

MEMORANDUM

TO: Stephen G. De Witte, PE
Project Management Coordinator
Division of Planning

FROM: Michael Carpenter, PE
Director
Division of Structural Design

BY: Brad Williams, PG
Geotechnical Branch

DATE: January 21, 2022

SUBJECT: Warren County
FD52 12F0 114 000-000
US 231/68/68x Intersection Study
Item # 3-00000.00
Mars # 134801P
Geotechnical Overview Report

1.0 Project Description

The Kentucky Transportation Cabinet (KYTC) is conducting a study to evaluate the US 231 and US 68 interchange in Warren county (please see attached scope map; Figure 1). This overview will be utilized to identify Geotechnical considerations for the study area. the project is located in the Bowling Green South (#235) United State Geologic Quadrangle (USGS).

Topography and Drainage:

The project study area is in the Mississippian Plateau or Pennyroyal Physiographic Region. This area is composed of Mississippian aged limestones. This Limestone plain is characterized by tens of thousands of sinkholes, sinking streams, streamless valleys, springs and caverns. The term karst is used to describe this type of terrain, a karst area produces a predominately underground drainage with a poorly developed surface drainage network. The Karst terrain of the Mississippian Plateau occurs because the bedrock in the eastern and southern parts of the region is dominated by thick deposits of Mississippian aged limestones. These limestones are soluble under the right conditions, which means they can easily be eroded by waters moving through the ground. These groundwaters can form miles of passages beneath the surface.

2.0 Scope of Work

This study will focus on the geotechnical and geologic features of the designated study area. Overview of the proposed study area will be provided by professional papers, available published geotechnical data, and the Geotechnical Branch's experience with highway design and construction with comparable projects in the region. The following sources were used:

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Stratigraphy

Saint Genevieve Limestone (Ste. Genevieve)

The Saint Genevieve limestone is from 190 to 320 feet thick and is divided into three members. The basal Fredonia Limestone Member is a very light gray, crossbedded and massive, oolitic to skeletal limestone. The overlying Rosiclaie Sandstone Member is composed of calcareous sandstone and shale, and the Levias Limestone Member is an oolitic to skeletal limestone similar to the Fredonia. The top of the Ste. Genevieve Limestone is placed below the sandy and silty fine-grained limestone of the Renault Limestone.

Geologic Quadrangle description

Limestone predominantly oolitic fine to medium grained-crystalline, argillaceous, coarse detrital; in part cherty; gray to white, slightly darker where weathered, where exposed to abundant direct sunlight, weathered rock is white, commonly spotted with reddish brown iron oxide stain; thin to thick bedded. Oolitic limestones are crossbedded in places and are generally thicker bedded and lighter colored than other lithologies. Fossiliferous, chert is plentiful in beds and stringers near base, rarely present as nodules; chert beds are fossiliferous Platycrinities throughout Lithostrotion (*Siphonodendron*) *genevievensis*; Chert is gray to black and weathers white, cream and reddish-brown; weathers blocky, particularly near base, where large, weathered blocks of chert as much as 2 feet long and 1 foot thick are common in soil residue.

Soils and unconsolidated materials:

Soils that typically underlay the proposed project corridor are classified as Unified Soil Classification System (USCS) as low plasticity clays (CL) and medium to high plasticity clays (CH).

CL materials are sometimes referred to as lean clays. CL classified soils are inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty-clays, and lean clays, they have a liquid limit of less than or equal to 50

CH materials are sometimes referred to as fat clays. CH classifies soils are inorganic clays that have a liquid limit of 50 or higher

Other soils of different classifications may be found in the project corridor during the subsurface investigation. Previous experience in the proposed project corridor area has shown that the two previously mentioned soil classifications are the most prevalent.

Geologic Structures and Hazards:

Structural Geology

Geologic mapping indicates that there are no mapped faults located within the project corridor. There may be localized faults that are currently unmapped. No issues are expected to arise due to the bedrocks structural condition.

Hazards:

Karst:

The KGS has designated the area of the proposed projects general karst potential as intense. The formation of sinkholes, caves and springs in this area is prevalent. Mapping indicates multiple mapped sinkholes in close proximity to the proposed project corridor. Sinkholes will be of particular concern as they impact construction in a multitude of ways.

Special treatment of sinkholes weather located by the project design team or on construction will be required. Identified sinkholes are generally treated by either capping the sinkhole or using the sinkhole for drainage (please see notes below). Some treated sinkholes may be off Right of Way. The Geotechnical Branche's Engineering Roadway Report will address these issues and call out what treatment will be required for each identified sinkhole. Sinkholes that form in the Ste. Genevieve Formation are generally deep with steep sides.

- a) All open sinkholes and/or solution cavities within the limits of construction, whether shown on the plans or not, that are not used for drainage purposes, shall be filled and/or capped in accordance with the current edition of Section 215 of the Standard Specifications for Road and Bridge Construction.
- b) Where a sinkhole is to be used for drainage purposes, the designer shall provide appropriate mitigation measures as outlined in section "Drainage to Significant Resources" in the Drainage Manual. This may include the use of vegetated channels, grass-lined swales, interceptor ditches, containment basins, etc. as designated in the Manual.
- c) 5.) All Sinkholes identified by the Project Design Team and any required mitigation will be shown on the plans. Mitigation shall consist of the use of permanent Erosion Control Devices such as silt checks, silt traps, sedimentation basins, etc., to filter the water runoff from the highway before it enters the sinkhole. Special care shall be exercised during construction to prevent siltation of any sinkhole, especially those, which are to be used for drainage purposes

Working in areas effected by karst can prove to be unpredictable. Rocklines determined by subsurface exploration can vary greatly in a relatively short distance.

Mines and Quarries

According to the Kentucky Geological Survey (KGS) mapping service there are no active mines or quarries in the proposed project corridor.

Geotechnical Considerations

Cut Slope Considerations

A detailed geotechnical exploration will be required for areas that involve widening existing cuts or creating new cuts. Cut slope configuration in rock are generally controlled by bedrock lithology, bedrock quality, results of Slake Durability Index (SDI) tests in shales and siltstones, and by the

presence of any fractures and/ or joints. The lithology of the of the rock underlying is highly susceptible to solutioning resulting in uneven and unpredictable rock line. Typical rock cut design for durable rock generally range from 1H:4V TO 1H:2V presplit slopes approximately in 30-foot intervals with 18-to-20-foot intermediate benches. These are general guidelines cut slopes widened of created may be flatter. This will be dependent on the height of the cuts and the type of rock encountered and its condition.

Embankment Considerations

Embankments that have side slopes that spill into a sinkhole that is used for drainage will require treatment as outlined in the Geotechnical Engineering Roadway Report. This will require a 100-year high water elevation for the sinkhole so that the embankment can be protected properly from high water issues that may affect the stability of the embankment in question.

With proper construction methods embankments constructed on 2H:1V slope configurations or flatter can be anticipated for slopes up to 20- feet tall. Any embankments built 20-feet or taller will require stability analysis and may require flatter slopes.

Subgrade

If sufficient rock from roadway excavation is available, the rock underlying the project corridor will be suitable for a rock roadbed from roadway excavation

If insufficient rock is available from roadway excavation there are multiple options for subgrade stabilization. A chemically stabilized subgrade by use of either lime or cement, thickness and type of treatment will be determined by laboratory testing of soil material. This treatment may not be suitable where there are multiple cross overs and tie-ins, maintenance of traffic issues, and dust concerns in urban areas. A subgrade consisting of Kentucky Coarse Aggregates #2, #3, or #23 wrapped or underlain with a geotextile fabric. A soil subgrade may also be a consideration depending on the CBR, and moisture content values determined by testing soil samples collected from the area.

If any pavement is to be removed the material under the pavement is expected to be soft and saturated and may also require manipulation.

Water Wells and Springs

Springs may be present within the proposed area. These locations should be inventoried to verify their locations. Spring boxes and/or granular material may be required in the vicinity of springs According to the KGS mapping service there are no water wells located in the project corridor These locations when encountered shall be verified and inventoried. If water wells are encountered during construction, special construction considerations will be required to close those wells. All water wells or cisterns within the limits of construction, weather shown on the plans or not shall be plugged in accordance with Section 708 of the current Standard Specifications for Road and Bridge Construction.

Ponds

Ponds are not located in the project corridor. If ponds are to be impacted by roadway construction due to alignment these ponds will require treatment. Such as removing soft and unstable material and stabilization of the area more than likely by use of Kentucky Corse Aggregate #2's, #3's or 23's and underlain by geotechnical fabric.

Gas and Oil Wells

According to the KGS mapping, there are no known oil or gas wells in the specified project corridor

Landslide Repair

Landslides are not anticipated to be an issue in the project corridor. Landslides that may be identified by the project design team will be addressed in the Geotechnical Engineering Roadway Report.

Conclusion

This is a general overview of the geotechnical considerations that need to be taken in to account during alignment selection and construction. This includes the bedrock, soil, and geotechnical hazards that are expected to be encountered in the project corridor. These features may have adverse impacts on the project.

A complete Geotechnical investigation including drilling, sampling, and testing of materials will be needed to anticipate and plan for any special treatment of issues encountered during that phase. This may include the taking of pavement cores were directed by the project team. Analysis of rock core and soil sample testing will be compiled and presented in a Geotechnical Engineering Roadway Report and A Structures Report if needed.

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References:

Contributions to the Geology of Kentucky, By George J. Grabowski Jr.

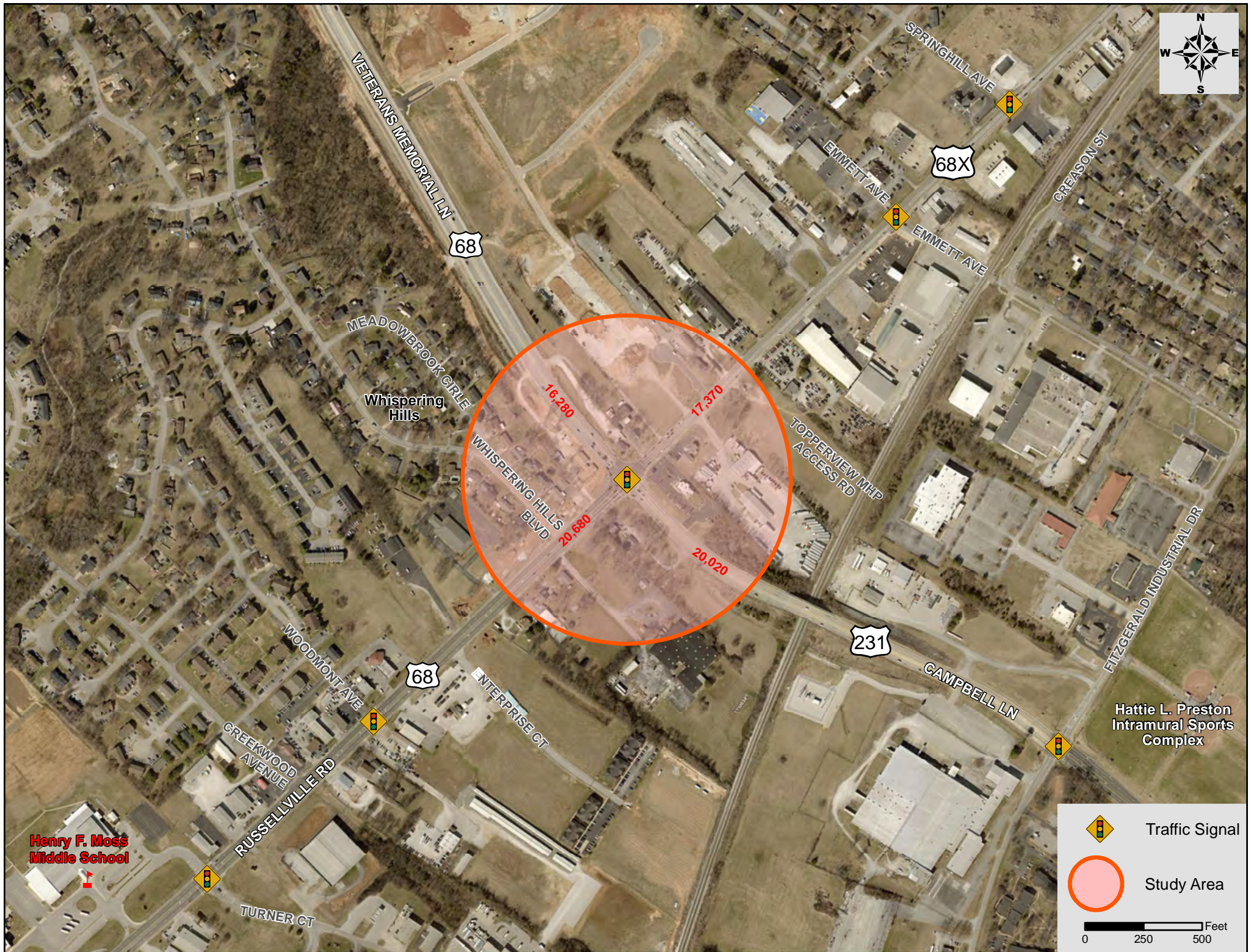
Geologic map of the Bowling Green South Quadrangle (GQ #235), by: Fred R. Shawe, the USGS, 1963

USDA Web Soil Survey

KYTC Projects Nearby (KYTC Geotechnical Report Number):

R-023-2018; Major Widening/Reconstruction of US- 31W

R-029- 2016; KY 884



Henry F. Moss
Middle School

Hattie L. Preston
Intramural Sports
Complex

 Traffic Signal

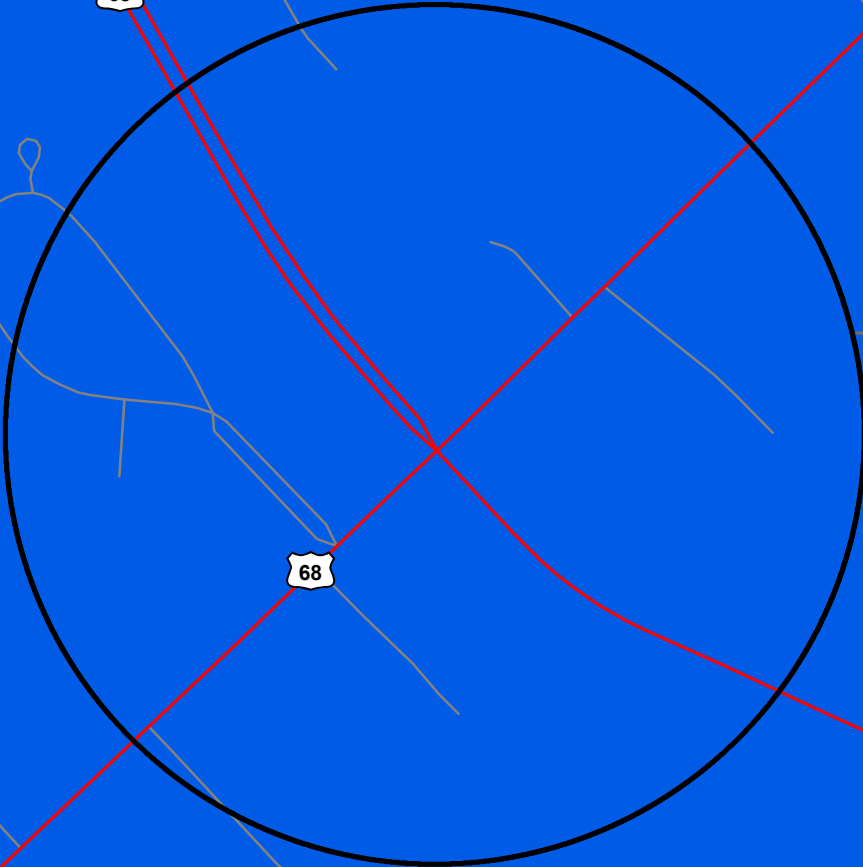
 Study Area

0 250 500 Feet



Warren County
US-231/US-68

Planning Study
Intersection of US-231 & US-68



Study Area

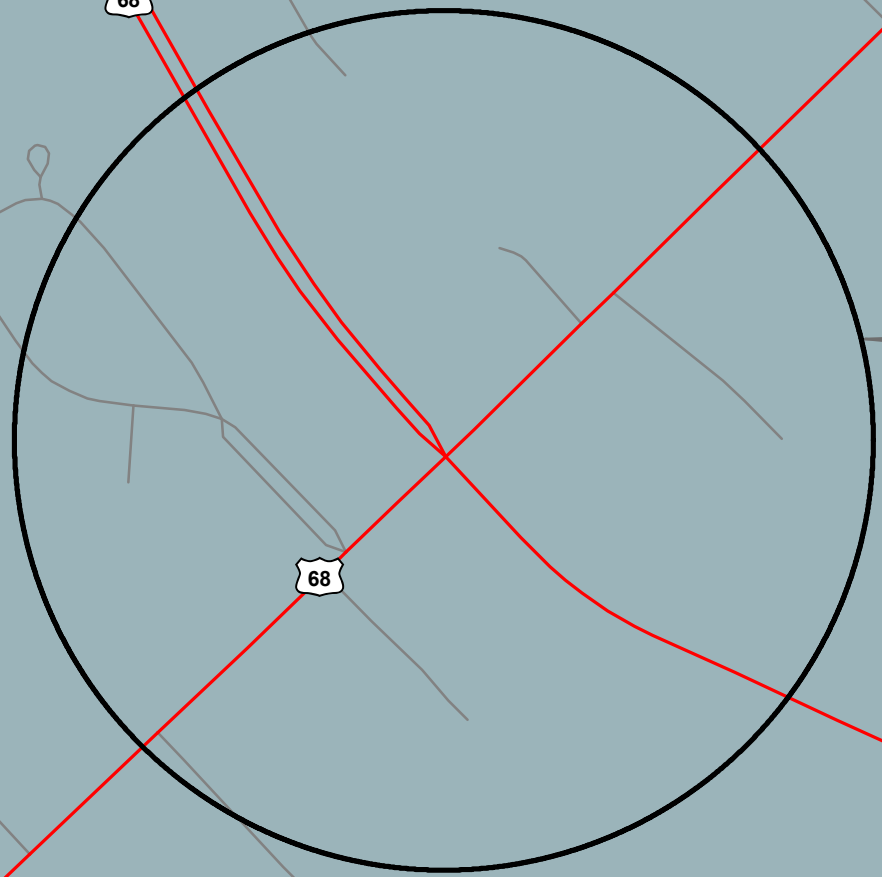
Legend
Karst
 INTENSE

0 380 760 1,520 Feet



Warren County
US-231/US-68

Planning Study
Intersection of US-231 & US-68



Study Area

Legend
Geologic Formations

	Ste. Genevieve Limestone
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0 380 760 1,520 Feet

31W

USGS, DGI