Needs Study of North Dakota Roads and Bridges

Status Report

ND-LTAP Western Roundtable

February 25, 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 – NDDOTPathways 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:
  o Joint collection - NDDOT staff and NDSU students
  o Number of counts taken - 1000+
  o Number of classification counts – 670
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
<table>
<thead>
<tr>
<th>Oil - Drilling Process</th>
<th>Trucks per Well</th>
<th>Inbound or Outbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>100</td>
<td>Inbound</td>
</tr>
<tr>
<td>Water (fresh)</td>
<td>450</td>
<td>Inbound</td>
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<tr>
<td>Water (waste)</td>
<td>225</td>
<td>Outbound</td>
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<tr>
<td>Fracturing tanks</td>
<td>115</td>
<td>Both</td>
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<tr>
<td>Rig equipment</td>
<td>65</td>
<td>Both</td>
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<tr>
<td>Drilling mud</td>
<td>50</td>
<td>Inbound</td>
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<tr>
<td>Chemical</td>
<td>5</td>
<td>Inbound</td>
</tr>
<tr>
<td>Cement</td>
<td>20</td>
<td>Inbound</td>
</tr>
<tr>
<td>Pipe</td>
<td>15</td>
<td>Inbound</td>
</tr>
<tr>
<td>Scoria/gravel</td>
<td>80</td>
<td>Inbound</td>
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<td>Fuel trucks</td>
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<td>Inbound</td>
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<tr>
<td>Frac/cement pumper trucks</td>
<td>15</td>
<td>Inbound</td>
</tr>
<tr>
<td>Workover rigs</td>
<td>3</td>
<td>Both</td>
</tr>
<tr>
<td>Total trucks</td>
<td>2,300</td>
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</tr>
</tbody>
</table>
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 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
  o Graveling and base stabilization
  o Graveling and base stabilization with armor coat
  o 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
  o Criteria for rehabilitation/replacement based upon FHWA criteria and discussions with NDDOT personnel
  o Short span bridges to be replaced by box culverts
  o 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
  o Apply deterioration models to forecast deck/superstructure/substructure condition
  o Forecast year of rehabilitation/replacement
  o Short span bridges to be replaced by box culverts
  o Bridge closings will not be predicted - closings at the discretion of local road authority
# Study Timeline

<table>
<thead>
<tr>
<th>Task</th>
<th>Start Date</th>
<th>Completion Date</th>
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<tbody>
<tr>
<td>Assumptions data collection</td>
<td>August 2013</td>
<td>August 2013</td>
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<tr>
<td>Jurisdictional data collection</td>
<td>June 2013</td>
<td>September 2013</td>
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<tr>
<td>Road condition assessment</td>
<td>July 2013</td>
<td>September 2013</td>
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<tr>
<td>Traffic counts</td>
<td>June 2013</td>
<td>October 2013</td>
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<td>Cost &amp; practices survey</td>
<td>August 2013</td>
<td>October 2013</td>
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<td>Non-destructive testing</td>
<td>July 2013</td>
<td>November 2013</td>
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<tr>
<td>Roadway &amp; bridge analysis, modeling, &amp; projections</td>
<td>Fall 2013</td>
<td>May 2014</td>
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<tr>
<td>Final report</td>
<td>June 2014</td>
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Study Outputs

• Needs – by biennium for next 20 years
  o Roads
    – Statewide
    – By county
    – By surface type
  o Bridges
    – Statewide
    – By county
Study Outputs

• Final report - data available via web for local road authorities, contractors, general public, etc.
  o Condition assessment
  o Traffic counts
  o Enhanced roadway data
  o 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 Homer – 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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alan.dybing@ndsu.edu

Updates and background posted at
www.ugpti.org/