

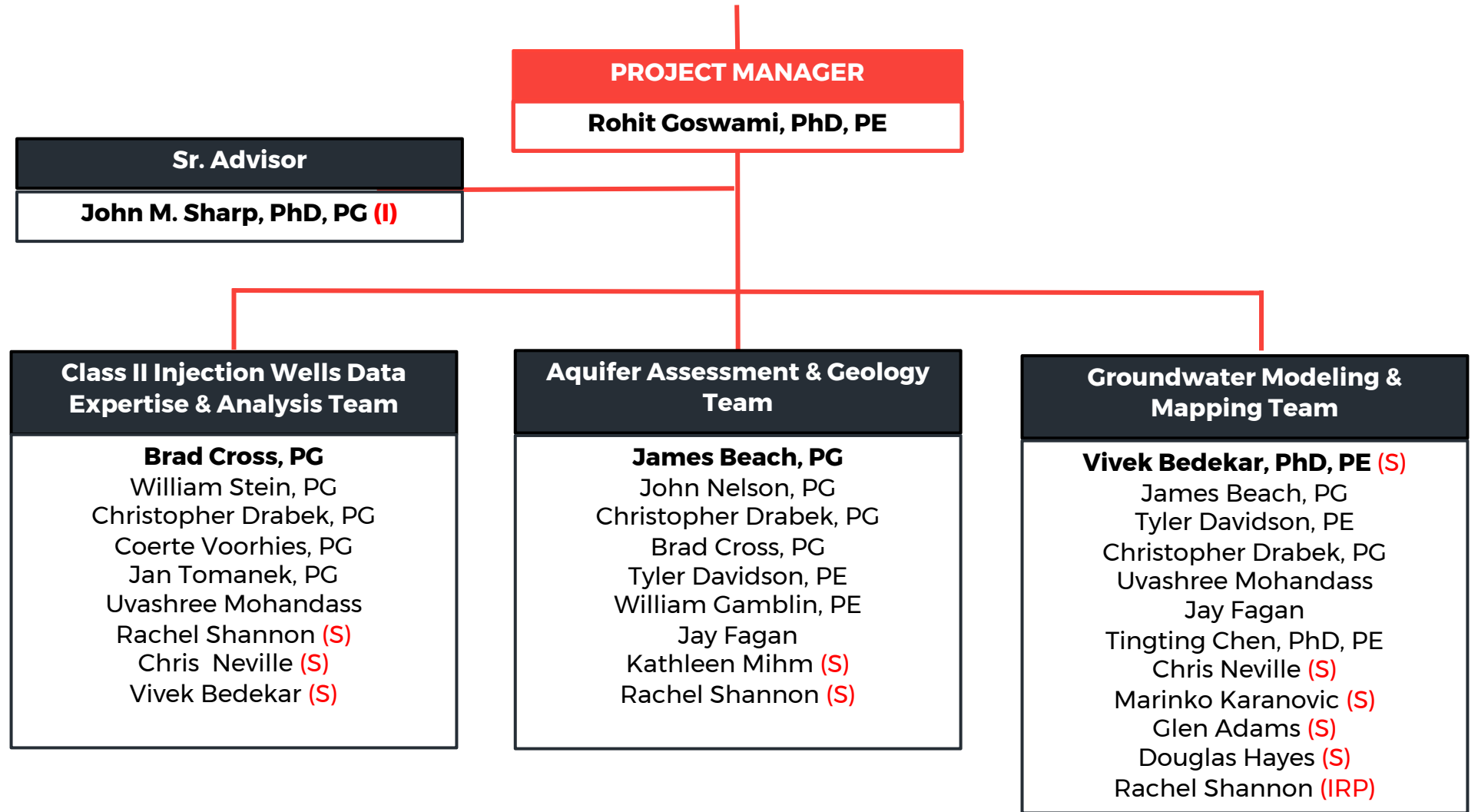
Services to Develop Procedures and Tools to Delineate Areas Designated or Used for Class II Well Wastewater Injectate



TWDB Contract # 2000012453

1st Workgroup Meeting: December 02, 2020





Technical Approach

- Project objective
 - *buffer zone*
- Technical approach
- Identification of Models
 - *literature and information review*
 - *preliminary modeling*
 - *aquifer assessment: parameters*
 - *UIC data analysis: RRC*
- Model development
 - *input dataset*
 - *deliverables requirement*

Project Schedule – WSP

DD: Data deliverables; **RD:** Report deliverables; **TT:** Technology transfer
PM: Project management; **TM:** Technical communication with TWDB staff
SM: Stakeholder meetings as organized by the TWDB staff

Tasks	2020				2021						
	O	N	D	J	F	M	A	M	J	J	A
Task 1: Literature Review			DD	TT							
Task 2: Aquifer Assessment		DD	TT		DD	TT					
Task 3: Aquifer Assessment Presentation		SM			DD	TT					
Task 4: Class II Well Data Procedures & Tools			DD	TT	DD	TT					
Task 5: Mapping Techniques Description			DD	TT	DD	TT					
Task 6: Techniques Presentation			SM		DD	TT					
Task 7: Injectate Mapping Procedures & Tools				DD	TT	DD	TT				
Task 8: Case Study				DD	TT		DD	TT			
Task 9: Procedures & Tool Testing						DD	TT				
Task 10: Final workgroup presentation							SM				
Task 11: Draft and Final Reports							DD	RD		DD	RD
Task 12: Project Management	SM	SM	SM	SM	SM	SM	SM	SM	SM	SM	SM

Project Progress

- Literature Review
 - *Dr. Sharp leading the team*
 - *Specific issues*
- Aquifer Assessment
 - *TWDB data*
 - *RRC data*
 - *Other data*
- RRC UIC dataset
 - *Data processing*
- Modeling Techniques & Tools

Literature Review

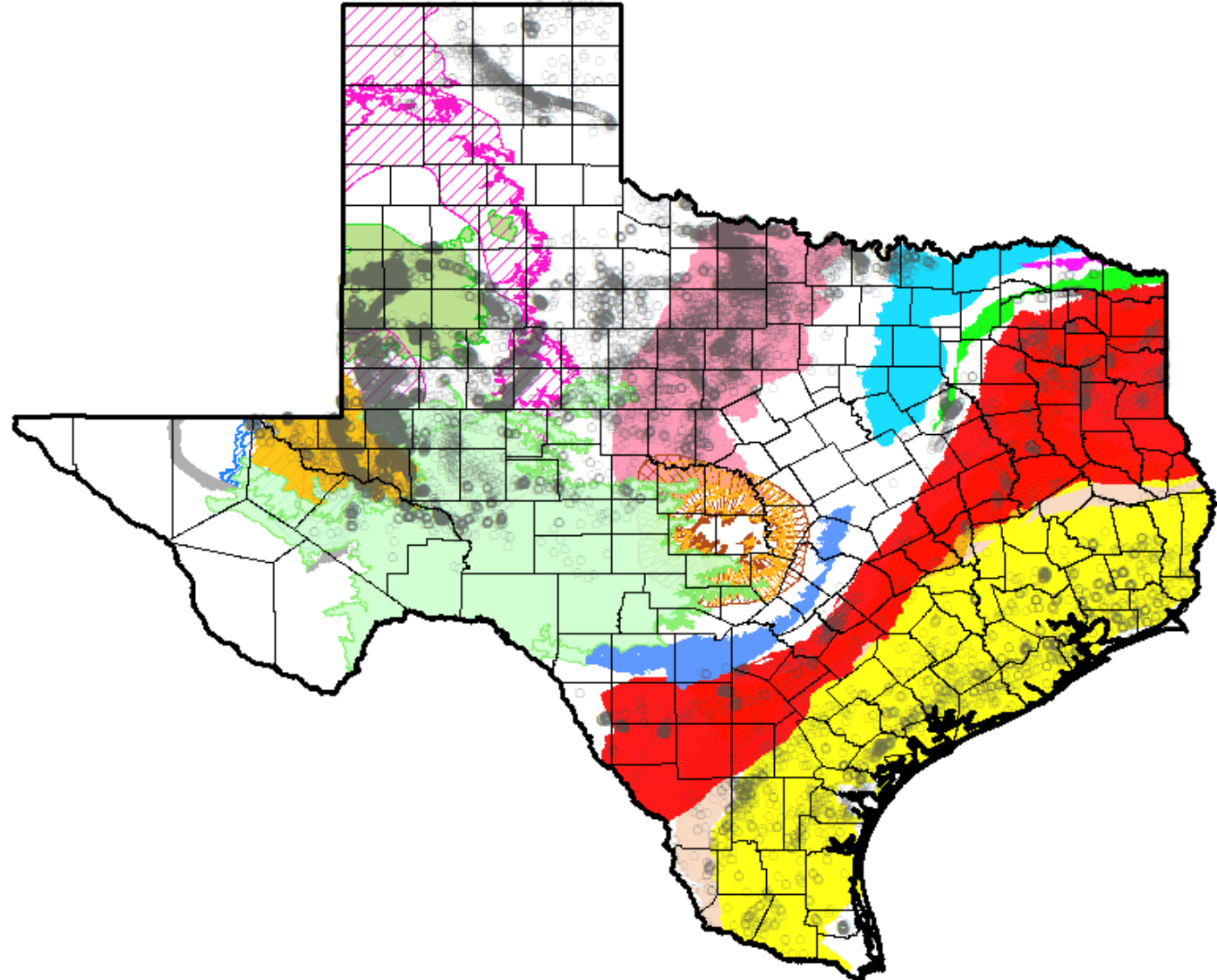
- Few studies addressing specific question
 - *General background*
 - *Further suggestions from TWDB/Workgroup*
- Reviewed 60+ articles
- Review to continue for the month
- Key issues
 - *protection of aquifers*
 - *seismic activity impacts*
 - *Injectate clogging formation*
- Wide variety of strata suitable for waste water injection.
- Regulatory issues
 - *Concentrate disposal permits*
 - *reliability over the life of the desalination system*

Aquifer Assessment

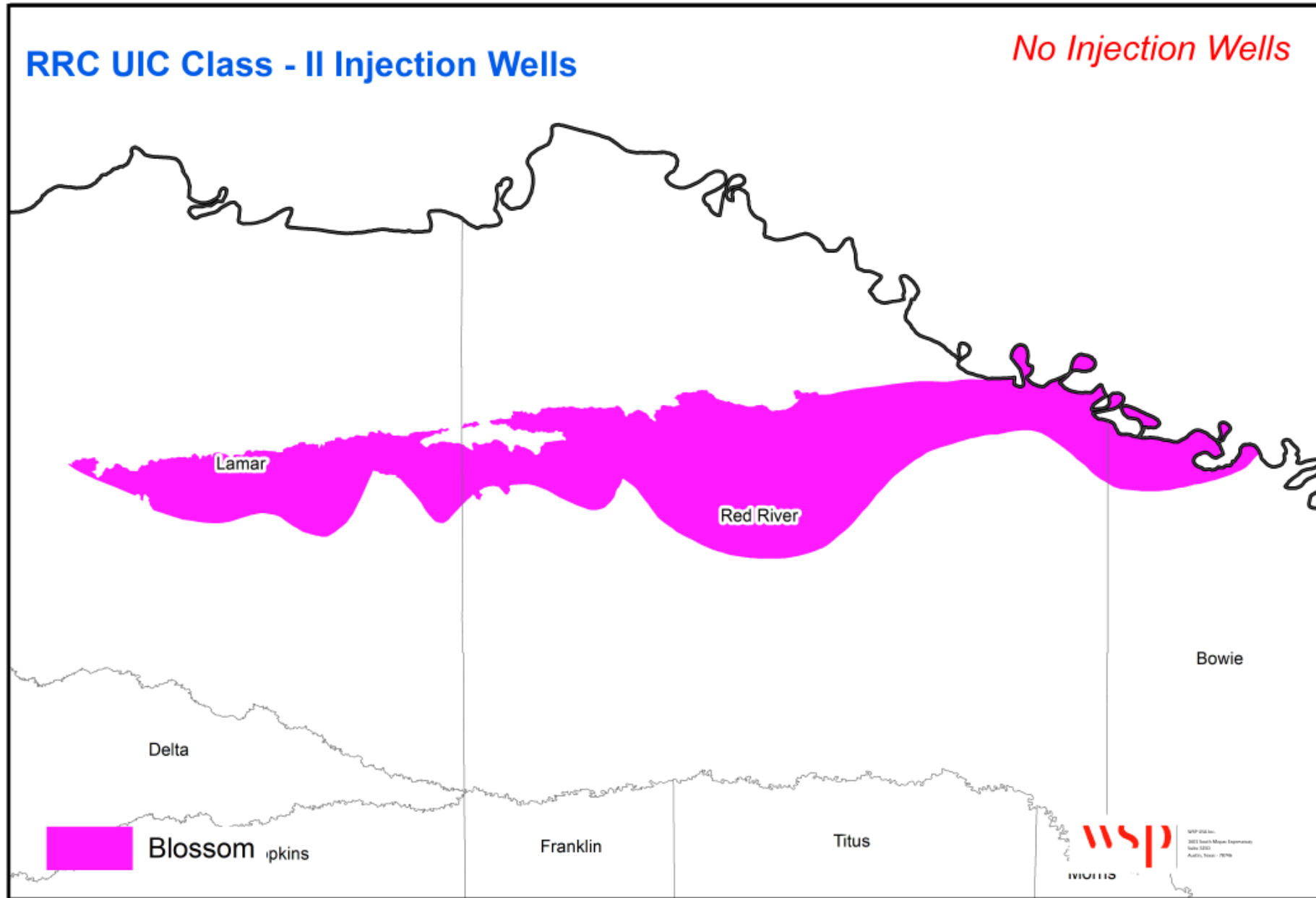
- Project Area
 - *Identification of 18 aquifers*
- Available data
 - *GAM*
 - *BRACS*
 - *SDR*
 - *RRC*
- Analysis process

Aquifer Assessment

- Study A quifers
- Peecos Valley
 - Gulf Coast
 - Carrizo - Wilcox
 - Edwards - Trinity Plateau
 - Edwards
 - Yegua Jackson
 - Sparta
 - Queen City
 - Nacatoch
 - Blossom
 - Woodbine
 - Edwards -Trinity(High Plains)
 - Dookum
 - Rustler
 - Capitan Reef Complex
 - Ellenburger - San Saba
 - Hickory
 - Cross Timbers

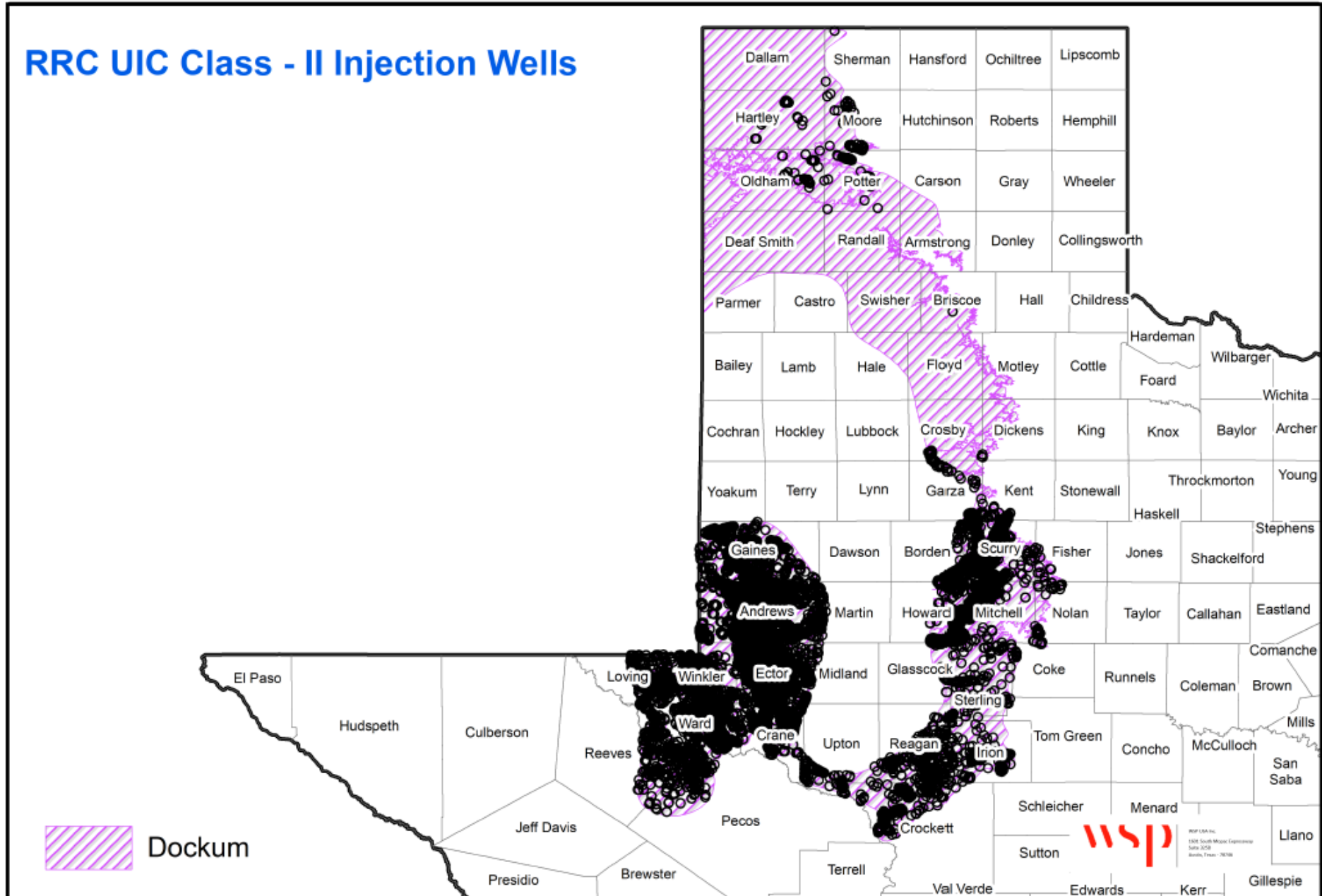


Aquifer Assessment Maps

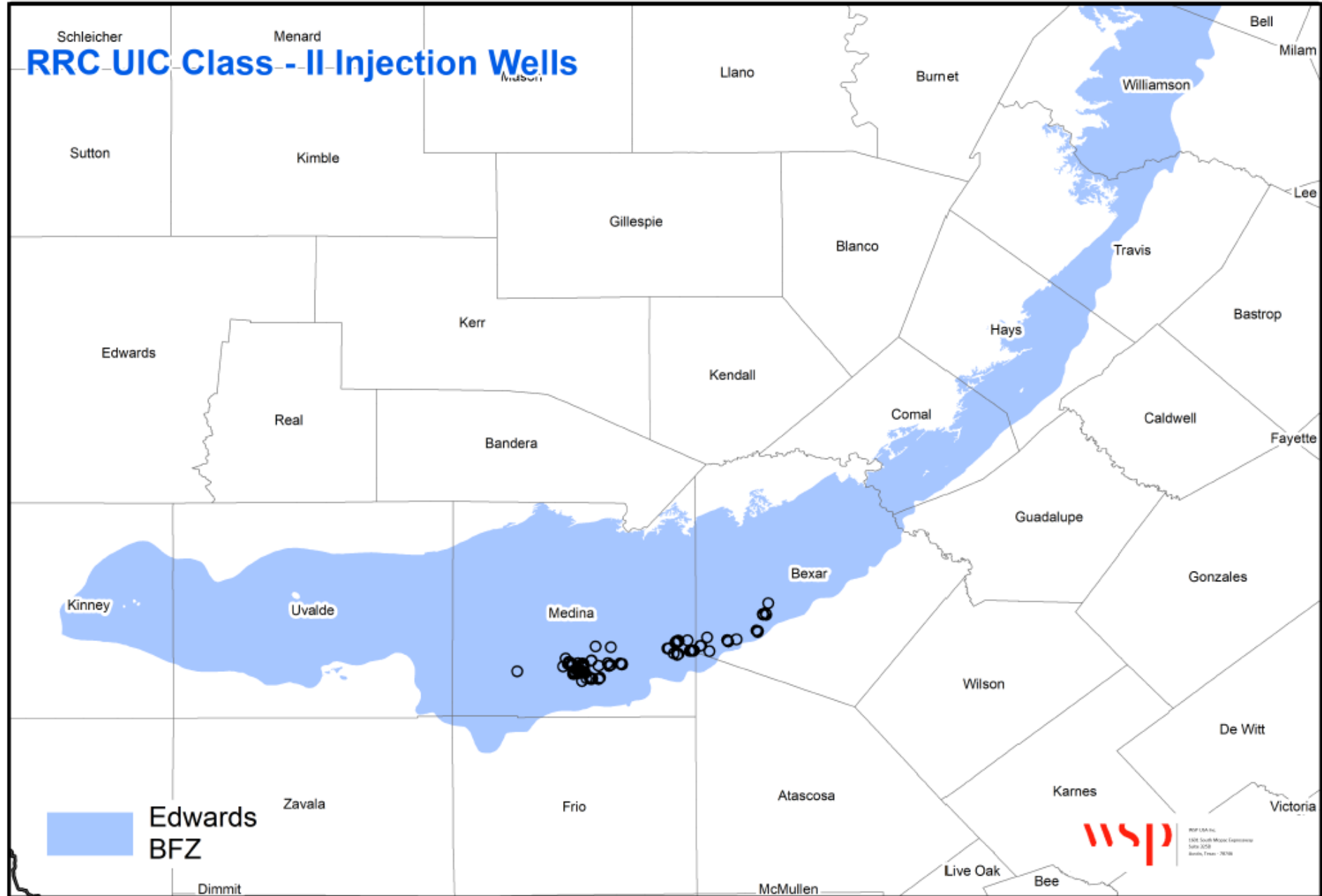


Aquifer Assessment Maps

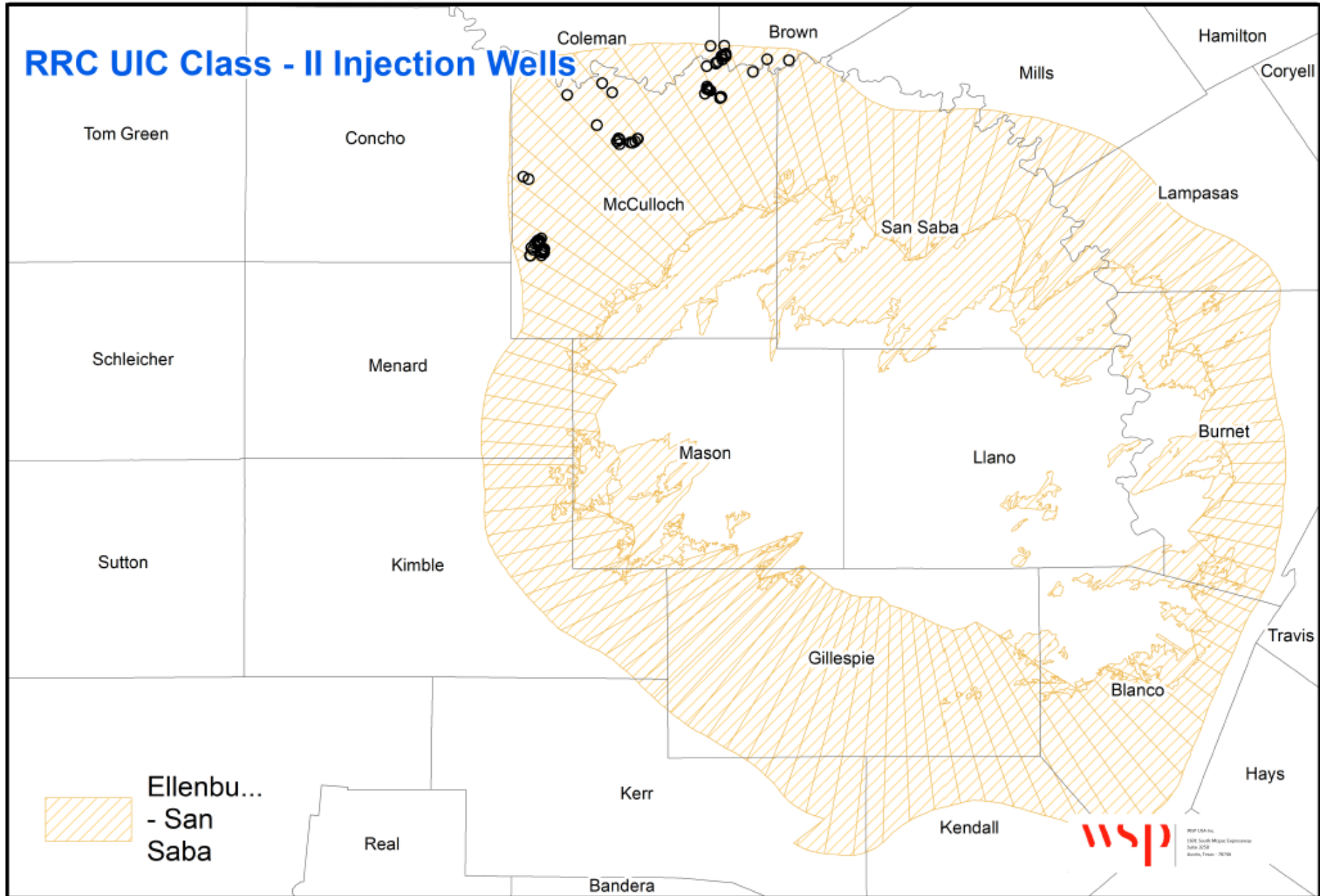
RRC UIC Class - II Injection Wells



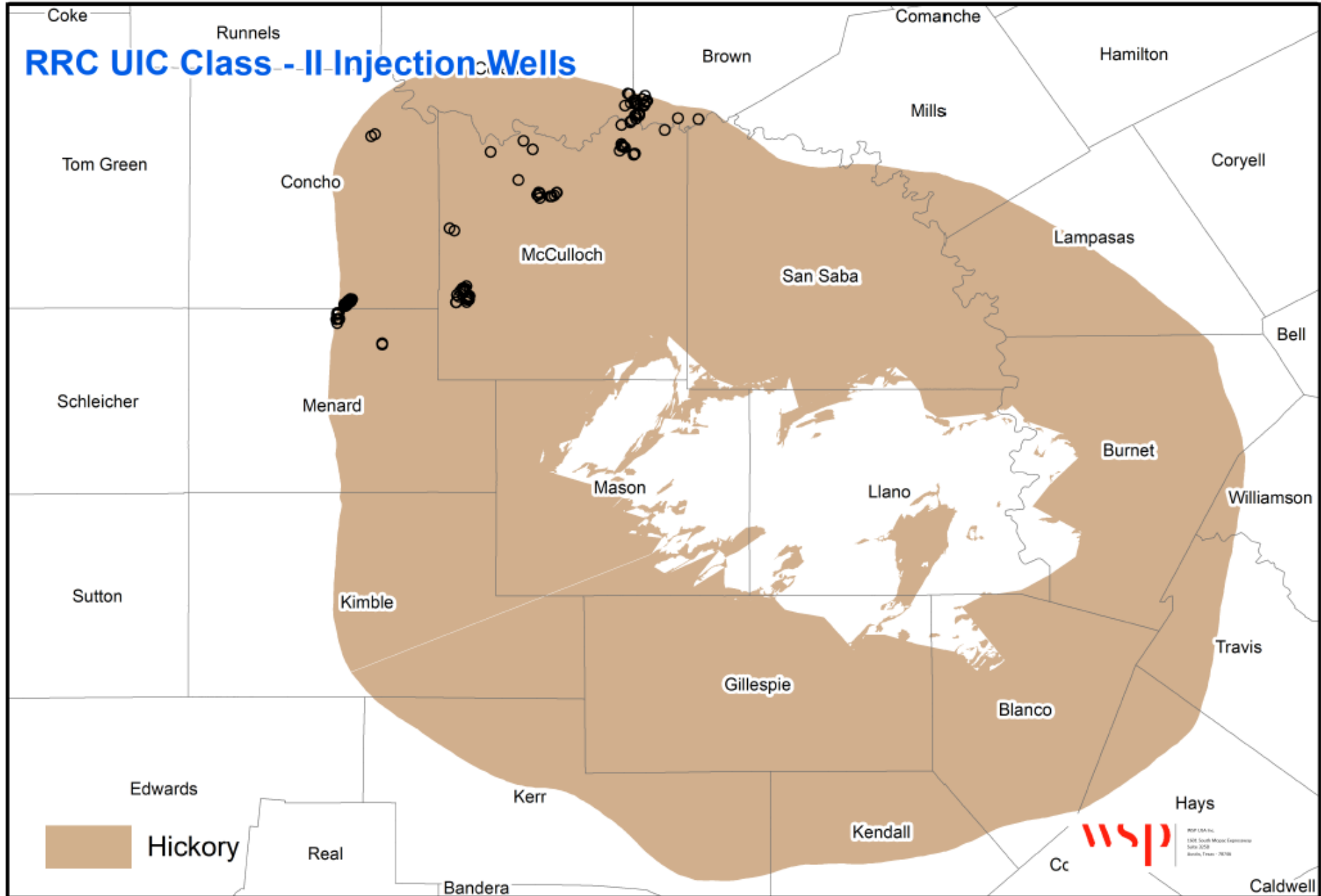
Aquifer Assessment Maps



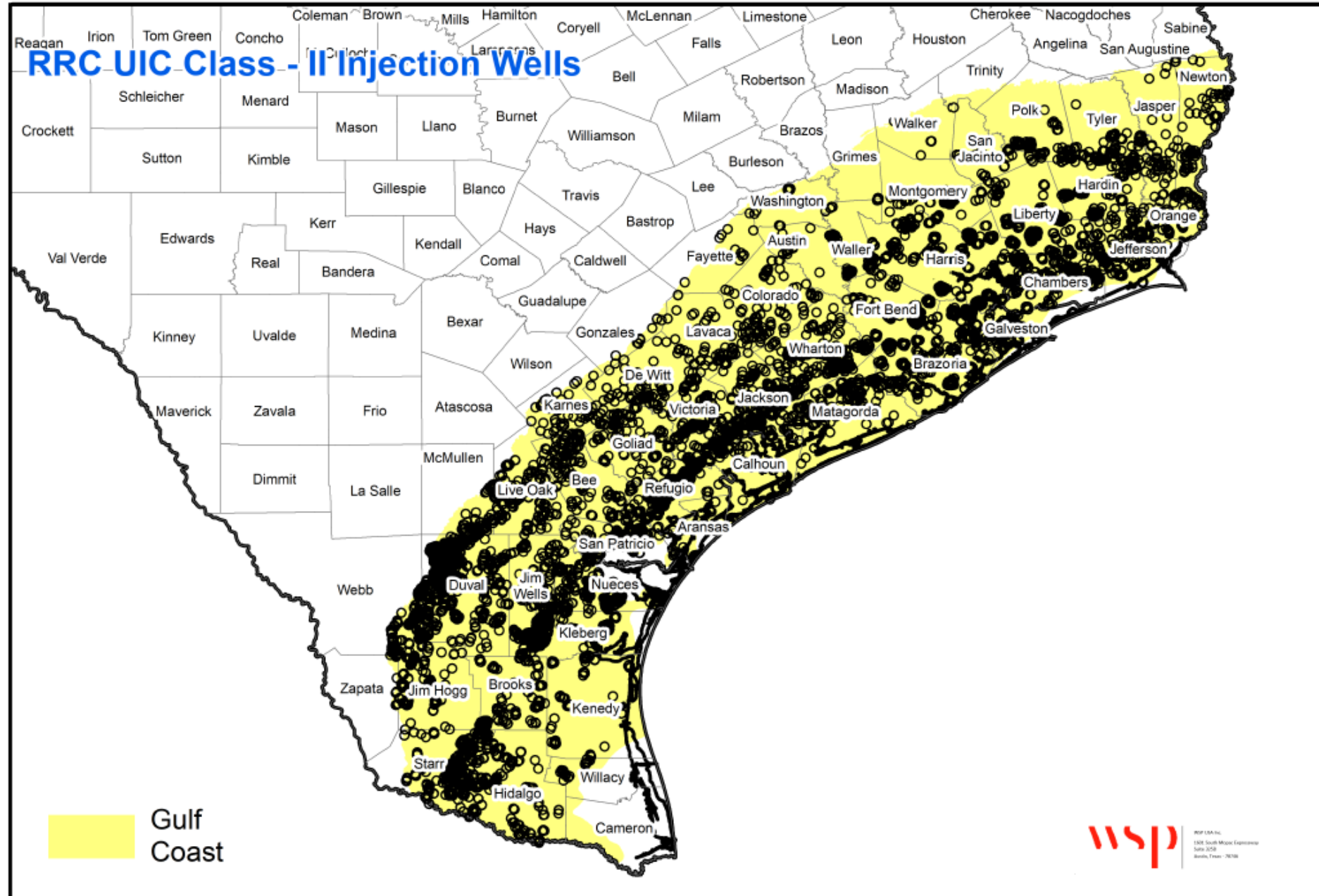
Aquifer Assessment Maps



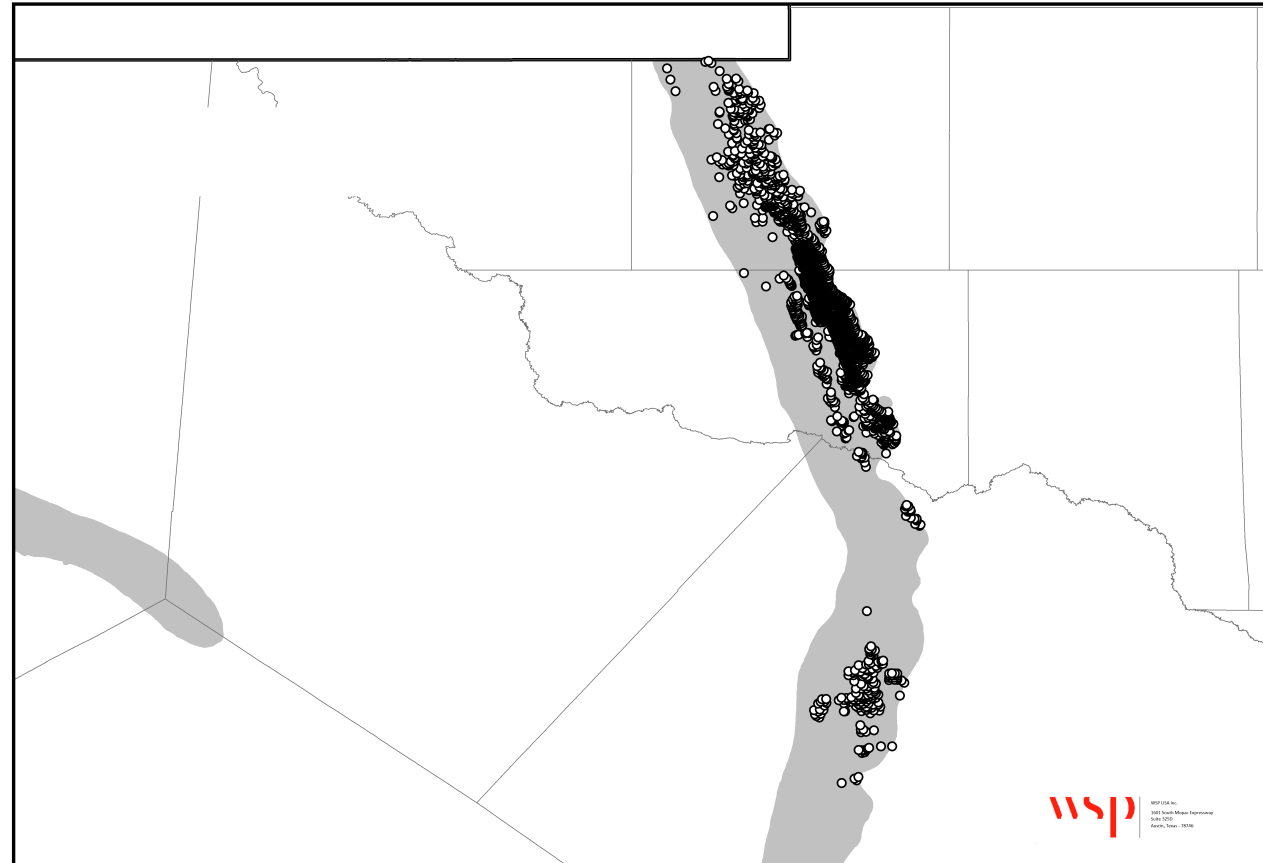
Aquifer Assessment Maps



Aquifer Assessment Maps

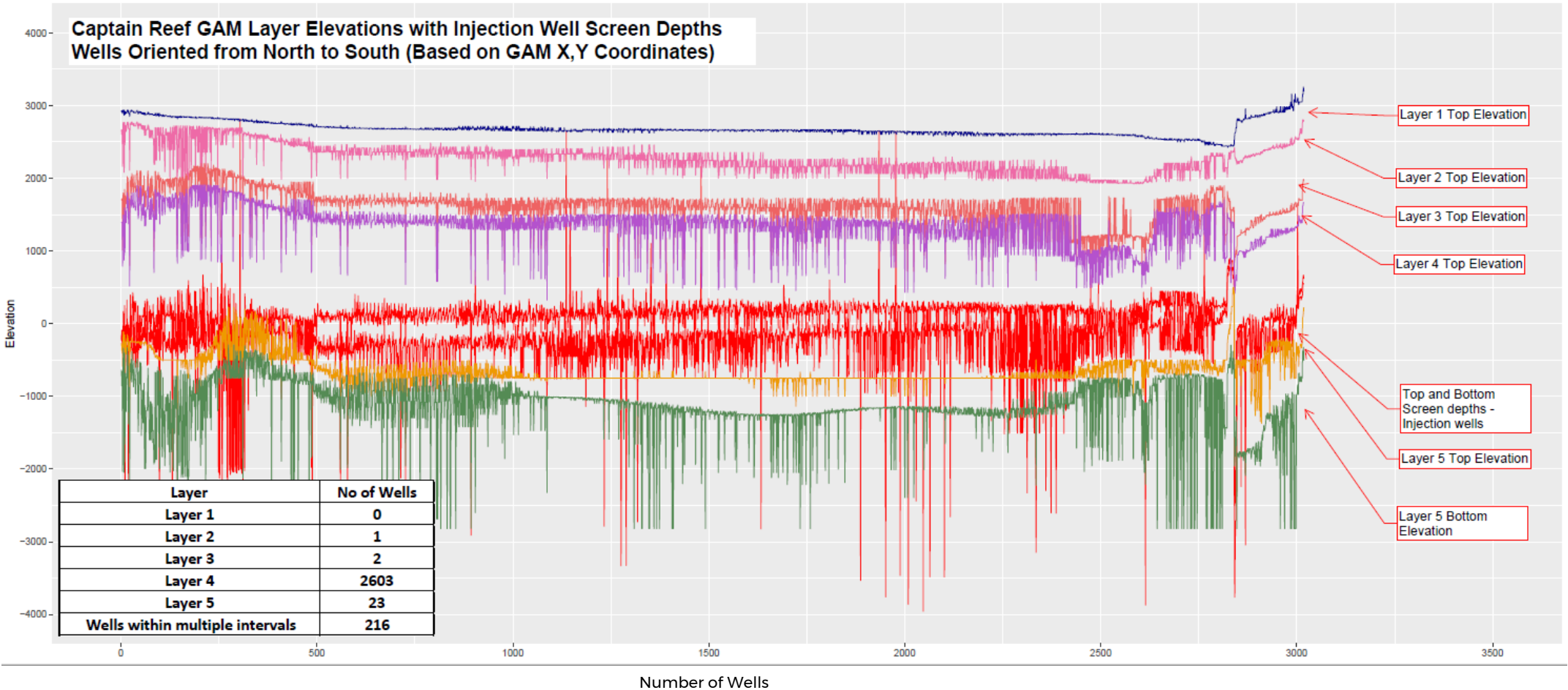
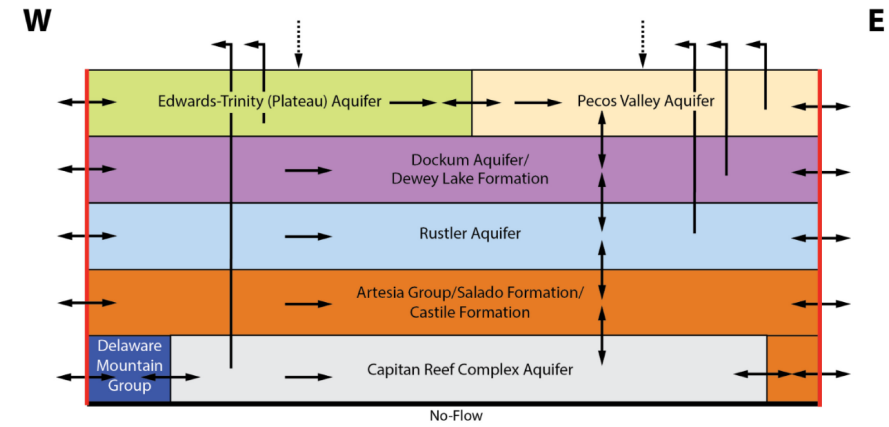


Aquifer Assessment Capitan Reef Complex GAM

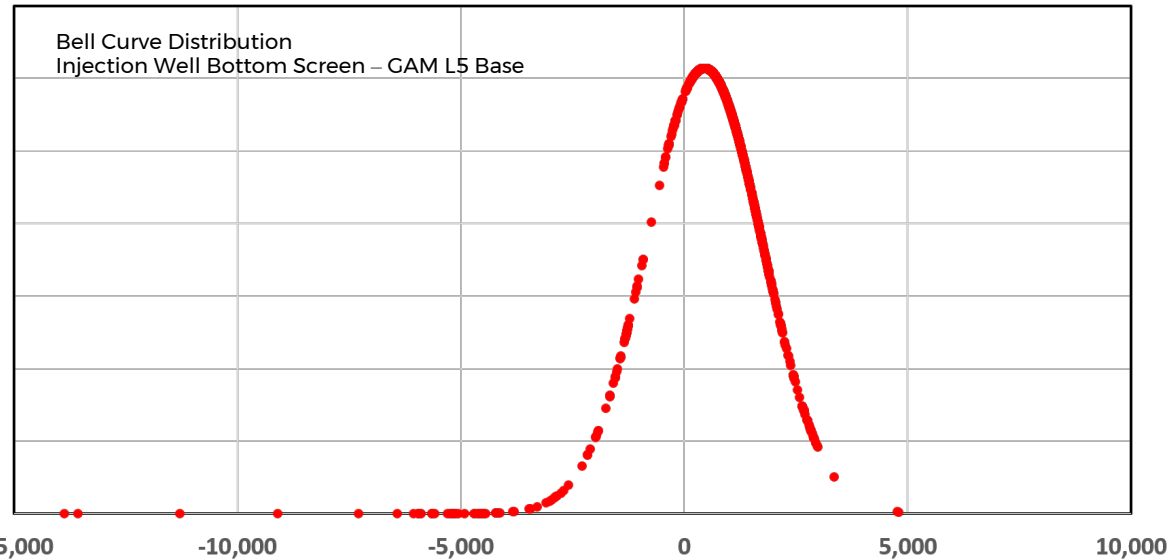
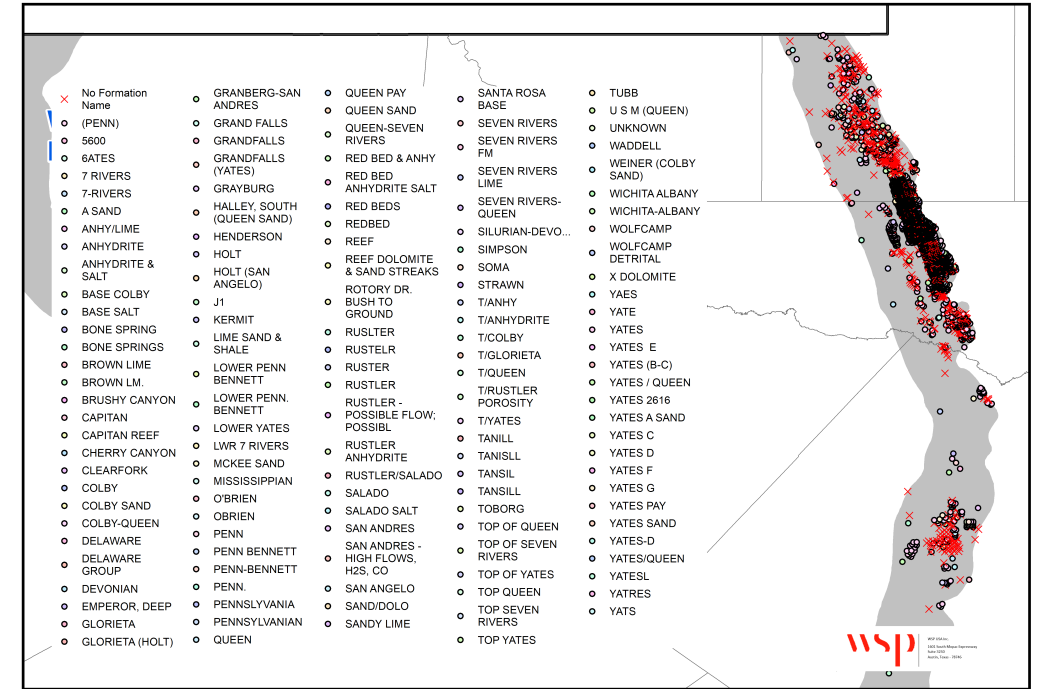
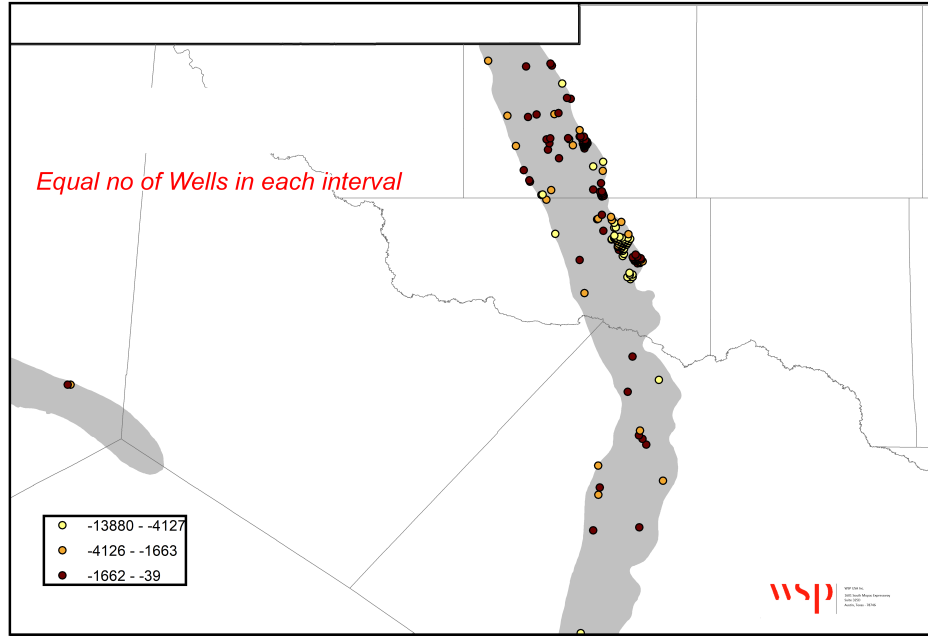


- Total Class II Injection Wells = 3,431
 - 3,016 wells in active dataset (415 missing land surface elevation)
- Wells with Injection Interval Within GAM = 2,845
- Wells with Injection Interval below GAM = 171

Aquifer Assessment Capitan Reef Complex GAM



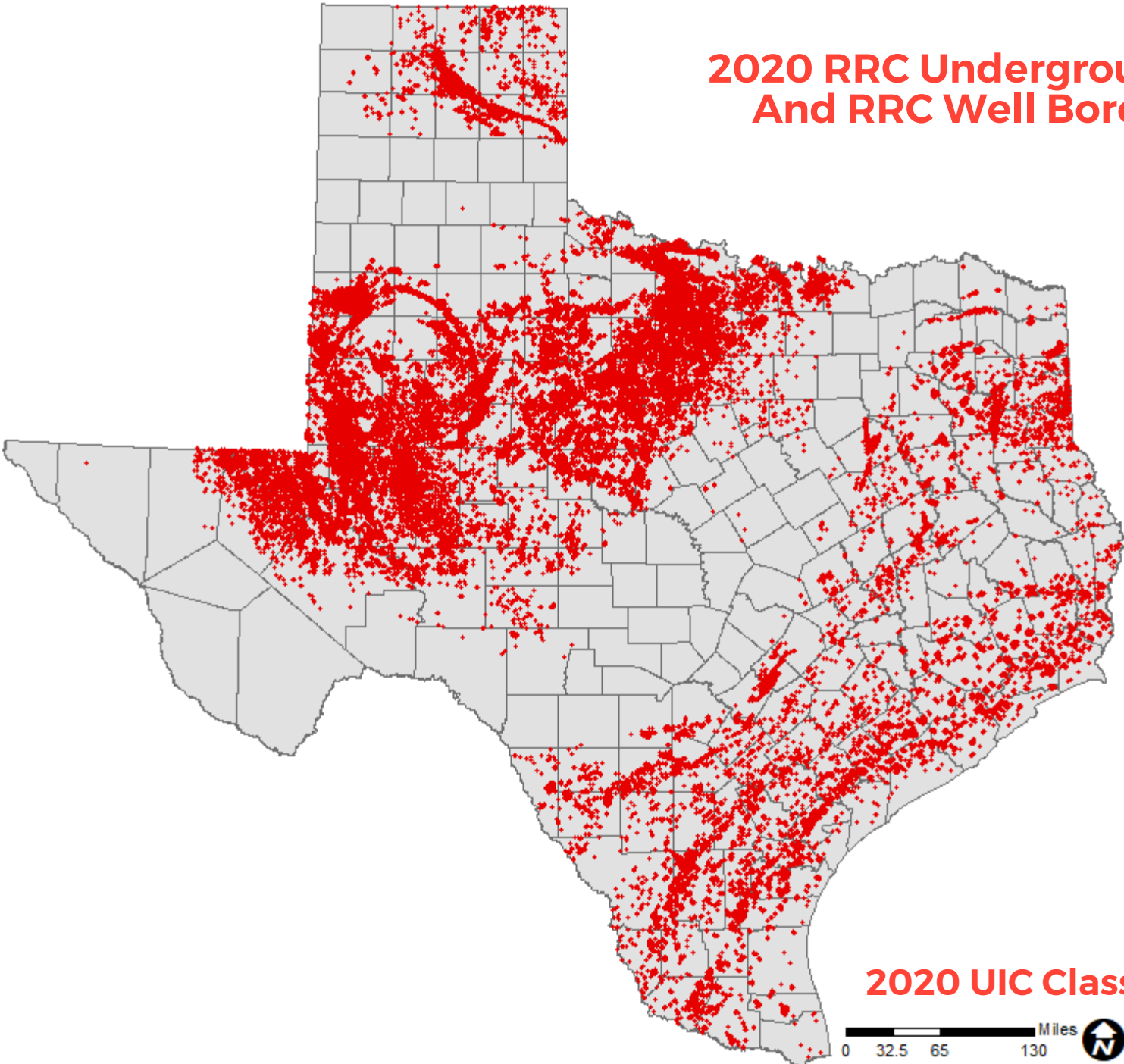
Aquifer Assessment Capitan Reef Complex GAM



RRC Class II Well Database & Procedures

- Latest available data download from RRC
 - *October 2020*
 - *Kept constant throughout the project*
 - *Updated once before final deliverables?*
- TWDB BRACS MS Access database & scripts
 - *Access database updated*
 - *Workflow created*
 - *Potential automation*
- Analysis of database
 - *Identify required attributes for input model*
 - *Identify Class II wells with missing attributes*

2020 RRC Underground Injection Control And RRC Well Bore Database Update



2020 UIC Class II Wells

2020 RRC UIC Data Update

UIC Inventory Permit Information
UIC Permit Remarks
UIC Monitor Information
H-10 (Monthly Monitor) Information
H-10H (Monthly Monitor) Information
Monitor Remarks
H-5 (Pressure Testing) Information
H-5 Remarks
UIC Enforcement Information
Enforcement Action Information
Enforcement Action Other Data
Enforcement Remarks
H-10H Monitor Annual Information
H-10 Violation Information

1	2	3	4	5	6	7
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ACTIVE	LETTER_DT CANCEL_DT W3_DATE LATDD LONGDD INJ_SW INJ_FW INJ_FRAC_W INJ_NORM INJ_CO2 INJ_GAS INJ_H2S INJ_POLYM INJ_STEAM INJ_AIR INJ_N INJ_OTHER INJ_BW INJ_LPG PERF_Z_TD	UIC_CNTY_NO UIC_REMARKS_KEY UIC_REMARKS_LINE UIC_API_FULL UIC_FIELD_NO UIC_CLASS UIC_APPR_DATE UIC_APPR_CC UIC_APPR_YR UIC_APPR_MONTH UIC_APPR_DAY UIC_W14_DATE UIC_W14_CC UIC_W14_YR UIC_W14_MONTH UIC_W14_DAY UIC_H1_DATE UIC_H1_CC UIC_H1_YR UIC_H1_MONTH UIC_H1_DAY UIC_LETTER_DATE	UIC_REMARKS_RMK UIC_MONTR_SW UIC_REMARKS_TYPE UIC_MONTR_FW UIC_REMARKS UIC_REMARK_ID UIC_REMARK_DATE UIC_REMARK_CCY UIC_REMARK_MM UIC_REMARK_DD UIC_MONTR_POLYMER UIC_MONTR_STEAM UIC_MONTR_AIR UIC_MONTR_NITROGEN UIC_MONTR_OTH UIC_MONTR_BW UIC_MONTR_LPG UIC_MONTR_SW_PCT UIC_MONTR_FW_PCT UIC_MONTR_FRAC_WATER_PCT UIC_MONTR_NORM_PCT UIC_MONTR_CO2_PCT	UIC_MONTR_W_STATUS MN_H10H_MONTH MN_H10H_MAX_HYDROCARB_PSIG MN_H10H_MAX_BRINE_PSIG MN_H10H_INJ_BRINE_BBL_SIGN MN_H10H_INJ_BRINE_BBL SMN_H10H_INJ_HYDRO_BBL_SIGN MN_H10H_INJ_HYDROCARB_BBL MN_H10H_INJ_GAS_MCF_SIGN MN_H10H_INJ_GAS_MCF MN_H10H_DOCUMENT_CYCLE MN_H10H_DOCUMENT_BATCH MN_H10H_DOCUMENT_ITEM	MN_REMARKS_TYPE MN_REMARKS	

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2020 RRC Well Bore Data Update

- Well Bore Technical Data Root Segment
- Well Bore Completion Information Segment
- Well Bore Technical Data Forms File Data
- Well Bore Remarks Segment
- Well Bore Tubing Segment
- Well Bore Casing Segment
- Well Bore Perf Segment
- Well Bore Liner Segment
- Well Bore Formation Data Segment
- Well Bore Squeeze Segment
- Well Bore Usable Quality Water Protection
- Well Bore Old Location Segment
- Well Bore New Location Segment
- Well Bore Plugging Data Segment
- Well Bore Plugging Remarks Segment
- Well Bore Plugging Record Segment
- Well Bore Plugging Data Casing-Tubing record
- Well Bore Plugging Perfs Segment
- Well Bore Plugging Data Nomenclature Segment
- Well Bore Drilling Permit Number
- Well Bore Well-ID Segment
- 14B2 Well Segment
- H-15 Report Segment
- H-15 Remark Segment
- Senate Bill 126 (2-Yr Inactive Program) Segment
- Well Bore - Drilling Permit Status Segment

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12		WB_ORIG_COMPL_YY	WB_GAS_WELL_NO	WB_W2_G1_DATE			WB_WGT_TENTHS1	
13		WB_ORIG_COMPL_MM	WB_MULT1_WELL_REC_NBR	WB_COMPL_DATE			WB_WGT_WHOLE2	
14		WB_ORIG_COMPL_DD	WB_API_SUFFIX	WB_COMPL_CENTURY			WB_WGT_TENTHS2	
15		WB_TOTAL_DEPTH	WB_ACTIVE_INACTIVE_CODE	WB_COMPL_YEAR			WB_CASING_DEPTH_SET	
16		WB_VALID_FLUID_LEVEL	WB_DWN_HOLE_COMMINGLE_CODE	WB_COMPL_MONTH			WB_MLTI_STG_TOOL_DPHT	
17		WB_CERT_REVOKED_DATE	WB_CREATED_FROM_PI_FLAG	WB_COMPL_DAY			WB_AMOUNT_OF_CEMENT	
18		WB_CERT_REVOKED_CC	WB_RULE_37_NBR	WB_DRL_COMPL_DATE			WB_CEMENT_MEASUREMENT	
19		WB_CERT_REVOKED_YY	WB_P_15	WB_PLUGB_DEPTH1			WB_HOLE_INCH	
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22		WB_CERTIFICATION_DENIAL_DATE		WB_SALT_WTR_NBR			WB_TOP_OF_CEMENT_CASING	
23		WB_CERTIFICATION_DENIAL_CC		WB_REMARKS_IND			WB_AMOUNT_CASING_LEFT	
24		WB_CERTIFICATION_DENIAL_YY		WB_ELEVATION				
25		WB_CERTIFICATION_DENIAL_MM		WB_ELEVATION_CODE				
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28		WB_ERROR_API_ASSIGN_CODE						
29		WB_REFER_CORRECT_API_NBR						
30		WB_DUMMY_API_NUMBER						
31		WB_DATE_DUMMY_REPLACED						
32		WB_NEWEST_DRL_PMT_NBR						
33		WB_CANCEL_EXPIRE_CODE						
34		WB_EXCEPT_13_A						
35		WB_FRESH_WATER_FLAG						

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4		WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER	WB_API_NUMBER
5		WB_FILE_KEY	WB_FILE_KEY	WB_FILE_KEY	WB_FILE_KEY	WB_LEASE_NAME	WB_LOC_COUNTY	WB_LOC_COUNTY
6	Legend	WB_LINE_COUNT	WB_FORMATION_CNTR	WB_SQUEEZE_CNTR	WB_FRESH_WATER_CNTR	WB_SEC_BLK_SURVEY_LOC	WB_ABSTRACT	WB_DATE_WELL_BORE_PLUGGED
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10	analyzed or imported into Access database	WB_SACKS_OF_CEMENT	WB_TOP_OF_LINER		WB_UQWP_TO	WB_DIST_FROM_SURVEY_LINES	WB_ALT_SECTION	WB_PLUG_MUD_APPLIED
11		WB_BOTTOM_OF_LINER				WB_DIST_DIRECT_NEAR_WELL	WB_ALT_ABSTRACT	WB_PLUG_MUD_WEIGHT
12							WB_FEET_FROM_SUR_SECT_1	WB_PLUG_DRIL_PERM_DATE
13							WB_DIREC_FROM_SUR_SECT_1	WB_PLUG_DRIL_PERM_NO
14							WB_FEET_FROM_SUR_SECT_2	WB_PLUG_DRIL_COMP_DATE
15							WB_DIREC_FROM_SUR_SECT_2	WB_PLUG_LOG_ATTACHED
16							WB_WGS84_LATITUDE	WB_PLUG_LOG_RELEASED_TO
17							WB_WGS84_LONGITUDE	WB_PLUG_TYPE_LOG
18							WB_PLANE_ZONE	WB_PLUG_FRESH_WATER_DEPTH
19							WB_PLANE_COORDINATE_EAST	WB_PLUG_FROM_UQWP_1
20							WB_PLANE_COORDINATE_NORTH	WB_PLUG_TO_UQWP_1
21							WB_VERIFICATION_FLAG	WB_PLUG_FROM_UQWP_2
22								WB_PLUG_TO_UQWP_2
23								WB_PLUG_FROM_UQWP_3
24								WB_PLUG_TO_UQWP_3
25								WB_PLUG_FROM_UQWP_4
26								WB_PLUG_TO_UQWP_4
27								WB_PLUG_MATERIAL_LEFT
28								WB_PLUG_OIL_CODE
29								WB_PLUG_OIL_DIST
30								WB_PLUG_OIL_LSE_NBR
31								WB_PLUG_OIL_WELL_NBR
32								WB_PLUG_GAS_CODE
33								WB_PLUG_GAS_RRC_ID
34								WB_PLUG_GAS_DIST
35								WB_PLUG_GAS_WELL_NO



Modeling Techniques & Tools

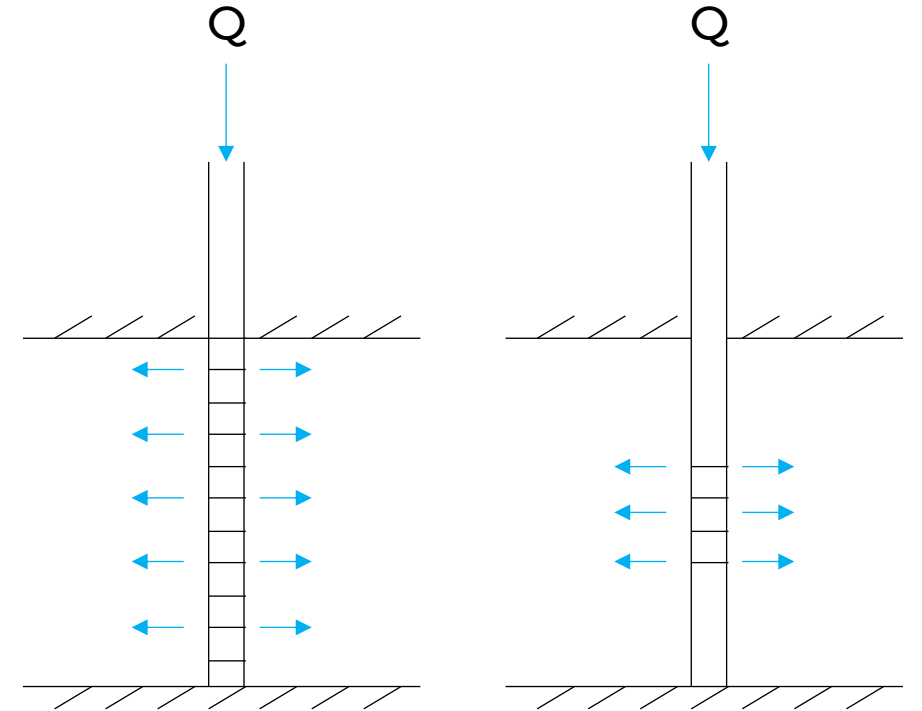
- link to database from Aquifer Assessment task
- identify the lateral and vertical impact of injection wells within aquifers
- procedures and tools:
 - *appropriate analytical/numerical solution*
 - *map the impact*
 - *visualization & documentation*

Modeling Approach

- Aquifer Assessment database
 - *location,*
 - *aquifer parameters*
 - *injection well parameters*
- Preliminary analysis
 - *simplifying assumptions*
 - *‘radius of influence’*
 - *flag zones for a detailed analysis:*
 - impact greater than the default buffer of 15 miles?
 - exceed ‘threshold’ injectate density?
 - exhibit potential boundary impacts?
 - other?
- detailed analysis for flagged zones

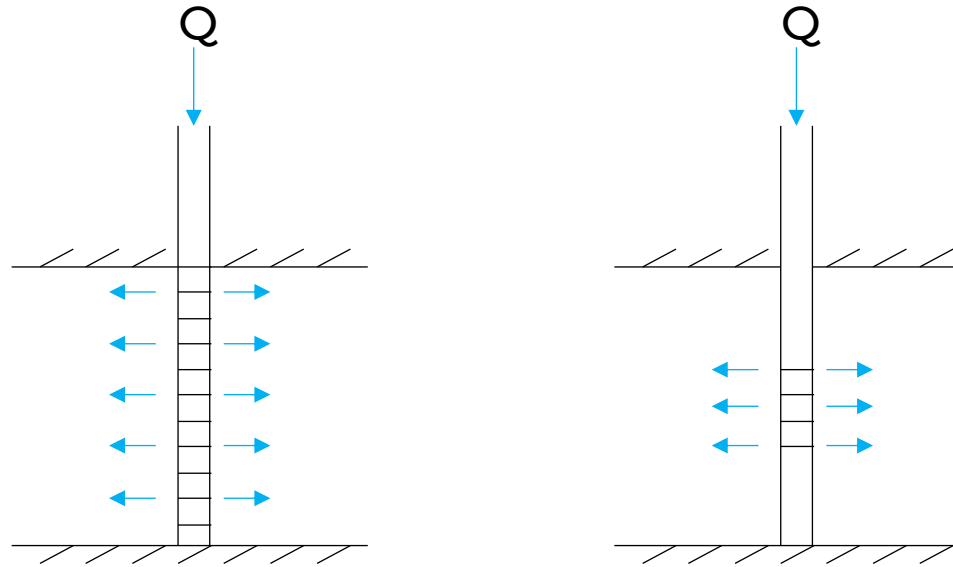
Conceptual Modeling: Example

- Confined aquifer
- Well considerations:
 - *Fully-penetrating*
 - *Partially-penetrating*
 - *Long-screen: multiple aquifers*
 - *Long-screen: aquifer stratification within thick aquifers*
- Solution considerations:
 - *Steady-state*
 - *Transient*
 - *Transient with wellbore storage*



Fully-penetrating well Partially-penetrating well

Modeling: Preliminary Analysis Examples



Solution	Fully-penetrating well	Partially-penetrating well
Steady-state	Thiem (1906)	Javandel (1982); Faybishenko et al (1995)
Transient	Theis (1935); Cooper and Jacob (1946)	Hantush (1961)
Transient with wellbore storage	Papadopoulos and Cooper (1967)	Dougherty and Babu (1984)

Modeling: Advanced Analysis Examples

- AEM Methods
 - *TTIM*
 - *TimML*
- Axisymmetric model
 - *MODFLOW 6*
- Other

Q & A

- WSP questions for Workgroup
 - *Suggestions*
- Next workgroup meeting