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3.20 GROUNDWATER IMPACTS

3.20.1 Introduction

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

- Impacts for Alternatives R and Refined Preferred Alternative P (RPA P) have been added.

Groundwater is found in subsurface materials such as soil and rock. Groundwater also travels through permeable materials such as gravel, sand, and limestone to form aquifers. The top of an aquifer is referred to as the water table. Significant rainfall or melting snow may raise the water table. This is known as "recharging the groundwater." Pumping groundwater to supply water for homes or industry, for crop irrigation, or diverting runoff through stormwater management systems may lower the water table (as cited in Groundwater Foundation, "The Basics," undated).

The United States Geological Survey (USGS) has stated that groundwater supplies 51 percent of the total U.S. population with its drinking water. Groundwater supplies 99 percent of the nation's rural population with its drinking water (Groundwater Foundation, "The Basics", undated). Protecting groundwater is vital to support public health as well as the natural environment.

The project area has multiple drinking water sources, including private water wells and Wellhead Protection Areas (WHPAs). WHPAs are defined by Indiana statute 327 IAC 8-4.1-1 (Article 8 Public Water Supply, Rule 4.1 Wellhead Protection, 2018) as "the surface and subsurface area which contributes water to a community public water supply system, production well or wellfield and through which contaminants are likely to move through and reach the well within a specified period of time. This area is delineated by fixed radius or by mathematical (hydrogeological mapping, analytical, semi analytical, or numerical flow/solute transport) methods" (Indiana Department of Environmental Management (IDEM)), "Frequently Asked Questions ", undated).

The Indiana Water Resource Management Act, IC 14-25-7 (IGA, "Indiana Water Resource Management Act (IC 14-25-7)", 2020), defines a Significant Water Withdrawal Facility as "the water withdrawal facilities of a person that, in the aggregate from all sources and by all methods, has the capability of withdrawing more than one hundred thousand 100,000 gallons of ground water, surface water, or ground and surface water combined in one day" (Indiana Department of Natural Resources (IDNR)), "Significant Water Withdrawal Facility Registration – Indiana Code 14-25-7-15", undated).

As cited in IDEM Proper Investigative Techniques in Karst, the 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). Please refer to **Section 3.23 – Karst Impacts**, in particular **Section 3.23.4 – Mitigation**. As it describes, the focus of karst mitigation is maintenance of the quality and quantity of water entering karst features and maintenance of flow exiting karst features. Locating water pathways in karst feature may be difficult; please refer to **Section 3.23.3.2 – Spring and Dye Traces** for a description of identifying such flows in the Study Area.

For detailed findings and backup analyses, please refer to **Appendix M-Groundwater Impact Analysis**.

3.20.2 Methodology and Process

GIS analysis was used to identify public and private water wells proximate to alternatives. "Proximate" is defined as within a 500-foot buffer area of alternative working alignments, or within a 1,000-foot buffer area within dominant limestone regions. For a more detailed explanation on how the GIS was used to determine potential impacts, please refer to **Appendix X**.

A request was submitted to the IDEM, along with project location and description, for the agency's written determination of WHPAs within the Mid-States Corridor Study Area. The IDEM determination[1] indicated that one WHPA was present, along with four Source Water Assessment Areas (SWAA), within the proposed alternative's working alignment (A. Turnbow, personal communication, March 17, 2021, March 23, 2021, and March 9, 2022). Additional areas were investigated in association with the Local Improvements and the addition of the RPA P and Alternative R variations; in November of 2021 and March of 2023 respectively, the IDEM online Source Water Proximity Determination Tool was used to determine the presence of SWAAs in these areas. SWAAs are part of the IDEM Source Water Assessment Program that "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," undated).

3.20.3 Analysis

Impacts of each alternative were analyzed and compared for three resources: 1) water wells, public and private, within and outside of dominant limestone regions, 2) WHPAs, and 3) sensitive aquifers (see **Figure 3.20-1**). Impacts to wells and WHPAs were determined by their presence within 500 feet of the right-of-way outside limestone geology and within 1,000 feet of the right-of-way within limestone geology. Only portions of alternatives traversing aquifers with sensitivity classified as high and very high were reflected in this analysis. Figures and comparisons discussed in this section are the summation of impacts for both the main alignment and associated local improvements.

Table 3.20-1 shows the results of the comparative analysis. **Appendix M** has more detailed breakdowns of the potential impacts to groundwater resources for each alternative, including facilities, sections, and local improvements.

For total wells impacted, Alternative R has the greatest number of potential impacts followed in order by Alternatives M, P, RPA P, O, and C. Alternative B has the smallest number of potential impacts. For wells within dominant limestone areas, Alternative O has twice as many well impacts as Alternative M, although the total number of wells impacted for the two alternatives are similar. Alternatives B, C, P, RPA P, and R impact no wells within dominant limestone areas. For wells outside of dominant limestone areas, Alternative R has the greatest number of potential impacts followed in order by Alternatives P, RPA P, M, C, and B. Alternative O has the smallest number of potential impacts outside limestone areas.

Alternative M impacts a single WHPA. Alternatives B, C, O, P, RPA P, and R impact no WHPAs.

Alternatives RPA P, P, R, and M have similar potential impacts to sensitive aquifer areas, which are higher than other alternatives. These are followed in order by Alternatives O, C, and B.

Note that Alternative R is located completely on existing US 231, and therefore is within 500 feet of existing development. Alternatives P and RPA P variations also use more sections of existing US 231 than other alternatives. Wells along the highway are already impacted by the existing facility.

1 WHPA locations are confidential. Specific locations and details may not be provided in public documents.

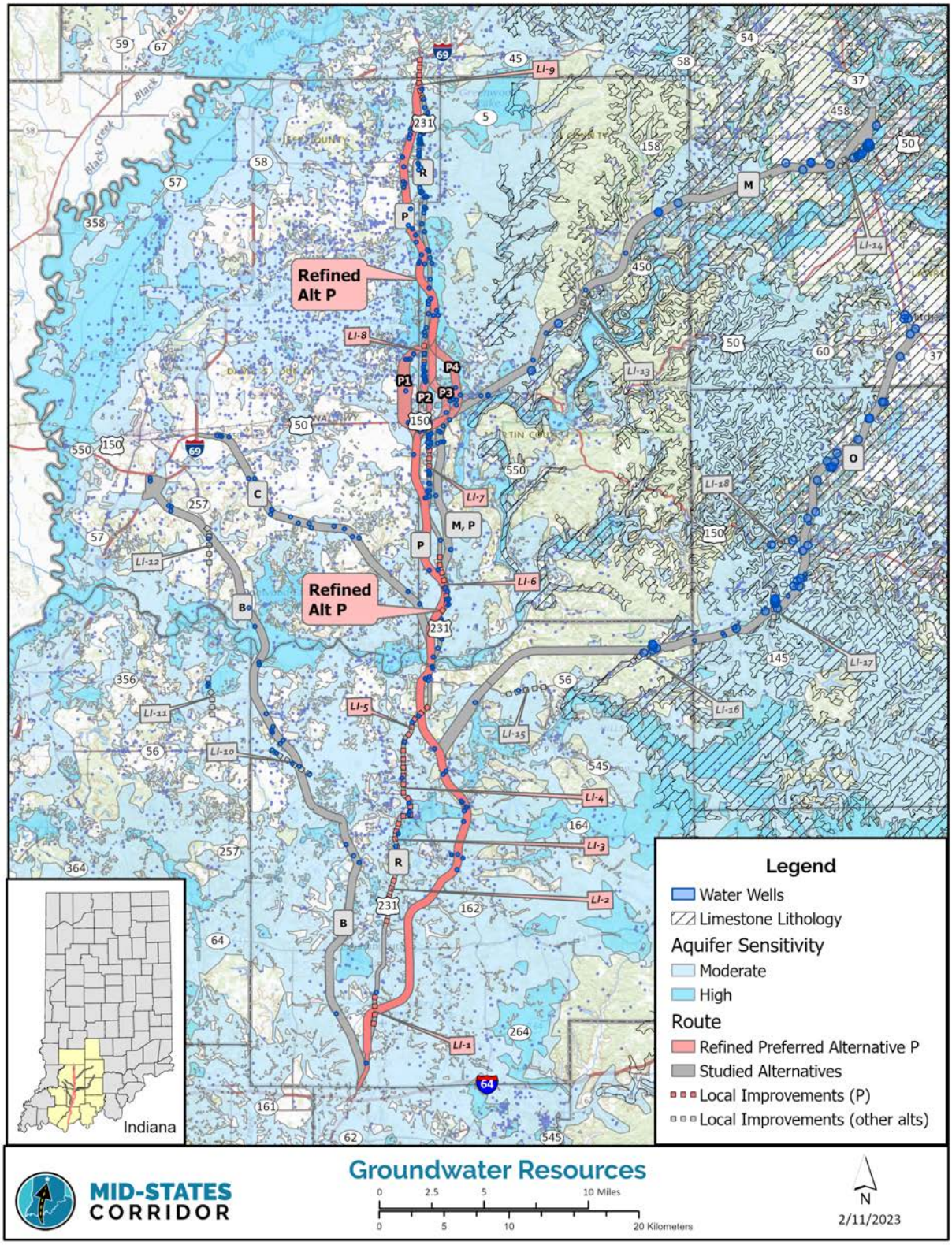

Figure 3.20-1: Potential Groundwater Impacts

Potential Groundwater Impacts					
Alternatives	Water Wells^			Wellhead Protection Areas	Route Length within Sensitive Aquifer Areas^^ (mi)
	Within Dominant Limestone	Outside Dominant Limestone	Total		
B Variations	0	33	33	0	30
C Variations	0	49-56	49-56	0	34
M Variations	24	61-63	88-90	1	55
O Variations	46-54	30-32	76-86	0	45
P Variations	0	86-90	86-90	0	56-57
RPA P Variations	0	82 - 90	82-90	0	56-58
R Variation	0	124	124	0	41

^ Wells occuring in geology with a limestone dominant lithology were buffered by 1000 feet to capture the sensitivity to runoff. Wells outside this geology were buffered by 500 feet. The number presented is the count of well buffers intersected by the ROWs.

^^ Analysis utilized IGS layer of Aquifer Sensitivity Near the Surface based on recharge rates. This analyis includes areas of moderate and high sensitivity, with recharge rates of 4.3 - 9.7 inches per year. No areas of very high sensitivty were present in the working ROWs.

* 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.

Figures presented include both the main alignment and local improvements.

Table 3.20-1: Potential Groundwater Impacts

Indiana currently has only one legally designated Sole Source Aquifer (SSA), the St. Joseph Aquifer System, located in Northern Indiana. The Study Area is outside of the SSA project review area; thus, the Federal Highway Administration (FHWA)/U.S. Environmental Protection Agency (EPA) Sole Source Aquifer Memorandum of Understanding (MOU) is not applicable, and no impacts are expected to the St. Joseph Aquifer System SSA.

3.20.4 Mitigation

Mitigation for groundwater impacts begins with the design and implementation of robust protection measures for all phases of the project, including pre- and post-construction. This includes a wide range of structural and non-structural BMPs in accordance with the IDEM Storm Water Quality Manual to prevent contaminants from entering the groundwater. Appropriate BMPs considered during Tier 2 studies will include establishing buffer zones along streams and wetlands, designing ditches to accommodate and treat roadside runoff and minimizing vegetation and tree clearing. Other measures may include partnering with state or local entities, such as municipalities identified within Source Water Assessment Areas, to conduct long-term water quality monitoring of public groundwater wells and impaired streams. Water wells, monitoring wells, and injection wells within the project area will be labeled on project plans. These facilities will be properly abandoned or plugged to prevent the migration of surface water or contaminants to the subsurface and to prevent migration of potential contaminants among and between water bearing zones. Well closures will be conducted by state-licensed water well drillers in accordance with state regulations 329 IAC 12-13. During geotechnical investigations, INDOT's Aquifer Protection Guidelines will be followed to ensure boreholes are properly closed in a manner that is protective of groundwater.

Road designs for Tier 2 NEPA studies will serve to further minimize potential groundwater resources impacts. Consultations with agencies and local jurisdictions will identify appropriate and effective mitigation measures.

3.20.5 Summary

Alternative B impacts the smallest number of public and private wells, while Alternative R impacts the greatest number of wells. Alternatives B, C, P, RPA P, and R impact no wells within a dominant limestone region, while Alternative O impacts the largest number of wells in a dominant limestone region. Alternatives B, C, O, P, RPA P, and R impact no WHPAs, while Alternative M impacts one. Alternative B has the least impacts within sensitive aquifer areas, while Alternatives P, RPA P, and M have the greatest impacts. Information and tables of alternatives broken down by facility and sections are provided in **Appendix M**.

The analysis shows that the number of potential wells impacted increases in more developed or developing areas, such as Alternative R and the northern portions of Alternatives P and RPA P. The analysis also shows that while highly sensitive aquifer areas are present to varying degrees within each alternative, Alternative P and RPA P had the longest length of alignment present within these sensitive areas. The most significant areas of concern include impacts to drinking water sources in dominant limestone regions and WHPAs. Mitigation measures identified in **Section 3.20.4** will be implemented to provide protection to groundwater resources.

After completion of the Tier 2 NEPA studies, permits relating to groundwater sources will be obtained from appropriate agencies.

Refined Preferred Alternative P does not have any wells present within a dominant limestone area and is not within any wellhead protection areas. It does have more than 55 miles of alignment within sensitive aquifer areas. The No-Build Alternative will have no groundwater impacts.