The I-69 Evansville-to-Indianapolis Study
Tier 1 Environmental Impact Statement

Task 4.4 Report

Preliminary Alternative Cost Estimates

February 11, 2002

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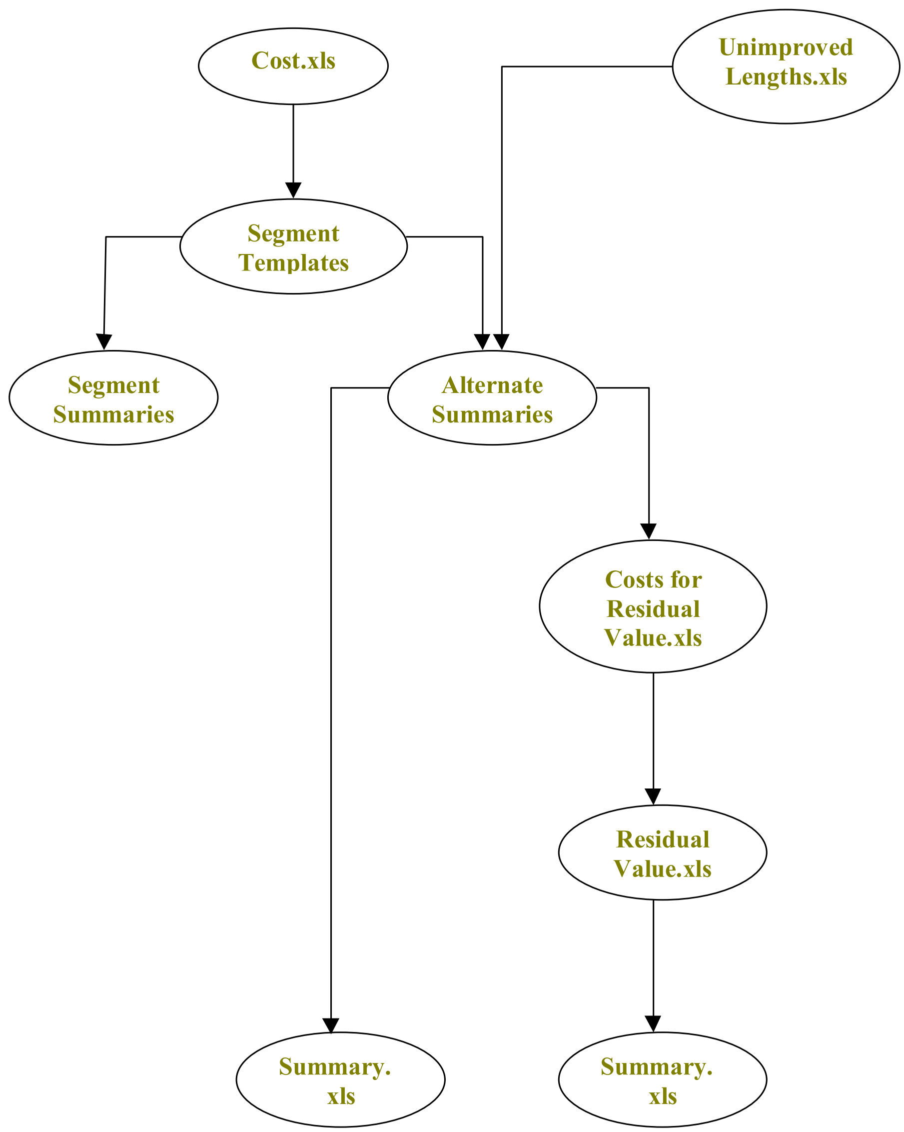
1.0 INTRODUCTION

To estimate costs for I-69 Route Concepts, several Excel spreadsheets were created and linked to each other. This permitted related data and estimates to be consistent among all spreadsheets. For example, if a unit cost changed, it was changed in only one location, and the information in all corresponding sheets was automatically updated. This eliminated many possible sources of error.

Figure 1 illustrates the relationship among these cost estimate worksheets. Section 2, Unit Cost Calculations, documents the determination of unit costs for components of highway construction. Section 3, Cost Estimation Methodology, describes how a series of linked spreadsheets used these unit costs to estimate construction costs for each route concept. These templates are internal working documents of the consultant team, and are not included as part of this documentation.

Figure 1 - Cost Estimating Spreadsheet Flowchart



2.0 UNIT COST CALCULATIONS

Cost.xls is a spreadsheet into which unit prices for each item are input. This sheet is the basis for all subsequent cost estimating work that follows. All templates are linked directly or indirectly to this spreadsheet. The unit prices on *Cost.xls* have been obtained from a various sources. The basic spreadsheet was copied from a Pre-engineering Cost Parameters General Guidelines compiled by Gary Mroczka of the Indiana Department of Transportation (INDOT) and dated 1/16/97. To account for inflation, these costs were adjusted by 1.52% to obtain costs for 1999. The remainder of the costs needed to complete cost estimates within each segment were hand-calculated. Unit prices used for these hand-calculations are from American Association of State Highway and Transportation Officials' (AASHTO) Trns-port Estimator program. Other hand-calculated unit prices used previous studies as guides to determine estimated costs for particular locations or types of work.

Following is a summary of methodologies used to estimate all unit costs used to calculate the preliminary route concept cost estimates.

2.1 ROADWAY COSTS

2.1.1 MAINLINE PAVEMENT

The following unit costs were incorporated into the mainline pavement per mile cost: 1)13 inches of QC/QA plain cement concrete pavement; 2)seven (7) inches of subbase for cement concrete pavement; 3)12 inches of recycled concrete aggregate; 4)D-1 construction joints; and 5)concrete median barrier (for urban sections only). The unit cost for each of these components was obtained from the American Association of State Highway and Transportation Officials' (AASHTO) Trns-port Estimator program. By utilizing these unit costs, a per mile cost was established for the following scenarios: 1)rural, four lane segment with 12 ft (3.6 m) lanes, 11 ft (3.3 m) outside shoulders [10 ft (3.0 m) paved], 4 ft (1.2 m) inside shoulders, and a 60 ft (18 m) grass median; 2)rural, six lane segment with 12 ft (3.6 m) lanes, 11 ft (3.3 m) outside shoulders [10 ft (3.0 m) paved], 4 ft (1.2 m) inside shoulders, and a 60 ft (18 m) grass median; 3)urban, four lane segment with 12 ft (3.6 m) lanes, 11 ft (3.3 m) outside shoulders [10 ft (3.0 m) paved], 12 ft (3.6 m) inside shoulders, and a 60 ft (18 m) grass median; 4)urban, four lane segment with 12 ft (3.6 m) lanes, 11 ft (3.3 m) outside shoulders [10 ft (3.0 m) paved], 12 ft (3.6 m) inside shoulders, and a 26 ft (8 m) concrete median barrier; and 5)urban, six lane segment with 12 ft (3.6 m) lanes, 11 ft (3.3 m) outside shoulders [10 ft (3.0 m) paved], 12 ft (3.6 m) inside shoulders and a 26 ft (8 m) concrete median barrier.

2.1.2 EARTHWORK

The following unit costs were incorporated into the earthwork per mile cost: 1)common excavation; 2)borrow; and 3)rock excavation. The unit cost for each of these components was obtained from the aforementioned Trns-port Estimator program. The amount (in cubic yards) per mile for each of these components was determined by taking an average from the 1996 Southwest Highway Draft EIS (preferred alignment) per mile amounts for the following types of terrains: 1)flat (level); 2)rolling, with solely common excavation; 3)rolling with common as well as rock excavation; and 4)hilly. By utilizing these unit costs and per mile amounts, a per mile cost was established for the four (4) different types of terrains. The terrain type for each segment was determined from personal knowledge of the topography, field reviews of the corridor, and engineering judgment using USGS 7.5 minute topographic quadrangle maps.

2.1.3 ADDITIONAL EARTHWORK FOR ELEVATED INTERSTATE

The cost for B-Borrow was the only cost used to determine the additional earthwork per mile cost to elevate the interstate. The unit cost for the B-Borrow was obtained from the Trns-port Estimator program. By utilizing this unit cost, a per mile cost was established for the following scenarios: 1)elevated four lane interstate, 100 ft (30.3 m) width; and 2)elevated six lane interstate 124 (37.5 m) width. For both scenarios, the height of fill was assumed to be 15 ft (5 m).

2.1.4 MAINTENANCE OF TRAFFIC

The following costs were incorporated into the maintenance of traffic per mile cost: 1)temporary cross over, type “B”; 2)two way traffic with temporary concrete median barrier and strengthened shoulders; and 3)two way traffic with temporary concrete median barrier. The unit cost for the first two components was taken from the January 16, 1997 edition of the Pre-Engineering Cost Parameters General Guidelines authored by Mr. Gary Mroczka of the Indiana Department of Transportation (INDOT), multiplied by a factor to convert the unit prices to 1999 dollars; the unit cost for the third component was obtained from the Trns-port Estimator program. By utilizing these unit costs, a per mile cost was established for maintenance of traffic. This cost was applied only to segments which utilized existing roadways. If a segment would be constructed through new terrain, the per mile maintenance of traffic cost was assumed negligible.

2.1.5 SIGNING AND LIGHTING

The per mile cost for signing and lighting utilized in this study was obtained using an average cost for signing and lighting from previous projects. Some level of engineering judgment also was used.

2.1.6 INTERCHANGE MAINTENANCE OF TRAFFIC

The unit cost associated with maintaining traffic during the construction of new interchanges, or reconstruction of existing interchanges, was assumed to only involve detour signage. This cost taken from the aforementioned INDOT General Guidelines (converted to 1999 dollars).

2.1.7 INTERCHANGE SIGNING AND LIGHTING

The unit cost of signing and lighting for interchanges was taken from the aforementioned INDOT General Guidelines (converted to 1999 dollars). For interchange types not listed in these guidelines, these types were compared to the sizes of interchanges listed, and a scaling factor was used to determine a cost. The order of costs for the different types of interchanges, from lowest to highest was assumed as: 1)directional ramp; 2)tight diamond; 3)urban single point diamond; 4)rural diamond; 5)trumpet; 6)partial cloverleaf; 7)full cloverleaf; and 8)directional.

2.1.8 ADDITIONAL (MISCELLANOUS) ROAD COSTS

Two types of costs for local road improvements were estimated: 1) cost per grade separation (county road over interstate only); and 2) cost for new frontage or access roads on the local road network. For the former, 0.5 miles of new roadway per grade separation was assumed; for the latter, scaling off of USGS topographic quadrangle or aerial maps was used to determine the length of roadway needed. The same unit cost, obtained from engineering judgment as well as from previous projects involving county roads, was used for both cases of local road improvements.

The unit cost of constructing mechanically stabilized earth (MSE) walls was taken from the aforementioned INDOT General Guidelines (converted to 1999 dollars). The walls were assumed to be 15 ft (5 m) high, with a 1,000 ft (305 m) taper at the beginning and end of the elevated section. Two walls (one on each side of the roadway) were assumed for each elevated section of the interstate.

The unit cost of constructing the leveling pads for the mechanically stabilized earth (MSE) walls was taken from the Trns-port Estimator program. The walls were assumed to have a 1,000 ft (305 m) transition at the beginning and end of the elevated section. Two walls (one on each side of the roadway) were assumed for each elevated section of the interstate.

The costs to construct rest areas were combined as one unit cost per rest area. Costs were obtained from previous preliminary cost estimating projects.

2.1.9 MAINLINE REMOVAL

The unit cost for (concrete) pavement removal was taken from the Trns-port Estimator program. This category was only used when the interstate was to be constructed over an existing major state or U.S. highway (e.g. U.S. 41 or S.R. 37). It was assumed that one half of the roadway along the segment was constructed with concrete, thereby requiring this cost to be included.

The unit cost for bridge removal was obtained from the aforementioned INDOT General Guidelines (converted to 1999 dollars). Three categories were established for bridges of with different ranges of span lengths: 1)bridges with a span less than 49 ft; 2)bridges with a span greater than 49 ft, but less than 98 ft; and 3)bridges with a span greater than 98 ft, but less than 148 ft. If a bridge span was longer than 148 ft, the span length was divided by 148 and the answer was rounded down to the nearest tenth to obtain the equivalent number of bridges to be removed with a span length between 98 and 148 ft.

2.2 BRIDGE COSTS

2.2.1 CREEK/RIVER CROSSINGS

The unit costs for new bridge construction over a creek or river were obtained by calculating an average construction cost from previous bridge design projects. Segments utilizing existing roadways (e.g. U.S. 41 or S.R. 37) would use the existing bridges, with some rehabilitation (e.g. widening, deck overlaying, railing replacement, etc.). The unit cost for such a use of existing bridges is approximately 40% of the unit cost for a new bridge. The length of a bridge for segments along new alignment was obtained by finding a state or U.S. highway nearby that crosses the same creek or river, and then increasing that bridge's length (as found in the Inventory of Bridges State Highway System of Indiana) by 30% for creeks and 20-25% for major rivers. If no state or U.S. highway crossed a particular waterway, the length of the bridge was assumed to be 100 ft. Bridge widths were assumed as: 1) 43 feet for a four-lane rural section; 2) 49 feet for a four-lane urban section; 3) 55 feet for a six-lane rural section; 4) 61 feet for a six-lane urban section; 5) 73 feet for an eight-lane urban section; 6) 85 feet for a ten-lane urban section; and 7) 97 feet for a twelve-lane urban section.

2.2.2 GRADE SEPARATIONS (COUNTY ROAD OVER INTERSTATE)

The unit cost of constructing a new county road bridge over the mainline was obtained from average construction costs from previous bridge design projects. For segments utilizing existing roadways (e.g. U.S. 41 or S.R. 37) all existing overhead bridges were assumed to be adequate, unless the existing mainline roadway was to be widened. In that case, the overhead bridge would be lengthened to account for the wider roadway it bridged. The length of new bridges was assumed to be 250 ft (slightly longer bridge lengths were used when associated with more lanes on the mainline roadway). The width of these bridges was assumed to be 45 ft. The bridge width was increased if the width of the crossing road was known (or assumed) to be larger than 45 ft.

2.2.3 GRADE SEPARATIONS (INTERSTATE OVER COUNTY ROAD)

The unit cost of constructing a new mainline bridge over a county road was obtained from average construction costs from previous bridge design projects. For segments utilizing existing roadways (e.g. U.S. 41 or S.R. 37) all existing bridges were assumed to be adequate, with some rehabilitation (e.g. widening, deck overlaying, railing replacement, etc.) needed. The unit cost was estimated at 40% of the unit cost for a new bridge. The length of bridge segments along new alignment was assumed to be 165 ft, while the width was assumed to be: 1) 43 feet for a four-lane rural section; 2) 49 feet for a four-lane urban section; 3) 55 feet for a six-lane rural section; 4) 61 feet for a six-lane urban section; 5) 73 feet for an eight-lane urban section; 6) 85 feet for a ten-lane urban section; and 7) 97 feet for a twelve-lane urban section.

2.3 INTERCHANGE COSTS

2.3.1 INTERCHANGE PAVEMENT AND EARTHWORK

The unit cost for the pavement for the different types of interchanges was obtained by calculating an average cost from INDOT's Mini-Scope Cost Estimate & Environmental Overview for S.R. 69 along U.S. 41, S.R. 641 and I-70 (dated April 28, 1997) and INDOT's Mini-Scope and Cost Estimate for S.R. 37/S.R. 69 (dated September 6, 1996). For interchange types not utilized in either of these studies, these types were compared to those that were utilized, and applying a scaling factor determined a cost. The order of costs for the different types of interchanges, from lowest to highest was: 1)directional ramp; 2)tight diamond; 3)urban single point diamond; 4)rural diamond; 5)trumpet; 6)partial cloverleaf; 7)full cloverleaf; and 8)directional. The following percentages were applied for the construction of an interchange: pavement – 40%; earthwork – 35%; and bridges and right-of-way – 25%. By utilizing these percentages, an earthwork cost was calculated for each type of interchange based on the pavement costs. These two numbers were summed to obtain a total pavement and earthwork cost for each type of interchange.

2.3.2 INTERCHANGE BRIDGES

The unit cost of constructing a new bridge for an interchange was obtained from average construction costs from previous bridge design projects. Bridges for Urban Single Point Diamond interchanges had higher unit costs than other interchange bridges due to the complexity of that type of interchange. Segments utilizing existing roadways (e.g. U.S. 41 or S.R. 37) would use the existing bridges, with some rehabilitation (e.g. widening, deck overlaying, railing replacement, etc.). The unit costs for these bridges was 40% of the unit cost for a new bridge. The length of each bridge was evaluated on a case-by-case basis.

2.4 RIGHT-OF-WAY COSTS

The right-of-way costs include costs for land acquisition, improvements required for construction, relocation costs, costs to acquire structures, improvements required due to lost access, and administrative fees. These costs are estimates only and are based on a windshield survey. The right-of-way required for proposed interchanges has not yet been determined and is only estimated at this time. These costs could change significantly after more precise right-of-way requirements have been determined.

The right-of-way and relocation costs for new terrain roads is approximately $450,000 per mile. This cost is derived from the 1995 right-of-way and relocation costs from the Draft EIS for Option 1 for the Southwest Indiana Highway. We have used a 5% inflation rate for six years and have added a 15% growth rate after inflation. This cost estimate is in 2001 dollars and assumes no major additional commercial or industrial development has occurred.

2.5 ENGINEERING COSTS

2.5.1 HIGHWAY DESIGN ENGINEERING

The cost for highway design engineering was estimated as a percentage of construction costs for the various highway components: mainline pavement; earthwork; maintenance of traffic; signing and lighting; miscellaneous road costs; mainline removal; and interchange pavement and earthwork. Different percentages were used depending on whether the construction was through an urban or a rural area.

2.5.2 BRIDGE DESIGN ENGINEERING

The cost for bridge design engineering was estimated as a a percentage of the construction costs for the various bridges: creek/river crossings; grade separations (county road over interstate); grade separations (interstate over county road); and interchanges. Different percentages were used for construction in urban and rural areas.

2.5.3 RIGHT-OF-WAY ENGINEERING & SERVICES

The cost for right-of-way engineering & services was estimated as a percentage of total costs for right-of-way land acquisition, improvements, and relocation costs.

3.0 COST ESTIMATION METHODOLOGY

All route concepts were divided into forty-two segments. Each route concept consists of a different combination of segments taking various routes from I-64 to I-465. The following paragraphs describe the linked templates which were used to compute costs for each route concept. These templates are internal working documents of the consultant team, and are not included as part of this documentation.

The *Segment Templates* compute costs for each segment or part of a segment. Some segments are broken into smaller sections to account for factors such as optional routings near cities and towns, changes in type of terrain, number of lanes, and/or urban/rural classification. Each template is directly linked to the *Cost.xls* spreadsheet. Some basic information is required in the beginning of each template. This information includes the section length, number of lanes, type of terrain, type of construction, urban/rural classification, and median width. Since the length of each section is given, costs associated with these items are automatically calculated. Costs which are dependent on the number of lanes, type of terrain, etc are linked to the cells with this information, and "if-then" statements link back to the cost.xls sheet and extract the appropriate cost. Segment costs are summed up in the "Total Segment Costs" at the end of the template.

Segment Summaries are spreadsheets that compile the information from each section within a segment. The costs in the *Segment Summaries* are linked to the "Total Segment Costs" in each section's template within that segment. In these summaries, each option within that segment is shown. *Segment Summaries* are simply sheets that summarize the costs and mileage of each segment. They are for reference only, as they are not linked to any other sheet.

The *Unimproved Lengths.xls* spreadsheet is a simple spreadsheet that allows you to input lengths of all unimproved sections for each route concept. "Unimproved sections" are sections of interstate that already have or have been committed to have a sufficient number of traveling lanes to accommodate the addition of I-69. No cost has been associated with these sections. This spreadsheet then sums up and gives the total mileage of all unimproved lengths in each route concept.

Each route concept has an *Alternate Summary* spreadsheet. These are very similar to the *Segment Summaries.* However, the *Alternate Summaries* contain each segment within an alternate, listed in order from I-64 to I-465. The *Alternate Summaries* also show each option (such as different routings near cities and major towns). An route concept may have up to 36 options. Each option is a route from I-64 to I-465, consisting of a combination of segments/sections through or around some cities or towns. The price and mileage for each option of that route concept is calculated. The price and mileage range for the route concept can be found within this information. Information in these summaries is also linked directly to the "Total Segment Costs" in each template within a segment. These *Alternate Summaries* search the total construction costs and the total construction mileage of each option to find the maximum and minimum costs and mileage for that route concept. Then the unimproved lengths are read from the *Unimproved Lengths.xls* spreadsheet to determine the maximum and minimum driving length of each alternate.

The *Costs for Residual Value.xls* spreadsheet is linked to the *Alternate Summaries* spreadsheets. This spreadsheet takes all the costs in the *Alternate Summaries* sheet and divides them out into the basic five cost components (Right-of-Way, Earthwork, Structural Costs, Road Base, and Road Surface/Other). For example it takes the Interchange cost and breaks it down into Road Base, Road Surface/Other, and Earthwork costs. Calculations for residual value from previous work broke the major costs (Pavement, Interchanges, Right-of-Way, Structures, etc) into percentages of the five cost components. After being reviewed and slightly modified, these percentages were used here. Values for this spreadsheet were calculated for the options with the maximum and minimum construction costs.

The *Residual Value.xls* spreadsheet sums each of the five cost components from the values from the *Costs for Residual Value.xls* spreadsheet. Then, the number of years for which the residual value shall be calculated (for example, 30 years) is inserted and the number of years of construction (for example 5 or 10 years) is inserted. Using this information, the percentage of remaining value at the end of the time period is determined. Residual values were not used in the Level 2 Screening of Alternatives; they are included as part of the cost estimation methodology should they ever be required in future analyses.

The *Summary.xls* spreadsheet summarizes all information for each alternate. It has links to the *Alternate Summaries* and the *Residual Value.xls* sheet. The *Summary.xls* sheet shows a range for each alternate of the total construction cost, the total number of construction miles, the total number of driving miles, and the residual value.

Figure 2 gives the range of cost estimates and driving miles for each Route Concept.

Figure 2 - Capital Cost and Mileage Estimates of the Route Concepts

(Constant 2001 Dollars)

	COST RANGE		DRIVING MILES	
Rte. Concept	**Minimum**	**Maximum**	**Minimum**	**Maximum**
A	$ 805,460,000	$ 1,056,810,000	155	58
B-1	$ 1,591,920,000	$ 1,897,490,000	150	156
B-2	$ 1,719,100,000	$ 1,931,150,000	147	151
C-1	$ 1,153,890,000	$ 1,453,740,000	146	149
C-2	$ 1,483,387,000	$ 1,747,925,000	145	149
D	$ 1,855,260,000	$ 2,115,330,000	164	168
E	$ 1,191,110,000	$ 1,473,540,000	150	153
F-1	$ 1,140,270,000	$ 1,302,010,000	141	142
F-2	$ 1,422,010,000	$ 1,566,450,000	137	139
G	$ 1,166,470,000	$ 1,329,150,000	142	143
H-1	$ 1,462,980,000	$ 1,661,460,000	141	146
H-2	$ 1,575,900,000	$ 1,689,810,000	139	140
I	$ 913,940,000	$ 966,050,000	143	143
J	$ 988,340,000	$ 1,136,270,000	141	142
K	$ 1,559,650,000	$ 1,634,020,000	152	152
L-1	$ 1,401,640,000	$ 1,619,670,000	148	152
L-2	$ 1,514,570,000	$ 1,648,010,000	146	147
M	$ 865,950,000	$ 908,580,000	161	161
N	$ 1,555,320,000	$ 1,678,640,000	159	161