To Pave or Not to Pave?

Making Informed Decisions on When to Upgrade a Gravel Road
How to decide when to pave or not?

- **Two new reports offer some help:**
  - **Cost Comparison of Treatments Used to Maintain and Upgrade Aggregate Roads**
    - Completed in 2005 and funded by the MN LRRB. Examined surface construction and maintenance costs to determine possible threshold values to go from gravel to paved.
  - **Local Road Surfacing Criteria**
    - Completed in 2004 and funded by the SD DOT. Developed a tool to compare the costs associated with different types of roads to determine the most economical surface type.
These reports offer

- A cost analysis based on spending history for low volume roads
- A method for estimating maintenance and construction costs
- An economic analysis procedure, including present worth evaluation
Key questions pertaining to gravel roads

• Two key questions when developing a maintenance plan for gravel road:
  - What is the best way to maintain a gravel road?
  - When should it be upgraded to a paved road?
Why is this an issue?

- Maintenance costs for both paved and unpaved roads are rising, and we need to optimize them over time.
- Reduced funding and resources require us to be more efficient spenders.
- Preparing for future maintenance and upgrades allows us to manage funds that are available.
Other issues

- Increased traffic due to development in the urban fringe
- Altered expectations due to changing rural lifestyles
- Shifts in agribusiness needs requires a shift in our roadway maintenance and construction strategies
When to pave?
When to pave?

- **Savings in routine and ongoing maintenance costs**
- **Increased quality of life**
  - less dust, cleaner environment
- **Lower vehicle operating expenses for users**
- **Increased safety and skid resistance**
- **Positive economic development**
  - people want to live, work and drive on paved roads, so economic activity will follow them
- **Political issues**
When not to pave?
When not to pave?

- Lack of funding for initial construction costs
- Traffic doesn’t warrant it
- Control growth in the area
- Adjacent property owners don’t want it
- Control speed on the roadway
- Political issues
Risks with paving

- Funding eventual rehabilitation of pavement
- Heavy traffic may overload, if not designed strongly
- May require full alignment and profile upgrade for safety
- May increase vehicle speeds and attract more traffic
- Some stakeholders may prefer gravel
Early roads

Lincoln Highway between Ames and Nevada, 1918.
(Courtesy: Iowa State Highway Commission)
Plank roads

Planks covering mud holes on Grand Avenue, north of Ames, 1920.
(Courtesy: Iowa State Highway Commission)
Minnesota project overview

- This project offered an analysis of county maintenance costs, practices, and traffic volumes for individual roads to help determine when it may be advantageous to upgrade the road based on cumulative maintenance costs.
- Other agencies can use the information to develop their own costs.
Minnesota project overview

• Data collection
  - Evaluated Minnesota County Road Historical Costs
  - Conducted Interviews and collected data from 16 county highway departments
    • County road maintenance costs for both gravel and bituminous roads
    • Minnesota county road costs vs. Average Annual Daily Traffic (AADT)
Data overview

• Data obtained from annual reports submitted to State Aid Office from 1997-2001
  - Roads were grouped by funding source
    • County State Aid Highways (CSAH)
    • County Roads (funded entirely by county funds)
    • Township and Municipal Roads
  - Detailed maintenance costs for each road were summarized and split into five main categories

• County traffic maps were used to obtain average daily traffic for each road segment
<table>
<thead>
<tr>
<th>Routine Maintenance</th>
<th>Repairs &amp; Replacements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoothing Surface*</td>
<td>Reshaping*</td>
</tr>
<tr>
<td>Minor Surface Repair*</td>
<td>Resurfacing**</td>
</tr>
<tr>
<td>Cleaning Culverts &amp; Ditches</td>
<td>Culverts, Bridges, Guardrails</td>
</tr>
<tr>
<td>Brush &amp; Weed Control</td>
<td>Special Work</td>
</tr>
<tr>
<td>Snow &amp; Ice Removal</td>
<td>Dust Treatments*</td>
</tr>
<tr>
<td>Traffic Services &amp; Signs</td>
<td>Mud Jacking &amp; Frost Boils*</td>
</tr>
<tr>
<td><strong>Betterments</strong></td>
<td><strong>Special Agreements</strong></td>
</tr>
<tr>
<td>New Culverts, Rails, or Tiling</td>
<td></td>
</tr>
<tr>
<td>Seeding &amp; Sodding</td>
<td></td>
</tr>
<tr>
<td>Bituminous Treatments***</td>
<td></td>
</tr>
</tbody>
</table>

* Costs related to routine maintenance of road surface
** Costs related to periodic maintenance of road surface
*** Cost can be for routine or periodic maintenance of road surface
Data analysis

• **Initial data analysis done for Waseca County**
  - Provided a snapshot of the kind of information available for use in this study

• **Assumed that maintenance cost would increase with an increase in traffic**

• **Roads chosen based on:**
  - surface types
  - high and low volume traffic counts
Waseca County Cumulative Maintenance cost/mile

Cumulative Maintenance cost/mile for different types of roads over time from 1984 to 2002.

- Low Volume Bituminous
- High Volume Bituminous
- Low Volume Gravel
- Concrete
- High Volume Gravel
## Typical maintenance costs/mile

<table>
<thead>
<tr>
<th>County</th>
<th>Road Type</th>
<th>Miles</th>
<th>Total Cost/Mile of Activities Influenced by Surface Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Gravel</td>
<td>313</td>
<td>$1,863</td>
</tr>
<tr>
<td></td>
<td>Bituminous</td>
<td>189</td>
<td>$638</td>
</tr>
<tr>
<td>B</td>
<td>Gravel</td>
<td>228</td>
<td>$1,456</td>
</tr>
<tr>
<td></td>
<td>Bituminous</td>
<td>442</td>
<td>$1,320</td>
</tr>
<tr>
<td>C</td>
<td>Gravel</td>
<td>297</td>
<td>$2,004</td>
</tr>
<tr>
<td></td>
<td>Bituminous</td>
<td>426</td>
<td>$2,105</td>
</tr>
<tr>
<td>D</td>
<td>Gravel</td>
<td>64</td>
<td>$273</td>
</tr>
<tr>
<td></td>
<td>Bituminous</td>
<td>198</td>
<td>$210</td>
</tr>
</tbody>
</table>
Average cost/mile for gravel road maintenance activities for one county

- Reshaping, $22, 1%
- Dust Treatment, $7, <1%
- Bituminous Treatments, $34, 1%
- Surface Treatment, $5, <1%
- Minor Surface Repair, $60, 3%
- Frost Boils/Patching, $2, <1%
- Snow and Ice Removal, $267, 11%
- Smoothing Surface, $403, 17%
- Regraveling, $971, 43%
- Other Maintenance Activities, $561, 24%
- Other Maintenance Activities, $561, 24%
Average cost/mile for bituminous road maintenance activities for one county

- Reshaping, $23, 1%
- Bituminous Treatments, $433, 12%
- Minor Surface Repair, $595, 17%
- Snow and Ice Removal, $757, 21%
- Other Maintenance Activities, $1,159, 33%
- Regraveling, $513, 15%
- Frost Boils/Patching, $2, <1%
- Dust Treatment, $3, <1%
- Surface Treatment, $1, <1%
- Smoothing Surface, $50, 1%
- Other Maintenance Activities, $1,159, 33%
Traffic’s effect on maintenance costs/mile

- Roads grouped by traffic volumes and surface type
- An increase in traffic should lead to an increase in maintenance costs, particularly for gravel roads
  - More gravel needed
  - More blading and smoothing of road surface needed
How to compare gravel vs. paved?

- Review the historical costs of maintaining bituminous roads
- Compute estimated costs of maintaining gravel roads
- Develop a cost estimate in the same way a contractor would
- Review the maintenance and construction costs, plot the costs over time, and make a decision.
Cumulative maintenance costs/mile over time for a gravel road

- Cumulative Total Cost ($)
- Time (years)

- Initial Construction
- Periodic Re-Gaveling
- Routine Maintenance (Re-Grading)
- Rehabilitation Alternative
Example: Present Worth Inputs

- Costs:
  - $5,175/yr (TYP)
  - $15,200
  - $131,600

- Benefits:
  - $5,175/yr (TYP)
  - $7,600/mi Seal Coat (TYP)

YEAR:
- 0
- 10
- 20
- 30
How does that apply to this agency?
• Investigated surfacing criteria for low volume roads
• Create a process comparing maintenance requirements for different surface types to assist in deciding the most economical surface type under a given set of conditions
• Surface types include:
  - HMA
  - Blotter
  - Gravel
  - Stabilized gravel
Final product is a computerized tool that allows an agency to modify the costs and treatments to fit their own conditions.
SD procedure

1. Identify the road section
   - Project limits
   - Average Daily Traffic (ADT) count

2. Determine agency costs
   - Dependent on surface type
   - Includes typical maintenance activities

3. Determine user costs
   - Vehicle operating costs
   - Crash costs
   - Scale the user costs
4. Summarize the total costs

5. Evaluate non-economic factors
   - Growth rates
   - Housing concentration and dust control needs
   - Mail routes
   - Industry and truck traffic
   - Political factors
How does that apply to this agency?
Conclusions

- Paved roads provide improvement over gravel in ways that are hard to quantify with dollars

- These include:
  - Improved winter surfaces
  - Improved safety from improved signage and delineation
  - Surface with higher skid resistance
  - Smoother surface that increases user satisfaction and reduces vehicle maintenance costs
  - Redistribution of traffic away from gravel roads
  - Increased tax base on adjacent property
Conclusions

- Costs vary considerably from one agency to another and from one season to another
- MN Study found that gravel road maintenance costs per mile appear to increase considerably after 200 vehicles/day
- SD study found that gravel roads are most cost effective at ADT levels below 150
- Begin planning for surface upgrades when traffic reaches 100 vehicles per day
Recommendations

• Our agency should begin to record maintenance and construction costs for future decisions and use of these tools, and for comparison to historical data.

• Both tools can be used to make informed decisions about paving or not paving a roadway section.