Infrastructure Needs: North Dakota's County, Township, & Tribal Roads & Bridges 2021-2040

Draft Report

Sharing the Vision for North Dakota's Transportation System

Virtual Meeting

July 21, 2020

Upper Great Plains Transportation Institute
North Dakota State University
Presenters: Dale Heglund, Alan Dybing, Bradley Wentz, Tim Horner

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Purpose of Today's Presentation

- Review draft report results with jurisdictions prior to legislative presentation.
  - No legislative presentation request at this time.
- Similar process as in 2016

Outline of Today's Presentation

- Introductory Remarks and Purpose of the Study
- Quick History of Studies
- Traffic Forecasting
- Unpaved (Gravel) Analysis
- Data Analysis Processes/Issues
- Paved Analysis
- Bridge Analysis
- Results - Summation of Needs
- Comment Process

Purpose of The Study

- Directed by 2019 Legislative Session
- Outcomes to be used for distributing HB 1066 (Operation Prairie Dog) county funding

Study Team

- Denver Tolliver
- Alan Dybing
- Brad Wentz
- Kelly Bengtson
- Pan Lu
- Dale Heglund
- Tim Horner
- Satpal Wadhwa
- Sharijad Hasan

Quick History of Studies

- 2010 study: UGPTI estimated road investment needs for the 2011 session
  - 21,500 new wells & increased ag. production
- 2012 study: updated investment needs
  - 46,000 new wells, ag. production, & initial bridge study
- 2014 Study: more comprehensive data
  - Higher roadway costs, ag. production, & 60,000 new wells
- 2016 Study: First study with GRIT and Reduced Oil Exploration: 30, 60, & 90 Rigs

Quick History of Studies

- 2020 study: First study with a 4-year gap between studies.
  - First study where it was known that funding distribution was partially tied to results

General Changes in Study Process

- Paved project history primarily came from GRIT
  - Obtained age, width and project data from counties through GRIT.
- Used new unpaved survey instrument
- UGPTI collected all pavement image and ride data via smartphone
- Traffic Model Sensitivity Process
  - Added late in study for COVID-19 and reduced oil price

Traffic Forecasting

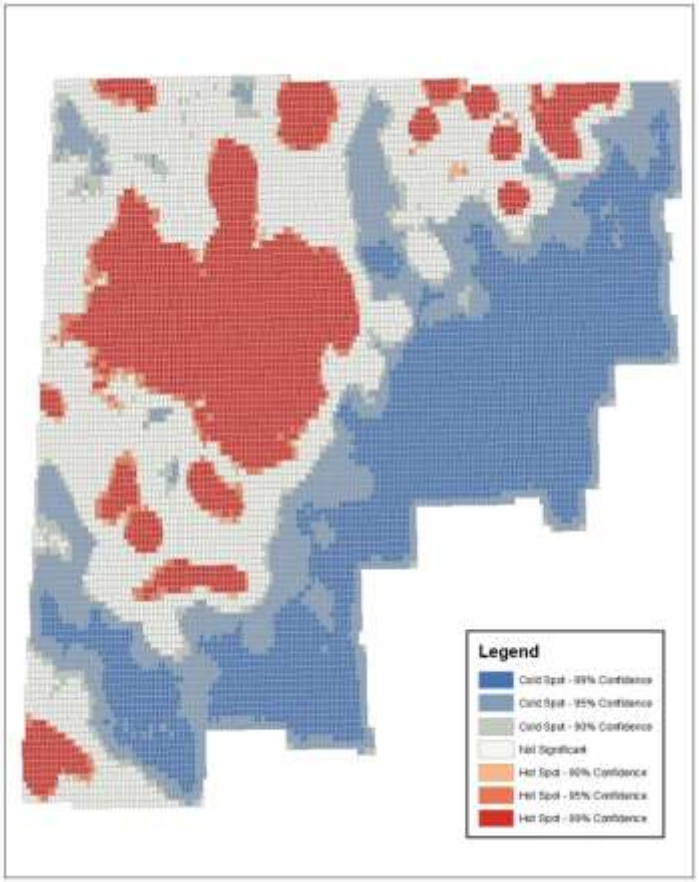
- Impacts to roadways are dependent on traffic levels
  - Unpaved
    - More frequent blading
    - More frequent and thicker gravel overlays
    - Dust suppressant and base stabilization
  - Paved
    - Design based upon projected ESALs
    - Pavement Thickness
    - Pavement Deterioration
- Travel Demand Model
  - Using agricultural and oil related data to forecast truck traffic over the next 20 years
  - Compared against observed traffic counts and adjusted

Model Groups

- Agriculture
  - Corn
  - Wheat
  - Soybeans
  - Barley
  - Canola
  - Sunflowers
  - Dry Edible Beans
  - Sugarbeets
  - Potatoes
- Oil
  - Fresh Water
  - Rigs
  - Equipment
  - Fuel
  - Mud
  - Pipe
  - Produced Water
  - Outbound Oil

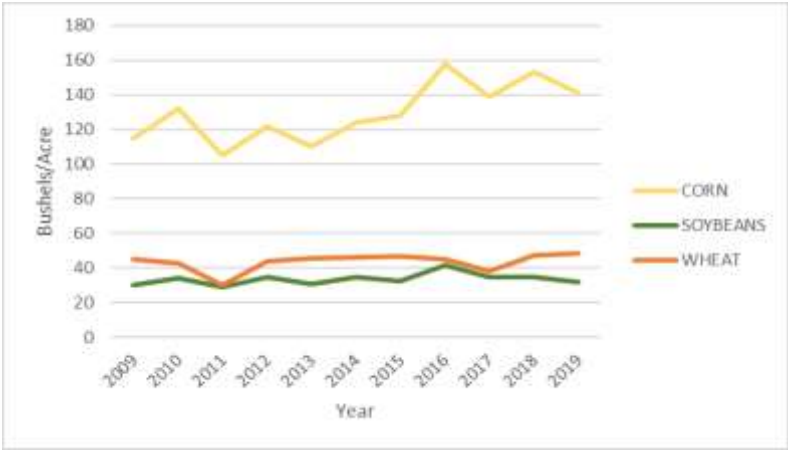
Oil Forecasts

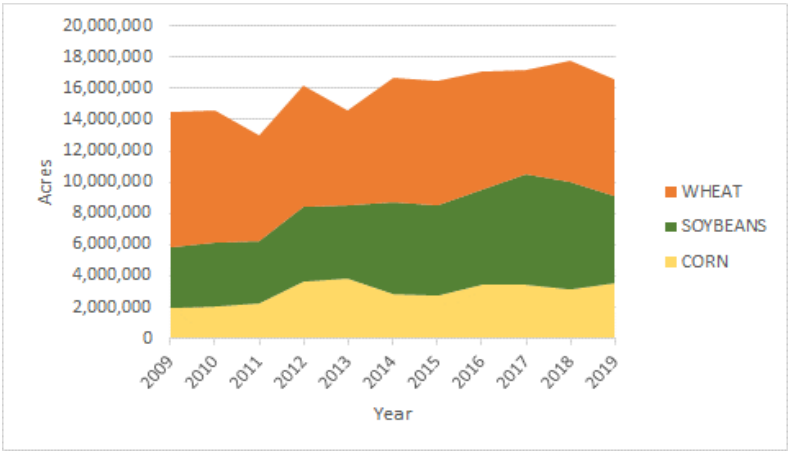
- The baseline forecast developed through discussions with Oil & Gas
- 1,440 new wells/year – equivalent to 60 operating rigs
- Spatial forecast of location



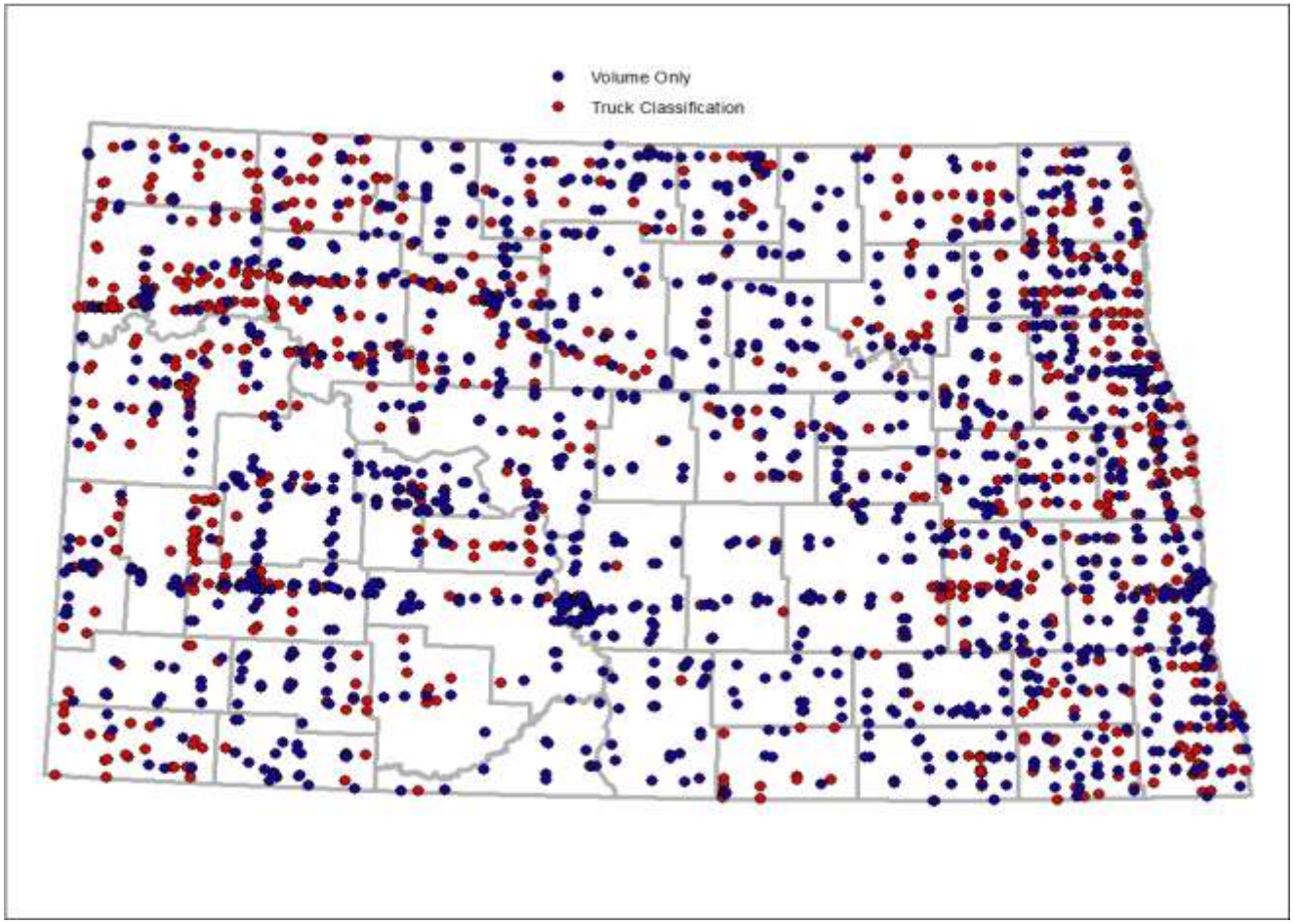
Agricultural Forecasts

- Historical yield and acreage data
- Trends developed from historical observations with adjustments for outliers





Traffic Counts

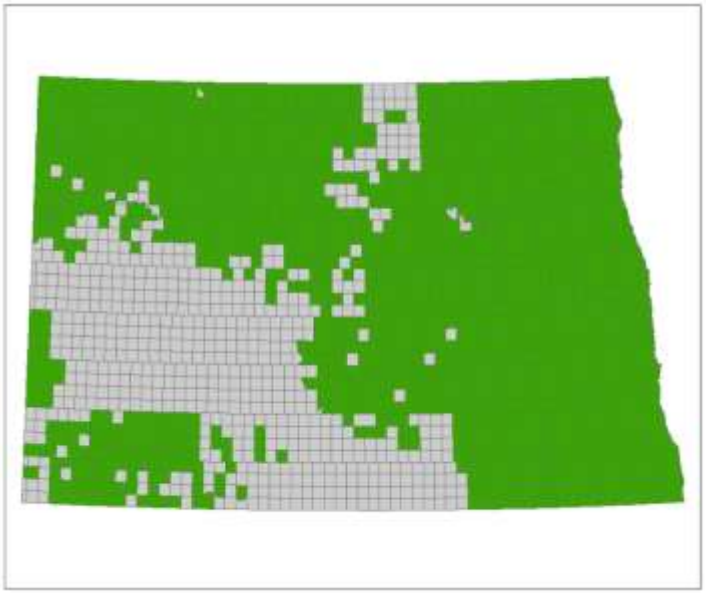


Unpaved Analysis

- Assigning maintenance costs based upon traffic level forecasts
- Survey of costs and practices
- Group miles by traffic levels
- Apply annualized costs to each traffic level and add up mileages across each jurisdiction

Gravel Survey

- Mailed to all 53 counties and roughly 1,300 organized townships
- Response rate:
  - Counties: 100%
  - Townships: 75%
- Costs and Practices



Gravel Survey

Aggregate Description

To provide information on the type and quality of aggregate used in your county, please check all boxes that apply. For example, if your county uses crushed, specification base gravel – select gravel, crushed material and specifications.

- Gravel ❑
- Scoria ❑
- Pit Run ❑
- Screened ❑
- Crushed Material ❑
- Specifications ❑
- Tested ❑
- Other_____ ❑

Placement Practices

When aggregate overlays are placed in your county, please select the typical practice that is used to apply an aggregate overlay.

- Truck Drop and Blade ❑
- Windrow/Equalize ❑
- Water/Rolling/Compaction ❑
- Other_____ ❑

Gravel Survey

Gravel Road Costs

Please report costs for gravel for county roads in the table below. The table asks for unit costs for graveling, maintaining, and operating gravel roads. If you are quoting contractor prices, please circle "yes" in the right hand column.

Gravel/Scoria Cost			
Average Gravel/Scoria Cost (crushing & royalties at the pit)		❑ Per cu. yard ❑ Per Ton	Is this Contractor Price? (yes/no)
Trucking Cost from Gravel Origin		❑ Per loaded mile ❑ Per cu. yard ❑ Per Ton	Is this Contractor Price? (yes/no)
Average trucking distance for aggregate		❑ Miles one-way ❑ Miles roundtrip	
Truck Payload		❑ Cu. Yards ❑ Tons	
Placement Costs		Per Mile	Is this Contractor Price? (yes/no)
Blading Cost		Annual cost per mile	Is this Contractor Price? (yes/no)
Dust Suppressant Costs		Per mile	Is this Contractor Price? (yes/no)
Base Stabilization Cost		Per mile	Is this Contractor Price? (yes/no)

Practices by Traffic Level

County Entry	Traffic Levels		
	Low	Medium	High
Daily Traffic (Total AADT)			
Average Regraveling Thickness			
Blading Frequency (# per month)			
Regraveling Frequency (years between regraveling)			
Dust Suppressant (yes/no)			
Base Stabilization (yes/no)			

If you answered yes for Dust Suppressant – which type do you use?

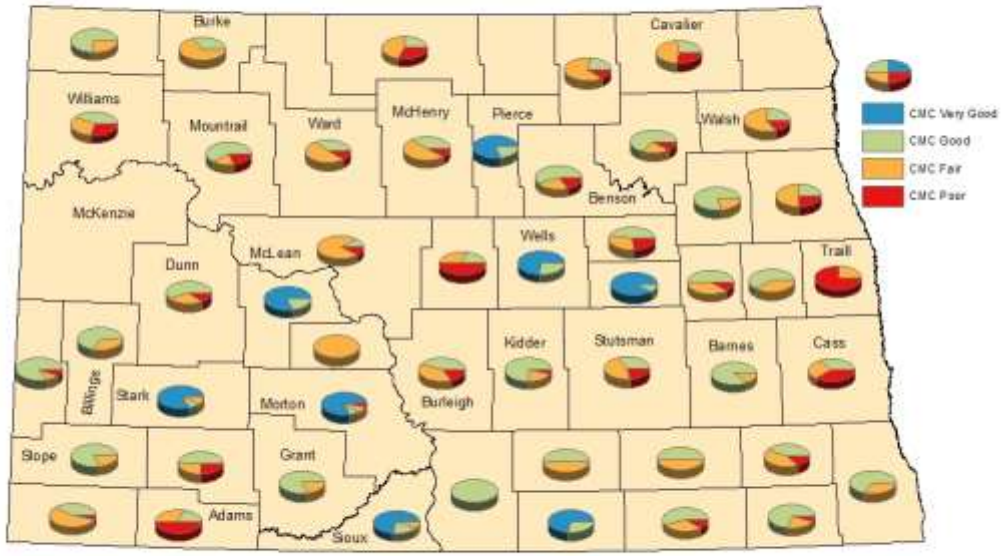
_____

If you answered yes for Base Stabilization – which type do you use?

_____

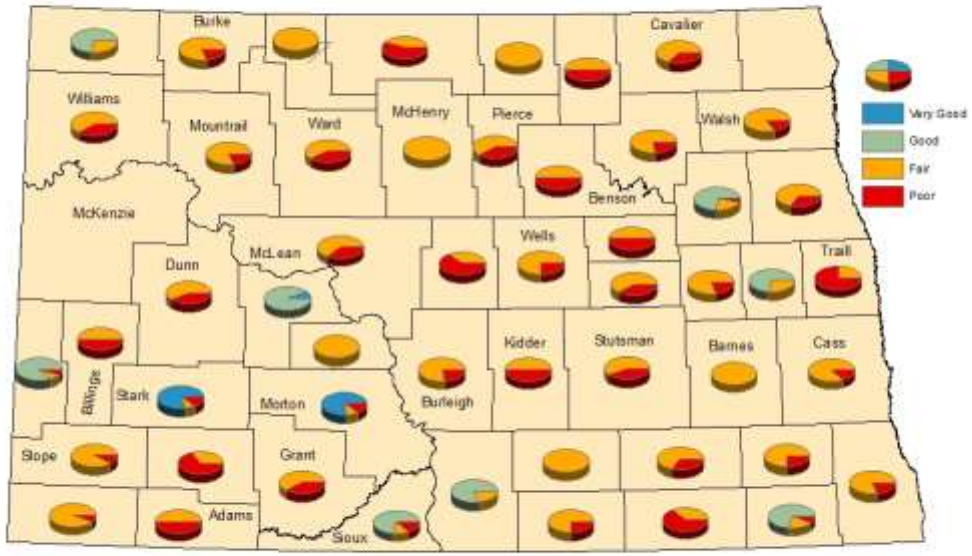
Unpaved Condition (CMC)

County Survey Responses

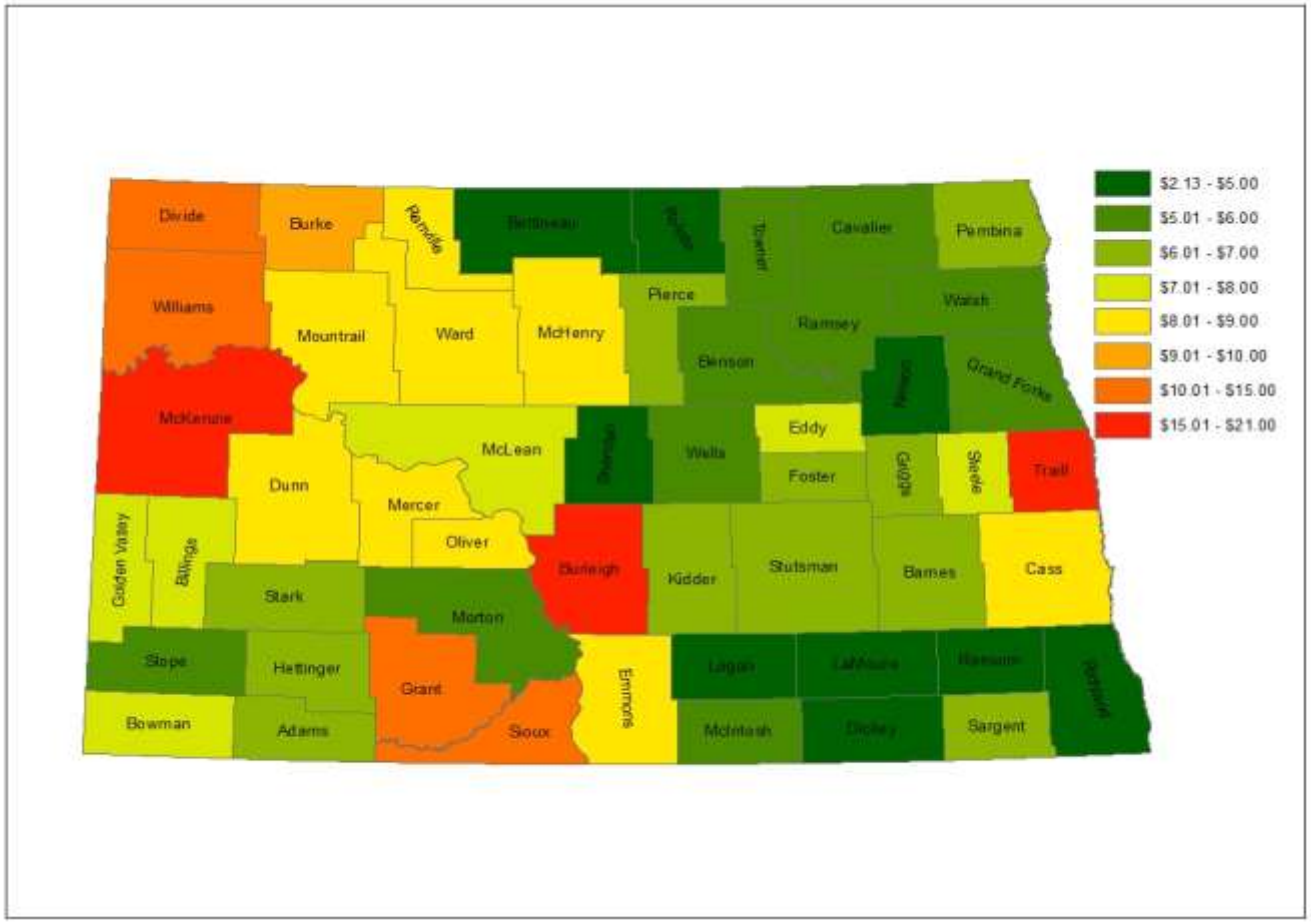


Unpaved Condition (non-CMC)

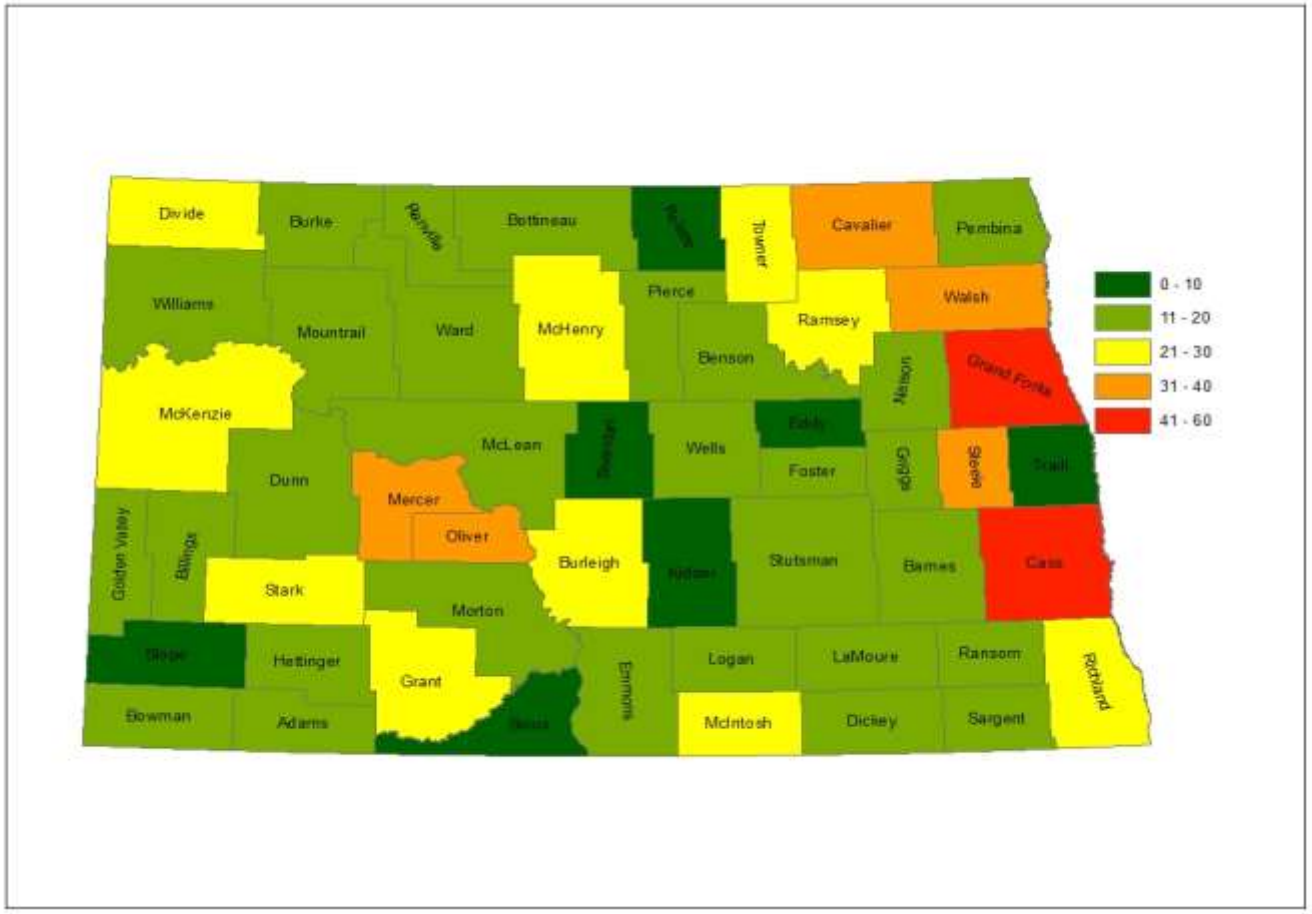
County Survey Responses



Aggregate Cost/Cu.Yd.



Average Trucking Distance



Gravel Testing and Specifications

NDSU | NDLTAP
GRAVEL ROAD WARRIOR

- Specifying and testing gravel insures that we are getting quality material.
- Wash boarding, rutting, dust, and loose rock/sand are all gravel quality issues.
- Gravel quality affects safety risks and maintenance costs
- Motor grader operators set the roadway shape, with a target 4% slope. Flat roads pothole.

Gravel Specs (blue)

Gravel Testing (blue)

Paved Analysis

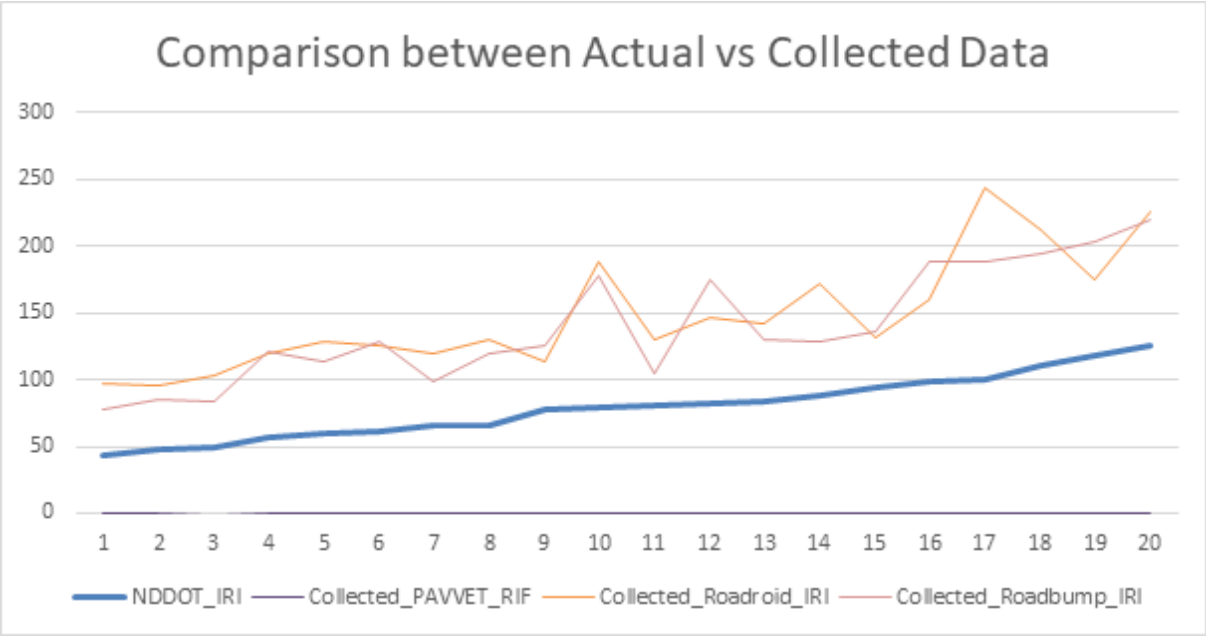
- Data Collection
  - Pavement condition
  - GRIT – County data
  - Existing Conditions
- Data Analysis
  - AASHTO routine
  - Costs
- Pavement results

Pavement Data Collection

- Condition data collection
  - Previous study - NDDOT Pathway van
  - Smartphone Application
  - Approx. 5300 miles of ride and image data collected

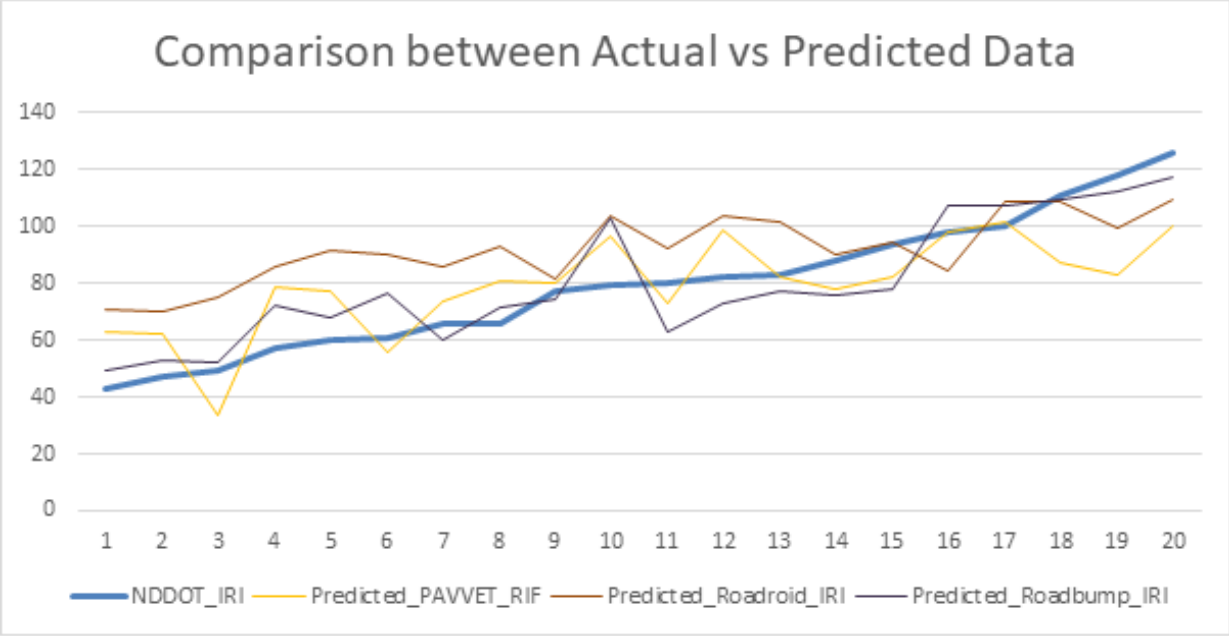
Pavement Data Collection

- All devices reported IRI based on accelerometer.
  - Calibration required with Pathway Van

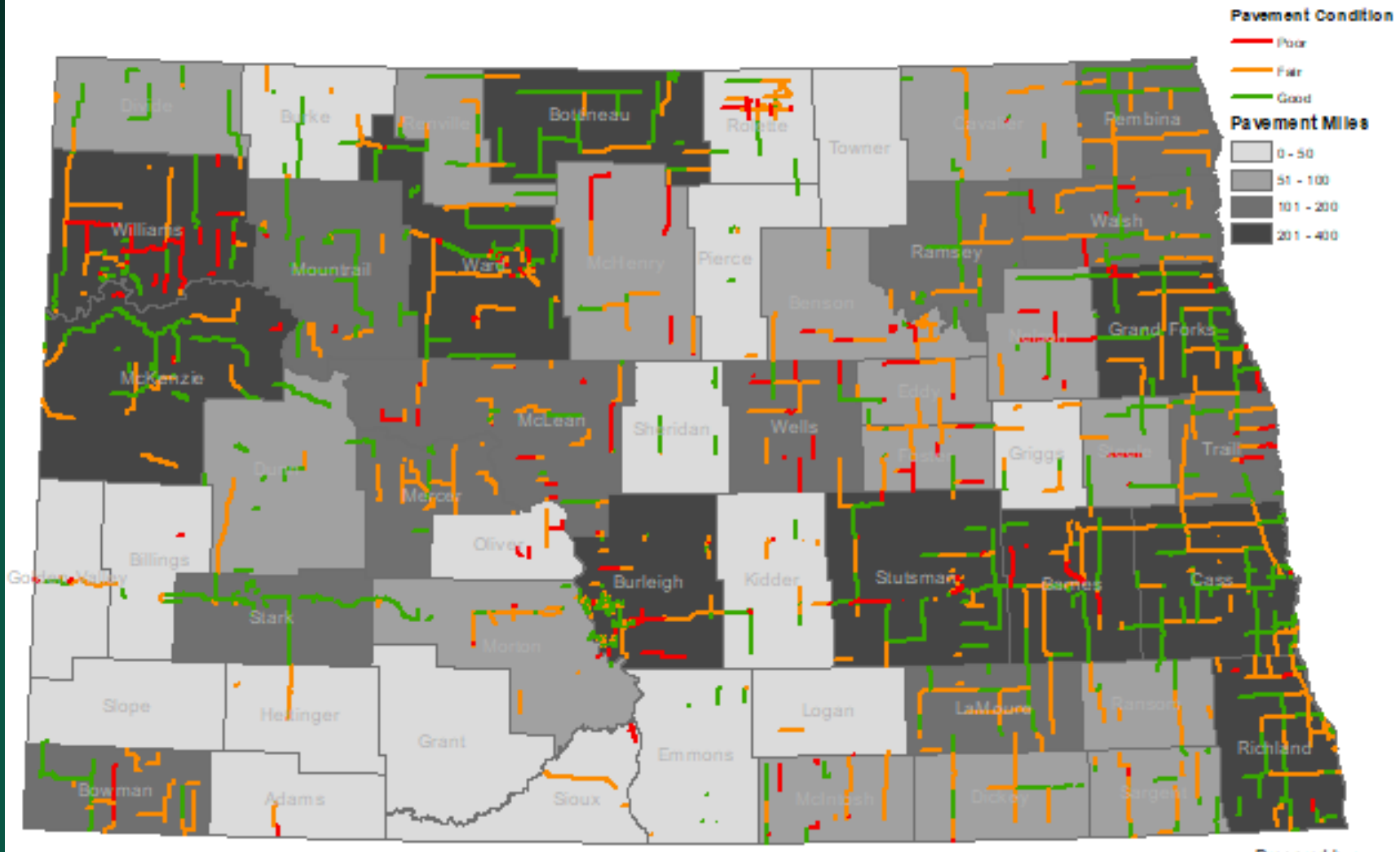


Pavement Data Collection

- All devices reported IRI based on accelerometer.
  - Good results after development of regression models



Pavement Condition
2019 Combined ride and condition



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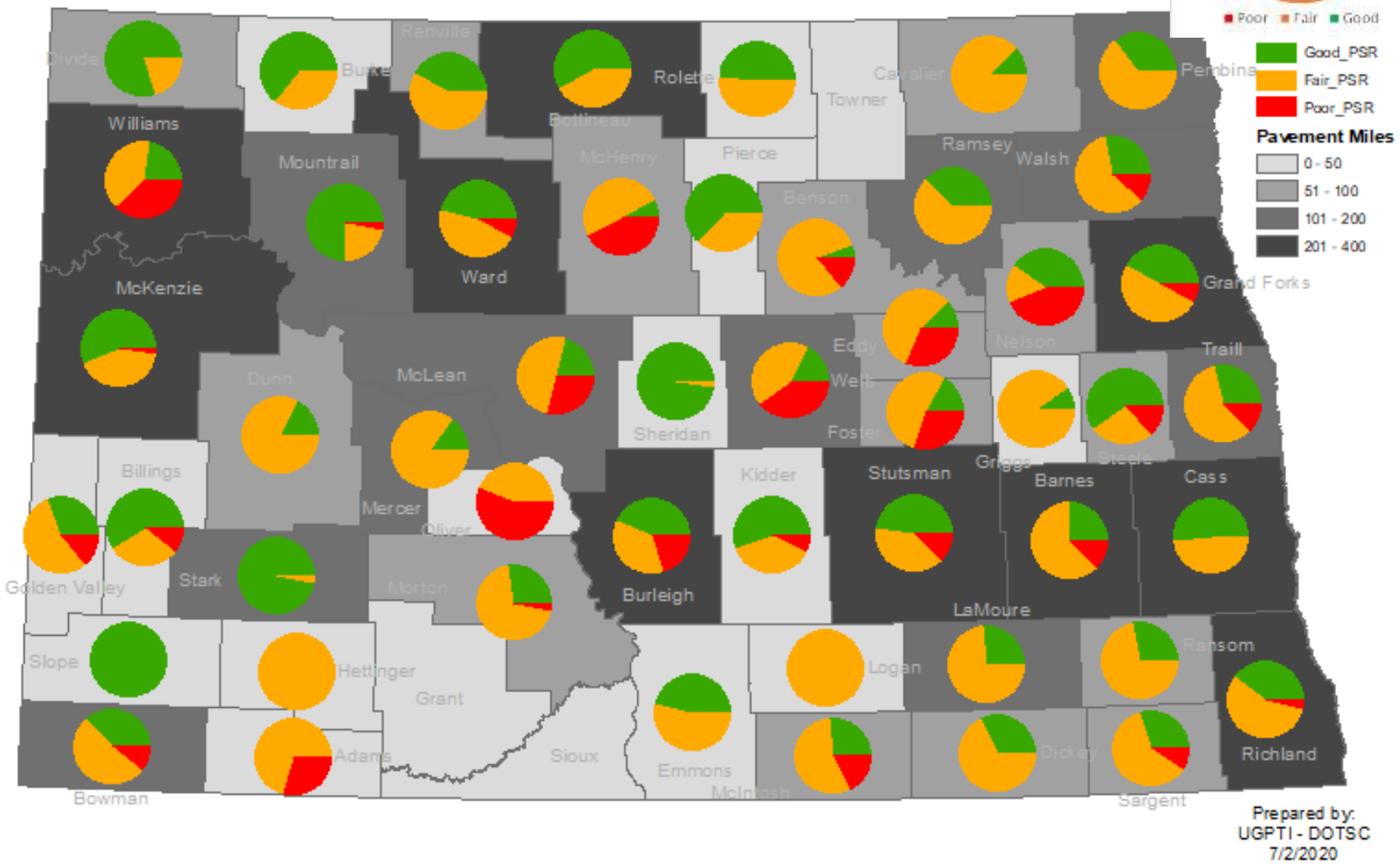
7/2/2020

Pavement Condition
2019 Combined ride and condition



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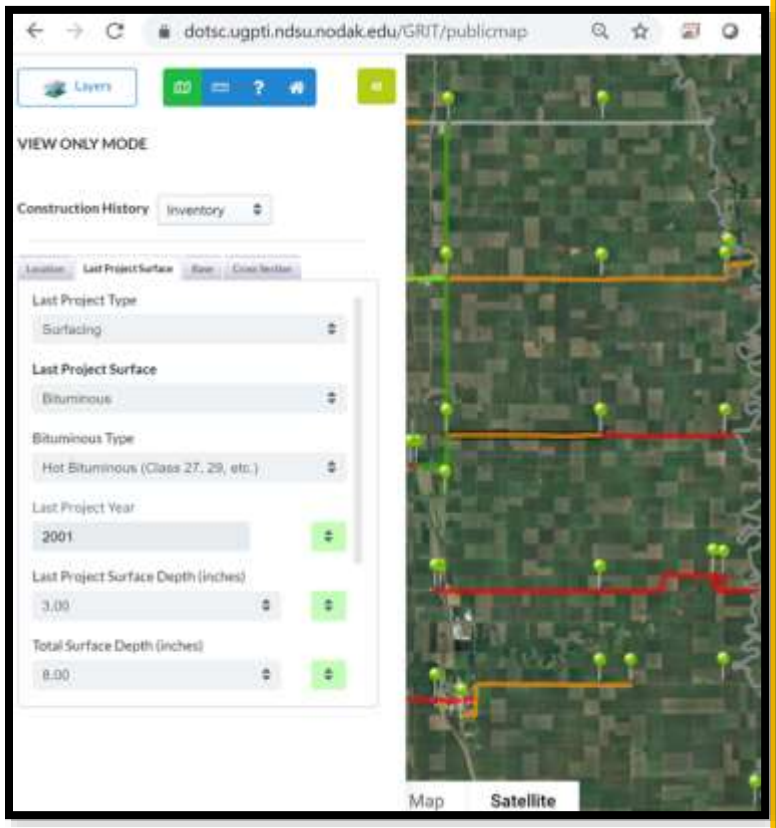
Data Collection (Cont.)

- **P**avement/subgrade strength and depth
  - Falling Weight Deflectometer and Ground Penetrating Radar
  - Sampling on all county paved segments > 2 miles in length
  - Completed October 28, 2015
  - **Updated with GRIT Data…**

Pavement Data Collection

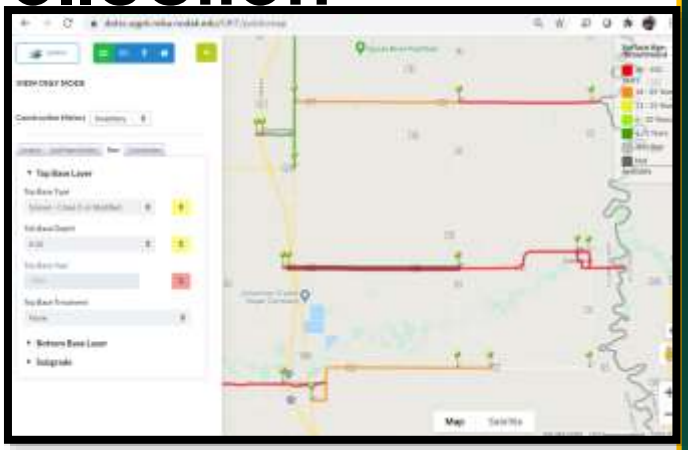
- **Geographic Roadway Inventory Tool (GRIT)**
  - Easy to use web-map based inventory tool
  - Available and in use by all ND Counties
  - Four Layers of Information
    - Construction History
    - Construction Planning
    - Minor Structures
    - Load Restrictions



https://www.ugpti.org/resources/asset-inventory/

Pavement Data Collection

- **Geographic Roadway Inventory Tool (GRIT)**
  - Construction History – SN
    - Pavement thickness and type
    - Base thickness and type
    - Subgrade strength
    - Pavement Age
  - Shoulder type and width

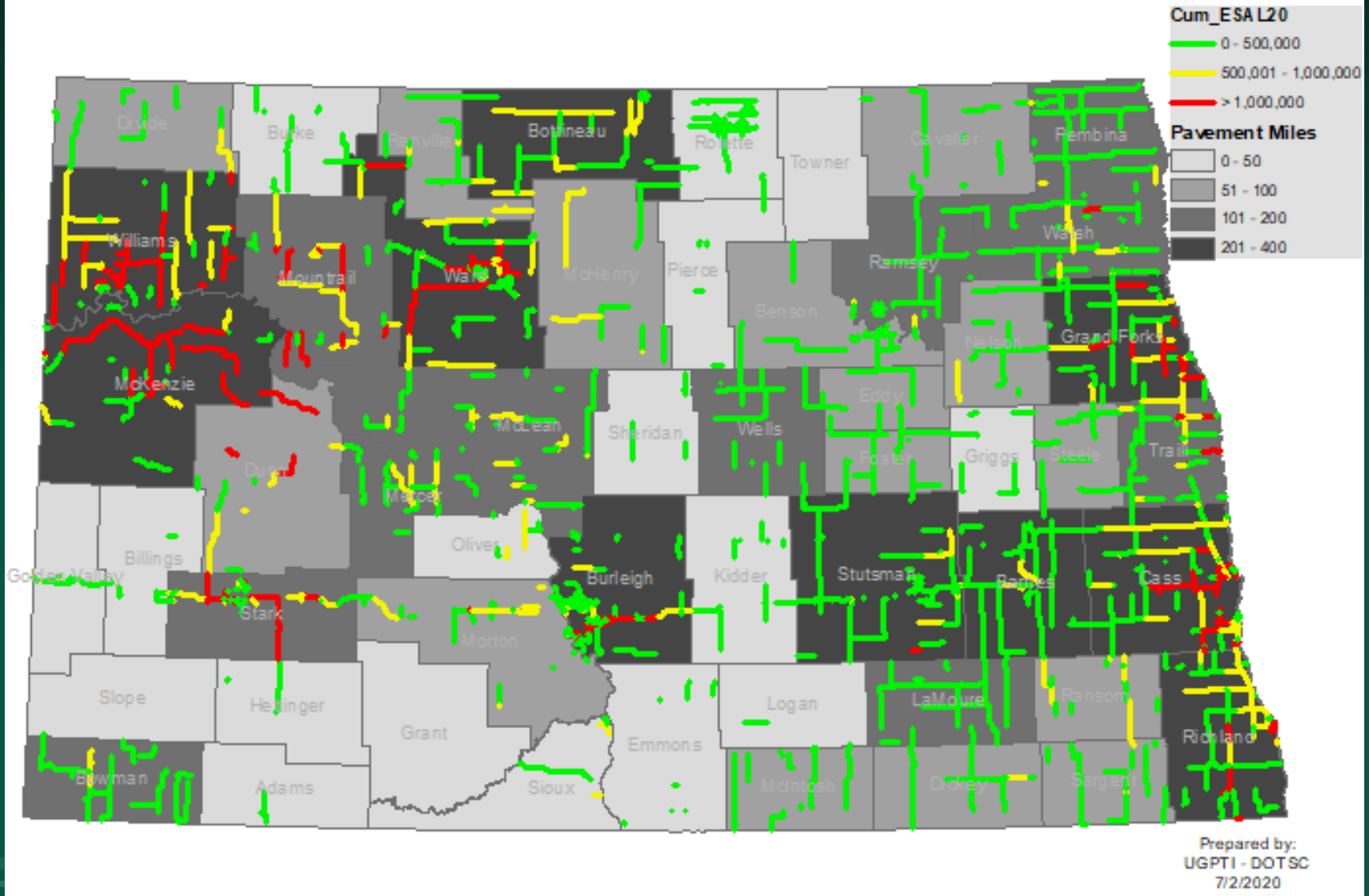


https://www.ugpti.org/resources/asset-inventory/

Paved Data Analysis

- AASHTO pavement design model
  - Design Inputs
    - PSR – initial pavement condition
    - Cumulative ESAL's – truck traffic
    - Structural Number SN – roadway strength
    - Subgrade strength – Resilient Modulus
- Other Inputs
  - Shoulder width

Equivalent Single Axle Loads (ESAL)
Cumulative ESAL over 20 year period



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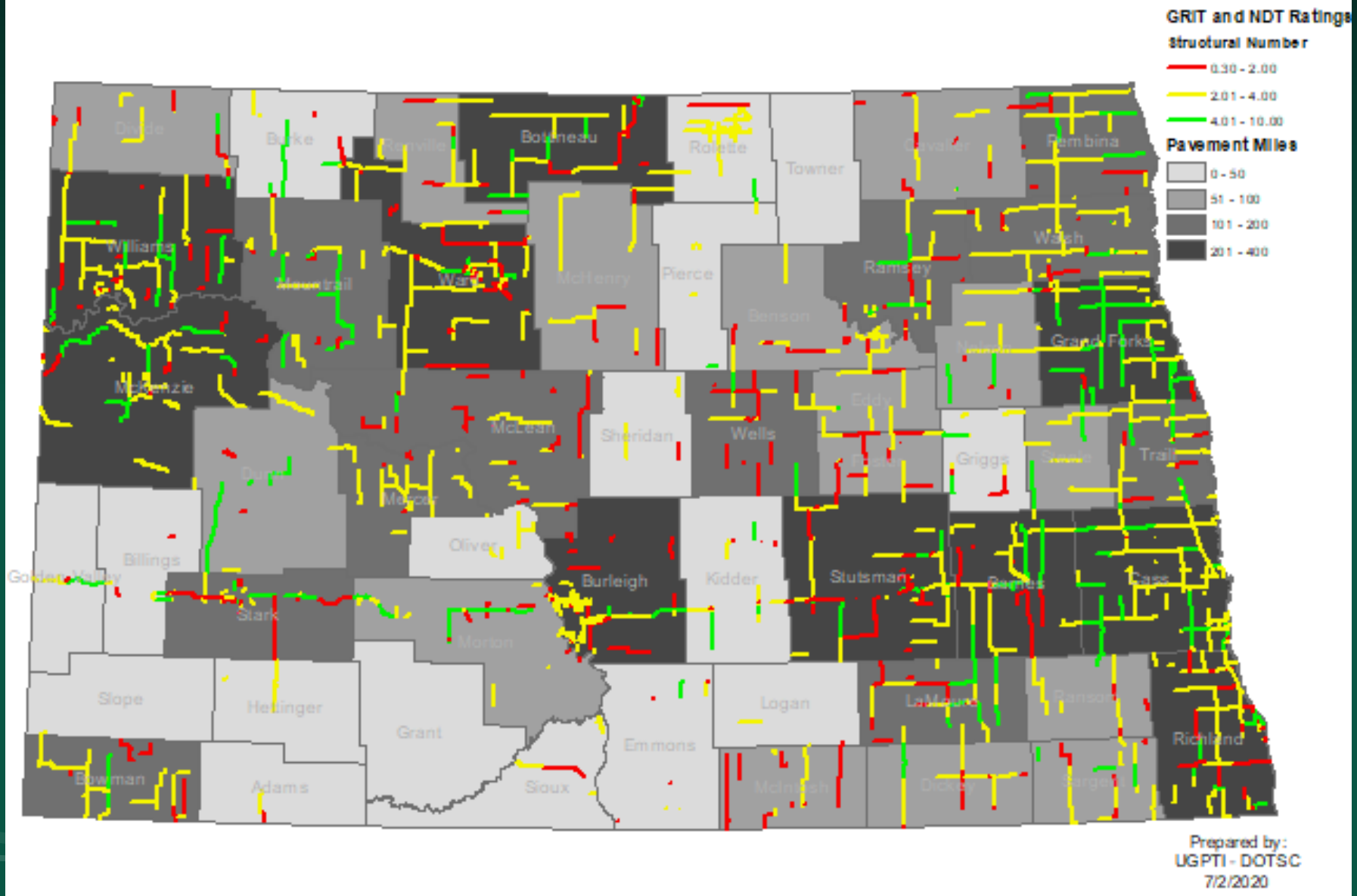
Structural Number (SN)
GRIT and NDT



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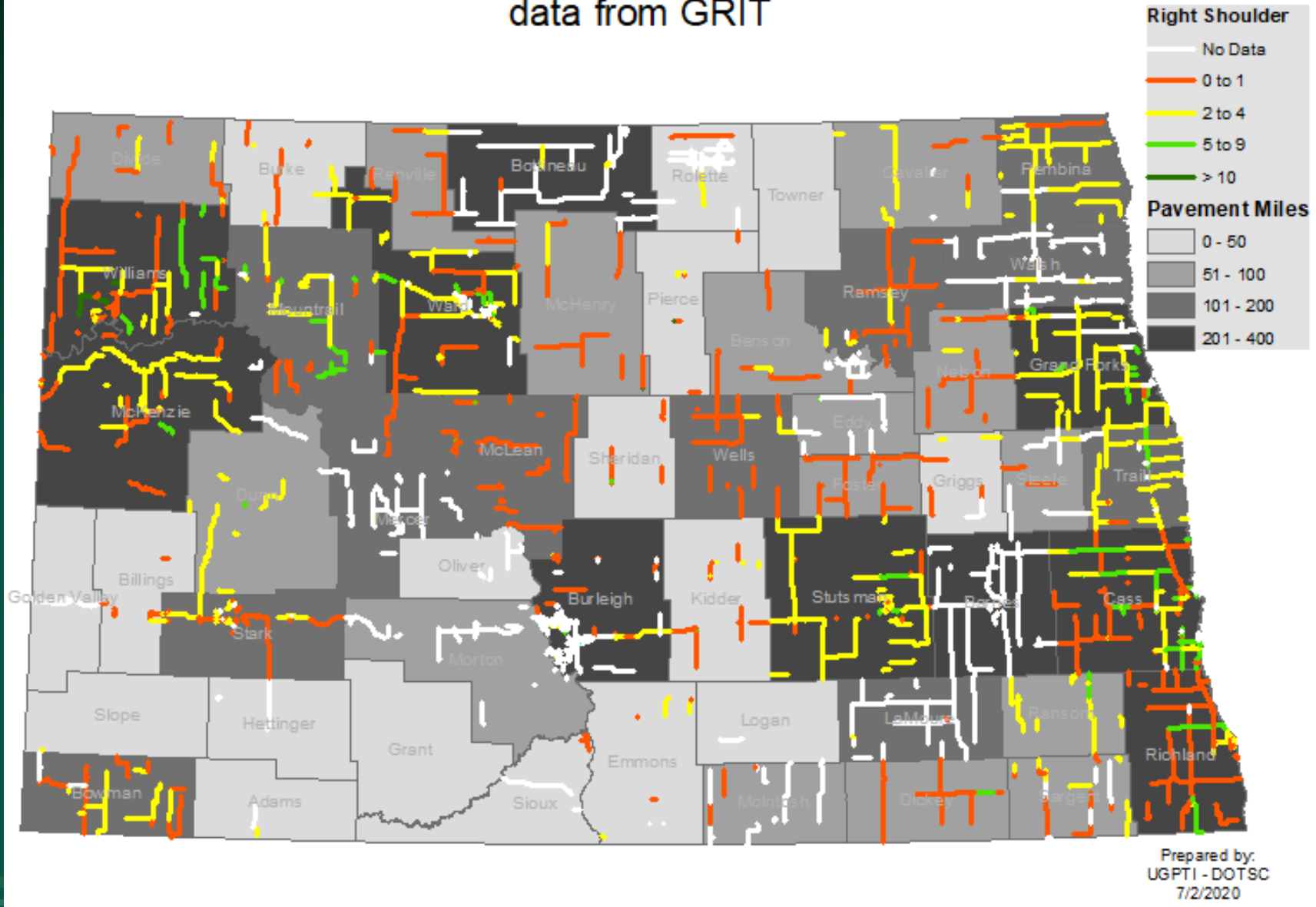
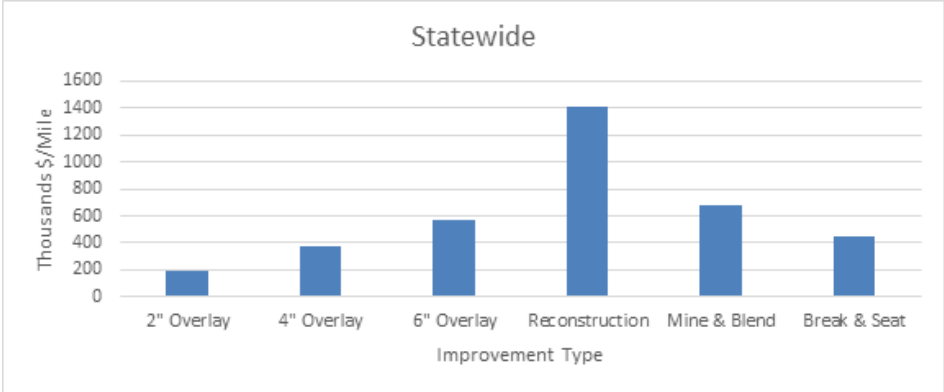
Shoulder Width
data from GRIT

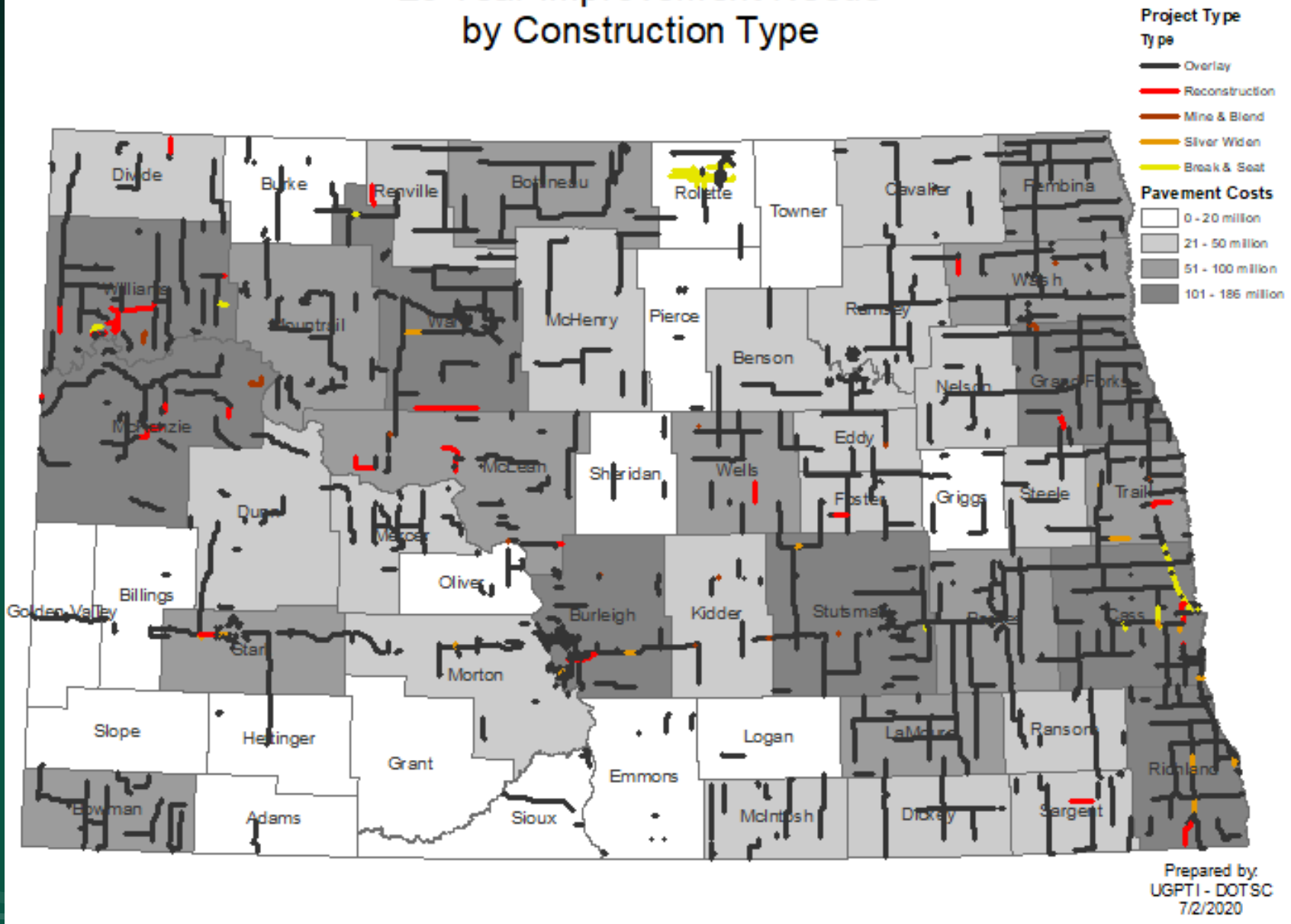


Paved Data Analysis

- **Project Selection and Costs**
  - Bituminous Overlay
    - $200 to $550,000
  - Total Reconstruction
    - $1.4 Million
  - Mine & Blend / Reclamation
    - $678,000
  - Widening with Overlay
    - Add $87,000 per foot width to overlay
  - Concrete Pavement Repair (CPR)
    - $450,000



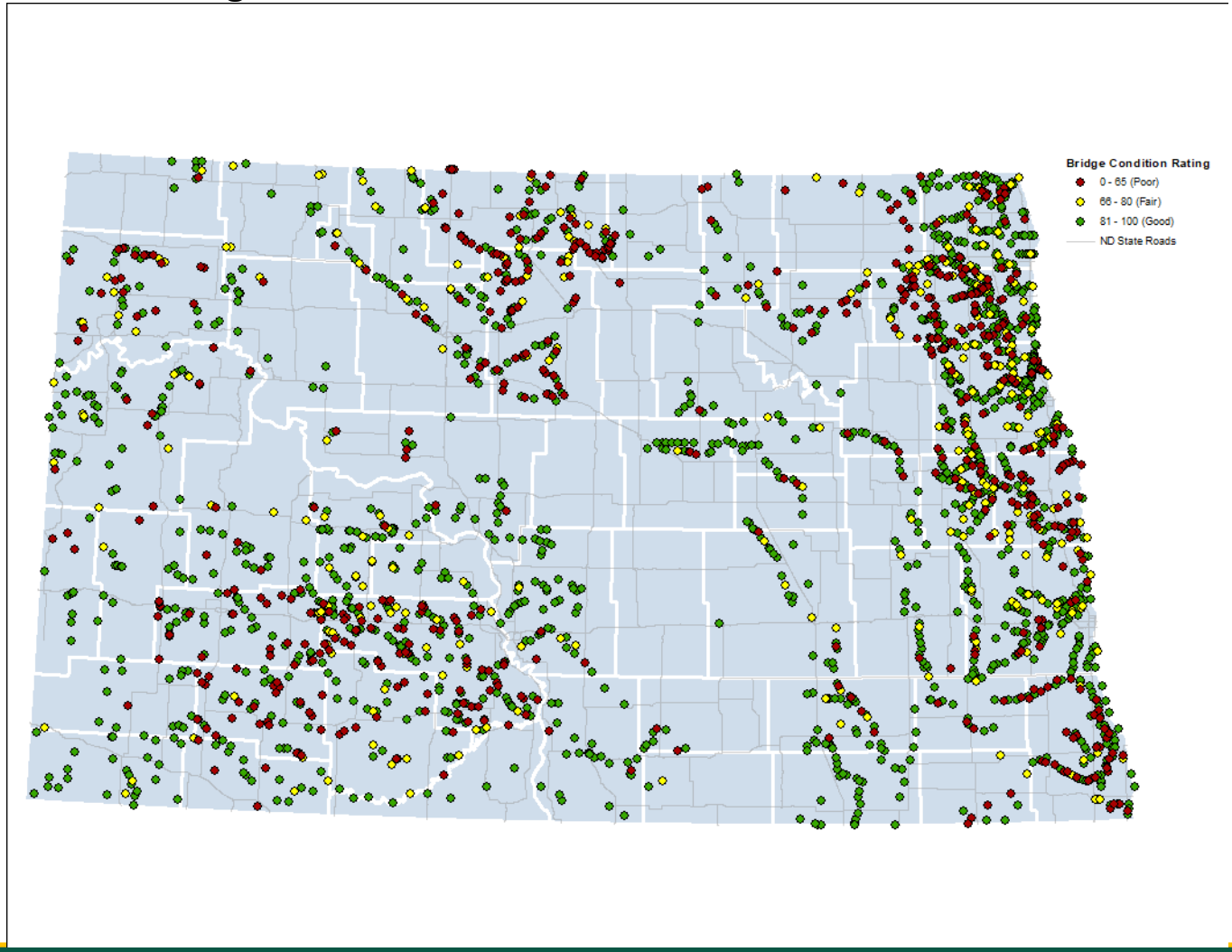
20 Year Improvement Needs by Construction Type



Bridge Analysis

- Data sources
  - Used the FHWA 2019 National Bridge Inventory System (NBIS).
    - Contained data from 2019 bridge safety surveys
  - Extracted the existing box culverts
  - Extracted minimum maintenance road based bridges – about 175
  - Extracted known improvements for 2019 and 2020

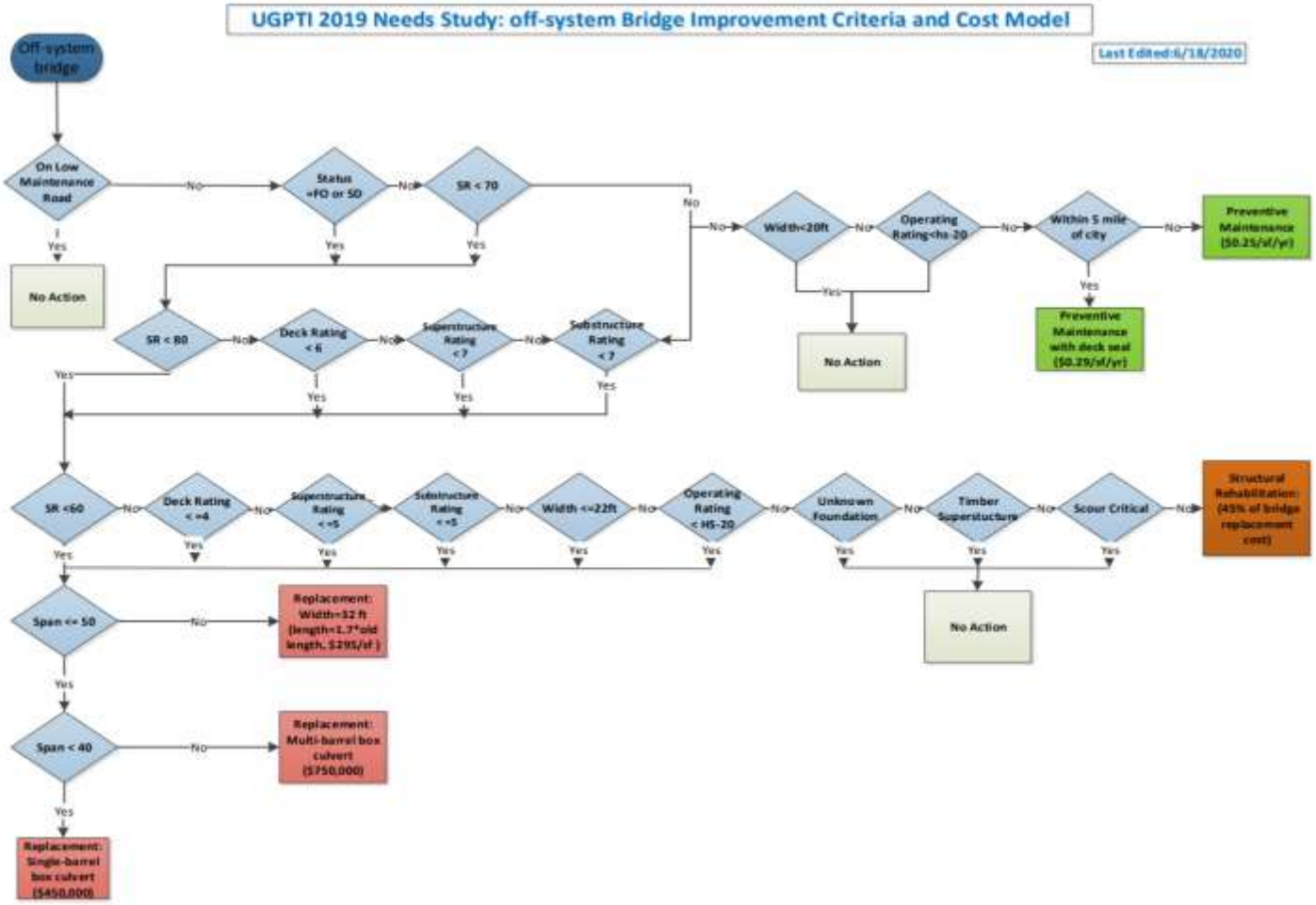
Bridge Condition and Location – FHWA NBIS - 2019



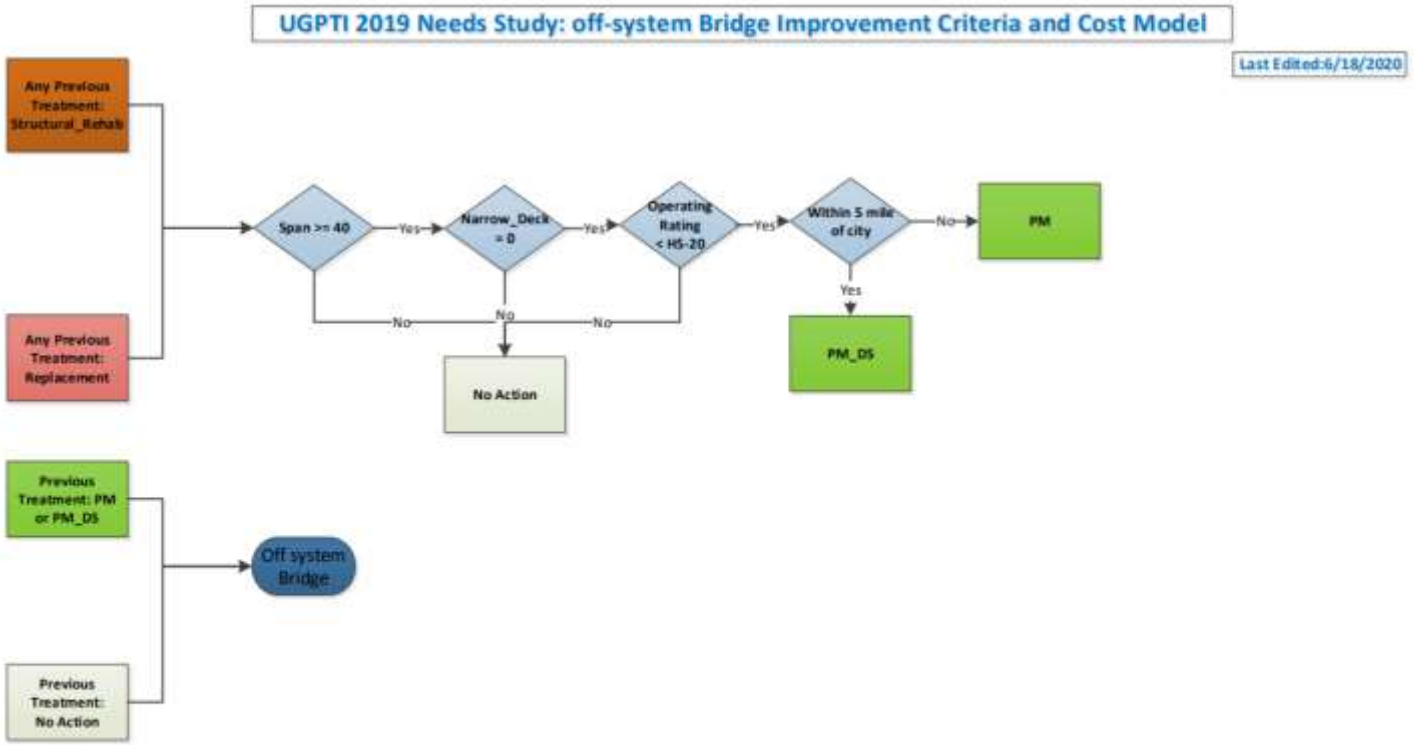
Bridge Analysis Methodology

- In a Nutshell – Reviewed the Following
  - Deck, Superstructure or Substructure <= 4
  - On-System bridges < HS-20
  - Structurally Deficient
  - Width < 20 ft. (off-system)
  - Low Sufficiency Rating with unknown foundation

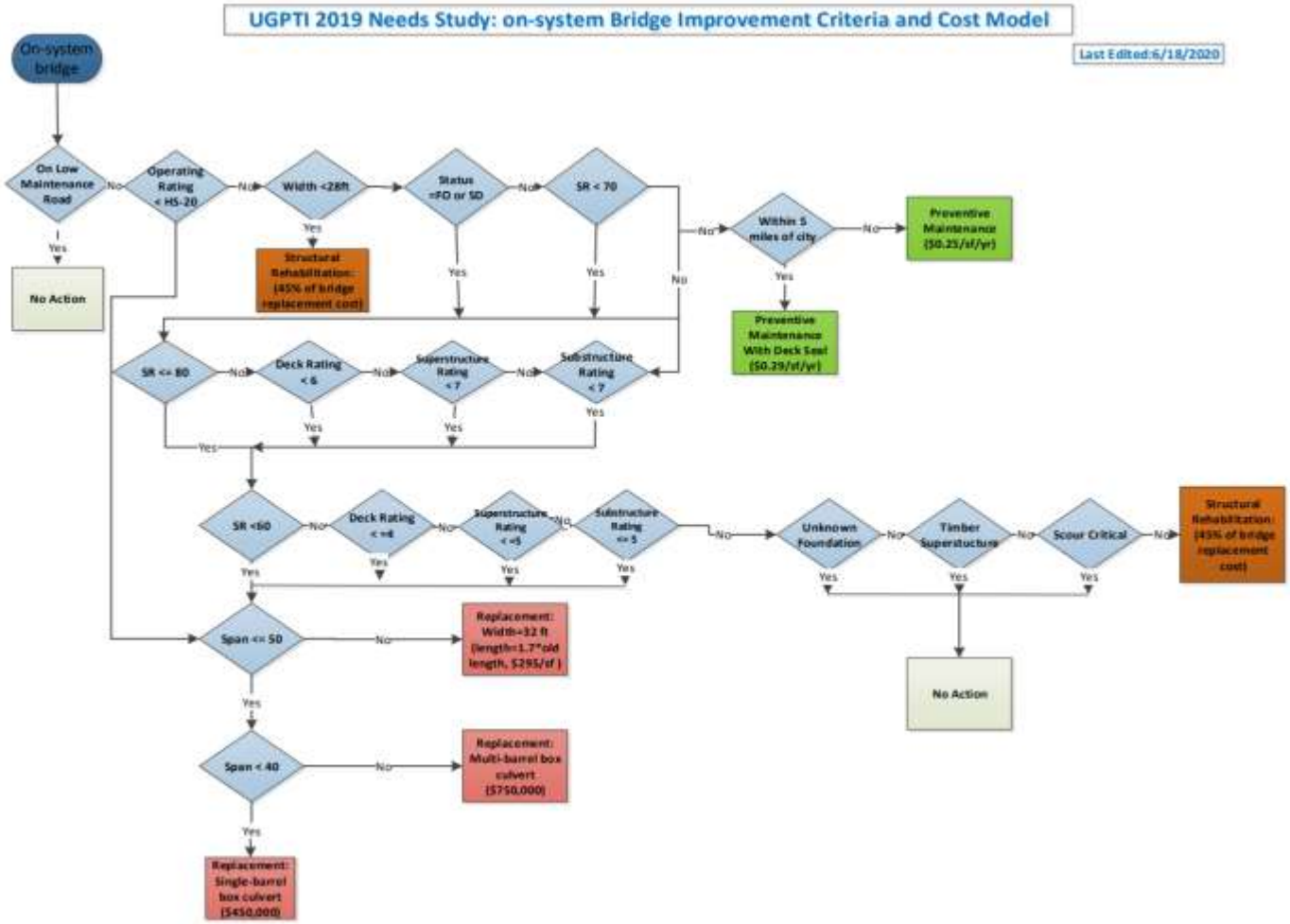
Bridge Analysis



Bridge Analysis

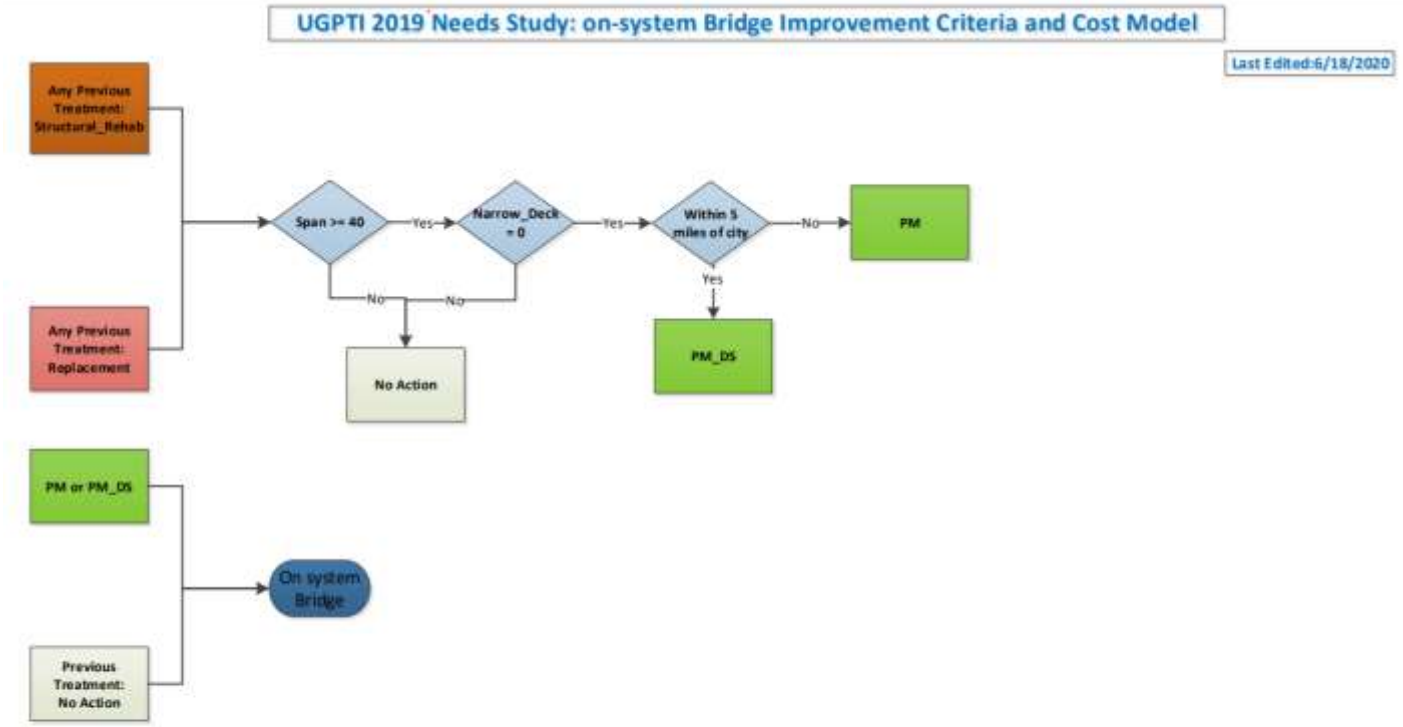


Bridge Analysis



2020

Bridge Analysis



Bridge Analysis

- Unit cost model
  - Based on 2019-20 NDDOT county bid reports
    - Examples obtained from Local Govt. Div.
    - Includes approach roadway, preliminary and construction engineering
- Replacement cost projections:
  - Bridges: $295/sf. deck area
  - Culverts: $450,000 per single barrel box and $750,000 per multiple barrel box.

Bridge Analysis

- Rehabilitation:
  - Deck widening 50% replacement cost
  - Deck replacement 45% replacement cost
- Preventive maintenance:
  - $0.25/sf./year – deck washing, deck and crack sealing and joint maintenance
  - $0.29/sf./year if within 5 miles of city > 5000 population

Results of Analysis: Unpaved, Paved and Bridges

Results of Unpaved Analysis by Jurisdiction (2021-2022)

Jurisdiction and/or Maintenance Resp.	Needs (Millions)	Percent of Needs
County	$ 395.86	65%
Township	$ 203.00	33%
Tribal	$ 12.22	2%
Total	**$ 611.08**	**100%**

Results of Unpaved Analysis by Jurisdiction (2021-2040))

Jurisdiction and/or Maintenance Resp.	Needs (Millions)	Percent of Needs
County	$3,794.97	65%
Township	$2,038.41	33%
Tribal	$ 122.72	2%
Total	**$6,136.10**	**100%**

Results of Paved Analysis

Summary of Paved Road Investment and Maintenance Needs for Counties and Townships in North Dakota

(Millions of 2020 Dollars)

Period	Statewide
2021-22	$ 388.46
2023-24	$ 406.97
2025-26	$ 304.56
2027-28	$ 264.53
2029-30	$ 222.20
2031-40	$ 1,081.77
2021-40	**$ 2,668.49**

Results of Bridge Analysis

Results of Bridge Analysis

Period	Rehabilitation		Replacement		Improved Bridges	Maintenance Cost $ Thousand	Total Cost $ Thousand
	Bridges	Cost $	Bridges	Cost $ Thousand			
Backlog	6	$2,252	619	$474,663			
2021-2022	1	$224.85	120	$92,018.59	121	$2,144.63	$94,388
2023-2024	1	$240.57	120	$92,018.59	121	$2,144.63	$94,404
2025-2026	1	$580.94	120	$92,018.59	121	$2,144.63	$94,744
2027-2028	1	$465.84	120	$92,018.59	121	$2,144.63	$94,629
2029-2030	1	$312.09	120	$92,018.59	121	$2,144.63	$94,475
2031-2040	1	$427.26	19	$14,569.61	20	$10,723.15	$25,720
2021-2040	6	$2,252	619	$474,663	625	$21,446	$498,360

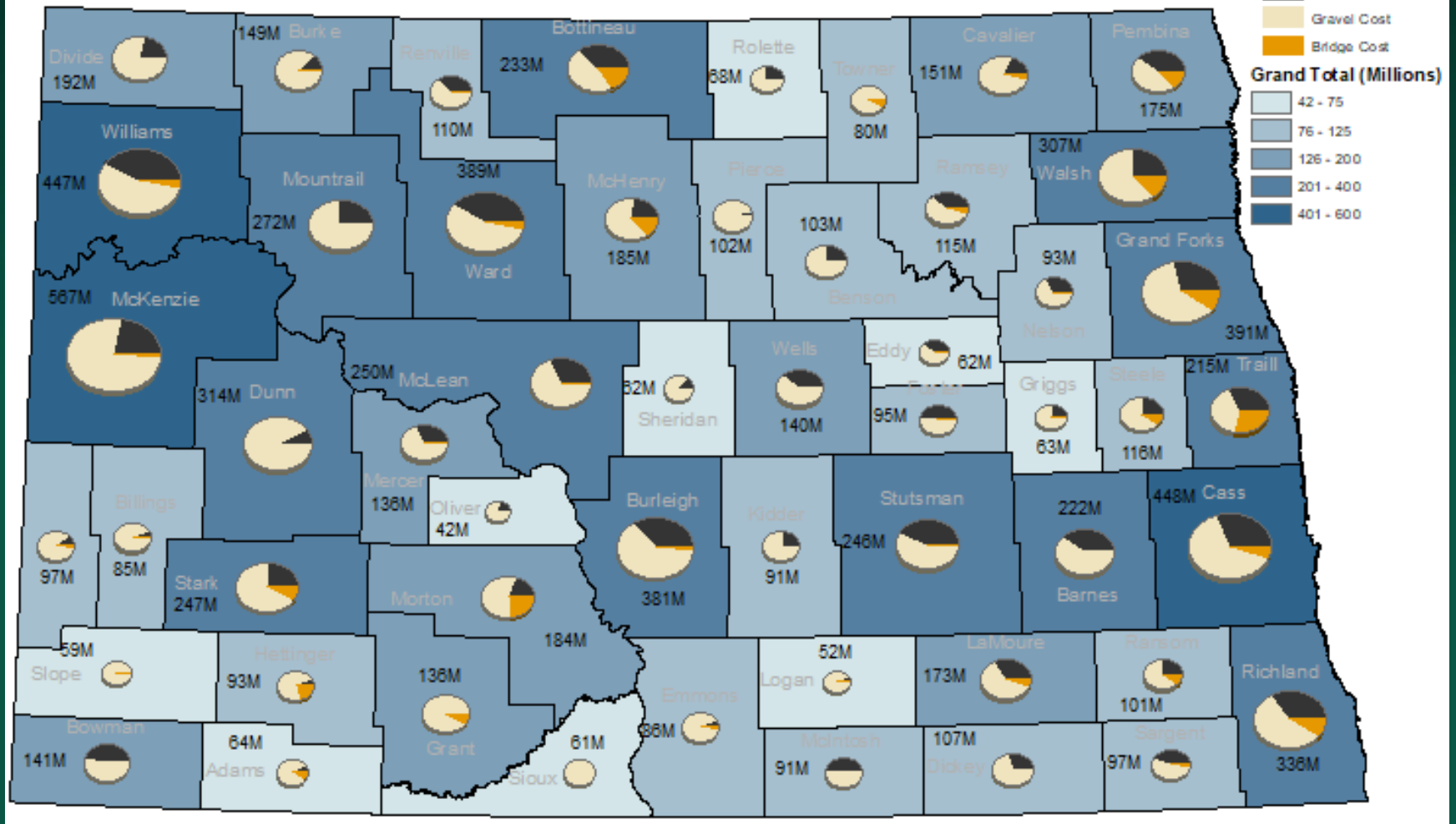
Statewide Results

$ Millions

Period	Unpaved	Paved	Bridges	Total
2021-2022	$ 611.08	$ 388.46	$94	$ 1093.54
2023-2024	$ 602.19	$ 406.97	$94	$ 1103.16
2025-2026	$ 616.21	$ 304.56	$95	$ 1015.77
2027-2028	$ 615.89	$ 264.53	$95	$ 975.42
2029-2030	$ 602.76	$ 222.20	$94	$ 918.96
2031-2040	$ 3,087.97	$ 1,081.77	$26	$ 4195.74
2021-2040	$ 6,136.10	$ 2,668.49	$498	$ 9302.59

Projected Total Costs

Pavement, Gravel, and Bridge Needs
2021 - 2040



Prepared by:
UGPTI - DOTSC
7/2/2020

Tracking of Comments/Responses

- As per 2014 Method.

Commenting Entity	UGPTI Emailed Road Authority Maps and Offered to Help(dch)	Tribal Contacts	UGPTI Visited Road Authority in Person (dch or bw)	UGPTI Contacted or Met With Road Authority's Consultant(dch)	Sent Response to UGPTI	UGTPI Emailed Response	UGPTI Phone Response
Adams County	X						
Barnes County	X		X	X	X	Mielke	X
Benson County	X		X		X		
Billings County	X		X		X	Mielke	
Bottineau County	X			X			
Bowman County	X			X			X
Burke County	X				X		
Burleigh County	X		X		X		Alan
Cass County	X		X				X
Cavalier County	X				X		
Dickey County	X		X	X	X	Mielke	
Divide County	X						
Dunn County	X		X				
Eddy County	X				X		
Emmons County	X		X	X			
Foster County	X						
Golden Valley County	X		X				
Grand Forks County	X		X		X		Alan
Grant County	X			X			
Griggs County	X						

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Assessment of ND County and Local Road Needs

2019-2021 Legislative Study

Related Links

- Study Overview
- Study Updates
- Geographic Roadway Inventory Tool (GRIT)

This effort responds to the North Dakota Legislature's request for a study of the transportation infrastructure of all county, township, and tribal roads and bridges in the state. The following document is in draft form and available for comments, and based on the comments is subject to potential edits. Comments will be taken until August 30, 2020 and then a final draft will be posted. Infrastructure needs are estimated using the most current crop and oil production forecasts, traffic estimates, and roadway condition data. Agricultural and oil related traffic is modeled in detail at sub-county level. Oil related traffic is predicted for individual spacing units, whereas agricultural production is estimated at the township level.

- **View the Draft Report** *(PDF, 4193K)*
- View the Supplemental Information

For questions or comments on the report, contact ndsu.roadneeds@ndsu.edu.

Final Reports from Past Legislative Studies

- 2015-2017 — Study of County and Local Roadway Needs
- 2013-2015 — Study of County and Local Roadway Needs
- 2011-2013 — Study of County and Local Roadway Needs

Comment Process

- Contact info – Email submittal preferred
- ndsu.roadneeds@ndsu.edu

- Responders will be Tim Horner, Dale Heglund, Brad Wentz or Alan Dybing