Appendix K | **2022 Permit Oversight-Cultural Resources Coordination**

Appendix K | **2022 Permit Oversight-Cultural Resources Coordination San Marcos**

March 30, 2021

Mason D. Miller
Archeological Principal Investigator

Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
1511 Colorado Avenue
PO Box 12276
Austin, TX 78711-2276

Attention: Tiffany Osburn

Re: Antiquities Code of Texas Cultural Resource Coordination Letter for the City of San Marcos, Edwards Aquifer Authority, and Texas State University's Proposed Habitat Conservation Plan Activities for 2022 along the San Marcos River, San Marcos, Hays County, Texas.

Dear Mr. Wolfe

This letter is intended to inform the Texas Historical Commission (THC) of continuing coordination of the proposed Edwards Aquifer Habitat Conservation Plan (EAHCP), components of which are located along the San Marcos River in San Marcos, Texas (**Figures 1 and 2**). The Edwards Aquifer Authority (EAA), working in partnership with the City of San Marcos (COSM) and Texas State University (TXST), is using the EAHCP to improve the conditions of the San Marcos River to promote the health and habitat of endangered aquatic species and to protect water quality through household hazardous waste management, native revegetation, non-native vegetation management, and recreation management actions. These actions, in turn, are subject to state-level archeological resource regulatory oversight outlined in the Antiquities Code of Texas (ACT). Through review of the proposed actions (as they are currently understood) and available background information, it is proposed that the components of the EAHCP will not likely adversely affect Historic Properties (resources eligible for or listed in the National Register of Historic Places) or State Antiquities Landmarks (SALs).

Of note, a similar letter to this has been prepared for the EAHCP's 2022 City of New Braunfels Work Plan which covers restoration activities along Landa Lake and the Comal River system within New Braunfels, Texas.

Regulatory/Management Summary

The EAHCP consists of a series of City or University-implemented improvement projects that the EAA reimburses through their EAHCP Program Management Fee. Construction will take place on land that is owned by the COSM and/or TXST, both political subdivisions of the State of Texas. Therefore, the

EAHCP falls under the state-level archeological resource regulatory oversight outlined in the ACT. Though 2022's proposed project actions are not subject to federal oversight that would require compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (Section 106), background research and regulatory recommendations are provided as though it were.

Project Description

As stated above, the EAHCP proposes to protect the water and habitat quality in Spring Lake and the San Marcos River through a series of restoration projects within and along the shores of the existing waterway (**Attachments 1** and **2**). According to the COSM and TXST Work Plan, within the San Marcos area there are approximately seven project components or conservation measures currently planned at locations along the San Marcos River as well as along Sessom Creek that include some physical construction/work (see Attachment 1 for Items 1-7). Nearly all these measures have been ongoing for several years, and some are spatial extensions of past projects that have been coordinated through your office previously (e.g., THC Ref. #202012176 and 202107829).

Based on the 2022 Work Plan project descriptions, many of the project components are of limited scope and potential to impact significant cultural resources. However, the EAHCP includes several projects involving workers manually removing of invasive plant species and planting native species in their place. These activities may impact intact native soils along and adjacent to the waterways (Items 1-2 and 5). Impacts will have a maximum depth of impact of less than one foot. Plantings will be incidental and will predominantly be less than a gallon in size. There is potential for shallowly buried cultural materials to be impacted by the plant removal and replanting projects, especially in locations adjacent to documented archeological sites and historic-age resources; however, these impacts are likely to be minor and in less well-preserved contexts. Previous EAHCP regulatory coordination (see THC Tracking #202012176) determined that a public-friendly cultural resource handout would serve as alternative mitigation for incidental impact to previously unrecorded archeological resources.

Of note in reference to the portions of Item 2 south of Interstate Highway (IH) 35: The COSM is actively working with the United States Army Corps of Engineers (USACE) on a different vegetation control initiative called the Riparian Restoration Plan (RRP). The RRP in this area largely overlaps what is depicted in this letter as an EAHCP component. The RRP is completely independent of the EAHCP. AmaTerra has coordinated that project separately (THC Ref# 202203827) and is currently developing field investigations to assess the RRP's potential to affect significant cultural resources. The only work preliminarily proposed for this area under the EAHCP is minor, incidental invasive plant cutting with no subsurface excavation.

The Sessom Creek sediment stabilization project (Item 7) is the only project with potential to impact cultural deposits. However, Phases 1 and 2 of this project have been surveyed for cultural resources under Texas Antiquities Permit 8867 (Miller and Korfmacher 2019). No further historic or archeological resources work is recommended, and the THC has reviewed and concurred with the report.

The floating plant removal (Item 3), invasive fauna removal (Item 4), recreation management (Item 6), and household hazardous waste programs will not likely result in impacts to any cultural resources.

Since the projects have overlapping footprints and some may take place anywhere within the overarching project area, the background research and environmental data are discussed in terms of the overarching project area rather than addressing each individual project separately. The parameters of each project will be discussed in more detail as it relates to the background overview.

Geology and Soils

The underlying geologic units of the project area are Quaternary-age alluvial floodplain deposits (Qal), Upper Cretaceous aged Del Rio Clay and Georgetown Limestone undivided (Kdg), and Late Cretaceous Eagle Ford Formation and Buda Limestone undivided (Keb) (**Figure 3**). The southern half of the project area overlays Holocene alluvial floodplain deposits which encompass the banks of the San Marcos River. In the northern section of the project area along the banks of Spring Lake, a section of the Del Rio Clay and Georgetown Limestone undivided formation encroaches upon the alluvium. The other geological formation within the project area is located in the northwestern portion of the project area and consists of the Eagle Ford Formation and Buda Limestone undivided.

Soils within the project area are derived from a series of floodplain deposits of Quaternary-age alluvium and marl from the Upper and Late Cretaceous formations. Five different soils are identified within the project are that consist of clays and silty clay loams (**Figure 4**). These are Oakalla silty clay loam (0-2% slopes, frequently flooded), Tinn clay (0-1% slopes), Lewisville silty clay (1-3% slopes), Krum clay (1-3 % slopes), Eckrant-Rock outcrop association (8-30% slopes), and Medlin, Eckrant association (8-30 % slopes).

Oakalla soils are characteristically well drained deep loamy soils that are formed in calcareous loamy alluvium and are commonly encountered within floodplains. Soils from this Series are the most common within the project area specifically the Oakalla soils frequently flooded (Ok) type.

Tinn clays are deep poorly drained soils that form in calcareous clayey alluvium and are commonly encountered on floodplains.

Lewisville silty clay is a well-drained, moderately permeable soil that formed in ancient loamy and clayey calcareous sediments.

The Krum series soils are well drained and consist of very deep to clayey alluvium, formed in calcareous clayey alluvium derived from interbedded chalk and marl.

Medlin series soils are deep, well drained, and slow permeable soils that formed in clayey marine sediments.

Eckrant series soils are very shallow to shallow, rocky, upland-variety, in-situ soils that immediately overlie limestone bedrock.

Many of the soils within the project area consist of alluvial silty clay loams. These soils have potential to contain not only surficial archeological deposits but deeply buried archeological materials as well that may be well preserved and in good context.

Previous Archeological Studies

A records search was conducted online through the Texas Archeological Sites Atlas (Atlas) maintained by the Texas Historical Commission (THC). The investigators identified all documented cultural resources and past archeological projects within 500 meters (0.31 miles) of the project area. The review identified 72 past archeological projects and 33 archeological sites within 500 meters of the project area (**Figures 5 and 6**).

The search revealed that 72 archeological projects consisting of several linear and area surveys, trench monitoring, marine investigations, and archeological excavations had been conducted within 500 meters (0.31 mile) of the project area. **Table 1** illustrates the archeological projects conducted within the project area including the date on which it was surveyed, sponsoring agency, company that conducted the work, type of work conducted, and recommendations.

Thirty-three archeological sites have been recorded within 500 meters (Figure 6). Of the 33 sites identified, 15 are located within or immediately adjacent to the project area. A brief description of the 15 adjacent sites is presented below. **Table 2** illustrates those nearest sites' distance from water, size, temporal setting, and NRHP/SAL listing potential/status.

41HY37 was recorded in 1979 as a prehistoric campsite and historic homestead site. Portions of the General Edward Burleson home were intact at the time of recording and a reconstruction of the original structure is now present on the site. Subsequent site revisits documents prehistoric lithic debris and stone tools at the site location. Depths of cultural material at the site extend to depths of approximately 2.4 meters. Site 41HY37 was listed as a SAL in 1999.

41HY133 was recorded in 1977 as an open campsite and midden on a knoll on the west bank of the San Marcos River. Material recorded at the site includes lithic debris, cores, a scraper, an Ensor point, burned bone, and burned limestone. The site had been partially disturbed by a sewer line and activity within the park where the site is located. Site 41HY133 was listed as a SAL in 1987.

41HY135 was recorded in 1977 as an open campsite on a prominent knoll on the bank the confluence of Purgatory Creek and San Marcos River. No size information was provided with the site form. Site 41HY135 was listed as a SAL in 1987.

41HY147 was recorded in 1979 as a multicomponent underwater site containing prehistoric lithics and artifacts associated with a mill site from the mid-19th century. The site is in Spring Lake of the San Marcos River, near the west bank. No size information was provided with the site form. A Pedernales point, and an 1860-1870 nickel were found at the site providing dates for the site. Site 41HY147 was listed as a SAL in 1999.

41HY160 was recorded in 1983 as a prehistoric campsite with a historic component. Artifacts recorded at the site include lithic debris and tools, ground stone artifacts, bone tools and faunal bone fragments, charcoal, and prehistoric ceramics. Subsequent revisits to site 41HY160 expanded the site boundary and documented significant historic deposits in addition to deposits of prehistoric cultural material which included Paleoindian materials. Site deposits potentially extend beyond 2.8 meters in depth. Site 41HY160 was listed as a SAL in 1999.

Table 1.Archeological survey projects within the project area.

Date	TAC Permit	Sponsoring Agency	Company	Type of Work	Recommendations
-	-	Unknown	Unknown	Unknown	Unknown
1987	-	FHWA		Survey	Unknown
1981	-	EPA		Survey	Unknown
1984	-	TPWD		Testing	Unknown
1996	-	TWDB		Survey	Unknown
1997	1811	City of San Marcos	Center for Archaeological Research	Testing at 41HY261	Site eligible for NHRP/SAL inclusion.
1999	2229	City of San Marcos		Survey and trenching of the Spring Lake Water Line	Data recovery recommended for 41HY37 and testing recommended for 41HY306.
2000	2308	LCRA		Survey	Unknown
2000	2406	Southwest Texas State University		Testing at 41HY37	Preservation of Feature 4 and potential use of site for public education purposes.
2001	-	Unknown	Unknown	Unknown	Unknown
2001	2396	Texas State University	Center for Archeological Studies	Monitoring of Tree Planting Project	Additional monitoring may be required
2001	2510	Texas State University	Center for Archeological Studies	Testing at 41HY160	Site eligible for NHRP/SAL inclusion.
2002	-	Texas State University		Monitoring	Unknown
2002	-	City of San Marcos		Survey	Unknown
2004	3438	Texas State University	Center for Archeological Studies	Data Recovery	Unknown
2005	3885	City of San Marcos	Texas State University	Survey of Rio Vista Park	If future impacts extend beyond 50 cmbs within 41HY393, additional work recommended to investigate potential deeply buried deposits.
2005-2006	3870	Texas State University	Texas State University	Survey and Monitoring of a fiber optic line.	Additional work may be required at 41HY160

Date	TAC Permit	Sponsoring Agency	Company	Type of Work	Recommendations
2006	4015	City of San Marcos	Texas State University	Survey and monitoring at Rio Vista Dam	No further work within project area
2007	4443	City of San Marcos	Hicks & Company	Survey for pedestrian bridge	Site not NRHP/SAL eligible
2010	5509	Texas State University	Center for Archeological Studies	Survey and monitoring on University properties.	41HY477 and investigated portion of 41HY161 not NRHP/SAL eligible
2011	5582	USACE	Center for Archeological Studies	Terrestrial and Underwater Survey of Spring Lake	Mitigation plans devised
2011	5869	City of San Marcos	Center for Archeological Studies	Trench Monitoring for waterline	Disturbed no sites found
2011	5943	Texas State University	Center for Archeological Studies	Monitoring of storm water outflow and waterline installation and testing at 41HY261	Site 41HY261 is NRHP/SAL eligible and construction impacts should be mitigated
2011	6001	City of San Marcos	Center for Archeological Studies	Linear Survey of .5-mile water main	Site ineligible for NRHP/SAL inclusion
2011	6058	City of San Marcos	Hicks and Company	Survey for street drainage project	No significant sites found
2012	6158	Texas State University	Center for Archeological Studies	Survey and monitoring on University properties	Additional investigations recommended within updated 41HY161 site boundary
2012	6365	Edwards Aquifer Authority	AmaTerra Environmental, Inc.	Survey	Additional monitoring may be required
2013	6595	City of San Marcos	Horizon	Survey of proposed hiking trail	Site 41HY489 not SAL eligible within the project area
2013	6679	City of San Marcos	Center for Archeological Studies	Monitoring of HCP locations within City Park	Further work at 41HY319 recommended for impacts greater than 2 feet
2014	6202	City of San Marcos	Center for Archeological Studies	Monitoring of Riverside Drive Reconstruction Project	City should continue to coordinate all potential impacts to 41HY261 with the THC.

Date	TAC Permit	Sponsoring Agency	Company	Type of Work	Recommendations
2014	6307	City of San Marcos	Cox McLain	Survey and monitoring of Sessom Creek Wastewater Improvement Project	Further work conducted at 41HY161 under other permits, no further work recommended elsewhere in the project area.
2014	6679	City of San Marcos	Center for Archeological Studies	Monitoring of Mechanical Excavation for HCP	Additional survey recommended
2014	6775	Texas State University	Center for Archeological Studies	Survey for proposed undertakings on TXST property	Avoidance or additional work recommended for sites 41HY160, 41HY161, 41HY37 and 41HY447
2016	7500	Texas State University	Center for Archeological Studies	Survey for proposed undertakings on TXST property	Avoidance or additional work recommended for sites 41HY160, 41HY161, 41HY531, 41HY37 and 41HY447
2017	7880	TxDOT	AmaTerra	Survey along IH-35 for roadway improvements between SH80 to RM 12.	Archeologists revisited Site 41HY261 and newly recorded Site 41HY534. No further work recommended.
2019	8609	City of San Marcos	AmaTerra	Pedestrian and backhoe survey along Purgatory Creek for proposed flood control improvements.	Archeologists revisited 41HY135 and newly recorded Sites 41HY551, 41HY552, and 41HY553. Sites 41HY135 and 41HY553 recommended for avoidance.
2019	8867	City of San Marcos	AmaTerra	Survey for the EAHCP's and City of San Marcos's proposed Sessom Creek Stream Restoration Project (Phases 1 and 2; see Attachment 1, Item 7)	Project area determined to be devoid of archeological deposits. No further work recommended in Phase 1 and 2 footprints.

Table 2. Recorded archeological sites within or immediately adjacent to the project components.

Site	Est. distance from water	Size	Temporal setting	Listing potential
41HY37	On the bank of Spring Lake	425 x 150 m	Prehistoric Campsite and historic remains associated with ruins of a house	Listed SAL in 1999; NRHP Eligible
41HY133	Along the west side of the San Marcos River	Not stated	Prehistoric campsite and Midden	Listed SAL in 1987; NRHP Eligible
41HY135	At the confluence of Purgatory Creek and the San Marcos River (on banks)	Not stated	Unknown prehistoric campsite	Listed as SAL in 1987
41HY147	Underwater site at Spring Lake of the San Marcos River near the west bank	Not stated	Multi-component. Transitional Archaic to 19th century historic	Listed as SAL in 1999
41HY160	On the bank of Spring Lake	114,667 m^2	Paeloindian to Late Prehistoric campsite; 19th-20th century historic	Listed SAL in 1999; NRHP Eligible
41HY161	Edge of site boundary extends to riverbank	120 x 250 m	Multi-component; Unknown prehistoric to historic	Listed SAL in 1987
41HY164	Along the San Marcos River	Not stated	Thompson's Dam and Millrace Site	Contributing resource to the Thompson-Cape Dam and Ditch Engineering Structure Location-Restricted National Register Property
41HY165	On the bank of Spring Lake	35,970 m^2	Paleoindian to historic	Research potential high, considered eligible for SAL and NRHP listing
41HY166	On the west bank of the San Marcos River	330 x 180 m	Late to Transitional Archaic, buried occupation site with temporal diagnostics and one observed buried hearth feature.	Currently listed as "undetermined" but recommended for avoidance below 555-foot elevation contour line.
41HY261	On the east bank of the San Marcos River	50,000 m^2	Historic Dam and Millrace and prehistoric occupation	Listed as SAL in 2013
41HY319	On the east bank of the San Marcos River	45 x 60 m	Unknown prehistoric lithic scatter	Not considered eligible
41HY425	On the west bank of the San Marcos River	100 x 40 m	Historic Scatter	Not considered eligible

Site	Est. distance from water	Size	Temporal setting	Listing potential
41HY432	On the east bank of the San Marcos River	30 x 30 m	Unknown prehistoric scatter	Listed as SAL in 1987
41HY489	On the east bank of the San Marcos River	570 x 200 m	Late 19th to mid-20th century midden, and unknown prehistoric lithic scatter	Not considered eligible

41HY161, also known as the Ice House Site, was originally recorded in 1979 (although the first site form on record dates to 1990). Little information is contained in the first site form, although the site is considered eligible for NRHP listing. A revisit site form dated April of 2010 discusses a multi-component site consisting of mixed historic and prehistoric components. Test units were excavated and produced 19th century and modern ceramics, nails, hardware and unknown metal, debitage, a biface, snail and mussel shell, window glass, vessel glass, brick and buttons. The size of the site was recorded as 9 meters x 11 meters and up to 90 centimeters below surface (cmbs). The two excavated test units served to expand the original dimensions of 41HY161 to include this new information. Another site revisit conducted in October 2010 further expanded the site dimensions by 120 meters x 250 meters. Site 41HY161 was revisited by AmaTerra in 2013 during a survey; results from a backhoe trench placed outside the recorded boundary expanded the site boundary to include the trench location. Site 41HY161 was listed as a SAL in 1987.

41HY164 was recorded in 1983 as the remains of the Thompson's Dam and Millrace site. The site was identified by the presence of the original dam, the artificial sluiceway, and the concrete foundation to the millwheel. Other structures were formerly present in the site area, but no surface expressions of those structures remain. The only prehistoric artifact documented at the site was a Travis dart point. No subsurface investigation was conducted at the site and buried components are likely present. The site is part of the Thompson-Cape Dam and Ditch Engineering Structure National Register District (Location Restricted).

41HY165 is a prehistoric open campsite located along the southeast shore of Spring Lake. The site was the subject of a Southwest Texas State University field school in 1984. The site contained chert flakes and bifaces and may be an extension of 41HY161 or 41HY47, as well as possibly extending into the lake. A portion of the site has most likely been buried by the construction of the dam. The original recordation recommended further work and suggested that the site may be eligible for NRHP and SAL listing, and was registered as a SAL in 1999. A 2011 revisit recorded a burned rock midden, occupations site and lithic scatter at 41HY165. The site was described as a multicomponent site with artifacts representing continuous episodes of habitation extending from the Paleoindian period to the historic era. The 2011 site form suggests the site measures 35,970 square meters and deposits up to 280 cmbs, with approximately 75% of the site remaining intact. The research value of 41HY165 is considered extremely high and in addition to its SAL listing, the site is considered eligible for NRHP inclusion.

41HY166 is a prehistoric-age occupation site observed between 10 and 150 centimeters below the ground surface. The site was first recorded in 1984 as part of Texas Parks and Wildlife Department's Fish Hatchery project. The investigators dug five backhoe trenches and four shovel tests during their

site investigations and recovered two dart points (Montell and Ensor) and a potential Castroville or Montell point preform among the lithic debris. The site recorder noted observing a buried, intact hearth feature at 140 centimeters below the surface that included burned rock, lithic debitage, charcoal, and faunal remains. The site's NRHP and SAL eligibility is listed as "undetermined," but the recorder recommended that future construction avoid the portions of the site that were below the 555-foot elevation contour where the deposits were seemingly intact.

41HY261 is a historic dam and millrace that was built atop a prehistoric occupation site. The prehistoric occupation is estimated to date between the Late Paleoindian and Late Prehistoric. The historic component of the site was reported to have been constructed around 1880. The depths of cultural deposits at the site are estimated to extend to depths of six to 20 feet. In 1994 the site was estimated to be approximately 90% intact, though that percentage varies between site revisits. The site was listed as a SAL in 2013 and is considered eligible for NRHP listing.

41HY319 is a lithic scatter of unknown age located on the east bank of the San Marcos River. The site is recorded as being 2,773 square meters and roughly 30% intact. A 2010 site revisit reduced the size of the site to 45 meters x 60 meters with deposits being roughly up to 120 cmbs. The 2010 site form suggests site 41HY319 is not eligible for SAL or NRHP listing.

41HY425, also known as Roger's River Resort, was recorded in 2006 as an early 20th century historic scatter containing features and artifacts associated with the resort. The resort was operational from 1912 to the 1950's. The site recorded glass, historic ceramic, and floor tiles. Archeologists also recorded three in situ foundations, another with a structure (an operable park ranger substation), three additional removed foundations, and two foundations encountered in a backhoe trench. Each of these features were spaced approximately two meters apart. The site is approximately 100 x 40 meters and extends down to 110 cmbs. In 2007 the site was listed as ineligible for SAL or NRHP listing.

41HY432 is a low density prehistoric lithic and burned rock scatter found on the east bank of the San Marcos River. The site is approximately 30 meters x 30 meters and has deposits between 10 and 70 cmbs. No diagnostics were encountered at the time of recordation and the site is not considered eligible for SAL or NRHP listing.

41HY489 was recorded in 2013 as a Late 19th to mid-20th century midden, and prehistoric lithic scatter of unknown age, located on an alluvial terrace east of the San Marcos River. The site is approximately 570 x 200 meters and contains deposits extending down to 45 cmbs. The site recorded lithic flakes, a burnt rock, a burnt bone fragment, whiteware sherds, wire nails, a belt buckle, ferrous metal, amethyst glass shards, aqua glass shards, green glass shards, and colorless glass shards. Site 41HY167 is considered undetermined for SAL and NRHP eligibility.

Identified Historic Resources

In addition to the numerous archeological sites and surveys recorded in the project vicinity, six properties listed on the National Register of Historic Places (NRHP), one NRHP historic district, one Recorded Texas Historic Landmark (RTHL), and several Official Texas Historical Markers (OTHM) are located within 500 meters of the project location (**Figure 5**). None of these properties are within or adjacent to the project area; the closest is the RTHL Fish Hatchery Office Building, approximately 280 feet west of the San Marcos River across University Drive. Due to the nature of the proposed

work, project historians recommend the Area of Potential Effect (APE) for historic properties be limited to the proposed project area footprint.

Regulatory Recommendations

Through this letter, AmaTerra requests the THC's concurrence with the recommendations provided for compliance with the ACT and in anticipation of potential Section 106. Based upon a review of the potential impacts associated with the proposed EAHCP, the Principal Investigator recommends that several project components have minimal potential to impact historic properties and/or SALs and should be cleared to proceed with no further cultural resource coordination required. If project plans remain as they are currently understood, shallow impacts from revegetation efforts in the vicinity of known sites or previously unsurveyed areas may impact archeological resources (Items 1, 2 and 5). Since all projects which have potential to impact sub-surface cultural deposits are incidental and will be shallow (less than one foot in depth), public outreach is recommended in lieu of archeological survey for all plantings under five gallons in size. This includes the portion of Item 2 located south of IH-35 that corresponds with the non-EAHCP COSM/USACE RRP described above and coordinated independently under (THC Ref# 202203827). As alternative mitigation for potential isolated and limited-scale incidental impacts stemming from vegetation control and planting activities, EAA plans to continue to distribute the public brochure it developed in 2021 (see THC Ref. #202107829) to riparian planting crews. In addition, the City will notify the THC if plantings larger than five gallons are anticipated in any location. A summary of project-specific recommendations is provided in **Attachment 1** below.

Thank you for your time in reviewing this submittal. If you have any questions or wish to discuss this further, please feel free to contact me at 512-329-0031 or mmiller@amaterra.com.

Sincerely,

Mason Miller
Archeological Principal Investigator

Cc: Olivia Ybarra, Edwards Aquifer Authority; Kristina Tolman, Edwards Aquifer Authority; Jamie Childers, Edwards Aquifer Authority; Melani Howard, City of San Marcos

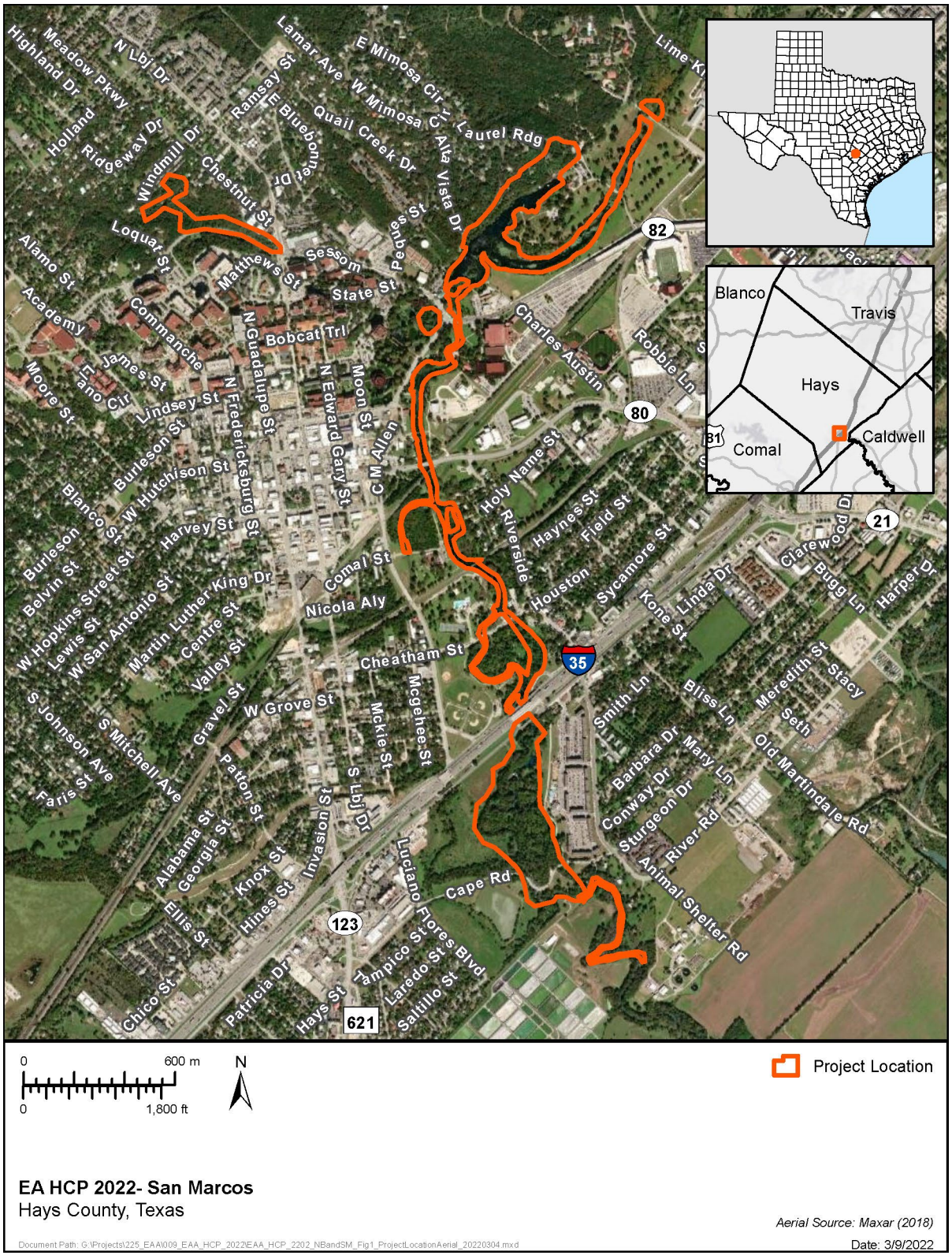

Figure 1. Project location map (aerial photo base).

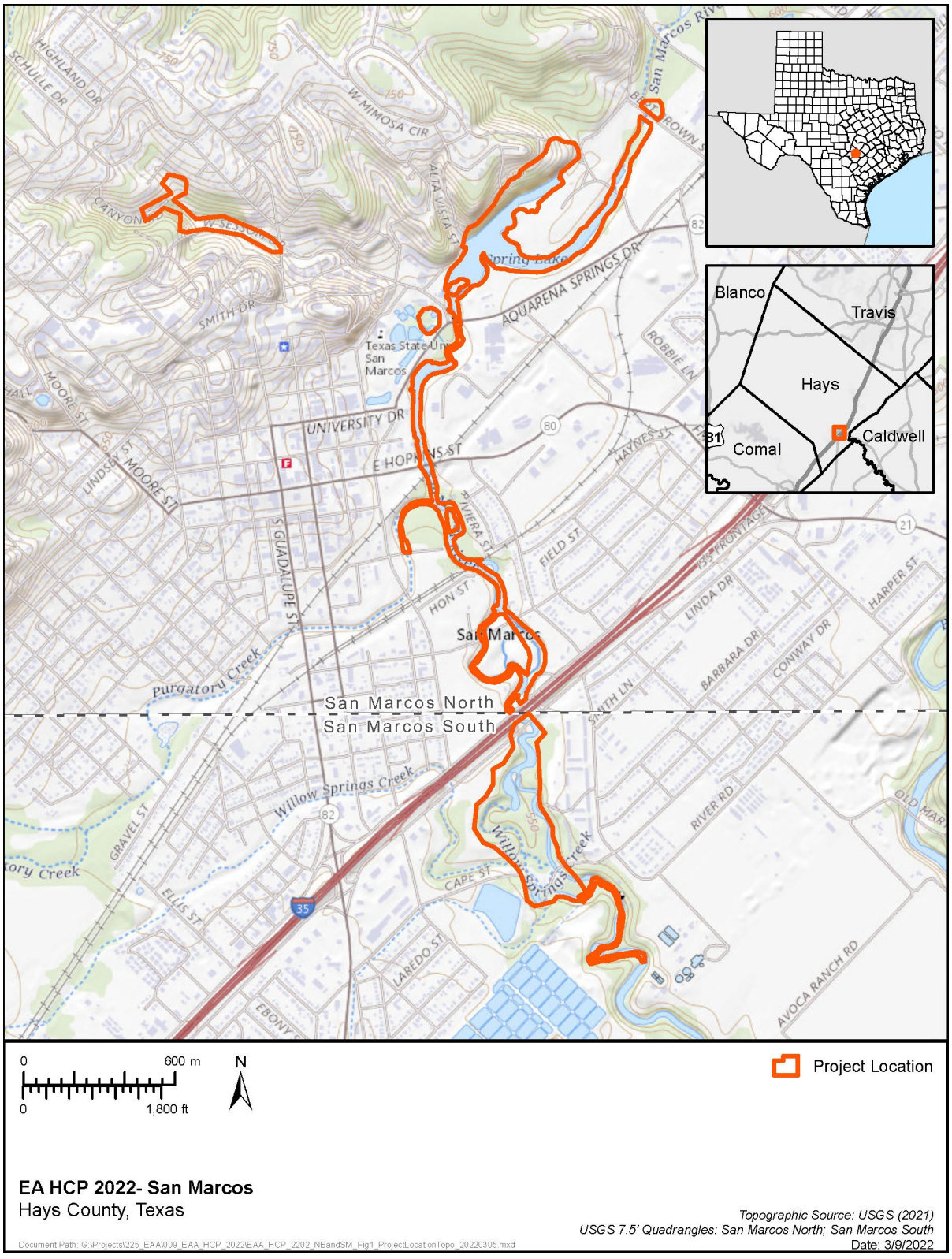

Figure 2. Project location map (USGS topo base).

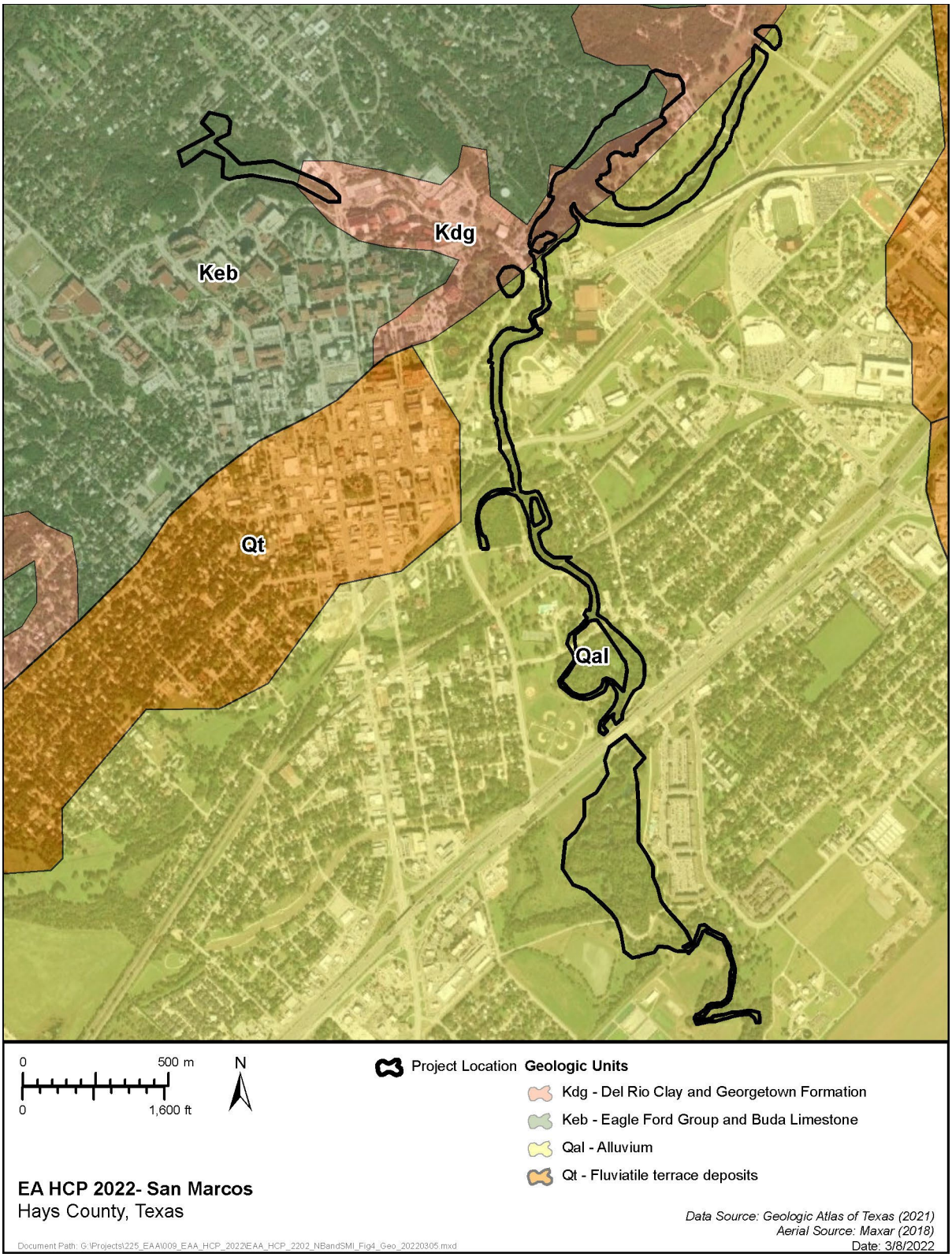

Figure 3. Map depicting the underlying geology of the project area.

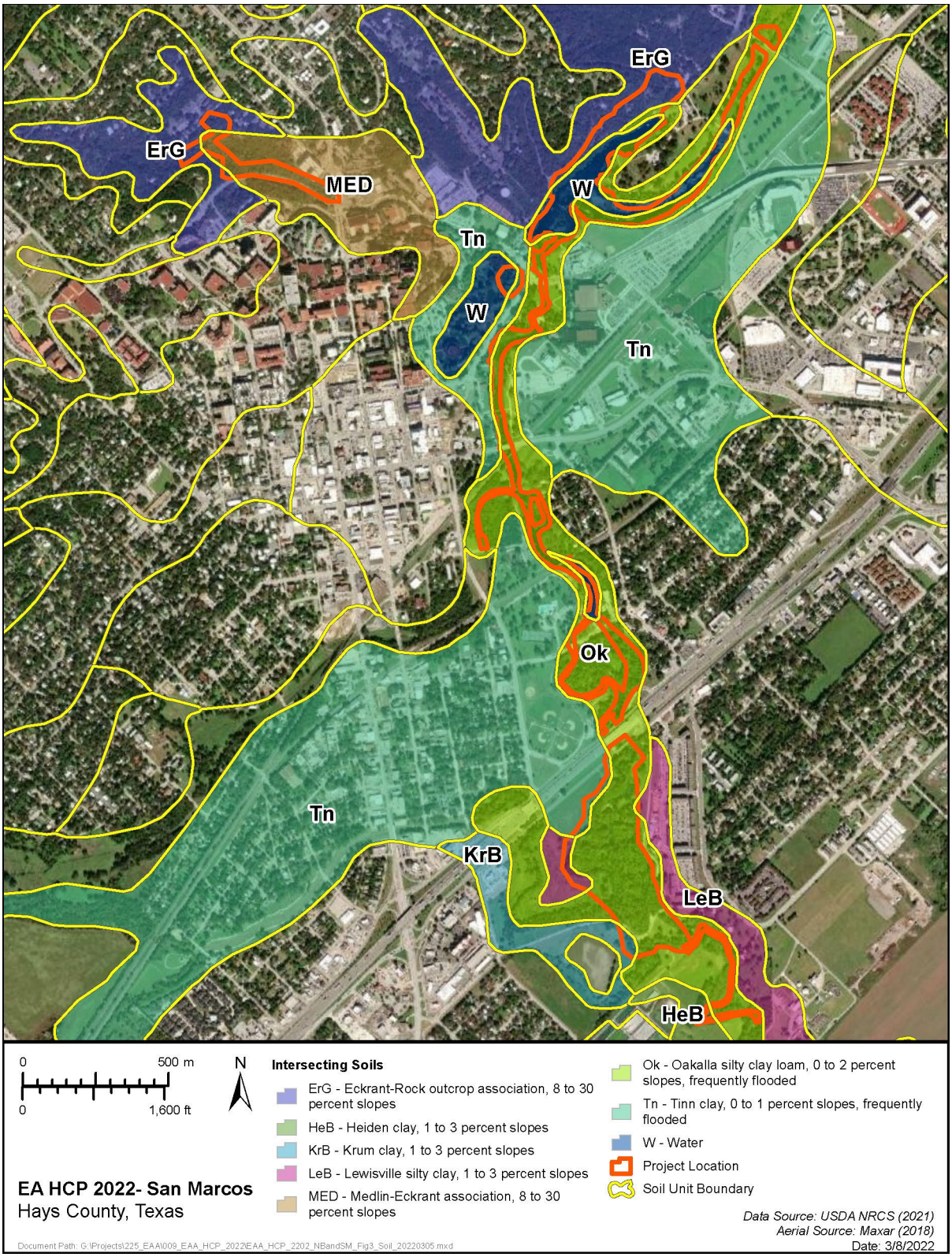

Figure 4. Soil map of the project area.

Surveys Key for Figure 5

Map ID	Year	Permit	Sponsor	Company
AS01	-	-	Unknown	
AS02	1997	-	Southwest Texas State University	
AS03	1984	-	Texas Parks and Wildlife Department	
AS04	1981	-	Environmental Protection Agency	
AS05	2001	-	Unknown	
AS06	1996	-	Texas Water Development Board	
AS07	1998	-	US Army	
AS08	1977	-	Soil Conservation Service	
AS09	1981	252	Lower Colorado River Authority	
AS10	1995	1495	Texas Parks and Wildlife Department	
AS11 & AS12	1997	1811	City of San Marcos	Center for Archeological Research
AS13	1998	1935	Texas Parks and Wildlife Department	TPWD
AS14 & AS15	2001	2396	Texas State University	TXST
AS16 & AS17	2000	2406	Southwest Texas State University	SWTXST
AS18	2001	2510	Texas State University	Center for Archaeological Studies
AS19	2006	2623	Texas State University	Center for Archaeological Studies
AS20 & AS21	2001	2624	Southwest Texas State University	SWTXST
AS22 & AS23	2003	2907	Southwest Texas State University	SWTXST
AS24	2004	3438	Texas State University	Center for Archaeological Studies
AS25	2005	3847	U. S. Department of Energy	SWCA
AS26 & AS27	2006	3870	Texas State University	Texas State University
AS28	2005	3885	City of San Marcos	Texas State University
AS29	2006	4015	City of San Marcos	Center for Archeological Research
AS30	2007	4443	City of San Marcos	Hicks & Company
AS31	2008	4841	Universities	Center for Archaeological Studies
AS32	2008	4871	University	Center for Archaeological Studies
AS33	2008	5059	Texas State University	Texas State University

Map ID	Year	Permit	Sponsor	Company
AS34	2009	5416	Texas State University	Center for Archaeological Studies
AS35	2010	5509	Texas State University	Center for Archaeological Studies
AS36	2011	5582	Corps of Engineers	Center for Archaeological Studies
AS37	2010	5634	Texas Department of Transportation	Stars, Inc.
AS38	2010	5751	Hays County	Cox/McLain Environmental Consulting
AS39	2011	5869	City of San Marcos	Center for Archaeological Studies
AS40	2011	5938	Texas State University	Texas State University
AS41	2011	5943	Texas State University	Center for Archaeological Studies
AS42	2011	6001	City of San Marcos	Center for Archaeological Studies
AS43	2011	6058	City of San Marcos	Hicks & Company
AS44	2012	6158	Texas State University	Center for Archaeological Studies
AS45	2014	6202	City of San Marcos	Center for Archaeological Studies
AS46	2012	6208	City of San Marcos, Texas Department of Transportation	Blanton & Associates, Inc.
AS47	2014	6307	City of San Marcos	Cox McLain
AS48	2012	6365	Edwards Aquifer Authority/City of San Marcos	AmaTerra Environmental, Inc.
AS49	2013	6444	Texas State University	Center for Archaeological Studies
AS50	2013	6595	City of San Marcos	Horizon
AS51	2013	6679	City of San Marcos	Center for Archaeological Studies
AS52	2014	6775	Texas State University	Center for Archaeological Studies
AS53	2015	7132	Texas State University-San Marcos	Center for Archaeological Studies
AS54	2015	7155	Texas State University	Center for Archaeological Studies
AS55	2015	7171	City of San Marcos	Center for Archaeological Studies
AS56	2016	7500	Texas State University	Center for Archaeological Studies

Map ID	Year	Permit	Sponsor	Company
AS57	2017	7880	TxDOT	AmaTerra Environmental, Inc.
AS58	2017	7884	City of San Marcos	Center for Archaeological Studies
AS59 to AS62	2017-2018	7900	Texas State University	Center for Archaeological Studies
AS63	2017	8158	Hays County	Cox McLain Environmental Consulting, Inc.
AS64	2018	8332	City of San Marcos	Center for Archaeological Studies
AS65	2019	8609	City of San Marcos	AmaTerra Environmental, Inc.
AS66	2019	8867	City of San Marcos	AmaTerra Environmental, Inc.
AS67	2019	8908	HUD	Cox McLain Environmental Consulting, Inc.
LS1	1987	-	FHWA	
LS2	1999	2229	City of San Marcos	
LS3	2000	2308	LCRA	
LS4	2000	2486	TXST	TXST
LS5	2002	2872	City of San Marcos	SWTXST

National Register Property Key for Figure 5

Map ID	Name	Reference Number	Atlas Number	Date Listed
A	Belger-Cahill Lime Kiln	83004490	2083004490	8/26/1983
B	Moore Grocery Company	83004506	2083004506	8/26/1983
C	Green and Faris Buildings	83004498	2083004498	8/26/1983
E	Hardy-Williams Building	83004499	2083004499	8/26/1983
F	Cock House	73001966	2073001966	4/2/1973
G	Hays County Courthouse	80004134	2080004134	5/23/1980
D	San Marcos Milling Company	83003799	2083003799	12/1/1983
H	Main Building, Southwest Texas Normal School	83004505	2083004505	8/26/1983
I	McKie-Bass Building	83003797	2083003797	12/1/1983
J	Hutchison House	83004503	2083004503	8/26/1983

Historical Marker Key for Figure 5

Map ID	Number	Marker Name	Year
OTHMs			
A	10272	First National Bank of San Marcos	1979
B	10280	Hays County Courthouses	1974
C	10292	Lime Kiln	1976
D	10303	Mexican War Camp	1972
E	10304	Mission San Francisco Xavier de los Delores	1936
F	10305	Moon, William W.	1975
G	10311	Post San Marcos	1973
H	10323	San Marcos Mill Tract	1986
I	10324	San Marcos National Fish Hatchery	1968
J	10325	San Marcos Springs	1971
K	10331	Thompson's Islands	1993
L	10274	Site of Hays County's First Public Building	1967
M	14273	Harper's Hall, Site of	1993
RTHLs			
A	10252	Cock, Charles S.	1968
B	10275	Fish Hatchery Office Building	1982
C	10283	Hutchison, Beverly	1968
D	10302	Merriman, Eli T.	1965
E	10307	Old Main	1963
F	16941	Southside School	2011

Attachment 1: Summary of EAHCP Components within the San Marcos Area and Regulatory Recommendations*

Item	Item Title (EAHCP Section)	Location	Work Summary	Estimated Impacts	Archeological Resource Recommendations	Historic Resource Recommendations
1	Texas Wild Rice Enhancement (5.3.1/5.4.1)	Spring Lake San Marcos River (Below IH-35)	The enhancement and restoration of Texas wild rice (TWR) will occur in two locations: 1) the lower section of Spring lake, above the spillway and 2) within the San Marcos River Channel below IH-35 to Cape Road. Invasive plants will be removed and specimens of potted TWR will be planted in their place.	Non-native plant species will be removed by hand, collected, checked for trapped fauna, and deposited at a composting facility. Trapped fauna will be returned to the river. TWR will be transplanted and grown from mature seeds. Transplanted TWR plants will be planted in 8-inch/one-gallon pots and replanted along the waterway after their roots develop. Expected depths of impacts are approximately one foot along the edge of the water body.	All work performed will be within the banks of the lake and river channel with a maximum depth of impact at approximately one foot. ***Continued public outreach brochure use recommended in lieu of archeological survey.***	All proposed work would be under water. With no potential to impact historic properties, *no survey recommended*.
2	Control of Non-Native Plant Species (5.3.8/5.4.3/ 5.4.12)	San Marcos River Spring Lake	Non-native aquatic and littoral plant species will be removed and replaced by native plants after a period of monitoring.	Divers manually remove invasive species and plant native plant species in selected aquatic and littoral areas. Non-native species, including hydrilla and hygrophila, will be removed by hand, collected, checked for trapped fauna, and deposited at a compositing facility. The removed plants will be replaced with native plant species, following the restoration goals outlined in the EAHCP. Where it is proposed, planting methodology is similar to the proposed TWR enhancement described above. Expected depths of impacts are approximately one foot along the edge of the water body. Most of the shoreline control areas are in maintenance stage, meaning periodic spot-removals, though seven sites require more intensive removal work: 1) shoreline and terrace northwest of Spring Lake; 2) Sink Creek channel northeast of Spring Lake, beyond Ben Brown Street; 3) in the San Marcos River channel below the Spring Lake spillway; 4) artificial pond at the	The replacement of non-native flora with native has limited potential to impact archeological deposits. ***Public outreach recommended in lieu of archeological survey except along the west bank of the San Marcos River between I-35 and Cape Road, which includes areas identified as needing survey in coordination of the San Marcos Riparian Restoration Project (THC Ref# 202203827). It is anticipated that planned survey associated with that project will encompass the same area as this project.***	No listed or eligible properties present at these locations. Potential to impact historic properties would be minimal; *no survey recommended*.

Item	Item Title (EAHCP Section)	Location	Work Summary	Estimated Impacts	Archeological Resource Recommendations	Historic Resource Recommendations
				Freeman Aquatic Biology Building; 5) San Marcos River western shoreline off University Drive; 6) small island in San Marcos River Channel immediately above IH-35 crossing; 7) and south of IH-35 to Stokes Park. Under the EAHCP, all work in these areas will be limited to invasive species removal. No replacement plantings are proposed at this time.		
3	Management of Floating Vegetation Mats and Litter (5.3.3/5.4.3)	San Marcos River Spring Lake	Management of floating vegetation mats and litter on TWR stands and other aquatic vegetation.	Nuisance floating plant species, including algae, are removed from Spring Lake and TWR stands in the San Marcos River at specified intervals. Inorganic litter will also be collected from the waterways and adjacent public lands. No subsurface impacts are anticipated.	As no subsurface impacts are anticipated during the collection of floating plant species and litter, *no further work is recommended.*	All proposed work would be within the banks of the lake and river. With no potential to impact historic properties, *no survey recommended*.
4	Non-Native Animal Species Control (5.3.5/5.3.9/ 5.4.11/5.4.13)	San Marcos River Spring Lake	Non-native, invasive faunal species (e.g. suckermouth catfish, tilapia, nutria) will be removed from the aquatic ecosystem.	Spear and bow fishing equipment, hand picking, and trapping will be utilized to capture invasive fish, and snails. Captured fauna will be documented and removed and/or euthanized. Methods used in trapping will avoid impacts to resident turtles and other native species. Minimal impact to the shoreline is anticipated.	As no subsurface impacts are anticipated during the capture of invasive faunal species, *no further work is recommended.*	All proposed work would be within the banks of the lake and river. With no potential to impact historic properties, *no survey recommended*.
5	Native Riparian Habitat Restoration (5.7.1)	San Marcos River	Native riparian habitat restoration will include the establishment of a water quality buffer and the treatment of non-native growth. Also reduces recreational foot traffic and resultant erosion.	Invasive species will be removed and/or treated using specified herbicides by a licensed herbicide applicator. Native plants propagated at the Discovery Center will be planted by volunteers in treated areas after a period of monitoring. Seedlings for planting will be predominantly held in one-gallon pots. Tree removal will not impact the soil, as the stumps will remain in place, the underlying root structure inhibiting erosion. Anticipated depths of impacts do not reach more than one foot.	Native riparian habitat will require planting native flora and the anticipated depth of impact of planting and cutting trees down to stumps is one foot. ***Public outreach recommended in lieu of archeological survey.***	No listed or eligible properties present at these locations. Replacement of non-native riparian vegetation has minimal potential to impact historic properties; *no survey recommended*.

Item	Item Title (EAHCP Section)	Location	Work Summary	Estimated Impacts	Archeological Resource Recommendations	Historic Resource Recommendations
6	Management of Recreation in Key Areas (5.3.2/5.4.2)	San Marcos River	Recreation management in key areas to limit impacts of incidental take from recreational activities.	Management strategies include public and school outreach, update of kiosk signs, video slides, trail maps, EACHP brochures, utilization of park rangers, and monitoring. Monitoring for Zebra mussels and the removal of litter. No subsurface impacts are anticipated.	The update of kiosk signs and trail maps should have no subsurface impact. *No further work recommended.*	Updating existing signs and trail maps has no potential to impact historic properties; *no survey recommended*.
7	Impervious Cover and Water Quality Protection (5.7.6)	Sessom Creek	Impervious cover and water quality protection include the implementation of the stream restoration project at Sessom Creek.	Phases I and 2 of the Sessom Creek project have been coordinated with the THC (see Permit 8867). AmaTerra Environmental, Inc. surveyed this area in 2019 and received concurrence that it should proceed with no adverse effects. Construction of Phase 1 will begin in 2022. Water quality sampling and monitoring prior to construction will set pre-construction parameters, and water quality monitoring will continue to monitor sediment loads in the water.	Phase 1 of the Sessom Creek Project will include the monitoring of sediment loads in the water and construction to stabilize sediment erosion. This area has been previously surveyed in recent years under TAC permit 8867. *No further work is recommended.*	This project area was previously surveyed by architectural historians in 2019 concurrent with archeological survey; no historic properties identified within the project area. *No further survey is recommended*.

* Table excludes EAHCP Items 5.2.1 (New/Old Channel Flow Split Management), 5.2.3 (Public Recreation Management), 5.2.4 (Hazardous Waste Transport Prohibition), and 5.2.11 (Golf Course Management) because they are unfunded for this year and are not likely to impact significant cultural resources.

Attachment 2: City of San Marcos 2021 EAHCP Work Plan Document

City of San Marcos/Texas State University

2022 Work Plan

2022 San Marcos/Texas State University Work Plan Budget

EAHCP Section	Conservation Measure	Table 7.1	Estimated 2022 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
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	$20,000	$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[B]	$1,100,000[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	***$616,000***	***$1,496,377***

A.) Difference of $80,000 (Texas wild-rice), $32,879 (Floating Veg Mats and Litter), and $11,744 (Non-Native Species Control) will go towards the Control of Non-Native Plants 2022 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. However, due to over expenditures in 2013, 2014, and 2015, there is no more funding available in the Sediment Management Conservation Measure.

C.) Funding will cover Sessom Creek Phase 1 channel restoration and construction administration services as well as bid oversight of Sessom Creek Phase 2.

2022 City of San Marcos/TxState Work Plan and Funding Application Amendments

Amendment #	Date EAHCP Committee Approved	Conservation Measure Amended	Y/N Funding Application Change	Funding Application Change ($)	Date EAA Board Approved	Comments
0	5/20//2021	Original Work Plan	NA	NA	NA	Original Work Plan

5.3.1/5.4.1 Texas Wild-Rice Enhancement and Restoration

Long-term Objective:
To achieve 8,000 – 15,450 m^2 of Texas wild-rice (TWR) and maintain existing and restored areas of TWR as required by the EAHCP.

Target for 2022:
The target area for planting TWR in 2022 is in the lower section of Spring Lake above both spillways to enhance the current TWR populations and in the expanded area below I-35. (Figure 1). The area between Hopkins Street and Cypress Island was designated as a primary work zone in 2021 and received extensive *Hydrilla* removal resulting in large areas denuded of submerged vegetation. From Spring Lake Dam to IH-35, TWR will be encouraged to expand naturally through the continued removal of invasive species within and around the perimeter of TWR stands or planted as needed. These efforts work towards attaining the 2027 biological goals as shown in Table 1.

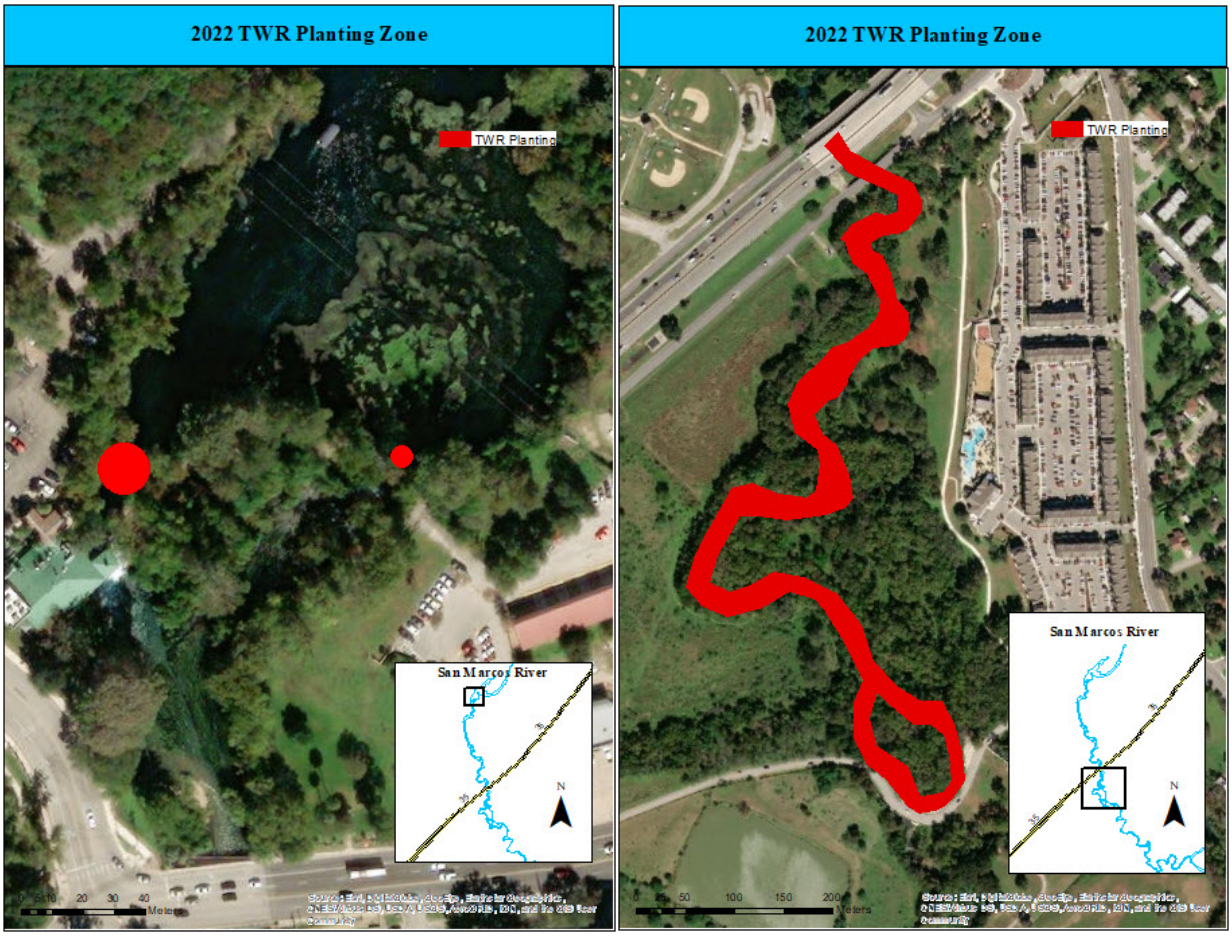

Figure 1. Proposed TWR planting sites for 2022

Table 1. TWR coverage in 2013, 2020, and 2027 long-term biological habitat goals

Reach	2013	2020	2027 Goal
Spring Lake	47	221	1000
Spring Lake Dam	376	1496	700
Sewell Park	945	1598	1100
Below Sewell-City Park	1733	3712	2300
City Park	351	2677	1750
Below City-Hopkins	NA	2224	NA
Hopkins St-Snake Island	718	1042	950
Snake Island-Cypress	NA	136	NA
Cypress Island-Rio Vista	0	353	350
IH-35 (Upper & Lower)	361	975	1050
Below IH-35	125	153*	280

*Spring 2021 MCWE Mapping

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 of non-natives 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 necessary.

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 provided by USFWS staff at the San Marcos Aquatic Research Center (SMARC). USFWS SMARC staff collect mature seeds from the panicle by gently pulling upwards until seeds are released. 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 by MCWE staff 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 USFWS staff at SMARC by removing them from floating vegetation mats or from fragments attached to mature plants in the river. TWR tillers are transported from SMARC 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 roots. 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. 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 & Control of Non-Native Plants). 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 Biological Monitoring program. The data collected is used to evaluate TWR coverage and identify areas of concern.

Budget:
Table 7.1:
$100,000

Estimated 2022 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 aquatic vegetation 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 m^3 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.

Target for 2022:
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*

Estimated budget for 2022:
$0

***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. However, due to over expenditures in 2013, 2014, and 2015, there is no more funding available in the Sediment Management Conservation Measure.**

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 2022:
In 2022, the removal of non-natives and planting of natives will adopt the following strategy to ensure best use of EAHCP funds and facilitate the achievement of long-term biological goals.

Hygrophila will be removed by the contractor following the top-down protocol. In 2022, this will coincide with *Hydrilla* removal, starting below the section finished in 2021 and continuing downstream.

Figure 2 (below) represents the 2022 work zone for removal of non-native aquatic plant species. The 2021 work zones will be reclassified as recovery zones in 2022. 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.

To prevent regrowth, the top priority for 2022 will be maintaining the 2021 work zones due to the large dense areas of *Hydrilla* that have been removed. The 2021 work zone had a large removal effort for non-native vegetation resulting in the largest recovery zone. This area will be regularly worked from upstream to downstream via snorkeling and SCUBA diving to prevent regrowth. Secondary priority will be making downstream progress in the new 2022 work zones which will follow the method of removal from upstream to downstream.

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 in Table 34 have 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.

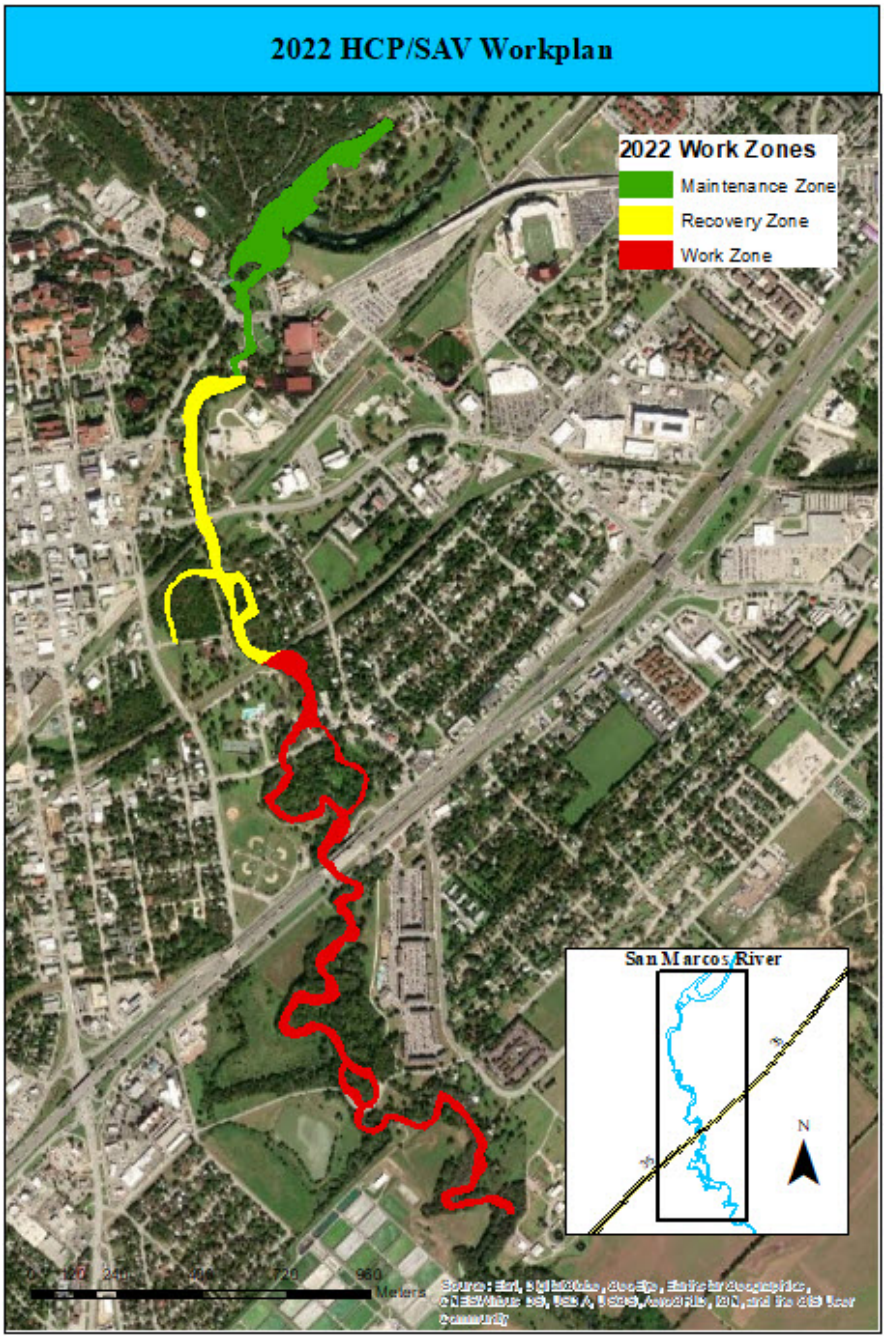

Figure 2. Proposed work zones for 2022 include the maintenance of *Hygrophila* and *Hydrilla* in Spring Lake, Spring Lake Dam, and Sewell Park, a recovery zone from the Below Sewell reach to at the railroad bridge just above the Cypress Island reach and the continued top-down removal of *Hygrophila* and *Hydrilla* starting at the railroad bridge just above the Cypress Island reach and extending to the wastewater treatment plant.

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 fountain darter 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 the San Marcos wastewater treatment plant. *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 2022, Spring Lake, Spring Lake Dam, and Sewell Park will be considered in maintenance condition and the reaches from Below Sewell to the railroad tracks above Cypress Island will transition to recovery zones (Figure 2). This area will require significant effort to prevent *Hydrilla* from reestablishing due to its overall abundance in that reach before removal began. The remaining stretch of river cover under the

EAHCP, from the train tracks above Cypress Island to the San Marcos wastewater treatment plant will be considered a work zone for 2022. The extent of 2022 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.

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 according to Table 2 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 (m^2) within San Marcos LTBG reaches and restoration reaches.

Reaches	**Species**	**Coverage[#] (m^2)**	**Restoration Goal**
		Bio-West Mapping	**2027**
LTBG Reaches		**Oct 2020**	
Spring Lake Dam	*Ludwigia*	8.8	100
	Cabomba	11.0	50
	Potamogeton	103.6	200
	Sagittaria	39.6	200
	Hydrocotyle	86.8	50

Reaches	Species	Coverage[#] (m^2)	Restoration Goal
		Bio-West Mapping	2027
LTBG Reaches		**Oct 2020**	
City Park	*Ludwigia*	8.3	150
	Cabomba	26.5	90
	Potamogeton	220.2	1450
	Sagittaria	0.13	300
	Hydrocotyle	0	10
IH-35 Combined	*Ludwigia*	58.4	100
	Cabomba	117.8	150
	Potamogeton	0	400
	Sagittaria	352.6	600
	Hydrocotyle	17.2	100
Restoration Reaches		**Oct 2018**	
Sewell Park	*Ludwigia*	3.8	25
	Cabomba	3.4	25
	Potamogeton	113.8	150
	Sagittaria	0	25
	Hydrocotyle	0	10
Below Sewell to City Park*	*Ludwigia*	34	50
	Cabomba	12	50
	Potamogeton	578.8	500
	Sagittaria	478	700
	Hydrocotyle	43.5	20
Hopkins St to Snake Island	*Ludwigia*	2.4	50
	Cabomba	108.3	50
	Potamogeton	63.5	475
	Sagittaria	1258.6	750
	Hydrocotyle	0	10
Cypress Island to Rio Vista Falls	*Ludwigia*	18.24	50
	Cabomba	200.52	50
	Potamogeton	6.12	150
	Sagittaria	14.02	50
	Hydrocotyle	0	0
IH-35 Lower	*Ludwigia*	64.5	50
	Cabomba	63.4	100
	Potamogeton	0	250
	Sagittaria	384.52	450
	Hydrocotyle	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 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 possibly occurred, 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 2022, removal efforts for littoral invasive species will continue to target the designated 2021 areas shown in **Figures 3 - 6** below. Most work areas are now in maintenance mode (blue) which require periodic regrowth removal. These seven regions have remaining spots of intense removal work. Addressing these seven zones will achieve a continuous buffer zone along the river that does not contribute seed source.

Figure 3. Spring Lake and Sink Creek Zones

Figure 3:

- 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.
- 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.
- 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.

These areas were worked as described in 2021, but the issues will continue into 2022. The four pink dots at the Spring Lake Natural Area trailhead represent stands of invasive trees that may still need to be addressed in 2022. The three green dots at Cypress Point represent an infestation of large ligustrum and chinaberry. This may also continue into 2022.

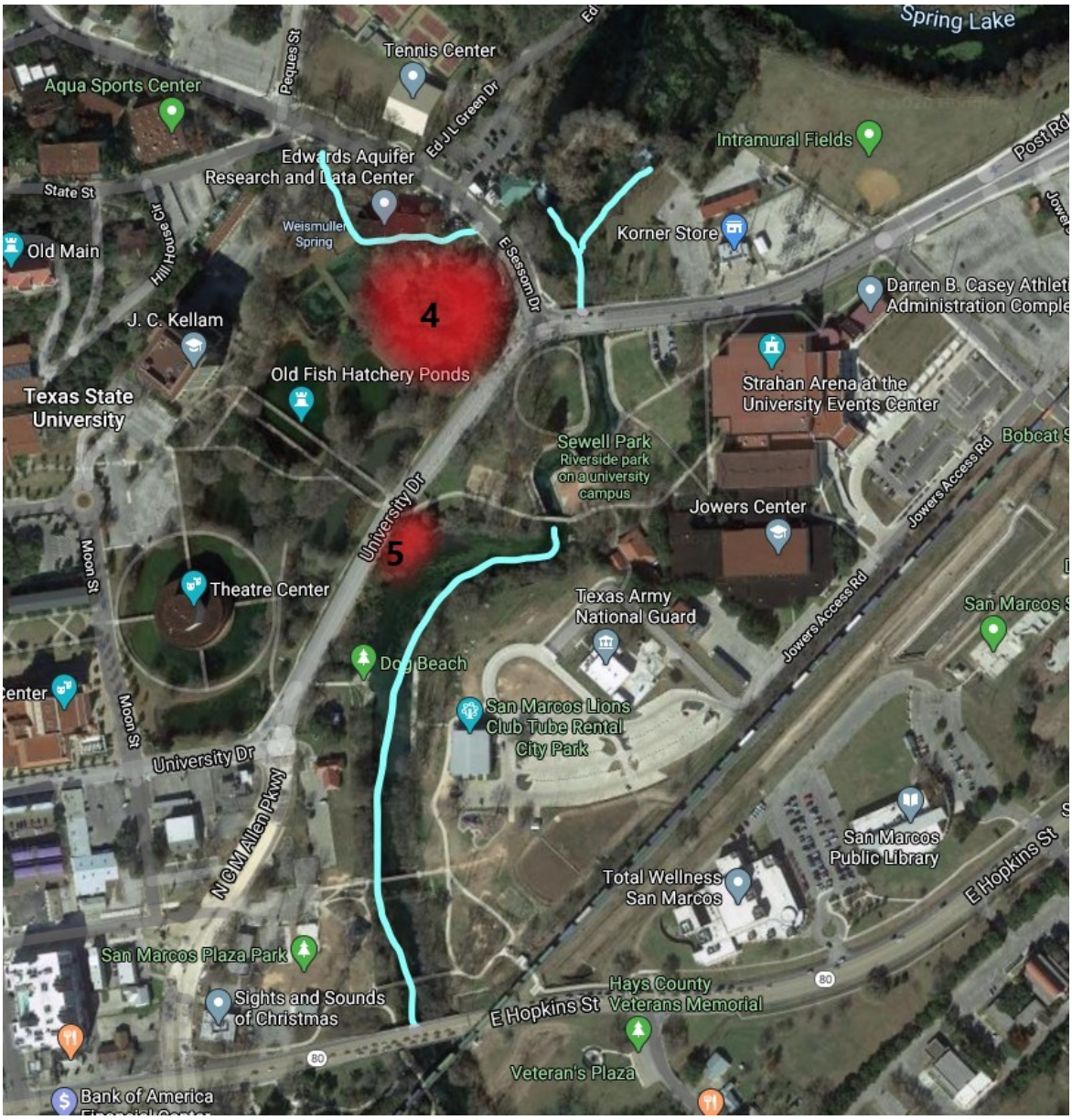

Figure 4. Freeman Aquatic Center, Headwaters, and City Park

Figure 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, non-native trees still exist along the creek through here, but otherwise it is in a maintenance state. In 2022, this area will need further attention to ensure the elimination of these large trees.
- 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 with follow-up efforts for the Arundo donax during 2022 to ensure it is fully eradicated.

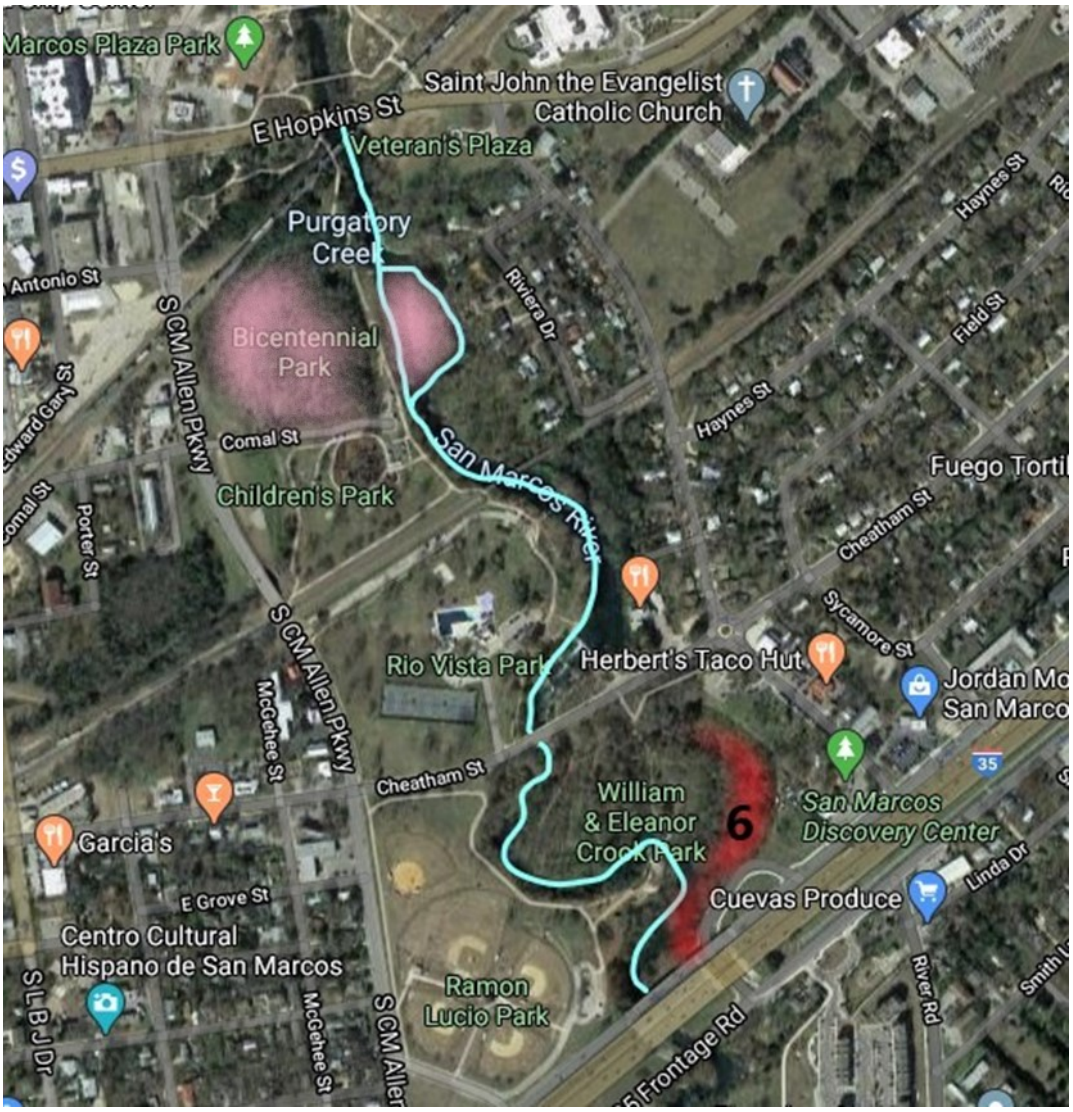

Figure 5. Veteran's Plaza, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, Crook Park

Figure 5:

- The majority of the Crook Park site has now been completed and put into a maintenance state. The Cheatham site was completed by another contractor and Bicentennial Park and the adjacent Snake Island (shaded pink) will be collaborative areas and require multiple workdays in 2022, even after 2021 work has been performed. A small island right upstream of I-35 is full of Chinese Tallow and also needs to be worked on.

Figure 6. Stokes Park/SMRF Property

Figure 6:

- Good progress was achieved in 2021, to include the removal of invasive littoral plants on the private landowner's property. Work will continue in 2022 in Area 7 as the size and infestation level make it challenging.

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 (m^2) 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 2022 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 2022:
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 continue to collaborate with other groups/contractors to maximize effectiveness and public involvement. 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 machete. 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. 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 (EAHCP § 5.4.7.1) and avoid contact with them. Vegetation mats are removed from zones four and five on an as-needed basis. 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 Upper Sewell Park 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 2022 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 2022:
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.* Nutria are not frequently observed, and trapping is labor intensive, therefore, nutria will not be trapped unless seen more frequently in Spring Lake and river.

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. Tournament participants are given a packet of information and are required to sign liability waivers. A free fish fry is held after the event and it should be noted that consumption of fish captured during the tournament is not condoned.

Effective removal of *Melanoides* and *Marisa cornuarietus* 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 pole-spearing tournaments each year.

Pole-spearing tournaments were initially cleared by the COSM and for every upcoming tournament, the COSM departments are notified.

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 contractor 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 2022 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 2022:
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. If additional repairs are needed, the City of San Marcos will cover construction costs.

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

Budget:
Table 7.1:
$20,000

Estimated 2022 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 2022:
Contractor (funded through the EAHCP and COSM) and volunteers will maintain all treated areas from Spring Lake to Stokes Park to reduces invasive regrowth and tributaries with seedbank source as appropriate. Areas that will be focused on in 2022 include Meeks, Bicentennial, and Ramon Lucio. 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. Thompson's Island will be added as a new site for invasive removal after maintenance is complete. If possible, the private properties on river left from Bicentennial to Cheatham Street, will also be addressed. This would require contacting the private landowners to gain access.

Figure 7. Focus for Meeks property that will expand toward Bicentennial throughout 2022.

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 2022 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 2022:

1. Hire nine Conservation Crew members that work approximately 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 SAV 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. Exclusion barriers are also established when flows are below 120 cfs and TWR stands are vulnerable (primarily during the recreation season).

b. Video loop at City Park 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 watercraft 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 2022 budget:
$56,000

5.7.6 Impervious Cover/Water Quality Protection

Long-term Objective:
Establish a program to protect water quality and reduce the impacts from contaminated runoff based on recommendations listed in the *San Marcos Watershed Protection Plan*.

Target for 2022
The EAHCP commitment for a combined effort (Sediment Management and Impervious Cover & Water Quality Protection) includes construction of Sessom Creek Restoration Phase 1 starting in 2022, 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. 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.

Target for 2022:
After completion of the removal of wastewater lines is accomplished in 2021, the creek restoration construction portion of Phase 1 will begin with potential completion in 2022. Phase 2 construction bid process will also occur in 2022.

Monitoring:
The EAA Sessom Creek Real-Time monitoring station will measure turbidity, DO, and temperature. Any changes due to Sessom Creek restoration will be monitored by this monitoring station.

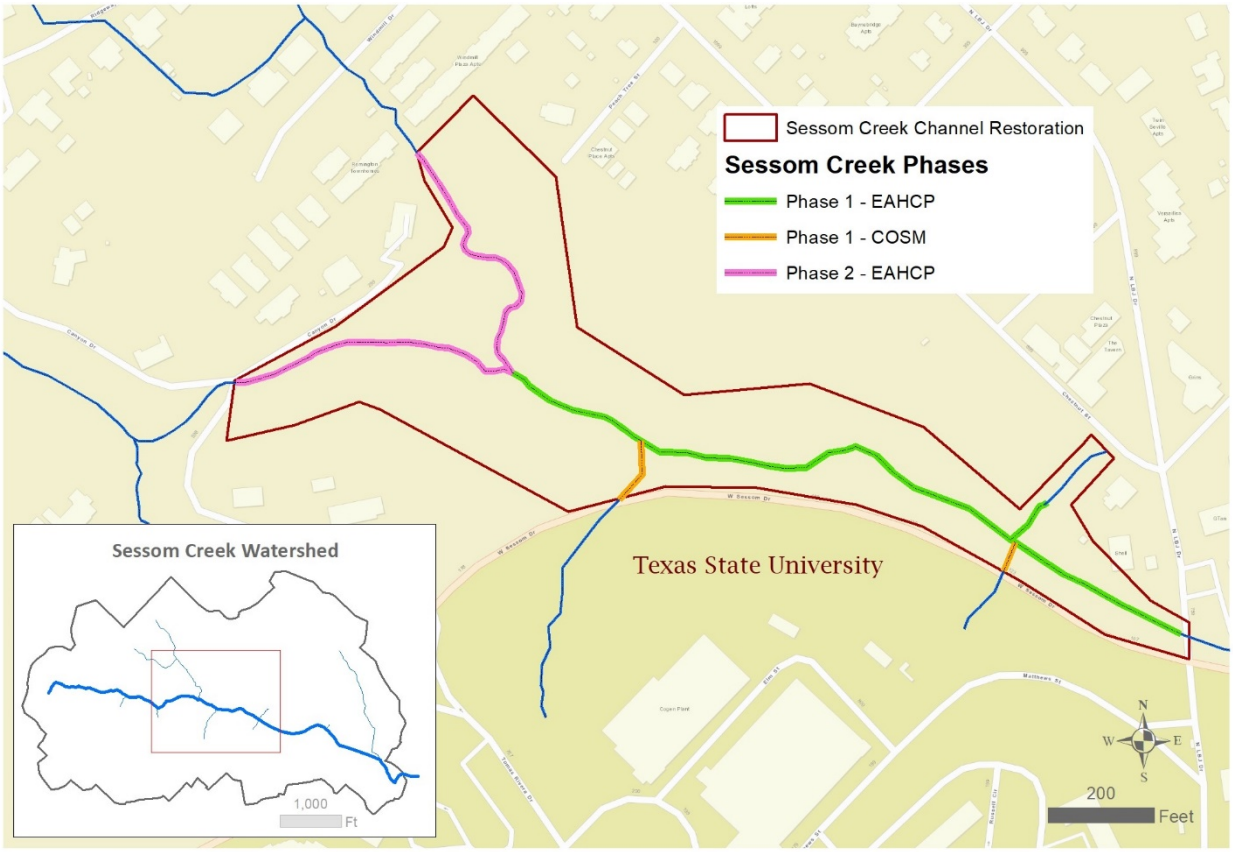

Figure 7. Sessom Creek Proposed Project Reaches - Phase 1 (green outline), Phase 2 (pink outline), Phase 3 (blue area)

Budget:
Table 7.1
$200,000

Estimated 2022 budget:
$1,100,000

***$1,528,200.00 was approved for this conservation measure in 2019, $1,037,862.00 remains as of the December 2020 invoice. Funding will cover Sessom Creek Phase 1 channel restoration and construction administration services as well as bid oversight of Sessom Creek Phase 2. Additional funds were spent on completion of the Phase 2 design in 2021. Phase 1 construction is expected to begin in late 2021 and continue into 2022.**

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 2022:
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 2022 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 2022:
Texas Department of Transportation is expected to approve the route in 2021.

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 2022:
$0

Estimated 2022 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 2022:
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 2022:
$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 2022:
All activities and funds associated with this measure have been completed.

Budget:
Table 7.1:
$0

Available budget for 2022:
$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 2022:
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 (08170500) 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 2022:
$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 2022:
Implement the diving protocols as outlined in the Spring Lake Management Plan, EAHCP, and the ITP with the following modifications: no more than 16 volunteer divers will be allowed in the lake per day, with no more than eight 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, Spring Lake Management Plan, EAHCP, and 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 2022:
$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, EAHCP, and ITP.

Target for 2022:
Implement the protocols for research as specified in the Spring Lake Management Plan, EAHCP, and 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 2022:
$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, EAHCP, and ITP.

Target for 2022:
Implement the protocols for boating as specified in the Spring Lake Management Plan in support of the EAHCP and 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 per the protocol defined 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 non-glass bottom boat activity must not interfere with routine 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 2022:
$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 2022:
Continued implementation of the Grounds Management Plan and Integrated Pest Management Plan. Texas State University recently completed conversion of the Golf Course to Intramural Recreation Fields. COSM will work with the Texas State Facilities to better understand how the change will affect the Grounds Management Plan and the Integrated Pesticide 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 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.

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 2022:
$0

Appendix K | **2022 Permit Oversight-Cultural Resources Coordination New Braunfels**

April 7, 2022

Mason D. Miller
Project Manager

Mark Wolfe
State Historic Preservation Officer
Texas Historical Commission
1511 Colorado Avenue
PO Box 12276
Austin, TX 78711-2276

Attention: Tiffany Osburn

Re: Antiquities Code of Texas Cultural Resource Coordination Letter for the City of New Braunfels' Proposed Habitat Conservation Plan in the Comal River, New Braunfels, Comal County, Texas.

Dear Mr. Wolfe

This letter is intended to inform the Texas Historical Commission (THC) of continuing coordination of the proposed Edwards Aquifer Habitat Conservation Plan (EAHCP), components of which are located within Landa Lake and along the Comal River in New Braunfels, Texas (**Figures 1 and 2**). The Edwards Aquifer Authority (EAA) has been working in partnership with the City of New Braunfels (CONB) and other entities through the EAHCP to improve the conditions of the Comal River and Landa Lake to promote the health and habitat of threatened and endangered aquatic species through a variety of water quality, household hazardous waste management, native revegetation, non-native vegetation management, and recreation management actions. These actions, in turn, are subject to state-level cultural resource regulatory oversight outlined in the Antiquities Code of Texas (ACT). Through review of the proposed actions (as they are currently understood) and available background information, it is proposed that current components of the EAHCP will not likely adversely affect Historic Properties or State Antiquities Landmarks (SALs).

Of note, a similar letter to this has been prepared for the EAHCP's other component, located along the San Marcos River within San Marcos, Texas.

Regulatory/Management Summary

The EAHCP is sponsored by a portion of the EAA Aquifer Management Fee and activities will be completed by the CONB. The project will be implemented on land that is owned by the City of New Braunfels, a political subdivision of the State of Texas or on private property within the Comal County Water Recreation District #1. Due to State involvement, construction falls under the state-level archeological resource regulatory oversight outlined in the ACT. Though 2022's proposed project actions are not subject to federal oversight that would require compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (Section 106), should permitting requirements change, background research and regulatory recommendations are provided as though it were.

Project Description

As stated above, the EAHCP proposes to protect the water and habitat quality in Landa Lake and the Comal River through a series of improvement initiatives and projects within and along the shores

of the existing waterways (**Attachments 1** and **2**). Nearly all of these measures have been ongoing for several years and some are spatial extensions of past projects that have been previously coordinated through the Texas Historical Commission (e.g. THC Ref. #202012123 and 202108208).

According to the CONB, many of the project components or conservation measures are of limited scope and potential for impact to significant cultural resources. However, the EAHCP calls for several projects that involve removing invasive plants and replacing them with native varieties within the waterway channel (**Attachment 1**; Items 1 and 2) and along the banks within the waterways' riparian zones. Aquatic plantings will take place within approximately 500 square meters of riverbed. Individual aquatic plants will be manually planted in the silty riverbed in a one-foot grid pattern to depths of 8-20 inches.

Riparian plantings along the shorelines (**Attachment 1:** Items 5 and 7) will be incidental and will predominantly be less than a gallon in size. There is potential for shallowly buried cultural materials to be impacted by plant removal and replanting projects, especially in locations adjacent to documented archeological sites and historic-age resources; however, these impacts are likely to be minor and in less well-preserved contexts. Previous EAHCP regulatory coordination (see THC Tracking #202012123) determined that a public-friendly cultural resource handout would serve as alternative mitigation for incidental impact to previously unrecorded archeological resources.

The floating aquatic vegetation (**Attachment 1**: Items 3 and 6) and invasive fauna (**Attachment 1:** Item 4) management projects and the household hazardous waste collection project will not likely result in impacts to any cultural resources.

Since many of the conservation measures have overlapping footprints and some may take place anywhere within the overarching project area, the background research and environmental data are discussed in terms of the overarching project area rather than addressing each individual project separately. The parameters of each project will be discussed in more detail as it relates to the background overview.

Geology and Soils

The project area is underlain by two distinct geological formations, Pleistocene and Holocene aged fluviatile terrace deposits (QT) and Early Cretaceous aged Edwards Limestone (Ked) (**Figure 3**). The southern half of the project area is underlain by Pleistocene and Holocene aged fluviatile terrace deposits which encompass the banks of the Comal River and the southern half of Landa Lake. The Edwards Limestone formation underlays the northern half of the project area - the northern half of Landa Lake and the headwaters of the Comal River.

Four different soils are identified within the project area (**Figure 4**). These are Purves clay (1-5% slope), Oakalla silt clay loam (less than 1% slope, rarely flooded), Oakalla soils (0-2% slopes, frequently flooded), Eckrant-Rock outcrop association (8-30% slope), which consist of predominately clay, and silty clay loams.

Purves clays are characterized as well drained gently sloping to steep clayey soils formed in interbedded limestone and marl. Typical soil profiles for these soils are as follows:

Eckrant Series soils are characterized as well drained, shallow clayey soils that are commonly encountered on nearly level to very steep ridges on dissected plains. These soils are derived from limestone.

Oakalla loams are characteristically well drained deep loamy soils that are formed in calcareous loamy alluvium and are commonly encountered within floodplains. Soils from this Series are the most common within the project area specifically the Oakalla soils frequently flooded (Ok) type.

Approximately 80% of soils within and along the project areas are derived from alluvial silty clay loam. These soils have potential to contain not only surficial archeological deposits but deeply buried archeological materials as well that may be well preserved and in intact contexts.

Previous Archeological Studies

A records search was conducted online through the Texas Archeological Sites Atlas (Atlas) maintained by the Texas Historical Commission (THC). Researchers focused on documented cultural resources and past archeological projects within 500 meters (0.31 mile) of the project. The review identified 27 past archeological projects and 22 archeological sites within 500 meters of the project area (**Figures 5 and 6**).

The search revealed that 27 archeological projects consisting of several linear and area surveys, trench monitoring, underwater investigations, and archeological excavations had been conducted within 500 meters (0.31 mile) of the project area. **Table 1** illustrates the archeological projects conducted within the project area including the date on which it was surveyed, sponsoring agency, company that conducted the work, type of work conducted, and recommendations.

Table 1. Survey projects within the project area.

Date	TAC Permit	Sponsoring Agency	Company	Type of Work	Recommendations
1993	1315	Edwards Aquifer Authority/City of New Braunfels	Espey, Huston, & Associates, Inc.	Eligibility testing as Landa Park golf course	No recommendations on the Atlas
2001	2524	Texas Department of Transportation	SWCA	Survey of bridge construction project at Landa Street	Disturbance from utility lines, no further archeological work recommended
2005	-	Lower Colorado River Authority	LCRA	Survey	No information available on the Atlas
2005	3740	Texas Department of Transportation	SWCA	Monitoring of a bridge replacement project	Heavily disturbed area, no sites found
2006	4200	Texas Department of Transportation	Hicks and Company	Survey of SH46	Further survey for site 41CM305
2008	4779	Lower Colorado River Authority	LCRA	Survey of Historical Properties	Trenching Recommended
2010	5642	City of New Braunfels	Ecological Communications Corporation	Archeological investigations at Landa Park	Several intact deposits discovered; further archeological work recommended
2012	6135	New Braunfels Utilities	HDR	Survey of Lakeview Wastewater Line Rehabilitation	No further archeological work recommended
2013	6378	Edwards Aquifer Authority	AmaTerra Environmental, Inc.	Survey and trenching of EAA HCP components	No sites or resources found
2014	6802	Corps of Engineers	AmaTerra Environmental, Inc.	Survey and monitoring of New Braunfels Utilities' proposed Comal Springs Conservation Center	Further coordination with THC prior to construction
2020	6575	Edwards Aquifer Authority	AmaTerra Environmental, Inc.	Survey and trenching of EAA HCP components	Heavily disturbed area within 41CM204. No intact deposits and no adverse effect to site.

2010 Landa Park and Golf Course Survey

Ecological Communications Corporation's (EComm's) 2010 intensive archeological survey of Landa Park and the Landa Park Golf Course is particularly relevant to the EAA's planned Riparian Planting Activities (**Attachment 1:** Item 7; Antiquities Permit 5642, Nickels 2011). During that survey, archeologists dug nearly 70 auger tests at regular intervals along the Landa Lake/Spring Run shorelines within Landa Park. Nine of those tests correspond with the riparian planting plan along the shoreline fronting Landa Park Golf Course (Auger Tests [AT] 6-14; **Figure 7**; see Nickels 2011: Figure 7-1). Of those, two were positive for artifacts (AT6 and AT12). AT12 contained three lithic flakes in the upper 20 centimeters only and AT6 contained a single solarized glass shard, also in the upper 20 centimeters of sediments. None of the tests in the vicinity of the proposed Spring Run riparian plantings were positive, with the nearest positive test (AT55) containing one flake in the upper 20 centimeters in disturbed contexts. Archeologists dug two auger tests near the proposed Mill Race riparian planting area (AT15-16), both of which were negative.

In addition, the EComm surveyors intensively inspected Landa Park and Golf Course property for surface artifacts, collecting all diagnostics. No significant archeological resources (artifacts or features) were observed or collected in the vicinity of the proposed Spring Run planting areas.

Table 2. Sites adjacent to or within the project area.

Site	Est. distance from water	Size	Temporal setting	Listing potential
41CM25	On the western bank of the Comal River	100 x 50 m	Late prehistoric through Archaic period	Listed as SAL in 1990
41CM167	100 meters north of the Old Channel of the Comal	No information on the Atlas	Late Archaic	Research potential high, considered eligible for SAL and NRHP listing
41CM175	35 m east of Landa Lake	325 x 500 m	Unknown prehistoric	Listed as SAL in 1987
41CM176	72 m west of the Comal River	150 m in diameter	Late Prehistoric	Listed as SAL in 1987
41CM177	6 meters south from the Comal River	150 x 50 m	Middle Archaic to Early Archaic	Listed SAL in 1987
41CM190	On the west bank of Landa Lake	122 x 46-61 m	Late PaleoIndian to Archaic	Listed SAL in 1990
41CM204	10 meters north of Blieders Creek	1.3 acres	Unknown prehistoric	Considered undetermined for SAL and NHRP listing
41CM205	225 m west of the Comal River	400 x 300 m	Unknown Prehistoric	Listed as SAL in 1994
41CM221	Comal Springs 10 m east of the site	10 x 35 m	Early Archaic to Late Archaic	Listed SAL in 2016

Recorded Archeological Sites

Fifteen archeological sites have been recorded as well within 500 meters. Of the 22 sites identified, nine are located within or immediately adjacent to the project area. Below a brief description of the

nine adjacent sites are given. **Table 2** illustrates those nearest sites' distance from water, size, temporal setting, and NRHP/SAL listing potential/status.

41CM25 is a Middle Archaic through Neoarchaic burial and open campsite recorded in 1936 with further work conducted in 1990 and 1992. The site was registered as a SAL in 1990. Burials, rock concentrations, and large quantities of worked chert were recorded in 1990. Additional further lithic debitage was recorded in 1992. The size of the site was originally recorded as 100 meters x 50 meters and 1 to 2 meters below surface. The additional work in 1992 adjusted the size of the site to 200 x 400 meters and at least 150 centimeters below surface (cmbs). An estimated 50 percent of the site was intact as of 1992.

41CM167 is a Late Prehistoric open campsite with hearths located north of the Old Channel of the Comal River. The site has very little information recorded on the Atlas but is considered eligible for both NRHP and SAL listing. A portion of the site has been buried by the construction of a sand volleyball court. The site was registered as a SAL in 1987. The site contained three separate small hearths, with a light scatter of lithics and processed faunal bone. An estimated 50 percent of the site was considered intact as of the recording of the site.

41CM175 is a Prehistoric habitation recorded in 1984 with further work conducted in 1987 and 2018. The site was registered as a SAL in 1987. Numerous lithic flakes and debitage were recorded in 1987. Additional debitage and projectile points were found during trenching in 2018. The original size of the site was recorded as 50 meters x 10-20 meters with an unknown depth. The additional work in 2018 adjusted the size of the site to 325 meters x 500 meters with an unknown depth. An estimated 20 percent of the site was intact as of 2018.

41CM176 is a Late Prehistoric open campsite with small hearths recorded in 1986. The site was registered as a SAL in 1987. Lithic flakes, ceramic sherds, burned rock and burned and cut bone were recorded. The size of the site was recorded as 150 meters in diameter and 30 cmbs. An estimated 50 percent of the site was intact at the time of recording.

41CM177 is a Middle to Early Archaic open campsite composed of several small hearths, and lithic and burned rock scatters. The site was originally recorded in 1984, and further work conducted in 2018. The site is considered eligible for both NRHP and SAL listing. Further archeological trenching was performed in 2018. The site was registered as a SAL in 1987. Burned limestone and chert, as well as lithic debitage, cores, bifaces, dart points and one possible Martindale Point were all recorded at the site in 1984. Additional debitage, faunal bone, snail shells, biface fragments, and a projectile point were found during the trenching in 2018. The size of the site was originally recorded as 150 meters x 50 meters with an unknown depth. The additional work in 2018 adjusted the size of the site as 275 meters x 360 meters with an undetermined depth. An estimated 20 percent of the site was intact as of the additional work in 2018.

41CM190, also known as the Parr Site, is a Late Paleoindian to Archaic open campsite composed of burned limestone rock feature and a lithic scatter. The site was originally recorded in 1990 and further work conducted in 2018. The site is considered eligible for both NRHP and SAL listing. Further archeological trenching was performed in 2018. The site was registered as a SAL in 1990. Chert flakes, burned rock, worked flakes and one dart point were all recorded at the site in 1990. Additional debitage, a Pedernales point base, biface fragments, mussel shell, and historic period nails and glass were found during trenching in 2018. The size of the site was originally recorded as 46 meters x 122 meters and about 50 cmbs. The additional work in 2018 adjusted the size of the site as 150 meters x 125 meters and 90 cmbs. An estimated 40 to 50 percent of the site was intact in upper reaches, with the possibility of more intact greater than 50 cmbs.

41CM204 is a Prehistoric to Transitional Archaic open campsite recorded in 1991 with further work conducted in 2010. The site has potential and is recommended for further testing, as such it is undetermined for eligibility for NHRP and SAL listings. Several hundred lithic flakes, bifaces, unifaces, a Frio point, burnt rocks, bone fragments and one hearth were recorded in 1991. Additional lithic flakes, burned clay, and a large quantity of fire cracked rock were observed during trenching in 2010. The size of the site was originally recorded as 5000 square meters and 2 meters below surface. The additional work in 2010 adjusted the size of the site to 1.3 acres and 3 plus meters below the surface. The percentage of the site intact is unknown and is recommended for further testing.

41CM205 is a Prehistoric open campsite and burnt rock midden recorded in 1992. The site was registered as a SAL in 1994. Burnt chert, lithic debris, flakes, cores, projectile points, unifacial scraper, bifaces, blanks, and freshwater mussel shells were recorded. The size of the site was recorded as 400 meters by 300 meters and 50 cmbs. An estimated 50 percent of the site was intact at the time of recording.

41CM221 is an Early Archaic through the Late Archaic lithic tool manufacturing area. The site was recorded in 1996. The site was designated as a SAL in 2016. Over 2000 lithic flakes and debitage, as well as numerous cores, unifaces, bifaces, 20 projectile points, FCR, mussel shell, and faunal bone were recorded at the site. The size of the site is 10 meters x 35 meters and 75 cmbs. An estimated 50 to 75 percent of the site was intact at the time of recording.

Identified Historic Resources

In addition to the numerous archeological sites and surveys recorded in the project vicinity, two NRHP historic districts, two NRHP properties, and 21 historic markers are located within the 500-meter buffer (see **Figure 4**). One of the historic districts is the NRHP-eligible New Braunfels City Water Works Historic District, located at the Headwaters at the Comal (also 41CM204). Most of the proposed items of the EAHCP do not overlap with any of the nearby historic properties. However, Item 8 at Landa Park is within the Comal Power Plant Historic District and is immediately adjacent to the Landa Industries Historic District. This location was previously coordinated with the THC office in January 2021 and July 2020, respectively.

Regulatory Recommendations

Through this letter, AmaTerra requests the THC's confirmed concurrence with the recommendations provided for compliance with the ACT and in anticipation of Section 106. Based upon a review of the potential impacts associated with the proposed EAHCP, the Project Manager recommends that several project components have minimal potential for impacting historic properties and/or SALs and should be cleared to proceed with no further cultural resource coordination required (see **Attachment 1**). Shallow impacts from revegetation efforts in the vicinity of known sites or previously unsurveyed areas may impact archeological resources (Items 1, 2, 5 and 7). Most of these areas have been surveyed many times over the past decades. Recent exhaustive surface inspection and auger testing (see Nickels 2011) directly within the proposed riparian planting footprints were either devoid of artifacts altogether or containing minimal artifacts in shallow and/or disturbed contexts. Though these planting components are within or next to recorded SALs, these previous survey findings suggest the planting activities are not likely to adversely effect SAL-eligible deposits.

Also, as mentioned previously, the EAA has developed a public brochure as alternative mitigation that they are distributing to planting crews that provides a cultural context and guidance on what to do if they were to find artifacts during their work. AmaTerra recommends that continued distribution of this brochure will be sufficient to mitigate any small, isolated impact to archeological resources that could occur.

Through this letter, AmaTerra requests the THC's concurrence with the recommendations provided for compliance with the ACT and in anticipation of Section 106. Thank you for your time in reviewing this submittal. If you have any questions or wish to discuss this further, please feel free to contact me at 512-329-0031 or mmiller@amaterra.com.

Sincerely,

Mason Miller
Archeological Principal Investigator

Cc: Olivia Ybarra, Edwards Aquifer Authority; Kristina Tolman, Edwards Aquifer Authority; Jamie Childers, Edwards Aquifer Authority; Mark Enders, City of New Braunfels

Reference Cited

Nickels, David
2011 Archaeological Investigations in Landa Park and Golf Course, City of New Braunfels, Comal County, Texas. Archeological Survey Report. Ecological Communications Corporation Project 100-006. Austin, Texas.

Attachments

Attachment 1: Summary of EAHCP Components within the New Braunfels Area and Regulatory Recommendations

Attachment 2: City of New Braunfels 2022 EAHCP Work Plan Document (prepared by EAA and CONB)

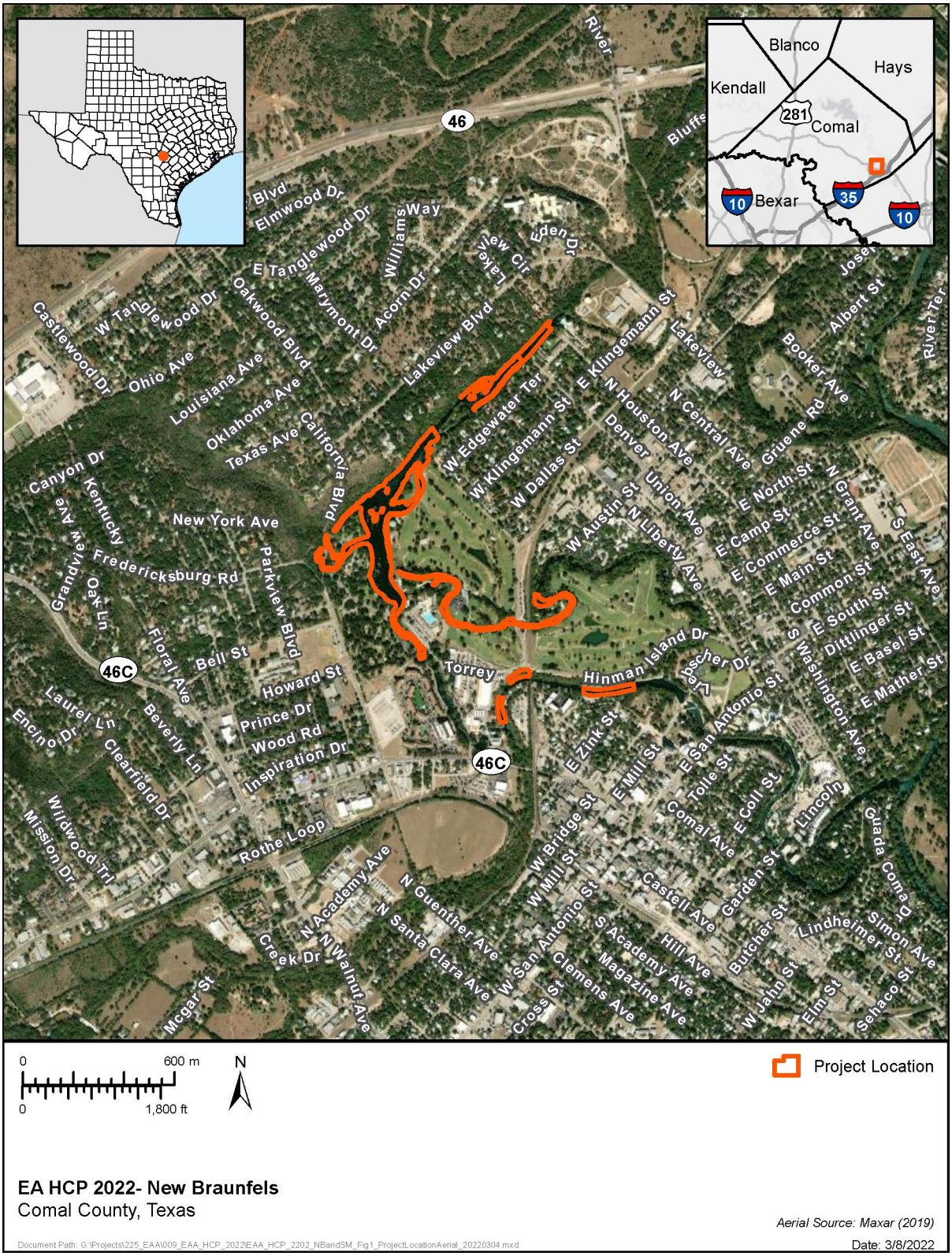

Figure 1. Project location map on modern aerial photograph.

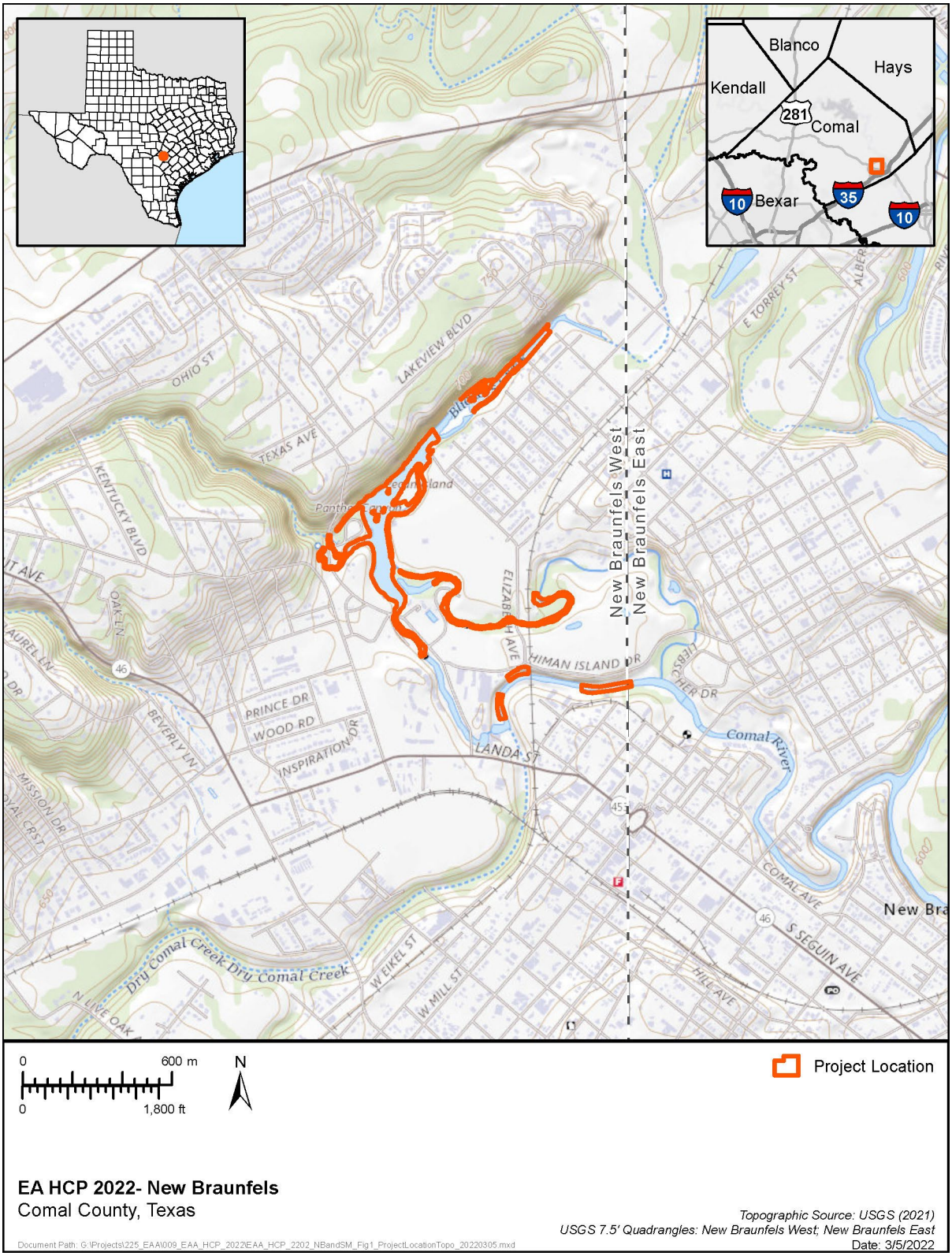

Figure 2. Project location map on USGS topographic quadrangle.

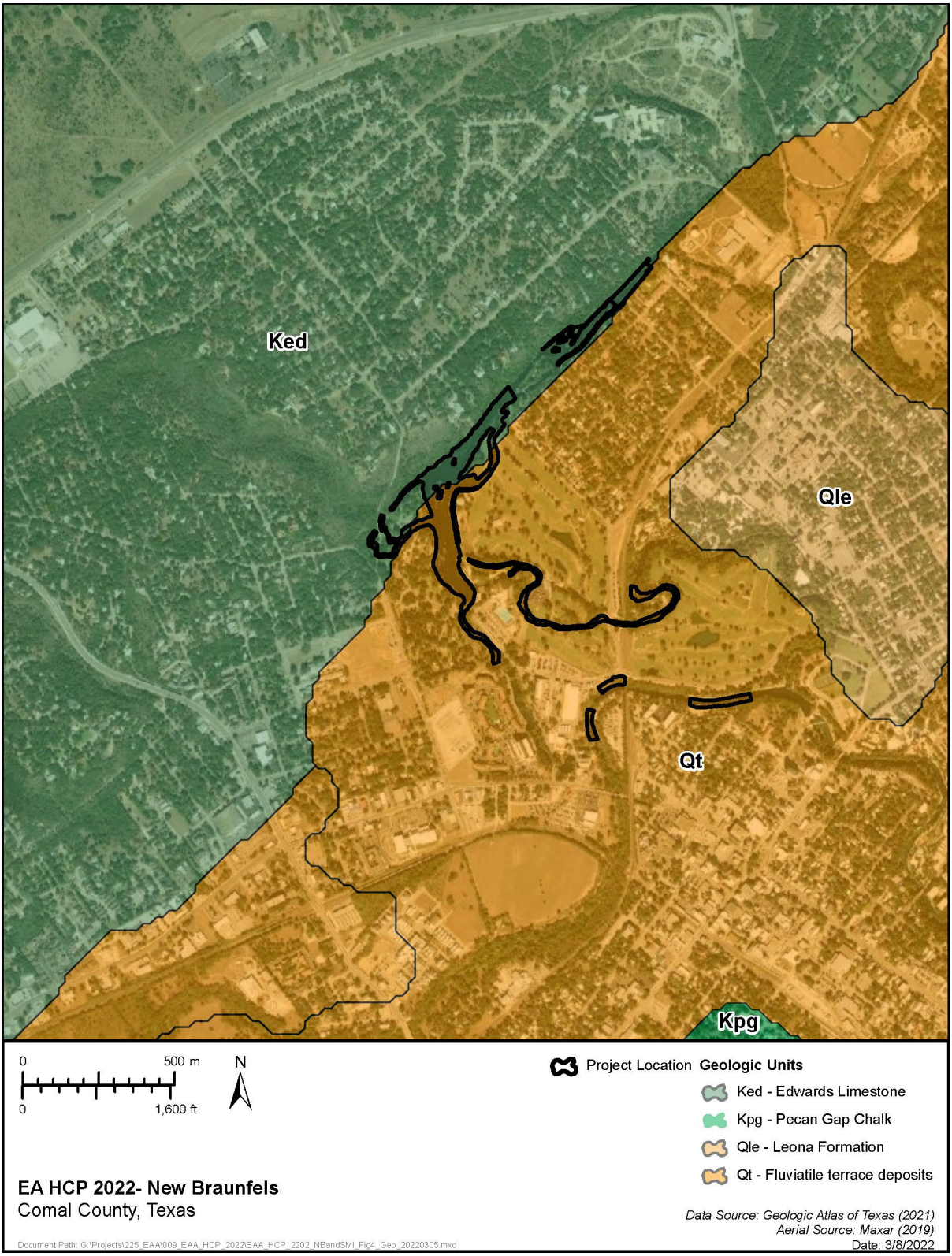

Figure 3. Map depicting the underlying geology of the project area.

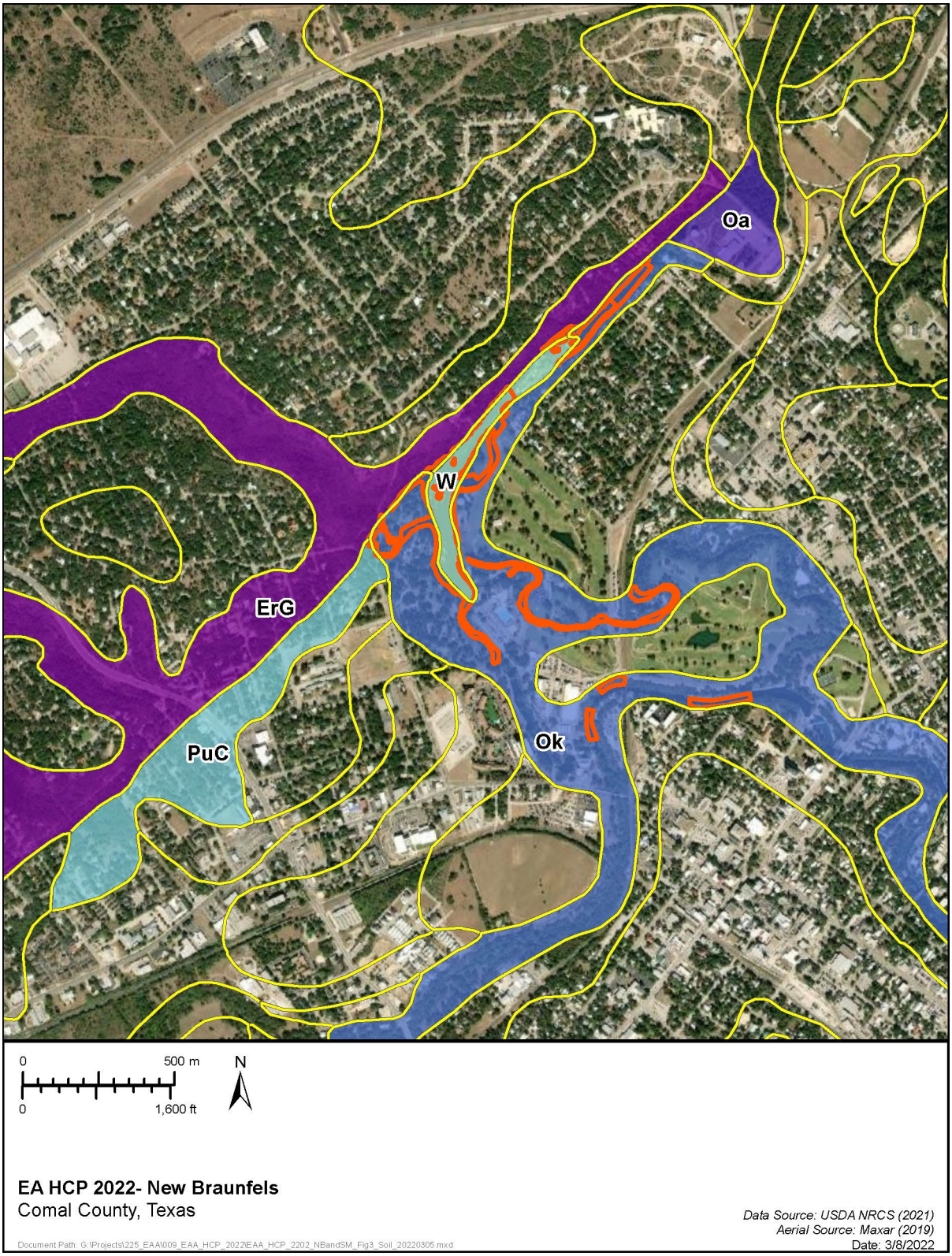

Figure 4. Soil map of the project area.

National Register Properties Key for Figure 5.

Map ID	Name	Reference Number	Date Listed	Atlas Number
A	Comal Hotel and Klein-Kuse House	86001373	6/26/1986	2086001373
B	Comal County Courthouse	76002017	12/12/1976	2076002017

Historical Marker Key for Figure 5.

Map ID	Number	Marker Type	Marker Name	Year
C	4842	OTHM	Nuestra Senora de Guadalupe Mission	1968
D	5381	RTHL	Moeller House, The	1970
E	16021	OTHM	Landa Park	2009
F	3573	OTHM	New Braunfels	1936
G	2779	OTHM	Torrey, John F., Early Mill and Factory	1936
H	17085	OTHM	Meriwether Milling	2012
I	1807	OTHM	First Patented Wire Fence	1982
J	17817	RTHL	Windwehen Home	2014
K	18357	OTHM	Mill Street Telegraph Station	2016
L	235	RTHL	Dietz, August, Cottage	1974
M	5364	RTHL	Klein, Joseph, House	1979
N	1404	RTHL	Eggeling Hotel	1979
O	5447	RTHL	Voigt House, The	1973
P	5348	OTHM	The Grotto	1980
Q	5306	OTHM	The Church of Saints Peter and Paul	1976
R	987	RTHL	Comal County Courthouse	1993
S	3574	OTHM	New Braunfels	2005
T	4840	RTHL	New Braunfels Academy	1965
U	5386	OTHM	New Braunfels Academy	1986

Attachment 1: Summary of EAHCP Components within the New Braunfels Area and Regulatory Recommendations*

Item	EAHCP Section	Location	Work Summary	Estimated Impacts	Archeological Resource Recommendations	Historic Resource Recommendations
1	Old Channel Aquatic Vegetation Restoration & Maintenance (5.2.2.1/5.2.2.3)	Old Channel of the Comal River	The enhancement and restoration of native aquatic plants within the Old Channel of the Comal River. Invasive plants will be removed and monitored for growth.	Non-native plant species have been previously removed and will be monitored for regrowth. Stem cuttings will be collected from selected areas within the Comal River system of *Ludwigia* and *Cabomba* which will be propagated in a shallow portion of Landa Lake. Transplants of *Ludwigia*, *Camboba* and *Sagittaria* will be planted as needed within the Old Channel to reach the desired coverage. Expected depths of impacts are estimated at 8-20 inches.	The planting of native flora within the area has a potential depth impact of 8-20 inches in the channel. ***Public outreach brochure in lieu of survey (Ref. #202012123).***	All proposed work would be within the banks of the river with no potential to impact historic properties. *No fieldwork recommended.*
2	Landa Lake/ Comal River Aquatic Vegetation Restoration & Maintenance (5.2.2.2/5.2.2.3)	Landa Lake New Channel of the Comal River Upper Spring Run	The enhancement and restoration of native aquatic plants within Landa Lake, Upper Spring Run, and the New Channel of the Comal River. Invasive plants will be removed as needed and replaced with native plants.	Previously removed invasive species within Landa Lake and Upper Spring Run will be monitored for regrowth and removed as needed. Stem cuttings will be collected from selected areas within the Comal River system of *Ludwigia* and *Cabomba* which will be propagated in a shallow portion of Landa Lake. Transplants of *Ludwigia*, *Camboba*, *Potamogeton* and *Sagittaria* will be planted as needed within the New Channel, Landa Lake, Upper Spring Run to reach the desired coverage. Expected depths of impacts are estimated at 8-20 inches.	The planting of native flora within the areas has a potential depth impact of 8-20 inches in the channel. ***Public outreach brochure in lieu of survey (Ref. #202012123).***	The planting of native flora should not introduce visual impacts to the NRHP Comal Power Plant Historic District nor the local Landa Industries Historic District, with limited potential for adverse effect. *No fieldwork recommended.*
3	Decaying Vegetation Removal and Dissolved Oxygen Management (5.2.4)	Landa Lake Upper Spring Run	Management of floating vegetation mats and dissolved oxygen levels for the protection of the biological community.	Sensors will be placed in Landa Lake and the Upper Spring Run to determine dissolved oxygen levels. Floating vegetation mats and decaying vegetation will be dislodged and removed during low-flow periods to meet desired dissolved oxygen levels for the foundation darter and other aquatic fauna. Minimal impact to the shoreline is anticipated.	No subsurface impacts are anticipated during the collection of floating plant species and monitoring of dissolved oxygen levels. *No fieldwork recommended.*	All proposed work would be within the banks of the lake with no potential to impact historic properties. *No fieldwork recommended.*
4	Non-Native Animal Species Control (5.2.5/5.2.9)	Comal River	Non-Native, invasive faunal species (e.g. suckermouth catfish, tilapia, nutria) will be removed from the aquatic ecosystem. Captured fauna will be documented prior to their removal.	Nets, spear and bow fishing equipment, hand picking, and trapping will be utilized to capture invasive fishand mammals. Captured fauna will be documented and removed and/or euthanized. Minimal impact to the shoreline is anticipated.	No subsurface impacts are anticipated during the capture of invasive faunal species. *No fieldwork recommended.*	All proposed work would be within the banks of the river with no potential to impact historic properties. *No fieldwork recommended.*

Item	EAHCP Section	Location	Work Summary	Estimated Impacts	Archeological Resource Recommendations	Historic Resource Recommendations
5	Native Riparian Habitat Restoration (5.2.8)	Landa Park Spring Run 1 and 2	Non-native plants are removed through mechanical and/or chemical methods. Larger trees are cut near the ground surface with the stump left in place and treated with herbicide. Temporary sediment control berms placed on surface near removed vegetation. Native species planted in newly-exposed locations and throughout the riparian zone within the project footprint.	Work area for Spring Run 1 measures approximately 300 square meters (60 x 5 m). Work area for Spring Run 2 measures approximately 600 square meters (30 x 20 meters). Minimal ground disturbance resulting from invasive plant removal; trees will be cut to ground surface then stump will be left in place and treated with herbicide. Native seedlings for planting will be predominantly held in 8-inch/one-gallon pots. Anticipated depths of impacts do not reach more than one foot.	Extensive previous survey suggests low potential for intact site deposits in work area vicinity. Small, localized work areas coupled with isolated, non-contiguous vertical impacts from plantings suggest limited potential for adverse effect to significant archeological resources. ***Public outreach in lieu of field survey.***	All proposed work would be along the banks of the river and lake with no potential to impact historic properties. *No fieldwork recommended.*
6	Litter and Floating Vegetation Management (5.2.10)	Landa Lake Old Channel of the Comal River	Management of the impact of floating vegetation mats and litter on aquatic vegetation and endangered species habitat.	Floating vegetation mats will be dislodged weekly between March and September. This will continue as needed during the remainder of the year. Inorganic litter will also be collected bi-monthly from the waterways. No sub-surface impacts are anticipated.	No subsurface impacts are anticipated during the collection of floating plant species and litter. *No fieldwork recommended.*	All proposed work would be within the banks of the river and lake with no potential to impact historic properties. *No fieldwork recommended.*
7	Native Riparian Habitat Restoration (5.7.1)	Landa Lake along western boundary of Golf Course Landa Lake small island near Spring Island Comal River along Mill Race at Landa Park Pavilion #16 Comal River on Wurstfest Grounds south of intersection of Elizabeth Avenue and Hinman Isl. Dr.	Non-native plants are removed through mechanical and/or chemical methods. Larger trees are cut near the ground surface with the stump left in place and treated with herbicide. Temporary sediment control berms placed on surface near removed vegetation. Native species planted in newly-exposed locations and throughout the riparian zone within the project footprint.	Work area for Landa Park Golf Course lakefront measures approximately 2,500 square meters (250 x 10 m). Work area for small island measures approximately 400 square meters (20 x 20 m). Work area for Mill Race measures approximately 300 square meters (25 x 14 m [max dimension]). Work area for Wurstfest Grounds measures approximately 1,000 square meters (70 x 16 m). Minimal ground disturbance resulting from invasive plant removal; trees will be cut to ground surface then stump will be left in place and treated with herbicide. Native seedlings for planting will be predominantly held in 8-inch/one-gallon pots. Anticipated depths of impacts do not reach more than one foot.	Previous archeological survey in Landa Park Golf Course and Mill Race vicinity indicate minimal potential for intact archeological site deposits. The removal of invasive species and subsequent planting of native flora within the area has an expected depth of impact at less than one foot. ***Public outreach brochure in lieu of survey.***	The planting of native flora should not introduce visual impacts NRHP Districts. There is limited potential for adverse effect. *No fieldwork recommended.*

Item	EAHCP Section	Location	Work Summary	Estimated Impacts	Archeological Resource Recommendations	Historic Resource Recommendations
8	Impervious Cover/ Water Quality Protection (5.7.6)	Landa Park Aquatics Center Parking Lot	Construction planning for proposed bioretention basin to be added as part of the Aquatics Center parking lot renovation.	Bio-retention basin will be used to treat stormwater runoff. Expected depths of impacts are estimated at 4-5'.	Proposed bioretention pond project was coordinated with the THC as part of the CY 2020 EAHCP activities. Project component will be constructed in heavily disturbed context with no potential for intact archeological deposits. ***Received concurrence that construction could proceed with no fieldwork required (Ref. #202012123).***	Based on available information, the physical improvements to the Landa Park Aquatic Center would not introduce visual intrusions to the Comal Power Plant Historic District that would impact the district's historic integrity. Landa Park has previously been determined not eligible for NRHP listing. The improvements are recommended as having no adverse effect under Section 106 and would not impact listed historic properties under TAC.

* Table excludes EAHCP Items 5.2.1 (New/Old Channel Flow Split Management), 5.2.3 (Public Recreation Management), 5.2.7 (Hazardous Waste Transport Prohibition), and 5.2.11 (Golf Course Management) because they are unfunded for this year and are not likely to impact significant cultural resources. Additionally, Items 5.2.6/6.3.6 (Gill Parasite Monitoring and Reduction) and 5.7.5 (Household Hazardous Waste Management) do not include any physical disturbance and are therefore not likely to impact significant cultural resources.

Attachment 2: City of New Braunfels 2022 EAHCP Work Plan Document

City of New Braunfels
2022 EAHCP Work Plan

2022 City of New Braunfels Work Plan Budget

EAHCP Section	Conservation Measure	Table 7.1	Estimated 2022 Budget
5.2.1	Flow Split Management	$30,000	$0
5.2.2.1/ 5.2.2.3	Old Channel Aquatic Vegetation Restoration & Maintenance	$100,000	$50,000
5.2.2.2/ 5.2.2.3	Landa Lake/ Comal River Aquatic Vegetation Restoration & Maintenance	$50,000	$100,000[1]
5.2.3	Management of Public Recreation	$0	$0
5.2.4	Decaying Vegetation Removal and Dissolved Oxygen Management	$15,000	$15,000
5.2.5/5.2.9	Non-Native Animal Species Control	$75,000	$45,000
5.2.6/ 6.3.6	Monitoring and Reduction of Gill Parasites	$75,000	$10,000
5.2.7	Prohibition of Hazardous Material Transport Routes	$0	$0
5.2.8	Native Riparian Habitat Restoration (Riffle Beetle)	$25,000	$25,000
5.2.10	Litter and Floating Vegetation Management	$0	$25,000
5.2.11	Golf Course Management	$0	$0
5.7.1	Native Riparian Habitat Restoration	$100,000	$125,000
5.7.5	Management of Household Hazardous Waste	$30,000	$40,385
5.7.6	Impervious Cover/ Water Quality Protection	$150,000	$15,000
	Totals	**$650,000**	**$450,385**

[1] The increase of $50,000 in the budget for Conservation Measure § 5.2.2.2/ 5.2.2.3 will be offset by a $50,000 decrease in the 2022 budget Old Channel Aquatic Vegetation Restoration Conservation Measure (EAHCP § 5.2.2.1).

2022 City of New Braunfels Work Plan and Funding Application Amendment

Amendment #	Date EAHCP Committee Approved	Conservation Measure Amended	Y/N Funding Application Change	Funding Application Change ($)	Date EAA Board Approved	Comments
0	5/20//2021	Original Work Plan	NA	NA	NA	Original Work Plan
0	10/14/2021	Original Funding Application	NA	NA	11/09/2021	Original Work Plan and Funding Application

5.2.1 Flow Split Management

Long-term Objective:
To sustain flow rates in the Old Channel of the Comal River that complement Old Channel aquatic vegetation restoration efforts, minimize channel scouring, and maximize the quality of fountain darter habitat.

Target for 2022:
Maintain flow rates in the Old and New Channels of the Comal River to meet objectives specified in the revised Table 5-3 of the EAHCP (**Table 1**).

Priority will be given to achieving target flow rates in the Old Channel and, secondly, to flow rates in the New Channel. City of New Braunfels staff will monitor streamflow conditions via USGS streamflow gages and operate the flow-control gate between Landa Lake and the Old Channel to achieve flow targets. Maintenance activities associated with the flow-control gates will be conducted as needed to ensure continued operability.

Table 1. EAHCP Table 5-3 (revised)

Total Comal Springflow (cfs)	Old Channel (cfs)		New Channel (cfs)	
	Fall, Winter	Spring, Summer	Fall, Winter	Spring, Summer
350+	65	60	280+	290+
300	65	60	235	240
250	60	55	190	195
200	60	55	140	145
150	55		95	
100	50		50	
80	45		35	
70	40		30	
60	35-40		25	
50	35-40		15	
40	30		10	
30	20		10	

Methodology:
The City of New Braunfels will manage the flow-split program according to flow rates specified in revised Table 5-3 (**Table 1**). A standard operating procedure has been developed by the City of New Braunfels to guide adjustments to the flow-control gate and to achieve flow-split targets. City of New Braunfels staff will monitor real-time streamflow conditions at USGS gages in the Comal River system and adjust the flow-control gates, as needed, to meet flow-split streamflow targets. The primary 48" culvert gate and the new back-up culvert gates will be operated conjunctively to meet target flow rates. Floating vegetation and debris will be manually removed from the control gate and screen from a canoe or boat. Vegetative material removed from the intake structure will be placed along the banks of Landa Lake and/ or returned to Landa Lake. Floating vegetation is managed and funded under task of EAHCP § 5.2.10: Litter and Floating Vegetation Management. The flow control gate will be exercised routinely to maintain functionality of the gate.

Monitoring:
Flow rates in the Old Channel, New Channel, and Comal River will be based on real-time streamflow data provided by the USGS gages in the Comal River. City of New Braunfels staff will monitor streamflow on a weekly basis, at minimum. Adjustments to the flow-control gate will be made on an as-needed basis to meet flow-spilt management objectives. City of New Braunfels staff will monitor the flow-control gate and intake screen on a regular basis to assess for vegetation build-up and debris that have the potential to restrict flow into the culvert between Landa Lake and the Old Channel. When required, trash racks and vegetation barrier booms will be cleaned to prevent accumulations of vegetation and debris. Accumulated vegetation will be placed along the banks of Landa Lake and/ or returned to Landa Lake.

Budget:
Table 7.1:
$30,000

Available budget:
$30,000

Estimated 2022 budget:
$0

5.2.2.1/ 5.2.2.3 Old Channel Aquatic Vegetation Restoration and Maintenance

Long-term Objective:
To achieve native submerged aquatic vegetation (SAV) coverage goals for the Old Channel Long-Term Biological Goal (LTBG) and Old Channel Environmental Restoration & Protection Area (ERPA) reaches as set forth in the revised EAHCP tables 4.1 and 4.1.1, respectively. The overall intent of the aquatic vegetation restoration program is to increase and preserve the coverage of high-quality habitat for the fountain darter (*Etheostoma fonticola*).

Target for 2022:

SAV restoration efforts in 2022 will include the planting of target SAV species in an effort to achieve annual SAV restoration goals and to maintain existing SAV coverage. **Figure 1** depicts the Comal River system and identifies individual Old Channel restoration reaches. The 2022 annual SAV restoration goals, as well as the EAHCP long-term SAV coverage goals, for the Old Channel LTBG and ERPA reaches are specified by reach and vegetation type in **Table 2**. Efforts will also be made in 2022 to monitor for and remove re-emergent non-native *Hygrophila* from the Old Channel LTBG and ERPA reaches.

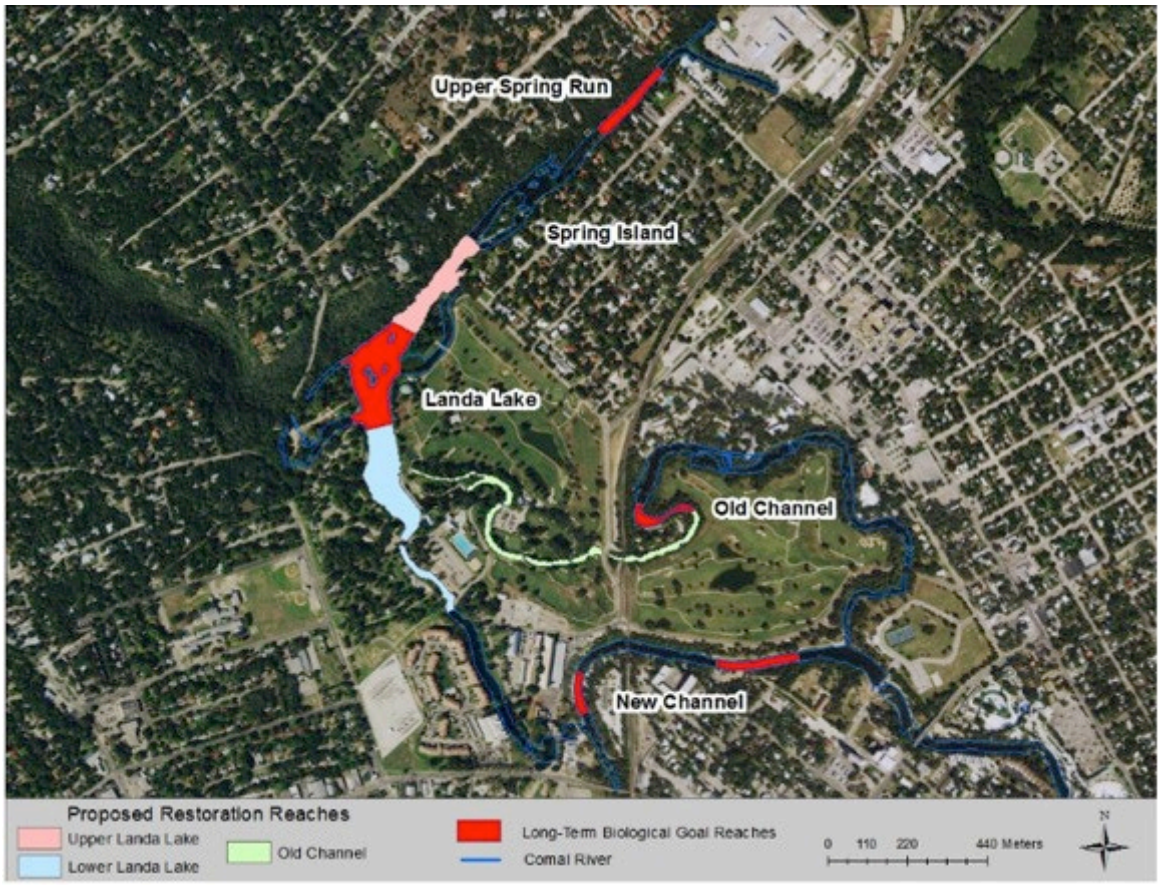

Figure 1: LTBG and restoration reaches for the Comal River System. The Old Channel ERPA restoration reach is shown in green and the Old Channel LTBG reach in red.

Table 2: Annual and long-term SAV restoration goals, in meters squared (m^2), within Old Channel LTBG & ERPA restoration reaches.

Reach	Aquatic Vegetation Species	Meters squared of aquatic vegetation (m^2)	Annual Restoration Goal	Approximate # of plantings needed to meet annual goal
		Long-term Goal	2022	2022
LTBG Reaches				
Old Channel	*Ludwigia*	425	50	750-1,000
	Cabomba	180	15	300
	Sagittaria	450	25*	300*
Restoration Reaches				
Old Channel ERPA	*Ludwigia*	850	15	225-300
	Cabomba	200	10	200
	Sagittaria	750	15*	180*
	Vallisneria	750	0	-
	Potamogeton	100	5	30

**Sagittaria* coverage will be monitored and planting will occur only as needed given its propensity to naturally expand.

Methodology:

Non-Native SAV Management:

Non-native SAV (i.e. *Hygrophila*) has largely been removed from the Old Channel between Landa Lake and the downstream limits of the Old Channel LTBG reach. SAV gardening will occur on a monthly basis throughout the Old Channel LTBG and Restoration reaches to identify and remove re-emergent non-native SAV. Small, localized growth of non-native SAV will be removed by selective physical extraction of visible plant and root mass.

Native SAV Restoration:

Target SAV species will be planted within the Old Channel LTBG and ERPA reaches to increase the coverage of individual aquatic plant species per the annual restoration goals set forth in **Table 2**. The approximate number of plants needed to achieve the annual goals is also included in **Table 2**. Individual plant species will be planted where space is available and in locations within the channel where light exposure, flow velocities, and substrate provide the most suitable conditions. Supplemental plantings of *Ludwigia* and *Cabomba* will be planted in existing restoration plots in the Old Channel LTBG and ERPA reaches, as necessary, to maintain existing coverage and/ or to replace any losses in coverage due to floods, natural competition or other factors.

Ludwigia will continue to be propagated in-situ within Landa Lake to provide plant stock for 2022 restoration efforts. In-situ propagation of *Ludwigia* will be conducted by collecting stem cuttings from *Ludwigia* plants present within the Comal River system. The cuttings will be placed in pots filled with substrate collected from within the Comal River system. The potted cuttings will be placed in Mobile Underwater Plant Propagation Trays (MUPPTs) that will be situated in a shallow portion of Landa Lake and allowed to produce roots and plant mass in advance of planting.

Ludwigia plants propagated in the MUPPTs, as well as *Ludwigia* cuttings, will be planted in suitable locations within the Old Channel LTBG and ERPA reaches to achieve an annual target of $50m^2$ and $15m^2$ of additional *Ludwigia* coverage, respectively. Slightly more than the targeted coverage of *Ludwigia* will be planted in order to account for plant die-off. Approximately 15-20 *Ludwigia* plants are needed to achieve $1m^2$ of coverage. Therefore, approximately 750-1,000 *Ludwigia* plants will be planted in the Old Channel LTBG reach and 225-300 within the Old Channel ERPA Restoration reach to achieve target annual coverage. Supplemental plantings of *Ludwigia* will be planted within existing restoration plots within the Old Channel LTBG and ERPA reaches, as needed, to maintain existing coverage of *Ludwigia*.

Cabomba typically thrives in deep, low-velocity areas and will be planted in the most suitable locations in the Old Channel LTBG and ERPA reaches to achieve an annual target of $15m^2$ and $10m^2$ of additional *Cabomba* coverage, respectively. *Cabomba* will be planted using stem cuttings and/ or with individual rooted plants. Stemmed cuttings will be collected from the New Channel and/ or the Spring-fed pool where *Cabomba* is abundant. The cuttings will be bundled into fist-sized bundles wrapped with rubber bands to keep bundles together. The *Cabomba* cutting bundles are typically 12 to 32 inches in length and will be planted at a depth of 2/3 their length, if possible, in soft, silty sediment. This planting depth prevents *Cabomba* from loosening and floating away and ensures multiple nodes are buried to encourage maximum development of root structure. Rooted *Cabomba* will also be utilized for planting. Rooted plants will be dug up individually from areas where *Cabomba* is abundant. The rooted plants will then be planted individually into silty streambed substrate. Both the stemmed cuttings and rooted plants will be planted in a grid-pattern at 1ft centers. Approximately 20 *Cabomba* plantings are needed to achieve $1m^2$ of coverage. Therefore, approximately 300 and 200 *Cabomba* plants will be planted in the Old Channel LTBG and Old Channel ERPA reaches, respectively. Significantly more plantings than required to meet the targeted coverage of *Cabomba* will be planted to account for plant die-off. Supplemental plantings of *Cabomba* will be planted within existing restoration plots within the Old Channel LTBG and ERPA reaches, as needed, to maintain existing coverage of *Cabomba*.

Sagittaria coverage will be monitored throughout the year to determine the extent of natural expansion and whether planting will be required to meet annual and long-term SAV goals. Based on existing coverage of *Sagittaria* in the Old Channel and its aggressive growth habit, it is not anticipated that *Sagittaria* will be planted in 2022. *Sagittaria* will be planted only as needed, in the most suitable locations in the Old Channel LTBG and ERPA reaches to achieve annual targets of $25m^2$ and $15m^2$ of additional *Sagittaria* coverage at full grow out. *Sagittaria* will be planted as transplants harvested from Landa Lake and in the Old Channel where dense *Sagittaria* stands exist. The leaves of the transplants will be trimmed prior to planting to decrease buoyancy and drag. A few *Sagittaria* plants can form a dense colony within several months. *Sagittaria* has been observed to be slightly tolerant of lower light levels allowing it to be planted in deeper water and in shady locations. Approximately 12 *Sagittaria* plants are needed to achieve $1m^2$ of coverage. Therefore, approximately 300 and 180 *Sagittaria* plants will be planted in the Old Channel LTBG and ERPA reaches, respectively, as needed, to achieve target annual coverage.

Potamogeton will be planted only as needed in the Old Channel ERPA reach to achieve an annual target of $5m^2$ of additional *Potamogeton* coverage at full grow out. It is expected that increases in *Potamogeton* will be achieved through natural expansion. If required, *Potamogeton* will be planted using bare-root rhizomes that are harvested from the Comal River system. Approximately six rhizome sections need to be planted to achieve $1m^2$ of *Potamogeton* coverage. Therefore, approximately 30 *Potamogeton* rhizomes will be planted in the Old Channel ERPA reach to achieve the target annual coverage.

Competition between native plants has been observed in the Old Channel where *Potamogeton* and *Sagittaria* have encroached on and taken over *Ludwigia* and *Cabomba* stands, resulting in loss of Ludwigia and *Cabomba* coverage. To minimize the effects of competition and to promote the growth and spread of *Ludwigia* and *Cabomba*, prioritized plot areas will be established for these species. The plots will be established by first clearing an area of *Sagittaria* and then planting Ludwigia/ Cabomba. Plant material that is removed during this activity will be collected and removed from the lake/ river. The plots will be maintained by removing *Sagittaria* that begins to encroach into the plots.

Following planting of native SAV, monthly gardening and maintenance will occur between March and October to assess health of plants and to identify and remove any non-native vegetation that is beginning to establish within planting areas.

Monitoring:
As discussed in previous sections, areas where non-native vegetation removal has occurred will be routinely monitored for the re-establishment of non-native vegetation. Planted areas will also be monitored to assess expansion, die-off, and competition by non-native species. Once native aquatic vegetation is established in an area, monitoring will be conducted on a less frequent basis.

Vegetation mapping in both the Old Channel LTBG reach and the Old Channel ERPA will be conducted to evaluate SAV coverage and to assess the progress of aquatic vegetation restoration efforts. Mapping is conducted by circling the perimeter of vegetation stands with a kayak equipped with a Trimble GPS unit. Mapping will occur in January, April, and October. The October mapping event will be used as a basis for assessing overall SAV coverage with respect developing annual restoration goals for 2022 and subsequent years.

Budget:
Table 7.1:
$100,000

Available budget:
$100,000

Estimated 2022 budget:
$50,000

*The decrease of $50,000 in the 2022 budget for this Conservation Measure will be used to fund the Comal River/ Landa Lake Aquatic Vegetation Restoration Conservation Measure (EAHCP § 5.2.2.2).

5.2.2.2/5.2.2.3 Comal River/ Landa Lake Aquatic Vegetation Restoration and Maintenance

Long-term Objective:
To achieve native submerged aquatic vegetation (SAV) coverage goals for the Landa Lake, New Channel, and Upper Spring Run LTBG reaches and the Upper/ Lower Landa Lake restoration reaches as set forth in revised EAHCP tables 4.1 and 4.1.1, respectively. The overall intent of native SAV restoration is to provide high quality habitat for the Fountain Darter.

Target for 2022:
Efforts in 2022 will include the planting of target native SAV to achieve annual aquatic vegetation restoration goals and to maintain existing SAV coverage. **Figure 2** illustrates the Comal Springs/ River ecosystem and identifies the Landa Lake, New Channel and Upper Spring Run LTBG reaches as well as the Upper/ Lower Landa Lake restoration reaches. The annual aquatic plant restoration goals for the Landa Lake, New Channel, and Upper Spring Run LTBG reaches and the Upper/ Lower Landa Lake restoration reaches are specified by reach and vegetation type in **Table 3**. In addition to planting the target native aquatic plants to meet annual goals, continued efforts will be made in 2022 to monitor for the re-establishment of non-native *Hygrophila* in Landa Lake, New Channel, and Upper Spring Run LTBG reaches and the Upper/ Lower Landa Lake restoration reaches. Any identified *Hygrophila* will be removed from the lake/ river.

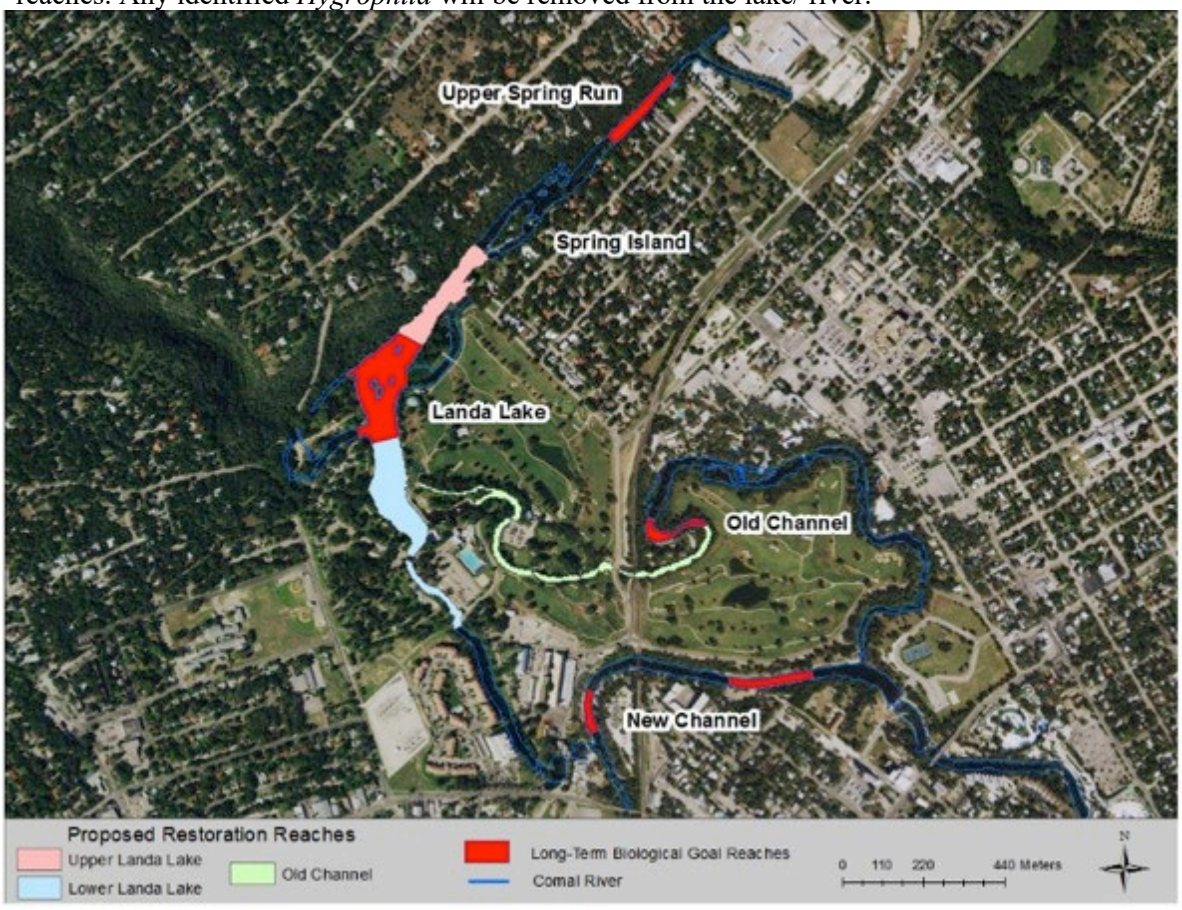

Figure 2: LTBG and restoration reaches for the Comal River System. The Upper and Lower Landa Lake restoration reaches are shown in light red and blue (respectively). The Landa Lake, New Channel, and Upper Spring Run LTBG reaches are shown in red.

Table 3: Annual and long-term SAV restoration goals, in meters squared (m^2), within Landa Lake, New Channel, and Upper Spring Run LTBG reaches and Upper/ Lower Landa Lake restoration reaches.

Reach	Aquatic Vegetation Species	Meters squared of aquatic vegetation (m^2)	Annual Restoration Goal	Approximate # of plants needed to meet annual goal
		Long-term Goal	2022	2022
LTBG Reaches				
Landa Lake	*Ludwigia*	900	35	525-700
	Cabomba	500	25	500
	Sagittaria	2,250	0	0
	Vallisneria	12,500	50	*
	Potamogeton	25	0	-
New Channel	*Ludwigia*	100	5	75-100
	Cabomba	2,500	15	300
	Sagittaria	0	0	0
Upper Spring Run	*Ludwigia*	25	5	75-100
	Cabomba	25	5	100
	Sagittaria	850	5**	60
Restoration Reaches				
Landa Lake Upper	*Ludwigia*	25	0	0
	Cabomba	250	10	200
	Sagittaria	250	25**	300
Landa Lake Lower	*Ludwigia*	50	5	75-100
	Cabomba	125	0	-
	Sagittaria	100	10**	120
	Vallisneria	22,500	-	-

**Vallisneria* will not be planted but will be allowed to naturally expand, as needed, to increase coverage.
**Based on Fall 2021 mapping of SAV, coverages exceed the long-term coverage goal. No planting will be necessary unless declines in coverage are observed throughout the season.

Methodology:

Non-Native Vegetation Management:

Non-native SAV (i.e. *Hygrophila*) will be removed, as needed, to minimize competition with native SAV. Large-scale removal of non-native SAV will not be required in 2022 as non-native SAV has largely been eliminated from Landa Lake and the Upper Spring Run area. Restoration areas will be monitored for the re-establishment of non-native SAV. Small, localized growth of non-native SAV will be removed by selective physical extraction of visible plant and root mass.

Native SAV Restoration:

Target SAV species will be planted within the Landa Lake, New Channel, and Upper Spring Run LTBG reaches to increase the coverage of individual plant species per the annual restoration goals set forth in **Table 3**. An approximate number of plants needed to achieve the annual goals is also included in **Table 3**. Individual plant species will be planted in locations within the Lake/ river

channel where light exposure, flow velocities, and substrate provide the best conditions for the individual plant types. Supplemental plantings of *Ludwigia* and *Cabomba* will be planted in existing restoration plots within the Landa Lake, New Channel, and Upper Spring Run LTBG reaches, as necessary, to maintain existing coverage or to replace any drastic losses in coverage due to floods, natural competition or other factors.

Ludwigia will continue to be propagated in-situ within Landa Lake in order to provide plant stock for 2022 restoration efforts. In-situ propagation of *Ludwigia* will be conducted by collecting stem cuttings from *Ludwigia* plants that exist within the Comal River system. The cuttings will be placed in pots filled with substrate collected from within the Comal River system. The potted cuttings will then be placed in Mobile Underwater Plant Propagation Trays (MUPPTs) and placed in a shallow portion of Landa Lake and allowed to produce roots and plant mass. *Ludwigia* plants propagated in the MUPPTs, as well as *Ludwigia* cuttings, will be planted in suitable locations within the Landa Lake LTBG reach to achieve an annual target of 35 m^2 of additional *Ludwigia* coverage at full grow out, within the New Channel LTBG reach to achieve an annual target of 5 m^2 of additional *Ludwigia* coverage at full grow out, and within the Upper Spring Run LTBG reach to achieve and annual target of 5 m^2 of additional *Ludwigia* coverage at full grow out. *Ludwigia* plants and cuttings will also be planted in suitable locations within Lower Landa Lake restoration reach to achieve an annual target of 5m^2 of additional *Ludwigia* coverage. Slightly more than the targeted coverage of *Ludwigia* will be planted to account for plant die-off. Based on previous restoration experience, approximately 15-20 *Ludwigia* plants are needed to achieve 1m^2 of coverage. Therefore, approximately 575-700, 75-100, 75-100 and 75-100 *Ludwigia* plants will be planted in the Landa Lake LTBG, New Channel LTBG, Upper Spring Run LTBG and Lower Landa Lake Restoration reaches, respectively, to achieve target annual coverage in each reach.

Cabomba typically thrives in deep, low-velocity areas and will be planted in the most suitable locations in the Landa Lake LTBG reach to achieve an annual target of 25 m^2 of additional *Cabomba* coverage at full grow out, within the New Channel LTBG reach to achieve an annual target of 15m^2 of additional *Cabomba* coverage at full grow out and within the Upper Spring Run LTBG reach to achieve an additional 5 m^2 of *Cabomba* coverage at full grow out. *Cabomba* will also be planted in suitable locations within the Upper Landa Lake restoration reach, as needed, to achieve an annual target of 10 m^2 of additional *Cabomba* coverage. *Cabomba* will not be planting in the reaches where coverage has exceeded the long-term goal based on Fall 2020 SAV mapping. *Cabomba* will be planted using stem cuttings and/ or individual rooted plants. Stemmed cuttings will be collected from the New Channel and / or the spring-fed pool. The cuttings will be bundled into fist-sized bundles wrapped with rubber bands to keep bundles together. The *Cabomba* cutting bundles are typically 12 to 32 inches in length and will be planted at a depth of 2/3 their length, if possible, in soft, silty sediment. This planting depth prevents *Cabomba* from loosening and floating away and ensures multiple nodes are buried for production of good root structure. Rooted *Cabomba* will also be utilized and will be harvested from areas in the Comal River system where *Cabomba* is abundant. The rooted plants will then be planted individually. Both the stemmed cuttings and rooted plants will be planted in a grid-pattern at 1ft centers. Significantly more than the targeted coverage of *Cabomba* will be planted in order to account for plant die-off. Approximately 20 *Cabomba* plantings are needed to achieve 1m^2 of coverage. Therefore, approximately 500, 300, and 100 *Cabomba* plants will be planted in the Landa Lake LTBG, New Channel LTBG, and the Upper Spring Run LTBG reaches, respectively to achieve target annual coverage in each reach. Approximately 200 *Cabomba* plants will be planted in the Upper Landa Lake restoration reach to achieve target annual coverage in each reach.

Sagittaria will be planted only as-needed in the most suitable locations in the Upper Spring Run LTBG, Upper Landa Lake and Lower Landa Lake reaches only on an as needed basis to achieve an annual target of $5m^2$, $25m^2$ and $10m^2$ of additional *Sagittaria* coverage, respectively, at full grow out. Due to its aggressive growth habit, observed natural expansion and existing coverage, it is not anticipated that *Sagittaria* will be planted in 2022 within any of the restoration reaches. If needed, *Sagittaria* will be planted as transplants harvested from Landa Lake. The leaves of the transplants will be trimmed prior to planting to decrease buoyancy and drag. Approximately 12 *Sagittaria* plants are needed to achieve $1m^2$ of coverage.

There are no coverage targets for *Potamogeton* in 2022. *Potamogeton* will be planted only as needed to maintain target coverages in the Landa Lake LTBG reach. *Potamogeton* will be planted as needed using bare-root rhizomes that are harvested from the Comal River system. Approximately six rhizome sections need to be planted to achieve $1m^2$ of *Potamogeton* coverage.

Competition between native plants has been observed where *Vallisneria* and *Sagittaria* will encroach on and take over *Ludwigia* and *Cabomba* stands. To minimize the effects of competition and to promote the growth and spread of *Ludwigia* and *Cabomba*, buffers will be created around planted *Ludwigia* and *Cabomba* stands to the extent practicable. Any plant material that is removed during this activity will be collected and removed from the lake/ river.

Following planting of native SAV, gardening and maintenance will occur on a monthly basis between March and October to assess health of plants and to identify and remove any non-native vegetation that is beginning to establish within planting areas.

Monitoring:
Routine monitoring will occur in order to identify re-establishment of non-native aquatic vegetation. Planted areas will also be monitored to assess expansion, die-off, and competition by native and non-native aquatic plant species. Once native aquatic vegetation is established in an area, monitoring will be conducted on a less frequent basis.

Seasonal vegetation mapping in the Landa Lake, New Channel, and Upper Spring Run LTBG reaches and the Upper/ Lower Landa Lake restoration reaches will be conducted to evaluate SAV coverage and to assess progress of aquatic vegetation restoration efforts. Mapping is conducted by circling the perimeter of vegetation stands with a kayak equipped with a Trimble GPS unit. Mapping will occur in January, April, and October. The October mapping event will be used as a basis for assessing overall SAV coverage with respect to developing annual restoration goals for 2022 and subsequent years.

Budget:
Table 7.1:
$50,000

Available budget:
$50,000

Estimated 2022 budget:
$100,000

*The increase of $50,000 in the budget for this Conservation Measure will be offset by a decrease in the 2022 budget Old Channel Aquatic Vegetation Restoration Conservation Measure (EAHCP § 5.2.2.1).

5.2.3 Management of Public Recreation

Public recreational use of the Comal River ecosystems includes swimming, wading, tubing, boating, canoeing, kayaking, golfing, scuba diving, snorkeling and fishing. To minimize the impacts of incidental take resulting from recreation, the City of New Braunfels will continue to implement existing recreation control measures as specified in Section 5.2.3(1) of the EAHCP and will seek voluntary participation in the Certificate of Inclusion (COI) program from outfitters who facilitate recreation activities within the Comal River system.

Long-term Objective:
To minimize and mitigate the impacts of recreation on endangered species habitat within the Spring Runs, Landa Lake and the Comal River.

Target for 2022:
Continue to enforce existing restrictions that limit recreational access to Landa Lake, Spring Runs, and the Old Channel of the Comal River.

Inform river recreation Outfitters of the EAHCP COI program.

Methods:
The City will continue to enforce City Code Sections 86-4 and 142-5 that restrict recreational access to Landa Lake, Spring Runs, and the Old Channel. Trained Park Rangers will continue to patrol applicable areas to prevent illegal access to these waterbodies.

The City will continue to work in conjunction with EAHCP program staff to develop COI program documents and strategies. The City will reach out to local river outfitters to inform them of the COI program once a framework for the COI program is established. The COI will include the minimum requirements as specified in EAHCP § 5.2.3 (2) a-h.

Monitoring:
Monitor the status of participating outfitters to comply with the minimum COI outfitter standards and requirements set forth in EAHCP § 5.2.3.

Budget:
Table 7.1:
$0

Available budget:
$0

Estimated 2022 budget:
$0

5.2.4 Decaying Vegetation Removal and Dissolved Oxygen Management

Long-term Objective:
Maintain adequate dissolved oxygen (DO) levels within Landa Lake for the protection of the biological community, including the fountain darter. Minimize and mitigate oxygen consumption caused by decaying vegetation.

Target for 2022:
Collect DO data spatially throughout Landa Lake and the Upper Spring Run during low-flow periods (<100 cfs discharge at Comal Springs). Displace floating vegetation mats, as needed, that form on Landa Lake to prevent oxygen consumption by decaying vegetation (management of floating/ decaying vegetation will be funded and accomplished through the Litter and Floating Vegetation Management Conservation Measure [EAHCP § 5.2.10]). Remove decaying vegetation from Landa Lake and Upper Spring Run during low-flow conditions (<100 cfs), as needed, to mitigate low DO levels caused by low-springflow and decaying vegetation.

Methods and Monitoring:

Approximately six logging DO sensors (e.g., comparable to MiniDOT sensors available from Precision Measurement Engineering [PME Inc. Vista, CA] that have been used in prior years) will be installed in key documented Fountain Darter habitat areas in Landa Lake during periods when Comal Springs discharge decreases below 100 cfs. The sensor data will be downloaded, and the equipment will be cleaned routinely, as needed, to prevent fouling. The main objective of this data collection is to continuously monitor DO conditions during low-flow events and prompt DO mitigation activities.

Aquatic vegetation conditions and floating vegetation mats will be visually observed on a regular basis (i.e. weekly at minimum) to assess for signs of stress, die-off. Floating aquatic vegetation and dead aquatic vegetation has the potential to cause oxygen depletion from the decomposition of the vegetation itself and from reduced atmospheric reaeration. Should vegetation die-off be observed due to low-flow or if floating vegetation mats reach impactive levels (if mats cover >25% of the mid-lake area or if individual mats are >3 meters diameter), displacement or removal of the decaying vegetation or vegetation mats will take place within one week of identification as part of Litter and Floating Vegetation Management Conservation Measure (EAHCP § 5.2.10).

If low springflow conditions (<100cfs) occur and vegetation decay or low DO is evident, intensive displacement or removal of decaying vegetation will be implemented, as appropriate, under EAHCP § 5.2.10. Intensive refers to the frequency of vegetation mat management being more than once per week. Displacement and/or removal will be conducted in the least disruptive method tested to be effective, to limit any additional DO stress from stirring, turbidity, etc.

Budget:
Table 7.1:
$15,000

Available budget:
$15,000

Estimated 2022 budget:
$15,000
*To be utilized only if low-flow conditions (<100cfs) are realized at Comal Springs.

5.2.5/5.2.9 Non-Native Animal Species Control

The City of New Braunfels will continue to implement a program to reduce non-native animal species in the Comal River system. The non-native animal species that will be targeted include the suckermouth armored catfish, sailfin catfish, tilapia, and nutria. Since this Work Plan has two components identified within the EAHCP, each component has been broken out to facilitate the development of the Work Plan and budgets.

Long-term Objective:
Reduce populations of non-native animal species to minimize their direct and indirect impacts to the Covered Species and the Comal River ecosystem.

Target for 2022:
Continue existing program to remove non-native invasive species, including tilapia, nutria, sailfin catfish and suckermouth armored catfish from the Comal River system utilizing removal methods proven successful in previous years. Continue to record counts and biomass of removed species per removal effort.

Methods:
Invasive species will be removed from Landa Lake and portions of the Comal River during routine removal sessions that will occur year-round.

Tilapia sailfin catfish and suckermouth armored catfish will be targeted throughout the Comal River system by divers with spears and spearguns. Upon removal from the water, all invasive fish will be eviscerated, in accordance with state laws, and disposed of. The carcasses will be measured (in inches) and weighed (in pounds). Total biomass of the removed fishes will be calculated. Total length of non-native fishes will also be measured to determine if, over time, the removal of adults affects target population demographics.

Box traps baited with carrots, sweet potatoes, and apples will be utilized to capture nutria. Traps will be placed in areas frequented by nutria (evident by slides, scat, chewed vegetation, lake-wall erosion and damage, and other observations). The traps will be checked in the late afternoon and again the next morning at approximately 7:30 am. Captured nutria will be euthanized. Removed nutria will be measured (in inches) and weighed (in pounds) prior to being disposed of**.**

Monitoring:
The non-native species removal program will involve obtaining and recording the following information:

- Date of removal.
- Number of hours worked.
- Type of species removed.
- Removal method.
- Number of individuals caught/speared.
- Total weight of individuals removed.
- Length of individuals removed.

The data provided will be used by CONB and EAHCP staff to generate catch per unit effort and to determine the effectiveness of the removal program.

The EAA Biological Monitoring program will also assess the status of non-native species populations and any impacts of non-native removal to the Covered Species.

Reduction of Non-Native Species Introduction and Live Bait Prohibition

Long-term Objective:
Minimize the introduction of non-native species to the Comal River system.

Target for 2022:
The City will enforce Ordinance No. 2019-42, City Code Section 142-4 and 142-6 enacted to control introductions of non-native aquatic organisms to the Comal River system.

Methods:
The City will uphold the ordinance prohibiting aquarium dumping and the use of non-native aquatic bait species.

Monitoring:
The EAA Biological Monitoring program and routine non-native removal sessions will detect the presence of newly introduced species.

Budget:
Table 7.1:
$75,000

Available budget:
$75,000

Estimated 2022 budget:
$45,000

5.2.6/6.3.6 Monitoring and Reduction of Gill Parasites

Long-term Objective:
To assess the threat of the gill parasite (*Centrocestus formosanus*) and the intestinal fluke parasite (*Haplorchis pumilio)* on fountain darter populations by monitoring parasite cercariae concentrations in the water column.

Target for 2022:
Perform parasite water column cercariae monitoring at four established monitoring transects. Analyze monitoring data to determine the overall effect and potential threat of the gill parasite and *H. pumilio* to fountain darter populations.

Methods:
To quantify the concentrations of drifting parasite cercariae in the Comal River study area, three transects (LL, OCR, RVP) that were previously sampled in 2015-2021 will be sampled in 2022. In addition, monitoring will also occur at a fourth transect at Pecan Island (PI) that was established in 2020 at the downstream end of the Pecan Island slough. The monitoring will occur once in late summer of 2022 in order to remain consistent with timing of previous years' monitoring.

Figure 3 illustrates the parasite cercariae monitoring locations. The four sampling transects are considered locations that adequately represent the Comal Spring system and are efficient for long-term monitoring of drifting cercariae.

At each of the selected transect locations, 5-L water samples will be collected from six points that are distributed throughout the water column both horizontally and vertically. For each transect, three sampling stations will be established that are equally spaced across the stream channel perpendicular to flow. At each of these stations, two 5-L samples will be collected, one approximately 5 cm from the surface and one at 60% of the depth at that location. Samples will be collected using a modified livewell pump attached to a standard flow/depth measurement rod and buckets marked at the 5-L volume. At the time of collection, each water sample will be immediately treated with 5 milliliters (ml) of formaldehyde to kill parasite cercariae, thus facilitating their capture (live cercariae can wiggle through the filter device). Filtration will involve passing the sample through a specialized filter apparatus containing three progressively finer nylon filters, the final filter having pores of 30 microns. After filtration of each sample, the 30- micron filter containing cercariae will be removed from the filtration apparatus and placed in a Petri dish. Each sample will then be stained with Rose Bengal solution and fixed with 10% formalin, at which point the Petri dish was closed and sealed with Parafilm for storage. Cercariae on each filter will later be counted using high-power microscopy at the BIO-WEST laboratory.

Budget:
Table 7.1:
$75,000

Available budget:
$75,000

Estimated 2022 budget:
$10,000

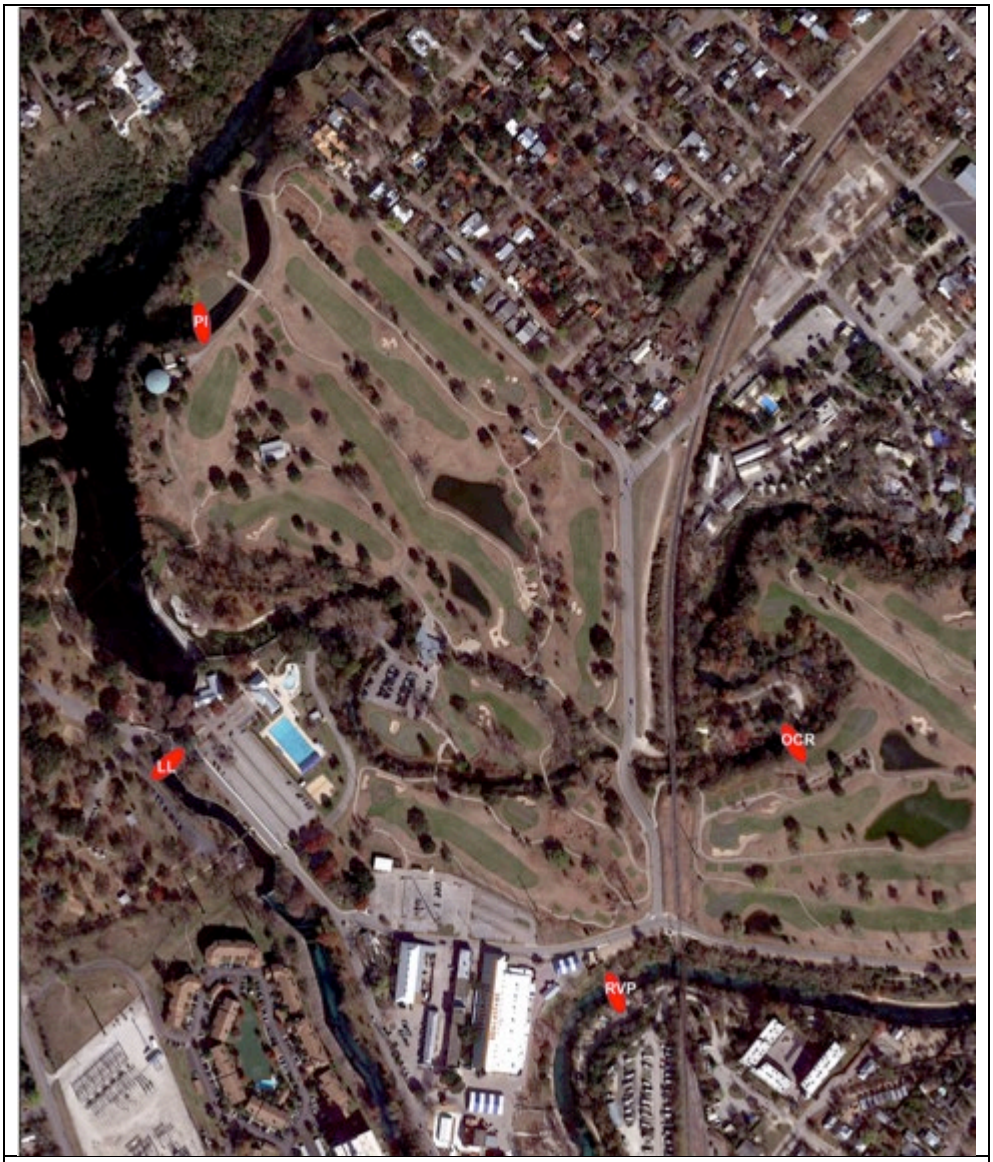

Figure 3. Parasite cercariae monitoring locations

5.2.7 Prohibition of Hazardous Materials Transport Across the Comal River and Its Tributaries

The City of New Braunfels will continue to prohibit the transport of hazardous materials on routes crossing the Comal River and its tributaries.

Long-term Objective:
To minimize the potential for accidental spills or releases of hazardous materials into the Comal River system that may cause negative impacts to the Covered Species.

Target for 2022:
Maintain existing HazMat transport signage and monitor for the presence of trucks carrying hazardous cargo on routes crossing the Comal River and its tributaries.

Methods:
City of New Braunfels Ordinance No. 93-7 effectively restricts the transport of hazardous cargo within Loop 337 and IH-35 and therefore, over roadways crossing the Comal River. Hazardous cargo route prohibition signage was installed in 2016 at key roadways near the headwaters of Landa Lake and the Comal River.

Monitoring:
Hazardous cargo restriction signage will be monitored and replaced/ repaired as needed. The City of New Braunfels Police Department will monitor for trucks carrying hazardous cargo on prohibited routes per City ordinance.

Budget:
Table 7.1:
$0

Available budget:
$0

Estimated 2022 budget:
$0

5.2.8 Native Riparian Habitat Restoration (Comal Springs riffle beetle)

Long-term Objective:
Establish a healthy, functioning riparian area along Spring Runs 1, 2 & 3, and the western shoreline of Landa Lake to benefit the Comal Springs riffle beetle (*Heterelmis comalensis*). Establish native riparian vegetation to increase the stability of the bank, decrease erosion/ sedimentation and increase the amount of available food sources (i.e. course particulate organic matter) for the riffle beetle.

Target for 2022:

Remove non-native vegetation along Spring Run 1 and Spring Run 2 (**Figure 4**). Plant and establish native vegetation to increase the density and area of the riparian zone along the Spring Runs.

Monitor and maintain previously restored riparian areas along Spring Run 3 and the western shoreline of Landa Lake. Plant additional native riparian plant species within the riparian buffer area, as needed, to increase the density of vegetative coverage in this area. Remove any re-emergent non-native vegetation and maintain sediment control berms. Replace/ maintain sediment control berms and install new berms, as needed.

Figure 4. Location of 2022 riparian restoration activities in Landa Park along Spring Run 1 (left) and Spring Run 2 (right).

Methods:

Invasive Species Management:

Non-native riparian vegetation along the banks of Spring Runs 1 & 2 will be treated using mechanical and chemical treatment methods. Non-native trees will be cut and removed, and remaining tree stump treated with aquatic-approved herbicide. Non-native vegetation along the Spring Runs is limited to only a few *Ligustrum* trees.

Native Plant Restoration:

Install sediment control berms in locations where non-native vegetation is removed/ treated. Following the successful treatment/ removal of non-native vegetation and installation erosion control berms, native riparian vegetation will be planted. Native plants will be selected based on sun exposure, proximity to the stream, growth habit, and ability to withstand deer browsing. Candidate native plant species may include those in **Table 4.**

Monitoring/ Maintenance:

Monitor the riparian zone along Spring Run 3 and the western shoreline of Landa Lake twice/ year, once in late spring/ early summer (April-June) and once in the fall (October) to assess for the re-emergence of non-native vegetation and to monitor the status of native plants and erosion control berms.

Mechanically remove any observed re-emergent, non-native invasive plants within the riparian zone along Spring Run 3 and along the western shoreline, as needed.

Plant supplemental native plants, as needed, to increase density of riparian buffer area. Native plants will be selected based on root structure, light requirements, drought tolerance, growth habits and deer-resistance. Candidate native plant species may include, but will not be limited, to those in **Table 4**. Re-construct erosion control berms as needed.

Monitor the stability and condition of existing sediment capture berms located along the Western Shoreline of Landa Lake. Repair and replace failing berms and install new berms as needed to help capture sediment prior to reduce sedimentation in Landa Lake.

Table 4. Candidate riparian plantings

Sun Species	Shade Species
Turks Cap (*Malvaviscus arboreus var. drummondii*)	Turks Cap (*Malvaviscus arboreus var. drummondii*)
Frostweed (*Verbesina virginica)*	Frostweed (*Verbesina virginica)*
Yellow Bidens (*Bidens laevis)*	Emory Sedge (*Carex emoryi*)
Swamp Milkweed (*Asclepias incarnata*)	Boneset/ Mistflower (*Ageratina havanensis*)
Switchgrass (*Panicum virgatum*)	Elderberry (*Sambucus canadensis)*
Bushy bluestem (*Andropogon glomeratus*)	Giant spiderwort (*Tradescantia gigantean)*
Emory Sedge (*Carex emoryi*)	Texas aster (*Symphyotrichum drummondii texanum)*
Sweetscent (*Pluchea odorata*)	Red salvia (*Salvia coccinea*)
Yellow compass plant *(Silphium integrifolium radulum*)	Inland Sea Oats (*Chasmanthium latifolium*)
Texas bluebells (*Eustoma exaltatum*)	

Table 4. Candidate riparian plantings

Trees and Shrubs
American Beautyberry (*Callicarpa americana)*
Bald Cypress (*Taxodium distichum)*
Bee Brush (*Eysenhardtia texana)*
Black Walnut (*Juglans nigra)*
Burr Oak (*Quercus macrocarpa)*
Buttonbush (*Cephalanthus occidentalis)*
Eve's Necklace (*Styphnolobium affine)*
Fragrant Sumac (*Rhus aromatica*)
Green Ash (*Fraxinus pennsylvanica)*
Mexican Buckeye (*Ungnadia speciosa)*
Mexican Plum (*Prunus mexicana)*
Mountain Laurel (*Sophora secundiflora*)
Possum Haw Holly (*Ilex ambigua)*
Red Buckeye (*Aesculus pavia)*
Red Mulberry (*Morus rubra)*
Dwarf Palmetto (*Sabal minor*)

Budget:

Table 7.1:
$25,000

Available budget:
$25,000

Estimated 2022 budget:
$25,000

5.2.10 Litter and Floating Vegetation Control

Long-term Objective:
Minimize the impacts of floating vegetation mats and litter on aquatic vegetation and endangered species habitat in Landa Lake, the Spring Runs, and the upper portion of the Old Channel. Mitigate low dissolved oxygen levels in Landa Lake caused by decaying vegetation. Minimize shading of and negative impacts to aquatic vegetation caused by floating vegetation mats.

Target for 2022:
Dislodge floating vegetation mats and remove litter from applicable portions of the Comal River system to prevent negative impacts to flow control structures, aquatic vegetation, and endangered species habitat. In the event of low-flow conditions or receipt of depressed dissolved oxygen levels in Landa Lake, the removal of and/or increased efforts to dislodge floating vegetation mats will be initiated to prevent oxygen consumption by decaying vegetative material.

Methods:
Floating Vegetation Mat Management: Floating vegetation mats are commonly observed within Landa Lake and are composed primarily of macrophyte fragments, algae, bryophytes and terrestrial debris. The vegetation mats are naturally occurring and are the result of natural processes. Maintenance activities associated with floating vegetation mats in Landa Lake will involve dislodging floating mats and facilitating migration of the mats downstream of Landa Lake. Any litter found within floating vegetation mats will be removed prior to dislodging. Maintenance of floating vegetation mats will occur on a weekly basis between March and September and on an as-needed basis during the remainder of the year. Floating vegetation mats will be dislodged from flow control structures, the Three Islands area, fishing pier and other locations where vegetation mats accumulate and negatively impact native aquatic vegetation. Additional efforts to displace and/ or remove floating and decaying vegetation will occur during low-flow conditions (<100cfs) and/ or when low dissolved oxygen levels are observed to further mitigate impacts to dissolved oxygen and native aquatic vegetation.

Litter Management: (May 1st to September 30th). Litter pickup within the riparian zone along the Old Channel will occur on a bi-monthly basis (twice/ month) between May 1st and September 30th. Litter will also be removed from within the Old Channel to the extent that it can be removed with a 10ft trash grabber. Removed litter will be quantified and reported on a monthly basis.

Monitoring:
Monitor litter and floating vegetation mats in applicable areas on a weekly basis and more frequently if low-flow conditions occur. Dissolved Oxygen concentrations will be monitored by EAA and as part of the Decaying Vegetation Removal and Dissolved Oxygen Management Conservation Measure (EAHCP § 5.2.4). City staff will monitor contractor efforts and coordinate additional efforts when deemed necessary.

Budget:
Table 7.1:
$0

Available budget:
$0

Estimated 2022 budget:
$25,000

5.2.11 Golf Course Management and Planning

The City of New Braunfels will implement their existing Integrated Pest Management Plan (IPMP) for Landa Park Golf Course. This process will incorporate public input and the Golf Course Advisory Board. The golf course IPMP will incorporate environmentally sensitive techniques to minimize chemical application, continue to improve water quality, and reduce negative effects to the ecosystem. Expanded water quality sampling targeted at Golf Course operations will be conducted as described in Section of 5.7.2 of the EAHCP.

Long-term Objective:
To manage the golf course and grounds in a way that minimizes negative impacts to the aquatic ecosystem in Landa Lake and the Comal River.

Target for 2022:
Continue to implement the IPMP and update as needed.

Methods:
The golf course and grounds will be maintained in an aesthetically pleasing, yet environmentally sensitive manner. It is the responsibility of the Golf Course Manager to maintain the course and grounds in accordance with the new IPMP. The IPMP describes chemicals and methods for controlling pests (i.e. insects, weeds, and other living organisms requiring control) on the golf course in a way that does not negatively impact water quality or endangered species.

Monitoring:
The EAHCP Water Quality Monitoring Program monitors surface water, groundwater, and fish tissue for a range of contaminants to collect information on the water quality of Comal Springs and associated surface waters.

Budget:
Table 7.1:
$0

Available budget:
$0

Estimated 2022 budget:
$0

5.7.1 Native Riparian Habitat Restoration

Long-term Objective:
Increase the area and density of native riparian vegetation, reduce the coverage of non-native riparian vegetation, and prevent streambank erosion in areas immediately adjacent to the Comal River and Landa Lake to complement aquatic vegetation restoration efforts and to help protect water quality.

Target for 2022:
Continue efforts to remove non-native riparian vegetation (i.e. *Ligustrum*, Chinese Tallow and Elephant Ears) from the banks of Landa Lake along the Landa Lake Golf Course, install sediment capture berms and plant native vegetation. The target work area for 2022 is the bank along the Landa Lake Golf Course downstream of Pecan Island to the Landa Lake Dam emergency spillway (**Figure 5**).

Figure 5. Location of 2022 riparian restoration activities along Landa Lake Golf Course in the vicinity of the NBU water tank.

Remove non-native vegetation (primarily Elephant Ear and Brazilian vervain) and plant native vegetation on a small island adjacent to "the Island" park owned by the Comal County Water Recreation District #1 (CCWRD#1) (**Figure 6**).

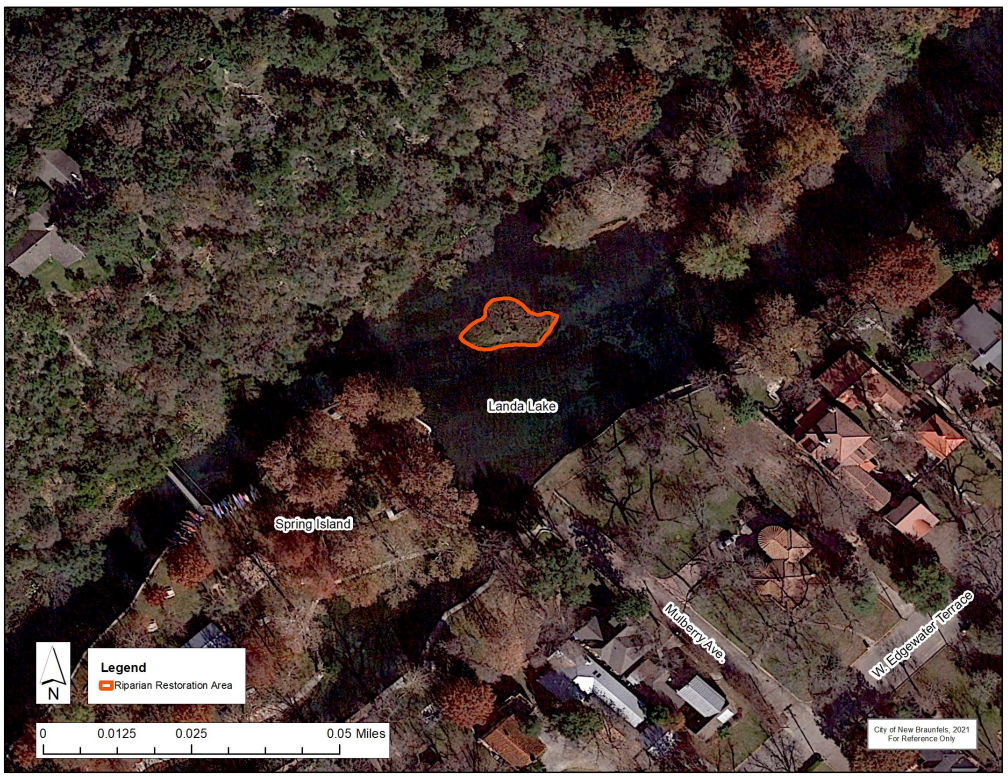

Figure 6. Location of 2022 riparian restoration activities on small island in the vicinity of the private island owned by the CCWRD #1

Plant native vegetation along the Mill Race of the Comal River in the vicinity of Landa Park Pavilion #16 and the USGS New Channel streamflow gaging station (**Figure 7**) to establish a riparian buffer zone.

Figure 7. Location of 2022 riparian restoration activities in Landa Park along the Mill Race of the Comal River near Pavilion 16.

Treat and remove non-native vegetation (primarily Arundo Cane) on the Wurstfest grounds along the banks of the New Channel of the Comal River (**Figure 8**), install sediment capture berms and plant native vegetation.

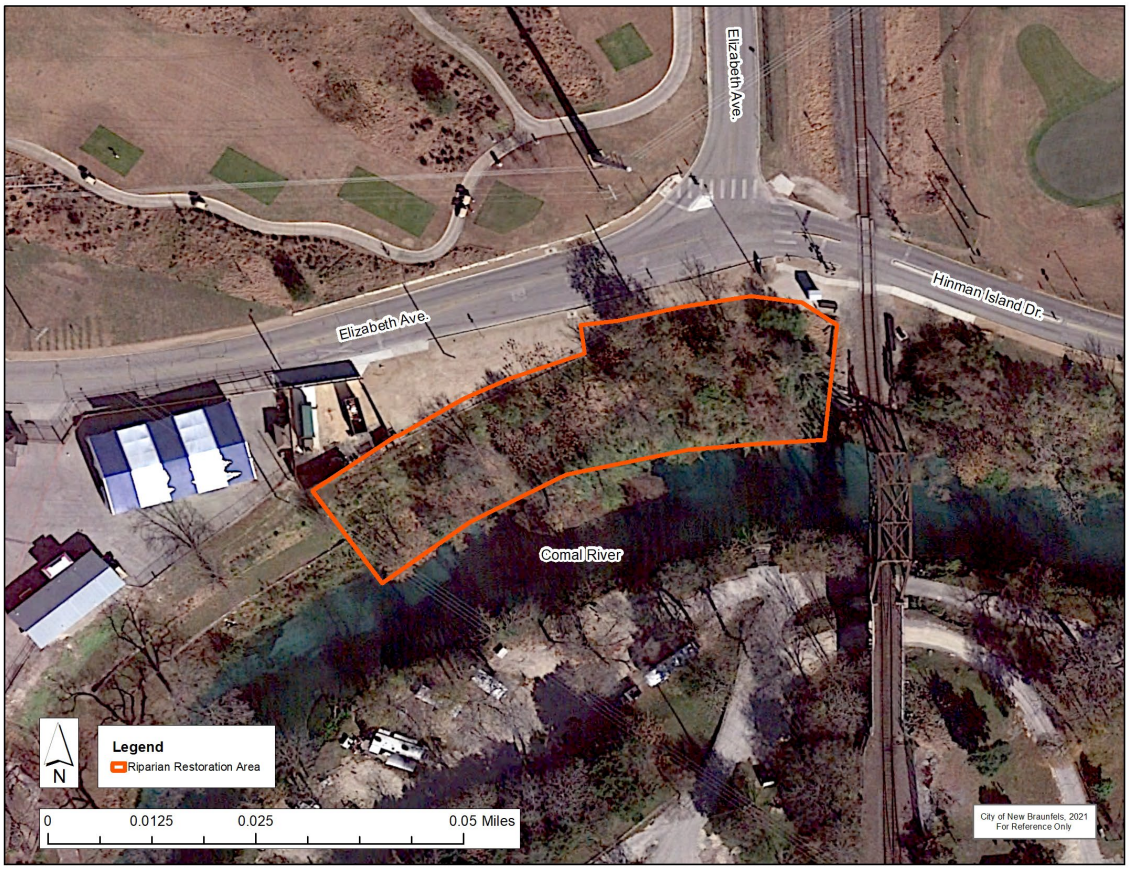

Figure 8. Location of 2022 riparian restoration activities on the Wurstfest grounds along the New Channel of the Comal River.

Monitor and maintain riparian areas where non-native riparian vegetation was treated/ removed in previous years to prevent re-establishment. Monitor and maintain previously planted areas to assess condition of riparian vegetation and promote the establishment/ growth of native vegetation. Plant additional native plants, and/ or grasses, as needed, to replace dead plantings or to vegetate bare areas. Maintenance of restored areas in Landa Park may include the installation of permanent fencing, as needed, to prevent disturbance of restored areas by park visitors.

Methods:

Invasive Species Management:

Non-native riparian vegetation will be treated with mechanical methods and/ or with use of an aquatic-approved herbicide. Elephant Ears will be treated in small sections to minimize overall herbicide usage and to minimize soil/ bank disturbance over large areas. Non-native trees will be cut and removed, and remaining tree stump treated with aquatic-approved herbicide.

Monitor areas where non-native plants were removed in previous years. Re-treat and remove re-emergent non-native vegetation.

Native Plant Restoration:

Install sediment control berms in locations where non-native plants are treated/ removed. Native plants will be planted following the successful treatment/ removal of non-native vegetation and installation erosion control berms. Native plants will be selected based on sun exposure, proximity to the stream, growth habit, and ability to withstand deer browsing. Candidate native plant species may include those in **Table 5 and 6.**

Table 5. Candidate riparian plantings for Landa Lake Golf Course and Landa Park

Trees and Shrubs	**Herbaceous**
American Beautyberry (*Callicarpa americana)*	Coral Honeysuckle (*Lonicera sempervirens*)
Bald Cypress (*Taxodium distichum)*	Creeping Spotflower (*Acmella repens*)
Bee Brush (*Eysenhardtia texana)*	Emory Sedge (*Carex emoryi*)
Black Walnut (*Juglans nigra)*	Frog Fruit (*Phyla nodiflora*)
Burr Oak (*Quercus macrocarpa)*	Frostweed (*Verbesina virginica)*
Buttonbush (*Cephalanthus occidentalis)*	Horse Herb (*Calyptocarpus vialis*)
Elderberry (*Sambucus canadensis)*	Inland Sea Oats (*Chasmanthium latifolium*)
Eve's Necklace (*Styphnolobium affine)*	Switchgrass (*Panicum virgatum*)
Fragrant Sumac (*Rhus aromatica*)	Texas Lantana (*Lantana urticoides*)
Green Ash (*Fraxinus pennsylvanica)*	Turks Cap (*Malvaviscus arboreus var. drummondii*)
Mexican Buckeye (*Ungnadia speciosa)*	Water Willow (*Decodon verticillatus*)
Mexican Plum (*Prunus mexicana)*	White Boneset (*Eupatorium serotinum*)
Mountain Laurel (*Sophora secundiflora*)	Yellow Bidens (*Bidens sp.*)
Possum Haw Holly (*Ilex ambigua)*	Woodland Sedge (*Carex blanda*)
Red Buckeye (*Aesculus pavia)*	Zexmenia (*Wedelia acapulcensis var. hispida)*
Red Mulberry (*Morus rubra)*	
Dwarf Palmetto (*Sabal minor*)	
Soapberry (*Sapindus drummondii)*	
Sycamore (*Platanus occidentalis)*	
Grasses	**Forbs**
Buffalo Grass (*Buchloe dactyloides)*	Texas Bluebonnet (*Lupinus texensis)*
Eastern Gamagrass (*Tripsacum dactyloides)*	Purple Prairie Clover (*Dalea purpurea)*
Green Sprangletop (*Leptochloa dubia)*	Partridge Pea (*Chamaechrista fasciculata)*
Prairie Wildrye (*Elymus canadensis)*	Texas Yellow Star (*Lindheimera texana)*
Switchgrass (*Panicum virgatum)*	Gayfeather (*Liatris mucronata)*
Little Bluestem (*Schizachyrium scoparium)*	White Prairie Clover (*Dalea candida)*
Blue Grama (*Bouteloua gracilis)*	Lemon Mint (*Monarda citridora)*
Sideoats Grama (*Bouteloua curtipendula)*	Plains Coreopsis (*Coreopsis tinctoria)*
Curly Mesquite (*Hilaria belangeri)*	Indian Blanket (*Gaillardia pulchella)*
Indiangrass (*Sorghastrum nutans)*	Tall Goldenrod (*Solidago altissima)*
Texas Cupgrass (*Eriochloa sericea)*	
Sand Dropseed (*Sporobolus cryptandrus)*	
Sand Lovegrass (*Eragrostis trichodes)*	
Big Bluestem (*Andropogon gerardii*)	
Cane Bluestem (*Bothriochloa barbinodis)*	
White Tridens (*Triden albescens)*	

Table 5. Candidate riparian plantings for Landa Lake Golf Course and Landa Park

Trees and Shrubs	Herbaceous
Western Wheatgrass (*Pascopyrum smithii)*	
Bushy Bluestem (*Andropogon glomeratus)*	

Table 6. Candidate riparian plantings for Comal County Water Recreation District #1 Property

Trees	Perennials
American Sycamore (*Platanus occidentalis)*	Coral Honeysuckle (*Lonicera sempervirens*)
Bald Cypress (*Taxodium distichum)*	Creeping Spotflower (*Acmella repens*)
Eastern Red Cedar *(Juniperus virginiana*)	Emory Sedge (*Carex emoryi*)
Cedar Elm (*Ulmus crassifolia*)	Frog Fruit (*Phyla nodiflora*)
Burr Oak (*Quercus macrocarpa)*	Damianita (*Chrysactinia mexicana*)
Eastern Cottonwood (*Populus deltoides*)	Fall Aster (*Symphyotrichum oblongifolium)*
Retama (*Parkinsonia aculeata*)	Four Nerve Daisy (*Tetraneuris scaposa)*
Eve's Necklace (*Styphnolobium affine)*	Frogfruit (*Phyla nodiflora)*
Texas Redbud (*Cercis canadensis var. texensis*)	Texas Lantana (*Lantana urticoides*)
Anacacho Orchid Tree (*Bauhinia lunaroides*)	Turks Cap (*Malvaviscus arboreus var. drummondii*)
Mountain Laurel (*Sophora secundiflora*)	Horsetail Reed (*Equisetum hyemale)*
Texas Persimmon (*Diospyros texana*)	Meahly Blue Sage (*Salvia farinacea)*
American Sycamore (*Platanus occidentalis*)	Missouri Primrose (*Oenothera macrocarpa)*
	Orange Zexmenia (*Wedelia acapulcensis var. hispida*)
	Pidgeonberry (*Rivina humilis*)
	Rock Rose (*Pavonia lasiopetala*)
	Snake Herb (*Dyschoriste linearis*)
	Tropical Sage (*Salvia coccinea*)
Grasses	**Shrubs/ Understory Plants**
Woodland Sedge (*Carex blanda*)	American Beautyberry (*Callicarpa americana*)
Eastern Gamagrass (*Tripsacum dactyloides)*	Buttonbush (*Cephalanthus occidentalis*)
Lindheimer Muhly (*Muhlenbergia lindheimeri*)	Coralbean (*Erythrina herbacea*)
Bushy Bluestem (*Andropogon glomeratus)*	Elderberry (*Sambucus canadensis*)
Switchgrass (*Panicum virgatum)*	Evergreen Sumac (*Rhus virens*)
Little Bluestem (*Schizachyrium scoparium)*	Fragrant Mimosa (*Mimosa borealis*)
Sideoats Grama (*Bouteloua curtipendula)*	Fragrant Mistflower (*Ageratina havanensis*)
Inland Sea Oats (*Chasmanthium latifolium*)	Indigobush (*Amorpha fruticosa*)
	Kidneywood (*Eysenhardtia texana*)
Misc	Mexican Buckeye (*Ungnadia speciosa*)
Lindheimer Marsh Fern (*Thelypteris ovata*)	Palmetto (*Sabal minor*)
Maidenhair Fern (*Adiantum capillus*)	Possumhaw (*Ilex decidua*)
Beargrass (*Nolina lindheimeriana*)	Red Buckeye (*Aesculus pavia*)
Texas Sotol (*Dasylirion texanum*)	Skunkbush (*Rhus aromatica var. trilobata*)
Alamo Vine (*Merremia dissecta*)	Texas Sage (*Leucophyllum frutescens*)
Coral Honeysuckle (*Lonicera sempervirens*)	Yaupon (*Ilex vomitoria*)
	Yellow Bells (*Tecoma stans)*

Monitoring:

Previously restored riparian areas will be monitored for the re-emergence of non-native vegetation and success of native plantings. Sediment capture structures will be monitored for effectiveness. Monitor native riparian plantings for success. A riparian habitat assessment will be conducted in the spring and fall to evaluate the condition of the riparian zone.

Budget:
Table 7.1:
$100,000

Available budget:
$100,000

Estimated 2022 budget:
$125,000

5.7.5 Management of Household Hazardous Wastes

Long-term Objective:
To minimize the potential for improper disposal of hazardous wastes and associated negative impacts to endangered species in the Comal River system.

Target for 2022:
Hold three household hazardous waste (HHW) collection events in New Braunfels. Continue to partner with New Braunfels Utilities (NBU) on the Operation MedSafe drug recovery program.

Methods:
Conduct three HHW collection events that incorporate an education and outreach component. The HHW events are coordinated by City's Solid Waste Division in conjunction with Comal County. The cost of each HHW event is approximately $40,000-$45,000 which includes event set-up and HHW disposal costs. The average cost of a HHW collection event is $40,385 based on HHW events held in 2018 and 2019. The cost of the first two HHW events is shared evenly between the City and Comal County. The EAHCP program will fund the third event.

HHW collection events are held at the New Braunfels City Hall. Hazardous waste that is collected during the HHW collection events will be hauled off and disposed of by Clean Harbors.

The City is continuing to explore the feasibility of implementing a HHW drop-off facility that will accept HHW on an ongoing basis throughout the year. Currently, it is expected that a HHW drop-off facility will be opened within three years. The facility will likely be open to the public 1-2 days/ week for the drop-off of HHW.

The New Braunfels Police Department partners with NBU to host an annual medicine drop-off event in New Braunfels. The CONB website also contains information about the Operation MedSafe event and tips on proper disposal of medications and drugs.

Monitoring:
The volume of hazardous waste collected and the number of participants for each HHW collection event will be documented.

Budget:
Table 7.1:
$30,000

Available budget:
$30,000

Estimated 2022 budget:
$40,385

5.7.6 Impervious Cover/Water Quality Protection

Long-term Objective:
To reduce non-point source pollutant discharges to Landa Lake and the Comal River system.

Target for 2022:

The City will begin planning for construction of a bioretention basin that is anticipated to be constructed at the Landa Park Aquatics Center parking lot in 2023. Design plans for this project were completed in 2020. The construction of the bioretention basin is in coordination with the City's project to renovate the parking lot.

Methods:

The City will work with the design engineer to secure required City permits for the project and address any comments resulting from City permit review. The City will solicit for a construction contractor in late 2022 to prepare for construction commencement in early 2023. The design engineer will prepare applicable bid documents and assist with the contractor solicitation.

Budget:
Table 7.1:
$150,000

Available budget:
$150,000

Estimated 2022 budget:
$15,000