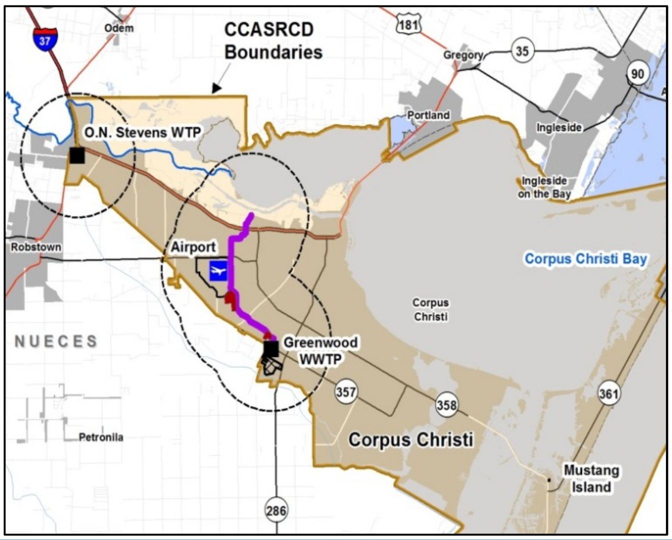

Aquifer Characterization Study for ASR Feasibility

Project No. E15127

Final Report

January 20, 2016

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Prepared for:

CCASRCD

Corpus Christi Aquifer Storage & Recovery Conservation District

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Acronyms

ASR	Aquifer Storage and Recovery
ASTM	American Society for Testing and Materials
avg	average
BRACS	Brackish Resources Aquifer Characterization System
CCASRCD	Corpus Christi Aquifer Storage and Recovery Conservation District
City	City of Corpus Christi
District	Corpus Christi Aquifer Storage and Recovery Conservation District
ft	feet or foot
ft/d	feet per day
ft-bls	feet below land surface
gpd	gallons per day
gpm	gallons per minute
mg/L	milligrams per liter
mgd	million gallons per day
msl	mean sea level
SP	Spontaneous (Self) Potential
TDS	total dissolved solids
TWDB	Texas Water Development Board
USGS	United States Geological Survey
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

1 Introduction

The Corpus Christi Aquifer Storage and Recovery Conservation District (District) was formed[1] in 2005 to facilitate aquifer storage and recovery project(s) by the City of Corpus Christi to enhance its water supply, treatment, and distribution operations for the benefit of its retail and wholesale customers (CCASRCD, 2014). The boundaries of the District coincide with the city limits of the City of Corpus Christi located predominantly in Nueces County and property owned or contracted to the City of Corpus Christi in San Patricio County. It is bounded to the north by the Corpus Christi Metropolitan Planning Organization, to the east by County Road 2849, to the south by the City of Corpus Christi city limits, and to the west by IH 37 and U.S. Hwy 77. A portion of the District extends to Aransas and Kleberg counties[2]. In the interest of the District's commitment to maintaining a sustainable, adequate, reliable, cost effective, and high quality source of groundwater to promote vitality, economy, and environment, the District contracted with HDR to perform an initial aquifer characterization study beneath the District to evaluate ASR feasibility in accordance with District goals and objectives.

Aquifer storage and recovery (ASR) is a long-term water supply strategy that can be effectively integrated into the City of Corpus Christi's (City's) regional water supply system to achieve long-range water planning goals. Determining the feasibility of ASR is important to the District and the City for the following reasons:

- ASR promotes diversification of regional water supplies – The City's existing system relies solely on surface water supplies from the Nueces, Lavaca-Navidad, and Colorado River Basins. ASR can be used conjunctively to minimize evaporative losses and to protect against impacts of future droughts.
- ASR helps provide cost-effective regional water supplies to meet competing demands – The proposed location for ASR feasibility is near existing City infrastructure and proposed infrastructure to serve industries along the Corpus Christi Ship Channel.
- ASR improves system operations and reduces annual operating costs – Several industrial processes have seasonal production periods that cause variability (and peaks) in water usage. ASR can provide additional water from storage when needed and reduce peaking on water system operations.

Previous studies conducted by the District provided the basis for this study. In 2009, the District developed a 5-year plan which outlined near-term activities to evaluate ASR feasibility (HDR, 2009). At the request of the District, the Texas Water Development Board (TWDB) conducted a geologic characterization of the District and surrounding counties in 2012 which included development of a relational database to include aquifer properties obtained by geophysical log interpretation, groundwater quality data, and other related information that was then integrated into the state-wide Brackish Resources Aquifer Characterization System (BRACS) program (Meyer, 2012). The study results presented in this report draw upon information from previous studies and further investigates ASR feasibility at three specific areas within the District boundaries: O.N. Stevens WTP, Corpus Christi International Airport and area adjacent to a proposed transmission pipeline to provide reuse water to industries along the Corpus Christi Ship Channel, and Greenwood WWTP as shown in Figure 1.

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[1] By the 79th Texas Legislature enactment of SB 1831, Section 1, Subtitle H, Title 6.

[2] Comprises about 2.4% of the surface area in Aransas and Kleberg counties.

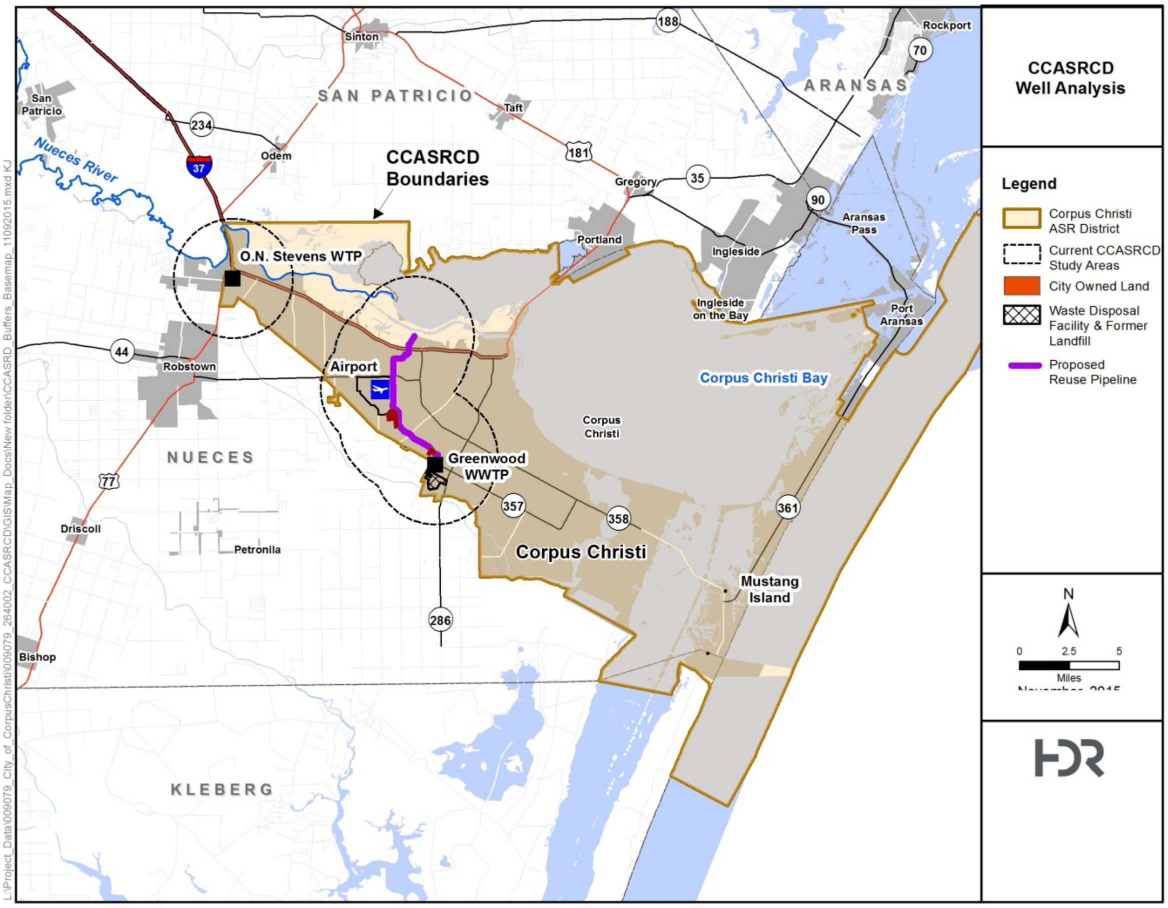


Figure 1 Approximate Location of Project Study Area

Primary study tasks summarized in this report include:

- Compiling and summarizing hydrogeology data and reports for the area and describing the groundwater setting;
- Studying and interpreting geophysical logs for the three target areas within the District boundaries to identify:
    - o Occurrence and thickness of sand zones and confining clay/silt layers and
    - o Fresh and slightly saline zones;
- Summarizing study results and estimating capital costs of potential ASR project; and
- Preparing a recommendation for a path forward considering findings.

2 Groundwater Setting

2.1 Geologic Setting

The Gulf Coast Aquifer is the primary water-bearing geologic formation beneath the project area, with the main hydrogeologic units consisting of the Chicot and Evangeline aquifers. The Beaumont Clay, Lissie Formation, and Goliad Sands are the major stratigraphic units of the Gulf Coast Aquifer, as shown in Figure 2. These units are hydrologically interconnected to yield small to moderate supplies of fresh and slightly saline water (Shafer and USGS, 1968). Geologic units of the Gulf Coast Aquifer system dip east toward the coast at a direction roughly perpendicular to the local shoreline and the strike of geologic units is approximately parallel to the shoreline (TWDB, 2010). The source of recharge to groundwater in Nueces County is primarily through precipitation on the outcrop in counties to the northwest and west, as depicted in Figure 3. The heterogeneous character of the stratigraphic units makes correlation and distinction of individual beds difficult even within short distances, however what is most important to note that the units are in hydrologic continuity (Shafer and USGS, 1968) as shown in Figure 4 and therefore recharge and recovery of an ASR program are likely to impact not only the direct storage zone but adjacent units. This hydro-geologic framework provides a desirable structure for multiple interval well screening to optimize well production performance. The rate of movement of groundwater ranges from tens to hundreds of feet per year, depending on the hydraulic gradient, permeability of sediments, and other factors (Shafer and USGS, 1968). Groundwater flow is in a southeasterly manner towards the Gulf of Mexico.

Water levels in the Gulf Coast aquifer in Nueces County fluctuate as a result of changes in rates of recharge, pumping, and barometric pressure. As shown in Figure 5, there is only one TWDB-registered well within the District area with water level measurements. For this reason it is difficult to determine the current water level and historical water level fluctuations within the study area, but it is estimated to be 10 to 40 feet below land surface based on Well # 8312701 and # 8322801 records.

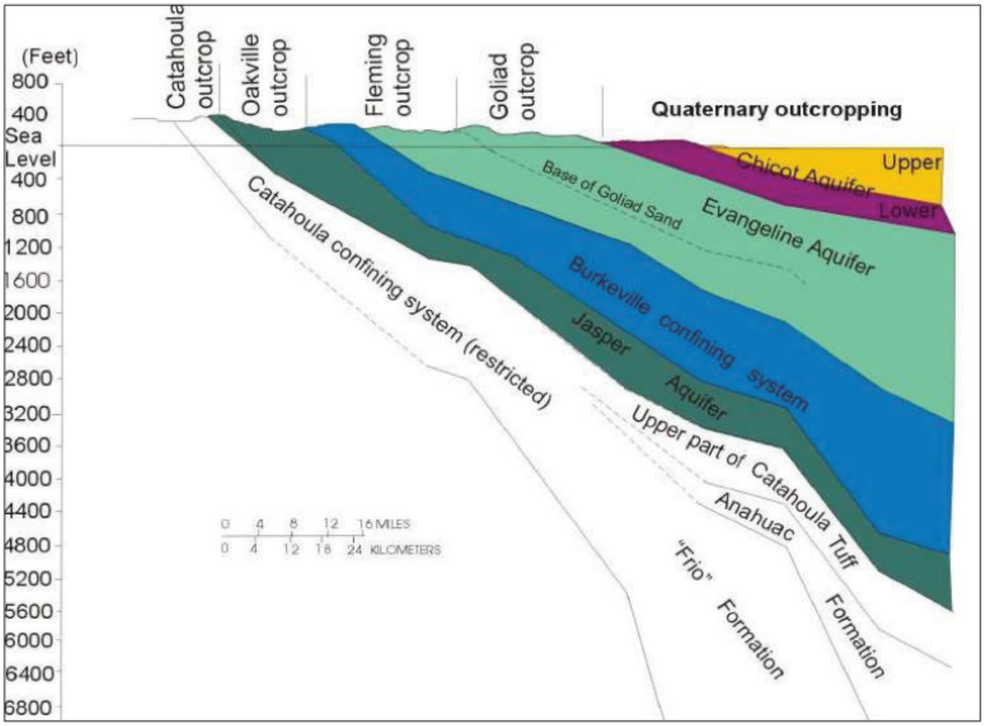
The Evangeline aquifer is the most productive water-bearing hydrogeologic unit in the Gulf Coast Aquifer, with well yields of around 800 gallons per minute (gpm) reported in the Nueces and San Patricio County vicinity as compared to 430 gpm reported for Chicot wells (TWDB, 2012). In the study area, the top of the Evangeline aquifer is roughly 400 to 700 feet below land surface[3] as shown in Figure 6. The Chicot aquifer overlays the Evangeline, and while it provides suitable supplies for domestic and livestock purposes, from a long-term perspective the Chicot aquifer does not present the most desirable long-term storage opportunity for an ASR system.

[3] Land surface in the study area is close to sea level at 0-10 ft-msl.

System	Series	Stratigraphic Units (TWDB, 2012)	Hydrogeologic Units Galloway (1991)	Estimated Thickness near Study Area (USGS, 1968)	Rock Characteristics	Water-bearing Property Columns	
Quaternary	Pleistocene	Alluvium/ Beaumont Clay	Chicot Aquifer	100-200	Clay, interbedded with layers of medium to fine sand.	Yields small to moderate quantities of fresh to moderately saline water.	Gulf Coast Aquifer
		Lissie Formation		200-300	Clay, sandy clay, sand and gravel.	Yields small to large quantities of fresh to slightly saline water.	
Tertiary	Pliocene	Willis		200-400	Sand, gravel, sandy clay, and clay.		
		Goliad Sand	Evangeline Aquifer	600-2,400(?)	Sand and sandstone interbedded with gravel and clay.	Capable of yielding moderate to large quantities of fresh, slightly saline , and saline water.	
	Miocene	Fleming/ Lagarto	Burkeville Confining System	3,600+(?)	Clay, silty calcareous clay, and interbedded sand and gravel. Caliche in the outcrop.	Yields small to large quantities of slightly saline to saline water.	
		Oakville Sandstone	Jasper Aquifer	3,000+(?)	Fine to coarse sand, sand-stone and clay.	Capable of yielding moderate to large quantities of slightly saline to saline water.	
	Oligocene	Catahoula Tuff	Catahoula Confining System	3,000+(?)	Predominantly tuffaceous clay and tuff, locally sandy clay, bentonitic clay, and thin beds of sand and conglomerate.	Yields small to moderate quantities of saline water.	

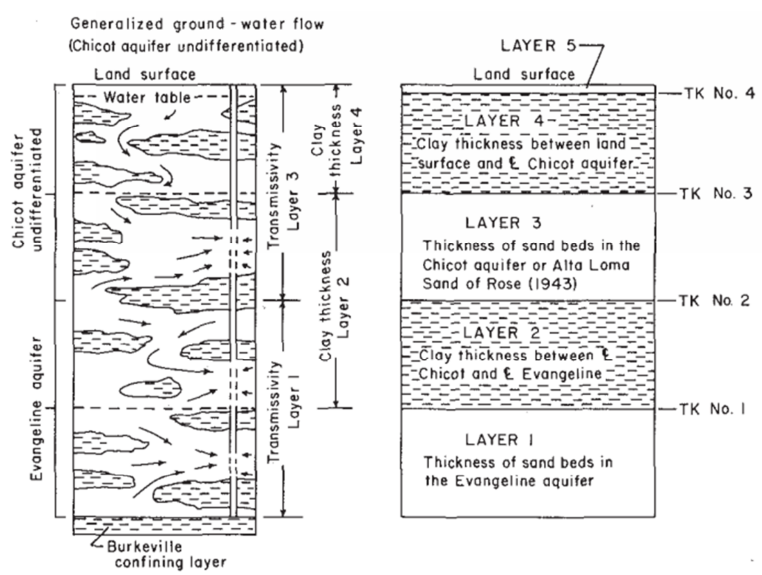
Figure 2 Gulf Coast Aquifer Water Bearing Properties near Project Study Area[4]

[4] Adapted from Baker and USGS, Stratigraphic and Hydrogeologic Framework of Part of the Coastal Plain of Texas, 1979.



Source: CCASRCD Groundwater Management Plan, 2014.

Figure 3 Cross Section of the Central Gulf Coast Aquifer (from West to East towards the Coast)



Source: USGS, 1985.

Figure 4 Hydrogeologic Conceptualization of the Gulf Coast Aquifer

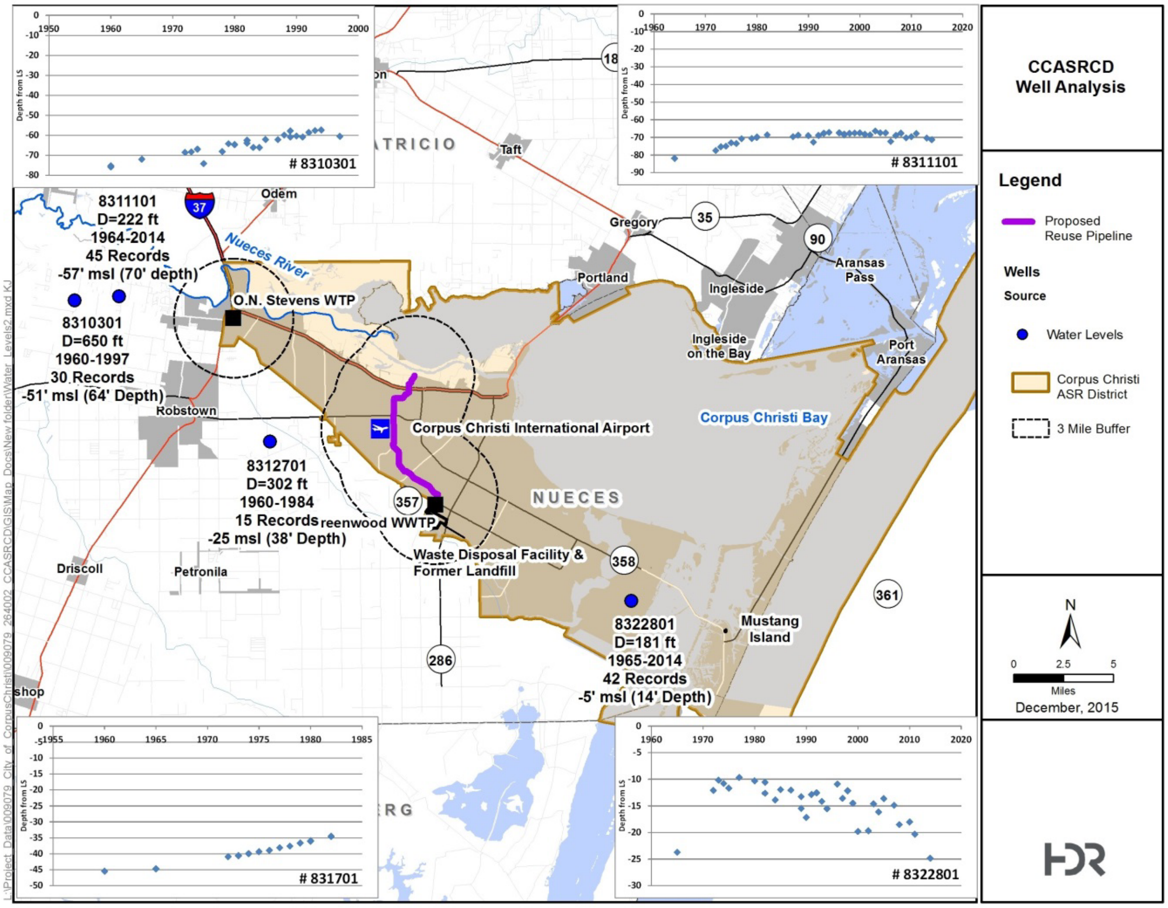
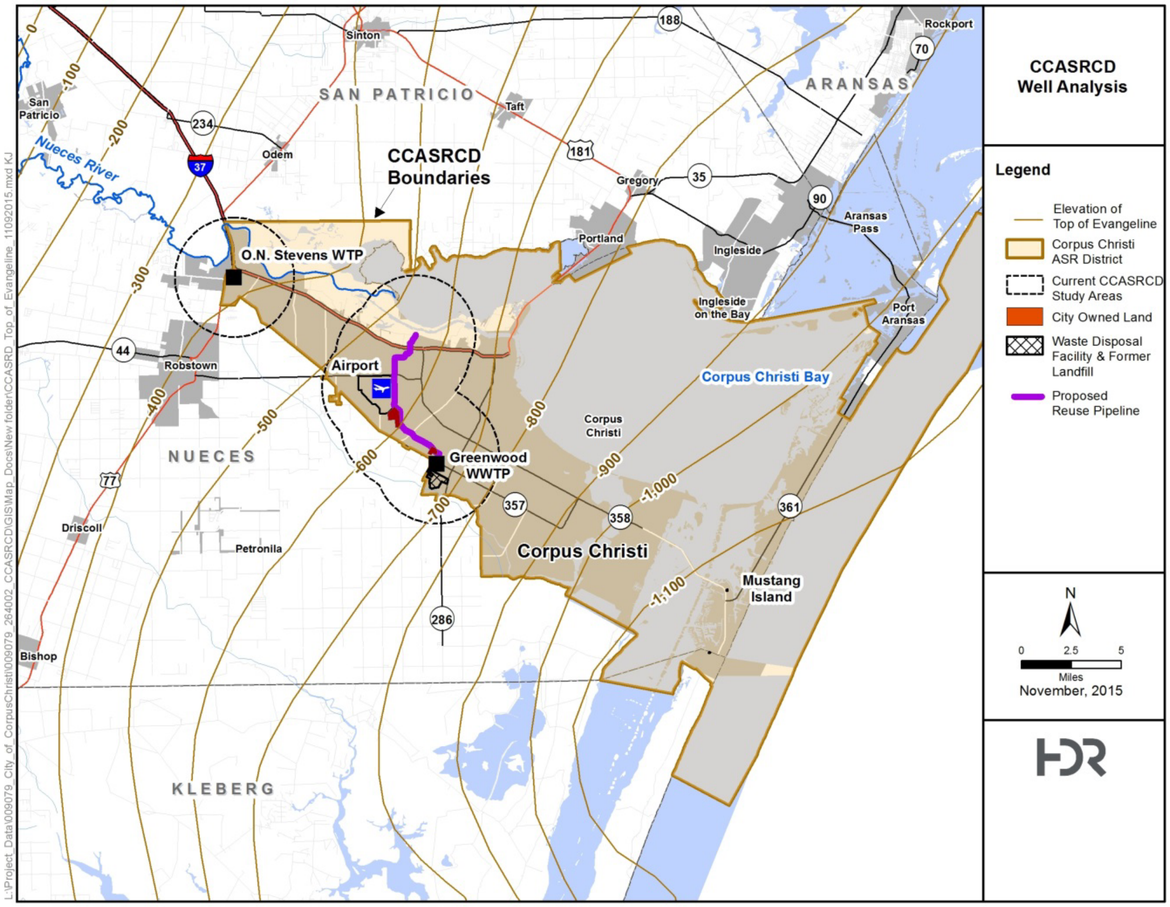


Figure 5 Historical Water Levels Near the District Area



Source of top elevation contours: United States Geological Survey, 1985.

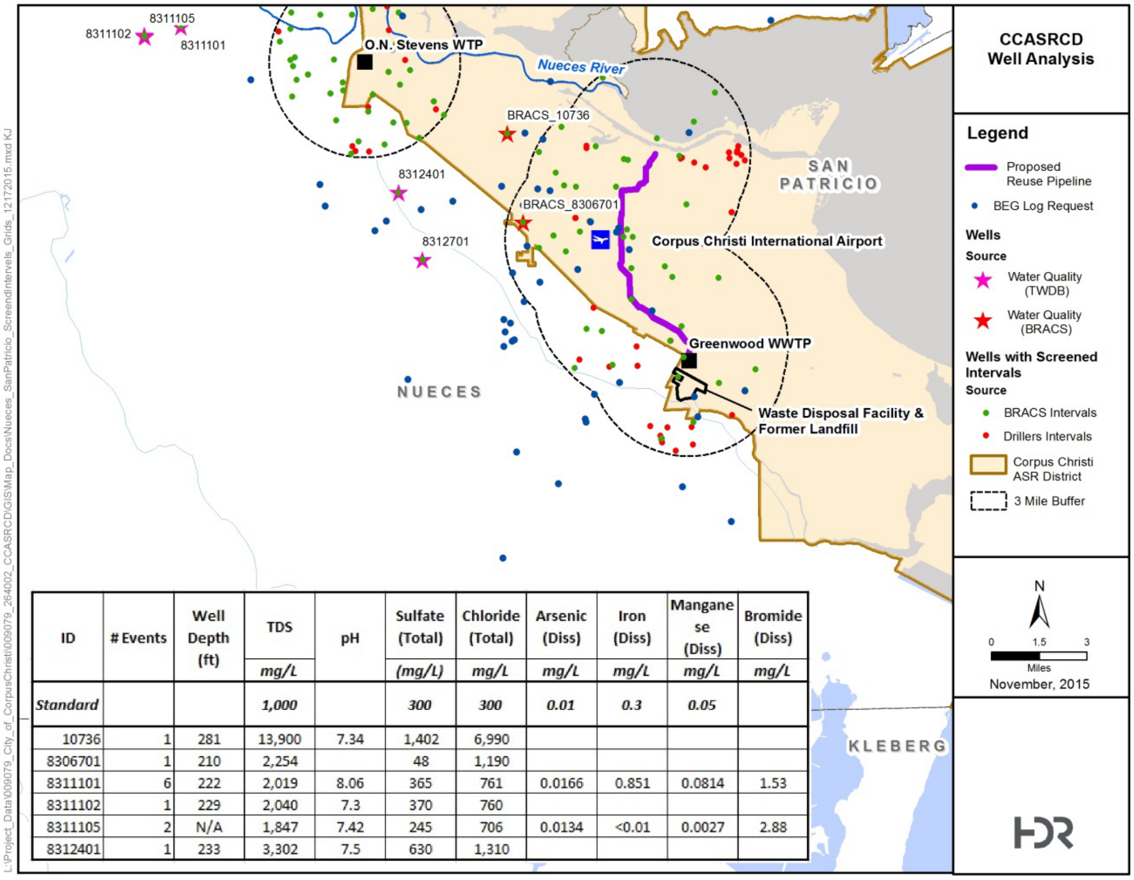
Figure 6 Top of Evangeline Aquifer in the Study Area Vicinity

2.2 Groundwater Quality and Local Well Setting

Groundwater quality is derived principally from groundwater movement through the aquifer and contact with rocks and soil that come in contact with the water. As the water moves deeper, mineral content of the water increases (Shafer and USGS, 1968).

Information on existing wells was obtained through the TWDB registered well database, BRACS, Drillers databases[5], and Bureau of Economic Geology Geophysical Log Library. Although numerous wells were identified in the study area, most of the wells are shallow (less than 200 feet) and data from these wells are not considered comparable to the aquifer characteristics in deeper zones where ASR storage is more desirable. Figure 7 shows wells deeper than 200 feet in the project area. Of these wells, only two reported water quality measurements within the District boundaries. The TDS concentrations range from 2,254 mg/L and 13,900 mg/L for well depths of 210 ft and 281 ft, respectively, and neither of these are screened in the Evangeline aquifer. In a TWDB 2012 study, electric and geophysical logs within the District area were interpreted by the TWDB and the findings

[5] Although the drillers database includes data collected on oil and gas wells and do not provide information on water quality in water-bearing zones, the drillers database includes data on aquifer lithology (or soil type) which was useful in mapping local stratigraphy and hydrogeology in the area as discussed in Chapter 3.



ID	# Events	Well Depth (ft)	TDS mg/L	pH	Sulfate (Total) (mg/L)	Chloride (Total) mg/L	Arsenic (Diss) mg/L	Iron (Diss) mg/L	Manganese (Diss) mg/L	Bromide (Diss) mg/L
Standard			*1,000*		*300*	*300*	*0.01*	*0.3*	*0.05*	
10736	1	281	13,900	7.34	1,402	6,990				
8306701	1	210	2,254		48	1,190				
8311101	6	222	2,019	8.06	365	761	0.0166	0.851	0.0814	1.53
8311102	1	229	2,040	7.3	370	760				
8311105	2	N/A	1,847	7.42	245	706	0.0134	<0.01	0.0027	2.88
8312401	1	233	3,302	7.5	630	1,310				

Source of water quality: TWDB registered well database.

Figure 7 Water Quality Results within the Vicinity of the Study Area

showed that resistivity is consistently 3 ohm-meters (10,000 mg/L TDS) or less for sand layers up to 1,000 ft depth (TWDB, 2012). Although ASR can be developed in saline aquifer systems, density stratification of recharged fresh water as compared to saline native groundwater reduces recovery efficiency especially with increasing duration of storage (Pyne, 2005). For this reason, the target zone for ASR storage is from 400 and 1,000 feet below land surface near O.N. Stevens and 600 to 1,000 feet below land surface closer to the Greenwood WWTP.

2.3 Hydraulic Properties and Well Yield

The TWDB's study (TWDB, 2012) collected hydraulic properties for 242 Gulf Coast aquifer wells in the San Patricio and Nueces County area, as summarized in Table 1. These hydraulic properties were added by the TWDB to the BRACS database (CCASRCD tables). As discussed previously and shown in Table 1, the average yield for wells screened in the Evangeline is about 800 gpm which includes wells located in San Patricio County where sand are generally thicker than those encountered in Nueces County and near the delta. The yield of wells located within the CCASRCD are anticipated to be closer to 400 to 500 gpm, with higher yields expected in areas with wells screened at multiple depth intervals in sands with thicknesses in excess of 100+ feet per interval.

Table 1 Hydraulic Properties of Aquifers Near the CCASRCD

Hydraulic Property	Chicot	Chicot and Evangeline	Evangeline
Transmissivity- gpd/ft (avg)	3,030 – 3,930 (3,560)	3,700 – 24,200 (10,100)	4,410 – 20,600 (7,875)
Hydraulic Conductivity- ft/d (avg)		1.8 – 20.9 (10.7)	5.7 – 15.4 (8.9)
Well Yield- gpm (avg)	2 – 1,500 (216)	10 – 1,800 (434)	15 – 3,000 (795)

Source: TWDB, 2012.

3 Geophysical Log Interpretation

Sand thickness is an important index of how readily an aquifer is recharged or withdrawn during ASR operations. Geophysical logs were used to identify sand thicknesses and estimated water quality beneath the three study areas within the District to prepare a preliminary assessment of ASR feasibility.

3.1 Method

Geophysical logs were used to identify stratigraphy, lithology, and estimated salinity in the areas within and surrounding the three study areas. Stratigraphy refers to the aquifer sub-units discussed previously (Figure 2) that together comprise the Gulf Coast Aquifer. Lithology describes the physical characteristics of the aquifer (sand, silt, and clay). Stratigraphy picks were taken directly from the TWDB geophysical log database and extrapolated between wells. Lithology picks were chosen based on the Spontaneous (Self) Potential (SP) log and resistivity log from each well. The method for analyzing logs is based on Driscoll, 1986. The analyzed SP logs usually exhibited a “baseline” with deflections of decreasing millivolts to the left of the baseline. The baseline represents clay layers, while deflections represent sand. The larger the deflection on the SP log to the left, the greater the sand content. The deflections are less defined in the upper sections of the boreholes where there is little difference in the salinity of the drilling fluids and the ambient aquifer water quality, as there is little difference in the electrical potential of the introduced and ambient water quality. The SP log deflections become greater as the ambient water quality becomes more saline and has greater contrast with the water used for drilling. The interpretation is qualitative based on the deviation from the baseline (associated with clay) and an absolute millivolt value cannot be placed on the materials. An example of a SP log interpretation from this study, well 13408, is shown in Figure 8.

At shallower, or depths with potable to brackish water, the resistivity log will become more resistive (less conductive) in more permeable zones and also show greater differences between shallow and deep resistivity. The resistivity log, in conjunction with SP log, at shallower fresher water depths can be analyzed in tandem to produce a better qualitative interpretation. As the formation water becomes more saline, the overall resistivity signature becomes less pronounced due to the overall saturation of higher salinity water causing sand and clay layers to both become more conductive.

Both logs can be used to qualitatively determine the increase in salinity with depth. The SP deflections become more pronounced in sand zones and the resistivity log becomes more conductive, regardless of lithology. Most of the logs analyzed exhibited these qualities below 900 to 1,000 feet. This correlates well with data from the TWDB.

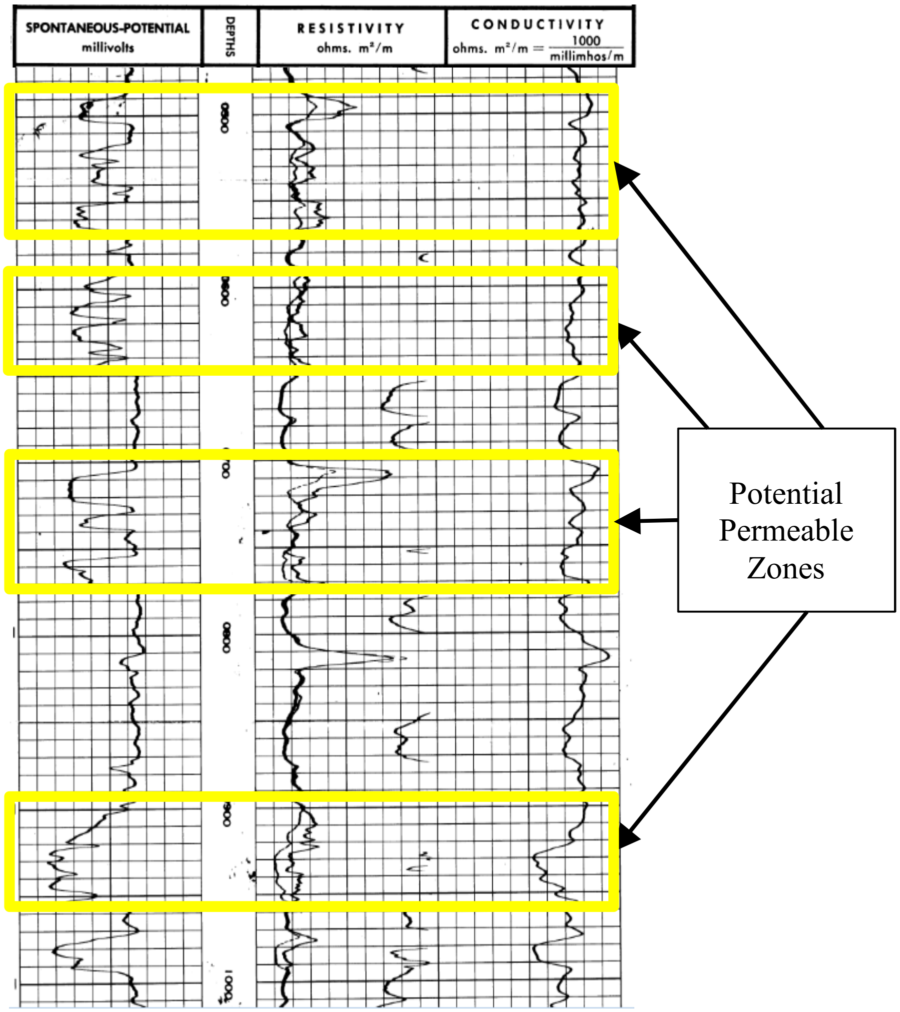


Figure 8 Example of a Well Log Interpreted in the Study Area (Well ID 13408)

3.2 Results

HDR compiled existing well information from publicly available databases (TWDB registered well, BRACS, and Drillers) in addition to logs from the Bureau of Economic Geology Geophysical Log Library. Wells with geophysical logs or identified aquifer properties located within the vicinity of the District are shown in Figure 9. Since most geophysical logs were recorded for oil and gas purposes, log records often begin at the bottom of surface casing which can be several hundred or thousand feet deep. In these instances, little to no information is included for the shallower, water-bearing zones of interest. Cross sections presented below show depths not logged as "No Record" or "Undefined". HDR obtained 60 geophysical logs which were interpreted to identify the occurrence and thickness of sand zones and confining clay/silt layers and fresh and saline zones in the vicinity of the three study areas. Thirty-two (32) geophysical logs were deemed good candidates for interpretation[6] as shown in Figure 10. These logs were used to develop cross sections to characterize aquifer conditions for the three study areas.

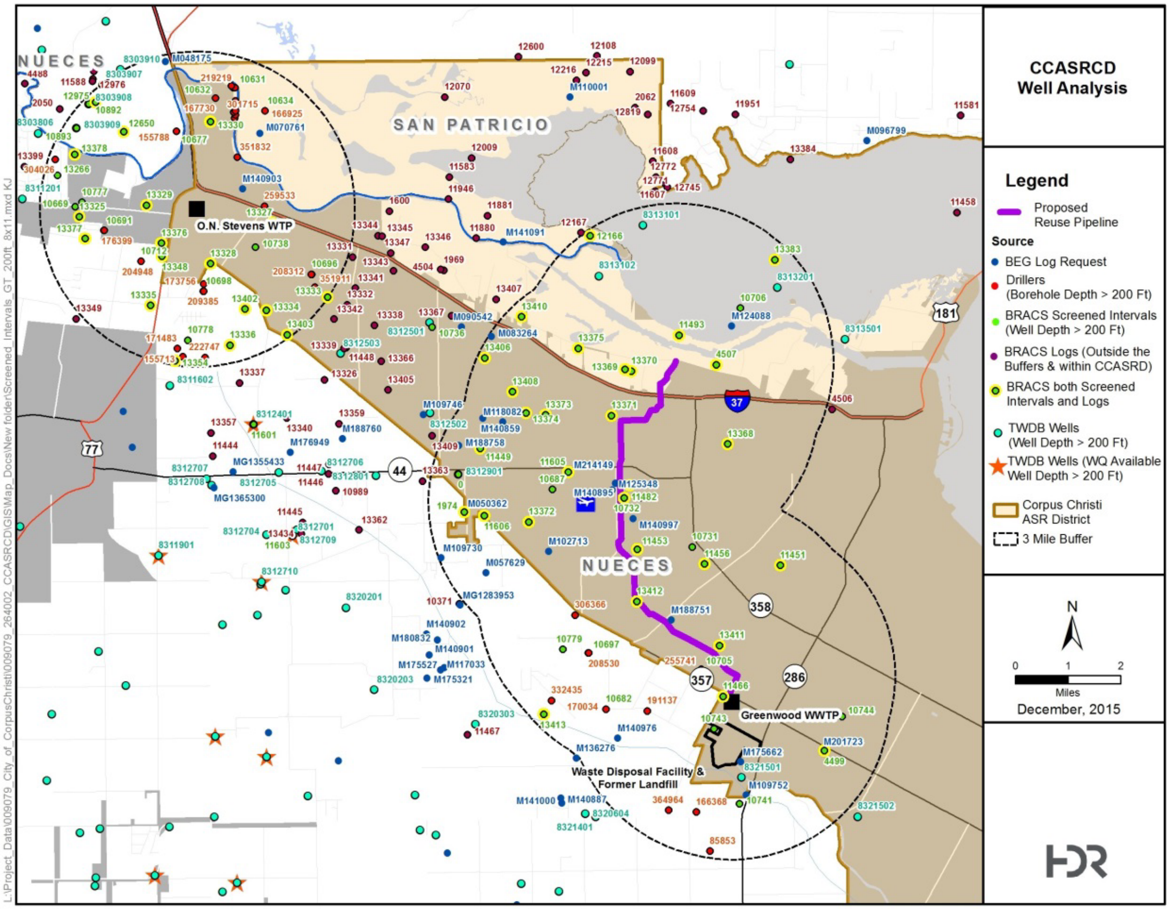


Figure 9 Existing Wells Located within the Vicinity of the Project Area

6 The criteria used to determine if a geophysical log was a good candidate for interpretation included: legibility and readings within a target zone from land surface to 1,200 ft-bls.

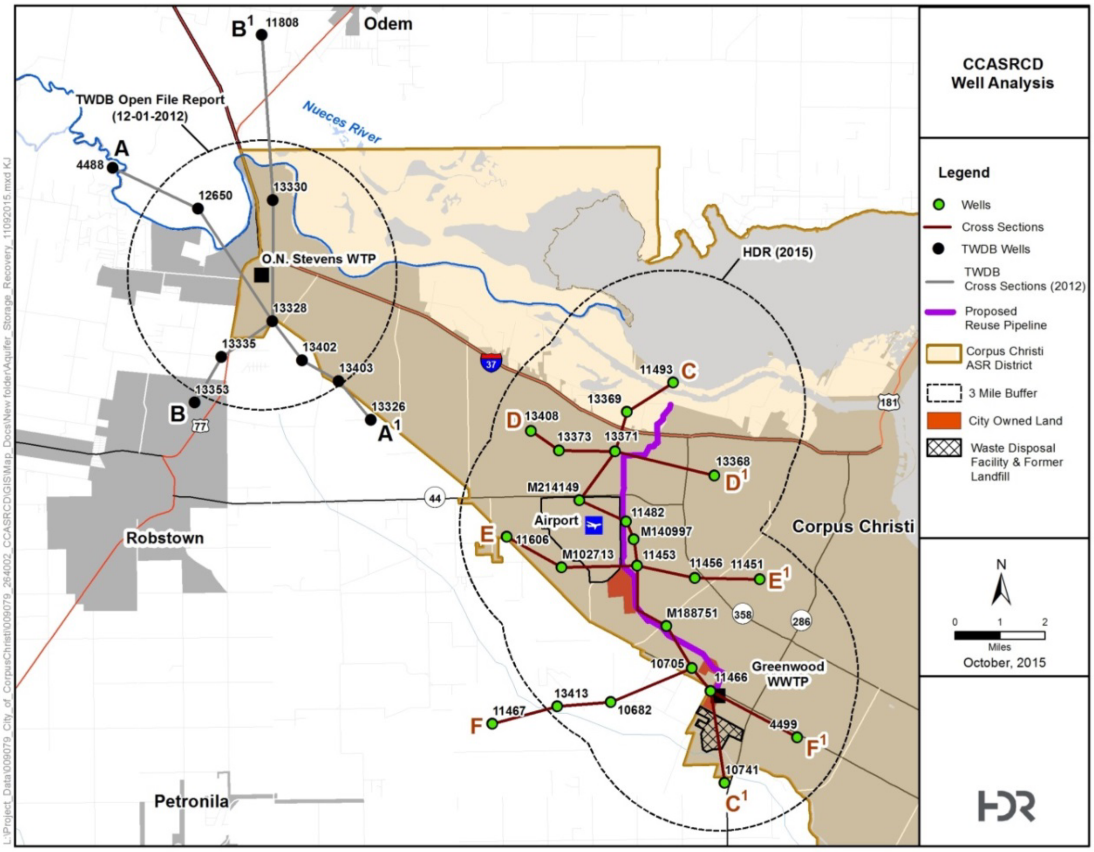


Figure 10 Cross Sections for Geophysical Log Interpretations

3.2.1 O.N. Stevens WTP Study Area

The TWDB (2012) study included two cross sections for the O.N. Stevens WTP study area. HDR reviewed and verified the TWDB interpretation to be appropriate for study purposes. Based on previous discussions, the target depth range for ASR in this area is 400 feet to 1,000 feet which is within the Evangeline aquifer and at estimated water quality less than 10,000 mg/L TDS. As shown in Figure 11, the most favorable sand thicknesses are located near the City of Robstown (ID 13353) and Nueces River (ID 4488). Neither of these areas is considered desirable for ASR. Also, areas near the Nueces River would need to be evaluated for surface and groundwater interaction and environmental impacts. The net sand thickness containing slightly saline water is considered very low, between 50 and 100 feet, interspersed with clay layers. Due to the high variability and thin sand layers with frequent intermittent clay, the O.N. Stevens WTP area is not considered as a favorable area for ASR.

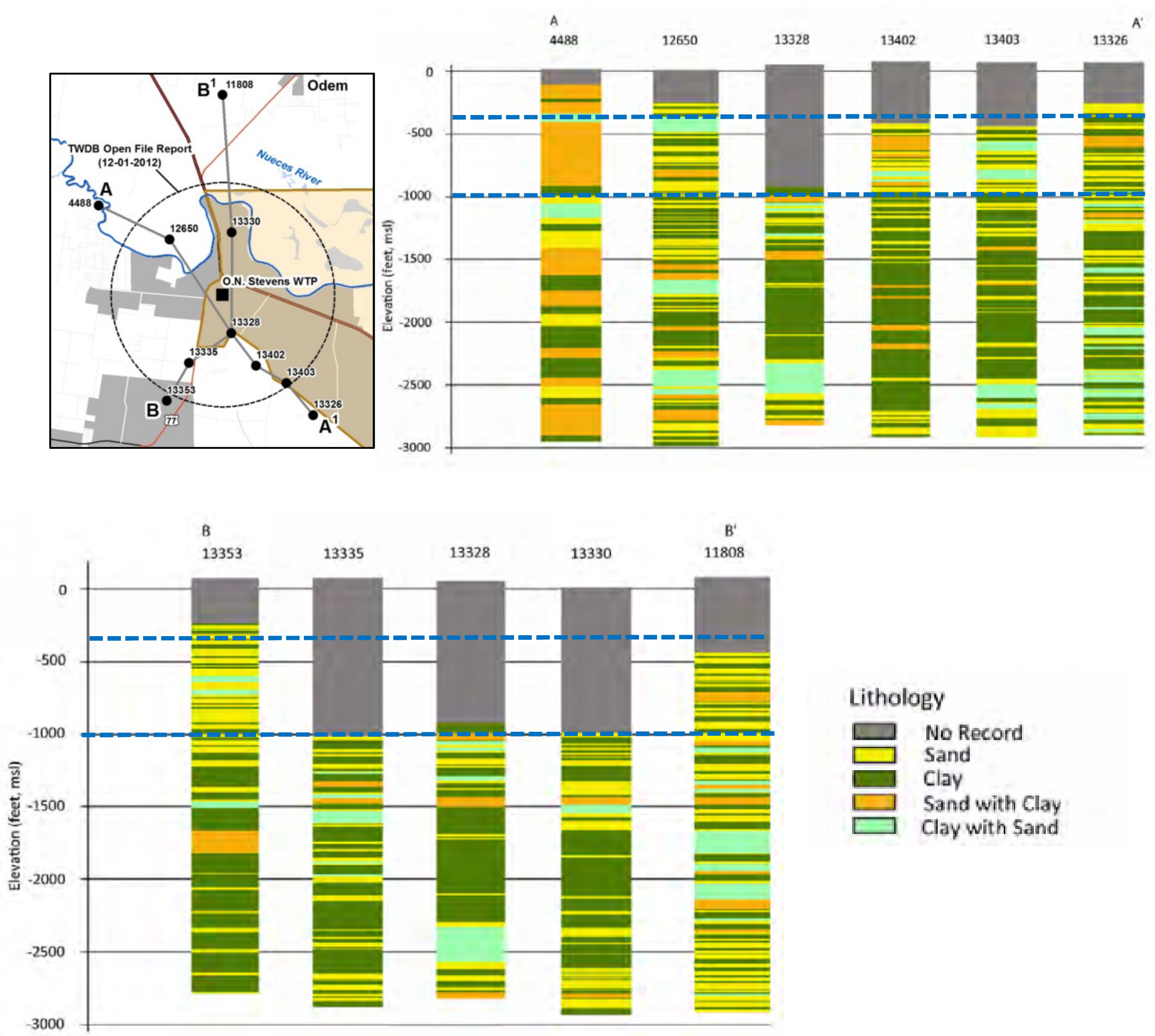


Figure 11 Cross Section A – A' and B – B' for the O.N. Stevens WTP Area (dashed lines represent range of target depths for ASR)

3.2.2 Corpus Christi International Airport and adjacent to Proposed Reuse Pipeline

HDR developed four cross sections for the area near Corpus Christi International Airport, proposed reuse pipeline to the Corpus Christi Ship Channel, and Greenwood WWTP (Figures 12 through 15). The target depth range for ASR near the Corpus Christi International Airport and proposed reuse pipeline area is around 500 feet to 1,000 feet, which is within the Evangeline aquifer at estimated water quality less than 10,000 mg/L TDS. The area near 11482 in Cross Section C - C[1] (Figure 12) shows potential. The north part of the area near the Nueces Delta consists of alluvial sands that provide little long term yield. Other than north of the airport near 13373 (Figure 13), the area close to the Nueces Delta shows less promise for ASR development. It is estimated that the most favorable area for ASR is located east of the airport (Figure 14) where greater sand thicknesses are reported. The area near the airport is inconclusive, but recommended for further investigation.

3.2.3 Greenwood WWTP

As mentioned previously, HDR developed four cross sections for areas near the Greenwood WWTP and proposed reuse pipeline to the Corpus Christi Ship Channel (Figures 12 through 15). The target depth range for ASR in the Greenwood WWTP area is 600 feet to 1,000 feet which is within the Evangeline aquifer at estimated water quality less than 10,000 mg/L TDS. As shown in Figure 15, the most favorable sand thicknesses near the Greenwood WWTP are located northwest of the plant (between 10682 and 10705). The net sand thickness containing slightly saline water is considered low, around 100 feet, interspersed with clay layers. The Greenwood WWTP area may show potential for ASR, but due to the high amount of irregularity over short distances and thin sand layers with frequent intermittent clay a site-specific characterization is important to determine ASR feasibility.

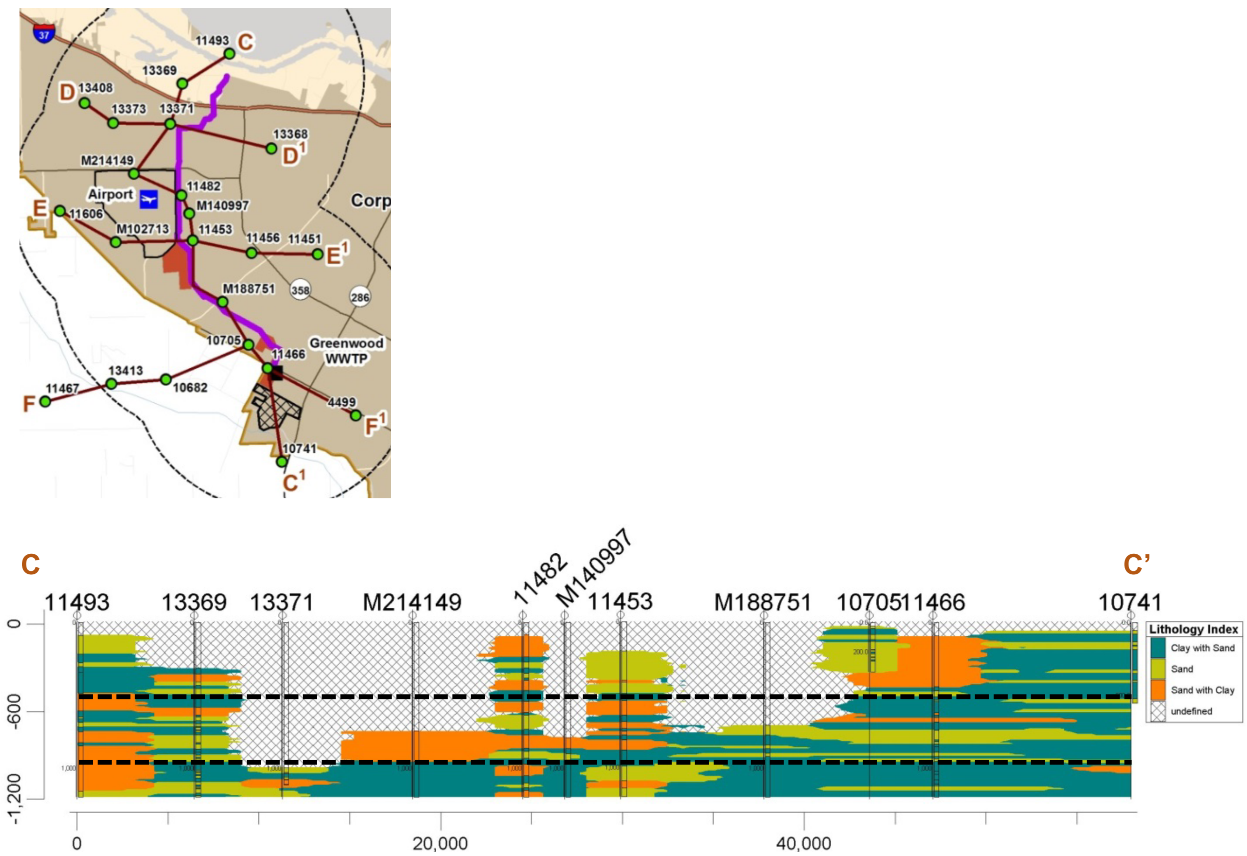


Figure 12 Cross Section C – C' (North to South) along the Proposed Reuse Pipeline Project (dashed lines represent range of target depths for ASR)

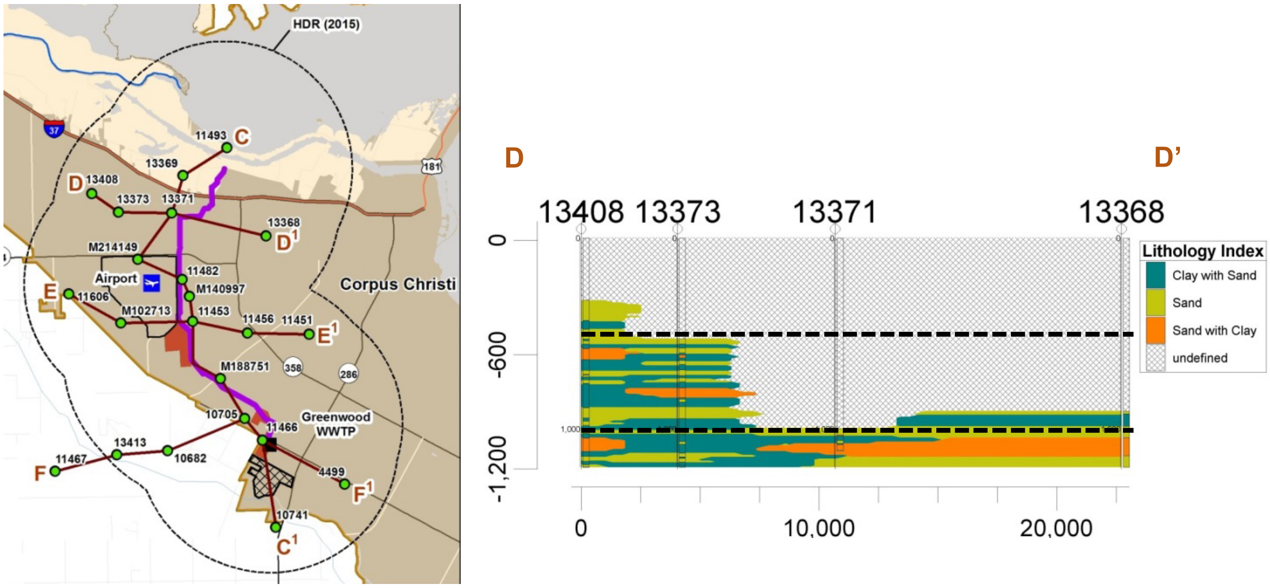


Figure 13 Cross Section D – D’ (West to East) for an area North of the Corpus Christi International Airport (dashed lines represent range of target depths for ASR)

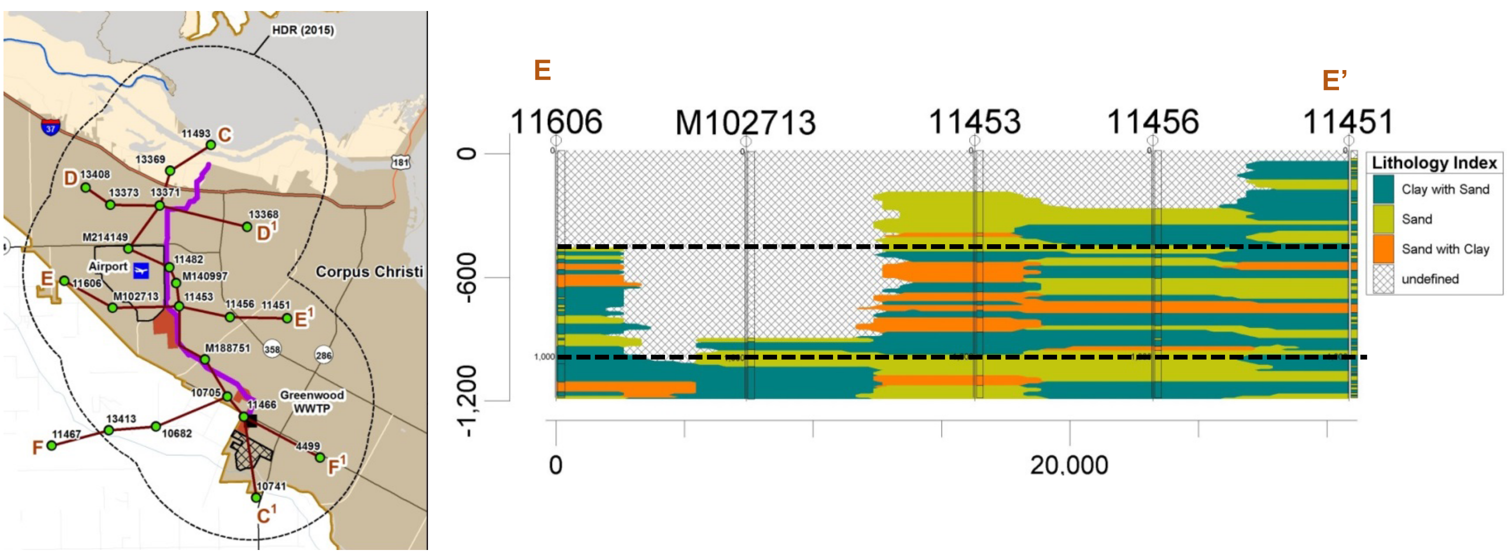


Figure 14 Cross Section E – E’ (West to East) for an area near the Corpus Christi International Airport (dashed lines represent range of target depths for ASR)

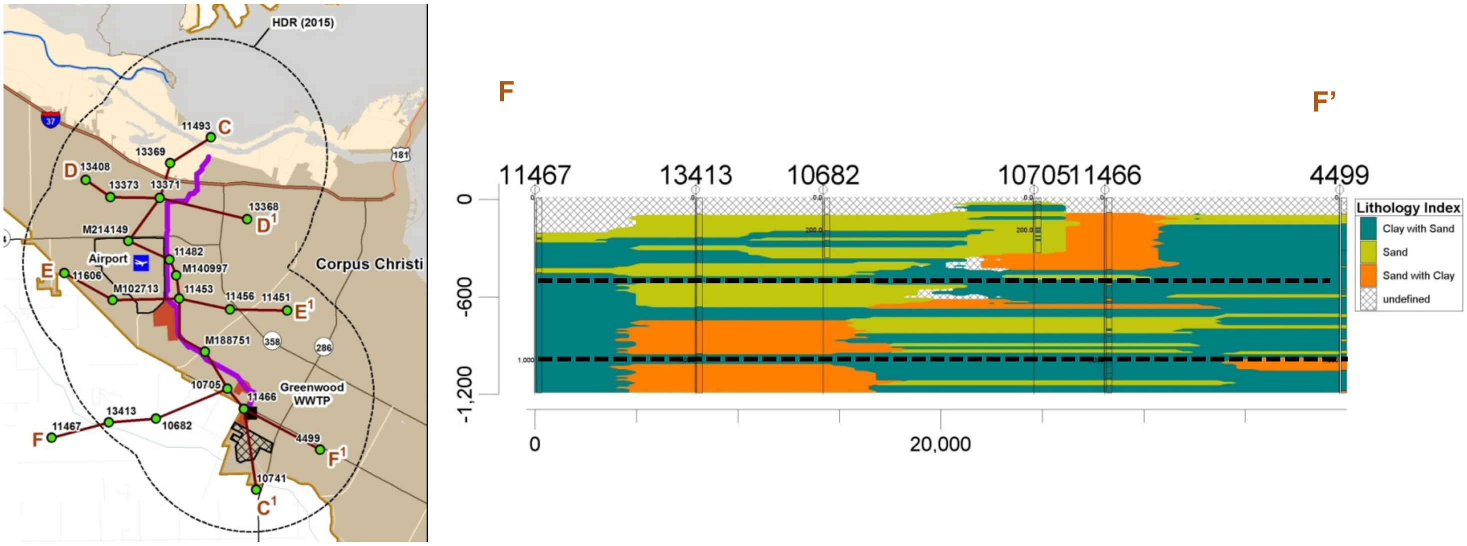


Figure 15 Cross Section F – F’ (West to East) Greenwood WWTP (dashed lines represent range of target depths for ASR)

4 Summary and Recommendations

Aquifer storage and recovery (ASR) is a long-term water supply strategy that can be effectively integrated into the City’s regional water supply system to achieve long-range water planning goals. Determining the feasibility of ASR is important to the District and the City for the following reasons:

- ASR promotes diversification of regional water supplies – The City’s existing system relies solely on surface water supplies from the Nueces, Lavaca-Navidad, and Colorado River Basins. ASR can be used conjunctively to minimize evaporative losses and to protect against impacts of future droughts.
- ASR helps provide cost-effective regional water supplies to meet competing demands – The proposed location for ASR feasibility is near existing City infrastructure and proposed infrastructure to serve industries along the Corpus Christi Ship Channel.
- ASR improves system operations and reduces annual operating costs – Several industrial processes have seasonal production periods that cause variability (and peaks) in water usage. ASR can provide additional water from storage when needed and reduce peaking on water system operations.

The most favorable area for ASR within the District boundaries based on this study is east of the Corpus Christi International Airport and north of the Greenwood WWTP along the southern segment of the proposed reuse pipeline, as shown in Figure 16, where multiple sand intervals have been identified at depths of 600 to 1,000 feet. Due to the high amount of irregularity over short distances and thin sand layers with frequent intermittent clay a site-specific characterization is important to determine ASR feasibility. The net sand thickness containing slightly saline water is considered low, around 100 to 200 feet, interspersed with clay layers. For this reason, well screens with multiple intervals will be necessary for ASR development.

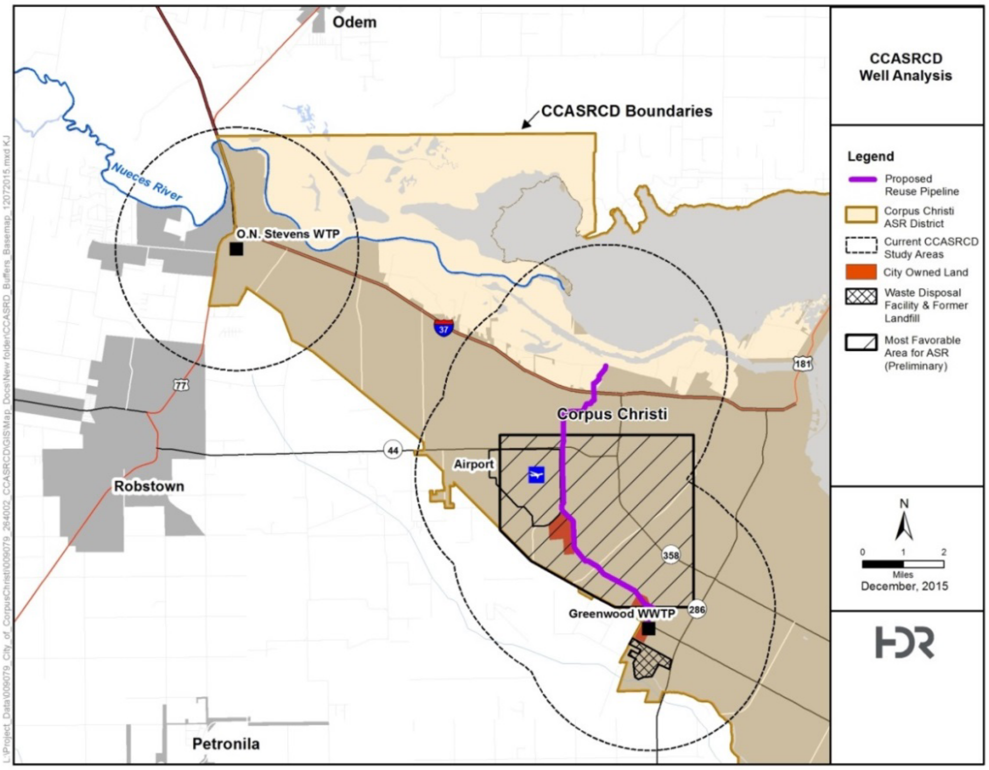


Figure 16 Most Favorable Area for ASR

The actual yield of an ASR project in this area is subject to site-specific aquifer conditions, which requires an exploratory testing program to confirm. However, based on this preliminary study it is estimated that a 5 mgd ASR project is feasible, which would require 10 wells[7] based on the previous hydraulic properties discussion in Chapter 2. A potential well configuration is shown in Figure 17. The configuration was selected to minimize well-field piping, provide flexibility for longer-term operation of ASR storage (1-2 years), utilize City-owned lands, and target the area east of the Airport where higher sand thicknesses are most prevalent to depths of 1,000. It assumes that wells 1 through 4, and 8 are located 500 feet from the treated reuse pipeline. All wells are spaced approximately 2,500 feet from each other. High density and residential areas are to be avoided, if possible. The total project cost is estimated to range from $9,200,000 to $13,800,000[8]. This cost estimates assumes utilization of the existing transmission pipeline to deliver water to and from the ASR wells and minimal water treatment.

HDR recommends conducting a multi-phased site-specific feasibility study to include the following major work items:

- exploratory/test drilling program,
- geochemical analysis and modeling, and
- development and application of a field-scale groundwater model to simulate ASR operations and recovery efficiency.

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7 This includes one well (10%) for contingency for operations and maintenance purposes.

8 The project cost is for a constructed project, and excludes the cost of the multi-phased site-specific feasibility study.

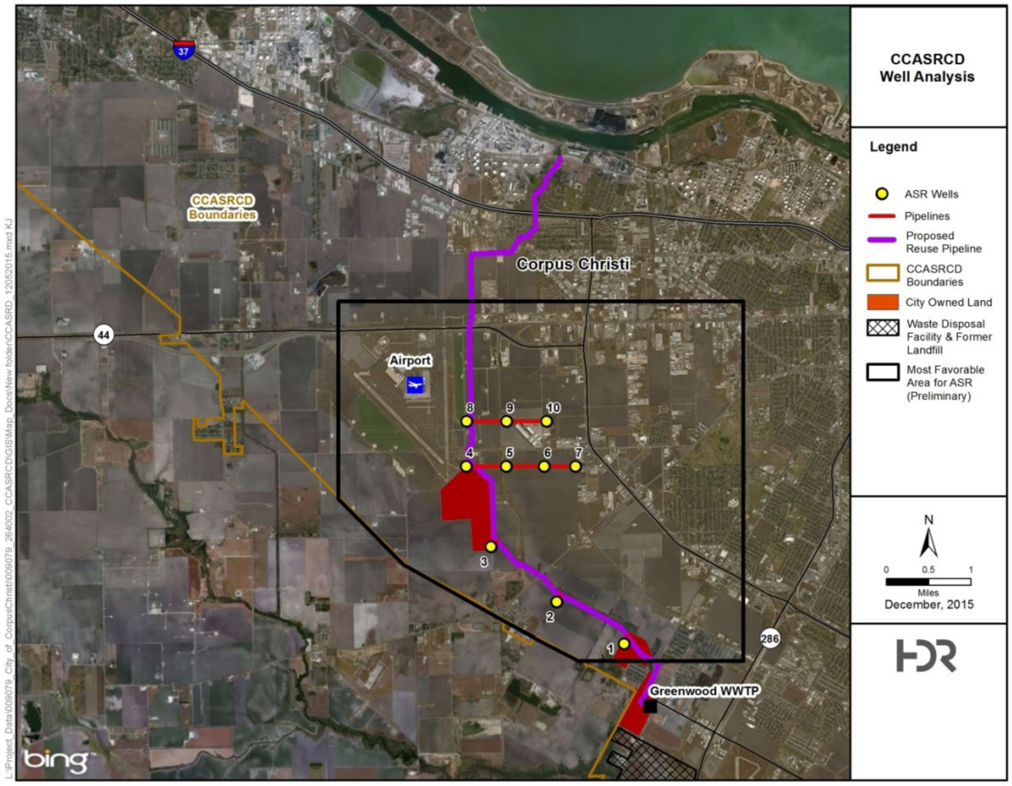

Figure 17 Potential Well Field Configuration for 5 mgd ASR Project

The exploratory/test drilling program is recommended to confirm aquifer yield and water quality conditions and identify multiple intervals with high sand content to target for ASR development. The recommended exploratory testing program includes drilling up to 3 exploratory boreholes completed to a depth of 1,200 feet to assess the geology, hydrogeology, water quality, and geochemistry. The test drilling program will be used to assess potential storage zones for treated water and also confining intervals that will limit vertical movement of water from the storage zone.

If the test borehole is completed as a monitor well for the ASR system, the screened zone will be fully developed to yield water quality samples representative of ambient groundwater and well development will adhere to ASTM guidelines.

Geochemical analysis is an important step in evaluating ASR feasibility. Its purpose is to determine the compatibility of treated, source water for storing within the native aquifer setting. First, the introduction of recharge water that is of a different quality than the native groundwater can result in reactions that lead to clogging of the near-well pore space. Clogging will result in increased pressures and reduced recharge capacity for the well. Second, recharge water can react with the soil media to mobilize undesirable constituents, increasing their concentration in the water when it is recovered. Geochemical modeling is recommended to determine whether either of these situations is likely to occur, and what operational approaches, water treatment, and/or aquifer conditioning might be necessary. A pH and/or slight change in the recharge water chemistry at the well head is sometimes necessary to stabilize the aquifer matrix or promote the retention of trace metals, metalloids and other deleterious constituents in the aquifer.

A potential concern with ASR operations is the mobilization of arsenic in groundwater in response to changes in aquifer geochemistry caused by the introduction of the recharge water. Changes in groundwater chemistry can affect the solubility of compounds that naturally occur, but are stabilized in aquifer formations. When these stabilized minerals are in the aquifer, it may be necessary to change the oxidation/reduction potential of the recharge water (pH and dissolved oxygen) to avoid mobilization of undesired constituents.

Finally, groundwater modeling is necessary to simulate storage and recovery operations to develop preferred operating parameters of ASR in accordance with CCASRCD's goals. Below approximately 1,000 feet, groundwater salinity increases substantially (Meyer, 2012), and the potential impacts of recharge waters mixing with higher salinity water becomes greater, which would decrease the recovery efficiency of the ASR system. If density effects are found to be important based on results of the exploratory testing and geochemical modeling, then a groundwater model known as SEAWAT will be used to consider density effects during transport.

5 References

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