

The City of New Braunfels' 2016 HCP work plan represents a collaboration of ideas, concerns, and methodologies discussed during the current planning year with Implementing Committee members, Science Committee members and stakeholders. The 2016 work plan builds upon work completed in 2013, 2014 and early 2015 to meet Edwards Aquifer Habitat Conservation Plan (EAHCP) goals and objectives.

5.2.1 Flow Split Management

The City of New Braunfels will continue to maintain flow-control structures and manage flow-partitioning between the Old and New Channels of the Comal River per Table 5-3 of the HCP.

Flow Control Structures

Long-term Objective: Maintain flow-control structures to allow for continued management of diversions from Landa Lake into the Old Channel of the Comal River to provide optimal habitat conditions for fountain darters.

Assumptions: None

Target 2016/Performance Measure: Ensure continued operability of the flow-control structures to allow for an effective flow-split management program. Install additional flow-control gates at the two 14" culverts, currently closed with threaded caps, to be utilized as a back-up to the existing primary 48" culvert and gate. The gates will allow for controlled flow into the Old Channel during maintenance activities required for long-term functionality. The 14" culverts and gates will also serve as a back-up to divert flow into the Old Channel during emergency situations in which the primary 48" culvert is unable to provide adequate flow rates. Install floating vegetation barrier booms in Landa Lake in front of each flow control gate to prevent materials from building up on culvert intake screens and therefore allow more precise flow control in accordance with Table 5.3 of the HCP.

Methods: The City of New Braunfels will exercise the flow-control gate on a regular basis to ensure continued operability. Visual inspection of the flow-control gate will occur on a regular basis to evaluate functionality and to assess for potential issues. Identified issues will be addressed to ensure continued operation of the flow-control structures and the continued ability to manipulate flows. Any necessary repairs to the flow-control structures will be immediately undertaken but will be dependent upon safe working conditions and availability of damaged parts.

Installation of flow-control gates at the 14” culverts will occur following the completion of design specifications, engineering analysis, and acquisition of required permits. The 14” culverts are located approximately 100 feet north of the primary 48” culvert and gate. The two 14” culverts exist where the former 24” culverts were capped and fitted with 14” pipe sleeves. Two separate vegetation barrier booms will be installed, with a proper anchoring system, in front on the existing 48” culvert control gate and the 14” culverts.

Monitoring: See Flow Split Management below.

Flow Split Management

Long-term Objective: To sustain flow rates in the Old Channel of the Comal River to compliment Old Channel aquatic vegetation restoration efforts, prevent channel scouring during high-flow events, and maximize the quality of fountain darter habitat.

Assumptions: Flow-split management is contingent upon continued access to USGS real-time streamflow data and operability of the flow-control gate.

Target 2016 /Performance Measure: Maintain flow rates in the Old and New Channels of the Comal River to meet objectives specified in Table 5-3 of the HCP. 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 to achieve target flows. Gates will be kept free of debris, to the extent practicable, and will be exercised routinely to maintain functionality of the gate.

Methods: The City of New Braunfels will manage the flow-split program according to flow rates specified in Table 5-3. A standard operating procedure has been developed by the City of New Braunfels to guide control gate manipulation and streamflow monitoring efforts to achieve flow-split targets. The City of New Braunfels staff will monitor real-time streamflow conditions at USGS gages in the Comal River system and adjust the flow-control gate, as needed, to meet flow-split targets. Additionally, when total Comal Spring flow drops below 150 cfs, City of New Braunfels staff will monitor and adjust the flow control structures more frequently, and as needed, to meet the flow-split guidelines defined in Table 5-3.

**TABLE 5-3
FLOW-SPLIT MANAGEMENT FOR OLD AND NEW CHANNELS**

| Total Comal Springflow (cfs) | Old Channel (cfs) | | New Channel (cfs) | |
|---------------------------------|-------------------|----------------|-------------------|----------------|
| | Fall, Winter | Spring, Summer | Fall, Winter | Spring, Summer |
| 350+ | 80 | 60 | 270+ | 290+ |
| 300 | 80 | 60 | 220 | 240 |
| 250 | 80 | 60 | 170 | 190 |
| 200 | 70 | 60 | 130 | 140 |
| 150 | | 60 | | 90 |
| 100 | | 60 | | 40 |
| 80 | | 50 | | 30 |
| 70 | | 50 | | 20 |
| 60 | | 40 | | 20 |
| 50 | | 40 | | 10 |
| 40 | | 30 | | 10 |
| 30 | | 20 | | 10 |

Monitoring: Monitoring of streamflow in the Old Channel, New Channel, and Comal River will be based on information provided by the USGS real-time streamflow gages in the Comal River. Necessary adjustments of the flow-control gate will be made on an on-going basis, and after major runoff events, to meet flow-split management objectives in Table 5-3. When required, trash racks will be cleaned to prevent build-up of vegetation and debris which may present operational problems and may inhibit sufficient flow to the culvert.

Allocated funds for 2016 (from Table 7.1): \$ 30,000

Completion of 2015 work activities: \$5,000

Estimated Budget: \$48,500

\$1,500 routine cleaning of trash racks and inspections

\$7,000 – Installation of floating vegetation control booms

\$40,000– Design and installation of flow-control devices at 14” culverts

5.2.2.1 Old Channel Restoration

The City of New Braunfels will continue to remove non-native aquatic vegetation, expand coverage of native aquatic vegetation and monitor previously restored native habitat. Additionally, the City of New Braunfels will continue to perform limited channel modifications to enhance fountain darter habitat, where applicable, in portions of the Old Channel from outlets at Landa Lake downstream to Hinman Island Drive above the confluence with the New Channel of the Comal River.

Old Channel Non-Native Vegetation Removal and Maintenance

In addition to continued monitoring and maintenance (gardening) of previously restored native vegetation from the former Sediment Island downstream to the horseshoe bend of the Old Channel, aquatic vegetation restoration efforts in 2016 will consist of non-native vegetation removal and subsequent native vegetation restoration in select areas of the Old

Channel between the culverts at Landa Lake downstream to approximately 2,400 feet past the Horseshoe bend. The City of New Braunfels’ spring-fed pool will be monitored for reestablishment of non-native vegetation that was removed in 2015. Gardening of this area will be accomplished on an as-needed basis.

Long-term Objective: To decrease the density of invasive, non-native aquatic vegetation and establish preferred native aquatic vegetation, to the maximum extent practicable, to enhance Covered Species habitat.

Assumptions: Aquatic restoration in certain locations of the Old Channel will be contingent upon the removal of non-native riparian vegetation which currently prohibits solar exposure to segments of the channel, especially along the banks. Removal of non-native riparian vegetation in targeted locations will allow additional sunlight to penetrate to portions of the channel that currently do not favor native aquatic species due to limited solar exposure associated with shading effects. Riparian restoration along the Old Channel will be conducted as part of task 5.7.1 (Native Riparian Habitat Restoration). Riparian restoration work will be carefully coordinated with Old Channel aquatic restoration efforts. Old Channel aquatic restoration will continue until the proportional native and non-native targets outlined in Table 4-6 of the HCP are achieved with anticipated funding defined in Table 7.1 of the HCP.

**TABLE 4-6
GOALS—FOUNTAIN DARTER HABITAT (AQUATIC VEGETATION) (m²)**

| Study Reach | <i>Bryophytes</i> | <i>Hygrophila</i> | <i>Ludwigia</i> | <i>Cabomba</i> | <i>Fil. Algae</i> | <i>Sagittaria</i> | <i>Vallisneria</i> |
|------------------------|-------------------|-------------------|-----------------|----------------|-------------------|-------------------|--------------------|
| Upper Spring Run Reach | 1,850 | 650 | 150 | | | 600 | |
| Landa Lake | 4,000 | 250 | 900 | 500 | | 1,250 | 13,500 |
| Old Channel | 150 | 200 | 1,500 | | 300 | | |
| New Channel | 150 | 1,350 | | 350 | | | |
| TOTAL | 6,150 | 2,450 | 2,550 | 850 | 300 | 1,850 | 13,500 |

****Bold/italics*** indicate a restoration activity that deviates from the Maximum observed.

Target 2016 /Performance Measure: Re-establishment of native aquatic vegetation and reduction of non-native aquatic vegetation in accordance with goals set forth in Table 4-6. Restoration efforts in 2016 will be focused in select portions of the Old Channel from the culverts at Landa Lake downstream through the horseshoe bend.

Methods: The target locations for non-native plant removal will be based on observations and historical vegetation mapping data identifying areas in which high value native vegetation has historically occurred. Assessments of potential restoration areas will consider the depth, velocity, and substrate conditions present in the areas along with existing non-native vegetation identified. In areas lacking vegetation, the reason vegetation is absent (*e.g.*, recent flood scour, unsuitable depth, solar exposure, velocities or substrate conditions) will be evaluated prior to final selection of target areas.

Selected locations will first be sampled to remove fountain darters. Sampling will employ appropriate methods such as fanning and/or seining depending on local conditions. Non-native vegetation will then be removed and placed adjacent to the stream where qualified personnel will examine the plants for fountain darters (eggs through adults). Fountain darter life stages will be returned to the stream. Native aquatic vegetation will be planted, as soon as possible, following the removal of non-native vegetation. Native vegetation for plantings will consist of vegetation grown within the Landa Lake MUPPT nursery or from direct transplants within the Comal system. A variety of native vegetation (e.g., *Ludwigia*, *Cabomba*, *bryophytes*, and filamentous algae) will be used to meet targets outlined in Table 4-6 of the HCP.

Monitoring: Areas where non-native vegetation removal has occurred will be routinely monitored for the reestablishment of non-native vegetation and effectiveness of the native aquatic vegetation planting. Once native aquatic vegetation is established in an area, monitoring will be conducted on a less frequent basis.

As noted in the HCP (Section 5.2.2.3), following natural disturbances such as floods, periods of limited recharge, and/or herbivory, as well as anthropogenic disturbances such as recreation or vandalism, the monitoring/maintenance schedule will be adjusted temporarily in order to provide stability for the re-establishment of native vegetation. Monitoring will include aerial coverage mapping of native and non-native vegetation within previously restored areas. Any reestablished non-native vegetation will be removed during each monitoring visit, and if deemed necessary, additional native vegetation will be planted. Removal of non-native vegetation will follow the same protocols as the original removal methodology. Removed vegetation will be disposed of properly according to TPWD Invasive Species Removal permit requirements.

Allocated funds for 2016 (from Table 7.1): \$125,000

Estimated Budget: \$125,000

5.2.2/5.2.3 Comal River Aquatic Vegetation Restoration and Maintenance

The City of New Braunfels will continue native aquatic vegetation restoration in Landa Lake and within targeted, sustainable reaches of the Comal River by replacing non-native aquatic vegetation with native aquatic species to enhance Covered Species habitat. Proposed work for 2016 includes removal of non-native aquatic plant species and planting of native aquatic vegetation in the Upper Spring Run area, assessment of potential restoration areas in the New Channel of the Comal River, and continued maintenance/gardening of previously restored areas. Native vegetation planting and non-native removal will be based on coverage targets identified in Table 4-5 and 4-6 of the HCP.

Native Aquatic Vegetation Restoration

Long-term Objective: To decrease density of invasive, non-native aquatic vegetation and establish favorable native aquatic vegetation, to the maximum extent practicable, within Landa Lake and select portions of the Comal River to enhance Covered Species habitat.

Assumptions: Native vegetation restoration will continue in areas of Landa Lake and the Comal River. Restoration efforts include continued removal of non-native aquatic vegetation throughout Landa Lake, while establishing additional *Cabomba* along the eastern shoreline of Landa Lake and along the New Braunfels' golf course property; establishing additional *Sagittaria* in shallower portions of Landa Lake; and establishing *Ludwigia* in upper sections of Landa Lake. In addition, in 2016, select locations in the New Channel of the Comal River will be evaluated for potential restoration activities.

Target 2016/Performance Measure: Re-establishment of native aquatic vegetation and reduction of non-native aquatic vegetation within Landa Lake in accordance with goals set forth in Table 4-6 of the HCP. In addition to ongoing gardening and maintenance of previously restored areas in Landa Lake, restoration efforts in 2016 will be focused on the removal of non-native aquatic vegetation and establishment of native vegetation in the Upper Spring Run area. The New Channel of the Comal River will be further assessed in order to identify potential areas for sustainable restoration that will benefit the Covered Species.

Methods: The target locations for non-native plant removal will be based on observations and historical vegetation mapping data identifying areas in which high value native vegetation has historically occurred. Assessments of potential restoration areas will consider depth, velocity, and substrate conditions along with existing non-native vegetation identified. In areas lacking vegetation, the reason vegetation is absent (*e.g.*, recent flood scour, unsuitable depth, solar exposure, velocities or substrate conditions) will be evaluated prior to final selection of target areas.

Selected locations will first be sampled to remove fountain darters. Sampling will employ appropriate methods such as fanning and/or seining depending on local conditions. Non-native vegetation will then be removed and placed adjacent to the stream where qualified personnel will examine the plants for fountain darters (eggs through adults). Fountain darter life stages will be returned to the stream. Native aquatic vegetation will be planted, as soon as possible, following the removal of non-native vegetation. Native vegetation for plantings will consist of vegetation grown within the Landa Lake MUPPT nursery or from direct transplants within the Comal system. A variety of native vegetation (*e.g.*, *Ludwigia*, *Cabomba*, *bryophytes*, and filamentous algae) will be used to meet targets

outlined in Table 4-6 of the HCP. In applicable locations, “mother” plant colonies will be established to allow for natural growth and expansion. If *Hygrophila* (non-native) coverage in specific areas decreases below the coverage area specified in Table 4-6, native plant species will be introduced to fill the coverage gap.

Monitoring: Each area in which non-native vegetation has been removed will be routinely monitored for the reestablishment of non-native vegetation and effectiveness of the native vegetation planting. Once native aquatic vegetation is established, monitoring will be conducted on a less frequent basis. However, if monitoring suggests continued gardening and/or supplemental planning is required, this will continue as needed.

However, as noted in the HCP (Section 5.2.2.3), following natural disturbances such as floods, periods of limited recharge, and/or herbivory, as well as anthropogenic disturbances such as recreation or vandalism, the monitoring/maintenance schedule will be adjusted temporarily in order to provide stability for the native vegetation reestablishment. Where possible, landowners immediately adjacent to Landa Lake and the Upper Spring Run area will be informed of aquatic restoration efforts in order to promote awareness and minimize negative impacts associated with recreation and/or maintenance. Monitoring will include estimated aerial coverage of native and non-native vegetation within the treated area. Any reestablished non-native vegetation will be removed during each monitoring visit and if deemed necessary, additional native vegetation will be planted. Removal of non-native vegetation will follow the same protocols as the original removal methodology. Removed vegetation will be transported to an off-site composting facility.

Allocated funds for 2016 (from Table 7.1): \$100,000

Estimated Budget: \$100,000

5.2.3 Management of Public Recreation

Public recreational use of the Comal River ecosystems include, but are not limited to 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 expand their existing recreation control measures as specified in Section 5.2.3.(1) of the HCP. The City of New Braunfels will enforce these measures (as covered in various sections of the HCP) to ensure their success.

Long-term Objective: To maintain and continue to expand the voluntary Certificate of Inclusion Program (COI) to outfitters utilizing the Comal River; educate the public about the Endangered Species and importance of their protection.

Assumptions: The success of this program will be contingent on the cooperation of river outfitters and their willingness to participate in the COI program.

Target 2016/Performance Measure: Continue to inform Outfitters of the benefits for participation in the COI program. Recruit Outfitters who conduct their operations in the Comal River system.

Methods: The City will utilize its existing public input process to continue with the COI application, criteria and program administration. The COI will include the minimum requirements as specified in Section 5.2.3 (2) a-h.

Monitoring: The City of New Braunfels staff will collaborate with all COI participants and report on the program annually.

Allocated funds for 2016: \$ 0

Estimated Budget: \$0

5.2.4 Decaying Vegetation Removal and Dissolved Oxygen Management

The City of New Braunfels will implement a dissolved oxygen (DO) management program within Landa Lake. The program will focus on monitoring of dissolved oxygen (and related parameters) and ensuring adequate DO levels for the ecosystem regardless of the initiating circumstances.

Long-term Objective: Maintain acceptable levels of DO within Landa Lake and minimize the impacts associated with decaying vegetation (or other factors). Long-term biological goals for the fountain darter include a management objective for maintaining dissolved oxygen concentrations > 4.0 mg/L throughout fountain darter habitat.

Assumptions: Section 5.2.4 of the HCP implies the initiation of DO mitigation activities when total Comal River discharge falls below 80 cfs. However, it is assumed that whenever low DO is evident, regardless of the Comal River flows, the remedial actions identified below are to be undertaken.

In 2015, additional DO monitoring will be conducted in order to better understand the spatial and temporal distribution of DO levels in Landa Lake and to evaluate the effectiveness of the aerators installed in Landa Lake in 2013. Dissolved oxygen management efforts in 2016 will be based on results of 2015 monitoring.

Target 2016/Performance Measure: Continue to monitor water quality parameters, including DO concentrations, within Landa Lake. Operate and maintain aerators and

associated equipment to mitigate low DO levels. Continue to evaluate the effectiveness of the program and the need for additional DO management strategies to meet DO objectives.

Methods: In 2013, real-time water quality monitoring equipment was installed in Landa Lake to monitor and record dissolved oxygen, temperature, pH, conductivity and turbidity. Real-time water quality data from the monitoring device is currently being transmitted via telemetry to provide access to the monitoring data via the internet. Water quality data will be assessed on a regular basis to identify problematic dissolved oxygen levels.

In 2013, two solar-powered aeration systems were installed in Landa Lake. The solar powered aerators were initially based on a target area of approximately 10 acres (i.e., ~ 70 percent of Landa Lake). If predicted or observed dissolved oxygen diel patterns are trending toward less than 4 mg/l (or other trigger/criteria as established through the Adaptive Management Process) the solar-powered aeration units will be deployed. Vegetation conditions will then be evaluated via visual observations for signs of stress or decay on a weekly basis. If vegetation decay is evident and the aeration system is not able to keep oxygen levels above target thresholds, then removal of decaying vegetation will be initiated or other comparable management strategies will be developed based on specific conditions. In the event of vegetation removal, vegetation will systematically be examined for covered species and the species salvaged and returned to the system. Removed vegetation will be disposed offsite at a compost facility.

In 2015, additional research was conducted to evaluate DO levels and trends throughout fountain darter habitat in Landa Lake. The 2015 research will be applied in order to define a more suitable DO management program which may include the installation of additional aerator units. Research findings will be incorporated into the 2016 management program. In the event of low spring flow conditions (<100 cfs), DO will be monitored spatially throughout Landa Lake and the Upper Spring Run area using near-continuous DO probes.

Monthly Monitoring: Real-time dissolved oxygen and temperature will be monitored to evaluate projected trends indicative of problematic temperature or oxygen levels. Vegetation in Landa Lake will be monitored on a monthly basis during the May through September period to assess overall conditions and apparent stress levels (i.e., leaf coloration and condition). In the event projected trends of problematic oxygen levels are observed, then vegetation conditions will be evaluated via visual observations for signs of stress or decay on a weekly basis.

Allocated funds for 2016 (from Table 7.1): \$15,000

Estimated Budget: \$ 20,000

\$ 15,000 Operation and Maintenance of WQ Instrumentation & Aerators

\$ 5,000 Additional DO Monitoring

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 catfish, tilapia, nutria, and ramshorn snail. Since this work plan has two components identified within the HCP, each component has been broken out to facilitate the development of the work plan and budgets.

Control of Harmful Non-Native Animal Species

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

Assumptions: The Edwards Aquifer Authority's HCP bio-monitoring Program will continue to track populations of targeted invasive, non-native species to monitor populations. Data collected as part of this program will be utilized to guide and refine invasive species removal efforts.

Target 2016/Performance Measure: Continue existing program to remove non-native invasive species from the Comal River system utilizing removal methods proven successful in previous years. Continue to record counts and biomass of removed species.

Methods: Seasonal concentration of tilapia and other non-native fish into localized areas will be exploited for removal through seining techniques utilizing mesh sizes that are selective against impacting fountain darters and other Covered Species. Each seining effort will involve salvage of native species, which will be returned to the system. The City of New Braunfels will continue its nutria trapping program. A major focus of non-native removal will target suckermouth catfish given their overall destructive impacts on habitats within the system. Given the anticipated difficulties in control of suckermouth catfish, several different removal techniques will be attempted that include trapping with hoop nets and gigging with divers. During these combined efforts, any ramshorn snails encountered in 2016 will continue to be removed. All removed non-native species will be disposed of offsite following City of New Braunfels policies.

Monitoring: The planned EAA bio-monitoring program will assess the status of non-native species populations.

Reduction of Non-Native Species Introduction and Live Bait Prohibition

The City of New Braunfels will continue efforts to minimize the introduction of non-native species from aquarium dumps and implement prohibitions regarding the use of specific live bait species. The City of New Braunfels will continue to educate and promote public awareness related to aquarium dumping and the use of specific bait fish in the Comal River system.

Long-term Objective: Reduce the introduction of non-native species to the Comal River ecosystem.

Assumptions: This effort is primarily a public outreach and education effort.

Target 2016/ Performance Measure: Expand education efforts associated with the dumping of aquarium species into local waterways. This will be achieved by distributing educational information and installing signage at key locations at Landa Lake and the Comal River. TPWD education materials and programs will be consulted and utilized.

The City of New Braunfels will continue to take action to develop an ordinance aimed at prohibiting aquarium trade dumping and the use of specific bait species.

Methods: Distribute education and outreach materials designed to inform the public of the impacts of invasive species on the Comal River ecosystem. TPWD programs regarding the introduction of non-native, invasive species will be assessed and potentially utilized. Installation of and improvements to existing signage will be managed according to existing City criteria.

Continue to solicit updated information, relevant studies, and opinions from Science expertise regarding potential threats or lack thereof to the Endangered Species by use of native species as live bait; compile into a useable format to assist in identifying native species to be used as bait.

The City will continue to promote the establishment of a live bait and aquarium dumping prohibition ordinance through public meetings, stakeholder input and the drafting of the ordinance. Input from the public and stakeholders will be presented to City Council for consideration.

Monitoring: It is anticipated that the bio-monitoring program will detect the presence of newly introduced species. Signage will be inspected annually for repair or replacement as necessary as well as identification of other locations that may need signage.

Total Allocated funds for 2016 (from Table 7.1): \$75,000

Total Estimated Budget: \$ 55,000

| | |
|-----------|-----------------------------------|
| \$ 2,000 | Signage and Educational Materials |
| \$ 53,000 | Non-native Species Control |

5.2.6/6.3.6 Monitoring and Reduction of Gill Parasites

The City of New Braunfels will continue to implement a monitoring program associated with the gill parasite (*Centrocestus formosanus*) and its intermediate host snail *Melanoides tuberculatus*.

Long-term Objective: To conduct monitoring and acquire data regarding gill parasite water column concentrations, fountain darter infection rates, host snail density and distribution, and other potential gill parasite hosts to determine potential threats to fountain darters and other Covered Species within the Comal system. Propose management measures, as needed, to minimize negative impacts on fountain darter populations by gill parasites.

Assumptions: The focus in 2016 will be on continued monitoring of water column cercariae along established transects and conducting an annual system-wide inventory of *Melanoides* distribution and density. Cercarial concentrations will continue to be monitored in established transects along the Comal River annually and more frequently when spring flow drops below 100 cfs or other springflow triggers that are developed. Cercariae water column concentration monitoring and snail abundance survey activities are expected to continue into subsequent years. Additional gill parasite research, including infection prevalence and density monitoring, will be completed in 2016 and are not anticipated to continue into subsequent years.

Target 2016/ Performance Measure: Continue existing monitoring program which includes snail distribution and density monitoring, cercariae water column concentration monitoring and snail infection prevalence.

Methods:

It is anticipated that methods used in 2014 and 2015 to conduct the annual *Melanoides* distribution and density survey will be used for 2016 monitoring. Two fisheries biologist using dip nets will traverse the entire Comal System recording the location of dip net sweeps and number of snails collected within each sweep. Water column cercarial concentration sampling will be conducted annually across the channel at the established transects. A total of 10 samples will be targeted at each cross section unless complex hydraulics suggests a higher spatial sampling. Sampling will proceed from downstream to upstream reaches. Samples will be collected between 9 and 11 am on sunny days to minimize temporal variance in the sampling. Each water sample will be filtered using an apparatus described in Cantu (2003). The cercariae will then be stained on the filters with a 10% Rose Bengal solution. Filters will then be transported to the contractor's laboratory where the number of cercariae on each filter will be counted with the aid of a dissecting microscope.

Cercarial concentrations will be monitored more frequently when spring flow declines below 100 cfs or other springflow triggers that are developed.

Allocated funds for 2016 (from Table 7.1): \$ 75,000

Estimated Budget: \$ 30,000

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

The City of New Braunfels will continue coordination with the Texas Department of Transportation (TXDOT) to promote prohibited transport of hazardous materials on routes crossing the Comal River and its tributaries. This effort may include development of local ordinances, installation of additional signage, and TXDOT approval.

Long-term Objective: Continue to identify and eliminate hazardous materials transport across the Comal River and its tributaries.

Assumptions: This effort will involve continual stakeholder engagement, public meetings, City Council consideration and coordination with TXDOT. This work plan element is contingent on TXDOT continuous participation and support.

Target 2016/ Performance Measure: Further identify roadways and alternate routes crossing the Comal River and its tributaries where the transport of hazardous materials poses a threat to the endangered species. Prepare maps and other information needed to inform City Council of the proposed route restrictions. Install signage at designated locations to inform hazardous material cargo carriers of the route prohibitions.

Methods: In 2015, the City of New Braunfels identified potential transport routes crossing the Comal River and its primary tributaries requiring protection and therefore prohibition. In 2016, this information will be used to initiate public meetings and draft ordinances to be considered by City Council. Efforts will be coordinated with TXDOT.

Monitoring: N/A

Allocated funds for 2016: \$0

Estimated Budget: \$3000

\$ 3000 – Hazardous Material Transport Route Prohibition Signage and Education

5.2.8 Native Riparian Habitat Restoration (Comal Springs Riffle Beetle)

The City of New Braunfels will continue to implement a program to restore native riparian zones along Spring Run 3 and the western shoreline of Landa Lake to benefit the Comal Springs Riffle Beetle. Upon establishment of riparian zones on City of New Braunfels property, the City will develop a program to incentivize landowners to establish native riparian vegetation along privately owned lots located on the Western shoreline of Landa Lake.

Long-term Objective: Establish a healthy, functioning riparian area along Spring Run 3 and the western shoreline of Landa Lake to benefit the Comal Springs Riffle Beetle. Establish native riparian vegetation species that will increase the amount of usable habitat and food sources. Riparian vegetation will also be established to promote bank stabilization and minimize slope erosion and sedimentation in Riffle Beetle habitat areas.

Assumptions: It is assumed this effort will continue to focus on the identification of target native riparian species most beneficial for the Comal Springs Riffle Beetle that also meet erosion control requirements. The target area for subsequent removal and establishment of native vegetation is the upstream 100 meters of Landa Lake and Spring Run 3 and proceeding north into private property lots (along the waters edge). It is assumed the effort will be split between the bluff and Spring Run 3 given the different characteristics in these locations and therefore differences in approaches are anticipated. Restoration of the remaining area will be accomplished in segments during future years and incorporate revisions based on monitoring of work that was undertaken in 2013, 2014, and 2015.

Target 2016/Performance Measure: Continue riparian restoration efforts based on monitoring and success of previous work. Continue to monitor recently restored areas for stability and established vegetative growth. Establish native riparian vegetation within the riparian zone of private lots located along the western shoreline of Landa Lake.

Methods: Continue the removal of non-native, invasive plant species within the riparian zone. Plant deer-resistant, native plant species in Spring and Fall in areas where vegetation is sparse or not present. Plantings will be focused immediately along the waters' edge and in areas immediately up gradient of the shoreline. Utilize native plant species which have been observed in the immediate area and have proven successful in previous planting efforts. Install erosion/ sediment control devices, as needed in areas lacking sufficient vegetation and stability, to control hillside erosion and resulting sedimentation to riffle beetle habitat areas. Install fencing around young plants, as needed, to control foraging and damage by wildlife. Irrigation lines were installed in previous years and will be utilized and maintained, as necessary, to increase the survivability of plantings. Private landowners will be approached to determine interest in expanding restoration efforts on to private lots located along the western shoreline of Landa Lake.

Monitoring: Monitoring will occur on a regular basis to assess the survivability of plantings and the presence of non-native vegetation. Planting plots have been mapped and are utilized to track the success of plantings in specific locations. Methods will be revised, as needed, based on results of monitoring. In the event of heavy rainfall, the erosion and sedimentation will be assessed in the following week. Sediment control devices will be monitored to assess effectiveness and stability. Sediment captured behind the control devices will continue to be measured and total volume quantified. The HCP Bio-monitoring program will track riffle beetle populations within Spring Run 3 and along the western shoreline of Landa Lake. Data collected as part of the bio-monitoring program will be utilized to determine locations for focusing riparian zone restoration activities.

Allocated funds for 2016 (from Table 7.1): \$25,000

Estimated Budget: \$25,000

5.2.10 Litter and Floating Vegetation Control

The City of New Braunfels will continue ongoing activities to manage floating vegetation and litter removal to enhance Covered Species and to prevent accumulations above and within aquatic vegetation restoration areas. Management activities will include dislodging of vegetation mats, to allow continued movement downstream, that form on top of the water surface and removal of litter for the littoral zone and stream bottom. The City of New Braunfels will manage aquatic vegetation in Landa Lake by dislodging floating vegetation entrained on the flow control structures, fishing piers, Landa Park Drive Bridge and other locations within Landa Lake where vegetation mats and litter accumulate.

Long-term Objective: Minimize impacts of floating vegetation and litter on the overall aquatic community within the Comal River system.

Assumptions: Litter removal and dislodging floating vegetation will follow existing protocols and schedules currently employed by the City of New Braunfels as described below.

Methods: Currently the City of New Braunfels contracts with a private contractor for removal of litter and dislodging of floating vegetation from Landa Lake, the Comal River and the Guadalupe River. Those contracts are renewed annually and in 2012 were set at a cost not to exceed \$160,000 and include numerous mechanisms to reduce cost and scope mid season. SCUBA collections on the Comal River were added in 2007 as a pilot program and in 2008 as part of the contracts. SCUBA was added to protect the underwater habitat in the Comal River. Also in 2008, litter collection in Landa Lake was added to specifically protect species habitat. The City of New Braunfels cooperated with the USFWS to implement litter collections in Landa Lake. These additional expenditures have been voluntary on the part of the City of New Braunfels in past years, but now are mandatory

based on requirements in the HCP Section 5.2.10. It is possible that without funding from the HCP, this mitigation action would be unfunded in 2016.

All litter removal and vegetation dislodging in Landa Lake is associated with protection of Covered Species habitat, as there is no tubing recreation in Landa Lake. Underwater collection (SCUBA) in the Comal River is associated with resource protection (species habitat), however above water collection on the Comal River is a direct result of tubing activities. Collections on the Guadalupe River have no relevance to the HCP or species protection. Therefore only costs associated with Landa Lake and underwater Comal River collections will be included in HCP activities and budgets.

Target 2016/Performance Measure: Continue efforts to remove litter and dislodge floating vegetation mats from applicable portions of the Comal River system to prevent negative impacts to flow control structures, aquatic restoration areas, and Covered Species habitat.

Methods:

Landa Lake - (Jan 1st to December 31st). Routine vegetation maintenance and litter removal will occur from Jan 1st to December 31st. Vegetation maintenance and litter removal will occur on a scheduled 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.

Comal River – (April 1st to October 30th). Vegetation maintenance and litter pickup from May 1st to September 30th is on a scheduled basis. Floating vegetation will be dislodged and inorganic litter will be picked up from the substrate, surface and littoral zone of the Old Channel. Underwater litter in the New Channel from the NBU Hydroelectric dam downstream to below the last tubers exit will be removed utilizing SCUBA.

Monitoring: City of New Braunfels staff will monitor litter and floating vegetation mats in applicable areas. City staff will monitor contractor efforts and coordinate additional efforts when deemed necessary.

Allocated funds for 2016 (from Table 7.1): \$ 0

Estimated Budget: \$30,000

\$20,000 Floating Vegetation Clearing (52 weeks)

\$5,000 Underwater Litter Collection (32 weeks, Comal River and Landa Lake)

\$5,000 Litter Removal within Old Channel of Comal River (16 weeks, Landa Lake to Elizabeth Street and from confluence of New and Old Channels to 100 ft up-stream of Hinmann Island Dr)

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 HCP.

Long-term Objective: Management of the golf course and grounds to minimize and reduce negative effects to aquatic ecosystem in Landa Lake and the Comal River.

Assumptions: The Landa Park Golf Course will continue to implement their existing IPMP and make adjustments to the plan as needed.

Target 2016/Performance Measure: Continue to implement and update the existing IPMP.

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 activities and materials to be used to control pests (i.e. insects, weeds, and other living organisms requiring control) on the golf course in a way that minimally impacts the environment.

Monitoring: Each year the City of New Braunfels Watershed Manger, in cooperation with the Golf Course Manager, will report on annual activities.

Allocated funds for 2016 (from Table 7.1): \$0

Estimated Budget: \$0

5.7.1 Native Riparian Habitat Restoration

The City of New Braunfels will continue efforts to provide further stabilization of the large eroding bluff along the Old Channel in the vicinity of the former sediment island. In addition to the completion of the bank stabilization project, native riparian vegetation will be established along select areas of the Old Channel to provide further bank stabilization and to compliment in-stream aquatic vegetation restoration efforts. The City of New Braunfels will also implement a program to increase the coverage area and density of the riparian zone along the Old Channel, golf course, and in the vicinity of Clemens Dam. As long term plans continue to take shape for the reestablishment of the riparian zone, private

and public landowners will be asked to participate in the plan. Reimbursement for the price of native plants will be provided to private and public landowners. Criteria to qualify for reimbursement will be established along with a list of preferred natives to replant will developed in consultation with the City of New Braunfels forester.

Long-term Objective: Increase native riparian vegetation, reduce non-native invasive riparian vegetation, and prevent streambank erosion in areas along the Old Channel of the Comal River that will compliment aquatic vegetation restoration efforts.

Assumptions: Sequencing will start with the completion of the bank stabilization project and continue with riparian vegetation restoration along the north bluff of the Old Channel. Construction of the bank stabilization project will be contingent upon adequate springflow rates (>130 cfs) for a 6-8 month period to allow for continuous work efforts.

Target 2016/Performance Measure: Commence and complete the bank stabilization project and associated riparian restoration in the Old Channel adjacent to where the sediment island was removed, according to completed construction plans.

Methods: Construction of the Old Channel bank stabilization project will be completed according to specifications provided in the “Comal River Bank Reclamation and Riparian Zone Restoration Construction Plans-May 2014” prepared by Freese and Nichols. Riparian restoration efforts associated with the project will be implemented per construction and revegetation plan specifications. Temporary erosion and sediment control BMPs will be installed and will remain in place until native vegetation becomes established and/ or the riparian zone is stabilized.

Monitoring: The effectiveness of bank stabilization and riparian vegetation will be assessed near the end of 2016 with sufficient lead time to influence work plan development for 2017.

Allocated funds for 2016 (from Table 7.1): \$100,000

Un-utilized funds allocated for 2015*: \$410,000

Estimated Budget: \$870,000

* A total of \$430,000 was allocated in 2015 for the construction of the bank stabilization project and associated riparian vegetation restoration. The project did not occur but an updated cost estimate of \$870,000 for construction and engineering support was prepared in 2015. Inflation associated with the delay in the construction start has added to project cost. The delay in the construction start was attributed to several factors including: 1) riparian restoration design modifications to address concerns raised by the EACHP Science Committee; 2) assurance that Comal spring flow conditions would remain well above the 130cfs

trigger for Provision M restrictions for the duration of the project; 3) floodplain permit acquisition at the time the project was ready to go to bid. In addition, final design considerations to address bank stability and incorporation of vegetative planting concepts prompted by the EAHCP Science Committee have also added to the cost. Approximately \$20,000 was expended by Freese and Nichols in 2015 for Science Committee meeting attendance, riparian restoration design modifications, floodplain permitting and construction bid support. To account for the increase in costs and delay in construction start, the annual allocation of \$100,000 for 2016 riparian restoration activities will be utilized along with remaining 2015 funding (\$410,000). An additional \$140,000 is proposed to bring total funding for 2016 to \$650,000. As a budget neutral consideration, it is planned future annual funding requests for task 5.7.1 will be decreased to account for larger expenditures in 2016. It is planned that future annual funding requests for task 5.7.1 will be decreased by 50% in both 2017 and 2018 and by 25% in both 2019 and 2020. It is expected that Native Riparian Habitat Restoration obligations, as identified in section 5.7.1 of the EAHCP, will be able to be accomplished given these planned budget decreases for 2017-2020. Construction bids were received in late 2015. The qualifying bid price was approximately \$757,000. A 5% contingency (approx. \$38,000) as well as materials testing (approx. \$3,500) and engineering oversight (approx. \$70,000) bring the overall cost of the project to approximately \$870,000, which is a \$220,000 increase from the initial cost estimate. This increase in project cost is proposed to be met by reducing the scope and associated funding of other City of New Braunfels EAHCP tasks in both 2016 and 2017. Tasks 5.2.5 (Non-Native Animal Species Control), 5.2.6 (Gill Parasite Control), 5.7.5 (Household Hazardous Waste Program) and 5.7.6 (Impervious Cover/ Water Quality Protection) will be reduced by \$20,000, \$45,000, \$30,000, and \$15,000, respectively, in both 2016 and 2017 to make funds available for the bank stabilization and riparian restoration project.

5.7.5 Management of Household Hazardous Wastes

The City of New Braunfels will continue the hazardous household waste (HHW) program that includes accepting prescription drugs and Freon, through the TCEQ and/or the waste disposal division of the City of New Braunfels. The City of New Braunfels will continue a HHW program in 2016 that will not utilize EAHCP funding to support additional HHW drop-off events.

Long-term Objective: Reduction in the improper disposal of hazardous wastes and incorporation of prescription drug and Freon drop off.

Assumptions: None

Target 2016/Performance Measure: Continue hazardous household waste program which will include two HHW collection events.

Methods: Conduct two HHW collection events which incorporate an education and outreach component.

Monitoring: The volume of hazardous waste material collected during the HHW collection events will be noted and compared to previous efforts.

Allocated funds for 2016 (from Table 7.1): \$ 30,000

Estimated Budget: \$ 0

5.7.6 Impervious Cover/Water Quality Protection/LID

The City of New Braunfels will expand criteria related to desired impervious cover, provide incentives to reduce existing impervious cover on public and private property in New Braunfels, and implement stormwater BMP's in the area of Landa Lake and the Springruns. The City of New Braunfels will implement a program based upon the low impact development (LID)/Water Quality Work Group Final Report recommendations for Implementation Strategies and best management practices (BMPs). The 2016 Work Plan includes implementation of an incentive program and directly supports the reduction of impervious cover at the Comal Springs Conservation Center.

Long-term Objective: Reduction and control of non-point source pollutant discharges to Landa Lake and the Comal River system. To increase public awareness of LID concepts and stormwater BMPs utilized to control pollutant discharges.

Assumptions: Efforts will focus on the implementation of a rebate program designed to offer incentives for residents and businesses to install LID BMPs. It is assumed residents and businesses in the Comal River watershed will take advantage of the rebates for the installation of LID BMPs on their property.

Planning discussions with New Braunfels Utilities (NBU) staff occurred in 2015 regarding the proposed Comal Springs Conservation Center and potential collaboration with the City of New Braunfels and the EAHCP. NBU anticipates beginning Phase I construction of the Comal Springs Conservation Center project in 2016.

Target 2016/Performance Measure: Implement a LID and impervious cover reduction rebate/incentive program targeted at residential and commercial properties contributing stormwater runoff to endangered species habitat within the Comal River system. BMP's developed as part of this program will include measures directly benefiting the Comal River system that are well above and beyond the features of the City's standard MS4 program. Efforts in 2016 will include collaboration with NBU to fund the removal of impervious cover immediately adjacent to Landa Lake at the proposed Comal Springs Conservation Center. The removal of impervious cover and subsequent native plant restoration will increase infiltration, minimize stormwater runoff and decrease the volume of sediment and pollutants entering Landa Lake.

Methods: The City of New Braunfels will implement a program to issue rebates to residents and businesses for installation of LID projects on their properties. Rebates will be provided for the LID BMPs such as removal of impervious cover, rainwater harvesting barrels, rain gardens, pervious pavement, and native landscaping within areas contributing stormwater runoff to Landa Lake.

The City will collaborate with NBU to decrease the amount of impervious cover at the Comal Springs Conservation Center. Native plant restoration will occur in areas where impervious cover was removed. Phase I of the Comal Springs Conservation Center project is scheduled to begin in 2016. The Comal Springs Conservation Center includes educational components to inform residents, developers, and construction contractors of LID treatment concepts, stormwater pollution mitigation and information on the endangered species.

Summary of the Comal Springs Conservation Center Project: The property designated for the Comal Springs Conservation Center consists of approximately 16 acres located at the headwaters of Landa Lake at the mouth of Blieders Creek. The existing site is owned by NBU and consists of asphalt parking areas and aging warehouse structures formerly utilized for NBU operations. Phase I of the project is expected to begin in 2016 and involves removal of 85% of the existing impervious cover, native plant restoration, restoration of Spring Run #4, and construction of LID features, such as bioswales and rain gardens, designed to treat stormwater runoff prior to entering Landa Lake. The project will provide direct water quality benefits to Landa Lake and the Comal River system by increasing infiltration and treating stormwater runoff. Phase I of the project also includes trails, an observation area, and an outdoor classroom intended to educate residents, students, and developers about LID concepts. Design plans for the project have been completed by NBU and are available for review. The estimated total cost for Phase 1 is \$6 million with \$95,000 being proposed for EAHCP funding through the 2016 City of New Braunfels Work Plan. In 2016 it is anticipated the EAHCP program can fund the removal of impervious cover and native plant restoration. In subsequent years EAHCP funding could help support the restoration of Blieders Creek along the project site and construction of a spring trail for observation of riparian habitat and facilitating water quality sampling.

Monitoring: None

Allocated funds for 2016 (from Table 7.1): \$100,000 (for LID program development and implementation) + \$50,000 (for stormwater BMPs)

Estimated Budget: \$135,000

\$40,000 LID Rebate/ Incentive Program Implementation & Community Outreach
\$95,000 Removal of impervious cover at Comal Springs Conservation Center

City of New Braunfels – 2016 HCP Budget

| HCP Section | Mitigation Action | 2016 HCP Budget (From Table 7.1) | 2015 HCP Budget | Estimated FY2016 Budget |
|--------------------|---|---|------------------------|--------------------------------|
| 5.2.1 | Flow Split Management* | 30,000 | 5,000 | 48,500 |
| 5.2.2.1 | Old Channel Restoration | 125,000 | 225,000 | 125,000 |
| 5.2.2/5.2.3 | Comal River Aquatic Vegetation Restoration | 100,000 | 275,000 | 100,000 |
| 5.2.3 | Management of Public Recreation | 0 | 0 | 0 |
| 5.2.4 | Decaying Vegetation Removal and Dissolved Oxygen Management | 15,000 | 105,000 | 20,000 |
| 5.2.5/5.2.9 | Non-native Animal Species Control | 75,000 | 75,000 | 55,000 |
| 5.2.6/6.3.6 | Monitoring and Reduction of Gill Parasites | 75,000 | 75,000 | 30,000 |
| 5.2.7 | Prohibition of Hazardous Material Transport Routes | 0 | 3,000 | 3,000 |
| 5.2.8 | Native Riparian Habitat Restoration (Riffle Beetle) | 25,000 | 50,000 | 25,000 |
| 5.2.10 | Litter and Floating Vegetation Management | 0 | 40,000 | 30,000 |
| 5.2.11 | Golf Course Management | 0 | 1000 | 0 |
| 5.7.1 | Native Riparian Habitat Restoration** | 100,000 | 430,000 | 870,000 |
| 5.7.5 | Management of Household Hazardous Waste | 30,000 | 30,000 | 0 |
| 5.7.6 | Impervious Cover/ Water Quality/ LID Program | 150,000 | 100,000 | 135,000 |
| Totals | | \$725,000 | \$1,414,000 | \$ 1,441,500 |

* Unexpended funds from 2015 (\$5,000) are included in 2016 to complete activities associated with maintenance and management of the flow-split infrastructure as indicated in the 2016 work plan. With these funds the total for 2016 is \$48,500. The work plan includes installation of flow control devices at the 14” culverts as well as installation of floating vegetation control booms at both the 14” culverts and 48” culverts.

** A total of \$430,000 was allocated in 2015 for the construction of the bank stabilization project and associated riparian vegetation restoration. The annual allocation of \$100,000 for 2016 riparian restoration activities is included along with remaining 2015 funding (\$410,000). An additional \$140,000 is proposed to bring total funding for 2016 to \$650,000. As a budget neutral consideration, it is planned that future annual funding requests for task 5.7.1 will be decreased to account for larger expenditures in 2016. It is planned that future annual funding requests for task 5.7.1 will be decreased by 50% in both 2017 and 2018 and by 25% in both 2019 and 2020. This strategy to fund the construction of the project was presented to and approved by the EAHCP Implementing Committee on October 15th, 2015.

The City of New Braunfels received competitive sealed proposals for the construction of the bank stabilization and riparian restoration project in late 2015. The expected cost to construct the project is \$870,000 which includes construction, engineering oversight, materials testing and contingency. In order to compensate for the increased project cost, the City of New Braunfels proposes to utilize funds from several EAHCP minimization and mitigation tasks in both 2016 and 2017. This includes decreasing the project scope and associated funding for Non-Native Animal Species Control (5.2.5), Monitoring and Reduction of Gill Parasites (5.2.6), Management of Household Hazardous Waste (5.7.5), and Impervious Cover/ Water Quality Protection (5.7.6) by \$20,000, \$45,000, \$30,000, and \$15,000, respectively, in both 2016 and 2017.