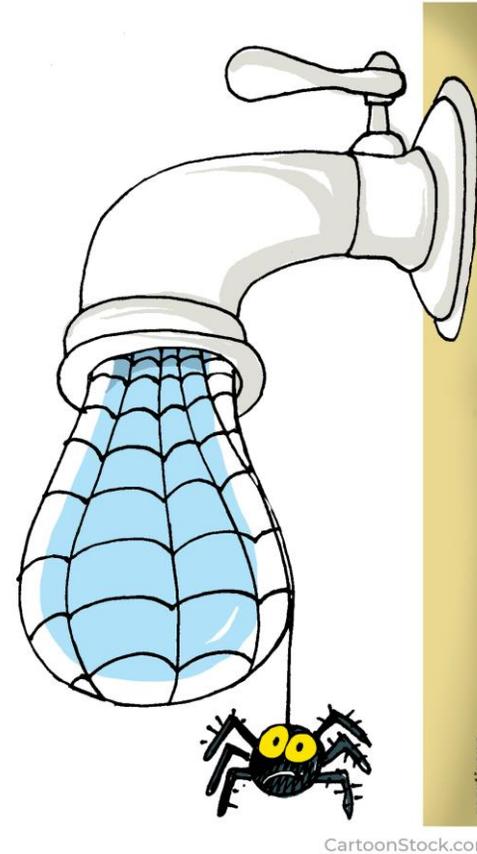


Proposed LPGCD Monitoring Well Strategy

Lost Pines GCD Board Meeting

November 15, 2023

**Allan Standen PG
LRE Water, LLC
Senior Advisor
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The Importance Monitoring Program



A focused groundwater monitoring program is critical for any District to manage its groundwater resources.

The monitoring program data collected should provide the District's board, staff and consultants with defensible data for each aquifer necessary to historically evaluate:

- DFCs,
- Mitigation impacts,
- Surface-groundwater shallow water systems,
- Local ground water level fluctuations,
- Water quality changes

This monitoring program needs to be consistently implemented and well documented and should be a priority,

Monitoring Program Data Requirements



A monitoring program for each aquifer must consist of wells with:

- Easy and repeatable access to well ???
- Have historical data
- Known water production zones (screen intervals)
- Represent one aquifer (confirmed by 3D model)
- Preferably fully penetrate the aquifer
- Have good representation in outcrop (unconfined) and downdip (confined aquifer)
- Absolute minimum of three (preferably more) wells within a specific geographic area with offset to allow contouring and determination of flow direction

Existing LPGCD Monitoring Program



Current LPGCD Monitoring Network

- Yegua-Jackson
- Queen City
- Sparta
- Carrizo
- Calvert Bluff
- Simsboro
- Hooper

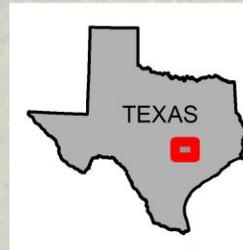
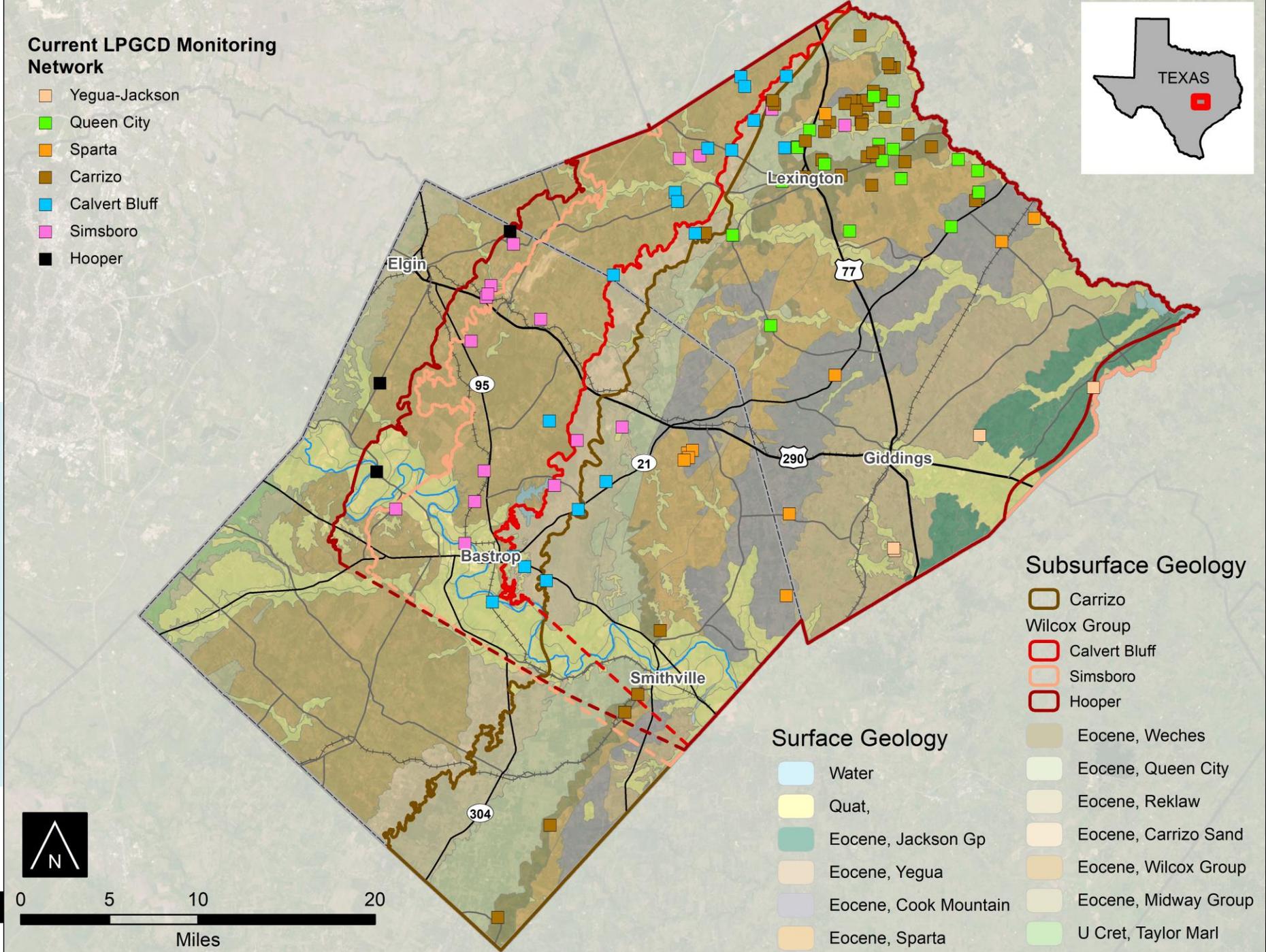


Figure 1

LPGCD Current Monitoring Program (118 wells)
Simsboro (18?)
Carrizo (45?)
Calvert Bluff (19?)
Queen City (19?)
Hooper (3?)
Sparta (10?)
Yegua-Jackson (3?)

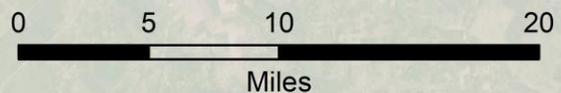


Subsurface Geology

- Carrizo
- Wilcox Group
- Calvert Bluff
- Simsboro
- Hooper
- Eocene, Weches
- Eocene, Queen City
- Eocene, Reklaw
- Eocene, Carrizo Sand
- Eocene, Wilcox Group
- Eocene, Midway Group
- U Cret, Taylor Marl

Surface Geology

- Water
- Quat,
- Eocene, Jackson Gp
- Eocene, Yegua
- Eocene, Cook Mountain
- Eocene, Sparta



Current LPGCD Monitoring Network

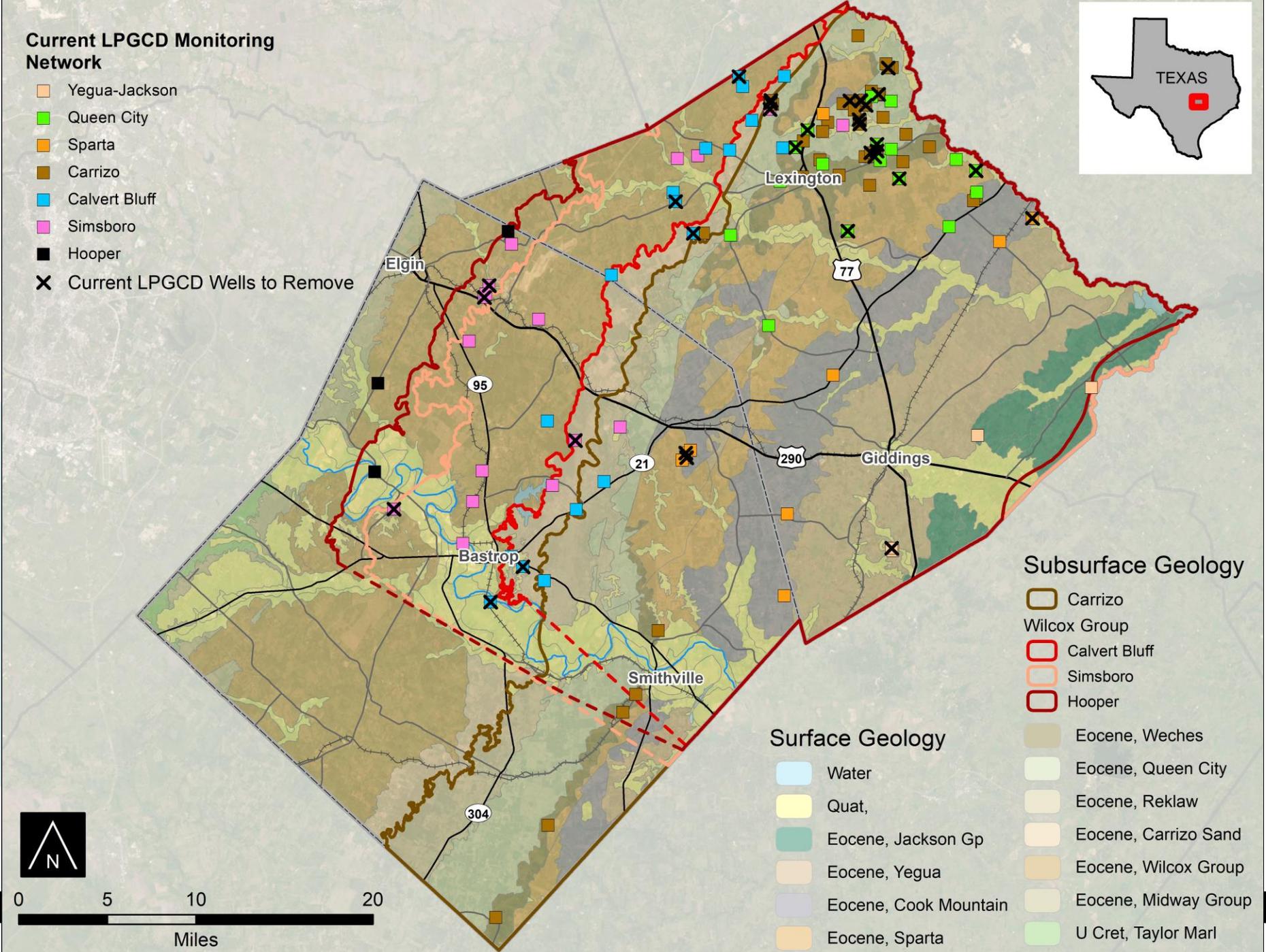
- Yegua-Jackson
- Queen City
- Sparta
- Carrizo
- Calvert Bluff
- Simsboro
- Hooper
- ✕ Current LPGCD Wells to Remove



Figure 2

LPGCD Current Monitoring Program

Proposed wells not to be included in DFC monitoring program



Subsurface Geology

- Carrizo
- Wilcox Group
- Calvert Bluff
- Simsboro
- Hooper
- Eocene, Weches
- Eocene, Queen City
- Eocene, Reklaw
- Eocene, Carrizo Sand
- Eocene, Wilcox Group
- Eocene, Midway Group
- U Cret, Taylor Marl

Surface Geology

- Water
- Quat,
- Eocene, Jackson Gp
- Eocene, Yegua
- Eocene, Cook Mountain
- Eocene, Sparta

Current LPGCD Monitoring Network

- Carrizo
- ✗ Current LPGCD Wells to Remove (Carrizo)

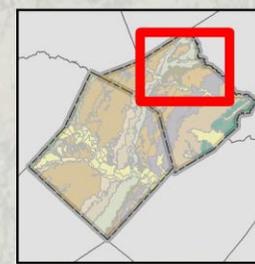
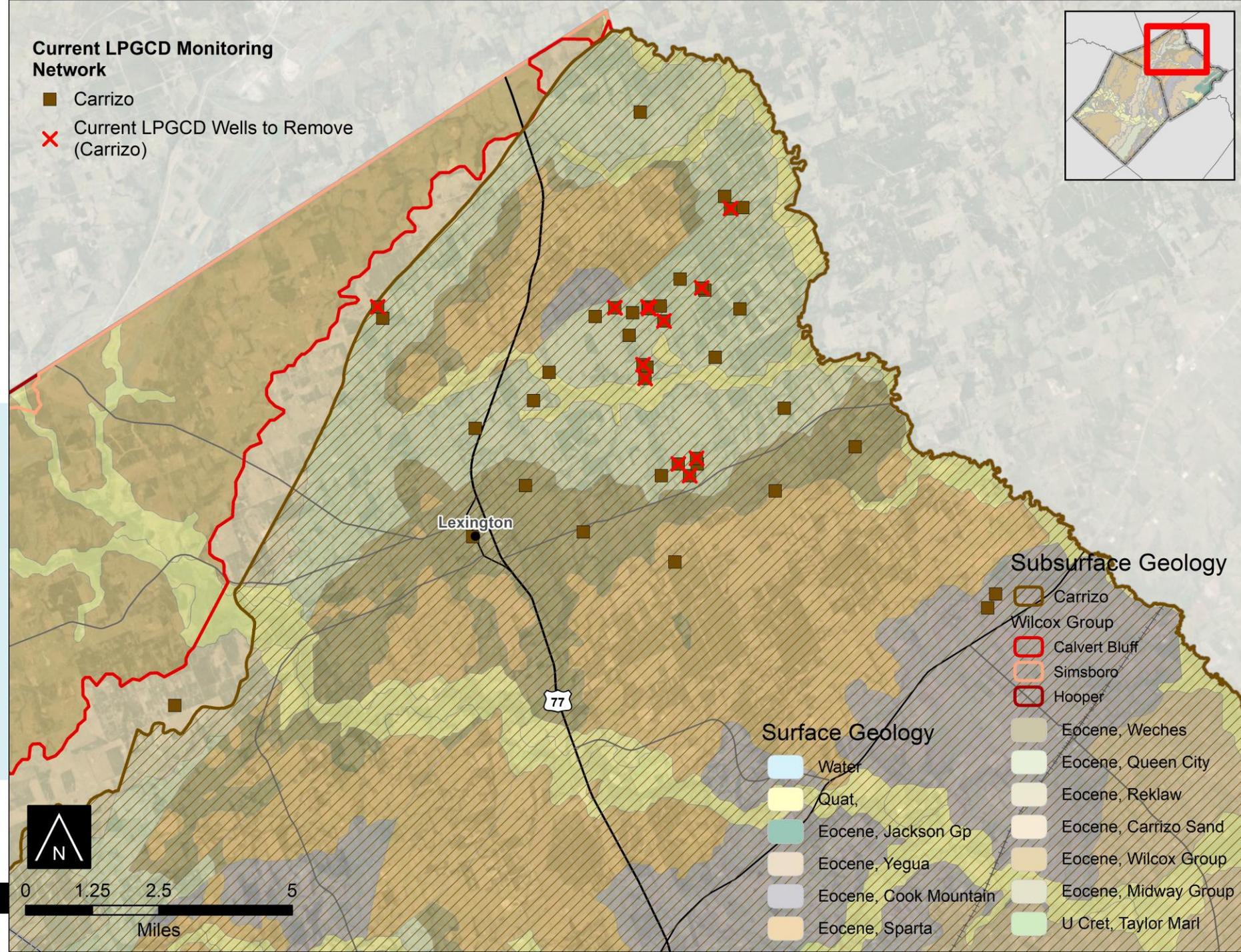


Figure 3

LPGCD Current Monitoring Program, NE Lee County, Carrizo Wells

Proposed wells not to be included in DFC monitoring program



Current LPGCD Monitoring Network

- Yegua-Jackson
- Queen City
- Sparta
- Carrizo
- Calvert Bluff
- Simsboro
- Hooper
- 2023 Water Level Measurements

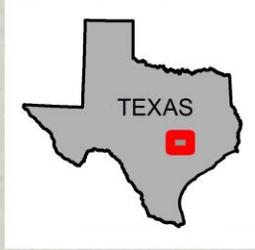
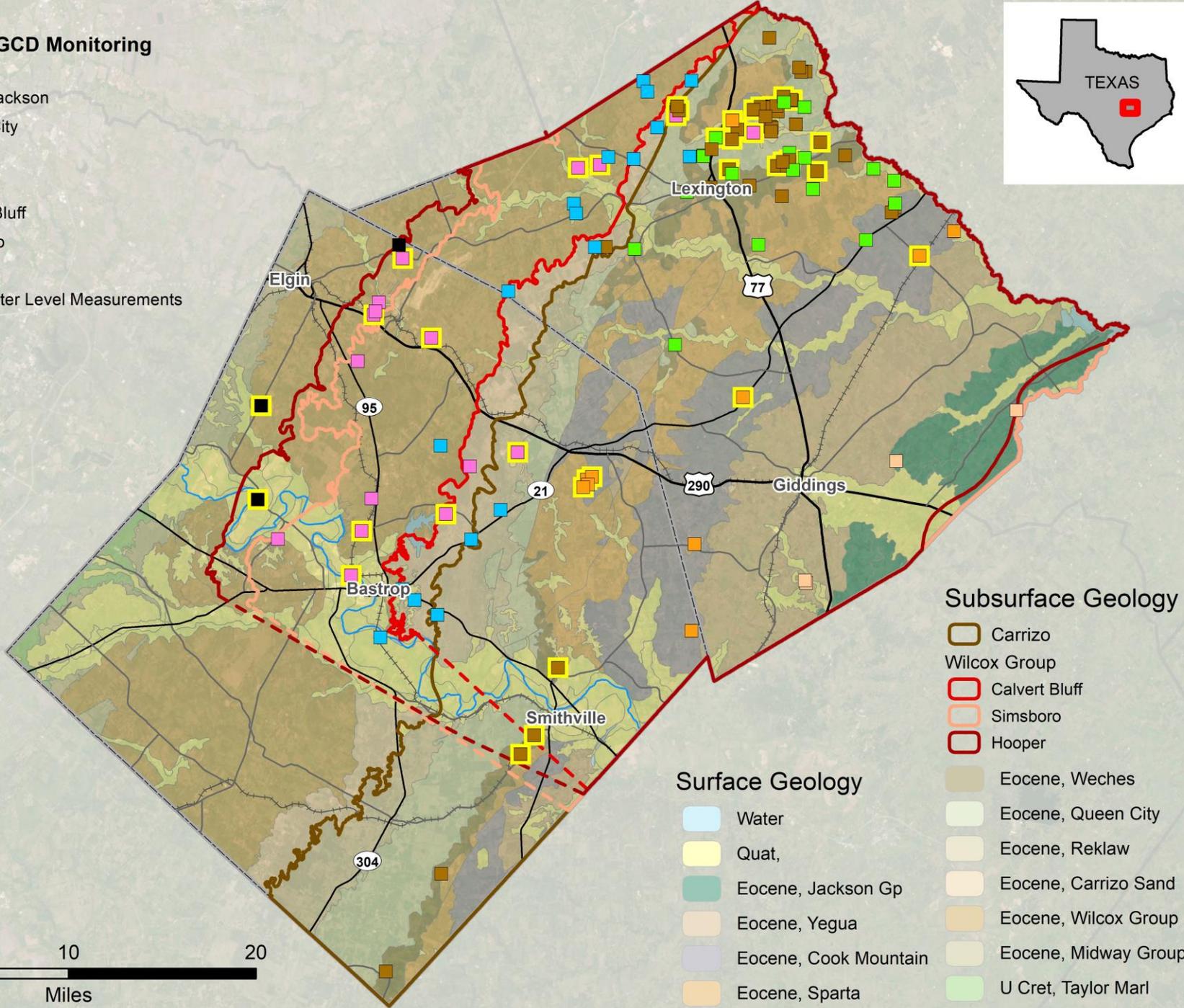


Figure 4

LPGCD monitoring wells that water levels were measured in late 2022 and 2023

**Carrizo (22),
Simsboro (12),
Sparta (6), Hooper (2),
Calvert Bluff and Queen City (1) and
Yegua- Jackson (0)**

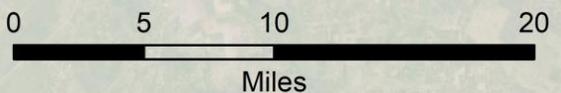


Subsurface Geology

- Carrizo
- Wilcox Group
 - Calvert Bluff
 - Simsboro
 - Hooper
- Eocene, Weches
- Eocene, Queen City
- Eocene, Reklaw
- Eocene, Carrizo Sand
- Eocene, Wilcox Group
- Eocene, Midway Group
- U Cret, Taylor Marl

Surface Geology

- Water
- Quat,
- Eocene, Jackson Gp
- Eocene, Yegua
- Eocene, Cook Mountain
- Eocene, Sparta



Proposed New LPGCD Monitoring Program



Selection Criteria for New LPGCD TWDB and TDLR Monitoring Water Wells



A total of 1,863 TWDB and 3,399 TDLR wells (May, 2023) were reviewed

Selection criteria included:

- Well location to supplement LPGCD existing monitor wells
- Well had to have a known screen or production interval(s)
- Well diameter
- Well purpose
- Well depth, deeper wells were preferred
- If well fully penetrates aquifer
- If well represents a confined or unconfined portion of the aquifer

After each monitor well was selected an aquifer designation was temporarily assigned to the well to be confirmed in the future by the 3D model

**Reviewed Wells
(Original Dataset)**

- ▲ TWDB Wells (n = 1,863)
- TDLR Wells (n = 3,399)

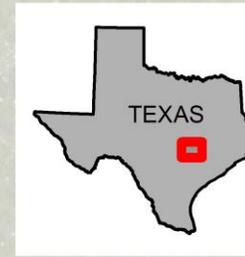


Figure 5

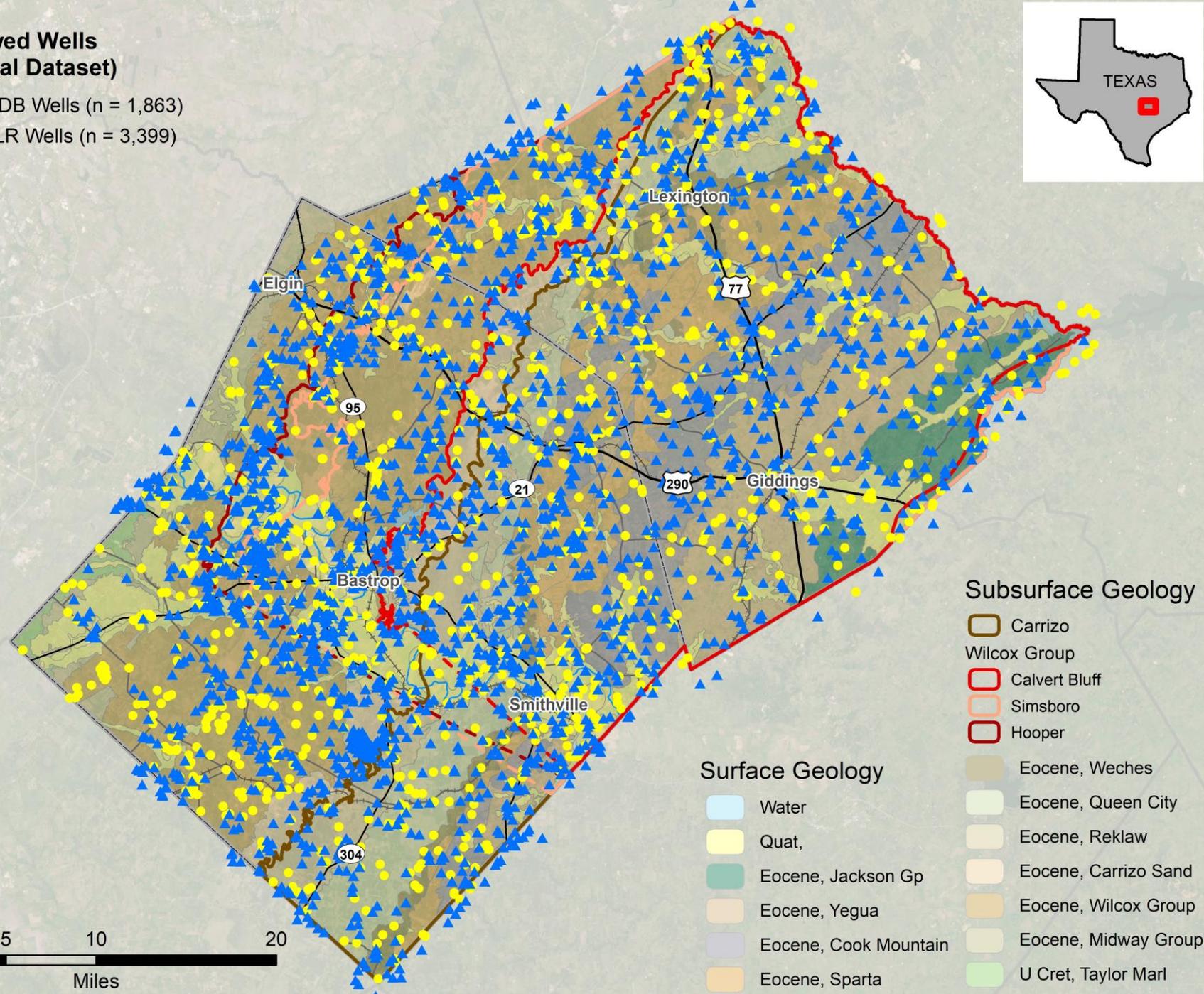
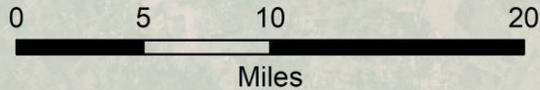
LPGCD

**2023 TWDB and TDLR
Database Water
Wells**

**All of wells that were
reviewed for this
monitoring program**

TWDB wells = 1,863

TDLR wells = 3,399



Surface Geology

- Water
- Quat,
- Eocene, Jackson Gp
- Eocene, Yegua
- Eocene, Cook Mountain
- Eocene, Sparta

Subsurface Geology

- Carrizo Wilcox Group
- Calvert Bluff
- Simsboro
- Hooper
- Eocene, Weches
- Eocene, Queen City
- Eocene, Reklaw
- Eocene, Carrizo Sand
- Eocene, Wilcox Group
- Eocene, Midway Group
- U Cret, Taylor Marl

Proposed Monitoring Network - Simsboro Aquifer

- Current LPGCD Wells
- Proposed TDLR Wells

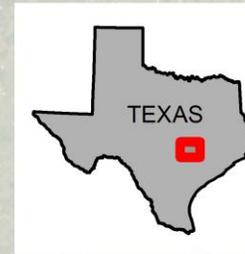
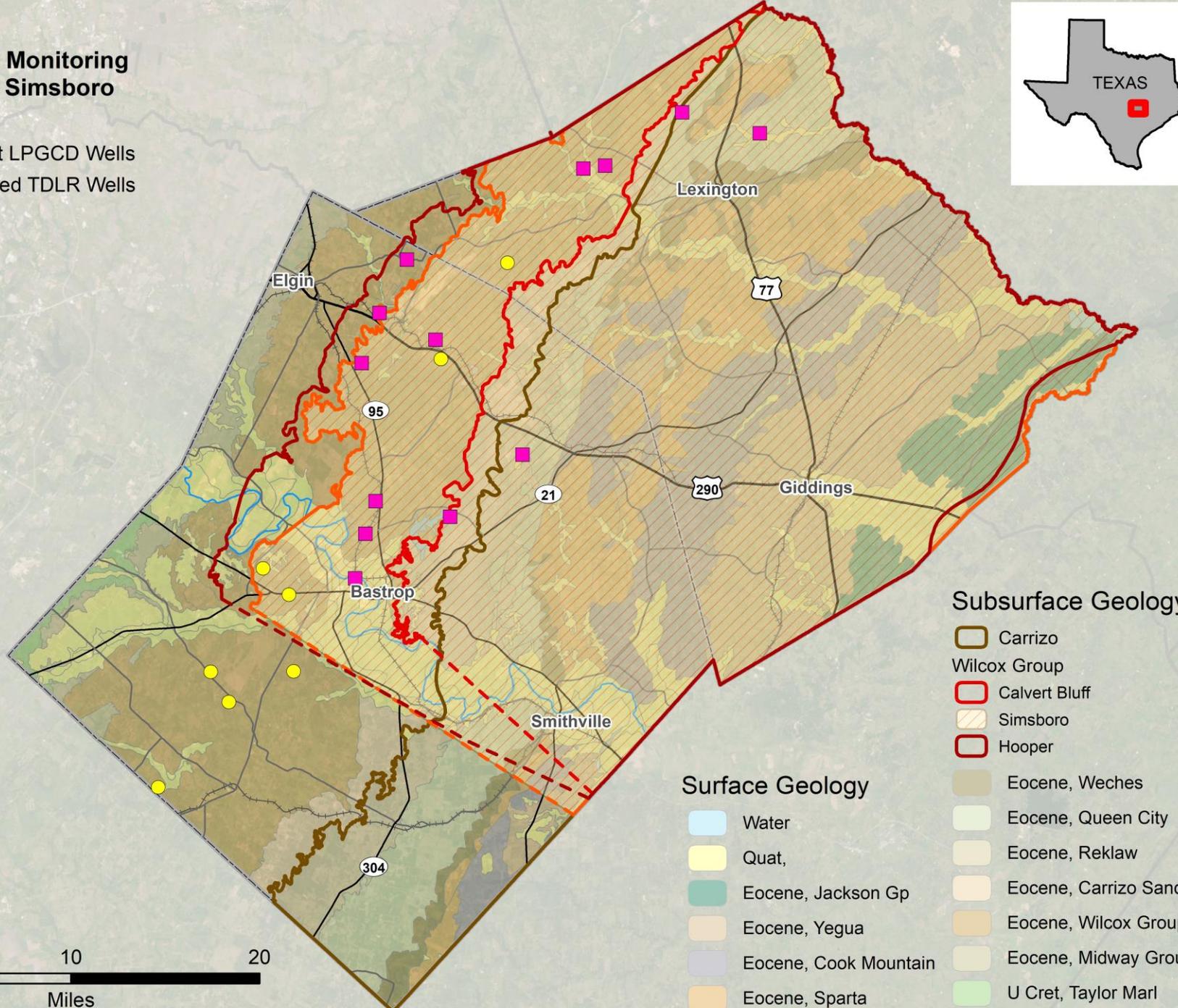
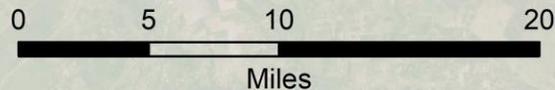


Figure 6

**LPGCD
Simsboro
revised existing
and new proposed
monitor well
System**

**Eight (8) new wells
proposed**



Proposed Monitoring Network - Carrizo Aquifer

- Current LPGCD Wells
- ▲ Proposed TWDB Wells
- Proposed TDLR Wells

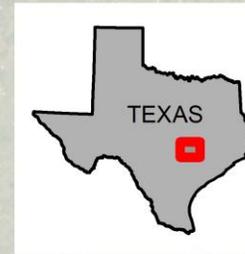
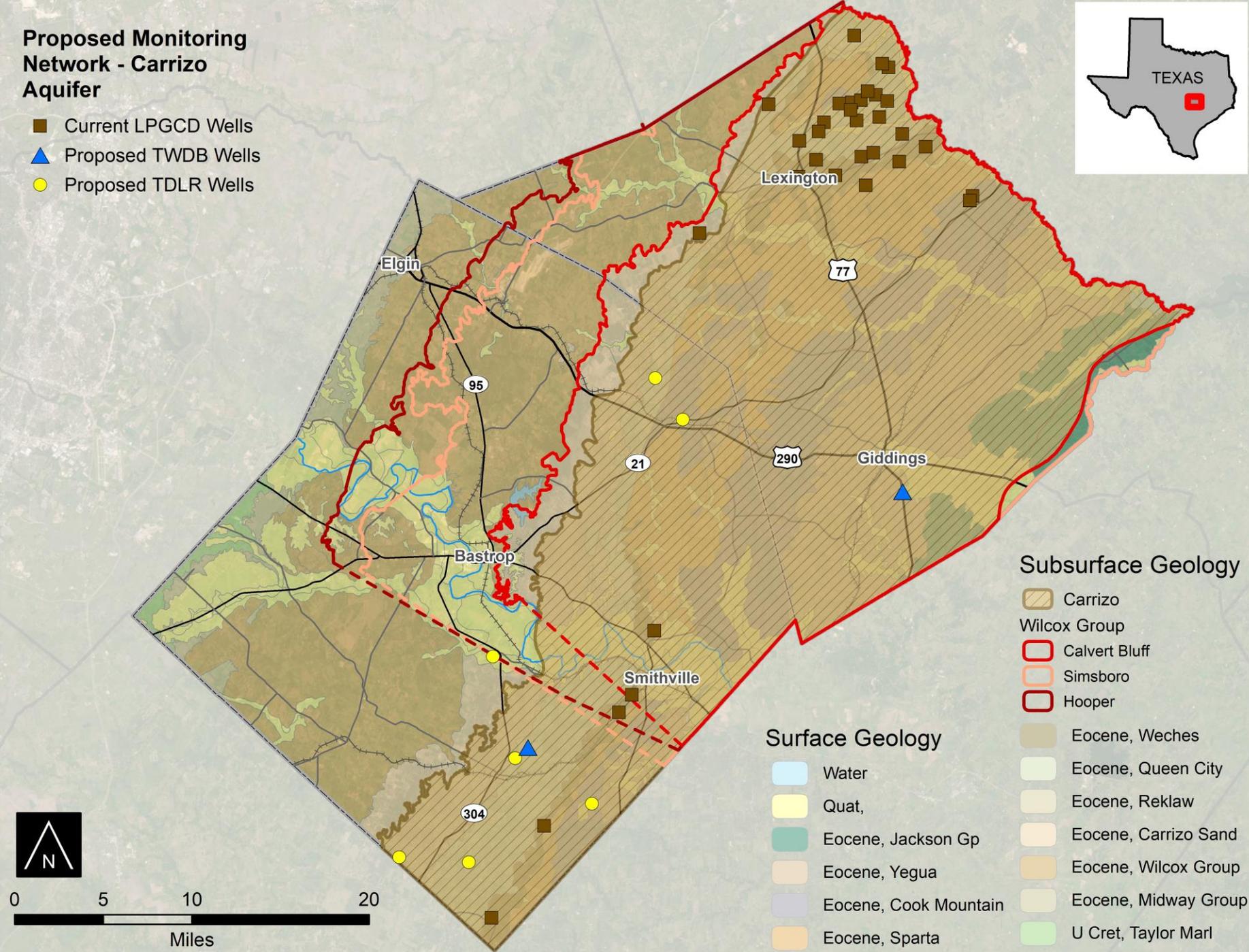


Figure 7

LPGCD Carrizo revised existing and new proposed monitor well system

Seven (7) new wells proposed



Proposed Monitoring Network - Calvert Bluff

- Current LPGCD Wells
- Proposed TDLR Wells

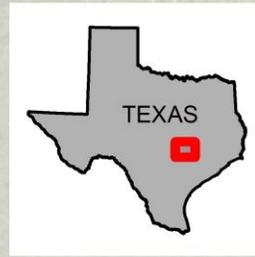
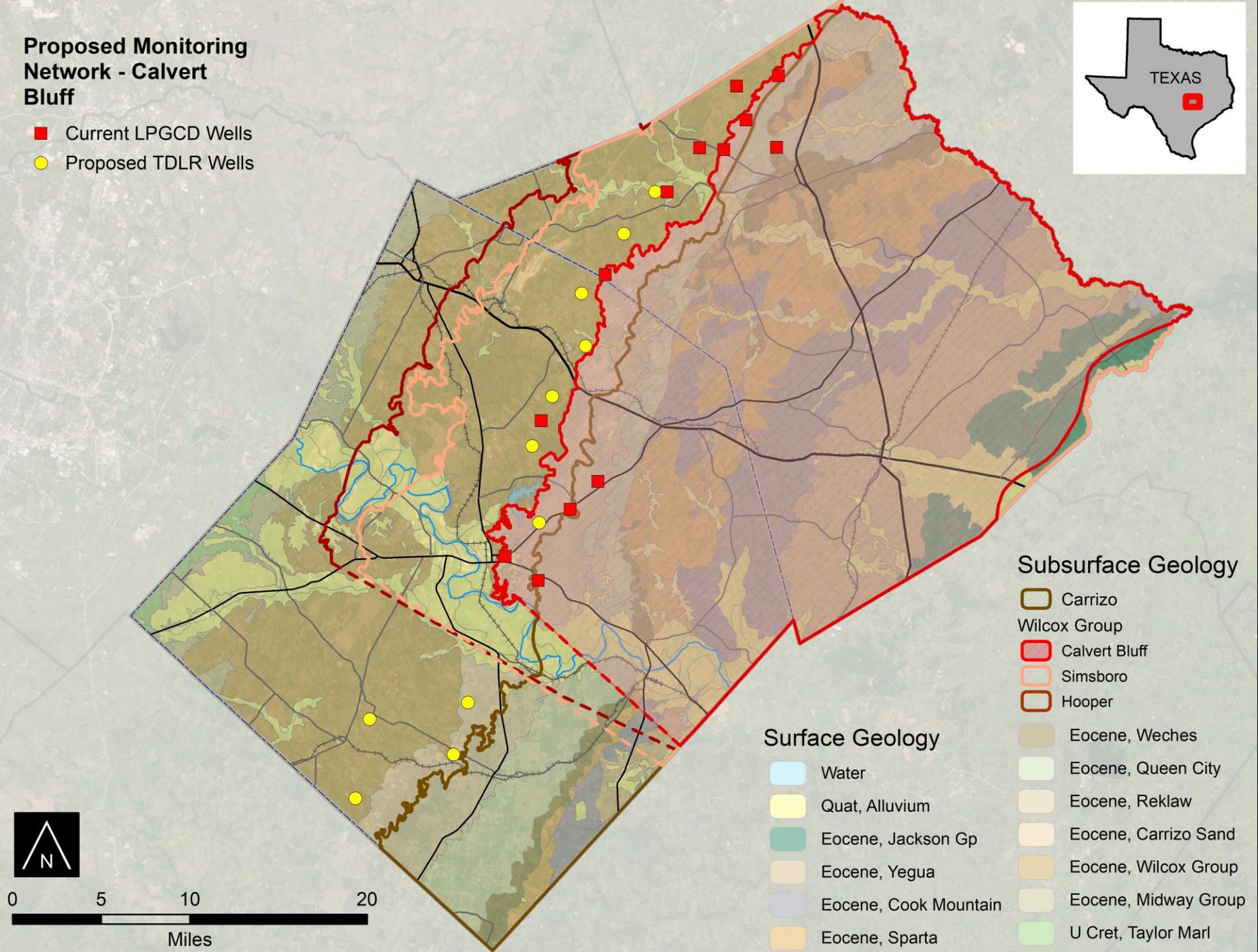


Figure 8

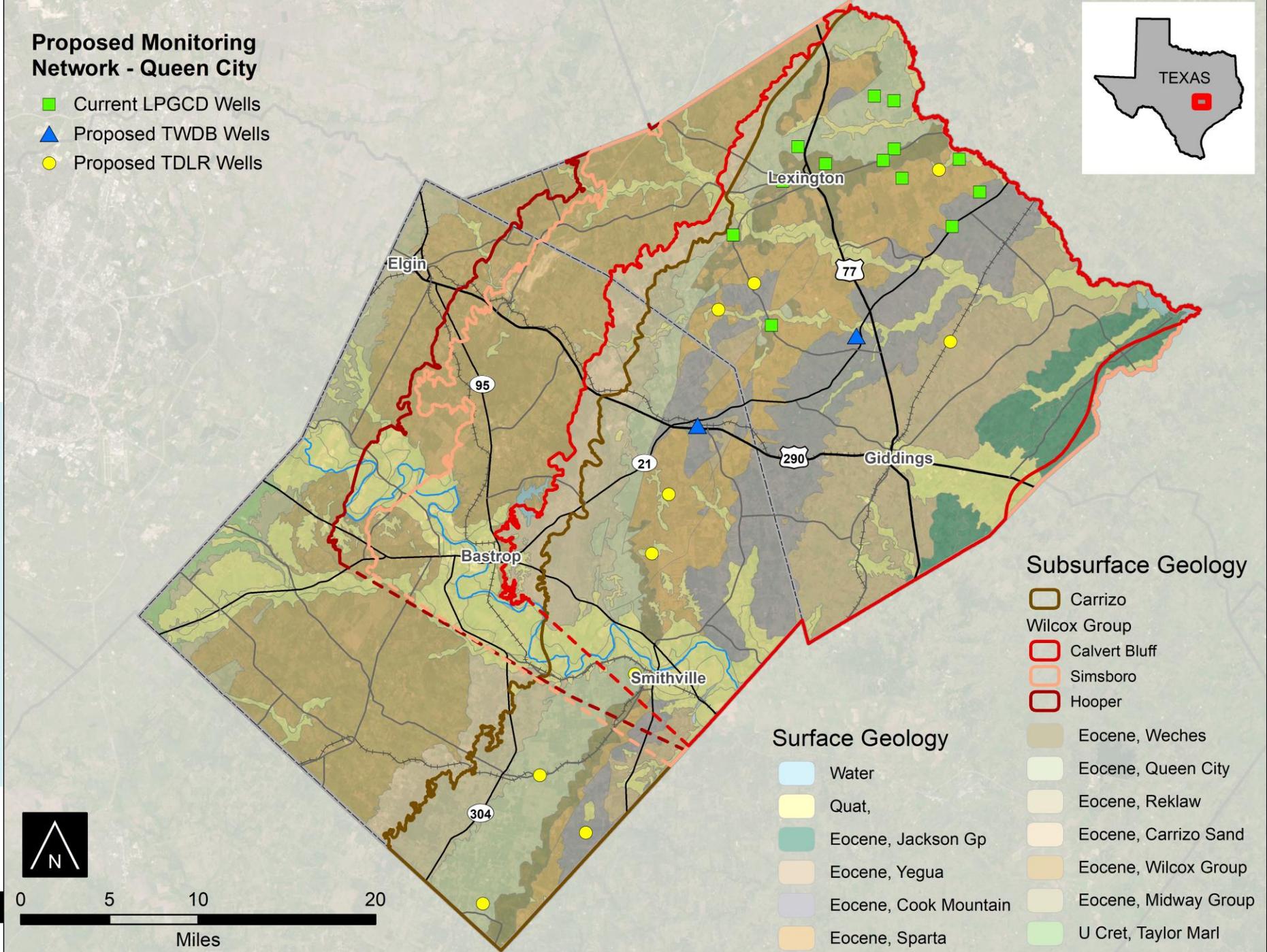
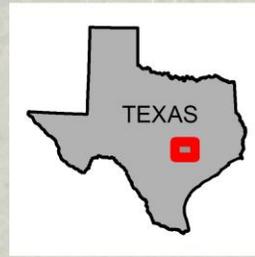
**LPGCD
Calvert Bluff
revised existing
and new proposed
monitor well
system**

**Eleven (11) new
wells proposed**



Proposed Monitoring Network - Queen City

- Current LPGCD Wells
- ▲ Proposed TWDB Wells
- Proposed TDLR Wells



Subsurface Geology

- Carrizo
- Wilcox Group
- Calvert Bluff
- Simsboro
- Hooper
- Eocene, Weches
- Eocene, Queen City
- Eocene, Reklaw
- Eocene, Carrizo Sand
- Eocene, Wilcox Group
- Eocene, Midway Group
- U Cret, Taylor Marl

Surface Geology

- Water
- Quat,
- Eocene, Jackson Gp
- Eocene, Yegua
- Eocene, Cook Mountain
- Eocene, Sparta

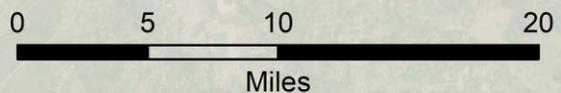


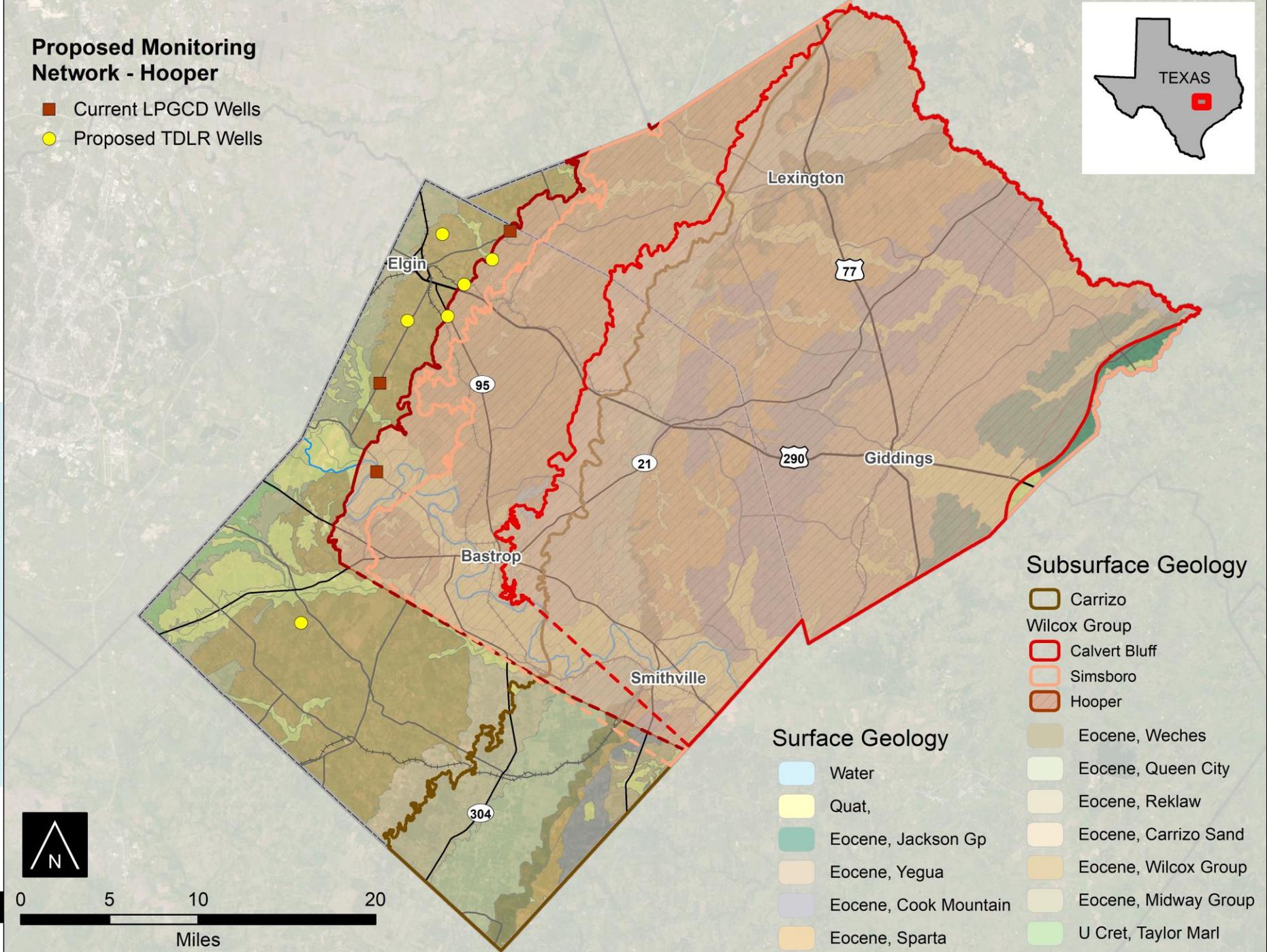
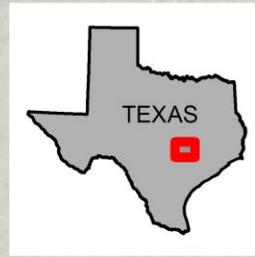
Figure 9

**LPGCD
Queen City
revised existing
and new proposed
monitor well
system**

**Nine (9) new wells
proposed**

Proposed Monitoring Network - Hooper

- Current LPGCD Wells
- Proposed TDLR Wells



Subsurface Geology

- Carrizo
- Wilcox Group
- Calvert Bluff
- Simsboro
- Hooper
- Eocene, Weches
- Eocene, Queen City
- Eocene, Reklaw
- Eocene, Carrizo Sand
- Eocene, Wilcox Group
- Eocene, Midway Group
- U Cret, Taylor Marl

Surface Geology

- Water
- Quat,
- Eocene, Jackson Gp
- Eocene, Yegua
- Eocene, Cook Mountain
- Eocene, Sparta

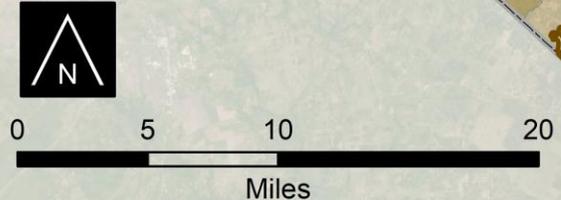


Figure 10
LPGCD
Hooper
revised existing
and new proposed
monitor well
system

Six (6) new wells
proposed

Proposed Monitoring Network - Sparta Aquifer

- Current LPGCD Wells
- Proposed TDLR Wells

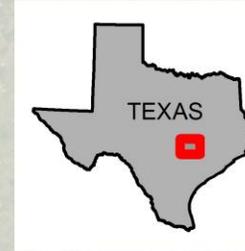
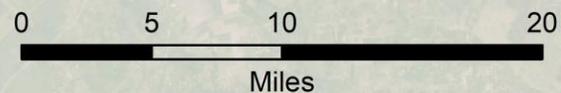
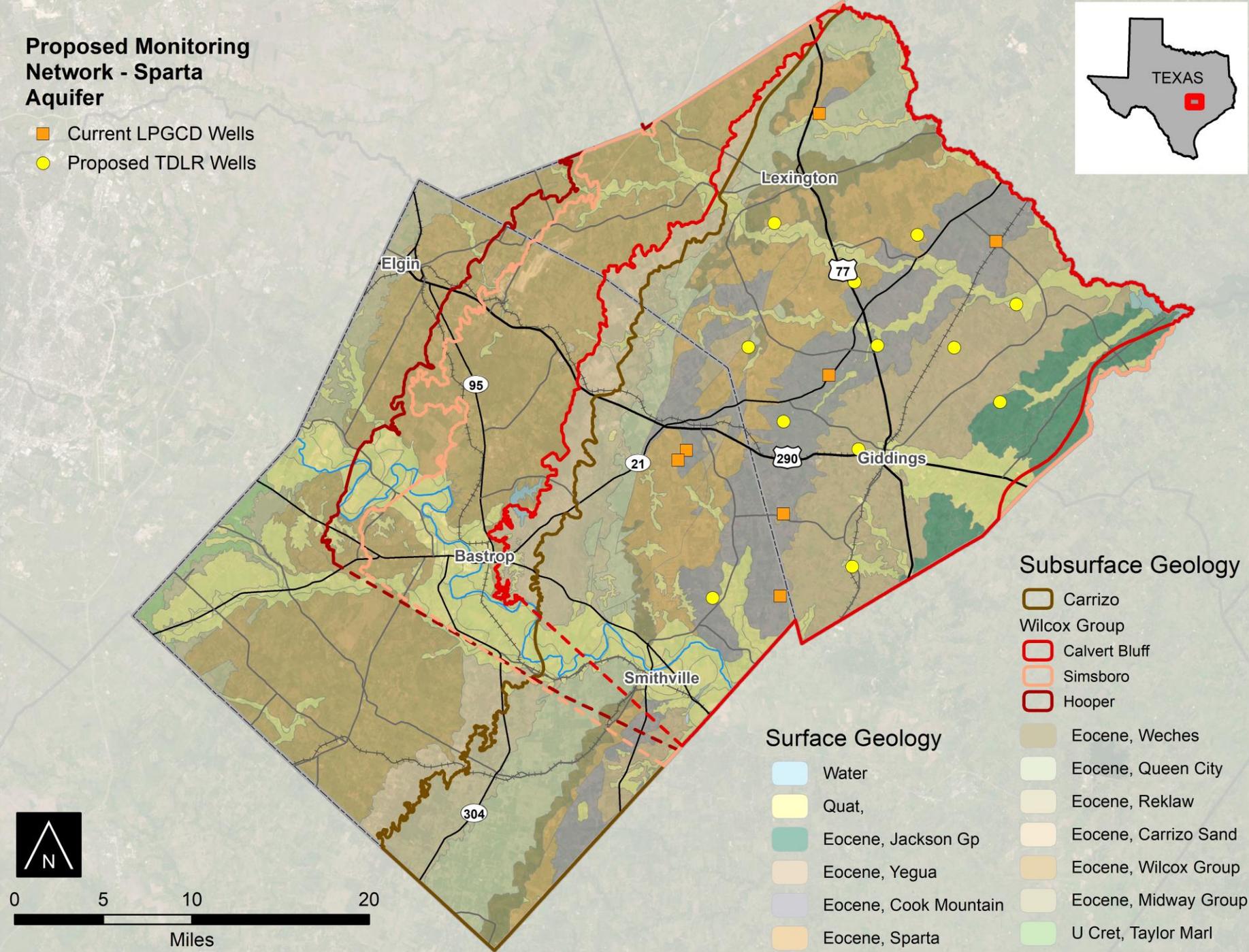


Figure 11

**LPGCD
Sparta**

**revised existing
and new proposed
monitor well
system**

**Twelve (12) new
wells proposed**



Proposed Monitoring Network - Yegua-Jackson

- Current LPGCD Wells
- Proposed TDLR Wells

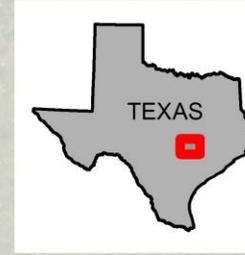
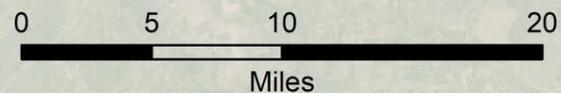
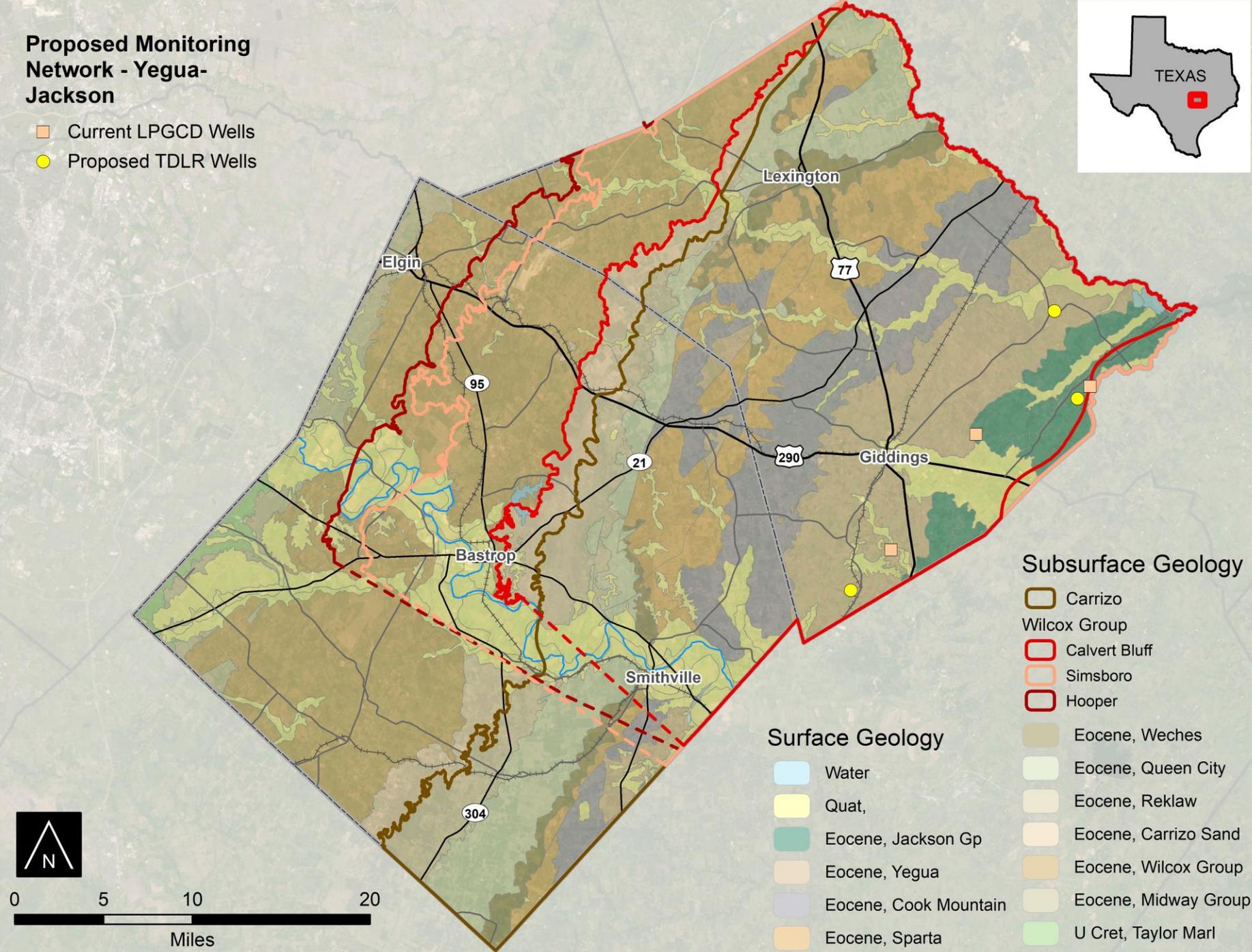


Figure 12

**LPGCD
Yegua-Jackson
revised existing
and new proposed
monitor well
system**

**Three (3) new wells
proposed**



LPGCD Monitoring Well Network

- Current LPGCD Wells to Keep
- ▲ Proposed TWDB Wells to Add
- Proposed TDLR Wells to Add
- ◆ Proposed Abandoned Oil & Gas Wells to Add

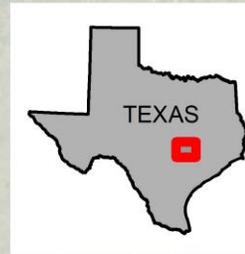
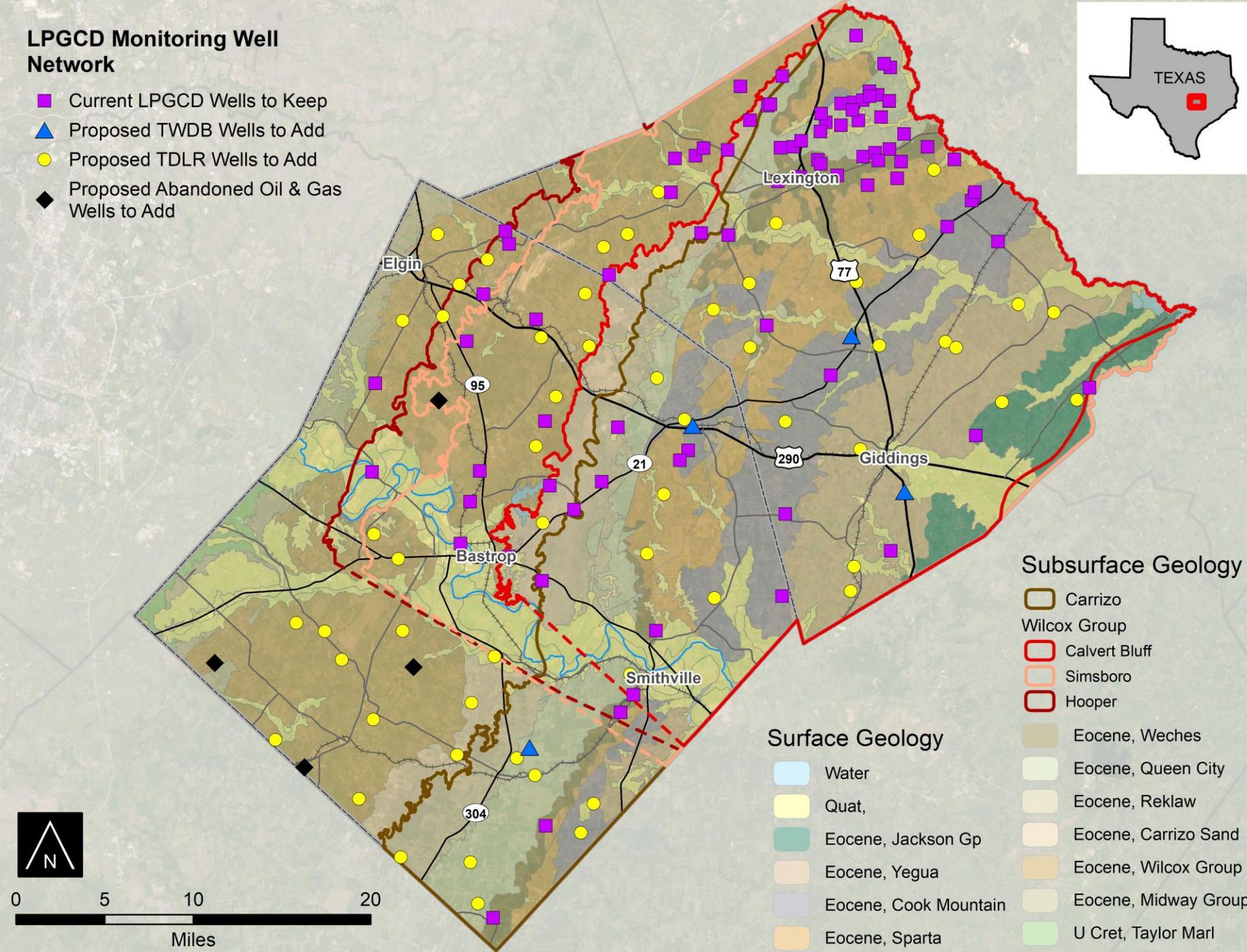


Figure 13

LPGCD revised existing and proposed monitoring well system



Recommendations for the New LPGCD Monitoring Program



Recommendations for the LPGCD Monitoring Well Program



A total of 61 new monitor wells TWDB (4) and TDLR (57) have been identified.

Neither the willingness of the landowner or the access (location or ability of well to be monitored) has been determined. The landowner's address and phone number have also not been determined.

LRE recommends that the District prioritize the upgrade of their existing monitoring program during the next three years.

This selection prioritization of these new monitor wells could be based on existing aquifer production, anticipated new well fields, areas with known water level and water quality issues, infilling of aquifer monitoring data gaps.

Recommendations for the LPGCD Monitoring Well Program

Possible new monitor well prioritization;

Year 1: All Simsboro (8) and Carrizo (7) now proposed monitoring well locations. Research screen (aquifer identification) on wells unknown in existing LPGCD monitoring database.

Year 2: All Calvert Bluff (11), Queen City (9) and selected Hooper (3 or 4 wells) new monitor wells.

Year 3: Finish Hooper (2 or 3), Sparta (12, may be reduced) and Yegua Jackson (3) new monitor wells

LPGCD's DFC monitoring wells should be measured at a minimum of twice a year (late winter and summer). All district monitor wells need to have water quality measured at a minimum of every two years.



Questions?

LRE WATER

