



2023 VISUAL DISTRESS SURVEY MANUAL



ENHANCED PAVEMENT MANAGEMENT SYSTEM

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INTRODUCTION

In 1993, the South Dakota Department of Transportation (SDDOT) initiated the Research Project SD93-14, *Enhancement of South Dakota's Pavement Management System*. As the Research Project progressed, it was determined that to better evaluate the condition of the pavement, a more detailed distress survey needed to be performed by SDDOT. The Research Technical Panel identified the failure mechanisms for pavements that were prevalent and would trigger a rehabilitation or reconstruction project in South Dakota. These distresses are listed in **Table 1**.

Flexible Pavements	Rigid Pavements
Transverse Cracking	D Cracking and ASR
Fatigue Cracking	Joint Spalling
Patching/Patch deterioration	Corner Cracking
Block Cracking	Faulting
Rutting	Joint Seal Damage
Roughness	Roughness
	Punchouts

Table 1: Original failure mechanisms for flexible and rigid pavements in South Dakota.

The Research Technical Panel and Deighton Associates, Ltd. staff then decided on categories of severity and extent for each distress. The extents and severity levels were based upon those given in the Strategic Highway Research Program's (SHRP) *Distress Identification Manual for the Long-Term Pavement Performance Project* 1993 Edition. A few modifications were made to better reflect conditions seen in South Dakota. The consultant then developed a process to collect data on the condition of the pavement based upon individual distresses.

Faulting, Roughness, and Rut Depth are the current types of distresses collected by Office of Transportation Inventory Management staff with a pavement condition monitoring vehicle from Pathway Services. All other distresses are currently collected by windshield visual distress survey performed by seasonal staff of the Office of Project Development. All distresses are collected by sections, the majority of which have a length of 0.250 mile. Visual distress data was first collected on a statewide basis in 1995.

The distress for Longitudinal Cracking in PCC pavement was added in 2008. This is part of a requirement for the Highway Performance Monitoring System (HPMS) data submittal.

The distress of Continuous Reinforced Concrete Paving (CRCP) Block Cracking was added as a new distress in 2016. This distress was identified as a new failure mechanism in CRCP built after 1995 and is now part of the Pavement Management analysis.

Collection of data for the new Transportation Performance Management (TPM) and HPMS protocols have begun. The Visual Distress portion of this manual will remain unchanged. Additional instructions have been added to this manual to provide the new distress collection protocols for Cracking Percent on Jointed Concrete Pavement (JCP) and the Cracking Percent on Continuous Reinforced Concrete Pavement (CRCP). The collection of Cracking Percent on Asphalt Concrete Pavement (ACP) will be done as an automated collection utilizing the equipment on the current road profiler and video log van.

DISTRESS DEFINITIONS

FLEXIBLE PAVEMENT DISTRESSES

Transverse Cracking:	Appears as cracks perpendicular to pavement centerline.
Fatigue Cracking:	Appears initially as a single longitudinal crack in the wheel path. Later appears as a series of interconnected cracks resembling alligator skin or chicken wire.
Patching and Patch Deterioration:	Appears as an area where the pavement surface has been removed and replaced, or as a localized overlay covering up other distresses. A major concern with patching is whether it's a patch or an overlay, and the effect the patch has on the distress indices that the patch is covering up. To help with the determination of whether to rate a patch as a patch or an overlay, refer to Figure 27 on page 29.
Block Cracking:	Appears as cracks which divide the surface into approximately rectangular pieces. In the low severity level, the cracks may appear as random longitudinal cracks between the wheel paths. This may include cracks in centerline rumble strips/stripes.
Rut Depth*:	Appears as a surface depression in the wheel paths.
Roughness*:	The rideability of the road section.
Cracking Percent (AC)*:	The total area of wheel path where cracking, regardless of severity, is detected.

*** Rut Depth, Roughness and Cracking Percent (AC) are not collected during the visual distress survey. Rut Depth, Roughness and Cracking Percent are collected by the current road profiler.**

RIGID PAVEMENT DISTRESSES

Durability Cracking (D-Cracking):	Appears as a series of closely spaced crescent-shaped hairline surface cracks. The crack often causes dark coloring of the surface in the surrounding area.
Alkali Silica Reactivity (ASR):	Appears as a series of interconnected cracks. Frequently, larger cracks are oriented in the longitudinal direction of the pavement and interconnected by finer transverse or random cracks.
Joint Spalling:	Appears as the cracking, breaking, chipping, or fraying of slab edges within 2 feet (0.6 meters) of a joint or crack.
Corner Cracking:	Appears as a crack extending vertically through the entire slab depth which intersects the joints at a distance less than 6 feet from the corner of the slab.
Faulting*:	Appears as the difference in elevation across a joint or crack.
Joint Seal Damage:	Appears as any condition which enables incompressible materials and/or significant amount of water to infiltrate the joint from the surface.
Punchouts:	The area enclosed by two closely spaced (usually less than 2 feet) transverse cracks, a short longitudinal crack, and the edge of the pavement or a longitudinal joint. Occurs on CRCP Only.
CRCP Block Cracking:	Appears as hairline transverse and longitudinal cracks that form a block pattern in CRCP pavement. Occurs on CRCP Only.
Roughness*:	The rideability of the road section.
Cracking Percent (JCP)**:	The percentage of Jointed Concrete Pavement Slabs that contain one or more transverse cracks extending at least one-half the lane width of the pavement.
Cracking Percent (CRCP)***:	The area of pavement where longitudinal cracking, punchouts and patched areas are detected.

* Faulting and Roughness are not collected during the visual distress survey. Faulting and Roughness are collected by the current road profiler.

** Cracking Percent (JCP) is collected manually by viewing pavement images from the current road profiler.

*** Cracking Percent (CRCP) is collected using a semi-automated method. The profiler collects the images and data and processes the ratings initially. A rater edits the data to ensure a more complete crack rating.

DISTRESS SEVERITY

DEFICIENCY	LOW	MEDIUM	HIGH
Transverse Cracking	Unsealed crack width < ¼ inch wide or sealed crack width is less than ¾ inch and no crack depression	Unsealed crack width is > ¼ inch and <1 or sealed crack width is > ¾ inch and < 1 inch and/or crack depression < ¼ inch	Any crack, unsealed or sealed, with width > 1 inch or crack depression > ¼ inch
Fatigue Cracking	Fine parallel cracks in the wheel path(s)	Alligator pattern clearly developed	Alligator pattern clearly developed with spalling and distortion
Patching and Patch Deterioration	Patch shows no visual distress of any type and with a smooth ride	Patch shows low or medium severity distress of any type and/ or notable roughness	Patch shows a high severity distress of any type and/ or distinct roughness
Block Cracking	Random longitudinal cracks between the wheel paths, Or interconnected transverse and longitudinal cracks that form blocks greater than 6 ft per side	Interconnected transverse and longitudinal cracks that form blocks 3 feet to 6 feet per side	Interconnected transverse and longitudinal cracks that form blocks less than 3 feet per side
D Cracking and ASR	Cracks are light, with no loose or missing pieces	Cracks are well defined and some small pieces are loose or missing	Cracks are well developed pattern with a significant amount of loose or missing material
Joint Spalling	Spalls < 3 inches wide with no significant loss of material or Joint and Spall repair patch with cracking	Spalls 3 to 6 inches with loss of material.	Spalls > 6 inches with significant loss of material.
Corner Cracking	Crack not spalled with no faulting and piece not broken	Crack spalled slightly, or faulting < 1/2 inch, or piece broken	Crack spalled, or faulting > 1/2 inch, or piece broken
Punchout	NO SEVERITY LEVELS		
CRCP Block Cracking	Closely spaced Transverse shrinkage cracks with occasional interconnected Longitudinal cracks occurring perpendicular to the parent Transverse cracks	The pattern between the Longitudinal and Transverse cracks create a “block” or rectangular pattern.	The pattern between the Longitudinal and Transverse cracks create a “block” or rectangular pattern. The cracking pattern is distorted and spalls are present in cracks
Joint Seal Damage	Damage to < 10% of joint	Damage to 10% - 50% of joint	Damage to > 50% of joint

Table 2: Severity levels used to describe the cracking failure mechanism deficiencies.

DISTRESS EXTENT

DEFICIENCY	LOW	MODERATE	HIGH	EXTREME
Transverse Cracking	> 50 ft spacing	>25 ft and < 50 ft spacing	>12 ft and <25 ft spacing	< 12 ft. spacing
Fatigue Cracking	1% to 9% of wheel path	10% to 24% of wheel path	25% to 49% of wheel path	> 49 % of wheel path
Patching and Patch Deterioration	1% to 9% of section	10% to 24% of section	25% to 49% of section	> 49 % of section
Block Cracking	1% to 9% of section	10% to 49% of section	>49% of section	N/A
D Cracking and ASR	1% to 9% of slabs	10% to 24% of slabs	25% to 49% of slabs	> 49 % of slabs
Joint Spalling	1% to 9% of joints	10% to 24% of joints	25% to 49% of joints	> 49 % of joints
Corner Cracking	1% to 9% of slabs	10% to 24% of slabs	25% to 49% of slabs	> 49 % of slabs
Punchout	1 to 2 per section	3 to 6 per section	7 or greater per section	N/A
CRCP Block Cracking	1% to 9% of section	10% to 24% of section	25% to 49% of section	> 49 % of section
Joint Seal Damage	1% to 9% of joints	10% to 24% of joints	25% to 49% of joints	> 49 % of joints

Table 3: Extent levels used to describe the cracking failure mechanism deficiencies.

DISTRESS SURVEY PROCEDURE

OVERVIEW

The distress survey processes must be able to identify and document the type, extent, and all levels of severity of pavement distress, particularly the first stages of severity.

The continuous survey is conducted by driving the shoulder of the road at 8 to 15 mph. The survey is conducted from a van or minivan to provide the best (highest) perspective of the pavement deficiencies. The survey uses a two-person team: a driver and a rater. The driver is responsible for, the safe operation of the van, and ensuring the correct location of the road section being rated. The rater determines and rates the pavement deficiencies. On roadways with limited to no shoulder, the driver aids the rater by identifying and rating the pavement distresses that are being driven over by the van. The rater is responsible for recording the distress ratings (after discussions with the driver) on the iPad or on paper. The iPad adds the obvious advantage of eliminating later keypunch time and costs.

All types of required visual pavement distresses are recorded during the survey. Severity levels and extents for each distress are shown in **Tables 2 and 3**. For most distresses, an extent is determined for each severity level. Transverse Cracking is the exception. When there is more than one level of severity of a single deficiency the “predominate” severity is recorded, with the extent being the total extent of all severities. This is further explained below in **Table 4**.

DISTRESS	SEVERITY RATING RECORDING METHOD	EXTENT LEVEL RECORDING METHOD
Transverse Cracking	PREDOMINATE	TOTAL
Fatigue Cracking	INDIVIDUAL	INDIVIDUAL
Patching and Patch Deterioration	INDIVIDUAL	INDIVIDUAL
Block Cracking	INDIVIDUAL	INDIVIDUAL
D Cracking and ASR	INDIVIDUAL	INDIVIDUAL
Joint Spalling	INDIVIDUAL	INDIVIDUAL
Corner Cracking	INDIVIDUAL	INDIVIDUAL
CRCP Block Cracking	INDIVIDUAL	INDIVIDUAL
Punchout	N/A	TOTAL
Joint Seal Damage	INDIVIDUAL	INDIVIDUAL

Table 4: Rating methods for individual distresses.

In conducting the continuous survey from a van, the crew must pay attention to the weather and the direction of the sun. Inclement weather influences the crew’s ability to see pavement distress. Any weather event which covers the pavement surface (snow, rain puddles, etc.) should cause the crew to stop rating until conditions improve. Rating should also cease when weather conditions limit the crew’s ability to be seen by passing traffic (fog, heavy rain, snow, etc.) to ensure the crew’s safety. When driving into the sun, the most distresses can be seen. When driving away from the sun, the raters may not see all or even any of the pavement distresses. The driver and rater must constantly check behind them for pavement distresses so as not to miss any.

iPAD OPERATION (ArcGIS Field Maps Application)

The distress survey mobile app uses ArcGIS Field Maps and ArcGIS Enterprise. Users can setup an Enterprise account by going to <https://sdgis.sd.gov/portal> and signing up for an account. Click on the “State of South Dakota” button shown in **Figure 1**.

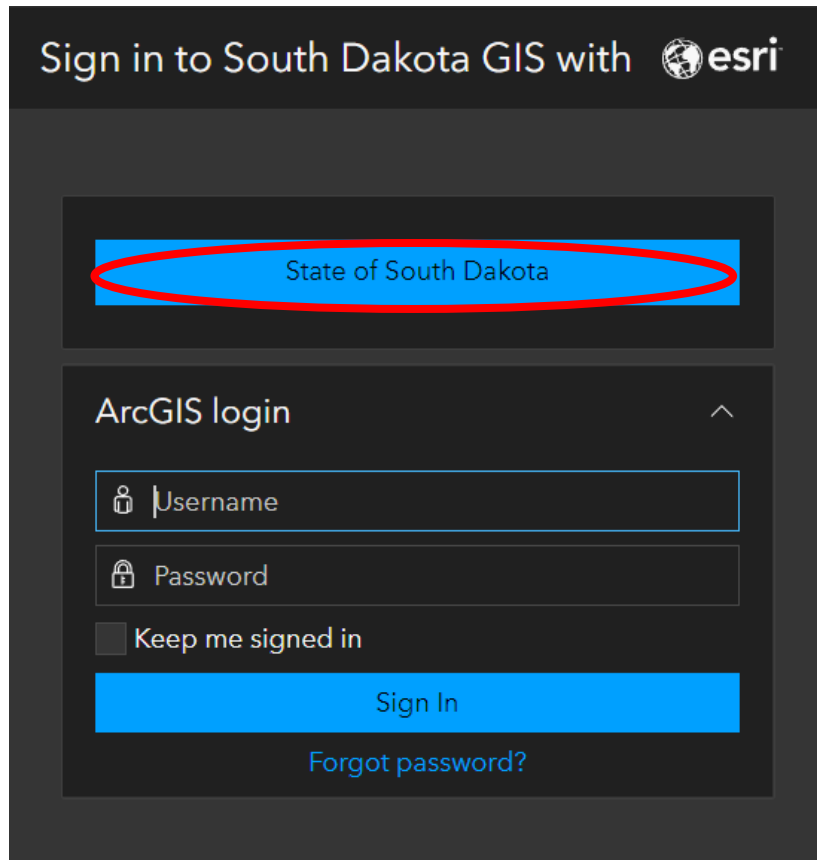



Figure 1: ArcGIS Enterprise Sign In

After clicking on the State of South Dakota a new screen will appear. Click on “Sign up now” shown in **Figure 2** to the right of “Don’t have an account?”.



Sign in with personal email

Sign in name _____

Password _____


[Forgot your password?](#)

Don't have an account?

Other sign in methods

Figure 2: Sign In Options Screen

After clicking on the “Sign up now” a new screen will appear shown in **Figure 3**. Fill out all the required fields, ensure “Send verification code” has been completed, and click on “Create” when finished.



Required fields underlined in red

Verification is necessary. Please click Send button.

Figure 3: Creating ArcGIS Enterprise Account
VISUAL DISTRESS SURVEY MANUAL

Once the account is setup, send an email to the DOT GIS Team, Kimberly Zerr and/or Kathryn Wesson, with the names of the new users. The DOT GIS Team will make sure permissions are set up for editing.

Once permissions and accounts are setup, the users can sign into ArcGIS Field Maps on the iPads. Click on “Field Maps” icon to open the application shown in **Figure 4**.

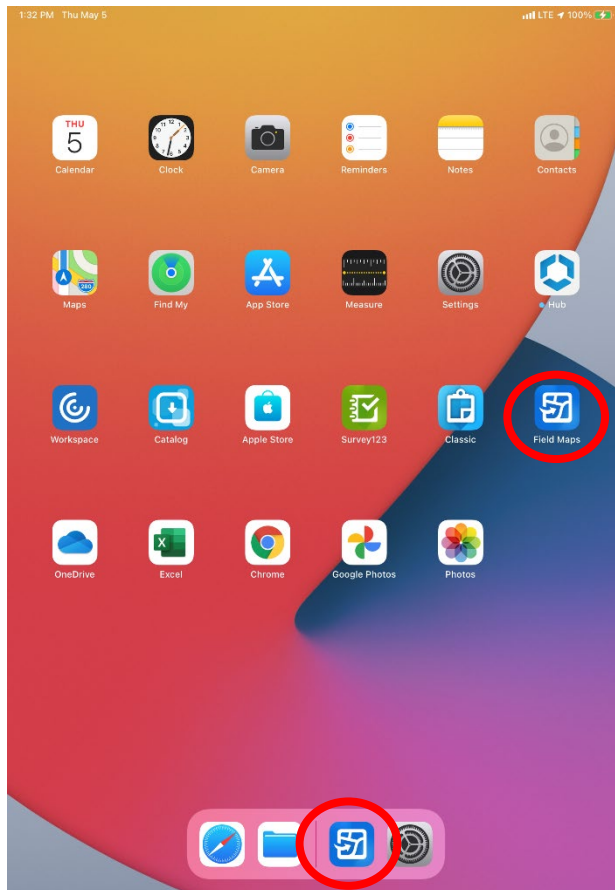


Figure 4: ArcGIS Field Maps Application

The ArcGIS Field Maps application will open. The users can sign into Field Maps using the “Sign In with ArcGIS Enterprise” option shown in **Figure 5**.

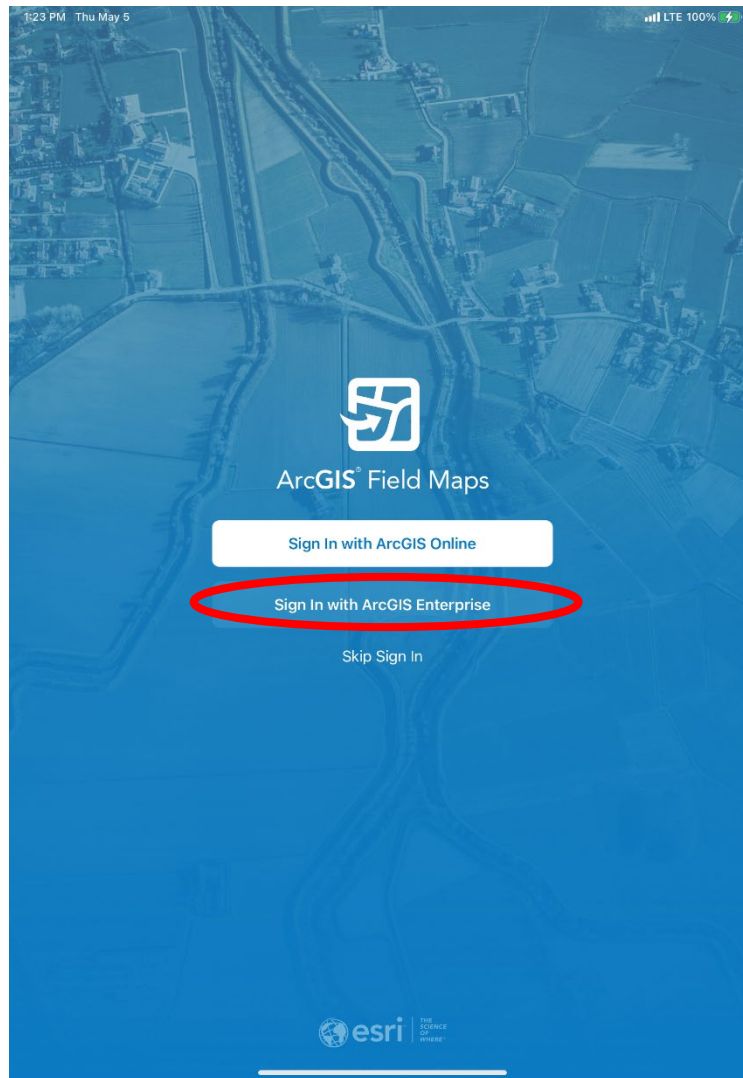


Figure 5: ArcGIS Field Maps Sign In Screen

A new screen will appear with options, if <https://sdgis.sd.gov/portal> does not appear at the top as an option to select, click on “Specify a New URL” to add <https://sdgis.sd.gov/portal> shown in **Figure 6**. Once the URL has been added, click on sdgis.sd.gov/portal.

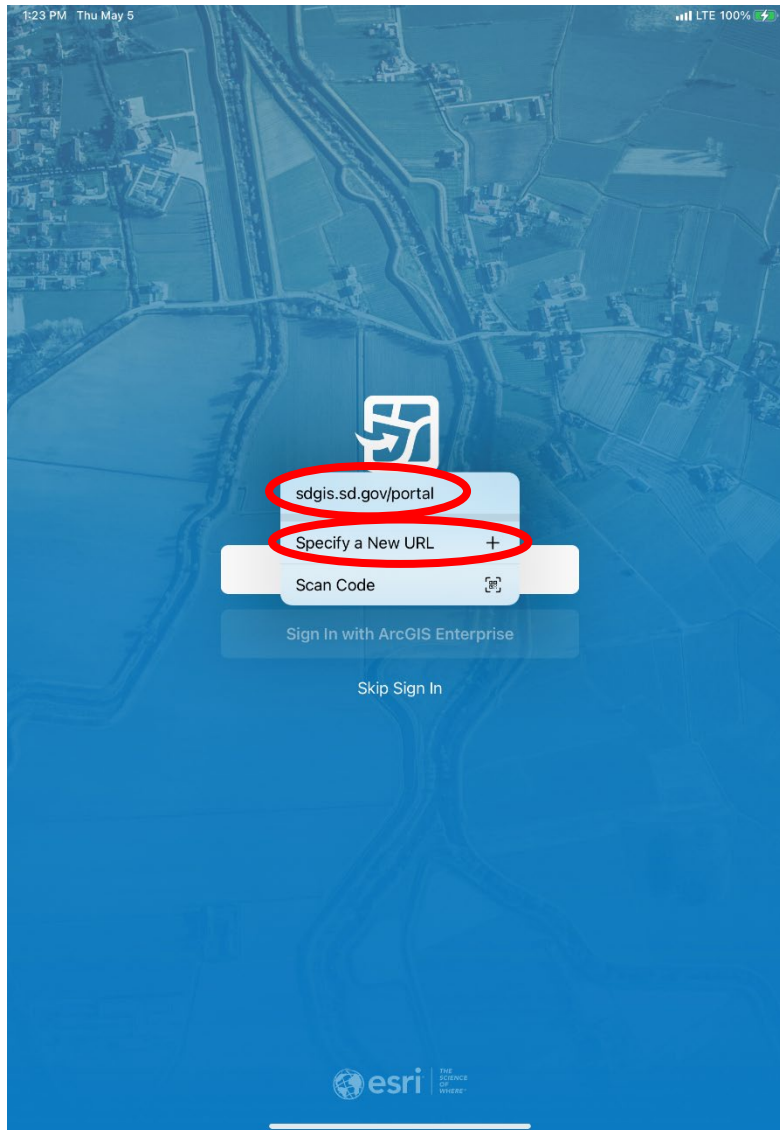


Figure 6: ArcGIS Field Maps ArcGIS Enterprise Sign In

A new screen will appear with options on which way to sign in shown **Figure 7**. If the user created an account with personal email, then signed in by filling out the in fields under “Sign in with personal email” and then click “Sign in”. If the user used state email, then click on “State of South Dakota Employee”.

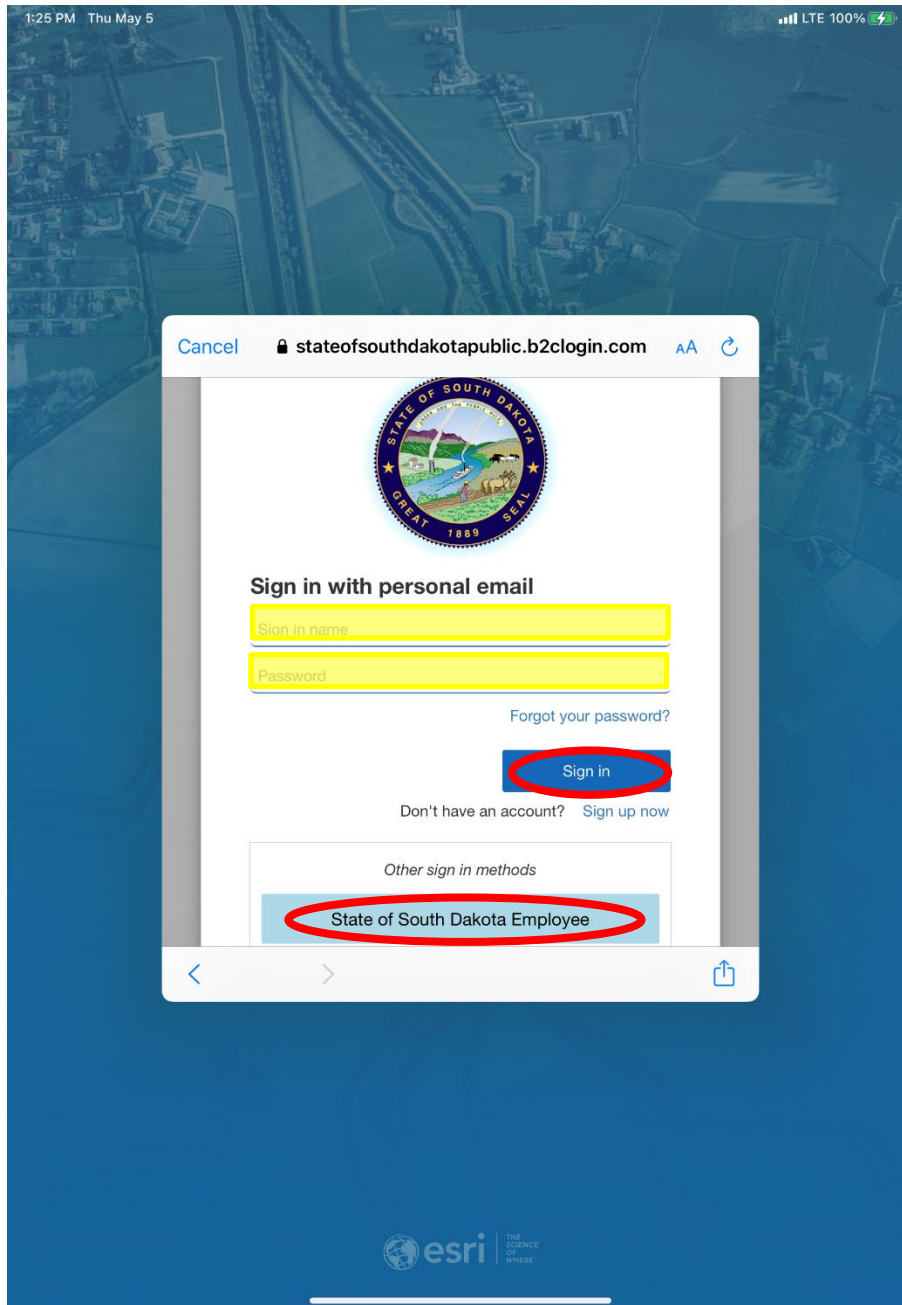


Figure 7: ArcGIS Field Maps ArcGIS Enterprise Sign In Options

A new screen will appear with Sign in to South Dakota GIS with “State of South Dakota” shown **Figure 8**. Click on “State of South Dakota”.

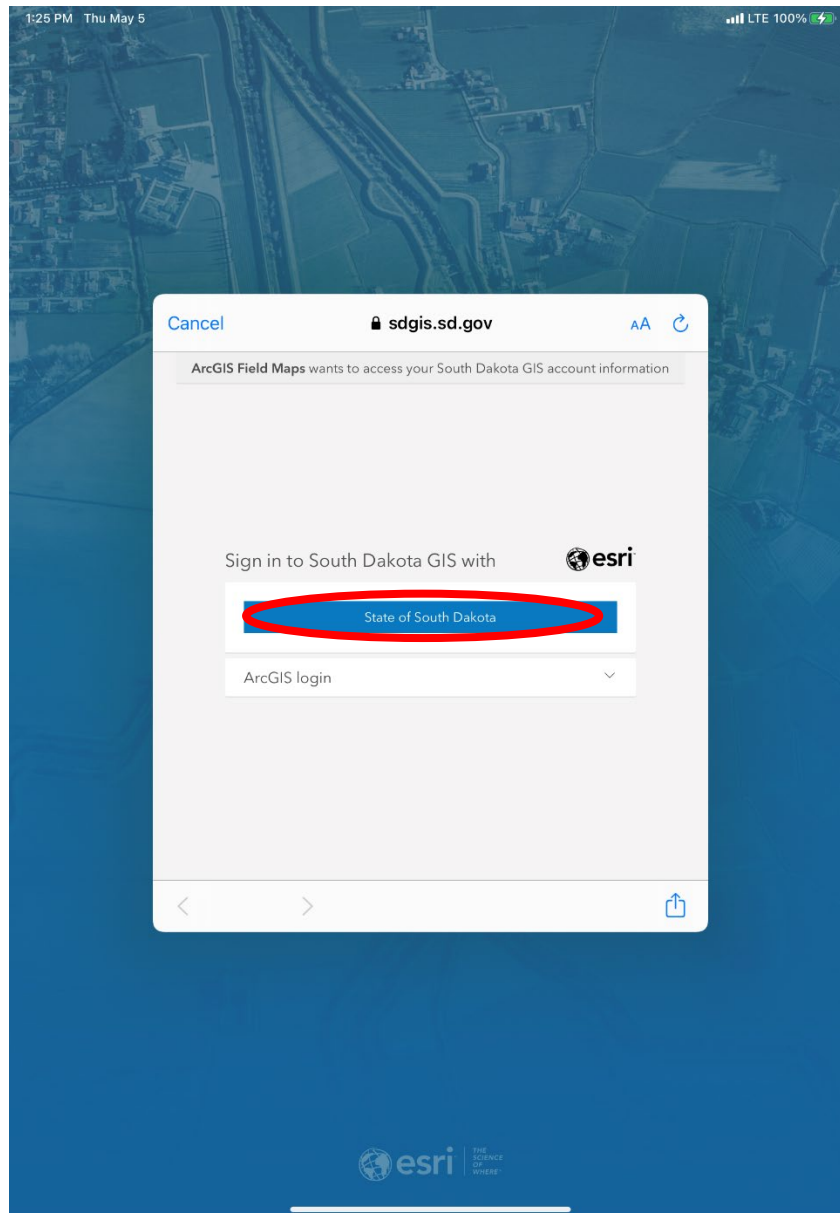


Figure 8: ArcGIS Field Maps Accessing South Dakota GIS Account Information

After successfully signing in, the screen will change from blue to white with screen called Maps. Offline map(s) will be needed to preform distress survey rating. Click on the three dots next to PD Distress Survey to open a menu shown in **Figure 9**.

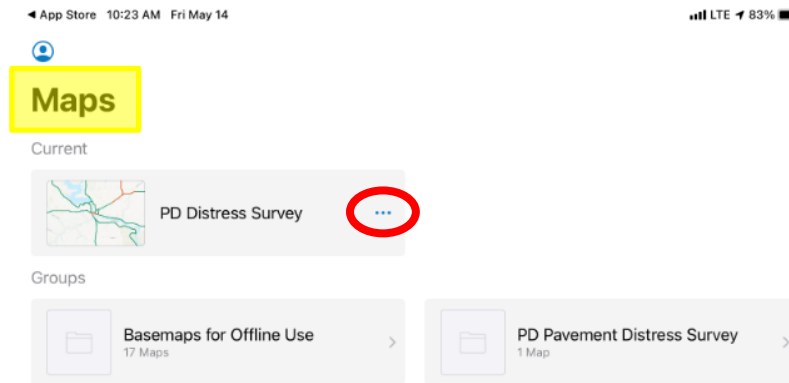


Figure 9: PD Distress Survey Menu

Click on “Add Offline Area” shown in **Figure 10**.

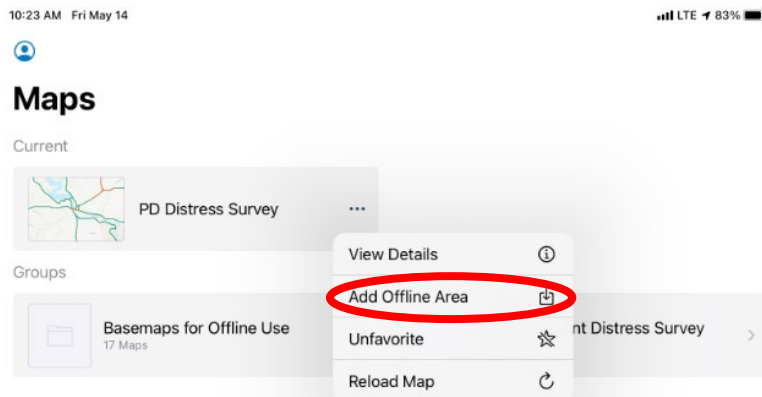


Figure 10: Add Offline Area to Create Offline Map(s)

The Add Offline Area menu will open. Click on the blue word to the right of the text Level of detail: to select the correct level of details to be included on the map. In this example click on **Streets** shown in **Figure 11**.

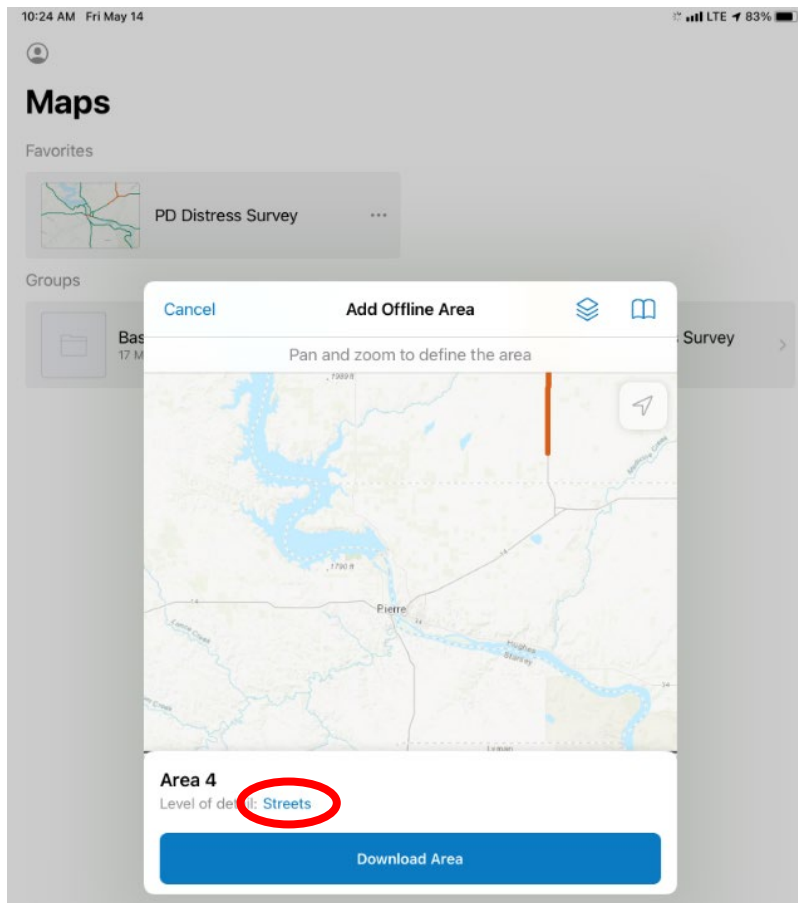


Figure 11: Level of Detail for Offline Area Map

Shown in **Figure 12**, a new window called Level of Detail will open, ensure that **Streets** is selected. The Level of Detail will initially start out as Room. Once **Streets** is selected the window will automatically close and bring back the Add Offline Area window.

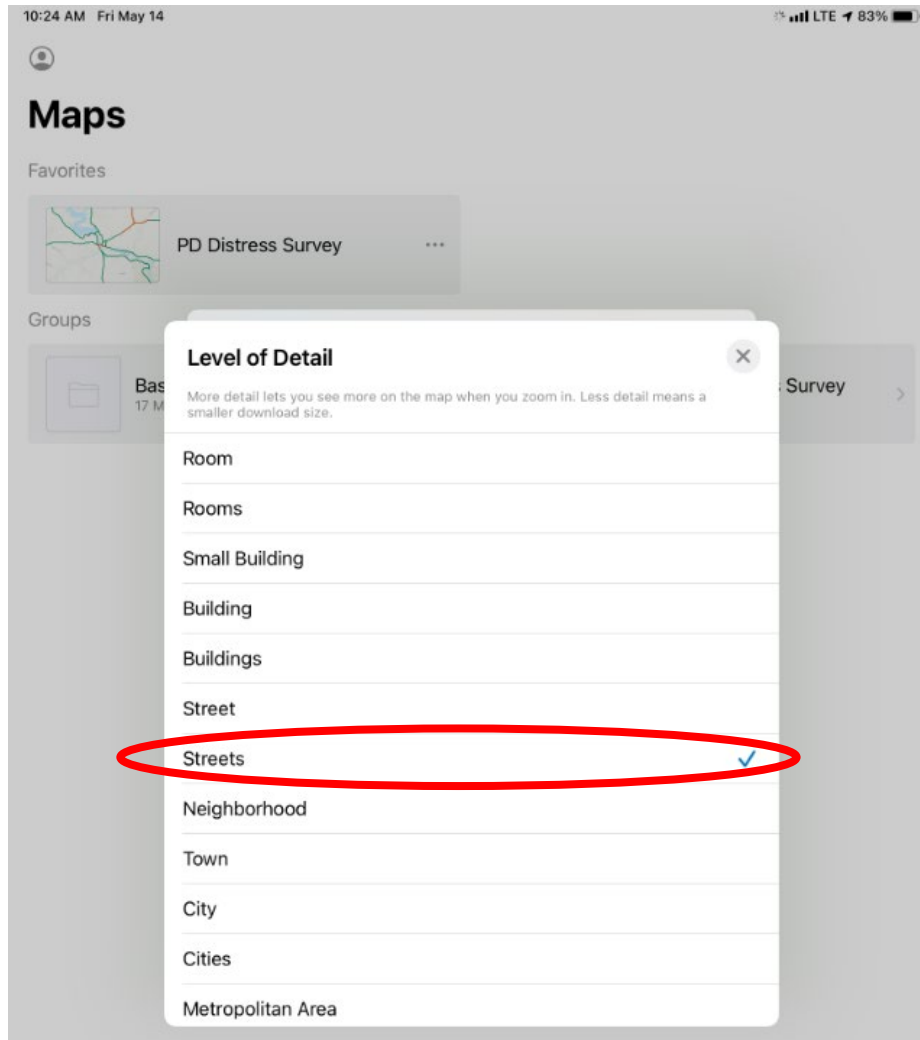


Figure 12: Level of Detail Options for Offline Area Map

Use the pan and zoom to define the area for offline use. A black box will outline the boundary of what is included in offline map if zoomed out. Once the area in the window is defined, click on Download Area once the Level of detail is set to **Streets** shown in **Figure 13**.

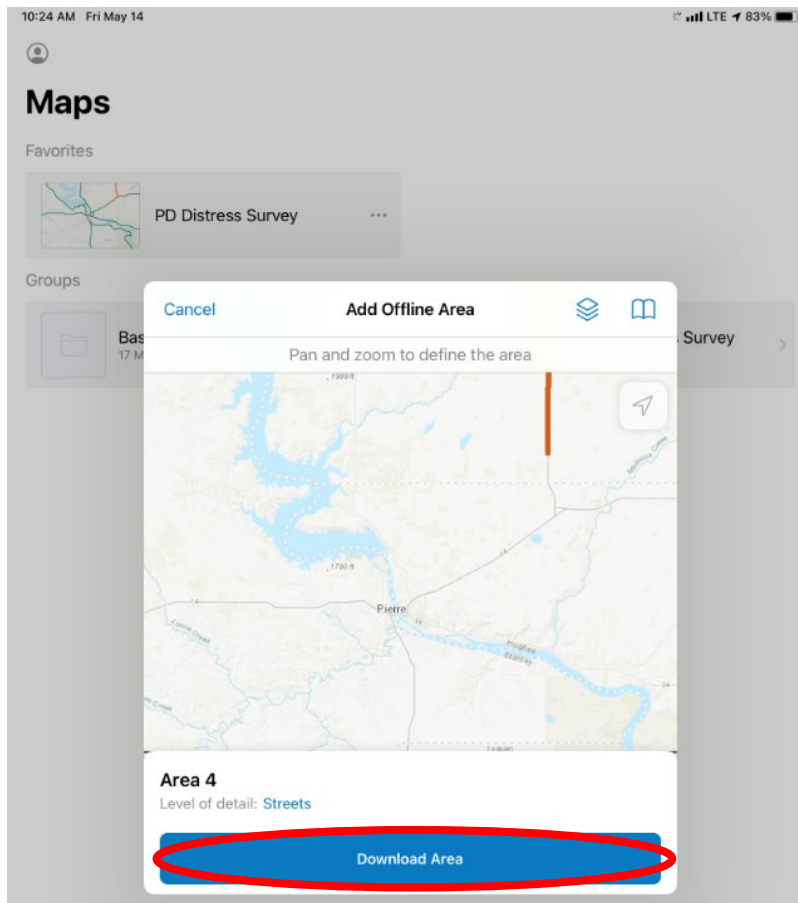


Figure 13: Boundary of Downloadable Area for Offline Area Map

The Add Offline Area window will close. A new map will appear called Area # shown in **Figure 14**. The downloading will take some time. Make sure the iPad is in cell service and/or connected to Wi-Fi to speed up the process. The circle is the progress bar.

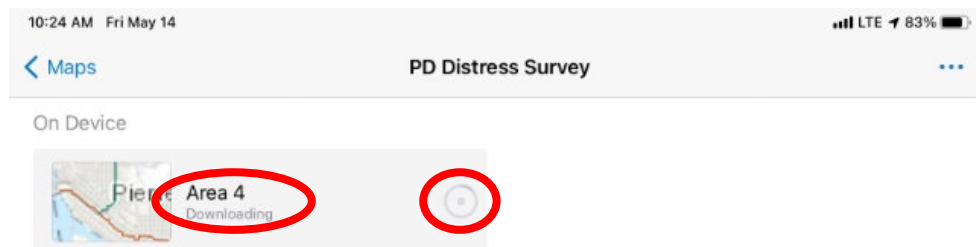


Figure 14: Offline Area Map Downloading Progress Circle

Once the download of the offline area map called Area # is done, click on the Area # to open and use the map just like the regular PD Distress Survey map which is an online version shown in **Figure 15**. The only difference with the offline map versus the online map is that the offline map needs to be manually Synced. The online map automatically syncs.



Figure 15: Opening Offline Area Map

Click on the Area # map to open the map for distress survey rating. The map will open. For this example, the Legend has been turned on to show the different pavement types. In **Figure 16**, green lines, orange lines, and a blue dot appear on the map. The green lines represent flexible pavement. The orange lines represent rigid pavement. The blue dot is the user's current location which is tracked by GPS. Not in the current example for pavement types is the purple line for CRCP and the pink line for gravel.

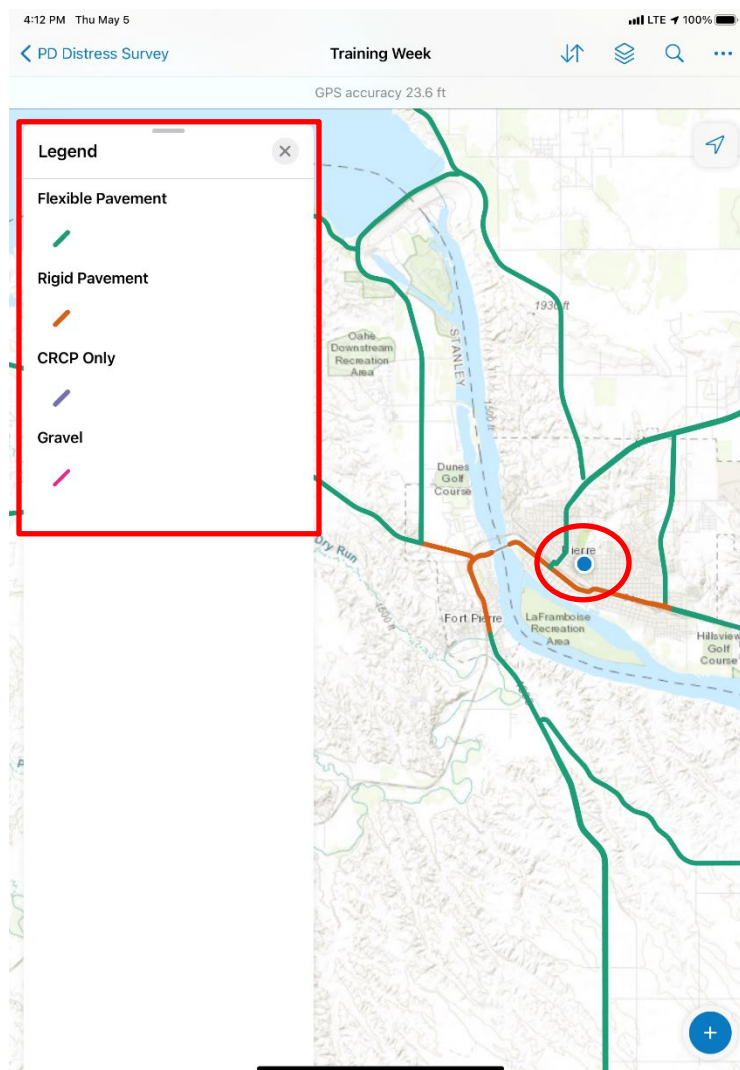


Figure 16: Map Legend and User Location

The user can zoom in and out by using two fingers. A zoomed area of the map can be seen in **Figure 17**. The user can select which distress segment to rate. The segment will be highlighted light blue also shown in **Figure 17**. A menu for the highlighted segment will appear to the left of the screen. Since the screen shots are being taken at the Becker Hanson Building the GPS blue dot is not located on the highlighted segment that is being “rated”. To open the edit menu to rate the segment, click on the pencil icon located in lower left-hand corner.

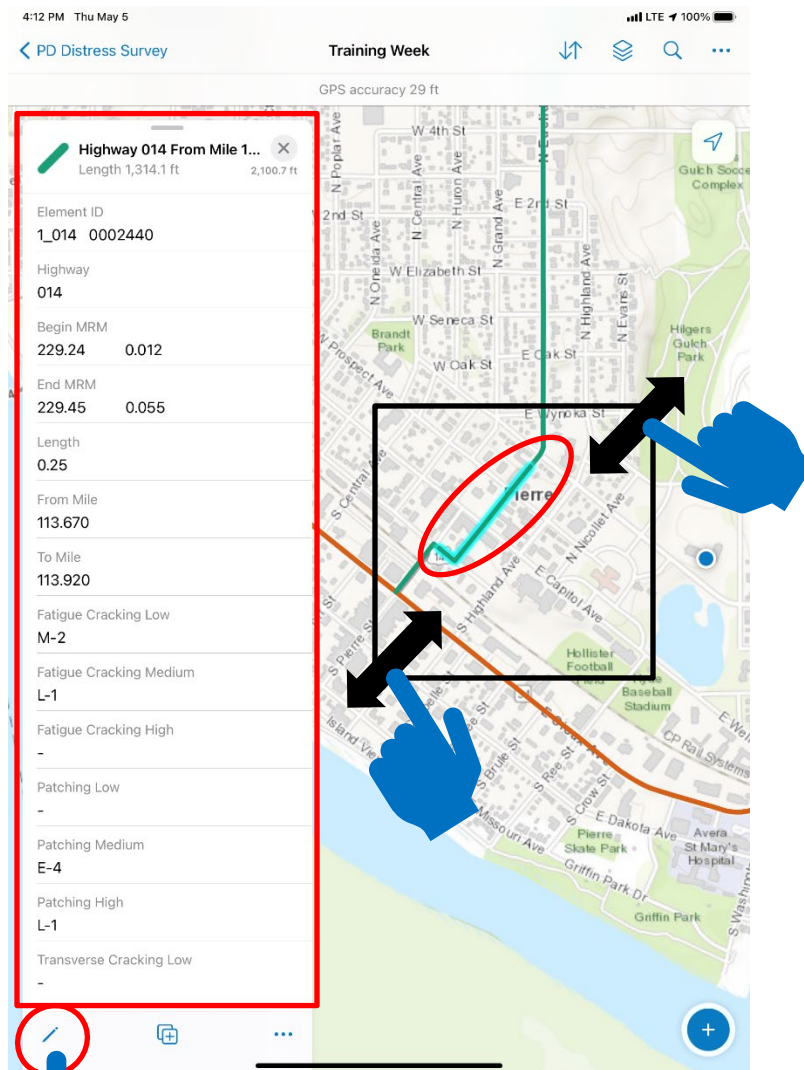


Figure 17: Selecting A Distress Segment

After clicking the pencil, the edit menu will change appearance slightly with gray boxes. Also, the user may find it easier to rotate the iPad for rating as shown in **Figure 18**.

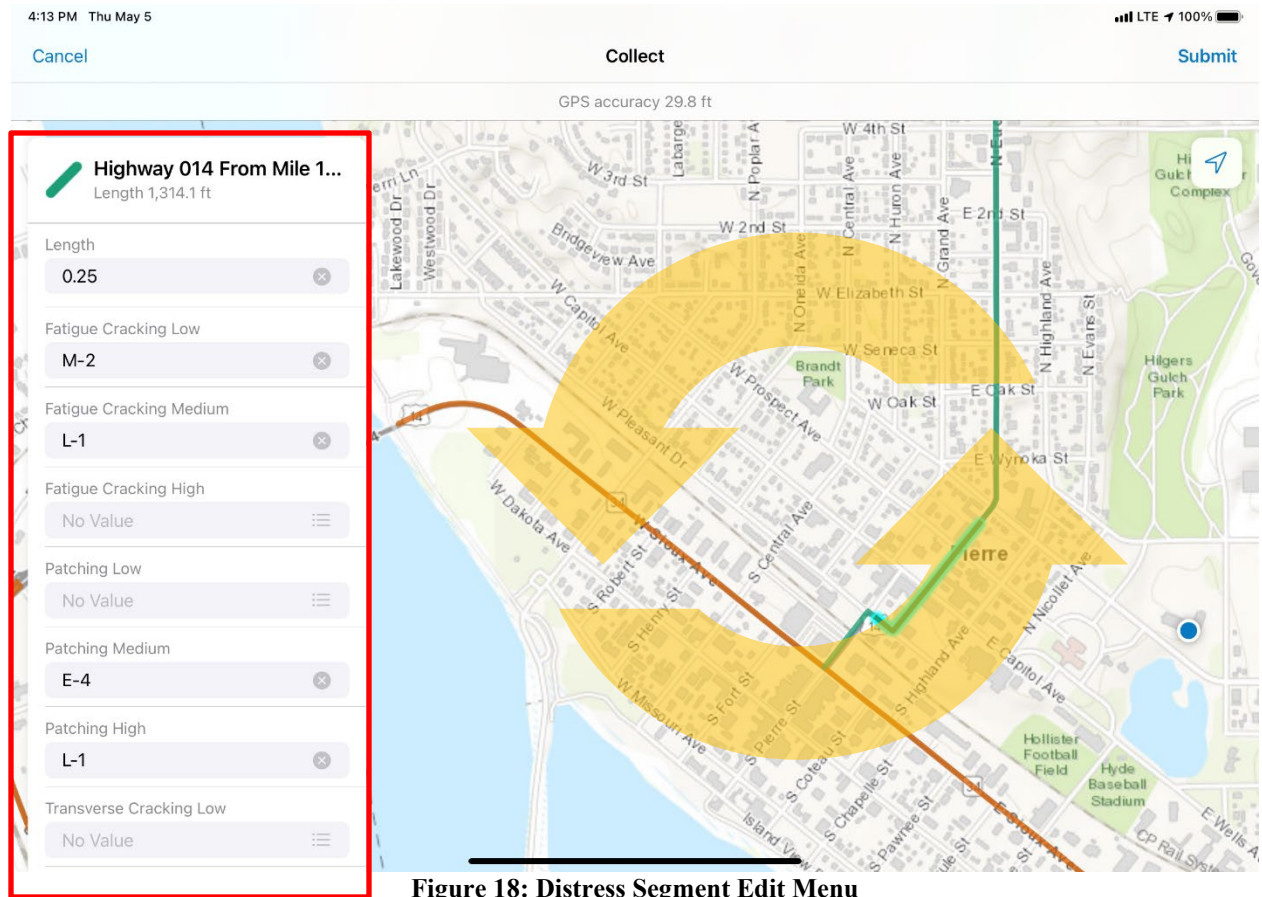


Figure 18: Distress Segment Edit Menu

When the user is performing the distress survey and notices a change in the previous year's pavement distress rating (whether severity or extent), the user clicks on which distress and which severity level. After selecting the pavement distress severity, the user can select the extent of that pavement distress severity. The user can close the menu by clicking "Done". In this example "Fatigue Cracking Medium Severity" and "1 to 9% of wheel path" is selected as shown in **Figure 19**.

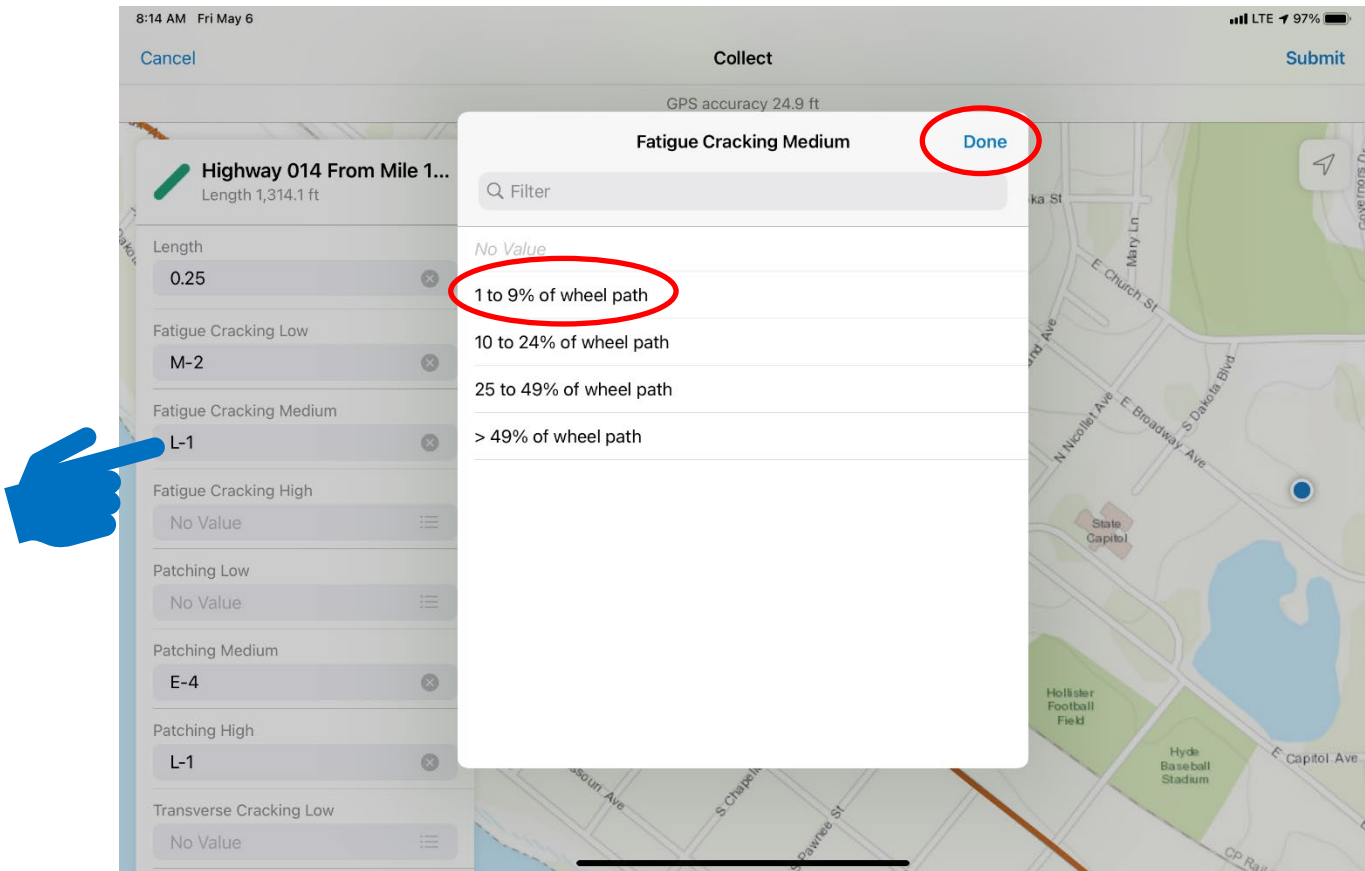


Figure 19: Fatigue Cracking Medium Severity and Selecting Extent Level

The user can move the edit menu up and down using a finger to find which pavement distress needs to be rated. More pavement distress fields for editing can be shown in **Figure 20**. Other fields that are required for distress survey are: Survey Date and Survey Crew. Other optional fields to fill out if encountered are Comments and Exempt Code. The comments section can be used to make note of a knocked down MRM, major pavement issue, or anything else that is a concern. Exempt Code is where the user can input construction zones.

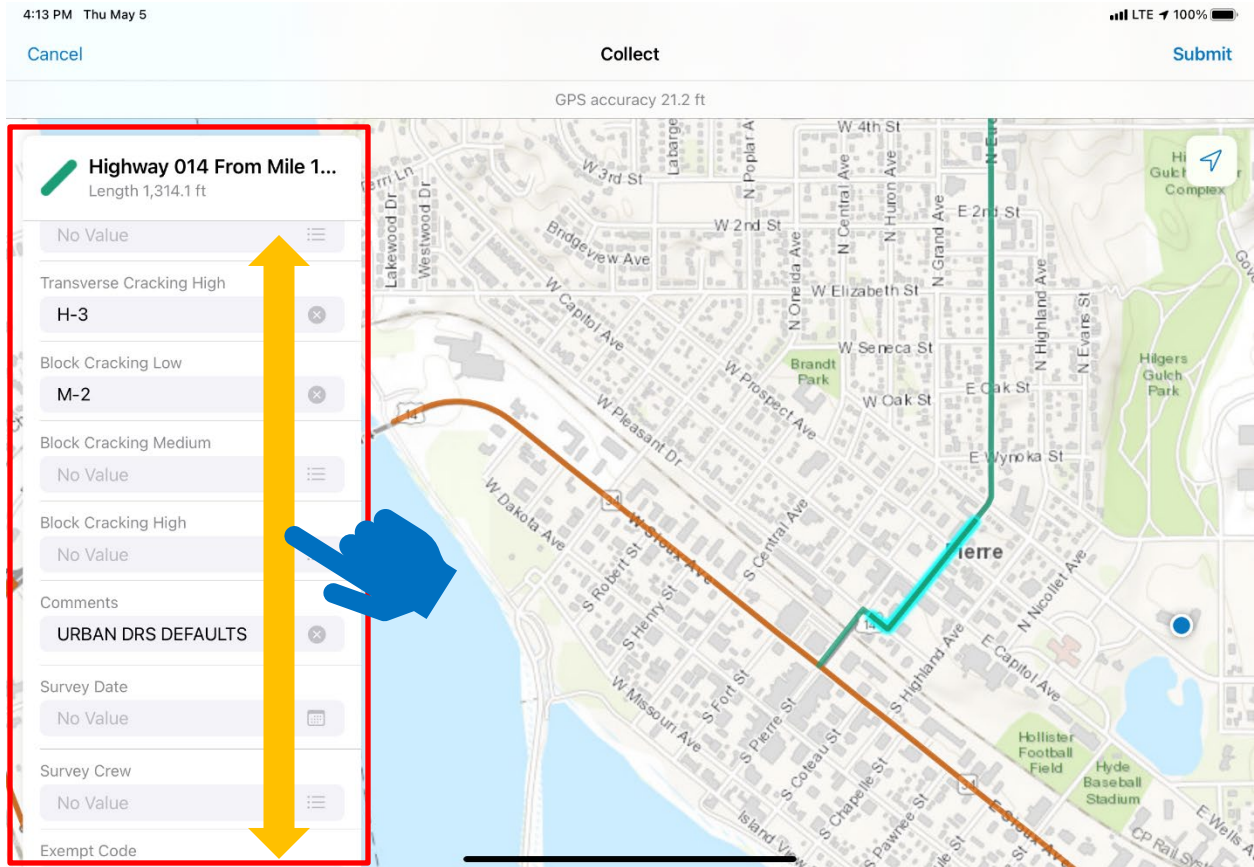


Figure 20: Showing User How to Scroll on Edit Menu

When editing Survey Date, click on survey date gray box, a calendar will open as shown in **Figure 21**. The user does not need to manually input the date and time. The user can just click the gray box again to close the calendar. Double clicking automatically time stamps the entry. Date and time stamp helps with QC when back in the office.

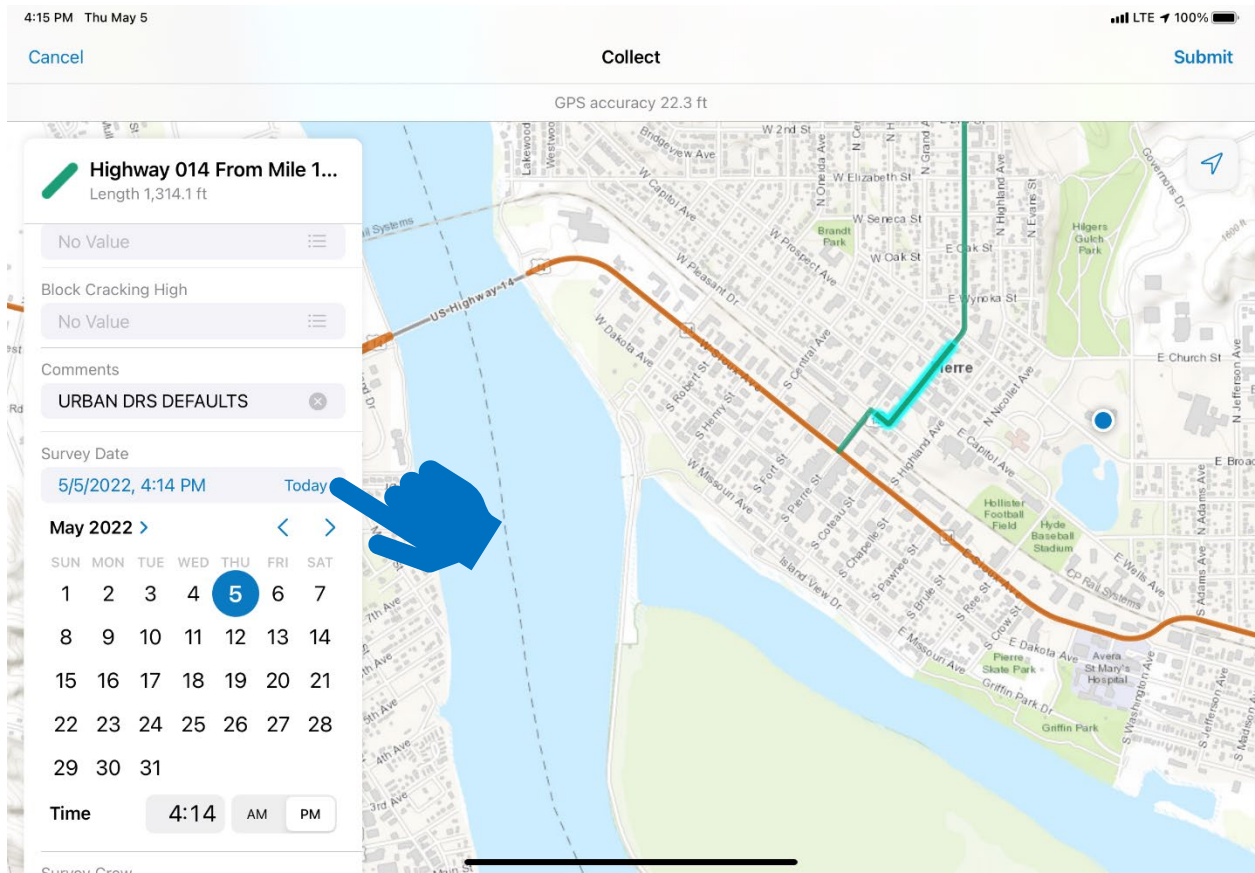


Figure 21: Survey Date for when Distress Segment was Rated

When editing Survey Crew, the user selects the team color which the user is assigned to which is shown in **Figure 22**. Green is reserved for fall clean-up for the Pavement Management Unit. The interns use team Red and team Blue. Click Done once the team has been selected. Team color is another field that is used in the QC process of the data collected.

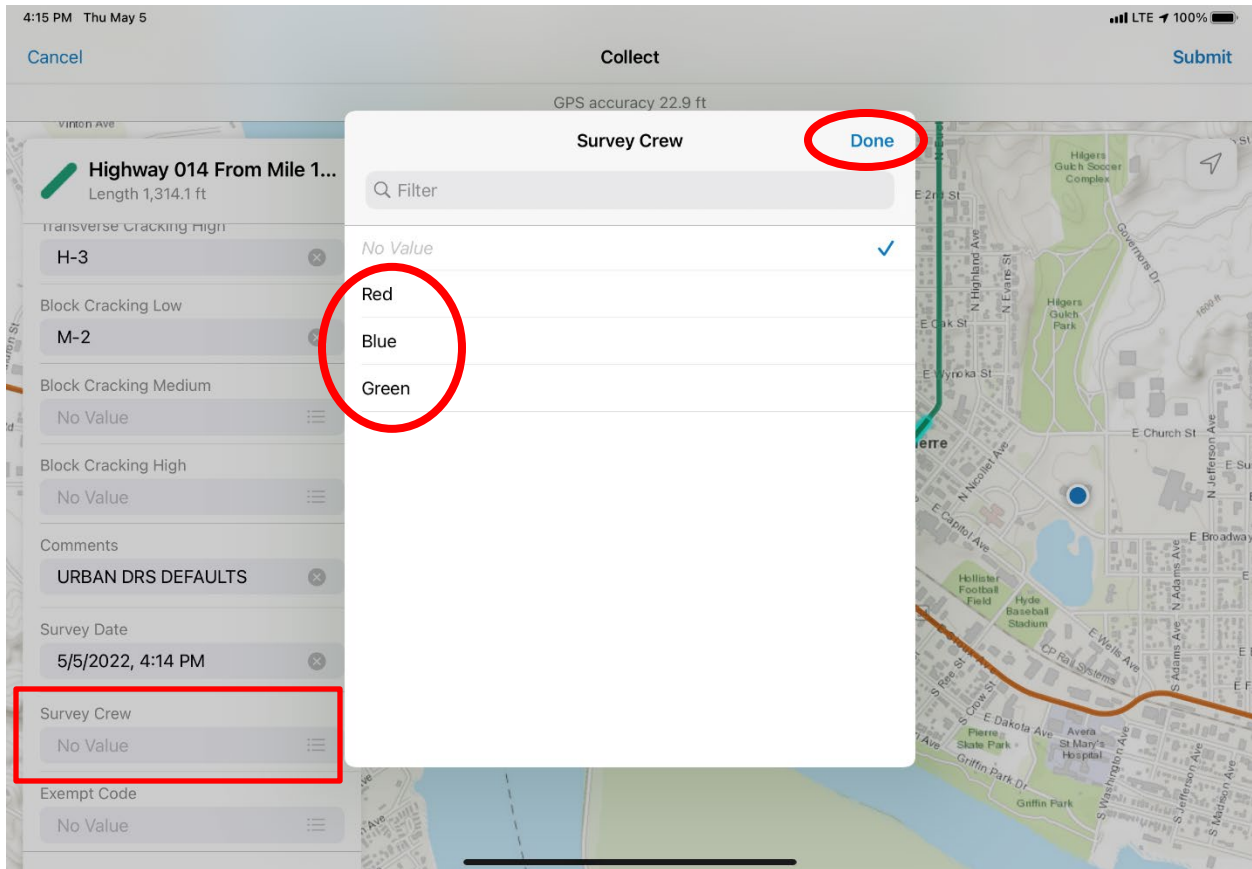


Figure 22: Survey Crew Edit for Selecting Crew Who Rated the Distress Segment

If a construction project is encountered that wasn't noted, click on Exempt Code and select "3 – Construction" and click "Done" followed by clicking "Submit" as shown in **Figure 23**. The user does not need to enter in any other data when construction is encountered. If the construction is long, the user can just enter Exempt Code 3 for the beginning few segments and the ending few segments. The user must make note on the written schedule when construction takes away segments being rated.

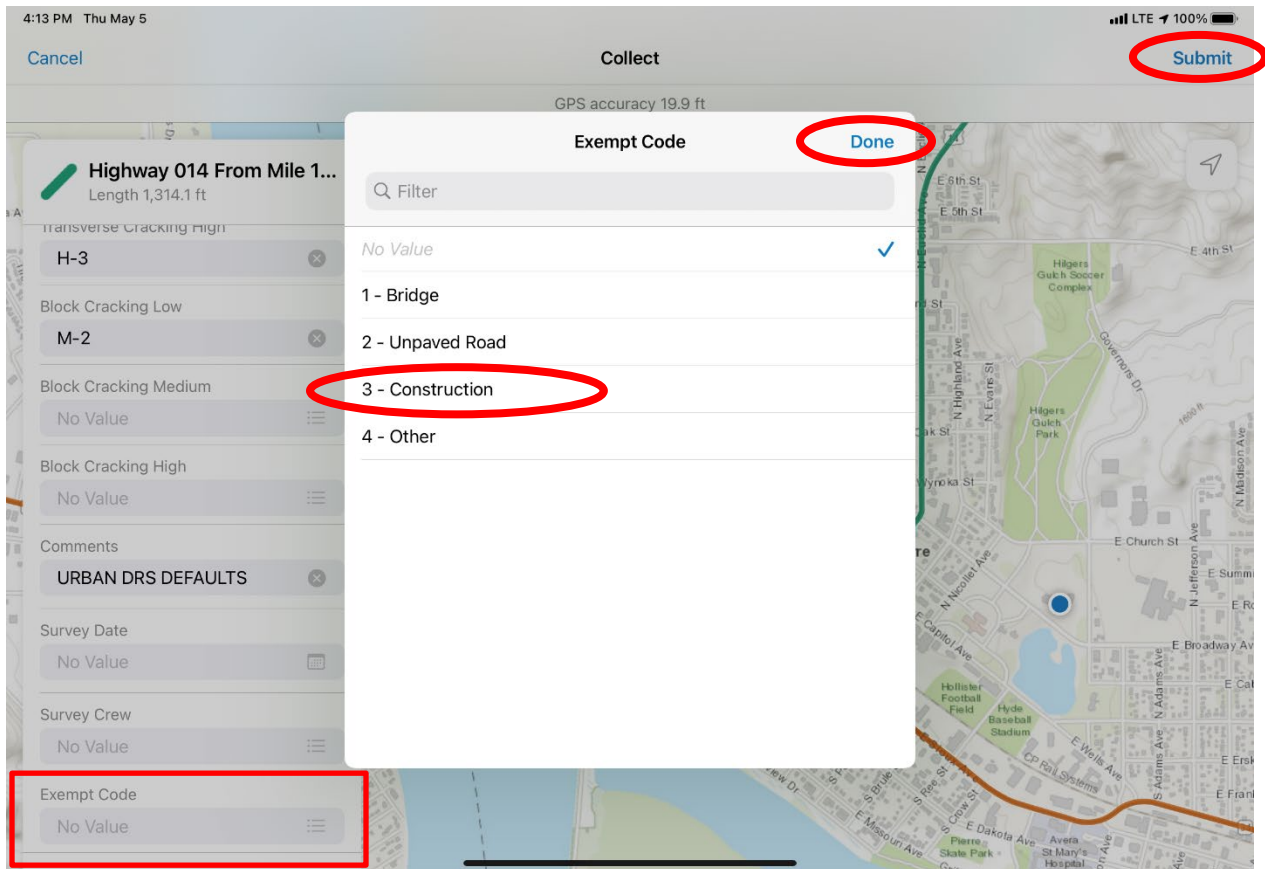


Figure 23: Exempt Code Edit for Construction

After the pavement segment has been rated, the user can click “Submit” which will close out of the edit menu as shown in **Figure 24**.

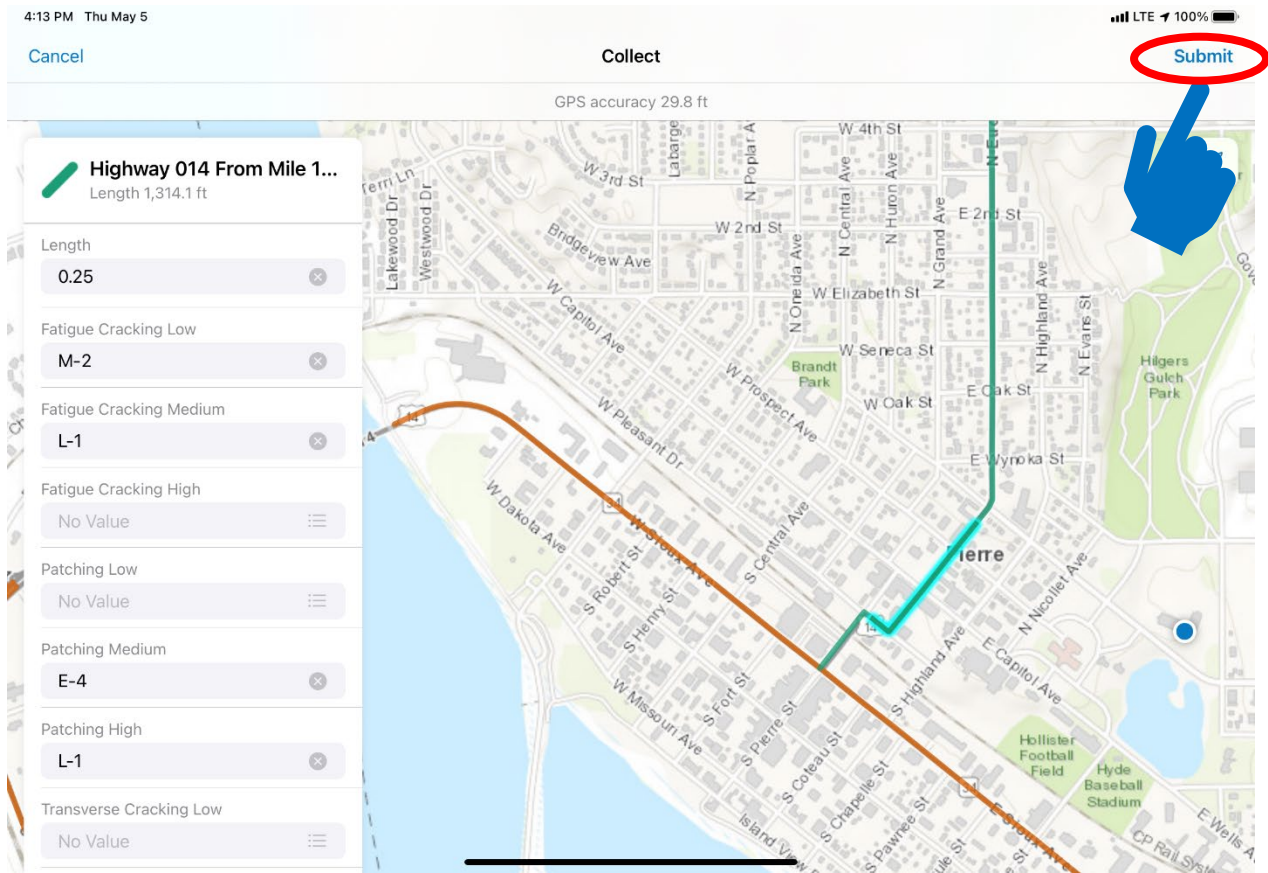


Figure 24: Exempt Code Edit for Construction

Once “Submit” has been successful, the user can now select the next pavement distress segment which is highlighted in light blue and is shown in **Figure 25**. The user can repeat this whole process over to rate the remaining distress segments on the weekly schedule.

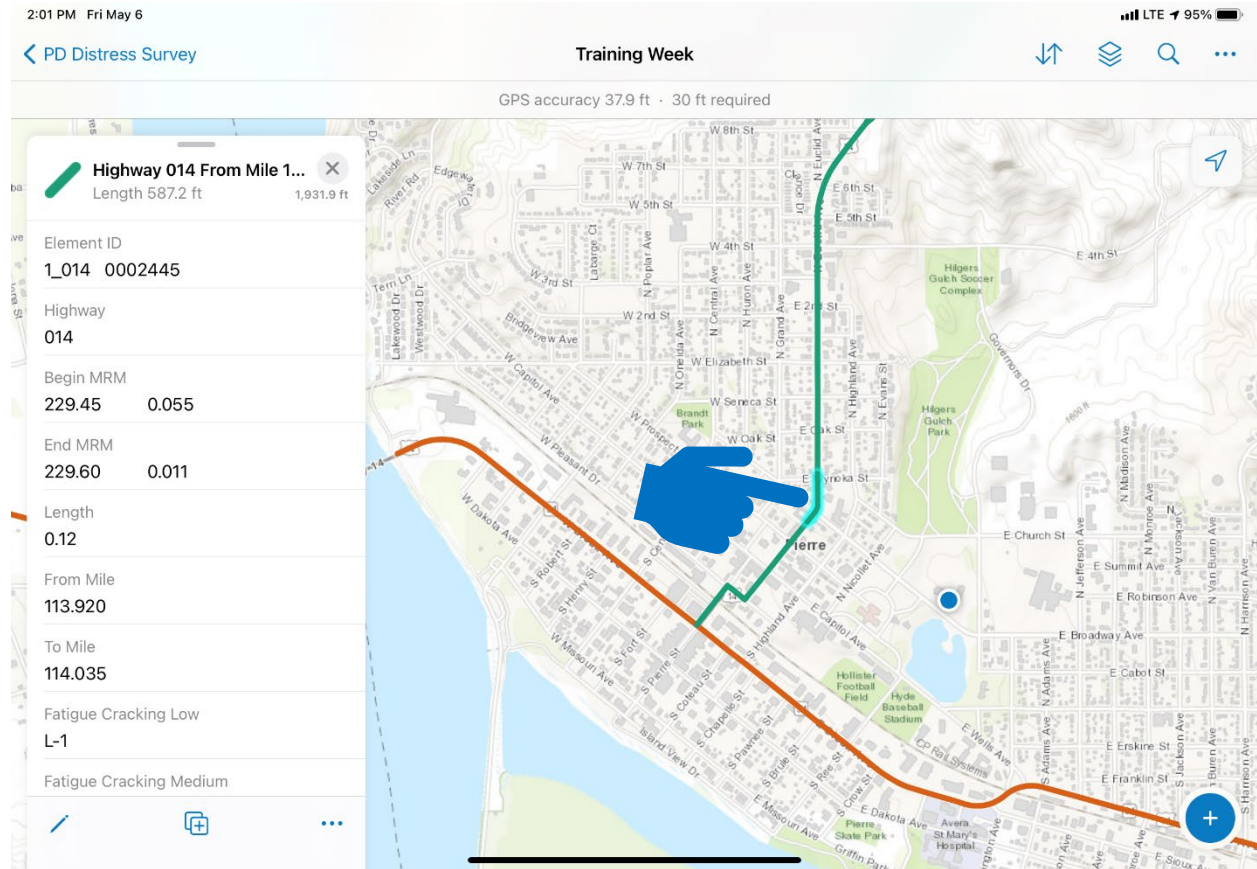


Figure 25: Selecting the Next Distress Segment for Rating

Once the user has finished rating for the day, the user should click “<PD Distress Survey” to get back to the main screen shown in **Figure 26**.

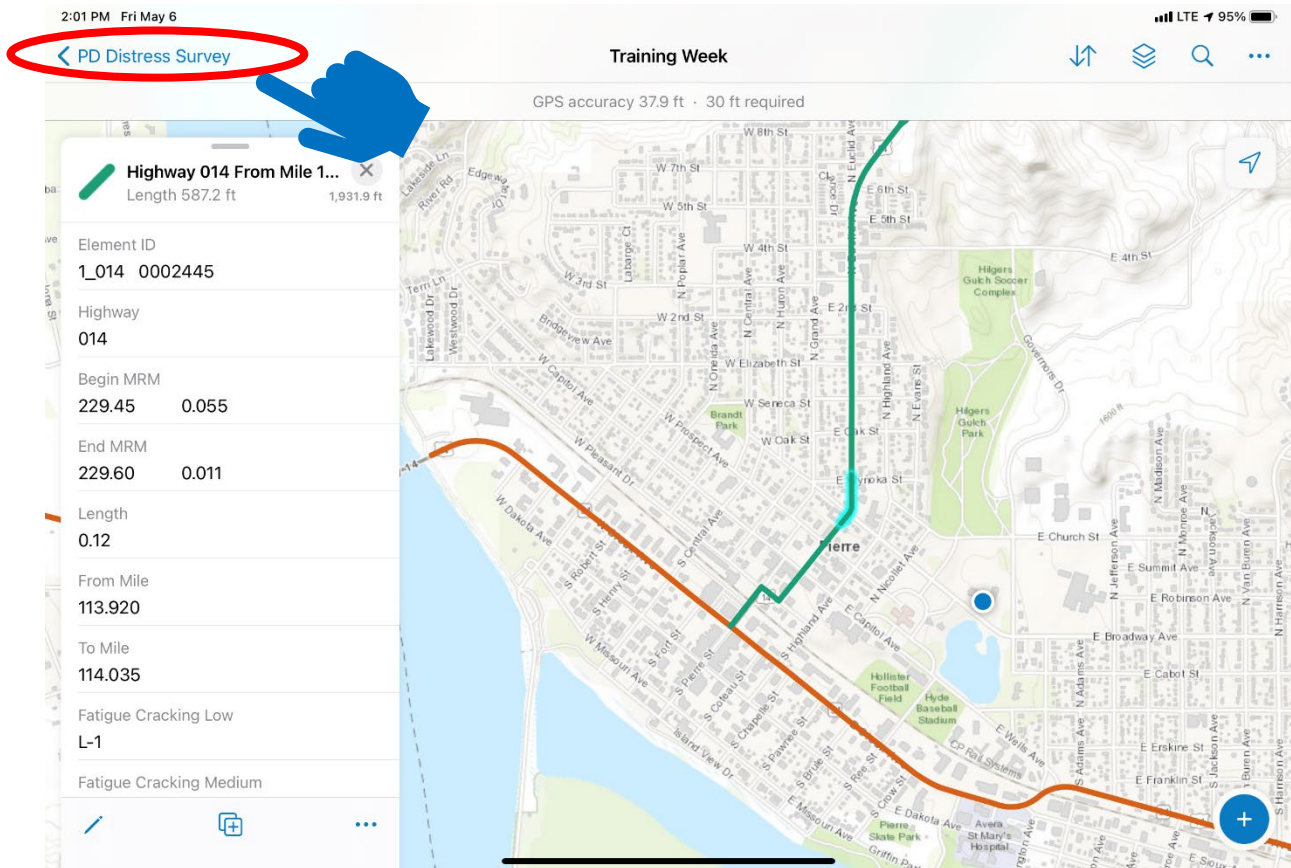


Figure 26: Selecting PD Distress Survey to Get to Main Screen

After the user gets back to the main screen for PD Distress Survey, the user will need to click on the three dots to the right of Area # to open the menu and click on Sync shown in **Figure 27**.

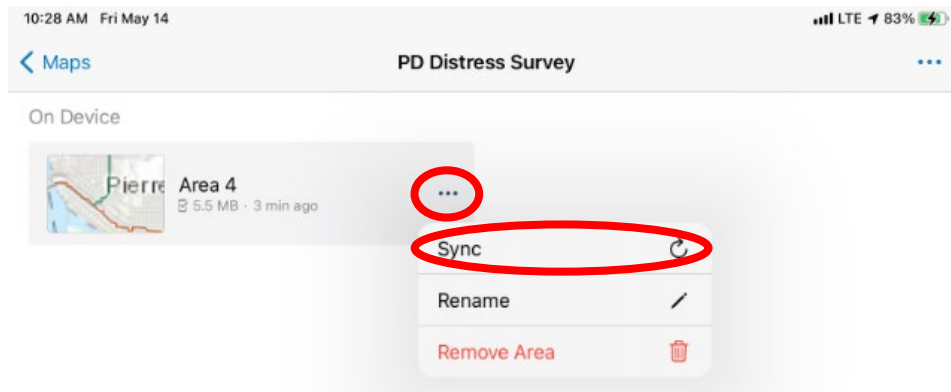


Figure 27: Syncing Offline Area Map

Just like downloading an offline map, syncing will take a little time. Make sure the iPad is in cell service and/or connected to Wi-Fi to speed up the process of syncing the data. The progress can be tracked from the circle progress bar shown in **Figure 28**. Syncing the data from the iPad uploads the data to the GIS SQL14 servers.

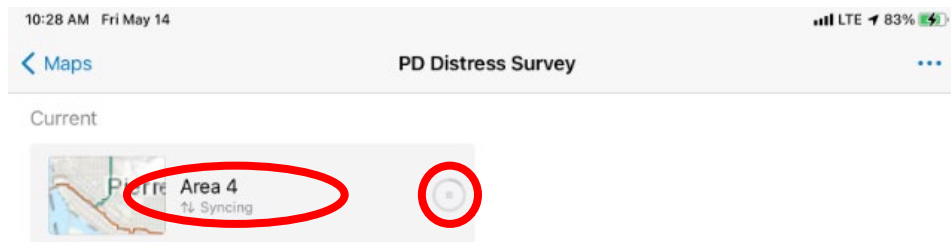


Figure 28: Syncing Offline Area Map Progress Circle

After syncing the offline map has been completed, the offline map Area # must be removed before continuing with the PD Distress Survey online map. Click on the three dots to open the menu, click on Remove Area shown in **Figure 29**.

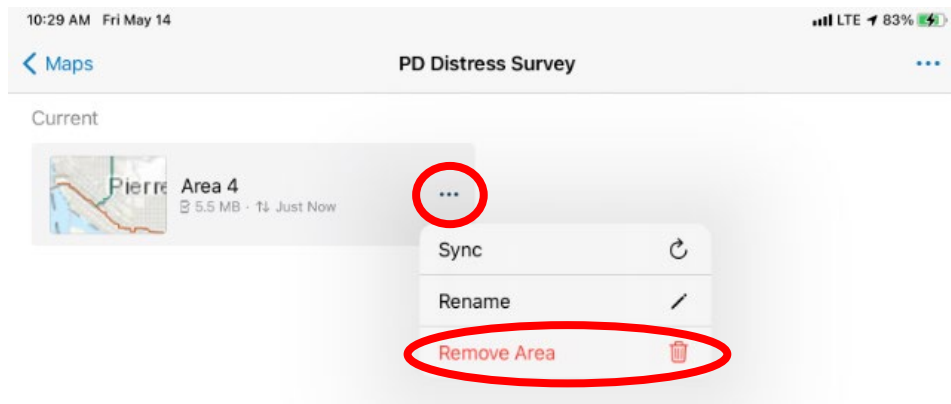


Figure 29: Removing Offline Area Map

The PD Distress Survey Map will reappear once the Area # offline map has been removed shown in **Figure 30**.

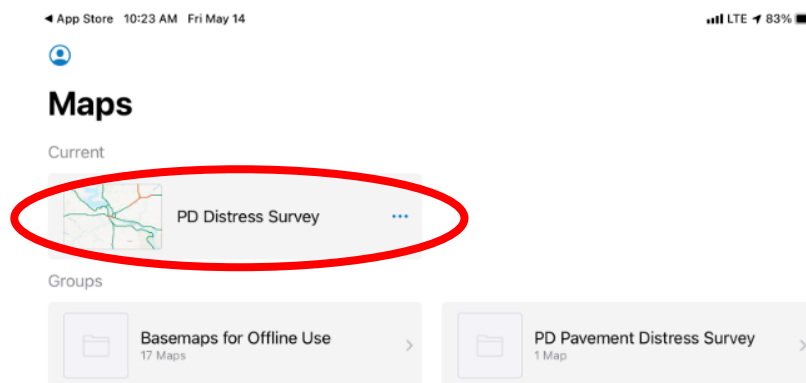


Figure 30: PD Distress Survey Map with No Offline Area Maps

Click on the three dots to open the menu. Click on Reload Map to refresh the PD Distress Survey map shown in **Figure 31**. Once the map has been refreshed click on PD Distress Survey to continue rating as normal.

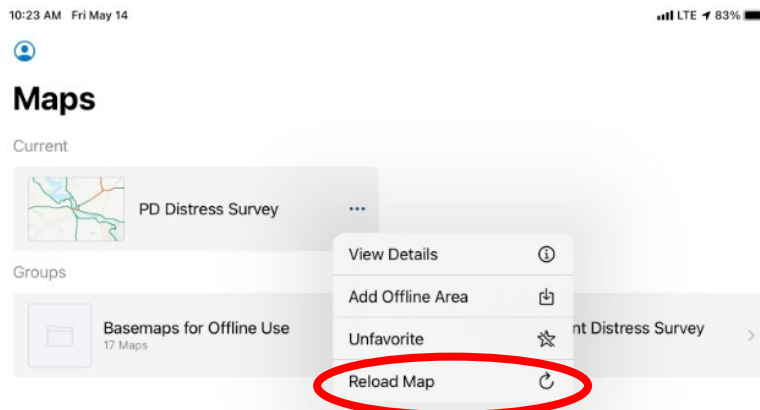


Figure 31: Reload PD Distress Survey Map

PAPER ENTRY OPERATION

If the iPad is unavailable or not working, data recording can be done manually on paper. Each pavement type (flexible, rigid, and gravel) has its own survey paper form. Ensure enough paper copies of each form are available. To determine which survey form to use, locate the highway segment to be rated in the Highway Needs Analysis Book and use the survey form for predominant pavement type. Data is recorded in a similar method to the iPad, write the proper severity in the column with the observed distress.

VISUAL SURVEY DISTRESSES - FLEXIBLE PAVEMENT

TRANSVERSE CRACKING

APPEARANCE:

Appears as cracks perpendicular to pavement centerline.

CAUSES:

- Poorly constructed paving joint
- Shrinkage of the asphalt concrete (AC) surface due to low temperatures or hardening of the asphalt
- Load and Moisture may accelerate the deterioration of the cracks

LOCATION:

May occur anywhere on the pavement surface

SEVERITY LEVELS:

LOW:

Unsealed crack width less than 1/4 inch wide
or
Sealed crack width is less than 3/4 inch
and/or
No crack depression

MEDIUM:

Unsealed crack width is greater than 1/4 inch and less than 1 inch
Or
Sealed crack width is greater than 3/4 inch and less than 1 inch
and/or
Crack depression is less than 1/4 inch

HIGH:

Any crack, unsealed or sealed, with width greater than 1 inch
or
Crack depression is greater than 1/4 inch

NOTE: Associated cracking (Random Cracking) should cause the severity level to be increased by one level.

EXTENTS:

LOW:

Crack spacing is greater than 50 feet average spacing

MODERATE:

Crack spacing is less than 50 feet and greater than 25 feet average spacing

HIGH:

Crack spacing is less than 25 feet and greater than 12 feet average spacing

EXTREME:

Crack spacing is less than 12 feet average spacing



Figure 32: Low Severity Transverse Cracking



Figure 33: Medium Severity Transverse Cracking



Figure 34: High Severity Transverse Cracking



Figure 35: High Severity Transverse Cracking with Depression

FATIGUE CRACKING

APPEARANCE:

Appears initially as a single longitudinal crack in the wheel path. Later appears as a series of interconnected cracks resembling alligator skin or chicken wire.

CAUSES:

- Fatigue failure of the asphalt concrete surface (or base) under repeated traffic loading
- Temperature and moisture may accelerate the initiation and propagation of the cracks

LOCATION:

Found in the wheel paths and turning movement locations

SEVERITY LEVELS:

LOW:

Fine parallel cracks in the wheel path(s)

MEDIUM:

Alligator pattern clearly developed

HIGH:

Alligator pattern clearly developed with spalling and distortion

EXTENTS:

LOW:

1 to 9 % of the wheel path is affected

MODERATE:

10 to 24 % of the wheel path is affected

HIGH:

25 to 49 % of the wheel path is affected

EXTREME:

Greater than 49 % of the wheel path is affected



Figure 36: Low Severity Fatigue Cracking



Figure 37: Medium Severity Fatigue Cracking



Figure 38: High Severity Fatigue Cracking

PATCHING AND PATCH DETERIORATION

APPEARANCE:

Appears as an area where the pavement surface has been removed and replaced, or as a localized overlay covering up another distress. A major concern with patching is whether it's a patch or an overlay, and the effect the patch has on the distress indices that the patch is covering up. To help with the determination of whether to rate a patch as a patch or an overlay, refer to Figure 27.

CAUSES:

- Often repair for some other distress
- May be caused by utility trenches across the roadway
- Traffic load, patch material, environment, and/or poor construction can accelerate deterioration

LOCATION:

Patches can occur anywhere on the pavement surface

SEVERITY LEVELS:

LOW:

Patch shows no visual distress of any type and with a smooth ride

MEDIUM:

Patch shows low or medium severity distress of any type and/ or notable roughness

HIGH:

Patch shows a high severity distress of any type and/ or distinct roughness

EXTENTS:

LOW:

1 to 9 % of the section is affected

MODERATE:

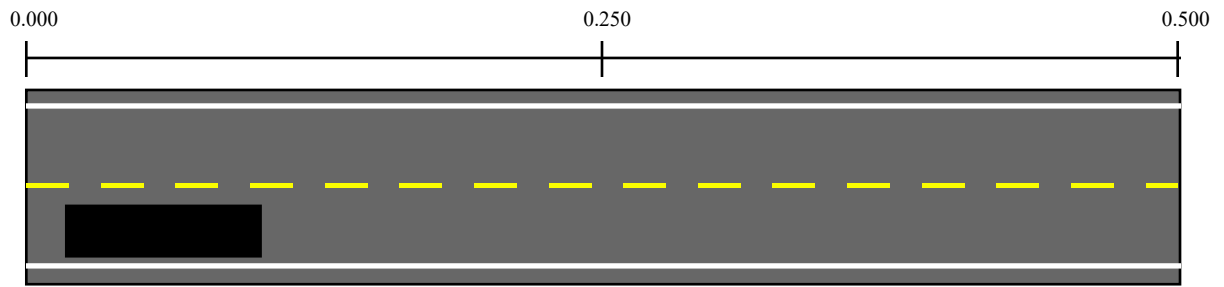
10 to 24 % of the section is affected

HIGH:

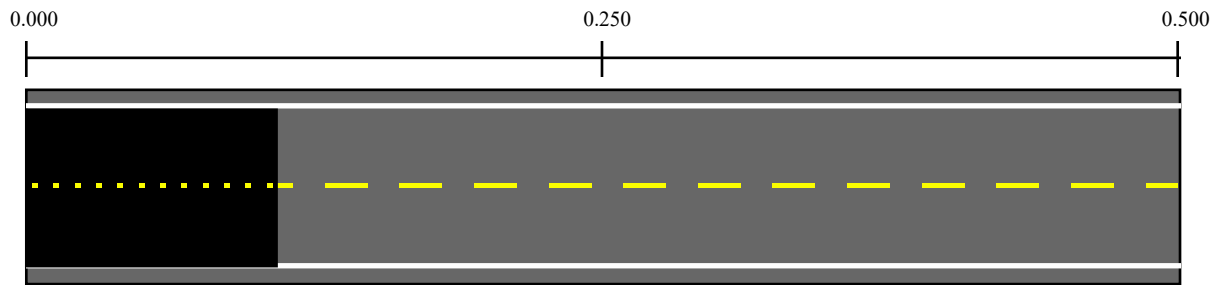
25 to 49 % of the section is affected

EXTREME:

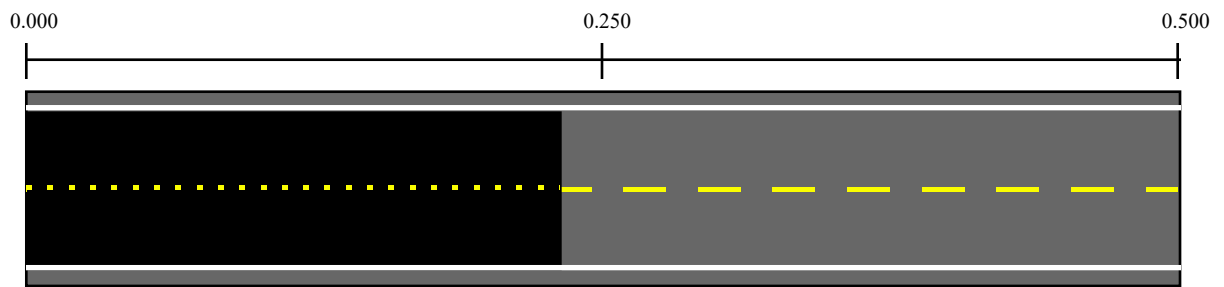
Greater than 49 % of the section is affected



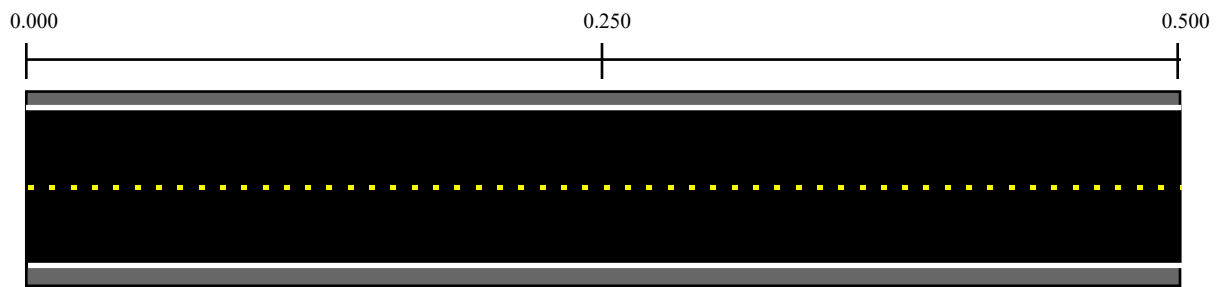
SCENARIO 1: RATE AS PATCH ONLY



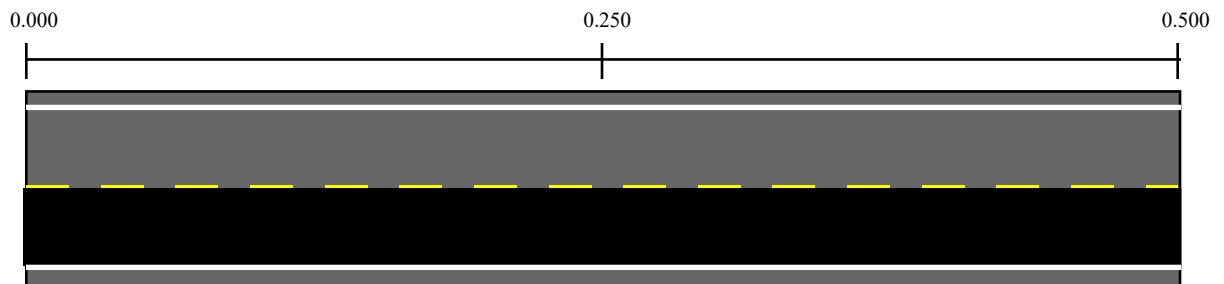
SCENARIO 2: LESS THAN HALF A SECTION, RATE AS PATCH ONLY



SCENARIO 3: GREATER THAN HALF A SECTION, RATE AS PATCH AND RATE DISTRESSES AS THEY SHOW THROUGH PATCH



SCENARIO 4: OVERLAY, RATE DISTRESSES AS THEY SHOW THROUGH



SCENARIO 5: RATE AS PATCH ONLY

Figure 39: Patch Rating Scenarios



Figure 40: Low Severity Patching



Figure 41: Medium Severity Patching



Figure 42: High Severity Patching

BLOCK CRACKING

APPEARANCE:

Appears as cracks which divide the surface into approximately rectangular pieces. In the low severity level, the cracks may appear as random longitudinal cracks between the wheel paths. This may include cracks in centerline rumble strips/stripes.

CAUSES:

- Shrinkage of the asphalt concrete surface
- Daily temperature cycling that results in daily stress/strain cycling
- Load can increase severity of block cracking

LOCATION:

Normally occurs over a large portion of pavement area, but sometimes it may occur only in non-traffic areas.

SEVERITY LEVELS:

LOW:

Random longitudinal cracks between the wheel paths,
Or interconnected transverse and longitudinal cracks that form blocks greater than 6 feet per side

MEDIUM:

Interconnected transverse and longitudinal cracks that form blocks 3 feet to 6 feet per side

HIGH:

Interconnected transverse and longitudinal cracks that form blocks less than 3 feet per side

EXTENTS:

LOW:

1 to 9 % of the section

MODERATE:

10 to 49% of the section

HIGH:

Greater than 49 % of the section



Figure 43: Low Severity Block Cracking



Figure 44: Medium Severity Block Cracking



Figure 45: High Severity Block Cracking

VISUAL SURVEY DISTRESSES - RIGID PAVEMENT

DURABILITY CRACKING (D-CRACKING)

APPEARANCE:

Appears as a series of closely spaced crescent-shaped hairline surface cracks. The crack often causes dark coloring of the surface in the surrounding area.

CAUSES:

- Presence of water
- Freeze-thaw cycles of the aggregate

LOCATION:

Adjacent and parallel to transverse and longitudinal joints and cracks, and the free edge of the pavement

SEVERITY LEVELS:

NOTE: Asphalt patches on concrete pavement should be rated as if the asphalt isn't there.

LOW:

Cracks are light, with no loose or missing pieces

MEDIUM:

Cracks are well defined and some small pieces are loose or missing

HIGH:

Cracks are well developed pattern with a significant amount of loose or missing material

EXTENTS:

LOW:

1 to 9 % of the slabs are affected

MODERATE:

10 to 24 % of the slabs are affected

HIGH:

25 to 49 % of the slabs are affected

EXTREME:

Greater than 49 % of the slabs are affected



Figure 46: Low Severity D-Cracking



Figure 47: Medium Severity D-Cracking



Figure 48: High Severity D-Cracking

ALKALI SILICA REACTIVITY (ASR)

APPEARANCE:

Appears as a series of interconnected cracks. Frequently, larger cracks are oriented in the longitudinal direction of the pavement and interconnected by finer transverse or random cracks.

CAUSES:

- Chemical reaction between the silica in the aggregate and the alkali in the sand
- Climatic conditions affect the rate of deterioration

LOCATION:

Entire slab, may be more noticeable in the wheel path

SEVERITY LEVELS:

NOTE: Asphalt patches on concrete pavement should be rated as if the asphalt isn't there.

LOW:

Cracks are light, with no loose or missing pieces

MEDIUM:

Cracks are well defined and some small pieces are loose or missing

HIGH:

Cracks are well developed pattern with a significant amount of loose or missing material

EXTENTS:

LOW:

1 to 9 % of the slabs are affected

MODERATE:

10 to 24 % of the slabs are affected

HIGH:

25 to 49 % of the slabs are affected

EXTREME:

Greater than 49 % of the slabs are affected

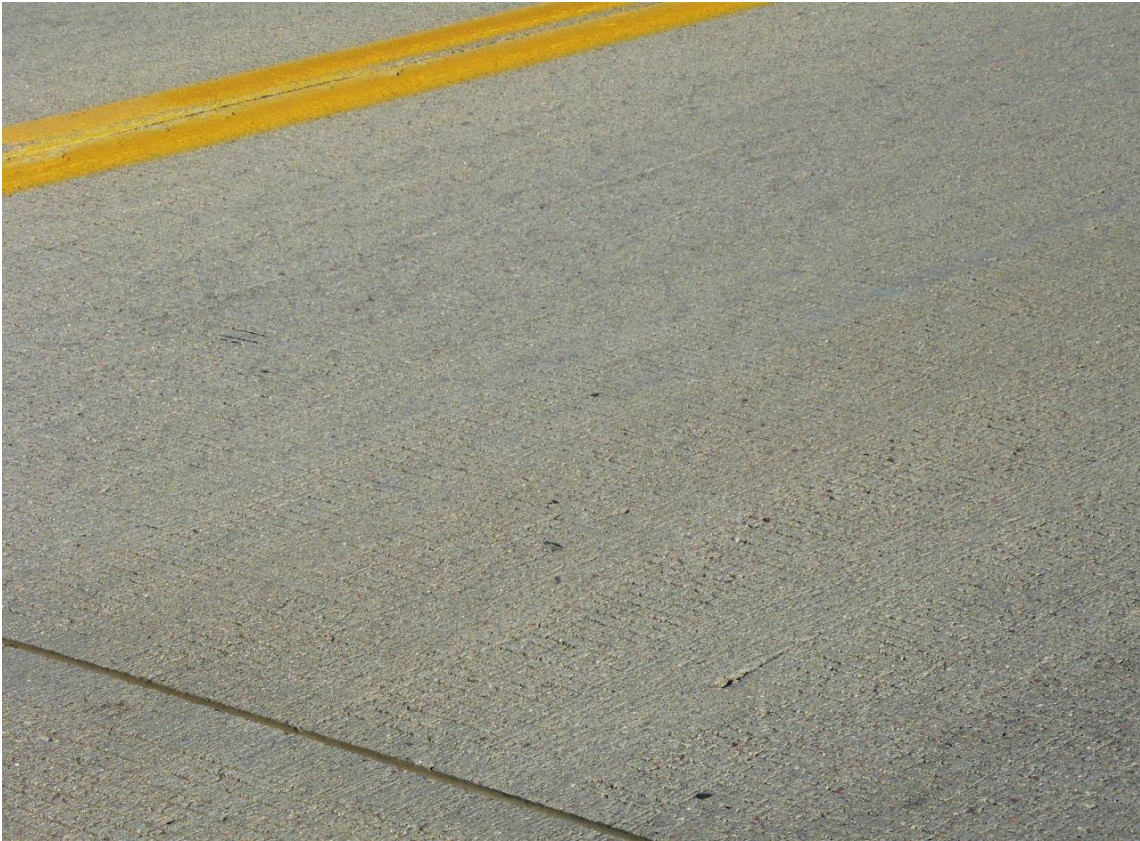


Figure 49: Low Severity ASR



Figure 50: Medium Severity ASR



Figure 51: High Severity ASR

JOINT SPALLING

APPEARANCE:

Appears as the cracking, breaking, chipping, or fraying of slab edges within 2 feet of a joint or crack.

CAUSES:

- Excessive stresses at the joint caused by infiltration of incompressible materials and subsequent expansion or by traffic loading
- Disintegration of the concrete
- Weak concrete at the joint (caused by overworking) combined with traffic loads
- Poorly designed or constructed load transfer device

LOCATION:

Along slab edges

SEVERITY LEVELS:

NOTE: Asphalt patches on concrete pavement should be rated as if the asphalt isn't there.

LOW:

Spalls less than 3 inches wide with no significant loss of material
or
Joint and Spall Repair Patch with cracking

MEDIUM:

Spalls 3 to 6 inches wide and may have loss of material

HIGH:

Spalls greater than 6 inches wide and may have significant loss of material

EXTENTS:

LOW:

1 to 9 % of the joints are affected

MODERATE:

10 to 24 % of the joints are affected

HIGH:

25 to 49 % of the joints are affected

EXTREME:

Greater than 49 % of the joints are affected



Figure 52: Low Severity Joint Spalling



Figure 53: Medium Severity Joint Spalling



Figure 54: High Severity Joint Spalling

CORNER CRACKING

APPEARANCE:

Appears as a crack extending vertically through the entire slab depth which intersects the joints at a distance less than 6 feet from the corner of the slab.

CAUSES:

- Heavy repeated loads combined with pumping, poor load transfer across the joint, and thermal curling and moisture warping of the slab

LOCATION:

Located at slab corners

SEVERITY LEVELS:

NOTE: Asphalt patches on concrete pavement should be rated as if the asphalt isn't there.

LOW:

Crack is not spalled with no faulting and piece is not broken

MEDIUM:

Crack is spalled slightly, and/or faulted less than 1/2 inch, or piece broken with tight crack

HIGH:

Crack is spalled, and/or faulted greater than 1/2 inch and/or piece is broken

EXTENTS:

LOW:

1 to 9 % of the slabs

MODERATE:

10 to 24 % of the slabs

HIGH:

25 to 49 % of the slabs

EXTREME:

Greater than 49 % of the slabs



Figure 55: Low Severity Corner Cracking



Figure 56: Medium Severity Corner Cracking



Figure 57: High Severity Corner Cracking

PUNCHOUTS

APPEARANCE:

Appears as the area enclosed by two closely spaced (usually less than 2 feet) transverse cracks, a short longitudinal crack, and the edge of the pavement or longitudinal joint. **Will occur on CRCP only. May be hidden by asphalt patch or a sawed in joint for repair.**

CAUSES:

- Loss of aggregate interlock at one or two of the transverse cracks
- Loss of support due to pumping

LOCATION:

Located near the pavement edge and/or longitudinal joints

SEVERITY LEVELS:

NO SEVERITY LEVELS ARE RECORDED

EXTENTS:

LOW:

1 or 2 per section

MODERATE:

3 to 6 per section

HIGH:

7 or greater per section



Figure 58: Punchout



Figure 59: Punchouts

CRCP BLOCK CRACKING

APPEARANCE:

Appears, in the lowest severity levels, as closely spaced transverse shrinkage cracks with occasional longitudinal cracks occurring perpendicular to the parent transverse cracks. In higher severity levels, the transverse and longitudinal cracks become interconnected and may contain distortion and spalling in both types of cracks. **Will occur on CRCP only. May be hidden by asphalt patch or a sawed in joint for repair.**

CAUSES:

- Over-development of transverse shrinkage cracks
- Cracking parallel to the longitudinal steel
- Climatic conditions affect the rate of deterioration

LOCATION:

Entire pavement, may be more noticeable in the wheel path

SEVERITY LEVELS:

NOTE: Asphalt patches on concrete pavement should be rated as if the asphalt isn't there. A light staining around the cracks may be present.

LOW:

Cracks are light, closely spaced, transverse shrinkage cracks with occasional longitudinal cracks occurring perpendicular to the parent transverse crack with little to no interconnection.

MEDIUM:

The pattern formed between the longitudinal cracks and transverse shrinkage cracks are more defined, creating a "block" pattern in the CRC pavements.

HIGH:

The "block" pattern is well defined, and the cracks are distorted with the presence of spalling in the cracks with loose or missing pieces.

EXTENTS:

LOW:

1 to 9 % of the section is affected

MODERATE:

10 to 24 % of the section is affected

HIGH:

25 to 49 % of the section is affected

EXTREME:

Greater than 49 % of the section is affected



Figure 60: Low Severity CRC Block Cracking



Figure 61: Low Severity CRC Block Cracking



Figure 62: Medium Severity CRC Block Cracking



Figure 63: High Severity CRC Block Cracking

JOINT SEAL DAMAGE

APPEARANCE:

Appears as any condition which enables incompressible materials and/or significant amount of water to infiltrate the joint from the surface.

CAUSES:

- Failure to clean joint before sealing
- Infiltration of incompressible material into the joint
- Inability of material to meet performance requirements

LOCATION:

Along transverse joints

SEVERITY LEVELS:

LOW:

Seal damage to less than 10 % of the joint

MEDIUM:

Seal damage to 10 % to 50 % of the joint

HIGH:

Seal damage to greater than 50% of the joint

EXTENTS:

LOW:

1 to 9 % of the joints are affected

MODERATE:

10 to 24 % of the joints are affected

HIGH:

25 to 49 % of the joints are affected

EXTREME:

Greater than 49 % of the joints are affected

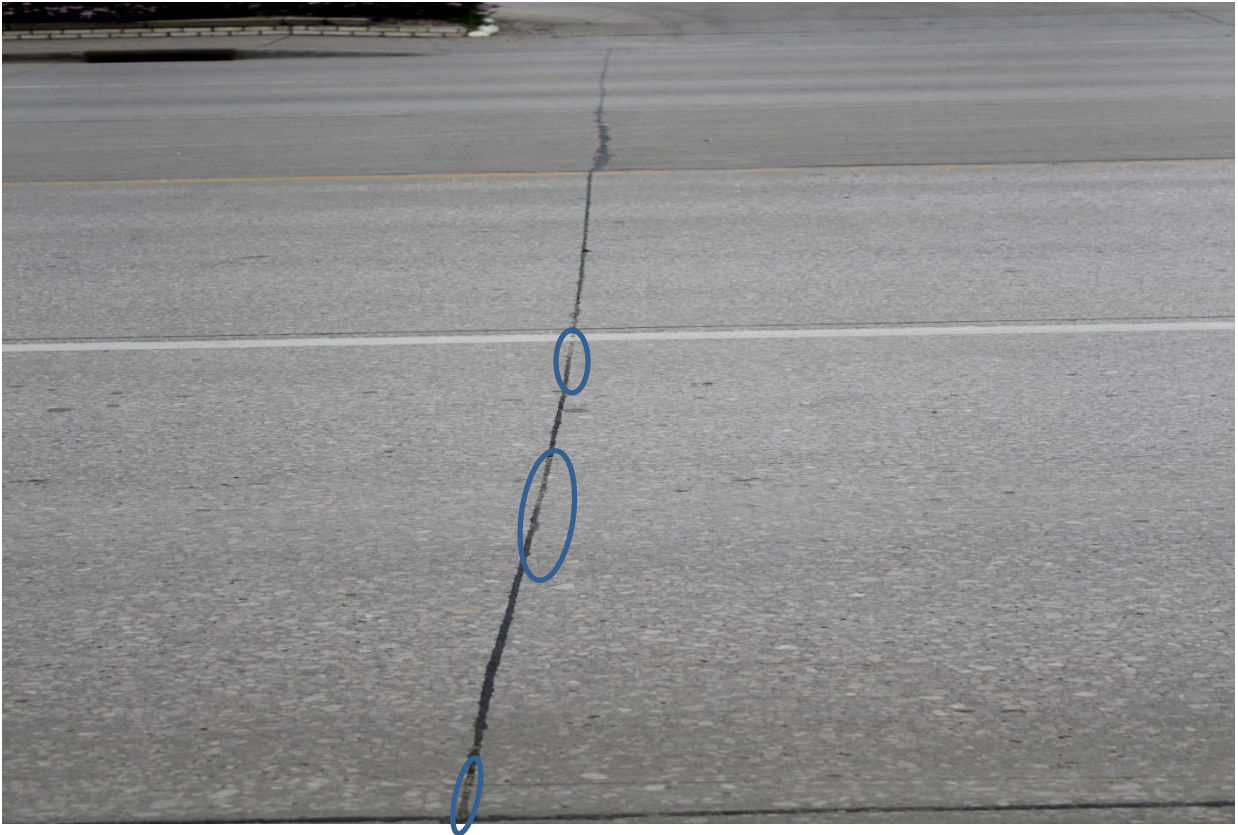


Figure 64: Low Severity Joint Seal Damage

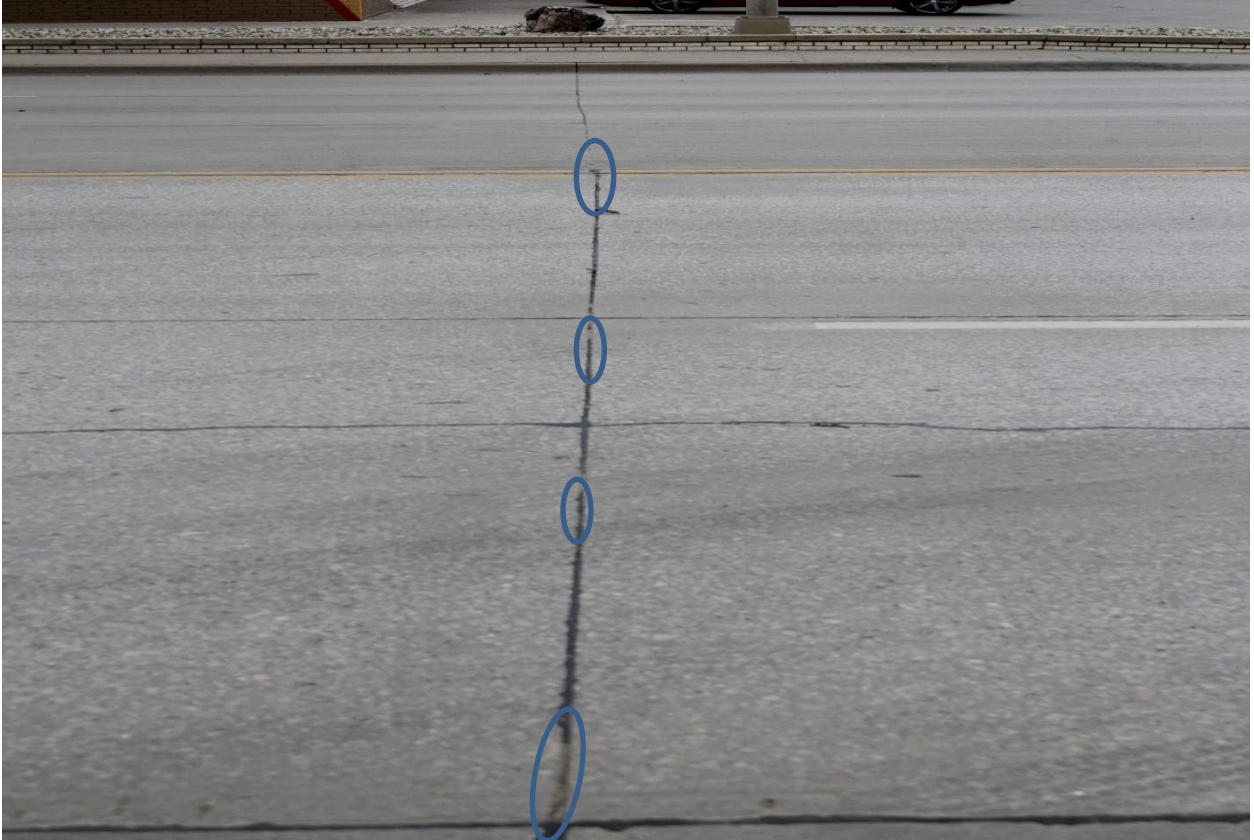


Figure 65: Medium Severity Joint Seal Damage



Figure 66: High Severity Joint Seal Damage

VISUAL DISTRESS SURVEY ON GRAVEL SURFACED HIGHWAYS

Beginning in the Summer of 1996, the pavement distress survey included the rating of gravel surfaced state highways. The rating of gravel sections of the state highway system was included as an attempt to have a condition rating for every segment of highway on the state system. The rating of gravel surfaced highways is a combination of the procedure used on the paved highway system and the rating guide provided by the *Rural Road Condition Survey Guide* published by SDDOT's Office of Research and Transportation Inventory Management in September 1995.

The rating is performed in a similar manner as on paved highways in that it is a continuous survey over the entire section. Sections for gravel surfaced highways are longer than those for paved highways in that section breaks are at every Uniform MRM only and hence are approximately 1.00 mile in length. The van does not drive on the shoulder of the road, but rather as close to center of highway as possible. The speed of the van while conducting the survey should be at the posted speed limit if travel at that speed is possible. The rater should move to the front passenger seat of the van to get a better feel for the roadway cross-section.

The rating of gravel surfaced highways differs from rating paved surfaced highways in that the highway is rated for an overall condition value. No individual distresses are rated. Each section is given a rating from 0 to 100, with 0 being unpassable and 100 being perfect condition. Gravel distresses that affect the rating are listed in **Table 5**. Gravel Rating Guidelines can be found in **Table 6** and Maximum Condition Ratings are found in **Table 7**. The Gravel Distress Survey Form is found in the Paper Entry Operation section on **page 23**.

DISTRESS TYPE	DEFINITION	LOW	MEDIUM	HIGH
Corrugation (Wash boarding)	Closely spaced ridges and valleys at fairly regular intervals	Ridges < 1inch deep	Ridges 1 to 3 inches deep	Ridges > 3 inches deep
Dust	Loose, flying small particles of binder and aggregate	See through	Visibility moderately obstructed	Severe visibility problem
Improper Cross Section	Road surface is not shaped or maintained to carry water to the ditches	Level Surface	Bowl-shaped Surface	Severe Surface Depressions
Inadequate Roadside Drainage	Ditches and culverts are not in good enough condition to direct and carry runoff water	Very little debris	Debris, some standing water	Lack of water runoff
Loose Aggregate	Loose aggregate particles moved away from the normal wheel path and berms formed in the center and/or along the shoulder of the roadway	Loose < 2" thick	Loose 2 to 4 inches thick	Loose > 4 inches thick
Potholes	Bowl-shaped depressions in the roadway surface	< 2 inches deep	2 to 4 inches deep	> 4 inches deep
Ruts	Surface depression in the wheel path parallel to the centerline	< 1 inch deep	1 to 3 inches deep	> 3 inches deep

Table 5: Gravel distress definitions and severities.

Rating = 100 to 81
Roadway surface is in excellent condition with very good rideability. The roadway has a good gravel thickness and excellent drainage. The only distress that is typically present is dusting in dry conditions.
Rating = 80 to 61
The roadway has adequate gravel thickness, a good crown, and good drainage characteristics. Distresses that may be present include loose aggregate and wash boarding. Some slight rutting (< 1 in) may exist in some areas during wet weather.
Rating = 60 to 41
The roadway has a good crown (3 to 6 in). Primary ditches are present on more than 50 percent of the roadway. Secondary ditches are evident along the shoulder line, and some culvert cleaning is necessary. The gravel layer is adequate, but additional aggregate is needed in isolated areas. Moderate wash boarding (1 to 2 in deep) exists over 10 to 25 percent of the area, and moderate rutting (1 to 2 in) occurs in wet weather. Occasional small potholes (<2 in deep) and some loose aggregate are present.
Rating = 40 to 21
Travel at slow speeds (<25 mph) is required. There is little or no roadway crown, moderate to severe wash boarding, severe loose aggregate, and moderate potholing. Up to 25 percent of the roadway has little or no aggregate. More than 50 percent of the ditches are inadequate, secondary ditches exist along most of the roadway, and the culverts are partially filled with debris.
Rating = 20 to 0
Travel on the roadway is very difficult. There is either no roadway crown or the roadway is bowl-shaped with extensive ponding. Severe ruts and potholes exist over more than 25 percent of the roadway, and many areas (> 25 percent) have little or no aggregate. There are few if any primary ditches, and secondary ditches are evident along most of the roadway. Culverts are either damaged or filled with debris

Table 6: Gravel rating guidelines.

DISTRESS CONDITION	SEVERITY LEVEL		
	LOW	MEDIUM	HIGH
CORRUGATION > 10 PERCENT ROADWAY	80	70	60
DUSTING	98	96	85
IMPROPER CROSS SECTION > 10 PERCENT ROADWAY	80	70	60
INADEQUATE ROADSIDE DRAINAGE >10% ROADWAY	80	70	60
LOOSE AGGREGATE	80	75	65
POTHLES	70	50	30
RUTTING	70	65	50

Table 7: Maximum gravel ratings.