Edwards-Trinity Plateau Brackish Groundwater Study

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BRACS Program

The Brackish Resources Aquifer Characterization System (BRACS) is a department of the Texas Water Development Board tasked with mapping the distribution and quality of brackish groundwater in the state of Texas, to aid in the exploration and development of this resource.

Our studies include extensive data collection where we compile and organize pubicly available hydrogeologic data into our Microsoft Access BRACS database. With this data, we conduct detailed mapping of stratigraphy, lithology, and water quality, and we estimate volumes of brackish groundwater. To date, we have completed 13 studies (both in-house and contracted) (Figure 1).

Our current studies (all in-house) include the Edwards-Trinity (Plateau) Aquifer, the Hill Country Trinity Aquifer (in review), and the Spart Aquifer in east Texas (Figure 2).

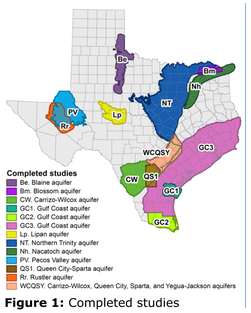


Figure 1: Completed studies

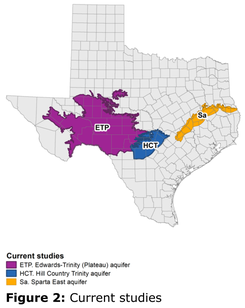


Figure 2: Current studies

BRACS Deliverables

A key goal of our program is to make our data accessible to the public. Our main deliverables for our studies include a peer-reviewed report, GIS files, and our Microsoft Access BRACS database (Figure 3).

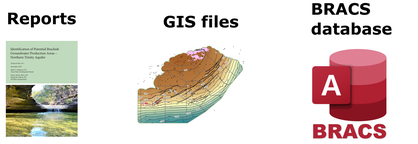


Figure 3: Publicly-available study deliverables of the BRACS Program

Though our reports and GIS data are more familiar deliverables, our Microsoft Access BRACS database contains a wealth of hydrogeologic information. Within the BRACS database, we store comprehensive information for each well and geophysical log used in our studies, including: Well location, identifying information, well depth, surface elevation, kelly bushing, geophysical log curve names, and depths of logged intervals. The BRACS database also stores all of our interpretations, including stratigraphic picks, lithologic picks, and salinity calculation results and methods.

Scan to visit BRACS database page

Scan to visit BRACS studies page

BRACS Contracts

In addition to our aquifer studies, this past year the TWDB contracted seven studies to further the science of brackish groundwater and aquifers including: 1) Brackish groundwater comingling study, 2) Seismic application to groundwater studies, 3) Drilling and Logging an ideal water exploration well, and 4) Core testing for the Hill Country Trinity and Edwards-Trinity (Plateau) aquifers. The reports and deliverables for these contracts should be available by the end of this year.

BRACS Database

The BRACS database is a relational database. A well's unique well ID (BRACS ID) is used to link together key tables described in Meyer (2020) (Figure 4).

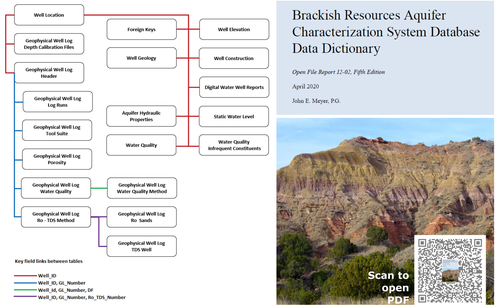


Figure 4: Left: Diagram relating key tables in the BRACS database. Right: Report detailing table contents and relationships in the BRACS database.

With a little knowledge of Microsoft Access, all of our data and interpretations can be queried from our BRACS Access Database, allowing users to generate tables and GIS files of geophysical log locations, stratigraphic picks, total dissolved solid values, and more. Below is an example of utilizing a key field to link two primary tables together in a query, yielding a new table of selected fields (Figure 5).

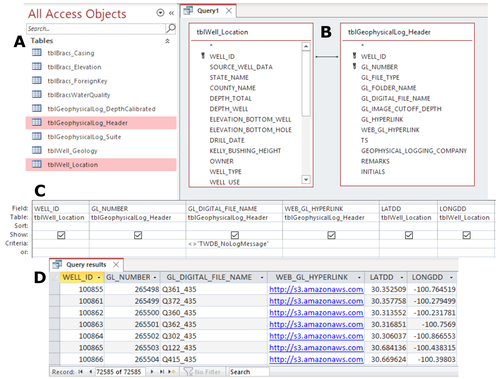


Figure 5: A) Example of primary tables in the BRACS database. **B)** Two tables (Well Location and Geophysical Log Header) joined via the unique well identifier WELL_ID by an Access query. **C)** Fields selected from the two joined tables to create a new table of the selected fields. Exclusion criteria may be added such as specifying a county, well depth, log type, etc. **D)** Resulting table of BRACS wells with geophysical logs including a weblink to directly download the geophysical log, and latitude and longitude to display the log locations in a GIS application. This query indicates there are 72,585 logs available in the BRACS database.

BRACS Edwards-Trinity Plateau Aquifer study

The Edwards-Trinity (Plateau) Aquifer brackish groundwater study is an in-house study by the BRACS department, scheduled for completion in 2023.

The study boundary is the official TWDB aquifer boundary for the Edwards-Trinity (Plateau) Aquifer, modified to extend downdip into Kinney and Maverick counties. The aquifer boundaries are comprised of several geologic and hydrogeologic features, indicated in Figure 6.

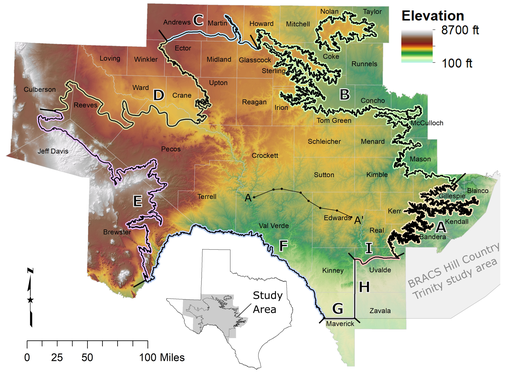


Figure 6: Map of study area boundaries. The various boundary conditions are labeled 'A' through 'I', and explained below. Explanations are modified from Barker and Ardis (1996), except for the study-specific boundaries 'G' and 'H'.

A - This boundary between the Edwards-Trinity (Plateau) Aquifer and Hill Country Trinity Aquifer is defined where the overlying Edwards Group is eroded and the Trinity outcrops. The Trinity is continuous between the two aquifers.

B - The updip limit of Cretaceous rock outcrop.

C - The updip limit of Cretacoues rock subcrop. Log response of basal Cretaceous sand becomes indistinguishable from Ogallala.

D - Where Cretaceous rocks abut Pecos Valley Alluvium.

E - Traversing the flanks of several mountain ranges, this boundary is loosely defined where Cretaceous rocks pinch out, are structurally detached, unsaturated, or are mostly impermeable.

F - This boundary coincides with the Rio Grande River, which acts as a regional groundwater drain according to potentiometric data.

G - A study-specific boundary estimated to encompass the downdip extent of very saline groundwater, up to 35,000 milligrams per liter total dissolved solids.

H - Boundary with BRACS Hill Country Trinity study to the east.

I - Approximate 3,000 milligrams per liter total dissolved solids line in the Edwards Group.

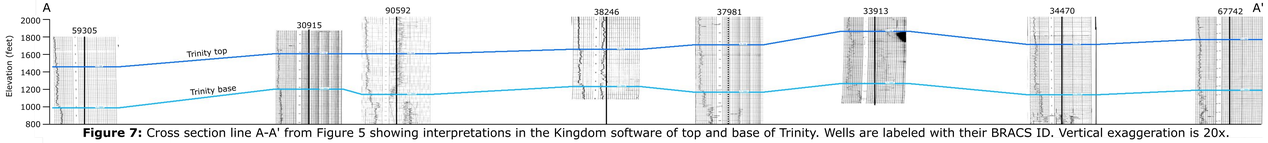


Figure 7: Cross section line A-A' from Figure 5 showing interpretations in the Kingdom software of top and base of Trinity. Wells are labeled with their BRACS ID. Vertical exaggeration is 20x.

Study Progress

We have completed our initial search for publicly-available geophysical logs, and are in the process of depth-calibrating necessary logs (most of our logs are rasters). We have also begun preliminary stratigraphic interpretations in the IHS Markit Kingdom® Software (Figure 7). Currently there are over 9,600 logs, including 3,200 depth-calibrated logs, within a 5-mile buffer of the study area available in the BRACS database (Figure 8). Our logs come primarily from the Railroad Commission of Texas Q-log library and digital log files, University Lands, and groundwater conservation districts. If you have a collection of logs you wish to make publicly available, please contact us and we will gladly add them to our database.

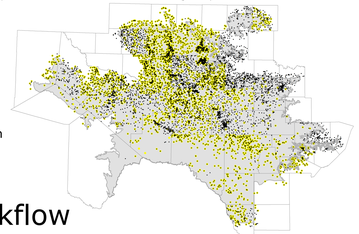


Figure 8: Location of geophysical logs in the study area. Locations highlighted yellow indicate the log has been depth calibrated.

Study Workflow

The scheduled workflow for this study is described in items 1-6 below, which is the general workflow for all BRACS studies.

1) Data collection: Data entry and QC in BRACS database. Our intial search for geophysical logs is complete, and we will identify additional lithologic descriptions, water quality analyses, and water well casing/screen information later in the study.

2) Stratigraphy: After stratigraphic interpretation is finalized in the IHS Markit Kingdom® Software, stratigraphic raster surfaces are interpolated in ArcGIS.

3) Lithology: Lithologic descriptions from driller logs and detailed cable-tool logs will be used to understand the distribution of sand and carbonate in the Trinity. Lithologic descriptions will also be used to help constrain the stratigraphic surfaces where geophysical logs are sparse, such as in Terrell and Val Verde counties.

4) Aquifer determination: Using the stratigraphic raster surfaces, all wells in the study area are intersected with the final surfaces. The screened intervals of water wells are then compared to the formation depths, and the formations overlapping the screened intervals are assigned to the wells. Water quality information from a well is generally only included if the screened interval corresponds to one formation via the aquifer determination (Figure 9).

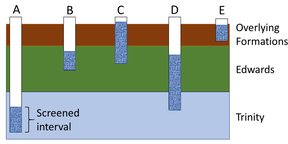


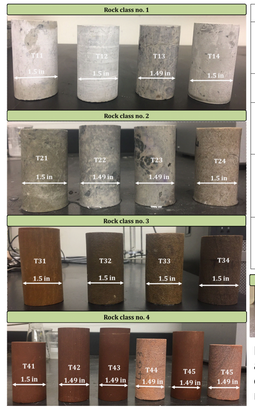
Figure 9: A and B) Water well information included in the study. **C)** Water well information may be included in study if static water level is below the top of the Edwards. **D and E)** Water well information not included in the study.

5) Water quality: After measured water quality is assigned to their respective formations via the aquifer determination process, we map the water salinity of each formation focusing on brackish water which is between 1,000 and 10,000 milligrams per liter total dissolved solids. Because measured water quality is generally restricted to the shallow, fresh intervals, we perform salinity calculations using resistivity logs to map the more saline intervals. Measured water quality is also necessary for the geophysical log calculations, as the relationship between formation water resistivity and its' total dissolved solids must be known.

6) Volume calculations: With the final stratigraphic surfaces and water salinity mapped, volumes of brackish groundwater for each formation are estimated. We will likely rely on generalized porosity values from TWDB Groundwater Availability Models.

Core Data

Faculty and staff of The University of Texas at Austin, through a contract with the TWDB (Torres-Verdin and others, in review), described, photographed, and measured petrophysical properties for the Edwards-Trinity (Plateau) Aquifer from nine cores managed by the Bureau of Economic Geology. Laboratory measurements, including nuclear magnetic resonance (NMR), total porosity, permeability, and electrical measurments, were conducted on 24 core samples from four representative rock classes of the Trinity hydrogeologic unit and one representative rock class from the Edwards hydrogeologic unit (Figure 10). Laboratory results are presented below in Table 1, and the laboratory methods are detailed in the final report which will be available online later this year. The core descriptions and photographs are available by request from the TWDB BRACS department.



Rock Class	Description
1	White to light gray, brittle limestone, embedded trace clay and gypsum, presence of bioturbation, and micro vugs.
2	White to light grey, brittle to soft limestone, embedded evaporates.
3	Brownish to tan mudstone with crossbedding and embedded dolomite. Poorly consolidated, friable and presence of small fracs
4	Red Massive well-sorted sandstone with a wide range of grain sizes, embedded calcite clasts and dark clays. Cross-bedded white calcarous thin layers
Edwards	White to brownish, limestone with Calcareous mudstone with embedded dolomite crystals, traces of evaporites, and large-size vugs

Figure 10: Photographs of the analyzed core samples and descriptions of the five representative rock classes.

Table 1: Summary of core sample analysis results.

Sample ID	Core ID	BRACS ID	Formation	Depth (ft)	Class	Porosity	*m*	Permeability (md)
T11	C02699	101130	Trinity	410	1	12	2.027	*damaged*
T12	C02699	101130	Trinity	420	1	7	2.027	*damaged*
T13	C02699	101130	Trinity	407.5	1	12.6	2.027	*damaged*
T14	C02698	101131	Trinity	442	1	10.7	2.027	*damaged*
T15	C02693	101129	Trinity	343	1	16.2	2.027	*damaged*
T21	C02698	101131	Trinity	445	2	6.5	1.79	0.0021
T22	C02698	101131	Trinity	444.5	2	6.8	1.79	0.002
T23	C02698	101131	Trinity	446	2	4.4	1.79	0.0006
T24	C02698	101131	Trinity	444	2	2.1	1.79	0.082
T25	C02698	101131	Trinity	447	2	1.6	1.79	0.00048
T31	C02698	101131	Trinity	454	3	5.6	2.204	0.017
T32	C02698	101131	Trinity	456	3	18.8	2.204	7
T33	C02698	101131	Trinity	455	3	21.4	2.204	440
T34	C02692	101094	Trinity	380	3	21.8	2.204	1378
T41	S07790	101099	Trinity	451	4	8.9	1.807	0.046
T42	S07790	101099	Trinity	447	4	15.7	1.807	0.043
T43	S07790	101099	Trinity	446	4	15.4	1.807	0.096
T44	S07790	101099	Trinity	463	4	18.5	1.807	*damaged*
T45	S07790	101099	Trinity	455	4	6.9	1.807	0.0028
E11	S08027	101097	Edwards	460	E	15.3	2.638	4.59
E12	S08027	101097	Edwards	460.2	E	19.9	2.638	6.12
E13	S08027	101097	Edwards	462	E	14.8	2.638	1.89
E14	S08027	101097	Edwards	462.2	E	12.7	2.638	4.5
E15	S08027	101097	Edwards	457	E	11.9	2.638	*damaged*

References

Barker, R.A. and Ardis, A.F., 1996, Hydrogeologic framework of the Edwards-Trinity Aquifer system, west-central Texas: U.S. Geological Survey, Professional Paper 1421-B, 61 p. and 8 plates.

Meyer, J.E., 2020, Brackish Resources Aquifer Characterization System Database data dictionary: Texas Water Development Board Open-File Report 12-02, Fifth Edition, 260 p.

Torres-Verdin, C., Heidari, Z., Casanova, R., Alhadi, A., and Gelvez, C., in review, Numeric Well Log Simulations and Core Testing for the Edwards-Trinity (Plateau) Aquifer, Texas Water Development Board Contract #2100012507, 104 p.