Needs Study of North Dakota Roads and Bridges

Status Report

Interim Economic Impact Committee

February 3, 2014

Upper Great Plains Transportation Institute
North Dakota State University

Study Goals

- Use improved data, traffic projections, and modeling techniques to improve on prior studies
- Better forecast of statewide investment needs for county and township roads and bridges, by biennium, for next 20 years
- Complete related work by late June 2014

Study Process

- Data collection on existing paved & gravel roads and bridges
- Data analysis
- Modeling - project future use (volumes & types)
- Project short- and long-term needs and costs

Coordination

- NDDOT
- North Dakota Association of Counties
- North Dakota Township Officers Association
- Industrial Commission - Oil & Gas Division
- North Dakota Petroleum Council
- North Dakota Agricultural Commodity Groups
- Kadrmas, Lee & Jackson
- Others

Data Collection - Completed

- County & township cost surveys
- Traffic counts – volume & vehicle types
- Ride quality – NDDOT Pathways van
- Structural pavement data - falling weight deflectometer (FWD) and ground penetrating radar (GPR)
- Traffic projections – oil & agriculture
- Roadway maintenance cost projections
- National Bridge Inventory data sets

Data Collection – Traffic Counts

- Traffic counts – volume and classification data on county and township roads for travel demand models and ESAL (equivalent single axle load) calculations:
  - Joint collection - NDDOT staff and NDSU students
  - Number of counts taken - 1000+
  - Number of classification counts – 670

County Traffic Counts 2013

Data Collection – Structural Data

- Falling weight deflectometer (FWD) and ground penetrating radar (GPR)
  - Verify prior estimates on subgrade strength and pavement/base layer thickness
  - Western ND – test all pavements not recently improved
  - Eastern ND – selected based on agricultural production facilities and other major traffic generators
  - 1560 miles tested

Data Collection – Cost Projections

- Gravel costs & production techniques
- Placement costs
- Transportation & placement costs
- Dust suppressant costs
- Intermediate practices
  - Stabilization armor coat
  - Double chip seal/armor coat
  - Others

Traffic Modeling Goals

- Update and enhance county and local roads traffic projection model developed for the 2011-13 legislative study
- Expanded data sets and enhanced models will facilitate better need and cost projections

Traffic Modeling Tools

- CUBE
  - Used to analyze impacts of various operating conditions & infrastructure improvements - study is utilizing 20 subset models
- Highway Performance Monitoring System (HPMS)
  - Used to predict road & bridge deterioration and subsequent maintenance & rehabilitation needs
- Highway Economic Requirements System (HERS-ST)
  - Identifies infrastructure deficiencies & selects most cost-effective mix of improvements

Traffic Projections

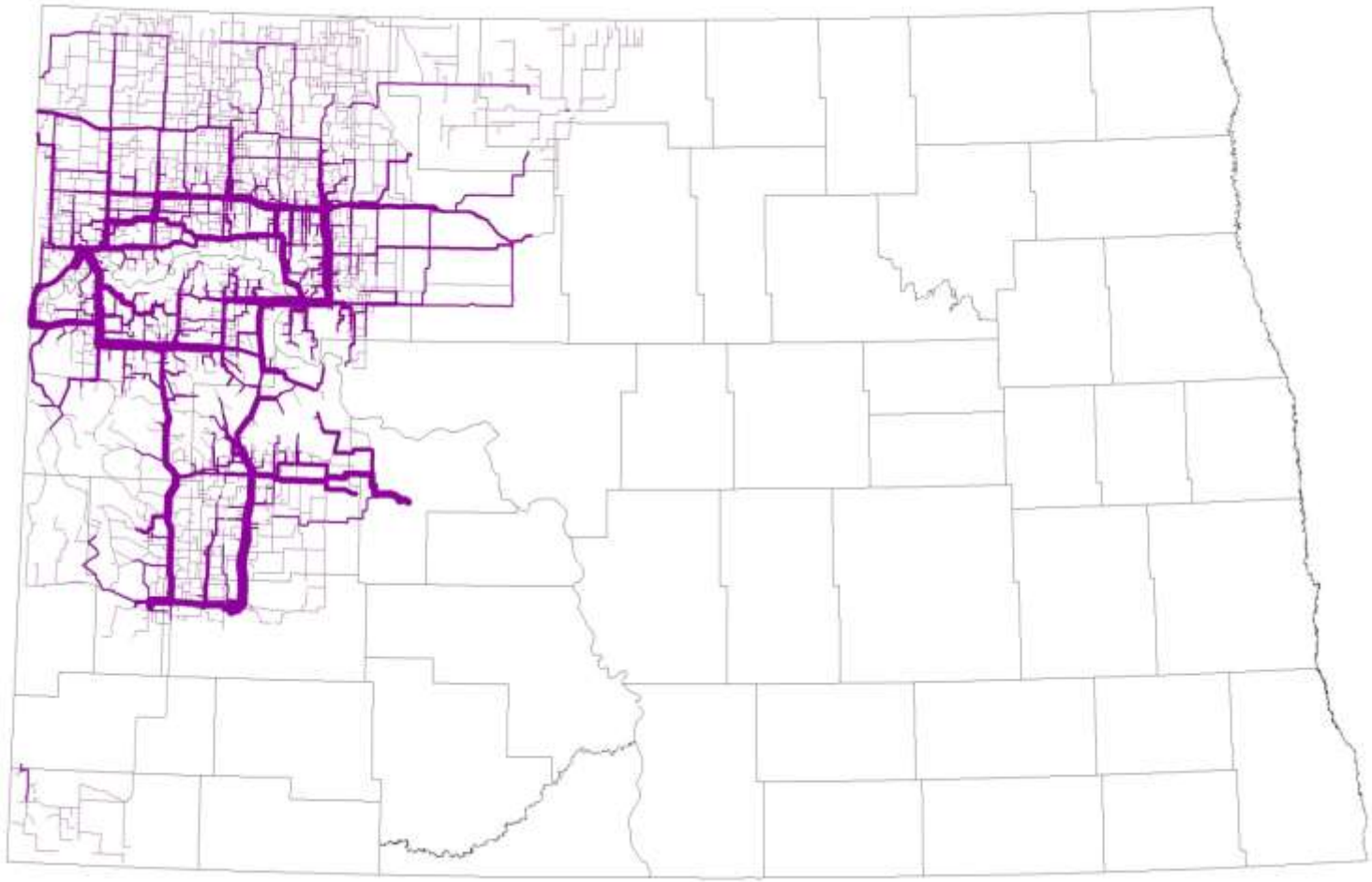
- Oil
  - Multiple discussions with Oil & Gas Division
  - Well sites, sand locations, & transload facilities
- Agriculture
  - Statewide grain elevator shipment data
  - Forecasts of crop types and yields
- Passenger
- Manufacturing
- Through traffic

Oil – Drilling Process	Trucks per Well	Inbound or Outbound
Sand	100	Inbound
Water (fresh)	450	Inbound
Water (waste)	225	Outbound
Fracturing tanks	115	Both
Rig equipment	65	Both
Drilling mud	50	Inbound
Chemical	5	Inbound
Cement	20	Inbound
Pipe	15	Inbound
Scoria/gravel	80	Inbound
Fuel trucks	7	Inbound
Frac/cement pumper trucks	15	Inbound
Workover rigs	3	Both
Total trucks	2,300	

Oil Well Shipment Projections

- Wastewater
- Outbound oil to pipeline locations or transload facilities

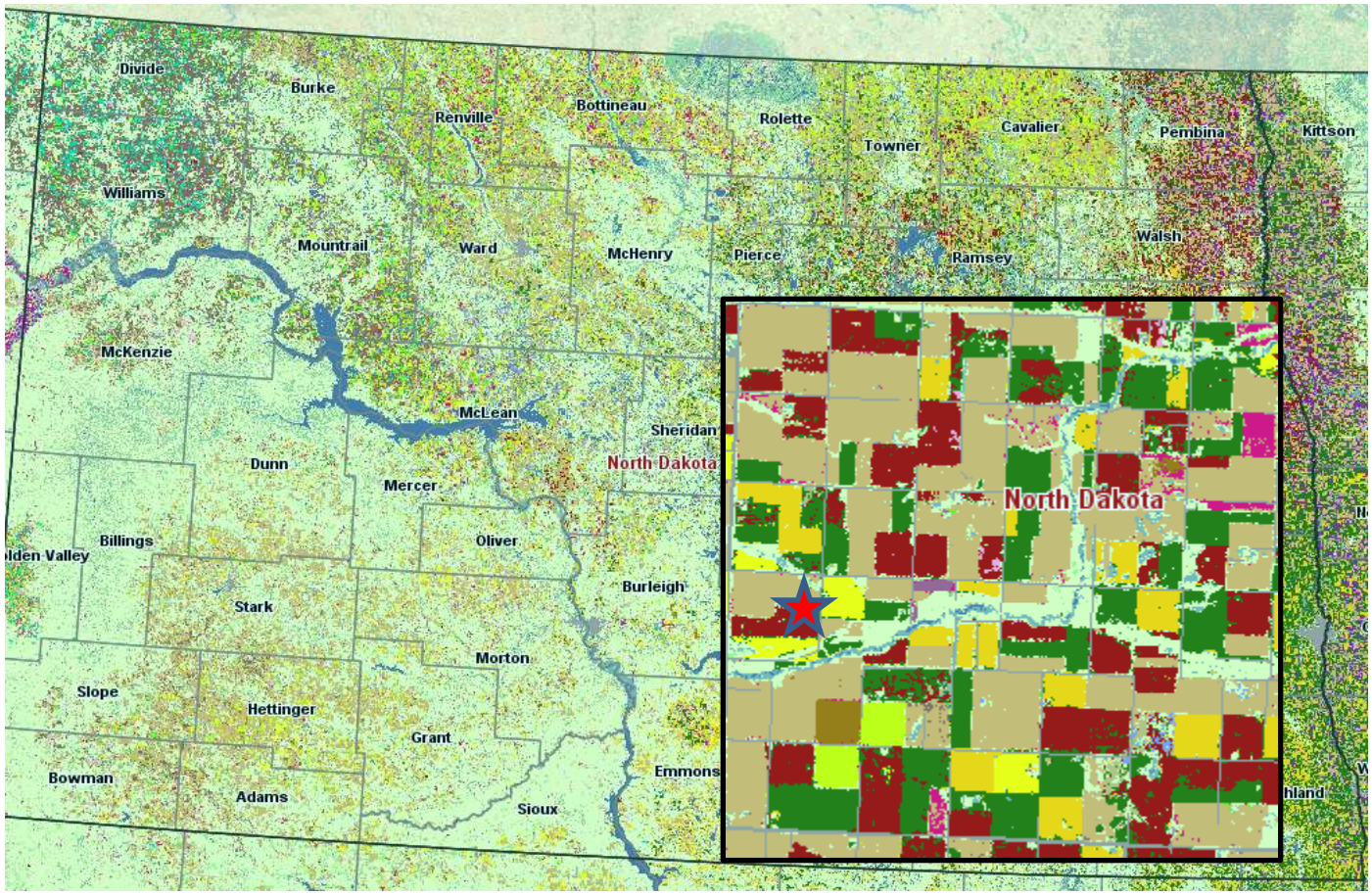
Oil Exploration Traffic Projections



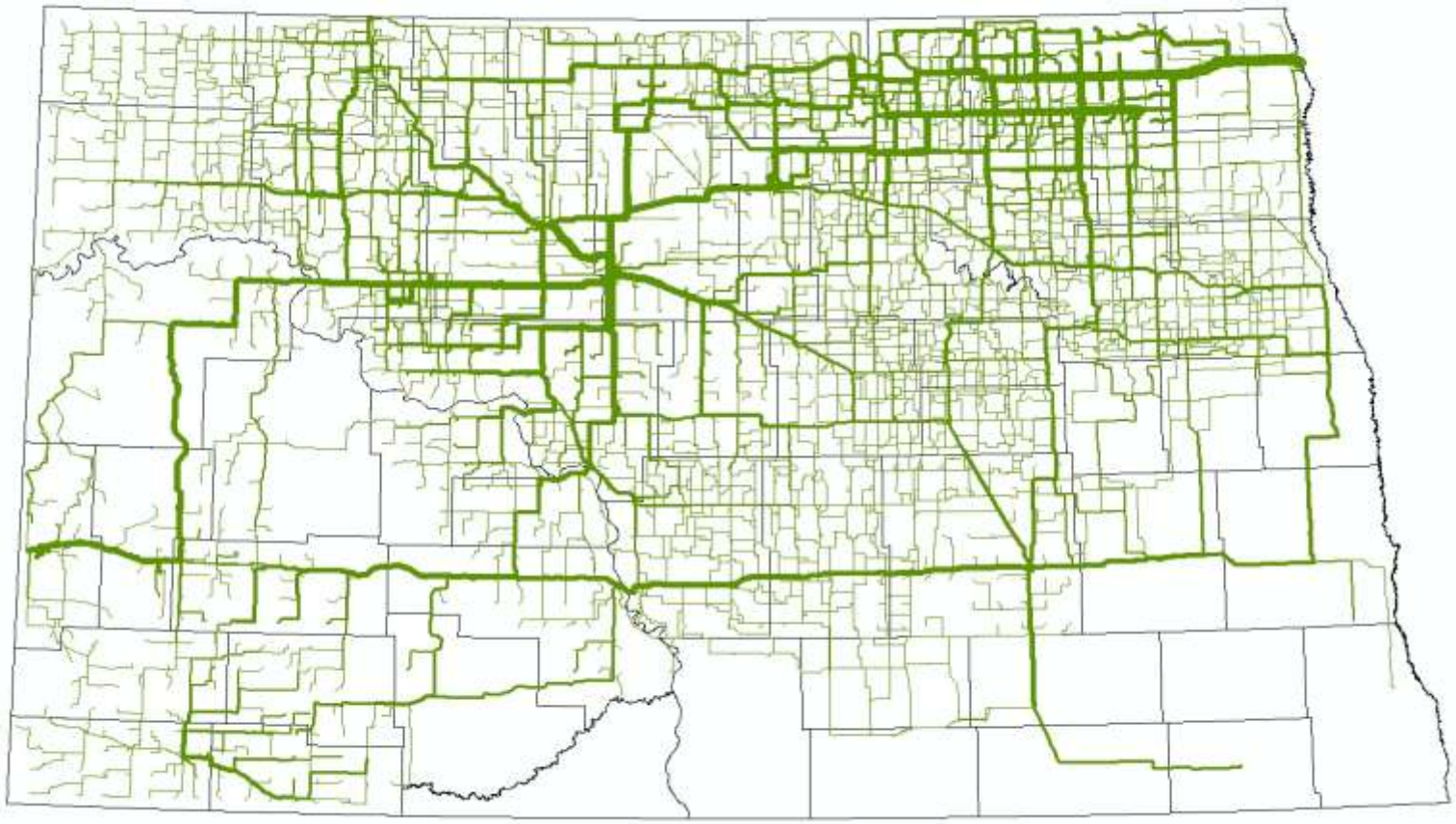
Agricultural Shipment Projections

Known	Crop production
Predict	Truck trips and routes
Known	Elevator & plant demands
Estimate	Segment specific traffic

Crop Production and Location



Crop Movement Projections - Canola



Modeling - Road Maintenance

- Life-cycle cost analysis - graveling and blading
  - Normal levels (regraveling every 5 years, blade 1/month)
  - Increased levels (regraveling every 3-4 years, blade 2/month)
  - High levels (regraveling every 2-3 years, blade 1/week)
  - Usage of dust suppressant on impacted roads

Gravel Road Projections

- Intermediate improvements
  - Graveling and base stabilization
  - Graveling and base stabilization with armor coat
  - Others as reported at the county level
- Asphalt surfacing

Gravel Road Projections

- Traffic model segmented based on traffic levels
- County-specific practices used as the base maintenance practices
- Life cycle costs calculated (i.e. 20-year cost of graveling)
- Maintenance type/improvement selected for AADT (annual average daily traffic) class based on minimum life cycle cost

Pavement Projections

- Pavement deterioration and recommended improvement process
  - Estimate remaining life given current condition and traffic levels
    - Verify past assumptions on layer thickness and subgrade strength
    - Apply traffic projections and present serviceability rating
  - Determine recommended improvements and costs based on width, starting condition, and future traffic estimates

Bridge Analysis & Projections

- 2,593 bridges on county/local system
  - 45% (1,167) more than 50 years old (theoretical design life)
  - 20% (519) more than 70 years old

Bridge Analysis & Projections

- Condition/appraisal data from National Bridge Inventory
  - 568 (22%) structurally deficient – one or more components rated in "poor" condition (**not** inherently unsafe, but needing attention)
  - 196 (8%) functionally obsolete – not designed to carry modern traffic volume, speed, size or weight

Bridge Analysis & Projections

- Current Needs
  - Criteria for rehabilitation/replacement based upon FHWA criteria and discussions with NDDOT personnel
  - Short span bridges to be replaced by box culverts
  - Replacement unit cost based upon recent county bridge projects

Bridge Analysis & Projections

- Preventive Maintenance
  - Project cyclical maintenance cost required for preservation of bridge investment
  - Maintenance model developed using feedback from counties, NDDOT, NCPP, and FHWA best practices:
    - Treatments
    - Intervals
    - Annualized cost

Bridge Analysis & Projections

- Future Needs
  - Apply deterioration models to forecast deck/superstructure/substructure condition
  - Forecast year of rehabilitation/replacement
  - Short span bridges to be replaced by box culverts
  - Bridge closings will not be predicted - closings at the discretion of local road authority

Study Timeline

Task	Start Date	Completion Date
Assumptions data collection	August 2013	August 2013
Jurisdictional data collection	June 2013	September 2013
Road condition assessment	July 2013	September 2013
Traffic counts	June 2013	October 2013
Cost & practices survey	August 2013	October 2013
Non-destructive testing	July 2013	November 2013
Roadway & bridge analysis, modeling, & projections	Fall 2013	May 2014
Final report		June 2014

Study Outputs

- Needs – by biennium for next 20 years
  - Roads
    - Statewide
    - By county
    - By surface type
  - Bridges
    - Statewide
    - By county

Study Outputs

- Final report – data available via web for local road authorities, contractors, general public, etc.
  - Condition assessment
  - Traffic counts
  - Enhanced roadway data
  - Cost projections
- Significant enhancements over 2011-13 study
- Extremely complex – tight timeframe
- On schedule

NDSU-UGPTI Study Team

- Denver Tolliver – UGPTI Director
- Alan Dybing – Associate Research Fellow
  - Traffic modeling/HERS-ST modeling
- Tim Horner – Program Director
  - Pavement/bridge costing & project coordination
- Brad Wentz – Program Director
  - Pavement condition, traffic data, & county scenarios
- Andrew Bratlien – Transportation Research Engineer
  - Non-destructive testing & bridge deterioration
- Pan Lu – Associate Research Fellow
  - Bridge condition, deterioration, & forecasting
- Jon Mielke – Program Administrator

Questions?

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Updates and background posted at
www.ugpti.org/