

### **6.3.1 Biological Monitoring Program for the Comal and San Marcos Aquatic Ecosystems**

#### **Long-term objective:**

Since 2000, the Edwards Aquifer Authority (EAA) has conducted an extensive biological monitoring program in the Comal and San Marcos spring systems. This program was referred to as the Variable Flow Study (VFS). In 2013, the elements of the VFS were incorporated into the Biological Monitoring Program (BioMP) for the Edwards Aquifer Habitat Conservation Plan.

The purpose of the BioMP is “to monitor changes to habitat availability and population abundance of the Covered Species that may result from Covered Activities” (EAHCP § 6.3.1). Another benefit of the BioMP is to collect data that can be used in the applied environmental research studies (EAHCP § 6.3.4) and provide data and information for the ecological model development described in EAHCP § 6.3.3. The BioMP includes: (1) Comprehensive Sampling, (2) any triggered Critical Period monitoring, (3) any high flow triggered monitoring (4) and any EAHCP-specific sampling required by Section 6.4.

#### **Target for 2018:**

For 2018, the BioMP for the Comal and San Marcos Aquatic Ecosystems will continue to use the standard operating procedures adopted in 2016 for Comprehensive, Critical Period, and EAHCP Low-Flow Sampling and for the EAHCP Baseline, Disturbance components of Biological Monitoring and Take Determinations.

The standard operating procedures, program changes adopted in the 2016 Expanded Water Quality Monitoring Program Work Group and the Biological Monitoring Program Work Group, became the standard operating procedures for biological monitoring that were first used in 2017.

In 2017, the standard operating procedures for the BioMP were the same as in 2016, with the following modifications:

1. Replacing the previously conducted macroinvertebrate food source monitoring with Texas Commission on Environmental Quality/Texas Parks & Wildlife Rapid Bio-Assessment (RBA) protocols for macroinvertebrate community health, conducted at the same time as fixed drop-net sampling for fountain darters at five reaches in the Comal system and four reaches in the San Marcos system.
2. Flow-partitioning within Landa Lake conducted by the EAA, but not through the EAHCP.
3. During the “Water Quality Grab Sampling” component of the BioMP, the method detection limit (MDL) for soluble reactive phosphorus were reduced from 50 µg/l to at least 5 µg/l.

Also in 2017, the EAA shared data with other entities conducting monitoring within the spring systems, such as the Guadalupe-Blanco River Authority & TCEQ Clean Rivers Program in the Comal and San Marcos rivers, the EAHCP Biological and Water Quality Monitoring Programs and the EAA Aquifer Science Department’s groundwater and spring orifice-sampling programs.

#### *Literature Review*

The purpose of the literature review is to familiarize the Contractor with the Biomonitoring program's history and recent relevant studies, to include compilation and annotation of historical data and information related to spring water quality and variable flow and to the

composition, diversity and distribution of aquatic biota in subterranean, orifice and spring pool/run habitats with a focus on the sensitivity of indicator species and Covered Species to variable flow, water quality and habitat conditions.

#### *Aquatic Vegetation Mapping*

The Contractor will conduct aquatic vegetation mapping for the entire in four representative reaches in the Comal Springs system to the confluence of the Comal and Guadalupe rivers and in three representative reaches in the the entire San Marcos Springs system to the downstream end of Thompson Island, excluding Spring Lake. ~~during~~ The comprehensive mapping is conducted using a GPS unit with real-time differential correction with sub-meter accuracy.

#### *Zebra Mussel Monitoring*

The contractor will conduct zebra mussel monitoring using passive techniques in both the Comal and San Marcos Rivers.

#### *Texas wild-rice Mapping*

The Contractor will map all Texas wild-rice from Spring Lake downstream to the confluence of the Blanco River on an annual basis. The annual mapping will occur during the summer (August) Comprehensive Biomonitoring sampling event. The location of every stand of wild-rice will be recorded using a GPS unit with real-time differential correction with sub-meter accuracy.

In addition, during both the Spring and Fall Comprehensive sampling events, Texas wild-rice areas in Sewell Park identified as vulnerable, as well as, sections of the San Marcos River upstream and downstream of I-35 be mapped

#### *Fountain Darter Sampling*

The Contractor will conduct drop and dip netting and visual aquatic surveys with SCUBA during the Spring and Fall sampling events. Additional dip net sampling will be conducted during the Summer sampling event. Aquatic vegetation as per Task 2 will be mapped in the reaches prior to drop and dip net activities.

#### *Drop Net Sampling*

Drop netting will be used to sample fountain darters in identified reaches of the rivers in specific aquatic vegetation types that have been selected through stratified  
Fountain darters will be identified, counted, measured, examined for condition and returned to the river at the point of collection. Other fish will be identified and released, or preserved and identified in a laboratory. Live ramshorn snails will be counted, measured, and destroyed. Exotic Asian snails and Asian clam will be identified, general abundance recorded, then destroyed. Furthermore, the vegetation type, height, areal coverage, substrate type, mean column velocity, velocity at 15 centimeters (cm) above the bottom, water temperature, conductivity, and dissolved oxygen levels will be recorded at each location.

#### *Dip Net Sampling*

The Contractor will conduct dip net timed surveys, as well as presence/absence surveys in specified sections throughout the spatial extent of both systems. Fountain darters collected by

dip net monitoring will be examined for condition. Timed surveys will be conducted in all habitat types within each section, moving upstream during the sampling process, up to a depth of 1.4 m, with prime darter habitat receiving the most effort.

Presence/absence surveys will be conducted by taking 4 dip net sweeps at 50 permanent sample site locations within the 4 representative reaches at Comal Springs (Upper Spring reach (5 locations), Landa Lake reach (20 locations), Old Channel reach (20 locations), and New Channel reach (5 locations)), and the 50 permanent sample site locations within the three representative reaches in San Marcos Springs (Spring Lake Dam reach (15 locations), City Park reach (20 locations), and I-35 reach (15 locations)).

#### *Visual Fountain Darter survey*

Visual aquatic surveys will be conducted using SCUBA in a fixed location in Landa Lake to identify fountain darters at depths deeper than conventional sampling methods allow.

#### *Comal Springs Invertebrate Sampling*

The Contractor will conduct sampling for Comal Springs invertebrates during the Spring and Fall sampling events.

- One drift net each will be placed over the main spring orifice of Spring Run 1, Spring Run 3, and Spring Run 7 at Comal Springs. All endangered invertebrates will be identified and counted in the field, and returned to the orifice they were collected upon completion of the 24-hour sample period. All other invertebrates will be preserved and transported to an off-site laboratory for taxonomic classification. Coordination with the USFWS San Marcos Aquatic Resources Center (ARC) will take place each time to assist with refugia collections when needed.
- The Comal Springs riffle beetle cotton lure standard operating procedure, or a suggested (and EAHCP staff approved) alternate method, and quantitative survey methods will be utilized to conduct Comal Springs riffle beetle sampling in 3 locations (Spring Run 3, western shoreline of Landa Lake, and Spring Island area). Ten springs within each of the 3 locations will be identified by the Contractor.
- The Comal Springs riffle beetle cotton lure standard operating procedure and cotton lure quantitative survey method allow Comal Springs riffle beetles to be identified, counted, and returned to their spring of origin. Other spring invertebrates collected on the lures will also be noted. These include two other riffle beetles (*Microcyloepus* sp. and *Stenelmis* sp.), Comal Springs dryopid beetles (*Stygoparnus comalensis*), and Peck's cave amphipod (*Stygobromus pecki*).

#### *Salamander Visual Observations*

The Contractor will conduct salamander sampling during each Spring and Fall sampling event. Comal Salamander surveys will be timed and conducted by observation from the surface or dive mask and snorkel at Spring Run 1, Spring Run 3, Spring Island spring runs, and at the eastern outfall at Spring Island.

San Marcos salamander surveys follow the quantitative sampling method described in Nelson, J. (M.S. Thesis, Texas State University, 1993). Observations for the San Marcos salamander will

be done by dive mask and snorkel or SCUBA for three, 5-minute timed surveys per area. San Marcos salamanders will be counted, measured and the overall substrate where they were found documented.

- In both systems, sampling will require turning over rocks in the sample site for set periods of time in order to expose the salamanders and obtain a visual count. Whenever possible, all rocks will be returned to their original location. For this monitoring, salamanders will only be observed and no collections will occur.

#### *Comal Springs Discharge Measurements*

The Contractor will conduct discharge measurements on Comal Springs during the Spring and Fall sampling events. Discharge measurements will be conducted at Spring Runs 1, 2, and 3, Upper Spring Run Reach, and the Old Channel below Elizabeth Street and will be used to establish the contributions of each major spring run to total discharge in the river and to establish the relative proportion of water flowing in the Old and New Channels.

#### *Water Quality Sampling*

The Contractor will maintain and download existing thermistors located throughout each system. Standard water quality parameters (water temperature, conductivity compensated to 25 °C, pH, dissolved oxygen, water depth at sampling point, and observations of local conditions) will be sampled during drop net sampling and fish community sampling activities.

#### *Fixed Station Photography*

The Contractor will photo document each established, fixed station photograph site. Photographs involve an upstream, across, and downstream picture of the reach and capture key changes in the habitat in the reach.

#### *Macroinvertebrate Community Assessment*

The macroinvertebrate community assessment will be conducted using rapid bioassessment (RBA) protocol as described in “Surface Water Quality Monitoring Procedures, Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data.” TCEQ RG-416. 2014. The RBAs will be conducted in 5 reaches in the Comal and 4 reaches in the San Marcos at the drop-net fountain darter sites. One composite sample will be collected from each reach (i.e. 9 samples total across both systems). Macroinvertebrate community assessments will be conducted during comprehensive and critical period sampling events.

#### *Fish Community Sampling*

The Contractor will collect fish once per year in odd numbered years in conjunction with routine Biological Monitoring sampling from both the Comal and San Marcos river systems and to test the fish for contaminants. The fish will be collected at 2 locations within each system, for a total of 4 sampling sites. For each river system, one site will be located near the spring orifices, or in the far upper reaches of the system, and the second site will be located at the most downstream biomonitoring reach for each system (Lower River Reach – Comal; I-35 Reach – San Marcos).

At each of the 4 locations, 2 fish species (fountain darter and a predator species such as largemouth bass, warmouth, or rock bass) will be collected at the locations for comparison. The

length, weight, and sex of each individual fish will be recorded prior to using the entire body to create a composite, homogenate fish sample.

#### *SAN MARCOS SYSTEM*

Two locations within Spring Lake associated with San Marcos Salamander surveys (Big Riverbed and Hotel Area) will be sampled for fish as well as one location just upstream of the dam near the eastern spillway. All three locations will involve SCUBA transect surveys.

Three additional SCUBA transects are in each river section (Upper, Mid, and Lower) of the San Marcos River, located in representative deep areas where seining has proven to be inefficient. The exact location of the SCUBA transects within each section may change slightly based on conditions at the time of the sampling event.

#### *COMAL SYSTEM*

Three locations within Landa Lake will be sampled via SCUBA transect surveys. In particular, one of the SCUBA transects in Landa Lake will be in the same location as the ongoing fountain darter belt transect survey. In addition, SCUBA transects will be conducted within the Upper Spring Run, Old Channel, and New Channel sections of the Comal River.

In addition to SCUBA surveys, three locations (Upper Spring Run, New Channel, and Old Channel) will be sampled via seines to evaluate and track fish populations in the Comal River. Fish within each transect will be identified, measured, examined for disease, and native fish returned to the river. Exotics will be removed from the system as per scientific permit. In addition to collected data on fish, each seine haul will include data on the velocity, depth, substrate composition, in-stream coverage, climatic conditions, and mesohabitat typing of the site at the time of the observation.

#### *EAHCP Habitat Baseline and Disturbance Determination*

This determination is intended to fulfill Section M 1a and 2a of the Incidental Take Permit.

#### *Document Baseline Habitat Conditions*

For the covered HCP species, the Contractor will use January 1 of the contract year GIS mapping, bio-monitoring data and other existing sources to establish occupied habitat for the HCP Covered Species. Specific to Item M (1a and 2a) of the ITP, only occupied habitat within the Comal and San Marcos Springs/River ecosystems will be included.

#### *Document HCP Mitigation Areal Extent Per Project*

The Contractor will work with staff and contractors from the City of New Braunfels, City of San Marcos and Texas State University, coordinating through EAA staff, to describe in GIS map form, representing a snapshot in time on December 31 of the contract year, the areal extent of all direct HCP mitigation and restoration activities in the Comal and San Marcos springs systems.

If GIS files of the project/affected areas are unavailable, the Contractor will either: 1) map those areas directly with high grade GPS in real-time, or 2) use existing areal imagery to pinpoint and outline locations with subsequent, supplemental GPS ground truth mapping. The Contractor will ensure that areas represented on all maps are representative of actual mitigation, not concept areas.

### *Assessment of Net Disturbance*

The Contractor will evaluate the baseline maps versus the HCP project maps and quantify the area of direct disturbance that may have potential effects from mitigation and restoration activities as described in Item M (1a and 2a) of the ITP. The focus will be on quantifying the direct impacts (removal of non-native vegetation, etc.) via areal coverage of habitat, but will also describe potential indirect impacts (turbidity, etc.) qualitatively. This analysis will not extend beyond comparisons of areal coverage of occupied habitat.

### *Annual "Take" Estimate*

The Contractor shall estimate Take for each of the Covered Species utilizing the information generated by Subtask 12.1, 12.2 and 12.3, the information and guidance in Chapters 4 and 6 of the HCP, the Biological and Conference Opinion issued by USFWS, and any other relevant information. The purpose of this Take estimation is to ensure compliance with Section H of the ITP.

### *CRITICAL PERIOD SAMPLING*

The Critical Period Monitoring component will be performed on both systems and be based upon established flow trigger levels for each system. The type and extent of sampling conducted is dependent on the respective trigger level and is designed to be duplicative of full biomonitoring sampling and will include species-specific sampling based on the flow triggers.

### *High/Low Flow Monitoring*

The Contractor will conduct high flow critical period monitoring only after the following triggering criteria are met:

- a) The daily average flow exceeds 385 cubic feet per second (cfs) in the San Marcos aquatic ecosystem or 500 cfs in the Comal aquatic ecosystem (total flow through the ecosystem as measured at the USGS gauging station located immediately downstream of the ecosystem); and
- b) After conducting a joint visual inspection of the aquatic ecosystem with the Contractor, EAA staff determines that high flow critical period monitoring is warranted and approved.

Before high flow critical period monitoring is conducted, the sampling parameters must be recommended by the Contractor and pre-approved by EAA staff, based on professional judgment, and may include any parameter from the full biomonitoring sampling, with the exception of gill net sampling.

The Comal and San Marcos springs systems flow-based triggers are associated with specific sampling parameters.

### *San Marcos System Sampling*

Low flow Critical Period Monitoring for the San Marcos River triggers at 120 cfs, with Texas wild-rice vulnerable stand monitoring as described in Task 3 of the Comprehensive Sampling Program. Monitoring will occur at 5 cfs declines or a maximum of once per week. The first Full Sampling Event is triggered at 100 cfs, with

subsequent declining Full Sampling Events triggering at 85, 60, 25, and 100 cfs for a total of five declining Full Sampling Events. In addition, two recovery Full Sampling Events would be conducted as the system rebounds from the low-flow period. Between Full Sampling Events, habitat evaluations, per every 5 cfs decline, would be conducted again not to exceed weekly monitoring.

#### *Comal System Sampling*

Low flow Critical Period Monitoring for the Comal River triggers at 200 cfs. This triggers the first Full Sampling Event with 4 subsequent Full Sampling Events being triggered at 150, 100, 50, and 10-0 cfs, respectively. Two recovery Full Sampling Events are scheduled as the flows rebound and stabilize from drought conditions. The Comal system also has habitat evaluations scheduled between Full Sampling Events; however, at 10 cfs increments again not to exceed weekly observation. An additional component for the Comal system is the detailed riffle beetle habitat evaluation and spring orifice condition documentation that is triggered at 120 cfs and continued at 10 cfs increments during decline.

A review of historic flow records indicates that the lower the flow, the lower the chance an even lower flow event will occur, thus reducing the chances of a complete decline and recovery as outlined above. Typically, both systems rebound from drought conditions due to a tropical depression rainfall event or some other weather pattern that produces a large amount of rainfall over the watershed. Flows typically come up rapidly and require a period of stabilization before the collection of biological data is meaningful.

#### *Gill Net Evaluation*

In addition to the full sampling activities outlined in 14.1 and 14.2, the Contractor will conduct gill net evaluations in the immediate vicinity of the fountain darter SCUBA surveys in Spring Lake and Landa Lake. The Spring Lake evaluation will be triggered at 85 cfs and lower triggers. The Landa Lake assessment will be triggered at 100 cfs and lower triggers. The survey is designed to examine exotic fish concentrations and stomach content analyses with respect to predation of listed species. The number of each species (native and non-native) collected in the gill net and the data will be recorded and converted to catch per unit effort.

#### *Water Quality Grab Sampling*

The Contractor will collect water quality grab samples at the established triggers in Subtasks 14.1 and 14.2 at 18 stations longitudinally distributed in the San Marcos system and 12 stations longitudinally distributed in the Comal system. The samples will be from the surface, mid-depth and near bottom.

#### *EAHCP Low Flow Sampling*

To protect the Covered Species, Chapter 6 of the EAHCP contains specific flow requirements for both systems that trigger sampling events. This sampling is in addition to the Comprehensive and Critical Period components and consists of an increased frequency of sampling for aquatic vegetation, Texas wild-rice mapping, as well as additional sampling of fountain darters, Comal Springs riffle beetles, and salamanders.

**Budget:**Table 7.1:

\$400,000

Available budget for 2018:

\$408,275

Estimated 2018 budget:

\$408,275

\*2018 EAHCP BioMP will be performed by an outside contractor; estimated annual costs for the BioMP m is \$408,275. The cost of any Critical Period monitoring component of the BioMP, as established by the former EAA Variable Flow Study, will continue to be paid by the EAA.