



APPENDIX HH
COMPARISON OF TIER 1 AND TIER 2 IMPACTS
FOR KEY RESOURCES

Tier 2 Environmental Impact Statement

I-69 Section 6

Martinsville to Indianapolis

September 26, 2017



COMPARISON OF TIER 1 AND TIER 2 IMPACTS FOR KEY RESOURCES

In an August 31, 2006 letter to INDOT and FHWA, Kenneth Westlake of USEPA Region 5 requested that impact information be provided in Tier 2 FEIS documents for this project. He requested that each Tier 2 FEIS provide a tally of impacts for all Tier 2 sections. The request asked that this tally include both direct and indirect impacts.

The information in this technical memo is provided to address this request. Following are the sources for the information provided:

- Section 1. Final Environmental Impact Statement, October 2007.
- Section 2. Final Environmental Impact Statement, February 2010.
- Section 3. Final Environmental Impact Statement, December 2009.
- Section 4. Final Environmental Impact Statement, July 2011.
- Section 5. Final Environmental Impact Statement, August 2013.
- Section 6. Final Environmental Impact Statement, February 2018.

Karst impacts are provided in this document for I-69 Sections 4 and 5. Karst impacts were published in the Tier 1 FEIS for only a limited number of features (sinking streams and large (over 80 acre) sinkholes). Also, no Tier 1 breakdown of karst impacts was provided by Tier 2 section. Accordingly, only totals of Tier 2 karst impacts are compared.

Indirect impacts were not estimated on a section-by-section basis in the Tier 1 FEIS. In addition, estimates of indirect impacts in I-69 Sections 5 and 6 were made for different forecast years (2035 and 2045, respectively) than for I-69 Sections 1 through 4 (2030). This tally of impacts for all Tier 2 sections shows only direct impacts.

Table 1 provides a tally of estimated impacts to these resources for all Tier 2 sections, using the data published in each Tier 2 section's FEIS. **Tables 2** through **8** provide breakdowns by Tier 2 section for each of these impact estimates. **Table 9** provides a comparison of the karst impacts in I-69 Sections 4 and 5. A discussion regarding impacts to each resource follows the table, which gives the section-by-section breakdown for impacts to that resource.

Tables 1 through 9 show “low” and “high” measures of impacts. The I-69 Section 4 FEIS reported “low” and “high” impact and cost estimates based on the potential use of low-cost design criteria and initial design criteria, respectively. The criteria were to be determined in design based on site specific conditions. The selection of a preferred NEPA alternative was made by comparing the range of impacts and costs for the alternatives.

Right of way impacts are on average 28 percent higher in Tier 1. The primary reason is that right of way of local service roads is outside of the typical section for the mainline alternative. Local



Table 1 - Total Impact Estimates, Compared with Tier 1 FEIS Estimates

Impact Category	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
		Low*	High*	Low*	High*
New Acres of right of way	5,860	7,112	7,465	+1,252	+1,605
Farmland Impacts (Acres)	4,470	4,021	4,126	-449	-344
Forest Impacts (Acres)	1,150	1,563	1,778	+413	+628
Wetland Impacts (Acres)	75	42	47	-33	-28
Floodplain Impacts (Acres)	830	790	805	-40	-25
Residential Impacts	390	478	482	+88	+92
Business Impacts	76	111	111	+35	+35

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.

Table 2 - New Acres of Right of way Impacts, Compared with Tier 1 FEIS Estimates

Section	Source of Updated Impacts	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
			Low*	High*	Low*	High*
1	Tier 2 Final EIS, Table 5.3-1	550	720	720	+170	+170
2	Tier 2 Final EIS, Table 5.3-1	1,300	1,702	1,702	+402	+402
3	Tier 2 Final EIS, Table 5.2-2	1,100	1,722	1,722	+622	+622
4	Tier 2 Final EIS, Table 5.3-1	1,560	1,456	1,809	-104	+249
5	Tier 2 Final EIS, Table 5.3-1	585	327	327	-258	-258
6	Tier 2 Final EIS, Table 5.3-1	605	1,185	1,185	+580	+580
	Total	5,700	7,112	7,465	+1,412	+1,765

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.

service roads were assumed in some locations in Tier 1, but only as part of the typical section of the I-69 mainline. In Tier 2, detailed impact and engineering studies have identified many locations where local service roads separate from the mainline typical section are needed. Such locations would have been identified in any Tier 1 alternative selected for Tier 2 studies.

Local service roads are used to provide a roadway entrance to properties whose existing access would be removed as part of I-69 project. If such access were not provided, the properties typically would need to be acquired by INDOT, further increasing the cost and impacts of the project.



In Tier 1, the footprint associated with each interchange was assumed to be ten acres outside of the mainline right of way. This was consistent with a typical rural diamond interchange whose ramps are separated by approximately 800 feet (e.g., the northbound exit and southbound entrance ramps are 800 feet apart). In Tier 2 studies, INDOT directed that many interchanges be larger, with ramp spacing increased by 50 percent (to 1,200 feet). This would allow for future “loop” ramps to be built, should traffic increases in future years require them. This increases the acres of right of way required for interchanges. Also, some interchanges (such as the North Pike and South Daviess interchanges in I-69 Section 2, and the County Line Interchange in I-69 Section 4) have lengthy local service roads to connect to the local highway system; these also require added right of way.

In addition, INDOT determined in Tier 1 that both I-69 Sections 3 and 6 would have rest areas. However, neither the Tier 1 estimates for I-69 Section 3 or Section 6 include the impacts for this rest area. The impacts associated with rest areas are included in the I-69 Section 3 Tier 2 estimates; they are not included in the I-69 Section 6 Tier 2 estimates. These rest area impacts were not allocated to specific Tier 2 sections in the Tier 1 FEIS estimates, and are not included in the **Table 2** summary of Tier 1 FEIS impacts.

Right of way impacts in I-69 Section 5 and Section 6 in both Tier 1 and Tier 2 include only that right of way outside of the existing SR 37 right of way. Tier 2 engineering efforts in I-69 Section 5 emphasized the reuse of the existing SR 37 right of way and pavement. This resulted in significant decreases in Tier 2 right of way impacts, as well as decreases in most resource impacts, as compared with Tier 1 estimates in I-69 Section 5. By comparison, engineering efforts in I-69 Section 6 identified the need for many local service roads outside of the I-69 mainline typical section. These have resulted in increases in the right of way required in I-69 Section 6.

As shown in **Table 3**, farmland impacts are somewhat less (five percent, on average) than those published in the Tier 1 FEIS. In I-69 Section 3, farmland impacts are considerably higher than the Tier 1 estimates, due to the addition of numerous local service roads not assumed in the Tier 1 study, as well as the inclusion of the impacts to provide a rest area in I-69 Section 3, which were not included in the Tier 1 estimate for I-69 Section 3. These are offset by the impacts in I-69 Section 4 and Section 5, where farmland impacts are much less than those shown in the Tier 1 FEIS.

As noted in the previous section, INDOT determined in the Tier 1 FEIS that both I-69 Sections 3 and 6 would each have a rest area. The impacts associated with rest areas were included in the project-wide farmland impact estimates shown in **Table 1**. The impacts associated with rest areas include a significant amount of farmland. The impacts associated with rest areas are included in the I-69 Section 3 Tier 2 estimates; they are not included in the I-69 Section 6 Tier 2 estimates. Farmland impacts attributable to rest areas were not allocated to specific Tier 2 sections in the Tier 1 FEIS estimates, and are not included in the Tier 1 FEIS impacts shown in **Table 3**.

Engineering efforts in I-69 Section 5 Tier 2 emphasized the reuse of the existing SR 37 right of way and pavement. This resulted in Tier 2 farmland impacts in I-69 Section 5 which were only 16 percent of those estimated in Tier 1.



Table 3 - Acres of Farmland Impacts, Compared with Tier 1 FEIS Estimates

Section	Source of Updated Impacts	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
			Low*	High*	Low*	High*
1	Tier 2 Final EIS, Table 5.3-1	540	630	630	+90	+90
2	Tier 2 Final EIS, Table 5.3-1	1,180	1,113	1,113	-67	-67
3	Tier 2 Final EIS, Table 5.4-7	1,070	1,501	1,501	+431	+431
4	Tier 2 Final EIS, Table 5.4-7	670	356	461	-314	-209
5	Tier 2 Final EIS, Table 5.4-6	385	60	60	-325	-325
6	Tier 2 Final EIS, Table 5.4-7	465	361	361	-104	-104
	Total	4,310	4,125	4,230	-289	-184

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.

As shown in **Table 4**, forest impacts are higher than those shown in the Tier 1 FEIS. The largest increases are in I-69 Sections 2, 5, 6 and perhaps Section 4. As may be seen by comparing **Tables 3 and 4**, these upward trends in forest impacts are matched in I-69 Sections 2, 5 and 6 with downward trends in farmland impacts. This suggests that some land identified in Tier 1 studies as farmland now is being identified as forested. Part of this is due to the more precise data available in Tier 2 studies for identifying forest.

Table 4 - Acres of Forest Impacts, Compared with Tier 1 FEIS Estimates

Section	Source of Updated Impacts	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
			Low*	High*	Low*	High*
1	Tier 2 Final EIS, Table 5.20-2	10	27	27	+17	+17
2	Tier 2 Final EIS, Table 5.20-5	100	210	210	+110	+110
3	Tier 2 Final EIS, Table 5.20-3	30	67	67	+37	+37
4	Tier 2 Final EIS, Table 5.20-6	890	872	1,087	-18	+197
5	Tier 2 Final EIS, Table 5.20-7	90	228	228	+138	+138
6	Revised Tier 1 Biological Opinion, Table 3	30	159	159	+129	+129
	Total	1,150	1,563	1,778	+413	+628

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.



The Tier 1 forest data used for comparing corridors was the best available data showing forest cover within the 26-county Tier 1 study area, and was suitable for comparing forest impacts for alternative corridors. It was provided by the United States Geological Survey, and is a subset of its National Land Cover Data set. It was derived by remote sensing photointerpretation techniques using satellite photography, with a nominal 30-meter (approximately 100 foot) resolution. The nominal date for these data was 1992.

The estimates for forest impacts in the Tier 2 studies are based upon field surveys and aerial photographs taken in various years between 2003 and 2016. These identified forested areas that may not have been identified in the dataset used in Tier 1, and on more precise delineation of forest size. Forests are identified using United States Department of Agriculture (USDA) definitions.

The greater forest impacts in Tier 2 may be attributable to two factors. First, smaller forested areas which were not identifiable from the USGS data set now are being identified by on-the-ground field surveys. Second, in some sections (particularly I-69 Sections 2, 5 and 6) many local service roads outside of the mainline typical section are located in forested areas.

As shown in **Table 5**, estimates of wetlands impacts are lower than Tier 1 estimates. Tier 2 estimates show wetland impacts which are on average 59 percent of those identified in Tier 1. Tier 1 identified wetlands using National Wetland Inventory (NWI) mapping; data were not field verified. In Tier 2, wetland identification relied on field studies; in each FEIS, wetland impacts for the preferred alternative are based upon field delineations in consultation with US Army Corps of Engineers. In addition, avoiding impacts to wetlands and other important water-quality resources is a significant consideration in determining Tier 2 preferred alternatives.

Table 5 - Acres of Wetlands Impacts, Compared with Tier 1 FEIS Estimates

Section	Source of Updated Impacts	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
			Low*	High*	Low*	High*
1	Tier 2 Draft EIS, Table 5.19-14	5	1	1	-4	-4
2	Tier 2 Final EIS, Table 5.19-13	35	24	24	-11	-11
3	Tier 2 Final EIS, Table 5.19-11	5	5	5	0	0
4	Tier 2 Final EIS, Table 5.19-12	20	5	10	-15	-10
5	Tier 2 Final EIS, Table 5.19-18	5	3	3	-2	-2
6	Tier 2 Final EIS, Table 5.19-19	5	4	4	-1	-1
	Total	75	42	47	-33	-28

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.



Tier 2 EISs show the following forested wetland impacts: two acres in I-69 Section 2, one acre in Section 3, two acres in Section 4, one acre in Section 5, and two acres in Section 6. Forested wetland impacts in I-69 Section 1 are negligible. Forested wetlands in I-69 Sections 2 through 6 are shown in **Table 5** (Wetland Impacts). These are excluded from **Table 4** (Forest Impacts) to avoid double-counting.

The Tier 1 analysis showed approximately half of the potential wetlands impacts for the entire project in I-69 Section 2. Significant efforts were made in I-69 Section 2 to minimize water quality impacts for its preferred alternative. The I-69 Section 2 FEIS showed over a 30 percent reduction in wetland impacts from those estimated in the Tier 1 FEIS.

As shown in **Table 6**, Tier 2 estimated floodplain impacts in I-69 Sections 1 through 5 generally are smaller than those estimated in Tier 1. They are much higher in I-69 Section 6. In Tier 1, floodplain impacts were estimated by digitizing data from a figure in “The Indiana Water Resource Availability, Uses and Needs” (1980). These data are very general. This was the best available source for use in Tier 1 to identify and compare floodplain impacts across a 26-county study area.

Table 6 - Acres of Floodplain Impacts, Compared with Tier 1 FEIS Estimates

Section	Source of Updated Impacts	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
			Low*	High*	Low*	High*
1	Tier 2 Draft EIS, Table 5.19-14	30	36	36	+6	+6
2	Tier 2 Final EIS, Table 5.19-13	420	166	166	-254	-254
3	Tier 2 Final EIS, Table 5.19-11	65	19	19	-46	-46
4	Tier 2 Final EIS, Table 5.19-12	130	36	51	-94	-79
5	Tier 2 Final EIS, Table 5.19-18	100	75	75	-25	-25
6	Tier 2 Final EIS, Table 5.19-19	85	458	458	+373	+373
	Total	830	790	805	-40	-25

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.

In Tier 2, floodplains are identified using county-level mapping from the Digital Flood Rate Insurance Maps (DFIRM) (dated 2004 through 2016). These data show floodplains identified by Federal Emergency Management Agency (FEMA) Flood Rate Insurance Maps (FIRM). The FIRM is the basis for floodplain management, mitigation, and insurance activities for the National Flood Insurance Program (NFIP). In addition, more detailed Tier 2 engineering studies avoided floodplains as part of overall avoidance of water resource impacts. For example, the reduction in floodplain impacts are more pronounced in I-69 Sections 2 through 4 (which are on new alignment) than in I-69 Section 5 (for which the alignment is constrained to use the right of way of existing SR 37). Likewise, much of existing SR 37 in I-69 Section 6 is in the floodplain



of the White River (and its associated tributaries). These floodplain impacts in I-69 Section 6 generally cannot be avoided.

It should be noted the most land shown as floodplain also would be classified as farmland or forested land.

As shown in **Table 7**, Tier 2 estimates of residential displacements are 23 percent higher than those estimated in the Tier 1 FEIS. They are noticeably higher in I-69 Sections 2, 4 and 6; they are lower in other sections. In I-69 Section 5, displacements are only 82 percent of Tier 1 estimates; this is in part due to the emphasis on reusing the existing SR 37 right of way and pavement for the I-69 Section 5 preferred alternative. The significant new development near SR 37 in I-69 Section 6 resulted in residential displacements which would not have been calculated in 2003 in the Tier 1 FEIS.

Table 7 - Number of Residential Displacements, Compared with Tier 1 FEIS Estimates

Section	Source of Updated Impacts	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
			Low*	High*	Low*	High*
1	Tier 2 Final EIS, Table 5.2-3	24	18	18	-6	-6
2	Tier 2 Final EIS, Table 5.2-4	37	65	65	+28	+28
3	Tier 2 Final EIS, Table 5.2-2	23	18	18	-5	-5
4	Tier 2 Final EIS, Table 5.2-2	33	71	75	+38	+42
5	Tier 2 Final EIS, Table 5.2-5	146	119	119	-27	-27
6	Tier 2 Final EIS, Table 5.2-5	127	187	187	+60	+60
	Total	390	478	482	+88	+92

* The I-69 Section 4 FEIS reported "low" and "high" impacts based on low-cost design criteria and initial design criteria, respectively.

As shown in **Table 8**, business displacements are virtually unchanged since Tier 1 estimates in I-69 Sections 1 through 5. Essentially all the increase in business displacements since Tier 1 are due to displacements in I-69 Section 6. The significant new development near SR 37 in I-69 Section 6 resulted in business displacements which would not have been calculated in 2003 in the Tier 1 FEIS.



Table 8 - Number of Business Displacements, Compared with Tier 1 FEIS Estimates

Section	Source of Updated Impacts	Tier 1 FEIS Impacts	Updated Impacts		Change from Tier 1 Estimates/Tier 2 Impacts	
			Low*	High*	Low*	High*
1	Tier 2 Final EIS, Table 5.2-3	2	2	2	0	0
2	Tier 2 Revised Draft EIS, Table 5.2-4	1	2	2	+1	+1
3	Tier 2 Final EIS, Table 5.2-2	0	1	1	+1	+1
4	Tier 2 Final EIS, Table 5.2-2	1	4	4	+3	+3
5	Tier 2 Final EIS, Table 5.2-5	22	18	18	-4	-4
6	Tier 2 Final EIS, Table 5.2-5	50	84	84	+34	+34
Total		76	111	111	+35	+35

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.

In Tier 1, karst impacts were not broken down by Tier 2 Section. Karst impacts were estimated for all alternatives within the 26-county Tier 1 Study Area using the best available data source for karst features within the entire Study Area. This source documented larger sinkhole areas, as well as sinking stream basins. It was provided by the Indiana Geological Survey, and was created in a systematic manner so that each county in the study area was mapped in a similar fashion. See pages 5-236 to 5-241 of the Tier 1 FEIS for more details. It was known that additional features would be identified in more detailed Tier 2 studies.

Karst impacts are compared for Tier 1 and Tier 2 in **Table 9**. Tier 2 studies identified features which were not included in the Tier 1 karst data. These included all sinkholes, swallets (the area where a stream sinks into the subsurface or the opening at the bottom of a sinkhole), caves, and springs. There are no Karst features in the I-69 Section 6 project area.

Table 9 - Number of Karst Impacts

Section	Source of Updated Impacts	Tier 1 FEIS Impacts (number)	Number of Karst Features	
			Low*	High*
4	Tier 2 Final EIS, Table 5.21-3		88	108
5	Tier 2 Final EIS, Table 5.21-4		110	110
Total		50	198	218

* The I-69 Section 4 FEIS reported “low” and “high” impacts based on low-cost design criteria and initial design criteria, respectively.