Post Oak Savannah Guidance Document for Evaluating Compliance with Desired Future Conditions and Protective Drawdown Limits

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August 2018

Version 2.0

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1 INTRODUCTION

This guidance document describes Post Oak Savannah Groundwater Conservation District (POSGCD) field protocols for measuring water levels and POSGCD technical analyses for evaluating measured water levels from its groundwater monitoring network to determine compliance with Desired Future Conditions (DFCs) and Protective Drawdown Limits (PDLs). This document is an overview of these protocols and analyses and is not intended to be an instruction manual.

The methodologies provided in this document were discussed and approved through a series of presentations at POSGCD DFC committee and board meetings throughout 2017 and early 2018 and have incorporated comments from board members and the public. The document also addresses comments received from Groundwater Management Area (GMA) 12 Groundwater Conservation Districts (GCDs) in early 2019. The document is intended to be a dynamic document that will be continually updated in response to new information and changes in site conditions. Adjustment to the methodologies are permitted by POSGCD as long as the reason for the adjustment is properly noted in the documentation for the data collection and analysis.

1.1 Desired Future Conditions

As described in Section 7 of its Management Plan, the POSGCD DFCs are listed in **Tables 1-1** through **1-4**. The DFCs in Tables 1-1 through 1-3 were adopted by GMA 12. The DFCs in Table 1-4 were adopted by GMA 8.

Table 1-1 GMA 12 and POSGCD adopted DFCs based on the average drawdown that occurs between January 2000 and December 2069

Aquifer	Drawdown (ft)
Sparta	28
Queen City	30
Carrizo	67
Upper Wilcox (Calvert Bluff Fm)	149
Middle Wilcox (Simsboro Fm)	318
Lower Wilcox (Hooper Fm)	205

Table 1-2 GMA 12 and POSGCD adopted DFCs based on the average drawdown that occurs between January 2010 and December 2069

Aquifer	Drawdown (ft)
Yegua-Jackson	100

Table 1-3 GMA 12 and POSGCD adopted DFCs for Brazos River Alluvium Aquifer based on the average decrease in saturated thickness that occurs between January 2010 and December 2069

Aquifer	County	Average Decrease in Saturated Thickness (ft)
Brazos River Alluvium Aquifer	Milam in GMA 12	5
	Burleson in GMA 12	6

Table 1-4 GMA 8 and POSGCD adopted DFCs based on average drawdown that occurs between January 2010 and December 2070

Aquifer	Drawdown (ft)
Paluxy	--
Glen Rose	212
Travis Peak	345
Hensell	229
Hosston	345

1.2 Protective Drawdown Limits

As described in Section 7 of its Management Plan, the POSGCD PDLs are listed in **Table 1-5**. Neither GMA 12 nor GMA 8 has established DFCs for the shallow or unconfined zones of the aquifers. The District developed the PDLs to protect the production capacity of existing wells in the shallow unconfined portions of the aquifer, where the water level above the well screen tends to be less than in the deep confined portions of the aquifer. The District created shallow management zones for each aquifer, except for the Brazos River Alluvium and Trinity aquifers. Each of the shallow management zones includes the portion of the aquifer that occurs at a depth of 400 feet or less, as measured from land surface.

Table 1-5 Protective drawdown limits threshold values for average drawdown for the shallow management zones

Aquifer	Average Drawdown (ft) that Occurs between January 2000 and December 2069 in the Shallow Management Zone
Sparta	20
Queen City	20
Carrizo	20
Upper Wilcox (Calvert Bluff Fm)	20
Middle Wilcox (Simsboro Fm)	20
Lower Wilcox (Hooper Fm)	20
Yegua	20
Jackson	20

2 MONITORING PERFORMANCE STANDARDS DEFINED IN POSGCD MANAGEMENT PLAN

The District will use measured water levels in its monitoring wells to determine its progress in conforming with its DFCs at least once every three years. This commitment is stated in Section 15.9 of POSGCD's Management Plan and is provided below:

> *"At least once every three years, the general manager will report to the Board the measured water levels obtained from the monitoring wells within each Management Zone, the average measured drawdown for each Management Zone calculated from the measured water levels of the monitoring wells within the Management Zone, a comparison of the average measured drawdowns for each Management Zone with the DFCs for each Management Zone, and the District's progress in conforming with the DFCs. (from Section 15.9 from POSGCD Management Plan"*

While the District Management Plan does not specify a schedule for evaluating compliance with its PDLs, the current POSGCD policy is to evaluate PDL compliance on the same schedule as DFCs.

3 POSGCD GROUNDWATER MONITORING WELL NETWORK

This section describes the monitoring network of groundwater wells that the District uses to measure changes in water levels over time.

3.1 Locations

The POSGCD network of groundwater wells is continually being updated, primarily due to the addition of wells. At the time this document was prepared, the POSGCD Monitoring Well network consists of the 109 wells shown in **Figure 3-1**. **Appendix A** provides information for the 109 wells in Figure 1, including their location, well depth, screened interval, and aquifer assignment. In addition to the 109 wells monitored by POSGCD, the District also utilizes additional monitoring data shared by Lost Pines GCD (6 wells) and Brazos Valley GCD (130 wells) from their District monitoring networks. **Figure 3-2** shows the monitoring wells that are less than 400 feet deep. This subset of the monitoring network is used for the Shallow Management Zone analyses. The POSGCD Monitoring Well network currently has 20 wells equipped with transducers, which collect continuous water level data. **Figure 3-3** shows the locations of POSGCD monitoring wells equipped with transducers.

3.2 Aquifer Assignments

POSGCD defines its aquifers based on the elevation surfaces for the model layers in the groundwater availability models unless there is good cause to use another source of information. Using the information from the groundwater availability models, POSGCD assigns a well to an aquifer (or formation) based on the methodology provided in **Appendix B**. Monitoring wells that are screened over more than one aquifer (or formation) are assigned to the aquifer (or formation) containing the majority of the screen interval. Wells without well screen information are not included in the monitoring network. The monitoring wells in Figures 3-1 and 3-2 are symbolized according to aquifer assignments.

If well screen information for a well is not available from the Texas Water Development Board (TWDB) groundwater database or cannot be identified from the well's driller log, then POSGCD will use the best available information to assign the well to an aquifer formation until POSGCD can use a downhole borehole video camera to determine the well screen interval. If there is not enough information to determine well screen placement in a well, the water level measurements from the well will not be used as part of the compliance evaluations. When aquifer (or formation) assignments for wells differ from the aquifer (or formation) assignments provided in the TWDB groundwater database, POSGCD will notify TWDB of the differences in the assignments and will coordinate with TWDB to try to agree on the appropriate assignment for the well. If POSGCD and TWDB cannot agree on well assignment, then POSGCD will document the discussion process and the reason for the different well assignments.

POSGCD will annually review and verify aquifer assignments according to the latest data available. As part of this annual review process, POSGCD will coordinate with neighboring GCDs to verify aquifer (or formation) assignments for wells. If POSGCD and the neighboring GCDs cannot agree on well assignments, then POSGD will document the discussion process and the reason for the different well assignments.

3.3 Monitoring Frequency

POSGCD will attempt to measure the water level in each monitoring well at least once a year during a four-month period between November 1 and March 1. A manual measurement consists of either an e-line or steel tape reading at the well. A goal of the monitoring is to obtain a set of water level measurements for the entire monitoring network that are all taken within the same time window of two months or less.

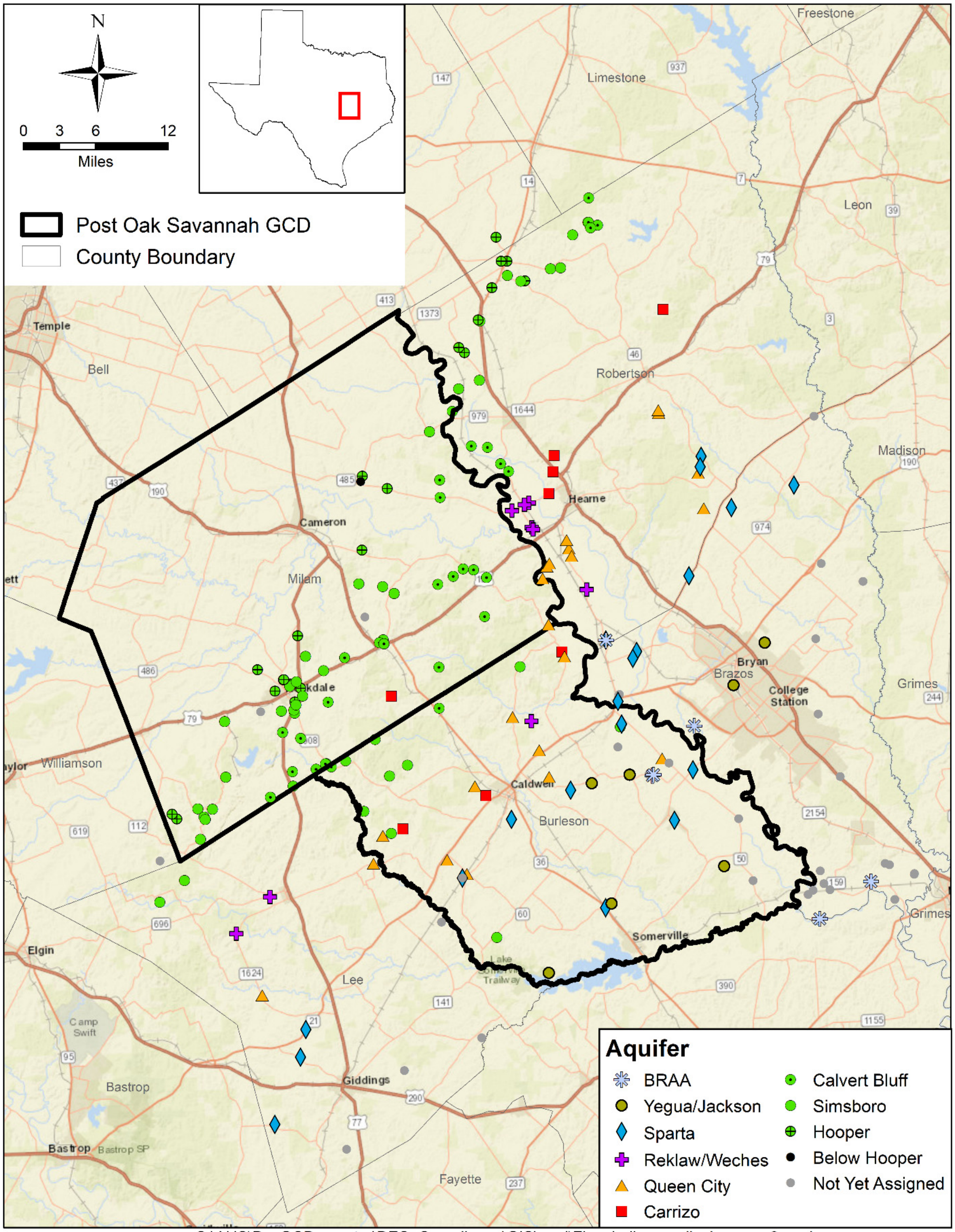
The four-month period between November 1 and March 1 is when seasonal groundwater pumping has historically been the lowest. As a result, the water levels in some of the monitoring wells are recovering during the time period. To capture the seasonal fluctuations in the water levels, POSGCD will measure water levels more frequently than once a year in selected monitoring wells that are instrumented with transducers that measure water levels on a pre-determined and scheduled timing. Currently, POSGCD is using transducers to measure water levels hourly. As funding becomes available, POSGCD will expand the seasonal and continual measurements of water levels at its monitoring wells.

3.4 Data Transparency

POSGCD will provide documentation to support aquifer assignments for every monitoring well. As part of its well database, POSGCD will create a diagram for each well that shows the Groundwater Availability Model (GAM) surfaces at the well location superimposed on the vertical location of the well screen. Examples of these well diagrams are shown in **Figures 3-4** and **3-5**. Where available, POSGCD will also provide additional aquifer assignment documentation, including well logs and downhole videos.

For every monitoring well, POSGCD will produce plots showing water levels through time. For monitoring wells used in DFC compliance, POSGCD will produce plots showing both water levels through time as well as drawdown through time, as compared to the DFC. An example water level and drawdown plot is shown in **Figure 3-6**. POSGCD will update these plots annually to incorporate new water level measurements.

POSGCD will produce yearly water level surfaces for all aquifer management zones. These will be based on all monitoring wells. An example water level surface map is shown in **Figure 3-7** for the Hooper Formation. POSGCD will update these plots annually to incorporate new wells and water level measurements.



S:\AUS\PosGCD_master\DFC_Compliance\GIS\mxd\Fig_shallow_wells_by_aq_v2.mxd

Figure 3-1 Monitoring well locations used in the DFC drawdown calculation.

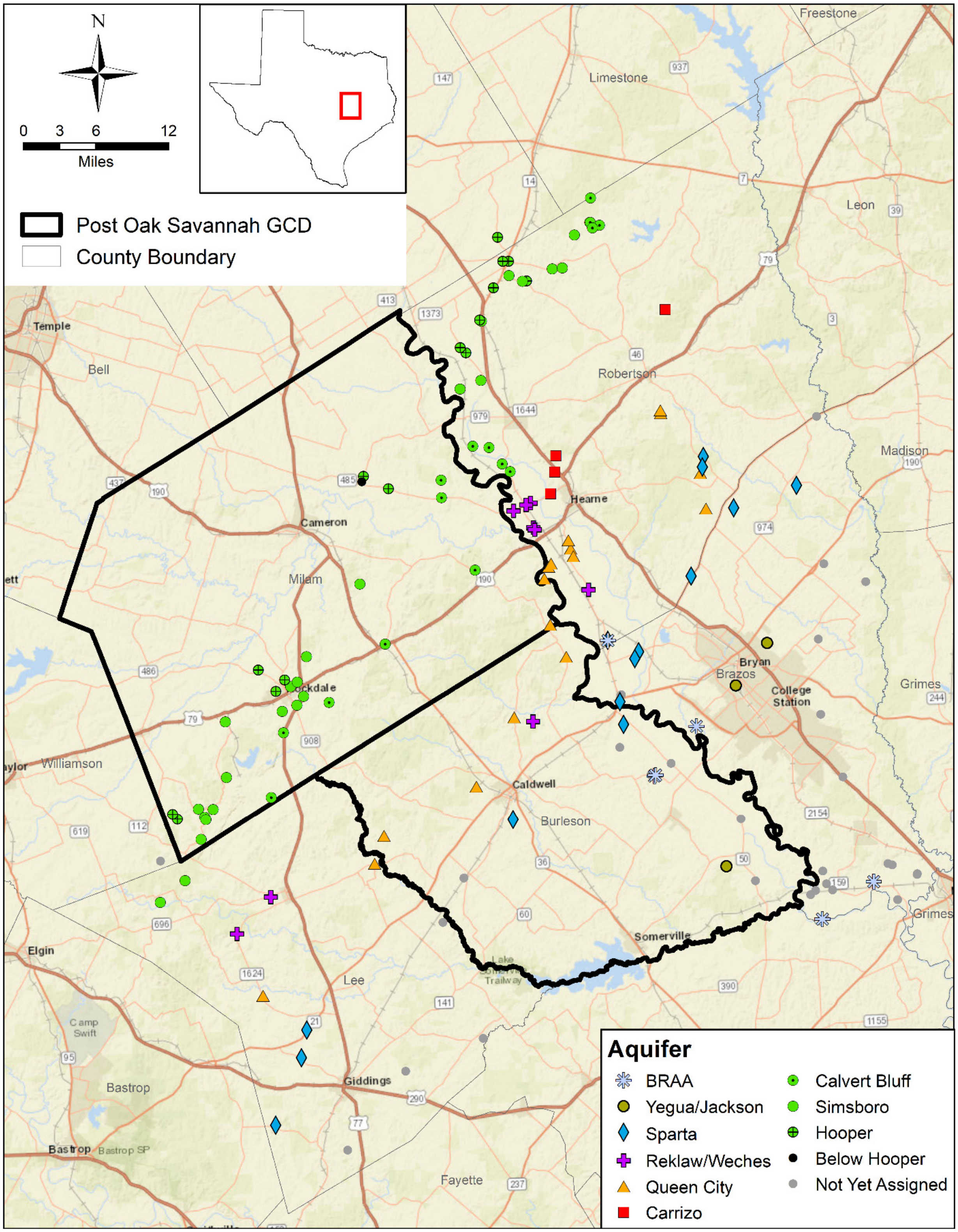


Figure 3-2 Shallow Monitoring well locations used in the PDL drawdown calculation

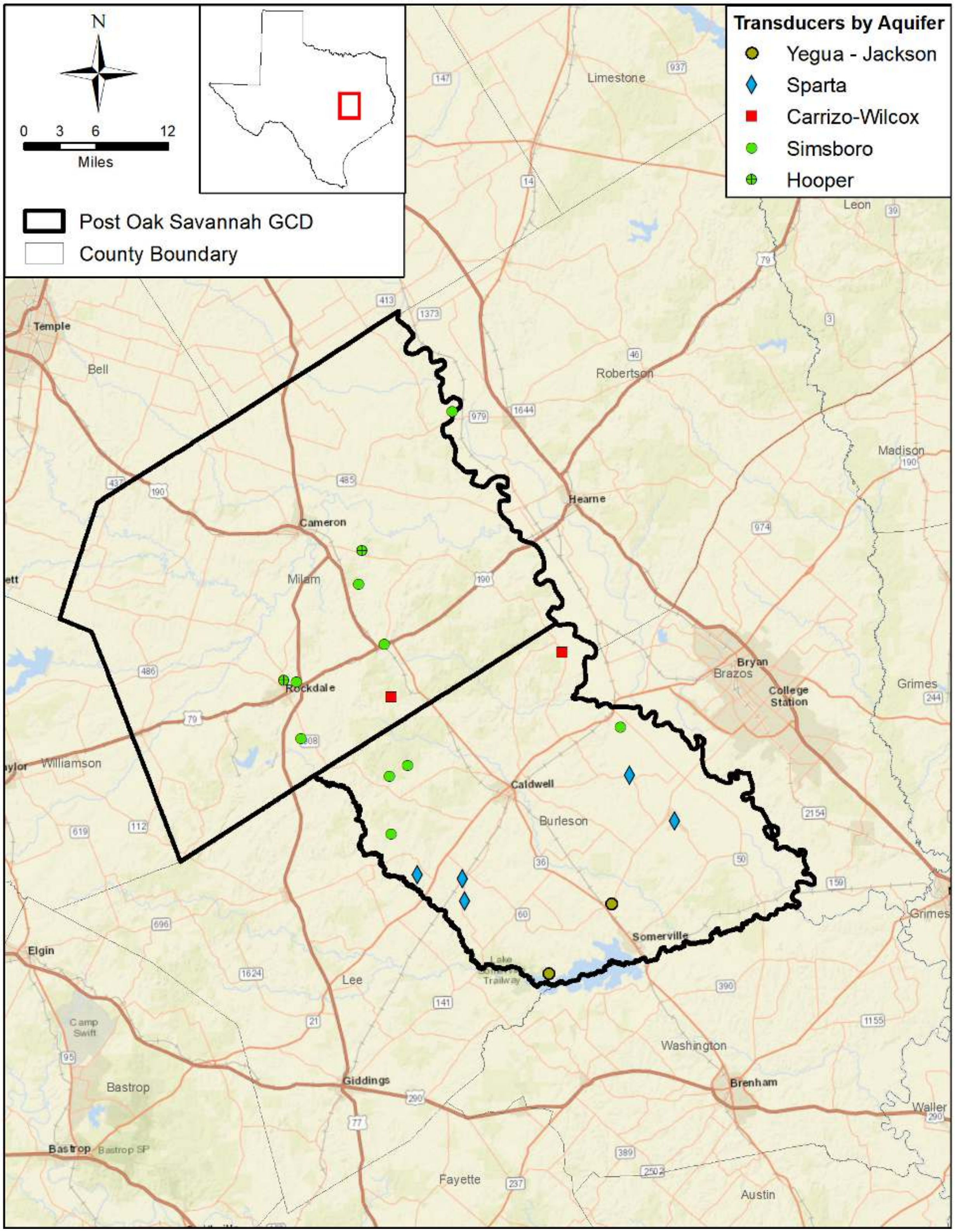


Figure 3-3 Monitoring well locations equipped with transducers in POSGCD

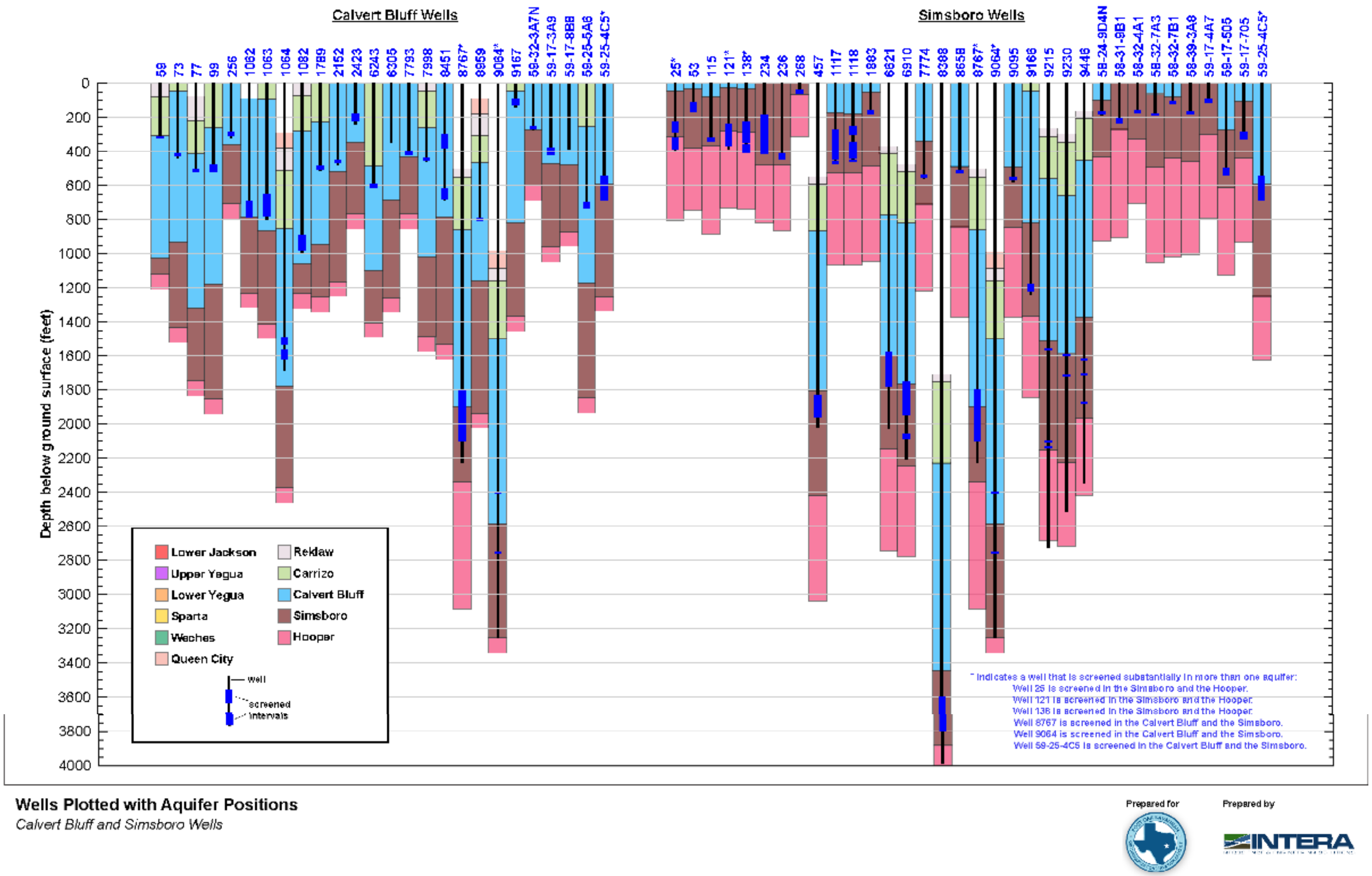


Figure 3-4 Monitoring wells with aquifer assignments in Calvert Bluff and Simsboro aquifers.

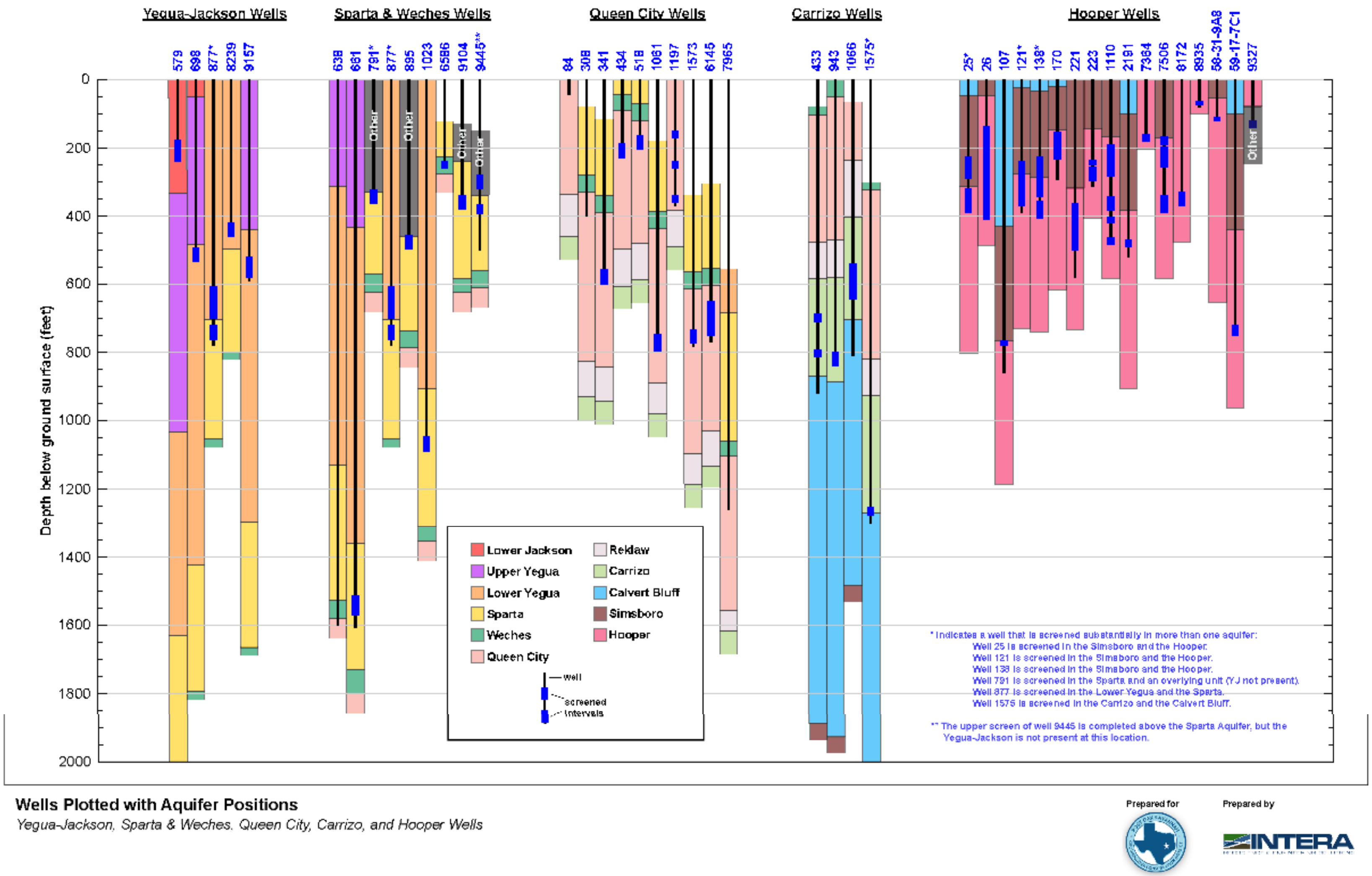


Figure 3-5 Monitoring wells with aquifer assignments in Yegua-Jackson, Queen City, Sparta, Carrizo and Hooper aquifers

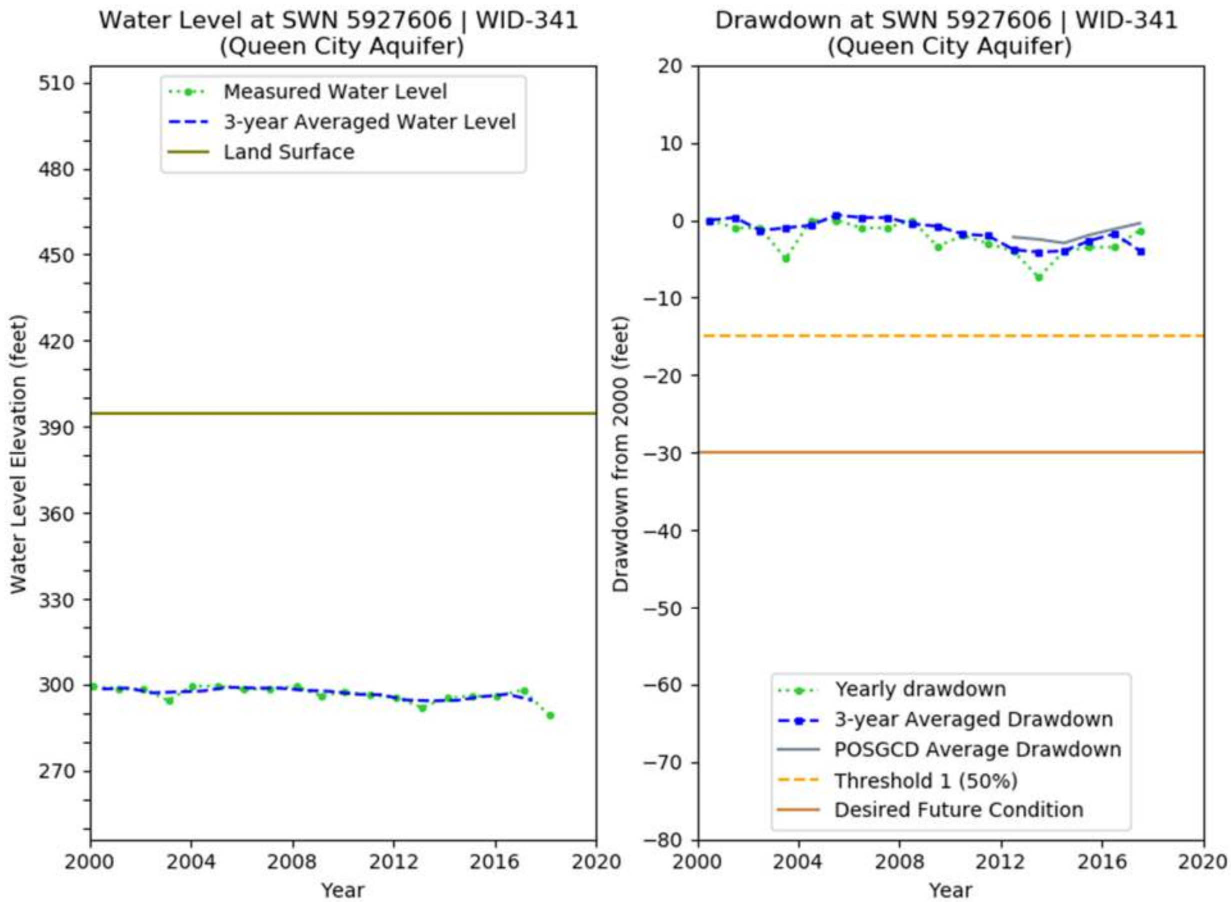


Figure 3-6 Example plot of water levels and drawdown at a monitoring well

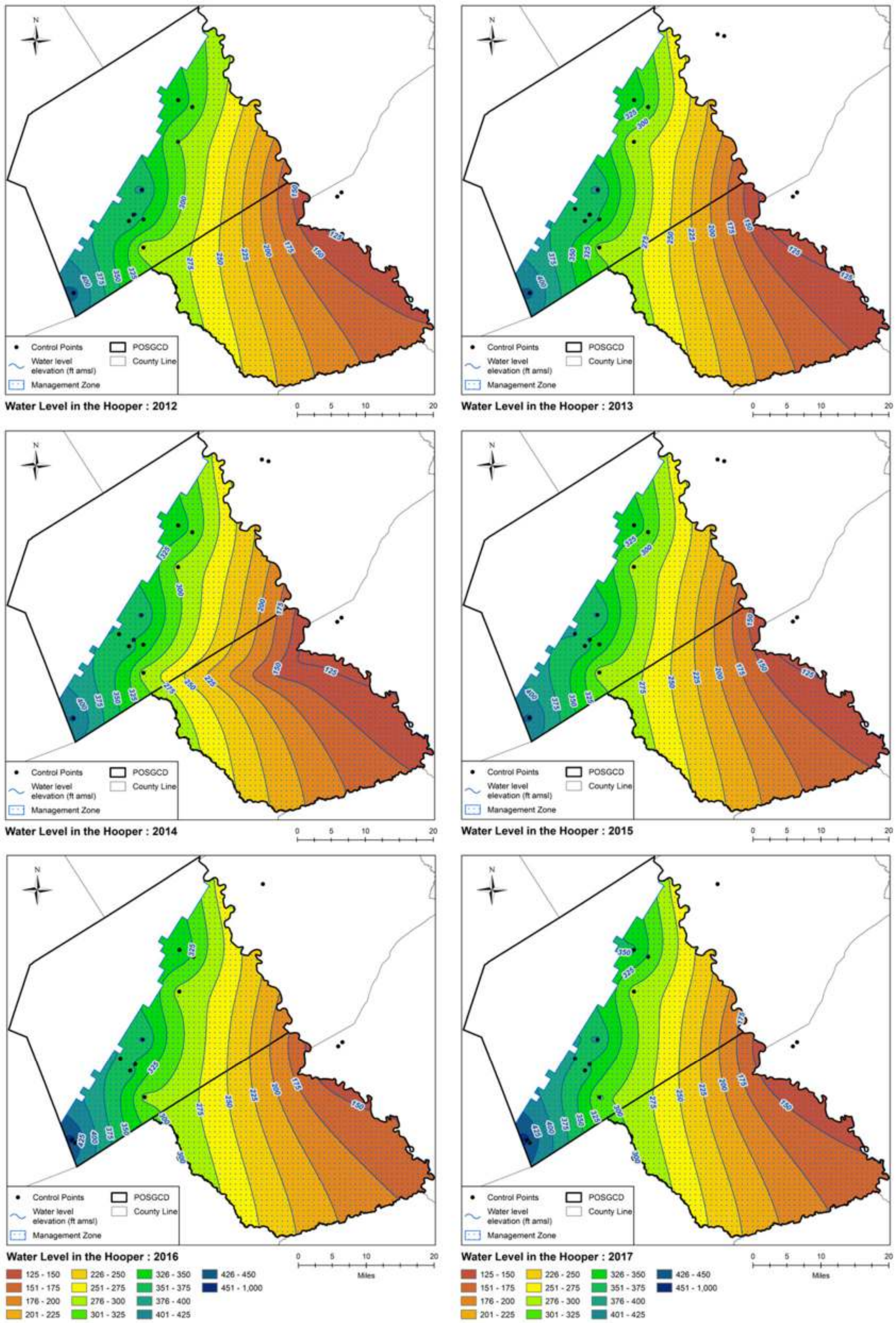


Figure 3-7 Example maps showing water level surfaces through time

4 COLLECTING AND MANAGING MONITORING DATA

This section describes the collection and management of water level measurements.

4.1 Collection procedures

POSGCD staff is responsible for measuring water levels from monitoring wells in Milam and Burleson counties. POSGCD staff will be trained prior to collecting monitoring data. Training requirements will include reading the most current set of POSGCD field data collection protocols and participating in a measurement survey. **Appendix C** contains the protocols that have been adopted by POSGCD at the time this document was finalized.

4.2 Health and Safety Plan

POSGCD monitoring activities will be conducted in accordance with the POSGCD Health and Safety Plan (**Appendix D**). POSGCD staff will be required to review the Health and Safety Plan prior to monitoring events and to have access to the Health and Safety Plan during a monitoring event.

4.3 Water Level Records

POSGCD will use field notebooks to record field notes associated with each measurement event. During or immediately after a measurement event, the level measurements will be recorded on the POSGCD water level form (**Appendix E**) for each individual well. The handwritten field water level measurements and notes will be scanned and entered into the POSGCD digital database within 2 weeks of recording.

4.4 Data Availability

POSGCD will post results from monitoring events on their web site in a timely fashion after the information has been properly reviewed and checked. Well location, well construction and water level hydrographs for the monitoring wells will be available on POSGCD's online mapping portal at www.posgcd.halff.com.

5 METHODOLOGY FOR CALCULATING DRAWDOWN FROM MEASURED GROUNDWATER LEVELS

This section describes the methodology that will be used to calculate an average drawdown over time that will be used to evaluate compliance to DFCs and PDLs.

5.1 Total Aquifer Management Zone

Appendix F describes the methodology used by POSGCD to calculate average drawdown values over time from the measured water levels. These drawdowns are used to evaluate compliance with DFCs. **Figure 5-1** shows the management zones over which average drawdown is calculated. The methodology uses Geographic Information Systems (GIS) to perform most of the mathematical calculations. **Figure 5-2** illustrates several of the calculations that use GIS. Several key points associated with the methodology are that it:

- Uses a two-dimensional averaging process that ignores the different thicknesses of the grid cells within an aquifer.
- Uses 3-year moving averages to assign water levels at wells.
- Incorporates only those wells that have a calculated annual water level for both the baseline year (2000) and the evaluation year (ex. 2012).
- Interpolates water level surfaces for the baseline year and the evaluation year over the entire District for each Aquifer Management Zone based on monitoring well point data from that aquifer.
- Distributes interpolated water levels to a grid with a uniform spacing of 500 by 500 feet.
- Calculates drawdown in an aquifer by averaging the baseline water level value of all grid cells in the Aquifer Management Zone and subtracting that from the average evaluation water level value of all grid cells in the Aquifer Management Zone.

5.2 Shallow Aquifer Management Zone

Appendix G describes the methodology used by POSGCD to calculate average drawdown values in the shallow aquifer (<400 feet deep) over time from the measured water levels. These drawdowns are used to evaluate compliance with PDLs. **Figure 5-3** shows the shallow zones (<400 feet deep) of each aquifer in the district. Several key points associated with the methodology are that it:

- Uses a three-dimensional averaging process that takes into account the different thicknesses of grid cells within an aquifer.
- Incorporates only those wells that are shallower than 400 feet deep.
- Uses 3-year moving averages to determine annual water levels at wells.
- Incorporates wells that have a calculated annual water level for both the baseline year (2000) and the evaluation year (ex. 2012).
- Interpolates shallow water level surfaces for the baseline year and the evaluation year over the entire District based on all shallow monitoring well point data.
- Distributes interpolated water levels to a grid with a uniform spacing of 500 feet by 500 feet.
- Calculates a drawdown for each grid cell as the difference in the baseline and evaluation year water elevations in that grid cell.

- Subdivides the 400-foot-thick shallow zone into 50-foot-thick layers to create a grid of 500 x 500 x 50 ft grid blocks that are each assigned to an aquifer
- Calculates drawdown in an aquifer by averaging the drawdown values of all blocks assigned to that aquifer.

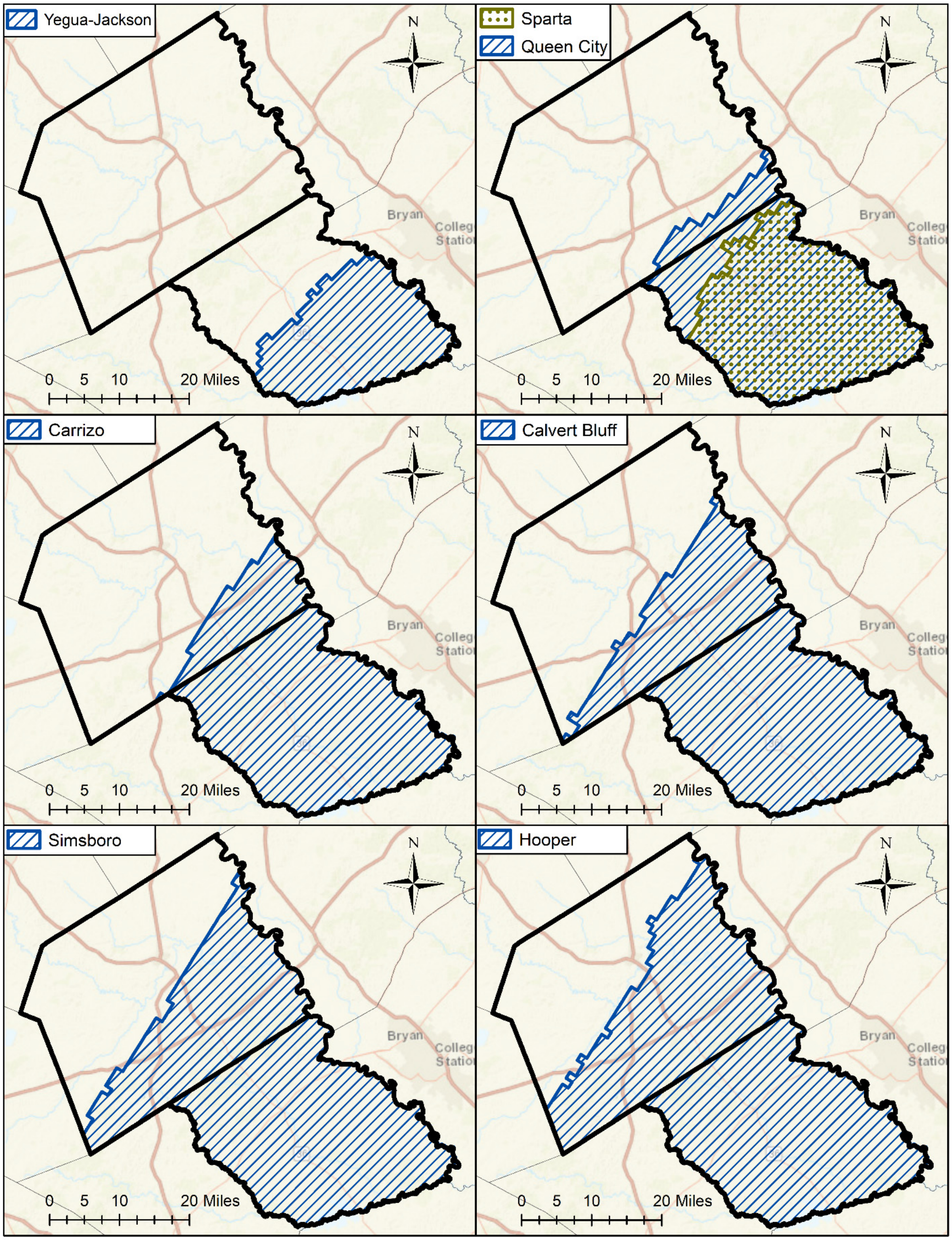


Figure 5-1 POSGCD total aquifer management zones for evaluating GMA 12 DFCs

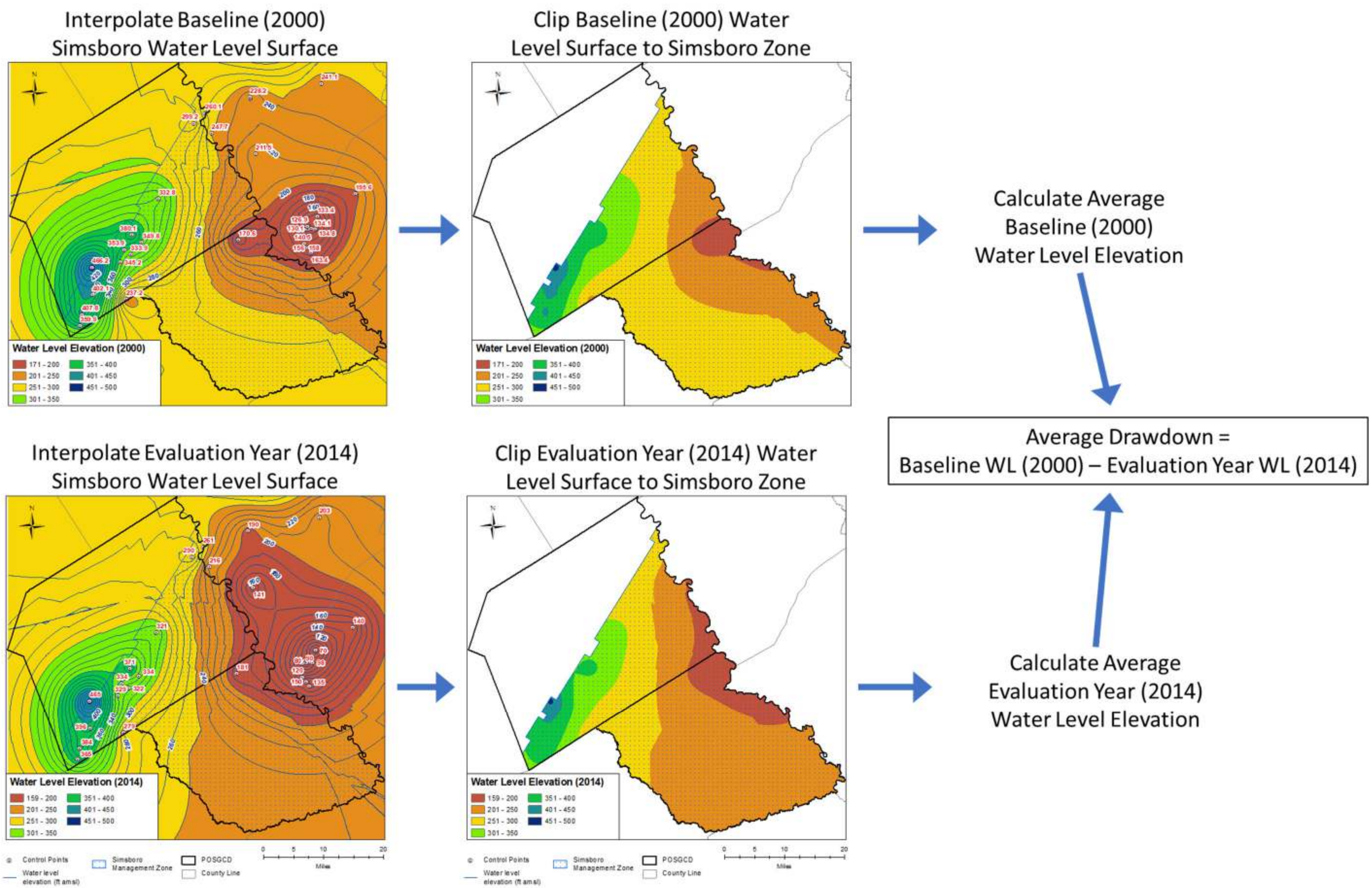


Figure 5-2 Diagram of drawdown calculation method for total aquifer management zones, using Simsboro as example

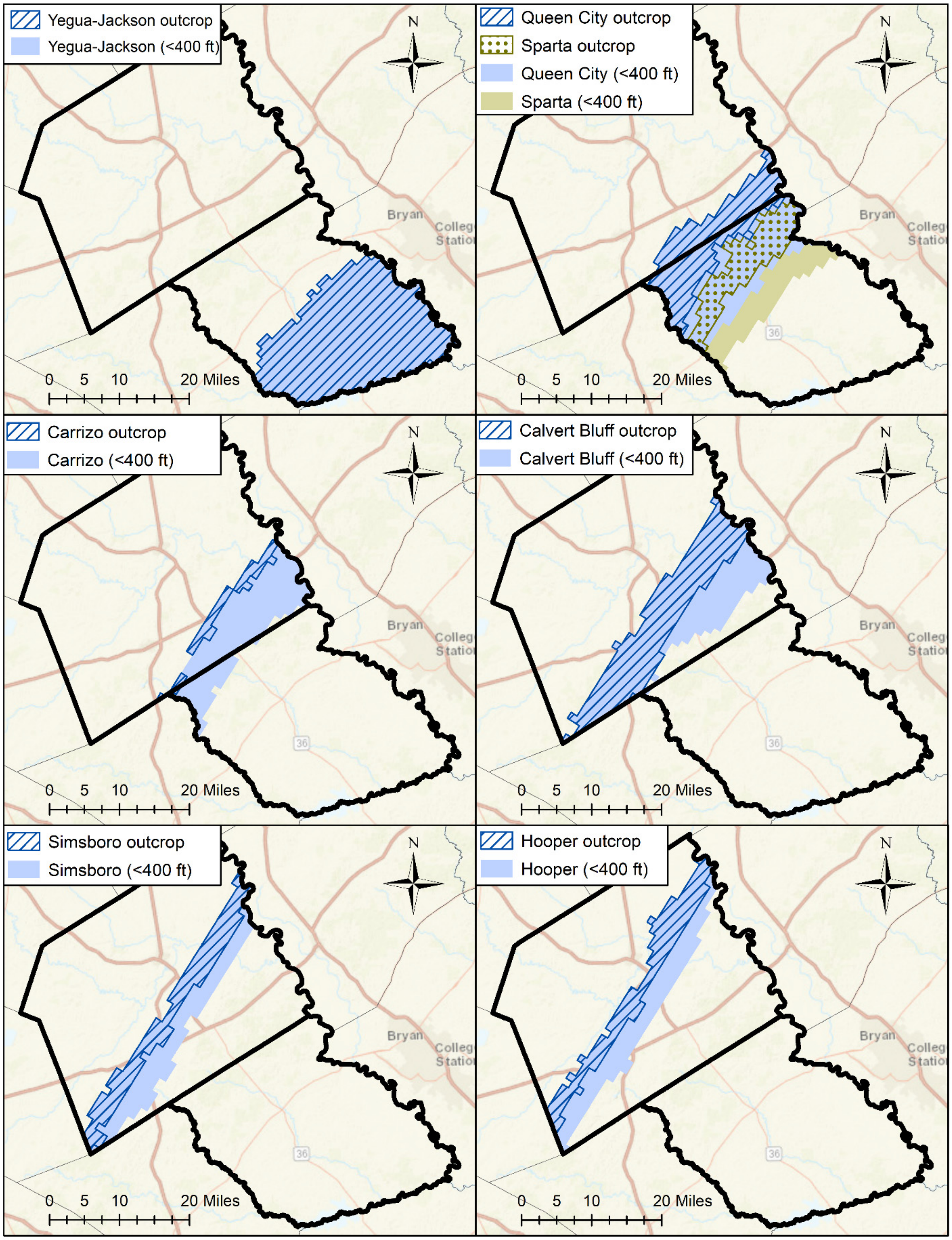


Figure 5-3 POSGCD shallow aquifer management zones for evaluating District PDLs

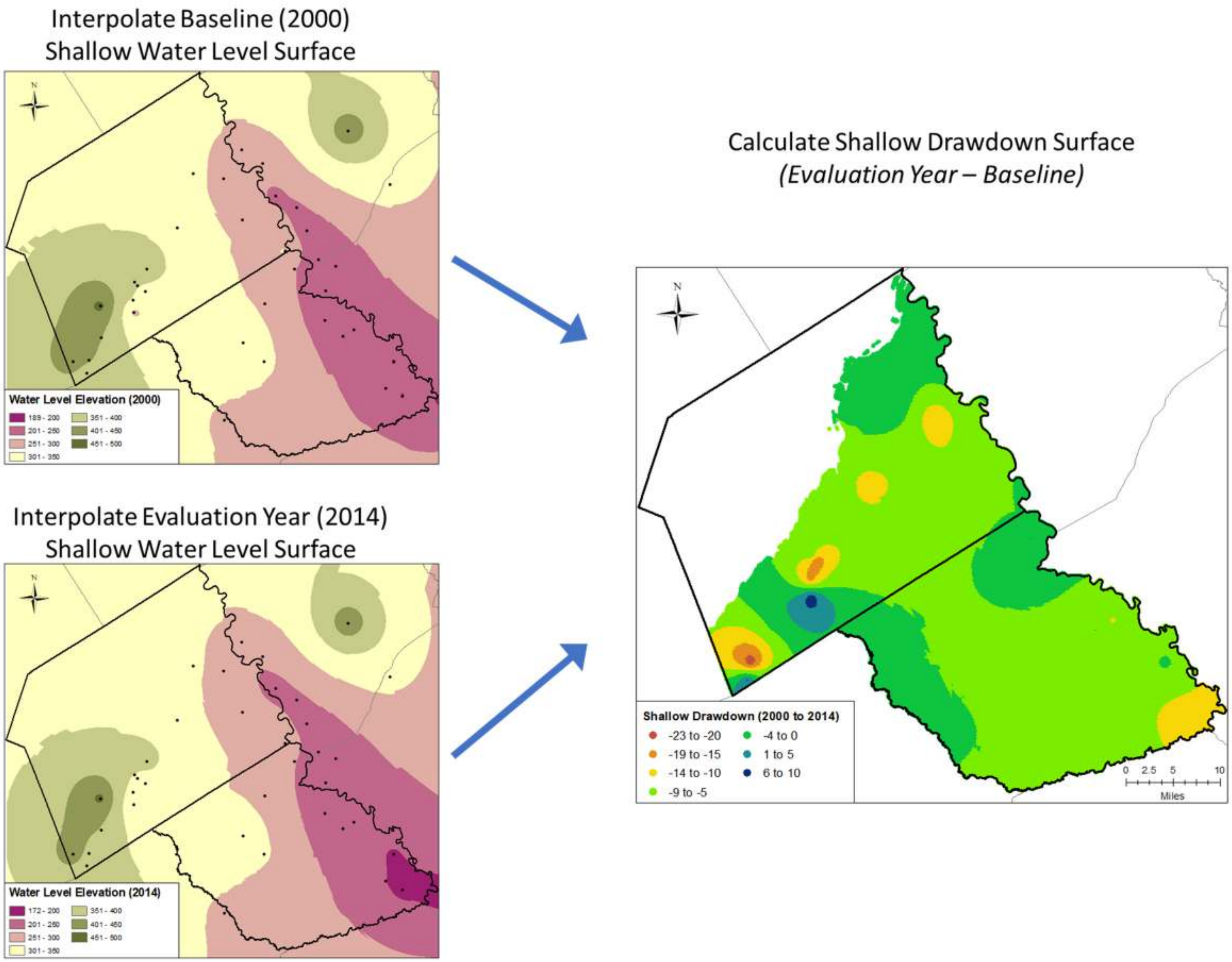


Figure 5-4 Diagram of drawdown calculation method for shallow aquifer zone, using all wells <400 feet deep

6 EVALUATING COMPLIANCE WITH DFCS AND PDLS

This section describes how POSGCD tracks compliance with DFCs and PDLs.

6.1 DFC Compliance - Total Aquifer Management Zones

POSGCD tracks compliance with DFCs by comparing average drawdowns determined for an aquifer in Section 5 to DFCs. **Table 6-1** provides the results from five previous evaluations that include the time periods 2000 to 2012, 2000 to 2013, 2000 to 2014, 2000 to 2014, 2000 to 2015, and 2000 to 2016. **Figure 6-1** compares the results from these evaluations to action levels identified in POSGCD Groundwater Rule 16.4 "Actions Based on Monitoring Results." POSGCD does not currently evaluate compliance with the Brazos River Alluvium Aquifer DFC defined as change in saturated thickness.

POSGCD does not currently evaluate compliance with GMA 8 DFCs (Table 1-4) since there is not currently any permitted pumping from these aquifers. POSGCD will re-visit GMA 8 DFCs if and when pumping is permitted in these aquifers in the future.

Table 6-1 Status of DFC compliance by total aquifer management zone (green text indicates compliance; orange text indicates at or above Threshold 1).

Management Zone	DFC	Drawdown from 2000 to 2012	Drawdown from 2000 to 2013	Drawdown from 2000 to 2014	Drawdown from 2000 to 2015	Drawdown from 2000 to 2016	Drawdown from 2000 to 2017
		Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)
Yegua Jackson	100	31.8 **(32%)**	34.5 **(34%)**	35.7 **(36%)**	40.0 **(40%)**	47.0 **(47%)**	46.9 **(47%)**
Sparta	28	3.8 **(14%)**	3.9 **(14%)**	4.5 **(16%)**	6.0 **(21%)**	10.4 **(37%)**	14.9 **(53%)**
Queen City	30	2.2 **(7%)**	2.5 **(8%)**	3.0 **(10%)**	1.9 **(6%)**	1.1 **(4%)**	0.4 **(1%)**
Carrizo	67	6.7 **(10%)**	9.3 **(14%)**	--	10.2 **(15%)**	10.6 **(16%)**	11.4 **(17%)**
Calvert Bluff (Upper Wilcox)	149	-13.2 **(-9%)**	-11.2 **(-8%)**	-10.5 **(-7%)**	-9.4 **(-6%)**	-9.7 **(-6%)**	-10.7 **(-7%)**
Simsboro (Middle Wilcox)	318	9.4 **(3%)**	12.1 **(4%)**	11.8 **(4%)**	11.0 **(3%)**	9.5 **(3%)**	8.8 **(3%)**
Hooper (Lower Wilcox)	205	7.1 **(3%)**	7.3 **(4%)**	8.0 **(4%)**	9.1 **(4%)**	8.6 **(4%)**	6.0 **(3%)**

6.2 PDL Compliance - Shallow Aquifer Management Zones

POSGCD will track compliance with PDLs by comparing average drawdowns determined for a shallow management zone in Section 5 to PDLs. **Table 6-2** shows the results from five previous evaluations that include the time periods 2000 to 2012, 2000 to 2013, 2000 to 2014, 2000 to 2014, 2000 to 2015, and 2000 to 2016. **Figure 6-2** compares the results from these evaluations for the shallow aquifer to action levels identified in POSGCD Groundwater Rule 16.4 "Actions Based on Monitoring Results." The current monitoring network only includes one Yegua-Jackson well with a depth of less than 400 feet. Because of the scarcity of the Yegua-Jackson wells to evaluate PDL compliance, the compliance for the Yegua formation and Jackson formation have been combined in Table 6-2 and is represented by the evaluation of compliance for the Yegua-Jackson Aquifer.

Table 6-2 Status of PDL compliance by shallow aquifer management zone (green text indicates compliance).

Management Zone	PDL	Drawdown from 2000 to 2012	Drawdown from 2000 to 2013	Drawdown from 2000 to 2014	Drawdown from 2000 to 2015	Drawdown from 2000 to 2016	Drawdown from 2000 to 2017
		Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)	Calculated Drawdown (% of DFC)
Yegua Jackson	20	5.7 **(29%)**	6.4 **(32%)**	6.8 **(34%)**	7.3 **(36%)**	4.1 **(21%)**	3.1 **(15%)**
Sparta	20	4 **(20%)**	4.5 **(22%)**	4.9 **(25%)**	4.5 **(22%)**	3.1 **(15%)**	2.4 **(12%)**
Queen City	20	3.4 **(17%)**	4.1 **(20%)**	4.6 **(23%)**	4.1 **(20%)**	2.2 **(11%)**	1.2 **(6%)**
Carrizo	20	4.7 **(23%)**	5.8 **(29%)**	6.2 **(31%)**	5.6 **(28%)**	3.5 **(18%)**	2.2 **(11%)**
Calvert Bluff (Upper Wilcox)	20	5.9 **(29%)**	7 **(35%)**	7.2 **(36%)**	6.7 **(34%)**	5.5 **(27%)**	4.5 **(22%)**
Simsboro (Middle Wilcox)	20	6 **(30%)**	6.6 **(33%)**	6.7 **(33%)**	6.1 **(31%)**	5 **(25%)**	4 **(20%)**
Hooper (Lower Wilcox)	20	6 **(30%)**	6.2 **(31%)**	6.3 **(32%)**	6.2 **(31%)**	5.1 **(26%)**	4.3 **(22%)**

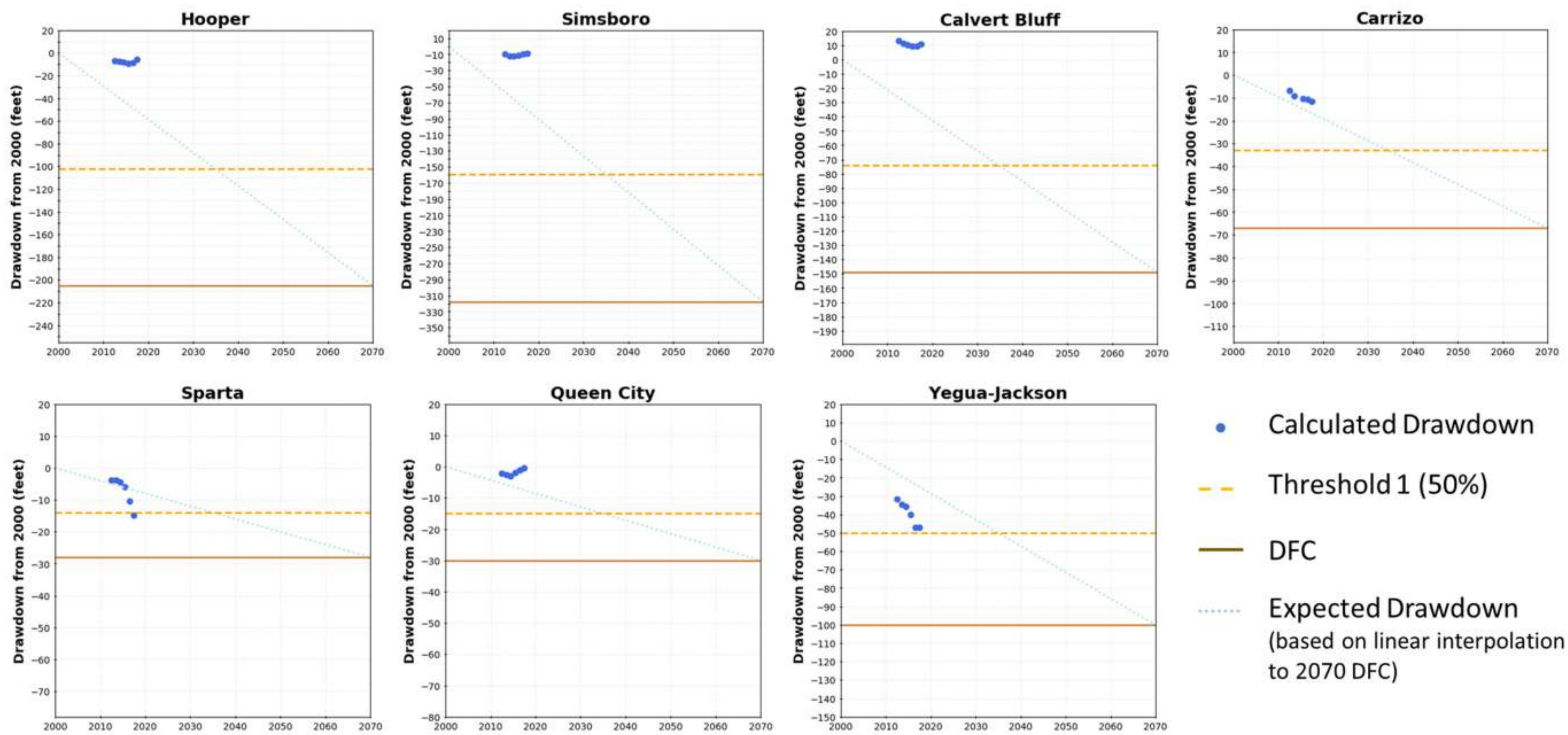


Figure 6-1 Status of DFC compliance by aquifer management zone

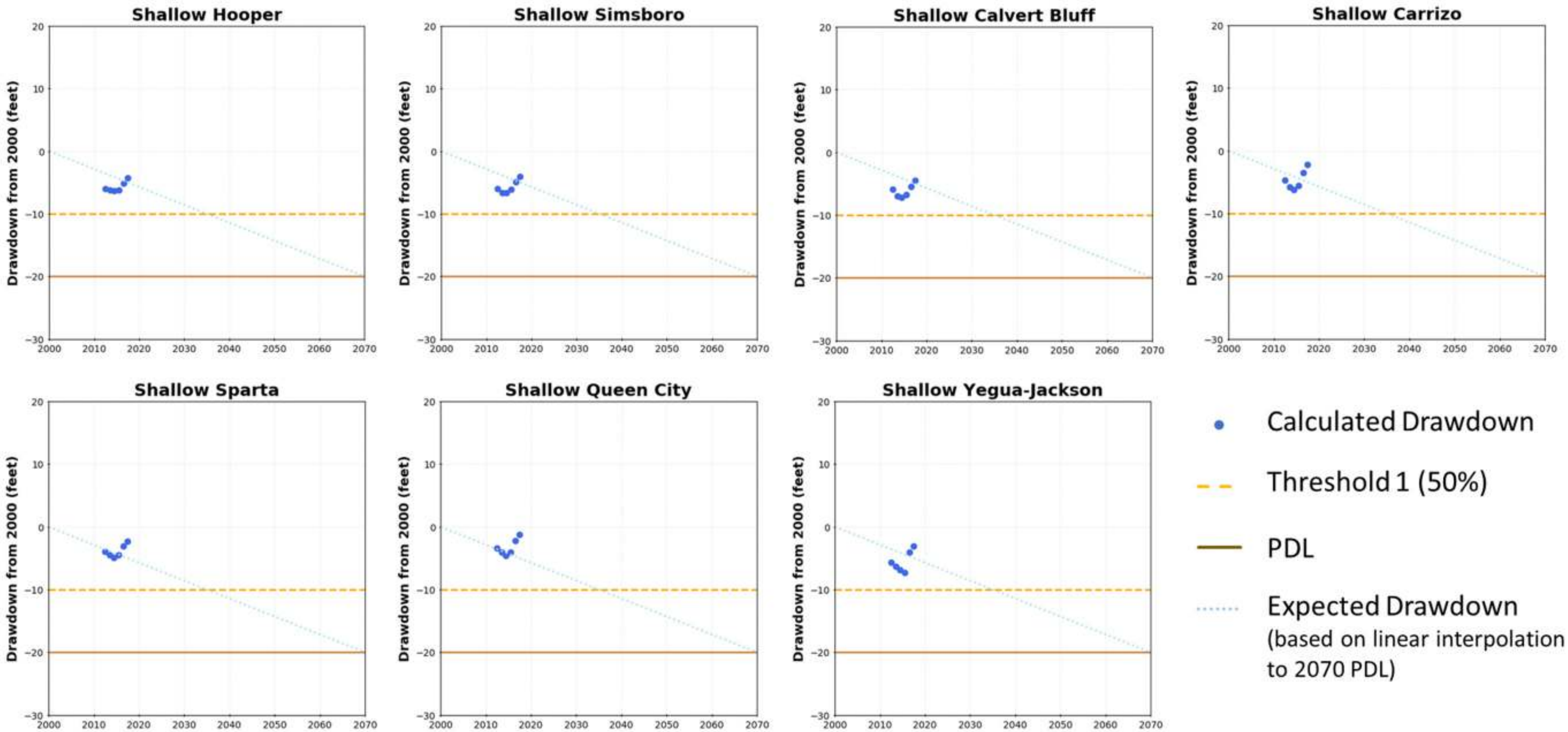


Figure 6-2 Status of PDL compliance by shallow aquifer management zone

APPENDIX A

POSGCD Groundwater Monitoring Well Network

POSGCD Well Number	State Well Number	Latitude *(decimal degrees)*	Longitude *(decimal degrees)*	Surface Elevation *(ft amsl)*	Depth *(ft)*	Screened Intervals	TWDB Aquifer	POSGCD Aquifer (First Unit)	POSGCD Aquifer (Second Unit)	County	Shallow?	Transducer
25	5917409	30.668888	-96.986388	505	391	226-290, 320-390	124HOOP - Hooper	Simsboro	Hooper	Milam	Yes	Yes
26	5917103	30.723888	-96.982777	457	410	136-410	124HOOP - Hooper	Hooper	--	Milam	No	
53	5909901	30.784166	-96.895555	434	169	109-169	124SMBR - Simsboro	Simsboro	--	Milam	Yes	Yes
59	5911402	30.796944	-96.734444	426	323	307-323	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	Yes	
73	5910907	30.780832	-96.784999	383	440	410-430	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	No	
77	5919103	30.740555	-96.720832	433	522	507-522	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	No	
84	5919302	30.728610	-96.632221	340	45	--	124QNCT - Queen City	Queen City	--	Milam	Yes	
99	5925508	30.569443	-96.947777	410	520	480-520	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	No	
107	5925102	30.600833	-96.982499	412	860	767-782	124SMBR - Simsboro	Hooper	--	Milam	No	Yes
115	5917715	30.640833	-96.987777	443	337	316-337	124SMBR - Simsboro	Simsboro	--	Milam	Yes	
121	5917714	30.663611	-96.995833	475	390	238-370	124SMBR - Simsboro	Hooper	Simsboro	Milam	Yes	
138	5917713	30.666388	-96.995833	485	408	226-346, 356-408	124SMBR - Simsboro	Hooper	Simsboro	Milam	No	
170	5824914	30.658333	-97.016666	495	295	153-233	124SMBR - Simsboro	Hooper	--	Milam	Yes	
221	5909605	30.824443	-96.889721	424	503	340-500	124HOOP - Hooper	Hooper	--	Milam	No	Yes
223	5902706	30.897499	-96.851944	359	315	235-250, 256-298	124WLCX - Wilcox	Hooper	--	Milam	Yes	
234	5902309	30.987777	-96.757777	299	417	185-417	124SMBR - Simsboro	Simsboro	--	Milam	No	Yes
236	5902307	30.964166	-96.790555	416	450	410-450	124WLCX - Wilcox	Simsboro	--	Milam	No	
256	5902901	30.884999	-96.778332	371	318	284-308	124WLCX - Wilcox	Calvert Bluff	--	Milam	Yes	
268	5832101	30.623332	-97.088055	474	60	40-60	124HOOP - Hooper	Simsboro	--	Milam	Yes	
308	5927716	30.537221	-96.741666	452	400	--	124QNCT - Queen City	Queen City	--	Burleson	Yes	
341	5927606	30.578054	-96.650555	394	600	558-600	124QNCT - Queen City	Queen City	--	Burleson	No	
433	5920410	30.695555	-96.614444	299	920	688-710, 794-815	124SMBR - Simsboro	Carrizo	--	Burleson	No	Yes
434	5920409	30.689721	-96.611388	299	230	188-230	124QNCT - Queen City	Queen City	--	Burleson	Yes	
457	5919502	30.679166	-96.673610	462	2018	1832-1958	124CZSB - Carrizo and Simsboro	Simsboro	--	Burleson	No	
518	5927204	30.618888	-96.686388	315	205	163-205	124QNCT - Queen City	Queen City	--	Burleson	Yes	
579	5937611	30.432221	-96.397777	233	240	177-240	124JCKSL - Lower Jackson	Lower Jackson	--	Burleson	Yes	
596	5937329	30.488610	-96.375554	215	58	--	111ABZR - Alluvium, Brazos River	BRAA	--	Burleson	Yes	
638	5937101	30.489166	-96.465000	240	1600	--	124QNCT - Queen City	Sparta	Weches/QC	Burleson	No	Yes
661	5936802	30.386944	-96.564722	342	1609	1513-1573	124SPRT - Sparta	Sparta	--	Burleson	No	
698	5943608	30.310833	-96.646388	270	533	494-533	124YEGUL - Lower Yegua	Lower Yegua	--	Burleson	No	Yes
787	5938701	30.413611	-96.358333	205	56	--	111ABZR - Alluvium, Brazos River	BRAA	--	Burleson	Yes	
791	5935208	30.496354	-96.691918	379	364	322-364	124SPRT - Sparta	Sparta	Above Sparta	Burleson	Yes	
859	5929456	30.543633	-96.493766	231	60	--	111ABZR - Alluvium, Brazos River	BRAA	--	Burleson	Yes	
860	5929457	30.544533	-96.492043	231	60	--	111ABZR - Alluvium, Brazos River	BRAA	--	Burleson	Yes	
877	5928619	30.545555	-96.525554	267	780	605-700, 719-765	124SPRT - Sparta	Lower Yegua	Sparta	Burleson	No	Yes
894	5928601	30.579166	-96.540555	240	58	--	111ABZR - Alluvium, Brazos River	BRAA	--	Burleson	Yes	
895	5928702	30.529166	-96.608333	346	498	456-498	124SPRT - Sparta	Sparta	--	Burleson	No	
943	5934106	30.488610	-96.843610	441	840	800-840	124CRRZ - Carrizo	Carrizo	--	Burleson	No	
1023	5929537	30.549166	-96.436944	225	1090	1048-1090	124SPRT - Sparta	Sparta	--	Burleson	No	

POSGCD Well Number	State Well Number	Latitude *(decimal degrees)*	Longitude *(decimal degrees)*	Surface Elevation *(ft amsl)*	Depth *(ft)*	Screened Intervals	TWDB Aquifer	POSGCD Aquifer (First Unit)	POSGCD Aquifer (Second Unit)	County	Shallow?	Transducer
1061	5934607	30.450000	-96.783333	404	797	745-797	124QNCT - Queen City	Queen City	--	Burleson	No	
1062	5918101	30.716233	-96.863433	565	790	689-790	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	No	
1063	5918104	30.712780	-96.868890	549	800	650-780	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	No	
1064	5918908	30.632283	-96.788067	520	1687	1490-1534, 1564-1620	124CZSB - Carrizo and Simsboro	Calvert Bluff	--	Burleson	No	
1066	5918705	30.648217	-96.854650	581	813	540-645	124SMBR - Simsboro	Carrizo	--	Milam	No	Yes
1082	5911703	30.787222	-96.716667	367	992	889-980	124SMBR - Simsboro	Calvert Bluff	--	Milam	No	
1110	5824611	30.671417	-97.004500	490	485	190-283, 343-383, 403-423, 463-483	124HOOP - Hooper	Hooper	--	Milam	No	
1117	5917712	30.631200	-96.990100	460	475	270-450, 460-475	124SMBR - Simsboro	Simsboro	--	Milam	No	
1118	5917711	30.634917	-96.991033	462	463	250-300, 345-443, 453-463	124SMBR - Simsboro	Simsboro	--	Milam	No	
1166	5929410	30.557917	-96.470083	225	71	--	111ABZR - Alluvium, Brazos River	BRAA	--	Burleson	Yes	
1197	5934107	30.481100	-96.872100	440	370	150-170, 240-260, 340-360	124QNCT - Queen City	Queen City	--	Burleson	Yes	
1573	5934601	30.432499	-96.756388	383	784	734-774	124QNCT - Queen City	Queen City	--	Burleson	No	
1575	5927718	30.525554	-96.726660	447	1300	1252-1277	124CZCB - Carrizo and Calvert Bluff	Carrizo	Calvert Bluff	Burleson	No	
1789	--	30.798454	-96.748917	436	515	487-507	--	Calvert Bluff	--	Milam	No	
1883	5832704	30.506500	-97.118558	482	180	160-180	124SMBR - Simsboro	Simsboro	--	Milam	Yes	
2152	5925409	30.560960	-96.995140	467	480	450-470	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	No	
2191	5917716	30.644744	-96.989442	464	520	470-490	124HOOP - Hooper	Hooper	--	Milam	No	
2423	5902904	30.905951	-96.778042	401	240	180-220	124SMBR - Simsboro	Calvert Bluff	--	Milam	Yes	
6145	5927611	30.545711	-96.637995	397	770	650-750	ND	Queen City	--	Burleson	No	
6243	5925502	30.565500	-96.941000	427	614	593-614	124CZCB - Carrizo and Calvert Bluff	Calvert Bluff	--	Burleson	No	
6305	5832908	30.531240	-97.026850	438	344	--	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	Yes	
6586	5927309	30.613416	-96.660202	381	260	240-260	ND	Weches	--	Burleson	Yes	
6621	5926402	30.552496	-96.860040	489	2020	1580-1780	124SMBR - Simsboro	Simsboro	--	Burleson	No	Yes
6910	5926403	30.564870	-96.834660	496	2200	1750-1950, 2060-2090	124SMBR - Simsboro	Simsboro	--	Burleson	No	Yes
7364	5824612	30.684551	-97.040073	432	180	160-180	124HOOP - Hooper	Hooper	--	Milam	Yes	
7506	5824610	30.671633	-97.003883	492	392	165-193, 196-259, 339-390	124HOOP - Hooper	Hooper	--	Milam	Yes	Yes
7774	5910705	30.780000	-96.862300	442	560	535-555	124CABF - Calvert Bluff	Simsboro	--	Milam	No	
7793	5925103	30.600880	-96.982490	412	420	400-420	124WLCX - Wilcox	Calvert Bluff	--	Milam	No	
7965	--	30.563800	-96.479600	231	1260	--	--	Queen City	--	Burleson	No	
7998	--	30.789912	-96.763097	490	460	435-455	--	Calvert Bluff	--	Milam	No	
8172	--	30.513820	-97.164501	579	370	330-370	--	Hooper	--	Milam	Yes	
8239	5928804	30.536717	-96.578450	304	460	418-460	124SPRT - Sparta	Lower Yegua	--	Burleson	No	
8388	5943104	30.355200	-96.717300	326	3988	3600-3800	124SMBR - Simsboro	Simsboro	--	Burleson	No	
8415	5929433	30.544721	-96.498610	233	59	--	111ABZR - Alluvium, Brazos River	BRAA	--	Burleson	Yes	
8451	5925408	30.563228	-96.962233	382	690	300-380, 620-680	124CABF - Calvert Bluff	Calvert Bluff	--	Milam	No	
8658	5910706	30.771300	-96.846400	420	528	508-528	124SMBR - Simsboro	Simsboro	--	Milam	No	
8767	5934108	30.483595	-96.860039	411	2230	1800-2100	124SMBR - Simsboro	Simsboro	Calvert Bluff	Burleson	No	Yes

POSGCD Well Number	State Well Number	Latitude *(decimal degrees)*	Longitude *(decimal degrees)*	Surface Elevation *(ft amsl)*	Depth *(ft)*	Screened Intervals	TWDB Aquifer	POSGCD Aquifer (First Unit)	POSGCD Aquifer (Second Unit)	County	Shallow?	Transducer
8935	5901904	30.913160	-96.886300	390	80	64-74	124HOOP - Hooper	Hooper	--	Milam	Yes	
8959	--	30.681466	-96.786821	442	810	790-810	--	Calvert Bluff	--	Milam	No	
9064	--	30.603240	-96.536250	241	3255	2400-2410, 2750-2760	--	Calvert Bluff	Simsboro	Burleson	No	Yes
9095	5910707	30.771301	-96.846388	420	580	550-570	124SMBR - Simsboro	Simsboro	--	Milam	No	
9104	5928342	30.606600	-96.534440	243	380	340-380	124SPRT - Sparta	Sparta	--	Burleson	Yes	
9157	5936809	30.391670	-96.556110	294	592	520-580	124JKYG - Jackson and Yegua	Lower Yegua	--	Burleson	No	Yes
9166	5918108	30.711389	-96.862500	505	1240	1178-1220	124SMBR - Simsboro	Simsboro	--	Milam	No	Yes
9167	5918109	30.711389	-96.862500	505	140	90-130	124CRRZ - Carrizo	Calvert Bluff	--	Milam	Yes	
9215	--	30.511139	-96.897167	386	2724	1560-1570, 2100-2110, 2130-2140	--	Simsboro	--	Burleson	No	
9230	--	30.596886	-96.878937	526	1720	1590-1600, 1710-1720	--	Simsboro	--	Burleson	No	
9327	--	30.906660	-96.888880	368	140	120-140	--	Below Hooper	--	Milam	Yes	
9346	--	30.540583	-96.907083	0	80	--	--	Reklaw	--	Burleson	Yes	
9372	--	30.541111	-96.904850	0	120	--	--	Queen City	--	Burleson	Yes	
9445	--	30.427742	-96.762821	361	400	280-320, 365-395	--	Sparta	Above Sparta	Burleson	Yes	Yes
9446	--	30.572378	-96.920656	423	2350	1620-1630, 1706-1716, 1870-1880	--	Simsboro	--	Burleson	No	
58-24-9D4N	--	30.634119	-97.008415	464	188	163-183	--	Simsboro	--	Milam	Yes	
58-24-9V7	--	30.633943	-97.037523	500	--	--	--	--	--	Milam	--	
58-31-9A8	--	30.507962	-97.158012	544	120	110-120	--	Hooper	--	Milam	Yes	
58-31-9B1	--	30.519604	-97.128551	552	235	205-235	--	Simsboro	--	Milam	Yes	
58-32-3A7N	--	30.608502	-97.007428	435	271	250-270	--	Calvert Bluff	--	Milam	Yes	
58-32-4A1	--	30.556658	-97.088541	495	174	154-174	--	Simsboro	--	Milam	Yes	
58-32-7A3	--	30.509591	-97.120047	493	185	175-185	--	Simsboro	--	Milam	Yes	
58-32-7B1	--	30.518687	-97.108176	477	123	103-123	--	Simsboro	--	Milam	Yes	
58-39-3A8	--	30.482943	-97.126022	476	182	162-182	--	Simsboro	--	Milam	Yes	
59-17-3A9	--	30.696090	-96.918013	450	418	378-418	--	Calvert Bluff	--	Milam	No	
59-17-3B8	--	30.743985	-96.888371	433	--	--	--	--	--	Milam	--	
59-17-4A7	--	30.698952	-96.972804	430	113	93-113	--	Simsboro	--	Milam	Yes	
59-17-505	--	30.681059	-96.948042	432	540	498-540	--	Simsboro	--	Milam	No	
59-17-705	--	30.651470	-96.978145	490	326	286-326	--	Simsboro	--	Milam	Yes	
59-17-7C1	--	30.660943	-96.980573	491	750	720-750	--	Hooper	--	Milam	No	
59-17-8B8	--	30.643409	-96.942916	478	385	--	--	Calvert Bluff	--	Milam	Yes	
59-25-4C5	--	30.543583	-96.994972	443	690	545-690	--	Simsboro	Calvert Bluff	Milam	No	
59-25-5A6	--	30.569386	-96.949069	401	734	694-734	--	Calvert Bluff	--	Milam	No	

APPENDIX B

POSGCD Aquifer Assignment Methodology

The following section outlines the methodology used by POSGCD to assign monitoring wells to aquifers. This methodology focuses on comparing the aquifer tops and bottoms (based on groundwater availability model surfaces) to screened intervals at a well location. The aquifer surfaces for the Queen City, Sparta, Carrizo, Calvert Bluff, Simsboro, and Hooper aquifers are taken from the Groundwater Availability Model (GAM) for the Queen City and Sparta Aquifers (Kelley and others, 2004). The aquifer surfaces for the Yegua-Jackson Aquifer are taken from the Yegua-Jackson Aquifer GAM (Deeds and others, 2010).

Step 1:

Extract the top and bottom of aquifer surfaces from groundwater available models (GAMs) at the center of the GAM grid cells.

Step 2:

Develop rasters for the tops and bottoms of aquifers of interest using the information from Step 1.

Step 3:

At each well location (designated by a latitude and longitude), extract the elevation of the tops and bottom of aquifers of interest. Convert the aquifer elevations to depths below ground surface elevation.

Step 4:

Using information from driller logs, the TWDB groundwater well database, field-measured values, or data tables in state reports, record the depth of the well and depth to each of the well's screened intervals into the POSGCD well database.

Step 5:

Using information from Steps 1 through 4, determine in which aquifer or formation the well terminates and in which aquifer or formation the screened intervals of a well are partitioned. Determine whether the well screen intervals reside in a single aquifer or multiple aquifers. If the well screens span multiple aquifers, then determine the portion of the well screens that intersect the different aquifers.

Step 6:

Construct figures that show the bottom of the well and the vertical location of the well screens relative to the tops and bottoms of the aquifers that exist at the well location.

Step 7:

Construct a table that lists the aquifers that the well screens intersect and the thickness of each intersected aquifer.

Step 8:

For wells with screens that intersect only one aquifer, assign the well to the aquifer intersected by the well screen.

Step 9:

For wells with screens that intersect more than one aquifer, assign the well to all aquifers intersected with priority given to the aquifer that contains the largest screened interval.

APPENDIX C

POSGCD Monitoring Protocols

Post Oak Savannah Groundwater Conservation District Monitoring Protocols

Post Oak Savannah Groundwater Conservation District
310 E Ave C
Milano, TX 76556

January 2018

Version 1.0

I. WATER LEVEL MEASUREMENT PROTOCOLS

A. Steel Tape (wetted-tape) method

Appropriate Wells for this method:

- ✓ water levels < 500 ft (< 200 ft for best results)
- ✓ an estimated water level is available

- X does NOT have angled casing
- X is NOT pumping
- X is NOT flowing
- X does NOT have water dripping into well or condensing on well casing

Required Materials:

- Graduated steel tape.
- Non-lead break-away weight (to attach to the end of the tape, if necessary)
- Non-toxic blue carpenter's chalk
- Clean rag.
- Pencil or pen.
- Water-level measurement field form.
- Two wrenches with adjustable jaws or other tools for removing well cap.
- Cleaning supplies for water-level tapes.

Steps:

1. If well is equipped with a submersible pump, confirm and record that the pump is not in operation. If the pump is operating, no water-level measurement should be taken or recorded. Obtain permission to collect measurement at a later time.
2. Record how long the pump has been off prior to taking the measurement. If the well has been pumped less than 24 hours prior to taking the water-level measurement, try to reschedule the measurement for another time when the pump can be shut down for the recommended 24 hours. If rescheduling is not possible, mark the ***Less than 24 hrs*** box on the field form. Estimate how long the well has been off and enter the time since pumping.
3. Identify a port or opening that provides access for the steel tape.
4. Measure and record the height of this opening above ground level. Record this as the measuring point correction value (***MP correction***). Describe the measuring point in the official record for the well, and use the same measuring point each time when measuring the water level. If not possible, record the height of the measuring point above land surface each time the static water level is measured.

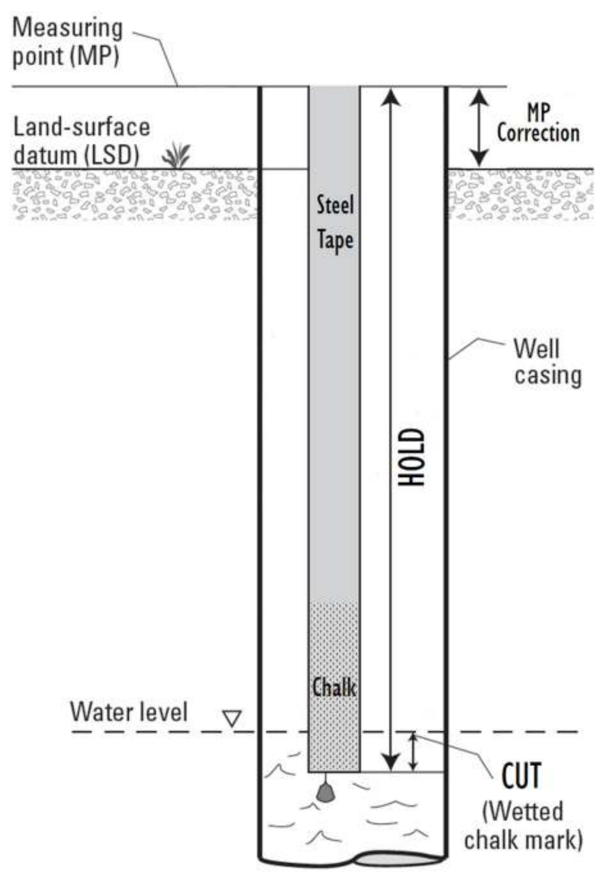


Figure 6-3 Steel tape diagram (modified from USGS, 2011)

5. Chalk the lowest 20 feet of the tape using a piece of blue carpenter's chalk.
6. Review recent measurements from the well and calculate a depth that is 10 feet lower than the last recorded static water level. Record this as the HOLD value.
7. Pinch the thumb and index finger on the tape at the HOLD value. Lower the weight and tape into the well the thumb and index finger meet the MP. The weight and tape should be lowered into the water slowly to prevent splashing.
8. Bring the tape to the surface. Record the length of the wetted chalk as the CUT value.
9. Subtract the CUT from the HOLD and record this number as the ***Depth to water from MP***.
10. Remove the wet chalk, wait 5 minutes and then make a check measurement by repeating steps 5 through 9 using a different HOLD value (1-2 feet lower or deeper) than that used for the original measurement.
11. If the check measurement does not agree with the original measurement within 0.02 foot, continue to make measurements until the measurements agree. If measurements continue to be unreliable, note in field log and reschedule the water-level measurement for a future date.
12. Subtract the ***MP correction*** from the ***Depth to water from MP*** value to get the depth to water below land-surface datum (LSD). Record the water level as the ***Depth to Water from Land Surface***. Note: If the water level is above LSD, record the depth to water in feet below land surface as a negative number.
13. Record date and time of measurement.
14. After completing the water-level measurement, remove the chalk and clean the lowest 30 feet with bleach wipes (0.525% sodium hypochlorite) or a chlorine bleach solution (minimum 0.5% sodium hypochlorite [NaOCl] and water). This will reduce the possibility of contamination of other wells from the tape.
15. Replace cap on any port in discharge head or casing. Leave the well and pump in the same condition as you found it prior to measurement.

Data Recording

- Scan and enter handwritten field water level measurements and notes into the official POSGCD digital database within 2 weeks of the measurement.

Other considerations

- Periodically check the tape for rust, breaks, kinks, and stretching.
- Calibrate the tape annually by comparing to an unused (unstretched) tape.

B. Electric Tape (E-Line) method

Appropriate Wells for this method:

- ✓ water levels < 500 ft (< 200 ft for best results)
- ✓ dripping or condensation on inside casing is OK
- X does NOT have very low specific conductance
- X does NOT have angled casing

Required Materials:

- Electric tape and supply reel.
- Clean rag.
- Pencil or pen.
- Water-level measurement field form.
- Two wrenches with adjustable jaws or other tools for removing well cap.
- Cleaning supplies for water-level tapes.
- Replacement batteries

Steps:

1. If well is equipped with a submersible pump, confirm and record that the pump is not in operation. If the pump is operating, no water-level measurement should be taken or recorded. Obtain permission to collect measurement at a later time.
2. Record how long the pump has been off prior to taking the measurement. If the well has been pumped less than 24 hours prior to taking the water-level measurement, try to reschedule the measurement for another time when the pump can be shut down for the recommended 24 hours. If rescheduling is not possible, mark the ***Less than 24 hrs*** box on the field form. Estimate how long the well has been off and enter the time since pumping.
3. Identify a port or opening that provides access for the steel tape.
4. Measure and record the height of this opening above ground level. Record this as the measuring point correction value (***MP correction***). Describe the measuring point in the official record for the well, and use the same measuring point each time when measuring the water level. If not possible,

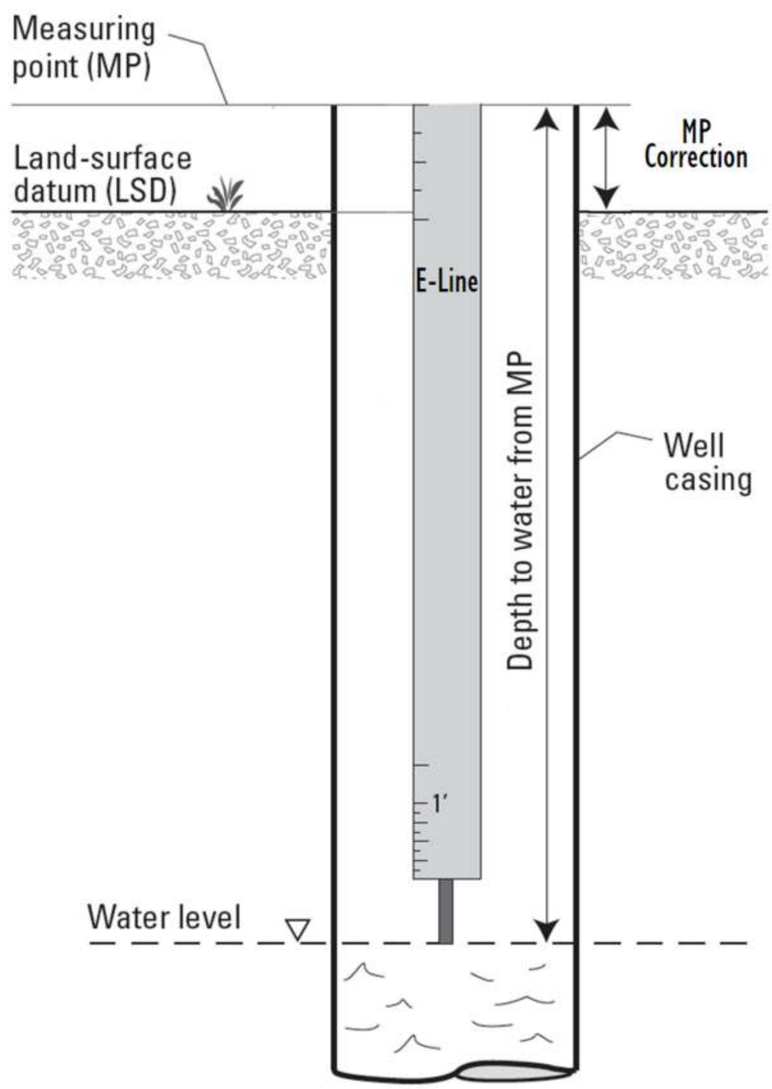


Figure 6-4 Electric tape diagram (modified from USGS, 2011)

record the height of the measuring point above land surface each time the static water level is measured.

5. Prior to lowering the tape down the well, dip the probe into tap water to check whether the electric tape is working properly.
6. Lower the tape slowly into the well until the indicator shows that the probe has made contact with the water surface.
7. Retract the e-line about one foot above the water surface and slowly lower again until the probe makes contact with the water surface.
8. Hold the electric line with a fingertip at the measuring point. Based on the 0.01 feet markings on the electric line, determine depth to water to the nearest 0.01 of a foot and record this value as the ***Depth to water from MP***.
9. Retract the e-line about 5 feet, wait five minutes and then repeat the measurement.
10. If the check measurement does not agree with the original measurement within 0.05 foot, continue to make measurements until the measurements agree. If measurements continue to be unreliable, note in field log and reschedule the water-level measurement for a future date.
11. Subtract the ***MP correction*** from the ***Depth to water from MP*** value to get the depth to water below land-surface datum (LSD). Record the water level as the ***Depth to Water from Land Surface***. Note: If the water level is above LSD, record the depth to water in feet below land surface as a negative number.
12. Record date and time of measurement.
13. After completing the water-level measurement, remove the chalk and clean the lowest 30 feet with bleach wipes (0.525% sodium hypochlorite) or a chlorine bleach solution (minimum 0.5% sodium hypochlorite [NaOCl] and water). This will reduce the possibility of contamination of other wells from the tape.
14. Replace cap on any port in discharge head or casing. Leave the well and pump in the same condition as you found it prior to measurement.

Data Recording

- Scan and enter handwritten field water level measurements and notes into the official POSGCD digital database within 2 weeks of the measurement.

Other considerations

- Periodically check the tape for rust, breaks, kinks, and stretching.
- Calibrate the tape annually by comparing to an unused (unstretched) steel tape and/or checking measurements against measurements from a calibrated steel tape.
- Check battery strength regularly.

C. Air Line method

Appropriate Wells for this method:

- ✓ Air line is already installed or can be installed
- ✓ Depth of air line is known

Required Materials:

- 1/8 or 1/4-inch diameter air line (seamless copper tubing, brass tubing, galvanized pipe or flexible plastic tubing)
- suitable pipe tee for connecting an altitude or pressure gauge to air line.
- Calibrated altitude gauge (readings in feet) or pressure gauge (readings in psi), and spare gauges.
- Compressed air source (ex. tire pump) and corresponding valve stem (ex. Schrader valve)
- Small open-end wrench
- Wire or electrician's tape
- Graduated steel tape
- Blue carpenter's chalk
- Clean rag
- Field notebook
- Pencil or pen
- Water-level measurement field form

Steps:

1. If well is equipped with a submersible pump, confirm and record that the pump is not in operation. If the pump is operating, no water-level measurement should be taken or recorded. Obtain permission to collect measurement at a later time.
2. Record how long the pump has been off prior to taking the measurement. If the well has been pumped less than 24 hours prior to taking the water-level measurement, try to reschedule the measurement for another time when the pump can be shut down for the recommended 24 hours. If rescheduling is not possible, mark the ***Less than 24 hrs*** box on the field form. Estimate how long the well has been off and enter the time since pumping.

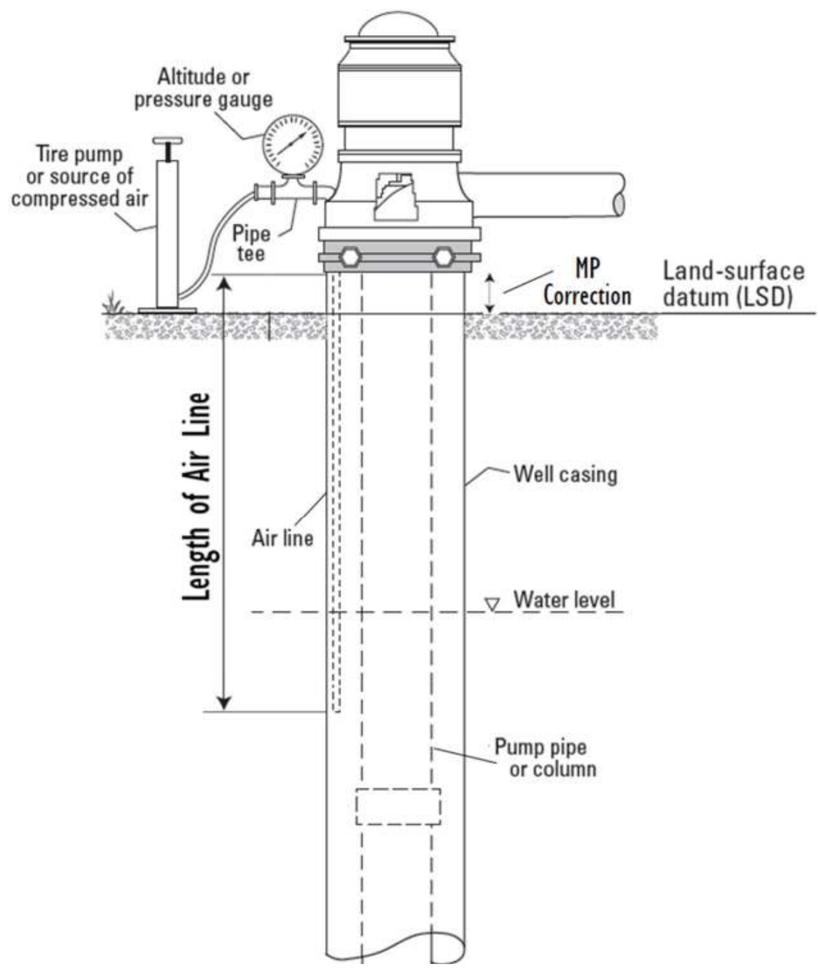


Figure 6-5 Air line diagram (modified from USGS, 2011)

3. Attach a pipe tee to the top end of the air line. On the opposite end of the pipe tee, attach a Schrader valve stem.
4. Use a wrench to connect an altitude gauge (readings in feet) or a pressure gauge (readings in psi) to the fitting on top of the pipe tee.
5. Connect a compressed air source to the valve stem fitting on the pipe tee.
6. Add compressed air to the air line and make sure that the gauge shows pressure is increasing. If the gauge does not move, this means there is a leak. Check connections and retry until problem is fixed. If problem cannot be fixed, retry with a different pressure gauge. If problem still cannot be fixed, measurement by air line is not possible.
7. Continue adding compressed air to the air line until gauge pressure stops increasing. This means all the water has been purged from the air line. Record this maximum pressure as the pressure at the bottom of the air line.
8. Remove the compressed air and make sure that the gauge shows pressure slowly decreasing. If the pressure instead decreases sharply to zero, this means there is a leak in the air line (ex. the tubing is cut or severed). If the pressure does not change, this means there is a blockage in the air line (ex. the tubing is plugged or crushed). In these cases, retry with a different pressure gauge. If problem cannot be fixed, measurement by air line is not possible until air line is replaced.
9. If air line and pressure gauge are working correctly, then after removing the compressed air, the gauge should slowly decrease and eventually stop at a constant pressure. Once the gauge holds constant for 5 minutes, record the gauge reading as the pressure of the water above the bottom of the air line.
10. Repeat steps 7 through 9 until gauge readings are consistent.
11. a) If using an altitude gauge (reads in feet), subtract the gauge reading from the total length of air line. Record this value as ***Depth to water from MP***.
    b) If using a pressure gauge (reads in psi), multiply the gauge reading by 2.31 to convert pressure to feet. Subtract this value from the total length of air line. Record this value as ***Depth to water from MP***.
12. Subtract the ***MP correction*** from the ***Depth to water from MP*** value to get the depth to water below land-surface datum (LSD). Record the water level as the ***Depth to Water from Land Surface***. Note: If the water level is above LSD, record the depth to water in feet below land surface as a negative number.
13. Record date and time of measurement.
14. Replace cap on any port in discharge head or casing. Leave the well and pump in the same condition as you found it prior to measurement.

Data Recording

- Scan and enter handwritten field water level measurements and notes into the official POSGCD digital database within 2 weeks of the measurement.

Other considerations

- If possible, air line length and measurement accuracy should be verified using an independent method (ex. steel tape measurement).
- The altitude/pressure gauge should be periodically calibrated.

D. Transducer method

Appropriate Wells for this method:

- ✓ Transducer is already installed or can be installed
- ✓ Has reliable power supply
- X Water levels do NOT fluctuate beyond range of transducer

Required Materials:

- Vented submersible pressure transducer (most installations) or non-vented submersible pressure transducer (for telemetry installations)
- Perforated PVC pipe to provide protective housing for transducer (necessary in pumping wells)
- Transducer Cables
- Suspension system for the transducer and cables (ex. wire ties)
- Power supply
- Computer with appropriate adapters and transducer software
- Graduated steel tape
- Blue carpenter's chalk
- Clean rag
- Field notebook
- Pencil or pen
- Contact-burnishing tool (ex. artist's eraser)
- Multi-meter
- Spare desiccant
- Replacement batteries
- Water-level measurement field form

Steps (Initial Installation):

1. Based on known well characteristics, choose the appropriate type of transducer for the well. For wells with little or no pumping, a 30 psi transducer (which allows 69 feet of submergence) is sufficient. In high-volume pumping wells, a 100 psi transducer (which allows for up to 197 feet of submergence) may be necessary.
2. For pumping wells, determine the depth to the pump and manufacture a protective sleeve that is long enough to extend well head down to just above the pump. This will be used to isolate the transducer from any frequency or electrical noise that may be generated by the pump.

3. Prior to going to field, install manufacturer supplied software to computer(s) that will be used to interface with the transducers and make sure software is working correctly.
4. Follow manufacturer's instructions to install transducer onto cable and connect transducer cable to computer, allowing software to establish signal to transducer.
5. In the software, input settings for data recording task. Start with a data collection frequency of one measurement per hour. After signal established and transducer programmed, disconnect transducer from computer.
6. Measure the water level in the well with a steel tape following the steel tape measuring protocol.
7. Install transducer in well by lowering it (with its protective pipe, if used) into the well slowly until it is submerged below the water level measured with the steel tape. ****Do NOT allow the transducer to free fall into the well.****

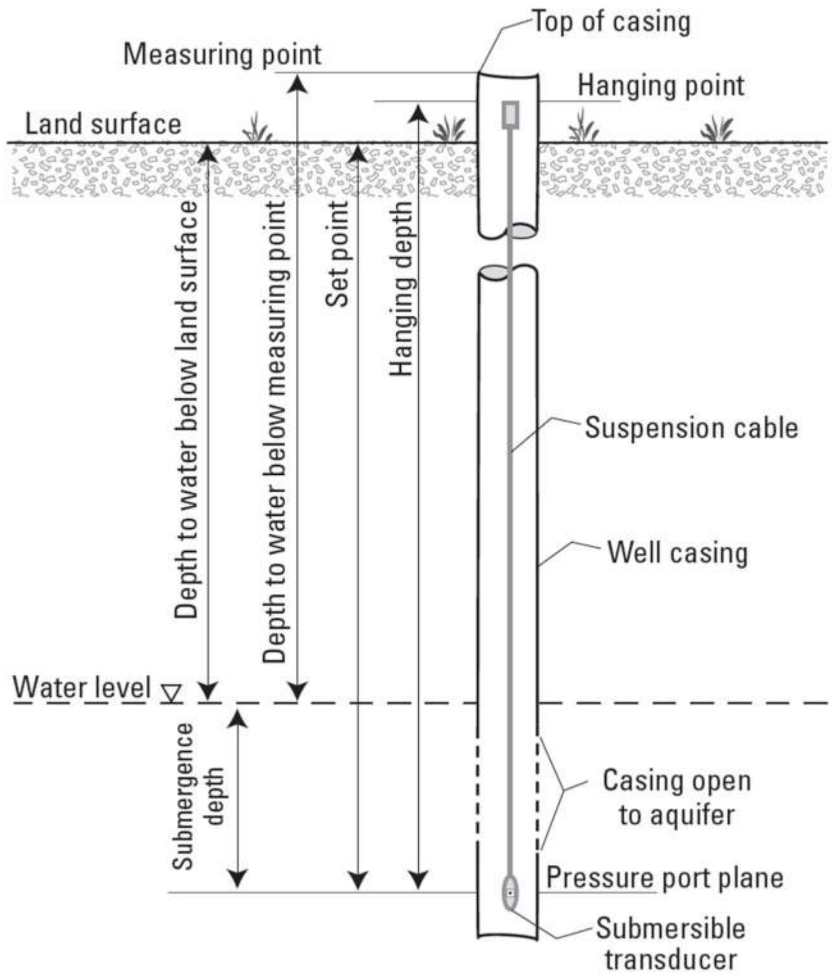


Figure 6-6 Transducer diagram (modified from USGS, 2011)

8. Continue lowering the transducer until it is deep enough that it will not go dry under anticipated water levels. For wells with little to no pumping (30 psi transducer), lower the transducer to approximately 50 feet below depth to water. For wells with high-volume pumping (100 psi transducer), lower the transducer to either the depth to the pump or 150 feet below depth to water, whichever is shallower.
9. Secure transducer and cable following manufacturer's recommendations to keep unit stable.
10. Mark the cable at the hanging point so that any future slippage can be determined.
11. Reconnect transducer to computer and ensure that the channel, scan intervals, and other functions selected are correct. Activate the data logger and set the correct time. Check that the water level measured is consistent with the water level measured with the steel tape. Make sure the data logger is operating prior to disconnecting from computer.
12. Record well and measuring point (MP) configuration, including the MP correction length above the land surface, the hanging point, and the hanging depth.

13. If necessary, install an instrument shelter that will protect the transducer and data logger from vandalism and weather.

Steps (Existing Installation):

1. Every 3-4 months (or life expectancy of desiccant), retrieve groundwater data by connecting transducer cable to computer and using data logger software.
2. Record the current water level displayed by the sensor.
3. Measure the water level in the well with a steel tape following the steel tape measuring protocol and record this value.
4. If the water-level measurement and transducer reading differ by more than 1 foot:
    a. Check that the transducer is working by raising the transducer in the well slightly and taking a reading. Return transducer exactly to its original position after this check.
    b. Check for other causes of measurement inconsistency such as cable kinks or slippage.
    c. Recalibrate or replace the transducer if necessary and reset the instrumentation to reflect the proper depth to water.
    d. Note ALL changes in the record.
5. If the water-level measurements retrieved from the transducer over the past months show any periods of flat-lining, this means the transducer went dry and indicates that the water level fluctuation exceeded the range of the transducer. If a 30 psi transducer is being used, replace the transducer with a 100 psi transducer and lower it to a deeper depth. If a 100 psi transducer is being used, lower the transducer to a deeper depth. If problem persists, continuous water level monitoring may not be possible at that well.
6. Perform basic maintenance checks:
    a. Check the charge on the battery and the charging current supply to the battery using a multimeter and replace batteries as necessary
    b. Check connections to the data logger and tighten as necessary.
    c. If corrosion is occurring, burnish contacts.
    d. Check desiccant and replace if necessary.
7. Verify the logger channel and scan intervals, document any changes to the data logger program, and reactivate the data logger to resume data collection. Make sure the data logger is operating prior to disconnecting cable from computer.
8. Repeat Steps 1 through 6.

Data Recording

- Scan and enter handwritten field water level measurements and notes into the official POSGCD digital database within 2 weeks of the measurement.
- Process downloaded transducer data and enter into the official POSGCD digital database within 2 weeks of collection.
- If data is collected remotely via telemetry, upload to the official POSGCD digital database weekly every Sunday at midnight.

Other considerations

- Transducers should be checked against other water level measurement methods regularly.
- Transducers may need to be periodically recalibrated and/or replaced.

II. Water Quality Measurement Protocols

A. Specific conductance meter (TDS)

Appropriate Wells for this method:

- ✓ Direct water sample retrievable
- ✓ Approx. TDS range known
- X Does NOT have high TDS values (that exceed range of meter)

Required Materials:

- Specific conductance meter
- Standard solution for instrument calibration
- Deionized water
- Plastic wash bottle
- Kimwipes
- Pencil or pen
- Water-level measurement field form
- Lab collection container & lab-specific instructions [if sending sample to outside testing facility]

Steps:

1. The meter should be calibrated on-site with two conductivity standards that bracket the expected conductivity of the sample. Pick these two standards and verify that they are not expired.
2. Bring standard solutions to the temperature of well water by suspending the standards in a bucket into which well water is flowing. Allow at least 15 minutes for temperature equilibration.
3. Rinse the probe with deionized water and blot dry.
4. Connect the probe to the meter and place the probe in one of the standardizing solutions.
5. Set the selector knob to conductivity and allow the reading to stabilize. Adjust the reading using the knob on the back of the instrument until the reading matches that of the standard.
6. Remove the conductivity probe from the standard solution, rinse with deionized water, and blot dry.
7. Repeat steps 4 through 6 with the second standardizing solution.
8. Submerge multimeter into well water and wait for temperature, pH and conductivity values to stabilize. Record temperature, pH and conductivity once readings have stabilized.
9. If taking a grab sample for further laboratory testing, acquire clean water sample from well after multimeter readings have stabilized. Follow the lab-specific instructions for collection and packaging of grab sample.
10. Remove probe, rinse with deionized water, and blot dry.
11. Turn meter off, disconnect probe, and pack both in their case.

Data Recording

- Scan and enter handwritten field water level measurements and notes into the official POSGCD digital database within 2 weeks of the measurement.
- Process downloaded transducer data and enter into the official POSGCD digital database within 2 weeks of collection.

Other considerations

- Meters need to be calibrated before each measurement.
- Calibration standard solutions need to be replaced regularly.
- Meters need regular maintenance and should be checked and calibrated periodically.

APPENDIX D

POSGCD Health and Safety Plan

Health and Safety Plan for Performing Well and/or Tap Sampling Activities within the POSGCD Jurisdiction, Milam and Burleson Counties, Texas

Prepared for:

Post Oak Savannah Groundwater Conservation District
310 East Avenue C
Milano, Texas 76556

Prepared by:

INTERA Inc.
1812 Centre Creek Dr., Suite 300
Austin, Texas 78754

October 2017

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1.0 INTRODUCTION

Post Oak Savannah Groundwater Conservation District (POSGCD) performs groundwater well sampling activities for multiple residences and public suppliers located within the POSGCD jurisdiction in Milam and/or Burleson Counties, Texas. This Health and Safety Plan (HASP) establishes guidelines and requirements for the safety of personnel during the performance of the field activities. The specific field activities addressed by this plan are defined in Section 4.0. Employees of POSGCD are required to abide by the provisions of this plan.

The health and safety guidelines and requirements presented are based on a review of available information and an evaluation of potential hazards. This HASP outlines the health and safety procedures and equipment required for activities at this site. This is a dynamic document. In the event that the contents of this HASP need to be changed, site personnel shall be informed of the change(s) and shall then be responsible for abiding by the protocol of those revisions. The Project Manager, the Project Health and Safety Officer, or the Site Safety Officer may modify this plan in response to additional information obtained regarding the potential hazards to personnel and conditions at the site. Consultation between the Project Manager and a Health and Safety Officer is recommended before establishing HASP modifications.

2.0 POLICY

POSGCD considers the prevention of illness, injury, and accidents in the workplace to have greater importance than any other facet of the work. Safety shall always take precedence over expediency or shortcuts, and every attempt shall be made to reduce the possibility of injury, illness, or accident occurrence. Site activities assigned under a subcontract or purchase order issued shall be conducted in accordance with the established safety regulations of the Occupational Safety and Health Administration (OSHA), and other applicable Federal, State, County, and City regulations. Personnel, including POSGCD subcontractors, lower tier subcontractors, consultants, and service personnel, who perform any task in relation to site activities or are visitors to the site, shall adhere to the provisions of these requirements. This HASP does not apply to owner representatives.

3.0 KEY PERSONNEL

Project Manager: Bobby Bazan (512-455-9900)

For this project, the Project Manager has the following responsibilities:

- Supervise the preparation and implementation of an approved HASP for this project;
- Ensure that the project is performed in a manner consistent with the HASP; and
- Ensure compliance with the HASP by POSGCD personnel.

The Project Manager has the authority to take the following actions:

- Suspend field activities if the health and safety of personnel are endangered, pending further consideration by the Project Health and Safety Officer or the Site Safety Officer (SSO); and
- Dismiss or suspend an individual from field activities for infractions of the HASP, pending further consideration by the Project Health and Safety Officer or the SSO.

Project Health and Safety Officer: Bobby Bazan (512-455-9900)

The Project Health and Safety Officer has the following responsibilities:

- Coordinate with the Project Manager as required in matters of health and safety;
- Develop a HASP for the project and to submit it to the Project Manager for approval;
- Appoint or approve a SSO to assist in implementing the HASP;
- Monitor compliance with the approved HASP;
- Assist the Project Manager in seeing that proper health and safety equipment is available for the project; and
- Approve personnel to work on this site according to appropriate medical monitoring, and health and safety training.

The Project Health and Safety Officer has the authority to take the following actions:

- Suspend work or otherwise limit exposure to personnel if the HASP appears to be unsuitable or inadequate;
- Direct personnel to change work practices if they are deemed to be hazardous to health and safety of personnel; and
- Remove personnel from the project if their actions or condition endangers their health and safety or the health and safety of co-workers.

Site Safety Officer (SSO): Bobby Bazan (512-455-9900)

The SSO has the following responsibilities:

- Direct health and safety activities on site;
- Report safety-related incidents or accidents to the Project Manager and the Project Health and Safety Officer;
- Assist the Project Manager in implementing the HASP; and
- Maintain health and safety equipment on site, as specified in the HASP.

The SSO has the authority to take the following actions:

- Suspend field activities if the health and safety of personnel are endangered, pending further consideration by the Project Manager and the Project Health and Safety Officer; and
- Dismiss or suspend an individual or subcontractor from field activities for infractions of the HASP, pending further consideration by the Project Manager and the Project Health and Safety Officer.

4.0 SITE ACTIVITIES

Post Oak Savannah Groundwater Conservation District (POSGCD) performs groundwater well sampling activities for multiple residences and public suppliers located within the POSGCD jurisdiction in Milam and/or Burleson Counties, Texas. This Health and Safety Plan encompasses activities required to complete the assessment objectives.

Activities for the groundwater well sampling activities include:

- Meeting or communicating with well owner to determine which wells will be sampled;
- If not personally performing the water sampling, the POSGCD representative will then escort subcontracted field personnel to each well for sampling activities;

For water level measurements:

- Documenting location of well to be sampled in field notebook and with photographs;
- Documenting the measured field parameters in field notebook or appropriate POSGCD field measurement form;

For water quality sampling:

- Identifying the tap located at, or nearest, to the wellhead;
- Purging the water well in accordance with Texas Commission on Environmental Quality (TCEQ) standard operating procedure (SOP) number 7.9;
- Documenting location of tap to be sampled in field notebook and with photographs;
- Documenting the measured field parameters during well purging including pH, conductivity, temperature, dissolved oxygen, turbidity and ORP;
- Collecting a representative sample in accordance with TCEQ SOP No. 7.10 in laboratory containers provided by the laboratory;
- And ice preservation of all samples collected for delivery to the analytical laboratory.

Groundwater quality samples will be submitted to DHL Analytical in Round Rock, Texas and samples will be analyzed for TAL metals plus cations by EPA method 6020A, anions by method E300, alkalinity by method M2320 B, dissolved silica by HACH 8185, specific conductance by method M2510 B, and volatile organic compounds (VOCs) by EPA method 8260C.

5.0 HAZARD ASSESSMENT

An assessment of the hazards has been made for each of the activities specified in Section 4.0.

The following hazards have been identified:

- Physical hazards associated with slips, trips, and falls;
- Physical hazards associated with driving from one site to the next;
- Physical hazards associated with water well sampling and heavy lifting;
- Physical hazards associated with extreme weather;
- Biological hazards related to insect and snake bites; and
- Chemical hazards of collecting potentially impacted groundwater samples.

On-site personnel and site visitors shall be made aware of and protected against the potential hazards listed above.

5.1 Physical Hazards

The on-site physical hazards that exist for well sampling primarily revolve around working on unfamiliar terrain around the well heads and driving from well location to well location. If POSGCD has not been to these well locations previously, care must be taken when walking around and determining sample locations near the well heads as there is a potential for on-site physical injury resulting from slips, trips and falls. Driving is a potential hazard so limit your distractions while behind the wheel, i.e. no texting or talking on mobile phones. Know your route to the next well location before you leave to avoid getting lost.

Additionally, multiple supplies and/or equipment may be used to assist in collecting the tap samples and heavy lifting may present itself. Use gloves when handling meters and sampling containers and ask someone to help when lifting heavy items. Do not try to lift by yourself or the potential of self-injury may occur.

Central Texas has the potential to be dramatic and extreme. In case of adverse weather or other environmental conditions, the SSO will determine if work can continue without compromising worker health and safety. The following adverse conditions could prompt a safety review:

- High winds;
- Extreme cold;
- Heavy precipitation;
- Fog; or
- Lightning storms.

5.2 Biological Hazards

Numerous types of pest organisms may be present at the site. Mosquitoes, bees, fire ants, chiggers or scorpions may be present at the site. Field personnel are encouraged to use insect repellents before venturing on site. Additionally, snakes may be present at the site and caution should be exercised especially around items such as tall grass and/or debris.

5.3 Chemical Hazards

For groundwater contamination sampling, field personnel will be collecting tap samples and analyzing them for TAL metals plus cations, anions, alkalinity, dissolved silica, specific conductance, and VOCs. It has not been confirmed whether groundwater is affected with these analytes so it is not known what chemical hazards exist at each residence. The best assurance of protection against potentially hazardous chemicals is avoidance. During the field event, it will be mandatory that field personnel wear safety glasses as to avoid potentially contaminated groundwater contact with the eyes. Nitrile gloves are also required when sampling to avoid potentially contaminated soil contact with the skin.

Ingestion of chemical hazards shall be controlled on this site by prohibiting eating, smoking, and drinking in the Exclusion Zone (refer to Section 6.2 for definitions of work zones), and by requiring field personnel to decontaminate themselves upon leaving the Exclusion Zone.

If contact is unavoidable in order to perform a required task, potential hazards will be minimized by using appropriate PPE to protect against exposure to dangerous or hazardous materials. Personal protective equipment (PPE) to protect the body against contact with known or anticipated chemical hazards has been divided into four categories by the EPA (i.e., Levels A, B, C, and D) according to the degree of protection afforded.

At this site, the levels of protection selected for activities specified in Section 4.0 are:

Level D – for site workers expected to come in direct contact with potentially impacted soil or water.

The following PPE is required for Level D Protection at the discretion of the SSO:

- Coveralls or appropriate work clothes;
- Safety-toed boots;
- Safety glasses or chemical splash goggles;
- Leather or heavy cotton gloves, as required, and nitrile gloves during sampling activities;
- Rain gear, as required;

- Hard hat, if overhead equipment is present; and
- Hearing protection, if heavy machinery is present.

6.0 GENERAL HEALTH AND SAFETY REQUIREMENTS

Safety equipment and PPE are discussed in this section so protection of the head, eyes, skin, feet, and respiratory system can be better understood. The SSO has the authority to make PPE exceptions for site personnel if he/she deems it in the best interest of the field personnel's well being. Such a PPE exception (i.e., modification to the HASP) shall be based on site specific information such as air monitoring data, visual observations, and weather data/observations. One example of such a modification to the HASP would be to decrease the use of respirators, hard hats, or poorly breathable clothing if heat stress is a primary concern during site activities and the use of the PPE was intended for a low-risk precaution. Under no circumstances shall the SSO make a PPE exception/modification if personnel shall be without the protection needed to be safe or to properly protect their health. If it appears that proposed PPE is inadequate, site work shall be suspended until new PPE or planning allows personnel to work safely.

6.1 Safety Equipment

In addition to the personal protective equipment listed below, the following general safety equipment shall be available: OSHA-approved first-aid kit, fire extinguisher, insect repellent/treatment, rinse water, and decontamination water. Table 1 provides a checklist for the health and safety equipment.

6.1.1 Head Protection

Hard hats shall be worn on-site when overhead hazards are present such as during drilling activities and when light and/or heavy equipment is on-site. Drilling and heavy equipment is not scheduled during this field event so hard hats are not warranted.

6.1.2 Eye Protection

For water quality sampling, POSGCD personnel working on site shall wear safety glasses. Additionally, when personnel are performing activities where the potential exists for increased exposure due to splash, dust, particle, or vapor, safety goggles, face shields, or full-face masks shall be worn as appropriate.

6.1.3 Skin Protection

POSGCD personnel working on site shall wear cotton clothing. Due to risks of working near electrical hazards and the possibility of electric shocks, cotton clothing, unlike synthetic materials, will be less likely to melt onto the skin and produce a more severe injury.

At the discretion of the SSO, site personnel may be required to wear disposable, chemically resistant clothing, and inner and outer gloves during soil excavation and/or sampling. This PPE shall be disposed of at the decontamination station after each use or when they become worn or punctured. The suit materials selected shall be resistant to the known or anticipated chemicals at the site. If the disposable protective suits appear to be deteriorating under chemical action, the SSO shall be notified. The seams between the sleeves and gloves, and the pant legs and boots shall be taped to prevent exposure in these areas.

6.1.4 Hearing Protection

At the discretion of the SSO, site personnel may be required to wear hearing protection, such as ear plugs, if loud noises exist on site and are considered a hazard to one's hearing.

6.1.5 Footwear

Personnel engaged in field activities at the site shall wear safety-toed boots at all times. If required by the site-specific HASP or the SSO, footwear may also need to be chemical resistant or boot covers may need to be added.

6.3 Decontamination

During field activities, if equipment needs to be decontaminated it will be carefully decontaminated as specified below.

6.3.1 Equipment Decontamination

For water quality sampling, POSGCD plans to sample directly from the tap if possible but if downhole sampling equipment is required only disposable equipment will be utilized; therefore, decontamination is not needed. However, if non-disposable equipment is used and contacts potentially contaminated media, it will be decontaminated upon completion of field activities. Spray bottles with distilled water and a liquinox/water mixture will be on site if decontamination is warranted.

6.3.2 Personnel Decontamination

Personnel decontamination facilities are to be established, if needed, and are to include the following:

- Hand and face wash; and
- Receptacles for disposal of used personal protective equipment (PPE).

This field effort will include personnel wearing appropriate PPE prior to initiating work at the site each day and will remove and throw away disposable PPE before leaving the site and/or moving to the next sampling location. Used nitrile gloves and disposable spoons will be disposed of in trash bags and the trash bags will be dumped in trash receptacles at the end of each day.

6.4 Medical Examination/OSHA Training

For potentially hazardous field activities such as contaminated water sampling, POSGCD plans to use appropriately trained subcontractors. Subcontractors involved in potentially hazardous field activities shall provide for medical examinations for their employees. Records of proof of medical examination shall be provided to POSGCD by other subcontractors and maintained in the project files.

In the case of potentially hazardous field activities, project personnel on site shall be 40-hour OSHA HAZWOPER trained. Proof of certification shall be available. If a field office is established, a copy of employees' certificates shall be kept in a file on site during work activities and in the project file in the office after the field activities are completed.

6.5 Site Activities Manager Notification

Field personnel shall inform the SSO or his/her designated representative before entering the site. If any previously unidentified potential hazards are discovered during fieldwork, personnel shall notify the SSO for further instructions.

6.6 Project Safety Meetings/Compliance Agreement

A safety meeting shall be conducted by the SSO at the start of each field effort, and thereafter, at the beginning of each day, or as appropriate, due to changing field conditions or the start of new tasks. Safety concerns associated with that day's activities shall be discussed. An attendance record shall be kept for safety meetings.

During the first safety meeting or prior to commencement of fieldwork, POSGCD personnel shall be provided with a copy of this HASP. Personnel shall be given the opportunity to review the plan and ask any questions. A log will be maintained where by project personnel will sign signifying that they have read and understood the HASP.

Project safety information shall be recorded in a field logbook. As appropriate, safety information shall include the following:

- Names of POSGCD, subcontractor, and visitor personnel;
- Dates and times for entry and exit of personnel at the site;
- Lists of accidents, injuries, illnesses, and incidences of safety infractions;
- Air quality and personal exposure monitoring data, if necessary; and
- Other information related to safety matters.

Accidents, illnesses, and/or other incidents shall be reported immediately to the SAM, the SSO, and/or the Project Health and Safety Officer.

6.7 Prohibitions

The following activities are prohibited at the site:

- Smoking, eating, drinking, chewing gum or tobacco, and storing food or food containers in the sampling area;
- Approach or entry into areas or spaces where toxic or explosive concentrations of gases or dust may exist without proper equipment available to enable safe entry and exit; and
- Unauthorized entry into confined spaces.

Field personnel shall practice good personal hygiene to avoid ingesting contaminants or spreading contaminated materials.

6.8 Site Visitors

Visits involving entry to the site by persons not directly involved in tasks identified in the Work Plan are discouraged. Persons designated Site Visitors shall be briefed by the POSGCD SSO as to on-site procedures, conditions, and hazards and shall be required to sign the project safety log before entering the site. Site Visitors shall be accompanied by authorized POSGCD site personnel while on site and shall be expected to follow directives from the SSO. Site Visitors shall provide their own PPE required for the area that they are visiting and shall be expected to follow applicable procedures and protocols.

7.0 LABORATORY CONSIDERATIONS

The laboratory directors or contacts shall be informed of any known contaminant levels in the samples that would require special handling procedures to prevent risks to the health and safety of laboratory personnel.

8.0 CONFINED SPACE ENTRY

A confined space is a space that by design has limited openings for entry and exit, unfavorable natural ventilation that could contain or produce dangerous air contaminants, and is not intended for human occupancy without the proper training and procedures. If any confined spaces are encountered, they are not to be entered and shall be reported to the SSO.

9.0 SHIPPING OF SAMPLES

Although it is highly unexpected, hazardous materials will be shipped by or under the supervision of a DOT trained member of the POSGCD staff or subcontracted personnel.

10.0 HAZARD COMMUNICATION (HAZCOM) PROGRAM

The Hazard Communication (Hazcom) Program is an important component of this Health and Safety Plan. The Hazcom Program designates the project personnel responsible for the implementation and maintenance of hazardous chemical labeling, and employee training and information requirements. The Hazcom Program also includes the hazardous chemical list for the site, and describes the labeling and information requirements associated with the hazardous chemicals likely to be used on-site.

10.1 Roles of Personnel

The SSO shall be the administrator of the site's Hazcom program in coordinating labeling, training, SDS (Safety Data Sheet, formerly known as Material Safety Data Sheet) information, hazardous chemical listings, subcontractor and client Hazcom communications and information exchange, and any necessary trade secret requests. The SSO shall also maintain the site's written Hazcom Program and monitor the implementation and effectiveness of this program. Subcontractors are responsible for complying with applicable POSGCD policies on hazardous chemicals and for providing Hazcom information to the SSO for hazardous chemicals brought to the site; the SSO shall then incorporate the subcontractor Hazcom information into the site's overall Hazcom program. POSGCD site personnel, other than the SSO, are responsible for the following:

- Know the site location of the SDSs and the Hazcom written program.
- Identifying the Hazcom program administrator.
- Competence in reading a SDS and a label, and how to use the applicable sections for safe job performance.
- Understanding potential hazards associated with chemicals in your work area.
- Sending received SDSs to the SSO.
- Notify the SSO of products received with no labels or damaged labels or if you are uncertain of whether a SDS is needed.

10.3 Information and Training

The SSO shall also be responsible for informing and training on site project personnel of the requirements of this plan, and the location and availability of the written Hazcom Program, including the list of hazardous chemicals and their SDSs. The SSO shall be responsible for updating the Hazardous Chemicals List and the associated SDS information.

10.4 Hazardous Chemical List

Hazardous chemicals are not known at these sites; however, alconox will be onsite if decontamination is warranted. The potential Hazardous Chemical List for the site during this assessment is:

- Alconox

The SDS for this chemical is in Attachment D. In the event that additional chemicals are purchased for use on-site, the Hazcom guidelines shall be followed.

10.6 Safety Data Sheets

SDSs for the chemicals identified on the Hazardous Chemical List are included as paper copies in Attachment D of this Health and Safety Plan (HASP). SDSs provide detailed information on specific chemicals, including potential hazardous effects, physical and chemical characteristics, and recommendations for appropriate protective measures. In order to maintain the SDSs in an accessible central place in the field, the SSO shall be responsible for keeping the HASP with the SDS (Attachment D) in the field vehicle at the site. Project personnel working on site shall be informed of its location and shall personally have access to the SDS information. The SSO is also responsible for ensuring that all SDSs are maintained and available, and that SDSs are obtained for new chemicals shipped to the site prior to their use.

11.0 EMERGENCIES/ACCIDENTS

11.1 On-Site Personnel and Visitors

Illnesses, injuries, and accidents occurring on site shall be addressed immediately in the following manner:

- Check the accident scene to determine if you or anyone else is in danger;
- Call the emergency phone number (911) if the emergency or accident appears serious. Emergency numbers are listed in Table 2;
- Begin care for the injured or exposed person(s) by removing them from immediate danger if a neck or back injury is not suspected;
- Render minor first aid as necessary; decontaminate affected personnel as necessary;
- Evacuate other personnel on site to a safe place until the SSO determines that it is safe for work to resume;
- Report the accident to the District Health and Safety Officer, the Project Health and Safety Officer, and the SSO immediately;
- Complete an Incident Investigation Report for near misses and injuries requiring medical attention;
- Collaborate with the District and Project Health and Safety Officer, the SSO, and the Project Manager to develop procedures to prevent a recurrence.

Should an emergency site evacuation become necessary for any reason, the SSO shall alert personnel to leave the site. An assembly point will be designated by the Site Manager/Health and Safety Officer at the beginning of the field work. Personnel shall not return to the site until an all-clear notification has been received from the SSO. In the event the accident is minor enough to transport the injured personnel to the hospital, follow the directions to the hospital provided on Figure HASP-1.

11.2 Surrounding Community

In the highly unlikely event that a site emergency has the potential to affect the community surrounding the site, the SSO shall be responsible for notifying the police and the fire departments using the telephone numbers listed in Table 2. The SSO shall provide whatever technical assistance is needed by these agencies.

12.0 REFERENCES

U.S. Code of Federal Regulations, 1995, Title 29, as cited.

TABLES

Table 1
Site Health and Safety Equipment Inventory Checklist
Include items as applicable for site activities

EMERGENCY RESPONSE	
☐	OSHA-APPROVED INDUSTRIAL FIRST AID KIT
☐	FIRE EXTINGUISHER (1 per field vehicle)
☐	EYE WASH
PERSONNEL PROTECTION	
☐	INSECT REPELLENT
☐	SNAKE GUARDS
☐	SAFETY VESTS
☐	SAFETY GLASSES
☐	NITRILE GLOVES (Outer)
☐	IGLOO™ WATER COOLER/CUPS
☐	GATORADE™
☐	DUCT TAPE
☐	CHEMICAL RESISTANT SAFETY-TOED RUBBER BOOTS OR BOOT COVERS
☐	HARD HAT
PERSONNEL DECONTAMINATION	
☐	4-MIL PLASTIC DROP CLOTHS
☐	PLASTIC WASHTUBS
☐	SPRAYER
☐	BRUSHES
☐	TRASH BAGS
☐	DETERGENT
☐	POTABLE OR DISTILLED WATER

Table 2
Emergency Phone Numbers

EMERGENCY SERVICE	LOCATION OR NOTE	TELEPHONE NO.
Fire Department	Call Emergency No.	911 or 713-692-1945 (non-emergency)
Police Department	Call Emergency No.	911 or 713-222-5408 (non-emergency)
Ambulance	Call Emergency No.	911
Hospital – Rockdale Hospital – Little River Healthcare located at 1700 Brazos Avenue, Rockdale, TX 76567	Call Emergency No. Main Number	911 or (512) 446-4500
Poison Control Center	Call Emergency No.	911 or 800-764-7661
District Health and Safety Officer	Bobby Bazan	(512) 455-9900 office

FIGURES

Figure HASP-1 Hospital Location Map- Rockdale Hospital

Search Results for "1700 Brazos Ave, Rockdale, TX 76567-2518"

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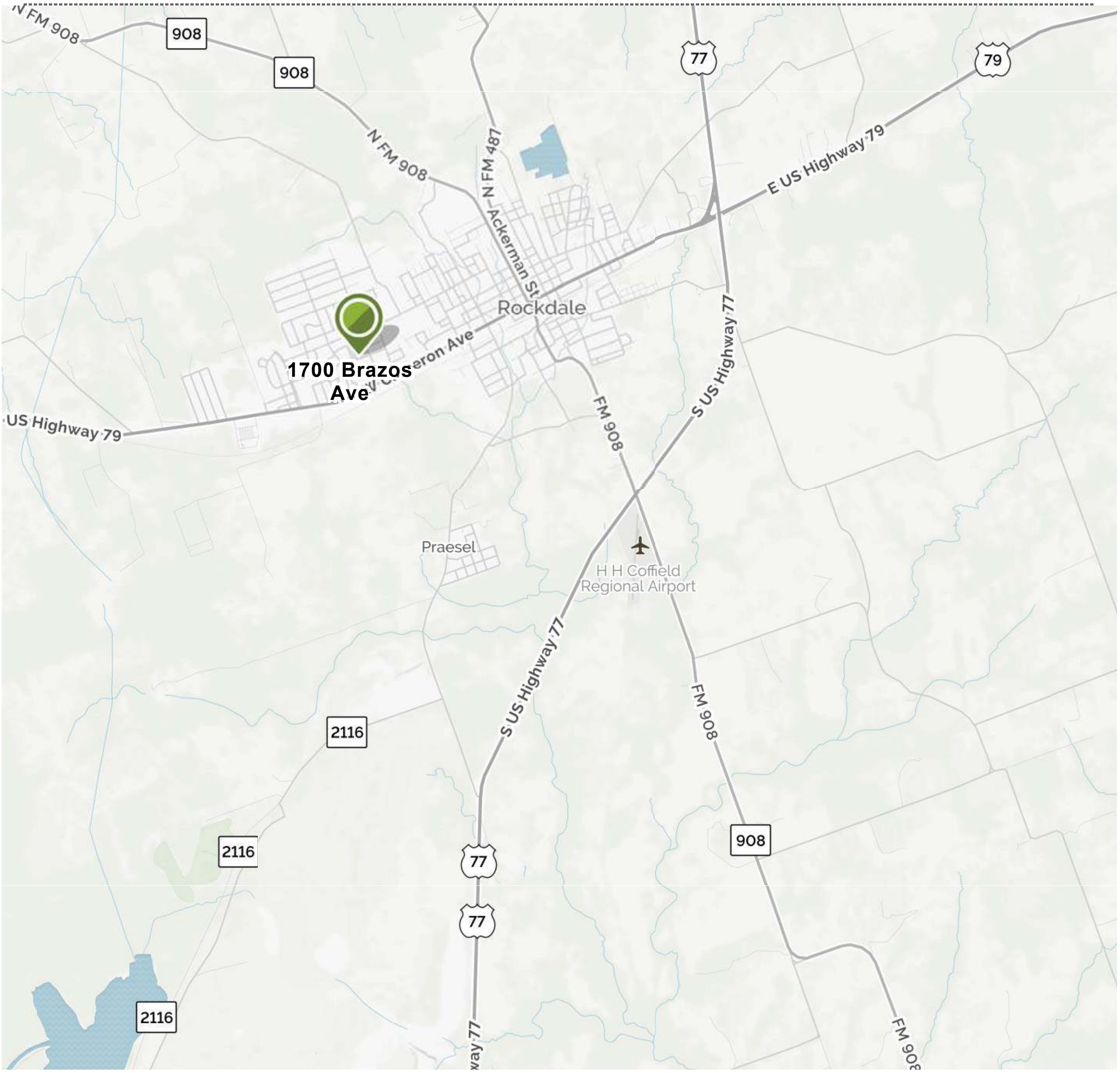
Rockdale Hospital - Little River Healthcare 512-446-4500

1. 1700 Brazos Ave
1700 Brazos Ave,
Rockdale, TX 76567-2518



FORM 1

Site Personnel Acknowledgement Form

SITE PERSONNEL ACKNOWLEDGMENT

Project Title & Task:____

SSHASP Date: ___________________________ Project Number: _________________________

By signing the following I acknowledge that I have read, understood, and agree to comply with the INTERA Site Specific Health and Safety Plan (SSHASP) and have been briefed on the nature of the contaminants (if any) and site hazards and the level and degree of exposure likely as a result of participation in this project.

Subcontracors: This site-specific HASP does not replace the requirement or liability for your company to have its own safety program and site-specific HASP. I also acknowledge that this plan is specific for this INTERA site and may not address unforeseen hazards not included in the SSHASP or for the specific contracted task.

Printed Name	Signature	Company/Organization	Date

FORM 2

Safety Meeting Attendance Form

SAFETY MEETING ATTENDANCE FORM

Date: ______________________________ Project Number: ______________________

Project Title & Task: ____

Has a Job Safety Analysis Form been completed for this task? ☐ Yes ☐ No (if no, fill it out now)

SAFETY TOPICS PRESENTED (describe specifics)

Protective Clothing/Equipment ____

Emergency Procedures ____

Chemical Hazards ____

Confirm that Safety Data Sheets are available for listed hazardous chemicals/substances. ☐ Yes ☐ N/A

Location of Nearest Hospital ____

Physical Hazards ____

Location of Mobile Phone ____

Special Equipment ____

Other ____

ATTENDEES

Printed Name	Signature

Meeting Conducted by:

______________________________ ______________________________

Printed Name Signature

FORM 3

Incident Investigation Report Form

INCIDENT INVESTIGATION REPORT FORM

Attach additional pages as necessary, if more than one employee was injured, each employee must fill out their own form. This form should also be used to report near-misses and property or environmental damage.

Incident Investigator to fill out:	
Reportable / Recordable / Non-Recordable / Near Miss / Property Damage / Environmental Damage	Case Number from OSHA 300 Log:
Site:	**Project Number:**

SECTION 1: INCIDENT REPORT			
Employee Injured, Ill, or Deceased (Skip this box for near-miss and property or environmental damage) Name: Address: Date of Birth: Date Hired: Male / Female			SECTION 1
Names and Project Roles of Other Affected Personnel (Witnesses of incident and/or personnel involved in near-miss or property or environmental damage)			
Site Project Manager			
Event Date	**Event Time**	**Time Personnel Began Work**	
Exact Location of Event: (description or address, if available)			
Event Resulted in: (circle one) Fatality / Injury / Illness / Near-Miss / Property Damage / Environmental Damage			
If fatality, date of death: ___ / ___ / ___			
Nature of the Event: (brief summary including body parts affected and/or property that was damaged)			
Object or substance that directly harmed the employee or property: (Leave blank if not applicable)			
Task Being Performed Just Prior To The Incident: (Describe the work objective, the specific activity being carried out, and any tools or equipment being used)			

Incident Investigator to fill out:		
Reportable / Recordable / Non-Recordable / Near Miss / Property Damage / Environmental Damage		Case Number from OSHA 300 Log:
Site:	**Project Number:**	

SECTION 1

Did the incident involve a vehicle? (include full description of vehicle and rental agency information if appropriate)

Full Description of Incident: (include task being performed, how the event occurred, equipment being used at the time, materials involved, workplace condition, and any other impacts)

Was First Aid Given? (Yes or No – Skip to next section if No)

- **Name of First Aid Attendant(s):**
- **List First Aid Given:**

Was Medical Treatment Beyond First Aid Necessary? (Yes or No – Skip to next section if No)

- **Was Employee Treated in an Emergency Room?** (Yes or No)
- **Was Employee Hospitalized overnight as an in-patient?** (Yes or No)
- **Type of Emergency Transportation:** (i.e., ambulance)
- Location of Medical Treatment Facility:
  Name:
  Address:
  Phone number:
- **Name of Doctor Providing Medical Treatment:**
- **Expected Length of Medical Leave Resulting from Incident:**
- **Medical Diagnosis:**

Section 1 Completed by:________________________________ **Title:** ________________________________

Phone: ________________________________ **Date:** ______________________

Incident Investigator to fill out:		
Reportable / Recordable / Non-Recordable / Near Miss / Property Damage / Environmental Damage		Case Number from OSHA 300 Log:
Site:	**Project Number:**	

SECTION 2

SECTION 2: INVESTIGATION REPORT (to be filled out by Incident Investigator)

Witness statements: (attach sheets as necessary, or NA if no witnesses)

Evidence collected:

Factors in Incident: (check all that apply)

☐ Mental stress factor	☐ Fatigue	☐ Remote site health
☐ Alcohol/drugs	☐ Exposure to sound/noise	☐ Exposure to particulates
☐ Biological exposure	☐ Mechanical vibration	☐ Cold Stress
☐ Chemical exposure	☐ Travel health	☐ Heat Stress
☐ Exposure to ionizing radiation	☐ Exposure to non-ionizing radiation	☐ Pre-existing medical condition
☐ Exposure to gas or vapour	☐ Repetitive movements	☐ Working at height
☐ Other muscular stress	☐ Other health/exposure	☐ Workplace design
☐ Non-compliance	☐ Equipment/property design	☐ Lifting/Hoisting
☐ Electrical	☐ Equipment/property fire	☐ Equipment/property damage
☐ Equipment failure	☐ Housekeeping	☐ Not otherwise specified

Details: (from Factors in previous section)

Incident Investigator to fill out:	
Reportable / Recordable / Non-Recordable / Near Miss / Property Damage / Environmental Damage	Case Number from OSHA 300 Log:
Site:	**Project Number:**

Actual Consequence Level (1 to 5 from Section 3.0 of Incident Investigation Program)

Potential Risk Classification Table (This table is used for any incident, near-miss, or property or environmental damage to determine if the Actual Consequence Level was a reasonably expected outcome or if the outcome could have been even worse. If the Maximum Reasonable Outcome was High or Critical, Corrective Actions must be put in place to lower future Reasonable Outcomes.)

Probability	Consequence: 1 Minor	2 Medium	3 Serious	4 Major	5 Catastrophic
A – Almost Certain	Moderate	High	Critical	Critical	Critical
B – Likely	Moderate	High	High	Critical	Critical
C – Possible	Low	Moderate	High	Critical	Critical
D – Unlikely	Low	Low	Moderate	High	Critical
E – Rare	Low	Low	Moderate	High	High

Max Reasonable Consequence (1 to 5)		**Max Reasonable Outcome** ☐ Critical ☐ High ☐ Moderate ☐ Low
Max Reasonable Probability (A to E)		

Summary of Investigation Findings:

SECTION 2

Incident Investigator to fill out:		
Reportable / Recordable / Non-Recordable / Near Miss / Property Damage / Environmental Damage		Case Number from OSHA 300 Log:
Site:	**Project Number:**	

Corrective Actions Taken to Prevent Recurrence of Event:	SECTION 2
Date Corrective Actions Implemented: ___ / ___ / ___	
Risk Analysis: (does the corrective action generate a new risk?)	

Section 2 Completed by:______________________________ **Title:** ______________________________

Phone: ______________________________ **Date:** ____________________

List of Necessary Contacts for Notification of Incident:

- INTERA Corporate Health and Safety Officer
- INTERA Branch Office Health and Safety Coordinator
- INTERA Project Manager, as applicable
- INTERA Human Resources Manager
- Client Project Manager, as applicable
- OSHA, as applicable

FORM 4

Site Visitor Log

INTERA

SITE VISITOR LOG

Project Title & Task: ____ Project Number:______________________________________

Date	Name/Signature	Company/Organization	Purpose of Visit	Arrival Time	Departure Time

ATTACHMENT A

Health and Safety Requirements for Heavy and Light Equipment

HEALTH AND SAFETY REQUIREMENTS
FOR HEAVY AND LIGHT EQUIPMENT

General

1. Ensure operators have demonstrated skills and/or have attended training on the safe operation of heavy/light equipment.
2. Operate equipment according to Department of Transportation (DOT) regulations.
3. Meet manufacturer's minimum requirements for safe operation of equipment.
4. Daily inspect heavy/light equipment before use. Identify defective equipment, remove it from service, and do not use it until repaired.
5. Before operating heavy/light equipment, inspect work areas, and provide safeguards for identified hazards.
6. Ensure operator's manual is accessible for all heavy/light equipment.
7. Before operating heavy/light equipment greater than 20 horsepower with an operator's seat (excluding trucks), ensure it is equipped with approved roll over protection safety (ROPS), if required.
8. Ensure heavy/light equipment with an operator's seat and equipped with roll over protection safety (ROPS) is equipped with a seat belt.
9. When operating heavy/light equipment, wear a seat belt where provided.
10. Before exiting operator's seat from all heavy/light equipment, lower attachments to the ground and apply parking brake.
11. When riding on heavy/light equipment, ride only on designated positions.
12. Do not use heavy/light equipment as a lifting device unless the equipment and rigging have been load-tested.
13. Ensure all equipment operated during poor visibility or inclement weather is equipped with proper lighting and appropriate safety devices (e.g., windshield wipers, defroster).
14. If it created a hazard to persons in the immediate work area, do not operate equipment.
15. Operate all heavy/light equipment within manufacturer's recommended operating parameters.
16. When digging, drilling, driving objects, or trenching close to energized circuits, locate underground utilities (e.g., electrical lines, telephone, water, natural gas, and other piping systems) and take measures to prevent damage.
17. Be careful when using ladders, handrails, steps, etc., to climb on or off heavy/light equipment.
18. Chock all vehicles with dual wheels. Chock medium-and heavy-duty vehicles (one ton or greater) and, on extremely hilly and mountainous terrain, chock smaller vehicles (1/2 ton pickups and ¾ ton service vehicles).
19. Wear footwear appropriate for the environment and for the equipment being used.

Operation of Light Equipment (Mowers, Tractors, chain Saws, Tamps, Etc.)

1. For manual opening of tailgates on dump trucks, install and use handgrips.
2. Ensure farm tractors used with bush hogs are equipped with heavy-metal mesh guards for personal protection.
3. When engaged in a winching operation with light equipment, be positioned safely (e.g., behind the door).
4. When working in the bucket of an aerial lift, wear a fall protection harness.
5. When operating a chain saw, wear eye and face protection and, except when working from a bucket truck or wood pole, wear chaps.
6. When operating a weedeater with a blade (brushsaw), wear leggings or chaps and eye and face protection.
7. When operating a tamp (except for pole tamps), wear foot protection including toe and metatarsal guards.
8. Use the following required personal protective equipment:
   a. Hard hats
   b. Hearing protection
   c. Safety glasses
   d. Work gloves

Operation of Heavy Equipment (Bulldozers, Motor Graders, Packers, Core Drills, Etc.)

1. When engaged in a winching operation, use heavy equipment equipped with heavy-metal mesh guards for protection.
2. Ensure all heavy equipment is equipped with back-up alarms and warning devices.
3. Ensure all heavy equipment is equipped with a fire extinguisher.
4. When clearing wooded areas, use heavy equipment equipped with closed clearing cab.
5. Safety glasses and heard hat are not required in the enclosed cab of bulldozers.
6. Use the following required personal protective equipment:
   a. Hard hats
   b. Hearing protection
   c. Safety glasses

ATTACHMENT A
EQUIPMENT SAFETY INSPECTION CHECKLIST
FOR LIGHT EQUIPMENT

Safety Inspector: ________________________ Site/Project: _______________ Date: __/__/__
License Plate: _____________________ Make/Model/Color: _____________________

Insert a check mark ✓ if ok, or an ✗ if there is an item deficiency.

Date							
Tire inflation							
Lug nuts							
Exhaust System							
Brakes							
Parking brake							
Engine lubricants							
Engine Coolants							
Steering							
Windshield							
Windshield Wipers							
Heater / Defroster							
Head / tail lights							
Turn indicators							
Instrument gauges							
Initials of Operator							

DESCRIPTION OF DEFICIENCIES: ____

____

REMEDY FOR DEFICIENCIES: ____

____

COMMENTS: ____

____

ATTACHMENT B
EQUIPMENT SAFETY INSPECTION CHECKLIST
FOR HEAVY EQUIPMENT

Safety Inspector: ________________________ Site/Project: _______________ Date: __/__/__
Equipment Type: _____________________ Equipment Number: _____________________

Insert a check mark ✓ if ok, an × if there is an item deficiency, or “NA” if the item does not apply.

FROM THE GROUND

Bucket or Blade	Excessive Wear or Damage, Cracks	
Bucket or Blade Cylinder & Linkage	Excessive Wear, Damage, Leaks, Lubricate	
Stick, Cylinder	Wear, Damage, Leaks, Lubricate	
Boom, Cylinders	Wear, Damage, Leaks, Lubricate	
Underneath Machine	Final Drive Leaks, Swing Drive Leaks, Damage	
Track Sag	Tightness, Wear	
Pivot Shafts	Oil Leaks	
Carbody	Cracks, Damage	
Undercarriage	Wear, Damage, Tension	
Steps and Handholds	Condition and Cleanliness	
Batteries & Hold Downs	Cleanliness, Loose Bolts & Nuts	
Windshield Wipers & Washers	Wear, Damage, Fluid Level	
Fire Extinguisher	Charge, Damage	
Engine Coolant	Fluid Level	
Primary/Secondary Fuel Filters	Leaks, Drain Water Separator	
Air Filter	Restriction Indicator	
Hydraulic Oil Tank	Fluid Level, Damage, Leaks	
Hydraulic Oil	Filter Leaks	
Radiator	Fin Blockage, Leaks	
Hydraulic Oil Cooler	Fin Blockage, Leaks	
AC Condenser	Fin Blockage, Leaks	
Lights and Mirrors	Damage	
Engine Oil Filter	Filter Leaks	
Hydraulic Oil Filter	Filter Leaks	
Overall Machine	Loose/Missing Nuts, Bolts, Guards, Cleanliness	

ENGINE COMPARTMENT

Engine Oil	Fluid Level	
Gear Oil	Fluid Level, Leaks	
Fuel Tank	Fuel Level, Damage, Leaks	
All Hoses	Cracks, Wear Spots, Leaks	
All Belts	Tightness, Wear, Cracks	
Overall Engine Compartment	Trash or Dirt Buildup, Leaks	

INSIDE THE CAB

Seat	Adjustment	
Seat belt & Mounting	Damage, Wear, Adjustment, Age	
Horn, Travel Alarm, Lights	Proper Function	
Indicators	Proper Function	
Monitor Panel	Proper Function	
Switches	Proper Function	
Travel Controls	Correct Operation	
Mirrors Adjustment	Adjustment, Cracks/Broken	
Heating and Cooling System	Proper Function	
Overall Cab Interior	Overall Cab Interior Cleanliness	

COMMENTS: ____

ATTACHMENT B

Heat and Cold Stress Casualty Prevention Plan

HEAT & COLD STRESS

CASUALTY PREVENTION PLAN

TABLE OF CONTENTS

1.0 HEAT STRESS CASUALTY PREVENTION PLAN

The increase in ambient air temperature and decreased body ventilation caused by protective outerwear creates an increase in the potential for injury, specifically, heat stress. Site personnel will be instructed in the identification of heat stress, the first-aid treatment procedures for the worker, and the prevention of heat stress casualties.

1.1 Sources of Heat Stress

Any process or job site that is likely to raise the workers deep core temperature (often listed as higher than 100.4 degrees F (38°C)) raises the risk of heat stress. Operations involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities have a high potential for inducing heat stress in employees. Outdoor operations conducted in hot weather especially those that require workers to wear semi-permeable or impermeable protective clothing, are also likely to cause heat stress among exposed workers.

Age, weight, degree of physical fitness, degree of acclimatization, metabolism, dehydration, use of alcohol or drugs, and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. However, even the type of clothing worn must be considered. Prior heat injury predisposes an individual to additional injury. Individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction, and relative humidity all affect an individual's response to heat.

1.2 Identification and Treatment of Heat Stress

Heat stress disorders include heat stroke (which can result in death), heat exhaustion (which can result in loss of consciousness, but responds well to treatment), heat cramps, heat rashes, and heat fatigue. The following sections list specifics on each condition, and how to treat the condition.

1.2.1 Heat Stroke

Heat Stroke is the most serious heat related disorder and occurs when the body's temperature regulation fails and body temperature rises to critical levels. The condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict. Heat stroke is a medical emergency that may result in death.

Symptoms: The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature (between 107ºF and 110ºF). Unconsciousness follows quickly and death is imminent if exposure continues. The attack will usually occur suddenly.

First Aid: If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady, cool area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the worker's physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker's protests, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

1.2.2 Heat Exhaustion

Heat exhaustion can be a precursor to heat stroke. However, unlike heat stroke, heat exhaustion responds readily to prompt treatment.

Symptoms: Usually begins with headache, nausea, vertigo, muscle weakness, thirst, and giddiness. Vomiting is common and the bowels may move involuntarily. The worker is very pale, his skin is clammy, and he may perspire profusely. The pulse is weak and fast, and breathing is shallow. Heat collapse may occur unless he lies down. This may pass, but sometimes it remains and death could occur.

First Aid: Immediately remove the worker to in a shady or cool area with good air circulation (in Zone 2, the Contamination Reduction Zone, if at a contaminated site). Remove all protective outer wear. Treat the worker for shock (make him lie down, raise his feet 6-12 inches and keep him warm, but loosen all clothing). If the worker is conscious, it may be helpful to give him sips of a salt-water solution (one teaspoon of salt to one glass of water). If the worker does not respond quickly to first aid, obtain professional medical assistance.

1.2.3 Heat Collapse

Heat collapse is often associated with heat exhaustion. In heat collapse, the brain does not receive enough oxygen because blood pools in the extremities. As a result, the exposed individual may lose consciousness. This reaction is similar to that of heat exhaustion and does not affect the body's heat balance. However, the onset of heat collapse is rapid and unpredictable and can be dangerous especially if workers are operating machinery or controlling an operation that should not be left unattended. The worker may also be injured when he or she faints.

Symptoms: Rapid loss of consciousness, other symptoms are similar to heat exhaustion or heat stroke.

First Aid: Check to see if the worker is breathing. If he or she is breathing, position the person on his or her back. Raise the worker's legs at least 12 inches above the ground.
Remove all protective outer wear as gently as possible. Loosen any restrictive clothing or belts. If the worker does not regain consciousness within one minute, call 911. Check the person's airway to make sure it is not obstructed. Check again to see if the person is breathing, coughing, or moving. These are signs of positive circulation. If these signs are absent, start CPR until emergency personnel arrive. If the worker regains consciousness, follow first aid guidance under heat exhaustion.

1.2.4 Heat Cramps

Heat Cramps are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (±0.3% NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments. Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur.

Symptoms: Muscle cramps, often in the legs, but could occur in any portion of the body.

First Aid: Recent studies have shown that drinking commercially available carbohydrate-electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

1.2.5 Heat Rashes

Heat Rashes are the most common problem in hot work environments where the skin is persistently wetted by unevaporated sweat.

Symptoms: Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Heat rash papules may become infected if they are not treated.

First Aid: In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

1.3 Prevention of Heat Stress

Acclimatize workers by exposing them to work in a hot environment for progressively longer periods. NIOSH (1986) suggests that workers who have had previous experience in jobs where heat levels are high enough to produce heat stress may acclimatize with a regimen of 50% exposure on day one, 60% on day two, 80% on day three, and 100% on day four. For new workers who will be similarly exposed, the regimen should be 20% on day one, with a 20% increase in exposure each additional day.

Replace Fluids by providing cool (50°-60°F) water or any cool liquid (except alcoholic beverages) to workers and encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of liquids should be placed close to the work area. Although some commercial replacement drinks contain salt, this is not necessary for acclimatized individuals because most people add enough salt to their summer diets.

Reduce the physical demands by reducing physical exertion such as excessive lifting, climbing, or digging with heavy objects. Spread the work over more individuals, use relief workers or assign extra workers. Provide external pacing to minimize overexertion.

Provide recovery areas such as air-conditioned enclosures, rooms, or work trucks and provide intermittent rest periods with water breaks.

Reschedule hot jobs for the cooler part of the day, and routine maintenance and repair work in hot areas should be scheduled for the cooler seasons of the year.

A work/rest guideline will be implemented for personnel required to wear Level C protection. The maximum wearing time guidelines are as follows:

Ambient Temperatures	Maximum Wearing Time
Above 90° F	½ hour
80° - 90° F	1 hour
70° - 80° F	2 hours
60° - 70° F	3 hours
50° - 60° F	4 hours
40° - 50° F	5 hours
30° - 40° F	6 hours
Below 30° F	8 hours

A sufficient period will be allowed for personnel to “cool down.” This may require shifts of workers during operations.

1.3.1 Personal Protective Equipment to Minimize Heat Stress

Reflective clothing, which can vary from vests and jackets to suits that completely enclose the worker from neck to feet, can reduce the radiant heat reaching the worker. However, since most reflective clothing does not allow air exchange through the garment, the reduction of radiant heat must more than offset the corresponding loss in evaporative cooling. For this reason, reflective clothing should be worn as loosely as possible. In situations where radiant heat is high, auxiliary cooling systems can be used under the reflective clothing.

Auxiliary body cooling ice vests, though heavy, may accommodate as many as 72 ice packets, which are usually filled with water. Carbon dioxide (dry ice) can also be used as a coolant. The cooling offered by ice packets lasts only 2 to 4 hours at moderate to heavy heat loads, and frequent replacement is necessary. However, ice vests do not tether the worker and thus permit maximum mobility. Cooling with ice is also relatively inexpensive.

Wetted clothing such as terry cloth coveralls or two-piece, whole-body cotton suits are another simple and inexpensive personal cooling technique. It is effective when reflective or other impermeable protective clothing is worn. This approach to auxiliary cooling can be quite effective under conditions of high temperature, good air flow, and low humidity.

1.4 Heat Stress Monitoring

Monitor workers who are at risk of heat stress, such as those wearing semi-permeable or impermeable clothing when the temperature exceeds 70°F, while working at high metabolic loads (greater than 500 kcal/hour). Personal monitoring can be done by checking the heart rate, recovery heart rate, oral temperature, or extent of body water loss.

Heart rate (HR) should be measured by the radial pulse for 30 seconds as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 110 beats per minute. If the HR is higher, the next work period should be shortened by or 33%, while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle should be shortened by 33%.

The recovery heart rate can be checked by comparing the pulse rate taken at 30 seconds (P1) with the pulse rate taken at 2.5 minutes (P3) after the rest break starts. The two pulse rates can be interpreted using the following criteria.

Heart rate recovery pattern	P3	Difference between P1 and P3
Satisfactory recovery	<90	--
High recovery (Conditions may require further study)	90	10
No recovery (May indicate too much stress)	90	<10

Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period, and before the worker drinks water. Oral temperature (TO) at the beginning of the rest period should not exceed 99° F. If it does, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period stays the same. However, if the TO exceeds 99.7° F at the beginning of the next period, the following work cycle should be further shortened by 33%. TO should be measured again at the end of the rest period to make sure it has dropped below 99° F.

1.5 Heat Stress Training

Workers should be properly trained on the above Heat Stress program, and should be aware of the following:

- Knowledge of the hazards of heat stress;
- Recognition of predisposing factors, danger signs, and symptoms;
- Awareness of first-aid procedures for, and the potential health effects of, heat stroke;
- Employee responsibilities in avoiding heat stress;
- Dangers of using drugs, including therapeutic ones, and alcohol in hot work environments;
- Use of protective clothing and equipment; and
- Purpose and coverage of environmental and medical surveillance programs and the advantages of worker participation in such programs.

1.6 Heat Stress References

https://www.osha.gov/SLTC/emergencypreparedness/guides/heat.html

2.0 COLD STRESS CASUALTY PREVENTION PLAN

Anyone working in a cold environment may be at risk of cold stress. Some workers may be required to work outdoors in cold environments and for extended periods, which creates an increase in the potential for cold stress injury. Site personnel will be instructed in the identification of cold stress, the first-aid treatment procedures for the worker, and the prevention of cold stress casualties.

2.1 Sources of Cold Stress

What constitutes extreme cold and its effects can vary across different areas of the country. In regions that are not used to winter weather, near freezing temperatures are considered "extreme cold." A cold environment forces the body to work harder to maintain its temperature. Whenever temperatures drop below normal and wind speed increases, heat can leave your body more rapidly. Wind chill is the temperature your body feels when air temperature and wind speed are combined. For example, when the air temperature is 40°F, and the wind speed is 35 mph, the effect on the exposed skin is as if the air temperature was 28°F. Cold stress occurs by driving down the skin temperature and eventually the internal body temperature (core temperature). This may lead to serious health problems, and may cause tissue damage, and possibly death.

Risk factors that contribute to cold stress include wetness/dampness, dressing improperly, and exhaustion, predisposing health conditions such as hypertension, hypothyroidism, and diabetes, and poor physical conditioning.

2.1 Identification and Treatment of Cold Stress

In a cold environment, most of the body's energy is used to keep the internal core temperature warm. Over time, the body will begin to shift blood flow from the extremities (hands, feet, arms, and legs) and outer skin to the core (chest and abdomen). This shift allows the exposed skin and the extremities to cool rapidly and increases the risk of frostbite and hypothermia. Combine this scenario with exposure to a wet environment, and trench foot may also be a problem.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is soaked in perspiration. Special protection of the hands is required to maintain manual dexterity for the prevention of accidents. Additional caution shall be exercised when workers are exposed to vibration, since blood circulation in extremities may already be impaired. Eye protection shall be worn by workers employed out of doors in a snow and/or ice terrain.

Trauma sustained in freezing or sub-zero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Provisions must be made to prevent hypothermia and secondary freezing of damaged tissues, in addition to providing for first aid treatment.

2.1.1 Hypothermia

Hypothermia occurs when body heat is lost faster than it can be replaced and the normal body temperature (98.6°F) drops to less than 95°F. Hypothermia is most likely at very cold temperatures, but it can occur even at cool temperatures (above 40°F), if a person becomes chilled from rain, sweat, or submersion in cold water.

Symptoms: In the mild symptoms of hypothermia, the exposed worker is still alert, but he or she may begin to shiver and stomp the feet in order to generate heat. As the body temperature continues to fall, symptoms will worsen and shivering will stop. The worker may lose coordination and fumble with items in the hand, become confused and disoriented, he or she may be unable to walk or stand, pupils become dilated, pulse and breathing become slowed, and loss of consciousness can occur. A person could die if help is not received immediately.

First Aid: Call 911 immediately in an emergency; otherwise seek medical assistance as soon as possible. Move the person to a warm, dry area. Remove wet clothes and replace with dry clothes, cover the body (including the head and neck) with layers of blankets; and with a vapor barrier (e.g. tarp, garbage bag). Do not cover the face.

If medical help is more than 30 minutes away, give warm sweetened drinks if alert (no alcohol), to help increase the body temperature. Never try to give a drink to an unconscious person. Place warm bottles or hot packs in armpits, sides of chest, and groin. Call 911 for additional rewarming instructions.

If a person is not breathing or has no pulse, call 911 for emergency medical assistance immediately. Treat the worker as per instructions for hypothermia, but be very careful and do not try to give an unconscious person fluids. Check him/her for signs of breathing and for a pulse. Check for 60 seconds. If after 60 seconds the affected worker is not breathing and does not have a pulse, trained workers may start rescue breaths for 3 minutes. Recheck for breathing and pulse, check for 60 seconds. If the worker is still not breathing and has no pulse, continue rescue breathing. Only start chest compressions per the direction of the 911 operator or emergency medical services. Reassess patient's physical status periodically.

2.1.2 Frostbite

Frostbite is an injury to the body that is caused by freezing of the skin and underlying tissues. The lower the temperature, the more quickly frostbite will occur. Frostbite typically affects the extremities, particularly the feet and hands. Amputation may be required in severe cases.

Symptoms: Reddened skin develops gray/white patches. Numbness in the affected body part, and the body part feels firm or hard. In severe cases, blisters may occur in the affected part.

First Aid: Follow the recommendations described above for hypothermia. Do not rub the affected area to warm it because this action can cause more damage. Do not apply snow/water. Do not break blisters. Loosely cover and protect the area from contact. Do not try to rewarm the frostbitten area before getting medical help; for example, do not place in warm water. If a frostbitten area is rewarmed and gets frozen again, more tissue damage will occur. It is safer for the frostbitten area to be rewarmed by medical professionals. Give warm sweetened drinks, if the person is alert. Avoid drinks with alcohol.

2.1.3 Trench Foot

Trench Foot or immersion foot is caused by prolonged exposure to wet and cold temperatures. It can occur at temperatures as high as 60°F if the feet are constantly wet. Non-freezing injury occurs because wet feet lose heat 25-times faster than dry feet. To prevent heat loss, the body constricts the blood vessels to shut down circulation in the feet. The skin tissue begins to die because of a lack of oxygen and nutrients and due to the buildup of toxic products.

Symptoms: Redness of the skin, swelling, numbness, blisters

First Aid: Call 911 immediately in an emergency; otherwise seek medical assistance as soon as possible. Remove the shoes, or boots, and wet socks. Dry the feet.

2.2 Prevention of Cold Stress

Engineering controls can be used to warm the work area. For example, radiant heaters may be used to warm workers in outdoor stations. If possible, shield work areas from drafts or wind to reduce wind chill.

Safe work practices should be used to help prevent cold stress. For example, it is easy to become dehydrated in cold weather. Workers should be provided with plenty of warm sweetened liquids (avoid alcoholic drinks). If possible, heavy work should be scheduled during the warmer part of the day. Workers should be assigned to tasks in pairs (buddy system), so that they can monitor each other for signs of cold stress. Workers should be allowed to interrupt their work, if they are extremely uncomfortable. Workers should be allowed frequent breaks in warm areas (including inside a heated truck). Acclimatize new workers and those returning after time away from work, by gradually increasing their workload, and allowing more frequent breaks in warm areas, as they build up a tolerance for working in the cold environment.

Dressing properly is extremely important to preventing cold stress. The type of fabric worn also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, silk and most synthetics, on the other hand, retain their insulation even when wet. The following are recommendations for working in cold environments:

Wear at least three layers of loose fitting clothing. Layering provides better insulation. Do not wear tight fitting clothing. An inner layer of wool, silk or synthetic helps keep moisture away from the body. A middle layer of wool or synthetic helps provide insulation even when wet. An outer wind and rain protection layer helps allows some ventilation to prevent overheating. Wear a hat or hood to help keep your whole body warmer. Hats reduce the amount of body heat that escapes from your head. Use a knit mask to cover the face and mouth (if needed). Use insulated gloves to protect the hands (water resistant if necessary). Wear insulated and waterproof boots (or other footwear).

2.3 Cold Stress Training

Workers should be properly trained on the above Heat Stress program, and should be aware of the following:

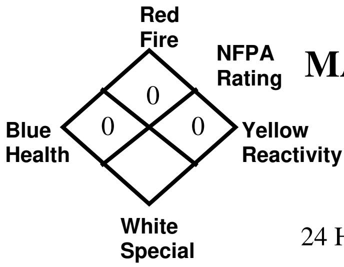
- Knowledge of the hazards and symptoms of cold stress.
- Monitor your physical condition and that of your coworkers.
- Dress properly for the cold.
- Stay dry in the cold because moisture or dampness (e.g. from sweating) can increase the rate of heat loss from the body.
- Keep extra clothing (including underwear) handy in case you get wet and need to change.
- Drink warm sweetened fluids (no alcohol).
- Use proper engineering controls, safe work practices, and personal protective equipment (PPE) provided by your employer.

2.4 Cold Stress References

https://www.osha.gov/SLTC/emergencypreparedness/guides/cold.html
http://www.cdc.gov/niosh/topics/coldstress/

ATTACHMENT C

Safety Data Sheets



Alconox ®

MATERIAL SAFETY DATA SHEET

Alconox, Inc.
30 Glenn Street
White Plains, NY 10603

24 Hour Emergency Number – Chem-Tel (800) 255-3924

I. IDENTIFICATION

Product Name (as appears on label)	ALCONOX
CAS Registry Number:	Not Applicable
Effective Date:	January 1, 2001
Chemical Family:	Anionic Powdered Detergent
Manufacturer Catalog Numbers for sizes	1104, 1125, 1150, 1101, 1103 and 1112

II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

There are no hazardous ingredients in ALCONOX as defined by the OSHA Standard and Hazardous Substance List 29 CFR 1910 Subpart Z.

III. PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point (F):	Not Applicable
Vapor Pressure (mm Hg):	Not Applicable
Vapor Density (AIR=1):	Not Applicable
Specific Gravity (Water=1):	Not Applicable
Melting Point:	Not Applicable
Evaporation Rate (Butyl Acetate=1):	Not Applicable
Solubility in Water:	Appreciable-Soluble to 10% at ambient conditions
Appearance:	White powder interspersed with cream colored flakes.
pH:	9.5 (1%)

IV. FIRE AND EXPLOSION DATA

Flash Point (Method Used):	None
Flammable Limits:	LEL: No Data UEL: No Data
Extinguishing Media:	Water, dry chemical, CO_2, foam
Special Fire fighting Procedures:	Self-contained positive pressure breathing apparatus and protective clothing should be worn when fighting fires involving chemicals.
Unusual Fire and Explosion Hazards:	None

V. REACTIVITY DATA

Stability:	Stable
Hazardous Polymerization:	Will not occur
Incompatibility (Materials to Avoid):	None
Hazardous Decomposition or Byproducts:	May release CO_2 on burning

VI. HEALTH HAZARD DATA

Route(s) of Entry:	Inhalation? Yes Skin? No Ingestion? Yes
Health Hazards (Acute and Chronic):	Inhalation of powder may prove locally irritating to mucous membranes. Ingestion may cause discomfort and/or diarrhea. Eye contact may prove irritating.
Carcinogenicity:	NTP? No IARC Monographs? No OSHA Regulated? No
Signs and Symptoms of Exposure:	Exposure may irritate mucous membranes. May cause sneezing.
Medical Conditions Generally Aggravated by Exposure:	Not established. Unnecessary exposure to this product or any industrial chemical should be avoided. Respiratory conditions may be aggravated by powder.
Emergency and First Aid Procedures:	Eyes: Immediately flush eyes with water for at least 15 minutes. Call a physician. Skin: Flush with plenty of water. Ingestion: Drink large quantities of water or milk. Do not induce vomiting. If vomiting occurs administer fluids. See a physician for discomfort.

VII. PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled:	Material foams profusely. Recover as much as possible and flush remainder to sewer. Material is biodegradable.
Waste Disposal Method:	Small quantities may be disposed of in sewer. Large quantities should be disposed of in accordance with local ordinances for detergent products.
Precautions to be Taken in Storing and Handling:	Material should be stored in a dry area to prevent caking.
Other Precautions:	No special requirements other than the good industrial hygiene and safety practices employed with any industrial chemical.

VIII. CONTROL MEASURES

Respiratory Protection (Specify Type):	Dust mask - Recommended
Ventilation:	Local Exhaust-Normal Special-Not Required Mechanical-Not Required Other-Not Required
Protective Gloves:	Impervious gloves are useful but not required.
Eye Protection:	Goggles are recommended when handling solutions.
Other Protective Clothing or Equipment:	None
Work/Hygienic Practices:	No special practices required

APPENDIX E

POSGCD Water Level Measurement Form

Aquifer(s) ______________________ **State Well No.** ______________

Owner **Address:** ____________________________

Land Surface Elevation : __________________ **County:** ____________________________

Well Location: Lat: ______________________ **Phone:** ____________________
Long: ______________________

Pump: Type: ____________ **Depth:** ft.
Setting: ____________ft.

M.P. _____________ ft. above land surface

Remarks:

Date of current measurement mm/dd/yyyy	Time since last pumped	Less than 24 hrs	Measuring Method	Measuring Point (MP) correction	Steel Tape Only		Depth to water from MP	Depth to water from Land Surface	Change in level since last static measurement	Field Observations	User I.D.
					HOLD	CUT					

APPENDIX F

Determining Average Drawdown in POSGCD Aquifer Management Zones for GMA 12 DFCs

The following section summarizes the methodology used by POSGCD to calculate average drawdown in the Aquifer Management Zones in order to determine DFC compliance:

Step 1:

For each monitoring well in the aquifer, determine the average *baseline* water level by averaging all water levels recorded at that well during a 3-year window around 2000 (1999 to 2001), including available monitoring data from neighboring Brazos Valley GCD and Lost Pines GCD.

Step 2:

For each monitoring well in the aquifer, determine the average *end* water level by averaging all water levels recorded at that well during a 3-year window around the *end* year, including available monitoring data from neighboring Brazos Valley GCD and Lost Pines GCD.

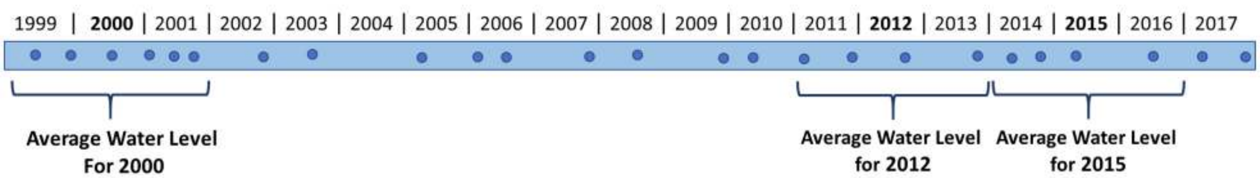


Figure E-1 Diagram of 3-year moving average calculation. Dots represent water level measurements.

Step 3a:

Using only those wells with a water level value in both the *baseline* year (2000) and the *end* year, interpolate a *baseline* (2000) water level surface with 500-foot grid cell size for the aquifer using the Kriging toolbox in ArcGIS.

Step 3b:

Using only those wells with a water level value in both the *baseline* year (2000) and the *end* year, interpolate a *current* water level surface with 500-foot grid cell size for the aquifer using the Kriging toolbox in ArcGIS.

Step 4a:

Clip the *baseline* water level surface (Step 3a) to the Management Zone extent using the Clip Raster toolbox in ArcGIS

Step 4b:

Clip the *end* water level surface (Step 3b) to the Management Zone extent using the Clip Raster toolbox in ArcGIS.

Step 5a:

Determine the average *baseline* water level value from the Raster Properties of the clipped *baseline* water level surface (Step 4a). This represents the average value of all grid cells falling within that Management Zone.

Step 5b:

Determine the average *end* water level value from the Raster Properties of the clipped *end* water level surface (Step 4b). This represents the average value of all grid cells falling within that Management Zone.

Step 6:

Calculate drawdown by subtracting the *end* water level value (Step 5b) from the *baseline* water level value (Step 5a).

APPENDIX G

Determining Average Drawdown in Shallow Aquifer Management Zones for POSGCD PDLs

The following section outlines the 2D (area-weighted) methodology that POSGCD used to calculate average drawdown in the Shallow Aquifer Management Zones. This value was used to determine PDL compliance.

Step 1:

For each monitoring well < 400 feet deep in the District, determine the average *baseline* water level by averaging all water levels recorded at that well during a 3-year window around 2000 (1999 to 2001).

Step 2:

For each monitoring well < 400 feet deep in the District, determine the average *evaluation* water level by averaging all water levels recorded at that well during a 3-year window around the *evaluation* year.

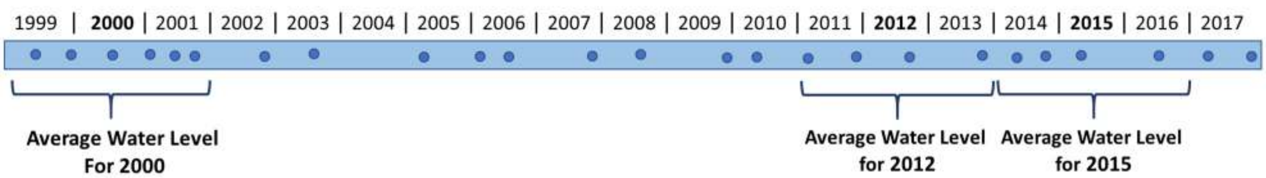


Figure G-1 Diagram of 3-year moving average calculation. Dots represent water level measurements.

Step 3a:

Using only those wells with a water level value in both the *baseline* year (2000) and the *evaluation* year, interpolate a *baseline* (2000) Shallow water level surface with 500-foot grid cell size using the Kriging toolbox in ArcGIS.

Step 3b:

Using only those wells with a water level value in both the *baseline* year (2000) and the *evaluation* year, interpolate an *evaluation* Shallow water level surface with 500-foot grid cell size for the aquifer using the Kriging toolbox in ArcGIS.

Step 4:

Calculate drawdown by subtracting the *baseline* water level surface (Step 3a) from the *evaluation* water level surface (Step 3b) using the Map Algebra toolbox in ArcGIS.

Step 5:

Create grid made of cells that are 500 ft L x 500 ft W x 50 ft H, as illustrated in **Figure G.2**, orthogonal to the rasters created in Steps #3a and 3b. The maximum elevation for this grid is 500 feet amsl and the minimum elevation is -200 feet amsl.

Step 6:

Assign each grid cell a drawdown value, using the drawdown raster created in Step #4. Each cell within a column of the grid (same easting and northing coordinates) will thus have the same drawdown value as the other cells within that column.

Step 7:

Assign each grid cell to an aquifer based on the centroid (middle point) of the grid cell. **Figure G-3** shows the aquifer assignments of grid cells at elevations of 400 ft amsl, 200 ft amsl, 50 ft amsl and -100 ft amsl. **Table G-1** shows the number of grid cells assigned to each aquifer by grid layer.

Step 8:

Calculate average drawdown for each aquifer according to the following equation, using Simsboro as an example. **Figure G-4** shows an illustration of this calculation, using Simsboro as an example.

$$Average\ Simsboro\ Drawdown = \frac{\sum Simsboro\ cell\ drawdown\ values}{number\ of\ Simsboro\ cells}$$

Table G-1 Number of grid cells assigned to each aquifer by 50-foot grid block layer

Elevation	Hooper	Simsboro	Calvert Bluff	Carrizo	Queen City	Sparta	Yegua-Jackson
500	677	3,047	1,292	1,337	1,432	198	165
450	3,058	5,096	7,058	2,243	5,404	1,384	556
400	6,806	7,562	12,587	2,681	8,687	3,200	2,294
350	11,825	9,415	14,455	4,355	13,708	4,691	9,199
300	13,354	10,637	15,784	4,615	15,852	5,977	20,746
250	11,799	11,728	18,386	5,627	16,429	7,065	31,681
200	11,264	11,331	18,455	6,876	16,296	6,908	47,254
150	10,373	10,869	18,620	8,736	16,481	6,384	47,264
100	7,902	10,203	17,508	8,600	15,775	6,150	45,930
50	4,856	7,410	13,408	7,017	13,894	6,226	44,544
0	3,103	4,024	8,783	4,848	9,600	6,114	43,108
-50	1,491	1,909	5,872	2,189	4,918	4,171	38,857
-100	647	874	3,255	656	1,951	2,091	29,043
-150	0	5	114	87	319	1,308	17,354
-200	0	0	0	0	0	0	1,403
TOTAL	***87,155***	***94,110***	***155,577***	***59,867***	***140,746***	***61,867***	***379,398***

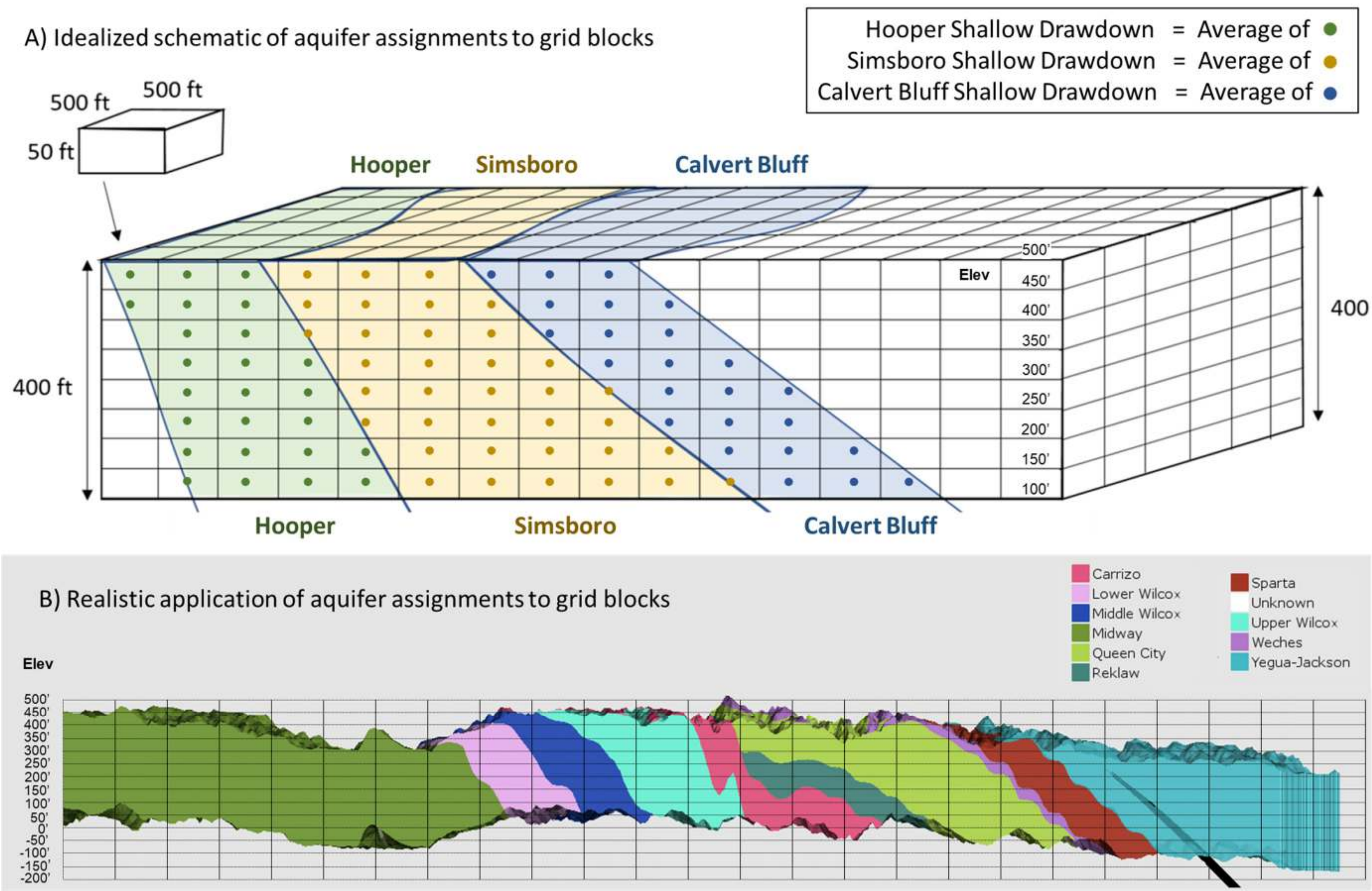


Figure G-2 Schematic diagram of A) idealized schematic of the aquifer assignments to grid blocks and B) a realistic application of aquifer assignments to grid blocks.

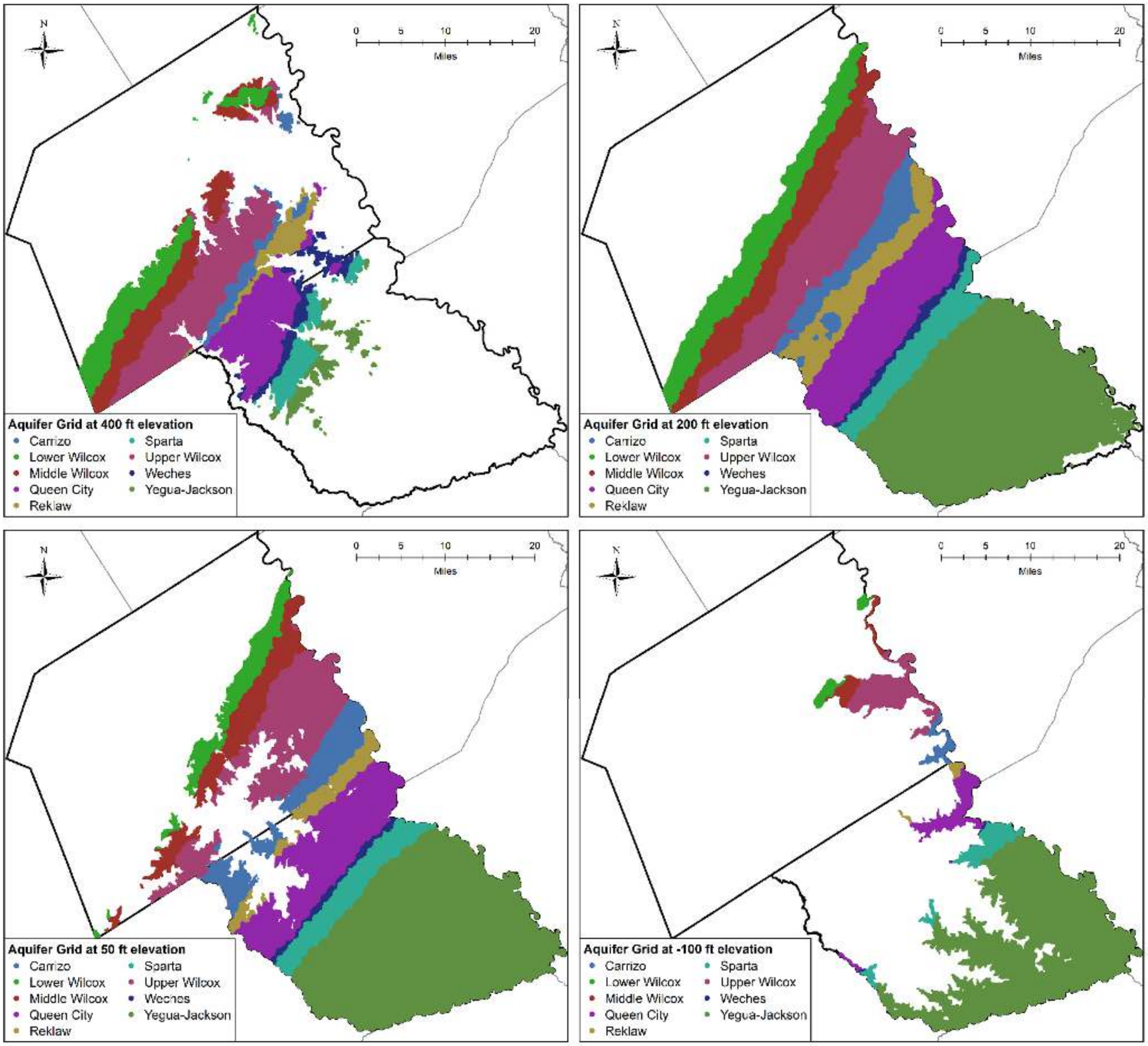


Figure G-3 Aquifer assignments of grid cells at elevations of 400, 200, 50 and -100 ft amsl

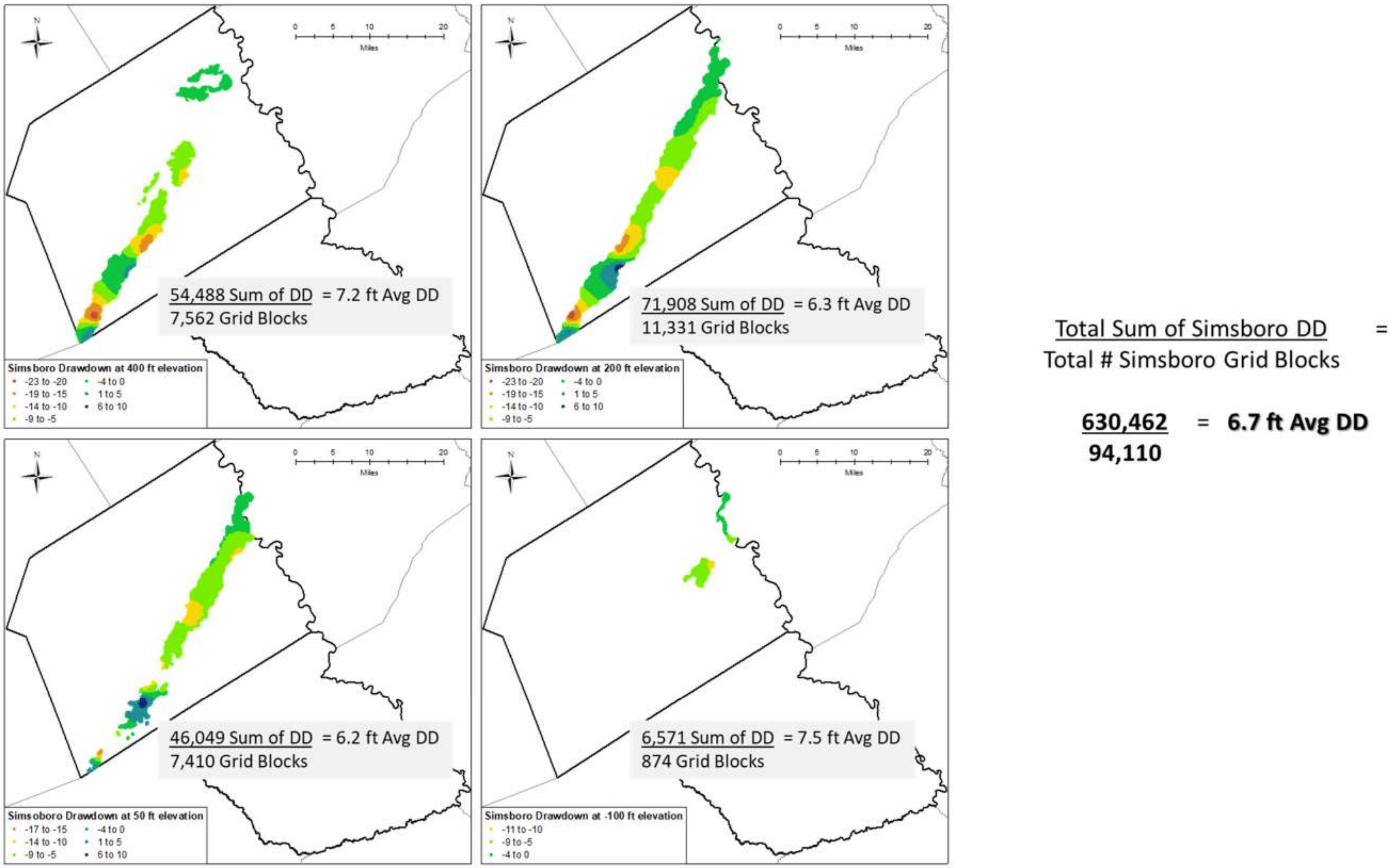


Figure G-4 Illustrated example of the 3D drawdown calculation, using Simsboro as an example.