

**City of San Marcos/Texas State
University
2021 Work Plan**

2021 San Marcos/Texas State University Work Plan Budget

EAHCP Section	Conservation Measure	Table 7.1	Estimated 2021 Budget
5.3.1/5.4.1	Texas wild-rice Enhancement	\$100,000	\$20,000 ^A
5.3.6/5.4.4	Sediment Management	\$25,000 ^B	\$0 ^B
5.3.8/5.4.3.1/5.4.12	Control of Non-Native Plant Species	\$50,000	\$160,000/\$40,000 Total is \$200,000 ^A
5.3.3/5.4.3	Management of Floating Vegetation Mats and Litter	\$80,000	\$30,000/ \$10,434/ \$6,687 Total is \$47,121 ^A
5.3.5/5.3.9/5.4.11/5.4.13	Non-Native Species Control	\$35,000	\$23,256 ^A
5.3.7	Designation of Permanent Access Points/Bank Stabilization	\$0	\$0
5.7.1	Native Riparian Restoration	\$20,000	\$20,000
5.3.2/5.4.2	Management of Recreation in Key Areas	\$56,000	\$56,000
5.7.6	Impervious Cover/Water Quality Protection	\$200,000 ^{AB}	\$1,000,000 ^C
5.7.5	Management of HHW	\$30,000	\$30,000
5.3.4	Prohibition of Hazardous Material Transport	\$0	\$0
5.3.4/5.4.5,8,9/5.7.3,4	Unfunded Measures	\$0	\$0
	Total	\$596,000	\$1,396,377

A.) Difference of \$80,000 (TWR), \$32,879 (Floating Veg Mats and Litter), and \$11,744 (Non-Native Species Control) and \$25,000 (IC/WQ Protection) will go towards the Control of Non-native Plants 2020 budget.

B.) Sediment Management funding (\$25,000) has gone towards the Impervious Cover and Water Quality Protection Conservation Measure (5.7.6) per the 2017 Sediment Removal and Impervious Cover/Water Quality Protection nonroutine adaptive management.

C.) Funding will cover Phase 1 channel restoration and bid oversight of Phase 2 channel restoration. This budget is subject to change after bids are received in late fall 2020.

2021 City of San Marcos/TxState Work Plan and Funding Application Amendments

Amendment #	Date Committee Approved	Conservation Measure Amended	Y/N Funding Application Change	Funding Application Change (\$)	Date EAA Board Approved	Comments
0	5/21/2020	Original Work Plan	NA	NA	NA	Original Work Plan
1	Pending 10/8/2020	Budget Table and Work Plan	Y - budgets for Floating Veg Mats and Non-native Species Control increased	Y	Pending 11/10/2020	Budgets were adjusted for the Floating Veg Mats and Non-Native Animal Species Control. The Work Plan work zones for the Control of Non-native Plant Species and Texas wild-rice were also expanded.
0	Pending 10/8/2020	Original Funding Application	NA	NA	Pending 11/10/2020	Original Funding Application

Amendment #1; pending Implementing Committee approval on October 8, 2020

Table 1. TWR expansion since 2013 relative to 2027 biological goals

Reach	2013	2019	2027 Goal
Spring Lake	47	192	1000
Spring Lake Dam	376	1376	700
Sewell Park	945	1140	1100
Below Sewell-City Park	1733	3105	2300
City Park	351	1653	1750
Hopkins St-Snake Island	718	1552	950
Cypress Island-Rio Vista	0	398	350
IH-35 (Upper & Lower)	361	893	1050
Below IH-35	125	179	280

Methodology: The optimal conditions for TWR are sandy to coarse soils with water depths generally greater than 1 meter in areas of higher current velocity. In stands of TWR that have non-native plant species intermixed, the non-natives are removed and the original TWR stand is monitored for natural expansion. Natural expansion refers to a native species' capacity to become reestablished in denuded areas after removal efforts have taken place, which is dependent on the continued maintenance (gardening) of non-native species thereafter. Similarly, for TWR stands adjacent to non-native vegetation; the non-native plants are removed and TWR is planted as required.

Removal of non-natives around existing TWR stands occurs by hand, with divers allowing the non-native plants to drift into a seine, bag or catch net set up downstream before being removed if river access is possible, or putting them directly into a skiff. The removed vegetation is moved to the shore and plants are shaken to remove trapped fauna which are documented and returned to the river. The remaining plant matter is then disposed at the COSM or Spring Lake composting facility when appropriate. Denuded areas are monitored, and any regrowth of non-native plants is removed. If TWR does not expand, natives may be planted to secure the area (5.3.8/5.4.3/5.4.12).

The contractor will grow TWR from both tillers and seeds, with mature seeds being collected from the panicle by gently pulling upwards until seeds are released or picked up from the San Marcos Aquatic Resources Center (SMARC). Mature seeds are plump, filled out, and either green or brown in color. Seeds are then placed in a plastic bag during collection and counted and potted within 3-6 months following collection. TWR seeds are placed on top of inundated soil in 8-inch pots and covered with pea gravel to secure the seeds from floating in the water. Seeds are spread out evenly within each pot, and gently pushed into the saturated soil and gravel mixture. Once TWR seeds have germinated they will be separated out and planted in a similar manner as TWR tillers. Tillers of TWR are collected by removing them from floating vegetation mats or from fragments attached to mature plants in the river. TWR tillers are transported to the raceways located at the Freeman Aquatic Biology (FAB) and potted in soil that consists of a bulk mixture containing topsoil and mushroom compost. TWR tillers are planted in 8-inch pots with the soil being highly saturated with water so that the tillers can be inserted without causing

damage to the plant. Density of fragments per pot is generally 3-5 individuals. The pots are placed into the FAB raceways with pumps generating current velocity over the newly planted fragments. Plants remain in the raceways until roots are firmly established in the pots.

The process of planting begins by transporting potted TWR individuals from the FAB to the planting site. A diver and a handler carry the plants to the designated section, and while the diver digs a hole in the substrate using a trowel, the handler gives the diver a pot of TWR. The contents are removed from the pot and inserted into the hole before returning the empty pot back to the handler for collection. The diver works downstream to upstream in a linear pattern of planting. Individuals are placed about 0.5 meters apart and gardened as needed to remove invading plants. This process is adjusted as needed to meet the varying conditions of each planting site and species.

Production of plants at the FAB is incorporated into this Work Plan budget (TWR Enhancement & Removal of non-natives). These methodologies may be adjusted as more is learned about collection and planting procedures.

Monitoring:

All newly planted areas are monitored via quadcopter and/or visual observation to evaluate success rate. Both planting and removal efforts are mapped and quantified via GIS techniques. System-wide TWR coverage is also monitored annually through the EAA BioMonitoring program. The data collected is used to evaluate TWR coverage and identify areas of concern.

Budget:

Table 7.1:
\$100,000

Estimated 2021 budget:
\$20,000

5.3.6/5.4.4 Sediment Management

The City of San Marcos (COSM) and Texas State University are partnering to remove sediment from the river bottom in support of the native SAV planting program from Spring Lake to IH-35.

Long-term Objective:

The removal of sediment in support of native aquatic planting activities has proven to be both ineffective and expensive. From 2013 to 2015, three of the six required sites have received only 158 m³ of sediment removal costing approximately \$555,000. In 2017, an Adaptive Management Proposal to amend this conservation measure in the EAHCP was approved.

The Sediment Removal and Impervious Cover/Water Quality Protection are combined into one conservation measure that addresses sediment control within the upper San Marcos River watershed to minimize sediment and other contaminated runoff. The primary focus is the Sessom Creek watershed, which contributes a heavy load of sediment during rain events; in the 2015 October flood, Sessom Creek dumped sediment on TWR stands and other native plant stands down to City Park.

The COSM will provide; (1) design of wastewater relocation and erosion/sediment control in Sessom Creek; (2) Sessom wastewater line rehab and relocation; and (3) construction of stormwater control (SWC) features and associated land management tasks that control erosion, minimize sedimentation, and reduce pollutants in the Sessom Creek watershed.

Additionally, Texas State University has received 319 funding from the TCEQ for SWCs in the Sessom Creek watershed. The Meadows Center for Water and the Environment is the point of contact for the EPA 319 funds.

Target for 2021:

See discussion in Section 5.7.6 Impervious Cover/Water Quality Protection

Method:

See discussion in Section 5.7.6 Impervious Cover/Water Quality Protection

Budget:

Table 7.1:

\$25,000*

***These funds will be transferred to the Impervious Cover and Water Quality Protection measures.**

Estimated budget for 2021:

\$0

5.3.8/5.4.3/5.4.12 Control of Non-Native Plant Species

Long-term Objective:

To decrease the density of non-native aquatic and littoral plants or eliminate if possible through monitored removal in and along the San Marcos River in an effort to enhance fountain darter habitat by increasing the distribution of native aquatic flora as assigned by the submerged aquatic vegetation (SAV) nonroutine adaptive management long-term goals.

Target for 2021:

In 2021, the removal of non-natives and planting of natives will adopt the following strategy in an effort to ensure best use of EAHCP funds and facilitate the achievement of long-term biological goals.

Hygrophila will be removed by the contractor from various sites within Spring Lake and volunteers will be used to assist with the removal of floating non-native species. It should be noted that TWR plantings have not been successful in areas of high silt and low current velocities. This reach will receive repeated removal treatments until native aquatic species naturally expand and are able to outcompete the non-native species.

Figure 2 (below) represents the 2021 work zone for removal of non-native aquatic plant species. The 2020 work zones will be reclassified as recovery zones in 2021. These recovery zones will be managed similarly to that described in the TWR enhancement and restoration measure (5.3.1/5.4.1) so that native species can expand either naturally or via planting while continuing to remove any regrowth of non-natives. Any maintenance zones will be regularly swept for remnant *Hydrilla* or *Hygrophila* regrowth and removed as necessary. The contractors will continue utilizing extended hours from May to October to take advantage of the longer periods of daylight, warmer weather, and to avoid hours of heavy river recreation.

The practice of removing non-native aquatic plant stands from upstream to downstream is reducing labor hours spent on gardening unwanted regrowth that results from non-native plant fragments drifting from upstream stands that reestablish in denuded areas and actively compete with newly planted or established native plant stands. This method also allows for increased natural expansion of native species in the absence of non-native species. Large homogenous stands of non-native aquatic vegetation will be targeted. Non-natives will be removed from mixed stands of native and non-native species and the area will be monitored for any regrowth. The plant species designated in Table 2 will be prioritized for planting after removal of non-native species, if necessary, depending on available habitat and history of the plant species' success in the available habitat. If the prioritized species has not been successful in the habitat type to be planted, another species may be planted in its place. Plantings will not occur in areas impacted by intense recreation.

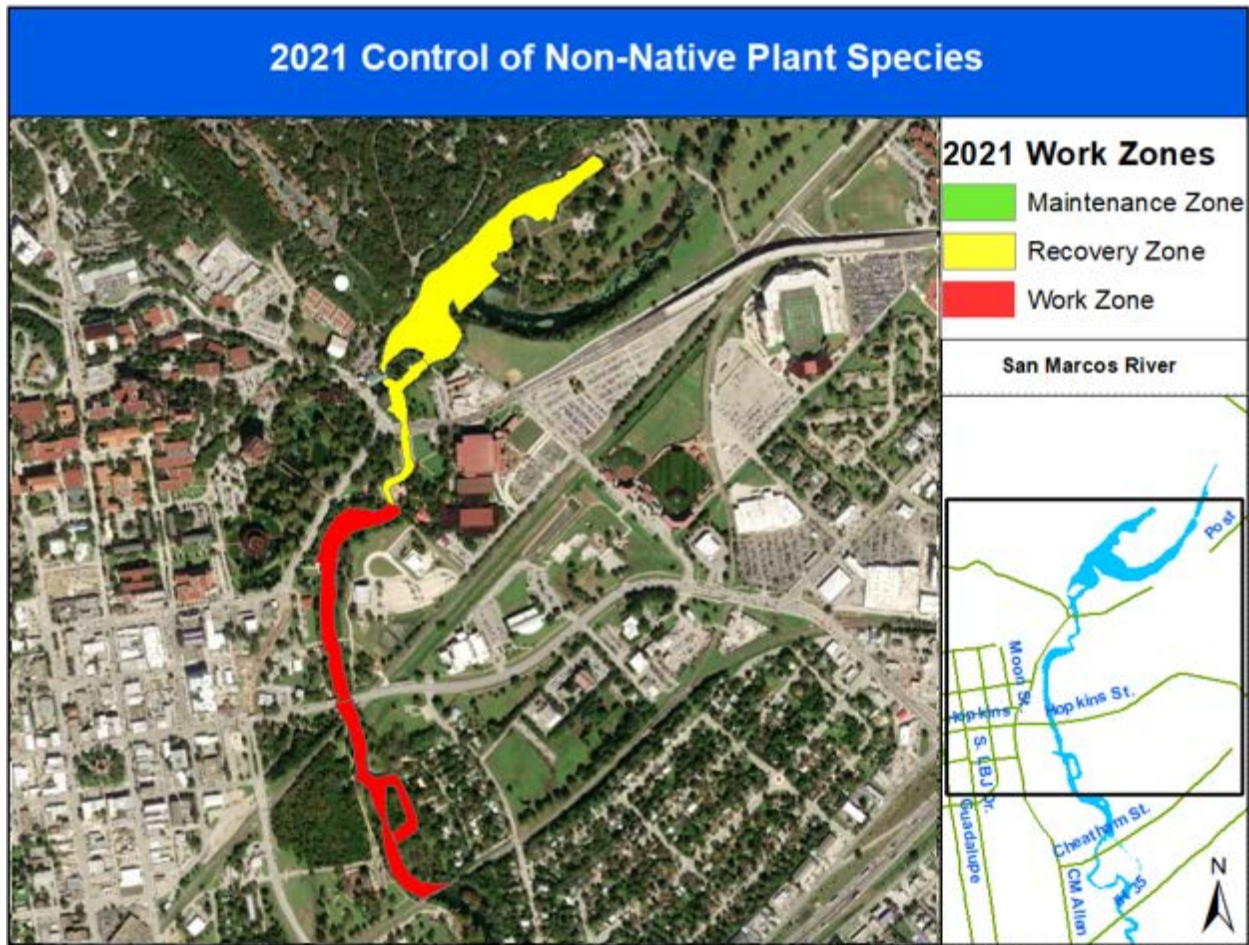


Figure 2. Proposed work zones for 2021 include recovery phase removal of *Hygrophila* in Spring Lake, Spring Lake Dam, and Sewell Park and continued top-down removal of *Hygrophila* starting in Below Sewell reach. *Hygrophila* removal will progress downstream up to the point where *Hydrilla* removal has been maintained. Both species will be removed simultaneously from that point on.

Methodology:

Non-Native Aquatic Plant Removal

Work efforts will focus on replacing non-native species within a given reach with natives, while placing emphasis on species diversity, species habitat preferences, and available habitat at the time of planting. The goal will be to eliminate dense stands of non-native species that then allow for native species to maintain and/or increase their coverage through natural expansion.

Non-native aquatic plants will be removed and replaced with native aquatic plants in association with TWR enhancement as described in Conservation Measure 5.3.1/5.4.1. Divers remove non-native aquatic plants by hand. The removed vegetation is allowed to drift down and is captured by a seine, bag, catch net, or transferred directly into a skiff where access and conditions allow. Any removed vegetation is shaken to remove trapped fauna which are returned to the river

before being disposed of at the COSM or Spring Lake composting facility. Denuded areas are then monitored for subsequent regrowth of non-native species, which are maintained as needed.

The upper San Marcos River was separated into eleven reaches from Spring Lake to Stokes Park. *Hydrilla* and *Hygrophila* have been removed from seven of these reaches since 2013 with limited success. *Hydrilla* and *Hygrophila* were removed from these reaches regardless of reach location along the upper river, which left large areas of these species upstream of removed areas and resulted in the cleared areas being quickly repopulated with large stands of these non-native species. Beginning in 2018, EAHCP contractors began a systematic upstream to downstream *Hydrilla* removal strategy beginning in the Spring Lake Dam reach. Currently, there is very little *Hydrilla* within Spring Lake and it is managed to a level that the lake should not be an upstream source of *Hydrilla* fragments or tubers. Beginning in 2019, contractors used the same process of removal of *Hygrophila* in Spring Lake.

Hydrilla and *Hygrophila* are now being systematically removed reach by reach. Reaches that have been thoroughly cleared of large patches of these species for two or more years are considered maintenance zones while reaches in which large amounts of these species are being removed are designated as work zones. A work zone in which all *Hydrilla* and *Hygrophila* have been thoroughly removed during the previous year are considered a recovery zone. These recovery zones may still require additional effort to ensure the thorough removal of these species' root systems and tubers. *Hydrilla* tubers can remain viable for multiple years despite being buried over 12 inches beneath the sediment. Downstream reaches with large areas of *Hydrilla* and *Hygrophila* are considered future work zones. In 2021, Spring Lake, Spring Lake Dam, and Sewell Park will be considered in recovery condition and the reaches from Below Sewell to the railroad tracks above Cypress Island will be considered work zones (Figure 2). The extent of 2021 work zone is estimated to slightly exceed the maximum removal allowable for *Hydrilla* and *Hygrophila* habitat disturbance limits, but disturbance estimates will be calculated on a regular basis as to not exceed the limit. Both the upper I-35 and lower I-35 reaches will be maintained to remove any newly establishing *Hydrilla* since these reaches have already been extensively cleared of *Hydrilla* in previous years.

Hydrilla and *Hygrophila* are removed by hand and, when possible, are collected from the river and transported to either the COSM or MCWE composting facilities. Areas of removal are then de-rooted, which includes meticulous removal of roots, small plants, and tubers. This process is repeated until no *Hydrilla* or *Hygrophila* are observed. After an area has been effectively de-rooted and no regrowth occurs, native plants are either planted or allowed to populate the cleared areas through natural expansion.

Planting of Native Species

The planting of native species begins once the designation of a work zone changes to recovery zone, as this maximizes reduction of invasive regrowth and subsequent outbreaks. This is expected to take 3-6 months from when the site is finished as a work zone, depending on the density and area of non-natives originally present in the site. Efforts primarily focus on preserving areas surrounding existing native species to allow for the natural expansion of those populations throughout the river system. In addition to the use of natural expansion, areas that have been stripped of all vegetation will be planted with native species best suited to that habitat type while ensuring a high level of biodiversity is maintained overall. The goal provides species presence within all reaches to allow for natural expansion downstream of each population. The plant species designated in Table 2 below will be prioritized for planting after removal of non-native species depending on available habitat and history of the plant species' success in the available habitat at a given site. If the prioritized species has not been successful in the habitat type to be planted, another species will be planted in its place. An exception to this will include areas within Spring Lake where the *Hygrophila* will be removed and replaced by native expansion according to the appropriate substrate, flow, depth, and sunlight. Plantings will not occur in areas impacted by intense recreation.

Table 2: Current aquatic vegetation coverage relative to the overall restoration goals, in meters squared (m²) within San Marcos LTBG reaches and restoration reaches.

Reaches	Species	Coverage [#] (m ²)	Restoration Goal
		Biowest Mapping	2027
LTBG Reaches		Oct 2019	
Spring Lake Dam	<i>Ludwigia</i>	12.6	100
	<i>Cabomba</i>	4.4	50
	<i>Potamogeton</i>	117	200
	<i>Sagittaria</i>	52.3	200
	<i>Hydrocotyle</i>	45	50
City Park	<i>Ludwigia</i>	41.75	150
	<i>Cabomba</i>	54.78	90
	<i>Potamogeton</i>	391.3	1450
	<i>Sagittaria</i>	50.6	300
	<i>Hydrocotyle</i>	0	10
IH-35 Upper	<i>Ludwigia</i>	5.5	50
	<i>Cabomba</i>	37.01	50
	<i>Potamogeton</i>	3.02	150
	<i>Sagittaria</i>	31.79	150
	<i>Hydrocotyle</i>	1.55	50
Restoration Reaches		Oct 2018	
Sewell Park	<i>Ludwigia</i>	3.8	25
	<i>Cabomba</i>	3.4	25
	<i>Potamogeton</i>	113.8	150

	<i>Sagittaria</i>	0	25
	<i>Hydrocotyle</i>	0	10
Below Sewell to City Park*	<i>Ludwigia</i>	34	50
	<i>Cabomba</i>	12	50
	<i>Potamogeton</i>	578.8	500
	<i>Sagittaria</i>	478	700
	<i>Hydrocotyle</i>	43.5	20
Hopkins St to Snake Island	<i>Ludwigia</i>	2.4	50
	<i>Cabomba</i>	108.3	50
	<i>Potamogeton</i>	63.5	475
	<i>Sagittaria</i>	1258.6	750
	<i>Hydrocotyle</i>	0	10
Cypress Island to Rio Vista Falls	<i>Ludwigia</i>	18.24	50
	<i>Cabomba</i>	200.52	50
	<i>Potamogeton</i>	6.12	150
	<i>Sagittaria</i>	14.02	50
	<i>Hydrocotyle</i>	0	0
IH-35 Lower	<i>Ludwigia</i>	64.5	50
	<i>Cabomba</i>	63.4	100
	<i>Potamogeton</i>	0	250
	<i>Sagittaria</i>	384.52	450
	<i>Hydrocotyle</i>	27.18	50

*Below Sewell reach was mapped in Oct 2019 by Texas State University Geography interns

Production of native SAV will continue at the FAB at Texas State University as described in the TWR Enhancement section (5.3.1/5.4.1). Fragments and tillers of native aquatic plants removed from floating vegetation mats or from fragments attached to mature plants in the river are used for propagation at FAB. Funding for the production of SAV at the FAB is incorporated into this Work Plan budget.

Native vegetation species are planted as described in the TWR Enhancement section (5.3.1/5.4.1) using a team that includes one or more divers and handler depending on depth and location. A hole is made in the substrate by a diver using a trowel, the handler gives the diver a pot of native SAV. The contents are removed from the pot and inserted into the hole before returning the empty pot back to the handler for collection. The diver works downstream to upstream in a linear pattern of planting. Individuals are placed about 0.25 meters apart and gardened as needed to remove invading plants. This process is adjusted as needed to meet the varying conditions of each planting site and species.

Environmental conditions at the time of planting determine which native species are planted. *Cabomba* and *Sagittaria* have exhibited greater success in finer substrates (silt) with areas of slower moving water. Both can be planted in a range of water depths. However, some reaches

are challenging, such as Cypress Island, where only TWR and *Heteranthera* have shown success in outcompeting *Hydrilla*.

In the San Marcos River, *Ludwigia* has been planted in a wide variety of habitat types ranging from areas with shallow depths, high velocities over coarse substrates to areas with slack-water habitat over silt substrate to determine which habitat results in greatest rates of expansion and persistence. In 2019, *Ludwigia* patches have expanded and contracted with fluctuations in recreational areas. This species' coverage expanded in reaches upstream of Hopkins Street, with many of the new patches being relatively small and occupying areas recently cleared of non-natives. This is possibly occurring, because for the first time *Ludwigia* has multiple source populations upstream. *Hygrophila* has been observed to reduce the expansion of two native species: *Ludwigia* and *Potamogeton*. *Potamogeton* is an additional species that has struggled to become established in a few reaches: being almost undetectable from Cypress Island onward. Like *Ludwigia*, *Potamogeton* has been planted in numerous areas with varying substrate compositions in an attempt to determine the most suitable habitat type. It was observed to exhibit the best growth in the upper reaches with high flow and dense, coarse substrates (gravel/sand and clay).

In 2016, *Hydrocotyle* was accepted as an approved native species to plant in the San Marcos River. *Hydrocotyle*, like *Ludwigia*, can become a littoral species, persisting in areas of shallow water. Therefore, these species are utilized to replant river margins or areas of very shallow water depths or along riverbanks.

Monitoring:

For aquatic plants, newly planted areas are monitored monthly to evaluate success rates. All planted areas are weeded (non-native species removed) and replanted as needed to stabilize the substrate. All planting and removal areas are monitored via quadcopter and/or visual observation. Both planting and removal efforts are mapped and quantified via GIS techniques. Work sites are separated into reaches to assess changes among and within reaches of the San Marcos River and to identify presence of non-native vegetation and also to assess the expansion of native vegetation. SAV coverage is also monitored annually within LTBG reaches through the EAA BioMonitoring program. The data collected is used to evaluate native SAV coverage and identify areas of concern.

Non-Native Littoral Plant Removal

Removal of littoral plants and other small caliper invasive plants in the riparian zone is also included in this budget. Littoral invasive removal efforts will address seed source and regrowth of invasive plants from above Spring Lake to Stokes Park (Section 5.3.8). Removal efforts will also extend to treat hot spots that contribute to regrowth.

In 2021, removal efforts for littoral invasive species will target areas shown in Figure 3 - 6 below. Most work areas are now in maintenance mode; requiring periodic regrowth removal. Seven regions that have spots of intense removal work still remain. Addressing these seven zones will connect a buffer zone along the river that does not contribute seed source.



Figure 3. Spring Lake and Sink Creek Zones

1. The area along **Sink Creek** upstream of **Bert Brown Road** is still full of Chinese Tallow trees. This area must be worked on to reduce the amount of Chinese Tallow seedlings found every year along Sink Creek. Japanese Honeysuckle and an occasional Elephant Ear can also be found here.
2. The **western shoreline** of **Spring Lake** is in a maintenance state, but the rest of the **hillside** has a number of invasive, exotic plant infestations. Cat's Claw Vine is prevalent at the top of the hill.
3. The **Spillway Island** has several Chinaberry, Chinese Tallow, and Ligustrum that need to be removed. Erosion control berms composed of cut debris will be created.

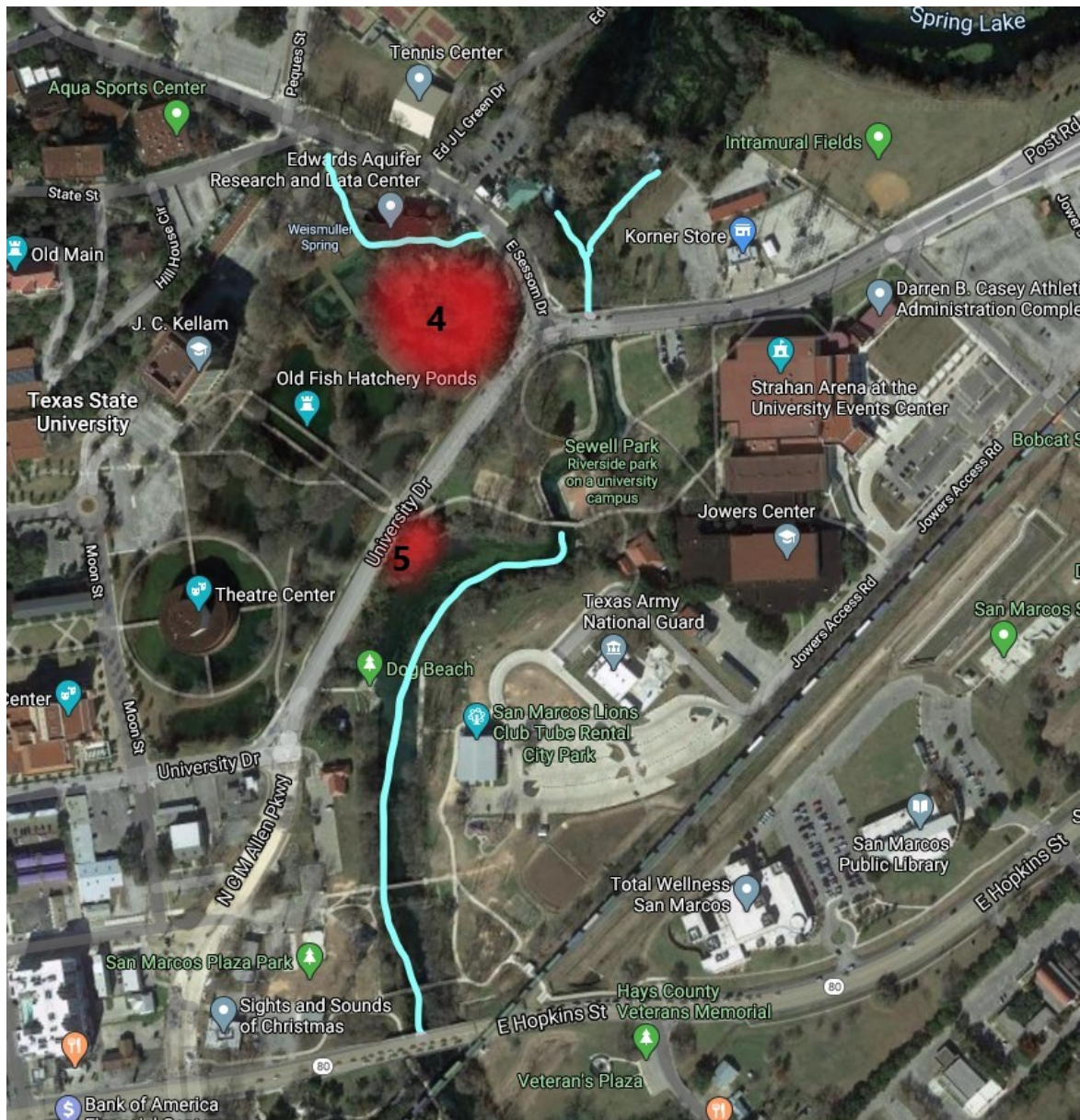


Figure 4. Freeman Aquatic Center, Headwaters, and City Park

4. The **pond** area adjacent to **Sessom Creek** at the **Freeman Aquatic Center** has a number of large Chinese Tallow, Ligustrum, Loquat, and Chinaberry. These had been paint marked in the past and the University was going to take them down, but that has not happened to date. They are an unnecessary seed source that continues to pose a threat to other nearby completed work. A couple of invasive, exotic trees still exist along the creek through here, but otherwise it is in a maintenance state.
5. An area along **University Drive**, across from **City Park** has a large stand of Giant Reed – *Arundo donax*. If this stand continues to thrive unchecked, it could continue to grow and occupy spaces where Ligustrum was removed. The river through this area is in a maintenance state.

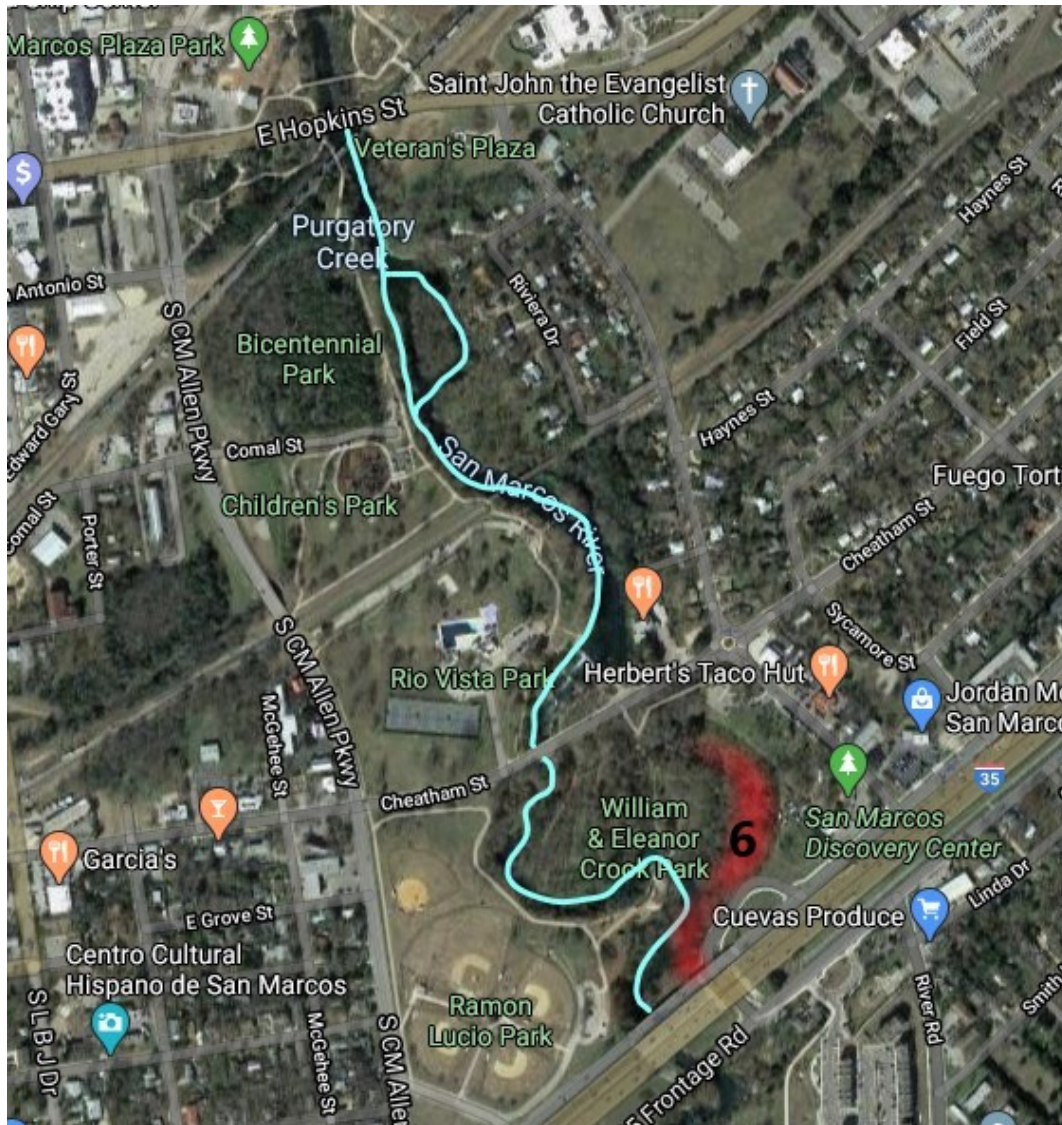


Figure 5. Veteran's Plaza, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, Crook Park

6. Most of the area between E. Hopkins and I-35 is in a maintenance state. However, the old mill run in **Crook Park** is an exception. It still has a huge number of Paper Mulberry trees that are up and down the bank close to the Discovery Center. Collaborative projects are needed upstream of Cheatham St. and in Bicentennial Park to work on Ligustrum removal.



Figure 6. Stokes Park/SMRF Property

7. The contractor has worked these areas, but not on the same level as the upstream sections. One private landowner has a large stand of Elephant Ears at I-35 that hinders success downstream. In addition to Elephant Ear removal, we will remove other invasive, exotic plant species in conjunction with other HCP contractors.

Monitoring:

For aquatic plants, newly planted areas are monitored monthly to evaluate success rates. All planting and removal areas are monitored via quadcopter and/or visual observation by snorkelers and scuba divers. Both planting and removal efforts are mapped and quantified via GIS techniques. Work sites are separated into reaches to assess changes among and within reaches of the San Marcos River and to identify presence of non-native vegetation and also to assess the expansion of native vegetation.

Progress for non-native littoral vegetation removal will be tracked with polygons containing the species removed, estimated area (m²) and percent removed. A composite map depicting the routine maintenance required to remove large areas of non-native aquatic vegetation will also be generated using weekly polygons.

Budget:

Table 7.1:

\$50,000

Estimated 2021 budget:

\$200,000: \$160,000 for Texas State University (aquatic) and \$40,000 for EBR (littoral)

5.3.3/5.4.3 Management of Floating Vegetation Mats and Litter

Long-term Objective:

Minimize impacts of floating vegetation and litter on TWR stands and overall aquatic community within the San Marcos River, as well as keep springs clear to enhance San Marcos salamander habitat.

Existing vegetation management activities in Spring Lake will continue to follow the Spring Lake Management Plan (approved by the President's Cabinet) and the EAHCP, as described under Methodology.

Target for 2021:

Management activities include removal of litter from the littoral zone, stream bottom and portions of the major tributaries, and vegetation mats from Spring Lake Dam reach to Stokes Park. Contractors will manage floating mats and litter from the entire reach. Texas State University will manage aquatic vegetation in Spring Lake through use of its harvester boat and trained divers authorized to dive in Spring Lake. Additionally, invasive aquatic floating vegetation will be managed by Texas State University with the assistance of EAHCP contractors and volunteers from various organizations.

Methodology:

Spring Lake: Each week about five springs are gardened, with divers returning to garden the same springs every two to three weeks. During summer algal blooms, the springs are managed more frequently (up to four springs per day), primarily to remove algae. Texas State employees and supervised volunteers fin the area around the springs to remove accumulated sediment, and then clear a 1.5-meter radius around each spring opening in Spring Lake with a scythe. Over the next 1.5-meter radius around the spring opening, they shear vegetation to a height of 30 cm, and then to one meter over the following three-meter radius. Plant materials are not collected, but rather carried away by the current. Cumulatively, about six meters of vegetation around each spring opening is modified. Mosses are not cut. The volume of plant material to be removed will vary by the amount of time between cuttings and season. The harvester boat will remove a range of 15 to 20 boatloads of plant material a month from Spring Lake. The harvester clears the top meter of the water column, cutting vegetation from sections one, two, and three once a week (EAHCP Figure 5-2). The harvested vegetation is visually checked by the driver for fauna caught in the vegetation. If the driver observes fauna, he/she will stop work and return the animal(s) back into Spring Lake if appropriate. Texas State employees and supervised volunteers are trained to recognize the Covered Species through the Diving for Science program (Section 5.4.7.1) and avoid contact with them. Vegetation mats are removed from zones four and five on an as-needed basis (EAHCP Figure 5-2). The total area cut equals about nine surface acres. The Habitat Conservation Plan Manager for the COSM schedules volunteer groups for the cleanup of nuisance floating species such as water hyacinth and water lettuce from Spring Lake. The floating plants are collected by hand and shaken prior to removal from the river to dislodge any aquatic animal species caught in the plant. The collected vegetation is transported to the COSM disposal facility.

San Marcos River: Floating vegetation in TWR stands and other natives is lifted off the stands and removed as needed. Inorganic litter is picked up weekly from the substrate, surface and littoral zones of the San Marcos River from Clear Springs Natural Area to City Park and from IH-35 to Stokes Island during the recreational season (May 1st to September 30th) and monthly during offseason. Litter is also removed from public lands within the four tributaries.

Monitoring:

In the event of low flows, this activity will be monitored by the EAA contractor for potential impacts on listed species and will be suspended if impacts are observed. Volume of litter removed will be tracked. Removal of vegetation mats will be tracked with polygons delineating work areas and attribute data that include date and location.

Budget:

Table 7.1:

\$80,000

Estimated 2021 budget:

\$47,121

5.3.5/5.3.9/5.4.11/5.4.13 Non-Native Species Control

Long-term Objective:

Reduction of non-native, invasive species in the San Marcos River to levels that minimize their possible impacts on Covered Species and the aquatic ecosystem.

Target for 2021:

Contractor will use methods that have proven to be successful in efficient removal of invasive species from Spring Lake to IH-35. Contractor will measure length and weight for fish species. The targeted species include suckermouth catfish, tilapia, and two snail species, *Melanoides* and *Marisa cornuarietis*. Contractor has not successfully trapped nutria in 2020 and has observed very few individuals. Therefore, traps will not be set in 2021.

Methodology:

Spear and bow fishing continue to be most effective methods for fish removal. Contractor uses spearfishing tournaments, permitted through the municipality, to increase total removal, while saving costs and providing an educational awareness component to participants. Contractor ensures that all methods avoid impacts to resident turtles and other native species.

Effective removal of *Melanoides* and *Marisa cornuarietis* is accomplished by determining the locations of highest snail density and using dip nets to remove the snails weekly. These species are best controlled by diving several hours after sunset to hand-pick the snails from the substrate and SAV. Snails are being collected during the two polespearing tournaments each year.

COSM has an ordinance prohibiting the dumping of aquaria into the San Marcos River (Sec. 58.037) and accepts unwanted aquatic fauna at the Discovery Center.

Monitoring:

In order to monitor the reduction of overall non-native species abundance in the San Marcos ecosystem, the COSM and Texas State University will compile information regarding the size (weight and total length) of the individual animals removed. This information may assist in determining overall effectiveness of this conservation measures impact of species population dynamics.

Budget:

Table 7.1:

\$35,000

Estimated 2021 budget

\$23,256

5.3.7 Designation of Permanent Access Points/Bank Stabilization

Long-term Objective:

Maintain integrity of structures that serve to control bank erosion, protect TWR and listed species habitat in the recreation traffic areas.

Target for 2021:

The COSM completed the construction of bank stabilization/access points at seven locations along the San Marcos River in 2014 with repairs made in 2017.

Monitoring:

A diver will measure possible undermining at each site twice yearly. The surface of each site will also be inspected for damage.

Budget:

Estimated 2021 budget:

\$0

5.7.1 Native Riparian Habitat Restoration

Long-term Objective:

Establish a robust native riparian and water quality buffer community that benefits Covered Species through increasing the habitat and water quality within the San Marcos River down to city limits. The buffer will also prevent public access which causes bank erosion and impacts TWR and other stands of native vegetation. A zone of prohibitive vegetation along the uppermost edge of the riparian and water quality buffer community will be established to encourage river users to access the river via hardened access points. Private riverside landowner participation in this program will be encouraged and the EAHCP will provide the labor and plants as practical. EAHCP-funded contractor(s) will perform invasive removal and maintenance. Native plantings and maintenance will be done by volunteers during regular planting events.

Target for 2021:

Contractor (funded through the EAHCP and COSM) and volunteers will maintain all treated areas from Spring Lake to Stokes Park, and any new adjacent areas to address invasive regrowth and/or seedbank source as appropriate. Volunteers plant natives in previously worked areas during regular planting days as needed. Initial invasive removal has been completed from headwaters to Stokes Park, so maintenance of all treated areas will be the primary focus with secondary seed source removals.

Methodology:

Contractor removes and treats invasive regrowth using a glyphosate/trichlopyr herbicide mix to treat the stumps and/or roots. On upland trees, shrub stumps and root buttresses, Relegate (Triclopyr-based herbicide) is used. The Relegate is mixed with glyphosate, Drexel Surf Ac 820 Surfactant and Turf Mark Blue, a blue dye. Roots are scraped and treated with herbicide mix then monitored. Volunteers complete all other native riparian habitat restoration as described above using plants propagated at the Discovery Center. Treated and adjacent areas will be monitored for re-growth and seed sources.

Monitoring:

Monitoring will occur monthly to check for re-growth and treat as needed. Maintenance will continue to be a mix of contract work funded by EAHCP and COSM, as well as volunteerism. The City will continue to provide all fences to protect the sites as well as game cameras and other security measures as needed to prevent theft, vandalism and unauthorized access.

Budget:

Table 7.1:

\$20,000

Estimated 2021 budget:

\$20,000

5.3.2/5.4.2 Management of Recreation in Key Areas

Long-term Objective:

To minimize the impacts of incidental take resulting from recreation which includes, but is not limited to swimming, wading, tubing, boating, canoeing, kayaking, golfing, scuba diving, snorkeling and fishing.

Target for 2021:

1. Hire nine Conservation Crew members that work 15 hours/week (Wed to Sun) from mid-May to September with members working prior to summer season and after to continue public outreach, recreation impact minimization efforts, and assists the MCWE HCP team in their efforts to remove floating vegetation mats and non-native vegetation.
2. Continue the implementation of the following recreational management goals at a minimum:
 - a. Signage. Signs have been posted in kiosks at most of the river access points. Signs cover the rules of the river and educate the public on the importance of the resource.
 - b. Video slides at City Park and Rio Vista Falls offering information about the river and safety rules while people are waiting for shuttle or tubes. Video was finished and installed in 2016/2017 for Lion's Club and will be updated and distributed electronically for increased exposure.
 - c. Posted maps showing trail, access points, and other amenities. River maps are located at the Discovery Center which serves as the trailhead to the San Marcos River and help inform visitors and recreationists about the San Marcos River/Blanco River confluence.
 - d. EAHCP brochures have been placed at the Tourist Information Bureau for visitors.
 - e. Park Rangers. Training materials covering the river flora and fauna have been developed and provided for the training of the park rangers, so they can help disseminate the information.
 - f. School Outreach. Implement an outreach program for San Marcos Consolidated Independent School District (SMCISD) so this information can be relayed to youth in San Marcos and indirectly to the parents. The San Marcos Discovery Center is a facility dedicated to public education and outreach regarding the San Marcos River. Outreach efforts include the production of an interactive river habitat card game that was introduced into the curriculum for SMCISD elementary schools.
 - g. Coordinate with the Texas State University Outdoor Recreation center to help educate river users about endangered species and EAHCP assets on the San Marcos River.

- h. Continue to provide outreach at booths including Concert Series (Earth & Water), Passport SMTX, Business Expo, Mermaid Society events, San Marcos Sustainability Fair, and Don't Mess with Texas Litter Cleanup.
- j. Continue to educate the public during volunteer planting days.
- k. Continue to educate the public engaged in water-based recreation on sustainable river behaviors that protect listed species and their habitats through interns and Conservation Crew program.
- l. Introduce the COI program to qualified third parties conducting recreational activities in and along the San Marcos River.
- m. Monitor and educate recreationists about the invasive zebra mussels.

Monitoring:

Litter removed from the river during the recreation season is tracked. Also, the Conservation Crew will monitor boats and river structures for the presence of zebra mussels from Spring Lake Dam to IH-35.

Budget:

Table 7.1:
\$56,000

Estimated 2021 budget:
\$56,000

5.7.6 Impervious Cover/Water Quality Protection

Long-term Objective:

The EAHCP commitment for a combined effort (Sediment Management and Impervious Cover & Water Quality Protection) includes construction of Sessom Restoration Phase 1 starting in 2021, the completion of the Downtown Pond in 2020, and the completion of Sessom Restoration Phase 2 by 2023.

The most cost-effective strategy identified through the adaptive management process (AMP) in 2017 was implementation of stream restoration projects in the middle reach of Sessom Creek. Restoration will also address a tributary flowing into the middle reach, the Windmill Tributary, that is experiencing accelerated stream erosion and also contributing high sediment loads. Primary objectives of the AMP strategies are (1) reduce existing stream erosion, and (2) accelerate the natural re-stabilization process for Sessom Creek, i.e., to return it to a state of geomorphic equilibrium.

The preliminary recommendations address Phase 1, approximately 1400 linear feet of Sessom Creek, from above North LBJ Drive upstream to the Windmill Tributary confluence and Phase 2, approximately 565 linear feet from the confluence to the Loquat/Canyon intersection, plus 550 linear feet of Windmill Tributary. A future potential Phase 3 addresses Sessom Creek above the Loquat/Canyon intersection (an additional 800 linear feet) (Figure 7). Stream and watershed restoration practices identified for each project reach include grade control, bank stabilization, gully control, stormwater management ponds, natural channel design, and riparian restoration.

In addition, the COSM has identified several other projects and concerns within the same geographic area. These include wastewater improvements, road repair and improvements, site-specific erosion repairs, and a water main project. These improvements will be funded by COSM and will work in concert with the stream restoration and stormwater management practices to the maximum extent practical. The wastewater improvement project is separate but is planned to occur concurrently with the other projects.

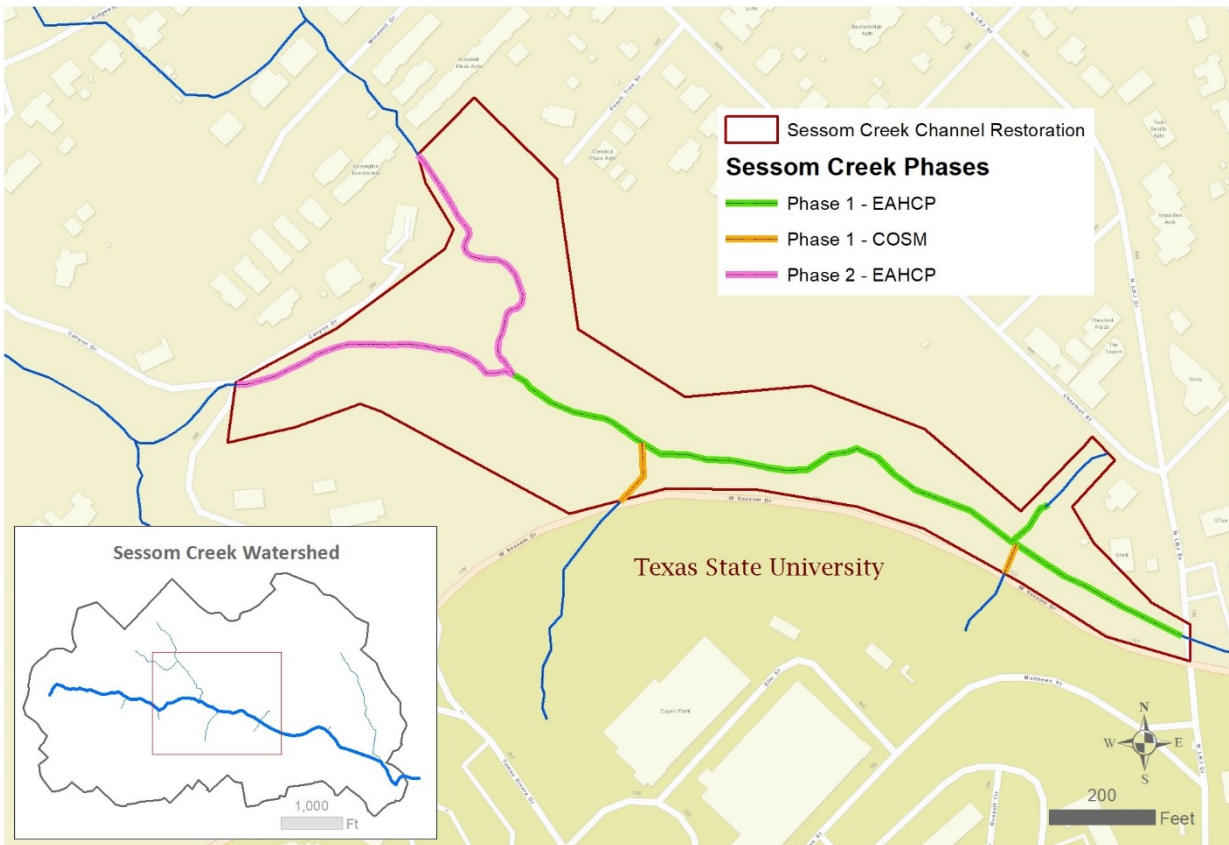


Figure 7. Sessom Creek Proposed Project Reaches - Phase 1 (green outline), Phase 2 (blue outline), Phase 3 (purple area)

Target for 2021:

Continue construction of Phase 1 restoration with Phase 2 construction beginning in late 2021. Continue working with Texas State University to control sediment loss into Sessom Creek from campus sites.

Monitoring:

Water quality monitoring program managed by the EAA will set the pre-construction parameters. The EAA Sessom Real-Time monitoring station and the applied research water quality sampling at the Freeman Aquatic Building will supply the data.

Budget:

Table 7.1

\$200,000

Estimated 2021 budget:

\$1,000,000

***\$1,528,200.00** was approved for this conservation measure in 2019. \$1,528,200.00 is expected to be spent from 2019 through 2023. Construction funds will be included in future funding applications when the construction bids are tabulated.

5.7.5 Management of Household Hazardous Waste

Long-term Objective:

Strengthen the COSM existing program that provides a place for citizens of San Marcos and Hays County to safely dispose of Household Hazardous Waste (HHW). This prevents the dumping of HHW into the river or recharge zone and thus impacting listed species.

Target 2021:

Target 3000 participants for public outreach events. Staff will conduct these events and convert or dispose of the HHW between events. Fund outreach to surrounding communities within the San Marcos River watershed that cannot afford to partner in a HHW collection program. Mailing quick fact flyers out with HHW information.

Methodology - Open drop-off opportunities two days a week (Tuesday and Friday) from 12:00 p.m. to 3:30 p.m. to the public.

Monitoring:

Track the amount of HHW received and number of participants from San Marcos, Hays County, and surrounding communities. All necessary documentation will be turned in to TCEQ. Identify the HHW that comes from communities with the San Marcos River watershed and the cost of collecting, processing and disposing of HHW from these communities.

Budget:

Table 7.1:

\$30,000

Estimated 2021 budget:

\$30,000

5.3.4 Prohibition of Hazardous Materials Transport Across the San Marcos River and its Tributaries

Long-term Objective:

Reduce the potential of spill of hazardous materials in the San Marcos River and its tributaries through the designation of a hazardous materials route in COSM.

Target for 2021:

Produce map with Texas Department of Transportation limitations and obtain their approval.

Monitoring:

Bi-annual monitoring of hazmat traps on designated roadways to determine functionality and annual monitoring of all installed signage is ongoing. Substandard conditions will be repaired or replaced as necessary.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0

Estimated 2021 budget:

\$0

5.7.3 Septic System Registration and Permitting Program

Long Term Objective:

To ensure an aerobic and anaerobic septic system registration, evaluation, and permitting program to prevent subsurface pollutant loadings from potentially being introduced to the San Marcos Springs ecosystem within city limits.

Target for 2021:

To maintain an accurate record of new and existing septic systems installed and modified in city jurisdiction. In addition, city ordinance requires all owners of septic systems connect to municipal sewer lines as they become available.

Methodology - It is required by law that all septic systems are permitted by the local Designated Representative (DR), which is the City of San Marcos Environmental Health Department. Plans are submitted with the application and reviewed by the DR for TCEQ compliance. Once these requirements are met, the permit to construct is issued. The design, site evaluation, installation and inspections can only be performed by individuals that are licensed by TCEQ. Before the installation or modification is approved, inspections are made by the DR to ensure that the system installed corresponds with the design. Once completed, a license to operate is issued to the property owner by the DR. All DRs are subject to TCEQ Compliance Reviews.

Monitoring:

The City of San Marcos Environmental Health Department reviews all applications and inspects the installations of all new and modified septic systems within the City's jurisdiction. The Department also monitors maintenance and responds to all complaints reported or observed.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0

5.7.4 Minimizing Impacts of Contaminated Runoff

Long-term Objective:

The goal of this measure is to reduce the input of sediment and roadway contaminants into the San Marcos River. In order to leverage existing investment from the COSM, the EAHCP will assist in constructing two ponds (estimated to be complete in 2020). Both ponds are designed for high pollutant load reduction and have been identified as a priority management strategy.

Target for 2021:

All activities and funds associated with this measure have been completed.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0

5.4.5 Diversion of Surface Water

Long-term Objective:

Texas State University will curtail its permitted surface water diversions as a function of total San Marcos springflow to protect the aquatic resources as specified under the EAHCP flow management strategy.

Target for 2021:

Restriction of surface pumping as specified under the EAHCP. Under TCEQ Certificates 18-3865 and 18-3866, Texas State University's total diversion rate from the headwaters of the San Marcos River for consumptive use is limited to 8.1 cfs (See EAHCP Section 2.5.5). The total diversion rate from Spring Lake is limited to 4.88 cfs; the total diversion rate from the San Marcos River at Sewell Park is limited to 3.22 cfs (See EAHCP Section 2.5.5.1 and 2.5.5.2 respectively).

Methodology - When flow at the USGS gauge at the University Bridge reaches 80 cfs, Texas State University will reduce the total rate of surface water diversion by 2 cfs, *i.e.*, to a total of approximately 6.1 cfs. This reduction in pumping will occur at the pump just below Spring Lake Dam in order to maximize the benefits to salamanders, TWR, and other aquatic resources in the San Marcos River below Spring Lake Dam. The University will reduce the total rate of surface water diversion by an additional 2 cfs when the USGS gauge reaches 60 cfs. The additional 2 cfs reduction will be made from the pumps located in the slough arm of Spring Lake, and, therefore, maximize the benefits to the aquatic resources within the main stem San Marcos River below Spring Lake Dam. When the USGS gauge reaches 52 cfs, Texas State University will reduce the total diversion rate to 1 cfs. This further reduction will be made by restricting the pumps located in the Sewell Park reach. The diversion of water will be suspended when the springflow reaches 45 cfs.

Monitoring:

Pumping rates will be reported on a daily basis when any of the pumping restrictions are in force.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0

5.4.7 Diving Classes in Spring Lake

Long-term Objective:

Maintain the integrity of the ecology within Spring Lake through controlling access to Spring Lake in accordance to federal, state and local laws.

Assumptions: All diving activities in Spring Lake are governed by the Spring Lake Management Plan.

Target for 2021:

Implement the diving protocols as outlined in the Spring Lake Management Plan and the EAHCP ITP with the following modifications: No more than 20 volunteer divers will be allowed in the lake per day, with not more than ten at one time.

Methodology - The Diving Safety Officer will monitor all diving activities in Spring Lake, assuring all guidelines contained in the Diving Safety Manual for Spring Lake and the EAHCP ITP are observed.

Monitoring:

The Lake Manager, with assistance from the Diving Safety Officer, will compile an annual summary of diving activities conducted in Spring Lake and provide to the Diving Control Board for its review.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0

5.4.8 Research Programs in Spring Lake

City ordinance and state law designate the public waters of Spring Lake as restricted to activities authorized by the University. Proposals for research projects in Spring Lake must be submitted to the Environmental Review Committee, through the Lake Manager, for review and approval.

Long-term Objective:

Maintain the integrity of the ecology within Spring Lake through controlling access to Spring Lake in accordance to federal, state and local laws. All research activities in Spring Lake are governed by the Spring Lake Management Plan.

Target for 2021:

Implement the protocols for research as specified in the Spring Lake Management Plan and the EAHCP ITP.

Methodology - Proposals for research projects in Spring Lake must be submitted to the Environmental Review Committee, through the Lake Manager, for review and approval.

Proposals for research projects must be submitted in writing and include:

1. Name and contact information of the responsible party conducting the research;
2. Purpose and expected outcomes of the activities, including a description of how the project contributes to science;
3. Description of activities, including, if appropriate, measures to be taken to minimize any impact on endangered species or their habitat, or any cultural resources found in the lake;
4. Methodology, including literature review;
5. Type of equipment used, how much; where it will be placed, and for how long it will remain in lake (see Equipment in Lake Section E of the Spring Lake Management Plan);
6. Expected impact; and
7. Timeline of project.

Monitoring:

The Lake Manager will compile an annual summary of the research conducted in the lake, including statements on the impact of these activities on the health of the lake.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0

5.4.10 Boating in Spring Lake and Sewell Park

Long-term Objective:

Maintain the integrity of the ecology within Spring Lake and San Marcos River through controlling access to Spring Lake in accordance to federal, state and local laws. All boating activities in Spring Lake are governed by the Spring Lake Management Plan and the EAHCP ITP.

Target for 2021:

Implement the protocols for boating as specified in the Spring Lake Management Plan in support of the EAHCP ITP.

Follow the below protocol for all boats (canoe, kayak, and paddleboards) used for educational activities, excluding glass bottom boats:

1. All boats must be properly washed/disinfected before being placed in lake and once they are removed (see Equipment in Lake in the Spring Lake Management Plan).
2. Participants must receive an orientation prior to boating including: instruction on safety, basic boat handling, and on-site rules and regulations. The orientation will cover information specific to Spring Lake's sensitivity and endangered species.
3. All boating events must be designed to keep participants away from glass bottom boat operations.

To minimize the impacts of boating on the Covered Species' habitat in Sewell Park, canoeing/kayaking classes in Sewell Park will be confined to the region between Sewell Park and Rio Vista dam. Students will enter/exit canoes/kayaks at specified access points to avoid impacting the flora and fauna along the bank. Classes will be no longer than two hours and up to three classes will be held per day. Classes will have a maximum of 20 students. All classes will be supervised.

Monitoring:

The Lake Manager will compile an annual summary of boating activities conducted on the lake, including statements on the impact of these activities on the health of the lake.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0

5.4.9 Management of Golf Course and Grounds

Long-term Objective:

Management of the grounds to minimize and reduce negative effects to aquatic ecosystem in Spring Lake and the San Marcos River.

Target for 2021:

Continued implementation of the Grounds Management Plan and Integrated Pest Management Plan.

Methodology - The grounds will be maintained to meet the recreational function in an environmentally sensitive manner. It is the responsibility of the Grounds Manager to maintain the Golf Course grounds in accordance with the Integrative Pest Management Plan (IPM). This plan describes the activities and materials to be used to control pests (i.e. insects, weeds, and other living organisms requiring control) in a way that minimally impacts the environment. The IPM is updated as needed by the Grounds Manager, in consultation with the Lake Manager and the Environmental Review Committee. The Grounds Manager will consult with the Lake Manager on any unique situations that may arise outside of routine maintenance that could impact Spring Lake. Upon completion of construction of the new Texas State University intramural fields, this protocol will be reviewed for updates.

Monitoring:

Each year the Grounds Manager will report to the Lake Manager detailed information on maintenance activities and materials used during the year.

Budget:

Table 7.1:

\$0

Available budget for 2021:

\$0