Texas Water Development Board (TWDB) Groundwater Availability Modeling (GAM) Program

Ian C. Jones, Ph.D., P.G.
Groundwater Availability Modeling
Texas Water Development Board

Texas Water Development Board

Disclaimer

The following presentation is based upon professional research and analysis within the scope of the Texas Water Development Board's statutory responsibilities and priorities but, unless specifically noted, does not necessarily reflect official Board positions or decisions.

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Agenda

- TWDB Introduction GAM
- Introduce Contract Team
- SwRI Presentation
  - Background and History
  - Project Approach
    - Model Details
    - Schedules
  - Request for Data

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GAM Program

- **Aim**: Develop groundwater flow models for the major and minor aquifers of Texas.
- **Purpose**: Tools that can be used to aid in groundwater resources management by stakeholders.
- **Public process**: Stakeholder involvement during model development process.
- **Models**: Freely available, standardized, thoroughly documented. Reports available over the internet.
- **Living tools**: Periodically updated.

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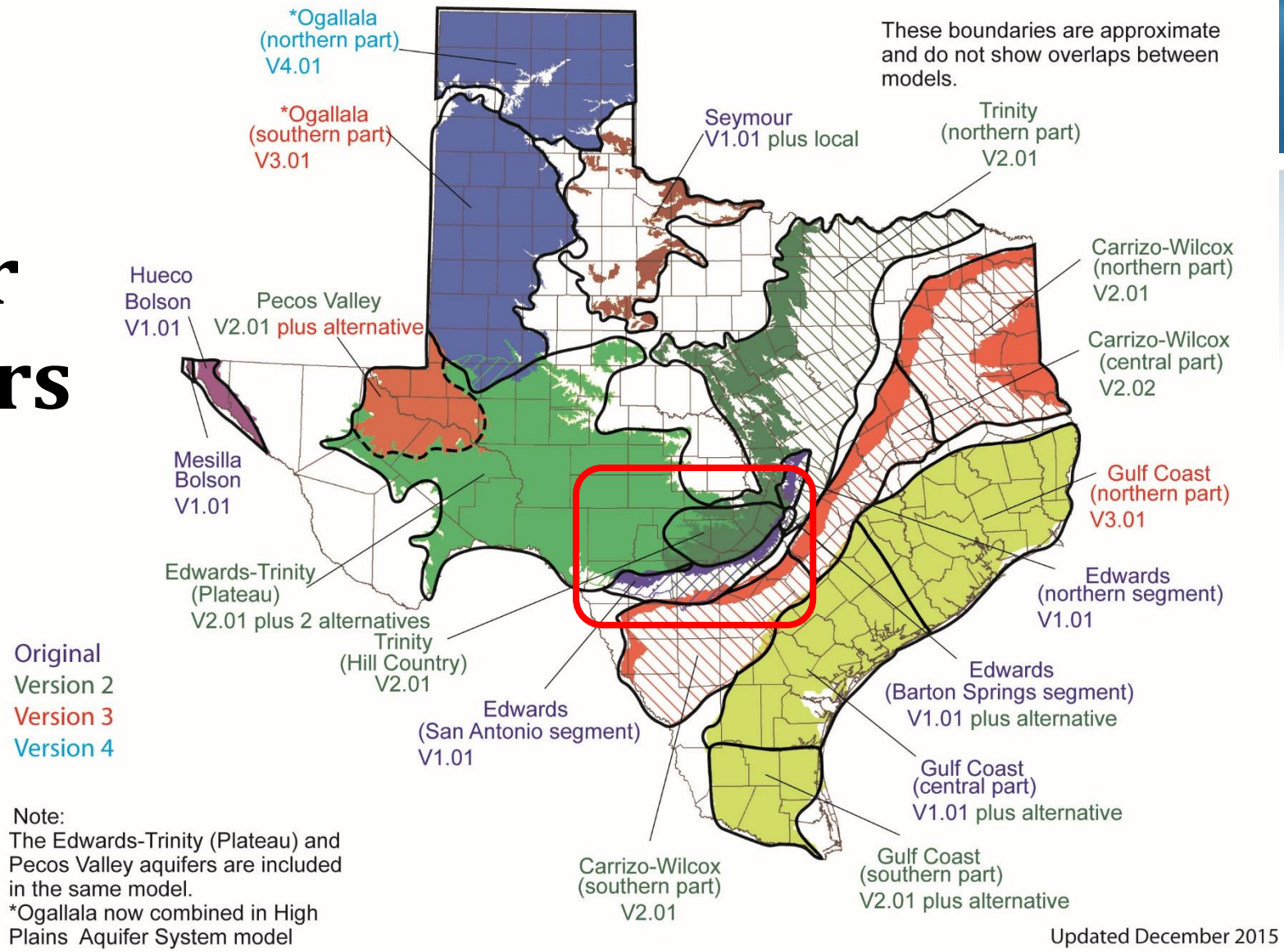
Major Aquifers



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Why Stakeholder Advisory Forums?

- Keep stakeholders updated about progress of the model
- Inform how the groundwater model can, should, and should not be used
- Provide stakeholders with the opportunity to provide input and data to assist with model development

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Contact Information

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http://www.twdb.texas.gov/groundwater/models/gam/trnt_h/trnt_h.asp

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Conceptual Model Update for the Hill Country Portion of the Trinity Aquifer

TWDB Contract No. 1648302061

SOUTHWEST RESEARCH INSTITUTE®

INTERA GEOSCIENCE & ENGINEERING SOLUTIONS

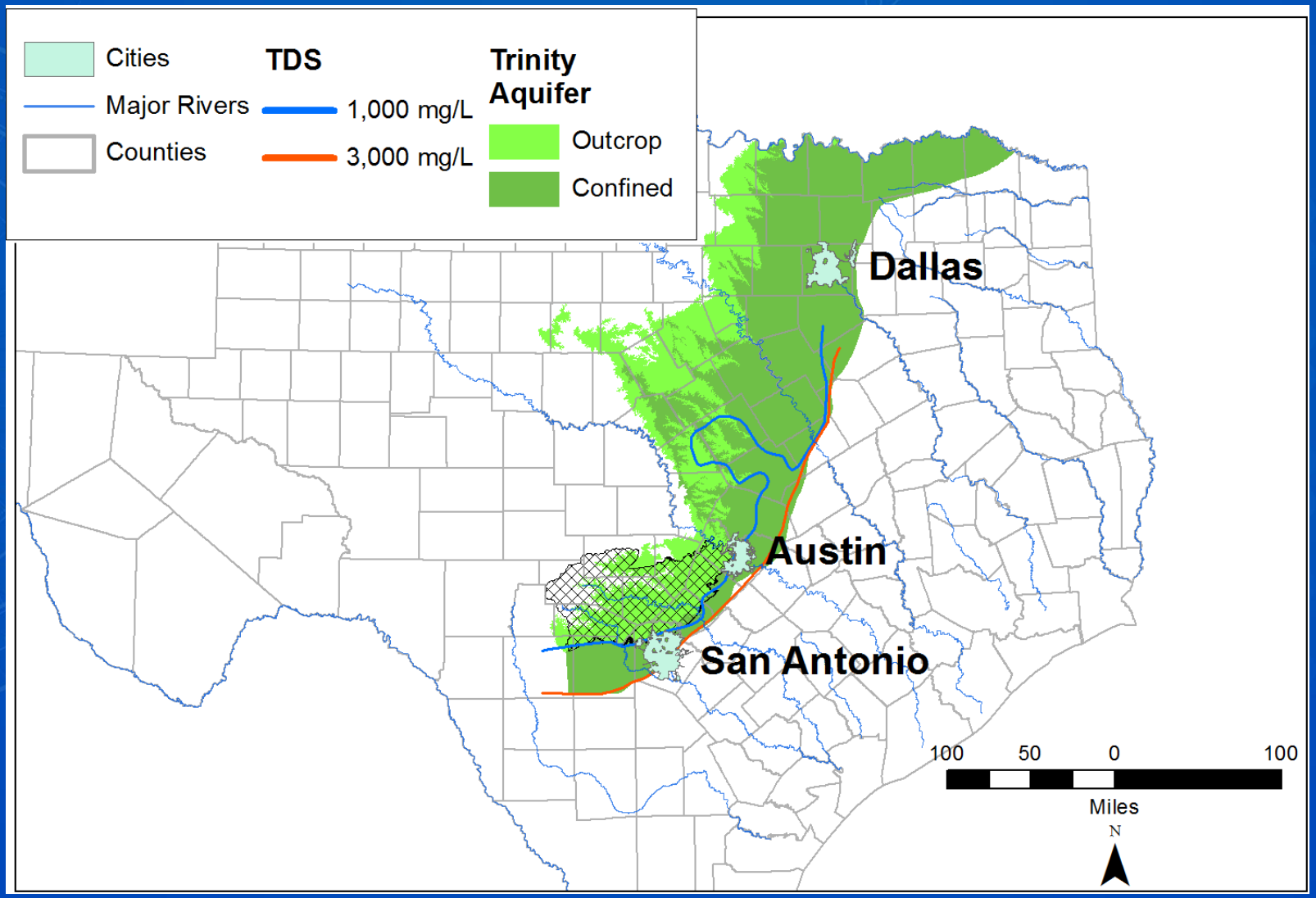
June 5, 2017

San Antonio, Texas

Project Team

- Ron Green, PhD, PG: Southwest Research Institute (SwRI) Project Manager
  - Nate Toll: Technical Lead, Hydrogeologist
  - Ron McGinnis: Structural Geologist, Geologic Modeler
  - Gary Walter, PhD: Hydrogeologist, Aqueous Geochemist
  - Leanne Stepchinski: Geologist
  - Beth Fratesi, PhD: Hydrogeologist
  - Rebecca Nunu: Geoscientist
  - Kirk Gulliver: Geoscientist
- Neil Deeds, PhD, PG, PE: (Intera) Project Manager and Technical Lead
  - Daniel Lupton, PG: Geologist
  - Toya Jones, PG: Hydrogeologist

Background

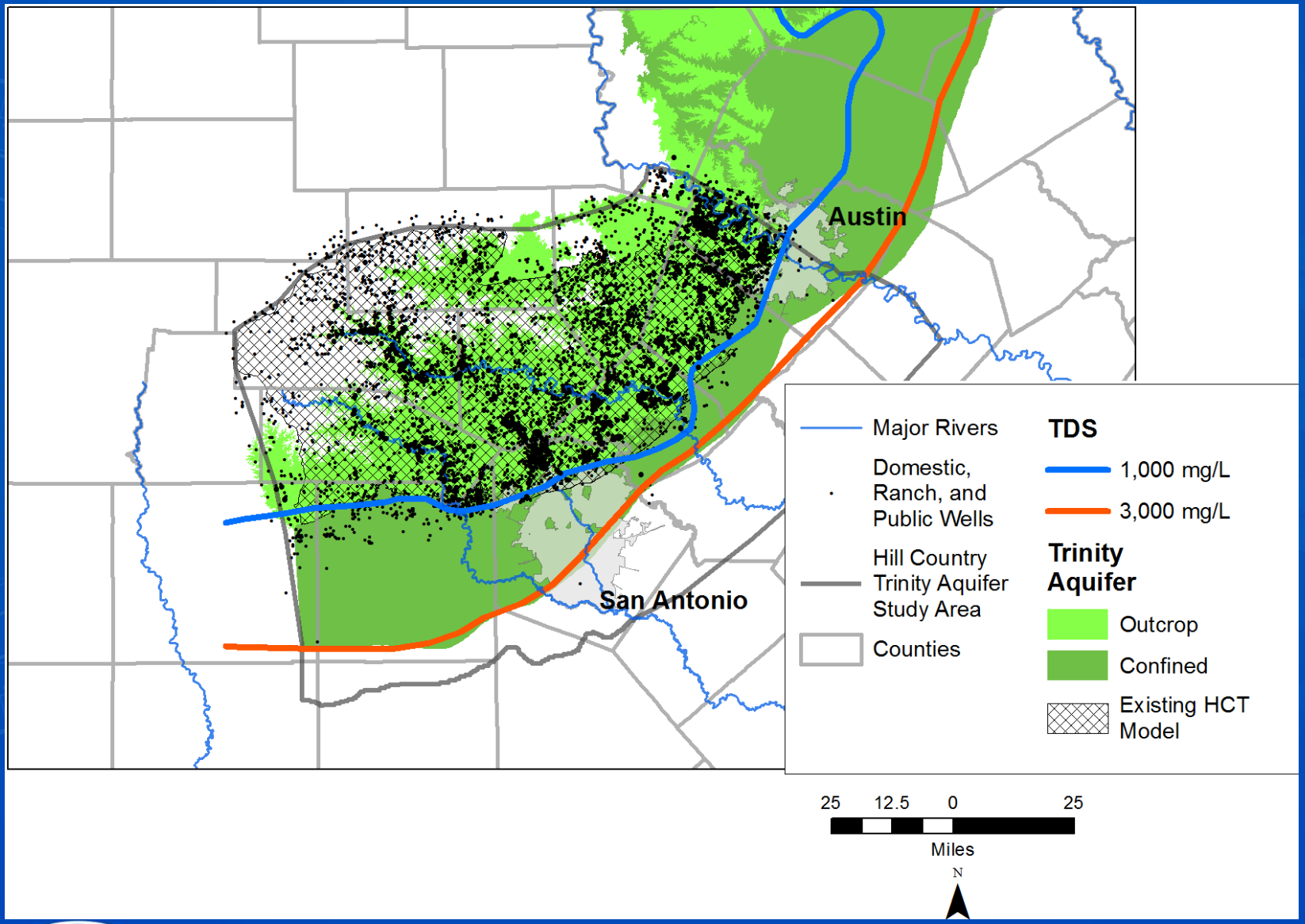


Background

- Increasing demand on the Trinity Aquifer as a resource
- "The fastest-**growing** region in the country is a 74-mile **corridor (I-35)** anchored at either end by **San Antonio and Austin** that is coalescing"

  (Oct. 2016, Forbes Magazine)
- Materials Industry (Limestone Quarries)

Existing Production



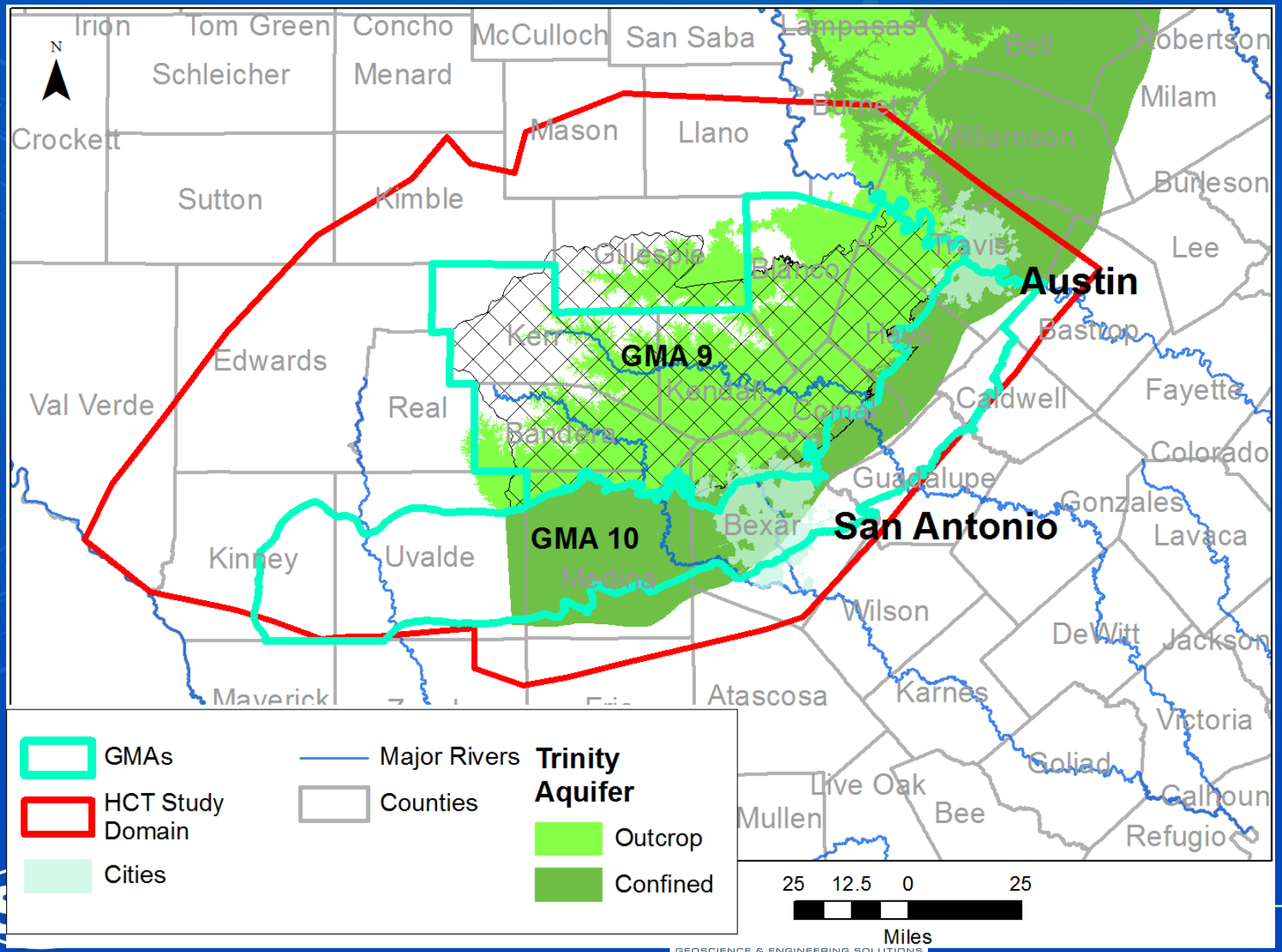
History of GAMs for the Hill Country Portion of the Trinity Aquifer

- Texas Water Development Board completed a **GAM in 2000** in cooperation with the Trinity Aquifer Advisory Committee
- In **2011**, TWDB completed an **update** to the model to include the lower Trinity
- **2017**, the TWDB contracted Southwest Research Institute (SwRI) to **update the conceptual model** for the Hill Country Portion of the Trinity Aquifer

Approach

- Objectives of this study include:
  - **Expansion** of the model region
  - Develop an understanding of the **inter-formational flow between the Trinity Aquifer and the Edwards Balcones** Fault Zone (BFZ) Aquifer
  - **Extend the datasets** for water levels, water chemistry, recharge, discharge, and hydraulic parameters both temporally and spatially

Conceptual Model Study Domain



Expanded Domain

- A key objective of this study was to expand the model domain.
  - Include downdip/confined portions of the Trinity Aquifer
    - Address inter-formational flow to the Edwards Aquifer
    - These portions are being utilized for water resources
  - Expand the model to the west to include portions of the Trinity Aquifer similar to the Northeastern portion.
    - Model will be coincident with the current Edwards Aquifer Authority numerical model domain.
  - Include all of GMA 9
- This is **Not the domain** for the future numerical model

Approach

- Project has **seven** main tasks

1. Project Management
2. Stakeholder Communication
3. Data Acquisition and Data Management
4. Geologic and Hydrostratigraphic Modeling
5. Hydraulic Data Analysis
6. Conceptual Model Synthesis
7. Reporting

Stakeholder Communications

- Two meetings during project duration
  - 1st meeting ~1 month after contract execution (Today)
  - 2nd meeting after submission of Draft Report to the TWDB (After May, 2018)

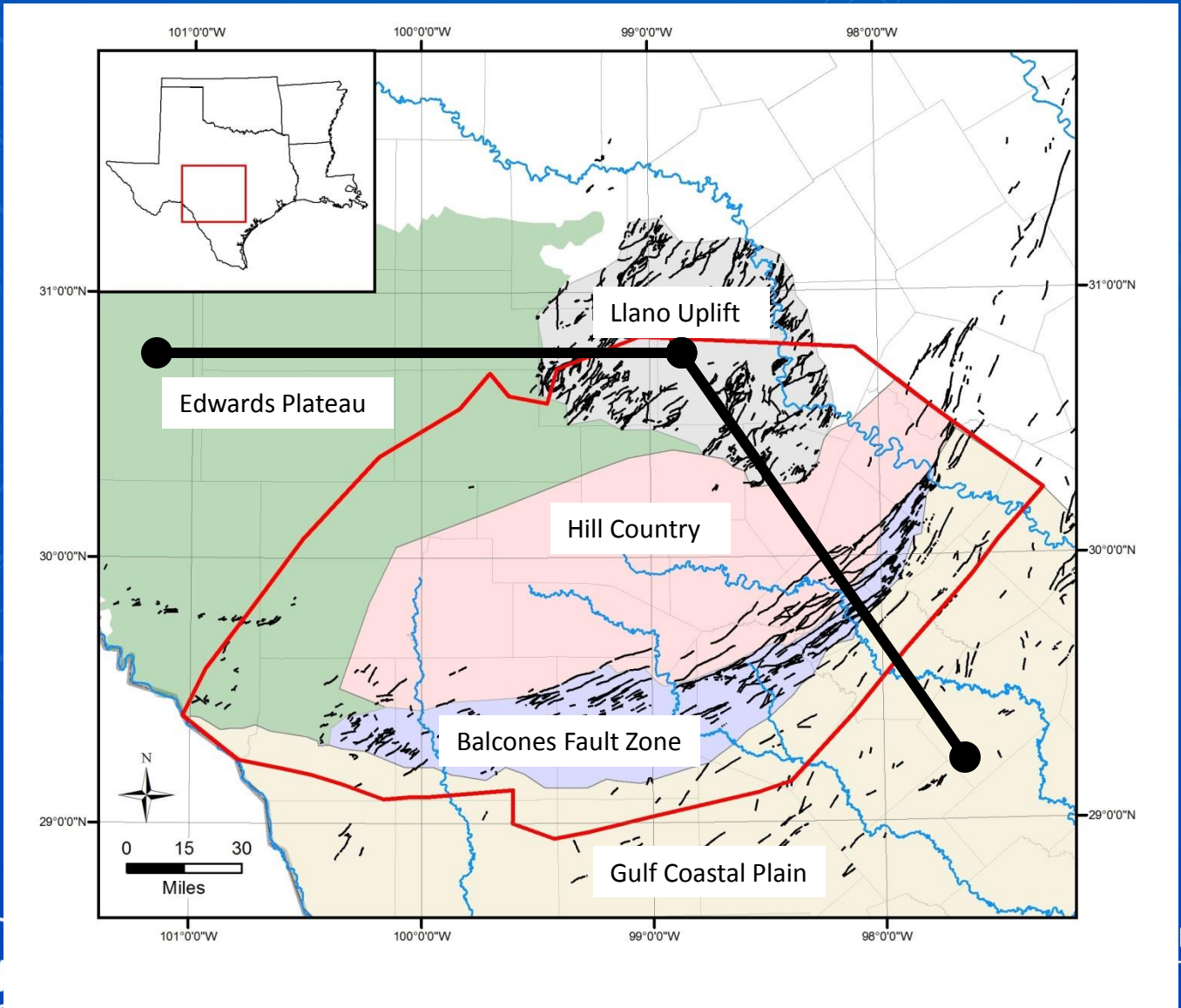
Data Acquisition and Data Management

- Mine all publically available digital datasets to acquire data relevant to stratigraphy, water levels, water chemistry, recharge, discharge, and hydraulic parameters.
- Search commercial data sources for geophysical logs and geologic interpretations.
- Conduct literature reviews for above data and geologic or hydrogeologic interpretations of the Trinity Aquifer.
- Evaluate submissions.
- **Compile GAM Geodatabase for use in future numerical model**

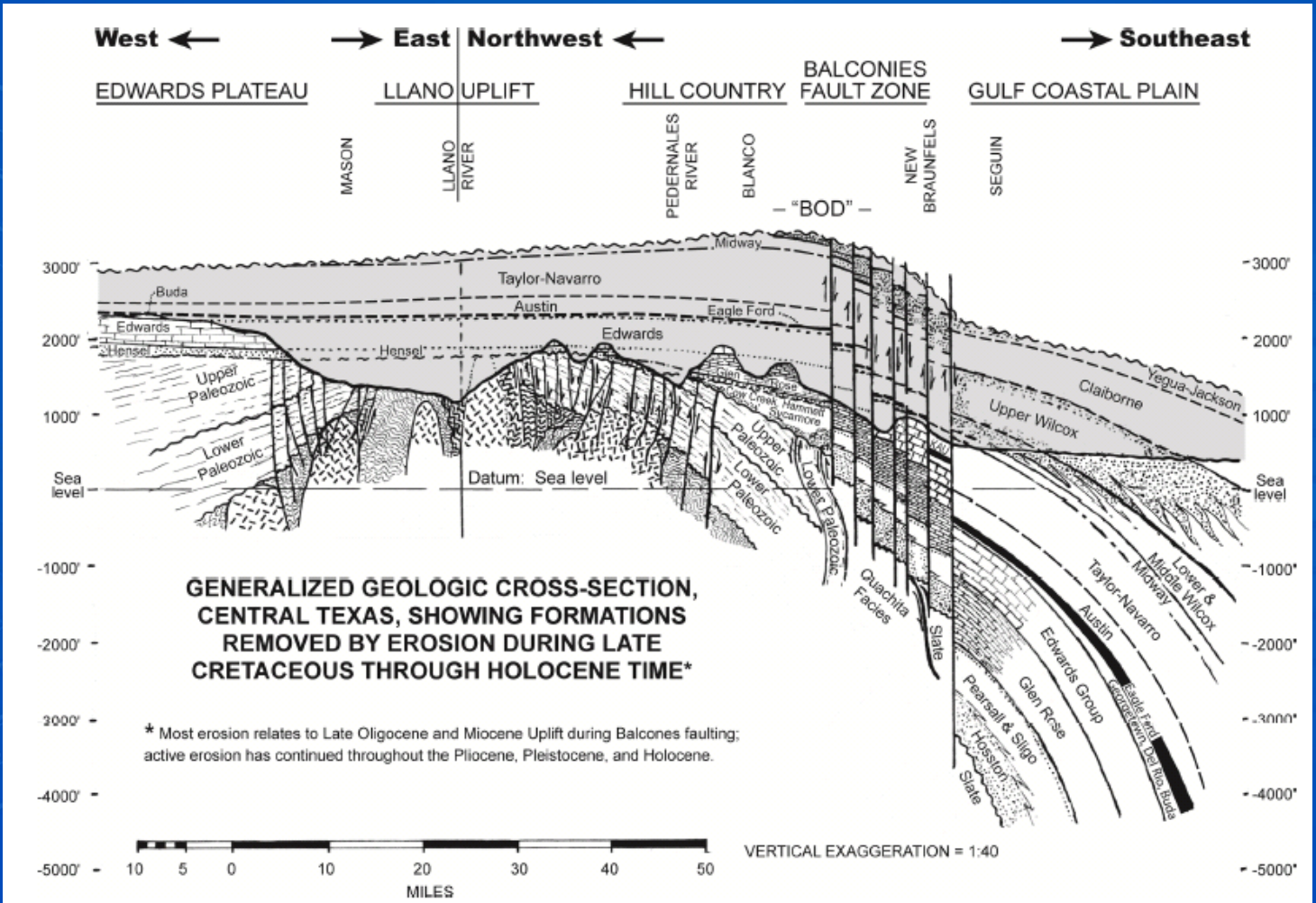
Geologic and Hydrostratigrapic Modeling

- Geophysical logs interpreted for stratigraphy yielding formation picks
  - Image logs and digital logs will be used
- Thickness for each formation will be catalogued to use where data gaps exist
- Formation picks for each formation will be interpolated across the study domain
- Available fault models will be used to provide control for offsetting units at faults

Depositional and Structural Domains

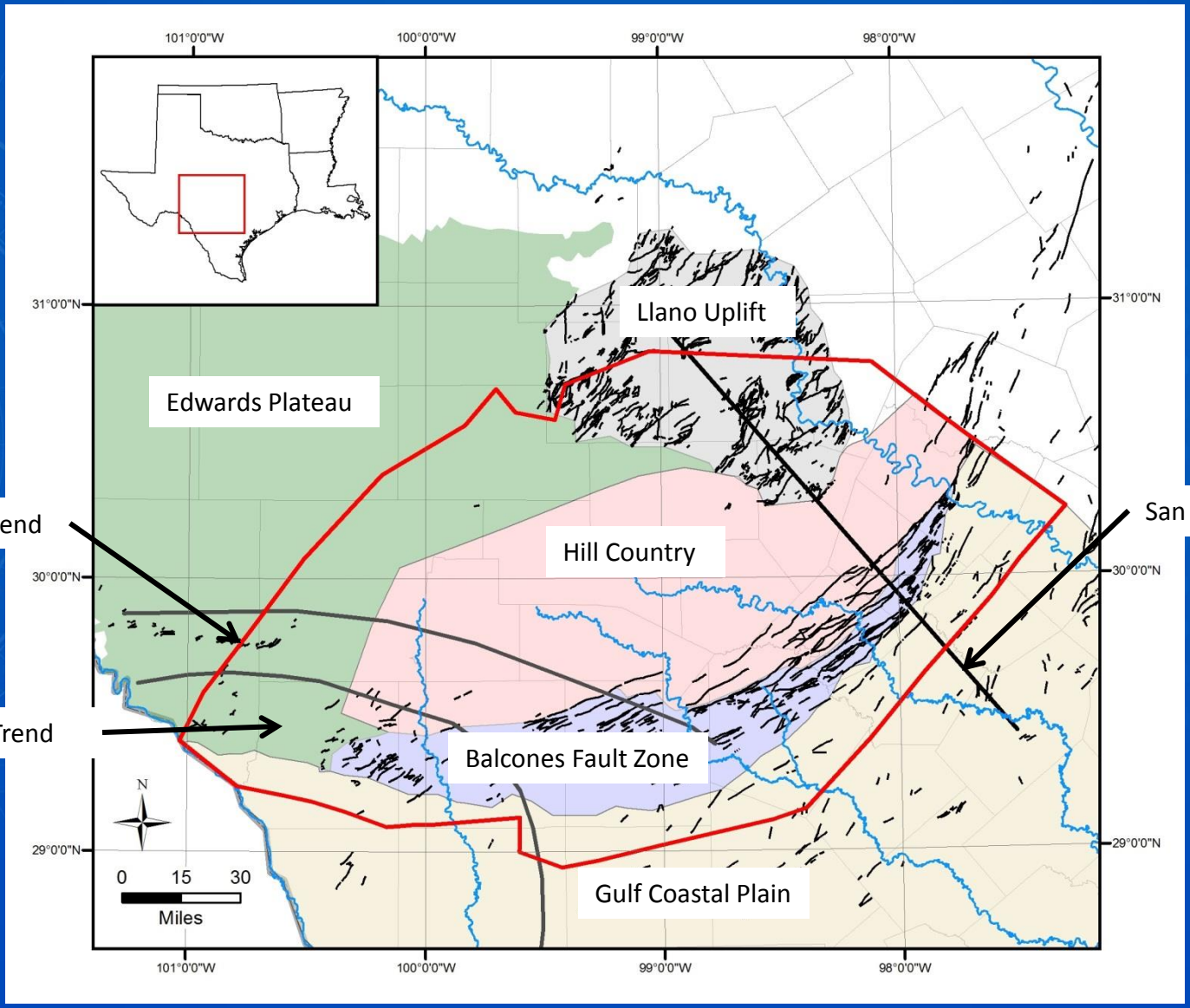


Depositional and Structural Domains

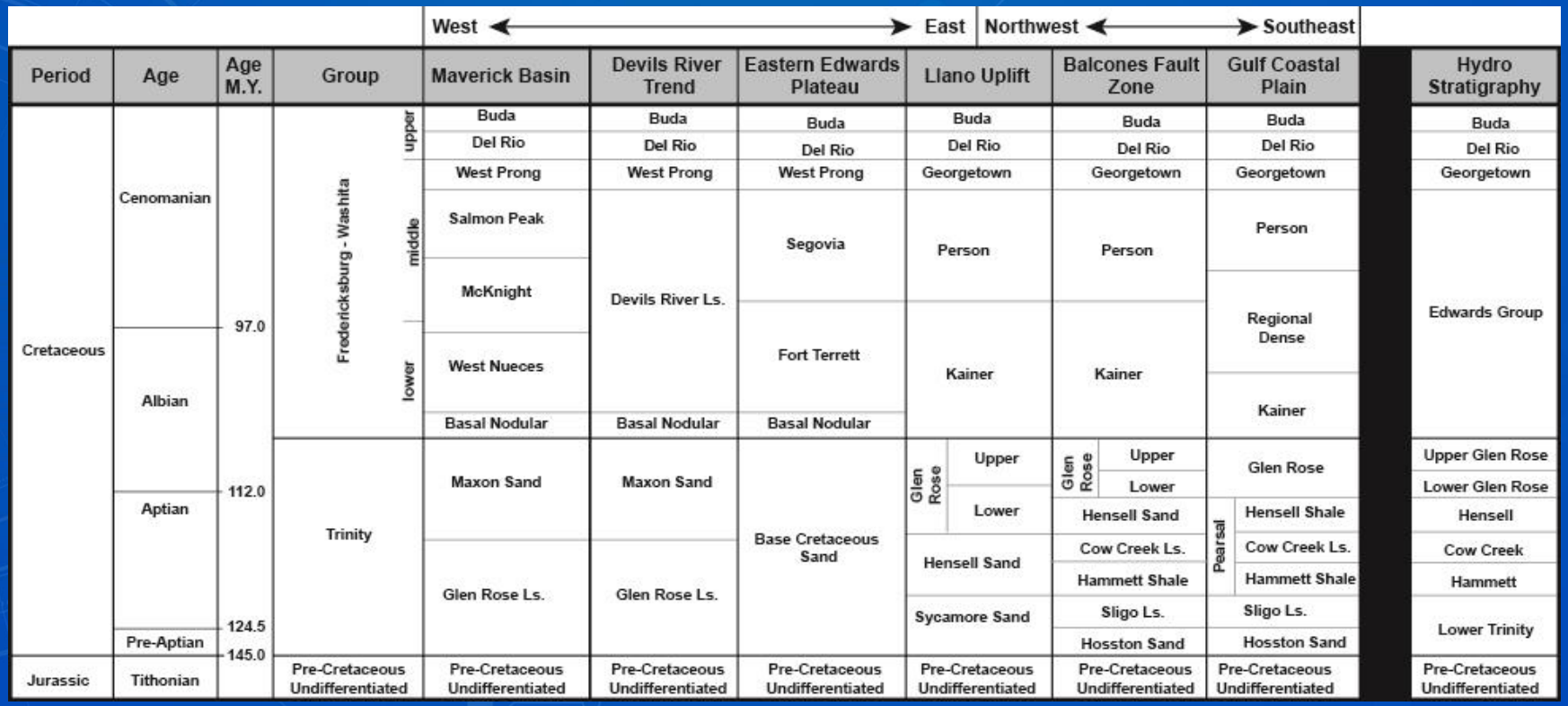


Generalized geologic cross-section, Central Texas, at present time, showing formations removed by Late Cretaceous through recent erosion; datum = modern sea-level; shaded area shows geologic section removed by post-Eocene erosion. Figure 29 from Rose, 2016.

Stratigraphy Across Domains



Stratigraphy and Hydrostratigraphy



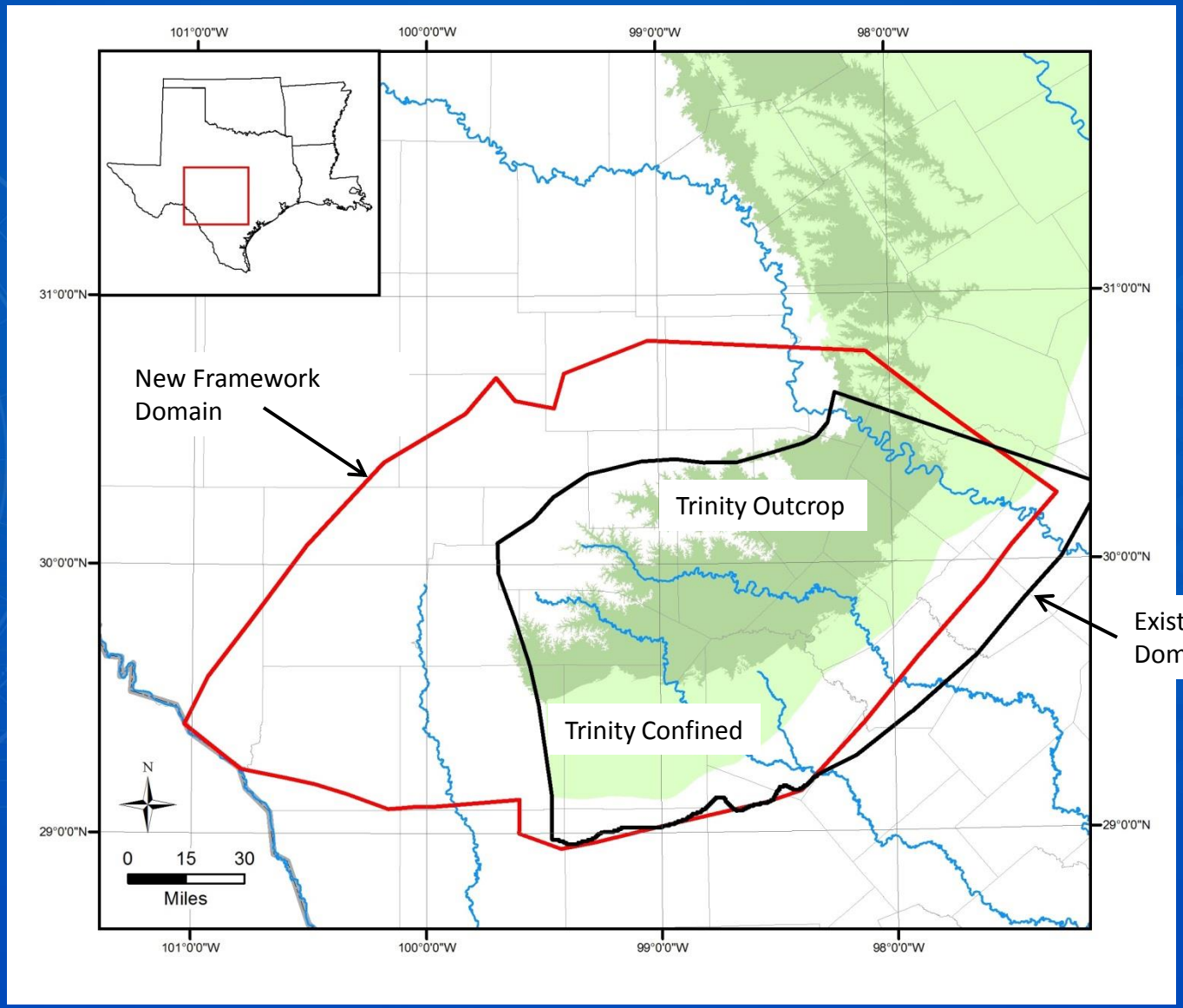
				West ← → East				Northwest ← → Southeast		
Period	Age	Age M.Y.	Group	Maverick Basin	Devils River Trend	Eastern Edwards Plateau	Llano Uplift	Balcones Fault Zone	Gulf Coastal Plain	Hydro Stratigraphy
Cretaceous	Cenomanian		Fredericksburg - Washita, upper	Buda	Buda	Buda	Buda	Buda	Buda	Buda
				Del Rio	Del Rio	Del Rio	Del Rio	Del Rio	Del Rio	Del Rio
				West Prong	West Prong	West Prong	Georgetown	Georgetown	Georgetown	Georgetown
			middle	Salmon Peak	Devils River Ls.	Segovia	Person	Person	Person	Edwards Group
				McKnight					Regional Dense	
		97.0	lower	West Nueces		Fort Terrett	Kainer	Kainer	Kainer	
	Albian			Basal Nodular	Basal Nodular	Basal Nodular				
			Trinity	Maxon Sand	Maxon Sand	Base Cretaceous Sand	Glen Rose: Upper	Glen Rose: Upper	Glen Rose	Upper Glen Rose
							Glen Rose: Lower	Glen Rose: Lower		Lower Glen Rose
	Aptian	112.0						Hensell Sand	Pearsal: Hensell Shale	Hensell
				Glen Rose Ls.	Glen Rose Ls.		Hensell Sand	Cow Creek Ls.	Pearsal: Cow Creek Ls.	Cow Creek
								Hammett Shale	Pearsal: Hammett Shale	Hammett
		124.5					Sycamore Sand	Sligo Ls.	Sligo Ls.	Lower Trinity
	Pre-Aptian	145.0						Hosston Sand	Hosston Sand	
Jurassic	Tithonian		Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated	Pre-Cretaceous Undifferentiated

Previous Hydrostratigraphy

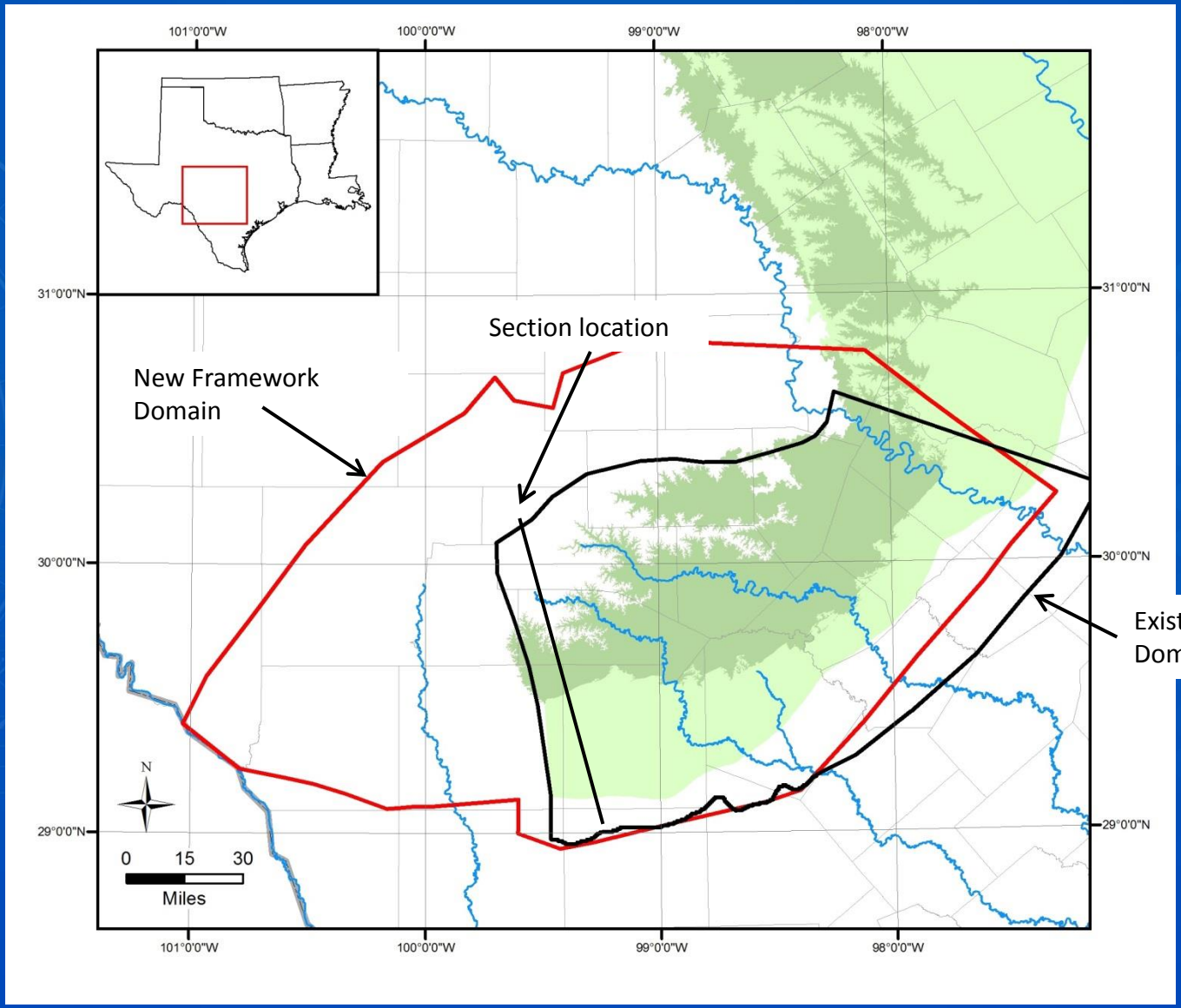
Era	System	Group	Stratigraphic unit		Hydrologic unit	
Cenozoic	Quaternary		Alluvium		Alluvium	
Mesozoic	Cretaceous	Edwards	Segovia Formation		Edwards Group	
			Fort Terrett Formation			
		Trinity	Glen Rose Limestone	Upper Member	Trinity Aquifer System	Upper Trinity
				Lower Member		Middle Trinity
			Hensell Sand/Bexar Shale			
			Cow Creek Limestone			
			Hammett Shale			Confining unit
			Sligo Formation			Lower Trinity
			Sycamore Sand/Hosston Formation			
Paleozoic			Undifferentiated Pre-Cretaceous rock			

TWDB, 2009

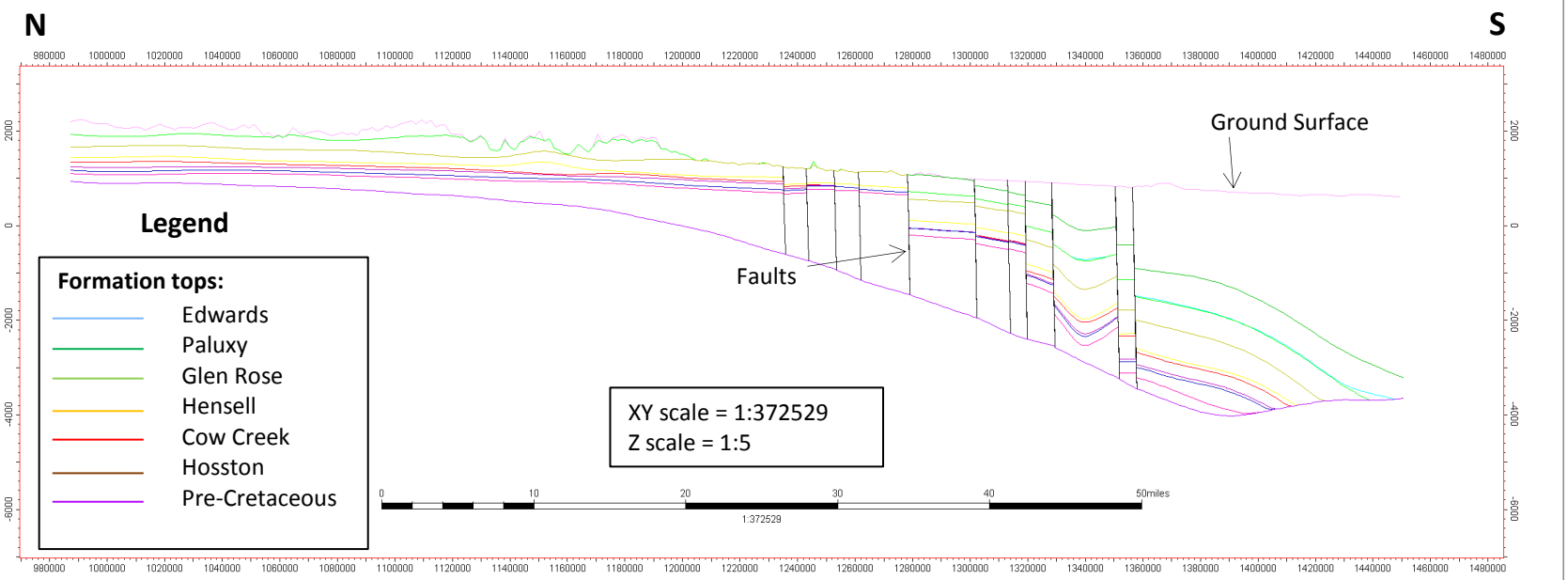
Existing Trinity Geologic Framework Model



Existing Trinity Geologic Framework Model

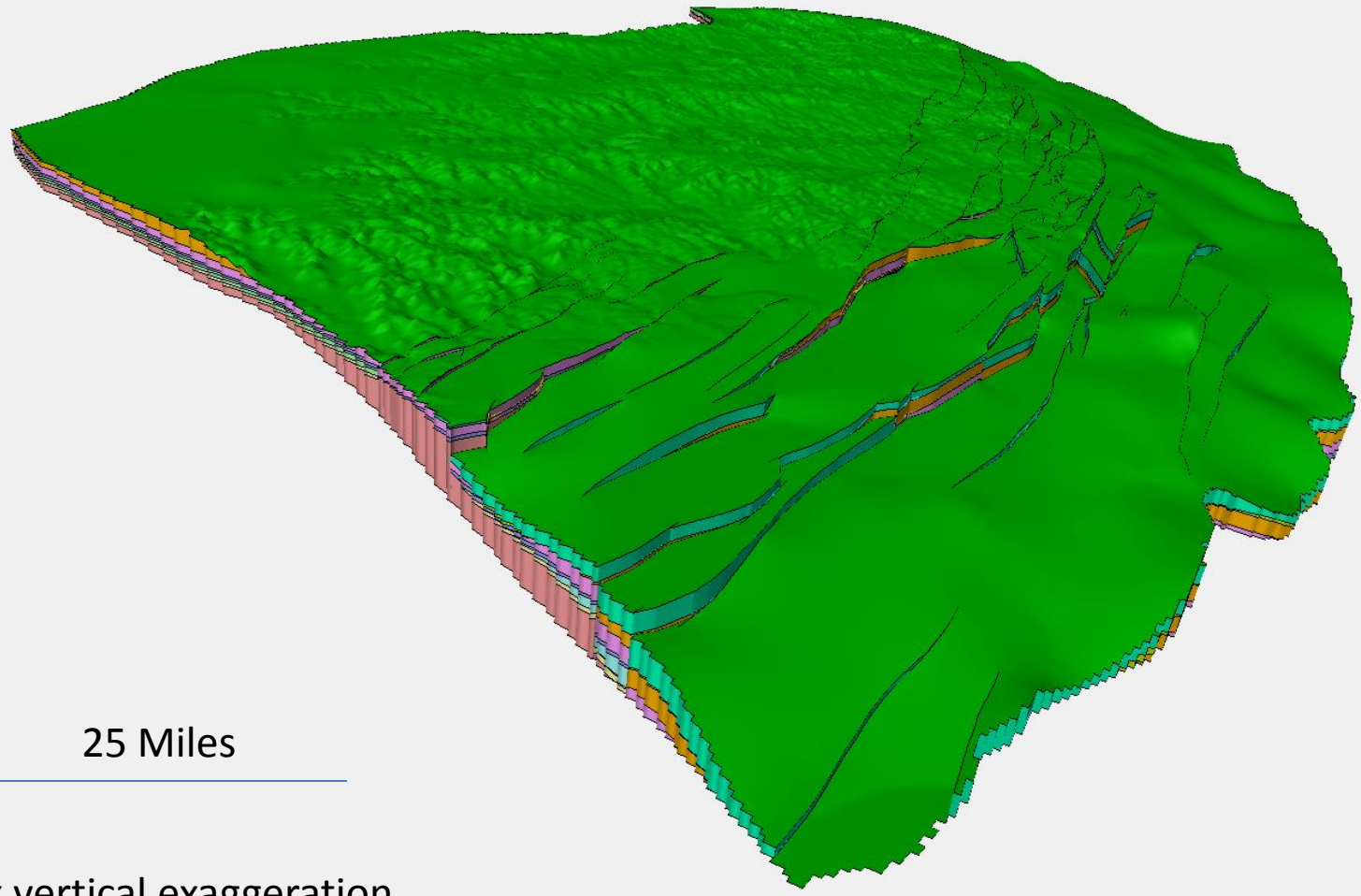


Hill Country Trinity Aquifer – West



Fault throw ranges from <20 to 700 ft

Existing Trinity Geologic Framework Model



Hydraulic Data Analysis

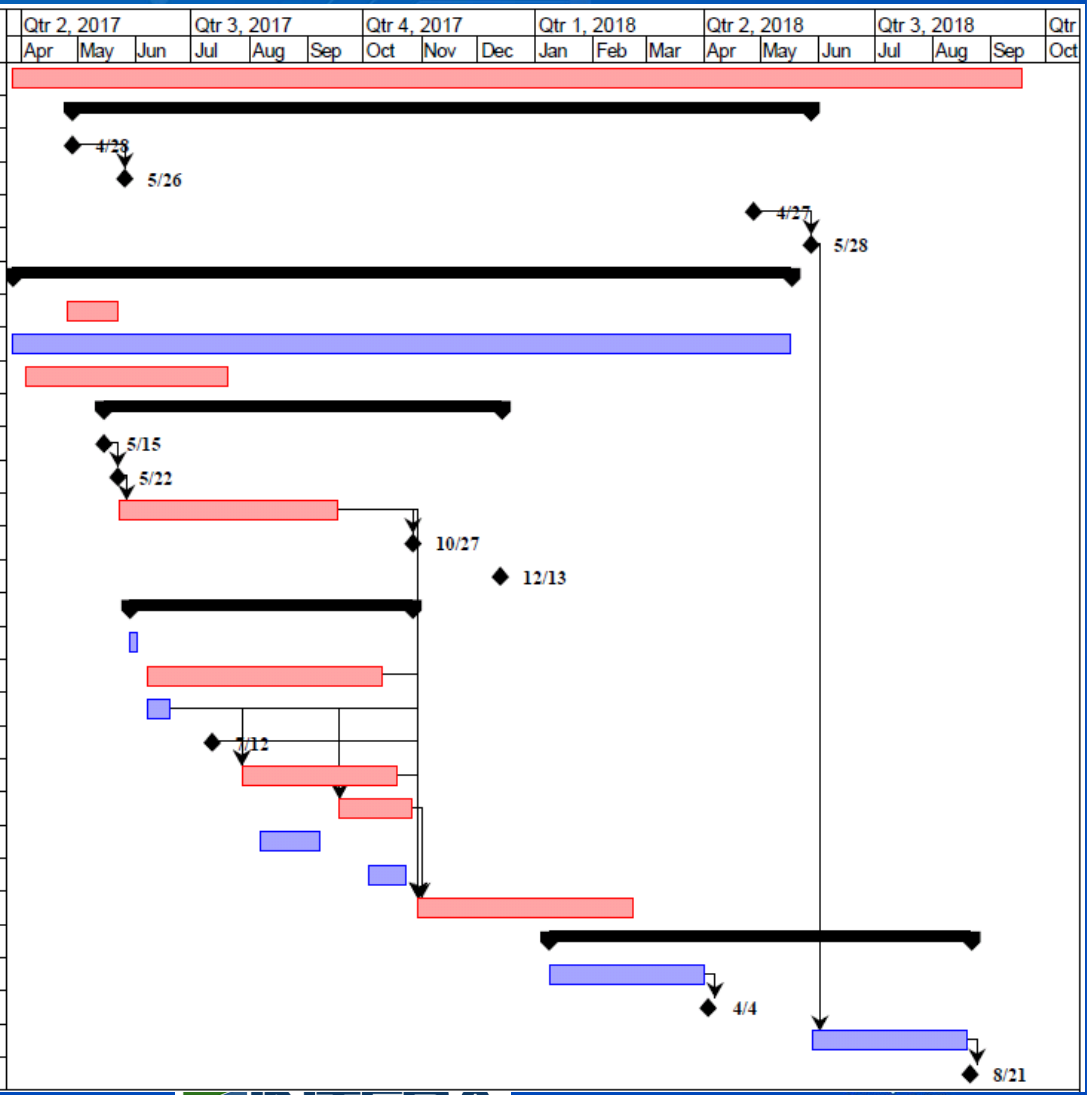
- Water Levels are analyzed to identify wells in each formation to serve as calibration targets, establish initial conditions, and inform our understanding of groundwater flow
- Recharge and Discharge data will be estimated for the study period
- Water Chemistry will be analyzed to determine if spatial and temporal trends exist and if it can inform our understanding of interformational flow.
- Hydraulic parameters will be analyzed to improved the empirical basis for the numerical model parameters

Conceptual Model Synthesis

- The collection of data in discrete parts of the aquifer does not constitute a conceptual model
- The SwRI team will develop a conceptual model that describes groundwater flow in the Hill Country portion of the Trinity Aquifer from recharge, through its path in the aquifer, to discharge at wells, springs, or rivers.
- A block model indicating flow in the aquifer will be developed
- Conceptual model and the data accumulated during the project is delivered in the Final Report to be used in an updated GAM numerical model.

Schedule

	Name	Duration	Successors
1	Project Management	387 days?	
2	**Stakeholder Communications**	**282 days?**	
3	Invite to Stakeholder Meeting 1	1 day	4
4	Stakeholder Meeting 1	1 day	
5	Invite to Stakeholder Meeting 2	1 day?	6
6	Stakeholder Meeting 2	1 day	30
7	**Data Acquisition and Data Man...**	**299 days?**	
8	Acquiring Log Data	21 days?	
9	GAM database management	299 days	
10	Sourcing required data from publi...	80 days	
11	**Geologic Interpratation Hydro...**	**153 days?**	
12	Stratigraphy Definition	1 day	13
13	Hydrostratigraphy Definition	1 day	14
14	Hydrostratigraphic Framework	85 days	15;26
15	Geologic Cross Sections	1 day?	
16	Geologic Description	1 day?	
17	**Hydraulic Analysis**	**110 days?**	
18	Physiography and Climate	5 days	
19	Water Levels and Regional GW ...	90 days	26
20	Rivers, streams, reservoirs, spr...	10 days	22;23;26
21	Discharge and Recharge Method	1 day?	22;23;26
22	Recharge	60 days	26
23	Discharge	30 days	26
24	Water Quality	25 days	
25	Material Properties	15 days	
26	Conceptual Model Synthesis	84 days	
27	**Reporting**	**161.875 da...**	
28	Report Preparation	60 days	29
29	Draft Report	1 day?	
30	Report Revision	60 days	31
31	Final Report	1 day?	



Request for Input

- Water level data with well attributes
- Geophysical logs: Images or digital logs
- Water chemistry data
- Spring discharge data
- Historical observations
- Pumping records

Submission Contacts

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Questions?

Trinity Hill Country Aquifer Conceptual Model Stakeholder Meeting 6/5/2017

Stakeholder Questions/Comments

1. [Brian:] Really glad to see overall objectives about expanding the region and looking at inter-formational flows and expanding the datasets. I'm really glad to see that y'all are looking to apply more detail to the stratigraphic units rather than lumping things because I think for me, a key objective would be to look at the intra-unit flows because [for example] what's the function of the Hensell, say, as you move down dip. So having that split out I guess you'll be able to in the future assign properties whereas at the end, the numerical model we have, we know that we'll be glad it's more detailed. I would like to see elevated to that objective additionally inter-formational flows and intra-flow. Those are key in some areas.
[Marcus: those are different formations.]
[Brian:] Well the Hensell for example, you call it the middle Trinity and you'd say that's an intra-formational flow versus how's the Hensell isolated in Lower Glen Rose vs Cow Creek
[Marcus: those are not formations right?]
[Brian:] Lithologic formations, but I'm saying, eventually they're mapped hydrostratigraphically from the Trinity, intra aquifer flow.

Nate: I think the fact that we had to be a little more detailed in the hydrostratigraphy was out of necessity because we crossed all these depositional environments and things change so much, we needed that flexibility. But when we had a discussion with Ian and his team about the hydrostratigraphic framework, we came to a consensus that its better to have more detail now and let the future numerical modeler [decide] because you can't go back and redo the picks.

2. Al: You mentioned that you'd [Nate would] be the clearinghouse for the data? So anybody casually happens to have some information can send it to you? Or are you and your team going to go out and try to collect the data?
Nate: Well it's not in the scope for us to go to every single district or go out and collect the data. If you have something and you can tell us what you have, we'd be happy to get it from you.
Ronny: Just to follow up on that, we're going to be scouring literature and every resource we can to get data. I think that you're [Nate is] just speaking to data that we may not be aware of. It would go through Nate.
Ron: We'd be glad to meet with you, Al, and sit down with you at your opportunity and convenience to get this information.
Al: I see where we are by looking at your chart and your cross-section. Right in the Balcones, were in the crack. It's just that I don't understand the concept of not going out trying to get data, rather than sitting back.
Ron: Well we will reach out. And in the past for other projects we've had out in this area we've gone out and met with people.

We've done that in the past, and you bring up a good point, we'll reach out and try to get with you as best we ca
Al: Your structural interpretation of the Balcones , do you have access to seismic data?
Ronny: we have access to what's publically available. You can't use, we have a lot of proprietary information , we'll leverage some of that information but we can't use it directly. So much of that data [on the map] is proprietary and there is some published stuff and well use that and we have that in as cross-sections where applicable.
Nate: So were constrained by our contract that we can't use proprietary information because then we can't disclose that to a public entity which then makes it available to the public.

3. (someone) Are you going to get into the brackish part of the domain?
Nate: Yes. So the whole downdip area gets into the brackish portion of the Trinity aquifer. So there are already wells in the brackish area of the Trinity aquifer and you can't look at the Trinity below the Edwards recharge zone, [without] getting into the brackish area. So I think we go well above 10,000 mg/L TDS.

4. Jeff: in terms of your recharge, are y'all planning on looking at stream recharge as well? Expanding [to] recharge from streams?
Nate: Yes, we're going to look at both distributed recharge, which is just infiltration through the ground, and also the focused recharge from streams, reservoirs. And we had approached looking to develop recharge estimates when we modeled the Edwards aquifer, and were trying to decide between using that or the [HEC-RAS infilitration model].

Participant	Organization
Mauricio Flores	Southwest Research Institute
Rebecca Nunu	Southwest Research Institute
Ronny McGinnis	Southwest Research Institute
Ian Jones	Texas Water Development Board
Al Broun	Hays Trinity Groundwater Conservation District
Jeff Watson	Hays Trinity Groundwater Conservation District
Paul Tybor	Hill County Underground Water Conservation District
Feather Wilson	Strata Geological
Ron Green	Southwest Research Institute
Gene Williams	Headwaters Groundwater Conservation District
Brian Hunt	Barton Springs/Edwards Aquifer Conservation District
Neil Deed	Intera Inc.
Joel Pigg	Real-Edwards Conservation and Reclamation District
Teresa Van Booven	Guadalupe-Blanco River Authority
George Wissman	Trinity Glen Rose Groundwater Conservation District
Emily Weiner	Trinity Glen Rose Groundwater Conservation District
Marcus Gary	Edwards Aquifer Authority
Ron Fieseler	Blanco-Pedernales Groundwater Conservation District
Nathaniel Toll	Southwest Research Institute