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