Springflow Habitat Protection Work Group

June 18, 2020
9:00-11:00am

Agenda Overview

- Confirm attendance
- Meeting logistics
- Public comment
- Approve meeting minutes
- Presentation and discussion
  - Regulatory framework for the San Marcos River State Scientific Area
  - Implementation of the San Marcos River State Scientific Area
  - Authorized pumping versus withdrawals
  - Other EAHCP AMP commitments
- Public comment
- Future meetings

Confirm attendance

Meeting logistics

- Virtual meeting logistics
  - Mute
  - Raise Hand
  - Chat / Asking questions
  - Meeting recording

- Meeting points of contact
  - Meeting access
    - Victor Hutchison (vhutchison@..)
  - Technical questions
    - Victor Hutchison (vhutchison@..)
    - Martin Hernandez (mhernandez@..)
  - Participant monitor
    - Kristy Kollaus (kkollaus@...)
  - Chat and Q&A monitors
    - Kristina Tolman (ktolman@...)
    - Damon Childs (dchilds@...)

TEXAS

PARKS &

WILDLIFE

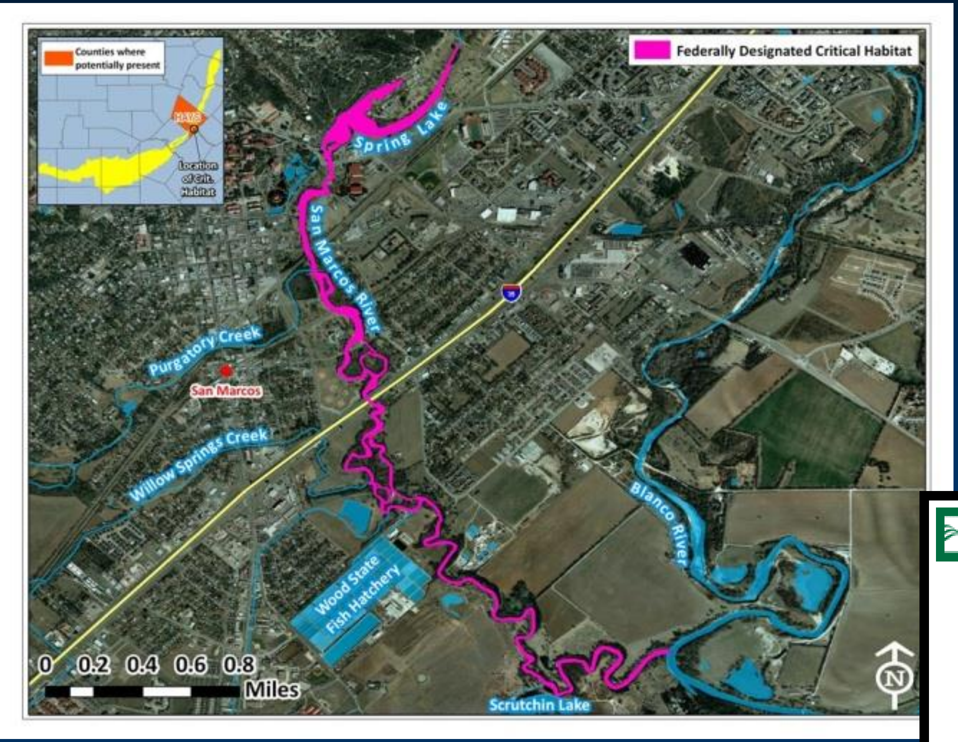
EAHCP SHP Workgroup Meeting 5

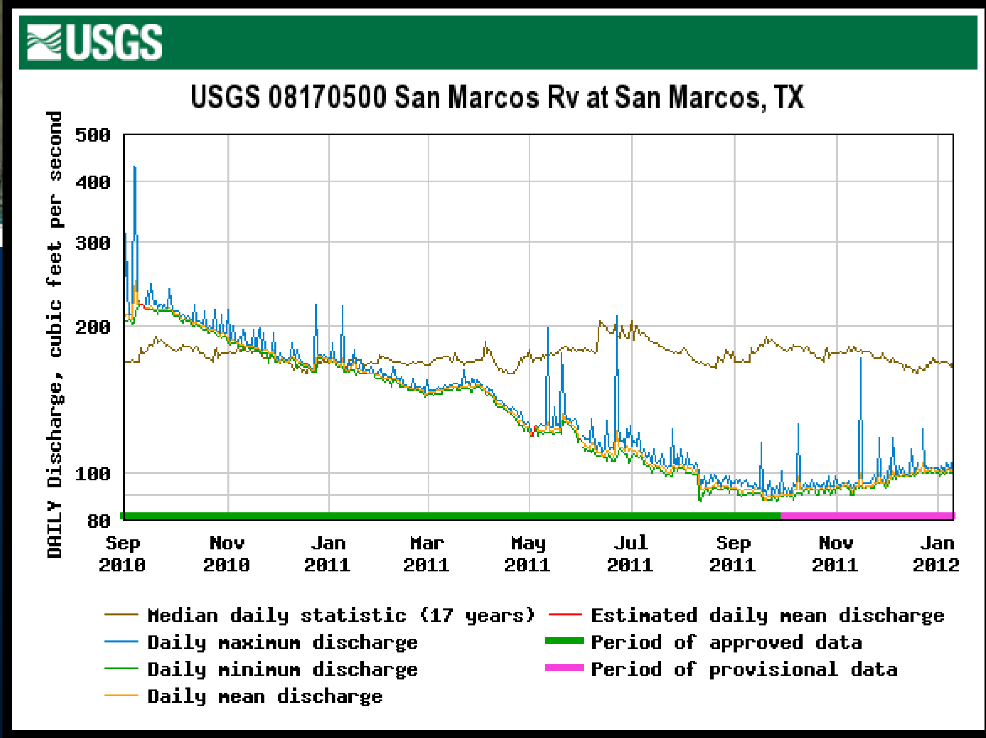
Regulatory framework for the San Marcos River State Scientific Area

Cindy Loeffler, Water Resources Branch

Texas Parks and Wildllife Department

San Marcos River



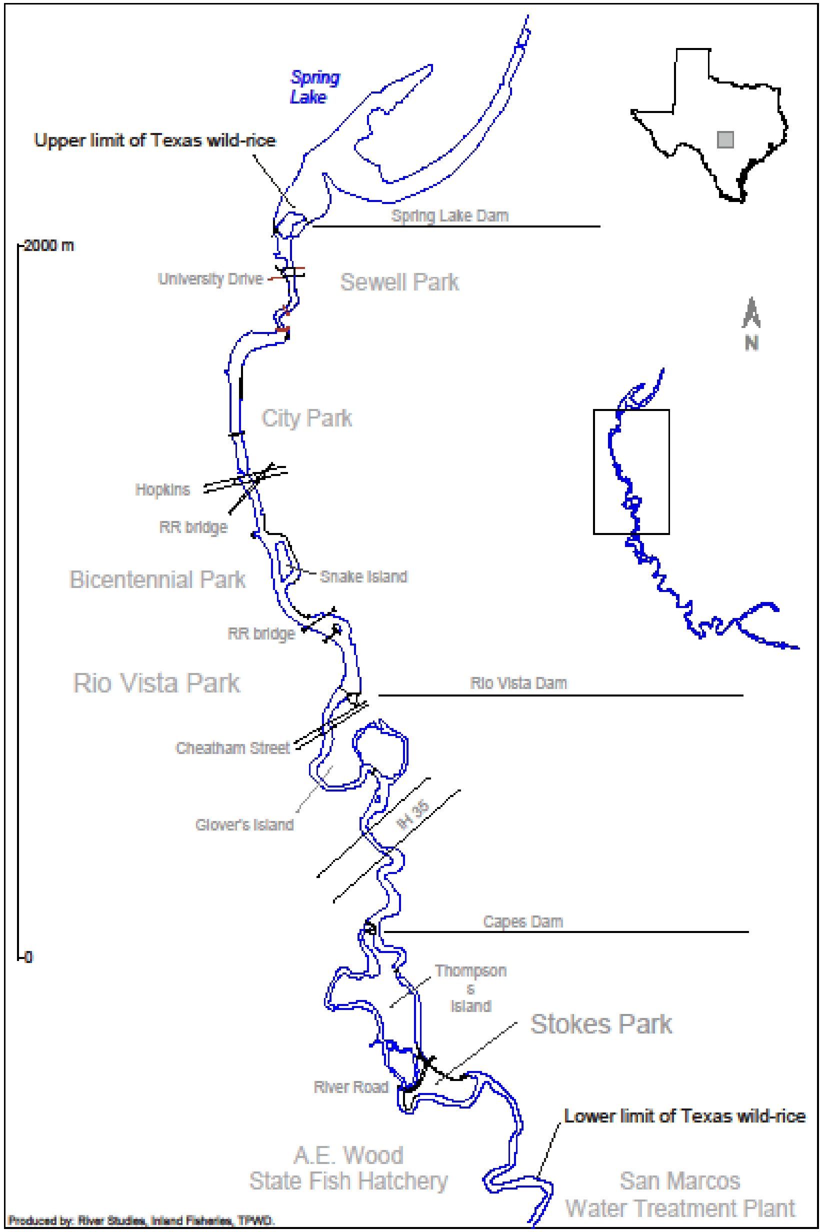


Management of Public Recreational Use of San Marcos Spring and River Ecosystem

- Species protection must allow for recreation.
- Community partners include San Marcos and Texas State University.
- San Marcos City Council adopted a resolution approving “recreation mitigation measures”.
- Texas State President’s Cabinet has also approved “Bottom Up” Package.

Some areas are better suited to recreational use….

….than others.



San Marcos River Scientific Area Designation Rule

- Public Waters - Spring Lake Dam to San Marcos Waste Water Treatment Plant
- Prohibit uprooting Texas wild-rice
- TPWD worked with local stakeholders to develop and implement a Public Awareness Campaign
- TPWD worked with Texas State University and City of San Marcos to redirect recreational access away from most sensitive areas
- In cooperation with University and City, employ physical barriers to protect most sensitive areas during periods of springflow below 120 cfs
- At no time will river access be completely blocked

Proposed Rule Schedule

TPW Commission Briefing	August 24, 2011
Public scoping	December 2011
Permission to publish rule	January 2012
Public scoping	February 2012
TPW Rule Adoption	March 2012

Summary of Public Comments received During initial public scoping

December 2, 2011 San Marcos Lions Club

December 6, 2011 Texas State University Campus

32 participants - Comments generally favorable except for one individual who thought Texas wild-rice did not warrant protection.

December 13, 2011 City of San Marcos, Grant Harris Building

11 participants - Comments generally favorable.

Nine comments have been received via email to date

Seven comments supported the designation of a State Scientific Area, one opposed “closing” the San Marcos River and one opposed anything associated with the EPA

Texas Parks and Wildlife Commission adopted new rule §57.910 proposed under these sections of the Parks and Wildlife Code:

§81.501, which authorizes the commission to create state scientific areas for the purposes of education, scientific research, and preservation of flora and fauna of scientific or educational value;

§13.101, which authorizes the commission to promulgate regulations, governing the health, safety, and protection of persons and property in state scientific areas, including regulations governing the conservation of natural features and destructive conduct; and

§88.006, which authorizes the department to adopt regulations governing the provisions of Chapter 88, which governs endangered plants.

San Marcos River State Scientific Area Rule

Parks and Wildlife Code, Chapter 13, Subchapter B; Chapter 81, Subchapter F; and Chapter 88.

§57.910. San Marcos River State Scientific Area.

(a) Purpose. The San Marcos River State Scientific Area is established for the purpose of education, scientific research, and preservation of flora and fauna of scientific or educational value, specifically, the preservation of Texas wild-rice (Zizania texana).

(b) Boundaries. The San Marcos State Scientific Area consists of the public waters of the San Marcos River from midstream to the boundary of public waters in the area within the following boundaries:

(1) 29 53 26.04 Lat N, 97 55 55.29 Long W (northeast boundary near Spring Lake Dam);

(2) 29 53 22.71 Lat N, 97 56 19.01 Long W (southeast boundary near the San Marcos Water Treatment Plant);

(3) 29 51 52.63 Lat N, 97 55 56.07 Long W (southwest boundary near the San Marcos Water Treatment Plant); and

(4) 29 51 53.92 Lat N, 97 55 31.94 Long W (northwest boundary near Spring Lake Dam).

San Marcos River State Scientific Area Rule

§57.910. San Marcos River State Scientific Area (continued)

(c) Restricted Areas. When the streamflow of the San Marcos River is measured at 120 cubic feet per second at the San Marcos River gauging station (United States Geological Survey gage 081705000 San Marcos River at San Marcos), the department may restrict areas by means of clearly marked booms, buoys, and/or signage to reflect the fact that the area is restricted to unauthorized entry.

(d) Prohibited Acts. It is an offense for any person to:

(1) move, remove, deface, alter, or destroy any sign, buoy, boom, or other such marking delineating the boundaries of the San Marcos River State Scientific Area or a restricted area within the area;

(2) uproot Texas wild-rice within the San Marcos State Scientific Area;

(3) enter an area that is marked by signage, booms, buoys, or other apparatus clearly identifying the area as a restricted area, except as may be permitted by the department or the U.S. Fish and Wildlife Service.

(e) Penalties. The penalty for violation of this section is prescribed by Parks and Wildlife Code, §13.112. (Class C Parks and Wildlife Code misdemeanor.)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Comal River State Scientific Area Rule

Original HCP Language:

To minimize the impacts of recreational activities on Texas wild-rice and other Covered Species habitat, Texas Parks and Wildlife Department (TPWD) in support of the HCP created a State Scientific Area in the San Marcos Springs ecosystem effective May 1, 2012. This Scientific Area is designed to protect Texas wild-rice by limiting recreation in these areas during low flow conditions. (See Section 5.6.1). TPWD also will pursue the creation of state scientific areas in the Comal Springs ecosystem for the protection of existing fountain darter habitat and additional habitat created by the City of New Braunfels. (See Section 5.2.2.2). TPWD seeks incidental take coverage for the implementation of the regulations creating these state scientific areas.

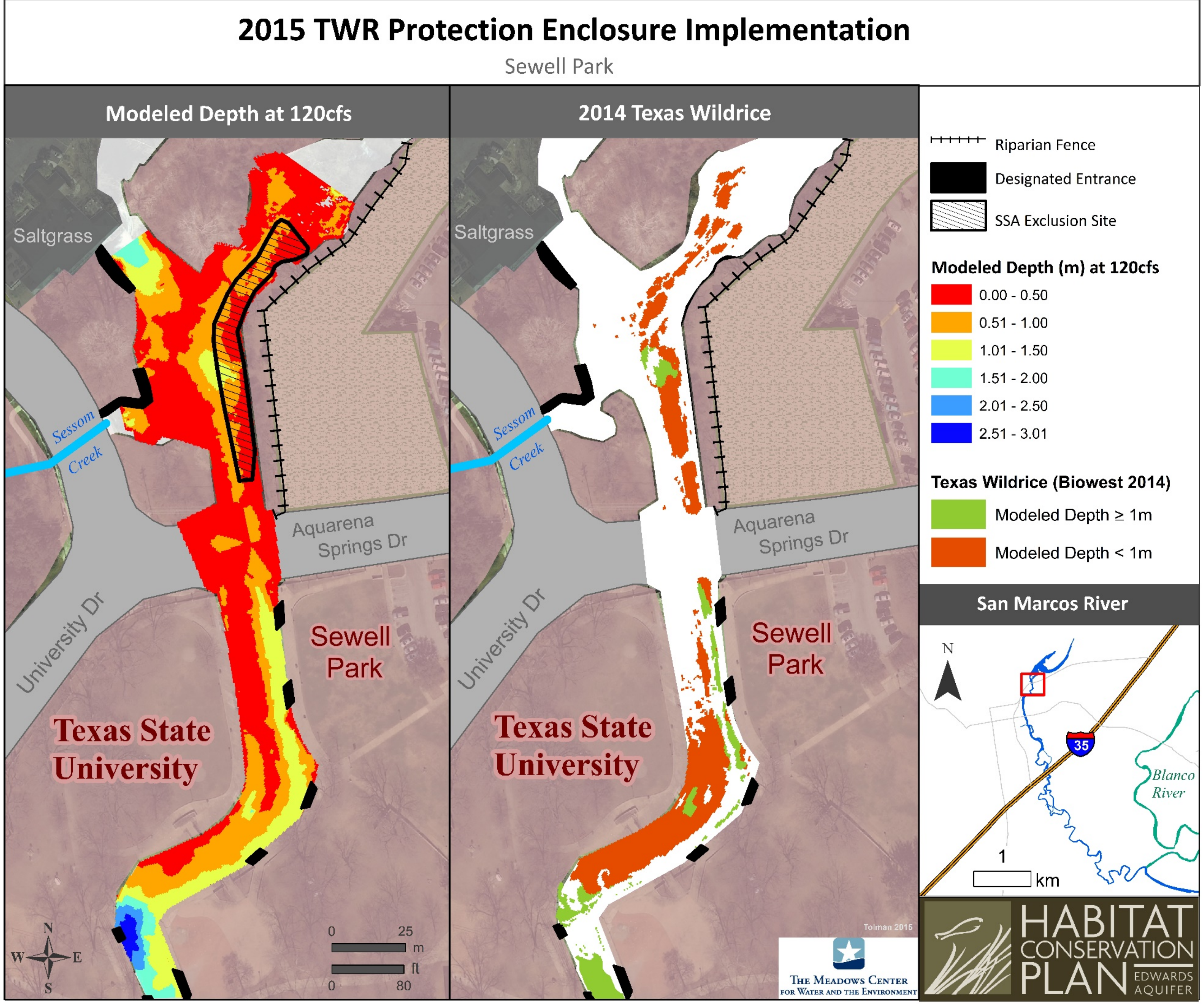
Phase II Work Plan Language:

In order to protect existing and restored fountain darter habitat, TPWD may pursue the creation of a State Scientific Area in the Comal Springs system. An Interlocal Agreement between the City of New Braunfels and TPWD will be pursued, if necessary, for local in-water enforcement of the protected zones.

Implementation of the San Marcos River State Scientific Area

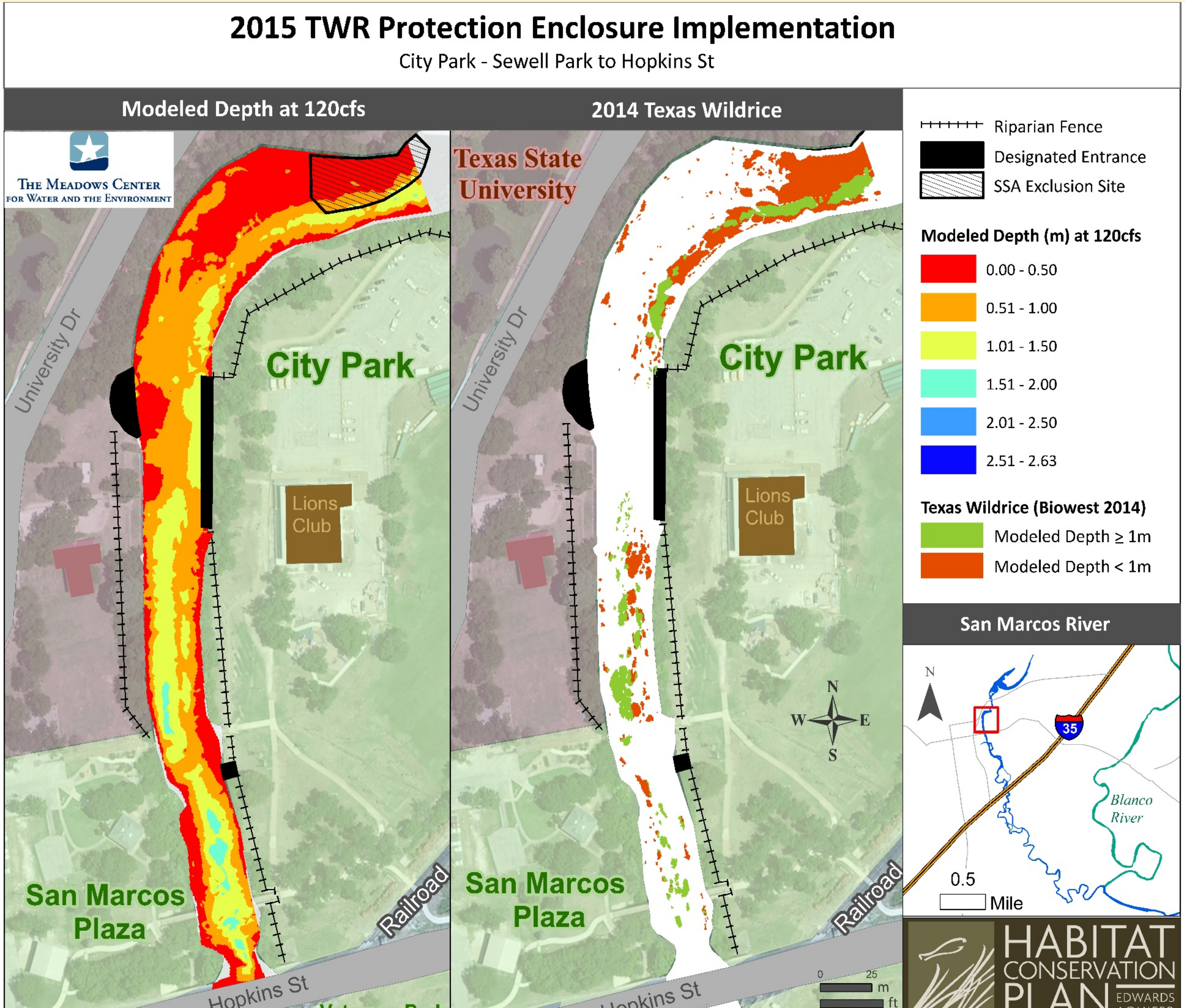
Melani Howard

City of San Marcos

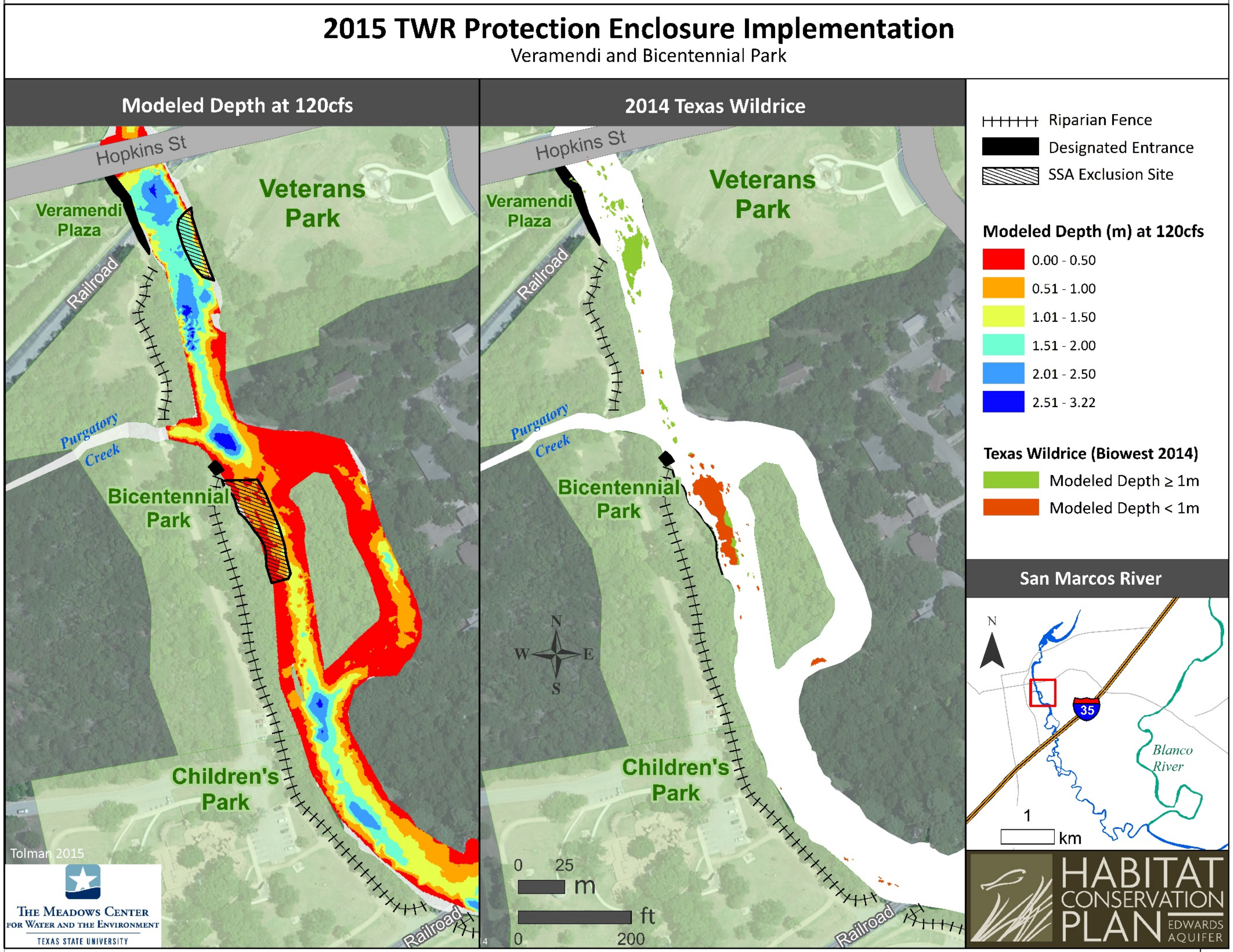


Exclusion zone locations were primarily based on three criteria:

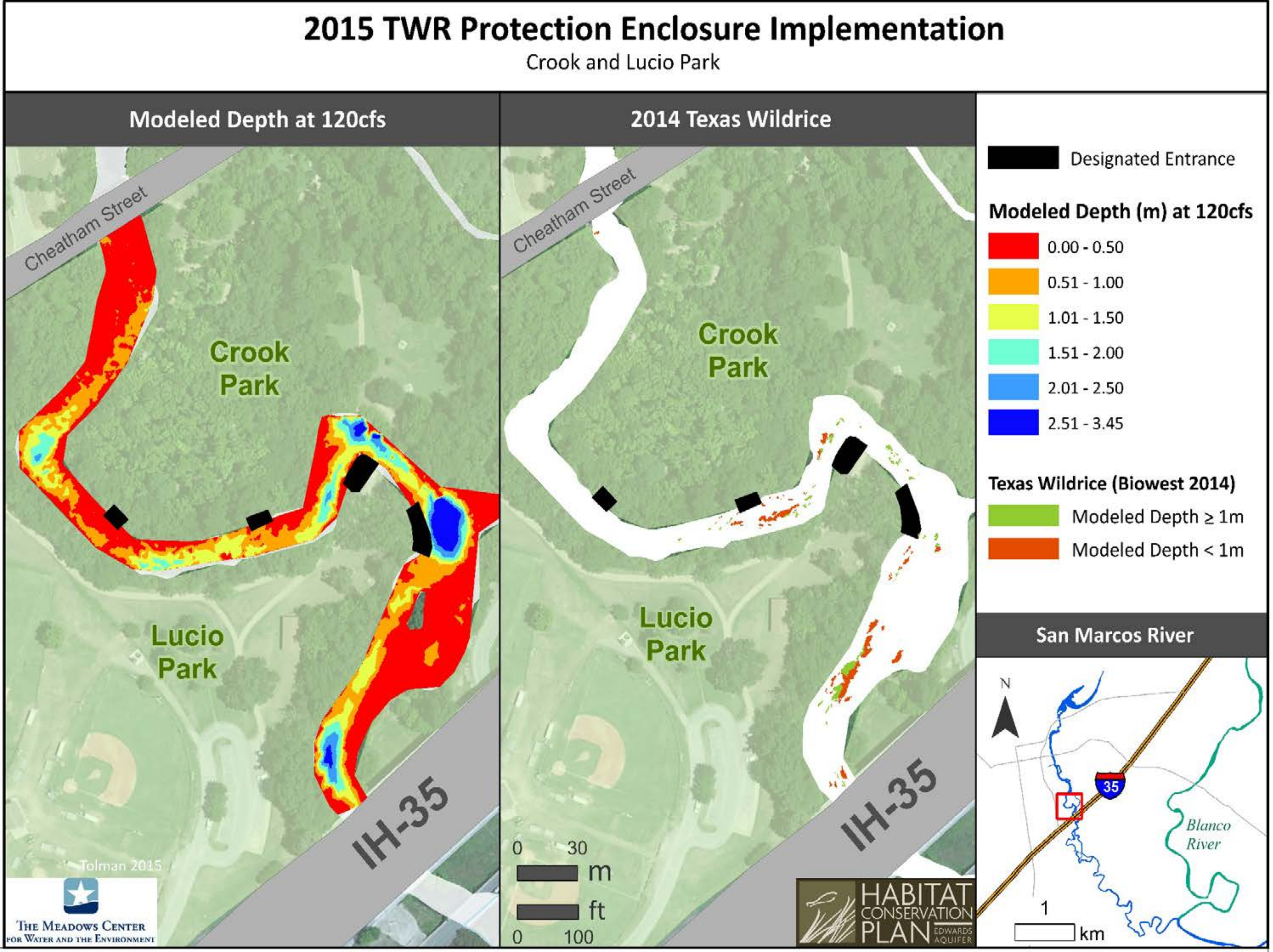
- Stands less than one meter depth at 120 cfs
- Persistent stands
  (based on Jackie Poole surveys)
- Proximity to recreation



Small persistent stands are scattered throughout above City Park above access points

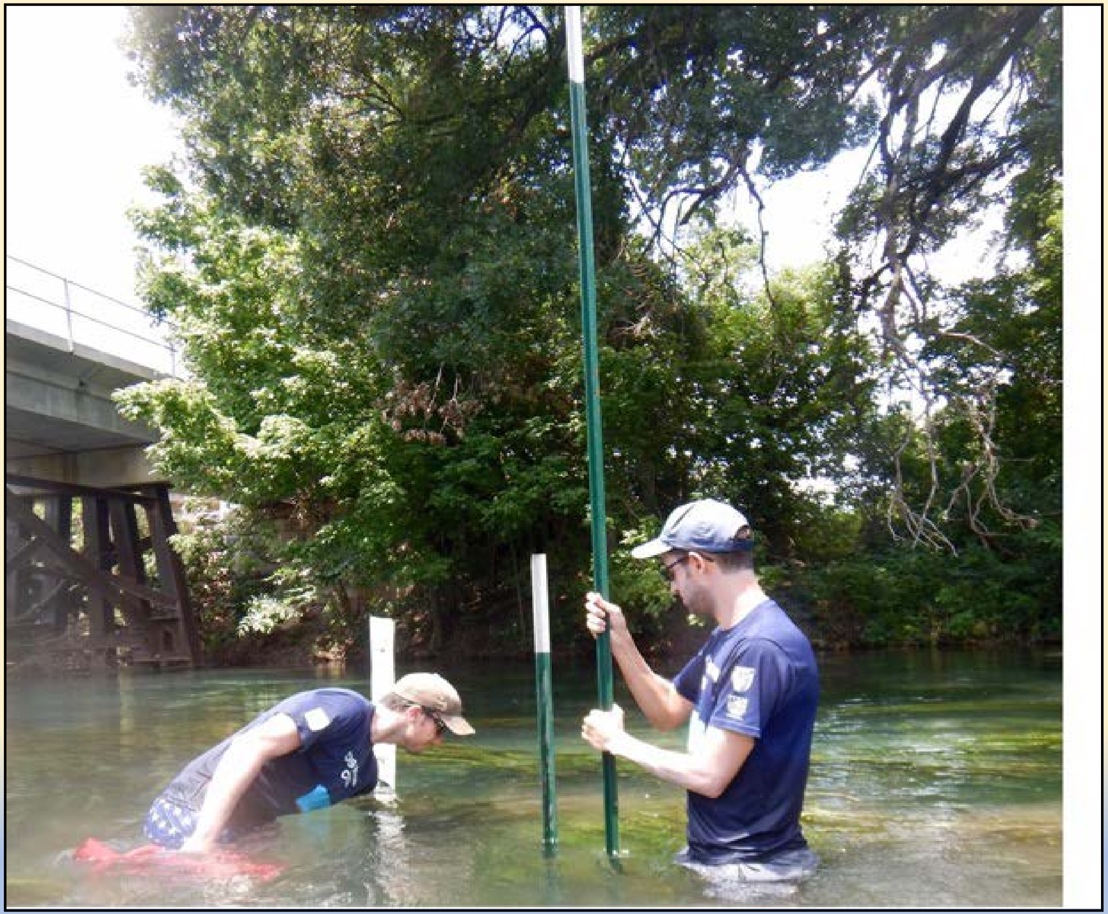


- Captured both persistent stands
- Riparian fence saved the stand below Purgatory Creek



One persistent stand above IH-35

Installation of Exclosures



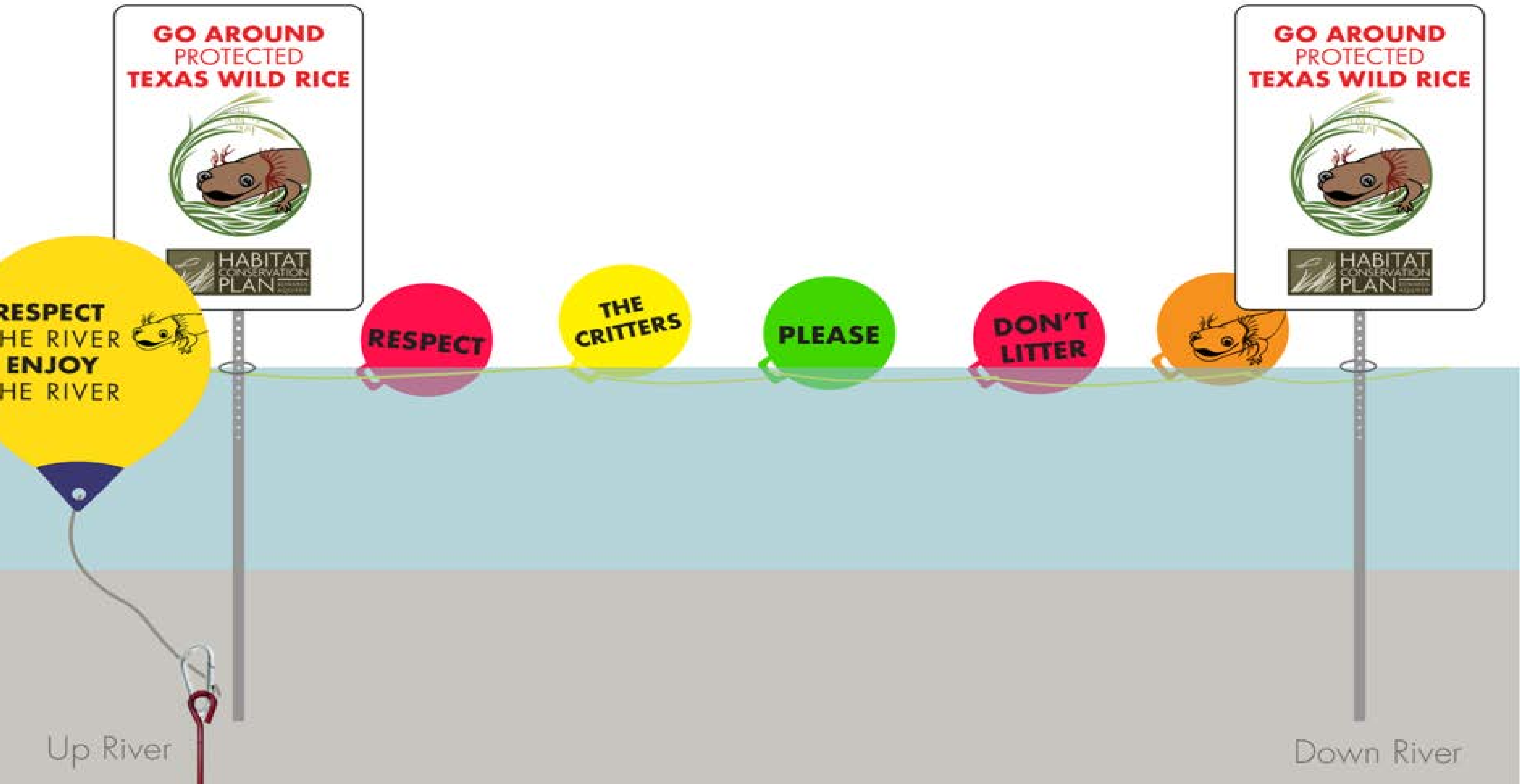

TEXAS WILD-RICE
PROTECTED BY LAW
SAN MARCOS RIVER
STATE
SCIENTIFIC AREA


DO NOT
ENTER
FENCED AREA


TEXAS WILD-RIC
PROTECTED BY LA
SAN MARCOS RIVER
STATE
SCIENTIFIC AREA

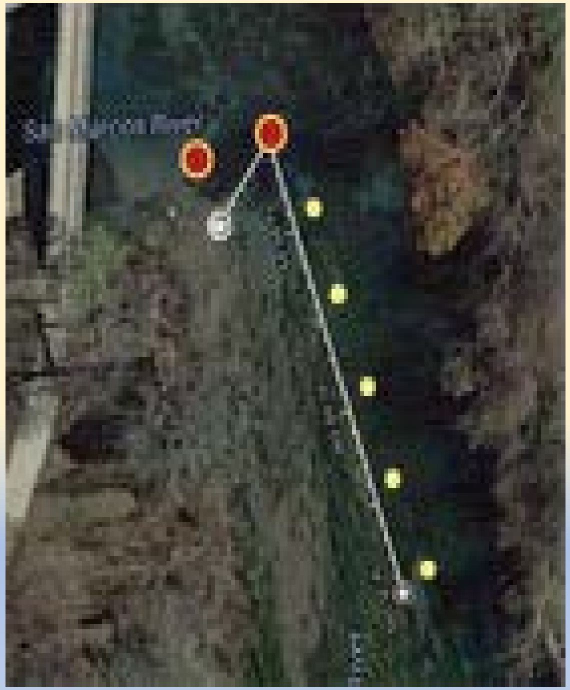

perception


CHARLOTTE PIPE



GO AROUND
PROTECTED
TEXAS WILD RICE
HABITAT
CONSERVATION
PLAN
RESPECT
HE RIVER
ENJOY
HE RIVER
RESPECT
THE
CRITTERS
PLEASE
DON'T
LITTER
GO AROUND
PROTECTED
TEXAS WILD RICE
HABITAT
CONSERVATION
PLAN
Up River
Down River


BE KIND
TO THE CRITTERS
PLEASE
DON'T LITTER



SUCCESS!

GIS Series (KT) – give an overview of existing features

Challenges

- T-post installation and removal
- Public safety (tube popping)
- Tuber hangout spot
- Park rangers/UPD do not enforce exclosure violation
- Large rain events
- Exclosure installation adds to the annual incidental take
- T-posts collect veg daily

Successes

- They work!
- Education opportunity
- Fences enhance stand protection
- Seeding TWR is the pathway to genetic diversity & appears to be the catalyst for expansion

Questions

1. Is an update needed for the 2009 Hardy bathymetry data?

2. What about targeting other aquatic plants and San Marcos salamander habitat?

3. Expand on BioWest observation of increased siltation in eastern spillway due to TWR expansion?

4. How much can exclusion zones be expanded without exceeding net disturbance?

5. What measures should be put in place to minimize recreational impacts as flows drop – will exclusion zones be enough?

2019 Withdrawal Summary

EDWARDS AQUIFER
AUTHORITY

Chuck Ahrens

Director, Water Resources

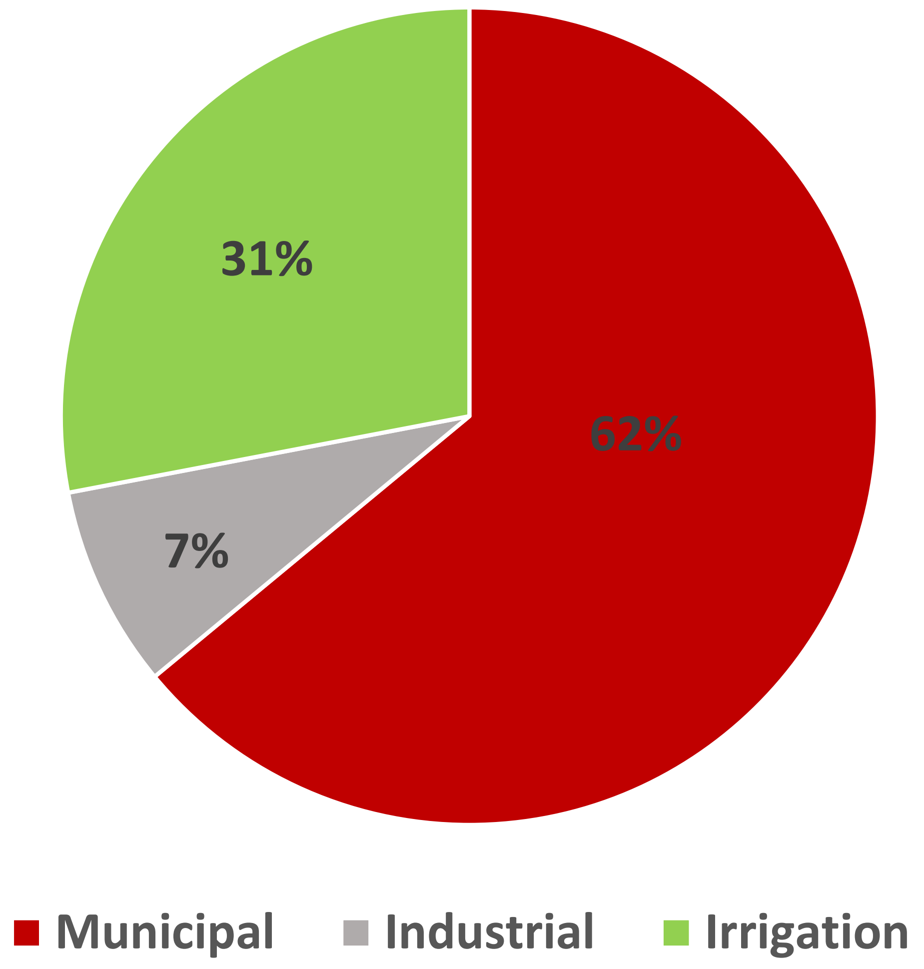
June 18, 2020

2019 Permitted Users

1,246 permit holders authorized 571,599 acre-feet

- 166 Municipal
- 282 Industrial
- 798 Irrigation

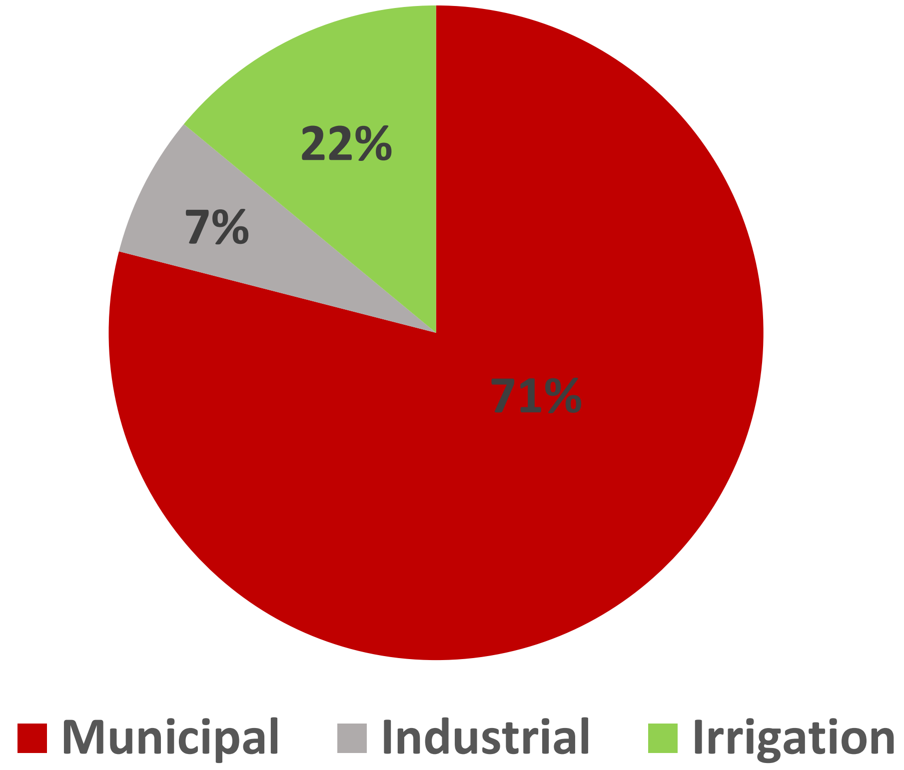
2019 Regional Authorizations by Purpose of Use



- **571,599 acre-feet: Municipal 356,010 acre-feet; Industrial 41,294 acre-feet; Irrigation 174,295 acre-ft.**

2019 Regional Permitted Withdrawals by Purpose of Use

Total Pumped = 339,020 acre-ft.
Total volume of unused water = 232,579 acre-ft.



Municipal = 241,489 acre-ft.; Industrial = 23,803 acre-ft.; Irrigation = 73,728 acre-ft.

Historical Data

Year	CPM	All Permits			
	SA / UV	Permitted	After CPM	Pumped	Un-Pumped
2008	1.64% / 0%	571,600	564,097	408,178	155,919
2009	11.8% / 0%	571,600	514,803	377,255	137,548
2010	0% / 0%	571,600	571,600	354,081	217,519
2011	19.2% / 2.60%	571,600	476,852	408,628	68,224
2012	22.4% / 17.40%	571,600	448,136	370,993	77,143
2013	28.9% / 41.80%	571,600	394,826	336,634	58,192
2014	35.0% / 44.0%	571,600	363,535	312,949	50,586
2015	19.7% / 20.4%	571,600	424,543 (Includes VISPO reduction)	305,507	119,036
2016	0% / 0%	571,600	571,600	305,994	265,605
2017	3.2% / 0%	571,600	555,472	359,852	195,620
2018	8.7% / 0%	571,600	528,470	351,140	177,330
2019	0% / 0%	571,600	571,600	339,020	232,580

Questions?

HABITAT CONSERVATION PLAN
EDWARDS AQUIFER

Other EAHCP AMP commitments

Table with EAHCP excerpts describing AMP study commitments and list of relevant studies undertaken in response to commitments

Issue 4:

The Implementing Committee should ensure … a rigorous review process … to assess the <u>extent to which adaptive management study commitments included in the EAHCP that are related to flow impacts have been met, will be met, or should be adjusted</u>

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"This objective assumes that a 10 percent deviation in average conditions would be acceptable; however, more extensive work to evaluate and assess water quality tolerances of the fountain darter will be addressed as part of the AMP." EAHCP: Page 4-5, repeated at page 4-27	Low-flow food source threshold study (BIO-WEST 2013) - Effects of low flow on fountain darter reproductive effort (BIO-WEST 2014) - Effects of predation on fountain darters (Texas State University and BIO-WEST 2014) - Fountain darter movement under low flow conditions in the Comal Springs/River ecosystem (BIO-WEST 2014b) - Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.
"This objective assumes that a 10 percent deviation would be acceptable. More extensive work to evaluate and assess water quality tolerances of the Comal Springs riffle beetle will be addressed as part of the AMP." EAHCP: Page 4-12	- Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) - Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b)

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
Comal Springs Dryopid Beetle and Peck's Cave Amphipod: "This goal assumes that a 10 percent deviation would be acceptable; however, more extensive work to evaluate and assess water quality tolerances of these species will be addressed as part of the AMP." EAHCP: Page 4-15	None.
Comal Springs Dryopid Beetle and Peck's Cave Amphipod: "As such, semiannual drift net sampling for both species will be continued in the context of the AMP during Phase I, and this additional data will be evaluated with the intent of establishing population metrics for these species for Phase II of the HCP." EAHCP: Page 4-15	Semiannual drift net sampling has continued during Phase I for these species. No 'population metrics' have been established.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"At this time, it is uncertain whether 196 cfs as a long-term average would be supportive of the conditions necessary to rejuvenate the system to the degree that would be necessary to prepare the system for repeated low-flow periods or extended low-flow periods. This rejuvenation of habitat is important not only to the fountain darter, but to all Covered Species at Comal Springs. This question will be examined in the AMP." EAHCP: Page 4-56	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.
During Phase I, applied research on the effects of low flows on the species and their habitat will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I package will be improved. Until the Phase I AMP decision-making process is complete, it will not be known what durations might be acceptable or the amount of additional flows that might be needed. EAHCP: Page 4-56	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"In addition, the projected extended periods of consecutive days below 150 cfs, 120 cfs, and 80 cfs for the HCP will require additional evaluation during the Phase I AMP. … . With the Phase I and Phase II flow-related measures in the HCP, the consecutive period below 150 cfs is projected to be approximately 2,760 days (or over 7.5 years). … During Phase I, applied research on the effects of low flows on the species and their habitat will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I package will be improved. Until the Phase I AMP decision-making process is complete, it will not be known what durations might be acceptable or the amount of additional flows that might be needed." EAHCP: Page 4-56	- Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) - Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) - Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b) -Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"A concern noted in Hardy (2011) is that at 30 cfs total Comal springflow, there is the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel. This could affect water quality in the Old Channel and the success of the proposed ERPA, and, thus, this flow pattern is proposed for study during Phase I." EAHCP: P. 4-74	Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits
Comal Springs Dryopid Beetle and Peck's Cave Amphipod "A concern identified, during these low-flow periods which will require further research includes the impacts to the energy flow regime in the Aquifer and near the springs." EAHCP Page 4-108	None.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"Three main concerns noted in Hardy (2011) regarding this flow regime were 1) the potential for aquatic vegetation die-off and subsequent dissolved oxygen (DO) problems in Landa Lake, 2) the reduction in larval production of fountain darters that would likely be experienced, and 3) the potential for cool water inflows from springs along the western margin of Landa Lake flowing down the New Channel instead of entering the Old Channel …. Regarding the first concern, the aquatic vegetation question remains unanswered and assessing aquatic vegetation dynamics relative to springflow is a critical applied research component in the AMP. … The third concern is directly related to uncertainty associated with the temperature modeling and will require additional hydrodynamic modeling with follow-up water temperature modeling in addition to intensified spatial monitoring during low-flow events, which are proposed HCP research components." EACHP: Page 4-88	-Low-flow threshold evaluation of native aquatic vegetation – Pond experiment (BIO-WEST 2013) -Laboratory versus field comparison of flow for aquatic vegetation in the Comal ecosystem (BIO-WEST 2013) -Bicarbonate utilization by SAV (pH Drift Study) (BIO-WEST 2013) -Algae and dissolved oxygen dynamics of Landa Lake and the Upper Spring Run (BIO-WEST 2015) -Ludwigia repens interference plant competition (BIO-WEST and CRASR 2015) -Distributional patterns of aquatic macrophytes in the San Marcos and Comal Rivers from 2000 to 2015 (Hutchinson and Foote 2017) -Phase I SAV AMP defines volumetric flow splits. COSM is tasked with implementation of flow splits -Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"Applied research and modeling conducted during Phase I are anticipated to provide valuable information on the low-flow requirements and subsurface habitat use of the Comal Springs riffle beetle, which will inform any Phase I and Phase II adjustments that may be necessary. (See, e.g., Section 6.3.4.2). From the statistical flow analysis presented in Table 4-30 it is evident that periods of low-flow will be extended for the HCP alternative compared to what was historically observed. As discussed in Section 4.2.1.3.1, this along with the long-term average flow management objective will need to be evaluated during Phase I activities. EAHCP: Page 4-106	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015) -Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the long-term, elevated temperature and low dissolved oxygen tolerances of the Comal Springs riffle beetle(Nowlin et al., 2017b) -Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle beetle (Nowlin et al., 2017) -Comal Springs Riffle Beetle (Heterelmis comalensis): Life History and Captive Propagation Techniques (BIO-WEST 2018)

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"A key unknown is the tolerance of native aquatic vegetation to reduced flow conditions in these systems. The timing and duration of these low-flow events will be studied relative to the native vegetation, starting with the plant species identified in the long-term biological goals for the fountain darter. Decay of the above ground and below ground biomass will be measured over time. … Water quality will be continuously measured to evaluate the before, during, and after effects of vegetation decay on water temperature, dissolved oxygen, carbon dioxide, and pH. Additional water quality parameters such as nutrients may also be studied. In addition to studying the effect of vegetation decline, decay and ultimately death, studies will be designed to evaluate recovery of native vegetation following various stages of aquatic vegetation decline and decay. EAHCP: Pages 6-8 and 6-9.	-Low-flow threshold evaluation of native aquatic vegetation – Pond experiment (BIO-WEST 2013) -Laboratory versus field comparison of flow for aquatic vegetation in the Comal ecosystem (BIO-WEST 2013) -Bicarbonate utilization by SAV (pH Drift Study) (BIO-WEST 2013) -Algae and dissolved oxygen dynamics of Landa Lake and the Upper Spring Run (BIO-WEST 2015) -Ludwigia repens interference plant competition (BIO-WEST and CRASR 2015) -Suspended sediment impacts on Texas wild-rice & other aquatic plant growth characteristics & aquatic macroinvertebrates (Crawford-Reynolds et al. 2017) -Distributional patterns of aquatic macrophytes in the San Marcos and Comal Rivers from 2000 to 2015 (Hutchinson and Foote 2017) -Landa Lake DO mgt plan -EAA RTWQ network -EAHCP WQ/Biomon monitoring

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
Another critical component of fountain darter habitat that is presently unknown is the relationship of macroinvertebrates (fountain darter's main food source) to low-flow conditions. Studies will be designed to evaluate the simulated effects of changing water quality conditions and aquatic vegetation composition on the macroinvertebrate (mainly amphipods) community. … Similar to the aquatic vegetation study, not only will simulated impacts be assessed during extended periods of simulated low flow, but recovery following these periods will be studied to learn response time (amphipod recovery) following a severe event. EACHP: Page 6-9	-Low-flow food source threshold study (BIO-WEST 2013)

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
The first step will be to assess the survival success of adults. Once an adult population is established, flow manipulations will be performed to study the affinity of riffle beetles to flow and to track movement from surface to subsurface habitats and vice versa. The immediate goal is not to establish a reproducing riffle beetle population but to evaluate movement patterns of riffle beetles during periods of varying springflow. EAHCP: Page 6-9	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015)
Once a population is established in the experimental habitat, extended periods of low-flow will be tested to evaluate the effect of these periods on riffle beetle survival and habitat use. Surface habitat will be completely removed for extended periods of time, water quality will be altered to simulate extreme conditions, and other factors adjusted (e.g., reductions in leaf material or detritus, etc.) to simulate conditions that might be experienced in the wild during these conditions. As with other proposed Tier A efforts, recovery following impacts will also be investigated. EAHCP: Pages 6-9 and 6-10	-Comal Springs riffle beetle occupancy modeling and population estimate within the Comal Springs system (ZARA et al. 2015) -Evaluation of the trophic level status and functional feeding group categorization of larvae and adult Comal Springs riffle beetle (Nowlin et al., 2017)

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
the concept of spring run connectivity will be tested. This will involve simulating subsurface habitat cutoff from surface habitat and riparian detritus, and subsurface habitats that are connected to surface habitats via the trickling of water across the surface habitat. This is a key study to assess the value of this concept as an additional protection measure in Spring Run 3 of the Comal system as discussed in BIO-WEST (2011). EAHCP: Page 6-10	-Effect of low-flow on riffle beetle survival in laboratory conditions (BIO-WEST et al. 2014) -Determination of Limitations of Comal Springs Riffle Beetle Plastron Use During Low-Flow Study (Nowlin et al. 2014) -Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015)
A series of low-flow experiments with various timing and durations will be evaluated while examining direct impacts to fountain darters. A whole host of questions can be addressed under this topic with just a few examples including: • when and where do darters move as vegetation decays and water quality deteriorates; • when does reproduction stop or does it; • does compensatory reproduction get triggered, and if so, when and what causes it; and • what is the effect of predation on fountain darter population size? EAHCP Page 6-10	-Low-flow food source threshold study (BIO-WEST 2013) -Effects of low flow on fountain darter reproductive effort (BIO-WEST 2014) -Effects of predation on fountain darters (Texas State University and BIO-WEST 2014) -Fountain darter movement under low flow conditions in the Comal Springs/River ecosystem (BIO-WEST 2014b)

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
A series of low-flow experiments with various timing and durations will be evaluated while examining direct impacts to Comal Springs riffle beetles. A core question is: when are reproduction and survival compromised as physical habitat (surface and subsurface) declines and water quality deteriorates? The reproduction component assumes that a reproducing population can be established in the study habitat during Phase I. If a reproducing population is successfully established, this flow manipulation research could be expanded to include evaluation of desirable and threshold environmental conditions for larval and pupae stages. EAHCP: Page 6-10.	Reproducing populations haven’t been established
Towards the end of Phase I, specific studies will be designed and conducted to test the validity of ecological model results. This may involve simple or complex parameters and single or multiple low-flow events depending on Phase II questions that may be relevant at that time. EAHCP: Page 6-11	None.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
The initial activity will be the evaluation of alternative methods for snail removal so that removal can be accomplished in the most effective, yet least destructive manner. The second activity deals with understanding the magnitude of snail removal necessary to affect downstream cercaria concentrations in the water column. Once the magnitude of snail removal for effective control of water column cercaria is identified, a study is necessary to evaluate the long-term benefits of that removal. EAHCP: Page 6-13	None.
Should it be determined during applied research conducted at the NFHTC during Phase I that spring run connectivity is effective and that additional protection may be required for the Comal Springs riffle beetle, then some version of that component may be implemented during Phase II. EAHCP: Page 6-18	-Comal Springs Riffle Beetle Habitat Connectivity Study (BIO-WEST and Texas State 2015)

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
Comal Springs Dryopid Beetle Adaptive Management Objectives • Maintain adequate water quality within aquifer (parameters maintained within historical ranges); • Monitor bad water line; • Determine spatial and temporal distribution in the Aquifer; • Determine life history characteristics (life span, tolerance to water quality changes, reproduction, food sources) and minimize impacts; and • Determine how food sources, particularly those that originate from far away (e.g., organic material washed in from recharge features and chemolithoautotrophic bacteria in deep aquifer) vary naturally and minimize impacts as appropriate. EAHCP: Page 6-19	Life history of CSDB is currently underway with Refugia program.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
Edwards Aquifer Diving Beetle Adaptive Management Objectives • Maintain adequate water quality within aquifer (parameters maintained within historical ranges); • Monitor bad water line; • Determine spatial and temporal distribution in the Aquifer; and • Determine life history characteristics (life span, tolerance to water quality changes, reproduction, food sources) and minimize impacts; and • Determine how food sources, particularly those that originate from far away (e.g., organic material washed in from recharge features and chemolithoautotrophic bacteria in deep aquifer) vary naturally and minimize impacts as appropriate. EAHCP: Pages 6-19 and 6-20	None.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"To be conservative, the long-term goal assumes that a 10 percent deviation would be acceptable; however, more extensive work to evaluate and assess the validity of that assumption and the water quality tolerances of the Texas blind salamander will be considered in the AMP." EAHCP: Page 4-35	None
"Although the projected long-term average flows are not concerns, the extended periods of consecutive daily average flows under 100 cfs and 80 cfs were examined. At 100 cfs, take for the fountain darter and impacts to Texas wild-rice have been documented. At 80 cfs, take is anticipated for the San Marcos salamander. Unfortunately, there is not a duration factor (i.e, memory) incorporated into any of the basic habitat modeling conducted for the incidental take analysis presented below. As such, a future evaluation of these potential impacts will be addressed with Phase I applied research and mechanistic ecological modeling." EAHCP: Page 4-62	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
"As discussed for Comal Springs, during Phase I, applied research on the effects of low flows on the Covered Species and their habitat at San Marcos Springs will be conducted, mechanistic ecological models with be developed and applied, and the MODFLOW model used to simulate the effects of the Phase I Package will be improved. Until the Phase I AMP decision-making is complete, it is not known whether additional flow protection measures might be necessary or what duration might be acceptable, or amount of additional flows that might be needed." EAHCP: Page 4-63	-Hardy T., Oborny E., and others, 2017. Fountain Darter modeling system for the Comal and San Marcos Rivers.

EXCERPT FROM EAHCP	STATUS OF STUDIES OR ALTERNATIVE APPROACH
An assumption was made that a minimum number of salamanders would survive in Spring Lake as long as some springflow was provided. Siltation around spring openings will likely be the biggest detriment to the salamander population in Spring Lake at extremely low flows. It has been observed in Landa Lake (Comal system) that as upwelling springs in the Upper Spring Run area cease flowing, siltation ensues and salamanders retreat from those areas. Although observed at Comal Springs, flows have not reached a level over the past decade at San Marcos Springs to cause a similar condition in Spring Lake, and as such this assumption is currently unfounded. Similarly, establishing a cutoff point on habitat suitability within Spring Lake would be equally unfounded at this time. This again highlights the importance of the applied research and mechanistic ecological modeling to be developed for this species as part of the AMP. EAHCP: Page 4-140	None


Photo courtesy TPWD

Next steps:

Identify any other AMP studies listed in EAHCP that are not currently in the table or any other omissions/corrections

Identify those study commitments that have not been met that Work Group recommends for continued consideration in our process.

HABITAT CONSERVATION PLAN EDWARDS AQUIFER

Thank you!

eahcp@edwardsaquifer.org