

Geologic Assessment

Texas Commission on Environmental Quality

For Regulated Activities on The Edwards Aquifer Recharge/transition Zones and Relating to 30 TAC §213.S(b)(3), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. My signature certifies that I am qualified as a geologist as defined by 30 TAC Chapter 213.

Print Name of Geologist: Douglas McGookey, P.G. Telephone: (210) 694-4545

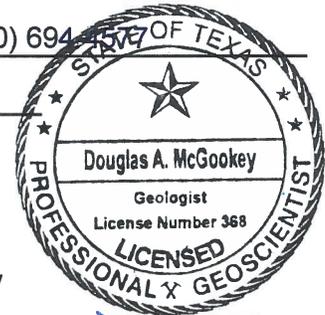
Date: October 27, 2017

Fax: (210) 694-4545

Representing: Medina Consulting Co., Inc. TBPG No. 50118

Signature of Geologist:





Regulated Entity Name: IH-10 Scenic Loop Road to Fair Oaks Parkway

Project Information

1. Date(s) Geologic Assessment was performed: September 17, 24, 27, and October 2 and 19, 2017

2. Type of Project:

WPAP

SCS

3. Location of Project:

Recharge Zone

Contributing Zone

Transition Zone

Contributing Zone within the Transition Zone

4. ☒ **Attachment A - Geologic Assessment Table.** Completed Geologic Assessment Table (Form TCEQ-0585-Table) is attached.
5. ☒ Soil cover on the project site is summarized in the table below and uses the SCS Hydrologic Soil Groups* (Urban Hydrology for Small Watersheds, Technical Release No. 55, Appendix A, Soil Conservation Service, 1986). If there is more than one soil type on the project site, show each soil type on the site Geologic Map or a separate soils map.

Table 1 - Soil Units, Infiltration Characteristics and Thickness

* Soil Group Definitions (Abbreviated)

- A. Soils having a high infiltration rate when thoroughly wetted.
- B. Soils having a moderate infiltration rate when thoroughly wetted.
- C. Soils having a slow infiltration rate when thoroughly wetted.
- D. Soils having a very slow infiltration rate when thoroughly wetted.

Bexar County Soils			
Soil Name	Group*	Thickness (ft)	CSJ*
Anhalt clay (Ca)	D	3	0072-07-070
Crawford and Bexar Stony Soils (Cb)	D	3	0072-07-070
Oakalla silty clay loam (Ok)	B	6.6	0072-07-070 0072-06-074
Eckrant cobbly clay (TaB)	C	2.5	0072-07-070
Eckrant cobbly clay (TaC)	C	2.5	0072-07-070
Sunev loam (VaB)	B	6	0072-07-070
Kendall County Soils			
Soil Name	Group*	Thickness (ft)	CSJ
Anhalt clay (1)	D	3	0072-06-074
Denton silty Clay (6)	C	5.8	0072-06-074
Doss silty Clay (8)	C	4	0072-06-074
Doss-Brackett Association, undulating (9)	C	1.6	0072-06-074
Oakalla silty clay loam (16)	B	6.67	0072-07-070 0072-06-074

***CSJ: Designation of Work Area soil is in**

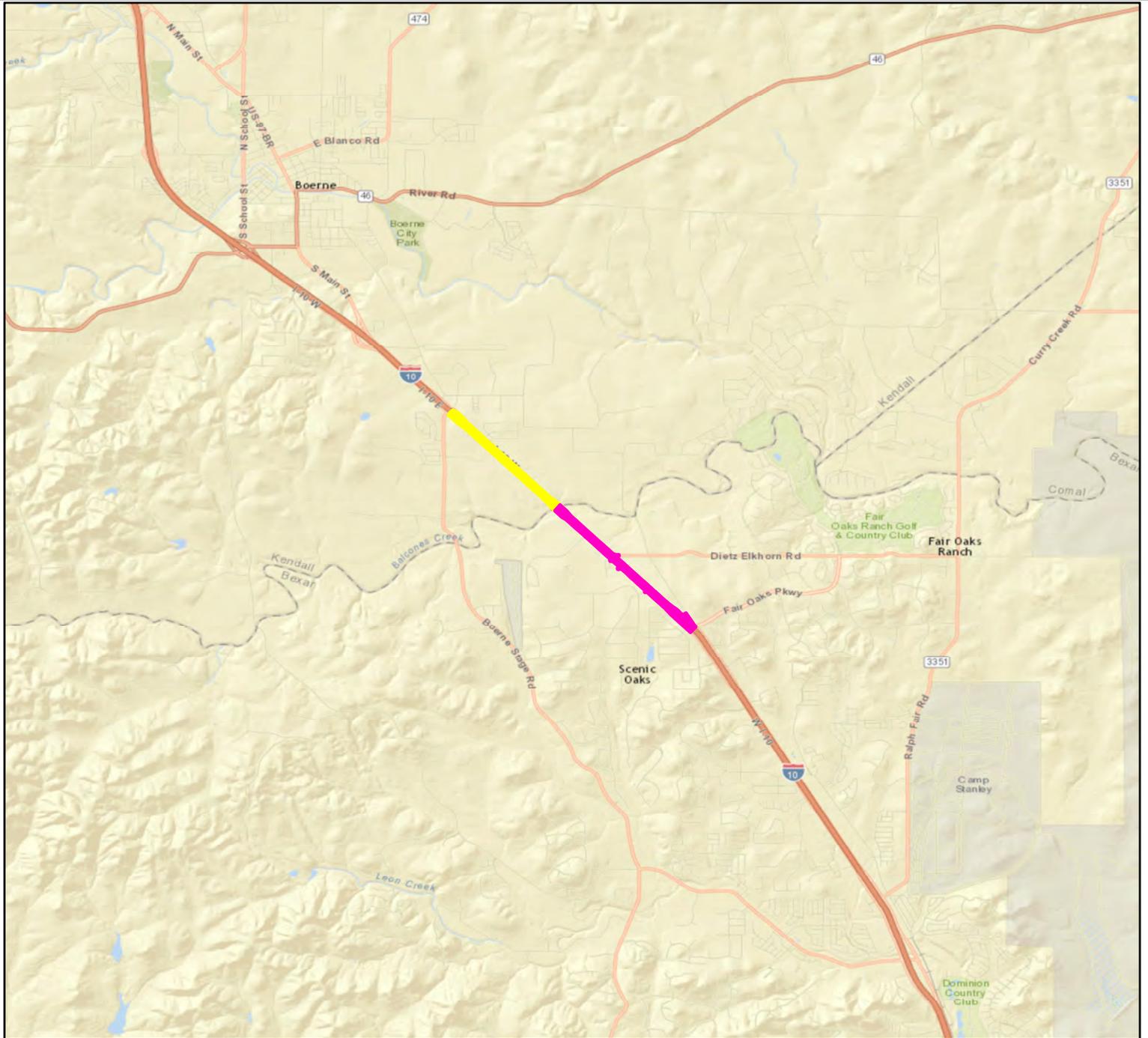
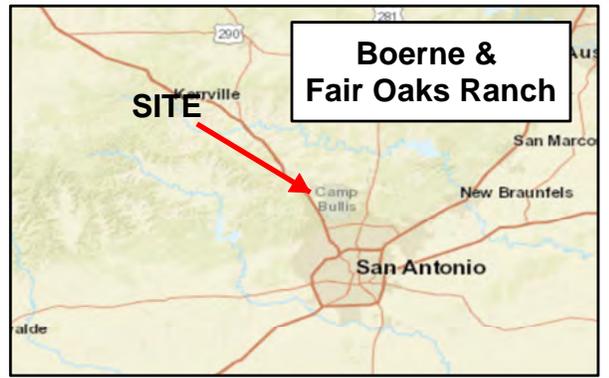
6. **Attachment C – Site Geology.** A narrative description of the site-specific geology including any features identified in the Geologic Assessment Table, a discussion of the potential for fluid movement to the Edwards Aquifer, stratigraphy, structure(s), and karst characteristics is attached.
7. **Attachment D – Site Geologic Map(s).** The Site Geologic Map must be the same scale as the applicant's Site Plan. The minimum scale is 1": 400'
 Applicant's Site Plan Scale: 1" = 100'
 Site Geologic Map Scale: 1" = 100'
 Site Soils Map Scale (if more than 1 soil type): 1" = 2,000" (Figure 5)
8. Method of collecting positional data:
 - Global Positioning System (GPS) technology.
 - Other method(s). Please describe method of data collection: _____
9. The project site and boundaries are clearly shown and labeled on the Site Geologic Map.
10. Surface geologic units are shown and labeled on the Site Geologic Map.
11. Geologic or manmade features were discovered on the project site during the field investigation. They are shown and labeled on the Site Geologic Map and are described in the attached Geologic Assessment Table.
 Geologic or manmade features were not discovered on the project site during the field investigation.
12. The Recharge Zone boundary is shown and labeled, if appropriate.
13. All known wells (test holes, water, oil, unplugged, capped and/or abandoned, etc.): If applicable, the information must agree with Item No. 20 of the WPAP Application Section.
 - There are _____ (#) wells present on the project site and the locations are shown and labeled. (Check all of the following that apply.)
 - The wells are not in use and have been properly abandoned.
 - The wells are not in use and will be properly abandoned.
 - The wells are in use and comply with 16 TAC Chapter 76.
 - There are no wells or test holes of any kind known to exist on the project site.

Administrative Information

14. Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

ATTACHMENTS

**ATTACHMENT A –
FIGURES**



Source: ArcMap GIS

CSJ 0072-06-074 CSJ 0072-07-070



Figure 1: Site Location Map
 IH-10 Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch,
 Kendall and Bexar Counties, Texas

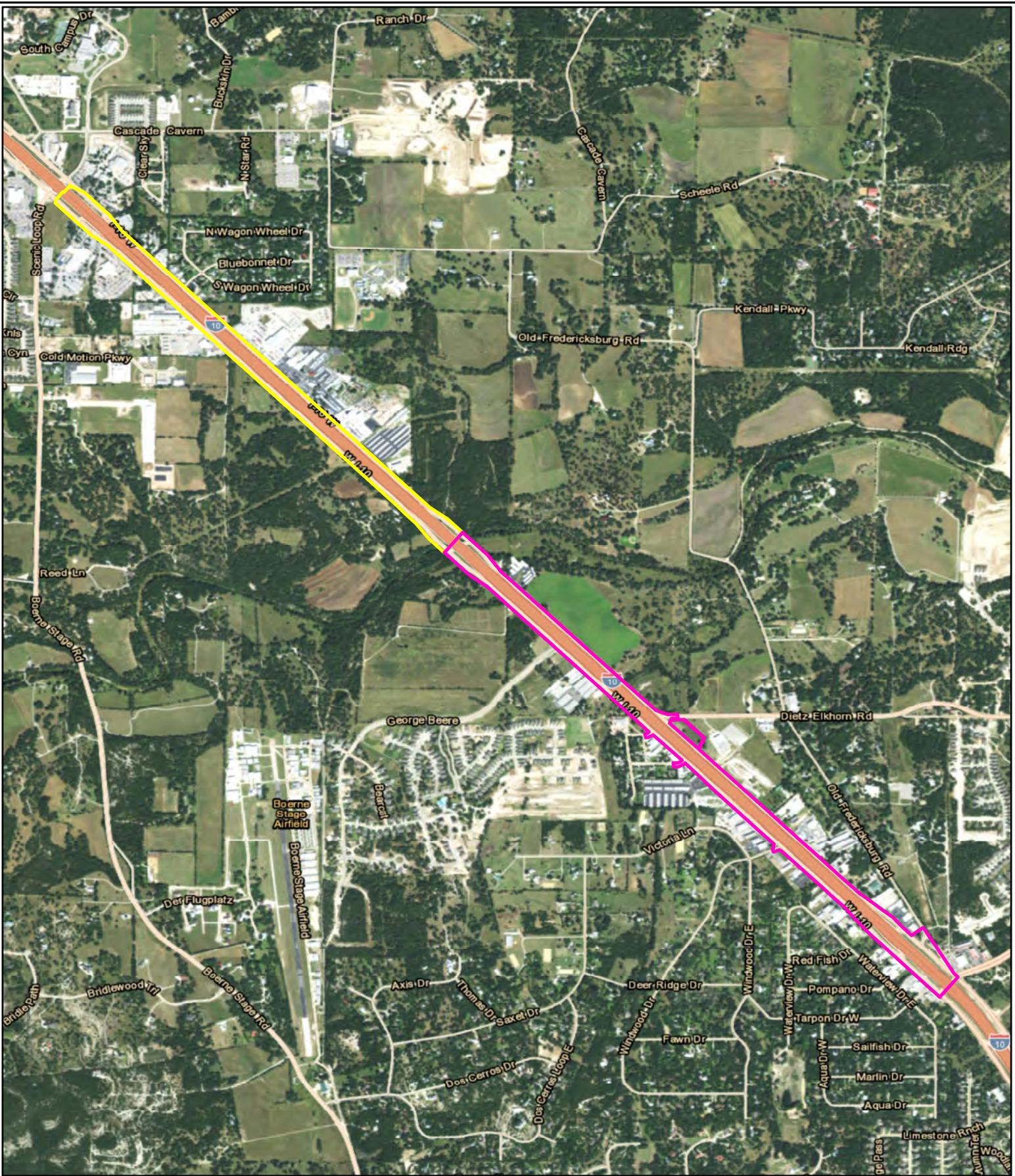


Author: Palani K. Whiting

1.5 0 1.5 Miles



Date: 10/18/2017



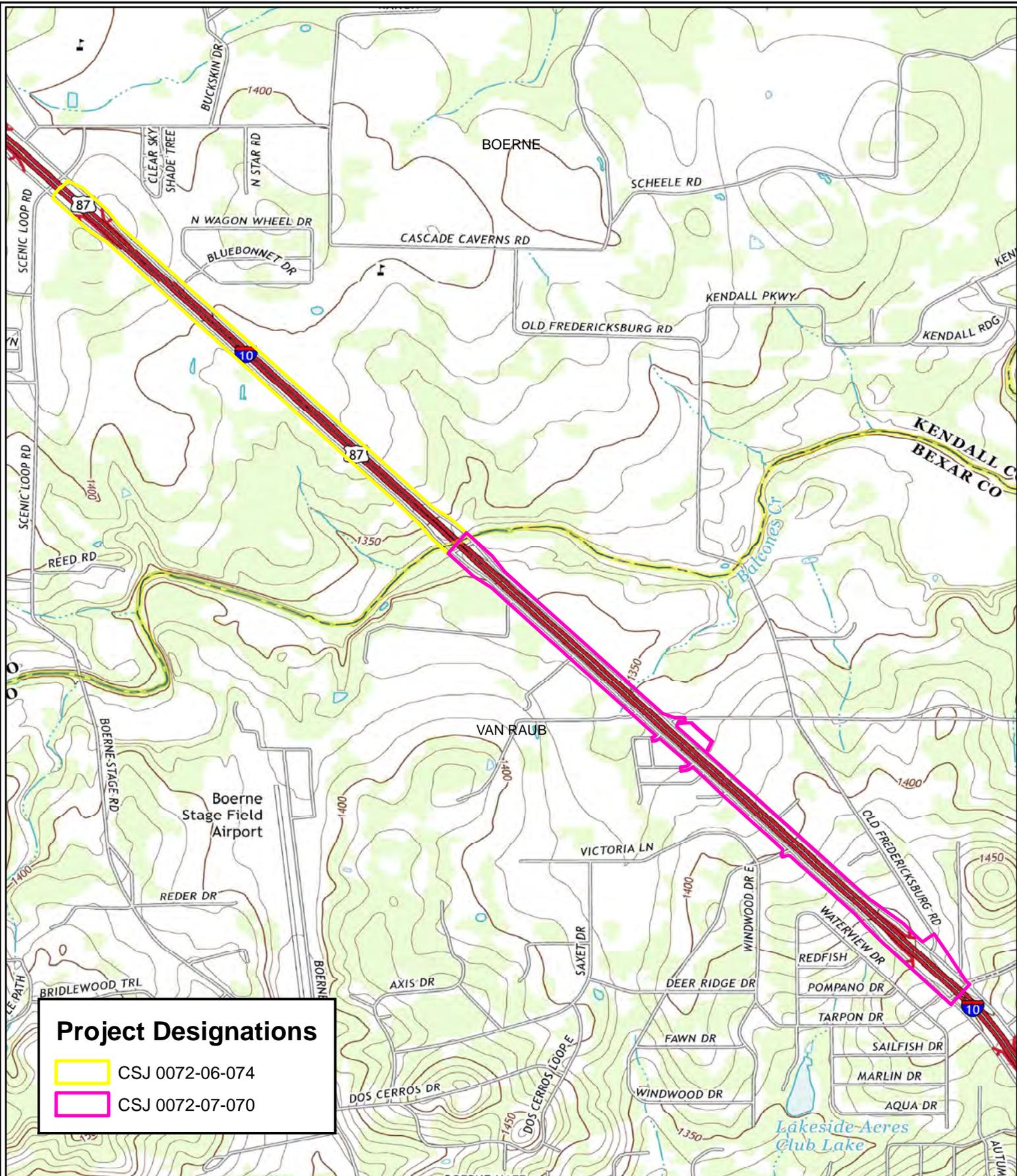
Source: ArcMap GIS.

CSJ 0072-06-074 CSJ 0072-07-070



Figure 2: Site and Vicinity Map
 IH-10 Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch,
 Kendall and Bexar Counties, Texas

N
 2,000 0 2,000 Feet
 Author: Palani K. Whiting
 Date: 10/18/2017



Source: USGS Topographic Map, 2013, Boerne and Van Raub, Texas Quads.



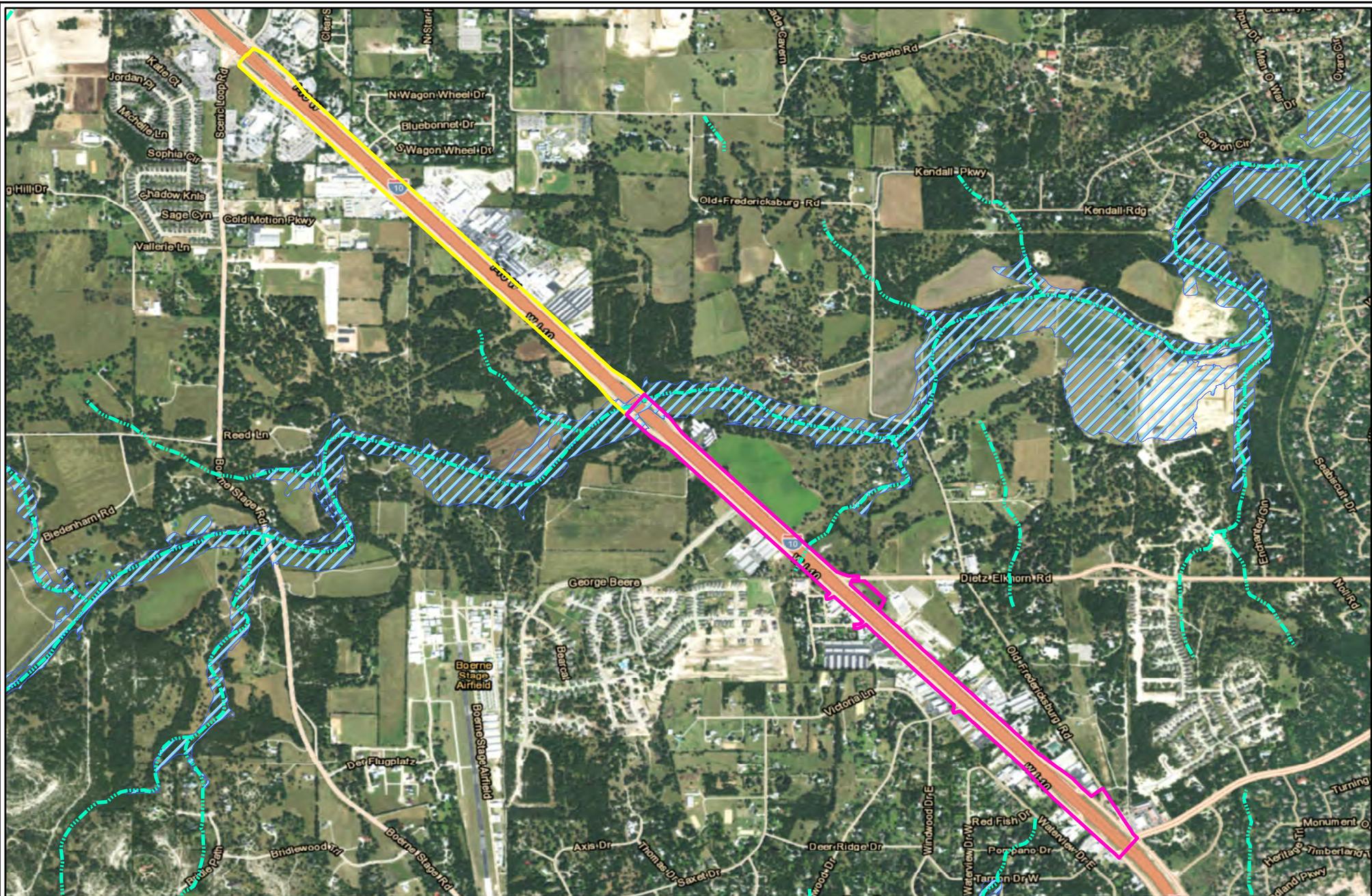
Figure 3: Topographic Map
 IH-10 Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch,
 Kendall and Bexar Counties, Texas



Author: Palani K. Whiting

0.35 0 0.35 Miles

Date: 10/18/2017



Source: FEMA FIRM, 48259C0525F, December 17, 2010.

 CSJ 0072-06-074

 CSJ 0072-07-070

 Tributaries

 100-year Floodplain



Figure 4: FEMA Map
 IH-10 Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

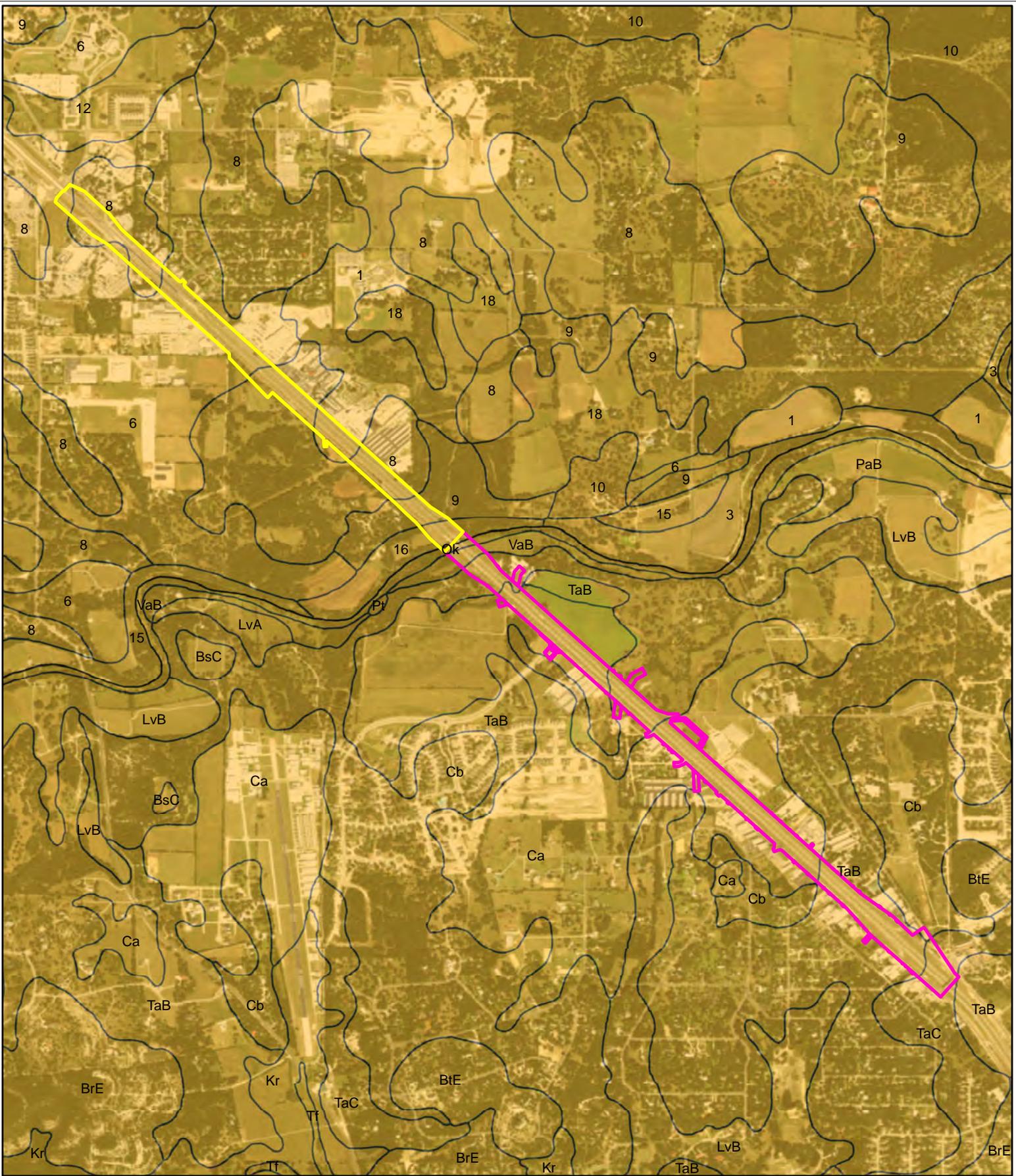


Author: Palani K. Whiting

0 0.35 0.35 Miles



Date: 10/18/2017



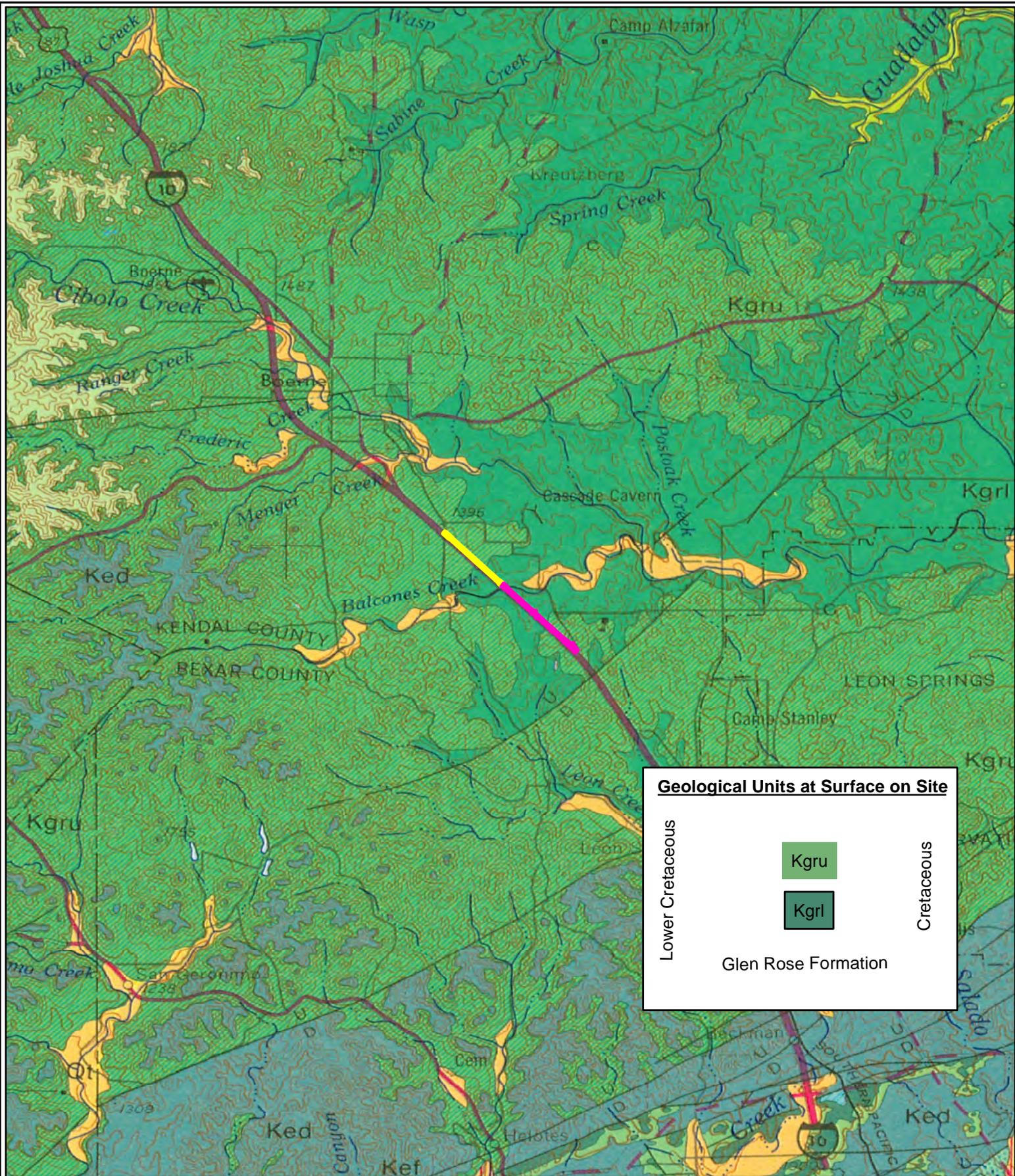
Source: NRCS, Web Soil Survey.

CSJ 0072-06-074
 CSJ 0072-07-070
 Soils



Figure 5: Soil Map
 IH-10 Scenic Loop Rd to Fair Oaks
 Parkway Geological Assessment
 Boerne and Fair Oaks Ranch,
 Kendall and Bexar Counties, Texas

N Author: Palani K. Whiting
 2,000 0 2,000 Feet
 Date: 10/23/2017



Source: USGS, Geological Atlas of Texas, San Antonio sheet, 1982.

 CSJ 0072-06-074

 CSJ 0072-07-070



Figure 6: Geology Map
 IH-10 Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch,
 Kendall and Bexar Counties, Texas

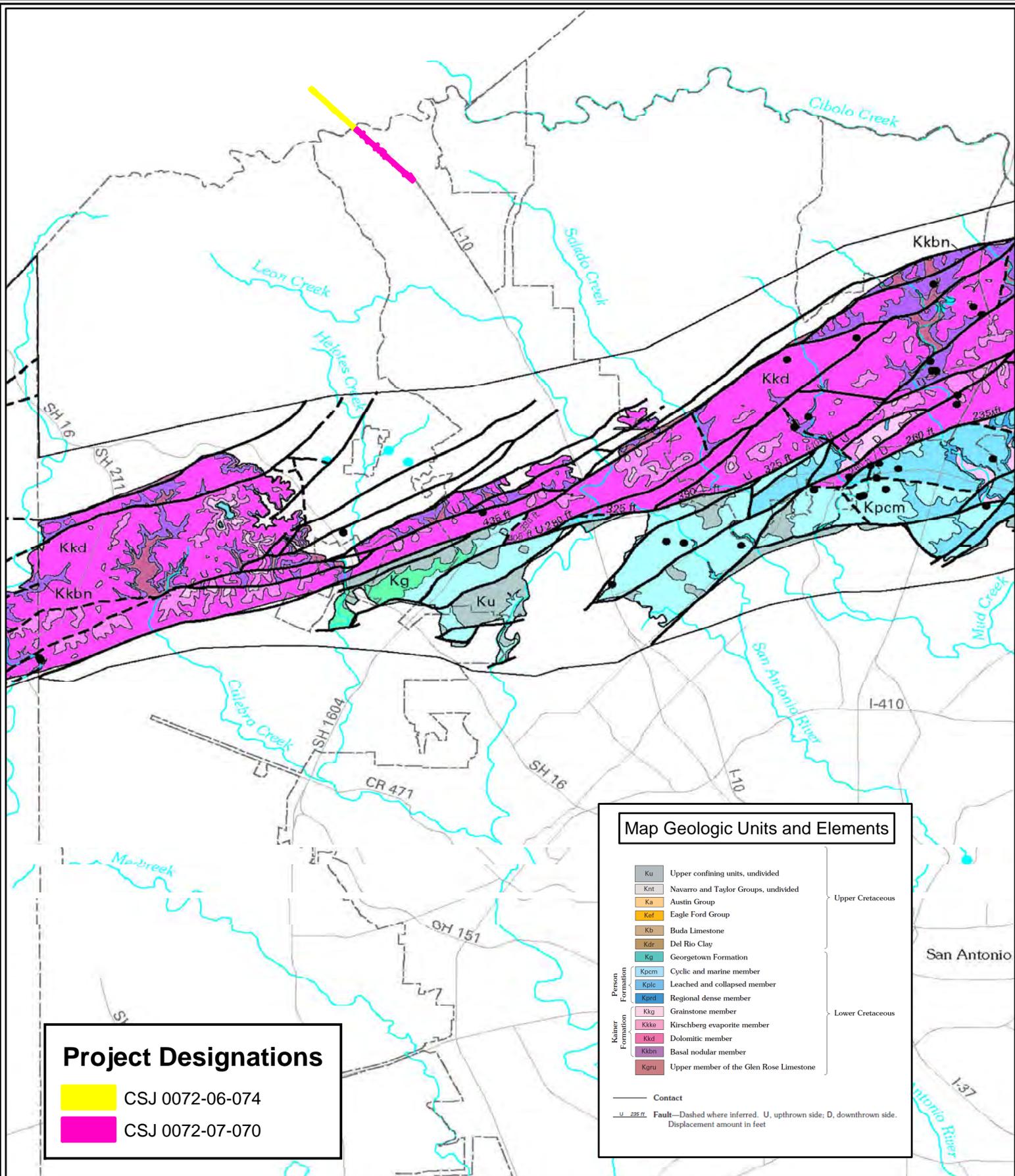


Author: Palani K. Whiting

2.5 0 2.5 Miles



Date: 10/18/2017



Project Designations

CSJ 0072-06-074

CSJ 0072-07-070

Map Geologic Units and Elements

Ku	Upper confining units, undivided	Upper Cretaceous	
Knt	Navarro and Taylor Groups, undivided		
Ka	Austin Group		
Kef	Eagle Ford Group		
Kb	Buda Limestone		
Kdr	Del Rio Clay		
Kg	Georgetown Formation		
Kpcm	Cyclic and marine member		Lower Cretaceous
Kpic	Leached and collapsed member		
Kprd	Regional dense member		
Kkg	Grainstone member		
Kkka	Kirschberg evaporite member		
Kkd	Dolomitic member		
Kkbn	Basal nodular member		
Kgru	Upper member of the Glen Rose Limestone		

— Contact

- - - - - Fault—Dashed where inferred. U, upthrown side; D, downthrown side. Displacement amount in feet

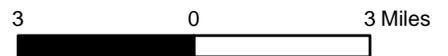
Source: USGS, Geologic Map of the Edwards Aquifer Recharge Zone, South-Central Texas.



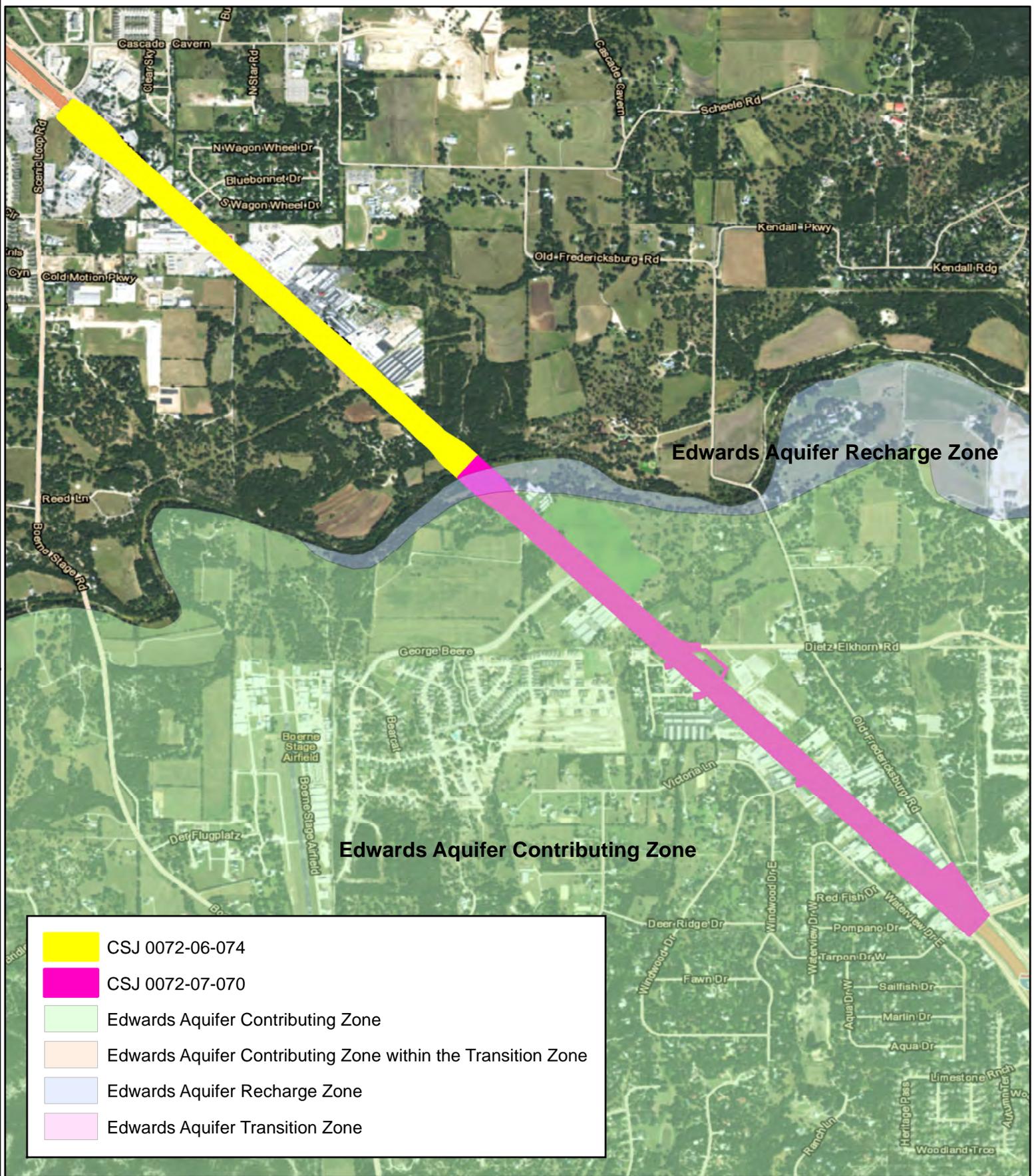
Figure 7: EA Project Area Geology
 IH 10 Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch,
 Kendall and Bexar Counties, Texas



Author: Palani K. Whiting



Date: 12/1/2017



Source: Edwards Aquifer Authority.

Figure 8: Edwards Aquifer Recharge Zone
 IH-10 Scenic Loop Rd to Fair Oaks Parkway
 Geological Review
 Boerne and Fair Oaks Ranch,
 Kendall and Bexar Counties, Texas



N Author: Palani K. Whiting
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 Date: 10/18/2017

**ATTACHMENT B –
GEOLOGIC ASSESSMENT TABLE**

**ATTACHMENT C –
STRATIGRAPHIC COLUMN**

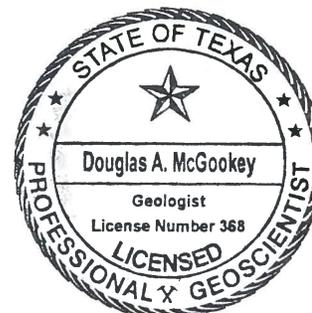
STRATIGRAPHIC COLUMN

Site Name: *IH-10 from Scenic Loop Road to Fair Oaks*
Location: *IH-10 From Scenic Loop Rd to Fair Oaks Parkway in Bexar and Kendall Counties, Texas*

Time Period (Era)	Formation	Subdivision	Hydrologic Function	Thickness (ft)	Lithology	Cavern Development	Porosity/ Permeability type
<i>Erosional Surface</i>							
Lower Cretaceous	Glen Rose Formation	Upper Member Glen Rose Limestone	CU	500	Alternating beds of yellowish-tan, medium-bedded limestone and argillaceous limestone with minor evaporite layers.	Some surface cave development associated with faults and fractures	Relatively impermeable
		Lower Member Glen Rose Limestone	AQ Trinity Aquifer	320	Hard limestone strata alternating with marl or marly limestone	Cave development associated with faults and fractures	Permeable, non-fabric porosity
	Hensell Sand		AQ Trinity Aquifer	300	Poorly sorted sand, silt, and clay	None	Permeable, fabric porosity
	Cow Creek Limestone		AQ Trinity Aquifer	60-90	Limestone: massive, off-white, in part honeycombed	Limestone caves	Permeable, fabric porosity

Notes: CU = Confining Unit; AQ = Aquifer

Source:
Geologic Framework and Hydrogeologic Characteristics of the Edwards Aquifer Recharge Zone, Bexar County, Texas: US Geological Survey, Water Resource Investigations Report (95-4030).
 Mount, Russel, *Investigations of Ground-Water Resources Near Fredericksburg, Texas*, Memorandum Report No. 63-03, Texas Water Commission, 1963.
 Clark and others, *Geology and Hydrostratigraphy of the Guadalupe River State Park and Honey Creek State Natural Area, Kendall and Comal Counties, Texas*, USGS, 2014.



Doug McGookey
 3-28-18

**ATTACHMENT D –
SITE GEOLOGY**

GEOLOGY NARRATIVE

Site Name: IH-10 from Scenic Loop Road to Fair Oaks Parkway

Location: IH-10 From Scenic Loop Road to Fair Oaks Parkway in Bexar and Kendall Counties, Texas

Location and Narrative Overview

The project site is located along Interstate Highway (IH) -10 from Fair Oaks Parkway in Bexar County to Scenic Loop Road in Kendall County, Texas. The project site consists of an existing interstate highway with east and west bound lanes, on- and off-ramps, turn around lanes, and associated infrastructure. There are existing easements between the frontage roads and commercial and residential parcels on both sides of IH-10.

The project site has been previously disturbed by many years of construction, improvements, and highway maintenance. Easements and right-of-way (ROW) on the east and west sides of the road have been previously disturbed for public utilities and include numerous manmade features such as telephone poles, sewer manholes, electric boxes, telephone and gas manhole boxes, fire hydrants, concrete drainage culverts, and driveway approaches. Landscaped areas are mostly covered with regularly maintained and mowed grasses and other herbaceous vegetation, shrubs, and trees. Most of the areas adjacent to the project site have been developed with residential and commercial properties.

The proposed project will provide necessary conversion of frontage roads from two-way to one-way, ramp reversals, installation of turnarounds, intersection improvements, and other operational improvements as shown on the final project plans.

The project site location is shown in Attachment A - Figures 1 and 2; topographic setting is shown in Figure 3.

Edwards Aquifer Zone and Contributing Zone

The project is along IH-10 from Fair Oaks Parkway to State Highway (SH) 46 in Bexar County and Kendall County Texas in the San Antonio District. The project lies within the Recharge and Contributing Zones of the Edwards Aquifer, with approximately 3.86 acres within the Recharge Zone and 71.61 acres within the Contributing Zone. The project is divided into Two Work Areas (WA). Maps showing the location of the project site is shown in Attachment A – Figures 1, 2, and 8.

100-Year Floodplain

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Bexar County Texas Community Panel Number 48259CO525F, December 17, 2010, was used to determine if the project site is located within the 100-year Floodplain. The project site is located mostly within Zone X, which represents areas determined to be outside the 0.2% annual chance floodplain. A section of the project area is located within the 100-year Floodplain, which represents areas determined to be within the 1% annual chance flood. The floodplain is noted in blue in Attachment A - Figure 4.

Site Specific Soils - Literature Review:

Soil Units: Soils within the project site according to the US Department of Agriculture's web soil survey and the Soil Survey of Bexar and Kendall Counties, Texas are described below. A figure showing the soils within the project site is shown in Attachment A - Figure 5.

Soil Descriptions

Bexar County Soils Located in Project Site CSJ 0072-07-070

Anhalt clay, 0 to 2 percent slopes (Ca): The Anhalt component makes up 100 percent of the map unit. Slopes are 0 to 2 percent. This component is on plains on plateaus. The parent material consists of residuum weathered from limestone. Depth to a root restrictive layer or bedrock is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches is low. Shrink-swell potential is very high. This soil is not flooded or ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. This soil does not meet hydric criteria.

Crawford and Bexar stony soils, 0 to 5 percent slopes (Cb): These soils occur as large areas, generally several hundred acres in size. These soils are stony clay in texture and are shallow to moderately deep over hard limestone. The surface layer is very dark gray to dark reddish-brown, non-calcareous clay and is 8 or 9 inches thick consisting of chert and limestone fragments. These fragments range in size from a quarter of an inch to 24 inches in diameter. The subsurface layer generally consists of a few chert fragments or small flags of cherty limestone. This soil is well drained and the depth to water table is more than 80 inches.

Oakalla silty clay loam, 0 to 2 percent slopes, frequently flooded (Ok): These soils form flood plains and consist of a loamy alluvium derived from limestone. They are thick soils up to 80 inches thick. The slopes are convex or rounded, and fairly smooth. The soils are dark colored, very shallow, clayey and weakly calcareous. They are developed over hard limestone and have scattered stones, gravel, channery fragments, cobblestones and flagstones on the surface within the surface layer. This soil is well drained and runoff class is negligible and the depth to water table is more than 80 inches.

Eckrant cobbly clay, 1 to 8 percent slopes (TaB): For the most part these soils are gently undulating and occur as nearly level to gently sloping areas. The slope can be as much as 12 percent in some places. These soils are generally dark colored, very shallow, calcareous and clayey. They are developed over hard limestone and have scattered stones, gravel, channery fragments, cobblestones and flagstones on the surface within the surface layer. The runoff class is medium and the depth to water table is more than 80 inches.

Eckrant cobbly clay, 5 to 15 percent slopes (TaC): These soils form in the northern third of the county. The slopes are convex or rounded, and fairly smooth. The soils are dark colored, very shallow, clayey and weakly calcareous and well drained. They are developed over hard limestone and have scattered stones, gravel, channery fragments, cobblestones and flagstones on the surface within the surface layer. The runoff class is medium and the depth to water table is more than 80 inches.

Sunev loam, 1 to 3 percent slopes (VaB): This soil occupies small, narrow terraces that are parallel to and slope toward the major water courses. The slopes are linear to convex and form from the loamy alluvium of quaternary age derived from mixed sources. The surface layer is brown and about 12 inches thick. The subsurface layers are up to 62 inches of pale-brown loam. This soil is well drained and depth to water table is more than 80 inches.

Kendall County Soil Located in Project Site CSJ 0072-07-070

Oakalla silty clay loam, 0 to 2 percent slopes, occasionally flooded (16): This soil is a deep nearly level soil located on flood plains of major streams. Slopes are smooth to slightly concave. Typically, the surface layer is a dark gray silty clay loam about 15 inches thick and below this layer it is dark grayish brown silty clay loam to a depth of 26 inches. Below that to a depth of 60 inches is grayish brown silty clay loam. This soil is well drained and is occasionally flooded. Surface runoff class is low and permeability is moderate. The runoff class is low and the depth to water table is more than 80 inches.

Bexar County Soil Located in Project Site CSJ 0072-06-074

Oakalla silty clay loam, 0 to 2 percent slopes, frequently flooded (Ok): These soils form flood plains and consist of loamy alluvium derived from limestone. They are thick soils up to 80 inches thick. The slopes are convex or rounded, and fairly smooth. The soils are dark colored, very shallow, clayey and weakly calcareous. They are developed over hard limestone and have scattered stones, gravel, channery fragments, cobblestones and flagstones on the surface within the surface layer. This soil is well drained and runoff class is negligible and the depth to water table is more than 80 inches.

Kendall County Soils Located in Project Site CSJ 0072-06-074

Anhalt clay, 1 to 3 percent slopes (1): The Anhalt component makes up 100 percent of the map unit. Slopes are 1 to 3 percent. This component is on plains on plateaus. The parent material consists of residuum weathered from limestone. Depth to a root restrictive layer or bedrock is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is low. Available water to a depth of 60 inches is low. Shrink-swell potential is very high. This soil is not flooded or ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. This soil does not meet hydric criteria. The calcium carbonate equivalent within 40 inches, typically, does not exceed 8 percent.

Denton silty clay, 1 to 3 percent slopes (6): This soil is moderately deep and gently sloping. Slopes are concave or convex. Typically, the surface layer is dark grayish brown silty clay approximately 24 inches thick. The subsoil is brown clay to a depth of approximately 39 inches and has small, rounded, soft calcium carbonate bodies and weakly cemented fragments of limestone. The subsoil rests on a bed of limestone and marl. It is a well-drained soil. Surface runoff is medium and permeability is slow. The available water capacity is medium

Doss silty clay, 1 to 5 percent slopes (8): This soil is a shallow gently sloping on uplands and is underlain by cemented marl and caliche. Slopes are smooth and average 3.5percent. Typically, the surface layer is a dark grayish brown silty clay and about 9 inches thick. The subsoil is brown silty clay to a depth of approximately 18 inches and contains may soft bodies of calcium carbonate. It rests on a bed of cemented marl and caliche that becomes softer as depth increases. This soil is well drained. Surface runoff is moderately low.

Doss-Brackett association, undulating (9): This association consists of shallow, loamy and clayey soils on uplands. The composition of variable. Typically, the surface layer is light brownish gray clay loam 7 inches thick. The subsoil is very pale brown clay loam to a depth of 19 inches and contains about 20 percent by volume soft and weakly cemented bodies of calcium carbonate. The subsoil rests on thinly interbedded, weakly cemented limestone and marl. Reaction of the soil is moderately alkaline throughout. The soils in this association are well drained. Surface runoff is medium to rapid. Permeability is moderately slow. The available water capacity is low to very low.

Oakalla silty clay loam, 0 to 2 percent slopes, occasionally flooded (16): This soil is a deep nearly level soil located on flood plains of major streams. Slopes are smooth to slightly concave and range from 0 to 2 percent. Typically, the surface layer is a dark gray silty clay loam about 15 inches thick and below this layer it is dark grayish brown silty clay loam to a depth of 26 inches. Below that to a depth of 60 inches is grayish brown silty clay loam. This soil is well drained and is occasionally flooded. Surface runoff class is low and permeability is moderate. The runoff class is low and the depth to water table is more than 80 inches.

Project site Specific Soils - Observations: The soils which originally underlain the project site were

described above. Most of the project site is covered with asphalt pavement. Exposed soils observed in the project site were within the easements and right of ways along the frontage roads and between the main lanes of the highway. The soils have been greatly disturbed due to construction of the highway and associated roads, and maintenance activities. Currently, areas with soil are covered with landscaping, including regularly mowed and maintained grasses and other herbaceous vegetation, shrubs, trees, imported fill, and manmade features.

In areas where soil was exposed, the soil resembled the descriptions in the soil surveys and whose descriptions are listed above.

Narrative of Site Specific Geology:

Literature Review:

The project site lies within the Recharge and Contributing Zones of the Edwards Aquifer. The entire Site is underlain by the Glen Rose limestone which is Lower Cretaceous in age according to the United States Geological Survey, *Geologic Map of the Edwards Recharge Zone, South Central Texas*. The Glen Rose limestone consists of two members, the Upper and Lower Glen Rose which is separated by a one-foot zone containing fossils of the bivalve *Corbula*. These shells are index fossils for the separation of between the two units in the Glen Rose.

Near the Bexar/Kendall County line, a small area of Edwards Recharge Zone is mapped along Balcones Creek, an ephemeral tributary of Cibolo Creek. This extension of the Recharge Zone into Kendall County at this location is due to the belief that flow from the Cibolo Creek recharges down and contributes hydraulically to the Edwards Recharge Zone. The Glen Rose limestone outcrops in the stream bed of the ephemeral creek as it crosses IH-10. The member is described below and shown in Attachment A – Figure 6 and Attachment F.

Site Specific Geology:

Much of the surface of the project site consists of an existing interstate highway with east and west bound lanes, on- and off-ramps, turn around lanes, and associated infrastructure with easements along the north and south sides in the ROW. Improvements along IH-10 include manmade features such as drainage culverts, utilities including electric and telephone poles, water and gas meters, underground sewer, storm water inlets, telephone, and cable utilities with access manholes or meters.

The Glen Rose formation is the uppermost, thickest and most extensively exposed formation of the Trinity Group, a series of shallow-water marine formations deposited on a southeastward flank of the Llano Uplift, through a number of sea regressions and transgressions. The formation consists mostly of hard limestone strata consisting of alternating beds of marl and marly limestone. The differing strengths of these limestone layers often weathers differentially and forms a topography that resembles

stair steps on hills. Below the Upper and Lower Glen Rose Limestone lie the Hensell Sandstone and the Cow Creek Limestone (Bureau of Economic Geology, Geologic Atlas of Texas).

A creek crossing was observed during the site visit. No fractures, faults, or recharge features were observed in the creek. Several areas had fossils that were from the Glen Rose Formation, however it was not certain whether the fossils were in place or brought in with the fill materials used along the highway easements. Most of the site is covered by highways, roads, soils and there is little evidence of limestone rocks at the surface. What little limestone that is present at the surface may have been redistributed during past construction activities and ground disturbance. There was little evidence that recharge is enhanced through any of the features observed on the Site. **If features are discovered during construction, work should stop and the Texas Commission on Environmental Quality (TCEQ) notified so that the feature can be evaluated.**

Examples of some of the features are described below and photographs are shown in Attachment E, Photographs.

S-1: Sewer Lines lie along the length of the Site in buried trenches. Utility covers mark the location of the sewer lines in many places. The sewer lines are buried and as long as the piping is intact, there is little chance of storm water migrating through the trenches into the Edwards Aquifer. An example of one of the many sewer utility covers located along the easement of IH-10 at the driveway to the CVS pharmacy on the northside of IH-10 is shown in Attachment E1-Photograph 4.

S-2: Sewer Lines lie along the length of the Site in buried trenches. Utility covers mark the location of the water lines in many places. The sewer lines are buried and as long as the piping is intact, there is little chance of storm water migrating through the trenches into the Edwards Aquifer. An example of one of the many sewer utility covers located on Old Fredericksburg Road is shown in Attachment E1-Photograph 5.

S-3: Example of a concrete drainage culvert and associated scour within the ROW along the Frontage Road of the west bound lane of IH-10 (Attachment E1-Photograph 8). The culverts are constructed of and paved with concrete so there is little chance of recharge of water entering the Edwards Aquifer from these features.

S-4: A silt screen utilized between the Frontage Road and west bound lanes of IH-10 west of Fair Oaks Parkway as a Best Management Practice (BMP) to control sediments in storm water (Attachment E1-Photograph 9).

S-5: Example of a concrete drainage culvert located in the ROW west of the east bound lane of IH-10 and the Frontage Road (Attachment E1-Photograph 19). The culverts are constructed of and paved with concrete so there is little chance of recharge of water entering the Edwards Aquifer from these features.

S-6: Numerous concrete box culverts for drainage under side roads, the interstate highway, and driveways are present along the Site. The culverts are constructed of and paved with concrete and are mostly underlain by concrete. There is little chance of recharge of water entering the Edwards Aquifer from these features. An example of one a boxed culvert within the ROW is shown in Attachment E2-Photograph 3.

Man-made features associated with utilities and culverts are unlikely to provide conduits for storm water flow to the subsurface. Photographs showing some of these features used as examples for the purposes of the Geologic Tables are shown below. Photographs of the Site showing examples of manmade features are included in Attachment E, Photographs.

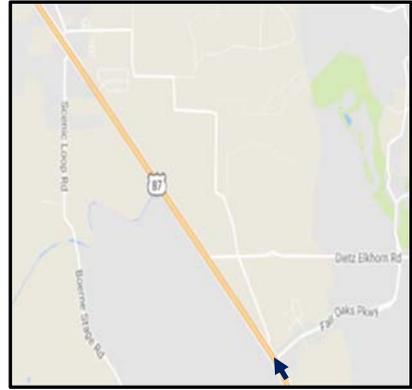
ATTACHMENT E1
PHOTOGRAPHS

CSJ 0072-07-070



Location

Photograph 1. View facing northeast from the bridge on Fair Oaks Parkway and IH-10 showing construction activities, and CVS Pharmacy in the background.



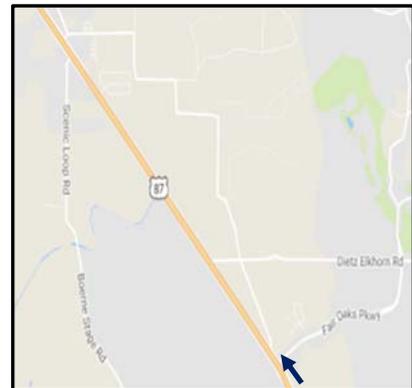
Location

Photograph 2. View facing northwest taken from the bridge on Fair Oaks Parkway and IH-10, showing the roadway and construction activities.



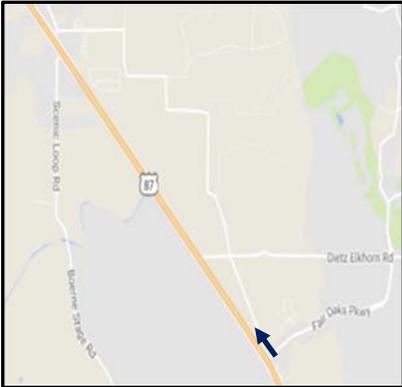
Location

Photograph 3. View facing southwest showing the bridge on Fair Oaks Parkway and IH-10, showing the roadway and construction activities. Commercial businesses are evident in the background.



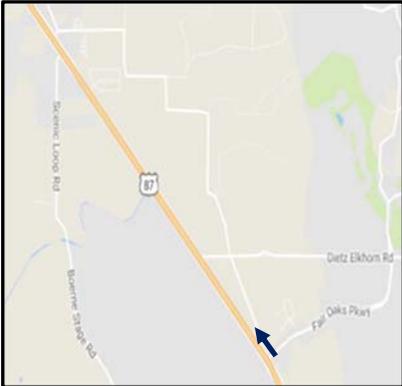
Location

Photograph 4. View facing northwest at driveway to CVS on the northside of IH-10. A sewer manhole is evident near the driveway and Old Fredericksburg Road is visible in the background (S-1).



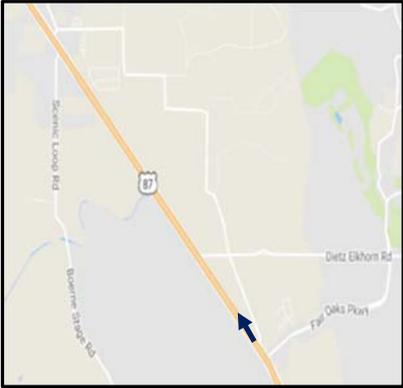
Location

Photograph 5. View facing southwest on Old Fredericksburg towards sewer manhole, utility pole, and strip mall evident in the background (S-2).



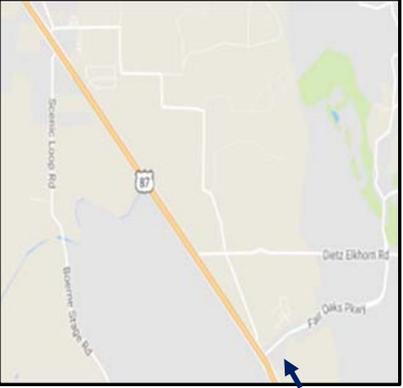
Location

Photograph 6. View facing northwest showing IH-10, and associated frontage roads and median strips. Commercial businesses are evident along the frontage roads on both sides of the highway.



Location

Photograph 7. On-ramp to west bound lanes of IH-10 northwest of Fair Oaks Pkwy.



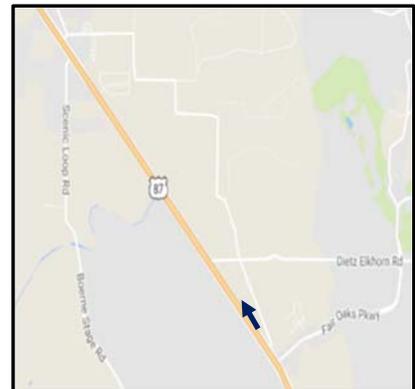
Location

Photograph 8. View facing northwest showing a culvert and associated scour within the ROW along the Frontage Road of the west bound lane of IH-10 (S-3).



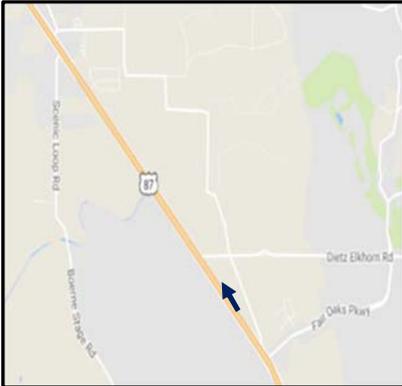
Location

Photograph 9. View of a BMP utilized between the Frontage Road and west bound lanes of IH-10 west of Fair Oaks Pkwy (S-4).



Location

Photograph 10. View facing northwest of the Frontage Road, and west bound and east bound lanes of IH-10.



Location

Photograph 11. View facing northwest of the Frontage Road north of the west bound lanes of IH-10. Commercial establishments are evident along with telephone poles, overhead electric lines, and billboard signs.

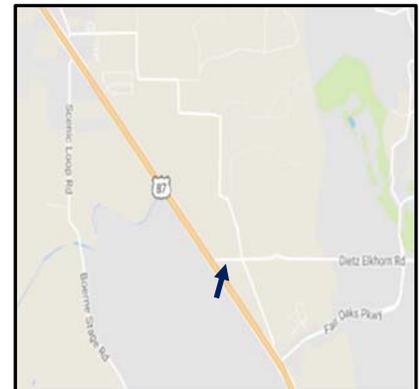


Location

Photograph 12. View facing northwest of commercial development north of the Frontage Road of the west bound lanes of IH-10. Billboards, street signs, and a transformer are evident in the photograph.



Photograph 13. View facing northeast of the culvert at Dietz Elkhorn.



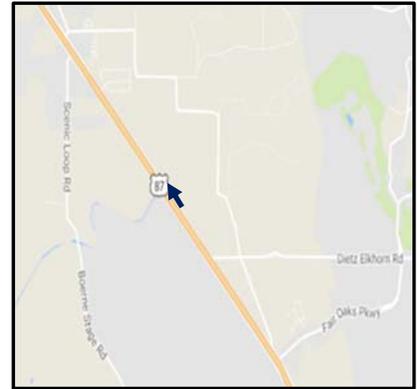
Location



Photograph 14. View facing southeast from drainage easement at Dietz Elkhorn towards IH-10. Telephone poles, utility lines, and billboard signs are present along the Frontage Road and associated with the Harley-Davidson east of the easement.

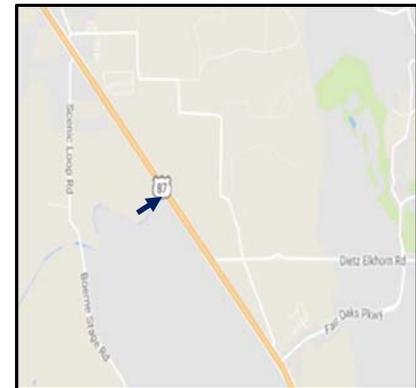


Location



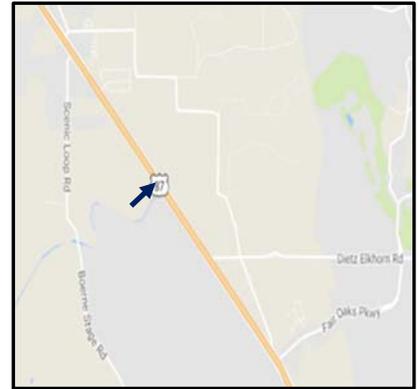
Location

Photograph 15. View facing northwest towards the riparian area of Balcones Creek.



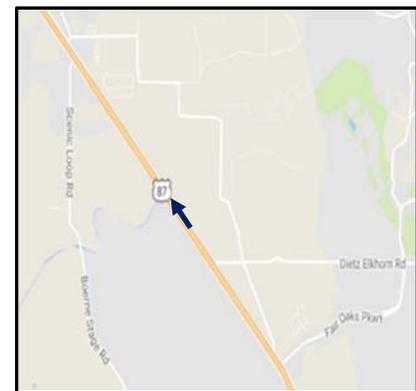
Location

Photograph 16. View facing northeast of the turnaround at Balcones Creek from the southwestern side of IH-10.



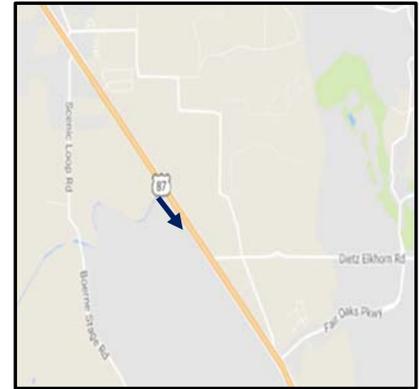
Location

Photograph 17. View facing northeast of the riparian area and channel of Balcones Creek.



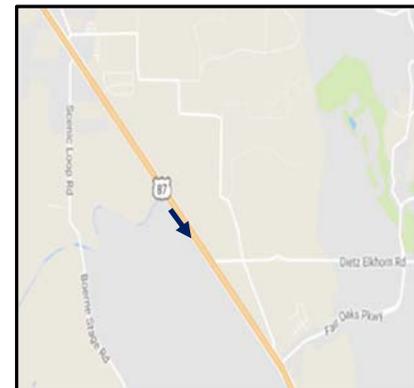
Location

Photograph 18. View facing northeast of the riparian area and channel of Balcones Creek.



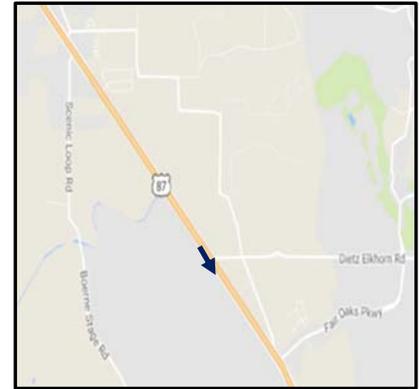
Location

Photograph 19. View facing southeast of culvert (S-5) located in the ROW west of the east bound lane of IH-10 and Frontage Road.



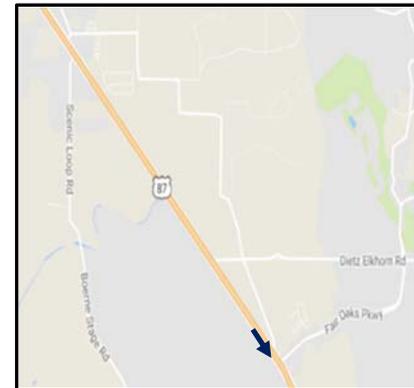
Location

Photograph 20. View facing southeast of the east bound lanes of IH-10 and associated Frontage Road, and the San Antonio Water System substation adjoining the project site west of IH-10 and the Frontage Road. Culvert in photograph is associated with S-5 in photograph 19.



Location

Photograph 21. View facing southeast of boxed culvert within the ROW long the Frontage Road and the east bound lanes of IH-10.

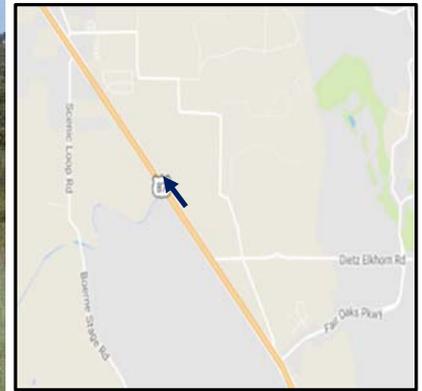


Location

Photograph 22. View facing southeast of the east bound lanes of IH-10 and Frontage Road as well as businesses adjacent to the project site and associated manmade utilities.

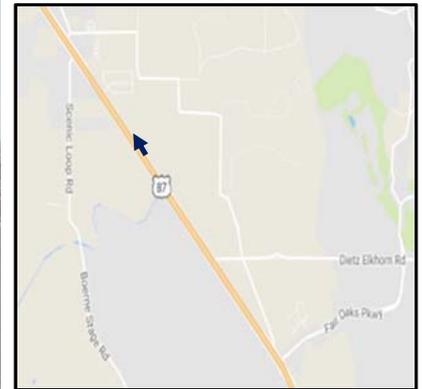
ATTACHMENT E2
PHOTOGRAPHS

CSJ 0072-06-074



Location

Photograph 1. View facing northeast towards Balcones Creek and the riparian area. An on-ramp to the west bound lanes of IH-10 is visible in the background past the creek.



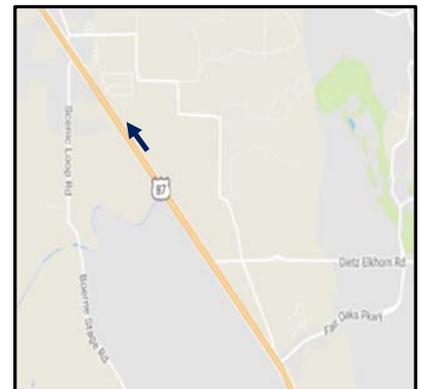
Location

Photograph 2. View facing northwest of IH-10 east and west bound lanes, frontage roads, and businesses along the ROW.



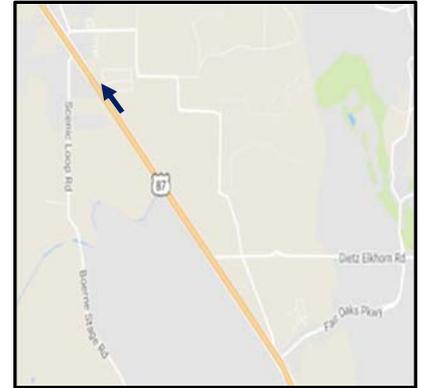
Location

Photograph 3. View facing southeast showing a boxed culvert within the ROW (S-6). A commercial business is in the background.



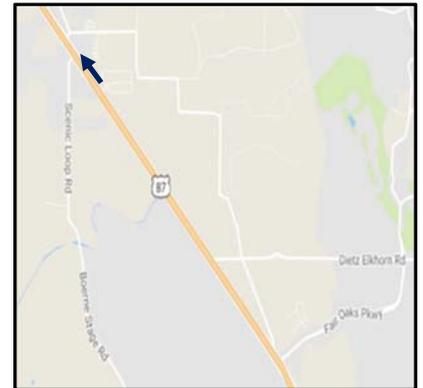
Location

Photograph 4. View facing northwest of cement drainage associated with the boxed culvert (S-6; photograph 3). Businesses and utilities present in the background.



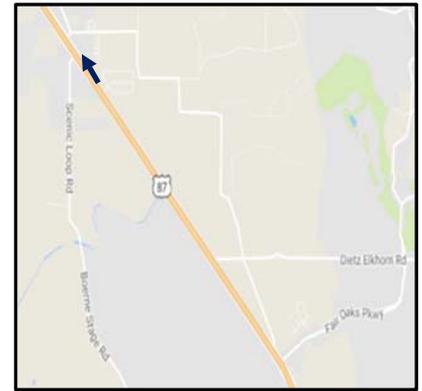
Location

Photograph 5. View facing northwest showing the west bound lanes and off-ramp of IH-10, and cement barriers and construction cones.



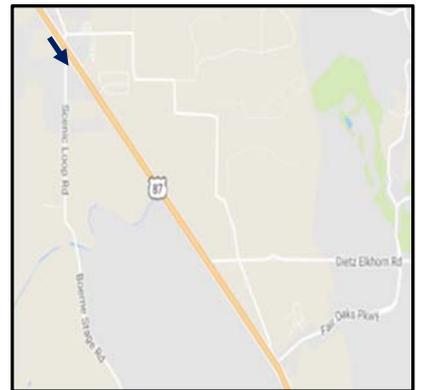
Location

Photograph 6. View facing northwest showing construction at Scenic Loop Road and IH-10 on the overpass. Businesses are present along the Frontage Road.



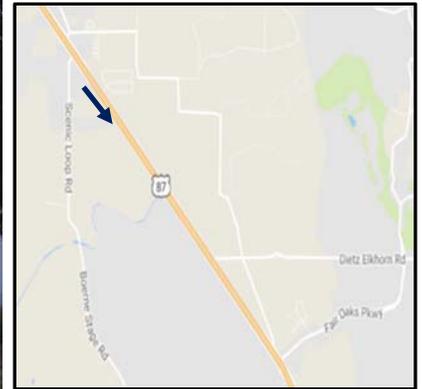
Location

Photograph 7. View facing northwest showing construction at Scenic Loop Road and IH-10 on the overpass. West bound lanes of IH-10 are evident in the background.



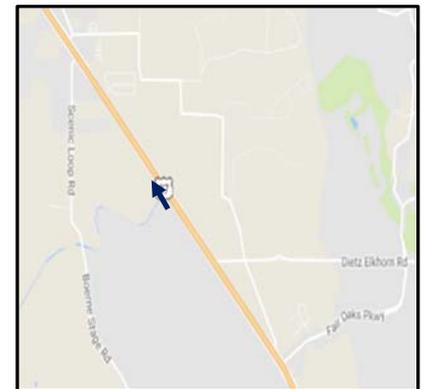
Location

Photograph 8. View facing southeast showing a utility cover and poles within the ROW along the Frontage Road of the east bound lane of IH-10.



Location

Photograph 9. View of ROW between the Frontage Road and east bound lanes of IH-10 southeast of Scenic Loop Road.



Location

Photograph 10. View facing northwest of the Frontage Road at the southern end of the project site, on the southwestern side of IH-10 just before the Balcones Creek turnaround.

REFERENCES

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Location: IH-10 Corridor from Scenic Loop Road to Fair Oaks Parkway in Bexar and Kendall Counties, Texas

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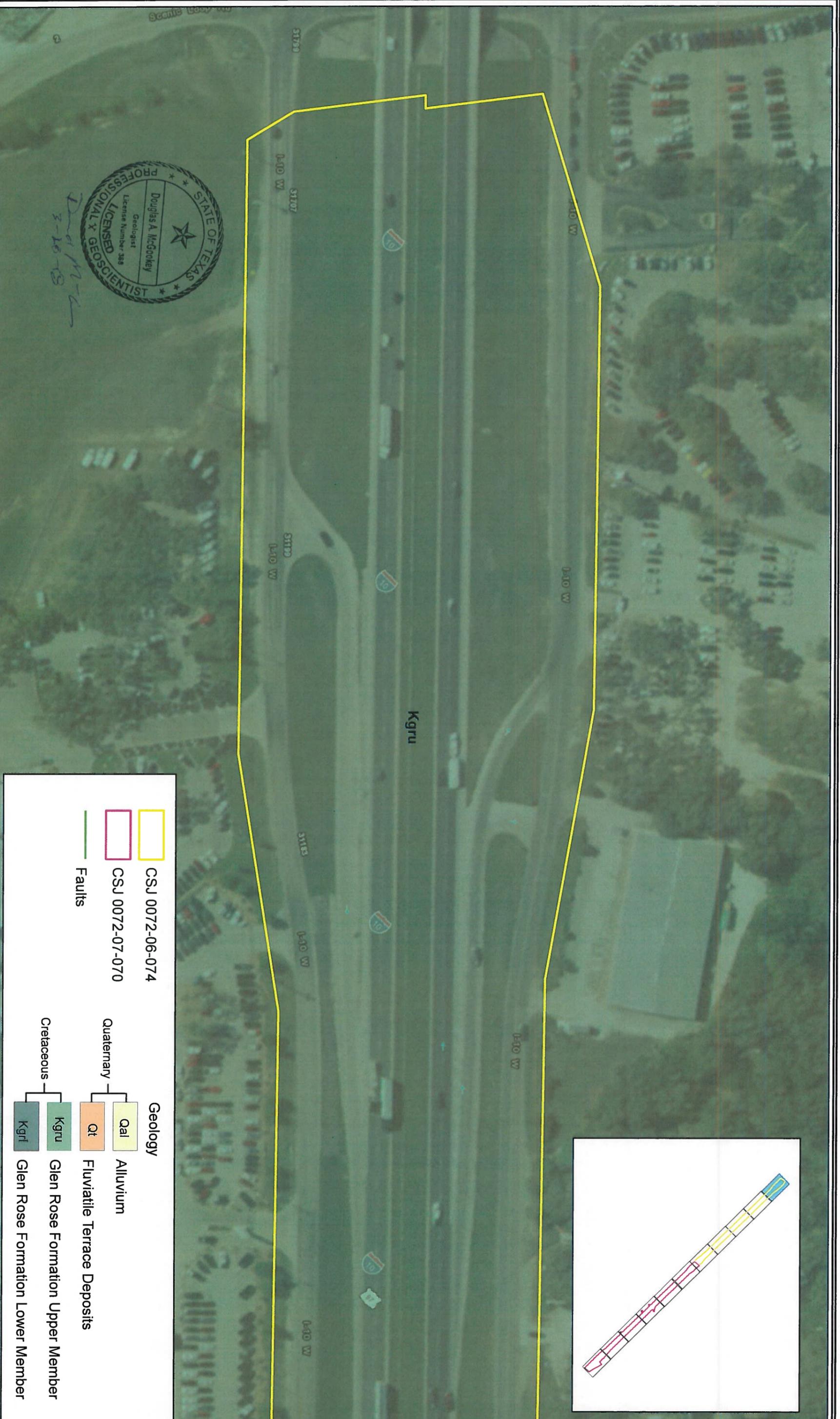
United States Department of Agriculture Soil Conservation Service in Cooperation with Texas Agriculture Experiment Station. Soil Survey Kendall County Texas. Electronic Version, original printed copy issued March 1981.

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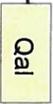
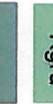
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ATTACHMENT F – SITE GEOLOGIC MAPS



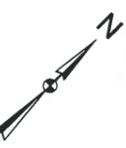
Source: United States Geological Survey, <https://mrdata.usgs.gov/geology/state/state.php?state=TX>.

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	CSJ 0072-07-070			Qt	Fluviatile Terrace Deposits
	Faults	Cretaceous		Kgru	Glen Rose Formation Upper Member
				Kgrl	Glen Rose Formation Lower Member



Medina Consulting Company, Inc.
 Figure 9: Project area Geology
 From Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

Map 1 of 11




1 in = 100 ft
 Author: Palani K. Whiting
 Date: 10/26/2017



Source: United States Geological Survey, <https://mrdata.usgs.gov/geology/state/state.php?state=TX>.



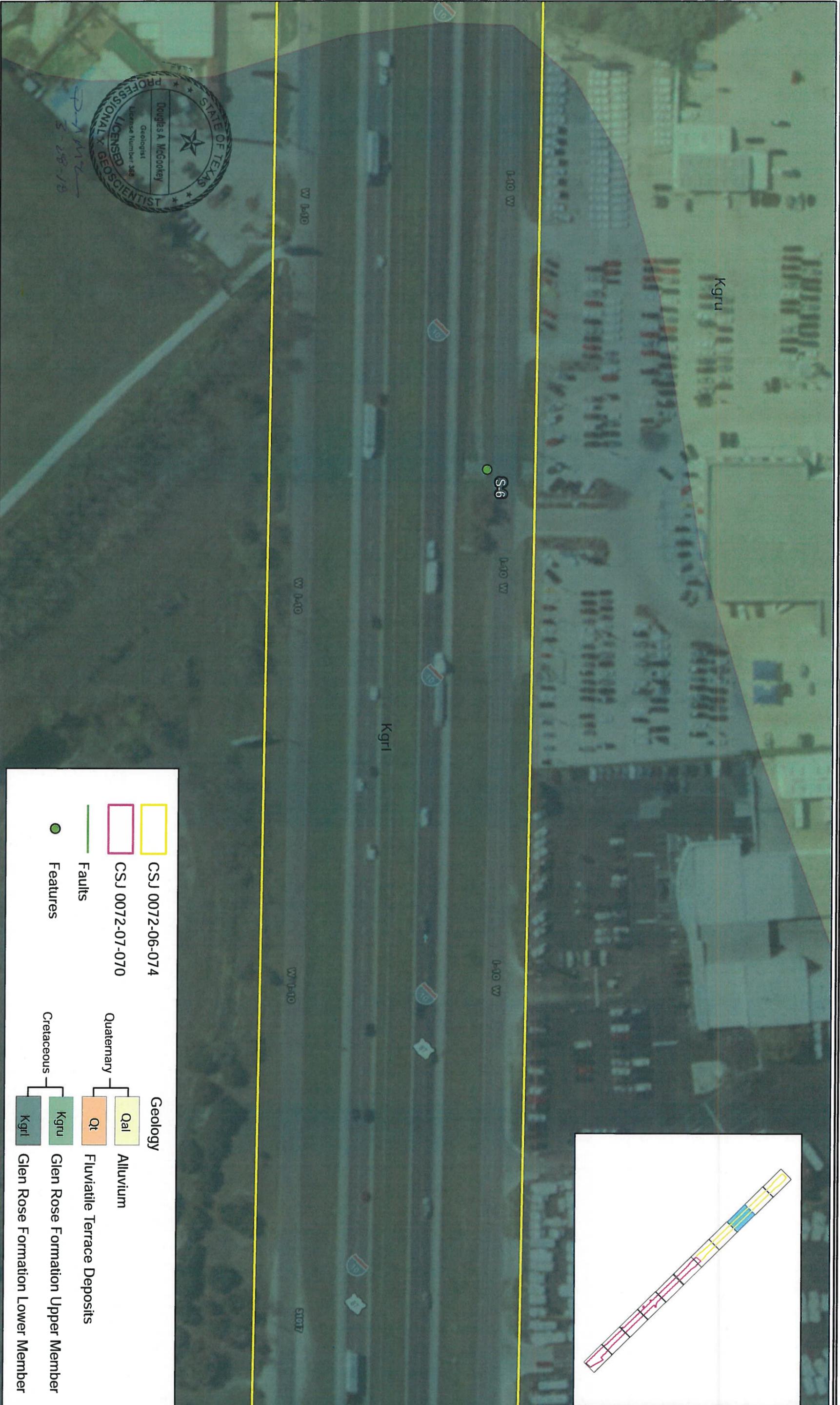
D.A. McG
5-28-18

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Quaternary				Qal	Alluvium														
		Qt	Fluvialite Terrace Deposits																
Cretaceous		Kgru	Glen Rose Formation Upper Member																
		Kgrl	Glen Rose Formation Lower Member																
	CSJ 0072-07-070	Faults																	
		Features																	

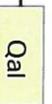


Figure 9: Project area Geology
From Scenic Loop Rd to Fair Oaks Parkway
Geological Assessment
Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

Map 2 of 11
Author: Palani K. Whiting
Date: 10/26/2017
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1 in = 100 ft



Source: United States Geological Survey, <https://mrdata.usgs.gov/geology/state/state.php?state=TX>.

	CSJ 0072-06-074	Geology  Alluvium  Fluvialite Terrace Deposits  Glen Rose Formation Upper Member  Glen Rose Formation Lower Member
	CSJ 0072-07-070	
	Faults	
	Features	



Medina Consulting Company, Inc.
 Figure 9: Project area Geology
 From Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

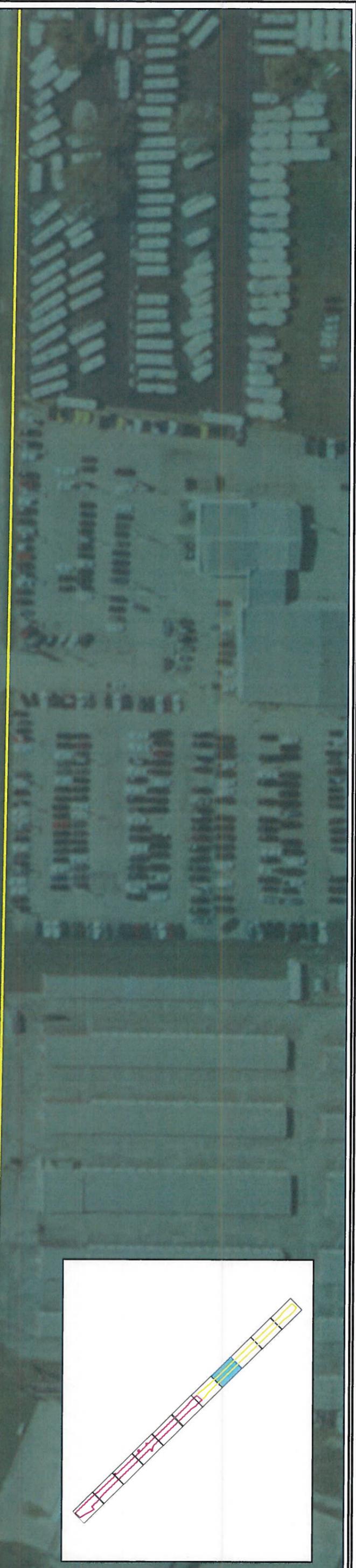
Map 3 of 11

Author: Palani K. Whiting

Date: 10/26/2017

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Source: United States Geological Survey, <https://mdata.usgs.gov/geology/state/state.php?state=TX>.



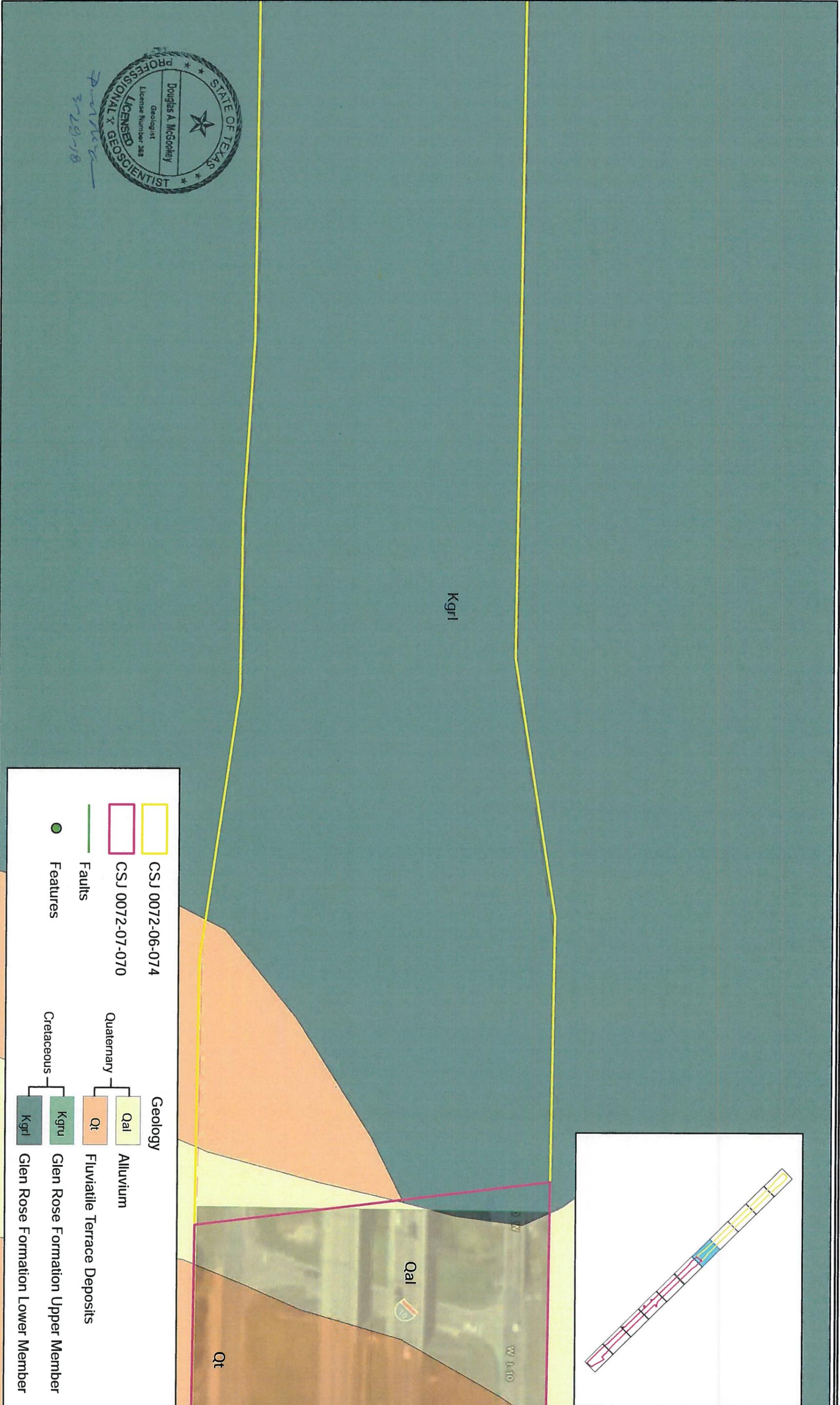
Figure 9: Project area Geology
 From Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

	CSJ 0072-06-074	Geology
	CSJ 0072-07-070	
	Faults	
	Features	
		Quaternary
	Qal	Alluvium
	Qt	Fluvialite Terrace Deposits
		Cretaceous
	Kgru	Glen Rose Formation Upper Member
	Kgrl	Glen Rose Formation Lower Member

Map 4 of 11



Author: Palani K. Whiting
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 Date: 10/26/2017



Source: United States Geological Survey, <https://mrdata.usgs.gov/geology/state/state.php?state=TX>.



Figure 9: Project area Geology
 From Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

	CSJ 0072-06-074	Geology
	CSJ 0072-07-070	
	Faults	Quaternary Qal Alluvium Qt Fluvialite Terrace Deposits Cretaceous Kgru Glen Rose Formation Upper Member Kgrl Glen Rose Formation Lower Member
	Features	

Map 5 of 11



Author: Palani K. Whiting
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 Date: 10/26/2017



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 3-28-13

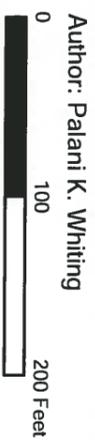
Source: United States Geological Survey, <https://mrdata.usgs.gov/geology/state/state.php?state=TX>.



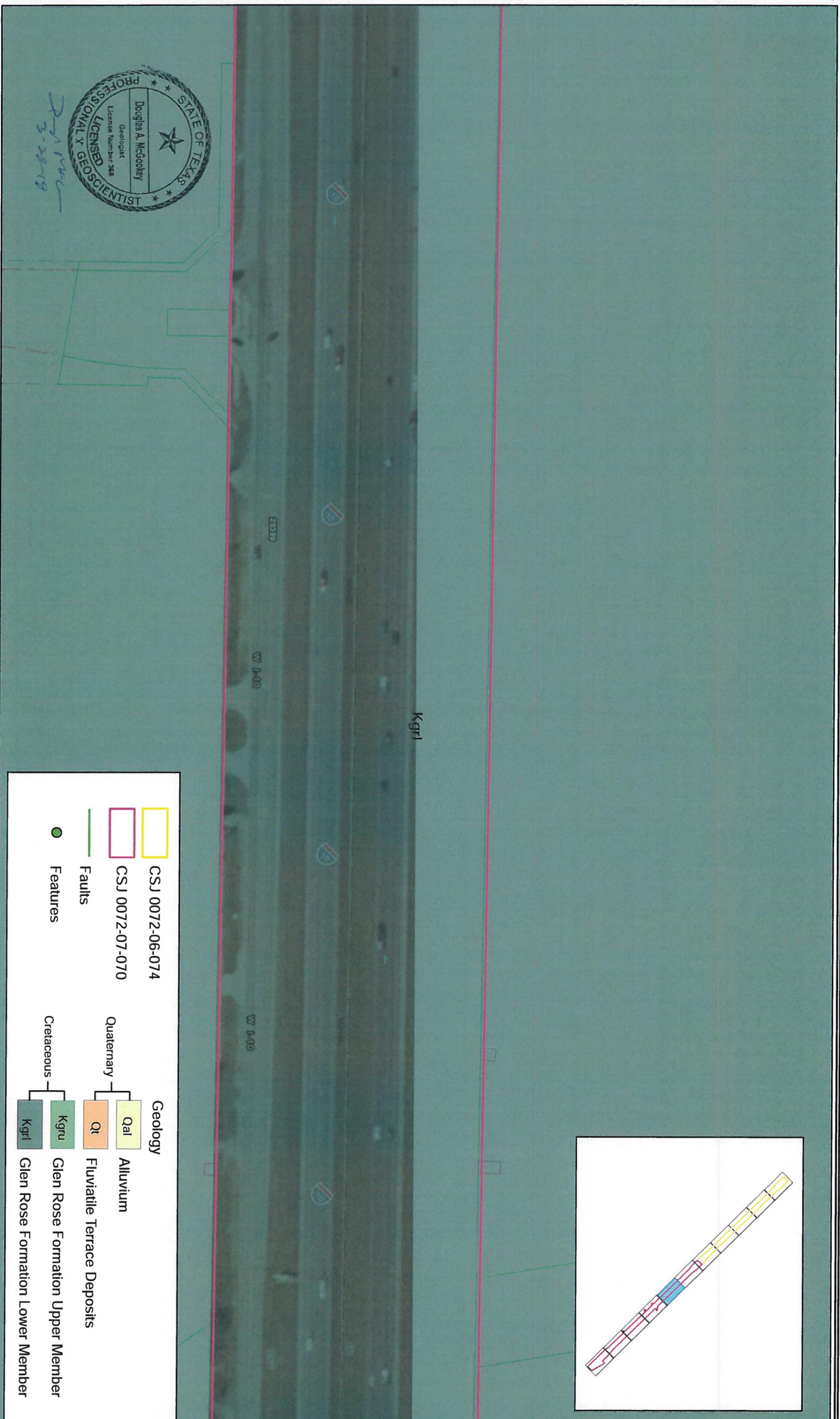
Figure 9: Project area Geology
 From Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

	CSJ 0072-06-074	Geology		Qal	Alluvium
	CSJ 0072-07-070			Qt	Fluvialite Terrace Deposits
	Faults	Cretaceous		Kgru	Glen Rose Formation Upper Member
	Features			Kgrl	Glen Rose Formation Lower Member

Map 6 of 11



Author: Palani K. Whiting
 Date: 10/26/2017
 1 in = 100 ft



Source: United States Geological Survey, <https://mrdata.usgs.gov/geology/state/state.php?state=TX>.

	CSJ 0072-06-074	Geology	<table border="0"> <tr> <td>Quaternary</td> <td></td> <td>Qal</td> <td>Alluvium</td> </tr> <tr> <td></td> <td></td> <td>Qt</td> <td>Fluviatile Terrace Deposits</td> </tr> <tr> <td>Cretaceous</td> <td></td> <td>Kgru</td> <td>Glen Rose Formation Upper Member</td> </tr> <tr> <td></td> <td></td> <td>Kgrl</td> <td>Glen Rose Formation Lower Member</td> </tr> </table>	Quaternary		Qal	Alluvium			Qt	Fluviatile Terrace Deposits	Cretaceous		Kgru	Glen Rose Formation Upper Member			Kgrl	Glen Rose Formation Lower Member
Quaternary				Qal	Alluvium														
		Qt	Fluviatile Terrace Deposits																
Cretaceous		Kgru	Glen Rose Formation Upper Member																
		Kgrl	Glen Rose Formation Lower Member																
	CSJ 0072-07-070	Faults																	
	Features																		

Figure 9: Project area Geology
 From Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas





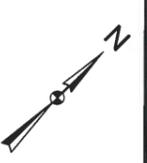
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Figure 9: Project area Geology
 From Scenic Loop Rd to Fair Oaks Parkway
 Geological Assessment
 Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

	CSJ 0072-06-074	Geology
	CSJ 0072-07-070	
	Faults	Quaternary <ul style="list-style-type: none"> Qal Alluvium Qt Fluvialite Terrace Deposits
	Features	Cretaceous <ul style="list-style-type: none"> Kgrru Glen Rose Formation Upper Member Kgri Glen Rose Formation Lower Member

Map 8 of 11



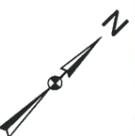
Author: Palani K. Whiting
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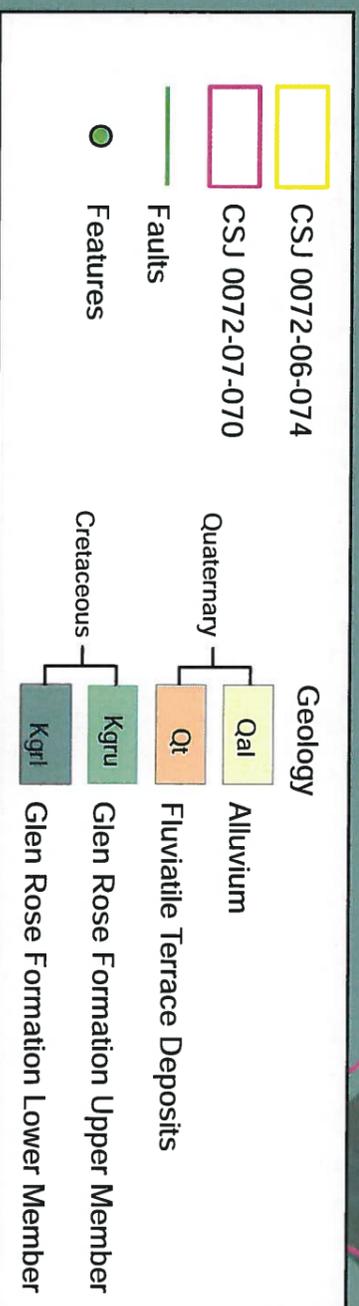


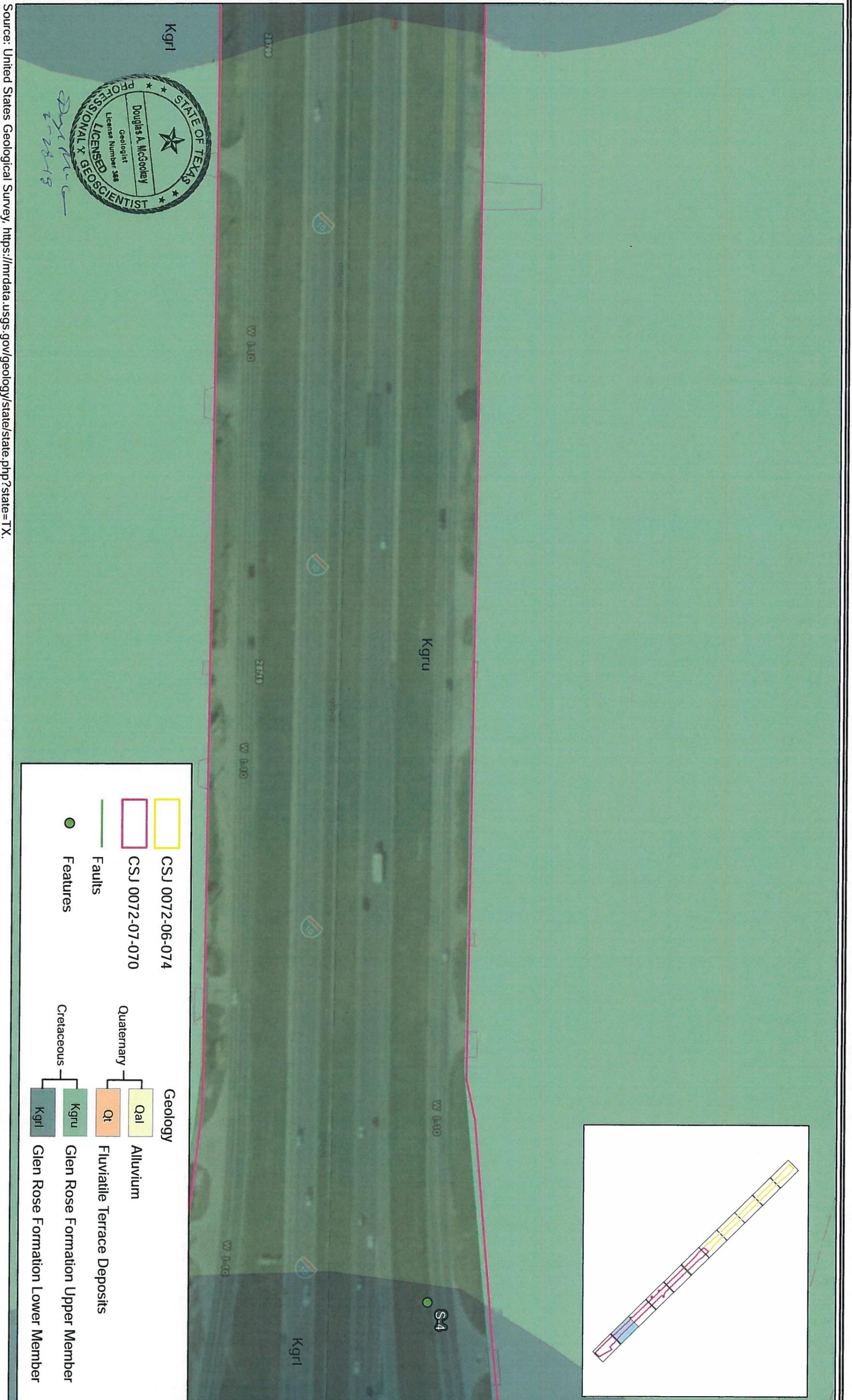
Figure 9: Project area Geology
From Scenic Loop Rd to Fair Oaks Parkway
Geological Assessment
Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

Map 9 of 11

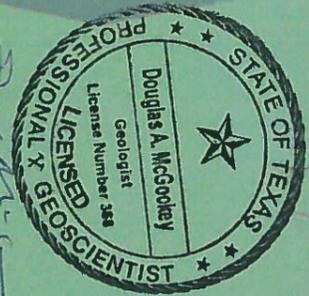


Author: Palani K. Whiting
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Source: United States Geological Survey <https://mrdata.usgs.gov/geology/state/state.php?state=TX>.



D.A. McGoolley
2-28-18

	CSJ 0072-06-074	Geology		Alluvium	
	CSJ 0072-07-070			Fluviatile Terrace Deposits	
	Faults	Quaternary		Glen Rose Formation Upper Member	
	Features			Cretaceous	Glen Rose Formation Lower Member



Figure 9: Project area Geology
From Scenic Loop Rd to Fair Oaks Parkway
Geological Assessment
Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

Map 10 of 11



Author: Palani K. Whiting
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Date: 10/26/2017



Douglas A. McCookley
3-28-18

Source: United States Geological Survey, <https://mdata.usgs.gov/geology/state/state.php?state=TX>.



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Figure 9: Project area Geology
From Scenic Loop Rd to Fair Oaks Parkway
Geological Assessment
Boerne and Fair Oaks Ranch, Kendall and Bexar Counties, Texas

	CSJ 0072-06-074	Geology																
	CSJ 0072-07-070																	
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Quaternary		Qal	Alluvium															
		Qt	Fluviatile Terrace Deposits															
Cretaceous		Kgru	Glen Rose Formation Upper Member															
		Kgrl	Glen Rose Formation Lower Member															
	Features																	

Map 11 of 11



Author: Palani K. Whiting
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Date: 10/26/2017