MID-STATES CORRIDOR

APPENDIX M – GROUNDWATER IMPACT ANALYSIS

Mid-States Corridor
Tier 1 Environmental Impact Statement

Prepared for

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Mid-States Regional Development Authority

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INDIANA DEPARTMENT OF TRANSPORTATION INDOT

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Introduction

The purpose of this section is to provide additional details regarding the potential groundwater impacts of project alternatives. The summary table, **Table 3.20-1**, in **Volume I, Section 3.20.3** provides an overview of potential groundwater impacts by range, the subsequent tables in this appendix isolate the impacts according to the extended alternative variations (e.g., Super-2 vs Expressway).

As described in **Section 3.20.1, Volume I**, the majority of the United States obtains its drinking water from groundwater supplies. Construction projects have the potential to impact both surface water and groundwater resources. Private residential wells may also be affected directly by nearby potential construction activities or potential construction activities up gradient (INDOT, 2011). Protection of groundwater, or underground water resources, is required by law and helps to ensure safe drinking, or potable, water supplies.

The 1974 Safe Drinking Water Act (SDWA), "was established to protect the quality of drinking water in the U.S. This law focuses on all water actually or potentially designed for drinking use, whether from above ground or underground sources." (EPA, "Summary of Safe Drinking Water", n.d.). The 1996 amendments to the SDWA, "require that EPA consider a detailed risk and cost assessment, and best available peer-reviewed science, when developing these standards." (EPA, "Summary of Safe Drinking Water", n.d). The Indiana Department of Environmental Management (IDEM) is the state agency charged with implementing programs to comply with SDWA, as established with 327 IAC 8 Public Water Supply (IGA, 2021). To satisfy the requirements of the 1996 amendments to the SDWA, IDEM has developed and instituted a Source Water Protection Program (SWPP). The SWPP incorporates several programs that include the Source Water Assessment Program (SWAP) and Wellhead Protection Program (WHPP). The SWAP identifies, "the areas that are sources of public drinking water, assess the susceptibility of water-supply systems to contamination, and inform the public of the results." (IDEM, "Source Water Protection", n.d.). The WHPP is the primary ground water element of the SWAP. The WHPP is "designed to protect Community Public Water Systems that use ground water as their water source." (IDEM, "Source Water Protection", n.d.). In order to provide additional safeguards and other baseline criteria public water systems can use to protect and prevent underground water supply sources from becoming contaminated, a Wellhead Protection Area (WHPA) is delineated and approved by IDEM (IDEM, "Source Water Protections", n.d.).

A significant percentage of the State's residents access residential well water that falls outside of these regulations. As a result, in 2008 the IDEM Groundwater Section established the Groundwater Monitoring Network (GWMN) to collect untreated water samples from groundwater wells throughout the state. One of the primary goals of groundwater sampling collection is to determine the quality of the groundwater in the state's aquifers (IDEM, "Statewide Groundwater Monitoring Network", n.d.). Furthermore, the transport of contaminants from the surface to the groundwater table primarily occurs during the migration of surface water to the groundwater table, or "recharge" of groundwater. Therefore, recharge rates that are higher or lower within a larger watershed are used as the basis for determining the sensitivity of the aquifer to contamination (IG&WS, "Map of Indiana Showing Near-Surface Aquifer Sensitivity", 2015). The Indiana Geological & Water Survey, Indiana University

developed a GIS aquifer sensitivity layer mapping that ranked aquifer sensitivity using 5 classifications that range from very low to very high based on recharge rates (inches/year). The classifications were also cross checked with databases of contaminants in groundwater. For the purposes of this study, only the aquifers with a sensitivity ranking of moderate to very high were used in the impact determination, meaning aquifers with recharge rates of 4.3 inches/year or higher were included (IGS, 2015).

Resource Analysis

As noted in **Section 3.20.2, Volume I,** Source Water Assessment Areas are part of the IDEM Source Water Assessment Program (SWAP). These serve to meet EPA federal requirements to "identify the areas that are sources of public drinking water, assess the susceptibility of water-supply systems to contamination, and inform the public of the results." (IDEM, *"Source Water Protection"*, n.d.). Three Source Water Assessment Areas (SWAAs) have been identified with new alignment of alternatives. These include Jasper Municipal Water Utility for Alternatives C, M, O and P; Winslow Water Works for Alternative B; and Bedford City Utilities for Alternative O. Additionally, the local improvement elements 4, 5, 10, 15 and 16 each fall within one of these SWAAs. LI-4 and 5 are part of Alternatives C, M, O and P (Jasper Municipal Water Utility); LI-10 is part of Alternative B (Winslow Water Works); and LI-15 and 16 are part of Alternative O (Bedford City Utilities).

Two noteworthy groundwater resources are Wellhead Protection Areas (WHPAs) and Sole Source Aquifers (SSA). There is only one SSA identified in Indiana. The St. Joseph Aquifer System is located in the north central portion of the State, primarily in St. Joseph and Elkhart counties, which is not in close proximity to the project area (INDOT, 2011).

As noted in **Section 3.20.1, Volume I**, the project area has multiple drinking water sources, including private water wells and Wellhead Protection Areas (WHPAs). One WHPA, Loogootee Water Works WHPA, has been identified as impacted. Alternative M mainline Right-of-Way (ROW) is within 700 feet and a proposed on/off ramp ROW is within 200 feet of the Loogootee WHPA.

Figure 1 illustrates that the majority of each alternative travels through highly sensitive aquifers. Alternatives in Orange, Crawford, Lawrence, Martin and Dubois counties traverse areas dominated by karst topography. As cited in IDEM Proper Investigative Techniques in Karst, the U.S. Geological Survey (USGS) defines karst as "a terrain generally underlain by limestone or dolomite in which the topography is chiefly formed by the dissolving of rock, and which may be characterized by sinkholes, sinking streams, closed depressions, subterranean drainage, and caves" (IDEM, 2019). Karst features are at or near the surface in all or portions of Orange, Crawford, Lawrence, Martin and Dubois counties. Groundwater resources in karst areas are sensitive to contamination. Karst features allow surface flows to enter groundwater quickly, with little or no soil filtration (IDEM, "Proper Investigative Techniques in Karst ", 2019). A more detailed discussion of potential karst impacts is contained in **Section 3.22, Volume I**.

Groundwater impacts were summarized in **Section 3.20.3, Volume I** using three resources: 1) water wells (public and private) within and outside of dominant limestone regions and total, 2) WHPAs and 3) sensitive aquifers (see **Figure 1**). Impacts to wells were determined by their presence within 500 feet of the ROW or within 1,000 feet of the ROW in dominant limestone areas. The potential impact to WHPAs as provided by IDEM was based on the working alignment's proximity to designated areas. Only alternative working alignments traversing aquifers with sensitivity classified as moderate, high, and very high are reflected in this analysis. A brief summation of these impacts are as follows:

- Alternative P has the greatest potential impacts to total wells and wells outside of a dominant limestone area.
- Alternative B has the least potential impacts to total wells.
- Alternatives B, C and P do not impact wells within a dominant limestone area.
- Alternative O has the least potential impacts to wells outside of a dominant limestone area.
- Alternative M impacts a WHPA.
- Alternatives B, C, O and P do not impact a WHPA.
- Alternatives P and M have the greatest potential impacts to sensitive aquifers.
- Alternative B has the least potential impacts to sensitive aquifers.

All alternatives have both Super-2 and expressway alignments. Only Alternative M is identified as potentially impacting a WHPA. **Tables 1-10** of this appendix present the impacts associated with each of these alternative variations, including those associated with any Local Improvements which are part of the alternative. **Figure 1** highlights groundwater resources, excluding the WHPA. This was identified by IDEM and is not shown to maintain confidentiality.

Highly sensitive aquifers and water wells are present along each alternative. As the map and tables show, the number of water wells potentially impacted increases in more developed areas, such as the northern half of Alternative P. Alternative P has the greatest potential impacts to wells outside of a dominant limestone area, and a similar maximum potential impact to total wells to Alternative M. Further, Alternative P's total alternative length within sensitive aquifer areas potential is the highest of any Alternative, but only slightly less than alternative M (**Table 11**).

Alternative B is in a less developed region outside of a dominant limestone area and has no WHPA. Alternative B's potential groundwater impacts (total wells and alternative length within sensitive aquifer areas) are lowest of all alternatives. Alternatives B, C and P do not impact wells within a dominant limestone area and Alternatives B, C, O and P do not impact a WHPA.

In Section 2 only, Alternative O impacts slightly fewer wells outside of a dominant limestone area and total wells. Alternatives C, M and P have slightly fewer sensitive aquifer impacts than Alternative B. Alternatives C, M, O and P all share most of their working alignment in Section 2. Alternatives C, M and P have the same potential impacts to wells, WHPA, and alternative length within a sensitive aquifer area impact in Section 2.

Figure 1 and **Tables 3-6 and 9-10** show that Alternatives C, M and P have identical impacts in Section 2. Alternative O also shares a significant amount of alignment with Alternatives C, M and P but diverts east south of the East Fork of the White River. Alternative B has its own alignment entirely, sharing no common centerline with the other alignments. Future alignment modifications within Section 2 would result in similar changes to potential groundwater impacts for each alternative, with the exception of Alternative B.

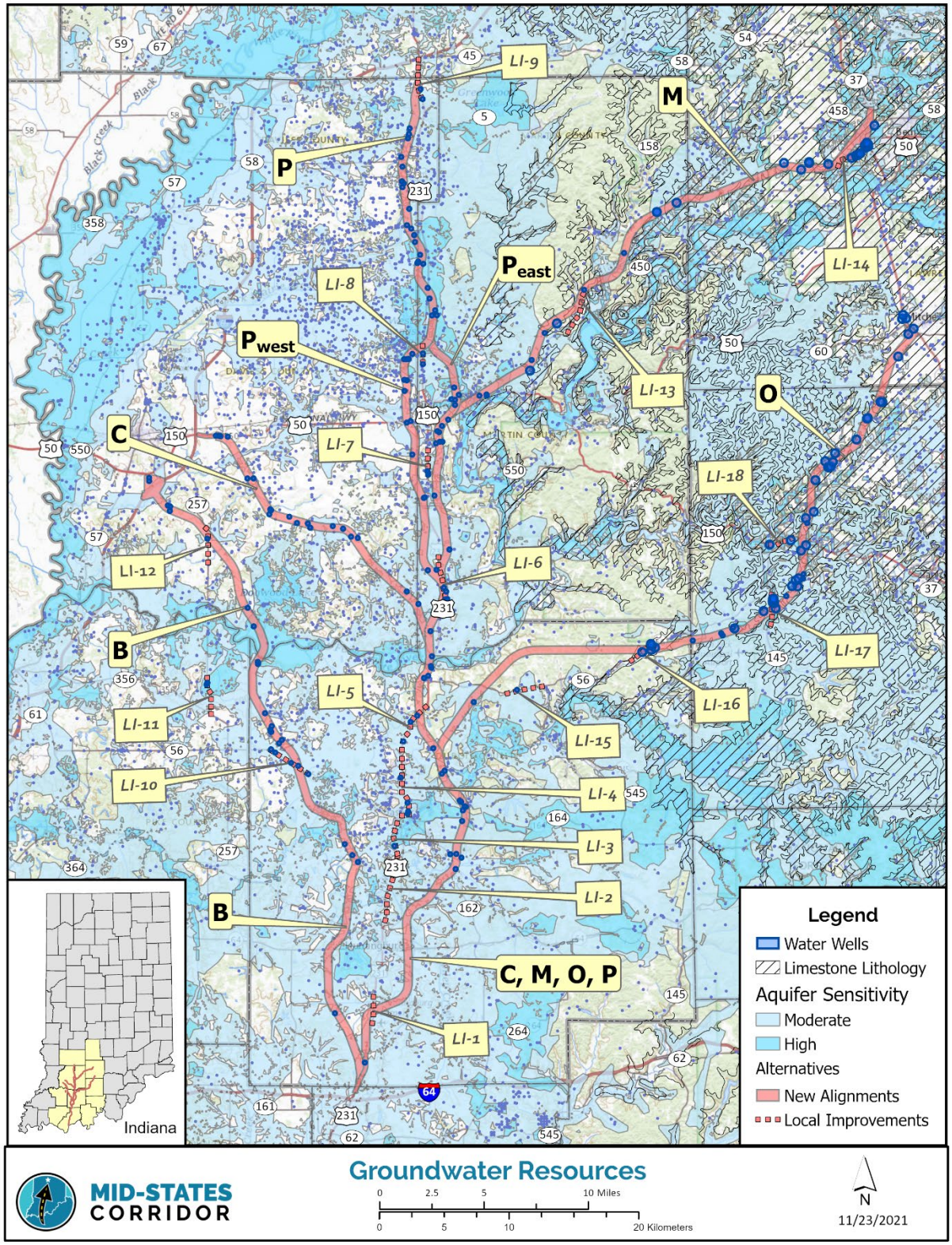

FIGURE 1: POTENTIAL GROUNDWATER IMPACTS

TABLE 1: POTENTIAL GROUNDWATER IMPACTS - WELLS, ALTERNATIVE B

Alternative			Section 2			Section 3		
			Wells in ROW Vicinity			Wells in ROW Vicinity		
Name	Facility*	Mapping Label	Within Dominant Limestone	Outside Dominant Limestone	Total Wells	Within Dominant Limestone	Outside Dominant Limestone	Total Wells
B	Expressway	B2-West	0	15	15	0	8	8
	Super 2	B3-West	0	15	15	0	8	8

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 2: POTENTIAL GROUNDWATER IMPACTS - OTHER, ALTERNATIVE B

Alternative			Section 2		Section 3	
Name	Facility*	Mapping Label	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)
B	Expressway	B2-West	0	17.5	0	3.5
	Super 2	B3-West	0	17.5	0	3.5

**Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 3: POTENTIAL GROUNDWATER IMPACTS - WELLS, ALTERNATIVE C

Alternative			Section 2			Section 3		
			Wells in ROW Vicinity			Wells in ROW Vicinity		
Name	Facility*	Mapping Label	Within Dominant Limestone	Outside Dominant Limestone	Total Wells	Within Dominant Limestone	Outside Dominant Limestone	Total Wells
C	Expressway	C2-East	0	18	18	0	24	24
	Super 2	C3-East	0	17	17	0	22	22

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 4: POTENTIAL GROUNDWATER IMPACTS - OTHER, ALTERNATIVE C

Alternative			Section 2		Section 3	
Name	Facility*	Mapping Label	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)
C	Expressway	C2-East	0	16.6	0	7.8
	Super 2	C3-East	0	16.6	0	7.8

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 5: POTENTIAL GROUNDWATER IMPACTS - WELLS, ALTERNATIVE M

Alternative			Section 2			Section 3		
			Wells in ROW Vicinity			Wells in ROW Vicinity		
Name	Facility*	Mapping Label	Within Dominant Limestone	Outside Dominant Limestone	Total Wells	Within Dominant Limestone	Outside Dominant Limestone	Total Wells
M	Expressway	M2-East	0	18	18	44	15	59
	Super 2	M3-East	0	17	17	44	15	59

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 6: POTENTIAL GROUNDWATER IMPACTS - OTHER, ALTERNATIVE M

Alternative			Section 2		Section 3	
Name	Facility*	Mapping Label	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)
M	Expressway	M2-East	0	16.6	1	25.3
	Super 2	M3-East	0	16.6	1	25.3

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 7: POTENTIAL GROUNDWATER IMPACTS - WELLS, ALTERNATIVE O

Alternative			Section 2			Section 3		
			Wells in ROW Vicinity			Wells in ROW Vicinity		
Name	Facility*	Mapping Label	Within Dominant Limestone	Outside Dominant Limestone	Total Wells	Within Dominant Limestone	Outside Dominant Limestone	Total Wells
O	Expressway	O2-East	0	14	14	49	0	49
	Super 2	O3-East	0	12	12	42	0	42

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 8: POTENTIAL GROUNDWATER IMPACTS - OTHER, ALTERNATIVE O

Alternative			Section 2		Section 3	
Name	Facility*	Mapping Label	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)
O	Expressway	O2-East	0	18.0	0	14.2
	Super 2	O3-East	0	18.0	0	14.2

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 9: POTENTIAL GROUNDWATER IMPACTS - WELLS, ALTERNATIVE P

Alternative				Section 2			Section 3		
				Wells in ROW Vicinity			Wells in ROW Vicinity		
Name	Facility*	Loogootee Bypass	Mapping Label	Within Dominant Limestone	Outside Dominant Limestone	Total Wells	Within Dominant Limestone	Outside Dominant Limestone	Total Wells
P	Expressway	east	P2-East$_{east}$	0	18	18	0	44	44
		west	P2-East$_{west}$	0	18	18	0	45	45
	Super 2	east	P3-East$_{east}$	0	17	17	0	45	45
		west	P3-East$_{west}$	0	17	17	0	44	44

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 10: POTENTIAL GROUNDWATER IMPACTS - OTHER, ALTERNATIVE P

Alternative				Section 2		Section 3	
Name	Facility*	Loogootee Bypass	Mapping Label	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)	Impacted Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)
P	Expressway	east	P2-East$_{east}$	0	16.6	0	25.6
		west	P2-East$_{west}$	0	16.6	0	26.0
	Super 2	east	P3-East$_{east}$	0	16.6	0	25.6
		west	P3-East$_{west}$	0	16.6	0	26.0

*Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.

TABLE 11: POTENTIAL GROUNDWATER IMPACTS SUMMARY

Alternatives**	Potential Groundwater Impacts*				
	Wells in ROW Vicinity			Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas (mi)
	Within Dominant Limestone	Outside Dominant Limestone	Total		
B	0	23	23	0	21.0
C	0	39 - 42	39 - 42	0	24.5
M	44	32 - 33	76 - 77	1	41.9
O	42 - 49	12 - 14	54 - 63	0	32.2
P	0	61 - 67	61 - 67	0	27.0 - 42.6

* Impacts are reported in ranges for all facility type options.

**Facility type 1, freeways, has been removed from consideration. Therefore, no modifications to existing US 231 in Section 1 and existing SR 37 in Section 3 are anticipated. No impacts are anticipated on either of these facilities.