Chapter 5  Minimization and Mitigation Measures; Measures Specifically Intended to Contribute to Recovery

The ESA requires the HCP to specify what steps the applicants will take to minimize and mitigate the impacts which will likely result from the anticipated incidental take associated with the Covered Activities. (16 U.S.C. § 1539(a)(2)(A)). In order to issue an incidental take permit, USFWS must find that the applicants “will, to the maximum extent practicable, minimize and mitigate the impacts of such taking.” (Id. at § 1539(a)(2)(A)(B)(ii)).

This chapter describes the measures that the Applicants commit to carry out to minimize and mitigate the incidental take resulting from the Covered Activities to the maximum extent practicable. Additionally, some measures identified in the Sections below go beyond the “minimize and mitigate” standard and actually contribute to the recovery of the Covered Species. This chapter identifies the impact of the anticipated incidental take to be addressed by each measure and how that measure positively addresses that impact. The overall management of the implementation of these measures is set out in Chapter 9.

5.0  Approach to the Implementation of the Minimization and Mitigation Measures

The HCP will be implemented in two phases. In the first phase of the HCP, habitat minimization and mitigation measures and measures to maintain continuous minimum springflow during a repeat of the drought of record (see Table 5-1) will be put into place promptly on issuance of the ITP. This Phase I package will be implemented throughout the permit term unless modified by the AMP. Other components of Phase I will include implementation of measures designed to contribute to recovery of the species, and a robust AMP. Information developed in the AMP during Phase I will inform decisions regarding whether it is necessary to implement any flow protection measures during Phase II of the HCP beyond those implemented in Phase I.
<table>
<thead>
<tr>
<th>TABLE 5-1</th>
<th>SUMMARY OF MINIMIZATION AND MITIGATION MEASURES INCLUDED IN THE PHASE I PACKAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Protection Measures</td>
<td>Emergency Stage V Critical Period Management Reductions</td>
</tr>
<tr>
<td></td>
<td>SAWS ASR Trade Off</td>
</tr>
<tr>
<td></td>
<td>Regional Water Conservation Program</td>
</tr>
<tr>
<td></td>
<td>Voluntary Irrigation Suspension Program Option</td>
</tr>
<tr>
<td>Habitat Protection Measures</td>
<td>Measures to Reduce the Impacts of Drought and Enhance the Viability of the Listed Species at San Marcos Springs</td>
</tr>
<tr>
<td></td>
<td>Measures to Reduce the Impacts of Drought and Enhance the Viability of the Listed Species at Comal Springs</td>
</tr>
<tr>
<td></td>
<td>Environmental Restoration and Protection Area at Comal Springs</td>
</tr>
<tr>
<td></td>
<td>Gill Parasite Control</td>
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<tr>
<td></td>
<td>Wild Rice Restoration and Maintenance at San Marcos Springs</td>
</tr>
<tr>
<td>Other Measures</td>
<td>Riparian Habitat Restoration</td>
</tr>
<tr>
<td></td>
<td>Household Hazardous Waste Programs</td>
</tr>
<tr>
<td></td>
<td>Water Quality Protection and Monitoring</td>
</tr>
<tr>
<td></td>
<td>NFHTC Refugia</td>
</tr>
</tbody>
</table>

ASR = Aquifer Storage and Recovery  
SAWS = San Antonio Water System  
NFHTC = National Fish Hatchery and Technology Center  
LID = Low Impact Development

In Phase II, the Applicants will implement the specified additional measures (see Section 5.5.2) if needed to ensure the springflows necessary to foster achievement of the biological goals and objectives as well as implementing any further adjustments to improve the effectiveness of the measures implemented in Phase I.

The decision as to the Phase II actions and any ongoing necessary adjustments will be made through the AMP as set out in Chapter 6 and, more specifically, in Article 7 of the FMA. Until the AMP decision-making process is complete, it is not known whether additional flow protection measures are required. To address the ability and commitment to achieve the existing flow...
objectives, while recognizing the uncertainty associated with those objectives, Applicants commit to implement a “presumptive” measure that is adequate to achieve the flow-related objectives for attaining the biological goals. If needed, the use of the expanded capacity of the SAWS ASR will be the “presumptive” additional measure to meet the biological objectives with critical period reductions in Stage V beyond those in Phase I, if necessary. (See Section 5.5.2).

Applicants will include in the Annual Report a description of the status of implementation of the minimization and mitigation measures and an evaluation of the effectiveness of those measures.

5.1 Edwards Aquifer Authority

5.1.1 San Marcos National Fish Hatchery and Technology Center, Uvalde National Fish Hatchery, and Inks Dam National Fish Hatchery – Refugia

The EAA will support and coordinate with the USFWS on the work relating to the San Marcos NFHTC’s operation and maintenance of a series of off-site refugia at USFWS’s San Marcos, Uvalde, and Inks Dam facilities. (See Section 6.4). The limited geographic distribution of these species leaves the populations vulnerable to extirpation throughout all or a significant part of their range. A series of refugia, with back-up populations at other facilities, will preserve the capacity for these species to be re-established in the event of the loss of population due to a catastrophic event such as the unexpected loss of springflow or a chemical spill.

The support of the refugia will augment the existing financial and physical resources of these facilities, and provide supplementary resources for appropriate research activities, as necessary, to house and protect adequate populations of Covered Species and expanded knowledge of their biology, life histories, and effective reintroduction techniques. The use of this support will be limited to the Covered Species in this HCP.

5.1.2 Voluntary Irrigation Suspension Program Option

The EAA will administer the Voluntary Irrigation Suspension Program Option (VISPO) program. As discussed below in Section 5.8, VISPO is intended to minimize and mitigate the impacts of incidental take from low springflows by suspending the use of Aquifer water for irrigation purposes during drought.

The use of Aquifer water for irrigation accounts for over 30 percent of the annual pumping. This use typically occurs between January and July. The concentrated use of the Aquifer can contribute to substantial drawdown in Aquifer levels. This measure will require EAA irrigation permit-holders who voluntarily participate in the program to suspend the use of Aquifer water for irrigation purposes during drought to maintain springflow.

5.1.2.1 Target Volume, Distribution & Eligible Permits

The volume goal for the VISPO program is 40,000 ac-ft/yr. Irrigation permit-holders in Atascosa, Bexar, Comal, and Hays counties will be approached for enrollment in the program first because these counties are closest to the springs where temporarily suspending pumping is
likely to be most effective. It is hoped that at least 10,000 ac-ft can be enrolled in these counties. Assuming that this goal can be obtained, the goal is to enroll 15,000 ac-ft/yr each in Medina and Uvalde counties.

The EAA anticipates that base irrigation groundwater permits will be the primary permits enrolled; however, all permitted irrigation water rights (base and unrestricted) will be accepted in the program. If an irrigation permit-holder desires to enroll less than its full permitted volume, their withdrawals will be monitored by real time automated meters installed by the EAA.

5.1.2.2 Program Trigger

The suspension of pumping by the participants in the program will be triggered if the J-17 index well in Bexar County is at or below 635 ft-MSL on the annual trigger date of October 1. This date provides irrigators, and businesses affected by the decisions made by irrigators, ample time to make crop planting and other business decisions. Announcing implementation of the program on that date will result in a complete suspension of withdrawals of the enrolled water for each program participant for the following calendar year beginning on January 1.

5.1.2.3 Program Term

Irrigators will be offered the option of committing to the program for either five- or ten-year programs. The payment structure is designed to encourage the longer commitment.

Five-year program:

- A standby fee of $50/acre-foot that increases 1.5 percent per year will be paid to the enrollee every year of the term, regardless of Aquifer conditions; and

- A fee of $150/acre-foot that increases 1.5 percent per year will be paid for each year when temporary pumping suspensions are required.

Ten-year program:

- A standby fee of $57.50/acre-foot for years 1-5 and $70.20/acre-foot for years 6-10 will be paid to the enrollee every year of the term, regardless of Aquifer conditions; and

- A fee of $172.50/acre-foot for years 1-5 and $210.60 for years 6-10 will be paid for each year when temporary pumping suspensions are required.

5.1.2.4 Full Subscription to VISPO Program Is Reasonably Certain to Occur

The VISPO Work Group sent letters to all EAA irrigators in November 2010 explaining the VISPO and inviting them to informational meetings to learn more. Two informational meetings
were held, one in Uvalde, Texas, on December 6, 2010, and one in Castroville, Texas, on December 7, 2010. Approximately 150 persons attended the meetings (approximately 35 in Uvalde and approximately 115 in Castroville).

Following the meetings, all irrigators were contacted again in January 2011 with a letter of inquiry, a list of Frequently Asked Questions and a schedule of payments for the five- and ten-year program options. (Attachment O) Irrigators were asked to indicate whether they were interested in participating in the VISPO program and, if so, whether they were likely to opt for the 5- or 10-year program.

The EARIP received positive written expressions of interest from irrigators in enrolling 17,226 ac-ft of water as indicated in Table 5-2. This level of response is higher than what has been received for similar surveys, particularly when the responses were solicited so far in advance of a commitment to go forward with the VISPO. Additionally, other irrigators contacted the EAA after the requested response deadline to express interest in the program. The positive responses indicate a reasonable likelihood of enrolling the full volume of permits once funding is available and contracted enrollment begins.

<table>
<thead>
<tr>
<th>Atascosa County</th>
<th>Comal County</th>
<th>Bexar County</th>
<th>Medina County</th>
<th>Uvalde County</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acre-feet of interest</td>
<td>200</td>
<td>242</td>
<td>1,186</td>
<td>933</td>
<td>6,258</td>
</tr>
<tr>
<td>5-Yr. Base</td>
<td>400</td>
<td>527</td>
<td>535</td>
<td>1,664</td>
<td>3,126</td>
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<tr>
<td>10-Yr. Base</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
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<tr>
<td>10-Yr. Unrestricted</td>
<td></td>
<td>266</td>
<td>376</td>
<td>200</td>
<td>842</td>
</tr>
<tr>
<td>TOTAL</td>
<td>600</td>
<td>282</td>
<td>2,332</td>
<td>5,197</td>
<td>8,815</td>
</tr>
</tbody>
</table>

Based on the responses and public input and the financial incentives offered to enrollees, the Applicants believe that: (1) the 40,000 ac-ft will be fully subscribed; and (2) the irrigators who initially opt for the five-year option will continue their participation in the program and that the full 40,000 feet will be subscribed over the requested 15-year term of the ITP. To the extent that the program is not fully subscribed, the Adaptive Management Process will be used to identify alternative measures, perhaps additional pumping cuts, achieve the full springflow protection anticipated from the VISPO program and those measures will be implemented.

### 5.1.3 Regional Water Conservation Program

Some communities and industries in the Edwards Aquifer region have demonstrated a commitment to water conservation. However, water conservation programs have not been implemented across the region or developed to target exempt domestic wells. The Regional Water Conservation Program will minimize and mitigate the impacts of pumping from the...
Aquifer by building on the expertise of the successful programs to realize savings throughout the Edwards Aquifer region.

The goal of the Regional Water Conservation Program is to conserve 20,000 ac-ft/yr of permitted or exempt Edwards Aquifer withdrawals. In exchange for technical assistance and incentives for implementing the various measures, one-half of the conserved water (10,000 ac-ft) will be committed to remain in the Aquifer unpumped, but still owned by participating permit-holders, for 15 years to benefit springflow levels and contribute to species protection. The other one-half of the conserved water will remain available to the participating entity.

To ensure that the benefit from this program is reasonably certain to be realized, SAWS and certain municipal purveyors will initially commit not to use an amount equal to 10,000 ac-ft/yr of permitted Edwards Aquifer water for municipal use immediately upon implementation of this measure, which will not be utilized, but will still be owned and controlled by the purveyor.

### 5.1.3.1 Administration

The EAA will administer the Regional Water Conservation Program targeting municipal water users and owners of exempt domestic wells. In this role, the EAA will seek out local program implementation entities, such as water purveyors and other governing or civic groups, to deliver the anticipated services (see Section 5.1.3.2) to Edwards Aquifer municipal permit-holders and domestic well-owners. The EAA, county governments, or a contractor may take responsibility for program delivery in areas where a water purveyor does not have a presence or otherwise chooses not to operate the program itself. The EAA will keep a record of committed water amounts and monitor water use by the implementing entity to ensure compliance.

The EAA will develop a set of forms and procedures for use by the local implementing entity. Technical assistance will also be provided or coordinated by the EAA. The EAA will recruit water purveyors and other entities to implement the Regional Water Conservation Program in their jurisdiction. Contracts will be negotiated and completed between the EAA as the coordinating entity and the local implementing agencies or groups.

The EAA will organize a Regional Conservation Monitoring Committee to be initially comprised of one representative knowledgeable in water conservation from SAWS, the City of San Marcos, the City of New Braunfels, the Bexar Metropolitan Water District, or its successor if that successor entity is not already represented on the Committee, and a small water purveyor which utilizes the Edwards Aquifer. The Regional Conservation Monitoring Committee will provide technical input and expertise, and seek any additional funding from other funding sources such as foundations, state agencies and private sector firms as opportunities arise.

The Regional Conservation Monitoring Committee will also:

- Rank proposed activities in order of efficiency based on water saved/cost;
- Comment on the potential of each activity to achieve its goal for the term of the HCP;
• Make specific recommendations on adjustments that should be made to each proposed activity with the expected result; and

• Prepare periodic statements to demonstrate that the program goals – 20,000 ac-ft saved and 10,000 ac-ft committed to the Aquifer for 15 years – will be achieved by the 10th year of operation.

5.1.3.2 Services, Techniques, Measures, and Technical Assistance

The Regional Water Conservation Program will focus on implementation of incentive programs encouraging: (1) reduction of “lost water” through leak detection; (2) installation of high-efficiency plumbing fixtures and high-efficiency toilets; (3) large-scale commercial/industrial retrofit rebate; and (4) water reclamation for efficient water use.

5.1.3.2.1 Lost Water & Leak Detection

Many municipal water purveyors in the Edwards Aquifer region provide water services to expansive suburban or rural service areas, resulting in extensive lengths of pipe and other transmission and distribution infrastructure systems in areas that are not frequently visited, leaving many water leaks undetected. Even if detected, many smaller purveyors lack the financial means or technical expertise to address the issue in a pro-active manner. The lost water technical assistance program is meant to help identify the sources of water lost from the distribution systems of these purveyors and marshal resources to assist in repair.

Where a water purveyor has estimated a total volume or percentage of water produced that is lost in transmission and identified where the loss is most likely occurring, the purveyor may submit an application to the EAA with a plan to reduce the lost water and a request for technical assistance. If the purveyor agrees to commit half of the saved water to remain unutilized for 15 years, then a one-time assistance of $500 for each ac-ft saved will be provided. The EAA will also seek to identify funding sources available to small water purveyors to help enhance or supplant any financial assistance provided by the EAA under this measure, or to organize other funding.

Where purveyors have the capability to identify or estimate water lost in the distribution system, the EAA will enter into contracts with SAWS, the City of San Marcos, the City of New Braunfels, or other interested parties or contractors to provide assistance with a distribution system leak detection and lost water survey for the participating purveyor. The EAA, recipient purveyor, and appropriate expert staff from the surveying entity, as appropriate, will use the gathered data to prepare a lost water analysis and improvement plan for the targeted purveyors. These purveyors would then request assistance from the EAA with this plan to reduce water lost during transmission.
5.1.3.2.2 High-Efficiency Plumbing Fixtures & Toilet Distribution Program

Many new homes and businesses have been built in the Edwards Aquifer region since 1992, when enhanced requirements for high-efficiency toilet and other fixtures became effective. However, many structures remain from prior to 1992 that still utilize older, high-flow toilets and plumbing fixtures. These relatively simple replacements rapidly conserve water – each old toilet replaced conserves 12,500 gallons per year, while a typical household that replaces plumbing fixtures saves 10,500 gallons per year. Even more water is saved when old toilets and fixtures in commercial and institutional settings are replaced.

Some water purveyors may decide to lead the initiative to recruit its customers in the replacement of older high-flow toilets with a new Caroma, two-volume, high-efficiency toilet (or another high-efficiency toilet). During this effort, high-efficiency faucets and shower-heads may also be provided. The purveyor then organizes the distribution of the toilets to customers who are interested in participating. The old toilet is collected to verify that the new toilet is installed. Partnerships with area plumbers, non-profits, and civic groups have proven to be effective means of ensuring the new fixtures and high-efficiency toilets are distributed and installed.

In other instances, the EAA or subcontractor, such as a county government, will make the toilets and high efficiency plumbing fixtures available to Edwards’ pumpers with exempt wells. The toilets will be distributed in the same manner as water-purveyor-led initiatives, or a central depot can be established that is staffed at specified times.

The EAA or the subcontractor will obtain the commitment in the form of a contract with the recipient to replace a high flow toilet using Aquifer water. It would also require a commitment to proper maintenance in the contract. Plumbers and/or non-profits may be utilized for this task as well.

5.1.3.2.3 Commercial/Industrial Retrofit Rebate

Commercial and industrial processes are often large users of water. Many processes which use water as an input or as part of the production practice in the past have alternative water-saving means available today. The type of business or industrial activity that may be updated with water-saving equipment or process varies widely, and each interested participant will require unique consideration of the individual circumstance, goal, and capacity.

The EAA will provide a full or part-time staff person to make the contacts and complete the planning and process implementation. Invoices from the participating commercial or industrial concern are to be sent to the EAA. For example, a comparable SAWS program pays for 50 percent of the cost of the technological change or $400 per ac-ft of water saved over 10 years, whichever is less. The Regional Water Conservation Program will be modeled on this SAWS program. SAWS staff will provide training and perhaps ongoing technical assistance for the EAA staff as needed. One of every two ac-ft saved will have to be left unutilized by the sponsoring entity for the duration of the ITP.
5.1.3.2.4 Water Reclamation for Efficient Water Use

This portion of the Regional Water Conservation Program will be operated by the EAA and target exempt well owners.

Staff person(s) involved will be technically proficient in a number of related technologies including condensate collection, gray water use, rainwater collection, xeriscaping, self-contained water systems, and drip irrigation. Her/his goal would be to identify rural residents that were willing to implement these technologies with a small subsidy from the sponsoring entity. The subsidy of $300 or $400 per ac-ft saved is the same as that for the other conservation programs but is unlikely to cover a significant portion of the total cost of the technology. Nevertheless, people regularly approach various water conservation information events throughout the region inquiring about these practices. A participant will have to commit to leaving 50 percent of the water savings in the Aquifer for 15 years.

In an urban setting, opportunities for this activity are mostly confined to new construction or large scale rehabilitations or conversions. In such a setting, the EAA will require a commitment by the appropriate water purveyor to leave one-half of the savings unutilized for the permit term.

5.1.3.3 Initial Commitment

Municipal water purveyors which utilize the Aquifer and have had success at implementing water conservation measures will initially commit an amount approximating 10,000 ac-ft/yr of permitted Aquifer water for municipal use immediately upon implementation of this measure, which will not be utilized, but will still be owned and controlled by the purveyor, as follows:

- San Antonio Water System: 8,000 ac-ft/yr
- TBD: 2,000 ac-ft/yr

As participating water purveyors and exempt well-owners achieve new water savings, the volume of conserved water committed by the new participants will be off-set against the initial commitment, allowing the initial commitment to revert to the control of the original permit-holder proportionally until the Regional Water Conservation Program achieves 20,000 ac-ft of savings, 10,000 ac-ft of which would remain unutilized by the new participating entities during the term of the HCP.

5.1.4 Critical Period Management – Stage V

5.1.4.1 Stage V Emergency Withdrawal Reductions

By December 31, 2012, EAA will amend its Critical Period Management Program to add a new emergency Stage V reduction of 44 percent applicable in both the San Antonio and Uvalde pools. Stage V is designed to be triggered only when other measures have not proven sufficiently effective in maintaining springflow during drought conditions. For the San Antonio Pool, Stage V would be triggered by a combination of monthly average J-17 levels below 625 feet or springflows of either 45 cfs based on a ten-day rolling average at Comal Springs or 40
cfs based on a three-day rolling average. The Uvalde Pool would trigger Stage V using the Uvalde County Index Well (J-27) water level of 840 ft-MSL.¹

### 5.1.4.2 Stage V Emergency Water Supply

It is anticipated that during Stage V, all outdoor use of groundwater withdrawn from the Aquifer will be prohibited, except for limited circumstances, such as foundation watering, watering from a hand held hose, and emergency uses such as firefighting. It is possible that some of the smaller municipal water providers who are entirely dependent on the Aquifer may not have sufficient water supplies to meet public health and safety needs with Stage V critical period reductions. In such cases, municipal water providers will not be denied the use of groundwater from the Aquifer to meet public health and safety needs, but they will incur substantial fines and penalties as determined by the EAA pursuant to its enforcement rules and policies if they do not achieve the reductions. With such fines or penalties for overuse, it is anticipated that it would be more cost effective for small municipal providers who are entirely dependent to ensure that they have sufficient supplies available through lease arrangements than to pay the penalties for overuse during Stage V reductions.

To facilitate the leasing of water under these types of emergency situations, the Applicants may, with the support of the EARIP, seek a legislative amendment of § 1.34 of the EAA Act to allow irrigation permit holders to lease “Base Irrigation Groundwater” to municipal and irrigation users within the same county as the place of use for the irrigation permit during severe drought conditions.

### 5.2 City of New Braunfels

#### 5.2.1 Flow-Split Management in the Old and New Channel

Presently, the culverts governing flow from Landa Lake into the Old Channel are inoperable. As a result, a constant level of springflow proceeds through the culverts and into the Old Channel. Over time, this has led to the scouring of preferred native vegetation types for fountain darters, and the establishment and eventual dominance by non-native non-preferred aquatic vegetation. Flow-split management is intended to complement the ecological restoration of aquatic vegetation in the Old Channel, by reducing long-duration high flows and allowing for more seasonal variability to be maintained, mimicking a more natural flow pattern.

To minimize and mitigate the impacts of low flows, the City of New Braunfels staff will manipulate at least once monthly the valves and culverts to the Old Channel and New Channel of the Comal River for the protection of existing and restored native aquatic vegetation in the river, based on EAA’s real-time flow gauges in these channels and as often as appropriate for the maintenance of a beneficial hydrologic condition of the Old Channel habitat. Prior to this, the City of New Braunfels will replace and repair existing gates and control mechanisms to restore the operability of all four water paths to the Old Channel from Landa Lake: the two small

¹ See also Section 5.5.2.
culverts, the one large culvert, and the Springfed Pool inlet. This repair will allow for the manipulation of water flow per the flow split strategy in Table 5-3 and the prevention of sustained high flows in the Old Channel that resulted in scouring.

A second objective is to maximize the quality of habitat in the Old Channel. This will be accomplished by: (1) providing an appropriate level of flow variability during average to high flow conditions; and (2) allowing proportionally more water to flow through the Old Channel versus the New Channel during periods of critically low-flow with the ultimate goal of preserving high quality fountain darter habitat within the Old Channel as long as possible.

A detailed description of flow-split management is described in BIO-WEST (2011c). Based on the analysis conducted to date, the desired goal for maximizing fountain darter habitat in upper portions of the Old Channel at all times is to maintain 40–80 cfs. Extremely uniform suitable habitat is present in the New Channel under modeled (10–300 cfs) flows (Hardy 2011). Table 5-3 describes the flow-split for total Comal springflow conditions. During average to high flow conditions the focus is on a seasonal flow split in order to optimize habitat conditions in the Old Channel over time. Slightly higher flows during the fall and winter will provide some channel maintenance benefit while not hindering overall fountain darter habitat. Optimal habitat conditions are proposed for spring and summer to provide the best opportunity for fountain darter recruitment.

**TABLE 5-3**

FLOW-SPLIT MANAGEMENT FOR OLD AND NEW CHANNELS

<table>
<thead>
<tr>
<th>Total Comal Springflow (cfs)</th>
<th>Old Channel (cfs)</th>
<th>New Channel (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall, Winter</td>
<td>Spring, Summer</td>
</tr>
<tr>
<td>350+</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>300</td>
<td>80</td>
<td>60</td>
</tr>
<tr>
<td>250</td>
<td>80</td>
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<td>50</td>
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<td>10</td>
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<td>40</td>
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<td>10</td>
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<tr>
<td>30</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

When total Comal springflow flows drop to 150 cfs, the flow split will be shifted to protecting the maximum amount of habitat within the Old Channel year-round, while continuing to provide flow in the New Channel at all times (see Table 5-3). Additionally, when total Comal springflow drops below 100 cfs, if necessary, the City of New Braunfels staff will manipulate the valves and culverts more frequently to maintain the flow split ratio as detailed in Table 5-3.
As discussed in Hardy (2011), 20 cfs in the Old Channel will provide approximately 75 percent of the maximum available fountain darter habitat in the Old Channel from a physical habitat perspective. In addition to physical habitat, four checkpoint temperature ranges have been identified as critical to the fountain darter life cycle: at and above 77 to 79°F there is reduction in fountain darter larval production; between 79°F and 82°F and above there is a reduction in egg production, and at approximately 91°F and 94°F larval and adult thermal death can be expected based on laboratory studies (Brandt et al. 1993, Bonner et al. 1998, McDonald et al. 2007). At 20 cfs, under the extreme ambient temperature conditions modeled in Hardy (2011), the Old Channel area between Landa Lake and Golf Course Road [Model Segment 18; Hardy 2011]) is projected to maintain water temperature below three of the four temperature threshold ranges at all times. Reduced larval production (up to 63 percent) has the potential to occur for portions of the day based on laboratory results from McDonald et al. (2007). Hardy (2011) shows that the lower portion of the next modeled segment downstream (Reach 19 – Old Channel above Elizabeth Street) is projected to have water temperatures high enough during portions of the day to cause reduction in egg production as well. All subsequent downstream Old Channel segments also are projected to have temperatures at least as high for short periods of time. However, it should be reiterated that even at 20 cfs, nowhere in the Old Channel during the extreme conditions modeled, are water temperatures projected to exceed levels necessary for adult or juvenile survival. (Hardy 2011).

Additionally, it should be noted that the City of New Braunfels is in the process of restoring the functionality of the Landa Lake Spillway and Landa Lake Dam. This repair and restoration project will protect the Old Channel from scouring in less severe rainfall events and reduce sedimentation effects in the Old Channel. This repair is contingent upon receiving permits from the Army Corp of Engineers and the USFWS.

5.2.2 Native Aquatic Vegetation Restoration and Maintenance

It has been documented over the past decade (BIO-WEST 2002a–2011a) that native aquatic vegetation plays a key role in supporting the native fish assemblages, including the fountain darter. To minimize and mitigate the impacts of incidental take from low-flow events by providing better habitat conditions for the ecological community, the City of New Braunfels will undertake a program of native aquatic vegetation restoration within key, sustainable reaches of the Comal River by planting native vegetation in unoccupied areas and in areas previously occupied by non-native aquatic vegetation, with the latter preceded by non-native vegetation removal.

The amounts and types of vegetation removed and restored in this program will be established by Table 4-5 and 4-6 respectively. Two-dimensional hydraulic models will be used to evaluate the potential for success of the native vegetation restoration. This evaluation will consider the depth, velocity, and substrate conditions present in the proposed areas along with what non-native vegetation is thriving in these areas. In areas that are bare of vegetation, the reason vegetation is absent (e.g., recent flood scour, or unsuitable depth, velocity or substrate conditions) will be evaluated prior to restoration. Following an evaluation of the physical habitat model, an evaluation of water quality conditions will also be conducted. In particular, the CO₂...
need of the native aquatic plant being considered for establishment and the CO$_2$ concentrations in the water column under varying flow conditions at the proposed restoration locations will be evaluated.

Additionally, restoration will involve acquiring local, disease- and pathogen-free plant material. The material will be removed from adjacent habitat, propagated off-site (e.g., at the NFHTC) using plant material removed from the Comal system. Alternatively, it may be purchased from vendors who meet locality and disease free criteria. When non-native species are removed, they will be disposed of properly.

The focus of native vegetation restoration will be on Landa Lake downstream of Spring Run 3 but above the New Channel USGS weir and on the portions of the Old Channel bordered on both sides by City of New Braunfels’ property, including the Old Channel ERPA. Restoration efforts will also include establishing additional *Cabomba* along the eastern shoreline of Landa Lake and along the New Braunfels’ golf course property to create valuable fountain darter habitat.

### 5.2.2.1 Old Channel Environmental Restoration and Protection Area (Old Channel ERPA)

To minimize and mitigate the impacts of recreation and pumping during periods of low flow, the City of New Braunfels will remove problematic non-native vegetation, restore native habitat (per Table 4-6), undertake limited channel modification to enhance fountain darter habitat, and remove a small sediment island. The Old Channel Environmental Restoration and Protection Area (ERPA) includes the EAA Variable Flow Study reach below Elizabeth Street upstream to the culverts feeding the Old Channel from Landa Lake where the preferred native aquatic vegetation of the fountain darter has been scoured and replaced over time with less-preferred non-native aquatic vegetation.

This measure does not include an experimental channel or recirculation in Landa Park. As additional research is conducted and new data established, the City of New Braunfels will consider additional measures to protect habitat in this stretch of the Old Channel, see BIO-WEST (2011c), based on the protocols set forth in the FMA for determination of AMP measures and their implementation.

One specific area of targeted sediment removal is a small island that has formed just behind the Springfed Pool and immediately downstream of Landa Lake. This sediment island continues to grow, has established destructive non-native cane, and has displaced/destroyed fountain darter habitat.

### 5.2.2.2 Comal River Restoration

Upon final determination of locations suitable fountain darter habitat for restoration in the Comal River proper (below the USGS gauging weir, aka Stinky Falls), the City of New Braunfels will conduct native vegetation restoration and yearly maintenance to establish additional fountain darter habitat. Areas for targeted restoration preferred by the City of New Braunfels include the
portion of the Comal River between Last Tubers Exit and the confluence of the Guadalupe River and portions of the Comal River that allow for protection on one side of the river and safe passage of recreators on the other side of the river. Once the habitat has been established, TPWD will pursue creation of State Scientific Areas to protect fountain darter habitat.

### 5.2.2.3 Native Aquatic Vegetation Maintenance

Restoring native vegetation within the Comal system will benefit the Covered Species, but will be unsuccessful or likely very limited in success if it is not monitored and protected over time. One-time restoration contradicts the purpose for these activities which is to provide better habitat conditions for the ecological community over time and in particular, upon entering into critical low-flow periods. To sustain these conditions prior to entering into low-flow periods, the City of New Braunfels will conduct yearly maintenance of native aquatic vegetation restoration sites in Landa Lake and the Old Channel, and the flow-split management discussed above in Section 5.2.1.

Native aquatic vegetation maintenance consists of actively monitoring and maintaining planted stands of native vegetation. Temporal monitoring will incorporate some form of quantitative measurement system to assess whether plantings are increasing, decreasing, or remaining stable. Additionally, intensive non-native vegetation control in the adjacent areas will be implemented until the native vegetation is well-established. It will include additional activities following natural disturbances such as floods, periods of limited recharge, and/or herbivory, as well as anthropogenic disturbances such as recreation or vandalism. Anytime a disturbance is observed, the monitoring/maintenance schedule will be modified temporarily in order to provide the stability for the native vegetation re-establishment.

### 5.2.3 Management of Public Recreational Use of Comal Springs and River Ecosystems

To minimize and mitigate the impacts of recreation, the City of New Braunfels will manage recreational use of the Comal Springs and Comal River Ecosystem through two methods:

1) The City of New Braunfels will not reduce current protections provided by City Ordinance or Policy and will continue to enforce these regulations, including:
   a. Limiting recreation on Landa Lake to Paddle Boats
   b. Prohibiting recreational access to the Spring Runs in Landa Park to the Wading Pool in Spring Run 2.
   c. Prohibiting water recreation on the Old Channel; with the exception of Schlitterbahn operations within its present location.

2) Pursuant to Section 9.2 of the IA, the City of New Braunfels will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses that facilitate recreational activities on the Comal River (Outfitters) that comply with the requirements of the COI program established in this section. Outfitters that opt into the COI program and receive a COI will receive incidental take coverage during the term of the COI, which
shall not extend beyond the Permit term. The City of New Braunfels is not required to regulate the recreational activities of those Outfitters that choose not to participate through the COI process beyond the minimization and mitigation activities the City of New Braunfels has committed to undertake in this HCP.

Outfitters can apply for a COI when the ITP is issued and every two years thereafter. For those Outfitters that voluntarily participate in order to obtain incidental take coverage for their recreational activities, the COI will contractually require those Outfitters to comply with and implement listed minimum standards set out below. The City of New Braunfels will not reduce or eliminate any of the listed minimum standards during the 15-year ITP term but reserves the right to add additional standards in the future. COIs from the City of New Braunfels will be issued for a two-year term; so that every two years conditions of the COI may be re-evaluated and increased if necessary to further promote mitigation activities, reflect changes in New Braunfels policy or ordinance as related to protection of habitat or address new information established through the best science available as related to the species. The City will provide each year to the Program Manager for incorporation into the Annual Report a copy of all COIs issued during that year and information regarding the Outfitters compliance with the minimum standards.

Minimum COI Outfitter Standards

a. Provide litter bags to all customers

b. Sponsor one Comal River Cleanup annually. Outfitters may sponsor an existing river cleanup or may organize their own. Services and resources provided as a sponsor must exceed $1,000 in direct payment or in-kind service.

c. Provide at point of purchase at place of business, educational signage about the endangered species, their Critical Habitat, and efforts to promote the Covered Species (largely HCP initiatives and Critical Period Management information). Design and artwork will be produced and supplied by the City of New Braunfels. Signage must be at a minimum 3’x 6’.

d. Require all businesses, at their respective business locations, to support and assist the City of New Braunfels’ enforcement of laws that relate to the Covered Species and their habitat. Specifically, this applies to, but is not limited to, litter prevention and habitat protection.

e. Outfitters must submit a yearly report to the City of New Braunfels by January 1 of each year, detailing activities related to the COI for the previous year.

f. If established, Outfitters shall provide at point of purchase at place of business, a map and educational sign about the State Scientific Areas. Design and artwork will be produced and supplied by the City of New Braunfels. Combined map and sign must be at a minimum 3’x 6’.
g. Assist the City of New Braunfels with implementation of additional recreational management measures and controls at flows below 100 cfs to reduce habitat effects, water quality degradation, and other determined negative effects.

h. Stencil all outfitter rented recreational equipment with an anti-litter message. The City of New Braunfels will design and supply the stencil to be used.

If an Outfitter is in violation of any standard, the City of New Braunfels may suspend or revoke the Outfitter’s COI after providing notice, an opportunity to come into full compliance, and a hearing.

5.2.4 Decaying Vegetation Removal and Dissolved Oxygen Management

The largest uncertainty noted in the Hardy (2011) report is the potential effect of extended low-flow periods on aquatic vegetation dynamics within the Comal system as neither the hydraulic and habitat modeling, nor water quality modeling conducted addresses this issue. The main concern is that under extremely low-flow conditions, aquatic vegetation may start to die, and subsequently decay, consuming a large amount of dissolved oxygen (DO) during the decay process. This in turn could cause large swings in the DO concentration within Landa Lake, which depending on the severity, could affect the biological community including the fountain darter. The concern is probably limited to the lake portions of the system as the culverts and weirs present at the uppermost portions of the Old and New Channels would likely provide sufficient re-aeration to compensate for most events. However, within the lake environment, problems could occur.

To minimize and mitigate the impact of incidental take from low-flow events, upon receipt of DO data indicating a water quality concern created by decaying vegetation and the total Comal springflow drops below 80 cfs, the City of New Braunfels will implement a dissolved oxygen management program. The program will be focused on ensuring adequate DO levels for the ecosystem. Techniques to accomplish this objective may include artificial aeration of areas of Landa Lake or other solutions. If appropriate, the program may include removal of decaying vegetation. Removal techniques for decaying vegetation, if necessary, may include using rakes/pitch forks and a jon boat to transfer material to the banks for subsequent disposal. In this way, greater dissolved oxygen will remain available for the living aquatic ecology, rather than be consumed in the decay process.

5.2.5 Control of Harmful Non-Native Animal Species

To minimize and mitigate the impacts of low flows, the City of New Braunfels will conduct non-native animal species control on an annual basis. Initial control efforts will be intense and take place during the winter’s first freeze, with continued control every winter. Control of non-natives will include annual maintenance and monitoring and non-natives will be disposed of out of the
The non-native animal species that will be addressed include the suckermouth catfish, tilapia, nutria, and ramshorn snail. Potential control methods are discussed below.

Studies have shown that many fishes (especially small fish) have very similar food habitats (Hubbs et al. 1978). If non-native species are added to the aquatic ecosystems, greater competition or overlap among species is possible as these non-native species may be able to acquire resources with greater efficiency than native species (USFWS 1984). Suckermouth catfishes (Loricariidae) are a non-native fish species that has become established in the waters of Texas including the Comal River. (Howells 2005). Suckermouth catfishes prefer to feed on periphyton and algae (Hoover et al. 2004). The fountain darter lays eggs on algae and loss of spawning habitat and possibly egg predation are potential threats from suckermouth catfish (SSC 2009). There is some concern that excessive numbers of suckermouth catfishes could cause direct (potential displacement) and indirect effects (disruption of food supply) to the fountain darter in the Comal River (SSC 2009). Suckermouth catfishes also burrow into the river banks, destabilizing them and causing the introduction of additional sediment load into the habitat.

Tilapia is another non-native fish species that can impact fountain darter habitat. Tilapia destroys vegetation by making bare ground nests. During times of low flow and drought this could further reduce already limited habitat for the fountain darter. Tilapia is a tropical species that will congregate in winter near spring openings and other warm water sources. When tilapia congregate this creates the opportunity to use seines, gill nets, cast nets, or other methods to remove large quantities with minimal impact to the habitat. Artificial heating could be one method used to congregate fish in areas away from springs and endangered species to minimize the impacts from collection efforts.

Similarly, tilapia tend to congregate in backwater pools during summer months. This may afford another opportunity for effective removal of the fish.

A non-native gastropod (giant ramshorn snail [Marisa cornuarietis]) also poses a threat to the Comal Springs ecosystem. The giant ramshorn snail, a species in the aquarium trade, was first discovered in Landa Lake in 1984. (McKinney and Sharp 1995). This snail grazes on aquatic plants and in the 1990s played a major role in reducing plant biomass in Landa Lake. This snail prefers clear streams and pools with temperatures of at least 66°F (19°C). When exposed to lower temperatures, the snails withdraw into their shells and only survive for short periods. The warmest temperature that the giant ramshorn snail can withstand is 102°F (39°C). Although the population has diminished since the mid-1990s, the potential for future alteration of plant communities by the Ramshorn in the Comal ecosystems remains. (McKinney and Sharp 1995; BIO-WEST 2007c). The strong preference of fountain darters for aquatic vegetation highlights the concern posed by the grazing activities of the giant ramshorn snail (BIO-WEST 2004a). This species will be monitored closely to assure that it does not significantly reduce the available fountain darter habitat.
5.2.6 Monitoring and Reduction of Gill Parasites

A major concern in the Comal Springs ecosystem is the continued presence of an Asian trematode, *Centrocestus formosanus*. This parasite was first discovered on fountain darters in the Comal River during October 1996. The parasite attaches to the fish’s gill filaments causing extensive gill tissue proliferation and damage (Mitchell *et al.* 2000) with mortality in the wild being reported following the discovery in 1996 (Tom Brandt, personal communication).

A non-native snail, *Melanoides tuberculatus*, that has been in central Texas since 1964 (Mitchell *et al.* 2005) has been confirmed as *C. formosanus*’ central Texas first intermediate host (Mitchell *et al.* 2000). Parasite monitoring via examination of presence on fountain darter gills to determine *C. formosanus* levels in the Comal River has been ongoing since the late 1990s by the USFWS, Texas State University, and BIO-WEST (EAA Variable Flow Study).

In 2010, USFWS and BIO-WEST conducted a pilot study for the EARIP to determine the effectiveness of *Melanoides tuberculatus* removal on lowering drifting gill parasite numbers in the Comal River. (USFWS NFHTC and BIO-WEST 2011). The study confirmed that removing *M. tuberculatus* from the Comal River will result in a decrease in *C. formosanus cercariae* in the water column. It also recommended adaptive management studies to better determine the magnitude and duration of the benefits from snail removal.

To minimize and mitigate for the impact of low flows, the City of New Braunfels will retain and oversee the work of a contractor to establish a gill parasite monitoring and reduction program. The program may consist of non-native snail removal based on the pilot study conducted by USFWS and BIO-WEST (*Id.*). However, additional research on the most effective means of gill parasite removal will be conducted as part of the AMP as discussed in Section 6.3.6 to determine the method of gill parasite control that will actually be implemented.

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

Hazardous materials transported by vehicles across the watershed of the Comal River and its tributaries present the possibility of accidental spills or releases into the environment. The limited geographic distribution of the Covered Species at Comal Springs could cause the species to be highly impacted by such a spill. The City of New Braunfels will coordinate with the Texas Department of Transportation (TDOT) to prohibit transportation of hazardous materials on routes that cross the Comal River and its tributaries. This effort may include legislation, City of New Braunfels ordinances, additional signage, and TDOT approval.

5.2.8 Native Riparian Habitat Restoration

To minimize and mitigate the impacts of low flow, the City of New Braunfels will restore native riparian zones, where appropriate, to benefit the Comal Springs riffle beetle by increasing the amount of usable habitat and food sources (*i.e.*, root structures and associated biofilms). The method of riparian zone establishment will include the removal of non-natives and replanting of native vegetation representative of a healthy, functioning riparian zone. Trees and plants with
extensive root systems will be given preference to create the maximum beetle habitat. Fine sediment covering exposed roots and springs will also be removed. The riparian zone will be monitored (at least annually) for continued success and removal of reestablished non-natives. Riparian zones will be protected until the preferred riparian zone is established. Riparian habitat zones will be created along both sides of Spring Run 3 and along the portion of the western shoreline that is owned by City of New Braunfels.

In addition, riparian restoration also benefits the system through bank stabilization and nutrient and sediment processes. The City of New Braunfels will develop a program to incentivize private landowners on the Comal River and its tributaries to establish riparian zones along the western shoreline.

5.2.9 Reduction of Non-Native Species Introduction and Live Bait Prohibition

Introducing non-native species into the Comal Springs and River results in predators and competitors for the Covered Species in the ecosystem. To mitigate the impacts of recreation and pumping from the Aquifer during drought, the City of New Braunfels will undertake measures to stop or substantially reduce the introduction of non-native species from aquarium dumps and prohibit the use of live bait species.

The City of New Braunfels will prohibit by Ordinance introductions of domestic and non-native aquatic organisms, targeting specifically bait species and aquarium trade species into the Comal system. This action will include signage at key entrance points to parks on Landa Lake and the Comal River.

5.2.10 Litter Collection and Floating Vegetation Management

To minimize and mitigate the impacts of recreation and pumping during low flow periods, the City of New Braunfels will clean litter and debris from and manage floating vegetation in the Comal Springs, Landa Lake, and Old and New Channels of the Comal River. Litter and debris collection both flood-related and routine, will utilize self-contained underwater breathing apparatus (SCUBA). Debris removal also includes the removal of litter from floating vegetation mats before dislodging the vegetation mat and allowing it to continue downstream. Vegetation mats shade out native vegetation and create die off of vegetation if the mats are allowed to collect and grow in size. By dislodging the floating vegetation mats, fountain darter habitat is maintained and protected.

5.2.11 Management of Golf Course Diversions and Operations

Historically, the City of New Braunfels Golf Course has not used its full permitted surface water rights for irrigating the Golf Course. From 2006 through 2010, an average of 115.4 ac-ft/yr of water was diverted under both permits for golf course irrigation compared to the full permitted amount of 300 ac-ft/yr. To reduce use of Comal River water further, the City of New Braunfels
is working with New Braunfels Utilities under a grant received by the Texas Water Development Board to develop and implement a reuse water system that will be used to maintain the golf course by supplementing or, to the extent feasible, replacing the surface diversions used for irrigation purposes. The design process has been started for the reuse system.

The City of New Braunfels will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the Covered Species. Any chemicals used will be applied by a licensed applicator in a manner consistent with the label directions. Expanded water quality sampling targeted at Golf Course operations will be conducted per Section of 5.7.2 of the HCP. Changes in golf course management will be addressed through the AMP as set out in Article 7 of the FMA.

5.3 City of San Marcos

5.3.1 Texas Wild-Rice Enhancement and Restoration

Hardy (2011) describes the potential addition of Texas wild-rice habitat that might be achieved with the removal of non-native aquatic vegetation (*Hydrilla verticillata* and *Hygrophila polysperma*). Hardy (2011) shows that the removal of *H. verticillata* and *H. polysperma* within Texas wild-rice patches and including a 2-meter buffer around those patches could potentially provide over 1,000 m$^2$ of additional optimum Texas wild-rice habitat area over the entire simulated flow range (45 to 80 cfs). Proactive planting and conservative non-native vegetation removal has a high potential for increasing existing Texas wild-rice occupied area that would remain hydraulically suitable at these modeled flow levels. (Hardy (2011).

Based on BIO-WEST and TPWD monitoring data collected over the past decade and Hardy (2011) model results, the City of San Marcos, in partnership with Texas State University, will implement a Texas wild-rice enhancement and restoration program. Model results will be used to identify restoration/enhancement areas for Texas wild-rice that have a high probability of success (i.e., optimal habitat). In mixed (Texas wild-rice and non-native vegetation) stand areas, the non-natives will be removed and the original Texas wild-rice stand monitored for expansion. Similarly, for Texas wild-rice occupied optimal areas with adjacent non-native vegetation, the non-native plants will be removed and the Texas wild-rice stand monitored for expansion. Finally, in optimal areas for Texas wild-rice that are unoccupied by Texas wild-rice, non-native vegetation will removed and Texas wild-rice plants planted and monitored to assess the potential success of transplants. As described in Hardy (2011), the specific areas chosen for field trials will first consider only optimal habitat areas that remain suitable over the full range of discharges between the long-term average and lower flows. Initial field experiments associated with Texas wild-rice enhancement will be initiated early in the first phase of the AMP.

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2 Figure 5-1 displays the areas where minimization and mitigation measures will be implemented by the City of San Marcos.
Figure 5-1. Areas where the City of San Marcos will implement Minimization and Mitigation Measures
5.3.2 Management of Recreation in Key Areas

Recreation plays an integral part in what makes the San Marcos River such an attractive resource. San Marcos is expected to double in population to over 94,000 people by 2030 with the Austin-San Antonio corridor increasing at the same rate. This is expected to lead to increased recreation, especially as the San Marcos River is reaching its capacity. The most prominent recreation feature of the river downstream of Sewell Park is the Noon Day Lion’s Club “Toob” Rental which is housed in the City’s recreation hall in City Park. Tubes are rented for a fee with proceeds gifted back to the community through the Lion’s Club. There are several other small businesses which rent tubes but these are minor contributors to the overall number of rentals.

Parking around the river is limited to City Park and at Rio Vista Park. No new parking is planned.

A major concern regarding Texas wild-rice is recreational activity in high-quality habitat areas of the San Marcos River. Several types of recreation occur traditionally on the San Marcos River, including swimming, snorkeling, scuba, non-motorized boating, tubing, wading, fishing, and recreating with dogs. All these activities impact Covered Species and their habitat, some to a greater degree than others. While exact impacts are unknown, as discharge decreases, a greater percentage of plants are exposed to potential negative consequences. Damage to wild-rice stands by recreationists, particularly dogs, through direct contact was documented by Breslin (1997). Wild-rice is further impacted through fragmentation of other vegetation which then floats downstream eventually collecting on wild-rice stands. Fountain darters are potentially impacted through increased turbidity and accidental contact. While there are hardscaped access points throughout City parks, numerous desire trails exist and contribute to bank erosion where recreationists enter and exit at whim.

Recreation control is not meant to curtail recreation for large stretches of the river, but simply within key high quality habitat areas for Texas wild-rice to limit unnecessary impacts during low-flow conditions. To minimize the impacts from recreation, the City of San Marcos will establish permanent river access points. Permanent access will be located at Dog Beach, Lion’s Club Tube Rental, Bicentennial Park, Rio Vista Park, the Wildlife Annex, and potentially other areas (as determined through the AMP). Areas between access points will be densely planted with vegetation that discourages streamside access.

Additionally, TPWD will pursue the creation of State Scientific Areas by limiting recreation in these specified areas during low flow conditions. With the exception of the eastern spillway immediately below Spring Lake dam, none of the protected areas would extend across the entire river channel in order to allow longitudinal connectivity for reasonable recreation throughout the river. The City of San Marcos will install kiosks showing access points, exclusion zones, and associated educational components at key locations.
5.3.2.1 Management of Public Recreational Use of San Marcos Springs and River Ecosystem

Public recreational use of the San Marcos Spring and 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 San Marcos will implement the Recreation Mitigation Measures adopted by the San Marcos City Council on February 1, 2011 (Resolution 2011-21) (Appendix N). Some of the measures adopted by the City Council are described elsewhere in this Section. Those not described elsewhere include:

1. Trespassing Enforcement. The public is accessing the river via private property without the permission of the property owners. Private property owners have requested City assistance through signage to enforce trespassing laws.

2. Buffer zones. Create an appropriate buffer zone by location to keep picnic tables, pop-up tents, shelters, and portable grills away from the river. Pushing these amenities farther away from the river will reduce litter getting into the river and decrease bank compaction/erosion.

3. Education of the river user and the community. Suggestions include:
   a. Signage. Post signage at the City Park tube rental facility, Rio Vista Falls and at proposed hard access points along the river. Signage will be simple, natural, and when possible the existing sign locations will be used (trying to avoid too many signs). Signs will have the same template and coloration so they are recognized up and down the river. Signs will cover the rules of the river and educate the public on the importance of the resource. All signs will be bilingual.
   b. Video Loop at City Park offering information about the river and safety rules while people are waiting for shuttle or tubes. Possibly also at Rio Vista Falls.
   c. Posted maps showing trail, access points, fishing access and other amenities. Include a map at Stokes Park to help inform about the San Marcos River/Blanco confluence.
   d. Recreation information at hotels/restaurants, bed and breakfast facilities, Chamber of Commerce, Visitor’s Center, City of San Marcos internet site, etc. could include information on restrictions so river users are prepared prior to entering the river.
   e. Park Rangers. Include a section on river biology in the training of the park rangers so they can help disseminate the information.
   f. School Outreach. Implement an outreach program for San Marcos Consolidated Independent School District (SMCISD) so this information can be relayed to youth in San Marcos and indirectly to the parents.
   g. Overall Interpretation Plan. This would pull all the informational ideas together for conformity, continuity, and implementation.
h. Lecture series at Texas State University.

i. Stencils on rented tubes.

4. Reduce turbidity and sedimentation through the establishment of watershed management strategies. This will decrease erosion and subsequent sedimentation and filter runoff to enhance water quality. Remove silt and accumulated sediment from designated areas within the river to more closely match historical conditions.

5. The development of a partnership between the City and the University to enforce suggested measures and educate river users, and the use of officers dedicated to enforcing environmental regulations working both in and along the river.

Pursuant to Section 9.2 of the IA, the City of San Marcos will issue Certificates of Inclusion (COIs) to those commercial outfitting businesses (businesses and nonprofit entities that rent tubes, canoes, kayaks, or similar equipment to facilitate recreational activities on the San Marcos River) (Outfitters) that comply with the requirements of the COI program established in this section. Outfitters that opt into the COI program and receive a COI will receive incidental take coverage during the term of the COI, which shall not extend beyond the Permit term. The City is not required to regulate the recreational activities of those Outfitters that choose not to participate through the COI process beyond the minimization and mitigation activities the City of San Marcos has committed to undertake in this HCP.

Outfitters can apply for a COI when the ITP is issued and every two years thereafter. For those Outfitters that voluntarily participate in order to obtain incidental take coverage for their recreational activities, the COI will contractually require those Outfitters to comply with and implement listed minimum standards set out below. The City of San Marcos will not reduce or eliminate any of the listed minimum standards during the 15-year ITP term but reserves the right to add additional standards in the future. COIs from the City will be issued based on a two-year term; so that every two years conditions of the COI may be increased if necessary to further promote mitigation activities, San Marcos policy or ordinance as related to protection of habitat or address new information established through the best science available as related to the species. The City will provide each year to the Program Manager for incorporation into the Annual Report a copy of all COIs issued during that year and information regarding the Outfitters compliance with the minimum standards.

COI Outfitter Standards

1) Provide litter bags to all customers

2) Sponsor at least one San Marcos River Cleanup annually. An Outfitter may sponsor an existing river cleanup or may organize its own. Services and resources provided as a sponsor must exceed $1,000 in direct payments or in-kind services.
3) Provide at point of purchase at each place of business of the Outfitter, educational signage about the Covered Species, their Critical Habitat, and efforts to protect the Covered Species (largely Applicant initiatives and CPM information). Design and artwork will be produced and supplied by the City. Signage must be at a minimum 3'x 6'.

4) Require each Outfitter, at each of its business locations, to support and assist the City's enforcement of laws that relate to the Covered Species and their habitat. Specifically, this applies to, but is not limited to, litter prevention and habitat protection.

5) If one or more State Scientific Areas are established in the City, each Outfitter must provide at point of purchase at each place of business, a map and educational sign about the areas. Design and artwork will be produced and supplied by the City. Combined map and sign must be at a minimum 3'x 6'.

6) Assist the City with implementation of additional recreational management measures and controls at flows below 100 cfs to reduce habitat effects, water quality degradation, and other negative effects.

7) Stencil all Outfitter-rented recreational equipment with an anti-litter message. The City will design and supply the stencils to be used.

Each Outfitter must submit a report to the City by January 31st of each year, detailing its activities related to the COI for the previous year. If an Outfitter is in violation of any standard, the City of San Marcos may suspend or revoke the Outfitter’s COI after providing notice, an opportunity to come fully into compliance, and a hearing.

5.3.3 Management of Aquatic Vegetation and Litter below Sewell Park

The San Marcos River is heavily used for recreation from Sewell Park to IH-35. To minimize the impacts of recreation on Texas wild-rice and other Covered Species, the City of San Marcos will perform activities to manage floating vegetation and litter to enhance habitats for Covered Species. Management activities will include removal of vegetation mats that form on top of the water surface as well as on top of Texas wild-rice plants, particularly during low flows, and removal of litter.

Vegetation mats interfere with Texas wild-rice by impeding flowering and reproduction, blocking sunlight, interfering with photosynthesis, and slowing current velocity (Power 1996). The City of San Marcos will push floating vegetation downstream of any Texas wild-rice stands. The City will monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation.

Inorganic litter will be removed from the San Marcos River from City Park to IH-35 during the recreational season (May through September) and less often during offseason. Litter in or around Texas wild-rice stands will not be removed.
5.3.4 **Prohibition of Hazardous Materials Transport Across the San Marcos River and Its Tributaries**

Hazardous materials transported by truck across the watershed of the San Marcos River and its tributaries presents the possibility of accidental spills or releases into the environment. The limited geographic distribution of the endangered species at San Marcos Springs could cause the species to be highly impacted by such a spill.

The City of San Marcos will coordinate with the Texas Department of Transportation to designate hazardous materials routes which minimize the potential for spills entering the San Marcos River. This effort will include legislation, if necessary, and additional signage.

5.3.5 **Reduction of Non-Native Species Introduction**

Introducing non-native species into the San Marcos Springs and River results in predators and competitors for the listed species in the ecosystem. To mitigate the impacts of recreation and pumping from the aquifer during drought, the City of San Marcos will stop or substantially reduce the introduction of non-native species from aquarium dumps.

Dumping aquariums into the San Marcos River and its tributaries will be minimized through education, including signage and brochures, and offering alternative disposal to citizens wanting to get rid of unwanted aquatic pets. The City of San Marcos will partner with the River Systems Institute, Texas State University, and local citizen groups to help distribute educational materials. Partnerships with the school districts will also be considered. Educational materials will also be provided to local pet shops.

5.3.6 **Sediment Removal below Sewell Park**

The City of San Marcos will remove sediment from the river bottom at various locations from City Park to IH-35. These areas include but are not limited to reaches of the river in City Park, Veramendi Park, Bicentennial Park, Rio Vista Park, and Ramon Lucio Park. Sediment has accumulated at these locations due to the installation of flood control dams, urbanization, and natural processes. These accumulations have altered the river’s morphology and natural flow patterns. In addition, deposition of sediments on or around Texas wild-rice stands causes direct mortality by smothering or burying strands.

To minimize and mitigate the impacts of incidental take from recreation and pumping during low flow periods, the City of San Marcos will remove sediment from key areas of Texas wild-rice habitat below Sewell Park.

Hydrosuction will be used to remove accumulations of sediment. The silt will be vacuumed using a hose that has screen to prevent suctioning biota greater than 0.25 inch in diameter. The divers doing the hydrosuctioning will take the following measures to minimize loss/harm of biota in the area. Divers will fin the area to be suctioned to encourage the darters and other biota to move out of the area. Divers will be trained to recognize all stages of listed species from larval to adult. The nozzle of the vacuum will be kept down in the soil and not allowed to swing through the water column during the operation. In addition, placement of stakes around the area to be suctioned will keep divers away from stands of Texas wild-rice. An observer will be on the...
bank to monitor the effluent for presence of listed species and all other biota, as well as for the safety of the diver.

Sediment samples will be sent to TCEQ for contaminant testing per TCEQ requirements.

### 5.3.7 Designation of Permanent Access Points/Bank Stabilization

To minimize the impacts of recreation, permanent access points will be combined with bank stabilization at various locations. They will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc., while stabilizing highly eroded banks. In these areas, the bank is eroding generally due to the clearing of riparian vegetation and specifically due to intense recreational use. The City of San Marcos will stabilize banks in eroded areas, to include City Park, Hopkins Street Underpass, Bicentennial Park, Rio Vista Park, Ramon Lucio Park, and Cheatham Street underpass.

Natural rock will be used to create a stone terrace for access and bank stabilization with the bank on either side restored with riparian vegetation. Native riparian vegetation will be planted in areas adjacent to the access/stabilization areas in order to discourage river users from entering the river in places other than the access point. Prior to each construction period, the area will be swept clean of darters and enclosures will be put into place to keep darters out of the construction area. No work outside this area will occur. If additional areas along the river require stabilization, the City of San Marcos will submit a scope of work for consideration through the AMP.

The City of San Marcos will establish permanent river access points. Permanent access will be located at dog beach, Lion's Club Tube Rental, Bicentennial Park, Rio Vista Park, the Wildlife Annex, and potentially other areas (as determined during the Adaptive Management Process). Areas between access points will be planted with vegetation that discourages streamside access (e.g., prickly pear and acacia).

### 5.3.8 Control of Non-Native Plant Species

The City will partner with Texas State University to implement an on-going non-native plant replacement program for the recreational corridor from Spring Lake to city limits. Non-native species of aquatic, littoral, and riparian plants will be replaced with native species to enhance Covered Species habitat. The divers that will be conducting sediment control will first remove non-native aquatic plant species from the area to be worked that day. Removal will initially focus on hydrilla (*Hydrilla verticillata*) as this species causes sediment deposition and adds turbidity to the water column when disturbed. The non-native aquatic plants will be shaken and bagged for removal from the system in the same manner described in Section 5.4.3.1. Areas will be "weeded" until the natives become established at the site.

The riparian zone will be restored to at least 15 meters in width where possible. Areas will be planted at a ratio of three hard mast trees to one soft mast tree, with 20 percent of the vegetation consisting of fruit-bearing shrubs. Vegetation such as big bluestem, switchgrass, Indian grass, live oak, Texas red oak, bur oak, pecan, bald cypress, American beautyberry, and
buttonbush will be used. Fencing may be required for the first two years to allow for the establishment of the species.

5.3.9 Control of Harmful Non-Native and Predator Species

Studies have shown that many fishes (especially small fish) have very similar food habitats (Hubbs et al. 1978). If non-native species are added to the aquatic ecosystems, greater competition or overlap among species is possible as these non-native species may be able to acquire resources with greater efficiency than native species (USFWS 1984). Suckermouth catfishes (Loricariidae) are a non-native fish species that has become established in the waters of Texas including the San Marcos River. (Howells 2005). Suckermouth catfishes prefer to feed on periphyton and algae. (Hoover et al. 2004). The fountain darter lays eggs on algae and loss of spawning habitat and possibly egg predation are potential threats from suckermouth catfish (SSC 2009). There is some concern that excessive numbers of suckermouth catfishes could cause direct (potential displacement) and indirect effects (disruption of food supply) to the fountain darter. (SSC 2009). Suckermouth catfishes also burrow into the river banks, destabilizing them and causing the introduction of additional sediment load into the habitats.

Tilapia is another non-native fish species that can impact fountain darter habitat. Tilapia destroys vegetation by making bare ground nests. During times of low flow and drought this could further reduce already limited habitat for the fountain darter. Tilapia is a tropical species that will congregate in winter near spring openings and other warm water sources. When Tilapia congregate this creates the opportunity to use seines, gill nets, cast nets, or other methods to remove large quantities with minimal impact to the habitat. Artificial heating could be one method used to congregate fish in areas away from springs and endangered species to minimize the impacts from collection efforts.

A non-native gastropod (giant ramshorn snail [Marisa cornuarietis]) also poses a threat to the San Marcos Springs ecosystem. The giant ramshorn snail, a species in the aquarium trade, was first discovered in Spring Lake in 1984 (McKinney and Sharp 1995). This snail grazes on aquatic plants and in the 1990s played a major role in reducing plant biomass in Spring Lake. This snail prefers clear streams and pools with temperatures of at least 66°F (19°C). When exposed to lower temperatures, the snails withdraw into their shells and only survive for short periods. The warmest temperature that the giant ramshorn snail can withstand is 102°F (39°C). Although the population has diminished since the mid-1990s, the potential for future alteration of plant communities in these two ecosystems remains and could affect endangered species (McKinney and Sharp 1995; BIO-WEST 2007c). The strong preference of fountain darters for aquatic vegetation highlights the concern posed by the grazing activities of the giant ramshorn snail (BIO-WEST 2004a).

To mitigate the impacts of incidental take by pumping and recreational activities, the City of San Marcos, in partnership with Texas State University, will implement non-native and predator species control for the San Marcos River on a periodic basis with expanded effort of control, if needed, at low flows. The species include suckermouth catfish, tilapia, and Melanoides and Marisa snails.
The *Pterygoplichthys disjunctivus vermiculated* (sailfin catfish) adults are concentrated in Spring Lake and *Hypostomus plecostomus* (suckermouth catfish) are found downstream of Spring Lake. Currently, the most effective method of removal for both species is to hunt with a gig or similar multi-pronged spear. Other technologies, such as the heat box, fish-specific disease, and daughter-less technology require further research for their applicability to these species in the San Marcos River. Additionally, incentives, such as bounty for capture, could be established to encourage fishing for catfish.

With respect to tilapia, the adults are concentrated in the slough arm of Spring Lake. The use of gill nets during their reproductive season (Jan – May) provides an effective method of removal. Using a large mesh net along with frequent checks will prevent capture of fountain darters and other desirable species. Additionally, incentives, such as bounty for capture, could be established to encourage fishing for tilapia.

*Melanoides* snails and the gill parasite (*Centrocestus formosanus*) have been present in the San Marcos system, but at low levels. Controls will not be implemented initially. However, *Melanoides* snails and the gill parasite (*Centrocestus formosanus*) will be monitored and any appropriate measures implemented through the Adaptive Management process. *Melanoides tuberculata* is located throughout the upper reach of the San Marcos River. If necessary, effective removal can be accomplished by determining the locations of highest snail density and use dip nets to remove the snails weekly. (See Section 6.36)

*Marisa cornuarietus* is found sporadically in the upper reach of the San Marcos River. This snail vertically migrates at night and is easily spotted with a flashlight. The species will be controlled by diving several hours after sunset to hand-pick the snails from the submergent vegetation.

All personnel implementing any portion of the HCP for the City of San Marcos will undergo an orientation at the NFHTC to ensure awareness of the listed species and safe procedures while working in and along the San Marcos River.

### 5.4 Texas State University

#### 5.4.1 Texas Wild-Rice Enhancement and Restoration

Texas State University will partner with the City of San Marcos to undertake a program of Texas wild-rice enhancement and restoration in Spring Lake and the San Marcos River within the University’s campus boundaries as described in Section 5.3.1 above.

#### 5.4.2 Management of Recreation in Key Areas

Texas State University will partner with the City of San Marcos to control recreation in Spring Lake and the San Marcos River within Texas State University campus boundaries.

To minimize the impacts from recreation, Texas State University will establish permanent access points on the east and west banks of the San Marcos River between Spring Lake dam and the Aquarena Drive bridge, and other areas as determined during the AMP. These areas will serve as entry and exit ways that could be used by canoeists, tubers, swimmers, etc. Areas between access points will be planted with vegetation that discourages streamside access (*e.g.*, prickly pear and acacia).
Additionally, TPWD will pursue creation of State Scientific Areas in the San Marcos Springs ecosystem and River that would limit recreation in these areas during low flow conditions. (See Section 5.6.1). With the exception of the eastern spillway immediately below Spring Lake Dam, none of the protected areas would extend across the entire river channel which would allow longitudinal connectivity throughout the river. Kiosks showing access points, exclusion zones, and associated educational components will be installed at key locations.

5.4.3 Management of Vegetation

5.4.3.1 Management of Submerged and Floating Aquatic Vegetation in Spring Lake

To mitigate the impacts of incidental take on Covered Species from recreation, Texas State University will manage aquatic vegetation in Spring Lake through use of its harvester boat and through hand cutting of vegetation by divers authorized to dive in Spring Lake.

Each week about five springs will be cut, thus returning to cut the same springs every two to three weeks. During summer algal blooms, the springs will be managed more frequently (up to four springs per day), but mostly to remove algae. Texas State employees and supervised volunteers will fill the area around the springs to remove accumulated sediment, and then clear a 1.5-meter radius around each spring opening in Spring Lake with a scythe. Over the next 1.5-meter radius around the spring opening, they will shear vegetation to a height of 30 cm, and then to one meter over the following three meter radius. Plant material will not be collected, but carried away by the current. Cumulatively, about six meters of vegetation around each spring opening will be modified. Mosses will not be cut. The volume of plant material to be removed will vary by the amount of time between cuttings, and season.

The harvester boat will remove a range of 15-to-20 boatloads of plant material a month from Spring Lake. The harvester will clear the top meter of the water column, cutting vegetation from sections one, two, and three once a week. (See Figure 5.2). The harvested vegetation will be visually checked by driver for fauna caught in the vegetation. If the driver observes fauna, he/she will stop work and put the animal(s) back into Spring Lake if appropriate. Texas State employees and supervised volunteers are trained to recognize the Covered Species through the Diving for Science program (Section 5.4.7.1), and avoid contact with them.

Vegetation mats will be removed from zones four and five on an as-needed basis. (Figure 5-2). The total area cut will equal about nine surface acres.

One permanent full-time person (Spring Lake Area Supervisor) is responsible for running the harvester and managing the removal of vegetation around the spring openings. The Spring Lake Area Supervisor also schedules cleanup of nuisance floating species such as water hyacinth and water lettuce from Spring Lake. The floating plants will be collected by hand and shaken prior to removal from the river to dislodge any aquatic species caught in the plant. The plants will be deposited into dump trucks and taken to the River System Institute compost area.
5.4.3.2 Management of Aquatic Vegetation from Sewell Park to City Park

To mitigate the impacts of incidental take from recreational activities, Texas State University will push floating vegetation downstream of any Texas wild-rice stands. Inorganic litter will be picked up weekly from the San Marcos River from Sewell Park to City Park during the recreational season (Memorial Day to Labor Day) and monthly during offseason.

Texas State University will monitor downstream Texas wild-rice stands to keep the stands clear of drifting vegetation. Divers will not pick up litter in or around Texas wild-rice stands.

University employees or others will be trained by the TPWD to recognize Texas wild-rice and to protect the plant stand while removing the accumulated floating plant material. On Texas wild-rice stands, Texas State University employees will lift (not push) the floating material from the top of the Texas wild-rice stands and allow it to float downstream. Downstream accumulations of plant material will be removed by the City of San Marcos to avoid impacts to Texas wild-rice further downstream.
**Figure 5.2: Aquatic Harvester Zones**

- **Zone 1:** Headwater Springs; Crater Bottom, Salt and Pepper 1&2, Weissmuller
- **Zone 2:** Boat Path; Diversion, Cream of Wheat, Ossified Forest
- **Zone 3:** Boat Path; River Bed, Catfish Hotel, Deep Hole, Harvester Channel
- **Zone 4:** Boat Path; Archeology Site, Kettleman’s, University Seminar Boat Path and Dock
- **Zone 5:** Sink Creek/slough channel
5.4.4 Sediment Removal in Spring Lake and from Spring Lake Dam to City Park

Monitoring of the San Marcos River since 1990 reveals that sediment production has increased from 160 m$^3$/yr to 920 m$^3$/yr due to a combination of upstream flood control dams and sediment inflow increases (Earl and Wood 2002). Deposition of sediments on or around Texas wild-rice stands causes direct mortality by smothering or burying stands. Texas State University will mitigate the impacts of incidental take from diving activities, research activities, recreation and pumping during low flow periods by removing sediment from key areas of Texas wild-rice habitat in Spring Lake and from Spring Lake Dam to City Park.

Hydrosuction will be used to remove accumulations of sediment. The silt will be vacuumed using a hose that has an end piece covered by a 0.25-inch mesh screen to prevent suctioning biota greater than 0.25 inch in diameter. The divers doing the hydrosuctioning will take the following measures to minimize loss/harm of biota in the area. Vegetation will be finned before turning on the pump. Finning will encourage the darters and other biota to move out of the area. Divers will be trained to recognize all stages of listed species from larval to adult. The nozzle of the vacuum will be kept down in the soil and not allowed to swing through the water column during the operation. In addition, placement of stakes around the area to be suctioned will keep divers away from stands of Texas wild-rice. An observer will be on the bank to monitor the effluent for presence of listed species and all other biota, as well as for the safety of the diver.

Sediment samples will be sent to TCEQ for contaminant testing per TCEQ requirements.

5.4.5 Diversion of Surface Water

Under TCEQ Certificates 18-3865 and 18-3866, Texas State University's total diversion rate from the headwaters of the San Marcos River for consumptive use is limited to 8.1 cfs. (See Section 2.5.5). The total diversion rate from Spring Lake is limited to 4.88 cfs; the total diversion rate from the San Marcos River at Sewell Park is limited to 3.22 cfs. (See Section 2.5.5.1 and 2.5.5.2 respectively). To minimize the impacts of these diversions, when flow at the USGS gauge at the University Bridge reaches 80 cfs, Texas State University will reduce the total rate of surface water diversion by 2 cfs, i.e., to a total of approximately 6.1 cfs. This reduction in pumping will occur at the pump just below Spring Lake Dam in order to maximize the benefits to salamanders, Texas wild-rice, and other aquatic resources in the San Marcos River below Spring Lake Dam. The University will reduce the total rate of surface water diversion by an additional 2 cfs when the USGS gauge reaches 60 cfs. The additional 2 cfs reduction will be made from the pumps located in the slough arm of Spring Lake, and, therefore, maximize the benefits to the aquatic resources within the main stem San Marcos River below Spring Lake Dam. When the USGS gauge reaches 49 cfs, Texas State University will reduce the total diversion rate to 1 cfs. This further reduction will be made by restricting the pumps located in the Sewell Park reach. The diversion of water will be suspended when the springflow reaches 45 cfs.
Figure 5-3. Texas State University Surface Water Diversions. The diversions are identified with stick pins. The diversions at the pump house (slough arm of Spring Lake) and industrial cooling towers are permitted under TCEQ Certificate 18-3865. The 513 ac-ft/yr municipal water right has not been exercised, and no diversion for this right currently exists. The diversions at Sewell Park and the “ponds” are permitted under TCEQ Certificate 18-3866. (See Sections 2.5.5.1 and 2.5.5.2 respectively).

The reductions in Texas State University’s total diversion rate for consumptive use is summarized in Table 5-4 below:
### Table 5-4. Reductions in Surface Water Diversion Rates during Low Flow Conditions under Texas State University’s TCEQ Certificates 18-3865 and 18-3866.

<table>
<thead>
<tr>
<th>Streamflow (cfs)</th>
<th>Spring Lake Diversions (cfs)</th>
<th>San Marcos River Diversions (cfs)</th>
<th>Total Diversion Rate (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;80</td>
<td>4.9</td>
<td>3.2</td>
<td>8.1</td>
</tr>
<tr>
<td>80 – 60</td>
<td>2.9</td>
<td>3.2</td>
<td>6.1</td>
</tr>
<tr>
<td>60 – 49</td>
<td>0.9</td>
<td>3.2</td>
<td>4.1</td>
</tr>
<tr>
<td>49-45</td>
<td>1.0</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>&lt;45</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Texas State University uses a 0.25-inch mesh screen to cover the intake for surface water diversions. These screens are routinely inspected and cleaned. Fountain darters have not been observed when the screen is cleaned; however, there is a possibility for capture of adults against the screen, but not pulled into the pipeline.

To avoid or minimize the impacts of the surface water diversions, the University will routinely monitor the screens to determine if any entrainment occurs and will make any necessary modifications to the screens to minimize any incident take from the operation of the diversions.

### 5.4.6 Sessom Creek Sand Bar Removal

For decades, a sand and gravel bar has been building with each major rain event at the confluence of Sessom Creek and the San Marcos River. The bar is about two-thirds meter deep, 7 meters wide, and 21 meters long (98.5 m³). Over time it has widened, deepened, and constricted the river channel; furthermore, the continued expansion has covered a stand of Texas wild-rice. The bar has become vegetated with both littoral and terrestrial plants, and is used heavily by recreationists as it provides a shallow swimming area.

To minimize and mitigate the impacts of incidental take from recreation, Texas State University and the City of San Marcos will conduct a study of sediment removal options to determine the best procedure to remove this sand and gravel bar that minimizes impacts to listed species. Texas State University will submit the study for review though the AMP and implement the actions coming out of that process.

A separate sediment retention pond has been constructed to minimize additional deposition to this area and will be maintained to maintain an effective level of performance.

### 5.4.7 Diving Classes in Spring Lake

#### 5.4.7.1 The Diving for Science Program

To minimize the impacts of the Diving for Science Program that trains and authorizes individuals to dive in Spring Lake, individuals authorized through this program must demonstrate a knowledge of listed species found in the lake and their habitat, laws and regulations impacting
these species, good buoyancy control, the ability to avoid contact with listed species, the ability to avoid disturbing critical habitat, and the ability to stay off the bottom of the lake. The program is taught as a two-day class with a maximum class size of 20 and is taught in the Dive Training Area. The program averages 350 trainees per year. Upon completion of this class, divers are allowed anywhere in Spring Lake to perform specific volunteer tasks such as finning spring areas covered with algae, and picking up litter. Projects are structured to minimize contact with listed species in an effort to ensure protection of listed species and their habitat. The Diving Supervisor coordinates and supervises all volunteer diving. No more than sixteen volunteer divers will be allowed in the lake per day, with no more than eight at one time.

Any individual diving outside of the Dive Training Area has to have completed the Diving for Science Program.

5.4.2 Texas State University Continuing Education

Texas State University Continuing Education classes for check-out dives will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

5.4.7.3 Texas State SCUBA Classes

Texas State SCUBA classes will be conducted in the Dive Training Area. To minimize the impacts of these classes, class size will be limited to 12 students and no more than three classes will be conducted per day.

5.4.8 Research Programs in Spring Lake

To minimize the impacts of its research programs, all proposals to conduct research in Spring Lake will be reviewed by the River Systems Institute to ensure there is no impact on Covered Species or their habitat. If incidental take cannot be avoided, it will be minimized by educating the researchers as to the area where the listed species are located and by requiring measures to minimize any potential impacts. All diving in support of a research study will be provided by individuals who have completed the Diving for Science program. Nothing herein is intended to obviate the need for individual research projects to obtain a permit under 16 U.S.C. § 1539(a)(1).

5.4.9 Management of Golf Course and Grounds

To minimize any impacts of the use of fertilizers and pesticides to maintain the golf course and grounds, Texas State University will develop a golf course management plan that will document current practices and include an Integrated Pest Management Plan (IPMP). The golf course management plan and IPMP will incorporate environmentally sensitive techniques to minimize chemical application, improve water quality, and reduce negative effects to the ecosystem. Any chemicals used will be applied by a licensed applicator in a manner consistent with the label instructions. Expanded water quality sampling targeted at Golf Course operations will be conducted as described in Section of 5.7.2 of the HCP. Changes in golf course management will be addressed through the AMP as set out in Article 7 of the FMA.
5.4.10 Boating in Spring Lake and Sewell Park

To minimize the impacts of boating on the Covered Species’ habitat in Spring Lake, boats in Spring Lake will be confined to areas that are mowed by the harvester, thereby not impacting vegetation and specifically avoiding Texas wild-rice stands. Individuals will enter and exit boats at specified access points to avoid impacting the flora and fauna along the bank. All boats launched into Spring Lake will undergo a USFWS-approved process for cleaning.

Further, canoeing/kayaking classes in the lake will be limited to no more than 2 classes per day and each class will be in the water no more than 1 hour. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised.

To minimize the impacts of boating on the Covered Species’ habitat in Sewell Park, canoeing/kayaking classes in Sewell Park will be confined to the region between Sewell Park and Rio Vista dam. Students will enter/exit canoes/kayaks at specified access points to avoid impacting the flora and fauna along the bank. Classes will be no longer than two hours and up to three classes will be held per day. Classes will have a maximum of 20 students in 10 canoes. All classes will be supervised.

5.4.11 Reduction of Non-Native Species Introduction

Texas State University will limit introductions of non-native species by aquarium dumps. Dumping aquariums into the San Marcos River and its tributaries will be minimized through education, including signage and brochures, and offering alternative disposal to citizens wanting to get rid of unwanted aquatic pets. Texas State University will partner with the City of San Marcos and local citizen groups to help distribute educational materials. Partnerships with the school districts will also be considered. Educational materials will also be provided to local pet shops.

5.4.12 Control of Non-Native Plant Species

Texas State University will partner with the City of San Marcos to implement a non-native plant replacement program for Spring Lake and the San Marcos River within the University’s campus boundaries as described in Section 5.3.8 above.

5.4.13 Control of Harmful Non-Native and Predator Species

Texas State University will partner with the City of San Marcos to undertake a program of non-native and predator species control for Spring Lake and the San Marcos River within the University’s campus boundaries as described in Section 5.3.9 above.

5.5 San Antonio Water System

5.5.1 Use of the SAWS ASR for Springflow Protection

The capacity and capabilities of the SAWS ASR can be used to meet SAWS ratepayer expectations and to play a significant role in maintaining a protective level of springflow in Comal and San Marcos Springs including during a repeat of a drought of record-like event. As discussed in section 5.8, this measure to minimize the impacts of incidental take from extended drought is the third element in the package of springflow protection measures (following the
VISPO and municipal conservation layers). It utilizes the SAWS ASR facility for storage and delivery of Aquifer water leased by the EAA. When triggers are reached, as described below, SAWS will use water stored in the ASR to serve as a baseload supply in its service area near to the springs. As described below, an amount equivalent to the water recovered from the ASR will be used to offset SAWS’s Edwards demand.

EAA will acquire through lease and option 50,000 ac-ft/yr of EAA-issued Final Initial Regular Permits. The EAA may use SAWS as its agent for this purpose. The leases and options will be acquired by EAA to fill, idle, and maintain a portion of the capacity of the SAWS ASR Project for subsequent use to protect springflows during identified drought-of-record conditions as described below.

The lease program is comprised of three components. The first one-third, approximating 16,667 acre-feet of permits, will be leased for immediate storage in the ASR. The remaining pumping rights will be placed under a lease option. One-third (16,667 ac/ft) of the total will be options exercised in the year after the 10-year moving annual average of Edwards recharge falls below 572,000 ac-ft/yr, as determined by the EAA (see Section 6.2.3), and is likely to continue to decrease. The last one-third will be options exercised when the 10-year moving recharge average is less than 472,000 ac-ft/yr, as determined by the EAA (see Section 6.2.3). When the leases are in place, this water will either be pumped to fill the SAWS ASR or not pumped for any reason. When the ASR is in recovery mode (i.e., when water is being returned from the ASR), the leased water will not be pumped. The water to fill SAWS ASR is generally provided by SAWS from their existing Edwards supplies and the first one-third of the regional leases water (16,667 ac-ft) which will be maintained at all times throughout the HCP duration. SAWS will store its own unused Edwards permits in addition to the HCP leases and lease-options in the ASR when possible. SAWS, with the assistance of the Regional Advisory Group will describe in the Annual Report the storage and recovery activities.

Trigger levels for implementation of ASR management in accordance with the HCP will be 630 ft-MSL at the J-17 index well during an identified repeat of drought conditions similar to the drought of record as indicated by the ten-year rolling average of Edwards recharge of 500,000 ac-ft, as determined by the EAA. When triggered, the ASR or other supplies capable of utilizing shared infrastructure will be activated to deliver up to 60 million gallons per day to SAWS distribution system during a repeat of drought of record-like conditions. When the monthly average groundwater levels at J-17 are below 630 ft-MSL and the ten-year rolling average of Aquifer recharge is 500,000 ac-ft or less, pumping of selected wells on the northeast side of SAWS water distribution system will be reduced in an amount that on a monthly basis equals the amount of water returned from the ASR only to the extent of the Aquifer water provided by the EAA for storage in the ASR. SAWS will use up to 100 percent of the conveyance capacity of existing SAWS ASR facilities to off-set SAWS’ Edwards Aquifer demand.

SAWS will attempt, to the extent practicable, to mimic the pattern of delivery developed by HDR Engineering (HDR 2011). That pattern of delivery, however, was intended to represent how the water in the ASR would have been managed in the drought of record in the 1950s. Future droughts of similar duration and magnitude undoubted will differ in the timing and pattern of
recharge in a given year. Thus, the actual pattern of delivery of water from the ASR may differ from that HDR used in its modeling simulations depending on the actual course of the drought. (See HDR 2011). Decisions as to the actual pattern of delivery will be determined by SAWS in conjunction with the Regional Advisory Group described below.

The use of the SAWS ASR is predicated on an assumption informed by HDR Engineers’ groundwater modeling that the SAWS ASR will be utilized to deliver approximately 126,000 ac-ft of water to SAWS distribution system during a decadal drought similar to the drought of record. It is further predicated on the assumption from HDR 2011 that the maximum amount of HCP water that will be delivered in a given year is 46,300 ac-ft.

The management of the ASR to protect spring flow necessarily involves some judgment and flexibility. SAWS will make the day-to-day decisions necessary to fulfill the ASR commitment. A 12-person Regional Advisory Group consisting of four representatives of SAWS, the Program Manager, and one representative each from EAA, EAA permit holder for irrigation purposes, small municipal pumpers, the Spring cities, environmental (including Texas Parks and Wildlife), industrial pumpers, and downstream interests will provide advice to SAWS regarding the implementation of the program. The Advisory Group will meet as needed but no less than quarterly. SAWS will organize and facilitate the Advisory Group.

Future droughts may not mimic the historic drought of record. SAWS, in consultation with the Regional Advisory Committee, will address future drought situations by reviewing the rolling-average recharge triggers which may result in potentially accelerating the activation of the lease-options, based on relevant indicators.

5.5.2 Phase II Expanded Use of the SAWS ASR and Water Resources Integration Program Pipeline

Based on the best available science currently available, the management objectives required to foster achievement of the biological goals include maintain daily average flows of no lower than 30 cfs (45 cfs monthly average) for no longer than a period of 6 months at a time at Comal Springs and daily average flows of no lower than 45 cfs (52 cfs monthly average) for no longer than 6 months at a time at San Marcos Springs. (See Section 4.2). During Phase I, additional studies on the effects of low flows on the species and their habitat will be conducted and the MODFLOW model used to simulate the effects of the Phase I Package will be improved and a new model developed. (See Section 6.4). Until the AMP decision-making process is complete, it is not known whether additional flow protection measures are required. Similarly, the duration and amount of additional flows that might be needed are equally unknown. To address the need now to demonstrate the ability and commitment to achieve the existing long-term biological objectives while recognizing the uncertainty associated with those objectives, the Applicants commit to implement a “presumptive” action that, when combined with the Phase I activities, is adequate to achieve the current biological objectives if such an action is needed. (See FMA § 7.14).

The presumptive action for Phase II of the HCP involves the use of the SAWS ASR with a planned construction of the WRIP Pipeline that is currently in the design stages and is
scheduled for completion by 2020. The WRIP consists of approximately 45 miles of water transmission pipeline and a pump station that will convey water from the SAWS ASR, Carrizo, and Brackish Desalination programs located at the Twin Oaks Facility property in south Bexar County to new and existing facilities in western and northwestern Bexar County. The pipeline generally follows a north-northwest alignment from south Bexar County, through the far west portions of Bexar County to SAWS' Anderson Pump Station near the intersection of Loop 1604 and Highway 151. The WRIP will link the existing facilities and new water supplies located at the ASR site in southern Bexar County with the southwestern and western portions of San Antonio.

SAWS' ability to expand the use of the ASR as a presumptive Phase II measure, if required, assumes that: (1) no additional water beyond those required for the Phase I use of the ASR will need to be stored; (2) the total amount of water to be returned from the ASR over the term of the permit will not exceed 126,000 ac-ft during the drought and 46,300 ac-ft in the worst year; and (3) no more than 40 percent of the capacity of the WRIP distribution system will be utilized at any time for HCP purposes.

To the extent that such a project cannot actually be designed and implemented to achieve the goals within the above-described assumptions, additional springflow protection will be obtained through additional CPM pumping cuts in Stage V or other measures that provide an equivalent measure of springflow protection to the Covered Species. The current science suggests that Stage V pumping cuts of 47 percent would be required along with the presumptive measure. (See Section 5.8.2).

5.6 Texas Parks and Wildlife Department
5.6.1 State Scientific Areas

A major concern regarding Texas wild-rice is recreational activity in high-quality habitat areas of the San Marcos River. Several types of recreation occur traditionally on the San Marcos River, including swimming, snorkeling, scuba, boating, tubing, wading, fishing, and recreating with dogs. All these activities can impact Covered Species and their habitat, some to a greater degree than others and while exact impacts are unknown, as discharge decreases, a greater percentage of plants are exposed to potential negative consequences.

Texas Parks and Wildlife Department (TPWD) has the authority to establish state “scientific areas” for the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value. (TPW Code § 81.501). To minimize the impacts of recreation, TPWD has created a two mile segment of the public waters of the San Marcos River as a State Scientific Area in the San Marcos Springs ecosystem. (30 TAC 57.910). This scientific area is designed to protect Texas wild-rice by restricting recreation in these areas during flow conditions below 120 cfs. The rule makes it unlawful for any person (1) to move, deface alter, or destroy any sign, bouy, boom or other such marking delineating the boundaries of the area; (2) uproot Texas wild-rice within the area; and (3) enter an area that is marked. The regulations are intended to preserve at least 1,000 m$^2$ of Texas wild-rice.
With the exception of the eastern spillway immediately below Spring Lake Dam, none of the protected areas extend across the entire river channel; thus, allowing longitudinal connectivity for recreation and access to be maintained downstream throughout the river. The City of San Marcos and Texas State University will install kiosks at key locations showing access points, exclusion zones, and associated educational components.

Interlocal agreements between the City of San Marcos and TPWD and Texas State University and TPWD will be used to allow for local in-water enforcement of the protected zones.

In order to protect existing and restored fountain darter habitat, TPWD will pursue creation of state scientific areas in the Comal Springs ecosystem. (See Section 5.2.2.2). The goal of the regulations will be to minimize impacts to habitat from recreation activities. An interlocal agreement between the City of New Braunfels and TPWD will be used to allow for local in-water enforcement of the protected zones.

## 5.7 Measures that Specifically Contribute to Recovery

All of the measures described above will not only minimize and mitigate the impacts of any incidental take, but will also contribute to the likelihood of the survival and recovery of the Covered Species. The EARIP, however, was established as a “recovery implementation program.” As such, the Applicants committed to implement measures that are specifically intended to contribute to the recovery of the Covered Species. The following sets out those specific measures.

### 5.7.1 Native Riparian Habitat Restoration

The City of San Marcos will undertake a program to increase the area of the riparian zone on public lands from City Park to IH-35 using native vegetation. As plans take shape for the reestablishment of the riparian zone, private landowners will be asked to participate in the plan. Reimbursement for the price of native plants will be provided to private landowners. Criteria to qualify for reimbursement will be established along with a list of preferred natives to replant.

Texas State University will undertake a similar program to restore the riparian zone with native vegetation in upper Sewell Park.

The City of New Braunfels will undertake a program to increase the area of the riparian zone along the Old Channel, the golf course and in the vicinity of Clemens Dam. As plans take shape for the reestablishment of the riparian zone, private landowners will be asked to participate in the plan. Reimbursement for the price of native plants will be provided to private landowners. Criteria to qualify for reimbursement will be established along with a list of preferred natives to replant.

### 5.7.2 Expanded Water Quality Monitoring

Early detection of water quality impairments that may negatively impact the listed species will contribute to protecting the Covered Species by allowing for investigation and adoption of any
necessary measures through the AMP to address the source(s) of the concerning indicators. Such measures may include stormwater detention and water quality basins, rain gardens, storm sewer filters, or constructed wetland filters as appropriate to the indicator of concern and physical setting of the respective system. In the event that certain constituents of concern are detected at levels indicating the potential for adverse effects, Best Management Practices (BMPs) will be evaluated to reduce and/or eliminate the constituent of concern if potential sources can be identified. Examples of constituents that could lead to BMP implementation and/or modifications include, but are not limited to, polycyclic aromatic hydrocarbons (PAHs), pesticides, ash, herbicides, turbidity, fertilizers, and bacteria from human and animal/pet waste.

The EAA and its predecessor agency have conducted a program of water quality data collection since 1968. (EAA 2010b). The EAA maintains a network of groundwater and surface water monitoring sites, including sites in the Comal and San Marcos springs. Each year EAA monitors the quality of water in the Aquifer by sampling approximately 80 wells, eight surface water sites and major spring groups across the region. Under this mitigation measure, EAA will expand its monitoring program to examine stormwater runoff, including additional surface and groundwater monitoring near the Comal and San Marcos springs. Water samples are routinely analyzed in the field for selected water quality parameters (i.e., temperature, pH, conductivity, and alkalinity) and in the laboratory for common major ions, metals, total dissolved solids, hardness, bacteria and nutrients. Many of the samples are also analyzed for semivolatile organic compounds and volatile organic compounds as well as pesticides, herbicides, and polychlorinated biphenyls.

EAA will manage and oversee the expanded monitoring of water quality around Landa Lake and the Comal River, and Spring Lake and the San Marcos River to include stormwater sampling and additional groundwater and surface water sampling as necessary. Particular focus will be placed on point and non-point sources. Areas that are to be targeted include, but are not limited to, large areas of impervious cover, golf courses, swimming pools, and industrial runoff areas. EAA will consult with the cities of New Braunfels and San Marcos regarding sampling locations within their respective jurisdictions.

More thorough and frequent water quality monitoring (surface, storm water, and groundwater) that takes into consideration the location, time of day, day of week, time of year, and all chemical water quality parameters believed to be significant will be established through the AMP. Sampling criteria will be developed based on need and relevance to each spring and River system’s differing characteristics and setting.

### 5.7.3 Septic System Registration and Permitting Program

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

### 5.7.4 Minimizing Impacts of Contaminated Runoff

The City of San Marcos will construct two sedimentation ponds along the river to help reduce the amount of contaminated materials that enters the river as a result of rain events. The ponds
will also reduce runoff velocity which will help to reduce bank erosion, and subsequently the amount of sediment that enters the river. The sedimentation ponds will be constructed by excavating and stabilizing a specified area, and building a controlled-release structure. Water source for the ponds is solely runoff from rain events. Specific details for all ponds will be submitted through the AMP as each pond is contracted for design. Each construction area will be surrounded by silt fence/rock berm to minimize runoff. Sediment controls will be monitored daily during construction and the construction area will be covered with a tarp in the event of rain.

The first pond will be located in Veramendi Park beside Hopkins Street bridge. This area receives a large amount of street runoff from three different storm drains. The first pond will be designed to remove sediment and street pollutants from runoff prior to entering the river. The size, shape, and depth will be determined based on an analysis of the volume of water discharging from the storm drains. The City of San Marcos will detain as much as possible for treatment purposes. The City of San Marcos will undertake required maintenance of the sedimentation ponds on a regular basis. The area is easily accessible and sediment will be dredged and carried to the City of San Marcos’s existing composting site at the Wastewater Treatment Plant.

The second pond will be created by widening of drainage ditches that run alongside Hopkins Street and cut directly to the San Marcos River. Widened areas will be designed to store water for a short period of time, but long enough to collect sediments and associated pollutants from roadway runoff.

5.7.5 Management of Household Hazardous Wastes

To date, water quality in the Aquifer and at the spring openings remains very good. However, as levels of development continue to increase over the recharge zone, transition zone, and even the contributing zone, the threats to water quality will increase. To reduce the potential for future water quality problems, the City of New Braunfels will initiate a hazardous household waste (HHW) program that will include 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 establish a four-times-a-year program that could be recognized in the City’s anticipated MS4 compliance and storm water permit as a contributing activity.

The City of San Marcos also will maintain a HHW program that involves the periodic collection of HHW and its disposal.

5.7.6 Impervious Cover/Water Quality Protection

Most potential water quality problems are linked to nonpoint source pollution such as fertilizer runoff and chemicals washed in from adjacent streets; however, spills and leaks from industrial and municipal infrastructure also present hazards. The potential for accidents and nonpoint source pollution to affect the Covered Species may be exacerbated during below average flows since chemicals and nutrients would be less diluted when a lower volume of water is present. Runoff and spills originating even at long distances from the spring openings also can affect water quality at the springs.
The City of New Braunfels will establish criteria related to desired impervious cover and provide incentives to reduce existing impervious cover on public and private property in New Braunfels. The City of New Braunfels will establish criteria and incentives for the program based upon the low impact development (LID)/Water Quality Work Group Final Report (Appendix Q) recommendations for Implementation Strategies and best management practices (BMPs).

The City of San Marcos will establish a program to protect water quality and reduce the impacts of impervious cover (such as through LID). The City of San Marcos will develop criteria and incentives for the program based upon the LID/Water Quality Work Group Final Report (Appendix Q) recommendations for Implementation Strategies and BMPs.

The EAA will put together materials regarding the value of a ban on the use of coal tar sealants and work with local governments to explore and encourage their consideration of such a ban.

5.8 HDR’s Analysis of the Springflow Protection Measures

5.8.1 Modeled Springflow with the Phase I Package

The flow protection measures included in the Phase I package are detailed in Sections 5.1.2 (VISPO), 5.1.3 (Conservation Program); 5.5.1 (SAWS ASR), and 5.1.4 (Stage V Emergency Withdrawal Reductions). Each element in the package is intended to contribute to maintaining an adequate level of continuous springflows during a repeat of the drought of record conditions. The elements are intended to work in a cumulative manner to provide sufficient springflow protection during a repeat of the drought of record conditions during Phase I.

To evaluate the effectiveness of the flow protection measures, the EARIP retained HDR Engineering, Inc. and Todd Engineers (collectively HDR) to simulate the springflows at Comal and San Marcos springs during a recurrence of drought of record conditions under baseline conditions and with sequential addition of each flow protection element of the Phase I measures to the baseline conditions. HDR used the U.S. Geological Survey’s MODFLOW groundwater model (Lindgren et al. 2004) in the simulations. The details of the model and the simulation results are set out in HDR, Inc. and Todd Engineers, “Evaluation of Water Management Programs and Alternatives for Springflow Protection of Endangered Species at Comal and San Marcos Springs,” October 2011 (HDR 2011).

The baseline scenario used in that simulation assumes that all of the Initial Regular Permits are being fully pumped (573,037 ac-ft) and all of the projected exempt domestic and livestock wells (13,296 ac-ft) and unpermitted federal wells (6,907 ac-ft) are being pumped to the maximum extent, subject to applicable critical period management rules. (HDR 2011). This assumption results in a projected theoretical maximum pumping of 593,240 ac-ft in each year. (Id.) The baseline simulations also assume that the critical period management pumping restrictions set out in SB 3 are in place, but do not assume that the continuous minimum springflow requirement of state law is implemented.

The assumption regarding the annual pumping level probably is conservative. The highest actual recorded annual level of pumping was 542,400 ac-ft, which occurred in 1989 before the
creation of the Edwards Aquifer Authority. Moreover, over the last 10 years (2000-2009) total pumping has averaged 381,000 ac-ft, with a maximum total pumping level of 456,500 ac-ft in 2006 and a minimum total pumping level of 317,600 ac-ft in 2004.

Under that baseline scenario, simulated springflow ceases at Comal Springs for 38 months during a repeat of the drought of record. Springflow at Comal Springs falls below 30 cfs (monthly average) for 54 months.

At San Marcos Springs, for the baseline scenario, springflow remains above zero during a repeat of drought of record conditions. It falls below 52 cfs (monthly average) for 20 months during a repeat of drought of record conditions. The minimum simulated springflow is two cfs (monthly average).

When the VISPO program is superimposed on that baseline, the simulated number of months in which the springflow ceases decreases by 12 months at Comal Springs (i.e., goes from 38 to 26 months). The number of months in which springflow was below 30 cfs (monthly average) improved by 18 months (i.e., went from 54 to 36 months).

At San Marcos Springs, the number of months in which springflow falls below 52 cfs (monthly average) is reduced by 6 months (i.e., from 20 to 14 months) during a repeat of the drought of record. The minimum springflow is 16 cfs (monthly average).

When the Regional Water Conservation Program is added to the package (baseline + VISPO + Conservation) the number of months during a repeat of drought of record conditions in which springflow at Comal Springs was below zero improved by 5 months for Comal Springs (i.e., goes from 26 to 21 months). The number of months in which springflow was below 30 cfs improved by two months (i.e., went from 36 to 34 months).

At San Marcos Springs, springflow below 52 cfs (monthly average) is reduced by two months (i.e., goes from 14 to 12 months) during a repeat of the drought of record. The minimum springflow improves to 19 cfs (monthly average).

When the use of the Phase I SAWS ASR is added to the package (baseline + VISPO + Conservation + SAWS ASR), simulated springflow at Comal Springs is always above zero cfs. The minimum springflow is 15 cfs (monthly average). The number of months in which springflow was below 30 cfs improved by 32 months (i.e., went from 34 to 2 months).

At San Marcos Springs, with the addition of the Phase I SAWS ASR element to the package, the number of months that springflow falls below 52 cfs (monthly average) is reduced by nine months (i.e., goes from 12 to 3 months) during a repeat of drought of record conditions. The minimum springflow improves to 49 cfs (monthly average).

When the Stage V pumping reduction is added to the package (baseline + VISPO + Conservation + SAWS ASR + Stage V), the minimum springflow at Comal Springs is 27 cfs (monthly average). The number of months in which springflow was below 30 cfs remained at two months.
At San Marcos Springs with the addition of the Stage V element to the package, the number of months that springflow falls below 52 cfs (monthly average) is reduced from three to two months during a repeat of the drought of record. The minimum springflow is 51 cfs (monthly average).

These results are summarized in Tables 5-5 and 5-6 and Figures 5-4 and 5-5.

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<tr>
<th>Spring</th>
<th>Threshold (cfs)</th>
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<th>VISPO + Conservation</th>
<th>VISPO + Conservation + SAWS ASR</th>
<th>VISPO + Conservation + SAWS ASR + Stage V</th>
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3 HDR 2011. Flow values are monthly average flows.
### Table 5-6
MONTHLY AVERAGE SPRINGFLOW FOR SELECTED STATISTICS (1947-2000)

<table>
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<tr>
<th>Spring</th>
<th>Statistic</th>
<th>Baseline (340K+)</th>
<th>VISPO</th>
<th>VISPO + Conservation</th>
<th>VISPO + Conservation + SAWS ASR</th>
<th>VISPO + Conservation + SAWS ASR + Stage V</th>
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**Figure 5-4.** Simulated Monthly Average Springflow at Comal Springs (1947-1960)
5.8.2 Modeled Springflow with the Phase I Package and the Presumptive Phase II Measure

The presumptive action for Phase II of the HCP, should it be determined to be necessary after completion of the strategic AMP, involves the continuation of the Phase I measures including the use of the SAWS ASR with the addition of the WRIP Pipeline that is currently in the design stages and is scheduled for completion by 2020. The WRIP will link the existing facilities and new water supplies located at the ASR site in southern Bexar County with the southwestern and western portions of San Antonio.

Currently, the 60-inch pipeline from the ASR constrains the ability of the ASR Trade-Off element in the Phase I package to enhance springflow at the worst part of a repeat of a drought of record-like event (i.e., 1955 and 1956). The WRIP pipeline extension will add capacity to the ASR distribution system that will allow more water to be returned from the ASR in a given time period and expand the geographic distribution served by the ASR. Simply removing the existing capacity bottleneck may enable the SAWS ASR Trade Off element to provide the necessary additional springflow to meet the current minimum flow objectives (45 cfs minimum monthly average at Comal Springs and 52 cfs minimum monthly average at San Marcos Springs).
removing the bottleneck of the ASR, under the operating assumptions set out below, is unable to fully meet the modeled necessary additional springflow to meet the current minimum flow objectives, the balance will be obtained through alterations to the conservation measures outlined in Chapter 5 including an increase in Stage V withdrawal reductions, if necessary.

SAWS’ ability to expand the use of the ASR as a presumptive Phase II measures, if required, assumes that: (1) no additional water will need to be stored; (2) the total amount of water to be returned from the ASR over the term of the permit will not exceed 126,000 ac-ft and 46,300 ac-ft in the worst year; and (3) the maximum annual utilization of the WRIP will be no more than 40 percent of the capacity of the WRIP distribution system at any time.

HDR simulated the hydrograph of the flow protection elements in the Phase I Package with the addition of the WRIP Pipeline during a drought of record-like event. Using the current hydrological model, the current minimum flow objective cannot be met at the Comal Springs, with the above-stated assumptions, without additional Stage V cutbacks. Using the three assumptions set out above, to achieve the current minimum flow objective at Comal Springs, an additional 3 percent increase was required in the Stage V withdrawal reductions over that required in Phase I, i.e., the withdrawal cutback in Stage V would be 47 percent rather than 44 percent.

Using the three assumptions and an additional three percent Stage V cutback, the minimum monthly average springflow at Comal Springs is 47 cfs. The number of months in which the flows fall below 60 cfs (monthly average) decreases from 73 months under the No Action Baseline to 17 months. (See also Section 4.2.)

The minimum monthly average springflow at San Marcos Springs is 52 cfs. This simulated minimum springflow occurs for one month during 1956.

The required Stage V withdrawal reductions are based on the best available aquifer model existing at this time. Based on this model’s known limitations and the biological uncertainties that will be addressed during Phase I, the three percent increase in the Stage V cutback may prove unnecessary to meet the current minimum flow objectives.

These results are summarized in Tables 5-7 and 5-8 and Figures 5-6 and 5-7.
Table 5-7. Springflow occurrences below selected thresholds with Phase I and II Measures (1947-2000)

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<tr>
<th>Spring</th>
<th>Threshold (cfs)</th>
<th>Baseline (340K+)</th>
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Table 5-8. Springflow for selected conditions with Phase I and II Measures (1947-2000)

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Units: cfs
Figure 5-6. Simulated monthly average springflow at Comal Springs (1947-1960) with the specified Phase II Presumptive Measure.
Figure 5-7. Simulated monthly average springflow at San Marcos Springs (1947-1960) with the specified Phase II Presumptive Measure.
5.8.3 The Impacts of Incidental Take Are Minimized and Mitigated to the Maximum Extent Practicable

One of the ITP issuance criteria prescribed in 50 C.F.R. § 17.22(b)(2), 50 CFR § 17.32(b)(2) and Section 10(a)(2)(B) is that the impacts of the incidental take be minimized and mitigated to the maximum extent practicable. This finding typically requires consideration of two factors: adequacy of the minimization and mitigation program, and whether it is the maximum that can be practically implemented by the applicant. To the extent that the minimization and mitigation program can be demonstrated to provide substantial benefits to the species, less emphasis can be placed on the second factor. (USFWS 1996c).

5.8.3.1 The Minimization and Mitigation Measures Provide Substantial Benefits to the Covered Species

As detailed above, the Phase I package of springflow protection measures provides substantial benefit to the Covered Species. (See Section 5.8.1). Under No Action Baseline conditions, Comal Springs is simulated to cease to flow for 38 months during a repeat of drought of record conditions, and the springflows are predicted to be below 30 cfs (monthly average) for 54 months. At San Marcos Springs, in the simulation of a repeat of the drought of record, the minimum flow will be 2 cfs, and springflows will be below 52 cfs (monthly average) for 20 months.

By contrast, with the Phase I springflow protection measures, Comal Springs is predicted to have continuous springflow during a repeat of drought of record conditions. Indeed, springflow will only fall below 30 cfs\(^4\) for 2 months, with the simulated minimum monthly average flow during that time of 27 cfs. At San Marcos Springs, springflow will only fall below 52 cfs for two months, with the simulated minimum monthly average flow of 50 cfs. Hardy (2011) found that these springflows will not appreciably reduce the likelihood of survival of these species and recovery during a one-time repeat of drought of record conditions during Phase I so long as all recommended measures are implemented to restore and protect the habitat of the Covered Species. Currently available information indicates that the presumptive Phase II measures, if implemented, will provide the necessary additional springflow to meet the currently defined minimum flow objectives necessary to attain the biological goals. (See Section 5.8.2)

In addition to protecting springflow, the minimization and mitigation measures will markedly diminish the impacts of recreation during low flows. A major concern regarding Texas wild-rice is recreational activity in high-quality habitat areas of the San Marcos River. The creation of state scientific areas in the spring and river ecosystem will establish a mechanism to exclude recreation from these areas during low flows. Similar state scientific areas will be established in the Comal River to protect restored fountain darter habitat. These measures to address

\(^4\) Except where specifically expressed as a daily average flows, the springflows in this section are set out as monthly average springflows.
recreational impacts will be augmented by limiting access points for recreational activities, sediment removal, and educational programs.

The gill parasite is a significant stressor of the fountain darter in the Comal ecosystem the effects of which may be exacerbated by low flows. The City of New Braunfels will implement a gill parasite control program to minimize this impact.

The Applicants will also implement other minimization and mitigation measures to limit the impacts of low flows on the Covered Species and their habitat. These include, but are not limited to, removal of non-native plants and replacing them with native vegetation favored by the Covered Species, maintenance of dissolved oxygen through removal of decaying aquatic vegetation during low flows, and programs to limit the impacts of predation and competition.

The Applicants have committed to a wide-range of minimization and mitigation measures, developed using the best available, peer-reviewed science, to reduce and mitigate the impacts from these threats. In addition, the Applicants will also implement measures that will contribute to the recovery of the Covered Species including measures to protect water quality and to restore riparian zones. Further, the Applicants will develop a predictive ecological model and conduct applied research to evaluate potential adverse ecological effects from Covered Activities, fill important data gaps, and put forward alternative conservation approaches or mitigation strategies to better benefit the Covered Species.

5.8.3.2 The Minimization and Mitigation Measures Represent Compliance with the Maximum Extent Practicable Requirement

The Applicants estimate the costs for implementation of the Phase I package alone will average approximately $17.5 million over the duration of the permit and over $18.6 million over the first seven years of the permit. (See Table 7-1). The costs cannot be measured entirely by money. SAWS will, for example, be sacrificing capacity in its ASR. Smaller municipalities may have to obtain additional water supplies to be able to meet the Stage V Critical Period Management reductions. (See Section 5.1.4.2).

The costs of the minimization and mitigation measures will be borne primarily by the holders of municipal and industrial permits issued by the EAA to withdraw groundwater from the Aquifer through increased Aquifer Management Fees (AMF). Irrigators will not contribute to funding the costs despite being major users of the Aquifer. (See Section 5.1.2.1). Irrigators’ fees are capped by the EAA Act at $2/acre-foot of water pumped each year and these payments are already consumed in paying for the administrative costs of existing EAA operations. (See EAA Act § 1.29(e)). It is estimated that, as a result of the HCP, the AMFs for municipal and industrial pumpers, may increase from the current $39/acre-foot of permitted withdrawals to between $88 to $116/acre-foot of permitted withdrawals. These costs will create greater costs for water users which cannot be easily absorbed throughout the region at this time.

During the development of the HCP, the Applicants also considered numerous alternative minimization and mitigation measures (see Section 1.7) designed to ensure springflows during
extended periods of drought. A single strategy that would rely only on restricting pumping at a level that would assure springflows considered protective of the listed species would create serious adverse impacts to human health and safety. Other programs for establishing alternative water supply sources for use in recharge augmentation or displacement of pumping were evaluated. The preliminary cost estimates associated with these programs were considered to be impractical due to costs ranging into the many hundreds of millions of dollars and potential regulatory, technical, or political impediments to their implementation.

Based on the predicted effectiveness of the springflow protection measures and other conservation measures, the substantial financial commitment required of municipal and industrial pumpers, and the excessive cost of alternate approaches identified, the Applicants believe that minimization and mitigation measures in this HCP satisfy the “maximum extent practicable” requirement for issuance of the ITP.

5.9 EAA’s Authority to Implement Measures to Maintain Springflow Prior to the Complete Implementation of the Phase I Package

The Plan Area at the time of the preparation of this HCP is experiencing drought conditions. While the Applicants at this time are unable to identify the exact nature, extent, or severity of the drought conditions, the potential exists that on the effective date of the Permit (in the event the Service approves the ITP application), the Plan Area will be in drought conditions of sufficient magnitude that immediate actions are required prior to the time that the Applicants are able to fully implement the minimization and mitigation measures described in Chapter 5. If so, EAA has the authority to take appropriate actions to protect the Covered Species while the Applicants are taking steps to fully implement their respective minimization and minimization measures under Chapter 5.

The EAA is a conservation and reclamation district created pursuant to Article XVI, Section 59 of the Texas Constitution. As such, the EAA is a political subdivision which has those powers expressly granted by statute and those necessarily implied as incident to its express powers. The EAA Act grants express power to the Authority to take action to protect the Covered Species and their habitat outside of the context of the HCP. Section 1.14(h) of the EAA Act provides that the EAA “through a program, shall implement and enforce water management practices, procedures, and methods to ensure that, not later than December 31, 2012, the continuous minimum springflows of the Comal Springs and the San Marcos Springs are maintained to protect endangered and threatened species to the extent required by federal law and to achieve other purposes provided by Subsection (a) of this section ... .” The relevant parts of subsections (a)(6) and (7) of Section 1.14 provide that the EAA is to, among other things, protect aquatic and wildlife habitat, and listed threatened or endangered species. In support of this broad authority to protect species, Section 1.115(e) of the EAA Regulations provides that the Board of Directors of the EAA may adopt emergency rules “in anticipation of imminent harm to human health, safety, or welfare, or if compliance with [normal rulemaking] procedures . . . would prevent an effective response to emergency aquifer or springflow
conditions.” Emergency rules may be adopted after five days’ notice and are effective immediately on adoption for a period of 120 days and may be renewed once for not more than 60 days.

Thus, EAA has broad authority and an independent state-law based mandate to take actions necessary to protect the Covered Species in the event the Plan Area is in severe drought on the effective date of the Permit and in advance of the ability of the Applicants to fully implement their respective minimization and mitigation measures. The scope and nature of any such measures would depend on the extent and severity of the drought conditions and their potential impact on the Covered Species.
Chapter 9 Permit Administration

9.1 Governance

9.1.1 Implementing Agreement and Related Documents

The Applicants have submitted an executed Implementing Agreement at (IA) to the Service. The IA has been executed by the EAA, the City of New Braunfels, the City of San Marcos, the City of San Antonio acting by and through its San Antonio Water System Board of Trustees, Texas State University – San Marcos, and the Texas Parks and Wildlife Department (TPWD). The EAA, the Cities and the University will be signing as permittees under the Section 10(a) permit. The TPWD will be signing to reflect certain limited obligations it has and will undertake to issue regulations creating state scientific areas in the Comal and San Marcos rivers. The IA will also reflect the signatures of the Texas Commission on Environmental Quality, the Texas Department of Agriculture, and the Texas Water Development Board for the sole purpose of discharging certain obligations imposed by the Texas Legislature when it instituted the EARIP.

The IA has been approved in substance by FWS. It is anticipated that FWS will execute the IA if it approves the issuance of the Incidental Take Permit.

The IA is an agreement that, among other things, “defines the obligations, benefits, rights, authorities, liabilities, and privileges of all signatories” to the HCP. FWS, “Habitat Conservation Planning and Incidental Take Permit Process Handbook” (FWS Handbook), Nov. 1996 at 3-37. The decision to develop an IA is within the sole discretion of the FWS’s Regional Director. Id.

Because of the multiple parties involved and the complexity of the HCP, it was anticipated that an IA would be necessary for the HCP. Accordingly, the Applicants developed a draft IA for their HCP and submitted it to FWS along with their permit application. In July 2011, the Regional Director for Region 2 determined that an IA was not required or necessary. Letter from Adam Zerrenner, Field Supervisor in the Service’s Austin Field Service, to Robert Gulley, EARIP Program Manager. The Service, however, said that if the Applicants wanted such an agreement, it would be willing to enter into an agreement that tracked closely with the template document set out in Appendix 4 of the FWS Handbook. Id. at 2.

The parties have also prepared an intergovernmental Funding and Management Agreement (FMA). This agreement will be executed only by the five permittees under the Section 10(a)(1)(B) permit. The purpose of the FMA is to establish in greater detail the procedures and mutual commitments among the permittees for funding and management of the HCP and adaptive management process. Key components include:

a. A description of the Program Management Responsibilities (Article Two)

b. A further commitment by each permittee to discharge its duties and responsibilities to implement the HCP (Article Three);
c. A process by which the Implementing Committee will develop and amend as necessary a comprehensive work plan and budget to identify the conservation measures, adaptive management activities, and associated costs necessary to implement the HCP (Article Four);

d. A commitment by the EAA to fund the conservation measures and adaptive management activities with special aquifer management fees paid to the EAA by industrial and municipal pumpers from the Edwards Aquifer (Article Five);

e. A commitment by the EAA to create and maintain appropriate restricted HCP funds (Article Five);

f. A process by which the EAA will provide funding to implement conservation measures (Article Six); and

g. General rights and remedies of the Parties, including additional mutual remedies in the event of non-performance by any party (Article Eight).

Article Seven of the FMA sets out the details of the AMP. Specifically, Article Seven provides the procedural steps and responsibilities of the permittees, the USFWS, and other EARIP stakeholders for making AMP decisions and the actions that will be taken as a result of the decisions. Key components include:

a. A description of the phases of adaptive management;
b. A monitoring program to include both compliance, effects and effectiveness;
c. Procedures to address adaptive management decisions of a routine, non-routine, and strategic nature;
d. Creation of an Implementing Committee comprised of one representative from each permittee as voting members and certain other non-voting members;
e. Creation of a voluntary Stakeholder Committee comprised of one representative from each of a diverse array of regional interest groups;
f. Creation of a Science Committee to consult with, advise and make recommendations to the Program Manager, Implementing Committee and Stakeholder Committee upon request on any adaptive management decision;
g. Procedures for the supplementation of the existing scientific record for the Covered Species and their habitat;
h. Procedures for identification of necessary research and modeling to be overseen by the Implementing Committee;
i. Creation of an independent Science Review Panel to provide scientific advice on issues related to the AMP; and
j. Procedures for action on the Scientific Record, including involvement of the Science Committee and independent Science Review Panel.

Article Seven is intended to provide the specifics of the process and procedures that support the substantive elements of the AMP set out in Chapter 6 of this HCP.

The FMA is attached hereto and incorporated in this HCP by reference herein. The USFWS is not a signatory to this Agreement. Because it is part of the HCP and will be relied on by USFWS in deciding whether the HCP meets the issuance criteria, the Applicants agree that
they will not amend the FMA in a manner that will cause the FMA to diverge from or create an inconsistency with the Permit, the IA, or this HCP except through the process for HCP amendments described below.

9.2 Permit Amendments

9.2.1 Clarifications and Minor Administrative Amendments

From time to time it may be necessary for the USFWS and the Applicants to clarify provisions of the HCP, the IA, or the ITP to deal with issues that arise with respect to the administration of the process or the precise meaning and intent of the language contained within those documents. Clarifications do not change the substantive provisions of any of the documents in any way but merely clarify and make more precise the provisions as they exist.

In addition, it is contemplated that, from time to time, it may be necessary to make Minor Administrative Amendments to the documents that do not make substantive changes to any of the provisions of the documents, but which may be necessary or convenient, over time, to more fully represent the overall intent of the Applicants and the USFWS. Clarifications and Minor Administrative Amendments to the documents may be approved by the local Field Supervisor, but in some instances may require Regional Office approval. Clarifications and Minor Administrative Amendments to the documents shall be memorialized by letter agreement or by substituted Plan Documents which are modified to contain only the Clarification or Minor Administrative Amendment. It is proposed that any request for Clarification or any proposed Minor Administrative Amendment will be processed and a response provided within 30 days after receipt by the USFWS or the Applicants, as the case may be.

The HCP may be amended without amending the ITP when the amendments are of a minor or technical nature such that the net effect on Covered Species involved and the levels of take resulting from the amendment are not meaningfully different from those described in the original HCP and the Service’s decision documents. Examples of minor amendments to the HCP that would not require an ITP amendment include, but are not limited to, (a) minor revisions to monitoring or reporting procedures and (b) minor revisions in accounting procedures.

To amend the HCP without amending the ITP, the Applicants must submit to the USFWS, in writing, a description of: (a) the proposed amendment; (b) an explanation of why the amendment is necessary or desirable; and (c) an explanation of why the Applicants believe the effects of the proposal are not different from those described in the original HCP. The Program Manager will publish the proposed amendment on the Program website and allow opportunity for public comment. If the USFWS concurs with the proposed amendment, then it shall authorize the HCP amendment in writing, and the amendment shall be considered effective upon the date of the written authorization from the USFWS.
9.2.2 Substantive Amendments

Except as provided for in Clarifications and Minor Administrative Amendments, neither the HCP, ITP, nor IA may be amended or modified in any way without the written approval of the Applicants and the USFWS. Any amendment involving the activities of the TPWD must be approved in writing by the TPWD. All proposed Substantive Amendments shall be reviewed by the Applicants. Substantive changes shall be processed as an amendment to the permit in accordance with the provisions of the ESA and regulations at 50 CFR Parts 13 and 17 and shall be subject to appropriate environmental review under the provisions of NEPA.

Substantive Amendments to the ITP would be required for major changes such as changes in location, activity, amount or type of take, or species covered by the permit. Examples of major changes include: (a) the listing under the ESA of a new species not currently addressed in the HCP that may be taken by Covered Activities; (b) the modification of any Covered Activity or minimization and mitigation measure under the HCP, including funding, that may affect take, the effects of the Covered Activities, or the nature or scope of the minimization and mitigation measures in a manner or to an extent not previously considered in issuing the ITP; and (c) any other modification of the Covered Activities that causes an effect to the Covered Species or critical habitat not considered in the original ITP.

A Substantive Amendment of the ITP must be treated in the same manner as an original permit application. Permit applications typically require a revised conservation plan, a permit application form, an implementing agreement, a NEPA document, and a 30-day public comment period. However, the specific documentation needed in support of a permit amendment may vary depending upon the nature of the amendment.

9.3 Annual Reporting

An annual report of Covered Activities as well as management activities undertaken under the terms of this HCP will be prepared by the Applicants and submitted to the USFWS’s Austin Field Office no later than the end of the first quarter after the preceding calendar year has been completed. The report will summarize information on the monitoring and management of the HCP including:

9.3.1 Monitoring Report

- EAA Permitted withdrawals
- Reference well levels
- Springflows at Comal and San Marcos Springs
- Aquifer recharge
- Aquifer discharge from wells and springflow
• Critical period management reductions
• Water quality data
• Location of sampling sites
• Methods for data collection and variables measured
• Frequency, timing, and duration of sampling for the variables
• Description of the data analysis and who conducted the analysis

9.3.2 **HCP Management**
• Adaptive management activities undertaken during the year
• Expenditures by the EAA on implementation activities
• Proposed activities for the next year
• Report on the status of implementation of minimization and mitigation measures and their effectiveness
• Interim updates and final copies of any research, thesis or dissertation, or published studies accomplished in association with the EARIP or HCP
• Description of species-specific research and management actions undertaken with specific reference to the biological goals and objectives identified for each species.
• Any changes to the Biological Goals and Key Management and Flow-related Objectives of the HCP
• Any changes to the objectives for the monitoring program
• Effects on the Covered Species or Permit Area
• Evaluation of progress toward achieving the Biological Goals and Objectives.
• Any recommendations regarding actions to be taken.

9.4 **Subsequent Listing of Covered Species**
The Applicants have elected to address unlisted species in the HCP and to have them included on the ITP. Therefore, if the species is subsequently listed, the Applicants would be in compliance with the Permit with respect to that species and the incidental take of the species would be authorized.
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