APPENDIX D

COST ESTIMATION METHODOLOGY

COST ESTIMATION METHODOLOGY

Introduction

Project Costing Guidelines were issued by the PMC to provide a uniform approach to the costing of alternatives for this Tier 2 study yet allowing flexibility to make refinements as warranted. These guidelines were reviewed by INDOT and Federal Highway Administration (FHWA) both at the Indiana Division Level and FHWA Headquarters during their development and this latest guidance seeks to reflect a logical approach to development of the range of costs for alternatives and a reflection of current bid costs.

Four alternatives (4, 5, 6, and 7) have been developed, with the Preferred Alternative being created from segments of each of the four developed alternatives. Each alternative was taken to a preliminary level of design, with alignments, profiles, and typical sections established for each unique condition throughout the project corridor. This higher level of design effort is unique to the Section 5 DEIS, and differs from the previous EIS documents for the I-69 Corridor. This higher level of design effort is necessary due to the more urbanized natural of the Section 5 Corridor; as well as the conversion of the existing State Route 37 roadway corridor from a limited access facility to an access controlled facility.

Actual quantities were calculated for each of the alternatives. The quantities were used to generate construction costs, using INDOT's newest estimating methodology, OMAN; which uses a quantity weighted average from historic data spanning from 1996 through the most current letting award. Roadway constructions costs were determined from over 100 individual pay items. The existing bridges were field inspected and treatments were recommended and cost based each alternative. Proposed bridges were also individually cost for each alternative. Maintenance of Traffic costs were determined based on a preliminary traffic scheme, with actual quantities calculated. Lump sum pay items were assigned based on projects of similar size, type, and complexity.

Section 1. Roadway Construction Cost

<u>Methodology</u>

In order to obtain accurate construction costs for each alternative; a preliminary design, including typical sections, profiles, alignments, and cross sections, was developed. From the preliminary design, actual quantities were determined. The roadway portion of the quantities was comprised of 117 individual pay items. The pay items were then loaded into INDOT's cost estimating software, OMAN. Quantities for each individual bridge, as well as quantities for the Maintenance of Traffic phasing were also calculated and run through OMAN, to determine a total cost of construction for each alternative.

The OMAN estimates are specific to each project, based on select data such as letting date, location, INDOT district, type of project, size of project, and complexity of the project. These

variables are used to sort through the historic official letting results that INDOT has recorded since 1996. The trends and prices from these letting results are used to forecast a future price of the I-69 project. The OMAN software uses a weight based average to calculate the unit price of each pay item. Each item has three weight based averages run; where each average pulls from a broader sample size. These three averages are used to create an estimated unit price for each item; which is used to calculate the total cost of the project.

The roadway quantities were broken into two sub-categories; mainline I-69 and secondary roadway quantities. The mainline quantities are related to the actual I-69 footprint, and include the I-69 lanes, ramp lanes, and collector distributer roads. The secondary roads are all other roadways affected during construction, included frontage and access roads. These roads will be constructed with the project to provide access where the placement of I-69 has required the change of access for a local roadway.

Bridge quantities are calculated based on the individual treatment of each bridge. These treatments have been determined by in-field inspections of the existing bridges on SR 37 and the requirements for proposed bridges. Bridge treatments included bridge rehabilitation, bridge widening, bridge replacement, and new bridge construction.

The costs associated with maintaining the traffic during construction have also been calculated. The actual quantity of the materials used for traffic phasing during construction were calculated; such as temporary pavement, barriers, temporary concrete walls, and pavement markings. The number of phases and work restrictions placed on the contractor are also considered when assigning a unit price and ultimately a cost of construction.

The alternatives are set up as paired concepts. Alternatives 4 and 5 utilize a larger footprint based on desirable criteria; while Alternatives 6 and 7 utilize a minimal footprint concept, trying to utilize the existing SR 37 footprint as much as possible while still meeting all minimum design criteria. The Preferred Alternative will be created using elements from each of the 4 alternatives. There will be nothing unique unto the Preferred Alternative; each design element will have been present in one of the 4 alternatives.

Design exceptions have been considered to lower initial construction cost, and minimize the construction footprint. These exceptions have been considered for design elements such as Critical length of grade, maximum grade, and shoulder width. Preliminary design exception requests have been vetted as part of the DEIS process, to insure these design exceptions would not compromise safety or functionality of I-69.

Pavement:

The Pavement cost was calculated based on full replacement of the existing pavement, along with full depth shoulder to match the adjacent travel lanes. This was done to provide an even comparison between all of the alternatives. the pavement design selected utilized the methodology MEPDG and was based on most current traffic model. A pavement design was assumed and verified to pass, but not refined. A refined pavement design will be provided during the design phase of the project.

Earthwork:
Actual cross sections were generated using typical sections for each roadway condition. A digital terrain model was developed from preliminary profiles and alignments based on preliminary typical sections.

Drainage: structures less than 20' in span.
The drainage design utilized existing structure locations for cross connection structures, as this corridor is already built up as along SR 37. Each existing structure was increased by one structure size for cost estimate, i.e. 24" increased to 36". As well as a preliminary estimate of additional drainage structures and storm sewers where median was enclosed and barrier wall will replace the median ditch.

Miscellaneous:
Other quantities that are not known at the current time, but common to this type of project were estimated using historic data for urban reconstruction projects of similar size, type, and complexity. These quantities include items related to highway lighting, signing, utility relocation, secondary road maintenance of traffic, and context sensitive solutions,

Percentage Costs: The following costs were estimated as a percentage of the total project construction cost: mobilization and demobilization; construction engineering (performed by the contractor, not construction inspection); Clearing of the Right-of-Way; and Maintaining Traffic were assigned percentages of the construction cost as dictated by the Indiana Design Manual (IDM).

- Mobilization and demobilization is 5 percent of construction costs,
- Construction engineering is 3 percent of construction costs,
- Clearing of the Right-of-Way is 3 percent of construction costs, and
- Maintaining Traffic is 3 percent of construction costs.

These percentage costs total 14 percent of total construction costs. The remaining 86 percent is the total of the actual quantities calculated.

OMAN:

Because OMAN estimates are forecasted using historic letting data; the actual estimate will be rerun as INDOT continues to let projects for construction and adds to their database. The final quantities will be refined once the project enters the design phase.

Geotechnical/Karst Construction:
No significant increase in cost of project due to existing area being disturbed and already built-up.

In addition to the six (6) categories listed above, additional costs will be incurred for construction in areas to address geotechnical issues related to subsidence and karst features.

Subsidence due to mining. *Section 5 does not pass through any areas where there has been any coal mining either surface of subsurface mining. Therefore no cost associated with subsidence due to coal mining activities has been included.*

Karst-related costs. The PMC analyzed costs of previous INDOT projects in areas with karst features to estimate karst-related increases in construction costs. This analysis showed that, on average, construction in areas with karst features leads to an increase of 5 percent in roadway construction costs. It is reasonable to assume that such practices in karst areas will be relatively similar and that the impact on the total bid price will remain close to the 5 percent value. In areas with karst features, this methodology adds 5 percent to roadway costs.

Roadway Construction Cost Calculation (summary sheet):
A spreadsheet was written in Microsoft® Office Excel format to calculate the construction cost estimates. Each alternative was broken into segments based on typical section. The summary sheet pulls together the individual sections, into on project cost. Each section calculates the quantity of the individual roadway, bridge, and maintenance of Traffic pay items, mentioned previously. These items are assigned a unit cost based on the OMAN estimator software, and summed for each alternative. The construction cost is inflated using a 3.5% per year inflation until the year 2015. Elements such a design cost, design change orders, and utility relocation are added a percentage of the total cost. These percentage costs are based on the historical data for similar projects.

The spreadsheet provides Year 2012 construction costs in the "Total Section Costs" worksheet.

Section 2. Bridge Construction Cost

Typical Bridge Construction Cost

Rehabilitation/Widening of Existing Mainline Bridges.

Field reviews were conducted on April 25th and April 26th of 2012 for the purpose of determining the extent that existing bridges along SR 37 could be incorporated into the alternatives under study for the DEIS stage for I-69 Section 5. Representing INDOT were Tom Seeman and Greg Carleton. Representing Michael Baker were Patrick Duncan and John Zuleger. Jim Gulick and Cheryl Folz represented Bernardin Lochmueller and Associates.

Under the low impact alternatives, there are some bridges where no work is expected, namely, Indiana Railroad, SR 48, and SR 46 all of which traverse over SR 37. Under the Preferred Alternative 8, a collector distributor route is being utilized along I-69 (SR 37). In this alternate, the presence of a potential 4(f) property (Wapahani Mountain Bike Park) necessitates a shift of the mainline to the west. Under this scenario, the existing SR 45 will not align properly and will have to be replaced. Consequently no field reviews were done for any of these bridges.

No work is contemplated at Arlington Road over SR 37, but there were questions concerning the vertical clearances and what modifications are needed if any. Field survey was completed at this location to gather the data necessary to advance the study. It appears that is is feasible to lower the mainline (SR 37) pavement under the bridge and achieve the required clearance. Consequently, no cost for this structure has been incorporated.

Field review reports were prepared to assess the scope at other existing bridge location. Quantities have been developed and a detailed estimate is included at each bridge. This detailed estimate used the actual quantities inputted into the OMAN software. Unit price adjustments were made to the spreadsheet and costs refined. A report was prepared that contained the field reports, recommendations, quantities and estimated costs that serves as the basis for the information contained in the DEIS. This report was reviewed by INDOT. Equivalent square footage costs for each bridge was determined and that value was used for input into the cost spreadsheet.

Bridge Replacement

Bridge replacements and new overpasses involve new construction. Several bridges were investigated to determine representative costs in today's bidding environment. Using quantities from the current SR 45 and SR 46 plans, a cost estimate using unit prices from OMAN was developed and a corresponding cost per square foot was developed. There has been much recent construction on SR 25 Hoosier Heartland Highway, and I-69, Sections 1-4. This gave a number of bridges that could be investigated to determine their unit costs. Where MSE walls were used to retain the fill, costs of providing the relevant pay items was determined and a cost per square foot of wall determined. The other bridge costs were associated with the deck area of the bridge. For overpasses with MSE walls, $110 per square foot was applied to the deck area and $57 per square feet was applied to the area of MSE walls required. Bridges that do not have MSE wall used $125 per square foot of deck area. In some bridge locations, longer than normal spans were required. This is due to large skews and crossing roadway widths. In these instances, the square foot of deck cost was "bumped up" to $150 per square feet.

Section 3. Reporting Year Cost Adjustments

Construction Year: The cost methodology provides a base Year 2012 cost. Both the Year 2012 Roadway Cost, as well as the Year 2012 Bridge Costs, was increased at an annual rate of 3.5 percent to provide Year 2015 costs. The 3.5 percent per year cost increase rate is the standard inflation value used by INDOT in its 2007 Long Range Plan Update to estimate project costs in future years.

Design Modifications: At the onset of a large project, the scope of both design and construction may not be easily definable. Additionally, even if there is a clearly defined scope, the scope may change during project development due to unforeseen circumstances. These potential design modifications can materially affect the final cost of the project. The Year 2012 construction costs for both roadway and bridges were adjusted to account for design modifications. Roadway and bridge costs were increased by 2 to 4 percent to account for possible design modifications.

These modifications are related to more refined data as the project moves towards final plans. More detailed survey and geotechnical information, while not affecting the project scope, may alter some of the design elements based on refined information not available prior to final design.

Construction Change Orders: After projects are bid there may be increased costs for changes that are specified during construction. These "change orders" may result in an increase in construction costs. These changes can occur due to unforeseen field conditions and/or quantities that exceed those estimated (e.g. driving piles longer than anticipated). Change orders can vary by the size, scope, and complexity of an alternative; however historic data from similar past INDOT projects have had an average increase in construction cost due to change orders of 5%.The Year 2012 construction costs for both roadway and bridges were increased by 5 percent to account for potential change orders.

Section 4. Design Costs

Highway Design Engineering: The cost for Highway Design Engineering is a percentage of the Roadway Construction Cost described in Section 1 (above). Different percentages were used for construction in urban and rural areas. For rural areas, Highway Design Engineering is estimated as 4 to 5 percent of the Roadway Construction Cost. Due to the potential for more design complexities within an urban area, Highway Design Engineering in urban areas is estimated as 7-8 percent of the Roadway Construction Cost. Other development cost including permitting, supplemental surveying, utility coordination, geotechnical investigations, etc were investigated. It was determined that 1 percent of the roadway construction cost would be added to the design engineering cost to reflect these added development costs. Given the urban/rural nature and the relative complexity of rehabilitation in this Section, this 1 percent factor was added to the upper end of the previously-established 7 percent design engineering cost. This provides an estimate of design engineering as 9 percent of roadway construction cost.

Bridge Design Engineering: The cost for Bridge Design Engineering is a percentage of the Bridge Construction Cost described in Section 2 (above). The Bridge Design Engineering is estimated at 7-8 percent of the Bridge Construction Cost. It was determined that 1 percent of the bridge construction cost would be added to the design engineering costs to account for geotechnical investigations. This 1 percent factor was added to the lower end of the previously-established 7 percent design engineering cost. This provides an estimate of design engineering as 8 percent of bridge construction cost.

Right-of-Way Engineering and Services: The cost for Right-of-Way Engineering & Services is developed as a part of the Right-of-Way Cost described in Section 6 (below). The Right-of-Way Engineering & Services is the administrative cost listed in that section.

Section 5. Construction-Agency Administration Cost

In order to oversee construction activities, INDOT incurs additional costs which are difficult to quantify precisely. These costs include, but are not limited to: construction inspection, general project administration (e.g. reproduction of construction plans and contract documents), and

public outreach. To account for these costs, 7.5 percent of the total constructed cost has been added to the cost estimate.

Section 6. Right-of-Way Cost

<u>Relocation and Right-of-way Acquisition Cost Methodology</u>:

The projected relocation and right-of-way acquisition costs for the Tier 2 EIS should include right-of-way costs for acreage and improvements required for actual construction, relocation costs, costs for acquiring structures and improvements due to lost access, and administrative fees. These costs are estimates only and are based on a field survey and aerial photo interpretation. A windshield survey has been conducted to evaluate the properties that would be impacted by the various working alignments.

The properties should be categorized into a range of values as shown on the table. Include a statement in the study such as: "Final right-of-way requirements have not yet been determined and are only estimated at this time. A home or business was considered displaced if it was located within the project right-of-way or if reasonable access to the property could not be maintained. The displacement of structures is estimated based upon predicted right-of-way requirements. These costs and relocation numbers are for comparison purposes only. They could change after more precise right-of-way requirements have been determined."

Based on meetings and input from INDOT, Michael Baker Corp., and the PMC, it has become apparent that the use of assessed values for determining market values for right-of-way cost purposes is not accurate. Michael Baker Corp. has completed some preliminary market research and the following method is proposed for figuring property values and right-of-way costs within the Section 5 corridor for the DEIS:

Starting with assessed values from the Monroe and Morgan County Assessors, it is proposed to manipulate these values as follows:

1) For single family residential parcels – Add additional 20% to assessed value
2) For non-single family residential parcels (churches, commercial, farm homesteads and multi-family residential) – Add 40% to assessed value.
3) For unimproved parcels (excluding vacant commercial parcels)

Part A: Estimate cost using two separate methods

· Apply 40% increase to assessed value (X * 40% + X) *(where X = assessed value)*

· Calculate assumed cost per acre using $4000 per acre (Y acres * $4000)

Part B: Compare the two values from Part A and select the more conservative (or higher) value

Part C: Apply an additional 200% to the value selected in Part B

4) For all categories – If a comparable or current for sale value is identified that is higher than the value derived using parameters above, then that comparable or current for sale value will be used as the final value.

The following suggestions and notes (See table at end of notes) were part of the original Tier 2 methodology and are still appropriate. Values have been updated as directed by INDOT:

1) It may be easier to break the proposed corridor into small workable segments that correspond with probable design segments. The probable design segments should be coordinated and approved by the PMC.

2) Remember this is an estimate only. Complete appraisals will be completed when the project reaches the R/W acquisition stage.

3) Special care needs to be made not to over or under estimate the value of residential housing units. The replacement housing study will be based on the estimated value.

   For purposes of these studies, the Administrative Fee per parcel will be $12,000* (see table). The estimate for multi-family and commercial relocatees may need to be revised based on individual circumstances. The Administrative Fee of $12,000 per parcel is included to cover the cost of R/W Services. Right-of-way services include appraisals, reviews, buying, recording and property management. This figure is an estimate based on recent INDOT right-of-way acquisitions. (*These costs are based on INDOT calculations from actual Tier 2 – Section 4 right-of-way costs)

   A Relocation Cost Estimate of $42,600.00* per single-family residential relocation and $15,100.00* for each residential unit in a multi-family development should be used in the table for an average cost. This fee includes differential housing payments, closing expenses and other residential relocation benefits. This figure is an estimate based on recent INDOT relocation costs. Due to some areas where the homes to be acquired are substandard and the relocation act's requirement that the relocatees be moved to suitable housing, the relocation cost estimates might need to be increased. This should be explained and included with comments in the replacement housing survey. Tenants also will be eligible for some assistance. (*These costs are based on INDOT calculations from actual Tier 2 – Section 4 right-of-way costs)

4) The study needs to pay particular attention and note any homes within a certain price range that seem to be particularly hard hit. The EEAC must then check to see if there are adequate replacement units available within that price range. This information will be part of the conceptual stage relocation plan.

5) Effective dates for cost estimates need to be established and shown on all tables (Use current year).

6) Utility items such as large transmission lines, service structures and substations should only include the land values. Utility relocation costs should be estimated with construction costs.

7) Billboards should be included in the R/W estimate. You may have several cost categories on the billboards. Many of the large new billboards are in the $100,000 to $150,000 range. Billboards should be considered individual parcels. Large business signs that are located on the business site should be included as a part of the property acquisition at that site.

8) The study assumes that all single-family residential dwellings are owner-occupied.

9) An effective date needs to be established in coordination with other segments (Use current year dollars).

10) This is an estimate with only limited title and boundary information. The Tier 1 Study used windshield surveys and public record searches to estimate the market value of the properties. For residential properties, typical outbuildings such as yard sheds, detached garages and small sheds are included with the residence. Larger and more unusual structures should be included under other categories. The primary residential exception to this method was the farm homesteads and any homes far larger or more expensive than the norm. The farm homesteads with barns and outbuildings have been noted in the table.

11) Commercial and industrial properties were considered to only have sites large enough to sufficiently support the existing improvements. Cost is the estimated market value of the improvements on only a site large enough to support the improvements.

12) Business such as service stations with other businesses attached (i.e. Subway or Cleaners) need to be considered as multiple relocations.

13) Residential Category SP is for residences estimated to cost less than $10,000.

14) The residential cost categories used for your section should also carry forward to the replacement housing study in the Conceptual Stage Relocation Plan.

15) The farmsteads have been allocated separately to allow for segregated analysis to estimate the contributing value of the improvements.

16) Working farms are separate businesses from the household relocations. The farm is considered to be a separate business relocation.

17) For illustrative purposes the commercial/office/industrial section has been divided into eight (8) categories. These are subject to adaptation to fit the section being studied. You may have more or fewer categories depending on your section.

18) Commercial/office/industrial parcels may also include additional relocates, such as tenants and related businesses.

19) Landlocked parcels and damaged parcels (where we are acquiring a portion of the property) are to be grouped under Damages. Landlocked parcels, land and homes without legal access to a road or highway, will be treated as being purchased. Parcels that are damaged by loss of value or utility such as parking, setbacks and other losses should be noted and included under Damages.

20) Special attention needs to be paid to dead-end roads or roads going over or under the new facility to measure any potential compensable damages.

21) Since this study is done with limited title information, the estimator should include additional parcels in the estimate to cover title issues. The Estimator will have to make this determination based on the quality, quantity and availability of information. If there is a high level of reliability, the number may be as low as 20% of the counted parcels, while other areas with dated and incomplete information, the number might be as high as 75% of the counted parcels. Many of these issues are not uncovered until complete title work is available.

22) This will be a Limited Access Facility and access rights will be acquired as part of the project. Therefore any damages incurred should be included in the right-of-way cost estimates.

23) A table similar to the following should be used to estimate right-of-way and relocation costs. <u>The cost categories may be modified to reflect the local situation</u>. The PMC will review these estimate sheets, but only the totals will be included in the EIS document.

Relocation and Right-of-way Cost Table **(Example)**
I-69 Section 5
Date:

TYPE	NUMBER (Properties)	COST	NUMBER RELOCATEES	AD FEE***	RELOCATION COSTS***	TOTAL COST
Residential-Sp	1	$10,000 (-)	1	$12,000	$42,600.00	$64,600
Residential-1	1	$10,000	1	$12,000	$42,600.00	$64,600
Residential-2	1	$20,000	1	$12,000	$42,600.00	$74,600
Residential-3	1	$50,000	1	$12,000	$42,600.00	$104,600
Residential-4	1	$75,000	1	$12,000	$42,600.00	$129,600
Residential-5	1	$100,000	1	$12,000	$42,600.00	$154,600
Residential-6	1	$125,000	1	$12,000	$42,600.00	$179,600
Residential-7	1	$150,000	1	$12,000	$42,600.00	$204,600
Residential-8	1	$200,000	1	$12,000	$42,600.00	$254,600
Residential-9	1	$250,000	1	$12,000	$42,600.00	$304,600

Residential-10	1	$300,000	1	$12,000	$42,600.00	$354,600
Residential-XXX	1	$600,000	1	$12,000	$42,600.00	$654,600
Farm Homestead	1	$300,000	1	$12,000	$42,600.00	$354,600
Multi-Family Housing	5	$35,000	1	$12,000	$15,100.00	$202,100
Church-1	1	$250,000	1	$12,000	$25,500.00	$287,500
Church-2	1	$400,000	1	$12,000	$25,500.00	$437,500
Church-3	1	$500,000	1	$12,000	$25,500.00	$537,500
Gas Station	1	$500,000	1	$12,000	$25,500.00	$537,500
Gas Station/Conv Store	1	$750,000	3	$12,000	$25,500.00	$838,500
Specialty		$400,000	1	$12,000	$*	$
Commercial-1	1	$100,000	1	$12,000	$25,500.00	$137,500
Commercial-2	1	$150,000	1	$12,000	$25,500.00	$187,500
Commercial-3	1	$200,000	2	$12,000	$25,500.00	$263,000
Commercial-4	1	$250,000	2	$12,000	$25,500.00	$313,000
Commercial-5	1	$300,000	2	$12,000	$25,500.00	$363,000
Commercial-6	1	$400,000	2	$12,000	$25,500.00	$463,000
Commercial-7	1	$500,000	2	$12,000	$25,500.00	$563,000
Commercial-8	1	$750,000	2	$12,000	$25,500.00	$813,000
Bill Boards	1		1	$12,000	*	$
Special (Large facility)		$0	0	$12,000	*	$0
Damages	NA	$3,500,000	0		*	$3,500,000
SUB-TOTAL						$12,343,400
		Area (AC)		Unit Cost ($/AC)		
Aggregate Land Value Estimate		1		$10,000		$10,000
Unimproved Parcel Estimate**		10		$10,000		$100,000
SUB-TOTAL						$110,000
TOTAL						**$12,453,400**

* To be determined by estimator.
** Includes additional parcels and parcels without significant structures. This includes unimproved farmland, pasture and forest.
***These costs are based on INDOT calculations from actual Tier 2 – Section 4 right-of-way costs

Section 7. Utility Relocation Costs

There has been ongoing coordination with local utilities regarding potential conflicts with their facilities. Where it was determined that a major utility (e.g. electric transmission lines, gas transmission pipelines, etc.) would need to be relocated due to the proposed construction, and if the relocation is determined to be eligible for reimbursement (i.e. the utility company has an easement for its facilities), then an estimated relocation cost was determined through consultation with that utility. The total cost of all necessary relocations for each alternative studied is the Utility Relocation Cost. Relocation costs developed for the Year 2012 were escalated and reported in 2015 dollars. Utility relocation costs in 2012 dollars were increased by 3.5 percent per year to show costs in 2015 dollars.

Section 8. Mitigation Costs

The PMC was responsible for providing guidance regarding mitigation information (cost, amount, location, etc.) for all mitigation that will take place outside of the proposed right-of-way for each section (e.g. wetland mitigation, core forest mitigation, etc.). Much of this base information for determining costs was provided by INDOT. This section's study identified potential mitigation measures and associated costs for each proposed alternative, as well as mitigation that is to be applied to account for impacts within the section. Mitigation costs are estimated for entire sections, since they cannot meaningfully be broken down by subsection. See DEIS Chapter 7.4 for a discussion on these mitigation costs.