

# Final Evaluation of Designated Roads (Crowned Ridge Wind II Phase)

Prepared for:  
**Codington County Highway Department**  
**Codington County, SD**

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Prepared by:

**BANNER**

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# Final Evaluation of Designated Roads (Crowned Ridge Wind II Phase)

## Codington County Highway Department Codington County, SD

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I hereby certify that this Report was prepared by me or under my direct supervision.

## TABLE OF CONTENTS

<b>SECTION I: INTRODUCTION .....</b>	<b>4</b>
<b>SECTION II: ROADWAY EVALUATION PROCESS.....</b>	<b>5</b>
GEOTECHNICAL INVESTIGATION .....	5
MANUAL ROADWAY DATA COLLECTION .....	5
GRAVEL ROADWAY CROWN AND SHOULDER TOPOGRAPHY .....	6
VISUAL INSPECTION AND OBSERVATION .....	6
CULVERT INSPECTION .....	6
<b>SECTION III: ASPHALT ROADWAY RATING.....</b>	<b>6</b>
<b>SECTION IV: GRAVEL ROADWAY RATING .....</b>	<b>11</b>
<b>SECTION V: CODINGTON COUNTY MAINTENANCE PLAN .....</b>	<b>14</b>
<b>SECTION VI: SUMMARY .....</b>	<b>15</b>
<b>SECTION VII: EVALUATION COMPARISON .....</b>	<b>18</b>
<b>SECTION VIII: RESTORATION RECOMMENDATIONS.....</b>	<b>20</b>
<b>APPENDIX A – PROJECT AREA MAP</b>	
<b>APPENDIX B – MANUAL ROADWAY MEASUREMENTS</b>	
<b>APPENDIX C – ADDITIONAL AREAS OF OBSERVATION</b>	
<b>APPENDIX D – CULVERT INSPECTIONS</b>	
<b>APPENDIX E – PASER MANUAL RATING SHEETS</b>	
<b>APPENDIX F – OPINION OF PROBABLE RESTORATION COSTS</b>	
<b>APPENDIX G – HAUL ROUTE COMPARISON PICTURES</b>	

## SECTION I: INTRODUCTION

NextEra Energy Resources LLC (Developer) has completed construction on the wind farm project referred to as Crowned Ridge Wind LLC. The construction was understood to be completed in two phases known as Crowned Ridge Wind I and Crowned Ridge Wind II, respectively, and each with preliminary transmission line phases. Portions of this wind farm project are located in Codington County, SD, where the Developer entered an agreement (Agreement for Road Use, Repair, and Improvements dated April 2<sup>nd</sup>, 2019) with the Codington County Highway Department (Owner) to utilize county roads as haul routes. The owner has consulted with Banner Associates, Inc. (Engineer) to perform two roadway evaluations of all proposed haul routes, once at a time prior to construction and once construction has ceased. The asphalt roadways used in this phase of the construction were presented to the Owner for post-construction evaluation on October 8, 2020. The gravel roadways used in this phase of construction were presented to the Owner for post-construction evaluation in November 2020. This report presents the Engineer’s findings for the post-construction roadway evaluation of the Crowned Ridge Wind II Phase.

It is our understanding Crowned Ridge Wind II consisted of the construction of approximately 88 turbines (59 in Codington County) and their connection to a substation located in Waverly Township. Crowned Ridge Wind II also crosses into Deuel County; however, this report only addresses the Codington County haul roads. More definitively, the project area is bound on the West by US Interstate 29, to the North by Codington County Highway No 6, to the East by the Codington County line, and to the South by the Codington County Line. The roads are identified in detail in Figure 1 below. Banner contacted the SDDOT regarding truck percentages of the ADT. The SDDOT stated that truck counts were not available for these two roads; however, the statewide average for Rural Collectors of this type is 13% of the ADT. The roads are in northeastern Codington County, near South Shore, SD. A project area map is provided in APPENDIX A.

A concrete batch plant was located within the footprint of this phase of the project. The batch plant was located in Section 26 – Township 117N – Range 51 west in Kranzburg Township, with access coming off of CCR No. 1 (Kranzburg Avenue). This facility generated substantial traffic both in frequency and loading on some of the roads evaluated as part of this phase. There were fifteen (15) miles of asphalt surfaced and eleven (11) miles of gravel surfaced Codington County highway roads designated as haul routes for the Crowned Ridge Wind II phase.

**Figure 1 – Roadway Inventory**

Roadway	Segment	Length (miles)	Surfacing	ADT	ADT-T
CCR No 1 – Kranzburg & 465 <sup>th</sup> Ave	172 <sup>nd</sup> St – 169 <sup>th</sup> St	3	Gravel	N/A	N/A
CCR No 5 – 462 <sup>nd</sup> Ave	177 <sup>th</sup> St – 175 <sup>th</sup> St	2	Gravel	N/A	N/A
CCR No 3 – 464 <sup>th</sup> Avenue	176 <sup>th</sup> St. – 172 <sup>nd</sup> St.	4	Asphalt	292	38
CCR No 3 – 463 <sup>rd</sup> Avenue	172 <sup>nd</sup> St. – 165 <sup>th</sup> St.	7	Asphalt	167	22
CCR No 6 – 165 <sup>th</sup> St	463 <sup>rd</sup> Ave – 466 <sup>th</sup> Ave	3	Gravel	N/A	N/A
CCR No 10 – 170 <sup>th</sup> St	461 <sup>st</sup> Ave – 463 <sup>rd</sup> Ave	2	Gravel	N/A	N/A
CCR No 10 – 169 <sup>th</sup> St	465 <sup>th</sup> Ave – 466 <sup>th</sup> Ave	1	Gravel	N/A	N/A
CCR No 20 – 176 <sup>th</sup> St	462 <sup>nd</sup> Ave – 466 <sup>th</sup> Ave	4	Asphalt	292	38
Total Miles		26			

\*CCR – Codington County Road

\*ADT – Average Daily Traffic

\*ADT-T – Average Daily Truck Traffic

## SECTION II: ROADWAY EVALUATION PROCESS

Banner compiled input from internal transportation engineers, clients of previous roadway inspection projects, and the current client's particular preferences in order to formulate an effective roadway evaluation process. Banner determined the most practical way to evaluate the roadway condition was to utilize three major categories of evaluation to include geotechnical investigation, manual roadway data collection, and visual inspection and observation. Further details are provided below.

### Geotechnical Investigation

Banner obtained the professional services of GeoTek Engineering & Testing Services, Inc. in Sioux Falls, SD to perform direct-push soil borings at a frequency of three per mile. The borings provide a representative sample of each segment of roadway in regards to the existing surfacing sections, as well as the type and condition of subgrade and underlying soils to a depth of four (4) feet. These efforts were performed prior to the start of construction. The following paragraph and Figure 2 are taken from the pre-construction geotechnical evaluation.

GeoTek reported an asphalt pavement and clean gravel base course thickness for the asphalt surfaced haul roads, and a clean gravel surfacing thickness for the gravel surfaced haul roads. The average material thickness for each haul road is broken down in Figure 2 below. Banner particularly requested reporting of clean and contaminated base course material, as contamination can contribute to a weaker pavement section. All base course material was reported as clean.

**Figure 2 – Average Surfacing Thicknesses**

Road	Average Asphalt Pavement Thickness (in)	Average Gravel Base Thickness (in)	Average Gravel Surfacing Thickness (in)
CCR No 1 – Kranzburg Ave	N/A	N/A	3.8
CCR No 1 – 465 <sup>th</sup> Ave	N/A	N/A	5.6
CCR No 3 – 464 <sup>th</sup> Avenue (S)	5.8	7.1	N/A
CCR No 3 – 463 <sup>rd</sup> Avenue (N)	5.0	7.9	N/A
CCR No 5 – 462 <sup>nd</sup> Ave	N/A	N/A	3.1
CCR No 6 – 165 <sup>th</sup> St	N/A	N/A	3.3
CCR No 10 – 170 <sup>th</sup> St (W)	N/A	N/A	4.3
CCR No 10 – 169 <sup>th</sup> St (E)	N/A	N/A	3.2
CCR No 20 – 176 <sup>th</sup> St	5.9	6.5	N/A
Overall – All Roads	5.5	7.3	3.9

### Manual Roadway Data Collection

Banner performed manual field measurements of pavement widths and rut depths, as well as additional depth measurements to document any pavement deformations. These measurements were taken at a frequency of five per mile. The field measurements consisted of Banner staff using a magnesium screed to provide a straight edge plane from the crown of the roadway to the shoulder. Banner then determined offsets from centerline and measured depths departing from the straight edge to 1/16" precision. These measurements were taken at the same locations as the pre-construction manual field measurements to provide a better understanding of one

aspect of potential roadway damages. These measurements were only taken on asphalt surfaced roadways, as the variability of gravel surfacing would make it too difficult to reproduce comparative results.

Banner reported that the rutting within the wheel paths on the segments of CCR No 3 south of US HWY 212 fell between 0" and 3/16" with an average of 1/16" as a departure from the straight edge. The segment of CCR No 3 north of US HWY 212 fell between 0" and 3/8" with an average of 1/8" as a departure from the straight edge. Banner also reported that a majority of the rutting within the wheel paths on CCR No 20 fell between 0" and 5/16" with an average of 1/16" as a departure from the straight edge. The full data set for manual roadway measurements can be found in APPENDIX B.

#### Gravel Roadway Crown and Shoulder Topography

During the pre-construction evaluation, Banner used ATV mounted Trimble surveying equipment to collect horizontal and vertical data representing the crown and shoulder points of all Codington County gravel roadways proposed to be used as haul roads. This effort was not repeated in for the post-construction evaluation in this phase of the project.

#### Visual Inspection and Observation

Banner collected video of each section of roadway from a vehicle mounted Go-Pro camera. Upon reviewing the video, Banner drove the roadway segments, making frequent stops to document and assess the frequency and severity of the different forms of distresses, defects, and deterioration related to both asphalt and gravel surfacing. Banner utilized notes from the inspection as well as pictures, video, and measurements to provide ratings for each roadway segment. Roadway rating criteria and results are provided in the Roadway Rating section of this report. Banner also noted areas of interest during the pre-construction observations. Those same locations were observed post construction to provide a comparison to the pre-construction condition of the noted location. A map and comparison observations can be found in APPENDIX C.

#### Culvert Inspection

During the visual inspection, Banner also assessed all drainage pipes crossing beneath the highways. During the assessment, Banner took pictures of each end of the culverts, as well as any deficiencies noticed. Banner also recorded the shape, size, and material of each culvert, as well as the aforementioned deficiencies that were photographed. This work was completed during the pre-construction evaluation and then the culverts were re-assessed during the post-construction evaluation, with any changes noted. A map and detailed assessment notes can be found in APPENDIX D.

## **SECTION III: ASPHALT ROADWAY RATING**

In an effort to give Codington County a basis for the condition of the prospective asphalt surfaced haul roads prior to construction, Banner has produced a rating for each one mile stretch of roadway evaluated. The rating system chosen by Banner is derived from the Pavement Surface Evaluation and Rating (PASER) Asphalt Roads Manual produced by the Transportation Information Center at the University of Wisconsin-Madison. The PASER Manual addresses four major categories of common asphalt pavement distress, to include: Surface defects, Surface deformation, Cracks, and Patches and potholes. Asphalt roadways are rated on a scale of 1 to 10; 1 -

failed, 10 – excellent. The Distress Identification Manual for the Long-Term Pavement Performance Program produced by the Federal Highway Administration was also used as an additional resource for identifying severity levels of the pavement distress. An excerpt from the PASER Manual regarding a general description of each surface rating is provided in APPENDIX E.

The four major categories of distress can be broken down further to provide a more comprehensive evaluation tool. Surface defects are represented by raveling, flushing, and polishing. Surface deformation is represented by rutting, distortion, rippling and shoving, settling, and heaving. Cracks can be represented by transverse, reflective, longitudinal, block, alligator, and slippage. These distresses, along with patches and potholes present on the roadway, were evaluated by Banner Engineers as being of low, medium, or high severity. The severity and frequency of the distresses were taken into account when formulating an overall rating reflective of the entire mile stretch of roadway.

Banner utilized visual inspection and manual field measurements to determine severity levels of the pavement distress. What follows is a general synopsis of the information collected and used to determine the PASER ratings. The PASER rating for each one mile segment of roadway is shown in Figure 3 on Page 11.

Mile No. 21 - CCR No 20 from 462<sup>nd</sup> Ave. – 463<sup>rd</sup> Ave.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in mid-lane and along roadway edge. Transverse and reflective cracks feel pounded down into base material while driving with a some being wide (1/2" or more in width).
- Large amount of cracking at east intersection.
- Minor scarring at west intersection.
- Moderate severity of block and alligator cracking present along outer 1/4 of lanes for approximately 20-25% of the segment length. More prominent in west bound lane.
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- One maintenance patch was noted along this segment of roadway, replacing areas of pavement that were compromised during construction.
- Rutting measured between 1/16<sup>th</sup> and 3/16<sup>th</sup> of an inch.

Mile No. 22 - CCR No 20 from 463<sup>rd</sup> Ave. – 464<sup>th</sup> Ave.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in mid-lane and along roadway edge. Transverse and reflective cracks feel pounded down into base material while driving.
- Moderate severity of block and alligator cracking present along outer 1/3 of lanes for approximately 25% of the segment length. More prominent in west bound lane.
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Moderate severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface, creating a slick travel surface.
- No new patches noted
- Rutting measured between 1/16<sup>th</sup> and 1/8<sup>th</sup> of an inch.

Mile No. 23 - CCR No 20 from 464<sup>th</sup> Ave. – 465<sup>th</sup> Ave.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in mid-lane and along roadway edge. More prominent on west bound lane.
- No noticeable alligator or block cracking.
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minimal severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- No new patches noted
- Rutting measured between 1/16<sup>th</sup> and 5/16<sup>th</sup> of an inch.

Mile No. 24 - CCR No 20 from 465<sup>th</sup> Ave. – 466<sup>th</sup> Ave.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in mid-lane and along roadway edge.
- No noticeable alligator or block cracking.
- Minimal severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- One maintenance patch was noted along this segment of roadway, replacing areas of pavement that were compromised during construction.
- Rutting measured between 1/16<sup>th</sup> and 3/16<sup>th</sup> of an inch.

Mile No. 25 - CCR No 3 from 175<sup>th</sup> St. to 176<sup>th</sup> St.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge.
- No noticeable alligator or block cracking.
- Asphalt settlement /movement was noted in some areas, particularly above culvert crossings.
- Minimal severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- No new patches noted
- Rutting measured between 1/16<sup>th</sup> and 3/16<sup>th</sup> of an inch.

Mile No. 26 - CCR No 3 from 174<sup>th</sup> St. to 175<sup>th</sup> St.

- Larger amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in centerline, mid-lane, wheel path and along roadway edge. Some raveling present along longitudinal cracks.
- Minor severity of block and alligator cracking present along outer 1/4 of lanes.
- Minimal severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- One maintenance patch was noted along this segment of roadway, replacing areas of pavement that were compromised during construction.
- Rutting measured between 1/16<sup>th</sup> and 3/16<sup>th</sup> of an inch.



Mile No. 27 - CCR No 3 from 173<sup>rd</sup> St. to 174<sup>th</sup> St.

- Larger amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in centerline, mid-lane, wheel path and along roadway edge. Some raveling present along longitudinal cracks.
- Minor severity of block and alligator cracking present along outer 1/4 of lanes.
- Minimal severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- No new patches observed.
- Rutting measured between 1/16<sup>th</sup> and 3/16<sup>th</sup> of an inch.

Mile No. 28 - CCR No 3 from 172<sup>nd</sup> St. to 173<sup>rd</sup> St.

- Larger amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in centerline, mid-lane, wheel path and along roadway edge.
- No alligator cracking present observed.
- Minimal severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- No new patches observed.
- Rutting measured between 1/16<sup>th</sup> and 1/8<sup>th</sup> of an inch.

Mile No. 29 - CCR No 3 from 171<sup>st</sup> St. to 172<sup>nd</sup> St.

- Minor amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge. Transverse and reflective cracks feel pounded down into base material while driving, causing unstable ride. Low severity.
- Minimal block and alligator cracking present.
- Minimal severity of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- No new patches observed.
- Rutting measured between 1/16<sup>th</sup> and 5/16<sup>th</sup> of an inch.

Mile No. 30 - CCR No 3 from 170<sup>th</sup> St. to 171<sup>st</sup> St.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge. Transverse and reflective cracks feel pounded down into base material while driving, causing unstable ride.
- Minor block and alligator cracking present.
- Minimal amount of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- One maintenance patch was noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- Severe scarring present at south intersection. This was also noted in pre-construction observations.
- Rutting measured between 1/16<sup>th</sup> and 9/16<sup>th</sup> of an inch.

Mile No. 31 - CCR No 3 from 169<sup>th</sup> St. to 170<sup>th</sup> St.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge. Some longitudinal cracks are wide and extending from deeper wheel ruts.
- Minimal block and alligator cracking present.
- Moderate amount of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- No new patches observed.
- Rutting measured between 1/16<sup>th</sup> and 1 inch.

Mile No. 32 - CCR No 3 from 168<sup>th</sup> St. to 169<sup>th</sup> St.

- Moderate amount of longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge.
- Minimal block and alligator cracking present along edges of roadway.
- Larger amount of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- Three maintenance patches were noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- Rutting measured between 1/16<sup>th</sup> and 1/4 of an inch.

Mile No. 33 - CCR No 3 from 167<sup>th</sup> St. to 168<sup>th</sup> St.

- Minor longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge. A few of the longitudinal cracks are wide (more than 1/2" wide).
- Some block and alligator cracking present along edges of roadway.
- Larger amount of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- Four maintenance patches were noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- Rutting measured between 1/16<sup>th</sup> and 1/4 of an inch.

Mile No. 34 - CCR No 3 from 166<sup>th</sup> St. to 167<sup>th</sup> St.

- Minor longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge. A few of the longitudinal cracks are wide (more than 1/2" wide).
- No apparent block and alligator cracking present.
- Larger amount of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- Two maintenance patches were noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- Rutting measured between 1/16<sup>th</sup> and 3/16<sup>th</sup> of an inch.

Mile No. 35 - CCR No 3 from 165<sup>th</sup> St. to 166<sup>th</sup> St.

- Minor longitudinal and transverse cracks throughout, with longitudinal cracks most prevalent in wheel path and along roadway edge. A few of the longitudinal cracks are wide (more than ½” wide).
- No apparent block and alligator cracking present.
- Minor amount of aggregates worn away in the wheel paths coupled with oil migrating to the surface.
- Two maintenance patches were noted along this segment of roadway, replacing area of pavement that was compromised during construction.
- South intersection has scarring from equipment. Also breaking up around radius.
- Rutting measured between 1/16<sup>th</sup> and 5/8<sup>th</sup> of an inch.

**Figure 3 – PASER Rating**

Roadway	Segment	Mile Reference	PASER Rating
CCR No 20 – 176 <sup>th</sup> St	462 <sup>nd</sup> Ave – 463 <sup>rd</sup> Ave	21	5
CCR No 20 – 176 <sup>th</sup> St	463 <sup>rd</sup> Ave – 464 <sup>th</sup> Ave	22	5
CCR No 20 – 176 <sup>th</sup> St	464 <sup>th</sup> Ave – 465 <sup>th</sup> Ave	23	7
CCR No 20 – 176 <sup>th</sup> St	465 <sup>th</sup> Ave – 466 <sup>th</sup> Ave	24	7
CCR No 3 - 464 <sup>th</sup> Ave	176 <sup>th</sup> St – 175 <sup>th</sup> St	25	7
CCR No 3 - 464 <sup>th</sup> Ave	175 <sup>th</sup> St – 174 <sup>th</sup> St	26	7
CCR No 3 - 464 <sup>th</sup> Ave	174 <sup>th</sup> St – 173 <sup>rd</sup> St	27	7
CCR No 3 - 464 <sup>th</sup> Ave	173 <sup>rd</sup> St – 172 <sup>nd</sup> St	28	7
CCR No 3 - 463 <sup>rd</sup> Ave	172 <sup>nd</sup> St – 171 <sup>st</sup> St	29	6
CCR No 3 – 463 <sup>rd</sup> Ave	171 <sup>st</sup> St – 170 <sup>th</sup> St	30	6
CCR No 3 - 463 <sup>rd</sup> Ave	170 <sup>th</sup> St – 169 <sup>th</sup> St	31	6
CCR No 3 - 463 <sup>rd</sup> Ave	169 <sup>th</sup> St – 168 <sup>th</sup> St	32	6
CCR No 3 - 463 <sup>rd</sup> Ave	168 <sup>th</sup> St – 167 <sup>th</sup> St	33	6
CCR No 3 - 463 <sup>rd</sup> Ave	167 <sup>th</sup> St – 166 <sup>th</sup> St	34	6
CCR No 3 - 463 <sup>rd</sup> Ave	166 <sup>th</sup> St – 165 <sup>th</sup> St	35	6

## SECTION IV: GRAVEL ROADWAY RATING

In an effort to give Codington County a basis for the condition of the prospective gravel haul roads prior to construction, Banner produced a rating for each one mile stretch of roadway evaluated. The rating system chosen by Banner is derived from the Pavement Surface Evaluation and Rating (PASER) Gravel Roads Manual produced by the Transportation Information Center at the University of Wisconsin-Madison. The PASER Manual addresses five major conditions and defects common to gravel roadways, to include: Crown, Drainage, Gravel Layer, Surface deformation, and Surface defects. Gravel roadways are rated on a scale of 1 to 5; 1 - failed, 5 – excellent. An excerpt from the PASER Manual with a general description of each surface rating is provided in APPENDIX F. Banner performed a similar visual inspection during the post-construction roadway evaluation but did not produce a corresponding PASER rating for each segment of roadway, as by the time the roadways were turned over for evaluation, the ground was frozen and not all aspects of the evaluation could be completed.

The five major conditions and defects can be broken down further to provide a more comprehensive evaluation tool. Crown not only refers to the height and condition of the crown at the centerline of the roadway, but also

the entire cross-slope of the roadway through the shoulders and to the ditch. Drainage assessment reflects the adequacy of the roadway corridor to convey water without having areas of standing water soaking into the roadway subgrade for long periods of time, through the use of roadside ditches and pass-through culverts. Gravel layer is a more tangible condition where the thickness and quality of the gravel can be measured and identified. Surface deformations are represented by conditions that create an unsafe roadway such as washboarding, potholes, and ruts. Surface defects are represented by dust and loose aggregate on the roadway. Banner evaluated the conditions and defects as being of low, medium, or high severity. The severity and frequency of the conditions were considered when formulating an overall rating reflecting the entire mile stretch of roadway. Something that must be understood is that many of the visual observations that are considered when rating these roadways can change significantly as a result of recent large weather events causing surface defects, or recent maintenance efforts repairing surface defects.

Banner utilized visual inspection to determine severity levels of the gravel conditions and defects to the extent possible with frozen ground. What follows is a general synopsis of the information collected for each stretch of gravel surfaced roadway.

#### CCR No 5 from 175<sup>th</sup> St. to 177<sup>th</sup> St.

- Visually the crown slopes appear to be adequate with fair drainage along the roadway.
- A notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter on the roadway created by Developer maintenance practices during construction. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. May be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.
- Minor loss of surface gravel noted in some areas along segment
- Minor rutting on roadway edge and in ditch
- Minimal other surface defects such as washboarding or potholing were noted. This is likely due to recent maintenance efforts and frozen ground.

#### CCR No 1 from 170<sup>th</sup> St. to 172<sup>nd</sup> St.

- Visually the crown slopes appear to be fair with good drainage along the roadway.
- A very notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter on the roadway created by Developer maintenance practices during construction. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. May be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.
- Many areas were noted where clay/subgrade material can be seen contaminating the surface gravel, particularly at the centerline and in wheel paths.
- Substantial loss of surface gravel noted along the entire segment
- Substantial washboarding and some potholing noted coupled with loss of surface gravel presents a very abrupt roadway for travel.

CCR No 10 from Kranzburg Ave. to 466<sup>th</sup> Ave.

- Visually the crown slopes appear to be fair with good drainage along roadway.
- A very notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter on the roadway created by Developer maintenance practices during construction. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. May be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.
- Some areas were noted where clay/subgrade material can be seen contaminating the surface gravel, particularly at the centerline and in wheel paths.
- Moderate loss of surface gravel noted along the entire segment
- Moderate washboarding noted.

CCR No 10 from 461<sup>st</sup> Ave. to 463<sup>rd</sup> Ave.

- Visually the crown slopes appear to be fair with good drainage along the roadway.
- A very notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter on the roadway created by Developer maintenance practices during construction. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. May be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.
- Substantial areas were noted where clay/subgrade material can be seen contaminating the surface gravel, particularly at the centerline and in wheel paths.
- Moderate loss of surface gravel noted along the entire segment
- Minor washboarding, rutting, and potholing noted.

CCR No 8 from 464<sup>th</sup> Ave. to 466<sup>th</sup> Ave.

- Visually the crown slopes appear to be fair with good drainage along the roadway.
- A very notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter on the roadway created by Developer maintenance practices during construction. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. May be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.
- Many areas were noted where clay/subgrade material can be seen contaminating the surface gravel, particularly at the centerline and in wheel paths.
- Substantial loss of surface gravel noted along the entire segment
- Minor washboarding, rutting, and potholing noted, but coupled with loss of gravel presents a very abrupt roadway for travel

## SECTION V: HAUL ROUTE MAINTENANCE

Representatives of Codington County and Banner Associates frequently traveled the haul routes to gauge the maintenance effort of the Developer during construction. The maintenance of the roads was the responsibility of the Developer for the duration of the construction period. Initial observations showed that the Developer did not take any pre-construction steps to improve the roadways and strengthen their ability to handle the proposed loadings anticipated with the project. Subsequent observations showed that the stretches of roadway evaluated in this phase of the project continued to deteriorate at a rapid pace, and some segments experienced excessive damages that at times created a compromised and unsafe roadway.

At times, the public traveling these roads contacted the Codington County Highway Department regarding potholes and roadway breakups creating safety concerns, particularly during night driving. The maintenance effort of the Developer to address these concerns was minimal throughout the duration of construction, particularly on the asphalt roadways, as it was noted that many areas of break-up were not maintained for a period of months. The developer did place temporary maintenance asphalt patches over areas of complete failure and break-up at the completion of construction. These patches are intended for short term maintenance relief only, and do not provide a long-term solution to the damages experienced. The Codington County Highway Department did not perform any routine maintenance on these stretches of roadway during the construction timeframe.

Maintenance efforts on the gravel roadways during construction consisted largely of the Developer digging out areas where their equipment could not pass and filling those areas with material in attempt to bridge the subgrade, as well as routine blading of the gravel surface. The Developer noted that the project did haul additional gravel material to the haul routes as problem areas arose to facilitate the movement of construction vehicles throughout the course of the project. In addition to the gravel material provided for construction purposes, it appears that during construction gravel material was pulled from the outer  $\frac{1}{4}$  of the roadway on each side, into the middle to provide a more stable single path for construction traffic. This assumption is made based on the condition of the gravel roads near the end of construction, as many of the gravel roadways showed crown slopes of 1.5 to 2.0 times as steep as pre-construction conditions. The steep crown slopes coupled with the roadway edges being dug down below the adjacent shoulder, created a curb and gutter appearance on the roadway which trapped water on the roadway and left little to no gravel surfacing on the roadway edges. This was present at minor to moderate severities along the gravel haul routes in this phase.

Banner was informed in August 2020 that the Developer had completed their use of the gravel haul roads associated with the wind farm construction. Banner performed an initial abbreviated evaluation of the gravel roads within the Crowned Ridge Wind I phase of the project. During this evaluation Banner identified many deficiencies with the gravel haul roads as presented by the Developer. These deficiencies placed the gravel haul roads in a far worse condition than that which they were prior to construction. Banner, the Owner, and the Developer met on site in September 2020 at which time Banner presented the unacceptable findings of the abbreviated evaluation. At that time, the Developer agreed to address all concerns as noted prior to returning the haul roads to the Owner for a post-construction evaluation to be administered. The items of concern noted during this meeting were to be addressed on the gravel surfaced haul routes in this phase of the project as well.

The Developer hired a contractor to perform some of the roadway restoration efforts noted in the aforementioned September 2020 site meeting. Representatives of Codington County and Banner Associates made site visits to assess the efforts and ensure care was being taken to restore the roadways appropriately. Both parties noted that substantial effort was made to dig out soft areas and clean up the roadway edges, as well as blade the existing gravel surfacing in a manner to more evenly distribute the surface material across the full width of the roadway creating a more consistent gravel surfacing depth and a more manageable crown slope. It was also noted that the center of the roadway had far thicker sections of gravel surfacing than the roadway edges prior to re-distribution efforts, likely being a direct result of the blading maintenance approach assumed earlier in this report. This substantial effort was consistent for approximately three (3) miles of the gravel surfaced roadway CCR No. 7 from 164<sup>th</sup> St. to 161<sup>st</sup> St. The gravel surfaced haul routes in this phase of the project did not receive the same restoration efforts, as it appears that there were no more soft areas dug out and replaced on these segments. The Developer did continue the efforts of removing the curb and gutter effect for these segments of gravel roadway. The Developer's efforts to redistribute the existing surfacing was also lacking, potentially partially due to the lack of material left after construction traffic had pounded it into the subgrade. There was a snow storm in mid-October that impacted the project area and restoration efforts, and it is not known whether the impending winter weather and associated ground freeze played a factor in the decision to suspend the dig out operations.

## SECTION VI: SUMMARY

Banner would consider the two-mile stretch of CCR No 20 from 462<sup>nd</sup> Ave. to 464<sup>th</sup> Ave to be in poor condition overall. Manual roadway measurements show that the roadways have experienced minor to moderate rutting in the wheel paths. Visual observations have shown substantial damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types at moderate to high severities, surface and wheel path wear. An assessment of this two-mile segment of roadway using the PASER system provided ratings of Five (5) each.

Banner would consider the two-mile stretch of CCR No 20 from 464<sup>th</sup> Ave. to 466<sup>th</sup> Ave. to be in good condition overall. Manual roadway measurements show that the roadways have experienced minor rutting in the wheel paths. Visual observations have shown minor damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types, surface and wheel path wear, and the need for a temporary maintenance patch. An assessment of this two-mile segment of roadway using the PASER system provided ratings of seven (7), each.

Banner would consider the four-mile stretch of CCR No 3 from 176<sup>th</sup> St. to 172<sup>nd</sup> St. to be in good condition overall. Manual roadway measurements show that the roadways have experienced minor rutting in the wheel paths. Visual observations have shown minor damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types, surface and wheel path wear, and the need for a temporary repair patch. It also was noted that the transverse cracks have been pounded down to a point that the ride quality at highway speeds has been reduced. An assessment of this four-mile segment of roadway using the PASER system provided ratings of six (6), each.

Banner would consider the three-mile stretch of CCR No 3 from 172<sup>nd</sup> St. to 169<sup>th</sup> St. to be in fair to good condition overall. Manual roadway measurements show that the roadways have experienced minor rutting in the wheel paths. Visual observations have shown minor damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types, surface and wheel path wear, and the need for temporary repair patches. It also was noted that the transverse cracks have been pounded down to a point that the ride quality at highway speeds has been reduced. An assessment of this three-mile segment of roadway using the PASER system provided ratings of six (6), each.

Banner would consider the four-mile stretch of CCR No 3 from 169<sup>th</sup> St. to 165<sup>th</sup> St. to be in fair to good condition overall. Manual roadway measurements show that the roadways have experienced minor rutting in the wheel paths. Visual observations have shown minor damage and deficiencies across all aspects of pavement evaluation, particularly related to cracking of all types, surface and wheel path wear, and the need for temporary repair patches. There is also some minor surface shifting in some areas. An assessment of this four-mile segment of roadway using the PASER system provided ratings of six (6), each.

Banner would consider the two-mile stretch of CCR No 5 from 175<sup>th</sup> St. to 177<sup>th</sup> St. to be in good condition overall. Banner noted minor deficiencies across the aspects of evaluation that were able to be completed, with the largest concern being the false edge of roadway created by scraping the roadway edge and shoulders. A full post-construction evaluation was not able to be completed due to frozen ground conditions, and therefore Banner could not report on all aspects of the evaluation process and chose not to give the roadways a post-construction PASER rating. Having knowledge of the effort and process the Developer put forth for digging out soft areas on other stretches of gravel roadway in the Crowned Ridge Wind I Phase but having suspended that effort prior to addressing this stretch of roadway, it is likely that there are soft areas that were exposed during construction that will show up again once the ground thaws. The number and size of these areas cannot be quantified at this time, and the only true way to find them will be to perform a follow-up inspection once ground conditions are favorable. Non-contaminated gravel surfacing depths were not investigated during the post-construction evaluation due to frozen ground conditions. The statements regarding frozen conditions and potential soft areas remain true for all remaining gravel surfaced haul roads reported on in this phase.

Banner would consider the two-mile stretch of CCR No 1 from 170<sup>th</sup> St. to 172<sup>nd</sup> St. to be in poor condition overall. Banner noted moderate to substantial severity of deficiencies across many aspects of the evaluation that were able to be completed, which included loss of gravel surfacing, contamination of the gravel surfacing that remained, washboarding and potholing, and a false roadway edge created by scraping the roadway shoulders down. These defects have led to abrupt driving conditions when traveling at posted roadway speeds.

Banner would consider the two-mile stretch of CCR No 10 from Kranzburg Ave. to 466<sup>th</sup> Ave. to be in fair condition overall. Banner noted moderate severity of deficiencies across many aspects of the evaluation that were able to be completed, which included loss of gravel surfacing, contamination of the gravel surfacing that remained, washboarding, and a false roadway edge created by scraping the roadway shoulders down.

Banner would consider the two-mile stretch of CCR No 10 from 461<sup>st</sup> Ave. to 463<sup>rd</sup> Ave. to be in poor to fair condition overall. Banner noted moderate to substantial severity of deficiencies across many aspects of the evaluation that were able to be completed, which included loss of gravel surfacing and contamination of the gravel surfacing that remained, as well as a false roadway edge created by scraping the roadway shoulders down.



Banner would consider the two-mile stretch of CCR No 8 from 464<sup>th</sup> Ave. to 466<sup>th</sup> Ave. to be in fair condition overall. Banner noted minor to substantial severity of deficiencies across many aspects of the evaluation that were able to be completed, which included loss of gravel surfacing and contamination of the gravel surfacing that remained, as well as a false roadway edge created by scraping the roadway shoulders down.

The lack of pre-construction efforts to enhance the roadway carrying capabilities, as well as a lack of ongoing maintenance during construction has proved to be detrimental to the asphalt roadways in general. The two-mile stretch of CCR No 20 from 462<sup>nd</sup> Ave. to 464<sup>th</sup> Ave. has been reduced to a state of partial failure. Many locations have exhibited excessive cracking, with some break-up of the surface material. The two-mile stretch of CCR No 20 from 464<sup>th</sup> Ave. to 466<sup>th</sup> Ave. and the four mile stretch of CCR 3 from 175<sup>th</sup> St. to 172<sup>nd</sup> St. has experienced new cracking of various types, which can be distinguished because old cracks along this stretch of roadway had previously been sealed. The seven-mile stretch of CCR No 3 from 172<sup>nd</sup> St. to 165<sup>th</sup> St., has experienced new cracking of various types, which can be distinguished because old cracks along this stretch of roadway had previously been sealed. The damage to the areas in this phase of the project that required full depth maintenance patching should be considered when assessing the roadway as a whole, as it is evidence that the entire roadway experienced a considerable amount of stress causing the weaker areas to fail, and the stronger areas to move closure to failure. With the amount of damage that can be seen from the surface, it can be concluded that the remaining roadway section has been further compromised as well.

As was noted in the pre-construction evaluation report, the Codington County Highway Department practices a preventative maintenance program for their roadways comprised largely of chip seals and overlays to ensure an extension of the roadway life cycle multiple times over before reaching a state of failure. This is a common practice in this area, particularly on rural roadways where low ADT counts result in a substantial increase in the longevity of quality constructed and maintained roadways. What has transpired on the two-mile stretch of CCR No 20 from 462<sup>nd</sup> Ave. to 464<sup>th</sup> Ave. would fall under the practice of reactive maintenance, in which the roadway is allowed to reach a point of failure and extensive restoration is necessary to return the roadway to a state in which future preventative maintenance can again be practiced. The damages experienced on the remaining stretches of asphalt surfaced roadway are more likely to be receptive to traditional preventative maintenance procedures such as an overlay.

With the roads having been in service for many years to this point and no significant damage noted on the pre-construction roadway evaluation, it is clear that the damages sustained by the haul routes from the construction activities are far beyond that in which typical traffic loadings over the course of sixteen months would have produced.

Restoration expectations for the haul routes were echoed at the South Dakota Public Utilities Commission meetings held on October 13<sup>th</sup> and again on October 28<sup>th</sup>, where commissioners made clear statements that the expectation for the roadway restoration efforts are for the roads to be returned in “perfect condition.” The commission reaction was particular to a letter received from the project’s public liaison, as well as comments made by the Codington County Highway Superintendent as well as photos that a local resident sent to the Public Utilities Commission. The damages were acknowledged by a representative of NextEra Energy and were quoted as being “typical” for a wind project site.

## SECTION VII: EVALUATION COMPARISON

Banner has compared the pre-construction roadway evaluation data with the post-construction roadway evaluation data. This section summarizes our findings.

CCR No 20 from 462<sup>nd</sup> Ave. 466<sup>th</sup> Ave.

This segment of roadway covers four (4) miles of asphalt roadway, totaling 20 manual roadway measurement locations (Each with 2 measurements). Of the 20 locations, 2 locations showed an increase in rut depth for at least one measurement at that location. The severity of the increased rut depths was 1/16th of an inch. The post-construction visual inspection showed an increase in both frequency and severity of the common asphalt pavement distresses. Cracking was much more prevalent on the post-construction inspection, particularly longitudinal and block cracking along each outer quarter of the roadway. Flushing and polishing increased significantly, with it being very evident that oil had migrated to the surface of the asphalt in a large portion of the wheel paths. The aggregate in the wheel paths has been worn to a point where there is no angularity left on the aggregates at the surface, creating a very slick and friction-free surface. Lastly, the roadway experienced areas of potholing and asphalt break-up, which resulted in the need for two (2) temporary maintenance patches to be placed.

CCR No 3 from 176<sup>th</sup> St. to 172<sup>nd</sup> St.

This segment of roadway covers four (4) miles of asphalt roadway, totaling 20 manual roadway measurement locations. Of the 20 locations, 2 showed an increase in rut depth for at least one measurement at that location. The severity of the increased rut depths ranged from 1/16th of an inch to 1/16th of an inch. Another one (1) location was patched due to damages sustained during construction and therefore a comparison could not be made. The post-construction visual inspection showed an increase in both frequency and severity of the common asphalt pavement distresses. Cracking was more prevalent on the post-construction inspection, particularly longitudinal and block cracking along each outer quarter of the roadway. Flushing and polishing increased significantly, with it being very evident that oil had migrated to the surface of the asphalt in a large portion of the wheel paths. The aggregate in the wheel paths has been worn to a point where there is no angularity left on the aggregates at the surface, creating a very slick and friction-free surface. Lastly, the roadway experienced areas of potholing and asphalt break-up, which resulted in the need for one (1) temporary maintenance patch to be placed.

CCR No 3 from 172<sup>nd</sup> St. to 165<sup>th</sup> St.

This segment of roadway covers seven (7) miles of asphalt roadway, totaling 35 manual roadway measurement locations (Each with 2 measurements). Of the 35 locations, 30 showed an increase in rut depth for at least one measurement at that location. The severity of the increased rut depths ranged from 1/16th of an inch to 5/16ths of an inch. Another one (1) location was patched due to damages sustained during construction and therefore a comparison could not be made. The post-construction visual inspection showed an increase in both frequency and severity of the common asphalt pavement distresses. Cracking was more prevalent on the post-construction inspection, particularly longitudinal and block cracking along each outer quarter of the roadway. Flushing and polishing increased significantly, with it being very evident that oil had migrated to the surface of the asphalt in a large portion of the wheel paths. The aggregate in the wheel paths has been worn to

a point where there is no angularity left on the aggregates at the surface, creating a very slick and friction-free surface. Lastly, the roadway experienced areas of potholing and asphalt break-up, which resulted in the need for twelve (12) temporary patches to be placed.

In general, the gravel surfaced roadways in this phase of the project exhibited higher severity levels of deficiencies of aspects of the roadway evaluation that were able to be completed, when comparing them to the pre-construction evaluation conditions. These deficiencies included more severe levels of aggregate loss from the roadways, more severe contamination of the gravel surfacing with clay/subgrade material, and more severe washboarding and potholing on some roadway segments. An additional change noted in the post-construction evaluation is a notable false edge/extension of the roadway is present where the Developer had utilized a scraper to cut down the long stretches of curb and gutter effect on the roadway. Some of the areas of false edge have an abrupt change in cross-slope from the real edge of roadway to the ditch foreslope. This may be dangerous to the travelling public if they do not realize that this is not part of the actual roadway.

Banner completed a visual inspection and assigned a PASER roadway rating to each one mile stretch of asphalt surfaced designated haul route. Figure 4 below shows a comparison of PASER ratings for each mile stretch of asphalt surfaced roadway in this phase of the project.

**Figure 4 – PASER Rating Comparison**

Roadway	Segment	PASER Rating	
		Pre-Construction	Post-Construction
CCR No 20 – 176 <sup>th</sup> St	462 <sup>nd</sup> Ave – 463 <sup>rd</sup> Ave	6	5
CCR No 20 – 176 <sup>th</sup> St	463 <sup>rd</sup> Ave – 464 <sup>th</sup> Ave	6	5
CCR No 20 – 176 <sup>th</sup> St	464 <sup>th</sup> Ave – 465 <sup>th</sup> Ave	8	7
CCR No 20 – 176 <sup>th</sup> St	465 <sup>th</sup> Ave – 466 <sup>th</sup> Ave	8	7
CCR No 3 - 464 <sup>th</sup> Ave	176 <sup>th</sup> St – 175 <sup>th</sup> St	8	7
CCR No 3 - 464 <sup>th</sup> Ave	175 <sup>th</sup> St – 174 <sup>th</sup> St	8	7
CCR No 3 - 464 <sup>th</sup> Ave	174 <sup>th</sup> St – 173 <sup>rd</sup> St	8	7
CCR No 3 - 464 <sup>th</sup> Ave	173 <sup>rd</sup> St – 172 <sup>nd</sup> St	8	7
CCR No 3 - 463 <sup>rd</sup> Ave	172 <sup>nd</sup> St – 171 <sup>st</sup> St	7	6
CCR No 3 – 463 <sup>rd</sup> Ave	171 <sup>st</sup> St – 170 <sup>th</sup> St	7	6
CCR No 3 - 463 <sup>rd</sup> Ave	170 <sup>th</sup> St – 169 <sup>th</sup> St	7	6
CCR No 3 - 463 <sup>rd</sup> Ave	169 <sup>th</sup> St – 168 <sup>th</sup> St	7	6
CCR No 3 - 463 <sup>rd</sup> Ave	168 <sup>th</sup> St – 167 <sup>th</sup> St	7	6
CCR No 3 - 463 <sup>rd</sup> Ave	167 <sup>th</sup> St – 166 <sup>th</sup> St	7	6
CCR No 3 - 463 <sup>rd</sup> Ave	166 <sup>th</sup> St – 165 <sup>th</sup> St	7	6

During construction, many intersections were widened to accommodate construction traffic, which required the contractor to remove and temporarily place traffic signs at intersections. It was noted that the most common temporary placement effort was by placing the signposts in PVC standpipes that were anchored into the ground. During the post construction evaluation, it was noted that many signs remained in the temporary PVC standpipes and/or were reinstalled but incorrectly and absent square placement to the corresponding intersection and roadways. The maintenance and reinstallation of these signs is of extreme importance.

Many areas of highway right of way that were vegetated prior to construction currently sit barren. The areas exhibiting a lack of vegetation were commonly observed in locations where existing intersections were widened

for construction and the widening was removed at the conclusion of construction, and locations where turbine access roads are installed off of the county highway. The lack of vegetation in these areas creates a concern for erosion and sediment transfer.

Banner noted that one culvert did experience damage due to construction activities. That culvert is identified as C95 in APPENDIX D.

APPENDIX G contains pre- and post-construction frozen frames from video of the haul routes collected by Banner. Each sheet shows a side-by-side comparison of the same location from each evaluation period. The damages shown are intended to depict the typical damage experienced by that segment of roadway. Please note that some haul routes were driven in opposite direction pre- and post-construction, so a red arrow is used to point out an identifier in each photo to verify it is the same location in both frozen frames. Banner has also included a sheet of photos taken during construction of areas of roadway that were completely compromised.

## SECTION VIII: RESTORATION RECOMMENDATIONS

In accordance with Section 3.2 *Repair of Designated Roads* of the *Agreement for Road Use, Repair, and Improvements*, the Developer is responsible for the restoration of all Designated Roads as specified in this Final Evaluation of Designated Roads Report. Restoration may include, but is not limited to, the following: 1) services of civil, structural and geotechnical consultant(s), 2) Design, plans, bidding, staking, testing, observation, etc., 3) repair of damaged roadway areas, additional gravel, asphalt overlays, etc., 4) replacement of roadway base and surfacing, 5) repair and/or replacement of bridges and/or culverts. All costs associated with the restoration of the roadways, bridges, and culverts along the designated roads shall be paid for by the Developer. Banner provides the following recommendations for restoration of the haul routes, broken down into various segments of roadway each corresponding to a different restoration effort.

CCR No 20 from 462<sup>nd</sup> Ave. to 464<sup>th</sup> Ave.

Banner has determined that there is no feasible rehabilitation effort that could return these segments of roadway to pre-construction condition. The roads have experienced extensive damages that have compromised the structural integrity of the roadway section and its overall useful life. Full reconstruction will include, but is not limited to, traffic control, shoulder preparation, reclamation of the in-place surfacing material, incorporation of virgin base course, roadway shaping, installation of 4" of asphalt concrete pavement surfacing, and restoring the shoulders of the roadway, and striping. This is the most reasonable way to return the road at least back to pre-construction condition.

CCR No 20 from 464<sup>th</sup> Ave. to 466<sup>th</sup> Ave. and CCR No 3 from 165<sup>th</sup> St. to 172<sup>nd</sup> St.

Banner has determined that these asphalt roadways experienced damages in excess of what was observed during the pre-construction evaluation, to include additional longitudinal and transverse cracking as well as the start of some block cracking. There was a total of thirteen temporary maintenance patches installed by the Developer after construction within these thirteen miles of roadway. Banner is recommending that this segment of roadway be assessed for any specific locations where damages require a full dig out and patching

effort, followed by milling 1.5" of the wearing course of asphalt and relaying a 2" wearing course. This is the most reasonable way to return the road at least back to pre-construction condition.

CCR No 3 from 172<sup>nd</sup> St. to 176<sup>th</sup> St.

Banner has determined that these asphalt roadways experienced damages in excess of what was observed during the pre-construction evaluation, to include additional longitudinal and transverse cracking. The additional damages are low in severity with the most prominent deficiency being the worn surface of the roadway, particularly in the wheel paths from construction traffic. Banner is recommending that a chip seal be applied to this segment of roadway. Codington County regularly performs a crack sealing effort prior to applying a chip seal. Therefore, Banner is recommending the Developer follow the same maintenance approach and perform a crack seal effort prior to a chip seal effort to ensure a product consistent with the maintenance practices that put the roadway at its pre-construction condition. This is the most reasonable way to return the road at least back to pre-construction condition.

CCR No 5 from 175<sup>th</sup> St. to 177<sup>th</sup> St. and CCR No 1 from 170<sup>th</sup> St. to 172<sup>nd</sup> St. and CCR No 10 from Kranzburg Ave. to 466<sup>th</sup> Ave. and CCR No 10 from 461<sup>st</sup> Ave. to 463<sup>rd</sup> Ave. and CCR No 8 from 464<sup>th</sup> Ave. to 466<sup>th</sup> Ave.

As was noted previously in this report, although the Developer continued to clean up the roadway edges, the same post-construction restoration effort to repair soft areas that arose during construction and appropriately re-distribute the existing gravel surfacing material to create a more uniform surface and manageable crown was not maintained for this segment of roadway. Banner does not feel it is reasonable to believe that this effort was abruptly determined to be no longer necessary by the Developer and therefore recommends that once the roadway is thawed in the Spring, the Developer perform the same assessment and digout effort that they felt was necessary for the initial three-mile stretch of CCR No 7 in the Crowned Ridge Wind I phase before frozen conditions set in. Due to the frozen conditions at the time of the post-construction evaluation, the extent of the need as well as the cost for this effort will likely vary across the gravel roadway segments. The developer shall also then redistribute what is available on the roadway as existing surfacing material in order to shape the roadway adequately. Banner recommends that the Developer seed the false roadway edges to provide a clear differentiation between the gravel roadway and the vegetated shoulders. This will help reduce the chance that the now barren roadway shoulders would erode, causing future damage. Once repairs are made, in accordance with the *Agreement for Road Use, Repair, and Improvements*, the Developer shall place 3" of SDDOT state spec. "gravel surface" material as defined in section 882 of the SDDOT specification book on gravel roads defined in the haul road agreement. It shall be noted that this effort has not yet been performed.

Banner recommends that all intersections within the project footprint are to be evaluated and all signs are to be re-installed, as necessary, in accordance with the Codington County Highway Department standards for placement in relation to the corresponding roadway and on proper sign posts using Codington County Highway Department approved hardware. This effort is required to be coordinated with the Codington County Highway Department prior to commencement of the effort. Banner also recommends that all areas of highway right-of-way in need of vegetative restoration are to be cleared of all rock and gravel debris and seeded using a Codington County Highway Department approved seed mix and method.

Banner recommends that a consultant be hired to produce construction documents and provide bidding and construction observation services appropriate for the effort necessary to complete the roadway restoration.



All restoration plans and specifications are required to be approved by the Codington County Highway Department prior to any restoration efforts taking place. Banner also recommends that a testing agency be hired to complete quality control testing for the roadway restoration efforts.

An opinion of probable restoration cost can be found in Appendix F. Please note this cost estimate is meant for a ballpark cost for informational purposes only, the Developer is responsible for all actual costs incurred to completely satisfy the restoration recommendations. In accordance with Section 3.2 *Repair of Designated Roads* of the *Agreement for Road Use, Repair, and Improvements*, the restoration of the Designated Roads shall be completed within 12 months of the Final Evaluation of Designated Roads report being issued to the Developer.



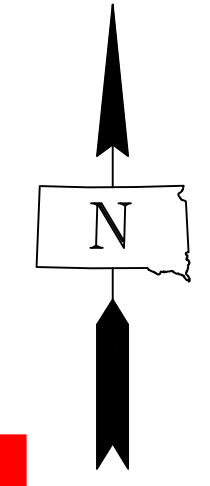
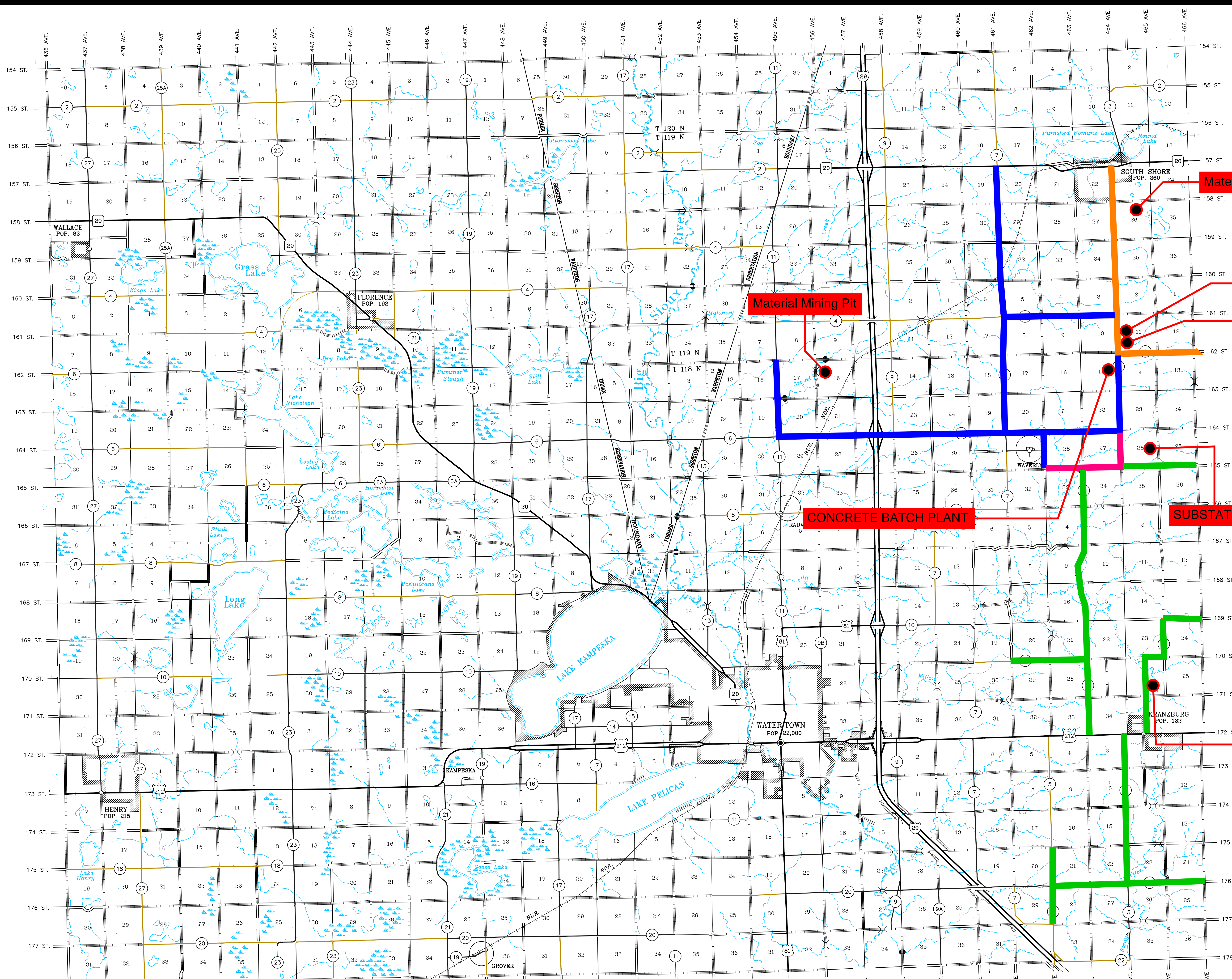
# APPENDIX A

## PROJECT AREA MAP

# PROJECT AREA MAP

## PROJECT AREA MAP

CROWNED RIDGE WIND, LLC  
IN CODINGTON COUNTY, SD



**LEGEND**

- TRANSMISSION LINE CRW I
- CROWNED RIDGE WIND I
- TRANSMISSION LINE CRW II
- CROWNED RIDGE WIND II
- STATE HIGHWAY
- COUNTY ASPHALT
- COUNTY GRAVEL

Total Asphalt Miles: 37.0  
Total Gravel Miles: 22.5  
Total Miles: 59.5



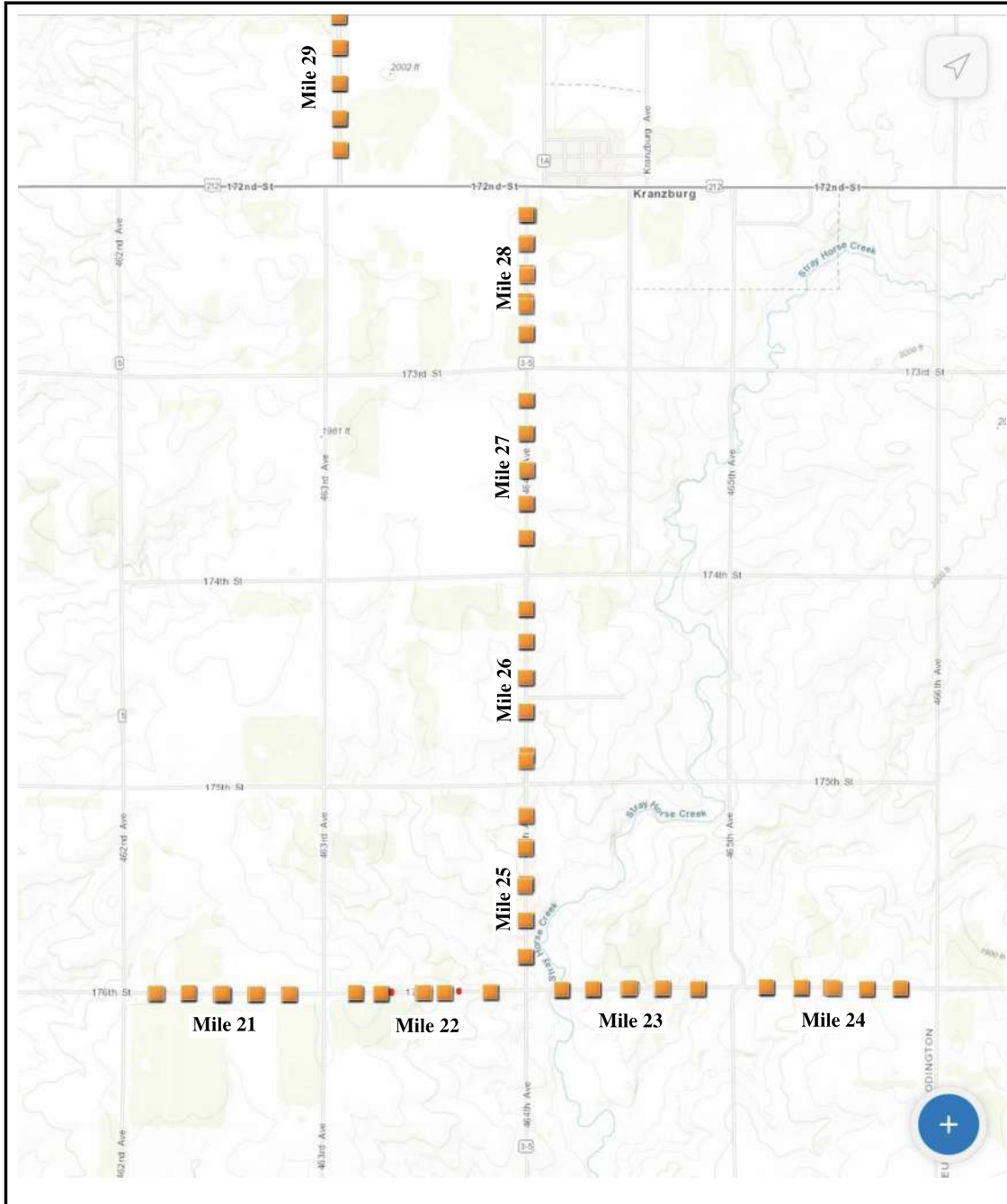
Prepared By:  
WAYLON BLASIUS, PE  
BANNER ASSOCIATES, INC.  
409 22ND AVE. S  
BROOKINGS, SD 57006  
605-692-6342





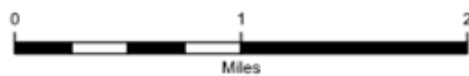
# APPENDIX B

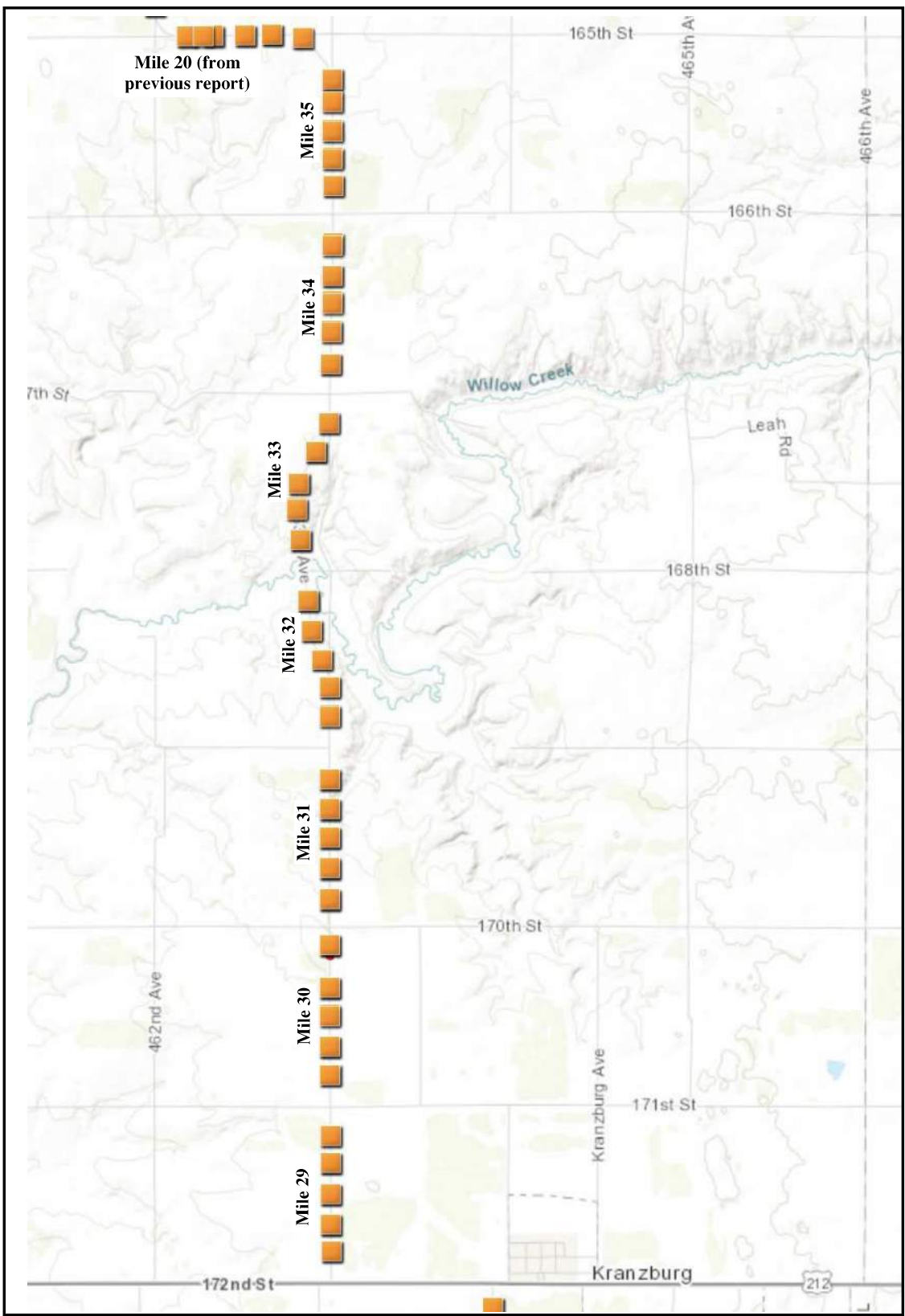
## MANUAL ROADWAY MEASUREMENTS



Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA | Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bu...

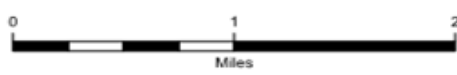
## Roadway Measurements Map





Esri, Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA | Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bu.

# Roadway Measurements Map



## MILE 21

Location ID	Lane	Lane Width 1	Lane Width 2
M201	South	163	163
Offset	Depth 1	Depth 2	Difference
18	0	0	0
34	1/16	1/16	0
56	0	0	0
81	0	0	0
103	1/16	1/16	0
119	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M240	North	147	147
Offset	Depth 1	Depth 2	Difference
6	0	0	0
26	1/16	1/16	0
47	0	0	0
69	0	0	0
91	3/16	3/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M202	South	157	157
Offset	Depth 1	Depth 2	Difference
5	0	0	0
28	1/16	1/16	0
51	0	0	0
74	0	0	0
94	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M239	North	152	152
Offset	Depth 1	Depth 2	Difference
14	0	0	0
35	1/16	1/16	0
73	0	0	0
94	1/16	1/16	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M203	South	155	155
Offset	Depth 1	Depth 2	Difference
4	0	0	0
19	1/16	1/16	0
47	0	0	0
80	0	0	0
107	1/16	1/16	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M238	North	154	154
Offset	Depth 1	Depth 2	Difference
11	0	0	0
23	1/16	1/16	0
45	0	0	0
76	0	0	0
98	1/16	1/16	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M204	South	154	154
Offset	Depth 1	Depth 2	Difference
6	0	0	0
32	1/8	1/8	0
57	0	0	0
75	0	0	0
102	1/16	1/16	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M237	North	154	154
Offset	Depth 1	Depth 2	Difference
12	0	0	0
36	1/16	1/16	0
53	0	0	0
87	0	0	0
104	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M205	South	147	147
Offset	Depth 1	Depth 2	Difference
8	0	0	0
28	1/8	1/8	0
56	0	0	0
85	0	0	0
99	1/16	1/16	0
109	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M236	North	160	160
Offset	Depth 1	Depth 2	Difference
26	0	0	0
43	1/16	1/16	0
59	0	0	0
92	0	0	0
106	1/16	1/16	0
120	0	0	0

## MILE 22

Location ID	Lane	Lane Width 1	Lane Width 2
M206	South	160	160
Offset	Depth 1	Depth 2	Difference
14	0	0	0
30	1/16	1/16	0
50	0	0	0
70	0	0	0
99	1/8	1/8	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M235	North	148	148
Offset	Depth 1	Depth 2	Difference
8	0	0	0
34	1/16	1/16	0
59	0	0	0
76	0	0	0
87	1/16	1/16	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M207	South	151	151
Offset	Depth 1	Depth 2	Difference
10	0	0	0
31	1/8	1/8	0
59	0	0	0
76	0	0	0
87	1/16	1/16	0
107	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M234	North	157	157
Offset	Depth 1	Depth 2	Difference
13	0	0	0
28	1/16	1/16	0
57	0	0	0
69	0	0	0
94	1/8	1/8	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M208	South	157	157
Offset	Depth 1	Depth 2	Difference
13	0	0	0
31	1/16	1/16	0
52	0	0	0
88	0	0	0
108	1/8	1/8	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M233	North	147	147
Offset	Depth 1	Depth 2	Difference
13	0	0	0
37	1/16	1/16	0
52	0	0	0
73	0	0	0
96	1/8	1/8	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M209	South	161	161
Offset	Depth 1	Depth 2	Difference
15	0	0	0
30	1/8	1/8	0
57	0	0	0
86	0	0	0
111	1/16	1/16	0
124	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M232	North	145	145
Offset	Depth 1	Depth 2	Difference
11	0	0	0
34	1/16	1/16	0
57	0	0	0
75	0	0	0
105	1/16	1/16	0
122	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M210	South	154	154
Offset	Depth 1	Depth 2	Difference
7	0	0	0
19	1/8	1/8	0
58	0	0	0
86	0	0	0
104	1/8	1/8	0
122	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M231	North	151	151
Offset	Depth 1	Depth 2	Difference
15	0	0	0
44	1/8	1/8	0
64	0	0	0
70	0	0	0
100	1/16	1/16	0
120	0	0	0

## MILE 23

Location ID	Lane	Lane Width 1	Lane Width 2
M211	South	N/A	
Offset	Depth 1	Depth 2	Difference
11	0	0	0
21	1/16	1/16	0
46	0	0	0
67	0	0	0
96	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M230	North	146	146
Offset	Depth 1	Depth 2	Difference
14	0	0	0
39	1/16	1/16	0
53	0	0	0
71	0	0	0
92	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M212	South	153	153
Offset	Depth 1	Depth 2	Difference
21	0	0	0
35	1/16	1/16	1/16
40	0	0	0
75	0	0	0
94	1/16	1/16	1/16
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M229	North	149	149
Offset	Depth 1	Depth 2	Difference
4	0	0	0
16	1/16	1/16	0
50	0	0	0
66	0	0	0
86	5/16	5/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M213	South	162	162
Offset	Depth 1	Depth 2	Difference
15	0	0	0
27	1/16	1/16	0
49	0	0	0
63	0	0	0
95	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M228	North	151	151
Offset	Depth 1	Depth 2	Difference
9	0	0	0
20	1/16	1/16	0
42	0	0	0
64	0	0	0
92	1/8	1/8	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M214	South	152	152
Offset	Depth 1	Depth 2	Difference
13	0	0	0
30	1/16	1/16	0
52	0	0	0
69	0	0	0
89	1/8	1/8	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M227	North	144	
Offset	Depth 1	Depth 2	Difference
10	0	0	0
28	1/16	1/16	0
47	0	0	0
67	0	0	0
88	3/16	3/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M215	South	149	149
Offset	Depth 1	Depth 2	Difference
11	0	0	0
26	0	0	0
52	0	0	0
76	0	0	0
89	1/8	1/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M226	North	144	144
Offset	Depth 1	Depth 2	Difference
10	0	0	0
34	1/16	1/16	0
57	0	0	0
71	0	0	0
97	1/16	1/16	0
113	0	0	0

## MILE 24

Location ID	Lane	Lane Width 1	Lane Width 2
M216	South	143	143
Offset	Depth 1	Depth 2	Difference
5	0	0	0
16	1/16	1/16	0
45	0	0	0
60	0	0	0
82	1/16	1/16	0
100	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M225	North	144	144
Offset	Depth 1	Depth 2	Difference
11	0	0	0
32	1/16	1/16	0
30	0	0	0
67	0	0	0
88	3/16	3/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M217	South	147	147
Offset	Depth 1	Depth 2	Difference
11	0	0	0
27	1/16	1/16	0
43	0	0	0
72	0	0	0
87	1/8	1/8	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M224	North	138	138
Offset	Depth 1	Depth 2	Difference
4	0	0	0
16	1/16	1/16	0
44	0	0	0
62	0	0	0
99	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M218	South	171	171
Offset	Depth 1	Depth 2	Difference
14	0	0	0
28	1/8	1/8	0
55	0	0	0
76	0	0	0
97	1/16	1/16	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M223	North	151	151
Offset	Depth 1	Depth 2	Difference
2	0	0	0
16	1/16	1/16	0
51	0	0	0
64	0	0	0
91	1/16	1/16	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M219	South	144	144
Offset	Depth 1	Depth 2	Difference
13	0	0	0
29	1/8	1/8	0
56	0	0	0
68	0	0	0
99	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M222	North	140	140
Offset	Depth 1	Depth 2	Difference
8	0	0	0
22	1/16	1/16	0
52	0	0	0
65	0	0	0
101	3/16	3/16	0
122	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M220	South	147	147
Offset	Depth 1	Depth 2	Difference
11	0	0	0
34	3/16	3/16	0
64	0	0	0
68	0	0	0
93	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M221	North	141	141
Offset	Depth 1	Depth 2	Difference
6	0	0	0
22	1/16	1/16	0
46	0	0	0
61	0	0	0
84	1/8	1/8	0
113	0	0	0

## MILE 25

Location ID	Lane	Lane Width 1	Lane Width 2
M241	East	144	144
Offset	Depth 1	Depth 2	Difference
12	0	0	0
33	1/16	1/16	0
50	0	0	0
82	0	0	0
98	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M280	West	156	
Offset	Depth 1	Depth 2	Difference
9	0	0	0
28	1/8	1/8	0
53	0	1/8	1/8
84	0	0	0
102	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M242	East	144	144
Offset	Depth 1	Depth 2	Difference
4	0	0	0
22	1/8	1/8	0
43	0	0	0
88	0	0	0
101	1/16	1/16	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M279	West	162	
Offset	Depth 1	Depth 2	Difference
14	0	0	0
35	1/16	1/16	0
51	0	0	0
83	0	0	0
107	1/16	1/16	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M243	East	143	143
Offset	Depth 1	Depth 2	Difference
7	0	0	0
21	1/8	1/8	0
41	0	0	0
86	0	0	0
98	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M278	West	158	
Offset	Depth 1	Depth 2	Difference
6	0	0	0
19	3/16	3/16	0
46	0	0	0
84	0	0	0
104	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M244	East	138	138
Offset	Depth 1	Depth 2	Difference
22	0	0	0
49	1/8	1/8	0
68	0	0	0
78	0	0	0
90	1/8	1/8	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M277	West	150	
Offset	Depth 1	Depth 2	Difference
7	0	0	0
22	1/8	1/8	0
34	0	0	0
82	0	0	0
99	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M245	East	148	148
Offset	Depth 1	Depth 2	Difference
39	0	0	0
50	1/16	1/16	0
67	0	0	0
81	0	0	0
102	1/8	1/8	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M276	West	154	
Offset	Depth 1	Depth 2	Difference
7	0	0	0
23	1/16	1/16	0
37	0	0	0
80	0	0	0
100	1/16	1/16	0
110	0	0	0



## MILE 26

Location ID	Lane	Lane Width 1	Lane Width 2
M246	East	149	149
Offset	Depth 1	Depth 2	Difference
6	0	0	0
26	1/16	1/16	0
50	0	0	0
78	0	0	0
99	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M275	West	154	154
Offset	Depth 1	Depth 2	Difference
11	0	0	0
23	1/8	1/8	0
60	0	0	0
75	0	0	0
94	1/16	1/16	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M247	East	143	143
Offset	Depth 1	Depth 2	Difference
0	0	0	0
13	1/16	1/16	0
26	0	0	0
71	0	0	0
85	1/16	1/16	0
97	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M274	West	161	161
Offset	Depth 1	Depth 2	Difference
19	0	0	0
34	1/16	1/16	0
58	0	0	0
82	0	0	0
96	1/8	1/8	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M248	East	150	150
Offset	Depth 1	Depth 2	Difference
6	0	0	0
20	1/8	1/8	0
48	0	0	0
76	0	0	0
94	1/8	1/8	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M273	West	157	157
Offset	Depth 1	Depth 2	Difference
19	0	0	0
34	1/16	1/16	0
47	0	0	0
87	0	0	0
111	1/16	1/16	0
124	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M249	East	151	152
Offset	Depth 1	Depth 2	Difference
11	0	0	0
33	3/16	3/16	0
54	0	0	0
81	0	0	0
106	1/8	1/8	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M272	West	152	152
Offset	Depth 1	Depth 2	Difference
5	0	0	0
27	1/8	1/8	0
58	0	0	0
78	0	0	0
98	1/8	1/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M250	East	151	151
Offset	Depth 1	Depth 2	Difference
6	0	0	0
25	1/16	1/16	0
43	0	0	0
83	0	0	0
102	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M271	West	156	156
Offset	Depth 1	Depth 2	Difference
12	0	0	0
29	1/16	1/16	0
45	0	0	0
78	0	0	0
106	3/16	3/16	0
112	0	0	0

## MILE 27

Location ID	Lane	Lane Width 1	Lane Width 2
M251	East	146	146
Offset	Depth 1	Depth 2	Difference
3	0	0	0
35	1/8	1/8	0
58	0	0	0
70	0	0	0
90	1/16	1/16	0
106	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M270	West	160	160
Offset	Depth 1	Depth 2	Difference
10	0	0	0
28	1/16	1/16	0
46	0	0	0
86	0	0	0
102	1/8	1/8	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M252	East	149	149
Offset	Depth 1	Depth 2	Difference
2	0	0	0
41	1/8	1/8	0
60	0	0	0
74	0	0	0
93	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M269	West	N/A	N/A
Offset	Depth 1	Depth 2	Difference
6	0	0	0
12	1/16	1/16	0
79	0	0	0
33	0	0	0
99	3/16	3/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M253	East	147	147
Offset	Depth 1	Depth 2	Difference
3	0	0	0
23	1/8	1/8	0
43	0	1/8	1/8
77	0	0	0
96	1/16	3/16	1/8
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M268	West	152	152
Offset	Depth 1	Depth 2	Difference
8	0	0	0
17	1/16	1/16	0
39	0	0	0
77	0	0	0
95	1/16	1/16	0
107	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M254	East	149	149
Offset	Depth 1	Depth 2	Difference
5	0	0	0
28	1/16	1/16	0
41	0	0	0
71	0	0	0
98	1/16	1/16	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M267	West	N/A	N/A
Offset	Depth 1	Depth 2	Difference
8	0	0	0
12	1/8	1/8	0
41	0	0	0
72	0	0	0
92	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M255	East	157	157
Offset	Depth 1	Depth 2	Difference
11	0	0	0
29	1/16	1/16	0
47	0	0	0
79	0	0	0
99	1/8	1/8	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M266	West	152	152
Offset	Depth 1	Depth 2	Difference
5	0	0	0
28	1/16	1/16	0
48	0	0	0
81	0	0	0
91	1/8	1/8	0
109	0	0	0

## MILE 28

Location ID	Lane	Lane Width 1	Lane Width 2
M256	East	150	150
Offset	Depth 1	Depth 2	Difference
11	0	0	0
24	1/16	1/16	0
36	0	0	0
87	0	0	0
100	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M265	West	152	152
Offset	Depth 1	Depth 2	Difference
9	0	0	0
34	1/8	1/8	0
60	0	0	0
80	0	0	0
97	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M257	East	149	149
Offset	Depth 1	Depth 2	Difference
9	0	0	0
28	1/16	1/16	0
38	0	0	0
83	0	0	0
102	1/8	1/8	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M264	West	160	160
Offset	Depth 1	Depth 2	Difference
13	0	0	0
32	1/16	1/16	0
49	0	0	0
80	0	0	0
92	1/8	1/8	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M258	East	150	150
Offset	Depth 1	Depth 2	Difference
9	0	0	0
29	1/16	1/16	0
46	0	0	0
72	0	0	0
96	1/16	1/16	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M263	West	157	157
Offset	Depth 1	Depth 2	Difference
27	0	0	0
43	1/8	1/8	0
74	0	0	0
99	1/8	1/8	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M259	East	147	147
Offset	Depth 1	Depth 2	Difference
8	0	0	0
33	1/8	1/8	0
59	0	0	0
74	0	0	0
97	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M262	West	160	160
Offset	Depth 1	Depth 2	Difference
15	0	0	0
31	1/16	1/16	0
42	0	0	0
57	0	0	0
79	1/16	1/16	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M260	East	145	145
Offset	Depth 1	Depth 2	Difference
5	0	0	0
18	1/16	1/16	0
40	0	0	0
68	0	0	0
88	1/8	1/8	0
105	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M261	West	165	165
Offset	Depth 1	Depth 2	Difference
14	0	0	0
31	1/16	1/16	0
45	0	0	0
77	0	0	0
101	1/8	1/8	0
116	0	0	0

## MILE 29

Location ID	Lane	Lane Width 1	Lane Width 2
M281	East	153	153
Offset	Depth 1	Depth 2	Difference
24	0	0	0
29	1/16	1/16	0
38	0	0	0
68	0	0	0
89	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M350	West	165	165
Offset	Depth 1	Depth 2	Difference
18	0	0	0
31	1/16	1/16	0
42	0	0	0
84	0	0	0
103	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M282	East	144	144
Offset	Depth 1	Depth 2	Difference
0	0	0	0
19	1/16	1/16	0
31	0	0	0
72	0	0	0
94	1/8	1/8	0
105	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M349	West	162	162
Offset	Depth 1	Depth 2	Difference
9	0	0	0
31	3/16	3/16	0
50	0	0	0
86	0	0	0
105	3/16	3/16	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M283	East	142	142
Offset	Depth 1	Depth 2	Difference
0	0	0	0
12	1/8	1/8	0
30	0	0	0
67	0	0	0
87	1/16	1/16	0
105	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M348	West	161	161
Offset	Depth 1	Depth 2	Difference
12	0	0	0
32	1/4	1/4	0
49	0	1/16	1/16
85	0	0	0
104	1/4	1/2	1/4
115	0	5/16	5/16

Location ID	Lane	Lane Width 1	Lane Width 2
M284	East	142	142
Offset	Depth 1	Depth 2	Difference
1	0	0	0
14	1/8	1/8	0
35	0	0	0
71	0	0	0
90	3/16	3/16	0
108	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M347	West	160	160
Offset	Depth 1	Depth 2	Difference
6	0	0	0
26	3/16	3/16	0
49	0	1/16	1/16
51	0	0	0
105	5/16	5/16	0
119	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M285	East	168	168
Offset	Depth 1	Depth 2	Difference
18	0	0	0
35	1/16	1/16	0
50	0	0	0
89	0	0	0
107	1/8	1/8	0
123	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M346	West	150	150
Offset	Depth 1	Depth 2	Difference
2	0	0	0
15	1/16	1/8	1/16
33	0	0	0
51	0	0	0
80	1/4	1/4	0
109	0	0	0

## MILE 30

Location ID	Lane	Lane Width 1	Lane Width 2
M286	East	161	161
Offset	Depth 1	Depth 2	Difference
6	0	0	0
34	5/16	5/16	0
56	0	0	0
67	0	0	0
105	3/8	1/2	1/8
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M345	West	151	151
Offset	Depth 1	Depth 2	Difference
2	0	0	0
20	3/8	9/16	3/16
53	0	0	0
61	0	0	0
88	3/16	3/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M287	East	157	157
Offset	Depth 1	Depth 2	Difference
12	0	0	0
31	1/16	1/16	0
43	0	0	0
87	0	0	0
106	1/16	1/16	0
120	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M344	West	152	152
Offset	Depth 1	Depth 2	Difference
4	0	0	0
19	1/16	1/16	0
43	0	0	0
76	0	0	0
90	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M288	East	162	162
Offset	Depth 1	Depth 2	Difference
10	0	0	0
25	1/16	1/16	0
40	0	0	0
64	0	0	0
96	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M343	West	153	153
Offset	Depth 1	Depth 2	Difference
4	0	0	0
25	3/16	1/2	5/16
52	0	0	0
60	0	0	0
89	3/16	3/16	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M289	East	157	157
Offset	Depth 1	Depth 2	Difference
5	0	0	0
16	1/8	1/8	0
34	0	0	0
78	0	0	0
92	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M342	West	152	152
Offset	Depth 1	Depth 2	Difference
1	0	0	0
18	1/8	1/8	0
48	0	0	0
60	0	0	0
87	1/8	1/8	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M290	East	155	155
Offset	Depth 1	Depth 2	Difference
3	0	0	0
37	1/16	1/16	0
49	0	0	0
76	0	0	0
96	1/16	1/8	1/16
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M341	West	161	161
Offset	Depth 1	Depth 2	Difference
7	0	0	0
18	1/16	1/16	0
41	0	0	0
60	0	0	0
84	1/8	1/8	0
114	0	0	0

## MILE 31

Location ID	Lane	Lane Width 1	Lane Width 2
M291	East	152	152
Offset	Depth 1	Depth 2	Difference
0	0	0	0
18	1/16	1/16	0
28	0	0	0
80	0	0	0
95	1/16	1/16	0
109	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M340	West	161	161
Offset	Depth 1	Depth 2	Difference
2	0	0	0
24	1/8	1/8	0
46	0	0	0
64	0	0	0
95	1/8	1/8	0
119	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M292	East	160	160
Offset	Depth 1	Depth 2	Difference
6	0	0	0
35	13/16	1 3/16	3/8
60	0	0	0
71	0	0	0
105	13/16	1 1/16	1/4
120	0	3/16	3/16

Location ID	Lane	Lane Width 1	Lane Width 2
M339	West	152	152
Offset	Depth 1	Depth 2	Difference
1	0	0	0
19	3/8	7/8	1/2
45	0	0	0
68	0	0	0
84	7/16	3/4	5/16
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M293	East	161	161
Offset	Depth 1	Depth 2	Difference
8	0	0	0
22	1/16	1/16	0
48	0	0	0
60	0	0	0
101	1/16	3/16	1/8
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M338	West	152	152
Offset	Depth 1	Depth 2	Difference
4	0	0	0
13	1/16	3/16	1/8
41	0	0	0
53	0	0	0
86	1/8	1/8	0
111	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M294	East	157	157
Offset	Depth 1	Depth 2	Difference
9	0	0	0
36	1/16	1/16	0
55	0	0	0
72	0	0	0
93	1/16	1/8	1/16
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M337	West	169	169
Offset	Depth 1	Depth 2	Difference
5	0	0	0
17	1/16	1/16	0
37	0	0	0
80	0	0	0
102	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M295	East	164	164
Offset	Depth 1	Depth 2	Difference
4	1/4	1/4	0
31	0	0	0
87	0	0	0
103	1/16	1/16	0
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M336	West	163	163
Offset	Depth 1	Depth 2	Difference
3	0	0	0
16	1/8	1/8	0
28	0	0	0
67	0	0	0
94	1/16	1/16	0
109	0	0	0

## MILE 32

Location ID	Lane	Lane Width 1	Lane Width 2
M296	East	161	
Offset	Depth 1	Depth 2	Difference
13	0	N/A	N/A
22	1/16	N/A	N/A
42	0	N/A	N/A
81	0	N/A	N/A
100	1/4	N/A	N/A
115	0	N/A	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M335	West	160	
Offset	Depth 1	Depth 2	Difference
1	0	N/A	N/A
8	3/16	N/A	N/A
24	0	N/A	N/A
67	0	N/A	N/A
98	3/16	N/A	N/A
112	0	N/A	N/A

Location ID	Lane	Lane Width 1	Lane Width 2
M297	East	163	163
Offset	Depth 1	Depth 2	Difference
9	0	0	0
22	1/8	1/8	0
47	0	0	0
64	0	0	0
80	1/8	1/8	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M334	West	147	147
Offset	Depth 1	Depth 2	Difference
1	0	0	0
12	3/16	3/16	0
32	0	0	0
65	0	0	0
86	1/8	1/8	0
109	0	1/16	1/16

Location ID	Lane	Lane Width 1	Lane Width 2
M298	East	170	170
Offset	Depth 1	Depth 2	Difference
4	0	0	0
18	1/8	1/8	0
43	0	0	0
55	0	0	0
90	1/8	1/8	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M333	West	154	154
Offset	Depth 1	Depth 2	Difference
9	0	0	0
16	3/16	1/4	1/16
40	0	0	0
60	0	0	0
80	1/16	1/16	0
105	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M299	East	156	156
Offset	Depth 1	Depth 2	Difference
4	0	0	0
16	3/16	3/16	0
42	0	0	0
70	1/16	1/16	0
89	0	0	0
99	1/8	1/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M332	West	155	155
Offset	Depth 1	Depth 2	Difference
8	0	0	0
16	1/8	1/8	0
32	0	0	0
50	0	0	0
67	0	0	0
98	1/8	1/8	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M300	East	168	168
Offset	Depth 1	Depth 2	Difference
5	0	0	0
19	3/16	3/16	0
51	0	1/16	1/16
70	0	0	0
95	3/16	3/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M331	West	155	155
Offset	Depth 1	Depth 2	Difference
9	0	0	0
15	3/16	3/16	0
52	0	0	0
74	0	0	0
94	1/8	1/8	0
116	0	0	0

## MILE 33

Location ID	Lane	Lane Width 1	Lane Width 2
M301	East	159	159
Offset	Depth 1	Depth 2	Difference
112	0	0	0
18	1/8	1/4	1/8
42	0	0	0
56	0	0	0
89	1/8	1/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M330	West	152	152
Offset	Depth 1	Depth 2	Difference
4	0	0	0
16	1/8	1/8	0
32	0	0	0
55	0	0	0
94	1/8	1/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M302	East	161	161
Offset	Depth 1	Depth 2	Difference
6	0	0	0
18	3/16	3/16	0
52	0	0	0
56	0	0	0
81	1/8	1/8	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M329	West	163	163
Offset	Depth 1	Depth 2	Difference
5	0	0	0
13	1/16	1/16	0
36	0	0	0
60	0	0	0
93	1/16	1/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M303	East	188	188
Offset	Depth 1	Depth 2	Difference
10	0	0	0
25	3/16	1/8	- 1/16
56	0	0	0
78	0	0	0
99	1/16	1/16	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M328	West	147	147
Offset	Depth 1	Depth 2	Difference
3	0	0	0
13	1/16	N/A	N/A
40	0	0	0
54	0	0	0
89	3/16	3/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M304	East	164	164
Offset	Depth 1	Depth 2	Difference
2	0	0	0
13	1/8	1/8	0
32	0	0	0
53	0	0	0
86	1/8	1/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M327	West	170	170
Offset	Depth 1	Depth 2	Difference
30	0	0	0
60	1/16	1/16	0
74	0	0	0
83	0	0	0
102	1/16	1/16	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M305	East	171	171
Offset	Depth 1	Depth 2	Difference
8	0	0	0
17	1/8	1/8	0
45	0	0	0
58	0	0	0
82	1/16	1/16	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M326	West	154	154
Offset	Depth 1	Depth 2	Difference
4	0	0	0
13	1/8	1/8	0
36	0	0	0
77	0	0	0
110	1/16	1/16	0
119	0	0	0



## MILE 34

Location ID	Lane	Lane Width 1	Lane Width 2
M306	East	156	
Offset	Depth 1	Depth 2	Difference
5	0	N/A	
18	3/8	N/A	
37	0	N/A	
62	0	N/A	
98	5/16	N/A	
115	0	N/A	

Location ID	Lane	Lane Width 1	Lane Width 2
M325	West	156	
Offset	Depth 1	Depth 2	Difference
4	1/16	N/A	
16	3/16	N/A	
34	0	N/A	
43	0	N/A	
62	0	N/A	
86	1/16	N/A	
113	0		

Location ID	Lane	Lane Width 1	Lane Width 2
M307	East	162	162
Offset	Depth 1	Depth 2	Difference
7	0	0	0
14	1/8	1/8	0
34	0	0	0
73	0	0	0
100	1/8	1/8	0
116	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M324	West	146	146
Offset	Depth 1	Depth 2	Difference
1	0	0	0
10	3/16	3/16	0
36	0	0	0
64	0	0	0
95	1/16	1/16	0
117	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M308	East	165	165
Offset	Depth 1	Depth 2	Difference
10	0	0	0
25	1/16	3/16	1/8
55	0	0	0
67	0	0	0
107	1/8	1/16	- 1/16
118	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M323	West	145	145
Offset	Depth 1	Depth 2	Difference
4	0	0	0
8	1/8	1/16	- 1/16
32	0	3/16	3/16
72	0	1/8	1/8
86	1/16	3/16	1/8
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M309	East	158	158
Offset	Depth 1	Depth 2	Difference
4	0	0	0
16	1/8	1/8	0
48	0	0	0
58	0	0	0
90	1/16	1/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M322	West	151	151
Offset	Depth 1	Depth 2	Difference
6	0	0	0
16	1/8	1/8	0
41	0	0	0
60	0	0	0
89	3/16	3/16	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M310	East	152	152
Offset	Depth 1	Depth 2	Difference
5	0	0	0
16	1/8	1/8	0
44	0	0	0
57	0	0	0
85	3/16	3/16	0
115	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M321	West	146	146
Offset	Depth 1	Depth 2	Difference
6	0	0	0
26	1/16	1/16	0
42	0	0	0
68	0	0	0
89	1/16	1/16	0
114	0	0	0

## MILE 35

Location ID	Lane	Lane Width 1	Lane Width 2
M311	East	156	156
Offset	Depth 1	Depth 2	Difference
2	0	0	0
13	3/8	3/8	0
34	0	0	0
63	0	0	0
76	1/8	1/8	0
101	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M312	East	143	143
Offset	Depth 1	Depth 2	Difference
4	0	0	0
13	1/16	1/16	0
34	0	0	0
49	0	0	0
90	0	0	0
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M313	East	154	154
Offset	Depth 1	Depth 2	Difference
8	0	0	0
15	1/16	1/16	0
35	0	1/16	1/16
50	0	0	0
77	1/8	3/16	1/16
110	0	1/8	1/8

Location ID	Lane	Lane Width 1	Lane Width 2
M314	East	153	157
Offset	Depth 1	Depth 2	Difference
2	0	0	0
22	5/8	5/8	0
53	0	0	0
69	0	0	0
93	3/8	3/8	0
114	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M315	East	174	174
Offset	Depth 1	Depth 2	Difference
4	0	0	0
11	1/8	1/8	1/8
36	0	0	0
45	0	0	0
74	1/8	1/8	1/8
93	1/16	1/16	1/16
112	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M320	West	159	159
Offset	Depth 1	Depth 2	Difference
2	0	0	0
8	3/16	3/16	0
32	0	0	0
44	0	0	0
62	0	0	0
86	0	0	0
100	1/16	1/16	0
112	0		

Location ID	Lane	Lane Width 1	Lane Width 2
M319	West	160	160
Offset	Depth 1	Depth 2	Difference
16	0	0	0
24	1/8	1/8	0
40	0	0	0
55	0	0	0
85	1/16	1/16	0
110	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M318	West	148	148
Offset	Depth 1	Depth 2	Difference
4	0	0	0
16	1/16	1/8	1/16
37	0	1/16	1/16
52	0	0	0
75	1/16	0	- 1/16
107	0	1/16	1/16

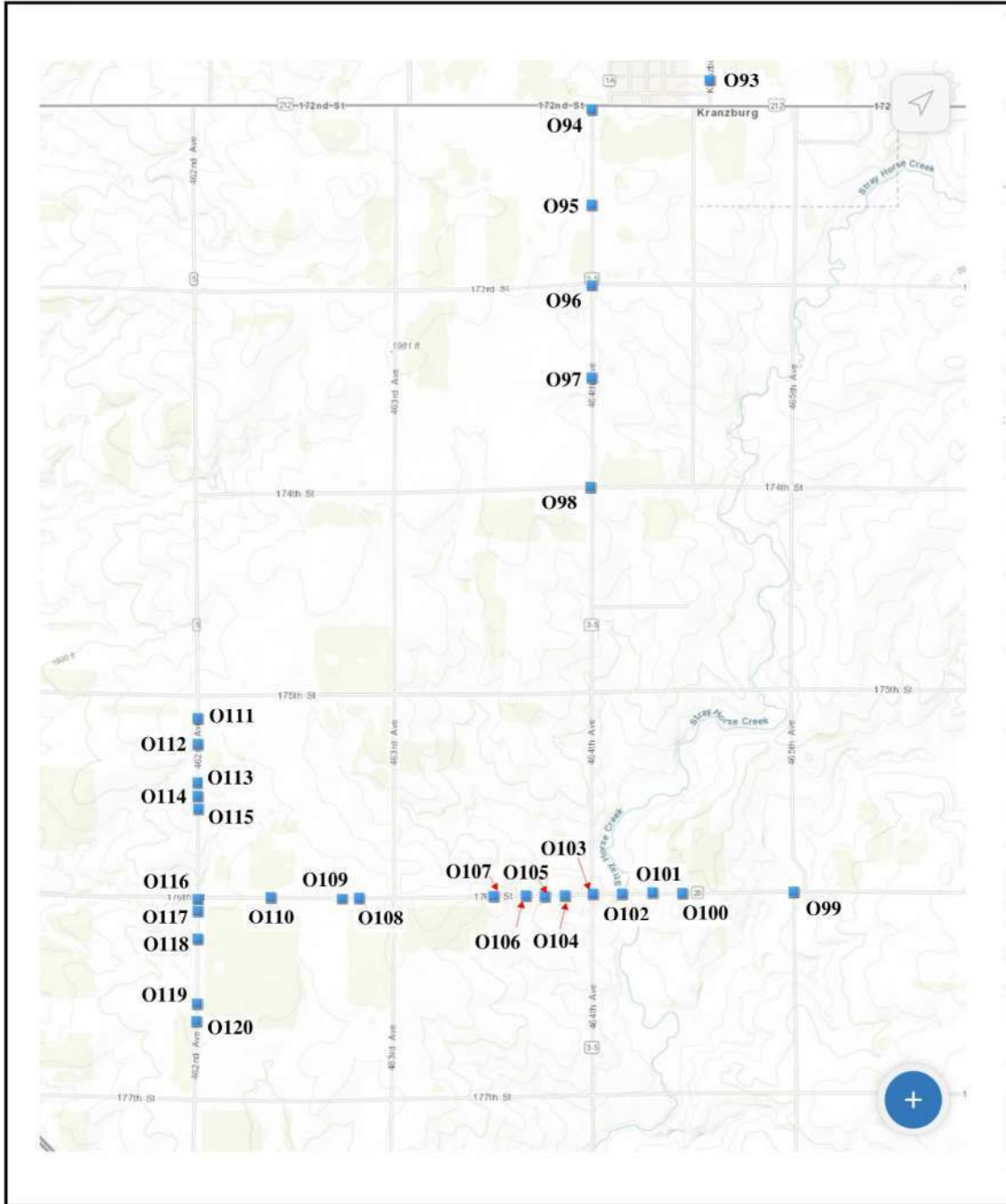
Location ID	Lane	Lane Width 1	Lane Width 2
M317	West	157	157
Offset	Depth 1	Depth 2	Difference
6	1/4	1/4	0
33	0	0	0
52	0	0	0
88	1/8	1/8	0
113	0	0	0

Location ID	Lane	Lane Width 1	Lane Width 2
M316	West	160	160
Offset	Depth 1	Depth 2	Difference
5	0	0	0
16	1/8	1/8	0
36	0	0	0
62	0	0	0
80	1/16	1/16	0
115	0	0	0



# APPENDIX C

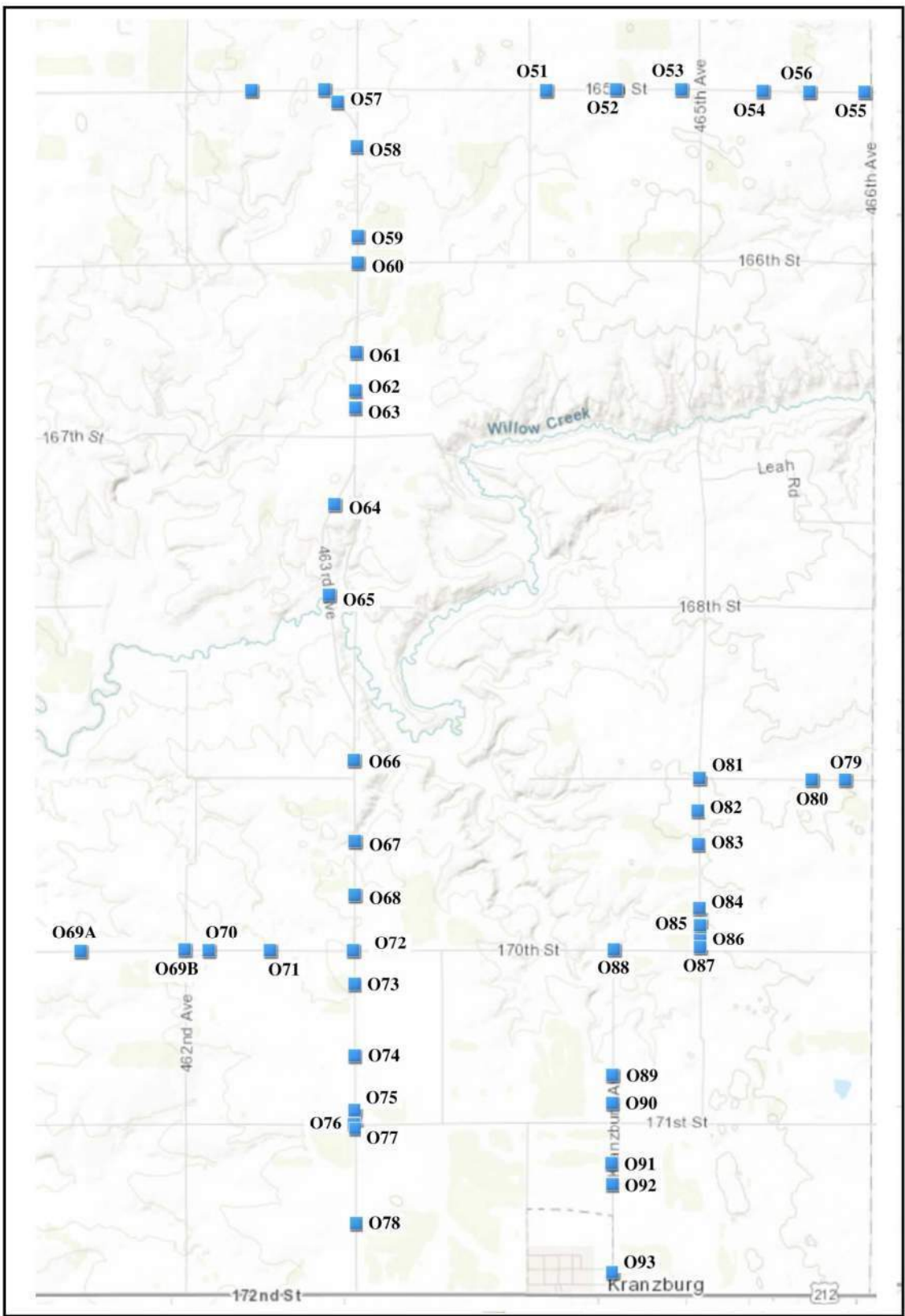
## ADDITIONAL AREAS OF OBSERVATION



Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA | Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bu...

## Additional Areas of Observation Map





Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA | Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bu...

## Additional Areas of Observation Map



## ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Pre-Construction Comments	Post-Construction Comparison
O51	165th St	Soft Area		No post-construction comparison due to gravel road variability and frozen conditions
O52	165th St	Soft Area	About 200' long. Edges light of aggregate on south. North has windrow blocking water drainage	No post-construction comparison due to gravel road variability and frozen conditions
O53	165th St	Soft Area	Edges light of aggregate on south. North has windrow blocking water drainage	No post-construction comparison due to gravel road variability and frozen conditions
O54	165th St	Potential issue with rain events	South edges along this mile light of aggregate.	No post-construction comparison due to gravel road variability and frozen conditions
O55	165th St	Potential issue with rain events	South edges along this mile light of aggregate.	No post-construction comparison due to gravel road variability and frozen conditions
O56	463rd Ave	Settlement above culvert	Road depressed at culvert crossing about 1". Full width of road	No post-construction comparison due to gravel road variability and frozen conditions
O57	463rd Ave	Settlement above culvert	1/2" at fog line and 1/8" at centerline. Also transverse cracking at crossings	Similar Condition
O58	463rd Ave	Start of pot hole	About 6" diameter	Temporary patch due to breakup during construction
O59	463rd Ave	Potential Start of pot hole	About 6" diameter	Temporary patch due to breakup during construction
O60	463rd Ave	Potential issue in intersection	Longitudinal crack through intersection 1/4". Traverse crack is wider at 1/2"	Similar Condition
O61	463rd Ave	Patch	Previous patch in centerline	Similar Condition
O62	463rd Ave	Settlement above culvert	5/8" at west fog line. 1/8" at centerline and east fog line	Temporary patch due to breakup during construction
O63	463rd Ave	Pot Hole	16" diameter in north bound lane	Temporary patch due to breakup during construction

## ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Comments	Post-Construction Comparison
O64	463rd Ave	Potential issue at longitudinal crack	Road depressed 1" at centerline along 30' long longitudinal crack	Temporary patch due to breakup during construction
O65	463rd Ave	Potential issue at transition to bridge	Pavement breaking up at bridge transition both north and south side.	Temporary patch due to breakup during construction
O66	463rd Ave	Cracking	Block cracking in wheel path on north bound lane	Temporary patch due to breakup during construction
O67	463rd Ave	Cracking	Block cracking in south bound lane. Two sections 30' long	Temporary patch due to breakup during construction
O68	463rd Ave	Rutting and Cracking	Rutting and excessive block cracking. Spot at same location as a road measurement previously taken for ruts	Temporary patch due to breakup during construction
O69A	170th St	Soft Area	Edges soft and light of aggregate. Slight rutting in wheel path.	No post-construction comparison due to gravel road variability and frozen conditions
O69B	170th St	Soft Area	Loose aggregate and slight rutting on south side. Light on aggregate on north side	No post-construction comparison due to gravel road variability and frozen conditions
O70	170th St	Potential issue	North side aggregate contaminated with organic soil from field entrance	No post-construction comparison due to gravel road variability and frozen conditions
O71	170th St	Soft Area	Slight rutting in surfacing	No post-construction comparison due to gravel road variability and frozen conditions
O72	170th St	Cracking	Excessive cracking in apron transition between asphalt and gravel	Similar Condition
O73	463rd Ave	Cracking	East edge along fog line. Longitudinal and block cracking about a half mile long.	Similar Condition
O74	463rd Ave	Cracking	More block cracking along east fog line	Similar Condition
O75	463rd Ave	Pot hole	Along east fog line. 6" dia	Similar Condition
O76	463rd Ave	Cracking	Longitudinal crack and previous damage to surface due to equipment crossing road	Similar Condition
O77	463rd Ave	Pot hole	6" pot hole started	Similar Condition
O78	463rd Ave	Cracking	Block cracking along east fog line. 8-10" blocks	Similar Condition

## ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Comments	Post-Construction Comparison
O79	169th St	Soft Area	Black subbase visible, min ruts, looks like water would not shed well off road	No post-construction comparison due to gravel road variability and frozen conditions
O80	169th St	Settlement over Culvert	North edge settling over culvert. Low on aggregate on edge	No post-construction comparison due to gravel road variability and frozen conditions
O81	169th St	Potential issue	Intersection may be issue due to lack of gravel	No post-construction comparison due to gravel road variability and frozen conditions
O82	465th Ave	Soft Area and rutting	Soft and ruts near center. Soft and lacking aggregate on edges	No post-construction comparison due to gravel road variability and frozen conditions
O83	465th Ave	Soft Area and rutting	Soft and ruts near center. Soft and lacking aggregate on edges	No post-construction comparison due to gravel road variability and frozen conditions
O84	465th Ave	Soft Area and rutting	Soft and ruts near center. Soft and lacking aggregate on edges	No post-construction comparison due to gravel road variability and frozen conditions
O85	465th Ave	Soft Area and rutting	Soft and ruts near center. Soft and lacking aggregate on edges	No post-construction comparison due to gravel road variability and frozen conditions
O86	465th Ave	Soft Area and rutting	Soft and ruts near center. Soft and lacking aggregate on edges	No post-construction comparison due to gravel road variability and frozen conditions
O87	465th Ave	Potential issue	Intersection may be issue due to lack of gravel	No post-construction comparison due to gravel road variability and frozen conditions
O88	Kranzburg Ave	Potential issue	Intersection may be issue due to lack of gravel	No post-construction comparison due to gravel road variability and frozen conditions
O89	Kranzburg Ave	Windrow	Loose aggregate with slight windrow on edges. Block water shedding off surface	No post-construction comparison due to gravel road variability and frozen conditions
O90	Kranzburg Ave	Soft Area	Soft spot in center of road	No post-construction comparison due to gravel road variability and frozen conditions
O91	Kranzburg Ave	Windrow	Loose aggregate with slight windrow on edges. Block water shedding off surface	No post-construction comparison due to gravel road variability and frozen conditions
O92	Kranzburg Ave	Soft Area	Soft spot in east edge of road	No post-construction comparison due to gravel road variability and frozen conditions



## ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Comments	Post-Construction Comparison
O93	Kranzburg Ave	Soft Area	Soft spot in east edge of road	No post-construction comparison due to gravel road variability and frozen conditions
O94	464th Ave	Cracking	Excess cracks at transition from HWY 212 to CCR 3	Similar Condition
O95	464th Ave	Cracking	Cracking along fog line. 1/2". Noted because wider than typical	Similar Condition
O96	464th Ave	Cracking	Cracking along fog line. 1/2". Noted because wider than typical and previously sealed	Similar Condition
O97	176th St	Cracking	Cracking along fog line. 1/2". Noted because wider than typical	Similar Condition
O98	176th St		Previously damaged due to some equipment crossing intersection	Similar Condition
O99	176th St	Settlement over Culvert	Depression in road at 3- culvert crossing . East end fog line 5/8", center 1/4". West end fog line 1/4", center 1/8"	Similar Condition
O100	176th St	Cracking	Cracking in wheel path, about 200'	Similar Condition
O101	176th St	Settlement over Culvert	Depression in road at culvert crossing. 3/8" at fog line, 1/8" at centerline	Similar Condition
O102	176th St	Patch	Previously patched at culvert crossing. Some reflective cracking and depressed slightly.	Similar Condition
O103	176th St		Intersection. Will be stopping and turning	Similar Condition
O104	176th St	Cracking	Longitudinal crack along fog line on south side. Typical along this mile	Similar Condition
O105	176th St	Cracking	Several similar locations with transverse and secondary cracking	Similar Condition
O106	176th St	Cracking	North side cracking in wheel path	Similar Condition
O107	176th St	Cracking	Transverse and secondary cracking, with pot hole started in center.	Similar Condition
O108	176th St	Cracking	Frequent locations with block cracking in wheel path on both directions	Similar Condition

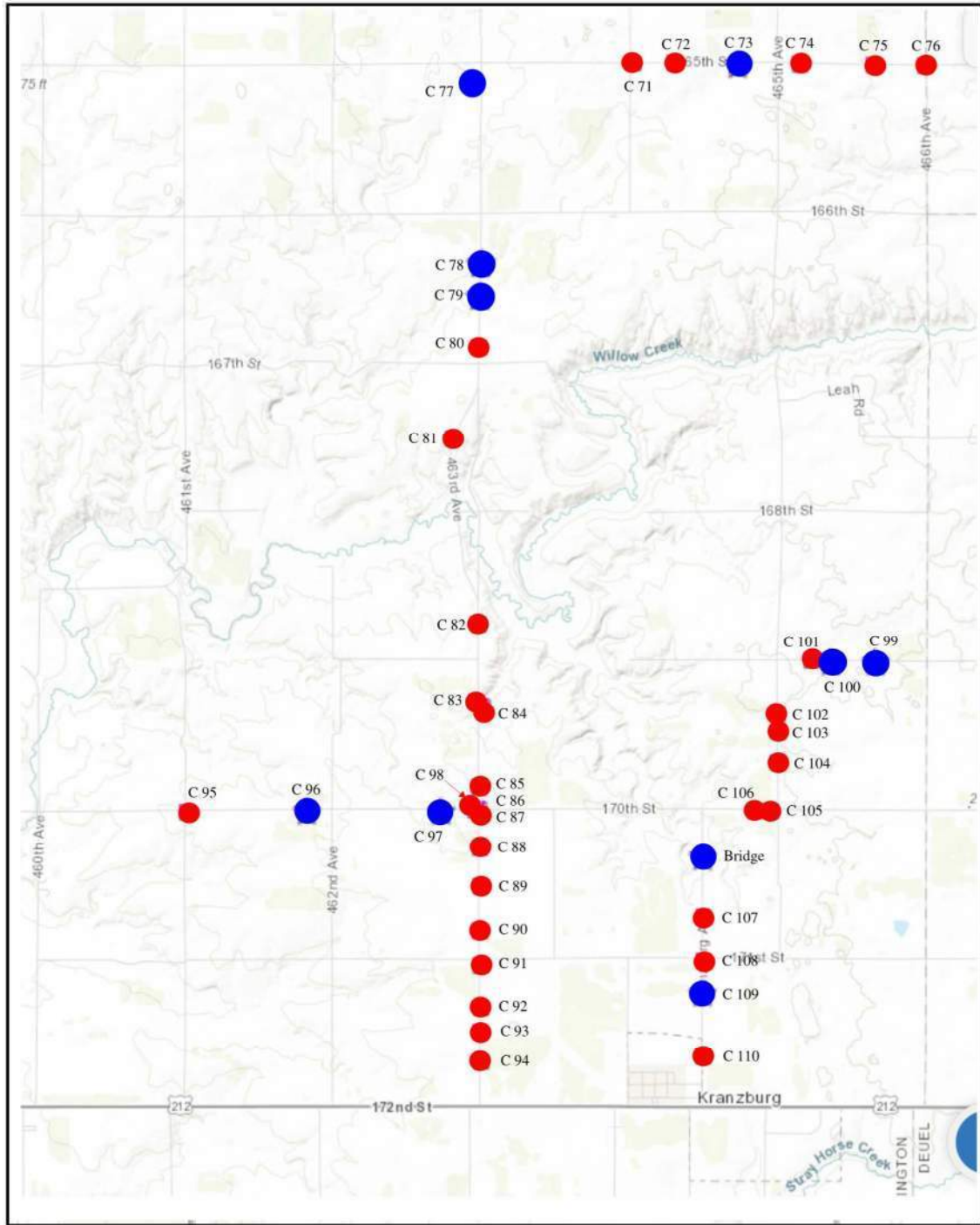
## ADDITIONAL AREAS OF OBSERVATION

ID	Street	Observation	Comments	Post-Construction Comparison
O109	176th St	Cracking	Frequent locations with transverse cracking and secondary cracking	Similar Condition
O110	176th St	Cracking	Block cracking in wheel path. 200-300'	Temporary patch due to breakup during construction
O111	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O112	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O113	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O114	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O115	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O116	462nd St		Intersection	No post-construction comparison due to gravel road variability and frozen conditions
O117	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O118	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O119	462nd St	Soft Area	Soft spot and rutted	No post-construction comparison due to gravel road variability and frozen conditions
O120	462nd St	Soft Area	Soft spot and rutted . About 400'	No post-construction comparison due to gravel road variability and frozen conditions



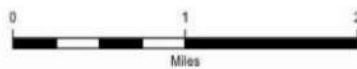
# APPENDIX D

## CULVERT INSPECTIONS



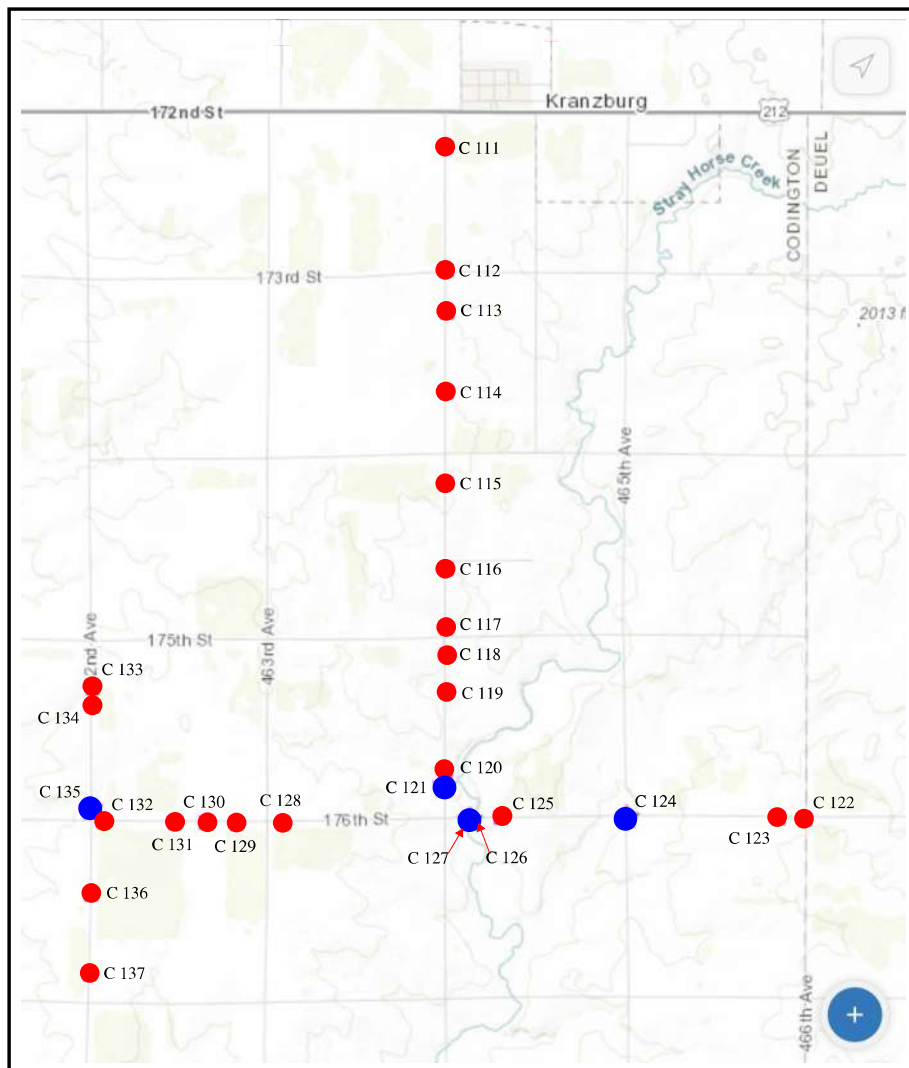
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## Culvert Map



Legend:

- Culverts Under 48" Diameter
- Culverts of 48" Diameter and Larger



Esrri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA | Esri, HERE, Garmin, INCREMENT P, METI/NASA, USGS, EPA, NPS, US Census Bu...

## Culvert Map



Legend:

- Culverts Under 48" Diameter
- Culverts of 48" Diameter and Larger

## PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C62	Round	24"	RCP	North	No End sections, first joint separated, cannot tell beyond that, concrete pipe end in rough condition	South	No End sections, first joint separated, cannot tell beyond that, concrete pipe end in rough condition
C63	Round	18"	RCP	North	No End Sections, joints starting to show some separation, concrete pipe end in rough condition	South	No End Sections, joints starting to show some separation, concrete pipe end in rough condition
C64	Round	84"	RCP	North	3-84" Pipes, End section separated on all 3 pipes with embankment falling through the separation on the center pipe, pipe themselves in good condition with exception of spalling and visible rebar on east pipe end section	South	3-84" Pipes @ 12' CL to CL, End section showing separation on all 3 pipes, East culvert has been patched
C65	Round	80"	CMP	North	Good condition, minimal rusting on bottom 1' of pipe	South	Good condition, minimal rusting on bottom 1' of pipe
C66	Round	24"	RCP	North	End section separated at first joint, debris coming through joint separation	South	End section separated 4" at first joint, Looks as though many joints are separated, debris coming through joint separation, End section also cracked and spalling
C67	Round	20"	RCP	North	Hard to see but debris at first joint suggesting separation at that location	South	Hard to see but debris at first joint suggesting separation at that location
C68	Round	20"	RCP	North	No end sections, first joint separated, looks as though other joints are separated also, debris coming through all separated joints, concrete pipe end in rough condition	South	No end sections, first joint separated, looks as though other joints are separated also, debris coming through all separated joints, concrete pipe end in rough condition
C69	Round	18"	RCP	West	End section separated at first joint with some debris starting to collect at that joint	East	Very hard to see, plenty of debris in end section of pipe
C70	Round	36"	CMP	West	Pipe rusting up beyond the springline	East	Pipe rusting up beyond the springline, small deformation in top of pipe
C71	Round	18"	RCP	North	RCP in good condition, minor spalling on flared end. End joint separation 1"	South	RCP in good condition, end flared slightly separated. Debris at end backing up water.
C72	Round	18"	RCP	North	RCP in good condition, flared end broken, steel exposed. Joint separated 1.5" with material from embankment falling through.	South	RCP in good condition. End separated 1".
C73	Arch	84x48	RCP	North	RCP in good condition. First joint slightly separated.	South	RCP in good condition. First joint slightly separated.

## POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C62	Round	24"	RCP	North	No Change Noted	South	No Change Noted
C63	Round	18"	RCP	North	No Change Noted	South	No Change Noted
C64	Round	84"	RCP	North	No Change Noted	South	No Change Noted
C65	Round	80"	CMP	North	No Change Noted	South	No Change Noted
C66	Round	24"	RCP	North	No Change Noted	South	No Change Noted
C67	Round	20"	RCP	North	No Change Noted	South	No Change Noted
C68	Round	20"	RCP	North	No Change Noted	South	No Change Noted
C69	Round	18"	RCP	West	No Change Noted	East	No Change Noted
C70	Round	36"	CMP	West	No Change Noted	East	No Change Noted
C71	Round	18"	RCP	North	No Change Noted	South	No Change Noted
C72	Round	18"	RCP	North	No Change Noted	South	No Change Noted
C73	Arch	84x48	RCP	North	No Change Noted	South	No Change Noted

### PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C74	Round	18	RCP	North	RCP 12" water. Cannot see condition	South	RCP in good condition
C75	Round	24	RCP	North	RCP full of water. Unable to see condition . Steel exposed on north end piece	South	RCP full of water. Unable to see condition . Steel exposed on end piece
C76	Round	16	RCP	North	RCP in good condition. Minor spalling on flared end. Steel exposed.	South	RCP in good condition. First joint slightly separated.
C77	Round	84	RCP	West	rcp, good condition, cable ties	East	rcp, good condition, cable ties
C78	Round	84	RCP	West	2 parallel RCP with 10ft separation. Good condition. First joint tie rod. Joints have been patched. Weathered ends	East	2 parallel RCP in good condition. End joints tie rod and patched. South pipe looks like patch coming out. Weathered ends
C79	Round	60	RCP	West	RCP in good condition. First joint slightly separated	East	RCP in good condition.
C80	Round	18	RCP	West	RCP. Scouring at end of pipe caused first section to disconnect and fall. Blocking flow.	East	RCP. End damaged with exposed rebar. Joint separated and material from embankment falling in.
C81	Round	24	RCP	West	RCP in good condition	East	RCP. Flared end piece separated completely from pipe. Joint damaged. Otherwise pipe in good condition
C82	Round	24	RCP	West	RCP in good condition . Flared end spalling. Steel exposed.	East	RCP in good condition. Minor spalling on flared end.
C83	Round	24	RCP	West	RCP in good condition . Tree in front of inlet	East	RCP in good condition overall. Flared end dislocated due to tree. Second joint separated.
C84	Round	24	RCP	West	RCP in good condition	East	RCP. First two joints separated completely. Rest of pipe in good condition.
C85	Round	24	RCP	West	RCP. End section damaged with steel exposed. Rest is in good condition	East	RCP. End section damaged with steel exposed. Rest is in good condition
C86	Round	18	RCP	West	RCP. End section damaged with steel exposed. Rest is in good condition	East	RCP. End section damaged with steel exposed. Rest is in good condition . Silt building up at end
C87	Round	30	RCP	West	RCP. End section spalled. Rest is in good condition . Water 24" deep in pipe.	East	RCP. End section spalled. Rest is in good condition . Water 24" deep in pipe.
C88	Round	42	RCP	West	RCP. Joint separation 1.5". End section with minor spalling and some steel exposed. Rest is in good condition .	East	RCP. Joint separation 1.5". End section with minor spalling and some steel exposed. Rest is in good condition .
C89	Round	16	RCP	West	RCP. Flared End section with minor spalling and some steel exposed. Rest is in good condition . 4" silt and some rock in inlet	East	RCP. Flared End section broken with rebar exposed. Rest is in good condition .
C90	Round	18	RCP	West	RCP. End section with spalling and some steel exposed. Pipe with 9" silt on bottom. Rest is in good condition.	East	RCP. End section broken and some steel exposed. 6" silt in pipe. Rest is in good condition .

### POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C74	Round	18	RCP	North	No Change Noted	South	No Change Noted
C75	Round	24	RCP	North	No Change Noted	South	No Change Noted
C76	Round	16	RCP	North	No Change Noted	South	No Change Noted
C77	Round	84	RCP	West	No Change Noted	East	No Change Noted
C78	Round	84	RCP	West	No Change Noted	East	No Change Noted
C79	Round	60	RCP	West	No Change Noted	East	No Change Noted
C80	Round	18	RCP	West	No Change Noted	East	No Change Noted
C81	Round	24	RCP	West	No Change Noted	East	No Change Noted
C82	Round	24	RCP	West	No Change Noted	East	No Change Noted
C83	Round	24	RCP	West	No Change Noted	East	No Change Noted
C84	Round	24	RCP	West	No Change Noted	East	No Change Noted
C85	Round	24	RCP	West	No Change Noted	East	No Change Noted
C86	Round	18	RCP	West	No Change Noted	East	No Change Noted
C87	Round	30	RCP	West	No Change Noted	East	No Change Noted
C88	Round	42	RCP	West	No Change Noted	East	No Change Noted
C89	Round	16	RCP	West	No Change Noted	East	No Change Noted
C90	Round	18	RCP	West	No Change Noted	East	No Change Noted

### PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C91	Round	18	RCP	West	RCP in good condition.	East	RCP in good condition. Minor spalling on end piece.
C92	Round	24	RCP	West	RCP in good condition. 12" water	East	RCP in good condition . End piece broken with some steel exposed.
C93	Round	18	RCP	West	RCP in good condition . End piece broken with some steel exposed.	East	RCP in good condition . End piece broken with some steel exposed.
C94	Round	24	RCP	West	RCP in good condition . End piece broken with some steel exposed. Material erosion around pipe.	East	RCP in good condition . End piece spalling with some steel exposed.
C95	Round	30	CMP	North	CMP in good condition	South	CMP in good condition. End is bend at top
C96	Round	60	CMP	North	CMP in good condition. Reeds growing in front of inlet. Some deflection of pipe under road.	South	CMP in good condition. 24" silt in pipe. Slight deflection of pipe under road.
C97	Box	48x80		North	Poured in place box. Concrete	South	Poured in place concrete box. Exposed rebar.
C98	Round	30	RCP	North	RCP. End section spalled. Rest is in good condition . Water 24" deep in pipe.	South	RCP in good condition. End spalling with some steel exposed. First joint slightly separated. Metal collar on outside to stop material from falling in joint
C99	Round	54	CMP	North	CMP in good condition overall. End is collapsed about 3' from end, over 2' deflection.	South	CMP in good condition. End has some damage on top. Hole cut in pipe.
C100	Round	60	CMP	North	CMP in good condition. 1" hole cut in top of pipe	South	CMP in good condition. Slight deflection in top of pipe approximately at south side of road.
C101	Round	24	CMP	North	CMP. Plugged and submerged. Cannot see pipe. Feel top and bottom with shovel.	South	CMP. Plugged and submerged. Cannot see pipe. Feel top and bottom with shovel.
C102	Round	24	RCP	West	RCP. Plugged cannot see pipe. Top of flared end looks good	East	RCP. Flared End has some damage and steel exposed. First joint slightly separated.
C103	Round	24	RCP	West	RCP in good condition but silted in 12" deep. Flared end damaged with steel exposed	East	RCP in good condition. 12" silt in pipe.
C104	Round	36	CMP	West	CMP. Water 32" deep cannot see condition	East	CMP. End is damaged and deflected about 12" from top. Cannot see condition of pipe
C105	Round	18	RCP	North	RCP in good condition. Minor spalling on flared end	South	RCP in good condition
C106	Round	18	CMP	North	CMP in good condition except the end is bent.	South	CMP end bent and pinched almost completely closed

### POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C91	Round	18	RCP	West	No Change Noted	East	No Change Noted
C92	Round	24	RCP	West	No Change Noted	East	No Change Noted
C93	Round	18	RCP	West	No Change Noted	East	No Change Noted
C94	Round	24	RCP	West	No Change Noted	East	No Change Noted
C95	Round	30	CMP	North	End of pipe damaged, sags near middle of road	South	No Change Noted
C96	Round	60	CMP	North	No Change Noted	South	No Change Noted
C97	Box	48x80		North	No Change Noted	South	No Change Noted
C98	Round	30	RCP	North	No Change Noted	South	No Change Noted
C99	Round	54	CMP	North	No Change Noted	South	No Change Noted
C100	Round	60	CMP	North	No Change Noted	South	No Change Noted
C101	Round	24	CMP	North	No Change Noted	South	No Change Noted
C102	Round	24	RCP	West	No Change Noted	East	No Change Noted
C103	Round	24	RCP	West	No Change Noted	East	No Change Noted
C104	Round	36	CMP	West	No Change Noted	East	No Change Noted
C105	Round	18	RCP	North	No Change Noted	South	No Change Noted
C106	Round	18	CMP	North	No Change Noted	South	No Change Noted



## PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C107	Round	15	RCP	West	RCP in good condition	East	RCP in good condition
C108	Round	14	RCP	West	RCP in good condition . Minor spalling on end	East	RCP. End piece broken. Hole in pipe about 2' from end
C109	Round	60	CMP	West	CMP in good condition. Slight deflection under road. Embankment eroding around pipe	East	CMP in good condition. Slight deflection under road
C110	Round	18	RCP	West	RCP in good condition. Minor spalling on flared end	East	RCP in good condition.
C111	Round	30	RCP	West	2 - 30" parallel RCP in good condition. 6 ft center to center. 1.5" separated on first joint of each pipe	East	2 - 30" parallel RCP in good condition. 6 ft center to center. 1.5" separated on first joint of each pipe
C112	Round	24	RCP	West	RCP in good condition. Flared end damaged. Steel exposed. 8" silt built up on bottom of pipe	East	RCP in good condition. Flared end damaged. Steel exposed. 8" silt built up on bottom of pipe
C113	Round	48	RCP	West	RCP in good condition. Tie rods on flared end.	East	RCP in good condition. Tie rods on flared end.
C114	Round	30	RCP	West	RCP in good condition. 1" slight separation of first joint	East	RCP in good condition. Flares damaged with exposed steel
C115	Round	36	RCP	West	RCP in good condition. Spalling on flared end. 1.5" separated on first joint	East	RCP in good condition. 1.5" separation at first joint.
C116	Round	42	RCP	West	RCP in good condition. Tie rods on end. Flared end damaged.	East	RCP in good condition. Tie rods on end
C117	Round	30	RCP	West	RCP in good condition. Damaged flared end. Rebar exposed	East	RCP in good condition. Minor spalling on flared end. Debris blocking outfall . 1" separation at first joint
C118	Round	18	RCP	West	RCP in good condition. Minor spalling on flared end	East	RCP in good condition. Minor spalling on flared end
C119	Round	30	RCP	West	RCP in good condition. First joint separated 1.5" water inflow at joint.	East	RCP in good condition. Bottom 6" silted. 2" separated on first joint. Spalling on flare
C120	Round	36	RCP	West	Inlet on private property outside road ROW. I did not cross fence to observe.	East	RCP. First four joints separated. Embankment falling in pipe. Spalling on flared end
C121	Box	48x80	Concrete	West	Poured in place box. Concrete	East	Poured in place box. Concrete
C122	Round	18	RCP	North	RCP in good condition. Flared end damaged with exposed steel. 6" silt in pipe	South	RCP. Flared end broken off. Rest in good condition.
C123	Round	24	RCP	North	24 or 30? Plugged with silt and debris. Flared end damaged. RCP	South	RCP. First joint separated and embankment falling in pipe. Silted nearly full.

## POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C107	Round	15	RCP	West	No Change Noted	East	No Change Noted
C108	Round	14	RCP	West	No Change Noted	East	No Change Noted
C109	Round	60	CMP	West	No Change Noted	East	No Change Noted
C110	Round	18	RCP	West	No Change Noted	East	No Change Noted
C111	Round	30	RCP	West	No Change Noted	East	No Change Noted
C112	Round	24	RCP	West	No Change Noted	East	No Change Noted
C113	Round	48	RCP	West	No Change Noted	East	No Change Noted
C114	Round	30	RCP	West	No Change Noted	East	No Change Noted
C115	Round	36	RCP	West	No Change Noted	East	No Change Noted
C116	Round	42	RCP	West	No Change Noted	East	Flared ends, sits crooked
C117	Round	30	RCP	West	No Change Noted	East	No Change Noted
C118	Round	18	RCP	West	No Change Noted	East	No Change Noted
C119	Round	30	RCP	West	No Change Noted	East	No Change Noted
C120	Round	36	RCP	West	No Change Noted	East	No Change Noted
C121	Box	48x80	Concrete	West	No Change Noted	East	No Change Noted
C122	Round	18	RCP	North	No Change Noted	South	No Change Noted
C123	Round	24	RCP	North	No Change Noted	South	No Change Noted

### PRE-CONSTRUCTION CULVERT OBSERVATIONS

ID	Shape	Size	Material	End	Note	End	Note
C124	Elliptical	84x120	CMP	North	CMP in good condition. 3 parallel CMP at 15' center to center. Inlet has debris and vegetation . Tie rods on joints	South	3 parallel CMP in good condition. Vegetation and trees at outlets . Slight deflection in east pipe on north side of road
C125	Round	48	RCP	North	RCP in good condition. 1" separated in first joint	South	RCP in good condition. 1" separated first joint
C126	Round	72	RCP	North	RCP in good condition. First joint separated . Flared end tie rod at joint. Parallel to CMP (see separate report)	South	RCP in good condition. First joint separated . Flared end tie rod at joint. Parallel to CMP (see separate report)
C127	Round	84	CMP	North	2 parallel CMP 25 ft center to center.	South	CMP in good condition. Parallel lines.
C128	Round	18	RCP	North	RCP in good condition. Silted end. Overgrown with vegetation	South	RCP half full of silt. Damaged flared end.
C129	Round	18	RCP	North	RCP in good condition. Flared end damaged	South	RCP in good condition. Spalling on flared end . Eroded under flared end
C130	Round	18	RCP	North	RCP in good condition. Flared end damaged . First joint separated	South	RCP in good condition. Spalling on flared end . Eroded under flared end . First joint slightly separated
C131	Round	24	RCP	North	RCP in good condition. First joint separated 1"	South	RCP in good condition. First joint separated 1"
C132	Round	18	RCP	North	RCP in good condition. Flared end broken off.	South	RCP in good condition. Flared end damaged with steel exposed
C133	Round	24	RCP	West	RCP in good condition. No flared end piece.	East	RCP in good condition. First piece end broken with exposed steel. No flared end
C134	Round	24	CMP	West	CMP in good condition.	East	CMP in good condition. End damaged and bent
C135	Round	60	CMP	West	CMP in good condition. Top of the west end bent. Rip rap at outlet	East	CMP in good condition. Rip rap and vegetation around inlet
C136	Round	18	RCP	West	RCP. 3/4 full of silt and water. Cannot see condition	East	RCP. 3/4 full of silt and water. Cannot see condition
C137	Round	18	RCP	West	RCP. 3/4 full of silt and water. Cannot see condition	East	RCP. 3/4 full of silt and water. Cannot see condition



### POST-CONSTRUCTION COMPARISON NOTES

ID	Shape	Size	Material	End	Note	End	Note
C124	Elliptical	84x120	CMP	North	No Change Noted	South	No Change Noted
C125	Round	48	RCP	North	No Change Noted	South	No Change Noted
C126	Round	72	RCP	North	No Change Noted	South	No Change Noted
C127	Round	84	CMP	North	No Change Noted	South	No Change Noted
C128	Round	18	RCP	North	No Change Noted	South	No Change Noted
C129	Round	18	RCP	North	No Change Noted	South	No Change Noted
C130	Round	18	RCP	North	No Change Noted	South	No Change Noted
C131	Round	24	RCP	North	No Change Noted	South	No Change Noted
C132	Round	18	RCP	North	No Change Noted	South	No Change Noted
C133	Round	24	RCP	West	No Change Noted	East	No Change Noted
C134	Round	24	CMP	West	No Change Noted	East	No Change Noted
C135	Round	60	CMP	West	No Change Noted	East	No Change Noted
C136	Round	18	RCP	West	No Change Noted	East	No Change Noted
C137	Round	18	RCP	West	No Change Noted	East	No Change Noted





# APPENDIX E

## PASER MANUAL RATING SHEET

## Rating system

Surface rating	Visible distress*	General condition/ treatment measures
<b>10</b> Excellent	None.	New construction.
<b>9</b> Excellent	None.	Recent overlay. Like new.
<b>8</b> Very Good	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40' or greater). All cracks sealed or tight (open less than 1/4").	Recent sealcoat or new cold mix. Little or no maintenance required.
<b>7</b> Good	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks (open 1/4") due to reflection or paving joints. Transverse cracks (open 1/4"–1/2") spaced 10' or more apart, little or slight crack raveling. No patching or very few patches in excellent condition.	First signs of aging. Maintain with routine crack filling.
<b>6</b> Good	Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open 1/4"–1/2"). Transverse cracks (open 1/4"–1/2"), some spaced less than 10'. First sign of block cracking. Slight to moderate flushing or polishing. Occasional patching in good condition.	Shows signs of aging. Sound structural condition. Could extend life with sealcoat.
<b>5</b> Fair	Moderate to severe raveling (loss of fine and coarse aggregate). Longitudinal and transverse cracks (open 1/2" or more) show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition.	Surface aging. Sound structural condition. Needs sealcoat or thin non-structural overlay (less than 2")
<b>4</b> Fair	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (1/2" deep or less).	Significant aging and first signs of need for strengthening. Would benefit from a structural overlay (2" or more).
<b>3</b> Poor	Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (greater than 1/2" but less than 2" deep). Occasional potholes.	Needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of overlay.
<b>2</b> Very Poor	Alligator cracking (over 25% of surface). Severe rutting or distortions (2" or more deep). Extensive patching in poor condition. Potholes.	Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective.
<b>1</b> Failed	Severe distress with extensive loss of surface integrity.	Failed. Needs total reconstruction.

\* Individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types.

## Rating road surface condition

A simplified rating system has been developed to help manage gravel roads. It uses a scale of 1 to 5—5 is **excellent** condition and 1 is **failed**. In a normal progression the road will start out in excellent condition and gradually deteriorate under the effects of traffic and weather. Routine grading and minor patching may be sufficient to restore the road to excellent condition. As conditions worsen, more extensive maintenance

may be required; complete rebuilding may eventually be necessary.

To select a rating first assess the crown, drainage, and gravel layer. Then review the individual defects and select the type of maintenance or rehabilitation necessary. The rating should reflect the condition and type of maintenance or repairs required. Look at the photographs in this section to become more familiar with the ratings and conditions.

### *Ratings are related to needed maintenance or repair*

- Rating 5** Newly constructed road. Excellent crown and drainage. No maintenance required.
- Rating 4** Good crown and drainage. Routine maintenance.
- Rating 3** Roadway shows traffic effects. Needs regrading, minor ditch maintenance, and spot gravel application.
- Rating 2** Road needs additional aggregate layer, major drainage improvements.
- Rating 1** Travel is difficult. Complete rebuilding required.

<i>Surface rating</i>	<i>Visible distress*</i>	<i>General condition/treatment measures</i>
<b>5</b> <b>Excellent</b>	No distress. Dust controlled. Excellent surface condition and ride.	New construction—or total reconstruction. Excellent drainage. Little or no maintenance needed.
<b>4</b> <b>Good</b>	Dust under dry conditions. Moderate loose aggregate. Slight washboarding.	Recently regraded. Good crown and drainage throughout. Adequate gravel for traffic. Routine grading and dust control may be needed.
<b>3</b> <b>Fair</b>	Good crown (3"–6"). Adequate ditches on more than 50% of roadway. Gravel layer mostly adequate but additional aggregate may be needed in some locations to correct washboarding or isolated potholes and ruts. Some culvert cleaning needed. Moderate washboarding (1"–2" deep) over 10%–25% of the area. Moderate dust, partial obstruction of vision. None or slight rutting (less than 1" deep). An occasional small pothole (less than 2" deep). Some loose aggregate (2" deep).	Shows traffic effects. Regrading (reworking) necessary to maintain. Needs some ditch improvement and culvert maintenance. Some areas may need additional gravel.
<b>2</b> <b>Poor</b>	Little or no roadway crown (less than 3"). Adequate ditches on less than 50% of roadway. Portions of the ditches may be filled, overgrown and/or show erosion. Some areas (25%) with little or no aggregate. Culverts partially full of debris. Moderate to severe washboarding (over 3" deep) over 25% of area. Moderate rutting (1"–3"), over 10%–25% of area. Moderate potholes (2"–4") over 10%–25% of area. Severe loose aggregate (over 4").	Travel at slow speeds (less than 25 mph) is required. Needs additional new aggregate. Major ditch construction and culvert maintenance also required.
<b>1</b> <b>Failed</b>	No roadway crown or road is bowl shaped with extensive ponding. Little if any ditching. Filled or damaged culverts. Severe rutting (over 3" deep), over 25% of the area. Severe potholes (over 4" deep), over 25% of area. Many areas (over 25%) with little or no aggregate.	Travel is difficult and road may be closed at times. Needs complete rebuilding and/or new culverts.

\* Individual road sections will not have all of the types of distress listed for any particular rating. They may have only one or two types.



# APPENDIX F

## OPINION OF PROBABLE RESTORATION COSTS



Banner Associates, Inc.  
 409 22nd Avenue South  
 Brookings, SD 57006  
 Tel 605.692.6342  
 Toll Free 855.323.6342  
 www.bannerassociates.com

# OPINION OF PROBABLE RESTORATION COST

## 25 Miles of CCR No. 3, CCR No. 20, CCR No. 1, CCR No. 10, & CCR No. 8

**PROJECT** Crowned Ridge Wind II Phase

**BAI NO 22913.00**

**LOCATION** Codington County, SD

**DATE** February 1, 2021

ITEM NO.	DESCRIPTION OF WORK AND MATERIALS	QTY	UNIT	UNIT PRICE	TOTAL
1	Traffic Control and Detour signing	25	Mile	\$1,500.00	\$37,500.00
2	Preparation of Roadway - Shoulder Removal	2	Mile	\$2,500.00	\$5,000.00
3	Reclamation of Existing Surfacing Section	2	Mile	\$20,000.00	\$40,000.00
4	Installation of Virgin Base Course and Roadway Shaping	2	Mile	\$35,000.00	\$70,000.00
5	Installation of Asphalt Surfacing Material (4" Thick)	2	Mile	\$290,000.00	\$580,000.00
6	Shoulder Restoration	2	Mile	\$2,500.00	\$5,000.00
7	Digouts (Reclaim, Remove 2", and Compact)	7	Mile	\$7,500.00	\$52,500.00
8	Patching Digout areas (2" Asphalt)	7	Mile	\$20,000.00	\$140,000.00
9	Milling 1.5" Wearing Course	7	Mile	\$12,000.00	\$84,000.00
10	2" Wearing Course Asphalt Surfacing Overlay	7	Mile	\$145,000.00	\$1,015,000.00
11	Crack Seal and Chip Seal	6	Mile	\$50,000.00	\$300,000.00
12	Roadway Striping	15	Mile	\$7,500.00	\$112,500.00
13	CMP Pipe restoration	1	Each	\$3,750.00	\$3,750.00
G1	Gravel Roadway Soft Area Repairs	11	Mile	\$13,000.00	\$136,500.00
G2	3" Gravel Surfacing Installation	11	Mile	\$50,000.00	\$525,000.00
G3	Sign Restoration	1	Lump Sum	\$12,500.00	\$12,500.00
G4	Seeding Restoration	1	Lump Sum	\$50,000.00	\$50,000.00
Asphalt Roadway Restoration Subtotal =					\$2,441,500.00
Gravel Roadway Restoration Subtotal =					\$724,000.00
Construction Contingencies (10%) =					\$316,925.00
<b>Opinion of Probable Construction Costs =</b>					<b>\$3,486,175</b>
Design, Bidding and Construction Services =					\$100,000
Quality Control Testing Services =					\$25,000
<b>Opinion of Probable Restoration Cost =</b>					<b>\$3,611,175</b>



## APPENDIX G

# HAUL ROUTE COMPARISON PICTURES





MILE 21 - CCR 20 - Intersection 462nd Ave. Time 0:07 on Post Segment B



MILE 21 - CCR 20 - Intersection 462nd Ave. Time 0:07 on Pre Segment B2



MILE 21 - CCR 20 - Time 0:32 on Post Segment B



MILE 21 - CCR 20 - Time 0:37 on Pre Segment B2



MILE 21 - CCR 20 - Time 1:08 on Post Segment B



MILE 21 - CCR 20 - Time 1:18 on Pre Segment B2



MILE 22 - CCR 20 - Intersection 464th Ave. Time 3:32 on Post Segment B



MILE 22 - CCR 20 - Intersection 464th Ave. Time 4:11 on Pre Segment B2



MILE 23 - CCR 20 - Intersection 465th Ave. Time 5:22 on Post Segment B



MILE 23 - CCR 20 - Intersection 465th Ave. Time 6:14 on Pre Segment B2



MILE 24 - CCR 20 - Time 6:36 on Post Segment B



MILE 24 - CCR 20 - Time 7:42 on Pre Segment B2



MILE 25 - CCR 3 - Time 0:33 on Post Segment C



MILE 25 - CCR 3 - Time 7:48 on Pre Segment C



MILE 26 - CCR 3 - Time 2:29 on Post Segment C



MILE 26 - CCR 3 - Time 5:52 on Pre Segment C





MILE 27 - CCR 3 - Time 4:50 on Post Segment C



MILE 27 - CCR 3 - Time 3:23 on Pre Segment C



MILE 28 - 3 - Time 7:34 on Post Segment C



MILE 28 - 3 - Time 0:34 on Pre Segment C



MILE 29 - CCR 3 - Time 1:17 on Post Segment D Part 1



MILE 29 - CCR 3 - Time 4:32 on Pre Segment D Part 2



MILE 30 - CCR 3 - Time 3:36 on Post Segment D Part 1



MILE 30 - CCR 3 - Time 2:13 on Pre Segment D Part 2



MILE 31 - CCR 3 - Time 5:05 on Post Segment D Part 1



MILE 31 - CCR 3 - Time 0:45 on Pre Segment D Part 2



MILE 32 - CCR 3 - Time 7:44 on Post Segment D Part 1



MILE 32 - CCR 3 - Time 6:57 on Pre Segment D Part 1



MILE 33 - CCR 3 - Time 0:58 on Post Segment D Part 2



MILE 33 - CCR 3 - Time 4:47 on Pre Segment D Part 1



MILE 34 - CCR 3 - Time 2:21 on Post Segment D Part 2



MILE 34 - CCR 3 - Time 3:23 on Pre Segment D Part 1





MILE 35 - CCR 3 - Time 4:30 on Post Segment D Part 2



MILE 35 - CCR 3 - Time 1:10 on Pre Segment D Part 1