MID-STATES CORRIDOR

APPENDIX Y – KARST IMPACT ANALYSIS

Mid-States Corridor
Tier 1 Environmental Impact Statement

Prepared for

Indiana Department of Transportation

Mid-States Corridor Regional Development Authority

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INDIANA DEPARTMENT OF TRANSPORTATION INDOT

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KARST IMPACTS ANALYSIS

Introduction

The following substantive changes have been made to this appendix since the Draft Environmental Impact Statement (DEIS) was published:

- Impacts for Alternatives R and Refined Preferred Alternative P (RPA P) have been added.
- Additional explanation of analysis methods has been added to the introduction.

Caves were analyzed using a count of cave entrances that are documented in the Indiana Geological and Water Survey's (IGWS) one kilometer cave entrance density tiles and Indiana Cave Survey's (ICS) cave database within one kilometer of each working alignment. The Indiana Cave Survey is an organization dedicated to cataloging cave and karst features in Indiana. To preserve confidentiality, caves are depicted in **Figure 3.23-1** using IGWS's cave entrance density tiles which indicate the number of caves within a one square kilometer tile but do not show individual entrance locations. Springs were analyzed using a count of springs within each alignment ROW. Sinkholes were analyzed using a count of sinkholes within each alignment ROW. Sinkhole Areas and Sinking-stream Basins were analyzed by determining the area in acres within each alignment ROW. Caves were analyzed using a count of caves within one-km cave density tiles that are intersected by the alignment. A count of significant caves was determined using ICS cave length data. Karst feature counts and acreages are based on IGWS and ICS data covering the entire study area. Additional features, not represented in current databases, are likely to be identified during Tier 2 environmental field studies.

Resource Analysis

Sinkhole areas and sinking stream basins are types of karst features used to characterize karst and analyze impacts. There is often overlap of these features and in extrapolating from a point feature to its broader area it is difficult to arrive at the most valid comparison of features when evaluating impacts. Generally, sinkhole areas include numerous small features which have little area for gathering surface water to sink into the karst. Sinking-stream basins tend to be larger in area with one or more interior sinkholes. It is often more important to consider the number of sinking stream basins with priority over the sinkhole areas with the exception of sinkhole plains with dense discrete sinkhole development and very limited surface drainage. **Table Y-1** presents impact feature counts and acreages for all alternatives and facility type variations. These results show that a vast majority of the impacts to karst resources are limited to Alternatives O and M which extend across the Crawford Upland Physiographic region containing karst terrain. The alternatives that avoid the Crawford Upland (B, C, P, RPA P and R) avoid karst impacts as the geology changes and there are no karst developing bedrock layers exposed near the surface. This results in a clear difference in karst impacts associated with eastern build alternatives versus western and central build alternatives.

While the potential impacts quantified in **Table Y-1** show a clear difference between alternatives with karst impacts and without karst impacts, the comparison of impacts between Alternatives O and M does not clearly distinguish these two alternatives as the sinkhole and sinking stream acreage impacts are generally comparable as are the cave entrance proximity and spring counts. To provide further context

for potential karst impacts, additional description of unique karst resources and National Natural Landmarks in the proximity of Alternatives O and M is provided below.

Characterization of the Lost River Basin karst system crossed by Alternative O is defined by the Orangeville Rise, Wesley Chapel Gulf, and Tolliver Swallow Hole, National Natural Landmark (s) designated by the U.S. National Park Service (1972 to 1973) (Hasenmueller, N., and others., 2003). These are unique surface karst features, and components of a karst system extending along and adjacent to a 22-mile-long dry bed of Lost River. These point features are connected to the larger Lost River basin. The general proximity of these resources to Alternatives O and M is shown in **Figure Y-1**. The National Natural Landmark features of Orangeville Rise, Tolliver Swallow Hole and Wesley Chapel Gulf will not be directly impacted by Alternative O. However, associated subterranean karst systems, including the Lost River Cave system, and karst habitats would have potential impacts resulting from crossing and modification of associated karst surface features resulting from highway construction. These specific impacts are not able to be determined presently.

DEIS - Karst Impacts													FEIS - Karst Impacts				
Alternative*	B		C		M		O		P				RPA	RPA	RPA	RPA	R
Variation	B2	B3	C2	C3	M2	M3	O2	O3	P2e	P2w	P3e	P3w	P1[2]	P2[1]	P3[2]	P4[2]	
Caves within 1 km (#)																	
Section 3**	-	-	-	-	28	28	21	21	-	-	-	-	-	-	-	-	-
Section 3 - LI***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	**28**	**28**	**21**	**21**	-	-	-	-	-	-	-	-	-
Dye Tracing Points (#)																	
Section 3	-	-	-	-	4	4	2	0	-	-	-	-	-	-	-	-	-
Section 3 - LI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	**4**	**4**	**2**	0	-	-	-	-	-	-	-	-	-
Dye Line Crossings (#)																	
Section 3	-	-	-	-	3	3	10	8	-	-	-	-	-	-	-	-	-
Section 3 - LI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	**3**	**3**	**10**	**8**	-	-	-	-	-	-	-	-	-
Springs (#)																	
Section 3	-	-	-	-	2	2	1	1	-	-	-	-	-	-	-	-	-
Section 3 - LI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	**2**	**2**	**1**	**1**	-	-	-	-	-	-	-	-	-
Sinkholes (#)																	
Section 3	1	1	-	-	54	52	22	36	-	-	-	-	-	-	-	-	-
Section 3 - LI	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-
Total	**1**	**1**	-	-	**57**	**55**	**22**	**36**	-	-	-	-	-	-	-	-	-
Sinkhole Areas (acres)																	
Section 3	-	-	-	-	385	376	157	78	-	-	-	-	-	-	-	-	-
Section 3 - LI	-	-	-	-	12	12	0.4	0.4	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	**397**	**388**	**157**	**78**	-	-	-	-	-	-	-	-	-
Sinking Stream Basins (acres)																	
Section 3	-	-	-	-	86	86	307	235	-	-	-	-	-	-	-	-	-
Section 3 - LI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	**86**	**86**	**307**	**235**	-	-	-	-	-	-	-	-	-

* Tier 1 Alternative impacts are reported in ranges including all the local improvements, facility types, and bypass variations. Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 are anticipated.

** All Karst Impacts occur in Section 3 of the Alignments

*** LI = Local Improvement

[1] Super 2 only

[2] Super 2 and Expressway

Table Y-1: Karst Resource Impacts by Alternative and Facility Type

Spring Mill State Park includes approximately 1,088 acres of forested Mitchell Plain and has very dense development of sinkholes and inter-connected karst springs with habitats for endangered karst species (Hasenmueller, N., and others., 2003). The Donaldson Woods Nature Preserve containing 67 acres of

virgin “old growth” woods over the karst system that lies within this park, but the karst features below the canopy have cave stream connectivity extending approximately 2.9 miles southwest across SR 37. Extensive sinkhole development over cave streams approximately 60 feet below ground have been dye traced to cave springs in the Spring Mill State Park (Hasenmueller, N. and others., 2003) which are habitat for the endangered Indiana Cave fish (Since 2014 the species of cave fish north of the Ohio River has been identified as *Amblyopsis hoosieri*). No direct karst impacts to the Spring Mill State Park karst system from construction of Alternative O are anticipated. The location of Alternative O is outside of the mapped recharge area of the Spring Mill State Park karst system. While the potential for drainage crossover between subsurface karst drainage basins exists, the potential for indirect water quality impacts to this system is also limited based on surface drainage and identified karst features within the vicinity of the recharge area boundary.

Bluespring Caverns is a commercialized portion of Blue Spring Cave with the entrance located 0.67 miles west of Hartleyville off US Highway 50 and 1.9 miles west of SR 37 (Hasenmueller, N., and others., 2003). Blue Spring Cave has a survey length of 22 miles and the multiple branching cave stream extends east and southeast to surface sinkholes in a line extending south along SR 37 to the west side of Mitchell, approximately 5.4 miles southeast of the Bluespring Caverns commercial entrance. The hydrological extent of the Blue Spring cave stream system east toward SR 37 as verified by dye tracing (Hasenmueller, N. and others, 2003) is much larger than the mapped cave system, indicating the potential presence of unmapped portions of the cave system. Indirect karst impacts to Blue Spring Cave System from the modification of drainage pathways resulting from the construction of the Alternative O intersection with SR 37 cannot presently be quantified. Indirect karst impacts to the Blue Spring Cave System resulting from additional traffic on SR 37 would be minimal. There are no plans to make improvements to existing SR 37 north of the connection at Mitchell which would result in direct karst impacts to Blue Springs Cave.

Characterization of Alternative M karst, north of East Fork White River begins near Trinity Springs. In this vicinity and extending to the east the sandstones and thin karstic limestones above valley floors discharge “mineral waters” laden with sulfurous and salty constituents historically used for medicinal health spas. North of the village of Williams from the Indian Creek channel east to the Salt Creek channel there are sparse sinkholes and karst valleys interconnected with cave streams of unknown extents. One limestone spring a mile west of Williams has a large sandstone structure built over it with open skylight and a sheltered area for collecting the spring water. East of Salt Creek at the intersection with SR 37, Alternative M crosses a more extensive concentration of caves and sinkholes as the terrain transitions out of the Crawford Upland and into the Mitchell Plain. This area south of the Salt Creek crossing of SR 37 is sinkhole plain with extensive overlying road and commercial development.

Based on the known karst features and systems associated with the areas crossed by Alternatives O and M, along with species of concern associated with these systems, the general assessment of potential karst impacts is considered to be greater for Alternative O compared to Alternative M.

However, karst impacts associated with either Alternatives M or O would require substantial additional agency coordination and field studies during Tier 2 to determine the details for karst impacts. These studies will be completed if either of these alternatives are selected as the preferred alternative. Additionally, there would likely be impacts to currently unidentified karst features, systems and karst obligate species which would be discovered during subsequent project development and require additional coordination for mitigation and treatment resolution. Mitigation guidelines to minimize harm to karst resources will be included as Tier 1 mitigation commitments to address these concerns.

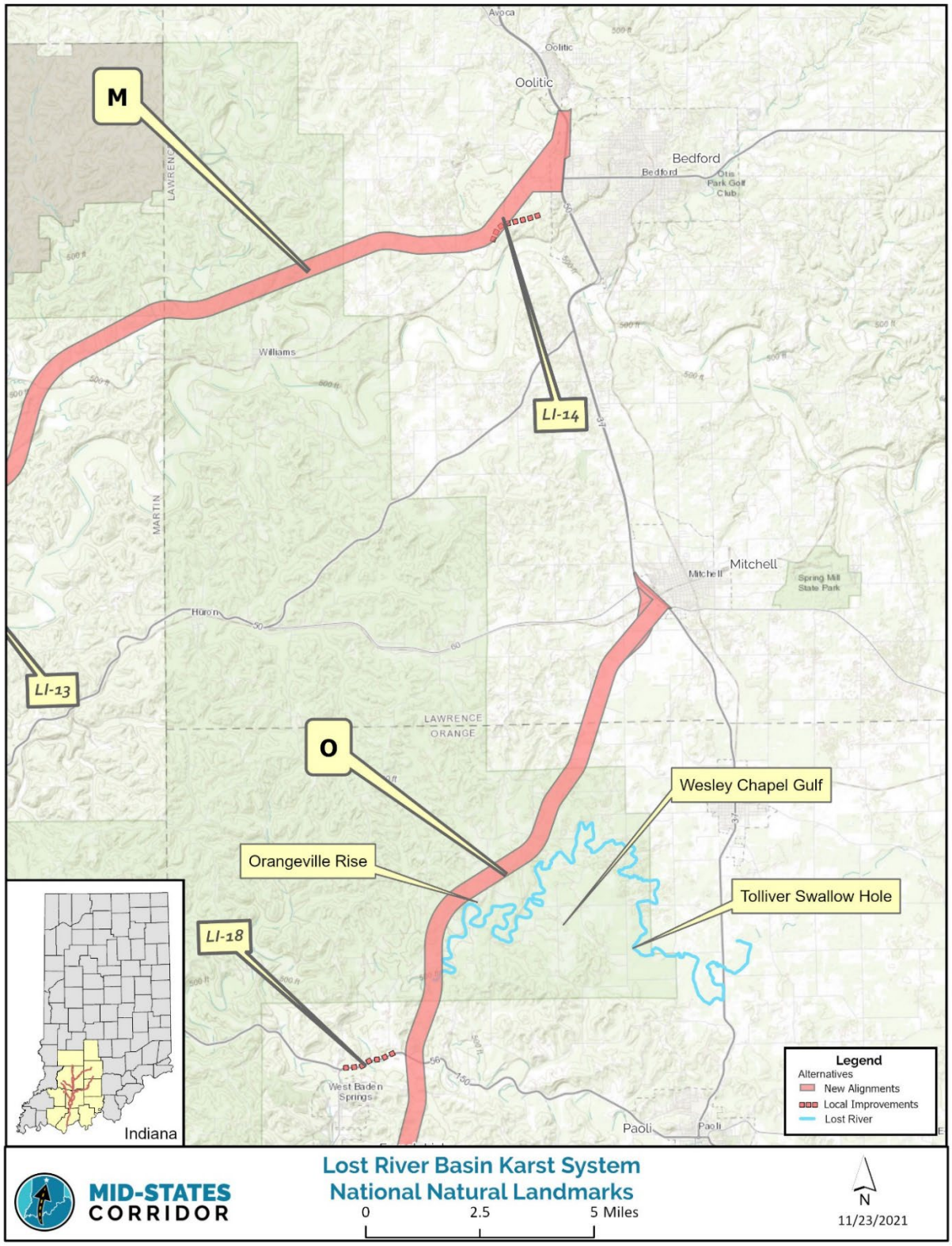

Figure Y-1. Lost River Basin Karst Features Associated with Alternatives M and O