

**Infrastructure Needs:
North Dakota's County, Township, & Tribal
Roads & Bridges
2015-2034**

July 8, 2014

Upper Great Plains Transportation Institute
North Dakota State University

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Contents

- History/purpose of road studies
- Data collection/field studies
- Major factors influencing results
- Analysis procedures/models
- Results and distributions of impacts
 - Region
 - Time period
- Next steps

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Road Infrastructure 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
- Current study: more comprehensive data
 - Higher roadway costs, ag. production, & 60,000 new wells

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Study Horizon

- 20 year time frame
- Traffic and investment needs estimated annually
- Results summarized by:
 - Biennium
 - Region
- Detailed results (by)
 - County
 - Jurisdiction

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Key Factors in Road Study (1)

Oil and Gas	Agriculture
Number of wells	Cultivated acres
Well locations	Crop mix
Production rate/curve	Yield
Inputs/outputs	Crop densities
Gathering pipeline	Elevator network

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Key Factors in Road Study (2)

Traffic	Road
Truck trips	Surface type
Truck axles/weights	Width & design
ESALs	Age & condition
Avg. Daily Traffic	Soil

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Data Sources (1)

Oil production	ND Oil & Gas Division
Pipeline/transload network	ND Pipeline Authority
Base road network	NDDOT GIS Hub
Crop production	USDA-NASS
Elevator demand	ND PSC

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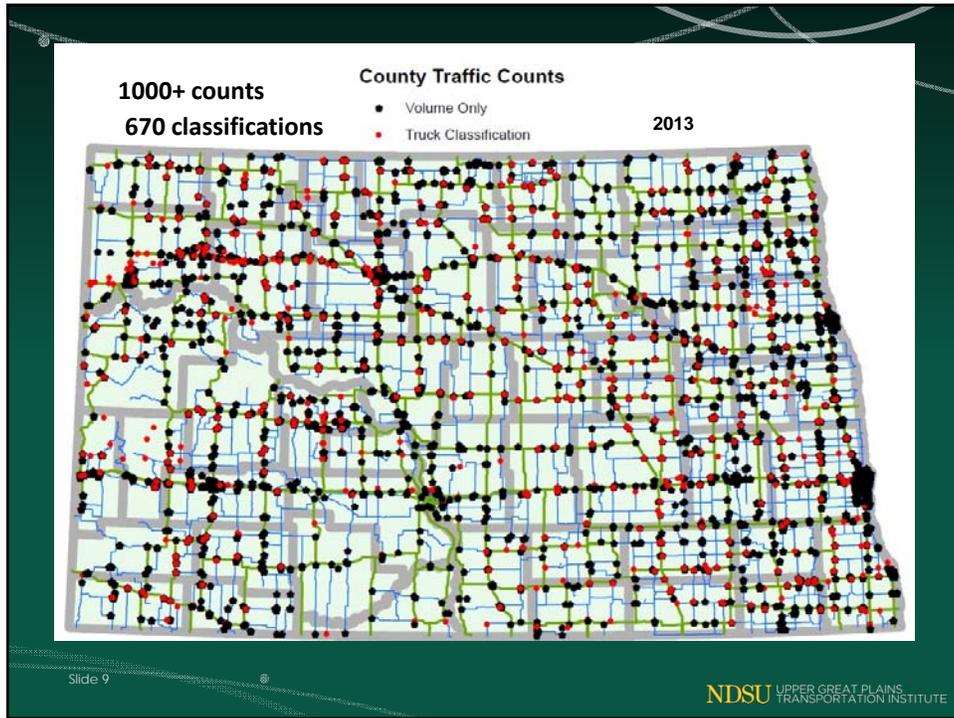
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Data Sources (2)

Traffic	Vehicle counts and classifications
	Surveys/elevator reports
Paved road condition	Pathways/surveys
Paved road structure	Falling Weight Deflector
	Ground Penetrating Radar
Unpaved roads	Surveys

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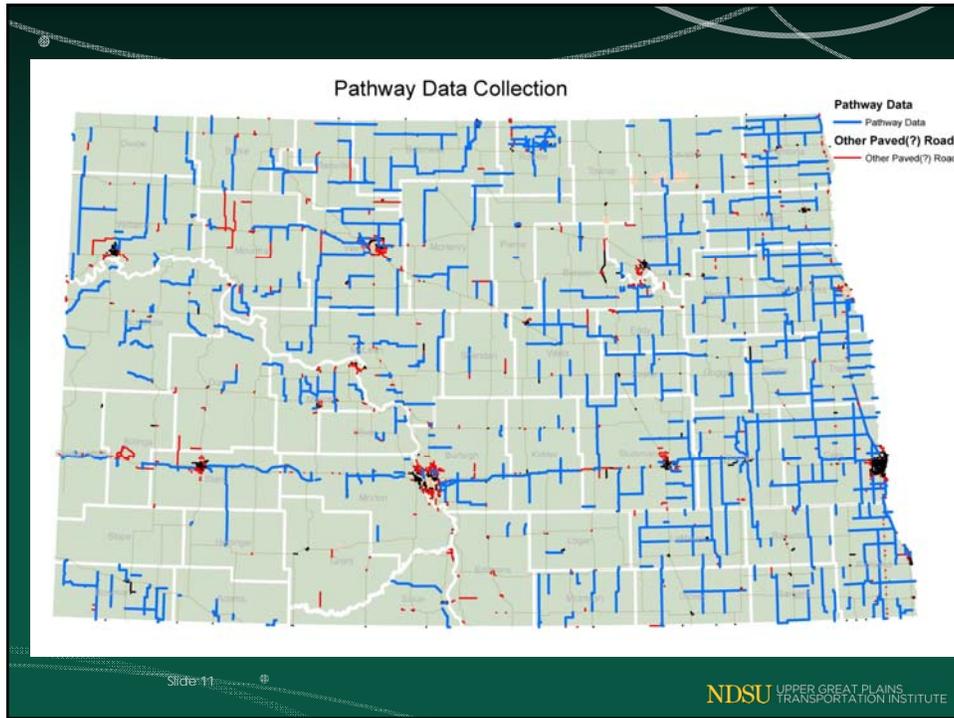


Pavement Data Collection

- Condition data
 - NDDOT Pathway van
 - Summer/fall 2013
 - 4,786 miles of paved county roads
- Pavement and shoulder width data
 - Scaled from video images – 4500 miles

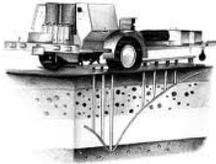
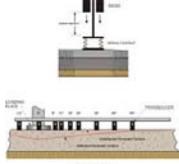
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Pavement Data Collection

- Non-destructive testing - verify prior estimates on subgrade strength
 - Falling Weight Deflectometer (FWD) and Ground Penetrating Radar (GPR)
 - Western ND – all rural pavements not recently improved, not under construction, and not in failure state (785 mi)
 - Eastern ND – selected based on agricultural production facilities and other major traffic generators (734 mi)


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Modeled Movements

- Agriculture
 - Wheat (including durum), corn, soybeans, barley, canola, sunflowers, sugar beets, potatoes, & beans
 - Fertilizer movements
 - Transshipments
- Oil Exploration/Production
 - Freshwater, sand, equipment, supplies, pipe, outbound saltwater, & outbound crude oil

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Agriculture Production Forecasts

- Production data: ND-NASS
- Production estimated at township level
- Elevator and plant demands from NDPSC and industry groups
- Forecasts of future production, yield and mix derived from multiple sources
 - USDA/NASS
 - NDSU/Extension
 - Industry

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Oil Development

- 2,300 truck trips per new well (drilling related)
 - 3 million gallons of freshwater
 - 4 million pounds of sand
- Initial production (IP) rate varies by county
- Outbound oil to transload locations
 - Base year: 67% truck, 33% pipe
 - 2024: 20% truck, 80% pipe,
 - 2,400 new miles of gathering pipeline/year

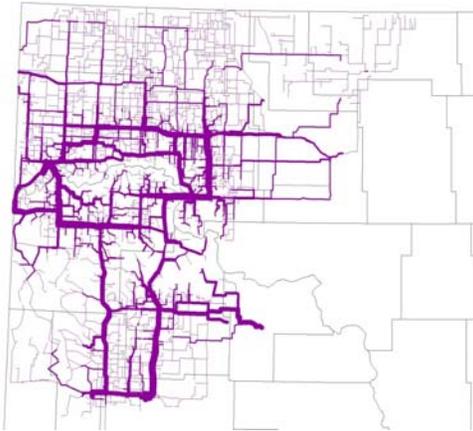
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Forecasting/Modeling Process

Trips generated	Trips originated or terminated
	E.g., wells and farms
Trips attracted	Rail & pipeline transfer facilities
	Grain elevators
Routes taken	Fastest path
Truck trips: segment	Oil-related, ag.-related, other
Calibration	Traffic data
Truck types and loads	Annual ESALs

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Oil Exploration Traffic Projections



Example of
predicted
traffic flows
over road
network

Crude oil
movements

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Crop Movement Projections - Wheat



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Unpaved Road Analysis

- Unpaved road miles grouped by traffic volume categories
- “Normal” practices established for each county based upon traffic observations and reported maintenance practices
- For traffic volumes above normal levels responses for oil impacted roads used to establish upper categories of maintenance

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Unpaved Improvement Types

- **Traffic Category Improvement**
 - Low: low volume average
 - Baseline: county average
 - Elevated: county average increased by 50%
 - Moderate: county average increased by 100%
 - High: county average increased by 150%, dust suppressant
 - Very high: county average increased by 200%, dust suppressant

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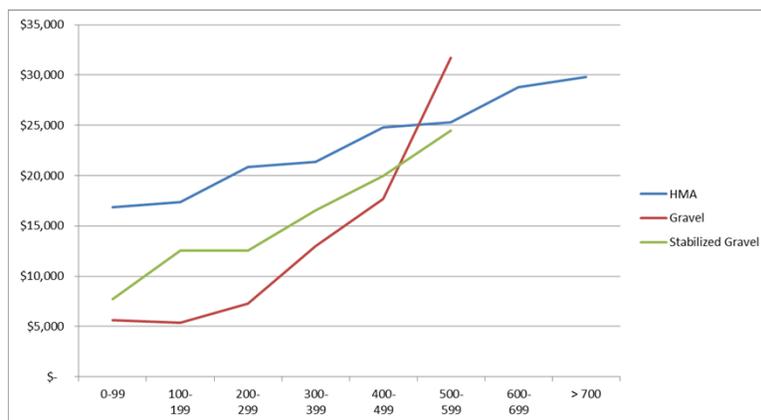
To Pave or Not?

- Conversion of gravel roads to hot mix asphalt (HMA) not directly considered, except for highest traffic roads
- Needs for the significantly increased gravel maintenance may be sufficient for paving of some road segments
- Surface type choice left to county
 - Reflect practices and local issues
 - Coordination with an overall planning effort

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Life Cycle Cost Comparison



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Unpaved Road Investment Needs (millions)

Period	Statewide	Oil Patch	Non-Oil
2015-2016	\$548.0	\$299.4	\$248.6
2017-2018	\$547.9	\$299.2	\$248.7
2019-2020	\$547.5	\$298.6	\$248.9
2021-2022	\$545.6	\$296.6	\$249.0
2023-2024	\$541.9	\$292.7	\$249.2
2025-2034	\$2,667.5	\$1,422.9	\$1,244.6
2015-2034	\$5,398.4	\$2,909.4	\$2,489.0

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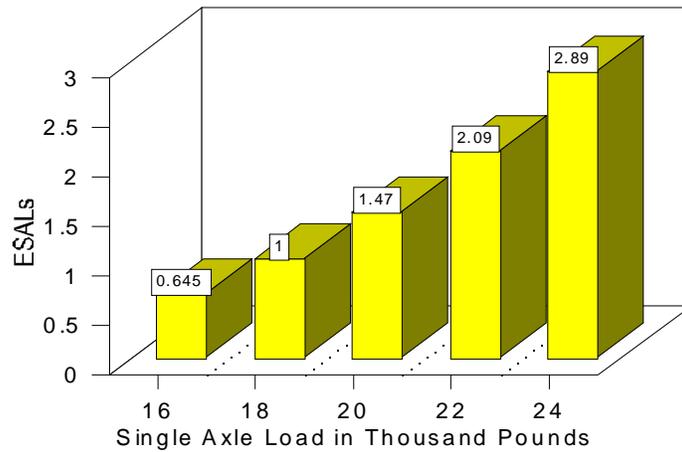
Paved Road Analysis Steps

- AASHTO 1993 Design Guide
- Predict year & type of improvement
- Improvement threshold based on pavement condition
- Year of improvement based on:
 - Existing structural capacity
 - Existing condition
 - Forecasted ESALs

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ESAL Factors: Single Axle



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Paved Road Improvements/Maint.

- Improvement type
 - Overlay
 - Sliver widening
 - Reconstruction
 - Mine & blend
- Normal maintenance
 - Chip seals
 - Crack sealing and patching
 - Other

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Paved Road Improvement Criteria

- Reconstruction
 - Condition and traffic volume
 - Subgrade modulus
 - Rutting
- Mine & Blend
 - Condition and traffic volume
 - Widening needed but thin/weak base
- Overlay
 - Pavement condition

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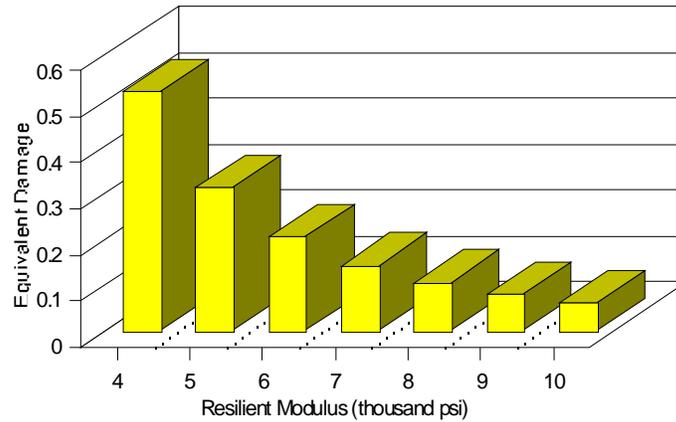
Pavement Serviceability Rating (PSR)

<i>PSR Range</i>	<i>General Rating</i>
5 to 4	Very Good
4 to 3	Good
3 to 2	Fair
2 to 1	Poor
1 to 0	Very Poor

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Effects of Soil Support



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Paved Road Improvements

Type	Miles	Percent
Resurface	5,005	88.1%
Reconstruct	253	4.5%
Mine/Blend	219	3.9%
Widen	201	3.5%

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Paved Road Investment Needs (millions)

Period	Statewide	Oil Patch	Non-Oil
2015-2016	\$377	\$186	\$191
2017-2018	\$323	\$120	\$203
2019-2020	\$285	\$158	\$127
2021-2022	\$236	\$133	\$103
2023-2024	\$138	\$52	\$86
2025-2034	\$1,326	\$513	\$812
2015-2034	\$2,685	\$1,162	\$1,522

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Bridge Analysis

- NBI: county and local
- Open bridges (other than culverts):
2,556
- Not considered: recently replaced or
minimum maintenance roads
- Improvements considered: replacement
or rehabilitation
- Maintenance

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Bridges Costs (1)

- Unit cost model
 - Based on 2011-2014 NDDOT bid reports
 - Discussed with NDDOT & counties
 - Includes approach roadway, engineering, etc.
- Replacement cost projections:
 - Bridges: \$250-\$275/sf. deck area
 - Culverts: \$400,000-\$600,000 /project

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Bridges Costs (2)

- Rehabilitation
 - Deck widening 50% replacement cost
 - Deck replacement 45% replacement cost
- Preventive maintenance
 - Annualized maintenance cost \$0.24 per sq. ft./year
 - \$0.29 per sq. ft. deck washing/sealing

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Bridge Investment Needs

- 2015-2034: \$327 million
- 77% of costs for replacements
- Backlog of 480+ bridges
- Backlog spread over 5 biennia
- Approx. \$70 million per biennium

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High Traffic Roadways

- Consideration of converting very high traffic (500+ trucks/day) gravel miles to asphalt
- 37 miles @ \$1.5 million/mile = \$58M

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Summary Compilation

Category	2014 Dollars
	2015-2016 Biennium
Gravel Roadway Needs	\$548M
Paved Roadway Needs	\$377M
Gravel to Pavement Option	\$58M
Total Roadway Needs (excluding bridges)	\$983M

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Next Steps

- Feedback from Legislature, NDDOT, and counties
- Written report/documentation
- Maps and data tables posted on UGPTI webpage
- Additional study requests

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Questions?

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Full Report: Spotlight Section at
www.ugpti.org/

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