

**Monthly Letter Progress Report # 6:
September 3, 2016-September 30, 2016
Study of Brackish Aquifers in Texas – Project No. 4 –
Trinity Aquifer
TWDB Contract No. 1600011950**

1.0 Budget and Expenses

This report summarizes the project costs for the billing period from Contract Approval Date (January 6, 2016) through the end of Period 13 of Fiscal Year 2016 (September 30, 2016). The total expenses through this period are \$74,309.77. A breakdown of the budget by task is provided in Table 1. A copy of the progress report has been sent to Texas Water Development Board (TWDB) along with the monthly invoice.

2.0 Progress on Tasks

This report summarizes activities on project tasks during Fiscal Year 2016, Period 13 (encompassing September 3-September 30) and represents the sixth progress report on this contract.

Task 1: Project Management

During the reporting period, progress was made on setting up the subcontracts with INTERA, as well as on the agreements with the two in-kind teaming partners, Edwards Aquifer Authority (EAA) and Barton Springs Edwards Aquifer Conservation District (BSEACD).

Based on discussions with our teaming partner INTERA, the Northern Trinity and the Hill Country Trinity Aquifer regions will be divided for the majority of this project. SwRI will be responsible for the Hill Country region and the area between the Hill Country and Northern Trinity Groundwater Availability Models (GAMs). INTERA will be responsible for the Northern Trinity region. At the end of the project, both regions will be combined into one deliverable.

The Expense budget has been modified so that the Bureau of Economic Geology (BEG) is no longer a participant in the study. An authorization-to-proceed (ATP) was transmitted to INTERA by SwRI on September 22, 2016 so that they could officially begin work on the project.

Task 2: Data Acquisition and Method Development

Task 2 has been subdivided into four subtasks. Progress on activities for the subtasks is as follows:

Subtask 2.1 Acquisition and Initial Analysis of Groundwater Samples

Water quality data were gathered from TWDB's groundwater database and reformatted to accommodate future statistical analyses. In addition to the aforementioned water quality database, spatial queries continued on Brackish Resources Aquifer Characterization System (BRACS)/TWDB databases. Other sources of information were evaluated, including groundwater conservation districts, oil and gas databases, and water supply wells.

Subtask 2.2 Acquisition and Initial Analysis of Geophysical Logs

Fifteen geophysical logs from the BRACS database, which extend throughout the northern edge of the data acquisition domain where geophysical data from the Trinity aquifer is sparse, were selected for digitization. In addition, four logs that were interpreted on paper have also been selected for digitization. These wells will be used as key wells¹ to assist with the log interpretation. The additional logs will be critical in building the stratigraphic framework model of the Trinity.

Development of a database with spatial attributes of all available logs [e.g. BRACS, Information Handling Services Markit (IHS Markit), BEG], with care to adhere to BRACS format, has continued. Other sources of relevant information including published literature, Groundwater Conservation Districts, Oil and Gas databases, water supply wells, Texas Commission on Environmental Quality (TCEQ) Public Supply, and United States Geological Survey (USGS) Produced Water databases have continued to be gathered and evaluated. A project database of water quality data relevant to the project domain and a preliminary hydrochemical facies analysis for the project domain has continued to be developed using TWDB's groundwater database. A license for the Gulf Coast IHS Markit database has been purchased by SwRI (using SwRI funds rather than project funds), and staff are being trained on how to use this database which will be utilized in the project. Key well information is under review by the project team.

Subtask 2.3 Develop Technical Approach for Estimating Total Dissolved Solids from Geophysical Logs

Efforts towards developing a method for correlating total dissolved solids (TDS) data and geophysical log attributes have been initiated. Given its technical complexity, work on this task will continue for most of the duration of the project. Interpretation of logs for stratigraphy has begun, as well as estimation of TDS/Salinity from logs.

Subtask 2.4 Use Geophysical Log Interpretation to Analyze Stratigraphy and Map Fresh, Brackish, and Saline Groundwater

Gamma ray logs are being utilized for interpreting stratigraphy. Resistivity and spontaneous potential (SP) curves will later be utilized for salinity analysis. Digitized well logs are being evaluated and the development of our interpretation approach is underway. Significant progress

¹ A key well is a well that is tightly constrained in terms of identification, position information, well geometry, pick information in measured depth, wireline log data tied to interval picks in measured depth, and formational water chemistry.

on this subtask has already occurred, however work is expected to continue during the next several reporting periods.

Task 3: Develop a Stratigraphic Framework Model of the Trinity Aquifer and Calculate Brackish Water Volumes

Task 3 has been subdivided into two subtasks. Progress on activities for the subtasks is as follows:

Subtask 3.1 Extend Stratigraphy for the Hill Country Trinity

Information on stratigraphy is being collected and evaluated based on the extent of the data acquisition domain. Literature continues to be assessed for useful stratigraphic and structural information (e.g., cross-sections, fence diagrams, structure contour maps, well header information, stratigraphic horizon picks from wells, and fault maps).

Well logs from the BRACS well database have stratigraphic information, including stratigraphic horizon picks and lithologic information. The data is being evaluated to determine whether stratigraphic picks are consistent with those from other logs in the region, and/or with picks from a known reliable source such as a Key Well (see footnote 1). Log information from the IHS database is being evaluated and the team is utilizing the database.

Subtask 3.2 Determine Volumes of Fresh, Brackish, and Saline Groundwater

Evaluation of the relationship between electrical resistivity and fluid salinity has continued during this period. It is recognized that articulating this relationship will be challenging due to the confounding influences of electrically conductive clay zones, but this work will be central to delineating the extent of brackish water in the Trinity Aquifer because geophysical logs will be the primary source of information used in this subtask.

Task 4: Delineate Potential Production Areas

Progress on this task is contingent on completion of the previous tasks.

Task 5: Determine the Amount of Brackish Groundwater that can be Produced without Causing Impact on Lateral and Vertical Fresh Water

Progress on this task is contingent on completion of the previous tasks.

Task 6: Stakeholder Communication

Progress on this task is contingent on completion of the previous tasks.

Task 7: Reporting

Task 7 has been subdivided into 2 subtasks. Progress on the subtasks is as follows:

Subtask 7.1 Project Monitoring Procedures

The project timeline has been reviewed periodically and frequently. The project budget has been monitored on a weekly basis using the SwRI Project Cost System. Project activity for each period is summarized in status reports for review by TWDB.

Subtask 7.2 Project Deliverables

Progress on this task during this reporting period has included preparing and delivering “Monthly Letter Progress Report #5: Period 12, Fiscal Year 2016.”

3.0 Planned Activities for the Next Reporting Period (Fiscal Year 2017, Period 1)

Task 1: Project Management

Subcontracts with the subcontractor, INTERA, as well as the agreements with the two in-kind teaming partners, EAA and BSEACD, will be finalized during the next reporting period.

Anticipating the finalization of the subcontract with INTERA before the end of Period 1, FY 2017, anticipated progress by INTERA during the next period is included below.

Task 2: Data Acquisition and Method Development

Task 2 has been subdivided into four subtasks. Planned activities for the subtasks are as follows:

Subtask 2.1 Acquisition and Initial Analysis of Groundwater Samples

Data on water quality from within the data acquisition domain will continue to be gathered during the next reporting period. This evaluation will be ongoing for most of the project.

Spatial queries will continue on BRACS/TWDB databases. Analysis and results of the groundwater data will continue. Collection of data on water quality will continue, as will evaluation of other potential sources of information, such as groundwater conservation district well databases, oil and gas databases, and water supply well databases.

INTERA plans to initiate an inventory of water wells with water quality measurements in the Northern Trinity study area. INTERA will start assessing screen completions in terms of aquifer units.

Subtask 2.2 Acquisition and Initial Analysis of Geophysical Logs

Nineteen additional gamma logs will be provided to Well Green Tech for digitization in order to fill in gaps from the first round of digitization. Digitized logs provided by the vendor will continue to be evaluated to support development of an interpretation approach. Development of a database with spatial attributes of all available logs (e.g., BRACS, IHS, BEG), with care to adhere to BRACS format, will continue. Other sources of relevant information including literature, Groundwater Conservation Districts, Oil and Gas databases, water supply wells,

TCEQ Public Supply, and USGS Produced Water databases will continue to be gathered and evaluated. A project database of water quality data relevant to the project domain and preliminary hydrochemical facies analysis for the project domain will continue to be developed using TWDB's groundwater database. Staff will continue to be trained on how to use the IHS database. Key well information will continue to be reviewed.

INTERA plans to inventory existing geophysical logs in the Northern Trinity footprint from the Northern Trinity GAM development, determine which logs have sand/limestone/shale picks (from Scott Hamlin at the BEG), and determine which logs have been digitized to LAS files. INTERA will also inventory available geophysical logs (e.g., short/long resistivity, spontaneous potential). Additionally, they will initiate determination of whether proximity of existing logs is sufficient for water well/geophysical log pairings.

Subtask 2.3 Develop Technical Approach for Estimating Total Dissolved Solids from Geophysical Logs

Efforts towards developing a method for correlating TDS data and geophysical log attributes will continue. Interpretation of logs for stratigraphy will continue.

Subtask 2.4 Use Geophysical Log Interpretation to Analyze Stratigraphy and Map Fresh, Brackish, and Saline Groundwater

Digitized well logs will continue to be evaluated, and the development of an interpretation approach will continue as well. Progress on this subtask is expected to continue during the next several reporting periods. Resistivity and SP curves will be evaluated with regard to potential digitization, to be utilized for salinity analysis in the future.

Task 3: Develop a Stratigraphic Framework Model of the Trinity Aquifer and Calculate Brackish Water Volumes

Task 3 has been subdivided into two subtasks. Planned activities for the subtasks are as follows:

Subtask 3.1 Extend Stratigraphy for the Hill Country Trinity

Progress on this subtask will continue in the next reporting period with the assessment of relevant data.

Subtask 3.2 Determine Volumes of Fresh, Brackish, and Saline Groundwater

Evaluation of the relationship between electrical resistivity and fluid salinity will continue during the next period. It is recognized that articulating this relationship will be challenging due to the confounding influences of electrically conductive clay zones, but this work will be central to delineating the extent of brackish water in the Trinity Aquifer because geophysical logs will be the primary source of information used in this subtask.

Task 4: Delineate Potential Production Areas

No work is expected to occur in the next reporting period.

Task 5: Determine the Amount of Brackish Groundwater that can be Produced without Causing Impact on Lateral and Vertical Fresh Water

No work is expected to occur in the next reporting period.

Task 6: Stakeholder Communication

No work is expected to occur in the next reporting period.

Task 7: Reporting

Task 7 has been subdivided into 2 subtasks. Planned activities for the subtasks are as follows:

Subtask 7.1 Project Monitoring Procedures

The project timeline will continue to be reviewed periodically and frequently. The project budget will continue to be monitored on a weekly basis using the SwRI Project Cost System. Project activity will continue to be summarized in status reports for review by TWDB.

Subtask 7.2 Project Deliverables

The sixth progress report (covering Period 13) will be submitted to TWDB during Fiscal Year 2017, Period 1.

4.0 Problems/Issues and Actions Required/Taken

No problems or issues were encountered during this period.

Table 1. Project Budget Versus Expenses

Task	Description	Budget (from SwRI Project Cost System)	Invoices			Remaining Budget
			Current	Previous	Total	
1	Project Management	\$22,640.00	\$99.18	\$86.41	\$16,452.31	\$6,187.69
2	Data Acquisition and Method Development	\$134,555.00	\$12,835.25	\$20,153.04	\$52,365.48	\$82,189.52
3	Develop a Stratigraphic Framework Model of the Trinity Aquifer and Calculate Brackish Water Volumes	\$116,878.00	\$0.00	\$0.00	\$0.00	\$116,878.00
4	Delineate Potential Production Areas	\$40,001.00	\$0.00	\$0.00	\$0.00	\$40,001.00
5	Determine the Amount of Brackish Groundwater that can be Produced without Causing Impact on Lateral and Vertical Fresh Water	\$56,740.00	\$0.00	\$0.00	\$0.00	\$56,740.00
6	Stakeholder Communication	\$35,631.00	\$0.00	\$0.00	\$0.00	\$35,631.00
7	Reporting	\$13,555.00	\$1,731.38	\$1,951.65	\$5,491.98	\$8,063.02
Total		\$420,000.00	\$14,665.81	\$22,191.10	\$74,309.77	\$345,690.23