Appendix A

Issue 1: The Implementing Committee should ensure a technical evaluation is undertaken of water quality impacts of predicted extended periods of flow below 80 cfs in both spring systems, either using the Hardy water quality model but calibrated and validated using data from recent low-flow periods or using an alternate approach.

The topic areas prioritized in Part 1 of the Work Group process under Issue 1, but with relevance to topics prioritized under Issues 2 through 4, from which specific requests for study proposals will be developed are organized under the following questions:

Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80cfs?

> *(Note: Data collected under low flow conditions in the Comal system in 2014 will be compared to model predictions as a validation exercise.)*

Question 1-2: Which spring openings will still be flowing at various flow levels below 80cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?

> *(Note: The focus for these efforts will be on getting a better understanding of actual flow distribution during periods of low flow to inform evaluations that previously were based on assumptions about the distribution.)*

Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?

> *(Note: Because the documentation for the modeling referenced in Question 1-1 acknowledges uncertainty about the underlying assumption that cool water would not bypass the Old Channel during low flow periods, approaches for evaluating the potential for such a bypass of flow will be considered.)*

Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?

> *(Note: Information collected to answer this question will be used to understand data gaps).*

Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?

> *(Note: Particularly if the results from Question 1-1 raise questions about modeling accuracy, other water quality modeling approaches that have been applied more widely will be evaluated for suitability.)*

Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?

> *(Note: This question is intended to assess if, based on results of inquiries under other questions, tools and data need to be supplemented.)*

More specific information about what is included as potential topics and topic areas under these questions to be addressed through studies or analyses in Part 2 of the Work Group process is set out in Appendix C for Issue 1 Themes and Topics, Appendix D for Issue 2 Themes and Topics, Appendix E for Issue 3 Themes and Topics, and Appendix F for Issue 4.

Issue 2: The Implementing Committee should ensure a technical evaluation is undertaken of potential impacts of predicted extended periods of flow below 80 cfs on Comal Springs riffle beetle (CSRB) populations.

The topic areas prioritized in Part 1 of the Work Group process under Issue 2, but with relevance to topics prioritized under Issues 1, 3 and 4 as well, from which specific requests for study proposals will be developed are organized under the following questions:

Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?

> *(Note: This inquiry is intended to focus on gaining an improved understanding of which individual spring openings or discharge areas are likely to continue to flow during extended periods of low flow to help inform management approaches. Initial efforts will include assessing existing data and the results of inquiries under Question 1-2 and all efforts will be informed by recognition of the need to avoid potentially damaging study approaches.)*

Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If

those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?

> *(Note: Ongoing genetic studies may provide insights on the effects of previous low flow periods on riffle beetle populations and subpopulations. Those study results will be reviewed for insights and, if determined appropriate based on those results, follow-up analyses will be considered.)*

More specific information about what is included as potential topics under these topic areas to be addressed through studies or analyses in Part 2 of the Work Group process is set out in Appendix C for Issue 1 Themes and Topics, Appendix D for Issue 2 Themes and Topics, and Appendix E for Issue 3 Themes and Topics.

Issue 3: The Implementing Committee should ensure that a technical evaluation is undertaken of potential impacts of predicted extended periods of flow below 80 cfs on San Marcos salamander populations, particularly for populations in the area below Spring Lake Dam, and on Texas wild-rice and other vegetation serving as habitat for fountain darters downstream of Spring Lake Dam, including consideration of impacts from recreation.

The topic areas prioritized in Part 1 of the Work Group process under Issue 3, but with relevance to Issue 1 and vegetative die-off in the Comal system as well, from which specific requests for study proposals will be developed are organized under the following questions:

Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?

> *(Note: Water quality modeling reports note uncertainty about the effect of potential vegetative die-off during extended low flows. Although short periods of low flow have not been observed to cause die-off raising water quality concerns, further consideration of that potential during extended low-flow periods is contemplated.)*

Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80cfs?

> *(Note: Efforts will focus on gaining an improved understanding about where flow will pass over the Spring Lake Dam during periods of low flow in order to better inform management measures aimed at protecting San*

Marcos salamanders and other Covered Species located just downstream of the dam.)

Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?

(Note: Efforts will focus on gaining an improved understanding of the highly significant recreational impacts in the San Marcos River during periods of low flow to help guide recreation and vegetation management.)

Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?

(Note: Building on an improved understanding of flow exiting Spring Lake and of recreational impacts during periods of low flow, approaches and locations for exclosures will be reviewed and, if determined appropriate, recommendations for revising approaches and locations will be considered.)

Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?

(Note: Efforts will focus on achieving an improved understanding of location of fountain darter populations based on updated habitat conditions that could help inform management decisions, such as exclosure configuration, during periods of low flows.)

More specific information about what is included as potential topics under these topic areas to be addressed through studies or analyses in Part 2 of the Work Group process is set out in Appendix C for Issue 1 Themes and Topics and Appendix E for Issue 3 Themes and Topics.

Issue 4: The Implementing Committee should ensure that a rigorous review process, involving input from qualified experts in addition to the Science Committee, is undertaken, as soon as reasonably possible, to inform study design for each of the above-listed technical evaluations and to assess the 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.

Under Issue 4, the Work Group reviewed study commitments identified in the EAHCP that did not fit neatly under Issues 1 through 3. As the Work Group recognized in its deliberations, multiple factors affect when, and how, it will be appropriate to undertake specific studies described in the EAHCP. Accordingly, the Work Group's categorization of the status of specific studies is acknowledged as simply representing a snapshot in time as EAHCP implementation continues and as adaptive management adjustments are made. The Work Group considered the various studies described in Chapters 4 and 6 of the EAHCP, generally characterizing them, based on a preliminary review, into 3 categories: 1) studies apparently already undertaken with no obvious inconsistency with EAHCP commitments, 2) studies not yet obviously undertaken or completed as described in the EAHCP but not identified as a priority for this Work Group, and 3) studies not yet undertaken as described in the EAHCP that are identified as a priority for this Work Group process. The topic areas prioritized in Part 1 of the Work Group process under Issue 4 from which specific requests for proposals to undertake studies will be developed are organized under the following questions:

Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?

> *(Note: A flow level of 80 cfs for a three-month period, as described in the flow-related objectives in the HCP, is not considered reasonably achievable. Other flow levels between 80 cfs and 30 cfs in the Comal system, and between 80 cfs and 45 cfs in the San Marcos system may be achievable for similar periods, although not in the form of an engineered pulse, and may have the potential to provide some of the benefits to Covered Species contemplated for the 80 cfs component. Accordingly, further review of existing Modflow model predictions will be undertaken to identify other such flow levels which will be assessed using the ecological model and other appropriate tools for potential benefits to the Covered Species, including*

through consideration of new insights gained through inquiries pursuant to other questions.)

Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?

(Note: The EAHCP identifies siltation around spring openings as likely the biggest detriment to the San Marcos salamander population in Spring Lake and downstream of Spring Lake Dam during low flow periods and, noting uncertainty because direct observations are lacking regarding siltation around those spring openings during low flows, indicates studies should be undertaken to assess the risk. Options for assessing that risk will be considered.)

Question 1-3: listed under Issue 1 above, also was identified as a Work Group priority under Issue 4.

More specific information about what is included as potential topics under these questions to be addressed through studies or analyses in Part 2 of the Work Group process is included in Appendix F for Issue 4 and Appendix E for Issue 3. More information about the other EAHCP-listed studies identified during the Work Group process that were not included as Work Group priorities also is included in Appendix F.

Appendix B

Springflow Habitat Protection Work Group

Meeting 16 Agenda
Wednesday June 23, 2021
2:00pm-4:00pm

Click here to join the meeting
Or call in 210-729-0064 Meeting
Phone Conference ID: 465 054 943#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. ***Update on the Implementing Committee's review of the* Springflow Habitat Protection Work Group Part 1 Report and Proposed Part 2 Charge**
   - Led by Scott Storment, EAHCP Program Manager

5. ***Discuss* Part 1 Technical Evaluation Prioritization Scheme Draft Proposal to Work Group Members and Work Group comments *and consider approval***
   - Led by Myron Hess, SHP Work Group Chair

6. **Public comment**

7. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 16 Minutes
Wednesday June 23, 2021
2:00pm-4:00pm

1. **Confirm attendance**
   10 of 12 Work Group members were present; Adam Yablonski and Charlie Kreitler were not in attendance.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   There were no public comments.

4. ***Update on the Implementing Committee's review of the* Springflow Habitat Protection Work Group Part 1 Report and Proposed Part 2 Charge**

   Scott Storment, EAHCP Program Manager, gave an update on the response of the Implementing Committee (IC) to the Work Group's Part 1 Report and Proposed Part 2 Charge. The May IC discussion resulted in a request for the Work Group to take the lead on the prioritization process which led to this meeting. The initial prioritization of this Work Group will be presented to the IC at their August meeting. They are expected to determine the next step at that time.

5. ***Discuss* Part 1 Technical Evaluation Prioritization Scheme Draft Proposal to Work Group Members and Work Group comments *and consider approval***

   Myron Hess, Springflow Habitat Protection (SHP) Work Group Chair, introduced the focus of meeting. The purpose of this meeting is to come to agreement on an approach to prioritization. After there is agreement on the prioritization approach, the group will move forward with prioritization. Myron talked through the major steps of the proposed process shared with the members before the meeting and indicated that the overall goal is to present the IC with an initial prioritization list at their August meeting.

Patrick Shriver reminded work group members that they (Work Group members) had received SAWS' (San Antonio Water Systems) position on the Work Group's Part 1 Report and Proposed Part 2 Charge that was provided to the IC. He expressed concern about the Work Group taking an approach to prioritization that might contradict SAWS' IC comments and offered ideas on an alternative prioritization approach that would allow each Work Group member the opportunity to document their position in prioritizing, or not, each of the 15 questions for the IC. Patrick also noted concerns about the schedule set out in the Proposed Part 2 Charge interfering with studies already budgeted and scheduled. Tom Arsuffi indicated that he did not believe it was clear that any studies would supersede otherwise scheduled tasks or studies. Myron noted the intent of the Proposed Part 2 Charge to reflect flexibility in scheduling.

Colette Barron Bradsby then recommended the group go through an initial sorting (e.g., high, medium, low ranking) to allow all members the opportunity to weigh in and to provide an initial focus on things the group agrees on to see if there is a natural sorting. She also questioned if there is enough information to provide a cost for each question and indicated that if there was not, that should be communicated to the IC given their emphasis on cost. Chuck Ahrens expressed his interest in better understanding costs to inform the rankings but acknowledged the difficulty of assigning specific costs at this stage.

Kimberly Meitzen reminded the group that the ultimate decision makers are the IC and that Work Group members were charged with prioritizing the questions presented in the *Part 1 Report and Proposed Part 2 Charge*. She indicated concern that the discussion was getting ahead of what the group was charged with undertaking. There was some discussion on the prioritization criteria between Myron, Patrick, and Jamie. Jamie noted that EAA staff is not in position to assign costs at this stage but could perhaps categorize broadly. Colette agreed with Kimberly and suggested the group focus on the prioritization and, specifically, on trying to identify areas of agreement.

Myron summarized a new potential approach to ranking based on the discussion: use a spreadsheet with the three ranking criteria and the option for assigning a high, medium, or low for each criterion for each question (or pairing) and a column in which each member could provide discussion of the rationale underlying the responses, or lack thereof, for each question. The discussion continued to focus on cost and the prioritization criteria.

Kimberly questioned the wording of "need" in the first prioritization criterion and Myron explained his rationale for the language. Patrick suggested that for a first pass the criteria be simplified to what gives the best value in managing the HCP? No changes were made to the proposed prioritization criteria from the discussion.

Chad Furl also recommended adding a column on the feasibility of conducting studies. Jacquelyn Duke suggested not adding columns but, instead, providing the opportunity for that input in the comment space. Ultimately, a decision was made to request each member to include any insight they might offer on likely cost and the feasibility of performing the study in the spreadsheet with their ranking. The group also agreed to list the 15 questions separately for the ranking exercise.

The steps in the process are that Myron and Jamie will develop a draft of the spreadsheet to be used for the ranking exercise and share it for review and feedback by the members. The spreadsheet will then be finalized based on any feedback and circulated to the members for completion in advance of the next meeting. Jamie proposed dates for next steps (draft to be circulated by June 25, member feedback on draft by June 29, and members will have July 6 through July 16 to complete and submit individual rankings). Results will be summarized and circulated to members in advance of the July 21 work group meeting.

6. Public comment

There were no public comments.

7. Future meetings

The work group is scheduled to meet July 21 (2:00-4:00 pm) and July 29 (2:00-4:00 pm). Access information and agendas will be distributed one week before each meeting.

Springflow Habitat Protection Work Group

Meeting 17 Agenda
Wednesday July 21, 2021
2:00pm-4:00pm

Click here to join the meeting

Or call in 210-729-0064 Meeting
Phone Conference ID: 734 215 218#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. **Approve Meeting Minutes**
   - June 23, 2021

5. ***Discuss results of initial individual ranking exercise for previously identified questions and seek agreement on a work-group prioritization***
   - Led by Myron Hess, SHP Work Group Chair

6. ***As appropriate, plan for next steps in work-group prioritization process and in reporting results to the Edwards Aquifer Habitat Conservation Plan Implementing Committee***
   - Led by Myron Hess, SHP Work Group Chair

7. **Public comment**

8. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 17 Minutes
Wednesday July 21, 2021
2:00pm-4:00pm

1. **Confirm attendance**
   All Work Group members were in attendance.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   There were no comments from the public.

4. **Approve Meeting Minutes**
   A motion was made by Doris Cooksey, seconded by Charlie Kreitler, to approve the Meeting Minutes from the June 23, 2021, Springflow Habitat Projection Work Group. There was no discussion and no objections. In the absence of objection, the Meeting Minutes were approved by consensus.

5. ***Discuss results of initial individual ranking exercise for previously identified questions and seek agreement on a work-group prioritization***
   The discussion was led by Myron Hess, Work Group Chair. The Work Group examined the results of the individual ranking question by question.

   Jamie Childers reminded the group of the three ranking criteria.

   1. Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.
   2. Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.
   3. Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on the Covered Species.

Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?

Myron noted his sense that, overall, the results ranked high across the three criteria.

Jacquelyn Duke commented that she was under the impression that the basic validation had been done and had ranked the question low. At 80 cfs, she recalled being answered by the experts that the system would still function normal. If the group is considering anything below 80 cfs there may need to be further discussion and analysis.

Charlie Kreitler agreed with Jacquelyn's comment. If validation of the Hardy Model below 80 cfs has not been studied, then it needs to be. For example, the Groundwater Model was reviewed two years ago and gave further strength and validation to the model. That said, the most recent drought condition data (2014) should be included in the Hardy Model in a validation analysis. Discussion indicated that the validation of that model using recent drought data, including 2014, has not been done.

Question: 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos Springs systems and how does that relate to effects on the Covered Species?

In response to Charlie's observations about available data, Myron agreed that answering this question likely requires reliance on what data have been collected under recent low flow periods and on establishing protocols to collect data during future low flow conditions. Patrick Shriver indicated general agreement about the value of observations and noted the need to consider that invertebrate species have been found in varying locations, including away from spring openings, during periods of drought.

Kimberly suggested identifying a category for high priority monitoring on an opportunistic basis. Jamie Childers noted the importance of developing a monitoring plan in the near-term to guide execution of those monitoring opportunities. Myron commented that in addition to flow source and direct species correlation, there is another component of trying to understand where flow would emerge during drought, such as impacts based on assumptions about flow path in Landa Lake.

Colette Barron Bradsby recommended key factors to keep in mind while examining the results of the individual ranking exercise. For example, are these questions opportunity based, very expensive to implement, and extraordinarily

complex to analyze. Tom Arsuffi asked, in terms of cost effectiveness, can questions regarding springflow be added to contracts that already exist for monitoring during low flow periods.

Chad Furl noted his agreement that understanding prioritization for future monitoring would be valuable and that monitoring could be considered for addition to contracts.

Myron noted that the distinction on which springs will still be flowing during drought is an observational component whereas the effect on Covered Species would be more complex and expensive.

Patrick commented that some species exist in subterranean habitats, so this question is broader than just springflow observations. Chad also noted that even determination of flow emergence in some locations will require diving because some springs emerge below the surface.

Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?

Myron remarked that this question did not rank particularly highly among the stakeholders, but could potentially be a monitoring effort during low flow periods. Charlie added that this question might be incorporated into Question 1-2, being that some flow is below the lake and water level, and easily could be made part of a monitoring program.

Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?

Myron remarked that this question mostly had medium rankings across the three criteria. Noting that response, Myron indicated his impression that this question likely will end up in a low priority category.

Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?

Patrick noted that the Groundwater Model is a regional simulation and lacks the resolution of observational monitoring (spring orifices). He also noted that attempting to model specific emergences would be challenging. In general, the structural geology of the Groundwater Model doesn't change.

Charlie added that during the Groundwater Model analysis they used as much information as they had to piece together anything that might have been missed regarding predicting drought emergence. Drilling specific monitoring wells for a validation study would be costly.

Myron asked if it made sense to treat this one as not a current high priority but to revisit it depending on results of Question 1-1. Tom Arsuffi noted that broader peer-reviewed studies of water quality models were not included in the development of the Hardy Model. If Question 1-1 is pursued, recent papers should be evaluated with respect to criteria that were used in the Hardy Model. Tom suggested this question, or this aspect of (1-5), be added to Question 1-1. He indicated Hardy cites regional literature associated with the San Marcos and Comal Springs but there is a lot of literature associated with water quality models across different systems that could be used in a validation study.

Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?

Myron noted that Work Group input mostly indicates high and medium prioritization. Charlie noted that the current Groundwater Model is based on the historical Drought of Record in the 1950's. The next Drought of Record may not look like the historical Drought of Record therefore, the model may not help determine which conservation measures and management strategies would be best to implement. Need a more proactive approach for addressing future droughts, but recognize that may be more appropriate for future phases.

Myron suggested that consideration of future drought scenarios might be something to be studied during the Incidental Take Permit renewal process in conjunction with addressing climate change. He noted that it is important to flag this now to ensure we have the information necessary to address it.

Tom noted that climate change is a really big factor and is advancing faster than earlier predictions. The HCP needs to be proactive in terms of changes relative to the Drought of Record, at least in terms of the next phase. Patrick noted the difficulty of forecasting future droughts. Doris Cooksey noted that she had not ranked particularly high because of complexity and this issue may be appropriate for farther down the road.

Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?

Myron noted that this question was not ranked high across the three criteria—largely split between medium and low–and that it may be a complex undertaking. Charlie agreed that it would be expensive to get new data on the spring geology. Jacquelyn and Charlie noted that this question likely could be answered with opportunistic observations and monitoring rather than modeling.

Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?

Myron noted variation in ranking across the three criteria but, overall, not ranking particularly high, with concerns expressed about undertaking new genetic studies. Myron commented that the initial phase contemplated in this question did not propose new studies but rather evaluation of results of ongoing genetic studies to help understand past drought effects on Comal Springs riffle beetles. Patrick noted the advantage of using non-invasive methods to gain insights, particularly for the future, and that this presents an opportunity. Charlie noted that there was no clear explanation of specifics of what to look for to understand low flow conditions.

Jacquelyn considered this question as low-hanging fruit because not recommending investing in new genetic studies but using existing studies for new insights. Research may provide insight on where the Comal Springs riffle beetles are going using genetic studies. Doris noted that she would now rank higher based on understanding reliance on existing studies.

Tom noted that simple non-invasive genetic studies can give insights on viability, stability, and help support learning about population changes and support the proposed population studies.

Chad commented, in response to a request from Brandon Payne, that a Comal Springs riffle beetle population study will occur in 2022-2023, using repeated surveys and numerical models will be used to understand surface populations. In addition, collected beetles, wherever found, will be archived. He also noted there are no future genetic studies planned at this juncture, however, want to be sure the EAHCP is in a position to do so in the future if determined appropriate.

Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?

Myron noted the rankings across criteria appear fairly consistent with high and medium rankings, mostly medium. Patrick referenced the gardening and management of habitat in the spring systems as playing a key role in his

ranking. Chad noted that some studies of die-off were done in the early years and other efforts found oxygenating Landa Lake was not successful. Chad suggested that, if pursued, this question might be answered with observations and monitoring, because previous prediction efforts were not successful.

Tom commented that there is vast literature on decaying vegetation in freshwater systems. There are a lot of modeling tools that could be used to study effects of vegetation die-off. Jamie noted that such modeling would depend on having a well-calibrated hydro-dynamic model. Modeling vegetation die-off would be very expensive and complex and require strong data. Even then it is very difficult to do it well. Tom added that standing-crop biomass and changes in productivity would need to be measured to support a modeling effort and that is not something we are doing. Very complex undertaking, but there may be an opportunity to collect data in the near-term.

Question: 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?

Myron noted that the rankings were predominantly in the medium category and were fairly consistent across the criteria. There was general agreement that this would be simple to do, but uncertainty about what to do in response to the information. Kimberly expressed concern about the salamander habitat downstream of the eastern spillway of Spring Lake Dam. As springflow decreases, it is unknown what could potentially happen in consideration to the bathymetry of the lake, with the lake bottom being higher upstream of the eastern spillway than other areas upstream of the dam. She expressed concerns that flow there might drop and her belief it would not be costly to approach the question.

Melani added that this question needs to be answered sooner rather than later. If results of a study indicate a need for a change to the dam, Texas State University would need to be advised and consulted.

Tom recommended that this question can be determined by changing the depths of the boards at Spring Lake Dam and observing response. Melani added that to a degree, at least conceptually, boards at the western spillway can be used to push water to the eastern spillway. Tom suggested that perhaps experimenting with use of boards might provide some insights on what to expect. Kimberly noted that moving boards at the dam could be an approach to address the issue however, this type of test will require a lot of logistics and coordination with Texas State University and is more complex than what may be assumed. Charlie noted that we might start with a testing scenario and then determine if modeling is needed.

In response to a question about when the dam went in, it was noted that it was the mid-1800s. Kimberly noted that the dam is a leaky structure so flow is not

just over the dam and recent modifications were aimed at reducing the leakage, so we don't know how things were altered. Kevin Mayes noted that in the early '90s, Texas Parks and Wildlife (TPWD) prepared a report analyzing changes in elevation at Spring Lake using boards at the dam and assessed effect on downstream flow, but did not look specifically at spillway flow. As Kimberly noted, the dam has likely changed due to significant infrastructure updates. He sent the TPWD report to the work group.

Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?

Myron noted that there was quite a bit of similarity in rankings across Questions 3-3 through 3-5, with some suggestion of combining them. There seemed to be broad acknowledgment of recreation as an important factor to be addressed; Tom suggested combining the three. Charlie agreed and noted that the lack of a strong recreation management plan in advance of serious drought, when more people will be drawn to the river, could be a disaster. Kimberly seconded those observations and noted the need to further explore how exclusion areas should be situated which is an effort that should be data-supported and driven.

Melani commented that the City of San Marcos would need to be a partner in gathering data on recreational impacts to the Covered Species and preparing a plan. Additionally, currently there is little to no enforcement of recreational activities on the San Marcos River. Patrick noted that he would need to have time to consider lumping the three questions together. Colette asked that Texas Parks and Wildlife participate in discussions of enforcement of limiting recreation in the State Scientific Area.

Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?

Melani commented that the exclosures are losing their effectiveness and people are not staying out of them. Kimberly noted that even with signage people are disregarding the exclosures. There is a basic lack of enforcement and it is a big problem, beyond what we have seen before. Melani added that the Conservation Crew is continuing to educate people, however it does not seem to be working to influence behavior.

Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?

Jacquelyn noted that based on the input from Melani and Kimberley, it seems to be a high priority to address these recreation issues.

Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?

Myron noted that the responses appear fairly consistent across the three criteria; it is a two-part inquiry. The flow analysis has been done but might merit some elaboration, however evaluation of the significance of the duration of springflow makes this is a complex question to answer. There were no additional comments from the Work Group.

Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?

This question did not rank very highly. Myron noted that siltation is acknowledged in the EAHCP as likely the greatest threat to SM salamanders in Spring Lake. Brandon Payne asked if this question is still relevant considering that pulse flow would cause more detriment than sustained low flow. Myron answered he is not aware of a basis for dismissing this as a concern. Myron also indicated that monitoring might be the only viable approach to address the question rather than modeling.

In terms of moving forward, there was discussion about ways to summarize the results, including examples of how some folks had already done that. Jamie Childers indicated that on July 23 she would distribute to Work Group members various summaries of the initial rankings along with suggestions of how the input and discussion might be organized for submission of recommendations to the Implementing Committee. At the July 29 meeting, the group will discuss and seek agreement on presenting the information to the EAHCP Implementing Committee. Members were asked to provide ideas for organizing results they would like to propose for discussion to Jamie by Tuesday, July 27, so they can be shared in advance of the July 29 meeting. There was discussion about the difficulty of being able to reach full consensus, particularly on this timeline.

During the discussion, Patrick also noted concern that decisions not to assign a priority response to specific questions were not receiving adequate

consideration. Myron indicated that, because the reasons for not choosing to provide a prioritization likely vary, it would be difficult to appropriately factor that in.

4. ***As appropriate, plan for next steps in work-group prioritization process and in reporting results to the Edwards Aquifer Habitat Conservation Plan Implementing Committee***
   As noted above, the Work Group will continue its efforts at the July 29 meeting and in the interim before that meeting.

5. **Public comment**
   There were no public comments.

6. **Future meetings**
   The next meeting will be Thursday, July 29 from 2:00-4:00pm.

7. **Adjourn** 4:20PM

Springflow Habitat Protection Work Group

Meeting 18 Agenda
Thursday July 29, 2021
2:00pm-4:00pm

Click here to join the meeting

Or call in 210-729-0064 Meeting
Phone Conference ID: 912 410 373#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. **Approve Meeting Minutes**
   - July 21, 2021 meeting

5. ***Review feedback on summaries of Work Group input and on draft summary of results of prioritization exercise and, as appropriate, take action, or plan for next steps, to report results to the Edwards Aquifer Habitat Conservation Plan Implementing Committee***
   - Led by Myron Hess, SHP Work Group Chair

6. **Public comment**

7. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 18 Minutes
Thursday July 29, 2021
2:00pm-4:00pm

1. **Confirm attendance**
   All Work Group members, with the exception of Ryan Kelso, were in attendance.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   There were no comments from the public.

4. **Approve Meeting Minutes**
   Because of the need for more time to review, the Springflow Habitat Protection Work Group will consider approval of the July 21, 2021 Meeting Minutes at the August 13, 2021 meeting.

5. ***Review feedback on summaries of Work Group input and on draft summary of results of prioritization exercise and, as appropriate, take action, or plan for next steps, to report results to the Edwards Aquifer Habitat Conservation Plan Implementing Committee***

   The discussion was led by Myron Hess, Work Group Chair. The Work Group examined the feedback summaries submitted by Work Group members and provided input on the results of the prioritization exercise.

   The first summary of results that was reviewed was provided by Texas Parks and Wildlife Department (TPWD). The data from the preliminary ranking exercise was used to configure results into a bar chart (the shorter the bar, the higher the ranking). Questions 3-1, 1-1, 1-2, 3-3 and 4-1, were ranked the highest among the Work Group. Myron Hess noted that following the discussion from SHP Work Group Meeting 17, some Work Group members indicated that they may have ranked the questions differently based on a further review. Colette Barron Bradsby confirmed that the graph provided by TPWD did not take into account the changes to the preliminary responses but that, based on the previous discussion, it did not appear that the changes discussed would have any major effect on the TPWD result summary.

Jamie Childers presented a graph of responses for each criterion initially ranked, presenting responses for each question along a 100% scale to illustrate the distribution among high, medium and low rankings, with blank responses also reflected.

Patrick Shriver presented visualizations of the initially ranked questions by criterion prior to SHP Work Group Meeting 17 (July 21, 2021). Three individual graphs were presented (one for each criterion: flow objectives, biological goals and associated objectives, and new information or management for design) which represented the Work Group's tendency for consensus or agreement on a question. The biggest difference from TPWD and Jamie's versions was in the weighting accorded to blank responses in Patrick's versions.

During the discussion in SHP Work Group Meeting 17, questions were systematically placed into specific categories or "buckets" and Jamie presented a visual representation of those buckets. Tom Arsuffi recommended that the buckets be ranked into a four-tiered system so that the EAHCP Implementing Committee can sufficiently review the results of the exercise. Myron suggested that the Work Group first finish working through the materials presented before considering any specific action, while planning to come back to Tom's proposal.

Myron presented a table that sought to summarize the discussion from Meeting 17 with the questions organized into four tiers: High Priority Tier, Monitoring Tier, Medium Priority Tier, and Low Priority Tier. Based on the Meeting 17 discussion, some questions were divided into two parts (e.g., a monitoring component and an application of the data component) that were ranked separately. Highlighted items in the table represented aspects that were not discussed at length or resolved during Meeting 17. Colette noted that the monitoring aspect of this tiered system was helpful in her analysis.

WORK GROUP DISCUSSION OF ADDITIONAL SUMMARIES PROVIDED:

TPWD Results Summary:
Colette, with the help of Kevin Mayes, offered a grouping combined with the bucket system that also proposed two potential ranking approaches for questions within the monitoring tier. For the bucket system, TPWD suggested including Question 4-1 in the complex bucket and Question 4-2 in the low priority bucket, with Question 3-2 added to the monitoring bucket. For prioritizing within the monitoring tier, Questions 1-2, 3-1, 2-1, 1-3, and 3-2 could be ranked based on the initial low, medium, high scores. Alternatively, they could be ranked within that tier based on sensitivity of the parameters being monitored to reduced springflow as related to physical habitat and water quality. Jacquelyn Duke added that, comparing the two prioritization approaches, the only question within the monitoring tier that would need further analysis for prioritization is Question 3-1 because all of the others

ranked similarly under both approaches. Chad Furl reminded the Work Group that current low flow monitoring is similar to routine monitoring but with an increase in frequency and interval and with additional water quality work, species counts, habitat monitoring and mapping. He noted that the monitoring aspects discussed here are significantly different from current low flow monitoring and would greatly improve aspects of the current low flow monitoring.

Patrick observed that Question 3-3 was not included in the TPWD bucket analysis. Tom reminded the Work Group that during Meeting 17, the group decided to combine Questions 3-3 through 3-5 and rank them as one high priority. Jamie and Colette clarified that the TPWD analysis was only considering prioritizing questions within the monitoring tier and do not address the results in the other tiers or in the bucket approach. It also was noted that combined Questions 3-3 through 3-5 were included in the high priority bucket in the TPWD analysis. Kimberly Meitzen noted that creating monitoring plans might be necessary as the first step to take prior to organizing monitoring questions within the tier unless this approach is used to prioritize development of monitoring plans. Myron also noted that the suggested cost categories for questions in the monitoring tier might need to be revisited to better reflect a monitoring-focused approach.

Patrick Shriver Results Summary for What to Include in any Report:
Patrick recommended that any report to the Implementing Committee include a degree of ranking to illustrate a greater propensity of agreement on items such as recreation and implementation of the State Scientific Area. Although there was not 100% consensus on any item, there was a similar prioritization reflected in the Work Group results. Additionally, discussion of SAWS position on certain questions might be included in a separate section. He indicated particular concern about approaches involving new models or engineered solutions at this juncture. He indicated more support for approaches that involve new uses of existing tools, collecting new data, and reviewing existing models. In particular, he indicated a strong concern about jumping now to developing new tools prematurely and a belief that the success of the EAHCP needs to be acknowledged.

Jacquelyn Duke Results Summary:
Jacquelyn recommended a report to the Implementing Committee that included Patrick's distribution graphs and the bucket approach to visualize the Work Group's collected priority categories. She also supported the TPWD approach for prioritizing within the monitoring tier. Adam Yablonski noted that a "blank" response might be interpreted as a negative opinion on Patrick's distribution graph and that would not be an accurate reflection of his decision not to provide a ranking, which was intended as neutral. The Work Group agreed that a "blank" response does not necessarily equate to a negative opinion on a question but rather may just indicate a question a Work Group member

preferred not to address. Jacquelyn suggested that blank responses could be presented along the zero line rather than necessarily being shown as a negative. Patrick agreed that blanks could be moved to zero line and treated as right in the middle. Colette recommended defining consensus and Patrick offered to revise his distribution graphs to better represent the "blank" responses.

Additional Discussion of Tom Arsuffi's Recommendation:
Tom offered the following tiered system based on the buckets:

Tier 1: High priority (literature review and recreation analysis) (1-1 and 3-3 through 3-5)
Tier 2: Timing, affordable, feasibility (1-1, 1-2, 2-2 (current genetic studies), 3-2)
Tier 3: Opportunistic monitoring (1-2, 1-3, 2-1, 3-1, 3-2)
Tier 4: High cost, complex, new studies, low priority (1-5, 1-6, 3-1, 2-2, 1-4)

Aligning these tiers with Myron's table would make a better visualization and textual justification for the Implementing Committee Report. Question 1-1 and a portion of 1-6 can be combined for a literature review of water quality models and added to a high priority tier with a caveat that SAWS opposed the high priority result for the full Question 1-6. Jacquelyn noted that 1-6 and 4-1 appear to be treated most differently in the two compilations. Patrick noted that his concerns about Question 1-6 are lessened if it is focused on a future permit and if any new modeling would be preceded by a showing of need.

Alignment of Myron and Tom's Summaries:
Colette noted that the bucket approach is a layer in the analysis of the prioritization exercise and can be used with any graph or table that has been presented. The buckets do not represent priority but rather a system of grouping into a tier. Myron recommended using the table approach he presented as the primary tool of representation for the sake of clarity and using a bucket analysis for supporting material. The group agreed that the groupings in Tom's system are not necessarily equal to the tiers in Myron's proposed system.

Kevin Mayes noted there is not a lot of difference in substance between Tom's proposals and Myron's table. He suggested that populating the feasibility column in Myron's table could acknowledge key aspects of Tom's bucket visualization. He also noted that various questions appear in multiple buckets.

Myron suggested working through the table and testing consensus for the placement of each question. Jacquelyn suggested focusing on the questions that had the most varied results to come to a consensus on where it belonged on the table. She referenced Questions 1-1 and 3-3 through 3-5 as apparently being agreed upon as high priority. Patrick concurred and suggested combining the moderate priority and low priority tiers together on Myron's table. He also indicated he is not comfortable moving to external RFP solicitation for

Questions in the moderate or low tiers as initially proposed. Jacquelyn recommended referencing the bucket approach and Patrick's consensus distribution graph in the Implementing Committee Report to justify the priority tiers presented in Myron's table. The group also discussed acknowledging the initial absence of 100% agreement on any one item.

Charlie Kreitler Results Summary:
Charlie Kreitler noted that the focus should be on identifying the critical issues. A solution would be to eliminate the lower tiers and decrease the priority content. Charlie recommended organizing the information into three buckets: 1) modeling efforts, 2) additional field data collection and 3) recreational management. He indicated that recreation and modeling are high on his priority list and monitoring is less expensive: three buckets addressing critical issues which is what the IC is looking for.

Discussion on the organization of Myron's Table:
The Work Group confirmed agreement on combining Questions 3-3 through 3-5. In combination, those questions would be placed into the **High Priority tier**, whatever we end up calling it. Additionally, Question 1-1, with a literature review of water quality models and with acknowledgment that it does not include new modeling, was agreed upon for placement in that tier. Although there was not full consensus to include Questions 1-6 and 4-1 in the High Priority items, there seemed to be potential agreement to live with including them as a Medium Priority tier, provided there was acknowledgment that SAWS had some concerns while recognizing that overall the Work Group supported those items.

Myron's table placed Questions 1-2, 1-3, 2-1, 3-1 (partial), and 3-2 into a **Monitoring Priority tier**. Kimberly noted concerns about Question 3-2 being treated solely as a monitoring exercise. She indicated this inquiry could be achieved through modeling rather than just monitoring. Jamie noted that monitoring plans can be developed prior to implementing a monitoring strategy. Myron added that the Monitoring Priorities would be appropriate for use in developing monitoring plans now to guide data collection during future low-flow conditions.

The remaining questions were placed into a new **"Un-Prioritized"** tier. Patrick added that the Un-Prioritized tier does not represent questions that were considered lacking in value but rather questions that the Work Group did not come to a consensus on. Myron added that the Un-Prioritized questions can always be reconsidered based on findings in the Monitoring Priority or High Priority tiers and Patrick noted that those questions would be appropriate for consideration as other studies are completed.

Discussion will continue at the next meeting.

6. Public comment

There were no comments from the public.

7. Future meetings

SHP Work Group Meeting 19 will be held on August 13, 2021 at 9:00am.

Springflow Habitat Protection Work Group

Meeting 19 Agenda
Friday, August 13, 2021
9:00am-11:00am

Click here to join the meeting

Or call in 210-729-0064 Meeting
Phone Conference ID: 982 098 527#

1. **Confirm attendance**

2. **Meeting logistics**

3. **Public comment**

4. **Approve Meeting Minutes**
   - July 21, 2021 Meeting 17
   - July 29, 2021 Meeting 18

5. ***Review feedback on response to the Edwards Aquifer Habitat Conservation Plan Implementing Committee and, as appropriate, take action on delivery of the response prior to the August 19, 2021 meeting***
   - Led by Myron Hess, SHP Work Group Chair

6. **Public comment**

7. **Future meetings**

Springflow Habitat Protection Work Group

Meeting 19 Minutes
Friday, August 13, 2021
9:00am-11:00am

1. **Confirm attendance**
   All Work Group members, except for Ryan Kelso, were in attendance.

2. **Meeting logistics**
   Jamie Childers provided an overview of virtual meeting logistics and meeting points of contact.

3. **Public comment**
   There were no comments from the public.

4. **Approve Meeting Minutes**
   - July 21, 2021- Meeting 17
     - A motion was made by Tom Arsuffi and seconded by Colette Barron Bradsby, to approve the Meeting Minutes from the July 21, 2021, Springflow Habitat Protection Work Group. There was no discussion and no objections. In the absence of objection, the Meeting Minutes were approved by consensus.
   - July 29, 2021- Meeting 18
     - Because of the need for more time to review, the Springflow Habitat Protection Work Group will consider approval of the July 29, 2021, Meeting Minutes at the next meeting.

5. ***Review feedback on response to the Edwards Aquifer Habitat Conservation Plan Implementing Committee and, as appropriate, take action on delivery of the response prior to the August 19, 2021, meeting.***
   The discussion was led by Myron Hess, Work Group Chair.

   Jamie Childers had previously consolidated Work Group comments on the draft response to the Implementing Committee into one document, which was used as the starting point for discussion. Comments were added in tracked changes.

The Work Group's discussion began with a review of "Table 1. Work Group Ranking Summary" in the report. Column one includes the number of the question(s) and a parenthetical summary statement of what it addresses. Column two provides an estimate of relative cost. The following discussion follows the color coding of the initial draft of the table: Green, Orange, Blue, and Yellow.

Discussion of Green Category Questions

Patrick Shriver recommended to change "high priority" phrasing to avoid confusion with the earlier prioritization efforts of the Work Group. Myron suggested the option of changing the title of the first grouping (Green Category Questions) from "High Priority" to "First Priority for Study". The group generally indicated agreement with that approach.

Myron noted that the combined questions 3-3 through 3-5 could increase the cost over the cost estimates for the individual questions. After discussion, there was agreement that an appropriate cost estimate for combined questions 3-3 to 3-5 would be low to medium.

The Work Group discussed the definition of "consensus" and determined to use the absence of objection as indicating consensus, consistent with the EARIP process and EAHCP guidance. For consistency with that practice, "full consensus" was changed to "consensus" throughout the table.

Discussion of Orange Category Questions

The Work Group decided to rearrange the table so that the First Priority for Monitoring Plans grouping (Orange Category) is presented immediately after the "First Priority for Study" grouping. The group agreed to change the title of the grouping to "First priority for developing monitoring plans for data collection during low-flow periods" to better reflect intent.

Myron requested the Work Group review the cost estimates for each question to assess if the estimates remain accurate for a monitoring approach because the estimates may have been developed assuming a directed study approach. There were no proposed revisions.

Discussion of Blue Category Questions

The Work Group changed the "Medium Priority" heading (Blue Category) to "Second Priority for Study" with an added explanation of "Ranked

highly but not consensus for first priority studies" to better coincide with the changed text to the other category headings.

Discussion of Yellow Category Questions

Colette commented that the phrase "Un-prioritized" gave the assumption that the questions under that category (Yellow Category) were not fully assessed when in fact the Work Group did consider those questions and determined they should be considered at a different point in time. There was agreement the heading for "un-prioritized" category should be changed to something like "Retained for future consideration and directed studies dependent on available state of knowledge and research necessity" to reflect the Work Group's perspective.

Myron noted that he had added brief parentheticals, following each question number throughout the table, to summarize the focus of the question and requested members to review that text to identify any concerns.

Doris Cooksey suggested adding a description of what the word "partial" meant. The group agreed to add a footnote to the table explaining that it referred to some questions being recommended to be addressed in part through monitoring and in part through studies based on results of monitoring.

Kevin Mayes suggested reordering the questions within the groupings in numerical sequence since there was no prioritization being recommended within the groupings. The group agreed that no prioritization within the individual groups was being suggested and that presenting the questions in numerical sequence within the groupings would be appropriate, with a brief explanation added to the table.

Additionally, a Low to Medium budget estimate was suggested to fill in the cost column for Question 3-2.

Following the review of each colored-coded category within the table, Patrick raised a question about the use in the table of the term "tier." The Work Group decided to remove the term "tier," because its inclusion could create undue confusion with earlier draft organizational approaches.

Review of remainder of text

The Work Group next moved to discussion of the text of the response, other than Table 1, to assess for consistency with the changes to the Table and address other proposed revisions. The Work Group operated on consensus—i.e., absence of objection—throughout the editing discussion.

The Work Group agreed to delete a restatement of the text of specific questions. The full text of the 15 questions will be included as an Appendix. Brief summaries of the categories in Table 1 were suggested for inclusion. The Work Group agreed it would be appropriate to keep the overall text brief.

The Group also agreed to move the discussion of initial prioritization efforts and the evolution of the final proposed prioritization to the portion of the document following Table 1. That portion will include a single graphic depicting the "buckets" approach, with other graphics moved to appendices.

The Group also determined that it would be best for Myron to provide the IC, at its Aug. 19 meeting, with a general update and an overview of the prioritization categories rather than a draft of the full table.

In terms of process moving forward, the Work Group will schedule an additional meeting to be used, if needed, to agree on the final text of the response for presentation to the IC. Prior to any additional meeting, proposed revised text will be circulated to the Work Group for review and comment. If comments are received, one or more additional revisions will be circulated for further review and comment. If a final version is achieved in that manner, without objection from any Work Group member, an additional meeting may not be needed prior to presenting the response to the IC. However, in the absence of achieving consensus on the text through that process, an additional meeting will be convened.

6. Public comment

There were no comments from the public.

7. Future meetings

A poll will be distributed to Work Group members to determine the date for a potential future meeting.

Appendix C

April 9, 2021

Scott Storment
Executive Director, Threatened & Endangered Species
EAHCP Program Manager
900 E. Quincey
San Antonio TX 78215

Subject: EAHCP Springflow Habitat Protection Work Group Charge Review

Scott,

SAWS is and has been a significant supporter of balancing the region's threatened and endangered species challenges with human activity. As the Implementing Committee (IC) representative for SAWS, I am providing my feedback on the Springflow Habitat Protection Work Group Part 1 Report and Proposed Part 2 Charge.

The Part 1 Report has documented significant amounts of material and efforts considered to date expanding on 80 cfs pulse flows and overarching scientific questions. I do appreciate the effort put forth by all the committee members throughout the nearly yearlong effort. The current prioritized work agreed upon using our established processes, priorities, and budgets should hold precedent for the remainder of the current permit commitments. In our opinion, our time and money are best spent adhering to the Phase II Work Plan in place. We do acknowledge that a better understanding of the system, as a whole, needs to be investigated further. However, any proposed studies should be reserved for discussions about the possible renewal of the ITP.

In the bigger picture, SAWS would find it difficult to support any additional Proposed Part 2 Charge additions justified through further prioritization. I offer the following thoughts on the proposed priorities:

- Coordinate the following through future applied research – (1-1), (1-2), (1-3), (1-4) & (*4.2)
    - This could mean EAA, any of its contractors and or USFWS research arm
- Existing tools – (1-5), (1-6).
    - These are system-wide tools. Continued development use and peer searches should be periodically performed to ensure the EAHCP remains current. SAWS suggests these are added to future EAA's work plans and coordinated under their modeling division
- Species specific studies – (2-1), (2-2)
    - Can be sent to future applied research and weighed in on by the CSRB work group or applicable equivalents if another species
- Relatively new work with system-wide management implications – (3-3) & (3-4)
    - During the development (EARIP) process SAWS felt that a better understanding was needed to gauge the impacts of system-wide recreational. Unfortunately, not much research has occurred or been documented. The heavily reduced impact of recreation

on the systems during COVID restrictions might offer new insight towards a balance management tool benefiting both systems. Elements of this information may be incorporated into future modeling but also materialize in applied research

- Minimum continuous springflows to the pulse flows up to 80 cfs – (4-1)
    - Better described for future permits
    - The region has in place an HCP and ITP for the partnered agencies as well as the endangered species habitat (including adaptive management provisions) that includes improvements to baseline conditions. Continued diversification and management actions by permitted water rights users and springflow community managers prove a commitment to a *natural environment* with healthy fluctuations. What those fluctuations are and how they play out is as complex as nature itself.
    - As an additional point of reference, I listened in as a guest to the majority of SHPWG meetings and most of the scientific input and observational accounts reflected positive results down in the approximate 40 cfs short-term ranges

As the SAWS IC representative, I appreciate the opportunity to review and weigh in on the Springflow Habitat Protection Work Group report. The Part 1 Report is well received and agree that all the items are of importance. However, SAWS is of the position that tabling them and balancing them with the priorities for future permitting considerations is the best current action.

Sincerely,

Darren Thompson
Director of Water Resources
San Antonio Water System

Appendix D

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	7	1	1	2	6	2	1	2	6	2	2	1

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	6	2	1	2	5	3	1	2	7	1	2	1

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	2	3	4	2	2	4	3	2	4	3	3	1
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	0	8	1	2	0	7	2	2	2	5	3	1

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	3	3	2	3	3	2	3	3	2	4	3	2

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	4	3	0	3	4	3	1	3	4	3	2	2

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	2	4	3	2	3	4	2	2	2	5	3	1

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	3	4	1	3	3	4	2	2	1	6	2	2
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	3	6	0	2	2	7	0	2	2	7	1	1

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	1	6	2	2	1	5	3	2	1	5	4	1
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	5	3	1	2	6	2	2	1	7	1	2	1

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	2	5	3	2	3	4	3	1	3	5	2	1
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	4	3	1	3	4	3	1	3	4	3	2	2

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.				Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.				Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.			
	H	M	L	Blank	H	M	L	Blank	H	M	L	Blank
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	5	3	1	2	5	3	2	1	5	3	2	1
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	1	4	4	2	0	4	4	3	0	4	6	1

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	CWK=If this evaluation has not already been done, it is logical from a cost and science basis that the Hardy modell should be used with 2014 data. JDUKE=I ranked this low because I feel that after listening to the experts and dialoguing with them, it is clear that the Hardy model has been shown to do these things, so spending more money/effort evaluating it is a low priority (these funds/efforts could be better allocated elsewhere). MH=The value of determining if the model is effective and suitable to projecting impacts of low flow regime is high because it is already developed, but there is uncertainty of application with low flows below 80cfs. This is a feasible and valuable study. Determining a flow regime that sustains the species is critical. At this time, we cannot fully answer that question. TLA=Cost Low. Requires evaluation of other WQ models to Hardy's. Hardy's model not well peer literature review evaluated. KM=Model is already developed and currently being used, but there is uncertainty with its application for low flows. This is also a good exercise to gage the need for an updated modeling approach. Reasonably feasible. AY= TPWD=Medium cost EAA=Probably low, but would depend on the ability of EAA staff to conduct the model runs. If handed to a third-party, most likely medium. MJH=Validation of modeling results can address critical uncertainties. Water quality predictions play an important role in numerous aspects of the EAHCP, including the ecological model. Using data previously collected during relatively low flow conditions in a validation exercise represents low-hanging fruit for use in helping to understand how well the modeling predictions match the data. The task likely could be undertaken at low cost. SAWS=General comment - Column B & C are not receiving consideration or ranking by SAWS. The basis for the position is NAS findings, history of modeling concurrence for the existing program and presentations to the SHPWG 2020 confirm overall accepted protective findings. This is not to say that performing the sensitivity exercise using the existing tools under EAA's modeling group oversight and applicable water qualities available modeling approaches couldn't provide nuanced findings at a relative medium to low cost under the above broad cost categories. Under column D SAWS would rank as low based on past HCP annual work plan actions (removal aeration and specific thermistor intervention strategies or monitoring) CPS=

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	CWK=It is imoprtant to understand which springs contain endangered species and which springs go dry during low flow conditions. If data are available for this issue from the 2014 drought, this analysis would greatly help. JDUKE= MH=This is important information for the riffle beetle and SM Salamander, but may not be feasible to obtain. May take significant amounts of dye testing or opportunistic low flow conditions. Important to retain the question but not push it for an RFP unless low flow conditions occur making this more practical to investigate. TLA=Cost Medium. KM=Important question, but may be difficult/challenging to examine through simulation modeling. May take significant amounts of dye testing or opportunistic low flow conditions. Important to retain the question but not push it for an RFP unless low flow conditions occur making this more practical to investigate. AY= TPWD=Medium cost EAA=Not sure what utility this would have for making future management decisions. I think it's widely recognized that at 30 cfs the springs at the bottom of the lake would likely be all that is left flowing. Concerning 'effects on Covered Species', EcoModel indicates darters can persist, past history suggest the other species were able to survive cessation of springflow for a period. No idea on costs. MJH=Numerous aspects of the flow objectives are based on assumptions about where flow will emerge during low flow periods. Having a better understanding of the accuracy of those assumptions will provide significant benefit in understanding impacts of various flow levels, the need for periods of increased flow to interrupt periods of low flow, and management approaches for benefiting Covered Species during extended low flow periods. Building on recently collected information, identifying which spring openings continue to flow could be a low cost undertaking if assessed along with monitoring during low flow periods. Just answering that aspect of the question would provide important insights. Costs for analysis of effects on Covered Species likely would be high, depending on level of analysis undertaken and species considered. Use of eDNA approaches might provide useful information on presence of riffle beetle for specific flow paths (although practicality of sample collection for underwater spring openings would need to be assessed), but likely would be high cost. SAWS=General comment - For columns B & C SAWS is not ranking (see above). Neither the GW model or specific singular spring orfi are exclusively responsible for ecosystem and covered species' survival. Species counts and weighted usable habitats of sentinel species are the overall mechanism of monitoring ecosystem health. To expand on the GW model, it has been shown to be a reasonable and conservative tool for assurances of minimum continuous discharge as a managed solution for endangered species critical and limited habitat. Under column D SAWS would rank as low but understands that compiling the mapping, observational flow context and in some cases subterranean habitat could or would provide context for site specific habitat. CPS=

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	CWK=This should be a relatively easy question to answer by looking at a bathymetric map of Landa Lake. JDUKE=Temps at 80 cfs didn't seem to be a major concern based on expert presentations. MH=Like Question 1-2, this seem to be important information for the species, but must be obtained during low flow periods, so is an opportunistic study. Hold in the "basket" for future opportunities. TLA=Cost Low. Desktop evaluation of existing data. KM=Similar comments as Q 1-2. AY= TPWD=Could be expensive to undertake high resolution temperature-flow dynamics EAA=The Old Channel is an important in stream refugium for the darter. Maybe worth examining. Low or medium. MJH=The premise that springflow is uniformly mixed in Landa Lake is a critical, but unproven, assumption underlying modeling predictions of temperature levels in the Old Channel and the likelihood of successful fountain darter reproduction there during extended periods of low flow. Questions about that assumption are expressly acknowledged in the modeling report. If assessed as an add-on during monitoring of future low flow conditions through strategic deployment of temperature sensors, this information likely could be obtained at low cost and should be incorporated now into monitoring protocols to ensure information is gathered when low flow conditions return. Alternatively, more sophisticated approaches might be considered for gaining insights more quickly, although likely at higher cost and only with good information about locations of springflow emergence during low flow conditions. SAWS=General comment - Column B & C SAWS is not ranking (see above). HCP annual work plan actions sited under comments of Q 1-1 question placing additional importance to the information as described. Nearly a decade of HCP implementation activities and two decades of temperature data collection, which included the 2011-2014 stress period along with highest ambient air temperatures as part of the instrumental record have/has not resulted adverse impacts to the covered species based on monitoring results, incidental take reporting and annual reports to USFWS. CPS=
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	CWK= JDUKE= MH=Similar comments as Q 1-2 & 1-3. Should this question include impacts to temperature? TLA=Cost Low, mirrors Question 1-1. KM=Similar comments as Q 1-2. Should this question include impacts to temperature? AY= TPWD= EAA=I suppose that would depend on the physio-chemical aspects of concern. The Water Quality monitoring program was reviewed by NAS and a Work Group, and is reported on annually in EAHCP annual report. MJH=Because the nature of the inquiry is somewhat unclear to me (e.g., what additional data are anticipated for collection), I find it difficult to rank. Similarly, it is difficult to offer a cost estimate without understanding what additional data would be proposed for collection. The spring location aspects might be addressed pursuant to Question 1-2 or Question 2-1, if one or both of those questions are prioritized highly. Similarly, there may be overlap with Question 2-1 with respect to physiochemical aspects. SAWS=General comment - Column B & C SAWS is not ranking (see above). SAWS engagement with the 2016 Expanded Water Quality Work was and is recalled having optimized sampling plans for the monitoring of water quality pertinent for healthy spring ecosystems. The dominant thinking during HCP development and the streamlining of water quality data collection was towards that acute hazardous spill risk events were of greater risk to the healthy protected ecosystems than background in place attenuating constituents, but broad monitoring for problem signs was prudent measure. CPS=Good question. I believe the EAA does testing during low flows that will continue to inform the process.

Question to rank	**To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.**
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	CWK=Hopefully the use of the Hardy model is acceptable, which negates the need for creatng another model JDUKE=I don't think it would be prudent to begin searching for or creating a new model at this point. MH=It is valuable to look for updated approaches (other options/alternatives) to be explored if the Hardy model does not prove to be effective. TLA=Cost Low. There are several major review papers on stream/freshwater WQ models and strengths and weaknesses of each. Perhaps comine 1-1, 1-4 and 1-5 from synthetic perspective = Cost Medium. KM=It is valuable to re-evaluate the model and look for updated approaches (other options/alternatives) to be explored. This could help inform some of the other questions related to better understanding habitat availability or covered species responses to low flow conditions. AY= TPWD=Paired with Question 1-1, should be an outcome of Question 1-1 project EAA= MJH=These valuations all assume that Question 1-1 is prioritized highly and is answered in a way that supports accuracy of predictions for existing modeling. If the existing modeling is indicated as likely inaccurate, then relative prioritization of this question should be revisited. SAWS=General comment - Column B & C SAWS is not ranking (see above). If Q 1-5 is a follow-up dependent on Q 1-1 there is already a built in prioritization making this question dependent and a follow-up. SAWS addressed that any Administration of EAA's Modeling group as it relates to other modeling considerations should be a periodic survey to remain relevant. The modeling for the EAHCP was/is extremely expensive and time consuming. It is appropriate to scan the space to see what others are doing but it is highly impractical within time frames and funding to constantly model. When a significant body of new information exists the ecosystem model could be looked at. CPS=

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	CWK=Much of our understanding of low spring flow conditions are based on a comparison to the drought of the 50's. The next severe drought may not look like the 50's. So we need to have scenarios that adresss a range of possible drought scenaios which migght occur. This should be duable through a series of modeling runs. JDUKE= MH=Feels redundant to questions 1-1 and 1-6. The Hardy model is over ten years old, so it's important to look at the field to see if there is another model or approach that would better answer the questions. TLA=Cost Medium. Down the line project incorporating regional/local Climate Change models. Consult with Katherine Hayhoe. KM=It seems like this Q, 1-1 and 1-6 could be related in terms of the need for re-evaluating and updated the existing models. The management decisions/actions for low flows could be re-evaluated. While there are some existing protections for mitigating low flows, there is not a clear plan for adaptive management during extended severe drought conditions, and that seems like a very important need. This may even relate to management decisions regarding exploring environmental flow augmentation to the springs or increased recreation regulations, etc... AY=Our predicitons are based on assumptions that pumping will occur at maximum permitted amount every year, but since the EAA began regulating pumping,there has never been more than 450,000 acre-feet withdrawn in a single year. Recent diversification projects by SAWS make it even less likely that we will see consistent, maxium possible pumping. How can we use available data on historical and predicted pumping levels to improve our predicitons of the severity and duration of low flow events? TPWD= EAA=Not sure I fully grasp the question. Water quantity predictions are available through MODFLOW simulations, water quality (temp and DO) are available through EcoModel report for repeat of DOR. MJH=These proposed prioritizations reflect the value of getting answers to other questions in order to allow this question to be answered in an effective way. Once answers to other questions have been obtained, prioritization of this question should be revisited. At that point, we will have information indicating which, if any, tools and data appear to be problematic, allowing more meaningful review of these issues. SAWS=General comment - Column B & C SAWS is not ranking (see above) There is a lot to unpack with this question. SAWS would say that the EAHCP program documents developed and approved constituete the management responses for conditions based situations. These management responses are based on the most up to date MODFLOW GW model that informs an Ecological Model (River hydraulics, Water quality, Submerged Vegetation, and Fountain Darters) EAHCP Contract No. 13-637-HCP final completed May 19, 2017. When developing tools to help design the management it was determined mechanistically to build the model on the species FD that the most information was available on, so that it could be built and useful for the program. This based on the information available, which to SAWS knowledge has not expanded enough related to the other sentinal species was the only way marker management strategies where field calibration was/is logical. CPS=Yes, current tools do predict future drought conditions with the exception of Climate Change issues like is currently being seen in the western U.S. The question is the level of sensitivity adequate. Models don't provide all answers, they are a tool but real data is needed especially when there is no/little data at low flow for calibration. With the unknowns of Climate Change happening and possible extreames that could occur the work in the refugia(s) become more important.

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	CWK=Data may not be available to make iinterprtations beyonn what has already been done. JDUKE=A major question here is whether these flow paths are occupied by covered species. MH=Would be very useful to know for development planning/recharge protection to enhance the water quantity and water quality of springflow. May be an opportunistic study similar to 1-2, 1-3, and 1-4, it is important to keep on this list as potential study if the conditions present themselves. TLA=Cost: No Clue. Ranked low because I can't see how flowpaths can be managed. KM=Would be very useful to know, but would be very challenging to quantify. Could help with local management decisions on land protection and water quantity and quality protections. Could also help understand how spatial habitat availability will change with changing spring flow location contributions. May be an opportunistic study similar to 1-2, 1-3, and 1-4, it is important to keep on this list as potential study if the conditions present themselves. AY= TPWD= EAA=Cost high. Chasing individual flow paths in a complex karstic environment appears to be a high cost effort with a low reward. It's recognized spring runs go dry during drought. I would pursue existing dye-trace data before initializing a new effort. MJH=I view this question as being closely related to Question 1-3 and to some extent to Question 1-5. However, I think this question has a predictive aspect for flow-persistence, through determination of association with fault blocks, that will not necessarily be addressed through those other questions. I have proposed rankings based on the assumption, consistent with the language of the note in the proposed charge, that non-invasive approaches for undertaking this work can be identified. I also assumed this question would fall in the high cost category, even for the initial flow-path aspect. Presence of Covered Species aspect appears to overlap with Question 1-2 and I assume will involve high cost. SAWS=SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. The structural geology as currently best understood and modeled is incorporated in the MODFLOW GW model which is widely accepted as the regional tool for simulating the Edwards Aquifer. During the EARIP process it became generally understood that some of the regional flow bypasses Comal and contributes to San Marcos. Logically precipitation or contributing flows sourced from other aquifers may play some role in future contributions to recovery. SAWS ranks the category D as generally a low contribution to management of the ecosystem. The caveat would be the setting of new wells as getting closer to spring ecosystems in Comal and San Marcos counties - ex. the original LCRA power plant well. EAA has permitting and oversite authority for these types of activity. CPS=This is good infromation but I'm not sure that knowing the flow paths is that helpful. In drought, there would likely be little rain so how or why does the flowpath matter if there is no water. Theis group doesn't regulate pumping so I'm struggling to determine how this is useful when there is little water available. The EAA has been studing the hydrology of the aquifer for years, so assuming this would take extensive studies to determine.

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	CWK=This is not the arena for more genetic studies. JDUKE=I think genetics studies can potentially provide valuable information in the connectivity and movement of beetles. It may also be able to discern where the beetles go when springs are low/dry. MH=not informed enough to provide ranking, but I do think the question is of value. TLA=Cost: Medium. Potentially high benefit in all 3 categories and another tool to support ongoing population studies and population stability questions. KM=I am not informed enough to provide ranking, but I do think the question is of value. AY= TPWD=Low cost EAA=High. MJH=This inquiry is intended to take advantage of ongoing work to gain new insights on how riffle beetle populations have been affected by previous periods of very low flows with the goal of using those insights for an improved understanding of the likely impact of future low flow periods. The precise timing of this work is dependent on completion of ongoing studies, which are expected to be completed soon. The initial work of assessing results of the current studies, likely would be low cost and could provide important new insights. If assessment of variations of ongoing studies or other studies becomes necessary, the cost likely would escalate significantly. SAWS=SAWS is not ranking column B due to positive NAS findings and its survival during the drought of the 50's with 4 months consecutive springflows cessation and survival. The Comal riffle beetle as one of the covered and sentinel benchmarking species for the EAHCP program was provided with positive hope for some of the ongoing genetics work during our SHPWG meetings. Due to these reasons SAWS sees upside for columns C & D rankings. Since the genetics work is still new and primarily simulated math it will likely be viewed as limiting leading to a low ranking related to biological goal and objectives setting. When considering a ranking for "new" and "important" information the genetics work presents the best case of noninvasive simulation, during the EARIP process the group decided against a few proposed studies and mitigations till more was understood about the species. CPS=1 & 2) Adds some value but usefulness around flow issues is undetermined. While interesting and useful in some ways, genetics may not be directly related to the flow issue we are specifically tasked to consider. 3) Do not know if information gained will improve management measures during low flow. Additionally, Genetics work is usually more expensive.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	CWK= JDUKE=This doesn't appear to happen considerably at 8 cfs. If the question were 'flows much lower than 80 cfs' this question become more valid and valuable. MH=this probably could be easily included in the other studies that would be done as flows dropped. TLA=Cost Low. Many simple WQ models available to assess this question. Significant scientific Literature exists on effects of decaying vegetation on DO and BOD in freshwaters. KM=This question may include two approaches - a lab study (veg die-off and DO) and a spatial analysis of habitat loss with low flow conditions. This study could be informed by using results from addressing 1-1, 1-5, and 1-6. **need to add temperature to this question. AY= TPWD=Medium-high cost EAA=High. MJH=Although the potential for vegetative die-off during extended periods of very low flow remains an unknown risk, conditions during less intense low-flow periods have not indicated the likelihood of a high risk level. However, because of the significance of potential impact, this risk should continue to be assessed. SAWS=SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. The best tool currently available to the EAHCP is the Ecological Model (River hydraulics, Water quality, Submerged Vegetation, and Fountain Darters) EAHCP Contract No. 13-637-HCP final completed May 19, 2017. When developing tools to help design the management it was determined mechanistically to build the model on the species FD. Though this tool is limited expansions for other specific species will be expensive (especially until their dynamics maps can be created with data from current research). The feasibility, time and cost involved will be extensive and may only be applicable in the future. CPS=Major shifts in vegetation would be expected to have negative impacts especially in a quick die off. Otherwisea slow die off would probably less impactful. Was going to rate as high but changed it to medium.

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	CWK=should be easy to resolve JDUKE= MH=I think this could be answered fairly easily with flow, water surface elevation, and bathymetry models. And also has a straightforward solution - dams can be modified as needed to ensure species survival. TLA= KM=Reasonable feasible. I think this could be answered with flow, water surface elevation, and bathymetry models. It would be useful to know at what discharge flows cease to flow over eastern spillway. We need a better idea of how much water is going over both western and eastern spillway under flow conditions below 80cfs. AY= TPWD=Low cost EAA=Low. MJH=As Ed Oborny noted there are San Marcos salamanders located downstream of both ends of the dam, which should be factored into consideration of how information gained might inform responses. Cost for undertaking this work is likely to be quite low. SAWS=Like questions 1-2 and 2-1 SAWS fails to see under specific sub habitat protectiveness exclusively set on an arbitrary flow value above “minimum continuous” springflow, which the program mitigates for. Past presentations by Hardy described incidental take of the FD from 80 cfs to 30 cfs. The ecological model capitalizes on modeling the knowns and simulating the system responses and not specific downscaled resolutions of the system. The data and feasibility for any of the higher resolution questions would just have investigators asking for more field calibrated information or creating simulations that conflict with the overall system findings by NAS. CPS=
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	CWK=Drought conditions are going to push floaters and swimmers to the San Marcos River. A strong program on how to control over use is needed. Very critical! JDUKE=Recreation is an ongoing human impact that will remain worth studying, especially during low flows. MH=As recreation increases, there may be a need to regulate it at certain low flow levels, and there is a need for data to support that potential effort. We know that impacts occur daily during the recreation season but don't know the significance on the species. We need to know when recreation should be curtailed for species survival. This study is important and feasible. TLA=Cost Low. 3-3 better adressed in 3-4. Suggest removing 3-3. KM=Reasonably feasible. We need more info on recreation impacts to TWR and we need a better understanding on impacts to fountain darter and salamander (little to non is known). As recreation increases, there may be a need to regulate it at certain low flow levels, and there is a need for data to support that potential effort. AY=It would be helpful to have data on recreational impacts. TPWD=Low cost EAA=Based on the data collected over the first half of the program, it seems the ability to create TWR is not terribly difficult. Currently, it has undergone a 3-4 fold expansion in ~ 7 years. MJH=Improved understanding of recreational impacts can inform future management approaches, particularly in the San Marcos system. This question and Question 3-4, which focuses more on approaches for limiting recreational impacts, are two parts of a related inquiry and I have ranked them accordingly. I think this would be low cost work. SAWS=General comment - Column B SAWS is not ranking. Revisiting Certificate of Inclusion (COI) based on formal scientific collected data may be one of the more readily adaptive management measures available for future management/protection of the two spring systems. Ecosystem modeling performed for the current existing - compliant ITP issuance assumed habitat condition with full historical recreational activities. The Ecosystems understanding could be much better understood and managed through a better appreciation of the recreational usages and potential management for future simulation(s). SAWS ranks this high in effect in two categories because it can likely only enhance the Biological goals/objectives baseline success through management and a great deal was empirically witnessed with Covid restrictions. CPS=Recreational impacts continue to be a significant concern. Evaluations after 2020 and the Covid lockdown are critical for shedding light on how much impact recreation has had. Hopefully every opportunity to collect data has occurred before this summer season begins. Impacts are easily preventable. Recreation is great and has economic value but species should not be put at risk.

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	CWK=covered in question 3-3 JDUKE=There's been a lot done on this but as 3-3 provides information, it will facilitate answers to this question. MH=Related to 3-2 and 3-3. Modeling in 1-1, 1-5, and 1-6 may inform this. should be easily answered from those models, should not require a special study TLA=Cost low for assessment and implementation. KM=Feasible. Related to 3-2 and 3-3. We need to revisit the SSAs and ensure adequate protections are in place during low flows to protect most suitable habitat for covered species. Modeling in 1-1, 1-5, and 1-6 may inform this. AY= TPWD=Low cost EAA=Medium. MJH=Improved understanding of recreational impacts can inform future management approaches, particularly in the San Marcos system. This question and Question 3-3, which focuses more on identifying the best locations for exclosures, are two parts of a related inquiry and I have ranked them accordingly. I think this would be low cost work. SAWS=SAWS is not ranking column B due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. CPS=This would be very informative and seems like it could be realistically accomplished. Infromation gained may translate to other areas of the springs.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	CWK=covered in question 3-3 JDUKE=I assume that this is being done by ongoing work already. MH=Seems feasible with existing and ongoing data collection and would provide a lot of valuable information that could inform question 3-4. TLA=Combine with 3-4. KM=Seems feasible with existing and ongoing data collection and would provide a lot of valuable information that could inform Q 3-4. AY= TPWD=Subset of 3-4; note that the SMRSSA rule speaks to exclosures for Texas wild-rice but not fountain darters, so there may be some limitations there EAA= MJH=In particular, it may be important to focus on areas where exclosures for protection of wild-rice would provide high benefit for fountain darters, although we also should understand any shortcomings in protection of fountain darters through use of exclosures, which are focused on wild-rice protection. This information is needed for answering Questions 3-3 and 3-4. This likely would be a low cost undertaking. SAWS=SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. Column D related to this topic easily provides "New" and "Important" information as it relates to the use of SSA's and habitat/populations for fountain darters. SAWS would only add why the SSA tool is limited to the San Marcos system and potentially other species could benefit from new SSA's, even if temporary during low flows. Therefore SAWS provided a medium ranking for column D. CPS=Important and can be reasonably accomplished.

Question to rank	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	CWK=See response to Question 1-6 JDUKE= MH=This question(s) would be answered in combination with 1-1, 2, 3, 4. Perhaps these should be combined in one study. This combination is the most critical of all the questions in the matrix. TLA=Combine with 1-1, 1-4 and 1-5. Cost Medium-High. With combinations, rankings across 3 ranking categories all are High. KM=Very important for predicting frequency and duration of low flows for flow protection management /mitigation. The second part of this question seems to be why we are asking many of these other questions, we don't know the impacts on the covered species - maybe this is too broad of a question. AY= TPWD= EAA=The first question has been described in the VISPO AMP SER. The second question has been answered for the darter via the EcoModel. Other species have not been specifically approached. MJH=More extensive evaluation of flow levels predicted by the updated model likely would be a low cost undertaking because the model runs already exist. Assessment of the significance of those durations for Covered Species would be much more challenging. Answers to various other questions identified by the Work Group would be required to assess that significance, which is reflecting in my assigned ranking. Although this work is needed, it likely makes sense to delay it until other key questions are addressed. SAWS=SAWS is not ranking column B due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. Based on the broad nature of this question and lack of basic species data, benchmarking of the subterranean Comal Springs endangered riffle beetle SAWS believes a future permit will benefit from better understanding, which has already been advanced by USFWS related to sampling techniques biological objectives and goals as well as new information will be available from current studies. However, this proposed modeling offers little value as described as an updated modeling exercise. (Over $2M of modeling and similar expenditures in scientific review has been spent in support of the current issued permit. CPS=
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	CWK=Minor concern JDUKE= MH=Like many of the other questions, this may not be feasible to study unless low flow conditions occur. But it should be included in the pack of studies that will be performed as flows decrease. TLA=Cost Low. Simple lab and field sedimentation experiments, existing sedimentation models. KM=May not be feasible to study unless low flow conditions occur. This is valuable to keep on the list because it could be an opportunistic study. It could provide insight related to other questions regarding spatial locations of suitable habitats during low flow conditions. AY= TPWD= EAA= MJH=This is acknowledged as a significant issue in the EAHCP ("Siltation around spring openings will likely be the biggest detriment to the salamander population in Spring Lake at extremely low flows." p. 4-140). However, it likely would be quite difficult to evaluate through a modeling exercise. If included as an explicit evaluation to be added to monitoring during low flow, along with collection of baseline information, it likely could be undertaken at low cost. SAWS=SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. Column D as described "important" new information is being ranked as LOW for the threatened San Marcos salamander by SAWS in that the proposed flow understanding between 30 cfs and 80 cfs for the species in question are and were understood with the tools used for evaluation of issuance of the permit evaluations. SAWS felt that because of the word new it would be unfair to not rank, but the flow modeling is an may be better understood and managed than some other threats and priorities facing the regional EAHCP. CPS=We probably have a good idea this isn't good, but with less turbulance there should generally be less silt input into the system.

Question to rank	Cost Perspective	Feasible to address?	Opportunistic Monitoring
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	Low to medium	Yes	NA
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	Variable low to high	No	Yes
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Variable low to high	Yes	Yes
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Low	Unclear	Yes
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	Variable low to high	Unclear	Unclear
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	Medium	Unclear	Unclear
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	High	Unclear	Yes
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	Variable low to high	Unclear	No
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	Variable low to high	No	Yes
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Low	Yes	Unclear
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	Low	Yes	Unclear
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Low to medium	Yes	Unclear
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	Unclear	Yes	Unclear
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	Variable low to high	Unclear	Unclear
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Low	No	Yes

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	High	high	high	If this evaluation has not already been done, it is logical from a cost and science basis that the Hardy modell should be used with 2014 data.
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	High	High	high	It is imoprtant to understand which springs contain endangered species and which springs go dry during low flow conditions. If data are available for this issue from the 2014 drought, this analysis would greatly help.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Low	Low	Low	This should be a relatively easy question to answer by looking at a bathymetric map of Landa Lake.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Medium	Medium	
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	Low	Low	Low	Hopefully the use of the Hardy model is acceptable, which negates the need for creatng another model
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	High	High	High	Much of our understanding of low spring flow conditions are based on a comparison to the drought of the 50's. The next severe drought may not look like the 50's. So we need to have scenarios that adresss a range of possible drought scenaios which migght occur. This should be duable through a series of modeling runs.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	Medium	Medium	Medium	Data may not be available to make iinterprtations beyonn what has already been done.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	Low	Low	Low	This is not the arena for more genetic studies.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	Medium	Medium	Medium	
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Medium	Medium	Medium	should be easy to resolve
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	High	High	High	Drought conditions are going to push floaters and swimmers to the San Marcos River. A strong program on how to control over use is needed. Very critical!
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Low	Low	Low	covered in question 3-3
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	Low	Low	Low	covered in question 3-3
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	High	High	High	See response to Question 1-6
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Low	Low	Low	Minor concern

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	Low	Low	Low	I ranked this low because I feel that after listening to the experts and dialoguing with them, it is clear that the Hardy model has been shown to do these things, so spending more money/effort evaluating it is a low priority (these funds/efforts could be better allocated elsewhere).
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	High	High	High	
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Low	Low	Low	Temps at 80 cfs didn't seem to be a major concern based on expert presentations.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Medium	Medium	
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	Low	Low	Low	I don't think it would be prudent to begin searching for or creating a new model at this point.
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	High	High	High	
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	High	High	High	A major question here is whether these flow paths are occupied by covered species.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	High	High	High	I think genetics studies can potentially provide valuable information in the connectivity and movement of beetles. It may also be able to discern where the beetles go when springs are low/dry.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	Medium	Medium	Medium	This doesn't appear to happen considerably at 8 cfs. If the question were 'flows much lower than 80 cfs' this question become more valid and valuable.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Low	Low	Low	

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	High	High	High	Recreation is an ongoing human impact that will remain worth studying, especially during low flows.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Medium	Medium	Medium	There's been a lot done on this but as 3-3 provides information, it will facilitate answers to this question.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	Medium	Medium	Medium	I assume that this is being done by ongoing work already.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	High	High	High	
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Low	Low	Low	

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	High	High	High	The value of determining if the model is effective and suitable to projecting impacts of low flow regime is high because it is already developed, but there is uncertainty of application with low flows below 80cfs. This is a feasible and valuable study. Determining a flow regime that sustains the species is critical. At this time, we cannot fully answer that question.
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	Medium	Medium	High	This is important information for the riffle beetle and SM Salamander, but may not be feasible to obtain. May take significant amounts of dye testing or opportunistic low flow conditions. Important to retain the question but not push it for an RFP unless low flow conditions occur making this more practical to investigate.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Medium	Medium	High	Like Question 1-2, this seem to be important information for the species, but must be obtained during low flow periods, so is an opportunistic study. Hold in the "basket" for future opportunities.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Medium	High	Similar comments as Q 1-2 & 1-3. Should this question include impacts to temperature?
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	High	High	High	It is valuable to look for updated approaches (other options/alternatives) to be explored if the Hardy model does not prove to be effective.
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	High	High	High	Feels redundant to questions 1-1 and 1-6. The Hardy model is over ten years old, so it's important to look at the field to see if there is another model or approach that would better answer the questions.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	Medium	Medium	High	Would be very useful to know for development planning/recharge protection to enhance the water quantity and water quality of springflow. May be an opportunistic study similar to 1-2, 1-3, and 1-4, it is important to keep on this list as potential study if the conditions present themselves.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?				not informed enough to provide ranking, but I do think the question is of value.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	Medium	Medium	Medium	this probably could be easily included in the other studies that would be done as flows dropped.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Medium	Medium	Medium	I think this could be answered fairly easily with flow, water surface elevation, and bathymetry models. And also has a straightforward solution - dams can be modified as needed to ensure species survival.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	High	High	High	As recreation increases, there may be a need to regulate it at certain low flow levels, and there is a need for data to support that potential effort. We know that impacts occur daily during the recreation season but don't know the significance on the species. We need to know when recreation should be curtailed for species survival. This study is important and feasible.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Low	Low	Low	Related to 3-2 and 3-3. Modeling in 1-1, 1-5, and 1-6 may inform this. should be easily answered from those models, should not require a special study

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	High	High	High	Seems feasible with existing and ongoing data collection and would provide a lot of valuable information that could inform question 3-4.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	High	High	High	This question(s) would be answered in combination with 1-1, 2, 3, 4. Perhaps these should be combined in one study. This combination is the most critical of all the questions in the matrix.
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Medium	Medium	Medium	Like many of the other questions, this may not be feasible to study unless low flow conditions occur. But it should be included in the pack of studies that will be performed as flows decrease.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	Medium	Medium	Medium	Cost Low. Requires evaluation of other WQ models to Hardy's. Hardy's model not well peer literature review evaluated.
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	High	Medium	Medium	Cost Medium.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Low	Low	Medium	Cost Low. Desktop evaluation of existing data.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Medium	Medium	Cost Low, mirrors Question 1-1.
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	Medium	Medium	Medium	Cost Low. There are several major review papers on stream/freshwater WQ models and strengths and weaknesses of each. Perhaps comine 1-1, 1-4 and 1-5 from synthetic perspective = Cost Medium.
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	Medium	Medium	Medium	Cost Medium. Down the line project incorporating regional/local Climate Change models. Consult with Katherine Hayhoe.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	Low	Low	Low	Cost: No Clue. Ranked low because I can't see how flowpaths can be managed.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	Medium	Medium	Medium	Cost: Medium. Potentially high benefit in all 3 categories and another tool to support ongoing population studies and population stability questions.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	Medium	Medium	Medium	Cost Low. Many simple WQ models available to assess this question. Significant scientific Literature exists on effects of decaying vegetation on DO and BOD in freshwaters.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Low	Low	Low	

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	Medium	Low	Medium	Cost Low. 3-3 better adressed in 3-4. Suggest removing 3-3.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	High	High	High	Cost low for assessment and implementation.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	Medium	Medium	Medium	Combine with 3-4.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	Medium	Medium	Medium	**Combine with 1-1, 1-4 and 1-5. Cost Medium-High. With combinations, rankings across 3 ranking categories all are High.**
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Low	Low	Low	Cost Low. Simple lab and field sedimentation experiments, existing sedimentation models.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of spring flows below 80 (cubic feet per second) cfs?	High	High	High	Model is already developed and currently being used, but there is uncertainty with its application for low flows. This is also a good exercise to gage the need for an updated modeling approach. Reasonably feasible.
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	Medium	Medium	High	Important question, but may be difficult/challenging to examine through simulation modeling. May take significant amounts of dye testing or opportunistic low flow conditions. Important to retain the question but not push it for an RFP unless low flow conditions occur making this more practical to investigate.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Medium	Medium	High	Similar comments as Q 1-2.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Medium	High	Similar comments as Q 1-2. Should this question include impacts to temperature?
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	High	High	High	It is valuable to re-evaluate the model and look for updated approaches (other options/alternatives) to be explored. This could help inform some of the other questions related to better understanding habitat availability or covered species responses to low flow conditions.
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make spring flow management decisions during periods of extended low flows?	High	High	High	It seems like this Q, 1-1 and 1-6 could be related in terms of the need for re-evaluating and updated the existing models. The management decisions/actions for low flows could be re-evaluated. While there are some existing protections for mitigating low flows, there is not a clear plan for adaptive management during extended severe drought conditions, and that seems like a very important need. This may even relate to management decisions regarding exploring environmental flow augmentation to the springs or increased recreation regulations, etc...
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	Medium	Medium	Medium	Would be very useful to know, but would be very challenging to quantify. Could help with local management decisions on land protection and water quantity and quality protections. Could also help understand how spatial habitat availability will change with changing spring flow location contributions. May be an opportunistic study similar to 1-2, 1-3, and 1-4, it is important to keep on this list as potential study if the conditions present themselves.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	Medium	Medium	Medium	I am not informed enough to provide ranking, but I do think the question is of value.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low spring flow in the future in both systems?	High	High	High	This question may include two approaches - a lab study (veg die-off and DO) and a spatial analysis of habitat loss with low flow conditions. This study could be informed by using results from addressing 1-1, 1-5, and 1-6. **need to add temperature to this question.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	High	High	High	Reasonable feasible. I think this could be answered with flow, water surface elevation, and bathymetry models. It would be useful to know at what discharge flows cease to flow over eastern spillway. We need a better idea of how much water is going over both western and eastern spillway under flow conditions below 80cfs.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	High	High	High	Reasonably feasible. We need more info on recreation impacts to TWR and we need a better understanding on impacts to fountain darter and salamander (little to non is known). As recreation increases, there may be a need to regulate it at certain low flow levels, and there is a need for data to support that potential effort.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	High	High	High	Feasible. Related to 3-2 and 3-3. We need to revisit the SSAs and ensure adequate protections are in place during low flows to protect most suitable habitat for covered species. Modeling in 1-1, 1-5, and 1-6 may inform this.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	High	High	High	Seems feasible with existing and ongoing data collection and would provide a lot of valuable information that could inform Q 3-4.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum spring flow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	High	High	High	Very important for predicting frequency and duration of low flows for flow protection management /mitigation. The second part of this question seems to be why we are asking many of these other questions, we don't know the impacts on the covered species - maybe this is too broad of a question.
Question 4-2: What is the likely effect of extended periods of spring flows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Low	Low	Low	May not be feasible to study unless low flow conditions occur. This is valuable to keep on the list because it could be an opportunistic study. It could provide insight related to other questions regarding spatial locations of suitable habitats during low flow conditions.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?				
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?				
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?				
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?				
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?				
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?				Our predicitons are based on assumptions that pumping will occur at maximum permitted amount every year, but since the EAA began regulating pumping,there has never been more than 450,000 acre-feet withdrawn in a single year. Recent diversification projects by SAWS make it even less likely that we will see consistent, maxium possible pumping. How can we use available data on historical and predicted pumping levels to improve our predicitons of the severity and duration of low flow events?
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?				
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?				
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?				
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?				

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?				It would be helpful to have data on recreational impacts.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?				
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?				
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?				
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?				

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	High	High	Medium	Medium cost
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	High	High	High	Medium cost
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Low	Medium	Medium	Could be expensive to undertake high resolution temperature-flow dynamics
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Medium	Medium	
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	High	High	Medium	Paired with Question 1-1, should be an outcome of Question 1-1 project
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	Medium	Medium	Low	
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	Medium	High	Medium	
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	High	High	Medium	Low cost

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted lowmedium springflow in the future in both systems?	High	High	High	Medium-high cost
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Medium	Medium	Low	Low cost
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	Medium	Medium	Low	Low cost
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Medium	Medium	Medium	Low cost
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	Medium	Medium	Low	Subset of 3-4; note that the SMRSSA rule speaks to exclosures for Texas wild-rice but not fountain darters, so there may be some limitations there
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	Medium	Medium	Medium	
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Medium	Medium	Low	

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	High	High	High	Probably low, but would depend on the ability of EAA staff to conduct the model runs. If handed to a third-party, most likely medium.
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	Low	Low	Low	Not sure what utility this would have for making future management decisions. I think it's widely recognized that at 30 cfs the springs at the bottom of the lake would likely be all that is left flowing. Concerning 'effects on Covered Species', EcoModel indicates darters can persist, past history suggest the other species were able to survive cessation of springflow for a period. No idea on costs.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	Medium	Medium	Medium	The Old Channel is an important in-stream refugium for the darter. Maybe worth examining. Low or medium.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Low	Low	Low	I suppose that would depend on the physio-chemical aspects of concern. The Water Quality monitoring program was reviewed by NAS and a Work Group, and is reported on annually in EAHCP annual report.
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?				
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?				Not sure I fully grasp the question. Water quantity predictions are available through MODFLOW simulations, water quality (temp and DO) are available through EcoModel report for repeat of DOR.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	Low	Low	Low	Cost high. Chasing individual flow paths in a complex karstic environment appears to be a high cost effort with a low reward. It's recognized spring runs go dry during drought. I would pursue existing dye-trace data before initializing a new effort.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	Medium	Medium	Medium	High.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	Medium	Medium	Medium	High.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Medium	Medium	Medium	Low.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	Low	Low	Low	Based on the data collected over the first half of the program, it seems the ability to create TWR is not terribly difficult. Currently, it has undergone a 3-4 fold expansion in ~ 7 years.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Medium	Medium	Medium	Medium.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?				
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	Low	Low	Low	The first question has been described in the VISPO AMP SER. The second question has been answered for the darter via the EcoModel. Other species have not been specifically approached.
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Medium	Medium	Medium	

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	High	Medium	High	Validation of modeling results can address critical uncertainties. Water quality predictions play an important role in numerous aspects of the EAHCP, including the ecological model. Using data previously collected during relatively low flow conditions in a validation exercise represents low-hanging fruit for use in helping to understand how well the modeling predictions match the data. The task likely could be undertaken at low cost.
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	High	High	High	Numerous aspects of the flow objectives are based on assumptions about where flow will emerge during low flow periods. Having a better understanding of the accuracy of those assumptions will provide significant benefit in understanding impacts of various flow levels, the need for periods of increased flow to interrupt periods of low flow, and management approaches for benefiting Covered Species during extended low flow periods. Building on recently collected information, identifying which spring openings continue to flow could be a low cost undertaking if assessed along with monitoring during low flow periods. Just answering that aspect of the question would provide important insights. Costs for analysis of effects on Covered Species likely would be high, depending on level of analysis undertaken and species considered. Use of eDNA approaches might provide useful information on presence of riffle beetle for specific flow paths (although practicality of sample collection for underwater spring openings would need to be assessed), but likely would be high cost.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	High	High	High	The premise that springflow is uniformly mixed in Landa Lake is a critical, but unproven, assumption underlying modeling predictions of temperature levels in the Old Channel and the likelihood of successful fountain darter reproduction there during extended periods of low flow. Questions about that assumption are expressly acknowledged in the modeling report. If assessed as an add-on during monitoring of future low flow conditions through strategic deployment of temperature sensors, this information likely could be obtained at low cost and should be incorporated now into monitoring protocols to ensure information is gathered when low flow conditions return. Alternatively, more sophisticated approaches might be considered for gaining insights more quickly, although likely at higher cost and only with good information about locations of springflow emergence during low flow conditions.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Low	Low	Because the nature of the inquiry is somewhat unclear to me (e.g., what additional data are anticipated for collection), I find it difficult to rank. Similarly, it is difficult to offer a cost estimate without understanding what additional data would be proposed for collection. The spring location aspects might be addressed pursuant to Question 1-2 or Question 2-1, if one or both of those questions are prioritized highly. Similarly, there may be overlap with Question 2-1 with respect to physiochemical aspects.
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	Medium	Low	Medium	These valuations all assume that Question 1-1 is prioritized highly and is answered in a way that supports accuracy of predictions for existing modeling. If the existing modeling is indicated as likely inaccurate, then relative prioritization of this question should be revisited.
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	Low	Low	Low	These proposed prioritizations reflect the value of getting answers to other questions in order to allow this question to be answered in an effective way. Once answers to other questions have been obtained, prioritization of this question should be revisited. At that point, we will have information indicating which, if any, tools and data appear to be problematic, allowing more meaningful review of these issues.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	High	High	Medium	I view this question as being closely related to Question 1-3 and to some extent to Question 1-5. However, I think this question has a predictive aspect for flow-persistence, through determination of association with fault blocks, that will not necessarily be addressed through those other questions. I have proposed rankings based on the assumption, consistent with the language of the note in the proposed charge, that non-invasive approaches for undertaking this work can be identified. I also assumed this question would fall in the high cost category, even for the initial flow-path aspect. Presence of Covered Species aspect appears to overlap with Question 1-2 and I assume will involve high cost.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	High	High	Medium	This inquiry is intended to take advantage of ongoing work to gain new insights on how riffle beetle populations have been affected by previous periods of very low flows with the goal of using those insights for an improved understanding of the likely impact of future low flow periods. The precise timing of this work is dependent on completion of ongoing studies, which are expected to be completed soon. The initial work of assessing results of the current studies, likely would be low cost and could provide important new insights. If assessment of variations of ongoing studies or other studies becomes necessary, the cost likely would escalate significantly.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	High	Medium	Medium	Although the potential for vegetative die-off during extended periods of very low flow remains an unknown risk, conditions during less intense low-flow periods have not indicated the likelihood of a high risk level. However, because of the significance of potential impact, this risk should continue to be assessed.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Medium	Low	Medium	As Ed Oborny noted there are San Marcos salamanders located downstream of both ends of the dam, which should be factored into consideration of how information gained might inform responses. Cost for undertaking this work is likely to be quite low.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	Medium	High	High	Improved understanding of recreational impacts can inform future management approaches, particularly in the San Marcos system. This question and Question 3-4, which focuses more on approaches for limiting recreational impacts, are two parts of a related inquiry and I have ranked them accordingly. I think this would be low cost work.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Medium	High	High	Improved understanding of recreational impacts can inform future management approaches, particularly in the San Marcos system. This question and Question 3-3, which focuses more on identifying the best locations for exclosures, are two parts of a related inquiry and I have ranked them accordingly. I think this would be low cost work.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	High	High	High	In particular, it may be important to focus on areas where exclosures for protection of wild-rice would provide high benefit for fountain darters, although we also should understand any shortcomings in protection of fountain darters through use of exclosures, which are focused on wild-rice protection. This information is needed for answering Questions 3-3 and 3-4. This likely would be a low cost undertaking.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	Medium	Medium	Medium	More extensive evaluation of flow levels predicted by the updated model likely would be a low cost undertaking because the model runs already exist. Assessment of the significance of those durations for Covered Species would be much more challenging. Answers to various other questions identified by the Work Group would be required to assess that significance, which is reflecting in my assigned ranking. Although this work is needed, it likely makes sense to delay it until other key questions are addressed.
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	High	Medium	Medium	This is acknowledged as a significant issue in the EAHCP ("Siltation around spring openings will likely be the biggest detriment to the salamander population in Spring Lake at extremely low flows." p. 4-140). However, it likely would be quite difficult to evaluate through a modeling exercise. If included as an explicit evaluation to be added to monitoring during low flow, along with collection of baseline information, it likely could be undertaken at low cost.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?			Low	General comment - Column B & C are not receiving consideration or ranking by SAWS. The basis for the position is NAS findings, history of modeling concurrence for the existing program and presentations to the SHPWG 2020 confirm overall accepted protective findings. This is not to say that performing the sensitivity exercise using the existing tools under EAA's modeling group oversight and applicable water qualities available modeling approaches couldn't provide nuanced findings at a relative medium to low cost under the above broad cost categories. Under column D SAWS would rank as low based on past HCP annual work plan actions (removal aeration and specific thermistor intervention strategies or monitoring)
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?			Low	General comment - For columns B & C SAWS is not ranking (see above). Neither the GW model or specific singular spring orfi are exclusively responsible for ecosystem and covered species' survival. Species counts and weighted usable habitats of sentinel species are the overall mechanism of monitoring ecosystem health. To expand on the GW model, it has been shown to be a reasonable and conservative tool for assurances of minimum continuous discharge as a managed solution for endangered species critical and limited habitat. Under column D SAWS would rank as low but understands that compiling the mapping, observational flow context and in some cases subterranean habitat could or would provide context for site specific habitat.
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?			Low	General comment - Column B & C SAWS is not ranking (see above). HCP annual work plan actions sited under comments of Q 1-1 question placing additional importance to the information as described. Nearly a decade of HCP implementation activities and two decades of temperature data collection, which included the 2011-2014 stress period along with highest ambient air temperatures as part of the instrumental record have/has not resulted adverse impacts to the covered species based on monitoring results, incidental take reporting and annual reports to USFWS.
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?			Low	General comment - Column B & C SAWS is not ranking (see above). SAWS engagement with the 2016 Expanded Water Quality Work was and is recalled having optimized sampling plans for the monitoring of water quality pertinent for healthy spring ecosystems. The dominant thinking during HCP development and the streamlining of water quality data collection was towards that acute hazardous spill risk events were of greater risk to the healthy protected ecosystems than background in place attenuating constituents, but broad monitoring for problem signs was prudent measure.
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?			Low	General comment - Column B & C SAWS is not ranking (see above). If Q 1-5 is a follow-up dependent on Q 1-1 there is already a built-in prioritization making this question dependent and a follow-up. SAWS addressed that any Administration of EAA's Modeling group as it relates to other modeling considerations should be a periodic survey to remain relevant. The modeling for the EAHCP was/is extremely expensive and time consuming. It is appropriate to scan the space to see what others are doing but it is highly impractical within time frames and funding to constantly model. When a significant body of new information exists the ecosystem model could be looked at.
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?			Medium	General comment - Column B & C SAWS is not ranking (see above) There is a lot to unpack with this question. SAWS would say that the EAHCP program documents developed and approved constituete the management responses for conditions based situations. These management responses are based on the most up to date MODFLOW GW model that informs an Ecological Model (River hydraulics, Water quality, Submerged Vegetation, and Fountain Darters) EAHCP Contract No. 13-637-HCP final completed May 19, 2017. When developing tools to help design the management it was determined mechanistically to build the model on the species FD that the most information was available on, so that it could be built and useful for the program. This based on the information available, which to SAWS knowledge has not expanded enough related to the other sentinal species was the only way marker management strategies where field calibration was/is logical.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?			Low	SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. The structural geology as currently best understood and modeled is incorporated in the MODFLOW GW model which is widely accepted as the regional tool for simulating the Edwards Aquifer. During the EARIP process it became generally understood that some of the regional flow bypasses Comal and contributes to San Marcos. Logically precipitation or contributing flows sourced from other aquifers may play some role in future contributions to recovery. SAWS ranks the category D as generally a low contribution to management of the ecosystem. The caveat would be the setting of new wells as getting closer to spring ecosystems in Comal and San Marcos counties - ex. the original LCRA power plant well. EAA has permitting and oversite authority for these types of activity.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?		Low	Medium	SAWS is not ranking column B due to positive NAS findings and its survival during the drought of the 50's with 4 months consecutive springflows cessation and survival. The Comal riffle beetle as one of the covered and sentinel benchmarking species for the EAHCP program was provided with positive hope for some of the ongoing genetics work during our SHPWG meetings. Due to these reasons SAWS sees upside for columns C & D rankings. Since the genetics work is still new and primarily simulated math it will likely be viewed as limiting leading to a low ranking related to biological goal and objectives setting. When considering a ranking for "new" and "important" information the genetics work presents the best case of noninvasive simulation, during the EARIP process the group decided against a few proposed studies and mitigations till more was understood about the species.

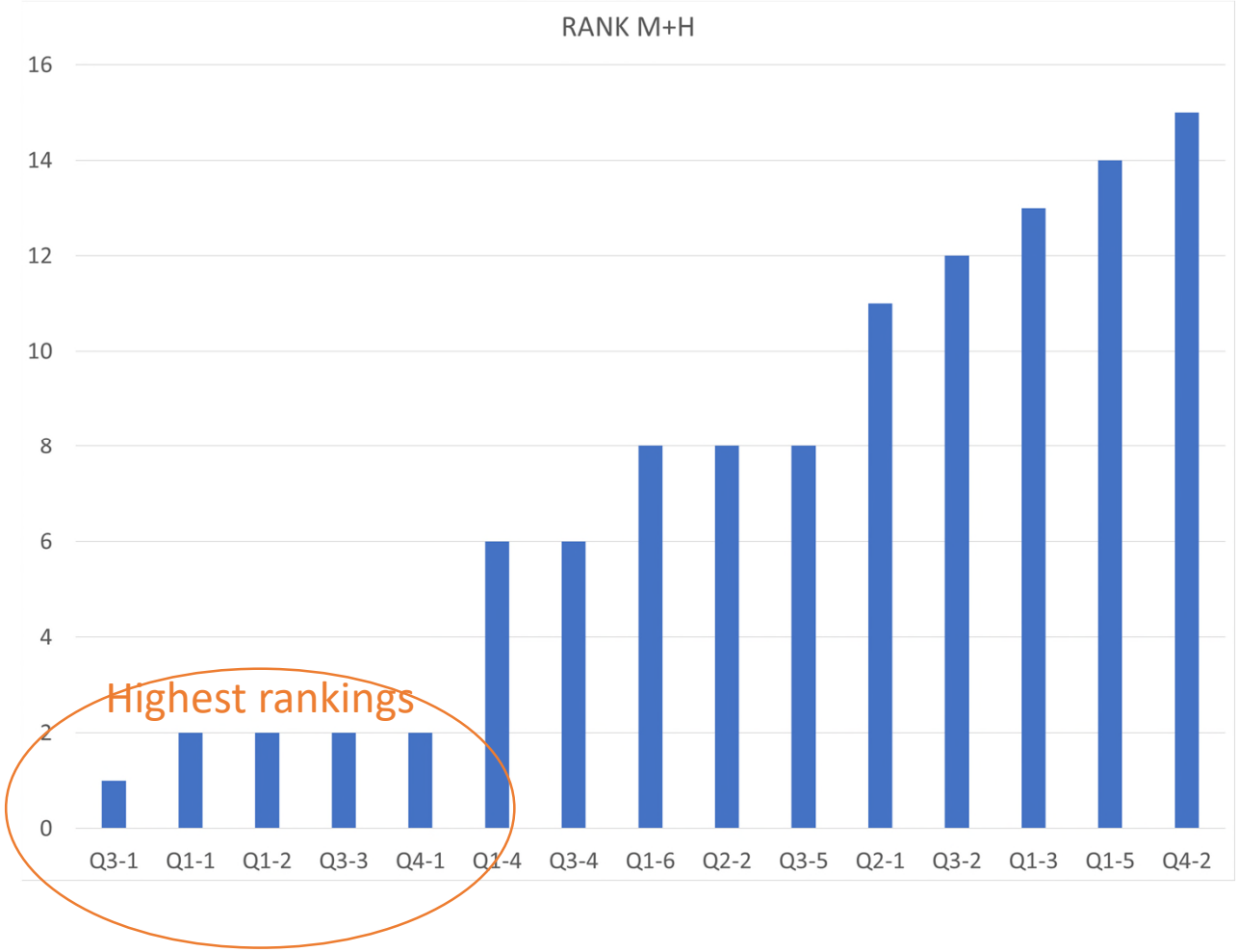
Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?			Low	SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. The best tool currently available to the EAHCP is the Ecological Model (River hydraulics, Water quality, Submerged Vegetation, and Fountain Darters) EAHCP Contract No. 13-637-HCP final completed May 19, 2017. When developing tools to help design the management it was determined mechanistically to build the model on the species FD. Though this tool is limited expansions for other specific species will be expensive (especially until their dynamics maps can be created with data from current research). The feasibility, time and cost involved will be extensive and may only be applicable in the future.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?			Low	Like questions 1-2 and 2-1 SAWS fails to see under specific sub habitat protectiveness exclusively set on an arbitrary flow value above "minimum continuous" springflow, which the program mitigates for. Past presentations by Hardy described incidental take of the FD from 80 cfs to 30 cfs. The ecological model capitalizes on modeling the knowns and simulating the system responses and not specific downscaled resolutions of the system. The data and feasibility for any of the higher resolution questions would just have investigators asking for more field calibrated information or creating simulations that conflict with the overall system findings by NAS.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?		Medium	High	General comment - Column B SAWS is not ranking. Revisiting Certificate of Inclusion (COI) based on formal scientific collected data may be one of the more readily adaptive management measures available for future management/protection of the two spring systems. Ecosystem modeling performed for the current existing - compliant ITP issuance assumed habitat condition with full historical recreational activities. The Ecosystems understanding could be much better understood and managed through a better appreciation of the recreational usages and potential management for future simulation(s). SAWS ranks this high in effect in two categories because it can likely only enhance the Biological goals/objectives baseline success through management and a great deal was empirically witnessed with Covid restrictions.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?		Low	Medium	SAWS is not ranking column B due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?			Medium	SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. Column D related to this topic easily provides "New" and "Important" information as it relates to the use of SSA's and habitat/populations for fountain darters. SAWS would only add why the SSA tool is limited to the San Marcos system and potentially other species could benefit from new SSA's, even if temporary during low flows. Therefore SAWS provided a medium ranking for column D.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?		Low	Low	SAWS is not ranking column B due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. Based on the broad nature of this question and lack of basic species data, benchmarking of the subterranean Comal Springs endangered riffle beetle SAWS believes a future permit will benefit from better understanding, which has already been advanced by USFWS related to sampling techniques biological objectives and goals as well as new information will be available from current studies. However, this proposed modeling offers little value as described as an updated modeling exercise. (Over $2M of modeling and similar expenditures in scientific review has been spent in support of the current issued permit.
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?			Low	SAWS is not ranking columns B&C due to positive NAS findings, SHPWG work group meetings lack of specific improved adaptive management insight provided regarding the topic. Column D as described "important" new information is being ranked as LOW for the threatened San Marcos salamander by SAWS in that the proposed flow understanding between 30 cfs and 80 cfs for the species in question are and were understood with the tools used for evaluation of issuance of the permit evaluations. SAWS felt that because of the word new it would be unfair to not rank, but the flow modeling is an may be better understood and managed than some other threats and priorities facing the regional EAHCP.

Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 1-1: Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80 (cubic feet per second) cfs?	High	High	High	
Question 1-2: Which spring openings will still be flowing at various flow levels below 80 cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?	High	High	High	
Question 1-3: How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?	High	High	High	
Question 1-4: Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group, adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?	Medium	Medium	Medium	Good question. I believe the EAA does testing during low flows that will continue to inform the process.
Question 1-5: Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?	Medium	Medium	Medium	
Question 1-6: Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?	Medium	Medium	Medium	Yes, current tools do predict future drought conditions **with the exception of Climate Change issues** like is currently being seen in the western U.S. The question is the level of sensitivity adequate. Models don't provide all answers, they are a tool but real data is needed especially when there is no/little data at low flow for calibration. With the unknowns of Climate Change happening and possible extreames that could occur the work in the refugia(s) become more important.
Question 2-1: What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?	Low	Medium	Medium	This is good infromation but I'm not sure that knowing the flow paths is that helpful. In drought, there would likely be little rain so how or why does the flowpath matter if there is no water. Theis group doesn't regulate pumping so I'm struggling to determine how this is useful when there is little water available. The EAA has been studing the hydrology of the aquifer for years, so assuming this would take extensive studies to determine.
Question 2-2: How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?	Medium	Medium	Low	1 & 2) Adds some value but usefulness around flow issues is undetermined. While interesting and useful in some ways, genetics may not be directly related to the flow issue we are specifically tasked to consider. 3) Do not know if information gained will improve management measures during low flow. Additionally, Genetics work is usually more expensive.
Question 3-1: How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?	Medium	Medium	Medium	Major shifts in vegetation would be expected to have negative impacts especially in a quick die off. Otherwisea slow die off would probably less impactful. Was going to rate as high but changed it to medium.
Question 3-2: Over what section of Spring Lake Dam does flow move during periods with flows below 80 cfs?	Medium	Medium	Medium	

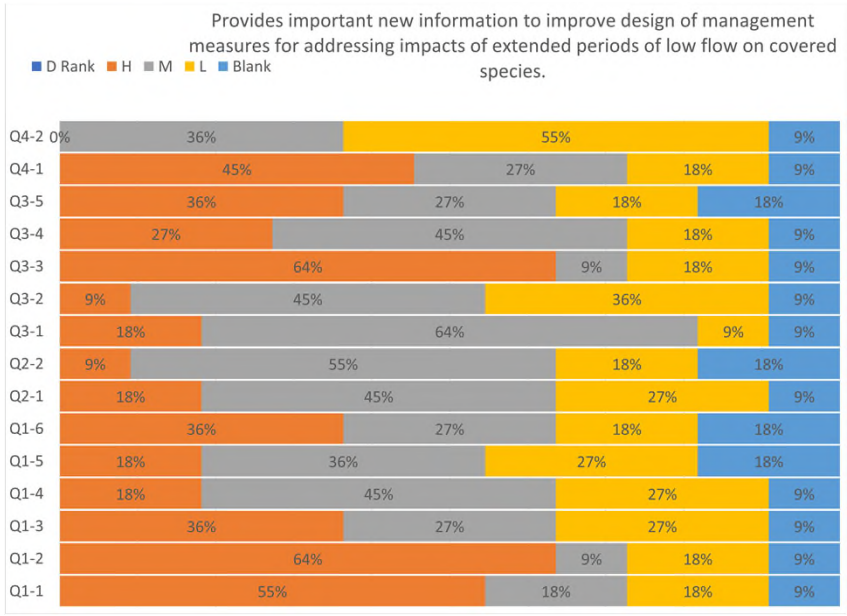
Question to rank	(Select High, Medium, Low from dropdown for each of applicable column.) Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan flow objectives; particularly the need for 80 cfs or a similar increased flow periodically during prolonged drought.	Adds value in clarifying uncertainty in the Edwards Aquifer Habitat Conservation Plan biological goals and associated objectives.	Provides important new information to improve design of management measures for addressing impacts of extended periods of low flow on covered species.	To the extent you have a perspective to share, you are encouraged to provide feedback including on factors affecting the appropriate ranking, feasibility of undertaking the underlying work, and likely cost (broad cost categories are high >$150K, medium $150K-$50K, or low <$50K). For questions with two discrete parts, feel free to provide feedback on those parts separately.
Question 3-3: What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows?	High	High	High	Recreational impacts continue to be a significant concern. Evaluations after 2020 and the Covid lockdown are critical for shedding light on how much impact recreation has had. Hopefully every opportunity to collect data has occurred before this summer season begins. Impacts are easily preventable. Recreation is great and has economic value but species should not be put at risk.
Question 3-4: What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) to ensure protections for Texas wild-rice, fountain darter, and the San Marcos salamander habitat during low flow conditions?	Medium	Medium	Medium	This would be very informative and seems like it could be realistically accomplished. Infromation gained may translate to other areas of the springs.
Question 3-5: Based on existing and ongoing data collection, what areas within the San Marcos system represent habitat important for maintaining fountain darter populations that can be factored into management decisions, in particular designation of exclosures under the SSA, during periods of low flows?	High	High	High	Important and can be reasonably accomplished.
Question 4-1: What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?	High	High	High	
Question 4-2: What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?	Medium		Medium	We probably have a good idea this isn't good, but with less turbulance there should generally be less silt input into the system.

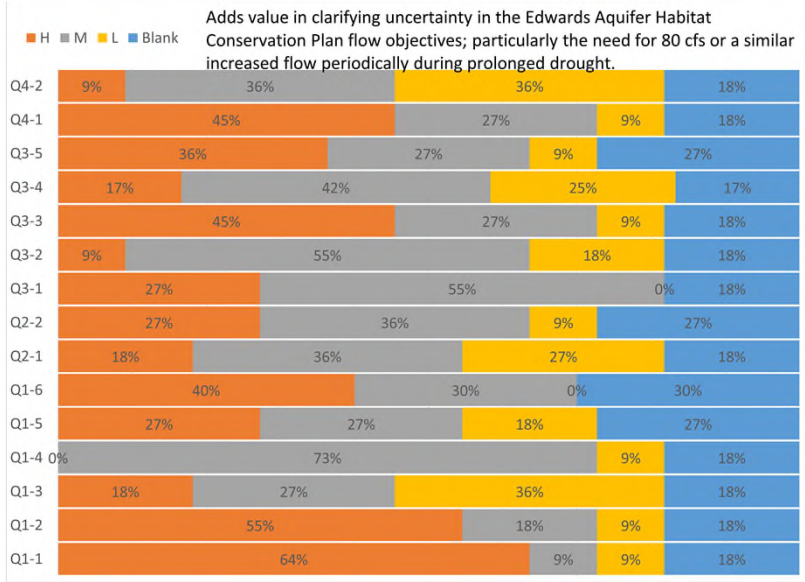
Appendix E

TPWD Summary
Lower number = higher rank

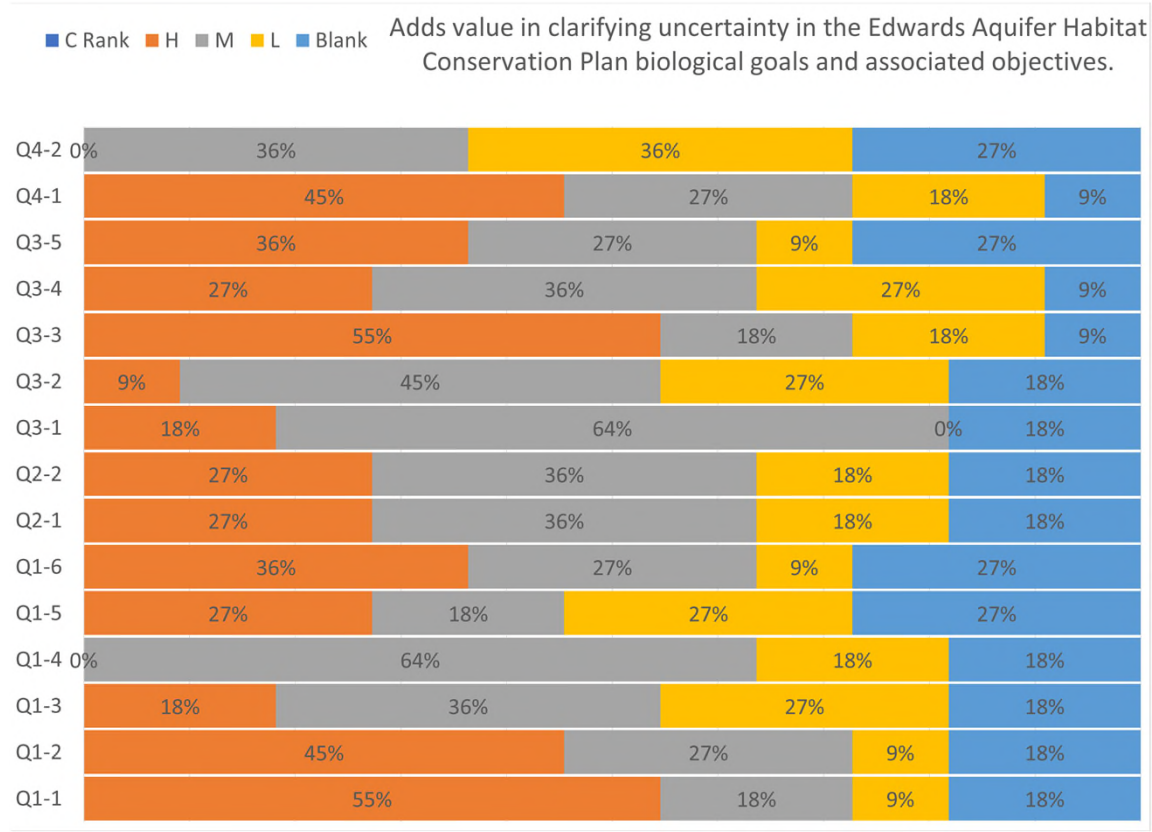


	H	M	H+M	L	RANK M+H
Q1-1	19	5	24	4	2
Q1-2	18	6	24	4	2
Q1-3	8	10	18	10	13
Q1-4	2	20	22	6	6
Q1-5	8	9	17	8	14
Q1-6	12	9	21	3	8
Q2-1	7	13	20	8	11
Q2-2	7	14	21	5	8
Q3-1	7	20	27	1	1
Q3-2	3	16	19	9	12
Q3-3	18	6	24	5	2
Q3-4	8	14	22	8	6
Q3-5	12	9	21	4	8
Q4-1	15	9	24	5	2
Q4-2	1	12	13	14	15





Jamie Childers illustrated responses received 7/16 for each category initially ranked by question where responses H+M+L+Blank = 100%

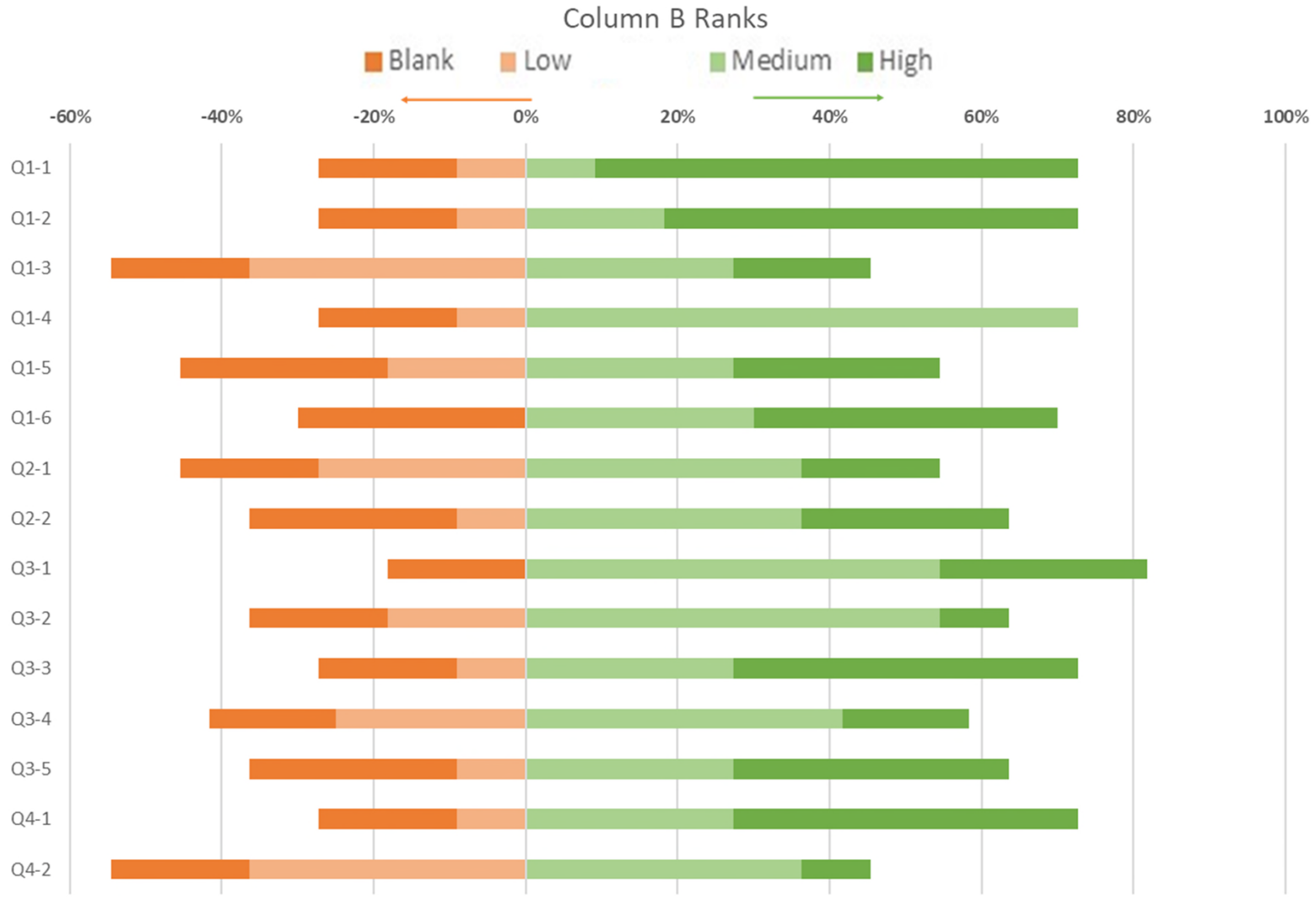


EAHCP SHPWG Rankings

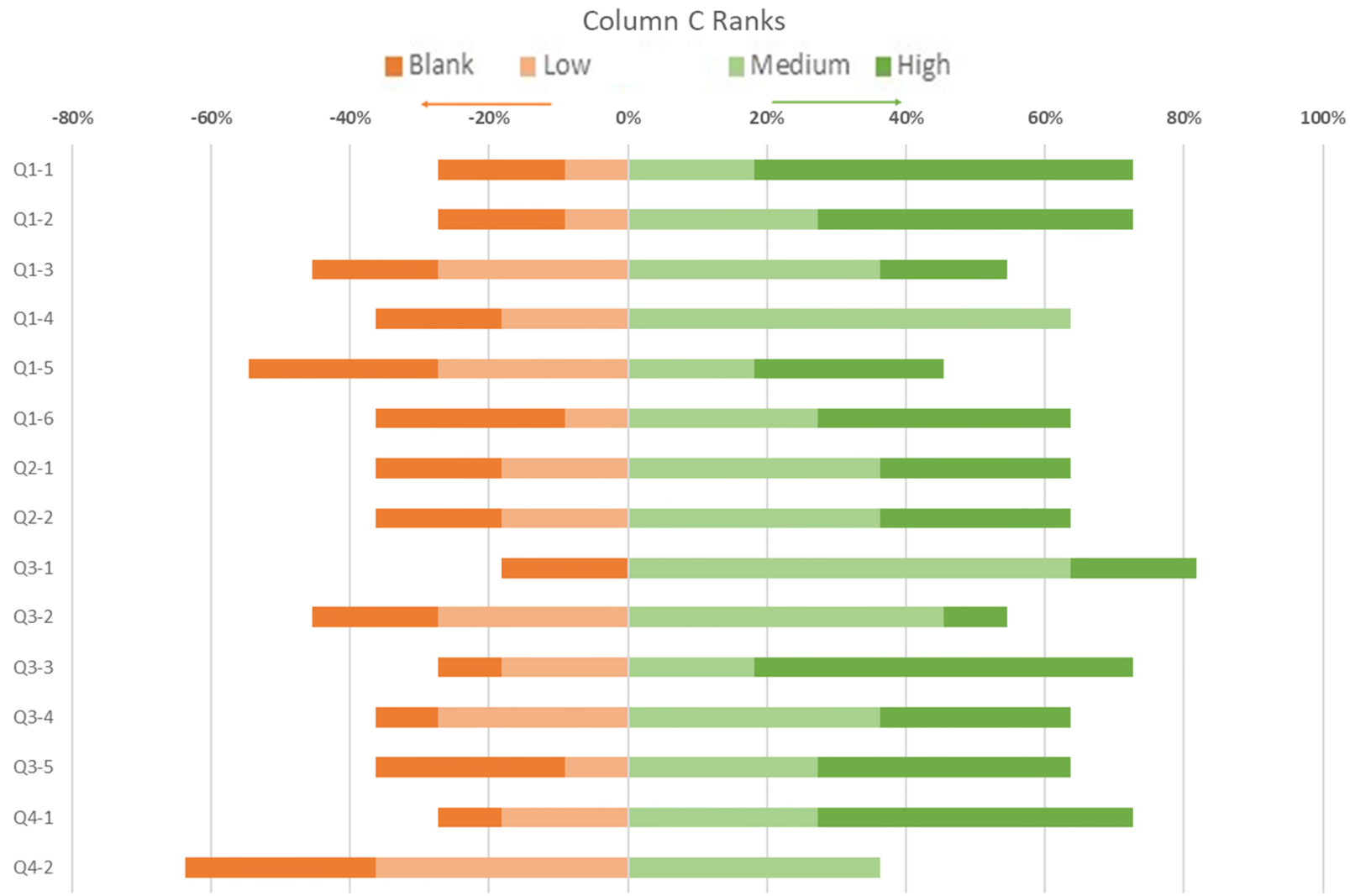
7-21-2021

This and next 4 slides are Patrick Shriver’s visualization of the initially ranked questions by category prior to our 7/21 meeting.

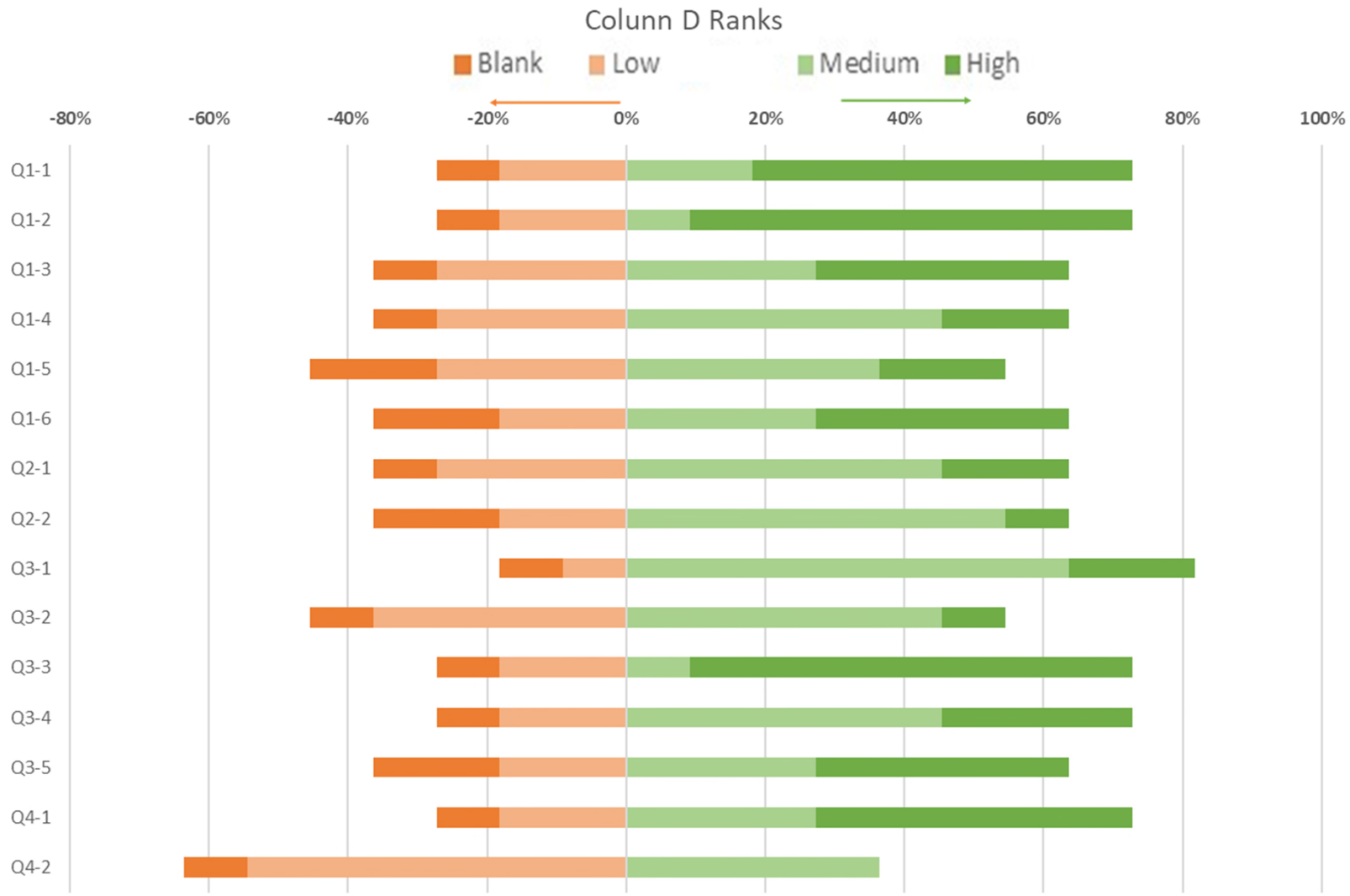
Flow Objectives; need for 80 cfs or similar increased flow periodically during prolonged drought



Biological goals and associated objectives



Provides *important* new information to improve design of management measures for impacts during extended low flow for species



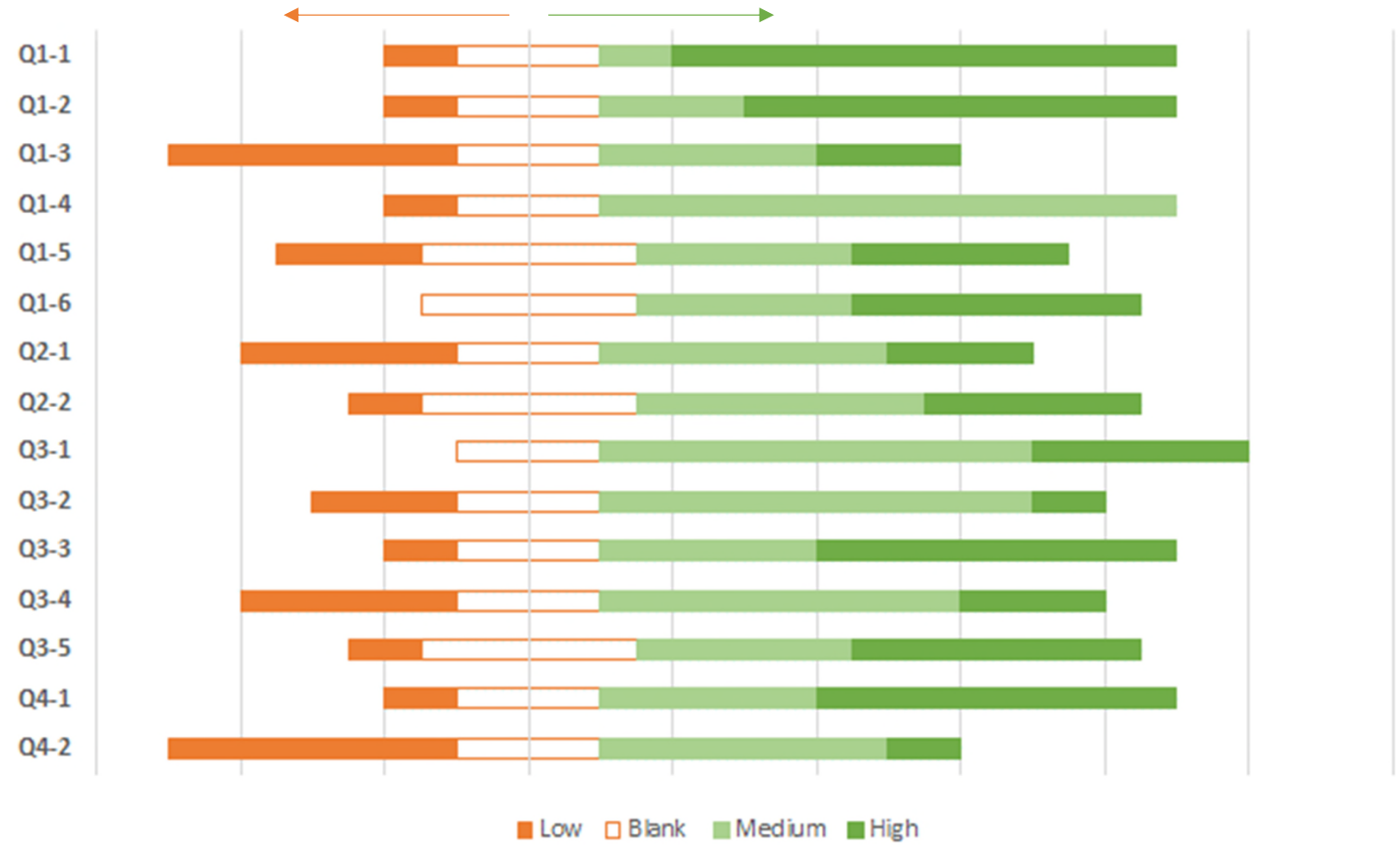
Visual Summary of looking at data – just my opinions not for public consumption DRAFT. Looking at data has/can provide some insight

- Appears ~1/12th of WG did not rank; otherwise, people who ranked like ranking ☺ but that is the general psychology trend; a segmentation of interests might provide additional insight.
- There is a visual shift to consensus on Column D questions/items; SAWS may be the reason this pulled in the direction. Less blanks and low rankings show *future* versus past tendency for new information
- Consensus / Column D has more folks moving to positive feelings "Yes"…
  - 3.3 – Recreation on sentinel/major species during low flow
  - 3.1 {SAWS not so much! Eco-model feasibility w/ significant new info. for model field verification… Gardening and Ed O. presentation!} Explore what is still a question for many stakeholders but not others
  - 1.2 WG {not SAWS}; orfi and flow feasibility? Is specific to beetle or more to it? GW model answers less than field investigations
- Consensus Column C / low for SAWS…
  - SAWS low – Q2-2, Q3-3 and Q3-4 mainly as + for lessor known species information
- Way more blanks in B&C
  - Column B questions of flow management of 80 cfs or some number above are arbitrary as well as shown to be not feasible during the EARIP scoping – costly solution before

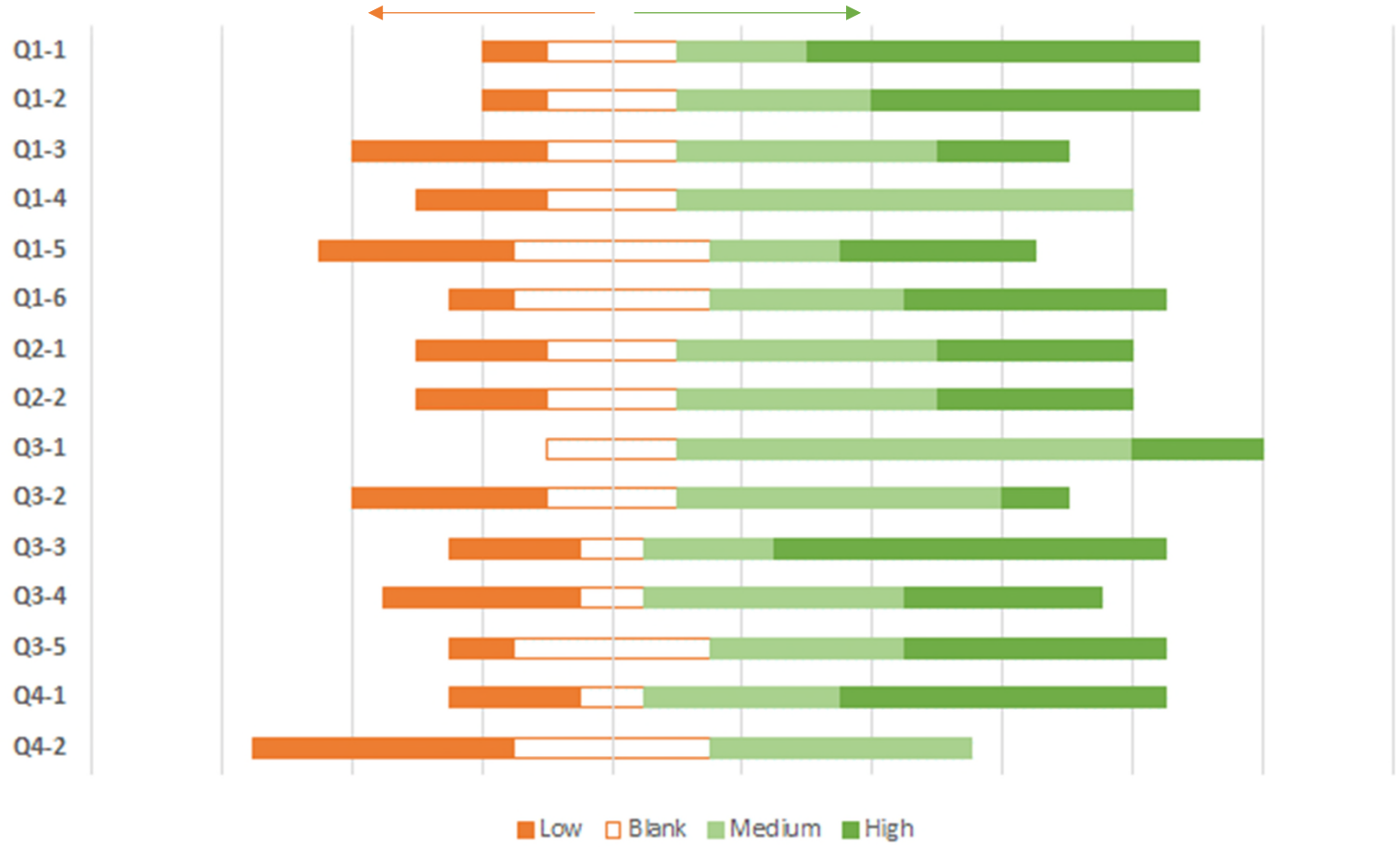
EAHCP SHPWG Rankings

8-3-2021

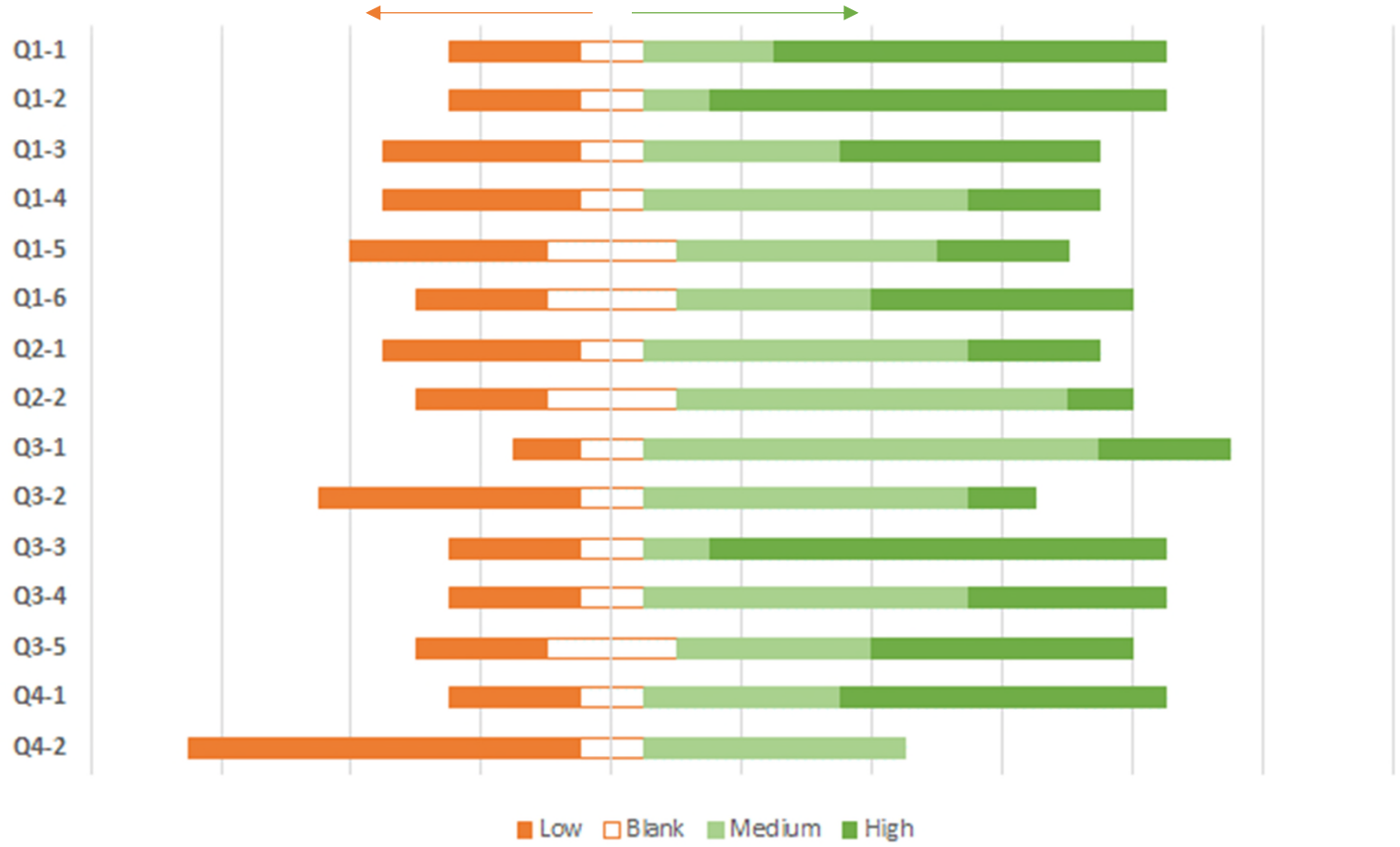
Flow Objectives; need for 80 cfs or similar increased flow periodically during prolonged drought



Biological goals and associated objectives



Provides *important* new information to improve design of management measures for impacts during extended low flow for species



Timing = 1-1

High priority = 1-1, 3-3/3-4/3-5 (Recreation)

Affordable = 1-1, 1-2, 2-2 (as lit review), 3-2

Feasible = 1-1, 2-2

Opportunistic Monitoring = 1-2, 1-3, 2-1, 3-1, 3-2

Jamie Childers' buckets from discussion 7/21 (4-1 and 4-2 haven't been bucketed. Where would these go?)

High cost = 1-5

Complex = 1-6, 3-1

Later = 2-2 (new studies)

Low priority = 1-4

MJH DRAFT FOR DISCUSSION PURPOSES—highlighting indicates aspect not fully discussed in meeting

SUMMARY OF SPRINGFLOW HABITAT PROTECTION WORK GROUP PRIORITIZATION EXERCISE

DATE?

Tier	Monitoring Option?	Feasibility issues?	Cost
High Priority Tier (Criterion: ≥12 High & H&M ≥ 21, but not in monitoring tier)			
Question 1-1 (19 H; 5 M; 4 L)(include lit. review of WQ models?)			L-M
Question 1-6 (12 H; 9 M; 3 L)(availability of results should be timed to inform next permit phase)		?	M-H
Combined Questions 3-3 thru 3-5 (18 H; 6 M; 5 L; 8H, 14 M, 8L; 12 H; 9 M; 4 L)			L-M
Question 4-1 (15 H; 9 M; 5 L)(Beyond presenting existing flow predictions, timing of work should take into account results of other studies)			L-H
Monitoring Tier for Opportunistic Data Collection (include now in monitoring plans for data collection during future low-flow periods) (Criterion: appropriate for monitoring)			
Question 1-2 (18 H; 6 M; 4 L)	Yes	Possibly for some aspects	L-H
Question 1-3 (5 H; 10 M; 10 L)	Yes		L-M
Question 2-1 (7 H; 13 M; 8 L)	Yes	Likely for some aspects	L-H
Question 3-1 **partial** (7 H; 20 M; 1 L) (standing crop biomass & veg. productivity data)	Yes		L-M
Question 3-2 (3 H; 13 M; 9 L)	Yes?		L
Medium Priority Tier (Criterion: ≥7 High and ≥9 Med. and not in High or Monitoring Tier)			
Question 1-5 (8 H; 9 M; 8 L)(assess after results for Question 1-1 known)			H
Question 2-2 **partial** (7 H; 14 M; 5 L)(analysis of results of ongoing genetic studies)			L-M
Low Priority Tier (Criterion: not in any other tier) Subject to reprioritization as new information becomes available)			
Question 1-4 (2 H; 17 M; 6 L)			L
Question 2-2 **partial** (consideration of new genetic studies)			H
Question 3-1 **partial** (analysis beyond data collection)			H
Question 4-2 (1H; 10 M; 14 L)	Yes?	Modeling	L?

MJH DRAFT FOR DISCUSSION PURPOSES—highlighting indicates aspect not fully discussed in meeting

SUMMARY OF SPRINGFLOW HABITAT PROTECTION WORK GROUP PRIORITIZATION EXERCISE

DATE?

Tier	Monitoring Option?	Feasibility issues?	Cost
High Priority Tier (Criterion: ≥12 High & H&M ≥ 21, but not in monitoring tier)			
Question 1-1 *[Based on consideration of the results of a validation and sensitivity exercise using data collected during 2014 drought conditions, is the Hardy model effective and suitable to evaluate water quality (dissolved oxygen and water temperature) effects of springflows below 80cfs?]* (19 H; 5 M; 4 L)(include lit. review of WQ models?)			L-M
Question 1-6 *[Do existing modeling and statistical tools and available data allow us to incorporate predictions for future drought conditions and make springflow management decisions during periods of extended low flows?]* (12 H; 9 M; 3 L)(availability of results should be timed to inform next permit phase)		?	M-H
Combined Questions 3-3 thru 3-5 *[What specific recreational impacts exist and what are their data-supported impacts to Texas wild-rice, fountain darters, and San Marcos salamander and are impacts greater during lower flows? What locations and approaches would be most effective for exclosures in the State Scientific Area (SSA) …? …what areas within the San Marcos system represent habitat important for maintaining fountain darter populations … in particular designation of exclosures under the SSA…?]* (18 H; 6 M; 5 L; 8H, 14 M, 8L; 12 H; 9 M; 4 L)			L-M
Question 4-1 *[What consecutive periods of flows at or below specific identified flow levels between 80 cubic-feet-per-second (cfs) and the relevant minimum springflow level for each spring system are predicted using the updated mod-flow model reflecting implementation of the Phase 2 flow protection Work Plan measures? What is the significance of those durations in terms of impacts on the Covered Species?]* (15 H; 9 M; 5 L)(Beyond presenting existing flow predictions, timing of work should take into account results of other studies)			L-H

Tier	Monitoring Option?	Feasibility issues?	Cost
Monitoring Tier for Opportunistic Data Collection (include now in monitoring plans for data collection during future low-flow periods) (Criterion: appropriate for monitoring)			
Question 1-2 *[Which spring openings will still be flowing at various flow levels below 80cfs in the Comal and San Marcos springs systems and how does that relate to effects on Covered Species?]* (18 H; 6 M; 4 L)	Yes	Possibly for some aspects	L-H
Question 1-3 *[How does the flow of cool water from spring openings in the Comal system travel through Landa Lake during extended periods of low flow and what is the potential for the cool water to bypass the Old Channel?* (5 H; 10 M; 10 L)	Yes		L-M
Question 2-1 *[What aquifer flow paths contribute to individual springs or spring emergence areas that are likely to be significant flow sources into the Comal and San Marcos systems during low flow periods and which fault block—upthrown block or downthrown block—are those flow paths associated with? And, are those springs habitat for, and occupied by, Covered Species?]* (7 H; 13 M; 8 L)	Yes	Likely for some aspects	L-H
Question 3-1 *[How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?]* (7 H; 20 M; 1 L) **partial** (collect standing crop biomass & veg. productivity data)	Yes		L-M
Question 3-2 *[Over what section of Spring Lake Dam does flow move during periods with flows below 80cfs?]* (3 H; 13 M; 9 L)	Yes?		L
Medium Priority Tier (Criterion: ≥7 High and ≥9 Med. and not in High or Monitoring Tier)			
Question 1-5 *[Depending on results of Question 1-1 regarding validation, what other modeling approaches should be considered for water quality impacts?]* (8 H; 9 M; 8 L)(assess after results for Question 1-1 known)			H
Question 2-2 *[How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?]* **partial** (7 H; 14 M; 5 L)(analysis of results of ongoing genetic studies)			L-M

Tier	Monitoring Option?	Feasibility issues?	Cost
Low Priority Tier (Criterion: not in any other tier) Subject to reprioritization as new information becomes available)			
Question 1-4 *[Is the available spring data being collected, consistent with the outcomes of the 2016 Expanded Water Quality Work Group adequate to inform how the physio-chemical aspects, chemistry, discharge, and spring locations change under low flow conditions?]* (2 H; 17 M; 6 L)			L
Question 2-2 [*[How can results of ongoing genetic studies be used to inform our understanding of impacts of low flow periods on Comal Springs riffle beetle? If those results are not sufficiently helpful in understanding such impacts, how could variations on those studies or other genetic studies be used to provide useful insights?]* **partial** (consideration of new genetic studies)			H
Question 3-1 *[How are changes related to vegetative die-off expected to affect the dynamics of habitat, dissolved oxygen and vegetation loss during predicted low springflow in the future in both systems?]* **partial** (analysis beyond data collection)			H
Question 4-2 *[What is the likely effect of extended periods of springflows below 80 cfs in the San Marcos system on siltation around spring openings and, in turn, on the population of San Marcos salamanders?]* (1H; 10 M; 14 L)	Yes?	Modeling	L?