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Las Vegas Wash Vegetation Monitoring Report, 2013

July 2014

SOUTHERN NEVADA WATER AUTHORITY

Las Vegas Wash Coordination Committee

Las Vegas Wash
Vegetation Monitoring Report, 2013

SOUTHERN NEVADA WATER AUTHORITY
Las Vegas Wash Project Coordination Team

Prepared for:

Las Vegas Wash Coordination Committee

Prepared by:

Jason R. Eckberg
Southern Nevada Water Authority
100 City Parkway, Suite 700
Las Vegas, Nevada 89106

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ABSTRACT

Revegetation projects have been conducted along the Las Vegas Wash for over 13 years to meet goals of the Las Vegas Wash Coordination Committee. In the fall of 2013, when monitoring for this report took place, approximately 373 acres of revegetation at 259 monitoring areas along the Las Vegas Wash were established. Ninety-one of these acres are wetland, with the remaining 282 being described as non-wetland. Sites ranging in age from 1 to 13 growing seasons had total cover, noxious species cover, species richness, and wetland prevalence index documented. Survivorship was calculated for five recently established sites with an average of 88.2% of the planted plants surviving until monitoring. Overall most sites either increased in cover or remained constant since 2012; only 10% of the revegetation sites decreased in cover. Most mature sites have stabilized and their 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, I would like to thank the following people for their assistance in monitoring and management of revegetation sites along the Las Vegas Wash; Carol Lane, Nick Rice, Tim Ricks, Debbie Van Dooremolen, and Seth Shanahan. In addition, I would like to specifically thank Giles Anthony and Soil-Tech for their dedication to planting and maintaining Las Vegas Wash revegetation sites. Keiba Crear has been a central figure in advocating for rigorous monitoring and proper maintenance and I thank you. Thank you to the many people who reviewed this document and provided invaluable comments. Finally, I would like to thank the 29 members of the Las Vegas Wash Coordination Committee, as well as 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

In 1997, t he Southern Nevada Water Authority (SNWA) assembled a citizens 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 29-member multi-stakeholder group consisting of federal, state, and local agencies, the university, private businesses, an environmental group, 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 are planted to help further protect the Wash from erosion as well as to improve the functional attributes of the ecosystem.

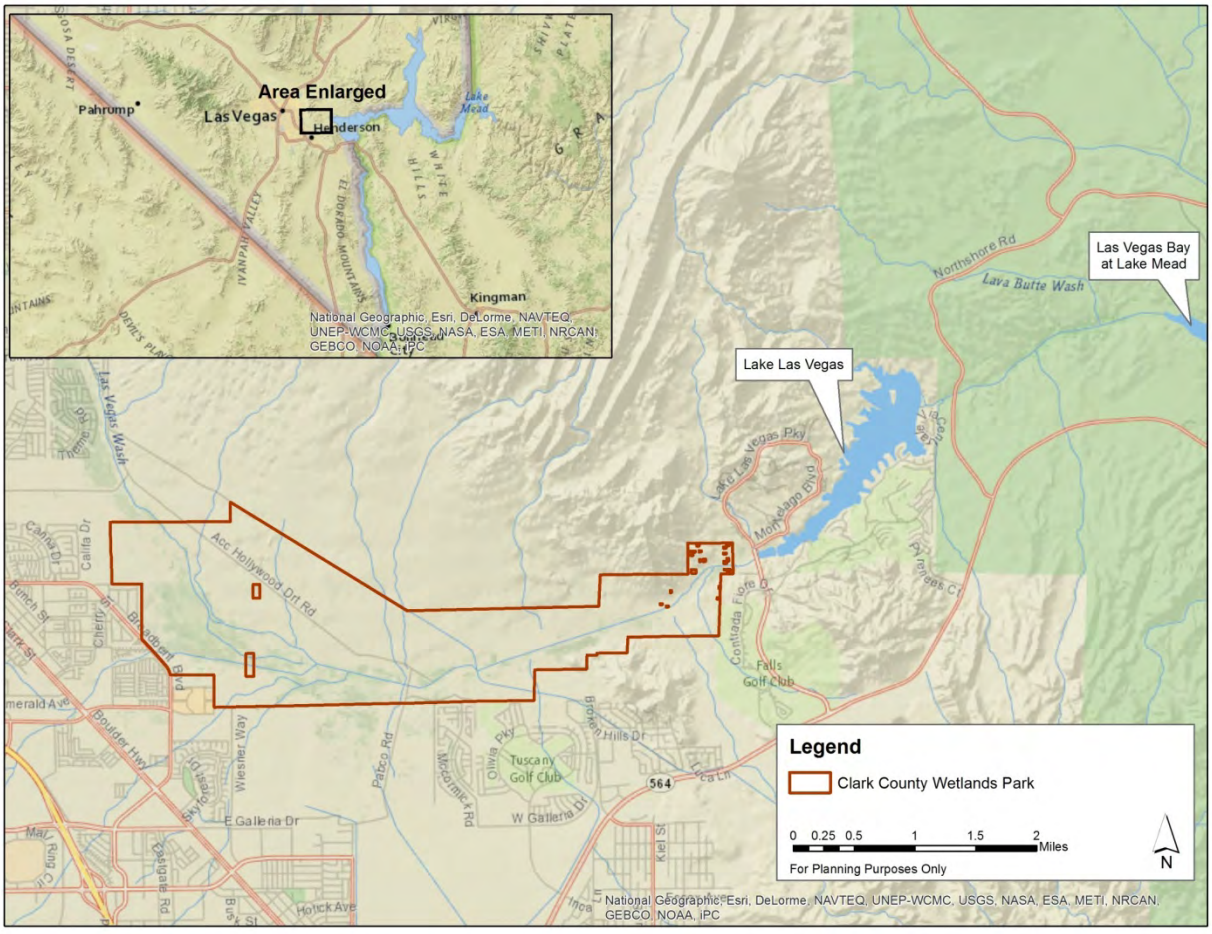

Figure 1. Las Vegas Wash location and general study area map.

The revegetation program is a critical component of the overall plan to stabilize and enhance the Wash. Plants help prevent erosion because their roots bind loose soil particles on the surface and in deep subsurface horizons, thereby acting as soil anchors during scouring events (i.e., floods). In addition, revegetation benefits a variety of wildlife species that occur along the Wash, and potentially provides a habitat for species formerly found along the Wash to reestablish there. Because the Wash was not historically a riverine system, it does not have an abundance of source plants native to these conditions. Moreover, during its transitional period, 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 the surrounding area 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 2013 data as part of a comprehensive vegetation monitoring program. Vegetation monitoring results from 2002 through 2012 have been previously documented (SNWA 2005, Eckberg and Shanahan 2008, and Eckberg 2014) and therefore are not described in detail in this report. A variety of other monitoring programs have been conducted to help describe the benefit of the ecological changes along the Wash for wildlife (Shanahan 2005a, Shanahan 2005b, Van Dooremolen 2010, O'Farrell and Shanahan 2006, Rice 2007); subsequently, these data are also not included in this report. Since 2003, monitoring activities have been conducted on progressively larger land areas; approximately 38 acres were monitored in 2003 to approximately 373 acres monitored in 2013. 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). The only exception is the Clark County Water Reclamation District (CCWRD) revegetation sites which are located just north of the CCWP.

1.3 Need for Revegetation and Vegetation Monitoring

Revegetation projects along the Wash are conducted for a few important reasons. Revegetation is a compensatory mitigation requirement for 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 United States. Section 404 of the CWA established a program to regulate the discharge of dredged or fill material into waters of the U.S., which includes wetlands associated with Wash erosion control projects. Section 404 permits require that revegetation projects are monitored for success; consequently, several performance indicators are monitored so that performance criteria can be achieved. The primary criterion is that mitigation areas provide the functional attributes of a natural wetland system and not necessarily specific numerical criteria.

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 projects. NDEP issues stormwater general permits for construction activities such as building erosion control facilities 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

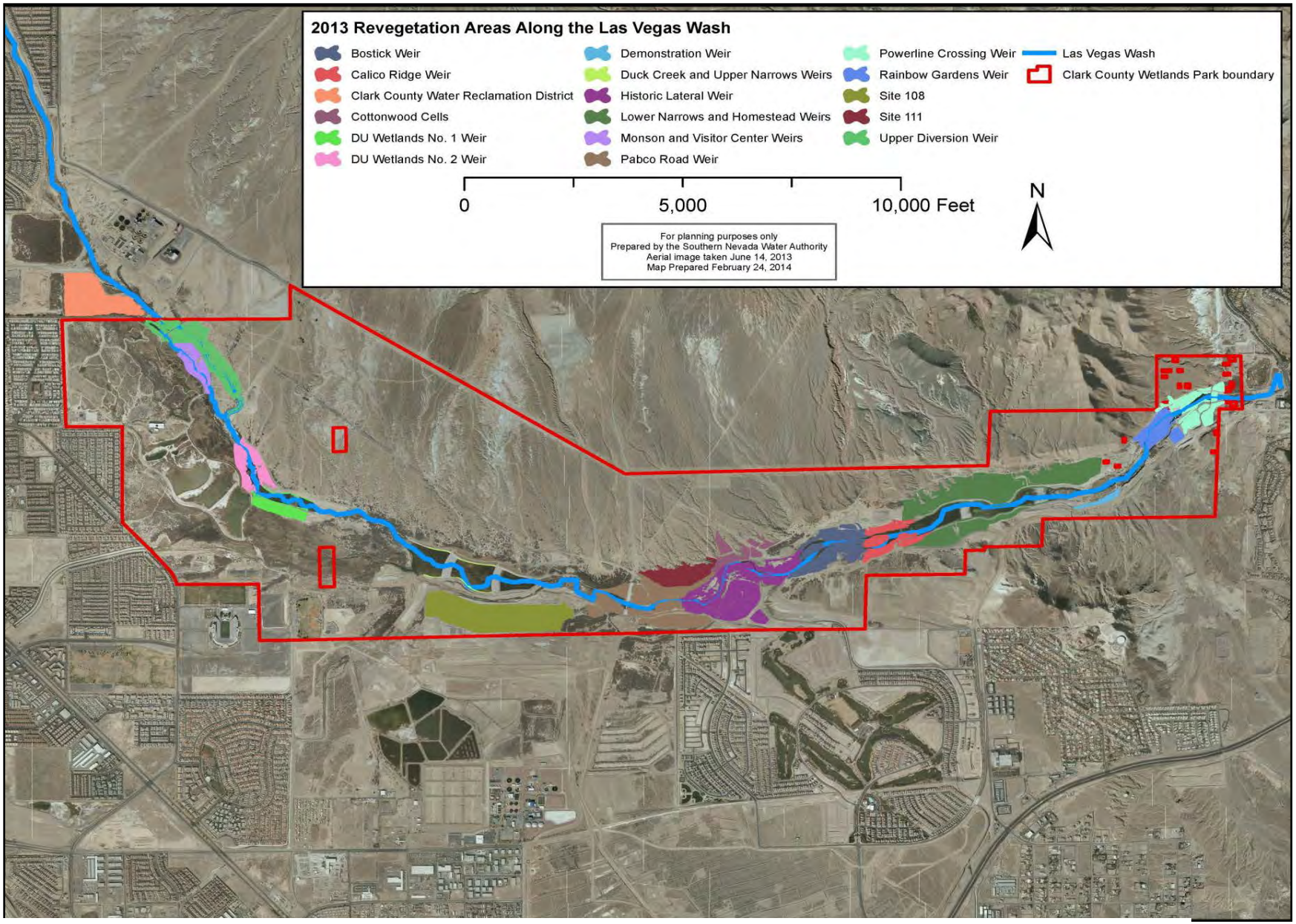

Figure 2. Location of the 2013 Las Vegas Wash revegetation sites and the Clark County Wetlands Park boundary.

require 35% total cover)…" Vegetation monitoring is an important tool to document vegetation cover and achievement of permit conditions.

In addition to permit-required revegetation, revegetation projects are also required by federal and state grants received by SNWA to help fund the erosion control program, as well as ecological enhancement along the Wash. Granting agencies or institutions require that revegetation projects are successful, and 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 methods.

1.4 Program Funding

The two major sources of funding for revegetation projects along the Wash are funding derived from grants and the Wash Capital Improvements Plan (Wash CIP). The Wash CIP exclusively funds revegetation activities stipulated in federal or state permits (e.g., wetland permits) obtained by SNWA as part of weir construction. In contrast, grant funds are used to supplement overall revegetation activities. The majority of the revegetation projects implemented along the Wash have been funded through various grants. Grants have come from a variety of sources including the Clark County Multiple Species Habitat Conservation Plan, NDEP, Nevada Division of State Parks (NDSP), and three rounds of the Southern Nevada Public Lands Management Act (SNPLMA IV, SNPLMA V, and SNPLMA VI).

2.0 MATERIALS AND METHODS

Monitoring was conducted between August and October 2013. Monitoring methods followed the same guidelines and techniques as in previous years and are described in detail in past reports (Eckberg 2014). As of August 2013, there were 46 wetland and 48 non-wetland revegetation sites. Many of the non-wetland sites were broken up into multiple monitoring areas (Table 1).

ArcGIS was used to monitor 48 of the 94 total revegetation sites in 2013 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).

All species documented during vegetation monitoring were crosschecked using the Integrated Taxonomic Information System (ITIS; www.itis.gov) to ensure that the scientific name is currently valid. Updates were made to three of the species found at the Wash (Table 2). Keeping this information updated ensures that communications regarding plants used and found at the Wash are as current as possible. Common names are not typically changed due to the variability in their use. Each plant species is assigned a Wetland Indicator Status by the National Wetland Plant List (Lichvar 2013) which is updated annually. Table 3 shows the updates to the status of three species found along the Wash in 2013.

Major Site	Acreage		No. of Monitoring Areas	
	2012	2013	2012	2013
Bostick Weir	24.1	24.3	14	13
Calico Ridge Weir	13.8	14.0	10	10
CCWRD	29.5	28.9	30	29
Cottonwood Cells	9.8	10.1	8	10
Demonstration Weir	2.6	2.6	2	2
Duck Creek Confluence and Upper Narrows Weirs	-	0.9	-	2
DU Wetlands No. 1 Weir	-	8.1	-	3
DU Wetlands No. 2 Weir	11.2	10.3	4	4
Historic Lateral Weir	43.7	44.1	13	13
Lower Narrows and Homestead Weirs	61.5	67.9	5	6
Monson and Visitor Center Weirs	9.0	9.0	4	4
Pabco Road Weir	38.9	38.7	18	18
Powerline Crossing Weir	14.6	14.7	16	17
Rainbow Gardens Weir	11.3	11.3	6	6
Site-108	50.3	50.7	66	72
Site-111	14.9	14.5	24	26
Upper Diversion Weir	24.4	23.3	24	24
TOTAL	359.6	373.4	244	259

Table 1. Change in cumulative acreage monitored and number of monitoring areas from 2012 to 2013.

Common Name	Previous Scientific Name	Current Scientific Name
marsh fleabane	*Pluchea odorata*	*Pluchea carolinensis*
Fremont's peppergrass	*Lepidium fremontii* var. *fremontii*	*Lepidium fremontii*
American black nightshade	*Solanum americanum*	*Solanum ptychanthum*

Table 2. Updated scientific names for plants found along the Las Vegas Wash in 2013.

Common Name	Scientific Name	2013 Wetland Indicator Status
bush seepweed	*Suaeda nigra*	Obligate wetland
salt heliotrope	*Heliotropium curassavicum*	Facultative upland
desert tobacco	*Nicotiana obtusifolia*	Facultative

Table 3. Updated Wetland Indicator Status for plants found along the Las Vegas Wash in 2013.

3.0 RESULTS AND DISCUSSION

The following subsections describe vegetation monitoring results for each site and for groupings of sites. From 2012 to 2013, the number of areas monitored increased by 15 and the acreage of monitored areas increased by 13.8 (Table 1). The total areas and acreage include sites monitored in the field as well as with ArcGIS. Cumulatively, there have been slightly more than 37.5 acres of wetlands created along the Wash in addition to those required by mitigation permits (Table 4). This includes 3.43 acres of wetlands associated with the Cottonwood Cells, which were fully funded by grants from the Bureau of Reclamation. Federally funded projects such as these are not eligible for use as mitigation of wetlands impacted in accordance with permits issued by the Corps.

Mitigation Project	Mitigation Permit Number	Mitigation Required (acres)	Wetland Area Created (acres)
Bostick Weir	200125114	7.88	16.87
Calico Ridge Weir	200450004	3.8	6.44
Clark County Water Reclamation District	SPK-2009-00227-SG	6.79	6.79°
Cottonwood Cells	N/A	-	3.43*
Demonstration Weir	199825148	0.9	0.69
Duck Creek Confluence and Upper Narrows Weirs	SPK-2009-00042	1.33	0.91
DU Wetlands No. 1 Weir	SPK-2010-00285-SG	1.22	0.78
DU Wetlands No. 2 Weir	2007-1961-SG	0.05	0.89
Historic Lateral Weir	199825148	4.9	18.92
Lower Narrows and Homestead Weirs	SPK-2008-01417-SG	6.25	2.83
Monson and Visitor Center Weirs	200250111	4.81	1.91
Pabco Road Weir	199725375	2.2	11.81
Powerline Crossing Weir	200450454	4.87	2.63
Rainbow Gardens Weir	200250054	1	7.43
Upper Diversion Weir	200550514	0.01	8.26
Bank Protection Projects	-	7.06	-
TOTAL		53.07	90.59

° Permit held by Clark County Water Reclamation District and not eligible for Wash wetland mitigation
* Federally funded revegetation not eligible for wetland mitigation

Table 4. Mitigation requirements and wetland areas established as of August 2013.

3.1 Bostick Weir

There are 13 monitoring areas associated with the Bostick Weir (Figure 3; Table 5). In 2013, four of these sites were monitored in the field, the remainder were monitored for total cover using ArcGIS. Most of these sites have apparently reached capacity in terms of vegetative growth as there has been little change for many years, especially on wetland sites. It is for this

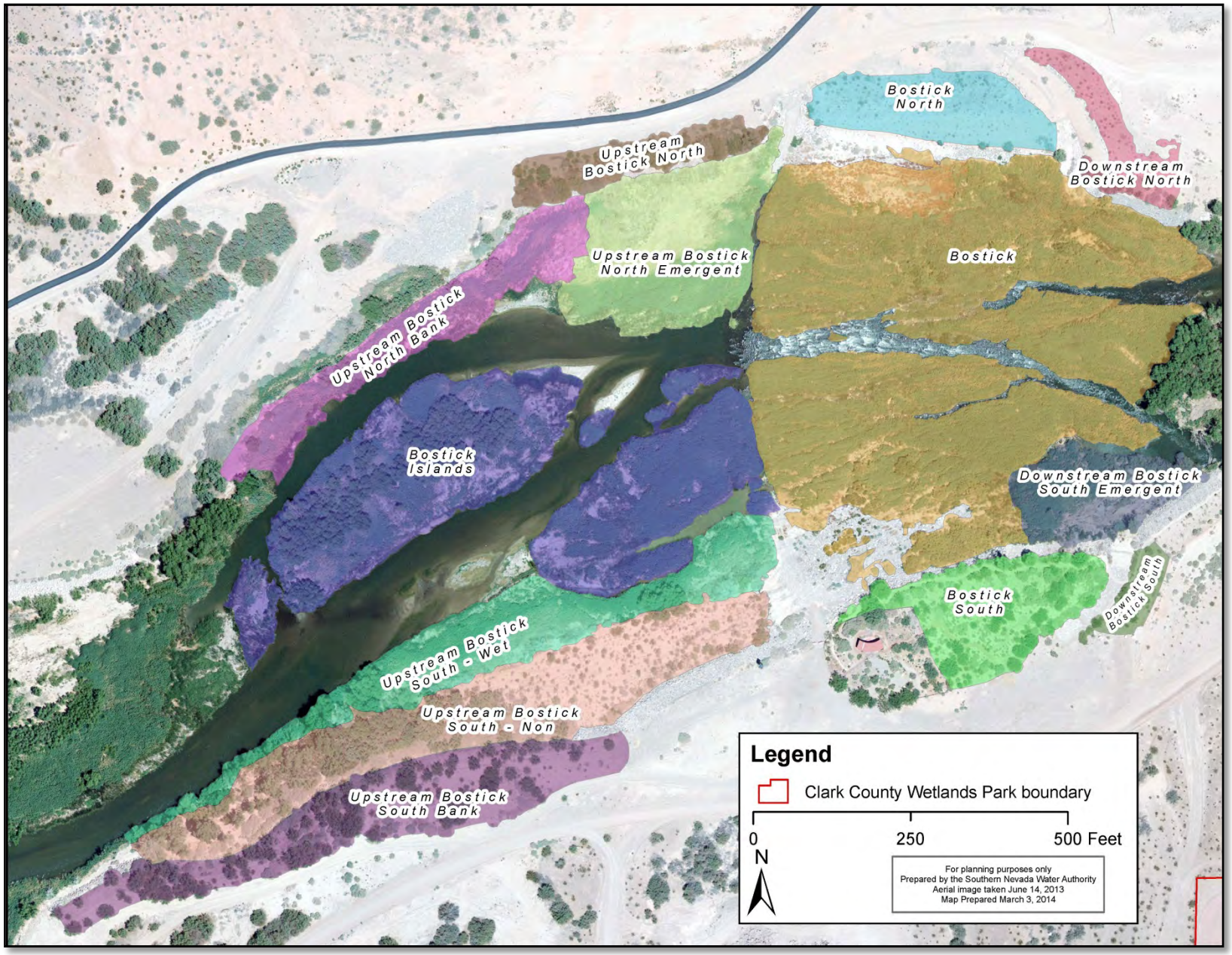

Figure 3. Aerial photograph of 2013 delineated Bostick Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
B	10	7.37	wet	75-100%	nm	nm	nm
BI	10	4.16	wet	75-100%	0.6%	14	1.87
BN	10	0.84	non-wet	25-50%	nm	nm	nm
BS	9	1.10	non-wet	75-100%	0.5%	12	3.45
DBN	10	0.45	non-wet	25-50%	nm	nm	nm
DBS	9	0.21	non-wet	75-100%	0.0%	8	4.82
DBSE	9	0.77	wet	75-100%	nm	nm	nm
UBN	10	0.56	non-wet	75-100%	nm	nm	nm
UBNB	9	1.21	wet	75-100%	nm	nm	nm
UBNE	9	1.65	wet	75-100%	2.5%	9	1.97
UBS	10	2.48	non-wet	75-100%	nm	nm	nm
UBS	10	1.71	wet	75-100%	nm	nm	nm
UBSB	9	1.78	non-wet	75-100%	nm	nm	nm

[1]B=Bostick, BI=Bostick Islands, BN=Bostick North, BS=-Bostick South, 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 5. Vegetation monitoring results for Bostick Weir revegetation sites in 2013.

reason that so few of the sites require annual field verification of site conditions. Only one Bostick site has had a change in total cover in the past three growing seasons and only four sites have changed in the past five growing seasons.

Bostick Islands was monitored in the field for the first time since the 2010 ve getation monitoring. The site was actively planted but only a small portion of the area planted in 2006 makes up the now 4.16-acre site. The remainder is passively created islands within the Wash channel upstream of the Bostick Weir. In 2013, the site had 14 species documented on it with the two dominants being common reed (*Phragmites australis*) and Goodding's willow (*Salix gooddingii*), both covering 25-50% of the site. The only other species that had more than 1% of the site's cover was southern cattail with a cover of between 5% and 25%.

Bostick South was planted in the fall of 2004 as a volunteer Green-Up event. This site has apparently reached its capacity with plant growth over the past few years. Each monitoring since 2011 has shown that the site has a total cover between 75% and 100%. In addition, honey mesquite (*Prosopis glandulosa* var. *torreyana*), has been the dominant species on the site since 2011 with 25-50% cover. Downstream Bostick South, also planted as part of the fall 2004 Green-Up, also had the maximum 75-100% total cover and was dominated by honey mesquite

(Figure 4). Unlike Bostick South, this is the first monitoring year that this site reached this cover range.

Figure 4. Honey mesquite and other vegetation at the Downstream Bostick South site in 2013.

The vegetation at Upstream Bostick North Emergent has recovered from the clearing that took place in 2010 in terms of total cover, which has been between 75% and 100% for the past three monitoring years. The dominant species on the site, common reed, has not changed since it was first monitored in 2006. What has not recovered since the 2010 clearing is this site's species richness; there were 21 species documented in 2008 and just 9 species in 2013.

The nine sites monitored using ArcGIS in 2013 had the same total cover when they were monitored in the field in 2012. Many of the sites had the same total cover for seven to eight growing seasons.

3.2 Calico Ridge Weir

In 2013, at the Calico Ridge Weir, the four non-wetland sites were monitored in the field, while the five wetland sites had their total cover measured using ArcGIS (Table 6; Figure 5). All nine sites had the same total cover as in 2012; all wetland sites had the maximum 75-100% cover and non-wetland sites had either 25-50% or 50-75% cover. This is a sign of successional maturity in sites that are in their ninth growing season.

Downstream Calico North was planted in 2005 and is in its ninth growing season. Both in 2012 and 2013, this site had a total cover in the range of 25-50%. One development since 2012 was a change in the plant composition. In 2012, the two co-dominant species were four-wing saltbush and quailbush, both at 5-25% cover. In 2013, four-wing saltbush and desert saltbush are the co-dominant species with the same cover range. Desert saltbush was not detected on the site in 2012 and quailbush was reduced to just 0.5% cover in 2013. This is likely due to the proximity to Lower Narrows Homestead North, which is dominated by desert saltbush that is successfully spreading into this adjacent site. It is unknown what caused quailbush to reduce on the site, perhaps soil hydrology or competition from other saltbush species.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
C	9	1.61	wet	75-100%	nm	nm	nm
DCN	9	0.65	non-wet	25-50%	0.0%	12	4.33
DCS	9	2.02	non-wet	25-50%	0.0%	12	4.91
DCS	9	0.27	wet	75-100%	nm	nm	nm
UCE	9	2.88	wet	75-100%	nm	nm	nm
UCN	9	1.98	non-wet	50-75%	0.1%	17	4.42
UCN	9	0.87	wet	75-100%	nm	nm	nm
UCS	9	2.87	non-wet	50-75%	0.5%	17	4.45
UCS	9	0.81	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 6. Vegetation monitoring results for Calico Ridge Weir revegetation sites in 2013.

The Green-Up site, Downstream Calico South-non-wetland, was planted in the spring of 2005 (Figure 6). In 2013, the total cover was in the range of 25-50%, which was the same as 2012. Total cover has fluctuated between 5-25% and 25-50% since it was first monitored in 2006. In 2013, the WPI indicated the plant community on the site had a rating of 4.91. With a maximum of 5.00, this site is one of the most upland species dominated along the Wash.

Upstream Calico North-non-wetland and Upstream Calico South-non-wetland both had total cover in the range of 50-75% in 2013, which is the same total cover as in 2012. Both sites also had the same number of species - 17. Upstream Calico North-non-wetland was dominated by four-wing saltbush, with a cover of 25-50%. Upstream Calico South-non-wetland had three co-dominant species; four-wing saltbush, desert saltbush, and creosote bush. All three of these species had a cover of 5-25%.

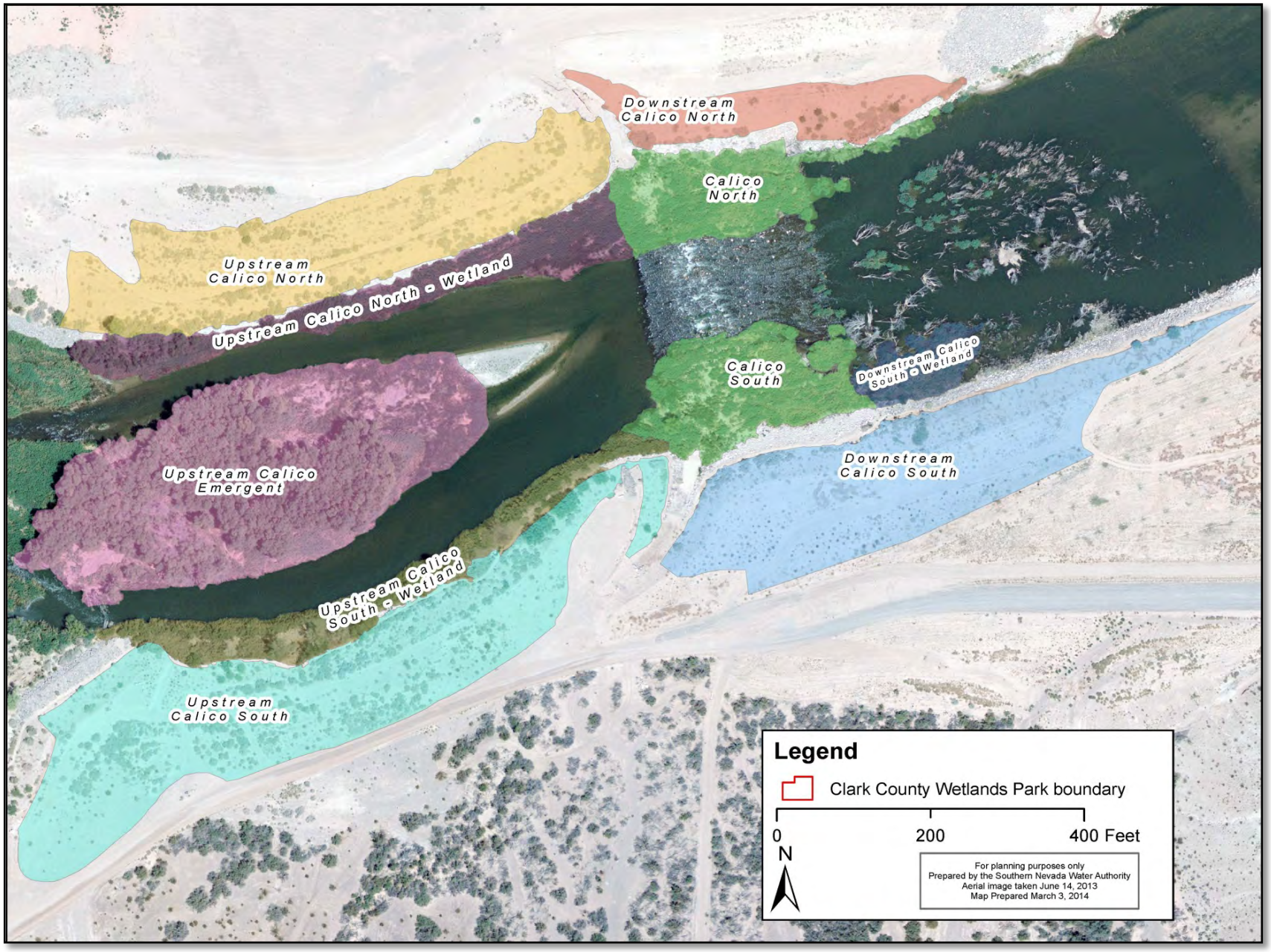

Figure 5. Aerial photograph of 2013 delineated Calico Ridge Weir revegetation sites.

Figure 6. The non-wetland Downstream Calico South revegetation site in 2013.

3.3 Clark County Water Reclamation District

The revegetation site located at the CCWRD was monitored for the fourth year in 2013 (Table 7). It was planted as the fall 2010 Green-Up location, divided into 29 monitoring areas based on size, and then categorized into wetland and non-wetland - per the jurisdictional determination conducted (prior to clearing the salt cedar that previously dominated the site). Since wetland areas follow non-linear patterns (Figure 7), the monitoring area was determined to be wetland if the majority of the site fell into the wetland delineated area. Non-wetland areas were not separated during monitoring but areas funded by NDEP and SNPLMA Round VI funds are shown in Figure 7.

There was a slight decrease in cover from 2012 to 2013 across the site as a whole - 76.4% down to 72.9%. However, most of this decrease can be attributed to loss of noxious or otherwise exotic plants including bassia (*Bassia hyssopifolia*), tall whitetop (*Lepidium latifolium*), and narrow-leaf dock (*Rumex stenophyllus*). A native species that also had an impact on the decrease in overall cover was salt heliotrope (*Heliotropium curassavicum*), which decreased from 10.1% to 0.7%.

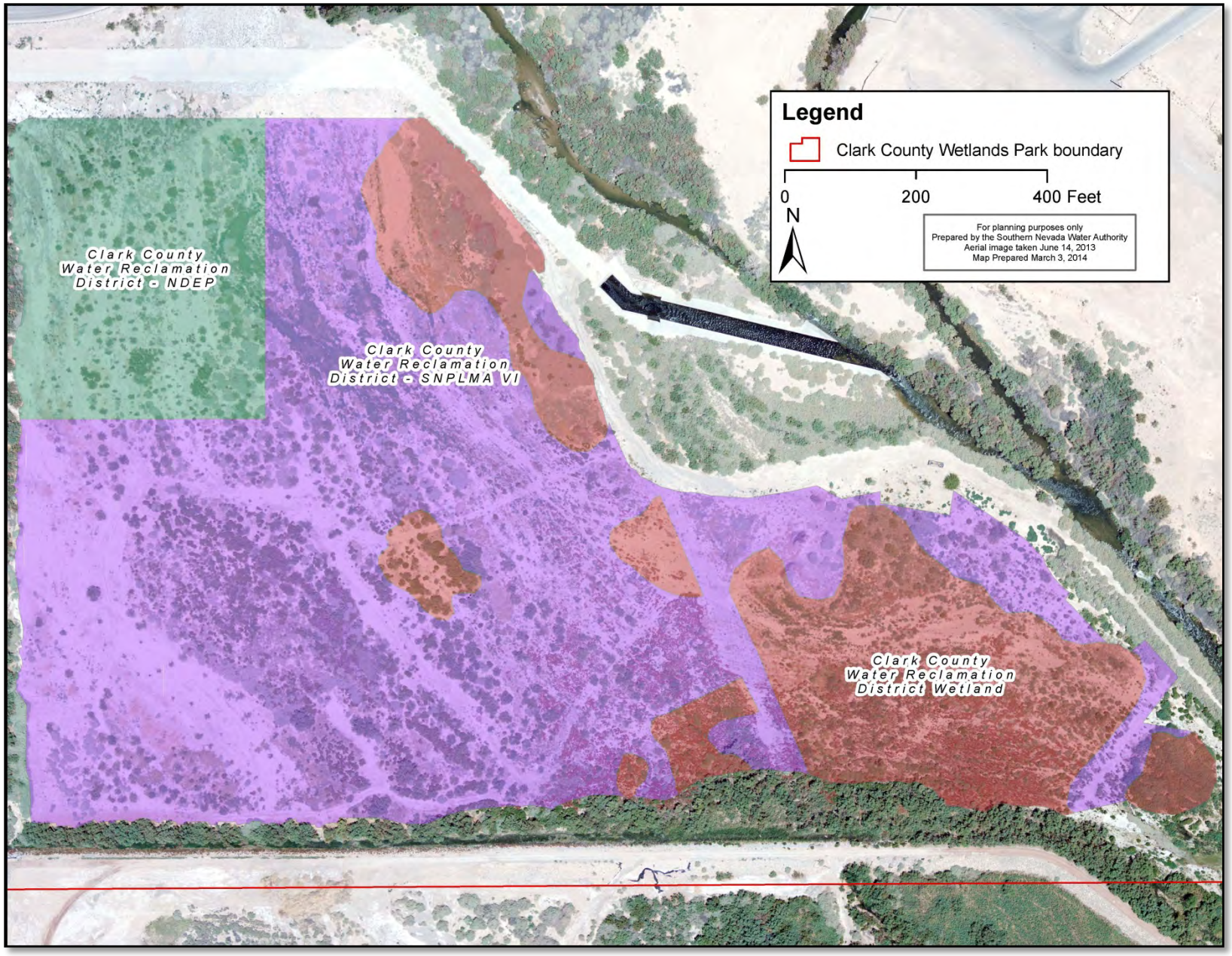

Figure 7. Aerial photograph of the 2013 delineated Clark County Water Reclamation District revegetation site.

Site Code	Growing Season	Acreage	Wetland Status[1]	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
CCWRD	4	22.13	non-wet	73.0%	8.7%	39	3.38
CCWRD	4	6.79	wet	72.9%	8.4%	25	3.24
TOTAL	4	28.98	both	72.9%	8.1%	42	3.38

[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 7. Vegetation monitoring results for Clark County Water Reclamation District revegetation sites in 2013.

This species is a perennial herb that has variable growth rates based on water availability and microclimatic conditions so the decline is not a concern regarding the overall state of the revegetation site. There were 42 species documented, the same as in 2012, with the dominant species being honey mesquite (Figure 8) in both years as well.

Figure 8. Honey mesquite, sunflower and cocklebur at the Clark County Water Reclamation District revegetation site in 2013.

3.4 Cottonwood Cells

Seven revegetation sites were monitored at the Cottonwood Cells (Figure 9) in 2013, with two sites being monitored for the first time this year (Table 8). The two original cottonwood cells (Cottonwood Cell 1 and Cottonwood Cell 2) were monitored for total cover using ArcGIS since they have had the same total cover for many years. Both of these sites continued to have 75-100% cover in 2013.

Cottonwood Cell North was planted in a Green-Up event in spring of 2012, so 2013 was the second year it was monitored. There was a substantial increase in total cover in this site's second year from 43.5% in 2012 to within the range of 75-100% in 2013. Species richness increased from 29 to 46. The first monitoring took place just six months after planting; the site continues to receive irrigation which may explain some of the growth. The increase in species richness is likely due to the site's topography, which is at the end of a desert wash as it enters the Wash. This has resulted in the establishment of many species, including some not seen on any Wash revegetation site prior to 2013 (Figure 10); yellow nightshade groundcherry (*Physalis crassifolia*), barrel cactus (*Ferocactus* sp.), Cooper's goldenbush (*Ericameria cooperi*), trailing windmills (*Allionia incarnate*), and chinchweed (*Pectis papposa*).

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
CC1	12	0.93	wet	75-100%	nm	nm	nm
CC2	9	0.53	wet	75-100%	nm	nm	nm
CC3	2	1.50	wet	25-50%	0.7%	33	2.69
CC3-2	1	0.39	wet	75-100%	5.0%	25	3.28
CCB	1	0.08	wet	75-100%	2.5%	23	1.82
CCN	2	4.83	non-wet	75-100%	0.1%	46	3.13
CCNS	2	1.83	non-wet	25-50%	0.1%	27	3.77

[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, CCNS=Cottonwood Cell North Stockpiles

[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 Cottonwood Cell revegetation sites in 2013.

Cottonwood Cell North Stockpiles was planted in conjunction with Cottonwood Cell North in the spring 2012 Green-Up. This site is much drier and not expected to reach the large total plant cover of Cottonwood Cell North. The total cover in both 2012 and 2013 was 25-50% and the dominant plant was desert saltbush, which had 24.3% vegetative cover in 2013. This site continued to be irrigated in 2013 and like most Wash revegetation sites, it resulted in an increase in species richness. There were 27 species on the site in 2013 compared to 15 in 2012. Two of the new species included chinchweed that was also found on Cottonwood Cell North and winterfat (*Krascheninnikovia lanata*), which had not been previously detected on any Wash revegetation site.

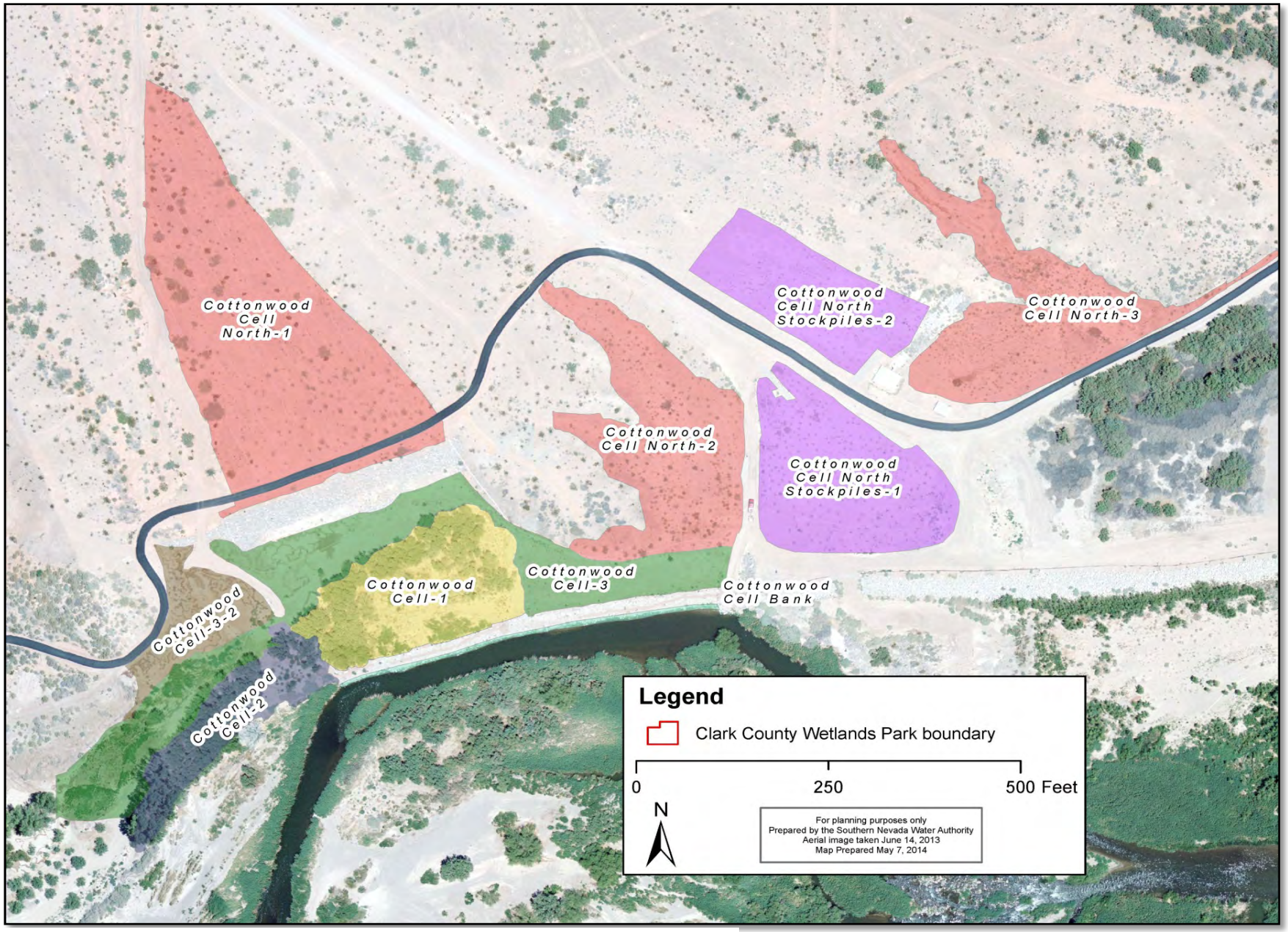

Figure 9. Aerial photograph of 2013 delineated Cottonwood Cell revegetation sites.

Cottonwood Cell 3 was the third component of the spring 2012 Green-Up. This site was planted exclusively with cottonwoods to expand the area of the two successful Cottonwood Cells. Despite being planted with just one species, there were 33 species detected in 2013, up from 25 in 2012. The total cover was between 25% and 50% and cottonwoods had cover range of 5-25%. In the fall of 2012, another area adjacent to Cottonwood Cell 3 started to become established with cottonwoods. It was subsequently planted with seep willow (*Baccharis salicifolia*) and named Cottonwood Cell 3-2. Both cottonwoods and seep willow have grown quickly and the site has a cover of 75-100% after its first growing season. The banks of the Wash near the Cottonwood Cells (Cottonwood Cell Bank) were also planted in the fall of 2012. This site also has the maximum cover of 75-100% and had 23 species in its first monitoring year, with just five species being planted.

Figure 10. Five species identified for the first time at Las Vegas Wash revegetation sites at Cottonwood Cell North and Cottonwood Cell North Stockpiles in 2013. Clockwise from upper right: trailing windmills, yellow nightshade groundcherry, chinchweed, Cooper's goldenbush, and winterfat.

3.5 Demonstration Weir

Both revegetation sites at the Demonstration Weir in 2013 (Figure 12; Table 9) were very similar to their conditions in 2012. Upstream Demonstration South-non-wetland and Upstream Demonstratation South-wetland both had the same total cover in 2012, with 50-75% and 75-100%, respectively. The dominant species on the non-wetland site remained creosote bush. The wetland site's dominant species was screwbean mesquite (*Prosopis pubescens*; Figure 11).

In 2012, screwbean mesquite was co-dominant with Goodding's willow, which declined in cover in 2013. This is a result of drying conditions caused by sedimentation in the Wash channel that altered water flow, decreasing the amount of water that reaches this site. These sites are going to be further impacted by the construction of the Three Kids Weir, which will effectively replace the Demonstration Weir.

Figure 11. Screwbean mesquite was the dominant species at Upstream Demonstration South-non-wetland in 2013.

3.6 Duck Creek Confluence and Upper Narrows Weirs

The Duck Creek Confluence and Upper Narrows Weirs were completed in early 2013. The only revegetation sites that were completed by the time monitoring began were the emergent areas along the banks - Duck Creek Upper Narrows Emergent (Figure 13; Table 10).

The areas on the north and south banks were planted with three wetland grasses (Figure 14); American bulrush (*Schoenoplectus americanus*), California bulrush (*Schoenoplectus californicus*), and tule (*Schoenoplectus acutus* var. *occidentalis*). Tule was the dominant species on the site. Pole plantings of seep willow, sandbar willow, and Goodding's willow were also planted throughout the site in the early months of 2013. At just under an acre (Table 10), the site had a total cover of 75.8%, calculated by taking the weighted average of the two areas on the north and south banks based on acreage. Non-wetland areas were planted on the north side of the weirs after vegetation monitoring concluded in 2013, and additional areas will be planted in 2014 on the south side.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
UDS	11	1.88	non-wet	50-75%	0.0%	10	4.50
UDS	11	0.69	wet	75-100%	0.0%	7	2.81

[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 9. Vegetation monitoring results for Demonstration Weir revegetation sites in 2013.

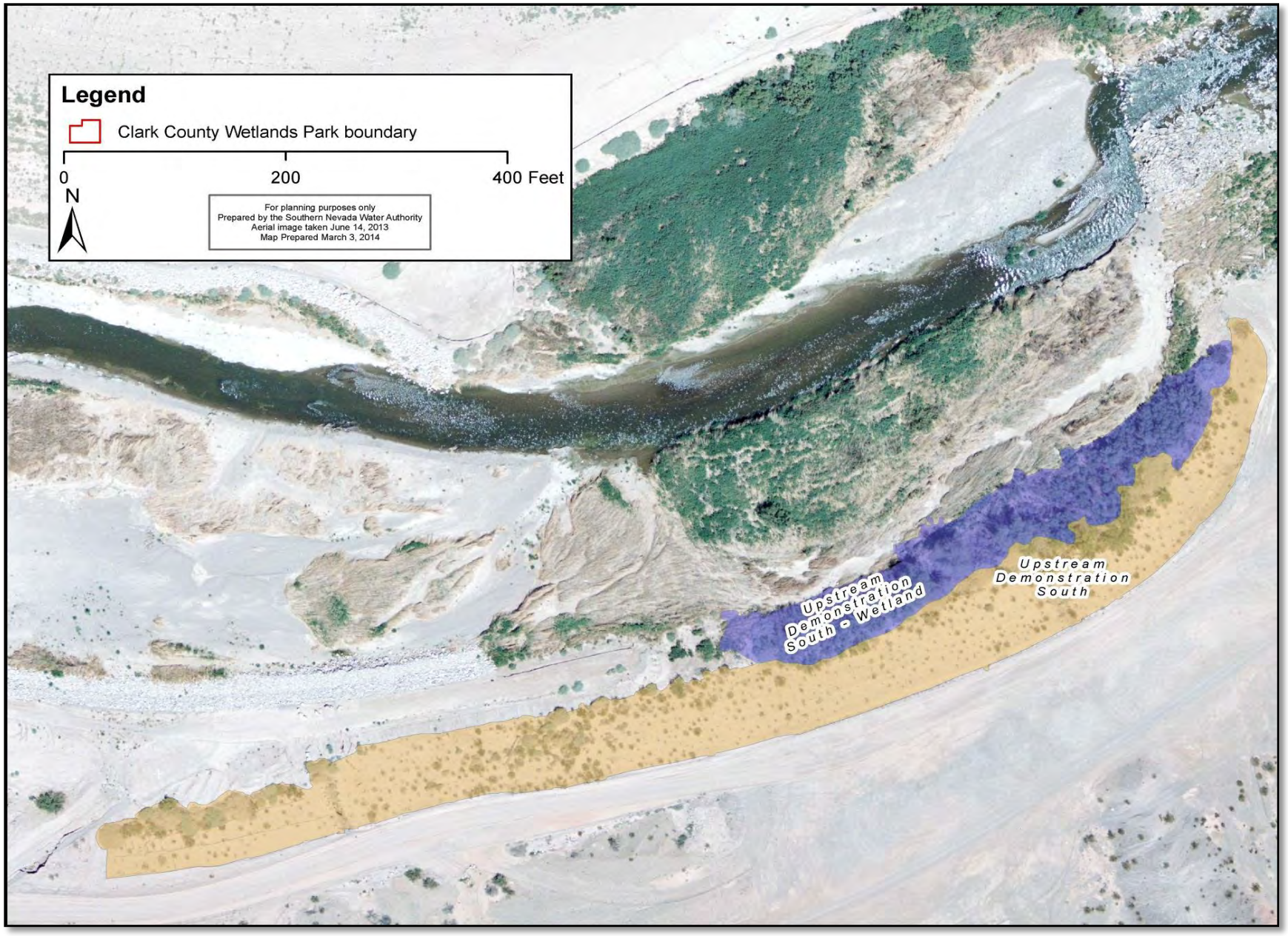

Figure 12. Aerial photograph of 2013 delineated Demonstration Weir revegetation sites.

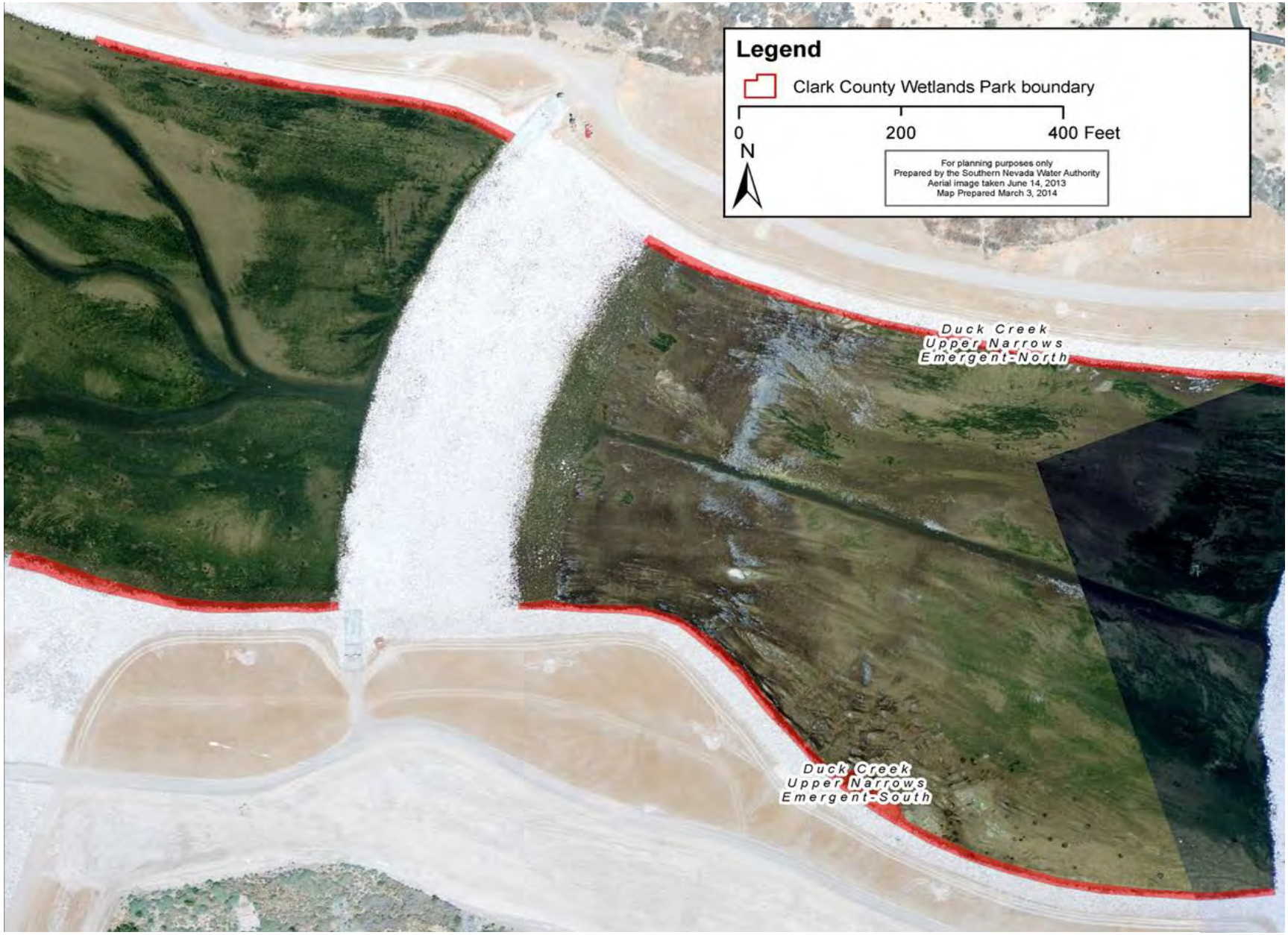

Figure 13. Aerial photograph of 2013 delineated Duck Creek Confluence and Upper Narrows Weirs revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DCUNE	1	0.91	wet	75.8%	1.3%	24	1.36

[1] DCUNE=Duck Creek Upper Narrows Emergent

[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 the Duck Creek Confluence and Upper Narrows Weirs revegetation sites in 2013.

Figure 14. Various emergent grasses were planted along the banks at the Duck Creek Confluence and Upper Narrows Weirs in 2013.

3.7 DU Wetlands No. 1 Weir

The DU Wetlands No. 1 Weir was completed in early 2013, and two sites were planted soon after. The wetland areas along the north and south banks of the Wash, DU Wetlands No. 1 Emergent (Table 11; Figure 15), were planted throughout the early months of 2013. DU Wetlands No. 1 South is an upland non-wetland site that was planted as part of the spring 2013 Green-Up.

Both sites have done very well in terms of plant growth and health in their first growing season. DU Wetlands No. 1 Emergent has already reached the maximum cover value in monitoring (75-100%; Table 11). It was planted with the same species as Duck Creek Upper Narrows Emergent as these two weir projects were constructed simultaneously. As with Duck Creek Upper Narrows Emergent, tule was also the dominant species of the 40 species found on this site, with 8.9% cover.

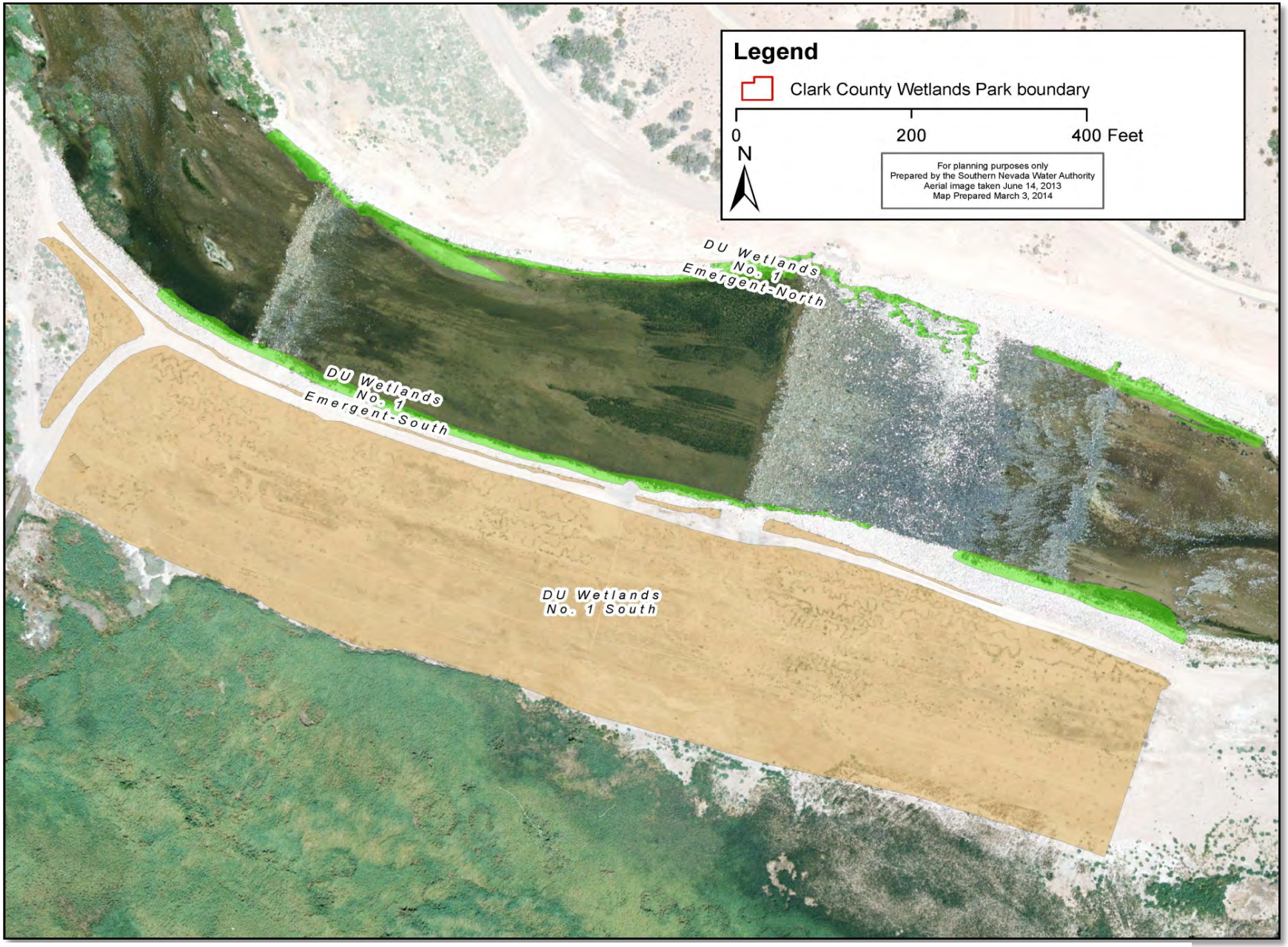

Figure 15. Aerial photograph of 2013 delineated DU Wetlands No. 1 Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DU1E	1	0.78	wet	75-100%	0.7%	40	1.60
DU1S	1	7.31	non-wet	50-75%	1.6%	22	3.46

[1] DU1S=DU Wetlands No. 1 South, DU1E=DU Wetlands No. 1 Emergent

[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 11. Vegetation monitoring results for DU Wetlands No. 1 Weir revegetation sites in 2013.

DU Wetlands No. 1 South had 50-75% vegetative cover after its first growing season and 22 species were documented, although there were only 7 species planted on the site. Alkali sacaton (*Sporobolus airoides*) was one of the planted species and was the dominant species, with 25-50% cover (Figure 16). There were also four noxious species found (higher than most sites), but none had a cover value of more than 1%. Future monitoring will determine if reduction in irrigation will result in decreased establishment and growth of these species.

Figure 16. Alkali sacaton, globemallow, and desert saltbush cover the majority of DU Wetlands No. 1 South after its first growing season in 2013.

3.8 DU Wetlands No. 2 Weir

The three revegetation sites at the DU Wetlands No. 2 Weir were all in their fourth growing season at the time of monitoring in 2013 (Figure 17; Table 12). All three sites have had the maximum cover range (75-100%) in each of the four monitoring years since the sites were established. The sole wetland site, DU Wetlands No. 2 Emergent, includes areas on the north and south banks of the Wash. As expected, this site is the most species rich of the three, with 28 species in 2013, up from 22 in the previous year. Goodding's willow dominates the site making up 50-75% of the cover. These trees were planted as pole plantings along the banks in 2010 and are now large trees with expansive canopies.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DU2E	4	2.03	wet	75-100%	2.8%	28	1.88
DU2N	4	4.67	non-wet	75-100%	0.5%	14	3.93
DU2S	4	4.73	non-wet	75-100%	1.6%	21	3.86

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

[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 DU Wetlands No. 2 Weir revegetation sites in 2013.

The DU Wetlands No. 2 North non-wetland site was planted in the spring of 2010. However, only 1,250 plants were planted, much less than the typical planting amounts for Wash revegetation sites. This was due to the high success of the hydroseeded plants, especially desert saltbush which has had 75-100% cover since the first monitoring year (Figure 18). In 2013, none of the other 13 species found on the site had more than 5% cover.

Figure 17. Desert saltbush has been the dominant plant in each of DU Wetlands No. 2 North's four growing seasons.

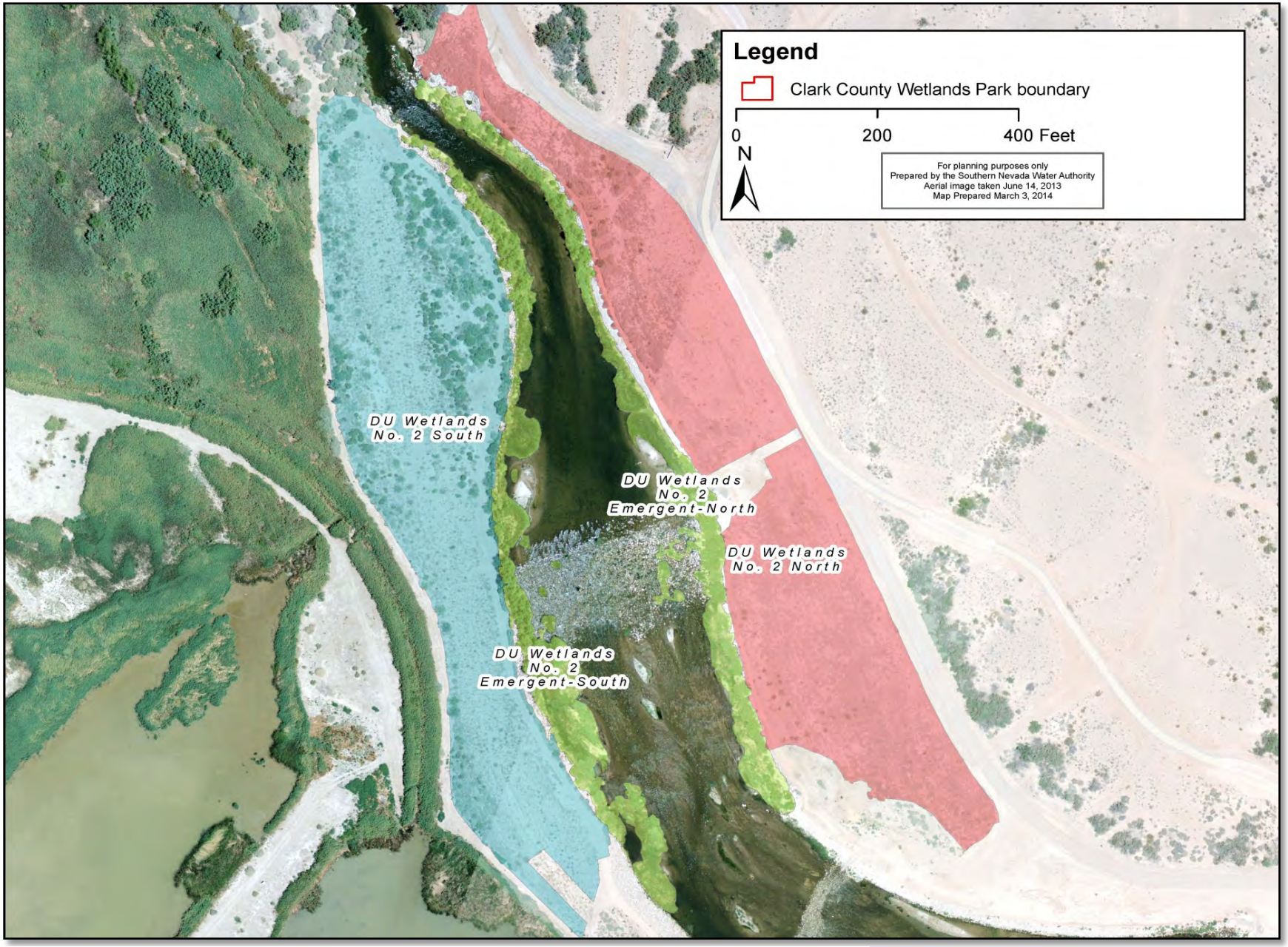

Figure 18. Aerial photograph of 2013 delineated DU Wetlands No. 2 Weir revegetation sites.

DU Wetlands No. 2 South was planted as part of the spring 2010 Green-Up. Seven species were planted on the site and 21 species were documented in 2013. However, three of the originally planted species (white bursage, desert marigold, and globemallow) were not among those that were found and documented. Once irrigation ceased and the growth of the dominant species, honey mesquite and quailbush, increased, it likely made conditions difficult for these smaller forbs to survive.

3.9 Historic Lateral Weir

Four of the 11 revegetation sites at the Historic Lateral Weir (Table 13; Figure 19) were monitored in 2013. This is due to the majority of the sites being very mature at 13 years old and likely reaching their maximum in terms of total vegetative cover. This is not to say that the sites are no longer dynamic or changing, but annual monitoring is not necessary to capture these minor changes. All of the wetland sites had the maximum 75-100% cover, along with two out of the five non-wetland sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DHLPW	13	8.00	wet	75-100%	nm	nm	nm
UHLN	13	4.14	non-wet	50-75%	5.7%	31	3.48
UHLN	13	1.78	wet	75-100%	nm	nm	nm
UHLNS	13	1.66	wet	75-100%	nm	nm	nm
UHLPW	13	4.37	wet	75-100%	nm	nm	nm
UHLS	13	1.22	wet	75-100%	nm	nm	nm
UHLSB	13	1.18	non-wet	75-100%	2.5%	23	3.90
UHLSB	13	1.89	wet	75-100%	nm	nm	nm
UHLSS	3	2.06	non-wet	5-25%	0.0%	14	3.26
UHLSUP	6	5.40	non-wet	75-100%	nm	nm	nm
UHLSUP2	3	12.39	non-wet	83.9%	0.2%	24	4.81

[1]DHLPW=Downstream Historic Lateral Passive Wetlands, UHLN=Upstream Historic Lateral North, UHLNS=Upstream Historic Lateral North South, UHLS=Upstream Historic Lateral South, UHLPW=Upstream Historic Lateral Passive Wetlands, 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 13. Vegetation monitoring results for Historic Lateral Weir revegetation sites in 2013.

Upstream Historic Lateral North-non-wetland has had 50-75% total cover for the past three growing seasons. This site has likely reached its maximum cover due to the large amount of gravel within the site that will prevent additional plant material from establishing in the center. Despite this, there were 31 species documented on the site in 2013 - greater than any previous year. Most of these species were found in a pool of standing water near the Wash as well as along the bank where the site connects to the Wash itself. Upstream Historic Lateral South Bank non-wetland has also had the same total cover in the past three growing seasons at

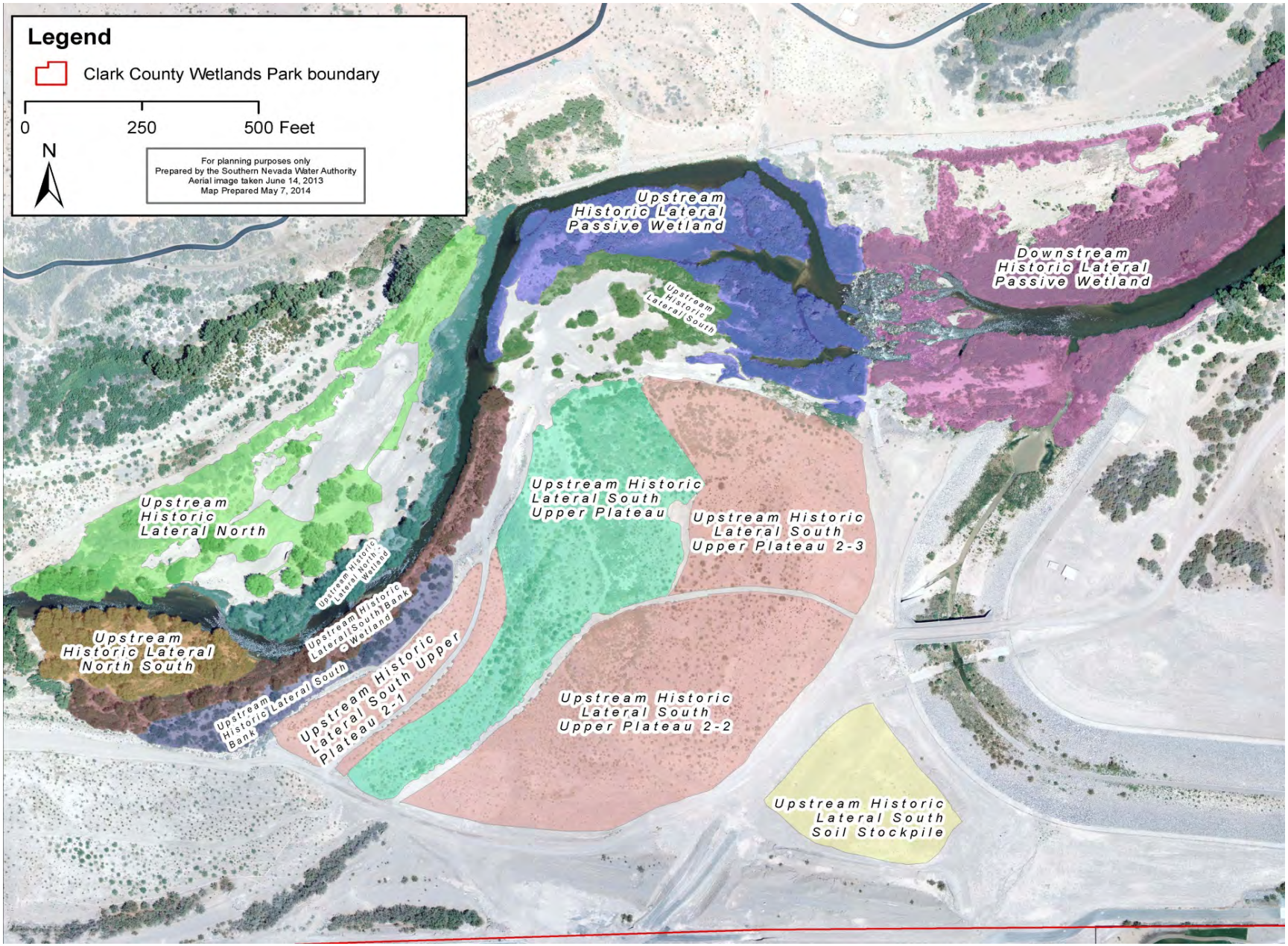

Figure 19. Aerial photograph of 2013 delineated Historic Lateral Weir revegetation sites.

75-100% (Figure 19). The dominant species of the 23 found on the site has also been honey mesquite for the past three monitoring years.

The Upstream Historic Lateral South Stockpile and Upstream Historic Lateral Upper Plateau 2 revegetation sites were both planted as part of the fall 2010 Green-Up and are in their third growing season. They are, however, quite different in their characteristics. The stockpile area is at a higher elevation and further away from the Wash. This results in the site being much drier and having a slower growth rate than sites that are wetter. The total cover has been the same each of the three growing seasons, 5-25%. Of concern is that the three species planted on the site (fourwing saltbush, desert saltbush, and alkali sacaton) all decreased in cover from 2012 to 2013. Five new species are keeping the total cover stable year over year.

Figure 20. Upstream Historic Lateral South Bank-non-wetland had many large individual plants in its thirteenth growing season in 2013.

Upstream Historic Lateral South Upper Plateau 2 had a sharp increase in total cover from 2012 to 2013, from 54.4% to 83.9% (total cover represents weighted average of the three monitoring areas that make up the revegetation site). Fourwing saltbush had the biggest increase, from 6.3% to 62.5%. It also had 50-75% cover in all three monitoring areas. Other plants, such as creosote bush, saw a decrease in cover and the total species richness also declined from 29 to 24. This is

expected as irrigation was very infr equent during the third growing season, and those species that may have required supplemental irrigation were lost and others decreased in growth rate.

3.10 Lower Narrows and Homestead Weirs

All four revegetation sites at the Lower Narrows and Homestead Weirs have reached the maximum total cover value of between 75% and 100% (Table 14; Figure 21). Three of the sites were in their second growing season, while the fourth site was about one-year old at the time of monitoring. The lone wetland site, Lower Narrows Homestead Emergent, was created to partially meet the 404 wetland mitigation permits for the construction of the two weirs. This site had the maximum cover in the first growing season and grew in terms of richness and diversity. In 2012, there were 26 species found on the site, including five planted species. In 2013, the richness increased to 39 species (Figure 22). The diversity also increased from 2012 to 2013 with the Simpson's Diversity Index reducing from 0.17 to 0.06.

Lower Narrows Homestead North was not planted with container plants; instead, irrigation was installed to establish the hydroseeded area once construction was completed. The three hydroseeded species (fourwing saltbush, desert saltbush, and alkali sacaton), were the dominant species in 2013, and 8 additional species self-established on the site bringing the species richness to 11. The two non-wetland sites on the south side of the Wash were hydroseeded with the same mixture but were also planted with container plants. Lower Narrows Homestead South 1 was planted during the fall 2011 Green-Up. Fourwing saltbush quickly grew and became the dominant plant in both monitoring years, with 75-100% cover in 2013. Lower Narrows Homestead South 2 was planted one year later during the fall 2012 Green-Up with the same plant mixture. Again, fourwing saltbush established quickly with the irrigated hydroseed, covering 75-100% of this site as well.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
LNHE	2	2.83	wet	75-100%	0.3%	39	1.61
LNHN	2	51.02	non-wet	75-100%	0.1%	11	4.12
LNHS1	2	7.33	non-wet	75-100%	0.1%	18	4.88
LNHS2	1	6.76	non-wet	75-100%	0.1%	17	4.77

[1]LNHE=Lower Narrows Homestead Emergent, LNHN=Lower Narrows Homestead North, LNHS1=Lower Narrows Homestead South 1, LNHS2=Lower Narrows Homestead South 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 14. Vegetation monitoring results for the Lower Narrows and Homestead Weirs revegetation sites in 2013.

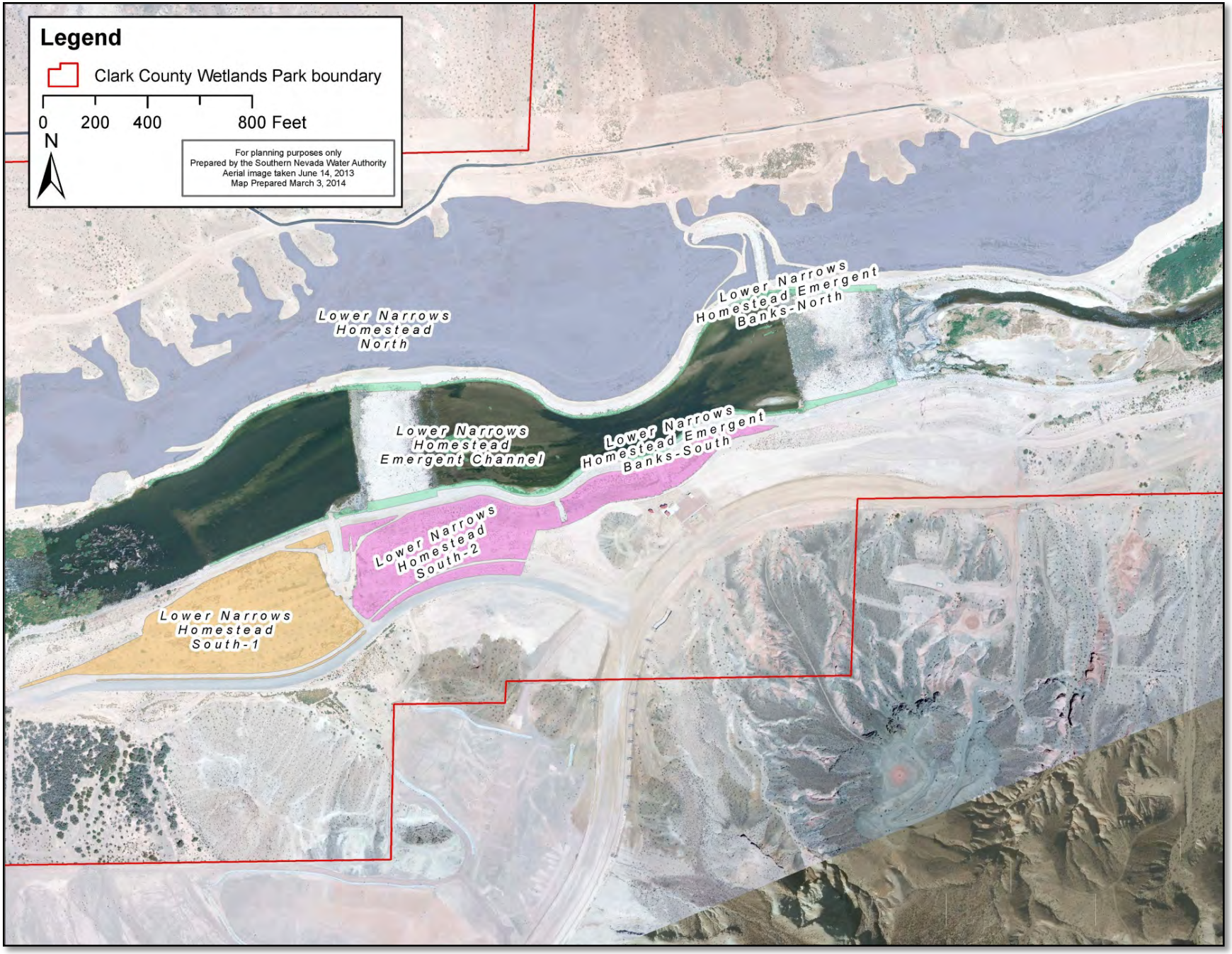

Figure 21. Aerial photograph of the 2013 delineated Lower Narrows and Homestead Weirs revegetation sites.

Figure 22. Lower Narrows Homestead Emergent increased in size and species richness in 2013.

3.11 Monson and Visitor Center Weirs

None of the four revegetation sites at the Monson and Visitor Center Weirs were monitored in the field in 2013 (Figure 23; Table 15). Instead, all four were monitored for total cover using ArcGIS. The only site that had a change in total cover compared to the previous three growing seasons was Downstream Monson South-non-wetland. From 2010 to 2012, this site had 50-75% total cover, including in 2010 when it was also monitored using ArcGIS. In 2013, the total cover of this site was calculated to be 75-100%. This is a result of changes in maintenance practices within the CCWP at this site. In past years, heavy maintenance occurred due to its proximity to walking trails. Plants are now allowed to grow much more without pruning or removal, resulting in a healthier site. Following the protocol for field monitoring, all four sites will be field monitored in 2014.

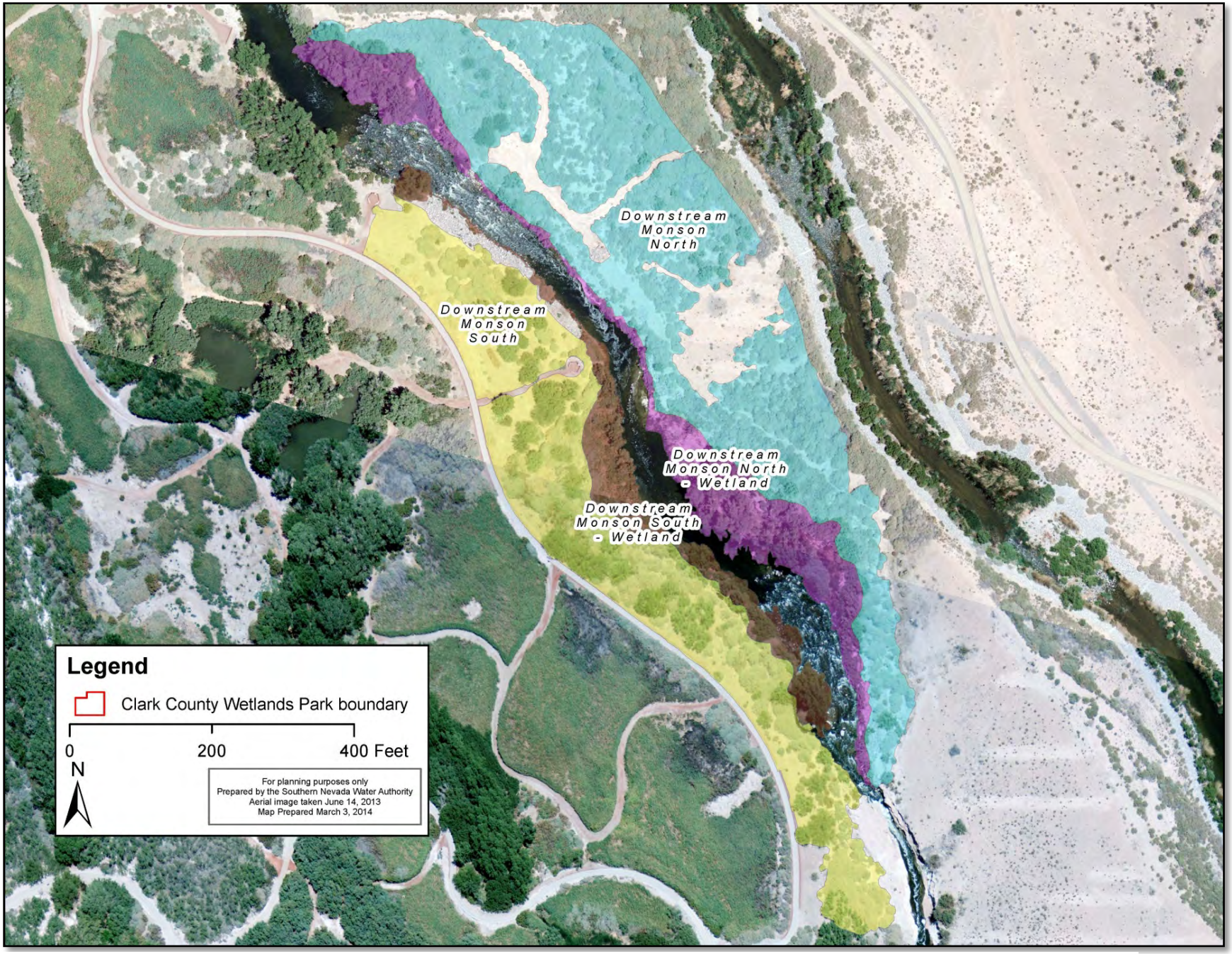

Figure 23. Aerial photograph of 2013 delineated Monson and Visitor Center Weirs revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DMN	11	4.06	non-wet	75-100%	nm	nm	nm
DMN	11	1.24	wet	75-100%	nm	nm	nm
DMS	11	2.99	non-wet	75-100%	nm	nm	nm
DMS	11	0.67	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 15. Vegetation monitoring results for the Monson and Visitor Center Weirs revegetation sites in 2013.

3.12 Pabco Road Weir

Seven of the 12 revegetation sites at the Pabco Road Weir were monitored in the field in 2013, with the remaining five having their total cover measured using ArcGIS (Figure 24; Table 16). Many of the sites measured in the field had changes in their total cover while all of the ArcGIS measured sites had their total cover remain the same.

The second largest site, Downstream Pabco North, has three separate monitoring areas (Figure 24) to allow for more accurate assessments of cover and site condition. The total cover on the site was exactly the same as in 2012 - 75.1%. This is a weighted average of the total cover of the three monitoring areas. There were 29 species found on the site which was the highest number of species here since its first monitoring after planting in 2009. This is uncommon as most sites decrease in species richness after irrigation has ceased.

Downstream Pabco North Bank was replanted in the spring of 2012 after the installation of bank protection removed much of the vegetation. The site's total cover increased substantially from 5-25% in 2012 to 50-75% in 2013 (Figure 25). Species richness on the site doubled from 14 to 28. This is likely due to the site still being irrigated and its proximity to the Wash channel.

Downstream Pabco South is one of the oldest revegetation sites along the Wash and as expected, has the highest vegetative cover rankings of 75-100%. What is less expected is that this wetland site has very low noxious weed cover, at just 1.6%. There has been very little maintenance done on this site for many years. The low noxious weed cover can be interpreted as being a result of the healthy native plant community not allowing exotics to become established in high numbers on the site.

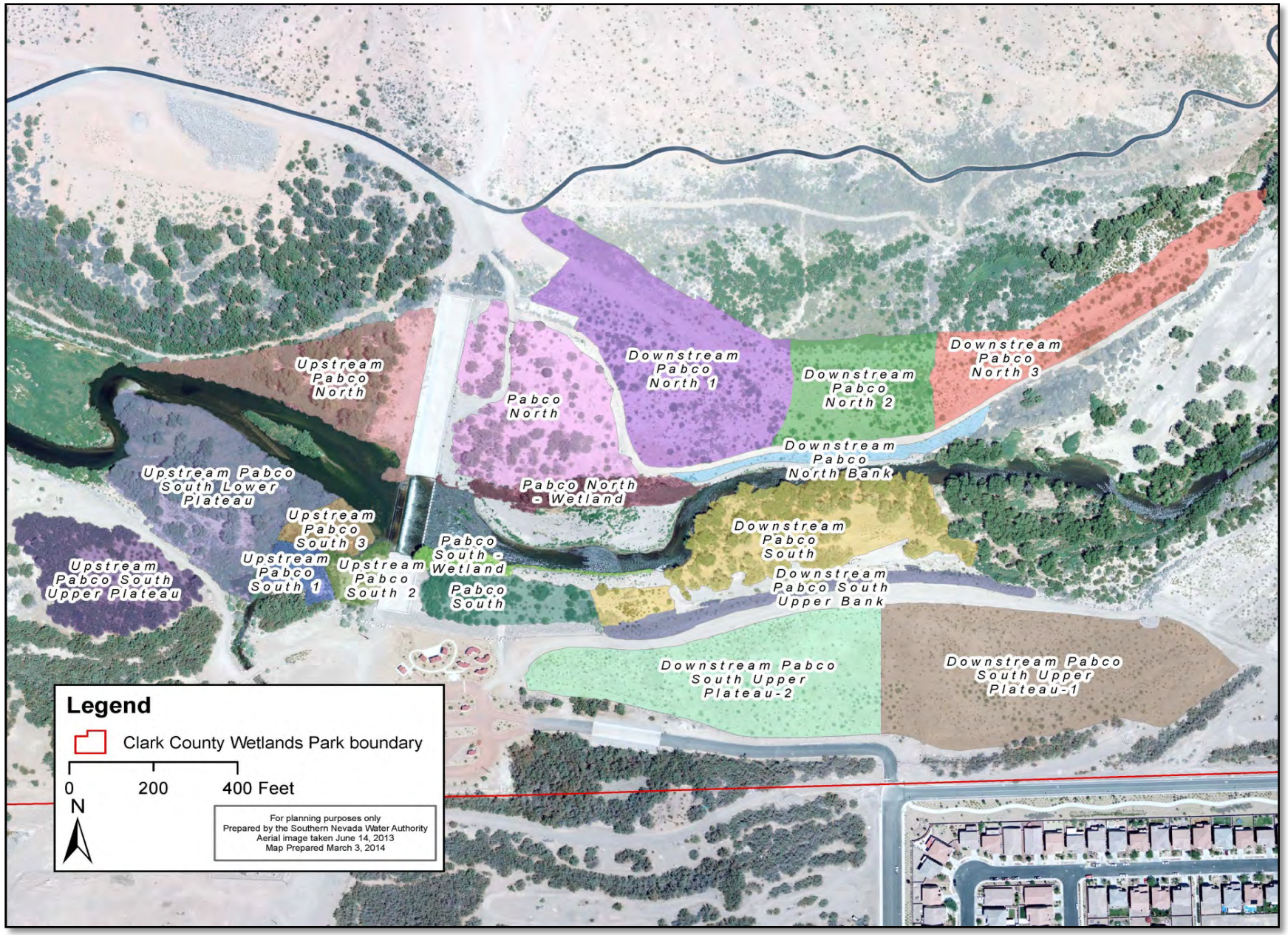

Figure 24. Aerial photograph of 2013 delineated Pabco Road Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DPN	5	9.39	non-wet	75.1%	0.6%	29	4.13
DPNB	2	0.53	non-wet	50-75%	0.7%	28	3.60
DPS	13	3.46	wet	75-100%	1.6%	48	2.64
DPSUB	3	0.86	non-wet	50-75%	3.7%	28	3.13
DPSUP	3	9.79	non-wet	50-75%	0.9%	40	4.22
PN	13	3.15	non-wet	75-100%	0.6%	25	3.43
PN	13	0.77	wet	75-100%	nm	nm	nm
PS	13	1.09	non-wet	75-100%	0.1%	21	4.65
PS	13	0.29	wet	75-100%	nm	nm	nm
UPN	8	2.61	wet	75-100%	nm	nm	nm
UPS*	13	4.68	wet	85.3%	nm	nm	nm
UPSUP	12	2.09	non-wet	75-100%	nm	nm	nm

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

* UPS includes Upstream Pabco South Lower Plateau

nm = this attribute was not monitored

Table 16. Vegetation monitoring results for Pabco Road Weir revegetation sites in 2013.

Figure 25. Downstream Pabco North Bank was dominated by screwbean and honey mesquite in 2013.

3.13 Powerline Crossing Weir

All nine revegetation sites at the Powerline Crossing Weir were in their seventh growing season during the 2013 monitoring (Table 17; Figure 26). All but one of the five wetland sites were at the maximum total cover in 2013 (Figure 27) and most of the non-wetland sites have had a stable cover value for many years.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
DPLNB	7	0.31	wet	75-100%	3.1%	18	2.64
DPLSB	7	0.25	wet	50-75%	37.5%	11	2.82
PLSB	7	0.55	non-wet	50-75%	0.0%	5	2.95
UPLNB	7	0.62	non-wet	5-25%	0.0%	3	3.05
UPLNE	7	1.07	wet	75-100%	nm	nm	nm
UPLNP	7	4.07	non-wet	59.0%	0.1%	17	3.43
UPLNW	7	0.35	wet	75-100%	1.6%	11	2.01
UPLSB	7	0.65	wet	75-100%	0.5%	15	2.15
UPLSP	7	6.82	non-wet	57.6%	0.0%	9	4.15

[1]DPLNB=Downstream Powerline North Bank, DPLSB=Downstream Powerline South Bank, UPLNW=Upstream Powerline North Wetland, UPLNP=Upstream Powerline North Plateau, UPLSP=Upstream Powerline South Plateau, UPLNE=Upstream Powerline North Emergent, UPLSB=Upstream Powerline South Bank, PLSB=Powerline South Bank, UPLNB=Upstream Powerline North 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 17. Vegetation monitoring results for Powerline Crossing Weir revegetation sites in 2013.

Upstream Powerline North Bank was planted in 2007 with the other Powerline Crossing sites and hydroseeded for a second time in 2010; however, the total cover has never exceeded 5-25%. It appears that this site's steep slope may be preventing many plants from establishing on the area. There may also be some aspect of the soil that is preventing plant growth, such as texture or lack of nutrients.

Two sites decreased in total cover from 2012 to 2013. The first is Downstream Powerline South Bank, which decreased from 75-100% down to 50-75% total cover. This site (as well as Downstream Powerline North Bank) is made up of vegetation planted and passively established on a concrete-bordered area filled with large rocks to prevent erosion. Since construction, the area has filled in with sediment that has allowed new plants to establish. However, due to its location, the site is prone to inundation and scouring during flood events which results in a regular flux of plants establishing and being removed from the site. This has also resulted in one of the highest noxious weed cover values along the Wash (Table 17). Future monitoring will determine if any maintenance is prudent or if natural removal by floods will alleviate the noxious weed problem.

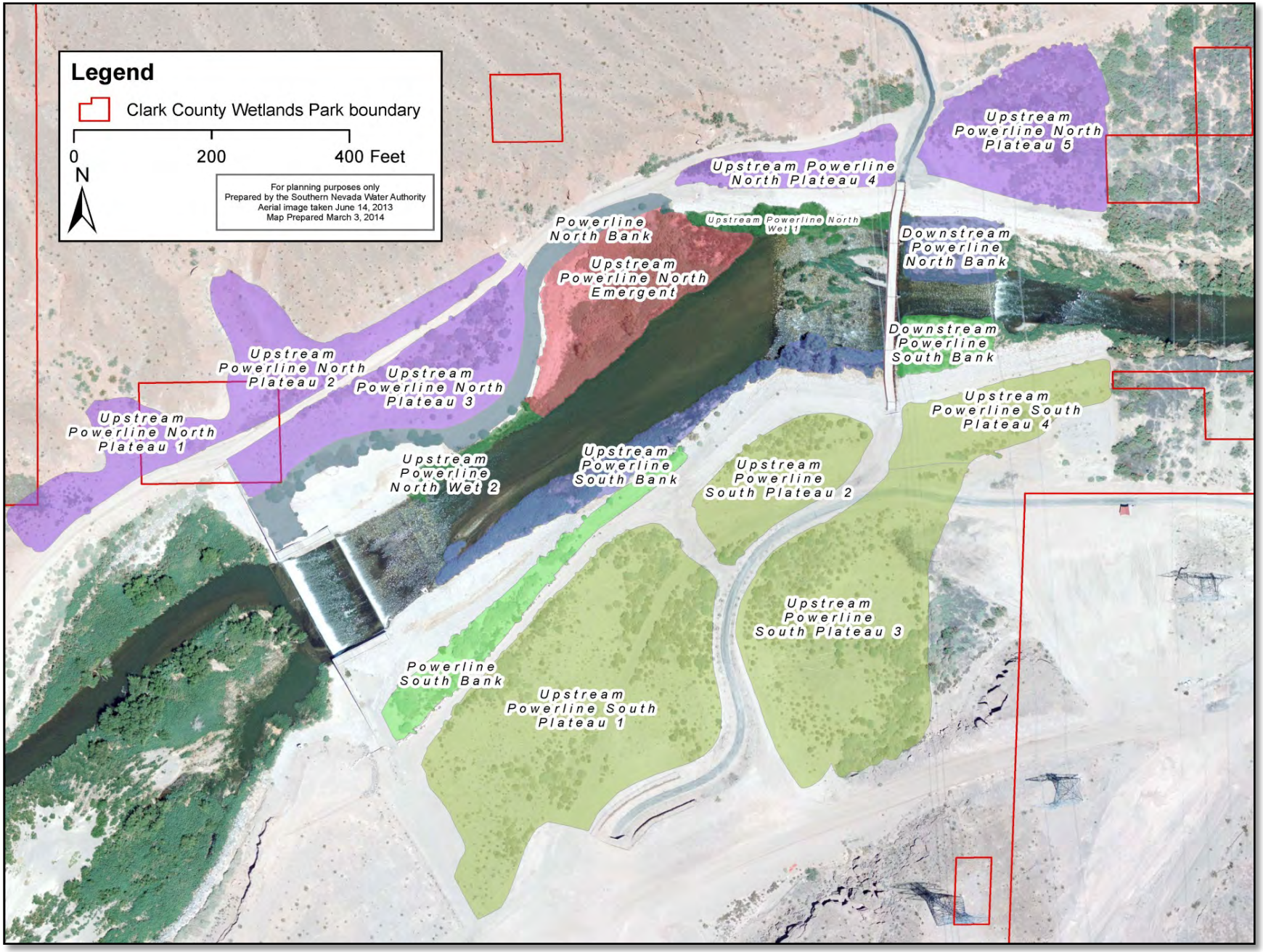

Figure 26. Aerial photograph of 2013 delineated Powerline Crossing Weir revegetation sites.

The other site at Powerline Crossing Weir that decreased in total cover in 2013 was Upstream Powerline South Plateau. Although the decline was not that substantial, cover was 60.2% in 2012 and 57.6% in 2013. The total cover for this site is derived from taking the weighted average of four monitoring areas (Figure 26) based on their size. The decline in total cover is directly related to the decline in cover of quailbush. This is surprising since quailbush cover at Wash revegetation sites typically does not decline without active maintenance activities.

Figure 27. Upstream Powerline South Bank (front) and Upstream Powerline North Wetland (back) in 2013.

3.14 Rainbow Gardens Weir

Only one of the six revegetation sites at the Rainbow Gardens Weir (Figure 28; Table 18) was field monitored in 2013 because the remaining sites had had constant total cover values for the previous three monitoring years. Upstream Rainbow North Bank was field monitored because it is the newest site and was in its fourth growing season in 2013. The total cover was the same as in 2012 at 50-75%. This site was established using exclusively hydroseed in 2010. It was irrigated for the first two growing seasons but continued to increase in total cover while decreasing in species richness. There were 15 species found on the site after the first growing season in 2010 compared to just 6 in the most recent monitoring.

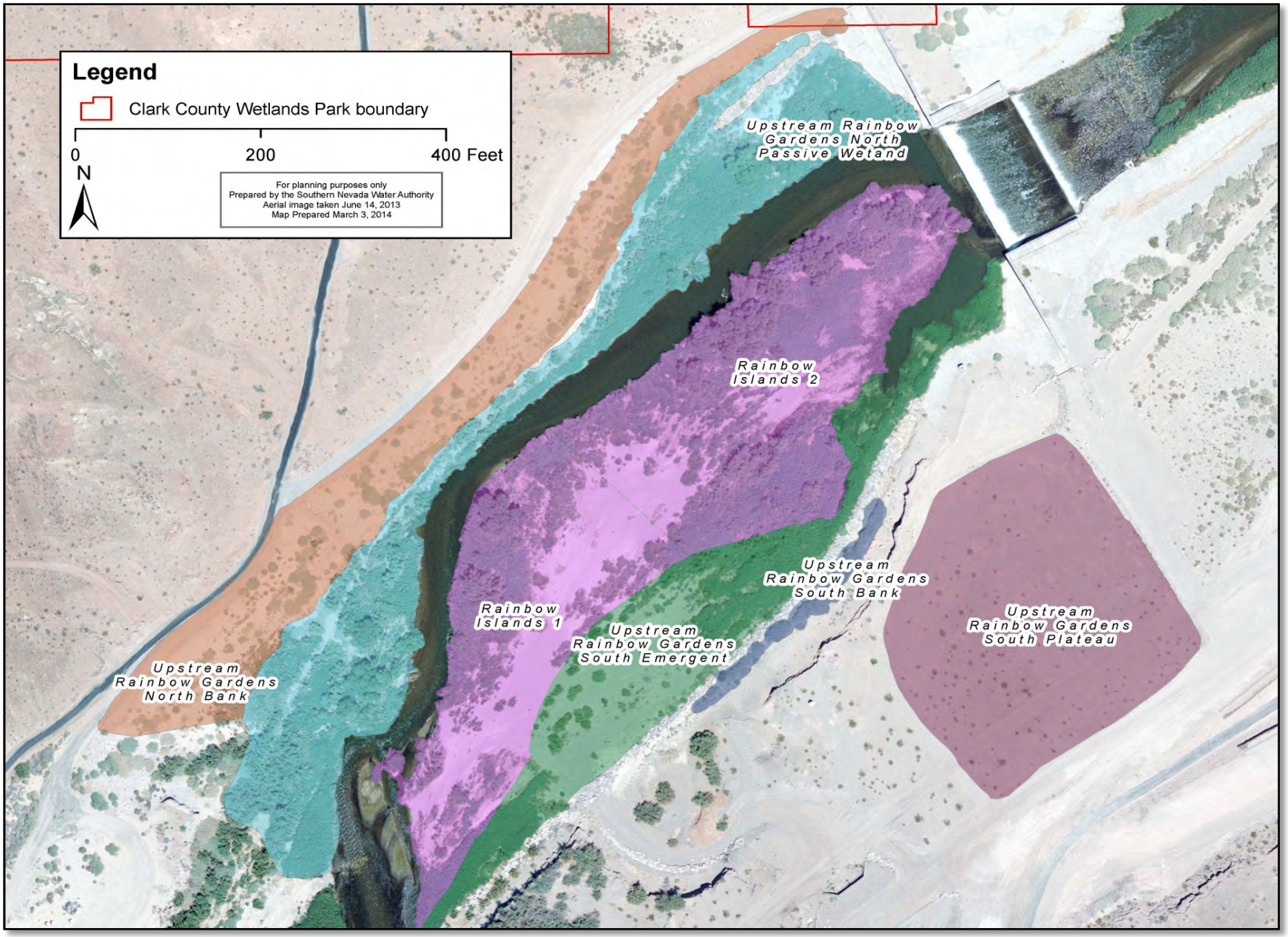

Figure 28. Aerial photograph of 2013 delineated Rainbow Gardens Weir revegetation sites.

Site Code[1]	Growing Season	Acreage	Wetland Status[2]	Total Cover	Noxious Species Cover	Number of Species	WPI[3]
RI	9	3.66	wet	75-100%	nm	nm	nm
URNB	4	1.67	non-wet	50-75%	2.5%	6	3.04
URNPW	9	2.31	wet	75-100%	nm	nm	nm
URSB	8	0.15	non-wet	75-100%	nm	nm	nm
URSE	9	1.46	wet	75-100%	nm	nm	nm
URSP	8	2.05	non-wet	5-25%	nm	nm	nm

[1]URNB=Upstream Rainbow North Bank, URNPW=Upstream Rainbow North Passive Wetlands, URSB=Upstream Rainbow South Bank, URSE=Upstream Rainbow South Emergent, URSP= Upstream Rainbow South Plateau, RI=Rainbow Islands

[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 18. Vegetation monitoring results for Rainbow Gardens Weir revegetation sites in 2013.

Upstream Rainbow South Plateau was monitored for total cover using ArcGIS in 2013 and found a decline from 25-50% (which it had for the previous monitoring years) to 5-25% in 2013. It is possible that site cover had been overestimated in previous years due to the difficulty in assessing total cover on this large site with little elevation change. However, it is also possible that the site has had a decline in actual vegetative cover. The site will be field monitored in 2014 to hopefully answer the question.

3.15 Site 108

Site 108 was monitored for total cover using ArcGIS in 2013. A total of 72 monitoring areas had their total cover measured, the total cover for the site as a whole, and the four funding areas, and was derived from calculating the weighted average of these monitoring areas (Table 19; Figure 29). The total cover of Site 108 as a whole has remained relatively constant over the past four years with a high of 57.3% in 2010 and a low of 47.2% in 2011. In 2013, calculated cover was in the middle at 55.3%. This indicates the site is mature and stable in its current state.

Funding Areas	Growing Season[3]	Acreage	Wetland Status[1]	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
NDEP	7	6.23	non-wet	26.6%	nm	nm	nm
NDSP	6	12.20	non-wet	79.4%	nm	nm	nm
SNPLMA IV	6 – 7	12.75	non-wet	65.0%	nm	nm	nm
SNPLMA V	6 – 7	16.64	non-wet	41.9%	nm	nm	nm
TOTAL	6 – 7	50.70	non-wet	55.3%	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

[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 19. Vegetation monitoring results for the Site 108 revegetation site in 2013.

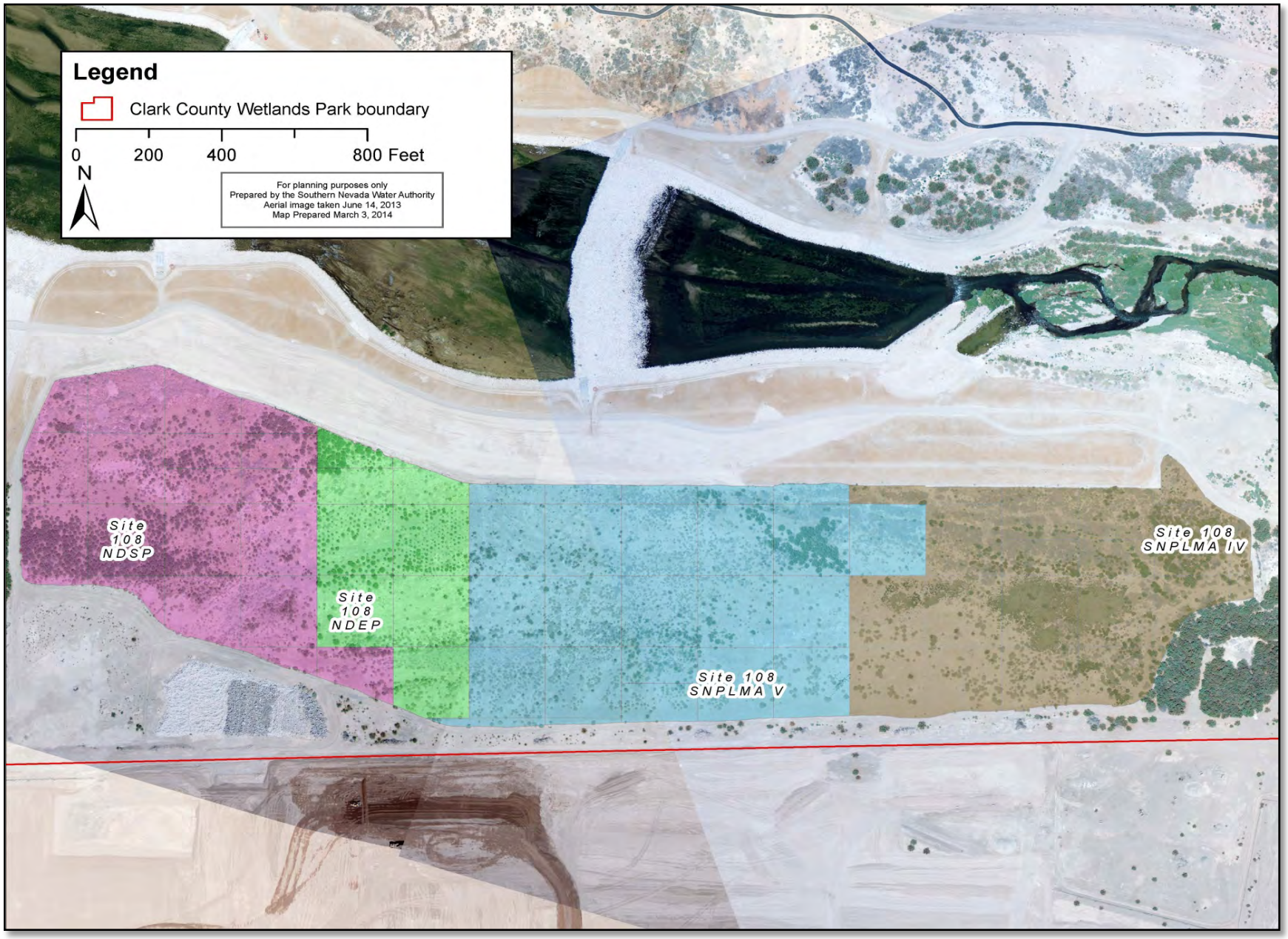

Figure 29. Aerial photograph of Site 108 with 2013 delineations based on funding source.

Substantial alterations to the surrounding landscape and within Site 108 will impact the site in 2014. Additional plantings will take place east and north of the site as part of mitigation for the Duck Creek Confluence and Upper Narrows Weirs. In addition, southern portions of the SNPLMA V and NDEP funding areas will be cleared and used as a soil fill area. These areas are underperforming in terms of vegetation growth, likely due to high salinity. Fill soil from the construction of the Archery and Silver Bowl Weirs will provide a platform with hopefully higher quality soil to achieve better revegetation results.

3.16 Site 111

The 26 monitoring areas at Site 111 were all monitored for total cover using ArcGIS in 2013 (Table 20; Figure 30). The total cover was similar to previous years at 79.2% (weighted average of all 26 monitoring areas), although slightly less than the field monitored total in 2012 of 86.9%. This site and each of its monitoring areas have likely reached equilibrium with little change happening on an annual basis. Per the guidelines laid out in previous reports regarding the monitoring schedule, Site 111 will likely be monitored every other year. In 2012, the trail system for the CCWP was completed on the north side of the Wash and bisects Site 111. Monitoring in 2014 will hopefully show if there are any impacts from this construction and the subsequent use by recreationists.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
S111	7	14.48	non-wet	79.2%	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 20. Vegetation monitoring results for the Site 111 revegetation site in 2013.

3.17 Upper Diversion Weir

All eight revegetation sites at the Upper Diversion Weir (Figure 31) were in their fifth growing season in 2013 (Table 21). All sites had similar total cover values for the past few years and cover measured using ArcGIS in 2013. Only two sites had less than the 75-100%, Downstream Upper Diversion North and Upstream Upper Diversion South. Both had higher cover in 2012.

Downstream Upper Diversion North is a non-wetland site that had the CCWP trail bisect it in 2013. This resulted in the loss of some of the dominant plant on the site, four-wing saltbush as well as the total cover for the site. It is likely that this was a temporary impact on the site as the trail will reduce the amount of foot traffic on the rest of the site. Future monitoring will determine the long-term impacts of this trail through the site.

Upstream Upper Diversion South is located just downstream of the Monson Channel-Wash confluence. There is a large stand of salt cedar in this area, some of which had encroached on this revegetation site. In addition, its proximity to the Wash resulted in the establishment of common reed. Fewer rain events and noxious weed removal are the likely cause of this site's total cover decline. Monitoring in 2014 will see if native plants are able to fill in the spaces left by the removal of these weeds.

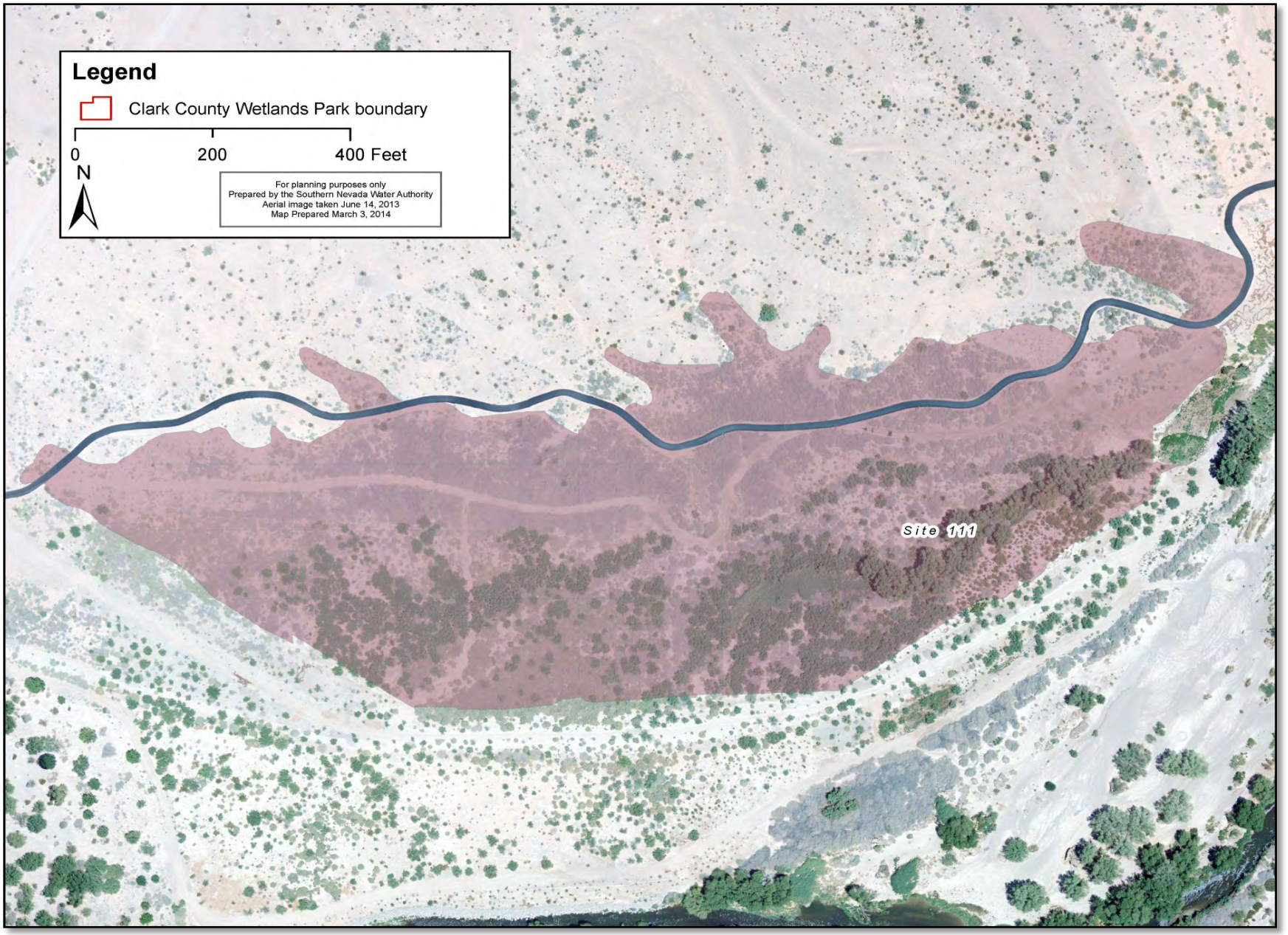

Figure 30. Aerial photograph of 2013 delineated the Site 111 revegetation site.

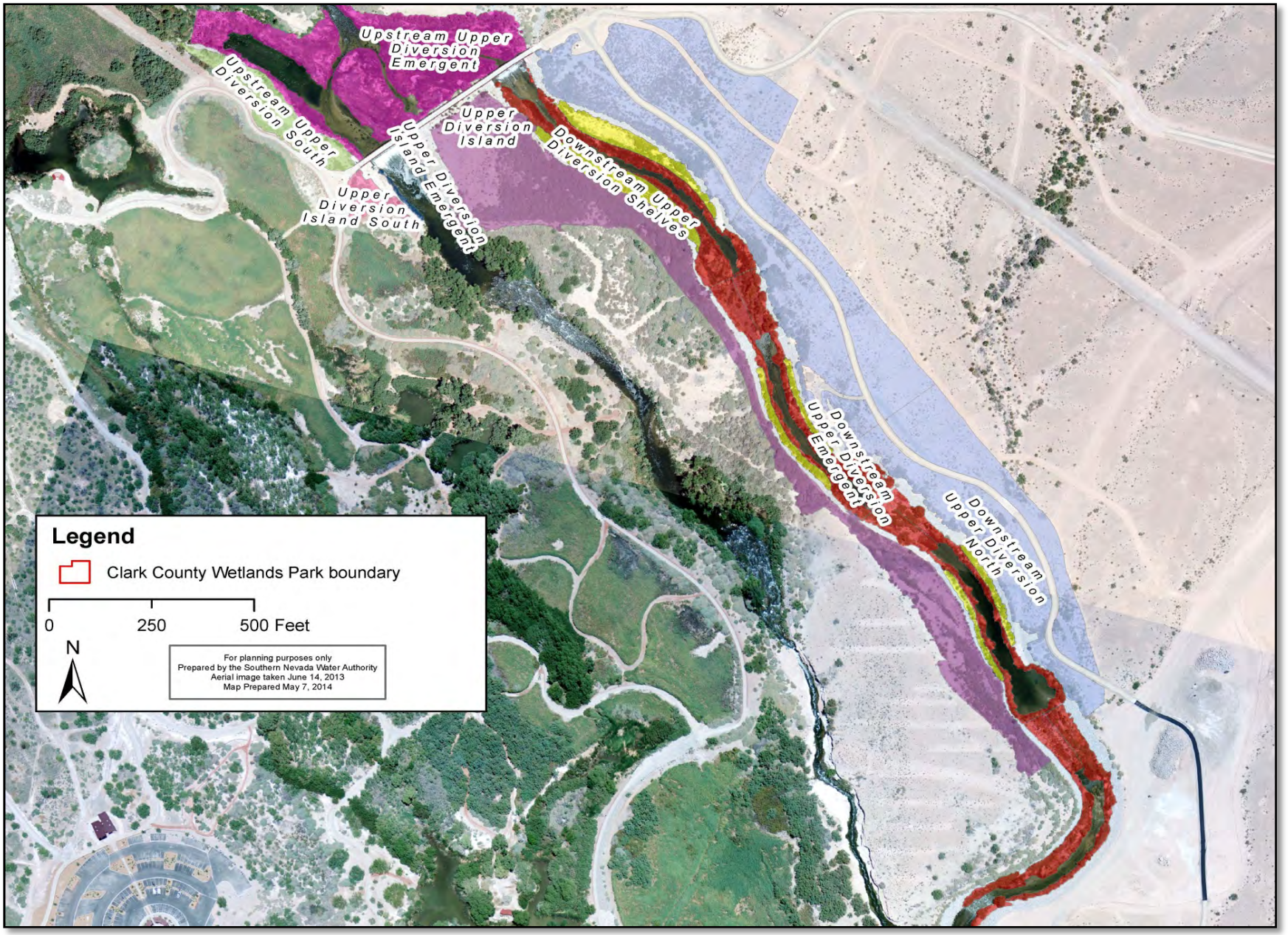

Figure 31. Aerial photograph of 2013 delineated Upper Diversion Weir revegetation sites.

Site Code	Growing Season	Acreage	Wetland Status	Total Cover	Noxious Species Cover	Number of Species	WPI[2]
DUDE	5	3.71	wet	75-100%	nm	nm	nm
DUDN	5	9.31	non-wet	71.3%	nm	nm	nm
DUDS	5	1.27	wet	75-100%	nm	nm	nm
UDI	5	4.81	non-wet	75-100%	nm	nm	nm
UUDE	5	0.13	wet	75-100%	nm	nm	nm
UDIE	5	3.15	wet	75-100%	nm	nm	nm
UUDS	5	0.72	non-wet	50-75%	nm	nm	nm
UDIS	5	0.21	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, UUDE=Upstream Upper Diversion Emergent, UDIE=Upper Diversion Island Emergent, UUDE=Upstream Upper Diversion Emergent, 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 21. Vegetation monitoring results for Upper Diversion Weir revegetation sites in 2013.

4.0 CONCLUSIONS

The revegetation program along the Wash in 2013 continued to show great success in terms of growing plant cover, plant survivorship, reduction of noxious weeds, and overall ecological health. Of the 94 total sites that were monitored in 2013 (S108, S111, and CCWRD considered one site each), 88 were also monitored in 2012. Sixty-eight (77.3%) of these 88 sites had the same cover in both years, 11 (12.5%) increased in cover, and 9 (10.2%) decreased. ArcGIS was used to measure total vegetative cover on 48 (51.1%) of the sites, which provides for improved efficiencies and accuracy in the overall monitoring effort.

5.0 RECOMMENDATIONS

Recommendations described by Eckberg and Shanahan (2009) resulted in criteria in which a site should be monitored using field protocol or using ArcGIS technology. After the scheduled fall 2013 and spring 2014 plantings, there will be 97 sites to monitor in 2014. Following the protocol, 74 (76.3%) of the sites will be monitored in the field. This is expected after so many sites being measured for cover using ArcGIS in 2013.

In terms of site maintenance, activities at older sites are typically minimal. There are some sites, specifically near Monson and Visitor Center Weirs, that have large amounts of salt cedar and other noxious weeds that should be addressed before becoming a larger problem.

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