EDWARDS AQUIFER
AUTHORITY

MEMORANDUM

To: Velma Danielson, General Manager

Through: John Hoyt, Assistant General Manager

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Date: March 5, 2009

Subject: Review of "Uvalde Water Supply Project Due Diligence Report Phase I" prepared for Southwest Texas Water Resource, L.P. by Pape-Dawson Engineers.

Background:

The purpose of this review was to provide a technical evaluation of the report titled "Uvalde Water Supply Project Due Diligence Report Phase I," which was prepared by Pape-Dawson Engineers for Southwest Texas Water Resources L.P. (STWR). The report, as prepared by Pape-Dawson, attempts to present the impacts on the Edwards Aquifer of a proposed project by STWR, which would pump Edwards groundwater in Uvalde County and convey it through a pipeline to Bexar County. At present, the Edwards Aquifer Authority Act prohibits the exportation of groundwater out of Uvalde County (and Medina County) via pipeline and, consequently, such a project would require legislative action to amend the Act.

Scope of Analysis:

This review focused on addressing the following sections of the report: 1) – Executive Summary, 2) – Water Source, and 3) – Water Supply Wells. The review included the text, tables, and figures for each of these three sections. However, other sections in the report related to Water Treatment Systems, Water Pumping Alternatives, Transmission Main, and Regulatory Compliance were deemed to lie outside the scope of this review and thus were not evaluated. In addition, it is important to note that this review sought solely to evaluate the report prepared by Pape-Dawson Engineers and did not endeavor to evaluate the merits of the actual project proposed by STWR.

Comments in this review fall under three major areas: technical issues (Technical Issues) related to the hydrologic analysis by Pape-Dawson, incorrect statements of fact (Factual Errors), and substantive suspected typographic errors (Typographic Error). The comments are organized by

page number and/or section and paragraph numbers. The comment type is contained within the parenthetical following the location of the comment.

Summary of Findings:

In general, the number of technical issues, factual errors, and, to a lesser degree, typographical errors, bring into question the validity of the analyses provide by Pape-Dawson as it applies to the proposed Uvalde Water Supply Project. As a result, it would be difficult to accurately evaluate the utility or merits of the proposed Uvalde Water Supply Project purely on the basis of the contents within the Pape-Dawson report.

The most significant of the technical errors centered on the application of Edwards Aquifer MODFLOW groundwater model as it relates to the Drought of Record. Generally, the de facto standard for groundwater modeling the Edwards Aquifer is to include the Drought of Record (the 1947 to 1973 time period) as part of any analysis. However, the Pape-Dawson analyses were performed using only the 1974 to 2000 time period and, therefore, ignored the greatest documented stress period for the aquifer, the Drought of Record. This is a notable omission given the potential significant ramifications a repeat of the Drought of Record could have on spring discharge from the Comal and San Marcos springs and the associated species protected under the Endangered Species Act.

In addition, the report fails to provide the appropriate comparative analysis of various modeling scenarios relative to index well water levels and spring discharges. Thus, it appears that more comparative analysis is required to objectively assess the impacts of various pumping models that could be utilized in the proposed water supply project. In addition, there was inadequate documentation and support material for some of the modeling scenarios that were used. As a result, Authority staff did not perform confirmation modeling simulations because the report modeling simulations were inappropriate for the analysis of a pipeline.

A detailed report of Authority staff's technical evaluation of the Pape-Dawson review is provided in report that follows.

Detailed Report Analyses:

- **Page ES-1, 3rd complete paragraph (Technical Issue and Factual Error).** This section references EAA Critical Period Trigger levels for Uvalde County. It is important to note; however, the Uvalde County trigger levels are not related to, nor were they chosen based on, a detailed hydrogeologic study.

  Also, the study notes a 50-year "period of reliability" record which begins in May 1958. As a matter of practice, regional water studies conducted as part of the state regional water planning process include an analysis of the "Drought of Record" period. While the study performed by Pape-Dawson did not include the Drought of Record, the Drought of Record has become the de facto standard for analysis of water related projects for the Edwards Aquifer region. The Drought of Record for the Edwards Aquifer region is the period from 1949 to 1956 and using the last 50 years of record would not include the Drought of Record. The period from May 1958 to the present also includes 1992, which was the wettest year on record. In addition, of the last 11 years, six of them included years with more than one million acre-feet of recharge and two years with more than two

million acre-feet of recharge (approximately two to four times above the median). The use of the Drought of Record period should be used for all aquifer evaluations as it best indicates how the aquifer will respond during the greatest period of stress. The report did not explain why the Drought of Record was excluded from the analysis.

- **Page ES-2, 2nd complete paragraph (Factual Error).** This section states that the results of Authority modeling "were considered during the Texas Legislature's consideration of Senate Bill 3 that set Critical Period Management Plan trigger levels and pumping reductions." This is not correct. Modeling was not performed by the Edwards Aquifer Authority staff in the development of Senate Bill 3 requirements. The Authority conducted modeling exercises related to Senate Bill 3 critical period requirements only after passage of the legislation to evaluate the effects of the new trigger levels.

- **Page ES-2, 3rd complete paragraph (Technical Issue).** The groundwater modeling efforts in this report utilized the 1974 to 2000 time period. Generally, an analysis of a project including the Drought of Record has become the de facto standard for groundwater management scenarios in the Edwards Aquifer. The Drought of Record is contained within the 1947 to 1973 time period of the model. The assumption that the recharge amounts will be "the same as historically experienced over the 1974 to 2000 time period" is not a conservative assumption for reliability of groundwater supply projects in the event of a repeat of the Drought of Record.

- **Page ES-3, 1st complete paragraph (Technical Issue).** It is not clear on what basis the assumptions were made for calculating aquifer drawdown in proximity of "a proposed well field." In addition, considering the heterogeneous nature of the aquifer, calculating drawdown by assuming a single value for transmissivity and storativity for the aquifer creates a very large range of uncertainty in the results, which was not discussed.

  Authority staff also evaluated the model cells at the three proposed well field locations and did not identify an area where transmissivity is 2,000,000 ft^2/d (or hydraulic conductivity at about 4,000 ft/d at 500 ft thickness of the aquifer) and storativity is 0.05 (or specific storage at about $1x10^{-4}$ ft^{-1}). If other data are used to derive the transmissivity and storativity numbers, they should be cited in the report. A review of the model data also indicates that these numbers appear to be very high for the portions of the aquifer under the three proposed well fields, considering the aquifer is confined at all three locations. For example, a value of 0.05 for storativity in a confined aquifer is not known from neither the hydrogeological literature nor as an input model parameter in the Edwards Aquifer groundwater flow model. It should be noted that specific storage of a confined aquifer plays an important role in determining values of storativity. For the Uvalde Pool (west of Knippa Gap), specific storage in the Edwards Aquifer is estimated at $1x10^{-6}$ ft^{-1} or 100 times smaller than those used in the report. Such differences in storativity will have a significant effect on the calculated range of well draw downs.

- **Page ES-3, 3rd complete paragraph (Technical Issue).** This report commonly cites the "SAWS most likely planning scenario design drought of 1984." The Authority does not use the SAWS planning scenario for modeling purposes as this does not cover the Drought of Record period. Generally, the Drought of Record is the best indicator for the reliability of a management scenario in the event of a repeat of the Drought of Record.

- **Pages ES-3 and 4, 4th complete paragraph (Technical Issue).** This section indicates that one of the modeling scenarios used for the pipeline evaluation is as follows: simulate the withdrawal of 585,000 acre-feet of groundwater from the aquifer (572,000 acre-feet of permitted pumping plus an estimate of13,000 acre-feet of domestic pumping) and transfer 40,000 acre-feet of pumping from Uvalde County, west of the town of Knippa, to be withdrawn from a simulated well field for municipal use in western Bexar County. The paragraph notes that the "Pool had a modeled expected yield of 77.7 % through the SAWS "most likely" planning scenario design drought of 1984." It is not clear what an "expected yield" is as it is not defined in this section of the report.

  There appears to be a need for an introduction paragraph in the Executive Summary and within Section 2.3.2 describing how the impact of an Uvalde County pipeline is going to be tested using the MODFLOW groundwater model. The model can be used to evaluate moving or concentrating pumping centers. However, the analysis was not carried out to a defensible conclusion because of technical limitations of failing to evaluate the Drought of Record, and because of the report's organization and structure. An introduction paragraph describing how modeling will be used to evaluate the proposed pipeline would be helpful.

  Authority staff believe that an improved method to model the effects of a pipeline from Uvalde County to Bexar County could be as follows: Perform a baseline run simulating aquifer pumping of all permitted and domestic wells and incorporating critical period reductions during the Drought of Record time period (years 1947 to 1973). Additional modeling scenarios would then be performed for comparison purposes and include the shifting of 40,000 acre-feet of groundwater in irrigation permits in Uvalde County west of the town of Knippa, to a municipal pumping curve at each of the three proposed well fields. (No groundwater would be transferred from Uvalde County.) Changes in groundwater levels in well J-27, well J-17, and discharges at Comal and San Marcos springs would be compared for each well field modeling scenario.

  To evaluate the benefits of a pipeline from Uvalde County versus the direct transfer of groundwater withdrawal permits to Bexar County, groundwater withdrawals from irrigation permits in Uvalde County west of Knippa Gap, would be transferred to a location in western Bexar County. A municipal pump curve would also need to be applied. The results of the simulations would be evaluated by comparing the changes in groundwater levels in well J-27, well J-17, and discharges at Comal and San Marcos springs for each scenario to the baseline modeling results. All model runs should use the 1947 to 1973 time period to cover the Drought of Record.

- **Page ES-4, 3rd paragraph, 2nd sentence, Section 2.6 on page 2-37, and Exhibits 2.14-2.17 (Technical Issue).** It is stated that "The simulated groundwater levels from the various modeled scenarios begin at approximately the same level in 1974 and begin to diverge from one another." The reason these model runs start at the same level is an artifact of using the same initial head to run all the simulations with the exception of the USGS base model. Therefore, it does not reflect short-term or long-term effects. If this is the case, it should be indicated in the report and the simulation of the first year or two should be excluded from analyses. Use of the 1947 to 1973 time series would solve this problem.

- **Page ES-4, 2nd full paragraph, and Page 2-25, 2nd paragraph (Technical Issue).** The report states that "Many additional scenarios were conducted that are not included in

this report." Authority staff cannot draw any conclusions from the scenarios because supporting data were not included in the report.

- **Page 2-3, Section 2.1.2, Edwards Aquifer Zones (Factual Error).** This section defines the Edwards Aquifer as having five main zones: the Contributing Zone, the Recharge Zone, the Transition Zone, the Water Table Zone, and the Artesian Zone. However, there is no "Water Table Zone" that is defined in the regulations or in generally accepted hydrogeologic literature on the Edwards Aquifer. If this is a new hydrologic term for the Edwards Aquifer, its inclusion should be justified and defined in the report.

- **Page 2-7, Section 2.1.6 (Technical Issue).** This section should be supported by the relevant quantitative model scenario results. The section consists of a suite of statements about "effect of pumping in the various pools" without any citation and supporting evidence.

- **Page 2-12, Section 2.2.1 -Well Field Selection Process (Technical Issue).** Initially, in Section 2.2.1, it was declared that "well field selection considered seven scientific parameters that might affect groundwater quality or quantity" and that "the higher the point value the greater the possibility a parameter may negatively affect groundwater quality and quantity" (p. 2-12). After the analysis, in Table 2-4 (p. 2-18), the total score for Area C is almost twice as high as Area A or B, but as a conclusion it was stated that "although Area C ranks higher in points than either Area A or B there is no single parameter that suggests Area C should not be considered for use as a well field for public supply" (p. 2-19). This should be reconsidered or discussed in the report as parameters for Area C indicate it is in close proximity and down gradient of the contaminant plume as well as having a lower transmissivity. It should be emphasized that, under equal conditions (pumping rate, recharge, etc.), aquifer areas possessing lower transmissivitiy provide deeper and more expanded well drawdown, which could lead to very negative consequences regarding possible changes in plume direction and which could also create water quality issues with other nearby wells.

- **Page 2-13, Section 2.2.1.1 Submergence (Technical Issue).** This section discusses several cases of Edwards Aquifer contamination that occurred when the Edwards Aquifer went from artesian to water-table conditions. In fact, the thickness of overburden (the distance from the top of the aquifer to the land surface) is not sufficient to provide total protection to the aquifer. Contamination can enter the aquifer through faults and fractures or poorly constructed water wells and is a function of hydraulic head and opportunity and is not necessarily related to "submergence." For example, if the hydraulic head in an aquifer overlying the Edwards is higher than the Edwards Aquifer, then groundwater and contaminants can enter the well (or fault) and travel vertically downward in the Edwards Aquifer, even if the Edwards is under artesian conditions.

- **Page 2-13, Section 2.2.1.2 Overburden (Technical Issue).** This section discusses the role of overburden in that the greater the overburden, the greater the protection from surface contamination. This is only partially correct in that the advantages of overburden can be easily compromised by the presence of faults, conduits, or improperly constructed or abandoned wells. The Leon Valley contamination case in Bexar County provides an excellent example of the failure of artesian conditions or overburden to protect the aquifer.

- **Page 2-15, Environmental Considerations (Technical Issue or Typographical Error).** Authority staff are not aware of any Edwards Aquifer wells that have been contaminated by polychlorinated biphenyls (PCB's) in the Uvalde County area. In addition, detections of herbicides, pesticides, and fumigant propellants are below Maximum Contaminant Limits (MCLs). However, a perchloroethylene (PCE) plume has been detected in the Edwards Aquifer on the east side of the City of Uvalde which has exceeded MCLs. It could be that this PCB reference in the report may be a typographical error for PCE.

- **Page 2-16, 2nd full paragraph (Technical Issue).** This paragraph notes that wellhead construction practices related to open well heads at or near the ground surface may result in agricultural contaminants entering wells. Generally, agricultural well heads in south central Texas are not completed in well pits and are usually sealed or covered to prevent contamination. A more likely cause of contamination entering the aquifer through large wells is the failure to properly seal the annular space during drilling and construction or the use of inferior casing for older wells. Shallow groundwater and surface water contaminants can enter the annular space in improperly sealed wells and result in groundwater contamination.

- **Page 2-16, 3rd paragraph – PCE plume in Exhibit 2-6 (Technical Issue).** This paragraph states that "The extent of this PCE plume has been relatively stable since 2001." While PCE concentrations have remained relatively constant in wells with historical detections, it is not clear if the vertical and horizontal extent of the plume moving to the northeast has been adequately defined. Because of the absence of wells near the plume, it may have traveled much farther than has been indicated on Exhibit 2-6. While dilution and natural attenuation have an impact on plume size, there is no hydrogeological reason to believe that the plume doesn't continue to move down gradient and toward proposed well field Area C. Even if the plume configuration has not changed at the current pumping conditions, increased pumping associated with a new well field may create a cone of depression, which may intersect the plume.

- **Page 2-17, Table 2-3 (Technical Issue).** The Edwards Aquifer MODFLOW model should not be used to determine the physical locations of conduits in the aquifer for a well field selection process. While model conduit locations are the best educated guess on where major conduits are located, these are approximations at best.

- **Page 2-19, 1st paragraph, Figure 2.1 (Technical Issue).** This section contains some incorrect assumptions regarding surface water recharge and groundwater occurrence and movement in karst terrains. For example, the paragraph states that the Salmon Peak outcrops occur greater than 6,000 feet from Area C and have steep slopes which cause rainfall to runoff fast and thus there is virtually no recharge. Any recharge that may occur should be from slow infiltration, which would not lead to high turbidity." Recharge in karst commonly occurs on steep slopes as well as in dry washes. Groundwater turbidity is a function of the connection of a well to an open conduit connected to surface recharge. Turbidity in wells within the Edwards Aquifer has been noted to occur within the artesian zone.

- **Pages 2-20 through 2-40, Section 2.3 (Technical Issue).** The modeling section is heavily weighted in the report but it was not clear why modeling was preformed or how it benefitted the project. Please review the comments above at **Page ES-3 and 4, 4th complete paragraph (Technical Issue).** The creation of a pipeline with a pumping

center in Uvalde County and a pipeline terminus in Bexar County would shift the pumping curve for 40,000 acre-feet of groundwater per year in Uvalde County from irrigation use to municipal use. If the intent was to evaluate other options such as the transfer of permitted pumping from Uvalde County to Bexar County, then that should be clearly stated in the report. In addition, the modeling section did not provide any information about the modeling assumptions and limitations.

- **Page 2-20, Section 2.3, Groundwater Modeling (Technical Issue).** It is not clear if the Edwards Aquifer MODFLOW model was appropriately applied. When the Edwards Aquifer groundwater-flow model (Lindgren et al., 2004) is used for testing different model scenarios, especially for the Uvalde Pool, the following circumstances should be taken into consideration with the conceptual model design:
    - The restricted Knippa Gap zone has not been explicitly defined and the Uvalde and San Antonio pools hydraulically communicate without restriction:
        - Via a highly permeable conduit zone (K = 75000 ft/d) in the northern part of the confined zone in eastern Uvalde County; and,
        - Via relatively highly permeable saline zone (where K is up to 2500 ft/d) in southeastern Uvalde County.
    - All the model restrictions stated in the Edwards Aquifer groundwater-flow report (Lindgren et al., 2004) regarding the scale of its application should be taken into account including:
        - "The Edwards Aquifer model is regional in nature, and therefore its application to local, site-specific issues is not appropriate; and,
        - The appreciable local-scale effects of the simulated conduits on ground-water flow in the conduit cells and the nearby model cells create issues with the suitability of the Edwards Aquifer model for subregional area applications."

- **Page 2-21, Model Selection, 2nd Paragraph (Technical Issue).** Regarding the San Antonio Water System (SAWS) model, the United States Geological Survey (USGS) did retain interconnected high permeability cells (conduits) within the model in the vicinity of Comal and San Marcos springs and also in a few other areas, but distributed (smeared) the higher conductivities to adjacent cells within many of the areas of the model.

- **Page 2-21, Model Selection, 2nd Paragraph, last sentence (Technical Issue).** This paragraph states that, according to USGS and SAWS staff the two MODFLOW models, with and without the conduits, both calibrate approximately the same. This statement is somewhat vague and could be misleading without further elaboration. Further explanation of what "both calibrate approximately the same" is merited.

- **Page 2-21, 3rd full paragraph (Factual Error).** The company that developed the management module is HydroGeoLogic, Inc., not Hydrologic Inc.

- **Pages 2-21 through 2-29, Section 2-2 (Technical Issue).** The report uses a simple rating method to compare three candidate sites. The method may be useful for screening a complicated system. However, it does not seem to serve the purpose in this report. Because there are only three locations to evaluate and all parameters in the ratings are treated equally without weighting, the outcome is not very useful. As indicated in the conclusion in Section 2.2.1.9 on page 2-19, the system failed to pick the location. Detailed analysis of existing data for site comparison is probably more useful.

- **Page 2-22, 3rd full paragraph (Technical Issue).** The modeling time period used in the report analyses was from 1974 to 2000. The Drought of Record is the de facto standard for analysis of water management scenarios in the Edwards Aquifer and contained within the 1947 to 1973 time period. The assumption that the recharge amounts will be "the same as historically experienced over the 1974 to 2000 time period" is not a conservative assumption for reliability of water supply projects in the event of a repeat of the Drought of Record. In addition, the first half of the transient model calibration for the Uvalde area (1947-1973) is more appropriate than the second half. The Drought of Record is the planning period commonly used for groundwater management scenarios.

- **Page 2-22, last paragraph (Factual Error).** Edwards Aquifer Authority staff were not asked to analyze Senate Bill 3 Critical Period Management Plan trigger levels and pumping reductions until after the bill had been passed and became law.

- **Page 2-23, Section 2.3.2, Modeling Scenarios (Technical Issue).** The report needs a paragraph explaining the methodology used to quantify the utility of an Uvalde County pipeline and how a groundwater model will be used to evaluate different management scenarios. This is covered in more detail in comments on **Page ES-3 and 4, 4th complete paragraph (Technical Issue).**

- **Page 2-23, 2nd full paragraph (Technical Issue).** This section discusses model calibration issues after 1991. It is not clear why the model did not calibrate better for this time period but may reflect the record 1992 recharge year and is another reason that the 1947 to 1973 model time step should be used. It is not clear what the report means when it states that "The fact that the modeled groundwater levels during the timeframe of 1991 to 2000 were higher than historical measured values was accounted for in estimating the reliability of the Uvalde Pool during various modeling scenarios (see Section 2.3.6)." This section of the report should describe how these higher levels were accounted for and what corrections were made. Use of the 1947 to 1973 time series would eliminate this issue.

- **Page 2-23, 2nd full paragraph (Technical Issue).** This paragraph attempts to summarize model simulation results. Since this paragraph is in the section dealing with model selection, it would seem more appropriate if this paragraph was included in Section 2.3.2 – Modeling Scenarios.

- **Page 2-23, Section 2.3.2 Modeling Scenarios (Factual Error).** The report states that "Five groundwater models were run . . ." This should probably read "Five modeling scenarios were run . . ."

- **Page 2-25, Section 2.3.2.3 (Technical Issue).** The report should provide a map showing the location of Well Field "D" and how many wells are included in the hypothetical well field. A detailed description of the initial model assumptions and a formal presentation of model results should be included. The discussion should include how the well file was modified.

- **Page 2.31, Section 2.3.6 – "Reconciling Inaccurate Modeled Water Elevations in J-27 from 1992 to 2000" (Technical Issue).** This section discusses some of the data issues

associated with the use of the second half of the model. The use of the first part of the model would resolve this issue and also cover the Drought of Record.

- **Page 2-35, Table 2-8 (Technical Issue).** To properly assess the impacts of water management projects under high stress periods, the "expected yield" concept should be applied to the Drought of Record covered by the first half of the model (1947-1973 time period).

- **Page 2-35, Section 2.5 and Page 2-37, Table 2-9 (Technical Issue).** Table 2-9 presents "historical probability distribution of critical management periods," which is assembled by downloading and analyzing index well and spring flow data from the Authority's website. The first paragraph in Section 2.5 states that the results represent "Critical Management Periods which would have been triggered in the past if the current TCEQ Critical Period Management triggers had been applied historically." Because critical period management involves dynamic changes in aquifer response, using historical data can be misleading and does not provide any value in evaluating a pipeline management scenario. For example, once the first Critical Period trigger is applied, its effect will propagate into the subsequent history of groundwater levels and change the frequency and duration of future Critical Period triggers, spring discharge, and groundwater levels. This is one reason why the predictions by a calibrated groundwater model are much more useful than using non-computational methods to assess historical data using Critical Period triggers. In addition, Authority staff were not aware of any TCEQ Critical Period triggers developed for the Edwards Aquifer.

- **Page 2-37, Section 2.6, and Page 2-38, Section 2.7 (Technical Issue).** Short-Term and Long-Term Effects on the San Antonio Pool are generally measured by comparing the management scenario with the baseline scenario in relation to an increase or decrease in the number of months the region would be in critical period based on groundwater levels or springflow using the 1947 to 1973 Drought of Record. If the model predicts that Comal or San Marcos springs would cease to flow, then the difference between the baseline and management scenario would be evaluated (in months of no flow at the springs or months in critical period). These management runs usually use the Drought of Record (first modeling period).

- **Page 2-39, Section 2.8 – Ancillary Model Findings (Technical Issue).** The report states that "Pape-Dawson modeled many scenarios that are not included in this report." Since no supporting data were included in the report, Authority staff were not able to draw any conclusions as to the accuracy or validity of this section of the report.

- **Page 2-40, Section 2.6 (Technical Issue).** Related to irrigation pumping curves, it is very difficult to predict in the model when farm-related irrigation occurs as it is very dependent upon early season soil moisture, rainfall patterns, crops, planting dates, etc. Over the last 30 years, the regional crop types have included spring and fall vegetables (using water in the spring and fall); corn, which uses water from March through June; wheat, which uses water in the late winter and spring months; and cotton, which uses less water than corn but uses it later in the year. The irrigation pump curves used in the model (see below) attempts to average the irrigation pumping demand for the region. The report indicated that Pape-Dawson developed an Agricultural Use Factor (AUF) but did not provide any further elaboration. The AUF should be clearly documented with description or citation if the authors believe an AUF other than that used in the Edwards

Aquifer MODFLOW model is necessary. In addition, the use of an AUF should be tested against baseline model runs to determine the effect. Making an AUF modification adds an additional layer of complexity to the analysis of the model results.

Existing EAA MODFLOW Seasonal withdrawal curve in percentages for each water withdrawal type by month.

Month	Municipal	Industrial	Agricultural
January	6.9	8.3	1.1
February	6.4	8.3	1.5
March	7.5	8.3	2.6
April	8	8.3	5.7
May	8.4	8.3	19
June	9.1	8.3	29
July	11	8.3	16.1
August	11.1	8.3	9.9
September	9	8.3	4.7
October	8.4	8.3	5.2
November	7.1	8.3	3.8
December	7.1	8.3	1.4
Total	100	99.6*	100

* Does not equal 100 percent because of rounding error

- **Page 3-2, Table 3-1, General Water Quality Summary (Factual Error).** Table 3-2 lists the typical range for the Edwards Aquifer as reported in the Authority's Hydrologic Data Report. This table has a number of factual errors. Given the importance of water quality, the Authority recommends that Table 3-2 be reevaluated for correctness. As an example, the TCEQ standards (30 TAC 290 Subchapter F: Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements for Public Water Systems) should be characterized by primary (health based) standards and secondary standards. Of the 15 TCEQ inorganic standards (§290.104(b) MCLs for inorganic compounds), the report only lists three. Of these three, Nitrogen, nitrate, dissolved is technically incorrect and should be listed as either Nitrate as Nitrogen, Nitrite as Nitrogen, or Nitrate and Nitrite as Nitrogen. Table 3-2 indicates that the typical range for nitrate –nitrite as N in the Edwards Aquifer "(EAA 2007)" is not detectable. However, the Authority's 2007 Hydrologic Data Report indicates the typical range of nitrate-nitrite as N ranges from non-detect to 2.5 mg/L and in 2007 Hydrologic Data Report, the range was from non-detect to 10.5 mg/L (above the MCL for this compound). In addition, Table 3-1 lists a standard for Bromate as 10 mg/L. There is no primary or secondary standard for Bromate in 30 TAC 290 Subchapter F. Bromate is generally considered a disinfection byproduct and would not be expected to occur in raw water.

  In addition, the table lists Chloride, dissolved; Fluoride, dissolved; Iron, dissolved; Nitrogen, nitrate, dissolved; and Sulfate, dissolved. The TCEQ standards do not list these

compounds as dissolved. The table also lists Disinfection Byproducts as "No test data available" when the Hydrologic Data Report lists the Total Trihalomethanes (TTHM) compounds individually under volatile organic compounds. Also, the compounds iron, chloride, pH, manganese, color, aluminum and copper are secondary standards and the TCEQ standard for copper is 1.0 mg/L and not 1.3 as indicated in Table 3.130 (TAC 290 Subchapter F). Also, there are no units for Color in Table 3.1.

Conclusions:

Authority staff found a number of technical and factual issues with the "Uvalde Water Supply Project, Due Diligence Report Phase I." These included the failure to perform modeling that included the Drought of Record (1947 to 1973 time period) as part of the analysis. The Drought of Record is the de facto standard for evaluating water management strategies for the Edwards Aquifer and is used to determine how the aquifer will respond during maximum stress periods. Since the Drought of Record was not utilized, the modeling analysis did not include a comparative analysis of the baseline scenario with modeling scenarios for index well groundwater elevations and spring discharges in the Uvalde and San Antonio pools. Authority staff believe that a proper evaluation of a proposed pipeline would require modeling efforts as defined in the third paragraph of the comment regarding report pages ES-3 and 4. In addition, there was inadequate documentation and support material for some of the modeling scenarios.

Authority staff did not perform confirmation modeling simulations because the report modeling simulations were considered inappropriate for the analysis of a proposed project. Therefore, Authority Staff concludes that the utility or merits of the proposed Uvalde County Supply Project cannot be fully evaluated based on the contents of the Pape-Dawson report.