Building a Database to Predict the Future

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33rd Annual North Central Local Roads Conference
Rapid City, SD - October 17-18,2018

Why????

- Becker County MN Engineer

- 2008 – County Board Requests

- Brad's rambling story….

…Critical step for effective

Transportation Asset Management

TAM Summary

- Inventory
- Performance Assessment
- Short Term Improvement Plans
- Performance Prediction
- Set Targets And Optimization
- Long Range Improvement Plans and Budget

Transportation Asset Management

Inventory

- **Geographic Roadway Inventory Tool (GRIT)**
  - Developed by UGPTI for ND Needs Study
  - Recent upgrade to GRIT 2.0
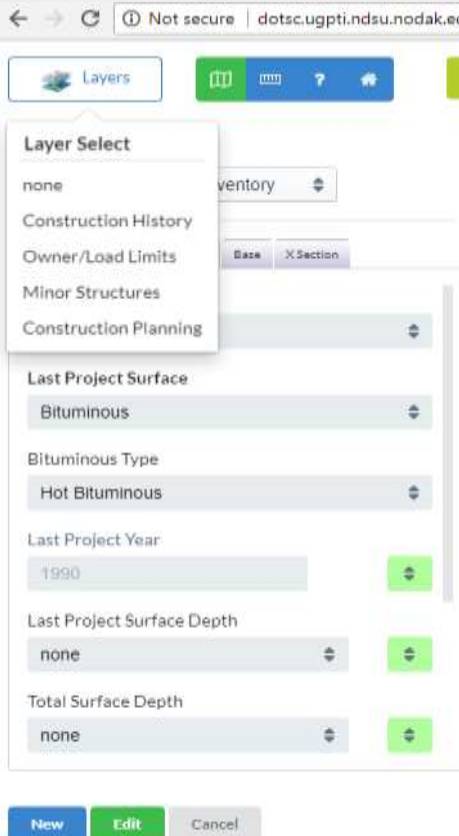 - Developed support agreement non-ND Counties

Inventory

- **Geographic Roadway Inventory Tool (GRIT)**
  - Currently 4 Layers of Data

| Construction History	Construction Planning	Bridges	Load Restrictions	Maintenance
Location	Location	Location	Location	Const History
Highway	Highway	Highway	Highway	Segments
Surface Type	Project Type	Type	Owner	Bituminous
Proj Type	Project #	Material	Func. Class	Seal Coat
LP Year	Planned Year	Span	Maintenance	Crack Seal
LP Depth	Status	Cell Diameter	Road Type	Patching
Total Depth	Bid Open Date	Cell Width	Seas. Load Limit	Striping
Base Type	Cost	Cell Height	Seas. Gross Lmt	Year
Base Depth	Start Date	Length	Yr Rnd Limit	Cost
Base Year	Public Impact	Year Installed	Yr Rnd Gross	Gravel
Base Treatment	Restrictions	Cover Depth		Blading
SubGrd Strength	Detour	Replace Cost		Regravel
Treatment	Comments	Condition		Reshape
Lane Width	Funding Srce	Rating Date		Spot Repair
Shoulder Width	Funding Splits	GVW Limit		Dust Control
Grade Year	Fund Commit	Axle Limit		Frequency
Striping				Cost
Rumble Strips				Concrete
Curbs				Cracks
Inslope				CPR
ROW				Cost
Owner				

Inventory

- **Geographic Roadway Inventory Tool (GRIT)**
  - Web Map viewers for all data items
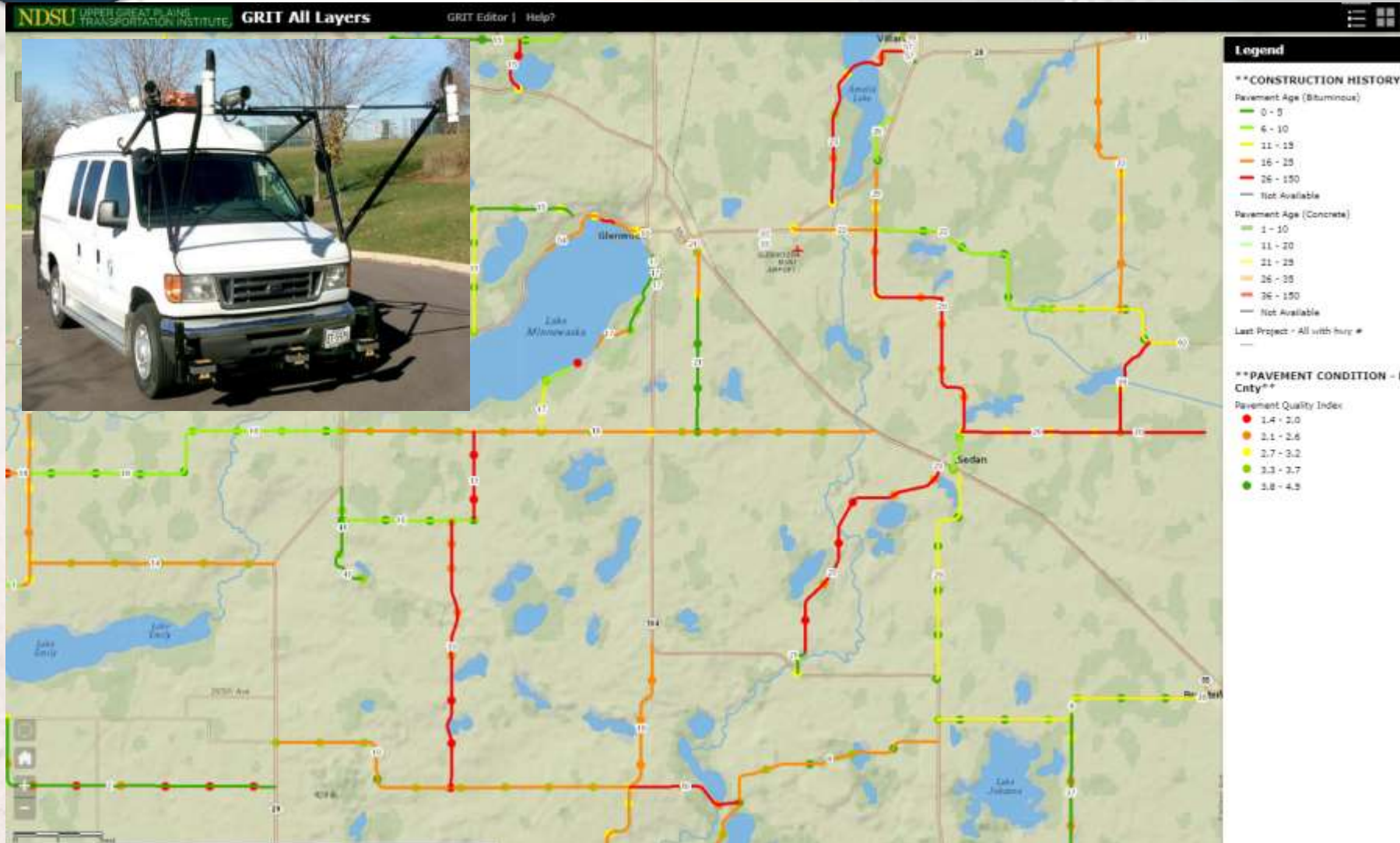 - GIS format for combining data
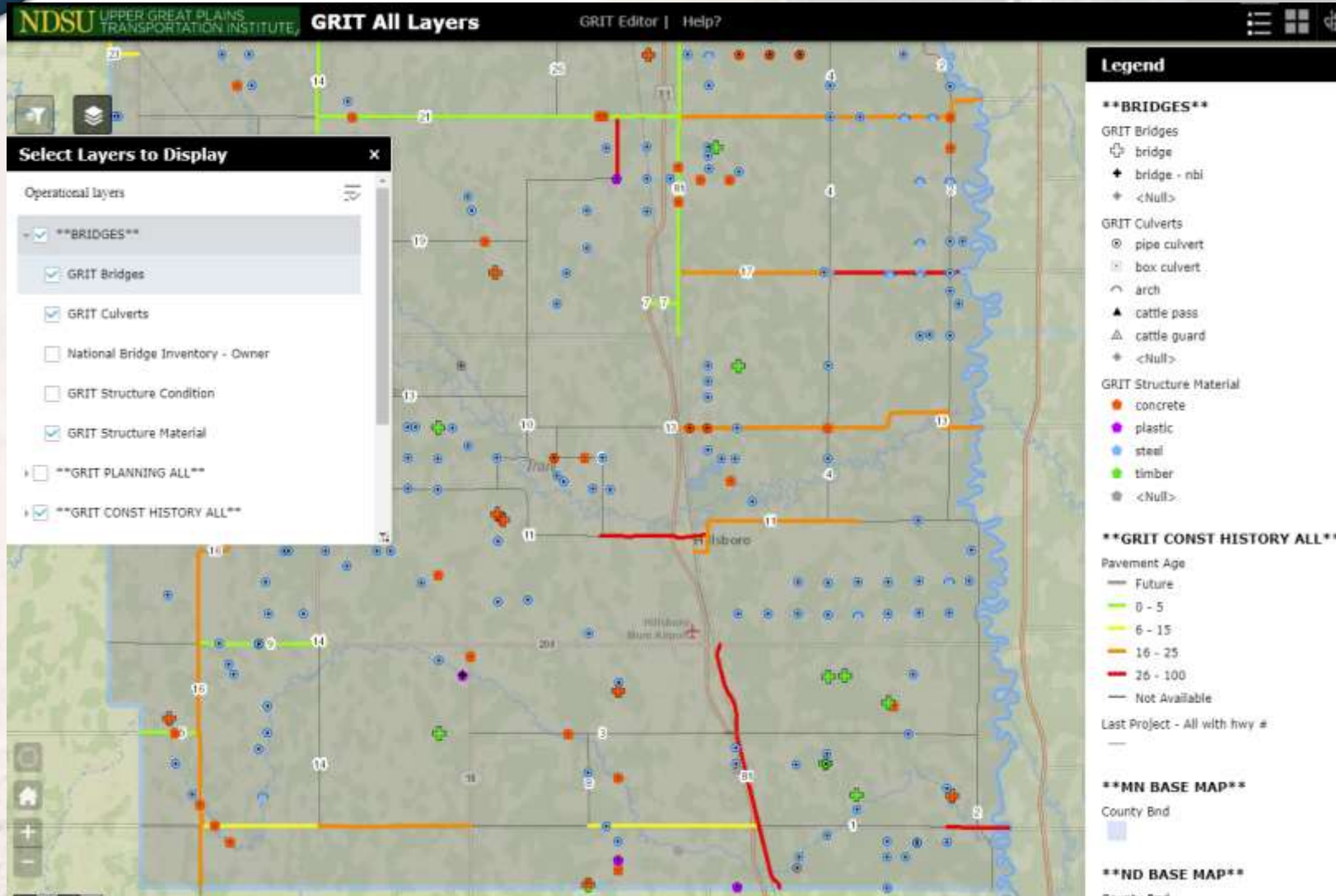
Inventory

- **Geographic Roadway Inventory Tool (GRIT)**
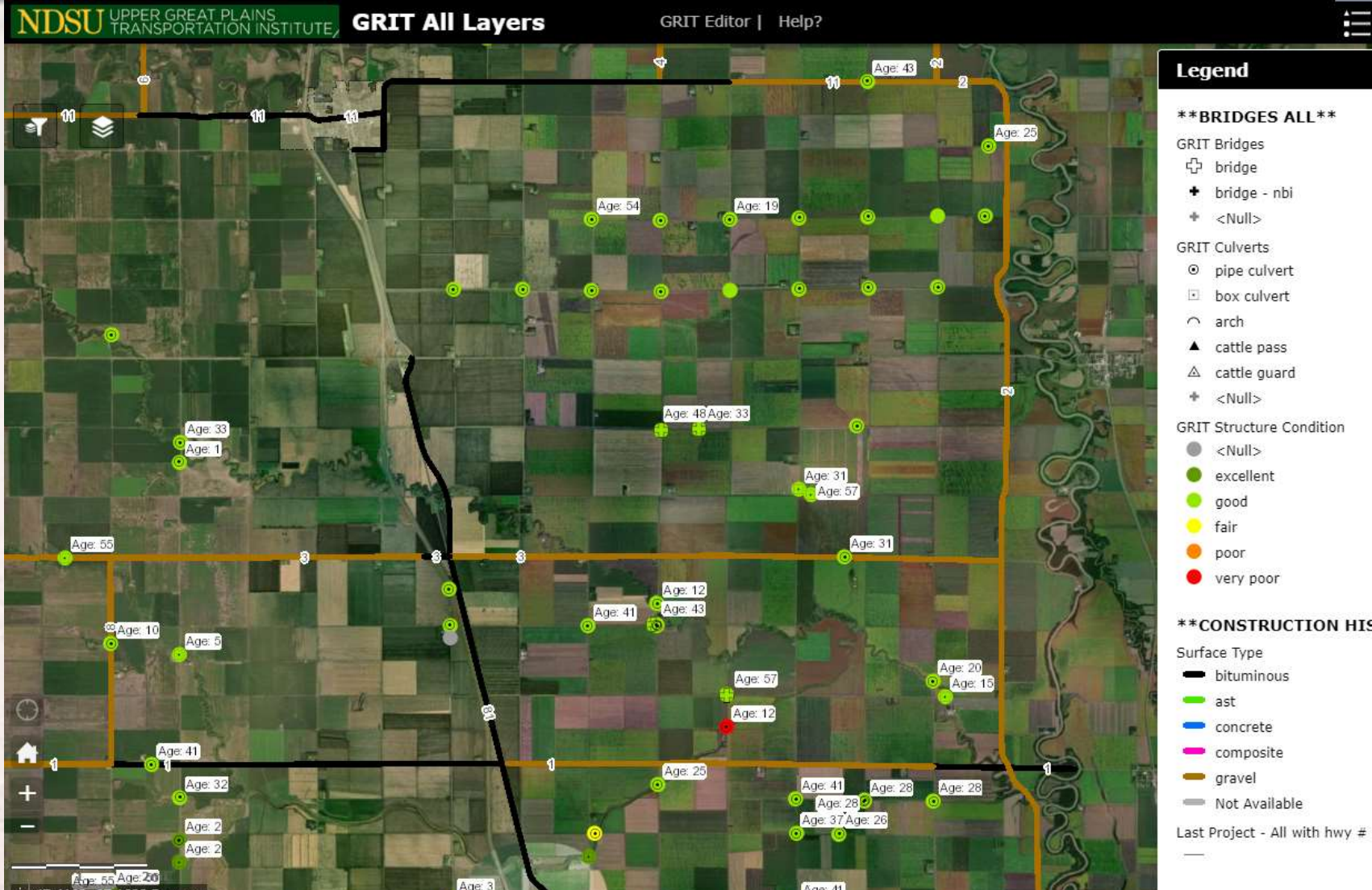 - GIS Web Services for all Data
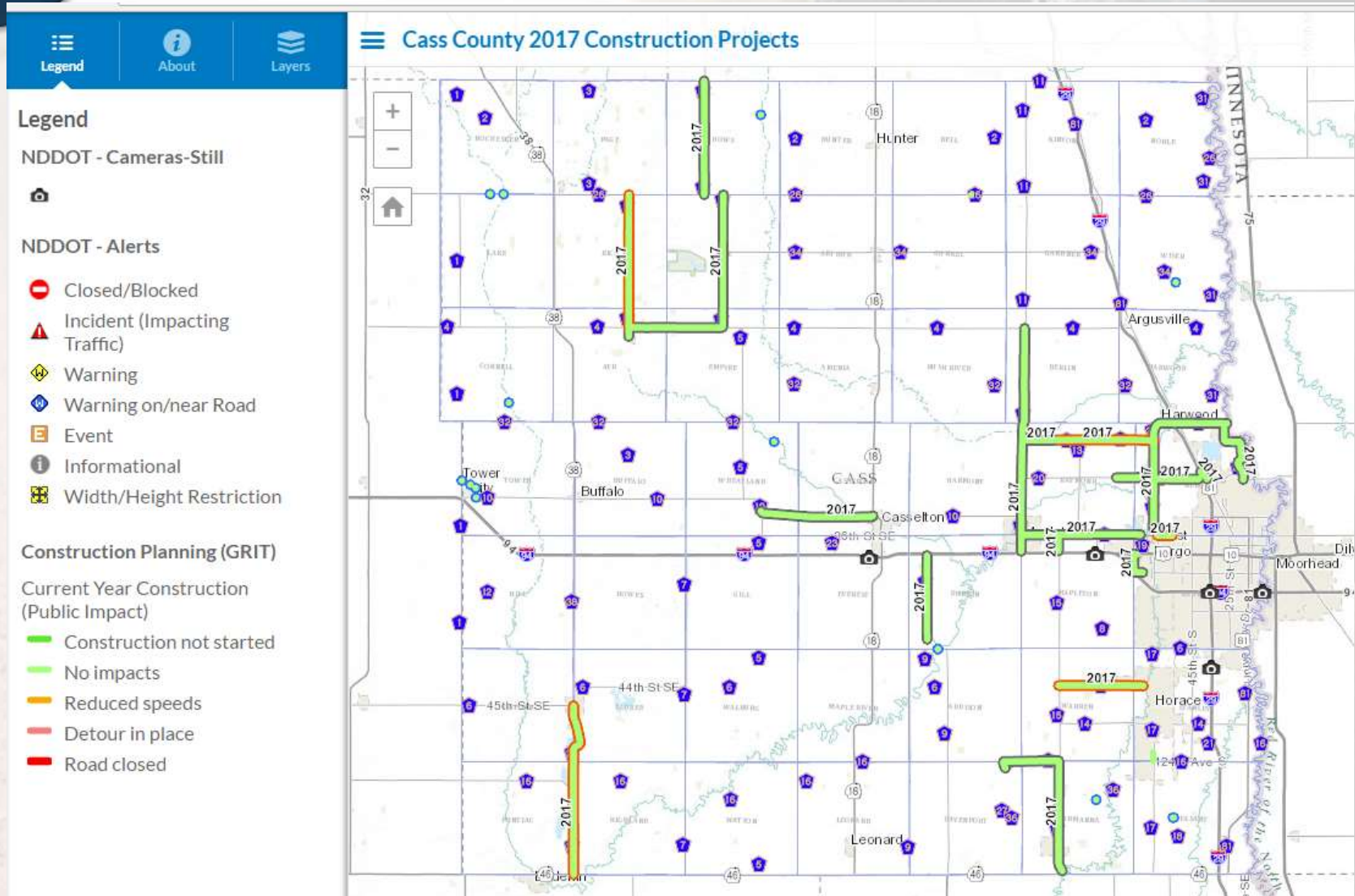
Performance Assessment

- **Geographic Roadway Inventory Tool (GRIT)**
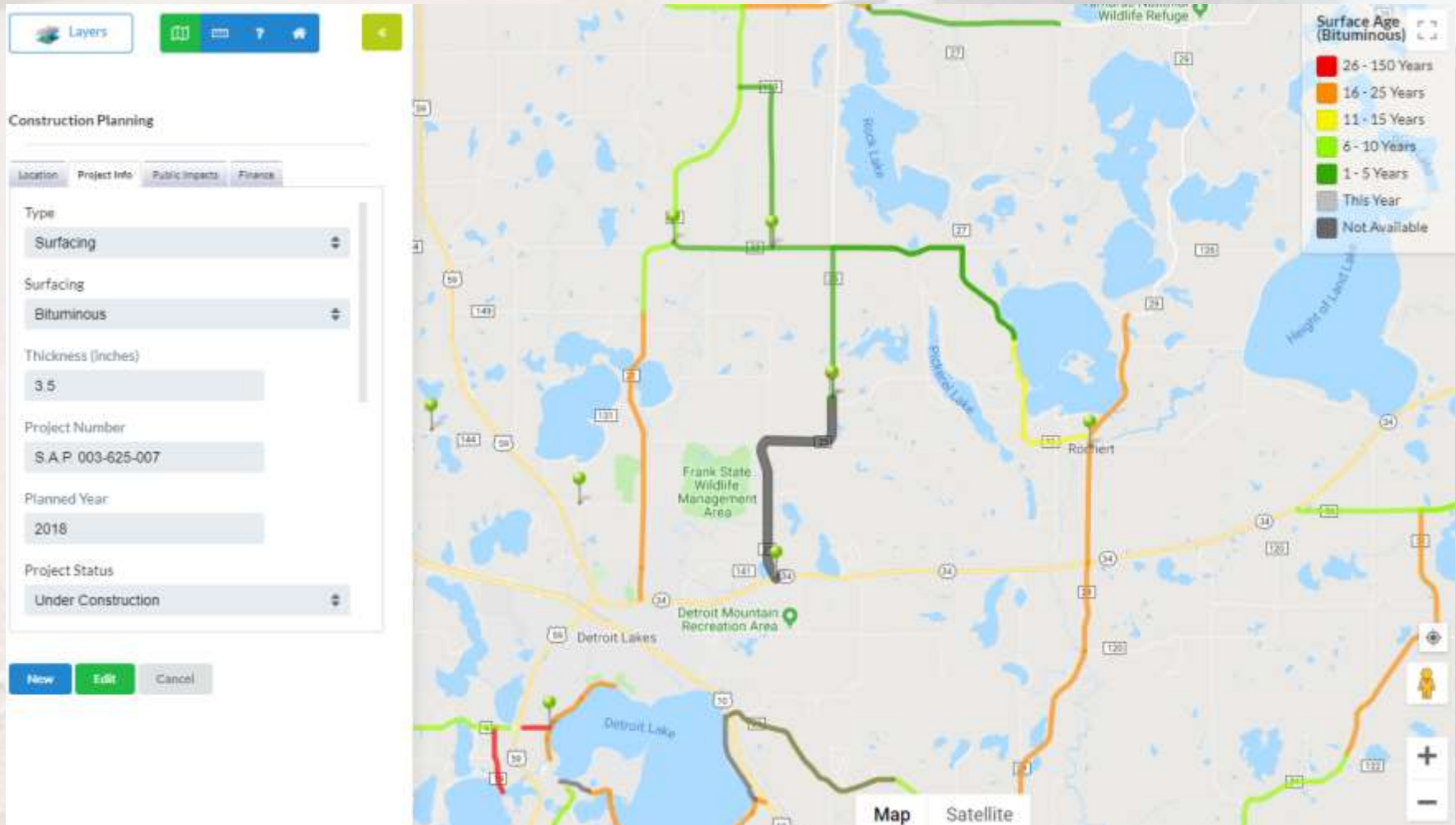 - Pavement Condition Rating

Performance Assessment

- **Geographic Roadway Inventory Tool (GRIT)**
  - Bridge Condition Rating

Short Term Plans

- **Geographic Roadway Inventory Tool (GRIT)**
  - Construction Planning Layer (5 Yr Plan)
  - Created by using current measures (condition or age)

Construction Planning

Location | Project Info | Public Impacts | Finance

Type
Surfacing

Surfacing
Bituminous

Thickness (Inches)
3.5

Project Number
S.A.P. 003-625-007

Planned Year
2018

Project Status
Under Construction

New | Edit | Cancel

Surface Age
(Bituminous)
- 26 - 150 Years
- 16 - 25 Years
- 11 - 15 Years
- 6 - 10 Years
- 1 - 5 Years
- This Year
- Not Available

- **Geographic Roadway Inventory Tool (GRIT)**
  - In Viewers Overlay 5 yr plan on performance data
  - Performance data ONLY from last year

Condition Forecasting

- **Geographic Roadway Inventory Tool (GRIT)**
  - MN LRRB Performance Prediction Project
  - Spring 2019 Completion

Goals

- Develop seamless data integration processes with MnDOT pavement condition and traffic data with GRIT inventory data.

- Develop a pavement condition forecasting module within GRIT based on the AASHTO 93 model.

- Provide on-line GIS web maps and services to prioritize roadway construction schedules and multi-year plans.

- **Geographic Roadway Inventory Tool (GRIT)**
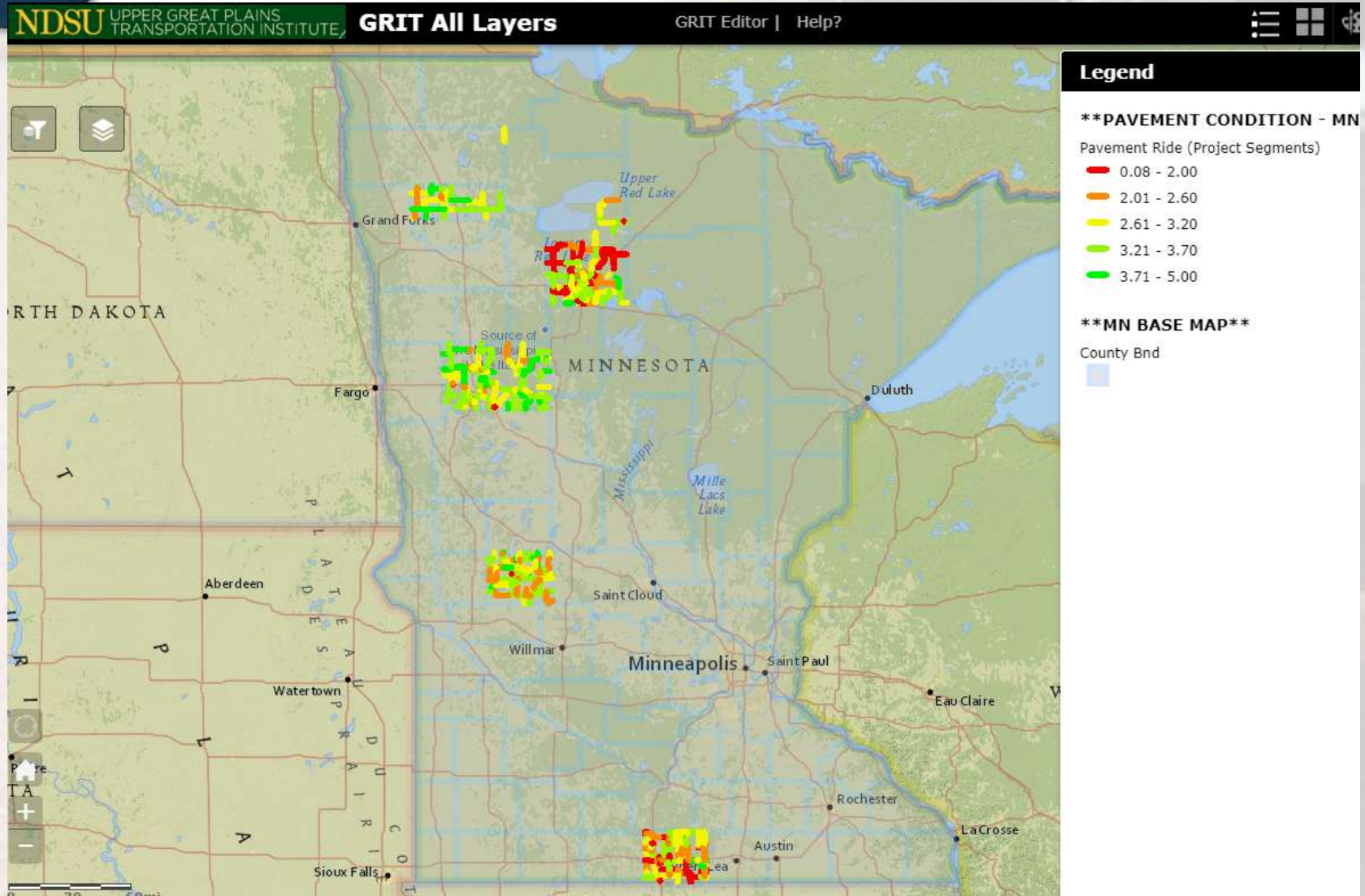 - Adding a Performance Section to the Construction History Layer

Condition Forecasting

- **Geographic Roadway Inventory Tool (GRIT)**
  - 1st Task - combining performance data with Inventory
  - This is pavement condition data averaged on project history

- **Geographic Roadway Inventory Tool (GRIT)**
  - With all inventory, planning, and Performance data geospatially combined model calculates what condition and age will be over the next 25 years.

$$\log(W_{18}) = Z_R \times S_o + 9.36 \log(SN + 1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \log(M_R) - 8.07$$

where:

W_{18}	=	predicted number of 18-kip equivalent single axle load applications
Z_R	=	standard normal deviate
S_o	=	combined standard error of the traffic prediction and performance prediction
ΔPSI	=	difference between the initial design serviceability index, p_o, and the design terminal serviceability index, p_t
M_R	=	resilient modulus (psi)
a_i	=	i^{th} layer coefficient
D_i	=	i^{th} layer thickness (in.)

Condition Forecasting

- **Geographic Roadway Inventory Tool (GRIT)**
  - Developing future year plans
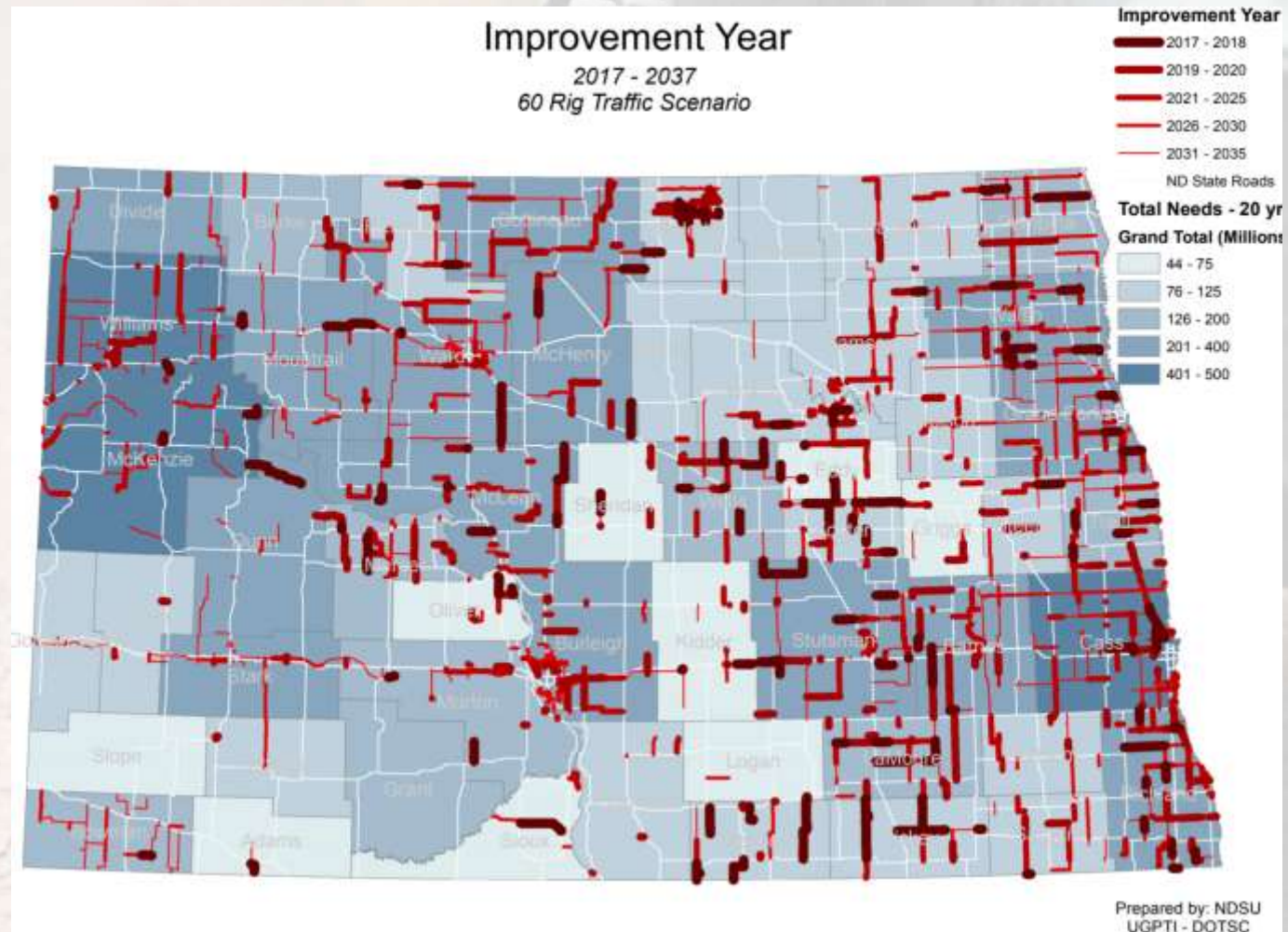 - BUT this time the condition and age will be for that future year
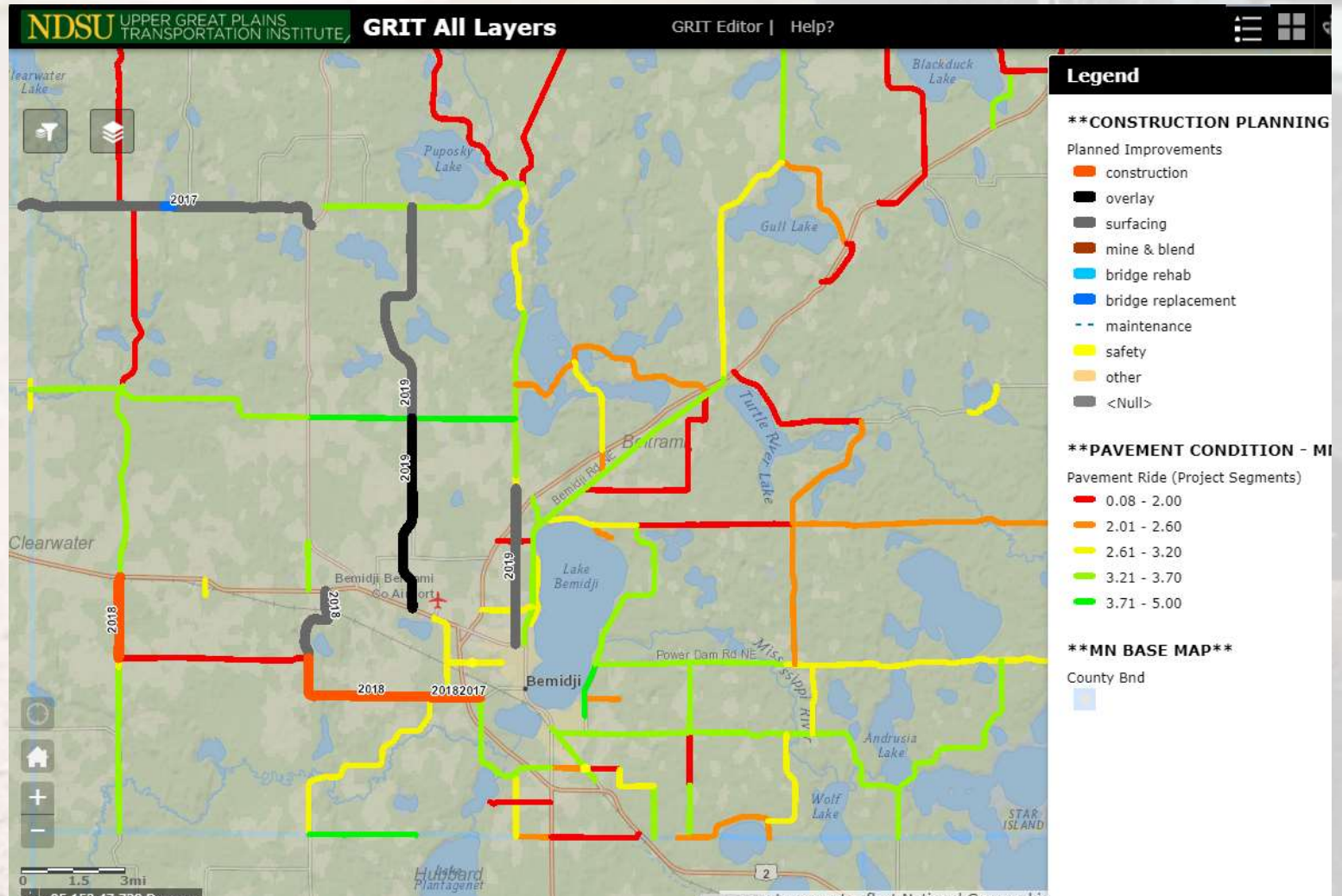
The Final Steps of TAM

- Setting Targets and Optimization Models
- Output 20 year Needs and Improvements
- Engineers and Managers generally prefer to use the data and develop their own long range plans

Set Targets And Optimization

Long Range Improvement Plans and Budget

Improvement Year
2017 - 2037
60 Rig Traffic Scenario

Improvement Year
- 2017 - 2018
- 2019 - 2020
- 2021 - 2025
- 2026 - 2030
- 2031 - 2035
ND State Roads
Total Needs - 20 yr
Grand Total (Millions)
- 44 - 75
- 76 - 125
- 126 - 200
- 201 - 400
- 401 - 500

Prepared by: NDSU
UGPTI - DOTSC

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- Short Term Improvement Plans
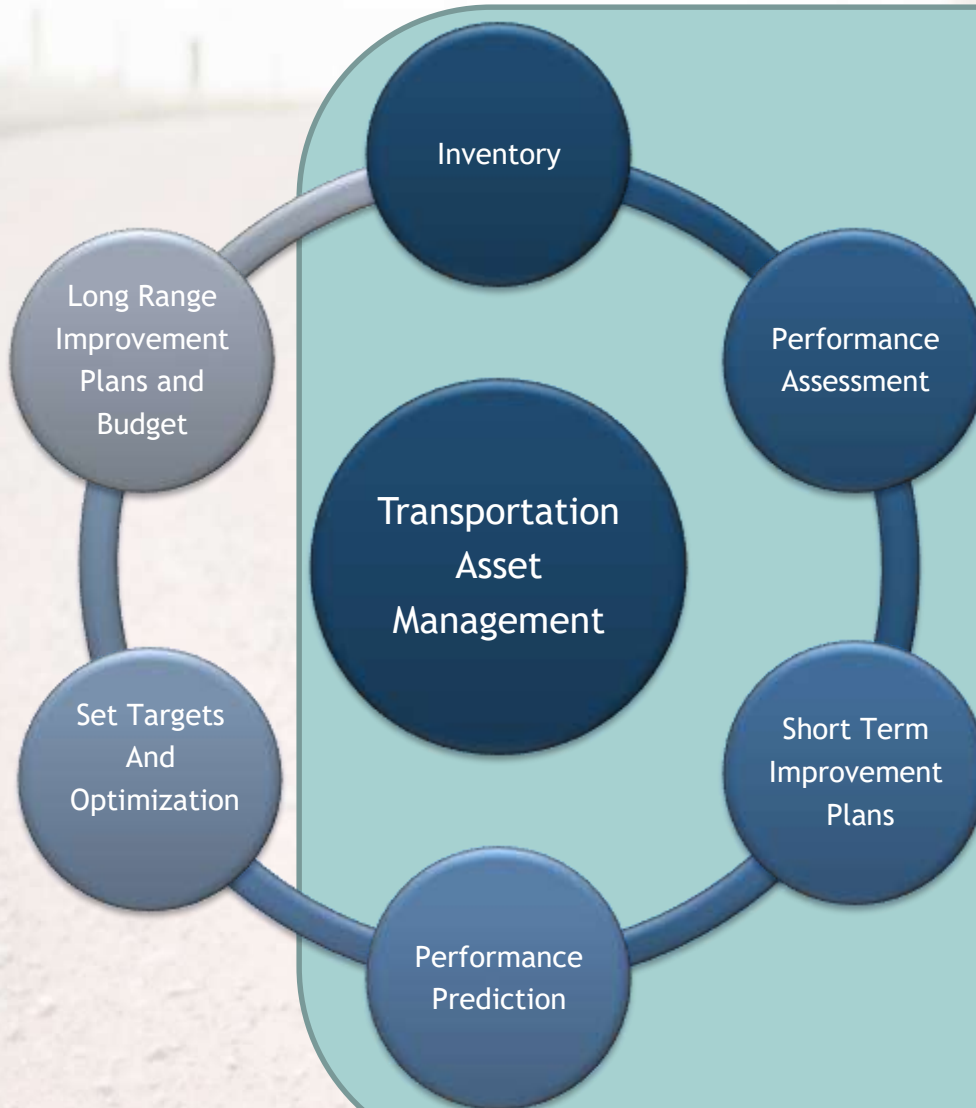
This is the Database we need to build!

More Information/Resources

- See the UGPTI Website at
  - https://www.ugpti.org/
    - Resources/Asset Inventory
- Email Contacts
  - Bradley.wentz@ndsu.edu
  - Andrew.Wrucke@ndsu.edu

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