STATE OF TEXAS TWDB Contract No. 1600011948

COUNTY OF TRAVIS General Revenue

DANIEL B. STEPHENS & ASSOCIATES, INC.

This Contract, (hereinafter "CONTRACT"), between the Texas Water Development Board (hereinafter "TWDB") and **Daniel B. Stephens & Associates, Inc.** (hereinafter "CONTRACTOR"), is composed of two parts, SECTION I. SPECIFIC CONDITIONS AND EXCEPTIONS TO THE STANDARD AGREEMENT and SECTION II. STANDARD AGREEMENT. The terms and conditions set forth in SECTION I will take precedence over terms and conditions in SECTION II.

SECTION I. SPECIFIC CONDITIONS AND EXCEPTIONS TO STANDARD AGREEMENT

ARTICLE l. DEFINITIONS

For the purposes of this CONTRACT, the following terms or phrases shall have the meaning ascribed therewith:

1. TWDB – The Texas Water Development Board, or its designated representative

2. CONTRACTOR – Daniel B. Stephens & Associates, Inc.

3. EXECUTIVE ADMINISTRATOR – The Executive Administrator of the TWDB or a designated representative

4. PARTICIPANT(S) – John Shomaker and Associates, Inc., Allan R. Standen, LLC, and Michelle Sutherland, LLC

5. REQUIRED INTERLOCAL AGREEMENT(S) – None

6. RESEARCH PROJECT – Identification of Potential Brackish Groundwater Production Areas – Blaine Aquifer

7. TWDB APPROVAL DATE – January 6, 2016

8. DEADLINE FOR CONTRACT EXECUTION – N/A

9. CONTRACT INITIATION DATE – January 6, 2016

10. DEADLINE FOR IDENTIFICATION OF POTENTIAL BRACKISH GROUNDWATER PRODUCTION AREAS: CONTRACTOR to provide a minimum of one-month advance notice to TWDB staff to setup and prepare for the meeting.

11. STUDY COMPLETION DATE – July 31, 2016

12. CONTRACT EXPIRATION DATE – September 30, 2016

13. TOTAL STUDY COSTS – $200,000.00

14. TWDB SHARE OF THE TOTAL STUDY COSTS – the lesser of $200,000.00 or 100.00 percent of the total study costs or individual payment submission

15. LOCAL SHARE OF THE TOTAL STUDY COSTS – $0 in cash or 0 percent of the total study costs or individual payment submission

16. PAYMENT SUBMISSION SCHEDULE –Monthly

17. OTHER SPECIAL CONDITIONS AND EXCEPTIONS TO STANDARD AGREEMENT OF THIS CONTRACT – See below

    a. Conflict of Interest: The CONTRACTOR agrees that it will not be involved in any new or existing contracts with persons or entities other than TWDB and regional water planning groups for brackish groundwater supply and availability studies involving the geographical study area of this CONTRACT (as detailed in Exhibit A and Exhibit I) while conducting the work required under this TWDB Contract without a prior no conflict of interest determination and written authorization by TWDB.

SECTION II. STANDARD AGREEMENT

ARTICLE I. RECITALS

Whereas, on TWDB APPROVAL DATE, the TWDB considered providing the CONTRACTOR a grant to conduct a RESEARCH PROJECT;

Whereas, the CONTRACTOR and PARTICIPANT will commit the LOCAL SHARE OF THE TOTAL STUDY COSTS, if applicable, in cash and/or in-kind services to pay for the LOCAL SHARE OF THE TOTAL STUDY COSTS of this RESEARCH PROJECT;

Whereas, the CONTRACTOR is the entity who will act as administrator of the TWDB's research grant and will be responsible for the execution of this contract;

Whereas, on the TWDB APPROVAL DATE, the TWDB approved a research grant to the CONTRACTOR;

Now, therefore, the TWDB and the CONTRACTOR, agree as follows:

ARTICLE II. PROJECT DESCRIPTION AND SERVICES TO BE PERFORMED

1. The TWDB enters into this CONTRACT pursuant to Water Code §16.012; Exhibit A, the original grant application, and Exhibit I, the original request for qualifications, which is incorporated herein and made a permanent part of this CONTRACT; and this CONTRACT.

2. The CONTRACTOR will conduct a RESEARCH PROJECT, as delineated and described in Exhibit A and Exhibit I, according to the Scope of Work contained in Exhibit B.

3. A progress report, including results to date, will be provided to the EXECUTIVE ADMINISTRATOR monthly, throughout the project. Special interim reports on special topics and/or results will be provided as appropriate. Instructions for the progress report are shown in Exhibit E, TWDB Guidelines for a Progress Report.

ARTICLE III. CONTRACT TERM, SCHEDULE, REPORTS, AND OTHER PRODUCTS

1. The CONTRACTOR has until the DEADLINE FOR CONTRACT EXECUTION to execute this CONTRACT and to provide acceptable evidence of any REQUIRED INTERLOCAL AGREEMENT(S) and the CONTRACTOR's ability to provide the LOCAL SHARE OF THE TOTAL STUDY COSTS, if applicable, to the EXECUTIVE ADMINISTRATOR for approval or the TWDB's SHARE OF THE TOTAL STUDY COSTS will be rescinded.

2. The term of this CONTRACT shall begin and the CONTRACTOR shall begin performing its obligations hereunder on the CONTRACT INITIATION DATE and shall expire on the CONTRACT EXPIRATION DATE. Delivery of an acceptable final report prior to the CONTRACT EXPIRATION DATE shall constitute completion of the terms of this CONTRACT.

3. The CONTRACTOR will complete the Scope of Work and will deliver seven (7) double-sided copies of a draft final report to the EXECUTIVE ADMINISTRATOR no later than the STUDY COMPLETION DATE. The draft final report will include the scope of work; a description of the research performed; the methodology and materials used; any diagrams or graphics used to explain the procedures related to the study; any data collected; an electronic copy of any computer programs, maps, or models developed under the terms of this CONTRACT; analysis of the research results; conclusions and recommendations; a list of references, a Table of Contents, List of Figures, List of Tables, an Executive Summary, and any other pertinent information. Each report shall have an authorship list of persons responsible for the studies: firm or agency names as authors are not acceptable. The reports shall be sealed as required by Texas Occupation Code, Title 6, Chapter 1002. All final reports should be prepared according to Exhibit D, Guidelines for Authors Submitting Contract Reports to the Texas Water Development Board, Exhibit G, Contract Data Requirements, and Exhibit H, Outline for Reports. After a 14-day review period, the EXECUTIVE ADMINISTRATOR will return review comments to the CONTRACTOR.

4. The CONTRACTOR will consider incorporating comments from the EXECUTIVE ADMINISTRATOR and other commentors on the draft final report into a final report. The CONTRACTOR will include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report. The CONTRACTOR will submit one (1) electronic copy of the entire final report in Portable Document Format (PDF) and seven (7) bound double-sided copies of the final report to the EXECUTIVE ADMINISTRATOR no later than thirty (30) days after the STUDY COMPLETION DATE. The CONTRACTOR will submit one (1) electronic copy of any computer programs or models developed under the terms of this CONTRACT. In compliance with Texas Administrative Code Chapters 206 and 213 (related to Accessibility and Usability of State Web Sites), the digital copy of the final report will comply with the requirements and standards specified in statute. After a 30-day review period, the EXECUTIVE ADMINISTRATOR will either accept or reject the final report. If the final report is rejected, the rejection letter sent to the CONTRACTOR shall state the reasons for rejection and the steps the CONTRACTOR need to take to have the final report accepted and the retainage released.

5. The CONTRACTOR will submit the most recent progress report with submittal of payments according to the PAYMENT SUBMISSION SCHEDULE. Progress reports shall be in written form and shall include a brief statement of the overall progress made since the last status report; a brief description of any problems that have been encountered during the previous reporting period that will affect the study, delay the timely completion of any portion of this CONTRACT, inhibit the completion of or cause a change in any of the study's products or objectives; and a description of any action the

CONTRACTOR plans to take to correct any problems that have been encountered.

6. The EXECUTIVE ADMINISTRATOR cannot extend the STUDY COMPLETION DATE or the CONTRACT EXPIRATION DATE. The CONTRACTOR shall notify the EXECUTIVE ADMINISTRATOR in writing and the CONTRACT MANAGER in person immediately if any problems encountered during the study will delay the timely completion of any portion of this CONTRACT.

ARTICLE IV. COMPENSATION AND REIMBURSEMENT

1. The TWDB agrees to compensate and reimburse the CONTRACTOR in a total amount not to exceed the TWDB's SHARE OF THE TOTAL STUDY COSTS for costs incurred and paid by the CONTRACTOR pursuant to performance of this CONTRACT. The CONTRACTOR will contribute local matching funds, if applicable, in sources and amounts defined as the LOCAL SHARE OF THE TOTAL STUDY COSTS. The TWDB shall reimburse the CONTRACTOR for ninety percent (90%) of the TWDB's share of each invoice pending the CONTRACTOR's performance, completion of a Final Report, and written acceptance of said Final Report by the EXECUTIVE ADMINISTRATOR, at which time the TWDB shall pay the retained ten percent (10%) to the CONTRACTOR.

2. The CONTRACTOR shall submit payments and documentation for reimbursement billing according to the PAYMENT SUBMISSION SCHEDULE and in accordance with the approved task and expense budgets contained in Exhibit C to this CONTRACT. The CONTRACTOR has budget flexibility within task and expense budget categories to the extent that the resulting change in amount in any one task or expense category does not exceed 35% of the total authorized amount by this CONTRACT for the task or category. Larger deviations shall require approval by EXECUTIVE ADMINISTRATOR or designee which will be documented through an Approved Budget Memorandum to the TWDB contract file. The CONTRACTOR will be required to provide written explanation for the overage and reallocation of the task and expense amount.

   For all reimbursement billings including any subcontractor's expenses, the EXECUTIVE ADMINISTRATOR must have determined that the REQUIRED INTERLOCAL AGREEMENT(S) and contracts or agreements between the CONTRACTOR and the subcontractor are consistent with the terms of this CONTRACT. The CONTRACTOR is fully responsible for paying all charges by subcontractors prior to reimbursement by the TWDB.

3. The CONTRACTOR and its subcontractors shall maintain satisfactory financial accounting documents and records, including copies of invoices and receipts, and shall make them available for examination and audit by the EXECUTIVE ADMINISTRATOR. Accounting by the CONTRACTOR and its subcontractors shall be in a manner consistent with Generally Accepted Accounting Principles.

4. By executing this CONTRACT, the CONTRACTOR accepts the authority of the State Auditor's Office, under direction of the legislative audit committee, to conduct audits and

investigations in connection with any and all state funds received pursuant to this contract. The CONTRACTOR shall comply with and cooperate in any such investigation or audit. The CONTRACTOR agrees to provide the State Auditor with access to any information the State Auditor considers relevant to the investigation or audit. The CONTRACTOR also agrees to include a provision in any subcontract related to this contract that requires the subcontractor to submit to audits and investigation by the State Auditor's Office in connection with any and all state funds received pursuant to the subcontract.

5. The CONTRACTOR shall submit a progress report as described in Article II, Item 3 and the following documentation which documents the TOTAL STUDY COSTS for the reporting period even if the TOTAL STUDY COSTS is zero for reimbursement by the TWDB to the CONTRACTOR for the TWDB's SHARE OF THE TOTAL STUDY COSTS shall be submitted by the CONTRACTOR to the EXECUTIVE ADMINISTRATOR for reimbursement billing:

A. Completed and Signed Payment Request Checklist which includes the following:
   (1) TWDB CONTRACT Number;
   (2) Billing period; beginning (date) to ending (date);
   (3) Total Expenses for this period;
   (4) Total In-kind services;
   (5) Less LOCAL SHARE OF THE TOTAL STUDY COSTS for the billing period;
   (6) Total TWDB's SHARE OF THE TOTAL STUDY COSTS for the billing period;
   (7) Amount of retainage to be withheld for the billing period;
   (8) Total costs to be reimbursed by the TWDB for the billing period; and
   (9) Certification, signed by the CONTRACTOR’s authorized representative, that the expenses submitted for the billing period are a true and correct representation of amounts paid for work performed directly related to this contract.

B. For direct expenses incurred by the CONTRACTOR other than subcontracted work:
   (1) A spreadsheet showing the tasks that were performed; the percent and cost of each task completed; a total cost figure for each direct expense category including labor, fringe, overhead, travel, and other expenses such as communication and postage, technical and computer services, expendable supplies, printing and reproduction; and
   (2) Copies of detailed, itemized invoices/receipts for other expenses (credit card summary receipts or statements are not acceptable)

C. For direct expenses incurred by the CONTRACTOR for subcontracted work:
   (1) Copies of invoices from the subcontractors to the CONTRACTOR showing breakdown of costs in hourly rates, travel and other expenses such as communications and supplies;
   (2) Copies of detailed, itemized invoices/receipts for other expenses (credit card summary receipts or statements are not acceptable)

D. For travel expenses for the CONTRACTOR and/or subcontractor(s) –

(1) Names, dates, work locations, time periods at work locations, itemization of subsistence expenses of each employee, limited, however, to travel expenses authorized for state employees by the General Appropriations Act, Tex. Leg. Regular Session, 2015, Article IX, Part 5, as amended or superseded. Receipts required for lodging;

(2) Copies of invoices or tickets for transportation costs or, if not available, names, dates, and points of travel of individuals; and

(3) All other reimbursable travel expenses -- invoices or purchase vouchers showing reason for expense with receipts to evidence the amount incurred.

6. Incomplete requests will be returned to the CONTRACTOR if deficiencies are not resolved within ten (10) business days.

7. If for some reason the reimbursement request cannot be processed due to the need for an amendment to the CONTRACT, the CONTRACTOR will be required to resubmit the Payment Request Checklist dated after the execution of the amendment.

8. The CONTRACTOR is responsible for any food or entertainment expenses incurred by its own organization or that of its subcontractors, outside that of the travel expenses authorized and approved by the State of Texas under this CONTRACT.

9. In accordance with Texas Administrative Code (TAC) Title 1, Part 5, Chapter 111, Subchapter B, Rule §111.14, the CONTRACTOR shall maintain business records documenting its compliance with the approved Historically Underutilized Business subcontracting plan in the format prescribed by the Texas Procurement and Support Services (Exhibit F). Exhibit F must include payment information on all HUB and non-HUB subcontractors. Submittal of these monthly reports is required as a condition of payment.

   The TWDB will monitor the HUB subcontracting plan monthly to ensure the value of the subcontracts meets or exceeds the HUB subcontracting provisions specified in the contract. The CONTRACTOR who fails to implement the HUB subcontracting plan in good faith will be reported to Texas Procurement and Support Services. The TWDB may revoke the contract for breach of contract and make a claim against the CONTRACTOR.

ARTICLE V. INTELLECTUAL PROPERTY: OWNERSHIP, PUBLICATION, AND ACKNOWLEGEMENT

1. "Use" of a work product, whether it's the CONTRACTOR Works, a Subcontractor Works or otherwise, shall mean and include, without limitation hereby, any lawful use, copying or dissemination of the work product, or any lawful development, use, copying or dissemination of derivative works of the work product, in any media or forms, whether now known or later existing.

2. "No Compensation Obligation" shall mean there is no obligation on the part of one co-owner or licensee of a work, whether it's the CONTRACTOR Works, a Subcontractor Works or otherwise, to compensate other co-owners, licensees or licensors of the work for any use of the work by the using co-owner or licensee, including but not limited to compensation for or in the form of: royalties; co-owner or licensee accounting; sharing of revenues or profits among co-owners, licensees or licensors; or any other form of compensation to the other co-owners, licensees or licensors on account of any use of the work.

3. "Dissemination" shall include, without limitation hereby, any and all manner of: physical distribution; publication; broadcast; electronic transmission; internet streaming; posting on the Internet or World Wide Web; or any other form of communication, transmission, distribution, sending or providing, in any forms or formats, and in or using any media, whether now known or later existing.

4. The TWDB shall have an unlimited, unrestricted, perpetual, irrevocable, non-exclusive royalty-free right to access and receive in usable form and format, and to use all technical or other data or information developed by the CONTRACTOR and Subcontractor in, or otherwise resulting from, the performance of services under this CONTRACT.

5. For purposes of this Article, "CONTRACTOR Works" are work products developed by the CONTRACTOR and Subcontractor using funds provided under this CONTRACT or otherwise rendered in or related to the performance in whole or part of this CONTRACT, including but not limited to reports, drafts of reports, or other material, data, drawings, studies, analyses, notes, plans, computer programs and codes, or other work products, whether final or intermediate.

    a. It is agreed that all CONTRACTOR Works shall be the joint property of the TWDB and the CONTRACTOR.

    b. The parties hereby agree that, if recognized as such by applicable law, the CONTRACTOR Works are intended to and shall be works-made-for-hire with joint ownership between the TWDB and the CONTRACTOR as such works are created in whole or part.

c. If the CONTRACTOR Works do not qualify as works-made-for-hire under applicable law, the CONTRACTOR hereby conveys co-ownership of such works to the TWDB as they are created in whole or part. If present conveyance is ineffective under applicable law, the CONTRACTOR agree to convey a co-ownership interest of the CONTRACTOR Works to the TWDB after creation in whole or part of such works, and to provide written documentation of such conveyance upon request by the TWDB.

d. The TWDB and the CONTRACTOR acknowledge that the copyright in and to a copyrightable CONTRACTOR Work subsists upon creation of the CONTRACTOR Works and its fixing in any tangible medium. The CONTRACTOR or the TWDB may register the copyrights to such Works jointly in the names of the CONTRACTOR and the TWDB.

e. The TWDB and the CONTRACTOR each shall have full and unrestricted rights to use a CONTRACTOR Works with No Compensation Obligation.

6. For purposes of this Article, "Subcontractor Works" include all work product developed in whole or part by or on behalf of Subcontractors engaged by the CONTRACTOR to perform work for or on behalf of any CONTRACTOR under this CONTRACT (or by the Subcontractors' Subcontractors hereunder, and so on). The CONTRACTOR shall secure in writing from any Subcontractors so engaged:

a. unlimited, unrestricted, perpetual, irrevocable, royalty-free rights of the TWDB (and, if desired, of the CONTRACTOR) to access and receive, and to use, any and all technical or other data or information developed in or resulting from the performance of services under such engagement, with No Compensation Obligation; and either

b. assignment by the Subcontractor to the TWDB (and, if desired by them, jointly to the CONTRACTOR) of ownership (or joint ownership with the Subcontractor) of all Subcontractor Works, with No Compensation Obligation; or

c. grant by Subcontractor of a non-exclusive, unrestricted, unlimited, perpetual, irrevocable, world-wide, royalty-free license to the TWDB (and, if desired by them, the CONTRACTOR) to use any and all Subcontractor Works, including the right to sublicense use to third parties, with No Compensation Obligation.

7. No unauthorized patents. The CONTRACTOR Works and Subcontractor Works or other work product developed or created in the performance of this CONTRACT or otherwise using funds provided hereunder shall not be patented by the CONTRACTOR or their Subcontractor unless the EXECUTIVE ADMINISTRATOR consents in writing to submission of an application for patent on such works; and provided that, unless otherwise agreed in writing, any application made for patent shall include and name the TWDB (and, as applicable and desired by them, the CONTRACTOR) as co-owners of the patented work:

a. no patent granted shall in any way limit, or be used by the CONTRACTOR or Subcontractor to limit or bar the TWDB's rights hereunder to access and receive in useable form and format, and right to use, any and all technical or other data or information developed in or resulting from performance pursuant to this CONTRACT or the use of funds provided hereunder; and

b. the TWDB (and, if applicable, the CONTRACTOR) shall have No Compensation Obligation to any other co-owners or licensees of any such patented work, unless otherwise expressly agreed in writing.

8. The CONTRACTOR shall include terms and conditions in all contracts or other engagement agreements with any Subcontractors as are necessary to secure these rights and protections for the TWDB; and shall require that their Subcontractors include similar such terms and conditions in any contracts or other engagements with their Subcontractors. For the purposes of this section, "Subcontractors" includes independent contractors (including consultants) and also employees working outside the course and scope of employment.

9. Any work products subject to a TWDB copyright or joint copyright and produced or developed by the CONTRACTOR or their Subcontractor pursuant to this CONTRACT or using any funding provided by the TWDB may be reproduced in any media, forms or formats by the TWDB or the CONTRACTOR at their own cost, and be disseminated in any medium, format or form by any party at its sole cost and in its sole discretion. The CONTRACTOR may utilize such work products as they may deem appropriate, including Dissemination of such work products or parts thereof under their own name, provided that any TWDB copyright is noted on the materials.

10. The CONTRACTOR agrees to acknowledge the TWDB in any news releases or other publications relating to the work performed under this CONTRACT.

ARTICLE VI. AMENDMENT, TERMINATION, AND STOP ORDERS

1. This CONTRACT may be altered or amended by mutual written consent or terminated by the EXECUTIVE ADMINISTRATOR at any time by written notice to the CONTRACTOR. Upon receipt of such termination notice, the CONTRACTOR shall, unless the notice directs otherwise, immediately discontinue all work in connection with the performance of this CONTRACT and shall proceed to cancel promptly all existing orders insofar as such orders are chargeable to this CONTRACT. The CONTRACTOR shall submit a statement showing in detail the work performed under this CONTRACT to the date of termination. The TWDB shall then pay the CONTRACTOR promptly that proportion of the prescribed fee, which applies to the work, actually performed under this CONTRACT, less all payments that have been previously made. Thereupon, copies of all work accomplished under this CONTRACT shall be delivered to the TWDB.

2. The EXECUTIVE ADMINISTRATOR may issue a Stop Work Order to the CONTRACTOR at any time. Upon receipt of such order, the CONTRACTOR shall discontinue all work under this CONTRACT and cancel all orders pursuant to this CONTRACT, unless the order directs otherwise. If the EXECUTIVE ADMINISTRATOR does not issue a Restart Order within 60 days after receipt by the CONTRACTOR of the Stop Work Order, the CONTRACTOR shall regard this CONTRACT terminated in accordance with the foregoing provisions.

ARTICLE VII. SUBCONTRACTS

Each Subcontract entered into to perform required work under this CONTRACT shall contain the following provisions:

1. a detailed budget estimate with specific cost details for each task or specific item of work to be performed by the Subcontractor and for each category of reimbursable expenses;

2. a clause stating that the Subcontract is subject to audit by the Texas State Auditor's Office and requiring the Subcontractor to cooperate with any request for information from the Texas State Auditor, as further described in Article X, Section 1, Paragraph D hereof;

3. a clause stating that payments under the Subcontract are contingent upon the appropriation of funds by the Texas Legislature, as further described in Article X, Section 1, Paragraph A hereof;

4. a clause stating that ownership of data, materials and work papers, in any media, that is gathered, compiled, adapted for use, or generated by the Subcontractor or the CONTRACTOR shall become data, materials and work owned by the TWDB and that Subcontractor shall have no proprietary rights in such data, materials and work papers, except as further described in Article V hereof;

5. a clause stating that Subcontractor shall keep timely and accurate books and records of accounts according to generally acceptable accounting principles as further described in Article X, Section 2, Paragraph G;

6. a clause stating that Subcontractor is solely responsible for securing all required licenses and permits from local, state and federal governmental entities and that Subcontractor is solely responsible for obtaining sufficient insurance in accordance with the general standards and practices of the industry or governmental entity; and

7. a clause stating that Subcontractor is an independent contractor and that the TWDB shall have no liability resulting from any failure of Subcontractor that results in breach of CONTRACT, property damage, personal injury or death.

ARTICLE VIII. LICENSES, PERMIT, AND INSURANCE

1. For the purpose of this CONTRACT, the CONTRACTOR will be considered an independent contractor and therefore solely responsible for liability resulting from negligent acts or omissions. The CONTRACTOR shall obtain all necessary insurance, in the judgment of the CONTRACTOR, to protect themselves, the TWDB, and employees and officials of the TWDB from liability arising out of this CONTRACT.

2. The CONTRACTOR shall be solely and entirely responsible for procuring all appropriate licenses and permits, which may be required by any competent authority for the CONTRACTOR to perform the subject work.

3. Indemnification. The CONTRACTOR shall indemnify and hold the TWDB and the State of Texas harmless, to the extent the CONTRACTOR may do so in accordance with state law, from any and all losses, damages, liability, or claims therefore, on account of personal injury, death, or property damage of any nature whatsoever caused by the CONTRACTOR, arising out of the activities and work conducted pursuant to this CONTRACT. The CONTRACTOR is solely responsible for liability arising out of its negligent acts or omissions during the performance of this CONTRACT.

ARTICLE IX. SEVERANCE PROVISION

Should any one or more provisions of this CONTRACT be held to be null, void, voidable, or for any reason whatsoever, of no force and effect, such provision(s) shall be construed as severable from the remainder of this CONTRACT and shall not affect the validity of all other provisions of this CONTRACT which shall remain of full force and effect.

ARTICLE X. GENERAL TERMS AND CONDITIONS

1. GENERAL TERMS.

   a. No Debt Against the State. This CONTRACT does not create any debt by or on behalf of the State of Texas and the TWDB. The TWDB's obligations under this CONTRACT are contingent upon the availability of appropriated funds and the continued legal authority of the TWDB to enter into this CONTRACT.

   b. Independent Contractor. Both parties hereto, in the performance of this contract, shall act in an individual capacity and not as agents, employees, partners, joint ventures or associates of one another. The employees or agents of one party shall not be deemed or construed to be the employees or agents of the other party for any purposes whatsoever.

   c. Procurement Laws. The CONTRACTOR shall comply with applicable State of Texas procurement laws, rules and policies, including but not limited to competitive bidding and the Professional Services Procurement Act, Government Code, Chapter

2254, relating to contracting with persons whose services are within the scope of practice of: accountants, architects, landscape architects, land surveyors, medical doctors, optometrists, professional engineers, real estate appraisers, professional nurses, and certified public accountants.

d. Right to Audit. The CONTRACTOR and its Subcontractors shall maintain all financial accounting documents and records, including copies of all invoices and receipts for expenditures, relating to the work under this CONTRACT. The CONTRACTOR shall make such documents and records available for examination and audit by the EXECUTIVE ADMINISTRATOR or any other authorized entity of the State of Texas. The CONTRACTOR'S financial accounting documents and records shall be kept and maintained in accordance with generally accepted accounting principles. By executing this CONTRACT, the CONTRACTOR accepts the authority of the Texas State Auditor's Office to conduct audits and investigations in connection with all state funds received pursuant to this CONTRACT. The CONTRACTOR shall comply with directives from the Texas State Auditor and shall cooperate in any such investigation or audit. The CONTRACTOR agrees to provide the Texas State Auditor with access to any information the Texas State Auditor considers relevant to the investigation or audit. The CONTRACTOR also agrees to include a provision in any Subcontract related to this CONTRACT that requires the Subcontractor to submit to audits and investigation by the State Auditor's Office in connection with all state funds received pursuant to the Subcontract.

e. Force Majeure. Unless otherwise provided, neither the CONTRACTOR nor the TWDB nor any agency of the State of Texas, shall be liable to the other for any delay in, or failure of performance, of a requirement contained in this CONTRACT caused by force majeure. The existence of such causes of delay or failure shall extend the period of performance until after the causes of delay or failure have been removed provided the non-performing party exercises all reasonable due diligence to perform. Force majeure is defined as acts of God, war, strike, fires, explosions, or other causes that are beyond the reasonable control of either party and that by exercise of due foresight such party could not reasonably have been expected to avoid, and which, by the exercise of all reasonable due diligence, such party is unable to overcome. Each party must inform the other in writing with proof of receipt within two (2) business days of the existence of such force majeure or otherwise waive this right as a defense.

f. Interested Parties. All non-governmental CONTRACTORS are required to submit a Certificate of Interested Parties at the time the signed contract is submitted to the TWDB. The Certificate of Interested Parties (Form 1295) is a sworn statement by the contracting business entity and must be submitted even if there is no interested party in the transaction. The Form 1295 and instructions for completing and submitting the form are available at: https://www.ethics.state.tx.us/tec/1295-Info.htm. The TWDB is prohibited from executing a contract unless the contracting business entity submits a completed Form 1295. Any contract resulting from a TWDB procurement with a business entity will be void if the Certificate of Interested Parties is not submitted within 30 days of submitting an executed contract.

2. STANDARDS OF PERFORMANCE.

a. Personnel. The CONTRACTOR shall assign only qualified personnel to perform the services required under this CONTRACT. The CONTRACTOR shall be responsible for ensuring that any Subcontractor utilized shall also assign only qualified personnel. Qualified personnel are persons who are properly licensed to perform the work and who have sufficient knowledge, skills and ability to perform the tasks and services required herein according to the standards of performance and care for their trade or profession.

b. Professional Standards. The CONTRACTOR shall provide the services and deliverables in accordance with applicable professional standards. The CONTRACTOR represents and warrants that he is authorized to acquire Subcontractors with the requisite qualifications, experience, personnel and other resources to perform in the manner required by this CONTRACT.

c. Antitrust. The CONTRACTOR represents and warrants that neither the CONTRACTOR nor any firm, corporation, partnership, or institution represented by the CONTRACTOR, or anyone acting for such firm, corporation, partnership, or institution has (1) violated the antitrust laws of the State of Texas under the Texas Business & Commerce Code, Chapter 15, of the federal antitrust laws; or (2) communicated directly or indirectly the proposal resulting in this CONTRACT to any competitor or other person engaged in such line of business during the procurement process for this CONTRACT.

d. Conflict of Interest. The CONTRACTOR represents and warrants that the CONTRACTOR has no actual or potential conflicts of interest in providing the deliverables required by this CONTRACT to the State of Texas and the TWDB. The CONTRACTOR represents that the provision of services under this CONTRACT will not create an appearance of impropriety. The CONTRACTOR also represents and warrants that, during the term of this CONTRACT, the CONTRACTOR will immediately notify the TWDB, in writing, of any potential conflict of interest that could adversely affect the TWDB by creating the appearance of a conflict of interest.

CONTRACTOR represents and warrants that neither the CONTRACTOR nor any person or entity that will participate financially in this CONTRACT has received compensation from the TWDB or any agency of the State of Texas for participation in the preparation of specifications for this CONTRACT. The CONTRACTOR represents and warrants that he has not given, offered to give, and does not intend to give at any time hereafter, any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor or service to any public servant in connection with this CONTRACT.

e. Proprietary and Confidential Information. The CONTRACTOR warrants and represents that any information that is proprietary or confidential, and is received by the CONTRACTOR from the TWDB or any governmental entity, shall not be

disclosed to third parties without the written consent of the TWDB or applicable governmental entity, whose consent shall not be unreasonably withheld.

f. Public Information Act. The CONTRACTOR acknowledges and agrees that all documents, in any media, generated in the performance of work conducted under this CONTRACT are subject to public disclosure under the Public Information Act, Government Code, Chapter 552. The CONTRACTOR shall produce all documents upon request of the TWDB within two (2) business days when the documents are required to comply with a request for information under the Public Information Act.

g. Accurate and Timely Record Keeping. The CONTRACTOR warrants and represents that he will keep timely, accurate and honest books and records relating to the work performed and the payments received under this CONTRACT according to generally accepted accounting standards. Further, the CONTRACTOR agrees that he will create such books and records at or about the time the transaction reflected in the books and records occurs.

h. Dispute Resolution. The CONTRACTOR and the TWDB agree to make a good faith effort to resolve any dispute relating to the work required under this CONTRACT through negotiation and mediation as provided by Government Code, Chapter 2260 relating to resolution of certain contract claims against the state. The CONTRACTOR and the TWDB further agree that they shall attempt to use any method of alternative dispute resolution mutually agreed upon to resolve any dispute arising under this CONTRACT if this CONTRACT is not subject to Chapter 2260.

i. Contract Administration. The TWDB shall designate a project manager for this CONTRACT. The project manager will serve as the point of contact between the TWDB and the CONTRACTOR. The TWDB's project manager shall supervise the TWDB's review of the CONTRACTOR's technical work, deliverables, draft reports, the final report, payment requests, schedules, financial and budget administration, and similar matters. The project manager does not have any express or implied authority to vary the terms of the CONTRACT, amend the CONTRACT in any way or waive strict performance of the terms or conditions of the CONTRACT.

ARTICLE XI. CORRESPONDENCE

All correspondence between the parties shall be made to the following addresses:

For the **TWDB**:

Contract Issues:
Texas Water Development Board
Attention: Contract Administration
P.O. Box 13231
Austin, Texas 78711-3231
Email: contracts@twdb.texas.gov

Payment Request Submission:
Texas Water Development Board
Attention: Accounts Payable
P.O. Box 13231
Austin, Texas 78711-3231
Email: invoice@twdb.texas.gov

Physical Address:
Stephen F. Austin State Office Building
1700 N. Congress Avenue
Austin, Texas 78701

For the **CONTRACTOR:**

Contract Issues:
Neil Blandford
Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100
Albuquerque, NM 87109
Email: **nblandford@dbstephens.com**

Payment Request Submission:
Neil Blandford
Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100
Albuquerque, NM 87109
Email: **nblandford@dbstephens.com**

Physical Address:
Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100
Albuquerque, NM 87109

IN WITNESS WHEREOF, the parties have caused this CONTRACT to be duly executed in multiple originals.

TEXAS WATER DEVELOPMENT BOARD

Kevin Patteson
Executive Administrator

Date: 4/11/16

DANIEL B. STEPHENS & ASSOCIATES, INC.

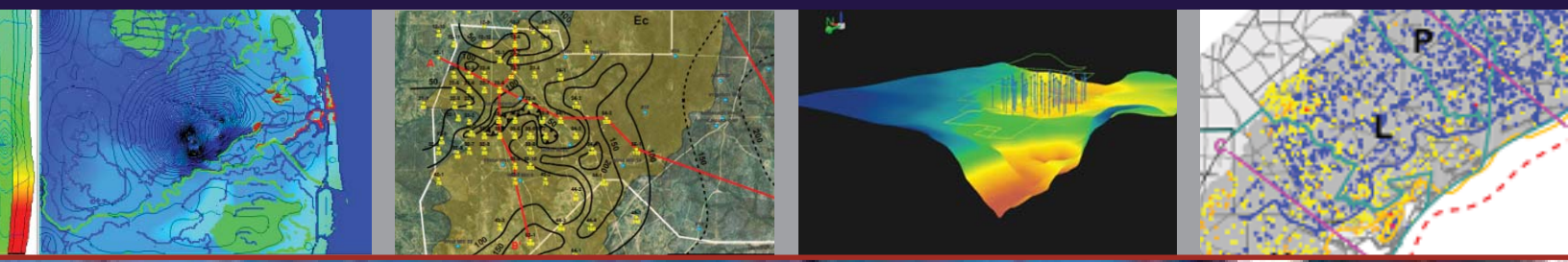
James Kelsey
President

Date: 4/6/16

EXHIBIT A

ORIGINAL GRANT APPLICATION

PROJECT 2: BLAINE AQUIFER



Services Associated to Study Brackish Aquifers in Texas

RFQ No. 580-16-RFQ0008

Class-Item Code(s): 918/55, 926/52

November 24, 2015

Prepared for

Texas Water Development Board
1700 North Congress Avenue, 6th Floor
Austin, TX 78701

Prepared by

Daniel B. Stephens & Associates, Inc.
6020 Academy NE, Suite 100
Albuquerque, NM 87109

Contract Administration
Texas Water Development Board
1700 North Congress Avenue, 6th Floor
Austin, Texas 78701

Re: **Response to RFQ 580-16-RFQ0008 Services Associated to Study Brackish Aquifers in Texas: Project 2. Blaine Aquifer**

Dear TWDB Selection Committee Members:

Daniel B. Stephens & Associates, Inc. (DBS&A) understands that you face an extremely tight schedule to complete the study of the Blaine Aquifer. DBS&A and our team members, John Shomaker & Associates, Alan R. Standen LLC, and Michelle A Sutherland LLC (HUB-certified), will meet this schedule and provide a product that fulfills all RFQ requirements.

Some of the benefits we offer the TWDB are:

- Team members with an **excellent understanding of the hydrogeology of Permian rocks** from north-central Texas to eastern New Mexico, and who have worked extensively with geophysical logs of Permian Guadalupian and Ochoan Series rocks.
- A detailed technical approach based on significant work our team members have already completed for the study area, and our **knowledge of aquifer conditions** gained through our work on other projects.
- Team members with in-depth experience in the **construction of hydro-stratigraphic models using multiple data sources,** such as BEG, RRC, BRACS, TWDB and TDLR.
- Exceptional GIS and database expertise. We have **used the BRACS database** extensively as part of two previous projects to evaluate brackish groundwater resources.
- **Sufficient professional labor resources** to meet the required schedule.
- Expert knowledge and experience in groundwater modeling and **quantitative analysis of brackish aquifer resources.**

We look forward to teaming with TWDB to successfully complete this important project.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Neil Blandford, P.G.
Principal Hydrologist, Vice President

Contents

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Section 7. Scope of Work 7-1

ATTACHMENT A

EXECUTION OF RESPONSE

Company Name: Daniel B. Stephens & Associates, Inc. 6020 Academy Road NE,

Address: Suite 100

Albuquerque, NM 87109

Phone Number: (505) 822-9400

I, Neil Blandford, P.G., am the above-referenced company's representative and I am authorized to submit this response and sign future contract documents. By signing, vendor certifies that if a Texas address is shown as the address, the vendor qualifies as a Texas Resident Bidder as defined in Texas Administrative Code, Title 34, Part 1, Chapter 20.

Authorized Signature

November 11, 2015
Date

2. COMPANY PROFILE SUMMARY AND HISTORY

a. Legal company name, address, phone number, and legal status (corporation, partnership, joint venture, sole proprietorship)

Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100

Albuquerque, New Mexico 87109

Phone: (505) 822-9400

Legal status: Corporation

b. Legal name of each participant/potential user(s), their possible involvement with the Project, their phone number, and email address. Also include the contact person(s) information should questions come up regarding the response.

Prime consultant:

Daniel B. Stephens & Associates, Inc.

Involvement: Project management, Hydrology/Water Quality, Groundwater Modeling, Database/GIS

For questions regarding this response, contact:
Mr. Neil Blandford, P.G.
Vice President, Principal Hydrologist
nblandford@dbstephens.com
(505) 822-9400

Subconsultants:

- John Shomaker and Associates, Inc.
  Stephen T. Finch, Jr., C.P.G.
  sfinch@shomaker.com
  (505) 345-3407
  Involvement: Hydrogeology/Water Quality, Expert Resources
- Allan R. Standen, LLC
  Allan R. Standen, P.G.
  astanden@att.net
  (512) 731-6242
  Involvement: Hydrogeology/Water Quality, Database/GIS
- Michelle Sutherland LLC
  Michelle A. Sutherland, P.E. (Sole Proprietor, HUB Certified)
  michelleasutherland@gmail.com
  (949) 702-3622
  Involvement: 3D Geologic Modeling

c. Name, title, phone number and email address of person submitting the response with the authority to bind the company.

Mr. Neil Blandford, P.G.

Vice President, Principal Hydrologist

nblandford@dbstephens.com

(505) 822-9400

d. Describe the general nature of previous work, the number of years in business, size and scope of operation

DBS&A is a full-service water resources and environmental consulting firm that has been providing services in groundwater and surface water hydrology, soil science, and environmental engineering for more than 30 years. Particular areas of expertise include hydrogeologic investigations, local and regional water resources planning and development, well-field design and construction, studies of contaminant transport in soil and groundwater, numerical groundwater flow and solute transport modeling, and remediation of soil and groundwater. Also of note are DBS&A's research capabilities and our unique soils testing laboratory.

DBS&A maintains offices in Austin and Lubbock, Texas; Albuquerque, New Mexico; Durango, Colorado; and Newport Beach, Santa Barbara, and Oakland, California. The firm is comprised of approximately 90 professionals, including hydrologists and geologists; soil and environmental scientists; civil, chemical, and environmental engineers; geographic information system (GIS) and computer drafting specialists; and field and laboratory technicians.

In Texas DBS&A has developed multiple Groundwater Availability Models (GAMs) for the TWDB and conducted two geologic structure projects (Capitan Reef Complex and Llano Uplift). For municipal water providers we have planned, designed and constructed well fields, evaluated existing well fields and projected well-field performance for water planning purposes. We have also investigated new sources of water, including deep brackish water. We have conducted or participated in numerous water planning efforts, including the current Region O Regional Water Plan. In addition, DBS&A has conducted groundwater supply investigations for numerous private entities.

For University Lands, we are completing a study of groundwater resources (predominately brackish), for aquifers to approximately 3,000 feet below land surface beneath many of their holdings in west Texas. Brackish aquifers of interest include the Dockum, Rustler, Capitan Reef Complex and various formations of the Permian Artesia Group.

Our proposed subcontractors, in total, have similar, relevant experience to that outlined above. DBS&A has worked closely in the past with all of our proposed team members. Mr. Allan Standen and Ms. Michelle Sutherland are former employees of DBS&A, and DBS&A has worked on multiple projects with JSAI in New Mexico and Texas for over 15 years. The DBS&A team will be able to function seamlessly due to this prior experience.

The main advantages that DBS&A offers TWDB are the following:

- Existing, in-depth knowledge of the hydrogeology of Permian rocks from north-central Texas to eastern New Mexico, including detailed experience working with geophysical logs of Permian Guadalupian and Ochoan Series rocks.
- Detailed experience, in Texas, with the siting, design and construction of brackish aquifer wells and well fields, and simulation of the effects of well field pumping. This knowledge will assist with reasonable delineation of potential production areas and particularly with determination of production volumes over the 30- and 50-year periods without causing unallowable impacts.
- Detailed knowledge, gained through direct project experience, of the BRACS database. We know what to expect in utilizing this database and adding project deliverables to the database.
- Extensive, in-depth experience in the construction of hydro-stratigraphic models using multiple data sources including BEG, RRC, BRACS, TWDB and TDLR. We know where the data sources are in Texas and how to access them efficiently.
- Extensive groundwater modeling experience, not only for water supply but also for groundwater quality.
- Adequate resources to complete the project on time. Our team has at least five team members that have 100% availability to ensure project delivery on schedule. In addition, the combined firm resources is approximately 100 technical staff , so additional resources can be called upon if needed.

SECTION 3 – COMPANY REFERENCES

REFERENCE #1: Daniel B. Stephens & Associates, Inc.

Name of Organization:	Colorado River Municipal Water District		
Business Address:	400 E. 24th Street		
Business City:	Big Spring		
Business State:	Texas	**Zip:**	79720
Contact Person Name:	John Grant		
Contact Person Title:	General Manager		
Phone Number:	(432) 267-6341	**Fax:**	(432) 267-3121
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3 – COMPANY REFERENCES

REFERENCE #2: Daniel B. Stephens & Associates, Inc.

Name of Organization:	West Central Texas Municipal Water District		
Business Address:	410 Hickory Street		
Business City:	Abilene		
Business State:	Texas	**Zip:**	79601
Contact Person Name:	Chris Wingert, P.E.		
Contact Person Title:	Planning and Development Manager		
Phone Number:	(325) 673-8254	**Fax:**	(325) 673-8272
Client Comments:			

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SECTION 3 – COMPANY REFERENCES

REFERENCE #3: Daniel B. Stephens & Associates, Inc.

Name of Organization:	Black & Veatch		
Business Address:	14100 San Pedro Avenue		
	Suite 410		
Business City:	San Antonio		
Business State:	Texas	**Zip:**	78232
Contact Person Name:	Phillip Cook		
Contact Person Title:	Project Manager, Water Division		
Phone Number:	(210) 404-1330	**Fax:**	(210) 404-1370
Client Comments:			

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SECTION 3 – COMPANY REFERENCES

REFERENCE #4: John Shomaker and Associates, Inc.

Name of Organization:	El Paso Water Utilities		
Business Address:	1154 Hawkins Blvd.		
Business City:	El Paso		
Business State:	Texas	**Zip:**	79925
Contact Person Name:	Scott Reinert, P.E., P.G.		
Contact Person Title:	Water Resource Manager		
Phone Number:	(915) 594-5579	**Fax:**	(915) 594-5572
Client Comments:			

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SECTION 3 – COMPANY REFERENCES

REFERENCE #5: Allan R. Standen LLC

Name of Organization:	Middle Pecos Groundwater Conservation District		
Business Address:	405 North Spring Drive		
Business City:	Fort Stockton		
Business State:	Texas	**Zip:**	79735
Contact Person Name:	Paul Weatherby		
Contact Person Title:	District Manager		
Phone Number:	(432) 336-0698	**Fax:**	(432) 336-3407
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

Ward County Brackish Water Supply

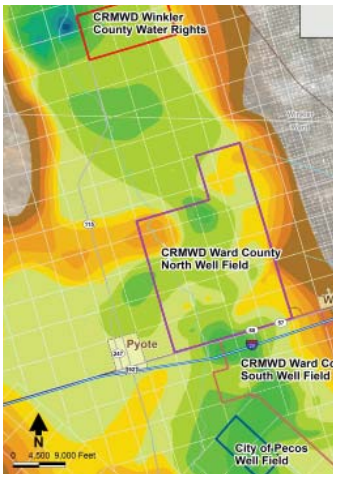
Monahans, Texas

Client

Colorado River Municipal Water District

Highlights

- Developed innovative methodology to characterize complex subsurface hydrogeologic conditions and evaluate water quality
- Well design, installation oversight and testing for 21 high capacity raw water supply wells
- Exceeded target groundwater production and water quality goals



Monitoring a pumping test of the completed production well.

The Colorado River Municipal Water District (CRMWD) in West Texas provides the raw water supply to about half a million people in its member cities of Odessa, Big Spring and Snyder and other municipalities and towns under contract. CRMWD's primary source of water is from three surface water reservoirs. The To provide an additional emergency water supply source in times of drought, CRMWD acquired a well field in Ward County with an existing production capacity of approximately 15 million gallons per day. The North Ward County Well Field is located in the Monument Draw Trough portion of the Pecos Valley Aquifer, much of which contains brackish water. The Pecos Valley Aquifer in this area is in hydraulic communication with the underlying Triassic Dockum Formation, which also contains brackish water. Total dissolved solids (TDS) concentrations generally increase with depth in the aquifer and to the west.

Worsening drought conditions in 2011 resulted in alarming rates of reservoir depletion, and CRMWD commenced an expansion of the well field with the goal of doubling its production capacity. By mid-2011 projections of water availability suggested that CRMWD's surface water sources could be extremely limited by early 2013. This situation required an aggressively accelerated construction schedule to bring the additional groundwater supply online before December 2012.

DBS&A planned and executed a Phase 1 test drilling investigation to characterize subsurface hydrogeologic conditions and evaluate water quality. Understanding of detailed well-field stratigraphy was required, and detailed interpretations of reworked Dockum Group sediments that compose portions of the Pecos Alluvium versus proper Dockum Group geologic contacts were necessary. A geophysical logging program was used to obtain data from which water quality was characterized. Correlations between resistivity (corrected for borehole and clay effects) and TDS and between TDS and chloride were established, and chloride concentrations (increasing with depth) were estimated for each boring. Based on this information, an innovative well design methodology was used to design multi-screen wells in such a way as to meet CRMWD's production capacity and water quality goals. Phase 2 of the project included contracting, construction oversight and aquifer testing of the 21 new supply wells, and subsequent procurement and installation oversight of the submersible pumps and wellhead completions and controls.

Lower Rio Grande Valley Brackish Groundwater Supply Analysis

Lower Rio Grande Valley, Texas

Client

Rio Grande Regional Water Authority

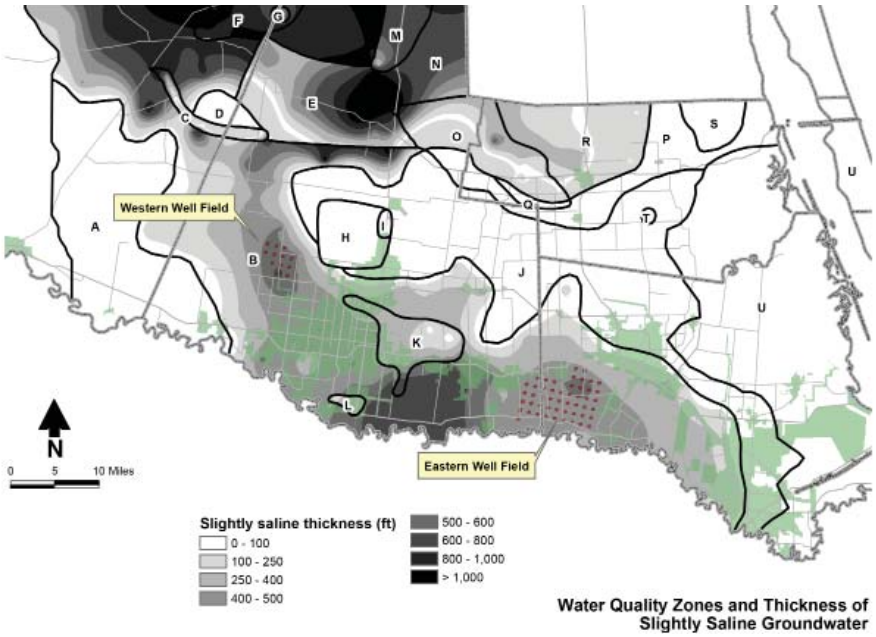
Black and Veatch

Highlights

- Conducted brackish groundwater resource analysis within three counties to identify well field locations and estimated pumping effects on water levels and water quality
- Preliminary feasibility of ASR and enhanced aquifer recharge
- Utilized BRACS database (TWDB Report 383) and TWDB GAMs

The Rio Grande Regional Water Authority (RGRWA) exists to help plan for and develop sustainable water supplies for the Rio Grande basin in Texas. DBS&A was subcontractor to Black and Veatch, who was awarded the Texas Water Development Board (TWDB) Facility Planning Grant on behalf of RGRWA, and is leading the development of a regional water supply facility concept and conducting preliminary engineering. Goals of the project are to establish new and reliable sources of drinking water, and to build linkages to further regionalize water systems in the valley. The Valley Water Supply project builds on the work of regional water planning and a Bureau of Reclamation Basin Study, both of which recommended brackish groundwater desalination.

DBS&A identified potential well-field locations based on analysis and consideration of water quality zones identified in the TWDB Brackish Resource Aquifer Characterization System (BRACS) study, the hydrogeology of the Gulf Coast aquifer System, the modeled available groundwater that corresponds to the desired future conditions, and other factors including land use and the existence of groundwater conservation districts. Detailed review of two existing groundwater models was conducted to select one for use during the project. A key planning concern was the potential for changes in water quality through time, so expected well-field source water was simulated using particle tracking and local mass-balance analysis from the model. The potential for aquifer storage and recovery (ASR) was also evaluated for two locations, as were other potential methods for conducting aquifer recharge.



Water Quality Zones and Thickness of Slightly Saline Groundwater

Preliminary well designs, estimates of well-yield and water quality, and well-field layout for two potential brackish aquifer well fields were provided to Black and Veatch for their scoping engineering analysis.

Brackish Groundwater Evaluation to Supplement Surface Water Municipal Supply

Shackelford County, Texas

Client

West Central Texas Municipal Water District

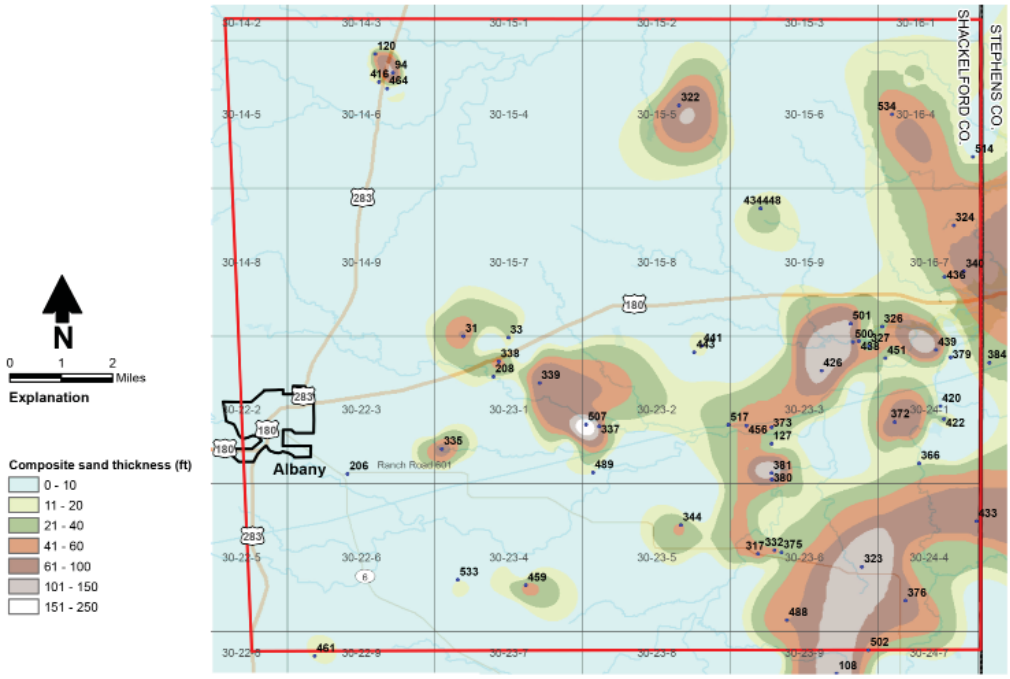
Highlights

- Conducted brackish groundwater resource evaluation to supplement surface water supplies diminished due to drought
- Identified multiple production zones with depth, estimated lateral connectivity, and estimated potential well yields and water quality

On behalf of the West Central Texas Municipal Water District (WCTMWD), DBS&A was the prime contractor for a study to identify potential brackish groundwater supplies to supplement surface water sources under severe pressure due to drought. Project goals were to identify a brackish groundwater supply of 2 million gallons per day adjacent to WCTMWD's existing water distribution system within a 150 square mile region west of Albany, Texas.

Project objectives were achieved through mapping, based on available data, the distribution of water-saturated sand within Permian strata in the subsurface. Aquifer characteristics, potential well production rates, and water quality were estimated based on available data. Over 500 drillers' reports were identified for the study area and screened for applicability; 429 drillers' reports were retained for detailed analysis. The driller's report geological descriptions were used to identify sand intervals greater than 10 feet thick from 200 feet below land surface (ft bls) to 3,000 ft bls. Potential brackish water production intervals were mapped for multiple depth intervals, and available water quality information was used to estimate the total dissolved solids content of groundwater.

Study conclusions were that brackish groundwater production is possible from Permian-age geologic units beneath the study area, although target areas are limited in geographic extent and well yields would likely be insufficient to meet WCTMWD goals. In addition, the expected water quality would be highly saline, leading to significant treatment costs.



Composite Sand Thickness Map for Depth Interval 1,500 to 3,000 Feet Below Ground Surface

Groundwater Modeling for Brackish Water Availability

Pecos Valley Aquifer, West Texas

Client

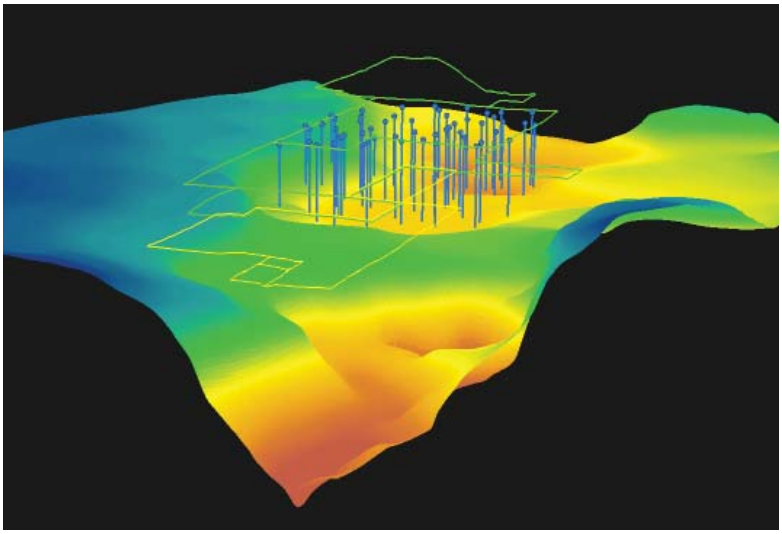
Colorado River Municipal Water District

Highlights

- Groundwater flow and solute transport modeling using MODFLOW, SEAWAT, MT3DMS, PEST and Groundwater Vistas to predict water quality at municipal well fields
- Brackish groundwater resource evaluation using geophysical log analysis and BRACS database (TWDB Report 382)

DBS&A constructed a three-dimensional regional groundwater flow model of the Pecos Valley Aquifer within the Monument Draw Trough in Ward and Winkler Counties, Texas, for the Colorado River Municipal Water District (CRMWD). The model was applied to evaluate well-field sustainability and expected changes in water quality (in progress) for multiple groundwater production scenarios. GIS data was integrated from multiple sources. ArcGIS was used for all GIS data development. Modeling codes applied include the United States Geological Survey's (USGS) MODFLOW-2000, SEAWAT, MT3DMS, the parameter estimation software PEST, and Groundwater Vistas for pre- and post-processing.

DBS&A constructed an 8-layer model with grid cells ranging from 440 feet to one mile on edge for an area of approximately 880 square miles (22 miles wide by 40 miles long) that included CRMWD's well fields and water right holdings in Ward and Winkler Counties. Wells and well fields for the towns of Grandfalls, Kermit, Monahans, Pecos, Wickett, and Wink are also included in the model. DBS&A used data from the Texas Water Development Board's (TWDB) Brackish Resources Aquifer Characterization System (BRACS) database to define the aquifer geometry and develop conceptual models of water quality outside the well-field area. Detailed configurations of water quality were determined for CRMWD's well field areas based on water quality sampling and geophysical log analysis from test borings. Historical pumping records for municipal wells were obtained from the TWDB's groundwater database and CRMWD records. In this portion of the Pecos Valley Aquifer, a shallow zone of fresh (< 1,000 mg/L TDS) water occurs along the eastern margin of the Monument Draw Trough. This freshwater zone is underlain by brackish water at depth and is abutted by brackish water to the west, thereby creating a pseudo-coastal type aquifer system where solute concentrations vary laterally and with depth.



Base of Pecos Valley Aquifer from BRACS study and existing Ward County municipal production wells.

DBS&A calibrated the model to historical conditions over the period of 1948-2009 using PEST to adjust the hydraulic conductivity field to simulate over 5,000 observations of hydraulic head through time at 85 wells. The optimization was conducted using the pilot point method where aquifer hydraulic conductivity for designated points is estimated in the model, and these points serve as the basis for the interpolation of aquifer permeability throughout the model domain using kriging.

Lower Rio Grande Valley Basin Study

Cameron, Willacy, and Hidalgo Counties, Texas

Client

Rio Grande Regional Water Authority and Bureau of Reclamation

Highlights

- Assessed water availability over 50-year planning horizon
- Evaluated range of water management strategies
- Developed preliminary engineering design and cost estimates for three regional brackish groundwater desalination facilities

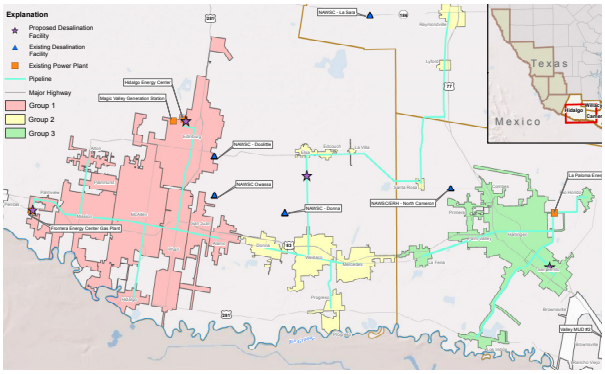
The Lower Rio Grande Valley of Texas is facing a water supply shortage as a result of rapidly growing population on both the Mexico and the United States sides of the Rio Grande. The Bureau of Reclamation, Rio Grande Regional Water Authority and its 53 member entities, in collaboration with the Texas Region M Planning Group, Texas Water Development Board, Texas Commission on Environmental Quality, and International Boundary and Water Commission, conducted a Basin Study to evaluate the impacts of climate variability on water availability over a 50-year planning horizon.

Study participants performed hydrologic projections of future water supply and demand in order to develop a planning objective: Alleviate projected water supply imbalances in the study area by developing one or more alternatives in Cameron, Willacy, and Hidalgo Counties. This will:

- Provide a minimum of 86,000 acre-feet of water year-round by 2060
- Protect existing water rights
- Be compatible with regulations, policies, and environmental law
- Be implementable within the reasonable control of study sponsors

DBS&A evaluated a range of water management strategies based on the planning objective. Brackish groundwater desalination (BGD) was selected for more detailed study, and three BGD alternatives were considered: 1. A single regional BGD facility, 2. Expansion of existing facilities, and 3. Three regional BGD systems. Of these three alternatives, only the three regional BGD systems concept met the evaluation criteria, and was therefore selected for DBS&A to develop a preliminary engineering design and cost estimate.

Key components of the preliminary engineering design include the co-location with power plants and a phased construction approach. Two of the three proposed BGD systems are co-located with power plants. The Texas Public Utility Commission allows power to be purchased at wholesale rates if the purchaser can connect directly to the generation facility. Co-location with a power plant not only decreases energy costs, but may also improve the reliability of power; the source of significant maintenance costs in other reverse osmosis plants in the region. The facility construction is proposed in two phases in which the 2040 demands were used to drive Phase 1, and 2060 demands used to drive Phase 2. Proportional demand calculations were used to develop proposed delivery volumes that meet and exceed the planning objective minimum of 86,000 acre-feet per year.



Proposed plant locations and pipelines

Evaluation of Brackish Groundwater Development for Municipal Supply

Alamogordo, New Mexico

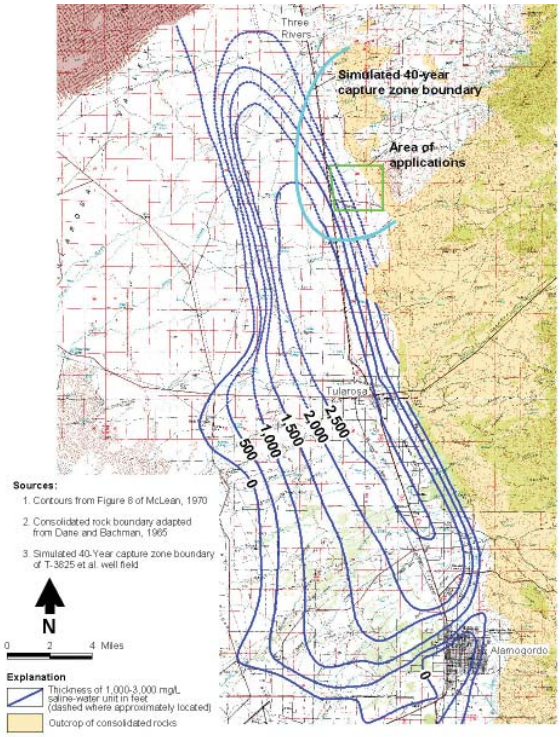
Client

City of Alamogordo, New Mexico

Highlights

- Provided expert testimony before the State Engineer and in District Court
- Analyzed brackish groundwater conditions and density-dependent groundwater flow
- Conducted groundwater flow modeling

DBS&A provided expert review and testimony before the New Mexico State Engineer and in District Court regarding hydrologic impacts and brackish water intrusion due to a proposed City of Alamogordo well field in the Tularosa Basin. The well filed was originally designed for a maximum withdrawal of up to 10,000 acre-feet per year. The City needed to secure a reliable 40-year water supply, and was actively engaged in seeking additional water resources to supplement surface water sources depleted by persistent drought.



Thickness of the 1,000-3,000 mg/L Saline-Water Unit Simulated 40-Year Capture Zone Boundary

The well field will pump water with total dissolved solids (TDS) of approximately 2,500 mg/l, which will be treated using desalinization. Freshwater in the Tularosa Basin flows from east to west, but rises toward the land surface in the center of the basin due to the presence of brine, which has TDS greater than that of seawater. A fresh water-saltwater interface exists within the basin, and it is therefore analogous to a coastal aquifer system. Issues of concern included water level decline, the potential for diminished flows to springs and the Rio Tularosa, and water quality degradation due to the encroachment of saline water. DBS&A provided expert review and analysis of the hydrogeologic and groundwater flow modeling analyses conducted by another consultant, and conducted detailed analyses of the potential for saline water encroachment (both lateral and vertical) into the proposed well field. Expert testimony was provided concerning all of these issues.

University Lands Brackish Groundwater Availability Analysis

University Lands, Multiple Counties, West Texas

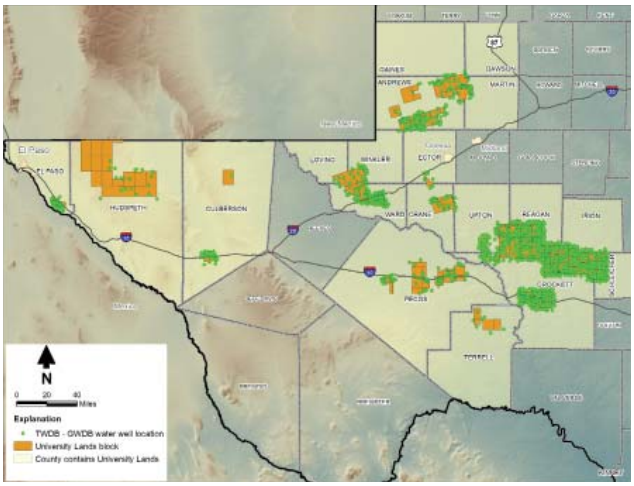
Client

University Lands

Highlights

- Detailed groundwater resource analysis (primarily brackish) within 12 counties of west Texas based on analysis of several thousand water well and oil and gas geophysical logs and driller's reports
- Stratigraphic analysis of Edwards-Trinity, Dockum, Rustler, Capitan Reef Complex and other potential Permian aquifers
- Utilization of existing GAMs and BRACS database (TWDB Report 382)

DBS&A was the prime contractor that assisted University Lands with evaluating, documenting and quantifying groundwater resources from land surface to approximately 3,000 to 5,000 feet beneath their holdings in 12 counties of west Texas. The analysis included a comprehensive review of existing reports and data, but more significantly involved the analysis of several thousand oil and gas geophysical logs, water well logs and cable-tool driller reports obtained from University Lands, Texas Railroad Commission and the Bureau of Economic Geology well log libraries.



DBS&A's analysis is focused on the production capacity of brackish water aquifers, such as the Dockum.

Much of the analysis focused on the production capacity (net sand analysis and aquifer thickness and extent) of brackish water aquifers such as the Trinity Group and Dockum Aquifers, since University Lands requires operators to utilize deeper brackish water resources for fracking and rig supply where feasible. DBS&A also compiled and analyzed water levels, water quality information and water well production capacities. In some regions, other potential aquifers in the Permian Artesia Group, such as the Queen Formation, were identified as potential brackish water resources. Study results included multiple geologic cross sections and a three-dimensional geologic model.

Other portions of the project included 1) development of a web site where oil and gas operators and other University Lands lease holders can apply for water supply well permits and upload completed water well information, such as well diagrams, geophysical logs and water quality, and 2) construction of a comprehensive water well inventory (database) for University Lands throughout Texas. These tasks coincide with the hydrogeologic analysis, since water well applications and proposed screen intervals can be checked against aquifer structural surfaces using custom GIS programming to confirm permitted well completion.

Hydrogeochemical Investigation of Salinity

Lower Rio Grande, New Mexico

Client

New Mexico Interstate Stream Commission

Highlights

- Identified potential sources of salinity and crucial data gaps
- Created a monitoring plan
- Conducted comprehensive hydrologic and geochemical investigation of groundwater and surface water interaction
- Monitoring and evaluating long-term changes in privately owned irrigation wells

DBS&A is engaged in an ongoing project to identify sources of salinity to the Rio Grande in southern New Mexico. River salinization can significantly impact water quality and is therefore an important consideration in water supply planning. Salts found in rivers can have anthropogenic sources, including urban runoff and wastewater effluent, as well as naturally occurring sources, such as deep saline groundwater and geothermal discharges. Added salts are subsequently concentrated by evapotranspiration from riparian and agricultural areas and, less significantly, by consumptive municipal and industrial use.

In the initial phase of this investigation, DBS&A focused on compilation, analysis, and simple mass balance modeling of existing surface water and groundwater data to identify potential sources of salinity and crucial data gaps; this information was essential in creation of the monitoring plan. In the second phase of the project, DBS&A conducted a comprehensive hydrologic and geochemical investigation of groundwater and surface water interactions in the complex interstate and international watershed. This phase included development of a monitoring plan for both groundwater and surface water; data collection to characterize the geochemical and isotopic composition of water and potential contributing sources throughout the study area; basic geochemical data, as well as stable and radioactive isotopes were used to fingerprint the various sources. In addition to data collection, major study components included (1) review of previous investigations, including a critique of methods used by previous investigators, (2) an evaluation of historical data, (3) a source water characterization based on recently collected data, (4) geochemical modeling (using PHREEQC), and (5) mass balance analysis. Each of these components provided multiple lines of evidence on which to base major findings of the study.

Natural sources of salinity can significantly impact water quality.

Currently, DBS&A is supporting state agencies with ongoing data collection efforts to evaluate long-term changes in privately owned irrigation wells and in monitoring wells throughout the study area.

Based on results of this study, which were corroborated by leading academics throughout the region, the State of New Mexico led the effort to form the Multi-State Salinity Coalition with Texas and Colorado. The Coalition is currently working with local irrigation districts, municipal and university partners in southern New Mexico and far west Texas to understand and attempt to control natural sources of salinity.

Groundwater Availability Modeling, Edwards-Trinity (High Plains) Aquifer

West Texas/Eastern New Mexico

Client

Texas Water Development Board

Highlights

- Developed a comprehensive ArcGIS geodatabase to help delineate model layers within the Cretaceous sequence underlying the Ogallala Formation
- Reviewed and screened more than 10,000 driller's reports
- Created a three-dimensional stratigraphic framework of the Edwards-Trinity (High Plains) Aquifer
- Constructed and calibrated three-dimensional groundwater flow model

DBS&A developed the Edwards-Trinity (High Plains) minor aquifer groundwater availability model (GAM). The aquifer occurs beneath the Southern Ogallala Aquifer in West Texas and Eastern New Mexico. A major task of this project was to develop a comprehensive ArcGIS geodatabase to help delineate model layers within the Cretaceous sequence underlying the Ogallala Formation for a 14-county area in the Southern Texas Panhandle.

The Edwards-Trinity (High Plains) Aquifer occurs beneath the Southern Ogallala Aquifer in West Texas and Eastern New Mexico.

DBS&A integrated data from various sources (including the Texas Natural Resources Information System, the Texas Water Development Board, the U.S. Department of Agriculture, and the U.S. Geological Survey) into ArcGIS, and developed a geodatabase that linked USGS, TWDB, and other various datasets to GIS utilizing TWDB GAM data standards.

More than 10,000 driller's reports were initially reviewed and screened for accurate location information, detailed drillers' lithologic descriptions, and well depth. Drillers' lithologic descriptions from almost 1,800 driller's reports were integrated with 111 geophysical logs to create three-dimensional isopach maps of these subsurface hydrogeologic units. Structural contour elevation surfaces and isopach maps were created for all units (top of Dockum Group, Antlers sandstone, Edwards and Comanche Peak limestones, Duck Creek and Kimichi shales) to create a three-dimensional stratigraphic framework of the Edwards-Trinity (High Plains) Aquifer. Detailed analysis of aquifer extents was required for Dawson and Gaines counties.

A three-dimensional groundwater flow model that includes the Ogallala and Edwards-Trinity (High Plains) aquifers was constructed and calibrated to predevelopment (1930) and post-development (1931-2000) aquifer conditions.

Evaluation of Capitan Reef as a Water Supply Source

Pecos County, Texas

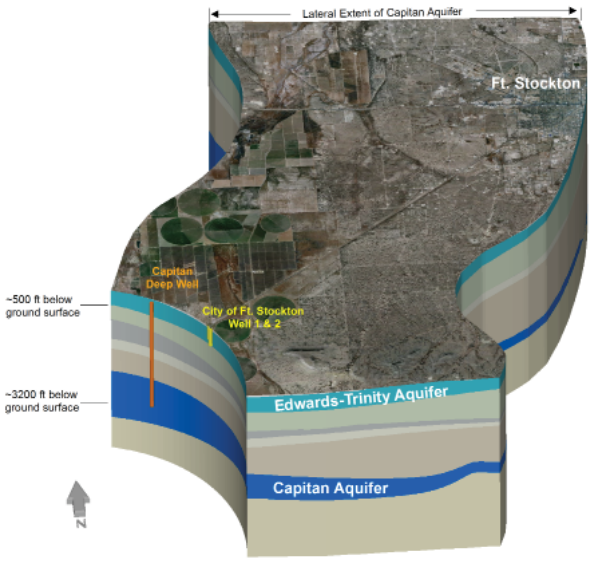
Client

City of Fort Stockton

Highlights

- Constructed 3-D stratigraphic model of the Pecos Alluvium, Edwards-Trinity Plateau, Dockum and Rustler Aquifers using over 700 geophysical logs, driller's logs and cable tool reports
- Evaluated potential of using Capitan Reef Aquifer as a water supply source for City of Fort Stockton
- Compiled georeferenced database and developed maps of aquifer extent, thickness, and depth to top from land surface

DBS&A was hired by the City of Fort Stockton to evaluate the potential impact of proposed pumping of 47,000 acre feet of groundwater on the City's municipal well field located in the Belding area of Pecos County, Texas. The project included review and analysis of existing hydrogeological reports and models. Over 700 geophysical logs, driller's logs, and cable tool reports were reviewed and screened to derive a final data set of 280 points that were integrated and used to construct a three-dimensional (3-D) stratigraphic model of the Pecos Alluvium, Edwards-Trinity (Plateau), Dockum, and Rustler Aquifers in the western third of Pecos County. DBS&A also constructed a groundwater flow model based on the 3-D geologic model to simulate the expected impacts of different external pumping scenarios on the City's municipal well field.



Aquifer cross section in City of Fort Stockton's Belding Water Rights Area

In a subsequent project, DBS&A evaluated the potential of using the Capitan Reef Complex Aquifer as a water supply. Available information on water quality and quantity for the Capitan Reef Complex Aquifer in south Pecos County was compiled, and the data was incorporated into a georeferenced project database. Maps and interpretations of depth to top of aquifer and aquifer thickness and extent were provided. Water quality samples were collected from a Capitan Reef Complex water well near the Belding Area to evaluate the need for water treatment. DBS&A also provided two alternate water supply test well designs used during the initial bid phase of the project.

Three-Dimensional Hydrogeologic Model for Fresh and Brackish Groundwater Evaluation

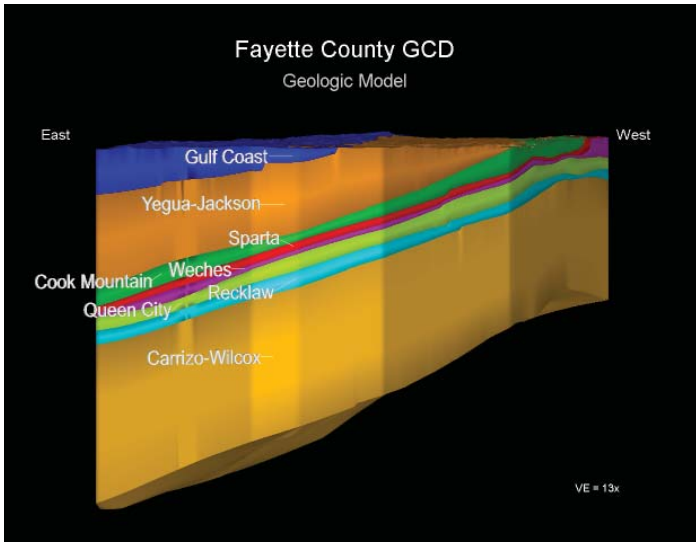
Fayette County, Texas

Client

Fayette County Groundwater Conservation District

Highlights

- Created a comprehensive three- dimensional hydrogeologic model
- Evaluated brackish and freshwater resources
- Conducted geophysical log analysis for aquifer characterization
- Determined spatial variability of water availability



3D Subsurface Aquifer Stratigraphy of Fayette County, Texas

DBS&A was contracted by the Fayette County Groundwater Conservation District to create a three dimensional (3-D) hydrogeologic model of Fayette County. The project included the identification and analysis of hydrogeologic and stratigraphic data within the county, and construction of an ArcGIS geodatabase to store and manage the applicable data. Geophysical logs were collected and interpreted to determine the top and bottom surfaces (where feasible) of the seven freshwater aquifers utilized in the county, as well as the brackish aquifers within the Calvert Bluff and Simsboro Formations of the Wilcox Group. The geophysical logs were also utilized to determine net sand thickness for each aquifer investigated. Driller's reports and well logs were then collected and classified by aquifer in order to further delineate the net sand content for each aquifer. Finally, estimates of groundwater in storage were made based on the net sand evaluations, aquifer extent, and assumptions regarding effective porosity. Results of the hydrogeologic analysis were compared to aquifer properties and other information in the groundwater availability model (GAM) to better understand and cross check the simulation framework.

All GIS data was developed utilizing ArcGIS software. The project data were integrated into a 3-D software package to create a 3-D hydrostratigraphic model of the county which could be used to conducted volume calculations and estimate the spatial variability of water availability. The 3-D model was used to assist with the development of desired future conditions (DFCs) of regional aquifers, including the Carrizo Wilcox.

Aquifer Storage and Recovery/Groundwater Banking

State of Texas

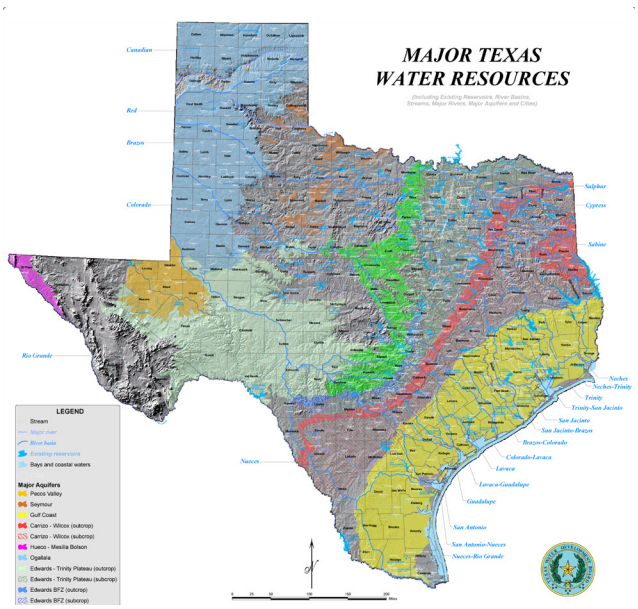
Client

Texas Water Development Board

Highlights

- Identified areas suitable for groundwater banking
- Constructed a statewide database using GIS data from multiple sources

The project identified areas suitable for groundwater banking of available surface water during non-drought periods using a custom developed GIS and a modified Boolean logic querying scheme. GIS was also used to identify general regions not suitable for groundwater banking. A number of factors were used to identify unsuitable or marginally suitable areas. These factors included limited aquifer storage capacity, poor surface water quality, areas with no surplus surface water, proximity to end users, and regions with adequate or surplus water over the 50-year planning horizon. Remaining areas were subjected to a more detailed feasibility analysis. Data was integrated into the GIS from multiple sources including USGS, TWDB, TNRIS, USDA, and regional water planning groups. A statewide database was constructed that related data layers to grid cells from which complex spatial analysis could be performed using weighted Boolean screens. Some evaluation factors include, soil type, water demand and availability, depth to water, water quality, among others. A custom graphical user interface (GUI) was developed within the ESRI ArcView application. Boolean logic was used to sieve overlying data layers within the GIS. GIS was then used to visually display the results of the Boolean query needed.



Data was integrated into the GIS from multiple sources including USGS, TWDB, TNRIS, USDA, and regional water planning groups.

The product that DBS&A developed consisted of two components: (1) a standard report with numerous graphics summarizing the work completed and its application for the client, and (2) a detailed review of the data quality going into each layer of the GIS and a user's manual with a detailed analysis of the GIS tool and the certainty and validity of the conclusions reached using the data available. The detailed review allows the client to develop their own Boolean queries for the assembled data sets with an understanding of the strengths and weaknesses of each component data set and of the GIS tools themselves. A site-specific analysis was performed that uses high resolution spatial data and stream flow hydrograph data to evaluate sites selected in the GIS screen. This approach calculated groundwater recharge and the surface area required to bank enough water to meet projected water shortages based on soil infiltration rates, available excess stream flows, and projected water deficits.

Hydrogeologic Analysis and Water Development Plan for Brackish Groundwater Well Field

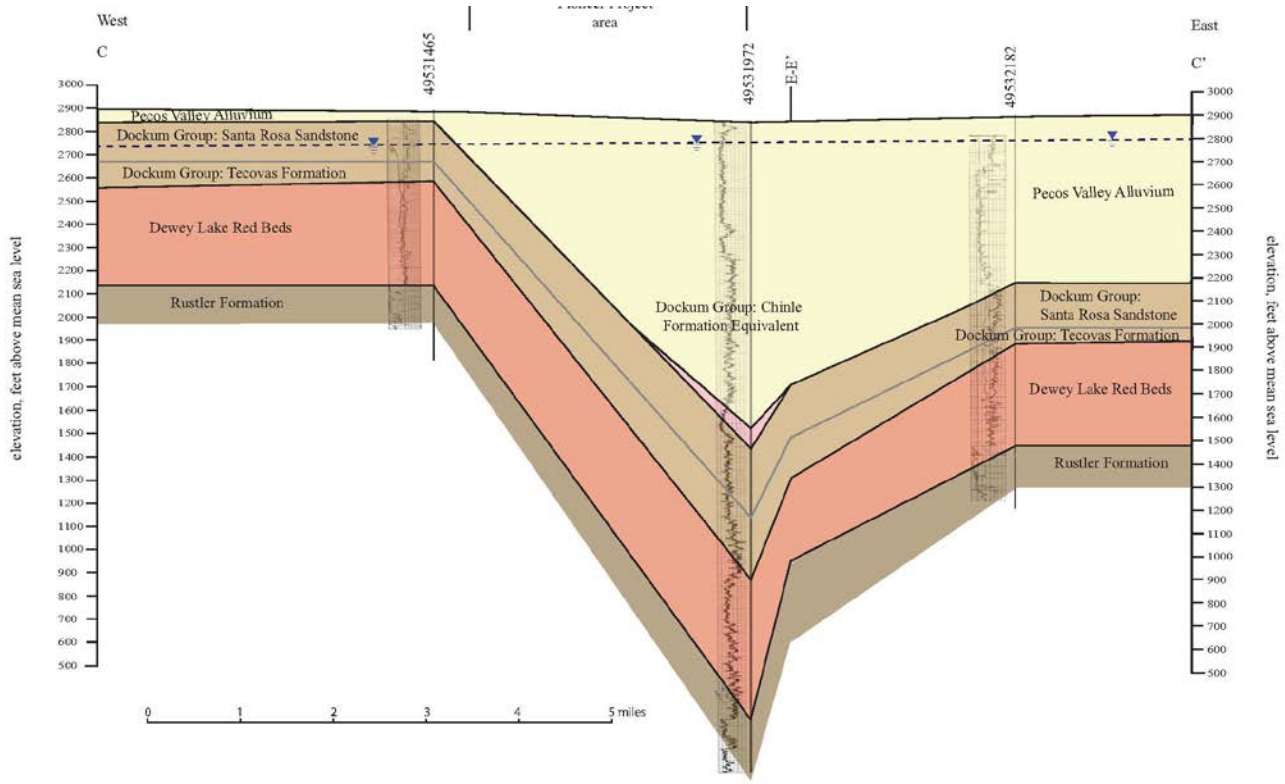
Winkler County, Texas

Highlights:

- Evaluated all data sources including BRACS database to develop detailed conceptual hydrogeologic model of Monument Draw Trough
- Identified target formations and zones for developing brackish groundwater well field to be used by oil and gas industry
- Developed calibrated three-dimensional groundwater flow model for evaluating well design, aquifer sustainability, and effects on fresh groundwater resources

From 2013 through 2014, JSAI performed the detailed hydrogeologic evaluation and water development plan for the DK Boyd Land Water Lease. The primary client was Macquarie Capital. The evaluation of brackish groundwater resources focused on 22 sections of land in Monument Draw trough, Winkler County, but the study area entailed all of Winkler County.

JSAI used geophysical logs from land owner, Texas Railroad Commission, and BRACS database and Pecos Valley assessment (Meyer et al., 2012) to define structure contours for tops and bottoms of Pecos Valley alluvium, Dockum, and Rustler aquifers. Existing data and geophysical logs were also used to assess distribution of fresh, brackish, and saline groundwater. The detailed hydrogeologic analysis was used to develop calibrated three-dimensional groundwater flow model for the Monument Draw trough and Winkler County. The model was used to determine feasibility of various brackish groundwater development scenarios for industrial uses.



Well Siting for Oil and Gas Industry Projects in Permian Basin

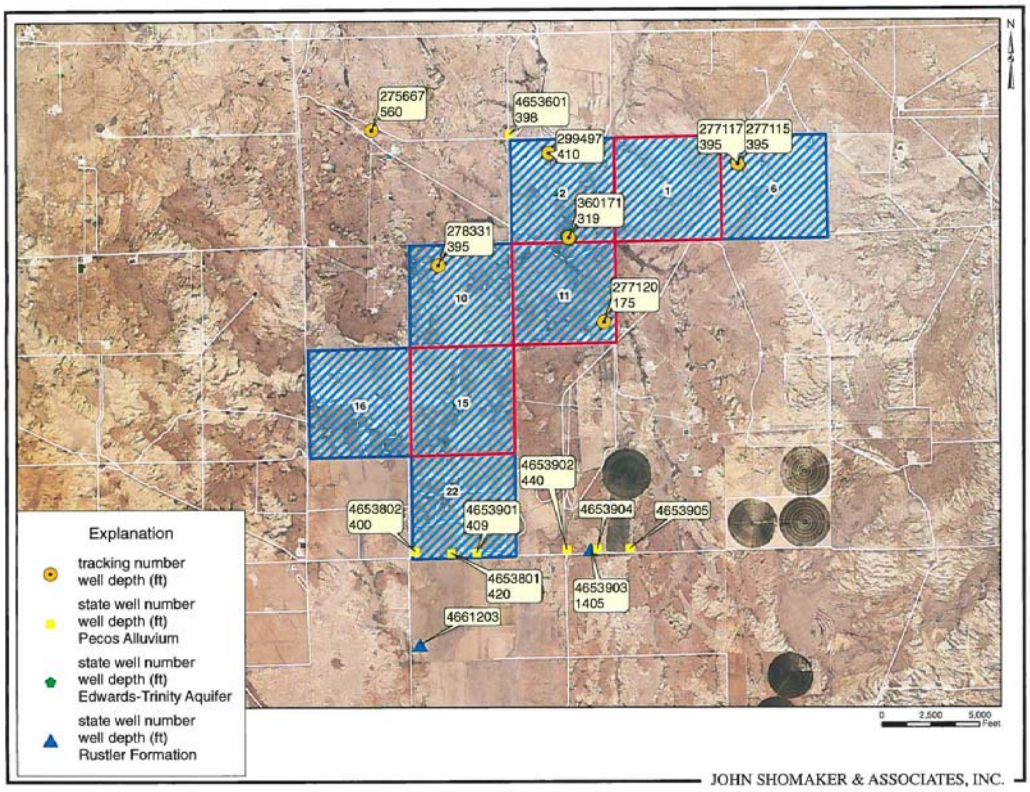
Reeves, Loving, and Ector Counties, Texas

Highlights:

- Evaluated site specific data to recommend target formations, drilling methods, and well completion details for half dozen projects in Permian Basin
- JSAI results and estimated cost to develop water supply wells were used by oil and gas industry to evaluate feasibility and cost of water supply options
- Four sites involved evaluation of the Rustler Formation as the target aquifer
- JSAI recommendations lead to successful completion of supply wells in regards to target depth, and maximizing well yield.

During 2013 and 2014 JSAI assisted Layne Drilling Company with evaluating potential for developing groundwater from the Rustler aquifer for oil and gas industry clients in Reeves, Loving, and Ector Counties. JSAI provided siting analysis for supply wells and proposed drilling methods and specifications for successful completion of supply wells. Project areas include the China Draw watershed west of Orla, Reeves County, Texas; Red Hill area in Loving County, Texas; oil and gas fields near Barella Farms in southern Reeves County, and the North Cowden unit in Ector County.

For the Reeves and Loving County projects, JSAI relied on the structure contour map of the Rustler Formation developed by Hiss (1976) and new well data provided by the client and landowner. Projected well depths and target production areas were successfully identified. These local detailed analyses of the Rustler top did not always match with the structure contours provided in the Rustler GAM. This was primarily due to the interpreted displacement along inferred faults in the Rustler GAM.



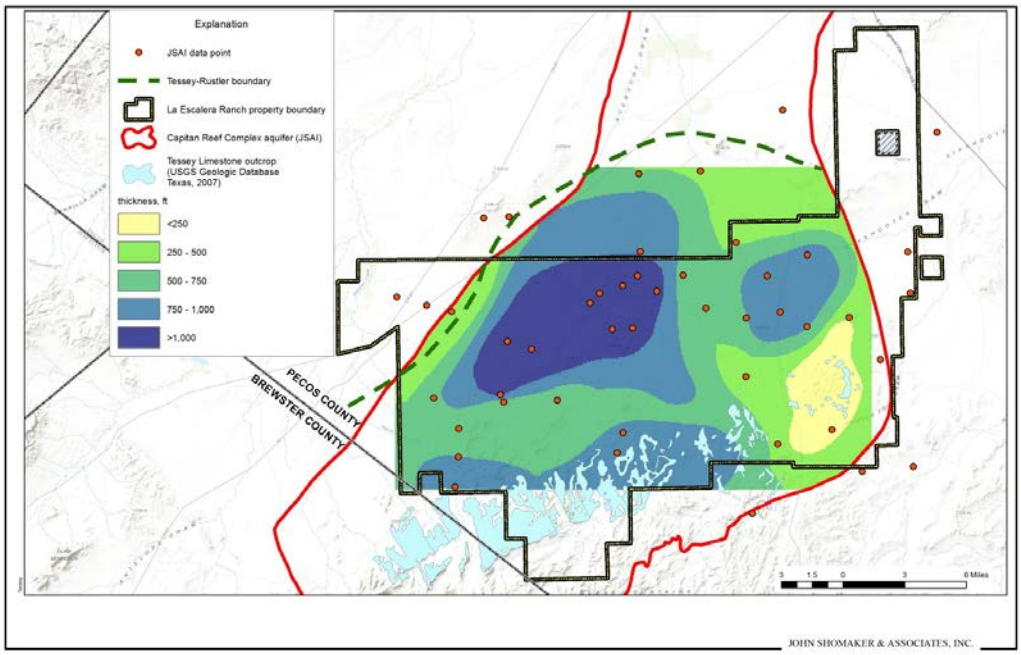
Groundwater Availability Analysis for La Escalera Ranch

Pecos County, Texas

Highlights:

- Evaluated all data sources including BRACS database to develop detailed conceptual hydrogeologic model of the 223,000 acre ranch in southern Pecos County
- The evaluation included the Edwards Trinity, Rustler, and Capitan Reef Complex aquifers.
- Performed field evaluations (down-hole video surveys, pumping tests, and water quality analysis) on dozens of wells located on La Escalera Ranch
- Developed geologic model that included revisions to the CRCX aquifer structure and extent, and the first detailed subsurface mapping of the Tessey Limestone.
- Collected and analyzed geophysical logs from abandoned oil and gas wells, and used the logs to successfully convert to water wells by identifying zones to shot perforate.
- Collaborated with Middle Pecos GCD and TWDB, and shared data and results for improvement to the development of the CRCX GAM currently in progress.
- Identified and mapped the transition from the Tessey Limestone to the Rustler Formation, which was previously estimated and unknown.

2014 to current, La Escalera Ranch Limited Partnership/Pecos County: performed detailed assessment of Capitan Reef Complex (CRCX) aquifer and relationship between Tessey Limestone and Rustler Formation. The study area focus on the 421 square mile ranch in Southern Pecos County and part of Brewster County, but also expanded out to the western and northern parts of Pecos County. This was the first known attempt to map the subsurface of the Tessey Limestone and how it transitions into the Rustler Formation and other geologic units. JSAI compiled and evaluated data from historical reports, BRACS database, Texas Railroad Commission, La Escalera Ranch, and XTO Energy (oil and gas leasee for La Escalera). The geologic model and hydrogeologic characterization for the CRCX and Rustler aquifers was redefined. Dataset and results were shared with the Middle Pecos GCD and the TWDB Groundwater Division July 18, 2015.



JSAI Geophysical Log Interpretation Projects

Texas and New Mexico

Highlights:

- JSAI analyzed hundreds of geophysical logs from oil and gas wells for evaluating the Capitan Reef Complex stratigraphy and identifying overlying formations.
- JSAI has specified geophysical logging methods for over 150 water supply well projects in Texas and New Mexico, and used the logs for evaluating formation characteristics and water quality (salinity, arsenic, uranium, etc) to recommend well completion depths and screen intervals.
- JSAI has evaluated geophysical logs as part of regional aquifer characterization projects in west Texas, southern New Mexico, central New Mexico, and eastern New Mexico.

JSAI staff has been mentored by Dr. John Shomaker on all aspects of applied hydrogeology; particularly geophysical log interpretation. Dr. Shomaker's expertise is based on 45 years of applied hydrogeologic investigations and well drilling projects with USGS (Dr. Shomaker worked with W. Hiss, C.V. Thies, and many others), oil, gas, and coal industries, and as a consultant. Over the years JSAI has worked extensively with many of the experts in the field of well drilling, geophysical logging, and geophysical log interpretation. Most of JSAI water supply well projects involve the collection of geophysical logs, analysis, and interpretation (particularly identification of poor groundwater quality zones from the SP and E-logs that are used for well completion recommendations). JSAI has been involved with over 250 large capacity water supply projects in Texas and New Mexico, ranging from shallow wells in alluvium to deep wells (over 3,000 ft) in sedimentary rocks.

JSAI Brackish Water Assessment

Texas and New Mexico

Highlights:

- Evaluated all data sources including BRACS database to develop detailed conceptual hydrogeologic model of Monument Draw Trough
- Identified target formations and zones for developing brackish groundwater well field to be used by oil and gas industry
- Developed calibrated three-dimensional groundwater flow model for evaluating well design, aquifer sustainability, and effects on fresh groundwater resources.

JSAI has performed numerous brackish groundwater assessments in New Mexico and Texas. JSAI has used a multi-disciplinary approach to successful complete brackish groundwater assessments that include: 1) collection of all possible data to support analysis, 2) interpretation of geophysical logs from water well and oil and gas well drilling projects, 3) development of geologic model, 4) geochemical analysis, 5) refining the hydrogeologic conceptual model so the distribution of brackish groundwater fits with understanding of recharge, discharge, and groundwater flow paths. Some notable brackish groundwater projects completed by JSAI include:

- Capitan Reef Complex aquifer in New Mexico and Texas. JSAI teamed with DBS&A to update the geologic framework established by Hiss (1975) for the TWDB in 2009. Since then JSAI has used unpublished water quality data from Hiss to define the salinity distribution in the CRCX aquifer in Winkler, Ward, and Pecos Counties.
- Regional assessment of brackish groundwater resources in the San Juan Basin of northwestern New Mexico for Jicarilla Apache Nation. Due to the lack of water well data, this project relied heavily on the interpretation of geophysical logs to define water quality zones in Cretaceous rocks.
- Middle Rio Grande Brackish groundwater assessment for the New Mexico Interstate Stream Commission and Albuquerque Bernalillo County Water Utility Authority. The project has involved a detailed assessment and quantification of deep brackish and saline groundwater inflow to the Middle Rio Grande Underground Water Basin.
- Tularosa Basin Water Plan and the Alamogordo Regional Water Supply Project. JSAI compiled data from previous researchers, and collected new data to define the fresh, brackish, and saline groundwater zones in the Tularosa Basin. Potential production zones were identified and evaluated for developing as a drought supply for the City of Alamogordo. JSAI has been involved from identifying the brackish water source to permitting, to well field development, and to final design of the regional project.

JSAI Permian Karst Aquifer Projects

Texas and New Mexico

Highlights:

- JSAI developed methods for mapping sink holes and karst features Permian rocks of Salt Underground Water Basin, parts of the Roswell Artesian Basin, and Upper Pecos Underground Water Basin
- JSAI has mapped the karst regions of the Capitan Reef Complex in southern Pecos County; including the Tessey Limestone
- JSAI has successfully completed water supply wells in Permian karst aquifers for La Escalera Ranch in southern Pecos County, NMISC Pecos River augmentation well field near Artesia, New Mexico, City of Carlsbad, New Mexico, and City of Santa Rosa, New Mexico

JSAI has worked extensively with Permian karst aquifers in West Texas and New Mexico:

- Detailed hydrogeologic characterization and development of groundwater flow model for the Salt Underground Water Basin in southeastern, New Mexico for the New Mexico Interstate Stream Commission. Primary aquifer consists of karstifed shelf-margin carbonates of the Permian Delaware Basin.
- Mapping of karst features in the Roswell Artesian Basin (Permian rocks stratigraphically equivalent to north-central Texas) to better understand groundwater flow paths and recharge patterns.
- Hydrogeologic characterization and development of groundwater flow model for the Colonias Wellfield, City of Santa Rosa, New Mexico. Project involved mapping of sinkholes and super sinkholes in the Upper Pecos River groundwater basin, hydrogeologic characterization of karst aquifer, and subsequent development of well field for City of Santa Rosa. Regional aquifer was formed by the dissolution of salts in Permian rocks and the collapse of overlying sedimentary units – similar to the Blaine aquifer in North Central Texas.

EDUCATION

M.S., Hydrology, 1987, New Mexico Institute of Mining and Technology

B.A., Environmental Science, 1984, University of Virginia

PROFESSIONAL REGISTRATIONS

Professional Geoscientist, Texas, No. 1034

Mr. Blandford specializes in water supply investigations and water rights analysis, numerical simulation of groundwater flow and solute transport, aquifer testing methods, muniipal well field development and source water determination, remediation well field design, and expert testimony.

Municipal Well Field Development and Sustainability Analysis, Colorado River Municipal Water District, Ward County, Texas
Principal investigator for test drilling program and subsequent construction and aquifer testing of 21 high-capacity, brackish raw water supply wells. The well field build-out was required to supplement existing groundwater supplies and was completed on a highly expedited schedule. Desired water quality was a key consideration for well field design and build out. Developed a groundwater flow model to assist with well-field operations, groundwater resources planning, and evaluation of long-term water quality

Brackish Aquifer Evaluation, University Lands, Midland, Texas
Principal-in-charge for evaluation of multiple brackish aquifers underlying University Lands in west Texas, including the Rustler Aquifer. Project included database development, construction of three-dimensional geologic models, and hydrogeologic analysis of multiple aquifers, including production zones, expected well yield and water quality.

Water Rights Appropriation, BOPCO LP, Carlsbad, New Mexico
Principal-in-charge for evaluation of sustainable water supply from Pecos Valley and Rustler Aquifers in northern portion of the Pecos Trough. Evaluated hydrogeology, water quality and developed a groundwater flow model of the aquifer system. Also identified well locations and expected well yield.

Groundwater Analysis and Planning Support, Colorado River Municipal Water District, West Texas
Principal-in-charge or principal investigator for multiple groundwater analysis and planning projects, including evaluation of the Snyder well field, assistance with development and evaluation of desired future conditions for multiple aquifers, evaluation of alternative and additional sources of water supply, and evaluation of potential sources for groundwater contamination within or near existing well fields.

Investigation and Characterization of Deep Saline Water, Lincoln County, New Mexico, Hideout of Lincoln County, LLC
Project manager for completion and testing of two deep (greater than 2,500 feet) exploratory water supply wells. Project included well design, permitting, and reporting; drilling oversight; aquifer testing design; implementation and analysis of results; collection of water quality and isotope samples for geochemical fingerprinting for the determination of water sources; and groundwater flow modeling for the assessment of hydrologic effects of deep water utilization.

Hydrogeologic Analysis of City of San Angelo Hickory Aquifer Well Field, McCulloch County, Texas
Provided senior-level review and support for hydrogeologic analysis of the City's Hickory aquifer well field. Project tasks included groundwater sampling, borehole geophysical logging, and hydrogeologic mapping and analysis of key geologic units and water quality constraints.

Development of Groundwater Availability Model for Edwards-Trinity (High Plains) Aquifer, Texas Water Development Board
Principal investigator for the development of a numerical groundwater flow model of the Edwards-Trinity (High Plains) aquifer in Texas and New Mexico. Project involved extensive data collection and development of the geologic framework of four lower Cretaceous hydrogeologic units based on geophysical and geologic well logs and development of new conceptual models of groundwater flow. Information was employed to develop a three-dimensional groundwater flow model that will be used by groundwater conservation districts and regional water planning groups to evaluate future groundwater availability.

Expert Testimony Regarding Numerical Groundwater Flow Modeling and Evaluation of Salinity Encroachment, City of Alamogordo, Alamogordo, New Mexico
Provided expert review and testimony regarding evaluation of multiple groundwater flow models, then applied the model results to predict hydrologic effects of a proposed brackish groundwater appropriation of 10,000 acre-feet per year by the City of Alamogordo. Also conducted an assessment and provided testimony regarding the potential for encroachment of saline groundwater due to pumping at the well field.

Evaluation of Current and Historical Underflow across Newport-Inglewood Uplift, West Basin Water Association, California
Project manager for evaluation of the historical underflow of groundwater between the Central Basin and West Coast Basin across the Newport-Inglewood Uplift. Project involved review and analysis of numerous historical reports regarding the hydrogeology and history of the region, groundwater modeling, and other analyses related to aquifer conditions, recharge, and saltwater intrusion.

Saltwater Intrusion Modeling, St. Johns River Water Management District, Seminole County, Florida
Principal investigator for evaluation of regional groundwater resources of Seminole County, Florida and adjacent regions using density-dependent groundwater flow and solute transport simulation (MODFLOW and DSTRAM). Model was used to estimate changes in water quality due to brackish water migration and seawater intrusion that could occur due to increased groundwater development in urban regions.

Development of Groundwater Availability Model for Southern Ogallala Aquifer, Texas Water Development Board, Texas and New Mexico
Principal investigator for development and application of numerical groundwater flow model for entire Southern Ogallala aquifer (29,000 square miles) in Texas and New Mexico. Project involved extensive data collection and incorporation into a numerical groundwater flow model using a geographic information system, model calibration and verification, presentation at public meetings, and detailed study documentation. Final model was applied by groundwater conservation districts and other stakeholders to assist with planning efforts.

Regulatory Support and Permit Evaluation, Florida Water Management Districts, Central Florida
Supervised and conducted modeling and review tasks, including reviews of modeling studies submitted in support of permit renewal for major municipal well fields and development and assessment of proposed saltwater intrusion criteria for determination of saltwater intrusion impacts. Supervised and reviewed cross-sectional density-dependent groundwater flow and solute transport modeling to determine extent of proposed Water Use Caution Area.

Selected Publications and Presentations

Blandford, T.N., M. Kuchanur, and R. Smith. 2008. Groundwater modeling of the Southern High Plains Aquifer: Effects of pre- and post-development recharge on water availability. Invited presentation to the Joint Meeting of the Geological Society of America, Soil Science Society of America, American Society of Agronomy, and Crop Science Society of America. Houston, Texas, October 5-9, 2008.

Blandford, T.N., D.J. Blazer, and A. Dutton. 2005. The effect of a priori knowledge on conceptual model refinement through numerical model development: A case study for the Southern High Plains of the United States. Invited presentation to ModelCARE 2005, Fifth International Conference on Calibration and Reliability in Groundwater Modeling, From Uncertainty to Decision Making. The Hague, The Netherlands, June 6-9, 2005.

Blandford, T.N., D.J. Blazer, A.R. Dutton, and R. Smith. 2004. Regional groundwater availability modeling of the Southern Ogallala aquifer of West Texas and Eastern New Mexico. In Rainwater, K.A. and T.M. Zobeck (eds.), 2004 High Plains Groundwater Resources: Challenges and Opportunities, Conference Proceedings. Lubbock, Texas, December 7-9, 2004.

Blandford, T.N. and D.J. Blazer. 2004. Hydrologic relationships and numerical simulations of the exchange of water between the Southern Ogallala and Edwards-Trinity aquifers in southwest Texas. In Aquifers of the Edwards Plateau, Mace, R.E., E.S. Angle, and W.F. Mullican, III (eds.), Texas Water Development Board Report 360:115-131. February 2004.

Blandford, T.N., D.J. Blazer, K.C. Calhoun, A.R. Dutton, T. Naing, R.C. Reedy, and B.R. Scanlon. 2003. Groundwater availability of the Southern Ogallala aquifer in Texas and New Mexico: Numerical simulations through 2050. Prepared for the Texas Water Development Board. 160p.

Blandford, T.N., D.J. Blazer, A.R. Dutton, and R.C. Reedy. 2002. Regional groundwater flow modeling of the Southern High Plains aquifer: Conceptual models applied and insights gained. Presented at Geological Society of America Annual Conference Special Session on Hydrogeology and Water Resources of the High Plains Aquifer: Issues for Public Policy Over the Next 50 Years. Denver, Colorado, October 27-30, 2002.

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Birdie, T. and T.N. Blandford. 1994. Groundwater flow and solute transport modeling study for Seminole County, Florida, and adjoining regions. St. Johns River Water Management District Special Publication.

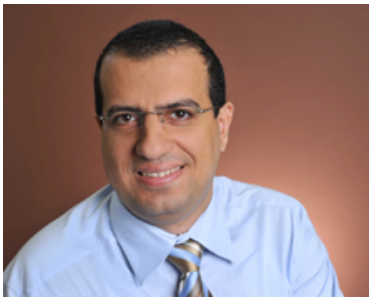
Blandford, T.N. and T. Birdie. 1993. Development of wellhead protection areas for the major public supply wells in Hernando County, Florida. Final report completed for the Southwest Florida Water Management District and Hernando County, Florida.

Huyakorn, P.S., J.B. Kool, and T.N. Blandford. 1993. An overview of modeling techniques for solute transport in groundwater. In Metals in groundwater, Allen, H., M. Perdue, and D. Brown (eds.). Lewis Publishers, Chelsea, Michigan.

Blandford, T.N. and T. Birdie. 1992. Regional groundwater flow modeling for east-central Florida with emphasis on Orange and Seminole Counties. St. Johns River Water Management District Special Publication SJ92-SP17.

Blandford, T.N. 1991. Vertical cross-sectional modeling analysis of groundwater flow and saltwater transport in Orange and Brevard Counties, Florida. Prepared for St. Johns River Water Management District by HydroGeoLogic, Inc., Herndon, Virginia.

Blandford, T.N., T. Birdie, and J.B. Robertson. 1991. Regional groundwater flow modeling for east-central Florida with emphasis on eastern and central Orange County. St. Johns River Water Management District Special Publication SJ91-SP4.



Dr. Botros is a senior hydrogeologist/engineer with more than 10 years of experience in developing, calibrating, and validating groundwater flow and contaminant transport models through saturated and unsaturated media. His expertise includes water resources management, statistical and geostatistical analysis of field and laboratory data, and optimization and uncertainty assessment of hydrologic parameters. He is proficient in multiple numerical modeling software programs such as MODFLOW, MODFLOW SURFACT, MODPATH, MT3D, PHT3D, SEAWAT, and PEST. He is also proficient in using Groundwater Vistas, ArcGIS mapping software, and in FORTRAN and MATLAB programming.

EDUCATION

Ph.D., Hydrogeology, 2007, University of Nevada-Reno

M.S., Civil Engineering, 2004, Cairo University, Egypt

B.S., Civil Engineering, 2000, Cairo University, Egypt

PROFESSIONAL REGISTRATIONS

Professional Engineer, California, No. 76531

PROFESSIONAL AFFILIATIONS

American Geophysical Union

Hydrologic Analysis and Groundwater Modeling, Lower Rio Grande Regional Facility Plan, Rio Grande Regional Water Authority, Texas
Technical lead for this project that used information provided in TWDB groundwater modeling and BRACS reports and their supporting GIS files to identify potential well field locations within Cameron, Hidalgo, and Willacy Counties that can meet estimated future water demands and that produce water quality in the range of 1,000 to 3,000 milligrams per liter. Tasks included refining the grid of an existing groundwater model that covers GMA-16 area and running predictive flow and particle tracking simulations to investigate hydrologic effects of potential well fields.

Municipal Well Field Modeling, Colorado River Municipal Water District, Ward County, Texas
Assisted water availability analysis for major water brackish water well field in Ward County. Tasks included compilation of geologic, water level and water quality data from multiple sources, including the TWDB geodatabase and the BRACS database to develop and calibrate a three-dimensional groundwater flow model using MODFLOW, MT3DMS and SEAWAT Version 4. Additional water quality modeling is ongoing.

Development of Groundwater Availability Model for Edwards-Trinity (High Plains) Aquifer, Texas Water Development Board
Assisted with the development of a three-dimensional transient numerical groundwater flow model and with the analysis of county-wide and groundwater conservation districts groundwater mass balance.

Remedial Design at a Contaminated Groundwater Site, Confidential Client, Midland County, Texas
Technical lead for the design of a groundwater remediation system for a brine plume resulting from leakage of a pipeline containing brine and entrained petroleum constituents. The highest concentrations were more than 140,000 mg/L. Project tasks included review of geologic and hydraulic data at the site, development of a two-dimensional groundwater flow and transport model using SEAWAT Version 4, and recommendation of location and extraction rates of remedial wells.

Assessment of Seawater Intrusion, Confidential Client, Florida
Technical lead for the evaluation of seawater intrusion related to an industrial facility near the Florida coastline. Developed a groundwater flow and solute transport model using SEAWAT-2000 to assess multiple potential sources of seawater intrusion.

Analysis of Municipal Water Supply Sources, City of Lubbock, Texas
Technical lead in assessing the sustainability of the City of Lubbock's Bailey County well field. Tasks included updating an existing three-dimensional groundwater flow model of the well field using newly acquired field data and estimating the longevity of the well field under various pumping scenarios. Study results were used by the City to make key water planning decisions.

Modeling Support for Bear Canyon Recharge Project for Permit Application, Albuquerque Bernalillo County Water Utility Authority, New Mexico
Bear Canyon is an artificial recharge project that uses in-stream infiltration to recharge the Middle Rio Grande Basin Aquifer. Project tasks included modifying the administrative groundwater flow model, used by the Office of the State Engineer, to incorporate the Bear Canyon recharge and recovery schedule. Modifications to the administrative model included refining the model grid around the Bear Canyon area and using of MODFLOW SURFACT code instead of MODFLOW for better handling of rewetting of model dry cells. Tasks also included providing water budget calculations for the Middle Rio Grande Basin as a result of the project implementation as a part of the permit application.

Groundwater Modeling for Santee Basin Groundwater Recharge and Replenishment Project, Padre Dam Municipal Water District, Santee, California
As lead modeler, conducted analytical calculations to evaluate multiple implementation scenarios of indirect potable reuse using different rates and locations of water injection and extraction. The screening computations were followed by development of a three-dimensional groundwater flow model and particle tracking simulations that included aquifer heterogeneity, complex aquifer boundaries and simulation of multiple ponds. Residence time of injected water was considered relative to State of California requirements.

Update and Recalibration of Rose Valley Groundwater Model for Permit Evaluation, Inyo County, California
As technical lead, performed substantial update and recalibration of an existing groundwater flow model of the valley. Updates included conducting a basin-wide recharge estimate, refinement of the model grid and boundary conditions, improved calibration to historical water levels, and consideration of major historical stresses on the basin. Performed predictive simulations that were used to maximize future pumping amounts without exceeding the allowable reduction in groundwater outflow to a terminal lake at the southern end of the valley.

Groundwater Flow and Contaminant Transport Modeling of Stage 2 Abatement Plan Proposal for the Tyrone Mine, Freeport McMoRan Tyrone, Inc., New Mexico
Technical lead for project to update an existing three-dimensional groundwater flow model using newly acquired field data and performed post-closure predictive simulations. Simulated geochemical transport modeling of 14 constituents of concern using PHT3D. Results of the modeling efforts were used to help propose abatement measures for the mine site, an area of approximately 15 square miles.

EDUCATION

M.A., Geology (emphasis in hydrogeology), University of Texas at Austin, 1988

B.S., Geological Sciences, Pennsylvania State University, 1986

PROFESSIONAL REGISTRATIONS

Professional Geoscientist, Texas, No.737

Mr. Donnelly specializes in hydrogeologic analysis and groundwater resources research, groundwater modeling, water-supply investigations, and planning and execution of large environmental investigations. He has been a professional hydrogeologist for over 25 years, and has specialized in Texas groundwater resources and groundwater flow modeling for over 20 years. He has extensive experience with the Texas Water Development Board (TWDB) Groundwater Availability Model (GAM) program, and worked in the TWDB GAM section for several years. He has extensive experience communicating with stakeholders, assisting them with understanding the GAM process and the results of model runs, producing reports and presentations on model results, and using all of the TWDB GAMs and groundwater database.

Groundwater Availability Models, Texas Water Development Board, Austin, Texas
Imported all available TWDB GAMs into Groundwater Vistas, checked all models for errors, and assured all GAMs were fully functional in Groundwater Vistas, which was selected as the TWDB choice for running all of these regional models. Initiated process for correcting errors and creating detailed users manuals on all GAMs. Performed a large number of simulations on many of these models, wrote numerous reports summarizing the results of model runs, and presented results at numerous public meetings.

Brackish Groundwater Investigation, Texas Water Development Board, Texas
Evaluated brackish water resources in all major and minor aquifers in Texas, including the Rustler and Blaine aquifers. Developed a comprehensive overview of the occurrence of brackish groundwater in the state that might be used for a variety of water supplies, including a characterization of each aquifer included in the study. Using GIS, produced hydrogeologic and water quality maps to assess potential brackish water resources for planning purposes. Wrote a comprehensive report on the brackish groundwater resources of each of the aquifers in the state, which was compiled into a Brackish Groundwater Manual for the TWDB.

Groundwater Resource Assessments, Various Locations, Texas
Provided evaluations of the potential for large groundwater supply projects for a Texas water supply district. Evaluations included review of all available literature and consultant reports, an assessment of environmental issues that may be associated with groundwater development in each area of interest, potential political/public opinion issues that may impact potential projects, and any other issues relevant to each area of interest.

Groundwater Conservation District Support, Various Clients, Texas
Provided support to several groundwater conservation districts with respect to the development of desired future conditions (DFCs) as part of multiple GMAs. Attended GMA meetings and assisted the districts navigate the discussion and evaluation of DFCs being proposed by the GMAs. Also assisted

districts with the evaluation of permit applications, including running groundwater flow models to confirm applicant simulations. As the District hydrologist for one district, assisted in evaluating all existing permits and provided technical review for new permits. This evaluation included running the regional GAM to assess hydrologic impacts of the requested pumping. Also assisted with permit hearings, assessing public input, and responding to applicants and board member questions and requests. Assisting the district with a contested case hearing on proposed permits.

Single-County Groundwater Flow Model, Hemphill County, Texas
Developed a groundwater flow model using MODFLOW for Hemphill County, Texas. This model was a grid refinement of the Northern Ogallala GAM, incorporating detailed new information on red bed surfaces, aquifer characteristics based on stratigraphic modeling, and surface features including significant detail on existing and new streams included in the model.

Groundwater Management Strategy Development and Groundwater Modeling, Edwards Aquifer Authority, San Antonio, Texas
Assisted with development of critical period rules, drought management strategies, and evaluation of the effect of increasing the total production from the aquifer. Modeled various strategies using current Edwards aquifer model (GWSIM-IV) and helped develop new strategies based on results. Member of the Authority's "Blue Ribbon Panel" for development of a new MODFLOW model for the San Antonio portion of the aquifer, and currently a member of the Authority's Aquifer Science Advisory Panel.

Regional Groundwater Model Development, Carrizo-Wilcox, South Texas
Developed a regional groundwater model of the Carrizo-Wilcox aquifer in South Texas. This model included aquifers from the base of the Wilcox to the Yegua Formation, and was constructed with a focus on the interaction between groundwater and surface water in the Wintergarden area. The model was constructed in MODFLOW and was used to predict changes in surface water flows using separate surface water models of the river basins in the study area.

Scenario Modeling to Assist Predictions of Subsidence-Chicot and Evangeline Aquifers, Houston
Converted a regional groundwater model of Chicot and Evangeline aquifers in the Houston area from GWMOD to MODFLOW. Further refined and calibrated the model, including incorporating estimates of interbedded clay dewatering and the resulting subsidence. Modeled a variety of scenarios to assist predictions of subsidence in the Houston area.

EDUCATION

M.S., Earth and Planetary Sciences, Hydrogeology specialty (with distinction, University of New Mexico, 1997

B.A., Geology, Indiana University, 1975

PROFESSIONAL REGISTRATIONS

Professional Geoscientist, Texas, No. 3139

PROFESSIONAL AFFILIATIONS

National Ground Water Association

Association of Ground Water Scientists and Engineers

Mr. Gray has more than 38 years of professional experience in hydrogeology and geology, and specializes in hydrogeologic assessment and characterization, well design and construction, municipal and industrial water supply development, groundwater flow modeling, aquifer test analysis, water resource investigations, and geochemical assessment. He has conducted numerous hydrogeologic research and characterization studies at sites throughout the southwest U.S. for governmental, tribal, and private clients. Mr. Gray recently designed and managed construction of three new well fields with a total production capacity of over 50 million gallons per day for municipal and private clients in Texas.

Well Field Expansion, Colorado River Municipal Water District, Ward County, Texas

As project manager, Mr. Gray was responsible for managing a $2.9 million engineering services contract and multiple drilling contracts totaling $8.4 million to expand the capacity of the District's Ward County North well field. He planned and supervised exploratory drilling and geochemical characterization studies within a 20 square mile area of the Pecos Valley Aquifer within the Monument Draw Trough. Variable water quality was characterized by employing an expanded suite of geophysical logs calibrated to results from isolated zonal sampling. Varying total dissolved solids (TDS) concentrations were estimated from corrected resistivity logs from 24 test borings. These data were used to develop well designs with appropriate screened intervals to meet the client's target water quality goals. Under Mr. Gray's management, 21 raw water supply wells were constructed under an accelerated 16-month schedule on time and within budget. He designed and oversaw 42 aquifer tests, performed analysis of aquifer test results, and produced 21 well completion reports submitted to the Texas Department of Environmental Quality (TCEQ) which approved all wells for use. The well field production goal was exceeded by over 100 percent and the final blended well field chloride and TDS levels were below the target levels.

Industrial Water Supply Development, Vista Sand, Hood County, Texas

As project manager, Mr. Gray was responsible for managing a $276,000 engineering services contract and a $1.3 million drilling contract to develop a water supply for a planned frac sand mine. He planned and supervised exploratory drilling to characterize aquifer conditions within the Trinity Formation throughout the planned 7 square mile mine site. Geophysical log interpretations were used to develop designs for 14 industrial supply wells. Mr. Gray oversaw well construction, development, aquifer testing, performed aquifer test analysis, and produced a summary well field completion report under an accelerated 6-month schedule and on time and within budget.

Well Field Development, City of Amarillo, Potter County, Texas

As project manager, Mr. Gray was responsible for planning and supervising exploratory drilling and conducting a hydrogeologic characterization study of the Ogallala Aquifer within a 17 square mile area of the City's undeveloped

water rights in Potter County to develop a new well field to replace drought-depleted surface water supplies from Lake Meredith. Data obtained from historical well logs and 23 new test borings were used to update the TWDB's Northern Ogallala GAM and perform predictive groundwater modeling simulations to develop a final well field design optimizing well location placement. Geophysical log interpretations were used to develop well designs for 21 municipal water supply wells. Mr. Gray was responsible for developing cost estimates, detailed well designs, plans and specifications, oversight of well construction, development and testing, aquifer test analysis, and producing 21 well completion reports submitted to the TCEQ which approved all wells for use. The project was completed within budget with a tested production capacity of over 25 million gpd, exceeding the project goal by 25 percent. This project received the National Groundwater Association's 2011 Groundwater Project of the Year Award for Water Supply.

Brackish Water Source Property Evaluations, Confidential Client, Reeves, Ward and Winkler Counties, Texas
Mr. Gray conducted hydrogeologic evaluations of properties for potential production of brackish water within an area of about 120 square miles in Reeves County and an area of about 100 square miles in Ward and Winkler Counties. The TWDB's BRACS database and Groundwater database were utilized to characterize detailed hydrogeology for targeted areas of the Pecos Valley Alluvium within the Pecos Trough and Monument Draw Trough. These data were used to generate structure maps of the base of the aquifer and potentiometric surface as well as maps of a variety of water quality parameters. This information was used to define areas for potential production and compute producible water volumes and water quality for the target areas.

Exploratory Test Well, Brown County Water Improvement District, Brown County, Texas
As project manager, Mr. Gray was responsible for managing drilling and engineering services contracts and oversight of drilling and construction of a 3,600 feet deep exploratory well to assess water quantity and quality in the Hickory Sand and Ellenburger Limestone Formations. Variable water quality was evaluated using a packer and multiple cement seals were emplaced to optimize the water quality of the well. Project results were presented at a public meeting of the Water District Board and summarized in a well completion report.

Groundwater Modeling, Town of Taos, New Mexico
Mr. Gray updated the New Mexico Office of the State Engineer's Taos Valley MODFLOW model and performed predictive simulations to evaluate several well field configuration and production scenarios and how proposed pumping may impact surface water systems and existing water rights in support of the Town's negotiations with Taos Pueblo and other water users in the Abeyta water rights settlement. This work enabled the client to negotiate favorable terms in the final settlement agreement.

Groundwater Modeling, City of Las Vegas, New Mexico
Mr. Gray interpreted drillers logs to identify formation contacts and prepared contour maps and grid files of top and bottom elevations for 11 formations using SURFER within a 92 square mile, structurally complex area encompassing the City's Taylor well field. He used these data to construct and calibrate an 11-layer groundwater flow model using MODFLOW SURFACT and performed predictive simulations of well field operational scenarios to evaluate well field sustainability. This work enabled the client to assess the timing and quantity of additional water supply needs while the well field is shut down to recover from heavily depleted conditions.

Geochemical and Groundwater Modeling of the El Molino Operable Unit, Phelps Dodge Corporation, Pecos, New Mexico
Mr. Gray constructed a 6-layer groundwater flow and transport model for an 11 square mile area in the vicinity of the Canon de La Madera Monocline and the Pecos Syncline in northern New Mexico using MODFLOW SURFACT. The model was used to simulate sulfate transport and plume migration from 2 tailing ponds at the

abandoned El Molino Mill in an area of complex, faulted and folded geology. A summary report was produced including model construction details and predictive simulation results.

Mount Taylor Pipeline Feasibility Study, Pueblo of Acoma, New Mexico, and Bureau of Reclamation
Mr. Gray conducted a regional water resource assessment and groundwater modeling study of a carbonate aquifer system in the San Andres Limestone and Glorieta Sandstone Formations within a 5,300 square mile area in north-central New Mexico to identify potential groundwater supplies for the proposed Mount Taylor Pipeline and assess predicted impacts to wells, springs, and the Rio San Jose under a variety of pumping and climate scenarios. The USGS San Andres-Glorieta aquifer MODFLOW model was updated by extending the transient period, incorporating pumping withdrawals from municipal and industrial users, updating water level calibration targets, and generating updated mountain front recharge rates derived from calculated excess precipitation amounts. The model was used to perform 50-year predictive simulations representing minimum, average and maximum precipitation conditions. The study also included an assessment of water chemistry from the Mount Taylor uranium mine and treatment processes necessary to meet drinking water standards. A summary report was produced detailing the model modifications and predictive simulation results.

Water Supply Assessment, The Hopi Tribe, Village of Sipaulovi, Arizona
Mr. Gray updated the USGS Black Mesa region MODFLOW model, created a linked telescopic mesh refinement model, and ran 40-year predictive simulations to assess impacts from a proposed new supply well and to optimize siting of the well location. A summary report detailing the model modifications and predictive modeling results was produced.

Recent Publications and Presentations

Gray, R.N., 2015. Well Performance Issues for Asset Management. Presented at the Rocky Mountain Section American Water Works Association 2015 New Mexico Spring Workshop. Albuquerque, New Mexico, May 1, 2015.

Gray, R.N., 2015. Water Supply Well Design and Construction - Technical Approach, Benefits, and Costs. Presented at the Society of Petroleum Engineers Environmental Study Group Luncheon. Midland, Texas, February 19, 2015.

Gray, R.N. 2013. Using Borehole Geophysics to Design a Well Field for Targeted Water Quality. Presented at the 2013 National Groundwater Association Groundwater Summit, San Antonio, Texas, May 2013.

Gray, R.N. 2012. Wellfield Development Challenges and Implementation. National Groundwater Association webinar series Brownbag Session. August 15, 2012.

Gray, R.N. 2011. Potter County Well Field Design, Modeling and Optimization (a case study). Presented at the American Society of Civil Engineers Texas Section Fall Meeting, Amarillo, Texas, September 2011.

Gray, R.N. 2011. Well Field Design, Modeling and Optimization (a case study). Presented at the Art of Water Supply Short Course, Las Cruces, New Mexico, April 2011.

EDUCATION

M.A., Geography (emphasis in GIS, Remote Sensing, and Water Resource Management), University of New Mexico, 1997

B.A., Geography (emphasis in Physical Geography and GIS), University of New Mexico, 1993

PROFESSIONAL REGISTRATIONS

Certified Geographic Information Systems Professional (G.I.S.P.),

GIS Certification Institute, September 2007

PROFESSIONAL AFFILIATIONS

New Mexico Geographic Information Council (NMGIC) member from 1999 to present. Board of Directors 2012-2013, President 2013

Kenny Calhoun, GISP, is the Manager of GIS services at DBS&A and is in charge of all GIS development. Mr. Calhoun specializes in coordination of enterprise-wide geographic information systems (GIS) for well, groundwater, land use, and water resources management. Implementation of various GIS software, global positioning system (GPS), and remote sensing technologies for GIS project management.

Groundwater Availability Modeling/Southern Ogallala Aquifer, Texas Water Development Board, Austin, Texas
Technical lead for GIS development of the Southern Ogallala and Edwards-Trinity (High Plains) groundwater availability models (GAMs). The models were constructed using detailed analyses of aquifer properties correlated to the depositional environment of the Ogallala formation based on thousands of well logs. The data was integrated from various sources including the Texas Natural Resources Information System (TNRIS), the TWDB, the U.S. Department of Agriculture (USDA), the New Mexico Office of the State Engineer, and the U.S. Geological Survey (USGS) into ArcView GIS. Developed a Microsoft Access database that linked the USGS, the TWDB, and various Regional Water Planning Group datasets to GIS. Digital elevation model (DEM) data were mosaiced to develop land surface topography. Performed coordinate conversion to integrate well location and attribute data, DEM data, stratigraphy, Public Land Survey System (PLSS) data, cultural features, and USGS raster topography data into a consistent coordinate system. Coordinated digitizing of springs, surface water features, aquifer bottom contours, and water table contours for use in ArcView. Used Landsat satellite imagery to delineate irrigated acreage. Produced maps and graphics for final report.

Groundwater Availability Modeling, Igneous and West Texas Bolsons Aquifers, Texas Water Development Board, Austin, Texas
Technical lead for GIS development of the Igneous and West Texas Bolsons Aquifers GAM. Calculated historical pumping allocations based on land use and groundwater pumping data integrated in GIS. Data integrated from various sources (including the TNRIS, the TWDB, the U.S. Department of Agriculture, and the USGS) into ArcView GIS. Developed a Microsoft Access database that linked USGS, TWDB, and other various datasets to GIS. DEM data was mosaiced to develop land surface topography. Performed coordinate conversion to integrate well location and attribute data, DEM data, stratigraphy, surface geology, precipitation, PLSS data, and cultural features into consistent coordinate system. Coordinated digitizing of springs, surface water features, USGS streamflow gain-loss study results, lake evaporation, and water table contours for use in ArcView. Produced maps and graphics for final report.

Online Water Well Registration Database and Online Mapping Application and Geodatabase Development, Northern Trinity Groundwater Conservation District, Tarrant County, Texas
Project manager and GIS technical lead responsible for developing a detailed and specialized approach to provide the Northern Trinity Groundwater Conservation District (NTGCD) with a multi-phased plan to develop and implement an online well registration database and subsequent water well geodatabase. Development of a web-based application was included to provide public access to well registration and drilling forms and applications in a web-based environment. The application was designed and implemented utilizing a MS SQL Server back-end relational database, with an ASP.Net WebForms front-end web application. The primary application for the online well registration database is for the management and acquisition of well registration information. Database capabilities include data collection using online forms, online documentation, procedures to support all permitting, monitoring, reporting to outside agencies, calendars, permit renewals, and fee/billing and payment. Phase 2 of the NTGCD system was the development of the online ArcGIS mapping application and accompanying geodatabase. The GIS application allows a user to easily view and navigate through pre-established maps and to run custom queries with the results viewed on the interactive map. The system is hosted through DBS&A servers.

GIS Support for State Road 114 Superfund Site, Texas Commission on Environmental Quality, Levelland, Texas
Served as GIS technical lead at a State-Lead Superfund Site in the final stages of the remedial investigation (RI). The site was used as a refinery from the mid-1940s through 1970s, with releases from the site threatening the local water supply. Supervised the development of a Microsoft Access water quality database. Performed a coordinate conversion to integrate well location and attribute data, DEM data, digital aerial photographs, and USGS raster topography data into a consistent coordinate system. Coordinated digitizing of wells and water table contours for use in ArcView. Produced maps and graphics for reports.

Database Management Systems for the Middle Rio Grande Endangered Species Collaborative Program, U.S. Army Corps of Engineers, Albuquerque District, New Mexico
Project manager for a multi-year contract to develop a comprehensive, web-accessible, GIS-based, database management system for projects associated with habitat restoration, water management, and scientific investigations within the Middle Rio Grande basin for the Middle Rio Grande Endangered Species Collaborative Program. The existing data used to support Rio Grande basin management has been collected by many different stakeholders, and is stored in different formats and systems. In their previous forms, these data sets were not easily accessible for use and analysis by all of the stakeholders. Integration of these data into a comprehensive, GIS-based, database management system has enabled the Corps of Engineers and its partner agencies to readily access and interact with these data through custom queries and analysis tools providing visual and graphic outputs.

Aquifer Storage and Recovery/Groundwater Banking, Texas Water Development Board, Austin, Texas
Project manager for identifying areas suitable for groundwater banking of available surface water across Texas during non-drought periods using a GIS and a modified Boolean logic querying scheme. Data was integrated into the GIS from multiple sources, including the USGS, the TWDB, the TNRIS, the USDA, and regional water planning groups. A statewide database was constructed that related data layers to grid cells from which complex spatial analysis could be performed using weighted Boolean screens. Developed a product that consisted of two components: (1) a standard report with eye-catching graphics summarizing work done and its application for the client and (2) a detailed review of data quality going into each layer of the GIS, including a user's manual with detailed analysis of certainty and validity of conclusions reached using available data. Detailed review allows client to develop its own Boolean queries for assembled datasets with an understanding of strengths and weaknesses of each component dataset and the GIS tools themselves.

GIS Support for Analysis of Municipal Water Supply Sources from the Southern Ogallala Aquifer, City of Lubbock, Texas
GIS technical lead for assessment of sustainability of the City's Bailey County well field and pumping groundwater from beneath the City to assist with meeting peak water demands. The project included the development of historical water level maps and other hydrogeologic analysis, along with development of detailed groundwater flow models for the City of Lubbock area and the Bailey County well field area (northern Bailey and Lamb counties, and southern Parmer and Castro counties). Integrated GIS data from various sources (including the TWDB and the USGS) into ArcView GIS geodatabase files. Used DEM data to develop land surface topography and spot well elevations. Performed coordinate conversion to integrate well location and attribute data, DEM data, stratigraphy, cultural features, and USGS raster topography data into consistent coordinate system. Coordinated digitizing of wells, surface water features, and water table contours for use in ArcView. Produced maps and graphics for reports.

GPS Utility Mapping for Water, Wastewater, and Natural Gas, City of Deming, New Mexico
Project manager and GIS technical lead for the development of a GPS/GIS utility map system for the City of Deming Department of Public Works. The project included locating and collecting GPS location data for approximately 3,500 valves, hydrants, wells, and manholes at sub-meter accuracy. Pipelines were then digitized using scanned city utility maps and the GPS point data as vertex anchor locations. The final deliverable was a GIS geodatabase utilized within the City's existing GIS mapping system and included three days of GIS/GPS on-site training.

EDUCATION

M.S., Hydrology and Water Resources, University of Arizona, 1984

B.S., Geology, University of Florida, 1980

Mr. DeWald specializes in the design, implementation, and maintenance of relational database systems. He manages very large of datasets using Microsoft SQL Server, MySQL, Oracle DBMS systems, SAS, SPSS, Stata, ANSI SQL, dBase, Visual FoxPro, and Microsoft Access. Areas of expertise include the design and programming of user interfaces for accessing relational database systems, systems analysis, and applications programming. He excels in importing and exporting data from diverse formats using optical character recognition (OCR) software, off-the-shelf import/export software, and custom-written C programs; migration of data from disparate computer systems using extract, transform, and load (ETL) processes; and data transfer via file transfer protocol.

High Plains Aquifer System Groundwater Availability Modeling, Texas Water Development Board
Provided database support and data analysis for an evaluation of the New Mexico Office of the State Engineer administrative model developed for the High Plains aquifer of the Lea County Basin. The objective was to determine the suitability of the model for predictive water resources analysis.

Bailey County Well Field Modeling, City of Lubbock, Texas
Database support and data analysis for project involving the assessment of sustainability of the City's Bailey County well field and pumping groundwater from beneath the City to assist with meeting peak water demands. Project included the development of historical water level maps and other hydrogeologic analysis, along with development of detailed groundwater flow models for the City of Lubbock area and the Bailey County well field area. Study results were used by the City to make key water planning decisions.

On-Line Well Registration Database and Mapping Application for Database Management Systems, Northern Trinity Groundwater Conservation District, Tarrant County, Texas
Database analyst and general project support to develop a detailed and specialized approach to provide the Northern Trinity Groundwater Conservation District (NTGCD) with a multi-phased plan to develop and implement an on-line well registration database and subsequent water well geodatabase, including an ArcGIS web-based application, to provide public access to well registration and drilling forms and applications in a web-based environment. Assisted in the design and implementation of the MS SQL Server back-end relational database, and the development of the ASP.Net WebForms front-end web application for water-well registration and management. The primary application for the on-line well registration database is for the management and acquisition of well registration information. Database capabilities include data collection using on-line forms, on-line documentation, procedures to support all permitting, monitoring, reporting to outside agencies, calendars, permit renewals, and fee/billing and payment. A main web page is the portal or entry point to the system. Once

logged in, a user is able to access and view information related to their well registration, drilling or production permitting, status of any current permitting process, or review of account balances. Phase 2 of the NTGCD system was the development of the on-line ArcGIS mapping application and accompanying geodatabase. The GIS application allows a user to easily view and navigate through pre-established maps and to run custom queries with the results viewed on the interactive map. The system is hosted through DBS&A servers.

Database Management Systems, U.S. Army Corps of Engineers, Albuquerque District, New Mexico
Database analyst for a multi-year contract to develop a comprehensive, web-accessible, GIS-based, database management system for projects associated with habitat restoration, water management, and scientific investigations within the Middle Rio Grande basin for the Middle Rio Grande Endangered Species Collaborative Program. The previous data used to support Rio Grande basin management was collected by many different stakeholders, and was stored in different formats and systems. In their previous form, these datasets were not easily accessible for use and analysis by all of the stakeholders. Integration of these data into a comprehensive, GIS-based, database management system has enabled the U.S. Army Corps of Engineers and its partner agencies to readily access and interact with these data through custom queries and analysis tools, providing visual and graphic outputs. Assisted in the design, implementation, and maintenance of the MS SQL Server back-end relational database, and the development of the ASP.Net WebForms front-end web application for managing client data and resources, as well as using web service calls to retrieve stream-flow data from the United States Geological Survey (USGS).

Little Colorado River Adjudication, The Hopi Tribe, Hopi Indian Reservation, Arizona
Database support and data analysis for staff representing the Hopi Tribe in litigation and related negotiations regarding Navajo and Coconino aquifer water resources and sustainability. Project tasks included the evaluation of groundwater resources, development of aquifer management plans and concepts, guidance regarding production well placement and expected long-term yield, predictions of groundwater withdrawals on wells of other ownership and surface water flows (stream and springs), and expert review and comment of work conducted by other consultants.

Tyrone Mine Stage 2 Abatement, Freeport-McMoRan Tyrone Mining, LLC, Tyrone, New Mexico
Database support and data analysis for development of abatement plan, including a detailed overview of groundwater impacts at the mine, historical and predictive groundwater flow modeling accounting for the effects of open pits, stockpiles and other mine facilities, geochemical transport modeling of 14 constituents of concern, and proposed abatement measures for the mine site, an area of approximately 15 square miles.

Water Rights Evaluation, Hopi Tribe Water Resource Program, Arizona
Performed data analysis of various land types to illustrate how different historical and current land use practices are related to water rights. Provided data to project manager and GIS analyst for further analysis and mapping.

Data Analysis Support for Environmental Mediation, Confidential Client, California
Database Analyst for environmental litigation involving allocation of responsibility for contamination at Superfund site, involving data collected from more than 1,000 monitor wells and approximately 250,000 records of chemistry data. Used document management tools and Quality Assurance/Quality Control (QA/QC) procedures to verify the validity and quality of the data. Produced data sets for reports and GIS maps, working closely with the litigation team.

Pueblo of Acoma, Acoma, New Mexico
Developed installation of U.S. E.P.A. STORET database for sharing of environmental data with other federal, state, and tribal agencies, and then populated the STORET database with data collected from tribal lands using

Extract, Transform, and Load best practices. Worked with tribal personnel to receive input on the design of a web interface, and then designed and implemented an ASP.Net Internet/Web application that provided access to tribal data in a Microsoft SQL Server relational database hosted on DBS&A servers. Also provided training and documentation to tribal personnel.

Data Analysis Support for Multiple Litigation, Water Resources, and Environmental Services Projects

- Database support and data analysis for a coal combustion waste study for the San Juan Coal Company, Northern New Mexico.

- Database, Modeling Data Support, and Interface Development for MTBE Products Liability Litigation, Confidential Client, United States.

- Midessa Groundwater Plume Database Development, U.S. Environmental Protection Agency, Midland County, Texas.

- Environmental Database support for Expert Technical Support of Groundwater Contamination study, Confidential Client, California.

- Database support and data analysis for a project involving a major water right purchase, Ward County Water Supply Data Quality Control, Colorado River Municipal Water District, Monahans, Texas.

- Database support and data analysis for State Road 114 Superfund Site Remedial Investigation, Design, and Action, Texas Commission on Environmental Quality and U.S. Environmental Protection Agency, Levelland, Texas.

- Database support and data analysis for West County Road 112 Superfund Site, U.S. Environmental Protection Agency, Midland, Texas.

- Initial Preliminary Data Review and Development in support of the development of a Regulatory Strategy for the Kuper-Sutherby Tract, Frost Geosciences, Inc., Helotes, Texas.

- On-Call Services for Environmental, GIS, Geotechnical Engineering, Sewer, and Water Utilities Design, City of Rialto, California.

- GIS data support for the Campbell Ranch Geologic Investigation for New Water Supply Well, Vidler Water Company, Central New Mexico.

- SQL Server database support and GIS data support for a Plume Litigation Project, Confidential Client, Montana.

- SQL Server database support and GIS data support for Hydrology Expert Services Related to Perchlorate and VOC Contamination, Confidential Client, California.

Specialization

More than 30 years of experience with groundwater resource evaluations, facility and field operations, database management, environmental assessments, mining and mineral exploration, and geographic information systems (GIS). During the last ten years, Mr. Standen has constructed a statewide GIS groundwater geodatabase of over 400,000 wells to improve consulting response time and reduce costs for his clients. He has specialized in constructing stratigraphic and/or lithologic datasets by integrating oil and gas geophysical logs, scout tickets, cable tool driller and water well driller's reports into county scale hydro-stratigraphy for 3-D models of the subsurface hydrogeology. He provided the geological framework for the development of the Amarillo and CRMWD well fields, both producing approximately 20 to 25 million gallons per day. He presently works with multiple groundwater conservation districts assisting them in with their groundwater management and monitoring needs.

Academic Degrees

M.A., Geology, University of Texas at Austin, 1987

B.S., Geological Sciences, Kent State University, 1976

Professional Registration

Professional Geoscientist No. 1227, Texas

Professional Experience

Allan R. Standen LLC, President & owner July 2011 to present

Daniel B. Stephens & Associates, Inc., Austin, Texas, 2003 to July, 2011
Texas Water Resources Technical Director

LBG-Guyton Associates, Austin, Texas, 1998-2003, Hydrogeologist

International Technology Corporation, Austin, Texas, 1994-1998, Hydrogeologist/Geologist

Bureau of Economic Geology, University of Texas, Austin, Texas, 1981-1994
Research Assistant, Texas minerals and strategic metals studies (part-time from 1981-1987)
Manager/Curator Core Research Center (1987-1991), Research Scientist II (1991-1994)

Precious Metal Minerals Exploration, part and full time, 1979-1984, Chevron and Bear Creek Mining,

Military Service

Military Service, Navy, 1967 to 1971, Diesel and Nuclear submarines, Honorable discharge

Representative Professional Assignments

- ***3-D Interactive Hydro-stratigraphic Models for the University of Texas (University Lands) including portions of twelve West Texas counties,*** Project area was approximately 1.2 million acres and involves building a interactive 3-D geological model of all aquifers and major oil and gas producing formations down to a depth of 20,000 feet within the University Lands leases in Crockett, Irion, Pecos, Reagan. Schleicher and Upton counties, west Texas (Permian Basin). Reviewed over 10,000 driller's reports and geophysical logs to select formation tops and water production zones to build surfaces and aquifer

thicknesses. Through a screening process, subsurface information from over 1,100 wells was used to build the 3d hydro-stratigraphic model.

- ***3-D Interactive Hydro-stratigraphic Model for Pecos County Texas (Middle Pecos Groundwater District)*** Project area was over 5,000 square miles and involve integrating the subsurface geology from 1,100 oil, gas and water well driller's reports and geophysical logs. Built 3-D surfaces for five aquifers (Pecos Valley Alluvium, Edwards-Trinity Plateau, Dockum, Rustler and Capitan Reef Complex) and oil and gas surfaces down to 23,000 feet (top of Ellenburger) in the Delaware Basin. Interactive 3-D model allows clients to create cross-sections, measure thicknesses or distances to tops of formations and query individual wells for specific information.

- ***Hydro-stratigraphic Framework for Crockett County GCD,*** Compiled over 800 cable tool driller's reports (BEG), geophysical logs (BEG) and water well driller's reports (TWDB, TDLR and TCEQ) to interpret subsurface geology. Using GIS, constructed a county wide stratigraphic framework of the Edwards, Trinity, and Dockum aquifers and the top surfaces of the Yates, San Andres and Ellenburger. Created net thickness isopachs of Edwards Limestone and net sand maps for Trinity and Dockum aquifers. Created a detailed recent water level surface using water level measurements from the TWDB and supplemented with water levels from recent water well drilling reports (TDLR). Provided client with hard and digital copies of data compiled in study, all GIS shapefiles created and Excel spreadsheets to aid District groundwater decisions.

- ***Hydro-stratigraphic Analysis of the Ward County well fields, Colorado River Municipal Water District:*** Constructed detailed GIS hydro-stratigraphy of the Pecos Alluvium and the Dockum aquifers within the Ward and Winkler CRMWD well field. Used over 200 driller's and cable tool reports and geophysical logs to delineate stratigraphic surfaces and net sands.

- ***3-D Hydro-stratigraphic Analysis of the City of Fort Stockton's water rights, City of Fort Stockton, Pecos County:*** Project manager to construct 3-D hydro-stratigraphic model of southwestern Pecos County. Investigated water quality and historical water level fluctuations in the study area. Compiled over 350 geophysical logs, cable tool driller's reports and water well driller's reports to construct detailed subsurface stratigraphic model of the Edwards, Trinity and Dockum aquifers.

- ***Development of Structure and Stratigraphy of the Capitan Reef Aquifer, West Texas, Texas Water Development Board contracted report:*** Project Manager and Principal Investigator of active project for the construction of a GIS structural and stratigraphic framework of the Capitan Reef Aquifer located within a six county area in far west Texas. Supervised the correlation of Permian stratigraphy involving geophysical logs, scout tickets and driller's reports.

- ***Development of Geologic Framework for Groundwater Availability Model for Edwards-Trinity (High Plains) Aquifer, Texas Water Development Board:*** Principal investigator for the development of geologic framework for the Edwards-Trinity (High Plains) aquifer in Texas and New Mexico. Project involved extensive data collection and development of the geologic framework of four lower Cretaceous hydrogeologic units based on geophysical and geologic well logs and development of new conceptual models of groundwater flow. Information was employed to develop a three-dimensional groundwater flow model that was used by groundwater conservation districts and regional water planning groups to evaluate future groundwater availability.

Steven T. Finch, Jr., CPG

V.P., Principal Hydrogeologist-Geochemist

sfinch@shomaker.com

EDUCATION

M.S., Geology
(Hydrogeochemistry), 1991
Northern Arizona University
Flagstaff, Arizona

B.S., Geology, 1985
Sul Ross State University
Alpine, Texas

REGISTRATIONS

Professional Geoscientist,
Texas, No. 5302

American Institute of Professional Geologists, CPG-9590

Steve Finch has more than 25 years of applied hydrogeology and geochemistry experience in many parts of Texas and New Mexico including the Delaware Basin, Rio Grande and Pecos River watersheds, Mimbres Basin, Estancia Basin, Hondo Basin, Jal Basin, Peñasco Basin, Salt Basin, Tularosa Basin, the Pecos River Valley and Roswell Artesian Basin. His work has included hydrogeologic investigations for groundwater resource development, aquifer-test interpretation, groundwater flow and contaminant-transport modeling, geochemical modeling, water-quality treatment studies, water-resource analysis for water plans, and well-drilling oversight and well-site hydrogeology.

Summary of Major Projects

- Northern San Juan Basin, New Mexico, analysis of deep well injection on formation damage and aquifer protection, 1992
- La Luz Well Field aquifer storage and recovery feasibility analysis and pilot study, City of Alamogordo, New Mexico, 1995-1998.
- Tularosa Basin fresh and brackish groundwater-resource assessment for the Tularosa-Salt Basins water plan, including desalination feasibility study for the City of Alamogordo, 1999-2001.
- Hydrogeologic analysis and development of groundwater flow model for Wild Horse Flat area, Culberson County Groundwater Conservation District, Far West Texas, 2001.
- Project manager for the drilling, construction, development, and testing of Buckman Wells 10 through 13, City of Santa Fe, New Mexico, 2003-2004.
- Hydrogeologic framework and recharge analysis for the Igneous-Bolson Groundwater Availability Model, Far West Texas, subcontracted to LBG-Guyton, 2003-2004.
- Development of regional groundwater flow model of the Eastern Tularosa Basin in support of City of Alamogordo's brackish groundwater applications T-3825 et al., 2005-2006
- Hydrogeologic and groundwater sustainability analysis for Chino Mines Company, and development of regional groundwater flow and solute transport model of the Mimbres Basin, southwestern, New Mexico, 2006.
- Project manager for the development of a groundwater flow and solute transport model of the Griggs and Walnut Superfund Site, Lac Cruces, New Mexico, 2006.
- Hydrogeologic framework and recharge analysis for the West Texas Bolsons Groundwater Availability Model, Far West Texas, subcontracted to LBG-Guyton, 2007.
- Hydrogeologic analysis and development of groundwater flow model of Salt Underground Water Basin, Otero County, New Mexico, 2010.
- Refined the Geologic Framework for the Capitan Reef aquifer, Far West Texas, 2009.
- Hydrogeologic analysis and groundwater flow model of Monument Draw Trough, Winkler County, Texas, 2014
- Water-resource assessment for La Escalera Ranch, Pecos County, Texas, 2014-2015

Professional Societies and Certifications

- Geological Society of America, Certificate of Appreciation as Distinguished Mentor
- U.S. Department of Interior Geological Survey, Certificate of Appreciation as Volunteer for Science Program
- International Association of Geochemistry and Cosmochemistry
- American Water Resources Association, New Mexico Section (Past President)
- National Ground Water Association
- American Chemical Society award for Outstanding Achievement in Chemistry

Professional Development

- Course work at University of New Mexico: Vadose-Zone Hydrology (Spring 1993)
- Borehole geophysical techniques for determining the water quality and reservoir parameters of fresh and saline water aquifers, 1993
- Environmental Education Enterprises' course on Modeling Groundwater Flow and Contaminant Transport (July 1995)
- Visual MODFLOW: The most widely used software package for MODFLOW, MODPATH, and MT3D, National Ground Water Association (Feb. 1999)
- Environmental Isotopes in Ground Water Resource and Contaminant Hydrogeology, National Ground Water Association course #394 (March 2002)
- Applications of Ground Water Geochemistry, Scottsdale, Arizona, National Ground Water Association Course #485, (Nov. 2006)
- Hydrogeology Instructor for Sul Ross State University Geology Field Camp, 2010 and 2012
- Instructor for Art of Water Supply Short Courses in Alpine, Texas, Canyon, Texas, and Las Cruces, New Mexico, 2010-2011
- 2015 Drilling Symposium, Nevada Water Resources Association

Project Relevant Presentations and Publications

Finch, S. T., and Bennett, J. B., 2002, Hydrogeology of Culberson County, Texas: Geological Society of America.

Finch, S. T., and Bennett, J. B., 2002, Concepts of Ground-Water Recharge in the Trans-Pecos Region, Texas:

Finch, S. T., 2004: The Difficulty in managing ground-water resources across political boundaries: presented in Austin Texas at the conference titled Texas Groundwater 2004: Towards Sustainability, sponsored by the International Institute for Sustainable Water Resources, November 19th, 2004.

Finch, S. T., 2011, Local regulation of water quality issues – a look into the future: CLE International, New Mexico Water Law Conference proceedings,

Finch, S. T., Jr., 2015, Quantification of fresh groundwater in the Capitan Reef Complex Aquifer, Southern Pecos County, Texas: National Ground Water Association, Groundwater Summit, San Antonio, Tx, March 16-16

John W. Shomaker, PhD, CPG

President, Senior Principal Hydrogeologist

jshomaker@shomaker.com

Dr. Shomaker has over 50 years of experience in New Mexico geology and hydrogeology, as Hydrologist with the U.S. Geological Survey (1965-1969), as Geologist with the (then) New Mexico Bureau of Mines and Mineral Resources (1969-1973), and with John Shomaker & Associates since 1973. He was Adjunct Associate Professor of Geology (1976-1998) and Adjunct Lecturer in Water Resources Administration (1994-1997) at the University of New Mexico.

Water Resource Development: Groundwater studies have included water-availability studies, well-site selection, consultation as to well-design in support of project engineers, well-construction oversight, interpretation of geophysical logs, aquifer tests and interpretation, prediction of effects of pumping, and design and supervision of monitoring and aquifer-restoration programs. Direct involvement in more than 100 large-capacity water-supply wells, in valley-fill aquifers, Mesozoic-age sedimentary rocks, limestone karst, and fractured igneous rocks, has included wells ranging up to 5,747 ft deep and 4,000 gpm. Clients have included municipalities, investor-owned utilities, federal and state government, tribes and pueblos, mutual domestic water associations, the mining industry, the oil-and-gas industry, manufacturing, and developers.

Groundwater-Flow Modeling: Models have included complex calibrated multi-layer regional models with groundwater and surface-water interaction, and radial-flow models for interpretation of pumping tests in complex aquifers.

Water Planning: Projects have included technical assistance with water-supply plans, and "40-Year Plans" submitted to the New Mexico State Engineer, for municipal and investor-owned utilities.

Water Rights and Permitting: Projects have included hundreds of water-right declarations and applications to the New Mexico State Engineer for new appropriations, transfers of water rights, and replacement wells, supported by hydrogeologic studies, calculations of drawdown and streamflow-depletion effects, and expert testimony.

Coal-Resource Studies: Coal exploration has included design, management, and field geological services for exploration drilling programs, coal mapping and sampling, and reserve calculations.

Expert Testimony: Dr. Shomaker has provided sworn testimony in 34 New Mexico State Engineer water-rights hearings, and in administrative hearings before the New Mexico Environment Department and Water Quality Control Commission, Oil Conservation Division, Mining and Minerals Division, and Interstate Stream Commission. He has testified in water matters before New Mexico State District Courts, and in interstate litigation before a U.S. Supreme Court Special Master, and before county commissions and committees of the New Mexico Legislature.

EDUCATION

Ph.D., Hydrogeology, 1995
University of Birmingham, England

M.Sc., Hydrogeology, 1985
University of Birmingham, England

M.A., Liberal Arts, 1984
St. John's College, Santa Fe

M.S., Geology, 1965
University of New Mexico

B.S., Geology, 1963
University of New Mexico

Training Program in Hydrology
U.S. Geological Survey, 1966

REGISTRATIONS

American Institute of Professional Geologists, CPG-2405

American Institute of Hydrology, Certificate No. 315

Registered Professional Geologist in:

- Arizona, No. 16,481
- Arkansas, No. 482
- Texas, No. 2558
- Wyoming, No. 182

(There is no licensing of Geologists in New Mexico.)

AFFILIATIONS

American Water Resources Association (AWRA)

American Water Works Association

International Association of Hydrogeologists

American Society of Civil Engineers (Affiliate)

Erwin Melis, PhD, PG

Senior Hydrogeologist

emelis@shomaker.com

Dr. Melis has more than 10 years of experience as a field geologist and has been working for JSAI for about 8 years. Dr. Melis is a Project Hydrogeologist with JSAI and has a broad range of experiences which include, geologic mapping, well construction oversight and systematic geologic interpretation.

Water Resource Development: Characterization of geologic and hydrogeologic data for areas in the Rocky Mountains, the Colorado Plateau, the Cordilleran, and the central United States leading to well siting recommendations, evaluation of groundwater supply, investment potential, litigation support, and evaluation of groundwater-in-storage for new developments.

Groundwater Flow Modeling: Development of site-specific groundwater flow models to evaluate groundwater supply, support environmental permitting, groundwater drawdown, and inflow calculations for trenching.

Permitting: Technical support with permit applications submitted to the New Mexico Office of the State Engineer related to exploratory, replacement, and monitoring wells. Technical support with permit applications submitted to the New Mexico Oil Conservation Division related to Salt Water disposal and injection wells.

Water Supply Well Projects: Developed exploratory, production and monitoring well designs and aided in technical well drilling specification development (as technical support for the Project Engineer) for water supply projects, brackish water supply projects, and wells completed in artesian aquifers with well casing diameters of up to 16-inches and depths up to 2,000 ft. Management of water supply well projects (as technical support for Project Engineer), including management of well drilling, completion, development, test pumping, and pumping schedule management to minimize adverse water quality issues.

Geologic, Hydrologic, and Environmental Field Services: Water quality sampling, soil sampling, and bedrock sampling, streamflow measurements, pumping tests, and oversight of drilling and construction of water supply wells and monitoring wells. Geophysical log interpretation for selecting water supply well production zones, and identifying fresh-saline interface. Geologic mapping, fracture orientation mapping, and airphoto interpretation resulting in the production of geologic maps and cross-sections in support of hydrogeologic evaluations.

Groundwater Monitoring: Directly involved with the completion of more than a dozen shallow boreholes and monitoring wells utilizing casing advance and auger drilling methods for verification of environmental impacts, depth to water, unsaturated zone thickness, and sub-surface geology for among others, the New Mexico Environment Department, the Environmental Protection Agency, the New Mexico Oil Conservation Division and the California Board of Water Resources.

Expert Testimony: Dr. Melis has provided expert witness testimony at the Lincoln County Planning and Zoning meeting, the Bernalillo County Commission meeting, and the Rio Arriba County Commission meeting.

EDUCATION

Ph.D., Geology, 2006
University of Maine, Orono, Maine

M.S., Geology, 2001
New Mexico Institute of Mining and Technology, Socorro, NM

B.S., Geology *cum laude*, 1996
University of Massachusetts
Amherst, MA

REGISTRATIONS

Professional Geologist, California, No. 8870

American Institute of Professional Geologists, Certificate No. MEM-0937

AFFILIATIONS

American Water Resource Association, (AWRA)

National Ground Water Association (NGWA)

Geological Society of America
Member of Structural Geology & Tectonics Division

Phi Beta Kappa, the academic honor society - Member of (elected May 1996)

Annie McCoy

Senior Hydrogeologist

amccoy@shomaker.com

Ms. McCoy has more than 10 years experience and is a Senior Hydrogeologist at JSAI.

Water Resource Development: Hydrogeologic characterization, well siting studies, evaluation of groundwater supply, and 40-Year Water Development Plans for municipalities, utilities, and water consumers associations.

Groundwater Flow Modeling: Development and calibration of site-specific and regional scale groundwater flow and contaminant transport models to evaluate groundwater supply, support environmental permitting, and support water rights applications. Operation of New Mexico Office of the State Engineer administrative models in support of water rights applications.

Permitting: Technical assistance with various permit applications submitted to the New Mexico Office of the State Engineer for new or replacement wells, proof of beneficial use, proof of completion of well, and to change existing water rights. Technical assistance with environmental permitting as required by State and Federal agencies, including discharge permitting.

Water Supply Well Projects: Development of detailed well drilling specifications (as technical support for Project Engineer) for water supply well projects, including wells completed in artesian aquifers with well depths exceeding 1,000 ft. Management of water supply well projects (as technical support for Project Engineer), including management of well drilling, completion, development, and test pumping. Evaluation of pumping test data and development of pumping schedules for water supply wells.

Groundwater Monitoring: Installation and sampling of groundwater monitoring wells. Installation and maintenance of long-term groundwater monitoring equipment, and development and maintenance of groundwater monitoring databases.

Geologic, Hydrogeologic, and Environmental Field Services: Water quality sampling, soil sampling, soil gas monitoring, streamflow measurements and seepage runs, pumping tests, oversight of drilling and completion of water supply wells and monitoring wells, and installation of long-term groundwater monitoring equipment. Oversight and management of membrane interface probe investigations and dig-and-haul remediation projects at petroleum storage tank sites. Geologic mapping and development of maps and cross-sections in support of hydrogeologic evaluations and environmental permitting.

Geophysical Log Interpretation: Interpretation of geophysical logs from boreholes drilled through unconsolidated sediments, sedimentary rocks, and volcanic rocks.

Statistical Analysis: Using applied environmental statistics, including parametric and non-parametric statistics, to characterize and evaluate hydrogeologic data.

EDUCATION

M.S., Geology, 2001
University of New Mexico
Albuquerque, New Mexico

B.A., Geology, 1999
Hampshire College
Amherst, Massachusetts

REGISTRATIONS

American Institute of Professional Geologists, CPG-11309

OSHA Hazardous Waste Operations and Emergency Response certification

MSHA Part 48 certification

AFFILIATIONS

American Water Resource Association (AWRA)

National Ground Water Association (NGWA)

Education

MSE, Environmental Engineering, University of Missouri-Rolla, 2004

BSE, Civil and Environmental Engineering, University of Iowa, 2002

Licenses

Professional Engineer, No. 106336, State of Texas

Work History

Sole Proprietor, Michelle A. Sutherland LLC, Austin, Texas, 2014-present

Daniel B. Stephens & Associates, Inc., Austin, Texas, 2007-2014, Project Engineer

Regenesis, San Clemente, California, 2004-2006, Research Engineer

University of Missouri Environmental Research Center, Rolla, Missouri, 2002-2004, Graduate Research Assistant

Institute for Environmental Research, Dortmund, Germany, 2002, Research Intern

University of Iowa Engineering Research Facility, Iowa City, Iowa, 1999-2002, Undergraduate Research Assistant

Ms. Sutherland has over ten years of experience conducting water resource evaluations and water quality analysis. She specializes in 3-D visualization and modeling of hydrogeologic data. Her project experience includes:

3-D Geologic Modeling

- **3-D Hydrostratigraphic Model, Middle Pecos GCD, Pecos County, Texas:** Created a county-wide 3-D hydrostratigraphic model of Pecos County, Texas using Leapfrog Hydro software and data from driller's reports and geophysical logs. The project included interpretation of 18 geologic formations, 5 aquifer systems, and recent water levels. The county spans 4,765 mi^2 and the model extends to a depth of 40,000 ft below ground surface.

- **3-D Hydrostratigraphic Model, Clearwater UWCD, Central Texas:** Created a county-wide 3-D hydrostratigraphic model of Bell County, Texas using Leapfrog Hydro software and data from multiple sources. The project included interpretation of four aquifer units, water levels within those aquifers and nine geologic formations. The model is fully interactive, meaning that the end-user can query data points and volumes within the model domain through a click of the mouse, generate cross-sections at any datum on the fly, turn layers on and off, and zoom and rotate the model.

- **Multiple Large-scale, 3-D Geologic Modeling and Groundwater Visualizations, West Texas:** Developed large-scale, detailed 3-D hydrogeologic models using Mining Visualization System (MVS) software for the following underground water conservation districts (UWCD) or groundwater conservation districts (GCD): Lone Wolf GCD (Mitchell County), Wes-Tex GCD (Nolan County), Permian Basin UWCD (Martin and Howard Counties), High Plains UWCD (Bailey, Castro, Deaf Smith, Lamb and Parmer Counties), North Plains GCD (Lipscomb County) and Hemphill County UWCD. Compiled geologic and hydrogeologic information from multiple sources into ArcGIS geodatabases and estimated water volumes within the study areas. For High Plains UWCD and North Plains GCD, created 3-D visualizations of projected water levels based on Desired Future Conditions (DFCs) to enhance stakeholder communication.

- **Geologic Analysis of the Ogallala Aquifer and Well Field Design, Potter County Well Field, City of Amarillo, Texas:** Constructed a hydrostratigraphic 3-D model (coarse, medium and fine sands, clay) of the proposed well field by using more than 200 driller's reports and geophysical logs. Proposed well locations were based on virtual cores within the 3-D hydrostratigraphic model. Subsequent drilling confirmed the utility of this approach. Project won the 2011 NGWA Groundwater Supply Award.

- **Southern Hartley County Groundwater Availability Study, City of Amarillo, Texas:** Evaluated the distribution of sand and clay intervals in the Ogallala Aquifer, interpolated a water level surface based on recent data and calculated water in storage based on average specific yield values.

Groundwater Flow Modeling

- **Bailey County Well Field Modeling, City of Lubbock, Texas:** Developed a detailed model of the saturated lithology in the Bailey County well field. Assisted in updating an existing MODFLOW model of the well field and surrounding area in order to estimate the longevity of the well field under various pumping scenarios.

- **Groundwater Model Evaluations, New Mexico:** Evaluated two existing MODLFOW flow models of the City of Espanola, NM and Ohkay Owingeh well fields. Determined how differences in model parameters impacted the model results. Developed a framework for future evaluations of new water supply wells and their potential impact on the City of Espanola and Ohkay Owingeh water rights areas.

- **Groundwater Availability Study, City of Fort Stockton, Texas:** Compiled historical pumping, geologic and hydraulic property data. Created a conceptual model and a MODFLOW flow model of the Edwards-Trinity aquifer to assess water availability for the City of Fort Stockton and surrounding area.

- **Confidential Client, Odessa, Texas:** Refined a MODFLOW flow and transport model to optimize pumping rates of a remediation system at a chromium site near Odessa, Texas.

- **Hemphill County Underground Water Conservation District:** Assisted in the construction of an updated, refined MODFLOW groundwater model of Hemphill County within the framework of the existing regional GAM. Developed 3-D models of aquifer materials and water level data. Created 3-D visualizations of GAM model runs.

Water Quality Studies

- **Pecan Valley Groundwater Conservation District:** Project manager for county-wide groundwater quality study. Reviewed historical data and developed a sampling plan for an on-going study.

- **Texana Groundwater Conservation District:** Project manager for a county-wide review of historical data and evaluation of new water quality data. Reviewed historical water level data, calculated average and cumulative changes in water levels, and developed recommendations for Desired Future Condition (DFC) compliance.

- **Water Quality 3-D Model of the Ogallala Aquifer, Ward County Well Field, Texas:** Constructed a 3-D hydrostratigraphic model (sands, clay) of the well field. Modeled the vertical and horizontal distribution of total dissolved solids (TDS) concentrations to identify areas of good quality and brackish groundwater. Calculated volumes of water in storage based on specific yields of aquifer materials and zones of brackish water.

Technical Training

Leapfrog Hydro and Leapfrog Geo Training Webinars, 2014-2015

Basic Well Log Analysis Course, American Association of Petroleum Geologists, 2014

Spatial Analyst and 3D Analyst Courses, presented by ESRI, 2009, 2014

Mining Visualization System (MVS) Training Course, 2008, 2011

Applied Groundwater Flow and Contaminant Transport Modeling, 2007

Vincent A. Clause

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EDUCATION

The University of Texas at Austin May 2014
M.A. in Geography and the Environment

The University of Texas at Austin May 2012
B.A. in Geography and the Environment
B.A. in Government

PROFESSIONAL EXPERIENCE

Allan R. Standen, LLC **Austin, TX** August 2014-Present
GIS Specialist, Environmental Consultant
Manage GIS Data and workflow.
Organize and process large well datasets in Access and ArcCatalog.
Create and finalize figures for projects, reports and presentations.
Use logs, driller reports and other available geologic data to identify subsurface formations.
Use interpolation and geology mapping techniques to create formation and water level surfaces.
Draft text for projects and reports.

The University of Texas at Austin **Austin, TX** August 2012-May 2014
Department of Geography and the Environment, Teaching Assistant
Taught weekly lab sections for *Intro to Physical Geography* and *Environmental GIS*.
Developed exercises, lectures and exams for lab sections.

UT Recsports, Intramural Supervisor and Referee September 2011-March 2014
Managed and coordinated referees during intramural activities.
Promoted positive sportsmanship.

Department of Geography and the Environment, EIS Lab Assistant August 2011- May 2012
Managed computers and supplies in lab space.
Provided GIS support to students and helped faculty with IT problems.

Grantworks Inc. **Austin, TX** June 2013 – January 2014
GIS Mapping Intern
Obtained and Pre-processed geospatial data from state and private agencies.
Drafted and Finalized Maps (e.g. comprehensive city plans, newspaper articles, proposals).
Traveled to various project sites to obtain geospatial data, and conduct field surveys.

Texas General Land Office **Austin, TX** August 2011-May 2012
Coastal Resources, GIS Intern
Organized and created digital data for Texas sediment database.
Processed LiDAR data for Texas Coastline.
Created shapefiles and maps for various coastal projects.

Teresa Lozano Long Institute of Latin American Studies **Austin, TX** August 2010-May 2012
Dr. Edgardo Latrubesse, GIS Research Intern
Developed GIS data from field work maps and GPS coordinates along the Madeira River.
Created and edited maps for various publications and projects.

PROFESSIONAL ASSIGNMENTS

3-D Interactive Hydro-stratigraphic Models for the University of Texas (University Lands) including portions of twelve West Texas counties

Screened over 10,000 driller's reports and geophysical logs to identify formation tops and water production zones to a depth of 20,000 feet within the University Lands leases in Crockett, Irion, Pecos, Reagan, Schleicher and Upton Counties. Developed a GIS dataset from the aforementioned wells with formation picks from the Edwards, Trinity, Dockum, Rustler, Yates, San Andres, Grayburg, Fusselman and Ellenburger. Drafted text for the data and methodology section of the final report.

Salado Springs Study and Updated 2015 Water Level Surfaces for Clearwater UWCD

Conducted a literature review and integrated TDLR well driller's reports, USGS gain/loss study data, TPWD spring data and speleological survey data to better understand the Salado Creek watershed hydraulic setting. Used CUWCD monitor well data to develop water level contours for the Edwards BFZ, Glen Rose, Hensell and Hosston aquifers. Drafted the report and created the associated figures and tables. Organized and develop a geodatabase with the GIS data used in the project.

3-D Interactive Hydro-stratigraphic Model for Pecos County Texas (Middle Pecos Groundwater District)

Utilized 1,100 oil, gas and water well driller's reports and geophysical logs for both geology and water level data. Integrated well data into GIS and hand contoured surfaces for five aquifers (Pecos Valley Alluvium, Edwards-Trinity Plateau, Dockum, Rustler and Capitan Reef Complex aquifers), and oil and gas surfaces down to 23,000 feet (top of Ellenburger) in the Delaware basin. Used interpolation methodology to develop surfaces for each of aforementioned surfaces. Created study area, data distribution and geologic formation surface figures that were included in the report. Developed a geodatabase with GIS data used in the project. Provided technical training for the 3D model and benefits of utilizing GIS data in workflow.

Hydro-stratigraphic Framework for Crockett County GCD

Finalized study area, data distribution and geologic formation figures for the Edwards, Trinity, Dockum, Yates, San Andres and Ellenburger surfaces. Created net thickness isopachs figures of Edwards Limestone, Trinity sands and Dockum sands. Created cross-sections that included water level data and the Edwards-Trinity, Dockum and Anhydrite surfaces. Developed a Geodatabase with GIS data used in the project.

3-D Interactive Hydro-stratigraphic Model for Bell County Texas (Clearwater Groundwater District)

Created study area and data distribution figures that were included in the report. Developed the basemap surface that was included in the 3D model. Developed a Geodatabase with GIS data used in the project.

Arizona State Museum *Report (Permit: ASM 2009-127ps)*

Helped coordinate and plan field work research and project objectives. Created and managed GIS data for archeological sites using photos and GPS coordinates. Created figures for report.

PUBLICATIONS, FIGURES AND PRESENTATIONS

- James A. Neely, Michael J. Aiuvalasit, and Vincent A. Clause. "New Light on the Prehistoric Purron Dam Complex: Small corporate group collaboration in the Tehuacan Valley, Puebla, Mexico." *Journal of Field Archaeology* (2015): 2042458215Y-0000000010.
- Clause, Vincent Anthony. "Integrating geologic and SRTM data to identify geomorphologic landforms in the Eastern Amazon River Valley." The University of Texas at Austin, Master's Thesis (2014): http://hdl.handle.net/215227555
- James A. Neely. "Tracking Canals in the Safford Basin: A Tale of Fate 34 & 54 Years in the Making." (2014). **Figure 5: Topographic map showing results of the Bajada Canals survey project.**
- Clause, Vincent Anthony. "The Effect of Urbanization on Stream Discharge in Houston, Texas." Southwest Association of American Geographers Annual Meeting Poster Competition. The University of Texas at Austin, (2011).

HONORS & AWARDS

- Department of Geography and the Environment, *2012 Outstanding Undergraduate Award*
- 2012 Student Employee of the Year, *Nominee*
- University Honors, *Spring 2009 and Spring 2011*

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HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.13 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.14(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION-1 RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: Daniel B. Stephens & Associates, Inc. State of Texas VID #: 1850341157300

Point of Contact: Neil Blandford, P.G. Phone #: 505-822-9400

E-mail Address: nblandford@dbstephens.com Fax #: 505-822-8877

b. Is your company a State of Texas certified HUB? ☐ **- Yes** ☑ **- No**

c. Requisition #: 580-16-RFQ0007 Bid Open Date: 11/13/15 (mm/dd/yyyy)

Neil Blandford, P.G.

Enter your company's name here: Daniel B. Stephens & Associates, Inc. Requisition #: 580-16-RFQ0007

SECTION-2: RESPONDENT's SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods, services, transportation and delivery will be subcontracted**. Note: In accordance with 34 TAC §20.11, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☑ - *Yes*, I will be subcontracting portions of the contract. (If *Yes*, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - *No*, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods, services, transportation and delivery. (If *No*, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%
6		%	%	%
7		%	%	%
8		%	%	%
9		%	%	%
10		%	%	%
11		%	%	%
12		%	%	%
13		%	%	%
14		%	%	%
15		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	**%**	**%**	**%**

(Note: If you have more than fifteen subcontracting opportunities, a continuation sheet is available online at http://window.state.tx.us/procurement/prog/hub/hub-subcontracting-plan/).

c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, Item b.

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☑ - *No* (If *No*, continue to Item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements**."

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☑ - *No* (If *No*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include transportation and delivery under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: Daniel B. Stephens & Associates, Inc. Requisition #: 580-16-RFQ0007

SECTION-3 SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.)

If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment, to include transportation and delivery.

N/A

SECTION-4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at http://www.window.state.tx.us/procurement/prog/hub/hub-forms/progressassessmentrpt.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

T. Neil Blandford	Neil Blandford	Vice President	11/13/15
Signature	Printed Name	Title	Date (mm/dd/yyyy)

Reminder:

- If you responded "Yes" to SECTION 2, Items c or d, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded "No" SECTION 2, Items c and d, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.

HSP Good Faith Effort - Method B (Attachment B)

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Enter your company's name here: Daniel B. Stephens & Associates, Inc. Requisition #: 580-16-RFQ0007

IMPORTANT*:** If you responded "No***" to **SECTION 2, Items c** and **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at http://window.state.tx.us/procurement/prog/hub/hub-forms/hub-sbcont-plan-gfe-achm-b.pdf.

SECTION B-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: 1 Description: 918-32 Consulting Services (Not Otherwise Classified)

SECTION B 2: MENTOR PROTÉGÉ PROGRAM

If respondent is participating as a Mentor in a State of Texas Mentor Protégé Program, submitting its Protégé (Protégé must be a State of Texas certified HUB) as a subcontractor to perform the subcontracting opportunity listed in **SECTION B-1**, constitutes a good faith effort to subcontract with a Texas certified HUB towards that specific portion of work.

Check the appropriate box (Yes or No) that indicates whether you will be subcontracting the portion of work you listed in SECTION B-1 to your Protégé.

☑ - Yes (If *Yes*, continue to SECTION B-4.)

☐ - No / Not Applicable (If *No* or *Not Applicable*, continue to SECTION B-3 and SECTION B-4.)

SECTION B 3: NOTIFICATION OF SUBCONTRACTING OPPORTUNITY

When completing this section you MUST comply with items a, b, c and d, thereby demonstrating your Good Faith Effort of having notified Texas certified HUBs and trade organizations or development centers about the subcontracting opportunity you listed in SECTION B-1. Your notice should include the scope of work, information regarding the location to review plans and specifications, bonding and insurance requirements, required qualifications, and identify a contact person. When sending notice of your subcontracting opportunity, you are encouraged to use the attached HUB Subcontracting Opportunity Notice form, which is also available online at http://www.window.state.tx.us/procurement/prog/hub/hub-subcontracting-plan.

Retain supporting documentation (i.e., certified letter, fax, e-mail) demonstrating evidence of your good faith effort to notify the Texas certified HUBs and trade organizations or development centers. Also, be mindful that a working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.

a. Provide written notification of the subcontracting opportunity you listed in SECTION B-1, to three (3) or more Texas certified HUBs. Unless the contracting agency specified a different time period, you must allow the HUBs at least seven (7) working days to respond to the notice prior to you submitting your bid response to the contracting agency. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

b. List the **three (3) Texas certified HUBs** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the company's Texas Vendor Identification (VID) Number, the date you sent notice to that company, and indicate whether it was responsive or non-responsive to your subcontracting opportunity notice.

Company Name	Texas VID (Do not enter Social Security Numbers.)	Date Notice Sent (mm/dd/yyyy)	Did the HUB Respond?
Michelle A. Sutherland, LLC	1472420119000	10/28/15	☑ - Yes ☐ - No
EE&G, INC.	1752949780600	10/28/15	☐ - Yes ☑ - No
Sarosdy Consulting, Inc.	1472613945500	10/28/15	☐ - Yes ☑ - No

c. Provide written notification of the subcontracting opportunity you listed in SECTION B-1 to two (2) or more trade organizations or development centers in Texas to assist in identifying potential HUBs by disseminating the subcontracting opportunity to their members/participants. Unless the contracting agency specified a different time period, you must provide your subcontracting opportunity notice to trade organizations or development centers at least seven (7) working days prior to submitting your bid response to the contracting agency. A list of trade organizations and development centers that have expressed an interest in receiving notices of subcontracting opportunities is available on the Statewide HUB Program's webpage at http://www.window.state.tx.us/procurement/prog/hub/mwb-links-1/.

d. List **two (2) trade organizations or development centers** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the date when you sent notice to it and indicate if it accepted or rejected your notice.

Trade Organizations or Development Centers	Date Notice Sent (mm/dd/yyyy)	Was the Notice Accepted?
El Paso Hispanic Chamber of Commerce	10/29/15	☐ - Yes ☑ - No
Women's Business Council Southwest	10/29/15	☐ - Yes ☑ - No

HSP Good Faith Effort - Method B (Attachment B) Cont.

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Enter your company's name here: Daniel B. Stephens & Associates, Inc. Requisition #: 580-16-RFQ0007

SECTION B-4: SUBCONTRACTOR SELECTION

Enter the item number and description of the subcontracting opportunity you listed in **SECTION 2, Item b,** of the completed HSP form for which you are completing the attachment.

a. Enter the item number and description of the subcontracting opportunity for which you are completing this Attachment B continuation page.

Item Number: 1 Description: 918-32 Consulting Services (Not Otherwise Classified)

b. List the subcontractor(s) you selected to perform the subcontracting opportunity you listed in **SECTION B-1**. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
Michelle A. Sutherland, LLC	☑ - Yes ☐ - No	1472420119000	$ 15,000	7.5 %
Allan R. Standen, LLC	☐ - Yes ☑ - No		$ 50,000	25 %
John Shomaker & Associates, Inc.	☐ - Yes ☑ - No		$ 50,000	25 %
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

c. If any of the subcontractors you have selected to perform the subcontracting opportunity you listed in **SECTION B-1** is **not** a Texas certified HUB, provide written justification for your selection process (attach additional page if necessary):

Qualified HUBs were solicited for this project as required by the RFQ. One Texas certified HUB was selected based on that HUB's qualifications for the services specified and the lack of response from the other HUBs solicited. DBS&A is including the non-HUB firms shown above because of their direct, prior experience in the project area with projects relevant to the RFQ and specialized expertise in hydrogeology of the subject aquifers, brackish water investigations, and geophysical log analysis.

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to **all** the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity it (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

SECTION 6
(if applicable)

Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity Submitting the RFQ

Not applicable. The only entity that owns at least 25% is the DBS&A ESOP Plan and Trust; Tax ID #85-0341157

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

7. DETAILED SCOPE OF WORK

Introduction

The State of Texas has future water demands that require the development of new sources of water. The 84th Texas State Legislature approved House Bill 30 which requires the TWDB to characterize brackish groundwater quality and spatial extent (vertical and lateral) in designated aquifers of Texas for possible future development. The development of this brackish water cannot cause significant impact to existing water quality and supplies. The Blaine Aquifer is one of the designated aquifers to be evaluated. Brackish groundwater studies are extremely important for potentially supplying future water demands in Texas and the consulting firms awarded these contracts must provide high quality, defendable science to evaluate these new water resources.

The DBS&A team, illustrated in the adjacent figure, consists of Daniel B. Stephens and Associates, Inc. (DBS&A), Allan R. Standen LLC (ARS LLC), John Shomaker and Associates, Inc. (JSAI) and Michelle Sutherland LLC (MS LLC). The principal investigators proposed for this team are applied hydrogeologists with significant field and research experience in west Texas aquifers and similar groundwater systems in the southwest; it is our opinion that this practical experience, in addition to the ability to conduct quantitative hydrogeologic analysis, is essential for successful project completion. Much of the proposed study is based on the review and analysis of field data. Potential weaknesses and assumptions inherent in the data may not be realized by professionals unfamiliar with field methods and practices.

We see the advantages that the DBS&A team offers Texas Water Development Board (TWDB) as follows:

- Team members have an excellent understanding of the hydrogeology of Permian rocks from north-central Texas to eastern New Mexico, and have worked extensively with geophysical logs of Permian Guadalupian and Ochoan Series rocks.
- Our approach is well thought out and we believe unique. We propose to define hydrogeologic units of the Blaine Aquifer and fill in data gaps using a multi-disciplinary approach based on stratigraphic, geomorphic, hydrogeologic, and geochemical analysis methods.
- In preparation for responding to this RFQ, we have already:

  1) Completed an in-depth analysis of the Permian Guadalupian-Series rocks in north-central Texas using published reports from TWDB, oil and gas industry, Texas Bureau of Economic Geology (BEG), and U.S. Department of Energy.

  2) Compiled a 2015 GIS version of the entire TWDB database of approximately 140,000 wells that includes well construction, most recent water quality, most recent infrequent chemical analysis, pump tests from remarks, screen and production intervals, historical water levels by decade and most recent water level.

  3) Constructed a 2015 GIS version of the Texas Department of Licensing and Regulation (TDLR) database of over 400,000 wells, which includes pump tests, driller's geologic description, water level measurements, and well construction information.

  4) Used the GIS shapefiles to screen well data to identify Blaine Aquifer information that will accelerate our technical analyses.
- The DBS&A team has extensive, in-depth experience in the construction of hydro-stratigraphic models using multiple data sources including BEG, Texas Railroad Commission (RRC), BRACS, TWDB and TDLR.
- The DBS&A team has strong groundwater modeling experience, and has constructed several GAMs and numerous other models for water resources analysis, including models of existing brackish aquifer well fields.
- The DBS&A team will deliver a LeapFrog 3D hydro-stratigraphic model as a project deliverable. The 3D model will allow TWDB staff to interactively view the compiled Blaine Aquifer well data and brackish water zones. The 3D model also provides the TWDB with a dynamic platform to input future projects and 3D Blaine model refinement, if desired. Various surfaces integral to the completion of this study cannot be easily verified or refined using GIS only, and the 3D approach will assist significantly in this regard.
- The DBS&A team has exceptional GIS and technology transfer expertise.
- The DBS&A team is comprised of at least five team members who have 100% availability to ensure project delivery on schedule. In addition, the combined firm resources is approximately 80 technical staff, so additional resources can be called upon if needed.
- The DBS&A team has a good track record of delivering projects on schedule.

Daniel B. Stephens & Associates, Inc.

DBS&A is a full-service water resources and environmental consulting firm that has been providing services in groundwater and surface

water hydrology, soil science, and environmental engineering for more than 30 years. Particular areas of expertise include hydrogeologic investigations, local and regional water resources planning and development, studies of contaminant transport in soil and groundwater, numerical modeling, and remediation of soil and groundwater. DBS&A operates offices in Austin and Lubbock, Texas, and also has offices in New Mexico, Colorado and California. The firm is comprised of approximately 90 professionals, including hydrologists and geologists; soil and environmental scientists; civil, chemical, and environmental engineers; GIS and computer drafting specialists; and field and laboratory technicians.

As prime contractor to TWDB, DBS&A will assume all project organization and management roles and ultimate responsibility for successful project completion. In addition, DBS&A will conduct the groundwater modeling and all BRACS database/GIS tasks as required by the scope of work in the RFQ. DBS&A provides an ideal combination of data management and GIS experience, along with water resources and water well data background, to support the development of a BRACS database. DBS&A has successfully completed two TWDB Groundwater Availability Models (GAMs), the GIS/database portions of two additional GAMs, two geologic structure projects and other assorted projects for the TWDB. We are familiar with TWDB expectations and protocols for project management, execution and completion, and contracting. In addition, we have used the existing BRACS database in detail for projects completed in the Monument Draw Trough of the Pecos Valley Aquifer in west Texas and the Gulf Coast Aquifer in the Lower Rio Grande Valley.

Allan R. Standen LLC

Mr. Standen has investigated the geology of Texas aquifers since his Senate Bill 1 work with LBG-Guyton (1998 to 2003) when he created all the GIS files and provided hydrogeological analysis for Region F aquifers. During his tenure with DBS&A from 2003 to 2011, he consulted for the High Plains UWCD, Hemphill and Mesa (Dawson County) GCDs and the City of Amarillo in the Texas Panhandle. He was DBS&A's lead geologist for the interpretation and construction of the Ogallala and Edwards-Trinity formations for the TWDB's Edwards-Trinity (High Plains) GAM (Blandford and others, 2008). Mr. Standen was also the principal investigator for the TWDB's Llano Uplift (Standen, 2008) and Capitan Reef Complex (2010) structure and stratigraphic studies involving the integration and stratigraphic interpretation of driller's reports and geophysical logs.

During the last four years, ARS LLC has completed the hydro-stratigraphic framework of the Cretaceous, Permian and Pennsylvanian formations for the Upper Trinity GCD under subcontract with Intera. ARS LLC has also completed county-scale 3D hydro-stratigraphic models (integrating driller's reports and geophysical logs) from land surface to the top of the Ellenburger Formation for Ward County (Standen, 2013) and the Middle Pecos Groundwater Conservation District (Pecos County) and a 3D geologic model for the Clearwater GCD (Bell County).

ARS LLC recently completed building (integrating over 1,000 driller's reports and geophysical logs) 3D hydro-stratigraphic datasets, including Delaware and Artesia Group Permian formations for University Lands in Pecos, Crockett, Upton, Reagan, Irion and Schleicher counties.

The role of ARS LLC will be to work in conjunction with JSAI to construct the hydrostratigraphy of the Blaine Aquifer, assist in the interpretation of water quality from resistivity logs, assist with the delineation of karst production zones, and assist Michelle Sutherland LLC with 3D geologic surface construction.

John Shomaker & Associates, Inc.

John Shomaker & Associates, Inc. (JSAI), an employee-owned corporation, has been providing professional hydrogeologic services in the area of water resource evaluation and development for over 42 years. Through careful selection and the introduction of highly motivated, qualified, and versatile people, JSAI has assembled a highly capable team to provide a full range of groundwater related studies. JSAI has a staff of about 18, which includes geologists, hydrogeologists, geochemists, hydrologists, GIS/AutoCAD analyst, and administrative support. Our core areas of expertise include applied hydrogeology, well design and construction, and groundwater modeling. JSAI has teamed with DBS&A on many projects in the past, in which a good and efficient working relationship has been established.

As a subcontractor, JSAI has assisted with the successful completion of the TWDB West Texas Bolsons GAM, Igneous-Bolson GAM, and Capitan Reef Complex stratigraphy. JSAI has also performed groundwater assessment projects and provided technical assistance for Culberson, Jeff Davis County, and Middle Pecos GCDs. More recently, JSAI has successfully performed water development projects in Far West and West Texas that involved hydrogeologic characterization of potential groundwater development area(s), groundwater flow model analysis, followed with drilling of production

wells. Clients have included El Paso Water Utility, water providers, oil and gas industry, and large ranches. JSAI has extensive experience with evaluating aquifer systems related to formations of the Permian Basin and shelf margin area in Texas and New Mexico, and is largely responsible for development of the Blaine Aquifer conceptual model presented in this RFQ.

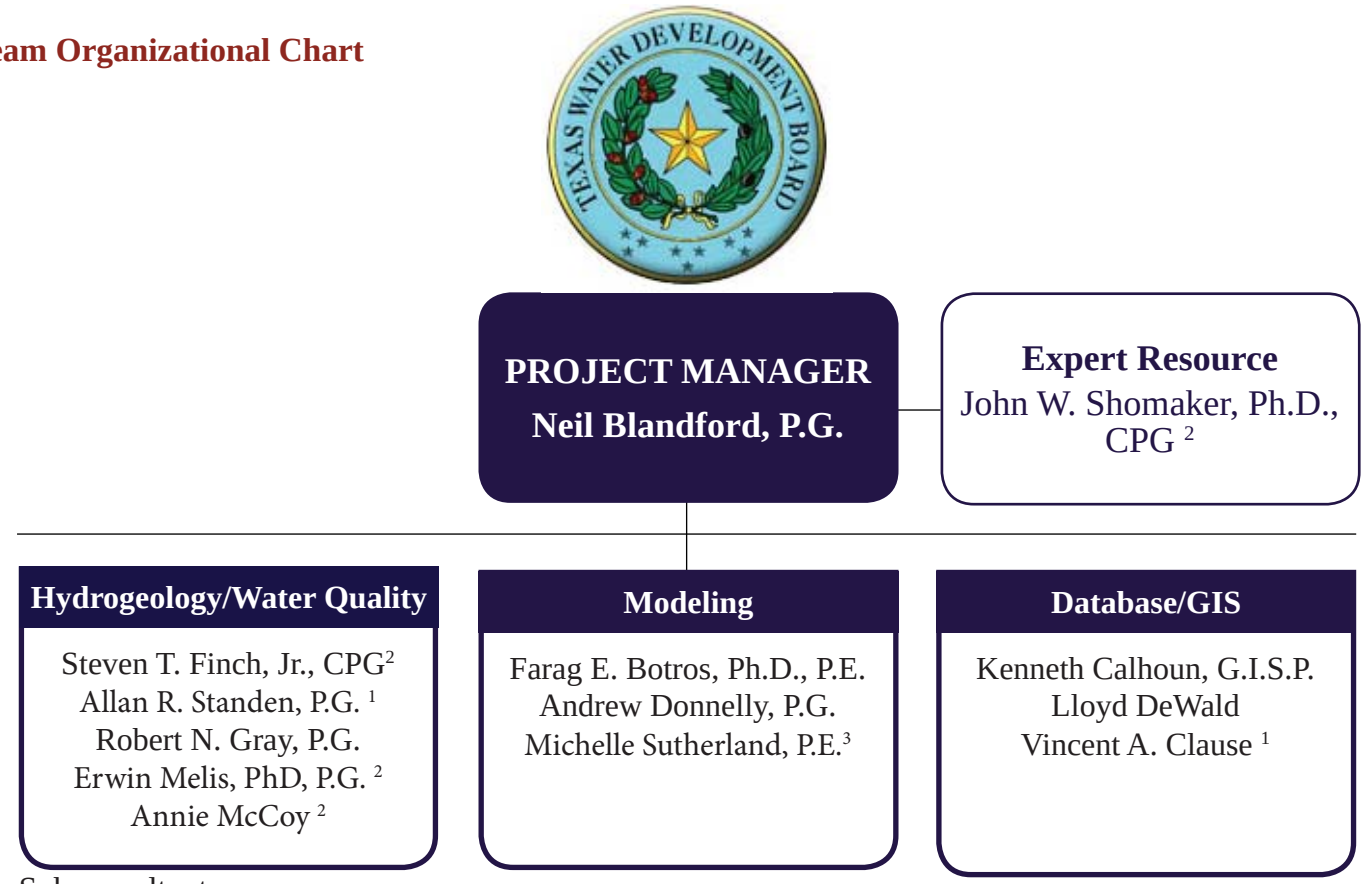
JSAI's role will include working with ARS, LLC in developing the hydrogeologic framework and characterization delineation of water quality zones specified in Tasks 3 and 4 of the proposed statement of work, assisting with QA/QC of databases developed for the project, providing technical guidance to Michelle Sutherland and DBS&A with the development of models, and assisting with conveying technical methods and results to TWDB and stakeholders.

Michelle A. Sutherland LLC

Michelle A. Sutherland, LLC was founded in 2014 to provide professional consulting services in water resource evaluations, and is a certified Historically Underutilized Business (HUB) business in Texas. Ms. Sutherland was an employee of DBS&A from 2007 through 2014. Ms. Sutherland, P.E., has 10 years of experience conducting regional and local spatial analysis of groundwater resources. She specializes in the application of modeling software to characterize water quality and quantity, with proficiency in geographical information systems (GIS), Groundwater Vistas (GWV), Earth Volumetric Studio (EVS), Leapfrog Hydro and Leapfrog Geo. Her expertise includes groundwater exploration, municipal well fields, geodatabases, MODFLOW models and three-dimensional (3D) hydrostratigraphic models.

Ms. Sutherland has extensive experience in developing complex hydrogeological and hydrostratigraphic models using GIS and 3D tools. Ms. Sutherland is an expert in conceptual model development using Leapfrog software, which we propose for use on this project. She created over 15 large-scale 3D hydrostratigraphic models for clients throughout Texas. In West Texas, she created county-wide or multi-county 3D hydrostratigraphic models for Hemphill UWCD, High Plains UWCD, North Plains GCD, Middle Pecos GCD and the City of Fort Stockton. She developed a 3D model that includes brackish aquifer zones [<1000 ppm total dissolved solids (TDS), 1000-3000 ppm TDS and >3000 ppm TDS] in the Pecos Valley Aquifer for

Team Organizational Chart



Subconsultants

1 Allan R. Standen LLC 2 John Shomaker and Associates, Inc. 3 Michelle Sutherland LLC

CRMWD. Ms. Sutherland will construct the 3D hydrostratigraphic surfaces for the project, based on data and interpretations provided by ARS and JSAI.

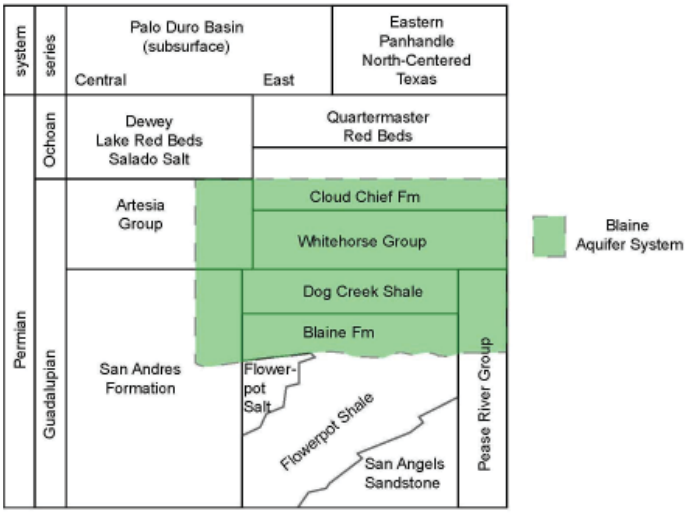
Blaine Aquifer system Background and Conceptual Overview

Prior to presenting the details of our proposed scope of work in task outline, we provide the following overview of the geology and hydrogeology of the Blaine Aquifer system. The overview is based on detailed analysis of existing references and data, and we believe provides a solid framework for successful project completion.

Geology

The Blaine Formation is a late Permian (Guadalupian series) evaporite and shallow marine rock that formed along the eastern shelf of the Permian Basin; it is underlain by the Flowerpot Shale, which defines the aquifer bottom. Geologic nomenclature within the Blaine Aquifer study area is variable and previous researchers have been inconsistent in their use of formation names. The primary Permian rocks of interest include the Whitehorse Group, Dog Creek Shale, Blaine Formation and stratigraphically equivalent rocks. In the northern part of the aquifer the Blaine Formation has been divided into five prominent members (Maderak, 1973), which are from top to bottom:

1. Acme Gypsum
2. Mangum Dolomite
3. Collingsworth Gypsum
4. Cedartop Gypsum
5. Haystack Gypsum



modified from J.S. Johnson (1978), Presley (1981), and Barnes (1974)

The overlying Dog Creek Shale is difficult to distinguish from the Blaine Formation because it has similar lithology. The Dog Creek Shale, from top to bottom, grades from red shale to gypsum and dolomite. In general, the Dog Creek shale has thinner beds than the Blaine Formation, and most researchers have combined these two formations into one aquifer unit (Smith, 1970; Maderak, 1972; Maderak, 1973; and Popkin, 1973).

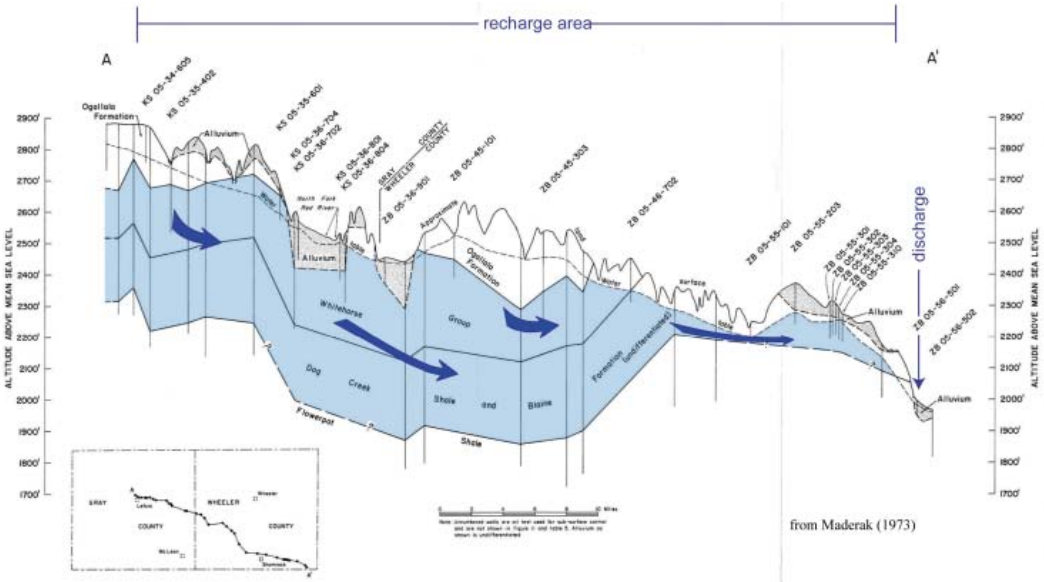
The Whitehorse Group consists of shale, silty sand, sandstone, gypsum, anhydrite, and dolomite. The Whitehorse Group grades into the Artesia Group to the west, and is equivalent to or is overlain by the Cloud Chief Formation. The Whitehorse Group, Dog Creek Shale, and Blaine Formation yield water to wells in the study area, with higher yields in places due to salt karst and resulting cavernous gypsum. For this reason we propose to combine all three units and refer to them as the Blaine Aquifer system. The Blaine Aquifer system thickness varies from less than 100 ft to over 1,000 ft (Smith, 1970; Maderak, 1972; Maderak, 1973; and Popkin, 1973).

Rocks overlying the Blaine Aquifer system, from oldest to youngest, include the Permian Quartermaster Formation and Tertiary and Quaternary rocks (Ogallala Formation, Seymour Formation, Lingos Formation and Quaternary alluvium).

Structure

Permian rocks of the Blaine Aquifer system crop out along the Bend Arch trending north to south and adjacent to Permian Basin eastern shelf (Core Labs, 1972). Older rocks crop out to the eastern edge of the aquifer system, and all Permian rocks dip westward about 25 feet per mile. The Blaine Formation outcrop has been mapped as a continuous section from Wheeler County to Fisher County, Texas; south of Fisher County it is mapped as discontinuous.

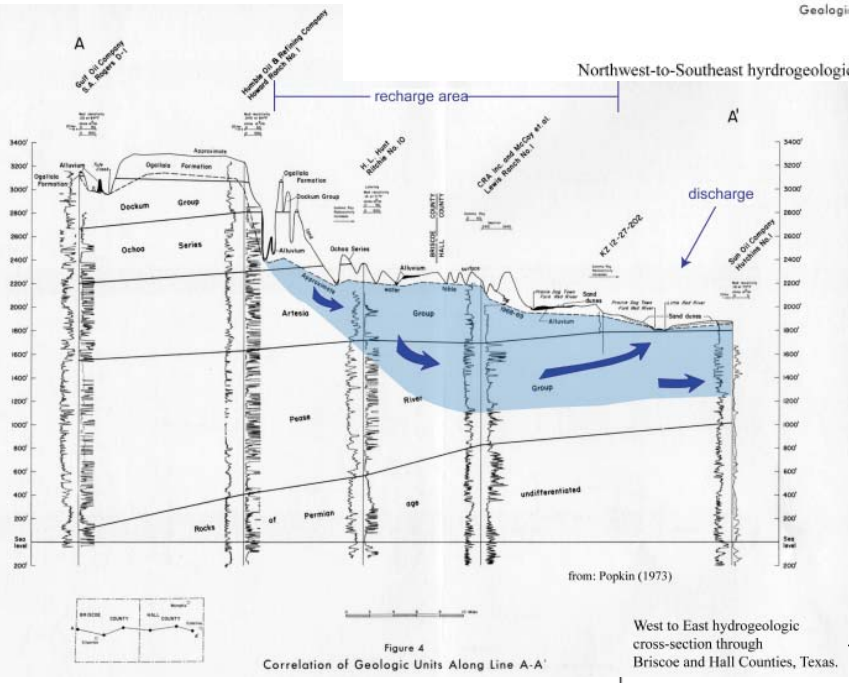
The three west-to-east cross sections shown below are in sequence from north to south. These cross sections show the westward dip of the Permian Formations, and the eastward direction of groundwater flow, consistent with land surface trends. The hydraulic relationship between the Blaine Formation and overlying Dog Creek Shale and Whitehorse Group can also be inferred.



from Maderak (1973)

Figure 5
Geologic Section A-A'

Northwest-to-Southeast hyrdrogeologic cross-section through Gray and Wheeler Counties, Texas.



from: Popkin (1973)

Figure 4
Correlation of Geologic Units Along Line A-A'

West to East hydrogeologic cross-section through Briscoe and Hall Counties, Texas.

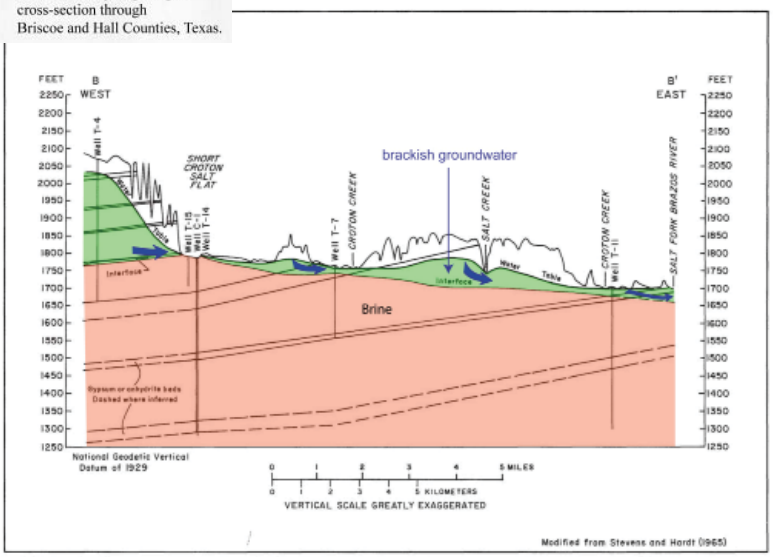


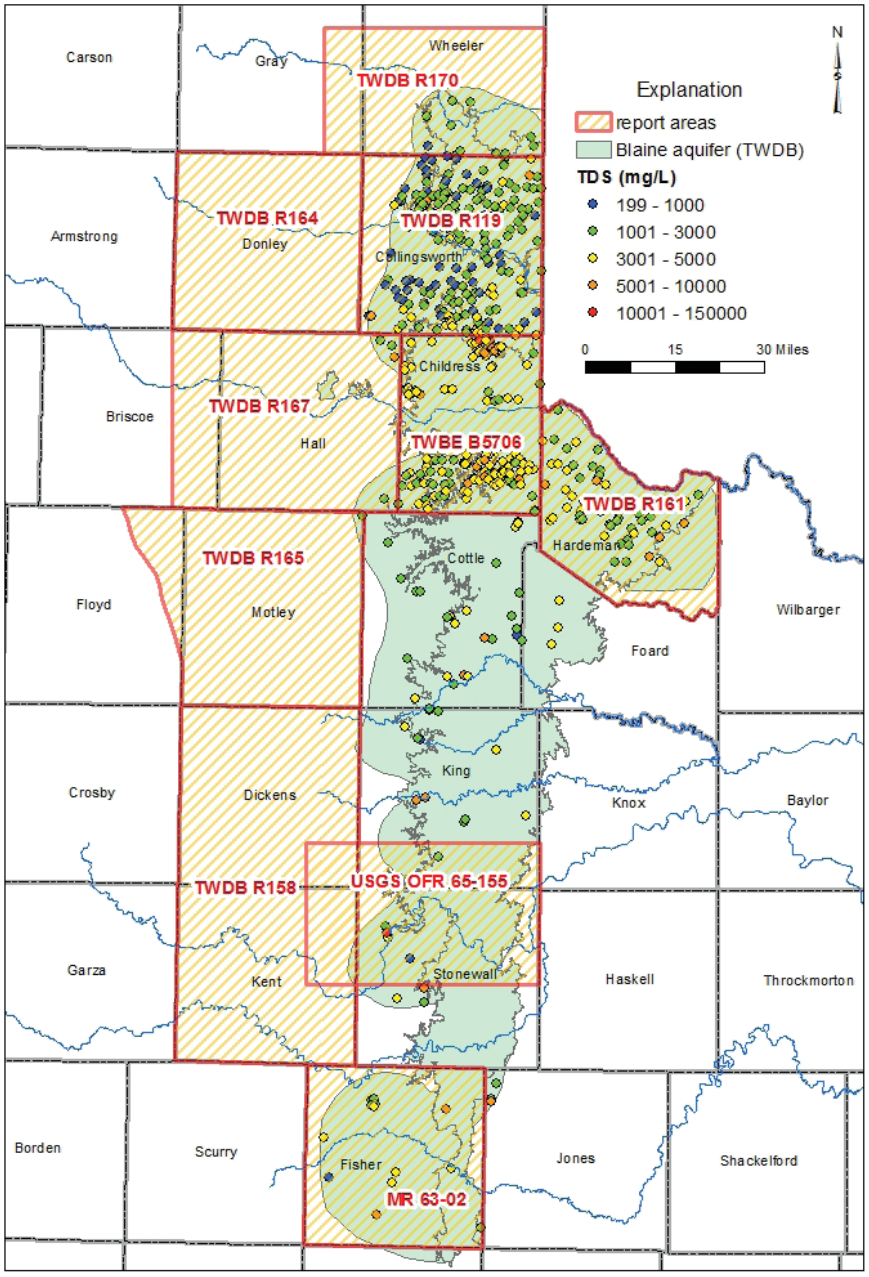
Figure 8.–East–west section B–B' through Croton Creek area showing geologic and hydrologic relations

Previous Hydrogeological Studies

Previous hydrogeological studies have been conducted for 1) regional assessment of saline groundwater resources for the North-Central Texas region, and for 2) local and county-wide water resource assessments. Regional assessment of saline groundwater resources of the Blaine Aquifer system were first performed by Winslow and Kister (1956), who identified the Blaine Formation as a significant source of brackish groundwater. Core Labs (1972) performed a more detailed assessment of the saline groundwater resources of Texas using available water quality data and interpretation of geophysical logs, although this assessment only considered the upper Permian rocks undifferentiated for the north-central Texas region. Duffin and Beynon (1992) compiled a summary of brackish and saline groundwater of the Permian rocks in North-Central Texas. LBG-Guyton (2003) prepared a summary of brackish groundwater resources for Texas and provide descriptions of the Whitehorse-Artesia and Blaine as separate aquifers. More recently, the Blaine Aquifer was assessed by Hopkins and Muller (2011) to describe water quality.

Below is a map showing the regions covered by previous hydrogeologic studies that contain data that will be used to assess the Blaine Aquifer system.

The northern half of the aquifer, where irrigation wells were established, has been studied from a perspective of general water resource assessment. These studies do not include structure contour maps of the Blaine Aquifer system, mapping of karst production zones, or detailed evaluation of water quality distribution.



Portions of the southern part of the Blaine Aquifer system have been evaluated by the USGS (Stevens and Hardt, 1965; Zohdy and Jackson, 1973; and Garza, 1982) and the Texas Water Commission (Burnilt, 1963) to identify sources of saline groundwater discharge to streams and agricultural lands. Other studies have been completed to investigate salinity control projects for the Brazos watershed.

The Seymour Aquifer GAM (Ewing and others, 2004) included the Permian rocks as a model layer underlying the Quaternary alluvium Seymour aquifer. Little effort was devoted to defining the structure, hydraulic properties, and water quality distribution in the Permian rocks, as the modeling effort was focused on the Seymour Aquifer.

Hydrogeologic Conceptual Model

The DBS&A team has thoroughly reviewed existing data and reports, and has conducted an initial evaluation groundwater flow patterns, hydraulic connectivity of the Whitehorse-Artesia Group with the Dog Creek Shale and Blaine Formations, and distribution of water quality. Based on these efforts we propose that the Blaine Aquifer system should include Whitehorse-Artesia Group, Dog Creek Shale, and the Blaine Formation, with the

bottom of the aquifer system defined as the top of the Flowerpot Shale.

We also propose to divide the Blaine Aquifer system into six hydrogeologic sub-regions based on regional groundwater flow paths, geologic unit extent, identified discharge areas and the western extent of the recharge area for Whitehorse-Artesia Group. Recognition of these hydrogeologic sub-regions is key to our proposed project approach and scope of work.

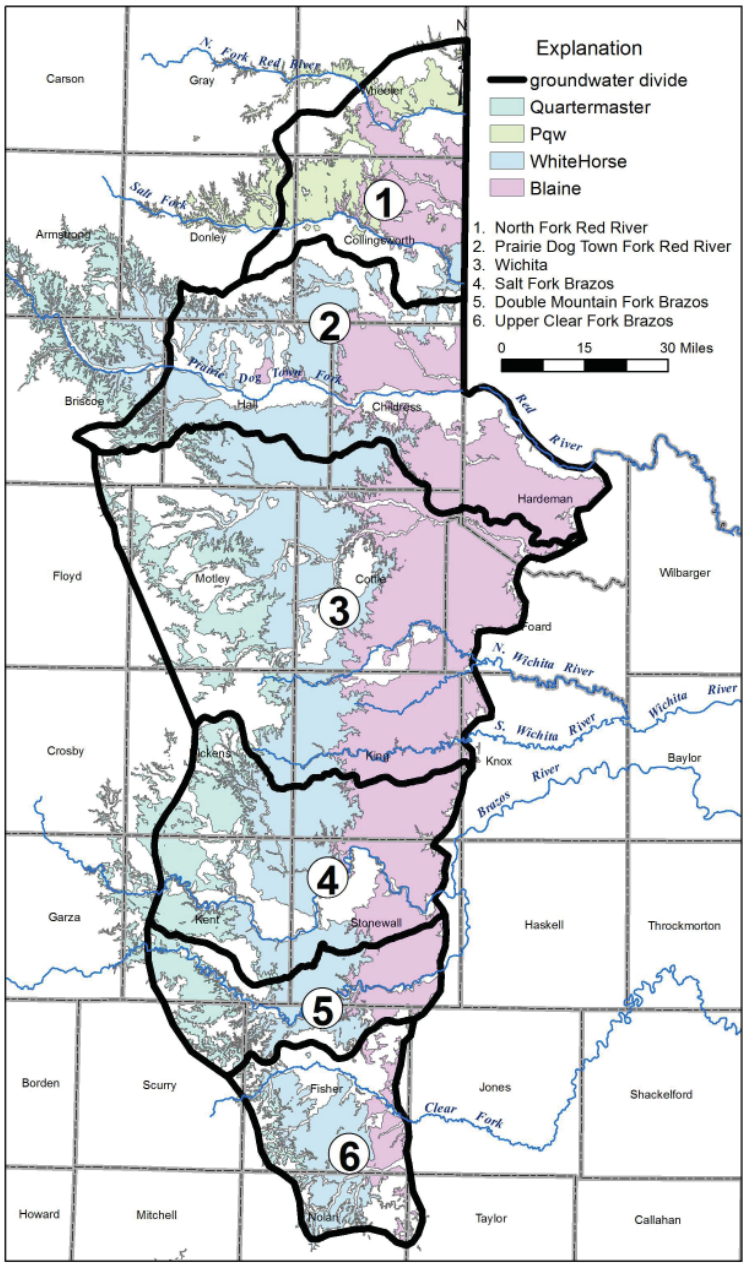
Evidence for supporting the proposed approach of considering a Blaine Aquifer system include: 1) groundwater flow is west to east, which is opposite of the westward dip of the formations, 2) salt karst features exist in these formations along the same flow path, 3) regional groundwater flow contouring indicates hydraulic connectivity between formations, and 4) local water quality suggests that the formations are relatively similar in character. Each of the proposed subregions are briefly presented below.

Hydrogeologic Sub-Region 1 includes the North Fork of the Red River watershed in Wheeler and Collingsworth counties. The Blaine Aquifer system in this sub-region has been developed for irrigated agriculture because extensive evaporite karstification of gypsum beds in the Blaine Formation leads to high well yield (Smith, 1970). Groundwater is fresh to brackish, and recharges from alluvium and karst features and discharges to springs and major drainages of the North Fork of the Red River (Maderak, 1973). Groundwater divides separate sub-Region 1 from Sub-Region 2.

Hydrogeologic Sub-Region 2 includes the Prairie Dog Town Fork of the Red River watershed in Briscoe, Hall, Childress, and Hardeman counties. Similar to Sub-Region 1, the Blaine Aquifer system in sub-region 2 has been developed for irrigated agriculture because of the extensive evaporite karstification of gypsum beds in the Whitehorse-Artesia and Blaine Formations and associated high well yield (Shafer, 1957; Maderak, 1972; and Popkin, 1973). Groundwater is fresh to brackish, is recharged from alluvium and karst features, and discharges to the Prairie Dog Town fork of the Red River. Groundwater divides separate sub-Region 2 from Sub-Regions 1 and 3.

Hydrogeologic Sub-Region 3 includes the Wichita River watershed in parts of Dickens, King, Kent, and Stonewall counties. The Blaine Aquifer system in this sub-region has not been extensively developed for water supply. Groundwater is brackish to saline (Smith, 1973), with no distinct spatial trend. Well yields appear to be lower than in Sub-Regions 1 and 2, with wells yielding water from the Whitehorse Group and Blaine Formation (Smith, 1973). Groundwater divides separate Sub-Region 3 from Sub-Regions 2 and 4. Sub-Region 3 is one of the least studied parts of the Blaine Aquifer system, and is considered a data gap area. There is fairly good coverage of water well driller's logs and oil and gas geophysical logs to further characterize this sub-region.

Hydrogeologic Sub-Region 4 includes the Salt Fork of the Brazos River watershed in parts of Dickens, Cottle, King, Kent, and Stonewall counties. The Blaine Aquifer system in Sub-Region 4 has



not been extensively developed for groundwater supply, primarily because of low yielding wells and a shallow brine interface below the water table (Garza, 1982). Groundwater is brackish to brine. As mapped by Stevens and Hardt (1965), there are zones of brackish groundwater found at the water table overlying brine groundwater zone. The areas of brackish groundwater are typically less than 200 feet thick and range from 3,000 to 5,000 miligrams per liter (mg/L) TDS, whereas the brine has a TDS of about 200,000 mg/L (Stevens and Hardt, 1965). Groundwater divides separate Sub-Region 4 from Sub-Regions 3 and 5.

Hydrogeologic Sub-Region 5 includes the Double Mountain Fork of the Brazos River watershed in parts of Kent, Stonewall, Scurry, and Fisher counties. The Blaine Aquifer system in Sub-Region 5 has not been extensively developed for water supply. Groundwater is brackish to saline, and part or all of Sub-Region 5 also has a brackish-brine interface. Groundwater divides separate Sub-Region 5 from Sub-Regions 4 and 6; Sub-Regions 4 and 5 have been characterized by Stevens and Hardt (1965).

Hydrogeologic Sub-Region 6 includes the Upper Clear Fork of the Brazos River watershed, primarily in Fisher County. The Blaine Aquifer system in this sub-region has not been extensively developed for water supply. Groundwater is brackish to saline, with no distinct spatial trend. A groundwater divide separates Sub-Region 6 from Sub-Region 5. The Permian rocks yield only small quantities of water to wells in region (Burnilt, 1963). Wells producing from the Permian rocks range in depth up to about 200 feet, and many are converted seismic test holes. Most wells completed in the Permian rocks appear to be producing water from sandstone beds of the Whitehorse Group.

The Blaine Aquifer system extends into southwestern Oklahoma adjacent to Sub-Regions 1 and 2. The Oklahoma portion of the aquifer has been extensively evaluated, and information from Steele and Barclay (1965), Johnson (1981), Johnson (1990), and Johnson (1992) will be useful for incorporation into the hydrogeologic framework and delineation of water quality zones in Texas. Extensive karst features have been mapped in the Oklahoma portion of the aquifer, which may be useful in determining if similar stratigraphic sequences have undergone the same degree of salt karstification Texas. Solution caves in gypsum beds of the Blaine Formation have also been identified by McGregor and others (1963) near Quanah, Texas (eastern side of Sub-Region 3).

The difference between dissolution of gypsum and halite is reflected in the salinity of the groundwater. It appears the karst features and production zones in the northern portion of the Blaine Aquifer system (Sub-Regions 1 and 2) are mostly due to gypsum dissolution in relatively thick gypsum beds interbedded with dolomite. Further south in Sub-Region 3, the gypsum beds appear to be thinner, are possibly discontinuous, and karstification is not as widespread. Sub-Region 4 appears to have halite as well as gypsum that have undergone dissolution. The geologic controls on karst, groundwater flow, and salinity, therefore, appear to change significantly from north to south in the Blaine Aquifer system. Furthermore, a brine interface and hydrodynamic barrier appears to exist to the west in the down-dip portion of the Blaine Aquifer system formations.

PROJECT TASKS

We propose the following task outline for the Blaine Brackish Aquifer Study:

Task 1 - Project Management and Monitoring

Task 2 - Meetings and Stakeholder Communications

Task 3 - Delineation of Groundwater Quality Zones and Volume Computations

Task 4 - Delineation of Potential Brackish Groundwater Production Zones

Task 5 - Determine Capacity of Potential Production Areas Over 30 and 50 Year Periods

Task 6 - Reports and Deliverables

Even if not stated explicitly in this section, we have addressed all required (non-optional) items as specified in the RFQ.

Task 1: Project Management and Monitoring

Our approach to project Task 1 is provided below, and our approach and deliverables for the remaining tasks are presented in sequence. The project schedule and percent effort table are provided at the end of this section.

As indicated on the project team organizational chart, the DBS&A Project Manager, Mr. Neil Blandford, will be the primary point of contact for the TWDB. Mr. Blandford has been with DBS&A for over 20 years, is a Vice President with signatory authority and the ability to direct labor and material assets toward the successful completion of projects.

Project progress monitoring procedures will be carried out in accordance with a well-established company system with automated, multi-level reporting for cost-control and project schedule evaluation. Project management will be streamlined through the use of a Deltek Vision cost accounting

system and, if needed, tools such as Microsoft Project. Project managers at DBS&A have real-time access to resource allocation reports and participate in company-wide resource planning conference calls; both of these tools aid in making the right team members available for projects when they are needed. All subcontracts will receive detailed work orders and project scopes to eliminate gaps in terms of deliverables.

Coordination with TWDB staff, and in particular the TWDB Project Manager, is critical to the success of this project. Formal meetings with appropriate TWDB staff will occur as described under Task 2. Detailed monthly progress reports will be submitted to the TWDB outlining progress of the project, anticipated problems or issues to be resolved, and proposed solutions. Issues of concern will be reported to the TWDB Project Manager by phone or in-person meeting as soon as they are recognized.

Task 2 - Meetings and Stakeholder Communications

As required in the RFQ, a minimum of four meetings will be held with the TWDB at project initiation, for discussion of the definition of "significant impact," for approval of project technical methodology, for discussion of potential production areas and prioritization for production calculations, and at project completion. Other meetings will be held as needed; we anticipate at least one additional meeting will be required during project execution to discuss technical issues and preliminary findings.

Representatives of the team will attend both required meetings and make a presentation at the second stakeholder meeting as required in the RFQ. If other stakeholder meetings are required, we will assist TWDB as needed. In addition, we anticipate contacting certain stakeholders in the region that may have useful information for completion of the study.

Task 3 - Delineation of Groundwater Quality Zones and Volume Computations

Our proposed approach for the delineation of fresh, brackish and saline groundwater vertically and horizontally is based on standard principals of applied hydrogeology and our understanding of the Blaine Aquifer system. Our general approach is as follows:

1. Use the best available data to define the Blaine Aquifer system extent, both horizontally and vertically.

2. Develop a database of existing water quality observations representative of the aquifer system framework, including TWDB data not previously assigned an aquifer code.

3. Identify water quality data gap areas from the compiled water quality database. Use interpretation of available geophysical logs to estimate groundwater salinity for data-gap areas.

4. Delineate groundwater quality zones as specified in the RFQ, and calculate volumes of fresh, brackish, and saline groundwater within those zones.

Each of these steps is presented in greater detail in the following subsections.

Definition of Blaine Aquifer System Extent

The Project Area in the RFQ is defined as the Blaine Aquifer extent as delineated by the TWDB. We believe that the project area extent can be expanded in accordance with existing data to better fulfill the RFQ requirements and the intent of HB30. We propose to lead a technical discussion at the kickoff meeting to propose our suggested project area extent and our justification, with particular focus on the western boundary and overlying, hydraulically connected Permian formations. Defining the horizontal and vertical extent of the Blaine Aquifer, and obtaining consensus for the technical approach with the TWDB, is critical for successful completion of the remainder of the project. Development of the aquifer framework will help us assign historical water quality data an aquifer code for wells with producing intervals, and will also identify the depth interval for evaluation of geophysical logs for interpretation of groundwater salinity. The following is an outline of our proposed approach for defining the aquifer geometry.

- All project-generated GIS shapefiles and raster files will follow the Second Edition of the BRACS data dictionary recommended file naming format.
- The raster files for Layer 2 in the Seymour GAM will be used as the starting point for defining the top and bottom of the Blaine Aquifer.
- Cross sections from existing published reports will be georeferenced and used to adjust the Blaine top and bottom elevations.
- Available driller's reports and geophysical logs will be compiled, evaluated and compared to the working Blaine framework, and the Blaine top and base raster surfaces will be modified in accordance with this new data. Data sources will include driller logs from published reports and TLDR well reports, logs from the BRACS database, geophysical logs and cable tool driller's reports from the BEG, and supplementary geophysical logs from the Texas Railroad Commission online database.

- These GIS Blaine raster surfaces will be used to determine Blaine production intervals on TDLR well logs and BEG cable tool driller's reports in areas with sparse well control, and to provide guidance to identify the Blaine interval on each geophysical log used to determine TDS.

Groundwater Quality Data Compilation and Analysis

Our approach to the compilation of groundwater quality data is as follows.

1. Compile TWDB groundwater quality data for the TWDB defined Blaine Aquifer area and extent of Blaine Aquifer system with less than (<) 35,000 mg/L TDS. This includes TWDB database and data from wells in TWDB historical reports that are identified representative of the Blaine Aquifer system.

2. Compile TWDB most recent groundwater quality data for TWDB Blaine Aquifer system. Based on proposal screening, there are 563 Blaine Aquifer system TWDB wells with water quality (see Figure above). Only 323 of these TWDB wells with water quality are reported to be solely in the Blaine Formation.

3. Research additional water quality data sources from Texas Water Commission, TWDB, and USGS reports, particularly from Burnilt (1963), Stevens and Hardt (1965), Smith (1970), Cronin (1972), Maderak (1972), Maderak (1973), Popkin (1973), Popkin (1973a), and Smith (1973). Where there is supporting water quality data without an aquifer code, the Blaine top and bottom raster surfaces will be used to determine the Blaine's top and bottom interval for the water quality sample location (without as assigned aquifer code) to determine if the analyses is representative of the Blaine. As approved by the TWDB Project Manager, the DBS&A team will contact the Panhandle, Mesquite, and Gateway GCDs for additional water-quality information.

4. Create Blaine groundwater chemistry tables using the compiled Blaine groundwater quality dataset plotting TDS ranges and selected cation and anions to develop water quality parameters with depth as described in Meyer, 2012 and 2014.

5. The work by Stevens and Hardt (1965) to define the brackish-brine groundwater interface and brackish groundwater thickness for parts of Dickens, King, Kent, and Stonewall counties will be georeferenced, digitized, and incorporated into the 3D model to assist in defining water quality zones.

6. The goals of this task will be to create a composite measured Blaine Aquifer groundwater quality GIS shapefile, and to identify water quality data gap areas.

Geophysical Log Analysis

For identified water-quality data gap areas, we propose to use the Resistivity Water Apparent (RWA) Minimum Method as described by Estepp (1998, 2010) and Meyer and others (2012 and 2014) to determine varying TDS concentrations within the aquifer from available geophysical logs. The RWA method requires application of a water quality correction factor to account for varying mixed mineral content such as elevated bicarbonate or sulfate concentrations. Several of the parameters needed to apply this method can be obtained from the logs themselves (formation depths, temperature gradient, deep resistivity and porosity, if available), while others will be developed using the BRACS database. This method is based on application of Archie's equation (Archie, 1942) that relates formation water resistivity to formation resistivity values measured by resistivity logging tools. The analysis of water-quality characteristics from geophysical logs will be calibrated to known water quality data, if data points with both water quality analysis and geophysical logs can be identified.

DBS&A applied a similar method to determine water quality from 23 test borings in the Monument Draw Trough to plan a brackish aquifer well field, and JSAI has conducted this type of analysis on multiple brackish groundwater production wells.

The first step in the geophysical log analysis will be to identify potentially usable logs from the BRACS database. The DBS&A team will create a GIS shapefile with a 10-mile buffer zone to the northeast, east, and southeast of the TWDB Blaine Aquifer extent and review geophysical logs with resistivity curves within that extent. Based on current screening of BRACS database, there are approximately 230 geophysical logs in the proposed region (out of 339 resistivity logs) that have resistivity curves that start within 200 feet of land surface. Next, using the Blaine top and base raster surfaces, we will determine which geophysical logs provide useful information within the Blaine interval. Other items, such as quality of the log header information, curve signature (definition and amplitude) and curve scale header values will also be reviewed. Based on this information and analysis, the best resistivity logs with the best geographic distribution to cover data gap areas will be selected for further analysis.

If needed, the BRACS database will be supplemented using additional subsurface data, including publicly available geophysical logs from the BEG or the Texas Railroad Commission. These supplemental logs, if any, will also be screened as

described above and will be incorporated into the BRACs database and Elog TDS shapefile.

Water quality data will be entered into the BRACS database (Microsoft Access) form used to calculate water quality correction factor, Rwe_Rw_cor (Meyer 2012 and Meyer and others, 2014). Water quality correction factors will be developed for brackish water and fresh water formations as appropriate by determining average concentrations for each constituent within the TDS ranges of <1,000; 1,000 to 3,000; 3,000 to 10,000 and 10,000 to 35,000 mg/L. Conversion charts from Schlumberger (1986) will be applied to complete this task. This approach allows for the extrapolation of water quality parameters without a nearby water quality sample (Meyer and others, 2014). The approach will be as follows:

1. Determine CT conversion factor as described in Meyer and others (2012 and 2014).

2. Determine and enter remaining required correction factors (Dt, Df, Ts, Tbh, Ro, porosity, and m) into the BRACS database to calculate an interpreted TDS value for a given geophysical log interval.

3. Using an iterative approach, the results of TDS values calculated with the RWA equations will be compared to TDS values from the compiled Blaine Aquifer water quality database, and the Ct and sodium chloride correction factors will be adjusted until a good match is obtained to determine appropriate input parameters for the defined ranges of TDS.

4. Water quality correction factors will be developed for brackish water and fresh water formations as appropriate by determining average concentrations for each constituent within defined ranges of TDS. Weighting multipliers developed by Schlumberger (1979, 1985) to cation and anion concentrations will be applied. All of the required correction parameters will be used with the RWA equations to extrapolate corrected specific conductance and interpreted TDS values from the measured formation resistivity values obtained from the resistivity logging data.

5. Using an iterative approach, the results of TDS values calculated with the RWA equations will be compared to measured TDS values from the database, and the Ct and sodium chloride correction factors will be adjusted until a good match with the BRACS data is obtained to determine appropriate input parameters for the various defined ranges of TDS.

6. Calculate an average estimated TDS concentration between the Blaine top and base surface for each geophysical log and update the Elog_TDS shapefile from with the estimated TDS. The location of the brine interface will be considered in the analysis.

Once these steps are complete, the measured Blaine Aquifer water quality shapefile will be joined with the Elog TDS shapefile to create a composite Blaine TDS shapefile. All database entries, GIS surfaces and related information will be used and stored in accordance with the BRACS database and RFQ requirements. Once the geophysical log analysis and data entry are complete, water quality zones based on the TDS concentration ranges specified in the RFP will be created in GIS for the Blaine study area and the BRACS database and 3D model will be updated.

Volume Computations

The volume of available fresh, brackish and saline groundwater for each groundwater quality zone will be estimated using the 3D geologic model. A composite 2014-2015 regional water level surface raster will be created using TWDB and TDLR water level measurements, and it will be imported into the BRACS database and the 3D model. A three-dimensional thickness isopach grid will be developed for each delineated groundwater quality zone, so that the volumes can be readily calculated using the refined Blaine top and bottom raster surfaces. Published or estimated storage coefficients representative of the aquifer system will be used, and the calculation will consider confined and unconfined storage using the storage calculation methods commonly employed by the TWDB.

Task 4 - Delineation of Potential Brackish Groundwater Production Zones

As specified in the RFQ and HB30, the potential brackish groundwater production zones must be separated by hydrogeologic barriers and from other parts of the aquifer used for other purposes [e.g. municipal, domestic, agricultural uses with greater than (>) 1,000 mg/l TDS] and wastewater injection and disposal well zones. To expedite the delineation of potential brackish groundwater production zones, the DBS&A team proposes performing the following steps:

- Step 1- Identify excluded areas of the Blaine Aquifer under HB30.
- Step 2 - Identify potential brackish groundwater production areas, based on TWDB definition of “potential” and how that relates to expected well field yield.
- Step 3 - Identify hydrogeologic barriers in the Blaine Aquifer and for each potential brackish groundwater production zone.
- Step 4 - Delineate each potential brackish groundwater production zone.

Identify Areas to Be Excluded For Development Under HB30

Areas that are excluded for future HB 30 brackish groundwater development include geological formations in areas with injection and disposal wells and areas with brackish groundwater used for water supply. We also propose considering brackish groundwater springs in state or federally protected areas. The DBS&A team understands that feedback from stakeholders and further definition of "significant impact" may change the requirements for areas that qualify for brackish groundwater development under HB30.

We propose to use the Blaine Aquifer system Sub-Regions (presented above) to provide the initial starting point for identifying areas to be excluded. Areas where the Seymour Aquifer overlies the Blaine Aquifer and are known to be in hydraulic communication will also be considered in this analysis. Evaluation of areas to be excluded will also include the following:

- **Public water supply, irrigation districts and domestic well field areas** - Blaine Aquifer Sub-Regions 1 and 2 are extensively used for irrigated agriculture, and will be considered for "off limits status" for brackish groundwater development. We will identify the remaining municipal, irrigation and areas with domestic well fields within study area using GCD and TCEQ public supply well databases.
- **Injection wells** - We will identify injection well data from the Texas RRC, and determine if injection wells are completed in zones the have potential hydraulic connection with the Blaine.
- **Federally or state protected and/or threatened brackish springs** - There may be springs that discharge from the Blaine Aquifer system that are protected by Texas Parks and Wildlife or have state or federal protection for endangered species. These spring areas (if any) will be identified and protected by a buffer zone.

Buffer zones will be created around each of these excluded areas; the size of the buffer zone will be dependent on estimated aquifer properties and stakeholder input. A GIS shapefile will be created for all excluded areas and the BRACS database and 3D model will be updated.

Identify and Characterize Potential Brackish Groundwater Production Zones

Groundwater production from the Blaine Aquifer is generally from karstified intervals. Identification of these potential karst zones is needed to identify brackish groundwater production zones with potential for higher well yields, to determine potential groundwater flow paths, and to identify production zone boundaries. The DBS&A team proposes the following steps for the areas of the Blaine Aquifer outside of the identified exclusion zones:

1. The team has created a GIS shapefile with over 1,400 TDLR water well drillers' reports deeper than 50 feet for the proposed Blaine study area. We will use the GIS raster top and base surfaces created during Task 3 to intersect with each driller's report and determine a Blaine top and bottom (where feasible) for each TDLR driller's report.

2. TDLR drillers' reports within the identified exclusion areas will be removed from the active dataset. The team will review the remaining TDLR drillers' reports for the top and bottom of the groundwater producing interval (screen, slotted or open). The DBS&A team will also capture well yield information from driller's reports.

3. The team will repeat the above process for selected deeper BEG cable tool drillers' reports with detailed descriptions looking for descriptions of karst features within the Blaine Aquifer.

4. The team will create a composite BlaineProd shapefile and update BRACS database and 3D model. The observed karst features and well production intervals will be used collectively to develop the Blaine Aquifer groundwater production zones.

5. An attempt will be made to correlate well data to hydraulic properties, so there will be a basis for the estimates of hydraulic properties for each potential production zone.

Delineate Potential Brackish Groundwater Production Areas

This subtask involves the delineation of potential brackish groundwater production areas separated by hydrogeologic barriers sufficient to prevent significant impacts to water availability or water quality in any part of the same or other fresh water aquifers. Potential hydrogeologic barriers include low-permeability geologic units (adjacent, underlying, and overlying), faults and fault zones, and hydrodynamic barriers created by a brine interface.

The Blaine aquifer Sub-Regions defined by DBS&A team member JSAI are based on groundwater divides, and provide a good starting point for defining hydrogeologic barriers. The potential for further division of Sub-Regions 3 through 6 will be evaluated, because these Sub-Regions are the most likely favorable for potential brackish groundwater development zones.

Much of the Blaine Aquifer system is under water table conditions, but certain areas contain an overlying low-permeability layer. From the analysis of logs conducted under Task 3, the DBS&A team will identify areas where the Blaine Aquifer system is confined by a regional overlying low-permeability zone such as the Quartermaster Formation. The DBS&A team will evaluate the overlying and adjacent low permeability layers and the brine interface using the 3D model or GIS and determine geographic areas where low-permeability layers are thick enough to form a hydrogeological barrier. The regional underlying low-permeability layer is the Flowerpot Shale, which will be defined in the 3D geologic model.

Previous work has not identified significant faults that would act as a hydrogeologic barriers. However the DBS&A team will perform a review of published geologic sources for mapped and inferred faults that may act as a hydrogeologic barrier.

The shapefiles created above and in Task 4 and under Task 3 (groundwater quality zones) will be used to delineate potential brackish groundwater production zones. Each potential zone will be characterized based on existing information and data, and the limits will be defined by the determined hydrogeologic barriers.

Task 5 - Determine Volume of Potential Production Areas Over 30 and 50 Year Periods

It is unlikely the existing Seymour GAM can be used to complete this task without significant modification. The Seymour Aquifer GAM includes the Blaine Aquifer as an underlying model layer, but does not adequately define the structure and characteristics of the Blaine Aquifer required to complete this project. For example, most of the Blaine Aquifer structure in the Seymour GAM is based on an inferred thickness and extent as opposed to well data, although ample data is available to develop a more representative geologic model of the Blaine Aquifer system. We will compare the updated Blaine Aquifer system framework to that included in the Seymour GAM to evaluate the extent of significant differences.

If the existing GAM is unsuitable for application, the DBS&A team will propose an alternative method that meets the requirements of the RFQ and that can be easily used and verified by the TWDB. One such option is the development of a superposition groundwater flow model based on the geologic model. Superposition (Reilly and others, 1987) is a useful, widely applied modeling approach that saves time and effort and can reduce uncertainty in some model evaluations. This approach is likely the best option for determining potential production volumes if the existing Seymour GAM is not representative of the Blaine Aquifer potential brackish groundwater production zone(s) evaluated.

Models designed to use superposition evaluate only changes in stress and changes in responses. Only the change in hydraulic heads (the drawdown) and change in groundwater flows are analyzed; this approach assumes that the response of the system is only due to the stress imposed (in this case pumping from a proposed well field) and is not due to other processes in the system. The absolute value of the hydraulic head and a quantification of the actual regional flows are not needed. If the problem to be solved involves only the evaluation of a change due to some change in stress, then the application of superposition can greatly simplify the data needs and time required for model development.

The MODFLOW finite difference code (Harbaugh and McDonald, 1996) and the graphical user interface from Groundwater Vistas 6 (Rumbaugh and Rumbaugh, 2011) will be used to model groundwater flow for this task if the GAM is not applicable. Standard MODFLOW boundary conditions and outputs can be used to simulate and represent 30-year and 50-year transient model runs, so the impacts to water quality and quantity can be reasonably evaluated. There are likely some potential impacts that cannot be reasonably addressed with a simplified model or even a standard GAM, such as evaluating the movement of brine by dewatering an overlying brackish groundwater volume. For these situations, the DBS&A team will work with the TWDB in developing the best analysis method that is defensible and achievable within the negotiated budget.

A second option that may also be used is simulation of drawdown due to proposed well field production using analytical methods such as the Theis equation. Analytical methods are widely used where hydraulic data is limited or screening type analyses are needed. Some geologic complexities, such as aquifer pinch-outs or barrier boundaries, can be incorporated in analytical approaches using the principal of superposition.

Regardless of the simulation approach ultimately selected, the Blaine production zone thicknesses created in the Blaine Prod shapefile (Task 4) will be used to calculate volumes and evaluate production potential for the 30- and 50-year periods.

Task 6 - Reports and Deliverables

The deadline for completing the project is August 31, 2016, and the project award is anticipated to occur in January 2016. We understand the importance of the project deadline, and we have taken the risk to invest significant time and resources

in getting a head start with detailed review of existing references and data sources, compilation of data sources, and performing a hydrogeologic analysis of the Blaine Aquifer system. We are ready to execute this project timely and provide the required deliverables on a schedule that will allow for TWDB review time. Contract deliverables are listed under Section III of the RFQ; the DBS&A team will provide the required deliverables. Some specifics of our approach to database updates and GIS datasets are provided below.

The DBS&A team has incorporated many types of historical data into Microsoft Access databases including TWDB groundwater database and water use data, Texas Commission on Environmental Quality (TCEQ) water supply data, and RRC oil and gas well location and completion information in many of our groundwater projects. We routinely integrate well data within ArcGIS-based applications and develop custom forms for data users to easily and efficiently import and link newly added data to our information management systems. We will apply Standard "Extract, Transform, and Load" (ETL) procedures will be used in this data acquisition phase of the project.

Data Model

The data dictionary for the BRACS database, as defined in TWDB Open-File Report 12-02, will be used to develop all project data models. The BRACS database structure relies on an extensive use of lookup tables. The data objects and relationships defined in this report will be strictly adhered to.

BRACS relational data models will be used to organize and structure data entered into the database. These relational data models define what information is to be contained in a database, how the information will be used, and how the items in the database will be related to each other. DBS&A has extensive experience developing relational data models and working with existing data models for similar databases. We routinely work with well data and understand the complexities of the various types of data that will be used in the system.

Data Standardization

The BRACS relational data model identified previously will be used to standardize and integrate the various datasets into the database. All data will be imported using data import templates developed for each source dataset. These tools allow the data administrator(s) to monitor data import procedures, establish content import parameters, streamline the data import process, and generate import reports, if necessary.

Quality Control (QC) Plan

A thorough quality-assured database is critical to any project, as database errors can result in incorrect analysis and reports. The DBS&A team will prepare

Hours each team member will spend on the project

	TEAM MEMBER	TASK 1	TASK 2	TASK 3	TASK 4	TASK 5	TASK 6
DBS&A	Neil Blandford, P.G.	10	40	8	8	20	32
	Farag E. Botros, Ph.D., P.E.					120	
	Andrew C.A. Donnelly, P.G.					40	
	Kenneth Calhoun, G.I.S.P.	2		12	30		60
	Robert N. Gray, P.G.			16	16		
	Lloyd DeWald			12	32		100
ARS	Allan R. Standen, P.G.	10	32	150	40		20
	Vincent A. Clause			168	16		
JSAI	John W. Shomaker, Ph.D., C.P.G.			24	12		
	Steven T. Finch, Jr., C.P.G.	10	32	50	40	8	20
	Erwin Melis, Ph.D., P.G.			100	10		
	Annie McCoy			100			
MS	Michelle Sutherland, P.E.		12	50	50		32

and implement a QC plan. The QC plan will include specific checklists to be used during the work progress and will consider the following issues:

- Verification against original source data. Part of DBS&A's standard QC procedure is to verify data entered into a database against the original source data (if available). Data imported from an internal agency database or an outside database will be compared against the post-imported database to compare records and ensure that no duplication of data has occurred.
- Level of confidence. Databases often contain uncertainties with regard to data collection techniques. Procedures will be developed that will screen the validity of these data collection techniques and possibly rank them according to specified levels of confidence in data accuracy.
- Self-validation. A series of checks will be built into the system for self-validation. Examples of this include instrument reporting ranges, historic data for a sampling location (where available), or expected ranges of values. Incorporating automatic checks against certain criteria is an efficient method for validating data and identifying outliers.

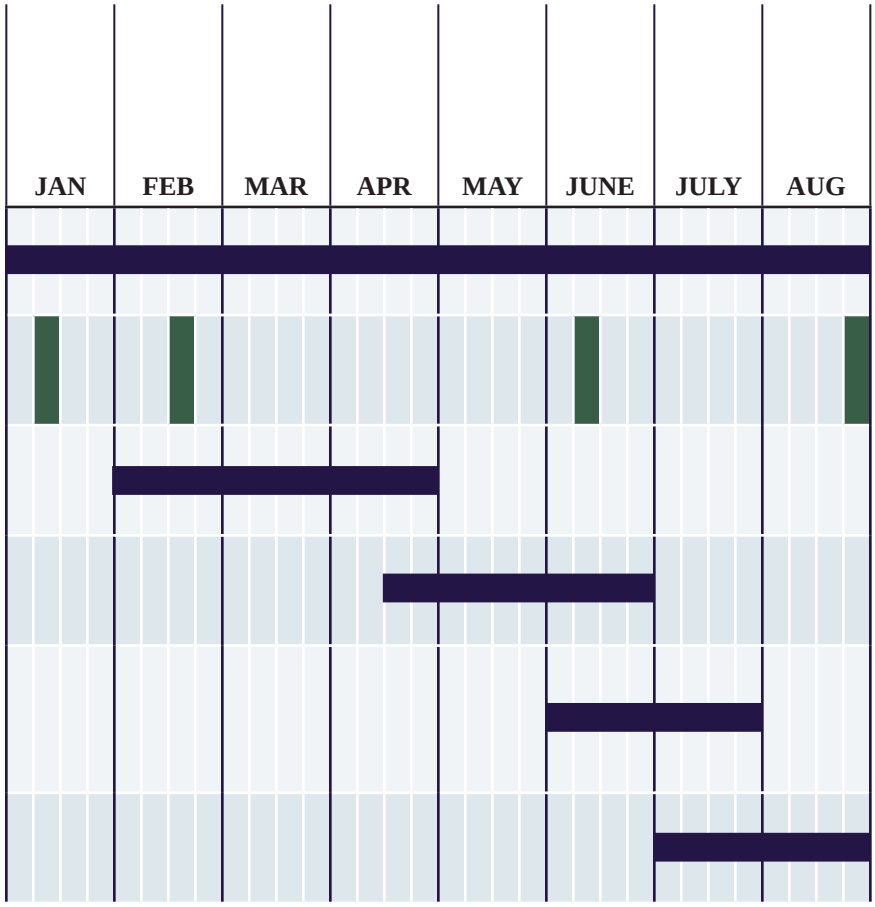
All GIS data will be stored and delivered in an ArcGIS GeoDatabase. Detailed metadata will accompany all GIS feature layers. The metadata will include data source, detailed field descriptions, and units. Any standard BRACS naming conventions will be utilized in the geodatabase. The geodatabase will include all point, line, polygon, and grid data. These files will include but may not be limited to:

- Well control point files
- Geologic formation top and bottom surface raster files
- Net sand raster files
- Salinity classification zone top and bottom raster files
- Proposed production area top and bottom raster surfaces
- Project raster snap grids

All geodatabase features will use the BRACS naming conventions and map projection parameters.

Schedule and Level of Effort

TASK	% EFFORT
1. Project Management and Monitoring	5
2. Meetings and Stakeholder Communications	15
3. Delineation of Groundwater Quality Zones and Volume Computations	30
4. Delineation of Potential Brackish Groundwater Production Zones	15
5. Determine Capacity of Potential Production Areas Over 30 and 50 Year Periods	20
6. Reports and Deliverables	15



B. PROJECT-MONITORING PROCEDURES

Project monitoring procedures are addressed as Task 1 beginning on Page 8. The monitoring procedures will be carried out in accordance with a well-established company system with automated, multi-level reporting for cost-control and project schedule evaluation.

C. PROJECT DELIVERABLES

Beginning on Page 13, we outline the reports and deliverables required by this project. Submission of Data and Data Sources as specified in RFQ includes:

- Electronic copies of all new well and water quality data, compatible with BRACs table design
- All geophysical well logs used for interpretation (TIFF and LAS format), with summary tables documenting interpreted data values
- Updated BRACs database
- Electronic copies of all new well and water quality data, compatible with BRACs table design, (TIFF and LAS)
- 3D LeapFrog Rustler model of Rustler top and bottom, salinity zones, production zones, exclusion zones, barriers and other relevant surfaces.
- 3D salinity GIS datasets and figures
- 3D potential production area datasets and figures
- Modeling of potential area datasets
- GeoDatabase of GIS deliverables, raster files and shapefiles
- Technical report and Technology transfer

D. ABILITIES

In our introduction, beginning on Page 1, a summary of our team's qualifications can be found which address all required abilities stated in RFQ section 2.4, items A through L. In addition, our team's qualifications are presented in our resumes (Section 4) and the provided project descriptions (Section 3) which are directly relevant to the proposed scope of work. Finally, our qualifications, knowledge and abilities are reflected in the proposed Scope of Work itself.

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EXHIBIT B

SCOPE OF WORK

Task 1 Project Management and Monitoring:
Our approach to project Task 1 is provided below, and our approach and deliverables for the remaining tasks are presented in sequence. The project schedule and percent effort table are provided in the Exhibit A. As indicated on the project team organizational chart, the DBS&A Project Manager, will be the primary point of contact for the TWDB contract.

Formal meetings with appropriate TWDB staff will occur as described under Task 2. Detailed monthly progress reports will be submitted to the TWDB outlining progress of the project, anticipated problems or issues to be resolved, and proposed solutions. Issues of concern will be reported to the TWDB Project Manager by phone or in-person meeting as soon as they are recognized.

Task 1 Deliverables:
A monthly progress report that includes the overall project progress, detailed progress by task, and an updated schedule. See Exhibit E, TWDB Guidelines for a Progress Report.

Task 2 Meetings and Stakeholder Communications:
As required in the RFQ, a minimum of four meetings will be held with the TWDB at project initiation, for approval of project technical methodology, for discussion of potential production areas and prioritization for production calculations, and at project completion. Other meetings will be held as needed.

Representatives of the team will attend both required meetings and make a presentation at the second stakeholder meeting as required in the RFQ. If other stakeholder meetings are required, we will assist TWDB as needed. In addition, we anticipate contacting certain stakeholders in the region that may have useful information for completion of the study.

Task 2 Deliverables:

- Stakeholder Meeting 1: Already held on October 26, 2015 in Austin, TX to explain TWDB's approach in implementing House Bill 30, solicit feedback on what constitutes "significant impact", and receive general comments concerning implementation of the legislation.

- TWDB Meeting 1: Project Initiation Meeting

- TWDB Meeting 2: Discussion and approval of Project methodology; date to be determined by the Contractor

- Stakeholder Meeting 2: Presentation and discussion of Potential Production Areas with stakeholder in the morning; date to be determined by the Contractor. The Contractor will set the date and provide a minimum of one-month advance notice to TWDB. TWDB staff will organize the meeting and invite stakeholders.

- TWDB Meeting 3: Discuss prioritization areas for production calculations with TWDB staff in the afternoon on the same day of the stakeholder meeting.

- TWDB Meeting 4: Project completion; formal presentation at the end of the Project.

- Additional technical meetings may be scheduled either in person, through a webinar, or teleconference venue to discuss project progress and issues. TWDB staff may periodically visit the Contractor's work premises to assess progress on the project.

Task 3 Delineation of Groundwater Quality Zones and Volume Computations:
Our proposed approach for the delineation of fresh, brackish and saline groundwater vertically and horizontally is based on standard principals of applied hydrogeology and our understanding of the Blaine Aquifer system. Our general approach is as follows:

1. Use the best available data to define the Blaine Aquifer system extent, both horizontally and vertically.
2. Develop a database of existing water quality observations representative of the aquifer system framework, including TWDB data not previously assigned an aquifer code.
3. Identify water quality data gap areas from the compiled water quality database. Use interpretation of available geophysical logs to estimate groundwater salinity for data-gap areas.
4. Delineate groundwater quality zones as specified in the RFQ, and calculate volumes of fresh, brackish, and saline groundwater within those zones.

Each of these steps is presented in greater detail in the following subsections.

<u>Definition of Blaine Aquifer System Extent</u>
The Project Area in the RFQ is defined as the Blaine Aquifer extent as delineated by the TWDB. We believe that the project area extent can be expanded in accordance with existing data to better fulfill the RFQ requirements and the intent of HB30. We propose to lead a technical discussion at the kickoff meeting to propose our suggested project area extent and our justification, with particular focus on the western boundary and overlying, hydraulically connected Permian formations. Defining the horizontal and vertical extent of the Blaine Aquifer, and obtaining consensus for the technical approach with the TWDB, is critical for successful completion of the remainder of the project. Development of the aquifer framework will help us assign historical water quality data an aquifer code for wells with producing intervals, and will also identify the depth interval for evaluation of geophysical logs for interpretation of groundwater salinity. The following is an outline of our proposed approach for defining the aquifer geometry.

1. All project-generated GIS shapefiles and raster files will follow the Second Edition of the BRACS data dictionary recommended file naming format.
2. The raster files for Layer 2 in the Seymour GAM will be used as the starting point for defining the top and bottom of the Blaine Aquifer.

3. Cross sections from existing published reports will be georeferenced and used to adjust the Blaine top and bottom elevations.
4. Available driller's reports and geophysical logs will be compiled, evaluated and compared to the working Blaine framework, and the Blaine top and base raster surfaces will be modified in accordance with this new data. Data sources will include driller logs from published reports and TLDR well reports, logs from the BRACS database, geophysical logs and cable tool driller's reports from the BEG, and supplementary geophysical logs from the Texas Railroad Commission online database.
5. These GIS Blaine raster surfaces will be used to determine Blaine production intervals on TDLR well logs and BEG cable tool driller's reports in areas with sparse well control, and to provide guidance to identify the Blaine interval on each geophysical log used to determine TDS.

Groundwater Quality Data Compilation and Analysis

Our approach to the compilation of groundwater quality data is as follows.

1. Compile TWDB groundwater quality data for the TWDB defined Blaine Aquifer area and extent of Blaine Aquifer system with less than (<) 35,000 mg/L TDS. This includes TWDB database and data from wells in TWDB historical reports that are identified representative of the Blaine Aquifer system.
2. Compile TWDB most recent groundwater quality data for TWDB Blaine Aquifer system. Based on proposal screening, there are 563 Blaine Aquifer system TWDB wells with water quality (see Figure above). Only 323 of these TWDB wells with water quality are reported to be solely in the Blaine Formation.
3. Research additional water quality data sources from Texas Water Commission, TWDB, and USGS reports, particularly from Burnilt (1963), Stevens and Hardt (1965), Smith (1970), Cronin (1972), Maderak (1972), Maderak (1973), Popkin (1973), Popkin (1973a), and Smith (1973). Where there is supporting water quality data without an aquifer code, the Blaine top and bottom raster surfaces will be used to determine the Blaine's top and bottom interval for the water quality sample location (without as assigned aquifer code) to determine if the analyses is representative of the Blaine. As approved by the TWDB Project Manager, the DBS&A team will contact the Panhandle, Mesquite, and Gateway GCDs for additional water-quality information.
4. Create Blaine groundwater chemistry tables using the compiled Blaine groundwater quality dataset plotting TDS ranges and selected cation and anions to develop water quality parameters with depth as described in Meyer, 2012 and 2014.
5. The work by Stevens and Hardt (1965) to define the brackish-brine groundwater interface and brackish groundwater thickness for parts of Dickens, King, Kent, and Stonewall counties will be georeferenced, digitized, and incorporated into the 3D model to assist in defining water quality zones.
6. The goals of this task will be to create a composite measured Blaine Aquifer groundwater quality GIS shapefile, and to identify water quality data gap areas.

Geophysical Log Analysis

For identified water-quality data gap areas, we propose to use the Resistivity Water

Apparent (RWA) Minimum Method as described by Estepp (1998, 2010) and Meyer and others (2012 and 2014) to determine varying TDS concentrations within the aquifer from available geophysical logs. The RWA method requires application of a water quality correction factor to account for varying mixed mineral content such as elevated bicarbonate or sulfate concentrations. Several of the parameters needed to apply this method can be obtained from the logs themselves (formation depths, temperature gradient, deep resistivity and porosity, if available), while others will be developed using the BRACS database. This method is based on application of Archie's equation (Archie, 1942) that relates formation water resistivity to formation resistivity values measured by resistivity logging tools. The analysis of water-quality characteristics from geophysical logs will be calibrated to known water quality data, if data points with both water quality analysis and geophysical logs can be identified.

The first step in the geophysical log analysis will be to identify potentially usable logs from the BRACS database. The DBS&A team will create a GIS shapefile with a 1-mile buffer zone to the northeast, east, and southeast of the TWDB Blaine Aquifer extent and review geophysical logs with resistivity curves within that extent. Based on current screening of BRACS database, there are approximately 230 geophysical logs in the proposed region (out of 339 resistivity logs) that have resistivity curves that start within 200 feet of land surface. Next, using the Blaine top and base raster surfaces, we will determine which geophysical logs provide useful information within the Blaine interval. Other items, such as quality of the log header information, curve signature (definition and amplitude) and curve scale header values will also be reviewed. Based on this information and analysis, the best resistivity logs with the best geographic distribution to cover data gap areas will be selected for further analysis.

If needed, the BRACS database will be supplemented using additional subsurface data, including publicly available geophysical logs from the BEG or the Texas Railroad Commission. These supplemental logs, if any, will also be screened as described above and will be incorporated into the BRACs database and Elog TDS shapefile. Water quality data will be entered into the BRACS database (Microsoft Access) form used to calculate water quality correction factor, Rwe_Rw_cor (Meyer 2012 and Meyer and others, 2014). Water quality correction factors will be developed for brackish water and fresh water formations as appropriate by determining average concentrations for each constituent within the TDS ranges of <1,000; 1,000 to 3,000; 3,000 to 10,000 and 10,000 to 35,000 mg/L. Conversion charts from Schlumberger (1986) will be applied to complete this task. This approach allows for the extrapolation of water quality parameters without a nearby water quality sample (Meyer and others, 2014). The approach will be as follows:

1. Determine CT conversion factor as described in Meyer and others (2012 and 2014).
2. Determine and enter remaining required correction factors (Dt, Df, Ts, Tbh, Ro, porosity, and m) into the BRACS database to calculate an interpreted TDS value for a given geophysical log interval.
3. Using an iterative approach, the results of TDS values calculated with the RWA equations will be compared to TDS values from the compiled Blaine Aquifer water quality database, and the Ct and sodium chloride correction factors will be adjusted until a good match is obtained to determine appropriate input parameters for the defined ranges of

TDS.

4. Water quality correction factors will be developed for brackish water and fresh water formations as appropriate by determining average concentrations for each constituent within defined ranges of TDS. Weighting multipliers developed by Schlumberger (1979, 1985) to cation and anion concentrations will be applied. All of the required correction parameters will be used with the RWA equations to extrapolate corrected specific conductance and interpreted TDS values from the measured formation resistivity values obtained from the resistivity logging data.
5. Using an iterative approach, the results of TDS values calculated with the RWA equations will be compared to measured TDS values from the database, and the Ct and sodium chloride correction factors will be adjusted until a good match with the BRACS data is obtained to determine appropriate input parameters for the various defined ranges of TDS.
6. Calculate an average estimated TDS concentration between the Blaine top and base surface for each geophysical log and update the Elog_TDS shapefile from with the estimated TDS. The location of the brine interface will be considered in the analysis.

Once these steps are complete, the measured Blaine Aquifer water quality shapefile will be joined with the Elog TDS shapefile to create a composite Blaine TDS shapefile. All database entries, GIS surfaces and related information will be used and stored in accordance with the BRACS database and RFQ requirements. Once the geophysical log analysis and data entry are complete, water quality zones based on the TDS concentration ranges specified in the RFP will be created in GIS for the Blaine study area and the BRACS database and 3D model will be updated.

Volume Computations

The volume of available fresh, brackish and saline groundwater for each groundwater quality zone will be estimated using the 3D geologic model. A composite 2014-2015 regional water level surface raster will be created using TWDB and TDLR water level measurements, and it will be imported into the BRACS database and the 3D geologic model. A three-dimensional thickness isopach grid will be developed for each delineated groundwater quality zone, so that the volumes can be readily calculated using the refined Blaine top and bottom raster surfaces. Published or estimated storage coefficients representative of the aquifer system will be used, and the calculation will consider confined and unconfined storage using the storage calculation methods commonly employed by the TWDB.

Task 3 Deliverables:

1. All well reports, geophysical well logs, and other well information used in a project shall be provided to TWDB. The methods and values (computational, empirical) used to interpret total dissolved solids (TDS) concentration from geophysical well logs will be fully documented in the final report.Digital formats: well reports, PDF; geophysical well logs, TIFF or LAS (if available).
2. All GIS files used in a project shall be provided to TWDB.

3. All GIS files will be summarized in an appendix in the technical report listing file names, type, and folder structure. See TWDB Report 383 for examples.

4. All GIS files will have descriptive metadata documenting the content, data structure, source(s), date(s), quality and other pertinent characteristics of the data using the Federal Geographic Data Committee (FGDC) metadata editor within ESRI's ArcCatalog.
5. All GIS file creation techniques will be described either in the technical report appendix for GIS files or in the section on a particular topic, such as net sand.
6. All volume computation and interpolation techniques will be described either in an appendix of the technical report for or in a section on a particular topic.
7. A draft report documenting the technique(s) and approaches for geophysical well log interpretation of aquifer total dissolved solids concentration. The report shall:
    - Identify types of geophysical well logs available in the area,
    - Describe how the interpreted total dissolved solids concentration from geophysical well log analysis relates to existing aquifer water chemistry as determined by direct measurements,
    - Describe how the log correction factors are determined, and
    - Describe how the interpretation techniques will be applied across the entire salinity range within the aquifer.

TWDB will have up to 10 business days to review the draft report, and the Contractor will schedule a meeting to discuss the techniques.

Task 4 Delineation of Potential Production Areas:

As specified in the RFQ and HB30, the potential production areas must be separated by hydrogeologic barriers and from other parts of the aquifer used for other purposes [e.g. municipal, domestic, agricultural uses with greater than (>) 1,000 mg/l TDS] and wastewater injection and disposal well zones. To expedite the delineation of potential production areas, the DBS&A team proposes performing the following steps:

Step 1 Identify excluded areas of the Blaine Aquifer under HB30.
Step 2 Identify potential production areas, based on TWDB definition of "potential" and how that relates to expected well field yield.
Step 3 Identify hydrogeologic barriers in the Blaine Aquifer and for each potential brackish groundwater production area.
Step 4 Delineate each potential production area.

<u>Identify Areas to Be Excluded For Development Under HB30</u>

Areas that are excluded for future HB 30 brackish groundwater development include geological formations in areas with injection and disposal wells and areas with brackish groundwater used for water supply. We also propose considering brackish groundwater springs in state or federally protected areas. The DBS&A team understands that feedback from stakeholders and further definition of "significant impact" may change the requirements for areas that qualify for brackish groundwater development under HB30.

We propose to use the Blaine Aquifer system Sub- Regions (presented above) to provide the initial starting point for identifying areas to be excluded. Areas where the Seymour Aquifer

overlies the Blaine Aquifer and are known to be in hydraulic communication will also be considered in this analysis. Evaluation of areas to be excluded will also include the following:

- Public water supply, irrigation districts and domestic well field areas - Blaine Aquifer Sub-Regions 1 and 2 are extensively used for irrigated agriculture, and will be considered for "off limits status" for brackish groundwater development. We will identify the remaining municipal, irrigation and areas with domestic well fields within study area using GCD and TCEQ public supply well databases.
- Injection wells - We will identify injection well data from the Texas RRC, and determine if injection wells are completed in zones the have potential hydraulic connection with the Blaine.
- Federally or state protected and/or threatened brackish springs - There may be springs that discharge from the Blaine Aquifer system that are protected by Texas Parks and Wildlife or have state or federal protection for endangered species. These spring areas (if any) will be identified and protected by a buffer zone.

Buffer zones will be created around each of these excluded areas; the size of the buffer zone will be dependent on estimated aquifer properties and stakeholder input. A GIS shapefile will be created for all excluded areas and the BRACS database and 3D model will be updated.

<u>Identify and Characterize Potential Production Areas</u>
Groundwater production from the Blaine Aquifer is generally from karstified intervals. Identification of these potential karst zones is needed to identify brackish groundwater production areas with potential for higher well yields, to determine potential groundwater flow paths, and to identify production area boundaries. The DBS&A team proposes the following steps for the areas of the Blaine Aquifer outside of the identified exclusion zones:

1. The team has created a GIS shapefile with over 1,400 TDLR water well drillers' reports deeper than 50 feet for the proposed Blaine study area. We will use the GIS raster top and base surfaces created during Task 3 to intersect with each driller's report and determine a Blaine top and bottom (where feasible) for each TDLR driller's report.
2. TDLR drillers' reports within the identified exclusion areas will be removed from the active dataset. The team will review the remaining TDLR drillers' reports for the top and bottom of the groundwater producing interval screen, slotted or open). The DBS&A team will also capture well yield information from driller's reports.
3. The team will repeat the above process for selected deeper BEG cable tool drillers' reports with detailed descriptions looking for descriptions of karst features within the Blaine Aquifer.
4. The team will create a composite BlaineProd shapefile and update BRACS database and 3D model. The observed karst features and well production intervals will be used collectively to develop the Blaine Aquifer groundwater production areas.
5. An attempt will be made to correlate well data to hydraulic properties, so there will be a basis for the estimates of hydraulic properties for each potential production area.

<u>Delineate Potential Production Areas</u>

This subtask involves the delineation of potential production areas separated by hydrogeologic barriers sufficient to prevent significant impacts to water availability or water quality in any part of the same or other fresh water aquifers. Potential hydrogeologic barriers include low-permeability geologic units (adjacent, underlying, and overlying), faults and fault zones, and hydrodynamic barriers created by a brine interface.

The Blaine aquifer Sub-Regions defined by DBS&A team member JSAI are based on groundwater divides, and provide a good starting point for defining hydrogeologic barriers. The potential for further division of Sub-Regions 3 through 6 will be evaluated, because these Sub-Regions are the most likely favorable for potential brackish groundwater development zones.

Much of the Blaine Aquifer system is under water table conditions, but certain areas contain an overlying low-permeability layer. From the analysis of logs conducted under Task 3, the DBS&A team will identify areas where the Blaine Aquifer system is confined by a regional overlying low-permeability zone such as the Quartermaster Formation. The DBS&A team will evaluate the overlying and adjacent low permeability layers and the brine interface using the 3D model or GIS and determine geographic areas where low-permeability layers are thick enough to form a hydrogeological barrier. The regional underlying low-permeability layer is the Flowerpot Shale, which will be defined in the 3D geologic model.

Previous work has not identified significant faults that would act as hydrogeologic barriers. However the DBS&A team will perform a review of published geologic sources for mapped and inferred faults that may act as a hydrogeologic barrier.

The shapefiles created above and in Task 4 and under Task 3 (groundwater quality zones) will be used to delineate potential production areas. Each potential area will be characterized based on existing information and data, and the limits will be defined by the determined hydrogeologic barriers.

Task 4 Deliverables:

1. Description of areas excluded from consideration as Potential Production Areas for the final report
2. GIS datasets delineating areas excluded from consideration as Potential Production Areas
3. Figure showing areas excluded from consideration as Potential Production Areas for the final report
4. Tools, files and/or scripts used to delineate Potential Production Areas
5. Description of any hydrogeologic barriers identified for the final report
6. GIS datasets of any hydrogeologic barriers identified for the final report
7. Figure showing any hydrogeologic barriers identified for the final report
8. Write up on Potential Production Areas identified for the final report
9. Potential Production Areas GIS datasets
10. Figure showing Potential Production Areas for the report
11. Before the second stakeholder meeting, create a range of possible impacts to water availability and water quality if the areas were produced
12. Define “significant impact” and a prioritized list of Potential Production Areas for 30-year

and 50-year pumping estimates after the second stakeholder meeting and exclude those areas from the Potential Production Areas

Task 5 Determine Volume of Potential Production Areas Over 30- and 50-Year Periods: It is unlikely the existing Seymour GAM can be used to complete this task without significant modification. The Seymour Aquifer GAM includes the Blaine Aquifer as an underlying model layer, but does not adequately define the structure and characteristics of the Blaine Aquifer required to complete this project. For example, most of the Blaine Aquifer structure in the Seymour GAM is based on an inferred thickness and extent as opposed to well data, although ample data is available to develop a more representative geologic model of the Blaine Aquifer system. We will compare the updated Blaine Aquifer system framework to that included in the Seymour GAM to evaluate the extent of significant differences.

If the existing GAM is unsuitable for application, the DBS&A team will propose an alternative method that meets the requirements of the RFQ and that can be easily used and verified by the TWDB. One such option is the development of a superposition groundwater flow model based on the geologic model. Superposition (Reilly and others, 1987) is a useful, widely applied modeling approach that saves time and effort and can reduce uncertainty in some model evaluations. This approach is likely the best option for determining potential production volumes if the existing Seymour GAM is not representative of the Blaine Aquifer potential production area(s) evaluated.

Models designed to use superposition evaluate only changes in stress and changes in responses. Only the change in hydraulic heads (the drawdown) and change in groundwater flows are analyzed; this approach assumes that the response of the system is only due to the stress imposed (in this case pumping from a proposed well field) and is not due to other processes in the system. The absolute value of the hydraulic head and a quantification of the actual regional flows are not needed. If the problem to be solved involves only the evaluation of a change due to some change in stress, then the application of superposition can greatly simplify the data needs and time required for model development.

The MODFLOW finite difference code (Harbaugh and McDonald, 1996) and the graphical user interface from Groundwater Vistas 6 (Rumbaugh and Rumbaugh, 2011) will be used to model groundwater flow for this task if the GAM is not applicable. Standard MODFLOW boundary conditions and outputs can be used to simulate and represent 30-year and 50-year transient model runs, so the impacts to water quality and quantity can be reasonably evaluated. There are likely some potential impacts that cannot be reasonably addressed with a simplified model or even a standard GAM, such as evaluating the movement of brine by dewatering an overlying brackish groundwater volume. For these situations, the DBS&A team will work with the TWDB in developing the best analysis method that is defensible and achievable within the project budget.

A second option that may also be used is simulation of drawdown due to proposed well field production using analytical methods such as the Theis equation. Analytical methods are widely used where hydraulic data is limited or screening type analyses are needed. Some geologic complexities, such as aquifer pinchouts or barrier boundaries, can be incorporated in

analytical approaches using the principle of superposition.

After the Stakeholder Meeting 2, TWDB will consider the Blaine Aquifer Stakeholders input and will prioritize the Potential Production Areas for evaluation. Regardless of the simulation approach selected, the Blaine production zone thicknesses created in the Blaine Prod shapefile (Task 4) will be used to calculate volumes and evaluate production potential for the 30- and 50-year periods. The production estimates and volume calculations should include a range of scenarios for each Potential Production Area..

Task 5 Deliverables:

1. Tools, files and/or scripts used to estimate the capacity of Potential Production Areas over 30- and 50-year periods, without causing a significant impact, as defined in Task 5.
2. Description of capacity of Potential Production Areas over 30- and 50-year periods, without causing a significant impact, as defined in Task 5, for the final report.
3. Table and graph of capacity of Potential Production Areas over 30 and 50 year periods, without causing a significant impact, as defined in Task 5, for the final report.

Task 6 - Reports and Deliverables

The study completion date or the contract expiration cannot be extended. The contractor shall notify in person immediately if any problems encountered during the project will delay the timely completion of any portion of this contract. Contract deliverables are listed under Section III of the RFQ; the DBS&A team will provide the required deliverables. Some specifics of our approach to database updates and GIS datasets are provided below.

Data Model

The data dictionary for the BRACS database, as defined in TWDB Open-File Report 12-02, will be used to develop all project data models. The BRACS database structure relies on an extensive use of lookup tables. The data objects and relationships defined in this report will be strictly adhered to.

BRACS relational data models will be used to organize and structure data entered into the database. These relational data models define what information is to be contained in a database, how the information will be used, and how the items in the database will be related to each other.

Data Standardization

The BRACS relational data model identified previously will be used to standardize and integrate the various datasets into the database. All data will be imported using data import templates developed for each source dataset. These tools allow the data administrator(s) to monitor data import procedures, establish content import parameters, streamline the data import process, and generate import reports, if necessary.

Quality Control (QC) Plan

A thorough quality-assured database is critical to any project, as database errors can result in

incorrect analysis and reports. The DBS&A team will prepare and implement a Quality Control plan. The Quality Control plan will include specific checklists to be used during the work progress and will consider the following issues:

- Verification against original source data. Part of DBS&A's standard QC procedure is to verify data entered into a database against the original source data (if available). Data imported from an internal agency database or an outside database will be compared against the post-imported database to compare records and ensure that no duplication of data has occurred.
- Level of confidence. Databases often contain uncertainties with regard to data collection techniques. Procedures will be developed that will screen the validity of these data collection techniques and possibly rank them according to specified levels of confidence in data accuracy.
- Self-validation. A series of checks will be built into the system for self-validation. Examples of this include instrument reporting ranges, historic data for a sampling location (where available), or expected ranges of values. Incorporating automatic checks against certain criteria is an efficient method for validating data and identifying outliers.

All GIS data will be stored and delivered in an ArcGIS GeoDatabase. Detailed metadata will accompany all GIS feature layers. The metadata will include data source, detailed field descriptions, and units. Any standard BRACS naming conventions will be utilized in the geodatabase. The geodatabase will include all point, line, polygon, and grid data. These files will include but may not be limited to:

- Well control point files
- Geologic formation top and bottom surface raster files
- Net sand raster files
- Salinity classification zone top and bottom raster files
- Proposed production area top and bottom raster surfaces
- Project raster snap grids

All geodatabase features will use the BRACS naming conventions and map projection parameters.

Task 6 Deliverables:

1. 3D LeapFrog Blaine model of Blaine Aquifer tops and bottoms, salinity zones, production zones, exclusion zones, barriers and other relevant surfaces.
2. 3D salinity GIS datasets and figures
3. 3D potential production area datasets and figures
4. 3D Modeling of potential area datasets
5. Updated data for the BRACS Database containing all new well records used in the Project.
6. Copies of water well reports, water quality reports (if available), and geophysical well logs used in the study, unless those reports and logs already exist in the TWDB Groundwater or BRACS databases.

7. Three-dimensional GIS datasets that delineate groundwater salinity zones using ranges of concentrations of total dissolved solids of 0 to 1,000 milligrams per liter (fresh), 1,000 to 3,000 milligrams per liter (slightly saline), 3,000 to 10,000 milligrams per liter (moderately saline), and 10,000 to 35,000 milligrams per liter (very saline).
8. Three-dimensional GIS datasets that delineate potential production areas and the estimated volumes of brackish groundwater production in 30- and 50-year timeframes.
9. A technical report summarizing the study. See Exhibit D for formatting guidelines and Exhibit H for the report outline.
10. All geophysical well logs interpreted for total dissolved solids will be submitted to TWDB and all interpretation data values (input and output) will be documented in table(s) with links to well numbers, log numbers, depths, and names of geological formations in a Microsoft Access database format that can be linked to existing BRACS Database tables. Geophysical well log data obtained for the Project must be non-confidential and submitted in a Tagged Image Format (TIFF) and, if available, Log ASCII Standard (LAS) format. New well control will be added to the BRACS Database with complete attributes. Water quality data will be compatible with the Groundwater Database table design and should include the source of the data.
11. The tools and techniques used for determining the extent and volumes of the required ranges of total dissolved solids in the groundwater shall be thorough, use defensible scientific means and approaches, and shall be documented in the technical report. The technique(s) used to determine if Potential Production Areas is hydrogeologically separated from fresh water aquifers shall be thoroughly documented in the technical report. Each Potential Production Area will be assigned a unique ID, and all production area attributes (ID, volume of brackish groundwater subdivided by salinity classification zones, 30-year and 50-year production calculation estimates) will be recorded in a Microsoft Access database table, in supporting GIS files (top, bottom, and lateral extent), and in groundwater modeling files.
12. The calculated volumes of groundwater within each aquifer and each TWDB-prioritized Potential Production Areas will be organized by salinity classification zone, county, groundwater conservation district, and groundwater management area. All GIS data shall be thoroughly documented with metadata including source, field descriptions, and units (as applicable) and use BRACS program-naming conventions and map Projection parameters. Geologic formation top and bottom raster surfaces, net sand raster maps, salinity classification zone top and bottom raster surfaces, proposed production area top and bottom raster surfaces, well control point files, and Project raster snap grid will be submitted to TWDB. All raster surfaces will share the same map Projection and snap grid attributes. TWDB must be able to replicate the volumes estimated and techniques used to determine the extents of each of the salinity classification zones. All Potential Production Areas modeling files will be submitted to TWDB.

13. Training for TWDB staff will be provided, as needed or requested. Training may include, but not limited to how the volumes were estimated and the techniques used to determine the extents of salinity zones, geophysical log interpretation procedures.
14. All draft and final reports shall be delivered in Microsoft Word and PDF formats. Draft deliverables will be submitted for review and commented by TWDB. These comments must be addressed in the Final Report and a copy of the comments must be incorporated into the final deliverables. Acceptance of the Final Report indicates the successful completion of the Project.

EXHIBIT C

TASK AND EXPENSE BUDGETS

TASK BUDGET

TASK	DESCRIPTION	AMOUNT
1	Project Management and Monitoring	$3,000.00
2	Meetings and Stakeholder Communications	17,000.00
3	Delineation of Groundwater Quality Zones and Volumes	90,000.00
4	Delineation of Potential Production Areas	28,000.00
5	Determine Volume of Potential Production Areas	28,000.00
6	Reports and Deliverables	34,000.00
TOTAL		**$200,000.00**

EXPENSE BUDGET

CATEGORY	AMOUNT
Salaries & Wages[1]	$25,145.00
Fringe[2]	13,151.00
Travel[3]	2,500.00
Other Expenses[4]	175.00
Subcontract Services	120,750.00
Overhead[5]	33,945.00
Profit	4,334.00
TOTAL	**$200,000.00**

[1] Salaries and Wages is defined as the cost of salaries of engineers, draftsmen, stenographers, surveymen, clerks, laborers, etc., for time directly chargeable to this contract.
[2] Fringe is defined as the cost of social security contributions, unemployment, excise, and payroll taxes, workers' compensation insurance, retirement benefits, medical and insurance benefits, sick leave, vacation, and holiday pay applicable thereto.
[3] Travel is limited to the maximum amounts authorized for state employees by the General Appropriations Act, Tex. Leg. Regular Session, 2015, Article IX, Part 5, as amended or superseded
[4] Other Expenses is defined to include expendable supplies, communications, reproduction, postage, and costs of public meetings directly chargeable to this CONTRACT.
[5] Overhead is defined as the costs incurred in maintaining a place of business and performing professional services similar to those specified in this contract.

EXHIBIT D

GUIDELINES FOR AUTHORS SUBMITTING CONTRACT REPORTS TO THE TEXAS WATER DEVELOPMENT BOARD

1.0 Introduction

The purpose of this document is to describe the required format of contract reports submitted to the Texas Water Development Board (TWDB). Our reason for standardizing the format of contract reports is to provide our customers a consistent, and therefore familiar, format for contract reports (which we post online for public access). Another reason for standardizing the format is so that we can more easily turn a contract report into a TWDB numbered report if we so choose. Remember that your report will not only be seen by TWDB staff, but also by any person interested in the results of your study. A professional and high quality report will reflect well on you, your employer, and the TWDB.

Available upon request, we will provide a Microsoft Word template (used to write these instructions) that gives the fonts, spacing, and other specifications for the headings and text of the report. Please follow this template as closely as possible.

2.0 Formatting your report

The TWDB format is designed for simplicity. For example, we use Times New Roman for all text. We use 12 point, single-spaced text, left justification for paragraph text, 18 point bold for first-level headings, and 14 point bold for second-level headings. Page numbers are centered at the bottom of the page. Other than page numbers, please refrain from adding content to the document header or footer. Page setup should use one-inch margins on all four sides.

2.1 Text

The best way to format your document is to use the styles described and embedded in the template document (Authors_Template.dot) that is available on request from the TWDB. To use the Authors_Template.dot file, open it in Word (make sure *.dot is listed under Files of type) and save it as a .doc file. Advanced users can add the .dot file to their computers as a template. Make sure the formatting bar is on the desktop (to open, go to View→Toolbars→Formatting) or, to view all of the formatting at once, go to Format→Styles and Formatting and select Available Styles from the dropdown box at the bottom of the window. The formatting in the template document provides styles (such as font type, spacing, and indents) for each piece of your report. Each style is named to describe what it should be used for (for example, style names include Chapter Title, Body Text, Heading 1, References, and Figure or Table Caption). As you add to your report, use the dropdown list on the Formatting Toolbar or the list in the Styles and Formatting window to adjust the text to the correct style. The Authors_Template.dot file shows and lists the specifications for each style.

2.1.1 Title

Give your report a title that gives the reader an idea of the topic of your report but is not terribly long. In addition to the general subject (for example, “Droughts”), you may include a few additional words to describe a place, methodology, or other detail focused on throughout the paper (for example, “Droughts in the High Plains of Texas” or “Evaluating the effects of drought using groundwater flow modeling”).

Please capitalize only the first letter of each word except 'minor' words such as 'and' and 'of'. Never use all caps.

Use headings to help the reader follow you through the main sections of your report and to make it easier for readers to skim through your report to find sections that might be the most interesting or useful to them. The text of the report should include an executive summary and sections outlined in 4.4 of Attachment 1. Headings for up to five levels of subdivision are provided in the template; however, we suggest not using more than three or four levels of subdivision except where absolutely necessary. Please avoid stacked headings (for example, a Heading 1 followed immediately by a Heading 2), and capitalize only the first letter of headings or words where appropriate—never use all caps.

2.2 Figures and photographs

To publish professional-looking graphics, **we need all originals to be saved at 300 dots-per-inch** (dpi) and in grayscale, if possible, or in the CMYK color format if color is necessary. Excessive use of color, especially color graphics that do not also work in grayscale, will prevent us from publishing your report as a TWDB numbered report (color reproduction costs can be prohibitive). Preferred file formats for your original graphics are Adobe Illustrator (.ai), Photoshop (.psd), EPS with .tiff preview, .jpg, .png, or .tiff files. Refrain from using low resolution .jpg or .gif files. Internet images at 72 dpi are unacceptable for use in reports.
All graphics shall be submitted in two forms:

1. Inserted into the Microsoft Word document before you submit your report. Ideally, inserted graphics should be centered on the page. Format the picture to downsize to 6 inches wide if necessary. Please do not upsize a graphic in Word.
2. Saved in one of the formats listed above.

2.2.1 Other graphics specifications

It is easiest to design your figures separately and add them in after the text of your report is more or less complete. Graphics should remain within the 1-inch page margins of the template (6.5 inches maximum graphic width). Be sure that the graphics (as well as tables) are numbered in the same order that they are mentioned in the text. Figures should appear embedded in the report after being called out in the text. Also, remember to include a caption for each graphic in Word, not as part of the graphic. We are not able to edit or format figure captions that are part of the figure. For figures and photographs, the caption should appear below the graphic. For tables, the caption should appear above.

2.2.2 Creating publication-quality graphics

When designing a graphic, make sure that the graphic (1) emphasizes the important information and does not show unnecessary data, lines, or labels; (2) includes the needed support material for the reader to understand what you are showing; and (3) is readable (see Figures 1 and 2 for examples). Edward R. Tufte's books on presenting information (Tufte, 1983; 1990; 1997) are great references on good graphic design. Figures 1 through 3 are examples of properly formatted, easy to understand graphics. Do not include fonts that are less than 6 points.

For good-looking graphics, the resolution needs to be high enough to provide a clear image at the size you make them within the report. In general, 300 dpi will make a clear image—200 dpi is a minimum. Try to create your figures at the same size they will be in the report, as resizing them in Word greatly

reduces image quality. Photographs taken with at least a two-megapixel camera (if using digital) and with good contrast will make the best images. Save the original, and then adjust color levels and size in a renamed image copy. Print a draft copy of your report to double-check that your figures and photographs have clear lines and show all the features that you want them to have.

Figures and photographs should be in grayscale. Color greatly adds to the cost of printing, so we are trying to keep it to a minimum. Also remember that your report may be photocopied, scanned, or downloaded and printed in black and white. For this reason, you should use symbols or patterns, or make sure that colors print as different shades in black and white. All interval or ratio data (data measuring continuous phenomena, with each color representing an equal interval) need to be displayed in a graded scale of a single color (Figure 3). This way your figures will be useful even as a photocopy.

If you need help with your graphics or have questions, please contact the TWDB graphics department at (512) 936-0129.

2.2.3 Using other people's graphics

Figures and photographs (and tables) need to be your own unless you have written permission from the publisher that allows us to reprint them (we will need a copy of this permission for our records). Avoid using any figures or photographs taken off the Internet or from newspapers or magazines—these sources are difficult to cite, and it is often time-consuming and expensive to gain permission to reproduce them.

2.3 Tables

Tables should be created in Microsoft Word (see Table 1). Tables should include a minimal amount of outlining or bold font to emphasize headings, totals, or other important points. Tables should be numbered separately from figures, and captions should appear above the text of the table.

Table 1: A sample table. Note caption above table.

Table text heading*

Table text	1940	1950	1960	1970	1980	1990	2000	%GW
Table text	15	441	340	926	196	522	83	97.4
Table text	64	944	626	173	356	171	516	99.9
Total	79	1385	966	1099	552	693	599	

* A footnote should look like this using 10 point Times New Roman.
%GW = percent groundwater
Be sure to describe any abbreviations or symbols, and, unlike in this table, be sure to note the units!

3.0 Units

Measurements should be in English units. Metric units may be included in parentheses after the English units.

All units of geologic time should conform to the most recent geologic timescale (Gradstein and others, 2004). A summary of this timescale is available from the International Commission on Stratigraphy's website at http://stratigraphy.org/chus.pdf.

4.0 Citations and references

It is important to give credit where credit is due. Therefore, be sure to use the appropriate citations and include references in your paper.

4.1 In-text citations

Each piece of information you use in your report that comes from an outside source must be cited within the text using the author's last name and the year of publication. If there are two authors, list the last name of each followed by the year, and if there are more than two authors, list the last name of the first author followed by "and others" and the year. For example: the end of the Jurassic Period occurred approximately 145.5 million years ago (Gradstein and others, 2004).

4.2 References

All sources that are cited within the report should be listed at the end of the paper under the heading References. The references should follow the guidelines in "Suggestions to Authors of the Reports of the United States Geological Survey" (Hansen, 1991). These are available online at http://www.nwrc.usgs.gov/lib/lib_sta.html (a link to the chapter "Preparing references for Survey reports," p. 234-241, is found here). Several examples of complete reference citations are listed at the end of these guidelines. Be sure that any citations that appear in tables or figures are included in the reference list. Also, before submitting the report, please check that all the citations in the report are included in the reference list and all references in the reference list are cited in the report. If at all possible, avoid web-based citations. These materials are often transient and therefore useless to future readers.

5.0 Submitting your report

Before you submit your report, proofread it. Look for spelling and grammatical errors. Also, check to see that you have structured the headings, paragraphs, and sentences in your paper so that it is easy to follow and understand (imagine you are a reader who does not already know the information you are presenting!).

6.0 Conclusions

Following the instructions above and providing accurate and readable text, tables, figures, and citations will help to make your report useful to readers. Scientists may read your report, as well as water planners, utility providers, and interested citizens. If your report successfully conveys accurate scientific information and explanations to these readers, we can help to create more informed decisions about the use, development, and management of water in the state.

7.0 Acknowledgments

Be sure to acknowledge the people and entities that assisted you in your study and report. For example: We would like to thank the Keck Geology Consortium, the American Society of Civil Engineers, and the Texas Bar CLE for providing examples to use in developing these guidelines. In addition, we appreciate Mike Parcher for providing information on how to create publication-quality graphics, Shirley Wade for creating the data used in sample Figure 1, and Ian Jones for providing sample Figure 3.

8.0 References

Gradstein, F.M., J.G. Ogg, and A.G. Smith, eds., 2005, A geologic time scale 2004: Cambridge, Cambridge University Press, 610 p.

Hansen, W.R., ed., 1991, Suggestions to authors of the reports of the United States Geological Survey (7th ed.): Washington, D.C., U.S. Government Printing Office, 289 p.

Tufte, E. R., 1983, The visual display of quantitative information: Cheshire, C.T., Graphics Press, 197 p.

Tufte, E. R., 1990, Envisioning information: Cheshire, C.T., Graphics Press, 126 p.

Tufte, E. R., 1997, Visual explanations: Cheshire, C.T., Graphics Press, 156 p.

9.0 Examples of references

Arroyo, J. A., and Mullican, III, W. F., 2004, Desalination: *in* Mace, R. E., Angle, E. S., and Mullican, W. F., III, editors, Aquifers of the Edwards Plateau: Texas Water Development Board Report 360, p. 293-302.

Bates, R. L., and Jackson, J. A., 1984, Dictionary of geological terms: Anchor Press/Doubleday, Garden City, New York, 571 p.

Blandford, T. N., Blazer, D. J., Calhoun, K. C., Dutton, A. R., Naing, T., Reedy, R. C., and Scanlon, B. R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico–Numerical simulations through 2050: contract report by Daniel B. Stephens and Associates, Inc., and the Bureau of Economic Geology, The University of Texas at Austin to the Texas Water Development Board, variably paginated.

Fenneman, N. M., 1931, Physiography of Western United States (1st edition): New York, McGraw-Hill, 534 p.

Hubert, M., 1999, Senate Bill 1–The first big bold step toward meeting Texas's future water needs: Texas Tech Law Review, v. 30, no. 1, p. 53-70.

Kunianski, E. L., 1989, Precipitation, streamflow, and baseflow in West-Central Texas, December 1974 through March 1977: U. S. Geological Survey Water-Resources Investigations Report 89-4208, 2 sheets.

Mace, R. E., Chowdhury, A. H., Anaya, R., and Way, S.-C., 2000, A numerical groundwater flow model of the Upper and Middle Trinity aquifer, Hill Country area: Texas Water Development Board Open File Report 00-02, 62 p.

Maclay, R. W., and Land, L. F., 1988, Simulation of flow in the Edwards aquifer, San Antonio Region, Texas, and refinements of storage and flow concepts: U. S. Geological Survey Water-Supply Paper 2336, 48 p.

For more examples of references, see p. 239-241 of "Suggestions to Authors of the Reports of the United States Geological Survey" at http://www.nwrc.usgs.gov/lib/lib_sta.html.

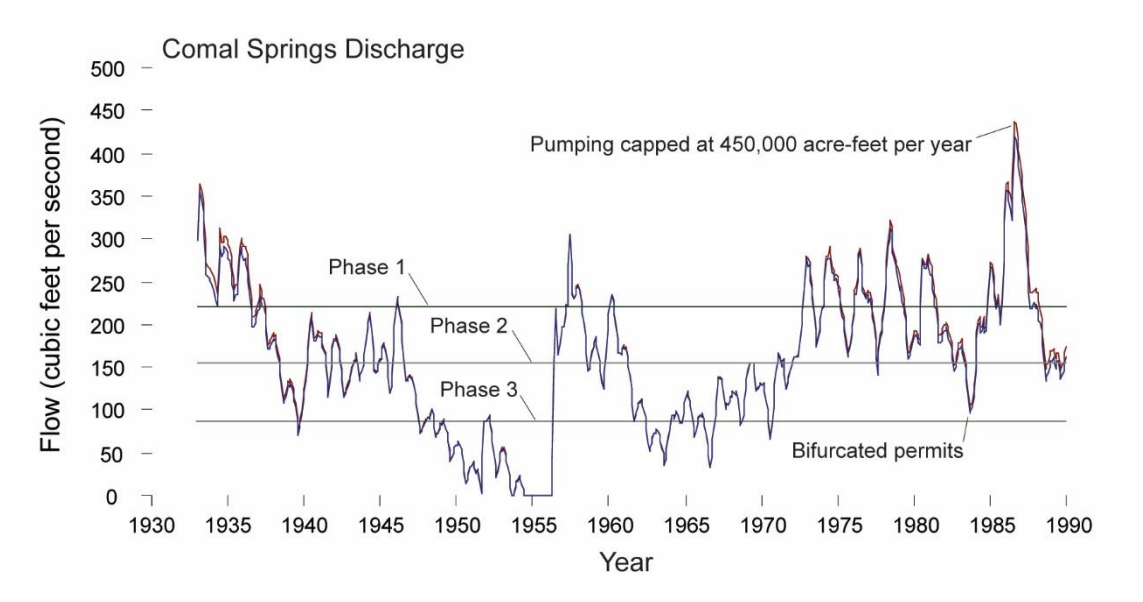

Figure 1. A sample figure showing only the information needed to help the reader understand the data. Font size for figure callouts or labels should never be less than 6 point.

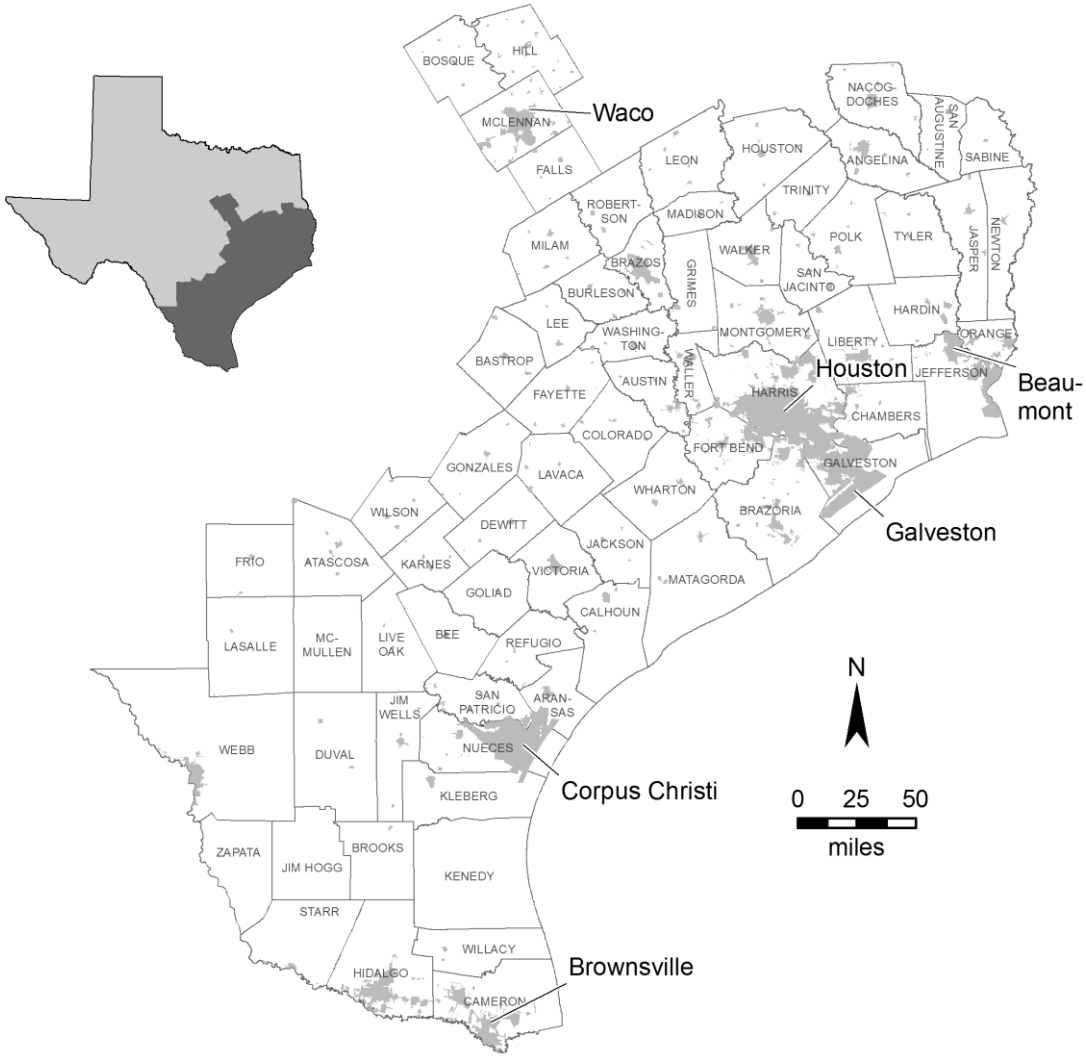

Figure 2. A sample subject area map, giving the reader enough information to understand the location being discussed in this conference. For map figures, be sure to include a north arrow to orient the reader, a scale, and, if needed, a submap that places the figure in greater geographic context. Be sure that text is readable and that any citations listed on the figure or in the figure caption are included in the reference list. Font size should never be less than 6 pt.

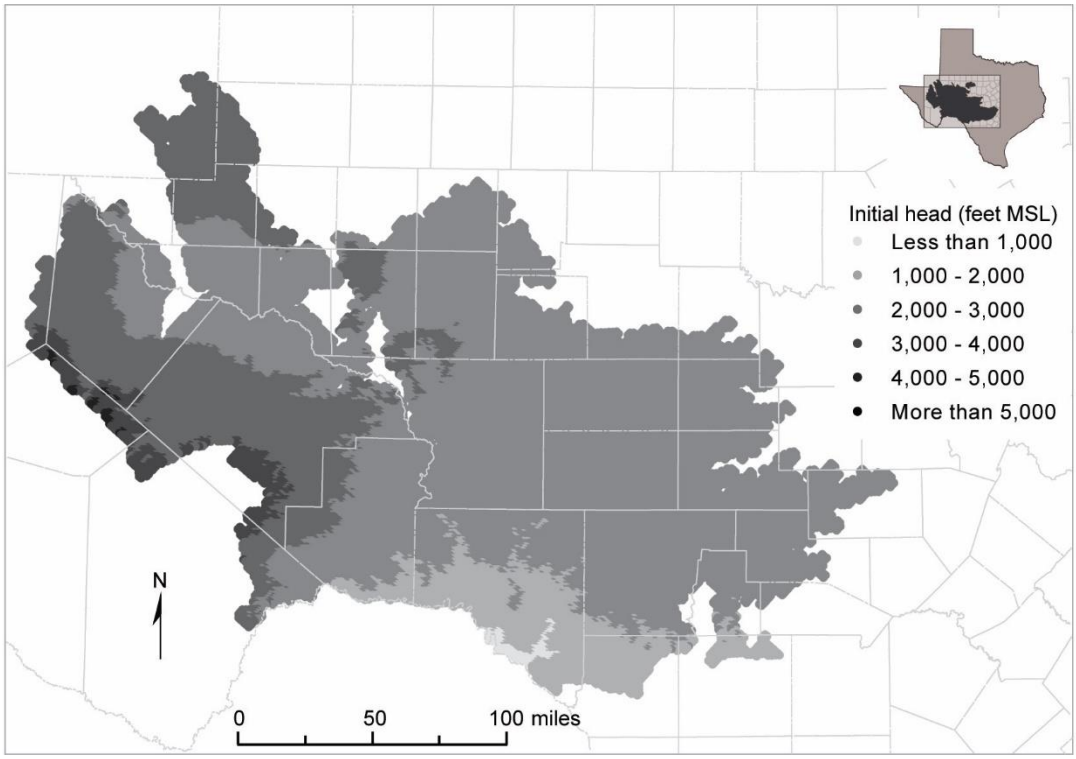

Figure 3. Initial hydraulic heads used in model simulations for layer 1. Note the use of grayscale shading to show differences.

EXHIBIT E

TWDB Guidelines for a Progress Report

Texas Water Development Board Contractors are required by their contracts to provide Progress Reports usually with the submission of an invoice/payment request.

The progress report should contain the following standard elements:

- Date: Date the memo is sent
- To: Name and position of the reader
- From: Name and position of the writer
- Subject: TWDB Contract Number and a clear phrase that focuses the reader's attention on the subject of the memo

Work Completed: *(The next section of a progress report explains what work has been done during the reporting period. Specify the dates of the reporting period and use active voice verbs to give the impression that you or you and your team have been busy) For Example:*

Task 1: Completed 3 draft chapters and all appendices. Met with sub consultants on their chapters.
Task 2: Completed sample collection throughout river reach.
Task 3: No work completed in reporting period.

Problems:
If the reader is likely to be interested in the glitches you have encountered along the way, mention the problems you have encountered and explain how you have solved them. If there are problems you have not yet been able to solve, explain your strategy for solving them and give tell the reader when you think you will have them solved.

EXHIBIT F

HUB SUBCONRACTING PLAN PROGRESS ASSESSMENT REPORT

(Use current form located at:
http://www.window.state.tx.us/procurement/prog/hub/hub-forms/)

EXHIBIT G

Brackish Resources Aquifer Characterization System Program

Contract Data Requirements

Revision Date: October 22, 2015

1. **Well Control**
   a. All data and information provided to TWDB must be non-confidential.
   b. All well attributes shall be added to the BRACS Database.
   c. All well reports, geophysical well logs, and other well information used in a project shall be provided to TWDB.
      i. Digital formats: well reports, PDF; Geophysical well logs, TIFF or LAS (if available).
   d. Data storage folder structure
      i. All well reports and geophysical well logs must be filed using this folder structure.
      ii. Water well and supporting data will be filed in a folder named DrillerWellLogs with subfolders named by state_county codes.
      iii. Geophysical well logs will be filed in a folder named GeophysicalWellLogs with subfolders named by state_county codes.
      iv. State_County code: example 42_029 for Bexar County. TWDB has a Microsoft Excel spreadsheet with the state and county codes.
   e. Digital file names
      i. Q-logs from the Railroad Commission of Texas Groundwater Advisory Unit: Example: Q123_029.tif. If there are multiple logs per well, add log1, log2, … to file name as a suffix. If more than one well is assigned the same Q number, add letters a, b, c, … to Q number, example Q123a_029.tif, Q123b_029.tif.
      ii. All other well control must have the State and County code prefix added to the filename (Example: 42029_123456.pdf.
      iii. The digital file name, file type, and folder name will be recorded in the BRACS Database table tblGeophysicalLog_Header or tblBracsWaterWellReports.

2. **BRACS Database**
   a. All new well control will be added to a copy of the BRACS Database.
   b. New data tied to existing well control in the BRACS Database, such as geology records (lithology; stratigraphic picks; salinity zones) will have applicable tables updated.
   c. Use Brackish Resources Aquifer Characterization System Database Data Dictionary (TWDB Open File Report 12-02, Second Edition, September 2014) to understand table relationships, field names, and data types.

d. New well control provided by a contractor will begin with a specified well _id. Coordinate with TWDB BRACS staff for this starting well_id number. As a contractor appends new well control to their copy of the BRACS Database, TWDB staff will continue to update the official BRACS Database. When the project is complete, TWDB staff will take all new project well control records and append them to the official BRACS Database.

3. GIS files

a. All GIS files will be compatible with ESRI ArcGIS version 10.2.

b. Map projection.

Texas State Mapping System, Albers Equal Area. The ESRI projection parameters are:

- Projection: Albers
- False_Easting: 4921250.0
- False_Northing: 19685000.0
- Central_Meridian: -100.0
- Standard_Parallel_1: 27.5
- Standard_Parallel_2: 35.0
- Latitude_Of_Origin: 31.25
- Linear Unit: Foot_US (0.3048006096012192)

Geographic Coordinate System: GCS_North_American_1983

- Angular Unit: Degree (0.0174532925199433)
- Prime Meridian: Greenwich (0.0)
- Datum: D_North_American_1983
- Spheroid: GRS_1980
- Semimajor Axis: 6378137.0
- Semiminor Axis: 6356752.314140356
- Inverse Flattening: 298.257222101

c. A project snap grid raster will be developed for each project using the Texas State Mapping System, Albers Equal Area projection. Each GIS raster file developed for a project will be snapped to this grid to ensure every grid cell in all rasters stack on top of each other without any offset. TWDB staff will create a snap grid slightly larger than the project area with a random integer cell value.

d. Standard GIS file naming conventions are essential. Refer to TWDB Report 383 for examples and table tblGisFile_NamingConventions in the BRACS Database for a broad range of codes. Contractor will provide TWDB with a list of new codes developed by the Contractor.

e. All GIS files will be summarized in an appendix in the technical report listing file names, type, and folder structure (see TWDB Report 383 for examples).

f. All GIS files will have descriptive metadata documenting the content, data structure, source(s), date(s), quality and other pertinent characteristics of the data using the Federal Geographic Data Committee (FGDC) metadata editor within ESRI's ArcCatalog.

g. All GIS file creation techniques will be described either in the technical report appendix for GIS files or in the section on a particular topic, such as net sand.

h. All well point files will contain field(s) with well identification numbers, such as the BRACS Database well_id, Groundwater Database state_well_number, Submitted Driller's Report track_number, API_number, or TCEQ Public Water Supply water_source code.

i. All GIS files (and subsequent map figures or tables) depicting groundwater salinity will use the color scheme shown in list item 5.

j. The TWDB Groundwater Availability Modeling (GAM) county shapefile will be used for mapping.

k. The TWDB 30 meter Digital Elevation Model (DEM) will be used for all elevations of well points and geologic formation surfaces. Should a better quality DEM become available for a project area, consult with TWDB staff and, if approved, provide the DEM to TWDB as a deliverable.

4. Groundwater salinity classification

a. Contractor will use the classification by Winslow, A.G., and Kister, L.R., 1956, Saline-Water Resources of Texas, U. S. Geological Survey Water Supply Paper 1365, 105 p.

Groundwater salinity classification	Salinity zone code	Total dissolved solids concentration (units: milligrams per liter)
Fresh	FR	0 to 1,000
Slightly saline	SS	1,000 to 3,000
Moderately saline	MS	3,000 to 10,000
Very saline	VS	10,000 to 35,000
Brine	BR	Greater than 35,000

b. The salinity zone code will be used for GIS file naming.

c. Technical report figures showing salinity zones or well control showing total dissolved solids concentration will use these colors.

d. Slightly and moderately saline (total dissolved solids concentration 1,000 to 10,000 milligrams per liter) groundwater is considered as brackish groundwater..

5. **Water quality data**
   a. All water quality data that is not in the TWDB Groundwater Database will be provided to TWDB as a deliverable. Paper documents will be scanned in PDF format and filed in the appropriate state and county folder in the DrillerWellLogs folder. Water quality well control will be added to the BRACS Database, and a digital file name for the PDF well documents will be added to the table tblBracsWaterWellReports.
   b. Water quality data will be evaluated to ensure that samples are accurately assigned to the correct aquifer and/or geologic formation using a systematic and reproducible technique.
   c. Water quality data, if not in the TWDB Groundwater Database, will be appended to tables tblBRACSWaterQuality and tlbBRACSInfrequentConstituents in the BRACS Database.

6. **Geophysical well log data**
   a. All new geophysical well log data used for a project will be provided to TWDB as a deliverable. Paper documents will be scanned in TIFF format and filed in the appropriate state_county code folder in the GeophysicalWellLogs folder. Well control will be added to the BRACS Database, the digital file name and additional attributes will be added to the table tblGeophysicalLog_Header, and log tools will be added to the table tblGeophysicalLog_Suite.

7. **Methodology for interpreting total dissolved solids from geophysical well logs**
   a. The methods (computational, empirical) used to interpret total dissolved solids concentrations from geophysical well logs will be fully documented in the technical report. All well records, input and output values, correction factors, and assumptions will be recorded in the BRACS Database. Links to water quality samples for specific depth zones within an aquifer will be provided with the geophysical well log record. If a new technique (or modification of an existing technique) is used, tables will be designed to link to the existing BRACS Database design to store the above mentioned parameters. Contractor will provide a data dictionary description for the new table design. All geophysical well logs, if not in the BRACS Database, will be provided to TWDB.
   b. A number of geophysical well log interpretation techniques are described in:

      Estepp, J.D., 1998, Evaluation of ground-water quality using geophysical logs: Texas Natural Resource Conservation Commission, unpublished report, 516 p.

8. Geologic formation lithology and stratigraphy

a. Geologic formation lithology and stratigraphic top/bottom depth values will be appended to the table tblWell_Geology.

b. Geologic formation lithology from driller well reports is converted to a simplified lithology using the BRACS Database table tblLkLithologicName_to_SimplifiedLithologicName. This table is updated as new terms are encountered.

c. Interpretation of sand/clay from geophysical well logs will use a four-tier classification system consisting of the following terms and sand percentages

   i. sand (100 percent sand)
   ii. sand with clay (65 percent sand)
   iii. clay with sand (35 percent sand)
   iv. clay (0 percent sand)

9. Well identification names and numbers

a. New well control added to the BRACS Database will have all well identification names or numbers added to the BRACS Database table tblBRACS_ForeignKey.

b. The BRACS Database table tblLkFK_ID_Name is a list of types of foreign keys. This table is updated as new sources of data are encountered. Consult with TWDB staff if this table needs updating during a project.

c. Wells used in a project cross section will have a record added to the BRACS Database table tblBRACS_ForeignKey.

10. Well locations

a. Latitude and longitude in decimal degree format will be used for each well.

b. NAD 83 horizontal datum will be used for each well.

c. Elevations using 30 meter DEM will be used.

d. Location attributes will be recorded in the BRACS Database table tblWell_Location.

11. Technical report

a. Use Times New Roman 12 point font.

b. Use one-inch margins.

c. Technical report will use the "Formatting Guidelines for Texas Water Development Board Reports" by Mace and others, 2007 http://www.twdb.texas.gov/about/contract_admin/index.asp

d. No abbreviations will be used in the report except BRACS, GIS, or TWDB. These abbreviations will be spelled out at first use.

e. Use proper grammar and spelling.

f. References must be listed in a separate section of the report and proper citations made within the text.

g. All GIS files used for figures will be provided as a deliverable.
h. The TWDB contract number will appear on the cover page.

EXHIBIT H

Brackish Resources Aquifer Characterization System Program

Outline for Report

Revision Date: January 13, 2016

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6. Groundwater salinity zones
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   - 6.2. Moderately saline zones
   - 6.3. Very saline zones
   - 6.4. Brine zones
7. Previous investigations
8. Data collection and analysis
9. Aquifer hydraulic properties
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11. Net sand analysis
12. Groundwater volume methodology
13. Geophysical well log analysis and methodology
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    - 14.1. Pumping analysis and results for 30-and 50-year periods
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    - 19.2. GIS file name codes

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EXHIBIT I

Original Request for Qualifications

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Texas Water Development Board

REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008

FOR

SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

Class-Item Code(s): 918/55, 926/52

RESPONSES DUE:

NOVEMBER 25, 2015 12:00 PM

PLEASE NOTE:

This Request for Qualifications No. 580-16-RFQ0008 is revised and supersedes Request for Qualification No. 580-16-RFQ0007 and any other documents.

Texas Water Development Board
P.O. Box 13231
Austin, TX 78711-3231
Contact: Tina Newstrom
Phone: 512-463-7825
Email: contracts@twdb.texas.gov

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ATTACHMENT A **1**

EXECUTION OF RESPONSE 1

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SECTION 3 – COMPANY REFERENCES ERROR! BOOKMARK NOT DEFINED.

SECTION 4 – RESUMES OF INDIVIDUALSERROR! BOOKMARK NOT DEFINED.

SECTION 5 **5**

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SECTION 6 **6**

SECTION I - OVERVIEW

1.1 OVERVIEW

The Texas Water Development Board (TWDB) request responses to this Request for Qualifications (RFQ) for the award of Services Contract(s) to conduct studies on six (6) Brackish Aquifers in Texas (hereafter referred to as "Project"). This RFQ is part of a requirement of House Bill 30, 84th Texas Legislative Session, for the TWDB to identify and designate brackish groundwater production zones in the aquifers of the state.

NOTE: Separate Statement of Qualifications (SOQ) is required to be submitted for each of the six (6) Projects as identified in Section II.

1.2 CONTRACT TERM

Service for each Project shall begin upon execution of the Contract. The completion date for three (3) of the Projects shall be August 31, 2016; and the remaining three (3) Projects shall be completed by August 31, 2017. Contract extensions for the studies will NOT be granted. The completion dates are identified in each Project.

NOTE: TWDB reserves the right to award each Project separately.

1.3 COMPENSATION

To be negotiated once the TWDB selects respondent(s) based on qualifications. Failure to arrive at mutually agreeable terms of a contract with the most qualified respondent shall constitute a rejection of the TWDB's offer and may result in subsequent negotiations with the next most qualified respondent. The TWDB reserves the right to reject any or all responses.

1.4 BACKGROUND

Planners and decision makers need reliable estimates of available fresh, brackish, and saline groundwater to better formulate water management strategies. Currently, the basis for determining the amount of brackish groundwater in Texas is decades-old data generated during a 2003 TWDB-funded study (LBG-Guyton, 2003, contract number 2001483395). The study helped lay the foundation for estimating brackish groundwater volumes in the state and documented that brackish groundwater is a tremendous asset in the state's water portfolio. However, the study was by design regional in scope, limited in areal extent, and narrow in its assessment of groundwater quality.

In 2009, the 81st Texas Legislature approved funding to establish the Brackish Resources Aquifer Characterization System (BRACS) program. The goal of the program is to map and characterize the brackish portions of the aquifers in Texas in sufficient detail to provide useful information and data to regional water planning groups and other entities interested in using brackish groundwater for desalination supplies. Since 2009, TWDB has completed three studies: the Pecos Valley Aquifer in West Texas (TWDB Report 382), Gulf Coast Aquifer in a four-county area in the Lower Rio Grande Valley (TWDB Report 383), and the Queen City and Sparta aquifers in part of a two-county area in south-central Texas (TWDB Technical Note 14-1). The TWDB also has two ongoing studies: the Carrizo-Wilcox Aquifer in a nine-county area in south-

central Texas scheduled for completion in spring 2016 and the Lipan Aquifer in a six-county area in West Texas scheduled for completion in summer 2016.

In 2015, the 84th Texas Legislature passed House Bill 30, directing the TWDB to conduct studies on and report to the legislature on a) four aquifers by December 1, 2016 and b) remaining aquifers in the state by December 1, 2022. This RFQ is for the Projects that require the TWDB to submit a report to the Texas Legislature by December 1, 2016, as well as additional studies. The Projects will also support implementation of House Bill 1232, (84th Texas Legislative Session), which requires mapping of confined and unconfined aquifers in the state by the TWDB.

SECTION II – STATEMENT OF WORK

2.1 DESCRIPTION OF SERVICES

The selected Contractor(s) will provide services, which shall include, but are not limited to, the requirements contained in this RFQ. Services set forth that contain the words "must" or "shall" are mandatory and must be provided as specified with no alterations, modifications or exceptions. Services set forth that contain the words "may" or "can" allow Respondents to offer alternatives to the manner in which the Services are provided. The selected Contractor(s) will provide assistance to the TWDB for activities described below for one or more of the Projects stated within this RFQ.

2.2 SCOPE OF WORK

General Requirements and Resource(s) for all six (6) Projects

To fulfill part of the requirements of House Bill 30, 84th Texas Legislature, 2015, the TWDB is requesting the Contractor to perform the following:

A. Delineate fresh, brackish, and saline groundwater both vertically and horizontally in the aquifers of the Project areas listed under The Projects.

B. Use the groundwater salinity classification developed by the U.S. Geological Survey (Winslow and Kister, 1956) to categorize the water delineated. The classification is based on the concentration of total dissolved solids (milligrams per liter) in water and includes the following: fresh (0 to 1,000); slightly saline (1,000 to 3,000); moderately saline (3,000 to 10,000); and very saline (10,000 to 35,000).

C. Quantify the volume of available fresh, brackish, and saline groundwater.

D. Delineate potential production areas that are separated by hydrogeologic barriers sufficient to prevent significant impacts to water availability or water quality in any part of the same or other fresh water aquifers. These potential production areas cannot include (a) an aquifer with an average total dissolved solids concentration of more than 1,000 milligrams per liter and which is serving as a significant source of water supply for municipal, domestic, or agricultural purposes, (b) a part of a geologic stratum that is designated or used for wastewater injection through the use of injection or disposal wells permitted under Texas Water Code Chapter 27, and/or (c) areas within the Harris-Galveston Subsidence District and the Fort Bend Subsidence District.

E. Meet with TWDB staff to discuss Contractor recommendations of potential production areas and develop a prioritized list of these areas for item 2.2G.

F. Meet with stakeholders to (1) explain TWDB's approach in implementing House Bill 30, (2) solicit feedback on what constitutes "significant impact", and (3) receive general comments concerning implementation of the legislation. *NOTE: Contractor(s) will not be making recommendations to the TWDB to designate brackish groundwater production zones; only the TWDB Executive Administrator will make these recommendations.*

G. Determine the volume of brackish groundwater that the potential production areas are capable of producing over a 30-year and a 50-year period without causing significant impact to water quality and quantity as described in item 2.2D.

H. **Resources**: The BRACS Database was developed to store and analyze well data for the completed BRACS studies. TWDB Open-File Report 12-02, Second Edition is a data dictionary for the BRACS Database. It describes the data objects or items in the database for the benefit of the user. In addition, previous and ongoing studies of the Groundwater Availability Modeling program have direct applicability to BRACS studies.

I. **Project Monitoring:** *At a minimum*, TWDB expects to meet with the Project Team (Contractor Meeting) four (4) times during the Project and conduct at least two (2) stakeholder meetings.

J. **Contractor Meetings shall include but not limited to:**
1) Project initiation; the beginning of the Project.
2) Discussion and approval of Project methodology; date to be determined by the Contractor.
3) Discussion of potential production areas and prioritization for production calculations; date to be determined by the Contractor.
4) Project completion; the end of the Project.

K. Additional technical meetings may be scheduled either in person, through a webinar, or teleconference venue to discuss Project progress and issues. TWDB staff may periodically visit the Contractor's work premises to assess progress on the Project.

L. Detailed monthly progress reports must be submitted to the TWDB outlining progress of the Project and include the original or adjusted schedule and detail how the Project is progressing relative to this yardstick. Project invoices cannot be processed without detailed descriptions of the progress made by tasks. Each of the Project tasks must be described in detail consistent with the budget description. The TWDB expects issues to be reported to the TWDB Project Manager immediately as they appear. Maintaining close coordination with TWDB throughout the Project will be critical.

M. A draft report documenting the technique(s) and approaches selected by the Contractor for geophysical well log interpretation of aquifer total dissolved solids concentration shall

be given to TWDB for review at a date determined by the Contractor. The report shall include information on the types of geophysical well logs available in the Project area, how the interpreted total dissolved solids concentration from geophysical well log analysis relates to existing aquifer water chemistry as determined by direct measurements (including specific examples), how the log correction factors are determined, and how the interpretation techniques will be applied across the entire salinity range within the aquifer. TWDB will have up to 10 business days to review the draft report, and the Contractor will schedule a meeting to discuss the techniques.

N. A meeting to discuss the potential production areas, at a date determined by the Contractor, shall be made prior to the end of the Project. Potential production areas will be prioritized for 30-year and 50-year pumping estimate task with input from stakeholders.

O. A formal presentation on the results of the Project shall be made to TWDB at the end of each Project.

P. **Stakeholder Meetings include but not limited to the following:**
1) For each Project, formal stakeholder meetings shall be scheduled and held.
2) The first general meeting was held October 26, 2015 from 10:00 am – 12:00pm in room 170 of the Stephen F. Austin Building in Austin, Texas. The general meeting was to explain TWDB's approach in implementing House Bill 30; solicit feedback on what constitutes "significant impact", and; receive general comments concerning implementation of the legislation.
3) The second meeting will be held at the end of the Project in the study area to provide information on the results of the Project and to solicit input on the potential production areas.

Q. TWDB will organize the meetings and invite stakeholders including at a minimum all the groundwater conservation districts within the Project area. The contractor will attend and make a presentation at the second stakeholder meeting.

R. Any meetings and/or conference calls will be held on regular business days (M - F) during regular business hours (8:00 am – 5:00 pm CT) upon agreed dates and times.

2.3 BRACKISH AQUIFERS

Project No. 1
Project Name: Gulf Coast Aquifer
Project Area: Gulf Coast Aquifer and adjacent strata (Catahoula Formation) that extend from the Texas-Louisiana border to the southern county lines of Brooks, Jim Hogg, and Kenedy counties and from the outcrop areas of these aquifers to the Gulf of Mexico.
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources:

"Hydrogeochemical evaluation of the Texas Gulf Coast Aquifer system and implications for developing groundwater availability models" (Young and others, 2014, TWDB contract 1148301233),
"Updating the hydrogeologic framework for the northern portion of the Gulf Coast Aquifer" (Young and others, 2012, TWDB contract 1004831113),
"Hydrostratigraphy of the Gulf Coast Aquifer from the Brazos River to the Rio Grande" (Young and others, 2010 TWDB contract 0804830795),
"Groundwater resource evaluation and availability model of the Gulf Coast Aquifer in the Lower Rio Grande Valley of Texas" (Chowdhury and Mace, 2007, TWDB Report 368),
"Groundwater availability model of the central Gulf Coast Aquifer system: numerical simulations through 1999" (Chowdhury and others, 2004),
"Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer system, Texas, 1891-2009" (Kasmarek, 2013, U.S. Geological Survey Scientific Investigations Report 2012-5154),
An alternative model "Groundwater management area 16 groundwater flow model" (Hutchison and others, 2011) was prepared for the Gulf Coast Aquifer.

TWDB is working on a groundwater model for the Gulf Coast Aquifer in groundwater management areas 15 and 16 scheduled for completion in December 2016.

Project No. 2
Project Name: Blaine Aquifer
Project Area: Blaine Aquifer, extent defined by the TWDB
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources: "Groundwater availability model for the Seymour Aquifer" (Ewing and others, 2004, TWDB contract) that includes Permian formations in layer 2.

Project No. 3
Project Name: Rustler Aquifer
Project Area: Rustler Aquifer, extent defined by the TWDB
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources: "Groundwater availability model report for the Rustler Aquifer" (Ewing and others, 2012 TWDB contract 0904831000)

Project No. 4
Project Name: Trinity Aquifer
Project Area: The northern and southern extent of Trinity Aquifer defined by the TWDB downdip until the total dissolved solids concentration in the aquifer transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources:
"Updated groundwater availability model of the northern Trinity and Woodbine Aquifers" (Kelley and others, 2014),

"Groundwater availability model for the Hill Country portion of the Trinity Aquifer System, Texas" (Jones and others, 2009), and
"Northern Trinity/Woodbine aquifer groundwater availability model" (R.W. Harden and Associates and others, 2004, TWDB contract 2003483483)

Project No. 5
Project Name: Blossom Aquifer
Project Area: Blossom Aquifer extent defined by the TWDB downdip until the groundwater total dissolved solids concentration transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources: TWDB Report 307

Project No. 6
Project Name: Nacatoch Aquifer
Project Area: Nacatoch Aquifer extent defined by the TWDB downdip until the groundwater total dissolved solids concentration transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources: "Nacatoch Aquifer groundwater availability model" (Beach and others, 2009, TWDB contract 0604830588).

2.4 RESPONSE REQUIREMENTS FOP EVALUATION

Respondents to this RFQ are required to indicate in Section 4.1.B(7)(d) of their response their abilities in the areas listed below (A-L). Please include years of experience, educational degrees and any professional certifications.

A. General hydrogeology;
B. Hydrogeology of the Project aquifer;
C. Interpreting and using geophysical well logs, as applicable to the Project;
D. Using data from TWDB Groundwater Availability Modeling Projects and other TWDB-contracted studies in the Project area;
E. Groundwater modeling in order to evaluate potential production areas;
F. Geographic Information System (GIS) files, use, and metadata documentation;
G. Communicating with the public;
H. Technology transfer;
I. Producing high-quality technical reports;
J. Using the TWDB BRACS and Groundwater databases;
K. Contract management including the ability to meet short and strict deadlines within budget; and
L. Demonstrate their ability to meet Project completion deadlines since there will be no contract extensions.

SECTION III – DELIVERABLES

3.1 CONTRACT DELIVERABLES

The Contractor shall deliver the following items to the TWDB on the date determined by each Project:

A. Updated data for the BRACS Database containing all new well records used in the Project.

B. Copies of water well reports, water quality reports, and geophysical well logs used in the study (unless those reports and logs already exist in the TWDB Groundwater or BRACS databases).

C. Three-dimensional GIS datasets that delineate groundwater salinity zones using ranges of concentrations of total dissolved solids of 0 to 1,000 milligrams per liter (fresh), 1,000 to 3,000 milligrams per liter (slightly saline), 3,000 to 10,000 milligrams per liter (moderately saline), and 10,000 to 35,000 milligrams per liter (very saline).

D. Three-dimensional GIS datasets that delineate potential production areas and the estimated volumes of brackish groundwater production in 30- and 50-year timeframes.

E. A technical report summarizing the study.

F. All geophysical well logs interpreted for total dissolved solids will be submitted to TWDB and all interpretation data values (input and output) will be documented in table(s) with links to well numbers, log numbers, depths, and names of geological formations in a Microsoft Access database format that can be linked to existing BRACS Database tables. Geophysical well log data obtained for the Project must be non-confidential and submitted in a Tagged Image Format (TIFF) and, if available, Log ASCII Standard (LAS) format. New well control will be added to the BRACS Database with complete attributes. Water quality data will be compatible with the Groundwater Database table design and should include the source of the data.

G. To develop new and updated maps of the water resources, the Project should use current information from a variety of non-proprietary databases and geophysical log repositories that are publicly available.

H. The tools and techniques used for determining the extent and volumes of the required ranges of total dissolved solids in the groundwater shall be thorough, use defensible scientific means and approaches, and shall be documented in the technical report. The technique(s) used to determine if a potential production area is hydrogeologically separated from fresh water aquifers shall be thoroughly documented in the technical report. Each potential production area will be assigned a unique ID, and all production area attributes (ID, volume of brackish groundwater subdivided by salinity classification zones, 30-year and 50-year production calculation estimates) will be recorded in a

Microsoft Access database table, in supporting GIS files (top, bottom, and lateral extent), and in groundwater modeling files.

I. The calculated volumes of groundwater within each aquifer and each TWDB-prioritized potential production area will be organized by salinity classification zone, county, groundwater conservation district, and groundwater management area. All GIS data shall be thoroughly documented with metadata including source, field descriptions, and units (as applicable) and use BRACS program-naming conventions and map Projection parameters. Geologic formation top and bottom raster surfaces, net sand raster maps, salinity classification zone top and bottom raster surfaces, proposed production area top and bottom raster surfaces, well control point files, and Project raster snap grid will be submitted to TWDB. All raster surfaces will share the same map Projection and snap grid attributes. TWDB must be able to replicate the volumes estimated and techniques used to determine the extents of each of the salinity classification zones. All potential production area modeling files will be submitted to TWDB.

J. Training for TWDB staff shall be provided, as needed or requested. Training may include, but not limited to how the volumes were estimated and the techniques used to determine the extents of salinity zones.

K. All draft and final reports shall be delivered in Microsoft Word and PDF formats. Draft deliverables will be submitted for review and comment by TWDB. These comments must be addressed in the Final Report and a copy of the comments must be incorporated into the final deliverables. Acceptance of the Final Report indicates the successful completion of the Project.

L. The BRACS program contract data requirements are available on the TWDB website at http://www.twdb.texas.gov/innovativewater/bracs/projects.asp and include information on GIS data and map Projection standards, BRACS Database standards, well report and geophysical well log file naming and organization standards, and other useful information.

SECTION IV – GENERAL INFORMATION

4.1 SOQ REQUIREMENTS

A. **SUBMISSIONS**: The Respondent shall submit one (1) original and six (6) double-sided, single-spaced copies of their SOQ on and one electronic copy for *each Project*; please indicate the Project No. on each response as listed in Section 2.3. You can submit a response for all or one of the Projects. However, a separate response is required for each Project and MUST indicate the Project No.:

1) ORIGINAL: One (1) complete ORIGINAL response (marked Original) which shall include a copy of the RFQ solicitation document along with the SOQ contents listed in paragraph B, below for each Project. The SOQ pages should be numbered and contain an organized, paginated table of contents corresponding to the section and pages of the response.

2) ELECTRONIC: One Portable Document Format files of the submission on a CD/DVD or USB drive.
3) Response may be tab indexed.
4) Responses must be delivered to the address noted in the RFQ.
5) Responses must be clearly marked **RESPONSE TO RFQ 580-16-RFQ0008**.
6) Responses must be complete and comprehensive.

B. **CONTENTS**: The Respondent shall submit all information listed below, in the order given, separated by labeled and tabbed sheets, as the response to this RFQ. The SOQ will only be considered if all items are submitted as required. Incomplete/late responses to this RFQ will not be considered. NOTE: Since there are six (6) Projects, a separate response for each Project is required and the Project No. MUST be indicated. ***You may make copies of any attachments and/or forms in the RFQ for submission purpose ONLY.***

1) Section 1: Signed/dated Execution of Response to the Request for Qualifications (ATTACHMENT A)
2) Section 2: Company Profile Summary and History, two (2) pages maximum. Response should include the following:
   a. Legal company name, address, phone number, and legal status (corporation, partnership, joint venture, sole proprietorship)
   b. Legal name of each participant/potential user(s), their possible involvement with the Project, their phone number, and email address. Also include the contact person(s) information should questions come up regarding the response.
   c. Name, title, phone number and email address of person submitting the response with the authority to bind the company.
   d. Describe the general nature of previous work, the number of years in business, size and scope of operation.
3) Section 3: Company References - Provide references from a minimum of three (3) customers to whom the Respondent has provided services in the past 36 months similar to the scope of work described in this specification.
4) Section 4: Resumes of Individuals - Submit qualifications and experience of Project staff that will be directly involved, at any level, with this Project. ***PLEASE NOTE: Resumes do not count towards the two page maximum listed in Section 2.***
5) Section 5: Historically Underutilized Businesses Subcontracting Plan and applicable forms.
6) Section 6: Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity submitting the RFQ (if applicable).
7) Section 7: Scope of Work - A detailed Scope of Work (SOW) describing the following:
   a. Each task, a percent of effort per each task, a proposed time schedule for each task, and the amount of time each team member will spend on the Project. This SOW shall not exceed 20 pages, using Times New Roman 12 font.

b. A description of project-monitoring procedures; In addition, the contractor should demonstrate they are able to meet project completion deadlines since there will be no contract extensions.
c. A description of the project deliverables (reports, plans, or other products that the Board will receive;
d. Indicate abilities as listed in Section 2.4(A-L).

4.2 RESPONSE COSTS

Respondents are responsible for all costs in the preparation and delivery of their response to this RFQ to TWDB.

4.3 TRAVEL EXPENSES

This contract may include travel throughout the State of Texas to perform the tasks therein. Any and all travel expenses shall be in accordance with the state travel and per diem allowances detailed at https://fmx.cpa.state.tx.us/fmx/travel/index.php.

4.4 MEETINGS

Any meetings and/or conference calls will be held on regular business days (M - F) during regular business hours (8:00 am – 5:00 pm CT) upon agreed dates and times.

4.5 SCHEDULE OF EVENTS:

The solicitation process for this RFQ will proceed according to the following schedule:

EVENT	DATE (Central Time)
Issue Request for Qualifications	Tuesday, November 10, 2015
Deadline for Submission of SOW	Wednesday, November 25, 2015 12:00 pm
Expected Date of Award of Contract	January, 2016
Expected Contract Start Date	January, 2016

4.6 REVISIONS TO SCHEDULE

TWDB reserves the right to change the dates in the Schedule of Events above upon written notification to prospective Respondent(s) as an addendum posted on the Electronic State Business Daily.

4.7 INQUIRIES

A. All inquiries shall be submitted in writing to the attention of TWDB Contract Administration Staff via e-mail to contracts@twdb.texas.gov.

B. Except as otherwise provided in this Section, upon issuance of this RFQ, other employees and representatives of TWDB will not answer questions or otherwise discuss the contents of this RFQ with any potential Respondent or its representatives. Failure to observe this restriction may result in disqualification of any subsequent RFQ. This restriction does not preclude discussions unrelated to this RFQ.

4.8 RESPONSE SUBMISSION

A. All responses must be received and date stamped by TWDB by the deadline listed in the Schedule of Events above. TWDB will NOT accept late submittals.

B. Responses should be placed in a separate envelope or package and correctly identified with the RFQ number and submittal deadline/RFQ opening date and time. It is Respondent's responsibility to appropriately mark and deliver this response to TWDB by the specified date.

C. Telephone, facsimile or emailed responses will not be accepted.

D. Receipt of all addenda, if applicable, to this response should be acknowledged by returning a signed copy of each addendum with the submitted response**.**

NOTE: Failure to return the required items with the response will result in rejection of your Response. TWDB will not be responsible for locating or securing information that is not included in your Response.

4.9 DELIVERY OF SUBMISSION

Responses may be submitted to TWDB by one of the following methods:

U.S. Postal Service
Texas Water Development Board
Contracting & Purchasing
P.O. Box 13231
Austin, TX 78711-3231

Overnight/Express Mail or Hand Delivery
Texas Water Development Board
1700 North Congress Avenue, 6th Floor
Austin, TX 78701
Hours: 8:00 am to 5:00 pm (CT)

4.10 OPENING

Responses will be opened at 1700 North Congress Avenue, 6th Floor, Austin, TX, at the submittal deadline. Only Respondent's names will be read.

All submitted response's become the property of TWDB after the submittal deadline/opening date. Responses submitted shall constitute an offer for a period of ninety (90) days or until selection is made by TWDB, whichever occurs first.

4.11 EVALUATION AND AWARD

A. TWDB shall award a Contract to the vendor whose response is most qualified to perform the Statement of Work for the State of Texas.

B. A committee will be established by TWDB (including TWDB employees) to evaluate the responses.

C. The evaluation applies to ***each*** Project, which will be evaluated separately. ***TWDB reserves the right to award each Project separately***.

The evaluation committee will determine best value by applying the following criteria:

Points Available	Evaluation Criteria
0 – 70	Qualifications and Experience
0 – 90	Technical Approach
0 – 40	Project Organization and Management
0 – 30	Reports and Deliverables
0 – 20	Feasible Approach
250	**Total Points Possible**

D. TWDB may, at its discretion, elect to have Respondents provide oral presentations and respond to inquiries from the evaluation committee related to their SOQ.

E. Past Performance: A Respondent's past performance will be measured based upon pass/fail criteria, in compliance with applicable provisions of §2155.074, 2155.075, 2156.007, 2157.003, and 2157.125, Gov't Code. Respondents may fail this selection criterion for any of the following conditions:

1) A score of less than 90% in the Vendor Performance System;
2) Currently under a Corrective Action Plan through the CPA;
3) Having repeated negative Vendor Performance Reports for the same reason; or
4) Having purchase orders that have been cancelled in the previous 12 months for non-performance (i.e. late delivery, etc.).

Contractor performance information is located on the CPA web site at: http://comptroller.texas.gov/procurement/prog/vendor_performance/

SECTION V – GENERAL TERMS AND CONDITIONS

5.1 GENERAL TERMS

Any Contract awarded as a result of this RFQ will contain the general terms and conditions provided in this document. Subcontractors must also comply. In addition, any Contract awarded as a result of this RFQ shall be governed, construed, and interpreted under the laws of the State of Texas. The factors listed in Texas Government Code, Title 10, Subtitle D, Section 2155.074, 2155.144, 2156.007, and 2157.003 shall also be considered in making an award when specified. Any legal actions must be filed in Travis County, Texas.

5.2 PATENTS OR COPYRIGHTS

The Contractor agrees to protect the State and TWDB from claims involving infringement of patents or copyrights. TWDB will not consider any RFQ that bears a copyright. RFQ will be subject to the Texas Public Information Act, Texas Government Code, Chapter 552, and may be disclosed to the public upon request. Subject to the Act, Respondents may protect trade and confidential information from public release. Trade secrets or other confidential information,

submitted as part of a RFQ, shall be clearly marked at each page it appears. Such marking shall be in **boldface type at least 14 point font.**

5.3 CONTRACTOR ASSIGNMENTS

Respondent hereby assigns to TWDB any and all claims for overcharges associated with this Contract arising under the antitrust laws of the United States 15 U.S.C.A. Section 1, et seq. (1973), and the antitrust laws of the State of Texas, TEX. Bus. & Comm. Code Ann. Sec. 15.01, et seq. (1967).

5.4 HISTORICALLY UNDERUTILIZED BUSINESSES SUBCONTRACTING PLAN

It is the policy of TWDB to make a good faith effort to achieve the annual program goals by contracting directly with Historically Underutilized Businesses (HUBs) or indirectly through subcontracting opportunities in accordance with the Texas Government Code, Chapter 2161, Subchapter F, and HUB Rules promulgated by the Comptroller of Public Accounts (CPA), 34 TAC, Chapter 20.

HUBs are strongly urged to respond to this RFQ. Under Texas law, state agencies are required to make a good faith effort to assist HUBs in receiving certain percentages of the total value of contract awards. Vendors who meet the qualifications are strongly encouraged to apply for certification as HUBs.

TWDB has determined that subcontracting is probable under any Contract awarded as a result of this RFQ. ALL VENDORS RESPONDING TO THIS RFQ, INCLUDING THOSE THAT ARE HUB CERTIFIED OR THOSE WHO DO NOT PLAN TO SUBCONTRACT, MUST COMPLETE A HUB SUBCONTRACTING PLAN (HSP) IN ACCORDANCE WITH THE STATE'S POLICY ON UTILIZATION OF HUBs. THE HSP MUST BE INCLUDED AS PART OF THE RFQ TO THIS RFQ. FAILURE TO COMPLETE THE HSP AS INSTRUCTED MAY RESULT IN DISQUALIFICATION OF THE RFQ FROM CONSIDERATION. Please review the HSP forms carefully and allow sufficient time to identify and contact HUBs and allow them to respond. Note that Vendors must demonstrate a good faith effort to contract with new HUBs if currently proposed HUBs have performed as subcontractors to the Vendor for more than five (5) years. If the Vendor does not plan to subcontract, Vendor must state that fact in their plan. An original, signed paper copy of the HSP must be submitted in an envelope that is separate from the rest of the RFQ. The completed plan shall become a part of the contract that may be awarded as a result of this RFQ.

5.5 HUB CONTINUING PERFORMANCE

Any Contract(s) awarded as a result of this RFQ shall include reporting responsibilities related to HUB subcontracting. Awarded Vendors may not change any subcontractor without submitting a revised HUB Subcontracting Plan (HSP) to TWDB. Any change to a subcontractor and revised HSP must be approved in writing by TWDB prior to implementation.

5.6 HUB RESOURCES AVAILABLE

A list of certified HUBs is available on the Texas Comptroller of Public Accounts (CPA) Web site at: http://www.window.state.tx.us/procurement/cmbl/hubonly.html. For additional information, contact the CPA's HUB program office at Texas4hubs@cpa.state.tx.us. If Vendors

know of any businesses that may qualify for certification as a HUB, they should encourage those businesses to contact the CPA HUB program office.

5.7 RESPONDENT'S AFFIRMATION

Signing this response (ATTACHMENT A - Execution of Response to the Request for Qualifications) with a false statement is a material breach of Contract and shall void the submitted response or any resulting Contract(s), and the Respondent shall be removed from all bid lists. By signature hereon affixed on ATTACHMENT A, the Respondent hereby certifies that:

A. The Respondent has not given, offered to give, nor intends to give at any time hereafter any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor, or service to a public servant in connection with the submitted bid;

B. Neither the Respondent nor the firm, corporation, partnership, or institution represented by the Respondent, or anyone acting for such firm, corporation or institution has violated the antitrust laws of this State or the Federal Antitrust Laws, nor communicated directly or indirectly this RFQ made to any competitor or any other person engaged in such line of business;

C. The Respondent is not a member of the TWDB, a TWDB staff member or a member of their immediate family;

D. Pursuant to Section 2155.004, Government Code, the Respondent has not received compensation for participation in the preparation of the specifications for this RFQ;

E. Pursuant to Section 231.006 (d), Family Code, re: child support, the Respondent certifies that the individual or business entity named in this bid is not ineligible to receive the specified payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate;

F. Under Section 2155.004 Government Code, the Respondent certifies that the individual or business entity named in this RFQ or Contract is not ineligible to receive the specified Contract and acknowledges that this Contract may be terminated and payment withheld if this certification is inaccurate;

G. The Respondent shall defend, indemnify, and hold harmless the State of Texas, all of its officers, agents and employees from and against all claims, actions, suits, demands, proceedings, costs, damages, and liabilities, arising out of, connected with, or resulting from any acts or omissions of Contractor or any agent, employee, subcontractor, or supplier of Respondent in the execution or performance of this contract;

H. Respondent agrees that any payments due under this contract will be applied towards any debt, including but not limited to delinquent taxes and child support that is owed to the State of Texas;

I. Respondent certifies that they are in compliance with Section 669.003 of the Government Code, relating to contracting with executive head of a State agency. If Section 669.003 applies, the Respondent will complete the following information in order for the bid to be evaluated:

Name of Former Executive: _____
Name of State Agency: _____
Date of Separation from State Agency: _____
Position with Respondent: _____

Date of Employment with Respondent: _____

J. Respondent agrees to comply with Government Code Section 2155.4441, pertaining to service contract use of products produced in the State of Texas; and

K. Respondent understands that acceptance of funds under this contract acts as acceptance of the authority of the State Auditor's Office, or any successor agency, to conduct an audit or investigation in connection with those funds. Respondent further agrees to cooperate fully with the State Auditor's Office or its successor in the conducting of the audit or investigation, including providing all records requested. Respondent will ensure that this clause concerning the authority to audit funds received indirectly by subcontractors through Respondent and the requirement to cooperate is included in any subcontract it awards.

5.8 EXECUTIVE ORDER 13224

The TWDB is federally mandated to adhere to the directions provided in the President's Executive Order (EO) 13224, Executive Order on Terrorist Financing – Blocking Property and Prohibiting Transactions with Persons Who Commit, Threaten to Commit, or Support Terrorism, effective 9/24/2001 and any subsequent changes made to it via cross-referencing Respondents/Contractors with the Federal General Services Administration's Excluded Parties List System (EPLS, http://www.sam.gov), which is inclusive of the United States Treasury's Office of Foreign Assets Control (OFAC) Specially Designated National (SDN) list.

5.9 FAMILY CODE REQUIREMENTS

Pursuant to Section 231.006 (c), Family Code, bid must include Names and Social Security Numbers of each person with at least 25% ownership of the business entity submitting the bid. Enter Name & Social Security Numbers for each person.

5.10 ADDITIONAL TERMS

Any terms and conditions attached to this RFQ will not be considered unless specifically referred to on this RFQ and may result in disqualification of this RFQ.

5.11 DISPUTE RESOLUTION

The dispute resolution process provided for in Chapter 2260 of the Texas Government Code must be used by the TWDB and the Respondent to attempt to resolve all disputes arising under this Contract.

5.12 NON-APPROPRIATION OF FUNDS

The State's funds are contingent on the availability of lawful appropriations by the Texas Legislature. If the Texas Legislature fails to continue funding for the payments due under an order referencing this Contract, the order will terminate as of the date that the funding expires, and TWDB will have no further obligation to make any payments.

5.13 PUBLIC INFORMATION ACT

Information, documentation, and other material in connection with this solicitation or any resulting Contract may be subject to public disclosure pursuant to Chapter 552 of the Texas

Government Code (the "Public Information Act"). Any part of the RFQ that is of a confidential or proprietary nature must be clearly and prominently marked as such by the Respondent.

5.14 TECHNOLOGY ACCESS CLAUSE

The Respondent expressly acknowledges that State funds may not be expended in connection with the purchase of an automated information system unless that system meets certain statutory requirements relating to accessibility by persons with visual impairments. Accordingly, the Respondent represents and warrants to the qualified ordering entity that the technology provided to the qualified ordering entity for purchase is capable, either by virtue of features included within the technology or because it is readily adaptable by use with other technology, of:

A. Providing equivalent access for effective use by both visual and non-visual means;
B. Presenting information, including prompts used for interactive communications, in formats intended for both visual and non-visual use; and
C. Being integrated into networks for obtaining, retrieving, and disseminating information used by individuals who are not blind or visually impaired.

For purposes of this clause, the phrase "equivalent access" means a substantially similar ability to communicate with or make use of the technology, either directly by features incorporated within the technology or by other reasonable means such as assistive devices or services that would constitute reasonable accommodations under the Federal Americans with Disabilities Act or similar state or federal laws. Examples of methods by which equivalent access may be provided include, but are not limited to, keyboard alternatives to mouse commands and other means of navigating graphical displays and customizable display appearance.

5.15 ETHICS

Under Section 2155.003, Government Code, an individual who interacts with public purchasers in any capacity is required to adhere to the guidelines established in Section 1.2 of the State of Texas Procurement Manual, which outlines the ethical standards required of public purchasers, employees, and bidders who interact with public purchasers in the conduct of state business, and with any opinions of or rules adopted by the Texas Ethics Commission. Entities who are interested in seeking business opportunities with the State must be mindful of these restrictions when interacting with public purchasers of TWDB or purchasers of other state agencies. Specifically, a TWDB employee may not have an interest in, or in any manner be connected with a contract or bid for a purchase of goods or services by an agency of the state; or in any manner, including by rebate or gift, accept or receive from a person to whom a contract may be awarded, directly or indirectly, anything of value or a promise, obligation, or Contract for future reward or compensation. Entities who are interested in seeking business opportunities with the State must be mindful of these restrictions when interacting with public purchasers of TWDB or purchasers of other State agencies.

5.16 FRAUD STATEMENT

Respondents understand that the TWDB does not tolerate any type of fraud. The TWDB's policy is to promote consistent, legal, and ethical organizational behavior by assigning responsibilities and providing guidelines to enforce controls. Any violations of law, agency policies, or standards of ethical conduct will be investigated, and appropriate actions will be

taken. Providers are expected to report any possible fraudulent or dishonest acts, waste, or abuse to the agency's Internal Audit division at 512-463-7978 or Nicole.Campbell@twdb.texas.gov.

5.17 CONFLICT OF INTERESTS

A RFQ will not be selected if it has a conflict of interest that will or may arise during the performance of its obligations under the Contract. For this reason, the submission in response to this RFQ must disclose all business interest and all relationships that could reasonably be considered to pose possible conflicts of interest in the offer's performance of contract obligations. In addition, Offers must represent and warrant in its response to this RFQ and in the contract that in the performance of services under the contract, (1) Respondent does not have and will not have any actual or potential conflict of interest, and (2) Respondent will take whatever reasonable actions may be necessary and prudent to avoid even the appearance of impropriety.

5.18 CONTRACT ADMINISTRATION

The TWDB shall designate a Project Manager for this Contract. The Project Manager will serve as the point of contact between the TWDB and the selected Contractor. The TWDB's Project Manager shall supervise the TWDB's review of contractor's technical work, deliverables, draft reports, the final report, payment requests, schedules, financial and budget administration, and similar matters. The Project Manager does not have any express or implied authority to vary the terms of the Contract, amend the Contract in any way or waive strict performance of the terms or conditions of the Contract.

5.19 CONTRACT REVISIONS

The contract may only be revised through a contract amendment process.

5.20 VENDOR PERFORMANCE

State agencies shall report a vendor's performance on any purchase of $25,000 or more from contracts administered by the commission or any other purchase made through an agency's delegated authority or a purchase made pursuant to the authority in Government Code, Title 10, Subtitle D or a purchase exemption from CPA/TPASS procurement rules and procedures.

5.21 DEFAULT

If Contractor is found to be in default under any provision of this Contract, TWDB may cancel the Contract without notice and either re-solicit or award the contract to the next best responsive and responsible Respondent. In the event of abandonment or default, Contractor will be responsible for paying damages to TWDB including but not limited to re-procurement costs, and any consequential damages to the State of Texas or TWDB resulting from Contractor's non-performance. The defaulting Contractor will not be considered in the re-solicitation and may not be considered in future solicitations for the same type of work, unless the specification or scope of work is significantly changed.

5.22 FORCE MAJEURE

Neither Contractor nor TWDB shall be liable to the other for any delay in, or failure of performance, of any requirement included in any PO resulting from this RFP caused by force majeure. The existence of such causes of delay or failure shall extend the period of performance until after the causes of delay or failure have been removed provided the non-performing party

exercises all reasonable due diligence to perform. Force majeure is defined as acts of God, war, fires, explosions, hurricanes, floods, failure of transportation, or other causes that are beyond the reasonable control of either party and that by exercise of due foresight such party could not reasonably have been expected to avoid, and which, by the exercise of all reasonable due diligence, such party is unable to overcome. Each party must inform the other in writing, with proof of receipt, within three (3) business days of the existence of such force majeure, or otherwise waive this right as a defense.

5.23 OWNERSHIP/INTELLECTUAL PROPERTY, INCLUDING RIGHTS TO DATA, DOCUMENTS AND COMPUTER SOFTWARE

For the purposes of this Contract, the term "Work" is defined as all reports, statistical analyses, work papers, work products, materials, approaches, designs, specifications, systems, documentation, methodologies, concepts, research, materials, intellectual property or other property developed, produced, or generated in connection with this Contract. All work performed pursuant to this Contract is made the exclusive property of TWDB. All right, title and interest in and to said property shall vest in TWDB upon creation and shall be deemed to be a work for hire and made in the course of the services rendered pursuant to this Contract. To the extent that title to any such work may not, by operation of law, vest in TWDB, or such work may not be considered a work made for hire, all rights, title and interest therein are hereby irrevocably assigned to TWDB. TWDB shall have the right to obtain and to hold in its name any and all patents, copyrights, registrations or such other protection as may be appropriate to the subject matter, and any extensions and renewals thereof. Contractor must give TWDB and/or the State of Texas, as well as any person designated by TWDB and/or the State of Texas, all assistance required to perfect the rights defined herein without any charge or expense beyond those amounts payable to Contractor for the services rendered under this Contract.

Contractor shall maintain and retain supporting fiscal and any other documents relevant to showing that any payments under this Contract funds were expended in accordance with the laws and regulations of the State of Texas, including but not limited to, requirements of the Comptroller of the State of Texas and the State Auditor. Contractor shall maintain all such documents and other records relating to this Contract and the State's property for a period of four (4) years after the date of submission of the final invoices or until a resolution of all billing questions, whichever is later. Contractor shall make available at reasonable times and upon reasonable notice, and for reasonable periods, all documents and other information related to the "Work" as defined in paragraph 11.30 of this Contract. Contractor and the subcontractors shall provide the State Auditor with any information that the State Auditor deems relevant to any investigation or audit. Contractor must retain all work and other supporting documents pertaining to this Contract, for purposes of inspecting, monitoring, auditing, or evaluating by TWDB and any authorized agency of the State of Texas, including an investigation or audit by the State Auditor.

Contractor shall cooperate with any authorized agents of the State of Texas and shall provide them with prompt access to all of such State's work as requested. Contractor's failure to comply with this Section shall constitute a material breach of this Contract and shall authorize the TWDB and the State of Texas to immediately assess appropriate damages for such failure. Pursuant to Government Code, §2262.003 the acceptance of funds by Contractor or any other

entity or person directly under this Contract, or indirectly through a subcontract under this Contract, shall constitute acceptance of the authority of the State Auditor to conduct an audit or investigation in connection with those funds. Contractor acknowledges and understands that the acceptance of funds under this Contract shall constitute consent to an audit by the State Auditor, Comptroller or other agency of the State of Texas. Contractor shall ensure that this paragraph concerning the State's authority to audit funds received indirectly by subcontractors through Contractor and the requirement to cooperate is included in any subcontract it awards. Furthermore, under the direction of the legislative audit committee, an entity that is the subject of an audit or investigation by the State Auditor must provide the State Auditor with access to any information the State Auditor considers relevant to the investigation or audit.

5.24 DRUG FREE WORKPLACE POLICY

The contractor shall comply with the applicable provisions of the Drug-Free Work Place Act of 1988 (Public Law 100-690, Title V, Subtitle D; 41 U.S.C. 701 ET SEQ.) and maintain a drug-free work environment; and the final rule, government-wide requirements for drug-free work place (grants), issued by the Office of Management and Budget and the Department of Defense (32 CFR Part 280, Subpart F) to implement the provisions of the Drug-Free Work Place Act of 1988 is incorporated by reference and the contractor shall comply with the relevant provisions thereof, including any amendments to the final rule that may hereafter be issued.

5.25 INSURANCE

Contractor represents and warrants that it will, within five (5) business days of executing this agreement, provide TWDB with current certificates of insurance or other proof acceptable to TWDB of the following insurance coverage: Standard Workers Compensation Insurance covering all personnel who will provide services under this Contract;

Commercial General Liability Insurance, personal injury and advertising injury with, at a minimum, the following limits: $500,000 minimum each occurrence; $1,000,000 per general aggregate. Contractor represents and warrants that all of the above coverage is with companies licensed in the state of Texas, with "A" rating from Best, and authorized to provide the corresponding coverage. Contractor also represents and warrants that all policies contain endorsements prohibiting cancellation except upon at least thirty (30) days prior written notice to TWDB. Contractor represents and warrants that it shall maintain the above insurance coverage during the term of this Contract, and shall provide TWDB with an executed copy of the policies immediately upon request.

5.26 ORDER PRECEDENCE

In the event of conflicts or inconsistencies between this contract and its exhibits or attachments, such conflicts or inconsistencies shall be resolved by reference to the documents in the following order of priority: Signed Contract (or Notice of Award), Attachments to the Contract (or Notice of Award), Request for Proposals, and Respondent's Response to Request for Proposals.

5.27 PROPRIETY INFORMATION

The TWDB is a government agency subject to the Texas Public Information Act (PIA), Chapter 552, Gov't Code. The Proposal and other information submitted to the TWDB by the Respondent are subject to release as public information. The Proposal and other submitted information shall

be presumed to be subject to disclosure unless a specific exception to disclosure under the PIA applies. If it is necessary for the Respondent to include proprietary or otherwise confidential information in its Proposal or other submitted information, the Respondent must clearly label that proprietary or confidential information and identify the specific exception to disclosure in the PIA. Merely making a blanket claim that the entire Proposal is protected from disclosure because it contains some proprietary information is not acceptable, and shall make the entire Proposal subject to release under the PIA. In order to trigger the process of seeking an Attorney General opinion on the release of proprietary or confidential information, the specific provisions of the Proposal that are considered by the Respondent to be proprietary or confidential must be clearly labeled as described above. Any information which is not clearly identified as proprietary or confidential shall be deemed to be subject to disclosure pursuant to the PIA.

All contracts shall include the following language**:** "**Contractor is required to make any information created or exchanged with the state pursuant to this contract, and not otherwise excepted from disclosure under the Texas Public Information Act, available in a format that is accessible by the public at no additional charge to the state**." In addition to this recommended language, the Comptroller also advises that in order to ***comply with the new statutory requirements***, each state governmental entity should supplement this provision with the additional terms agreed upon by the parties regarding the specific format by which the vendor is required to make the information accessible by the public.

5.28 PUBLIC DISCLOSURE

No public disclosures or news releases pertaining to this contract shall be made without prior written approval of TWDB.

5.29 SUBSTITUTIONS

Substitutions are not permitted without written approval of TWDB.

5.30 TAXES

Contractor represents and warrants that it shall pay all taxes or similar amounts resulting from this Contract, including, but not limited to, any federal, State, or local income, sales or excise taxes of Contractor or its employees. TWDB shall not be liable for any taxes resulting from this Contract.

5.31 ACTS OR OMISSIONS

Vendor shall indemnify and hold harmless the State of Texas and Customers, AND/OR THEIR OFFICERS, AGENTS, EMPLOYEES, REPRESENTATIVES, CONTRACTORS, ASSIGNEES, AND/OR DESIGNEES FROM ANY AND ALL LIABILITY, ACTIONS, CLAIMS, DEMANDS, OR SUITS, AND ALL RELATED COSTS, ATTORNEY FEES, AND EXPENSES arising out of, or resulting from any acts or omissions of the Vendor or its agents, employees, subcontractors, Order Fulfillers, or suppliers of subcontractors in the execution or performance of the Contract and any Purchase Orders issued under the Contract. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE

ATTORNEY GENERAL. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM.

5.32 INFRINGEMENTS

a) Vendor shall indemnify and hold harmless the State of Texas and Customers, AND/OR THEIR EMPLOYEES, AGENTS, REPRESENTATIVES, CONTRACTORS, ASSIGNEES, AND/OR DESIGNEES from any and all third party claims involving infringement of United States patents, copyrights, trade and service marks, and any other intellectual or intangible property rights in connection with the PERFORMANCES OR ACTIONS OF VENDOR PURSUANT TO THIS CONTRACT. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM. VENDOR SHALL BE LIABLE TO PAY ALL COSTS OF DEFENSE INCLUDING ATTORNEYS' FEES. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE ATTORNEY GENERAL.

b) Vendor shall have no liability under this section if the alleged infringement is caused in whole or in part by: (i) use of the product or service for a purpose or in a manner for which the product or service was not designed, (ii) any modification made to the product without Vendor's written approval, (iii) any modifications made to the product by the Vendor pursuant to Customer's specific instructions, (iv) any intellectual property right owned by or licensed to Customer, or (v) any use of the product or service by Customer that is not in conformity with the terms of any applicable license agreement.

c) If Vendor becomes aware of an actual or potential claim, or Customer provides Vendor with notice of an actual or potential claim, Vendor may (or in the case of an injunction against Customer, shall), at Vendor's sole option and expense; (i) procure for the Customer the right to continue to use the affected portion of the product or service, or
(ii) modify or replace the affected portion of the product or service with functionally equivalent or superior product or service so that Customer's use is non-infringing.

5.33 TAXES/WORKERS' COMPENSATION/UNEMPLOYMENT INSURANCE – INCLUDING INDEMNITY

1) VENDOR AGREES AND ACKNOWLEDGES THAT DURING THE EXISTENCE OF THIS CONTRACT, VENDOR SHALL BE ENTIRELY RESPONSIBLE FOR THE LIABILITY AND PAYMENT OF VENDOR'S AND VENDOR'S EMPLOYEES' TAXES OF WHATEVER KIND, ARISING OUT OF THE PERFORMANCES IN THIS CONTRACT. VENDOR AGREES TO COMPLY WITH ALL STATE AND FEDERAL LAWS APPLICABLE TO ANY SUCH PERSONS, INCLUDING LAWS REGARDING WAGES, TAXES, INSURANCE, AND WORKERS' COMPENSATION. THE CUSTOMER AND/OR THE STATE SHALL NOT BE LIABLE TO THE VENDOR, ITS EMPLOYEES, AGENTS, OR OTHERS FOR THE PAYMENT OF TAXES OR THE PROVISION OF UNEMPLOYMENT INSURANCE AND/OR WORKERS'

COMPENSATION OR ANY BENEFIT AVAILABLE TO A STATE EMPLOYEE OR EMPLOYEE OF ANOTHER GOVERNMENTAL ENTITY CUSTOMER.

2) VENDOR AGREES TO INDEMNIFY AND HOLD HARMLESS CUSTOMERS, THE STATE OF TEXAS AND/OR THEIR EMPLOYEES, AGENTS, REPRESENTATIVES, CONTRACTORS, AND/OR ASSIGNEES FROM ANY AND ALL LIABILITY, ACTIONS, CLAIMS, DEMANDS, OR SUITS, AND ALL RELATED COSTS, ATTORNEYS' FEES, AND EXPENSES, RELATING TO TAX LIABILITY, UNEMPLOYMENT INSURANCE AND/OR WORKERS'
COMPENSATION IN ITS PERFORMANCE UNDER THIS CONTRACT. VENDOR SHALL BE LIABLE TO PAY ALL COSTS OF DEFENSE INCLUDING ATTORNEYS' FEES. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE ATTORNEY GENERAL. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM.

ATTACHMENT A
EXECUTION OF RESPONSE
FOR PROJECT NO. _____

Company Name: _____

Address: _____

_____

_____

Phone Number: _____

I, _____, am the above-referenced company's representative and I am authorized to submit this response and sign future contract documents. By signing, vendor certifies that if a Texas address is shown as the address, the vendor qualifies as a Texas Resident Bidder as defined in Texas Administrative Code, Title 34, Part 1, Chapter 20.

_____ _____
Authorized Signature Date

SECTION 2
COMPANY PROFILE SUMMARY AND HISTORY
FOR PROJECT NO. _____

(To be provided by Respondent)

SECTION 3

COMPANY REFERENCES
FOR PROJECT NO. _____

REFERENCE #1

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3

COMPANY REFERENCES
FOR PROJECT NO. _____

REFERENCE #2

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3

COMPANY REFERENCES
FOR PROJECT NO. _____

REFERENCE #3

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 4
RESUMES OF INDIVIDUALS
FOR PROJECT NO. _____

(To be provided by Respondent)

SECTION 5

Historically Underutilized Businesses Subcontracting Plan

FOR PROJECT NO. _____

Please see SECTION IV, GENERAL INFORMATION, No. 4.1-B5

All HUB Subcontracting Plan Forms must be completed and submitted with the Response.

The forms are entitled and can be found at:

HUB Subcontracting Plan Form
HUB Subcontracting Plan Form, SECTION 2 continuation sheet
HUB Subcontracting Plan Good Faith Effort - Method A (Attachment A)
HUB Subcontracting Plan Good Faith Effort - Method B (Attachment B)
HUB Subcontracting Opportunity Notification Form

http://comptroller.texas.gov/procurement/prog/hub/hub-subcontracting-plan/

SECTION 7
(if applicable)
FOR PROJECT NO. _____

Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity Submitting the RFQ

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

SECTION 7
SCOPE OF WORK
FOR PROJECT NO. _____

(To be provided by Respondent)