OIL & GAS PRODUCTION
TRANSPORTATION IMPACT STUDY

Presentation to Boulder County Board of County Commissioners
December 6, 2012
STUDY OBJECTIVES

- Identify potential impacts of oil and gas industry on Boulder County roads
- Estimate general magnitude of:
  - Oil & gas related truck traffic
  - Incremental road deterioration and safety costs
- Develop a cost recovery mechanism that allows the County to offset increased road deterioration and safety costs
- Integrate study results with forthcoming oil & gas land use regulations
Service Delivery Challenges

- Oil & gas industry has unusual characteristics...
  - Dispersed
  - Road intensive
  - Migratory
  - Evolving: drilling to production
  - Uncertain pace and intensity of development
  - Uncertain traffic patterns
STUDY PROCESS DIAGRAM

Inventory of Existing Roadway Conditions

Trip Generation and Vehicle Types

Oil and Gas Development Scenarios

Travel Model
- Trips per Roadway Segment
- Loads per Roadway Segment

Types of Mitigation
- Increased Maintenance
- Expedited Reconstruction
- Multi-modal Safety (shoulders)

Road Deterioration and Safety Costs

Fee Per Well
STUDY AREA
TRIP GENERATION – CLUSTERED DEVELOPMENT

- Sources include recent planning documents from:
  - Pennsylvania
  - New York
  - Utah
  - Texas

- Assumes clustered development, horizontal drilling, hydraulic fracturing

- Four wells, one pad

- National studies adapted to observed patterns in Wattenberg/Niobrara

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<table>
<thead>
<tr>
<th>Phase</th>
<th>Truck Trips</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>87</td>
<td>Pad and Road Construction</td>
</tr>
<tr>
<td>Drilling</td>
<td>93</td>
<td>Drilling Rig</td>
</tr>
<tr>
<td></td>
<td>270</td>
<td>Drilling Fluid and Materials</td>
</tr>
<tr>
<td></td>
<td>453</td>
<td>Drilling Equipment (casing, drill pipe, etc)</td>
</tr>
<tr>
<td>Completion</td>
<td>42</td>
<td>Completion Rig</td>
</tr>
<tr>
<td></td>
<td>170</td>
<td>Completion Fluid and Materials</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Completion Equipment (pipe, wellhead, etc)</td>
</tr>
<tr>
<td></td>
<td>317</td>
<td>Fracturing Equipment (pump trucks, tanks, etc)</td>
</tr>
<tr>
<td></td>
<td>4,152</td>
<td>Fracture Water</td>
</tr>
<tr>
<td></td>
<td>191</td>
<td>Fracture Sand</td>
</tr>
<tr>
<td></td>
<td>1,400</td>
<td>Flowback Water Disposal</td>
</tr>
<tr>
<td><strong>Total Development Trips</strong></td>
<td><strong>7,184</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Annual Production Trips Per Pad</strong></td>
<td><strong>730</strong></td>
<td></td>
</tr>
</tbody>
</table>

Sources:

"Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in Marcellus Shale and Other Low-Permeability Gas Reservoirs", NTC Consultants, September 2009 and February 2011.

"Highway Freight Traffic Associated with the Development of Oil and Gas Wells", Utah Department of Transportation, October 2006.

"Potential Development of the Natural Gas Resources in the Marcellus Shale", National Park Service, December 2008
SCENARIO DEVELOPMENT

- Three scenarios
- Range of hypothetical outcomes
- Based on expected spacing (COGCC) and plausible rig allocations
- Accelerated Scenario
  - About 30 pads per year over 9 years (10 rigs)
  - 824 producing wells (2031)
- Steady Scenario
  - About 15 pads per year over 16 years (5 rigs)
  - 824 producing wells (2031)
- Low Scenario
  - About 3 pads per year over 16 years (1 rig)
  - 180 producing wells (2031)
Annual producing wells build over time as new wells are drilled and completed.

**SCENARIO DEVELOPMENT**

**NEW AND PRODUCING WELLS**
TRAVEL MODEL ROADWAY NETWORK
No Boulder County-maintained road is expected to exceed the existing capacity threshold due to added oil and gas trips.
AVERAGE DAILY TRIPS BY STAGE
For one pad with four wells

Approximate Duration
HEAVY VEHICLE IMPACTS

- Loaded water truck
  - 6,500 – 11,000 times the load impact of a passenger car

- Rig truck
  - 20,000 – 30,000 times the load impact of a passenger car
Vehicle Miles of Travel (VMT) increase is less than 1% over background
Load increase is 20 – 160% over background
## Types of Mitigation

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Mitigation Activity</th>
<th>Road Deterioration</th>
<th>Roadway Safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpaved/Gravel</td>
<td>Increased frequency of:</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Grading</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Gravel application</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Dust suppression</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Asphalt Roads</td>
<td>• Good/Fair condition</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>• Poor condition</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sub-standard shoulders</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Increased overlay frequency</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Expedited reconstruction</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Shoulder widening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Roads</td>
<td>• Incremental reduction in service life – expedited reconstruction</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
## Cumulative Costs by Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Road Deterioration Costs</th>
<th>Safety Costs</th>
<th>Total Costs</th>
<th>Average Annual Costs (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>$5,980,000</td>
<td>$2,110,000</td>
<td>$8,090,000</td>
<td>$0.5M ($0.1M – $0.9M)</td>
</tr>
<tr>
<td>Steady</td>
<td>$24,760,000</td>
<td>$2,830,000</td>
<td>$27,590,000</td>
<td>$1.7M ($0.7M – $2.6M)</td>
</tr>
<tr>
<td>Accelerated</td>
<td>$24,460,000</td>
<td>$2,840,000</td>
<td>$27,300,000</td>
<td>$1.7M ($0.4M – $4.0M)</td>
</tr>
</tbody>
</table>

Costs are 16-year cumulative figures in current year dollars.
ROAD DETERIORATION AND SAFETY FEE

- Isolates oil & gas impacts on county roads
- Designed to recoup the incremental county cost associated with road deterioration and safety
- Based on blend of the three scenarios and average trip lengths
- Fee designed to be applied in the oil and gas land use application process
Fees per pad and well are averaged across the three scenarios.
## Oil & Gas Roadway Fees

<table>
<thead>
<tr>
<th></th>
<th>Road Deterioration Fee</th>
<th>Safety Fee</th>
<th>Total Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pad</td>
<td>$1,200</td>
<td>-</td>
<td>$1,200</td>
</tr>
<tr>
<td>Well</td>
<td>$30,700</td>
<td>$6,200</td>
<td>$36,900</td>
</tr>
</tbody>
</table>

Fees are in current year dollars.
SUMMARY

- Average-based methodology recognizes current uncertainties:
  - Location of drilling is unknown
  - Traffic patterns unknown
  - Pace of field development uncertain
  - Water sources are unknown

- Fees based on apportionment of expected *incremental* road costs per pad and per well

- Major impact is road deterioration

- Fees are a tool to recover costs during period when transportation impacts are most intense—well development
QUESTIONS
## Cumulative Costs by Scenario
### Alternative Methodology for Poor Condition Asphalt Roads*

<table>
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<tr>
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<th>Total Costs</th>
<th>Average Annual Costs (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>$3,120,000</td>
<td>$2,110,000</td>
<td>$5,230,000</td>
<td>$0.3M ($0.1M – $0.4M)</td>
</tr>
<tr>
<td>Steady</td>
<td>$13,990,000</td>
<td>$2,830,000</td>
<td>$16,820,000</td>
<td>$1.1M ($0.6M – $1.3M)</td>
</tr>
<tr>
<td>Accelerated</td>
<td>$15,860,000</td>
<td>$2,840,000</td>
<td>$18,700,000</td>
<td>$1.2M ($0.7M – $2.0M)</td>
</tr>
</tbody>
</table>

Costs are 16-year cumulative figures in current year dollars.

* Methodology for poor condition asphalt roads the same as for good/fair condition roads; based on overlay depth required to offset O&G truck impacts.
## Oil & Gas Roadway Fees
### Alternative Methodology for Poor Condition Asphalt Roads*

<table>
<thead>
<tr>
<th></th>
<th>Road Deterioration Fee</th>
<th>Safety Fee</th>
<th>Total Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pad</td>
<td>$700</td>
<td>-</td>
<td>$700</td>
</tr>
<tr>
<td>Well</td>
<td>$17,700</td>
<td>$6,200</td>
<td>$23,900</td>
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</tbody>
</table>

Fees are in current year dollars.

* Methodology for poor condition asphalt roads the same as for good/fair condition roads; based on overlay depth required to offset O&G truck impacts.
POOR CONDITION ASPHALT REPLACEMENT COSTS

- Construction Items included in Poor Asphalt Road Deterioration Fee:
  - Removal of Existing Asphalt
  - Placement of New Asphalt

- Construction Items **NOT** included in Poor Asphalt Road Deterioration Fee:
  - Removals / Resets / Utility Relocations
  - Earthwork / Subgrade Re-stabilization
  - Drainage Modifications / Erosion Control / Water Quality
  - Pavement Striping
  - Construction Traffic Control
  - Mobilization
  - Engineering / Construction Management / Material Testing
PAVEMENT DETERIORATION CURVE
FISCAL CHALLENGE

Public Investment Timing

Infrastructure Needs

Resource Production

Construction

Planning & Design

Capital Revenues

Revenues Received

1 to 3 Years
WELD COUNTY
WELL DEVELOPMENT PATTERNS

Source: COGCC