

# FEASIBILITY AND HYDROLOGY & HYDRAULICS STUDY

214th Street Corridor  
Brookings County, SD

MARCH 2024





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Brookings County Board of Commissioners  
520 3<sup>rd</sup> Street  
Suite 210  
Brookings, SD 57006

RE: 214<sup>th</sup> Street Feasibility and Hydrology & Hydraulics Study

Dear Board of Commissioners:

The Banner/HDR team is happy to present our findings for the feasibility and hydrology and hydraulics analysis for the 214<sup>th</sup> Street corridor in Brookings County, South Dakota. Brookings County and Banner/HDR partnered to identify key considerations that were in need of study to determine the feasibility of improving the three-mile stretch of roadway from Brookings County Road 21 to Brookings County Road 23. Those key considerations were analyzed and the potential impacts associated are presented within.

Banner/HDR evaluated and has prepared information for consideration on the following areas of potential impact: Data Collection including limited topographic survey, traffic counts, and existing utilities within the corridor; Traffic Analysis and Corridor Warrants including future average daily traffic projections, recommended lane and shoulder configurations, and auxiliary lane warrants and intersection controls; Hydrologic and Hydraulic analysis of the expansive flood plain impacts associated with various roadway gradeline adjustments and structure layouts including Federal Emergency Management Association compliance and upstream and downstream water surface elevation changes; Multi-modal Corridor typical sections including bicycle lanes and shared use paths; Right-of-way Needs for permanent and temporary acquisitions; Utility Impacts including significance of facilities and potential expansion; Environmental Considerations including social, cultural and economical; Potential Project Costs; and Potential Next Steps to investigate Funding Opportunities.

Understanding this is the first of many steps towards improving the 214<sup>th</sup> Street corridor, Banner/HDR is excited to be part of the team to get the proverbial ball rolling and provide Brookings County with the preliminary information necessary to make informed decisions regarding the next steps in making these improvements a reality. We look forward to working hand-in-hand to ensure our findings are understood and any recommendations are clear.

Respectfully,

A handwritten signature in blue ink that reads "Waylon Blasius". The signature is fluid and cursive, with a long horizontal flourish extending to the right.

Waylon Blasius, PE  
Banner Associates, Inc.

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## Introduction

### Study Area Background

Brookings County is evaluating the feasibility of improving a three-mile stretch of 214<sup>th</sup> Street in Brookings County, South Dakota. The study corridor begins on the west end at the intersection of Brookings County Road 21/34<sup>th</sup> Avenue and terminates on the east end at the intersection of Brookings County Road 23/Broadway Avenue within the City of Aurora, inclusive of the respective intersections. The roadway being evaluated, 214<sup>th</sup> Street, is a granular surfaced roadway currently under jurisdiction of two separate townships, Trenton and Aurora, respectively. Immediately west of the west termination point of this study, 214<sup>th</sup> Street becomes 20<sup>th</sup> Street South within the City of Brookings, South Dakota. At the east end of this study area, 214<sup>th</sup> Street becomes Redmond Road within the City of Aurora, South Dakota. In support of improvements to this corridor alongside Brookings County are the municipalities in which it will be connecting, the City of Brookings and the City of Aurora, as well as the economic development corporations associated with each respective municipality. **Figure 1** depicts a project study area map.

At first glance, improving such a stretch of roadway may appear to many as a “want” more than a “need”. That is, until you dive into the many social, economical, and safety factors that would see drastic improvements with an improved 214<sup>th</sup> Street corridor. In the Fall of 2023, contractors completed the construction and opened for traffic a new interchange with Interstate 29, just one-half mile west of the west end of this study area and improved the roadway up to the Brookings County Road 21/34<sup>th</sup> Avenue intersection, which is within this study area. The interchange was justified through studies as a critical piece of infrastructure to improve commuter times, increase level of service on other nearby City, County, and State roadways, improve safety and reduce crash rates on other nearby City, County, and State roadways, stimulate economic development on the growing South third of the City of Brookings, and provide easier access to Interstate 29. Additional commitment was made to assess the feasibility of an improved 214<sup>th</sup> Street, as that directly affects the actual improvements used to justify the Interstate 29 interchange. Trenton and Aurora Townships have recently submitted petitions to convey jurisdiction of this segment of 214<sup>th</sup> Street to Brookings County due to challenges and costs associated with maintenance of the roadway to adequately and safely handle the increased traffic from the newly opened interchange.

Many of the improvements identified for the justification of the interchange are shared goals of the potential improvements to the 214<sup>th</sup> Street corridor. Through the proposal process and project team meetings, Brookings County has shared their goals for this project, which include; accommodating traffic that the new interchange is producing, improved truck route and truck traffic flow to industrial and agricultural facilities east of Brookings, improved accessibility through improved drainage concepts and design through a floodplain, opportunity for economic development, and an improved roadway corridor to contribute to the safety and connectivity of pedestrian and vehicular commuters.

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## Development and Connectivity

The City of Brookings, with a population of 23,277 at the 2020 census, has seen the large majority of its recent growth occur along and south of the 20<sup>th</sup> Street South corridor within the city. The City of Aurora, with a population of 1,047 at the 2020 census, has seen increased residential and commercial/industrial growth occur along 214<sup>th</sup> Street/Redmond Road over the past decade. Plans for additional commercial and residential development are already in place for locations near and along the 20<sup>th</sup> Street South corridor in Brookings as a result of the new interchange being constructed. Plans are also in place for additional residential development within the City of Aurora in two separate locations that would generate traffic through this corridor. Aurora residents are within the Brookings Public School district and 20<sup>th</sup> Street South is a main east/west thoroughfare leading to many of the public schools, acting as a main rural commuter route for school buses, students, and parents alike.

Brookings also serves as an employment hub for Aurora residents, with commuters currently having to travel additional miles north to US Highway 14 and then join many other commuters traveling the US Highway, ultimately resulting in increased commuter times, increased crash risks, and reduced level of service once the roadway reaches Brookings city limits. Improving 214<sup>th</sup> Street would allow these commuters a direct route to the east/west and north/south major arterials within the City of Brookings, 20<sup>th</sup> Street South and 22<sup>nd</sup> Avenue and 34<sup>th</sup> Avenue, respectively. The noted major arterials are routes to some of the City of Brookings's largest employers, including South Dakota State University, Daktronics, 3M, Twin City Fan, and Larson Manufacturing, with an estimated workforce of 5,400 full-time employees between the five of them. The US Census Bureau data indicated that in 2015, over 9,000 employees commute to the City of Brookings for employment, with a contingent of those coming from the City of Aurora.

Brookings County recently invested in improvements to Brookings County Road 21/34<sup>th</sup> Avenue to provide a north/south paved minor arterial for commuter and truck traffic looking to travel across Brookings without having to travel through town. The once a gravel surfaced roadway that was somewhat susceptible to instability during high water years is now a two-lane asphalt paved segment with providing shorter travel times for those trucks looking to access industrial hubs from Brookings to Aurora, to include LG Everist, Valero Renewables, and Novita, as well as the local cooperative in Aurora. Additional improvements to 214<sup>th</sup> Street would further improve not only the opportunities for truck traffic to utilize a secondary east/west connector to these major industrial partners, but also may help improve the overall truck traffic flow in the general area. **Figure 2** depicts a map identifying the major commuter and agricultural destinations that would be directly impacted by improvements to 214<sup>th</sup> Street.

Last but certainly not least, an improved 214<sup>th</sup> Street corridor offers the opportunity for additional multi-modal commuter and recreational routes. The aforementioned 20<sup>th</sup> Street South and Interstate 29 interchange project brought a connection to the expansive 23 miles of City of Brookings Trail and Bicycle network system, all the way to Brookings County Road 21/34<sup>th</sup> Avenue, on the west end of this study area. Bicycle commuters currently utilize alternative paved road routes to travel from Aurora to Brookings, drastically increasing their commute time and effort. Alternative layouts offering bicycle lanes or separated shared use paths would enhance pedestrian connectivity and cycling opportunities in both communities, where Brookings currently distinguishes themselves as a bicycle friendly community.

**Figure 3** depicts the present day City of Brookings Trail and Bicycle Network system, with the potential connection to Aurora along 214<sup>th</sup> Street identified.

The various benefits of an improved 214<sup>th</sup> Street corridor noted in the project background have led Brookings County to take the next step of identifying and evaluating the potential impacts that an improved corridor may have, as well as the key considerations of how to get from a concept to reality. These key considerations are typical for many roadway improvement projects and their significance grows as the amount of change from existing to proposed grows. The key considerations evaluated in this report are as follows: data collection, traffic and corridor planning, gradeline and geometrics, hydrologic and hydraulic analysis, right-of-way impacts, utility impacts, and cost.

## Key Considerations

### Data collection

The very first step in the approach to evaluating the feasibility of improving the 214<sup>th</sup> street corridor was to collect information associated with the various key considerations of the corridor, providing a clearer understanding of the existing conditions of the roadway and setting a baseline for evaluation metrics. Banner deployed a survey team to collect topographic survey of the existing roadway centerline and edge lines, drainage structure sizes, material, and invert elevations throughout the corridor. Banner also captured aerial imagery of the corridor in the fall of 2022 to provide an up-to-date visual of present-day conditions. The ground survey was then combined with LiDAR aerial survey data set on a three-meter grid. The practice of combining the two surveys allows for a precise look at the critical roadway features while also having a comfortable idea of the impacts of the adjacent landscape, without having to commit resources to physically hand survey all of the study area. Brookings County requested to forego a legal boundary survey at this time.

The topographic survey data collected provides the project team with valuable information for assessing impacts. First, the topographic survey is turned into a surface file which is used to establish the existing roadway and adjacent landscape elevations. The information not only informs the design team of how wide the existing roadway is but is critical for determining how much material will need to be removed or imported to achieve various proposed roadway designs. This information is also critical for hydrology and hydraulics modeling within a floodplain, allowing the design team to make comparisons to baseline flood elevations and check compliance with regulatory agency requirements. Lastly, the drainage structure detail allows the design team to evaluate existing conditions and set a baseline with confidence, while also providing the flow lines necessary to maintain for any proposed drainage structure modeling efforts.

Banner inquired with all utility owners within the project area that are known to have a facility present. Private utilities may be present near the Right-of-Way line but were not identified. Through preliminary coordination efforts Banner received written descriptions, .pdf maps, and CADD maps to lay out the footprint of the existing utilities within the project area. Further discussion regarding utility coordination is available later in this report.

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Traffic data gathered by HDR included intersection turning movement counts at the 214<sup>th</sup> Street and Brookings County Road 21 and Redmond Road and Brookings County 23 intersections and roadway segment daily traffic counts near the study area. The traffic data includes information regarding traffic volumes during peak hour and daily periods, traffic directionality, vehicle classification, and bicycle/pedestrian traffic. In addition, SDDOT crash history records were reviewed for years 2018 to 2022 to determine any existing crash trends along the study corridor.

Utilizing study area traffic data, traffic forecasts were developed for a projected '2045 Design Year' and incorporated future anticipated traffic growth and shifts that are likely to accompany the opening of the I-29 Exit 130 (20<sup>th</sup> Street South) interchange. Based on these projections, roadway functional classification, assumed design speed, safety impacts, anticipated commuter and truck vehicle users, and design guidance references, preliminary planning recommendations were made to address future corridors needs.

### **Traffic and Corridor Planning**

The purpose of the 214<sup>th</sup> Street traffic and corridor planning analysis, completed by HDR, was to review the following design elements with consideration to existing and future conditions:

- Crash history review for study intersections and road segments
- Traffic Volumes and Forecasts (peak hour and daily traffic) for the following scenarios:
  - 2023 Existing Conditions
  - 2045 Design Year
- Corridor Planning Recommendations
  - Roadway Typical Section
  - Turn Lanes
  - Intersection Traffic Control
  - Multimodal Improvements
  - Access Management

The following sections detail the planning analysis with regard to the design elements described above and the resulting preliminary long-range corridor planning findings and recommendations.

### **Crash History Review**

Crash history was reviewed to identify crash locations along the 214<sup>th</sup> Street study corridor. Crash records from the State of South Dakota crash database for years 2018 to 2022 were obtained via the *SDDOT Intersection Crash Diagram Export and Local Roads Map Viewer and Data Download*. The figure below depicts the study area crash records derived from SDDOT sources. No fatal or severe injury crashes occurred along this segment.



Figure: 214<sup>th</sup> Street Corridor Crash Records

### **Traffic Volumes and Forecasts**

Peak hour and daily traffic volume forecasts were prepared to aid traffic planning efforts and the determination of street section elements for the 214<sup>th</sup> Street study corridor. The following volume scenarios were developed:

- 2023 Existing Conditions
- 2045 Design Year

### **Traffic Data Sources**

Intersections: 13-hour intersection turning movement counts were utilized / collected for the following intersections:

- 214<sup>th</sup> Street & 34<sup>th</sup> Avenue: Previously collected during the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study* prior to the opening of the interchange
- Redmond Road & 476<sup>th</sup> Avenue: Collected by HDR on February 8, 2023 for this study

Roadway Segments: 24-hour daily segment counts previously collected by the SDDOT and for the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*. Segment volumes were also estimated using typical 'K' factors that are based on the percentage of daily traffic occurring in a peak hour.

Overall corridor peak hours were defined within the traffic counts and generally reflect:

- AM: 7:15 – 8:15 a.m.
- PM: 4:30 – 5:30 p.m.

Truck percentages are based on available truck counts within the sources of data.

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### **Traffic Forecasts**

The following process was used to develop the Existing and future-year traffic forecast volumes:

**A. 2023 Existing Conditions Volumes:** Existing traffic volumes factored to a September design season

**B. 2045 Design Year Volumes:** Future traffic growth through year 2045 and traffic pattern changes based on the opening of the I-29 Exit 130 (20<sup>th</sup> Street South) interchange

1. Initial traffic growth to year 2045 based on forecasts developed for the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study* and SDDOT-derived Brookings County growth rates
2. Traffic pattern shifts accounting for the attraction of this corridor due to the I-29 Exit 130 (20<sup>th</sup> Street South) interchange, connection to the City of Brookings, and future paved road conditions
3. Future Aurora development of both residential and employment land uses

2045 Design Year daily and peak hour traffic volumes are summarized in **Figure 4** and the 2023 Existing Conditions traffic volumes are provided in the 'Traffic Planning Analysis' technical memo provided in the **Appendix**. The corresponding traffic volumes were then utilized as the basis for the traffic operations analysis and corridor planning recommendations.

### **Corridor Planning Findings and Recommendations**

Analysis of the future traffic volumes, operations, and street section and traffic planning design elements for the 214<sup>th</sup> Street study corridor resulted in the general findings shown below. Further discussion is included in the 'Traffic Planning Analysis' technical memo provided in the **Appendix A**.

#### **214<sup>th</sup> Street Study Corridor**

- No major safety trends found in observed crash data
- Daily Traffic Volumes:
  - 2023 Existing Conditions: 100-1,000 ADT
  - 2045 Design Year: 4,000 ADT
- A rural 2-lane highway is anticipated to provide sufficient capacity through 2045 based on projected 2045 Design Year traffic volumes (4,000 ADT) and roadway function classification
- Roadway width and multimodal improvement recommendations are based on:
  - Projected 2045 Design Year traffic volumes (4,000 ADT)
  - Assumed design speed of 60 mph
  - Anticipated commuter and truck vehicle users
  - Typical section, multimodal, and access recommendations based on guidance from:
    - *Highway Safety Manual (HSM)*
    - *Brookings County Master Transportation Plan*
    - *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*
    - *SDDOT Road Design Manual and Local Roads Plan*
    - *Access Management Manual*
    - Other design guidance resources (see 'Traffic Planning Analysis' technical memo)

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### 214<sup>th</sup> Street & Brookings County 21 Intersection

- Turn lane and intersection traffic control improvements will be necessary for sufficient LOS performance in the 2045 Design Year
  - Consistent with *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study* recommendations
- Signalization likely needed in the future
  - Planning-Level Signal Warrant Review Timeframe: 2035-2040

### Redmond Road & Brookings County 23 Intersection

- Existing intersection anticipated to manage future traffic growth through 2045 Design Year
- Review intersection in conjunction with future Aurora development or as conditions change

Traffic planning recommendations for the 2045 Design Year scenario are shown in **Figure 4** and identified in the lists below. Recommended lane configuration and intersection control modifications for study intersections are noted in **Bold**:

### 214<sup>th</sup> Street Study Corridor

- Roadway Section: **Rural Minor Arterial Highway**
  - Number of Through Lanes: **2 Lanes**
  - Lane Width: **12 ft.**
  - Shoulder Width: **8 ft. (6 ft. if ROW is constrained)**
- Multimodal Improvements: **Install 8-10 ft. Shared Use Path**
  - Install shared use path along the south side of 214<sup>th</sup> Street to tie in with shared use path constructed with the I-29 Exit 130 (20<sup>th</sup> Street South) interchange project
  - If ROW is constrained, consider an 8 ft. shared use path width or a paved shoulder
- Access Management
  - Follow access spacing and best practice for rural areas guidance outlined in the *Brookings County MTP* and *SDDOT Road Design Manual*
  - Protect intersection functional area
  - Existing access points within the functional area should be removed when parcels redevelop or change land use

### 214<sup>th</sup> Street & Brookings County 21 Intersection

- Construct volume-warranted and operations-based turn lanes
- Approach lane configuration and traffic control:
  - **EB: LT, T/RT**
  - **WB: LT, T/RT**
  - **NB: LT, T/RT**
  - **SB: LT, T, RT**
  - Signalize intersection (when warranted)
  - Monitor approaches with stop control based on interim traffic volumes and patterns between 2023 and 2045 (prior to signalization):

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- Consider switching approaches with stop control (if needed)
  - Consider installation of all-way stop control (if needed)

### Redmond Road & Brookings County 23 Intersection

- Construct volume-warranted southbound right turn lane
- Approach lane and intersection control:
  - EB: LT/T/RT
  - WB: LT/T/RT
  - NB: LT/T/RT
  - **SB: LT/T, RT**
  - Maintain stop control on eastbound and westbound approaches

### Gradeline and Geometrics

Improvements to the 214<sup>th</sup> Street corridor should incorporate prioritizing the consideration of generally accepted design standards for similar classifications of roadway with the anticipated speed limits and traffic volumes forecasted for this roadway. The improved roadway should meet vertical geometric considerations for stopping sight distances and passing sight distances, greatly improving the safety for travelers of the corridor. Historically, storm water has overtopped 214<sup>th</sup> Street prior to the 10-year storm recurrence interval event. In instances where overtopping doesn't occur, segments of the 214<sup>th</sup> Street corridor are inundated with flood waters up to the roadway shoulders for a period of time, saturating the roadway and creating instability in the gravel surfacing. Analyzing highway hydraulics is dependent on the roadway vertical profile, setting the stage for overtopping locations and elevations as well as upstream impoundment of water. Lastly, the improved roadway gradeline should consider the blowing and drifting snow, and the maintenance effort and safety hazards of a low-profile road.

Horizontal geometrics should also be reviewed when establishing a proposed alignment for the 214<sup>th</sup> Street roadway. The improved roadway should meet geometric considerations for adding necessary curves where deflection angles exceed recommended maximums. The location of the alignment within the public right-of-way will be an important factor in identifying and mitigating impacts to adjacent properties. Typically, with a symmetrical typical section, centering the roadway in the right-of-way is recommended. If additional bicycle lanes or shared use paths are being considered, offsetting the centerline of the roadway within the right-of-way may be preferred to keep the impacts similar on both sides of the roadway and/or to avoid significant impacts on one side.

The gradeline and geometrics, coupled with the roadway typical section make up the roadway corridor. Many alternative typical section layouts can be considered for improvements to the 214<sup>th</sup> Street corridor. Four (4) typical sections that were evaluated as part of this study represent various levels of opportunity within the corridor. Two (2) of the typical sections provide dedicated pedestrian and bicycle accommodations, one (1) provides recommended lane and shoulder configurations based on South Dakota Department of Transportation road design standards for projected ADT as well as Brookings County Master Transportation Plan recommendations based on roadway classification, and one (1) provides minimum lane and shoulder configurations that do not meet recommended design criteria. **Figure 5 (2 pages)** depicts the typical sections and their specific dimensions.

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## Hydrology and Hydraulics

### Floodplain and Drainage Considerations

A key issue for improving 214<sup>th</sup> Street are the impacts to the floodplains and adjacent properties while allowing traffic to travel the road reasonably safely. **Figure 6** depicts the existing floodplain map.

### Drainage Basins

The three mile stretch of 214<sup>th</sup> Street crosses the Deer Creek floodplain and includes several contributing drainage basins varying in size and the basins flow generally from north to south in this area. The elevations along 214<sup>th</sup> Street are higher near Aurora and drop as you travel west and approach 34<sup>th</sup> Avenue. The largest basin is Deer Creek which is about 64 square miles and the rest range in size from 0.2 square miles to 21.5 square miles. Altogether, the entire drainage area north of 214<sup>th</sup> Street between Aurora and Brookings is approximately 95 square miles. **Figure 7** depicts the existing drainage basins conveying flow to the crossings along 214<sup>th</sup> Street.

### Drainage Patterns

The conveyance on the eastern half of 214<sup>th</sup> Street near Aurora is separated from the western half and is well organized. It has a total drainage area of about 6.5 square miles between its two tributaries. But the western half contains Deer Creek and the other tributaries with drainage channels that are less organized and tend to combine between the drainage areas when flows leave their channel banks. This natural interbasin flow occurs from 214<sup>th</sup> Street up to the railroad embankment as well as north of US14 and one mile north of Bushnell. The upstream railroad forces the upstream drainage through several bridges and a couple smaller culvert structures.

The actual Deer Creek main channel as shown on the USGS topography maps show approximately one mile of straightened channel, presumably channelized with equipment many years ago, after it passes south of the railroad and continues for one-half mile downstream of 214<sup>th</sup> Street. The straightened channel cuts through the old natural channel path which is sinusoidal in the vicinity of 214<sup>th</sup> Street.

**Figure 8** depicts the Surface water channels and their drainage pattern through upstream and downstream embankments. **Figure 9** depicts the pipe culverts, box culverts, and bridge structures that are used to convey the major drainage ways through upstream and downstream embankments.

### Roadway and culverts history

Currently, there are fourteen round culverts and one box culvert in this three mile stretch of 214<sup>th</sup> Street. Fourteen CMP were surveyed ranging in diameter from 24" to 72" along with the box culvert (8'x5') that allows passage of a conveyor belt system under the road for a mining operation. The box culvert is elevated high enough and does not convey runoff up to the 100-year event. Altogether, there are approximately 311 square feet of flow area provided with fourteen culverts including the box or 271 square feet excluding the box flow area.

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Previously, as referenced in a 1980 bridge inspection report, there was a 60' bridge on Deer Creek that was replaced with five (5) 72" diameter CMP culvert. It is likely there were additional bridges in place and switched to less expensive culvert when they required replacement over time.

Existing Drainage Performance:

The existing 214<sup>th</sup> Street gradeline and culverts overtop prior to the 10-year storm event, so the roadway doesn't currently meet the Local Roads Plan as a gravel local road. This is a nuisance and a hazard for vehicle travel when spring snowmelt or heavy rainfall events occur. The 100-year storm event significantly overtops the road, but the overtopping allows the Deer Creek drainage system to relieve itself. The overtopping occurs on the western half of 214<sup>th</sup> Street where Deer Creek and the other tributaries are conveying drainage.

Gradeline Alternatives Drainage Performance (P1-P4):

**Figure 10** depicts the roadway gradeline alternatives evaluated, looking downstream. Those alternatives are described in more detail below.

Gradeline Alternative P1 – 25-year design:

Upgrading 214<sup>th</sup> Street to a SDDOT classification for a Local Road with an ADT more than 100 vehicles would mean there would be no overtopping at the 25-year storm event with 1-foot of freeboard. This would greatly improve travel during flooding events compared to the existing condition. This was the first alternative iteration in the preliminary design of setting the gradeline. The east half of 214<sup>th</sup> Street only needs to handle the six-square mile drainage area and can be accommodated relatively easy without much upsizing to the existing structure size.

The western half, where the main channel of Deer Creek sits, is much more difficult to accommodate. Not only do the culvert sizes need major increases, but by raising the gradeline to meet the 25-year freeboard requirement, the impacts for the 100-year event would cause an increase in water surface elevations of 0.9-foot and more. The structure sizes to meet this design are not feasible.

Gradeline Alternative P2 – 10-year design:

Opting for a 10-year design frequency reduces the cost of roadwork and structures and decreases the impact for the 100-year, but it also decreases the serviceability for traffic during flooding events. The alternative doesn't overtop during the 10-year event, but it does overtop at the 25-year event if the structures are not sized adequately. The impact to the 100-year event is at least 0.8-feet. There is no freeboard for the 25-year event, while the freeboard for the 10-year event is 0.7-feet at the upstream side of the road embankment.

Gradeline Alternative P3 – 10-year design

A minor adjustment of lowering the gradeline elevation by 0.2-feet for 1,300-feet of the road of Alternative 2 still meets the 10-year overtopping goal, but the 100-year impact is close to 0.5-feet. There is no freeboard for the 25-year event, while the freeboard for the 10-year event is 0.5-feet at the upstream side of the road embankment.

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### Gradeline Alternative P4 – Existing gradeline

For purposes of evaluating a Do Nothing alternative for evaluating improvements to be made with the surfacing of the roadway while neglecting the concern for saturated shoulders and overtopping, a gradeline alternative of matching existing centerline of roadway elevations is being considered.

#### Structure Scenarios Drainage Performance:

Sizing the culverts or bridge structures for a feasibility study is only an estimate and final sizing will occur with preliminary and final designs. That being said, there were a range of structures used in the model to get an idea of the cost ranges. The first scenario doubles the existing structure flow area while the second scenario then quadruples. The third scenario looks at the upstream railroad bridges. The fourth scenario scales it back closer to the existing condition structure sizes. **Figure 11** identifies the existing drainage structures for the present-day crossings at 214<sup>th</sup> Street as well as the evaluated structure improvement scenarios, which are described in more detail below.

#### Structure Scenario S1:

Sizing the structures to double the existing flow area of 311 square feet results in about 720 square feet spread out over seven different locations of culverts and bridges.

#### Structure Scenario S2:

Quadrupling the existing structure size results in a total of about 1,250 square feet flow area. The 25-year event does not overtop 214<sup>th</sup> Street under this scenario and the impact to the 100-year event ranges between 0.5-feet and 0.9-feet depending on which gradeline scenario is applied.

#### Structure Scenario S3:

Considering the upstream railroad bridges as a guide results in 3,040 square feet of total flow area. The 25-year event does not overtop 214<sup>th</sup> Street under this scenario and the impacts to the 100-year event ranges between 0.5-feet and 0.9-feet depending on which gradeline alternative is used.

#### Structure Scenario S4:

Structure sizes closer to the existing flow area results in 214<sup>th</sup> Street overtopping at the 25-year event and impacts to the 100-year event of 1-foot or more.

The 100-year impacts for each alternative and scenario are shown in the attached 100-year floodplain impacts referenced on Figure 15 (Scenario Evaluation Matrix B) in the vicinity of the project area.

### Unintended Consequences and Mitigation Alternatives

Raising the road grade across a floodplain requires the balance of increasing bridge and culvert sizes through the road to decrease impacts. The topography of 214<sup>th</sup> Street drops in elevation from east to west until it ties into 34<sup>th</sup> Avenue. If culvert and bridge structures are not large enough to pass the obstructed flows, the result is for drainage to move to lower elevations which in this case is 34<sup>th</sup> Avenue. 34<sup>th</sup> Avenue is already known to overtop frequently. It is likely that drainage patterns will change, like

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more drainage directed to the west under Interstate 29 than the existing condition. This study only evaluated 214<sup>th</sup> Street improvements to road grade and hydraulic structure such as bridges and culverts.

To mitigate the change in flows due to the project, it is possible to further explore other grading adjustments to redirect drainage in other areas such as 34<sup>th</sup> Avenue, or upstream of 214<sup>th</sup> Street and downstream of 214<sup>th</sup> Street. It was not feasible to explore these mitigation alternatives during this study but could be discussed as the project continues.

### Drainage Model and Analysis

FEMA recently issued preliminary floodplain maps for Brookings County as part of their RiskMAP updates. The maps are based on 2D hydraulic model output from software developed by the US Army Corps of Engineers called HEC-RAS. The 2D model incorporates LIDAR elevation data which is coupled with rain-on-grid hydrology to represent several return intervals such as the 1-percent-annual-chance (aka known as the 100-year) storm event.

The term "100-year flood" is used to describe the recurrence interval of floods. The 100-year recurrence interval means that a flood of that magnitude has a one percent annual chance of occurring in any given year. In other words, the chances that a river will flow as high as the 100-year flood stage this year is 1 in 100. Statistically, each year begins with the same 1-percent chance that a 100-year event will occur.

The Brookings County FEMA 2D model was obtained and enhanced with survey data in the area near 214<sup>th</sup> Street with culvert and roadway data, adding breaklines, terrain modifications, and other minor adjustments to better represent the drainage through the area. FEMA identifies this model as Work Area 20 (WA20). There are additional 2D models in Eastern SD with similar sizes and different work areas. Along the Big Sioux River, there are several other work areas upstream and downstream from WA20 and although they are separate, they do use output from one model as input for the next downstream model. The WA20 2D model domain consisted of about 1,000 square miles which is represented by a 2D mesh as 750,000 cells and an average cell size of 187-ft by 187-ft. Running the entire model takes over 84-hours of computational time at a 15-minute timestep and the file size is well over 40 gigabytes including the terrain and output files for all the storm events.

After excessive computer processing time, the model was broken down into a smaller, more manageable analysis area of about six-square miles centered around the Deer Creek floodplain and 214<sup>th</sup> Street that allowed less file size and lower run times for running numerous alternatives of varying road gradelines and culvert and bridge structure sizes. Since the railroad bridges control the inflows at the upstream end of the smaller analysis area, the hydrographs for each of the storm events were obtained from the base WA20 FEMA 2D model area and used as the input for the smaller analysis area for 214<sup>th</sup> Street. The mesh sizes within the smaller area were decreased to 150-feet by 150-feet to obtain a more accurate model and the timesteps were lowered from 15-minutes in the WA20 base model, all the way down to 2-seconds for some models to reduce instability and continuity errors. Refining the mesh sizes and further enhancing the mesh with additional breaklines produces a more accurate result, but it does require the model timestep to be lowered which in-turn runs longer again and can result in more continuity error and model instability. The model runtimes for the smaller model area range from 20 seconds to 2 seconds. **Figure 10** depicts the modeled gradelines and the resultant upstream water surface elevation impacts associated with the various alternatives.

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## Floodplain Development Permit

The current *effective* FEMA map is a Zone A without base flood elevations. FEMA is in the process of updating the maps in Brookings County and has issued *preliminary* maps which will become *effective* when the appeal process and community officially adopts the maps. Although the *preliminary* FEMA maps have been released and show updated boundaries, the Zone A designation will remain the same for the 214<sup>th</sup> Street study area. The community regulates floodplain development at the local level by requiring a floodplain development permit application to assure that development meets both minimum federal and local floodplain requirements. The community has the authority to approve/deny a floodplain development permit. FEMA does not approve development for participating NFIP communities.

## FEMA CLOMR or LOMR

A Conditional Letter of Map Revision (CLOMR) may be requested by the community when the project's effects are found to increase base flood elevations more than 1.0 foot at any point in the vicinity of the project. The impacted area is currently not developed and further supports a CLOMR to not be required. If the community elects to submit a CLOMR, it would need to be submitted prior to construction; the CLOMR process requires at least 18 months. The cost of a CLOMR is estimated to be between \$50,000 and \$100,000. FEMA reviews a CLOMR submittal and requires a review fee as shown in the Table 1. For this type of project, a "CLOMR Based on Levee Based on Levee, Berm, or other Structural Measures" has a FEMA review fee of \$7,000 (plus \$60/hr) in an online submittal would be assessed.

A Letter of Map Revision (LOMR) may or may not be required, coordination would occur with the Floodplain Administrators to determine if required after completion of the project. It is recommended that a LOMR be submitted to notify affected landowners of increases in base flood elevations as this would impact their flood insurance premiums of insurable structures. If a LOMR is required after the project is complete, the cost to prepare the submittal is between \$50,000 and \$100,000; however, if a CLOMR was previously submitted, the LOMR cost would be less with the assumption there were no significant changes made to the project since the CLOMR. For this type of project, a "LOMR Based on Levee Based on Levee, Berm, or other Structural Measures," the FEMA review fee is \$9,000 (plus \$60/hr) in an online submittal would be assessed. And if a CLOMR was submitted, a follow-up LOMR FEMA review fee is \$8,000.

Table 1 - FEMA Review Fees (Jan, 2024)

<b>Requests for Map Changes Requiring Special Technical Review</b>	<b>Paper Form Fee</b>	<b>Online LOMC Fee</b>
CLOMR Based on New Hydrology, Bridge, Culvert, Channel or Combination Thereof	\$6,750	\$6,500
CLOMR Based on Levee, Berm or Other Structural Measures	\$7,250 (plus \$60/hr)	\$7,000 (plus \$60/hr)
LOMR Based on Bridge, Culvert, Channel, Hydrology, or Combination Thereof	\$8,250	\$8,000
LOMR Based on Levee, Berm or Other Structural Measures	\$9,250 (plus \$60/hr)	\$9,000 (plus \$60/hr)
LOMR Based on As-Built Information Submitted as a Follow-up to a CLOMR	\$8,250	\$8,000
LOMR Based Solely on Submission of More Detailed Data	Free	Free
LOMR/CLOMR Based on Structural Measures on Alluvial Fans	\$7,250 (plus \$60/hr)	\$7,000 (plus \$60/hr)

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## Right-of-Way Expansion

The present-day right-of-way for the township roadway is assumed to be sixty-six feet wide, or the statutory thirty-three feet from the section line each direction. This is true up to the limits of the City of Aurora, where existing right-of-way may vary. No legal boundary research has been performed but the general layout of existing fence lines appears to support that assumption. Understanding the potential for jurisdiction of the roadway to be conveyed to Brookings County, they may prefer to initiate efforts to acquire additional right-of-way to a minimum width of eighty total, feet for maintenance and safety purposes. An increase in public right-of-way needs may be dictated by the improvement alternative selected for the roadway corridor. The Brookings County Master Transportation Plan classifies this roadway as a Minor Arterial if improved, and recommends a 100' right-of-way width for that classification.

Improving 214<sup>th</sup> Street by raising the roadway's gradeline and incorporating a wider paved travel surface will likely result in a need for expanding the right-of-way from its present day sixty-six foot width. An eighty-foot right-of-way would contain the grading limits for large portions of some of the alternative layouts, where others may require one hundred feet of total right-of-way to contain the grading limits. Although participating adjacent landowners is a necessity, a majority of the adjacent property to the roadway corridor would see minimal impact with widening of the right-of-way. Some of the more significant impacts will consist of tree removal, fence removal and replacement, and loss of productive land. Additional temporary easement may be necessary to be acquired from adjacent landowners to allow for construction to be completed in an efficient manner. This easement would be returned to the land owner upon completion of the project. The impacts associated with right-of-way acquisition are negotiated through landowner meetings and follow generally accepted appraisal and offering procedures.

Once the project reaches city limits in Aurora, the expansion of the right-of-way would contain many more challenges. It is typical in Brookings County for there to be a minimum of eighty feet of public right-of-way through County Highway corridors. Although some grading work can be completed within temporary easements outside of the right-of-way, it is critical to ensure that enough public right-of-way is in place for future maintenance needs as well as growth or expansion of any corridor attributes. In cooperation with the City of Aurora, and upon determination of jurisdiction of the roadway right-of-way within city limits, Brookings County will need to carefully consider the impacts to the adjacent landowners if additional right-of-way acquisition is necessary for construction. These factors alone may dictate the typical roadway section which is able to be constructed within city limits, and may require alternative right-of-way widths within city limits. It shall be noted that the reduced speeds on the roadway within city limits do allow for a smaller footprint to be constructed while maintaining consistent safety standards. **Figure 12 (6 pages)** depicts the existing right-of-way as well as potential proposed right-of-way lines at eighty feet (80') and one-hundred feet (100), as well as some general grading limits from alternatives evaluated through this corridor.

## Utility Coordination

The straight shot from Brookings to Aurora down 214<sup>th</sup> street has become a popular route for private utility facilities providing service to Aurora. The multiple benefits of this corridor for utility companies include the shortest distance for materials to be installed and maintained, as well as the lack of hard surfacing making installation, adjustment, and relocation much less costly. Utility companies with facilities present in the corridor are listed below, along with the significance and their intent to potentially expand.

The utilities indicated in this report are all likely to be impacted by the improvement of 214<sup>th</sup> Street. Whether the utility is directly in conflict with the construction, or the owner prefers to relocate the utility to ensure it does not fall beneath the paved surfacing, close coordination early and throughout will be necessary to ensure service is not disrupted inadvertently and all outages can be planned and communicated.

Among all of the utility owners within the corridor, perhaps the most critical coordination will need to be completed with the City of Aurora. The City of Aurora presently has additional residential/commercial developments proposed within city limits and has project plans being prepared for utility improvements along and beneath present-day 214<sup>th</sup> Street/Redmond Road, to be constructed in the coming construction seasons. In addition to the utility imminent utility improvement project noted, the City of Aurora is also undergoing studies and funding application work for a 12" watermain transmission connection to traverse from Aurora to 34<sup>th</sup> Avenue/Brookings County 21 where it would tie to Brookings Municipal Utilities, as well as a sanitary sewer treatment expansion project to increase the capacity of treatment available to them due to significant residential growth (100%+) in the recent decade. Cost share opportunities may be available if roadway improvements can be made on a similar timeline as utility improvements. **Figure 13** depicts the utilities identified within the corridor.

Utility Owner	Facilities In Area	Significance	Plans for Expansion
<b>Brookings Municipal Utilities</b>	<ul style="list-style-type: none"> <li>- Water</li> <li>- Sanitary Sewer</li> <li>- Electrical</li> </ul>	<ul style="list-style-type: none"> <li>- 12" Watermain Stub</li> <li>- Sanitary Manholes</li> <li>- Overhead Transmission Line</li> </ul>	Potential expansion of 10" watermain to Aurora
<b>Mediacom</b>	Telecommunications	Major service line to Aurora	None
<b>Northwestern Energy</b>	Natural Gas	3" Gast Main to Aurora	None
<b>Sioux Valley Energy</b>	Electrical	<ul style="list-style-type: none"> <li>- Overhead Transmission lines to residences along 214<sup>th</sup></li> <li>- Underground line to LG Everist Mining dredge</li> </ul>	Potential expansion with increase of residential, commercial, industrial needs outside City limits
<b>Novita</b>	6" Sanitary Forcemain	Sanitary Forcemain to service entire facility	None
<b>City of Aurora</b>	<ul style="list-style-type: none"> <li>- Water</li> <li>- Sanitary Sewer</li> <li>- Storm Sewer</li> <li>- Electrical</li> </ul>	<ul style="list-style-type: none"> <li>- Water main and services</li> <li>- Sanitary main, services, and adjacent lagoons</li> <li>- Culverts and conveyance</li> <li>- Underground main and services</li> </ul>	Expansion with increase in residential/commercial/industrial needs within City limits

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## Preliminary Environmental Report

A preliminary environmental report has been prepared for the study area containing the 214<sup>th</sup> Street roadway corridor. The report is the first step in identifying potential impacts to social, environmental, and historical/cultural resources in the study area. Continued efforts to comply with requirements associated with the various resources that are deemed critical within the roadway corridor will be necessary as the project moves forward. The full report contains additional information about each of the resources as well as the likely considerations for next steps in the process and can be found in the **Appendix B**.

## Opinions of Potential Costs

In order to evaluate costs for so many different options, we have prepared an alternatives index that will aid in understanding what potential costs are associated with what alternative options for the various typical sections, roadway profiles, and structure layouts.

The team identified significant costs associated with the steps moving forward beyond this study, all the way through construction of a proposed improvement project. An independent cost estimate has been prepared for each alternative, and a summary is being presented in this report. The independent costs estimates can be found in the Appendix. It should be understood that these costs are preliminary in nature and it was necessary to make many assumptions to complete these estimates. All estimates are provided in 2024 dollars and should be projected to escalate according to inflation when considering future budgeting dollars.

Significant costs considered are as follows:

- Planning, Grant Writing, and Environmental Services
- Geotechnical Exploration and Recommendations
- Design Engineering
- ROW Acquisition
- Utility Coordination and Relocation
- Construction Engineering
- Construction Costs broken into 5 sub-categories
  - o Mobilization, Bonds, and Insurance
  - o Grading and Earthwork
  - o Surfacing
  - o Structures
  - o Ancillary Items
- Contingencies for all Phases

**Figure 14** depicts the opinions of probable project costs for twenty-five (25) combinations of alternatives evaluated through this corridor. A complete set of the costs broken down into the significant categories indicated above is available in the **Appendix C**.

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## Next Steps to be Considered

With the understanding that Trenton and Aurora Townships have formally requested Brookings County to take over jurisdiction of this segment of 214<sup>th</sup> Street, it is in the best interest of Brookings County to evaluate the short- and long-term goals and impacts of the corridor and move forward accordingly. **Figure 15 (3 pages)** depicts an indexing guide as well as two evaluation matrices that further identify the impacts associated with the scenarios combining all typical section and profile scenarios, as well as all profile and structure scenarios, respectively.

This study has identified three (3) practical alternatives for Brookings County to consider. Additional alternatives may be considered that are not presented in this report. It may be in the best interest of Brookings County to hold a public input meeting to further understand the opinion of the County residents and stakeholders in regard to the alternatives presented here, as well as provide opportunity for additional alternatives to be identified. Furthermore, it may be prudent for Brookings County to establish an advisory team to work with the commission to identify the priorities of the impacted entities and public alike, and conclude where the vision, costs, and timelines align. The three alternatives presented below are only applicable if Brookings County obtains jurisdiction over the roadway segment.

### Do Nothing Alternative

Brookings County may consider to “Do Nothing” with the roadway corridor. Minor improvements such as additional gravel surfacing and regular maintenance would fall under this category. This alternative would improve safety and usability of the roadway, but only slightly. Increases in daily traffic volumes would increase, but not to the levels projected in this report. Brookings County would be able to dictate the timeline for this alternative. The “Do Nothing” approach is the least expensive of the alternatives in the short term as it does not require significant financial commitment for reconstruction efforts. Long term costs associated with this alternative will depend on the ability for the crossings along the roadway to handle increased traffic loadings as well as the ability for the roadbed to withstand the increased traffic loadings. Impacts associated with the Right-of-Way, Floodplain, Environmental Considerations, and Utilities would likely be kept to a minimum if this alternative is pursued. This alternative does not achieve many of the goals set forth by Brookings County for this corridor.

### Fund Locally Alternative

Brookings County may consider pursuing an improvement to the corridor that can be funded locally. Local entities that could be considered to participate in the funding of the improvements would be those that may benefit most from the improvements. This could include connecting municipalities, economic development corporations, and private interest groups. The South Dakota Department of Transportation could also be contacted for support and guidance for additional local funding available for a project.

It is anticipated that a locally funded alternative would be more comprehensive than the “Do Nothing” alternative, and therefore this alternative would improve safety and usability of the roadway to the extent offered by the selected improvements. It is likely that daily traffic volumes would increase with the improvements, and potentially to levels in which the improvements made should consider generally accepted design and safety standards. Brookings County would be able to dictate the timeline for this alternative regarding the financing of the project, based on available funding and additional local

participation. Environmental analysis and floodplain impacts may dictate the timeline, dependent on the scope and scale of improvements pursued. The short term and long-term costs associated with selecting this alternative would be directly related to the improvement selected. It is likely that this alternative would achieve some, but not all of the goals set forth by Brookings County for this corridor.

The next steps associated with the Fund Locally Alternative would consist of the following critical items: Collaborate with funding partners and major stakeholders to identify the affordable improvements to be made; Consult with an Engineering firm to further develop schematic drawings of the identified improvements and evaluate the actual impacts associated with Right-of-Way, Floodplain, Environmental Considerations, and Utilities; Pursue efforts to remediate impacts identified; follow through with Design and Construction of the selected improvements. The timeframe for this alternative is dependent on the associated impacts but could generally be considered feasible to be completed within five (5) years of selecting an improvement, establishing a financing plan, and initiating consultation with Engineering.

#### Apply for Outside Funding Alternative

Brookings County may consider pursuing improvements to the corridor that have anticipated costs to be beyond that which could be funded locally. It is anticipated that the improvements requiring assistance from outside funding sources would be the most comprehensive projects, providing the largest benefit to the roadway corridor. Funding received from non-local sources would require certain procedures and protocols to be followed as well as come with recommendations and guidance for associated impacts to the roadway corridor. This alternative generally requires cooperation and participation by the South Dakota Department of Transportation, as the facilitators of the funding. The short-term costs associated with selecting this alternative would be directly related to the improvement selected, but it can be anticipated that a minimum 20% local cost-share would be necessary. The long-term costs will again be associated with the selected improvement and the life-cycle maintenance of that improvement.

The next steps associated with the “Apply for Outside Funding Alternative” will vary based on if Brookings County will seek outside funding for planning and design services as well as construction, or construction only. If Brookings County desires to seek outside funding for planning and design services, the next steps would generally consist of the following critical items: Collaborate with entities benefiting from the potential improvements to gain support and potential local cost-share commitment to the project; Consult with a Planning and Engineering firm to identify potential funding opportunities, ensure all related funding application requirements are met, and write a grant application for consideration by outside funding sources; Complete an Environmental Assessment and identify a preferred alternative for construction; Follow program requirements to evaluate the actual impacts associated with Right-of-Way, Floodplain, Environmental Considerations, and Utilities; Pursue efforts to remediate impacts identified; follow through with Design and Construction of the selected improvements. The timeframe for this alternative is dependent on the associated impacts and follows a general timeline once funding is awarded but could generally be considered feasible for construction to be completed within eight (8) years of being awarded outside funding, if a planning and design grant is awarded upon first application and a subsequent construction grant is awarded upon first application. The County should be aware that these programs are very competitive, and it may not be typical for projects to be awarded upon first application.

If Brookings County desires to seek outside funding for construction only, the next steps would generally consist of the following critical items: Collaborate with entities benefiting from the potential

improvements to gain support and potential local cost-share commitment to the project; Consult with an Engineering firm to further develop schematic drawings of the identified improvements, prepare preliminary design plans, and evaluate the actual impacts associated with Right-of-Way, Floodplain, Environmental Considerations, and Utilities; Pursue efforts to remediate impacts identified and advance design efforts to near final design; Consult with a Planning and Engineering firm to identify potential funding opportunities, ensure all related funding application requirements are met, and write a grant application for consideration by outside funding sources; Submit all project information for review and concurrence by the South Dakota Department of Transportation; follow through with Final Design and Construction of the selected improvements. The timeframe for this alternative is dependent on the associated impacts and follows a general timeline once funding is awarded. but could generally be considered feasible to be completed within eight (8) years of selecting an improvement and initiating consultation with Engineering, if a construction grant is awarded upon first application. The County should be aware that these programs are very competitive, and it may not be typical for projects to be awarded upon first application.

## Funding Opportunities

Potential grant funding opportunities that are likely applicable to the Brookings County 214<sup>th</sup> Street project are identified in the list below. It is important to stress that these grant applications have requirements that focus heavily on project readiness, in terms of project design and environmental analysis and approvals, which greatly impacts the chances of success in acquiring these funds. It should be noted that some grant programs, most notably the RAISE grant program, have the opportunity to apply for planning projects which aid with design and environmental analysis efforts.

### Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grant Program:

- USDOT link: <https://www.transportation.gov/RAISEgrants/about>
- Can be used for planning or capital projects
- Minimum requested project dollars:
  - Planning Project: No minimum
    - Purchase of right-of-way (ROW) is not eligible under a planning grant
  - Capital project: \$1 million
- Fund Obligations: Within 2 years of the end of the fiscal year for which they are authorized
- Application Requirements:
  - Provide Benefit-Cost Analysis (BCA) for proposed project
  - May require approval by State as part of the Long Range Plans and Transportation Improvement Program (TIP)/Statewide Transportation Improvement Program (STIP)
  - Receive or have substantially completed all Federal, State, and local permits and approvals including National Environmental Policy Act (NEPA) analysis at time of the submittal
  - Demonstrate through included project schedule that applicants will reasonably expect to have ROW acquisition and design completed along with any other approvals or pre-construction steps

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**MEGA Grant Program:**

- USDOT link: <https://www.transportation.gov/grants/mega-grant-program>
- Application Requirements:
  - Provide Benefit-Cost Analysis (BCA) for proposed project
  - May require approval by State as part of the Long Range Plans and Transportation Improvement Program (TIP)/Statewide Transportation Improvement Program (STIP)
  - Receive or have substantially completed all Federal, State, and local permits and approvals including National Environmental Policy Act (NEPA) analysis at time of the submittal
  - Demonstrate through included project schedule that applicants will reasonably expect to have right-of-way acquisition and design completed along with any other approvals or pre-construction steps
  - Additional guidance: <https://www.transportation.gov/grants/mega-additional-guidance>

**Rural Surface Transportation Grant Program:**

- USDOT link: <https://www.transportation.gov/grants/rural-surface-transportation-grant-program>
- Application Requirements:
  - Provide Benefit-Cost Analysis (BCA) for proposed project
  - May require approval by State as part of the Long Range Plans and Transportation Improvement Program (TIP)/Statewide Transportation Improvement Program (STIP)
  - Receive or have substantially completed all Federal, State, and local permits and approvals including National Environmental Policy Act (NEPA) analysis at time of the submittal
  - Demonstrate through included project schedule that applicants will reasonably expect to have right-of-way acquisition and design completed along with any other approvals or pre-construction steps
  - Additional guidance: <https://www.transportation.gov/grants/rural-additional-guidance>

Understanding this is the first of many steps towards improving the 214<sup>th</sup> Street corridor, Banner/HDR is excited to be part of the team to get the proverbial ball rolling and provide Brookings County with the preliminary information necessary to make informed decisions regarding the next steps in making these improvements a reality. We look forward to working hand-in-hand to ensure our findings are understood and any recommendations are clear, and carrying those forward into the next steps desired by Brookings County.

# Project Location

214th Street  
Brookings County, SD

Figure 1 - Project Location Map

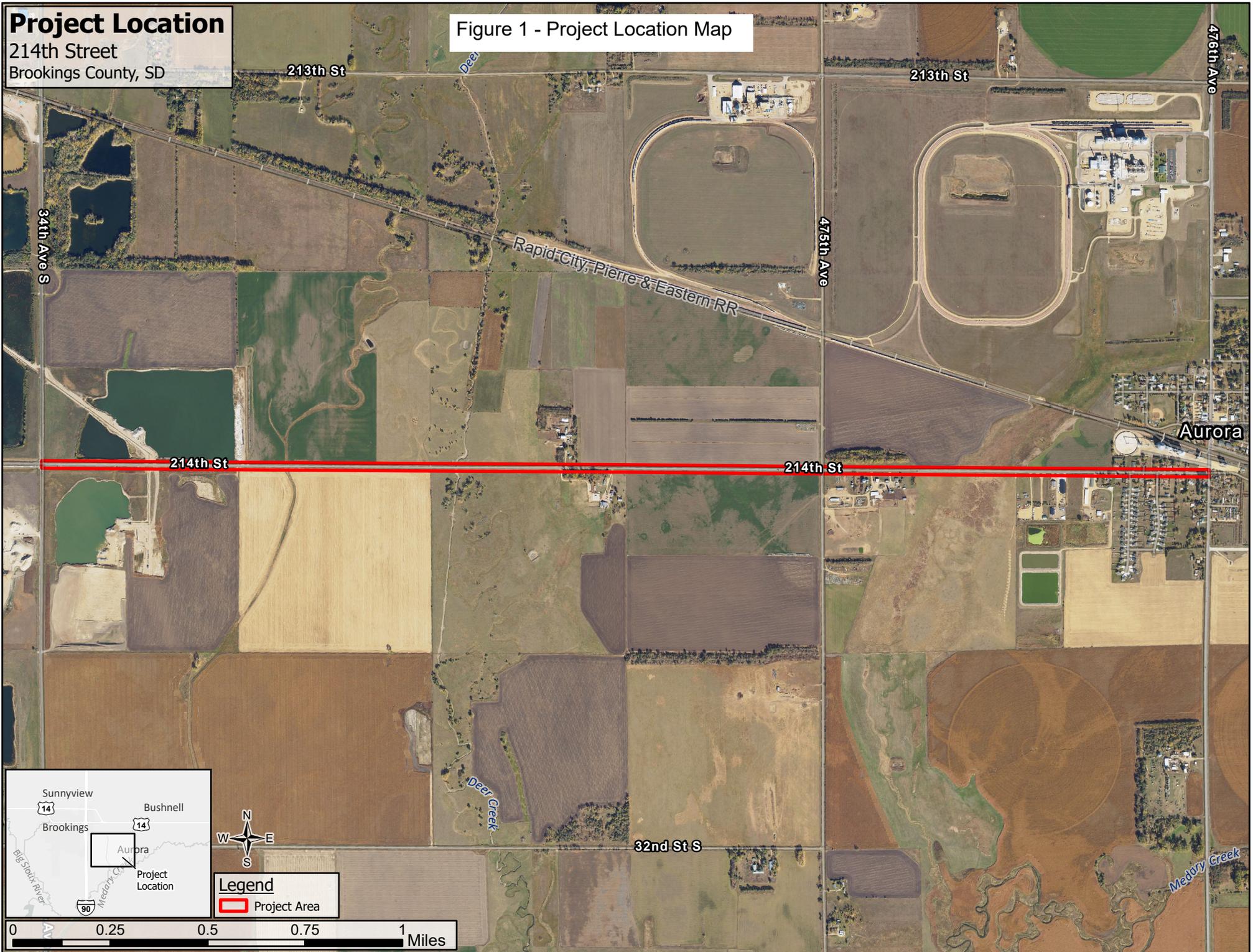
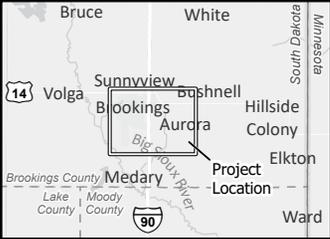
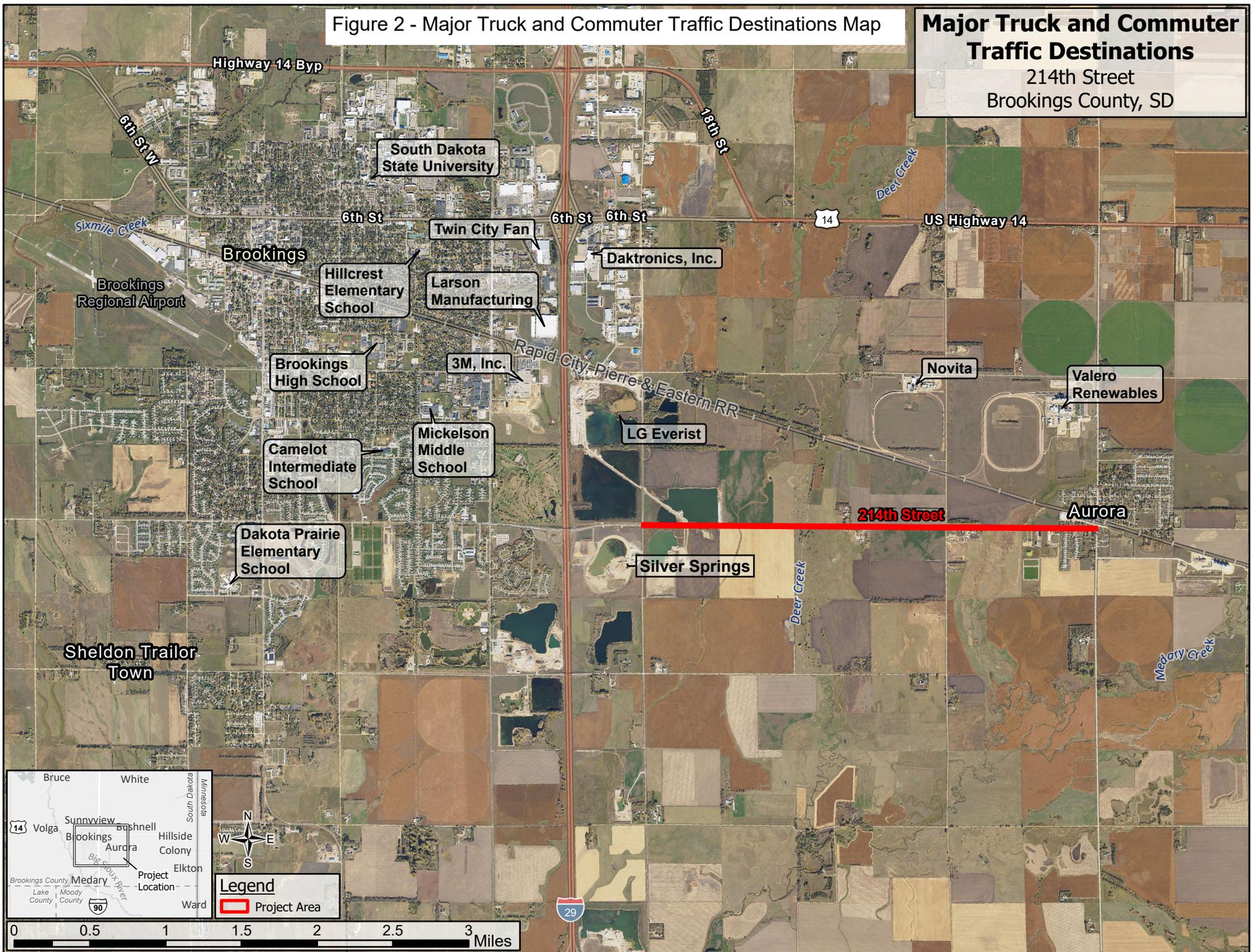


Figure 2 - Major Truck and Commuter Traffic Destinations Map

# Major Truck and Commuter Traffic Destinations

214th Street  
Brookings County, SD



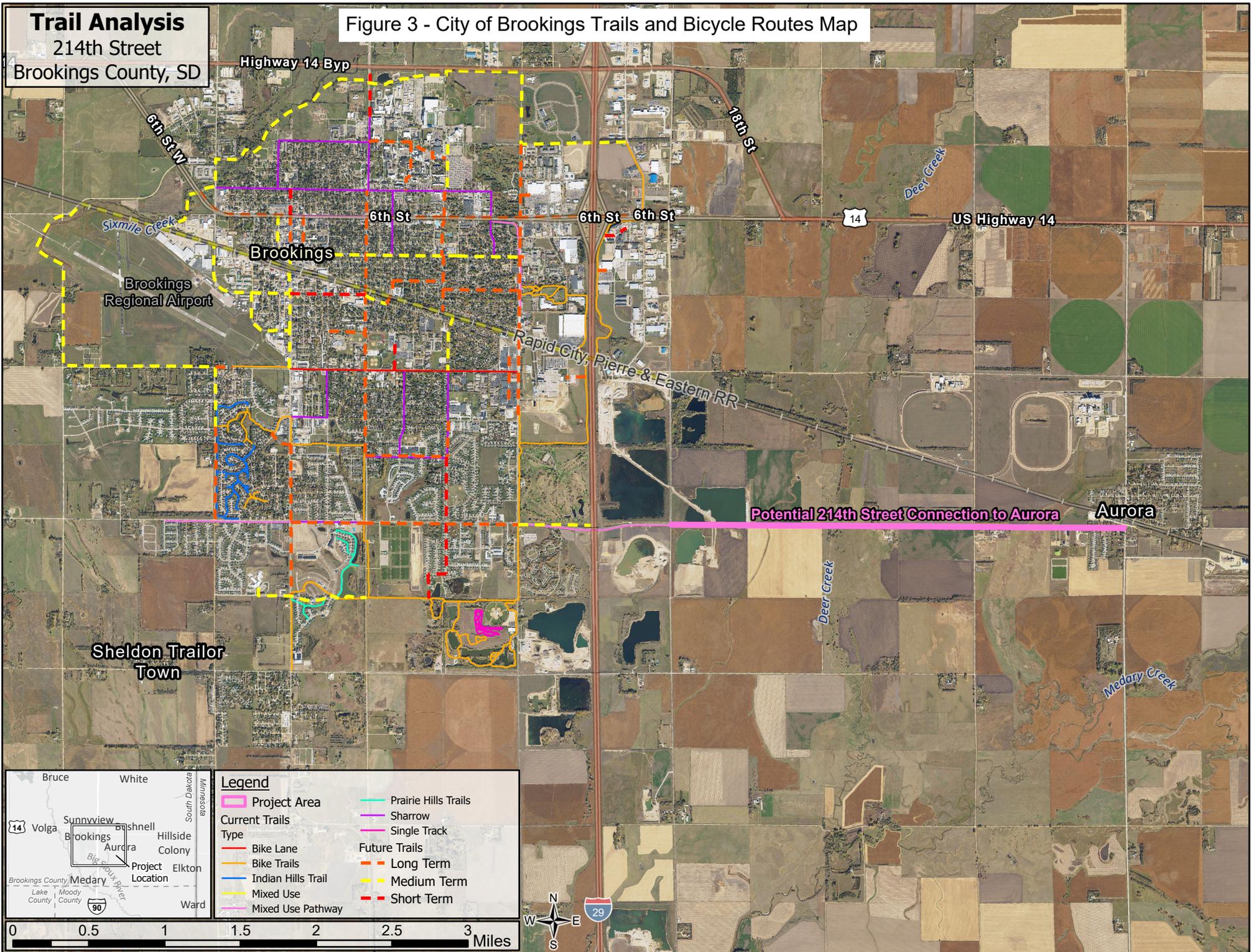
**Legend**  
Project Area



# Trail Analysis

214th Street  
Brookings County, SD

Figure 3 - City of Brookings Trails and Bicycle Routes Map



**Legend**

- Project Area
- Prairie Hills Trails
- Sharrow
- Single Track
- Current Trails**
- Bike Lane
- Bike Trails
- Indian Hills Trail
- Mixed Use
- Mixed Use Pathway
- Future Trails**
- Long Term
- Medium Term
- Short Term

**Map Labels:**

Brookings Regional Airport

Sheldon Traylor Town

Aurora

Highway 14 Byp

US Highway 14

6th St

18th St

Deer Creek

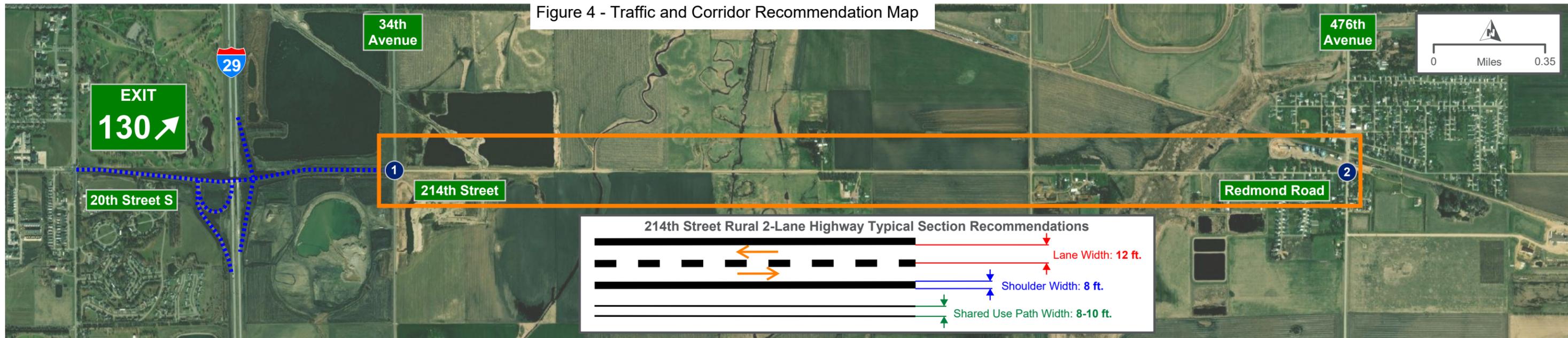
Medary Creek

Rapid City, Pierre & Eastern RR

Potential 214th Street Connection to Aurora

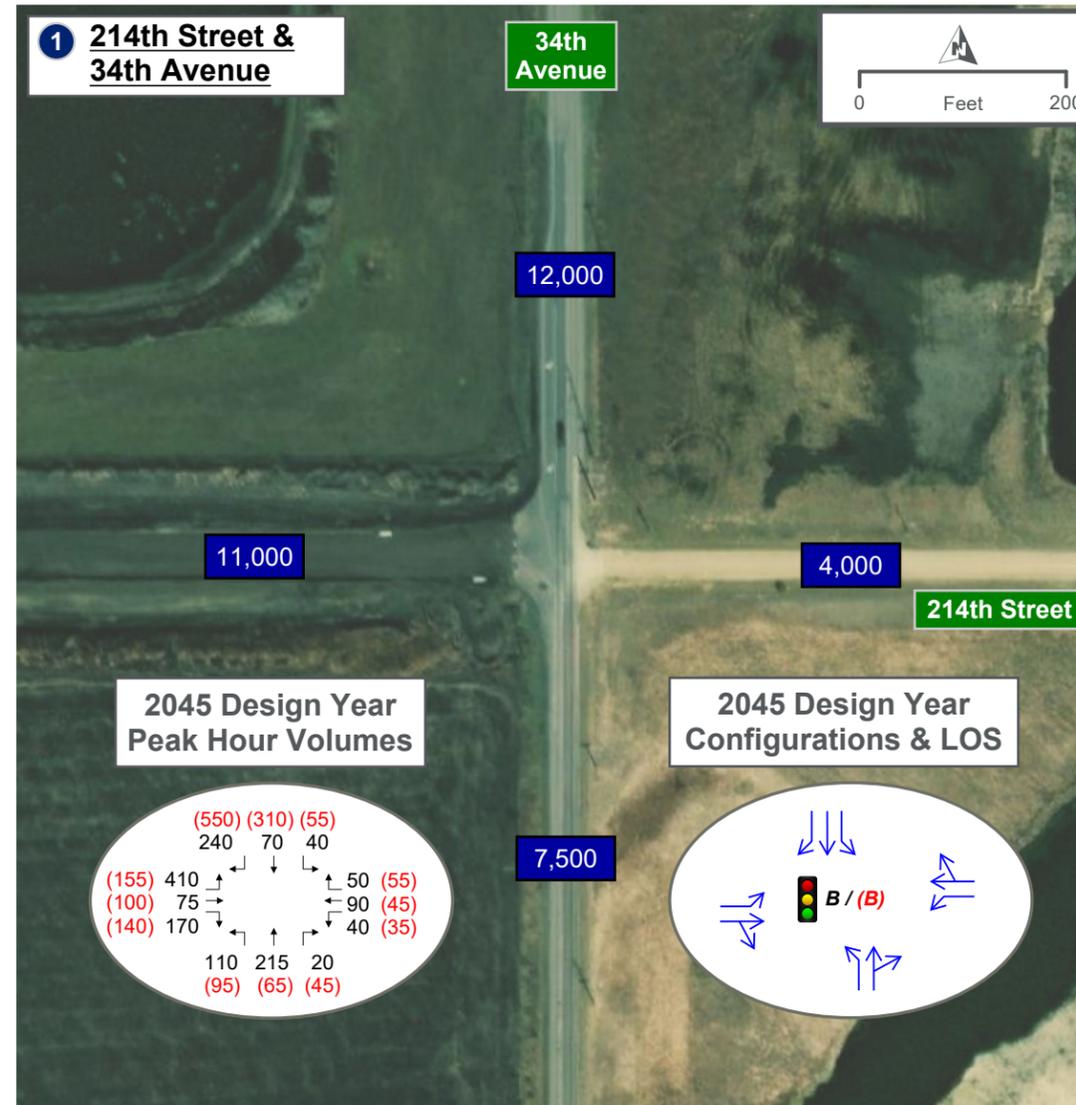
0 0.5 1 1.5 2 2.5 3 Miles

Figure 4 - Traffic and Corridor Recommendation Map



**LEGEND**

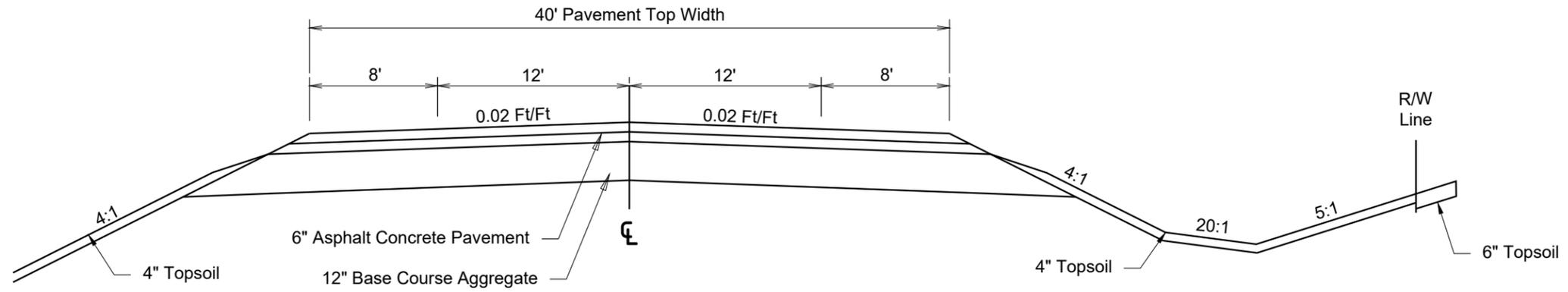
- 1 Study Intersection
- Study Road Segment
- I-29 Exit 130 Interchange and 20th Street S Proposed Configurations
- Traffic Volumes**
- AM (PM)** Peak Hour Traffic Volumes
- Daily Volumes:**
- 2,000 2045 Design Year
- Intersection Control / Level of Service (LOS)**
- STOP Stop Control (Stop Sign)  
Overall Intersection **A / (A)**  
Worst-case Approach **C / (C)**
- Traffic Signal  
Overall Intersection **A / (A)**
- Intersection Lane Configurations**
- ⇨ Existing Lane Configuration
- ⇨⇨ I-29 Exit 130 (20th Street S) IJR Recommended Lane Configuration
- ⇨⇨ Recommended Intersection Lane Configuration



**STUDY AREA RECOMMENDATIONS**

# TYPICAL GRADING SECTIONS

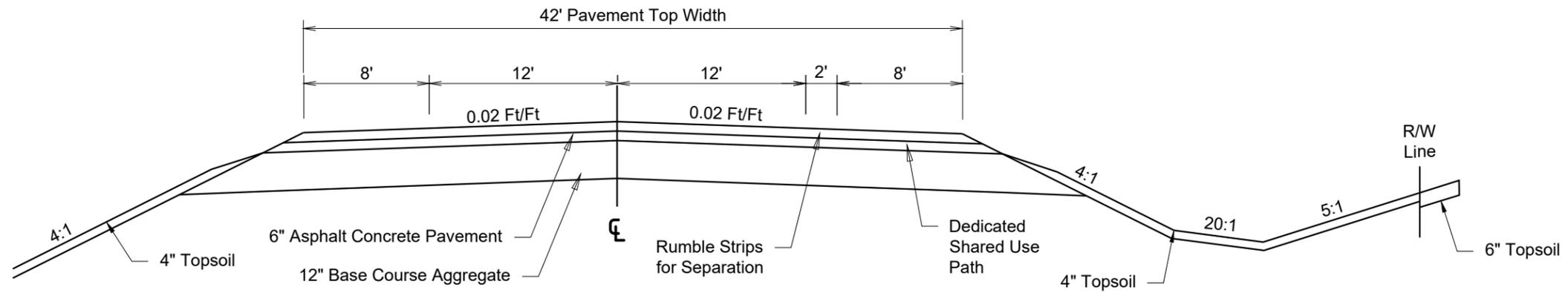
## Section T1



**\*T1** - 2-12' Lanes with 8' paved shoulders with sloped ditch

\* - 8' shoulder recommended for safety and traffic flow based on generally accepted roadway design guidance. 6' shoulder minimum recommended by roadway classification in Brookings County Master Transportation Plan

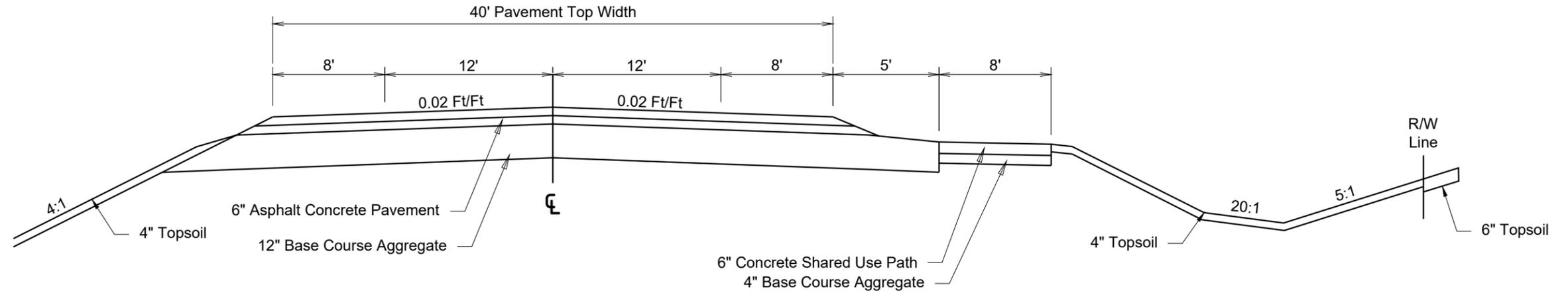
## Section T2



**T2** - 2-12' Lanes with 2' shoulder, rumble strips, and 8' paved shared use path with sloped ditch

# TYPICAL GRADING SECTIONS

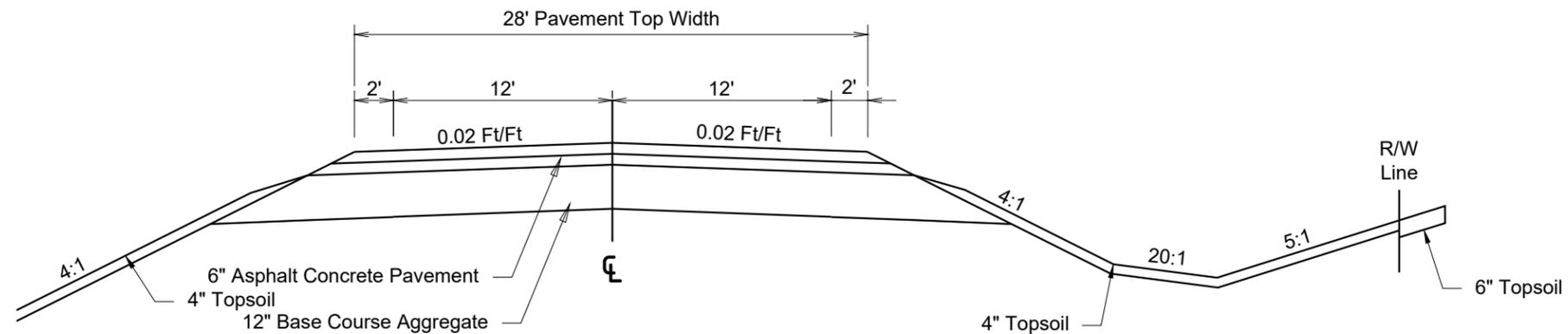
## Section T3



**\*T3** - 2-12' Lanes with 8' paved shoulders, 5' boulevard south at 10% grade and 8' paved shared use path with sloped ditch

\* - 8' shoulder recommended for safety and traffic flow based on generally accepted roadway design guidance. 6' shoulder minimum recommended by roadway classification in Brookings County Master Transportation Plan

## Section T4



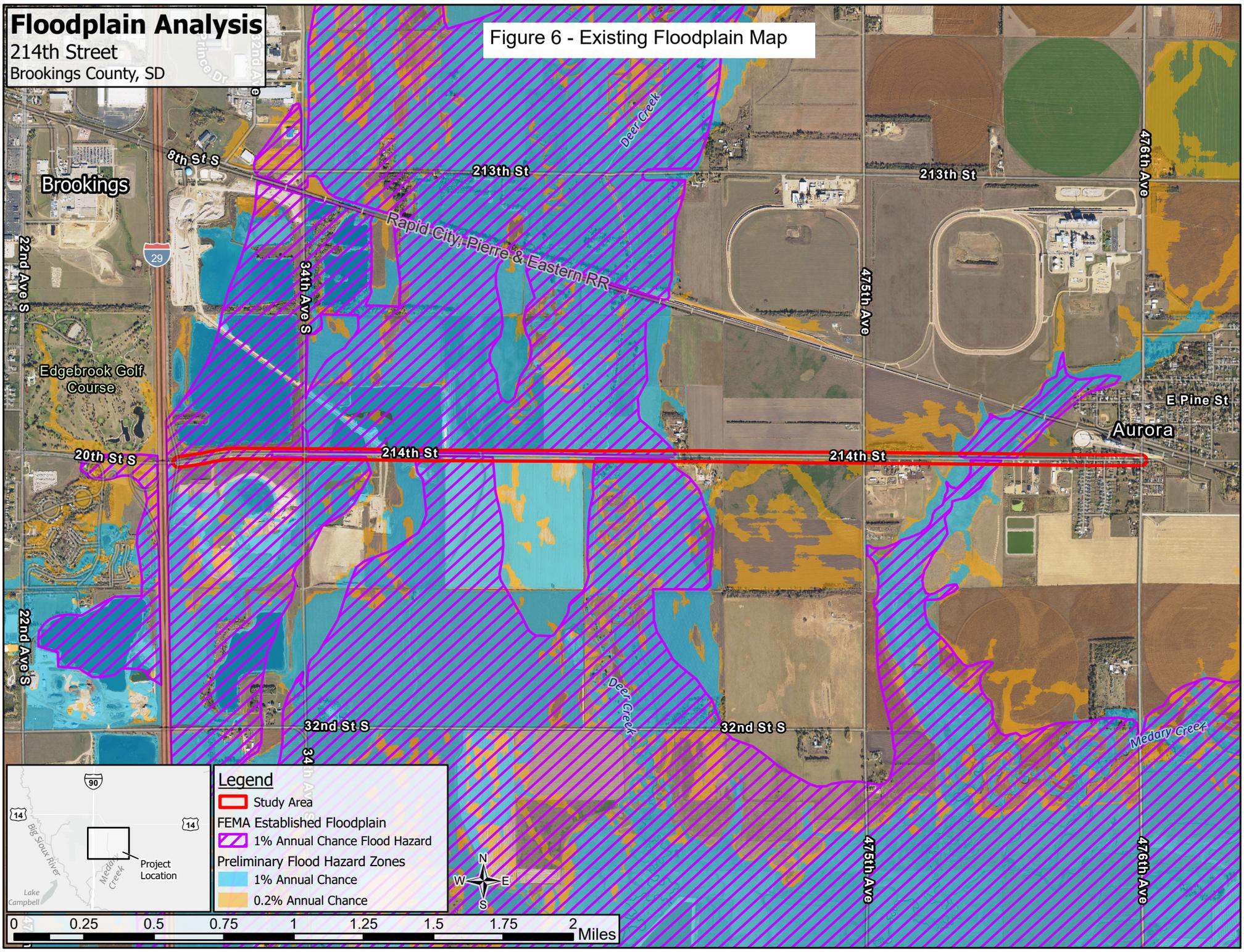
**\*\*T4** - 2-12' Lanes with 2' shoulder with sloped ditch

\* - 2' shoulder does not meet any minimum criteria for projected AADT or roadway classification and is not recommended

# Floodplain Analysis

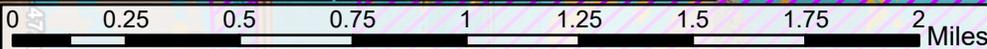
214th Street  
Brookings County, SD

Figure 6 - Existing Floodplain Map



**Legend**

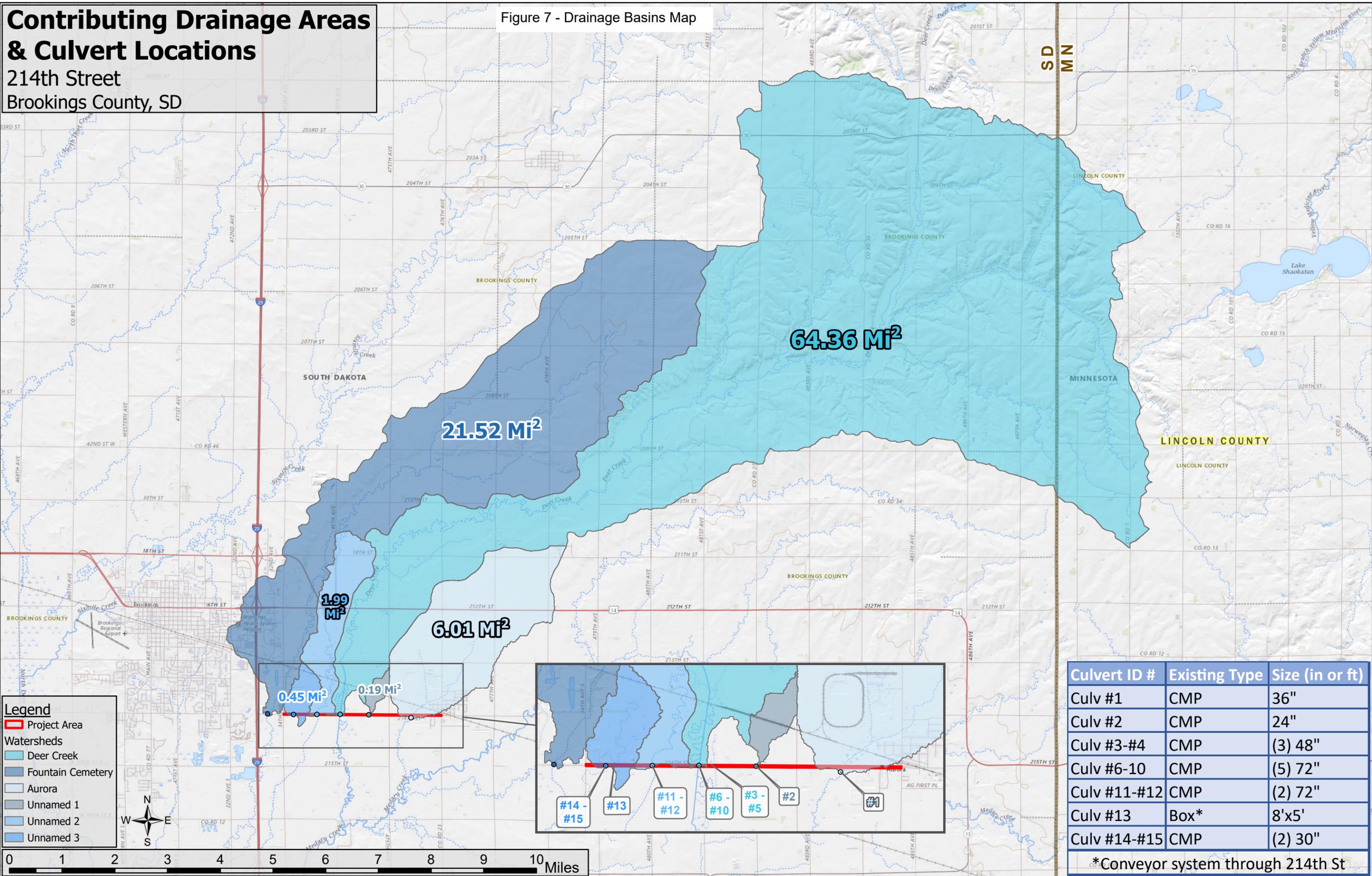
- Study Area
- FEMA Established Floodplain
- 1% Annual Chance Flood Hazard
- Preliminary Flood Hazard Zones
  - 1% Annual Chance
  - 0.2% Annual Chance



# Contributing Drainage Areas & Culvert Locations

214th Street  
Brookings County, SD

Figure 7 - Drainage Basins Map



**Legend**

- Project Area
- Watersheds
  - Deer Creek
  - Fountain Cemetery
  - Aurora
  - Unnamed 1
  - Unnamed 2
  - Unnamed 3

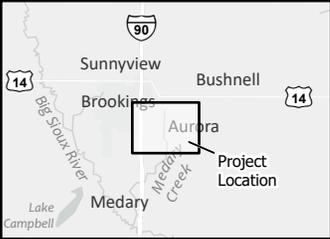
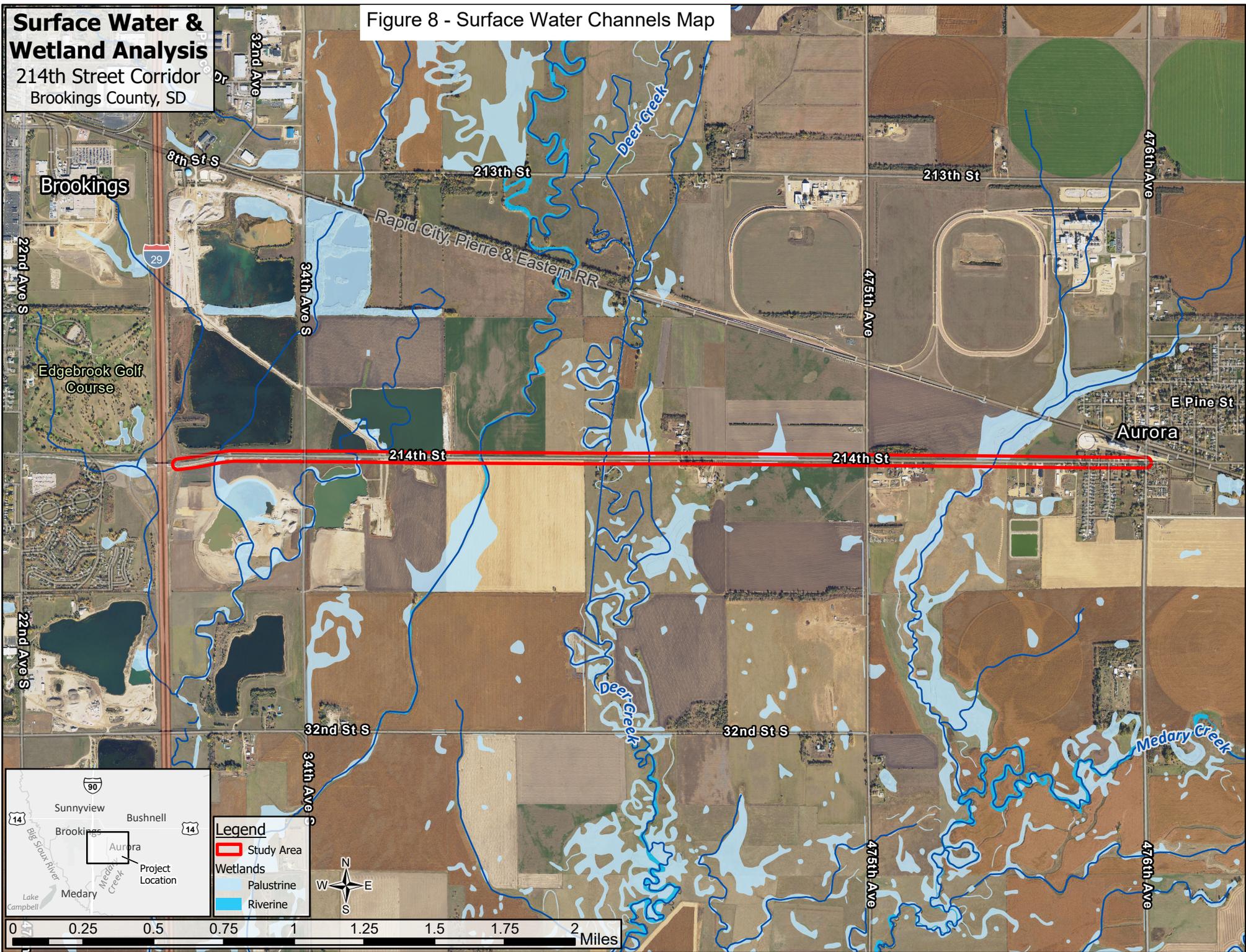


Culvert ID #	Existing Type	Size (in or ft)
Culv #1	CMP	36"
Culv #2	CMP	24"
Culv #3-#4	CMP	(3) 48"
Culv #6-10	CMP	(5) 72"
Culv #11-#12	CMP	(2) 72"
Culv #13	Box*	8'x5'
Culv #14-#15	CMP	(2) 30"

\*Conveyor system through 214th St

**Surface Water & Wetland Analysis**  
 214th Street Corridor  
 Brookings County, SD

Figure 8 - Surface Water Channels Map



**Legend**

- Study Area
- Wetlands
  - Palustrine
  - Riverine



# Major Stream Crossings

## 214th Street - Brookings County, SD

Figure 9 - Upstream and Downstream Crossing Structures Map

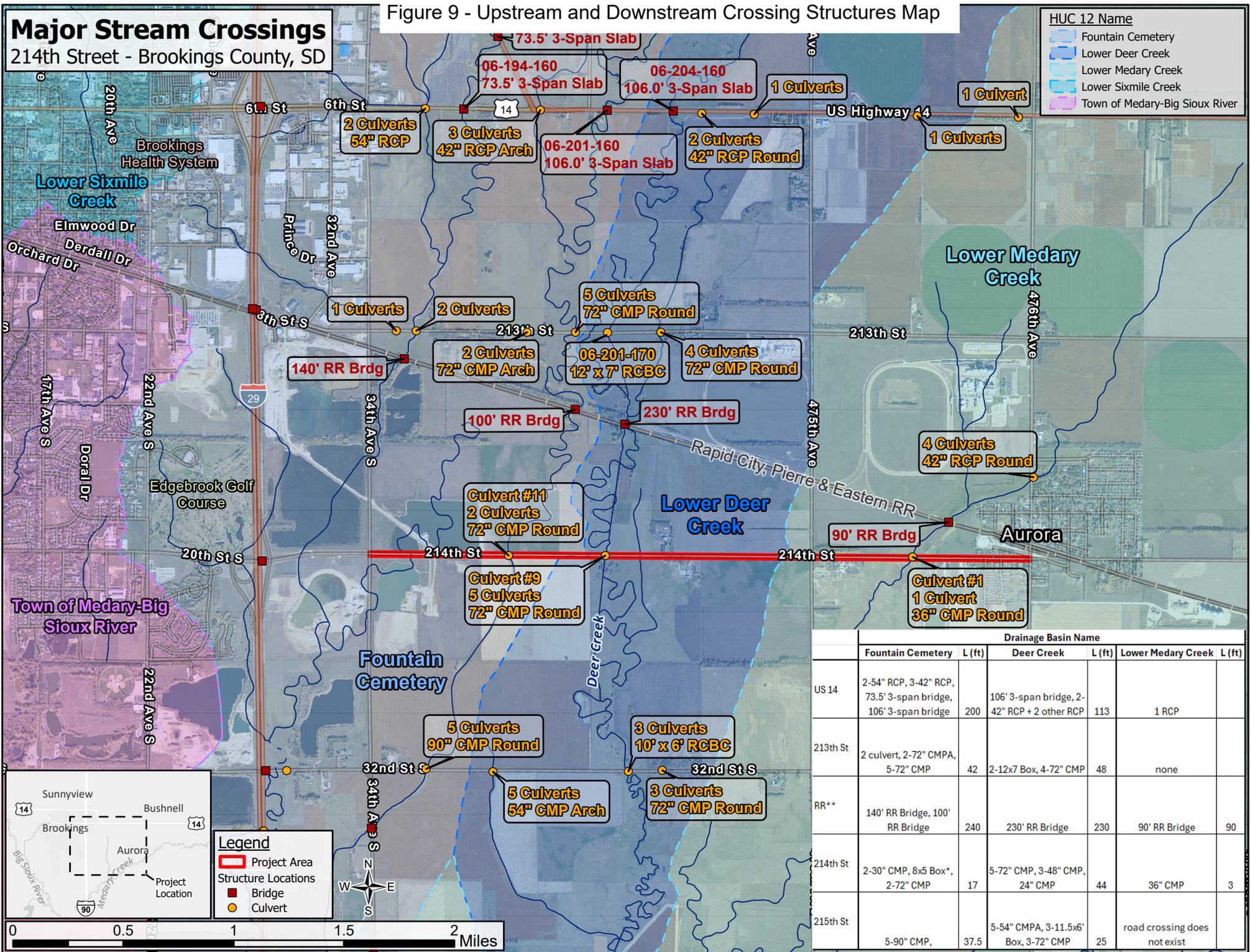


Figure 10 - Roadway Profile Alternatives

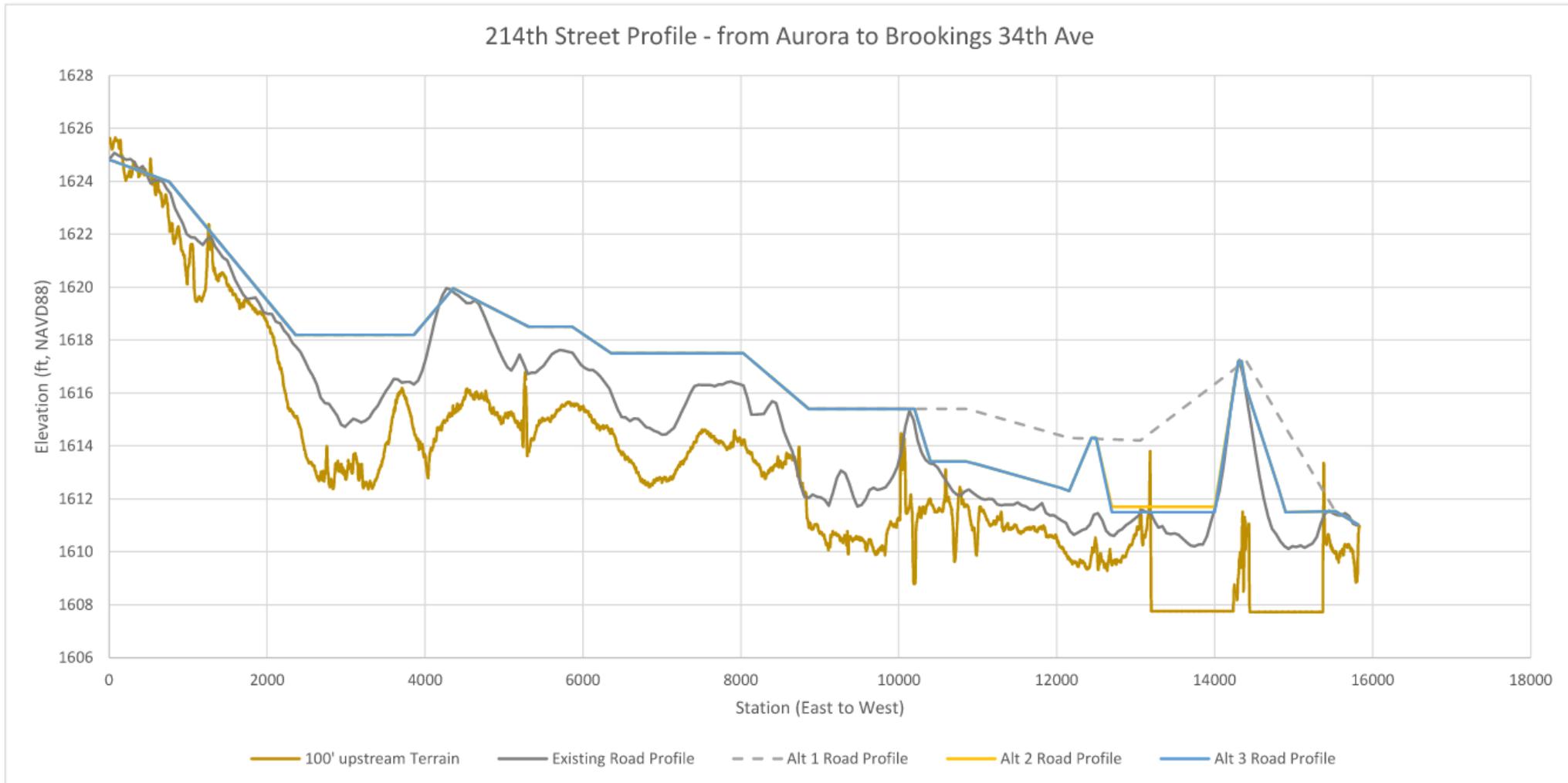


Figure 11 - Highway Structures Alternatives

ID	Culvert No.	Existing (311 SqFt)			S1 - Double Existing Flow Area (647 SqFt)			S2 - Quadruple Existing Flow Area (1251 SqFt)		
		Type	Size (ft)	Channel	Model Crossing	Comparable Structure	Model Crossing	Comparable Structure		
1	1	CMP	3'	Poorly Defined	Box	16x3	2-8'x4' Box	Box	32x3	3-11'x4' Box
2	2	CMP	2'	None	RCP	2'	1-24" RCP	RCP	2'	1-24" RCP
4	3 - 5	CMP	3-4'	Somewhat defined, Overflow	Box	20x4	2-10'x4' Box	Box	40x4	4-10'x4' Box
9	6 - 10	CMP	5-6'	Well Defined, Main	Box	32x8	3-11'x9' Box	Box	64x8	2-Span CCB
11	11 - 12	CMP	2-6'	Well Defined	Box	25x6	2-13'x7' Box	Box	50x6	2-Span CCB
N/A					N/A			N/A		
13	13	Box*	8x5	None - Conveyor	Box*	8x5	8'x5' Box Extensions	Box*	8x5	8'x5' Box Extensions
15	14 - 15	CMP	2-2.5'	Poorly Defined, Overflow	Box	28x2.5	2-14'x4' Box	Box	56x2.5	4-14'x4' Box
Opinions of Cost for Typical Sections T1, T2, and T3					T1 & T2		\$2,560,000.00	T1 & T2		\$5,310,000.00
					T3		\$2,560,000.00	T3		\$5,440,000.00

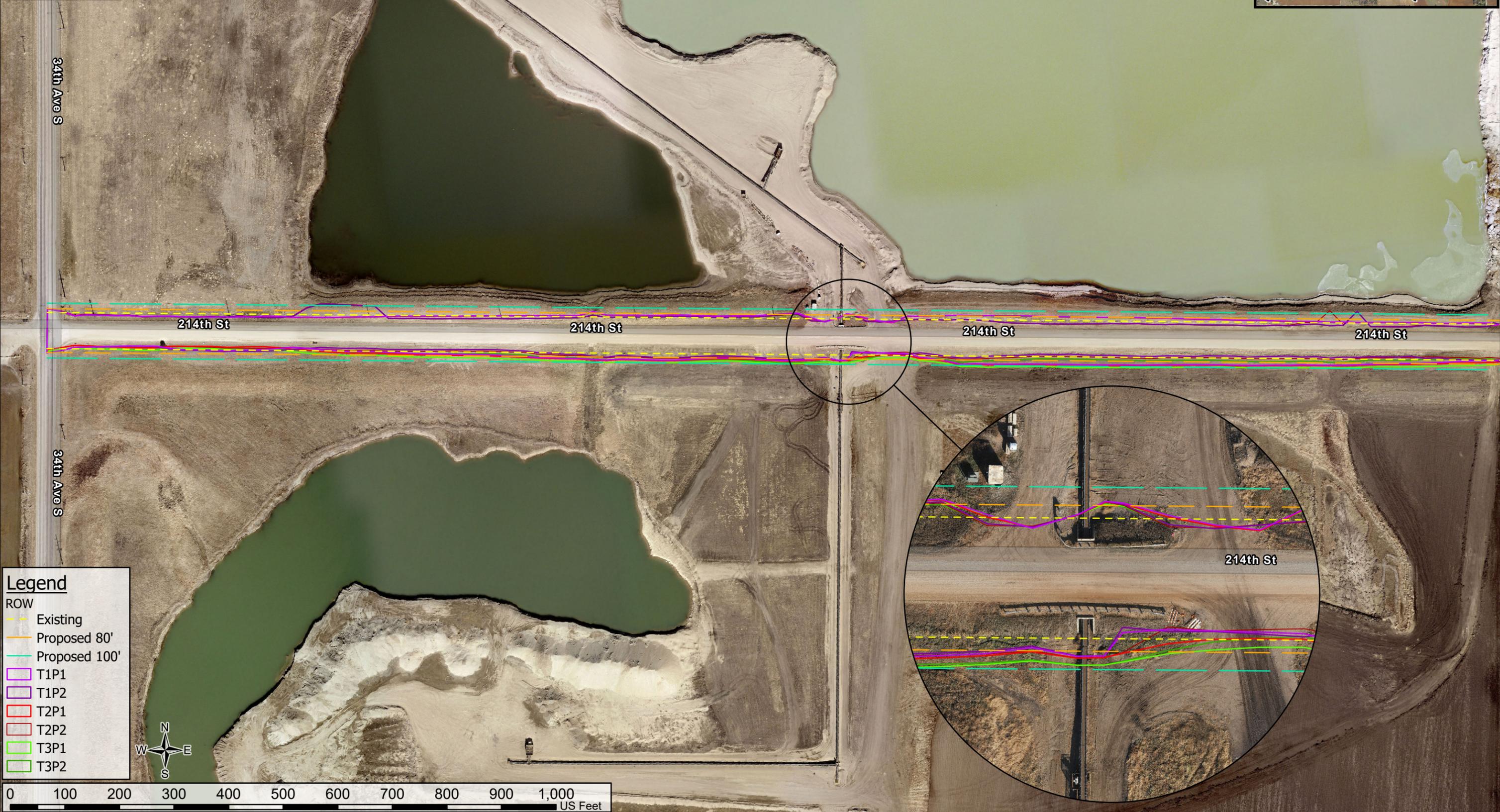
ID	Culvert No.	Existing (311 SqFt)			S3 - Similar to Upstream RR Crossings (3037 SqFt)			S4 - Similar to Existing Flow Area (342 SqFt)		
		Type	Size (ft)	Channel	Model Crossing	Comparable Structure	Model Crossing	Comparable Structure		
1	1	CMP	3'	Poorly Defined	Box	85x3	3-Span CCB	Box	8x3	8'x4' Box
2	2	CMP	2'	None	RCP	2'	1-24" RCP	RCP	2'	1-24" RCP
4	3 - 5	CMP	3-4'	Somewhat defined, Overflow	Box	20x4	2-10'x4' Box	Box	10x4	10'x4' Box
9	6 - 10	CMP	5-6'	Well Defined, Main	Box	120x8	3-Span CCB	Box	16x8	2-8'x9' Box
11	11 - 12	CMP	2-6'	Well Defined	Box	95x7	3-Span CCB	Box	12x6	12'x7' Box
N/A					Box	28x3	2-14'x4' Box	N/A		
13	13	Box*	8x5	None - Conveyor	Box*	8x5	8'x5' Box Extensions	Box*	8x5	8'x5' Box Extensions
15	14 - 15	CMP	2-2.5'	Poorly Defined, Overflow	Box	190x5	5-Span CCB	Box	14x2.5	2-7'x3' Box
Opinions of Cost for Typical Sections T1, T2, and T3					T1 & T2		\$9,365,000.00	T1 & T2		\$1,583,000.00
					T3		\$9,903,000.00	T3		\$1,583,000.00

# Right-of-Way Impacts

214th Street  
Brookings County, SD

Page: 1 of 6  
Mile: 0.5 - 1

Figure 12 - Right-of-Way Expansion Visuals



**Legend**

ROW

- Existing
- Proposed 80'
- Proposed 100'
- T1P1
- T1P2
- T2P1
- T2P2
- T3P1
- T3P2

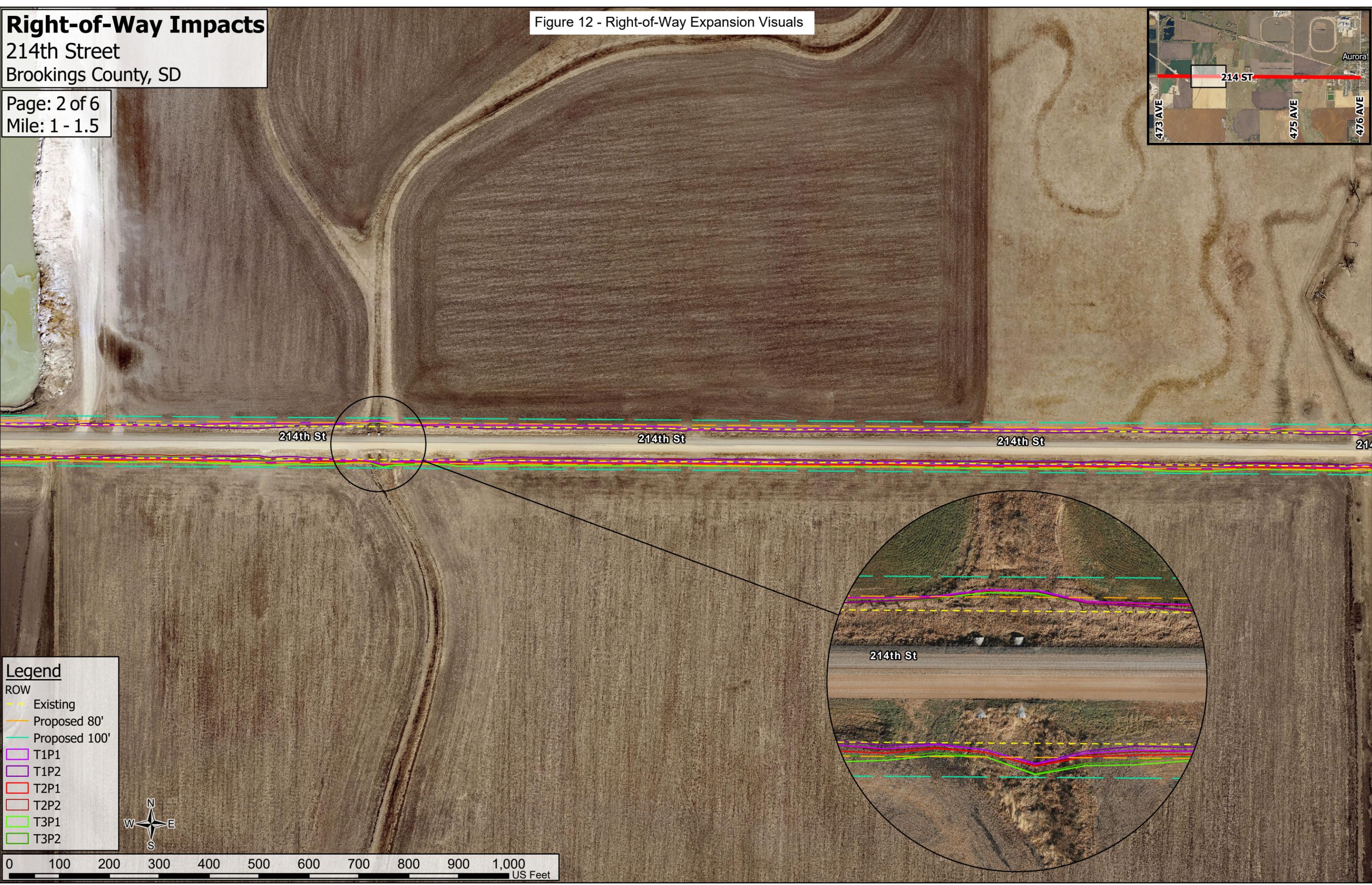


# Right-of-Way Impacts

214th Street  
Brookings County, SD

Page: 2 of 6  
Mile: 1 - 1.5

Figure 12 - Right-of-Way Expansion Visuals



- Legend**
- ROW
- Existing
  - Proposed 80'
  - Proposed 100'
  - T1P1
  - T1P2
  - T2P1
  - T2P2
  - T3P1
  - T3P2

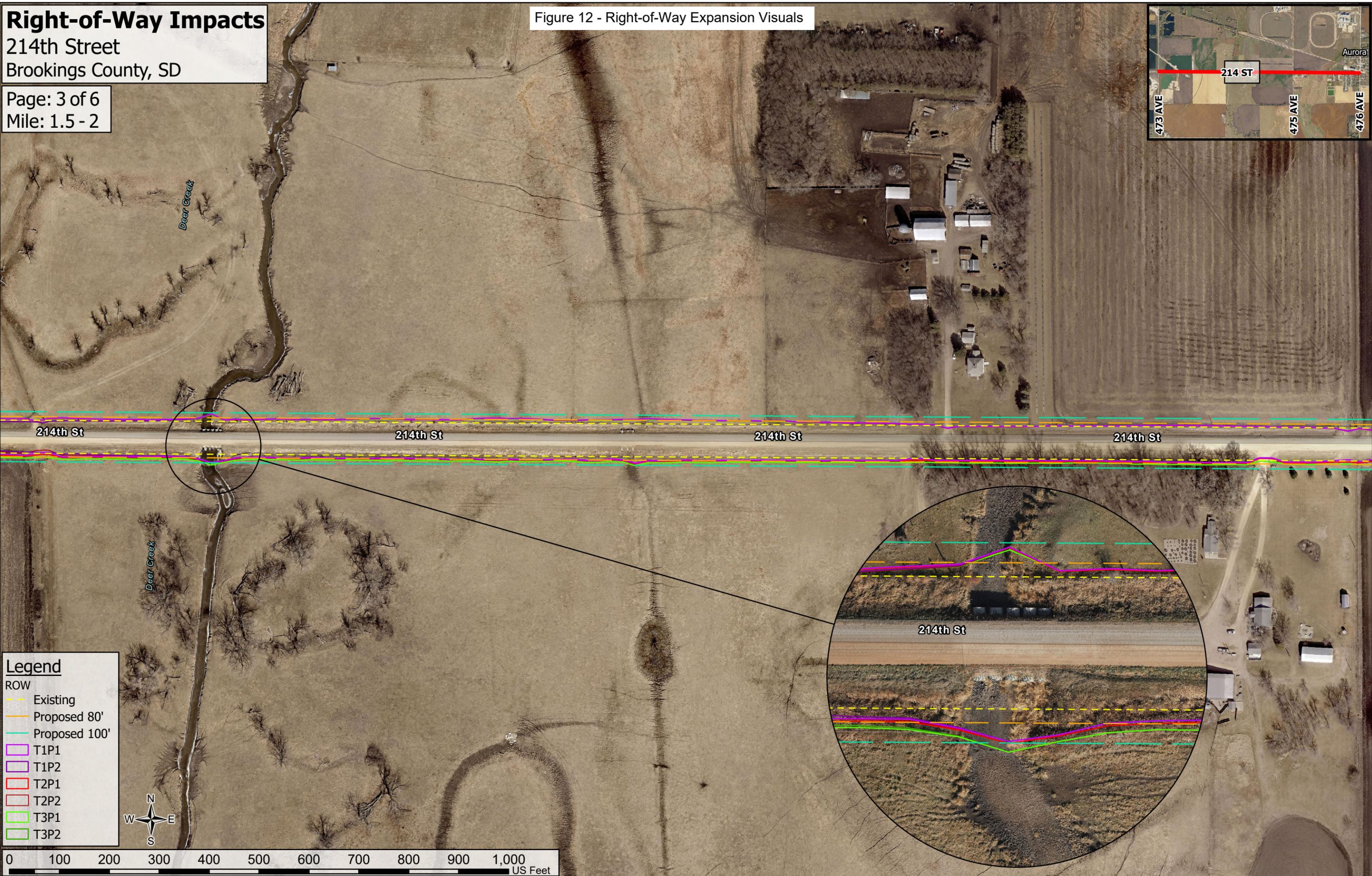


# Right-of-Way Impacts

214th Street  
Brookings County, SD

Page: 3 of 6  
Mile: 1.5 - 2

Figure 12 - Right-of-Way Expansion Visuals



**Legend**

ROW

- Existing (Yellow dashed line)
- Proposed 80' (Orange dashed line)
- Proposed 100' (Cyan dashed line)
- T1P1 (Purple solid line)
- T1P2 (Light purple solid line)
- T2P1 (Red solid line)
- T2P2 (Light red solid line)
- T3P1 (Green solid line)
- T3P2 (Light green solid line)

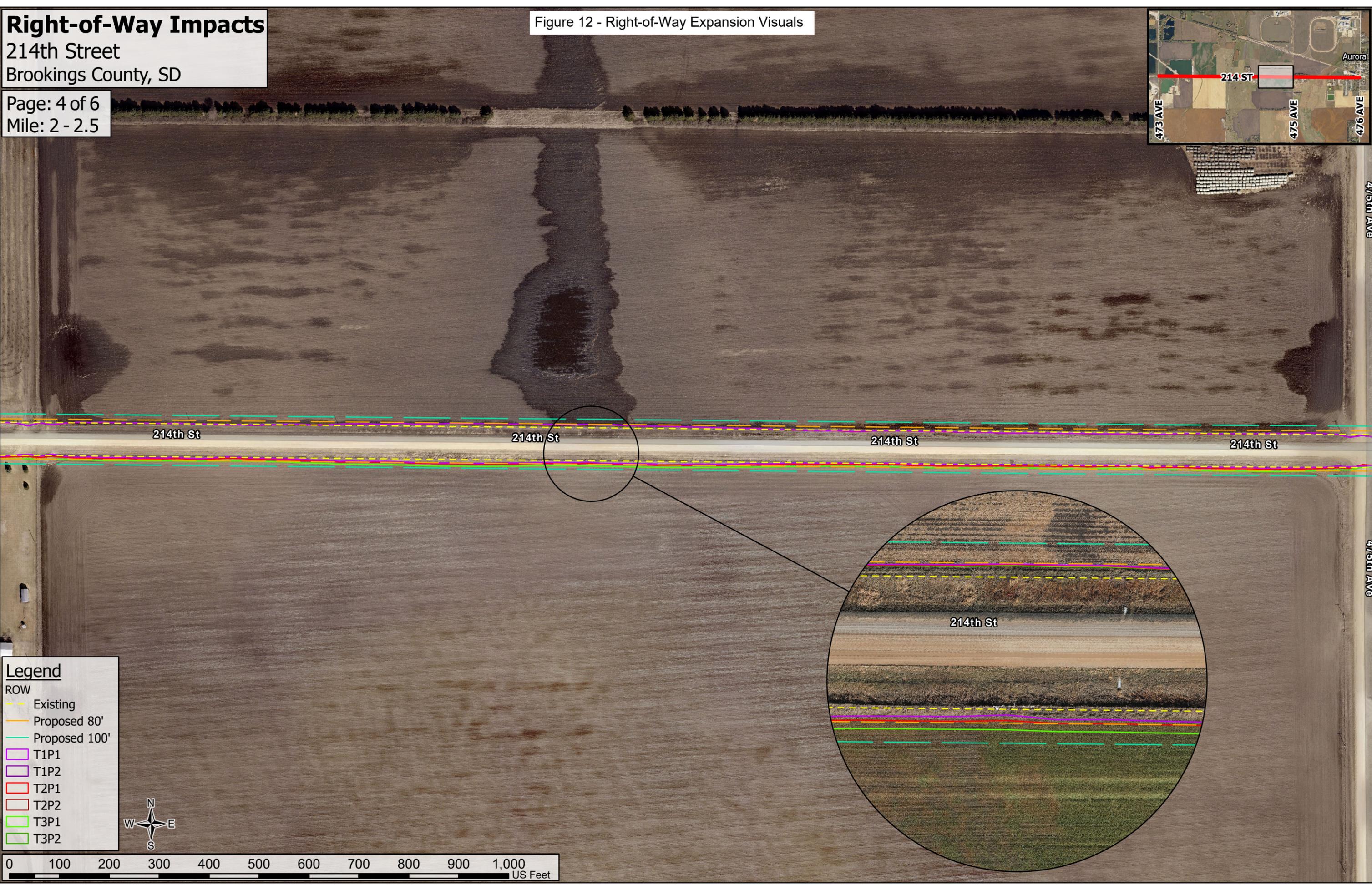


# Right-of-Way Impacts

214th Street  
Brookings County, SD

Page: 4 of 6  
Mile: 2 - 2.5

Figure 12 - Right-of-Way Expansion Visuals



**Legend**

ROW

- Existing
- Proposed 80'
- Proposed 100'
- T1P1
- T1P2
- T2P1
- T2P2
- T3P1
- T3P2

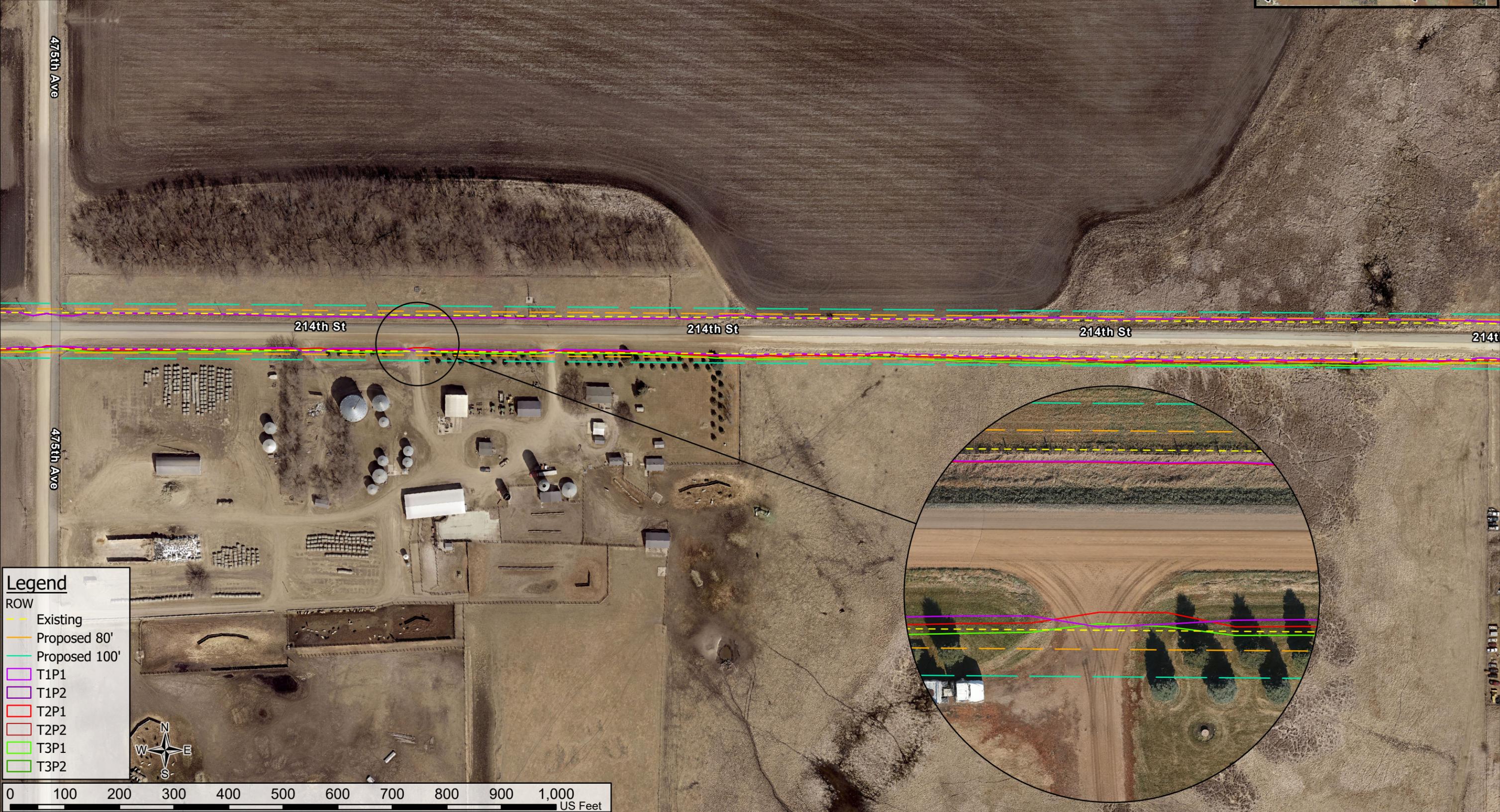


# Right-of-Way Impacts

214th Street  
Brookings County, SD

Page: 5 of 6  
Mile: 2.5 - 3

Figure 12 - Right-of-Way Expansion Visuals



**Legend**

ROW

- Existing (Yellow dashed line)
- Proposed 80' (Orange dashed line)
- Proposed 100' (Cyan dashed line)
- T1P1 (Purple solid line)
- T1P2 (Pink solid line)
- T2P1 (Red solid line)
- T2P2 (Light Red solid line)
- T3P1 (Light Green solid line)
- T3P2 (Green solid line)



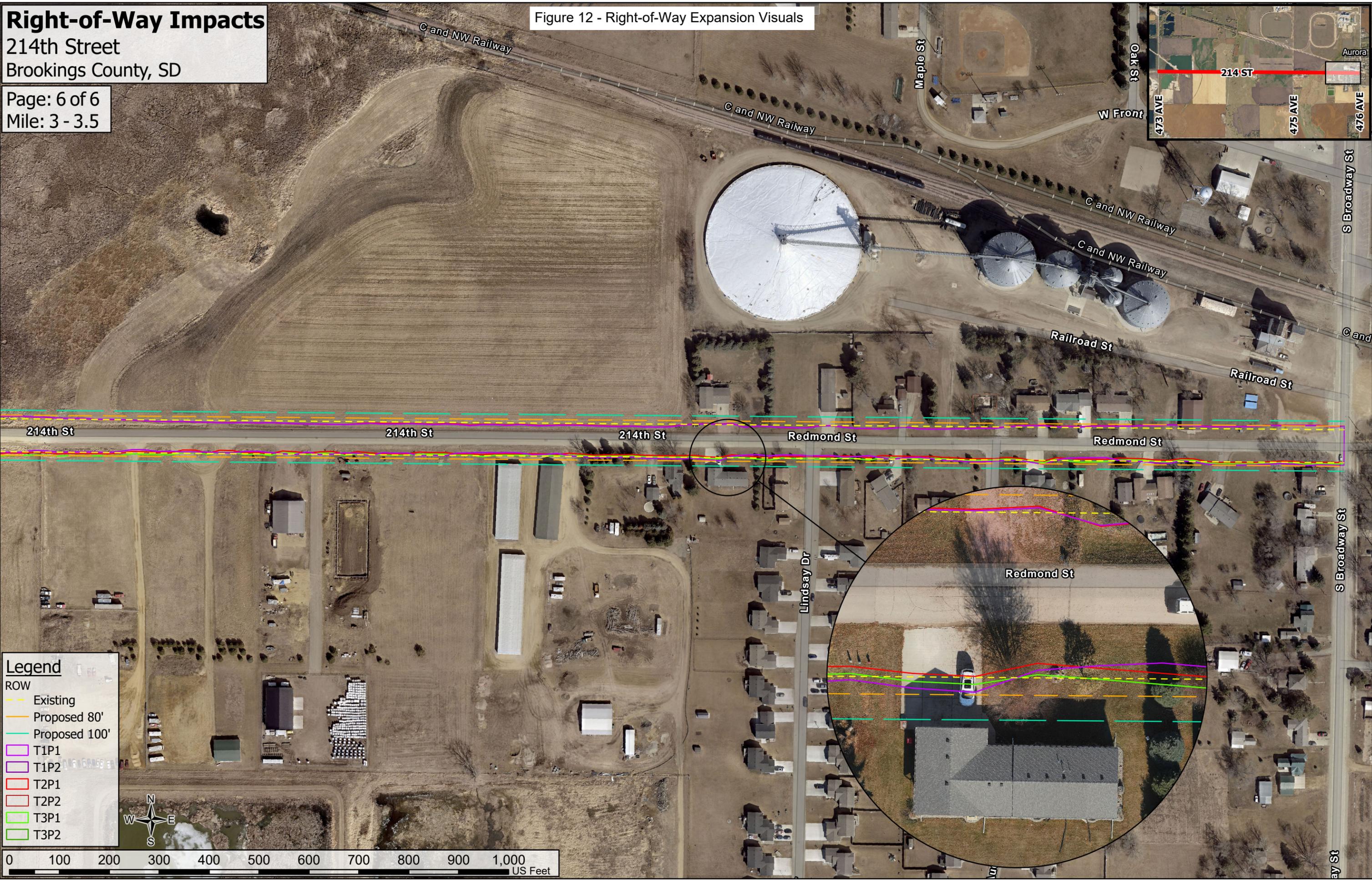
# Right-of-Way Impacts

## 214th Street

Brookings County, SD

Page: 6 of 6  
Mile: 3 - 3.5

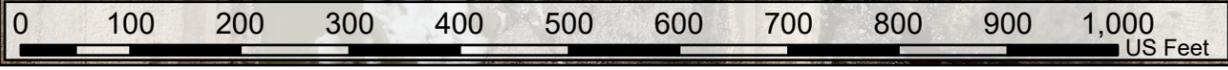
Figure 12 - Right-of-Way Expansion Visuals



**Legend**

ROW

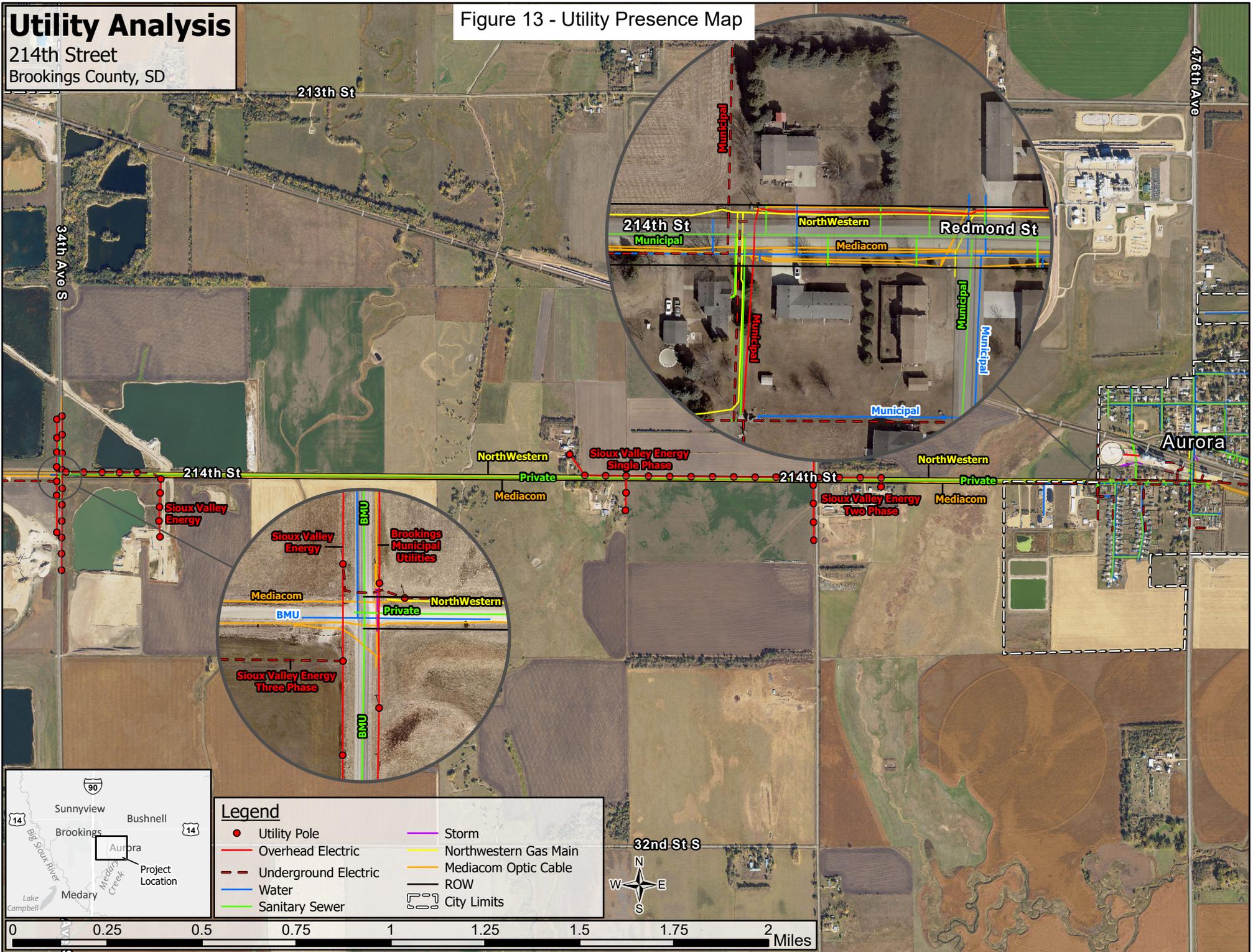
- Existing
- Proposed 80'
- Proposed 100'
- T1P1
- T1P2
- T2P1
- T2P2
- T3P1
- T3P2



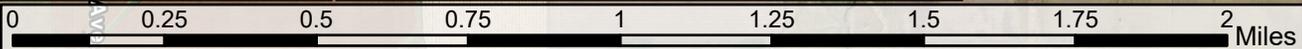
# Utility Analysis

214th Street  
Brookings County, SD

Figure 13 - Utility Presence Map



Legend	
● Utility Pole	— Storm
— Overhead Electric	— Northwestern Gas Main
- - - Underground Electric	— Mediacom Optic Cable
— Water	— ROW
— Sanitary Sewer	City Limits



## Indexing Guide for Alternative Analysis

### Typical Sections

**\*T1** – 2-12' Lanes with 8' paved shoulders with sloped ditch

**T2** – 2-12' Lanes with 2' shoulder, rumble strips, and 8' paved shared use path with sloped ditch

**\*T3** – 2-12' Lanes with 8' paved shoulders, 5' boulevard south at 10% grade and 8' paved shared use path with sloped ditch

**\*\*T4** – 2-12' Lanes with 2' shoulder with sloped ditch

\* - 8' shoulder recommended for safety and traffic flow based on generally accepted roadway design guidance. 6' shoulder minimum recommended by roadway classification in Brookings County Master Transportation Plan

\*\* - 2' shoulder does not meet any minimum criteria for projected AADT or roadway classification and is not recommended

### Roadway Profiles

**P1** – Established based on providing 1' of freeboard to the subgrade shoulder if maintaining the existing culvert layout

**P2** – Established based on reducing the upstream Water Surface Elevation increase to 0.5' or less and no overtopping during 25yr storm event

**P3** – Established to optimize lessening of the impact to the upstream floodplain water surface elevation

**P4** – Existing finished grade centerline elevation

### Structure Layouts

**S1** – Baseline start point by increasing flow area approximately double existing flow area

**S2** – Double the baseline flow area or 4-times existing flow area

**S3** – Comparable structure sizing to railroad bridge just upstream of project area

**S4** – Replaces all structure to adequate length for clear zone requirements and offers generally the same flow area as existing crossing pipes

### Example Indexing

**T1-P1** = Typical Section 1 built on roadway profile 1

**T2-P2-S2** = Typical Section 2 built on roadway profile 2 with structure layout

Figure 14 - Opinions of Cost Summary

<b>Opinion of Probable Project Cost Summary</b>			
<b>Alternative</b>	<b>Cost</b>	<b>Cost Share Local (20%)</b>	<b>Cost Share Federal (80%)</b>
T1-P1-S1	\$11,000,000	\$2,200,000	\$8,800,000
T1-P1-S2	\$14,600,000	\$2,920,000	\$11,680,000
T1-P1-S3	\$20,000,000	\$4,000,000	\$16,000,000
T1-P1-S4	\$10,000,000	\$2,000,000	\$8,000,000
T1-P2/P3-S1	\$10,400,000	\$2,080,000	\$8,320,000
T1-P2/P3-S2	\$14,000,000	\$2,800,000	\$11,200,000
T1-P2/P3-S3	\$19,000,000	\$3,800,000	\$15,200,000
T1-P2/P3-S4	\$9,200,000	\$1,840,000	\$7,360,000
<b>T2</b>			
T2-P1-S1	\$11,800,000	\$2,360,000	\$9,440,000
T2-P1-S2	\$15,300,000	\$3,060,000	\$12,240,000
T2-P1-S3	\$20,500,000	\$4,100,000	\$16,400,000
T2-P1-S4	\$10,600,000	\$2,120,000	\$8,480,000
T2-P2/P3-S1	\$11,200,000	\$2,240,000	\$8,960,000
T2-P2/P3-S2	\$14,700,000	\$2,940,000	\$11,760,000
T2-P2/P3-S3	\$19,700,000	\$3,940,000	\$15,760,000
T2-P2/P3-S4	\$10,000,000	\$2,000,000	\$8,000,000
<b>T3</b>			
T3-P1-S1	\$12,700,000	\$2,540,000	\$10,160,000
T3-P1-S2	\$16,300,000	\$3,260,000	\$13,040,000
T3-P1-S3	\$22,200,000	\$4,440,000	\$17,760,000
T3-P1-S4	\$11,600,000	\$2,320,000	\$9,280,000
T3-P2/P3-S1	\$12,200,000	\$2,440,000	\$9,760,000
T3-P2/P3-S2	\$15,800,000	\$3,160,000	\$12,640,000
T3-P2/P3-S3	\$21,500,000	\$4,300,000	\$17,200,000
T3-P2/P3-S4	\$10,900,000	\$2,180,000	\$8,720,000
<b>T4</b>			
T4-P4-S4	\$5,500,000	\$1,100,000	\$4,400,000

Figure 15 - Evaluation Matrices

**SCENARIO EVALUATION MATRIX A**

Scenario	Project Goals					Geometrics and Typical Sections					Right-of-Way Considerations			Utility Considerations	Potential Cost Considerations (Full Cost not considering cost share)
	Paved Roadway from Brookings to Aurora	Increased Safety for Commuters	Multi-Modal Opportunities for Pedestrian Traffic	Confidence in Long-Term Viability of Roadway	Likely to Meet Design Standards for Vertical Geometrics	Frequency of Likely Roadway Overtopping	Likely to Meet Design Recommendations for Projected AADT	Incorporates Dedicated Shared Use Lane	Likely Need for ROW Expansion	Likely Need for Temporary Construction Easement	Impacts of Grading Limits to Adjacent Properties within City Limits	Likely Impact to Utilities Within Existing ROW	Likely Impact to Utilities Outside Existing ROW	Relationship of Cost to other alternatives.	
<b>T1-P1</b>	YES	HIGH	MED	HIGH	HIGH	LOW	HIGH	LOW	MED	HIGH	MED	HIGH	MED	MED	
<b>T1-P2</b>	YES	HIGH	MED	MED	HIGH	MED	HIGH	LOW	MED	HIGH	MED	HIGH	MED	MED	
<b>T1-P3</b>	YES	HIGH	MED	MED	HIGH	MED	HIGH	LOW	MED	HIGH	MED	HIGH	MED	MED	
<b>T2-P1</b>	YES	HIGH	HIGH	HIGH	HIGH	LOW	HIGH	HIGH	MED	HIGH	MED	HIGH	MED	HIGH	
<b>T2-P2</b>	YES	HIGH	HIGH	MED	HIGH	MED	HIGH	HIGH	MED	HIGH	MED	HIGH	MED	MED	
<b>T2-P3</b>	YES	HIGH	HIGH	MED	HIGH	MED	HIGH	HIGH	MED	HIGH	MED	HIGH	MED	MED	
<b>T3-P1</b>	YES	HIGH	HIGH	HIGH	HIGH	LOW	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	MED	HIGH	
<b>T3-P2</b>	YES	HIGH	HIGH	MED	HIGH	MED	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	MED	HIGH	
<b>T3-P3</b>	YES	HIGH	HIGH	MED	HIGH	MED	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH	MED	HIGH	
<b>T4-P4</b>	YES	LOW	LOW	LOW	LOW	HIGH	LOW	LOW	LOW	LOW	LOW	HIGH	LOW	LOW	

Figure 15 - Evaluation Matrices

**SCENARIO EVALUATION MATRIX B**

Scenario	Roadway Overtopping Based on Model Outputs			Upstream Impacts			Downstream Impacts			Potential Cost Considerations (Full Cost not considering cost share)
	10 – Year Storm Event Hydrology	25 – Year Storm Event Hydrology	100 – Year Storm Event Hydrology	Water Surface Elevation Change (100 – Year Storm Event Hydrology)	Potential for Floodplain Development Permit (FDP), CLOMR, or LOMR	Change in Inundation Limits of Productive Land	Water Surface Elevation Change (100 – Year Storm Event Hydrology)	Significance of Change to Downstream Flows	Change in Inundation Limits of Productive Land	
P1-S1	NO	NO	YES	HIGH	FDP, CLOMR, LOMR	HIGH	HIGH	HIGH	HIGH	HIGH
P1-S2	NO	NO	YES	MED	FDP, CLOMR, LOMR	MED	MED	MED	MED	HIGH
P1-S3	NO	NO	YES	MED	FDP, CLOMR, LOMR	MED	MED	MED	MED	HIGH
P1-S4	NO	YES	YES	HIGH	FDP, CLOMR, LOMR	HIGH	HIGH	HIGH	HIGH	MED
P2-S1	NO	NO	YES	HIGH	FDP, CLOMR, LOMR	HIGH	HIGH	HIGH	HIGH	MED
P2-S2	NO	NO	YES	MED	FDP, CLOMR, LOMR	MED	MED	MED	MED	HIGH
P2-S3	NO	NO	YES	MED	FDP, CLOMR, LOMR	MED	MED	MED	MED	HIGH
P2-S4	NO	YES	YES	HIGH	FDP, CLOMR, LOMR	HIGH	HIGH	HIGH	HIGH	MED
P3-S1	NO	NO	YES	HIGH	FDP, CLOMR, LOMR	HIGH	HIGH	HIGH	HIGH	MED
P3-S2	NO	NO	YES	LOW	FDP, LOMR	LOW	LOW	LOW	LOW	HIGH
P3-S3	NO	NO	YES	LOW	FDP, LOMR	LOW	LOW	LOW	LOW	HIGH
P3-S4	NO	YES	YES	HIGH	FDP, CLOMR, LOMR	HIGH	HIGH	HIGH	HIGH	MED
P4-S4	YES	YES	YES	LOW	NONE	LOW	LOW	LOW	LOW	LOW

# APPENDIX A - TRAFFIC PLANNING ANALYSIS REPORT

# Technical Memo

Date: Tuesday, February 20, 2024

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Project: Brookings County 214<sup>th</sup> Street Feasibility and H&H Study

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To: Study Team

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From: HDR

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Subject: Traffic Planning Analysis

## Introduction

The purpose of this memo is to document the traffic planning analysis for the 214<sup>th</sup> Street corridor between 34<sup>th</sup> Avenue and 476<sup>th</sup> Avenue located in Brookings County between the Cities of Brookings and Aurora. This analysis was conducted in conjunction with the Brookings County 214<sup>th</sup> Street Feasibility and H&H Study and was performed to identify long-range street section needs and traffic planning recommendations for 214<sup>th</sup> Street due to the anticipated increased traffic resulting from the opening of the I-29 Exit 130 (20<sup>th</sup> Street S) interchange in 2023.

The traffic planning analysis reviewed the following design elements:

- Crash history review for study intersections and road segments
- Peak hour and daily traffic volumes and operations for the following scenarios:
  - 2023 Existing Conditions
  - 2045 Design Year
- Street section recommendations
  - Roadway Widths
  - Turn Lanes
  - Intersection Traffic Control
  - Multimodal Improvements
  - Access Management

The study area, shown in **Figure 1**, encompasses 214<sup>th</sup> Street between 34<sup>th</sup> Avenue and 476<sup>th</sup> Avenue and the following intersections:

- 214<sup>th</sup> Street & 34<sup>th</sup> Avenue
- 214<sup>th</sup> Street / Redmond Road & 476<sup>th</sup> Avenue



# Crash History Review

Crash history was reviewed to identify crash locations along the 214<sup>th</sup> Street study corridor. Crash records from the State of South Dakota crash database for years 2018 to 2022 (the 5 most recent years of complete data) were obtained via the *South Dakota Department of Transportation (SDDOT) Intersection Crash Diagram Export and Local Roads Map Viewer and Data Download*. The following sections summarize relevant crash characteristics for study intersections and corridor segments.

**Figure 2** depicts the study area crash records derived from the *SDDOT Local Roads Map Viewer and Data Download*. It should be noted that the Local Roads Map Viewer does not show data from 2018 and thus that data was reviewed via other sources. Intersection crash diagrams are included in the **Appendix**.



**Figure 2: 214<sup>th</sup> Street Corridor Crash Records**

## Intersections

Crashes occurring within a 250 ft. radius and defined as intersection-related were categorized as an intersection crash for this review. Zero crashes were reported at the 214<sup>th</sup> Street & 34<sup>th</sup> Avenue and Redmond Road & 476<sup>th</sup> Avenue intersections. Two crashes were reported at the 214<sup>th</sup> Street & 475<sup>th</sup> Avenue intersection and are detailed in the bulleted list below.

- 214<sup>th</sup> Street & 475<sup>th</sup> Avenue (2 total crashes)
  - No fatal or incapacitating injury crashes
  - 1 non-incapacitating injury crash due to a failure to yield between westbound through and southbound through vehicle movements
  - 1 property damage only (PDO) crash due to distracted driving between eastbound through and northbound through vehicle movements
  - Both crashes were right angle collisions
  - Currently, no stop signs are present at any intersection approach. Consider the installation of stop signs on the northbound and southbound approaches to improve safety and prioritize eastbound and westbound movements.

## Corridor Segments

Crashes identified as non-junction (including wild-animal hit crashes) were categorized as a corridor segment crash for this review. A total of two crashes were reported and are detailed in the following bulleted list.

- 214<sup>th</sup> Street Corridor Segment (2 total crashes)
  - No fatal or severe injury crashes
  - 1 single vehicle crash involving wet, icy, and/or snowy road conditions that resulted in a possible injury
    - Location: approximately 1 mile east of 34<sup>th</sup> Avenue
  - 1 single vehicle / wild animal hit crash
    - Location: approximately 0.5 miles west of 475<sup>th</sup> Avenue

## Traffic Volumes and Forecasts

Peak hour and daily traffic volume forecasts were prepared to aid traffic planning efforts and the determination of street section elements for the 214<sup>th</sup> Street study corridor (see 'Street Section and Traffic Planning' section for further discussion). The following volume scenarios were developed:

- 2023 Existing Conditions
- 2045 Design Year

## Data Sources

### Intersection Turning Movements

13-hour intersection turning movement counts were utilized / collected for the following intersections:

- 214<sup>th</sup> Street & 34<sup>th</sup> Avenue: Previously collected during the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study* (prior to the opening of the interchange)
  - Note: It is anticipated that if updated counts are needed for a future grant application, those counts would occur after the interchange is open
- Redmond Road & 476<sup>th</sup> Avenue: Collected by HDR on February 8, 2023 for this study

Overall corridor peak hours were defined within the traffic counts and generally reflect:

- AM: 7:15 – 8:15 a.m.
- PM: 4:30 – 5:30 p.m.

Specific peak hours of individual intersections or corridor segments may vary by 15 minutes before or after the study area peak hour. For the purposes of this study, the peak hour volumes from each location were used in the development of the existing volume data set.

Truck percentages are based on available truck counts within the sources of data.

## Roadway Segment Volumes

24-hour daily traffic counts (segment counts), previously collected by the South Dakota Department of Transportation (SDDOT) and for the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*, were utilized for this study. Segments without 24-hour daily traffic counts were estimated based on typical 'K' factors (the percentage of daily traffic occurring in a peak hour).

## Forecast Methodology

### Growth Rates

The following sources were utilized to determine future traffic growth to year 2045:

- SDDOT-derived growth rates for Brookings County rural arterial / collector / local roadways
- *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study* forecasts

### Seasonal Adjustment

All volumes were factored to a September design season (reflective of an Average Daily Traffic volume, or ADT).

### Forecast Process

Traffic forecasts were developed using *NCHRP 765: Analytical Travel Forecasting Approaches for Project-Level Planning and Design* methodology. Future-year daily volumes were refined using existing segment counts and *NCHRP 765* factoring procedures. Future-year intersection peak hour turning movement volumes were developed using the *NCHRP 765* 'Iterative Procedure – Directional Method'. Peak hour volumes were smoothed and/or balanced between intersections. In addition, forecast volumes were coordinated with forecasts included in the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*.

The following process was used to develop the Existing and future-year traffic volumes for the study:

#### A. 2023 Existing Conditions Volumes

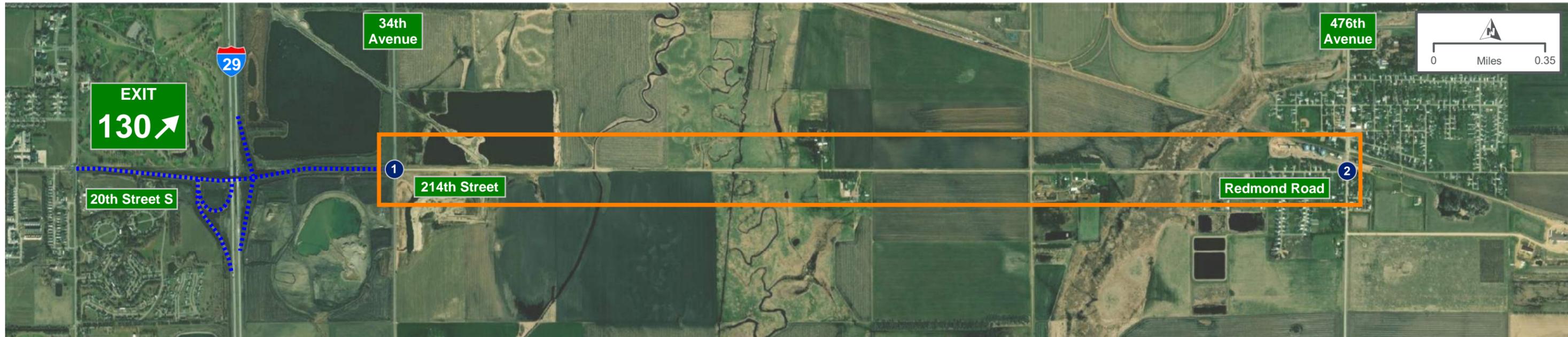
1. Identify baseline daily segment and intersection peak hour volumes
  - a. Segments: Daily count volumes previously collected by SDDOT and for the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*
  - b. Intersections: HDR-collected and previously collected for the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*
2. Apply seasonal factor to all counts to a September design season
3. Smooth and/or balance intersection peak hour volumes; smooth daily volumes

#### B. 2045 Design Year Volumes

1. Initial traffic growth to year 2045
  - a. Coordinate with 2045 Build condition volumes forecast, included in *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*, for 214<sup>th</sup> Street & 34<sup>th</sup> Avenue intersection

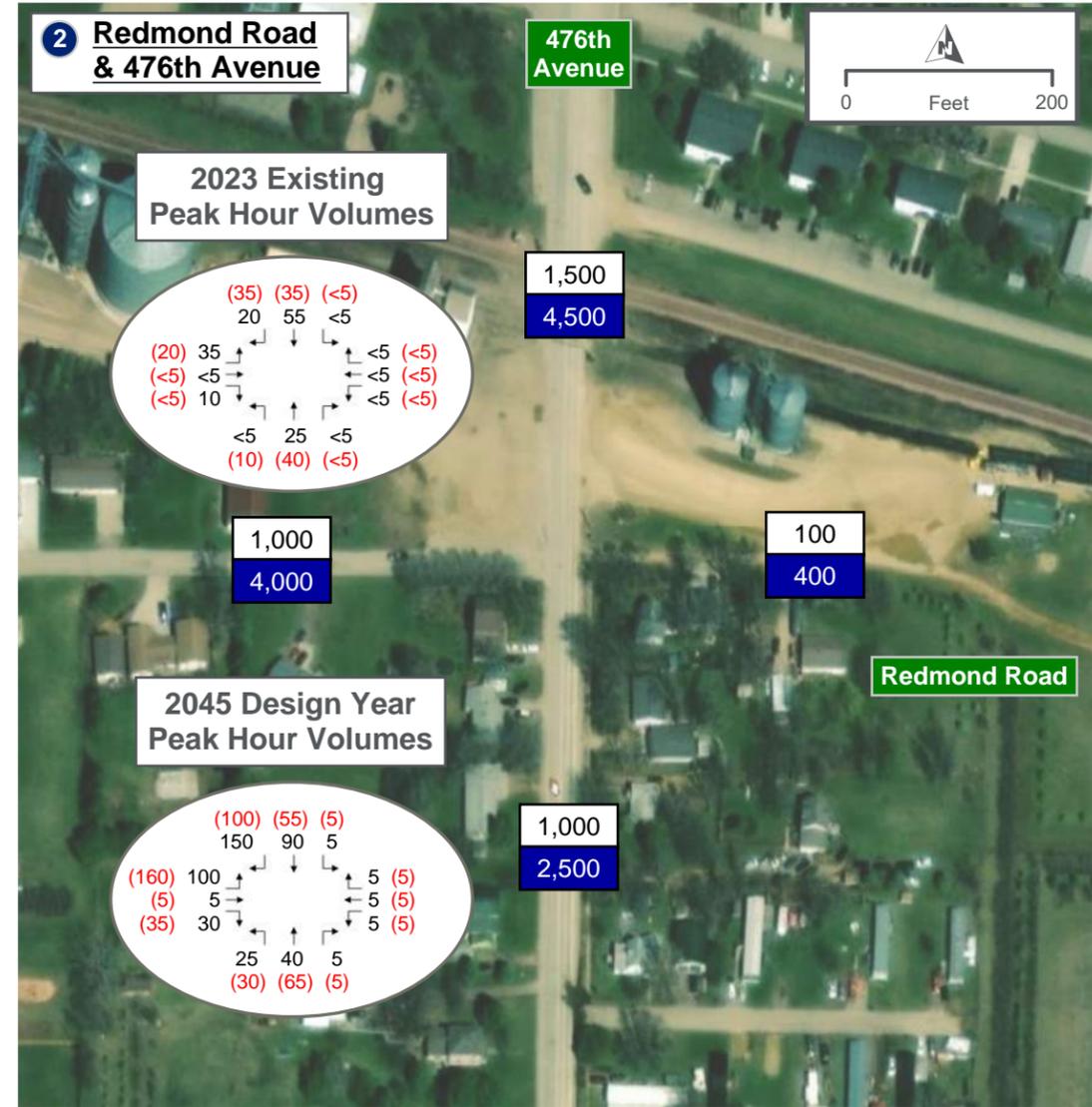
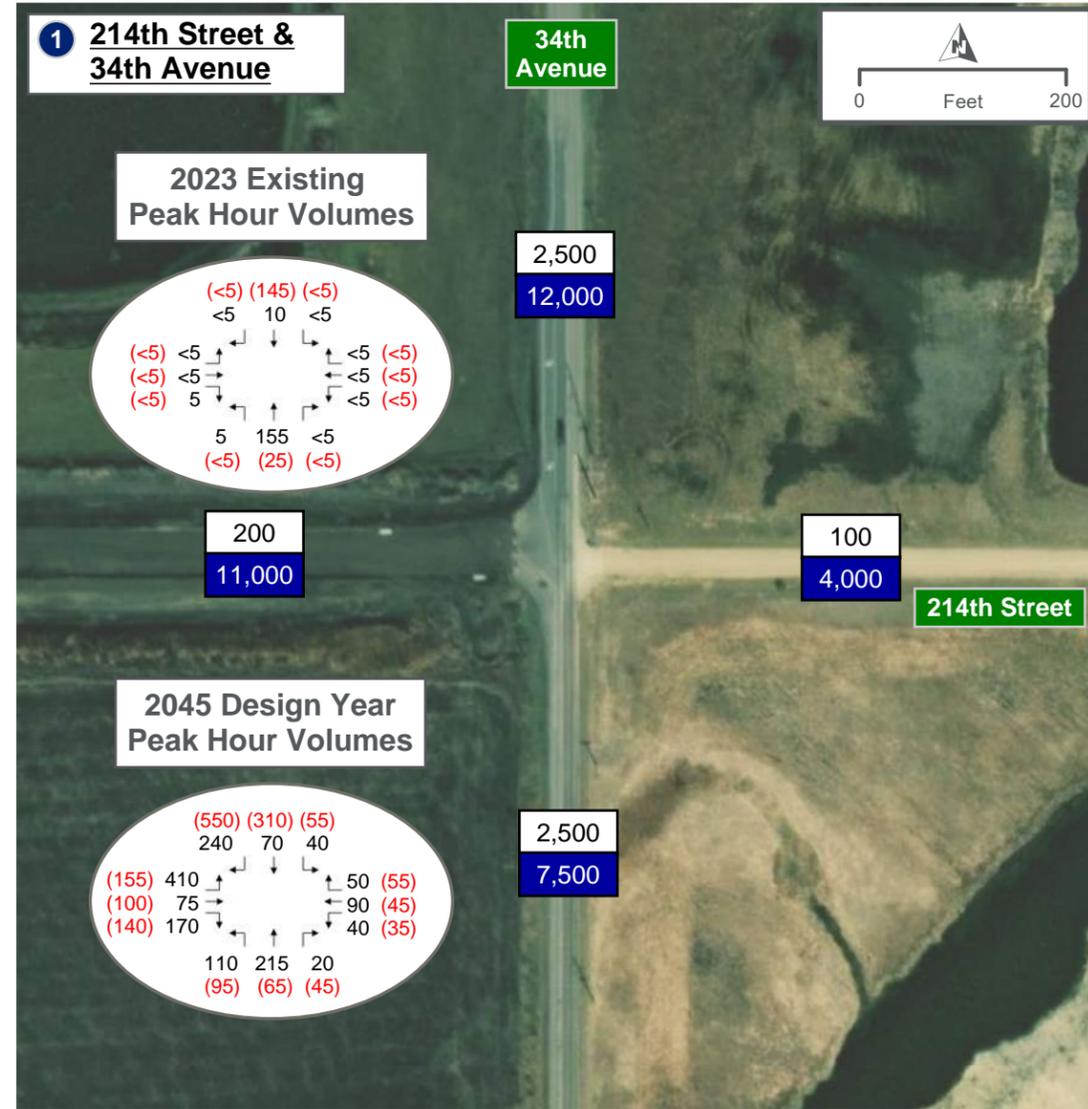
- b. Use SDDOT-derived growth rate to adjust volumes to 2045 year for Redmond Road & 476<sup>th</sup> Avenue
2. Directional Adjustment (at Redmond Road & 476<sup>th</sup> Avenue intersection)
  - a. Reassign the existing eastbound left turn and southbound right turn movement directionality to reflect greater use of 214<sup>th</sup> Street by Aurora commuting traffic following the opening of the I-29 Exit 130 (20<sup>th</sup> Street South) interchange
3. Regional Traffic Shift (north of Aurora)
  - a. Reassign 40 percent of peak hour two-way traffic to eastbound left turn and southbound right turn movements to reflect greater use of 214<sup>th</sup> Street by regional traffic north of Aurora following the opening of the I-29 Exit 130 (20<sup>th</sup> Street South) interchange
4. Aurora Growth Adjustment
  - a. Reallocate 15 percent of eastbound left turn and southbound right turn movement traffic to eastbound right turn and northbound left turn movements to reflect anticipated growth south of Aurora and greater use of 214<sup>th</sup> Street by that traffic following the opening of the I-29 Exit 130 (20<sup>th</sup> Street South) interchange
5. Smooth and/or balance intersection peak hour volumes; smooth daily volumes

Daily and peak hour traffic volumes are summarized in **Figure 3**.



**LEGEND**

- 1 Study Intersection
  - Study Road Segment
  - I-29 Exit 130 Interchange and 20th Street S Proposed Configurations
- Traffic Volumes
- AM (PM) Peak Hour Traffic Volumes
- Daily Volumes:
- 500 2023 Existing Conditions
  - 2,000 2045 Design Year



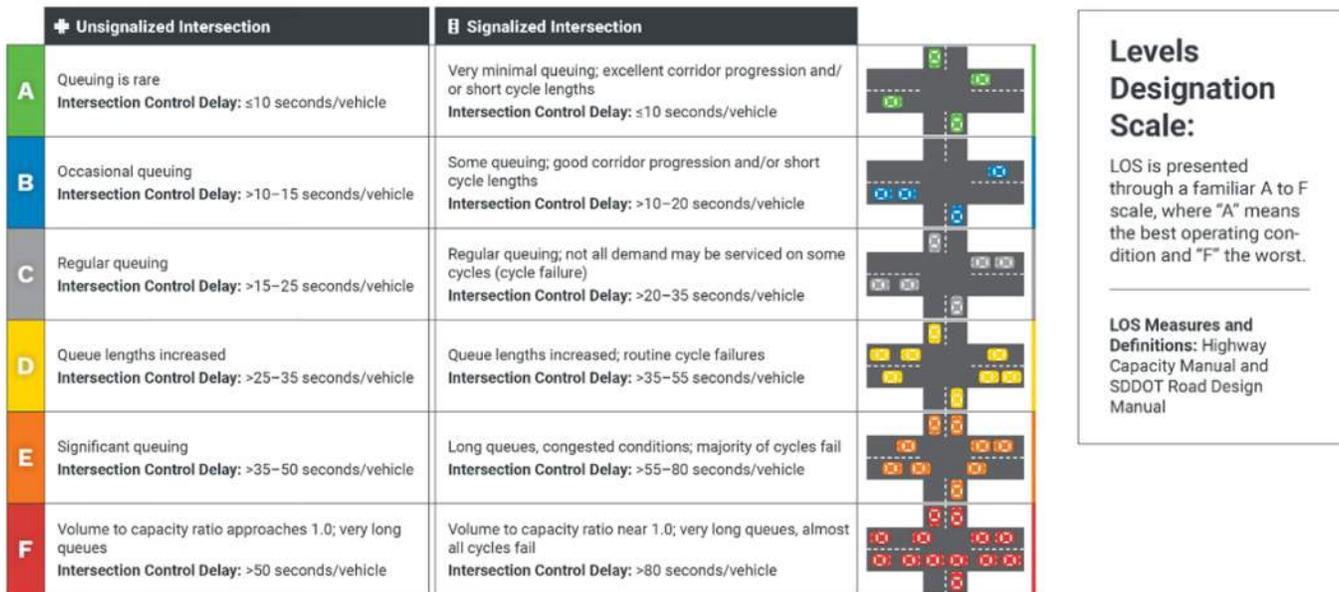
**DAILY AND PEAK HOUR TRAFFIC VOLUMES**



# Traffic Operations Analysis

## Operational Performance

Operational performance of intersections is evaluated in terms of quality of service, which describes how well a transportation facility operates from a traveler’s perspective. Quality of service is typically measured with ‘Level of Service’ (LOS), which is presented by a letter grade similar to those used in school. A summary of LOS measures for different roadway facilities pertinent to this study are provided in **Figure 4**. Peak hour LOS is calculated for study area intersections using Synchro version 11 and methodologies described in the Highway Capacity Manual 7<sup>th</sup> Edition.



Note: Unsignalized intersection control delay shown in figure for overall (or weighted) intersection delay. Two-way stop-control delay (TWSC) is measured from the worst-case stop-controlled approach with the same average delay (seconds/vehicle) thresholds.

**Figure 4: LOS Descriptions**

## Traffic Operations Analysis

Traffic operations were analyzed for the following scenarios:

- 2023 Existing Conditions
- 2045 Design Year

Operational results for each scenario are summarized in **Table 1** and **Table 2**. Both study intersections were analyzed under No Build and Build conditions in the 2045 Design Year to indicate the need for intersection improvements. Locations that do not meet acceptable operations and LOS are noted in **bold Orange text** in the tables.

Traffic volumes, intersection LOS, and recommended lane configurations and traffic control are shown in **Figure 5**. Based on the analysis, 2045 Design Year recommended lane configuration and intersection control modifications for study intersections are noted in **Bold Orange** in the following lists.



**Table 1: Study Intersection Operations – 2023 Existing Conditions**

Intersection	Intersection Control	Measure	AM LOS Delay / LOS	PM LOS Delay / LOS
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue</b>	TWSC	Overall: (WCSC):	0.4 / A (8.4 / A)	0.1 / A (9.8 / A)
<b>Redmond Road &amp; 476<sup>th</sup> Avenue</b>	TWSC	Overall: (WCSC):	2.9 / A (9.3 / A)	2.0 / A (9.5 / A)

**Table 2: Study Intersection Operations – 2045 Design Year**

Intersection	Intersection Control	Measure	AM LOS Delay / LOS	PM LOS Delay / LOS
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue</b> (no build)	TWSC	Overall: (WCSC):	<b>560.7 / F</b> <b>(1286.5 / F)</b>	<b>264.6 / F</b> <b>(967.9 / F)</b>
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue</b> (with additional turn lanes)	TWSC	Overall: (WCSC):	<b>203.4 / F</b> <b>(464.5 / F)</b>	<b>56.1 / F</b> <b>(194.7 / F)</b>
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue</b> (with additional turn lanes)	Signal	Overall:	13.1 / B	12.4 / B
<b>Redmond Road &amp; 476<sup>th</sup> Avenue</b> (no build)	TWSC	Overall: (WCSC):	4.3 / A (11.9 / B)	6.2 / A (12.6 / B)
<b>Redmond Road &amp; 476<sup>th</sup> Avenue</b> (with additional turn lanes)	TWSC	Overall: (WCSC):	4.0 / A (10.9 / B)	5.8 / A (11.8 / B)

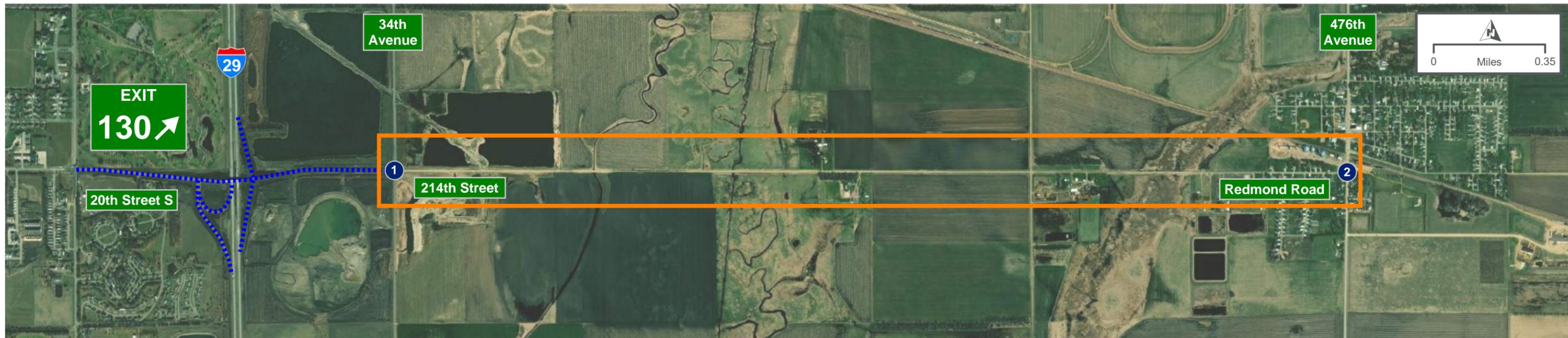
Note: Intersections analyzed under two-way stop control (TWSC) were observed with stop signs on the eastbound / westbound approaches.

### 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

- Construct volume-warranted and operations-based turn lanes
- Approach lane configuration and traffic control:
  - **EB: LT, T/RT**
  - **WB: LT, T/RT**
  - **NB: LT, T/RT**
  - **SB: LT, T, RT**
  - Signalize intersection (when warranted)
  - Monitor approaches with stop control based on interim traffic volumes and patterns between 2023 and 2045 (prior to signalization):
    - Consider switching approaches with stop control (if needed)
    - Consider install all-way stop control (if needed)

### Redmond Road & 476<sup>th</sup> Avenue Intersection

- Construct volume-warranted southbound right turn lane
- Approach lane configuration and intersection control:
  - EB: LT/T/RT
  - WB: LT/T/RT
  - NB: LT/T/RT
  - **SB: LT/T, RT**
  - Maintain stop control on eastbound and westbound approaches



**LEGEND**

- 1** Study Intersection
- Study Road Segment
- I-29 Exit 130 Interchange and 20th Street S Proposed Configurations

**Traffic Volumes**

AM (PM) Peak Hour Traffic Volumes

Daily Volumes:

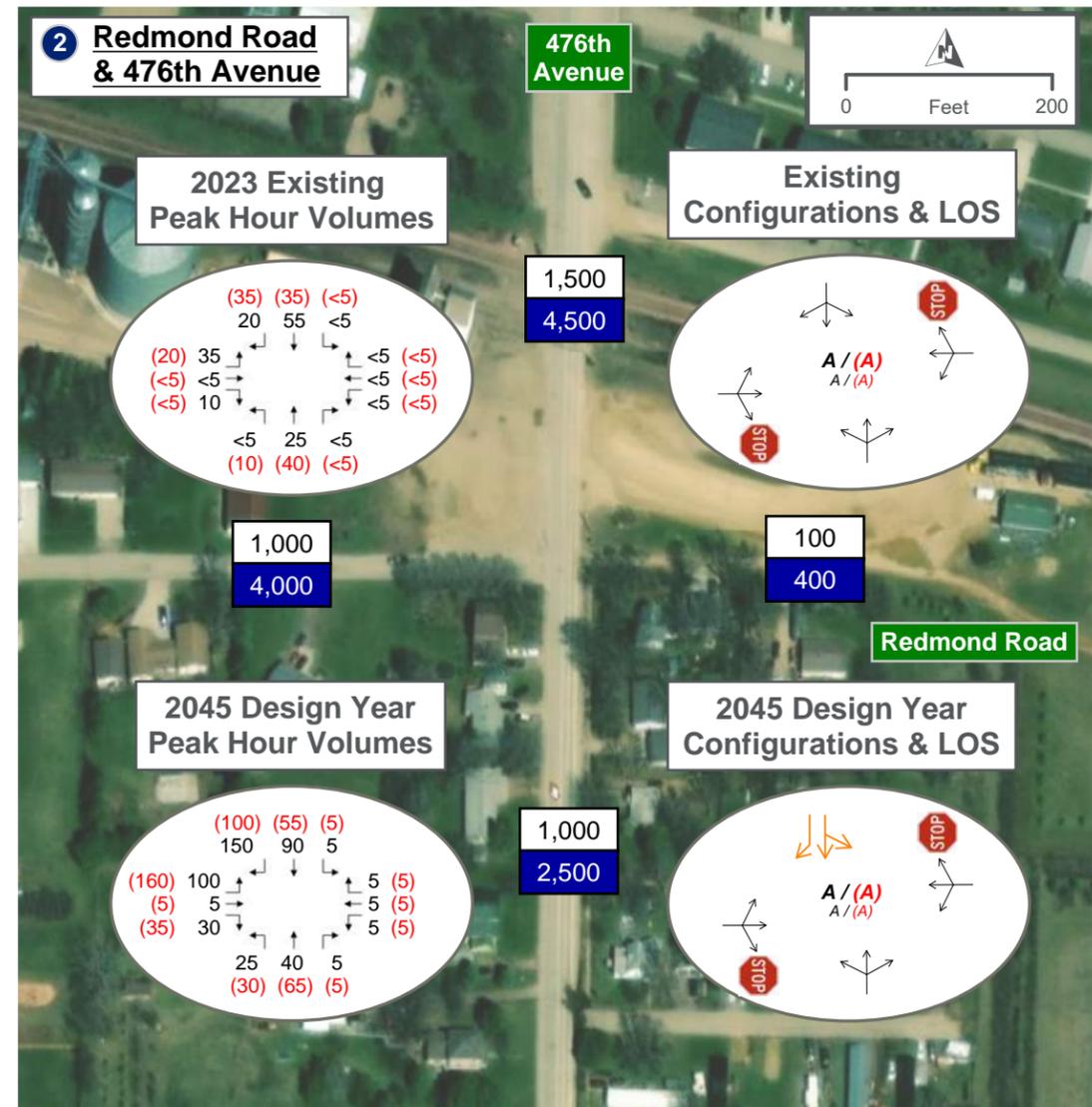
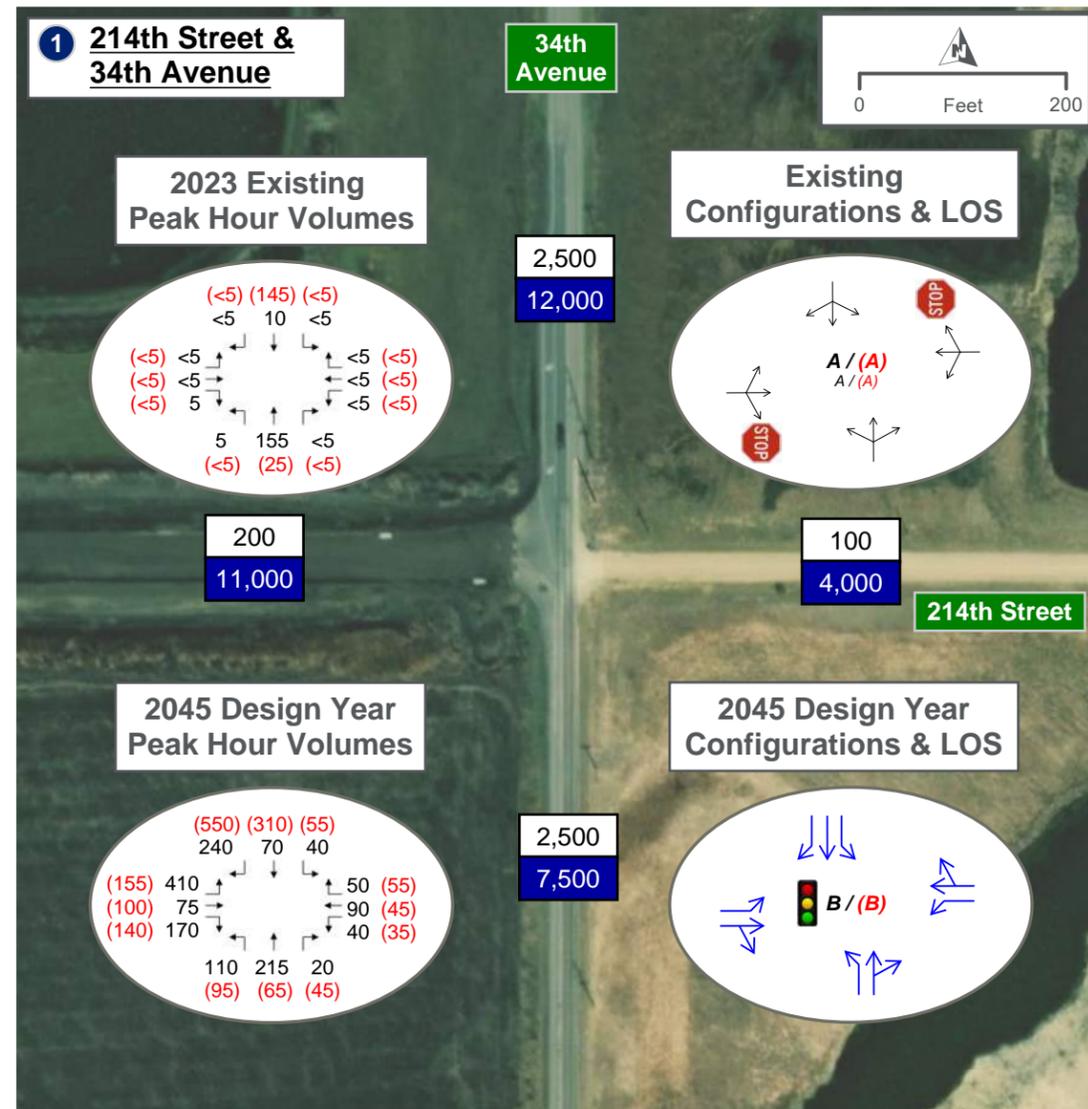
- 500 2023 Existing Conditions
- 2,000 2045 Design Year

**Intersection Control / Level of Service (LOS)**

- STOP Stop Control (Stop Sign)
  - Overall Intersection **A / (A)**
  - Worst-case Approach **C / (C)**
- Traffic Signal
  - Overall Intersection **A / (A)**

**Intersection Lane Configurations**

- Existing Lane Configuration
- I-29 Exit 130 (20th Street S) IJR Recommended Lane Configuration
- Recommended Intersection Lane Configuration



TRAFFIC VOLUMES, LOS, AND RECOMMENDED LANE CONFIGURATIONS AND TRAFFIC CONTROL



# Street Section and Traffic Planning

Based on the 2045 Design Year traffic volumes, preliminary street section design recommendations for 214<sup>th</sup> Street were developed to provide long-range corridor design guidance using the following sources:

- *Brookings County Master Transportation Plan (MTP)*
- Federal Highway Administration (FHWA)
  - *Highway Safety Manual (HSM)*
  - *Small Town and Rural Multimodal Networks*
- *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*
- National Association of City Transportation Officials (NACTO)
  - *Designing for All Ages & Abilities*
- South Dakota Department of Transportation (SDDOT)
  - *Road Design Manual*
  - *Local Roads Plan*
- Transportation Research Board (TRB)
  - *Access Management Manual*

## Roadway Width

Engineering guidance for the number of lanes and roadway lane and shoulder widths are based on several design considerations including projected traffic volumes, roadway functional classification, speed, safety, and vehicle user type. With these considerations in mind, the following design assumptions were made for the recommendation process:

Design Assumptions:

- Traffic Volumes: 4,000 ADT (2045 Design Year)
- Functional Classification: Rural Minor Arterial (*Brookings County MTP Major Roads Plan*)
  - Connect smaller activity center with higher functioning route (e.g. state highways)
  - Serve medium-length to long distance trips
  - Serve higher volumes of traffic at higher speeds
- Speed:
  - Design Speed: 60 mph
  - Posted Speed: 55 mph
- Anticipated Vehicle Users: Commuters and Trucks

Based on the design assumptions, the following design guidance is recommended:

### **Number of Through Lanes: 2 Lanes**

*Brookings County MTP* Guidance:

- 2 lanes based on 'minor arterial' typical section (*Figure 11*, also shown in **Figure 6**)

*SDDOT Road Design Manual* Guidance:

- 2 lanes generally provide adequate capacity for roadways with anticipated traffic volumes less than 8,000 ADT (*Table 15-9*)

Recommendation Summary:

- Construct 214<sup>th</sup> Street as a rural 2-lane highway based on 2045 Design Year ADT and engineering guidance

**Lane Width: 12 ft.**

*Brookings County MTP* Guidance:

- 12 ft. lane widths based on 'minor arterial' typical section

*SDDOT Road Design Manual* Guidance:

- 12 ft. lane widths for all rural highways due to the 2-lane rural highway type, projected 2045 Design Year ADT, design speed, and the potential severity of a potential crash (*Table 7-1*)
- Minimal reduction in highway capacity occurs between 12 and 11 ft. lanes but 10 ft. lanes and narrower may have a significant loss in highway capacity
- Research indicates there is only a slight decrease in safety when providing 11 ft. lanes compared to 12 ft. lanes. However, crashes can be expected to increase more significantly when 10 ft. or narrower lanes are provided

*SDDOT Local Roads Plan* Guidance:

- Minimum width of traveled way of 24 ft for 60 mph design speed and projected design ADTs over 2,000 (*Exhibit 5-5*)

*Highway Safety Manual (HSM)* Guidance:

- Based on crash modification factors (CMFs) included in the *HSM*, the following percentage increases in crashes are expected for rural 2-lane roadways with greater than 2,000 ADT under these scenarios:
  - Reduction from 12 ft. to 11 ft. lanes = 5% expected increase in crashes
  - Reduction from 12 ft. to 10 ft. lanes = 30% expected increase in crashes

Recommendation Summary:

- Install 12 ft. lanes based on roadway type, 2045 design year ADT, design speed, anticipated vehicle user type, safety benefits, and engineering guidance

**Shoulder Width: 8 ft. (6 ft. if ROW is constrained)**

*Brookings County MTP* Guidance:

- 6 ft. shoulder widths based on 'minor arterial' typical section

*SDDOT Road Design Manual and Local Roads Plan* Guidance:

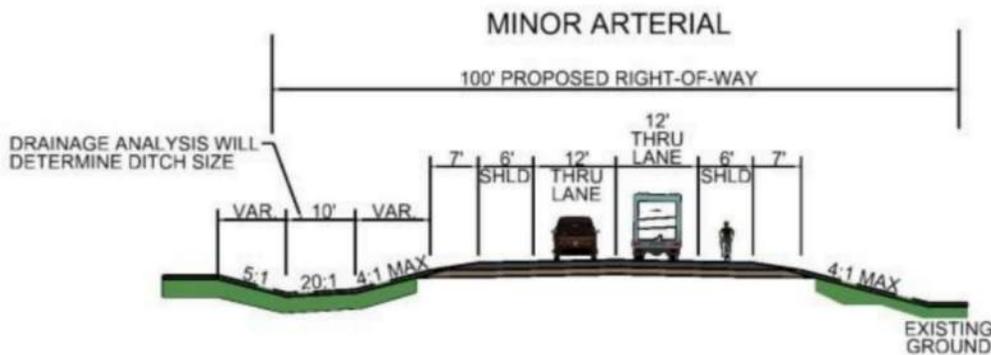
- 8 ft. shoulder widths due to the 2-lane rural highway type, projected 2045 Design Year ADT, and design speed
- 8 ft. shoulder widths for 60 mph design speed and projected design ADTs over 2,000

*Highway Safety Manual (HSM) Guidance:*

- Based on crash modification factors (CMFs) included in the *HSM*, the following percentage increases or decreases in crashes are expected for rural 2-lane roadways with greater than 2,000 ADT under these scenarios:
  - 6 ft. shoulder width: 0% expected increase/decrease in crashes (base condition)
  - Increase from 6 ft. to 8 ft. shoulder width: 13% expected decrease in crashes

*Recommendation Summary:*

- Install 8 ft. shoulders along study corridor if right-of-way (ROW) is available based on design speed, 2045 design year ADT, safety benefits, and engineering guidance. If ROW is constrained, consider 6 ft. shoulders instead.
  - This recommendation may need to be considered in conjunction with proposed bike-pedestrian facilities discussed in the ‘Multimodal Improvements’ sub-section.



**Figure 6: Example Minor Arterial Typical Section (Source: Brookings County MTP)**

## Turn Lanes

The *SDDOT Road Design Manual* presents guidelines to evaluate warrants for left and right-turn lanes for the major roadway at unsignalized intersections. These guidelines focus on three primary criterion:

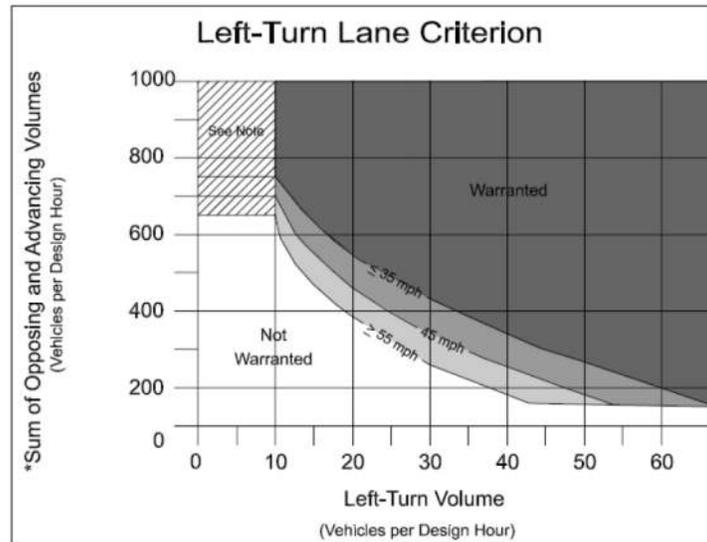
- Criterion 1: Vehicular volume
- Criterion 2: Crash experience
- Criterion 3: Special cases
  - Railroad crossings
  - Geometric/safety concerns
  - Non-traversable median (applies to left-turn criterion only)

The evaluation process consists of three requirements, including:

- Turn lane should be installed if Criterion 1 (volume), 2 (crash), or 3 (special cases) are met; and
- The turn lane complies with access management spacing standards; and
- The turn lane conforms to appropriate design guidelines.

This review focuses on Criterion 1 (volume) to provide a planning-level review of future turn lane volume needs at unsignalized intersections. The SDDOT uses volume criteria curves

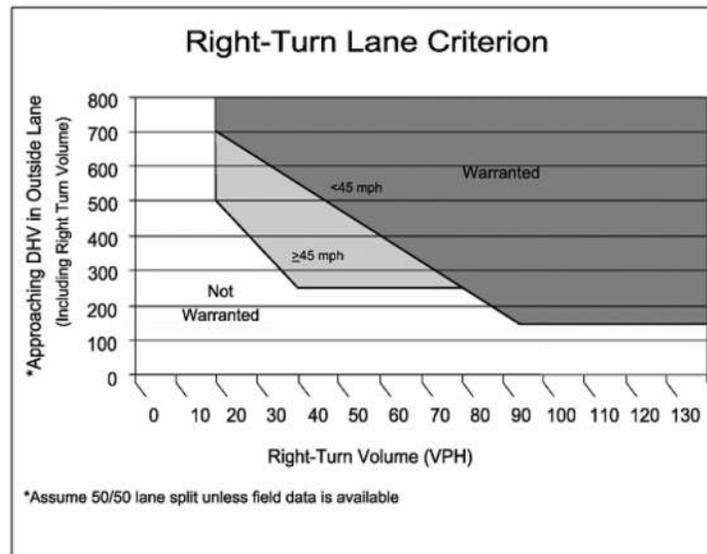
developed by the Texas Transportation Institute (TTI), and obtained from the Oregon Department of Transportation, that account for speed, number of lanes, and traffic volumes. Left-turn and right-turn volume warrant curves are shown in **Figure 7** and **Figure 8** respectively. Turn lane needs at signalized intersections and stop controlled approaches are determined by an operations analysis. The planning-level volume warrant review is summarized in **Table 3** and is detailed for each analysis intersection in the **Appendix**.



Source: Oregon DOT Analysis Procedures Manual 2008

\* $(\text{Advancing Vol} / \# \text{ of Advancing Through Lanes}) + (\text{Opposing Vol} / \# \text{ of Opposing Through Lanes})$

**Figure 7: Left-turn Lane Volume Criterion (Source: SDDOT Road Design Manual)**



**Figure 8: Right-turn Lane Volume Criterion (Source: SDDOT Road Design Manual)**



**Table 3: 214<sup>th</sup> Street Unsignalized Approach Turn Lane Volume Warrant Review**

Scenario	Design Speed (mph)	Northbound		Southbound	
		Left turn	Right turn	Left turn	Right turn
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue Intersection</b>					
2023 Existing Conditions	50	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet
2045 Design Year	50	<b>Meets Criterion</b>	Does Not Meet	<b>Meets Criterion</b>	<b>Meets Criterion</b>
<b>Redmond Road &amp; 476<sup>th</sup> Avenue Intersection</b>					
2023 Existing Conditions	30	Does Not Meet	Does Not Meet	Does Not Meet	Does Not Meet
2045 Design Year	30	Does Not Meet	Does Not Meet	Does Not Meet	<b>Meets Criterion</b>

Based on the turn lane volume warrant review, the following turn lanes will be warranted through the 2045 Design Year scenario:

**214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection**

- Northbound left turn lane
  - Warranted by 2027 (recommended in *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*)
- Southbound left turn lane
  - Warranted by 2027 (recommended in *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*)
- Southbound right turn lane
  - Warranted with Year 2022 Interchange Project (recommended in *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*)

**Redmond Road & 476<sup>th</sup> Avenue Intersection**

- Southbound right turn lane

In addition to warranted turn lanes, it is anticipated the following operations-based turn lanes will be needed to meet intersection traffic operational goals by Year 2045:

**214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection**

- Eastbound left turn lane
  - Included in Year 2022 Interchange Project (recommended in *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*)
- Westbound left turn lane
  - Included in Year 2045 (recommended in *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*)

SDDOT provides two options for turn lane design, based on whether turn lanes meet or do not meet warrants. The warranted turn lane design incorporates queue and total deceleration distance (related to design speed) while unwarranted turn lane design includes 100-foot turn lane length plus bay taper. Recommended minimum turn lane lengths, based on *SDDOT Road Design Manual* guidelines, for the 2045 Design Year scenario are shown in **Table 4**.



Turn lane lengths are based on the assumed design speeds for 214<sup>th</sup> Street (60 mph), 34<sup>th</sup> Avenue (50 mph), and 476<sup>th</sup> Avenue (30 mph). Storage lengths for warranted turn lanes were determined using 95<sup>th</sup> percentile queues reported for the Synchro 11 analysis output.

For additional consideration, the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study* included turn lane lengths for the 214<sup>th</sup> Street & 34<sup>th</sup> Avenue intersection that are provided in **Table 5**. These turn lane length recommendations were made based on an assumption that the area will urbanize over time and the speed limit will be lowered to match those settings. A design speed of 40 mph was used for all approaches of the intersection under this scenario. These results showcase that if the area does urbanize and/or the posted speed limit is lowered, the turn lane length needs will be reduced.

**Table 4: 2045 Design Year Turn Lane Lengths**

Turn Lane	Design Speed (mph)	Bay Taper (ft)	Deceleration Distance (ft)	Storage Length (ft)	Total Turn Lane Length (ft)
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue Intersection</b>					
Eastbound Left Turn	60	120	455	175	<b>630</b>
Westbound Left Turn	60	120	455	25	<b>480</b>
Northbound Left Turn	50	120	320	75	<b>395</b>
Southbound Left Turn	50	120	320	25	<b>345</b>
Southbound Right Turn	50	120	320	175	<b>495</b>
<b>Redmond Road &amp; 476<sup>th</sup> Avenue Intersection</b>					
Southbound Right Turn	30	60	105	25	<b>130</b>

**Table 5: 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection 2045 Design Year Turn Lane Lengths (*I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study* Design Speed Assumptions)**

Turn Lane	Design Speed (mph)	Bay Taper (ft)	Deceleration Distance (ft)	Storage Length (ft)	Total Turn Lane Length (ft)
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue Intersection</b>					
Eastbound Left Turn	40	60	185	175	<b>360</b>
Westbound Left Turn	40	60	185	25	<b>210</b>
Northbound Left Turn	40	60	185	50	<b>260</b>
Southbound Left Turn	40	60	185	25	<b>210</b>
Southbound Right Turn	40	60	185	175	<b>360</b>

## Intersection Traffic Control

Intersection traffic control was evaluated for both study intersections along 214<sup>th</sup> Street to verify sufficient traffic operations and LOS are provided through the 2045 Design Year.

### Planning-Level Traffic Signal Warrant Analysis

One primary consideration is to determine whether a traffic signal will be warranted at study intersections through the 2045 Design Year. To determine this, a planning level traffic signal volume warrant analysis was conducted to help gauge when a signal may be warranted.

Warrant 3 (Peak Hour) was the basis for this analysis as future-year volume data were only available for AM and PM peak hours.

In typical cases when traffic data beyond the peak hours is not readily available, Warrant 3 may be used as a litmus test to gauge an approximate timeframe for when Warrant 1 or 2 may be met. Where Warrant 3 was exceeded, an approximate planning-level warrant timeframe was indicated using straight-line growth estimation of volume growth between 2023 Existing Conditions and 2045 Design Year scenarios. A summary of the analysis is shown in **Table 6**. The HCS-based signal warrant analysis sheets are provided in the **Appendix**.

Based on a review of Warrant 3 and traffic operations, the following was determined:

#### 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

- Warrant 3 threshold exceeded by 2045 Design Year with or without additional turn lane improvements
  - Planning-Level Signal Warrant Timeframe:
    - Without additional turn lanes: 2030-2035
    - With additional turn lanes: 2035-2040
  - If posted speed limits were reduced, the signal warrant timing may change
- Signalization is needed to meet operational goals by 2045 Design Year scenario with or without the installation of additional turn lanes
- Recommendations:
  - Signalize intersection (when warranted)
  - Monitor approaches with stop control based on interim traffic volumes and patterns between 2023 and 2045 (prior to signalization):
    - Consider switching approaches with stop control (if needed)
    - Consider installation of all-way stop control (if needed)

#### Redmond Road & 476<sup>th</sup> Avenue Intersection

- Signalization not warranted through 2045 Design Year
- Recommendation: Maintain stop control on eastbound and westbound approaches



**Table 6: Study Intersection Traffic Signal Warrant Summary**

Scenario	Unsignalized Traffic Control	Unsignalized LOS AM / PM	Warrant 3	Planning-Level Signal Warrant Timeframe
<b>214<sup>th</sup> Street &amp; 34<sup>th</sup> Avenue Intersection</b>				
2023 Existing Conditions	TWSC*	A / A	Does not Exceed Warrant Threshold	n/a
2045 Design Year (no build)	TWSC*	F / F	Exceeds Warrant Threshold	2030-2035
2045 Design Year (with additional turn lanes)	TWSC*	F / F	Exceeds Warrant Threshold	2035-2040
<b>Redmond Road &amp; 476<sup>th</sup> Avenue Intersection</b>				
2023 Existing Conditions	TWSC*	A / A	Does not Exceed Warrant Threshold	n/a
2045 Design Year (no build)	TWSC*	B / B	Does not Exceed Warrant Threshold	n/a
2045 Design Year (with additional turn lanes)	TWSC*	B / B	Does not Exceed Warrant Threshold	n/a

n/a not applicable

\*TWSC LOS represents worst-cast stop-controlled approach

## Multimodal Improvements

Potential multimodal improvements (i.e. bicycle and pedestrian facilities) along 214<sup>th</sup> Street were reviewed in accordance with projected 2045 traffic volumes and engineering design guidance and best practice references. Similar to the ‘Roadway Widths’ sub-section, multimodal facility design considerations include traffic volumes, vehicle speeds, and percentage of truck vehicle users on the adjacent roadway. With these considerations in mind, the focus of this review is to determine a facility type where bicyclists and pedestrians feel most comfortable.

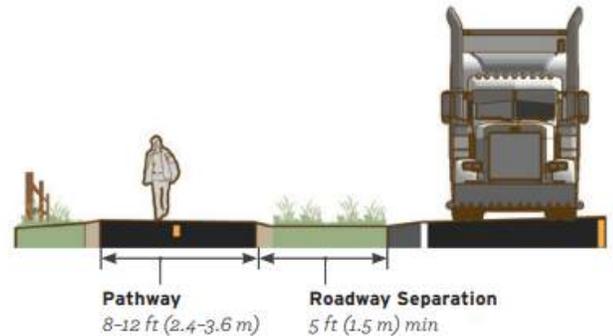
The *Brookings County MTP* outlined several multimodal goals which established the foundation for network enhancement projects. These projects included a proposed trail connection between the Cities of Aurora and Brookings (see *Table 15*). Proposed alignments for such a trail connection were along the railroad or 213<sup>th</sup> Street, however, these were identified prior to the I-29 Exit 130 (20<sup>th</sup> Street South) interchange project. As part of interchange project, a shared use path will be installed along the south side of 20<sup>th</sup> Street S / 214<sup>th</sup> Street to 34<sup>th</sup> Avenue.

To improve multimodal connectivity between the Cities of Aurora and Brookings, it is recommended to construct a multimodal facility along the south side of 214<sup>th</sup> Street from 34<sup>th</sup> Avenue to Aurora, if sufficient ROW is available, using the following design guidance:

## Facility Type: 8-10 ft. Shared Use Path

### Shared Use Path / Sidepath (examples shown in **Figure 9** and **Figure 10**)

- Application: A bidirectional shared use path located immediately adjacent and parallel to a roadway. Offers high-quality user experience for users of all ages and abilities compared to on-roadway facilities in heavy traffic environments, allow for reduced roadway crossing distances, and maintain rural and small-town characteristics



**Figure 9: Shared Use Path Example**  
(Source: *FHWA*)

- Benefits
  - Completes networks where high-speed roads provide the only corridors available
  - Fills gaps in networks of low-stress local routes such as shared use paths and bicycle boulevards
  - Provides a more appropriate facility for users of all ages and abilities than shoulders or mixed traffic facilities on roads with moderate or high traffic intensity
  - Encourages bicycling and walking in areas where high-volume and high-speed motor vehicle traffic would otherwise discourage it
  - Provides, in some cases, access to areas that are otherwise served only by limited-access roadways
  - Maintains rural character through reduced paved roadway width compared to a non-physically separated facility
  - Very supportive of rural character when combined with vegetation to visually and physically separate the side path from the roadway
- Drawbacks
  - Requires a wider ROW to accommodate space between a shared use path and a high speed road facility
- Design Width (see typical sections from the *Brookings County MTP* in **Figure 11** and *SDDOT Road Design Manual* in **Figure 12**)
  - Recommended width: 10 ft.
  - Minimum width: 8 ft.
- Design Roadway Separation
  - Recommended minimum separation width: 6.5 ft.
  - Minimum separation width: 5 ft.
  - Separation narrower than 5 ft. is not recommended but may be accommodated with use of a physical barrier between the path and roadway



**Figure 10: Shared Use Path Example on 22nd Avenue in Brookings, SD**  
(Source: *Google Streetview*)

Recommendation Summary:

- Construct 10 ft. shared use path along 214<sup>th</sup> Street to:
  - Connect with shared use path included in the I-29 Exit 130 (20<sup>th</sup> Street South) interchange project
  - Provide greater separation between road and multimodal users
  - Provide greater comfort and safety for multimodal users
- If ROW is constrained, consider the following:
  - A reduced shared use path width of 8 ft.
  - The use of physical barriers to accommodate narrow roadway separation

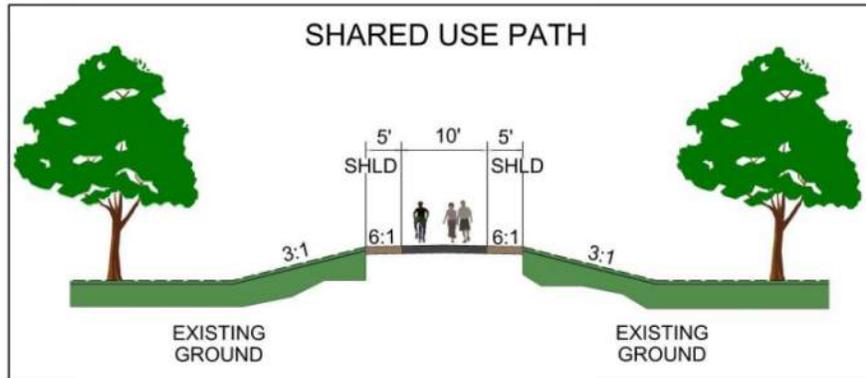


Figure 11: Shared Use Path Typical Section (Source: Brookings County MTP)

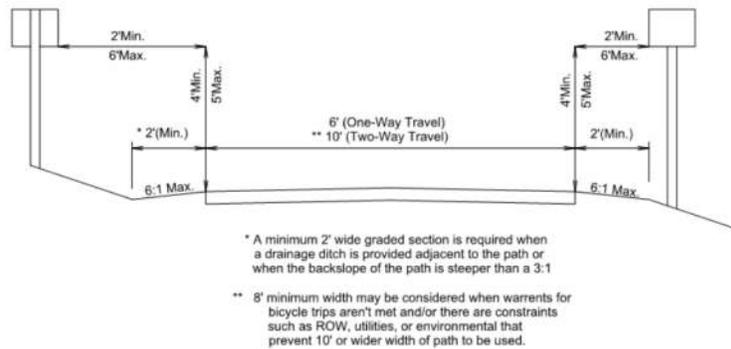


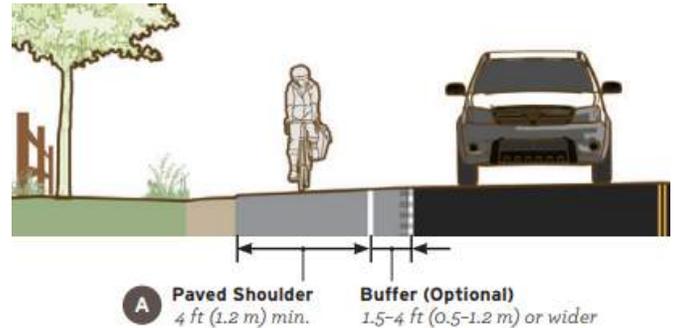
Figure 16-30 Typical Shared Use Path Configuration

Figure 12: Shared Use Path Typical Section (Source: SDDOT Road Design Manual)

## Facility Type: Paved Shoulder

### Paved Shoulder (examples shown in **Figure 13** and **Figure 14**)

- Application: Paved shoulders on the edge of a roadway can be enhanced to serve as a functional space for bicyclists and pedestrians to travel in absence of other facilities with more separation. Appropriate on roads with moderate to high volumes and speeds and on roadways with a large amount of truck traffic
- Benefits
  - Improves bicyclist experiences on roadways with higher speeds or traffic volumes
  - Provides stable surface off the roadway for pedestrians and bicyclists to use when sidewalks are not provided
  - Reduces pedestrian “walking along roadway” and bicyclist “struck from behind” crashes
- Drawbacks
  - No physical separation between vehicles and multimodal users (i.e., less comfortable and safe for users)
  - Enhancements with increased levels of striping and signing may interfere with the low-clutter character of a rural environment
  - Requires a wider roadway to provide an accessible shoulder space
- Design Considerations
  - Recommended minimum paved shoulder width of 7 ft. for Minor Arterial roadways
  - Include edge line rumble strips and pavement markings to improve delineation and safety



**Figure 13: Paved Shoulder Example (Source: FHWA)**



**Figure 14: Paved Shoulder Example in D'Iberville, MS (Source: FHWA)**

### Recommendation Summary:

- Consider paved shoulder as an alternative to a shared use path if ROW is constrained
  - Paved shoulders reflect an alternative to the recommended shared use path due to lack of physical separation between road and multimodal users which decreases safety and makes multimodal users feel less comfortable

## Access Management

Brookings County Access Management Guidelines were developed as part of the *Brookings County MTP Major Roads Plan* to provide a means to balance private property concerns with the need for a safe and efficient transportation system. These guidelines, adopted and expanded from the *SDDOT Road Design Manual*, include directions for signal spacing, intersection spacing, driveway density, and direct property access as well as a set of best practices for urban and rural areas. Brookings County access spacing guidelines are shown in **Figure 15**.

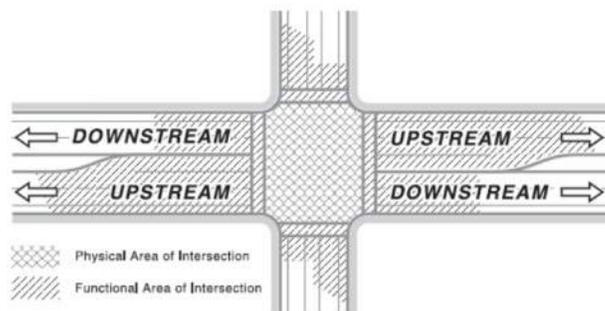
**Table 7: Brookings County Access Spacing Guidelines**

	Signal Spacing (miles)	Unsignalized Cross Street (feet)*	Access Density	Direct Access
State Highway (freeway)	N/A	N/A	N/A	No
State Highway	1/2	2,640	at half-mile increments	Exception Only
Major Arterial (urban)	1/2	2,640 full 1,320 partial	at quarter-mile increments	Exception Only
Minor Arterial (urban)	1/2	1,320 full 660 partial	1 access/block face, right in/right out preferred	Exception Only
Major Collector (urban)	1/4	1,320 (full/partial)	2 accesses/block face	Yes
Minor Collector (urban)	1/4	1,320 (full/partial)	5 accesses/side/mile	Yes
Major Arterial (rural)	1/4	1,000 (full/partial)	5 accesses/side/mile	Exception Only
Minor Arterial (rural)	1/4	1,000 (full/partial)	5 accesses/side/mile	Exception Only
Major Collector (rural)	1/4	1,000 (full/partial)	5 accesses/side/mile	Yes
Minor Collector (rural)	1/4	1,000 (full/partial)	5 accesses/side/mile	Yes

\*Full denotes a standard full-movement intersection. Partial denotes a restricted movement intersection (i.e., right-in/right-out).  
Source: Adapted from South Dakota DOT Roadway Design Manual, Chapter 17 – Access Management, Figure 17-1

**Figure 15: Brookings County Access Spacing Guidelines (Source: Brookings County MTP)**

With consideration to these standards, access management along 214<sup>th</sup> Street should follow all access management guidelines stated in the *Brookings County MTP*, with a particular focus on access spacing and best practices for rural areas. The protection of intersection functional, especially at major intersections, should be a priority. The functional area at intersections, shown in **Figure 16**, is where motorists decelerate, maneuver into the appropriate lane, prepare to brake or stop or turn as they approach an intersection; and accelerate or maneuver as they depart the intersection.



**Figure 16: Intersection Functional Area (Source: SDDOT Road Design Manual)**

Intersection functional areas were reviewed at study intersection along the 214<sup>th</sup> corridor using the following methodology:

### **Access Review Methodology**

The feasibility, or ‘window of opportunity’, of an access point between major intersections review conditions upstream and downstream of the access point using the following methodology:

*‘Downstream (of the proposed access) on the Major Roadway Condition’*

1. Upstream functional dimensions of the major intersection
  - a. Distance traveled during driver’s perception-reaction time (d1, Table 17-2, Table 17-3 *SDDOT Road Design Manual Chapter 17*) + deceleration-maneuver distances (d2, Table 17-3 *SDDOT Road Design Manual Chapter 17*) + 95<sup>th</sup> % queue length (d3)

*‘Upstream (of the proposed access) on the Major Roadway Condition’*

1. Downstream functional dimensions of the major intersection
  - a. Acceleration distance (Exhibit 14-11, *Access Management Manual*)
  - b. Decision sight distance (Exhibit 14-12, *Access Management Manual*)
2. Upstream functional dimensions of the minor access/driveway
  - a. Distance traveled during driver’s perception-reaction time (d1, Table 17-2 *SDDOT Road Design Manual Chapter 17*) + deceleration-maneuver distances (d2, Table 17-3 *SDDOT Road Design Manual Chapter 17*)
3. Stopping sight distance (Table 17-4, *Access Management Manual*)

### 214<sup>th</sup> Street Study Intersection Access Reviews

Assumptions used in this analysis include:

- Posted Speed Limit:
  - 214<sup>th</sup> Street: 55 mph
  - 34<sup>th</sup> Avenue: 45 mph
  - Redmond Road: 25 mph
  - 476<sup>th</sup> Avenue: 25 mph
- Rural setting along 214<sup>th</sup> Street and 34<sup>th</sup> Avenue
- Urban setting along Redmond Road and 476<sup>th</sup> Avenue
- 2045 Design Year 95<sup>th</sup> percentile queues

All functional area measures are from edge of travel way (or stop bar) to edge of travel way on the cross-street and are based on analysis-measured 2045 Design Year 95<sup>th</sup> percentile queues. Intersection functional areas based on this analysis are depicted in **Figure 17** and **Figure 18**. Intersection functional area dimension calculations are provided in the **Appendix**. It should be noted that these reviews assume a 214<sup>th</sup> Street posted speed limit of 55 mph and if speed limits are later reduced, the functional area footprints would also be reduced.

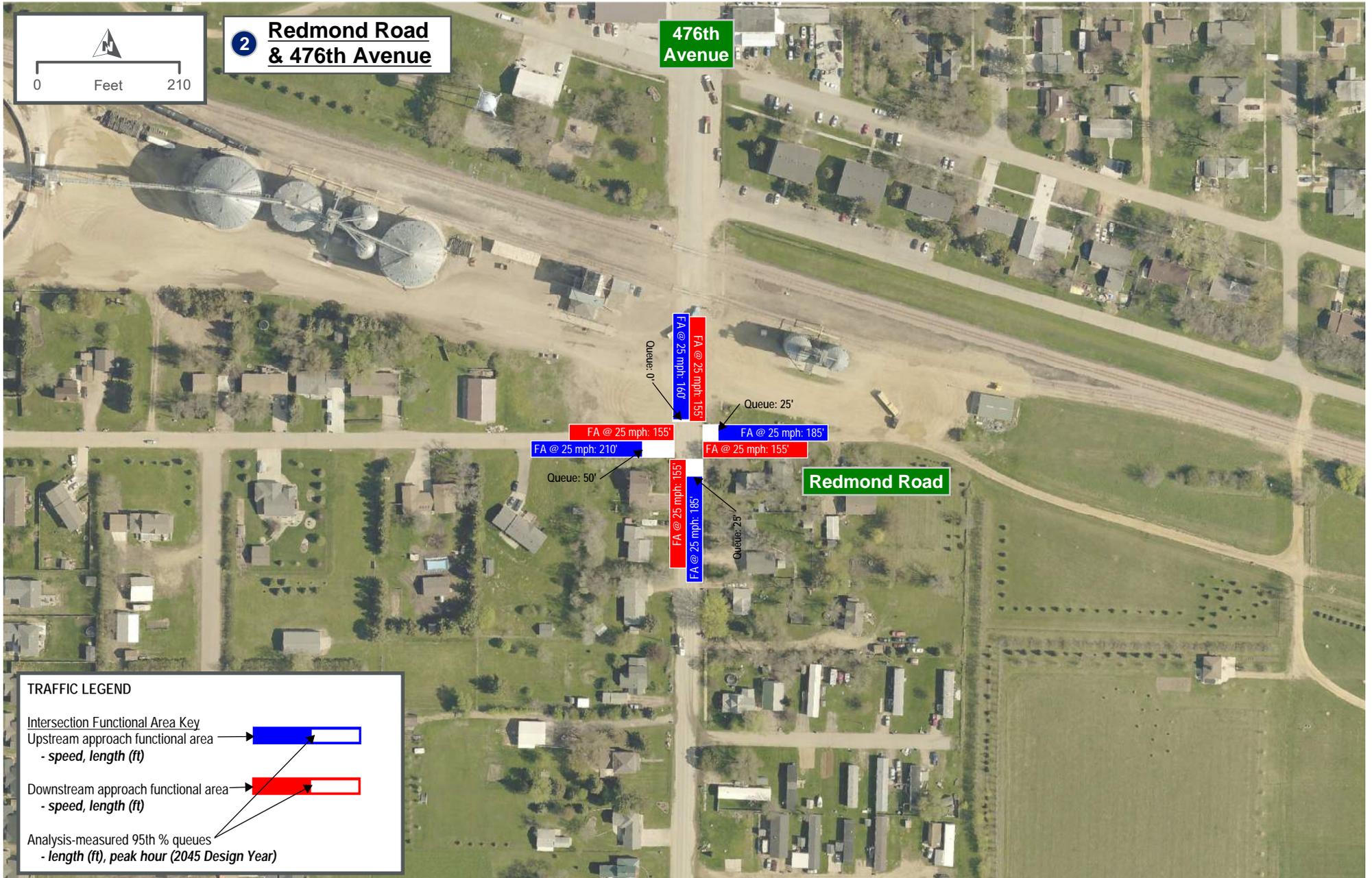
Future access along the development, if considered, should only be allowed in areas outside of the intersection functional area or with a right-in right-out access and a corresponding raised median. Existing access points within the functional area should be removed when parcels redevelop or change land use.



214TH STREET & 34TH AVENUE INTERSECTION FUNCTIONAL AREA



FIGURE 17



**REDMOND ROAD & 476TH AVENUE INTERSECTION FUNCTIONAL AREA**



**FIGURE 18**

# Findings and Recommendations

Analysis of the future traffic volumes, operations, and street section and traffic planning design elements for the 214<sup>th</sup> Street study corridor resulted in the following general findings:

## General Findings

### 214<sup>th</sup> Street Study Corridor

- No major safety trends found in observed crash data.
- Daily Traffic Volumes:
  - 2023 Existing Conditions: 100-1,000 ADT
  - 2045 Design Year: 4,000 ADT
- A rural 2-lane highway is anticipated to provide sufficient capacity through the 2045 Design Year based on projected 2045 Design Year traffic volumes (4,000 ADT) and roadway function classification.
- Roadway width and multimodal improvement recommendations are based on:
  - Projected 2045 Design Year traffic volumes (4,000 ADT)
  - Assumed design speed of 60 mph
  - Percentage of truck vehicle users
  - Safety considerations based on *Highway Safety Manual (HSM)* guidance
  - Multimodal goals and projects outlined in the *Brookings County MTP*
  - Design guidance derived from resources identified in the 'Street Section and Traffic Planning' section
- Multimodal improvement recommendations align with goals and proposed projects in the *Brookings County MTP* to improve multimodal connectivity between the Cities of Aurora and Brookings
- Access management recommendations are based on access spacing, best practices, and intersection functional area guidelines outlined in the *Brookings County MTP*, *SDDOT Road Design Manual*, and the *Access Management Manual*

### 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

- Turn lane and intersection traffic control improvements will be necessary for sufficient LOS performance in the 2045 Design Year.
- Turn lane needs are consistent with those outlined in the *I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*.
- Signalization likely needed by the 2045 Design Year for sufficient LOS.
  - Planning-Level Signal Warrant Review Timeframe: 2035-2040

### Redmond Road & 476<sup>th</sup> Avenue Intersection

- Intersection is anticipated to have near optimal LOS performance with existing configurations through the 2045 Design Year.

## Recommendations

The following summarizes traffic planning recommendations for the 2045 Design Year scenario based on analysis conducted for this memo. Recommendations are shown in **Figure 19** and identified in the lists below. Recommended lane configuration and intersection control modifications for study intersections are noted in **Bold Orange**:

### 214<sup>th</sup> Street Study Corridor

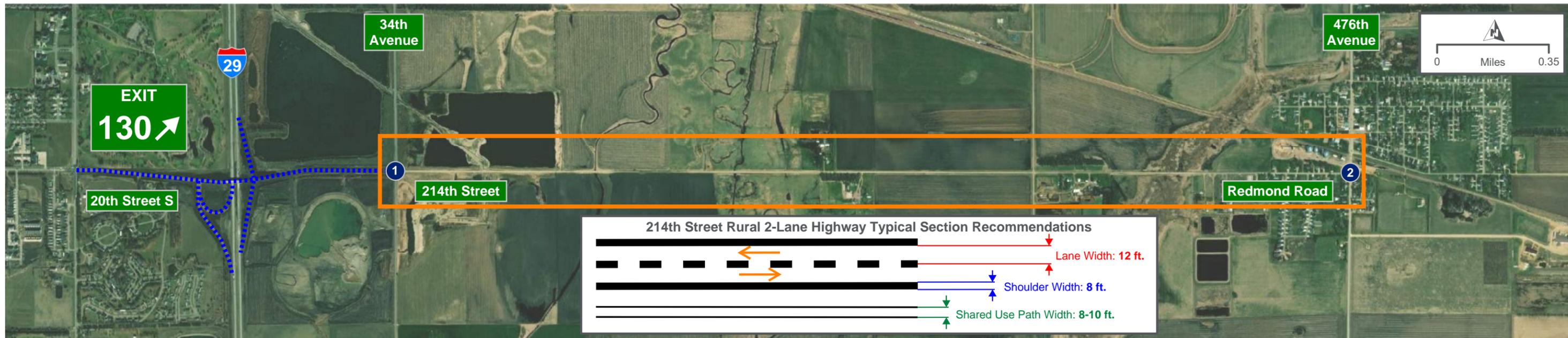
- Roadway Section: **Rural Minor Arterial Highway**
  - Number of Through Lanes: **2 Lanes**
  - Lane Width: **12 ft.**
  - Shoulder Width: **8 ft. (6 ft. if ROW is constrained)**
- Multimodal Improvements: **Install 8-10 ft. Shared Use Path**
  - Install shared use path along the south side of 214<sup>th</sup> Street to tie in with the planned shared use path being constructed with the I-29 Exit 130 (20<sup>th</sup> Street South) interchange project.
  - If ROW is constrained, consider an 8 ft. shared use path width or a paved shoulder as an alternative (see discussion in ‘Multimodal Improvements’ section).
- Access Management
  - Follow access spacing and best practice for rural areas guidance outlined in the *Brookings County MTP* and *SDDOT Road Design Manual*
  - Protect intersection functional area (identified in **Figure 17** and **Figure 18**)
  - Existing access points within the functional area should be removed when parcels redevelop or change land use

### 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

- Construct volume-warranted and operations-based turn lanes
- Approach lane configuration and traffic control:
  - **EB: LT, T/RT**
  - **WB: LT, T/RT**
  - **NB: LT, T/RT**
  - **SB: LT, T, RT**
  - Signalize intersection (when warranted)
  - Monitor approaches with stop control based on interim traffic volumes and patterns between 2023 and 2045 (prior to signalization):
    - Consider switching approaches with stop control (if needed)
    - Consider installation of all-way stop control (if needed)

### Redmond Road & 476<sup>th</sup> Avenue Intersection

- Construct volume-warranted southbound right turn lane
- Approach lane and intersection control:
  - EB: LT/T/RT
  - WB: LT/T/RT
  - NB: LT/T/RT
  - **SB: LT/T, RT**
  - Maintain stop control on eastbound and westbound approaches



**LEGEND**

- 1** Study Intersection
- Study Road Segment
- I-29 Exit 130 Interchange and 20th Street S Proposed Configurations

**Traffic Volumes**

AM (PM) Peak Hour Traffic Volumes

Daily Volumes:

2,000 2045 Design Year

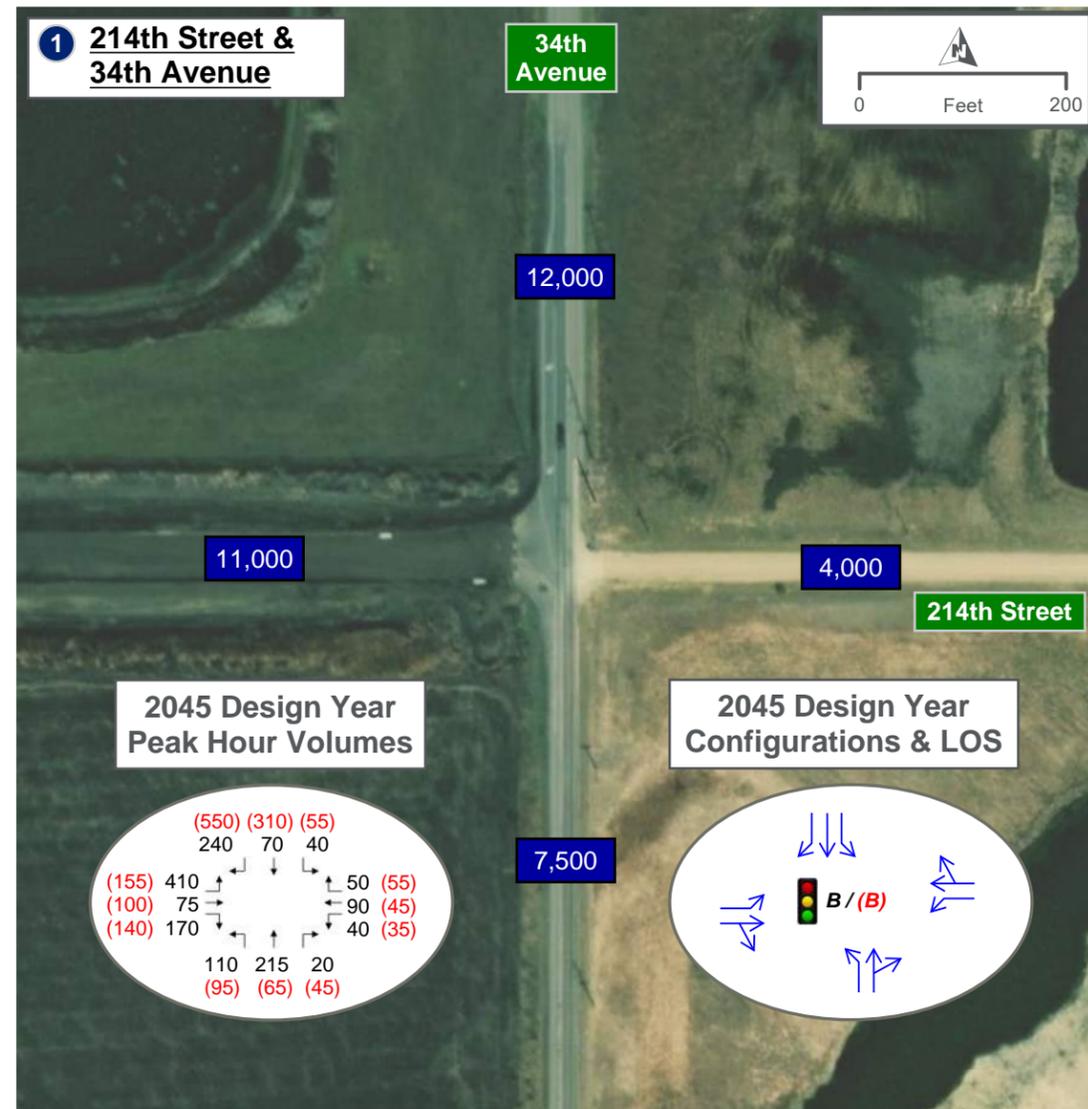
Intersection Control / Level of Service (LOS)

STOP Stop Control (Stop Sign)  
Overall Intersection **A / (A)**  
Worst-case Approach **C / (C)**

Traffic Signal  
Overall Intersection **A / (A)**

Intersection Lane Configurations

- Existing Lane Configuration
- I-29 Exit 130 (20th Street S) IJR Recommended Lane Configuration
- Recommended Intersection Lane Configuration



STUDY AREA RECOMMENDATIONS



## References

Access Management Manual (2<sup>nd</sup> Edition). Transportation Research Board, 2014.

*Brookings County Master Transportation Plan*. Publication HP5510 (15) 3616 P. FHWA, SDDOT, and Brookings County, 2013.

Designing for All Ages & Abilities: Contextual Guidance for High-Comfort Bicycle Facilities. National Association of City Transportation Officials, 2017.

Dickman et al. *Small Town and Rural Multimodal Networks*. Publication FHWA-HEP-17-024. FHWA, U.S. Department of Transportation, 2016.

Highway Safety Manual (1<sup>st</sup> Edition). American Association of State Highway and Transportation Officials, Washington, D.C., 2010.

*I-29 Exit 130 (20<sup>th</sup> Street South) Interchange Justification Study*. SDDOT and City of Brookings, 2020.

SDDOT Local Roads Plan. South Dakota Department of Transportation, 2011.  
[localroadsplan.pdf \(sd.gov\)](#)

SDDOT Road Design Manual. South Dakota Department of Transportation. [preface-rd.pdf \(sd.gov\)](#).



# Appendix



# Appendix A: Intersection Crash Diagram

214<sup>th</sup> Street & 475<sup>th</sup> Avenue Intersection



← ↓ P P ⊗ 04/11/22 07:56  
 ■ ☀ D 2204247

- ← Vehicle Path
- ↺ U Turn
- ▢ Parked Vehicle
- ⬇ Unknown dir.
- ↔ Backing Vehicle
- 🚶 Ran off road
- ←| Rear End
- ⊕ More Units
- ↔| Head On
- 🚶 Pedestrian
- ↺ Sideswipe
- ▢ Fixed Object
- ↙ Left Turn
- 🐾 Wild Animal
- ↘ Right Turn

- PDO
- ⊗ Injury
- Fatal
- ☀ Clear
- ☁ Cloudy
- 🌫 Fog
- 🌧 Rain
- ❄ Snow
- 🌬 Wind

- D- Dry
- W- Wet
- S- Winter
- O- Other

- 💊 Drugs
- 🍷 Alcohol
- 📱 Distracted
- 🚗 Speed
- 😓 Fatigue
- 🚧 Work Zone
- T -Truck
- M-Motorcycle
- P -Passenger
- A-ATV
- R-Tractor
- E-Equipment
- B-Bicycle
- L -Railway

↑ → P P ○ 04/23/20 17:57  
 ☀ D 📱 2004716

214 ST and 475 AVE



# Appendix B: Synchro Output

## **2023 Existing Conditions**

214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

Redmond Road & 476<sup>th</sup> Avenue Intersection

## **2045 Design Year**

214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

Redmond Road & 476<sup>th</sup> Avenue Intersection

HCM 6th TWSC  
3: 34th Avenue & 214th Street

06/01/2023

Intersection												
Int Delay, s/veh	0.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	5	0	0	0	5	155	0	0	10	1
Future Vol, veh/h	0	0	5	0	0	0	5	155	0	0	10	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	79	79	79	79	79	79	79	79	79	79	79	79
Heavy Vehicles, %	0	0	0	0	0	0	60	0	0	0	8	0
Mvmt Flow	0	0	6	0	0	0	6	196	0	0	13	1

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	222	222	14	225	222	196	14	0	0	196	0	0
Stage 1	14	14	-	208	208	-	-	-	-	-	-	-
Stage 2	208	208	-	17	14	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.7	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.74	-	-	2.2	-	-
Pot Cap-1 Maneuver	738	680	1072	735	680	850	1297	-	-	1389	-	-
Stage 1	1011	888	-	799	734	-	-	-	-	-	-	-
Stage 2	799	734	-	1008	888	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	735	677	1072	728	677	850	1297	-	-	1389	-	-
Mov Cap-2 Maneuver	735	677	-	728	677	-	-	-	-	-	-	-
Stage 1	1006	888	-	795	730	-	-	-	-	-	-	-
Stage 2	795	730	-	1002	888	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.4	0	0.2	0
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1297	-	-	1072	-	1389	-
HCM Lane V/C Ratio	0.005	-	-	0.006	-	-	-
HCM Control Delay (s)	7.8	0	-	8.4	0	0	-
HCM Lane LOS	A	A	-	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-	0	-

Intersection												
Int Delay, s/veh	2.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	35	0	10	0	0	0	1	25	0	0	55	20
Future Vol, veh/h	35	0	10	0	0	0	1	25	0	0	55	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	80	80	80	80	80	80	80	80	80	80	80	80
Heavy Vehicles, %	0	0	0	0	0	0	0	17	0	0	27	0
Mvmt Flow	44	0	13	0	0	0	1	31	0	0	69	25

Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	115	115	82	121	127	31	94	0	0	31	0	0
Stage 1	82	82	-	33	33	-	-	-	-	-	-	-
Stage 2	33	33	-	88	94	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	867	779	983	859	767	1049	1513	-	-	1595	-	-
Stage 1	931	831	-	988	872	-	-	-	-	-	-	-
Stage 2	988	872	-	925	821	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	866	778	983	848	766	1049	1513	-	-	1595	-	-
Mov Cap-2 Maneuver	866	778	-	848	766	-	-	-	-	-	-	-
Stage 1	930	831	-	987	871	-	-	-	-	-	-	-
Stage 2	987	871	-	913	821	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.3	0	0.3	0
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1513	-	-	890	-	1595	-
HCM Lane V/C Ratio	0.001	-	-	0.063	-	-	-
HCM Control Delay (s)	7.4	0	-	9.3	0	0	-
HCM Lane LOS	A	A	-	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.2	-	0	-

HCM 6th TWSC  
3: 34th Avenue & 214th Street

06/01/2023

Intersection												
Int Delay, s/veh	0.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	0	0	2	0	0	0	0	25	0	0	145	0
Future Vol, veh/h	0	0	2	0	0	0	0	25	0	0	145	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	82	82	82	82	82	82	82	82	82	82	82	82
Heavy Vehicles, %	0	0	50	0	0	0	0	4	0	0	8	0
Mvmt Flow	0	0	2	0	0	0	0	30	0	0	177	0

Major/Minor	Minor2		Minor1			Major1		Major2				
Conflicting Flow All	207	207	177	208	207	30	177	0	0	30	0	0
Stage 1	177	177	-	30	30	-	-	-	-	-	-	-
Stage 2	30	30	-	178	177	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.7	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.75	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	755	693	756	754	693	1050	1411	-	-	1596	-	-
Stage 1	829	756	-	992	874	-	-	-	-	-	-	-
Stage 2	992	874	-	828	756	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	755	693	756	752	693	1050	1411	-	-	1596	-	-
Mov Cap-2 Maneuver	755	693	-	752	693	-	-	-	-	-	-	-
Stage 1	829	756	-	992	874	-	-	-	-	-	-	-
Stage 2	992	874	-	825	756	-	-	-	-	-	-	-

Approach	EB		WB			NB		SB		
HCM Control Delay, s	9.8		0			0		0		
HCM LOS	A		A							

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1411	-	-	756	-	1596	-
HCM Lane V/C Ratio	-	-	-	0.003	-	-	-
HCM Control Delay (s)	0	-	-	9.8	0	0	-
HCM Lane LOS	A	-	-	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	-	0	-

Intersection												
Int Delay, s/veh	2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	20	0	1	0	0	0	10	40	0	1	35	35
Future Vol, veh/h	20	0	1	0	0	0	10	40	0	1	35	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	78	78	78	78	78	78	78	78	78	78	78	78
Heavy Vehicles, %	0	0	0	0	0	0	0	9	14	0	7	0
Mvmt Flow	26	0	1	0	0	0	13	51	0	1	45	45

Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	147	147	68	147	169	51	90	0	0	51	0	0
Stage 1	70	70	-	77	77	-	-	-	-	-	-	-
Stage 2	77	77	-	70	92	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	826	748	1001	826	728	1023	1518	-	-	1568	-	-
Stage 1	945	841	-	937	835	-	-	-	-	-	-	-
Stage 2	937	835	-	945	823	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	819	741	1001	819	721	1023	1518	-	-	1568	-	-
Mov Cap-2 Maneuver	819	741	-	819	721	-	-	-	-	-	-	-
Stage 1	936	840	-	929	827	-	-	-	-	-	-	-
Stage 2	929	827	-	943	822	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.5	0	1.5	0.1
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1518	-	-	826	-	1568	-
HCM Lane V/C Ratio	0.008	-	-	0.033	-	0.001	-
HCM Control Delay (s)	7.4	0	-	9.5	0	7.3	0
HCM Lane LOS	A	A	-	A	A	A	A
HCM 95th %tile Q(veh)	0	-	-	0.1	-	0	-

HCM 6th TWSC  
3: 34th Avenue & 214th Street

06/01/2023

Intersection												
Int Delay, s/veh	560.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	410	75	170	40	90	50	110	215	20	40	70	240
Future Vol, veh/h	410	75	170	40	90	50	110	215	20	40	70	240
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	60	0	0	0	8	0
Mvmt Flow	456	83	189	44	100	56	122	239	22	44	78	267

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	872	805	212	930	927	250	345	0	0	261	0	0
Stage 1	300	300	-	494	494	-	-	-	-	-	-	-
Stage 2	572	505	-	436	433	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.7	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.74	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 273	318	833	250	270	794	952	-	-	1315	-	-
Stage 1	713	669	-	561	550	-	-	-	-	-	-	-
Stage 2	509	544	-	603	585	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 142	259	833	126	220	794	952	-	-	1315	-	-
Mov Cap-2 Maneuver	~ 142	259	-	126	220	-	-	-	-	-	-	-
Stage 1	606	640	-	477	468	-	-	-	-	-	-	-
Stage 2	~ 316	462	-	388	560	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, \$	1286.5		76.8		3		0.9	
HCM LOS	F		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	952	-	-	194	228	1315	-	-
HCM Lane V/C Ratio	0.128	-	-	3.751	0.877	0.034	-	-
HCM Control Delay (s)	9.3	0		\$ 1286.5	76.8	7.8	0	-
HCM Lane LOS	A	A	-	F	F	A	A	-
HCM 95th %tile Q(veh)	0.4	-	-	70.6	7.1	0.1	-	-

Notes  
 ~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

HCM 6th TWSC  
3: 34th Avenue & 214th Street

06/01/2023

Intersection												
Int Delay, s/veh	203.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔	↔		↔	↔		↔	↔		↔	↔	↔
Traffic Vol, veh/h	410	75	170	40	90	50	110	215	20	40	70	240
Future Vol, veh/h	410	75	170	40	90	50	110	215	20	40	70	240
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	200	-	-	105	-	-	200	-	-	215	-	215
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	60	0	0	0	8	0
Mvmt Flow	456	83	189	44	100	56	122	239	22	44	78	267

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	738	671	78	930	927	250	345	0	0	261	0	0
Stage 1	166	166	-	494	494	-	-	-	-	-	-	-
Stage 2	572	505	-	436	433	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.7	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.74	-	-	2.2	-	-
Pot Cap-1 Maneuver	~ 336	380	988	250	270	794	952	-	-	1315	-	-
Stage 1	841	765	-	561	550	-	-	-	-	-	-	-
Stage 2	509	544	-	603	585	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 182	320	988	143	228	794	952	-	-	1315	-	-
Mov Cap-2 Maneuver	~ 182	320	-	143	228	-	-	-	-	-	-	-
Stage 1	733	740	-	489	480	-	-	-	-	-	-	-
Stage 2	~ 327	474	-	418	566	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	464.5	31.1	3	0.9
HCM LOS	F	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	952	-	-	182	603	143	306	1315	-	-
HCM Lane V/C Ratio	0.128	-	-	2.503	0.451	0.311	0.508	0.034	-	-
HCM Control Delay (s)	9.3	-	-	732.6	15.8	41.1	28.3	7.8	-	-
HCM Lane LOS	A	-	-	F	C	E	D	A	-	-
HCM 95th %tile Q(veh)	0.4	-	-	38.6	2.3	1.2	2.7	0.1	-	-

Notes  
 ~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

# HCM 6th Signalized Intersection Summary

## 3: 34th Avenue & 214th Street

06/01/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	410	75	170	40	90	50	110	215	20	40	70	240
Future Volume (veh/h)	410	75	170	40	90	50	110	215	20	40	70	240
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1800	1800	1800	1800	958	1800	1800	1800	1688	1800
Adj Flow Rate, veh/h	456	83	189	44	100	56	122	239	22	44	78	267
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	0	0	0	0	0	60	0	0	0	8	0
Cap, veh/h	684	235	534	570	521	292	293	474	44	342	493	446
Arrive On Green	0.48	0.48	0.48	0.48	0.48	0.48	0.29	0.29	0.29	0.29	0.29	0.29
Sat Flow, veh/h	1250	488	1112	1125	1084	607	560	1624	149	1136	1688	1525
Grp Volume(v), veh/h	456	0	272	44	0	156	122	0	261	44	78	267
Grp Sat Flow(s),veh/h/ln	1250	0	1600	1125	0	1691	560	0	1773	1136	1688	1525
Q Serve(g_s), s	15.9	0.0	5.2	1.2	0.0	2.6	10.0	0.0	5.9	1.6	1.7	7.3
Cycle Q Clear(g_c), s	18.5	0.0	5.2	6.4	0.0	2.6	11.7	0.0	5.9	7.5	1.7	7.3
Prop In Lane	1.00		0.69	1.00		0.36	1.00		0.08	1.00		1.00
Lane Grp Cap(c), veh/h	684	0	769	570	0	813	293	0	518	342	493	446
V/C Ratio(X)	0.67	0.00	0.35	0.08	0.00	0.19	0.42	0.00	0.50	0.13	0.16	0.60
Avail Cap(c_a), veh/h	948	0	1107	807	0	1170	309	0	568	374	540	488
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(l)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.5	0.0	7.9	9.9	0.0	7.2	17.1	0.0	14.2	17.4	12.7	14.7
Incr Delay (d2), s/veh	1.1	0.0	0.3	0.1	0.0	0.1	0.9	0.0	0.8	0.2	0.1	1.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	6.0	0.0	2.3	0.4	0.0	1.2	1.9	0.0	3.5	0.7	0.9	3.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	13.6	0.0	8.1	9.9	0.0	7.3	18.0	0.0	15.0	17.5	12.9	16.4
LnGrp LOS	B	A	A	A	A	A	B	A	B	B	B	B
Approach Vol, veh/h		728			200			383			389	
Approach Delay, s/veh		11.6			7.9			15.9			15.8	
Approach LOS		B			A			B			B	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		28.8		19.6		28.8		19.6				
Change Period (Y+Rc), s		5.5		5.5		5.5		5.5				
Max Green Setting (Gmax), s		33.5		15.5		33.5		15.5				
Max Q Clear Time (g_c+I1), s		20.5		9.5		8.4		13.7				
Green Ext Time (p_c), s		2.8		0.8		1.0		0.5				
<b>Intersection Summary</b>												
HCM 6th Ctrl Delay				13.1								
HCM 6th LOS				B								

# HCM 6th Signalized Intersection Summary

## 3: 34th Avenue & 214th Street

06/01/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	410	75	170	40	90	50	110	215	20	40	70	240
Future Volume (veh/h)	410	75	170	40	90	50	110	215	20	40	70	240
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1800	1800	1800	1800	958	1800	1800	1800	1688	1800
Adj Flow Rate, veh/h	456	83	189	44	100	56	122	239	22	44	78	267
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	0	0	0	0	0	60	0	0	0	8	0
Cap, veh/h	684	235	534	570	521	292	293	475	44	342	493	446
Arrive On Green	0.48	0.48	0.48	0.48	0.48	0.48	0.29	0.29	0.29	0.29	0.29	0.29
Sat Flow, veh/h	1250	488	1112	1125	1084	607	560	1624	149	1136	1688	1525
Grp Volume(v), veh/h	456	0	272	44	0	156	122	0	261	44	78	267
Grp Sat Flow(s),veh/h/ln	1250	0	1600	1125	0	1691	560	0	1773	1136	1688	1525
Q Serve(g_s), s	15.9	0.0	5.2	1.2	0.0	2.6	10.0	0.0	5.9	1.6	1.7	7.3
Cycle Q Clear(g_c), s	18.5	0.0	5.2	6.4	0.0	2.6	11.7	0.0	5.9	7.5	1.7	7.3
Prop In Lane	1.00		0.69	1.00		0.36	1.00		0.08	1.00		1.00
Lane Grp Cap(c), veh/h	684	0	769	570	0	813	293	0	518	342	493	446
V/C Ratio(X)	0.67	0.00	0.35	0.08	0.00	0.19	0.42	0.00	0.50	0.13	0.16	0.60
Avail Cap(c_a), veh/h	947	0	1106	807	0	1169	309	0	567	373	540	488
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	12.5	0.0	7.9	9.9	0.0	7.2	17.1	0.0	14.2	17.4	12.7	14.7
Incr Delay (d2), s/veh	1.1	0.0	0.3	0.1	0.0	0.1	0.9	0.0	0.8	0.2	0.1	1.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	6.0	0.0	2.3	0.4	0.0	1.2	2.0	0.0	3.6	0.7	0.9	4.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	13.6	0.0	8.1	9.9	0.0	7.3	18.0	0.0	15.0	17.5	12.9	16.4
LnGrp LOS	B	A	A	A	A	A	B	A	B	B	B	B
Approach Vol, veh/h		728			200			383			389	
Approach Delay, s/veh		11.6			7.9			15.9			15.8	
Approach LOS		B			A			B			B	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		28.8		19.7		28.8		19.7				
Change Period (Y+Rc), s		5.5		5.5		5.5		5.5				
Max Green Setting (Gmax), s		33.5		15.5		33.5		15.5				
Max Q Clear Time (g_c+I1), s		20.5		9.5		8.4		13.7				
Green Ext Time (p_c), s		2.8		0.8		1.0		0.5				
<b>Intersection Summary</b>												
HCM 6th Ctrl Delay				13.1								
HCM 6th LOS				B								

Intersection												
Int Delay, s/veh	4.3											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	100	5	30	5	5	5	25	40	5	5	90	150
Future Vol, veh/h	100	5	30	5	5	5	25	40	5	5	90	150
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	17	0	0	27	0
Mvmt Flow	111	6	33	6	6	6	28	44	6	6	100	167

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	305	302	184	318	382	47	267	0	0	50	0	0
Stage 1	196	196	-	103	103	-	-	-	-	-	-	-
Stage 2	109	106	-	215	279	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	651	614	864	639	554	1028	1308	-	-	1570	-	-
Stage 1	810	742	-	908	814	-	-	-	-	-	-	-
Stage 2	901	811	-	792	683	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	630	597	864	597	539	1028	1308	-	-	1570	-	-
Mov Cap-2 Maneuver	630	597	-	597	539	-	-	-	-	-	-	-
Stage 1	792	738	-	888	796	-	-	-	-	-	-	-
Stage 2	870	793	-	752	680	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	11.9		10.5		2.8		0.1	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1308	-	-	669	666	1570	-	-
HCM Lane V/C Ratio	0.021	-	-	0.224	0.025	0.004	-	-
HCM Control Delay (s)	7.8	0	-	11.9	10.5	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.9	0.1	0	-	-

Intersection												
Int Delay, s/veh	4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	↗
Traffic Vol, veh/h	100	5	30	5	5	5	25	40	5	5	90	150
Future Vol, veh/h	100	5	30	5	5	5	25	40	5	5	90	150
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	150
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	17	0	0	27	0
Mvmt Flow	111	6	33	6	6	6	28	44	6	6	100	167

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	221	218	100	318	382	47	267	0	0	50	0	0
Stage 1	112	112	-	103	103	-	-	-	-	-	-	-
Stage 2	109	106	-	215	279	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	739	684	961	639	554	1028	1308	-	-	1570	-	-
Stage 1	898	807	-	908	814	-	-	-	-	-	-	-
Stage 2	901	811	-	792	683	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	715	666	961	601	539	1028	1308	-	-	1570	-	-
Mov Cap-2 Maneuver	715	666	-	601	539	-	-	-	-	-	-	-
Stage 1	878	803	-	888	796	-	-	-	-	-	-	-
Stage 2	870	793	-	755	680	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	10.9		10.5		2.8		0.1	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1308	-	-	756	668	1570	-	-
HCM Lane V/C Ratio	0.021	-	-	0.198	0.025	0.004	-	-
HCM Control Delay (s)	7.8	0	-	10.9	10.5	7.3	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.7	0.1	0	-	-

HCM 6th TWSC  
3: 34th Avenue & 214th Street

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Intersection												
Int Delay, s/veh	264.6											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	155	100	140	35	45	55	95	65	45	55	310	550
Future Vol, veh/h	155	100	140	35	45	55	95	65	45	55	310	550
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	50	0	0	0	0	4	0	0	8	0
Mvmt Flow	172	111	156	39	50	61	106	72	50	61	344	611

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	1137	1106	650	1214	1386	97	955	0	0	122	0	0
Stage 1	772	772	-	309	309	-	-	-	-	-	-	-
Stage 2	365	334	-	905	1077	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.7	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.75	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	181	212	394	160	144	965	728	-	-	1478	-	-
Stage 1	395	412	-	705	663	-	-	-	-	-	-	-
Stage 2	658	647	-	334	298	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 90	160	394	~ 36	109	965	728	-	-	1478	-	-
Mov Cap-2 Maneuver	~ 90	160	-	~ 36	109	-	-	-	-	-	-	-
Stage 1	333	370	-	594	559	-	-	-	-	-	-	-
Stage 2	473	545	-	127	267	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	\$ 967.9		\$ 390.6		5		0.5	
HCM LOS	F		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	728	-	-	146	94	1478	-	-
HCM Lane V/C Ratio	0.145	-	-	3.006	1.596	0.041	-	-
HCM Control Delay (s)	10.8	0	-	\$ 967.9	\$ 390.6	7.5	0	-
HCM Lane LOS	B	A	-	F	F	A	A	-
HCM 95th %tile Q(veh)	0.5	-	-	40.7	11.8	0.1	-	-

Notes  
 ~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

HCM 6th TWSC  
3: 34th Avenue & 214th Street

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Intersection												
Int Delay, s/veh	24.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↖	↗		↖	↗		↖	↗		↖	↗	↖
Traffic Vol, veh/h	155	100	140	35	45	55	95	65	45	55	310	550
Future Vol, veh/h	155	100	140	35	45	55	95	65	45	55	310	550
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	200	-	-	105	-	-	200	-	-	215	-	215
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	50	0	0	0	0	4	0	0	8	0
Mvmt Flow	172	111	156	39	50	61	106	72	50	61	344	611

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	831	800	344	1214	1386	97	955	0	0	122	0	0
Stage 1	466	466	-	309	309	-	-	-	-	-	-	-
Stage 2	365	334	-	905	1077	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.7	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.75	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	291	320	602	160	144	965	728	-	-	1478	-	-
Stage 1	581	566	-	705	663	-	-	-	-	-	-	-
Stage 2	658	647	-	334	298	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	~ 159	262	602	69	118	965	728	-	-	1478	-	-
Mov Cap-2 Maneuver	~ 159	262	-	69	118	-	-	-	-	-	-	-
Stage 1	496	543	-	602	566	-	-	-	-	-	-	-
Stage 2	480	553	-	189	286	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	79.4		54.4		5		0.5	
HCM LOS	F		F					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	728	-	-	159	391	69	228	1478	-	-
HCM Lane V/C Ratio	0.145	-	-	1.083	0.682	0.564	0.487	0.041	-	-
HCM Control Delay (s)	10.8	-	-	153.1	31.8	110.2	34.9	7.5	-	-
HCM Lane LOS	B	-	-	F	D	F	D	A	-	-
HCM 95th %tile Q(veh)	0.5	-	-	8.9	4.9	2.4	2.4	0.1	-	-

Notes  
 ~: Volume exceeds capacity    \$: Delay exceeds 300s    +: Computation Not Defined    \*: All major volume in platoon

# HCM 6th Signalized Intersection Summary

## 3: 34th Avenue & 214th Street

06/01/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	155	100	140	35	45	55	95	65	45	55	310	550
Future Volume (veh/h)	155	100	140	35	45	55	95	65	45	55	310	550
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1098	1800	1800	1800	1800	1744	1800	1800	1688	1800
Adj Flow Rate, veh/h	172	111	156	39	50	61	106	72	50	61	344	611
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	0	50	0	0	0	0	4	0	0	8	0
Cap, veh/h	438	175	246	300	191	233	378	459	319	735	809	731
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.48	0.48	0.48	0.48	0.48	0.48
Sat Flow, veh/h	1302	677	952	1130	738	900	597	958	666	1289	1688	1525
Grp Volume(v), veh/h	172	0	267	39	0	111	106	0	122	61	344	611
Grp Sat Flow(s),veh/h/ln	1302	0	1629	1130	0	1638	597	0	1624	1289	1688	1525
Q Serve(g_s), s	5.1	0.0	6.1	1.3	0.0	2.3	5.9	0.0	1.8	1.2	5.6	14.6
Cycle Q Clear(g_c), s	7.3	0.0	6.1	7.4	0.0	2.3	11.5	0.0	1.8	2.9	5.6	14.6
Prop In Lane	1.00		0.58	1.00		0.55	1.00		0.41	1.00		1.00
Lane Grp Cap(c), veh/h	438	0	421	300	0	424	378	0	778	735	809	731
V/C Ratio(X)	0.39	0.00	0.63	0.13	0.00	0.26	0.28	0.00	0.16	0.08	0.43	0.84
Avail Cap(c_a), veh/h	769	0	835	587	0	840	484	0	1065	963	1107	1000
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	15.3	0.0	13.8	17.1	0.0	12.4	10.9	0.0	6.2	7.0	7.1	9.5
Incr Delay (d2), s/veh	0.6	0.0	1.6	0.2	0.0	0.3	0.4	0.0	0.1	0.0	0.4	4.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.0	0.0	3.0	0.5	0.0	1.1	1.0	0.0	0.6	0.4	2.1	6.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	15.9	0.0	15.4	17.3	0.0	12.7	11.3	0.0	6.2	7.0	7.5	14.1
LnGrp LOS	B	A	B	B	A	B	B	A	A	A	A	B
Approach Vol, veh/h		439			150			228			1016	
Approach Delay, s/veh		15.6			13.9			8.6			11.4	
Approach LOS		B			B			A			B	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		16.3		25.6		16.3		25.6				
Change Period (Y+Rc), s		5.5		5.5		5.5		5.5				
Max Green Setting (Gmax), s		21.5		27.5		21.5		27.5				
Max Q Clear Time (g_c+I1), s		9.3		16.6		9.4		13.5				
Green Ext Time (p_c), s		1.5		3.5		0.4		1.3				

### Intersection Summary

HCM 6th Ctrl Delay	12.3
HCM 6th LOS	B

# HCM 6th Signalized Intersection Summary

## 3: 34th Avenue & 214th Street

06/01/2023



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	155	100	140	35	45	55	95	65	45	55	310	550
Future Volume (veh/h)	155	100	140	35	45	55	95	65	45	55	310	550
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1800	1800	1098	1800	1800	1800	1800	1744	1800	1800	1688	1800
Adj Flow Rate, veh/h	172	111	156	39	50	61	106	72	50	61	344	611
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	0	0	50	0	0	0	0	4	0	0	8	0
Cap, veh/h	440	177	248	302	192	235	377	459	318	733	807	730
Arrive On Green	0.26	0.26	0.26	0.26	0.26	0.26	0.48	0.48	0.48	0.48	0.48	0.48
Sat Flow, veh/h	1302	677	952	1130	738	900	597	958	666	1289	1688	1525
Grp Volume(v), veh/h	172	0	267	39	0	111	106	0	122	61	344	611
Grp Sat Flow(s),veh/h/ln	1302	0	1629	1130	0	1638	597	0	1624	1289	1688	1525
Q Serve(g_s), s	5.1	0.0	6.1	1.3	0.0	2.3	6.0	0.0	1.8	1.2	5.6	14.7
Cycle Q Clear(g_c), s	7.4	0.0	6.1	7.4	0.0	2.3	11.6	0.0	1.8	3.0	5.6	14.7
Prop In Lane	1.00		0.58	1.00		0.55	1.00		0.41	1.00		1.00
Lane Grp Cap(c), veh/h	440	0	425	302	0	427	377	0	777	733	807	730
V/C Ratio(X)	0.39	0.00	0.63	0.13	0.00	0.26	0.28	0.00	0.16	0.08	0.43	0.84
Avail Cap(c_a), veh/h	765	0	830	583	0	835	480	0	1059	957	1100	995
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	15.3	0.0	13.8	17.1	0.0	12.4	11.0	0.0	6.2	7.0	7.2	9.6
Incr Delay (d2), s/veh	0.6	0.0	1.5	0.2	0.0	0.3	0.4	0.0	0.1	0.0	0.4	4.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(95%),veh/ln	2.2	0.0	3.4	0.5	0.0	1.2	1.0	0.0	0.6	0.4	2.1	6.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	15.8	0.0	15.3	17.3	0.0	12.7	11.4	0.0	6.3	7.1	7.6	14.3
LnGrp LOS	B	A	B	B	A	B	B	A	A	A	A	B
Approach Vol, veh/h		439			150			228			1016	
Approach Delay, s/veh		15.5			13.9			8.7			11.6	
Approach LOS		B			B			A			B	
Timer - Assigned Phs		2		4		6		8				
Phs Duration (G+Y+Rc), s		16.5		25.7		16.5		25.7				
Change Period (Y+Rc), s		5.5		5.5		5.5		5.5				
Max Green Setting (Gmax), s		21.5		27.5		21.5		27.5				
Max Q Clear Time (g_c+I1), s		9.4		16.7		9.4		13.6				
Green Ext Time (p_c), s		1.7		3.5		0.5		1.3				
<b>Intersection Summary</b>												
HCM 6th Ctrl Delay				12.3								
HCM 6th LOS				B								

HCM 6th TWSC  
6: 476th Avenue & 214th Street

06/01/2023

Intersection												
Int Delay, s/veh	6.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	160	5	35	5	5	5	30	65	5	5	55	100
Future Vol, veh/h	160	5	35	5	5	5	30	65	5	5	55	100
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	9	14	0	7	0
Mvmt Flow	178	6	39	6	6	6	33	72	6	6	61	111

Major/Minor	Minor2		Minor1			Major1		Major2				
Conflicting Flow All	276	273	117	292	325	75	172	0	0	78	0	0
Stage 1	129	129	-	141	141	-	-	-	-	-	-	-
Stage 2	147	144	-	151	184	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	680	637	941	664	596	992	1417	-	-	1533	-	-
Stage 1	880	793	-	867	784	-	-	-	-	-	-	-
Stage 2	860	782	-	856	751	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	657	619	941	619	579	992	1417	-	-	1533	-	-
Mov Cap-2 Maneuver	657	619	-	619	579	-	-	-	-	-	-	-
Stage 1	859	790	-	846	765	-	-	-	-	-	-	-
Stage 2	829	763	-	812	748	-	-	-	-	-	-	-

Approach	EB		WB			NB		SB		
HCM Control Delay, s	12.6		10.3			2.3		0.2		
HCM LOS	B		B							

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1417	-	-	693	690	1533	-
HCM Lane V/C Ratio	0.024	-	-	0.321	0.024	0.004	-
HCM Control Delay (s)	7.6	0	-	12.6	10.3	7.4	0
HCM Lane LOS	A	A	-	B	B	A	A
HCM 95th %tile Q(veh)	0.1	-	-	1.4	0.1	0	-

Intersection												
Int Delay, s/veh	5.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	↗
Traffic Vol, veh/h	160	5	35	5	5	5	30	65	5	5	55	100
Future Vol, veh/h	160	5	35	5	5	5	30	65	5	5	55	100
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None									
Storage Length	-	-	-	-	-	-	-	-	-	-	-	150
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	0	0	0	0	0	0	0	9	14	0	7	0
Mvmt Flow	178	6	39	6	6	6	33	72	6	6	61	111

Major/Minor	Minor2		Minor1		Major1		Major2					
Conflicting Flow All	220	217	61	292	325	75	172	0	0	78	0	0
Stage 1	73	73	-	141	141	-	-	-	-	-	-	-
Stage 2	147	144	-	151	184	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.1	6.5	6.2	4.1	-	-	4.1	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.1	5.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.5	4	3.3	2.2	-	-	2.2	-	-
Pot Cap-1 Maneuver	740	685	1010	664	596	992	1417	-	-	1533	-	-
Stage 1	942	838	-	867	784	-	-	-	-	-	-	-
Stage 2	860	782	-	856	751	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	715	666	1010	621	579	992	1417	-	-	1533	-	-
Mov Cap-2 Maneuver	715	666	-	621	579	-	-	-	-	-	-	-
Stage 1	919	835	-	846	765	-	-	-	-	-	-	-
Stage 2	829	763	-	814	748	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	11.8		10.3		2.3		0.2	
HCM LOS	B		B					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1417	-	-	752	690	1533	-	-
HCM Lane V/C Ratio	0.024	-	-	0.296	0.024	0.004	-	-
HCM Control Delay (s)	7.6	0	-	11.8	10.3	7.4	0	-
HCM Lane LOS	A	A	-	B	B	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	1.2	0.1	0	-	-

# Appendix C: Turn Lane Warrants

## **2023 Existing Conditions**

214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

Redmond Road & 476<sup>th</sup> Avenue Intersection

## **2045 Design Year**

214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

Redmond Road & 476<sup>th</sup> Avenue Intersection

Turn Lane Warrants:

**2023 EXISTING**

34th Avenue S / 476th Avenue

214th Street

Intersection Peak Hour Turning Movement Volumes					Warrant Volumes (for SDDOT Figures)							
SB	LT	I	RT	Existing Lane Configurations:	PM	AM	AM	PM	Left Turn		Right Turn	
									SB LT	Adv+Opp	NB LT	SB RT
							0	0	<u>AM</u>			<u>AM</u>
							155	25	I			155
							5	0	I	0	5	11
									LT		1	25
										0	0	145

Warrant Summary Matrix

	LT	RT
SB	No	No
NB	No	No

Redmond Road

SB	LT	I	RT	Existing Lane Configurations:	PM	AM	AM	PM	Left Turn		Right Turn	
									SB LT	Adv+Opp	NB LT	SB RT
							0	0	<u>AM</u>			<u>AM</u>
							25	40	I			25
							1	10	I	0	1	75
									LT		20	40
										1	35	70

Warrant Summary Matrix Legend

All speeds
35 mph
>35 mph - 45 mph
45mph or higher
Not Warranted
Not Applicable

Turn Lane Warrants:

**2045 DESIGN YEAR**

34th Avenue S / 476th Avenue

214th Street

Intersection Peak Hour Turning Movement Volumes					Warrant Volumes (for SDDOT Figures)							
SB	LT	I	RT	Existing Lane Configurations:	PM	AM	AM	PM	Left Turn		Right Turn	
									SB LT	Adv+Opp	NB LT	SB RT
							20	45	<u>AM</u>			<u>AM</u>
							215	65	I			235
							110	95	I	40	110	310
									LT		240	110
										55	550	860

Warrant Summary Matrix

	LT	RT
SB	Yes	Yes
NB	Yes	No

Redmond Road

SB	LT	I	RT	Existing Lane Configurations:	PM	AM	AM	PM	Left Turn		Right Turn	
									SB LT	Adv+Opp	NB LT	SB RT
							5	5	<u>AM</u>			<u>AM</u>
							40	65	I			45
							25	30	I	5	25	240
									LT		150	70
										5	100	155

Warrant Summary Matrix Legend

All speeds
Approaching
>35 mph - 45 mph
45mph or higher
Not Warranted
Not Applicable



# Appendix D: Signal Warrant Reports

214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

Redmond Road & 476<sup>th</sup> Avenue Intersection

# HCS Warrants Report

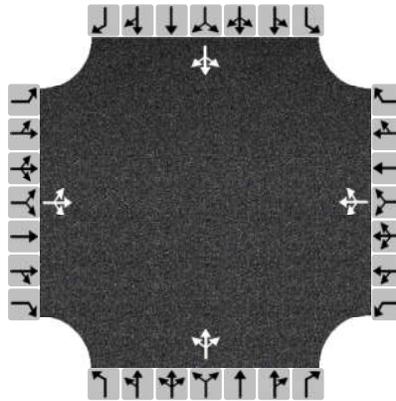
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	Existings Conditions: 214th St & 34th Ave S		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	45	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	
Vehicle Volumes Averages (veh/h)	0	0	0	0	0	0	0	15	0	0	12	0
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (56%)	4A (70%)	4B (56%)
07 - 08	171	5	176	0	0	No	No	No	No	No	No	No	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	170	2	172	0	0	No	No	No	No	No	No	No	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	341	7	348	0	0	0	0	0	0	0	0	0	0	0

**Warrants**

<b>Warrant 1: Eight-Hour Vehicular Volume</b>	
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	
56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	
<b>Warrant 2: Four-Hour Vehicular Volume</b>	
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	
<b>Warrant 3: Peak Hour</b>	
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	
<b>Warrant 4: Pedestrian Volume</b>	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
<b>Warrant 5: School Crossing</b>	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	
<b>Warrant 6: Coordinated Signal System</b>	
Degree of Platooning (Predominant direction or both directions)	
<b>Warrant 7: Crash Experience</b>	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	
<b>Warrant 8: Roadway Network</b>	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
<b>Warrant 9: Grade Crossing</b>	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	

# HCS Warrants Report

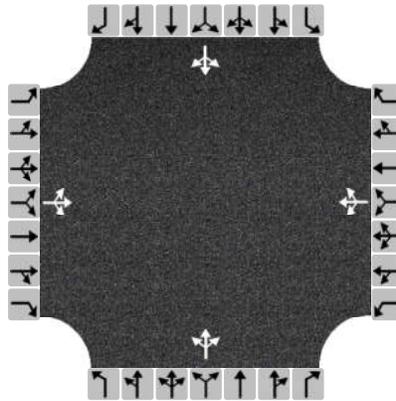
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2045
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	2045 No Build: 214th St & 34th Ave S		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	45	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	
Vehicle Volumes Averages (veh/h)	47	14	25	6	11	8	17	23	5	7	31	65
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (56%)	4A (70%)	4B (56%)
07 - 08	695	655	1530	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	1120	395	1650	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	1815	1050	3180	0	0	2	2	2	2	2	0	2	0	0

<b>Warrants</b>	
<b>Warrant 1: Eight-Hour Vehicular Volume</b>	
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	
56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	
<b>Warrant 2: Four-Hour Vehicular Volume</b>	
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	
<b>Warrant 3: Peak Hour</b>	
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	✓
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	✓
<b>Warrant 4: Pedestrian Volume</b>	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
<b>Warrant 5: School Crossing</b>	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	
<b>Warrant 6: Coordinated Signal System</b>	
Degree of Platooning (Predominant direction or both directions)	
<b>Warrant 7: Crash Experience</b>	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	
<b>Warrant 8: Roadway Network</b>	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
<b>Warrant 9: Grade Crossing</b>	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	

# HCS Warrants Report

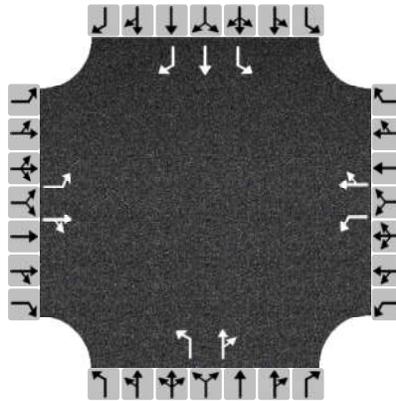
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2045
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	2045 Build: 214th St & 34th Ave S		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	45	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	1	1	0	1	1	0	1	1	0	1	1	1
Lane Usage	L	TR		L	TR		L	TR		L	T	R
Vehicle Volumes Averages (veh/h)	47	14	25	6	11	8	17	23	5	7	31	65
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (56%)	4A (70%)	4B (56%)
07 - 08	695	655	1530	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	1120	395	1650	0	0	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	1815	1050	3180	0	0	2	2	2	2	2	0	2	0	0

<b>Warrants</b>	
<b>Warrant 1: Eight-Hour Vehicular Volume</b>	
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	
56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	
<b>Warrant 2: Four-Hour Vehicular Volume</b>	
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	
<b>Warrant 3: Peak Hour</b>	
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	✓
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	✓
<b>Warrant 4: Pedestrian Volume</b>	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
<b>Warrant 5: School Crossing</b>	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	
<b>Warrant 6: Coordinated Signal System</b>	
Degree of Platooning (Predominant direction or both directions)	
<b>Warrant 7: Crash Experience</b>	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	
<b>Warrant 8: Roadway Network</b>	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
<b>Warrant 9: Grade Crossing</b>	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	

# HCS Warrants Report

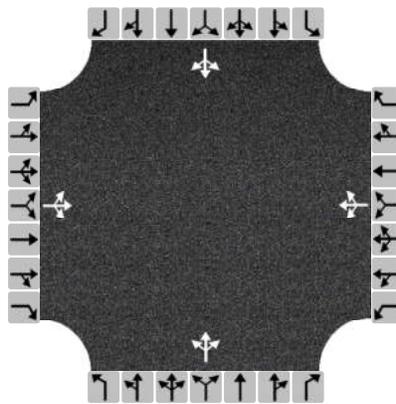
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2033
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	No Build: 214th St & 34th Ave S		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	45	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	
Vehicle Volumes Averages (veh/h)	21	6	12	2	5	4	8	18	2	3	21	30
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (56%)	4A (70%)	4B (56%)
07 - 08	409	300	791	0	0	Yes	Yes	No	No	Yes	No	Yes	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	601	180	842	0	0	Yes	Yes	Yes	Yes	Yes	No	No	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	1010	480	1633	0	0	2	2	1	1	2	0	1	0	0

**Warrants**

<b>Warrant 1: Eight-Hour Vehicular Volume</b>														
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--														
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--														
56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 2: Four-Hour Vehicular Volume</b>														
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)														
<b>Warrant 3: Peak Hour</b>														
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--														
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 4: Pedestrian Volume</b>														
A. Four Hour Volumes --or--														
B. One-Hour Volumes														
<b>Warrant 5: School Crossing</b>														
Gaps Same Period --and--														
Student Volumes														
Nearest Traffic Control Signal (optional)														
<b>Warrant 6: Coordinated Signal System</b>														
Degree of Platooning (Predominant direction or both directions)														
<b>Warrant 7: Crash Experience</b>														
A. Adequate trials of alternatives, observance and enforcement failed --and--														
B. Reported crashes susceptible to correction by signal (12-month period) --and--														
C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied														
<b>Warrant 8: Roadway Network</b>														
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--														
B. Weekend Volume (Five hours total)														
<b>Warrant 9: Grade Crossing</b>														
A. Grade Crossing within 140 ft --and--														
B. Peak-Hour Vehicular Volumes														

# HCS Warrants Report

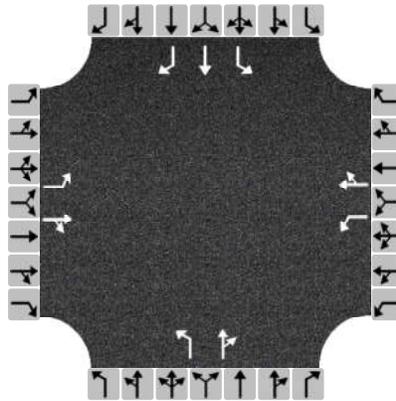
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2036 (Year of Need)
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	Build: 214th St & 34th Ave S		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	45	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
Movement	L	T	R	L	T	R	L	T	R	L	T	R
Number of Lanes, N	1	1	0	1	1	0	1	1	0	1	1	1
Lane Usage	L	TR		L	TR		L	TR		L	T	R
Vehicle Volumes Averages (veh/h)	27	8	15	3	6	5	10	19	3	4	24	38
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (70%)	1A (56%)	1B (70%)	1B (56%)	2 (70%)	3A (70%)	3B (56%)	4A (70%)	4B (56%)
07 - 08	480	389	976	0	0	Yes	Yes	No	No	Yes	No	Yes	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	733	235	1049	0	0	Yes	Yes	Yes	Yes	Yes	No	No	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	1213	624	2025	0	0	2	2	1	1	2	0	1	0	0

**Warrants**

<b>Warrant 1: Eight-Hour Vehicular Volume</b>														
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--														
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--														
56% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 2: Four-Hour Vehicular Volume</b>														
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)														
<b>Warrant 3: Peak Hour</b>														
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--														
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 4: Pedestrian Volume</b>														
A. Four Hour Volumes --or--														
B. One-Hour Volumes														
<b>Warrant 5: School Crossing</b>														
Gaps Same Period --and--														
Student Volumes														
Nearest Traffic Control Signal (optional)														
<b>Warrant 6: Coordinated Signal System</b>														
Degree of Platooning (Predominant direction or both directions)														
<b>Warrant 7: Crash Experience</b>														
A. Adequate trials of alternatives, observance and enforcement failed --and--														
B. Reported crashes susceptible to correction by signal (12-month period) --and--														
C. 56% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied														
<b>Warrant 8: Roadway Network</b>														
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--														
B. Weekend Volume (Five hours total)														
<b>Warrant 9: Grade Crossing</b>														
A. Grade Crossing within 140 ft --and--														
B. Peak-Hour Vehicular Volumes														

# HCS Warrants Report

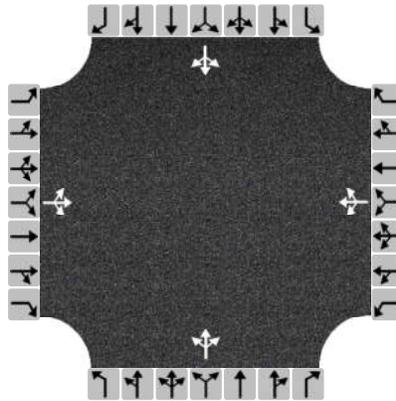
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2023
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	Existings Conditions: Redmond Rd & 476th Ave		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	25	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	
Vehicle Volumes Averages (veh/h)	4	0	0	0	0	0	0	5	0	0	7	4
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A ( 100% )	1A ( 80% )	1B ( 100% )	1B ( 80% )	2 ( 100% )	3A ( 100% )	3B ( 80% )	4A ( 100% )	4B ( 80% )
07 - 08	101	45	146	0	0	No	No	No	No	No	No	No	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	121	21	142	0	0	No	No	No	No	No	No	No	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	222	66	288	0	0	0	0	0	0	0	0	0	0	0

**Warrants**

**Warrant 1: Eight-Hour Vehicular Volume**

- A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--
- B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--
- 80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)

**Warrant 2: Four-Hour Vehicular Volume**

- Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)

**Warrant 3: Peak Hour**

- A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--
- B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)

**Warrant 4: Pedestrian Volume**

- A. Four Hour Volumes --or--
- B. One-Hour Volumes

**Warrant 5: School Crossing**

- Gaps Same Period --and--
- Student Volumes
- Nearest Traffic Control Signal (optional)

**Warrant 6: Coordinated Signal System**

- Degree of Platooning (Predominant direction or both directions)

**Warrant 7: Crash Experience**

- A. Adequate trials of alternatives, observance and enforcement failed --and--
- B. Reported crashes susceptible to correction by signal (12-month period) --and--
- C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied

**Warrant 8: Roadway Network**

- A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--
- B. Weekend Volume (Five hours total)

**Warrant 9: Grade Crossing**

- A. Grade Crossing within 140 ft --and--
- B. Peak-Hour Vehicular Volumes

# HCS Warrants Report

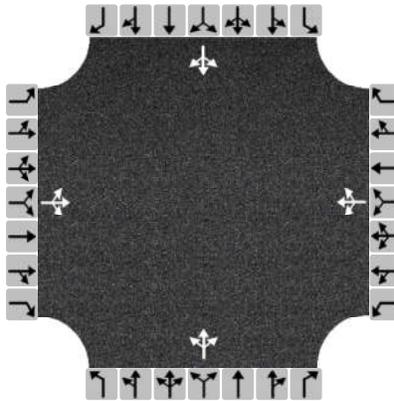
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2045
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	2045 No Build: Redmond Rd & 476th Ave		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	25	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	1	0	0	1	0	0	1	0	0	1	0
Lane Usage		LTR			LTR			LTR			LTR	
Vehicle Volumes Averages (veh/h)	21	0	5	0	0	0	4	8	0	0	12	20
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (80%)	4A (100%)	4B (80%)
07 - 08	315	135	465	0	0	No	No	No	No	No	No	No	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	260	200	475	0	0	No	No	No	No	No	No	No	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	575	335	940	0	0	0	0	0	0	0	0	0	0	0

<b>Warrants</b>	
<b>Warrant 1: Eight-Hour Vehicular Volume</b>	
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--	
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--	
80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)	
<b>Warrant 2: Four-Hour Vehicular Volume</b>	
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)	
<b>Warrant 3: Peak Hour</b>	
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--	
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)	
<b>Warrant 4: Pedestrian Volume</b>	
A. Four Hour Volumes --or--	
B. One-Hour Volumes	
<b>Warrant 5: School Crossing</b>	
Gaps Same Period --and--	
Student Volumes	
Nearest Traffic Control Signal (optional)	
<b>Warrant 6: Coordinated Signal System</b>	
Degree of Platooning (Predominant direction or both directions)	
<b>Warrant 7: Crash Experience</b>	
A. Adequate trials of alternatives, observance and enforcement failed --and--	
B. Reported crashes susceptible to correction by signal (12-month period) --and--	
C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied	
<b>Warrant 8: Roadway Network</b>	
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--	
B. Weekend Volume (Five hours total)	
<b>Warrant 9: Grade Crossing</b>	
A. Grade Crossing within 140 ft --and--	
B. Peak-Hour Vehicular Volumes	

# HCS Warrants Report

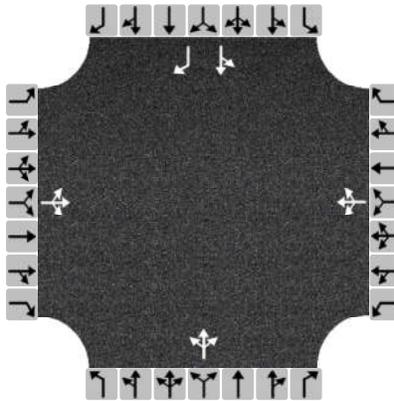
## Project Information

Analyst	HDR	Date	3/27/2023
Agency	HDR	Analysis Year	2045
Jurisdiction	Brookings County	Time Period Analyzed	Peak Hours
Project Description	2045 Build: Redmond Rd & 476th Ave		

## General

Major Street Direction	North-South	Population < 10,000	No
Starting Time Interval	7	Coordinated Signal System	No
Median Type	Undivided	Crashes (crashes/year)	0
Major Street Speed (mi/h)	25	Adequate Trials of Crash Exp. Alt.	No
Nearest Signal (ft)	0		

## Geometry and Traffic



Approach	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
Movement												
Number of Lanes, N	0	1	0	0	1	0	0	1	0	0	1	1
Lane Usage		LTR			LTR			LTR			LT	R
Vehicle Volumes Averages (veh/h)	21	0	5	0	0	0	4	8	0	0	12	20
Pedestrian Averages (peds/h)	0			0			0			0		
Gap Averages (gaps/h)	0			0			0			0		
Delay (s/veh)	0.0			0.0			0.0			0.0		
Delay (veh-hrs)	0.0			0.0			0.0			0.0		

## School Crossing and Roadway Network

Number of Students in Highest Hour	0	Two or More Major Routes	No
Number of Adequate Gaps in Period	0	Weekend Counts	No
Number of Minutes in Period	0	5-year Growth Factor (%)	0

## Railroad Crossing

Grade Crossing Approach	None	Rail Traffic (trains/day)	4
Highest Volume Hour with Trains	Unknown	High Occupancy Buses (%)	0
Distance to Stop Line (ft)	-	Tractor-Trailer Trucks (%)	10

<b>Volume Summary</b>														
Hour	Major Volume	Minor Volume	Total Volume	Peds/h	Gaps/h	1A (100%)	1A (80%)	1B (100%)	1B (80%)	2 (100%)	3A (100%)	3B (80%)	4A (100%)	4B (80%)
07 - 08	315	135	465	0	0	No	No	No	No	No	No	No	No	No
08 - 09	0	0	0	0	0	No	No	No	No	No	No	No	No	No
09 - 10	0	0	0	0	0	No	No	No	No	No	No	No	No	No
10 - 11	0	0	0	0	0	No	No	No	No	No	No	No	No	No
11 - 12	0	0	0	0	0	No	No	No	No	No	No	No	No	No
12 - 13	0	0	0	0	0	No	No	No	No	No	No	No	No	No
13 - 14	0	0	0	0	0	No	No	No	No	No	No	No	No	No
14 - 15	0	0	0	0	0	No	No	No	No	No	No	No	No	No
15 - 16	0	0	0	0	0	No	No	No	No	No	No	No	No	No
16 - 17	260	200	475	0	0	No	No	No	No	No	No	No	No	No
17 - 18	0	0	0	0	0	No	No	No	No	No	No	No	No	No
18 - 19	0	0	0	0	0	No	No	No	No	No	No	No	No	No
Total	575	335	940	0	0	0	0	0	0	0	0	0	0	0

**Warrants**

<b>Warrant 1: Eight-Hour Vehicular Volume</b>														
A. Minimum Vehicular Volumes (Both major approaches --and-- higher minor approach) --or--														
B. Interruption of Continuous Traffic (Both major approaches --and-- higher minor approach) --or--														
80% Vehicular --and-- Interruption Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 2: Four-Hour Vehicular Volume</b>														
Four-Hour Vehicular Volume (Both major approaches --and-- higher minor approach)														
<b>Warrant 3: Peak Hour</b>														
A. Peak-Hour Conditions (Minor delay -- and-- minor volume --and-- total volume) --or--														
B. Peak-Hour Vehicular Volumes (Both major approaches --and-- higher minor approach)														
<b>Warrant 4: Pedestrian Volume</b>														
A. Four Hour Volumes --or--														
B. One-Hour Volumes														
<b>Warrant 5: School Crossing</b>														
Gaps Same Period --and--														
Student Volumes														
Nearest Traffic Control Signal (optional)														
<b>Warrant 6: Coordinated Signal System</b>														
Degree of Platooning (Predominant direction or both directions)														
<b>Warrant 7: Crash Experience</b>														
A. Adequate trials of alternatives, observance and enforcement failed --and--														
B. Reported crashes susceptible to correction by signal (12-month period) --and--														
C. 80% Volumes for Warrants 1A, 1B, --or-- 4 are satisfied														
<b>Warrant 8: Roadway Network</b>														
A. Weekday Volume (Peak hour total --and-- projected warrants 1, 2, or 3) --or--														
B. Weekend Volume (Five hours total)														
<b>Warrant 9: Grade Crossing</b>														
A. Grade Crossing within 140 ft --and--														
B. Peak-Hour Vehicular Volumes														



# Appendix E: Intersection Functional Area Dimension Calculations

## 2045 Design Year

214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

Redmond Road & 476<sup>th</sup> Avenue Intersection



## Methodology

The feasibility, or ‘window of opportunity’, of an access point between major intersections review conditions upstream and downstream of the access point using the following methodology:

### *‘Downstream (of the proposed access) on the Major Roadway Condition’*

1. Upstream functional dimensions of the major intersection
  - a. Distance traveled during driver’s perception-reaction time (d1, Table 17-2<sup>1</sup>) + deceleration-maneuver distances (d2, Table 17-3<sup>1</sup>) + 95<sup>th</sup> % queue length (d3)

### *‘Upstream (of the proposed access) on the Major Roadway Condition’*

1. Downstream functional dimensions of the major intersection
  - a. Acceleration distance (Exhibit 14-11<sup>2</sup>)
  - b. Decision sight distance (Exhibit 14-12<sup>2</sup>)
2. Upstream functional dimensions of the minor access/driveway
  - a. Distance traveled during driver’s perception-reaction time (d1, Table 17-2<sup>1</sup>) + deceleration-maneuver distances (d2, Table 17-3<sup>1</sup>)
3. Stopping sight distance (Table 17-4<sup>1</sup>)

## 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection

**Table 1: 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection – Eastbound Movement 95<sup>th</sup> % Queues**

Eastbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	175	75
Through	0	0
Right Turn	75	100

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
55 mph posted speed limit  
Rural setting  
2.5s perception-reaction time (SDDOT guidance for Rural setting)

### *‘Downstream (of the proposed access) on the Major Roadway Condition’*

1. Upstream functional dimension of the 214<sup>th</sup> Street & 34<sup>th</sup> Avenue eastbound approach: 200 feet + 525 feet + 175 feet = 900 feet

### *Upstream (of the proposed access) on the Major Roadway Condition’*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 1,000 feet
  - b. Decision sight distance (rural): 535 feet
2. Upstream functional dimension of proposed access: 200 feet + 525 feet = 725 feet

<sup>1</sup> SDDOT Road Design Manual, Chapter 17 – Access Management. SDDOT.

<sup>2</sup> Access Management Manual, Second Edition. Transportation Research Board. 2014.



3. Stopping sight distance: 495 feet

**Table 2: 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection – Westbound Movement 95<sup>th</sup> % Queues**

Westbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	25	25
Through	0	0
Right Turn	50	50

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
55 mph posted speed limit  
Rural setting  
2.5s perception-reaction time (SDDOT guidance for Rural setting)

*'Downstream (of the proposed access) on the Major Roadway Condition'*

1. Upstream functional dimension of the 214<sup>th</sup> Street & 34<sup>th</sup> Avenue westbound approach: 200 feet + 525 feet + 50 feet = 775 feet

*Upstream (of the proposed access) on the Major Roadway Condition'*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 1,000 feet
  - b. Decision sight distance (rural): 535 feet
2. Upstream functional dimension of proposed access: 200 feet + 525 feet = 725 feet
3. Stopping sight distance: 495 feet

**Table 3: 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection – Northbound Movement 95<sup>th</sup> % Queues**

Northbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	75	50
Through	0	0
Right Turn	100	25

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
45 mph speed limit  
Rural setting  
2.5s perception-reaction time (SDDOT guidance for Rural setting)

*'Downstream (of the proposed access) on the Major Roadway Condition'*

1. Upstream functional dimension of the 214<sup>th</sup> Street & 34<sup>th</sup> Avenue northbound approach: 165 feet + 360 feet + 100 feet = 625 feet



*'Upstream (of the proposed access) on the Major Roadway Condition'*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 580 feet
  - b. Decision sight distance (rural): 395 feet
2. Upstream functional dimension of proposed access: 165 feet + 360 feet = 525 feet
3. Stopping sight distance: 360 feet

**Table 4: 214<sup>th</sup> Street & 34<sup>th</sup> Avenue Intersection – Southbound Movement 95<sup>th</sup> % Queues**

Southbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	25	25
Through	25	75
Right Turn	125	175

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
45 mph speed limit  
Rural setting  
2.5s perception-reaction time (SDDOT guidance for Rural setting)

*'Downstream (of the proposed access) on the Major Roadway Condition'*

1. Upstream functional dimension of the 214<sup>th</sup> Street & 34<sup>th</sup> Avenue southbound approach: 165 feet + 360 feet + 175 feet = 700 feet

*'Upstream (of the proposed access) on the Major Roadway Condition'*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 580 feet
  - b. Decision sight distance (rural): 395 feet
2. Upstream functional dimension of proposed access: 165 feet + 360 feet = 525 feet
3. Stopping sight distance: 360 feet

**Redmond Road & 476<sup>th</sup> Avenue Intersection**

**Table 5: Redmond Road & 476<sup>th</sup> Avenue Intersection – Eastbound Movement 95<sup>th</sup> % Queues**

Eastbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	25	50
Through	0	0
Right Turn	0	0

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
25 mph speed limit  
Urban setting  
1.5s perception-reaction time (SDDOT guidance for Urban setting)



*'Downstream (of the proposed access) on the Major Roadway Condition'*

1. Upstream functional dimension of the Redmond Road & 476<sup>th</sup> Avenue eastbound approach: 55 feet + 105 feet + 50 feet = 210 feet

*'Upstream (of the proposed access) on the Major Roadway Condition'*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 150 feet
  - b. Decision sight distance (urban): 400 feet
2. Upstream functional dimension of proposed access: 55 feet + 105 feet = 160 feet
3. Stopping sight distance: 155 feet

**Table 6: Redmond Road & 476<sup>th</sup> Avenue Intersection – Westbound Movement 95<sup>th</sup> % Queues**

Westbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	25	25
Through	0	0
Right Turn	0	0

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
 25 mph speed limit  
 Urban setting  
 1.5s perception-reaction time (SDDOT guidance for Urban setting)

*'Downstream (of the proposed access) on the Major Roadway Condition'*

1. Upstream functional dimension of the Redmond Road & 476<sup>th</sup> Avenue westbound approach: 55 feet + 105 feet + 25 feet = 185 feet

*'Upstream (of the proposed access) on the Major Roadway Condition'*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 150 feet
  - b. Decision sight distance (urban): 400 feet
2. Upstream functional dimension of proposed access: 55 feet + 105 feet = 160 feet
3. Stopping sight distance: 155 feet



**Table 7: Redmond Road & 476<sup>th</sup> Avenue Intersection – Northbound Movement 95<sup>th</sup> % Queues**

Northbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	25	25
Through	0	0
Right Turn	0	0

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
 25 mph speed limit  
 Urban setting  
 1.5s perception-reaction time (SDDOT guidance for Urban setting)

*‘Downstream (of the proposed access) on the Major Roadway Condition’*

1. Upstream functional dimension of the Redmond Road & 476<sup>th</sup> Avenue northbound approach: 55 feet + 105 feet + 25 feet = 185 feet

*‘Upstream (of the proposed access) on the Major Roadway Condition’*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 150 feet
  - b. Decision sight distance (urban): 400 feet
2. Upstream functional dimension of proposed access: 55 feet + 105 feet = 160 feet
3. Stopping sight distance: 155 feet

**Table 8: Redmond Road & 476<sup>th</sup> Avenue Intersection – Southbound Movement 95<sup>th</sup> % Queues**

Southbound Movement	AM Queue (ft)	PM Queue (ft)
Left Turn	0	0
Through	0	0
Right Turn	0	0

2045 Design Year operations analysis 95<sup>th</sup> percentile queue length  
 25 mph speed limit  
 Urban setting  
 1.5s perception-reaction time (SDDOT guidance for Urban setting)

*‘Downstream (of the proposed access) on the Major Roadway Condition’*

1. Upstream functional dimension of the Redmond Road & 476<sup>th</sup> Avenue northbound approach: 55 feet + 105 feet + 0 feet = 160 feet

*‘Upstream (of the proposed access) on the Major Roadway Condition’*

1. Downstream functional dimension from major intersection
  - a. Acceleration distance: 150 feet
  - b. Decision sight distance (urban): 400 feet



2. Upstream functional dimension of proposed access: 55 feet + 105 feet = 160 feet
3. Stopping sight distance: 155 feet

# APPENDIX B - PRELIMINARY ENVIRONMENTAL REPORT

engineering a better community

# PRELIMINARY ENVIRONMENTAL REPORT

214th Street Corridor  
Brookings County, SD

JANUARY 2024

**BANNER**  
engineering a better community



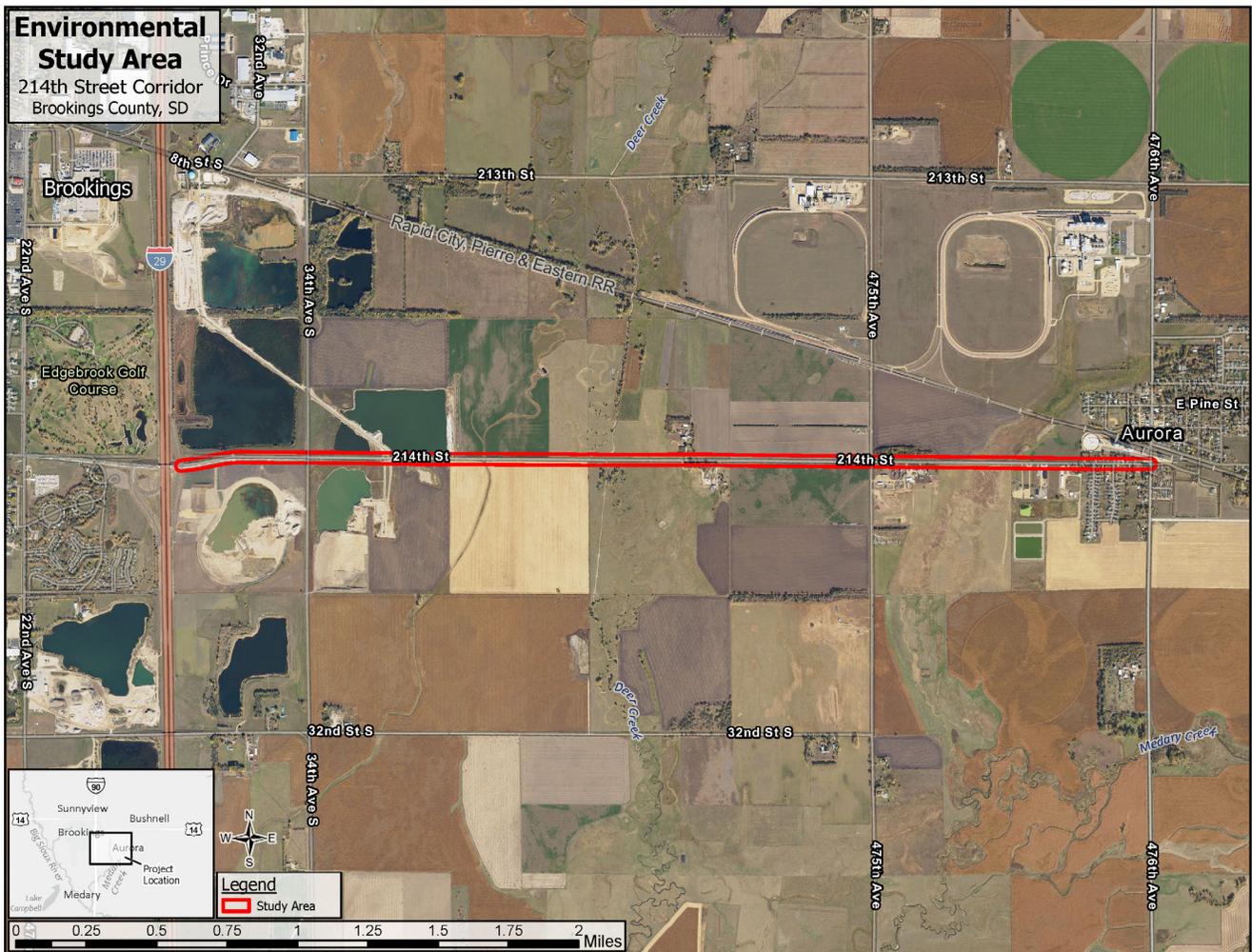
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## 1.0 PROJECT LOCATION

The Environmental Study Area (Study Area) is located in Sections 31-35, Township 110 North, Range 49 West and Sections 2-6, Township 109 North, Range 49 West, Brookings County, South Dakota. The Study Area is approximately a 3.5-mile-long, 100-foot wide corridor along 214<sup>th</sup> Street. The corridor begins east of the I-29 and 214<sup>th</sup> Street interchange, extending east for 3.5 miles to the intersection of 476<sup>th</sup> Avenue and 214<sup>th</sup> Street in Aurora. This preliminary environmental analysis memo will outline the probable resources within the Study Area and discuss any potential issues that may require further investigation. Refer to **Figure 1**.

**Figure 1. Environmental Study Area**



The proposed project would reconstruct 214<sup>th</sup> Street to improve commuter safety and truck traffic flow and also would address surface water management issues along the roadway, such as overtopping. Specific roadway widths and water crossing structures have not yet been finalized.

## 2.0 RESOURCES EVALUATED

The following sections provide preliminary discussion of the potentially affected resources in and around the Study Area. Current conditions (January 2024) and potential impacts are described for each resource. While impacts to all resources were considered, only those which could be impacted are described. Resources with no expected impact are not discussed further in this preliminary evaluation and include airport hazards, coastal barrier resources, sole source aquifers, Section 4(f) and 6(f) properties, and wild and scenic rivers. Four resources, noise, air quality, hazardous materials, and environmental justice, are also not described in detail below. As the project moves forward, these resources will be considered using current data for the Study Area.

### 2.1 LISTED SPECIES (FEDERAL AND STATE)

#### FEDERALLY LISTED SPECIES

A search of the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) database (Project Code: 2024-0034116) returned seven species having the potential to be present in the Study Area (USFWS 2024a). Preliminary effect determinations and the reasoning for the determination are listed in the table below.

Species	Status	Preliminary Effect Determination	Comments
Northern Long-eared Bat ( <i>Myotis septentrionalis</i> )	Endangered	No Effect	No habitat present.
Tricolored Bat ( <i>Perimyotis subflavus</i> )	Proposed Endangered	No Effect	No habitat present.
Red Knot ( <i>Calidris canutus rufa</i> )	Threatened	No Effect	No habitat present.
Topeka Shiner ( <i>Notropis topeka</i> )	Endangered	May Affect, Not Likely to Adversely Affect	Deer Creek is a known Topeka shiner stream.
Dakota Skipper ( <i>Hesperia dacotae</i> )	Threatened	No Effect	No habitat present.
Monarch Butterfly ( <i>Danaus plexippus</i> )	Candidate	No Effect	Habitat is likely present.
Western Prairie Fringed Orchid ( <i>Platanthera praeclara</i> )	Threatened	No Effect	No habitat present.

Deer Creek crosses the Study Area and is a known inhabited Topeka shiner stream. Best management practices for water quality should be followed to prevent excess sediment from entering the creek during construction activities.

Milkweed, the primary food source for the monarch butterfly caterpillar, likely exists within the Study Area. As a candidate species, monarchs have no legal status under the Endangered Species Act, unless the project is located on federal lands, where candidate species are treated as proposed species. There are no federal lands located within the Study Area.

#### STATE LISTED SPECIES

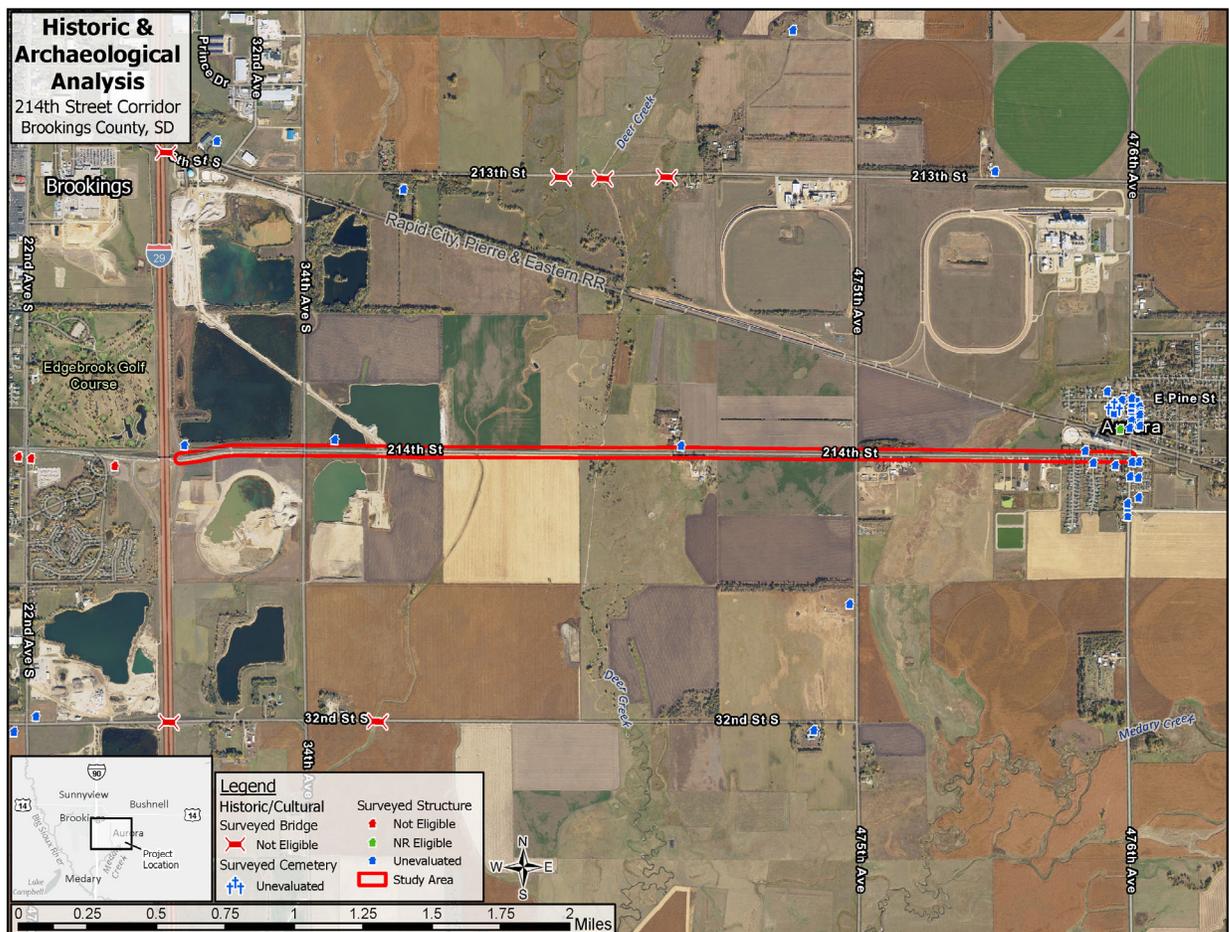
A review of the South Dakota Department of Game, Fish and Parks' South Dakota Environmental Review Tool returned no state listed threatened or endangered species present within the Study Area (SDGFP 2024).

## 2.2 CULTURAL RESOURCES

A search of the South Dakota Historic Preservation Office (SHPO) Cultural Resource Geographic Research Information Display (CRGRID) database revealed no historic or archaeological structures within the Study Area. Several unevaluated structures were found adjacent to but outside the Study Area (SHPO CRGRID 2024). As the project moves forward, a Level I record search would be completed for the Area of Potential Effect (APE) for the project. In this case, the APE will likely be the same as the Study Area. A Level I record search will return a list and map showing known sites, previous surveys, historic structures, and associated eligibility status of sites or structures within a one-mile buffer of the APE. Refer to **Figure 2**.

A Level III cultural survey would be conducted for any locations along the project corridor that have been determined to have not been previously disturbed or for any records that were returned during the Level I record search with a status of “unevaluated”. Cultivation in agricultural practices does not extend deep enough to be considered as previously disturbed, so most of the 214<sup>th</sup> Street corridor would likely need to be surveyed.

**Figure 2. Historic and Archaeological Analysis**

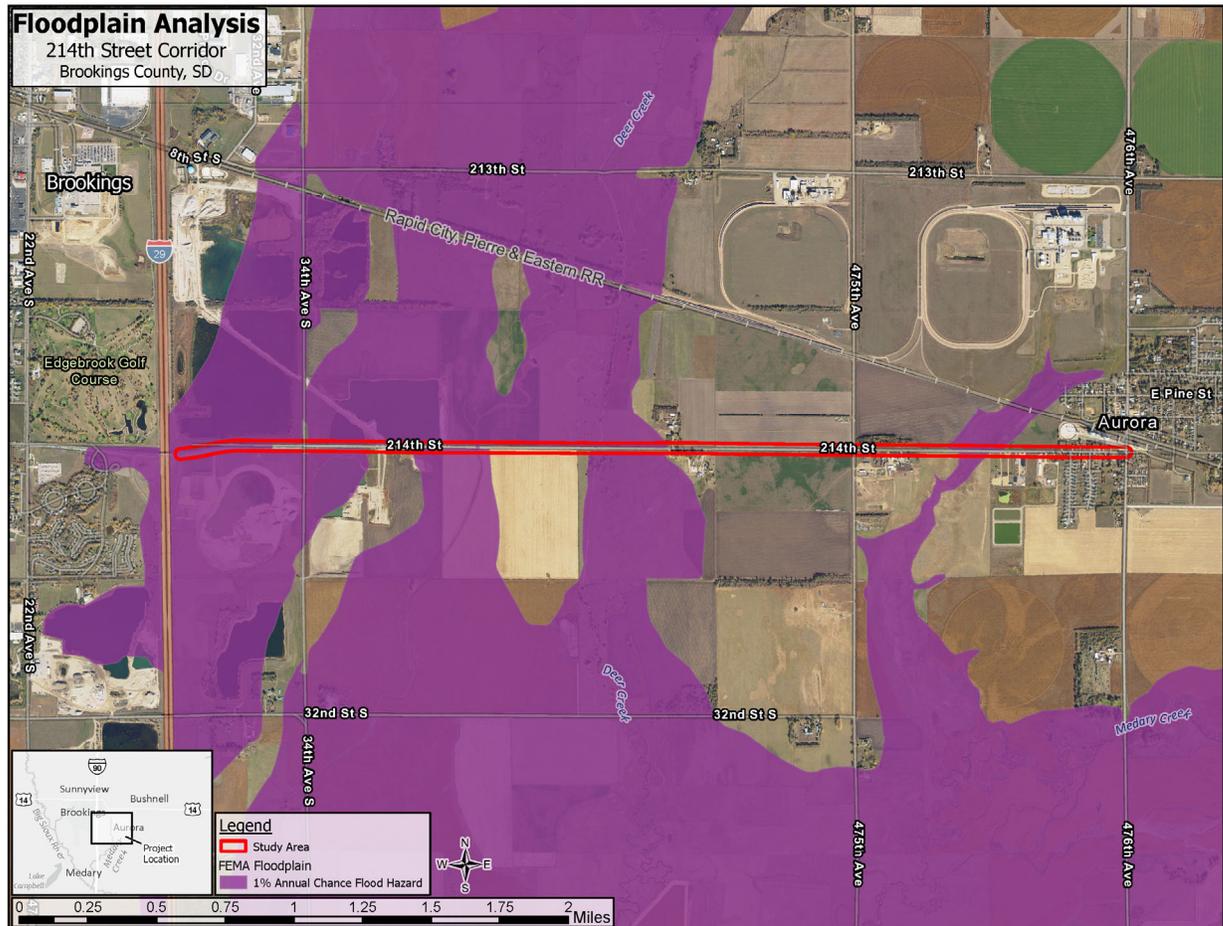




## 2.4 FLOODPLAINS

Within the Study Area, floodplain designated as Zone A (100 Year – 1% Annual Chance of Flood Hazard and 500 Year – 0.2% Annual Chance of Flood Hazard) exists (FEMA 2008). The portions of the Study Area located in designated floodplain are found along 214<sup>th</sup> Street from I-29 to just west of Aurora including the Deer Creek drainage area. Refer to **Figure 4**.

**Figure 4. Floodplains**



## 2.5 GROUNDWATER

Brookings Municipal Utilities supplies water to the City of Aurora as well as two other smaller water systems located north and south of Brookings (BMU 2022). The Study Area is underlain by two aquifers: the Big Sioux Aquifer and the Rutland Aquifer. The Big Sioux Aquifer underlies an area of 470 square miles, more than one-half of Brookings County. Depths to the top of the Big Sioux Aquifer range from land surface to 212 feet. The Rutland Aquifer underlies an area of 250 square miles in the south-central and eastern parts of the county. Depths from land surface to the top of the Rutland Aquifer range from 23 feet in the south-central to 432 feet in the east-central part of the county (Hamilton 1988).

## 2.6 LAND USE

Land uses within the Study Area include agriculture, transportation corridor, mining industry, rural residential and small-town urban uses. Additional right-of-way will likely be required for the project if 214<sup>th</sup> Street is widened. Coordination with local landowners will be needed. If permanent acquisition of ROW is required in areas of prime and unique farmland resources, coordination would need to be completed with the Natural Resources Conservation Service for this resource.

## 3.0 FUTURE CONSIDERATIONS AND NEXT STEPS

### 3.1 AGENCY COORDINATION

As the project moves forward, agency and tribal coordination would occur as needed to obtain comments and recommendations on avoidance and minimization for environmental resources. Based on past similar project coordination completed with agencies, comments would include, but are not limited to, water quality standards, storm water pollution prevention, seasonal work restrictions for listed species, dewatering and/or sediment collection, air quality, contaminated materials, and prime and unique farmland.

### 3.2 PERMITTING REQUIREMENTS

As the project moves forward, the following activities are anticipated to be required:

#### **1. Section 404 Permitting under the Clean Water Act**

A Section 404 permit would be required for impacts occurring in jurisdictional waters or OWUS features. To accurately determine wetland impacts, a field wetland delineation would be required. If mitigation for wetland or OWUS impacts is required, this will need to be secured and purchased prior to the issuance of a Section 404 permit. A Section 404 permit would need to be granted prior to any work occurring in wetlands in the Study Area.

As likely requirements under the Section 404 Permit, best management practices for sedimentation control and erosion protection would need to be implanted along the project length. The permit may also require special conditions for work activities occurring in a Topeka shiner stream. A Stormwater Pollution Prevention Plan (SWPPP) and certification under the General Permit for Construction Activities through the South Dakota Department of Agriculture and Natural Resources would be required if the project disturbs one or more acres of land.

#### **2. Brookings County Floodplain Development Permit**

#### **3. Level I Record Search, Level III Survey**

A Level I record search and a Level III survey would need to be completed in the Survey Area for compliance with Section 106 of the National Register of Historic Places. After the Level III survey is completed, the report would be provided to the State Historic Preservation Office (SHPO) for effect determination concurrence.

#### **4. Utility Survey and Coordination**

Utilities are present along 214<sup>th</sup> Street within the Study Area. Utility type and locations would be identified through additional survey and project design. Coordination with the local utility companies would be required to move or reinstall affected utilities by the project.

**References:**

Federal Emergency Management Agency (FEMA). 2008. FEMA Flood Map Service Center: Search by Address – Aurora, SD. Retrieved. January 9, 2024 from:

<https://msc.fema.gov/portal/search?AddressQuery=aurora%2C%20sd#searchresultsanchor>

South Dakota Department of Game, Fish and Parks (SDGFP), 2024. South Dakota Environmental Review Tool. Retrieved January 19, 2024 from: <https://ert.gfp.sd.gov/content/map>

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<https://ipac.ecosphere.fws.gov/project/DKEAAQXVWVHUXBBG5DZZYDVEWU/documents>

## APPENDIX C - OPINIONS OF COST

## Indexing Guide for Alternative Analysis

### Typical Sections

**\*T1** – 2-12' Lanes with 8' paved shoulders with sloped ditch

**T2** – 2-12' Lanes with 2' shoulder, rumble strips, and 8' paved shared use path with sloped ditch

**\*T3** – 2-12' Lanes with 8' paved shoulders, 5' boulevard south at 10% grade and 8' paved shared use path with sloped ditch

**\*\*T4** – 2-12' Lanes with 2' shoulder with sloped ditch

\* - 8' shoulder recommended for safety and traffic flow based on generally accepted roadway design guidance. 6' shoulder minimum recommended by roadway classification in Brookings County Master Transportation Plan

\*\* - 2' shoulder does not meet any minimum criteria for projected AADT or roadway classification and is not recommended

### Roadway Profiles

**P1** – Established based on providing 1' of freeboard to the subgrade shoulder if maintaining the existing culvert layout

**P2** – Established based on reducing the upstream Water Surface Elevation increase to 0.5' or less and no overtopping during 25yr storm event

**P3** – Established to optimize lessening of the impact to the upstream floodplain water surface elevation

**P4** – Existing finished grade centerline elevation

### Structure Layouts

**S1** – Baseline start point by increasing flow area approximately double existing flow area

**S2** – Double the baseline flow area or 4-times existing flow area

**S3** – Comparable structure sizing to railroad bridge just upstream of project area

**S4** – Replaces all structure to adequate length for clear zone requirements and offers generally the same flow area as existing crossing pipes

### Example Indexing

**T1-P1** = Typical Section 1 built on roadway profile 1

**T2-P2-S2** = Typical Section 2 built on roadway profile 2 with structure layout



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T1-P1-S1

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$657,000	\$657,000
2	Grading and Earthwork	1	LS	\$1,900,000	\$1,900,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$2,560,000	\$2,560,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$8,867,000
Construction Contingencies (20%) =					\$1,773,400
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,596,000
<b>Opinion of Probable Project Cost =</b>					<b>\$10,963,000</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative **T1-P1-S2**  
**LOCATION** Brookings County, South Dakota  
**DATE** February 2024

**BAI NO 23996.00**

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$884,800	\$884,800
2	Grading and Earthwork	1	LS	\$2,000,000	\$2,000,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$5,310,000	\$5,310,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$11,944,800
Construction Contingencies (20%) =					\$2,388,960
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,150,064
<b>Opinion of Probable Project Cost =</b>					<b>\$14,594,864</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T1-P1-S3

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$1,213,000	\$1,213,000
2	Grading and Earthwork	1	LS	\$2,050,000	\$2,050,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$9,365,000	\$9,365,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$16,378,000
Construction Contingencies (20%) =					\$3,275,600
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,948,040
<b>Opinion of Probable Project Cost =</b>					<b>\$19,826,040</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T1-P1-S4

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$587,000	\$587,000
2	Grading and Earthwork	1	LS	\$2,000,000	\$2,000,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$1,583,000	\$1,583,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$7,920,000
Construction Contingencies (20%) =					\$1,584,000
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,425,600
<b>Opinion of Probable Project Cost =</b>					<b>\$9,845,600</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T1-P2-S1

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$621,000	\$621,000
2	Grading and Earthwork	1	LS	\$1,450,000	\$1,450,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$2,560,000	\$2,560,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$8,381,000
Construction Contingencies (20%) =					\$1,676,200
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,508,580
<b>Opinion of Probable Project Cost =</b>					<b>\$10,389,580</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T1-P2-S2

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$841,000	\$841,000
2	Grading and Earthwork	1	LS	\$1,450,000	\$1,450,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$5,310,000	\$5,310,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$11,351,000
Construction Contingencies (20%) =					\$2,270,200
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,043,180
<b>Opinion of Probable Project Cost =</b>					<b>\$13,894,180</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T1-P2-S3

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$1,165,000	\$1,165,000
2	Grading and Earthwork	1	LS	\$1,450,000	\$1,450,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$9,365,000	\$9,365,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$15,730,000
Construction Contingencies (20%) =					\$3,146,000
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,831,400
<b>Opinion of Probable Project Cost =</b>					<b>\$19,061,400</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T1-P2-S4

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$543,000	\$543,000
2	Grading and Earthwork	1	LS	\$1,450,000	\$1,450,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$1,583,000	\$1,583,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal=					\$7,326,000
Construction Contingencies=					\$1,465,200
Planning, Grant Writing, and Environmental Services=					\$150,000
ROW Acquisition=					\$250,000
Utility Coordination and Relocation					\$100,000
Geotechnical Exploration and Recommendations=					\$25,000
Design and Construction Engineering=					\$1,318,680
<b>Opinion of Probable Project Cost =</b>					<b>\$9,144,680</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P1-S1

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$709,000	\$709,000
2	Grading and Earthwork	1	LS	\$1,900,000	\$1,900,000
3	Surfacing	1	LS	\$4,000,000	\$4,000,000
4	Structures	1	LS	\$2,560,000	\$2,560,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$9,569,000
Construction Contingencies (20%) =					\$1,913,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,722,000
<b>Opinion of Probable Project Cost =</b>					<b>\$11,791,000</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P1-S2

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$929,000	\$929,000
2	Grading and Earthwork	1	LS	\$1,900,000	\$1,900,000
3	Surfacing	1	LS	\$4,000,000	\$4,000,000
4	Structres	1	LS	\$5,310,000	\$5,310,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$12,539,000
Construction Contingencies (20%) =					\$2,507,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,257,020
<b>Opinion of Probable Project Cost =</b>					<b>\$15,296,020</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P1-S3

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$1,253,000	\$1,253,000
2	Grading and Earthwork	1	LS	\$1,900,000	\$1,900,000
3	Surfacing	1	LS	\$4,000,000	\$4,000,000
4	Structres	1	LS	\$9,365,000	\$9,365,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$16,918,000
Construction Contingencies (20%) =					\$3,383,600
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$3,045,240
<b>Opinion of Probable Project Cost =</b>					<b>\$20,463,240</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P1-S4

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$631,000	\$631,000
2	Grading and Earthwork	1	LS	\$1,900,000	\$1,900,000
3	Surfacing	1	LS	\$4,000,000	\$4,000,000
4	Structres	1	LS	\$1,583,000	\$1,583,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$8,514,000
Construction Contingencies (20%) =					\$1,702,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,532,520
<b>Opinion of Probable Project Cost =</b>					<b>\$10,546,520</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P2-S1

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$669,000	\$669,000
2	Grading and Earthwork	1	LS	\$1,400,000	\$1,400,000
3	Surfacing	1	LS	\$4,000,000	\$4,000,000
4	Structures	1	LS	\$2,560,000	\$2,560,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$9,029,000
Construction Contingencies (20%) =					\$1,805,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,625,220
<b>Opinion of Probable Project Cost =</b>					<b>\$11,154,220</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P2-S2

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$889,000	\$889,000
2	Grading and Earthwork	1	LS	\$1,400,000	\$1,400,000
3	Surfacing	1	LS	\$4,000,000	\$4,000,000
4	Structures	1	LS	\$5,310,000	\$5,310,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$11,999,000
Construction Contingencies (20%) =					\$2,399,800.00
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,159,820
<b>Opinion of Probable Project Cost =</b>					<b>\$14,658,820</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P2-S3

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$1,213,000.00	\$1,213,000
2	Grading and Earthwork	1	LS	\$1,400,000.00	\$1,400,000
3	Surfacing	1	LS	\$4,000,000.00	\$4,000,000
4	Structures	1	LS	\$ 9,365,000.00	\$9,365,000
5	Ancillary Items	1	LS	\$ 400,000.00	\$400,000
Construction Costs Subtotal =					\$16,378,000
Construction Contingencies (20%) =					\$3,275,600
Planning, Grant Writing, and Environmental Services =					\$100,000
ROW Acquisition =					\$120,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,948,040
<b>Opinion of Probable Project Cost =</b>					<b>\$19,646,040</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T2-P2-S4

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$591,000	\$591,000
2	Grading and Earthwork	1	LS	\$1,400,000	\$1,400,000
3	Surfacing	1	LS	\$4,000,000	\$4,000,000
4	Structures	1	LS	\$1,583,000	\$1,583,000
5	Ancillary Items	1	LS	\$400,000	\$400,000
Construction Costs Subtotal =					\$7,974,000
Construction Contingencies (20%) =					\$1,594,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,435,320
<b>Opinion of Probable Project Cost =</b>					<b>\$9,909,320</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P1-S1

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$765,000	\$765,000
2	Grading and Earthwork	1	LS	\$2,200,000	\$2,200,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$2,560,000	\$2,560,000
5	Ancillary items	1	LS	\$1,500,000	\$1,450,000
Construction Costs Subtotal =					\$10,325,000
Construction Contingencies (20%) =					\$2,065,000
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,858,500
<b>Opinion of Probable Project Cost =</b>					<b>\$12,683,500</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P1-S2

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$987,000	\$987,000
2	Grading and Earthwork	1	LS	\$2,200,000	\$2,200,000
3	Surfacing	1	LS	\$3,200,000	\$3,200,000
4	Structures	1	LS	\$5,440,000	\$5,440,000
5	Ancillary items	1	LS	\$1,500,000	\$1,500,000
Construction Costs Subtotal =					\$13,327,000
Construction Contingencies (20%) =					\$2,665,400
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,398,860
<b>Opinion of Probable Project Cost =</b>					<b>\$16,225,860</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P1-S3

**BAI NO** 23996.00

**LOCATION** Brookings Couty, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$1,356,000	\$1,356,000
2	Grading and Earthwork	1	LS	\$2,200,000	\$2,200,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$9,903,000	\$9,903,000
5	Ancillary items	1	LS	\$1,500,000	\$1,500,000
Construction Costs Subtotal =					\$18,309,000
Construction Contingencies (20%) =					\$3,661,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$3,295,620
<b>Opinion of Probable Project Cost =</b>					<b>\$22,104,620</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P1-S4

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$691,000	\$691,000
2	Grading and Earthwork	1	LS	\$2,200,000	\$2,200,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$1,583,000	\$1,583,000
5	Ancillary items	1	LS	\$1,500,000	\$1,500,000
Construction Costs Subtotal =					\$9,324,000
Construction Contingencies (20%) =					\$1,864,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,678,320
<b>Opinion of Probable Project Cost =</b>					<b>\$11,502,320</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P2-S1

**BAI NO 23996.00**

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$729,000	\$729,000
	Grading and Earthwork	1	LS	\$1,700,000	\$1,700,000
	Surfacing	1	LS	\$3,350,000	\$3,350,000
	Structures	1	LS	\$2,560,000	\$2,560,000
	Ancillary Items	1	LS	\$1,500,000	\$1,500,000
Construction Costs Subtotal =					\$9,839,000
Construction Contingencies (20%) =					\$1,967,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,771,020
<b>Opinion of Probable Project Cost =</b>					<b>\$12,110,020</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P2-S2

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$959,000	\$959,000
	Grading and Earthwork	1	LS	\$1,700,000	\$1,700,000
	Surfacing	1	LS	\$3,350,000	\$3,350,000
	Structures	1	LS	\$5,440,000	\$5,440,000
	Ancillary Items	1	LS	\$1,500,000	\$1,500,000
Construction Costs Subtotal =					\$12,949,000
Construction Contingencies (20%) =					\$2,589,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$2,330,820
<b>Opinion of Probable Project Cost =</b>					<b>\$15,779,820</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P2-S3

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$1,316,000	\$1,316,000
	Grading and Earthwork	1	LS	\$1,700,000	\$1,700,000
	Surfacing	1	LS	\$3,350,000	\$3,350,000
	Structures	1	LS	\$9,903,000	\$9,903,000
	Ancillary Items	1	LS	\$1,500,000	\$1,500,000
Construction Costs Subtotal =					\$17,769,000
Construction Contingencies (20%) =					\$3,553,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$3,198,420
<b>Opinion of Probable Project Cost =</b>					<b>\$21,467,420</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T3-P2-S4

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$651,000	\$651,000
2	Grading and Earthwork	1	LS	\$1,700,000	\$1,700,000
3	Surfacing	1	LS	\$3,350,000	\$3,350,000
4	Structures	1	LS	\$1,583,000	\$1,583,000
5	Ancillary Items	1	LS	\$1,500,000	\$1,500,000
Construction Costs Subtotal =					\$8,784,000
Construction Contingencies (20%) =					\$1,756,800
Planning, Grant Writing, and Environmental Services =					\$150,000
ROW Acquisition =					\$250,000
Utility Coordination and Relocation =					\$100,000
Geotechnical Exploration and Recommendations =					\$25,000
Design and Construction Engineering (15%) =					\$1,581,120
<b>Opinion of Probable Project Cost =</b>					<b>\$10,865,120</b>



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# OPINION OF PROBABLE PROJECT COST

**PROJECT** 214th St. Feasibility Study - Alternative T4-P4-S4

**BAI NO** 23996.00

**LOCATION** Brookings County, South Dakota

**DATE** February 2024

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Mobilization, Bonds & Insurance	1	LS	\$336,000	\$336,000
2	Grading and Earthwork	1	LS	\$500,000	\$500,000
3	Surfacing	1	LS	\$2,200,000	\$2,200,000
4	Structures	1	LS	\$1,250,000	\$1,250,000
5	Ancillary Items	1	LS	\$250,000	\$250,000
Construction Costs Subtotal=					\$4,536,000
Construction Contingencies=					\$907,200
Planning, Grant Writing, and Environmental Services=					\$50,000
ROW Acquisition=					\$50,000
Utility Coordination and Relocation					\$25,000
Geotechnical Exploration and Recommendations=					\$25,000
Design and Construction Engineering=					\$816,480
<b>Opinion of Probable Project Cost =</b>					<b>\$5,477,480</b>