

**City of New Braunfels
2019 EAHCP Work Plan**

2019 City of New Braunfels Work Plan Budget

| HCP Section | Conservation Measure | Table 7.1 | Available Budget for 2019 | Estimated 2019 Budget | Difference from Available Budget |
|---------------------|--|------------------|----------------------------------|------------------------------|---|
| 5.2.1 | Flow Split Management | \$30,000 | \$30,000 | \$0 | \$30,000 |
| 5.2.2.1/ 5.2.2.3 | Old Channel Aquatic Vegetation Restoration & Maintenance | \$100,000 | \$100,000 | \$50,000 | \$50,000 |
| 5.2.2.2/ 5.2.2.3 | Landa Lake/ Comal River Aquatic Vegetation Restoration & Maintenance | \$50,000 | \$50,000 | \$100,000 | (\$50,000) ¹ |
| 5.2.3 | Management of Public Recreation | \$0 | \$0 | \$0 | \$0 |
| 5.2.4 | Decaying Vegetation Removal and Dissolved Oxygen Management | \$15,000 | \$15,000 | \$12,800 ² | \$2,200 |
| 5.2.5/5.2.9 | Non-Native Animal Species Control | \$75,000 | \$75,000 | \$55,000 | \$20,000 |
| 5.2.6/ 6.3.6 | Monitoring and Reduction of Gill Parasites | \$75,000 | \$75,000 | \$10,000 ² | \$65,000 |
| 5.2.7 | Prohibition of Hazardous Material Transport Routes | \$0 | \$0 | \$0 | \$0 |
| 5.2.8 | Native Riparian Habitat Restoration (Riffle Beetle) | \$25,000 | \$25,000 | \$25,000 | \$0 |
| 5.2.10 | Litter and Floating Vegetation Management | \$0 | \$0 | \$30,000 | (\$30,000) |
| 5.2.11 | Golf Course Management | \$0 | \$0 | \$0 | \$0 |
| 5.7.1 | Native Riparian Habitat Restoration | \$100,000 | \$75,000 | \$102,200 | (\$27,200) ³ |
| 5.7.5 | Management of Household Hazardous Waste | \$30,000 | \$30,000 | \$30,000 | \$0 |
| 5.7.6 | Impervious Cover/ Water Quality Protection | \$150,000 | \$250,000 ⁴ | \$250,000 | \$0 |
| | Totals | \$650,000 | \$725,000 | \$665,000 | \$60,000 |

¹ The increase of \$50,000 for Task 5.2.2.2 is to be offset by a \$50,000 decrease for Task 5.2.2.1.

² Funds for these measures will be expended only if low-flow conditions (<100 cfs) are realized at Comal Springs.

³ The increase in the budget for Task 5.7.1 will be offset by a decreased budget for Task 5.2.6 and Task 5.2.4.

⁴ The increase in the Task 5.7.6 available budget is a result of the re-allocation of unspent funds from 2018 (\$100,000) to 2019.

5.2.1 Flow Split Management

Long-term Objective:

To sustain flow rates in the Old Channel of the Comal River that compliment Old Channel aquatic vegetation restoration efforts, minimize channel scouring, and maximize the quality of fountain darter habitat.

Target for 2019:

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. 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 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 2019 budget:

\$0

5.2.2.1/ 5.2.2.3 Old Channel Aquatic Vegetation Restoration and Maintenance

Long-term Objective:

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

Target for 2019:

Efforts in 2019 will include the planting of target native aquatic vegetation to achieve annual aquatic vegetation restoration goals and to maintain existing target aquatic vegetation coverage. **Figure 1** illustrates the Comal River system and identifies the Old Channel LTBG reach (shown along the Old Channel in red) and the Old Channel ERPA (shown in light green and labeled as the Old Channel Restoration Reach). The 2019 annual aquatic plant restoration goals, as well as the long-term goals, for the Old Channel LTBG reach and the Old Channel ERPA are specified by reach and vegetation type in **Table 2**. Continued efforts will also be made in 2019 to remove, suppress, and potentially eliminate non-native *Hygrophila* from the Old Channel LTBG reach and the Old Channel ERPA.

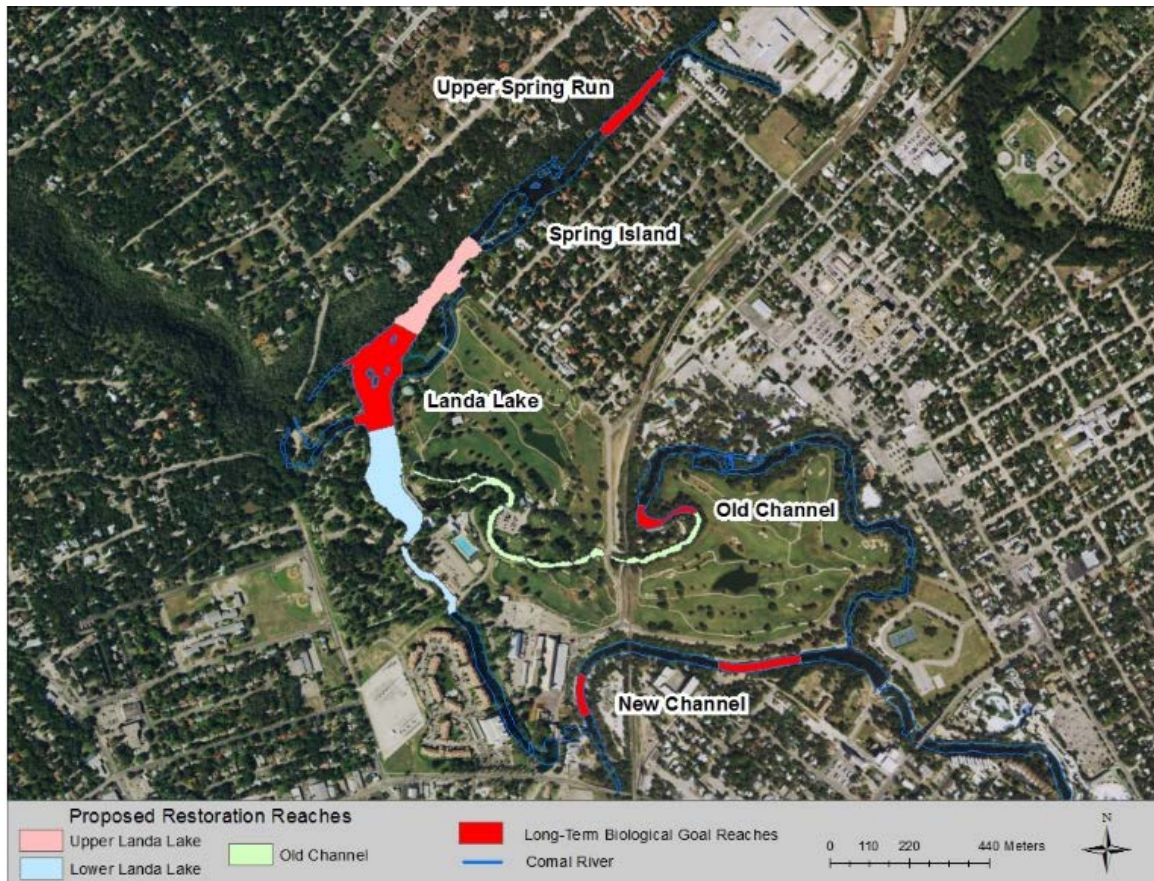


Figure 1: Long-term biological goal reaches and restoration reaches for the Comal System. The Old Channel ERPA restoration reach is shown in green. The Old Channel LTBG reach is shown in red.

Table 2: Annual and long-term aquatic vegetation restoration goals, in meters squared (m²), 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 | 2019 | 2019 |
| LTBG Reaches | | | | |
| Old Channel | <i>Ludwigia</i> | 425 | 75 | 1,125-1,500 |
| | <i>Cabomba</i> | 180 | 30 | 600 |
| | <i>Sagittaria</i> | 450 | 75 | 900 |
| Restoration Reaches | | | | |
| Old Channel ERPA | <i>Ludwigia</i> | 850 | 0* | - |
| | <i>Cabomba</i> | 200 | 0* | - |
| | <i>Sagittaria</i> | 750 | 0 | - |
| | <i>Vallisneria</i> | 750 | 0 | - |
| | <i>Potamogeton</i> | 100 | 0 | - |

*Supplemental plantings of *Ludwigia* and *Cabomba* will be planted in existing restoration plots in the Old Channel ERPA, as necessary, to maintain existing coverage and/ or to replace any drastic losses in coverage due to floods, natural competition or other factors.

Methodology:

Non-Native Vegetation Management:

Non-native aquatic vegetation (i.e. *Hygrophila*) will be removed to minimize competition with native submerged aquatic vegetation (SAV). Large-scale removal of non-native SAV will be completed, as needed, by using a 4-step method that involves 1) initial removal of plant and root mass, 2) secondary removal and clearing of remaining plant and root mass approximately one week following initial removal, 3) allowing for a grace period of 2-3 weeks to allow areas to settle and remaining roots to grow, 4) a final, detailed effort to remove all remaining roots from the area.

Aquatic vegetation gardening will occur on a monthly basis in areas where non-native vegetation has previously been removed on in order to identify and remove re-emergent non-native SAV. Small, localized growth of non-native SAV will be removed by selectively extracting visible plant and root mass.

Native SAV Restoration:

Target SAV species will be planted within the Old Channel LTBG reach to increase the coverage of individual aquatic plant species per the annual restoration goals set forth in **Table 2**. An approximate number of plants needed to achieve the annual goals is also included in **Table 2**. Individual plant species will be planted where planting space is available and in locations within the channel where light exposure, flow velocities, and substrate provide the most suitable conditions for the individual plant types. 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. There are no annual restoration goals set forth for the Old Channel ERPA in 2019.

Ludwigia will continue to be propagated in-situ within Landa Lake to provide plant stock for 2019 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 are then 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.

Ludwigia plants propagated in the MUPPTs, as well as *Ludwigia* cuttings, will be planted in suitable locations within the Old Channel LTBG reach to achieve an annual target of 75 m² of additional *Ludwigia* coverage. 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 1m² of coverage. Therefore, approximately 1,125-1,500 *Ludwigia* plants will be planted in the Old Channel LTBG reach to achieve target annual coverage. Supplemental plantings of *Ludwigia* will be planted within existing restoration plots within the Old Channel ERPA, 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 reach to achieve an annual target of 30 m² of additional *Cabomba* coverage. *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. 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 1m² of coverage. Therefore, approximately 600 *Cabomba* plants will be planted in the Old Channel LTBG reach. Supplemental plantings of *Cabomba* will be planted within existing restoration plots within the Old Channel ERPA, as needed, to maintain existing coverage of *Cabomba*.

Sagittaria will be planted in the most suitable locations in the Old Channel LTBG reach to achieve an annual target of 75 m² of additional *Sagittaria* coverage at full grow out. *Sagittaria* will be planted as transplants harvested from Landa Lake and other areas 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 1m² of coverage. Therefore, approximately 900 *Sagittaria* plants will be planted in the Old Channel LTBG reach to achieve target annual coverage.

Potamogeton coverage in the Old Channel ERPA currently exceeds the long-term aquatic coverage goal and therefore is not planning on being planted in 2019 unless coverage declines below the long-term goal. *Potamogeton* will be planted only on an as-needed basis and will be planted in the most suitable locations in the Old Channel ERPA reach to maintain coverage consistent with the long-term coverage goal. *Potamogeton* is suited to locations with high velocities and as such planting efforts in the Old Channel will be focused in fast-flowing areas to fill this niche.

Potamogeton will be planted only on an as needed basis using bare- root rhizomes harvested from the Comal River system.

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. 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. Priority will be given first to planting *Ludwigia* and *Cabomba* in areas that are expected to have minimal competition impact on these species.

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 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 meeting long-term vegetation goals and developing annual restoration goals for 2020 and subsequent years.

Budget:

Table 7.1:

\$100,000

Available budget:

\$100,000

Estimated 2019 budget:

\$50,000*

*The decrease of \$50,000 in the budget for this task will be utilized for Task 5.2.2.2: Comal River/ Landa Lake Aquatic Vegetation Restoration.

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

Long-term Objective:

To achieve native aquatic vegetation 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 HCP tables 4.1 and 4.1.1, respectively. The overall intent of native aquatic vegetation plant restoration is to provide high quality habitat for the fountain darter.

Target for 2019:

Efforts in 2019 will include the planting of target native aquatic vegetation to achieve annual aquatic vegetation restoration goals and to maintain existing aquatic vegetation 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 2019 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.

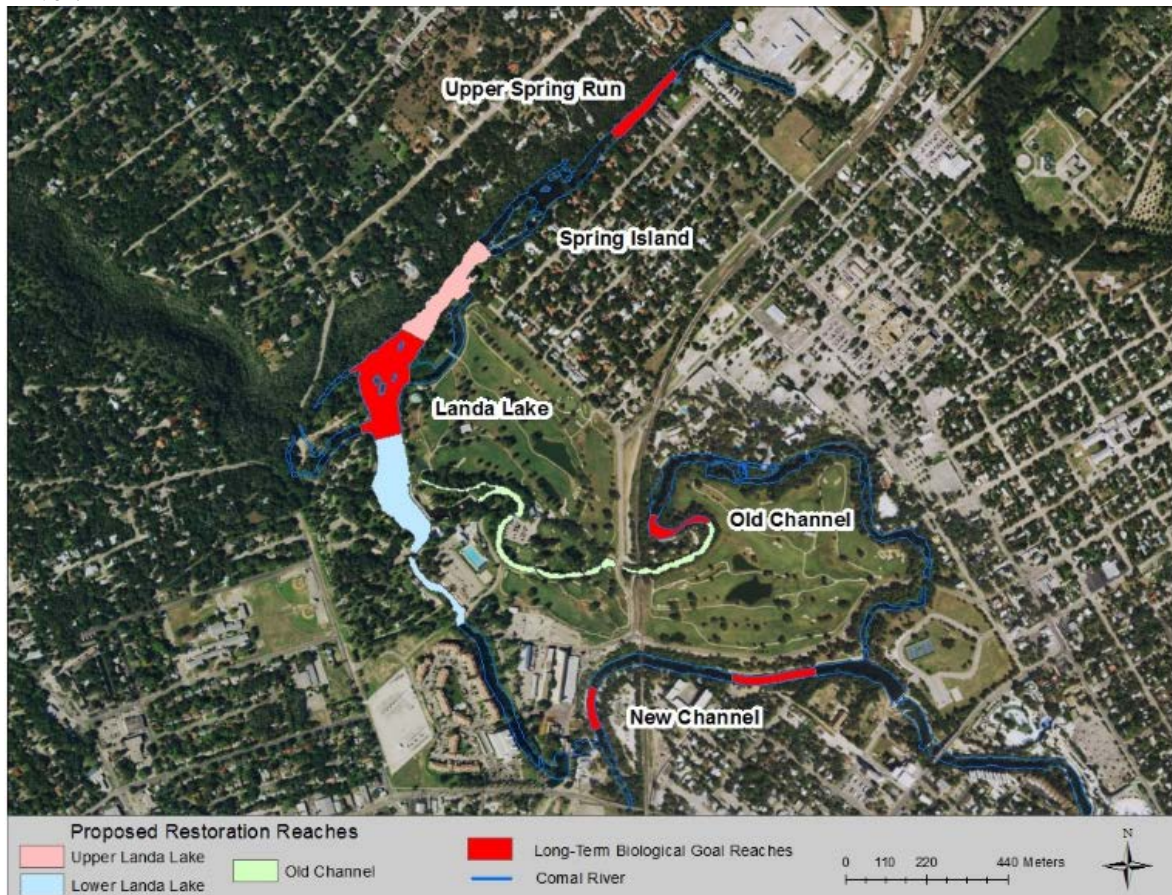


Figure 2: Long-term biological goal reaches and restoration reaches for the Comal System. The Upper and Lower Landa Lake restoration reaches are shown in light red and blue (respectively). The Landa Lake, New Channel, and Upper Spring Run LTBG reaches are shown in red.

Table 3: Annual and long-term aquatic vegetation restoration goals, in meters squared (m²), 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 (m²) | Annual Restoration Goal | Approximate # of plantings needed to meet annual goal |
|---------------------|----------------------------|---|-------------------------|---|
| | | Long-term Goal | 2019 | 2019 |
| LTBG Reaches | | | | |
| Landa Lake | Ludwigia | 900 | 75 | 1,125-1,500 |
| | Cabomba | 500 | 50 | 1,000 |
| | Sagittaria | 2,250 | 0 | 0 |
| | Vallisneria | 12,500 | 75 | * |
| | Potamogeton | 25 | 5 | 30 |
| New Channel | Ludwigia | 100 | 15 | 225-300 |
| | Cabomba | 2,500 | 20 | 400 |
| | Sagittaria | 0 | - | - |
| Upper Spring Run | Ludwigia | 25 | 5 | 75-100 |
| | Cabomba | 25 | 5 | 100 |
| | Sagittaria | 850 | 5** | 60 |
| Restoration Reaches | | | | |
| Landa Lake Upper | Ludwigia | 25 | 25 | 375-500 |
| | Cabomba | 250 | 25 | 500 |
| | Sagittaria | 250 | 50** | 600 |
| Landa Lake Lower | Ludwigia | 50 | 15 | 225-300 |
| | Cabomba | 125 | 10** | 200 |
| | Sagittaria | 100 | 25** | 1200 |
| | Potamogeton | 22,500 | - | - |

**Vallisneria* will not be planted but will be allowed to naturally expand, as needed, to increase coverage.

**Based on previous mapping of SAV, coverages exceed the long-term coverage goal. SAV coverages based on Fall 2018 mapping will be used as a benchmark to determine if aerial coverage has fallen short of the long-term goals and whether planting will need to occur.

Methodology:

Non-Native Vegetation Management:

Non-native aquatic vegetation (i.e. *Hygrophila*) will be removed, as needed, to minimize competition with native submerged aquatic vegetation (SAV). Large-scale removal of non-native SAV is not expected to occur in 2019 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 selectively extracting 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 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 2019 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 75 m² of additional *Ludwigia* coverage at full grow out, within the New Channel LTBG reach to achieve an annual target of 15 m² of additional *Ludwigia* coverage at full grow out, and within the Upper Spring Run LTBG reach to achieve an annual target of 5 m² of additional *Ludwigia* coverage at full grow out. *Ludwigia* plants and cuttings will also be planted in suitable locations within the Upper and Lower Landa Lake restoration reaches to achieve an annual target of 25 m² and 15 m² of additional *Ludwigia* coverage, respectively. 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 1m² of coverage. Therefore, approximately 1,125-1,500, 225-300, and 75-100 *Ludwigia* 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 375-500 and 225-300 *Ludwigia* plants will be planted in the Upper Landa Lake 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 50 m² of additional *Cabomba* coverage at full grow out, within the New Channel LTBG reach to achieve an annual target of 20 m² of additional *Cabomba* coverage at full grow out and within the Upper Spring Run LTBG reach to achieve an additional 5 m² of *Cabomba* coverage at full grow out. *Cabomba* will also be planted in suitable locations within the Upper and Lower Landa Lake restoration reaches, as needed, to achieve an annual target of 25 m² and 10 m² of additional *Cabomba* coverage, respectively. *Cabomba* will not be planting in the reaches where coverage has exceeded the long-term goal based on Fall 2018 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 1m² of coverage. Therefore, approximately 1,000, 400, 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 500 and 200 *Cabomba* plants will be

planted in the Upper Landa Lake and Lower Landa Lake restoration reaches, respectively, to achieve target annual coverage in each reach.

Sagittaria will be planted 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 5m², 50m² and 25m² of additional *Sagittaria* coverage, respectively, at full grow out. *Sagittaria* will not be planting in the reaches where coverage has exceeded the long-term goal based on Fall 2018 SAV mapping. *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 1m² of coverage.

Potamogeton will be planted in the most suitable locations in the Landa Lake LTBG reach to achieve an annual target of 5 m² of additional *Potamogeton* coverage at full grow out. *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 1m² of *Potamogeton* coverage. Therefore, approximately 30 *Potamogeton* rhizomes will be planted in the Landa Lake LTBG reach to achieve the target annual 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 meeting long-term vegetation goals and developing annual restoration goals for 2020 and subsequent years.

Budget:

Table 7.1:

\$50,000

Available budget:

\$50,000

Estimated 2019 budget:

\$100,000*

*The increase of \$50,000 in the budget for this task will be offset by a decrease in the budget for Task 5.2.2.1: Old Channel Aquatic Vegetation Restoration

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 HCP 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 2019:

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 existing recreational access restrictions on Landa Lake, Spring Runs, and the Old Channel utilizing trained Park Rangers.

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 Section 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 section 5.2.3 of the EAHCP.

Budget:

Table 7.1:

\$0

Available budget:

\$0

Estimated 2019 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 2019:

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 Task 5.2.10: Litter and Floating Vegetation Management). 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-spring flow 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 sensors will be downloaded and cleaned routinely, as needed, to prevent fouling. The main objective of this 2019 data collection is to establish 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 impactful 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 Task 5.2.10.

If low spring-flow conditions (<100cfs) occur and vegetation decay or low DO is evident, intensive displacement or removal of decaying vegetation will be implemented, as appropriate, under task 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 2019 budget:

\$12,800*

*To be utilized only if low-flow conditions (<100cfs) are realized at Comal Springs. Based on current and projected springflow at Comal Springs, it is not anticipated that DO monitoring activities will be required.

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, 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.

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 2019:

Continue existing program to remove non-native invasive species, including tilapia, nutria, 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.

Methods:

Invasive species including armored catfish, tilapia, and nutria will be removed from Landa Lake and portions of the Comal River during 5-6, three-day removal sessions. These sessions will occur approximately from February to October.

Gill nets will be the primary method for capturing tilapia within Landa Lake. Gill nets will be set primarily at the southern end of Landa Lake (**Figure 3**). Fyke nets will also be utilized in Landa Lake during each trapping session to capture non-native fishes. Fyke nets are passive traps that have 50-foot leads that guide fish into a 12-foot long by 3-foot wide hoop net. Fyke nets will be set in the Pecan Island slough area of Landa Lake (**Figure 3**). Snorkelers equipped with spears will also target non-native fishes early in the morning and late in the afternoon (times of high fish activity) in areas of high fish density (**Figure 3**).

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. An attempt will also be made to determine the sex of each individual to develop a sex ratio of the species being removed during the project's timeline.

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.

Approximate locations that will be targeted for non-native species removal are shown in **Figure 3** below. Trapping locations will be adjusted, as needed, based on capture rates and successes of previous removal efforts.



Figure 3. Primary non-native species target areas

Monitoring:

Over the past few years, each fish species has shown a significant decrease in average length and weight as compared to 2013 data. This decrease in size may indicate that removal efforts are suppressing the population's ability to gain adult mass and capacity to breed. The removal program will record 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 EAHCP staff to generate catch per unit effort and determine the effectiveness of the removal program.

The HCP 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 2019:

The City will continue to work towards the development of an ordinance or other mechanism designed to control introductions of non-native aquatic organisms to the Comal River system. The ordinance or alternative mechanism will specifically address the usage of live bait and aquarium dumping.

Methods:

City staff will draft an ordinance prohibiting aquarium dumping and the possession of certain live bait species. The City will consult with Texas Parks and Wildlife on the regulation of live bait. The ordinance will be presented to City Council for consideration.

Monitoring:

It is anticipated that the HCP Biological Monitoring program will detect the presence of newly introduced species.

Budget:

Table 7.1:

\$75,000

Available budget:

\$75,000

Estimated 2019 budget:

\$55,000

5.2.6/6.3.6 Monitoring and Reduction of Gill Parasites

Long-term Objective:

To conduct monitoring and acquire data on host snail (*M. tuberculatus*) density and distributions and gill parasite cercariae water column concentrations to assess the threat of the gill parasite to fountain darter populations.

Target for 2019:

Perform gill parasite cercariae water column concentration monitoring if low-flow conditions (<100cfs) are realized. Analyze monitoring data to determine the overall effect and potential threat of the gill parasite to fountain darter populations.

Methods:

To quantify density of drifting gill parasite (*C. formosanus*) cercariae in the Comal River study area during low-flow periods (<100 cfs), the same 3 transects (LL, OCR, RVP) sampled in 2015-2018 will be sampled in 2019. It has been concluded that during normal flow conditions and with the existing abundance of host snail, there is not a significant threat to fountain darter populations caused by the gill parasite (BIO-WEST, 2017). Past research has indicated that gill parasite cercarial concentrations may increase during drought conditions (BIO-WEST, 2017). Therefore, drifting gill parasite cercariae monitoring will only be initiated if low-flow conditions are realized.

Figure 4 illustrates the cercariae monitoring locations. It is felt that these 3 sites adequately represent the system as a whole and allow for efficient long-term monitoring of drifting cercariae.



Figure 4. Gill parasite cercariae monitoring locations

At each of the selected transect locations, 5-L water samples will be collected from six points that are evenly 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.

In 2019, cercarial monitoring will be conducted only once when springflow is less than 100 cfs. Monitoring will be targeted to a time when springflow is anticipated to be at its minimum for the year.

Budget:

Table 7.1:

\$75,000

Available budget:

\$75,000

Estimated 2019 budget:

\$ 10,000*

*To be utilized only if low-flow conditions (<100cfs) are realized at Comal Springs.

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 2019:

Maintain signage installed in 2016 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:

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 2019 budget:

\$0

5.2.8 Native Riparian Habitat Restoration (Comal Springs Riffle Beetle)

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 to increase the stability of the bank, decrease erosion/ sedimentation and increase the amount of available food sources (i.e. coarse particulate organic matter) for the riffle beetle.

Target for 2019:

Monitor the riparian vegetation and buffer area that was established in 2018 along the southeast side of Spring Run 3. Plant additional native riparian plant species within the riparian buffer area, as needed, to increase the density of vegetative coverage in this area. Monitor the riparian zone along the northwest side of Spring Run 3 and the Western shoreline of Landa Lake. Continue to maintain previously restored areas along Spring Run 3 and the Western shoreline of Landa Lake and remove any re-emergent non-native vegetation.

Methods:

In 2018, CoNB established a 10-15 foot riparian buffer with native plants along the length of the southeast bank of Spring Run 3. In order to create a more robust riparian area and increase the density of native vegetation along the southeast bank of Spring Run 3, additional native plants will be planted in 2019. 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**. Native plants will be installed in locations within the riparian buffer area along Spring Run 3 in areas that were not fully planted in 2018 or where initial plantings failed to establish.

Continue to mechanically remove re-emergent, non-native plant species within the riparian zone along the northwest bank of Spring Run 3 and along the western shoreline, as needed, where non-native plants have previously been removed.

Table 4. Candidate riparian plantings

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

Monitoring:

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

Budget:

Table 7.1:

\$25,000

Available budget:

\$25,000

Estimated 2019 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 2019:

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 in order to further mitigate impacts to dissolved oxygen and native aquatic vegetation.

Litter Management: (March 1st to October 30th). Litter pickup within the riparian zone along the Old Channel and the Spring Runs will occur on a bi-monthly basis (twice/ month) between March 1st and October 30th. Litter will also be removed from within the Old Channel and Spring Runs 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. DO concentrations will be monitored by EAA and as part of Task 5.2.4 (Decaying Vegetation Removal and Dissolved Oxygen Mgmt). City staff will monitor contractor efforts and coordinate additional efforts when deemed necessary.

Budget:

Table 7.1:

\$0

Available budget:

\$0

Estimated 2019 budget:

\$30,000

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 HCP.

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 2019:

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 includes base flow and storm sampling at designated locations along the Comal River both up- and downstream of the Landa Park Golf Course. Samples are analyzed for various herbicides and pesticides per the IPMP to control pests and weeds. Detections of any pesticides and herbicides utilized for golf course maintenance operations may warrant the need for revisions to the existing IPMP.

Budget:

Table 7.1:

\$0

Available budget:

\$0

Estimated 2019 budget:

\$0

5.7.1 Native Riparian Habitat Restoration

Long-term Objective:

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

Target for 2019:

Increase the coverage and density of native vegetation in the riparian zone along the golf course side of the Old Channel between Elizabeth Avenue and the Old Channel LTGB reach where non-native, invasive plants were removed in 2017 and 2018 (**Figure 6a**).

Remove non-native riparian vegetation (i.e. Elephant Ears) from the banks of Landa Lake and from islands located within Landa Lake. Establish riparian protection zones within Landa Park and increase the density of native riparian vegetation within those areas (**Figure 6b**).

Maintain areas where non-native plants were removed in previous years to prevent re-establishment. Monitor and maintain previously planted areas to promote establishment and growth of native vegetation.



Figure 6a. Location of 2019 riparian restoration activities along the Old Channel.



Figure 6b. Location of 2019 riparian restoration zones along the Landa Lake.

Methods:

Invasive Species Management:

Non-native riparian vegetation (primarily Elephant Ear) along the banks of Landa Lake and on islands within Landa Lake will be treated using an aquatic-approved herbicide. Elephant ears are present and abundant on both City and private properties along the banks of Landa Lake. Control of elephant ears and non-native riparian vegetation in the area of Landa Lake is not currently included as a measure in the EAHCP. The need to control elephant ears around Landa Lake is needed to maintain suppressed levels of elephant ears in the riparian zone along the Old Channel. Elephant Ear control will first be targeted to City property (i.e. Landa Park and City Golf Course) that can be accessed readily. Elephant Ear treatment on private property will be conducted upon approval from the property owner.

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

Native Plant Restoration:

Plant native riparian plants along the Old Channel between Elizabeth Street and the Old Channel LTBG reach in areas where non-natives were removed in previous years. 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** based on the success of

previous restoration efforts. Native plant restoration along the Old Channel will include primarily the planting of potted plants.

Establish riparian protection areas within Landa Park in areas identified as “Riparian Zones” in the City of New Braunfels’ *Landa Park and Arboretum Master Plan*, dated July 2017. The riparian protection areas are identified in **Figure 6b**. Currently, these areas are denuded of vegetation with erosion evident. The riparian zones will be delineated, protective fencing or barrier installed, soil prepared/ amended and native plants planted to establish riparian vegetation, minimize erosion and stabilize the banks. Soil preparation will include soil scarification and the addition of compost material. Candidate native plant species may include those in **Table 5** based on the success of previous restoration efforts. Native plant restoration in this area will include both planting of potted plants and distribution of a native seed mix. **Temporary irrigation will be installed to promote establishment of vegetation.**

Table 5. Candidate riparian plantings

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

Table 5. Candidate riparian plantings

| Trees and Shrubs | Herbaceous |
|--|-------------------|
| Western Wheatgrass (<i>Pascopyrum smithii</i>) | |
| Cereal Rye (<i>Secale cereale</i>) | |
| Bushy Bluestem (<i>Andropogon glomeratus</i>) | |

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 assessment will be conducted twice annually in Spring and Fall to evaluate the condition of the riparian zone.

Budget:

Table 7.1:

\$100,000

Available budget:

\$75,000 (available budget less than Table 7.1 due to funds utilized to fund the Bank Stabilization Project in 2016)

Estimated 2019 budget:

\$102,200*

*The increase in the budget for Task 5.7.1 will be offset by a decreased budget for Task 5.2.6 and Task 5.2.4.

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 2019:

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. Each HHW event costs approximately \$40,000-\$45,000 which includes event set-up and HHW disposal costs. The cost of the first two HHW events is shared evenly between the City and Comal County. The third event is funded largely by the EAHCP (\$30,000) with the remaining cost paid for by the City (\$10,000-\$15,000).

The 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.

The EAHCP adaptive management process may be initiated in future years to consider changes to the EAHCP with respect to management of HHW in New Braunfels.

Monitoring:

The volume of hazardous waste material 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 2019 budget:

\$ 30,000

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 2019:

The City will implement water quality management strategies identified in the *Water Quality Protection Plan (WQPP): Phase I* that was developed in 2017. Specific activities to be completed in 2019 include the design and installation of an underground stormwater filtration to treat stormwater that discharges to Spring Run #1 and design of a stormwater treatment project for a City-owned parking lot located at the corner of Elizabeth Ave and Landa Park Drive.

Methods:

The WQPP that was developed in 2017 includes evaluation criteria for seven water quality retrofit projects within the Comal River watershed. The potential water quality projects are presented in **Table 6**.

| <u>Design Data</u> | <u>Site 1</u> | <u>Site 2</u> | <u>Site 3</u> | <u>Site 4</u> | <u>Site 5</u> | <u>Site 6</u> | <u>Site 7</u> |
|----------------------------------|---|---|---|--|--|---|--|
| <u>Location</u> | Elizabeth Ave at Landa Lake | North Union Street From Dallas St to Edgewater | North Houston Ave at Landa Lake | Golf Course Club House | Overflow Parking along Elizabeth Ave | Fredericksburg Road Storm Drain Outfall into Landa Park | Landa Park Aquatic Complex Parking Lot |
| Recommended Measure | Rain Garden | Linear Roadside Rain Garden | Rain Garden | Grass/gravel pavers, function as filter strip | Grass/gravel pavers | Storm Drain Underground Vault | Permeable Pavers |
| Approx. Drainage area (acres) | 5.0 | 4.0 | 4.3 | 0.26 | 1.2 | 5.4 | 1.5 |
| Approx. Impervious cover (acres) | 1.9 | 1.2 | 1.3 | 0.24 | 0 | 5 | 1.4 |
| Approx. % Impervious Cover | 38.0% | 30.0% | 30.2% | 92.3% | 0.0% | 92.6% | 93.3% |
| Measure width (feet) | 30 | 8 | 30 | 20 | 20 | NA | 100 |
| Measure length (feet) | 50 | 300 | 70 | 150 | 800 | NA | 160 |
| Measure footprint (sq ft) | 1500 | 2400 | 2100 | 3000 | 16,000 | NA | 16000 |
| Measure depth (ft) | 1.5 | 1 | 1 | NA | NA | NA | NA |
| Measure Volume (cubic feet) | 2250 | 2400 | 2100 | NA | NA | NA | NA |
| Runoff depth treated (inches) | 0.34 | 0.52 | 0.44 | NA | NA | NA | NA |
| TSS lbs per year managed | 875 | 720 | 700 | 170 | 15 | 2200 | 170 |
| Estimated measure cost/SF | \$33.00 | \$40.00 | \$33.00 | \$8.00 | \$6.00 | NA | \$15.00 |
| Cost per Unit | | | | | | \$60,000.00 12'x6'x84" | |
| Total Measure Cost | \$71,156 | \$138,000 | \$99,619 | \$34,500 | \$138,000 | \$86,250 | \$345,000 |
| Cost/TSS lbs managed/year | \$81 | \$192 | \$142 | \$203 | \$9,200 | \$39 | \$2,029 |
| Maintenance Requirements | MINIMAL to MODERATE: Vegetation management required, occasional sediment/debris removal | MINIMAL to MODERATE: Vegetation management required, occasional sediment/debris removal | MINIMAL to MODERATE: Vegetation management required, occasional sediment/debris removal | MODERATE: Vegetation management, rejuvenation may be necessary, inspect two times per year | MODERATE: Vegetation management, rejuvenation may be necessary, inspect two times per year | MODERATE: Inspect four times per year, removal of sediment and debris | MODERATE: Semi-annual inspection, vacuuming required based on infiltration loss/sediment load. |

The City will construct a stormwater treatment facility at the end of North Houston Ave (Site 3) in 2019. The project will involve removal of approximately 2,000 ft² of existing asphalt pavement. The existing asphalt pavement will be replaced with a bio-retention basin that was designed to infiltrate and treat stormwater runoff prior to entering Landa Lake at the Upper Spring Run. The stormwater treatment facility is expected to prevent approximately 700 lbs/year of sediment, solids and associated pollutants from entering Landa Lake. Design of the bio-retention basin was completed in 2018. The City of New Braunfels will assume responsibility of ongoing maintenance of the stormwater facility to ensure maximum sediment and pollutant removal.

The City will design and install an underground stormwater treatment vault that will treat stormwater runoff that discharges via underground storm drain piping to Spring Run #1 (Site 6, **Figure 7**). There is existing underground stormwater infrastructure in the residential neighborhood immediately adjacent to Landa Park, Landa Lake and Spring Run 1. This stormwater infrastructure is comprised of drainage inlets that collect stormwater runoff from roadways and an approximately 50-acre drainage area. The drainage inlets are connected to underground stormwater piping that conveys stormwater to an outfall that discharges to Spring Run 1. There is observable sedimentation in Spring Run 1 near the stormwater pipe outfall following storm events. The project will involve design and installation of a large underground stormwater filtration/ treatment vault in-line with the existing stormwater pipe located beneath Fredericksburg Road. The project is estimated to prevent approximately 2,200 lbs/ year of sediment, solids, and associated pollutants from entering the Spring Run 1 and the Comal River system. The City of New Braunfels will assume routine maintenance of the stormwater treatment unit following installation. Maintenance will include quarterly inspections and annual removal of accumulated material from within the treatment chamber.



Figure 7. Map of water quality treatment vault

The City will also contract with an engineer for design of a pervious parking surface at a City-owned parking lot located at the corner of Elizabeth Ave and Landa Park Drive. The parking lot is currently used for employee and visitor parking and is constructed of a traditional, impervious asphalt surface. Stormwater runoff from the parking lot drains to the New Channel of the Comal River. The pervious parking surface will reduce the volume of stormwater runoff and filter stormwater prior to entering the Comal River system. Construction of the pervious parking lot will occur in 2020 once plans and cost estimates have been developed.

Budget:

Table 7.1:

\$150,000

Available budget:

\$250,000

Estimated 2019 budget:

\$250,000*

*Approx. \$100,000 for the construction of the bio-retention basin at North Houston Avenue, \$110,000 for design and construction of the stormwater treatment vault at Frederick Ave and \$40,000 for design of a permeable parking surface.