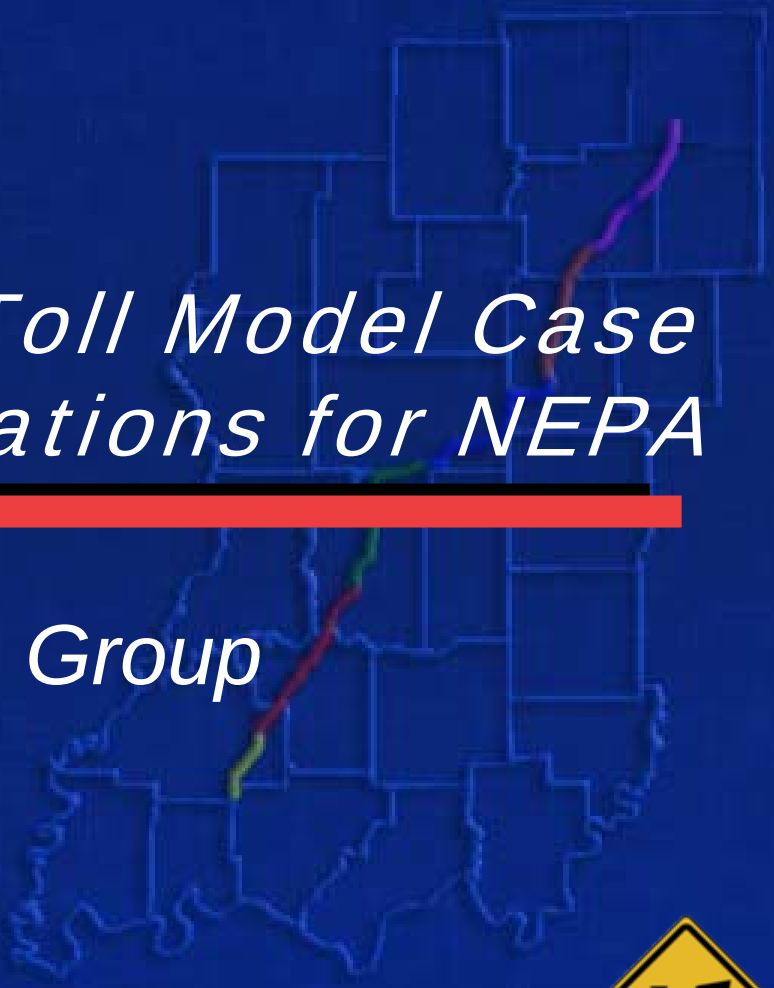
I-69 in Indiana: A Toll Model Case Study & Its Implications for NEPA

Kentucky Model Users Group

June 12, 2008



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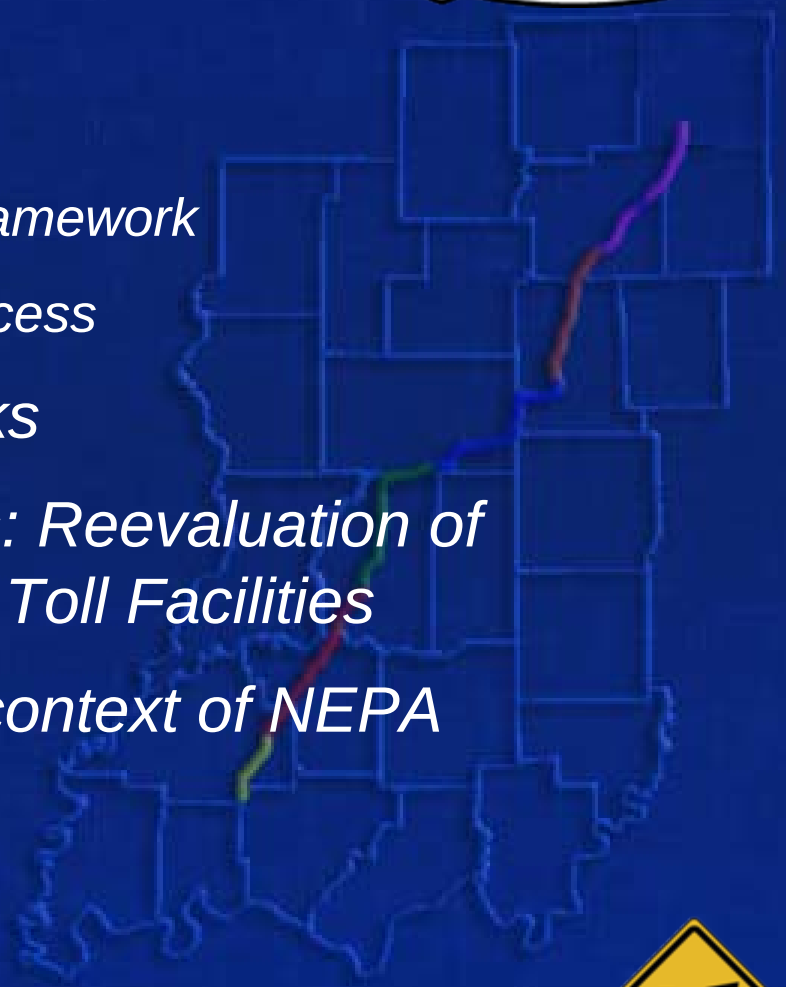
Major Topics

- *General Background*
  - *Indiana Statewide Modeling Framework*
  - *Overview of "Tier 1" NEPA Process*
- *The Toll Model – How It Works*
- *Traffic and Revenue Findings: Reevaluation of Major "Tier 1" Alternatives as Toll Facilities*
- *Implications of Tolling in the context of NEPA*



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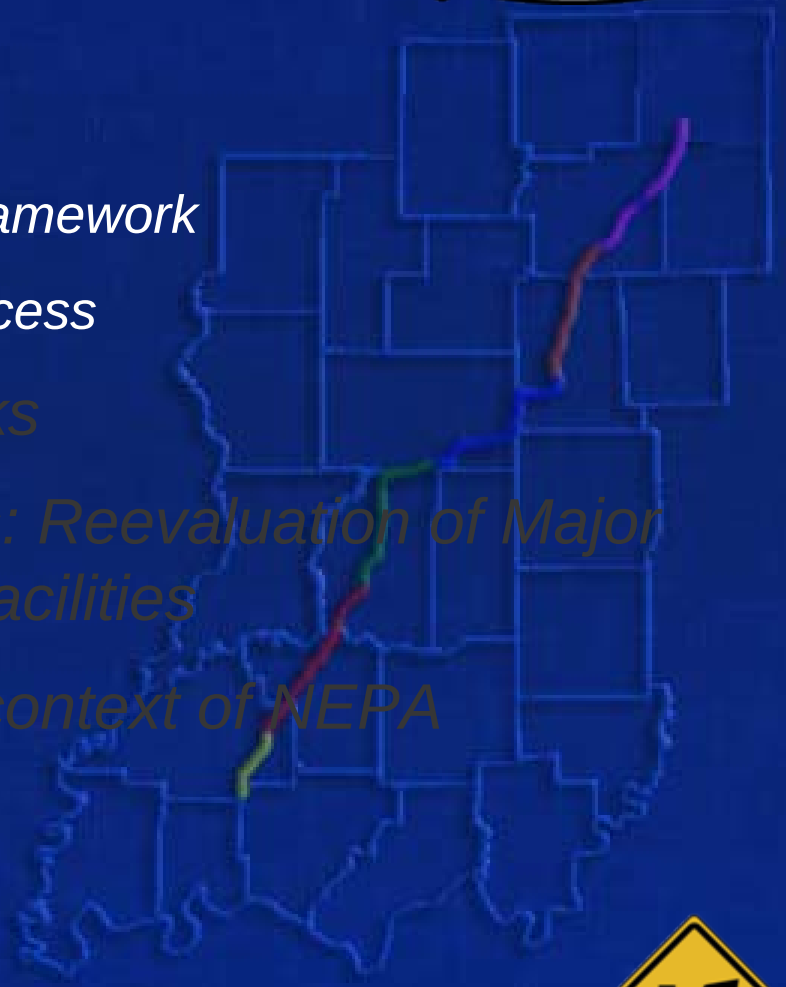
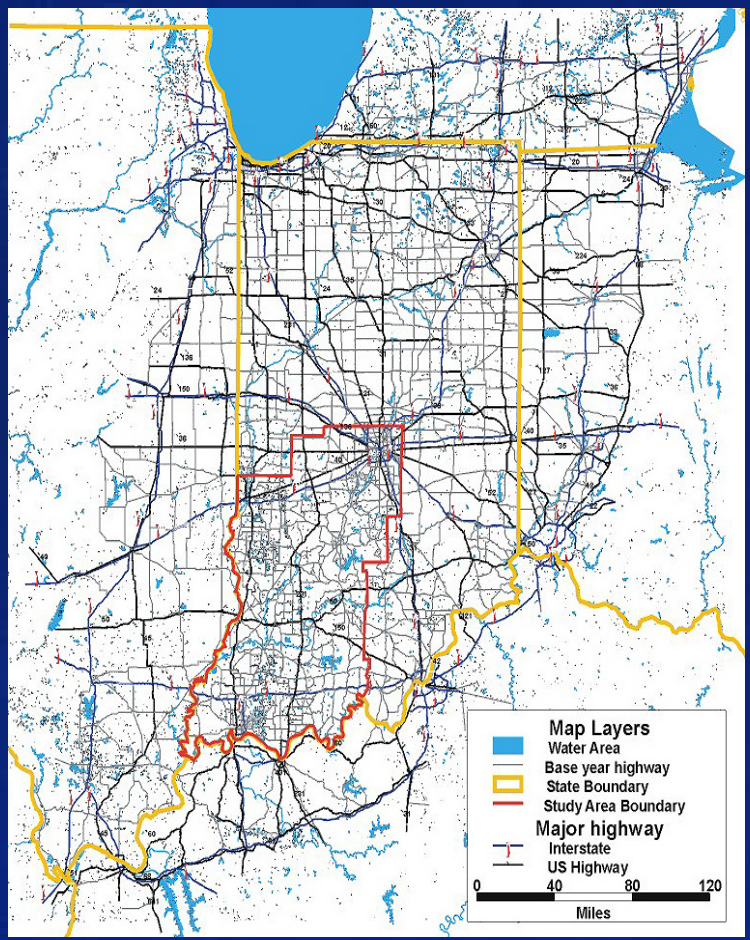


NEPA Tier 1 Modeling

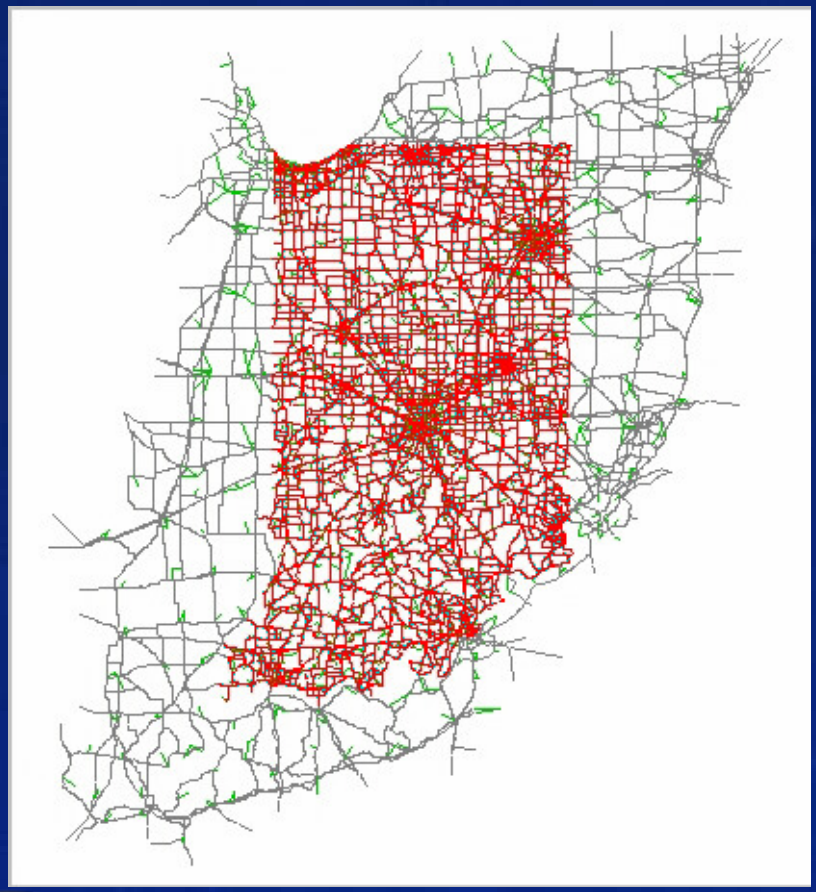


Modeling / Forecasting Approach …

It all started with earlier versions of the Indiana Statewide Travel Demand Model (ISTDM) – versions 2 and 3

NEPA Tier 2 Modeling

ISTDM v4 Road Network

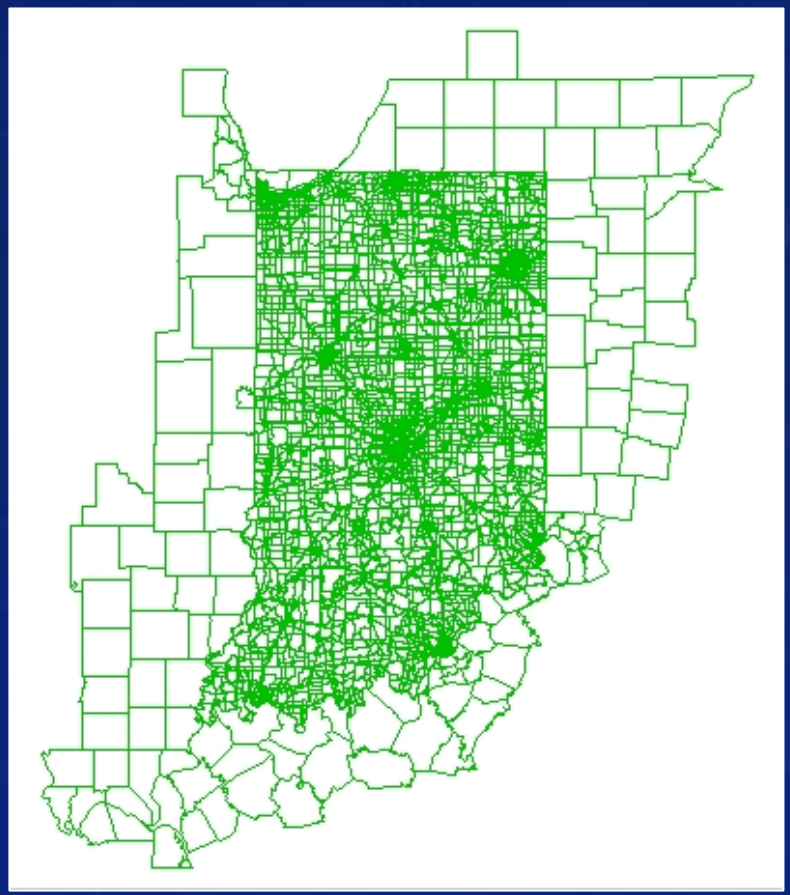


- *Network Attributes*
  - ✓ *Lanes, lane widths*
  - ✓ *Directionality*
  - ✓ *Shoulders, shoulder widths*
  - ✓ *Medians, when present, and median width*
  - ✓ *Access control*
  - ✓ *Count data*
  - ✓ *Functional Class*
  - ✓ *Signals*

25,000 links & 32,000 miles

NEPA Tier 2 Modeling

ISTDM v4 Traffic Analysis Zones

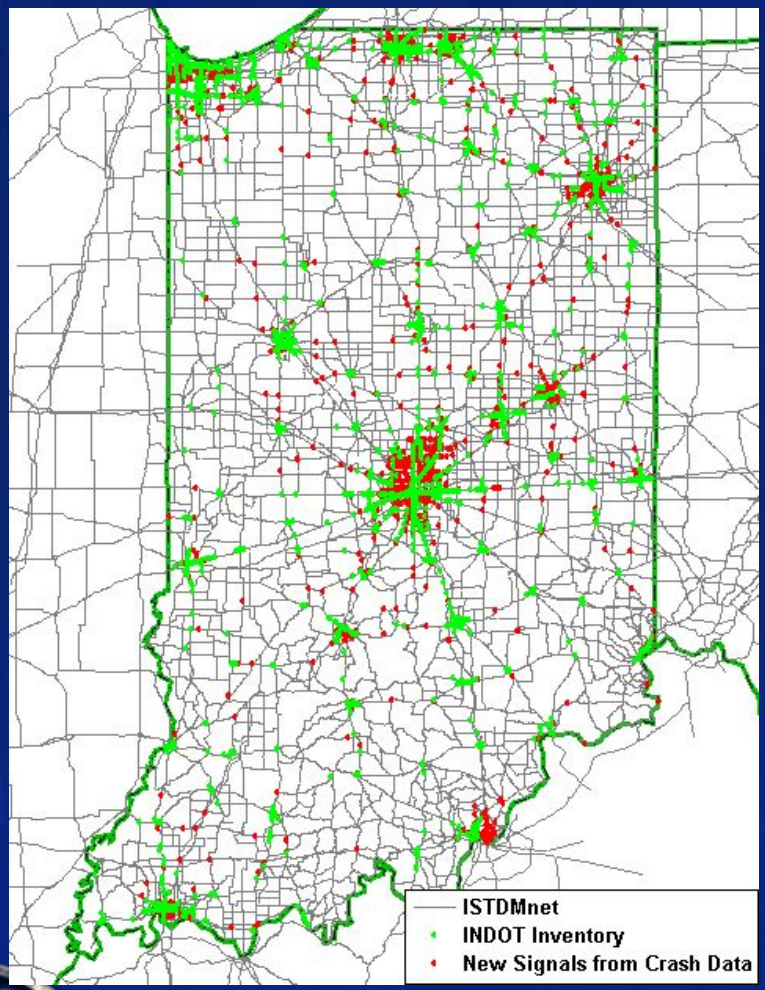


4,720
TAZs

- *TAZ GIS-based process:*
  - ✓ *Conform to roads*
  - ✓ *CTPP boundaries*
  - ✓ *Maximum number of connectors-per-zone → 3*
  - ✓ *No connection to facilities with full or partial access control*

NEPA Tier 2 Modeling

Network & TAZ Attributes



Almost 3,900 signals statewide …

- ✓ *2,638 on State system*
- ✓ *1,225 on local jurisdictional roads*

Capacities computed from geometric link attributes

Free flow speeds computed from posted speeds and facility / area types

Intersection delays computed from type of traffic control device and approach priority

Tier 2 Approach

Indiana Statewide Travel Demand Model (version 4)

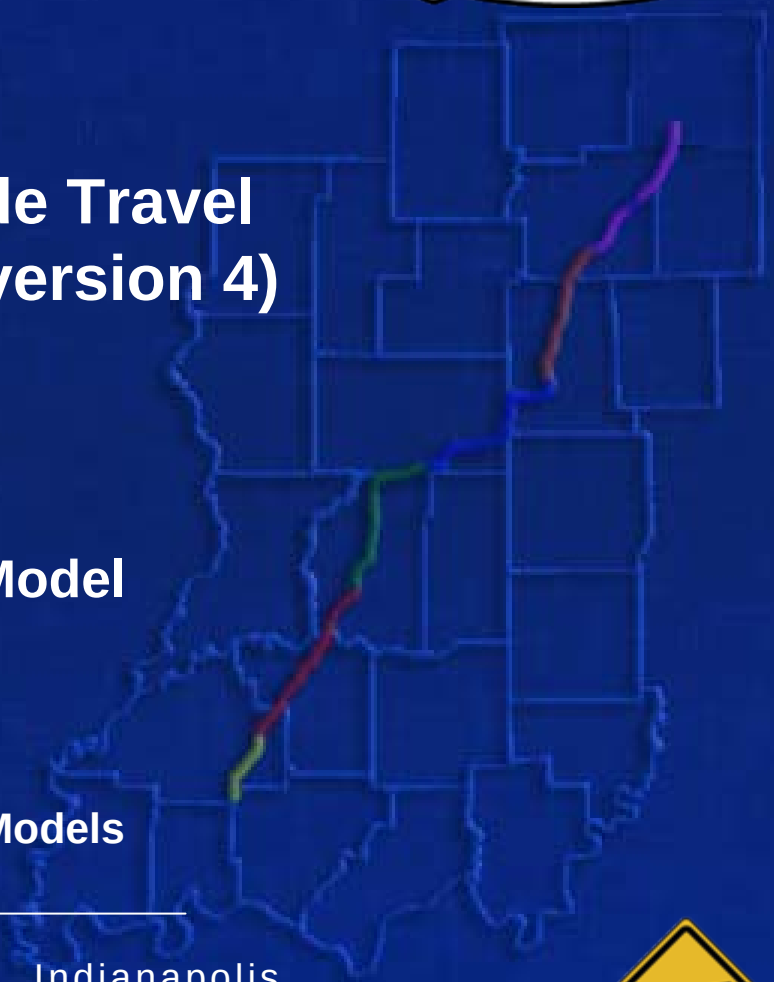
↓

I-69 Corridor Model

↓

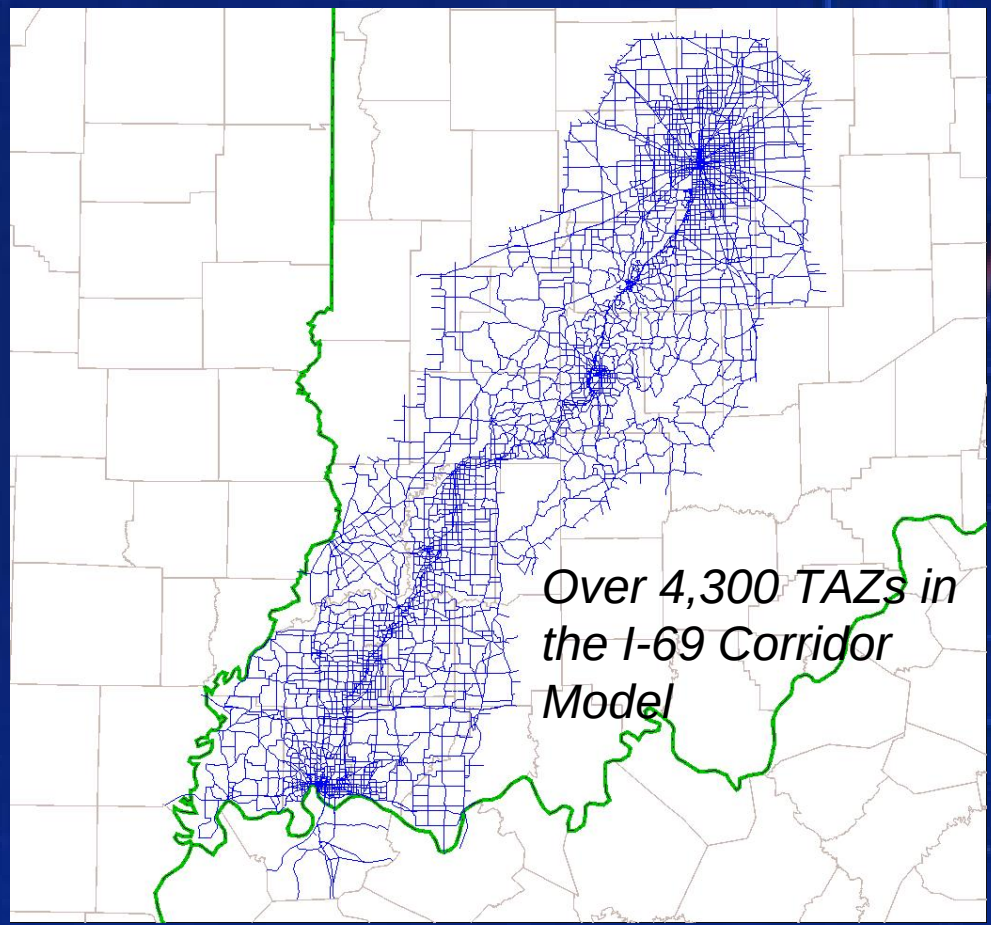
Microsimulation Models

Bloomington Martinsville Indianapolis



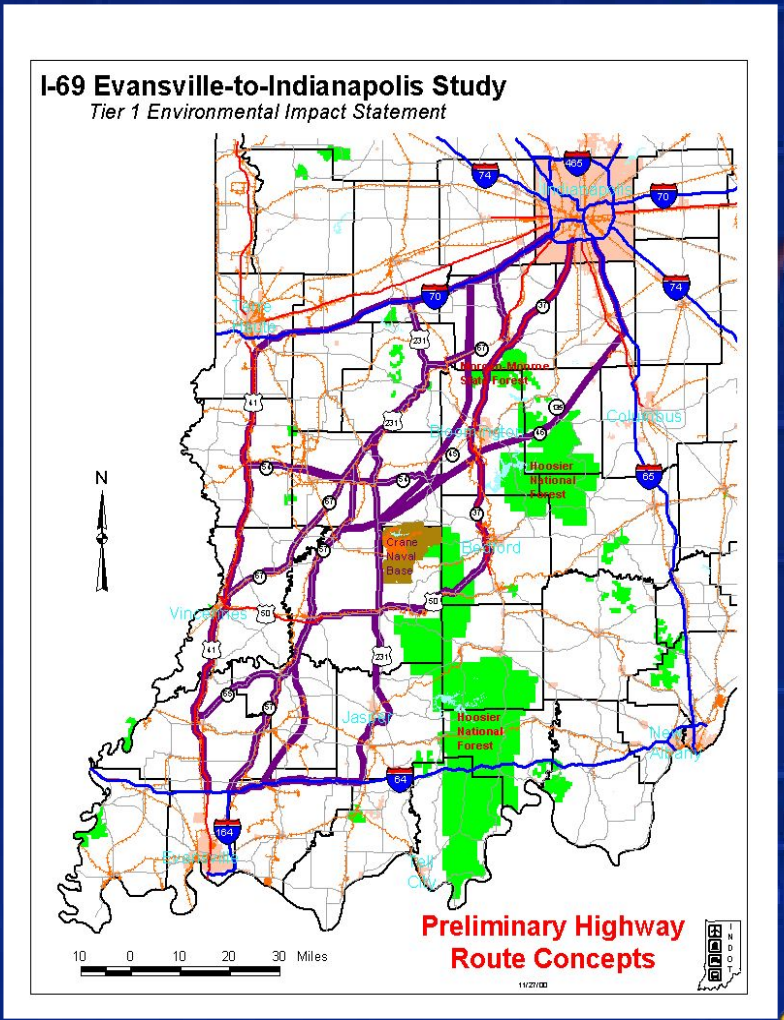
I-69 Corridor Model Network

- ✓ *Highly disaggregated subarea model within the ISTDM*
- ✓ *Peak period time- of-day and 24-hour model*



Tier 1 Alternatives and Study Process

- *Began by modeling 14 preliminary highway route concepts - "A" through "N"*
  - *Several with as many as 4 variations*
- *Eventually whittled down to a total of 12 including alternatives*
- *These 12 evaluated on a wide variety of model generated "performance measures" and affected environmental resources*



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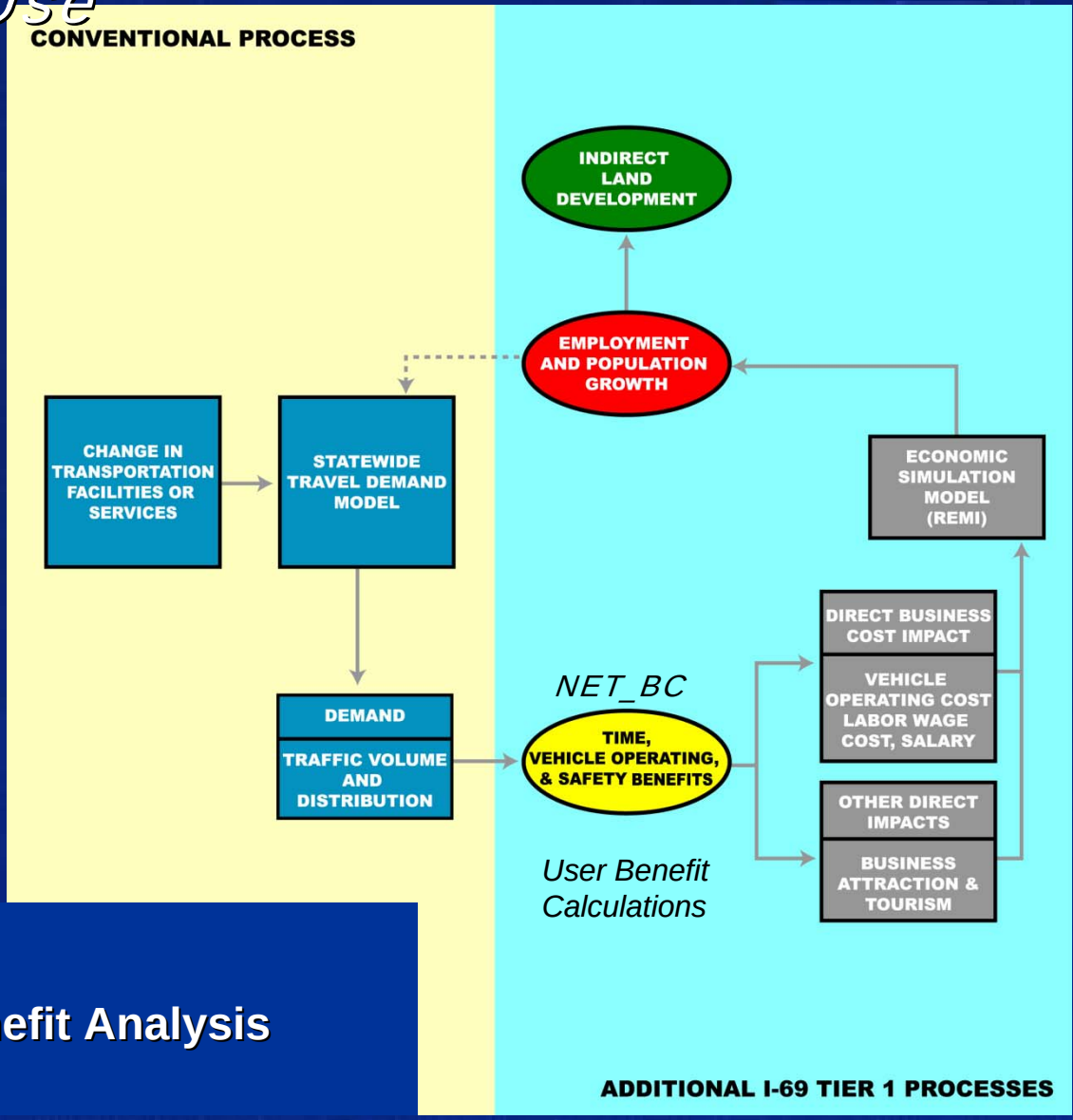
Tier 1 Transportation-Economic- Land Use Process

Integrated process – plus the GIS capabilities of TransCAD – used for generating numerous performance measures



Mid-90s, INDOT developed…

"Major Corridor Investment Benefit Analysis System" (MCIBAS)

Tier 1 Performance Measures

Table 3-35 - 4: Performance of Alternatives on Project Goals

	1	2A	2B	2C	3A	3B	3C	4A	4B	4C	5A	5B
Indy-Evv Travel Time Savings	○	◉	◉	◉	●	●	●	◉	●	●	◉	◉
Improved Personal Accessibility	○	◉	◉	◉	●	●	●	○	○	◉	●	●
International & Interstate Freight Movement	○	○	○	●	●	●	●	◉	◉	●	●	●
Reduction in Traffic Crashes	○	○	○	●	○	●	●	○	○	●	●	●
Congestion Relief	○	○	◉	●	◉	●	●	○	◉	●	◉	●
Improved Business Accessibility	○	○	○	●	○	●	●	○	○	●	●	●
Long-Term Economic Growth	○	◉	◉	●	●	●	●	◉	◉	●	●	●
Economic Benefits to a Wide Spectrum of Regional Residents	○	◉	◉	●	●	●	●	◉	◉	●	●	●
Improved Access to Intermodal Facilities	○	◉	◉	◉	●	●	◉	◉	●	◉	●	◉

SOURCE: Bernardin, Lochmueller & Associates, Inc.

○ LOW ◉ MEDIUM ● HIGH

Key Findings in Tier 1 DEIS

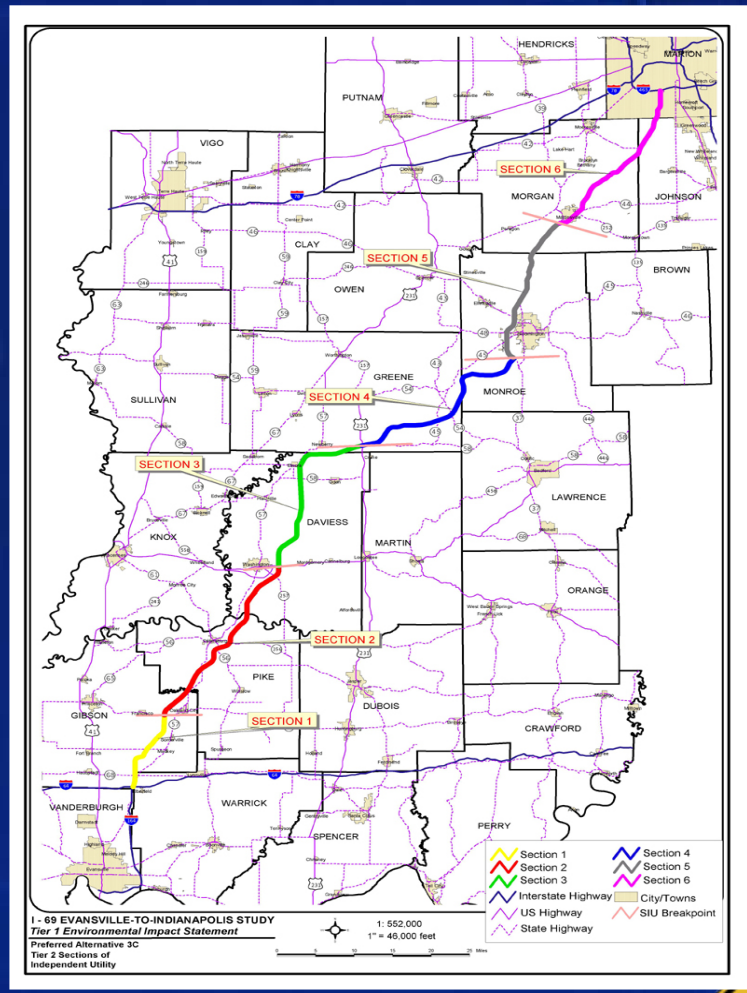
Preferred versus Non-Preferred Alternatives	
Preferred Alternatives	2C, 3B, **3C**, 4B, 4C
Non-Preferred Alternatives	1, 2A, 2B, 4A,3A, 5A, 5B

… for performance reasons

… for environmental reasons

Tier 1 Corridor Selection – Route 3C

- *3B eliminated on environmental grounds*
- *4C had highest wetland impacts; doubtful it could pass the Section 404 "LEDPA" test*
- *4B has serious potential for inducing sprawl and poorer performance than 2C or 3C*
- *2C about the same price range as 3C, but poorer performance*
- ***3C viewed as best long-range solution for Indiana***



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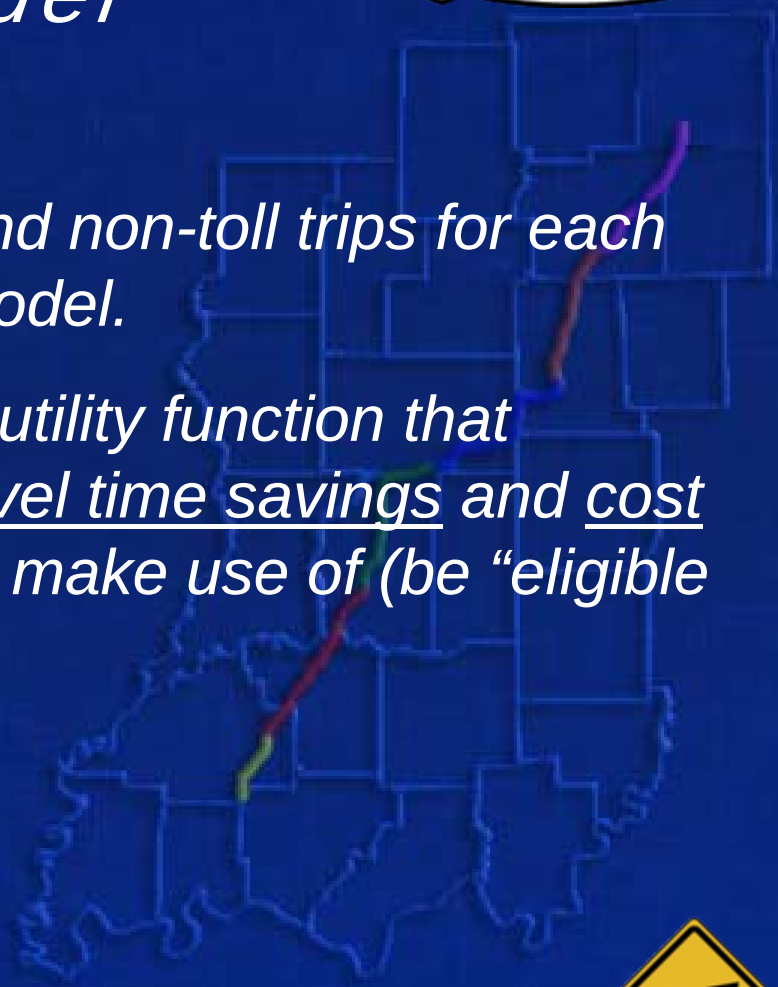
I-69 Toll Choice Model

- *Estimates the number of toll and non-toll trips for each origin-destination pair in the model.*
- *Uses a "post-distribution" logit utility function that considers a combination of travel time savings and cost to determine if a trip is likely to make use of (be "eligible for") a toll route.*

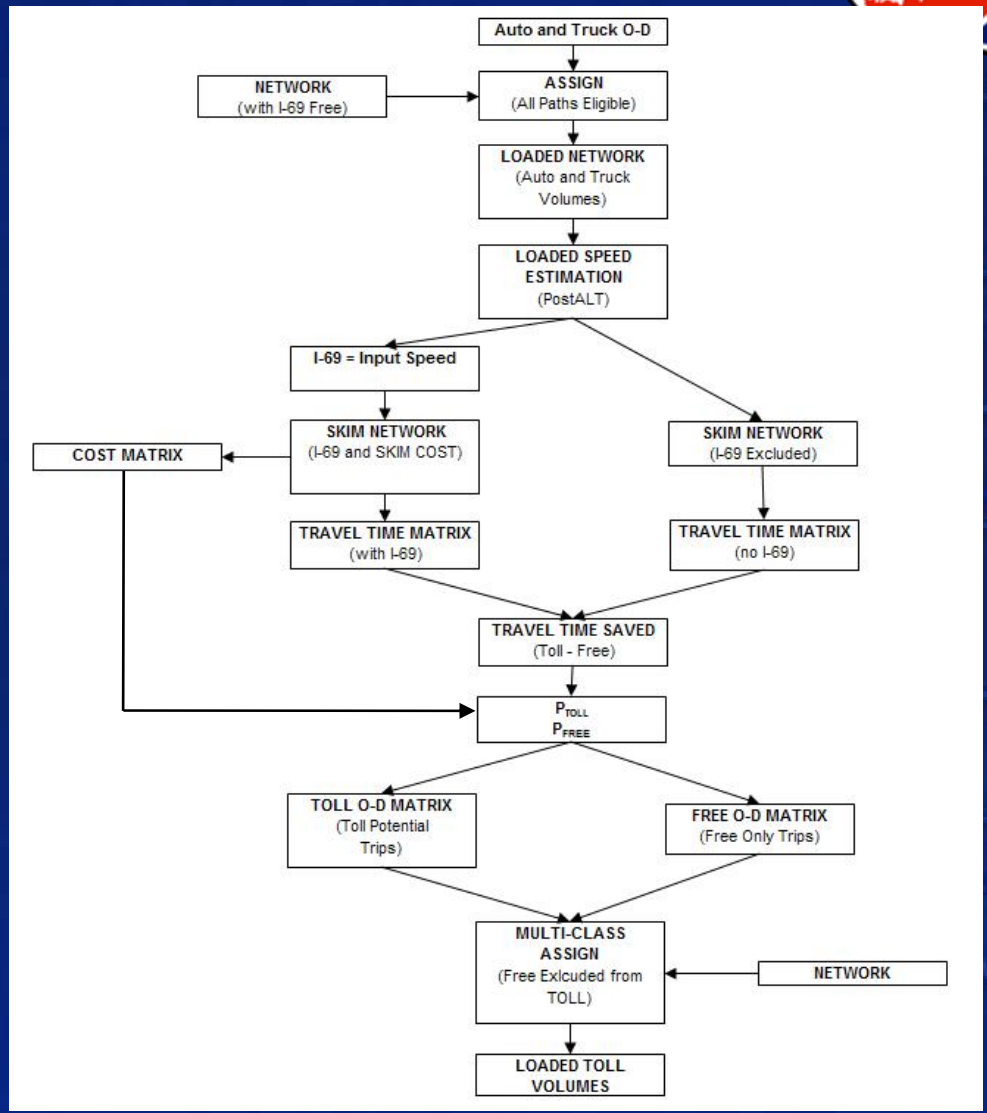


Toll Choice Model

$$P_{Toll} = \frac{1.0}{1.0 + e^{[a(T_{Toll} - T_{Free}) + b(C_{Toll})]}}$$

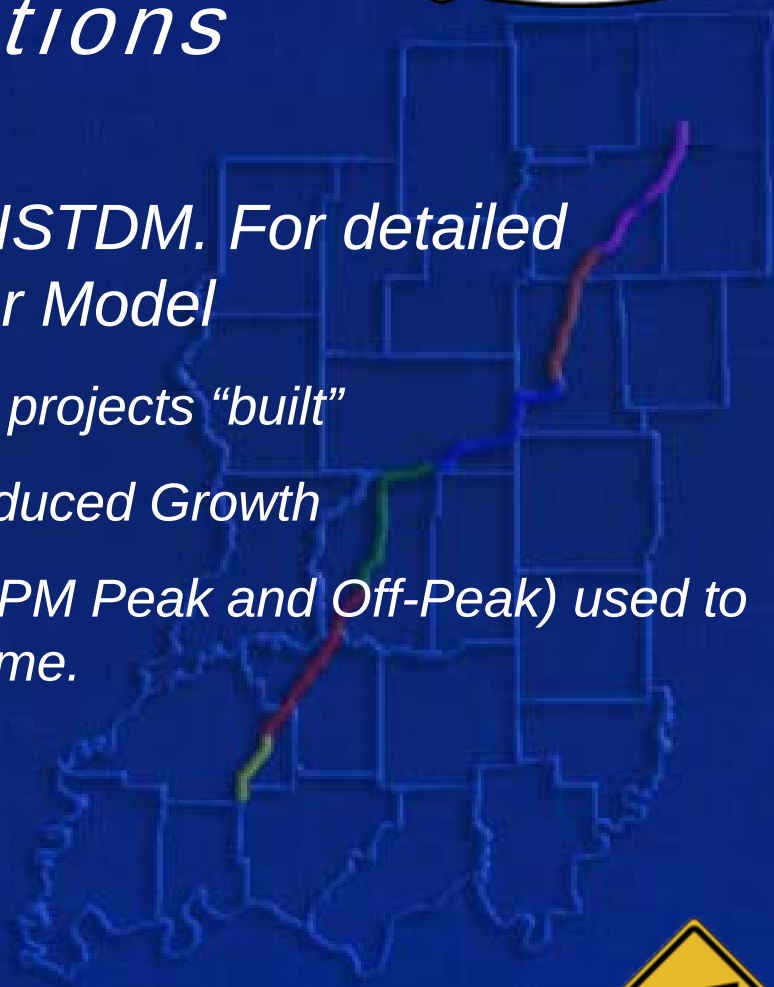
- P_{Toll} = Probability of using toll route
- T_{Toll} = Travel time using the toll route
- T_{Free} = Travel time using the non toll route
- C_{Toll} = Toll cost using the toll route
- Alpha = Time coefficient
- Beta = Cost coefficient

I-69 Toll Choice Model



Toll Model Assumptions

- *Most of the analysis using the ISTDM. For detailed analysis, used the I-69 Corridor Model*
  - *Network Design - Statewide LRP projects "built"*
  - *Land Use Assumptions - 2030 Induced Growth*
  - *Time of Day volumes (AM Peak, PM Peak and Off-Peak) used to estimate TOD congested travel time.*

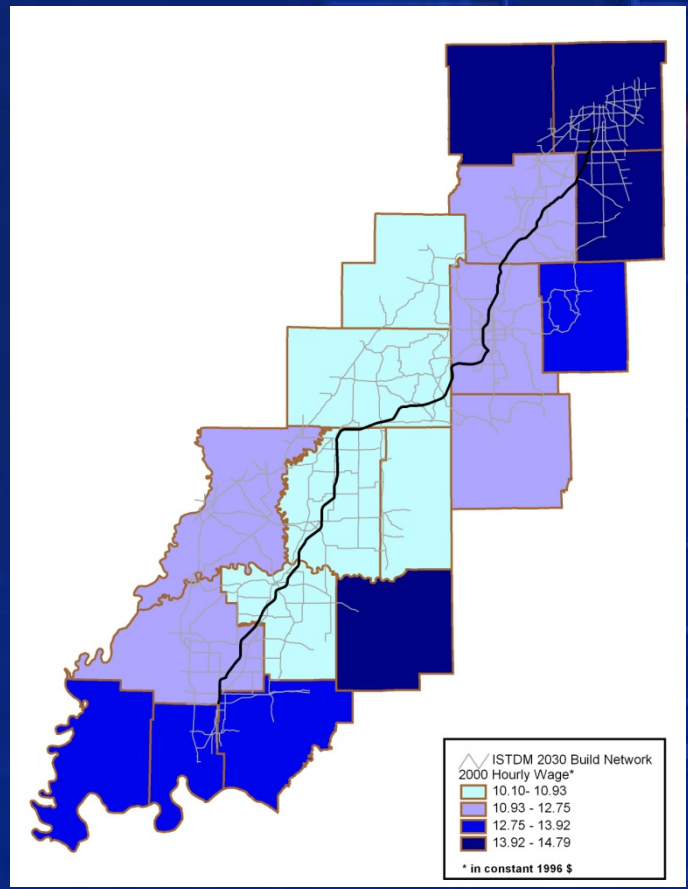


Toll Model Assumptions – Trip Purposes

- *Individual trip purposes were used to vary the value of time for sub-markets*
- *Auto trip purposes (HBW, HBO, NHB, Long)*
- *Non-Freight Trucks = Single Unit*
  - *Single Unit (4 Tire) = 2/3 of Non-Freight Truck (used auto toll rates)*
  - *Single Unit (4+ Tire) = 1/3 of Non-Freight Truck*
- *Freight Trucks = Combo Unit (much higher tolls)*

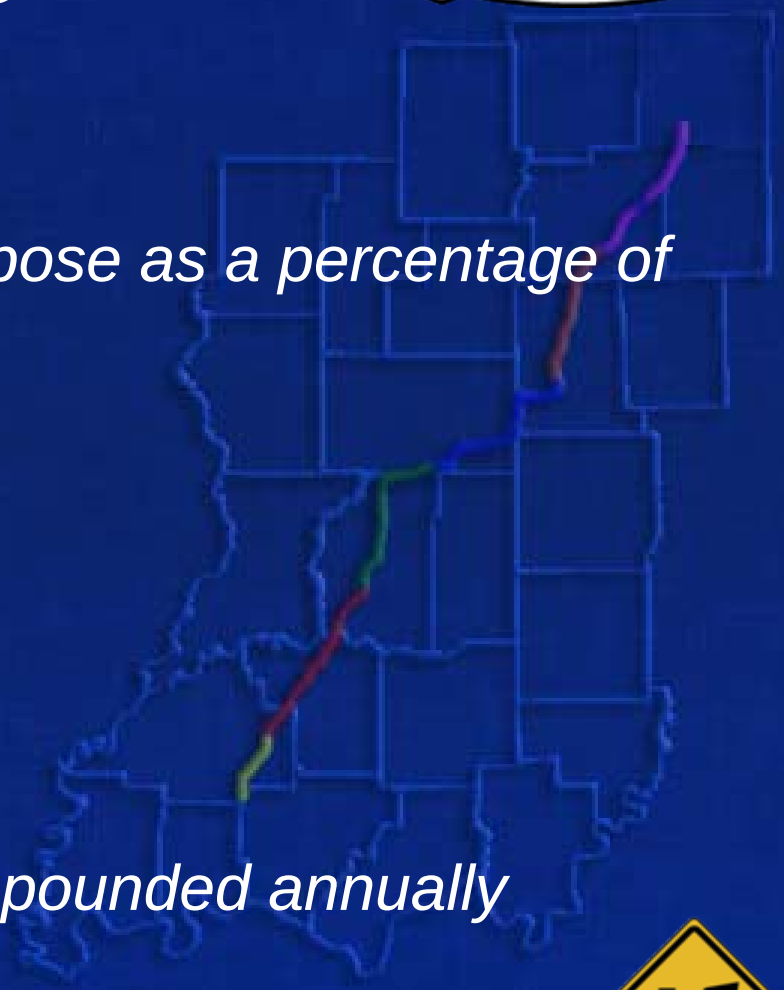
Model Assumptions – Value of Time

- *Value of time (VOT) used to estimate the Beta Coefficient.*
  - *Beta = (Alpha*60) / VOT*
- *Established the median hourly wage for the region of $12.09*
- *Later refinement – Specific VOTs by county of origin*



Model Assumptions – Value of Time

- VOT assigned to each trip purpose as a percentage of wage *(Source: URS Corporation)*
  - HBW: 61.2%
  - HBShop: 29.6%
  - HBO: 55.2%
  - Non-Home Based Work: 53.8%
  - Non-Home Based Other: 64.1%
  - Truck: 335.1%
- 2030 VOTs inflated at 3% compounded annually



Calibration of Alpha Coefficients

Purpose	Original Alphas	Final Calibrated Alphas
HBW	0.1228	0.4269
HBO	0.0350	0.4697
NHB	0.0858	0.5910
LNG / Ext	0.0350	0.1782 / 0.1573
Sing Unit	0.0237	0.4236
Comb Unit	0.0237	0.1000

- Betas
  - Calculated using Alpha and VOT
  - Beta = (Alpha*60)/VOT

Resulting Elasticities by Vehicle Class

Vehicle Class	Variable	Base Line Toll Rates	Double Base Line Toll Rate
Auto	VMT	2,544,700	1,478,960
	"100%" Toll Rate	$ 0.05	$ 0.10
	Elasticity		-0.42
Combo Trucks	VMT	231,230	103,198
	"100%" Toll Rate	$ 0.15	$ 0.30
	Elasticity		-0.55
Single Unit Trucks > 4 Tires	VMT	103,686	77,975
	"100%" Toll Rate	$ 0.10	$ 0.20
	Elasticity		-0.25
Single Unit Trucks 4 Tires	VMT	236,547	217,684
	"100%" Toll Rate	$ 0.05	$ 0.10
	Elasticity		-0.08

Scenarios

- *The following scenarios were tested with inflated tolls in 2030.*
  - *50% Base Toll Rate*
  - *75% Base Toll Rate*
  - *125% Base Toll Rate*
  - *150% Base Toll Rate*
  - *Split Toll Rate (South of BLM / North of BLM)*
    - *0% / 100%*
    - *50% / 100%*
- *Eventually, Governor Daniels had to promise non-inflated toll rates on the Indiana Toll Road as a condition of legislative approval of the lease. Subsequent scenarios revised to assume this lower rate structure in 2030.*

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INTERSTATE 69

Alternative 1

Alternative 2C

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INTERSTATE 69

Alternative 4B

Alternative 4C

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Alternative 3C

The alternative selected as "preferred" in the Tier 1 ROD

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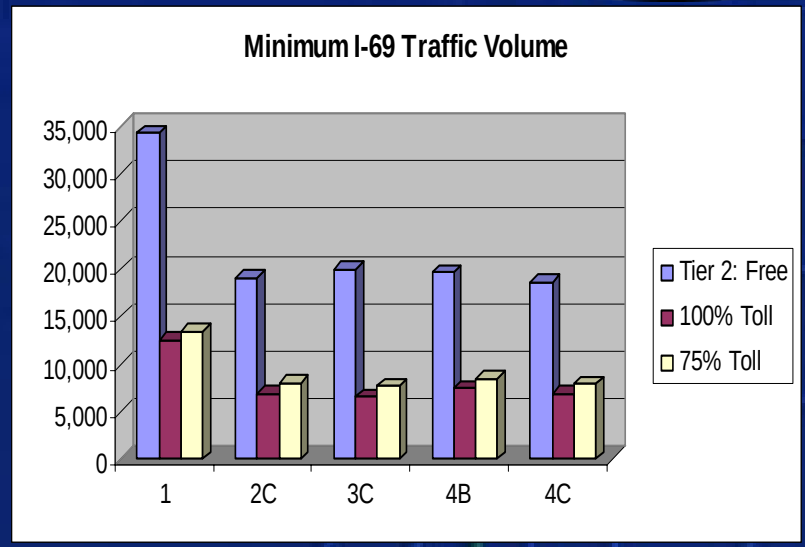
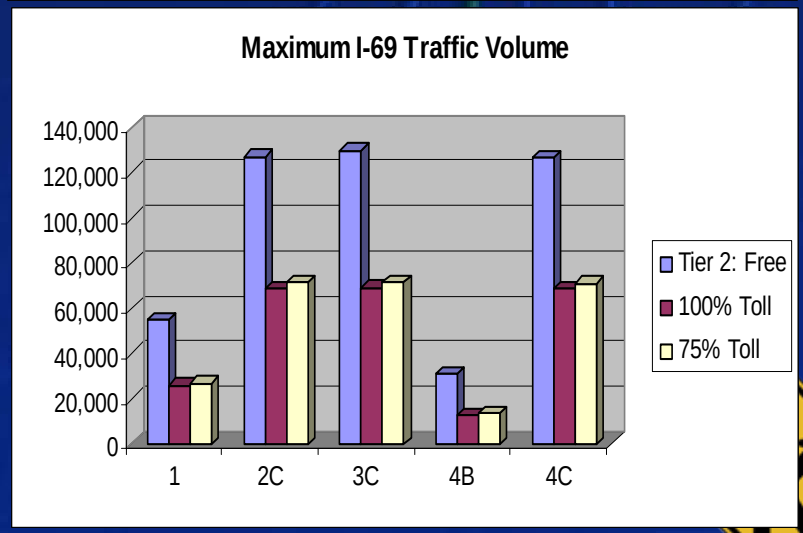
Traffic …

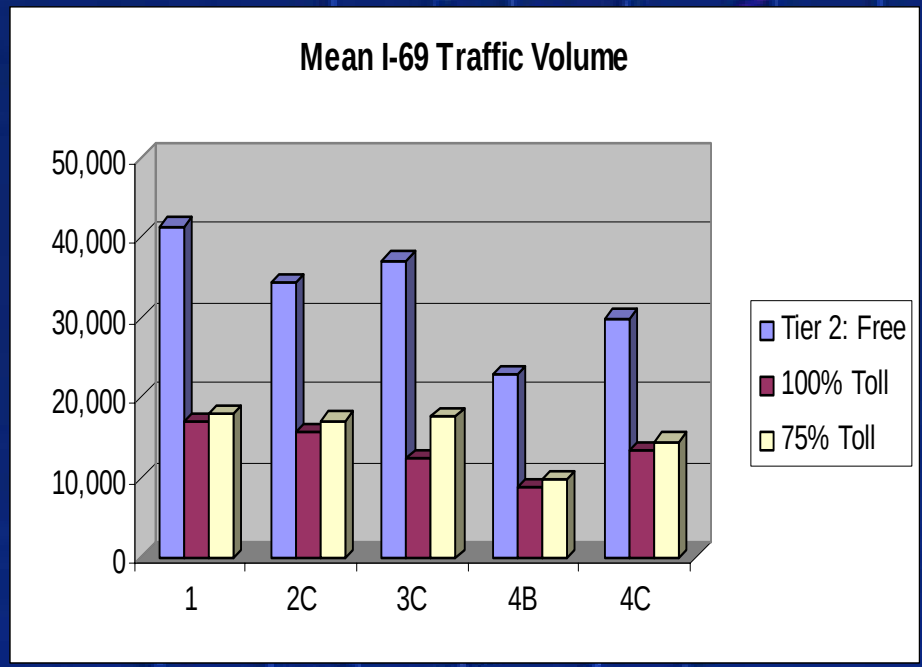
- *Alternative 1 is a special case – entirely on an existing highway.*
- *Tolled minimum traffic volumes are difficult to defend.*
- *Tolls tested to date have a dramatic effect on both minima and maxima.*
  - ***Minima: 57-67% reductions***
  - ***Maxima: 44-60% reductions***
- *Alternatives that use SR 37 – 2C, 3C, and 4C – all have far larger maxima that the other alternatives.*





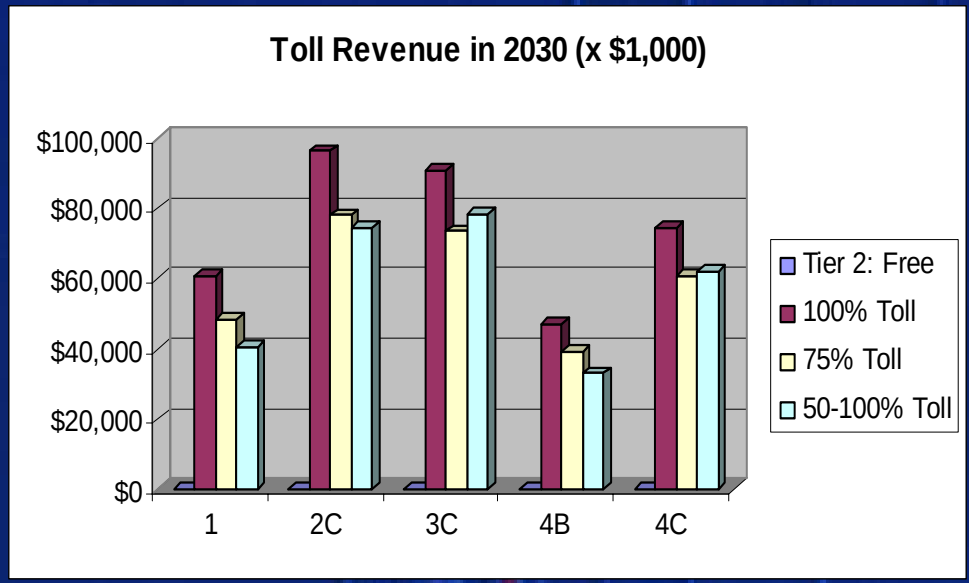
Traffic …

- *Alternative **3C experiences the largest percentage decline** in average traffic volumes between the non-toll and the 100% toll scenarios – very disconcerting!*
  - *67% decrease*
- *At the 100% toll level, Alternative 3C has the second lowest mean traffic volume – second only to 4B.*
- *At the 75% toll level, Alternative 3C has the highest mean traffic volume – tied with Alternative 1 (a special case).*



… and Revenue

- *At the 100% toll level …*
  - *Alternative 2C achieves the highest revenue with $96.4 million in 2030.*
  - *Alternative 3C achieves the second highest revenue with $90.9 million in 2030.*
- *At the 75% toll level …*
  - *Alternative 2C: $78 million*
  - *Alternative 3C: $73.6 million*
- *At the split 50-100% toll level, preliminary modeling suggests :*
  - *Alternative 3C achieves the highest revenue with $78.4 million in 2030.*



Split tolls increase minimum traffic volumes and generate reasonable revenue comparable to 75%. Worth resolving the technical problems.

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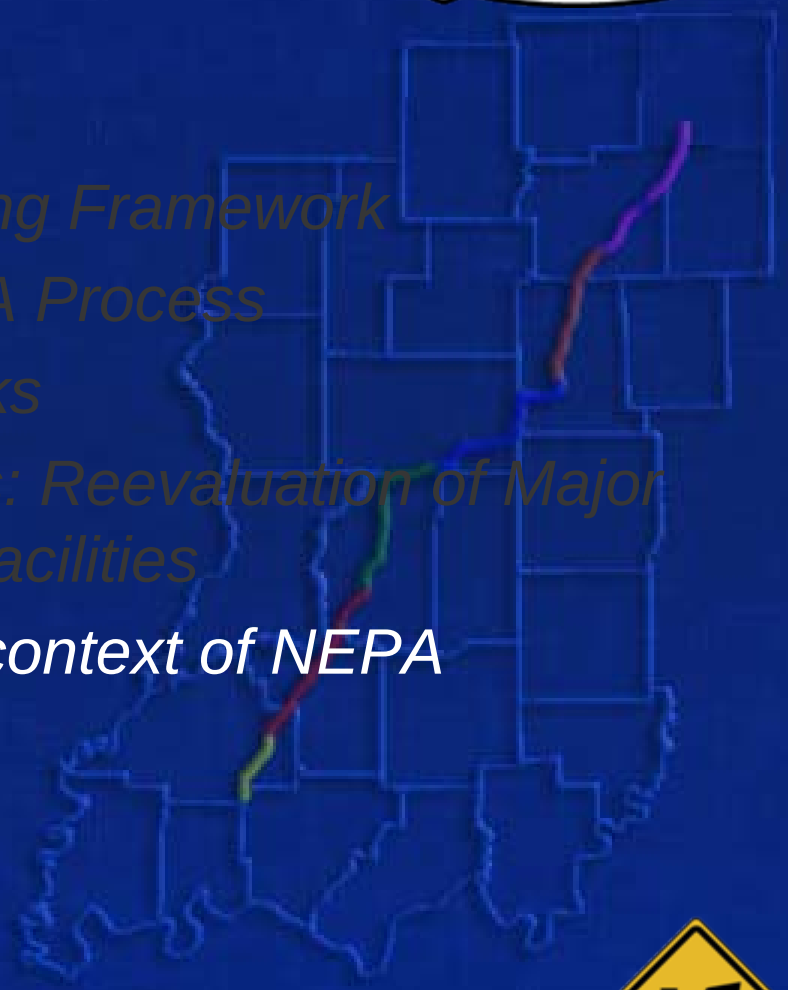
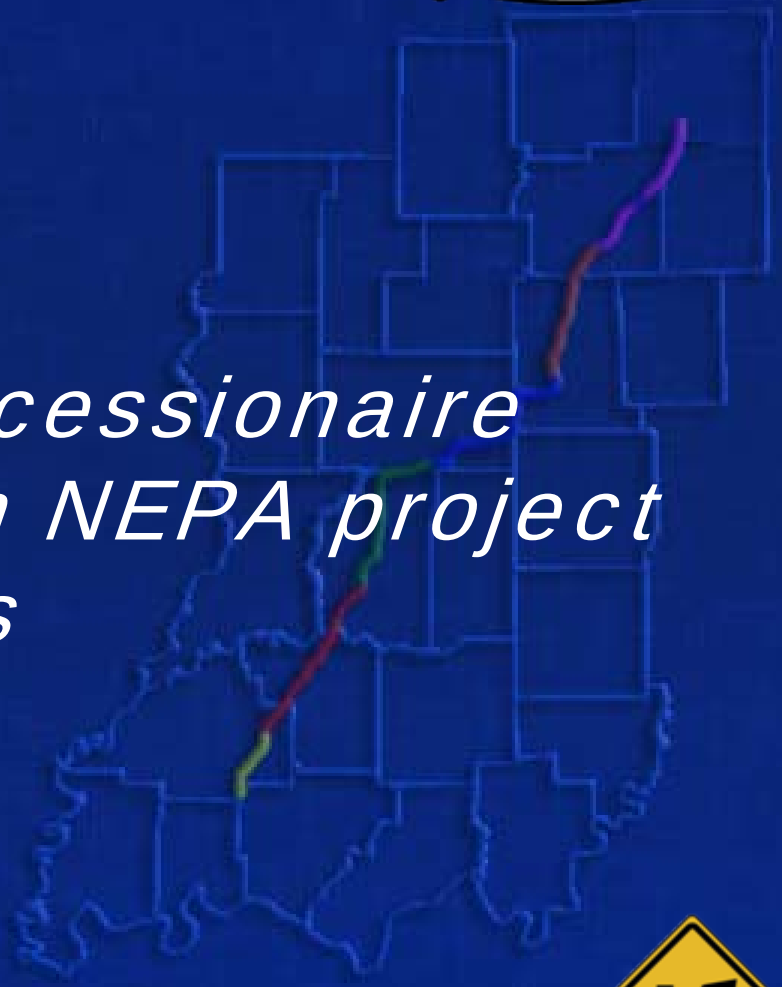


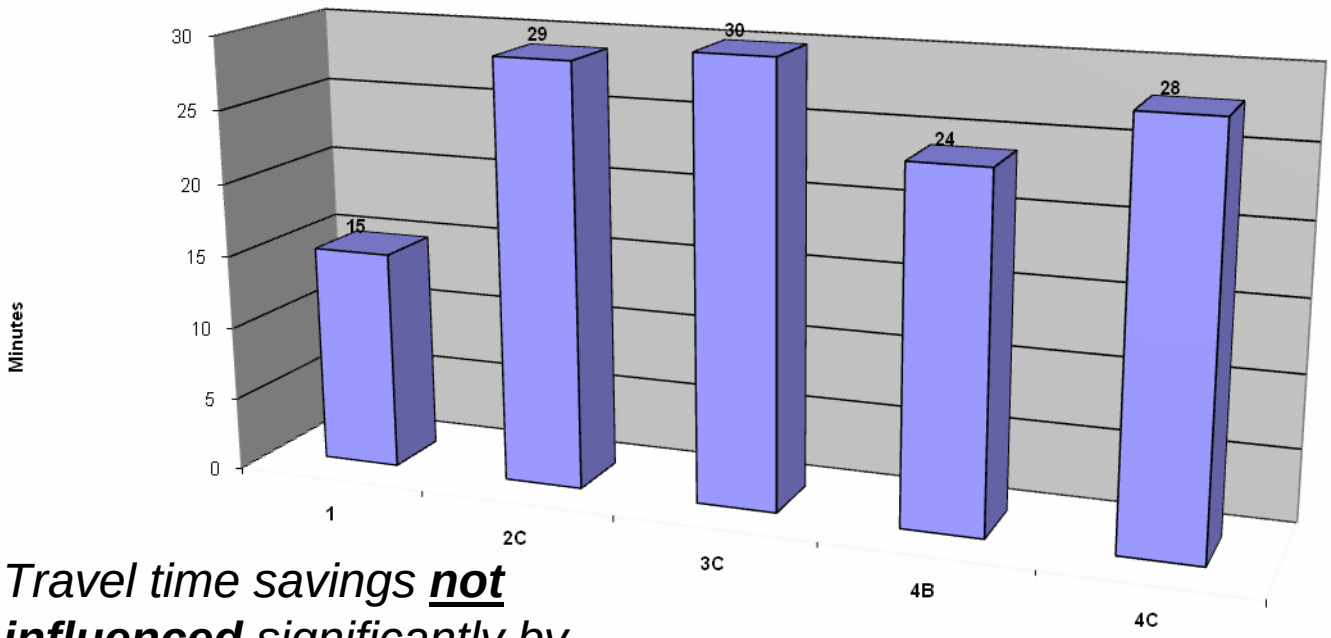
The Challenge:

To balance concessionaire revenue goals with NEPA project goals



Toll Performance Evaluation: Travel Time Savings

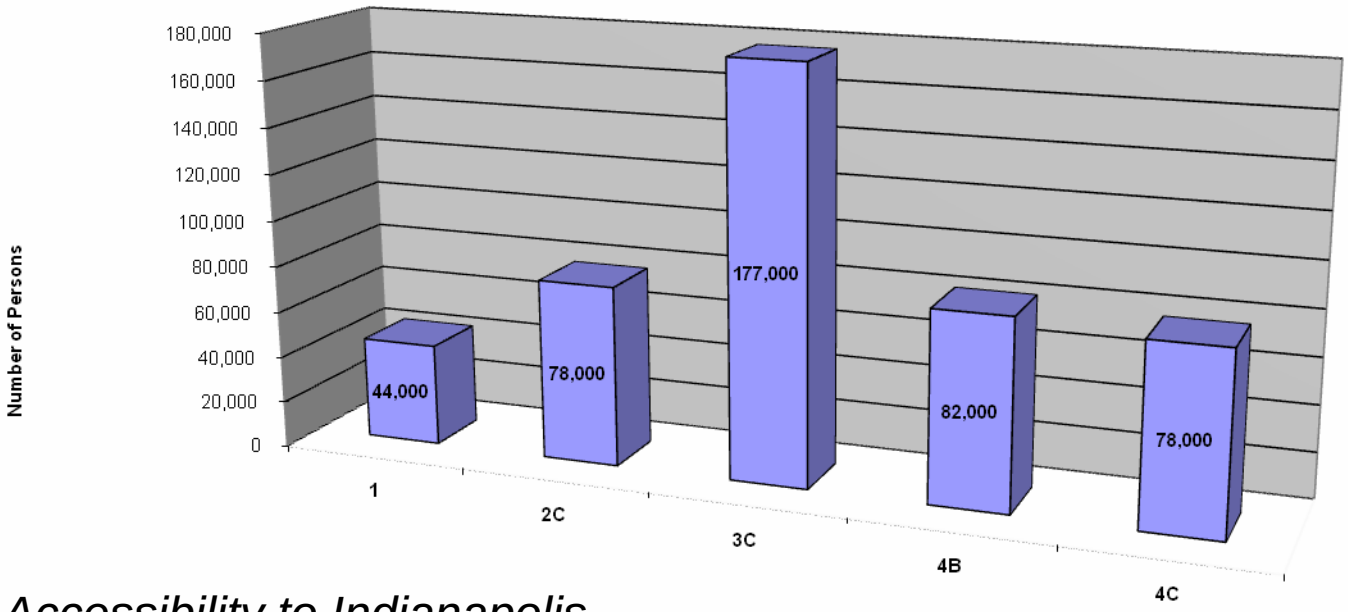
Figure 3-4: Typical Travel Time Savings - Tolled Alternatives, 75% Toll Rate



*Travel time savings **not influenced** significantly by tolling*

Toll Performance Evaluation: Access to Indianapolis

Figure 3-5: Year 2030 Increase in Three-Hour Access to Indianapolis by Alternative



Accessibility to Indianapolis ***not influenced*** *by tolling*

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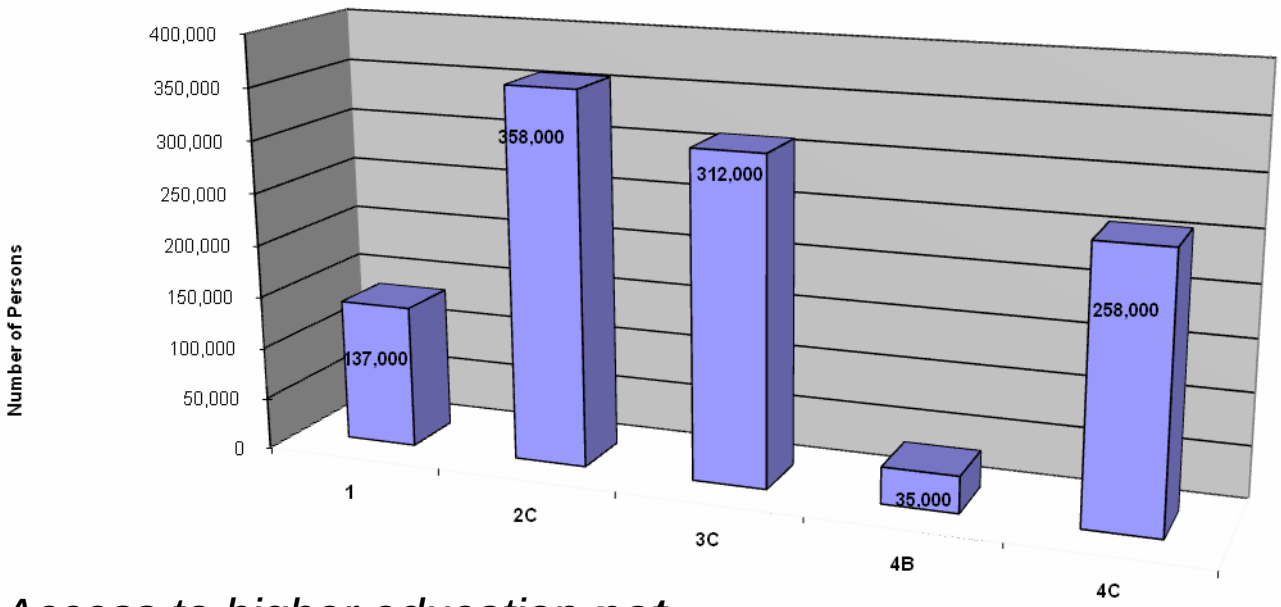
Toll Performance Evaluation: Access to Higher Education

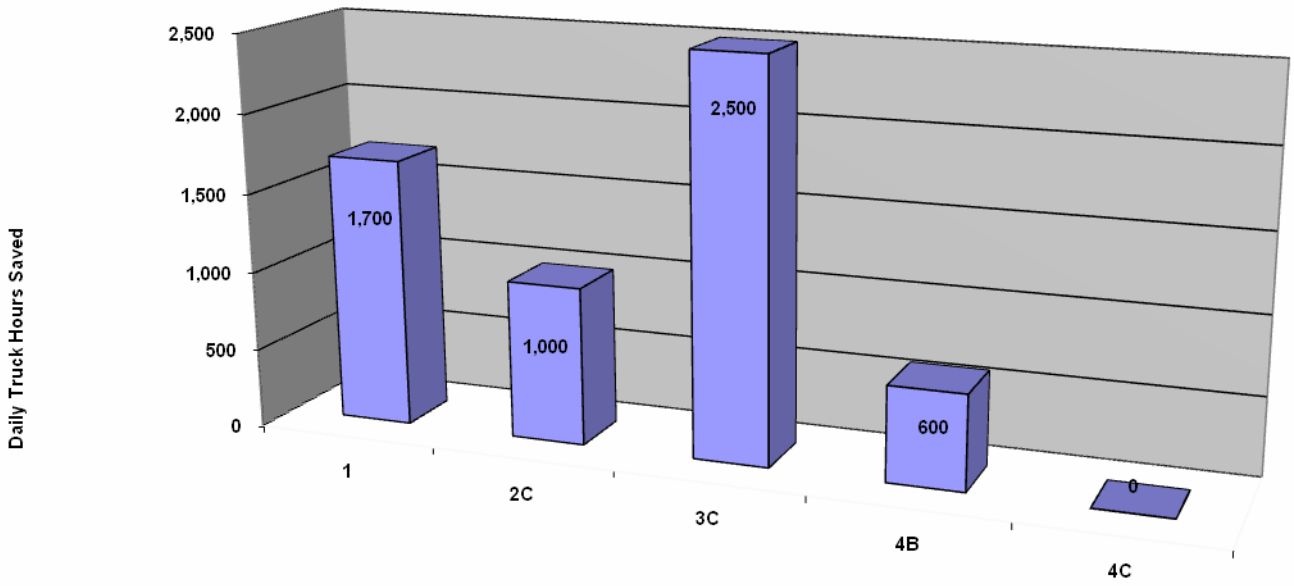
Figure 3-6: Year 2030 Increases in Access Opportunities to Higher Education by Alternative



*Access to higher education **not influenced** by tolling*

Toll Performance Evaluation: Truck Hours Saved

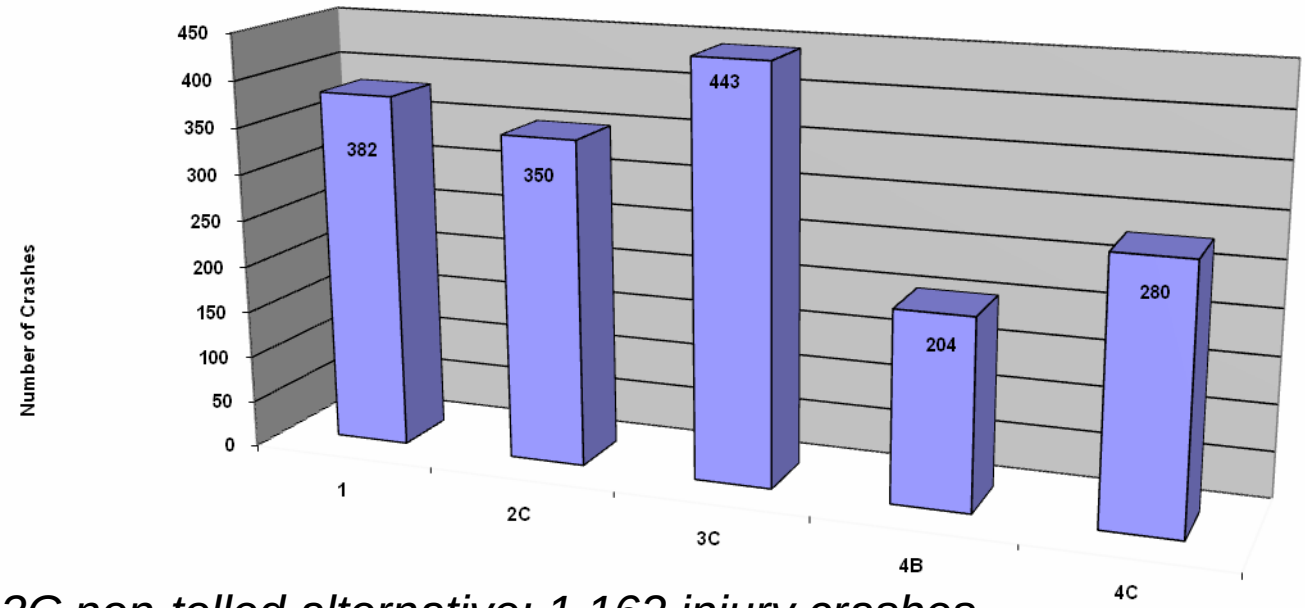
Figure 3-11: Forecasted Year 2030 Daily Truck Hours Saved by Alternative, 75% Toll Rate



*3C non-toll alternative: 4,600 daily truck hours saved – Tolling a **46% decline***

Toll Performance Evaluation: Injury Crash Reductions

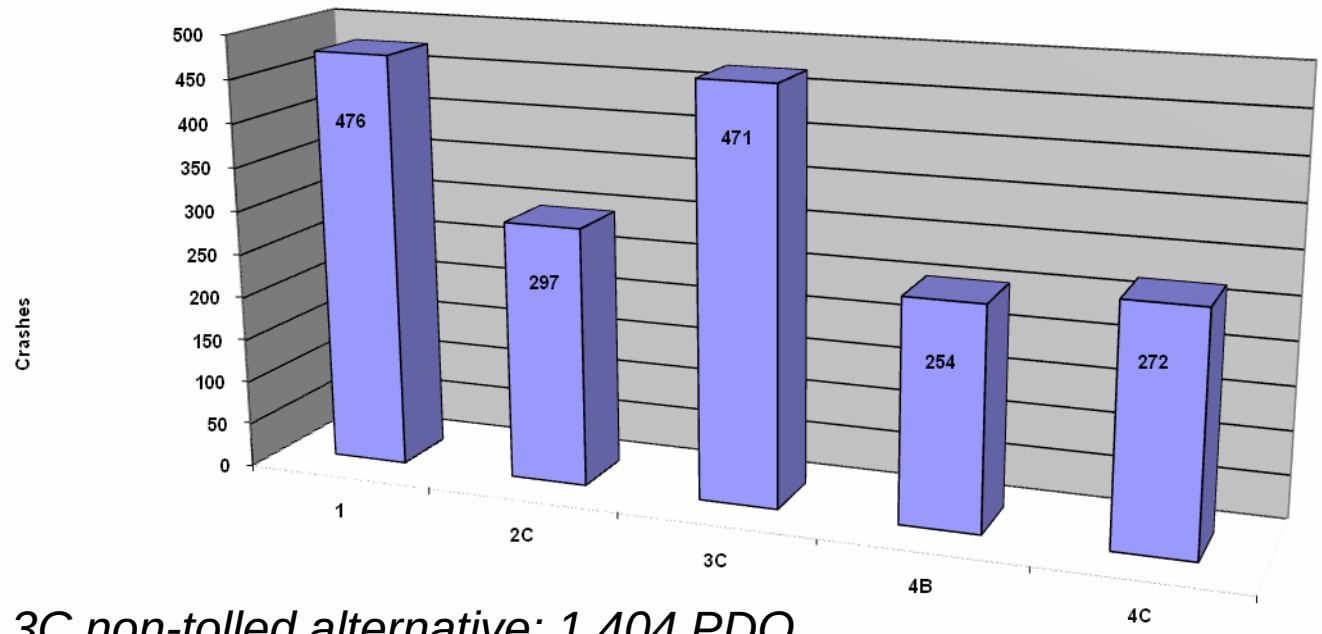
Figure 3-7: Forecasted Year 2030 Annual Injury Crash Reductions by Alternative, 75% Toll Rate



*3C non-tolled alternative: 1,162 injury crashes saved – Tolling a **61% decline***

Toll Performance Evaluation: PDO Crash Reductions

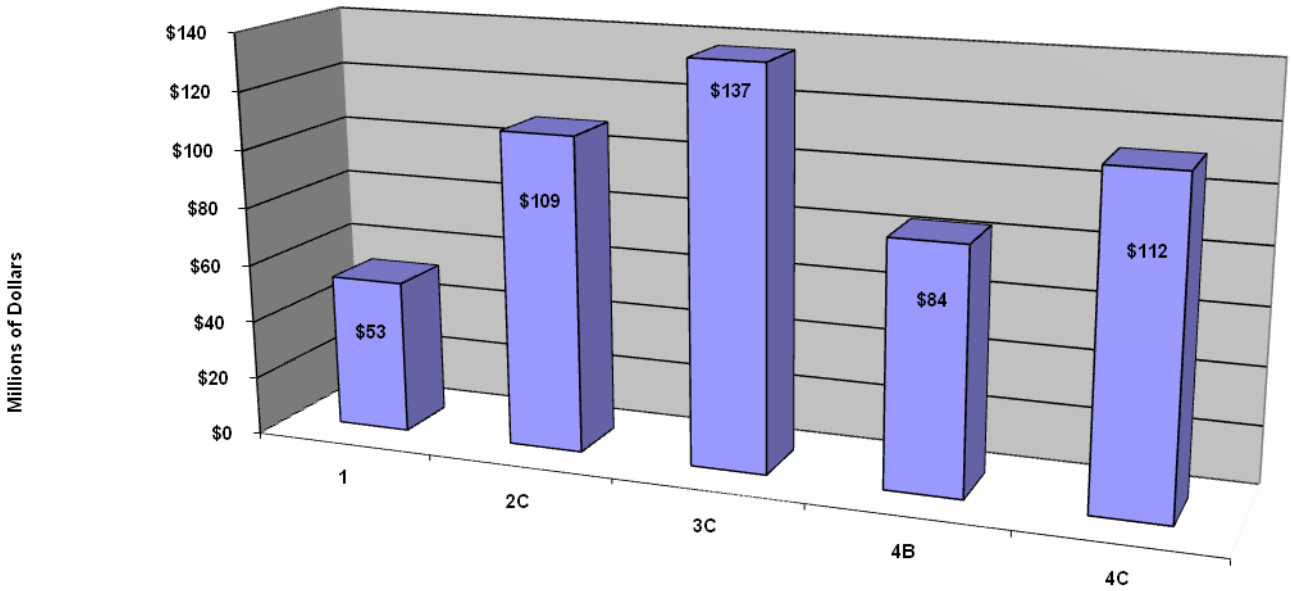
Figure 3-8: Forecasted Year 2030 Property Damage Only Crashes by Alternative, 75% Toll Rate



*3C non-tolled alternative: 1,404 PDO crashes saved – Tolling a **68% reduction***

Toll Performance Evaluation: Increased Personal Income

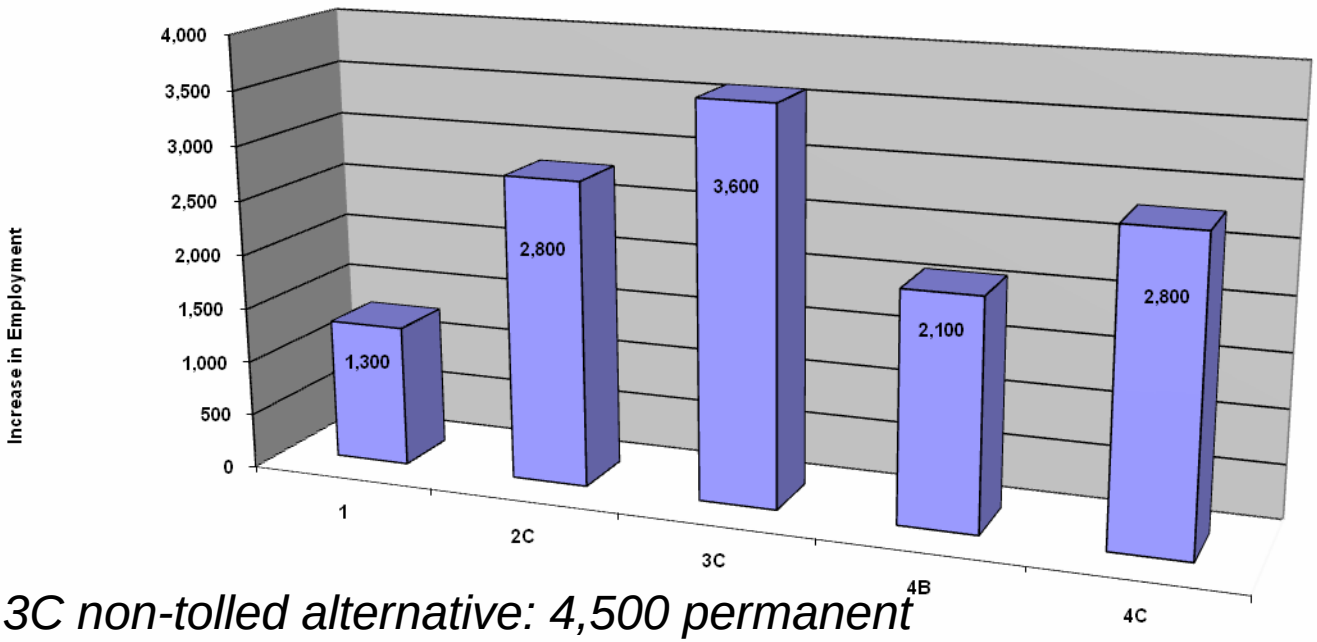
Figure 3-9: Forecasted Year 2030 Increases in Personal Income by Alternative, 75% Toll Rate



*3C non-tolled alternative: $171 million increase in annual disposable income – Tolling **80% of non-toll***

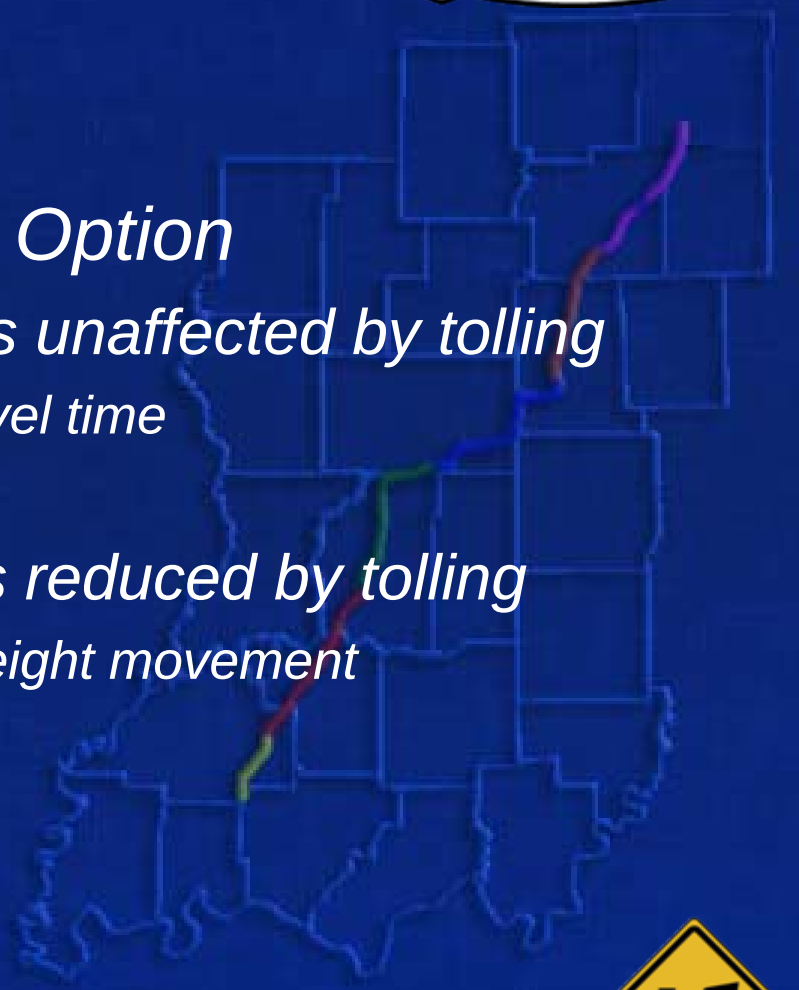
Toll Performance Evaluation: Employment Increase

Figure 3-10: Forecasted Year 2030 Increases in Employment by Alternative, 75% Toll Rate



*3C non-tolled alternative: 4,500 permanent new jobs – Tolling **80% of non-toll***

I-69 Tier 1 EIS Reevaluation – Highlights



- Comparison with Non-Toll Option
  - Performance on some goals unaffected by tolling
    - Evansville-to-Indianapolis travel time
    - Personal accessibility
  - Performance on other goals reduced by tolling
    - Interstate and international freight movement
    - Crash reduction
    - Congestion relief
    - Economic development

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- Timing "Tradeoffs"
  - May receive benefits many years sooner
  - May receive some benefits in reduced magnitude
- Final Outcome…
  - Tolling dropped due to the low revenue and big drop in performance. Risk of not meeting the NEPA test of Purpose & Need in court.
  - 3C no longer the "stand-out performer"
  - Will it be back? Who knows?

many thanks!

BERNARDIN · LOCHMUELLER & ASSOCIATES, INC.