

**FINAL MONITORING REPORT
FOR YEAR 2 VEGETATION PLOT
MONITOR SERVICES FOR THE
ARROYO COLORADO
VEGETATION MANAGEMENT
PROJECT WITHIN THE LOWER RIO
GRANDE FLOOD CONTROL
PROJECT, CAMERON COUNTY,
TEXAS**

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Contract 191BWC20D0003
Order 191BWC22F0074

August 2023



Cover Photograph:

“Sunrise along the Arroyo Colorado near the Treasure Hills Golf Course Vegetation Plot
Monitoring Plots,” Vernadero Group Inc., 21 June 2023

EXECUTIVE SUMMARY

Vernadero Group Inc. was contracted to provide the U.S. Section, International Boundary and Water Commission (USIBWC), with Vegetation Plot Monitoring (VPM) and reporting services for the Arroyo Colorado Floodway Vegetation Management Project within the Lower Rio Grande Flood Control Project (LRGFCP), Cameron County, Texas. The Arroyo Colorado Floodway is a component of the LRGFCP. The USIBWC is authorized to construct, operate, and maintain any project or works constructed by the United States on the LRGFCP. The Arroyo Colorado Floodway has a design capacity of 21,000 cubic feet per second (cfs) and conveys flood flows diverted from the Rio Grande east to the Laguna Madre. To maintain the design capacity, reduce erosion potential, stabilize stream banks, manage wildlife habitat, and control invasive species, the USIBWC controls woody vegetation within the channel and banks. Vegetation is mowed or treated mechanically and chemically, through provisions in leases, or through cooperative agreements for recreation areas.

In 2021 and early 2022, USIBWC contracted the removal of approximately 70 acres of woody vegetation along the Arroyo Colorado Floodway. Following all woody vegetative removal activities, the USIBWC contractor revegetated approximately 70 acres of cleared areas using native grass, forbs, and other species to stabilize the channel banks, to maintain the channel's 21,000 cfs design flood conveyance, and to provide vegetative cover for wildlife. Our VPM and reporting services supported the USIBWC's vegetation management activities by determining if the herbaceous plantings had become self-sustaining and providing feedback on the maintenance program. In October 2022, our biologists established and monitored 60 permanent vegetation monitoring quadrats. Those quadrats were established at random locations within areas of the Arroyo Colorado Floodway Revegetation Project that had been seeded with herbaceous vegetation and where native plants had been -00-p. Quadrat locations were prioritized based on landowner permission and ease of access.

We conducted Year 2 (2023) monitoring at the permanently established quadrats and used the data collected to compare our results to the plant cover success criteria for the project that were approved by the U.S. Fish and Wildlife Service in the *2016 Final Vegetation Management Plan*.

During Year 2 monitoring, the planted areas of the overall project did not meet the final success criterion of 20 percent cover for native herbaceous seed mix species or the final success criterion for percent cover free of nonnative species (80 percent). Similar to Year 1 results, which also did not meet the final success criteria, Year 2 had a low cover of the seed mix species and installed native plants. Fewer native species were observed during Year 2 (7) than Year 1 (11). Year 1 had a 3.5 percent cover of native herbaceous seed mix species and 68.8 percent cover free of nonnative species compared to 4.7 percent cover of native herbaceous seed mix species and 60.1 percent cover free of nonnative species for Year 2.

It is possible the low cover of the seed mix species observed during Year 1 and Year 2 monitoring is due to the initial timing of initial seeding. For best results, including maximizing germination rates of native grasses and reducing the germination rates of invasive plant species, native grass seeding would take place in late summer or early fall (between 20 August

and 30 September). Seeding of the designated areas commenced once the vegetation removal was completed, and the seed was spread with a broadcast device in November and December 2021. It may also be that site preparation prior to seeding was not sufficient to ensure adequate seed-soil contact. Seeded areas are generally cleared of substantial debris and any other impediments to seed-soil contact prior to broadcasting the seed mix.

New native plants were also installed along the arroyo in November and December 2021, with additional plantings at Hugh Ramsey Nature Park in April 2022. Approximately 30,000 plants were installed along the arroyo using biodegradable grow tubes and were immediately watered. Based on our monitoring efforts along the arroyo during planting, both the site conditions and the health of the plants during installation appeared to be conducive to plant survival. However, during Year 1 and Year 2 monitoring, very few of the installed plants on the list of native species were observed within the 60 monitoring plots.

The primary goals of the removal of woody vegetation along the Arroyo Colorado Floodway and the revegetation of cleared areas using native grass, forbs, and other species were to (1) stabilize the channel banks, (2) maintain the channel's 21,000 cfs design flood conveyance, and (3) provide vegetative cover for wildlife. While the project did not meet the Year 1 or Year 2 final success criterion, the vegetation currently present along the banks of the Arroyo Colorado does help stabilize the channel banks and allow for design flood conveyance. Further, common reed (*Phragmites australis*) along the banks of the arroyo provides some vegetative cover and travel function for wildlife, but this is less than expected from the species planted.

Based on the results of our annual monitoring and failure to meet Year 2 success criteria, we recommend that USIBWC consider additional seeding with native species in late summer or early fall. Further, it may prove useful to conduct monthly monitoring immediately following any additional revegetation efforts in order to monitor seed sprout and survival of the installed plants. Similar monthly inspection of all initially seeded areas could have been useful for documenting failures prior to Year 1 monitoring and making necessary adjustments as they were encountered.

We also recommend treating nonnative grasses along the arroyo, primarily Guinea grass (*Urochloa maxima*), that are present within the revegetated areas. We further recommend a spot treatment program to target the nonnative grasses using glyphosate herbicide. This action may reduce the amount of unwanted nonnative plants that would later impede native plant establishment, and it would complement efforts that are already occurring along the arroyo, such as the efforts at Hugh Ramsey Nature Park to remove Guinea grass.

In addition to the above recommendations, we suggest that USIBWC coordinate with maintenance and mowing crews who are maintaining areas along the arroyo to ensure that the timing of their activities does not interfere with planned annual monitoring events.

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LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|----------------|---|
| cfs | cubic feet per second |
| FM | Farm to Market |
| GIS | geographic information system |
| GPS | global positioning system |
| ID | identification |
| LRGFCP | Lower Rio Grande Flood Control Project |
| m ² | square meter(s) |
| N/A | not applicable |
| USIBWC | U.S. Section, International Boundary and Water Commission |
| Vernadero | Vernadero Group Inc. |
| VPM | Vegetation Plot Monitoring |

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1.0 INTRODUCTION

Vernadero Group Inc. (Vernadero) was contracted to provide the U.S. Section, International Boundary and Water Commission (USIBWC), with Vegetation Plot Monitoring (VPM) and reporting services for the Arroyo Colorado Floodway Vegetation Management Project within the Lower Rio Grande Flood Control Project (LRGFCP), Cameron County, Texas (**Figure 1-1**).

1.1 Arroyo Colorado Floodway

The Arroyo Colorado Floodway is a component of the LRGFCP. The USIBWC is authorized to construct, operate, and maintain any project or works constructed by the United States on the LRGFCP, as authorized by the Act of the 74th Congress, Sec. I, Ch. 561 (House Resolution 6453), approved 19 August 1935 (49 Stat. 660), and codified at 22 United States Code in Sections 277, 277a, 277b, and 277c, and Acts amendatory thereof and supplementary thereto. The LRGFCP is composed of 270 miles of levee and floodways, as well as the Arroyo Colorado Floodway, which extends from Anzalduas Dam, located approximately 13 miles downstream from Peñitas, Texas, to beyond Brownsville, Texas. The interior floodway consists of the Main Floodway, which splits into the North Floodway and the Arroyo Colorado Floodway at the City of Mercedes, Texas (**Figure 1-1**). The Arroyo Colorado Floodway has a design capacity of 21,000 cubic feet per second (cfs) and conveys flood flows diverted from the Rio Grande east to the Laguna Madre. Areas adjacent to the Arroyo Colorado flood flows are protected from flooding via natural high ground and 25 miles of engineered levee.

1.2 Vegetation Removal Efforts

To maintain the design capacity, reduce erosion potential, stabilize stream banks, manage wildlife habitat, and control invasive species, the USIBWC controls woody vegetation within the channel and banks. Vegetation is mowed or treated mechanically and chemically, through provisions in leases, or through cooperative agreements for recreation areas. To maintain the Arroyo Colorado's design flood conveyance, the USIBWC will continue to mechanically remove woody vegetation and maintain and mow grass and brush within an approximately 45-acre area along the Arroyo Colorado Floodway between Business 77 and Farm to Market (FM) 509 in Harlingen, Cameron County, Texas (**Figure 1-2**).

In 2021 and early 2022, USIBWC contracted the removal of approximately 70 acres of woody vegetation (Swift Operating Partners LLC 2021) from a 50-foot buffer along the Arroyo Colorado Floodway, except within areas where the slope is too steep (i.e., more than 18-degree slope) from Business 77 to FM 509 (see **Figure 1-2**). In most areas where the buffer was reduced due to steep slopes, the area on the opposite bank was extended to a maximum of 100 feet to compensate for the reduction in buffer (**Figures 1-3** and **1-4**). The USIBWC vegetation management contractor mowed grass and cut woody vegetation and brush from land, rather than from the Arroyo Colorado Floodway channel itself and where slopes are too steep to use mechanical means of vegetation removal (areas where the slope is greater than 18 degrees). The USIBWC vegetation management contractor used hand equipment, including chainsaws and weed eaters equipped with metal saw blades, to remove the trees and shrubs.

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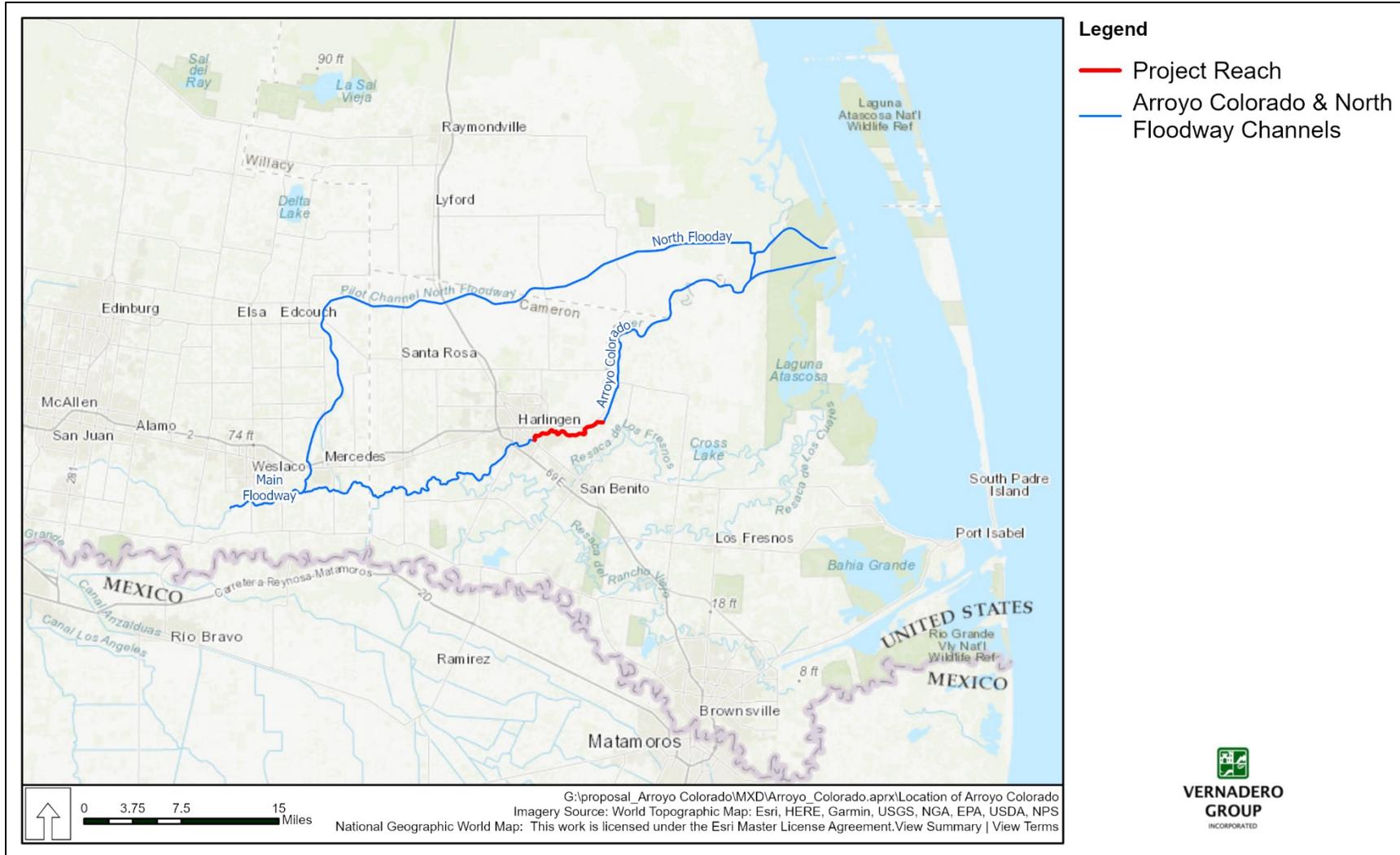


Figure 1-1. Location of Main Floodway, North Floodway, and Arroyo Colorado



Figure 1-2. Location of the Vegetation Management Project Reach

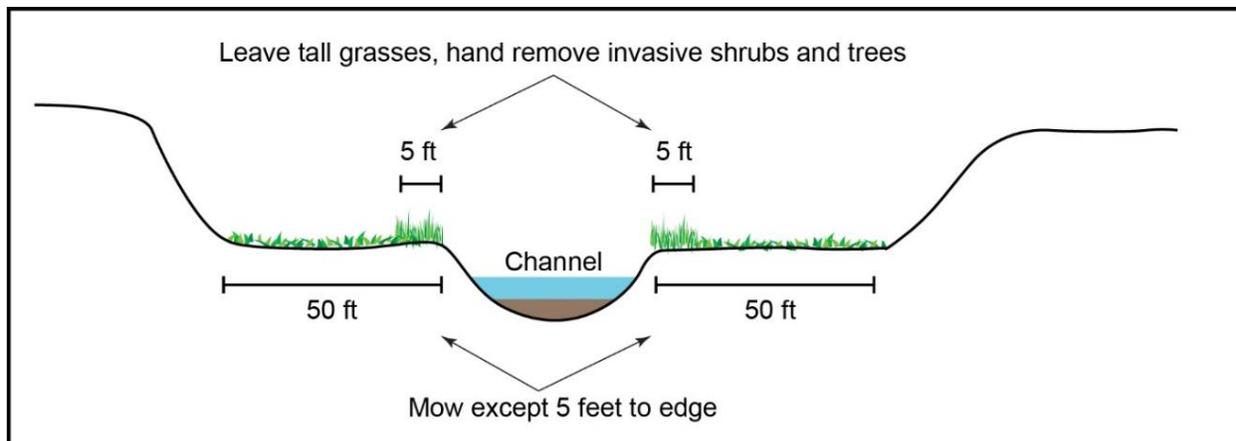


Figure 1-3. Typical Configuration of Vegetation Removal Activities

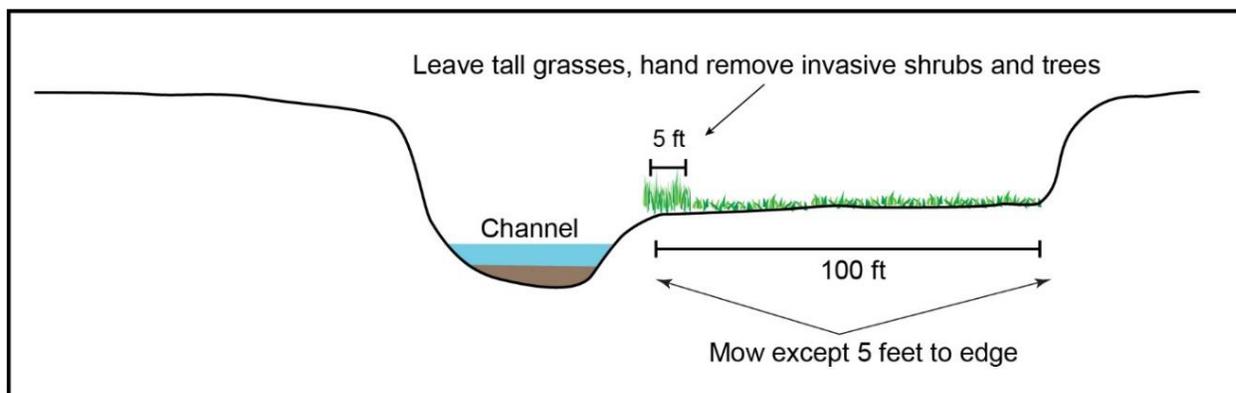


Figure 1-4. Example of Slope-Restricted, Modified Vegetation Removal Area

All trees and shrubs were cut at ground level. No cut vegetation was stockpiled on the site; the biomass was either mulched on the site using a chipper and dispersed or it was hauled off the site. The USIBWC vegetation management contractor used all-terrain vehicles, trucks, tractors, a backhoe, and similar pieces of equipment to haul the biomass off the site. Site access requirements and limitations determined the type of equipment used to haul biomass.

Stumps of cut trees and shrubs were treated immediately with an approved herbicide to prevent regrowth, and all herbicides proposed for use were submitted by the vegetation management contractor to the USIBWC for approval prior to use. The manufacturer’s and the State of Texas’ recommended rates of herbicide application for each targeted species were followed. A State of Texas-certified pesticide applicator supervised all herbicide applications to ensure that only target species were treated and that appropriate herbicides were used.

Following all woody vegetative removal activities, the USIBWC vegetation management contractor revegetated approximately 70 acres of the cleared areas along the Arroyo Colorado Floodway (Swift Operating Partners LLC 2021) using native grasses, forbs, and other species to stabilize the channel banks, to maintain the channel’s 21,000 cfs design flood conveyance, and to provide vegetative cover for wildlife (**Figures 1-5 and 1-6**).

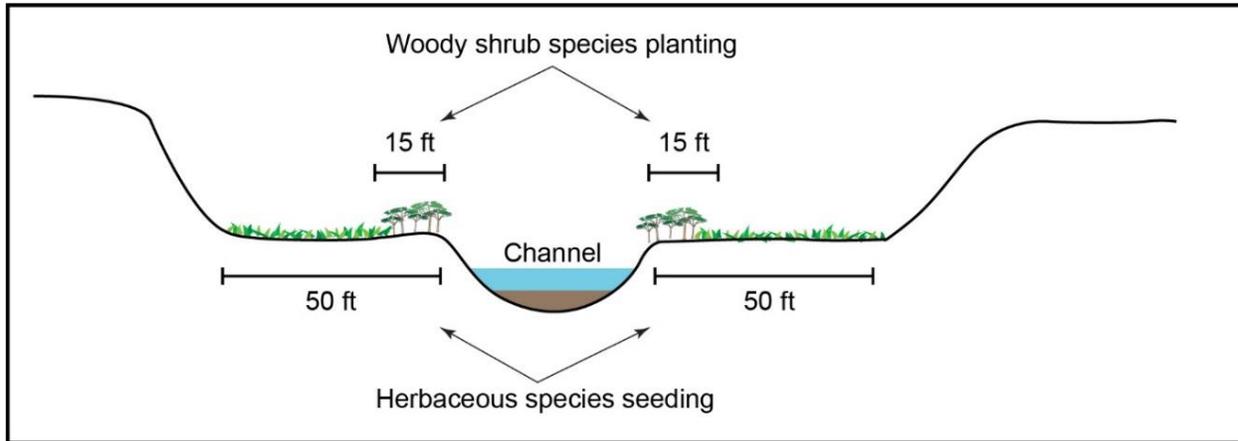


Figure 1-5. Typical Vegetation Replanting Configuration

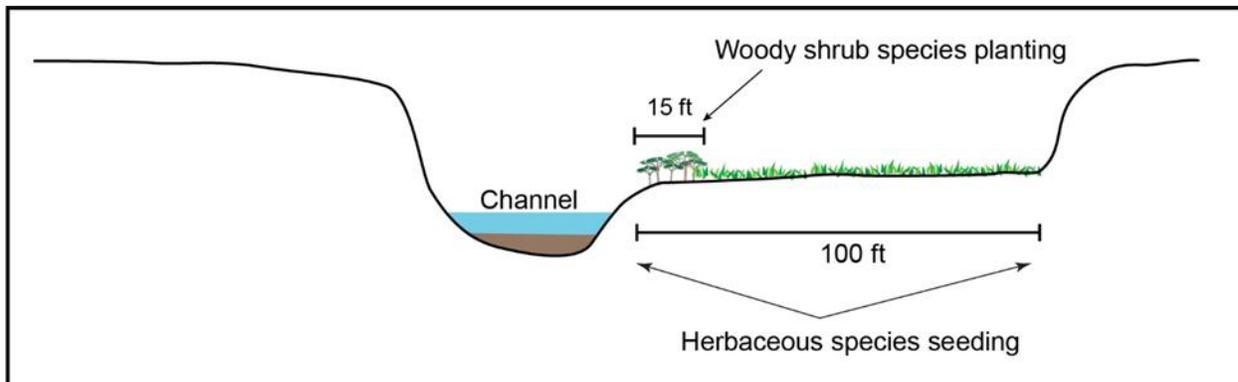


Figure 1-6. Modified Vegetation Replanting Configuration

1.3 Post-Clearing Revegetation

Woody vegetation removal and mowing will likely further favor the establishment of nonnative and invasive plant species that are prevalent within the floodway and increase soil compaction, which would reduce plant productivity. To promote the establishment of native vegetative species, designated areas along the Arroyo Colorado were reseeded once vegetation removal was complete (Swift Operating Partners LLC 2021). A locally sourced South Texas Native Seed Mix specially formulated using the species presented below in **Table 1-1** was applied at the USIBWC-specified rate of 2 pounds pure live seed per 1,000 square feet (Swift Operating Partners LLC 2021). In addition, approximately 30,000 new plants that included an assortment of the approved species listed in **Table 1-2** were installed in the area approximately 0 to 15 feet along the Arroyo Colorado (Swift Operating Partners LLC 2021).

Table 1-1. Native Grass Seed Mixture

| Species Common Name (Scientific Name) | Percent of Seed Mixture |
|---|-------------------------|
| Green Sprangletop (<i>Leptochloa dubia</i>) | 8.35 |
| Illinois Bundleflower (<i>Desmanthus Illinoensis</i>) | 16.69 |
| Hooded Windmill Grass (<i>Chloris cucullata</i>) | 1.67 |
| Maximillian Sunflower (<i>Helianthus maximiliani</i>) | 16.69 |
| Plains Coreopsis (<i>Coreopsis tinctoria</i>) | 8.35 |
| Black-Eyed Susan (<i>Rudbeckia hirta</i>) | 16.69 |
| Engelmann's Daisy (<i>Engelmannia peristenia</i>) | 8.35 |
| Swamp Milkweed (<i>Asclepias incarnata</i>) | 0.67 |
| Mexican Hat (<i>Ratibida columnifera</i>) | 12.52 |
| Canada Prairie Wildrye (<i>Elymus canadensis</i>) | 8.35 |
| Wild Bergamot (<i>Monarda fistulosa</i>) | 1.67 |

Source: Swift Operating Partners LLC 2021

Table 1-2. Approved List of Installed Plant Species

| Species Common Name (Scientific Name) |
|--|
| Leather Leaf (<i>Maytenus phyllanthoides</i>) |
| Carolina Wolfberry (<i>Lycium carolinianum</i>) |
| Mexican Buttonbush (<i>Cephalanthus salicifolius</i>) |
| Primrose Willow (<i>Ludwigia octovalvis</i>) |
| Rio Grande Butterfly Bush (<i>Buddleja sessiliflora</i>) |
| Rio Grande Dewberry (<i>Rubus riograndis</i>) |
| Sprawling Lippia (<i>Lippia alba</i>) |
| Willow-Leaf Heimia (<i>Heimia salicifolia</i>) |
| Vasey's Adelia (<i>Adelia vaseyi</i>) |
| Seepwillow (Mulefat) (<i>Baccharis salicifolia</i>) |
| Runyon's Water Willow (<i>Justicia runyonii</i>) |
| Berlandier's Trumpets (<i>Acleisanthes obtusa</i>) |
| Brushland Lantana (<i>Lantana achyranthifolia</i>) |
| Manzanita (Barbados Cherry) (<i>Malpighia glabra</i>) |
| Betony Leaf Mistflower (<i>Conoclinium betonicifolium</i>) |
| Coastal Germander (<i>Teucrium cubense</i>) |
| Berlandier's Fiddlewood (<i>Citharexylum berlandieri</i>) |

Source: Swift Operating Partners LLC 2021

1.4 Vegetation Plot Monitoring

Vernadero's contracted VPM and reporting services support the USIBWC's vegetation management activities by determining if the herbaceous plantings are self-sustaining and providing feedback on the maintenance program.

2.0 METHODOLOGY

2.1 Establishment of Vegetation Monitoring Plots

In October 2022, Vernadero biologists Ms. Carey Lynn Perry and Mr. Arnaud Kerisit established 60 permanent sample plots for monitoring purposes as described by the scope of work and the 2016 *Arroyo Colorado Floodway Vegetation Management Plan* (**Figure 2-1** and **Table 2-1**). Permanent 1-meter-by-1-meter (1 square meter [m²]) vegetation monitoring quadrats were established at random locations within areas of the Arroyo Colorado Floodway Revegetation Project that had been seeded with herbaceous vegetation and where native plants had been installed. Quadrat locations were prioritized using landowner permission and ease of access (**Figure 2-1** and **Table 2-1**).

**Table 2-1. Vegetation Plot Monitoring Quadrats
Established at Locations along the Arroyo Colorado Floodway**

| Location | Acres Seeded and Planted | VPM Quadrats Established |
|---|--------------------------|--------------------------|
| McKelvey Park | 2.88 | 3 |
| McCullough Park/Riverside Drive | 4.1 | 6 |
| Hugh Ramsey Nature Park | 4.84 | 7 |
| City of Harlingen Landfill and Transfer Station | 7.75 | 10 |
| Treasure Hills Golf Club | 7.2 | 14 |
| Harlingen WaterWorks Wastewater Plant | 5.0 | 6 |
| Bence Property/East Golf Course | 3.88 | 6 |
| San Benito Wastewater Treatment Plant | 3.5 | 3 |
| Santos – Fishing Spot | 0.47 | 2 |
| Navigation District – Next to Cemetery Road | 1.18 | 3 |
| TOTAL | 40.8 | 60 |

Source: Swift Operating Partners LLC 2022
VPM – Vegetation Plot Monitoring

Once quadrat locations were determined, we recorded each quadrat's location in the field at the quadrat's upstream, inland corner. We recorded the quadrat position with a submeter-accurate global positioning system (GPS) unit so that each quadrat can be reestablished in the same position in subsequent monitoring years.

2.2 Vegetation Plot Monitor Services (Year 2)

We conducted Year 2 (2023) monitoring at the permanently established quadrats in June. In addition to the VPM services, we qualitatively assessed the survival and vigor of any recently planted native woody plants identified within the revegetation area. We collected visual estimates of percent cover of all native and nonnative herbaceous species within each 1 m² quadrat using modified Daubenmire (1959) cover class categories as described in the *Arroyo*

Colorado Floodway Vegetation Management Plan (**Table 2-2**). We also recorded the percent cover of bare ground and dead vegetation within each quadrat.

Table 2-2. Visually Estimated Cover Class System Used to Estimate Absolute Percent Cover of Herbaceous Plants (modified from Daubenmire 1959)

| Visually Estimated Cover Categories | Median Percent Cover | Cover Class |
|-------------------------------------|----------------------|-------------|
| 0–1% | 0.5% | 1 |
| 1–5% | 3% | 2 |
| 5–25% | 15% | 3 |
| 25–50% | 37.5% | 4 |
| 50–75% | 62.5% | 5 |
| 75–95% | 85% | 6 |
| > 95% | 97.5% | 7 |

We recorded the distribution and abundance of nonnative herbaceous and woody species up to approximately 2 meters from each quadrat boundary as part of a general site assessment for the revegetated areas. We also qualitatively assessed the survival and vigor of the planted native woody vegetation within that 2-meter area of each quadrat (**Table 2-3**).

Table 2-3. Vigor Rating Used to Assess Health of Planted Woody Species

| Plant Health | Identifying Characteristics | Rating |
|------------------|---|--------|
| Healthy Plant | Deep green leaves and no sign of stress | 4 |
| Loss of Vigor | Reduced vigor, browning of leaf tips, wilting, etc. | 3 |
| Poor Health | Up to one-third of the plant shows signs of poor health (wilting, browning, necrosis, etc.) | 2 |
| Very Poor Health | Severe necrosis or wilting | 1 |
| Dead | All leaves dry, shriveled, and necrotic | 0 |

We identified all plants based on nomenclature and characteristics noted in the *Manual of the Vascular Plants of Texas* (Correll and Johnston 1970) and *Plants of Deep South Texas: A Field Guide to the Woody and Flowering Species* (Richardson and King 2010). We collected all plants that we could not initially identify in the field and properly stored them in a temperature-controlled container for later identification.

2.2.1 Monitoring Success Criteria

We utilized the data collected to compare to the approved plant cover success criteria for the project (**Table 2-4**). The plant cover success criteria were approved by the U.S. Fish and Wildlife Service via the *2016 Vegetation Management Plan* (USIBWC 2016).

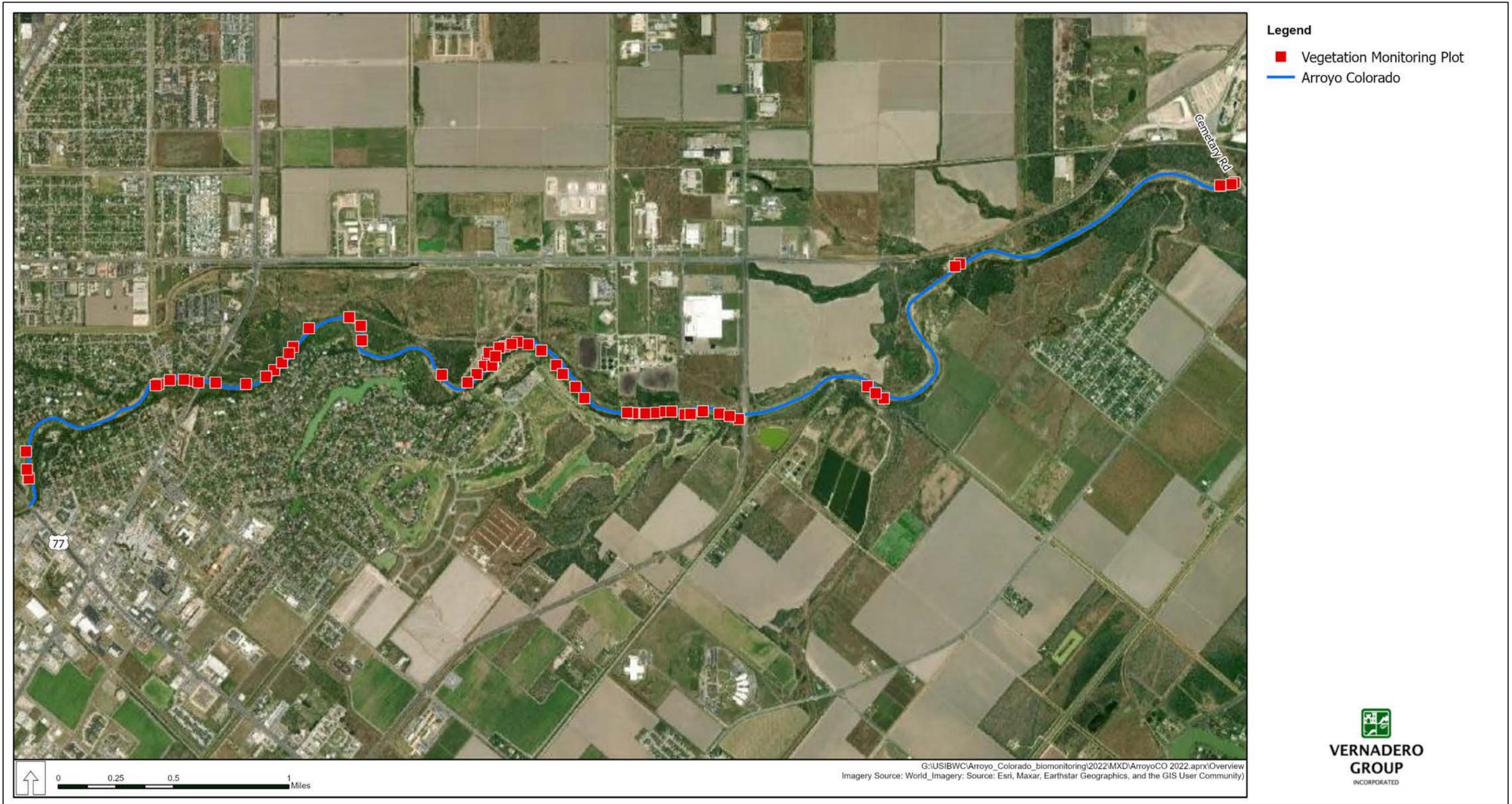


Figure 2-1. Vegetation Plot Monitoring Locations Established along the Arroyo Colorado Floodway

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The planting areas should be on a self-sustaining trajectory by the end of three years. The overall project average of native herbaceous seed mix species should achieve a minimum of 20 percent cover for Monitoring Year 1, a minimum 40 percent cover for Monitoring Year 2, and a minimum 60 percent cover for Monitoring Years 3 through 5 (**Table 2-4**). No more than 20 percent of the vegetation cover should be composed of nonnative plant species during any of the Monitoring Years (**Table 2-4**).

Table 2-4. Final Success Criteria¹

| Vegetation | Total Cover (percent) | | | Cover Free of Nonnative Species (percent) |
|------------------------------------|-----------------------|--------|-----------|---|
| | Year 1 | Year 2 | Years 3–5 | |
| Native Herbaceous Seed Mix Species | 20 | 40 | 60 | 80 |

Source: USIBWC 2016

¹ The planting areas should be on a self-sustaining trajectory by the end of three years. The overall project average of native herbaceous seed mix species should achieve a minimum of 20 percent cover for Monitoring Year 1, a minimum 40 percent cover for Monitoring Year 2, and a minimum 60 percent cover for Monitoring Years 3 through 5. No more than 20 percent of the vegetation cover should be composed of nonnative plant species during any of the Monitoring Years.

We collected photographs of each VPM quadrat using ArcGIS Field Maps (**Appendix A**). All photographs were spatially located and include the name of the photographer, project name, date and time of photograph, GPS location and aspect, and description of photograph embedded within each photograph's metadata.

2.2.2 Citizen Scientist Volunteer Opportunity (Year 2)

Vernadero attempted to coordinate a citizen scientist volunteer opportunity in June 2023. We contacted representatives from the U.S. Fish and Wildlife Service, U.S. Department of Agriculture, Arroyo Colorado Audubon Society, Friends of Hugh Ramsey Nature Park, and the South Texas Border Chapter Texas Master Naturalists to inform them of our intent to provide technical and logistical leadership for an annual "citizen scientist"-style volunteer opportunity for up to 10 volunteers to assist the VPM data collection at up to 10 of the 1 m² plots that are located on publicly accessible locations at Hugh Ramsey Nature Park. We informed them that the intended purpose of the volunteer opportunity is to create a limited opportunity for members of the community to participate in the VPM field activities under the direction of a master's-level professional. The goal is to provide a technically satisfying experience for volunteers who that have already demonstrated their interest in botany and ecology by completing the Texas programs and being active in the field and community.

2.3 Consulting Hours for Public Involvement

Vernadero prepared a presentation summarizing the results of the Year 1 and Year 2 annual monitoring for the USIBWC to present at the USIBWC Lower Rio Grande Citizens Forum.

2.4 Vegetation Monitoring Plots Established during Year 1 Monitoring in 2022

2.4.1 McKelvey Park

Approximately 2.88 acres of vegetation removal and seeding/planting were completed at McKelvey Park in November and December 2021 (Swift Operating Partners LLC 2022), and we established three vegetation monitoring quadrats in 2022 (**Figure 2-2**). The City of Harlingen is the landowner of this parcel. We contacted the Director of Parks and Recreation, Mr. Javier Mendez, and Park Superintendent, Mr. Armando Villela, for access. Year 2 monitoring at McKelvey Park was completed on 19 June 2023.

2.4.2 McCullough Park/Riverside Drive

Approximately 4.1 acres of vegetation removal and seeding/planting were completed at McCullough Park in November and December 2021 (Swift Operating Partners LLC 2022), and we established six vegetation monitoring quadrats in 2022 (**Figure 2-3**). We contacted the Director of Parks and Recreation, Mr. Javier Mendez, and Park Superintendent, Mr. Armando Villela, for access. Year 2 monitoring at McCullough Park was completed on 20 June 2023.

2.4.3 Hugh Ramsey Nature Park

Approximately 4.84 acres of vegetation removal and seeding/planting were completed at Hugh Ramsey Nature Park in November and December 2021 and April 2022 (Swift Operating Partners LLC 2022), and we established seven vegetation monitoring quadrats in 2022 (**Figure 2-4**). This area includes Hugh Ramsey Nature Park and the small stretch of the bank west of Ed Carey Drive (Parkwood East). The City of Harlingen Parks and Recreation team were the contacts for access. Ms. Christina Mild, lead volunteer for the park, was also notified. Year 2 monitoring at Hugh Ramsey Nature Park was completed on 20 June 2023.

2.4.4 City of Harlingen Landfill and Transfer Station

Approximately 7.75 acres of vegetation removal and seeding/planting were completed at the City of Harlingen Landfill and Transfer Station in November and December 2021 (Swift Operating Partners LLC 2022), and we established 10 vegetation monitoring quadrats in 2022 (**Figures 2-5 and 2-6**). Access was coordinated through the City of Harlingen Landfill Manager and staff on site at the weigh station. Year 2 monitoring at the City of Harlingen Landfill and Transfer Station was completed on 20 June 2023.

2.4.5 Treasure Hills Golf Club

Approximately 7.2 acres of vegetation removal and seeding/planting were completed at the Treasure Hills Golf Club in December 2021 (Swift Operating Partners LLC 2022), and we established 14 vegetation monitoring quadrats in 2022 (**Figures 2-7 and 2-8**). Permission for



Figure 2-2. Vegetation Plot Monitoring Established at McKelvey Park

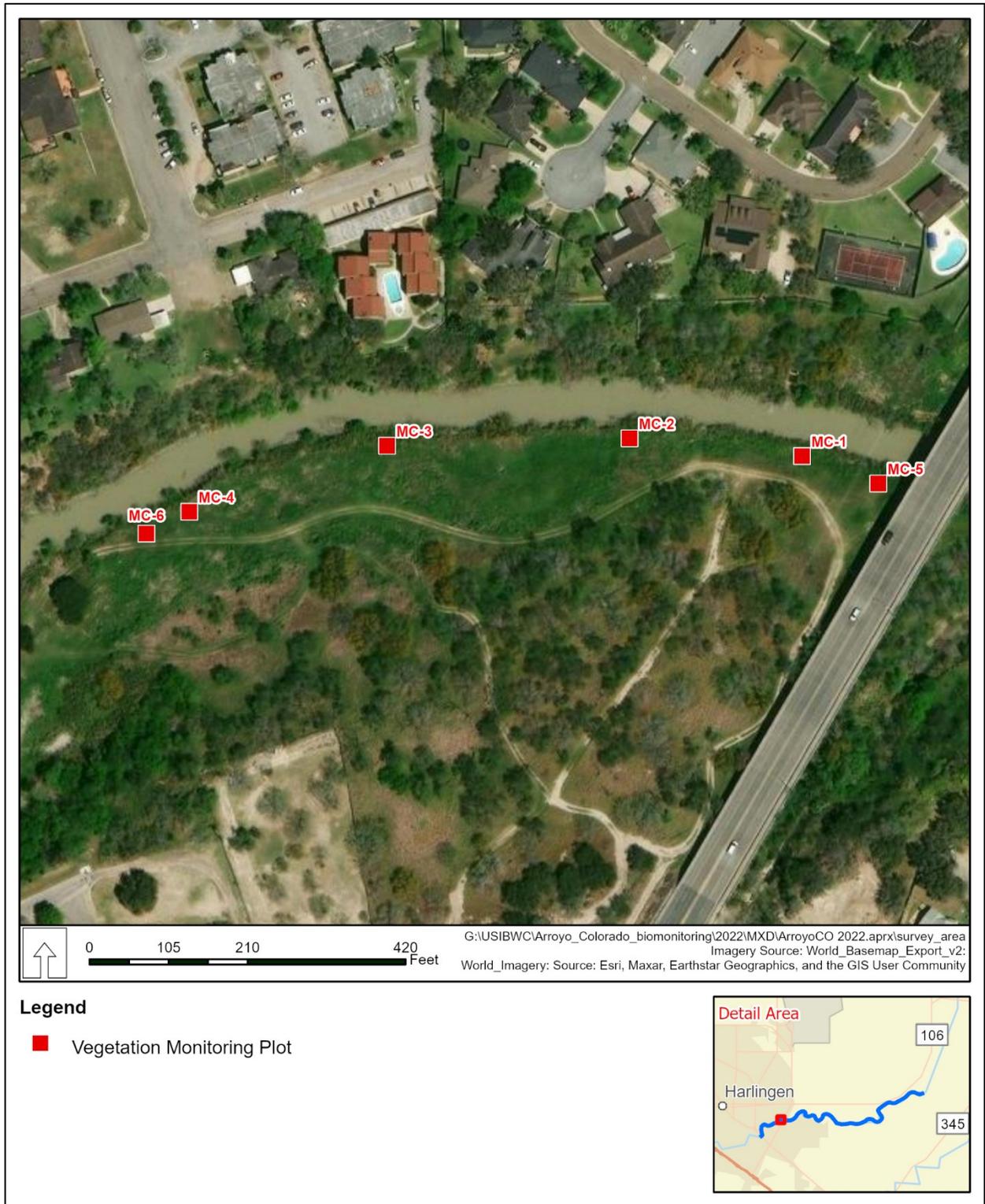


Figure 2-3. Vegetation Plot Monitoring Quadrats Established at McCullough Park



Figure 2-4. Vegetation Plot Monitoring Quadrats Established at Hugh Ramsey Park

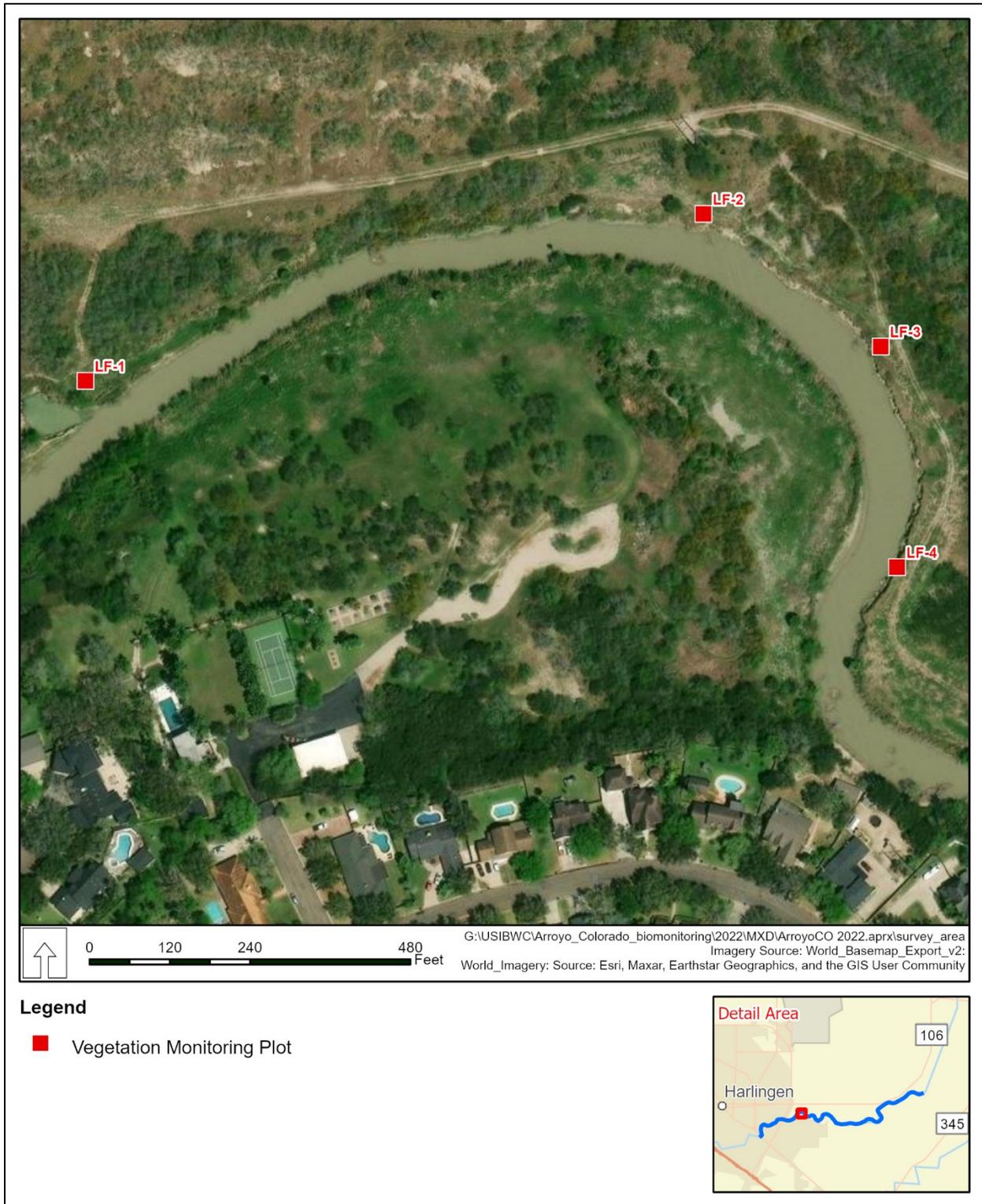


Figure 2-5. Vegetation Plot Monitoring Quadrats Established within the Western Portion of the City of Harlingen Landfill and Transfer Station

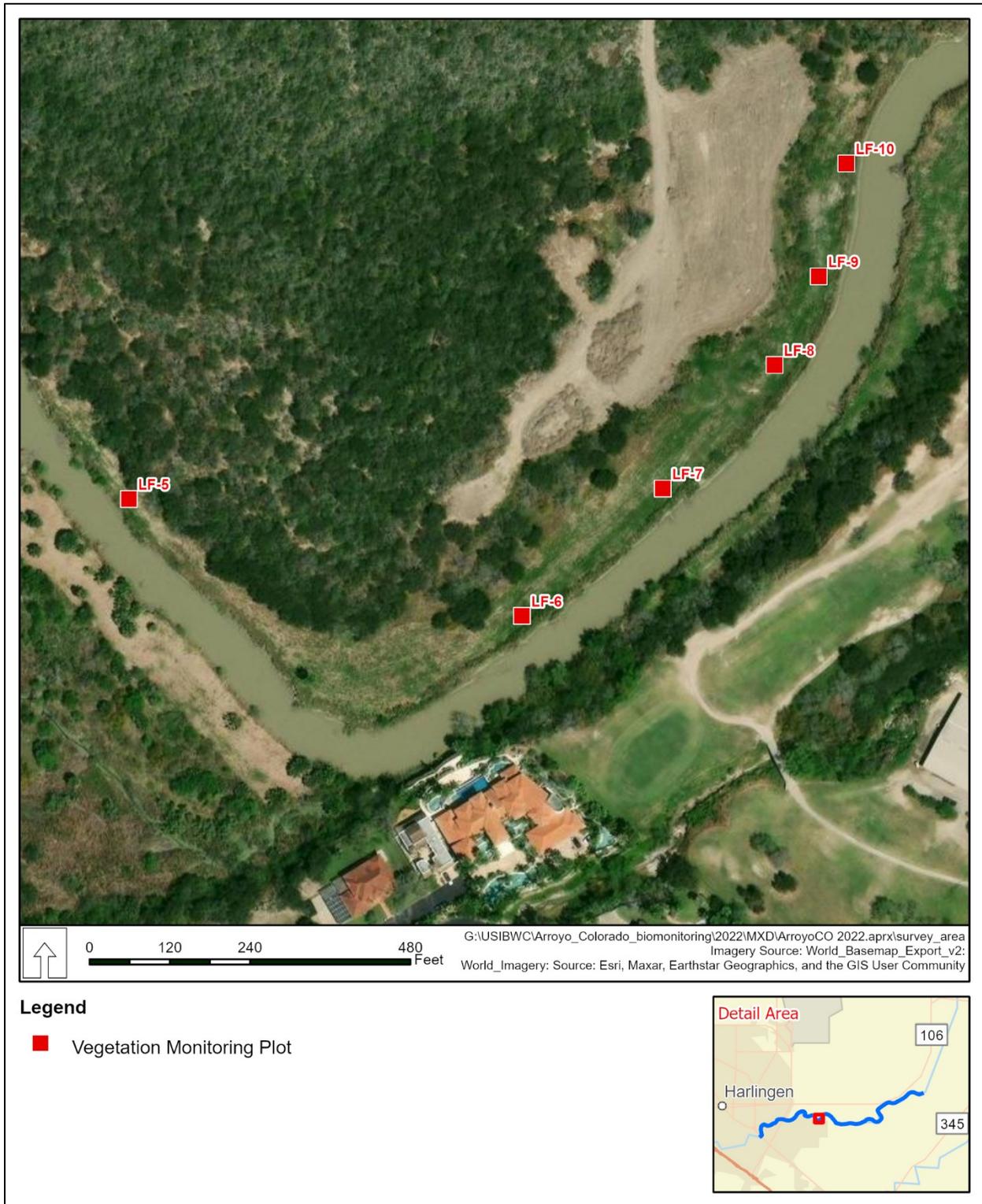


Figure 2-6. Vegetation Plot Monitoring Quadrats Established within the Eastern Portion of the City of Harlingen Landfill and Transfer Station

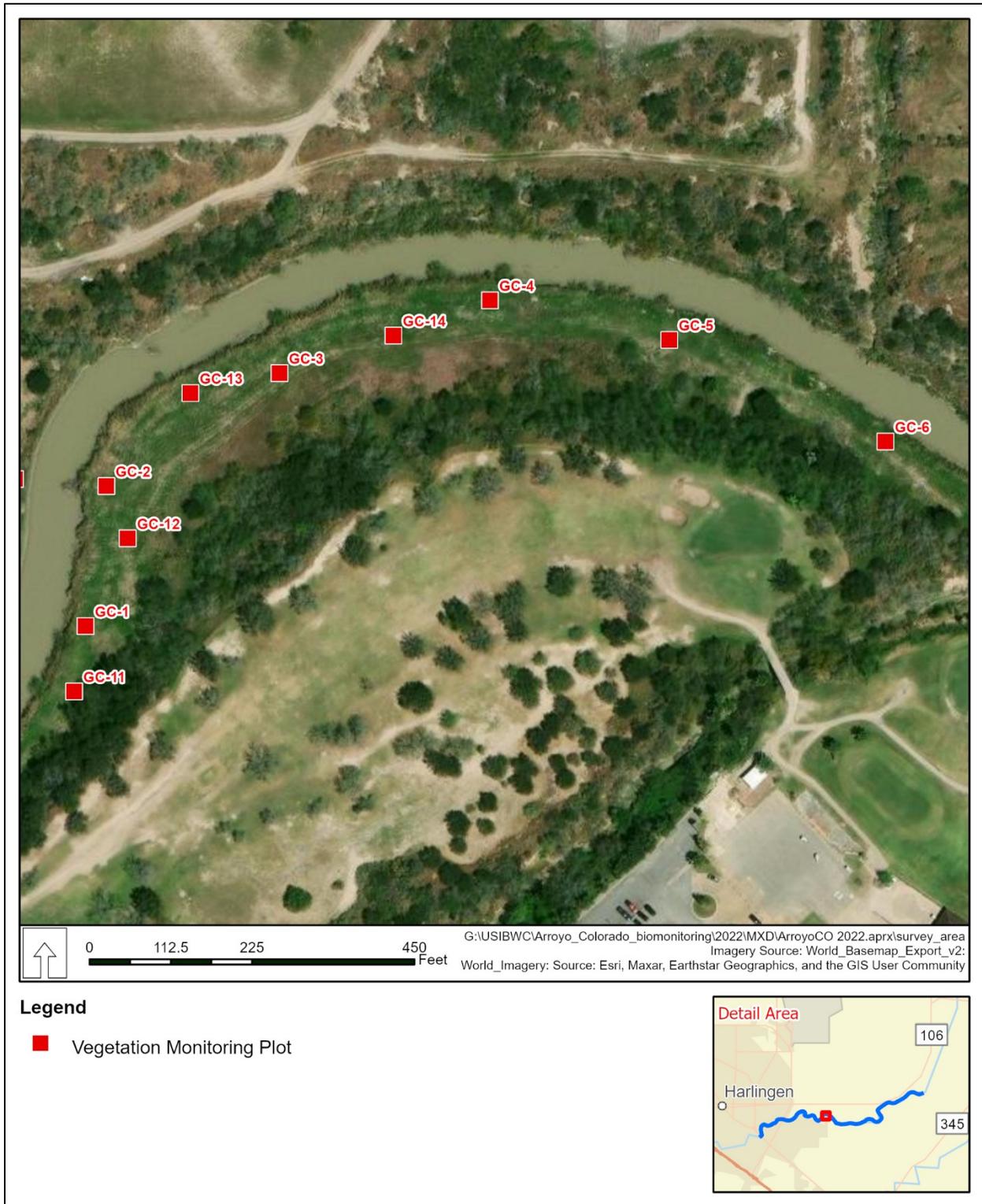


Figure 2-7. Vegetation Plot Monitoring Quadrats Established within the Western Portion of the Treasure Hills Golf Club



Figure 2-8. Vegetation Plot Monitoring Quadrats Established within the Eastern Portion of the Treasure Hills Golf Club

access was gained via the Clubhouse, and the Treasure Hills Golf Club Manager, Mr. Gene Estilette, was contacted. Year 2 monitoring at the Treasure Hills Golf Club was completed on 21 June 2023.

2.4.6 Harlingen WaterWorks Wastewater Plant

Approximately 5.0 acres of vegetation removal and seeding/planting were completed at the Harlingen WaterWorks Wastewater Plant in November and December 2021 (Swift Operating Partners LLC 2022), and we established six vegetation monitoring quadrats in 2022 (**Figure 2-9**). The Harlingen Department of Public Works and the Harlingen WaterWorks staff were our points of contact for access. We checked in and checked out at the security desk upon entry to the plant. Year 2 monitoring at the Harlingen WaterWorks Wastewater Plant was completed on 20 June 2023.

2.4.7 Bence Property

Approximately 3.88 acres of vegetation removal and seeding/planting were completed at the Bence property in December 2021 (Swift Operating Partners LLC 2022), and we established six vegetation monitoring quadrats in 2022 (**Figure 2-10**). Access to this area was obtained through the Bence property adjacent to FM 509, and access approval was received from Mr. Travis Bence. Year 2 monitoring at the Bence property was completed on 21 June 2023.

2.4.8 San Benito Wastewater Treatment Plant

Approximately 3.5 acres of vegetation removal and seeding/planting were completed at the San Benito Wastewater Treatment Plant in February and March 2022 (Swift Operating Partners LLC 2022), and we established three vegetation monitoring quadrats in 2022 (**Figure 2-11**). The City of San Benito's Public Works Director, Mr. Oscar Garcia, was contacted for access to this area, and approval for access was obtained from the onsite wastewater plant staff. Year 2 monitoring at the San Benito Wastewater Treatment Plant was completed on 20 June 2023.

2.4.9 Santos – Fishing Spot

Approximately 0.47 acre of vegetation removal and seeding/planting were completed at the Santos Fishing Spot property in February and April 2022 (Swift Operating Partners LLC 2022), and we established two vegetation monitoring quadrats in 2022 (**Figure 2-12**). Mr. Santos owns this property and utilizes it as a fishing rental. He permitted us access to the site for monitoring. Year 2 monitoring at the Santos property was completed on 19 June 2023.

2.4.10 Navigation District – Next to Cemetery Road

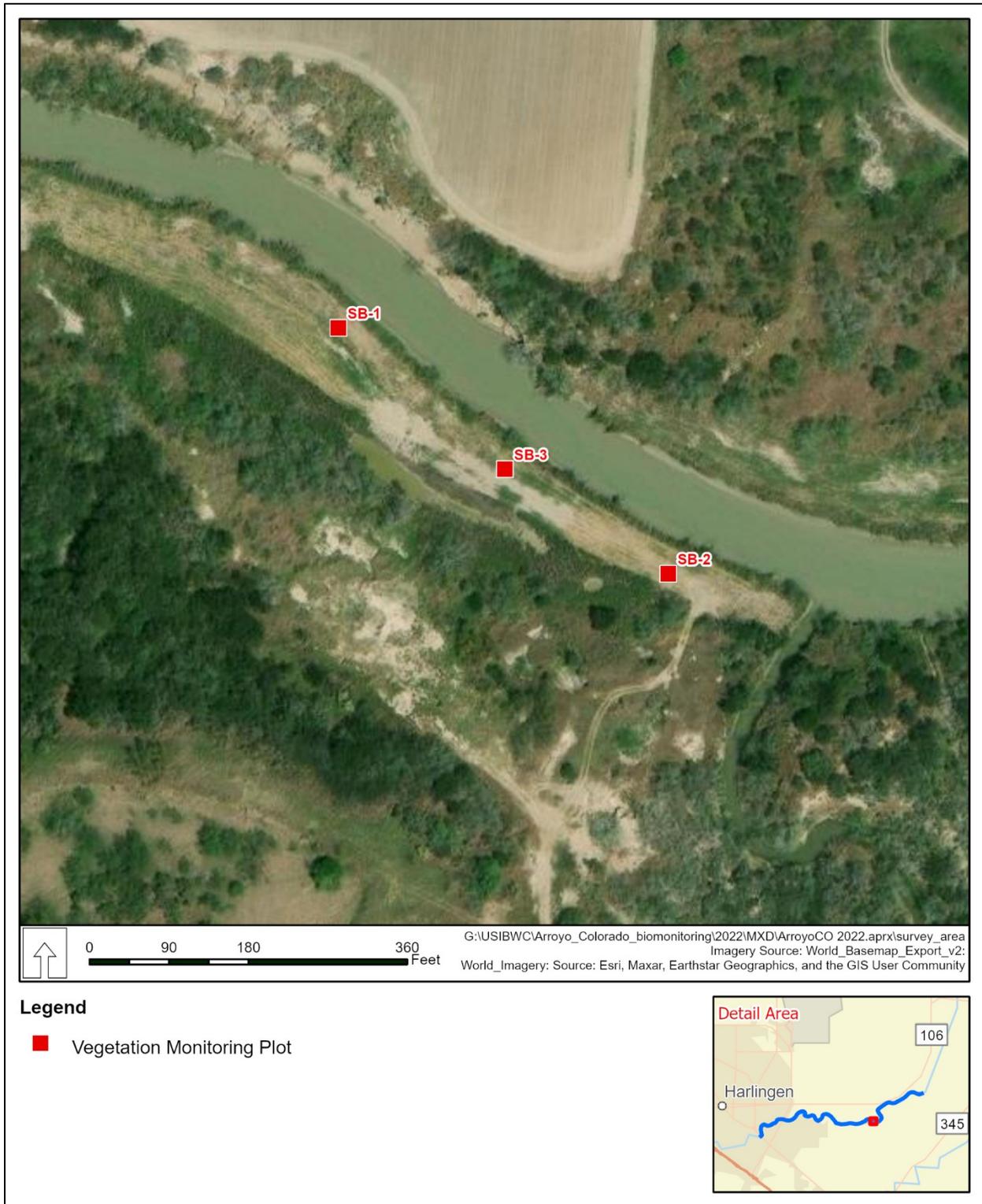
Approximately 1.18 acres of vegetation removal and seeding/planting were completed at the Port of Harlingen Navigation District property in February and March 2022 (Swift Operating Partners LLC 2022), and we established three vegetation monitoring quadrats in 2022 (**Figure 2-13**). The Navigation District owns this property, which is adjacent to Cemetery Road. The Port of Harlingen Navigation District was contacted for access. Year 2 monitoring at the Port of Harlingen Navigation District property was completed on 19 June 2023.



**Figure 2-9. Vegetation Plot Monitoring Quadrats
Established at the Harlingen WaterWorks Wastewater Plant**



Figure 2-10. Vegetation Plot Monitoring Quadrats Established at the Bence Property



**Figure 2-11. Vegetation Plot Monitoring Quadrats
Established at the San Benito Wastewater Treatment Plant**

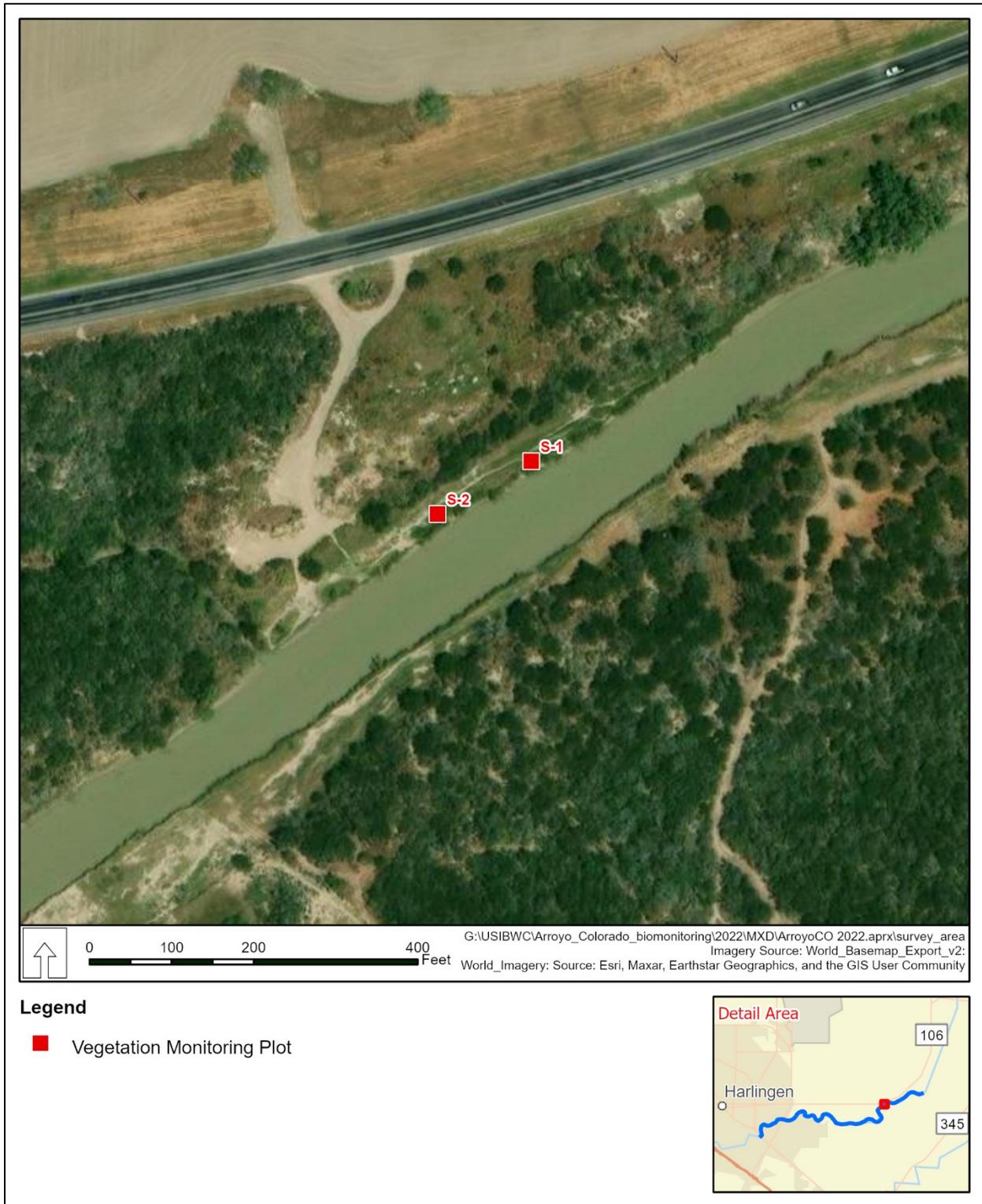


Figure 2-12. Vegetation Plot Monitoring Quadrats Established at the Santos Fishing Spot Property



**Figure 2-13. Vegetation Plot Monitoring Quadrats
Established at the Navigation District Property next to Cemetery Road**

The location of each of the 60 quadrats established during Year 1 monitoring in 2002 is provided in **Table 2-5**.

**Table 2-5. Locations of Vegetation Plot Monitoring Quadrats
Established during Year 1 Monitoring in 2022 along the Arroyo Colorado Floodway**

| Location | VPM Plot ID | Latitude | Longitude |
|---|-------------|-------------|--------------|
| McKelvey Park | MK-1 | 26.17846205 | -97.67731307 |
| McKelvey Park | MK-2 | 26.17902186 | -97.67742549 |
| McKelvey Park | MK-3 | 26.18003175 | -97.67748301 |
| McCullough Park | MC-1 | 26.18400203 | -97.6669538 |
| McCullough Park | MC-2 | 26.18405989 | -97.66758109 |
| McCullough Park | MC-3 | 26.18403585 | -97.66846324 |
| McCullough Park | MC-4 | 26.18382023 | -97.66918267 |
| McCullough Park | MC-5 | 26.1839122 | -97.66667662 |
| McCullough Park | MC-6 | 26.18374876 | -97.66933839 |
| Hugh Ramsey Nature Park | HR-1 | 26.18389372 | -97.66559392 |
| Hugh Ramsey Nature Park | HR-2 | 26.18381669 | -97.66368419 |
| Hugh Ramsey Nature Park | HR-3 | 26.18459167 | -97.6619174 |
| Hugh Ramsey Nature Park | HR-4 | 26.18589105 | -97.6607324 |
| Hugh Ramsey Nature Park | HR-5 | 26.18423402 | -97.6624328 |
| Hugh Ramsey Nature Park | HR-6 | 26.18502133 | -97.6614266 |
| Hugh Ramsey Nature Park | HR-7 | 26.18554235 | -97.6609953 |
| City of Harlingen Landfill and Transfer Station | LF-1 | 26.18694347 | -97.6597467 |
| City of Harlingen Landfill and Transfer Station | LF-2 | 26.18755733 | -97.6572156 |
| City of Harlingen Landfill and Transfer Station | LF-3 | 26.18706977 | -97.6564897 |
| City of Harlingen Landfill and Transfer Station | LF-4 | 26.1862588 | -97.6564227 |
| City of Harlingen Landfill and Transfer Station | LF-5 | 26.18433215 | -97.6514108 |
| City of Harlingen Landfill and Transfer Station | LF-6 | 26.18390262 | -97.6498014 |
| City of Harlingen Landfill and Transfer Station | LF-7 | 26.18437051 | -97.6492245 |
| City of Harlingen Landfill and Transfer Station | LF-8 | 26.18482499 | -97.6487666 |
| City of Harlingen Landfill and Transfer Station | LF-9 | 26.1851504 | -97.6485857 |
| City of Harlingen Landfill and Transfer Station | LF-10 | 26.18556573 | -97.6484728 |
| Treasure Hills Golf Club | GC-1 | 26.1850654 | -97.6482055 |
| Treasure Hills Golf Club | GC-2 | 26.18554194 | -97.6481264 |
| Treasure Hills Golf Club | GC-3 | 26.18592616 | -97.6474701 |
| Treasure Hills Golf Club | GC-4 | 26.18617385 | -97.6466721 |
| Treasure Hills Golf Club | GC-5 | 26.18603904 | -97.6459923 |
| Treasure Hills Golf Club | GC-6 | 26.1856932 | -97.6451728 |
| Treasure Hills Golf Club | GC-7 | 26.18487612 | -97.644239 |

| Location | VPM Plot ID | Latitude | Longitude |
|---|-------------|-------------|--------------|
| Treasure Hills Golf Club | GC-8 | 26.1843722 | -97.6438335 |
| Treasure Hills Golf Club | GC-9 | 26.18365083 | -97.6430296 |
| Treasure Hills Golf Club | GC-10 | 26.1830243 | -97.6424816 |
| Treasure Hills Golf Club | GC-11 | 26.18484309 | -97.6482487 |
| Treasure Hills Golf Club | GC-12 | 26.18536408 | -97.6480457 |
| Treasure Hills Golf Club | GC-13 | 26.18585833 | -97.6478078 |
| Treasure Hills Golf Club | GC-14 | 26.18605391 | -97.647038 |
| Harlingen WaterWorks Wastewater Plant | WW-1 | 26.1821748 | -97.639414 |
| Harlingen WaterWorks Wastewater Plant | WW-2 | 26.18216864 | -97.6386444 |
| Harlingen WaterWorks Wastewater Plant | WW-3 | 26.18219965 | -97.637977 |
| Harlingen WaterWorks Wastewater Plant | WW-4 | 26.18227137 | -97.6374065 |
| Harlingen WaterWorks Wastewater Plant | WW-5 | 26.18221336 | -97.6397938 |
| Harlingen WaterWorks Wastewater Plant | WW-6 | 26.18227068 | -97.6370199 |
| Bence Property/East Golf Course | B-1 | 26.18211244 | -97.6361894 |
| Bence Property/East Golf Course | B-2 | 26.18228677 | -97.6350513 |
| Bence Property/East Golf Course | B-3 | 26.18215859 | -97.6340173 |
| Bence Property/East Golf Course | B-4 | 26.18184702 | -97.6327918 |
| Bence Property/East Golf Course | B-5 | 26.1821366 | -97.6358228 |
| Bence Property/East Golf Course | B-6 | 26.1820216 | -97.633374 |
| San Benito Wastewater Treatment Plant | SB-1 | 26.18369193 | -97.624733 |
| San Benito Wastewater Treatment Plant | SB-2 | 26.18300732 | -97.6237095 |
| San Benito Wastewater Treatment Plant | SB-3 | 26.18329869 | -97.6242164 |
| Santos – Fishing Spot | S-1 | 26.19057021 | -97.6189324 |
| Santos – Fishing Spot | S-2 | 26.19041192 | -97.6192449 |
| Navigation District – Next to Cemetery Road | NV-1 | 26.19494397 | -97.6026198 |
| Navigation District – Next to Cemetery Road | NV-2 | 26.19511146 | -97.60117208 |
| Navigation District – Next to Cemetery Road | NV-3 | 26.19501578 | -97.6019108 |

VPM – vegetation plot monitoring; ID – Identification

2.5 Summary of 2022 Vegetation Plot Monitor Services (Year 1)

During Year 1 monitoring, the planted areas of the overall project did not meet the final success criterion of 20 percent cover for native herbaceous seed mix species or the final success criterion for percent cover free of nonnative species (80 percent). The average cover of native herbaceous seed mix species was only 3.5 percent, and the average cover of nonnative species was 31.2 percent. We observed few species that were included in the native herbaceous seed mix or the list of native plants to be installed during Year 1 monitoring. Across all 60 plots, the average total percent cover we observed during Year 1 monitoring was approximately 83.3 percent. Of that total, the average cover of native species accounted for 53.3 percent, and the

average percent cover of planted native species, including observed species in the native seed mix and those observed native species that had been installed, was approximately 10.2 percent.

Of native species, we most commonly observed the sea oxeye (*Borrichia frutescens*) (accounting for 19.5 percent cover across all plots) and common reed (*Phragmites australis*) (accounting for 8.6 percent cover across all plots). The two most common nonnative species we observed were Guinea grass (*Urochloa maxima*) (accounting for 21.8 percent cover across all plots) and Bermuda grass (*Cynodon dactylon*) (accounting for 5.25 percent cover across all plots).

3.0 RESULTS

3.1 2023 Vegetation Plot Monitor Services (Year 2)

3.1.1 Monitoring Success Criteria

During Year 2 monitoring, the project did not meet the final success criterion (see **Table 2-4**) of 20 percent cover for native herbaceous seed mix species or the final success criterion for percent cover free of nonnative species (80 percent) (**Table 3-1**). The average cover of native herbaceous seed mix species was only 4.7 percent, and the average cover of nonnative species was 39.9 percent, with 60.1 percent free of nonnative species (**Table 31** and **Figure 3-1**). Across all 60 plots, the average total percent cover we observed during Year 1 monitoring was approximately 90.6 percent (**Table 3-1** and **Figure 3-1**). Of that total, the average cover of native species accounted for 51.1 percent, and the average percent cover of planted native species, including observed species in the native seed mix and those observed native species that had been installed, was approximately 8.6 percent (**Table 3-2** and **Figure 3-13**).

Table 3-1. Average Percent Cover by Species Classification during Year 2 Monitoring

| Species Classification | Success Criteria ¹ | Total Cover |
|--|--------------------------------------|--|
| Native Herbaceous Seed Mix Species | 20 percent | 4.7 percent |
| Nonnative Species | 80 percent free of nonnative species | 39.9 percent (60.1 percent free of nonnative species) |
| All Species | N/A | 90.6 percent |
| All Native Herbaceous Species | N/A | 51.1 percent |
| All Planted Species (Native Herbaceous Seed Mix Species and Native Plants Installed) | N/A | 8.6 percent |

Source: USIBWC 2016

N/A – not applicable

¹ The planting areas should be on a self-sustaining trajectory by the end of three years. The overall project average of native herbaceous seed mix species in Year 2 should achieve a minimum of 20 percent cover for Monitoring Year 1, a minimum 40 percent cover for Monitoring Year 2, and a minimum 60 percent cover for Monitoring Years 3 through 5. No more than 20 percent of the vegetation cover should be composed of nonnative plant species during any of the monitoring years.

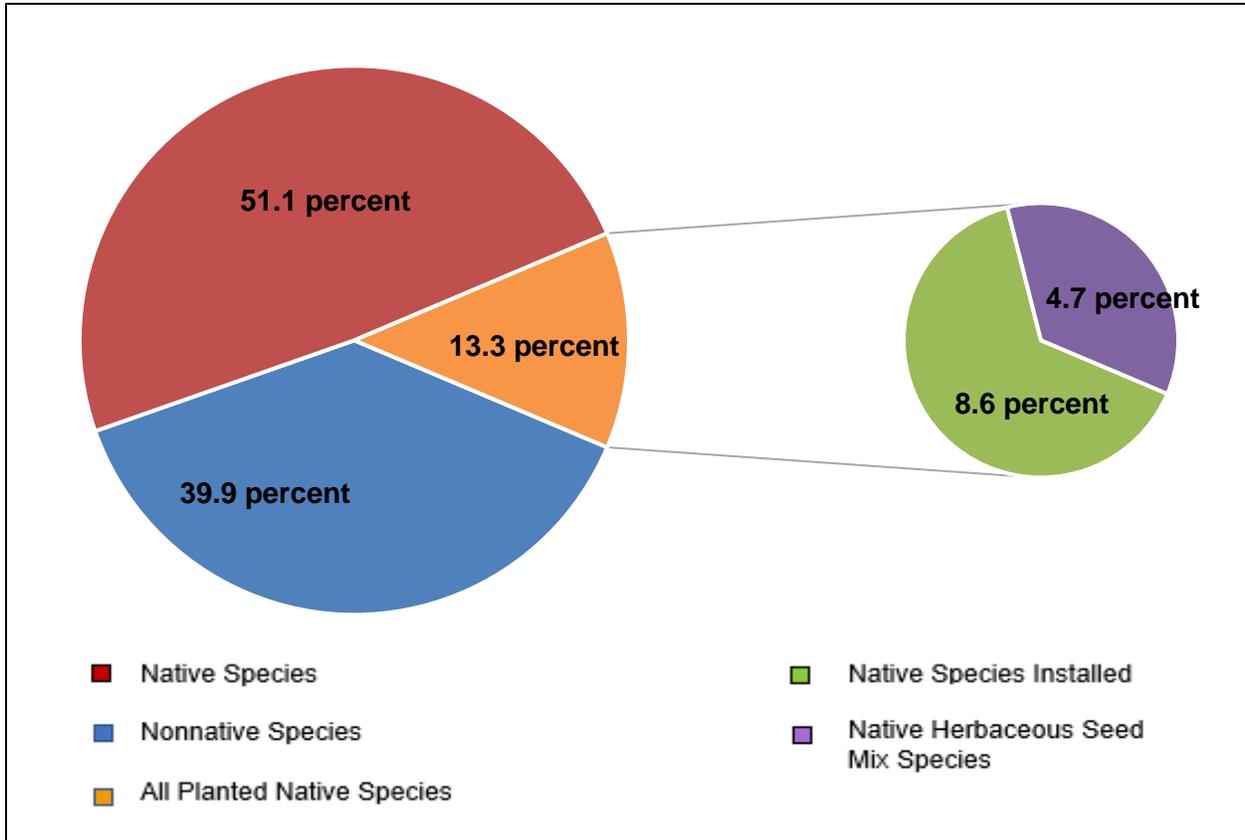


Figure 3-1. Average Percent Cover by Species Classification during Year 2 Monitoring

We observed few species that were included in the native herbaceous seed mix (**Table 3-2**) or the list of native plants to be installed (**Table 3-2**) during Year 2 monitoring. The species we observed included betony leaf mistflower (*Conoclinium Betonicifolium*), coastal germander (*Teucrium cubense*), hooded windmill grass (*Chloris cucullata*), Maximilian sunflower (*Helianthus maximiliani*), Rio Grande dewberry (*Rubus riograndis*), sprawling lippia (*Lippia alba*), and willow-leaf heimia (*Heimia salicifolia*) (**Table 3-2**). The most common seed mix species we observed were hooded windmill grass (accounting for 3.78 percent across all plots) and sprawling lippia (accounting for 2.55 percent across all plots) (**Table 3-2**). Hooded windmill grass was present at 5 of the 10 properties (City of Harlingen Landfill and Transfer Station, McCullough Park, McKelvey Park, Santos Fishing Spot, and Treasure Hills Golf Club). Sprawling lippia was present at 4 of the 10 properties (Hugh Ramsey Nature Park, McCullough Park, McKelvey Park, and Treasure Hills Golf Club).

Of native species, we most commonly observed sea oxeye (*Borrchia frutescens*) (accounting for 19.92 percent cover across all plots) and common reed (*Phragmites australis*) (accounting for 8.35 percent cover across all plots) (**Table 3-2**). Sea oxeye was present at 8 of the 10 properties where vegetation monitoring took place (Bence Property, Harlingen Water Works, McCullough Park, McKelvey Park, Navigation District, Santos Fishing Spot, and Treasure Hills Golf Club). Common reed was present at 9 of the 10 properties (Bence Property, Harlingen WaterWorks, Hugh Ramsey, City of Harlingen Landfill and Transfer Station, McCullough Park, McKelvey Park, Navigation District, Santo Fishing Spot, and Treasure Hills Golf Club).

The two most common nonnative species observed were Guinea grass (*Urochloa maxima*) (accounting for 26.4 percent cover across all plots) and Bermuda grass (*Cynodon dactylon*) (accounting for 8.7 percent cover across all plots) (**Table 3-2**). Guinea grass was present on 6 of the 10 properties (Bence Property, Harlingen Water Works, Hugh Ramsey, City of Harlingen Landfill and Transfer Station, San Benito Wastewater Plant, and Treasure Hills Golf Club). Bermuda grass was present at 4 of the 10 properties (Bence Property, Harlingen Water Works, McCullough Park, and San Benito Wastewater Treatment Plant).

Table 3-2. Average Cover along the Arroyo Colorado by Species Observed within Plots during Year 2 Monitoring

| Species | Cover (Percent) | Native/ Nonnative | In Seed Mix/ Planting List |
|--|-----------------|-------------------|----------------------------|
| <i>Abutilon sp.</i> | 0.03 | Native | No |
| <i>Ambrosia sp.</i> | 0.33 | Native | No |
| American Germander (<i>Teucrium canadense</i>) | 0.28 | Native | No |
| Balloon Vine (<i>Cardiospermum halicacabum</i>) | 0.50 | Native | No |
| Bermuda grass (<i>Cynodon dactylon</i>) | 8.67 | Nonnative | No |
| Betony Leaf Mistflower (<i>Conoclinium betonicifolium</i>) | 1.58 | Native | Yes |
| Bush Morning Glory (<i>Ipomoea carnea</i>) | 4.05 | Nonnative | no |
| Coastal Germander (<i>Teucrium cubense</i>) | 2.33 | Native | Yes |
| Common Reed (<i>Phragmites australis</i>) | 8.35 | Native | No |

| Species | Cover (Percent) | Native/ Nonnative | In Seed Mix/ Planting List |
|---|-----------------|-------------------|----------------------------|
| False Ragweed (<i>Parthenium hysterophorus</i>) | 0.83 | Native | No |
| Frog Fruit (<i>Phyla nodiflora</i>) | 0.00 | Native | No |
| Giant Bristlegrass (<i>Setaria magna</i>) | 2.33 | Native | No |
| Guinea Grass (<i>Urochloa maxima</i>) | 26.37 | Nonnative | No |
| Honey Mesquite (<i>Prosopis glandulosa</i>) | 0.08 | Native | No |
| Hooded Windmill Grass (<i>Chloris cucullata</i>) | 3.78 | Native | Yes |
| Knockaway (<i>Ehretia anacua</i>) | 0.17 | Native | No |
| Lance Leaf Blanket flower (<i>Gaillardia aestivalis</i>) | 0.08 | Native | No |
| Maidencane (<i>Panicum hemitomon</i>) | 0.62 | Native | No |
| Many-Spiked Flat Sedge (<i>Cyperus polystachyos</i>) | 0.03 | Native | No |
| Maximilian Sunflower (<i>Helianthus maximiliani</i>) | 0.67 | Native | Yes |
| Mexican Ash (<i>Fraxinus berlandieriana</i>) | 0.00 | Native | No |
| <i>Mimosa</i> sp. | 0.33 | Native | No |
| <i>Paspalum</i> sp. | 0.33 | Native | No |
| Retama (<i>Parkinsonia aculeata</i>) | 0.03 | Native | No |
| Rio Grande Dewberry (<i>Rubus riograndis</i>) | 1.20 | Native | Yes |
| Sea Oxeye (<i>Borrchia frutescens</i>) | 19.92 | Native | No |
| Southern Annual Saltmarsh Aster (<i>Symphyotrichum divaricatum</i>) | 1.67 | Native | No |
| Sprawling Lippia (<i>Lippia alba</i>) | 2.55 | Native | Yes |
| Texas Nightshade (<i>Solanum triquetrum</i>) | 0.33 | Native | No |
| Tumble Windmill Grass (<i>Chloris verticillata</i>) | 0.07 | Native | No |
| Unknown sp. (Unknown 1) | 0.00 | | |
| Violet Ruella (<i>Ruellia nudiflora</i>) | 0.17 | Native | No |
| Willow-Leaf heimia (<i>Heimia salicifolia</i>) | 0.13 | Native | Yes |
| White Mistflower (<i>Fleischmannia incarnata</i>) | 0.08 | Native | No |

3.2 General Site Assessment

We recorded the distribution and abundance of nonnative herbaceous and woody species up to approximately 2 meters from each quadrat boundary as part of a general site assessment for the revegetated areas. The most commonly encountered nonnative herbaceous species across the revegetation areas were shrub morning glory and Guinea grass. The abundance of woody species at the site was low, with a total of only 28 individual woody plants observed within 2 m of the 60 vegetation monitoring plots. However, all woody species observed were healthy, with no sign of stress and assigned a vigor rating of “4” (see Table 2-3). Retama (*Parkinsonia aculeata*) was the most commonly observed woody species across the site.

To date, colonization of the revegetated areas by volunteer native species is high and over half of the vegetative cover at the project is provided by these volunteer native species. The most commonly observed volunteer native groundcover species were sea oxeye and common reed.

Signs of wildlife utilization and few wildlife species were observed during Year 2 monitoring in June 2023. Common wildlife included: black-bellied whistling duck (*Dendrocygna autumnalis*), brown anole (*Anolis sagrei*), Eurasian collared dove (*Streptopelia decaocto*), house wren (*Troglodytes aedon*), great-tailed grackle (*Quiscalus mexicanus*), mourning dove (*Zenaida macroura*), turkey vulture (*Cathartes aura*), red-winged blackbird (*Agelaius phoeniceus*), long-billed thrasher (*Toxostoma longirostre*), northern cardinal (*Cardinalis cardinalis*), northern mockingbird (*Mimus polyglottos*), laughing gull (*Leucophaeus atricilla*), red-winged blackbird (*Agelaius phoeniceus*), green jay (*Cyanocorax yncas*), golden-fronted woodpecker (*Melanerpes aurifrons*), Carolina wren (*Thryothorus ludovicianus*), curved-bill thrasher (*Toxostoma curvirostre*), great blue heron (*Ardea herodias*), great white egret (*Ardea alba*), double-crested cormorant (*Phalacrocorax auritus*), snowy egret (*Egretta thula*), common chachalaca (*Ortalis vetula*), javelina (*Pecari tajacu*), and feral hog (*Sus scrofa*). No evidence of site disturbance associated with these species was encountered.

3.3 Citizen Scientist Volunteer Opportunity (Year 2)

As described in Section 2.2.2, Vernadero attempted to coordinate a citizen scientist volunteer opportunity in June 2023. However, no interested volunteers responded to our requests. Therefore, Citizen Scientist Volunteer Opportunity services were attempted but no volunteers participated.

3.4 Comparison of Year 1 and Year 2 Vegetation Plot Monitor Services

The project did not meet the final success criteria for Year 1 or Year 2 (**Table 2-4**). The average cover of native species for Year 1 was 3.5 percent cover compared to 4.7 percent cover for Year 2. The average cover of nonnative species was 31.2 percent for Year 1 and 39.9 percent for Year 2. The average total cover for all 60 plots was 83.3 percent for Year 1, and 90.6 percent for Year 2. The average percent cover of native species accounted for 53.3 for Year 1, and 51.1 percent for Year 2. The average percent cover of planted species, including observed species in the native seed mix and those observed species that had been installed, was 10.2 percent for Year 1 and 8.6 percent for Year 2 (**Table 3-3**).

Table 3-3. Comparison of Year 1 and Year 2 Average Percent Cover by Species Classification

| Species Classification | Success Criteria | Total Cover Year 1 | Total Cover Year 2 |
|------------------------------------|--------------------------------------|--|---|
| Native Herbaceous Seed Mix Species | 20 percent | 3.5 percent | 4.7 percent |
| Nonnative Species | 80 percent free of nonnative species | 31.2 percent (68.8 percent free of nonnative species) | 39.9 percent (60.1 percent free of nonnative species) |
| All Species | N/A | 83.3 percent | 90.6 percent |
| All Native Herbaceous Species | N/A | 53.3 percent | 51.1 percent |

| Species Classification | Success Criteria | Total Cover Year 1 | Total Cover Year 2 |
|--|------------------|--------------------|--------------------|
| All Planted Species (Native Herbaceous Seed Mix Species and Native Plants Installed) | N/A | 10.2 percent | 8.6 percent |

N/A – not applicable

During both Year 1 and 2, the monitoring team observed few species that were included in the native herbaceous seed mix or the list of installed native plants. Year 1 had a total of 11 native species, including coastal germander (*Teucrium cubense*), Maximilian sunflower, Vasey's adelia (*Adelia vaseyi*), hooded windmill grass, Rio Grande dewberry, betony leaf mistflower, black-eyed Susan, brushland lantana (*Lantana achyranthifolia*), swamp milkweed (*Asclepias incarnata*), willow-leaf heimia, and sprawling lippia. Year 2 had a total of seven native species, including betony leaf mistflower, coastal germander, hooded windmill grass, Maximilian sunflower, Rio Grande dewberry, sprawling lippia, and willow-leaf heimia. The most common seed mix species observed during Year 1 were coastal germander (accounting for 3.43 percent cover across all plots) and Maximilian sunflower (accounting for 1.82 percent across all plots). Coastal germander was present at 3 of the 10 properties (Bence Property, Hugh Ramsey Nature Park, and Treasure Hills Golf Club). Maximilian sunflower was present at 5 of the 10 properties (Bence Property, Hugh Ramsey Natural Park, City of Harlingen Landfill and Transfer Station, McCullough Park, and Treasure Hills Golf Club). For Year 2, the most common seed mix species observed were hooded windmill grass (accounting for 3.78 percent across all plots) and sprawling lippia (accounting for 2.55 percent across all plots). Hooded windmill grass was present at 5 of the 10 properties (City of Harlingen Landfill and Transfer Station, McCullough Park, McKelvey Park, Santos Fishing Spot, and Treasure Hills Golf Club). Sprawling lippia was present at 4 of the 10 properties (Hugh Ramsey Nature Park, McCullough Park, McKelvey Park, and Treasure Hills Golf Club) (**Table 3-4**).

The most common native species were the same during both Year 1 and Year 2 monitoring. Sea oxeye and common reed accounted for 19.6 and 8.6 percent cover across all plots during Year 1 compared to 19.92 and 8.35 percent across all plots during Year 2. During Year 1, sea oxeye was present at 8 of the 10 properties (Bence Property, Harlingen WaterWorks Wastewater Plant, City of Harlingen Landfill and Transfer Station, McCullough Park/Riverside Drive, Navigational District, San Benito Wastewater Treatment Plant, Santos Fishing Spot, and Treasure Hills Golf Club). During Year 2, sea oxeye was also present at 8 of the 10 properties where vegetation monitoring took place (Bence Property, Harlingen Water Works, McCullough Park, McKelvey Park, Navigation District, Santos Fishing Spot, and Treasure Hills Golf Club). During Year 1, Common reed was present at 8 of the 10 properties (Bence Property, Harlingen WaterWorks Wastewater Plant, City of Harlingen Landfill and Transfer Station, McCullough Park/Riverside Drive, Navigational District, San Benito Wastewater Treatment Plant, Santos Fishing Spot, and Treasure Hills Golf Club). During Year 2, common reed was present at 9 of the 10 properties (Bence Property, Harlingen Water Works, Hugh Ramsey, City of Harlingen Landfill and Transfer Station, McCullough Park, McKelvey Park, Navigation District, Santo Fishing Spot, and Treasure Hills Golf Club) (**Table 3-4**).

The two most common nonnative species observed were the same during Year 1 and Year 2. Guinea grass accounted for 21.8 percent cover across all plots during Year 1 compared to 26.4 percent cover across all plots for Year 2. Bermuda grass accounted for 5.25 percent cover across all plots during Year 1 compared to 8.6 percent cover across all plots during Year 2. For Year 1, Guinea grass was present on 7 of the 10 properties where vegetation monitoring took place (Hugh Ramsey Natural Park, City of Harlingen Landfill and Transfer Station, Treasure Hills Golf Club, Bence Property, Harlingen WaterWorks Wastewater Plant, McCullough Park/Riverside Drive, and San Benito Wastewater Plant), while Bermuda grass was present at 4 of the 10 properties (Harlingen WaterWorks Wastewater Plant, City of Harlingen Landfill and Transfer Station, McCullough Park/Riverside Drive, and McKelvey Park). During Year 2, Guinea grass was present on 6 of the 10 properties (Bence Property, Harlingen Water Works, Hugh Ramsey, City of Harlingen Landfill and Transfer Station, San Benito Wastewater Plant, and Treasure Hills Golf Club). Bermuda grass was present at 4 of the 10 properties (Bence Property, Harlingen Water Works, McCullough Park, and San Benito Wastewater plant) (**Table 3-4**).

Table 3-4. Comparison of Year 1 and 2 Average Cover along the Arroyo Colorado by Species Observed within Plots during Monitoring

| Species | Cover Year 1 (Percent) | Cover Year 2 (Percent) | Native/ Nonnative | In Seed Mix/ Planting List |
|--|---------------------------|---------------------------|----------------------|-------------------------------|
| <i>Abutilon sp.</i> | 0.00 | 0.03 | Native | No |
| <i>Alternanthera sp.</i> | 0.03 | 0.00 | Nonnative | No |
| <i>Ambrosia sp.</i> | 0.00 | 0.33 | Native | No |
| American Germander (<i>Teucrium canadense</i>) | 0.08 | 0.28 | Native | No |
| Balloon Vine (<i>Cardiospermum halicacabum</i>) | 0.00 | 0.50 | Native | No |
| Bermuda Grass (<i>Cynodon dactylon</i>) | 5.25 | 8.67 | Nonnative | No |
| Betony Leaf Mistflower (<i>Conoclinium betonicifolium</i>) | 0.83 | 1.58 | Native | Yes |
| Black-Eyed Susan (<i>Rudbeckia hirta</i>) | 0.07 | 0.00 | Native | Yes |
| Brushland Lantana (<i>Lantana achyranthifolia</i>) | 0.05 | 0.00 | Native | Yes |
| Bush Morning Glory (<i>Ipomoea carnea</i>) | 2.72 | 4.05 | Nonnative | No |
| Castor Bean (<i>Ricinus communis</i>) | 0.33 | 0.00 | Nonnative | No |
| Coastal Germander (<i>Teucrium cubense</i>) | 3.43 | 2.33 | Native | Yes |
| Common Dandelion (<i>Taraxacum officinale</i>) | 0.02 | 0.00 | Native | No |
| Common Reed (<i>Phragmites australis</i>) | 8.60 | 8.35 | Native | No |
| <i>Eriochloa sp.</i> | 0.08 | 0.00 | Native | No |
| False Ragweed (<i>Parthenium hysterophorus</i>) | 0.00 | 0.83 | Native | No |
| Frog Fruit (<i>Phyla nodiflora</i>) | 0.00 | 0.00 | Native | No |
| Giant Bristlegrass (<i>Setaria magna</i>) | 1.17 | 2.33 | Native | No |
| Guinea Grass (<i>Urochloa maxima</i>) | 21.80 | 26.37 | Nonnative | No |
| Honey Mesquite (<i>Prosopis glandulosa</i>) | 0.02 | 0.08 | Native | No |

| Species | Cover Year 1 (Percent) | Cover Year 2 (Percent) | Native/ Nonnative | In Seed Mix/ Planting List |
|--|---------------------------|---------------------------|----------------------|-------------------------------|
| Hooded Windmill Grass (<i>Chloris cucullata</i>) | 1.55 | 3.78 | Native | Yes |
| Knockaway (<i>Ehretia anacua</i>) | 0.08 | 0.17 | Native | No |
| Lance Leaf Blanket flower (<i>Gaillardia aestivalis</i>) | 1.08 | 0.08 | Native | No |
| <i>Lycopus</i> sp. | 0.02 | 0.00 | Native | No |
| Maidencane (<i>Panicum hemitomon</i>) | 0.08 | 0.62 | Native | No |
| Many-Spiked Flat Sedge (<i>Cyperus polystachyos</i>) | 0.03 | 0.03 | Native | No |
| Maximilian Sunflower (<i>Helianthus maximiliani</i>) | 1.82 | 0.67 | Native | Yes |
| Mexican Ash (<i>Fraxinus berlandieriana</i>) | 0.03 | 0.00 | Native | No |
| <i>Mimosa</i> sp. | 0.10 | 0.33 | Native | No |
| <i>Paspalum</i> sp. | 0.50 | 0.33 | Native | No |
| Pond Flatsedge (<i>Cyperus ochraceus</i>) | 0.20 | 0.00 | Native | No |
| Retama (<i>Parkinsonia aculeata</i>) | 0.28 | 0.03 | Native | No |
| Rio Grande Dewberry (<i>Rubus riograndis</i>) | 0.95 | 1.20 | Native | Yes |
| Rooseveltweed (<i>Baccharis neglecta</i>) | 0.17 | 0.00 | Native | No |
| Salt Heliotrope (<i>Heliotropium curassavicum</i>) | 1.25 | 0.00 | Native | No |
| Saltgrass (<i>Distichlis spicata</i>) | 0.75 | 0.00 | Native | No |
| Sea Oxeye (<i>Borrchia frutescens</i>) | 19.50 | 19.92 | Native | No |
| Silverleaf Nightshade (<i>Solanum elaeagnifolium</i>) | 1.08 | 0.00 | Native | No |
| <i>Solanum</i> sp. | 0.03 | 0.00 | Native | No |
| <i>Solidago</i> sp. | 0.05 | 0.00 | Native | No |
| Southern Annual Saltmarsh Aster (<i>Symphyotrichum divaricatum</i>) | 0.37 | 1.67 | Native | No |
| Sprawling Lippia (<i>Lippia alba</i>) | 1.45 | 2.55 | Native | Yes |
| Swamp Milkweed (<i>Asclepias incarnata</i>) | 0.05 | 0.00 | Native | Yes |
| Talayote (<i>Cynanchum racemosum</i>) | 0.08 | 0.00 | Native | No |
| Texas Nightshade (<i>Solanum triquetrum</i>) | 0.42 | 0.33 | Native | No |
| Tumble Windmill Grass (<i>Chloris verticillata</i>) | 3.37 | 0.07 | Native | No |
| Unknown sp. (Unknown 1) | 0.00 | 0.00 | Native | No |
| Vasey's Adelia (<i>Adelia vaseyi</i>) | 0.03 | 0.00 | Native | Yes |
| Violet Ruella (<i>Ruellia nudiflora</i>) | 2.27 | 0.17 | Native | No |
| Willow-Leaf Heimia (<i>Heimia salicifolia</i>) | 0.17 | 0.13 | Native | Yes |
| White Mistflower (<i>Fleischmannia incarnata</i>) | 0.00 | 0.08 | Native | No |
| Winged Loosestrife (<i>Lythrum alatum</i>) | 0.67 | 0.00 | Native | No |

4.0 CONCLUSIONS AND MANAGEMENT RECOMMENDATIONS

4.1 Conclusions

Seeding of the designated areas where invasive species or trees were removed, or that were open land, commenced once the vegetation removal was completed (Swift Operating Partners LLC 2021). The seed was spread with a broadcast device (Swift Operating Partners LLC 2021), and for the majority of vegetation removal areas along the arroyo seeding was completed in November and December 2021 (Swift Operating Partners LLC 2022). Based on other successful revegetation efforts along the Arroyo Colorado Floodway in the vicinity of clearing areas and in other regions of south Texas (Smith et al. 2010), a seed mix of annuals and perennials that do well in floodplain soils was chosen to be seeded within the Arroyo Colorado Floodway. The locally sourced seed mix included fast-germinating native grasses, as well as native herbaceous species that germinate and establish more slowly over time (see **Table 1-1**).

For best results, including maximizing germination rates of native grasses and reducing the germination rates of invasive plant species, native grass seeding would take place in late summer or early fall (between 20 August and 30 September) (Smith et al. 2010). It is possible the low cover of the seed mix species observed during Year 2 monitoring was due to the initial timing of seeding that was completed by the vegetation management contractor later in the year (November and December). It may also be that site preparation prior to seeding was not sufficient to ensure seed-soil contact. Seeded areas are generally cleared of substantial debris and any other impediments to seed-soil contact prior to broadcasting the seed mix. Broadcast seeding is a method of spreading seeds mechanically over a soil surface, and this method is especially useful in uneven soil surfaces or poorly prepared soil surfaces such as those along the arroyo. However, broadcast seeding should generally be followed by dragging or cultipacking (i.e., using a cultipacker, which is a device pulled behind a tractor that rolls over the soils and seeds) operations to ensure soil-seed contact and soil coverage of seeds to reduce bird, small-mammal, and insect foraging.

New native plants (see **Table 1-2**) were also installed along the arroyo banks in November and December 2021, with additional plantings at Hugh Ramsey Nature Park in April 2022 (Swift Operating Partners LLC 2022). Fall in the Rio Grande Valley is typically the best time of year for highest planting success due to the cooler temperatures and available moisture from rainfall. Approximately 30,000 plants were installed along the arroyo using biodegradable grow tubes and were immediately watered (Swift Operating Partners LLC 2021). Based on our monitoring efforts along the arroyo during planting, both the site conditions and the health of the plants during installation appeared to be conducive to plant survival. However, during Year 2 monitoring, very few plants that were included on the list of native species installed were observed within the 60 monitoring plots. Of those observed, all appeared to be in good health. Without the inclusion of any geographic information system (GIS) data or maps of the planted areas as part of the task order for monitoring, it is likely that many of our monitoring plots fell outside those areas where the plants were installed. It is also possible that, due to the small size of the plants installed, they were not able to establish and compete with other species that recolonized the area following the vegetation removal. For instance, the project's *Final*

Vegetation Management Plan (USIBWC 2016) recommended that 4-inch container plantings be installed for the majority of species, but smaller grow tubes were installed by the vegetation management contractor.

The primary goals of the removal of woody vegetation along the Arroyo Colorado Floodway and the revegetation of cleared areas using native grass, forbs, and other species was to (1) stabilize the channel banks, (2) maintain the channel's 21,000 cfs design flood conveyance, and (3) provide vegetative cover for wildlife. While the project did not meet the Year 2 final success criterion (see **Table 3-2**), the vegetation that is currently present along the banks of the Arroyo Colorado does help to stabilize the channel banks and allow for design flood conveyance. Further, common reed along the banks of the arroyo does provide some vegetative cover and travel function for wildlife, but of a lower value than expected from the species planted.

4.2 Management Recommendations

Our Year 2 monitoring of native species percent cover was used to evaluate the success of the reseeding and planting efforts and should be used to direct maintenance activities or techniques to ensure the success of the revegetation in an adaptive management approach. As noted above, although the project did not meet the Year 2 final success criterion, the vegetation that is currently present along the banks of the Arroyo Colorado does help to stabilize the channel banks and allow for design flood conveyance. Even so, based on the results of our annual monitoring and failure to meet Year 2 success criteria, we recommend that USIBWC consider additional seeding with native herbaceous species in late summer or early fall (**Table 4-1**). When USIBWC is deciding whether or not to implement the recommended additional seeding and determining its timing, it is important to consider that some native seeds can and frequently do not germinate and establish until three or more years after being planted (Smith et al. 2010). While some early successional plants establish quickly, many of the most desirable native species rarely, if ever, visibly establish until a year or more after being planted. Smith et al. (2010) monitored plantings that were very successful in the long term but did not observe a single native seedling present for six months to 1.5 years after initial planting. Even under ideal moisture and planting conditions, the maximum expression of a reseeded native community may still take a minimum of six months.

Further, it may prove useful to conduct monthly monitoring immediately following any additional revegetation efforts (**Table 4-1**) in order to monitor seed sprout and survival of the installed plants. Similar monthly inspection of all initially seeded areas could have been useful for documenting failures and making necessary adjustments as those failures were encountered. Our Year 1 monitoring took place approximately 10 to 11 months after the initial seeding and after other native and nonnative species had recolonized the vegetation removal areas. If the maintenance and monitoring cannot be conducted in-house, USIBWC should plan to set aside funding for contracting routine/annual vegetation maintenance and monitoring.

We also recommend the treatment of nonnative grasses along the arroyo, primarily Guinea grass, that are present within the revegetated areas (**Table 4-1**). Nonnative grasses often invade restoration sites within three months of planting, even with very little rain, and the

amount of nonnative grasses that emerge on a restoration site is directly correlated to the quality of site preparation done before seeding (Smith et al. 2010). Thorough site preparation efforts usually result in only sporadic early occurrences of exotic grasses after planting (Smith et al. 2010).

We recommend a spot treatment program to target the nonnative grasses using glyphosate herbicide. This action may reduce the amount of unwanted nonnative plants that would later impede native plant establishment and would complement efforts that are already occurring along the arroyo, such as the efforts at Hugh Ramsey Nature Park to remove Guinea grass. Once establishment of the native plantings occurs, the spread and reinvasion of nonnatives will likely be slowed significantly. Biannual herbicide treatment of patches of nonnative grasses is the greatest insurance of long-term success and productivity of a native restoration site (Smith et al. 2010). Typically, early spring and early fall are appropriate times for these applications. Smith et al. (2010) have found that spot treatment of nonnative grasses is the most beneficial post-planting management action on native plant restoration sites throughout south Texas.

Table 4-1. Management Recommendations

| Recommendation | Timing | Location |
|---|--|--|
| Additional Seeding with Native Herbaceous Species | Late summer or early fall | All previously seeded areas along the Arroyo Colorado. |
| Monthly Monitoring Immediately Following Any Additional Revegetation Effort | Monthly from time of seeding through the end of the following growing season | 1-square-meter vegetation monitoring quadrats established at random locations during any additional revegetation effort; the number of quadrats should be proportionate to the total area of additional seeding. |
| Spot Treatment Using Glyphosate Herbicide to Target Guinea Grass | Early spring and early fall | Harlingen Water Works Property, Hugh Ramsey Nature Preserve, Harlingen Landfill and Transfer Station Property, Treasure Hills Golf Course. |

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5.0 REFERENCES

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- Smith, F.S., W.R. Pawelek, W.W. Ocumpaugh, and T. Falk. 2010.** *South Texas Natives: General Guidelines for Native Seeding in South Texas*.
<https://www.ckwri.tamuk.edu/sites/default/files/pdf-attachment/20160518_general_guidelines_for_native_seeding_in_south_texas.pdf>. Accessed 8 November 2022.
- Swift Operating Partners LLC. 2021.** *Final Work Plan, Arroyo Colorado Vegetation Management Project Harlingen, TX – from US 77 to Cemetery Road*.
- Swift Operating Partners LLC. 2022.** *Supplement to Final Report, Arroyo Colorado Vegetation Management Project Details by Area*.
- U.S. Section, International Boundary and Water Commission. (USIBWC). 2016.** *Final Vegetation Management Plan Clearing Areas along the Arroyo Colorado Floodway in the Lower Rio Grande Flood Control Project Area Cameron County, Texas*. Prepared by Gulf South Research Corporation (November 2015) and revised by USIBWC (January 2016).

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Appendix A. Year 2 (2023) Plot Monitoring Photographs

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Photograph A-1. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MK-1 Located on McKelvey Park Property (Photograph taken by Carey Lynn Perry, Vernadero Group Inc. [Vernadero], 2206 hours, 19 June 2023.)



Photograph A-2. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MK-2 Located on McKelvey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 2211 hours, 19 June 2023.)



Photograph A-3. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MK-3 Located on McKelvey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 2215 hours, 19 June 2023.)



Photograph A-4. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MC-1 Located on McCullough Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1556 hours, 20 June 2023.)



Photograph A-5. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MC-2 Located on McCullough Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1559 hours, 20 June 2023.)



Photograph A-6. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MC-3 Located on McCullough Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1607 hours, 20 June 2023.)



Photograph A-7. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MC-4 Located on McCullough Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1611 hours, 20 June 2023.)



Photograph A-8. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MC-5 Located on McCullough Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1553 hours, 20 June 2023.)



Photograph A-9. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number MC-6 Located on McCullough Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1614 hours, 20 June 2023.)



Photograph A-10. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number HR-1 Located on Hugh Ramsey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1126 hours, 20 June 2023.)



Photograph A-11. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number HR-2 Located on Hugh Ramsey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1132 hours, 20 June 2023.)



Photograph A-12. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number HR-3 Located on Hugh Ramsey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1143 hours, 20 June 2023.)



Photograph A-13. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number HR-4 Located on Hugh Ramsey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1202 hours, 20 June 2023.)



Photograph A-14. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number HR-5 Located on Hugh Ramsey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1139 hours, 20 June 2023.)



Photograph A-15. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number HR-6 Located on Hugh Ramsey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1148 hours, 20 June 2023.)



Photograph A-16. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number HR-7 Located on Hugh Ramsey Park Property (Photograph taken by Carey Lynn Perry, Vernadero, 1153 hours, 20 October 2023.)



Photograph A-17. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-1 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1208 hours, 20 June 2023.)



Photograph A-18. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-2 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1218 hours, 20 June 2023.)



Photograph A-19. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-3 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1222 hours, 20 June 2023.)



Photograph A-20. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-4 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1229 hours, 20 June 2023.)



Photograph A-21. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-5 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1311 hours, 20 June 2023.)



Photograph A-22. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-6 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1315 hours, 20 June 2023.)



Photograph A-23. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-7 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1320 hours, 20 June 2023.)



Photograph A-24. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-8 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1329 hours, 20 June 2023.)



Photograph A-25. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-9 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1332 hours, 20 June 2023.)



Photograph A-26. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number LF-10 Located on the City of Harlingen and Transfer Station Property (Photograph taken by Carey Lynn Perry, Vernadero, 1336 hours, 20 June 2023.)



Photograph A-27. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-1 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1141 hours, 21 June 2023.)



Photograph A-28. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-2 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1150 hours, 21 June 2023.)



Photograph A-29. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-3 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1158 hours, 21 June 2023.)



Photograph A-30. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-4 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1210 hours, 21 June 2023.)



Photograph A-31. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-5 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1218 hours, 21 June 2023.)



Photograph A-32. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-6 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1223 hours, 21 June 2023.)



Photograph A-33. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-7 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1243 hours, 21 October 2023.)



Photograph A-34. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-8 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1248 hours, 21 June 2023.)



Photograph A-35. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-9 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1300 hours, 21 June 2023.)



Photograph A-36. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-10 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1309 hours, 21 June 2023.)



Photograph A-37. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-11 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1137 hours, 21 June 2023.)



Photograph A-38. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-12 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1147 hours, 21 June 2023.)



Photograph A-39. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-13 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1154 hours, 21 June 2023.)



Photograph A-40. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number GC-14 Located on the Treasure Hills Golf Club Property (Photograph taken by Carey Lynn Perry, Vernadero, 1200 hours, 21 June 2023.)



Photograph A-41. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number WW-1 Located on the Harlingen WaterWorks Wastewater Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1508 hours, 20 June 2023.)



Photograph A-42. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number WW-2 Located on the Harlingen WaterWorks Wastewater Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1515 hours, 20 June 2023.)



Photograph A-43. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number WW-3 Located on the Harlingen WaterWorks Wastewater Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1519 hours, 20 June 2023.)



Photograph A-44. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number WW-4 Located on the Harlingen WaterWorks Wastewater Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1523 hours, 20 June 2023.)



Photograph A-45. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number WW-5 Located on the Harlingen WaterWorks Wastewater Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1506 hours, 20 June 2023.)



Photograph A-46. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number WW-6 Located on the Harlingen WaterWorks Wastewater Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1527 hours, 20 June 2023.)



Photograph A-47. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number B-1 Located on the Bence Property/East Golf Course (Photograph taken by Carey Lynn Perry, Vernadero, 1348 hours, 21 June 2023.)



Photograph A-48. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number B-2 Located on the Bence Property/East Golf Course (Photograph taken by Carey Lynn Perry, Vernadero, 1348 hours, 21 October 2023.)



Photograph A-49. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number B-3 Located on the Bence Property/East Golf Course (Photograph taken by Carey Lynn Perry, Vernadero, 1340 hours, 21 June 2023.)



Photograph A-50. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number B-4 Located on the Bence Property/East Golf Course (Photograph taken by Carey Lynn Perry, Vernadero, 1335 hours, 21 June 2023.)



Photograph A-51. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number B-5 Located on the Bence Property/East Golf Course (Photograph taken by Carey Lynn Perry, Vernadero, 1345 hours, 21 June 2023.)



Photograph A-52. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number B-6 Located on the Bence Property/East Golf Course (Photograph taken by Carey Lynn Perry, Vernadero, 1337 hours, 21 June 2023.)



Photograph A-53. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number SB-1 Located on the San Benito Wastewater Treatment Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1421 hours, 20 June 2023.)



Photograph A-54. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number SB-2 Located on the San Benito Wastewater Treatment Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1414 hours, 20 June 2023.)



Photograph A-55. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number SB-3 Located on the San Benito Wastewater Treatment Plant Property (Photograph taken by Carey Lynn Perry, Vernadero, 1418 hours, 20 June 2023.)



Photograph A-56. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number S-1 Located on the Santos Fishing Spot Property (Photograph taken by Carey Lynn Perry, Vernadero, 2220 hours, 19 June 2023.)



Photograph A-57. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number S-2 Located on the Santos Fishing Spot Property (Photograph taken by Carey Lynn Perry, Vernadero, 2219 hours, 19 June 2023.)



Photograph A-58. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number NV-1 Located on the Navigation District Property (Photograph taken by Carey Lynn Perry, Vernadero, 2222 hours, 19 June 2023.)



Photograph A-59. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number NV-2 Located on the Navigation District Property (Photograph taken by Carey Lynn Perry, Vernadero, 2224 hours, 19 June 2023.)



Photograph A-60. Vegetation Plot Monitoring Services for the Arroyo Colorado Vegetation Management Project. Vegetation Plot Number NV-3 Located on the Navigation District Property (Photograph taken by Carey Lynn Perry, Vernadero, 2223 hours, 19 June 2023.)