Needs Study of North Dakota Roads and Bridges

Status Report

Interim Economic Impact Committee

October 8, 2013

Upper Great Plains Transportation Institute
North Dakota State University
Study Objectives

• Forecast investment needs for county and township roads and bridges over the next 20 years

• Quantify investments needed for efficient year-round freight transportation while providing travelers with acceptable roadway service
Study Results

- Infrastructure needs – county & township roads & bridges
  - Statewide (summation of all jurisdictions)
  - County level (by surface type and jurisdiction)
  - 20-year estimates reported by biennium
Study Process

• Data collection on existing roads & bridges
• Analyze data
• Project future use – volumes & types
• Develop long-term need projections
Enhanced Data Collection - Status

- County & township surveys
- Traffic counts – volume & types
- Ride quality – NDDOT Pathways van
- Structural data - falling weight deflectometer (FWD) and ground penetrating radar (GPR)
- Traffic projections – ag & oil
Data Collection - Status

• Roadway jurisdiction/ownership surveys:
  – County major collector (CMC/Federal Aid)
  – County – non-CMC
  – Township
  – Township owned, but maintained by the county
  – Private
  – Status: 50 of 53 counties have submitted maps
  – Very good progress
Data Collection - Status

• Survey of counties and townships
  o 2011-13 study: 51 county & 230 township responses
  o Current study: All counties and townships are being surveyed

• Status
  – Surveys have been sent out to the counties; awaiting response
Data Collection - Status

- 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 to be taken - 1000+
  - Number of classification counts – 670
  - Data collection 98% complete
  - Remaining counts completed by November
Data Collection - Status

- Structural data - falling weight deflectometer (FWD) and ground penetrating radar (GPR)
  - Verify prior estimates on subgrade strength
  - 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 - Status

• Traffic projections – ag & oil
  o Oil production
    o Multiple discussions with Oil & Gas Division
    o Data on underlying assumptions expected early October
  o Agricultural production
    o All data has been collected
    o Forecasts of crop types and yields will be developed following discussions with NDSU Extension and producer groups
Data Collection Status

– Oil locations:
  • Most locations have been obtained
  • UGPTI still needs confirmation from industry for the following locations
    – Sand locations (NDDOT and industry)
    – Transload facilities (NDDOT and industry)
Data Collection - Status

- Agriculture locations:
  - Elevator movement data has been obtained
  - Most recent 5 years of crop and production data have been processed
Data Collection – Cost Projections

- Aggregate (gravel) costs
- Gravel production techniques
- Placement costs
- Transportation costs from pit to roads
- Dust suppressant usage/costs
- Stabilization usage/costs
- Intermediate practices
  - Stabilization armor coat
  - Double chip seal/armor coat
  - Others
Data Transparency

- Traffic counts will be displayed via a website maintained by UGPTI
- Roadway condition information will be available via the Web to all stakeholders
- County level costs will be published on the UGPTI website
Traffic Model

Projections for:
• Oil
• Agriculture
• Passenger
• Manufacturing
• Through traffic
Traffic Model Goals

• Update and enhance the 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 Model

• Modeling
  – The entire modeling process will utilize Cube Base, Voyager and Cargo methodology
  – Specific models for agricultural commodities and oil movements
  – Inclusion of direct passenger modeling
  – Coordination with NDDOT - network modeling necessarily includes state highways
<table>
<thead>
<tr>
<th>Oil – Drilling Process</th>
<th>Number of Trucks</th>
<th>Inbound or Outbound</th>
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<tbody>
<tr>
<td>Sand</td>
<td>100</td>
<td>Inbound</td>
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<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>
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<tr>
<td>Chemical</td>
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<td>Inbound</td>
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<tr>
<td>Cement</td>
<td>20</td>
<td>Inbound</td>
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<tr>
<td>Pipe</td>
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<td>Scoria/gravel</td>
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<td>Inbound</td>
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<td>Fuel trucks</td>
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<tr>
<td>Frac/cement pumper trucks</td>
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<td>Inbound</td>
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<tr>
<td>Workover rigs</td>
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<td>Both</td>
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<tr>
<td><strong>Total trucks</strong></td>
<td><strong>2,300</strong></td>
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</tbody>
</table>
Traffic Model

- Outbound Crude Oil Shipments
  - Drilling and hydraulic fracturing equipment
  - Wastewater
  - Outbound oil to transload locations or final destinations
Agricultural Analysis

**Known**
- Crop production

**Predict**
- Truck trips and routes

**Known**
- Elevator & plant demands

**Estimate**
- Segment specific traffic

**Data:** crop production (NASS), elevator volumes (NDPSC), in-state processors (survey), road network (NDDOT-GIS Hub), local road data (2008 survey)
Crop Production and Location
Modeling - Road Maintenance

• Life-cycle cost analysis - practices
  – Graveling and blading
    • Normal levels (e.g. regraveling every 5 years, blade once per month)
    • Increased levels (e.g. regraveling every 3-4 years, blade twice per month)
    • High levels (e.g. regraveling every 2-3 years, blade once per week)
    • Usage of dust suppressant on impacted roads
Gravel Road Analysis

- Intermediate improvements
  - Graveling and base stabilization
  - Graveling and base stabilization with armor coat
  - Others as reported at the county level
- Asphalt surface
Gravel Road Analysis

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

• Pavement deterioration and recommended improvement process
  – Estimate remaining life given current condition and traffic levels
    • Verify past assumptions on 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

• 2,666 bridges on county/local system
  – 46% (1,232) more than 50 years old (theoretical design life)
  – 23% (595) more than 70 years old
Bridge Analysis

- Condition/appraisal data from National Bridge Inventory (NBI)
  - Structurally deficient (SD) – one or more components rated in “poor” condition (≤4 on 0-9 scale)
  - Functionally obsolete (FO) – bridge is not designed to carry modern traffic volume, speed, size or weight
  - Bridges with SD or FO status may require posting or closure
Bridge Analysis

• Current Needs
  – Rehabilitation/replacement eligibility based on FHWA criteria
  – Rehabilitation/replacement costs based on NDDOT project costs
  – Current inventory: 25% (676) deficient, 7% (190) obsolete bridges
  – Prioritize backlogged projects based on detour vehicle-miles traveled, including bridge weight restrictions
Bridge Analysis

• Preventive Maintenance
  – Maintenance activities and intervals based on county surveys, FHWA recommendations
  – Maintenance costs based on county survey
Bridge Analysis

• Bridge Deterioration Models
  – Developed empirical models to forecast deck/superstructure/substructure deterioration
    • Bridge age and age squared as continuous variables
    • Indicator variables:
      – Reconstruction history
      – ADT level (high and low)
      – Bridge material (timber, steel, and concrete)

• NBI 2012 data
Bridge Analysis

• 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
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
  - Pavement non-destructive testing & bridge deterioration
- Jon Mielke – Program Administrator
### Study Timeline

<table>
<thead>
<tr>
<th>Task</th>
<th>Start Date</th>
<th>Completion Date</th>
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<tbody>
<tr>
<td>Traffic counts</td>
<td>June 2013</td>
<td>October 2013</td>
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<td>Traffic modeling</td>
<td>June 2013</td>
<td>January 2014</td>
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<td>Jurisdiction data collection</td>
<td>June 2013</td>
<td>September 2013</td>
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<td>Road condition assessment</td>
<td>July 2013</td>
<td>September 2013</td>
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<td>Non-destructive testing</td>
<td>July 2013</td>
<td>November 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>Assumptions data collection</td>
<td>August 2013</td>
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<td>Roadway analysis</td>
<td>Fall 2013</td>
<td>May 2014</td>
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<tr>
<td>Bridge analysis</td>
<td>Fall 2013</td>
<td>May 2014</td>
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<tr>
<td>Final report</td>
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<td>June 2014</td>
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Study Outputs

- Final report – electronic and hard copy
  - Methods
  - Assumptions
  - Procedures
  - Summary of data
  - Results – needs (by biennium)
    - Roads
      - Statewide
      - By county
      - By surface type
    - Bridges
      - Statewide
      - By county
Study Outputs

• Final report – collected data available via web
  - Condition assessment
  - Traffic counts
  - Enhanced roadway data
  - Cost projections
• Significant enhancements over 2011-13 study
• Extremely complex – tight timeframe
• On schedule
Questions?

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Updates and background posted at
www.ugpti.org/