

FINAL: UPPER COASTAL PLAIN EAST AQUIFER DATA ENTRY FOR THE BRACKISH RESOURCES AQUIFER CHARACTERIZATION SYSTEM DATABASE

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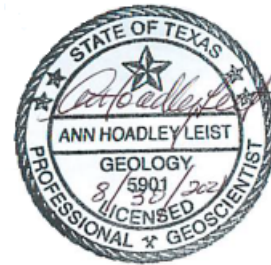




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This document is released for the purpose of interim review under the authority of Allan R. Standen, PG 1227 on June 30, 2021. Information contained within this draft report and associated files are not to be used for policy decision purposes, as materials submitted are subject to change.

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1 Introduction

The Brackish Resources Aquifer Characterization System (BRACS) database was developed in 2009 to organize well and geologic data in a readily available format for brackish-water characterization projects in Texas (Meyer, 2012). The first major expansion of the database began in 2011 with Texas Water Development Board (TWDB) contracted study “Locating, Scanning, and Delivering Digital Geophysical Well Logs and Associated Data for Brackish Resources Aquifer Characterization System (BRACS)”, completed by the Bureau of Economic Geology (BEG). This study delivered a state-wide geographic coverage of 19,727 geophysical logs that met key BRACS criteria (Ortuño and others, 2012). Since this early study, the BRACS database has gradually evolved as data is made available to the TWDB through contracted and internal studies.

In October 2020, Allan R. Standen, LLC (ARS LLC) was contracted by the TWDB to process 19,163 well files from the TWDB unprocessed log collection for the Upper Coastal Plain East (UCPE) Aquifer System. The project began in late 2020 and resulted in 11,102 new well records while also improving 1,655 existing well records. This data accounts for a 148% increase from the prior 7,498 well records in BRACS database well coverage for the UCPE Aquifer System and will be used in future studies to map aquifers and help characterize brackish resources.

2 Study Area

The project study area includes fifty-five counties in East-Southeast Texas that overlie the UCPE aquifer system. This stacked aquifer system includes portions of the Carrizo-Wilcox, Queen City, Sparta, and Yegua-Jackson aquifers that are bounded by the Texas-Louisiana Border to the east, the Gulf of Mexico to the south and Brazos River Basin to the west (Figure 2.1). Prior to this study, the BRACS database included 7,498 well records within the study area which correlate to geophysical logs, well driller reports, and analytical results.

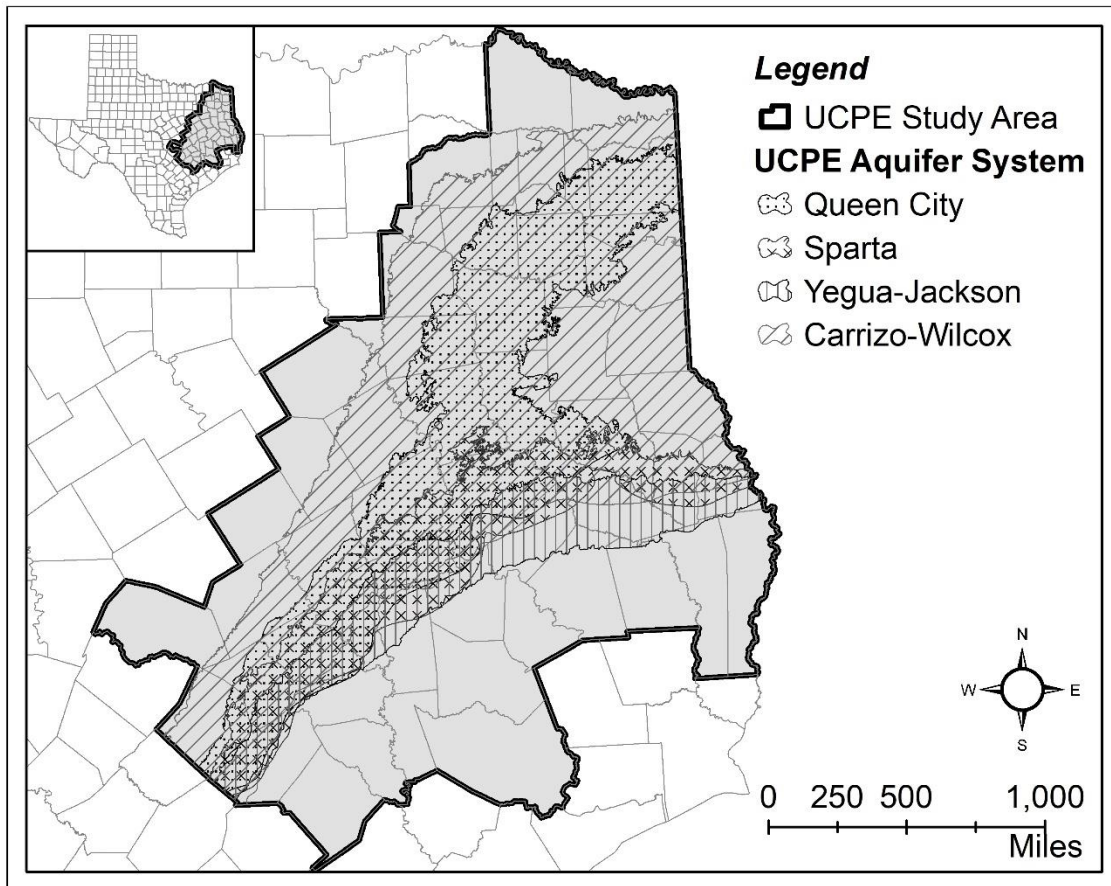


Figure 2.1. Upper Coastal Plain East study area with related aquifer units.

3 Unprocessed Log Collection

The unprocessed geophysical log collection includes digital well files from specialized collections that include, but are not limited to, the Railroad Commission of Texas (RRC) Groundwater Advisory Unit Q-Logs, Texas Commission on Environmental Quality miscellaneous scanned geophysical well logs and the University of Texas University Lands System geophysical well logs. These collections have not been curated and additional research is required for each well file before it can be added to the BRACS database. This includes identifying relevant foreign key and location attributes in addition to duplicate records between the unprocessed collection and BRACS database. Once logs in this collection are reviewed and it is determined that they add value, they are removed from this collection and appended to the BRACS database.

4 Technical Approach

The study consisted of an initial screening and processing phase where log attributes, foreign keys, and locations were assigned, and duplicate records were identified. This initial phase was followed by data entry where the integrity of the data was emphasized through quality control workflow procedures. A general overview of this technical approach is provided below (Figure 4.1).

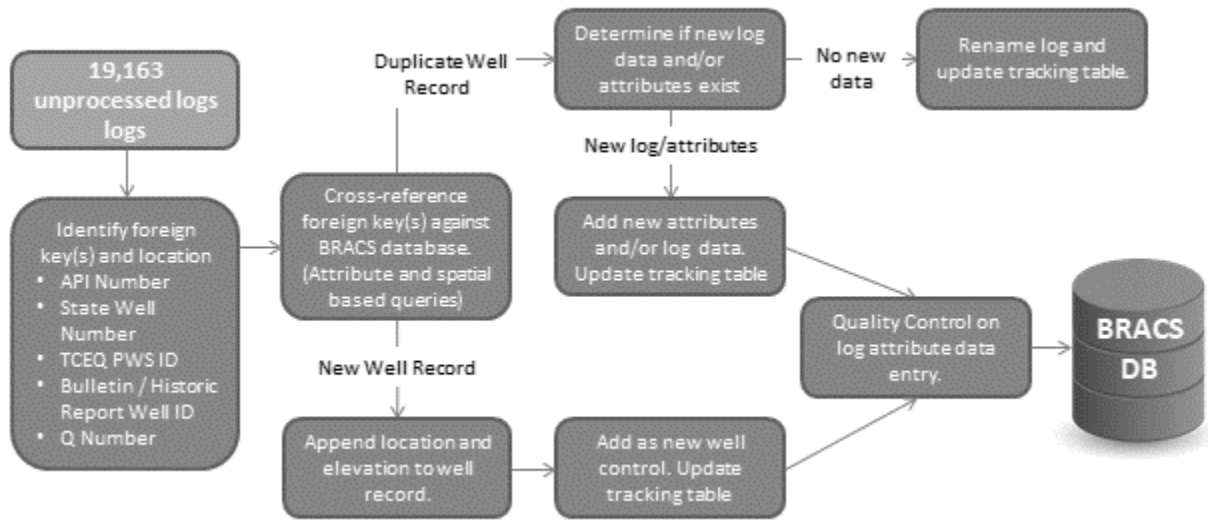


Figure 4.1. Technical approach workflow

4.1 Well Log Attributes

All 19,163 log files provided to ARS LLC underwent a review process that began with opening each log file to confirm useability and documenting relevant attributes within a project tracking document. A useable log file was legible and included BRACS relevant information. Logs that were not useable, were either unreadable, outside the study area, or did not contain BRACS data (e.g., well location map). These were documented and provided to the TWDB.

BRACS attributes collected from each log were associated with the following BRACS database tables: tblWell_Location, tblBracs_ForeignKey, tblGeophysicalLog_Header and tblGeophysicalLog_Suite. They included the following fields: county name, depth total, drill date, kelly bushing height, well type, well use, owner, well number, log tools and start/end tool depths. An uncomplicated task that at times was very challenging due to log image quality issues that prevented the identification log attributes. To mitigate this issue, oil and gas databases were referenced (e.g. Railroad Commission of Texas Oil and Gas Lease and Well Database) to identify the non-readable attributes of the log.

4.2 Foreign Keys

An attempt was made to identify relevant foreign keys for all 19,163 unprocessed logs. Most well log filenames included a Q or American Petroleum Institute (API) number, and foreign keys were occasionally annotated on the scanned image file. Q numbers were assumed to be correct, however API and State Well Number (SWN) were reviewed for accuracy. Nearly every well file in the unprocessed collection included two foreign keys.

A search was performed for potential missing foreign key(s) when they were not provided. This included using header information to locate the corresponding API number for oil and gas well files, or SWN for water wells. Location-based queries were also used to cross-reference the unprocessed file locations against the TWDB Groundwater Database (GWDB) well locations to identify SWNs that are associated with industrial, and oil and gas wells. Additionally, the GWDB remarks field was reviewed for possible foreign key references, and a TCEQ Q Log dataset acquired from the TWDB was used to match Q numbers with a corresponding API.

4.3 Well Locations

Well locations were assigned to each well file in North American Datum 83 geographic coordinates using one of several approaches that were dependent on well type and available foreign keys(s). The Railroad Commission of Texas and other available oil and gas databases were referenced when an API number was available. Original Texas Land Survey (OTLS) header information, and ArcGIS measurement tools were utilized to determine locations for water wells and wells without an API. Log header contextual information such as an address or landmark in conjunction with aerial imagery was occasionally used when survey information was not provided. GWDB coordinates were applied to wells with a SWN when other location information was not available. The location method for outside sources is unknown, however, when locations were derived from header information the appropriate location method accompanied the well file in the BRACS database.

Reliable location information was not available for approximately 2% of the well files. Historical groundwater reports and bulletins were initially referenced to identify locations for these well files, but this approach was abandoned one-third of the way through the project after not providing a single well location. Instead, replacement logs that contained useful BRACS data were provided to the TWDB to fulfill the work order log quota.

Each unprocessed well record was also assigned a 30-M DEM elevation value in US Feet and corresponding state well grid based on location coordinate information.

4.4 Duplicate Well Records

Identifying duplicate well records was a priority since they introduced redundancy within the BRACS database. The unprocessed collection contained duplicate records that were identified by matching foreign keys in addition to reviewing wells with identical drill dates, well depths and well owners. Duplicate records were compared against each other to identify the best log file, and the inferior log file was documented and removed from additional processing.

Once unprocessed duplicate files were removed, the remaining files were compared against the BRACS database well records. This occurred through foreign key matching of available API, SWN and Q number, however since duplicate Q numbers can exist, each was reviewed to validate the match. Every BRACS or unprocessed well record that did not include an API number was also compared against the opposite collection to identify duplicates where a foreign key match would not have been possible.

When duplicate records were identified, a review of the BRACS well record was conducted to confirm the accuracy of the existing data, identify missing information, and update or add the unprocessed log file if it was better quality or contained new information. Many times, a duplicate record led to the improvement of an existing BRACS entry. Duplicate records that did not add additional value were documented and removed from additional processing.

4.5 Data Entry Quality Assurance and Control

Data entry began by opening and reviewing each well record for a second time as a quality control measure to confirm the accuracy of the data collected during processing. After attributes were confirmed, they were entered into the BRACS database using copy-paste from the well log attribute tracking document to reduce user data entry errors. Additionally, relevant log file remarks such as log quality issues, datum observations and annotated notes such as formation picks were recorded within the appropriate remarks field. Well file pathways were appended to each record within the BRACS database using the predefined pathway structure. All new entries and duplicate updates were documented within a project tracking document and provided to the TWDB.

Nearly all the well log files in the unprocessed collection corresponded to geophysical logs. For each geophysical log, the tools and logged intervals were entered into the BRACS database. Our team was sometimes forced to make judgement calls on these attributes due to issues with log quality, scan image resolution and scale. Log top and bottom depths were reported to the nearest foot when log quality permitted, however if log quality prevented an exact measurement the depth was rounded to the nearest 5-foot increment. Tools that were unreadable were not entered into the database, however, if a tool or tools were readable for select intervals they were recorded in the database and a note was made in the appropriate remarks field.

5 Results

The unprocessed collection contained 14,639 new and unique log files that resulted in 11,102 new BRACS well records, a 148% increase for the study area, and 14% increase in state-wide BRACS well coverage. The significant difference in new log files and BRACS data entries occurred as many-to-one relationships were established between new log files and unique well records. Oil and Gas wells accounted for 10,533 of the new records with 569 related to water wells.

A total of 4,287 duplicate files were identified with 1,655 providing new or better information to pre-existing BRACS database entries. A remainder of 237 log files were determined to be either illegible, outside the study area or did not provide BRACS information (Table 5.1).

Table 5.1. Upper Coastal Plain East data entry summary table.

	Total	UCPE 55-County Study Area	BRACS Statewide
New Log Files	14,639	148% - Increase	14% - Increase
Duplicate Log Files - New/Better Information	1,655	22% - Updated	2% - Updated
Duplicate Log Files	2,632	N/A	N/A
Illegible, Outside Study Area, Not BRACS	237	N/A	N/A
Total	19,163	-	-

This new data resulted in at least a 50% increase in well control for over half the study area with some increasing over a 100% from prior well control. A summary of new and duplicate records for each county is provided in Table 5.2.

Table 5.2. Unprocessed well log file summary table for the fifty-five county study area.

	Unprocessed Well Log Files							BRACS Well Records		
	New Well Log Files	Duplicate Record - New Data	Duplicate Record	Unable to Locate*	Incorrect Folder*	Invalid / Illegible	Total	Existing BRACS Records	New Well Records	Well Record Increase
Anderson	1,557	71	127	35	2	4	1,759	160	1031	644%
Angelina	34	41	35	4	-	-	110	125	38	30%
Austin	166	32	13	1	-	-	211	100	165	165%
Bastrop	94	59	154	44	-	-	307	874	139	16%
Bowie	22	19	-	-	-	-	41	92	22	24%
Brazos	283	44	90	1	3	12	429	163	283	174%
Burleson	391	46	35	6	1	2	474	280	396	141%
Camp	-	-	-	-	-	-	0	24	0	0%
Cass	14	50	2	-	1	-	66	95	12	13%
Cherokee	561	36	46	3	1	3	646	127	403	317%
Colorado	625	49	33	7	1	3	710	162	624	385%
Falls	54	36	163	1	-	2	255	101	51	50%
Fayette	280	71	126	19	1	-	477	503	295	59%
Franklin	-	-	1	-	-	-	1	41	0	0%
Freestone	552	1	27	15	-	-	580	127	345	272%
Gregg	34	3	5	4	1	-	42	40	39	98%
Grimes	60	23	72	-	1	1	156	101	58	57%
Harris	1,856	60	118	127	-	61	2,095	166	1560	940%
Harrison	1,152	71	90	17	5	2	1,315	134	779	581%
Henderson	48	29	13	1	21	1	91	109	50	46%
Hopkins	81	16	5	3	-	-	102	90	83	92%
Houston	614	70	200	9	2	12	896	236	405	172%
Jasper	9	18	-	9	-	3	30	61	19	31%
Lee	286	88	93	6	-	1	468	411	292	71%
Leon	40	41	17	6	-	18	116	139	48	35%

	Unprocessed Well Log Files							BRACS Well Records		
	New Well Log Files	Duplicate Record - New Data	Duplicate Record	Unable to Locate*	Incorrect Folder*	Invalid / Illegible	Total	Existing BRACS Records	New Well Records	Well Record Increase
Limestone	379	7	88	22	-	16	490	90	310	344%
Madison	330	25	61	8	5	25	441	77	224	291%
Marion	6	-	-	-	-	-	6	39	8	21%
Milam	235	104	105	27	-	25	469	265	233	88%
Montgomery	364	64	138	13	-	8	574	130	328	252%
Morris	3	5	2	-	-	-	10	24	3	13%
Nacogdoches	109	87	48	6	-	-	244	144	117	81%
Navarro	487	8	19	79	-	1	515	169	441	261%
Newton	15	28	3	5	1	2	48	56	22	39%
Panola	1699	38	62	7	1	10	1,809	93	1057	1137%
Polk	36	36	4	2	-	3	79	91	38	42%
Rains	-	-	1	-	-	-	1	31	0	0%
Red River	21	20	18	-	-	-	59	161	21	13%
Robertson	52	20	177	-	-	2	251	215	51	24%
Rusk	807	32	20	19	-	4	863	438	544	124%
Sabine	57	21	29	1	1	1	108	46	58	126%
San Augustine	30	4	24	-	-	-	58	21	30	143%
San Jacinto	60	5	1	3	-	-	66	43	6	14%
Shelby	136	31	14	-	-	-	181	71	130	183%
Smith	7	1	4	-	-	1	13	67	7	10%
Titus	-	-	3	-	-	-	3	43	0	0%
Trinity	37	15	25	2	-	-	77	68	38	56%
Tyler	23	28	2	-	-	1	54	66	23	35%
Upshur	-	-	2	-	-	-	2	50	0	0%
Van Zandt	57	-	1	1	-	-	58	71	59	83%

	Unprocessed Well Log Files							BRACS Well Records		
	New Well Log Files	Duplicate Record - New Data	Duplicate Record	Unable to Locate*	Incorrect Folder*	Invalid / Illegible	Total	Existing BRACS Records	New Well Records	Well Record Increase
Walker	59	20	40	6	-	8	127	84	59	70%
Waller	5	-	1	-	-	1	7	88	5	6%
Washington	118	12	46	6	1	2	178	93	124	133%
Williamson	114	50	158	1	0	2	324	115	29	25%
Wood	-	-	-	-	-	-	0	88	0	0%
Incorrect Folder	15	20	14	-	-	-	49	* Files Counts were not included in total. Talled as Incorrect Folder or Replacement Log Files.		
Replacement Log Files	565	-	-	-	-	-	565			
Unaccounted			30							
Totals	14,639	1,655	2,605	526	49	237	19,136	7,498	11,102	148%

Replacement logs were provided for a small subset for well log files that could not be located because of log quality issues or missing survey information. Replacement logs helped infill areas with poor well control and included Resistivity and/or Porosity tools. Logs were provided on a county-by-county basis based on need (Table 5.3).

Table 5.3. Replacement log need and provided logs by county.

County	Needed	Provided
Anderson	35	37
Angelina	4	4
Austin	1	1
Bastrop	44	46
Brazos	1	1
Burleson	6	7
Cherokee	3	4
Colorado	7	9
Falls	1	2
Fayette	19	21
Freestone	15	17
Gregg	4	5
Harris	127	130
Harrison	17	21
Henderson	1	2
Hopkins	3	3
Houston	9	10
Jasper	9	11
Lee	6	8
Leon	6	6
Limestone	22	24
Madison	8	8
Milam	27	27
Montgomery	13	14
Nacogdoches	6	7
Navarro	79	80
Newton	5	7
Panola	7	9
Polk	2	2
Rusk	19	21
Sabine	1	1
San Jacinto	3	3
Trinity	2	2
Van Zandt	1	2
Walker	6	6
Washington	6	6
Williamson	1	1
Total	526	565

6 Final Remarks

The successful completion of this project allowed ARS LLC to inventory and process 19,163 well log files from the TWDB unprocessed geophysical log collection. This new well data provides valuable information for future brackish-aquifer characterization projects and utility for groundwater availability and stratigraphic aquifer models. Additionally, there are 27 Groundwater Conservation Districts, 4 Groundwater Management Areas, 6 Regional Planning Areas and over 200 local municipalities that stand to benefit. Very few gaps in data coverage remain within the study area because of the high volume of data that was processed. Any future data mining efforts in the study area should be targeted to specific 2.5-minute state well grids. This project has demonstrated the value of the unprocessed geophysical log collection, by not only providing a substantial increase in new data, but also through updates and improvements to existing BRACS data entries.

References

- Ortuño, Daniel H., Averett, Aaron R., Clift, Sigrid J., and Paine, Jeffrey G. 2012, Locating, Scanning and Delivering Digital Geophysical Well Logs and Associated Data for Brackish Resources Aquifer Characterization System (BRACS): contract report by The University of Texas at Austin, Bureau of Economic Geology, to the Texas Water Development Board, 11 p.
- Meyer, John E., 2012, Brackish Resources Aquifer Characterization System Database Data Dictionary - First Edition: Texas Water Development Board, Open File Report 12-02 130 p.