Appendix I | **2023 City of San Marcos and Texas State University Reports**

Appendix I1 | **Aquatic Vegetation Restoration / Floating Vegetation Mat Management**

2023 Edwards Aquifer Habitat Conservation Plan Annual Report – Appendix I1:

Texas Wild-Rice Enhancement, Aquatic Vegetation Restoration and Floating Vegetation Mat Management in the Upper San Marcos River

The Meadows Center for Water and the Environment

Texas State University

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Prepared for:

City of San Marcos, Texas State University & Edwards Aquifer Habitat Conservation Plan

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The Habitat Field Crew as part of the Ecological Research Group at The Meadows Center for Water and the Environment, part of Texas State University, serves as a pillar of environmental stewardship for the Upper San Marcos River, whether it's striving to restore and preserve the unique aquatic ecosystem of the Upper San Marcos River and its inhabitants, engaging in community outreach, mentoring students and volunteers through hands-on experience, or by simply leaving the river in a better state than it was when our crew arrives on site. Our efforts' success is a direct result of our dedicated crew, both past and present, who constantly push conservation boundaries to revitalize the headwaters of this unique ecosystem. However, we are not alone in this endeavor. It is only possible through the coordinated efforts of fellow EAHCP contractors, City of San Marcos, Edwards Aquifer Authority, Texas State University Departments, volunteer groups, and other organizations, that all continue to play critical roles in this program's progression.

Texas Wild-Rice Enhancement (EAHCP 5.3.1)

EAHCP Obligations:

The City of San Marcos (CoSM), in partnership with the Meadows Center for Water and the Environment (Texas State University), will identify areas of optimal habitat for *Zizania texana* (Texas wild-rice, (TWR)) and target those areas for restoration. Restoration will include the removal of non-native submersed aquatic vegetation (SAV) species, propagation and planting of TWR and continual monitoring of new and existing stands.

2023 Compliance Actions:

TWR coverage was increased through maintenance of existing stands with a focus on reaches that have not already exceeded the 2027 goal from EAHCP Table 34. Existing stands throughout the river were maintained by focused gardening and removal of non-native SAV regrowth within and immediately adjacent to stands which helped to suppress expansion of non-native SAV and promoting the expansion of TWR. New TWR stands were allowed to establish clearing non-native SAV from areas of suitable habitat, allowing for TWR to naturally seed these areas and, through regular gardening, preventing non-natives from outcompeting TWR seedlings.

Prior to focused removal of non-native SAV, the vegetation was fanned to displace fountain darters (*Etheostoma fonticola*) or any other aquatic fauna. Removal was performed manually by hand with vegetation being captured in bags or skiffs, when possible, to minimize non-native propagation by fragmentation downstream. After removal, the collected material was sorted, any native biota caught within was returned to the river, and all remaining vegetation was disposed of at either the CoSM or Spring Lake composting facility.

TWR was not planted in 2023 due to low-flows and the continued implementation of EAHCP Condition M, which was triggered on June 1st, 2022 and remained in place throughout 2023 limiting SAV restoration activities and minimizing disturbance. Efforts were made to enhance TWR through the use of stand-up paddle boards ("Paddle Sweep") to access and remove non-native SAV by hand around existing stands. This new method has proven to be highly effective along shallow bank margins while minimizing disturbance caused by foot traffic. The use of paddle sweeps also provides an elevated vantage point to scout for non-native regrowth and enables crew members to cover large sections of river within a single field shift. In addition to paddle sweeps, routine walk-in maintenance sweeps were also performed by

targeting any reemerging *Hydrilla verticillata* (Hydrilla) and *Hygrophila polysperma* (Hygrophila) in previously cleared areas, as well as around TWR stands.

Low flow conditions throughout 2023 have allowed for the expansion of non-native floating vegetation in areas that had been previously occupied by TWR. *Nasturtium officinale* (Nasturtium) and *Ceratopteris thalictroides* (Ceratopteris) expanded significantly from Sewell Park to City Park and has been documented spreading into downstream reaches which has caused significant die-off of TWR and other native SAV in several areas. Significant effort was put forth in 2023 to manage these non-native species and limit its negative impacts to TWR. The removal of these two species is especially difficult and time consuming. To supplement EAHCP funding and to support effective removal and maintenance of floating non-native SAV, outside funding from the Environmental Service Committee at Texas State University was obtained for 2024 and potentially for future years. Persistent low-flow conditions also resulted in the dewatering of several mature stands of TWR resulting in desiccation and die-off. The new available habitat made space on banks for Ceratopteris to thrive. Its spore production capabilities also allow this species to expand and outcompete native SAV.

Texas Wild-Rice Seedling Propagation

TWR that was grown from seedlings is maintained in the outdoor, aquifer-fed, raceways at the Freeman Aquatic Building (FAB) on the campus of Texas State University (**Figure 1**). TWR planting did not take place in 2023 due to Condition M protocols and healthy population size in the river. Since TWR has also exceeded its coverage goals in many reaches, planting of other native plants was prioritized to help promote a more heterogeneous native aquatic plant community to help support fountain darter densities. Texas wild-rice expansion is continually observed in the river via both seed and tiller reproduction, with seedling growth occurring in freshly denuded areas. Care is taken to allow this expansion to take place naturally when non-native SAV is removed in those areas.

Figure 1. Texas wild-rice seed propagation and grow out in Texas State University raceways.

Proposed Activities for 2024:

The top-down strategy will continue with maintenance removal of Hydrilla and Hygrophila regrowth from Spring Lake to the railroad bridge just upstream from Cypress Island. The river section from the upper portion of Cypress Island to Rio Vista Dam will be in recovery. Most of the planting of native species will take place in the Recovery Zone but will occur outside the areas of heavy recreation traffic. To this point we have achieved the eradication of all large dense areas of Hydrilla, therefore future restoration efforts will be directed to the maintenance of resilient populations of all native SAV species, including Texas wild-rice, and preventing reemergence of non-native species. Effort will go towards fostering the natural expansion of native species into areas cleared of Hydrilla and Hygrophila and increasing the density of TWR in areas it is already present. Supplemental outside funding will continue to be necessary to suppress Nasturtium and Ceratopteris in the upper sections of the river, especially in densely seeding stands of TWR, along river margins, and in areas that become exposed during low-flow conditions.

Control of Non-Native Plant Species (EAHCP 5.3.8)

EAHCP Obligations:

The COSM will partner with Texas State University to develop and implement a non-native plant removal program reaching from Spring Lake downstream to the city limits. Appropriate permits will be obtained for the removal of non-native plants.

2023 Compliance Actions:

Non-Native Aquatic Plant Removal

The strategy of non-native removal shifted to a top-down methodology in 2019 to include non-designated reaches that have not been treated previously. This minimizes the spread of non-native plants from upstream sources and significantly improves overall efficiency. Each reach is designated as a Work Zone, Recovery Zone, or Maintenance Zone. A Work Zone will receive focused effort and large-scale non-native SAV removal. The next stage is designation as a Recovery Zone which is an area that has already received removal treatment in the past, but still requires regular small-scale removal to prevent non-native SAV from reestablishing. This supports natural expansion of native SAV and concurrent planting in areas that do not have enough coverage to support natural expansion. The final designation is a Maintenance Zone, which has had nearly all non-native SAV removed, and the focus has shifted to supporting native populations.

The primary focus in 2023 was concentrated on the maintenance of all previously restored reaches due to Condition M protocols that have been in place since mid-2022. Persistent low flows throughout this period stressed native SAV species allowing for rapid expansion of non-native and invasive floating vegetation in sensitive areas as the river contracted, exposing marginal areas that were dominated by TWR or other native SAV. The reduction of SAV populations coupled with the reproductive potential of invasive floating species created wide-spread negative effects throughout several reaches in the river, especially in the seeding area of TWR from Sewell Park to City Park.

Nasturtium, Ceratopteris*, Eichhornia crassipes* (water hyacinth) and *Pistia stratiotes* (water lettuce) and vegetation mats consisting of dislodged *Ceratophyllum demersum* (Ceratophyllum) from Spring Lake interfere with photosynthetic processes by blocking sunlight to underlying SAV; however, the invasive floating vegetation species actively outcompete TWR whereas vegetation mats accumulate primarily on

emersed stands. While negative effects from these species are caused by different mechanisms, they all eventually lead to native SAV die–off. Therefore, it is critical to remove floating vegetation and clear vegetation mats covering native SAV to maintain the health of the SAV communities. Currently, all species mentioned above persist in Spring Lake which continues to serve as source population that spreads downstream and thus will require routine removal to prevent the spread and establishment of non-native SAV fragments downstream. Outside funding was acquired to supplement the effective management of these species, both in Spring Lake and the upper reaches of the river throughout 2023 and will continue through 2024.

In addition to Nasturtium and Ceratopteris, *Limnophila sessiliflora* (Limnophila) is another non-native species that is beginning to expand in reaches that had historically been excluded from work plans such as the Bicentennial reach. This species often inhabitats the same areas as Cabomba, which looks very similar, and is often difficult to visualize until Limnophila becomes fully established in an area. It can grow fully submerged and also slightly emergant along bank margins. As more effort is targeted at removing non-native SAV species, such as Hydrilla and Hygrophila, this species is often the next most competitive species to expand into the newly denuded areas. In 2023, increased effort was expended on this species therefore Limnophila will be included in all future removal effort throughout all reaches.

Denuded areas (not due to recreation) with suitable habitat are typically replanted with native SAV species grown at the Texas State University raceways at the Freeman Aquatic Building; however, given the continued implementation of Condition M, special approval of a novel planting method was granted by USFWS that minimized disturbance by transplanting cuttings of native SAV directly within the river. Stock of plants were still maintained at the raceways and the number of individuals for each native SAV being maintained at this location were recorded to track inventory and assess stock in relation to work plans at the end of each month (**Table 1**). Native SAV species were selected for planting based on habitat preference and corresponding suitability of denuded area, with a focus on improving SAV diversity. Efforts in the river were aimed at allowing for natural expansion of native stands, but if a native species is not present in an appropriate area, then raceway stocks will be used to introduce those species to that area. The 2023 work zone did receive several rounds of transplanting that will continue into 2024 as those reaches transition into Recovery Zones.

Geographic area of removal, planting, and number of individuals of each species planted were tracked with polygons created in ArcMap and overlaid on georeferenced aerial imagery of the river. Using this data, estimates of area planted for each native SAV species were generated throughout the year to evaluate work progress (**Table 2** and **Table 3**). All data reported is from Jan 1st, 2023 – Oct 31st, 2023.

Table 1. Number of individual plants per species maintained each month in the raceways at the Freeman Aquatic Building through October 31st, 2023.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
Zizania	195	195	195	195	195	195	195	195	250	250
Ludwigia	474	732	732	732	2502	2502	2502	2502	2502	1600
Potamogeton	0	0	0	0	0	0	0	0	0	0
Sagittaria	0	0	0	0	0	0	0	0	0	0
Cabomba	160	160	160	160	160	160	160	160	160	160
Hydrocotyle	0	0	0	0	0	0	0	0	0	0

Native Planting and Non-Native Removal

Table 2. Number of individuals of each native species planted in the San Marcos River in 2023. *denotes reaches that were designated as Work Zones in 2023.

River reach	Designation	Species	N (individuals planted)	Area planted (m^2)
Spring Lake	Restoration	No Planting	0	0
Spring Lake Dam	LTBG	No Planting	0	0
Sewell Park	Restoration	No Planting	0	0
Below Sewell Park	Restoration	No Planting	0	0
City Park	LTBG	No Planting	0	0
Below City to Hopkins	None	Ludwigia	792	199.56
Hopkins/Snake Island	Restoration	Ludwigia	1674	419.41
Bicentennial	None	Ludwigia	5396	996.91
Cypress Island*	Restoration	No Planting	0	0
Rio Vista*	None	No Planting	0	0
I-35 Upper	LTBG	No Planting	0	0
I-35 Lower	Restoration	No Planting	0	0
Below I-35	None	No Planting	0	0
Total River		Ludwigia	7862	1612.88

Table 3. Estimated area (m^2) of non-native vegetation and floating non-native vegetation removed by reach in 2023. *Denotes reaches that were designated as Work Zones in 2023.

River reach	Species	Area Removed (m^2)
Spring Lake	*Hydrilla*	10.35
	Hygrophila	28.01
	Pistia	0.27
Spring Lake Dam LTBG	*Hydrilla*	1.5
	Hygrophila	17.86
	Ceratopteris	5.83
Sewell Park	*Hydrilla*	0.36
	Hygrophila	24.86
	Nasturtium	9.04
	Ceratopteris	14.94
Below Sewell	*Hydrilla*	0.26
	Hygrophila	63.85
	Nasturtium	255.63
	Ceratopteris	231.21
City Park LTBG	*Hydrilla*	3.73
	Hygrophila	37.43
	Nasturtium	89.62
	Ceratopteris	55.13
Below City to Hopkins	*Hydrilla*	5.99
	Hygrophila	44.84

	Nasturtium	22.51
	Ceratopteris	19.79
Hopkins/Snake Island	*Hydrilla*	81.54
	Hygrophila	169.43
	Limnophila	1.61
	Nasturtium	43.51
	Ceratopteris	17.24
Bicentennial	*Hydrilla*	230.35
	Hygrophila	444.28
	Limnophila	18.5
	Nasturtium	0.96
	Ceratopteris	7.4
Cypress Island*	*Hydrilla*	1.41
	Hygrophila	6.59
Rio Vista*	*Hydrilla*	0.14
	Hygrophila	10.1
	Limnophila	0.7
	Pistia	13.33
I-35 LTBG	*Hydrilla*	15.06
I-35 Lower	*Hydrilla*	4.68
	Hygrophila	7.49
Total River	*Hydrilla*	355.37
	Hygrophila	854.73
	Nasturtium	421.27
	Ceratopteris	351.54
	Limnophila	20.81
	Pistia	13.6

2023 LTBG and Restoration Reaches (Submersed Aquatic Vegetation Non-Native Removal and Native Planting Sites)

Ludwigia repens (Ludwigia)*, Cabomba caroliniana* (Cabomba), *Sagittaria platyphylla* (Sagittaria), *Potamogeton illinoensis* (Potamogeton), and *Hydrocotyle verticillata* (Hydrocotyle). Transplanting of native SAV was approved by USFWS as an acceptable method that limits disturbance while under Condition M. Therefore, planting methods switched from growing out mature potted plants in raceways to instead collecting cuttings from within the river and immediately transferring them to the substrate in the target areas. The non-designated reaches have historically not been treated and are now part of the removal plan require a significant amount of effort to remove and restrict regrowth of large areas of non-native SAV. **Figure 2** shows all the reaches, and designations, within the current EAHCP area of responsibility.

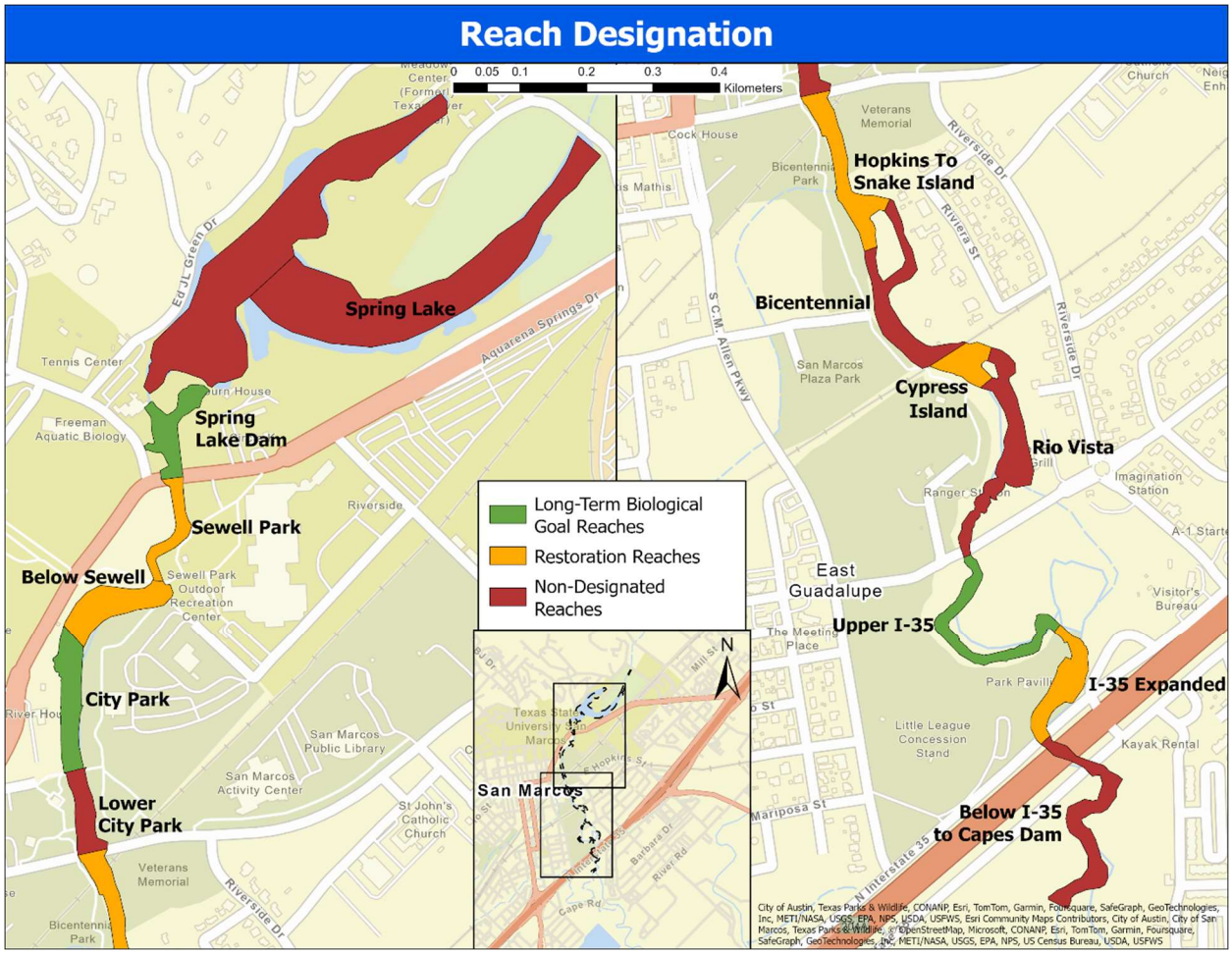

Figure 2. *Long Term Biological Goal, Restoration, and Non-Designated reaches. The 2023 work year included focused removal in the Cypress Island and Rio Vista reaches, frequent maintenance in the Bicentennial reach, and planting in the Hopkins to Snake Island and Bicentennial reaches.*

Spring Lake

For 2023, Spring Lake was designated as a Maintenance Zone requiring ongoing maintenance (i.e. limited, selective removal of non-native SAV) which has proven successful. Hygrophila was targeted for removal; however, several small sources of Hydrilla were also identified and removed. The non-native vegetation removal took place above the Eastern and Western spillways, but the entire lake was monitored. Maintenance effort resulted in the removal of 28.01 m^2 of Hygrophila and 10.35 m^2 of Hydrilla (**Figure 3**). Hygrophila is currently in a maintenance level within the lake and native SAV species, such as Ludwigia and Cabomba, are established, but struggling to compete with the expansion of Eurasian milfoil throughout the area that received large scale Hygrophila removal in recent years. The large native SAV patches above both spillways continue to send propagules downstream through fragmentation with visible increases in the Spring Lake Dam reach. Hygrophila maintenance in Spring Lake requires occasional sweeps using a combination of SCUBA divers, snorkelers, and kayakers, focusing on areas with any recent regrowth. Effort is limited to the minimum amount necessary to prevent Hygrophila from becoming reestablished and proliferating. Monitoring for Hydrilla will need to increase as it has now been noted in several locations throughout Spring Lake. Though still limited to small areas, Hydrilla has the potential to expand significantly in a short amount of time. TWR above each spillway did not respond well to the prolonged drought and reduced spring flow activities, leading to lower densities than observed in 2022.

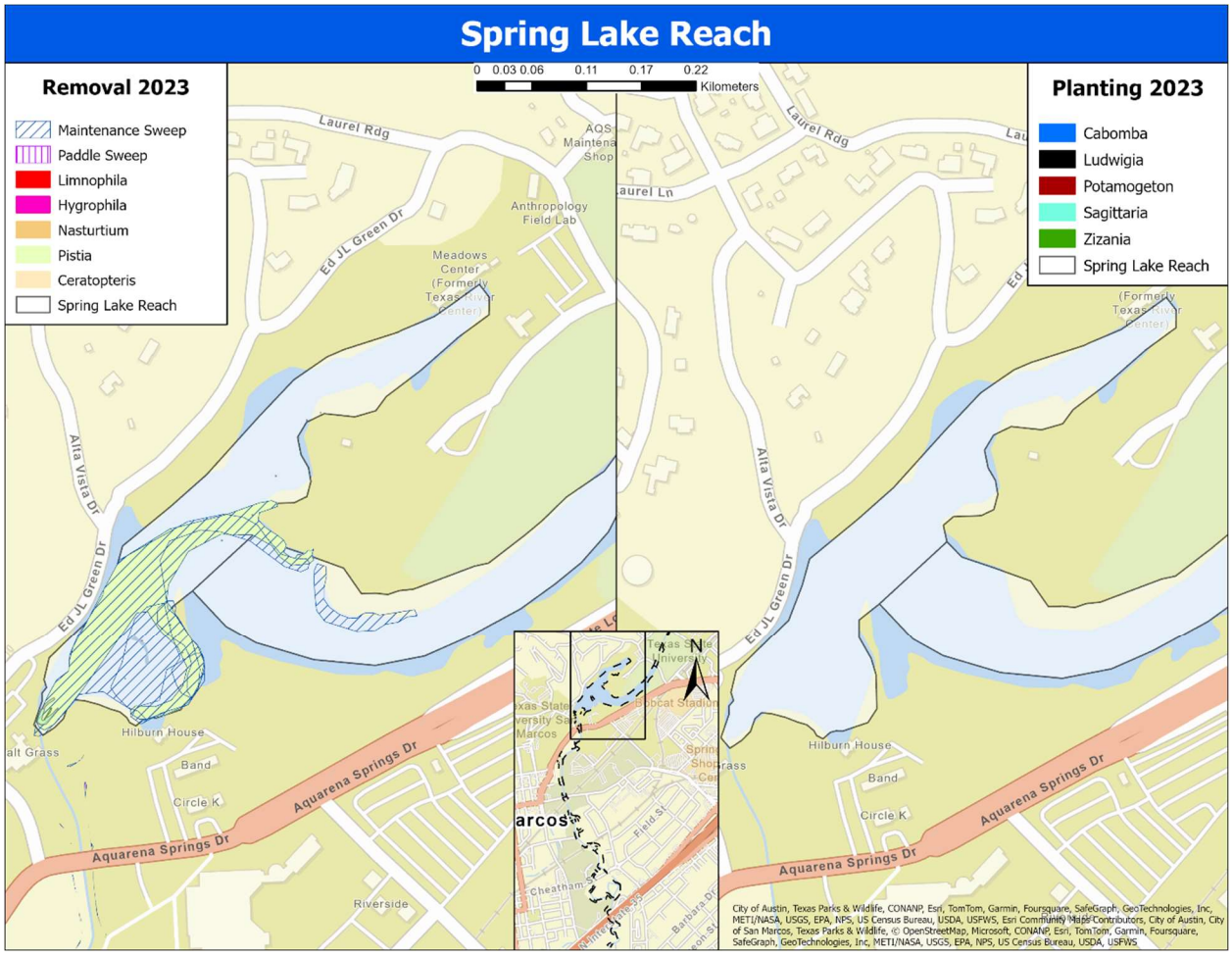

Figure 3. Locations of non-native vegetation removal in Spring Lake restoration reach in 2023. No planting occurred in 2023 within this reach.

Spring Lake Dam LTBG Reach

Spring Lake Dam LTBG reach was designated as a Maintenance Zone for 2023 and required occasional maintenance to prevent non-native SAV regrowth. Maintenance effort resulted in the removal of 17.86 m^2 of Hygrophila, 1.5 m^2 of Hydrilla, and 5.83 m^2 of Ceratopteris (**Figure 4**). No planting of native SAV occurred in this reach. Heavy recreation, coupled with low-flow conditions, resulting in impacts to TWR and along other native SAV and allowed non-native SAV species to reestablish, as sources of non-native SAV persist in Spring Lake. Patches of Ludwigia, Cabomba and Sagittaria were observed throughout the reach but at reduced coverages due to these conditions. This reach will remain a Maintenance Zone in 2024.

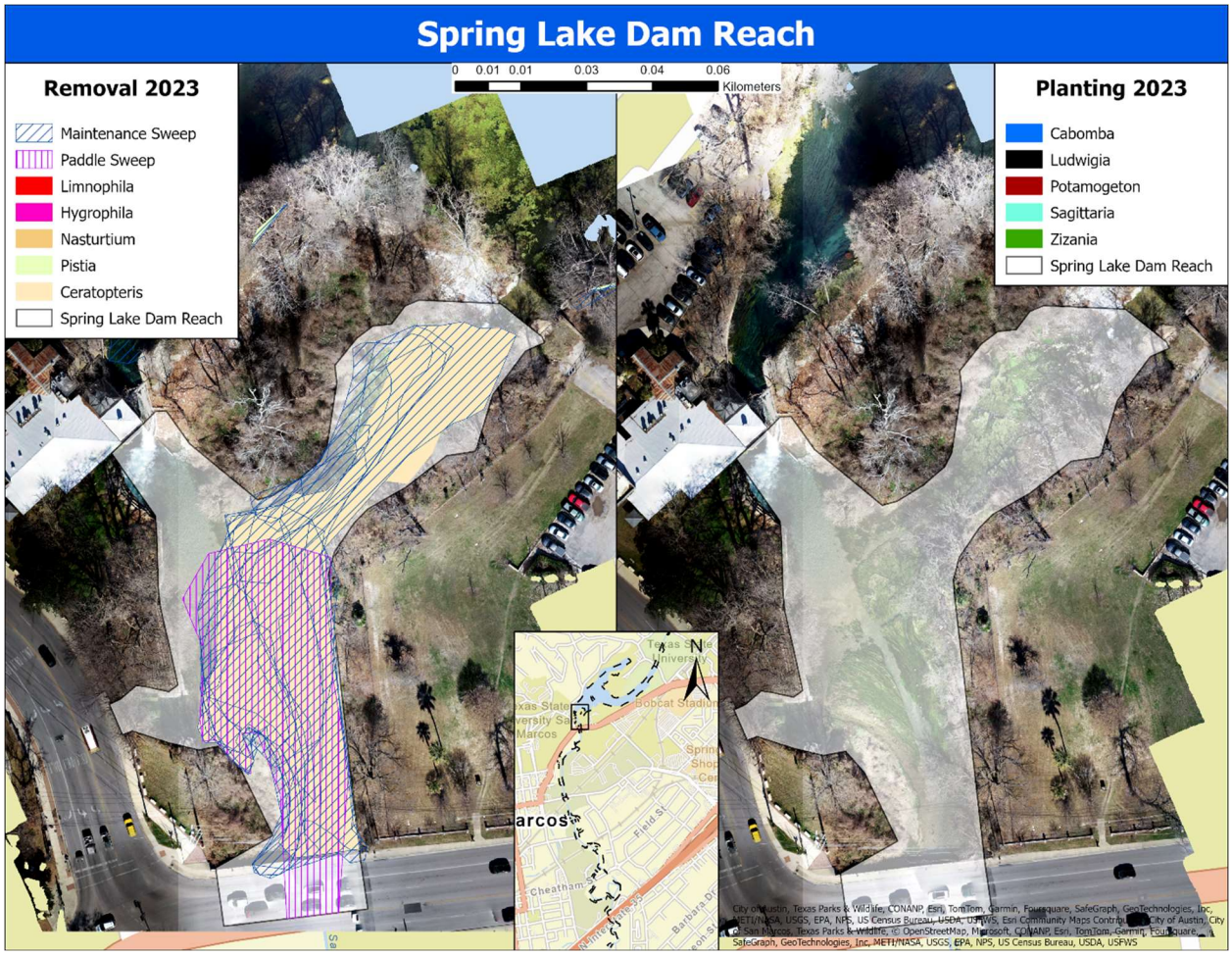

Figure 4*. Locations of non-native vegetation removal and native SAV planting in Spring Lake Dam Long Term Biological Goal reach in 2023. No planting occurred in 2023 within this reach.*

Sewell Park Restoration Reach

The Sewell Park Restoration reach was designated as a Maintenance Zone in 2023 and required occasional maintenance to remove non-native SAV within existing patches of native SAV. Maintenance effort resulted in the removal of 24.85 m^2 of Hygrophila, 0.36 m^2 of Hydrilla, 9.04 m^2 of Nasturtium, and 14.94 m^2 of Ceratopteris (**Figure 5**). Persistent low-flow conditions experienced throughout 2023 caused native SAV within shallow areas to be overtaken by other semi-aquatic and terrestrial species. Non-native floating vegetation also expanded in areas where river levels declined and created extremely shallow or dewatered areas because of low-flow conditions. This is anticipated to continue to be problematic so long as source populations persist upstream. This reach will be designated as a Maintenance Zone in 2024 and will continue to receive routine maintenance and limited native, non-TWR SAV planting.

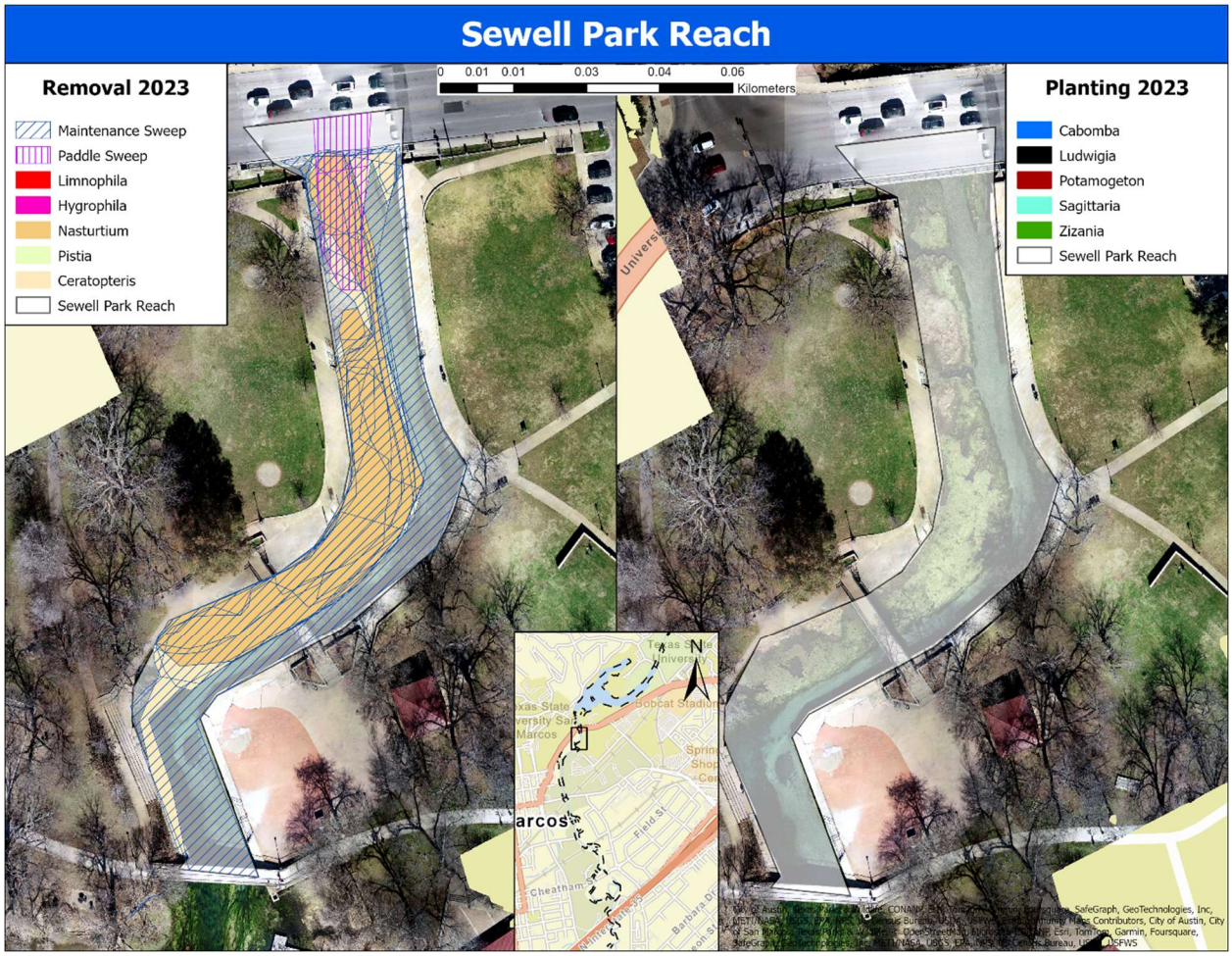

Figure 5*. Locations of non-native vegetation removal and native SAV planting in Sewell Park Restoration reach in 2023. No planting occurred in 2023 within this reach.*

Below Sewell Restoration Reach

The Below Sewell Restoration reach was designated as a Maintenance Zone for 2023; however, this substantial effort was put forth in this reach to combat the rapid expansion of floating invasive species. As waters receded due to drought and declining spring flow, nearly half the wetted channel was exposed, negatively impacting or killing populations of seeding TWR and subsequently transforming this area into a terrestrial environment. Maintenance effort resulted in the removal of 63.85 m^2 of Hygrophila, 0.26 m^2 Hydrilla, 255.63 m^2 of Nasturtium, and 231.21 m^2 of Ceratopteris (**Figure 6**). Nasturtium and Ceratopteris readily expanded in this reach in areas had become dewatered, were denuded of TWR and/ or exhibited extremely shallow conditions Effective management of these two species required outside funding to control and to supplement EAHCP funding. Most of this removal effort took place outside the bounds of the wetted river channel so as not to violate Condition M protocols. This reach will remain a Maintenance Zone in 2024.

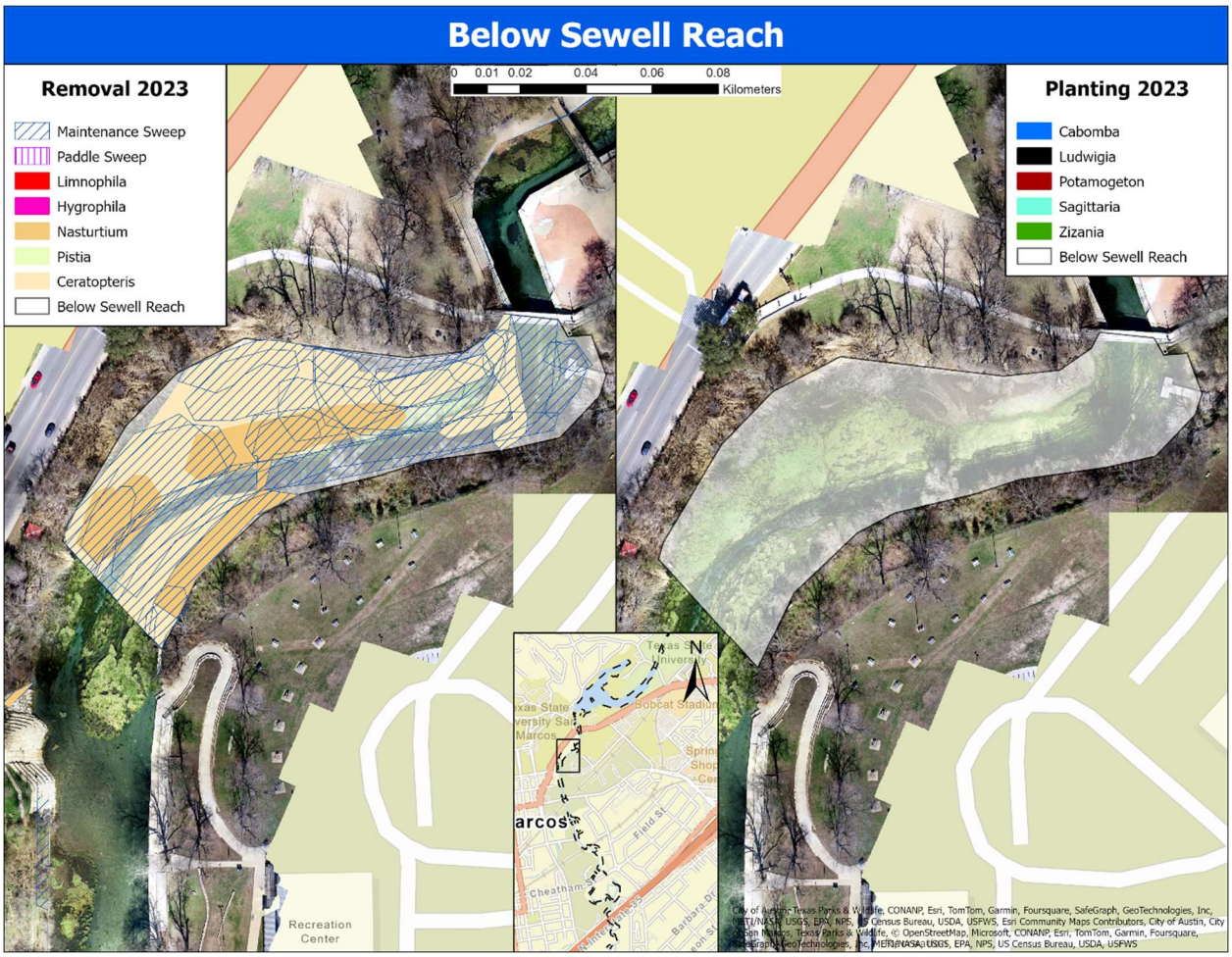

Figure 6. *Locations of non-native vegetation removal and native SAV planting in Below Sewell Restoration reach in 2023. No planting occurred in 2023 for this reach.*

City Park LTBG Reach

The City Park LTBG reach was designated as a Maintenance Zone for 2023, having already received large-scale removal in prior years. Maintenance effort resulted in the removal of 37.43 m^2 of Hygrophila, 3.73 m^2 Hydrilla, 89.62 m^2 of Nasturtium, and 55.13 m^2 of Ceratopteris (**Figure 7**). TWR, along with other native SAV along Dog Beach (i.e. river-right), where significantly affected by a combination of recreation and low-flow conditions. Supplemental plantings of native, non-TWR SAV will likely be required in 2024 and future years to reach target SAV goals. This reach will remain a Maintenance Zone in 2024.

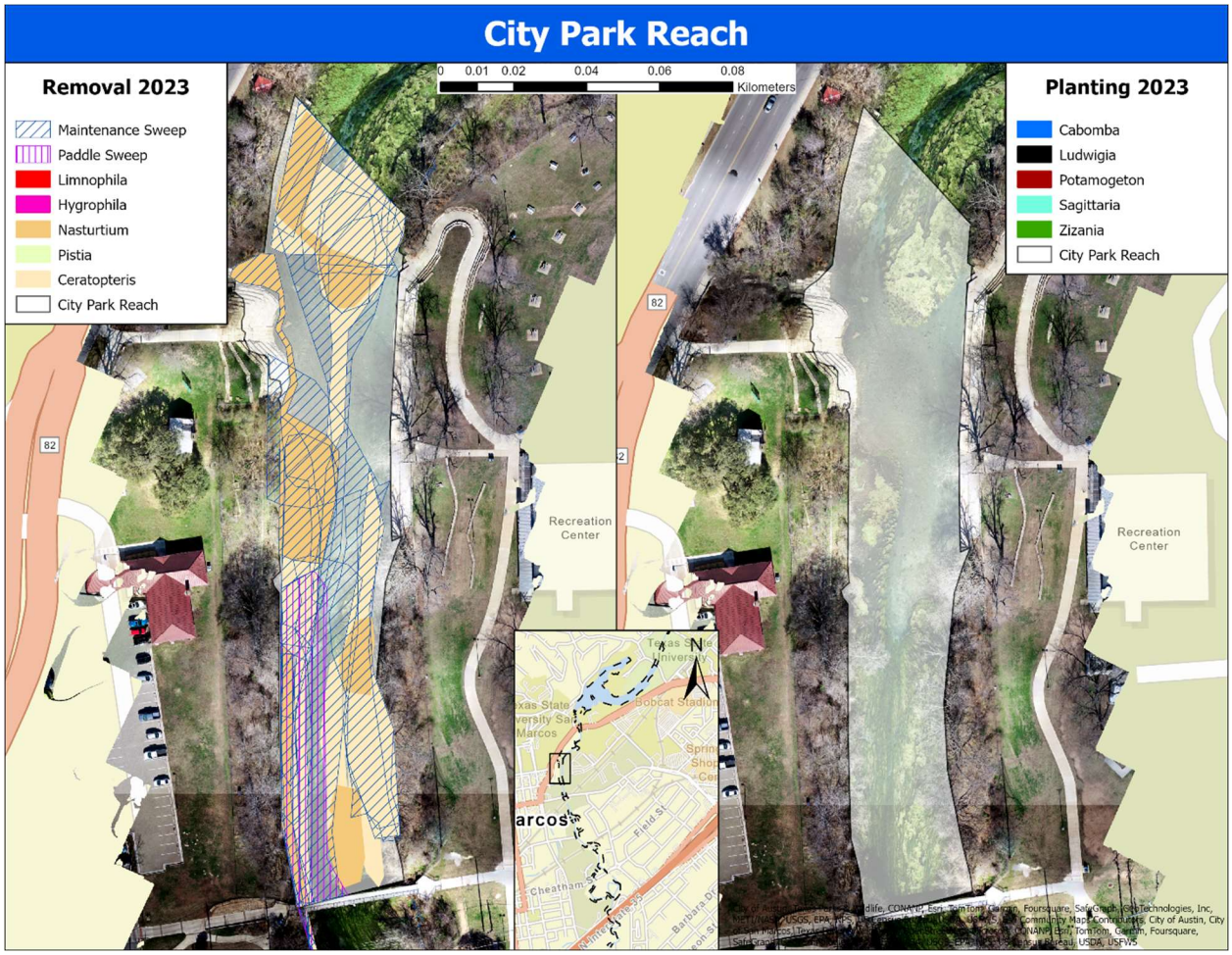

Figure 7. *Locations of non-native vegetation removal and native SAV planting within City Park Long Term Biological Goal Reach in 2023. No planting occurred in 2023 within this reach.*

Lower City Park Reach

The Lower City Park reach is a non-designated reach that was a Maintenance Zone for 2023. The area received a relatively high level of maintenance removal effort and supplemental plantings of Ludwigia to bolster native SAV coverage. Maintenance effort resulted in the removal of 44.84 m^2 of Hygrophila, 5.99 m^2 Hydrilla, 22.51 m^2 of Nasturtium, and 19.79 m^2 of Ceratopteris (**Figure 8**). Planting of native SAV was focused in areas outside the recreation corridor and away from designated river access points. The species of focus was solely Ludwigia because of available suitable habitat in areas that remained denuded after recreation season subsided. A total of 792 individual sprigs of Ludwigia were transplanted (**Table 2**) in 2023. This reach will remain a Maintenance Zone in 2024.

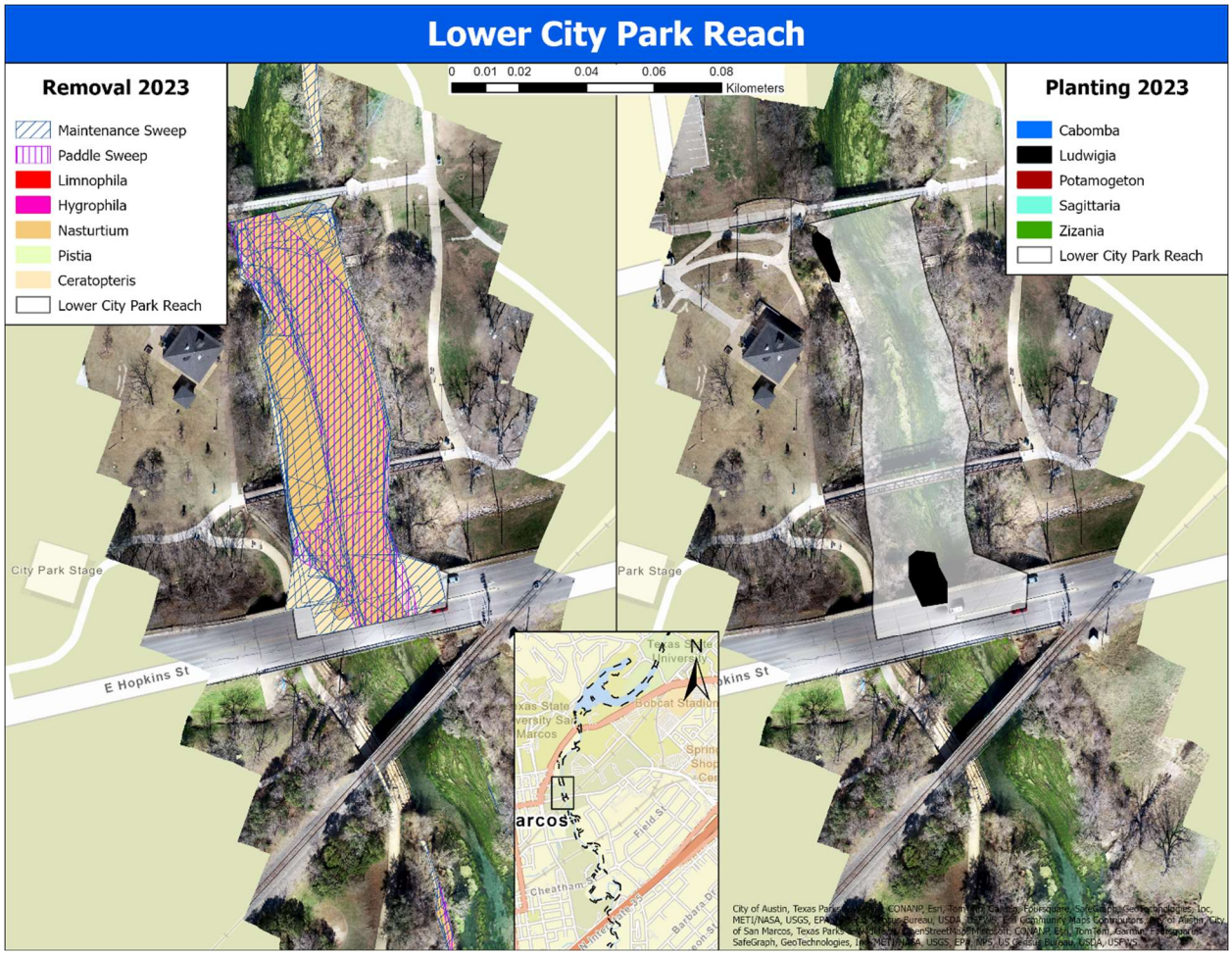

Figure 8. *Locations of non-native vegetation removal and native SAV planting within the Lower City Park reach in 2023.*

Hopkins to Snake Island Restoration Reach

The Hopkins to Snake Island Restoration reach was designated as a Maintenance Zone in 2023. This reach received a relatively high level of maintenance removal effort resulting in the removal of 169.43 m^2 of Hygrophila, 81.54 m^2 of Hydrilla, 43.51 m^2 of Nasturtium, 17.24 m^2 of Ceratopteris, and 1.61 m^2 of Limnophila (**Figure 9**). A total of 1674 individual sprigs of Ludwigia were transplanted in 2023 (**Table 2**). Cabomba, Ludwigia, and Sagittaria have significantly expanded in this reach through natural mechanisms. Supplemental planting of Ludwigia occurred in this reach in 2023 to recolonize areas where native SAV was affected by recreational activity. This area continues to exhibit a diverse community of SAV including species that have been documented to support higher densities of fountain darters. This reach will remain a Maintenance Zone in 2024.

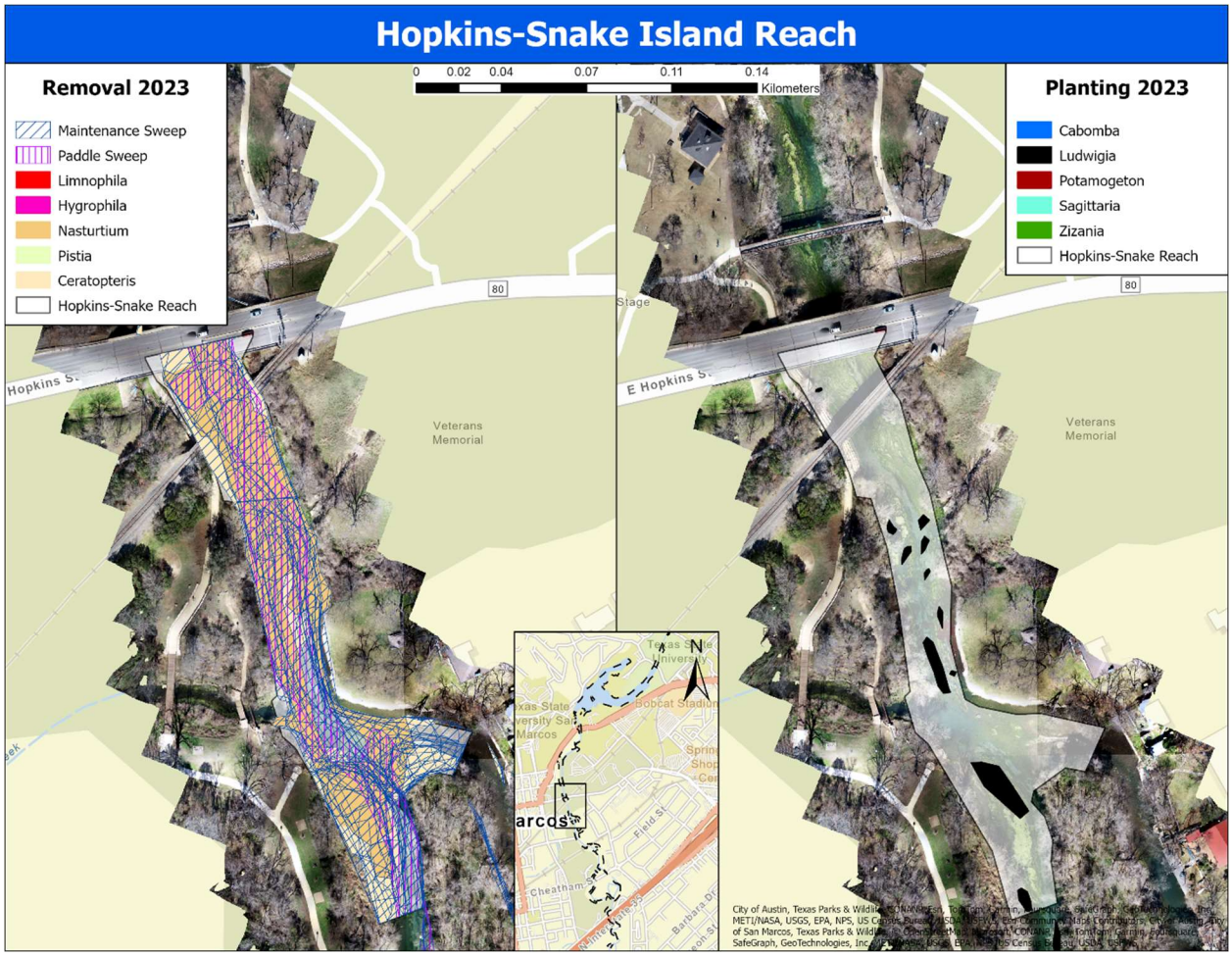

Figure 9. *Locations of non-native vegetation removal and native SAV planting within the Hopkins to Snake Island reach in 2023.*

Bicentennial Reach

The Bicentennial reach, a non-designated reach, was the primary Work Zone in 2022 and a Recovery Zone in 2023. Extensive maintenance was conducted in this reach throughout 2023, while under Condition M. This area was dominated by Hydrilla prior to bulk removal treatment that occurred in Spring of 2022, therefore very few native aquatic species were present after Hydrilla regrowth had subsided. Supplemental transplanting of 5396 individual sprigs of Ludwigia occurred within this reach (**Table 2**). Two native SAV species, Cabomba and Sagittaria, were already present and displayed rapid natural expansion throughout this reach with little-to-no assistance beyond the maintenance of non-native SAV. Frequent maintenance removal effort resulted in the removal of 230.35 m^2 of Hygrophila, 444.28 m^2 of Hydrilla, 0.96 m^2 of Nasturtium, 7.4 m^2 of Ceratopteris, and 18.5 of Limnophila (**Figure 10**). This reach will become a Maintenance Zone in 2024.

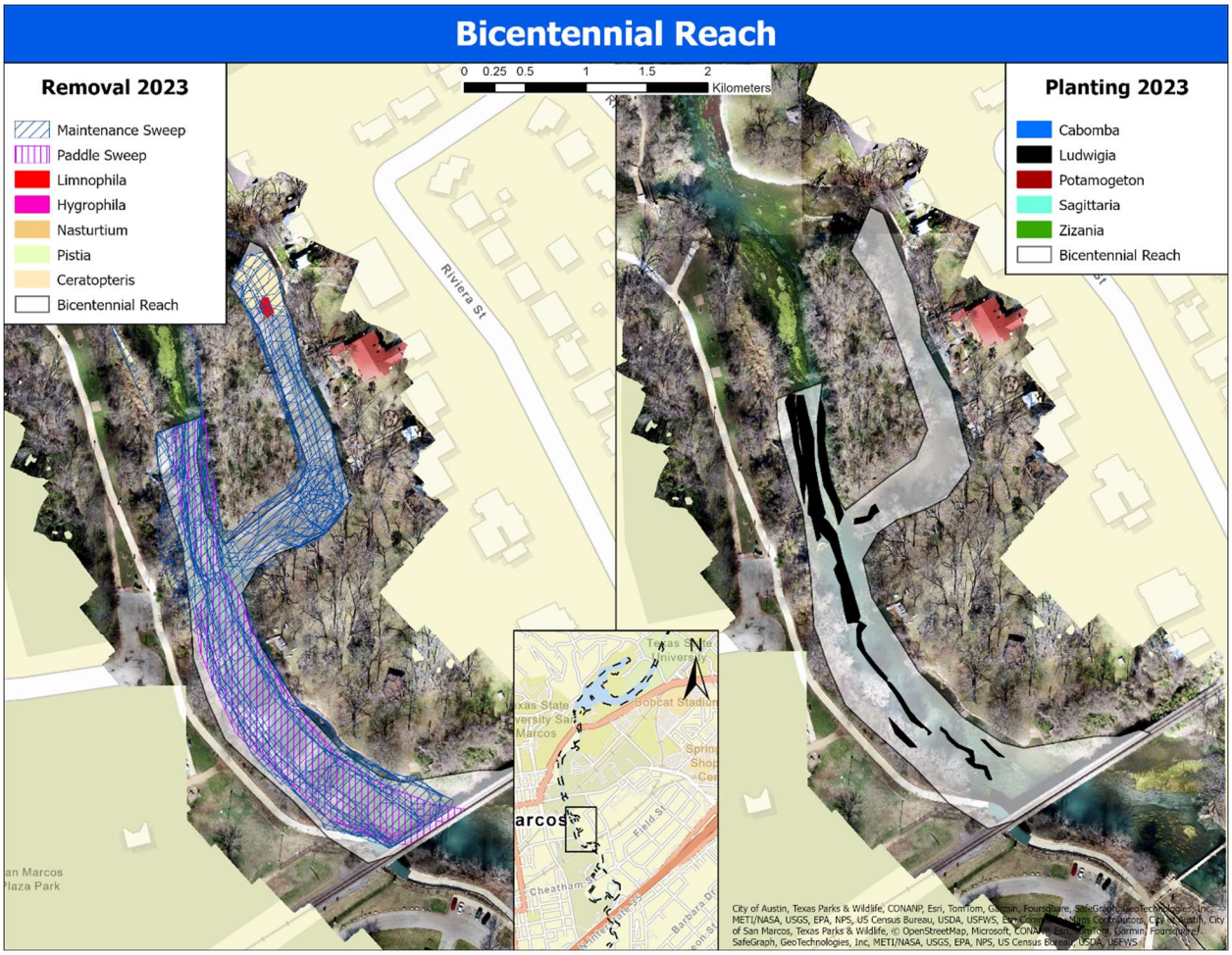

Figure 10. *Locations of non-native vegetation removal and native SAV planting within the Bicentennial reach in 2023.*

Cypress Island Restoration Reach

Cypress Island is a restoration reach and was part of the primary Work Zone for 2023. No bulk removal of non-native SAV has been conducted since mid-2022 due to the implementation of Condition M; however, river recreation throughout the summer 2023 resulted in the loss of significant SAV , native and non-native, in this area. Nearly all non-native SAV was affected and/ or removed by river recreation, and with approval from USFWS, non-native regrowth was suppressed post-recreation season through repetitive maintenance sweeps. Removal effort for this reach only began after the end of recreation season, accounting for a short period of effort before the annual reporting period ended. A total of 6.59 m^2 of Hygrophila and 1.41 m^2 of Hydrilla were removed in 2023 (**Figure 11**). Cabomba displayed the greatest resilience to recreational affects and has expanded into areas previously occupied by Hydrilla earlier in the year. Planting efforts in this reach will take place in 2024 in areas outside recreation foot-traffic, after frequent maintenance sweeps. These plans will prioritize diversifying the native SAV community. This reach will become a Recovery Zone in 2024.

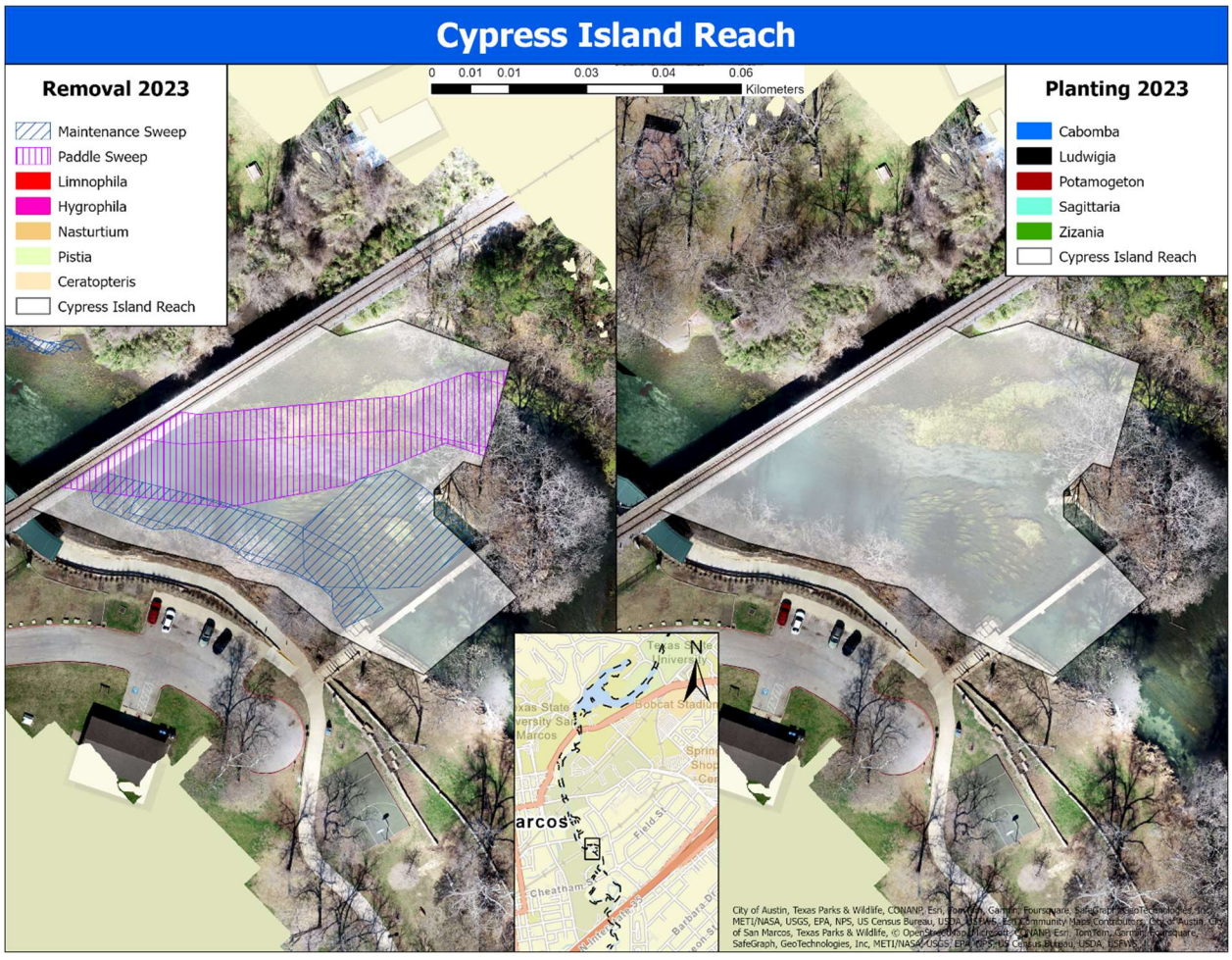

Figure 11. *Locations of non-native vegetation removal and native SAV planting within the Cypress Island reach in 2023. No planting occurred in 2023 within this reach.*

Rio Vista Reach

Rio Vista is a non-designated reach which was a part of the Work Zone in 2023. Similar to the Cypress Island reach, no bulk non-native SAV removal has been conducted since mid-2022 due to the implementation of Condition M; however, recreational affects coupled with low-flow conditions, resulted in the significant denudation of all SAV species. Nearly all non-native SAV populations were removed as a result of recreational foot traffic, and with approval from USFWS, non-native regrowth was suppressed post-recreation season through repetitive maintenance sweeps. Removal effort for this reach only began after the end of recreation season, only accounting for a short period of maintenance before the annual reporting period ended, resulting in the removal of 10.1 m^2 of Hygrophila, 0.14 m^2 of Hydrilla, and 13.33 m^2 of Pista (**Figure 12**). Cabomba displayed the greatest resilience to the recreational damage that occurred and has expanded into areas previously occupied by Hydrilla earlier in the year. Planting efforts in this reach will take place in 2024 in areas outside recreation foot-traffic and after frequent maintenance sweeps. These plans will prioritize diversifying the native SAV community. This reach will become a Recovery Zone in 2024.

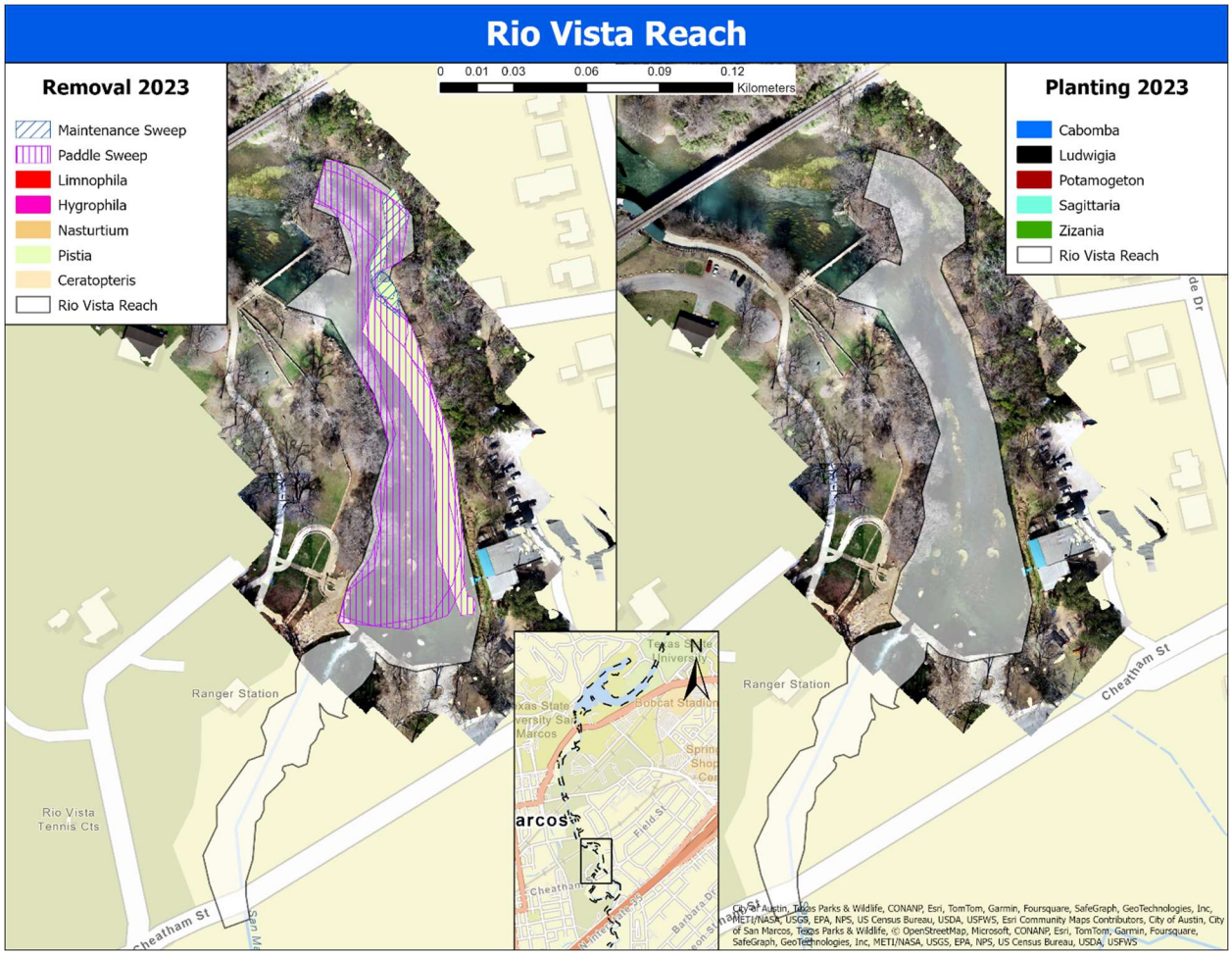

***Figure 12**. Locations of non-native vegetation removal and native SAV planting within the Rio Vista reach in 2023. No planting occurred in 2023 within this reach.*

I-35 Upper LTBG Reach

The I-35 Upper LTBG reach will be a designated Work Zone in 2024. This reach received some removal work in 2023 to conserve effort that has previously occurred to minimized regrowth and expansion of non-natives. A total of 15.06 m^2 of Hydrilla were removed by maintenance sweeps (**Figure 13**). This reach was treated heavily for removal efforts early in the implementation of the EAHCP; thus, an effort was made to maintain progress. Native SAV was planted in previous years and continue to occupy suitable habitat in this reach, suggesting successful restoration of the native SAV community. No plantings took place during 2023 while under Condition M.

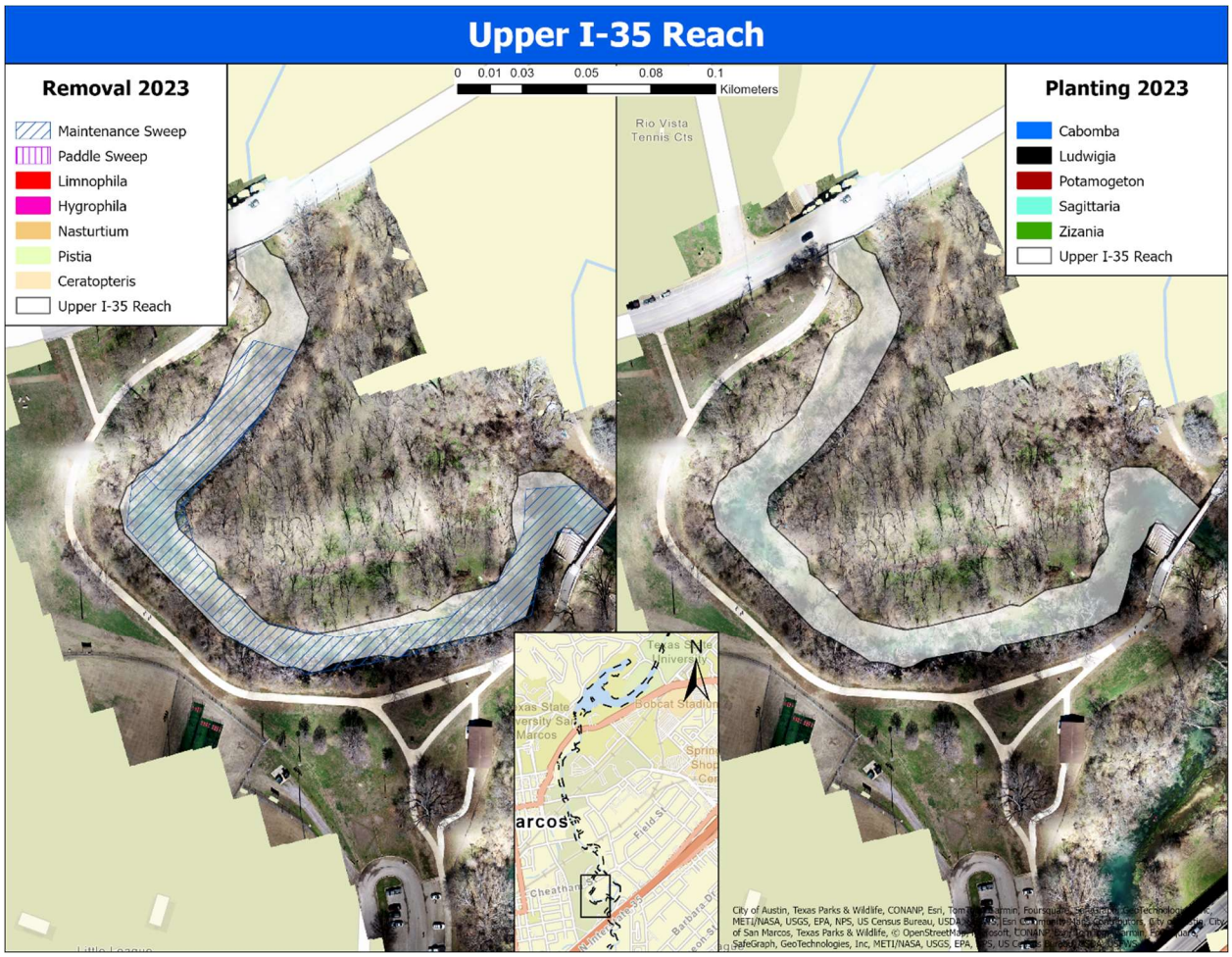

Figure 13. *Locations of non-native vegetation removal and native SAV planting within the Upper I-35 reach in 2023. No planting occurred in 2023 within this reach.*

Expanded I-35 Restoration Reach

The expanded I-35 reach will be a designated Work Zone in 2024. Like the Upper I-35 Reach, this reach received some removal in 2023 to conserve effort that has previously occurred to minimize regrowth and expansion of non-natives. A total of 7.49 m^2 of Hygrophila and 4.68 m^2 of Hydrilla were removed by maintenance sweeps (**Figure 14**). This reach was treated heavily for removal efforts early in the implementation of the EAHCP; thus, an effort was made to maintain progress. Native SAV were planted in previous years and continue to occupy suitable habitat in this reach, suggesting successful restoration of the native SAV community. No plantings took place during 2023 while under Condition M.

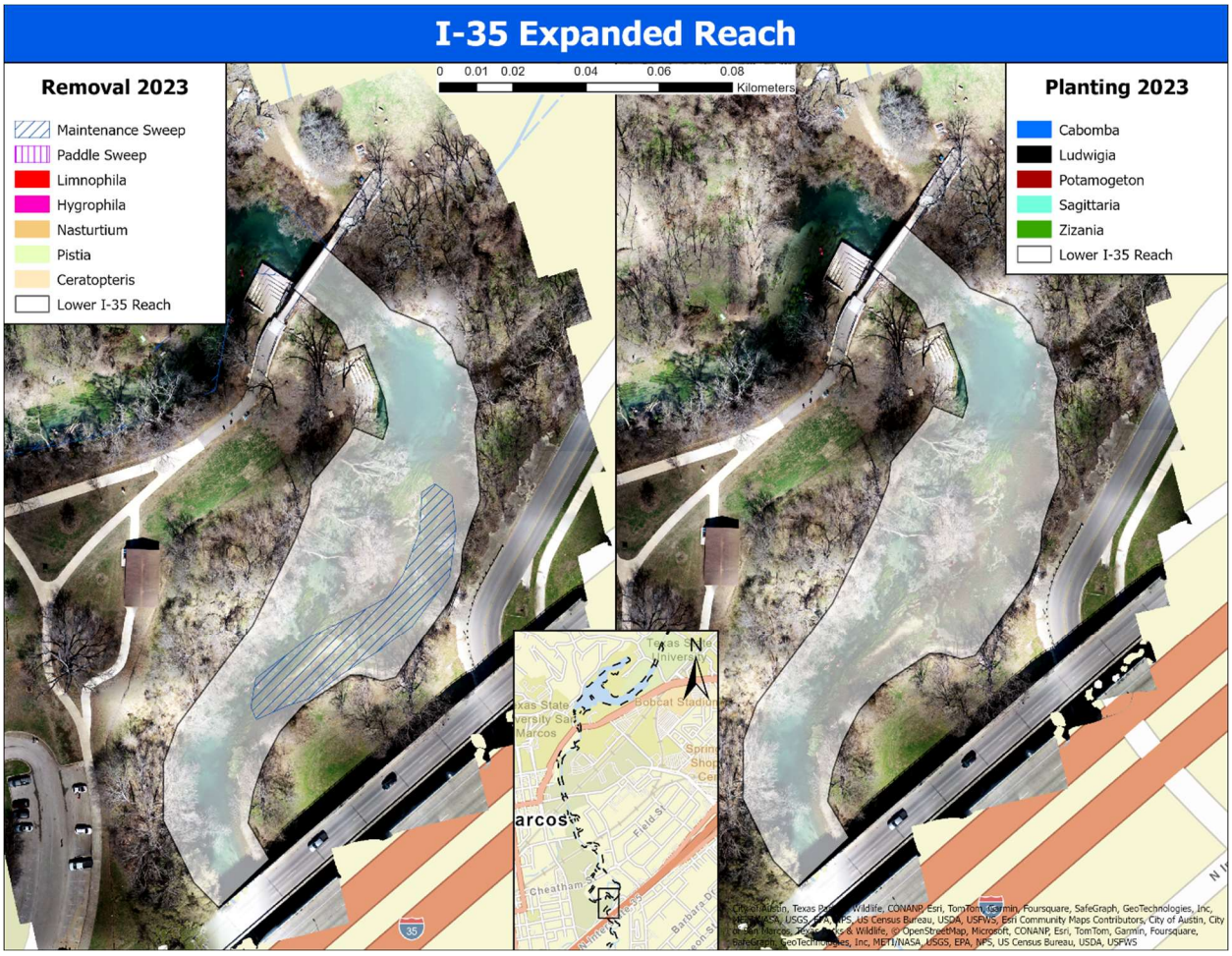

Figure 14. *Locations of non-native vegetation removal and native SAV planting within the Expanded I-35 reach in 2023. No planting occurred in 2023 within this reach.*

Below I-35 Reach

No non-native SAV removal or native SAV planting occurred in the Below I-35 reach in 2023. This reach will be designated as a future Work Zone beyond 2024. Current efforts will focus on upstream progress before any work occurs in this reach.

Vegetation Mat Removal (EAHCP 5.3.3)

EAHCP Obligations:

The COSM will partner with Texas State University to develop and implement a floating vegetation mat removal program reaching from Spring Lake downstream to the city boundary. Floating vegetation mats will be removed primarily from Texas wild-rice (TWR) stands to keep the mats from interfering with photosynthesis and slowing current velocity.

2023 Compliance Actions:

Approximately 5,943.37 m^2 of floating vegetation mats were removed from in and around TWR stands spanning from Spring Lake to Snake Island throughout 2023 (**Figure 15**). The areas of focus were the State Scientific Area protection zones, due to presence of denser populations and emergent seeding heads of TWR. Observationally, Spring Lake operations harvester activities increase the amount of floating vegetation caught in vegetation mats and effort required to remove them. However, vegetation mats were decreased in 2023 compared to prior years. This occurred at the same time flows dropped, perhaps due to the constriction and channelization of the river or reduced spring flow activity in Spring Lake. Recreation and floating non-native vegetation contributed to the denuding of large areas of Texas wild-rice which may also have contributed to less vegetation mat build up on Texas wild-rice stands. Furthermore, fully disloged plants and fragments of Texas wild-rice composed the majority of vegetation mats during the summer recreation season.

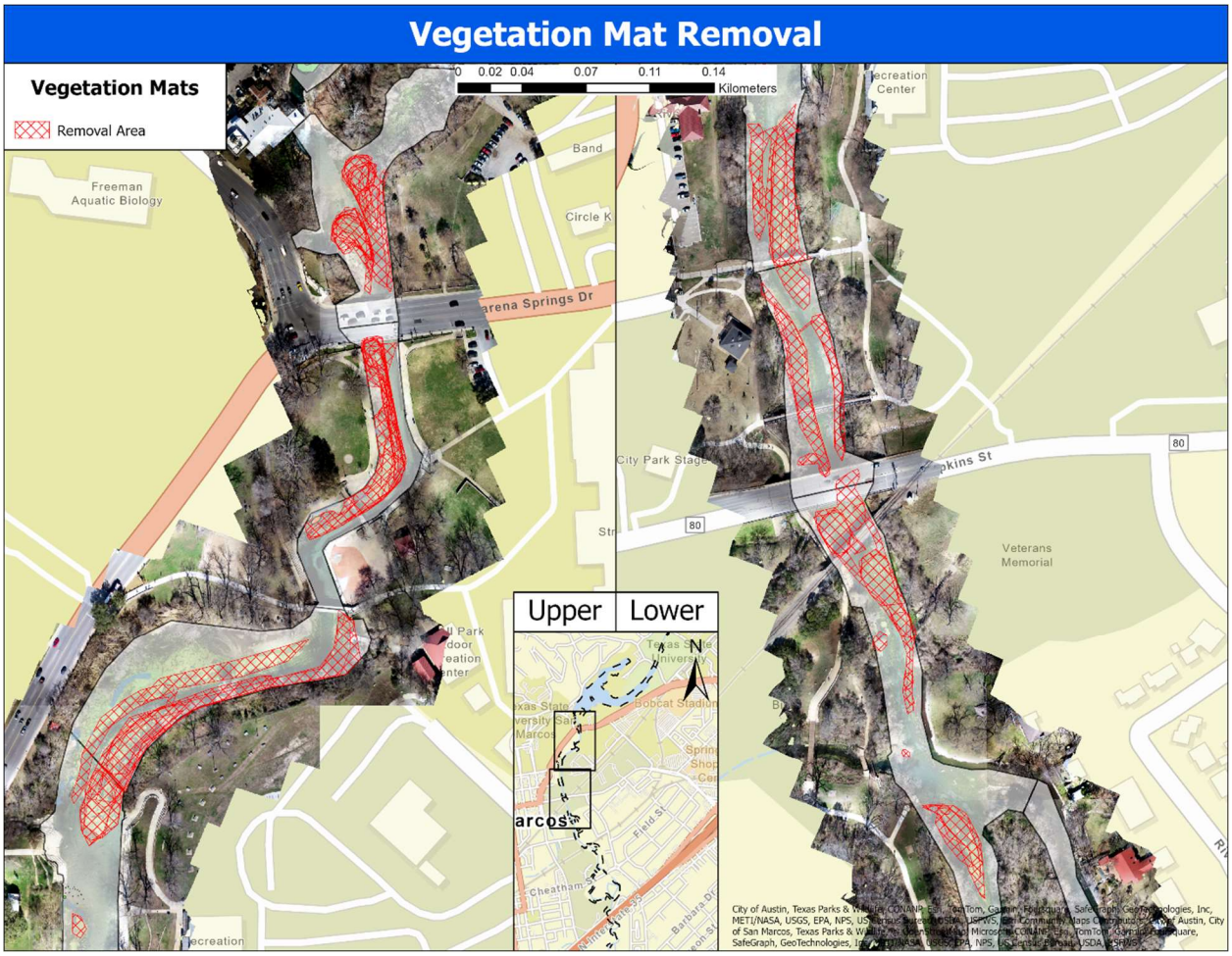

Figure 15. *Floating vegetation mat management areas, 2023.*

2023 Summary

The top-down removal strategy continues to be successful and allows for focused effort and maintainable progress, while also supporting native SAV to natural propagation and expansion downstream of existing populations. Texas wild-rice and other native species continue to expand in areas where Hydrilla and Hygrophila have been removed, and only require planting in large, denuded areas. Regular maintenance of treated areas is essential to facilitate this expansion. Compound this effort with continued downstream progress, the amount of maintenance effort required increases each year with the continual addition of Work Zones. Upper reaches that have already reached this level of maintenance require removal sweeps approximately once a month with some focus areas requiring a few additional days per month. Additionally, stress imposed by low flows and increased recreation has increased the ability of non-native SAV species to become re-established in areas that have received thorough removal treatments in the past. Some areas have remained in maintenance condition for years, but non-natives have recently begun to recolonize from upstream sources or regrow from buried tubers. Removal efforts and areas of focus are constantly being adjusted to account for this.

River recreation, floating non-native species, and low flow conditions contributed to observable effects on TWR and other native SAV while areas less affected by recreation saw expansion of native SAV, especially in the portion of the river between Hopkins Street to Cypress Island. A combination of non-native SAV maintenance and native SAV planting was successful throughout these reaches in the past

and represents a diverse community assemblage of native SAV. These communities are mostly outside of highly recreated areas, providing refuge for fauna, such as fountain darters, throughout the recreation season (**Figure 16**).

Large-scale Hydrilla removal did not occur in 2023 due to Condition M protocols; however, river recreation throughout the summer season resulted in the denudation of the last of the remaining Hydrilla populations from Cypress Island to Rio Vista Park and the area was able to be maintained with approval from USFWS. Native SAV, such as Cabomba and Sagittaria, have also been observed expanding throughout the section of river from Snake Island to Cypress Island throughout the year, despite the loss of coverage during the months of intense recreation. In addition to natural expansion in this area, supplemental transplanting of Ludwigia proved to be successful and are now colonizing denuded areas downstream from this location.

Floating vegetation mat removal efforts continue to be focused on the TWR protection zones (i.e. TWR exclosures) within the San Marcos River State Scientific Area and the large, dense stands of TWR in Spring Lake Dam, Sewell Park, and Below Sewell reaches, as well as in Bicentennial Park. The amount of vegetation mat buildup depends on the amount of Ceratophyllum discharged from spring lake, as well as flow regimes and spring-head activities. There has been a notable increase in other non-native floating vegetation, mostly Nasturtium and Ceratopteris, building up and negatively affecting TWR stands, mainly Below Sewell Park, with emergent plants. Both of these non-native species tend to form dense mats which restricting flows and causes harm to TWR. These species can also grow in terrestrial environments as flows recede, taking root on exposed bank margins and shallow areas within the river. Outside funding was needed and will continue to be necessary to suppress Nasturtium and Ceratopteris in the upper sections of the river while simultaneously continuing with SAV restoration efforts. Without an effort to control the source populations of these species, an increase in effort will be required to prevent negative impacts to TWR.

Our crew continues to utilize Texas State University students funded through a federal work-study program along with volunteers and supplemental awards to bolster restoration efforts. Approximately $36,000 was utilized in 2023 to supplement the EAHCP conservation measures to sustain the same level of effort that was achieved in past years while also tackling the removal of floating and submerged plants in areas that have been previously restored. This supplemental funding allows for a holistic approach to restoration efforts on the San Marcos River by generating a crew large enough to maintain the longitudinal area of river that are being converted to Maintenance Zones year after year. This funding also grants the capacity to adequately tackle issues beyond the scope of submerged aquatic vegetation, such as the removal of floating non-native species as well as the removal of non-native SAV from littoral and terrestrial zones. University students are also primarily responsible for maintaining the

Figure 16. *Hopkins Street to Snake Island restoration reach removal and planting progress in early 2023. Before treatment (left, 2020) and progress of native SAV expansion 2 years after treatment and initial planting (right, Jan 2023). This reach provides an example of restoration efforts that focus on obtaining a diverse composition of SAV species and coverage.*

supply of native SAV plants at FAB for planting in Recovery Zones and other areas throughout the river since in-channel nurseries are not feasible for the San Marcos system.

Proposed Activities for 2024

For 2024, the aquatic vegetation treatment work plan continues the strategy of top-down removal for non-native SAV. Effort will focus on maintaining the upper reaches with a focus on removing any regrowth, and frequent maintenance and planting within the 2023 work zone. Since the 2024 work zone has already been treated for removal in previous years, most of the focus will rely on the continued maintenance and suppression of non-native SAV regrowth and subsequent planting of native SAV that may not be present, or that have reduced coverage. All forecasted work may likely be in the context of Condition M still being in place, as flows are currently well below 120cfs. An additional $45,000 has been awarded from Texas State University for 2024 to target floating invasive species, as well as invasive and non-native SAV removal from within Spring Lake and within the area of university grounds, bringing the total supplemental funding for 2024 up to approximately $70,000. This total also includes numerous

work-study awards that are also provided by Texas State University to its students and helps to maintain the crew size needed to conduct large-scale, aquatic habitat restoration on the San Marcos River under the EAHCP. This dynamic management process continues to require adaptability due to newly established non-native species, increased climate change induced stressors for native SAV species, and increasing recreational impacts due to a growing regional population and record high summer temperatures.

Appendix I2 | **Management of Recreation in Key Areas**

2023 EAHCP Annual Report – Appendix I2:

EAHCP Management of Public Recreation (EAHCP Section 5.3.2/ 5.4.2)

2023 Overview and Summary of Activities

City of San Marcos/ Texas State University

Management activities associated with river recreation in the San Marcos River system per EAHCP Sections 5.3.2 & 5.4.2 are conducted help minimize impacts to threatened and endangered species and their habitats. River recreation management activities conducted in 2023 are outlined below.

Conservation Crew

In 2023, the City of San Marcos (CoSM), through Texas State University (TXST), hired part-time Conservation Crew staff to patrol and monitor the upper San Marcos River, assist with EAHCP-related activities, educate river visitors of the EAHCP, and promote stewardship of the San Marcos River.

In 2023, nine part-time staff worked during the peak recreation season (May-Aug) and between 2-4 staff during the off-season. On average each staff person worked approximately 15 hours per week with a total of approximately 3,800 hours worked in 2023. In early May 2023, an orientation/ training was provided to the Conservation Crew to familiarize them with the EAHCP, park rules and daily duties. The Conservation Crew utilized a Daily Checklist (**Attachment A**) to guide their daily activities as they patrol the primary recreation areas of the river between Upper Sewell Park and IH-35. COSM staff managed the Conservation Crew and coordinated scheduling.

The conservation crew engages with river visitors and provides them with information on the EAHCP, threatened and endangered species, park rules and good river stewardship practices. A focus of the education is on protection of Texas Wild-Rice (TWR) and aquatic vegetation in the river and why visitors should strive to avoid or minimize disturbance of aquatic vegetation. The Conservation Crew tracks the number of conservations held with river visitors and in 2023 a total of 4,185 conversations were held.

The Conservation Crew routinely collects litter from the river and adjacent parks as they patrol the river. In addition, the Conservation Crew maintains and recovers litter placed in several "trash collection boats" located in the river. In 2023, the Conservation Crew collected a total of 4,290 ft^3 of litter from the river and 1,145 ft^3 of litter from City Parks.

The Conservation Crew also assists with native riparian plantings and with the set-up, monitoring, and maintenance of TWR exclusion barriers.

Signage

CoSM and TXST kept in place and maintained existing signage within riverfront parks that is related to the EAHCP, park rules and general river stewardship. In addition, CoSM installed new

signage at multiple locations within City riverfront parks to educate visitors of park rules and regulations. The signage helps to inform river and park visitors of the EAHCP, threatened/ endangered species, general park regulations and environmental protection initiatives. **Figure 1a** shows examples of existing signage located within CoSM and TXST riverfront parks. **Figure 1b** shows examples of new signage installed in 2023 within CoSM riverfront parks.

COSM, TXST, and EAA collaborated with a TXST workgroup to begin the development of updated EAHCP-related signage for TXST riverfront parks (i.e. Sewell and Upper Sewell Parks). It is anticipated that the updated signage will be completed and installed in 2024.

Figure 1a. Examples of existing **s**ignage installed within riverfront parks along the upper San Marcos River. The top two signs are located in CoSM's Rio Vista Park and the bottom two signs are located in TXSTs Sewell and Upper Sewell Parks.

Figure 1b. Examples of new signage installed in 2023 within CoSM riverfront parks along the upper San Marcos River.

Installation of Texas Wild-Rice Exclosures and Protection Zones with the Defined State San Marcos River Scientific Area

San Marcos River flow remained below 120 cfs for the duration of 2023. As such, TWR exclosures, buoys and signage established to protect TWR stands and sensitive habitat during low-flow periods remained in place throughout the entire year. **Figure 2** shows the location of the TWR protection zones and **Figure 3** shows examples of the installed protection zones. The Conservation Crew routinely monitored and maintained the exclosures throughout 2023. The exclosures will remain in place until river flow increases above 120cfs.

Figure 2. Map showing the location of TWR protection zones in the San Marcos River.

Figure 3. Photos showing the buoys, signage and exclosures that were installed to denote the TWR protection zones in the San Marcos River. The photo on the upper left is in the river immediately downstream of the Hopkins St bridge, photo on the right is immediately downstream of Sewell Park, photo on bottom left is at Bicentennial Park at the Purgatory Creek confluence and photo on bottom right is the signage in place at the Eastern Spillway area just below Spring Lake dam.

Designated River Access Points and River Access Restrictions

COSM and TXST continued the strategy to focus river access to designated stabilized river access points along the river while restricting access to other segments of river with fencing and/ or dense riparian vegetation. This strategy has proven to be highly effective in preventing trampling and disturbance of both riparian and aquatic vegetation in areas where fencing is in place and river access restricted.

Attachment A: EAHCP Conservation Crew Daily Task Report/ Checklist

Daily Tasks - Monitoring the River 2023

*Inform and educate the public - i.e. endangered species that inhabit the river (focus on TWR)
*Give park information and directions when needed

❒	Report any suspicious activity to SMPD and Park Rangers (or Kaya/Dakota/Eric)
❒	Pick up litter and trash along trails
❒	Remove/push along any floating vegetative mats
❒	Remove any accessible floating litter from the river
❒	Inspect the fences/barriers: report holes, tears, and/or any structural issues Notes: _____
❒	Report any people behind the fence/barriers Notes: _____
❒	Inspect HCP signs - remove and report graffiti Notes: _____
❒	Empty out trash boats every shift Notes: _____
❒	Make note of any problem areas along the river* Notes: _____
❒	Survey the TWR population – impacts and document people or dogs in TWR stands Notes: _____
❒	Survey and maintain SSA's - keep clear of vegetative mats and build up Notes: _____
❒	Comments: _____

LITTER COUNTS:

# of bags from river: _____ **# of conversations:** _____

# of bags from parks: _____

Appendix I3 | **Litter Removal**

2023 EAHCP Annual Report – Appendix I3:

City of San Marcos & Texas State University EAHCP Litter Management Summary

(EAHCP Sections 5.3.3 & 5.4.3)

Litter was collected from within the San Marcos River from Spring Lake to Stokes Park throughout 2023. Although litter collection activities occurred year-round, efforts were amplified during the river recreation season (May-Sept). The entire river segment from Spring Lake Dam to Stokes Park was cleaned once per month during the non-recreation season and once per week during the recreation season. Funding for litter collection efforts was provided through both the EAHCP program and the City of San Marcos. The volume of litter collected from within the San Marcos River in 2023 is summarized below in **Table 1** and **Figure 1**. Total litter removed from the San Marcos River in 2023 was 438.9 ft^3.

In addition, litter was removed from the lower portions of several tributaries of the San Marcos River that include Willow Springs Creek, Purgatory Creek, Sessom Creek and Riverside Drive drainage channel. The volume of litter collected from within San Marcos River tributaries in 2023 is summarized below in **Table 2** and **Figure 2**. Total litter removed from the San Marcos River tributaries in 2023 was 126.6 ft^3.

In addition to the in-channel litter cleanup summarized above, the CoSM and TXST routinely collect and manage litter within riverfront parks and within contributing watershed areas with the use of staff, contractors and volunteers.

Table 1. Volume of litter collected, per reach, and removed from the San Marcos River in 2023.

2023 Litter Removed (ft^3)				
	Spring Lake Dam to City Park	City Park to IH35	IH35 to Stokes Park	Total
January	0.0	8.0	10.7	18.8
February	0.0	4.0	13.4	17.4
March	0.0	4.0	8.0	12.1
April	0.0	4.0	10.7	14.7
May	1.1	34.8	33.5	69.4
June	1.1	25.5	30.8	57.4
July	1.1	65.7	22.8	89.5
August	1.3	45.6	22.8	69.7
September	1.3	48.2	10.9	60.4
October	0.0	5.4	0.0	5.4
November	0.0	13.4	0.0	13.4
December	0.0	5.4	5.4	10.7
Total	5.9	264.0	169.0	438.9

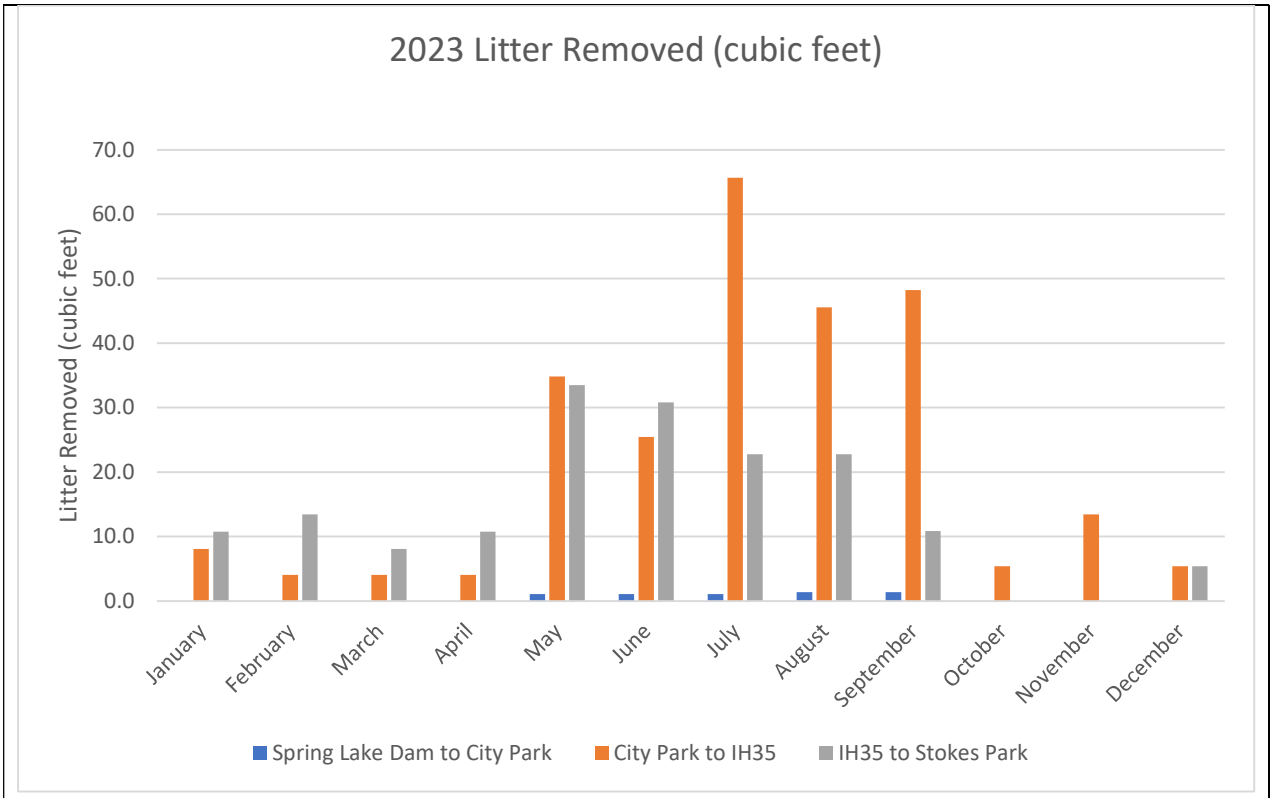

Figure 1. Volume of litter collected, per month, from the San Marcos River in 2023.

Table 2. Volume of litter collected, per reach, and removed from San Marcos River tributaries in 2023.

2023 Litter Removed (ft^3)					
	Willow Sprgs Creek	**Purgatory Creek**	**Riverside Dr Drainage**	**Sessom Creek**	**Total**
January	26.8	21.4	16.1	0.0	64.3
March	10.7	0.0	5.4	2.7	18.8
July	2.7	2.7	2.7	0.0	8.0
December	16.1	2.7	16.1	0.7	35.5
Total	56.3	26.8	40.2	3.4	126.6

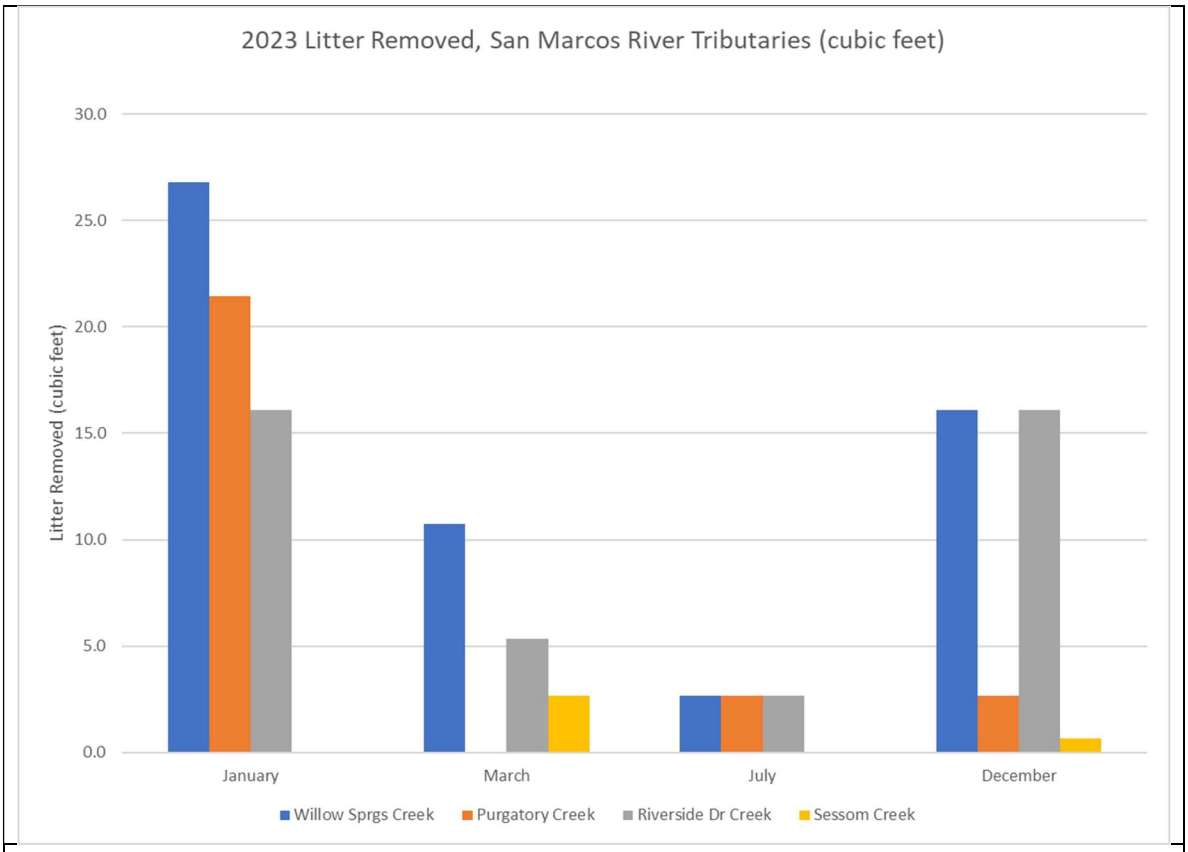

Figure 2. Volume of litter collected, per session, from San Marcos River tributaries in 2023.

Appendix I4 | **Non-Native Littoral Plant Removal**

2023 EAHCP Annual Report – Appendix I4:
Non-Native Littoral Vegetation Management
(EAHCP Section 5.3.8)

In 2023, non-native riparian/ littoral vegetation removal efforts consisted of initial treatment and re-treatment of non-native, invasive vegetation along the San Marcos River from above Bert Brown Road (upstream of Spring Lake) to just downstream of IH-35.

Targeted non-native species included Brazilian Vervain, Caribbean Lantana (and hybrids), Cat's Claw Vine, Chinaberry, Chinese Elm, Chinese Privet, Chinese Tallow, Eleagnus sp., Elephant Ears, English Ivy, Japanese Honeysuckle, Johnson Grass, Ligustrum, Limnophila, Nandina, Parrot's Feather, Periwinkle, Purple Trailing Lantana, Umbrella Sedge, Vasey Grass, Water Hyacinth, Wisteria and Arundo Cane.

Initial non-native vegetation managment occurred in 2023 in the area around the Texas State University Freeman Aquatic Building stormwater ponds, within Sink Creek upstream of Spring Lake, Lower Sewell Park and Snake Island (**Figure 1**). In these areas non-native vegetation was cut and herbicide applied to reduce the potential for re-establishment. The work within Lower Sewell Park consisted of the cutting and herbicide-treatment of a dense stand of Arundo Cane located immediately along the riverbank. Approximately 1/3 of the stand was cut and treated in 2023. The remaining portion of the stand will be managed in 2024. Work on Snake Island was halted after a dispute with a neighboring property regarding ownership of the island.

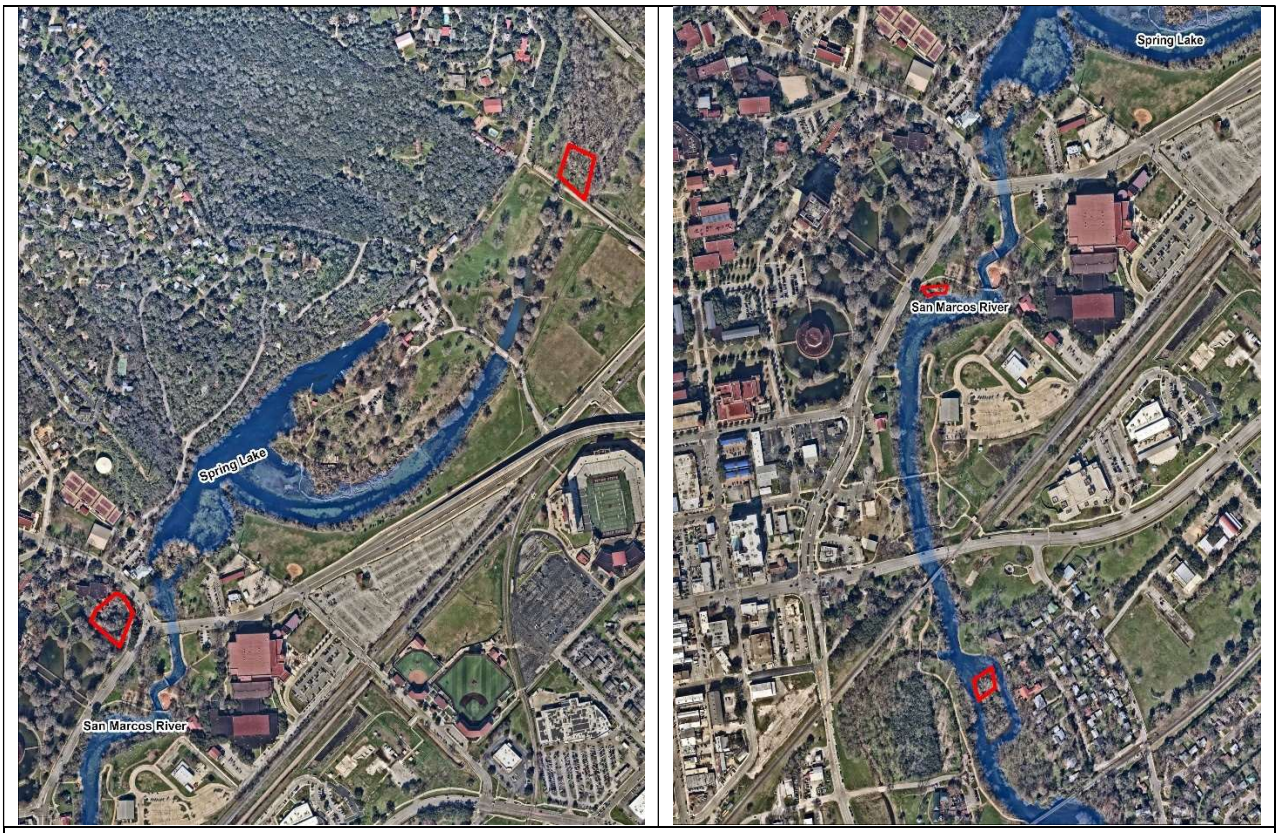

Figure 1. Locations where intensive, initial non-native, invasive vegetation management occurred in 2023.

Routine maintenance included monthly monitoring of the littoral zone along the San Marcos River from Sink Creek to just downstream of IH-35 and herbicide-treatment of any observed re-emergent non-native vegetation. Locations where intensive maintenance was required included the slough arm of Spring Lake (i.e. lower Sink Creek), Spring Lake Dam "Island" area, Crook Park, Ramon Lucio Park and the IH-35 area (**Figure 2**).

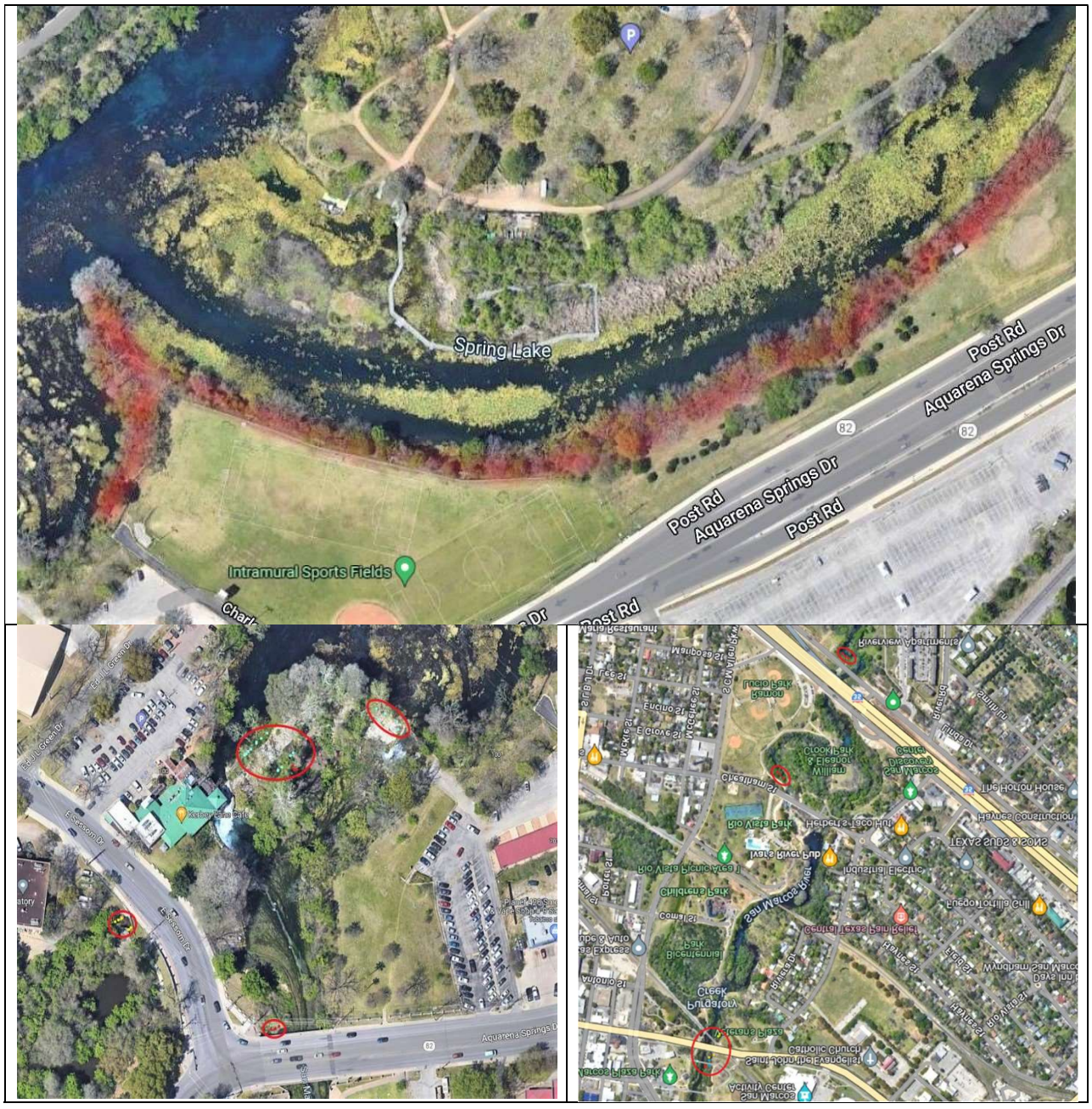

Figure 2. Locations where intensive non-native, invasive vegetation maintenance occurred in 2023.

Photo Log:

Photo 1. Re-emergent elephant ears in Crook Park that were identified and treated with herbicide.


Photo 2a & 2b. Cutting and treatment of non-native trees adjacent to the TXST Freeman Aquatic Building Ponds.

Photo 3. Cutting and treatment of Arundo Cane along the San Marcos River in Lower Sewell Park.

<u>Herbicide Applications</u>

Chemicals (herbicides) were applied with a 1- or 2-gallon pump-up sprayer, set on a steady stream for a more precise target hit, to minimize leaching and non-target plant damage. The sides of stumps and root flares of woody plants were scarred up with a machete or other blade to expose more of the cambium layer and then treated with herbicide.

The herbicide mixtures applied to non-native vegetation in 2023 included:

Tree and Shrub Mix: Vastlan at 5 oz per gallon, mixed with **Aquastar** at 5 oz per gallon. **Aqua King Plus** Surfactant at 1 oz per gallon, and **Turf Mark Blue**, blue dye, at 1 oz per gallon. This mix can be used anywhere as both herbicides can be applied in wetland or upland areas.

Sensitive Mixes: These are basically weaker versions of the Tree and Shrub Mix. **Vastlan** at 1-2.5 oz per gallon, **Aquastar** at 2.5 oz per gallon, **Aqua King Plus** Surfactant at 1 oz per gallon, and **Turf Mark Blue**, blue dye at 1 oz per gallon. This can be applied in wetland or upland areas.

Aquatic Mix: Clearcast at 6 oz per gallon, mixed with **Aqua King Plus** Surfactant at 1 oz per gallon, and Turf Mark Blue, blue dye, at 1 oz per gallon.

Appendix I5 | **Control of Non-Native Animal Species**

2023 EAHCP Annual Report – Appendix I5:

EAHCP Control of Non-Native Animal Species (EAHCP Sections 5.3.9 & 5.4.13)

2023 Overview and Summary of Activities - City of San Marcos/ Texas State University

Summary

In 2023, non-native fish and aquatic species were managed in the upper portion of the San Marcos River system to help minimize direct and indirect impacts to threatened and endangered species as well as to the overall aquatic ecosystem. As in previous years, the non-native species targeted for removal included tilapia, suckermouth armored catfish, sailfin catfish and non-native snails.

Removal of these non-native species was conducted primarily by polespearing and spearfishing with the addition of limited bowfishing. Spearfishing was conducted regularly throughout the year in various locations throughout the upper portion of the river system, primarily from Spring Lake Dam to the Rio Vista Dam and from Capes Dam to Stokes Park. Spearfishing was also conducted in Spring Lake to primarily target tilapia.

Routine non-native removal efforts were supported by polespear tournaments in which the public was invited to participate by competing with other participants to remove as many tilapia, suckermouth armored catfish and non-native snails as possible from the San Marcos River over a two-week period. Two polespear tournaments were held in 2023, one in mid-February and one in late Oct-early November.

Results

A total of 1,828 suckermouth armored catfish, 2 sailfin catfish and 212 tilapia were removed from the San Marcos River system in 2023. This equated to the removal of 1,317 lbs. of biomass from the river system.

All removals were from the upper portion of the river system between Spring Lake and Stokes Park. Most of the tilapia removed were from Spring Lake and catfishes from the river. The February polespear tournament yielded removal of 337 suckermouth armored catfish and 25 tilapia (**Figure 1**). The November polespear tournament yielded the removal of 505 suckermouth armored catfish and 16 tilapia (**Figure 2**). All other removals were a results of routine spearfishing efforts. The total number of hours spent on non-native removal efforts was approximately 600 hours.

Figure 1. Results of the Spring 2023 Non-Native Polespear Tournament

Figure 2. Results of the Winter 2023 Non-Native Polespear Tournament

Detailed non-native removal data for 2023 is included in **Attachment 1**.

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Edwards Aquifer Habitat Conservation Plan - San Marcos River System

Invasive fish and animal control

2023 Work Chart

Totals:		600		1828	716.07	2	1.07	212	599.72	0	0	1316.86
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
1/5/2023	Spring Lake Dam to Rio Vista Dam	0.25	Bounty	58	1.85							
1/10/2023	Rio Vista Dam to Capes Dam	0.25	Bounty	36	24.13							
1/1-31/23	Office	40.5	Tournament Programming									
		41		94	25.98	0	0	0	0			25.98
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
2/10/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	9	4.89							
2/10/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	11	6.83							
2/10/2023	Capes Dam to Stokes Park	0.2	Tournament	5	3.09							
2/11/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	11	6.32							
2/11/2023	Capes Dam to Stokes Park	0.2	Tournament	43	8.88							
2/11/2023	Capes Dam to Stokes Park	0.2	Tournament	32	12.99							
2/11/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	13	7.9			1	0.38			
2/11/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	5	4.06			2	5.81			
2/11/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	9	4.82							
2/13/2023	Capes Dam to Stokes Park	0.2	Tournament	25	5.13							
2/13/2023	Capes Dam to Stokes Park	0.2	Tournament	18	3.28							
2/13/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	12	7.02			1	1.38			
2/13/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament					5	13.69			
2/13/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	7	4.2			3	1.5			
2/15/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament					4	11.2			
2/15/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	4	2.59			2	2.13			
2/15/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	3	2.93			1	0.38			
2/15/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	11	7.3							
2/15/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	8	2.92							
2/16/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	8	2.95							
2/12/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	2	0.31							
2/18/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	3	1.69							
2/18/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	1	0.81							
2/19/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	1	0.81							
2/19/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	1	0.44							
2/19/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	8	5.41							
2/20/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	4	1.57							
2/21/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	3	2.9							
2/21/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	5	0.93							
2/22/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	1	0.056							
2/21/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament					3	7.08			
2/23/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	11	5.52			1	0.69			
2/24/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	2	0.69							
2/24/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	2	1.82							
2/25/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	19	7.83							
2/25/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	23	9.9							
2/25/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	3	1.81							
2/26/2023	Capes Dam to Stokes Park	0.2	Tournament	3	0.87							
2/26/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	1	0.44			2	1.25			
2/26/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	10	3.63							
2/1-27/23	Office	92	Tournament									
2/3/2023	Spring Lake	5	Spearfishing					5	24.07			
2/7/2023	Spring Lake Dam to Rio Vista Dam	3	Spearfishing	7	2.63							
2/10/2023	Spring Lake	5	Spearfishing					10	32.57			
2/13/2023	Spring Lake	5	Spearfishing					7	19.01			
2/21/2023	Rio Vista Dam to Stokes Park	5	Spearfishing	62	30.13							
2/27/2023	Spring Lake	5	Spearfishing					8	18.57			
		128		406	178.296	0	0	55	139.71	0	0	318.006
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
3/8/2023	Spring Lake	5	pearfishing/Gill Net/Bowfishing					7	29.14			
3/9/2023	Rio Vista Dam to Capes Dam	1	Spearfishing	3	2.01							
3/13/2023	Spring Lake	5	pearfishing/Gill Net/Bowfishing					12	56.96			
3/20/2023	Spring Lake	5	pearfishing/Gill Net/Bowfishing					11	31.26			
3/22/2023	Capes Dam to Stokes Park	3	Spearfishing	14	5.51							
3/23/2023	Spring Lake	5	pearfishing/Gill Net/Bowfishing					17	51.27			
3/27/2023	Spring Lake	5.5	pearfishing/Gill Net/Bowfishing					18	62.45			
3/31/2023	Rio Vista Dam to Capes Dam	0.5	Bounty	26	9.01							
		30		43	16.53	0	0	65	231.08	0	0	247.61
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
4/3/2023	Spring Lake	5	pearfishing/Gill Net/Bowfishing					3	8.19			
4/6/2023	Spring Lake Dam to Rio Vista Dam	3	Spearfishing	4	1.32			1	2.44			
4/9/2023	Spring Lake Dam to Rio Vista Dam	0.25	Bounty	6	5.51							
4/13/2023	Spring Lake	5	Spearfishing/Bowfishing									
4/19/2023	Spring Lake	4.75	Gill Net					12	33.94			
4/20/2023	Rio Vista Dam to Capes Dam	3	Spearfishing	4	1.25							
		21		14	8.08	0	0	16	44.57			52.65
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
5/3/2023	Rio Vista Dam to Capes Dam	1	Spearfishing	3	1.19							
5/8/2023	Spring Lake Dam to Rio Vista Dam	6	Spearfishing/Gill net	1	1.06			8	14.52			
5/10/2023	Capes Dam to Stokes Park	2	Spearfishing	6	1.38							
5/11/2023	Spring Lake Dam to Rio Vista Dam	8	Spearfishing	32	16.79							
5/15/2023	Rio Vista Dam to Capes Dam	1	Spearfishing	1	0.44							
5/17/2023	Rio Vista Dam to Capes Dam	4	Spearfishing	14	4.58							
5/18/2023	Spring Lake Dam to Rio Vista Dam	10	Spearfishing	64	31.4	1	0.38					
5/19/2023	Spring Lake	8	pearfishing/Gill Net/Bowfishing					25	81.56			
5/22/2023	Capes Dam to Stokes Park	1	Spearfishing	2	1							
5/25/2023	Spring Lake Dam to Rio Vista Dam	9	Spearfishing	46	20.35							
		50		169	78.19	1	0.38	33	96.08			174.65
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
6/1/2023	Spring Lake Dam to Rio Vista Dam	5	Spearfishing	38	21.56							
6/5/2023	Capes Dam to Stokes Park	1	Spearfishing	5	2							
6/7/2023	Rio Vista Dam to Capes Dam	2	Spearfishing	9	2.83			1	0.94			
6/8/2023	Spring Lake Dam to Rio Vista Dam	3	Spearfishing	24	12.99							
6/12/2023	Capes Dam to Stokes Park	1	Spearfishing	5	1.94							
6/15/2023	Spring Lake Dam to Rio Vista Dam	5	Spearfishing	30	14.56			1	0.56			
6/19/2023	Rio Vista Dam to Capes Dam	2	Spearfishing	8	4.13							
6/23/2023	Spring Lake Dam to Rio Vista Dam	5	Spearfishing	33	15.47							
6/29/2023	Spring Lake Dam to Rio Vista Dam	4	Spearfishing	24	12.33							
6/30/2023	Spring Lake Dam to Rio Vista Dam	6	Spearfishing	56	23.5							
		34		232	111.31	0	0	2	1.5			112.81
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
7/10/2023	Rio Vista Dam to Capes Dam	1	Spearfishing	1	1.5							
7/12/2023	Capes Dam to Stokes Park	2	Spearfishing	6	3.5							
7/13/2023	Spring Lake Dam to Rio Vista Dam	8	Spearfishing	45	16.09							
7/17/2023	Rio Vista Dam to Capes Dam	2	Spearfishing	10	3.26							
7/21/2023	Spring Lake Dam to Rio Vista Dam	1	Spearfishing	2	1.44							
7/27/2023	Rio Vista Dam to Capes Dam	2	Spearfishing	7	2.01							
7/31/2023	Spring Lake Dam to Rio Vista Dam	1	Spearfishing	1	0.44							
		17		72	28.24	0	0	0	0			28.24
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
8/2/2023	Spring Lake Dam to Rio Vista Dam	8	Spearfishing	62	27.11							
8/10/2023	Rio Vista Dam to Capes Dam	1	Spearfishing	5	2.32							
8/14/2023	Spring Lake Dam to Rio Vista Dam	1	Spearfishing	1	0.25							
8/16/2023	Spring Lake Dam to Rio Vista Dam	8	Spearfishing	73	32.63							
8/24/2023	Rio Vista Dam to Capes Dam	2	Spearfishing	12	4.26							
8/25/2023	Spring Lake Dam to Rio Vista Dam	8	Spearfishing	50	19.79	1	0.69					
8/31/2023	Rio Vista Dam to Capes Dam	2	Spearfishing	9	1.33							

		30		212	87.69	1	0.69	0	0			88.38
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
9/1-30/23	Office	20	Tournament Programming									
9/21/2023	Rio Vista Dam to Capes Dam	3	Spearfishing	14	3.78							
9/25/2023	Spring Lake Dam to Rio Vista Dam	1	Spearfishing	1	0.44							
		24		15	4.22			0	0			4.22
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
10/20/2023	Spring Lake Dam to Rio Vista Dam	8	Spearfishing	64	27.06							
10/1-31/23	Office	64.4	Tournament Programming									
10/28/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	2	1.19							
10/29/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	39	20.007							
10/29/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	32	10.97							
10/29/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	11	7.33							
10/20/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	38	12.29							
10/30/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	36	8.63							
10/21/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	4	1.13							
10/31/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	2	0.76							
		74		228	89.367			0	0			89.367
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
11/1/2023	Spring Lake	10	Spearfishing					13	35.46			
11/1/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	3	1.3			1	0.06			
11/1/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	26	10.99							
11/1/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	3	0.94			1	0.05			
11/1/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament					6	6.7			
11/1/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	17	5.89							
11/2/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	1	0.19							
11/2/2023	Capes Dam to Stokes Park	0.2	Tournament	2	0.88							
11/3/2023	Capes Dam to Stokes Park	0.2	Tournament	76	8.21							
11/3/2023	Capes Dam to Stokes Park	0.2	Tournament	42	8.32							
11/3/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	1	0.006							
11/4/2023	Capes Dam to Stokes Park	0.2	Tournament	1	0.06							
11/4/2023	Capes Dam to Stokes Park	0.2	Tournament	1	0.006							
11/5/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	2	0.073							
11/5/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament					1	0.31			
11/5/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	1	1.25							
11/5/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	10	3.5							
11/5/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	1	0.38							
11/5/2023	Capes Dam to Stokes Park	0.2	Tournament	31	3.68							
11/5/2023	Capes Dam to Stokes Park	0.2	Tournament	21	2.61							
11/6/2023	Capes Dam to Stokes Park	0.2	Tournament	5	1.94							
11/6/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament					7	13.26			
11/7/2023	Capes Dam to Stokes Park	0.2	Tournament	3	0.82							
11/7/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	1	0.31							
11/8/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	1	0.44							
11/8/2023	Capes Dam to Stokes Park	0.2	Tournament	3	1.12							
11/8/2023	Capes Dam to Stokes Park	0.2	Tournament	34	9.97							
11/8/2023	Capes Dam to Stokes Park	0.2	Tournament	16	6.005							
11/9/2023	Rio Vista Dam to Capes Dam	0.2	Tournament	12	0.66							
11/10/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	1	1.13							
11/10/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	23	14.104							
11/11/2023	Capes Dam to Stokes Park	0.2	Tournament	1	0.013							
11/11/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	1	0.31							
11/11/2023	Spring Lake Dam to Rio Vista Dam	0.2	Tournament	1	0.75							
	Office	103.4	Tournament Programming									
		120		341	85.857	0	0	29	55.84			141.697
Dates	Location	Hours	Type of Work	Plecos Caught	Total Pleco Weight	Sailfins Caught	Total Sailfin Weight	Tilapia Caught	Tilapia Total Weight	Nutria Caught	Nutria Total Weight	Notes
12/11/2023	Spring Lake	13	Spearfishing					10	27.5			
12/20/2023	Spring Lake Dam to Rio Vista Dam		Spearfishing	2	2.31			2	3.44			
12/1-31/23	Office	18	Tournament Programming									
		31		2	2.31	0	0	12	30.94			33.25

Appendix I6 | **Native Riparian Habitat Restoration**

2023 EAHCP Annual Report – Appendix I6:

EAHCP Native Riparian Restoration (EAHCP Sections 5.7.1)

2023 Overview and Summary of Activities

City of San Marcos/ Texas State University

Summary

In 2023, riparian restoration efforts were focused on the continued removal and management of non-native, invasive vegetation within the riparian zone of the upper San Marcos River. Target non-native species included, but were not limited to, Privet (*Ligustrum* sp), Chinese Tallow (*Triadica sebifera*), Chinaberry (*Melia azedarach*) and Paper Mulberry (*Broussonetia papyrifera*).

Work efforts in 2023 included the initial removal of dense, non-native vegetation in focused areas as well as treatment of re-emergent non-native vegetation within the riparian zone along the river corridor from Spring Lake to IH-35. The primary focus area in 2023 for initial non-native vegetation removal was within a City of San Marcos-owned property located along the river across from the Cypress Island of Rio Vista Park (**Figure 1**). Work at this location included cutting of large non-native trees (primarily ligustrum and Chinese Tallow) and application of herbicide to help prevent re-growth (**Figure 2**). Slash material from cut non-native trees was used to form sediment control berms in the area where vegetation was removed (**Figure 2**). Maintenance of the riparian zone to remove re-emergent non-native vegetation occurred throughout 2023, generally from Spring Lake Dam to Stokes Park.

Native vegetation was planted within the riparian area along the San Marcos River in 2023. Plantings consisted of the following native plants that were planted in the Riverside Dr property work area where intensive non-native vegetation removal occurred:

- American Beauty Berry (1)
- American Sycamore (1)
- Brushy Bluestem (6)
- Chili Pequin (6)
- Coralberry (6)
- Eastern Gamma (2)
- Elbow Bush (2)
- Inland Sea Oats (20)
- Kidneywood (1)
- Little Bluestem (6)
- Melic Grass (20)
- Osage Orange (7)
- Pigeonberry (6)
- Switchgrass (6)
- Turks Cap (1)

Substantial riparian restoration efforts also occurred in 2023 through the US Army Corps of Engineers (USACE) San Marcos River Section 206 Aquatic Ecosystem Restoration Project. Through this project, non-native species including Elephant Ears, Ligustrum, Chinaberry and Chinese Tallow were removed from COSM and State of Texas properties located along the San Marcos River, primarily downstream of IH-35. The project also included planting of native vegetation in areas where non-native vegetation was removed. Non-native removal efforts to target remaining Elephant Ears as well as native planting will continue into 2024. Work areas included Bicentennial Park, Ramon Lucio Park, Crook Park, Thompson's Island, Stokes Park, TPWD A.E. Wood State Fish Hatchery, and the COSM Wastewater Treatment Plant (**Figure 3**).

Figures

Figure 1. Location of intensive, non-native vegetation removal work area where work occurred in 2023 along the San Marcos River across the river from the "Cypress Island" of Rio Vista Park.

Figure 2. Photos of riparian restoration activity along the San Marcos River at the "Riverside" property across from the Cypress Island of Rio Vista Park. Photos primarily depict removed and treated ligustrum trees and formation of sediment control berms.

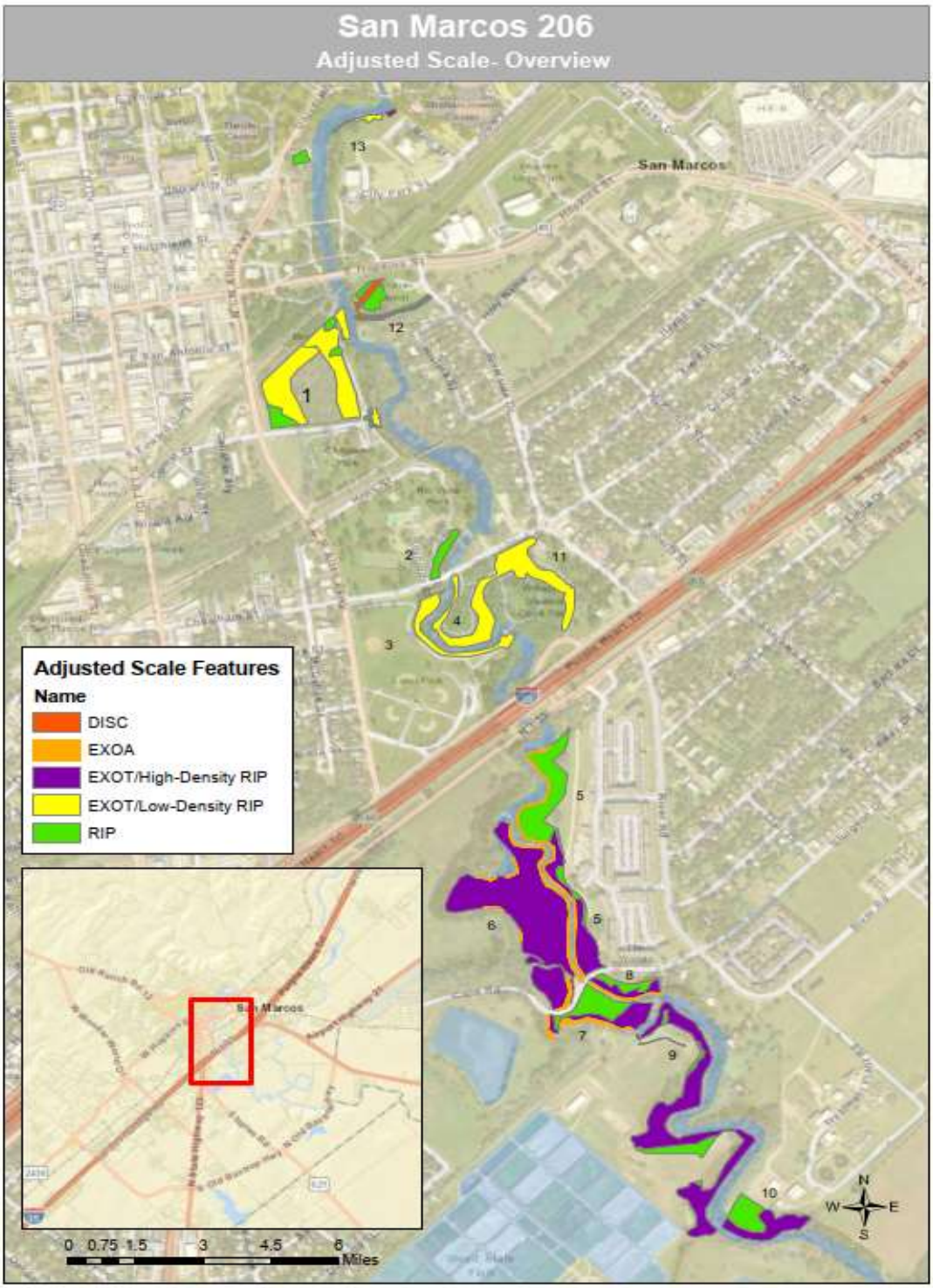


Figure 3. USACE San Marcos River Aquatic Ecosystem Restoration Project Work Areas. (EXOA represents areas where Elephant Ear treatment have or will occur, EXOT/ High-Density RIP represents areas where significant non-native removal and plantings has or will occur. EXOT/ Low-Density RIP represents areas where light, non-native removal and plantings has or will occur. RIP represents areas where only native plantings has or will occur).

Appendix I7 | **Household Hazardous Waste**

2023 EAHCP Annual Report – Appendix I7:

City of San Marcos Household Hazardous Waste Management (EAHCP Section 5.7.5)

Summary of 2023 Activities

The City of San Marcos Household Hazardous Waste (HHW) collection program was made available, free of charge, for all Hays County residents throughout 2023. Through this program, residents were allowed to drop off household chemicals and paint that are considered hazardous to the environment. The HHW program also includes the implementation of a reuse program for items that are in good condition and able to be reused by interested visitors. Labor needed to operate the facility was contracted through Green Guy Recycling. Throughout 2023, the HHW collection center was open to the public every Friday from 12:00pm to 3:30pm and Saturday from 8am to 12pm. The HHW collection center is located at 630 E. Hopkins, San Marcos, TX 78666.

Most participants come from the cities of San Marcos, Kyle, Wimberley, and areas outside of the city limits. These areas are home to environmentally sensitive watersheds and the Edwards Aquifer Contributing and Recharge Zones. Offering a safe alternative to improper or illegal dumping of hazardous household chemicals is paramount to protecting water quality and minimizing the potential for pollutant releases.

HHW Drop-Off Center Participation

The primary function of the HHW program is the drop-off center. Residents are able to drive into the unloading area, where they are met by an HHW worker. The participants remain in their vehicle as HHW center workers unload the containers onto a cart. Each participant fills out a survey and provides their address. From these surveys, monthly participation rates are tracked for each community. The average number of participants for 2023 was 213 per month and the total amount of HHW dropped-off at the center was 171,585 lbs.

The HHW facility is open to all residents of Hays County. Most of the residents come from the COSM and areas outside of municipal jurisdictions. The San Marcos region is an environmentally sensitive area for the San Marcos River. Preventing illegal dumping and pollution in this region makes great strides towards protecting water quality.

Reuse Program Participation

The reuse program supports the drop-off center by attracting residents and diverting reusable items from the disposal stream. When chemicals are unloaded, the worker segregates new and slightly used containers that are ready for use. Many visitors with items eligible for reuse are in the moving process. Rather than moving all their cleaning supplies, they have the option to deliver them to the HHW. These items are taken to the reuse building and are sorted on shelves. This building is open to the public during regular operating hours. Reuse participants fill out a form documenting the materials they pick up. This form explains that unused items are to be returned to HHW and not to be thrown into the regular waste stream. Participation for the reuse program has grown over time. The program also serves to educate the public about safe disposal and alternatives to harmful chemicals.

This program received many compliments from visitors. Participants save money by collecting reuse items at no cost and the HHW program saves money by reducing disposal expenses. The annual outreach goal for HHW is 1400 total participants.

The amount of household hazardous waste diverted from the waste stream and distributed by the Reuse Program totaled 7,624 pounds.

The Chemicals

The household hazardous materials accepted by HHW include a wide range of common chemicals and waste products. After the household waste is unloaded from the vehicle, the material is sorted and weighed. Each item is sorted based on chemical type. HHW facility workers collaborate with the chemical disposal company to evaluate the waste stream and finding storage and shipping options that reduce the expense. For example, oil based and latex paint, liquid flammables, used motor oil, cooking oil, and anti-freeze are bulked into 55-gallon drums. The remaining chemicals are sorted into either 55-gallon drums or lined gaylord boxes. Each container is stored in a chemical building or under cover until they are shipped to recycling facilities and a chemical landfill.

HHW collected and disposed of approximately 171,585 pounds of HHW in 2023. Without this program, much of this waste would have been improperly disposed of in the municipal waste stream or illegally dumped. Drop-off disposal weights for 2023 averaged 14,299 per month.

Appendix I8 | **Sessom Creek Phase 1 Stream Restoration**

2023 EAHCP Annual Report – Appendix I8:

EAHCP Impervious Cover and Water Quality Protection – Sessom Creek Stream Restoration (EAHCP Section 5.7.6)

2023 Summary of Activities - City of San Marcos

City of San Marcos efforts in 2023 associated with the EAHCP Impervious Cover/ Water Quality Protection measure (EAHCP Section 5.7.6) included the construction of Phase 1 of the Sessom Creek Stream Restoration project and engineering design of Phase 2 of the project.

Sessom Creek Stream Restoration, Ph 1 Project Overview

The Sessom Creek Stream Restoration Phase 1 project area is located within and immediately adjacent to Sessom Creek which is a tributary of the San Marcos River (**Figure 1**). The project included the removal of exposed sanitary sewer collection system pipes from the creek channel, peripheral drainage improvements, construction of stream stabilization features and native plant restoration. Plant restoration efforts included the removal of non-native vegetation, distribution of native seed and live plantings, all of which was supplemented by volunteer efforts. The project also included the installation of a temporary irrigation system that was installed and operated to help ensure the successful and speedy establishment of native vegetation needed for soil stabilization.

The City of San Marcos contracted with Santa Clara Construction for construction services associated with the project. Construction of the project began in the Fall of 2022 and was completed in May 2023. Over the course of 2023, the establishment of planted native vegetation was observed throughout the project area. The project is expected to reduce erosion, decrease sediment and pollutant loading to the San Marcos River and reduce the potential for wastewater collection line breaks and discharges.

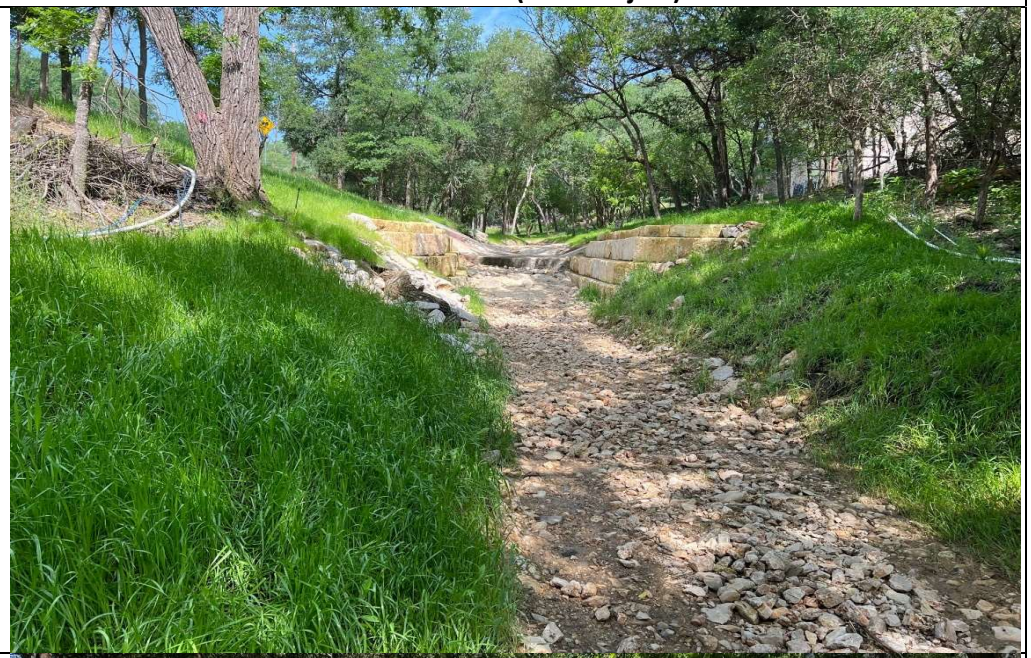
Photos of the project, including pre- and post-project photos are included below in the Project Photo log.

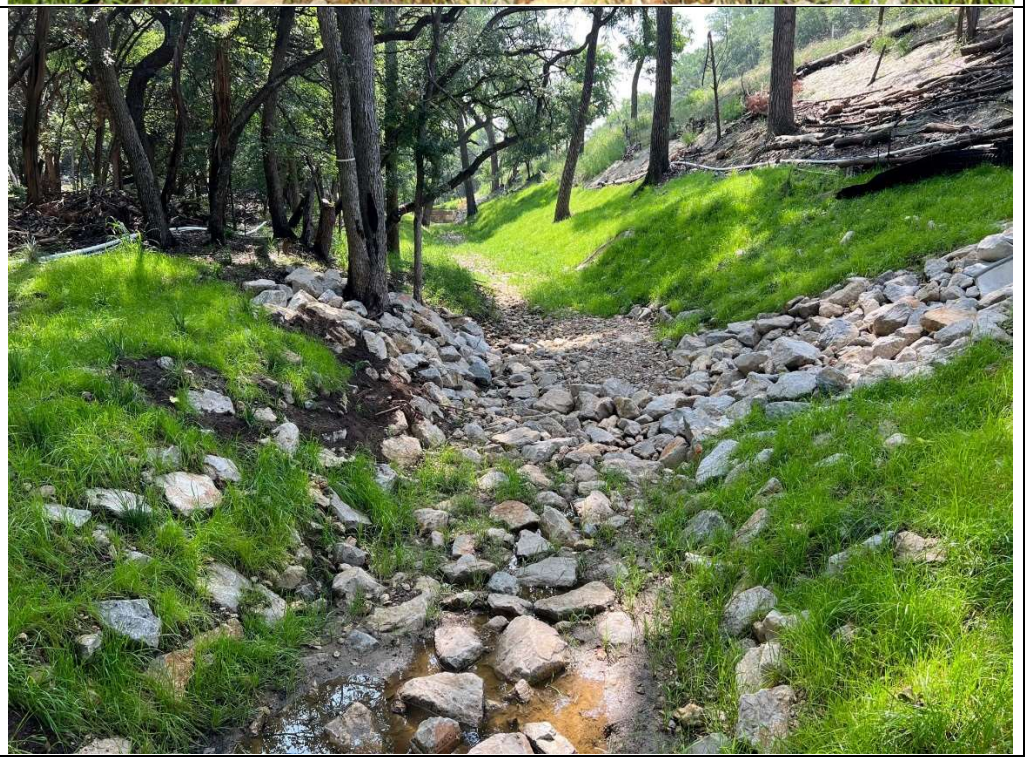
Sessom Creek Stream Restoration, Ph 2 Planning

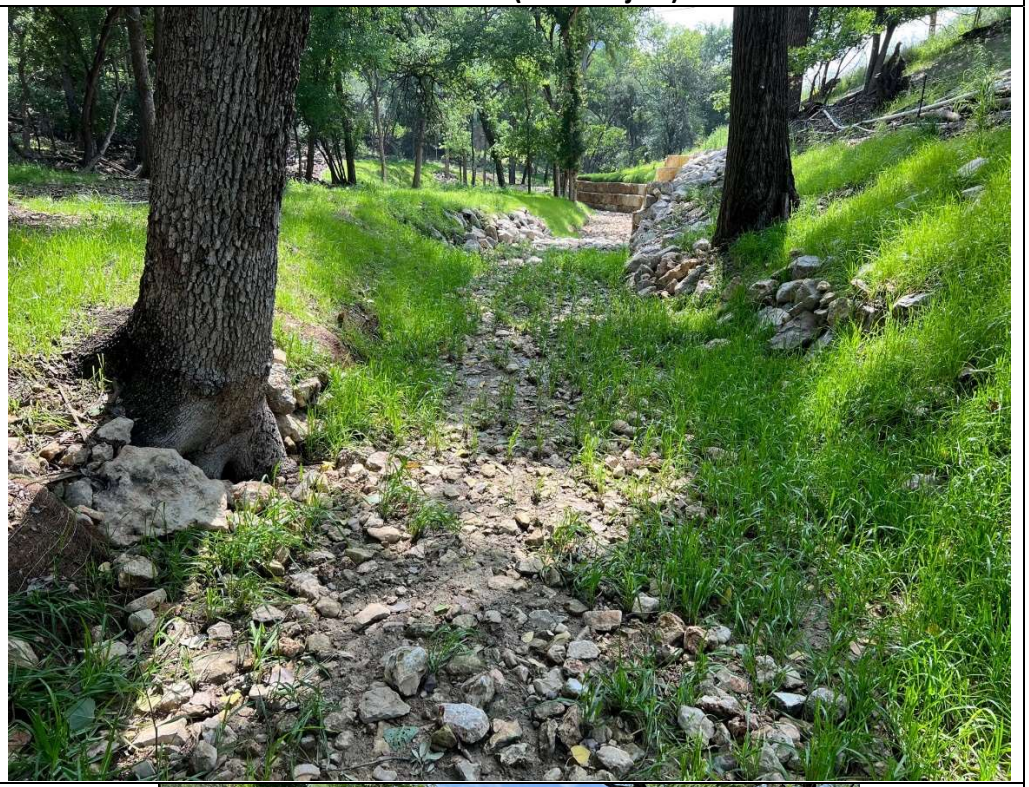
The City of San Marcos contracted with Kimley-Horn for the design of Phase 2 of the Sessom Creek Improvement project. Phase 2 will include similar elements as Phase 1 that will include removal of exposed sanitary sewer collection system pipes from the creek channel, peripheral drainage improvements, installation of constructed riffles/ pools and extensive native plant restoration in portions of Sessom Creek upstream of the Phase 1 project area, including the Windmill tributary of Sessom Creek. Kimley-Horn subcontracted with Ecosystem Planning and Restoration to develop design plans for the stream restoration portion of the project which will utilize a natural channel design approach to improve and stabilize the channel and reduce ongoing erosion. As of December 2023, design of the project was at 99% completion. It is anticipated that final design will be fully completed in early 2024 after which the City will solicit for a construction contractor. Construction is expected to begin in Summer of 2024.

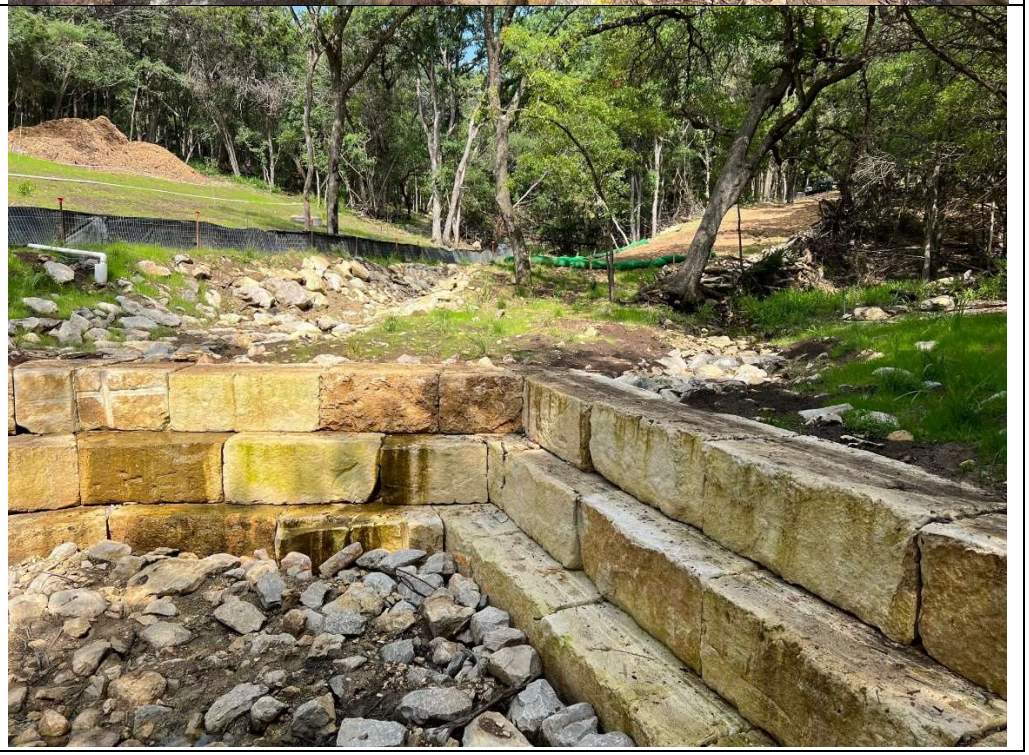
Figure 1. Location of the Sessom Creek Stream Restoration project.

Project Photo Log

Sessom Creek (Pre-Project)	Sessom Creek (Post-Project)
	
	

Sessom Creek (Pre-Project)	Sessom Creek (Post-Project)
	
	

Sessom Creek (Pre-Project)	Sessom Creek (Post-Project)
	
	

Sessom Creek (Pre-Project)	Sessom Creek (Post-Project)
	
	

Sessom Creek (Pre-Project)	Sessom Creek (Post-Project)
	

Upper-project area as of August 2023

Mid-project area as of August 2023

Appendix I9 | **Spring Lake Activities**

EAHCP Annual Report - Appendix 9: Spring Lake Activities (Spring Lake Permitted Scuba Dives)						
2023	TXST Student OW Dives (Within Training Area)	OW Checkout Dives (within Training Area)	Volunteer Dives (DAC-Trainined Divers Performing Maintenance)	Research Dives	External Dives	New Volunteers (Supervised Dives within Training Area)
January	0	394	164	0	0	23
February	0	379	157	0	6	18
March	10	421	150	0	0	16
April	56	479	152	21	0	11
May	0	498	233	22	0	17
June	12	390	178	2	0	16
July	1	327	192	21	0	23
August	0	394	164	24	0	18
September	0	219	101	12	0	20
October	36	129	93	7	2	6
November	16	328	118	8	0	10
December	0	230	105	1	0	16
YTD	131	4188	1807	118	8	194

EAHCP Annual Report - Appendix 9: Spring Lake Activities (Access Request Log)

Approved Spring Lake Access Activities 2023					
Name	Department /Agency	Duration		Description	Impact +/-
Daniel Benson	TXST Facilites Special Projects	10/3/2022	11/30/2022	Installation of floating docks for Glass Bottomed Boats; site improvements for staff and public accessibility	moderate
Stefanie Bergmanson (Dr. Castro)	TXST Biology Dept	10/10/2022	10/24/2022	Wildlife Techniques Lab-Bio4435/5435; Macro Invertebrate Survey/Sampling	minimal
Cantu, Ruby	B17 Entertainment-Production Co. w/TXST Media	10/31/2022	5/15/2023	Following several TXST students on/off campus; goal is to showcase campus, campus life, San Marcos, & TXST	minimal
Cassano, Isabella	Ava Studios Paris	2/13/2023	2/15/2023	documentary on climate change solutions globally, in Turkey and Texas; staff interviews	minimal
Conchran, Jerry	Texas Water Safari	6/6/2023	6/10/2023	60th Annual TX Water Safari- Canoe race from San Marcos TX to Seadrift, TX	minimal
Davis, Allison	UT Depart. of Integrative Biology	6/14/2018	Still Active	Sailfin/Amazon mollie, gambusia, Surviving without sex: use of phenotypic variation in an asexual fish.	minimal
Daw, Adam	USFWS San Marcos Aquatic Resources Center	12/31/2023	3/1/2023	collect Texas Blind Salamanders and San Marcos salamanders for the Edwards Aquifer Refugia Program	moderate
Dillard, Courtne	TXST Sport and Science Graduate Program	10/29/2022	10/29/2022	5k- "Trick or Trot" fundraiser _ 5k trail run	minimal
Gabor, Caitlin	TXST- Biology Dept	4/18/2023	4/25/2023	Bio 1331 students- Field exercise capture and id of small fishes	minimal
Gibson, Randy	USFWS San Marcos Aquatic Resources Center	1/10/2023	1/31/2023	Hotel Springs sampling- amphipod collections (30 total)	minimal
Gibson, Randy	USFWS San Marcos Aquatic Resources Center	3/1/2023	12/31/2023	Headwater Heterelmis genetics	minimal
Gluesenkamp, Andy	San Antonio Zoo	2/17/2023	2/18/2023	Mexican Tetra collections; Fish will be collected using collapsible mesh minnow traps	minimal
Gonzales, Isabel	TXST History Department	3/22/2023	4/8/2023	Thesis Proposal- Gonzales, I. ; photographing the Spring Lake Hillside Trails to document what structures of Aquarena Springs are still standing	minimal
Hart, Haskell	Individual- Personal Research	08/0//2023	Still Active	eDNA sequencing and analysis of Spring Lake water	minimal
Kollaus, Kristy	Edward's Aquifer Authority	9/16/2023	9/16/2023	Sediment sampling as part of the annual water quality component of the Edwards Aquifer Habitat Conservation Plan; Snorkeling	minimal
Kollaus, Kristy	Edward's Aquifer Authority	1/10/2023	12/12/2023	Water quality collection at Hotel Spring as part of the Edwards Aquifer Water Quality Monitoring Program	minimal
Kollaus, Kristy	Edward's Aquifer Authority	5/26/2023	5/26/2023	Collection of bass for the purpose of testing fish tissue for contaminants and metals as part of the EAHCP water quality program	minimal
Krause, Samantha	TXST Geography	11/4/2022	11/10/2022	GEO 4430 Field Methods class; practicing compass and tape mapping, simple vegetation survey (species identification, tree height & tree diameter measurements)	minimal
Lemke, David	TXST Biology Dept	8/30/2022	8/31/2023	Class visits for BIO 4410/5410 (Field Biology of Plants); observation and identification	minimal
Morreale, Andrew	TXST Campus/Outdoor Recreation	2/26/2023	2/28/2023	Adventure Trip Leader Training. Student Staff training experience; Kayak training	minimal
Morreale, Andrew	TXST Campus/Outdoor Recreation	2/25/2023	2/25/2023	Adventure Trip Leader skills development and instruction on interpretation as it relates to Spring Lake and the San Marcos River	minimal
Navarro, Aspen	Meadows Center/ San Marcos River Foundation	4/21/2021	Still Active	Invasive removal volunteer days; (SMRF) and volunteers to remove invasive plant species from Sink Creek	minimal
Oborney, Ed	BioWest	7/1/2012	Still Active	EAHCP biological monitoring_COMPREHENSIVE AND CRITICAL PERIOD MONITORING PROGRAM;	minimal
Ruckstuhl, Eric	EBR Enterprises EAHCP contractor	1/1/2013	Still Active	Herbicide treatments and removsl of riparian invasive plants	minimal
Schegel, Erich	Austin Opera	4/8/2023	4/28/2023	Photo shoot; snorkeling and diving- Recreate the poster for the Austin Opera performance of The Pearl Fishers (pearl diving opera).	minimal
Seidel, Nick	TXST Recreation Triathlon Club	3/4/2023	3/5/2023	The Texas State Triathlon (swimming, biking and running) in Spring Lake	minimal
Smith, Heather	TXST Anthropology	10/7/2022	5/12/2023	Ground Penetrating Radar for archaeological survey	minimal
Spencer, Ryan	TXST Biology Dept	8/29/2022	5/31/2024	Disertation Proposal, Spencer, R.; Staff time for interviews and focus groups;Pre and Post Questionnaires, Semi-Structured Interviews , Focus Groups, and Tour Observations	minimal
Torres, Anthony	TXST Engineering	7/10/2023	7/10/2023	NASA Summer camp for local high school students at TxState; water sampling and techniques for determining water quality	minimal
Wells, Mona	Meadows Center for Water and the Environment	1/10/2023	Pending	instatement of ecological observatory; long-term monitoring buoy on Spring Lake	N/A
Ybarra, Rebecca	City of San Marcos - Destination Services	10/17/2022	11/25/2022	Tourism promotional video for San Marcos - featuring the Meadows Center - 360 video - on the glass bottom boat and diver within Spring Lake	minimal