonstrates that while the required maintenance activity of removing vegetation from the weirs has an immediate large impact on these specific wetlands on weirs, the recovery is also very swift.

3.2 Bostick Weir

Nine of the 14 revegetation sites at the Bostick Weir were monitored in the field in 2021 (Table 4, Figure 4). Most of the sites were in the 17th or 18th growing season in 2021 and are considered well established. The only site younger than 16 growing seasons is Bostick South Tamarisk (BST) which was in its 6th growing season. Measuring over 21 acres, this is a very large site when compared to most other Wash revegetation sites, and one of the largest measured as a single monitoring area. The total cover varied from 75-100% in 2019, to 25-50% in 2020, to 50-75% in 2021. It is possible that at such a large scale it is difficult to correctly quantify the total plant cover in the field accurately. Another possible reason is that the majority of cover during field surveys comes from creosote bush (*Larrea tridentata*) which has sparse leaves and may not be picked up well in the aerial imagery. Beginning with field seasons 2023, it is recommended that BST be divided into 3 sites.

Site Code ¹	Growing Season	Acres	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
B	18	8.52	wet	75-100%	nm	nm	nm
BI	18	5.46	wet	75-100%	nm	nm	nm
BN	18	0.86	non-wet	25-50%	0.0%	6	4.46
BS	17	1.21	non-wet	75-100%	0.1%	15	3.82
BST	6	21.02	non-wet	50-75%	2.5%	24	4.53
DBN	18	0.48	non-wet	25-50%	0.1%	4	4.81
DBS	17	0.22	non-wet	50-75%	0.0%	4	4.64
DBSE	17	0.81	wet	75-100%	nm	nm	nm
UBN	18	0.56	non-wet	50-75%	nm	nm	nm
UBNB	17	2.15	wet	75-100%	nm	nm	nm
UBNE	17	1.88	wet	75-100%	2.6%	18	2.06
UBS	18	2.54	non-wet	75-100%	3.8%	22	3.23
UBS	18	2.17	wet	75-100%	2.6%	20	2.23
UBSB	17	1.71	non-wet	75-100%	0.0%	7	3.53

¹B=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

²Wetland 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

³Wetland 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 2021.

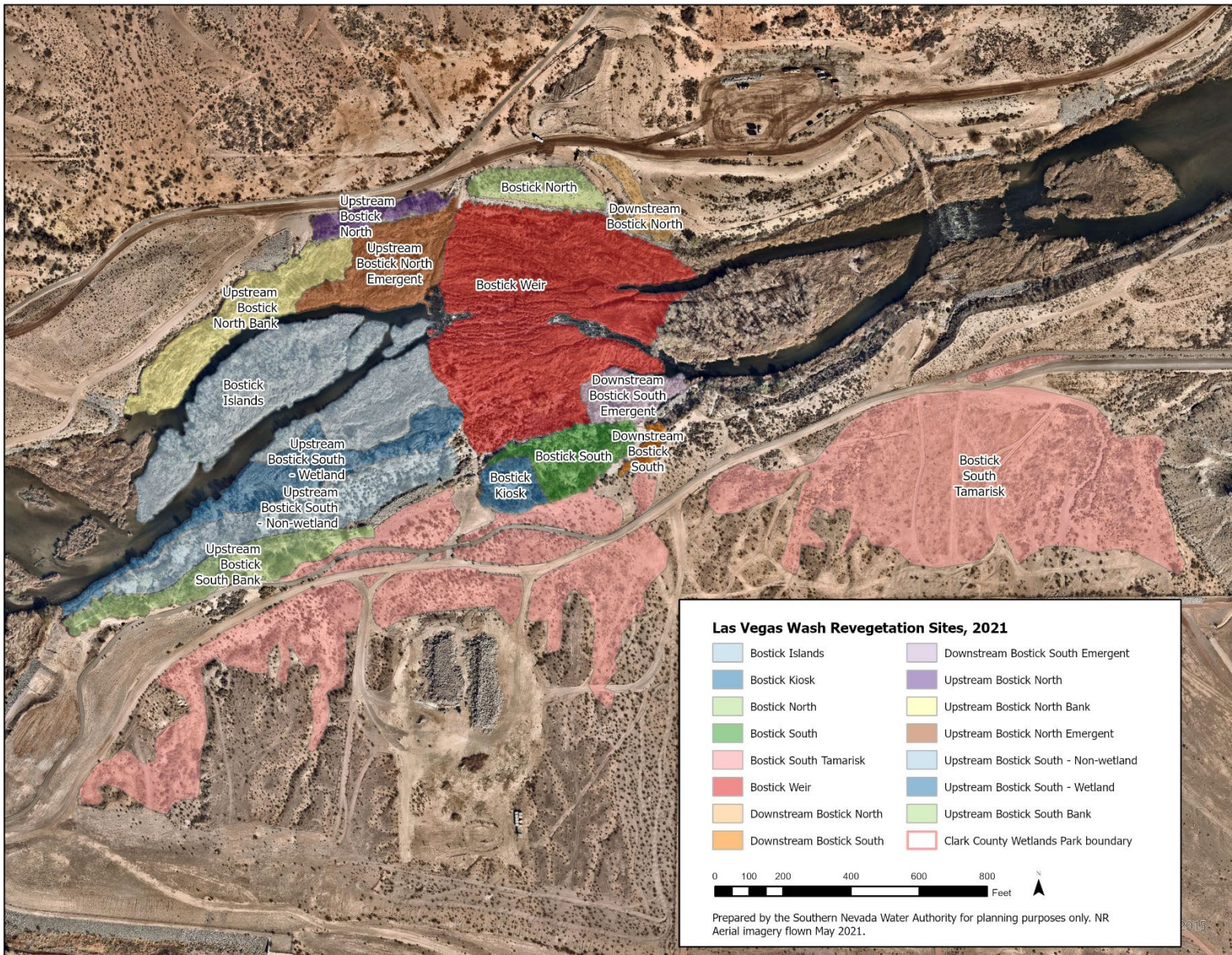


Figure 4. Aerial photograph of 2021 delineated Bostick Weir revegetation sites.

Total cover for Bostick North (BN), Downstream Bostick North (DBN), and Bostick South Tamarisk (BST) all had slight increases from 2020 to 2021. This increase could be attributed to not being able to properly identify total cover using ArcGIS. Although these sites have seen an increase, their total cover is still relatively low. Therefore, these sites are great candidates for enhancements under the Long-Term Management Plan.

3.3 Calico Ridge Weir

The Calico Ridge Weir is known as a two-stage weir. There is a typical rock rip-rap section in the center of the Wash channel, then two higher elevation components to the north and south. These two higher elevation portions being slightly above the water table have passively filled in with wetland vegetation soon after construction was completed. This site is known as Calico (C) for vegetation monitoring and is broken up into two monitoring sites, Calico north and south. The center channel has typically not had vegetation establish, likely due to the higher velocities in the narrower section. Identical to 2020, in 2021 Calico Ridge Weir (CRW) had 0.08 acres of wetlands and was included in vegetation monitoring for the second year in a row (Table 5, Figure 5).

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
C	17	2.23	wet	75-100%	nm	nm	nm
CRW	17	0.08	wet	75-100%	nm	nm	nm
DCN	17	0.66	non-wet	50-75%	0.0%	9	4.27
DCS	17	2.27	non-wet	5-25%	nm	nm	nm
DCS	17	2.36	wet	75-100%	nm	nm	nm
UCE	17	3.78	wet	75-100%	0.0%	2	1.97
UCN	17	1.91	non-wet	5-25%	nm	nm	nm
UCN	17	1.13	wet	75-100%	nm	nm	nm
UCS	17	2.89	non-wet	50-75%	nm	nm	nm
UCS	17	0.86	wet	75-100%	nm	nm	nm

¹C=Calico, CRW=Calico Ridge Weir, DCN=Downstream Calico North, DCS=Downstream Calico South, UCE=Upstream Calico Emergent, UCN=Upstream Calico North, UCS=Upstream Calico South

²Wetland 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

³Wetland 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 and Calico Ridge weirs revegetation sites in 2021.

The Calico Ridge sites are in their 17th growing season (Table 5, Figure 5), so most sites do not vary year to year in total cover. There has been a noticeable trend in total cover at Downstream Calico South – Non-Wetland (DCN-N) since 2018 and recorded its lowest cover in 2020. Survey results from 2021 show an increase in cover from 5-25% to 50-75%. The number of plant species and abundance did not vary much between the years, so this result is likely to do to changes in surveyors. In 2021, this project was moved to a new surveyor and likely overestimated the total cover for some sights. Future survey results will help determine if this site is a candidate for enhancement under the long-term management starting in 2023. Upstream Calico Emergent (UCE)

decreased from 7 total species to 2 in 2021. This site is now completely dominated by common reed making up 87.5% total cover. As a result, this site is a good candidate for enhancement under the long-term management starting in 2023. However, this site is difficult to reach so priority will go to sites that are good candidates for enhancement and also are more easily accessible.

3.4 Clark County Water Reclamation District

The CCWRD revegetation site (Table 6, Figure 6) was monitored with ArcGIS in 2021 for the third year in a row and will likely continue to be monitored this way moving forward. In 2020, it was determined that access was difficult to any interior area of the site. Although vegetation is visible along the perimeter, that vegetation would not be an accurate representation of the site. Funding is being identified to be able to remove weeds such as salt cedar which has reestablished on the site as well as larger undesirable species such as quailbush. Removing these plants should open up the access road and allow for monitoring the interior of the site. Measuring the total cover of the site using ArcGIS shows the total cover stayed the same as in 2019 and 2020, 75-100%. While there is a wetland component to the site used for mitigation of Corps permits (Table 2), there is no distinction on the ground. Therefore, the site is monitored as a single monitoring area.

Site Code	Growing Season	Acreage	Wetland Status ¹	Total Cover	Noxious Species Cover	Number of Species	WPI ²
CCWRD	12	28.42	both	75-100%	nm	nm	nm

¹Wetland 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

²Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 6. Monitoring results for the CCWRD revegetation site in 2021.

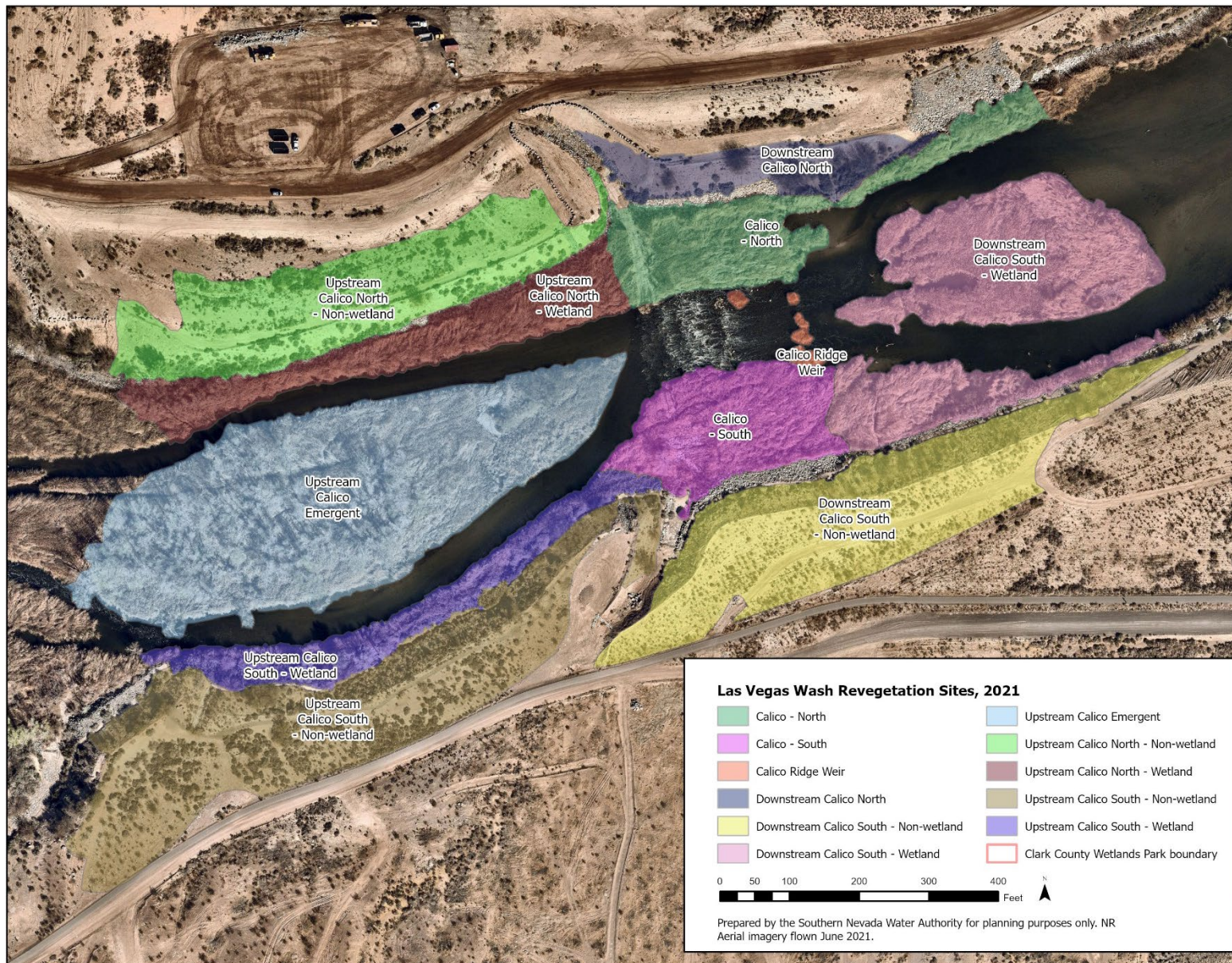


Figure 5. Aerial photograph of 2021 delineated Calico Ridge Weir revegetation sites.

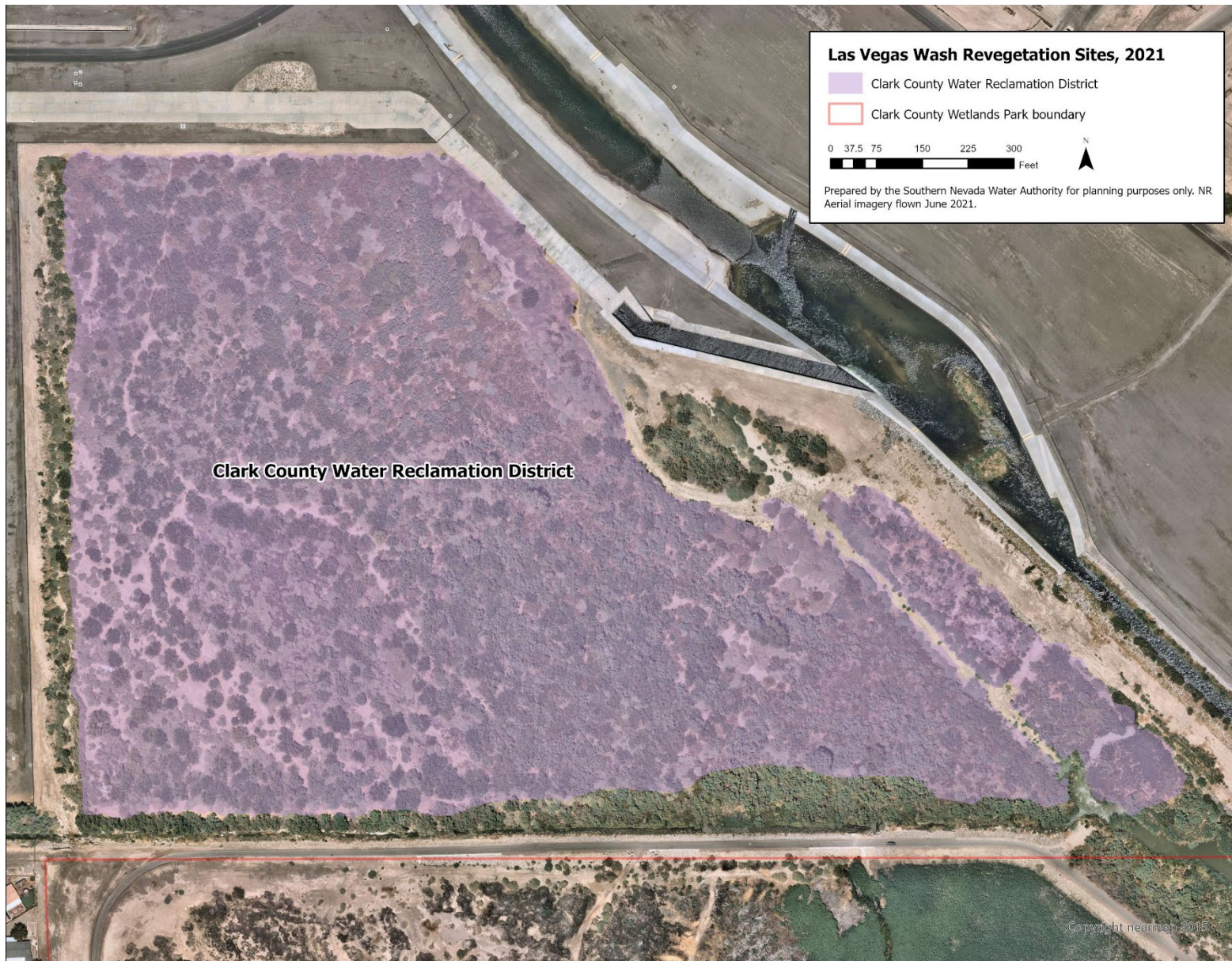


Figure 6. Aerial photograph of 2021 delineated CCWRD revegetation sites.

3.5 Cottonwood Cells

All revegetation sites at the Cottonwood Cells were monitored in the field in 2021 (Table 7, Figure 7). Four of the seven sites had the same total cover as in 2020 while Cottonwood Cell 2 (CC2) declined and Cottonwood Cell North (CCN) and Cottonwood Cell North Stockpile (CCNS) both increased. CCN is made up of three monitoring areas, two of which had increased in total cover while the third was the same as the previous year. This non-wetland site along with Cottonwood Cells North Stockpiles (CCNS) are away from the water and much of them are way above the groundwater table. CCN total cover had increased from 48.3% to 80.5% while CCNS increased from 5-25% to 50-75%. These results further suggest that the aerial imagery is unable to adequately show some of the vegetation on these upland sites.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
CC1	20	0.98	wet	75-100%	32.7%	19	2.11
CC2	17	0.53	wet	50-75%	0.5%	6	2.06
CC3	10	1.15	wet	75-100%	0.5%	18	3.27
CC3-2	9	0.40	wet	75-100%	2.5%	8	3.64
CC3-B	9	0.11	wet	75-100%	2.6%	9	2.16
CCN	10	4.38	non-wet	80.5%	0.3%	19	2.32
CCNS	10	0.76	non-wet	50-75%	0.0%	7	3.83

¹CC1=Cottonwood Cell 1, CC2=Cottonwood Cell 2, CC3=Cottonwood Cell 3, CC3-2=Cottonwood Cell 3-2, CC3-B=Cottonwood Cell 3 - Bank, CCN=Cottonwood Cell North, CCNS=Cottonwood Cell North Stockpiles

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 7. Vegetation monitoring results for Cottonwood Cells revegetation sites in 2021.

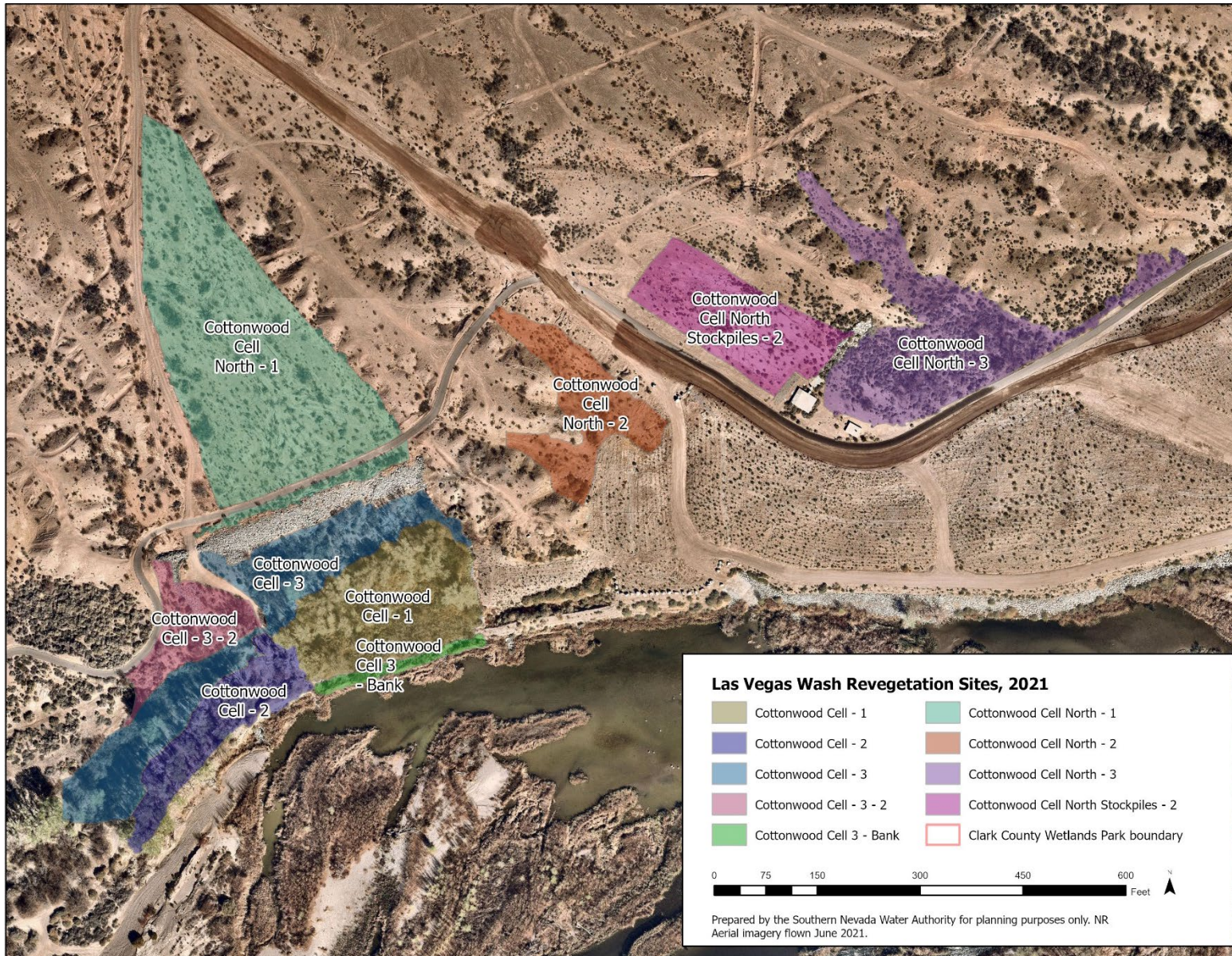


Figure 7. Aerial photograph of 2021 delineated Cottonwood Cells revegetation sites.

3.6 Demonstration Weir

The two sites at the Demonstration Weir were monitored using ArcGIS in 2021 (Table 8, Figure 8). ArcGIS showed that Upstream Demonstration South - Non-Wetland (UDS-N) had the same total cover as it has had since 2015, 25-50%. This site has not changed much in terms of species composition or cover in many years except for a decline in the cover of the dominant species, creosote bush. Using ArcGIS we are unable to identify plants down to their species so it is unclear if Saltlover (*Halogeton glomeratus*) that was first identified in 2020 has spread. Saltlover is known across many Wash sites and is rapidly spreading, future monitoring will assist in making sure this species doesn't become an issue with the overall health of native vegetation. Upstream Demonstration South – Wetland (UDS-W) has had the same cover of 75-100% for all but two monitoring years since first monitored, 2016 and 2018. These past dips in total cover are likely due to the construction of the Three Kids Weir which reduced the size of the site and increased the distance of vegetation from the Wash channel. In terms of plant growth, the site has appeared to recover and has had a consistently high total cover for the past several years.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
UDS	19	1.75	non-wet	25-50%	nm	nm	nm
UDS	19	0.57	wet	75-100%	nm	nm	nm

¹UDS=Upstream Demonstration South

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 8. Vegetation monitoring results for Demonstration Weir revegetation sites in 2021.

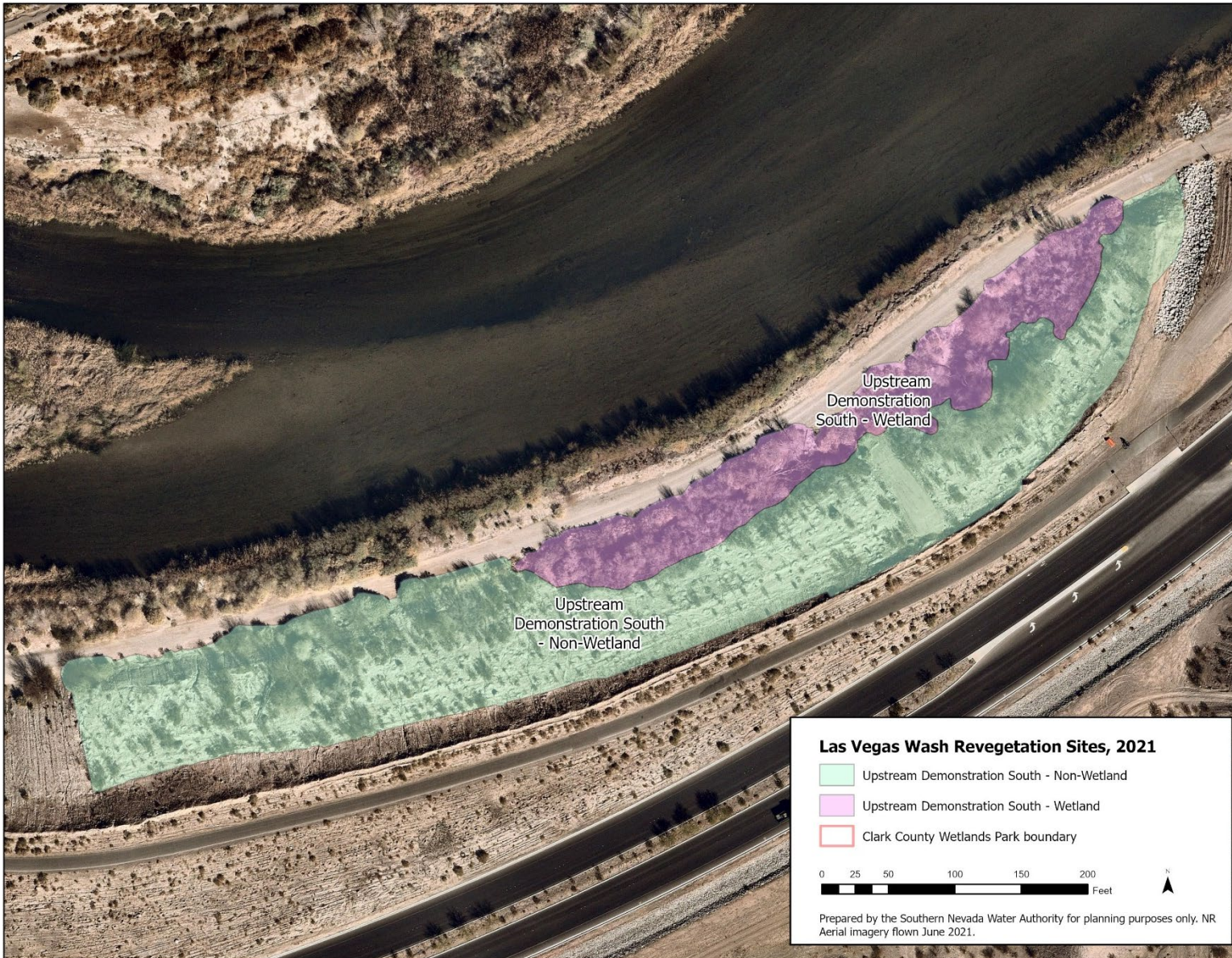


Figure 8. Aerial photograph of 2021 delineated Demonstration Weir revegetation sites.

3.7 Duck Creek Confluence and Upper Narrows Weirs

Duck Creek Upper Narrows Emergent (DCUNE) was the only site monitored in the field in 2021. DCUNE, in its 9th growing season, saw an increase in species from 7 recorded in 2020 to 23 in 2021. This is similar to results from previous years. ArcGIS was used to determine the total cover of the remaining 12 sites (Table 9, Figure 9). Using ArcGIS, Duck Creek Upper Narrows North (DCUNN), Duck Creek Upper Narrows South-1 (DCUNS-1), and Duck Creek Upper Narrows South-3 (DCUNS-3), all had a slight decrease in total cover. This change from 2020 could be a result of misidentifying plants using ArcGIS. Duck Creek Upper Narrows South - 2 (DCUNS-2) total cover remained the same as in 2020 at 5-25%. Additional plantings and irrigation of this site began in 2021 and future surveys will determine if these efforts were successful.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DCUNE	9	10.02	wet	75-100%	2.6%	23	1.88
DCUNN	8	13.81	non-wet	50-75%	nm	nm	nm
DCUNNR	8	1.48	non-wet	75-100%	nm	nm	nm
DCUNNS	8	1.31	non-wet	5-25%	nm	nm	nm
DCUNS-1	8	9.43	non-wet	50-75%	nm	nm	nm
DCUNS-2	7	10.95	non-wet	5-25%	nm	nm	nm
DCUNS-3	7	10.47	non-wet	50-75%	nm	nm	nm
DCUNSF	6	11.59	non-wet	1-5%	nm	nm	nm
DCUNSR	7	3.04	non-wet	75-100%	nm	nm	nm
DCCS	7	1.32	wet	75-100%	nm	nm	nm
DCCW	8	3.99	wet	75-100%	nm	nm	nm
UDCCI	8	2.74	wet	75-100%	nm	nm	nm
UNW	8	3.43	wet	75-100%	nm	nm	nm

¹DCUNE=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, DCUNSF= Duck Creek Upper Narrows South Fill, 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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 9. Vegetation monitoring results for Duck Creek Confluence and Upper Narrows weirs revegetation sites in 2021.

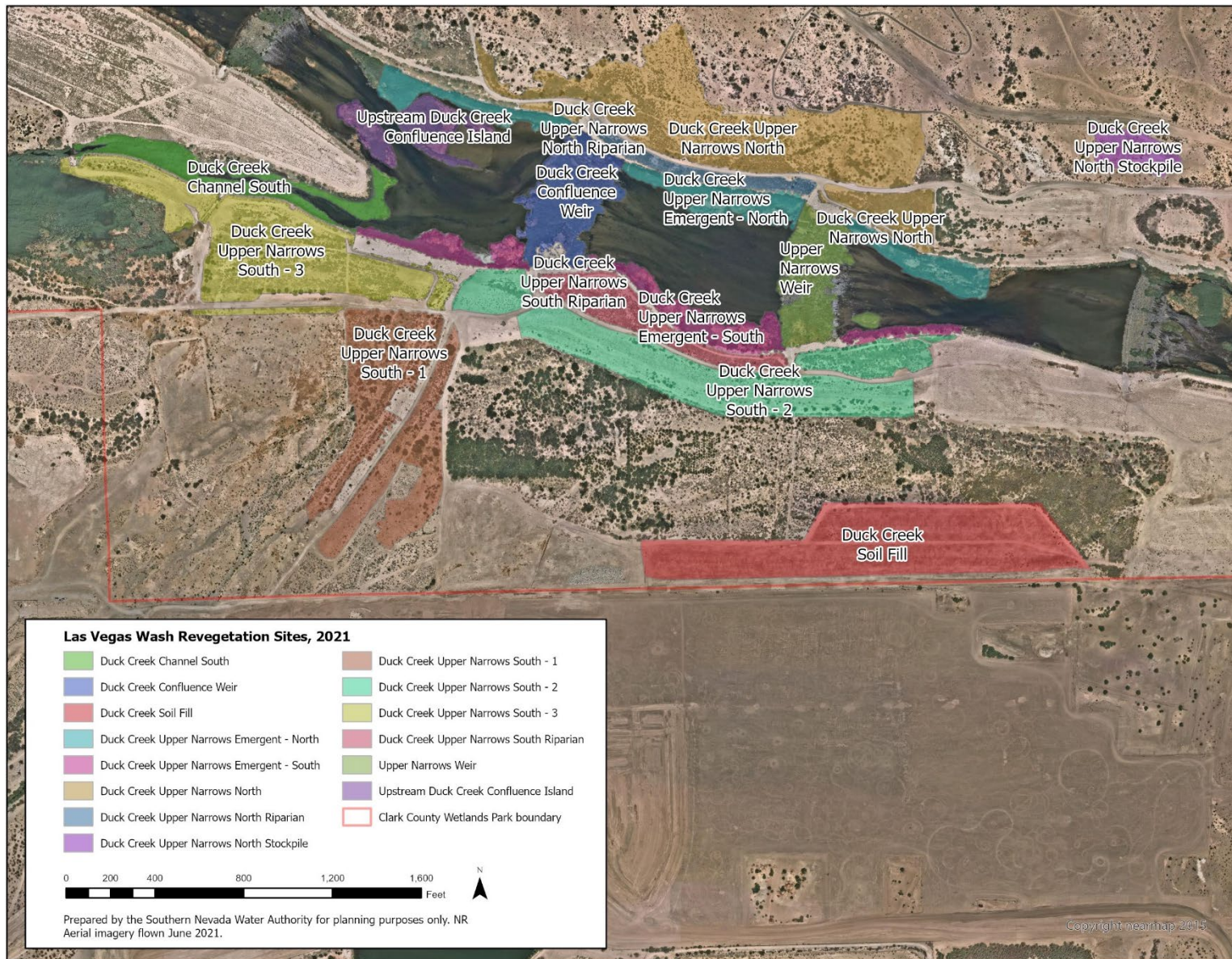


Figure 9. Aerial photograph of 2021 delineated Duck Creek Confluence and Upper Narrows weirs revegetation sites.

3.8 DU Wetlands No. 1 Weir

Three of four sites at the DU Wetlands No. 1 Weir were monitored in the field in 2021 (Table 10, Figure 10). Of the two planted sites, DU Wetlands No. 1 South (DU1S) increased in cover from the previous year while DU Wetlands No. 1 Emergent (DU1E) decreased. The DU Wetlands No. 1 Tamarisk site (DU1T) also decreased in total cover. Both sites went from 75-100% to 50-75% while DU1S increased to 75-100%. Although no plants were actively planted at DU1T, it recorded its highest species richness with 15 species identified.

Early in 2019, DU Wetlands No. 1 Weir (DU1W) had all of the vegetation removed from it to return the weir to the designed grade. Therefore, the site was monitored, but no vegetation was identified using ArcGIS. In 2020, the acreage of vegetation on the weir was more than double any previous monitoring year. There were 1.45 acres of passively established vegetation measured from aerial imagery in 2020, the previous highest amount was 0.67 acres in 2018. Results from 2021 show that vegetation is continuing to grow on the weir and DU1W now has 1.54 acres of vegetation established.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DU1E	9	2.68	wet	50-75%	0.8%	23	2.13
DU1S	9	7.96	non-wet	75-100%	0.5%	13	3.58
DU1T	6	1.29	non-wet	50-75%	37.5%	15	3.36
DU1W	9	1.54	wet	75-100%	nm	nm	nm

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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 10. Vegetation monitoring results for DU Wetlands No. 1 Weir revegetation sites in 2021.

3.9 DU Wetlands No. 2 Weir

Two of the four revegetation sites at the DU Wetlands No. 2 Weir were monitored in the field in 2021 while the remaining two were monitored using ArcGIS (Table 11, Figure 11). DU Wetlands No. 1 Emergent (DU2E) and DU Wetlands No. 1 South (DU2S) total cover stayed that same as in the previous year. However, both sites experienced a significant increase in noxious species presence. Tamarisk was recorded at DU2E and DU2S increasing their noxious species percentage from less than 3% to 9.7% and 15%, respectively. Making sure tamarisk does not continue to spread throughout each site should be a top priority moving forward and if deemed appropriate discussions about removal of this species should occur.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DU2E	12	1.47	wet	75-100%	9.7%	19	2.38
DU2N	12	3.02	non-wet	75-100%	15.0%	13	3.48
DU2S	12	1.56	non-wet	25-50%	nm	nm	nm
DU2W	12	0.24	wet	75-100%	nm	nm	nm

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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

nm = this attribute was not monitored

Table 11. Vegetation monitoring results for DU Wetlands No. 2 Weir revegetation sites in 2021.

DU Wetlands No. 2 Emergent (DU2E) also had some of the vegetation removed during 2019 to allow for Wash flows to travel straight across the weir structures and through the channel. Results from this year's surveys has identified 19 species of plants covering 75-100% of the site. Nineteen species is 10 less species than what was identified during 2019 surveys, but this is expected due to the removal of vegetation. Future monitoring will identify if the species richness returns to where it was prior to the vegetation removal.

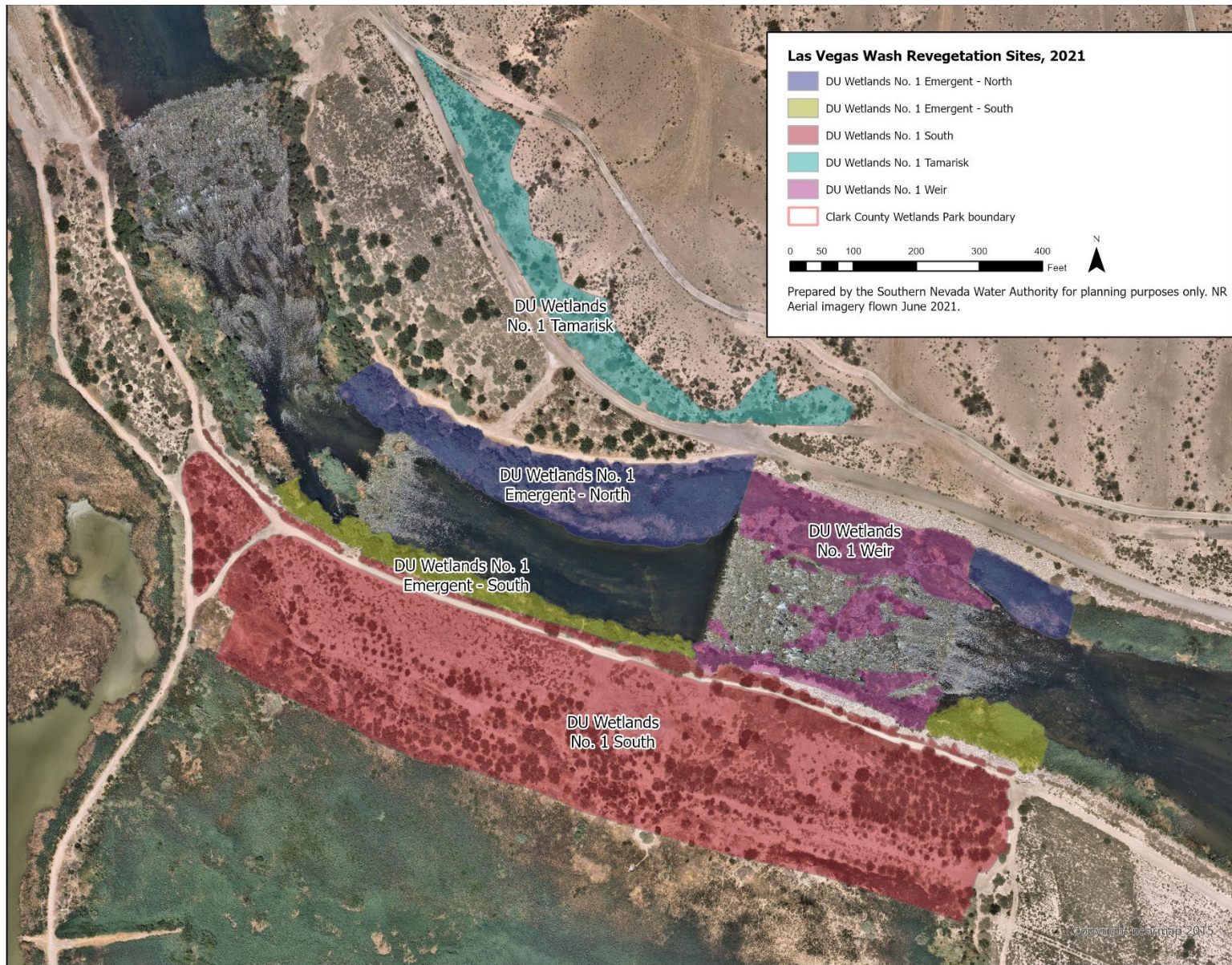


Figure 10. Aerial photograph of 2021 delineated DU Wetlands No. 1 Weir revegetation sites.

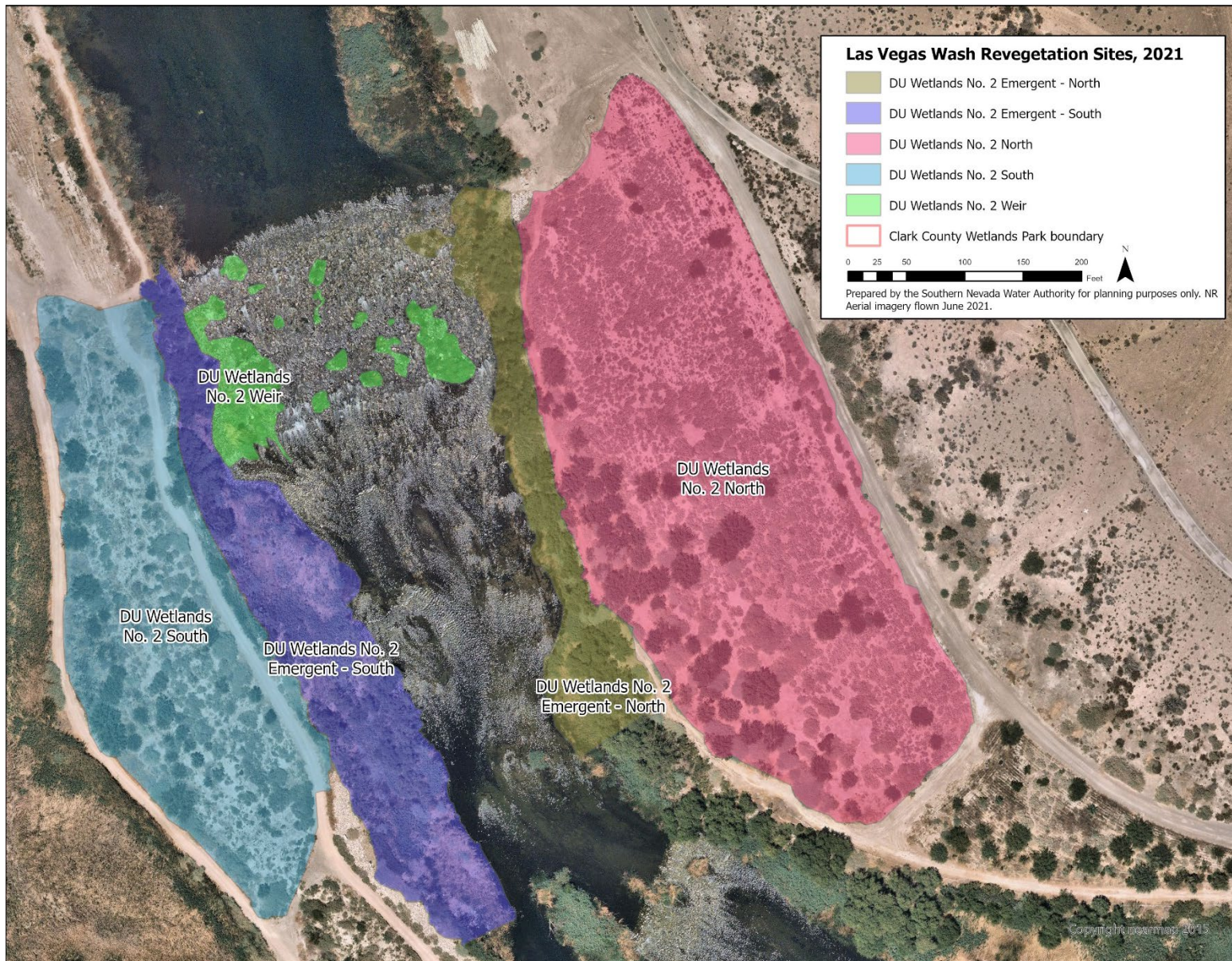


Figure 11. Aerial photograph of 2021 delineated DU Wetlands No. 2 Weir revegetation sites.

3.10 Historic Lateral Weir

This is the second growing season for both Historic Lateral Weir Emergent - North (HLWE-N) and Historic Lateral Weir Emergent - South (HLWE-S). In their first year of monitoring, HLWE-N was measured to be 0.79 acres and HLWE-S was 0.50 acres with both having 75-100% cover range. Both sites grew now measuring 0.88 and 0.53 acres respectively (Table 12, Figure 12). This is the first year for surveys of these sites and both had a total cover of 75-100%. HLWE-N had 18 species while 11 species were identified at HLWE-S.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DHLPW	21	3.89	wet	75-100%	nm	nm	nm
HLWE-N	2	0.88	wet	75-100%	2.5%	18	2.06
HLWE-S	2	0.53	wet	75-100%	0.6%	11	2.18
HLW	21	3.05	wet	75-100%	nm	nm	nm
UHLN	21	4.45	non-wet	50-75%	2.7%	29	3.08
UHLN	21	2.20	wet	75-100%	15.5%	26	2.38
UHLNS	21	1.64	wet	75-100%	2.7%	19	2.08
UHLPW	21	6.09	wet	75-100%	nm	nm	nm
UHLSB	21	1.23	non-wet	75-100%	0.1%	8	4.20
UHLSB	21	0.95	wet	75-100%	0.1%	19	2.08
UHLSUP	14	3.21	non-wet	50-75%	0.5%	12	4.64
UHLSUP2	11	10.95	non-wet	50-75%	0.4%	14	4.72

¹DHLPW=Downstream Historic Lateral Passive Wetlands, HLWE-N= Historic Lateral Weir Emergent North, HLWE-S=Historic Lateral Weir Emergent South, HLW=Historic Lateral Weir, UHLN=Upstream Historic Lateral North, UHLNS=Upstream Historic Lateral North South, UHLPW=Upstream Historic Lateral Passive Wetlands, UHLSB=Upstream Historic Lateral South Bank, UHLSUP=Upstream Historic Lateral South Upper Plateau, UHLSUP2=Upstream Historic Lateral South Upper Plateau 2

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

nm = this attribute was not monitored

Table 12. Vegetation monitoring results for Historic Lateral Weir revegetation sites in 2021.

There were new upland areas created with the Historic Lateral Expansion as well. These areas are being separated into their own section for monitoring purposes to emphasize that they were created only as a result of the expansion project. Details on these sites can be found in the following section of this report.

Many of the other emergent wetland sites at the Historic Lateral Weir were also impacted by the expansion project. The Historic Lateral Weir (HLW) revegetation site was reduced to 0.42 acres in 2018, grew to 1.07 in 2019 and in 2020, a year after construction was completed, there was 2.95 acres of vegetation established on the weir. Currently being measured at 3.05 acres, this is the most ever recorded for this site. This could be partially attributed to the expansion creating additional space for vegetation to establish. However, other weir clearing projects have also resulted in increased acreage. It appears that the disturbance is promoting growth of emergent wetland vegetation on the weirs.

There are passively created wetland areas upstream and downstream of the weir that were moderately impacted by the expansion project. Upstream Historic Lateral Passive Wetland (UHLPW) was 4.49 acres in 2017. In 2018 and 2019, there was no vegetation visible in the channel upstream of the weir using aerial imagery. In 2020, the vegetation had regrown to a size of 5.54 acres, and in 2021 the site measured at 6.09 acres which is greater than any previous monitoring year. The Downstream Historic Lateral Passive Wetland (DHLPW) site was reduced from 6.66 acres in 2017 to 1.95 acres in 2018 and stayed at a similar amount of 1.78 acres in 2019. In 2020, the site was measured at 3.27 acres and is currently measured at 3.89 acres.

Nine sites at the Historic Lateral Weir were monitored in the field in 2021. Most had the same total cover except Upstream Historic Lateral North – Wetland (UHLN-N) which decreased and Upstream Historic Lateral South Upper Plateau - 2 (UHLSUP2) which increased. UHLSUP2 went from 58.8% total cover in 2019 to 33.8% in 2020, now measuring at 62.5% this is the highest percentage recorded since 2015.

Upstream Historic Lateral North – Wetland (UHLN-W) recorded 15% noxious species in 2019 and 15.5% in 2021. Although these past few years have not varied much, this is a significant jump from the 3% recorded in 2017. Noxious species at this site should continue to be monitored to make sure they do not take over the site. If noxious species percentages continue to increase, removal strategies should be discussed.

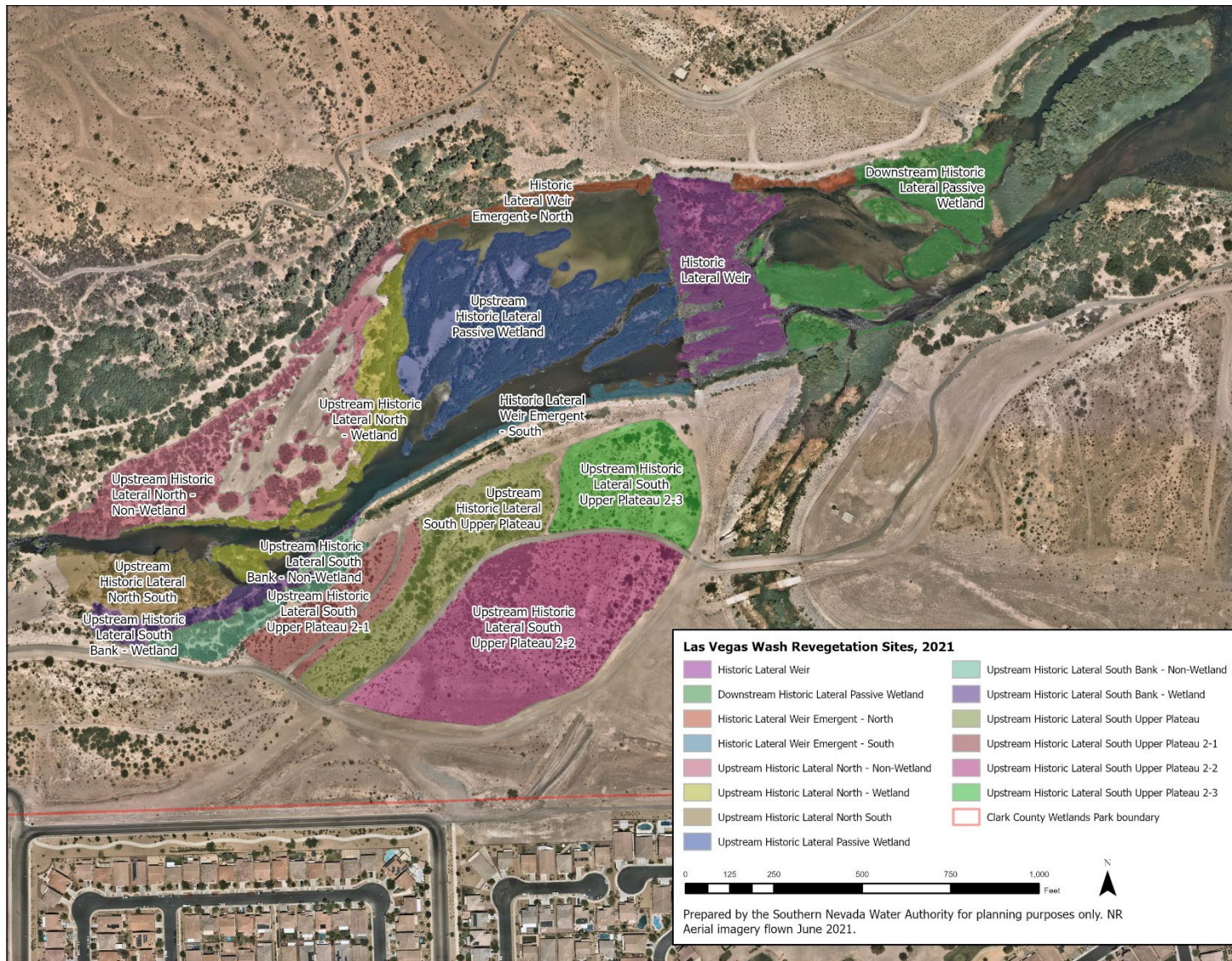


Figure 12. Aerial photograph of 2021 delineated Historic Lateral Weir revegetation sites.

3.11 Historic Lateral Weir Expansion

Historic Lateral Weir Expansion sites are in their second growing season and were all surveyed in the field in 2021 (Table 13, Figure 13). Historic Lateral Expansion South (HLES) was divided into five sections with four planted so far. The four planted areas have been planted by Girl Scouts as part of achieving their Gold Star Award. The first area was planted in the fall of 2019 the other three were planted in fall of 2020. Since these plantings occurred in the fall, they were not included in the 2020 report and this report will be the first time they are discussed. The fifth unplanted area at HLES is intended to be used for additional Scout or small group plantings.

For monitoring purposes, HLEN was separated into four areas. These were the four stations that the volunteers were separated into during the Fall 2019 Green-Up as well. Two of the areas saw a decrease in total cover from 2020 to 2021 going from 62.5% to 37.5%. Using a weighted average of the mid-point of each areas total cover and each areas acreage as the weight, the site had a total cover of 41.3% which is down from the 59.3% recorded in 2020. The dominant species on the site were alkali sacaton (*Sporobolus airoides*), desert globemallow (*Sphaeralcea ambigua ssp. rugosa*) and brittle bush (*Encelia farinosa*) making up most of the total cover. Unlike 2020 when quailbush dominated the site, it now only accounts for 10% of the cover. Therefore, efforts to thin this native shrub have been working and allowing other native species to grow. The only noxious weed identified was salt cedar with a low cover of 0.3% which is a slight increase from 2020. Numerous milkweed plants were planted at this site after multiple sightings of monarchs in the cottonwood cell to the west. No monarchs have been identified at this specific site, but a dead monarch caterpillar was found on the Historic Lateral Expansion South 4 (HLES-4) site in November of 2021. This site is directly across the Wash from HLEN.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
HLEN	2	9.75	non-wet	41.3%	0.3%	32	1.91
HLES	2	2.91	non-wet	27.3%	0.2%	31	2.56
HLES-T	2	0.42	wet	75-100%	2.5%	18	2.20

¹HLEN=Historic Lateral Expansion North, HLES=Historic Lateral Expansion South, HLES-T=Historic Lateral Expansion South Trench

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

nm = this attribute was not monitored

Table 13. Vegetation monitoring results for Historic Lateral Weir Expansion revegetation sites.

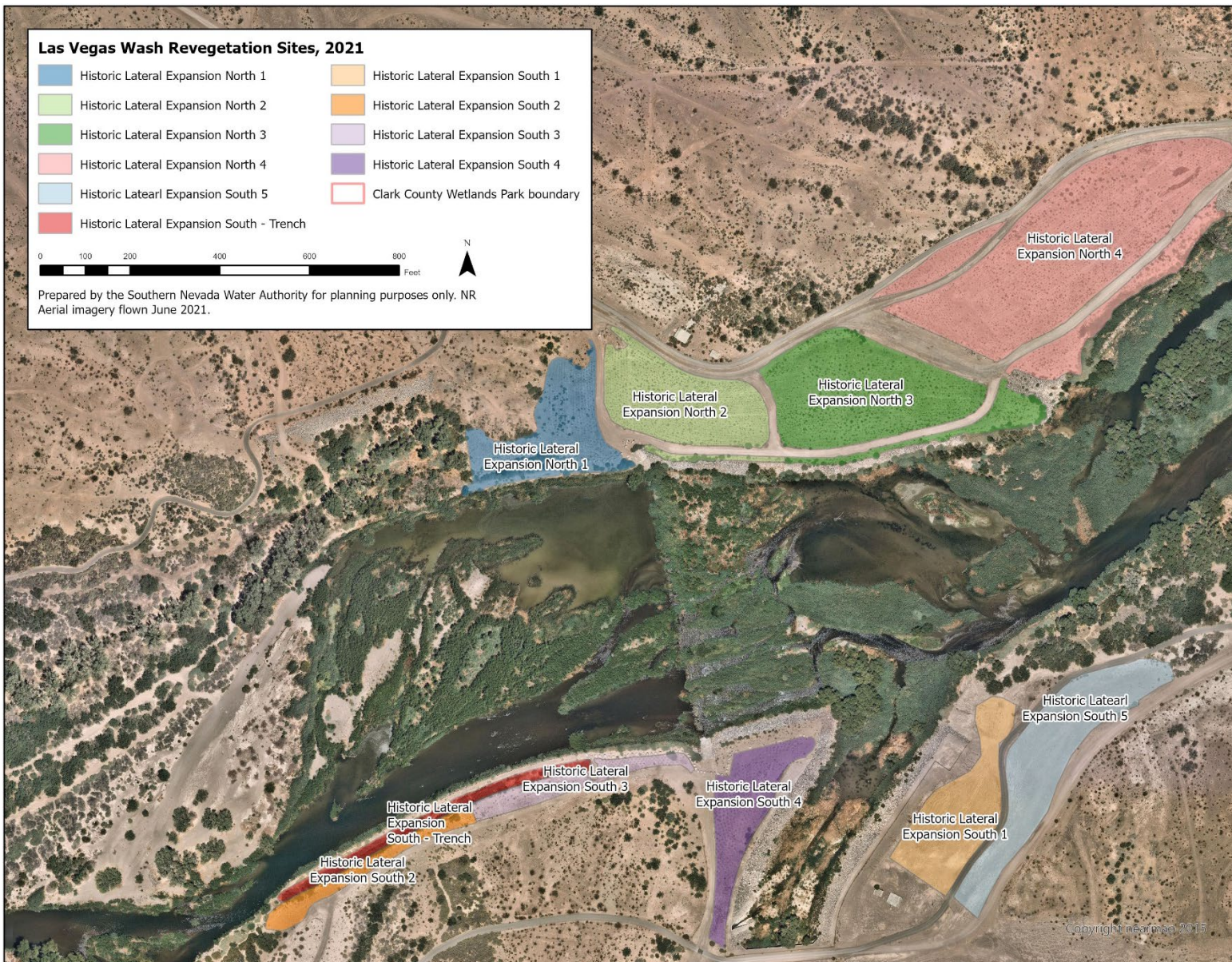


Figure 13. Aerial photograph of 2021 delineated Historic Lateral Weir Expansion revegetation sites.

Historic Lateral Weir Expansion South 1 (HLES-1) was a large contributor in bringing the overall total cover for this site down. HLES-1 recoded a total cover of 0.03 in 2021. Historic Lateral Expansion South 2 (HLES-2), Historic Lateral Expansion South 3 (HLES-3), and HLES-4 had a total cover of 62.5, 37.5, and 37.5 respectively. The overall cover for the site in 2021 was 27.3%. Both total cover and species richness increased significantly from 2020. HLES went from 2.5% total cover comprised of 8 species to 27.3% total cover and 31 species. These sites are only in their second growing season so fluctuations in total cover and species richness is expected. As these sites mature, we will begin to see more consistent results year after year.

The third revegetation site at the Historic Lateral Expansion is HLES-T which was a result of an engineering design only used here and the Sunrise Mountain Weir. A large trench was dug outside of the Wash channel on the back side of the bank protection installed along the water. This trench is designed to allow for riparian trees and other vegetation to grow near the banks of the Wash without the risk of impeding the flows. This trench remained at 75-100% cover for the second year in a row and was dominated by Common reed and Fremont’s cottonwood (*Populus fremontii*). A total of 18 species passively established or remained following the first growing season.

3.12 Lower Narrows and Homestead Weirs

Lower Narrows Homestead North was the only site monitored in the field in 2021 (Table 14, Figure 14). LNHN had very similar total cover, number of species, and noxious plant cover results to those found in previous monitoring years. The remaining six revegetation sites were all monitored using ArcGIS. Two sites that were monitoring using ArcGIS saw a decline in total cover. Lower Narrows Homestead South 1 and Lower Narrows Homestead South 3 went from 25-50% in 2020 to 5-25% in 2021.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
HW	10	4.07	wet	75-100%	nm	nm	nm
LNW	10	3.71	wet	75-100%	nm	nm	nm
LNHE	10	6.61	wet	75-100%	nm	nm	nm
LNHN	10	40.92	non-wet	50-75%	0.1%	16	3.95
LNHS1	10	7.38	non-wet	5-25%	nm	nm	nm
LNHS2	9	6.65	non-wet	25-50%	nm	nm	nm
LNHS3	10	2.22	non-wet	5-25%	nm	nm	nm

¹HW=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

²Wetland 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

³Wetland 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 Lower Narrows and Homestead weirs revegetation sites in 2021.

Lower Narrows Homestead South 1 (LNHS1) and Lower Narrows Homestead South 2 (LNHS2) were both planted as Green-Up volunteer events. LNHS1 was planted in the fall of 2011 and LNHS2 was planted in the fall of 2012.

Using ArcGIS, all wetland sites had the same 75-100% total cover as seen in previous years. Lower Narrows Homestead Emergent (LNHE) includes vegetation within the Wash channel and on both the north and south banks (Figure 14). All wetland sites saw slight increase in acreage. Homestead Weir (HW) increased from 3.96 to 4.07 acres in 2021. Lower Narrows Weir (LNW) increased in acreage from 3.50 recorded in 2020 to 3.71 acres and Lower Narrows Homestead Emergent (LNHE) increased in acreage from 6.26 to 6.61.

3.13 Monson and Visitor Center Weirs

All four revegetation sites at the Monson and Visitor Center weirs were monitored in the field in 2021 (Figure 15, Table 15). Like previous years, all sites had a total cover of 75-100%. Although Downstream Monson South – Non-wetland (DMS-N) and Downstream Monson South – Wetland (DMS -W) were also monitored in the field in 2020, only the plant species were recorded. Therefore, repeat monitoring of these sites was warranted. Given the maturity of these sites, there is not much change in species and their cover year to year.

Noxious plant cover for Downstream Monson South – Wetland (DMS-W) showed an increase from 18% in 2019 to 45.5% in 2021. The three main species causing this increase were salt cedar, johnsongrass, and silver-leaf nightshade all making up 15% total cover. This site is a good candidate for invasive and other undesirable species removal under the Long-Term Management Plan.

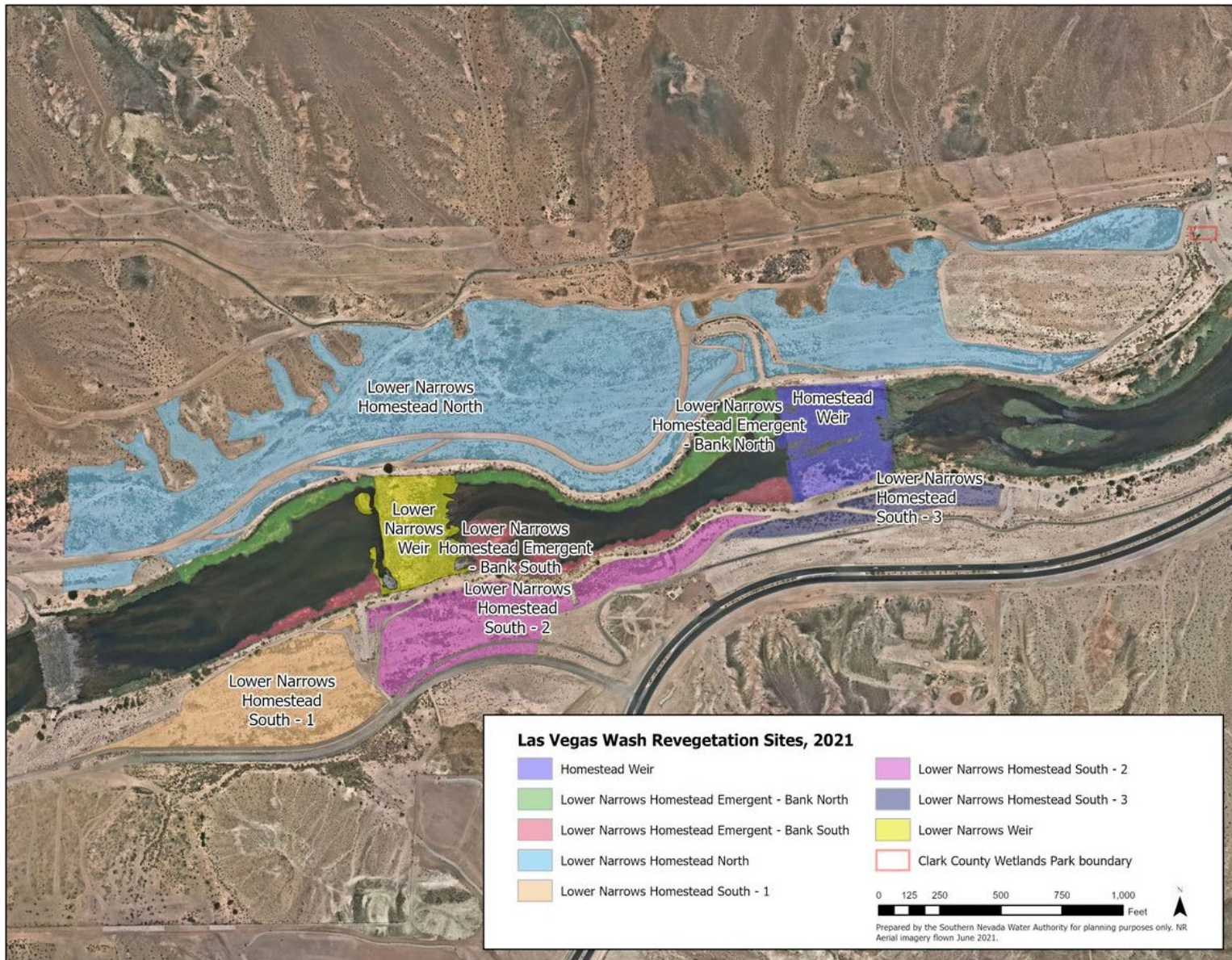


Figure 14. Aerial photograph of 2021 delineated Lower Narrows and Homestead weirs revegetation sites.

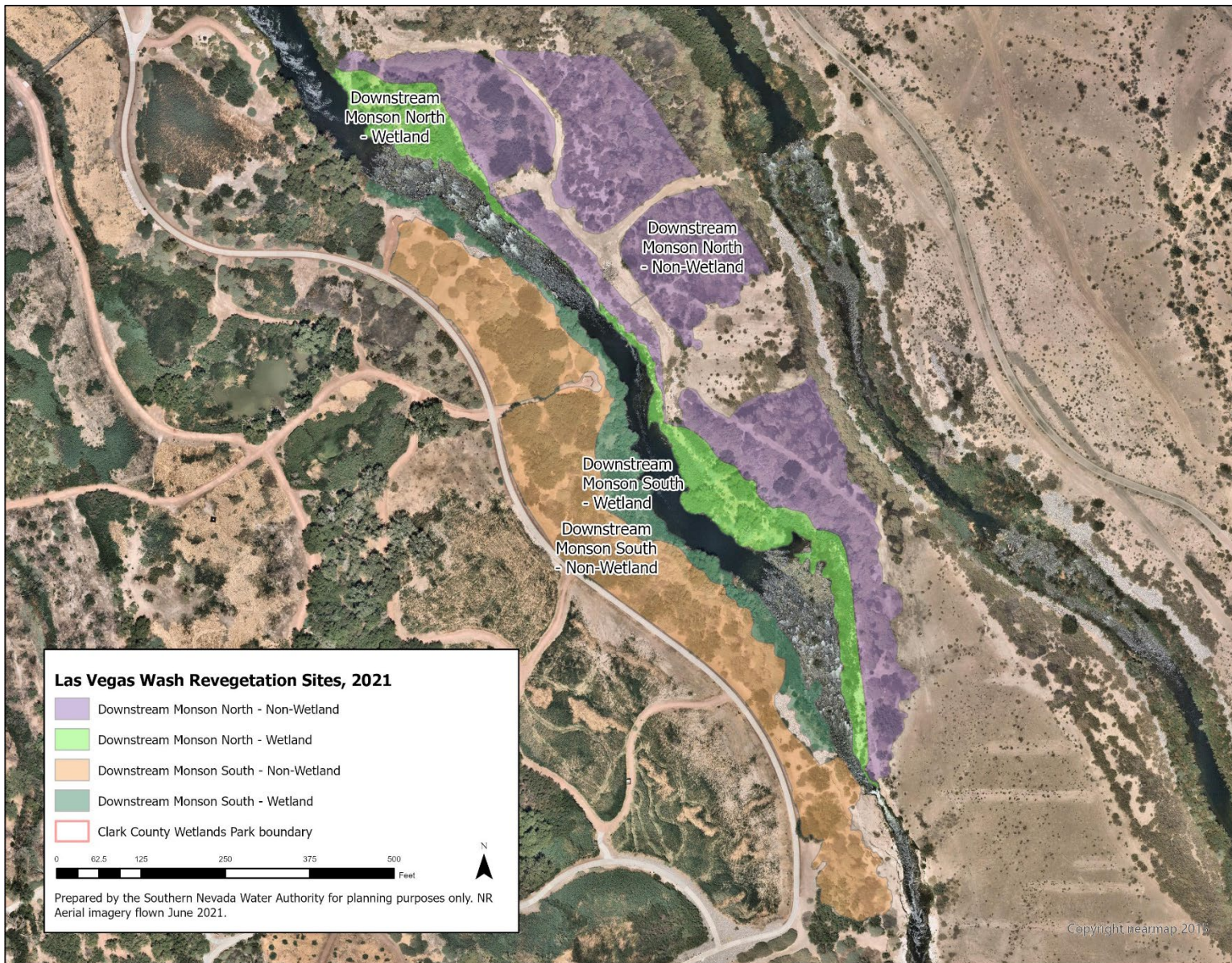


Figure 15. Aerial photograph of 2021 delineated Monson and Visitor Center weirs revegetation sites.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DMN	19	3.78	non-wet	75-100%	15%	7	4.05
DMN	19	1.16	wet	75-100%	20%	21	2.30
DMS	19	2.89	non-wet	75-100%	0.5%	8	3.83
DMS	19	0.74	wet	75-100%	45.5%	17	2.37

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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 15. Vegetation monitoring results for Monson and Visitor Center weirs revegetation sites in 2021.

3.14 Pabco Road Weir

Five of the 15 revegetation sites associated with the Pabco Road Weir were monitored in the field in 2021 (Table 16, Figure 16). Four of the sites had the same cover as in 2020, while Downstream Pabco South Upper Plateau-3 (DPSUP-3) saw a decrease in total cover. DPSUP-3 went from 62.5% total cover in 2020 to 37.5 in 2021. Quailbush (*Atriplex lentiformis*) was the main reason for this decline going from 37.5% in 2020 to 2.5% in 2021. ArcGIS results for the Pabco sites showed a decrease in total cover at four sites, an increase at one site and the remaining five sites total cover stayed the same.

The Upstream Pabco Island (UPI) site was removed in early 2020. In 2019, the site was 0.82 acres and at the time of monitoring in 2021 it remained the same size as recorded in the previous year at 0.02 acres. The Downstream Pabco Island (DPI) site is 1.42 acres in size and is scheduled for removal in 2022. Although Upstream Pabco North (UPN) was mostly removed in 2020 it currently measures 2.37 acres of passively established wetlands. This site was originally planted in 2001 but continued to grow due to sediment deposition and began to impede water flow over the weir. Figure 17 shows the transition of the site with aerial imagery from February 2021 to February 2022.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DPI	21	1.42	wet	75-100%	nm	nm	nm
DPN	13	9.48	non-wet	75-100%	nm	nm	nm
DPNB	10	0.89	wet	75-100%	nm	nm	nm
DPS	21	4.14	wet	25-50%	nm	nm	nm
DPSUB	11	1.01	non-wet	1-5%	nm	nm	nm
DPSUP	11	9.57	non-wet	5-25%	nm	nm	nm
DPSUP-3	4	0.58	non-wet	25-50%	0.5%	12	3.56
PN	21	3.59	non-wet	25-50%	nm	nm	nm
PN	21	0.85	wet	75-100%	nm	nm	nm
PS	21	1.27	non-wet	75-100%	0.0%	12	3.88
PS	21	0.41	wet	75-100%	1.1%	15	2.07
UPI	21	0.02	wet	75-100%	nm	nm	nm
UPN	16	2.37	wet	75-100%	5.6%	39	2.03
UPS	20	1.59	wet	50-75%	2.7%	25	2.10
UPSUP	20	2.25	non-wet	75-100%	nm	nm	nm

¹DPI=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, DPSUP-3=Downstream Pabco South Upper Plateau-3 PN=Pabco North, PS=Pabco South, UPI=Upstream Pabco Island, UPN=Upstream Pabco North, UPS=Upstream Pabco South, UPSUP=Upstream Pabco South Upper Plateau

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

nm = this attribute was not monitored

Table 16. Vegetation monitoring results for Pabco Road Weir revegetation sites in 2021.

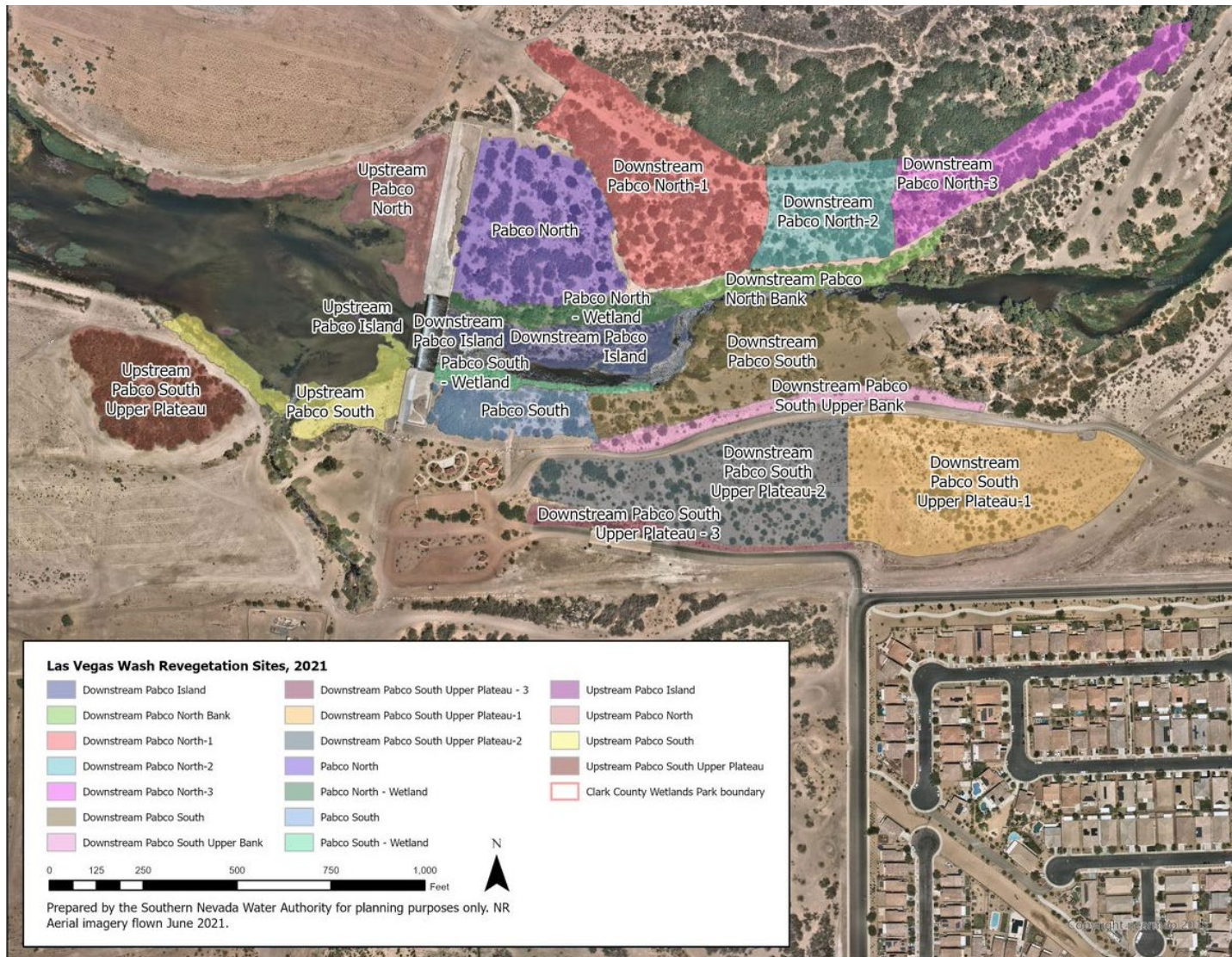


Figure 16. Aerial photograph of 2021 delineated Pabco Road Weir revegetation sites.



Figure 17. Upstream Pabco North’s transformation from February 2020 (top left), June 2020 (top right), June 2021 (bottom left) October 2021 (bottom right) to February 2022 (bottom right).

3.15 Powerline Crossing Weir

Eight of the eleven revegetation sites at the Powerline Crossing Weir were monitored in the field in 2021 (Table 17, Figure 18). All sites total cover remained the same except for Upstream Powerline North Bank (UPLNB) increased while Upstream Powerline South Plateau (UPLSP) decreased slightly. All sites are in their 15th growing season and therefore do not experience much change over the years. Although Downstream Powerline North Bank (DPLNB) and Downstream Powerline South Bank (DPLSB) noxious plant cover stayed the same from 2020 and 2021 both sites have high noxious plant covered compared to the other sites. These sites should be considered for invasive and other undesirable species removal under the Long-Term Management Plan.

Of the three sites that were monitored using ArcGIS two of them had the same cover as recorded in 2020 while Upstream Powerline North Plateau so a slight decrease in cover going from 60.5% recorded in 2020 to 20-50% recorded in 2021.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DPLNB	15	0.32	wet	75-100%	15%	7	2.28
DPLSB	15	0.25	wet	75-100%	37.5%	4	2.41
PCW	15	0.28	wet	75-100%	nm	nm	nm
PLSB	15	0.57	non-wet	50-75%	0.0%	5	3.05
UPI	15	0.05	wet	75-100%	nm	nm	nm
UPLNB	15	0.65	non-wet	5-25%	0.0%	4	3.30
UPLNE	15	1.10	wet	75-100%	0.5%	11	2.28
UPLNP	15	3.96	non-wet	25-50%	nm	nm	nm
UPLNW	15	0.43	wet	75-100%	0.5%	4	2.01
UPLSB	15	0.88	wet	75-100%	0.5%	13	2.04
UPLSP	15	5.79	non-wet	60.7%	0.0%	8	4.35

¹DPLNB=Downstream Powerline North Bank, DPLSB=Downstream Powerline South Bank, PCW=Powerline Crossing Weir, PLSB=Powerline South Bank, UPI=Upstream Powerline Island, 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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 17 . Vegetation monitoring results for Powerline Crossing Weir revegetation sites in 2021.

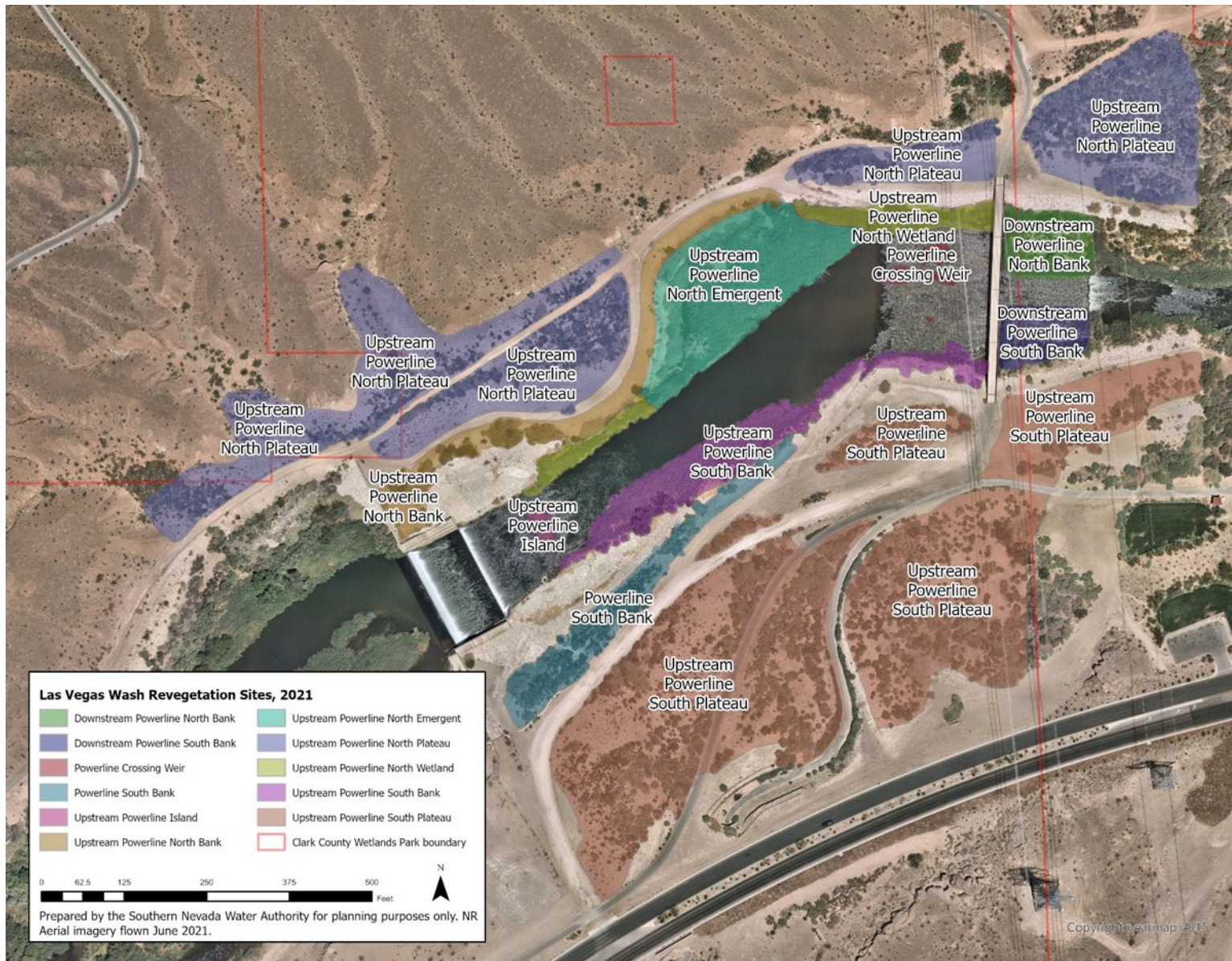


Figure 18. Vegetation monitoring results for Powerline Crossing Weir revegetation sites in 2021.

3.16 Rainbow Gardens Weir

Only one site at the Rainbow Gardens Weir was surveyed in the field in 2021 (Table 18, Figure 19). Upstream Rainbow North Bank (URNB) saw a decrease in total cover from 2020 but an increase from 2019. The 2020 results were collected using ArcGIS and therefore could have been an overestimate of total cover. Consistently, looking at past results when URNB was monitored using ArcGIS total cover was estimated to be 62.5% (2018 and 2020), however field surveys during the other sampling years estimated total cover to be 15% (2017 and 2019) or 37.5% (2021). Results suggest that when ArcGIS is used to determine the total cover of this site it is a slight overestimate to the action cover being seen during field surveys.

Upstream Rainbow Island (URI) did not grow in size from 2020 to 2021 but has still grown significantly over the years. This site sits at 4.75 acres and is scheduled to be removed in 2022. All sites monitoring using ArcGIS had the same total cover as recorded in 2020.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
RI	17	1.08	wet	75-100%	nm	nm	nm
URI	17	4.75	wet	75-100%	nm	nm	nm
URNB	12	1.64	non-wet	25-50%	2.5%	11	3.53
URNPW	17	2.66	wet	75-100%	nm	nm	nm
URSB1	16	0.02	non-wet	75-100%	nm	nm	nm
URSB2	14	0.73	non-wet	75-100%	nm	nm	nm
URSE	17	0.83	wet	75-100%	nm	nm	nm
URSP	16	1.39	non-wet	5-25%	nm	nm	nm

¹RI=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

²Wetland 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

³Wetland 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 18. Vegetation monitoring results for Rainbow Gardens Weir revegetation sites in 2021.

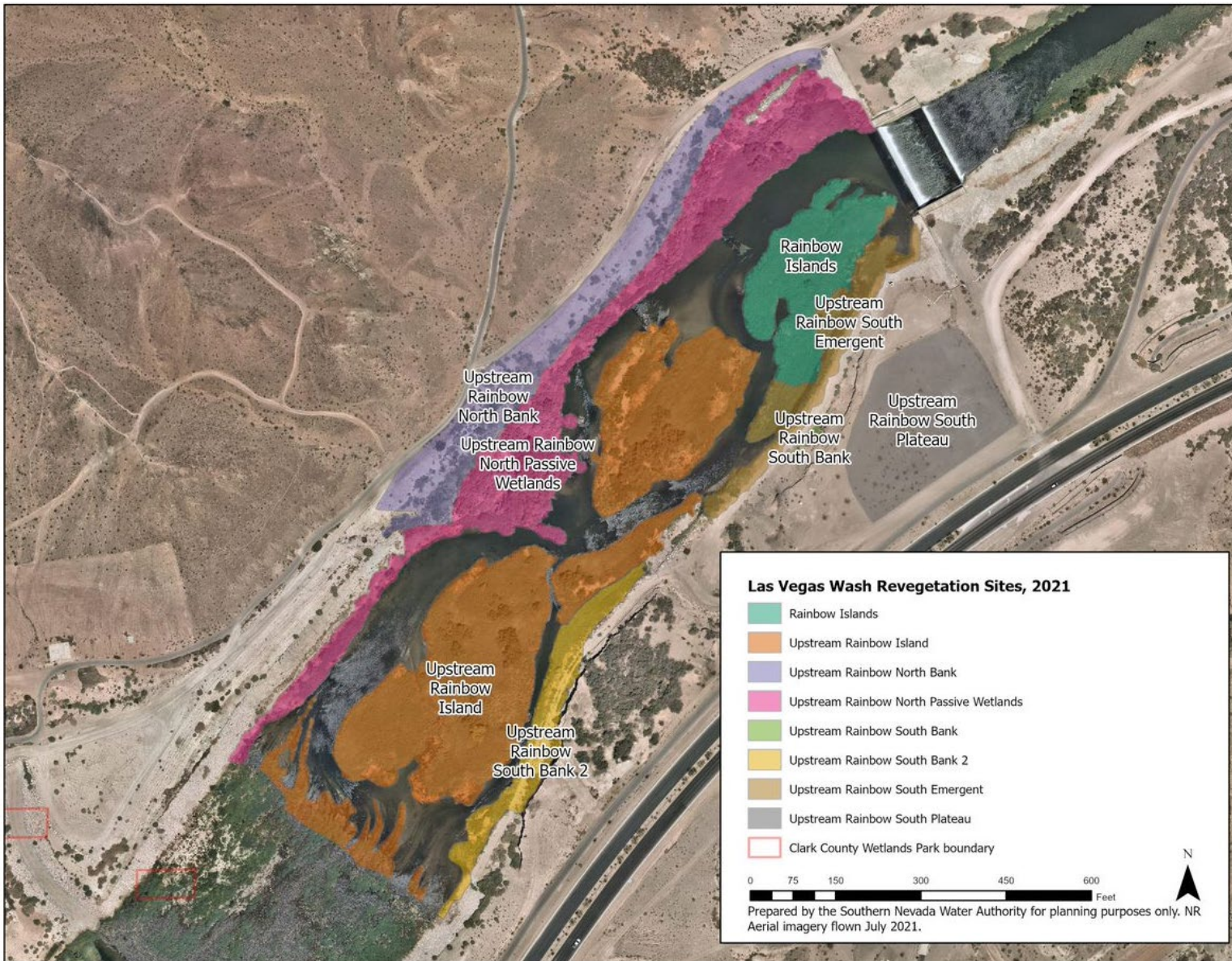


Figure 19. Aerial photograph of 2021 delineated Rainbow Gardens Weir revegetation sites.

3.17 Site 108

Like 2020, Site 108 was monitored for total cover using ArcGIS in 2021. Due to personnel changes staff was unable to field survey Site 108 (Table 19, Figure 20). This is still the largest contiguous revegetation site along the Wash, at 38.17 acres, despite being much larger at completion at nearly 60 acres. It was planted in phases through its four different funding sources (grants from NDEP, NDSP, and two rounds of SNPLMA [4 and 5]) in the spring and fall of 2006.

There was not much change in total cover over the past year. Results from 2021 showed a total cover of 83.7% compared to the 84.1% recorded in 2020. While this is a large site, it is broken up into 59 monitoring areas all less than 2 acres and most less than 1 acre in size.

Funding Areas	Growing Season ³	Acreage	Wetland Status ¹	Total Cover	Noxious Species Cover	Number of Species	WPI ²
NDEP	15	5.72	non-wet	75.7%	nm	nm	nm
NDSP	15	13.16	non-wet	83.4%	nm	nm	nm
SNPLMA IV	15	7.49	non-wet	87.5%	nm	nm	nm
SNPLMA V	15	11.80	non-wet	85.5%	nm	nm	nm
TOTAL	15	38.17	non-wet	83.7%	nm	nm	nm

¹Wetland 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

²Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

³Portions 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 19. Vegetation monitoring results for the Site 108 revegetation site in 2021.

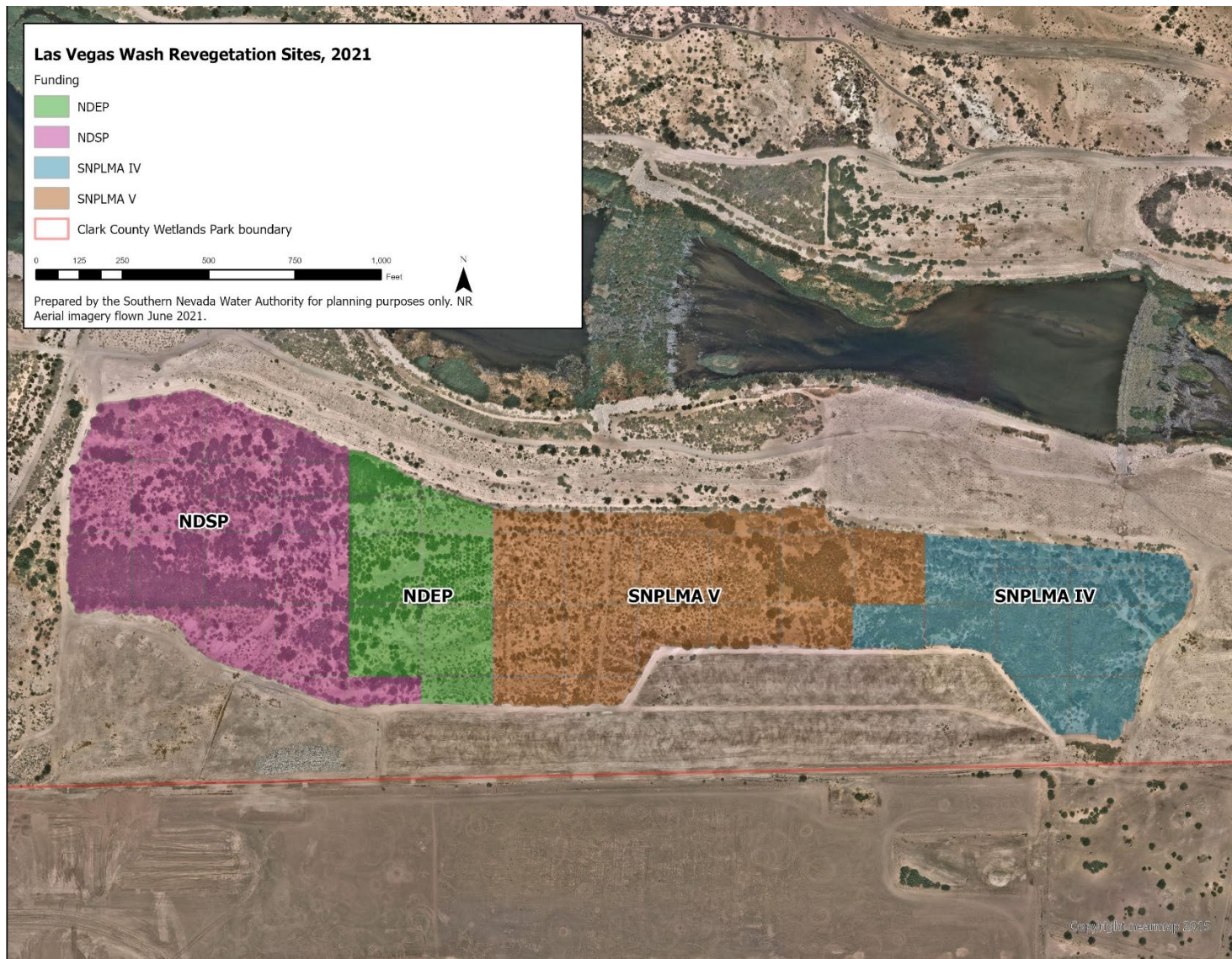


Figure 20. Aerial photograph of Site 108 with 2021 delineations based on funding source.

3.18 Site 111

Site 111 was planted as a single site but due to being one of the larger revegetation sites along the Wash it is broken up into 26 monitoring areas (Table 20, Figure 21). All sites were monitored using ArcGIS in 2021. Total cover for the site had increased from 72.9% recorded in 2020 to 81.4% in 2021. This site is in its 14th growing seasons so there is not much change that occurs year to year. Explanations for the increase in total cover may be part due to misidentifying plants while obtaining total cover in ArcGIS. Although ArcGIS is not the most accurate way to determine total cover, it allows us to get an estimated cover even when access is limited. There were seven sites in 2020 that were unable to be monitored in the field to do limited access and therefore the only data recorded for these sites in 2020 was there total cover using ArcGIS. All 26 monitoring areas are scheduled to be surveyed in the field in 2022.

Site Code	Growing Season	Acreage	Wetland Status ¹	Total Cover	Noxious Species Cover	Number of Species	WPI ²
S111	14	14.93	non-wet	81.4%	nm	nm	nm

¹Wetland 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

²Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 20. Vegetation monitoring results for the Site 111 revegetation site in 2021.

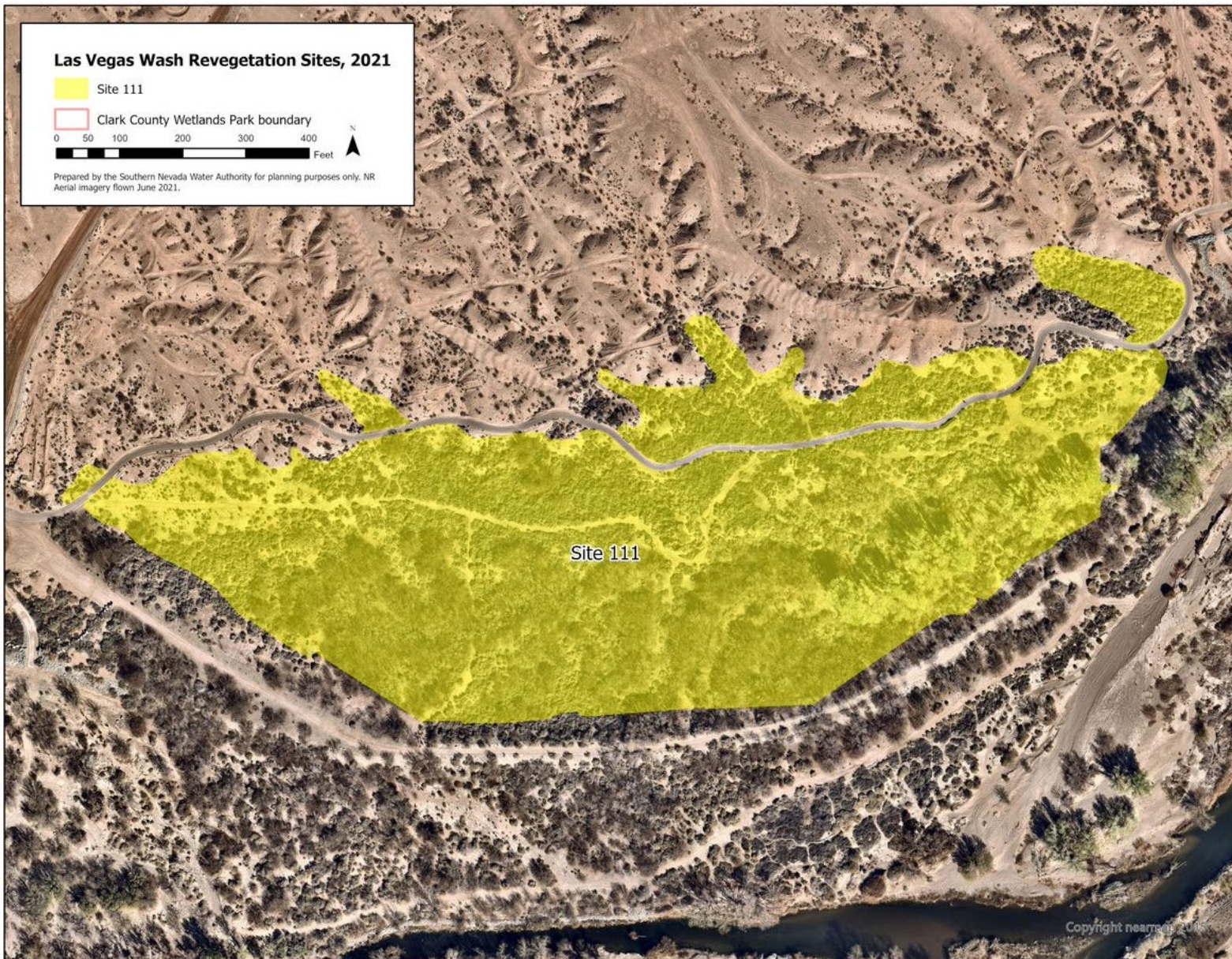


Figure 21. Aerial photograph of the 2021 delineated Site 111 revegetation site.

3.19 Sunrise Mountain Weir

Sunrise Mountain Weir added two new revegetation sites in 2021 bringing the total number of sites up to seven. Of these sites, five were monitored in the field in 2021 while the remaining two were monitored using ArcGIS (Table 21, Figure 22). Sunrise Mountain North (SMN) was originally slated to be planted during the March 2020 Green-Up event, but due to COVID-19 was canceled. Contractors still planted mesquite trees at this site, so the site was surveyed and survival of these trees was documented. All sites that are in their second growing season recorded the same total cover as in the previous year. Sunrise Mountain South-1 (SMS-1) was planted during a Green-Up event in May 2021. Both SMN and SMS-1 had 50-75% total cover, but this could be a product of the plants being small in size. Overtime these sites should fill in nicely and we should see an increase in total cover.

Sunrise Mountain Emergent-South (SME-S) saw an increase in noxious plant cover from 0.5% recorded in 2020 to 15% recorded in 2021. This year was the first field survey year for Sunrise Mountain South Trenches (SMT) and it recorded a noxious plant cover of 37.5%. Tamarisk is the noxious species found at both SME-S and SMT. If noxious species cover continues to increase at these sites, removal under the Long-Term Management Plan should be considered.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
SME-N	2	1.30	wet	75-100%	0.5%	12	2.05
SME-S	2	0.81	wet	75-100%	15%	26	1.11
SMI	2	1.58	wet	75-100%	nm	nm	nm
SMS-1	1	9.44	non-wet	50-75%	0.1%	15	1.63
SMN	1	9.17	non-wet	50-75%	0.1%	31	2.67
SMT	2	0.71	non-wet	75-100%	37.5%	10	1.67
SMW	2	0.58	wet	75-100%	nm	nm	nm

¹SME=Sunrise Mountain Emergent, SMI=Sunrise Mountain Islands, SMT=Sunrise Mountain Trenches, SMW=Sunrise Mountain Weir

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

nm = this attribute was not monitored

Table 21. Vegetation monitoring results for the Sunrise Mountain Weir revegetation sites in 2021.

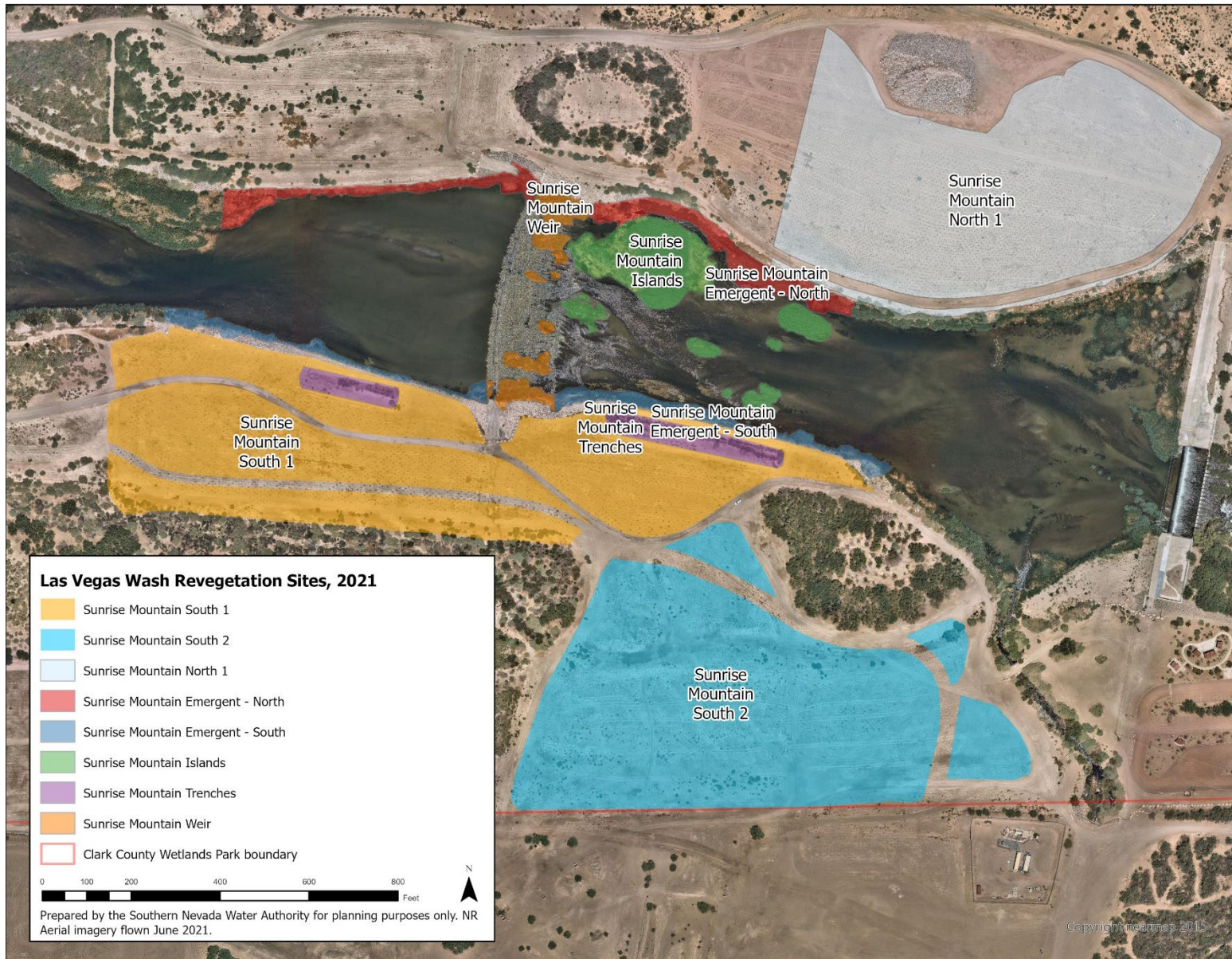


Figure 22. Aerial photograph of 2021 delineated Sunrise Mountain Weir revegetation sites.

3.20 Three Kids Weir

Six of the eight revegetation sites at the Three Kids Weir were monitored in the field in 2021 (Table 22, Figure 23). Lower Narrows Homestead North 2 (LNHN2) was separated from LNHN at the Lower Narrows and Homestead weirs during construction of the Three Kids Weir and hydroseeded again after the Three Kids Weir was completed. Upstream Three Kids South (U3KS) is the lone Green-Up site associated with the Three Kids Weir. U3KS was planted in March of 2017. This site was also hydroseeded after weir construction but unlike LNHN2, the site was also planted with approximately 4000 container plants and irrigated for three growing seasons.

LNHN2 saw a jump in total number of species going from five species recorded in 2020 to 11 species recorded in 2021. The two dominant species, desert saltbush and fourwing saltbush make up almost all of the cover for the site. Both species had been hydroseeded on the site. U3KS was one of the sites monitored in both 2020 and 2021. Results from the 2021 field season show very little change over year. Both years had a relatively high number of species at 15 in 2020 and 16 in 2021. Same as in 2020, the two co-dominant species were four-wing saltbush, which was hydroseeded, and creosote bush, which was planted during the Green-Up.

The remaining two sites were monitored using ArcGIS. Both sites were in their fifth growing season and had no changes in total cover from 2020.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
LNHB-N	6	2.17	wet	75-100%	0.1%	18	2.65
LNHB-S	6	3.45	wet	75-100%	2.5%	15	3.59
LNHN2	5	9.60	non-wet	50-75%	0.5%	11	4.17
3KW	5	4.19	wet	75-100%	nm	nm	nm
U3KI	5	1.21	wet	75-100%	nm	nm	nm
U3KNB	6	4.65	wet	75-100%	0.5%	17	2.40
U3KS	5	7.03	non-wet	75-100%	0.0%	16	4.65
U3KSB	6	1.88	wet	75-100%	2.5%	11	2.02

¹LNHB-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, U3KS=Upstream Three Kids South, U3KSB= Upstream Three Kids South Bank

²Wetland 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

³Wetland 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 Three Kids Weir revegetation sites in 2021.

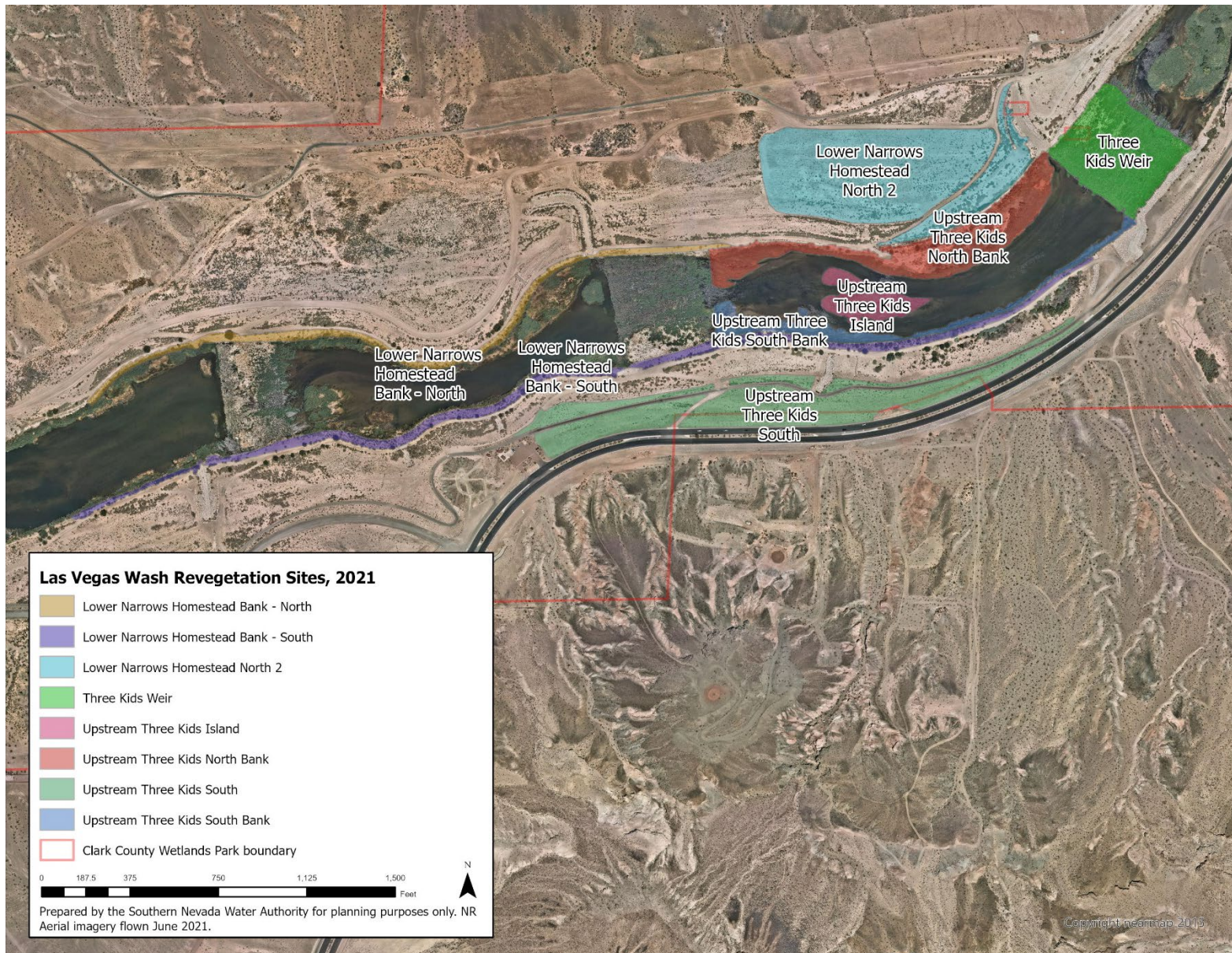


Figure 23. Aerial photograph of 2021 delineated Three Kids Weir revegetation sites.

3.21 Tropicana Weir

There are five sites associated with the Tropicana Weir (Table 23, Figure 24). All sites but Tropicana Weir (TW) were monitoring in the field in 2021. Three of the sites were actively planted as Green-Up volunteer events. Tropicana West 1 (TW1) was the spring 2018 event, Tropicana West 2 (TW2) was the fall 2018 event, and Tropicana East (TE) was the spring 2019 event. The remaining two sites were passively created. TW is the vegetation growing on the weir itself and Tropicana Weir Emergent (TWE) is the vegetation growing on the Wash banks upstream and downstream of the weir. TWE is broken up into two monitoring areas, east and west, and then combined using a weighted average based on acreage.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
TE	3	6.97	non-wet	50-75%	0.0%	12	2.73
TW	2	1.65	wet	75-100%	nm	nm	nm
TW1	4	6.54	wet	75-100%	30.0%	20	2.66
TW2	3	10.60	wet	50-75%	15.1%	24	2.64
TWE	3	2.42	wet	75-100%	30.3%	23	1.87

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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland

nm = this attribute was not monitored

Table 23. Vegetation monitoring results for Tropicana Weir revegetation sites in 2021.

TW1 was in its fourth growing season at the time of monitoring in 2021. It continued to have the maximum total cover value of 75-100% as it did the previous three monitoring years. This is despite the continued reduction in species richness with 20 species documented in 2021 compared to 21 in 2020, 26 in 2019, and 37 in 2018. A reduction in species richness is normal for Wash revegetation sites after each of the first few years after establishment. The wide-open spaces and frequent irrigation when first created allow for both native and non-native species to establish quickly. Once irrigation is reduced or ceases, many of these species are not able to survive. Unfortunately, one of the non-native species that established on TW1 was bassia which has been the dominant species on the site each of the four monitoring years. In 2021, this species had a total cover of 37.5%. This is down from 2019 but the same as the 2020 results even despite the efforts put in place to reduce its abundance. TW2 was in its third growing season in 2021. This site had a total cover of 50-75% which is down from the previous year. Also, like TW1, TW2's dominant species was bassia with 37.5% cover. Efforts to remove bassia should continue on both of these sites that are adjacent to each other. TW1, TW2 and TWE all had high noxious species cover in 2021. Although it is likely these results were overestimated, it still shows that noxious species at these sites should continue to be monitored and removal efforts may need to be discussed in the future.

On the other side of the Wash, TE was also monitored for the third time in 2021. Unlike previous years, bassia at this site has increased going from 2.5% in 2020 to 15% in 2021. This site also saw

a significant reduction in number of species going from 31 species in 2020 to 12 species in 2021. These results are not unexpected because TE is only in its third growing season so fluctuations in species is likely to occur for the first several years. The total cover of the site was 50-75%. Because this site is at a higher elevation up from the Wash and groundwater, it is expected to have a lower total cover when it reaches maturity compared to the western sites.

The Tropicana Weir had so little vegetation on it in the first two years after being completed, it wasn't included in monitoring. In 2020, there was 1.90 acres of vegetation passively created and 1.71 acres in 2021. The passively established TWE site also grew substantially since 2019 when it measured at 0.73 acres to the 2.40 acres in 2021.

3.22 Upper Diversion Weir

One of the eight revegetation sites at the Upper Diversion Weir was monitored in the field in 2021 (Table 24, Figure 25). Only Upper Diversion Island (UDI) was monitored in the field while the rest were monitored using ArcGIS. UDI had the same cover as in previous years ranging from 75-100% and only 1 additional species recorded in 2021 compared to results from 2017 and 2019. UDI did see a significant increase in noxious plant cover going from going from 1.3% in 2019 to 33.3% in 2021. Although there was definitely an increase in noxious plants, results from this field season consistently showed an overestimation of cover per plant species. This is a direct result of having a new surveyor take over the project. Noxious species should be monitored closing during the next field sampling season but we anticipate to see this percentage decrease as surveyors gain a better understand and more experience taking over this project.

The remaining seven sites were all monitored using ArcGIS and results showed that two sites decreased in total cover, one site increased and the remaining four sites total cover stayed the same. Downstream Upper Diversion North (DUDN) total cover went from 54% recorded in 2020 to 39.3% recorded in 2021. These results continue to show a decrease in total cover for DUDN beginning in 2019. Field monitoring results for the 2022 season will help determine if this trend is accurate or possibly errors in determining total cover using ArcGIS. If this trend continues, this site may be a good candidate for enhancement under the Las Vegas Wash Long-Term Revegetation Management Plan.

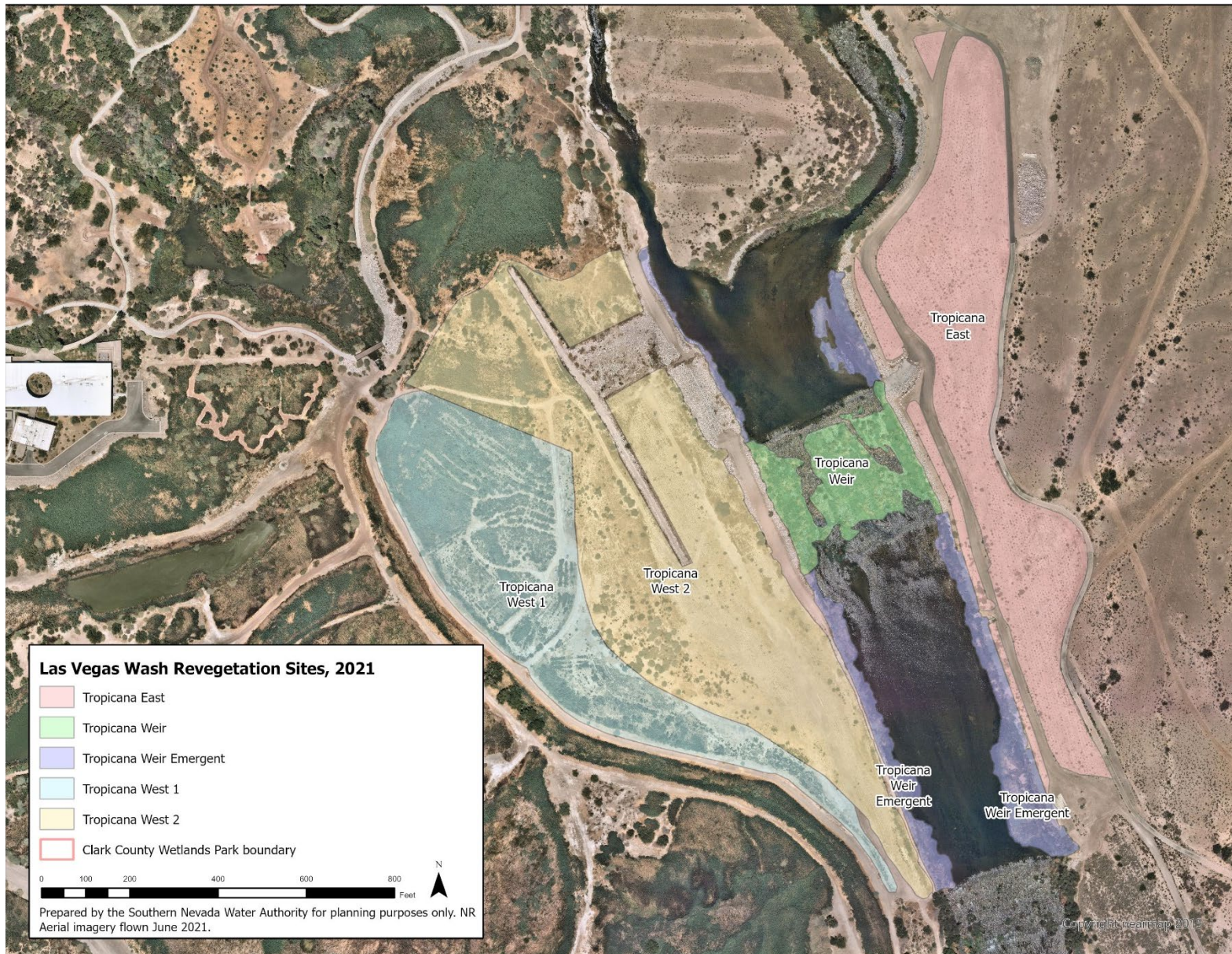


Figure 24. Aerial photograph of 2021 delineated Tropicana Weir revegetation sites.

Site Code ¹	Growing Season	Acreage	Wetland Status ²	Total Cover	Noxious Species Cover	Number of Species	WPI ³
DUDE	13	3.92	wet	75-100%	nm	nm	nm
DUDN	13	9.95	non-wet	39.3%	nm	nm	nm
DUDS	13	1.43	wet	87.5%	nm	nm	nm
UDI	13	5.18	non-wet	75.0%	33.3%	18	3.6
UDIE	13	0.35	wet	37.5%	nm	nm	nm
UDIS	13	0.22	non-wet	75-100%	nm	nm	nm
UUDE	13	2.95	wet	75-100%	nm	nm	nm
UUDS	13	0.77	non-wet	75-100%	nm	nm	nm

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

²Wetland 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

³Wetland Prevalence Index (WPI) value. $WPI \leq 2.0$ = wetland, $2.0 < WPI < 2.5$ = likely wetland, $2.5 \leq WPI < 3.5$ = may be wetland, $3.5 \leq WPI < 4.0$ = not likely a wetland, and $WPI \geq 4.0$ = upland
nm = this attribute was not monitored

Table 24. Vegetation monitoring results for Upper Diversion Weir revegetation sites in 2021.

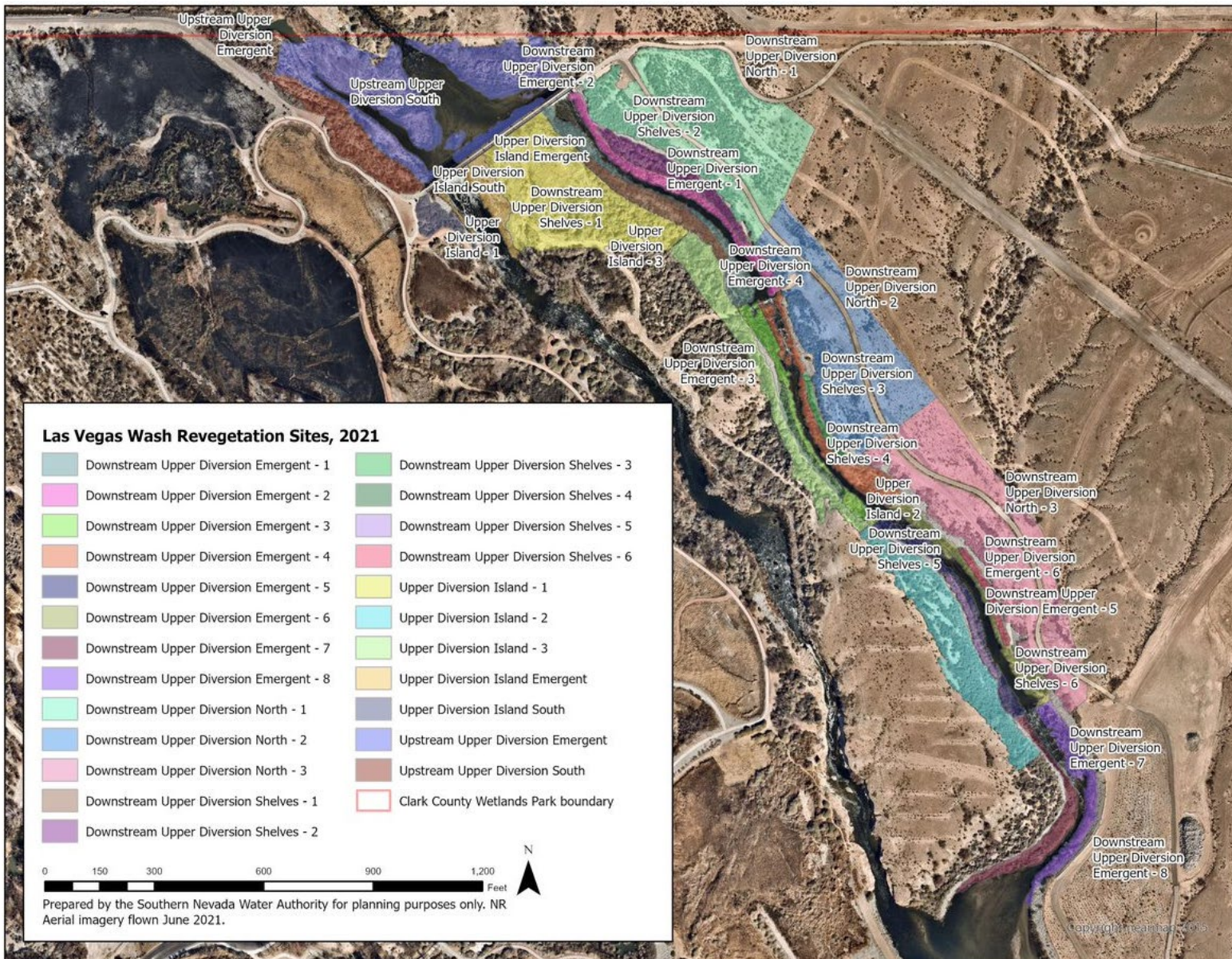


Figure 25. Aerial photograph of 2021 delineated Upper Diversion Weir revegetation sites.

4.0 CONCLUSIONS

For comprehensive environmental programs such as the one 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 performing in relation to select quantitative measurements of native plant restoration. In simple terms, for the revegetation program as a whole and for individual sites, success occurs when there is an increase in native plant cover up to a self-sustaining level, survivorship of planted plants, and an ongoing control or reduction of noxious weeds. More difficult to measure goals include providing wildlife habitat and increasing the overall ecological health of the system. However, wildlife surveys and the summation of other measurements should indicate to managers and stakeholders whether these goals are being met.

Of the 78 sites monitored in the field, 49 (62.8%) had the same cover as they did in the previous field monitoring season, 12 (15.4%) increased in cover, and 12 (15.4%) decreased in cover. The remaining 5 sites (6.4%) were first monitored in 2021. These sites were all located at the Historic Lateral and Sunrise Mountain weirs. ArcGIS was used to measure the total cover for the remaining 76 (49.4%) sites.

A new project lead was assigned to this work at the beginning of 2021 and when changes in personnel occur you can expect there to be some differences in visual estimations of plant cover. These changes may help explain some results from this report. For example, most species cover was over-estimated at the individual level, so seeing increases in noxious weed cover is also likely overestimated. Future surveys will help determine if these increases are a concern or just an overestimation. Moving forward, staff will make sure that the sum of individual species cover falls within the range of the total cover for each monitoring area.

This report marks the final year of funding from the Wash CIP and moving forward revegetation efforts along the Wash will be funded by the Wash long term operations budget, as well as state and federal grants. This also means that moving forward, vegetation monitoring will follow the Las Vegas Wash Long-Term Revegetation Management Plan. The main priorities from this plan are to improve habitat for wildlife, determine sites that need enhancements, noxious weed removal and more.

This report determined there are currently three sites that are good candidates for enhancement and three additional sites that are good candidates for noxious weed removal followed by enhancement (Table 25). These sites were all surveyed in the field in 2021, so additional sites may be added following the completion of the 2022 field survey season. This table may change annually and will be used as a tool to guide future revegetation efforts along the Wash.

Site Code	Candidate for Enhancement	Candidate for Noxious Weed Removal and Enhancement
BST	X	
BN	X	
DBN	X	
UCE		X
DMS-W		X
DPLNB		X
DPLSB		X

Table 25. Vegetation sites that are good candidates for enhancement or noxious weed removal and enhancement following the Las Vegas Wash Long-term Revegetation Management Plan.

5.0 RECOMENDATIONS

Annual monitoring of the vegetation has provided many years of data to compare and contrast. 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 decreases 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 that are not listed in Table 25 are DCN-N, UDS-N, DU2E, DU2S, and UHLN-W. All of these sites except DCN-N saw an increase in noxious weeds and may need to be added to the table above. Although these results may be overestimated, future surveys will allow us to better track changes and aid in management decisions.

The 2020 report recommended that Lower Narrows Homestead South 1 (LNHS1) and Lower Narrows Homestead South 2 (LNHS2) be closely monitored due to their lack of total cover. Both sites were planted as Green-Ups in 2011 and 2012 and their total cover has declined to just 25-50% recorded in 2020. Due to these declining trends, it has been determined that enhancements to these sites is critical. Therefore, both LNHS1 and LNHS2 will be the location for our spring 2024 Green-Up event. This will allow for additional plants to be planted to improve overall cover and also provide better habitat for wildlife.

Having 154 revegetation sites along the Wash it is impossible to field survey all sites each year. Therefore, ArcGIS is used to determine total site cover of the sites that are not field monitored. This has been proven to be a useful tool to allow staff to evaluate every site each year, but results suggest it may not be the most accurate. Some sites total cover decreases during ArcGIS monitoring years and increases during field survey years. This is likely due to the inability to identify some plants using ArcGIS. Although there is some inaccuracy using this system, ArcGIS should continue to be used and the results interpreted lightly. All sites are monitored in the field every other year, so, management decisions should be based off field survey results only.

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