5.19 Water Resources

For purposes of this section, Preferred Alternative 8 that was identified in the Draft Environmental Impact Statement (DEIS) will be referred to as "Alternative 8." The Preferred Alternative for the Final Environmental Impact Statement (FEIS) will be referred to as the "Refined Preferred Alternative 8."

Since the publishing of the DEIS, the following substantive changes have occurred to this section:

- Updates were made throughout **Section 5.19** to add information regarding Refined Preferred Alternative 8.
- **Section 5.19.2.2**, *Methodology* – Added information regarding the use of the QHEI and HHEI methodologies.
- Stream and wetland data were updated based on field site visits with the USACE and IDEM in January, 2013, and are reflected throughout this section.
- A mitigation commitment to prevent drainage from increasing above the existing SR 37 levels for both Bennett's Dump and Lemon Lane Landfill Superfund sites have been added in **Section 5.16.4**, *Mitigation*.
- The jurisdictional opinions for streams within the existing SR 37 right-of-way have been updated based on the January 2013 field review with the USACE and IDEM.

5.19.1 Introduction

This chapter evaluates the project's potential impacts on water resources. The analysis of water resource impacts includes an assessment of the existing condition of water bodies affected by this project, as well as an assessment of the project's potential impact on those resources. This analysis takes into account both surface water resources and groundwater resources.

Section 5 of I-69 entails upgrading an existing multi-lane, divided transportation facility to a full freeway design. Most of the right-of-way used for the Section 5 project already is devoted to transportation use. Accordingly, the impacts to most natural resources in Section 5 will be lessened (on a per-mile basis) in comparison with Sections 1 through 4, which are being constructed on new terrain. The analysis in this chapter distinguishes resource impacts which occur within the existing rights-of-way for SR 37 and other transportation facilities from those which occur elsewhere. Many of the streams discussed in this chapter have been previously modified and impacted (i.e., captured in ditches, concrete channels, pipes, culverts, and/or bridges). Alterations to stream segments within existing SR 37 structures that result from the I-69 conversion are considered minor impacts due to the previous modifications during the construction of existing SR 37. In addition, many of the remaining impacts are from extensions

to these existing structures (i.e., lengthening of existing culverts, widening of existing bridges, re-routing of concrete channels).

5.19.2 Surface Waters

5.19.2.1 Introduction

Wetlands

Wetlands are important ecologically, socially, and economically to the health of Indiana's environment. Some ecological functions of wetlands are:

- Nutrient primary production and transport
- Habitat and sanctuary for animals
- Hydrological support for adjacent communities
- Shoreline protection
- Storm/flood water storage and peak flow reduction
- Groundwater recharge
- Water purification
- Water supply
- Effect on climatic conditions (temperature, oxygen, and carbon dioxide cycles)
- Support of isolated genetic population pools
- Species reproduction and development

In addition, wetlands support many human activities. Some activities are as follows:

- Commercial fisheries
- Recreation (hunting, fishing, boating, and swimming)
- Forestry products
- Agricultural products
- Aesthetics
- Educational centers
- Peat mining

Wetlands cover about 813,000 acres (3.5% of total area) of Indiana. Wetlands are an important natural resource, because they support rich biological communities across the state. Because of their functions and values, there are several federal and state laws that regulate activities that affect wetlands. The major laws protecting wetlands include the Federal Clean Water Act (CWA), the River and Harbors Act, and Indiana's Flood Control Act. There are a number of

definitions for a wetland; however, all definitions have three common criteria that define whether an area is a wetland. These criteria are:

- Wetland's vegetation—plants that are adapted to a wet environment.
- Hydric soils—soils that are characterized by anaerobic conditions.
- Hydrology—an area that is inundated or saturated to the surface for at least 5% of the growing season in most years.

Rivers and Streams

The Tier 1 Environmental Impact Statement (EIS) listed the names (if available) of all streams and rivers identified on the United States Geological Survey (USGS) quadrangle maps impacted by the preferred alternative. The Tier 2 streams and rivers evaluation included a more detailed analysis of the streams and rivers impacted by the Section 5 alternatives. This analysis included identifying all streams and rivers that may be impacted (including small streams that may not be on the USGS quadrangle maps), identifying the flow regime of rivers and streams impacted (i.e., perennial, intermittent, or ephemeral), taking photographs, measuring the ordinary high water mark (OHWM), estimating the amount of riparian corridor, and completing a quality assessment using the Qualitative Habitat Evaluation Index (QHEI) or the Headwater Habitat Evaluation Index (HHEI) on each river or stream at the point of impact. This information provided a more complete description of the rivers and streams impacted than the information provided in the Tier 1 EIS. This FEIS will also include measures to minimize impacts to rivers and streams.

Floodplains

Floodplains are a vital part of a river or stream ecosystem. They are important because they act as flood buffers, water filters, and nurseries, and because they are major centers of biological life in the river or stream ecosystem. Floodplains are also important for maintenance of water quality, as they provide access for fresh water to reach wetlands and backwaters, dilute salts and nutrients, and improve the overall health of the habitat used by many species of birds, fish, and plants. They are vital biologically, because they represent areas where many species reproduce and are important for breeding and regeneration cycles.

The Tier 1 EIS evaluated the potential impacts to floodplains for all alternatives using Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) maps and estimating the total amount of floodplains impacted. The Tier 2 FEIS for Section 5 further refines potential floodplain impacts from the Tier 1 preferred alternative by estimating the total amount of impacts for each of the Tier 2 alternatives. In addition, the Tier 2 FEIS quantifies and describes the floodplains being crossed and describes efforts that are being made to reduce the amount of floodplain impacts (see **Section 5.19.2.3**, *Analysis*, below).

5.19.2.2 Methodology

Information from several different sources was used to evaluate potential impacts to existing surface water resources:

- A Geographic Information System (GIS) stream layer derived from the National Hydrography Dataset was used to identify the main streams within the project corridor and calculate the lengths of impacts within the project corridor.

- The on-line GIS program and the Hydrologic Map Server-Online Watershed Delineator (HYMAPS-OWL), developed by Purdue University were used as the basis for developing the watershed of several of the major streams within the project corridor boundary.

- The Natural Resources Conservation Service (NRCS) Web Soil Survey was used to identify smaller headwater streams within the project corridor in accordance with HHEI protocol. The State of Ohio's Environmental Protection Agency's (OEPA) *Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams* (OEPA, 2009) was used as guidance for conducting the HHEI assessments. The Indiana Department of Environmental Management's (IDEM's) *Qualitative Habitat Evaluation Index* (QHEI) - *Standard Operating Procedure* (IDEM, 2006) provided guidance for the QHEI analysis.

- Field observations provided valuable information on small drainageways and streams as well as the width, depth, and substrate of the named streams.

- The Draft 2012 IDEM 303(d) Impaired Streams list was reviewed to identify any impaired streams in the project corridor.

- General water quality information about the watershed basins was taken from publications by Indiana Department of Natural Resources (IDNR), United State Geological Survey (USGS), and the Indiana Geological Survey (IGS).

- Monroe and Morgan county officials were contacted to identify legal drains in the area.

- Interagency water resource meetings were held December 14, 2004, February 23, 2005, and February 9, 2007, to establish procedures for coordinating with resource agencies regarding water-related issues during the Tier 2 studies and to identify guidelines for evaluating and mitigating impacts to water resources. Agencies having representatives attending the meetings, in addition to the Federal Highway Administration (FHWA) and Indiana Department of Transportation (INDOT), were the United States Environmental Protection Agency (USEPA) Region 5, United States Army Corps of Engineers (USACE), IDEM, and IDNR. The minutes of the meetings are included in **Appendix C**, *Agency Coordination Correspondence.*

- A USACE/IDEM Wetland and Stream Field Review was conducted in Section 5 on September 22, 2005. The purpose of the review was to evaluate the jurisdictional status of waters identified within the Section 5 corridor during field studies. In addition, interpretations of various scenarios were considered to establish a consistent approach to jurisdictional determinations to be implemented for all six I-69 Tier 2 sections. Several wetland and stream crossing locations were selected for review as representative of conditions within the corridor. A summary of the field review is in **Appendix C**, *Agency Coordination Correspondence.* A follow-up field review with the USACE and IDEM

was conducted on January 29, 2013 to evaluate the jurisdictional status for the roadside ditches within the existing SR 37 right-of-way. Information from this field review was used to revise the jurisdictional opinions.

Methods employed in the analysis and evaluation of wetlands, streams, floodplains, and surface water quality are identified in the following paragraphs. Water resources discussed in **Section 5.19**, *Water Resources*, are shown, in relation to the Section 5 alternatives, on **Figure 5.19-1** (National Wetland Inventory [NWI] and Field Verified Wetlands), **Figure 5.19-2** (Streams) and **Figure 5.19-3** (Impaired Streams). Figures are located at the end of this section.

Wetland Assessment

Several sources of information were consulted to identify potential wetlands and wetland soil units within the Section 5 corridor. These included the United States Fish and Wildlife Service's (USFWS's) *National Wetland Inventory* (NWI) and the NRCS's *Soil Survey* for Morgan and Monroe counties. These maps identified potential wetland areas within the corridor.

The delineation of wetlands and other "waters of the U.S." within the Section 5 study corridor was based on the methodology described in the regional supplement to the *Corps of Engineers Wetland Delineation Manual: Midwest Region* (Version 2.0, Environmental Laboratory, 2010), as required by current USACE policy that was in effect during the time this survey was completed. Prior to the fieldwork, the background information was reviewed to establish the probability and approximate location of wetlands. Next, a general reconnaissance of the project area was conducted to determine site conditions. The Section 5 alternatives were then walked with the specific intent of determining wetland boundaries. Data stations were established at locations within and near the wetland areas to document soil characteristics, evidence of hydrology, and dominant vegetation. Although a full soil profile was not examined to confirm soil series designations, soils were examined to a depth of at least 16 inches to assess soil characteristics and site hydrology. Complete descriptions of typical soil series can be found in the *Soil Survey* for Morgan and Monroe counties. The I-69 Evansville to Indianapolis Section 5 field survey of surface water resources was completed during 2005, 2006, 2011, and 2012.

A complete wetland assessment report was prepared as a separate report, titled, *Final Wetland Technical Report, I-69 Section 5: SR 37 South of Bloomington to SR 39 in Monroe and Morgan Counties, Indiana* (Baker, 2012), and is located in **Appendix F**. In addition to descriptions of each wetland within the construction limits of the alternatives, the report includes the following:

- *Site Photographs*. Photographs of each identified wetland are provided in Appendix A of the *Final Wetland Technical Report.* These photographs are the visual documentation of site conditions at the time of inspection and are intended to provide representative visual samples of the wetlands.

- *Indiana Wetland Rapid Assessment Protocol (INWRAP) documentation, Wetland Determination Data Forms – Midwest Region.* Wetland Determination Data Forms are included for wetlands impacted by the Refined Preferred Alternative 8 and are located in Appendices B, C, D, and E of the *Final Wetland Technical Report*.

INWRAP

The Indiana Wetland Rapid Assessment Protocol (INWRAP) was developed by Taylor University Environmental Research Group (TERG) in response to a need by state and federal agencies to have a better way of quickly and accurately depicting the quality of a wetland. The effort to develop INWRAP methodology was initiated by IDNR and TERG. It was eventually funded in 1998 by the USEPA under Section 104(b) of the CWA (Grant #CD 985484-0100). The INWRAP assessment method was identified in the February 22, 2005, Interagency Water Resource Meeting as being the assessment method to be used during the I-69 Tier 2 studies for assessing the quality of the wetlands impacted by the alternatives. None of the agencies in attendance objected to the use of INWRAP. (Agency attendees and meeting minutes can be found in **Appendix C**, *Agency Coordination Correspondence*).

INWRAP results in the documentation of various wetland characteristics on field data sheets using a three-tiered approach, as follows:

1) An Assessment Overview records information on the size of the wetland complex and its associated wetland polygons, general classification, setting, and connection relative to other wetlands on the landscape and adjacent land use, as well as standard date, personnel, and identification data.

2) An individual polygon approach was adopted wherein 11 preliminary assessment features were recorded for each polygon including presence of standing water, soil type, hydrology disturbances, presence of exotic species, and the presence of "red flag" indicators, such as threatened and endangered species.

3) This step provides a more detailed perspective on the hydrology (water quality and flood/stormwater storage) and vegetative structure of the individual wetland polygons within the complex.

The INWRAP data, associated maps, and data sheets are provided in Appendix F, *Final Wetland Technical Report*.

Streams: QHEI/HHEI

Qualitative Habitat Evaluation Index (QHEI): Streams possessing drainage areas larger than one square mile or with natural maximum pool depths greater than 40 centimeters (cm) (15.75 inches) were evaluated using the IDEM QHEI protocol (IDEM, 2006). While the OEPA originally developed the QHEI to evaluate fish habitat in streams, the IDEM Biological Studies Section and other agencies routinely utilize the QHEI as a measure of general habitat health. QHEI was selected as the methodology used in this study because it was currently being used by IDEM to assess habitat quality. In a letter dated February 16, 2005 (see **Appendix C**, *Agency Coordination Correspondence*), IDEM requested that stream

QHEI Score (Max. 100)	Indicates
Above 64	Habitat capable of supporting a balanced warm water community.
51 – 64	Stream par ially supportive of its aqua ic life use designation.
Less than 51	Stream may be non-supporting of its aquatic life use designation.

habitat assessments be completed using Ohio EPA's QHEI and Headwater Habitat Evaluation Index (HHEI) (discussed below).

Various attributes of habitat within the survey reach were scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrate; amount and quality of in-stream cover; channel morphology; extent and quality of riparian vegetation; pool, riffle, and run development and quality; and gradient are the metrics used to determine the QHEI score. Each metric was scored individually and then summed to provide the total QHEI score that typically ranges from 20 to 100.

The QHEI is used to evaluate the characteristics of a stream segment (reach), as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. IDEM indicates that QHEI scores above 64 suggest that the habitat is capable of supporting a balanced warm water community; scores between 51 and 64 suggest the streams are partially supportive of a stream's aquatic life use designation; and scores less than 51 suggest the streams are non-supporting for aquatic life use (IDEM, 2006).[1] QHEI indices and corresponding IDEM criteria are outlined below.

Substrate:

- Type - Measures size and characteristics of channel bottom material; types include soil, rocks, water, and leaf tissues.
- Origin - Identifies the parent material of the substrate.
- Silt Cover - Measures amount of substrate material covered by silt.
- Embeddedness - Measures the degree that gravel, cobble, and boulder substrates are surrounded, or covered by sand and silt.

Instream Cover:

- Type - Measures presence of structures and/or cover habitat which support aquatic species; types include soil (bank morphology), rocks, water, and vegetation (dead and alive).
- Amount - Measures quality of the stream characterized by valuable habitat.

Channel Morphology:

- Sinuosity - Measures the degree to which the stream meanders (i.e., bends).

[1] A supporting / non-supporting designation indicates that a stream may / may not provide suitable habitat to sustain the flora (plants) and fauna (animals) typically found in this region of Indiana.

- Development - Measures quality of fast-moving turbulent riffles and slowly-moving deep pool complexes.
- Channelization - Identifies man-made channel modifications.
- Stability - Identifies the quality of the channel in relation to creation and stability of the macrohabitat, including the erosion potential of the stream banks.

Riparian Zone and Bank Erosion:

- Riparian Width - Measures width of the streamside vegetation that effectively buffers the stream from development (i.e., human land uses).
- Floodplain Quality - Identifies land use(s) within floodplain that can minimize direct runoff and erosional effects. Floodplain refers to areas immediately outside of the riparian zone, or greater than 100 feet from the stream, whichever is wider.
- Bank Erosion - Measures the degree of instability of the stream banks caused by either natural water flow or animals (e.g., livestock).

Pool/Glide and Riffle/Run Quality:

- Max Pool Depth - Measures water depth of deepest pool.
- Morphology - Measures shape of pools when compared with riffles, or the relative widths of pools and riffles.
- Current - Measures flow velocity through pools and riffles.
- Riffle/Run Depth - Measures water depth of best riffle and best run habitat.
- Riffle/Run Substrate - Measures the size and characteristics of the material comprising the channel bottom material of riffles and runs and the degree to which it contributes to the stability of the bottom.

Gradient:

- Stream Profile - Measures slope through the sampling area; accounts for varying influence of gradient with respect to stream size (i.e., stream width & drainage area).
- Riffle/Run Embeddedness - Measures the degree that cobble, gravel, and boulder substrates are surrounded or covered by sand and silt.

Headwater Habitat Evaluation Index (HHEI): Primary headwater streams[2] were assessed using the OEPA's HHEI. As discussed above, QHEI was selected as the methodology used in this study because it was currently being used by IDEM to assess habitat quality. The use of HHEI was a logical step for smaller streams as it was also developed by the Ohio EPA, but for smaller headwater streams. In a letter dated February 16, 2005 (see **Appendix C**, *Agency Coordination Correspondence*), IDEM requested that stream habitat assessments be completed using Ohio EPA's QHEI and HHEI. The use of the Ohio HHEI was reviewed by the Interagency Water Resource Team, which included USEPA, for use on the I-69 project to assess all stream channels that did not meet the criteria for the Quality Habitat Evaluation Index (QHEI). This was determined at the Team's meeting of February 23, 2005 (see **Appendix C**, *Agency Coordination Correspondence*, for the meeting summary). The HHEI is being used as a method to determine the stream quality of the smaller headwater streams using the criteria outlined below. Each stream with a drainage area less than one square mile and pool depth of less than 40 cm identified within the right-of-way of the alternatives was inspected for its ability to provide primary headwaters habitat. Habitat stations represent the entirety of the habitat available along a representative 200-foot reach of stream (or the entire distance of that specific stream segment if less than 200 feet). Each time the habitat changed along the length of the tributary within the right-of-way, another assessment was completed. Habitat changes were considered to be segment changes and thus, each segment and unique tributary was assessed individually.

HHEI Class /*Score* (*Max. 100*)

Class I / ***up to 39*** Indicates lowest potential to support diverse array of aquatic fauna. If channel is modified, score range is up to 30.

Class II / ***40 to 59*** Indicates moderate potential to support diverse warm-water aquatic fauna. If channel is modified, score range is 30 and above.

Class III / ***60 and above*** Indicates greatest potential to support a diverse array of fauna adapted to headwater habitat. Channel must be in natural state, not modified.

The HHEI method of stream habitat assessment classifies streams as Class I, II, or III, and also categorizes them according to whether their channels have been modified (Modified Class I, II, or III). For perennial or interstitial natural channels, HHEI scores of Class III streams range between 60 and 80 out of a maximum of 100 points; they indicate a potential to support a unique assemblage of headwater species. One of the criteria for a Class III stream is that its channel be in its "natural" state; therefore, no modified primary headwater streams may be classified as Class III streams. Class II streams have scores that range between 40 and 59. Modified Class II streams typically score between 30 and 59. Class I streams, which range between 20 and 40, represent reaches that are normally dry (ephemeral) and do not support a diversity of aquatic life. Scores for Modified Class I streams range between 0 and 30. Class I streams have the lowest potential to support a diverse array of aquatic fauna typically found in stream environments.

[2] As described in detail in the *Field Evaluation Manual for Ohio's Primary Headwater Habitat Streams* (Ohio EPA, 2009), a primary headwater habitat stream is "a surface water of the state, having a defined bed and bank, with either continuous or periodical flowing water, with watershed area less than or equal to 1.0 square mile (259 hectares), and a maximum depth of water pools equal to or less than 40 cm." Primary headwater habitat streams are defined based on substrate type, quality, maximum pool depth, and bank full width, i.e., the total width of the stream at the boundary line of terrestrial vegetation.

The scores were developed specifically for the I-69 project to aid in the interpretation of information obtained in the HHEI assessments. The general theory is that the higher the HHEI score, the higher the probability that the stream supports a more diverse aquatic fauna community. Corollary to this theory, a stream expected to support a more diverse aquatic community is a higher quality stream compared to one that would not be expected to support a diverse aquatic community. This stream quality interpretation was developed based on input from the I-69 Water Resources Technical Committee composed of representatives of FHWA, INDOT, USEPA Region 5, USACE, USFWS, IDEM, and IDNR.

The QHEI/HHEI evaluations and supporting data are presented in a separate report, which includes a brief description of each stream segment surveyed. The report and associated maps are provided in **Appendix M**, *Final Stream Assessment Report*. Tributary and segment data sheets for each unique stream or unique habitat (i.e., segment), prepared as part of the evaluation, are also included in this report.

In addition to the above-listed information, each stream was further classified as ephemeral, intermittent, or perennial. The classification was based upon USGS map designations.

Ephemeral Streams: An ephemeral stream is a stream that flows only during and for short periods following precipitation (less than 30% of the time) and flows in low areas that may or may not have a well-defined channel. Some commonly used names for ephemeral streams include: stormwater channel, drain, swale, gully, hollow, or saddle. Since ephemeral streams are often headwater streams, it is typically recommended that roads, site-preparation, and other soil-disturbing activities be minimized in ephemeral stream areas to avoid erosion and sedimentation from stormwater runoff that will flow downstream into larger streams or waterbodies. All streams identified in the field that were not represented on the USGS maps were classified as ephemeral streams for this study.

Intermittent Streams: An intermittent stream is a stream that flows only during wet periods of the year (30% to 90% of the time) and flows in a continuous well-defined channel. During dry periods, especially in summer months, intermittent streams may go down to a “trickle of water” and appear dry when, in fact, there is water flowing through the stream bottom or “substrate.” All streams that were identified on the USGS maps by a broken blue line were considered intermittent streams for this report.

Perennial Streams: Perennial streams are streams that flow throughout the majority of the year (greater than 90% of the time) and flow in a well-defined channel. However, perennial streams can “dry up,” particularly during extended periods of drought. All streams that were identified on the USGS maps by a solid blue line were considered perennial streams for this report.

Floodplains

FEMA FIRM ID Numbers 1801770015B, 1801760075B, 18105C0050D, 18105C0131D, and 18105C0133D for Monroe and Morgan counties were reviewed to identify floodplains within the rights-of-way of the alternatives. The floodplain area within the right-of-way of each of these alternatives was calculated in order to quantify potential impacts.

Surface Water Quality

Two main regional studies were used to evaluate water quality in the project corridor. The first was IDNR, Division of Water's "Ground-Water Resources in the White and West Fork White River Basin" (Beaty, 2002). The second was from the City of Bloomington's, Bloomington and Monroe County Environmental Water Quality website.[3]

5.19.2.3 Analysis

Wetlands

The following are short descriptions of the types of wetlands in the Section 5 corridor based on NWI mapping used during the Tier 1 study as the basis for estimating potential wetland impacts within the study's alternative corridors. To determine whether the project would impact wetlands in the corridor, it was necessary to verify the accuracy of the NWI data in the field. **Table 5.19-1** provides information about the NWI mapped wetlands as well as the wetlands identified during field studies in the Section 5 corridor.

Table 5.19-1: Wetlands in Section 5 Corridor

Wetland Type	Number of NWI Wetlands*	NWI Wetland Acreage*	Number of Field Verified Wetlands	Field Verified Wetland Acreage
Palustrine Emergent (PEM)	7	3.53	36	10.34
Palustrine Forested (PFO)	20	59.10	21	37.52
Palustrine Scrub-Shrub (PSS)	2	5.99	7	3.41
Palustrine Unconsolidated Bottom (PUB)	26	19.63	43	29.68
Palustrine Aquatic Bed (PAB)	0	0.00	2	2.23
Total	**55**	**88.25**	**109**	**83.18**

Source: ** Information obtained from USFWS, NWI, (http://www.fws.gov/wetlands/Data/index.html).*

Palustrine Emergent Wetlands (PEM)—NWI data indicated approximately 3.53 acres of emergent wetlands located within the study corridor. These wetlands support erect, largely herbaceous perennial species and contain permanent water for most of the growing season during years with normal precipitation levels. These wetlands maintain the same appearance each year unless extreme climatic conditions cause flooding or other atypical local changes. Emergent wetlands traditionally include marsh, meadow, and fen communities.

[3] City of Bloomington and Monroe County, Environmental Water Quality Website, http://bloomington.in.gov/documents/viewDocument.php?document_id=3013 (Last accessed 3/21/13).

Palustrine Scrub/Shrub Wetlands (PSS)—NWI data indicated approximately 5.99 acres of scrub-shrub wetlands located within the study corridor. These wetlands support largely woody species less than 20 feet tall. The species include shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Many of the scrub/shrub wetlands in the Midwest develop into forested wetlands.

Palustrine Forested Wetlands (PFO)—NWI data indicated approximately 59.10 acres of forested wetlands located within the study corridor. These wetlands support large woody species greater than 20 feet in height and include various hydrological regimes. This class generally possesses various layers of vegetation including canopy trees, subcanopy trees, shrubs, and herbaceous ground layer vegetation. Forested wetlands traditionally include bottomland hardwood and swamp communities.

Palustrine Unconsolidated Bottom Wetlands (PUB)—NWI data indicated approximately 19.63 acres of unconsolidated bottom wetlands located within the study corridor. These are wetlands and deepwater habitats that support less than 30% cover of vegetation, contain at least 25% cover of substrate smaller than stones, and have various permanent or semi-permanent water regimes. These communities rarely comprise a stable substrate for aquatic vegetative growth.

Wetland Assessments Within the 2,000-foot Study Corridor

Generally speaking, NWI wetlands are identified by aerial mapping and are not field-verified. Because of this, wetlands are sometimes erroneously identified, missed, or misidentified. In addition, the criteria used in identifying these wetlands were different from those currently used by the USACE. To determine whether the project would impact wetlands in the corridor, it was necessary to verify the accuracy of the NWI data in the field. Therefore, for the Tier 2 study in Section 5, wetland resources within the 2,000-foot-wide study corridor were identified through a combination of field reconnaissance surveys and GIS mapping. For consistency with the previous NWI discussion, this section characterizes the field-confirmed wetlands according to the *Classification of Wetlands and Deepwater Habitats of the United States.* The complete wetland assessment report can be found in **Appendix F**, *Final Wetland Technical Report*. This section (**Section 5.19.2.3**, *Analysis*), provides a summary of the report findings and includes an evaluation of the potential impacts to the wetlands assessed within the project corridor.

As noted above, NWI data indicated the presence of 55 palustrine wetland systems (PEM, PSS, PFO, and PUB) totaling approximately 88.25 acres in the Section 5 corridor. However, the field reconnaissance resulted in the identification and assessment of a total of 109 wetlands in the corridor. Of these, 36 wetlands were identified as palustrine emergent (PEM), seven as palustrine scrub-shrub (PSS), 21 as palustrine forested (PFO), 43 as open water (PUB), and two as palustrine aquatic bed (PAB).

The field reconnaissance identified wetlands within the corridor ranging in size from less than one tenth of an acre to approximately 10.29 acres. The total area of all forested wetlands (PFO) within the Section 5 corridor is approximately 37.52 acres. The total area of all scrub/shrub wetlands (PSS) within the Section 5 corridor is approximately 3.41 acres. The total area of all

emergent wetlands (PEM) within the Section 5 corridor is approximately 10.34 acres. The total area of the open water (PUB) within the corridor is approximately 29.68 acres. The total area of aquatic bed (PAB) within the corridor is approximately 2.23 acres. **Figure 5.19-1** shows the NWI and field verified wetlands in the project corridor. (Figures are located at the end of this chapter.) **Table 5.19-1** compares the amount and acreage of NWI mapped wetlands and field verified wetlands in the Section 5 corridor.

Potential Impacts to Wetlands by Alternative

INWRAP was used to assess the quality of the wetlands potentially impacted by the alternatives. As a part of the INWRAP analysis, two or more individual wetland polygons could be combined to create a wetland complex. Of the 66 individual wetland polygons (excluding open water) and wetland complexes, the following 33 complexes (not including open water polygons) are within the construction limits of one or more alternatives; S5w007, S5w011, S5w021, S5w024, S5w062, S5w063, S5w065, S5w066, S5w068, S5w069, S5w070, S5w071, S5w080, S5w091, S5w095, S5w104, S5w109, S5w119, S5w120, S5w121, S5w122, S5w123, S5w124, S5w125, S5w126, S5w127, S5w128, S5w145, S5w146, S5w147, S5w148, S5w149, and S5w150.

Table 5.19-2 identifies the potentially impacted wetlands in the Section 5 corridor by type and number of acres, and it indicates, based on professional opinion, whether they should be considered "waters of the U.S." or "waters of the state."[4] In addition, **Table 5.19-2** lists each of the 33 wetland complexes and 10 open water features impacted by one or more of the six alternatives, their potential jurisdictional status, and the acreage impacted by each alternative for the construction limits. **Table 5.19-3** lists each of the wetland complexes and open water features impacted by one or more of the six alternatives, their potential jurisdictional status, and the acreage impacted by each alternative for the right-of-way limits. The pond impacts were calculated by taking the entire acreage of the pond if any portion of the pond was impacted. This was done as a worst case scenario since it is difficult to tell in the NEPA stage if the entire pond would need to be drained and/or filled in to accommodate the final design. As such, impacts to these pond features may decrease during permitting. The one exception is Weimer Lake (S5w014), located within Wapehani Mountain Bike Park, where it was determined at this stage

[4] "Waters of the U.S." are within the jurisdiction of USACE under the CWA. The term includes waters that are used or could be used for interstate commerce. This includes wetlands, ponds, lakes, territorial seas, rivers, and tributary streams including any definable intermittent waterways, and some ditches below the "ordinary high water mark" (OHWM). Also included are manmade water bodies such as quarries and ponds, which are no longer actively being mined or constructed and are connected to other "waters." A specific, detailed definition of "waters of the U.S." can be found in the *Federal Register* (33 §CFR 328.3). In Indiana, "waters of the U.S." are also subject to regulation by IDEM, which maintains jurisdiction over the state's water quality issues.

"Waters of the state" are within the jurisdiction of IDEM. They are generally defined as surface and underground water bodies that extend through or exist wholly in the state. They include, but are not limited to streams and both isolated and non-isolated wetlands. Private ponds, or any pond, reservoir, or facility built for reduction of pollutants prior to discharge are not included in this definition. In addition to "waters of the U.S.," IDEM regulates and issues permits for isolated wetland impacts.

that only the portion of the inlet to the lake within the right-of-way will be impacted by this project.

Most of the wetlands potentially impacted in Section 5 are preliminarily identified as "waters of the U.S." and would fall under USACE and IDEM jurisdiction, based on professional opinion. Thirty-two of the wetland complexes and eight of the ponds that are impacted by at least one alternative are included in this category. IDEM regulates isolated wetlands that do not fall under USACE jurisdiction. The isolated wetlands are regulated by IDEM under the Isolated Wetlands Regulatory Program. They are considered isolated wetlands because they are not connected to, have no significant nexus to, or are not adjacent to "waters of the U.S," which are regulated by the USACE. One wetland and two ponds are included as isolated wetlands based on professional opinion. Descriptions of the 33 wetland complexes are provided in **Appendix F,** *Final Wetland Technical Report*.

Note that the identification of wetlands as "waters of the U.S." was based on definitions and guidance found in 33 CFR §328.3, USACE Regulatory Guidance Letters, the wetland delineation manual, and field observations performed as part of the INWRAP evaluation. IDEM and USACE conducted preliminary field reviews in September 2005 and January 2013 to evaluate the potential jurisdiction of identified water resources within the Section 5 corridor. The USACE will make the final determinations regarding the jurisdictional status of wetlands during permitting. USEPA will review the final decision on the federal jurisdictional determinations made by the USACE as part of its responsibility in jointly administering Section 404 of the CWA and has the ability to overturn the USACE determination if deemed necessary.

No single alternative impacts all 33 wetland complexes or 10 open water features found within the construction limits. The total number of wetland complexes and open water features impacted by the alternatives range from 22 (Refined Preferred Alternative 8) to 35 (Alternative 5). **Table 5.19-4** lists the total of potential impacts to wetlands by type within the construction limits. **Table 5.19-5** lists the total of potential impacts to wetland by type within the right-of-way. Based on the construction limits, the total area of wetland and open water impacts range from approximately 3.45 acres to 20.24 acres (Refined Preferred Alternative 8 and Alternative 5, respectively). Total impacts for Refined Preferred Alternative 8 are 3.45 acres. The majority of the wetland impacts for the Refined Preferred Alternative 8 are classified as palustrine emergent wetlands (PEM).

The Tier 1 study estimated 5 acres of wetland impacts in the Section 5 corridor (Tier 1 FEIS, Table 6-30, based on NWI data). It should be noted that the Tier 1 estimation of impacts was based on NWI data, while the Tier 2 evaluation is based on field reconnaissance and determinations of wetlands within the construction limits of the Section 5 alternatives. For further information on the comparison of Tier 1 and Tier 2 impacts, please refer to **Appendix MM**, *Tier 1 – Tier 2 Impact Comparison*.

Table 5.19-2: Potential Wetland Impacts, by Wetland Site – (Construction Limits)

Wetland Site ID	Type	Jurisdiction		Total Wetland Acres	Acres of Impact by Alternative					
		Waters of the U.S.	Waters of the State		4	5	6	7	8	Refined Preferred Alternative 8
S5w007	PEM	x	x	0.03	0.00	0.03	0.00	0.00	0.00	0.00
S5w010	PUB	x	x	0.05	0.05	0.05	0.00	0.00	0.00	0.00
S5w011	PEM		x	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5w014b	PUB	x	x	7.27	0.00	0.00	0.00	0.02	0.00	0.02
S5w021	PEM	x	x	0.13	0.13	0.13	0.13	0.13	0.13	0.13
S5w024	PSS/ PEM/ PSS	x	x	0.24	0.03	0.03	0.00	0.00	0.00	0.00
				(0.02/0.14/0.08)	(0.01/0.02/0.00)	(0.01/0.02/0.00)	(0.00/0.00/0.00)	(0.00/0.00/0.00)	(0.00/0.00/0.00)	(0.00/0.00/0.00)
S5w053	PUB		x	0.71	0.71	0.71	0.00	0.00	0.00	0.00
S5w061	PUB	x	x	0.08	0.08	0.08	0.00	0.00	0.00	0.00
S5w062	PAB/ PFO	x	x	3.25	0.22	0.53	0.19	0.11	0.27	0.15
				(1.47/1.78)	(0.03/ 0.19)	(0.20/0.33)	(0.06/0.13)	(0.00/0.11)	(0.08/0.19)	(0.02/0.13)
S5w063	PEM/ PFO	x	x	2.04	0.00	1.82	1.82	0.76	1.77	0.00
				(1.44/0.60)	(0.00/0.00)	(1.22/0.60)	(1.22/0.60)	(0.58/0.18)	(1.17/0.60)	(0.00/0.00)
S5w065	PFO	x	x	0.71	0.36	0.71	0.71	0.18	0.71	0.00
S5w066	PEM	x	x	0.15	0.15	0.15	0.12	0.08	0.15	0.12
S5w067	PUB	x	x	2.88	0.00	2.88	2.88	0.00	0.00	0.00
S5w068	PEM	x	x	0.16	0.16	0.16	0.16	0.08	0.01	0.01
S5w069	PSS/ PFO/ PEM/ PSS/ PAB/ PEM	x	x	3.52	0.53	0.56	0.55	0.38	0.42	0.33
				(0.72/1.67/0.02/0.07/ 0.76/0.28)	(0.00/0.00/0.02/0.07/ 0.17/0.27)	(0.00/0.00/0.02/0.07/ 0.20/0.27)	(0.02/0.05/0.02/0.07/ 0.11/0.28)	(0.01/0.00/0.02/0.07/ 0.00/0.28)	(0.00/0.00/0.02/0.07/ 0.06/0.27)	(0.00/0.00/0.02/0.04/ 0.00/0.27)
S5w70	PEM/ PFO/ PEM	x	x	10.92	2.58	4.25	4.12	0.48	3.18	0.16
				(0.54/10.29/0.09)	(0.05/2.44/0.09)	(0.40/3.76/0.09)	(0.40/3.63/0.09)	(0.00/0.48/0.00)	(0.31/2.79/0.08)	(0.14/0.02/0.00)
S5w071	PFO	x	x	31.75	0.05	0.05	0.02	0.00	0.00	0.00
S5w072	PUB	x	x	0.37	0.00	0.00	0.37	0.00	0.37	0.00
S5w079	PUB	x	x	0.46	0.46	0.46	0.00	0.00	0.00	0.00
S5w080	PFO	x	x	0.56	0.00	0.00	0.01	0.00	0.00	0.00
S5w088	PUB	x	x	2.13	0.00	0.00	2.13	2.13	2.13	0.00
S5w091	PSS	x	x	0.88	0.88	0.88	0.88	0.88	0.88	0.88
S5w095	PFO	x	x	0.19	0.00	0.00	0.00	0.01	0.00	0.00
S5w097	PUB		x	0.05	0.00	0.00	0.00	0.05	0.00	0.00
S5w102	PUB	x	x	0.10	0.10	0.00	0.00	0.00	0.00	0.00
S5w104	PEM	x	x	0.40	0.25	0.25	0.00	0.00	0.00	0.00

Table 5.19-2: Potential Wetland Impacts, by Wetland Site – (Construction Limits)

Wetland Site ID	Type	Jurisdiction		Total Wetland Acres	Acres of Impact by Alternative					
		Waters of the U.S.	Waters of the State		4	5	6	7	8	Refined Preferred Alternative 8
S5w109	PSS	x	x	1.01	0.37	0.38	0.12	0.15	0.12	0.12
S5w119	PEM	x	x	0.05	0.05	0.05	0.05	0.05	0.05	0.05
S5w120	PEM	X	X	0.20	0.02	0.02	0.06	0.06	0.04	0.06
S5w121	PEM	x	x	0.04	0.04	0.04	0.04	0.04	0.04	0.04
S5w122	PEM	x	x	0.28	0.28	0.28	0.01	0.01	0.01	0.01
S5w123	PEM	x	x	0.18	0.10	0.12	0.02	0.00	0.01	0.00
S5w124	PEM	x	x	0.14	0.11	0.13	0.00	0.00	0.00	0.00
S5W125	PEM/ PEM/ PFO/ PFO	x	x	7.40	2.47	2.47	0.90	0.71	0.89	0.48
				(3.75/1.03/0.33/2.29)	(1.07/0.21/0.32/0.87)	(1.07/0.23/0.31/0.86)	(0.69/0.00/0.00/0.21)	(0.62/0.00/0.00/0.09)	(0.68/0.00/0.00/0.21)	(0.43/0.00/0.00/0.05)
S5w126	PFO	x	x	5.00	1.37	1.37	0.00	0.00	0.00	0.00
S5w127	PFO	x	x	1.16	0.44	0.44	0.35	0.16	0.35	0.10
S5w128	PFO	x	x	2.65	0.32	0.32	0.00	0.21	0.21	0.21
S5w145	PEM	x	x	0.06	0.06	0.06	0.06	0.01	0.06	0.06
S5w146	PFO	x	x	0.14	0.14	0.14	0.01	0.11	0.14	0.01
S5w147	PFO	x	x	0.23	0.06	0.23	0.00	0.11	0.07	0.07
S5w148	PEM	x	x	0.09	0.08	0.08	0.08	0.08	0.08	0.08
S5w149	PEM/ PEM/ PFO	x	x	1.27	0.37	0.37	0.54	0.38	0.36	0.35
				(0.40/0.11/0.76)	(0.26/0.11/0.00)	(0.26/0.11/0.00)	(0.39/0.11/0.04)	(0.27/0.11/0.00)	(0.25/0.11/0.00	(0.24/0.11/0.00
S5w150	PEM	x	x	0.07	0.07	0.00	0.00	0.00	0.00	0.00
Total					13.10	20.24	16.34	7.34	12.46	3.45
PAB					0.20	0.40	0.17	0.00	0.14	0.02
PEM					3.61	5.20	3.94	2.43	3.48	1.78
PFO					6.56	9.12	5.76	1.64	5.27	0.59
PSS					1.33	1.34	1.09	1.11	1.07	1.04
PUB					1.40	4.18	5.38	2.20	2.50	0.02

Table 5.19-3: Potential Wetland Impacts, by Wetland Site – (Right-of-Way Limits)

Wetland Site ID	Type	Jurisdiction		Total Wetland Acres	Acres of Impact by Alternative					
		Waters of the U.S.	Waters of the State		4	5	6	7	8	Refined Preferred Alternative 8
S5w007	PEM	x	x	0.03	0.03	0.03	0.03	0.03	0.03	0.03
S5w010	PUB	x	x	0.05	0.05	0.05	0.00	0.00	0.00	0.00
S5w011	PEM		x	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5w014	PEM/PUB	x	x	7.41	0.00	0.00	0.01	0.03	0.01	0.03
				(0.14/7.27)	(0.00/0.00)	(0.00/0.00)	(0.00/0.01)	(0.01/0.02)	(0.00/0.01)	(0.01/0.02)
S5w015	PEM	x	x	0.07	0.07	0.07	0.07	0.07	0.07	0.07
S5w021	PEM	x	x	0.13	0.13	0.13	0.13	0.13	0.13	0.13
S5w024	PSS/PEM/PSS	x	x	0.24	0.06	0.07	0.00	0.00	0.00	0.00
				(0.02/0.14/0.08)	(0.01/0.04/0.01)	(0.01/0.05/0.01)	(0.00/0.00/0.00)	(0.00/0.00/0.00)	(0.00/0.00/0.00)	(0.00/0.00/0.00)
S5w053	PUB		x	0.71	0.71	0.71	0.00	0.00	0.00	0.00
S5w061	PUB	x	x	0.08	0.08	0.08	0.00	0.08	0.08	0.08
S5w062	PAB/PFO	x	x	3.25	0.36	0.62	0.42	0.37	0.43	0.37
				(1.47/1.78)	(0.09/0.27)	(0.24/0.38)	(0.14/0.28)	(0.09/0.28)	(0.15/0.28)	(0.09/0.28)
S5w063	PEM/PFO	x	x	2.04	0.00	1.90	1.89	1.08	1.94	0.00
				(1.44/0.60)	(0.00/0.00)	(1.30/0.60)	(1.29/0.60)	(0.72/0.36)	(1.34/0.60)	(0.00/0.00)
S5w064a	PFO	x	x	1.78	0.00	0.01	0.00	0.00	0.00	0.00
S5w065	PFO	x	x	0.71	0.40	0.71	0.71	0.33	0.71	0.03
S5w066	PEM	x	x	0.15	0.15	0.15	0.15	0.15	0.15	0.15
S5w067	PUB	x	x	2.88	0.00	2.88	2.88	0.00	2.88	0.00
S5w068	PEM	x	x	0.16	0.16	0.16	0.16	0.16	0.16	0.16
S5w069	PSS/ PFO/ PEM/ PSS/ PAB/ PEM	x	x	3.52	0.57	0.61	0.65	0.39	0.51	0.35
				(0.72/ 1.67/ 0.02/ 0.07/ 0.76/ 0.28)	(0.01/ 0.00/ 0.02/ 0.07/ 0.19/ 0.28)	(0.01/ 0.00/0.02/ 0.07/ 0.23/ 0.28)	(0.05/ 0.10/ 0.02/ 0.07/ 0.13/ 0.28)	(0.01/ 0.00/ 0.02/ 0.07/ 0.01/ 0.28)	(0.00/ 0.00/ 0.02/ 0.07/ 0.14/ 0.28)	(0.00/ 0.00/ 0.02/ 0.06/ 0.00/ 0.27)
S5w70	PEM/ PFO/ PEM	x	x	10.92	3.58	4.97	4.89	1.66	4.77	0.76
				(0.54/ 10.29/ 0.09)	(0.53/ 2.96/ 0.09)	(0.54/ 4.34/ 0.09)	(0.54/ 4.26/ 0.09)	(0.53/ 1.13/ 0.00)	(0.54/ 4.14/ 0.09)	(0.53/ 0.23/ 0.00)
S5w071	PFO	x	x	31.75	0.06	0.06	0.04	0.01	0.00	0.00
S5w072	PUB	x	x	0.37	0.37	0.37	0.37	0.37	0.37	0.37
S5w079	PUB	x	x	0.46	0.46	0.46	0.46	0.00	0.46	0.00
S5w080	PFO	x	x	0.56	0.01	0.01	0.01	0.00	0.00	0.00
S5w088	PUB	x	x	2.13	2.13	2.13	2.13	2.13	2.13	2.13
S5w091	PSS	x	x	0.88	0.88	0.88	0.88	0.88	0.88	0.88

Table 5.19-3: Potential Wetland Impacts, by Wetland Site – (Right-of-Way Limits)

Wetland Site ID	Type	Jurisdiction		Total Wetland Acres	Acres of Impact by Alternative					
		Waters of the U.S.	Waters of the State		4	5	6	7	8	Refined Preferred Alternative 8
S5w095	PFO	x	x	0.19	0.00	0.00	0.00	0.02	0.00	0.00
S5w097	PUB		x	0.05	0.00	0.00	0.00	0.05	0.00	0.00
S5w100	PUB	x	x	0.29	0.29	0.00	0.00	0.00	0.00	0.00
S5w102	PUB	x	x	0.10	0.10	0.00	0.00	0.00	0.00	0.00
S5w104	PEM	x	x	0.40	0.29	0.30	0.01	0.01	0.01	0.01
S5w109	PSS	x	x	1.01	0.48	0.47	0.22	0.24	0.22	0.22
S5w119	PEM	x	x	0.05	0.05	0.05	0.05	0.05	0.05	0.05
S5w120	PEM	x	x	0.20	0.20	0.20	0.20	0.20	0.20	0.20
S5w121	PEM	x	x	0.04	0.04	0.04	0.04	0.04	0.04	0.04
S5w122	PEM	x	x	0.28	0.28	0.28	0.28	0.28	0.28	0.28
S5w123	PEM	x	x	0.18	0.12	0.14	0.04	0.00	0.06	0.00
S5w124	PEM	x	x	0.14	0.13	0.14	0.01	0.00	0.02	0.00
S5w125	PEM/ PEM/ PFO/ PFO	x	x	7.40	2.79	2.82	0.97	0.77	0.97	0.73
				(3.75/ 1.03/ 0.33/ 2.29)	(1.17/ 0.25/ 0.33/ 1.04)	(1.17/ 0.28/ 0.33/ 1.04)	(0.72/ 0.00/ 0.00/ 0.25)	(0.64/ 0.00/ 0.00/ 0.13)	(0.72/ 0.00/ 0.00/ 0.25)	(0.62/ 0.00/ 0.00/ 0.11)
S5w126	PFO	x	x	5.00	1.57	1.58	0.00	0.00	0.00	0.00
S5w127	PFO	x	x	1.16	0.55	0.55	0.42	0.21	0.39	0.17
S5w128	PFO	x	x	2.65	0.37	0.38	0.01	0.28	0.28	0.28
S5w145	PEM	x	x	0.06	0.06	0.06	0.06	0.03	0.06	0.06
S5w146	PFO	x	x	0.14	0.14	0.14	0.14	0.14	0.14	0.14
S5w147	PFO	x	x	0.23	0.10	0.23	0.00	0.16	0.15	0.16
S5w148	PEM	x	x	0.09	0.08	0.08	0.08	0.08	0.08	0.08
S5w149	PEM/ PEM/ PFO	x	x	1.27	0.40	0.39	0.58	0.41	0.39	0.38
				(0.40/ 0.11/ 0.76)	(0.29/ 0.11/ 0.00)	(0.28/ 0.11/ 0.00)	(0.40/ 0.11/ 0.07)	(0.30/ 0.11/ 0.00)	(0.28/ 0.11/ 0.00)	(0.27/ 0.11/ 0.00)
S5w150	PEM	x	x	0.07	0.07	0.00	0.00	0.00	0.00	0.00
Total					18.38	24.92	19.00	10.85	19.06	8.35
PAB					0.28	0.47	0.27	0.10	0.29	0.09
PEM					4.65	5.96	4.77	3.85	4.73	3.10
PFO					7.80	10.36	6.89	3.05	6.94	1.40
PSS					1.46	1.45	1.22	1.20	1.17	1.16
PUB					4.19	6.68	5.85	2.65	5.93	2.60

Table 5.19-4: Summary of Potential Impacts to Wetlands within Construction Limits (in acres)

Wetland Type	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact
PAB	0.03	0.17	0.20	0.09	0.31	0.40	0.02	0.15	0.17	0.00	0.00	0.00	0.06	0.08	0.14	0.02	0.00	0.02
PEM	1.68	1.93	3.61	2.05	3.15	5.20	1.78	2.16	3.94	1.26	1.17	2.43	1.53	1.95	3.48	1.34	0.44	1.78
PFO	0.68	5.88	6.56	0.82	8.30	9.12	0.56	5.20	5.76	0.48	1.16	1.64	0.75	4.52	5.27	0.32	0.27	0.59
PSS	1.12	0.21	1.33	1.12	0.22	1.34	1.02	0.07	1.09	1.05	0.06	1.11	1.02	0.05	1.07	1.02	0.02	1.04
PUB	0.00	1.40	1.40	0.00	4.18	4.18	0.01	5.37	5.38	0.01	2.19	2.20	0.01	2.49	2.50	0.01	0.01	0.02
Totals	**3.51**	**9.59**	**13.10**	**4.08**	**16.16**	**20.24**	**3.39**	**12.95**	**16.34**	**2.80**	**4.58**	**7.38**	**3.37**	**9.09**	**12.46**	2.71	0.74	3.45

** SR37 ROW = SR 37 right-of-way*

Table 5.19-5: Summary of Potential Impacts to Wetlands within Right-of-Way (in acres)

Wetland Type	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact	Within Existing SR37 ROW*	Outside of Existing SR37 ROW*	Total Impact
PAB	0.09	0.19	0.28	0.09	0.38	0.47	0.09	0.18	0.27	0.09	0.01	0.10	0.09	0.20	0.29	0.09	0.00	0.09
PEM	2.45	2.20	4.65	2.45	3.51	5.96	2.45	2.32	4.77	2.45	1.40	3.85	2.45	2.28	4.73	2.45	0.65	3.10
PFO	0.96	6.84	7.80	0.97	9.39	10.36	0.97	5.92	6.89	0.97	2.08	3.05	0.97	5.97	6.94	0.97	0.43	1.40
PSS	1.12	0.34	1.46	1.12	0.33	1.45	1.12	0.10	1.22	1.12	0.08	1.20	1.12	0.05	1.17	1.12	0.04	1.16
PUB	0.01	4.18	4.19	0.01	6.67	6.68	0.02	5.83	5.85	0.02	2.63	2.65	0.02	5.91	5.93	0.02	2.58	2.60
Totals	**4.63**	**13.75**	**18.38**	**4.64**	**20.28**	**24.92**	**4.65**	**14.35**	**19.00**	**4.65**	**6.20**	**10.85**	**4.65**	**14.41**	**19.06**	**4.65**	**3.70**	**8.35**

** SR37 ROW = SR 37 right-of-way*

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Anticipated indirect impacts for wetlands could include properties with wetlands purchased by a developer to build a service facility such as a gas station and/or convenience food mart at an interchange. However, the federal "no net loss of wetlands" policy in the CWA permitting requirements nearly eliminates the possibility of future cumulative wetland acreage losses.[5] The no net loss policy, including mitigation requirements associated with the USACE regulatory program have actually increased the amount of wetlands in the area, based on coordination with local elected officials. Therefore, no long-term indirect or direct loss of wetlands is anticipated due to the implementation of I-69.

INWRAP

Appendix F, *Final Wetland Technical Report*, contains detailed INWRAP data on 33 of the wetland complexes (these 33 wetland complexes contain 49 wetland units) that would be impacted by the alternatives, including a description of each wetland and its rating ("poor," "fair," or "good") for quality of animal habitat, botanical measures, and hydrology. No quality assessments were completed on the 10 wetland complexes consisting entirely of open water ponds. **Table 5.19-6** illustrates the general quality of each wetland or wetland complex and provides a comparison of wetlands affected by each proposed alternative. In summary, the INWRAP evaluation of each of the 33 non-PUB wetland complexes (49 impacted wetland units) potentially impacted by the project yielded the following ratings for animal habitat, botanical measures, and hydrology:

Animal habitat:	23 are "poor"	14 are "fair"	12 are "good"
Botanical:	36 are "poor"	13 are "fair"	0 are "good"
Hydrology:	1 is "poor"	23 are "fair"	25 are "good"

Note that each individual wetland unit within the wetland complexes was assigned a quality rating. The total amount of non-PUB individual wetland units being potentially impacted is 49.

The general quality of the wetlands impacted by the alternatives is fair to poor. The majority of the wetlands show poor to fair quality in their regard to animal habitat; poor to fair in botanical quality; and, fair to good quality in their hydrology measure.

[5] In 1993, the executive branch adopted the "no net loss" of wetlands strategy as a basic principle for Section 404 permitting. (Source: White House Office on Environmental Policy, "Protecting America's Wetlands: A Fair, Flexible and Effective Approach," August 24, 1993, http://www.wetlands.com/fed/aug93wet htm.)

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Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4						Alternative 5						Alternative 6						Alternative 7						Alternative 8						Refined Preferred Alternative 8					
S5W007	USACE Jurisdiction: Yes	Cowardin et al. Classification							PEM																													
		Indiana Community Type							WM																													
		Size (acres)							0.03																													
		Impact (acres)							0.03																													
		Animal Habitat							poor																													
		Botanical							poor																													
		Hydrology							fair																													
		Red Flags							N																													
S5W011	USACE Jurisdiction: No	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	WM						WM						WM						WM						WM						WM					
		Size (acres)	0.01						0.01						0.01						0.01						0.01						0.01					
		Impact (acres)	0.01						0.01						0.01						0.01						0.01						0.01					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					
S5W021	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	SFB						SFB						SFB						SFB						SFB						SFB					
		Size (acres)	0.13						0.13						0.13						0.13						0.13						0.13					
		Impact (acres)	0.13						0.13						0.13						0.13						0.13						0.13					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					
S5W024	USACE Jurisdiction: Yes	Cowardin et al. Classification	PSS	PEM	PSS				PSS	PEM	PSS																											
		Indiana Community Type	SC	SHM	SC				SC	SHM	SC																											
		Size (acres)	0.02	0.14	0.08				0.02	0.14	0.08																											
		Impact (acres)	0.01	0.02	0.00				0.01	0.02	0.00																											
		Animal Habitat	poor	poor	poor				poor	poor	poor																											
		Botanical	poor	poor	poor				poor	poor	poor																											
		Hydrology	fair	fair	fair				fair	fair	fair																											
		Red Flags	N	N	N				N	N	N																											

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4						Alternative 5						Alternative 6						Alternative 7						Alternative 8						Refined Preferred Alternative 8					
S5W062	USACE Jurisdiction: Yes	Cowardin et al. Classification	PAB	PFO					PAB	PFO					PAB	PFO					PAB	PFO					PAB	PFO					PAB	PFO				
		Indiana Community Type	DM	FF					DM	FF					DM	FF					DM	FF					DM	FF					DM	FF				
		Size (acres)	1.47	1.78					1.47	1.78					1.47	1.78					1.47	1.78					1.47	1.78					1.47	1.78				
		Impact (acres)	0.03	0.19					0.20	0.33					0.06	0.13					0.00	0.11					0.08	0.19					0.02	0.13				
		Animal Habitat	fair	fair					fair	fair					fair	fair					fair	fair					fair	fair					fair	fair				
		Botanical	fair	poor					fair	poor					fair	poor					fair	poor					fair	poor					fair	poor				
		Hydrology	fair	good					fair	good					fair	good					fair	good					fair	good					fair	good				
		Red Flags	N	N					N	N					N	N					N	N					N	N					N	N				
S5W063	USACE Jurisdiction: Yes	Cowardin et al. Classification							PEM	PFO					PEM	PFO					PEM	PFO					PEM	PFO										
		Indiana Community Type							SM	FF					SM	FF					SM	FF					SM	FF										
		Size (acres)							1.44	0.60					1.44	0.60					1.44	0.60					1.44	0.60										
		Impact (acres)							1.22	0.60					1.22	0.60					0.58	0.18					1.17	0.60										
		Animal Habitat							fair	fair					fair	fair					fair	fair					fair	fair										
		Botanical							poor	poor					poor	poor					poor	poor					poor	poor										
		Hydrology							good	good					good	good					good	good					good	good										
		Red Flags							N	N					N	N					N	N					N	N										
S5W065	USACE Jurisdiction: Yes	Cowardin et al. Classification	PFO						PFO						PFO						PFO						PFO											
		Indiana Community Type	SF						SF						SF						SF						SF											
		Size (acres)	0.71						0.71						0.71						0.71						0.71											
		Impact (acres)	0.36						0.71						0.71						0.18						0.71											
		Animal Habitat	good						good						good						good						good											
		Botanical	poor						poor						poor						poor						poor											
		Hydrology	good						good						good						good						good											
		Red Flags	N						N						N						N						N											
S5W066	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	SFB						SFB						SFB						SFB						SFB						SFB					
		Size (acres)	0.15						0.15						0.15						0.15						0.15						0.15					
		Impact (acres)	0.15						0.15						0.12						0.08						0.15						0.12					
		Animal Habitat	fair						fair						fair						fair						fair						fair					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	good						good						good						good						good						good					
		Red Flags	N						N						N						N						N						N					

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4						Alternative 5						Alternative 6						Alternative 7						Alternative 8						Refined Preferred Alternative 8					
S5W068	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	WM						WM						WM						WM						WM						WM					
		Size (acres)	0.16						0.16						0.16						0.16						0.16						0.16					
		Impact (acres)	0.16						0.16						0.16						0.08						0.01						0.01					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	good						good						good						good						good						good					
		Red Flags	N						N						N						N						N						N					
S5W069	USACE Jurisdiction: Yes	Cowardin et al. Classification	PSS	PFO	PEM	PSS	PAB	PEM	PSS	PFO	PEM	PSS	PAB	PEM	PSS	PFO	PEM	PSS	PAB	PEM	PSS	PFO	PEM	PSS	PAB	PEM	PSS	PFO	PEM	PSS	PAB	PEM	PSS	PFO	PEM	PSS	PAB	PEM
		Indiana Community Type	SFB	FF	SHM	SHM	SOW	DM	SFB	FF	SHM	SHM	SOW	DM	SFB	FF	SHM	SHM	SOW	DM	SFB	FF	SHM	SHM	SOW	DM	SFB	FF	SHM	SHM	SOW	DM	SFB	FF	SHM	SHM	SOW	DM
		Size (acres)	0.72	1.67	0.02	0.07	0.76	0.28	0.72	1.67	0.02	0.07	0.76	0.28	0.72	1.67	0.02	0.07	0.76	0.28	0.72	1.67	0.02	0.07	0.76	0.28	0.72	1.67	0.02	0.07	0.76	0.28	0.72	1.67	0.02	0.07	0.76	0.28
		Impact (acres)	0.00	0.00	0.02	0.07	0.17	0.27	0.00	0.00	0.02	0.07	0.20	0.27	0.02	0.05	0.02	0.07	0.11	0.28	0.01	0.00	0.02	0.07	0.00	0.28	0.00	0.00	0.02	0.07	0.06	0.27	0.00	0.00	0.02	0.04	0.00	0.27
		Animal Habitat	poor	good	fair	fair	poor	poor	poor	good	fair	fair	poor	poor	poor	good	fair	fair	poor	poor	poor	good	fair	fair	poor	poor	poor	good	fair	fair	poor	poor	poor	good	fair	fair	poor	poor
		Botanical	fair	poor	poor	fair	fair	fair	fair	poor	poor	fair	fair	fair	fair	poor	poor	fair	fair	fair	fair	poor	poor	fair	fair	fair	fair	poor	poor	fair	fair	fair	fair	poor	poor	fair	fair	fair
		Hydrology	good	good	fair	good	fair	fair	good	good	fair	good	fair	fair	good	good	fair	good	fair	fair	good	good	fair	good	fair	fair	good	good	fair	good	fair	fair	good	good	fair	good	fair	fair
		Red Flags	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
S5W070	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM	PFO	PEM				PEM	PFO	PEM				PEM	PFO	PEM				PEM	PFO	PEM				PEM	PFO	PEM				PEM	PFO	PEM			
		Indiana Community Type	SHM	SF	SHM				SHM	SF	SHM				SHM	SF	SHM				SHM	SF	SHM				SHM	SF	SHM				SHM	SF	SHM			
		Size (acres)	0.54	10.29	0.09				0.54	10.29	0.09				0.54	10.29	0.09				0.54	10.29	0.09				0.54	10.29	0.09				0.54	10.29	0.09			
		Impact (acres)	0.05	2.44	0.09				0.40	3.76	0.09				0.40	3.63	0.09				0.00	0.48	0.00				0.31	2.79	0.08				0.14	0.02	0.00			
		Animal Habitat	fair	good	fair				fair	good	fair				fair	good	fair				fair	good	fair				fair	good	fair				fair	good	fair			
		Botanical	poor	poor	poor				poor	poor	poor				poor	poor	poor				poor	poor	poor				poor	poor	poor				poor	poor	poor			
		Hydrology	good	good	good				good	good	good				good	good	good				good	good	good				good	good	good				good	good	good			
		Red Flags	N	N	N				N	N	N				N	N	N				N	N	N				N	N	N				N	N	N			
S5W071	USACE Jurisdiction: Yes	Cowardin et al. Classification	PFO						PFO						PFO																							
		Indiana Community Type	FF						FF						FF																							
		Size (acres)	31.75						31.75						31.75																							
		Impact (acres)	0.05						0.05						0.02																							
		Animal Habitat	good						good						good																							
		Botanical	fair						fair						fair																							
		Hydrology	fair						fair						fair																							
		Red Flags	N						N						N																							

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5W080	USACE Jurisdiction: Yes	Cowardin et al. Classification			PFO			
		Indiana Community Type			FF			
		Size (acres)			0.56			
		Impact (acres)			0.01			
		Animal Habitat			good			
		Botanical			fair			
		Hydrology			fair			
		Red Flags			N			
S5W091	USACE Jurisdiction: Yes	Cowardin et al. Classification	PSS	PSS	PSS	PSS	PSS	PSS
		Indiana Community Type	SFB	SFB	SFB	SFB	SFB	SFB
		Size (acres)	0.88	0.88	0.88	0.88	0.88	0.88
		Impact (acres)	0.88	0.88	0.88	0.88	0.88	0.88
		Animal Habitat	fair	fair	fair	fair	fair	fair
		Botanical	poor	poor	poor	poor	poor	poor
		Hydrology	fair	fair	fair	fair	fair	fair
		Red Flags	N	N	N	N	N	N
S5W095	USACE Jurisdiction: Yes	Cowardin et al. Classification				PFO		
		Indiana Community Type				FF		
		Size (acres)				0.19		
		Impact (acres)				0.01		
		Animal Habitat				fair		
		Botanical				poor		
		Hydrology				good		
		Red Flags				N		
S5W104	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM	PEM				
		Indiana Community Type	SM	SM				
		Size (acres)	0.40	0.40				
		Impact (acres)	0.25	0.25				
		Animal Habitat	poor	poor				
		Botanical	fair	fair				
		Hydrology	good	good				
		Red Flags	N	N				

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4						Alternative 5						Alternative 6						Alternative 7						Alternative 8						Refined Preferred Alternative 8					
S5W109	USACE Jurisdiction: Yes	Cowardin et al. Classification	PSS						PSS						PSS						PSS						PSS						PSS					
		Indiana Community Type	SC						SC						SC						SC						SC						SC					
		Size (acres)	1.01						1.01						1.01						1.01						1.01						1.01					
		Impact (acres)	0.37						0.38						0.12						0.15						0.12						0.12					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					
S5W119	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	SFB						SFB						SFB						SFB						SFB						SFB					
		Size (acres)	0.05						0.05						0.05						0.05						0.05						0.05					
		Impact (acres)	0.05						0.05						0.05						0.05						0.05						0.05					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	poor						poor						poor						poor						poor						poor					
		Red Flags	N						N						N						N						N						N					
S5W120	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	SFB						SFB						SFB						SFB						SFB						SFB					
		Size (acres)	0.20						0.20						0.20						0.20						0.20						0.20					
		Impact (acres)	0.02						0.02						0.06						0.06						0.04						0.06					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					
S5W121	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	SFB						SFB						SFB						SFB						SFB						SFB					
		Size (acres)	0.04						0.04						0.04						0.04						0.04						0.04					
		Impact (acres)	0.04						0.04						0.04						0.04						0.04						0.04					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4						Alternative 5						Alternative 6						Alternative 7						Alternative 8						Refined Preferred Alternative 8					
S5W122	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	WM						WM						WM						WM						WM						WM					
		Size (acres)	0.28						0.28						0.28						0.28						0.28						0.28					
		Impact (acres)	0.28						0.28						0.01						0.01						0.01						0.01					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					
S5W123	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM												PEM											
		Indiana Community Type	WM						WM						WM												WM											
		Size (acres)	0.18						0.18						0.18												0.18											
		Impact (acres)	0.10						0.12						0.02												0.01											
		Animal Habitat	poor						poor						poor												poor											
		Botanical	poor						poor						poor												poor											
		Hydrology	good						good						good												good											
		Red Flags	N						N						N												N											
S5W124	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM																													
		Indiana Community Type	WM						WM																													
		Size (acres)	0.140						0.140																													
		Impact (acres)	0.110						0.130																													
		Animal Habitat	poor						poor																													
		Botanical	poor						poor																													
		Hydrology	good						good																													
		Red Flags	N						N																													
S5W125	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM	PEM	PFO	PFO			PEM	PEM	PFO	PFO			PEM	PEM	PFO	PFO			PEM	PEM	PFO	PFO			PEM	PEM	PFO	PFO			PEM	PEM	PFO	PFO		
		Indiana Community Type	WM	WM	FF	FF			WM	WM	FF	FF			WM	WM	FF	FF			WM	WM	FF	FF			WM	WM	FF	FF			WM	WM	FF	FF		
		Size (acres)	3.75	1.03	0.33	2.29			3.75	1.03	0.33	2.29			3.75	1.03	0.33	2.29			3.75	1.03	0.33	2.29			3.75	1.03	0.33	2.29			3.75	1.03	0.33	2.29		
		Impact (acres)	1.07	0.21	0.32	0.87			1.07	0.23	0.31	0.86			0.69	0.00	0.00	0.21			0.62	0.00	0.00	0.09			0.68	0.00	0.00	0.21			0.43	0.00	0.00	0.05		
		Animal Habitat	poor	poor	good	good			poor	poor	good	good			poor	poor	good	good			poor	poor	good	good			poor	poor	good	good			poor	poor	good	good		
		Botanical	poor	poor	fair	fair			poor	poor	fair	fair			poor	poor	fair	fair			poor	poor	fair	fair			poor	poor	fair	fair			poor	poor	fair	fair		
		Hydrology	fair	good	good	good			fair	good	good	good			fair	good	good	good			fair	good	good	good			fair	good	good	good			fair	good	good	good		
		Red Flags	N	N	N	N			N	N	N	N			N	N	N	N			N	N	N	N			N	N	N	N			N	N	N	N		

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5W126	USACE Jurisdiction: Yes	Cowardin et al. Classification	PFO	PFO				
		Indiana Community Type	FF	FF				
		Size (acres)	5.00	5.00				
		Impact (acres)	1.37	1.37				
		Animal Habitat	good	good				
		Botanical	fair	fair				
		Hydrology	good	good				
		Red Flags	N	N				
S5W127	USACE Jurisdiction: Yes	Cowardin et al. Classification	PFO	PFO	PFO	PFO	PFO	PFO
		Indiana Community Type	FF	FF	FF	FF	FF	FF
		Size (acres)	1.16	1.16	1.16	1.16	1.16	1.16
		Impact (acres)	0.44	0.44	0.35	0.16	0.35	0.10
		Animal Habitat	good	good	good	good	good	good
		Botanical	fair	fair	fair	fair	fair	fair
		Hydrology	good	good	good	good	good	good
		Red Flags	N	N	N	N	N	N
S5W128	USACE Jurisdiction: Yes	Cowardin et al. Classification	PFO	PFO		PFO	PFO	PFO
		Indiana Community Type	FF	FF		FF	FF	FF
		Size (acres)	2.65	2.65		2.65	2.65	2.65
		Impact (acres)	0.32	0.32		0.21	0.21	0.21
		Animal Habitat	good	good		good	good	good
		Botanical	poor	poor		poor	poor	poor
		Hydrology	good	good		good	good	good
		Red Flags	N	N		N	N	N
S5W145	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM	PEM	PEM	PEM	PEM	PEM
		Indiana Community Type	WM	WM	WM	WM	WM	WM
		Size (acres)	0.06	0.06	0.06	0.06	0.06	0.06
		Impact (acres)	0.06	0.06	0.06	0.01	0.06	0.06
		Animal Habitat	fair	fair	fair	fair	fair	fair
		Botanical	poor	poor	poor	poor	poor	poor
		Hydrology	fair	fair	fair	fair	fair	fair
		Red Flags	N	N	N	N	N	N

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4						Alternative 5						Alternative 6						Alternative 7						Alternative 8						Refined Preferred Alternative 8					
S5W146	USACE Jurisdiction: Yes	Cowardin et al. Classification	PFO						PFO						PFO						PFO						PFO						PFO					
		Indiana Community Type	FF						FF						FF						FF						FF						FF					
		Size (acres)	0.14						0.14						0.14						0.14						0.14						0.14					
		Impact (acres)	0.14						0.14						0.01						0.11						0.14						0.01					
		Animal Habitat	fair						fair						fair						fair						fair						fair					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					
S5W147	USACE Jurisdiction: Yes	Cowardin et al. Classification	PFO						PFO												PFO						PFO						PFO					
		Indiana Community Type	FF						FF												FF						FF						FF					
		Size (acres)	0.23						0.23												0.23						0.23						0.23					
		Impact (acres)	0.06						0.23												0.11						0.07						0.07					
		Animal Habitat	good						good												good						good						good					
		Botanical	fair						fair												fair						fair						fair					
		Hydrology	good						good												good						good						good					
		Red Flags	N						N												N						N						N					
S5W148	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM						PEM						PEM						PEM						PEM						PEM					
		Indiana Community Type	SM						SM						SM						SM						SM						SM					
		Size (acres)	0.09						0.09						0.09						0.09						0.09						0.09					
		Impact (acres)	0.08						0.08						0.08						0.08						0.08						0.08					
		Animal Habitat	poor						poor						poor						poor						poor						poor					
		Botanical	poor						poor						poor						poor						poor						poor					
		Hydrology	fair						fair						fair						fair						fair						fair					
		Red Flags	N						N						N						N						N						N					
S5W149	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM	PEM	PFO				PEM	PEM	PFO				PEM	PEM	PFO				PEM	PEM	PFO				PEM	PEM	PFO				PEM	PEM	PFO			
		Indiana Community Type	SM	SM	SF				SM	SM	SF				SM	SM	SF				SM	SM	SF				SM	SM	SF				SM	SM	SF			
		Size (acres)	0.40	0.11	0.76				0.40	0.11	0.76				0.40	0.11	0.76				0.40	0.11	0.76				0.40	0.11	0.76				0.40	0.11	0.76			
		Impact (acres)	0.26	0.11	0.00				0.26	0.11	0.00				0.39	0.11	0.04				0.27	0.11	0.00				0.25	0.11	0.00				0.24	0.11	0.00			
		Animal Habitat	poor	poor	good				poor	poor	good				poor	poor	good				poor	poor	good				poor	poor	good				poor	poor	good			
		Botanical	fair	fair	poor				fair	fair	poor				fair	fair	poor				fair	fair	poor				fair	fair	poor				fair	fair	poor			
		Hydrology	good	good	fair				good	good	fair				good	good	fair				good	good	fair				good	good	fair				good	good	fair			
		Red Flags	N	N	N				N	N	N				N	N	N				N	N	N				N	N	N				N	N	N			

Table 5.19-6: Wetland Impacts Matrix Table for Section 5 Alternatives (Construction Limits)

Wetland ID		DATA	Alternative 4						Alternative 5						Alternative 6						Alternative 7						Alternative 8						Refined Preferred Alternative 8					
S5W150	USACE Jurisdiction: Yes	Cowardin et al. Classification	PEM																																			
		Indiana Community Type	WM																																			
		Size (acres)	0.07																																			
		Impact (acres)	0.07																																			
		Animal Habitat	fair																																			
		Botanical	poor																																			
		Hydrology	fair																																			
		Red Flags	N																																			

Indiana Community Type Abbreviations

B = bog
DM = deep marsh
F = fen
FF = floodplain forest
SMF - sand/muck flat
SFB = seasonally flooded basin
SM = sedge meadow
SHM = shallow marsh
SOW = shallow open water
SC = scrub-carr
SW = swamp forest
WM = wet meadow
WP = wet prairie

Cowardin et al. Classifications

PEM = palustrine emergent
PSS = palustrine scrub/shrub
PFO = palustrine forest
PAB = palustrine aquatic bed

Red Flag Indicators (for specific information regarding the nature of a red flag indicator designated by "Y", consult the INWRAP data sheets)

Y = yes
N = no

Note: USACE jurisdictional status is based on professional opinion only. Official correspondence on jurisdictional verification will be completed during permitting.

Gray shaded cells indicate wetland polygons that are entirely or partially within the construction limits of the respective alternative

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Farmed Wetlands

According to the United States Department of Agriculture (USDA) National Food Security Act Manual, (3rd Edition, September 2000), farmed wetlands are "wetlands that were drained, dredged, filled, leveled, or otherwise manipulated before December 23, 1985, for the purpose of, or to have the effect of, making the production of an agricultural commodity possible, and continue to meet specific wetland hydrology criteria". All of these criteria must be met before an area can be considered "farmed wetland." If an existing agricultural wetland is not cultivated, i.e., is left fallow, for five years or more, it becomes regulated as a wetland and farming cannot be reinitiated without the appropriate permits in place. A review of USDA-NRCS records in Morgan and Monroe counties revealed that no farmed wetlands would be impacted by the Section 5 alternatives.

Open Water

USGS topographic maps (1:24,000 series) of the Section 5 corridor were reviewed, and no named lakes were identified. However, a review of the IGS GIS data and 2010 aerial photography, combined with field observations, identified 43 open water bodies in the project corridor. All of the areas were artificially created for the purposes of aesthetics, recreational use, agricultural use, wildlife habitat, mining operations, or stormwater treatment. The water bodies are shown on **Figure 5.19-1** as palustrine unconsolidated bottom wetlands (PUB). The impacts to these water bodies are included in **Table 5.19-2**. Of the 43 open water bodies found within the corridor only 10 are impacted within the six alternatives under consideration. Alternatives 4, 5, 6, 7, and 8 impact between one and eight open water bodies. The Refined Preferred Alternative 8 impacts one open water body. Explanations of their jurisdictional status assessment are found in **Appendix F**, *Final Wetland Technical Report*.

Rivers and Streams

A review of USGS topographic mapping and field investigations showed that there are no identified "rivers" within the Section 5 corridor.

A total of 477 potentially impacted stream segments, including existing culverts, were identified within the six alternatives studied throughout the Section 5 corridor. QHEI or HHEI assessments were completed for those non-culverted (potentially impacted) segments, as appropriate. No assessments were completed for the culverted segments. However, concrete gutters and roadside ditches were assessed. Continuing coordination with the regulatory agencies will occur to determine any mitigation requirements for these previously impacted resources (i.e., culverts, concrete gutters, or roadside ditches). However, at this time, it is anticipated that mitigation will not be required for those previously disturbed channels including enclosed culverted segments. A single stream impact may have more than one stream assessment segment due to the fact that if the habitat along the length of the stream changed, a separate assessment was made for each reach of distinct habitat. However, if the habitat along the entire impact length of the stream did not change, then only one assessment segment was completed. If two or more alternatives cross a stream in the same location and the habitat was consistent throughout the stream reach, then only one assessment was made. The streams were generally assessed from the south end to the

north end of the corridor, and the numbering system utilized to identify the streams in the study followed suit such that the numbers are in ascending order from south to north. As the QHEI/HHEI scores indicate, approximately one-third (29.5%) of streams crossed by the alternatives have at least moderate water quality. Only one of the 29 stream segments assessed using the QHEI has a score in the highest quality category. About 6% of the stream segments assessed using the HHEI (19 of the 341 crossing locations) had scores in the highest quality category.

Figure 5.19-2 shows the streams by type (perennial, intermittent, and ephemeral), location, and relationship to the alternatives in Section 5.

Of the 477 stream segments, 27 were identified as perennial, 38 as intermittent, and 412 as ephemeral. Of the total segments, 107 are in existing culverts and/or pipes. Stream assessments were completed for artificial channels, such as, roadway ditches, dump rock gutters (riprap lined channels), and concrete channels. QHEI and HHEI assessments were not completed for stream segments in existing pipes and/or culverts, resulting in 370 stream segments being assessed using QHEI or HHEI assessment methods.

Stream Assessments—Thumbnail Sketch

The 370 QHEI and HHEI assessments revealed the following about the streams evaluated:

QHEI Evaluation

- Seven streams (5 perennial and 2 intermittent) in the Section 5 corridor met the criteria for QHEI evaluation.
- 29 stream reaches met the criteria for evaluation using IDEM's QHEI protocol.
- QHEI scores ranged from 24 to 66.5.
  - Score less than 51: 18 - the stream may be non-supportive of its aquatic life use designation.
  - Score from 51-64: 10 - the streams are partially supportive of their aquatic life use designations.
  - Score greater than 64: 1 - the streams are capable of supporting a balanced warm water community.

HHEI Evaluation

- 341 reaches met the criteria for evaluation using the Ohio EPA's HHEI protocol and were classified as follows:
  - Class I Natural (Score up to 40): 128
  - Class I Modified (Score up to 30): 115
  - Class II Natural (Score 40 to 59): 60
  - Class II Modified (Score 30 to 59): 19
  - Class III Natural (Score 60 and over): 19
- HHEI scores for 243 stream reaches suggest the streams have low potential to support diversity in stream plants and animals.
- HHEI scores for 98 stream reaches suggest the streams have at least moderate potential to support diversity in stream plants and animals.

- **Perennial Streams**: All of the perennial streams in Section 5 met the criteria for evaluation using QHEI protocol. Griffy Creek (S5-s065a_1 and S5-s065a_3, S5-s065b, S5-s065c, and S5-s065d); Beanblossom Creek (S5-s081a through S5-s081h); Bryant Creek (S5-s288a through S5-s288c); Little Indian Creek (S5-s345c through S5-s345h); and Jordan Creek (S5-s350a through S5-s350d) are the perennial streams in the Section 5 corridor identified as being potentially impacted by the alternatives. These perennial streams are located throughout the Section 5 corridor. In addition, Buckner Branch (i.e., S5-s351a and S5-s351c) and an unnamed tributary to Bryant Creek (i.e., S5-s253e), designated as an intermittent streams on USGS mapping, were assessed using the QHEI methodology for the following reasons. Buckner Branch's drainage area is greater than 1 mi^2 (i.e.,1.25 mi^2), and an unnamed tributary of Bryant Creek (S5-s253e) has natural pool depths greater than 40 centimeters (15.75 inches).

The QHEI score at the crossing of Griffy Creek north of West Bayles Road (S5-s065a_1, S5-s065a_2, S5-s065a_3) (Alternative 4) was 61.5. Based on IDEM criteria (see **Section 5.19.2.2**, *Methodology*), a score between 51 and 64 indicates a stream that may be partially supportive of their aquatic life use designations. Griffy Creek located near its confluence with Beanblossom Creek near SR 37 (S5-s065b, S5-s065c, S5-s065d) (crossed by all the alternatives, including the Refined Preferred Alternative 8) received a QHEI score of 37. Scores of less than 51 indicate that a stream may not be supportive of its aquatic life use designation.

The QHEI score at the crossing of Beanblossom Creek (S5-s081a) (crossed by Alternatives 5, 6, 7, and 8) is 51.5; the score at Beanblossom Creek crossing at S5-s081b (crossed by all of the alternatives, including the Refined Preferred Alternative 8) east of Walnut Street was 51.5, as well. However, farther downstream, the QHEI decreased to a score of 34.75 (crossings S5-s081c, S5-s081d, S5-s081e) (all of the alternatives) but increased again to 48.0 at the S5-s081f crossing (crossed by all of the alternatives, including the Refined Preferred Alternative 8), and was 48 for Alternatives 6 and 7 at crossings S5-s081g and S5-s081h.

The reach identified as S5-s253e (unnamed tributary to Bryant Creek) received a QHEI score of 55.5, and is crossed by all of the alternatives including the Refined Preferred Alternative 8. According to IDEM criteria, a score between 51 and 64 indicates that a particular stream may only be partially supportive of their aquatic life use designations.

The segment of Bryant Creek (S5-s288a), from north of Bryant's Creek Road to SR 37 received a score of 66.5 (crossed by all of the alternatives, including the Refined Preferred Alternative 8). The QHEI score for Bryant Creek (S5-s288b and S5-s288c), west of SR 37 was 64.0 and is crossed by all of the alternatives, including the Refined Preferred Alternative 8. Based on IDEM criteria, a score over 64 indicates a stream is capable of supporting a balanced warm water community.

The segment of Little Indian Creek east of SR 37 scored higher than reaches sampled farther downstream. The QHEI score east of the existing SR 37 bridge (S5-s345c) (crossed by all of the alternatives, including the Refined Preferred Alternative 8) was 60; while the score along segment (S5-s345d and S5-s345e) (crossed by all of the alternatives, including the Refined Preferred Alternative 8) was 52.5. The score for sample reach S5-s345f crossed by Alternatives 4, 5, 6, and 8 was 46.75. The score at S5-s345g was 46.75, and it is crossed by Alternatives 4, 6, & 8. The score was 46.75 for sample reach S5-s345h (crossed by Alternatives 4, 5, 6, 7, and 8), as well.

Jordan Creek and Buckner Branch may not be supporting their aquatic use designation. The primary cause for poor habitat development appears to be manipulation of the resources' natural hydrology from agricultural practices. Jordan Creek received QHEI scores between 24 and 31 at several sampling segments. Specifically, Jordan Creek (S5-s350a) (crossed by Alternative 5), east of SR 37, scored 30 while closer to its crossing with SR 37 (S5-s350b, S5-s350c, and S5-s350d), it received a QHEI score of only 24 (crossed by all of the alternatives, including the Refined Preferred Alternative 8).

Buckner Branch at its crossing with SR 37 received a score of 31 for all segments assessed (S5-s351a, & S5-s351c). These potential impacts to Buckner Branch are associated with all the alternatives, including the Refined Preferred Alternative 8.

Overall impacts (approximate linear feet of stream within the right-of-way) to perennial streams, including bridged portions, associated with the alternatives are as follows: Alternative 4 – 4,029 linear feet; Alternative 5 – 4,554 linear feet; Alternative 6 – 3,863 linear feet; Alternative 7 – 3,851 linear feet; Alternative 8 – 3,831 linear feet; and Refined Preferred Alternative 8 – 3,028 linear feet, as shown in **Table 5.19-7**. Detailed information can be found in **Table 5.19-8**.

Table 5.19-7: Summary of Potential Stream and Riparian Corridor Impacts

	Alternatives					
	4	5	6	7	8	Refined Preferred Alternative 8
Stream Types - Linear Feet in Existing Right-of-Way						
Ephemeral	87,432	83,795	68,414	66,804	69,506	65,692
Intermittent	14,984	14,816	12,915	12,636	13,067	11,862
Perennial	4,029	4,554	3,863	3,851	3,831	3,028
Totals	106,445	103,165	85,192	83,291	86,404	80,582
Stream Relocation: Linear Feet	73,463	68,675	55,557	53,360	56,480	51,629
Riparian Corridor Acres	198.47	181.08	116.16	113.34	121.59	107.27

- **Intermittent Streams:** 23 HHEI evaluations were performed for intermittent streams/stream segments intersected by the Section 5 alternatives. These intermittent stream segments include tributaries of Clear Creek, Stout Creek, Beanblossom Creek, Fox Hollow of the Beanblossom watershed, Little Indian Creek, Bryant Creek, and Indian Creek. As indicated above, Buckner Branch and an unnamed tributary to Bryant Creek (i.e., S5-s253e) are intermittent streams; however, they met the criteria for evaluation using the QHEI protocol.

  Of the 23 assessments of intermittent streams using HHEI protocol, three were identified as Modified Class I Primary Headwater Habitat (PHWH) streams. These previously impacted stream segments have a limited potential to support aquatic life. Five stream segments were identified as falling within the Class I PHWH range of HHEI scores between 20 to 40. Eight stream segments had HHEI scores ranging from 40 to 59 and were identified as Class II PHWH. HHEI scores of 60 and over (or from 50 to 59, with greater than 20% substrate being boulder, boulder/slab, cobble or bedrock) were identified as Class III PHWH. Seven stream segments were identified as Class III PHWH streams. Scores above 60 suggest that these streams have the highest quality and potential to support a diverse array of flora/fauna.

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s001_1	Unnamed trib of Clear Creek	Ephemeral	0.01	0.12	0.12	0.00	0.00	0.00	0.00
S5-s001_2	Unnamed trib of Clear Creek	Ephemeral	0.01	0.25	0.25	0.00	0.00	0.00	0.00
S5-s001c	Unnamed trib of Clear Creek	Ephemeral	0.04	1.56	1.55	0.82	0.64	0.81	0.76
S5-s001d	Unnamed trib of Clear Creek	Ephemeral	0.02	0.14	0.14	0.05	0.04	0.05	0.04
S5-s001d_1	Unnamed trib of Clear Creek	Ephemeral	0.01	0.20	0.20	0.19	0.18	0.19	0.19
S5-s001d_2	Unnamed trib of Clear Creek	Ephemeral	0.02	0.43	0.43	0.01	0.01	0.01	0.01
S5-s001e	Unnamed trib of Clear Creek	Intermittent	0.08	0.32	0.31	0.20	0.21	0.20	0.19
S5-s001f	Unnamed trib of Clear Creek	Intermittent	0.08	0.15	0.14	0.14	0.14	0.14	0.14
S5-s001g	Unnamed trib of Clear Creek	Intermittent	0.08	0.04	0.04	0.04	0.04	0.04	0.04
S5-s001h	Unnamed trib of Clear Creek	Intermittent	0.08	0.03	0.03	0.03	0.03	0.03	0.03
S5-s003	Unnamed trib of Clear Creek	Ephemeral	0.01	0.92	0.93	0.00	0.00	0.00	0.00
S5-s004	Unnamed trib of Clear Creek	Ephemeral	0.05	4.14	4.13	0.00	0.00	0.00	0.00
S5-s005a	Unnamed trib of Clear Creek	Ephemeral	0.01	1.30	1.30	0.66	0.00	0.66	0.61
S5-s005b	Unnamed trib of Clear Creek	Ephemeral	0.01	0.06	0.06	0.06	0.02	0.06	0.06
S5-s005c	Unnamed trib of Clear Creek	Ephemeral	0.01	0.28	0.32	0.62	1.48	0.61	0.59
S5-s006a	Unnamed trib of Clear Creek	Ephemeral	0.01	1.77	1.77	1.21	0.78	1.24	1.14
S5-s006a_1	Unnamed trib of Clear Creek	Ephemeral	0.01	0.09	0.09	0.09	0.09	0.09	0.09
S5-s006a_3	Unnamed trib of Clear Creek	Ephemeral	0.01	0.74	0.74	0.74	0.74	0.74	0.74
S5-s007	Unnamed trib of Clear Creek	Ephemeral	0.01	0.01	0.01	0.00	0.00	0.00	0.00
S5-s008	Unnamed trib of Clear Creek	Ephemeral	0.01	0.12	0.12	0.00	0.00	0.00	0.00
S5-s011c	Unnamed trib of Clear Creek	Ephemeral	0.01	0.44	0.43	0.46	0.48	0.48	0.47
S5-s012	Unnamed trib of Clear Creek	Intermittent	0.24	0.14	0.62	0.00	0.16	0.17	0.19
S5-s012a	Unnamed trib of Clear Creek	Ephemeral	0.24	0.09	0.10	0.02	0.09	0.09	0.09
S5-s012b	Unnamed trib of Clear Creek	Ephemeral	0.24	0.24	0.24	0.24	0.24	0.24	0.24
S5-s012c	Unnamed trib of Clear Creek	Ephemeral	0.24	0.09	0.09	0.09	0.09	0.09	0.09
S5-s013	Unnamed trib of Clear Creek	Ephemeral	0.01	0.53	0.50	0.14	0.14	0.14	0.14
S5-s014_1	Unnamed trib of Clear Creek	Ephemeral	0.01	0.06	0.14	0.00	0.14	0.14	0.14
S5-s014a	Unnamed trib of Clear Creek	Ephemeral	0.07	0.00	0.55	0.00	0.57	0.80	0.66
S5-s014b	Unnamed trib of Clear Creek	Ephemeral	0.06	0.06	0.11	0.01	0.11	0.11	0.11
S5-s014d	Unnamed trib of Clear Creek	Ephemeral	0.06	0.15	0.15	0.15	0.15	0.15	0.15
S5-s014e	Unnamed trib of Clear Creek	Ephemeral	0.06	0.16	0.16	0.16	0.16	0.16	0.16
S5-s014f	Unnamed trib of Clear Creek	Ephemeral	0.06	0.71	1.07	0.26	0.94	0.94	0.94
S5-s015	Unnamed trib of Clear Creek	Ephemeral	0.42	0.00	0.38	0.00	0.01	0.34	0.10
S5-s016a	Unnamed trib of Clear Creek	Ephemeral	0.23	0.00	0.00	0.00	0.00	0.10	0.00
S5-s016b	Unnamed trib of Clear Creek	Ephemeral	0.23	0.09	0.09	0.08	0.09	0.09	0.09
S5-s016c	Unnamed trib of Clear Creek	Ephemeral	0.23	0.00	0.00	0.13	0.16	0.13	0.16
S5-s018	Unnamed trib of Clear Creek	Ephemeral	0.01	0.01	0.01	0.01	0.01	0.19	0.01
S5-s019a	Unnamed trib of Clear Creek	Ephemeral	0.14	0.03	0.03	0.00	0.00	0.00	0.00
S5-s019a_1	Unnamed trib of Clear Creek	Ephemeral	0.14	0.07	0.07	0.00	0.00	0.00	0.00
S5-s019e	Unnamed trib of Clear Creek	Ephemeral	0.14	0.14	0.14	0.04	0.04	0.04	0.04
S5-s019e_1	Unnamed trib of Clear Creek	Ephemeral	0.14	0.32	0.32	0.15	0.15	0.15	0.15

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s019f	Unnamed trib of Clear Creek	Ephemeral	0.14	0.10	0.12	0.02	0.02	0.02	0.02
S5-s020	Unnamed trib of Clear Creek	Ephemeral	0.01	0.01	0.05	0.00	0.00	0.00	0.00
S5-s024a	Unnamed trib of Clear Creek	Ephemeral	0.42	0.01	0.01	0.00	0.00	0.00	0.00
S5-s024b	Unnamed trib of Clear Creek	Ephemeral	0.04	0.11	0.11	0.00	0.00	0.00	0.00
S5-s024c	Unnamed trib of Clear Creek	Ephemeral	0.04	0.37	0.37	0.00	0.00	0.00	0.00
S5-s025a	Unnamed trib of Clear Creek	Ephemeral	0.01	0.09	0.11	0.00	0.00	0.00	0.00
S5-s026e	Unnamed trib of Clear Creek	Ephemeral	0.42	0.06	0.06	0.00	0.00	0.00	0.00
S5-s026f	Unnamed trib of Clear Creek	Ephemeral	0.42	0.04	0.04	0.00	0.00	0.00	0.00
S5-s026g	Unnamed trib of Clear Creek	Ephemeral	0.42	0.03	0.03	0.00	0.00	0.00	0.00
S5-s027a	Unnamed trib of Stout Creek	Ephemeral	0.05	0.26	0.26	0.00	0.11	0.08	0.09
S5-s027b	Unnamed trib of Stout Creek	Ephemeral	0.05	0.01	0.01	0.00	0.01	0.01	0.01
S5-s029a	Unnamed trib of Stout Creek	Ephemeral	0.08	0.03	0.03	0.03	0.03	0.03	0.03
S5-s030a	Unnamed trib of Clear Creek	Ephemeral	0.03	0.10	0.09	0.08	0.13	0.13	0.09
S5-s030b	Unnamed trib of Clear Creek	Ephemeral	0.03	0.18	0.18	0.17	0.17	0.17	0.17
S5-s030c	Unnamed trib of Clear Creek	Ephemeral	0.03	0.75	0.88	0.14	0.14	0.14	0.14
S5-s032_1b	Unnamed trib of Stout Creek	Intermittent	0.41	0.91	0.91	0.14	0.47	0.50	0.55
S5-s036_1	Unnamed trib of Stout Creek	Ephemeral	0.24	0.00	0.01	0.00	0.00	0.00	0.00
S5-s037b	Unnamed trib of Stout Creek	Ephemeral	0.02	0.27	0.27	0.27	0.27	0.27	0.27
S5-s037c	Unnamed trib of Stout Creek	Ephemeral	0.02	0.18	0.18	0.18	0.18	0.18	0.18
S5-s040	Unnamed trib of Stout Creek	Ephemeral	0.02	0.03	0.03	0.00	0.00	0.00	0.00
S5-s041	Unnamed trib of Stout Creek	Ephemeral	0.02	0.13	0.12	0.00	0.00	0.00	0.00
S5-s043a	Unnamed trib of Stout Creek	Ephemeral	0.27	0.08	0.07	0.07	0.07	0.07	0.07
S5-s043b_1	Unnamed trib of Stout Creek	Ephemeral	0.01	0.02	0.02	0.02	0.02	0.02	0.02
S5-s043c_1a	Unnamed trib of Stout Creek	Ephemeral	0.01	0.15	0.16	0.11	0.11	0.11	0.11
S5-s043c_3	Unnamed trib of Stout Creek	Ephemeral	0.01	0.15	0.16	0.14	0.14	0.14	0.14
S5-s043d	Unnamed trib of Stout Creek	Ephemeral	0.27	0.17	0.17	0.16	0.16	0.16	0.16
S5-s046	Unnamed trib of Stout Creek	Ephemeral	0.28	0.01	0.01	0.01	0.01	0.01	0.01
S5-s048b	Unnamed trib of Stout Creek	Ephemeral	0.04	0.29	0.29	0.29	0.29	0.29	0.29
S5-s048c	Unnamed trib of Stout Creek	Ephemeral	0.70	0.01	0.01	0.01	0.01	0.01	0.01
S5-s050b	Unnamed trib of Stout Creek	Ephemeral	0.02	0.05	0.05	0.05	0.05	0.05	0.05
S5-s051	Unnamed trib of Stout Creek	Ephemeral	0.70	0.07	0.07	0.07	0.07	0.07	0.07
S5-s059a	Unnamed trib of Griffy Creek	Ephemeral	0.04	0.77	0.41	0.00	0.01	0.01	0.01
S5-s060a	Unnamed trib of Griffy Creek	Ephemeral	0.04	0.07	0.07	0.01	0.01	0.01	0.01
S5-s060b	Unnamed trib of Griffy Creek	Ephemeral	0.04	0.03	0.00	0.00	0.00	0.00	0.00
S5-s060c	Unnamed trib of Griffy Creek	Ephemeral	0.04	1.75	0.01	0.00	0.00	0.00	0.00
S5-s061a	Unnamed trib of Griffy Creek	Ephemeral	0.02	0.59	0.59	0.00	0.34	0.34	0.34
S5-s061b	Unnamed trib of Griffy Creek	Ephemeral	0.02	0.01	0.01	0.00	0.00	0.00	0.00
S5-s061c	Unnamed trib of Griffy Creek	Ephemeral	0.02	0.46	0.28	0.00	0.00	0.00	0.00
S5-s062	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.30	0.00	0.00	0.00	0.00	0.00
S5-s063	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.29	0.00	0.00	0.00	0.00	0.00
S5-s064	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.19	0.00	0.00	0.00	0.00	0.00

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s065a_1	Griffy Creek	Perennial	12.49	0.03	0.00	0.00	0.00	0.00	0.00
S5-s065a_2	Griffy Creek	Perennial	12.49	0.09	0.00	0.00	0.00	0.00	0.00
S5-s065a_3	Griffy Creek	Perennial	12.49	0.45	0.00	0.00	0.00	0.00	0.00
S5-s065b	Griffy Creek	Perennial	14.1	0.32	0.33	0.27	0.42	0.27	0.27
S5-s065c	Griffy Creek	Perennial	14.1	0.01	0.01	0.01	0.01	0.01	0.01
S5-s065d	Griffy Creek	Perennial	14.10	0.77	0.72	0.59	0.76	0.61	0.57
S5-s067	Unnamed trib of Griffy Creek	Ephemeral	0.02	1.81	0.00	0.00	0.00	0.00	0.00
S5-s068a	Unnamed trib of Griffy Creek	Ephemeral	0.09	1.35	0.00	0.00	0.00	0.00	0.00
S5-s068b	Unnamed trib of Griffy Creek	Ephemeral	0.09	0.15	0.00	0.00	0.00	0.00	0.00
S5-s068c	Unnamed trib of Griffy Creek	Ephemeral	0.09	0.49	0.00	0.00	0.00	0.00	0.00
S5-s070	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.40	0.40	0.39	0.40	0.39	0.39
S5-s070_1a	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.39	0.47	0.40	0.40	0.40	0.40
S5-s070_1b	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.23	0.31	0.24	0.24	0.24	0.24
S5-s071a	Unnamed trib of Griffy Creek	Ephemeral	0.06	0.34	0.26	0.24	0.24	0.24	0.24
S5-s071b	Unnamed trib of Griffy Creek	Ephemeral	0.06	0.29	0.23	0.23	0.29	0.23	0.23
S5-s071c	Unnamed trib of Griffy Creek	Ephemeral	0.05	0.03	0.02	0.02	0.23	0.02	0.02
S5-s074c	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.00	0.08	0.01	0.01	0.01	0.00
S5-s076	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.61	0.84	0.29	0.43	0.44	0.32
S5-s077	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.31	0.31	0.30	0.29	0.29	0.26
S5-s078a	Unnamed trib of Griffy Creek	Ephemeral	0.04	0.23	0.23	0.15	0.22	0.19	0.10
S5-s078b	Unnamed trib of Griffy Creek	Ephemeral	0.05	0.20	0.19	0.18	0.18	0.17	0.15
S5-s078c	Unnamed trib of Griffy Creek	Ephemeral	0.04	0.22	0.22	0.21	0.10	0.10	0.09
S5-s080	Unnamed trib of Griffy Creek	Ephemeral	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5-s081a	Beanblossom Creek	Perennial	42.73	0.17	1.50	1.34	0.56	1.35	0.17
S5-s081c	Beanblossom Creek	Perennial	42.73	1.11	1.31	1.24	1.11	1.23	1.11
S5-s081d	Beanblossom Creek	Perennial	42.73	0.26	0.26	0.26	0.26	0.26	0.26
S5-s081e	Beanblossom Creek	Perennial	42.73	0.92	0.93	0.71	0.69	0.88	0.71
S5-s081f	Beanblossom Creek	Perennial	42.73	0.51	0.47	0.62	0.51	0.44	0.41
S5-s081g	Beanblossom Creek	Perennial	42.73	0.01	0.01	0.01	0.02	0.01	0.01
S5-s081h	Beanblossom Creek	Perennial	42.73	0.20	0.26	0.40	0.47	0.19	0.09
S5-s082_1	Unnamed trib of Beanblossom Creek	Ephemeral	0.02	1.75	2.65	2.23	1.18	2.65	1.08
S5-s082a	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.00	0.34	0.28	0.00	0.26	0.00
S5-s082b	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.00	0.03	0.03	0.00	0.03	0.00
S5-s082c	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.00	0.01	0.01	0.00	0.01	0.00
S5-s082d	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.00	0.01	0.01	0.00	0.01	0.00
S5-s083a	Unnamed trib of Beanblossom Creek	Ephemeral	0.02	0.97	0.96	0.81	0.44	0.96	0.44
S5-s083c	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.80	0.85	0.83	0.87	0.83	0.80
S5-s085a	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.09	0.11	0.11	0.00	0.00	0.00
S5-s085b	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.00	0.00	0.08	0.00	0.00	0.00
S5-s085c	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.00	0.00	0.12	0.01	0.00	0.00
S5-s088a	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.09	0.09	0.09	0.09	0.09	0.07

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s088b	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.54	0.55	0.78	0.54	0.78	0.47
S5-s088c	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.00	0.00	0.01	0.00	0.00	0.00
S5-s091	Unnamed trib of Beanblossom Creek	Ephemeral	0.26	0.02	0.03	0.00	0.00	0.00	0.00
S5-s091a	Unnamed trib of Beanblossom Creek	Ephemeral	0.02	1.00	1.00	0.64	0.36	0.61	0.31
S5-s091b	Unnamed trib of Beanblossom Creek	Ephemeral	0.02	0.03	0.03	0.03	0.00	0.00	0.00
S5-s092a	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	1.13	1.09	0.00	0.00	0.00	0.00
S5-s092c	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.06	0.06	0.16	0.06	0.16	0.12
S5-s092d	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.01	0.01	0.01	0.01	0.01	0.01
S5-s093	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.84	0.75	0.00	0.00	0.00	0.00
S5-s094	Unnamed trib of Beanblossom Creek	Ephemeral	0.26	0.66	0.72	0.00	0.00	0.00	0.00
S5-s098	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.67	0.66	0.37	0.74	0.37	0.34
S5-s099	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.21	0.22	0.10	0.37	0.09	0.07
S5-s100c	Unnamed trib of Beanblossom Creek	Ephemeral	0.09	1.46	1.48	0.48	0.39	0.55	0.53
S5-s100d	Unnamed trib of Beanblossom Creek	Ephemeral	0.09	0.78	0.78	0.78	0.78	0.78	0.78
S5-s100e	Unnamed trib of Beanblossom Creek	Ephemeral	0.09	0.66	0.65	0.56	0.55	0.59	0.44
S5-s102	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.87	0.93	0.00	0.00	0.00	0.00
S5-s107	Unnamed trib of Beanblossom Creek	Ephemeral	0.02	5.18	5.23	3.48	2.36	4.02	3.24
S5-s108	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.40	0.40	0.40	0.40	0.40	0.40
S5-s109	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.60	0.60	0.60	0.52	0.60	0.60
S5-s111	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.08	0.08	0.00	0.00	0.00	0.00
S5-s112	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.10	0.10	0.10	0.10	0.10	0.10
S5-s113	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.06	0.06	0.06	0.06	0.06	0.06
S5-s114_1	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	1.39	1.42	1.27	1.61	1.25	0.78
S5-s115	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.60	0.60	0.49	0.61	0.49	0.30
S5-s116	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	1.08	1.06	0.65	1.07	0.74	0.49
S5-s117	Unnamed trib of Beanblossom Creek	Ephemeral	0.14	0.05	0.06	0.00	0.00	0.00	0.00
S5-s123	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.68	0.64	0.09	0.00	0.09	0.09
S5-s126	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.02	0.02	0.01	0.00	0.01	0.01
S5-s127_2	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.02	0.02	0.02	0.02	0.02	0.02
S5-s127a	Unnamed trib of Beanblossom Creek	Ephemeral	0.02	0.19	0.19	0.74	0.81	0.74	0.74
S5-s127b	Unnamed trib of Beanblossom Creek	Ephemeral	0.02	0.95	0.95	1.15	1.15	1.15	1.15
S5-s128	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.18	0.18	0.18	0.18	0.18	0.18
S5-s129	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.00	0.00	0.01	0.01	0.01	0.01
S5-s130	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5-s131a	Unnamed trib of Beanblossom Creek	Ephemeral	0.03	1.81	1.77	0.17	0.00	0.04	0.04
S5-s131b	Unnamed trib of Beanblossom Creek	Ephemeral	0.03	0.06	0.06	0.03	0.00	0.02	0.02
S5-s132	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.47	0.44	0.00	0.00	0.00	0.00
S5-s134	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	1.30	1.30	1.15	1.20	1.28	0.49
S5-s135	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.63	0.62	0.49	0.56	0.63	0.16
S5-s136	Unnamed trib of Beanblossom Creek	Ephemeral	0.16	0.00	0.00	0.00	0.00	0.00	0.16
S5-s146	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.50	0.51	0.00	0.00	0.00	0.00

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s147a	Unnamed trib of Beanblossom Creek	Intermittent	0.17	0.81	0.76	0.33	0.48	0.32	0.33
S5-s147b	Unnamed trib of Beanblossom Creek	Intermittent	0.17	0.62	0.62	0.62	0.62	0.62	0.62
S5-s147b_1	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.11	0.11	0.11	0.11	0.11	0.11
S5-s147b_2	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.48	0.48	0.48	0.48	0.48	0.48
S5-s147c	Unnamed trib of Beanblossom Creek	Intermittent	0.17	6.66	6.53	0.88	4.07	0.89	0.63
S5-s148a	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	2.16	2.16	0.78	0.90	0.78	0.54
S5-s148b	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.01	0.01	0.01	0.01	0.01	0.01
S5-s148c	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.46	0.46	0.46	0.46	0.46	0.46
S5-s149	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.20	0.10	0.00	0.24	0.00	0.00
S5-s150	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.49	0.49	0.00	0.39	0.00	0.01
S5-s150_2	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.34	0.34	0.03	0.34	0.03	0.05
S5-s151	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.11	0.08	0.02	0.08	0.02	0.02
S5-s152	Unnamed trib of Beanblossom Creek	Ephemeral	0.17	0.14	0.14	0.00	0.00	0.00	0.00
S5-s155_1	Unnamed trib of Fox Hollow	Ephemeral	0.01	0.14	0.14	0.14	0.12	0.12	0.10
S5-s155a	Unnamed trib of Fox Hollow	Ephemeral	0.01	0.46	0.47	0.31	0.24	0.29	0.26
S5-s156	Unnamed trib of Fox Hollow	Ephemeral	0.10	0.11	0.11	0.00	0.00	0.00	0.00
S5-s160b	Unnamed trib of Fox Hollow	Intermittent	0.06	0.43	0.44	0.44	0.33	0.44	0.44
S5-s160c	Unnamed trib of Fox Hollow	Intermittent	0.06	0.24	0.25	0.25	0.25	0.25	0.25
S5-s161	Unnamed trib of Fox Hollow	Ephemeral	0.21	0.01	0.01	0.01	0.01	0.01	0.01
S5-s181a	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.27	0.27	0.27	0.24	0.27	0.27
S5-s181b	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.79	0.79	0.78	0.32	0.78	0.70
S5-s182	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.27	0.27	0.27	0.23	0.27	0.27
S5-s183	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.19	0.18	0.02	0.00	0.02	0.01
S5-s184	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.17	0.14	0.06	0.00	0.07	0.02
S5-s185a	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	2.43	2.42	1.53	0.67	1.55	1.32
S5-s185b	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.09	0.08	0.02	0.00	0.02	0.01
S5-s185c	Unnamed trib of Beanblossom Creek	Ephemeral	0.04	0.44	0.36	0.11	0.00	0.13	0.01
S5-s188	Unnamed trib of Beanblossom Creek	Ephemeral	0.09	1.15	1.16	0.01	0.00	0.01	0.01
S5-s189	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.46	0.46	0.00	0.00	0.00	0.00
S5-s190a	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.37	0.37	0.37	0.33	0.37	0.37
S5-s190b	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	1.46	1.48	0.63	0.35	0.59	0.52
S5-s191	Unnamed trib of Beanblossom Creek	Ephemeral	0.06	0.01	0.01	0.01	0.01	0.01	0.01
S5-s192	Unnamed trib of Beanblossom Creek	Ephemeral	0.06	0.38	0.37	0.00	0.00	0.00	0.00
S5-s193	Unnamed trib of Beanblossom Creek	Ephemeral	0.01	0.70	0.68	0.05	0.00	0.04	0.03
S5-s198	Unnamed trib of Payne Hollow	Ephemeral	0.13	0.14	0.14	0.15	0.14	0.15	0.15
S5-s202	Unnamed trib of Payne Hollow	Ephemeral	0.13	0.01	0.01	0.38	0.00	0.38	0.38
S5-s207	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.58	0.55	0.89	0.44	0.87	0.50
S5-s208	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.01	0.00	0.04	0.00	0.04	0.00
S5-s216b	Unnamed trib of Payne Hollow	Ephemeral	0.03	0.63	0.63	0.63	0.36	0.63	0.63
S5-s216b_1	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.33	0.33	0.33	0.16	0.33	0.33
S5-s216c	Unnamed trib of Payne Hollow	Ephemeral	0.03	0.59	0.57	0.81	0.53	0.81	0.80

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s217	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.12	0.13	0.17	0.08	0.19	0.19
S5-s219_1	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.05	0.05	0.05	0.05	0.05	0.05
S5-s219a	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.08	0.07	0.34	0.29	0.34	0.06
S5-s219b	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.33	0.33	0.33	0.33	0.33	0.33
S5-s219c	Unnamed trib of Payne Hollow	Ephemeral	0.01	1.12	1.12	0.97	0.37	0.97	1.12
S5-s220a	Unnamed trib of Payne Hollow	Ephemeral	0.01	1.54	1.49	0.26	0.00	0.18	0.03
S5-s224	Unnamed trib of Payne Hollow	Ephemeral	0.06	0.20	0.25	0.01	0.01	0.01	0.01
S5-s227	Unnamed trib of Payne Hollow	Ephemeral	0.01	1.90	1.89	1.62	0.00	1.62	1.42
S5-s228a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.61	0.61	0.61	0.61	0.61	0.61
S5-s228b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.59	0.62	0.58	0.58	0.58	0.58
S5-s229	Unnamed trib of Payne Hollow	Ephemeral	0.02	0.45	0.45	0.25	0.01	0.24	0.16
S5-s237	Unnamed trib of Indian Creek	Ephemeral	0.03	2.31	2.33	0.00	0.00	0.00	0.00
S5-s238a	Unnamed trib of Indian Creek	Ephemeral	0.02	0.13	0.22	0.23	0.23	0.22	0.22
S5-s238b	Unnamed trib of Indian Creek	Ephemeral	0.02	3.67	3.77	0.43	0.21	0.43	0.36
S5-s239a	Unnamed trib of Indian Creek	Ephemeral	0.01	0.67	0.68	0.49	0.39	0.42	0.32
S5-s239b	Unnamed trib of Indian Creek	Ephemeral	0.02	0.03	0.03	0.03	0.03	0.03	0.03
S5-s239e	Unnamed trib of Indian Creek	Ephemeral	0.02	0.51	0.51	0.22	0.17	0.23	0.09
S5-s239f	Unnamed trib of Indian Creek	Intermittent	0.02	2.26	2.25	0.00	0.00	0.00	0.00
S5-s240	Unnamed trib of Indian Creek	Intermittent	0.01	1.12	1.12	0.00	0.00	0.00	0.00
S5-s241a	Unnamed trib of Indian Creek	Ephemeral	0.01	0.09	0.10	0.78	0.20	0.49	0.52
S5-s241b	Unnamed trib of Indian Creek	Ephemeral	0.01	0.32	0.32	0.33	0.33	0.33	0.33
S5-s241c	Unnamed trib of Indian Creek	Ephemeral	0.01	0.17	0.17	0.17	0.17	0.17	0.17
S5-s242_1b	Unnamed trib of Indian Creek	Ephemeral	0.01	0.01	0.01	0.01	0.00	0.00	0.00
S5-s242_1c	Unnamed trib of Indian Creek	Ephemeral	0.01	0.48	0.48	0.41	0.24	0.41	0.41
S5-s242a	Unnamed trib of Indian Creek	Ephemeral	0.08	0.31	0.29	0.39	0.03	0.03	0.03
S5-s242b	Unnamed trib of Indian Creek	Ephemeral	0.08	0.57	0.57	0.57	0.50	0.51	0.51
S5-s242c	Unnamed trib of Indian Creek	Ephemeral	0.08	0.51	0.59	0.36	0.17	0.35	0.30
S5-s246_1	Unnamed trib of Indian Creek	Ephemeral	0.01	0.26	0.26	0.25	0.22	0.25	0.25
S5-s246_1a	Unnamed trib of Indian Creek	Ephemeral	0.01	0.65	0.67	0.18	0.44	0.17	0.12
S5-s246_2	Unnamed trib of Indian Creek	Ephemeral	0.01	0.30	0.30	0.30	0.30	0.30	0.30
S5-s246_2a	Unnamed trib of Indian Creek	Ephemeral	0.01	0.17	0.17	0.17	0.17	0.17	0.17
S5-s246a	Unnamed trib of Indian Creek	Ephemeral	0.08	0.14	0.15	0.08	0.08	0.08	0.08
S5-s246b	Unnamed trib of Indian Creek	Ephemeral	0.08	0.49	0.49	0.49	0.48	0.49	0.49
S5-s246c	Unnamed trib of Indian Creek	Intermittent	0.08	1.13	1.11	0.54	0.25	0.58	0.45
S5-s248	Unnamed trib of Indian Creek	Ephemeral	0.14	0.01	0.01	0.00	0.00	0.00	0.00
S5-s250	Unnamed trib of Indian Creek	Ephemeral	0.14	0.16	0.17	0.17	0.17	0.17	0.17
S5-s253a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.63	0.63	0.63	0.63	0.63	0.63
S5-s253a_1	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.71	0.71	0.71	0.71	0.71	0.71
S5-s253a_2	Unnamed trib of Bryant Creek	Ephemeral	0.01	1.58	1.58	1.58	1.58	1.58	1.58
S5-s253b	Unnamed trib of Bryant Creek	Intermittent	0.64	4.70	4.70	4.70	4.70	4.70	4.70
S5-s253c	Unnamed trib of Bryant Creek	Intermittent	0.48	12.59	12.59	12.59	12.59	12.59	12.59

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s253d	Unnamed trib of Bryant Creek	Intermittent	0.7	0.09	0.09	0.09	0.09	0.09	0.09
S5-s253e	Unnamed trib of Bryant Creek	Intermittent	0.70	0.67	0.65	0.65	0.65	0.65	0.65
S5-s254b	Unnamed trib of Bryant Creek	Intermittent	0.09	1.06	1.09	1.08	1.09	1.09	1.09
S5-s254c	Unnamed trib of Bryant Creek	Intermittent	0.09	1.51	1.51	1.46	1.46	1.46	1.46
S5-s254d	Unnamed trib of Bryant Creek	Intermittent	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5-s257	Unnamed trib of Indian Creek	Ephemeral	0.07	0.01	0.01	0.01	0.01	0.01	0.01
S5-s264	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.16	0.17	0.01	0.01	0.01	0.01
S5-s264a	Unnamed trib of Bryant Creek	Intermittent	0.01	0.67	0.67	0.47	0.47	0.47	0.47
S5-s265a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.42	0.43	0.26	0.26	0.26	0.26
S5-s265b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.20	0.20	0.20	0.20	0.20	0.20
S5-s266a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.49	0.50	0.42	0.42	0.42	0.42
S5-s266b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.19	0.19	0.19	0.19	0.19	0.19
S5-s267a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.58	0.57	0.57	0.57	0.57	0.57
S5-s267c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5-s268a	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.29	0.30	0.21	0.21	0.21	0.21
S5-s268b	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.19	0.19	0.19	0.19	0.19	0.19
S5-s268c	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.09	0.09	0.09	0.09	0.09	0.09
S5-s269a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.35	0.36	0.15	0.15	0.15	0.15
S5-s269b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.12	0.12	0.12	0.12	0.12	0.12
S5-s269c	Unnamed trib of Bryant Creek	Ephemeral	0.64	0.01	0.01	0.01	0.01	0.01	0.01
S5-s270a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.66	0.65	0.65	0.65	0.65	0.65
S5-s270b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.22	0.22	0.22	0.22	0.22	0.22
S5-s270c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.10	0.10	0.10	0.10	0.10	0.10
S5-s271a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.55	0.56	0.26	0.26	0.26	0.26
S5-s271b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.07	0.07	0.07	0.07	0.07	0.07
S5-s271c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.05	0.05	0.05	0.05	0.05	0.05
S5-s272a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.60	0.61	0.34	0.34	0.34	0.34
S5-s273a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.05	0.01	0.01	0.01	0.01	0.01
S5-s273b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.60	0.58	0.58	0.58	0.58	0.58
S5-s273c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.05	0.05	0.05	0.05	0.05	0.05
S5-s274a	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.57	0.55	0.34	0.34	0.34	0.34
S5-s274b	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.13	0.13	0.13	0.13	0.13	0.13
S5-s275a	Unnamed trib of Bryant Creek	Ephemeral	0.07	0.23	0.22	0.22	0.22	0.22	0.22
S5-s275b	Unnamed trib of Bryant Creek	Ephemeral	0.07	0.40	0.40	0.40	0.40	0.40	0.40
S5-s275c	Unnamed trib of Bryant Creek	Ephemeral	0.07	0.24	0.24	0.24	0.24	0.24	0.24
S5-s276a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.52	0.35	0.21	0.21	0.21	0.21
S5-s277a	Unnamed trib of Bryant Creek	Ephemeral	0.64	0.28	0.27	0.27	0.27	0.27	0.27
S5-s277b	Unnamed trib of Bryant Creek	Ephemeral	0.04	0.05	0.05	0.05	0.05	0.05	0.05
S5-s277c	Unnamed trib of Bryant Creek	Ephemeral	0.04	0.24	0.24	0.24	0.24	0.24	0.24
S5-s278a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.41	0.40	0.40	0.40	0.40	0.40
S5-s278b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.96	0.96	0.96	0.96	0.96	0.96

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s279a	Unnamed trib of Bryant Creek	Ephemeral	0.1	0.36	0.37	0.09	0.12	0.12	0.13
S5-s279b	Unnamed trib of Bryant Creek	Ephemeral	0.10	0.04	0.04	0.04	0.04	0.04	0.04
S5-s281	Unnamed trib of Bryant Creek	Ephemeral	0.09	0.01	0.01	0.00	0.00	0.00	0.00
S5-s284a	Unnamed trib of Bryant Creek	Ephemeral	0.04	0.58	0.56	0.56	0.56	0.56	0.56
S5-s284b	Unnamed trib of Bryant Creek	Ephemeral	0.04	0.13	0.12	0.12	0.12	0.12	0.12
S5-s284c	Unnamed trib of Bryant Creek	Ephemeral	0.04	0.11	0.10	0.10	0.10	0.10	0.10
S5-s285a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.79	0.61	0.38	0.41	0.41	0.41
S5-s285b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.02	0.02	0.02	0.02	0.02	0.02
S5-s286	Unnamed trib of Bryant Creek	Ephemeral	0.12	0.39	0.38	0.38	0.38	0.38	0.38
S5-s287a_1	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.72	0.61	0.23	0.36	0.36	0.37
S5-s287b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.57	0.56	0.03	0.33	0.33	0.33
S5-s287c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5-s288a	Bryant Creek	Perennial	5.72	0.06	0.07	0.06	0.77	0.06	0.06
S5-s288c	Bryant Creek	Perennial	5.72	0.01	0.01	0.00	0.00	0.00	0.00
S5-s289a	Unnamed trib of Bryant Creek	Ephemeral	0.05	0.00	0.00	0.00	0.14	0.00	0.00
S5-s289e_1	Unnamed trib of Bryant Creek	Ephemeral	0.05	0.01	0.01	0.01	0.01	0.01	0.01
S5-s289f	Unnamed trib of Bryant Creek	Ephemeral	0.05	0.07	0.07	0.01	0.01	0.01	0.01
S5-s290	Unnamed trib of Bryant Creek	Intermittent	0.19	0.11	0.09	0.04	0.04	0.04	0.01
S5-s291	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.39	0.39	0.32	0.31	0.31	0.31
S5-s293a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.15	0.13	0.05	0.05	0.05	0.05
S5-s293b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.14	0.14	0.14	0.14	0.14	0.14
S5-s293c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.29	0.29	0.28	0.28	0.28	0.25
S5-s294a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.17	0.17	0.07	0.07	0.07	0.07
S5-s294a_1	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.05	0.05	0.00	0.00	0.00	0.00
S5-s294a_2	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.12	0.12	0.06	0.08	0.08	0.08
S5-s294b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.02	0.02	0.02	0.02	0.02	0.02
S5-s294c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.47	0.48	0.51	0.47	0.47	0.36
S5-s299a	Unnamed trib of Bryant Creek	Ephemeral	0.11	0.88	0.31	0.57	0.51	0.51	0.36
S5-s299a_1	Unnamed trib of Bryant Creek	Ephemeral	0.14	2.43	2.39	2.43	2.43	2.43	2.43
S5-s299b	Unnamed trib of Bryant Creek	Ephemeral	0.11	0.06	0.05	0.06	0.06	0.06	0.06
S5-s299c	Unnamed trib of Bryant Creek	Ephemeral	0.11	0.27	0.20	0.26	0.25	0.25	0.25
S5-s299d	Unnamed trib of Bryant Creek	Ephemeral	0.13	1.84	1.68	1.59	1.71	1.72	1.67
S5-s300a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.17	0.16	0.16	0.16	0.16	0.16
S5-s301	Unnamed trib of Bryant Creek	Ephemeral	0.14	0.01	0.01	0.01	0.01	0.01	0.01
S5-s302a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.28	0.27	0.27	0.30	0.30	0.30
S5-s303	Unnamed trib of Bryant Creek	Ephemeral	0.14	0.00	0.00	0.00	0.01	0.01	0.01
S5-s308	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.87	0.00	0.00	0.00	0.00	0.00
S5-s314a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.54	0.04	0.05	0.05	0.05	0.06
S5-s314b_1	Unnamed trib of Bryant Creek	Ephemeral	0.1	0.11	0.09	0.09	0.09	0.09	0.09
S5-s315a	Unnamed trib of Bryant Creek	Ephemeral	0.04	3.71	0.47	0.41	0.40	0.41	0.41
S5-s315b	Unnamed trib of Bryant Creek	Ephemeral	0.04	0.23	0.23	0.23	0.22	0.22	0.22

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s316_1	Unnamed trib of Bryant Creek	Ephemeral	0.01	1.38	1.43	0.00	0.00	0.00	0.00
S5-s316a	Unnamed trib of Bryant Creek	Ephemeral	0.02	1.16	0.71	0.02	0.02	0.02	0.02
S5-s316b	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.24	0.01	0.01	0.01	0.01	0.01
S5-s316c	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.57	0.40	0.31	0.32	0.31	0.31
S5-s316d	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.12	0.12	0.11	0.11	0.11	0.11
S5-s317	Unnamed trib of Bryant Creek	Ephemeral	0.01	1.39	0.00	0.00	0.00	0.00	0.00
S5-s318	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.38	0.00	0.00	0.00	0.00	0.00
S5-s319_1a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5-s319_1b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.03	0.03	0.03	0.03	0.03	0.03
S5-s319_1c	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.02	0.02	0.02	0.02	0.02	0.02
S5-s319a	Unnamed trib of Bryant Creek	Ephemeral	0.02	2.56	1.29	0.00	0.00	0.00	0.00
S5-s319b	Unnamed trib of Bryant Creek	Ephemeral	0.02	0.97	0.01	0.01	0.01	0.01	0.01
S5-s320	Unnamed trib of Bryant Creek	Ephemeral	0.01	1.72	1.00	0.33	0.33	0.33	0.33
S5-s324	Unnamed trib of Bryant Creek	Ephemeral	0.63	0.01	0.00	0.00	0.00	0.00	0.00
S5-s325	Unnamed trib of Little Indian Creek	Ephemeral	0.01	2.37	0.00	0.00	0.00	0.00	0.00
S5-s326a	Unnamed trib of Little Indian Creek	Ephemeral	0.01	1.20	0.80	0.00	0.00	0.00	0.00
S5-s326b	Unnamed trib of Little Indian Creek	Intermittent	0.43	0.16	0.16	0.16	0.16	0.16	0.16
S5-s326c	Unnamed trib of Little Indian Creek	Intermittent	0.43	0.39	0.39	0.39	0.39	0.39	0.39
S5-s327	Unnamed trib of Little Indian Creek	Ephemeral	0.01	0.32	0.28	0.00	0.00	0.00	0.00
S5-s328	Unnamed trib of Little Indian Creek	Ephemeral	0.01	0.22	0.22	0.00	0.00	0.00	0.00
S5-s329	Unnamed trib of Little Indian Creek	Ephemeral	0.43	0.12	0.10	0.00	0.00	0.00	0.00
S5-s330a	Unnamed trib of Little Indian Creek	Ephemeral	0.04	0.02	0.00	0.00	0.00	0.00	0.00
S5-s330b	Unnamed trib of Little Indian Creek	Intermittent	0.04	0.90	0.50	0.43	0.44	0.42	0.42
S5-s330b_1	Unnamed trib of Little Indian Creek	Ephemeral	0.01	0.64	0.64	0.64	0.63	0.64	0.64
S5-s330c	Unnamed trib of Little Indian Creek	Intermittent	0.04	2.41	2.35	1.39	2.70	2.47	2.37
S5-s331a	Unnamed trib of Little Indian Creek	Ephemeral	0.1	0.02	0.01	0.00	0.21	0.11	0.03
S5-s331b	Unnamed trib of Little Indian Creek	Intermittent	0.1	0.89	0.88	0.80	0.90	0.89	0.85
S5-s331d	Unnamed trib of Little Indian Creek	Intermittent	0.10	1.27	1.28	1.24	1.28	1.22	1.14
S5-s338b	Unnamed trib of Little Indian Creek	Ephemeral	0.03	0.37	0.70	0.37	0.38	0.39	0.36
S5-s338c	Unnamed trib of Little Indian Creek	Ephemeral	0.03	0.20	0.20	0.11	0.20	0.11	0.11
S5-s343a	Unnamed trib of Little Indian Creek	Ephemeral	0.06	0.90	0.79	0.01	0.01	0.01	0.01
S5-s343b	Unnamed trib of Little Indian Creek	Ephemeral	0.06	0.47	0.47	0.36	0.36	0.36	0.36
S5-s343e	Unnamed trib of Little Indian Creek	Ephemeral	0.06	0.52	0.76	0.27	0.26	0.27	0.27
S5-s343f	Unnamed trib of Little Indian Creek	Ephemeral	0.06	0.01	0.01	0.00	0.00	0.00	0.00
S5-s344_2a	Unnamed trib of Little Indian Creek	Ephemeral	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S5-s344_2b	Unnamed trib of Little Indian Creek	Ephemeral	0.01	0.23	0.23	0.15	0.15	0.13	0.12
S5-s344a	Unnamed trib of Little Indian Creek	Ephemeral	0.10	0.14	0.14	0.00	0.00	0.00	0.00
S5-s344a_1	Unnamed trib of Little Indian Creek	Ephemeral	0.02	0.01	0.01	0.00	0.00	0.00	0.00
S5-s344b	Unnamed trib of Little Indian Creek	Ephemeral	0.10	0.01	0.01	0.01	0.01	0.01	0.01
S5-s344c	Unnamed trib of Little Indian Creek	Ephemeral	0.10	0.21	0.21	0.11	0.11	0.11	0.11
S5-s345c	Little Indian Creek	Perennial	10.75	0.06	0.05	0.05	0.05	0.05	0.05

Table 5.19-8: Potential Riparian Habitat Impacts (Acres) by Alternative

Stream ID #	Stream Name	USGS Stream Type	Drain-Area (mi^2)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
S5-s345e	Little Indian Creek	Perennial	10.75	0.43	0.43	0.26	0.30	0.35	0.34
S5-s345f	Little Indian Creek	Perennial	11.88	0.13	0.04	1.12	0.00	1.16	0.00
S5-s345h	Little Indian Creek	Perennial	11.88	0.14	1.40	0.05	0.91	0.03	0.00
S5-s346a	Unnamed trib of Little Indian Creek	Ephemeral	0.04	0.13	0.15	0.00	0.00	0.00	0.00
S5-s348a_1	Unnamed trib of Little Indian Creek	Ephemeral	0.01	0.02	0.02	0.02	0.02	0.02	0.01
S5-s348c	Unnamed trib of Little Indian Creek	Ephemeral	0.04	0.49	0.49	0.26	0.26	0.26	0.26
S5-s348d	Unnamed trib of Little Indian Creek	Ephemeral	0.03	0.12	0.13	0.00	0.00	0.00	0.00
S5-s349c	Unnamed trib of Little Indian Creek	Intermittent	0.97	0.00	0.00	1.12	0.00	1.12	0.00
S5-s349e	Unnamed trib of Little Indian Creek	Intermittent	0.97	0.68	0.29	0.57	0.10	0.56	0.06
S5-s350a	Jordan Creek	Perennial	2.72	0.00	0.18	0.00	0.00	0.00	0.00
S5-s352c	Indian Creek	Perennial	1.01	0.02	0.02	0.05	0.06	0.05	0.05
S5-s357a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.45	0.44	0.44	0.44	0.44	0.44
S5-s357b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.10	0.10	0.10	0.10	0.10	0.10
S5-s357c	Unnamed trib of Bryant Creek	Ephemeral	0.64	0.09	0.09	0.09	0.09	0.09	0.09
S5-s358a	Unnamed trib of Bryant Creek	Ephemeral	0.64	0.49	0.48	0.48	0.48	0.48	0.48
S5-s358b	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.17	0.17	0.17	0.17	0.17	0.17
S5-s358c	Unnamed trib of Bryant Creek	Ephemeral	0.64	0.05	0.05	0.05	0.05	0.05	0.05
S5-s359_2	Unnamed trib of Bryant Creek	Ephemeral	0.03	0.30	0.29	0.16	0.16	0.16	0.16
S5-s359b	Unnamed trib of Bryant Creek	Ephemeral	0.05	0.25	0.24	0.01	0.01	0.01	0.01
S5-s359c	Unnamed trib of Bryant Creek	Ephemeral	0.05	0.08	0.08	0.02	0.02	0.02	0.02
S5-s360b_1	Unnamed trib of Fox Hollow	Ephemeral	0.01	0.09	0.09	0.09	0.00	0.09	0.09
S5-s361	Unnamed trib of Little Indian Creek	Ephemeral	0.01	1.36	0.00	0.00	0.00	0.00	0.00
S5-s363a	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.07	0.07	0.07	0.07	0.07	0.07
S5-s365	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.21	0.22	0.05	0.05	0.05	0.05
S5-s366	Unnamed trib of Payne Hollow	Ephemeral	0.01	0.43	0.47	0.33	0.26	0.42	0.42
S5-s383	Unnamed trib of Bryant Creek	Ephemeral	0.01	0.52	0.27	0.27	0.27	0.27	0.27
S5-s384a	Unnamed trib of Indian Creek	Ephemeral	0.02	0.36	0.44	0.30	0.30	0.30	0.30
S5-s384d	Unnamed trib of Indian Creek	Ephemeral	0.04	0.21	0.20	0.11	0.11	0.11	0.11
S5-s420	Unnamed trib of Clear Creek	Ephemeral	0.02	0.00	0.00	0.23	0.87	0.23	0.87
		Grand Total		198.47	181.08	116.16	113.34	121.59	107.27
		Riparian Habitat Excluding Area Over Culverts		184.37	167.23	103.27	101.13	108.84	94.84

Note: A value of 0.00 entered in the table above indicates that a stream's riparian habitat is not impacted by an alternative.

- **Ephemeral Streams**: 318 HHEI evaluations were performed for ephemeral stream segments intersected by the Section 5 alternatives. These ephemeral stream segments are tributaries of Clear Creek, Stout Creek, Griffy Creek, Beanblossom Creek, Fox Hollow and Payne Hollow of the Beanblossom watershed, Bryant Creek, Little Indian Creek, and Indian Creek. None of the ephemeral stream segments had drainage areas or pools large enough to warrant evaluations using QHEI protocol; therefore, all were evaluated using HHEI protocol.

  Of the 318 assessments of ephemeral stream segments, 123 were identified as Class I PHWH streams with scores below 40. A total of 112 of the 318 stream segments with scores up to 30 were identified as Modified Class I PHWH streams. These streams have the lowest potential to support a diverse array of flora/fauna. A total of 19 of the 318 stream segments with scores above 30 were identified as Modified Class II PHWH streams. A total of 52 of the 318 stream segments with scores ranging from 40 to 59 were identified as Class II PHWH streams. Scores between 40 and 59 suggest these streams have moderate potential to support a diversity of stream flora/fauna. A total of 12 of the 318 stream segments with scores above 60 (or from 50 to 59, with greater than 20% substrate being boulder, boulder/slab, cobble, or bedrock) were identified as Class III PHWH streams. Scores above 60 suggest that these streams have the highest quality and potential to support a diverse array of flora/fauna.

Potential Stream and Riparian Impacts

Water body modification impacts affect wetlands and streams and their associated riparian communities. Riparian communities are plant communities such as upland forest areas adjacent to streams that are at least moderately affected by their proximity to water. These areas provide habitat for many species and provide functions similar to wetlands such as floodflow attenuation, sediment stabilization, and toxicant retention.

Streams: Larger stream crossings are generally accomplished using bridges or large culverts. Existing bridge crossings in Section 5 include Griffy Creek, Beanblossom Creek, Bryant Creek, Little Indian Creek, and Jordan Creek, as well as the wetland/unnamed tributary complex in the Beanblossom Valley. All of the existing intermittent and ephemeral stream crossing are in culverts or pipes less than 20 feet wide. Because this project consists of upgrading an existing facility; detailed bridge and large culvert design was not completed for this phase of the project. Structure size and type as well as specific design information for mitigation will not be determined until final design after the FEIS and Record of Decision (ROD).

In addition to bridges for larger streams, other stream crossings will be accomplished by the use of culverts, pipes, or channel relocations. These activities would require an alteration to the natural shape of the stream. Such alterations—which could include channel widening; enclosure; straightening and realignment; and, bank shaping and stabilization—can trigger the following impacts:

- Channel widening - Reduction in stream velocity allowing accumulation of sediments, or altering riffle-pool complexes.

- Channel enclosure (pipes/culverts) - Restriction of flow during peak flood events; accumulation of backwater; and/or disruption of the natural ecology of a water body by blocking sunlight, blocking natural aquatic and wildlife habitat, and destroying bottom substrate important to macroinvertebrate communities.

- Channel realignment/straightening - By removing meanders, an increase in stream velocity and energy resulting in stream bank erosion, loss of stream bank vegetation, and destruction of riffle/pool habitats.

- Bank shaping and stabilization - Loss of habitat due to replacing natural vegetation with hard armoring (e.g., riprap).

- Placing bridge piers below ordinary high water - Loss of habitat and flow alterations in the area of the piers.

With regard to perennial stream crossings, it is anticipated that the majority of these crossings will require implementation of some stability measures with associated dredging and/or filling of streams and their banks. Exceptions may be where such streams are located in broad floodplains, where the majority of the floodplain will be bridged, and no bridge abutment or pier will be located in close proximity to the active stream channel. Where stability measures are proposed, alternatives to riprap, such as bioengineering methods, and new construction or retrofit of culverts for Aquatic Organism Passage (AOP) will be considered, where practicable.

Because this project is on existing alignment, stream crossing are dictated by the current roadway. During the development and evaluation of overpasses, interchanges, and local access roads, careful consideration was given to stream crossings to avoid or minimize their associated impacts. As noted, bridges are proposed for all alternatives at locations where there are existing bridges in place. Locations chosen for all stream crossings were evaluated for design feasibility, as well as environmental impact. The total linear feet of streams, including existing roadside ditches and existing culverts or pipes and bridges within the right-of-way of the alternatives ranges from approximately 80,582 linear feet (Refined Preferred Alternative 8) to approximately 106,445 linear feet (Alternative 4). Taking into consideration previously impacted lengths (i.e., existing concrete gutter, roadside ditches, and/or culvert), the range of potential impacts to natural streams is between 25,574 linear feet (Refined Preferred Alternative 8) and 51,002 linear feet (Alternative 4). Total stream lengths within existing concrete gutter and/or culvert range from 41,241 linear feet (Alternative 7) to 41,635 linear feet (Alternative 5). A summary of potential impacts to streams by structure type within the I-69 right-of-way can be found in **Table 5.19-9**. A detailed breakdown of the length of channel previously impacted is shown at the end of **Table 5.19-10.**

Table 5.19-9: Summary of Potential Impacts to Streams within I-69 Right-of-Way by Structure Type

Structure Type	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8	Existing SR 37 ROW Impacts
Bridge	838	832	890	848	857	815	815
Concrete Gutter	22,529	22,509	22,791	22,843	22,891	22,891	22,427
Culvert	19,128	19,126	18,566	18,398	18,598	18,584	17,734
Dump Rock Gutter	1,975	2,083	1,887	1,954	1,996	1,949	1,887
Natural	51,002	46,804	29,506	28,010	30,519	25,574	15,578
Roadside Ditch	10,973	11,811	11,552	11,238	11,543	10,769	10,394
Total Impacts	106,445	103,165	85,192	83,291	86,404	80,582	68,835
Percent New Impacts	36%	34%	19%	17%	20%	15%	-

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Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s001_1	Unnamed trib of Clear Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	188	0.01	188	188	0.01	188	188	0.01	188	188	0.01	188	188	0.01	188	188	0.01	188
S5-s001_2	Unnamed trib of Clear Creek	Ephemeral	-	17	0.01	Roadside Ditch	Modified Class I	144	0.01	144	144	0.01	144	144	0.01	144	144	0.01	144	144	0.01	144	144	0.01	144
S5-s001b	Unnamed trib of Clear Creek	Ephemeral	-	-	0.04	Culvert		58	0.01	0	58	0.01	0	58	0.01	0	58	0.01	0	58	0.01	0	58	0.01	0
S5-s001c	Unnamed trib of Clear Creek	Ephemeral	-	33	0.04	Natural	Class I	411	0.06	411	408	0.06	408	226	0.03	226	172	0.03	172	223	0.03	223	209	0.03	209
S5-s001d	Unnamed trib of Clear Creek	Ephemeral	-	17	0.02	Roadside Ditch	Modified Class I	312	0.01	312	312	0.01	312	312	0.01	312	312	0.01	312	312	0.01	312	312	0.01	312
S5-s001d_1	Unnamed trib of Clear Creek	Ephemeral	-	22	0.01	Dump Rock Gutter	Modified Class I	146	0.02	146	146	0.02	146	146	0.02	146	146	0.02	146	146	0.02	146	146	0.02	146
S5-s001d_2	Unnamed trib of Clear Creek	Ephemeral	-	17	0.02	Roadside Ditch	Modified Class I	70	0.01	70	70	0.01	70	70	0.01	70	70	0.01	70	70	0.01	70	70	0.01	70
S5-s001e	Unnamed trib of Clear Creek	Intermittent	-	-	0.08	Culvert		400	0.02	0	397	0.02	0	402	0.02	0	409	0.02	0	402	0.02	0	401	0.02	0
S5-s001f	Unnamed trib of Clear Creek	Intermittent	-	65	0.08	Natural	Class III	25	0.01	0	25	0.01	0	25	0.01	0	25	0.01	0	25	0.01	0	25	0.01	0
S5-s001g	Unnamed trib of Clear Creek	Intermittent	-	-	0.08	Culvert		91	0.01	0	91	0.01	0	91	0.01	0	91	0.01	0	91	0.01	0	91	0.01	0
S5-s001h	Unnamed trib of Clear Creek	Intermittent	-	65	0.08	Natural	Class III	34	0.01	0	34	0.01	0	34	0.01	0	34	0.01	0	34	0.01	0	34	0.01	0
S5-s003	Unnamed trib of Clear Creek	Ephemeral	-	39	0.01	Natural	Class I	185	0.01	185	188	0.01	188	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s004	Unnamed trib of Clear Creek	Ephemeral	-	79	0.05	Natural	Class III	1,140	0.09	1,140	1,149	0.09	1149	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s005a	Unnamed trib of Clear Creek	Ephemeral	-	26	0.01	Natural	Class I	379	0.03	379	379	0.03	379	143	0.01	0	0	0.00	0	142	0.01	0	142	0.01	0
S5-s005b	Unnamed trib of Clear Creek	Ephemeral	-	-	0.01	Culvert		45	0.01	0	45	0.01	0	45	0.01	0	6	0.01	0	45	0.01	0	45	0.01	0
S5-s005c	Unnamed trib of Clear Creek	Ephemeral	-	26	0.01	Natural	Class I	74	0.01	74	83	0.01	83	151	0.01	0	269	0.02	0	149	0.01	0	148	0.01	0
S5-s006a	Unnamed trib of Clear Creek	Ephemeral	-	39	0.01	Natural	Class I	551	0.06	551	551	0.06	551	282	0.03	282	212	0.02	212	293	0.03	293	285	0.03	285
S5-s006a_1	Unnamed trib of Clear Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	215	0.01	215	215	0.01	215	215	0.01	215	215	0.01	215	215	0.01	215	215	0.01	215
S5-s006a_2	Unnamed trib of Clear Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	261	0.01	261	261	0.01	261	261	0.01	261	261	0.01	261	261	0.01	261	261	0.01	261
S5-s006a_3	Unnamed trib of Clear Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	434	0.01	434	434	0.01	434	434	0.01	434	434	0.01	434	434	0.01	434	434	0.01	434
S5-s006a_4	Unnamed trib of Clear Creek	Ephemeral	-	-	0.01	Culvert		21	0.01	0	21	0.01	0	21	0.01	0	21	0.01	0	21	0.01	0	21	0.01	0
S5-s007	Unnamed trib of Clear Creek	Ephemeral	-	29	0.01	Natural	Class I	121	0.01	121	121	0.01	121	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s008	Unnamed trib of Clear Creek	Ephemeral	-	29	0.01	Natural	Class I	238	0.01	238	238	0.01	238	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s009	Unnamed trib of Clear Creek	Ephemeral	-	29	0.01	Natural	Class I	78	0.01	78	75	0.01	75	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s010_1	Unnamed trib of Clear Creek	Ephemeral	-	32	0.01	Natural	Class I	53	0.01	53	53	0.01	53	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s010a	Unnamed trib of Clear Creek	Ephemeral	-	29	0.01	Natural	Class I	131	0.01	131	131	0.01	131	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s011c	Unnamed trib of Clear Creek	Ephemeral	-	22	0.01	Dump Rock Gutter	Modified Class I	410	0.04	410	410	0.04	410	410	0.04	410	410	0.04	410	410	0.04	410	410	0.04	410
S5-s012	Unnamed trib of Clear Creek	Intermittent	-	70	0.24	Natural	Class III	0	0.00	0	58	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s012_1	Unnamed trib of Clear Creek	Ephemeral	-	22	0.24	Dump Rock Gutter	Modified Class I	0	0.00	0	36	0.01	36	0	0.00	0	36	0.01	36	36	0.01	36	36	0.01	36
S5-s012a	Unnamed trib of Clear Creek	Ephemeral	-	81	0.24	Natural	Class III	99	0.04	0	152	0.06	0	7	0.01	0	103	0.04	0	105	0.04	0	114	0.05	0
S5-s012b	Unnamed trib of Clear Creek	Ephemeral	-	-	0.24	Culvert		304	0.03	0	304	0.03	0	304	0.03	0	304	0.03	0	304	0.03	0	304	0.03	0
S5-s012c	Unnamed trib of Clear Creek	Ephemeral	-	51	0.24	Natural	Class II	45	0.01	0	126	0.01	0	56	0.01	0	126	0.01	0	126	0.01	0	126	0.01	0
S5-s013	Unnamed trib of Clear Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	252	0.01	252	252	0.01	252	252	0.01	252	252	0.01	252	252	0.01	252	252	0.01	252
S5-s014_1	Unnamed trib of Clear Creek	Ephemeral	-	12	0.01	Dump Rock Gutter	Modified Class I	283	0.02	283	283	0.02	283	283	0.02	283	283	0.02	283	283	0.02	283	283	0.02	283

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s014a	Unnamed trib of Clear Creek	Ephemeral	-	48	0.07	Natural	Class II	0	0.00	0	35	0.01	35	0	0.00	0	46	0.02	46	91	0.04	91	54	0.02	54
S5-s014b	Unnamed trib of Clear Creek	Ephemeral	-	12	0.06	Concrete Gutter	Modified Class I	138	0.01	138	138	0.01	138	138	0.01	138	138	0.01	138	138	0.01	138	138	0.01	138
S5-s014c	Unnamed trib of Clear Creek	Ephemeral	-	-	0.06	Culvert		126	0.01	0	126	0.01	0	126	0.01	0	126	0.01	0	126	0.01	0	126	0.01	0
S5-s014d	Unnamed trib of Clear Creek	Ephemeral	-	12	0.06	Dump Rock Gutter	Modified Class I	320	0.02	320	320	0.02	320	320	0.02	320	320	0.02	320	320	0.02	320	320	0.02	320
S5-s014e	Unnamed trib of Clear Creek	Ephemeral	-	-	0.06	Culvert		351	0.02	0	351	0.02	0	351	0.02	0	351	0.02	0	351	0.02	0	351	0.02	0
S5-s014f	Unnamed trib of Clear Creek	Ephemeral	-	54	0.06	Natural	Class II	318	0.02	318	440	0.02	440	243	0.01	243	332	0.02	332	331	0.02	331	335	0.02	335
S5-s016a	Unnamed trib of Clear Creek	Ephemeral	-	28	0.23	Dump Rock Gutter	Modified Class I	2	0.01	2	36	0.01	0	0	0.00	0	31	0.01	0	73	0.01	0	19	0.01	0
S5-s016a_1	Unnamed trib of Clear Creek	Ephemeral	-	12	0.02	Concrete Gutter	Modified Class I	1,803	0.13	1,803	1,803	0.13	1803	1,803	0.13	1,803	1,803	0.13	1,803	1,803	0.13	1,803	1,803	0.13	1,803
S5-s016b	Unnamed trib of Clear Creek	Ephemeral	-	12	0.23	Concrete Gutter	Modified Class I	106	0.01	0	106	0.01	0	72	0.01	0	106	0.01	0	106	0.01	0	106	0.01	0
S5-s016c	Unnamed trib of Clear Creek	Ephemeral	-	-	0.23	Culvert		268	0.02	0	268	0.02	0	320	0.03	0	320	0.03	0	320	0.03	0	320	0.03	0
S5-s018	Unnamed trib of Clear Creek	Ephemeral	-	26	0.01	Natural	Class I	0	0.00	0	60	0.01	60	0	0.00	0	45	0.01	45	140	0.01	140	8	0.01	8
S5-s019a	Unnamed trib of Clear Creek	Ephemeral	-	-	0.14	Culvert		46	0.01	0	47	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s019a_1	Unnamed trib of Clear Creek	Ephemeral	-	56	0.14	Natural	Class II	159	0.03	159	159	0.03	159	79	0.02	0	79	0.02	0	79	0.02	0	79	0.02	0
S5-s019b	Unnamed trib of Clear Creek	Ephemeral	-	-	0.14	Culvert		110	0.01	0	110	0.01	0	110	0.01	0	110	0.01	0	110	0.01	0	110	0.01	0
S5-s019c	Unnamed trib of Clear Creek	Ephemeral	-	34	0.14	Roadside Ditch	Modified Class II	64	0.01	64	64	0.01	64	64	0.01	0	64	0.01	0	64	0.01	0	64	0.01	0
S5-s019d	Unnamed trib of Clear Creek	Ephemeral	-	-	0.14	Culvert		110	0.01	0	110	0.01	0	110	0.01	0	110	0.01	0	110	0.01	0	110	0.01	0
S5-s019e	Unnamed trib of Clear Creek	Ephemeral	-	12	0.14	Concrete Gutter	Modified Class I	184	0.01	184	184	0.01	184	184	0.01	0	184	0.01	0	184	0.01	0	184	0.01	0
S5-s019e_1	Unnamed trib of Clear Creek	Ephemeral	-	12	0.14	Concrete Gutter	Modified Class I	167	0.01	167	167	0.01	167	167	0.01	0	167	0.01	0	167	0.01	0	167	0.01	0
S5-s019f	Unnamed trib of Clear Creek	Ephemeral	-	-	0.14	Culvert		208	0.01	0	208	0.01	0	130	0.01	0	130	0.01	0	130	0.01	0	130	0.01	0
S5-s019g	Unnamed trib of Clear Creek	Ephemeral	-	34	0.14	Roadside Ditch	Modified Class II	199	0.01	199	199	0.01	199	170	0.01	170	170	0.01	170	170	0.01	170	170	0.01	170
S5-s020	Unnamed trib of Clear Creek	Ephemeral	-	39	0.01	Natural	Class I	165	0.01	165	165	0.01	165	86	0.01	0	86	0.01	0	86	0.01	0	86	0.01	0
S5-s024a_1	Unnamed trib of Clear Creek	Ephemeral	-	12	0.04	Concrete Gutter	Modified Class I	355	0.01	355	355	0.01	355	355	0.01	355	355	0.01	355	355	0.01	355	355	0.01	355
S5-s024a_2	Unnamed trib of Clear Creek	Ephemeral	-	27	0.04	Dump Rock Gutter	Modified Class I	123	0.02	123	123	0.02	123	35	0.01	35	35	0.01	35	35	0.01	35	42	0.01	42
S5-s024b	Unnamed trib of Clear Creek	Ephemeral	-	-	0.04	Culvert		74	0.02	0	74	0.02	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s024c	Unnamed trib of Clear Creek	Ephemeral	-	32	0.04	Natural	Class I	76	0.02	0	76	0.02	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s025a	Unnamed trib of Clear Creek	Ephemeral	-	23	0.01	Roadside Ditch	Modified Class I	395	0.02	395	395	0.02	395	395	0.02	395	395	0.02	395	395	0.02	395	395	0.02	395
S5-s025b	Unnamed trib of Clear Creek	Ephemeral	-	12	0.01	Roadside Ditch	Modified Class I	74	0.01	74	74	0.01	74	74	0.01	74	74	0.01	74	74	0.01	74	74	0.01	74
S5-s025c	Unnamed trib of Clear Creek	Ephemeral	-	27	0.01	Natural	Class I	54	0.01	0	56	0.01	0	56	0.01	0	56	0.01	0	56	0.01	0	56	0.01	0
S5-s025d	Unnamed trib of Clear Creek	Ephemeral	-	-	0.01	Culvert		236	0.02	0	236	0.02	0	236	0.02	0	236	0.02	0	236	0.02	0	236	0.02	0
S5-s026a	Unnamed trib of Clear Creek	Ephemeral	-	-	0.33	Culvert		202	0.03	0	202	0.03	0	54	0.01	0	54	0.01	0	54	0.01	0	158	0.02	0
S5-s026b	Unnamed trib of Clear Creek	Ephemeral	-	52	0.33	Roadside Ditch	Modified Class II	17	0.01	0	30	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s027a	Unnamed trib of Stout Creek	Ephemeral	-	30	0.05	Natural	Class I	333	0.02	333	333	0.02	333	0	0.00	0	125	0.01	125	116	0.01	116	236	0.01	236
S5-s027b	Unnamed trib of Stout Creek	Ephemeral	-	-	0.05	Culvert		72	0.01	0	72	0.01	0	10	0.01	0	72	0.01	0	72	0.01	0	72	0.01	0

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s029a	Unnamed trib of Stout Creek	Ephemeral	-	29	0.08	Roadside Ditch	Modified Class I	258	0.02	258	258	0.02	258	242	0.02	242	258	0.02	258	258	0.02	258	258	0.02	258
S5-s029b	Unnamed trib of Stout Creek	Ephemeral	-	-	0.08	Culvert		16	0.01	0	16	0.01	0	0	0.00	0	16	0.01	0	16	0.01	0	16	0.01	0
S5-s029c	Unnamed trib of Stout Creek	Ephemeral	-	29	0.08	Roadside Ditch	Modified Class I	107	0.01	107	107	0.01	107	33	0.01	33	107	0.01	107	107	0.01	107	99	0.01	99
S5-s030a	Unnamed trib of Clear Creek	Ephemeral	-	16	0.03	Natural	Modified Class I	19	0.01	19	16	0.01	16	13	0.01	0	81	0.01	81	64	0.01	64	16	0.01	16
S5-s030b	Unnamed trib of Clear Creek	Ephemeral	-	-	0.03	Culvert		269	0.02	0	269	0.02	0	269	0.02	0	269	0.02	0	269	0.02	0	269	0.02	0
S5-s030c	Unnamed trib of Clear Creek	Ephemeral	-	38	0.03	Natural	Class I	265	0.05	230	303	0.06	267	100	0.02	64	100	0.02	64	100	0.02	64	100	0.02	64
S5-s032_1b	Unnamed trib of Stout Creek	Intermittent	-	55	0.41	Natural	Class II	146	0.01	0	146	0.01	0	49	0.01	49	113	0.01	0	111	0.01	0	133	0.01	0
S5-s032_1c	Unnamed trib of Stout Creek	Intermittent	-	-	0.41	Culvert		93	0.01	0	93	0.01	0	92	0.01	0	93	0.01	0	93	0.01	0	93	0.01	0
S5-s032_1d	Unnamed trib of Stout Creek	Intermittent	-	48	0.41	Natural	Class II	143	0.01	0	142	0.01	0	43	0.01	0	115	0.01	0	122	0.01	0	133	0.01	0
S5-s035a	Unnamed trib of Stout Creek	Ephemeral	-	-	0.12	Culvert		201	0.02	0	199	0.02	0	199	0.02	0	199	0.02	0	199	0.02	0	199	0.02	0
S5-s035b	Unnamed trib of Stout Creek	Ephemeral	-	-	0.12	Culvert		337	0.04	0	337	0.04	0	337	0.04	0	337	0.04	0	337	0.04	0	337	0.04	0
S5-s035c	Unnamed trib of Stout Creek	Ephemeral	-	46	0.12	Roadside Ditch	Modified Class II	152	0.02	0	152	0.02	0	152	0.02	0	152	0.02	0	152	0.02	0	152	0.02	0
S5-s035d	Unnamed trib of Stout Creek	Ephemeral	-	-	0.12	Culvert		574	0.12	0	574	0.12	0	574	0.12	0	574	0.12	0	574	0.12	0	574	0.12	0
S5-s035e	Unnamed trib of Stout Creek	Ephemeral	-	27	0.06	Dump Rock Gutter	Modified Class I	6	0.01	0	8	0.01	0	8	0.01	0	8	0.01	0	8	0.01	8	8	0.01	8
S5-s036_1	Unnamed trib of Stout Creek	Ephemeral	-	13	0.01	Dump Rock Gutter	Modified Class I	0	0.00	0	36	0.01	36	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s037a	Unnamed trib of Stout Creek	Ephemeral	-	17	0.02	Natural	Class I	59	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0
S5-s037b	Unnamed trib of Stout Creek	Ephemeral	-	-	0.02	Culvert		358	0.02	0	358	0.02	0	358	0.02	0	358	0.02	0	358	0.02	0	358	0.02	0
S5-s037c	Unnamed trib of Stout Creek	Ephemeral	-	17	0.02	Natural	Class I	41	0.01	0	41	0.01	0	41	0.01	0	41	0.01	0	41	0.01	0	41	0.01	0
S5-s042	Unnamed trib of Stout Creek	Ephemeral	-	17	0.02	Natural	Class I	77	0.01	77	79	0.01	79	79	0.01	79	79	0.01	79	79	0.01	79	79	0.01	79
S5-s043a	Unnamed trib of Stout Creek	Ephemeral	-	-	0.27	Culvert		296	0.02	0	296	0.02	0	296	0.02	0	296	0.02	0	296	0.02	0	296	0.02	0
S5-s043b	Unnamed trib of Stout Creek	Ephemeral	-	51	0.27	Natural	Class II	318	0.02	258	322	0.02	260	279	0.02	260	279	0.02	260	279	0.02	260	279	0.02	260
S5-s043b_1	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	429	0.01	429	429	0.01	429	429	0.01	429	429	0.01	429	429	0.01	429	429	0.01	429
S5-s043b_1a	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Dump Rock Gutter	Modified Class I	109	0.01	109	109	0.01	109	109	0.01	109	109	0.01	109	109	0.01	109	109	0.01	109
S5-s043b_1b	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	109	0.01	109	109	0.01	109	109	0.01	109	109	0.01	109	109	0.01	109	109	0.01	109
S5-s043b_2	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Dump Rock Gutter	Modified Class I	114	0.01	114	114	0.01	114	114	0.01	114	114	0.01	114	114	0.01	114	114	0.01	114
S5-s043b_3	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	334	0.01	334	334	0.01	334	334	0.01	334	334	0.01	334	334	0.01	334	334	0.01	334
S5-s043c_1a	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	151	0.01	151	151	0.01	151	151	0.01	151	151	0.01	151	151	0.01	151	151	0.01	151
S5-s043c_1b	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Dump Rock Gutter	Modified Class I	62	0.01	62	62	0.01	62	62	0.01	62	62	0.01	62	62	0.01	62	62	0.01	62
S5-s043c_1c	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	49	0.01	49	49	0.01	49	49	0.01	49	49	0.01	49	49	0.01	49	49	0.01	49
S5-s043c_2	Unnamed trib of Stout Creek	Ephemeral	-	18	0.01	Natural	Class I	44	0.01	0	47	0.01	0	43	0.01	0	43	0.01	0	43	0.01	0	43	0.01	0
S5-s043c_3	Unnamed trib of Stout Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	204	0.01	204	204	0.01	204	204	0.01	204	204	0.01	204	204	0.01	204	204	0.01	204
S5-s043d	Unnamed trib of Stout Creek	Ephemeral	-	-	0.27	Culvert		287	0.02	0	285	0.02	0	285	0.02	0	285	0.02	0	285	0.02	0	285	0.02	0
S5-s048a	Unnamed trib of Stout Creek	Ephemeral	-	18	0.04	Natural	Class I	14	0.01	0	16	0.01	0	16	0.01	0	16	0.01	0	16	0.01	0	16	0.01	0
S5-s048b	Unnamed trib of Stout Creek	Ephemeral	-	-	0.04	Culvert		322	0.02	0	322	0.02	0	322	0.02	0	322	0.02	0	322	0.02	0	322	0.02	0

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s050a	Unnamed trib of Stout Creek	Ephemeral	-	-	0.02	Culvert		191	0.04	0	191	0.04	0	191	0.04	0	191	0.04	0	191	0.04	0	191	0.04	0
S5-s050b	Unnamed trib of Stout Creek	Ephemeral	-	48	0.02	Natural	Class II	42	0.01	0	42	0.01	0	42	0.01	0	42	0.01	0	42	0.01	0	42	0.01	0
S5-s059a	Unnamed trib of Griffy Creek	Ephemeral	-	42	0.04	Natural	Class II	330	0.05	0	174	0.02	174	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s060a	Unnamed trib of Griffy Creek	Ephemeral	-	34	0.04	Natural	Class I	165	0.01	165	147	0.01	147	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s060b	Unnamed trib of Griffy Creek	Ephemeral	-	-	0.04	Culvert		32	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s060c	Unnamed trib of Griffy Creek	Ephemeral	-	34	0.04	Natural	Class I	404	0.02	404	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s061a	Unnamed trib of Griffy Creek	Ephemeral	-	51	0.02	Natural	Class II	87	0.02	87	87	0.02	87	0	0.00	0	13	0.01	13	12	0.01	12	11	0.01	11
S5-s061b	Unnamed trib of Griffy Creek	Ephemeral	-	-	0.02	Culvert		30	0.01	0	30	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s061c	Unnamed trib of Griffy Creek	Ephemeral	-	30	0.02	Natural	Class I	273	0.02	273	102	0.01	102	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s062	Unnamed trib of Griffy Creek	Ephemeral	-	43	0.01	Natural	Class II	140	0.01	140	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s063	Unnamed trib of Griffy Creek	Ephemeral	-	43	0.01	Natural	Class II	82	0.01	82	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s064	Unnamed trib of Griffy Creek	Ephemeral	-	38	0.01	Natural	Class I	102	0.01	102	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s065a_1	Griffy Creek	Perennial	61.5	-	12.49	Natural	Warm Water Habitat	32	0.03	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s065a_2	Griffy Creek	Perennial	-	-	12.49	Culvert		58	0.06	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s065a_3	Griffy Creek	Perennial	61.5	-	12.49	Natural	Warm Water Habitat	321	0.32	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s065b	Griffy Creek	Perennial	37	-	14.10	Natural	Modified Warm Water Habitat	113	0.13	0	115	0.14	0	102	0.12	0	137	0.16	0	102	0.12	0	102	0.12	0
S5-s065c	Griffy Creek	Perennial	37	-	14.10	Bridge	Modified Warm Water Habitat	135	0.16	0	135	0.16	0	135	0.16	0	135	0.16	0	135	0.16	0	135	0.16	0
S5-s065d	Griffy Creek	Perennial	37	-	14.10	Natural	Modified Warm Water Habitat	220	0.26	0	175	0.21	0	125	0.15	0	251	0.30	0	131	0.16	0	102	0.12	0
S5-s067	Unnamed trib of Griffy Creek	Ephemeral	-	52	0.02	Natural	Class II	415	0.05	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s068a	Unnamed trib of Griffy Creek	Ephemeral	-	44	0.09	Natural	Class II	309	0.02	309	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s068b	Unnamed trib of Griffy Creek	Ephemeral	-	-	0.09	Culvert		36	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s068c	Unnamed trib of Griffy Creek	Ephemeral	-	45	0.09	Natural	Class II	286	0.04	286	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s070	Unnamed trib of Griffy Creek	Ephemeral	-	36	0.01	Roadside Ditch	Modified Class II	351	0.02	351	351	0.02	351	351	0.02	351	351	0.02	351	351	0.02	351	351	0.02	351
S5-s070_1a	Unnamed trib of Griffy Creek	Ephemeral	-	17	0.01	Concrete Gutter	Modified Class I	155	0.01	155	155	0.01	155	155	0.01	155	155	0.01	155	155	0.01	155	155	0.01	155
S5-s070_1b	Unnamed trib of Griffy Creek	Ephemeral	-	14	0.01	Natural	Modified Class I	52	0.01	52	52	0.01	52	52	0.01	52	52	0.01	52	52	0.01	52	52	0.01	52
S5-s071a	Unnamed trib of Griffy Creek	Ephemeral	-	50	0.06	Natural	Class II	82	0.02	0	32	0.01	0	31	0.01	0	31	0.01	0	31	0.01	0	31	0.01	0
S5-s071a_1	Unnamed trib of Griffy Creek	Ephemeral	-	24	0.06	Natural	Modified Class I	0	0.00	0	18	0.01	18	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s071b	Unnamed trib of Griffy Creek	Ephemeral	-	-	0.06	Culvert		535	0.10	0	535	0.10	0	535	0.10	0	535	0.10	0	535	0.10	0	535	0.1	0
S5-s071c	Unnamed trib of Griffy Creek	Ephemeral	-	17	0.05	Natural	Modified Class I	18	0.01	0	4	0.01	0	4	0.01	0	60	0.01	0	4	0.01	0	4	0.01	0
S5-s073	Unnamed trib of Griffy Creek	Ephemeral	-	28	0.01	Natural	Class I	0	0.00	0	212	0.01	212	163	0.01	163	166	0.01	166	163	0.01	163	147	0.01	147
S5-s074a	Unnamed trib of Griffy Creek	Ephemeral	-	28	0.01	Natural	Class I	0	0.00	0	71	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0	45	0.01	0
S5-s074b	Unnamed trib of Griffy Creek	Ephemeral	-	-	0.01	Culvert		0	0.00	0	29	0.01	0	29	0.01	0	29	0.01	0	29	0.01	0	29	0.01	0
S5-s074c	Unnamed trib of Griffy Creek	Ephemeral	-	28	0.01	Natural	Class I	0	0.00	0	125	0.01	0	114	0.01	0	114	0.01	0	114	0.01	0	65	0.01	0
S5-s076	Unnamed trib of Griffy Creek	Ephemeral	-	27	0.01	Natural	Class I	44	0.01	44	275	0.02	275	0	0.00	0	27	0.01	27	23	0.01	23	0	0	0
S5-s077	Unnamed trib of Griffy Creek	Ephemeral	-	40	0.01	Natural	Class II	221	0.01	221	221	0.01	221	168	0.01	168	192	0.01	192	212	0.01	212	98	0.01	98
S5-s078a	Unnamed trib of Griffy Creek	Ephemeral	-	33	0.04	Natural	Class I	65	0.01	0	64	0.01	0	44	0.01	0	65	0.01	0	55	0.01	0	34	0.01	0
S5-s078b	Unnamed trib of Griffy Creek	Ephemeral	-	-	0.05	Culvert		61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0

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Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s078c	Unnamed trib of Griffy Creek	Ephemeral	-	33	0.04	Natural	Class I	72	0.01	0	60	0.01	0	74	0.01	0	22	0.01	0	23	0.01	0	25	0.01	0
S5-s080	Unnamed trib of Griffy Creek	Ephemeral	-	43	0.01	Roadside Ditch	Modified Class II	274	0.01	274	274	0.01	274	274	0.01	274	274	0.01	274	274	0.01	274	274	0.01	274
S5-s081a	Beanblossom Creek	Perennial	51.5	-	42.73	Natural	Warm Water Habitat	0	0.00	0	443	0.65	0	370	0.54	0	123	0.18	0	386	0.57	0	0	0	0
S5-s081b	Beanblossom Creek	Perennial	51.5	-	42.73	Bridge	Warm Water Habitat	13	0.01	0	32	0.04	0	32	0.04	0	15	0.02	0	32	0.04	0	15	0.02	0
S5-s081c	Beanblossom Creek	Perennial	34.75	-	42.73	Natural	Modified Warm Water Habitat	575	0.69	0	575	0.69	0	575	0.69	0	575	0.69	0	575	0.69	0	575	0.69	0
S5-s081d	Beanblossom Creek	Perennial	34.75	-	42.73	Bridge	Modified Warm Water Habitat	207	0.25	0	207	0.25	0	207	0.25	0	207	0.25	0	207	0.25	0	207	0.25	0
S5-s081e	Beanblossom Creek	Perennial	34.75	-	42.73	Natural	Modified Warm Water Habitat	539	0.64	0	559	0.67	0	444	0.53	44	437	0.52	0	569	0.68	0	453	0.54	0
S5-s081f	Beanblossom Creek	Perennial	48	-	42.73	Natural	Warm Water Habitat	59	0.06	0	67	0.07	0	162	0.17	0	128	0.13	0	67	0.07	0	67	0.07	0
S5-s081g	Beanblossom Creek	Perennial	48	-	42.73	Bridge	Warm Water Habitat	0	0.00	0	0	0.00	0	33	0.03	0	33	0.03	0	0	0.00	0	0	0	0
S5-s081h	Beanblossom Creek	Perennial	48	-	42.73	Natural	Warm Water Habitat	0	0.00	0	0	0.00	0	13	0.01	0	45	0.05	0	0	0.00	0	0	0	0
S5-s082_1	Unnamed trib of Beanblossom Creek	Ephemeral	-	46	0.02	Roadside Ditch	Modified Class II	1,400	0.13	1400	1,404	0.13	1404	1,404	0.13	1404	1,399	0.13	1399	1,404	0.13	1404	1399	0.13	1399
S5-s082a	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		0	0.00	0	139	0.01	0	139	0.01	0	0	0.00	0	139	0.01	0	0	0	0
S5-s082b	Unnamed trib of Beanblossom Creek	Ephemeral	-	43	0.04	Roadside Ditch	Modified Class II	0	0.00	0	671	0.03	671	493	0.02	493	232	0.01	0	482	0.02	482	0	0	0
S5-s082c	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		0	0.00	0	71	0.01	0	36	0.01	0	0	0.00	0	0	0.00	0	0	0	0
S5-s082d	Unnamed trib of Beanblossom Creek	Ephemeral	-	43	0.04	Roadside Ditch	Modified Class II	0	0.00	0	156	0.01	156	156	0.01	156	0	0.00	0	136	0.01	136	0	0	0
S5-s083a	Unnamed trib of Beanblossom Creek	Ephemeral	-	30	0.02	Natural	Class I	262	0.04	262	262	0.04	262	262	0.04	262	136	0.02	136	262	0.04	262	136	0.02	136
S5-s083b	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.01	Culvert		79	0.02	0	79	0.02	0	79	0.02	0	79	0.02	0	79	0.02	0	79	0.02	0
S5-s083c	Unnamed trib of Beanblossom Creek	Ephemeral	-	39	0.01	Roadside Ditch	Modified Class II	712	0.05	712	712	0.05	712	712	0.05	712	712	0.05	712	712	0.05	712	712	0.05	712
S5-s085a	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	202	0.01	202	202	0.01	202	202	0.01	202	202	0.01	202	202	0.01	202	202	0.01	202
S5-s085b	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.01	Culvert		62	0.01	0	62	0.01	0	62	0.01	0	62	0.01	0	62	0.01	0	62	0.01	0
S5-s085c	Unnamed trib of Beanblossom Creek	Ephemeral	-	26	0.01	Roadside Ditch	Modified Class I	203	0.02	203	203	0.02	203	203	0.02	203	203	0.02	203	203	0.02	203	203	0.02	203
S5-s086a	Unnamed trib of Beanblossom Creek	Ephemeral	-	34	0.02	Roadside Ditch	Modified Class II	0	0.00	0	142	0.01	142	210	0.01	210	228	0.01	228	142	0.01	142	0	0	0
S5-s088a	Unnamed trib of Beanblossom Creek	Ephemeral	-	19	0.01	Roadside Ditch	Modified Class I	20	0.01	20	20	0.01	20	20	0.01	20	20	0.01	20	20	0.01	20	20	0.01	20
S5-s088b	Unnamed trib of Beanblossom Creek	Ephemeral	-	31	0.01	Roadside Ditch	Modified Class II	345	0.04	345	345	0.04	345	345	0.04	345	345	0.04	345	345	0.04	345	345	0.04	345
S5-s088c	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.01	Culvert		187	0.02	0	187	0.02	0	187	0.02	0	187	0.02	0	187	0.02	0	187	0.02	0

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s091a	Unnamed trib of Beanblossom Creek	Ephemeral	-	35	0.02	Natural	Class I	245	0.02	0	247	0.02	0	148	0.01	0	90	0.01	0	140	0.01	0	73	0.01	0
S5-s091b	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.02	Culvert		182	0.01	0	182	0.01	0	182	0.01	0	182	0.01	0	182	0.01	0	182	0.01	0
S5-s092a	Unnamed trib of Beanblossom Creek	Ephemeral	-	28	0.04	Natural	Class I	273	0.02	0	263	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s092c	Unnamed trib of Beanblossom Creek	Ephemeral	-	43	0.04	Natural	Class II	16	0.01	0	17	0.01	0	56	0.01	0	17	0.01	0	69	0.01	0	17	0.01	0
S5-s092d	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		46	0.01	0	46	0.01	0	46	0.01	0	46	0.01	0	46	0.01	0	46	0.01	0
S5-s092e	Unnamed trib of Beanblossom Creek	Ephemeral	-	53	0.04	Natural	Class II	15	0.01	0	15	0.01	0	15	0.01	0	15	0.01	0	15	0.01	0	15	0.01	0
S5-s092f	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		213	0.02	0	213	0.02	0	213	0.02	0	213	0.02	0	213	0.02	0	213	0.02	0
S5-s092f_1	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	137	0.01	137	137	0.01	137	137	0.01	137	137	0.01	137	137	0.01	137	137	0.01	137
S5-s092f_2	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	57	0.01	57	57	0.01	57	57	0.01	57	57	0.01	57	57	0.01	57	57	0.01	57
S5-s092h	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		54	0.01	0	54	0.01	0	54	0.01	0	54	0.01	0	54	0.01	0	54	0.01	0
S5-s092i	Unnamed trib of Beanblossom Creek	Ephemeral	-	26	0.04	Natural	Class I	40	0.01	0	40	0.01	0	35	0.01	0	2	0.01	0	2	0.01	0	2	0.01	0
S5-s092j	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		33	0.01	0	42	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s093	Unnamed trib of Beanblossom Creek	Ephemeral	-	42	0.01	Natural	Class II	265	0.01	0	228	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s098	Unnamed trib of Beanblossom Creek	Ephemeral	-	35	0.01	Natural	Class I	76	0.01	76	74	0.01	74	0	0.00	0	100	0.01	100	1	0.01	1	0	0	0
S5-s099	Unnamed trib of Beanblossom Creek	Ephemeral	-	19	0.01	Natural	Class I	8	0.01	8	8	0.01	8	0	0.00	0	56	0.01	56	0	0.00	0	0	0	0
S5-s100c	Unnamed trib of Beanblossom Creek	Ephemeral	-	27	0.09	Natural	Class I	321	0.03	0	323	0.03	0	107	0.01	0	89	0.01	0	124	0.01	0	118	0.01	0
S5-s100d	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.09	Culvert		392	0.03	0	392	0.03	0	392	0.03	0	392	0.03	0	392	0.03	0	392	0.03	0
S5-s100e	Unnamed trib of Beanblossom Creek	Ephemeral	-	64	0.09	Natural	Class III	146	0.02	0	144	0.02	0	123	0.02	0	126	0.02	0	131	0.02	0	97	0.01	0
S5-s102	Unnamed trib of Beanblossom Creek	Ephemeral	-	41	0.01	Natural	Class II	361	0.01	361	334	0.01	334	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s107	Unnamed trib of Beanblossom Creek	Ephemeral	-	33	0.02	Natural	Class I	1,282	0.16	1282	1,282	0.16	1282	765	0.10	765	520	0.07	520	942	0.12	942	576	0.07	576
S5-s108	Unnamed trib of Beanblossom Creek	Ephemeral	-	30	0.01	Natural	Class I	302	0.01	302	302	0.01	302	288	0.01	288	245	0.01	245	302	0.01	302	280	0.01	280
S5-s109	Unnamed trib of Beanblossom Creek	Ephemeral	-	30	0.01	Natural	Class I	247	0.01	247	247	0.01	247	184	0.01	184	43	0.01	43	229	0.01	229	179	0.01	179
S5-s110	Unnamed trib of Beanblossom Creek	Ephemeral	-	29	0.01	Natural	Class I	86	0.01	86	96	0.01	96	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s111	Unnamed trib of Beanblossom Creek	Ephemeral	-	29	0.01	Natural	Class I	103	0.01	103	103	0.01	103	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s112	Unnamed trib of Beanblossom Creek	Ephemeral	-	29	0.01	Natural	Class I	94	0.01	94	94	0.01	94	88	0.01	88	0	0.00	0	81	0.01	81	26	0.01	26
S5-s113	Unnamed trib of Beanblossom Creek	Ephemeral	-	29	0.01	Natural	Class I	51	0.01	51	51	0.01	51	51	0.01	51	0	0.00	0	51	0.01	51	20	0.01	20

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s114_1	Unnamed trib of Beanblossom Creek	Ephemeral	-	39	0.01	Natural	Class I	267	0.01	267	277	0.01	277	222	0.01	222	330	0.01	330	211	0.01	211	101	0.01	101
S5-s115	Unnamed trib of Beanblossom Creek	Ephemeral	-	39	0.01	Natural	Class I	177	0.01	177	177	0.01	177	177	0.01	177	177	0.01	177	177	0.01	177	0	0	0
S5-s116	Unnamed trib of Beanblossom Creek	Ephemeral	-	39	0.01	Natural	Class I	387	0.02	387	387	0.02	387	387	0.02	387	387	0.02	387	387	0.02	387	83	0.01	83
S5-s123	Unnamed trib of Beanblossom Creek	Ephemeral	-	28	0.01	Natural	Class I	131	0.01	131	121	0.01	121	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s126	Unnamed trib of Beanblossom Creek	Ephemeral	-	28	0.01	Natural	Class I	86	0.01	86	77	0.01	77	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s127_2	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	87	0.01	87	87	0.01	87	87	0.01	87	87	0.01	87	87	0.01	87	87	0.01	87
S5-s127_3	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.02	Concrete Gutter	Modified Class I	486	0.02	486	486	0.02	486	486	0.02	486	486	0.02	486	486	0.02	486	486	0.02	486
S5-s127_3a	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.02	Concrete Gutter	Modified Class I	226	0.01	226	226	0.01	226	226	0.01	226	226	0.01	226	226	0.01	226	226	0.01	226
S5-s127_3b	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.02	Culvert		57	0.01	0	57	0.01	0	57	0.01	0	57	0.01	0	57	0.01	0	57	0.01	0
S5-s127a	Unnamed trib of Beanblossom Creek	Ephemeral	-	51	0.02	Natural	Class II	0	0.00	0	0	0.00	0	173	0.01	173	186	0.01	186	173	0.01	173	173	0.01	173
S5-s127b	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.02	Concrete Gutter	Modified Class I	226	0.01	226	226	0.01	226	239	0.01	239	239	0.01	239	239	0.01	239	239	0.01	239
S5-s127b_1	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.02	Concrete Gutter	Modified Class I	415	0.01	415	415	0.01	415	415	0.01	415	415	0.01	415	415	0.01	415	415	0.01	415
S5-s128	Unnamed trib of Beanblossom Creek	Ephemeral	-	40	0.01	Natural	Class II	92	0.01	92	92	0.01	92	141	0.01	141	141	0.01	141	141	0.01	141	141	0.01	141
S5-s129	Unnamed trib of Beanblossom Creek	Ephemeral	-	39	0.01	Natural	Class I	0	0.00	0	0	0.00	0	124	0.01	124	124	0.01	124	124	0.01	124	124	0.01	124
S5-s130	Unnamed trib of Beanblossom Creek	Ephemeral	-	40	0.01	Natural	Class II	59	0.01	59	58	0.01	58	108	0.01	108	108	0.01	108	108	0.01	108	108	0.01	108
S5-s131a	Unnamed trib of Beanblossom Creek	Ephemeral	-	41	0.03	Natural	Class II	478	0.04	478	467	0.04	467	3	0.01	3	0	0.00	0	0	0.00	0	0	0	0
S5-s131b	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.03	Culvert		76	0.01	0	76	0.01	0	76	0.01	0	0	0.00	0	65	0.01	0	65	0.01	0
S5-s131c	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.03	Concrete Gutter	Modified Class I	414	0.01	414	414	0.01	414	414	0.01	414	414	0.01	414	414	0.01	414	414	0.01	414
S5-s132	Unnamed trib of Beanblossom Creek	Ephemeral	-	52	0.01	Natural	Class II	30	0.01	30	24	0.01	24	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s134	Unnamed trib of Beanblossom Creek	Ephemeral	-	38	0.01	Natural	Class I	223	0.02	223	222	0.02	222	190	0.01	190	217	0.01	217	217	0.01	217	59	0.01	59
S5-s135	Unnamed trib of Beanblossom Creek	Ephemeral	-	35	0.01	Natural	Class I	83	0.01	83	82	0.01	82	39	0.01	39	88	0.01	88	81	0.01	81	0	0	0
S5-s146	Unnamed trib of Beanblossom Creek	Ephemeral	-	28	0.01	Natural	Class I	87	0.01	87	90	0.01	90	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s147a	Unnamed trib of Beanblossom Creek	Intermittent	-	51	0.17	Natural	Class II	159	0.01	159	137	0.01	137	76	0.01	0	121	0.01	121	75	0.01	0	76	0.01	0
S5-s147b	Unnamed trib of Beanblossom Creek	Intermittent	-	-	0.17	Culvert		424	0.04	0	424	0.04	0	424	0.04	0	424	0.04	0	424	0.04	0	424	0.04	0
S5-s147b_1	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	95	0.01	95	95	0.01	95	95	0.01	95	95	0.01	95	95	0.01	95	95	0.01	95
S5-s147b_2	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	708	0.02	708	708	0.02	708	708	0.02	708	708	0.02	708	708	0.02	708	708	0.02	708
S5-s147c	Unnamed trib of Beanblossom Creek	Intermittent	-	66	0.17	Natural	Class III	1,482	0.34	1482	1,454	0.33	1454	218	0.05	0	951	0.22	951	217	0.05	0	144	0.03	0

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Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s148a	Unnamed trib of Beanblossom Creek	Ephemeral	-	63	0.04	Natural	Class III	797	0.04	797	797	0.04	797	340	0.02	340	453	0.02	453	340	0.02	340	325	0.02	325
S5-s148b	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0
S5-s148c	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.04	Concrete Gutter	Modified Class I	320	0.01	320	320	0.01	320	320	0.01	320	320	0.01	320	320	0.01	320	320	0.01	320
S5-s149	Unnamed trib of Beanblossom Creek	Ephemeral	-	36	0.01	Natural	Class I	102	0.01	102	57	0.01	57	0	0.00	0	109	0.01	109	0	0.00	0	0	0	0
S5-s150	Unnamed trib of Beanblossom Creek	Ephemeral	-	36	0.01	Natural	Class I	182	0.01	182	182	0.01	182	0	0.00	0	182	0.01	182	0	0.00	0	0	0	0
S5-s150_2	Unnamed trib of Beanblossom Creek	Ephemeral	-	21	0.01	Natural	Class I	100	0.01	100	100	0.01	100	0	0.00	0	100	0.01	100	0	0.00	0	0	0	0
S5-s151	Unnamed trib of Beanblossom Creek	Ephemeral	-	33	0.01	Natural	Class I	175	0.01	175	166	0.01	166	103	0.01	103	167	0.01	167	102	0.01	102	103	0.01	103
S5-s152	Unnamed trib of Beanblossom Creek	Ephemeral	-	41	0.17	Natural	Class II	213	0.01	213	213	0.01	213	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s155_1	Unnamed trib of Fox Hollow	Ephemeral	-	28	0.01	Natural	Class I	82	0.01	82	82	0.01	82	39	0.01	39	14	0.01	14	27	0.01	27	14	0.01	14
S5-s155a	Unnamed trib of Fox Hollow	Ephemeral	-	86	0.01	Natural	Class III	95	0.03	95	96	0.03	96	22	0.01	22	11	0.01	11	19	0.01	19	16	0.01	16
S5-s160b	Unnamed trib of Fox Hollow	Intermittent	-	-	0.06	Culvert		334	0.02	0	334	0.02	0	334	0.02	0	334	0.02	0	334	0.02	0	334	0.02	0
S5-s160c	Unnamed trib of Fox Hollow	Intermittent	-	38	0.06	Natural	Class I	56	0.01	0	59	0.01	0	59	0.01	0	59	0.01	0	59	0.01	0	59	0.01	0
S5-s181a	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	432	0.01	432	432	0.01	432	432	0.01	432	432	0.01	432	432	0.01	432	432	0.01	432
S5-s181b	Unnamed trib of Beanblossom Creek	Ephemeral	-	57	0.01	Natural	Class II	309	0.02	309	309	0.02	309	260	0.02	260	122	0.01	122	264	0.02	264	199	0.01	199
S5-s182	Unnamed trib of Beanblossom Creek	Ephemeral	-	52	0.01	Natural	Class II	322	0.01	322	322	0.01	322	322	0.01	322	322	0.01	322	322	0.01	322	322	0.01	322
S5-s183	Unnamed trib of Beanblossom Creek	Ephemeral	-	52	0.01	Natural	Class II	116	0.01	116	116	0.01	116	80	0.01	80	0	0.00	0	83	0.01	83	0	0	0
S5-s184	Unnamed trib of Beanblossom Creek	Ephemeral	-	46	0.01	Natural	Class II	111	0.01	111	92	0.01	92	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s185_1	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.04	Concrete Gutter	Modified Class I	114	0.01	114	114	0.01	114	114	0.01	114	114	0.01	114	114	0.01	114	114	0.01	114
S5-s185a	Unnamed trib of Beanblossom Creek	Ephemeral	-	57	0.04	Natural	Class II	666	0.03	666	666	0.03	666	434	0.02	434	243	0.01	243	439	0.02	439	380	0.02	380
S5-s185b	Unnamed trib of Beanblossom Creek	Ephemeral	-	-	0.04	Culvert		21	0.01	0	21	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s185c	Unnamed trib of Beanblossom Creek	Ephemeral	-	57	0.04	Natural	Class II	110	0.01	110	94	0.01	94	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s188	Unnamed trib of Beanblossom Creek	Ephemeral	-	37	0.09	Natural	Class I	177	0.01	177	174	0.01	174	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s189	Unnamed trib of Beanblossom Creek	Ephemeral	-	29	0.01	Natural	Class I	142	0.01	142	140	0.01	140	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s190a	Unnamed trib of Beanblossom Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	459	0.01	459	459	0.01	459	459	0.01	459	459	0.01	459	459	0.01	459	459	0.01	459
S5-s190b	Unnamed trib of Beanblossom Creek	Ephemeral	-	77	0.01	Natural	Class III	327	0.05	327	331	0.05	331	175	0.02	175	102	0.01	102	176	0.02	176	135	0.02	135
S5-s193	Unnamed trib of Beanblossom Creek	Ephemeral	-	48	0.01	Natural	Class II	145	0.01	145	140	0.01	140	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s207	Unnamed trib of Payne Hollow	Ephemeral	-	33	0.01	Natural	Class I	326	0.04	326	315	0.04	315	400	0.05	400	251	0.03	251	399	0.05	399	302	0.03	302
S5-s208	Unnamed trib of Payne Hollow	Ephemeral	-	21	0.01	Natural	Class I	41	0.01	41	25	0.01	25	109	0.01	109	0	0.00	0	106	0.01	106	0	0	0
S5-s216b	Unnamed trib of Payne Hollow	Ephemeral	-	-	0.03	Culvert		351	0.01	0	351	0.01	0	351	0.01	0	346	0.01	0	351	0.01	0	351	0.01	0

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s216b_1	Unnamed trib of Payne Hollow	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	472	0.01	472	472	0.01	472	472	0.01	472	465	0.01	465	472	0.01	472	472	0.01	472
S5-s216c	Unnamed trib of Payne Hollow	Ephemeral	-	76	0.03	Natural	Class III	138	0.02	0	130	0.02	0	206	0.03	0	125	0.02	0	193	0.03	0	193	0.03	0
S5-s217	Unnamed trib of Payne Hollow	Ephemeral	-	70	0.01	Natural	Class III	159	0.01	159	164	0.01	164	179	0.01	179	126	0.01	126	179	0.01	179	179	0.01	179
S5-s219_1	Unnamed trib of Payne Hollow	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	186	0.01	186	186	0.01	186	186	0.01	186	186	0.01	186	186	0.01	186	186	0.01	186
S5-s219a	Unnamed trib of Payne Hollow	Ephemeral	-	57	0.01	Natural	Class II	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0
S5-s219b	Unnamed trib of Payne Hollow	Ephemeral	-	-	0.01	Culvert		307	0.02	0	307	0.02	0	307	0.02	0	307	0.02	0	307	0.02	0	307	0.02	0
S5-s219c	Unnamed trib of Payne Hollow	Ephemeral	-	29	0.01	Natural	Class I	350	0.03	350	350	0.03	350	294	0.02	294	120	0.01	0	294	0.02	294	350	0.03	350
S5-s220a	Unnamed trib of Payne Hollow	Ephemeral	-	29	0.01	Natural	Class I	163	0.01	163	162	0.01	162	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s227	Unnamed trib of Payne Hollow	Ephemeral	-	17	0.01	Natural	Class I	413	0.03	413	416	0.03	416	401	0.03	401	0	0.00	0	399	0.03	399	375	0.03	375
S5-s228a	Unnamed trib of Bryant Creek	Ephemeral	-	17	0.01	Concrete Gutter	Modified Class I	162	0.01	162	162	0.01	162	162	0.01	162	162	0.01	162	162	0.01	162	162	0.01	162
S5-s228b	Unnamed trib of Bryant Creek	Ephemeral	-	40	0.01	Natural	Class II	187	0.01	187	190	0.01	190	190	0.01	190	190	0.01	190	190	0.01	190	190	0.01	190
S5-s229	Unnamed trib of Payne Hollow	Ephemeral	-	33	0.02	Natural	Class I	329	0.01	329	329	0.01	329	214	0.01	214	0	0.00	0	213	0.01	213	177	0.01	177
S5-s229_1	Unnamed trib of Payne Hollow	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	199	0.01	199	199	0.01	199	199	0.01	199	158	0.01	158	199	0.01	199	199	0.01	199
S5-s237	Unnamed trib of Indian Creek	Ephemeral	-	24	0.03	Natural	Class I	528	0.04	528	550	0.04	550	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s238a	Unnamed trib of Indian Creek	Ephemeral	-	12	0.02	Concrete Gutter	Modified Class I	142	0.01	142	142	0.01	142	142	0.01	142	142	0.01	142	142	0.01	142	142	0.01	142
S5-s238b	Unnamed trib of Indian Creek	Ephemeral	-	45	0.02	Natural	Class II	879	0.11	879	913	0.12	913	121	0.02	121	57	0.01	57	122	0.02	122	88	0.01	88
S5-s239a	Unnamed trib of Indian Creek	Ephemeral	-	17	0.01	Natural	Class I	121	0.01	0	121	0.01	0	121	0.01	0	100	0.01	0	104	0.01	0	44	0.01	0
S5-s239b	Unnamed trib of Indian Creek	Ephemeral	-	-	0.02	Culvert		228	0.01	0	228	0.01	0	228	0.01	0	228	0.01	0	228	0.01	0	228	0.01	0
S5-s239c	Unnamed trib of Indian Creek	Ephemeral	-	22	0.02	Concrete Gutter	Modified Class I	17	0.01	0	17	0.01	0	17	0.01	0	17	0.01	0	17	0.01	0	17	0.01	0
S5-s239d	Unnamed trib of Indian Creek	Ephemeral	-	-	0.02	Culvert		32	0.01	0	32	0.01	0	32	0.01	0	32	0.01	0	32	0.01	0	32	0.01	0
S5-s239e	Unnamed trib of Indian Creek	Ephemeral	-	60	0.02	Natural	Class III	368	0.04	368	371	0.04	371	87	0.01	0	53	0.01	0	100	0.01	0	35	0.01	0
S5-s239f	Unnamed trib of Indian Creek	Intermittent	-	60	0.02	Natural	Class III	497	0.05	497	494	0.05	494	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s240	Unnamed trib of Indian Creek	Intermittent	-	43	0.01	Natural	Class II	211	0.01	211	211	0.01	211	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s241a	Unnamed trib of Indian Creek	Ephemeral	-	50	0.01	Natural	Class II	40	0.01	0	41	0.01	0	197	0.01	0	71	0.01	0	146	0.01	0	117	0.01	0
S5-s241b	Unnamed trib of Indian Creek	Ephemeral	-	-	0.01	Culvert		395	0.02	0	395	0.02	0	395	0.02	0	395	0.02	0	395	0.02	0	395	0.02	0
S5-s241c	Unnamed trib of Indian Creek	Ephemeral	-	45	0.01	Natural	Class II	41	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0
S5-s242_1a	Unnamed trib of Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	76	0.01	76	76	0.01	76	76	0.01	76	76	0.01	76	76	0.01	76	76	0.01	76
S5-s242_1b	Unnamed trib of Indian Creek	Ephemeral	-	-	0.01	Culvert		51	0.01	0	51	0.01	0	51	0.01	0	51	0.01	0	51	0.01	0	51	0.01	0
S5-s242_1c	Unnamed trib of Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	416	0.01	416	416	0.01	416	416	0.01	416	416	0.01	416	416	0.01	416	416	0.01	416
S5-s242a	Unnamed trib of Indian Creek	Ephemeral	-	39	0.08	Natural	Class I	118	0.01	0	115	0.01	0	174	0.02	0	36	0.01	0	36	0.01	0	36	0.01	0
S5-s242b	Unnamed trib of Indian Creek	Ephemeral	-	-	0.08	Culvert		502	0.06	0	502	0.06	0	502	0.06	0	502	0.06	0	502	0.06	0	502	0.06	0
S5-s242c	Unnamed trib of Indian Creek	Ephemeral	-	52	0.08	Natural	Class II	116	0.02	0	136	0.02	0	92	0.01	0	49	0.01	0	94	0.01	0	82	0.01	0
S5-s246_1	Unnamed trib of Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	428	0.02	428	428	0.02	428	428	0.02	428	428	0.02	428	428	0.02	428	428	0.02	428
S5-s246_1a	Unnamed trib of Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	592	0.03	592	592	0.03	592	592	0.03	592	592	0.03	592	592	0.03	592	592	0.03	592
S5-s246_2	Unnamed trib of Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	462	0.01	462	462	0.01	462	462	0.01	462	462	0.01	462	462	0.01	462	462	0.01	462

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s246_2a	Unnamed trib of Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	211	0.01	211	211	0.01	211	211	0.01	211	211	0.01	211	211	0.01	211	211	0.01	211
S5-s246_3	Unnamed trib of Indian Creek	Ephemeral	-	-	0.01	Culvert		104	0.01	0	104	0.01	0	104	0.01	0	104	0.01	0	104	0.01	0	104	0.01	0
S5-s246a	Unnamed trib of Indian Creek	Ephemeral	-	40	0.08	Natural	Class II	39	0.01	0	41	0.01	0	21	0.01	0	21	0.01	0	21	0.01	0	21	0.01	0
S5-s246b	Unnamed trib of Indian Creek	Ephemeral	-	-	0.08	Culvert		554	0.11	0	554	0.11	0	554	0.11	0	554	0.11	0	554	0.11	0	554	0.11	0
S5-s246c	Unnamed trib of Indian Creek	Intermittent	-	38	0.08	Natural	Class I	456	0.04	456	455	0.04	455	340	0.03	340	235	0.02	235	345	0.03	345	342	0.03	342
S5-s253a†	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Natural	Class I	416	0.02	416	416	0.02	416	416	0.02	416	416	0.02	416	416	0.02	416	416	0.02	416
S5-s253a_1†	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	437	0.02	437	437	0.02	437	437	0.02	437	437	0.02	437	437	0.02	437	437	0.02	437
S5-s253a_2†	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	516	0.02	516	516	0.02	516	516	0.02	516	516	0.02	516	516	0.02	516	516	0.02	516
S5-s253b†	Unnamed trib of Bryant Creek	Intermittent	-	63.5	0.14	Natural	Class III	1,223	0.36	1223	1,223	0.36	1223	1,223	0.36	1223	1,223	0.36	1223	1,223	0.36	1223	1223	0.36	1223
S5-s253c†	Unnamed trib of Bryant Creek	Intermittent	-	80	0.48	Natural	Class III	3,432	1.02	3,409	3,432	1.02	3,409	3,432	1.02	3409	3,432	1.02	3409	3,432	1.02	3,409	3432	1.02	3409
S5-s253d†	Unnamed trib of Bryant Creek	Intermittent	-	-	0.70	Culvert		195	0.06	0	195	0.06	0	195	0.06	0	195	0.06	0	195	0.06	0	195	0.06	0
S5-s253e	Unnamed trib of Bryant Creek	Intermittent	55.5	-	0.71	Natural	Warm Water Habitat	368	0.13	278	363	0.13	275	363	0.13	275	363	0.13	275	363	0.13	275	363	0.13	275
S5-s254b	Unnamed trib of Bryant Creek	Intermittent	-	41	0.09	Natural	Class II	155	0.02	155	165	0.02	165	165	0.02	165	165	0.02	165	165	0.02	165	165	0.02	165
S5-s254c†	Unnamed trib of Bryant Creek	Intermittent	-	-	0.09	Culvert		451	0.05	0	451	0.05	0	451	0.05	0	451	0.05	0	451	0.05	0	451	0.05	0
S5-s254d†	Unnamed trib of Bryant Creek	Intermittent	-	20	0.01	Natural	Modified Class I	22	0.01	0	22	0.01	0	22	0.01	0	22	0.01	0	22	0.01	0	22	0.01	0
S5-s264	Unnamed trib of Bryant Creek	Ephemeral	-	21	0.01	Natural	Class I	113	0.01	0	115	0.01	0	36	0.01	0	36	0.01	0	36	0.01	0	36	0.01	0
S5-s264a†	Unnamed trib of Bryant Creek	Intermittent	-	-	0.01	Culvert		213	0.01	0	213	0.01	0	213	0.01	0	213	0.01	0	213	0.01	0	213	0.01	0
S5-s265a	Unnamed trib of Bryant Creek	Ephemeral	-	22	0.01	Natural	Class I	91	0.01	0	93	0.01	0	57	0.01	0	57	0.01	0	57	0.01	0	57	0.01	0
S5-s265b†	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		159	0.01	0	159	0.01	0	159	0.01	0	159	0.01	0	159	0.01	0	159	0.01	0
S5-s265c†	Unnamed trib of Bryant Creek	Ephemeral	-	30	0.01	Natural	Modified Class II	36	0.01	0	36	0.01	0	36	0.01	0	36	0.01	0	36	0.01	0	36	0.01	0
S5-s266a	Unnamed trib of Bryant Creek	Ephemeral	-	21	0.01	Natural	Class I	108	0.01	0	110	0.01	0	92	0.01	0	92	0.01	0	92	0.01	0	92	0.01	0
S5-s266b†	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		183	0.01	0	183	0.01	0	183	0.01	0	183	0.01	0	183	0.01	0	183	0.01	0
S5-s267a	Unnamed trib of Bryant Creek	Ephemeral	-	35	0.01	Natural	Class I	127	0.01	0	125	0.01	0	125	0.01	0	125	0.01	0	125	0.01	0	125	0.01	0
S5-s267b†	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		204	0.01	0	204	0.01	0	204	0.01	0	204	0.01	0	204	0.01	0	204	0.01	0
S5-s267c†	Unnamed trib of Bryant Creek	Ephemeral	-	20	0.01	Natural	Modified Class I	13	0.01	0	13	0.01	0	13	0.01	0	13	0.01	0	13	0.01	0	13	0.01	0
S5-s268a	Unnamed trib of Bryant Creek	Ephemeral	-	28	0.02	Natural	Class I	62	0.01	0	65	0.01	0	45	0.01	0	45	0.01	0	45	0.01	0	45	0.01	0
S5-s268b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.02	Culvert		149	0.01	0	149	0.01	0	149	0.01	0	149	0.01	0	149	0.01	0	149	0.01	0
S5-s268c†	Unnamed trib of Bryant Creek	Ephemeral	-	38	0.02	Natural	Class I	154	0.02	154	154	0.02	154	154	0.02	154	154	0.02	154	154	0.02	154	154	0.02	154
S5-s269a	Unnamed trib of Bryant Creek	Ephemeral	-	28	0.01	Natural	Class I	92	0.01	0	94	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0
S5-s269b†	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		168	0.01	0	168	0.01	0	168	0.01	0	168	0.01	0	168	0.01	0	168	0.01	0
S5-s269c†	Unnamed trib of Bryant Creek	Ephemeral	-	38	0.01	Natural	Class I	12	0.01	0	12	0.01	0	12	0.01	0	12	0.01	0	12	0.01	0	12	0.01	0
S5-s270a	Unnamed trib of Bryant Creek	Ephemeral	-	19	0.01	Natural	Class I	153	0.01	0	150	0.01	0	150	0.01	0	150	0.01	0	150	0.01	0	150	0.01	0
S5-s270b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		139	0.01	0	139	0.01	0	139	0.01	0	139	0.01	0	139	0.01	0	139	0.01	0
S5-s270c†	Unnamed trib of Bryant Creek	Ephemeral	-	33	0.01	Natural	Class I	202	0.02	0	202	0.02	0	202	0.02	0	202	0.02	0	202	0.02	0	202	0.02	0
S5-s271a	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Natural	Class I	92	0.01	0	92	0.01	0	73	0.01	0	73	0.01	0	73	0.01	0	73	0.01	0
S5-s271b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		106	0.01	0	106	0.01	0	106	0.01	0	106	0.01	0	106	0.01	0	106	0.01	0
S5-s271c†	Unnamed trib of Bryant Creek	Ephemeral	-	14	0.01	Natural	Modified Class I	75	0.01	0	75	0.01	0	75	0.01	0	75	0.01	0	75	0.01	0	75	0.01	0
S5-s272a	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Natural	Class I	88	0.01	0	88	0.01	0	82	0.01	0	82	0.01	0	82	0.01	0	82	0.01	0
S5-s272b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		129	0.01	0	129	0.01	0	129	0.01	0	129	0.01	0	129	0.01	0	129	0.01	0
S5-s273a	Unnamed trib of Bryant Creek	Ephemeral	-	50	0.01	Natural	Class II	11	0.01	11	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s273b	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	130	0.01	130	130	0.01	130	130	0.01	130	130	0.01	130	130	0.01	130	130	0.01	130
S5-s273c†	Unnamed trib of Bryant Creek	Ephemeral	-	19	0.01	Natural	Modified Class I	52	0.01	52	52	0.01	52	52	0.01	52	52	0.01	52	52	0.01	52	52	0.01	52
S5-s274a	Unnamed trib of Bryant Creek	Ephemeral	-	28	0.02	Natural	Class I	114	0.01	0	116	0.01	0	74	0.01	0	74	0.01	0	74	0.01	0	74	0.01	0
S5-s274b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.02	Culvert		139	0.01	0	139	0.01	0	139	0.01	0	139	0.01	0	139	0.01	0	139	0.01	0
S5-s274c	Unnamed trib of Bryant Creek	Ephemeral	-	23	0.02	Natural	Class I	52	0.01	0	52	0.01	0	52	0.01	0	52	0.01	0	52	0.01	0	52	0.01	0
S5-s275a	Unnamed trib of Bryant Creek	Ephemeral	-	40	0.07	Natural	Class II	52	0.01	0	50	0.01	0	50	0.01	0	50	0.01	0	50	0.01	0	50	0.01	0
S5-s275b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.07	Culvert		344	0.02	0	344	0.02	0	344	0.02	0	344	0.02	0	344	0.02	0	344	0.02	0
S5-s275c†	Unnamed trib of Bryant Creek	Ephemeral	-	43	0.07	Natural	Class II	179	0.02	0	179	0.02	0	179	0.02	0	179	0.02	0	179	0.02	0	179	0.02	0
S5-s276a	Unnamed trib of Bryant Creek	Ephemeral	-	21	0.01	Natural	Class I	247	0.01	247	212	0.01	212	172	0.01	172	172	0.01	172	172	0.01	172	172	0.01	172
S5-s277a	Unnamed trib of Bryant Creek	Ephemeral	-	51	0.04	Natural	Class II	75	0.01	0	73	0.01	0	73	0.01	0	73	0.01	0	73	0.01	0	73	0.01	0
S5-s277b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.04	Culvert		196	0.02	0	196	0.02	0	196	0.02	0	196	0.02	0	196	0.02	0	196	0.02	0
S5-s277c†	Unnamed trib of Bryant Creek	Ephemeral	-	33	0.04	Natural	Class I	188	0.02	0	188	0.02	0	188	0.02	0	188	0.02	0	188	0.02	0	188	0.02	0
S5-s278a	Unnamed trib of Bryant Creek	Ephemeral	-	40	0.01	Natural	Class II	103	0.01	103	101	0.01	101	101	0.01	101	101	0.01	101	101	0.01	101	101	0.01	101
S5-s278b	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	706	0.03	706	706	0.03	706	706	0.03	706	706	0.03	706	706	0.03	706	706	0.03	706
S5-s279a	Unnamed trib of Bryant Creek	Ephemeral	-	72	0.10	Natural	Class III	81	0.01	0	83	0.01	0	23	0.01	0	28	0.01	0	30	0.01	0	33	0.01	0
S5-s279b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.10	Culvert		136	0.01	0	136	0.01	0	136	0.01	0	136	0.01	0	136	0.01	0	136	0.01	0
S5-s284a	Unnamed trib of Bryant Creek	Ephemeral	-	21	0.04	Natural	Modified Class I	321	0.01	321	319	0.01	319	319	0.01	319	319	0.01	319	319	0.01	319	319	0.01	319
S5-s284b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.04	Culvert		74	0.01	0	74	0.01	0	74	0.01	0	74	0.01	0	74	0.01	0	74	0.01	0
S5-s284c	Unnamed trib of Bryant Creek	Ephemeral	-	30	0.04	Natural	Class I	80	0.01	80	80	0.01	80	80	0.01	80	80	0.01	80	80	0.01	80	80	0.01	80
S5-s285a	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Natural	Modified Class I	178	0.01	0	135	0.01	0	88	0.01	0	90	0.01	0	90	0.01	0	90	0.01	0
S5-s285b†	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		166	0.01	0	166	0.01	0	166	0.01	0	166	0.01	0	166	0.01	0	166	0.01	0
S5-s286	Unnamed trib of Bryant Creek	Ephemeral	-	58	0.12	Natural	Class II	347	0.02	347	344	0.02	344	344	0.02	344	344	0.02	344	344	0.02	344	344	0.02	344
S5-s287a_1	Unnamed trib of Bryant Creek	Ephemeral	-	37	0.01	Natural	Class I	164	0.01	0	141	0.01	0	57	0.01	0	88	0.01	0	88	0.01	0	88	0.01	0
S5-s287b	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	101	0.01	101	101	0.01	101	35	0.01	35	101	0.01	101	101	0.01	101	101	0.01	101
S5-s287c	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		68	0.01	0	68	0.01	0	68	0.01	0	68	0.01	0	68	0.01	0	68	0.01	0
S5-s287d†	Unnamed trib of Bryant Creek	Ephemeral	-	25	0.01	Natural	Class I	371	0.01	371	371	0.01	371	371	0.01	342	371	0.01	342	371	0.01	342	371	0.01	342
S5-s288_1	Unnamed trib of Bryant Creek	Ephemeral	-	37	0.01	Natural	Class I	0	0.00	0	0	0.00	0	0	0.00	0	50	0.01	50	0	0.00	0	0	0	0
S5-s288_1a	Unnamed trib of Bryant Creek	Ephemeral	-	26	0.09	Natural	Class I	0	0.00	0	0	0.00	0	0	0.00	0	52	0.01	52	0	0.00	0	0	0	0
S5-s288_1b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.09	Culvert		0	0.00	0	0	0.00	0	0	0.00	0	28	0.01	0	0	0.00	0	0	0	0
S5-s288a	Bryant Creek	Perennial	66.5	-	5.72	Natural	Warm Water Habitat	120	0.10	0	176	0.14	0	116	0.09	0	300	0.24	0	108	0.09	0	108	0.09	0
S5-s288b	Bryant Creek	Perennial	64	-	5.72	Bridge	Warm Water Habitat	199	0.09	0	199	0.09	0	199	0.09	0	199	0.09	0	199	0.09	0	199	0.09	0
S5-s288c	Bryant Creek	Perennial	64	-	5.72	Natural	Warm Water Habitat	161	0.07	0	159	0.07	0	140	0.06	0	140	0.06	0	140	0.06	0	140	0.06	0
S5-s289a	Unnamed trib of Bryant Creek	Ephemeral	-	25	0.05	Natural	Class I	17	0.01	17	8	0.01	8	8	0.01	8	107	0.01	107	8	0.01	8	8	0.01	8
S5-s289b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.05	Culvert		28	0.01	0	28	0.01	0	28	0.01	0	28	0.01	0	28	0.01	0	28	0.01	0
S5-s289c	Unnamed trib of Bryant Creek	Ephemeral	-	35	0.05	Natural	Class I	20	0.01	20	19	0.01	19	19	0.01	19	19	0.01	0	19	0.01	19	19	0.01	19
S5-s289e	Unnamed trib of Bryant Creek	Ephemeral	-	27	0.05	Dump Rock Gutter	Modified Class I	400	0.02	400	400	0.02	400	400	0.02	400	400	0.02	400	400	0.02	400	400	0.02	400
S5-s289e_1	Unnamed trib of Bryant Creek	Ephemeral	-	27	0.05	Concrete Gutter	Modified Class I	86	0.01	86	85	0.01	85	85	0.01	85	85	0.01	85	85	0.01	85	85	0.01	85

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s289e_2	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	554	0.02	554	554	0.02	554	554	0.02	554	554	0.02	554	554	0.02	554	554	0.02	554
S5-s289f	Unnamed trib of Bryant Creek	Ephemeral	-	48	0.05	Roadside Ditch	Modified Class II	565	0.06	565	565	0.06	565	565	0.06	565	565	0.06	565	565	0.06	565	565	0.06	565
S5-s291	Unnamed trib of Bryant Creek	Ephemeral	-	18	0.01	Natural	Class I	103	0.01	103	106	0.01	106	81	0.01	81	83	0.01	83	82	0.01	82	82	0.01	82
S5-s293a	Unnamed trib of Bryant Creek	Ephemeral	-	31	0.01	Natural	Class I	70	0.01	0	65	0.01	0	38	0.01	0	38	0.01	0	38	0.01	0	38	0.01	0
S5-s293b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		237	0.02	0	237	0.02	0	237	0.02	0	237	0.02	0	237	0.02	0	237	0.02	0
S5-s293c	Unnamed trib of Bryant Creek	Ephemeral	-	60	0.01	Natural	Class III	89	0.01	0	81	0.01	0	80	0.01	0	82	0.01	0	82	0.01	0	55	0.01	0
S5-s294a	Unnamed trib of Bryant Creek	Ephemeral	-	14	0.01	Natural	Modified Class I	66	0.01	0	63	0.01	0	41	0.01	0	42	0.01	0	43	0.01	0	43	0.01	0
S5-s294a_1	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	304	0.01	304	304	0.01	304	282	0.01	282	282	0.01	282	282	0.01	282	282	0.01	282
S5-s294a_2	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	146	0.01	146	146	0.01	146	146	0.01	146	146	0.01	146	146	0.01	146	146	0.01	146
S5-s294b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		233	0.01	0	233	0.01	0	233	0.01	0	233	0.01	0	233	0.01	0	233	0.01	0
S5-s294c	Unnamed trib of Bryant Creek	Ephemeral	-	29	0.01	Natural	Class I	109	0.01	0	111	0.01	0	116	0.01	0	126	0.01	0	126	0.01	0	80	0.01	0
S5-s299a	Unnamed trib of Bryant Creek	Ephemeral	-	30	0.11	Natural	Class I	177	0.01	177	94	0.01	94	150	0.01	150	136	0.01	136	136	0.01	136	85	0.01	85
S5-s299a_1	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.14	Concrete Gutter	Modified Class I	1,164	0.03	1164	1,164	0.03	1164	1,164	0.03	1164	1,164	0.03	1164	1,164	0.03	1164	1164	0.03	1164
S5-s299b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.11	Culvert		39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0	39	0.01	0
S5-s299c	Unnamed trib of Bryant Creek	Ephemeral	-	34	0.11	Roadside Ditch	Modified Class II	159	0.01	159	159	0.01	159	159	0.01	159	159	0.01	159	159	0.01	159	159	0.01	159
S5-s299d	Unnamed trib of Bryant Creek	Ephemeral	-	51	0.13	Natural	Class II	845	0.22	845	815	0.22	815	785	0.21	785	751	0.20	751	761	0.20	761	656	0.17	656
S5-s300a	Unnamed trib of Bryant Creek	Ephemeral	-	40	0.01	Natural	Class II	99	0.01	0	98	0.01	0	98	0.01	0	98	0.01	0	98	0.01	0	98	0.01	0
S5-s300b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		291	0.01	0	291	0.01	0	291	0.01	0	291	0.01	0	291	0.01	0	291	0.01	0
S5-s302a	Unnamed trib of Bryant Creek	Ephemeral	-	21	0.01	Natural	Class I	125	0.01	0	123	0.01	0	123	0.01	0	124	0.01	0	124	0.01	0	124	0.01	0
S5-s302b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		281	0.02	0	281	0.02	0	281	0.02	0	281	0.02	0	281	0.02	0	281	0.02	0
S5-s308	Unnamed trib of Bryant Creek	Ephemeral	-	22	0.01	Natural	Class I	113	0.01	113	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s314a	Unnamed trib of Bryant Creek	Ephemeral	-	18	0.01	Roadside Ditch	Modified Class I	156	0.01	156	8	0.01	8	8	0.01	8	8	0.01	8	8	0.01	8	7	0.01	7
S5-s314b	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.10	Concrete Gutter	Modified Class I	498	0.03	498	498	0.03	498	498	0.03	498	498	0.03	498	498	0.03	498	498	0.03	498
S5-s314b_1	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.10	Concrete Gutter	Modified Class I	500	0.03	500	500	0.03	500	500	0.03	500	500	0.03	500	500	0.03	500	500	0.03	500
S5-s314c	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.10	Culvert		199	0.01	0	199	0.01	0	199	0.01	0	199	0.01	0	199	0.01	0	199	0.01	0
S5-s315a	Unnamed trib of Bryant Creek	Ephemeral	-	25	0.04	Natural	Class I	875	0.04	875	202	0.01	202	228	0.01	228	228	0.01	228	228	0.01	228	229	0.01	229
S5-s315b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.04	Culvert		168	0.01	0	168	0.01	0	168	0.01	0	168	0.01	0	168	0.01	0	168	0.01	0
S5-s315c	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.04	Concrete Gutter	Modified Class I	878	0.04	878	878	0.04	878	878	0.04	878	878	0.04	878	878	0.04	878	878	0.04	878
S5-s315d	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.04	Culvert		115	0.01	0	115	0.01	0	115	0.01	0	115	0.01	0	115	0.01	0	115	0.01	0
S5-s316_1	Unnamed trib of Bryant Creek	Ephemeral	-	33	0.01	Natural	Class I	379	0.04	379	323	0.04	323	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s316a	Unnamed trib of Bryant Creek	Ephemeral	-	30	0.02	Natural	Class I	285	0.02	285	168	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s316b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.02	Culvert		94	0.01	0	8	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s316c	Unnamed trib of Bryant Creek	Ephemeral	-	16	0.02	Natural	Modified Class I	337	0.02	337	337	0.02	337	73	0.01	73	73	0.01	73	73	0.01	73	73	0.01	73
S5-s316d	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.02	Culvert		56	0.01	0	56	0.01	0	56	0.01	0	56	0.01	0	56	0.01	0	56	0.01	0
S5-s317	Unnamed trib of Bryant Creek	Ephemeral	-	15	0.01	Natural	Class I	408	0.02	408	0	0.00	0	7	0.01	7	7	0.01	7	7	0.01	7	7	0.01	7
S5-s318	Unnamed trib of Bryant Creek	Ephemeral	-	24	0.01	Natural	Class I	112	0.01	112	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0

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Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s319_1a	Unnamed trib of Bryant Creek	Ephemeral	-	16	0.01	Concrete Gutter	Modified Class I	24	0.01	24	24	0.01	24	24	0.01	24	24	0.01	24	24	0.01	24	24	0.01	24
S5-s319_1b	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		55	0.01	0	23	0.01	0	55	0.01	0	55	0.01	0	55	0.01	0	55	0.01	0
S5-s319_1c	Unnamed trib of Bryant Creek	Ephemeral	-	32	0.01	Natural	Modified Class II	51	0.01	51	0	0.00	0	27	0.01	27	27	0.01	27	27	0.01	27	38	0.01	38
S5-s319a	Unnamed trib of Bryant Creek	Ephemeral	-	30	0.02	Natural	Class I	518	0.06	518	315	0.04	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s319b	Unnamed trib of Bryant Creek	Ephemeral	-	46	0.02	Natural	Class II	172	0.01	172	0	0.00	0	11	0.01	11	11	0.01	11	11	0.01	11	14	0.01	14
S5-s320	Unnamed trib of Bryant Creek	Ephemeral	-	29	0.01	Natural	Class I	437	0.07	437	215	0.03	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s325	Unnamed trib of Little Indian Creek	Ephemeral	-	25	0.01	Natural	Class I	525	0.05	525	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s326a	Unnamed trib of Little Indian Creek	Ephemeral	-	6	0.01	Natural	Modified Class I	251	0.01	251	116	0.01	116	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s326b	Unnamed trib of Little Indian Creek	Intermittent	-	38	0.43	Natural	Class I	251	0.05	251	250	0.05	250	84	0.02	84	75	0.01	75	99	0.02	99	97	0.02	97
S5-s326c	Unnamed trib of Little Indian Creek	Intermittent	-	19	0.43	Roadside Ditch	Modified Class I	592	0.04	592	592	0.04	592	592	0.04	592	592	0.04	592	592	0.04	592	592	0.04	592
S5-s327	Unnamed trib of Little Indian Creek	Ephemeral	-	22	0.01	Natural	Class I	169	0.01	169	95	0.01	95	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s328	Unnamed trib of Little Indian Creek	Ephemeral	-	17	0.01	Natural	Class I	144	0.01	144	96	0.01	96	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s330a	Unnamed trib of Little Indian Creek	Ephemeral	-	18	0.04	Natural	Class I	99	0.01	99	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s330b	Unnamed trib of Little Indian Creek	Intermittent	-	34	0.04	Natural	Class I	143	0.02	143	120	0.01	120	103	0.01	103	106	0.01	106	101	0.01	101	101	0.01	101
S5-s330b_1	Unnamed trib of Little Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	426	0.01	426	426	0.01	426	426	0.01	426	426	0.01	426	426	0.01	426	426	0.01	426
S5-s330c	Unnamed trib of Little Indian Creek	Intermittent	-	17	0.04	Concrete Gutter	Modified Class I	832	0.02	832	832	0.02	832	832	0.02	832	832	0.02	832	832	0.02	832	832	0.02	832
S5-s331a	Unnamed trib of Little Indian Creek	Ephemeral	-	37	0.10	Natural	Class I	80	0.01	0	81	0.01	0	27	0.01	27	158	0.02	158	107	0.01	107	37	0.01	37
S5-s331b	Unnamed trib of Little Indian Creek	Intermittent	-	-	0.10	Culvert		408	0.04	0	408	0.04	0	408	0.04	0	408	0.04	0	408	0.04	0	408	0.04	0
S5-s331d	Unnamed trib of Little Indian Creek	Intermittent	-	57	0.10	Natural	Class II	492	0.09	492	494	0.09	494	494	0.09	494	494	0.09	494	494	0.09	494	478	0.09	478
S5-s338b	Unnamed trib of Little Indian Creek	Ephemeral	-	39	0.03	Natural	Class I	98	0.02	0	164	0.03	0	96	0.02	0	99	0.02	0	102	0.02	0	95	0.02	0
S5-s338c	Unnamed trib of Little Indian Creek	Ephemeral	-	-	0.03	Culvert		240	0.04	0	240	0.04	0	240	0.04	0	240	0.04	0	240	0.04	0	240	0.04	0
S5-s343a	Unnamed trib of Little Indian Creek	Ephemeral	-	34	0.06	Natural	Class I	164	0.02	0	146	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s343b	Unnamed trib of Little Indian Creek	Ephemeral	-	-	0.06	Culvert		324	0.03	0	324	0.03	0	290	0.03	0	290	0.03	0	290	0.03	0	290	0.03	0
S5-s343e	Unnamed trib of Little Indian Creek	Ephemeral	-	23	0.06	Natural	Class I	196	0.01	0	308	0.02	0	84	0.01	0	81	0.01	0	85	0.01	0	85	0.01	0
S5-s343f	Unnamed trib of Little Indian Creek	Ephemeral	-	-	0.06	Culvert		34	0.01	0	34	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s343g	Unnamed trib of Little Indian Creek	Ephemeral	-	64	0.06	Natural	Class III	28	0.01	0	30	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s344_2	Unnamed trib of Little Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	309	0.01	309	309	0.01	309	309	0.01	309	309	0.01	309	309	0.01	309	309	0.01	309
S5-s344_2a	Unnamed trib of Little Indian Creek	Ephemeral	-	-	0.01	Culvert		61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0	61	0.01	0
S5-s344_2b	Unnamed trib of Little Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	193	0.01	193	193	0.01	193	193	0.01	193	193	0.01	193	193	0.01	193	193	0.01	193

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s344a	Unnamed trib of Little Indian Creek	Ephemeral	-	29	0.10	Natural	Modified Class I	197	0.01	0	195	0.01	0	90	0.01	0	90	0.01	0	79	0.01	0	79	0.01	0
S5-s344a_1	Unnamed trib of Little Indian Creek	Ephemeral	-	15	0.02	Roadside Ditch	Modified Class I	485	0.03	485	485	0.03	485	485	0.03	485	485	0.03	485	485	0.03	485	485	0.03	485
S5-s344b	Unnamed trib of Little Indian Creek	Ephemeral	-	-	0.10	Culvert		180	0.01	0	180	0.01	0	180	0.01	0	180	0.01	0	180	0.01	0	180	0.01	0
S5-s344c	Unnamed trib of Little Indian Creek	Ephemeral	-	23	0.10	Natural	Modified Class I	213	0.01	0	214	0.01	0	87	0.01	0	87	0.01	0	87	0.01	0	87	0.01	0
S5-s345c	Little Indian Creek	Perennial	60	-	10.75	Natural	Warm Water Habitat	113	0.09	0	108	0.09	0	99	0.08	0	106	0.09	0	99	0.08	0	100	0.08	0
S5-s345d	Little Indian Creek	Perennial	52.5	-	10.75	Bridge	Warm Water Habitat	130	0.10	0	130	0.10	0	130	0.10	0	130	0.10	0	130	0.10	0	130	0.1	0
S5-s345e	Little Indian Creek	Perennial	52.5	-	10.75	Natural	Warm Water Habitat	186	0.25	0	186	0.25	0	111	0.15	0	122	0.16	0	138	0.18	0	134	0.18	0
S5-s345f	Little Indian Creek	Perennial	46.75	-	11.88	Natural	Warm Water Habitat	107	0.04	0	41	0.02	0	335	0.14	0	0	0.00	0	327	0.14	0	0	0	0
S5-s345g	Little Indian Creek	Perennial	46.75	-	11.88	Bridge	Warm Water Habitat	25	0.01	0	0	0.00	0	25	0.01	0	0	0.00	0	25	0.01	0	0	0	0
S5-s345h	Little Indian Creek	Perennial	46.75	-	11.88	Natural	Warm Water Habitat	121	0.05	0	435	0.18	0	74	0.03	0	219	0.09	0	38	0.02	0	0	0	0
S5-s346a	Unnamed trib of Little Indian Creek	Ephemeral	-	37	0.04	Natural	Class I	274	0.03	0	282	0.03	0	120	0.01	120	120	0.01	120	120	0.01	120	120	0.01	120
S5-s346a_1	Unnamed trib of Little Indian Creek	Ephemeral	-	15	0.01	Roadside Ditch	Modified Class I	531	0.02	531	531	0.02	531	531	0.02	531	531	0.02	531	531	0.02	531	531	0.02	531
S5-s346a_2	Unnamed trib of Little Indian Creek	Ephemeral	-	32	0.01	Roadside Ditch	Modified Class II	112	0.01	112	112	0.01	112	112	0.01	112	112	0.01	112	112	0.01	112	112	0.01	112
S5-s346b	Unnamed trib of Little Indian Creek	Ephemeral	-	-	0.04	Culvert		164	0.02	0	164	0.02	0	164	0.02	0	164	0.02	0	164	0.02	0	164	0.02	0
S5-s346c	Unnamed trib of Little Indian Creek	Ephemeral	-	49	0.04	Natural	Modified Class II	221	0.01	0	222	0.01	0	92	0.01	0	91	0.01	0	92	0.01	0	92	0.01	0
S5-s348a	Unnamed trib of Little Indian Creek	Ephemeral	-	15	0.04	Roadside Ditch	Modified Class I	618	0.03	618	618	0.03	618	618	0.03	618	618	0.03	618	618	0.03	618	618	0.03	618
S5-s348a_1	Unnamed trib of Little Indian Creek	Ephemeral	-	6	0.01	Roadside Ditch	Modified Class I	279	0.01	279	279	0.01	279	279	0.01	279	279	0.01	279	279	0.01	279	279	0.01	279
S5-s348b	Unnamed trib of Little Indian Creek	Ephemeral	-	-	0.04	Culvert		183	0.01	0	183	0.01	0	183	0.01	0	183	0.01	0	183	0.01	0	183	0.01	0
S5-s348c	Unnamed trib of Little Indian Creek	Ephemeral	-	40	0.04	Natural	Modified Class II	187	0.01	0	187	0.01	0	104	0.01	0	105	0.01	0	104	0.01	0	104	0.01	0
S5-s348d	Unnamed trib of Little Indian Creek	Ephemeral	-	22	0.03	Natural	Class I	9	0.01	0	10	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s349a	Unnamed trib of Little Indian Creek	Intermittent	-	56	0.92	Natural	Class II	0	0.00	0	219	0.03	0	206	0.03	206	173	0.02	0	206	0.03	206	182	0.02	0
S5-s349b	Unnamed trib of Little Indian Creek	Intermittent	-	-	0.92	Culvert		0	0.00	0	0	0.00	0	0	0.00	0	13	0.01	0	0	0.00	0	22	0.01	0
S5-s349c	Unnamed trib of Little Indian Creek	Intermittent	-	53	0.97	Natural	Class II	84	0.02	0	163	0.04	0	665	0.15	665	79	0.02	0	665	0.15	665	92	0.02	0
S5-s349d	Unnamed trib of Little Indian Creek	Intermittent	-	-	0.97	Culvert		183	0.04	0	183	0.04	0	183	0.04	0	183	0.04	0	183	0.04	0	183	0.04	0
S5-s349e	Unnamed trib of Little Indian Creek	Intermittent	-	32	0.97	Natural	Class I	764	0.17	698	259	0.06	0	720	0.16	720	253	0.06	0	712	0.16	712	144	0.03	0
S5-s350a	Jordan Creek	Perennial	30	-	2.72	Natural	Limited Resource Water	0	0.00	0	169	0.02	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s350b	Jordan Creek	Perennial	24	-	2.72	Natural	Limited Resource Water	218	0.03	0	157	0.02	0	209	0.02	0	195	0.02	0	196	0.02	0	207	0.02	0

Table 5.19-10: Potential Stream Impacts and Potential Stream Relocation Lengths by Alternatives

Stream ID#	Stream Name	USGS Stream Type	QHEI Score	HHEI Score	Drain Area (mi2)	Channel Type	Stream Habitat Classification	Alternative 4			Alternative 5			Alternative 6			Alternative 7			Alternative 8			Refined Preferred Alternative 8		
								LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.	LF in ROW	AC in ROW	LF Relo.
S5-s350c	Jordan Creek	Perennial	24	-	2.72	Bridge	Limited Resource Water	129	0.01	0	129	0.01	0	129	0.01	0	129	0.01	0	129	0.01	0	129	0.01	0
S5-s350d	Jordan Creek	Perennial	24	-	2.72	Natural	Limited Resource Water	248	0.03	0	357	0.04	0	98	0.01	0	225	0.03	0	98	0.01	0	225	0.03	0
S5-s351a	Buckner Branch	Intermittent	31	-	1.25	Natural	Limited Resource Water	230	0.03	0	240	0.03	0	101	0.01	0	87	0.01	0	106	0.01	0	94	0.01	0
S5-s351b	Buckner Branch	Intermittent	-	-	1.25	Culvert		192	0.03	0	192	0.03	0	192	0.03	0	192	0.03	0	192	0.03	0	192	0.03	0
S5-s351c	Buckner Branch	Intermittent	31	-	1.25	Natural	Limited Resource Water	203	0.03	0	246	0.03	0	84	0.01	0	81	0.01	0	81	0.01	0	92	0.01	0
S5-s357a	Unnamed trib of Bryant Creek	Ephemeral	-	22	0.01	Natural	Class I	95	0.01	0	93	0.01	0	93	0.01	0	93	0.01	0	93	0.01	0	93	0.01	0
S5-s357b†	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		318	0.01	0	318	0.01	0	318	0.01	0	318	0.01	0	318	0.01	0	318	0.01	0
S5-s357c†	Unnamed trib of Bryant Creek	Ephemeral	-	40	0.01	Natural	Class II	55	0.01	0	55	0.01	0	55	0.01	0	55	0.01	0	55	0.01	0	55	0.01	0
S5-s358a	Unnamed trib of Bryant Creek	Ephemeral	-	10	0.01	Natural	Class I	104	0.01	0	102	0.01	0	102	0.01	0	102	0.01	0	102	0.01	0	102	0.01	0
S5-s358b†	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.01	Culvert		290	0.01	0	290	0.01	0	290	0.01	0	290	0.01	0	290	0.01	0	290	0.01	0
S5-s358c†	Unnamed trib of Bryant Creek	Ephemeral	-	22	0.01	Natural	Modified Class I	27	0.01	0	27	0.01	0	27	0.01	0	27	0.01	0	27	0.01	0	27	0.01	0
S5-s359_2	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.03	Concrete Gutter	Modified Class I	693	0.02	693	693	0.02	693	585	0.02	585	585	0.02	585	585	0.02	585	585	0.02	585
S5-s359b	Unnamed trib of Bryant Creek	Ephemeral	-	48	0.05	Natural	Class II	71	0.01	71	69	0.01	69	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s359c	Unnamed trib of Bryant Creek	Ephemeral	-	-	0.05	Culvert		347	0.03	0	347	0.03	0	328	0.02	0	328	0.02	0	328	0.02	0	328	0.02	0
S5-s360b_1	Unnamed trib of Fox Hollow	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	355	0.01	355	355	0.01	355	355	0.01	355	355	0.01	355	355	0.01	355	355	0.01	355
S5-s361	Unnamed trib of Little Indian Creek	Ephemeral	-	50	0.01	Natural	Class II	255	0.08	255	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s361_1	Unnamed trib of Little Indian Creek	Ephemeral	-	32	0.01	Natural	Class I	68	0.01	68	0	0.00	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s363a	Unnamed trib of Bryant Creek	Ephemeral	-	38	0.01	Natural	Class I	132	0.01	132	132	0.01	132	132	0.01	132	132	0.01	132	132	0.01	132	132	0.01	132
S5-s365	Unnamed trib of Bryant Creek	Ephemeral	-	27	0.01	Natural	Class I	184	0.01	184	187	0.01	187	144	0.01	144	144	0.01	144	144	0.01	144	144	0.01	144
S5-s366	Unnamed trib of Payne Hollow	Ephemeral	-	21	0.01	Natural	Class I	10	0.01	10	19	0.01	19	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s368	Unnamed trib of Bryant Creek	Ephemeral	-	40	0.01	Natural	Class II	86	0.01	0	85	0.01	0	0	0.00	0	0	0.00	0	0	0.00	0	0	0	0
S5-s383	Unnamed trib of Bryant Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	160	0.01	160	141	0.01	141	141	0.01	141	141	0.01	141	141	0.01	141	141	0.01	141
S5-s384a	Unnamed trib of Indian Creek	Ephemeral	-	22	0.02	Roadside Ditch	Modified Class I	2,379	0.10	2379	2,379	0.10	2379	2,379	0.10	2379	2,379	0.10	2379	2,379	0.10	2379	2379	0.1	2379
S5-s384b	Unnamed trib of Indian Creek	Ephemeral	-	12	0.04	Concrete Gutter	Modified Class I	101	0.01	101	101	0.01	101	101	0.01	101	101	0.01	101	101	0.01	101	101	0.01	101
S5-s384b_1	Unnamed trib of Indian Creek	Ephemeral	-	12	0.01	Concrete Gutter	Modified Class I	42	0.01	42	42	0.01	42	42	0.01	42	42	0.01	42	42	0.01	42	42	0.01	42
S5-s384c	Unnamed trib of Indian Creek	Ephemeral	-	-	0.04	Culvert		48	0.01	0	48	0.01	0	48	0.01	0	48	0.01	0	48	0.01	0	48	0.01	0
S5-s384d	Unnamed trib of Indian Creek	Ephemeral	-	12	0.04	Concrete Gutter	Modified Class I	99	0.01	99	99	0.01	99	99	0.01	99	99	0.01	99	99	0.01	99	99	0.01	99
S5-s420	Unnamed trib of Clear Creek	Ephemeral	-	12	0.02	Concrete Gutter	Modified Class I	0	0.00	0	0	0.00	0	499	0.01	499	499	0.01	499	499	0.01	499	499	0.01	499
							Grand Total	106,445	13.57	73,463	103,165	13.59	68,675	85,192	11.49	55,557	83,291	11.23	53,360	86,404	11.70	56,480	80,582	10.24	51,629

Abbreviations: LF = Linear feet, USGS = United States Geological Survey, HHEI = Headwater Habitat Evaluation Index, QHEI = Qualitative Headwater Evaluation Index, Relo. = Relocation, Ripar. = Riparian, ROW = Right-of-way, trib = Tributary

† At least a portion of this stream lies within the bifurcation area. The total stream length is 9,809 LF within the bifurcation area under all alternatives. Within the bifurcation area the total stream relocation is 6,579 LF under alternatives 4 and 5; 6,550 LF under alternatives 6, 7, and 8; and 6,549 LF under Refined Preferred Alternative 8.

Note: Width of the ordinary high water mark (OHWM) x linear feet of impact = acres of impact. HHEI and QHEI were not completed on culverted segments of the stream.

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Table 5.19-11 summarizes the potential impacts to streams by Alternative right-of-way and provides a comparison for the existing SR 37 right-of-way impacts as well as the percentage of new impacts.

Table 5.19-11: Summary of Potential Impacts to Streams within I-69 Right-of Way by Stream Type

Stream Type	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8	Existing SR 37 ROW Impacts
Ephemeral	87,432	83,795	68,414	66,804	69,506	65,692	56,439
Intermittent	14,984	14,816	12,915	12,636	13,067	11,862	9,909
Perennial	4,029	4,554	3,863	3,851	3,831	3,028	2,487
Total Impacts	106,445	103,165	85,192	83,291	86,404	80,582	68,835
Percent New Impacts	36%	34%	19%	17%	20%	15%	-

In addition to comparing linear feet of stream impacts associated with the alternatives, a weighted comparison of the alternatives' stream impacts was made. This approach was arrived at in consultation with resource agencies. The values of habitat evaluation scores are multiplied by stream length, and then summed for all streams impacted by each alternative. The summed scores for each alternative are divided by the value of the alternative, with the result expressed as a percentage. This implies that Refined Preferred Alternative 8 has a value of 100%. Weighted stream impact values for alternatives fell within the range of 100% to 158% for HHEI evaluated streams and between 100% and 153% for QHEI evaluated streams. **Table 5.19-12** provides a more detailed review of the QHEI and HHEI data and potential stream impacts and stream relocation impacts.

Table 5.19-12: Stream Impacts by Alternatives, Weighted by Habitat Evaluation Score

Habitat Eval. / Score Ranges	Alternatives - Linear Feet of Impact					
	4	5	6	7	8	Refined Preferred Alternative 8
HHEI Streams						
0 - 40	59,526	56,135	47,254	46,198	48,032	44,946
41 - 59	12,859	12,253	8,787	7,439	9,107	7,435
60 - 100	10,160	10,248	6,174	6,874	6,286	6,040
Totals	82,545	78,636	62,215	60,511	63,425	58,421
QHEI Streams						
0 - 50	3,129	3,607	2,851	2,884	2,786	2,388
51 - 64	1,523	1,620	1,444	1,198	1,487	1,081
> 64	120	176	116	300	108	108
Totals	4,772	5,403	4,411	4,382	4,381	3,577
Impact Lengths Multiplied by Habitat Evaluation Score, Percent Comparison						
HHEI	2,638,024	2,531,726	1,826,432	1,773,555	1,872,304	1,673,398
	158%	151%	109%	106%	112%	100%
QHEI	202,777	225,657	191,322	188,711	188,522	147,562
	137%	153%	130%	128%	128%	100%

The Section 5 alternatives may require the relocation of many stream segments. As previously discussed, multiple segments (indicating a change in habitat) can make up one stream reach. Alternative 4 would relocate 236 stream segments, Alternative 5 would relocate 225 stream segments, Alternative 6 would relocate 181 stream segments, Alternative 7 would relocate 181 stream segments, Alternative 8 would relocate 187 stream segments, and Refined Preferred Alternative 8 would relocate 175 stream segments. The lengths of relocations depend on the alternatives considered, ranging from a total of approximately 51,629 linear feet (Refined Preferred Alternative 8) to 73,463 linear feet (Alternative 4). Many of these relocations are currently roadside ditches within existing transportation right-of-ways (see **Table 5.19-13**). Natural stream relocations range between 16,729 linear feet (Refined Preferred Alternative 8) to 38,824 linear feet (Alternative 4).

Table 5.19-13: Summary of Potential Stream Relocations within I-69 Right-of-Way by Structure Type

Structure Type	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
Bridge	0	0	0	0	0	0
Concrete Gutter	22,406	22,386	22,351	22,369	22,417	22,417
Culvert	0	0	0	0	0	0
Dump Rock Gutter	1,969	2,039	1,879	1,915	1,923	1,930
Natural	38,284	32,621	19,991	18,286	20,813	16,729
Roadside Ditch	10,804	11,629	11,336	10,790	11,327	10,553
Total Relocations	73,463	68,675	55,557	53,360	56,480	51,629

Riparian Corridors: This analysis considers a riparian zone to be any forested area that is adjacent to the stream within 100 feet on either side of the stream centerline. The methodology for calculating the riparian impacts has been used in Sections 1-4. To remain consistent between the six section, this methodology has been utilized in Section 5. The 100 foot riparian zone was determined based upon information in the Habitat Management Sheet for Riparian Zones published by the Indiana Division of Fish and Wildlife in October 2004. It states "Depending on the size and slope of the floodplain, riparian corridors should be at least 50 to 100 feet in width on each side of the watercourse to adequately address wildlife and water quality needs." Impacts to plant communities within this zone are identified by calculating the total area of the community within the zone and also by measuring the linear feet that the community extends along the stream. While coordination with IDEM has determined that mitigation for impacts would be based on the linear feet measurement, knowing the total acres potentially impacted offers a better understanding of the potential effects of the project on flora and fauna in the vicinity of the streams.

Potential riparian corridor impacts range from approximately 107.27 acres (Refined Preferred Alternative 8) to 198.47 acres (Alternative 4). All riparian areas within the right-of-way of an alternative are considered to be potentially impacted. **Table 5.19-7** briefly summarizes the potential stream and riparian corridor impact with each of the alternatives. **Table 5.19-8** identifies the streams having riparian corridors that could be impacted and the acres of potential impact, by alternative.

Floodplains

According to FIRM No. 18105C0131D for Monroe County, the project crosses the 100-year floodplain of Beanblossom Creek in several locations, depending on the alternative. All of the alternatives have what could be considered both transverse and longitudinal crossings of this floodplain. The Beanblossom floodplain at existing SR 37 is approximately 5,070 feet wide in this valley. Each alternative includes service roads connecting North Bottom Road with SR 37, as well as separate spurs for local traffic to East Ellis Road and North Kinser Pike. Alternatives 4, 5, 6, 7, and 8 include an access road on the east side of the roadway between Walnut Street and Connaught Road, resulting in additional floodplain impacts. Refined Preferred Alternative 8

does not have this east side access road, eliminating additional impacts in this area of the Beanblossom Creek floodplain. In addition, Alternatives 5 and 8 (Option A) would have a full interchange at Walnut Street, resulting in additional floodplain impacts when compared to the other build alternatives. Alternatives 7, 8 (Option B), and the Refined Preferred Alternative 8 maintain the existing partial interchange, resulting in less impacts to the floodplain of Beanblossom Creek.

According to FIRM No. 18105C0050D for Monroe County, the project crosses the 100-year floodplain of Bryant Creek. Alternatives 4, 5, 6, 8 and Refined Preferred Alternative 8 cross the floodplain in the same approximate locations resulting in similar floodplain impacts. However, Alternatives 6, 8, and Refined Preferred Alternative 8 have a smaller footprint due to the minimal impact criteria, resulting in less impacts to the Bryant Creek floodplain. Alternative 7 crosses this floodplain in an additional location from a connector road leading to East Bryant's Creek Road, resulting in a larger floodplain impact in this area.

FIRM No. 1801760075B of Morgan County identifies the 100-year floodplain of Little Indian Creek. The floodplain is approximately 1,780 feet wide in this broad valley and includes a 100-year floodplain of an unnamed tributary to Little Indian Creek. Each of the alternatives could be considered to have both transverse and longitudinal floodplain encroachments. Alternatives 4, 6, and 8 impact this floodplain with both the mainline crossing as well as southbound exit/on ramps, Godsey Road crossroad, and Liberty Church Road crossroad. Alternatives 5 and 7 each impact the Little Indian Creek floodplain with multiple southbound ramps, a crossroad connecting Godsey Road and Liberty Church Road, as well as the mainline. Refined Preferred Alternative 8 shifts the Liberty Church Road interchange approximately 700 feet north of the current intersection of Godsey Road/Liberty Church Road, moving the interchange ramps out of the floodplain. This shift minimized impacts to the floodplain when compared to the other alternatives.

The Indian Creek (FIRM No. 1801770015B) 100-year floodplain is only slightly encroached by the northern termini of each of the alternatives. There are no proposed improvements to the existing bridge over Indian Creek and thus, impacts to this resource shall be considered minor.

In all, the impacts to floodplains range from 75.15 acres (Refined Preferred Alternative 8) to 145.50 acres (Alternative 5) and are shown on **Table 5.19-14.** Existing SR 37 right-of-way accounts for 46% to 89% of the total acres of floodplain impacts included in the alternatives, and 89% of the total acres of floodplain impacts for Refined Preferred Alternative 8.

Table 5.19-14: Floodplain Impacts

Impacts (Acres)	Build Alternatives					
	4	5	6	7	8	Refined Preferred Alternative 8
Within SR 37 Right-of-Way	66.49	66.60	66.60	66.59	66.60	66.60
Outside of SR 37 Right-of-Way	59.06	78.90	60.38	33.10	61.92	8.55
Total Acres of Impact	125.55	145.50	126.98	99.69	128.52	75.15
Percent of Impacts Outside Existing SR 37 Right-of-Way	47%	54%	48%	33%	48%	11%

Hydraulic analysis and an Aquatic Organism Passage (AOP) analysis will be performed at a later stage of the project in the vicinity of stream crossings which require bridges to ensure that the proposed crossings will not result in significant increases in flooding. This includes crossings of Griffy Creek, Beanblossom Creek, Bryant Creek, Little Indian Creek, and Jordan Creek, as well as the wetland/unnamed tributary complex in the Beanblossom Valley. The creek openings of the proposed bridges[6] over these streams would be sized so that 100-year floodway elevations would not be substantially affected. There would be no significant change in flood risk due to implementation of I-69, and there would be no increase in potential for interruption or termination of emergency service or emergency evacuation routes. Flood easements may be acquired if determined appropriate.[7]

Surface Water Quality

In accordance with Section 305(b) of the CWA, IDEM publishes the annual *Integrated Water Quality Monitoring and Assessment Report*. This report includes updating the Section 303(d) (CWA) List of Impaired Waters for the State of Indiana (IDEM 2012)[8] every two years. These are water bodies that do not or are not expected to meet applicable water quality standards with federal technology based standards alone. A review of the Draft 2012 list shows that there are three impaired waters within the Section 5 corridor. They include from north to south: Weimer Lake, Beanblossom Creek, and Indian Creek. However, only Beanblossom Creek is crossed by any of the alternatives. Beanblossom Creek is identified on the Draft 2012 303(d) List of Impaired Waters due to PCB contamination and is crossed by all the project's alternatives. The other impaired waters (Weimer Lake and Indian Creek) are not directly crossed by any of the alternatives. Alternatives 7 and Refined Preferred Alternative 8 extend an existing pipe culvert

6 Some existing bridges may require replacement due to condition of the structure or because of the geometric features of the mainline (for various alternatives, particularly 4 & 5).

7 Refer to **Chapter 13**, *Glossary, Acronyms, and Index*, for further discussion of Flood Easements.

8 IDEM has provided a draft list of impaired waters for 2012. This list has not yet been approved.

along an inlet to Weimer Lake. **Figure 5.19-3** shows the location of impaired streams in the vicinity of Section 5.

The Upper White River Watershed, Lower White River Watershed, and Lower East Fork White River Watershed are the three 8-digit watersheds traversed by the project corridor. These watersheds are briefly described in **Section 4.3.2**, *Water Resources*. Information regarding water quality in the three 8-digit watersheds and their sub-watersheds within the project corridor is summarized below.

Upper White River Watershed. Numerous streams identified in the project corridor are within the Upper White River Watershed. These streams are tributaries to the White River, which drains to the Wabash River. Several streams in the watershed are included in the State of Indiana's Draft 2012 CWA Section 303(d) list of impaired waterbodies (IDEM 2012), including White River itself and Indian Creek. However, none of the alternatives cross either of the impaired watercourses. The White River is listed as impaired due to its impaired biotic communities and Fish Consumption Advisory (FCA) for polychlorinated biphenyl (PCBs). Indian Creek is listed with unacceptable levels of coliform bacteria *E. coli*. **Table 5.19-8** identifies the major streams and tributaries within the right-of-way of each alternative.

Section 5 of the I-69 corridor crosses three sub-watersheds of the Upper White River Watershed. The three sub-watersheds are briefly described below (IGS GIS Atlas, 2012).

- Indian Creek-Sand Creek Watershed: This sub-watershed encompasses approximately 7,835 acres, and it includes approximately 3,200 feet of the northernmost portion of the Section 5 corridor. There are no National Pollutant Discharge System (NPDES) discharge points in this sub-watershed.

- Little Indian Creek-Jordan Creek Watershed: This sub-watershed encompasses approximately 10,896 acres, and it is located from Maxwell Hill south to Pine Boulevard (east of SR 37). There are no NPDES discharge points in this sub-watershed.

- Bryant Creek Watershed: This sub-watershed encompasses approximately 7,277 acres, and it is located from Pine Boulevard (east of SR 37) south to West Burma Road (west of SR 37). There are no NPDES discharge points in this sub-watershed.

Lower White River Watershed. Numerous streams identified in the project corridor are within the Lower White River Watershed. These streams are tributaries to the White River, which drains to the Wabash River. Several streams in the watershed are included in the State of Indiana's Draft 2012 CWA Section 303(d) list of impaired waterbodies (IDEM 2012), including the White River itself and Beanblossom Creek. None of the alternatives cross the White River. However, all of the alternatives cross Beanblossom Creek, which is listed as impaired with high levels of PCBs.

Section 5 of the I-69 corridor crosses four sub-watersheds of the Lower White River Watershed. The four sub-watersheds are briefly described below (IGS GIS Atlas, 2012).

- Beanblossom Creek-Indian Creek Watershed: This sub-watershed encompasses approximately 11,673 acres, and it covers a small portion in the middle of the Section 5 corridor. There are no NPDES discharge points in this sub-watershed.

- Beanblossom Creek-Buck Creek/Muddy Fork Watershed: This sub-watershed encompasses approximately 12,115 acres, and it covers the middle portion of the Section 5 corridor. There are no NPDES discharge points in this sub-watershed.

- Beanblossom Creek-Stout Creek Watershed: This sub-watershed encompasses approximately 15,518 acres, and it covers the middle portion of the Section 5 corridor. There are three NPDES discharge points in this watershed. Only one is located upstream of the corridor, and it is identified as the ABB Power T & D Company (formally Westinghouse). This outfall is in the headwaters of an unnamed tributary to Stout Creek of the Beanblossom watershed. However, none of the alternatives directly cross Stout Creek. There are two other NPDES discharges which are located well downstream and west of the project corridor. They include the Star of Indiana (old Brown School Waste Water Treatment Plant) facility and the Bloomington North (Blucher Poole) Sewage Treatment Plant.

- Griffy Creek Watershed: This sub-watershed encompasses approximately 9,027 acres, and it extends from Beanblossom Creek south to North Kinser Pike Road. There are no NPDES discharge points in this sub-watershed.

Lower East Fork White River Watershed. Numerous streams identified in the project corridor are within the Lower East Fork White River Watershed. These streams are tributaries to the Lower East Fork White River, which originates from the confluence of the Upper East Fork White River and Muscatatuck River near Medora, then flows southwest before joining the Lower White River near Petersburg and ultimately discharging into the Wabash River. Several streams in the watershed are in the State of Indiana's Draft 2012 CWA Section 303(d) list of impaired waterbodies (IDEM 2012), including the Lower East Fork White River itself and Clear Creek, as well as Weimer Lake. Only Weimer Lake is within the Section 5 corridor, and it is not directly crossed by any alternative. Weimer Lake is listed due to its impaired biotic communities and FCA for mercury. Several tributaries to the Lower East Fork White River and Clear Creek are within the Section 5 corridor.

Section 5 corridor crosses two sub-watersheds of the Lower East Fork White River Watershed. The two sub-watersheds are briefly described below (IGS GIS Atlas, 2012).

- Clear Creek-May Creek Watershed: This sub-watershed encompasses approximately 19,182 acres, and it covers the southern terminus of the Section 5 corridor. There is one NPDES discharge facility in the watershed. It is identified as the Dillman Road Waste Water Treatment Plant that discharges into Clear Creek. This is located well south and downstream of the corridor.

- Clear Creek-Jackson Creek Watershed: This sub-watershed encompasses approximately 16,074 acres, and it covers the southern portion of the Section 5 corridor. There is one NPDES discharge point in the watershed located at Keil Brothers Oil Company service

station for groundwater treatment. This point source discharges into a tributary to Jackson Creek that feeds Clear Creek, located east and downstream of the corridor.

5.19.2.4 Mitigation

Chapter 7, *Mitigation and Commitments*, contains details on proposed measures to mitigate surface water resource impacts that may result from the project. The following paragraphs outline the proposed measures.

Wetlands

Within the Section 5 corridor, there are 21 palustrine forested (PFO) wetlands totaling approximately 37.52 acres, 36 palustrine emergent (PEM) wetlands totaling approximately 10.34 acres, seven palustrine shrub/scrub (PSS) wetlands totaling approximately 3.41 acres, two palustrine aquatic bed (PAB) wetlands totaling approximately 2.23 acres, and 43 palustrine unconsolidated bottom (PUB) wetlands totaling approximately 29.68 acres. Of these 109 wetlands, 49 are within the construction limits of one or more alternatives. For the purposes of the Section 5 INWRAP analysis, some of these wetlands were combined into complexes. Thirty-three (33) wetland complexes (not including open water) are within the construction limits of one or more alternatives. One of these wetland complexes appears to be a "waters of the state" (isolated) and would be regulated solely by IDEM. Thirty-two (32) of these wetland complexes appear to be "waters of the U.S." and, as such, would be under the jurisdiction of USACE and IDEM. Depending on the alternatives considered, the total impacts to emergent, scrub-shrub, aquatic bed, and forested wetlands range from approximately 3.43 acres to 16.06 acres. PUB wetland impacts are discussed with impacts to open water (see **Section 5.19.2**, *Surface Waters*). The following measures will be utilized to address impacts on wetlands:

- **Avoidance and Minimization—**Wetlands and wetland complexes will be avoided when possible and follow the Wetlands MOU dated January 28, 1991, between INDOT, IDNR, and USFWS. If unable to be avoided completely, wetland impacts will be minimized by shifts in the alignment wherever practicable and feasible in final design. A firm commitment was made that wetlands and other water resources will be actively avoided wherever practicable and feasible throughout the final design of the Section 5 roadway. In determining avoidance and minimization for wetland impacts, two options for the Walnut Street interchange were evaluated in the DEIS. During the development of the FEIS, the justification for the use of a partial interchange at Walnut Street was approved by FHWA and the east side access road north of this interchange was also shortened to reduce impacts to wetlands within the Beanblossom floodplain. Wetland impacts were minimized from 9.96 acres for Alternative 8 (Option A) to 3.43 acres for Refined Preferred Alternative 8. All water resource areas within the right-of-way will be identified on the design plans, and these areas will have erosion control measures as approved by IDEM as part of the overall erosion control plan for the roadway project to prevent any filling or contamination of these areas during construction of the Section 5 project.

  Revised Tier 1 Conceptual Forest and Wetland Mitigation and Enhancement Plan— During Tier 1, INDOT and FHWA developed a Tier 1 *Forest and Wetland Mitigation*

and Enhancement Plan ("Plan") for the proposed project in consultation with the USFWS and other review agencies. An updated version of that Plan has since been developed,[9] and its stipulations regarding wetland mitigation are included in USFWS's revised Tier 1 Biological Opinion issued on August 24, 2006 (as amended May 25, 2011).[10] The revised Tier 1 Plan included a commitment to replace wetlands at a ratio of 3 to 1 for forested and scrub/shrub wetlands, and a ratio of 2 to 1 for emergent wetlands. The wetland mitigation sites will include an approximate 25% buffer area around them in appropriate areas. Based on these mitigation ratios, depending on the alternatives considered, mitigation for wetland impacts ranges from approximately 10.61 acres (Refined Preferred Alternative 8) to 53.23 acres (Alternative 5). **Table 5.19-15** identifies the potential mitigation for each alternative.

Table 5.19-15: Potential Acres of Wetland Mitigation

Acres Assuming 2 to 1 Ratio for Emergent, 2 to 1 Ratio for Aquatic Bed, 3 to 1 Ratio for Scrub/Shrub, 3 to 1 Ratio for Forested, and a 25% Buffer	Alternatives: Potential Acres of Wetland Mitigation					
	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
	39.11	53.23	35.96	16.39	32.83	10.61

The revised Plan also identifies the general location of 13 potential mitigation sites along the entire Tier 1 Preferred Alternative 3C corridor from Evansville to Indianapolis for the design and construction of wetlands and upland forest. In Section 5, three potential mitigation sites have been identified: West Fork White River (Bryant Creek), Beanblossom Bottoms (Monroe County), and Morgan-Monroe State Forest (Morgan County). These sites are described in **Chapter 7,** *Mitigation and Commitments*. These sites have been identified for further consideration. Other areas may also be identified in the future.

- **Wetland Pooling—**If appropriate, wetland mitigation may include wetland pooling, meaning efforts will be made to group mitigation sites together to create a more substantial and effective mitigation site.
- **Wetland Mitigation and Monitoring Plans—**As required for Section 404 permitting, Wetland Mitigation and Monitoring Plans will be prepared. Additional measures to

[9] Appendix D of the Tier 1 BA Addendum contains the revised Tier 1 Plan, which is also included in this FEIS as **Appendix S**, *Revised Tier 1 Conceptual Forest and Wetland Mitigation Plan & Comparison of Tier 1 Plans*. A copy of the original *Tier 1 Conceptual Forest and Wetland Mitigation and Enhancement Plan* was included as Appendix NN in the Tier 1 FEIS, Volume II.

[10] The revised Tier 1 BO was primarily based on the agency's review of two documents: the *Tier 1 Biological Assessment for Threatened and Endangered Species, Interstate 69, Indianapolis to Evansville*, dated July 18, 2003, revised October 27, 2003 (hereafter referred to as the Tier 1 BA); and the *Tier 1 Biological Assessment Addendum* dated March 7, 2006, (hereafter referred to as the Tier 1 BA Addendum).

minimize impacts to specific wetland sites will be considered, including narrowing the right-of-way; installing drainage features such as swales to ensure that roadway runoff does not enter wetland areas; and, designing culverts to maintain the flow of water to a wetland area otherwise cut off from its existing water source.

- **Spraying of Herbicides—**To prevent herbicides from entering wetland areas, "Do Not Spray" signs will be posted as appropriate in the right-of-way.

Given that wetlands may naturally increase, decrease, be eliminated, or form over the course of time, detailed mitigation plans will be developed before or during final design to meet the permitting requirements of the USACE. At that time, additional measures to minimize impacts to specific wetland sites will be considered, including narrowing the right-of-way; installing drainage features such as swales to ensure that roadway runoff does not enter wetland areas; and designing culverts to maintain the flow of water to a wetland area otherwise cut off from its existing water source. A more detailed conceptual mitigation plan is included in the Section 5 Tier 2 Biological Assessment (BA), included as **Appendix LL1** (redacted).

Open Water

Ten of the 43 palustrine unconsolidated bottom (PUB) wetlands located within the Section 5 corridor would be affected by the project. The total acres of impacts range from 1.40 acres to 5.38 acres, depending on the alternative considered. Mitigation will be accomplished using a 1 to 1 ratio, as previously agreed upon by the regulatory agencies. Borrow pit construction or preservation of existing open water areas may be considered for mitigating these open water impacts. The total amount of mitigation for impacts to open water/PUBs, by alternative, is shown on **Table 5.19-16**.

Table 5.19-16: Potential Open Water Impacts

Open Water (1 to 1 Ratio)	Alternatives					
	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
Acres for Mitigation	1.40	4.18	5.38	2.20	2.50	0.02

Rivers and Streams

Because the project is on existing alignment through Section 5, the majority of proposed stream crossings have been previously disturbed. Where the interstate design intersects a stream crossing structure associated with an existing local road, it may be necessary to modify or relocate that structure to accommodate the planned interstate construction. Where reasonable, Refined Preferred Alternative 8 will cross streams at their narrowest floodway width and utilize existing stream crossings where appropriate. The potential impacts to streams vary with the alternatives considered. The linear feet of all streams, including culverts (perennial, intermittent, and ephemeral) within the existing right-of-way range from approximately 80,582 linear feet

(Refined Preferred Alternative 8) to 106,445 linear feet (Alternative 4). However, the regulatory agencies will not require mitigation for concrete gutters, roadside ditches, or culverted segments that are determined to not be jurisdictional resources.

IDEM and USACE criteria call for mitigating stream impacts based on the length of impact. A linear foot ratio as agreed upon by the regulatory agencies will be used to mitigate impacts to streams in Section 5. Stream impacts that require mitigation by IDEM and the USACE would range from approximately 26,389 linear feet (Refined Preferred Alternative 8) to 51,840 linear feet (Alternative 4). **Table 5.19-17** summarizes potential mitigation for stream impacts (excluding concrete gutters, dump rock gutter, roadside ditches, or culverted segments) for each of the alternatives. The mitigation concept being proposed for stream mitigation for Section 5 includes stream restoration, stream enhancement, and stream preservation by conservation easements being recorded as approved by the regulatory agencies. The realignment of surface streams or impacts to riffle-pool complexes and natural stream geomorphology will be avoided where reasonable. In instances where this is not possible, stream impacts will be minimized and mitigated. Stream relocations within Indiana bat maternity colony areas will be completed using the natural channel design features that are identified through coordination with the resource agencies. The cost estimate in **Chapter 7**, *Mitigation and* Commitments, for stream mitigation was calculated on a per acre basis and not a linear feet basis, due to the proposed stream mitigation concept identified above. Stream mitigation will be completed to compensate for linear feet of stream impacts in coordination with both the USACE and IDEM during the permitting process of the Section 5 project. Wherever possible, both banks of stream mitigation areas will be protected. If both banks cannot be protected, coordination with both IDEM and USACE will be completed to identify the amount of mitigation credits that INDOT may receive based on the proposed mitigation site. Consideration will be given in the design phase to planting trees and shrubs along relocated streams and outside right-of-way edge.

Water bodies, wetlands, and other natural areas outside the construction limits but within the right-of-way will be delineated and posted with “Do Not Disturb” signs. Tree clearing and snag removal will be kept to a minimum and limited to within the construction limits and calendar requirements. In the median, tree clearing will be kept to a minimum with woods kept in as much a natural state as reasonable if it is sufficiently outside any clear zone requirements. Note that providing approximately 20 feet of cleared space around a bridge would be permitted to allow sufficient room for bridge maintenance and inspection.

Coordination with IDEM and USACE has been initiated and will continue throughout the development of the proposed mitigation sites that will be offered for compensatory mitigation in Section 5. Natural channel stream designs for perennial and larger intermittent stream relocation located within the Indiana bat maternity colony areas and the Winter Action Area may include but will not be limited to stream designs that incorporate riffle/run/pool/glide or step/pool sequences and sinuosity to replicate natural channel geomorphology, in-stream structures (log and rock vanes) to help prevent stream bank erosion and provide fish habitat, and riparian buffer plantings outside the clear zone of the roadway. Off-site channel restoration for compensatory mitigation will also be completed including the same natural stream channel design features.

Table 5.19-17: Potential Mitigation for Streams and Riparian Impacts

Mitigation (1 to 1 Ratio)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
For Natural Streams*:						
Linear feet in right-of-way	51,840	47,636	30,396	28,858	31,376	26,389
Acres in right-of-way	9.59	9.59	7.65	7.39	7.84	6.41

** Natural Streams include the natural channels and bridge structures and excludes concrete gutter, culverts, dump rock gutter, and roadside ditch structures.*

Continued efforts will be made during final design to identify design features that would minimize impacts at stream crossings, including identifying measures to keep channel and bank modifications to a minimum and, where feasible, to avoid channel alterations below the ordinary high water elevation. Mitigation of stream impacts could include installing three-sided culverts or oversized box culverts sunk into the streambed that would retain the natural channel bottom, thereby facilitating the migration of stream fauna through the culverts and reducing impacts to the flow rate. The culverts should be of sufficient size to prevent upstream bed instability and erosion of downstream banks. The channels of Griffy Creek, Beanblossom Creek, Bryant Creek, Little Indian Creek, and Jordan Creek, as well as the wetland/unnamed tributary complex in the Beanblossom Valley and a portion of their overbanks will be bridged to minimize stream and riparian impacts.

During the design phase, consideration will be given to using alternative armoring materials and to including portions of dry land under the bridge opening that is not armored with riprap. The use of bioengineering techniques to provide natural protection of stream banks will be considered and implemented, where practicable. Installation of riprap will be limited to areas necessary to protect the integrity of structures being installed. If riprap is required, it will be installed outside the thalweg and between the toe of slope and the OHWM, where possible. In some instances, such as culvert inlets and outlets, riprap may need to be placed within the thalweg to prevent scour. Riprap will be installed at the same elevation as the thalweg to avoid fish passage issues. Riprap may also be needed above the OHWM to protect bridge piers and abutments from scour where bioengineering will not sufficiently withstand high flow velocities.

Erosion and sedimentation control and other measures will be employed to avoid or minimize the temporary impacts to streams during construction activities. Implementation of an approved stormwater pollution prevention plan will aid in the control of erosion and sedimentation. All construction activities must comply with federal and state soil erosion and sedimentation regulations, including a stormwater pollution prevention plan (SWPPP) for the installation and maintenance of Best Management Practices (BMPs) on site. This plan will be developed in conjunction with final construction plans. INDOT Standard Specifications, Special Provisions, and IDEM Stormwater Quality Manual will govern construction activities to control erosion and subsequent water pollution.

Other details of mitigation will be coordinated with the regulatory agencies with jurisdiction during the permitting process. In addition, INDOT will coordinate with IDEM, IDNR, and USACE to take into account any recent stream stabilization projects. In addition, any stream relocations required within an Indiana bat maternity colony area in Section 5 will be completed with a natural stream design. USFWS will be included in the coordination regarding the relocation during the permitting process to assure that any concerns relative to the Indiana bat are addressed as part of the stream relocation.For additional discussion of mitigation measures, see **Chapter 7**, *Mitigation and Commitments.*

Floodplain

A final hydraulic design study that addresses various structure size and types will be completed during the final design phase of I-69, and a summary of this will be included with the Field Check Plans and Design Summary. Longitudinal and transverse floodplain encroachments will be minimized, where reasonable, through re-use of existing bridges, and design practices such as longer bridges and perpendicular stream crossings where new bridges are warranted. The crossings at Bryant Creek, Jordan Creek, and the Buckner Branch of Little Indian Creek are transverse crossings. A hydraulic study during final design will determine the length of the span. Refined Preferred Alternative 8 would encroach longitudinally upon the Little Indian Creek floodplain. The Beanblossom Creek and Griffy Creek floodplains are so broad that Refined Preferred Alternative 8's crossings could be classified as either longitudinal or transverse. The Indian Creek floodplain is only slightly encroached by the northern termini of each of the alternatives. There are no proposed improvements to the existing bridge over Indian Creek and thus, impacts to this resource shall be considered minor. Flood easements may be acquired at these or other locations if determined appropriate.

INDOT will seek and secure a formal permit application to IDNR Division of Water during this phase of project development in all areas that require a "Construction in a Floodway" permit.

Drainage Control

Roadway runoff can have significant impacts to the water quality of receiving streams. Numerous constituents may be found in roadway runoff from multiple sources. These constituents include: particulates, nitrogen, phosphorus, metals, salts, petroleum, pesticides, PCBs, rubber, pathogenic bacteria, and asbestos. These constituents are originated by many different sources. Some of the primary sources include: deicing chemicals, tire wear, wear of engine parts and other moving parts, exhaust, motor lubricant leaks and blow-by, roadside fertilizing and spraying, and precipitation. These items are of special concern in karst areas and are discussed in **Section 5.21**, *Karst Impacts*.

Of the identified runoff constituents, a point of primary concern is the build-up of deicing chemicals in the atmosphere, due to the seasonally large volumes of this contaminant. Salting of a highway in winter with the drainage from the road could cause changes in the water quality of a number of streams, especially those with little volume or flow. Salting of any road may lead to adverse effects for aquatic and terrestrial organisms. A variety of environmental consequences have been associated with the use of deicing chemicals and their associated additives. Road

salting affects water quality, soil properties, plants, and animals. Salt inhibits plant growth by changing soil structure, changing the osmotic gradient and through chloride ion toxicity (NCHRP, 1976). Excess salinity causes moisture stress in plants, suppresses proper nutrient uptake, and leads to deficiencies in plant nutrition (NCHRP, 1978). In addition, additives can contribute to eutrophication in wetlands and toxicity to its inhabitants. Where appropriate, construct roadside ditches that are grass-lined and connected to filter strips and containment basins. Make every effort to minimize the amount of salt used on the bridges and roads. Use alternative substances or low salt (e.g., sand) as much as possible. More detail related to INDOT's current de-icing practices is presented in INDOT Snow and Ice Control Instructions, **Appendix Q**, *INDOT SOP's - Wells, Asbestos, Snow & Ice Control*.

BMPs will be used to prevent non-point source pollution, to control storm water runoff, and to minimize sediment damage to water quality and aquatic habitats (see **Section 7.3**, *Section 5 Mitigation Measures and Commitments*).

Hazardous Material Spill Response

The release of hazardous and potentially harmful materials into adjacent surface and subsurface waters from spills along highways is a concern both during and after construction. These items are of special concern in karst areas, as noted in **Section 5.21**, *Karst Impacts*. This is especially true when the highway is anticipated to be used by large volumes of semi-trucks transporting a wide variety of such substances. Because each of the alternatives for Section 5 would cross a number of streams, the potential for such impacts exists for all of the alternatives.

During construction of I-69, contractors will be required to provide an acceptable spill response plan. This response plan will include telephone numbers for emergency response personnel and copies of agreements with any agencies which are part of the spill-response effort. An emergency contact telephone number also is required. Special measures including diversions of highway runoff from direct discharge off of bridge decks into streams, and containment basins to detain accidental spills, will be incorporated into final design plans for perennial streams within any of the Indiana bat maternity colony areas.

Following construction of I-69, emergency spill response for hazardous materials transported on the highway will be handled by local fire departments and regional hazardous materials units coordinated through the deputy state fire marshals in Bloomington and Terre Haute. Currently, law enforcement and nearly all fire departments within the study area possess either awareness-level or operations-level capabilities for responding to hazardous material spills or releases. Awareness includes the recognition of hazardous material placards and the means to cordon off an incident site. Operations level includes booms for diking spills, personal protection equipment to work within contaminated sites, and other basic containment equipment. If called upon, INDOT state highway equipment and resources can also be deployed to assist in containment anywhere along the proposed interstate facility.

Indiana's State Emergency Commission has established 11 Regional Response Teams throughout the state, each of which will have full Level A hazardous materials response capabilities. Currently, the hazardous materials units of Bloomington Township and Crane Naval

Surface Warfare Center (NSWC) are the closest regional unit with Level A capabilities to the Section 5 study area. Evansville, Vincennes, Terre Haute, and Marion County/Indianapolis area are the other regional units with Level A capabilities. The I-69 project will help accelerate emergency response to incidents on routes served by these units.

5.19.2.5 Summary

As **Table 5.19-18** indicates, impacts to surface waters are anticipated in Section 5. In the case of impacts to wetlands, the differences among the alternatives' impacts varies. For example, there is a 12.63 acre difference between the greatest (Alternative 5) and the least (Refined Preferred Alternative 8) impacts to non-open water wetlands. The Refined Preferred Alternative 8 has the least amount of impact to non-open water wetlands at 3.43 acres. The total range of impacts, including open water, is from 3.43 acres (Refined Preferred Alternative 8) to 20.24 acres (Alternative 5). The INWRAP evaluations rated the majority of the wetlands as poor to fair quality in their regard to animal habitat; poor to fair in botanical quality; and fair to good quality in their hydrology measure. The range of impacts to streams between the alternatives is also relatively small. The linear feet of streams within the right-of-way of the alternatives range from 80,582 linear feet (Refined Preferred Alternative 8) to 106,445 linear feet (Alternative 4). Potential stream relocations range from 51,629 linear feet (Refined Preferred Alternative 8) to 73,463 linear feet (Alternative 4). The total *acres* of impact (linear feet *x* width of stream's OHWM divided by 43,560) range from 10.24 acre to 13.59 acres, with only 3.35 acres separating the alternatives with the greatest and least acreage impact. The habitat evaluations determined that the majority of the smaller streams in the project corridor are of poor quality.

Because Section 5 of I-69 entails upgrading an existing multi-lane, divided transportation facility to a full freeway design, most of the right-of-way used for the Section 5 project already is devoted to transportation use. Accordingly, the impacts to most natural resources in Section 5 will be lessened (on a per-mile basis) in comparison with Sections 1 through 4, which are being constructed on new terrain.

Existing SR 37 right-of-way accounts for 25% to 79% of the total acres of wetland impacts included in the alternatives and 79% of the total acres of wetland impacts for Refined Preferred Alternative 8. Correspondingly, the percentage of new impacts to wetlands among the alternatives ranges between 21% (Refined Preferred Alternative 8) to 75% (Alternative 5).

Existing SR 37 right-of-way accounts for 64% to 85% of the total linear feet of stream impacts included in the alternatives and 85% of stream impacts for Refined Preferred Alternative 8. Likewise, the percentage of new impacts to streams from the build alternatives ranges between 15% (Refined Preferred Alternative 8) to 36% (Alternative 4). Stream relocations within the existing SR 37 right-of-way account for 59% to 85% of the total linear feet of stream relocations with 85% of the total linear feet of stream relocations for Refined Preferred Alternative 8 within existing SR 37 right-of-way. Consequently, the percentage of new stream relocation impacts among the alternatives ranges between 15% (Refined Preferred Alternative 8) to 41% (Alternative 4).

Existing SR 37 right-of-way accounts for 46% to 89% of the total acres of floodplain impacts included in the alternatives and 89% of the total acres of floodplain impacts for Refined Preferred Alternative 8. Moreover, the percentage of new impacts to floodplains from the build alternatives range from 11% (Refined Preferred Alternative 8) to 54% (Alternative 5).

Early coordination has occurred, and consultation is ongoing with the regulatory agencies. It is anticipated that a USACE 404 Permit, an IDEM 401 Water Quality Certification, an IDEM Isolated Wetlands Permit, an IDEM Rule 5 Permit, and an IDNR Construction in a Floodway Permit would be needed to construct any of the proposed alternatives. Detailed permit coordination would occur before or during the final design phase of the project. The permits will include a detailed mitigation and monitoring plan for wetland, forest, and stream impacts, as appropriate. **Table 5.19-18** provides a summary of potential surface water resource impacts by alternative. **Section 5.23**, *Permits,* provides more detailed information about permits that may be required. **Chapter 7**, *Mitigation and Commitments*, provides detailed discussion of measures to mitigate surface water resource impacts.

Table 5.19-18: Summary of Potential Impacts to Surface Waters, by Alternative

Wetland Impacts	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
Construction Limit Wetland Impacts (acres):						
Aquatic Bed	0.20	0.40	0.17	0.00	0.14	0.02
Emergent	3.61	5.20	3.94	2.43	3.48	1.78
Scrub/Shrub	1.33	1.34	1.09	1.11	1.07	1.04
Forested	6.56	9.12	5.76	1.64	5.27	0.59
Total Impacts (Construction Limits)	11.70	16.06	10.96	5.18	9.96	3.43
Construction Limit Wetland Impacts within Existing SR 37 Right-of-Way	3.51	4.08	3.38	2.79	3.36	2.70
Percent New Impacts	70%	75%	69%	46%	66%	21%
Stream Impacts	**Alternative 4**	**Alternative 5**	**Alternative 6**	**Alternative 7**	**Alternative 8**	**Refined Preferred Alternative 8**
Total Linear Feet of Stream Impacts within Right-of-Way	106,445	103,165	85,192	83,291	86,404	80,582
Linear Feet of Impacts within Existing SR 37 Right-of-Way	67,833	67,875	68,832	68,834	68,835	68,815
Percent New Impacts	36%	34%	19%	17%	20%	15%
Right-of-Way Limit Impacts (total acres):	13.57	13.59	11.49	11.23	11.7	10.24
Linear Feet of Stream Relocations within Project Corridor - Total Relocations	73,463	68,675	55,557	53,360	56,480	51,629
Linear Feet of Stream Relocations within Existing SR 37 Right-of-Way	43,516	43,532	43,979	43,758	43,966	43,823
Percent New Impacts	41%	37%	21%	18%	22%	15%
Riparian Corridor: Acres of Impact	198.47	181.08	116.16	113.34	121.59	107.27
Open Water Impacts	**Alternative 4**	**Alternative 5**	**Alternative 6**	**Alternative 7**	**Alternative 8**	**Refined Preferred Alternative 8**
Open Water (acres) (Construction Limits): (PUBs)	1.40	4.18	5.38	2.20	2.50	0.02
Open Water Impacts (acres) (Construction Limits) within Existing SR 37 Right-of-Way	0.00	0.00	0.01	0.01	0.01	0.01
Percent New Impacts	100%	100%	99.81%	99.89%	99.60%	99.86%
Floodplain Impacts	**Alternative 4**	**Alternative 5**	**Alternative 6**	**Alternative 7**	**Alternative 8**	**Refined Preferred Alternative 8**
Floodplain Impacts within Right-of-Way (acres)	125.55	145.50	126.98	99.69	128.52	75.15
Floodplain Impacts within Existing SR 37 Right-of-Way (acres)	66.49	66.60	66.60	66.59	66.60	66.60
Percent New Impacts	47%	54%	48%	33%	48%	11%

5.19.3 Groundwater

5.19.3.1 Introduction

This section evaluates the project's impact on groundwater quality. The analysis of ground water impacts includes an assessment of the existing groundwater conditions in the study area as well as the project's potential impact on groundwater resources. If there is a potential impact to groundwater resources due to project construction, proposed mitigation measures are discussed. These items are of special concern in karst areas and are discussed in **Section 5.21**, *Karst Impacts*.

Wellhead protection areas were authorized by the 1986 Amendments to the Safe Drinking Water Act. When a proposed project encroaches upon a wellhead protection area (WHPA), the delineated area is identified and coordination with the community's wellhead protection program is documented.

Early coordination with USEPA is necessary if a proposed project potentially affects an area designated as the principal or sole source aquifer under Section 1414(e) of the Safe Drinking Water Act. Currently, only the St. Joseph Aquifer (near South Bend) is designated as a sole source aquifer in Indiana, and it is not located within the project limits.

USEPA Class V injection well permits may be required for various types of projects. For example, such a permit could be required by USEPA Region 5 if a Class V injection well is located within the karst region of the state, a sole source aquifer area, a state designated source water protection area for a public water supply, or anywhere untreated fluids discharged through a Class V injection well may otherwise endanger an underground source of drinking water. If there are measures in place to prevent contamination of groundwater, a Class V well could be authorized by rule rather than by a permit. Most of the Class V well permits anticipated within Section 5 would fall into this category as they would be part of sinkhole mitigation under the Karst MOU (see **Section 5.21**, *Karst Impacts*). A goal of the Karst MOU is to reduce impacts to the susceptible karst environment. Mitigation measures developed under the Karst MOU will be intended to reduce karst impacts and associated impacts to groundwater.

A Class V Well Inventory Form would need to be provided to USEPA Region 5 prior to construction of a Class V injection well so that USEPA could determine if a Class V injection well permit will be required for any Class V wells. For the I-69 project, if the inventory information provided indicates that any injection well would likely contaminate any underground source of drinking water, a permit would be required. Any permit would need to be applied for and obtained prior to construction of the Class V well. The specific Section 5 sinkholes to be modified for storm water drainage will be determined in the subsequent Karst MOU steps and in consultation with USEPA and the MOU signatory agencies. Some of these mitigation measures would be considered to be Class V wells under the Safe Drinking Water Act's Underground Injection Control (UIC) program.

5.19.3.2 Methodology

The IDNR 'Water Well Record Database' was used to locate groundwater wells within a 1,000-foot vicinity of all alternatives (via the individual record retrievals and the IndianaMap: http://inmap.indiana.edu/index.html). The 1,000-foot search criterion for the water well database was established using the USEPA Calculated Fixed Radius method that determines a zone of concern around a well. Well record location descriptions varied in detail, if the reported location was within 1,000 feet of an alternative, the well was listed as a potential impact. Additional groundwater information was obtained from various publications from the IDNR, Division of Water, including *Ground-Water Resources In The White And West Fork White River Basin*, Indiana (Beaty, 2002), *Bedrock Aquifer Systems of Monroe County, Indiana* (Maier, 2003), *Unconsolidated Aquifer Systems of Monroe County, Indiana* (Maier, 2003), and *U.S. Geological Survey, Water Resources, Hydrogeologic Atlas of Aquifers in Indiana* (Fenelon and Bobay, 1994). Additional well records are publicly available for use by FHWA and INDOT in connection with the Lemon Lane Landfill /Illinois Central Spring and Bennett's Dump Superfund investigations that included private well inventory in the area surrounding each site.

5.19.3.3 Analysis

Private/Public Wells

In the project area, public drinking water is supplied by private wells and by municipally-owned systems. In the Section 5 corridor, most of the unconsolidated wells appear to be developed in sand and gravel and some fine-grained silt and clay.

Four public water supply systems provide drinking water in the Section 5 Study Area. They are the following: Southern Monroe Water Company, City of Bloomington Utilities Department, and Washington Township Water Corporation, all in Bloomington, as well as Martinsville Water Utility in Martinsville.

Southern Monroe Water Company covers from the southern terminus north to the SR 37 and Rockport Road area. The City of Bloomington Utilities Department covers from the SR 37 and Rockport Road area north to the SR 37 and Acuff Road and continues along the eastside of SR 37 to Wiley Road. The Washington Township Water Corporation covers along the west side of SR 37 from Acuff Road north to Godsey Road in Morgan County and along the east side of SR 37 from Wiley Road to Cooksey Lane. All three public systems obtain water from Lake Monroe. The Section 5 corridor is closest to Lake Monroe at its southern terminus where the closest drainage to Lake Monroe is 2.5 miles away and is separated by Clear Creek. While there will be utility line relocations, no impacts to Lake Monroe, Southern Monroe Water Company, City of Bloomington Utilities, or Washington Township Water Corporation water supplies are anticipated to result from construction within the Section 5 corridor.

Martinsville Water Utility covers along the west side of SR 37 from Legendary Hills north to the northern terminus and along the east side of SR 37 from Pine Boulevard to the northern terminus. Martinsville Water Utility has provided information indicating that its closest wells to the Section 5 corridor are across Indian Creek and located 2.86 miles away. These wells are located along the White River in Martinsville, Indiana, which is north of the Section 5/Section 6

terminus. The Martinsville Water Utility stated that these wells are developed in the White River Aquifer. While there may be utility line relocations, no impact to these wells is anticipated as a result of construction within the Section 5 corridor.

The IDNR Division of Water also registers significant water withdrawal facilities in the State of Indiana (Water Resource Management Act, 1982 (IC 14-25-7). Significant withdrawal facilities are defined 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 100,000 gallons of ground water, surface water, or ground and surface water combined in one (1) day." Significant withdrawal facilities records include the original registration form, location map, and annual water use report for each facility (Division of Water, 2004). Two significant water withdrawal facilities are located either within the Section 5 Corridor or within 1,000 feet of the Alternatives 4, 5, 6, 7, 8, or Refined Preferred Alternative 8 right-of-way. Refer to **Table 5.19-19**. These facilities are either active limestone quarry or limestone milling operations located in the City of Bloomington.

Table 5.19-19: Private Wells, Significant Withdraw Facilities, and Wellhead Protection Areas in Vicinity of Right-of-Way Alternatives

	Quantity Type	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
IDNR Listed Wells within 1,000 feet of the right-of-way (excludes monitoring wells)	Number of wells	86	85	71	69	72	73
IDNR listed significant water withdrawal facilities within 1,000 feet of the right-of-way	Number of facilities	2	2	1	1	1	1
IDNR listed Wellhead Protection Area within 1,000 feet of the right-of-way	Number of Areas	1	1	1	1	1	1

Wellhead Protection Zones

Coordination with IDEM indicates that there is one WHPA in or adjacent to the Section 5 corridor. A non-community WHPA is located near the northern terminus of Section 5 and serves several businesses, residents, and a hotel on Old SR 37 and east of Legendary Hills. Refer to **Table 5.19-19**.

Bedrock Aquifer Systems—The bedrock (consolidated) aquifers in Section 5 have generally limited availability, and the majority of the population's water supply comes from reservoirs in Monroe County. Where they are in use, the majority of wells are completed in the Salem, Harrodsburg, St. Louis, and Ste. Genevieve limestone formations primarily along joints, fractures, and bedding planes. The other study area formations are well known for poor production of groundwater. As a consequence, well production is typically low in the range of less than two gallons per minute (gpm) to rarely as much as 10 gpm. However, the few wells that intersect fracture zones and karst conduits can have greater yields (Maier, 2003a). See **Section 5.21**, *Karst Impacts*, for further information.

Unconsolidated Aquifer Systems—Groundwater resources in unconsolidated material along much of the study area are limited; the majority of the area's water supply comes from reservoirs in Monroe County and in the White River Aquifer in Morgan County. While water wells have been completed in unconsolidated materials along or near the study area, the unconsolidated materials in the study area are typically too fine for yielding groundwater and, therefore, are primarily limited to along valley fill and terraces, such as Beanblossom Valley (Maier, 2003b) and in the White River Aquifer in Morgan County (Beaty, 2002).

The number of private groundwater wells within 1,000 feet of the right-of-way limits of each of the alternatives ranges from 69 (Alternative 7) to 86 (Alternative 4). **Table 5.19-19** shows the number of groundwater wells within 1,000 feet in the right-of-way of each of the alternatives.

Groundwater Quality

Water is available from both consolidated and unconsolidated aquifers in the study area. The principle bedrock aquifers in the region are composed of Harrodsburg, Salem, St. Louis, and Ste. Genevieve Limestones and Bordan Group. The unconsolidated aquifer consists of medium to fine glacial sands. **Section 4.3.2**, *Water Resources,* describes the aquifers in Section 5 in more detail.

The Section 5 study area is within a karst area. Water resources in karst areas are especially sensitive to impairment. Karst flowpaths (the distance and direction water travels while in the karst system) are interconnected and can cross groundwater aquifers used as private and public water supplies. Groundwater wells are used in generally rural portions of the Section 5 study area. A few springs may also be used by individual landowners as a potable water supply and for livestock. Very little water purification occurs in karst areas, because the water flows directly through cracks and fissures in rocks rather than percolating slowly through soil as in other types of terrain. Therefore, surface and groundwater quality is an important concern in karst areas, since karst flowpaths can convey pollutants to these water sources.

As detailed in **Section 5.21**, *Karst Impacts*, to define guidelines for the development of transportation projects in karst areas and to minimize the impact of construction projects, the INDOT, IDEM, IDNR, and the USFWS entered into the Karst Memorandum of Understanding (Karst MOU) in 1993. It should be noted that for I-69 Tier 2 studies in Sections 4 and 5, the USEPA was invited to participate in the karst study and assessment. This evolved out of USEPA's participation in the I-69 Tier 1 study, in particular its interest in water resource impacts in karst areas (see **Section 5.21**, *Karst Impacts,* **5.21.2** *Methodology*). The Karst MOU memorializes that the signatory agencies have agreed to the implementation of a 17 step process for development of highway projects in karst terrain; both pre-construction and post construction annual pollutant loading estimates from Section 5 pavement runoff to specific karst features. The Karst MOU document is presented in **Appendix Y**, *Final Karst Report (Redacted).*

Consequences of road construction can include excess sedimentation of surface water, increased surface runoff, and mounding of surface water, all of which may disrupt the natural groundwater cycle. Such disturbances can lead to decreased infiltration and a locally lowered groundwater table resulting in interruption of shallow rural water supplies. Where ground water from private,

individual wells is the principal source of potable water, there is the potential that road surface stormwater runoff or surface spills to karst features (e.g., gasoline tankers, chemical transports, etc.) from the new roadway could enter the groundwater system and affect drinking water in the area.

Section 5.21, *Karst Impacts*, **Chapter 7**, *Mitigation and Commitments*, and **Appendix Y**, *Final Karst Report (Redacted)*, identifies BMPs that will be considered for implementation for the project and includes additional information pertaining to mitigation of highway runoff to karst features. Under the Karst MOU, a monitoring and maintenance plan will be developed for affected karst features.

No currently designated sole source aquifers exist within the project limits. The only sole source aquifer in Indiana is the St. Joseph Aquifer in South Bend.

There are no public water supply wells or impoundments within or adjacent to the Section 5 corridor, and no impacts to local public water supplies are anticipated. Where groundwater from private, individual wells is the principal source of potable water, there is the potential that road surface stormwater runoff from the new roadway could affect drinking water in the area.

Per USEPA written comments on the Section 4 DEIS, a firm commitment has been made that if active groundwater flow paths are discovered, measures will be taken to perpetuate the flow and protect water quality. INDOT will coordinate with the USEPA Superfund Project Manager if groundwater flow paths are anticipated to be impacted in areas of Lemon Lane and/or Bennett's Dump superfund sites. Other commitments can be found in **Chapter 7**, *Mitigation and Commitments*.

5.19.3.4 Mitigation

Grassy swales to facilitate infiltration and associated recharge of groundwater supplies, and construction methods to reduce erosion, sedimentation, and turbidity that road construction could temporarily cause would be among the measures employed to protect groundwater resources. BMPs will be used during construction of this project to reduce groundwater impacts. Under the Karst MOU, a monitoring and maintenance plan will be developed for karst features that receive highway drainage.

INDOT has made a mitigation commitment to prevent drainage from increasing above the existing SR 37 levels extending along the eastern side of SR 37 that is within the Site HM-6 Lane Landfill/ILCS recharge area and along the northwest quadrant of the SR 37/SR 46 interchange area at the Site HM-10 - Bennett's Dump area to address USEPA and IDEM concerns regarding changes in existing groundwater flow. Coordination with USEPA and IDEM has occurred throughout the Section 5 study and will continue through the design phase.

See **Chapter 7**, *Mitigation and Commitments*, for additional discussion of mitigation for water quality impacts.

5.19.3.5 Summary

There are no public water supply wells, or water supply impoundments, or sole source aquifers in or adjacent to the project corridor. There is one wellhead protection zone, two significant water withdrawal facilities, and between 69 to 86 private groundwater wells within 1,000 feet of the right-of-way limits of the alternatives. INDOT's Standard Specifications and BMPs will be used during construction to minimize the temporary impacts that roadway construction can cause to groundwater.

Section 5.19 Figure Index

(Figures follow this index.)

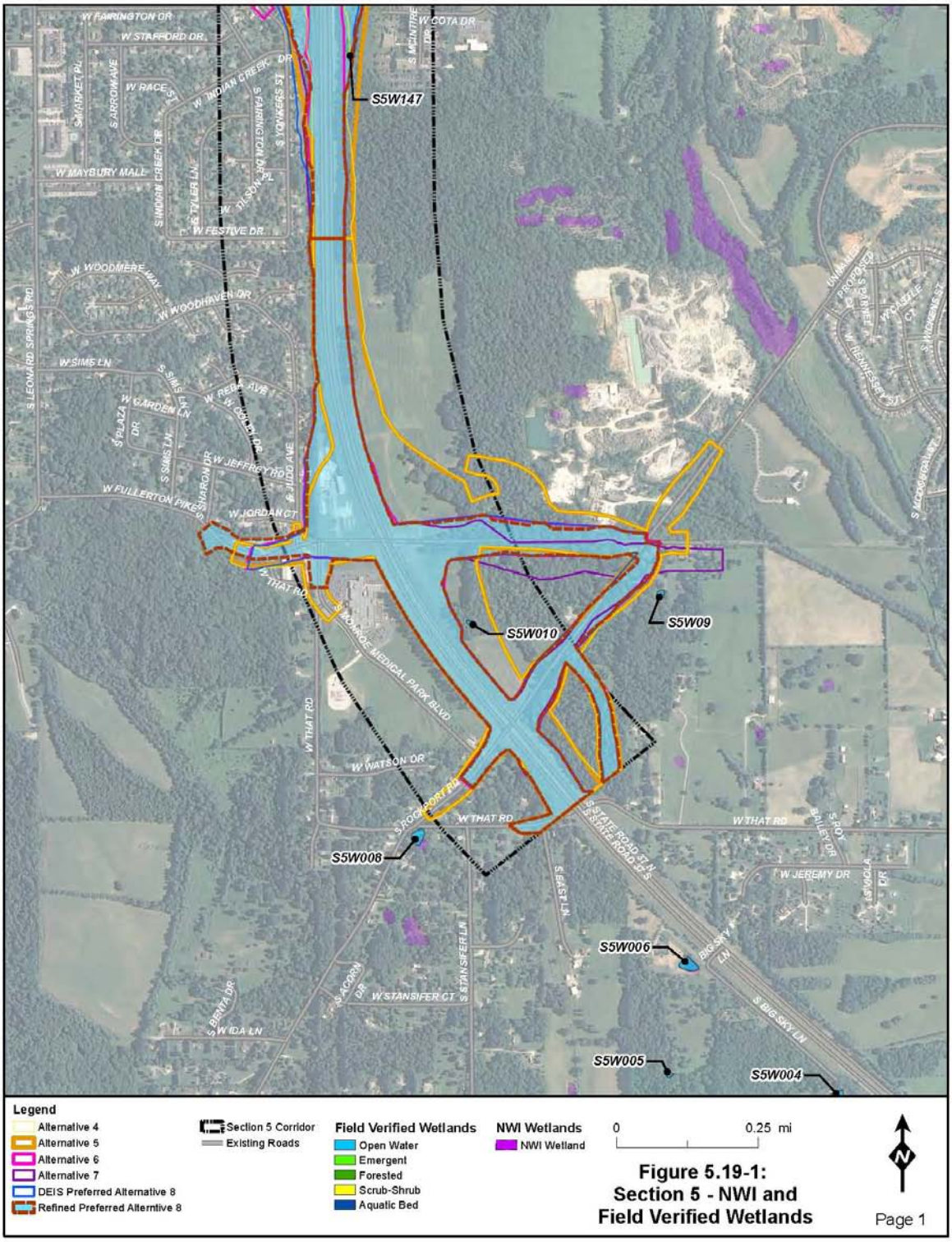


Figure 5.19-1: Section 5 - NWI and Field Verified Wetlands (Sheet 1 of 14)

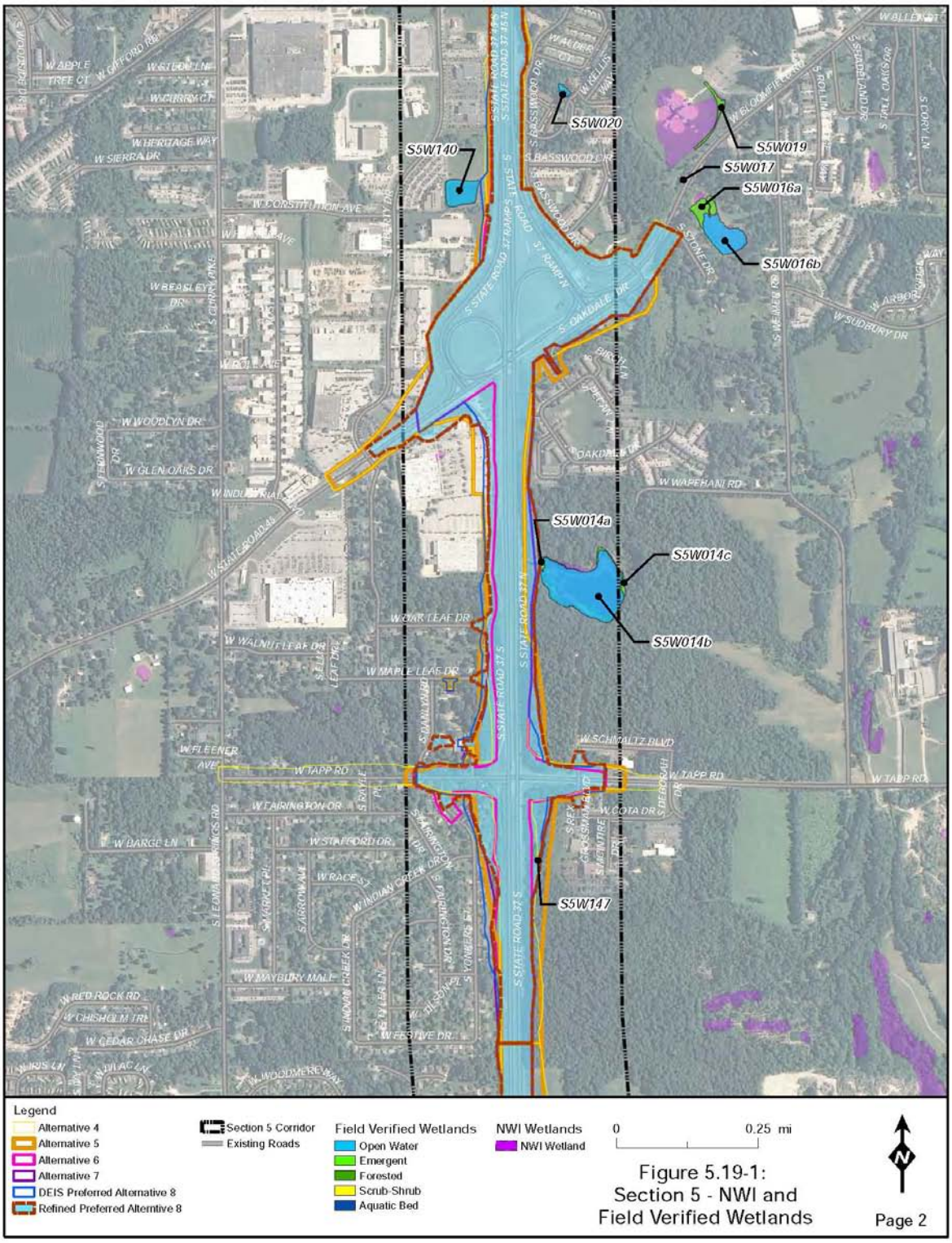
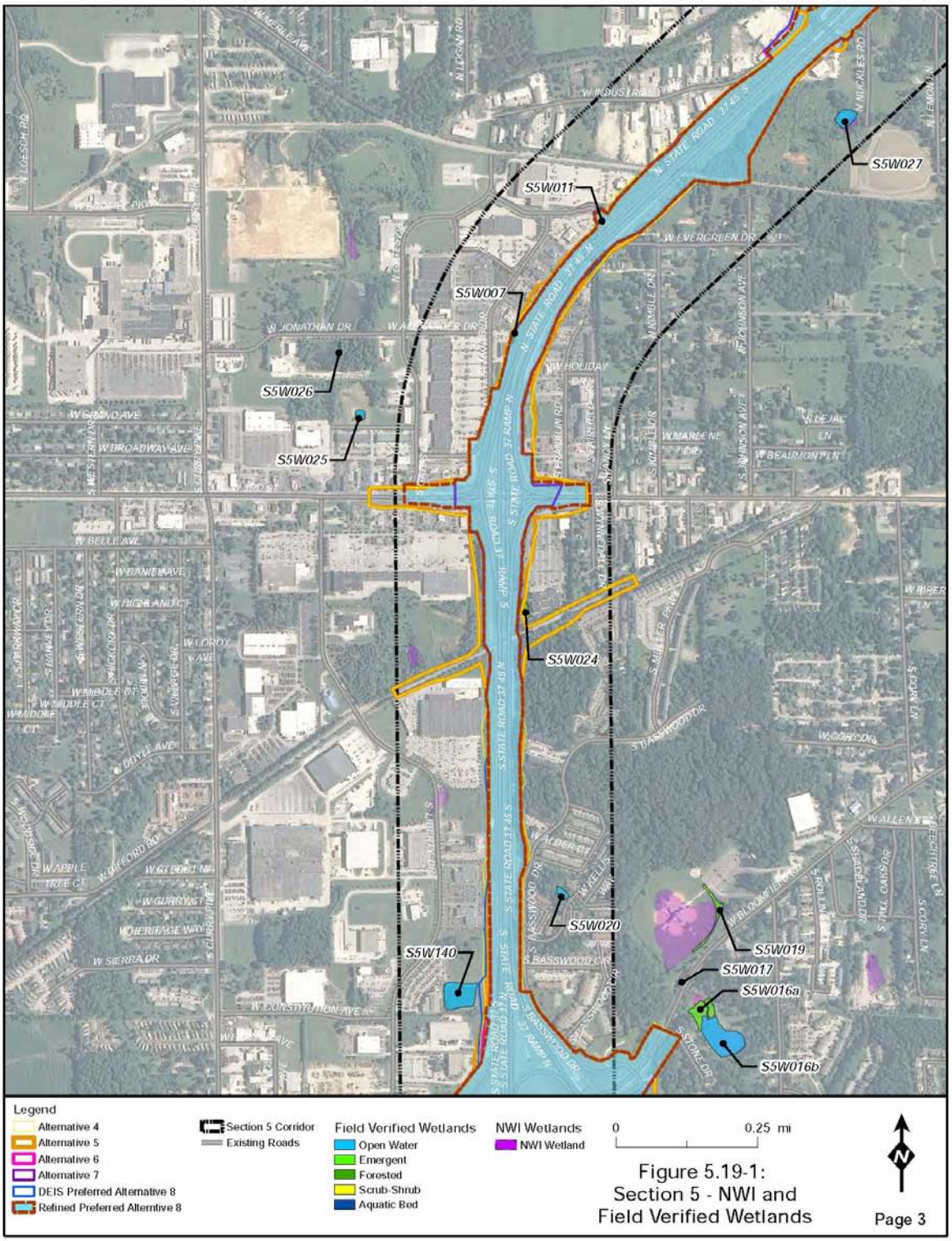


Figure 5.19-1: Section 5 - NWI and Field Verified Wetlands (Sheet 2 of 14)



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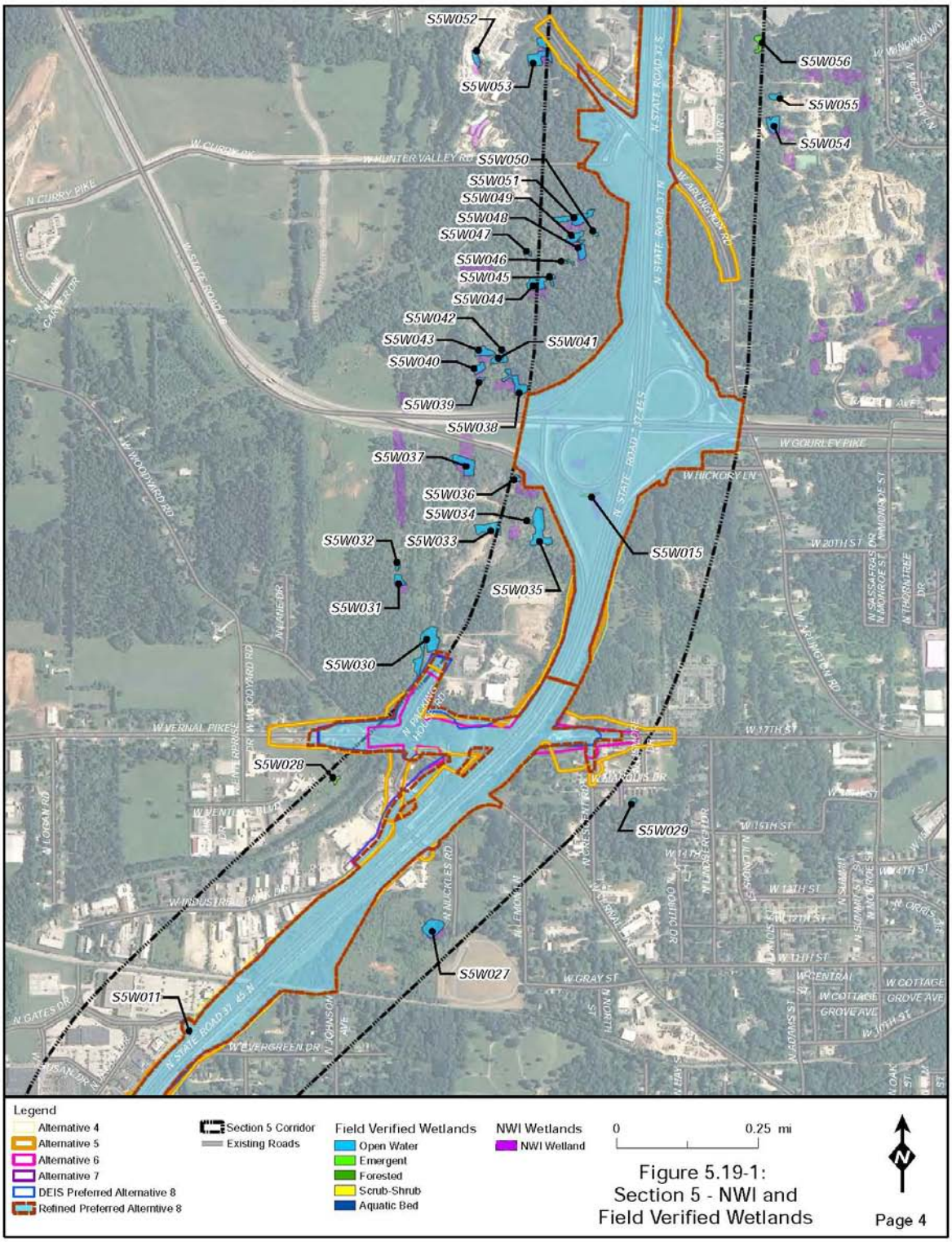

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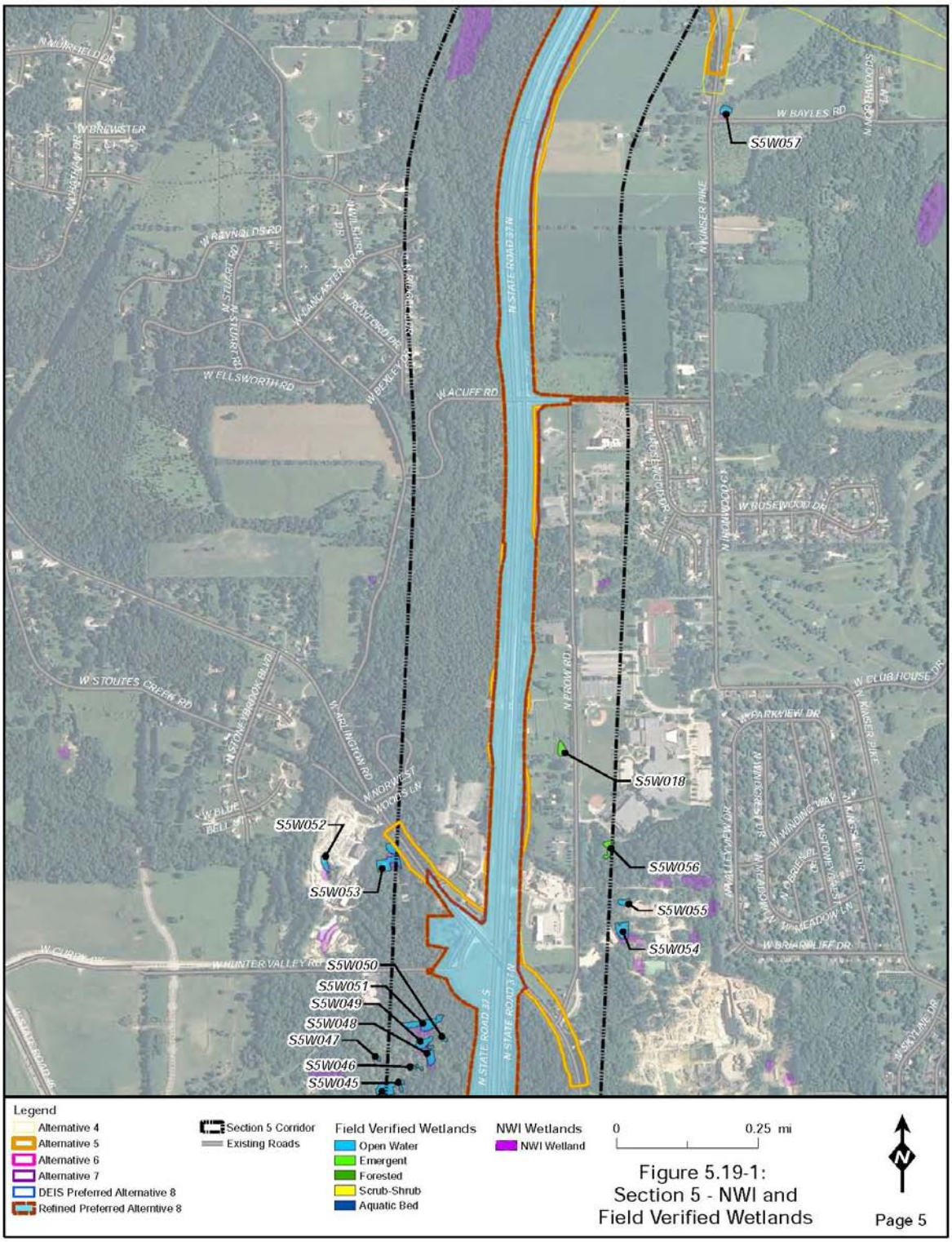

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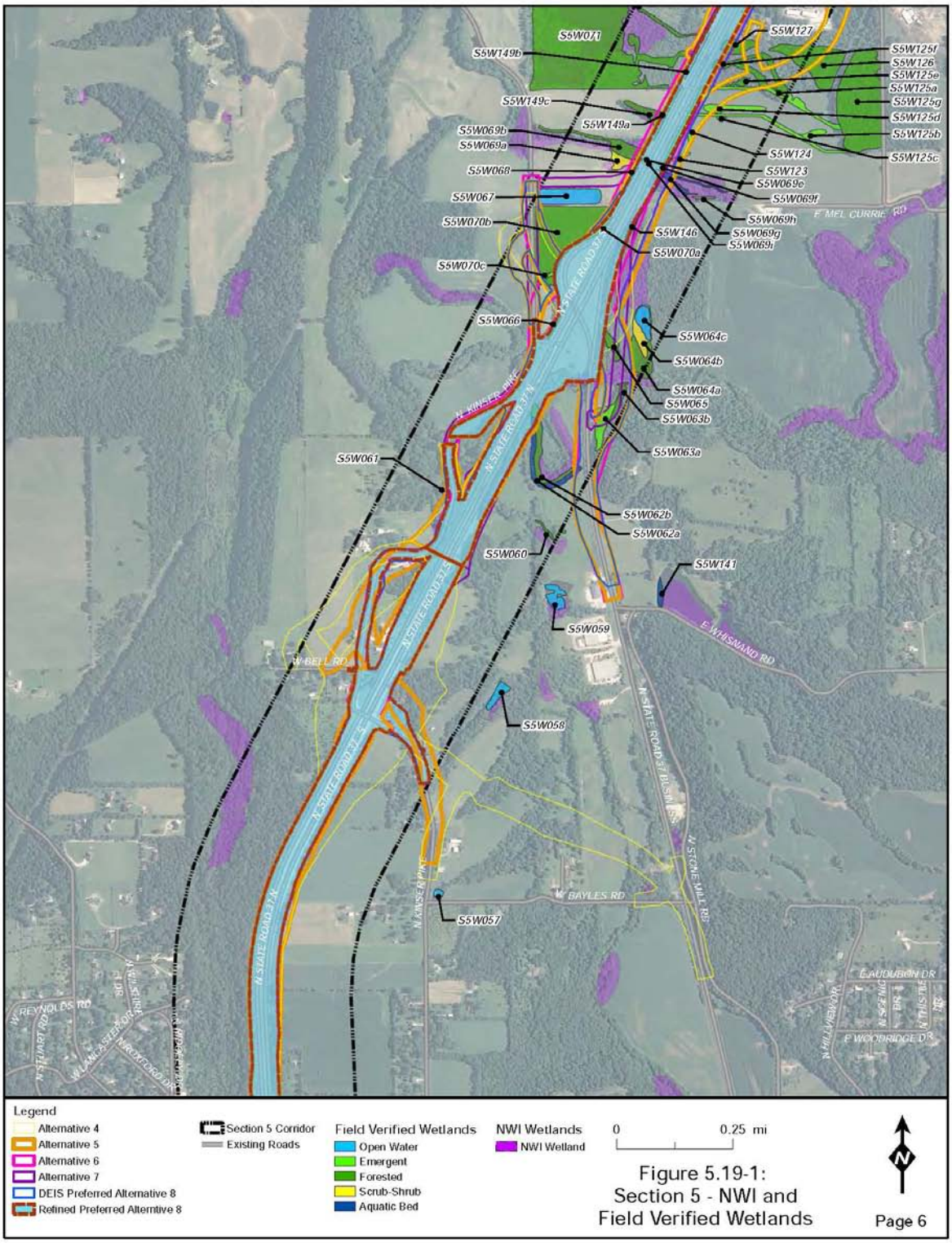

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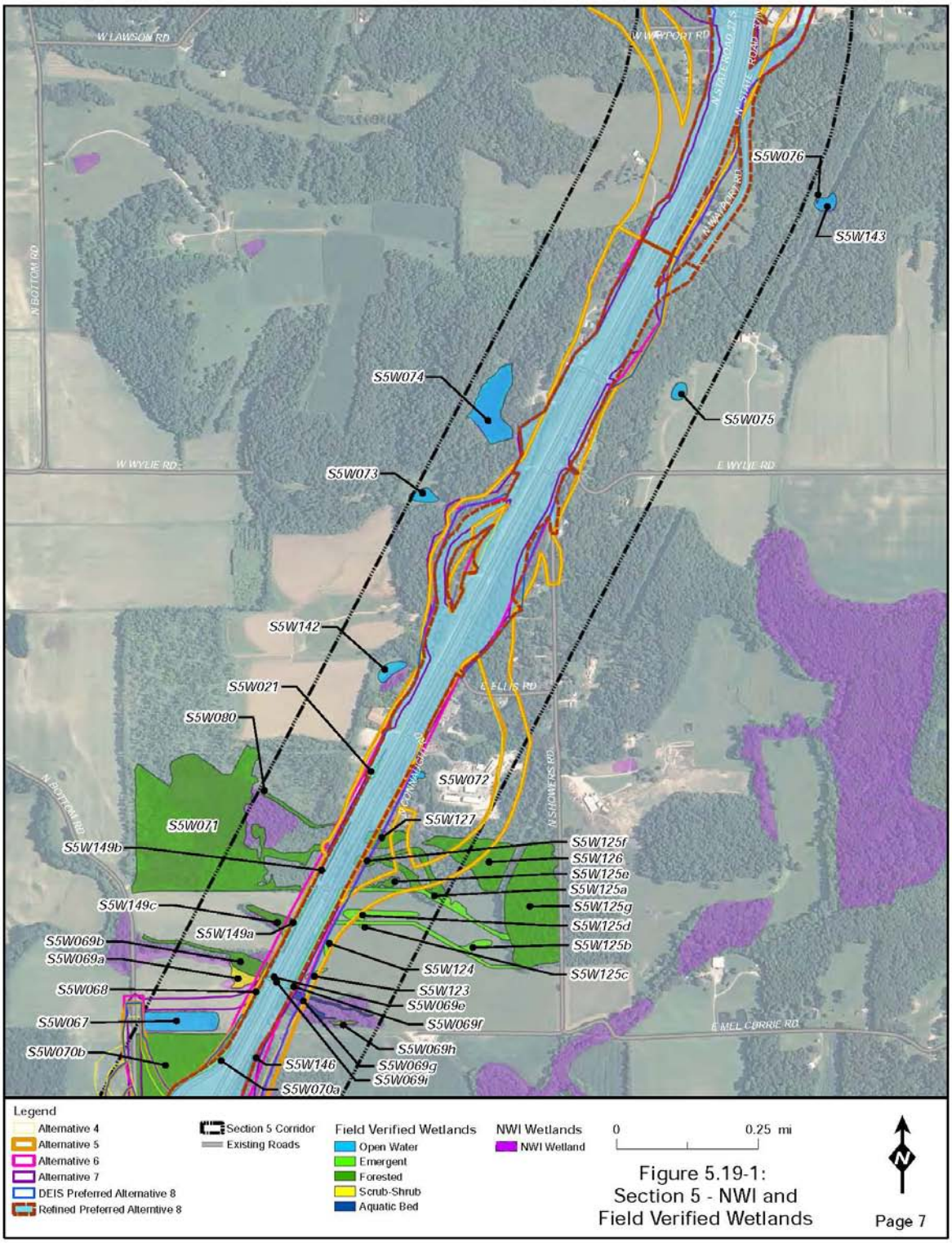
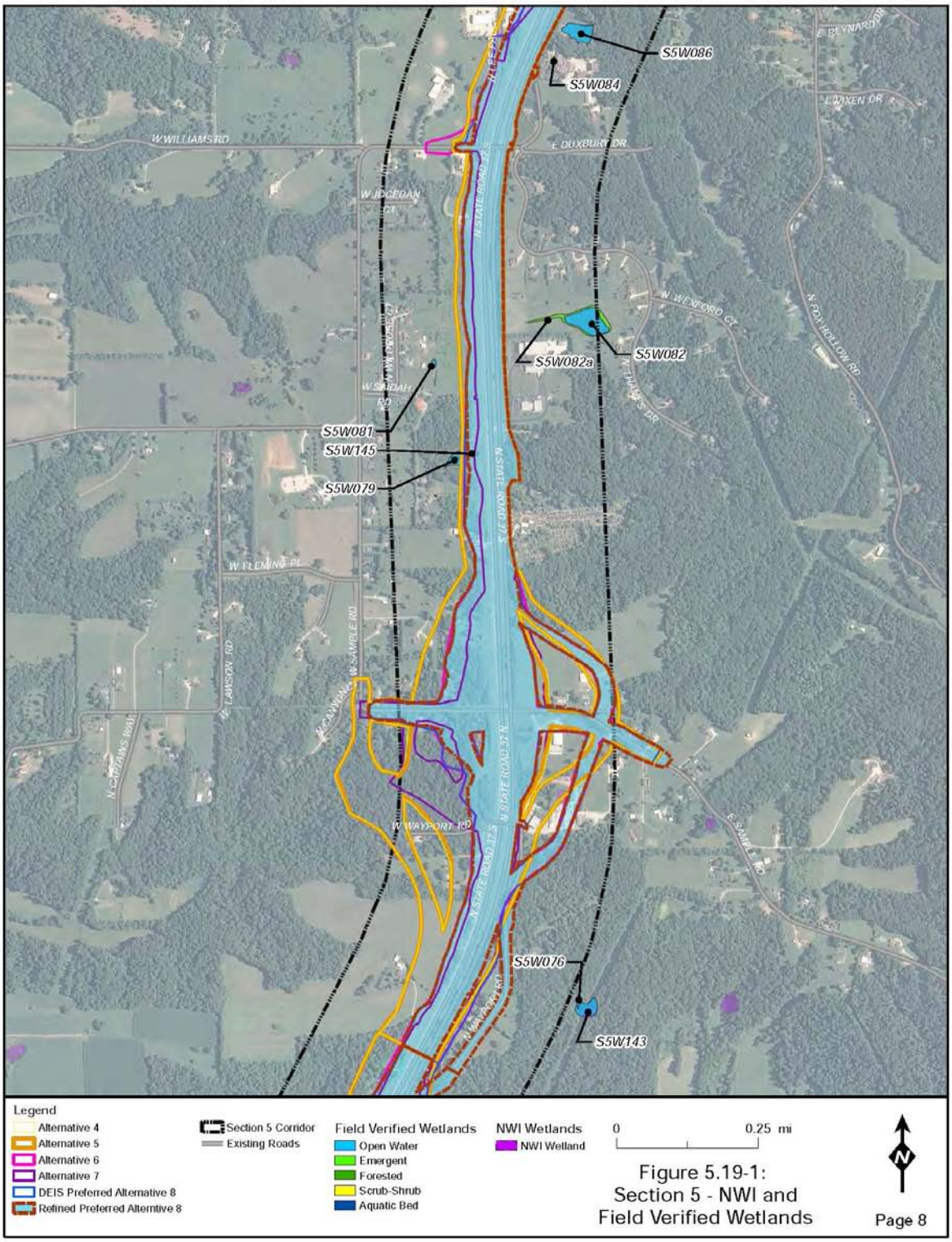


Figure 5.19-1: Section 5 - NWI and Field Verified Wetlands (Sheet 7 of 14)



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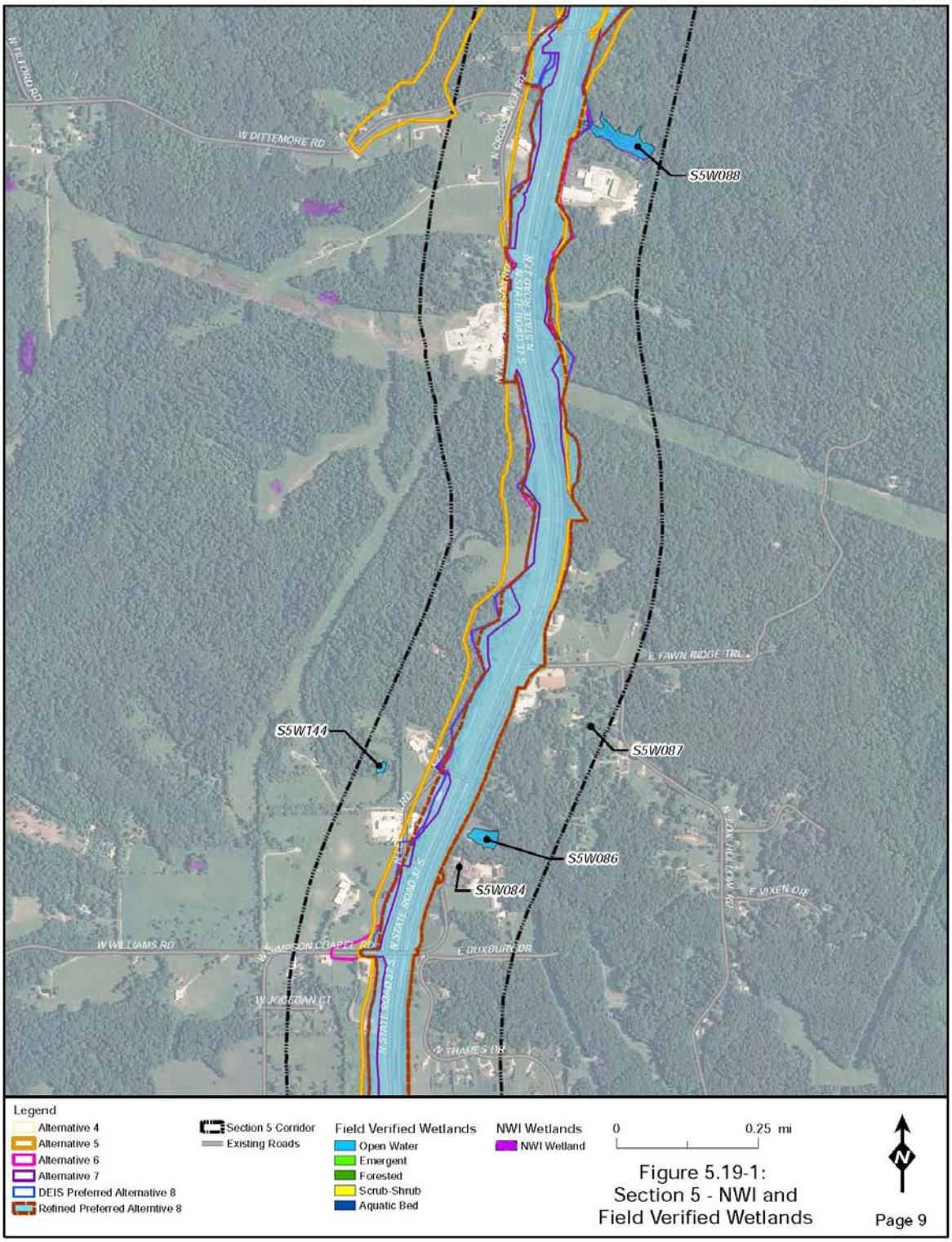

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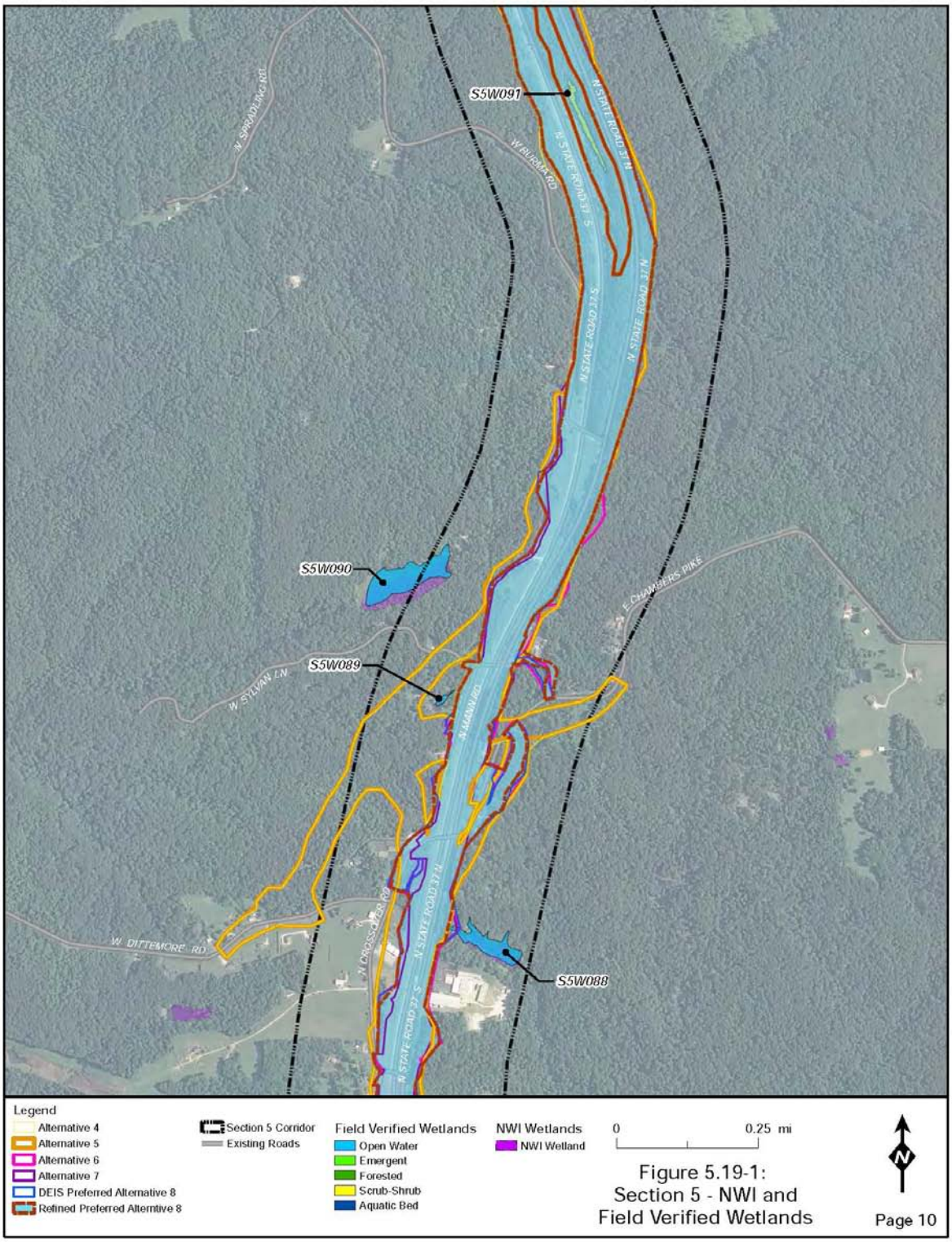

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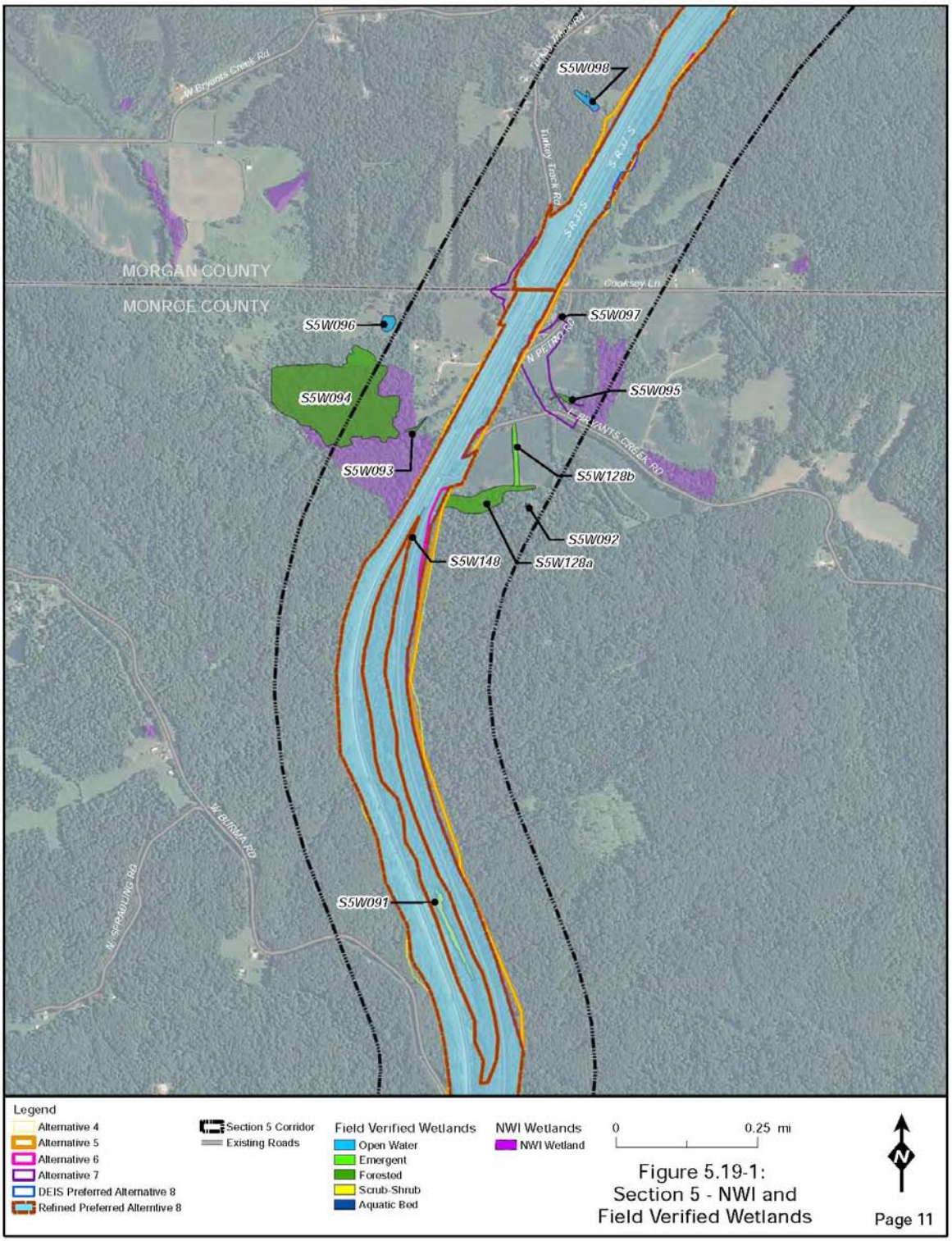

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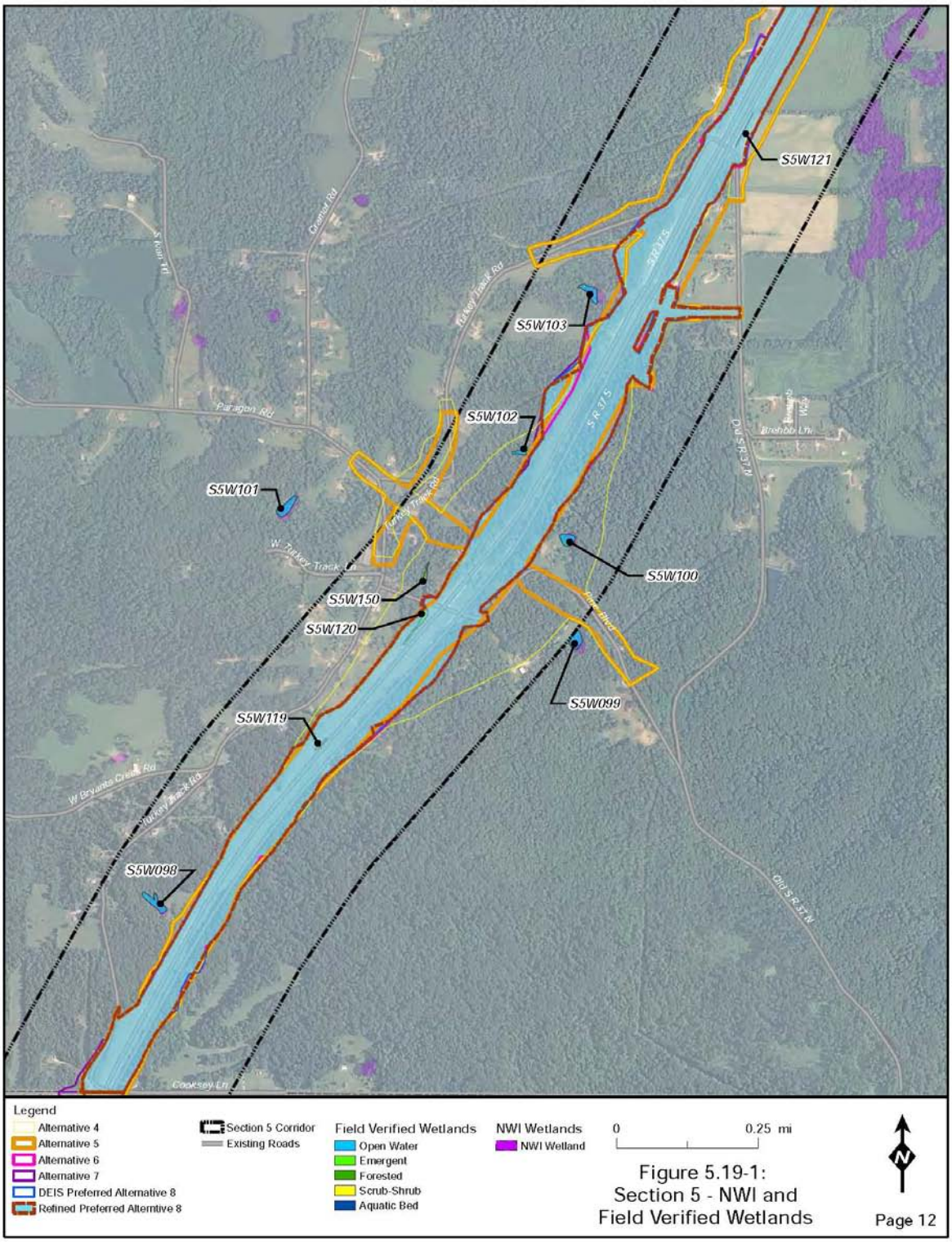

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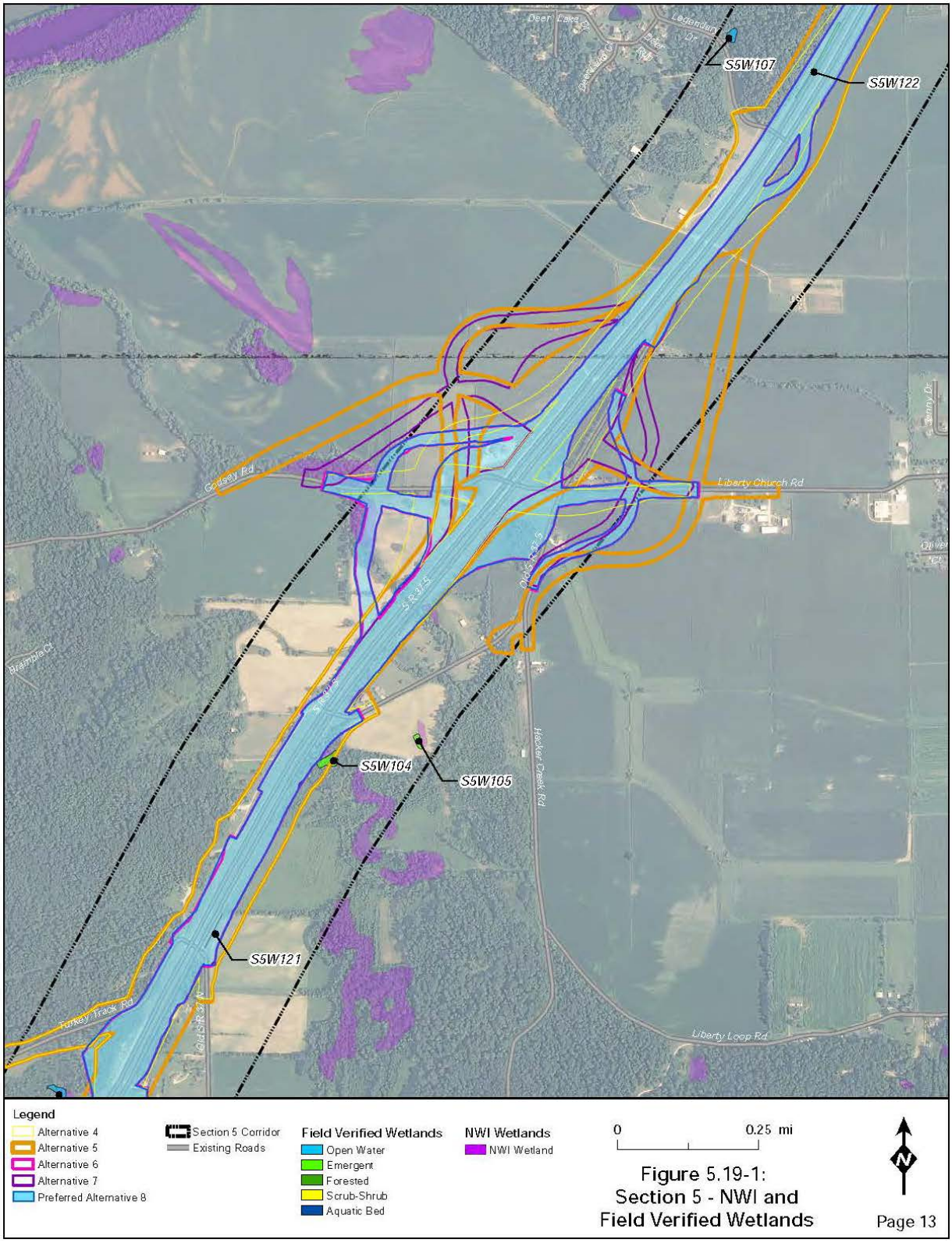

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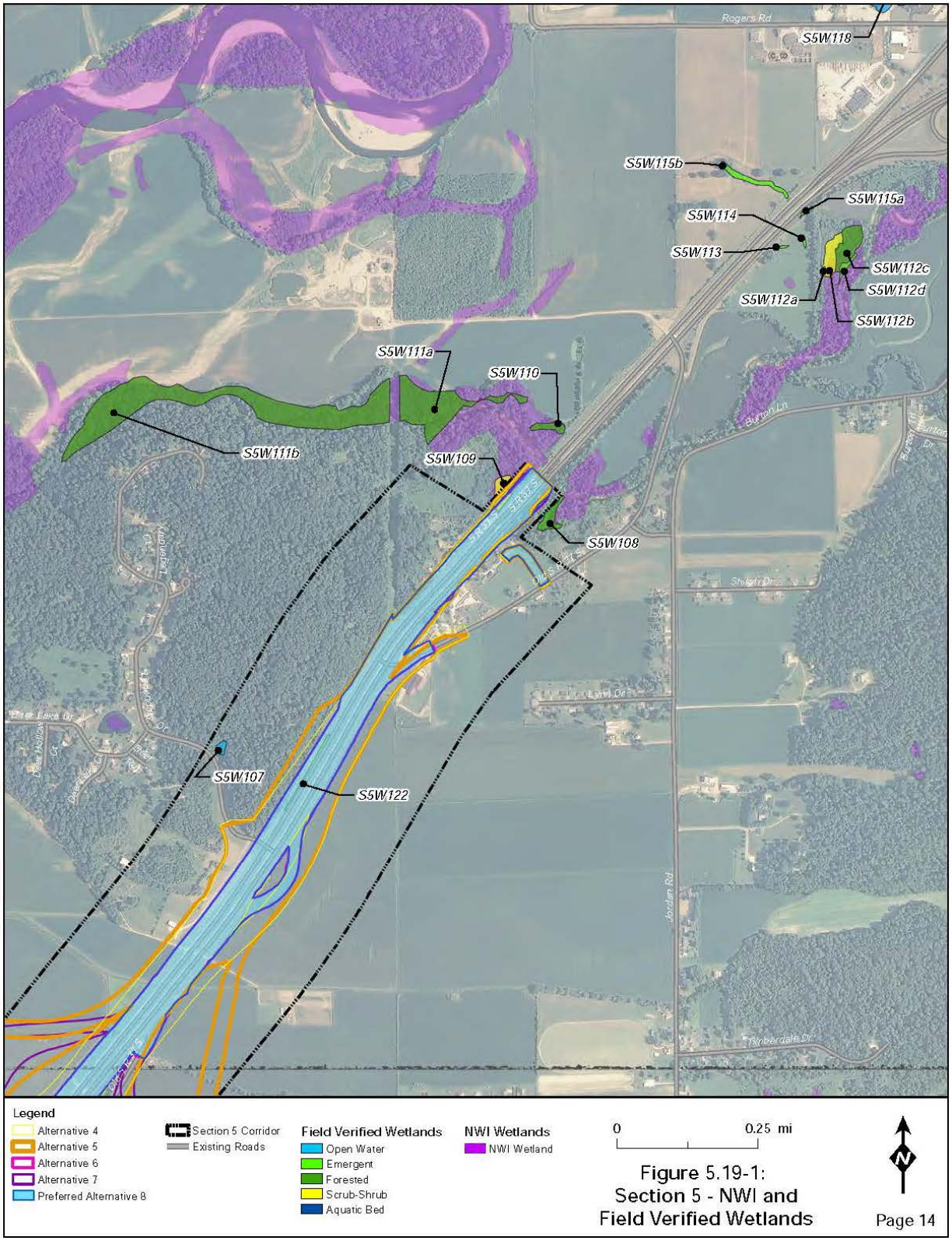

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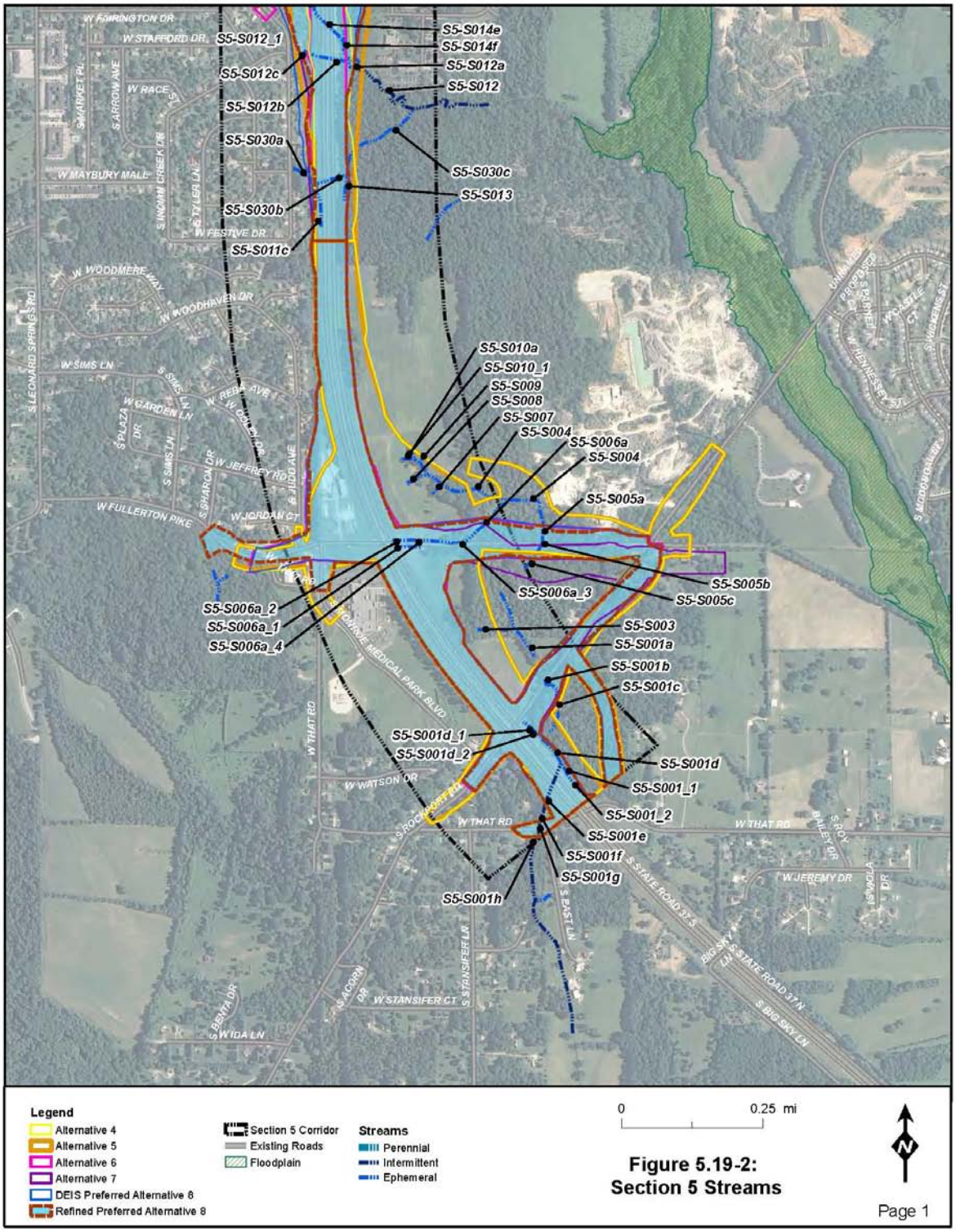


Figure 5.19-2: Section 5 Streams (Sheet 1 of 14)

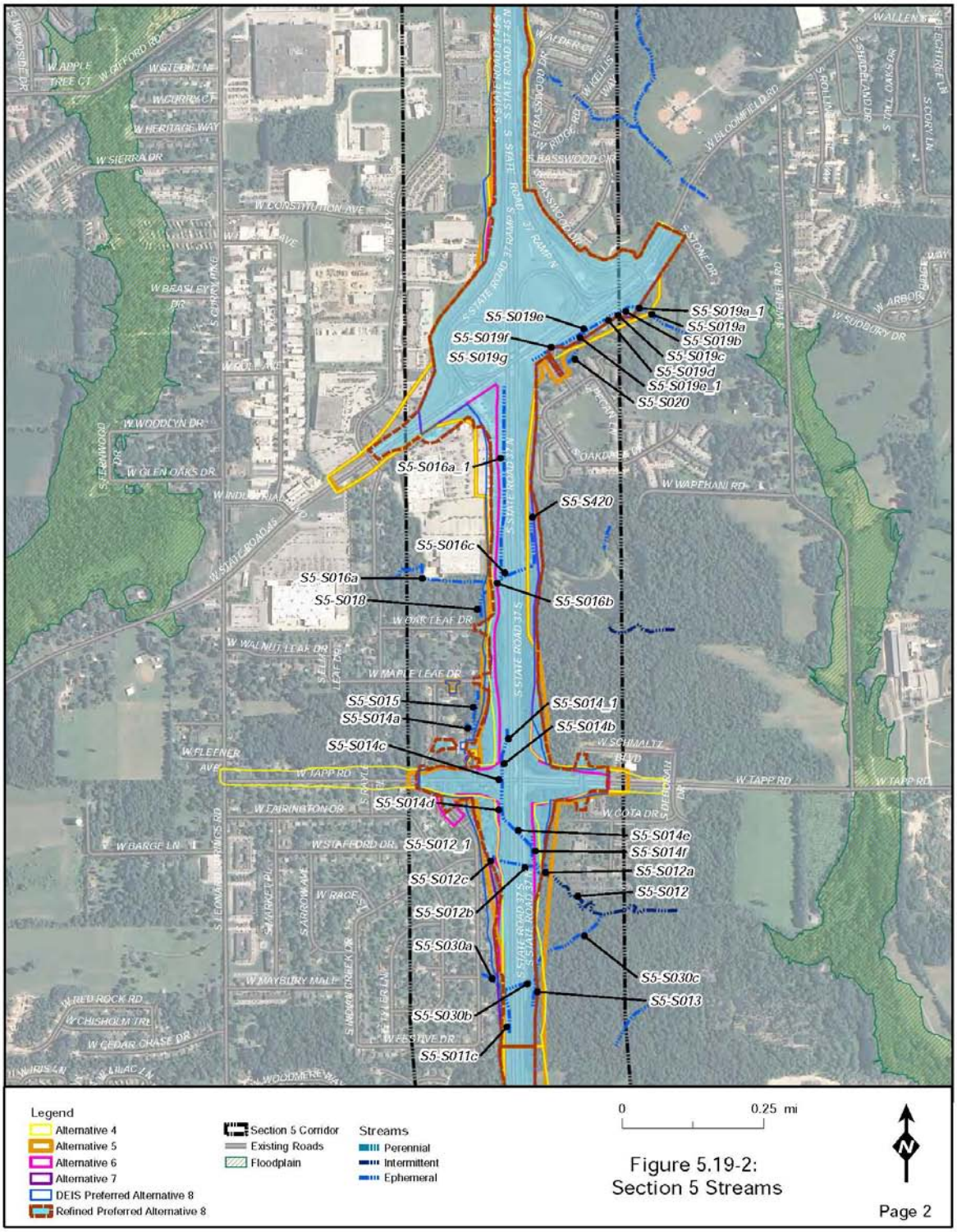


Figure 5.19-2: Section 5 Streams (Sheet 2 of 14)

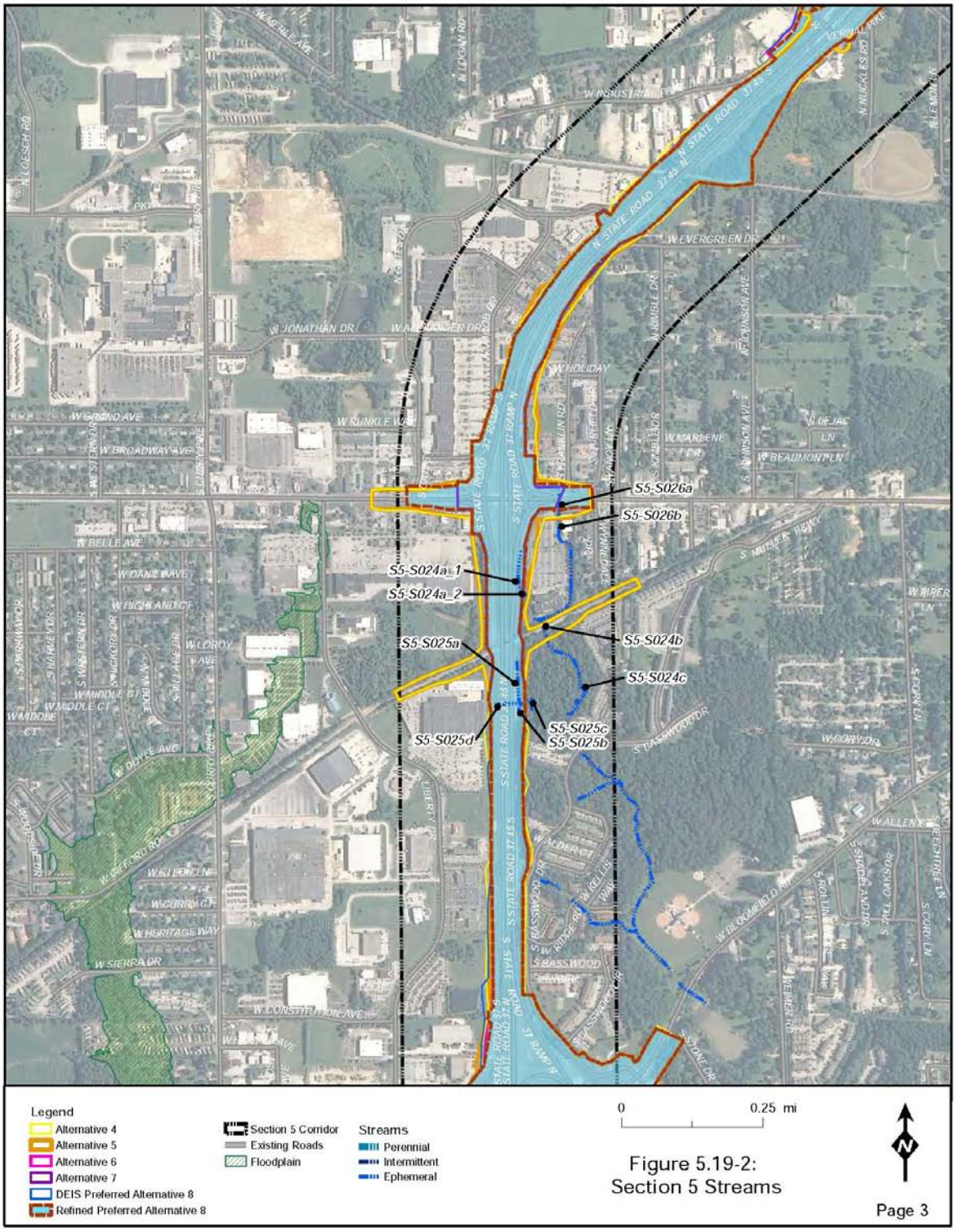
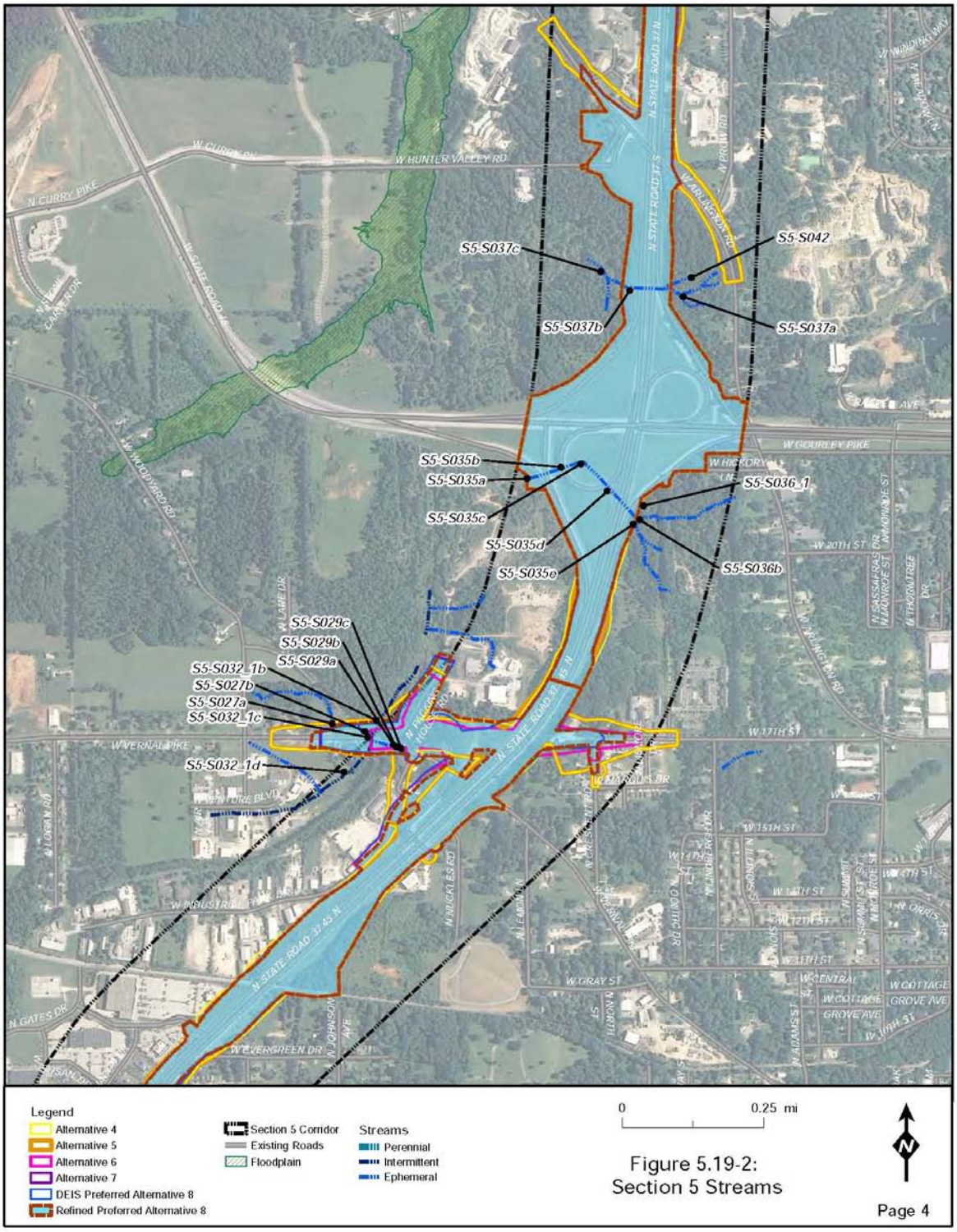


Figure 5.19-2: Section 5 Streams (Sheet 3 of 14)



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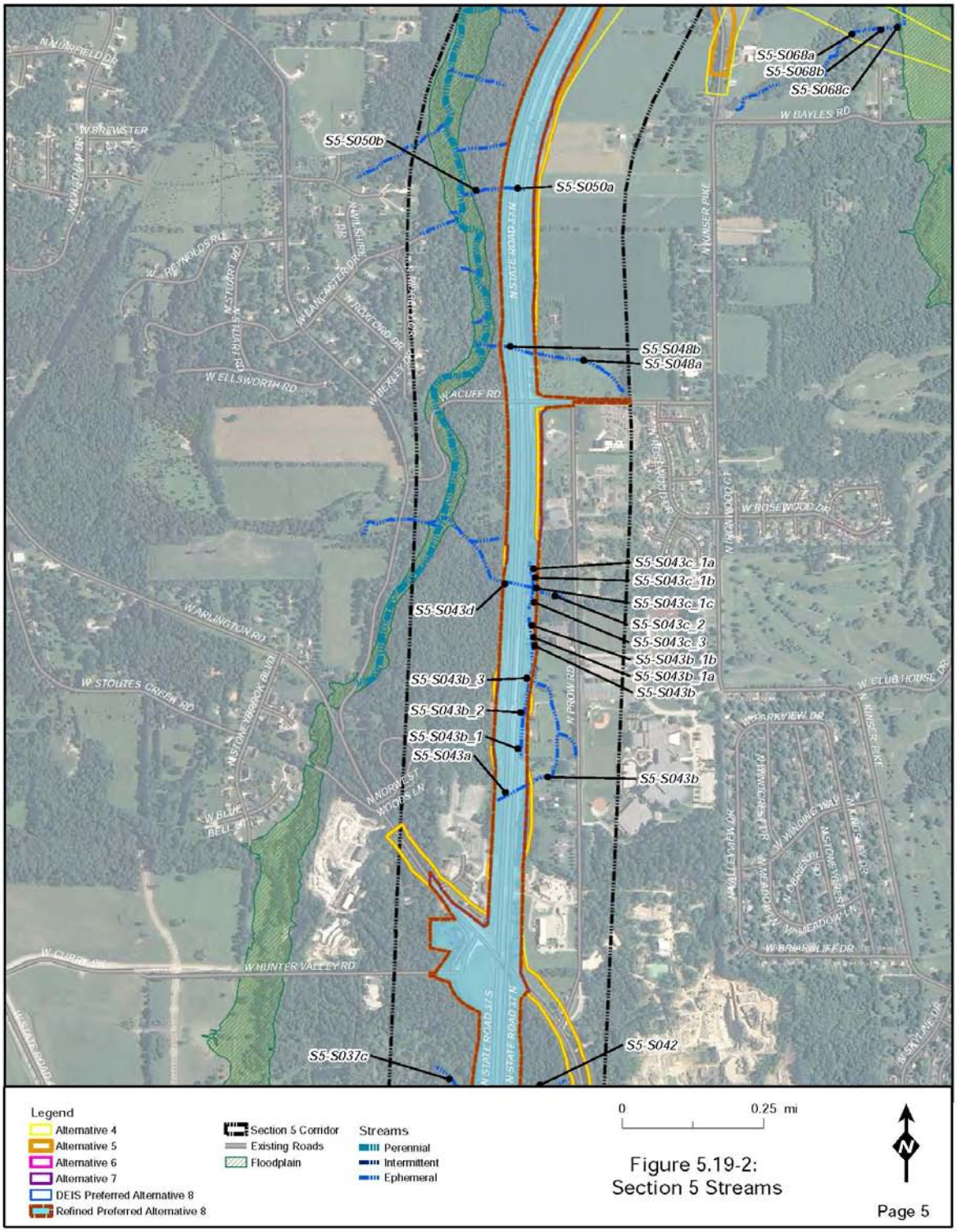
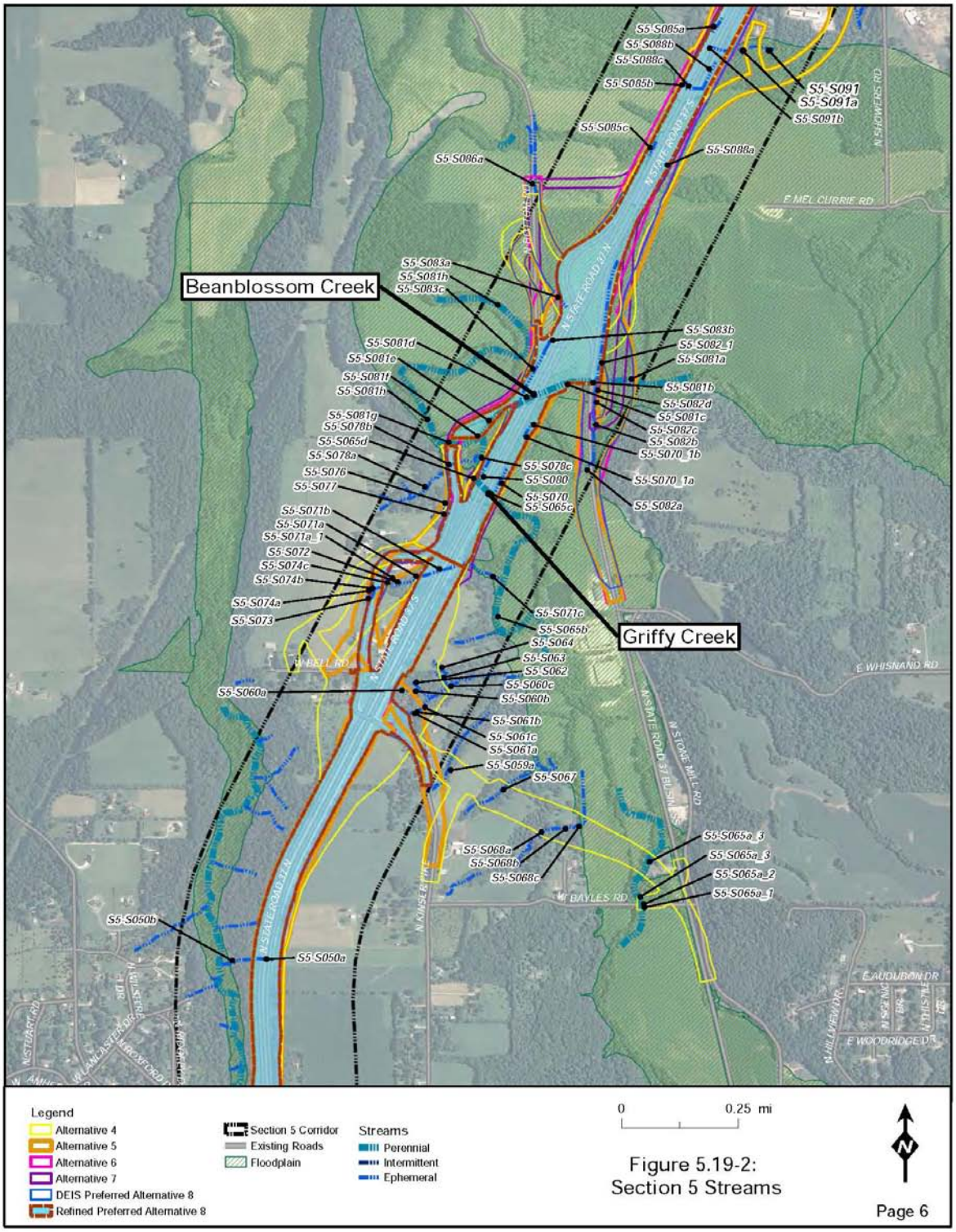


Figure 5.19-2: Section 5 Streams (Sheet 5 of 14)



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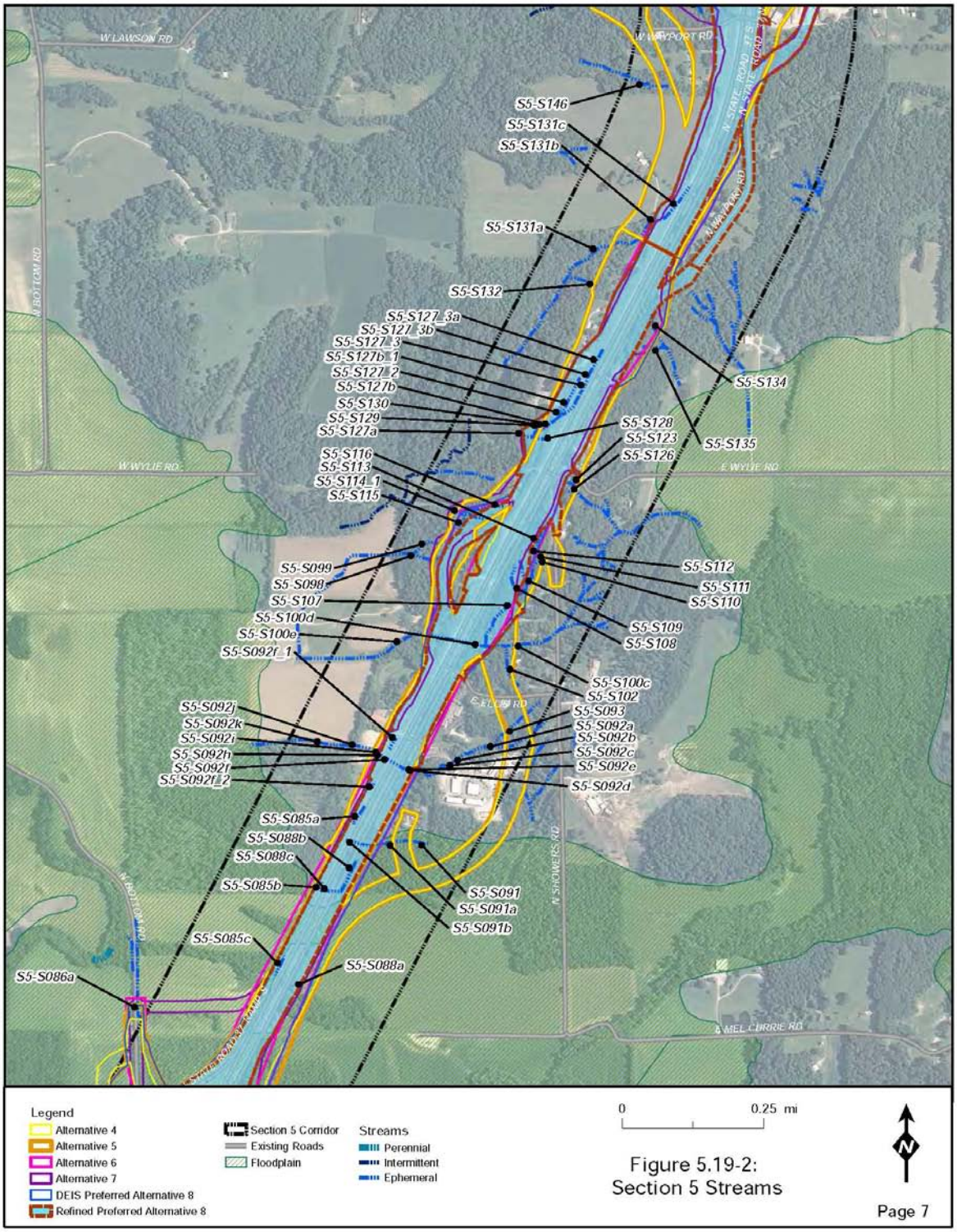

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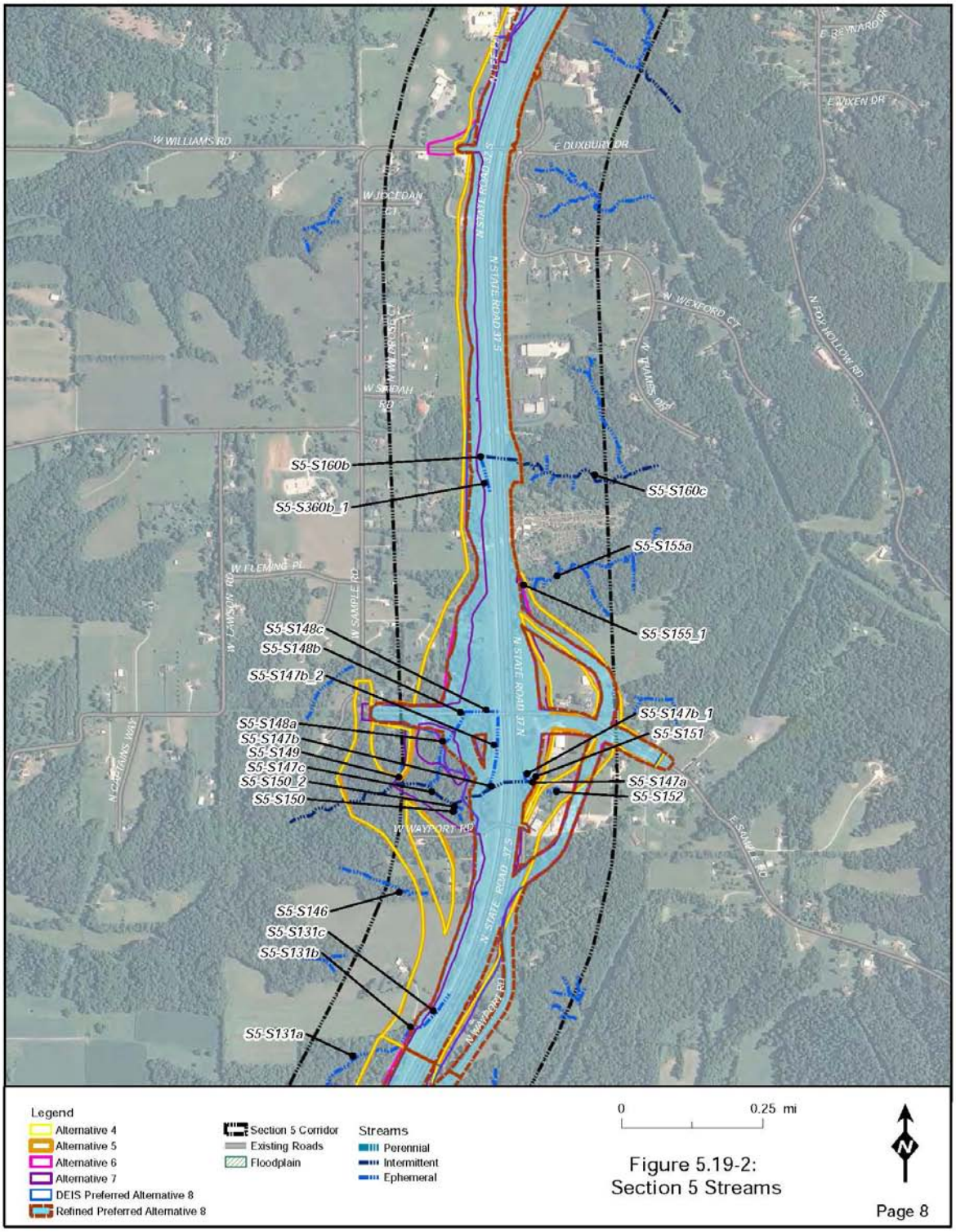

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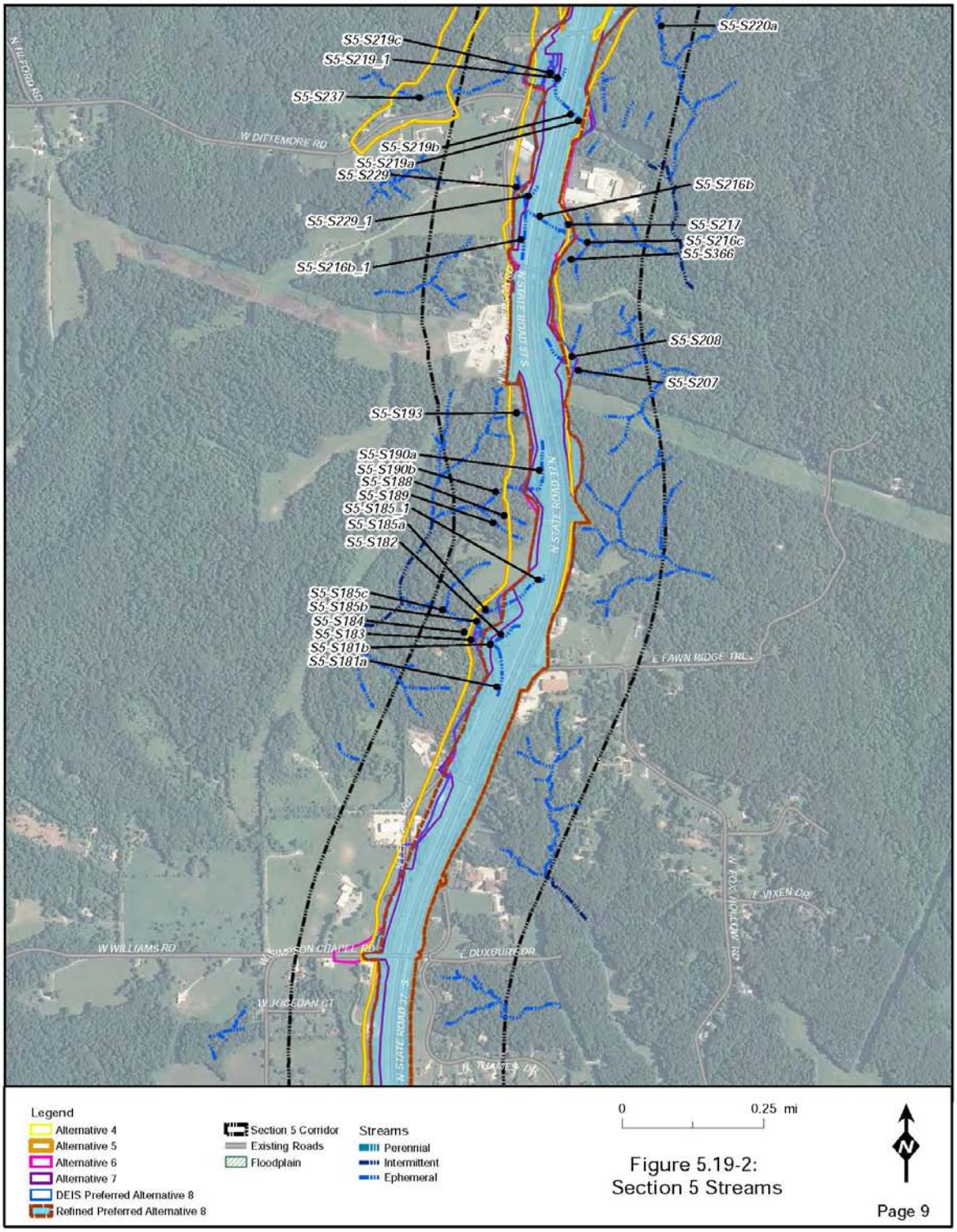

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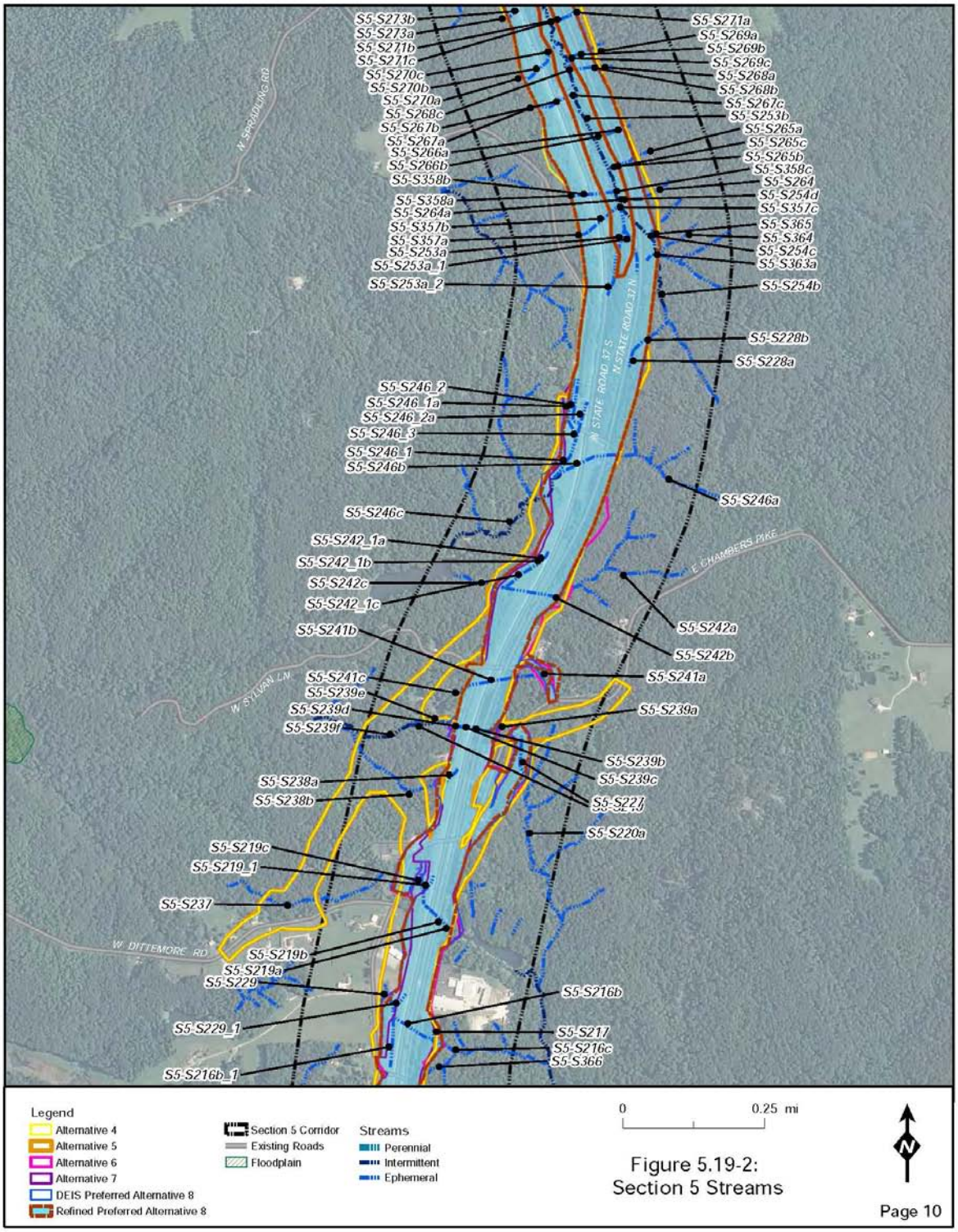

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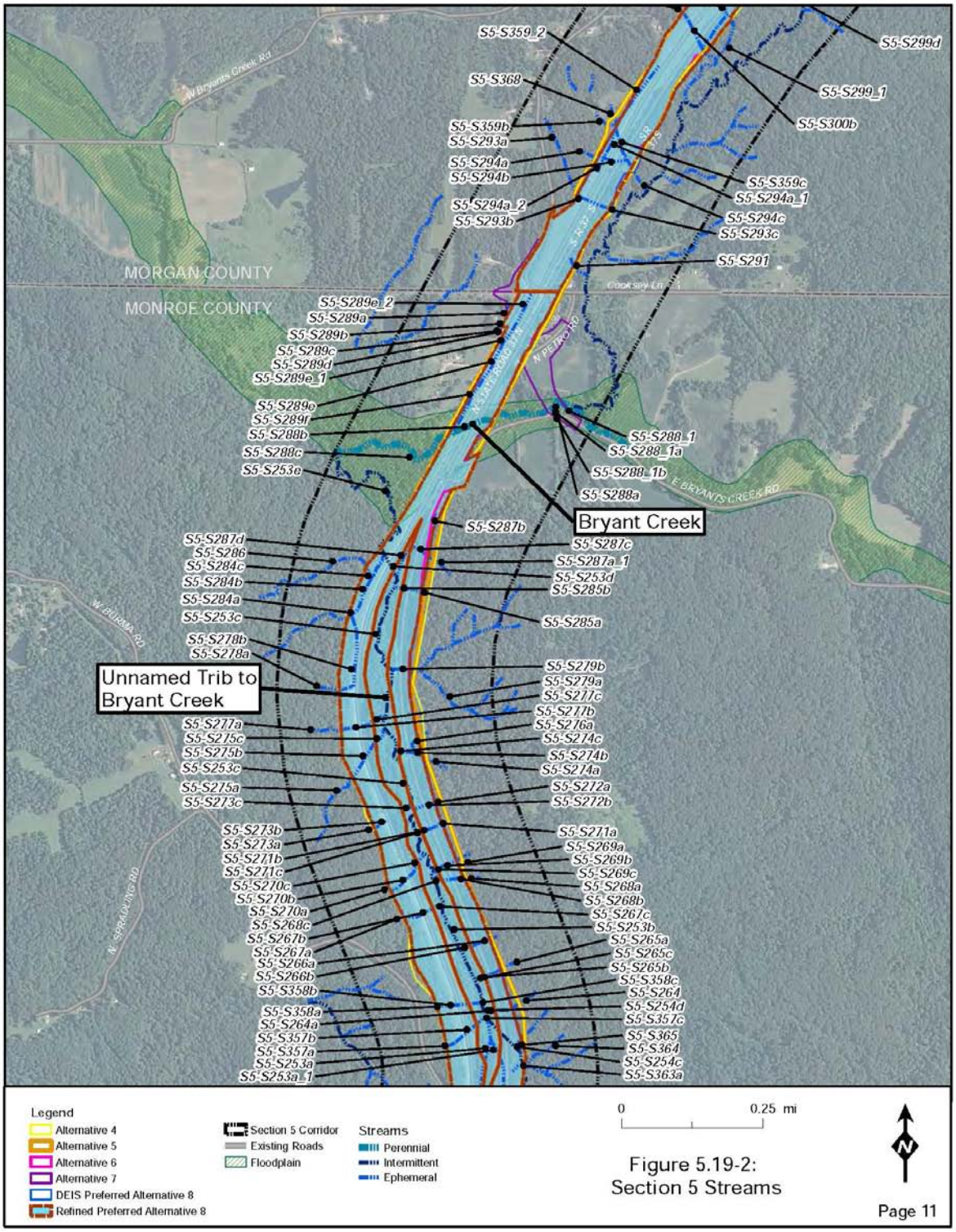

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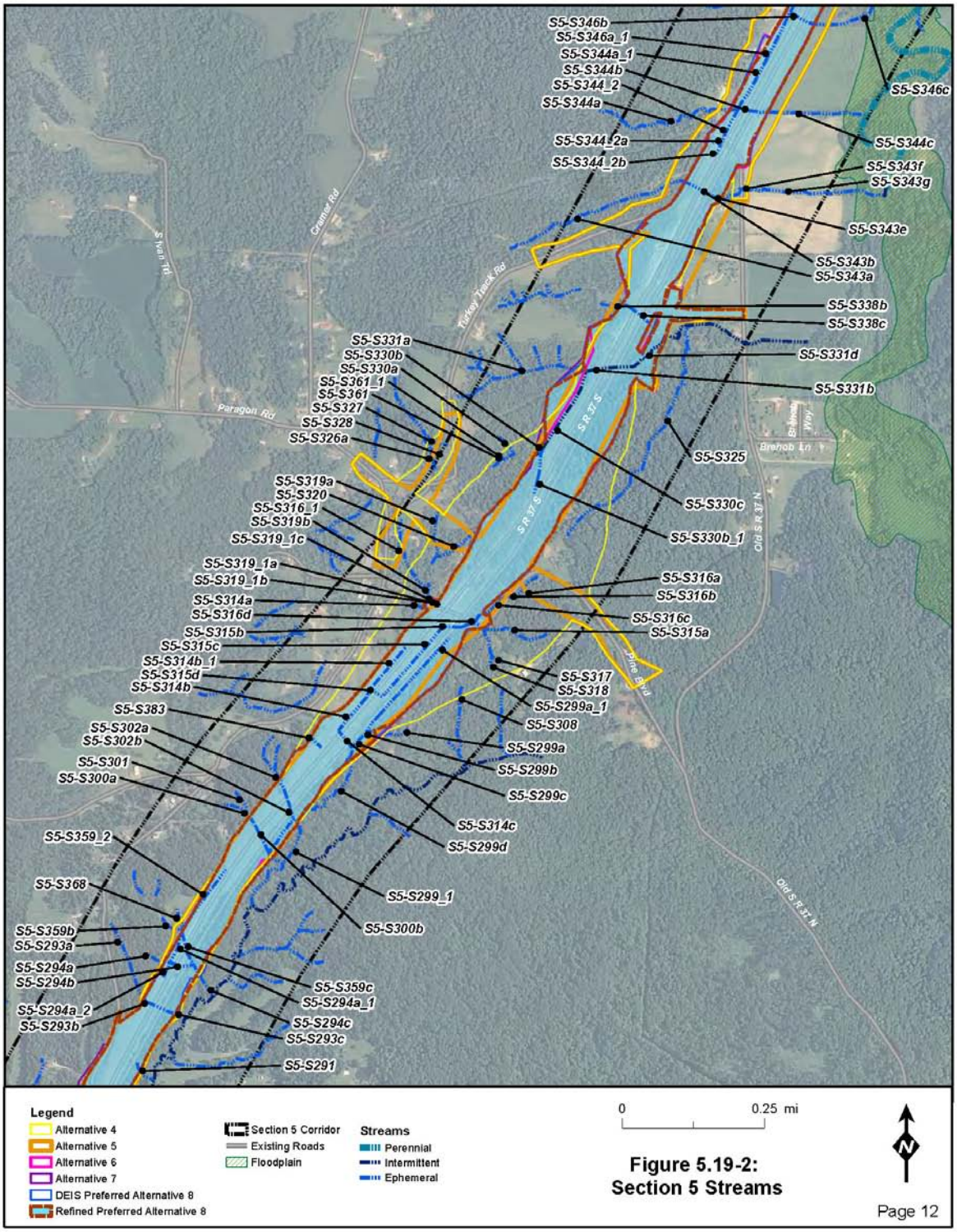

Figure 5.19-2: Section 5 Streams (Sheet 12 of 14)

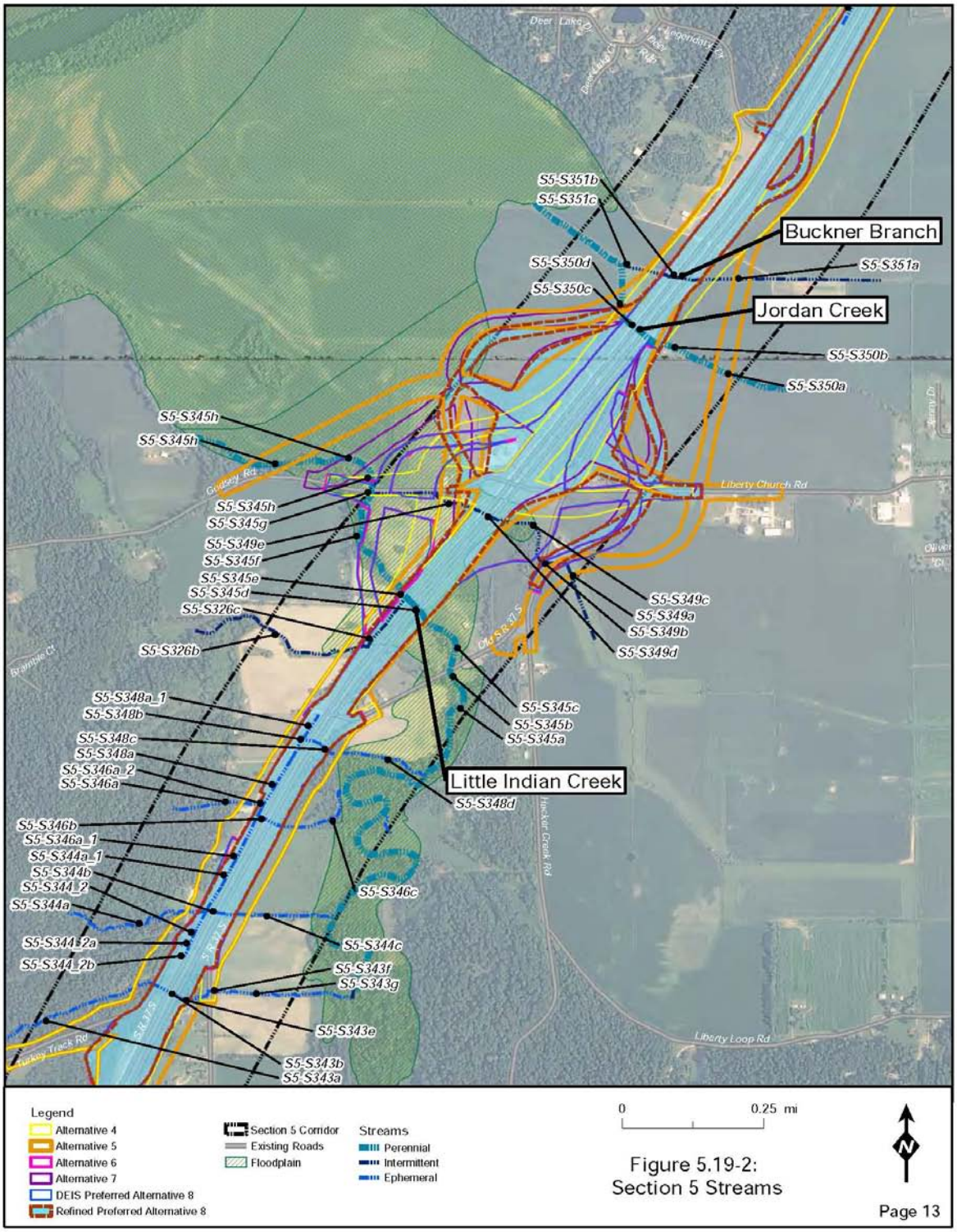

Figure 5.19-2: Section 5 Streams (Sheet 13 of 14)

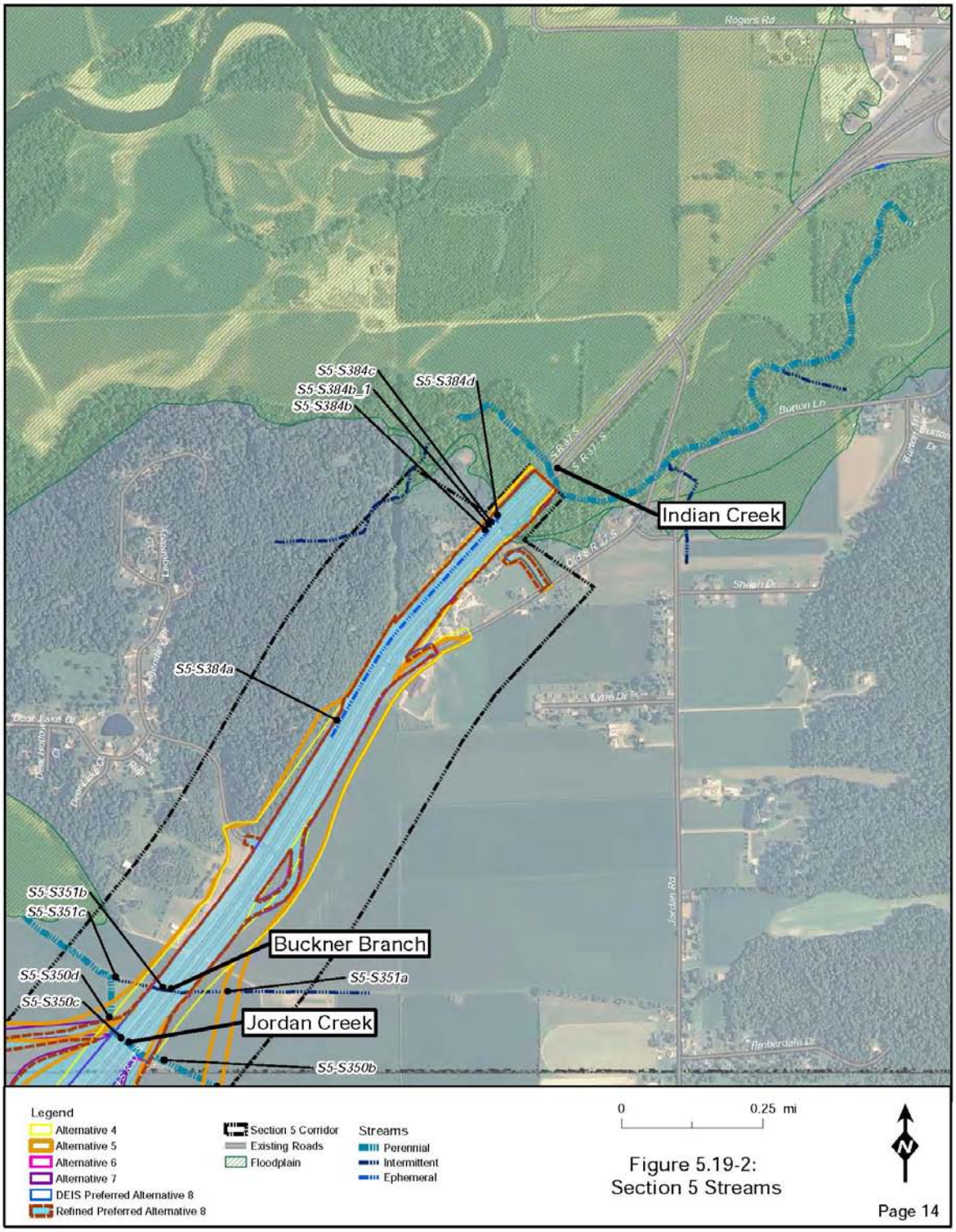

Figure 5.19-2: Section 5 Streams (Sheet 14 of 14)

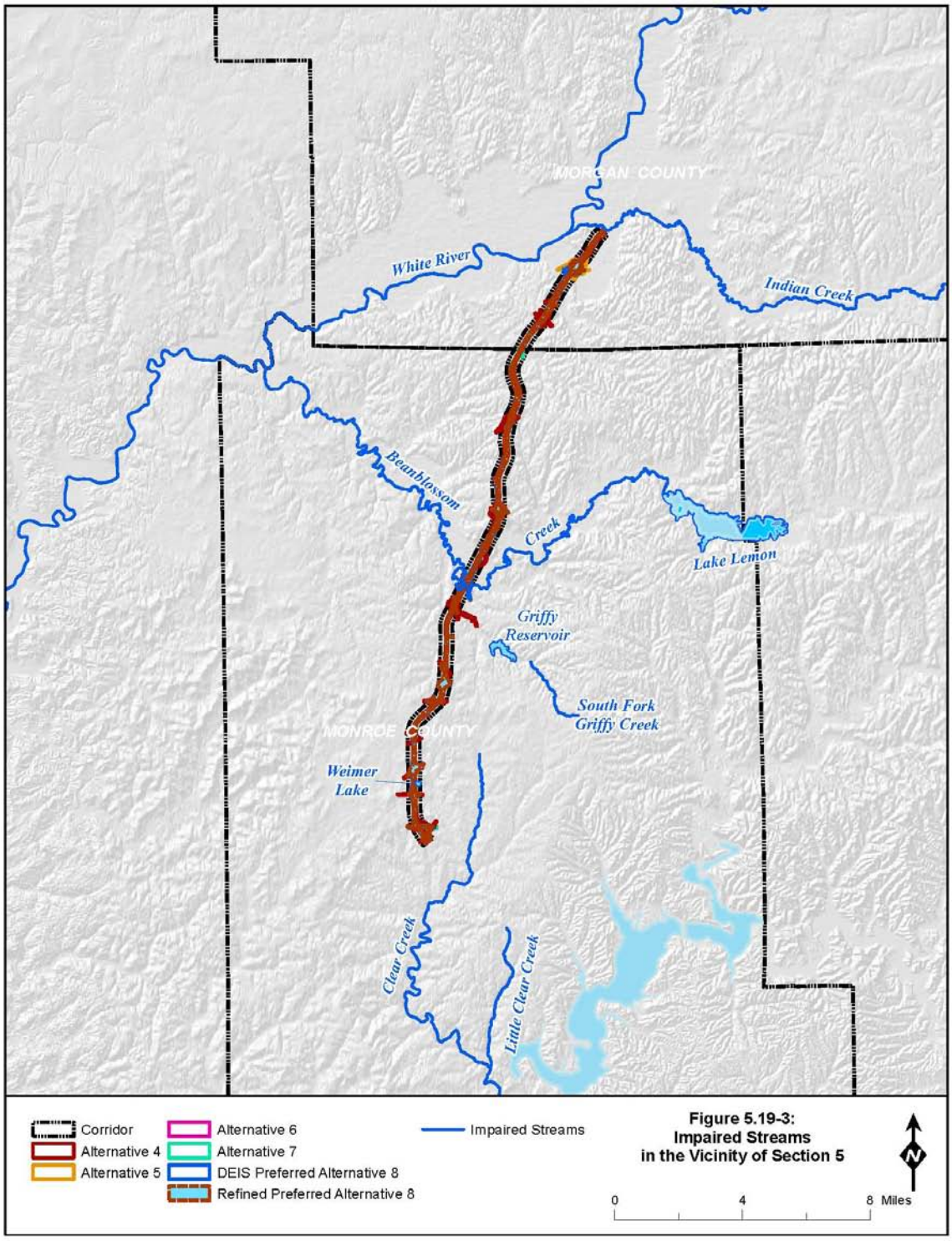

Figure 5.19-3: Impaired Streams in the Vicinity of Section 5

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5.20 Forest Impacts

For purposes of this section, Preferred Alternative 8 that was identified in the Draft Environmental Impact Statement (DEIS) will be referred to as "Alternative 8." The Preferred Alternative for the Final Environmental Impact Statement (FEIS) will be referred to as the "Refined Preferred Alternative 8."

Since the publishing of the DEIS, the following substantive change has been made to this section:

- **Section 5.20.3**, *Analysis*, and **Section 5.20.4**, *Mitigation*, were updated with information for Refined Preferred Alternative 8.

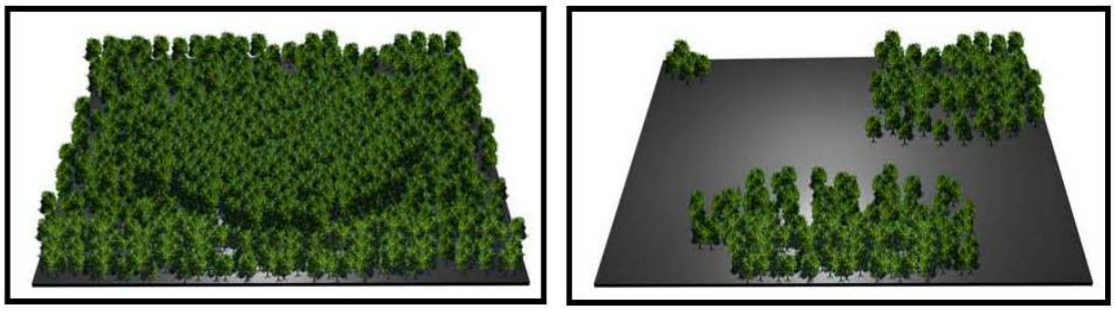
- **Section 5.20.4**, *Mitigation*, was updated to include more detailed information about mitigation sites for Section 5.

5.20.1 Introduction

Forests are a large and important resource in Indiana. Indiana's forests make significant environmental and economic contributions, including: timber, outdoor recreation, protection of soil and water resources, and habitat for many plant and animal species. Approximately 4.5 million acres, or 20%, of Indiana is forested. Most forests are located in the southern half of the state (Tormoehlen et al., 2000). The majority of Indiana's forests are composed of hardwood species. The primary hardwood forest types in Indiana are oak-hickory and maple-beech (Schmidt et al., 2000).

In addition to impacts from the direct taking of forested land, habitats such as forests, prairies, and wetlands may be adversely affected by fragmentation. Habitat fragmentation (especially the loss of core forest habitat – see discussion below) is perhaps the most pervasive type of habitat alteration taking place in the world today. It can be defined as the steady transformation of once large and continuous tracts of natural landscape into smaller and more isolated patches or fragments surrounded by disturbed areas (Temple and Wilcox, 1984). **Figure 5.20–1** shows a forest before and after fragmentation occurs. Fragmentation can increase the likelihood of invasive species entering an area's remaining habitat. Invasive plant species can cause ecological damage by displacing native plant species, eliminating food and cover for wildlife, and threatening rare plant and animal species. The Invasive Plant Species Assessment Working Group (IPSAWG) was formed to address invasive species in Indiana. A number of agencies and organizations, including the Indiana Department of Transportation (INDOT), participate in this group.[1]

[1] Partners in IPSAWG include the United States Fish and Wildlife Service (USFWS), the National Park Service (NPS), the United States Forest Service (USFS), The Nature Conservancy, The Wildlife Society Indiana Chapter, Purdue Cooperative Extension Service, the Indiana Department of Natural Resources (IDNR), the Indiana Department of Environmental Management (IDEM), the Indiana Chapter of the American Society of Landscape Architects, Indiana Forage Council, Indiana Wildlife Federation, Indiana Seed Trade Association, Indiana State Beekeepers Association, Indiana Native Plant and Wildflower Society, Indiana Farm Bureau, Indiana State Chemist, White River Gardens, Grazing Lands Conservation Initiative, Green Industry Alliance, Indiana Academy of Science, Indianapolis Landscapers Association, and the Indianapolis Zoo.



Left: Forest Prior to Fragmentation. **Right: Forest After Fragmentation**

Figure 5.20-1: Forest Fragmentation

Core habitat is the interior portion of any particular habitat. Core habitat can be associated with different ecosystem types, such as forest and prairies. In southern Indiana, most core habitat is generally associated with forests; no large tracts of prairie (the other type of core habitat historically found in Indiana) remain. Core forest is generally accepted to be the portion of the forest that is 100 meters (328 feet) from the edge (Temple, 1986). The outer portion of forest is considered the edge habitat. **Figure 5.20–2** illustrates core forest habitat in relation to edge habitat. Core forest can be affected directly by impacting the core area or indirectly by altering the edge of the forest, which in turn redefines the core area. Many species require core habitat to flourish, and a loss of core habitat can cause or worsen stress to those species. For example, fragmentation and/or redefinition of core forest habitat can affect migratory birds in a number of ways. Some birds require large blocks of forest to successfully nest and fledge their young. Nests deep in a forest tract are also often less susceptible to cowbird parasitism and predation by edge species such as raccoons. Fragmentation and/or redefinition also can affect bird use by separating habitat blocks so that they no longer function as one habitat unit.

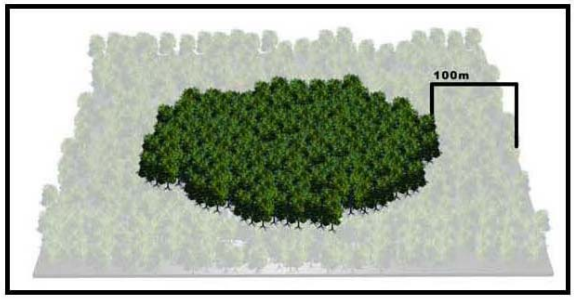


Figure 5.20-2: Diagram of Core Forest Habitat

Section 5 of I-69 entails upgrading an existing multi-lane, divided transportation facility to a full freeway design. Most of the right-of-way used for the Section 5 project already is devoted to transportation use. Accordingly, the impacts to most natural resources in Section 5 will be lessened (on a per-mile basis) in comparison with Sections 1 through 4, which are being

constructed primarily on previously undeveloped terrain. The resource impacts in this chapter include forest impacts both within and outside the existing right-of-way for SR 37 and other transportation facilities. The majority of mainline impacts are to forests that were previously affected by the construction of SR 37. Impacts to forest habitat would occur from construction along the mainline, new interchanges, and local access road construction.

5.20.2 Methodology

The Tier 1 study used the Geographic Information System (GIS) developed for Southwest Indiana to estimate impacts to forests. Alternative alignments were overlain on the 1992 United States Geological Survey (USGS) Land Cover data layer (published in 1998) in the GIS, as described in the Tier 1 FEIS (see Section 5.21, *Forest Impacts*, of the Tier 1 FEIS). The total forest acreages included the right-of-way needed for the mainline of the interstate from the intersection of SR 37 at That Road to SR 39 at SR 37, as well as the potential interchanges with Paragon Road, Sample Road, Walnut Street, Kinser Pike, SR 46, SR 48/3rd Street, SR 45/2nd Street, and Fullerton Pike.

During the Tier 2 study in Section 5, potential impacts to forested areas due to the project were identified using Year 2010 aerial photography from the National Agriculture Imagery Program supported by field surveys to verify or revise the GIS data layers. The field reconnaissance enabled the identification of small woodlots and narrow wooded areas along fencerows and streams that were not shown on the USGS data and, therefore, not included in the Tier 1 forest acreage estimates. Total Tier 2 acreages evaluated include the right-of-way needs for the mainline and interchanges in addition to county road overpasses, proposed road relocations, and new local access roads.

Forests identified in the field and through aerial photography were digitized and given a specific reference number with current aerial photographs as a backdrop. Field investigations and review of aerial photography resulted in the identification of four United States Department of Agriculture (USDA) forest classification types in the corridor for Section 5. **Table 5.20-1** lists the four types and describes the species associated with each. The forest areas within the corridor were outlined and color-coded by forest type, and the acres of each type within the corridor were calculated. The proposed right-of-way of each end-to-end alternative was placed over the aerial mapping showing the outlined forest types, and the affected forest areas were calculated for each alternative. Forest block boundaries were also digitized for any areas where alternatives extended outside the project corridor.

The USDA definition of forest land was used for determining impacts to forests for this study. The USDA definition of forest land is an area with at least 10% tree stocking, or an area that formerly had such tree stocking and is not currently developed for non-forest use. These areas must be at least one acre in size, and roadside, streamside, and/or windbreak strips of trees must have a crown width of at least 120 feet. Within areas initially identified as forests, unimproved roads, trails, and/or clearings less than 120 feet wide were classified as forest land. Furthermore, water bodies that were less than 30 feet in width were also classified the same as the surrounding forest. All forests within the corridor and the area 150 meters (492 feet) beyond the Section 5 corridor and each alternatives' right-of-way were included to determine whether core forests

would be affected by the project. The large scope of this study area was chosen to ensure accurate core forest analysis results as well as to aid in determining whether core forests would be affected by the project.

In order to capture these areas, a polygon forest dataset was created. Forest area polygons were digitized at a scale varying from 1:10,000 to 1:3,000 depending on the detail of the area of concern. The aforementioned USDA guidelines for forest classification were used during attribution, and any polygons that did not meet these requirements were not classified as forests. To determine forest cover type of individual forests, the USDA Forest Service – Forest Inventory and Analysis (FIA) Program countrywide raster dataset was used. Individual polygons were selected and classified based on forest types present in the FIA dataset. Cells from the FIA dataset were identified, and the forest type with the highest percentage was used to classify the forest. For areas where classification in the FIA dataset was unknown but aerial imagery provided evidence of forest coverage, forest types closest in proximity to areas in question were used and subsequently field verified.

In order to assess the direct impacts on core forests within the study area, spatial analysis was done on the forest dataset. To correctly identify core forests within the study area, the forest edge must first be determined. This was done by creating a buffer of 100 meters (328 feet) inside the areas classified as forested land. The area within the 100-meter (328-foot) buffer was erased from the forest dataset, and this was exported to create a core forest dataset.

In order to determine potential impacts to forested land within the study area, both the forest and core forests datasets were used. Areas of each specific forest type and core forest within the study area were calculated in acres. The proposed right-of-way of each build alterative was placed over the forest and core forest datasets, and the areas of affected forests and core forests were calculated.

Indicators of potential indirect and cumulative effects of the project on forest resources was obtained from many sources, including coordination with local county offices and staff in the project area (several of whom served on Section 5's expert land use panel), as well as private industry development experts in the area. The analyses used the Regional Economic Models, Inc. (REMI) to calculate projected population and employment changes in each of five economic zones within the 26-county, Tier 1 I-69 Study Area for the year 2035.[2] Growth for each region was delegated into Traffic Analysis Zones (TAZs) based on input from the expert land use panels. The indirect impacts to forests are summarized in **Section 5.20.3**, *Analysis*. The indirect impacts to forests (which are based upon these forecasted growth projections) and other key resources in Section 5 are described in detail in **Section 5.24**, *Indirect and Cumulative Impacts*.

5.20.3 Analysis

Field investigations and review of aerial photography resulted in the identification of four USDA forest classification types in the corridor for Section 5. **Table 5.20-1** lists the four types and

[2] REMI forecasts in Tier 1 projected to the year 2034. As such, the design year for Section 5 (2035) represents a slight extrapolation.

describes the species associated with each. **Table 5.20-2** lists the forest types, the acres of each within the project corridor and within the proposed right-of-way of the build alternatives in Section 5, and the degree of impact anticipated (i.e., edge, fragment, or total). The location of all forest areas within the project corridor is depicted in **Figure 5.20-3**. Unless otherwise noted, figures are located at the end of this chapter.

Table 5.20-1: Forest Types and Associated Plant Species in the Section 5 Corridor

USDA Forest Classifications	Representative Plant Species
Elm-ash-cottonwood	Forests in which lowland elm, ash, red maple, silver maple, and cottonwood, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the elm-ash-cottonwood forest type in Indiana include sycamore, yellow-poplar, red oak, and black walnut.
Maple-beech	Forests in which hard maple, beech, American elm, and red maple, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the maple-beech forest type in Indiana include white oaks, red oaks, hickories, yellow-poplar, and ash.
Cherry-ash-yellow poplar	Forests in which black cherry, white ash, and yellow poplar, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the cherry-ash-yellow poplar forest type in Indiana include black walnut, American elm, white oak, and hard maples.
Oak-hickory	Forests in which upland oaks and hickories, singly or in combination, comprise a plurality of the stocking. Species commonly associated with the oak-hickory forest type in Indiana include yellow-poplar, ash, black cherry, cottonwood, and black walnut.

A 1999-2003 survey of Indiana's forests published by the USDA Forest Service identified a total of 233,600 acres of forest in the two counties in Section 5, as follows:

- Monroe County – 142,600 acres
- Morgan County – 91,000 acres

The selected Tier 1 corridor for I-69 in Section 5 is comprised of approximately 5,086 acres of land, of which 1,904 acres (or 37%) is forest (including upland and wetland forest), and is located on 193 separate tracts. Approximately 19% (967 acres) of the corridor is within the existing SR 37 right-of-way. **Figure 5.20-3** shows an overview of the forest areas within the Section 5 Tier 1 corridor. The forest areas range in size from approximately 0.01 acre to 181 acres within the corridor; 10 of the tracts are greater than 50 acres. The largest tract (181 acres) within the corridor is located east of SR 37 and north of West Burma Road. The predominant forest type within the corridor is oak-hickory, totaling approximately 1,555 acres, or 82% of the total forested acres. Maple-beech accounts for 8%, cherry-ash-yellow poplar accounts for 6%, and elm-ash-cottonwood accounts for 4% of the total forested acres. The alternatives also affect 14 additional forest tracts that lie entirely outside the Tier 1 approved 2,000-foot corridor. No

single alternative affects all 14 of these forest tracts. Impacts to these tracts range from 5 tracts affected (Alternative 7 and Refined Preferred Alternative 8) to 13 tracts affected (Alternative 4).

The potential impacts to forests for Alternatives 4, 5, 6, 7, 8, and Refined Preferred Alternative 8 range from 229 acres (Refined Preferred Alternative 8) to 441 acres (Alternative 4), which are 12% and 23% of the total forest area in the corridor, respectively. This is approximately 74 acres less than the 303 acres estimated in the revised Tier 1 Biological Opinion (BO).[3] These impacts do not account for impacts due to relocation of utilities or billboards, since the specific location of such impacts cannot be identified at this time. **Appendix LL1**, *Redacted Tier 2 Biological Assessment*, contains general estimates of forest impacts due to utility and billboard relocations.

Table 5.20-2 identifies direct impacts to forests for each alternative as well as the impact types for each identified forest. Impact types are defined as edge, fragment, or total. An "edge" impact type is identified as an alternative affecting one side of the forest, leaving the remaining forest on one side of the right-of-way. Edge type impacts to forests range from 60.8% of the total forest impacts (Alternative 5) to 80.4% (Alternative 6). Refined Preferred Alternative 8 edge type impacts are 76.23% of the total forest impacts. A "fragment" impact type is identified when the alternative splits the forest such that one or more forest areas remain on each side of the right-of-way. Fragment type impacts to forests range from 0.7% (Alternative 6) to 25.8% (Alternative 5), with Refined Preferred Alternative 8 fragment type impacts at 4.09% of the total forest impacts. A “total” impact type is identified when the entire forest will be affected by the alternative or less than 1 acre will remain. Total type impacts to forest range from 12.5% (Alternative 4) to 19.68% (Refined Preferred Alternative 8).

The difference in impacts from the original Tier 1 study is largely the result of the more detailed analysis performed in Tier 2 analysis that involved revised alternative alignments, different data sources for forest, and field identification of wooded areas not included in the Tier 1 estimation of forest acres affected (see **Section 5.20.2**, *Methodology*). The Tier 1 FEIS estimates also included parallel frontage roads while Tier 2 includes local access roads outside of the mainline typical sections. These are primarily located within the rural (i.e. forested) areas of the Section 5 corridor and connect existing local roads. The Tier 1 FEIS typical section assumed that any local access roads were immediately adjacent to, and part of, the typical section of the mainline. These differences in the footprints are consistent with the acreage changes between the Tier 1 FEIS Preferred Alternative and the Tier 2 Build Alternatives. **Figure 5.20-3** depicts the impacts to forest areas by alternative.

Seventeen forests that include wetland areas within their boundaries (F025, F122, F126, F130, F131, F134, F136, F139, F144, F145, F147, F150, F151, F152, F154, F221, and F229) have the potential to be affected by one or more of the alternatives. The numbers in **Table 5.20-2** include impacts to those wetlands.

The Indiana Wetland Rapid Assessment Protocol (INWRAP) was used to assess the wetlands within the construction limits of the Section 5 alternatives. **Section 5.19**, *Water Resources*,

[3] Tier 1 Section 7 consultation was reinitiated in 2013 in part because forest impacts (including right-of-way [in both upland and wetland] and general estimates for utilities and billboards) exceeded the original thresholds in the revised Tier 1 BO. The resulting Amendment 2 of the revised Tier 1 BO increases the Section 5 forest impact threshold to 350 acres.

provides a detailed description of wetlands in the Section 5 corridor, as well as potential impacts to wetlands as a result of each alternative and potential mitigation of these impacts. **Section 5.19.2.2**, *Methodology (Water Quality Impacts)* provides the INWRAP methodology, and **Section 5.19.2.3**, *Analysis (Water Quality Impacts)* provides the results of the INWRAP assessment. For mitigation purposes, forested wetlands are treated as wetlands. **Chapter 7**, *Mitigation and Commitments*, includes further discussion of mitigation of impacts to forested wetlands. For impacts to forested wetlands, see **Table 5.20-3**.

Impacts to all forests within the Tier 1 Section 5 corridor, including the forested wetlands are shown in **Table 5.20-2**. Note that some of the forest areas affected extend beyond the 2,000-foot corridor boundary, while others are located entirely outside the corridor. These forest areas are affected by portions of the project, such as interchanges or local access roads that extend beyond the limits of the Tier 1 Section 5 corridor. Forests with acreages outside the Tier 1 Section 5 corridor boundary are indicated with an "†" in the "Forest ID" column.

The potential impacts to non-wetland forests that would result from construction of Section 5 of the I-69 project for alternatives vary from approximately 227.66 acres (Refined Preferred Alternative 8) to 433.16 acres (Alternative 4).

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Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
0 - 4.9 acres	Oak-Hickory	F061†	0.01	0.34	Edge	0.35	Edge	0.03	Edge	0.20	Edge	0.19	Edge	0.27	Edge
	Elm-Ash-Cottonwood	F254†	0.01	0.00		0.00		0.00		0.00		0.00			
	Elm-Ash-Cottonwood	F269†	0.01	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F054†	0.02	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F129†	0.02	0.00		0.01	Edge	0.00		0.00		0.00			
	Maple-Beech	F138	0.02	0.00		0.00		0.02	Total	0.01	Edge	0.00			
	Oak-Hickory	F230	0.03	0.00		0.00		0.00		0.01	Edge	0.00			
	Cherry-Ash-Yellow Poplar	F044†	0.06	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F034†	0.07	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F006†	0.12	0.07	Edge	0.07	Edge	0.07	Edge	0.07	Edge	0.07	Edge	0.07	Edge
	Oak-Hickory	F173†	0.12	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F224	0.13	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F136	0.14	0.14	Total	0.14	Total	0.14	Total	0.14	Total	0.14	Total	0.14	Total
	Oak-Hickory	F004†	0.16	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F245†	0.18	0.01	Edge	0.01	Edge	0.00		0.00		0.00			
	Oak-Hickory	F229	0.19	0.00		0.00		0.00		0.02	Edge	0.00			
	Oak-Hickory	F207†	0.21	0.00		0.00		0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F025	0.23	0.10	Edge	0.23	Edge	0.00		0.16	Edge	0.15	Edge	0.16	Edge
	Oak-Hickory	F201†	0.23	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F117†	0.24	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F128	0.27	0.00		0.22	Total	0.19	Total	0.05	Total	0.20	Total		
	Oak-Hickory	F010†	0.28	0.00		0.00		0.00		0.00		0.00			
	Elm-Ash-Cottonwood	F270†	0.31	0.04	Edge	0.04	Edge	0.09	Edge	0.10	Edge	0.09	Edge	0.09	Edge
	Oak-Hickory	F008†	0.32	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F145	0.33	0.33	Total	0.33	Total	0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F083†	0.35	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F077†	0.41	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F043	0.42	0.01	Edge	0.00		0.00		0.00		0.00			
	Oak-Hickory	F027†	0.46	0.29	Edge	0.15	Edge	0.00		0.00		0.00			
	Maple-Beech	F143†	0.53	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F240†	0.53	0.00		0.00		0.00		0.00		0.00			

Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
	Maple-Beech	F154	0.56	0.01	Edge	0.01	Edge	0.01	Edge	0.00		0.00			
	Maple-Beech	F126	0.60	0.00		0.60	Total	0.60	Total	0.36	Total	0.60	Total		
	Elm-Ash-Cottonwood	F264†	0.61	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F051†	0.68	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F131	0.71	0.40	Edge	0.71	Total	0.71	Total	0.33	Edge	0.71	Total	0.03	Edge
	Oak-Hickory	F071†	0.74	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F144	0.76	0.00		0.00		0.07	Edge	0.00		0.00			
	Oak-Hickory	F213	0.78	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F227	0.81	0.05	Edge	0.06	Edge	0.05	Edge	0.19	Fragment	0.05	Fragment	0.05	Fragment
	Oak-Hickory	F078†	0.89	0.48	Edge	0.46	Edge	0.00		0.00		0.00			
	Maple-Beech	F141†	0.95	0.00		0.00		0.12	Edge	0.01	Edge	0.00			
	Oak-Hickory	F106†	0.97	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F125†	0.97	0.00		1.53	Edge	1.77	Edge	0.02	Edge	1.61	Edge		
	Oak-Hickory	F226	1.04	0.01	Edge	0.01	Edge	0.01	Edge	0.34	Total	0.01	Edge	0.01	Edge
	Oak-Hickory	F196	1.06	0.00		0.00		0.00		0.00		0.00			
	Elm-Ash-Cottonwood	F272†	1.07	0.39	Edge	0.40	Edge	0.22	Edge	0.24	Edge	0.22	Edge	0.22	Edge
	Cherry-Ash-Yellow Poplar	F023	1.09	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F255	1.15	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F149	1.16	0.89	Fragment	0.90	Total	0.00		0.00		0.00			
	Maple-Beech	F152	1.16	0.55	Edge	0.55	Edge	0.42	Edge	0.21	Edge	0.39	Edge	0.17	Edge
	Oak-Hickory	F243	1.19	1.19	Total	0.30	Total	0.31	Total	0.31	Total	0.31	Total	0.32	Total
	Oak-Hickory	F199†	1.20	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F133	1.29	1.26	Total	1.29	Total	1.09	Total	0.88	Total	1.28	Total	0.88	Total
	Oak-Hickory	F231	1.29	0.00		0.00		0.00		0.47	Fragment	0.00			
	Oak-Hickory	F062†	1.29	2.09	Edge	2.07	Edge	0.88	Edge	1.94	Edge	1.96	Edge	1.92	Edge
	Cherry-Ash-Yellow Poplar	F020†	1.35	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F214	1.38	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F130†	1.40	0.00		0.01	Edge	0.00		0.00		0.00			
	Maple-Beech	F158	1.40	0.17	Edge	0.21	Edge	0.09	Edge	0.00		0.09	Edge	0.1	Edge
	Cherry-Ash-Yellow Poplar	F019	1.43	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F139†	1.44	0.00		0.00		0.10	Edge	0.00		0.00			

Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
	Maple-Beech	F150†	1.44	1.57	Fragment	1.58	Fragment	0.00		0.00		0.00			
	Oak-Hickory	F105	1.49	1.49	Total	1.17	Total	0.00		1.05	Total	1.05	Total	1.07	Total
	Oak-Hickory	F232†	1.56	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F162	1.59	1.06	Total	1.05	Total	0.96	Total	1.00	Total	0.97	Total	0.83	Total
	Oak-Hickory	F251	1.60	1.21	Total	1.46	Total	0.82	Total	0.79	Edge	0.82	Total	0.82	Total
	Oak-Hickory	F085†	1.65	0.00		0.00		0.00		0.00		0.00			
	Elm-Ash-Cottonwood	F268†**	1.68	0.33	Edge	0.34	Edge	0.46	Edge	0.55	Edge	0.47	Edge	0.44	Edge
	Oak-Hickory	F176	1.69	1.53	Total	1.42	Total	0.42	Edge	0.11	Edge	0.42	Edge	0.38	Edge
	Cherry-Ash-Yellow Poplar	F021†	1.70	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F244	1.76	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F122	1.78	0.27	Edge	0.38	Edge	0.28	Edge	0.28	Edge	0.28	Edge	0.28	Edge
	Oak-Hickory	F076	1.79	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F068†	1.80	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F178	1.81	1.67	Total	1.60	Total	0.96	Edge	1.18	Total	0.96	Edge	0.96	Edge
	Oak-Hickory	F204†	1.82	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F079†	1.84	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F037†	1.88	0.69	Edge	0.74	Edge	0.21	Edge	0.21	Edge	0.21	Edge	0.21	Edge
	Oak-Hickory	F188	1.90	1.06	Total	1.05	Total	0.83	Edge	0.07	Edge	0.83	Edge	0.78	Edge
	Oak-Hickory	F235	1.97	0.00		0.00		0.00		0.15	Edge	0.00			
	Oak-Hickory	F121	2.01	0.71	Edge	0.68	Edge	0.58	Edge	0.52	Edge	0.38	Edge	0.31	Edge
	Oak-Hickory	F169	2.14	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F216	2.17	0.98	Edge	0.99	Edge	0.53	Edge	0.53	Edge	0.54	Edge	0.53	Edge
	Elm-Ash-Cottonwood	F261	2.20	0.00		0.00		1.82	Total	0.00		1.83	Total		
	Maple-Beech	F147	2.29	1.04	Fragment	1.04	Fragment	0.25	Edge	0.13	Edge	0.25	Edge	0.11	Edge
	Cherry-Ash-Yellow Poplar	F032†	2.29	0.12	Edge	0.02	Edge	0.01	Edge	0.04	Edge	0.02	Edge	0.05	Edge
	Oak-Hickory	F069	2.31	0.04	Edge	0.04	Edge	0.04	Edge	0.04	Edge	0.04	Edge	0.04	Edge
	Oak-Hickory	F258†	2.31	0.00		0.30	Edge	0.00		0.00		0.00			
	Oak-Hickory	F183†	2.31	2.09	Edge	2.09	Edge	0.09	Edge	0.03	Edge	0.10	Edge	0.09	Edge
	Oak-Hickory	F064†	2.34	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F197	2.38	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F114†	2.44	0.00		0.00		0.00		0.00		0.00			

Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
	Oak-Hickory	F211	2.53	2.53	Total	2.53	Total	2.01	Edge	1.23	Edge	2.00	Total	2.18	Total
	Oak-Hickory	F080	2.55	0.79	Edge	0.81	Edge	0.25	Edge	0.25	Edge	0.25	Edge	0.25	Edge
	Oak-Hickory	F123	2.58	1.71	Edge	1.68	Edge	1.26	Edge	1.23	Edge	1.52	Edge	1.25	Edge
	Oak-Hickory	F221	2.65	0.37	Edge	0.38	Edge	0.01	Edge	0.28	Edge	0.28	Edge	0.28	Edge
	Oak-Hickory	F257†	2.66	0.00		0.00		0.00		0.00		0.00			
	Elm-Ash-Cottonwood	F252†	2.69	0.22	Edge	0.22	Edge	0.13	Edge	0.13	Edge	0.13	Edge	0.13	Edge
	Maple-Beech	F045	2.70	0.36	Edge	0.36	Edge	0.00		0.00		0.00			
	Oak-Hickory	F102	2.71	0.54	Edge	0.09	Edge	0.02	Edge	0.05	Edge	0.04	Edge	0.06	Edge
	Oak-Hickory	F259†	2.78	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F146	2.85	0.02	Edge	0.02	Edge	0.24	Edge	0.00		0.00			
	Maple-Beech	F159	3.06	2.48	Edge	2.46	Edge	1.36	Edge	1.22	Edge	1.37	Edge	1.33	Edge
	Maple-Beech	F046	3.09	0.19	Edge	0.19	Edge	0.00		0.00		0.00			
	Oak-Hickory	F160	3.36	1.22	Edge	1.21	Edge	1.19	Edge	0.75	Edge	1.24	Edge	0.99	Edge
	Oak-Hickory	F063	3.46	0.00		0.00		0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F048	3.47	0.07	Edge	0.05	Edge	0.02	Edge	0.01	Edge	0.02	Edge	0.01	Edge
	Oak-Hickory	F081†	3.62	0.80	Edge	0.82	Edge	0.01	Edge	0.01	Edge	0.01	Edge	0.01	Edge
	Oak-Hickory	F186	3.65	2.17	Edge	2.16	Edge	1.46	Edge	0.48	Edge	1.47	Edge	1.47	Edge
	Elm-Ash-Cottonwood	F260†	3.80	0.05	Edge	0.00		1.28	Edge	0.00		1.33	Edge		
	Maple-Beech	F137†	3.83	0.45	Edge	0.50	Edge	0.37	Edge	0.16	Edge	0.37	Edge	0.06	Edge
	Oak-Hickory	F065**	3.84	0.94	Edge	0.56	Edge	0.07	Edge	0.07	Edge	0.07	Edge	0.07	Edge
	Oak-Hickory	F009	3.86	0.70	Edge	0.66	Edge	0.67	Edge	0.79	Edge	0.73	Edge	0.72	Edge
	Oak-Hickory	F198†	3.92	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F053	3.96	0.01	Edge	0.01	Edge	0.01	Edge	0.01	Edge	0.01	Edge	0.01	Edge
	Oak-Hickory	F127†	3.96	0.38	Edge	0.34	Edge	0.24	Edge	0.33	Edge	0.31	Edge	0.23	Edge
	Oak-Hickory	F184	3.96	3.96	Total	3.96	Total	3.84	Total	2.67	Edge	3.80	Total	3.8	Total
	Oak-Hickory	F177†	3.99	5.36	Edge	5.30	Edge	1.18	Edge	3.06	Edge	1.18	Edge	0.89	Edge
	Maple-Beech	F124	4.02	0.50	Edge	1.03	Edge	0.72	Edge	0.51	Edge	0.69	Edge	0.51	Edge
	Oak-Hickory	F074†	4.03	0.28	Edge	0.30	Edge	0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F031	4.15	0.83	Edge	2.78	Edge	0.25	Edge	2.48	Edge	3.13	Edge	2.69	Edge
	Elm-Ash-Cottonwood	F263†	4.15	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F088†	4.25	0.00		0.00		0.00		0.00		0.00			

Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
	Oak-Hickory	F052	4.32	3.98	Total	4.00	Total	3.98	Total	3.98	Total	3.98	Total	3.98	Total
	Oak-Hickory	F116**	4.42	2.86	Edge	2.81	Edge	2.63	Edge	2.63	Edge	2.63	Edge	2.54	Edge
	Oak-Hickory	F237	4.57	0.10	Edge	0.09	Edge	0.09	Edge	0.25	Edge	0.09	Edge	0.09	Edge
	Oak-Hickory	F058	4.65	2.52	Edge	2.60	Edge	2.33	Edge	2.84	Edge	2.83	Edge	3.04	Edge
	Oak-Hickory	F066†	4.79	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F228†	4.94	0.00		0.00		0.00		0.00		0.00			
5 - 9.9 acres	Oak-Hickory	F067	5.22	0.02	Edge	0.01	Edge	0.00		0.00		0.00			
	Oak-Hickory	F086	5.22	0.44	Edge	0.47	Edge	0.47	Edge	0.47	Edge	0.47	Edge	0.47	Edge
	Oak-Hickory	F191	5.83	1.40	Edge	1.35	Edge	0.98	Edge	0.00		0.98	Edge	0.66	Edge
	Elm-Ash-Cottonwood	F267	5.84	0.24	Edge	0.23	Edge	0.23	Edge	0.23	Edge	0.23	Edge	0.23	Edge
	Oak-Hickory	F206†	6.01	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F208	6.03	0.12	Edge	0.11	Edge	0.52	Edge	0.41	Edge	0.52	Edge	0.14	Edge
	Oak-Hickory	F238	6.07	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F234†	6.12	0.00		0.00		0.00		0.00		0.00			
	Maple-Beech	F151†	6.23	0.06	Edge	0.06	Edge	0.04	Edge	0.01	Edge	0.00			
	Oak-Hickory	F089	6.29	0.00		0.00		0.00		0.00		0.00			
	Elm-Ash-Cottonwood	F265†	6.34	0.00		0.00		0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F035†	6.37	0.00		0.00		0.00		0.01	Edge	0.28	Edge	0.01	Edge
	Oak-Hickory	F087†	6.37	0.21	Edge	0.19	Edge	0.11	Edge	0.11	Edge	0.11	Edge	0.11	Edge
	Maple-Beech	F164	6.52	3.84	Edge	3.92	Edge	2.17	Edge	1.23	Edge	2.89	Edge	2.17	Edge
	Maple-Beech	F163	6.64	5.03	Edge	5.10	Edge	3.06	Edge	2.73	Edge	3.14	Edge	3.11	Edge
	Oak-Hickory	F075†	6.93	0.92	Edge	0.89	Edge	0.89	Edge	0.89	Edge	0.89	Edge	0.89	Edge
	Oak-Hickory	F167†	6.93	0.00		0.00		0.00		0.01	Edge	0.00			
	Oak-Hickory	F120†	6.94	0.78	Edge	1.01	Edge	0.45	Edge	0.58	Edge	0.60	Edge	0.44	Edge
	Oak-Hickory	F242†	6.95	0.00		0.00		0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F016†	7.48	14.21	Fragment	14.20	Edge	4.82	Edge	1.34	Edge	4.89	Edge	4.13	Edge
	Oak-Hickory	F175†	7.77	5.25	Fragment	5.19	Fragment	1.11	Edge	2.37	Edge	1.11	Edge	1.25	Edge
	Oak-Hickory	F108†	7.88	3.46	Edge	0.28	Edge	0.00		0.00		0.00			
	Oak-Hickory	F179†	8.82	14.37	Fragment	13.87	Fragment	3.25	Edge	6.03	Fragment	3.23	Edge	2.35	Edge
	Oak-Hickory	F195†	9.61	0.00		0.00		0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F041†	9.90	0.00		0.00		0.00		0.00		0.00			

Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
10 - 24.9 acres	Maple-Beech	F134	10.29	2.96	Edge	4.34	Edge	4.26	Edge	1.13	Edge	4.14	Edge	0.23	Edge
	Maple-Beech	F042	10.45	0.67	Edge	0.45	Edge	0.00		0.00		0.00			
	Maple-Beech	F113†**	11.20	0.71	Edge	0.58	Edge	0.56	Edge	1.44	Edge	0.56	Edge	0.56	Edge
	Oak-Hickory	F059**	11.63	2.68	Fragment	2.21	Edge	1.74	Fragment	1.64	Fragment	1.65	Fragment	1.63	Fragment
	Oak-Hickory	F236†**	14.01	0.05	Edge	0.04	Edge	0.04	Edge	0.40	Edge	0.04	Edge	0.04	Edge
	Cherry-Ash-Yellow Poplar	F013†	14.26	5.45	Edge	5.69	Edge	3.30	Edge	7.20	Edge	3.27	Edge	3.15	Edge
	Oak-Hickory	F072	14.31	1.27	Edge	1.28	Edge	0.84	Edge	0.84	Edge	0.84	Edge	0.84	Edge
	Oak-Hickory	F036†	14.64	0.22	Edge	0.22	Edge	0.78	Edge	1.46	Edge	0.78	Edge	1.44	Edge
	Oak-Hickory	F249†	14.67	4.82	Edge	5.38	Edge	4.89	Edge	4.95	Edge	4.92	Edge	4.72	Edge
	Oak-Hickory	F165†	15.52	0.97	Edge	0.94	Edge	0.09	Edge	0.00		0.09	Edge	0.09	Edge
	Maple-Beech	F155†	16.19	7.89	Fragment	7.80	Fragment	1.08	Edge	0.64	Edge	1.08	Edge	0.63	Edge
	Cherry-Ash-Yellow Poplar	F011†	16.57	11.76	Fragment	11.43	Fragment	7.99	Edge	7.40	Edge	6.95	Edge	7.15	Edge
	Maple-Beech	F156†	18.21	0.26	Edge	0.27	Edge	0.31	Edge	0.00		0.00			
	Oak-Hickory	F200†	20.38	0.90	Edge	0.94	Edge	0.94	Edge	0.94	Edge	0.94	Edge	0.94	Edge
	Oak-Hickory	F225†	21.60	0.46	Edge	0.43	Edge	0.30	Edge	0.30	Edge	0.30	Edge	0.3	Edge
	Oak-Hickory	F217†	21.71	0.03	Edge	0.01	Edge	0.01	Edge	0.01	Edge	0.01	Edge	0.01	Edge
	Oak-Hickory	F090†	21.75	0.00		0.00		0.00		0.00		0.00			
25 - 49.9 acres	Oak-Hickory	F033†	25.64	1.20	Edge	3.84	Edge	1.84	Edge	4.27	Edge	2.47	Edge	4.21	Edge
	Maple-Beech	F132†	26.74	7.25	Fragment	11.06	Edge	7.77	Edge	5.26	Fragment	9.35	Edge	1.28	Edge
	Oak-Hickory	F189†	28.70	3.59	Edge	3.63	Edge	2.49	Edge	2.37	Edge	2.34	Edge	2.22	Edge
	Oak-Hickory	F100†	30.64	0.00		0.00		0.00		0.00		0.00			
	Oak-Hickory	F219*, **	31.87	31.87	Total	31.87	Total	31.87	Total	31.87	Total	31.87	Total	31.87	Total
	Oak-Hickory	F203†	33.22	2.10	Edge	2.29	Edge	3.40	Edge	1.62	Edge	3.40	Edge	3.4	Edge
	Oak-Hickory	F073†	33.57	3.34	Edge	3.34	Edge	3.34	Edge	3.34	Edge	3.34	Edge	3.34	Edge
	Oak-Hickory	F239	35.53	3.12	Edge	2.44	Edge	1.92	Edge	2.16	Edge	2.16	Edge	2.16	Edge
	Oak-Hickory	F095	36.24	2.30	Edge	2.30	Edge	2.30	Edge	2.30	Edge	2.30	Edge	2.3	Edge
	Oak-Hickory	F212†	37.87	27.62	Fragment	28.04	Fragment	2.06	Edge	1.51	Edge	2.07	Edge	1.91	Edge
	Oak-Hickory	F084†	38.03	1.35	Edge	1.25	Edge	1.02	Edge	1.03	Edge	1.02	Edge	1.02	Edge
	Cherry-Ash-Yellow Poplar	F024†**	42.00	5.48	Edge	9.24	Edge	2.32	Edge	4.32	Edge	4.04	Edge	4.34	Edge
	Oak-Hickory	F215†	43.36	7.99	Edge	8.05	Edge	3.17	Edge	2.50	Edge	3.19	Edge	2.92	Edge

Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
50 - 99.9 acres	Oak-Hickory	F168†**	50.21	14.37	Fragment	14.58	Fragment	9.86	Edge	10.53	Fragment	9.60	Edge	8.53	Edge
	Oak-Hickory	F246†	52.20	24.81	Edge	14.31	Edge	12.56	Edge	12.70	Edge	12.45	Edge	12.34	Edge
	Oak-Hickory	F202†	52.53	15.62	Edge	15.49	Edge	6.57	Edge	3.96	Edge	6.50	Edge	5.5	Edge
	Elm-Ash-Cottonwood	F266†	52.63	2.99	Edge	4.70	Edge	0.47	Edge	0.46	Edge	0.47	Edge	0.47	Edge
	Oak-Hickory	F171†**	61.89	4.64	Edge	4.76	Edge	4.67	Edge	4.04	Edge	5.40	Edge	4.74	Edge
	Oak-Hickory	F210†	65.67	12.17	Edge	12.10	Edge	7.01	Edge	2.75	Edge	7.02	Edge	6.12	Edge
	Oak-Hickory	F220†	85.29	17.19	Edge	16.33	Edge	16.33	Edge	16.33	Edge	16.34	Edge	16.34	Edge
	Oak-Hickory	F250†	90.32	29.60	Edge	19.17	Fragment	5.75	Edge	8.41	Edge	7.94	Fragment	7.69	Fragment
	Oak-Hickory	F241†	98.33	30.02	Edge	13.51	Edge	11.03	Edge	10.99	Edge	11.00	Edge	10.69	Edge
> 100 acres	Oak-Hickory	F218†	181.45	24.38	Edge	23.25	Edge	19.26	Edge	17.52	Edge	18.13	Edge	18.17	Edge
Total in Tier 1 Section 5 Corridor			1904.22	425.52		398.97		243.11		233.17		254.03		227.17	
Forests Outside Tier 1 Section 5 Corridor	Maple-Beech	F119†	0.00	0.00		0.00		0.04	Edge	0.00		0.00			
	Oak-Hickory	F092†	0.00	0.31	Edge	0.00		0.00		0.00		0.00			
	Oak-Hickory	F039†	0.00	0.23	Edge	0.21	Edge	0.21	Edge	0.21	Edge	0.21	Edge	0.21	Edge
	Oak-Hickory	F038†	0.00	0.35	Edge	0.35	Edge	0.35	Edge	0.35	Edge	0.35	Edge	0.35	Edge
	Oak-Hickory	F012†	0.00	0.71	Edge	0.49	Edge	0.33	Edge	0.35	Edge	0.32	Edge	0.57	Edge
	Oak-Hickory	F104†	0.00	0.77	Edge	0.32	Edge	0.00		0.00		0.00			
	Oak-Hickory	F262†	0.00	0.74	Edge	1.90	Fragment	0.68	Edge	1.91	Edge	0.59	Edge	-	-
	Elm-Ash-Cottonwood	F101†	0.00	1.61	Total	0.00		0.00		0.00		0.00			
	Oak-Hickory	F014†	0.00	1.70	Edge	1.69	Edge	0.78	Edge	0.00		0.76	Edge	0.76	Edge
	Cherry-Ash-Yellow Poplar	F015†	0.00	2.13	Edge	2.10	Edge	0.00		0.00		0.00			
	Cherry-Ash-Yellow Poplar	F097†	0.00	1.94	Fragment	0.00		0.00		0.00		0.00			
	Oak-Hickory	F103†	0.00	2.40	Edge	0.00		0.00		0.00		0.00			
	Oak-Hickory	F099†	0.00	2.54	Edge	0.00		0.00		0.00		0.00			
	Oak-Hickory	F091†	0.00	0.01	Edge	0.00		0.00		0.00		0.00			
Total Forests Outside Tier 1 Section 5 Corridor			0.00	15.44		7.06		2.39		2.82		2.23		1.89	

Table 5.20-2: Section 5 - Potential Direct Impacts to Forested Areas, by Alternative

Total Acres of Forest Type in Corridor	Forest Type	Forest ID	Total Acres in Corridor	Alternative 4		Alternative 5		Alternative 6		Alternative 7		Alternative 8		Refined Preferred Alternative 8	
				Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact	Acres Impact	Type Impact
Total, All Forest***			1904.22	440.96		406.03		245.50		235.99		256.26		229.06	
Total Forested Wetlands in ROW			37.52	7.80		10.36		6.89		3.05		6.94		1.40	
Total, All Upland Forests			1866.70	433.16		395.67		238.61		232.94		249.32		227.66	
		Total Impact Type		Acres	Percent of Total****	Acres	Percent of Total****	Acres	Percent of Total****	Acres	Percent of Total****	Acres	Percent of Total****	Acres	Percent of Total****
		Edge		275.23	62.42%	246.83	60.79%	197.41	80.41%	170.71	72.34%	197.88	77.22%	173.80	75.88%
		Fragment		110.84	25.14%	104.60	25.76%	1.74	0.71%	24.12	10.22%	9.64	3.76%	9.37	4.09%
		Total		54.89	12.45%	54.60	13.45%	46.35	18.88%	41.16	17.44%	48.74	19.02%	45.89	20.03%

† Indicates forest tract with some portion of the tract located outside the Section 5 corridor boundary.

** Indicates forest tract with some portion of the tract in the bifurcation area.*

*** Includes multiple encroachments upon forests.*

**** Includes forested wetland acreage that will be preserved within the right-of-way.*

***** Percentages may not equal 100.0% due to rounding.*

Note: An "edge" impact means the alternative impacts one side of the forest leaving the remaining forest on one side of the right-of-way. "Fragment" means the alternative splits the forest such that one or more forest areas remain on each side of the right-of-way. "Total" means the entire forest will be impacted by the alternative or less than 1 acre, which is the USDA size criterion for forest, will remain.

Table 5.20-3: Wetland Impacts in Forested Areas (Forested Wetlands)

Impacts (Acres)	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8
Total Forest	440.96	406.03	245.5	235.99	256.26	229.06
F025 wetland impact acres	0.10	0.23	0.00	0.16	0.15	0.16
F122 wetland impact acres	0.27	0.38	0.28	0.28	0.28	0.28
F126 wetland impact acres	0.00	0.60	0.60	0.36	0.60	0.00
F130 wetland impact acres	0.00	0.01	0.00	0.00	0.00	0.00
F131 wetland impact acres	0.40	0.71	0.71	0.33	0.71	0.03
F134 wetland impact acres	2.96	4.34	4.26	1.13	4.14	0.23
F136 wetland impact acres	0.14	0.14	0.14	0.14	0.14	0.14
F139 wetland impact acres	0.00	0.00	0.10	0.00	0.00	0.00
F144 wetland impact acres	0.00	0.00	0.07	0.00	0.00	0.00
F145 wetland impact acres	0.33	0.33	0.00	0.00	0.00	0.00
F147 wetland impact acres	1.04	1.04	0.25	0.13	0.25	0.11
F150 wetland impact acres	1.57	1.58	0.00	0.00	0.00	0.00
F151 wetland impact acres	0.06	0.06	0.04	0.01	0.00	0.00
F152 wetland impact acres	0.55	0.55	0.42	0.21	0.39	0.17
F154 wetland impact acres	0.01	0.01	0.01	0.00	0.00	0.00
F221 wetland impact acres	0.37	0.38	0.01	0.28	0.28	0.28
F229 wetland impact acres	0.00	0.00	0.00	0.02	0.00	0.00
Total Forested Wetland Impact Acres	7.80	10.36	6.89	3.05	6.94	1.40
Non-Wetland Forest Acres Affected	433.16	395.67	238.61	232.94	249.32	227.66

Core Forest Impacts

Section 5 Alternatives affect 24 core forest habitats (**Table 5.20-4**). A pre- and post-depiction of core forest habitat is shown in **Figure 5.20-4**. In order to determine potential impacts to core forest, all forests within 150 meters (492 feet) of the Tier 1 Section 5 corridor and each alternatives' right-of-way were included in the analysis. Then, core forest impacts were analyzed to 100 meters (328 feet) beyond the edge of each alternative's right-of-way. In some cases, the total core forest area and the remaining core forest area as presented here will be larger than forested impacts. This is because core forest impacts are analyzed to 100 meters (328 feet) beyond the edge of the alternative right-of-way, while forested impacts are only assessed and limited to impacts within the right-of-way.

For analysis of core forest impacts, the following forest descriptions (in most cases) are combinations of two or more contiguous USDA forest types (e.g., maple-beech, oak-hickory, elm-ash-cottonwood, etc.). The USDA forest types are described earlier in this section. In many cases, these different forest types form larger, contiguous stands of forest. These adjacent tracts of different forest types must be grouped and analyzed as a single unit in order to quantify core forest impacts.

Forest A (F024): This is a cherry-ash-yellow poplar stand with approximately 15.34 acres of core forest habitat located south of Tapp Road and east of SR 37. Approximately 42 acres of the forest are within the project corridor. Impacts to Forest A range from 2.32 acres (Alternative 6) to 9.24 acres (Alternative 5). Impacts associated with each alternative would redefine the boundaries of the core forest area. The size of the core forest habitat would be reduced, ranging from 13.13 acres (Alternative 5) and to 14.87 (Alternatives 6, 7, 8, and Refined Preferred Alternative 8). Core forest impacts for the alternatives range from at the low end 0.47-acre (Alternatives 6, 7, 8, and Refined Preferred Alternative 8) to at the high end 2.21 acres (Alternative 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest B (F033): This is an oak-hickory stand with approximately 1.41 acres of core forest habitat located north of Tapp Road and east of SR 37. Approximately 26 acres of the forest are within the project corridor. Impacts to Forest B range from 1.20 acres (Alternative 4) to 4.27 acres (Alternative 7). None of the alternatives would redefine the core forest area.

Forest C (F084): This is an oak-hickory stand with approximately 11.51 acres of core forest habitat located west of SR 37 between West Arlington Road and West Acuff Road. Approximately 38 acres of the forest are located within the project corridor. Impacts to Forest C range from 1.02 acres (Alternatives 6, 8, and Refined Preferred Alternative 8) to 1.35 acres (Alternative 4). Each alternative redefines the core forest area. The size of the core forest habitat would be reduced, ranging from10.78 acres (Alternative 4) to 10.98 acres (Alternatives 6, 7, 8, and Refined Preferred Alternative 8). This is a difference of 0.53-acre (Alternatives 6, 7, 8, and Refined Preferred Alternative 8) to 0.73-acre (Alternative 4). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest D (F090, F095, F100): This is an oak-hickory stand with approximately 28.69 acres of core forest habitat located north of West Acuff Road and west of SR 37. Approximately 89 acres of the forest are located within the project corridor. Impacts to Forest D total 2.30 acres for all alternatives. Each alternative would redefine the core forest area. The size of the core forest habitat would be reduced to 26.78 acres for all alternatives, with a difference of 1.91 acres. The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest E (F132): This is a maple-beech stand with approximately 2.80 acres of core forest habitat located northeast of the SR 37/Walnut Street interchange ramp. Approximately 27 acres of the forest are located within the project corridor. Impacts to Forest E range from 1.28 acres (Refined Preferred Alternative 8) to 11.06 acres (Alternative 5). Each alternative would redefine the core forest area. The remaining size of the core forest habitat would be reduced, ranging from 1.18 acres (Alternative 5) to 2.76 (Refined Preferred Alternative 8). This is a difference of 0.04 acre (Refined Preferred Alternative 8) to 1.62 acres (Alternative 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest F (F151, F154, F156): This is a maple-beech stand with approximately 12.64 acres of core forest habitat located northeast of Bottom Road west of SR 37. Approximately 25 acres of the forest are located within the project corridor. Impacts to Forest F range from none (Alternative 8 and Refined Preferred Alternative 8) to 0.36-acre (Alternative 6). Alternatives 4, 5, and 6 would redefine the core forest area. The remaining size of the core forest habitat would be reduced, ranging from 12.25 acres (Alternatives 4 and 5) to 12.32 acres (Alternative 6). This is a difference of 0.32 acre (Alternative 6) to 0.39 acre (Alternative 4, and 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest G (F168, F169): This is an oak-hickory stand with approximately 4.17 acres of core forest habitat located west of Stonebelt Drive on the west side of SR 37. Approximately 52 acres of the forest are located within the project corridor. Impacts to Forest G range from 8.53 acres (Refined Preferred Alternative 8) to 14.58 acres (Alternative 5). Alternatives 4 and 5 would redefine the core forest area. The size of the core forest habitat would be reduced to 3.84 acres (Alternative 4) and to 3.85 acres (Alternative 5). This is a difference of 0.32 acre (Alternative 5) and 0.33 acre (Alternative 4). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest H (F171): This is an oak hickory stand with approximately 1.25 acres of core forest habitat located east of North Wayport Road and south of East Sample Road. Approximately 62 acres of the forest are located within the project corridor. Impacts to Forest H range from 4.04 acres (Alternative 7) to 5.40 acres (Alternative 8). Alternatives 6, 7, 8, and Refined Preferred Alternative 8 would redefine the core forest area. The size of the core forest habitat would be reduced to a range of 1.06 acres (Alternative 7) to 1.09 acres (Alternative 6). This is a difference of 0.16 acre (Alternative 6) to 0.19 acre (Alternative 7). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest I (F177, F179): This is an oak-hickory stand with approximately 6.65 acres of core forest habitat located south of West Sample Road. Approximately 12.81 acres of the forest are located within the project corridor. Impacts to Forest I range from 3.24 acres (Refined Preferred Alternative 8) to 19.73 acres (Alternative 4). Each alternative would redefine the core forest area. The size of the core forest habitat would be reduced, ranging from none (Alternatives 4 and 5) to 6.45 acres (Refined Preferred Alternative 8). This is a difference of 0.20 acre (Refined Preferred Alternative 8) to 6.65 acres (Alternatives 4 and 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest J (F203): This is an oak-hickory stand with approximately 10.31 acres of core forest habitat located north of East Fawn Ridge Trail. Approximately 33.22 acres of the forest are located within the project corridor. Impacts to Forest J range from 1.62 acres (Alternative 7) to 3.40 acres (Alternatives 6, 8, and Refined Preferred Alternative 8). Each alternative would redefine the core forest area. The size of the core forest habitat would be reduced, ranging from 8.67 acres (Alternative 6, 8, and Refined Preferred Alternative 8) to 9.52 acres (Alternative 7). This is a difference of 0.79 acre (Alternative 7) to 1.64 acres (Alternatives 6, 8, and Refined Preferred Alternative 8). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest K (F202): This is an oak-hickory stand with approximately 2.86 acres of core forest habitat located west of Norm Anderson Road. Approximately 52.53 acres of the forest are located within the project corridor. Impacts to Forest K range from 3.96 acres (Alternative 7) to 15.62 acres (Alternative 4). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from none (Alternative 5) to 2.61 acres (Alternative 7). This is a difference of 0.25 acre (Alternative 7) to 2.86 acres (Alternative 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest L (F210): This is an oak-hickory stand with approximately 2.52 acres of core forest habitat located east of SR 37 and east of Norm Anderson Road. Approximately 65.67 acres of the forest are located within the project corridor. Impacts to Forest L range from 2.75 acres (Alternative 7) to 12.17 acres (Alternative 4). Alternatives 4, 5, 6, and 8 would redefine the core forest area. The size of the core forest would be reduced, ranging from 2.28 acres (Alternative 6) to 2.50 acres (Alternative 5). This is a difference of 0.02 acre (Alternative 5) to 0.24 acre (Alternative 6). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest M (F210): This is an oak-hickory stand with approximately 11.47 acres of core forest habitat located east of East Chambers Pike. Approximately 65.67 acres of the forest are located within the project corridor. Impacts to Forest M range from 2.75 acres (Alternative 7) to 12.17 acres (Alternative 4). Alternatives 4, 5, 6, 8, and Refined Preferred Alternative 8 would redefine the core forest area. The size of the core forest would be reduced, ranging from 9.51 acres (Alternative 5) to 10.13 acres (Refined Preferred Alternative 8). This is a difference of 1.34 acres (Refined Preferred Alternative 8) to 1.96 acres (Alternative 5). The impacts for

Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest N (F212): This is an oak-hickory stand with approximately 13.54 acres of core forest habitat located southwest of North Mann Road. Approximately 37.87 acres of the forest are within the project corridor. Impacts to Forest N range from 1.51 acres (Alternative 7) to 28.04 acres (Alternative 5). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from none (Alternatives 4 and 5) to 13.45 acres (Alternative 7). This is a difference of 0.09 acre (Alternative 7) to 13.54 acres (Alternatives 4 and 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest O (F215): This is an oak-hickory stand with approximately 7.02 acres of core forest habitat located west of West Burma Road. Approximately 43.36 acres of the forest are within the project corridor. Impacts to Forest O range from 2.50 acres (Alternative 7) to 8.05 acres (Alternative 5). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from 6.21 acres (Alternative 5) to 6.95 acres (Refined Preferred Alternative 8). This is a difference of 0.07 acre (Refined Preferred Alternative 8) to 0.81 acre (Alternative 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest P (F217): This is an oak-hickory stand with approximately 2.59 acres of core forest habitat located west of West Burma Road. Approximately 21.71 acres of the forest are within the project corridor. Impacts to Forest P range from 0.01 acre (Alternatives 6, 7, 8, and Refined Preferred Alternative 8) to 0.10 acre (Alternative 5). Each alternative would redefine the core forest area. The size of the core forest would be reduced to 2.58 acres for all alternatives, a difference of only 0.01 acre. The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest Q (F217): This is an oak-hickory stand with approximately 1.20 acres of core forest habitat located west of West Burma Road. Approximately 21.71 acres of the forest are within the project corridor. Impacts to Forest Q range from 0.01 acre (Alternatives 6, 7, 8, and Refined Preferred Alternative 8) to 0.10 acre (Alternative 5). None of the alternatives would redefine the core forest area.

Forest R (F216, 218): This is an oak-hickory stand with approximately 120.16 acres of core forest habitat located north of East Chambers Pike. Approximately 183.62 acres of the forest are within the project corridor. Impacts to Forest R range from 18.05 acres (Alternative 7) to 25.36 acres (Alternative 4). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from 97.19 acres (Alternative 4) to 103.64 acres (Alternative 7). This is a difference of 16.52 acres (Alternative 7) to 22.97 acres (Alternative 4). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest S (F220, F225, F228): This is an oak-hickory stand with approximately 68.73 acres of core forest habitat located north of West Burma Road. Approximately 111.83 acres of the forest

are within the project corridor. Impacts to Forest S range from 16.63 acres (Alternatives 6 and 7) to 17.65 acres (Alternative 4). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from 59.26 acres (Alternative 4) to 59.67 acres (Alternatives 6, 7, 8, and Refined Preferred Alternative 8). This is a difference of 9.06 acres (Alternatives 6, 7, 8, and Refined Preferred Alternative 8) to 9.47 acres (Alternative 4). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5.**

Forest T (F241): This is an oak-hickory stand with approximately 39.38 acres of core forest habitat located east of SR 37 between Cooksey Lane and Pine Boulevard. Approximately 98.33 acres of the forest are within the project corridor. Impacts to Forest T range from 10.69 acres (Refined Preferred Alternative 8) to 30.02 acres (Alternative 4). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from to 32.14 acres (Alternative 4) to 35.60 acres (Alternative 5). This is a difference of 3.78 acres (Alternative 5) to 7.24 acres (Alternative 4). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest U (F246): This is an oak-hickory stand with approximately 21.27 acres of core forest habitat located east of State SR 37 between Pine Boulevard and Old SR 37 North. Approximately 52.20 acres of the forest are within the project corridor. Impacts to Forest U range from 12.34 acres (Refined Preferred Alternative 8) to 24.81 acres (Alternative 4). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from 11.10 acres (Alternative 4) to 18.75 acres (Alternative 5). This is a difference of 2.52 acres (Alternative 5) to 10.17 acres (Alternative 4). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest V (F250): This is an oak-hickory stand with approximately 1.54 acres of core forest habitat located west of SR 37 and east of Turkey Track Road. Approximately 90.32 acres of the forest are within the project corridor. Impacts to Forest V range from 5.75 acres (Alternative 6) to 29.60 acres (Alternative 4). Each alternative would redefine the core forest area. The core forest would be eliminated with all alternatives. The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest W (F250): This is an oak-hickory stand with approximately 23.35 acres of core forest habitat located west of SR 37 and north of Turkey Track Road. Approximately 90.32 acres of the forest are within the project corridor. Impacts to Forest W range from 5.75 acres (Alternative 6) to 29.60 acres (Alternative 4). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from 21.15 acres (Alternatives 4 and 5) to 23.30 (Refined Preferred Alternative 8). This is a difference of 0.05 acre (Refined Preferred Alternative 8) to 2.20 acres (Alternatives 4 and 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Forest X (F266): This is a maple-beech stand with approximately 28.80 acres of core forest habitat located west of SR 37 and north of Legendary Drive. Approximately 52.63 acres of the forest are within the project corridor. Impacts to Forest X range from 0.46 acre (Alternative 7) to 4.70 acres (Alternative 5). Each alternative would redefine the core forest area. The size of the core forest would be reduced, ranging from 27.00 acres (Alternative 5) to 28.74 acres (Alternative 7). This is a difference of 0.06 acre (Alternative 7) to 1.80 acres (Alternative 5). The impacts for Alternatives 4, 5, 6, 7, and 8 are shown in **Figure 5.20-4** and the impacts for Refined Preferred Alternative 8 are shown in **Figure 5.20-5**.

Table 5.20-4: Summary of Impacts to Core Forest Habitat

Impact (Acres)	Build Alternatives					
	4	5	6	7	8	Refined Preferred Alternative 8
Forest A (F024 - 42.00 acres)						
Forest Acres Affected	5.48	9.24	2.32	4.32	4.04	4.34
Total Core Forest Area	15.34	15.34	15.34	15.34	15.34	15.34
Remaining Core Forest Area	13.25	13.13	14.87	14.87	14.87	14.87
Impact on Core Forest	2.09	2.21	0.47	0.47	0.47	0.47
Forest B (F033 - 25.64 acres)						
Forest Acres Affected	1.20	3.84	1.84	4.27	2.47	4.21
Total Core Forest Area	1.41	1.41	1.41	1.41	1.41	1.41
Remaining Core Forest Area	1.41	1.41	1.41	1.41	1.41	1.41
Impact on Core Forest	0.00	0.00	0.00	0.00	0.00	0.00
Forest C (F084 - 38.03 acres)						
Forest Acres Affected	1.35	1.25	1.02	1.03	1.02	1.02
Total Core Forest Area	11.51	11.51	11.51	11.51	11.51	11.51
Remaining Core Forest Area	10.78	10.83	10.98	10.98	10.98	10.98
Impact on Core Forest	0.73	0.68	0.53	0.53	0.53	0.53
Forest D (F090, F095, F100 - 88.63 acres)						
Forest Acres Affected	2.30	2.30	2.30	2.30	2.30	2.30
Total Core Forest Area	28.69	28.69	28.69	28.69	28.69	28.69
Remaining Core Forest Area	26.78	26.78	26.78	26.78	26.78	26.78
Impact on Core Forest	1.91	1.91	1.91	1.91	1.91	1.91
Forest E (F132 - 26.74 acres)						
Forest Acres Affected	7.25	11.06	7.77	5.26	9.35	1.28
Total Core Forest Area	2.80	2.80	2.80	2.80	2.80	2.80
Remaining Core Forest Area	1.70	1.18	1.59	1.98	1.59	2.76
Impact on Core Forest	1.10	1.62	1.21	0.82	1.21	0.04

Table 5.20-4: Summary of Impacts to Core Forest Habitat

Impact (Acres)	Build Alternatives					
	4	5	6	7	8	Refined Preferred Alternative 8
Forest F (F151, F154, F156 - 25.00 acres)						
Forest Acres Affected	0.33	0.34	0.36	0.01	0.00	0.00
Total Core Forest Area	12.64	12.64	12.64	12.64	12.64	12.64
Remaining Core Forest Area	12.25	12.25	12.32	12.64	12.64	12.64
Impact on Core Forest	0.39	0.39	0.32	0.00	0.00	0.00
Forest G (F168, F169 - 52.35 acres)						
Forest Acres Affected	14.37	14.58	9.86	10.53	9.60	8.53
Total Core Forest Area	4.17	4.17	4.17	4.17	4.17	4.17
Remaining Core Forest Area	3.84	3.85	4.17	4.17	4.17	4.17
Impact on Core Forest	0.33	0.32	0.00	0.00	0.00	0.00
Forest H (F171 - 61.89 acres)						
Forest Acres Affected	4.64	4.76	4.67	4.04	5.40	4.74
Total Core Forest Area	1.25	1.25	1.25	1.25	1.25	1.25
Remaining Core Forest Area	1.25	1.25	1.09	1.06	1.08	1.08
Impact on Core Forest	0.00	0.00	0.16	0.19	0.17	0.17
Forest I (F177, F179 - 12.81 acres)						
Forest Acres Affected	19.73	19.17	4.43	9.09	4.41	3.24
Total Core Forest Area	6.65	6.65	6.65	6.65	6.65	6.65
Remaining Core Forest Area	0.00	0.00	5.77	2.32	5.77	6.45
Impact on Core Forest	6.65	6.65	0.88	4.33	0.88	0.20
Forest J (F203 - 33.22 acres)						
Forest Acres Affected	2.10	2.29	3.40	1.62	3.40	3.40
Total Core Forest Area	10.31	10.31	10.31	10.31	10.31	10.31
Remaining Core Forest Area	9.44	9.39	8.67	9.52	8.67	8.67
Impact on Core Forest	0.87	0.92	1.64	0.79	1.64	1.64
Forest K (F202 - 52.53 acres)						
Forest Acres Affected	15.62	15.49	6.57	3.96	6.50	5.50
Total Core Forest Area	2.86	2.86	2.86	2.86	2.86	2.86
Remaining Core Forest Area	0.01	0.00	2.21	2.61	2.21	2.47
Impact on Core Forest	2.85	2.86	0.65	0.25	0.65	0.39
Forest L (F210 - 65.67 acres)						
Forest Acres Affected	12.17	12.10	7.01	2.75	7.02	6.12
Total Core Forest Area	2.52	2.52	2.52	2.52	2.52	2.52
Remaining Core Forest Area	2.49	2.50	2.28	2.52	2.30	2.52
Impact on Core Forest	0.03	0.02	0.24	0.00	0.22	0.00

Table 5.20-4: Summary of Impacts to Core Forest Habitat

Impact (Acres)	Build Alternatives					
	4	5	6	7	8	Refined Preferred Alternative 8
Forest M (F210 - 65.67 acres)						
Forest Acres Affected	12.17	12.10	7.01	2.75	7.02	6.12
Total Core Forest Area	11.47	11.47	11.47	11.47	11.47	11.47
Remaining Core Forest Area	9.52	9.51	9.73	11.47	9.81	10.13
Impact on Core Forest	1.95	1.96	1.74	0.00	1.66	1.34
Forest N (F212 - 37.87 acres)						
Forest Acres Affected	27.62	28.04	2.06	1.51	2.07	1.91
Total Core Forest Area	13.54	13.54	13.54	13.54	13.54	13.54
Remaining Core Forest Area	0.00	0.00	13.28	13.45	13.27	13.32
Impact on Core Forest	13.54	13.54	0.26	0.09	0.27	0.22
Forest O (F215 - 43.36 acres)						
Forest Acres Affected	7.99	8.05	3.17	2.50	3.19	2.92
Total Core Forest Area	7.02	7.02	7.02	7.02	7.02	7.02
Remaining Core Forest Area	6.22	6.21	6.75	6.79	6.73	6.95
Impact on Core Forest	0.80	0.81	0.27	0.23	0.29	0.07
Forest P (F217 - 21.71 acres)						
Forest Acres Affected	0.03	0.10	0.01	0.01	0.01	0.01
Total Core Forest Area	2.59	2.59	2.59	2.59	2.59	2.59
Remaining Core Forest Area	2.58	2.58	2.58	2.58	2.58	2.58
Impact on Core Forest	0.01	0.01	0.01	0.01	0.01	0.01
Forest Q (F217 - 21.71 acres)						
Forest Acres Affected	0.03	0.10	0.01	0.01	0.01	0.01
Total Core Forest Area	1.20	1.20	1.20	1.20	1.20	1.20
Remaining Core Forest Area	1.20	1.20	1.20	1.20	1.20	1.20
Impact on Core Forest	0.00	0.00	0.00	0.00	0.00	0.00
Forest R (F216, F218 - 183.62 acres)						
Forest Acres Affected	25.36	24.24	19.79	18.05	18.67	18.70
Total Core Forest Area	120.16	120.16	120.16	120.16	120.16	120.16
Remaining Core Forest Area	97.19	98.20	102.87	103.64	103.57	103.62
Impact on Core Forest	22.97	21.96	17.29	16.52	16.59	16.54
Forest S (F220, F225, F228 - 111.83 acres)						
Forest Acres Affected	17.65	16.76	16.63	16.63	16.64	16.64
Total Core Forest Area	68.73	68.73	68.73	68.73	68.73	68.73
Remaining Core Forest Area	59.26	59.61	59.67	59.67	59.67	59.67
Impact on Core Forest	9.47	9.12	9.06	9.06	9.06	9.06

Table 5.20-4: Summary of Impacts to Core Forest Habitat

Impact (Acres)	Build Alternatives					
	4	5	6	7	8	Refined Preferred Alternative 8
Forest T (F241 - 98.33 acres)						
Forest Acres Affected	30.02	13.51	11.03	10.99	11.00	10.69
Total Core Forest Area	39.38	39.38	39.38	39.38	39.38	39.38
Remaining Core Forest Area	32.14	35.60	34.70	34.61	34.60	34.63
Impact on Core Forest	7.24	3.78	4.68	4.77	4.78	4.75
Forest U (F246 - 52.20 acres)						
Forest Acres Affected	24.81	14.31	12.56	12.70	12.45	12.34
Total Core Forest Area	21.27	21.27	21.27	21.27	21.27	21.27
Remaining Core Forest Area	11.10	18.75	18.41	18.42	18.43	18.43
Impact on Core Forest	10.17	2.52	2.86	2.85	2.84	2.84
Forest V (F250 - 90.32 acres)						
Forest Acres Affected	29.60	19.17	5.75	8.41	7.94	7.69
Total Core Forest Area	1.54	1.54	1.54	1.54	1.54	1.54
Remaining Core Forest Area	0.00	0.00	0.01	0.00	0.00	0.00
Impact on Core Forest	1.54	1.54	1.53	1.54	1.54	1.54
Forest W (F250 - 90.32 acres)						
Forest Acres Affected	29.60	19.17	5.75	8.41	7.94	7.69
Total Core Forest Area	23.35	23.35	23.35	23.35	23.35	23.35
Remaining Core Forest Area	21.15	21.15	23.25	23.25	23.28	23.30
Impact on Core Forest	2.20	2.20	0.10	0.10	0.07	0.05
Forest X (F266 - 52.63 acres)						
Forest Acres Affected	2.99	4.70	0.47	0.46	0.47	0.47
Total Core Forest Area	28.80	28.80	28.80	28.80	28.80	28.80
Remaining Core Forest Area	28.41	27.00	28.73	28.74	28.73	28.73
Impact on Core Forest	0.39	1.80	0.07	0.06	0.07	0.07
Total Impact on Core Forest Habitat Acres	**87.23**	**76.82**	**45.88**	**44.52**	**44.86**	**41.84**
Total Remaining Core Forest Habitat Acres	**351.97**	**362.38**	**393.32**	**394.68**	**394.34**	**397.36**

Note: "Remaining Core Forest" was obtained by subtracting the "Total Core Forest Area" from the "Impact on Core Forest."

Multiple Encroachments

Of the 145 forests potentially affected by the alternatives 126 would have multiple encroachments. Multiple encroachments are the result of the mainline alternatives impacting a forest in more than one location, or are the combination of the mainline alternatives and side road improvements affecting the forest in more than one location. Forests with multiple

encroachments are indicated with an "**" in the "Forest ID" column in **Table 5.20-2** and are shown on **Figure 5.20-3**.

Indirect Impacts

Indirect impacts to forests could occur if forested land is used for commercial or residential development that is induced as a result of the construction of I-69. The total estimated induced growth impacts for the Section 5 project are 95 acres of which, 11 to 23 acres are increased densities on developed land, 32 to 37 acres are agricultural land, and 40 to 47 acres are forest land. The primary induced land use changes are anticipated to occur in TAZs located near proposed interchanges.

The 2006 USGS National Land Cover Database was used to identify the amount and types of land cover in the induced growth TAZs.[4] **Table 5.20.5** shows the total amount of land, by land type and county, in the 29 to 31 TAZs predicted to experience growth as a result of the I-69 Section 5 project. The number of TAZs experiencing growth varies with alternative. Within the 31 TAZs predicted to experience growth related to Refined Preferred Alternative 8, land cover categorized as Agricultural/Other (in and out of a floodplain) represents 40% of the total acres in the TAZs compared with 41% forest, and 19% developed. Indirect and cumulative impacts are addressed in detail in **Section 5.24**, *Indirect and Cumulative Impacts.* **Appendix AA**, *Indirect Impact Analysis*, documents the induced growth forecasts in the Section 5 study area.

[4] A traffic analysis zone (TAZ) is one of many small areas within a larger geographical study area that has been subdivided for purposes of obtaining socioeconomic and traffic data in a manageable fashion. The geographical scope of the Section 5 was identified as Monroe and Morgan Counties. Growth induced by the I-69 Section 5 project (indirect impact) was predicted to occur in a total of 29 to 31 TAZs distributed within these two counties.

Table 5.20-5: USGS National Land Cover Database: Amount of Land Cover Types in Induced Growth TAZs

County (# TAZs represented)	Developed Land in Acres (%)	Unusable Land in Acres (%)	Ag/Other Land in Floodplain in Acres (%)	Available Ag/Other Land in Acres (%)	Forest Land in Floodplain in Acres (%)	Available Forest Land in Acres (%)	Total Acres in TAZs
Alternative 4							
Monroe (16)*	1,636	0	266	1,941	302	3,485	7,629
Morgan (15)**	1,973	4	831	3,482	324	2,944	9,557
Total Acres (%)	**3,609 (21%)**	**4 (0%)**	**6,520 (38%)**		**7,055 (41%)**		**17,186**
Alternatives 5, 7, 8, and Refined Preferred Alternative 8							
Monroe (15)*	1,459	0	347	2,037	409	3,680	7,931
Morgan (16)**	2,028	4	831	4,110	324	3,252	10,549
Total Acres (%)	**3,487 (19%)**	**4 (0%)**	**7,325 (40%)**		**7,665 (41%)**		**18,480**
Alternative 6							
Monroe (13)*	1,341	0	103	1,005	102	1,904	4,454
Morgan (16)**	2,028	4	831	4,110	324	3,252	10,549
Total Acres (%)	**3,369 (22%)**	**4 (0%)**	**6,049 (40%)**		**5,582 (37%)**		**15,003**

Source: USGS 2006 National Land Cover Dataset for Zone 49

Cover types:

Developed: Open Water; Developed, Open Space; Developed, Low Intensity; Developed, Medium Intensity; and Developed, High Intensity.

Unusable: Woody Wetlands; and Emergent Herbaceous Wetlands.

Agriculture Land/Other: Barren Land (Rock/Sand/Clay); Shrub/Scrub; Grassland/Herbaceous; Pasture/Hay; and Cultivated Crops.

Forest Land: Deciduous Forest; Evergreen Forest; and Mixed Forest.

** Monroe County: Induced growth in these TAZs is anticipated to impact 35% agricultural land / 65% forest. These percentages are applied where growth is expected to occur on non-developed land.*

*** Morgan County: Induced growth in these TAZs is anticipated to impact 55% agricultural land / 45% forest. These percentages are applied where growth is expected to occur on non-developed land.*

5.20.4 Mitigation

In the Tier 1 Record of Decision (ROD), INDOT committed to mitigate upland forest impacts at a 3 to 1 ratio for the I-69 Evansville to Indianapolis project. This commitment considers upland forests as all those not classified as wetlands. INDOT and the Federal Highway Administration (FHWA) offered this level of mitigation as environmental stewardship to assure adequate habitat for the Indiana bat as well as other species. The implementation of this effort is now required under the Terms and Conditions of the I-69 Revised Tier 1 BO issued by the USFWS under the authority of Section 7 of the Endangered Species Act (ESA). Mitigation may be in the form of planting unforested areas with a goal of 1 to 1 replacement or protecting existing forests by fee simple purchase, permanent protective easement, or a combination of actions with a goal of 2 to 1 protective measures. The 3 to 1 ratio will be achieved for the overall I-69 Evansville to

Indianapolis project; the ratio for an individual Tier 2 section could be higher or lower than 3 to 1. Areas converted to mitigation land will no longer be available for timbering activities. Therefore, these lands will be taken out of production of forest products. Per federal law, all land for the project will be purchased at fair market value. In the case of mitigation land, the land must be purchased from willing sellers in accordance with FHWA policy. Mitigation of forest impacts is discussed in further detail in **Chapter 7**, *Mitigation and Commitments*.

INDOT and FHWA voluntarily committed to mitigate impacts to upland forests at a 3 to 1 ratio averaged over the entire length of the I-69 corridor, which includes a 1 to 1 ratio of replacement plus a 2 to 1 ratio of forest preservation (see **Section 7.2**, *Major Mitigation Initiatives*). Actual ratios within each individual section may vary from the overall average. For purposes of this analysis, reforestation will be at 1 to 1 ratio, and preservation of existing forest at 2 to 1 ratio within the Section 5 geographic scope. Thus, it is estimated that approximately 433 acres (Alternative 4), 396 acres (Alternative 5), 239 acres (Alternative 6), 233 acres (Alternative 7), 249 acres (Alternative 8), and 228 acres (Refined Preferred Alternative 8) of agricultural land would be converted for the Section 5 upland forest mitigation program. Upland forest mitigation is provided at a 3 to 1 ratio, however, the remaining 2 to 1 as forest preservation.

Likewise there will be some conversion of agricultural land to provide for the mitigation of direct impacts to wetlands, including forested wetlands, within the Section 5 geographic scope. A Memorandum of Understanding (MOU) executed between INDOT, USFWS, and IDNR in 1991 (see **Appendix V**, *Wetlands Memorandum of Understanding*) established mitigation ratios for a variety of wetland types. Based on those ratios, it is estimated that approximately 39.11 acres (Alternative 4), 53.23 acres (Alternative 5), 35.96 acres (Alternative 6), 16.39 acres (Alternative 7), 32.83 acres (Alternative 8), and 10.61 acres (Refined Preferred Alternative 8) of agricultural land would be converted to wetlands as part of the wetland mitigation program within Section 5. (See **Section 5.19**, *Water Resources*, **Table 5.19-15** for potential impacts to wetlands within the right-of-way.)

Total loss of agricultural land due to mitigation for forest and wetland losses would range from 239 to 472 acres. Total indirect impacts due to induced development would range from 32 to 37 acres. The Refined Preferred Alternative 8 would convert a total of 338 acres of agricultural lands based on 62 acres of direct impact, 37 acres of indirect impact, and 239 acres of mitigation for forests and wetlands. Alternative 4 wound have the highest loss, converting a total of 655 acres of agricultural lands based on 151 acres direct impact, 32 acres indirect impact, and 472 acres of mitigation for forest and wetlands. Some forested areas are also classified as wetlands. Wetlands will be replaced in accordance with the MOU between INDOT, USFWS, and the Indiana Department of Natural Resources (IDNR) as dated January 28, 1991, or any successor agreement entered into by these agencies. Wetlands will be mitigated at appropriate ratios. Under the 1991 MOU, emergent and scrub/shrub wetlands would be mitigated at a ratio of 2 to 1 or 3 to 1 and forested wetlands would be mitigated at a ratio of 3 to 1 or 4 to 1. Ratios used to determine mitigation will depend upon the quality of the resource. In the case of any forested wetlands in this section, it is anticipated a 3 to 1 ratio would apply. If the forests are identified as non-wetland forests in a floodway, a 2 to 1 replacement or 10 to 1 preservation ratio would apply, as applicable by the IDNR Construction in a Floodway permit. If needed, the necessary permit would be secured before or during the design phase of the project. All non-wetland forest

replacement (including floodway forest) will be included as part of the 3 to 1 upland forest mitigation.

During the Tier 1 studies, potential mitigation sites were identified because they offer opportunities for habitat restoration and/or preservation. Large, existing forest and wetland complexes may be used as potential mitigation sites with the goal of increasing core forest and reducing fragmentation. **Appendix S**, *Revised Tier 1 Conceptual Forest and Wetland Mitigation Plan & Comparison of Tier 1 Plans*, identifies the general location of potential mitigation sites for the design and planting of upland forest. In the vicinity of Section 5, West Fork White River (Bryant Creek), Beanblossom Bottoms (Monroe County), and Morgan and Monroe State Forest (Morgan County) were identified as potential mitigation sites. Mitigation in these areas would increase the amount of core forest and provide habitat for the Indiana bat and other species. Additional mitigation sites may be identified during the future stages of project development.

In December 2012, INDOT submitted a Section 5 Tier 2 Biological Assessment (BA) which provided additional details on the mitigation plans in Section 5. The Section 5 Tier 2 BA (redacted) can be found in Appendix **LL1**. On July 25, 2013, USFWS issued its BO for Section 5. The Tier 2 Section 5 BA includes mitigation information for Section 5, including 20 possible mitigation sites. These sites are associated with four (4) maternity colonies (Crooked Creek, Lambs Creek, West Fork [Bryant Creek], and Beanblossom Nature Preserve); three (3) summer habitat focus areas (Morgan Monroe State Forest, Maple Grove Historic District, and Beanblossom Creek), and one (1) area south of Bloomington. Of these 20 proposed mitigation sites, nine (9) include forest preservation only. They are Berean Valley, Ravinia Woods, Canyon, Stone Belt, Beanblossom Creek, Griffith, Chambers Pike, Big Bend, and Stout Creek. The remaining 11 sites will include construction activities such as tree planting (reforestation), and wetland and stream restoration/creation. The tree species that will be planted within the proposed mitigation sites will be species taken from the IDNR (Region 3) approved tree list. These species will be planted in the appropriate areas according to their USFWS Indicator Status as identified in the "*National List of Vascular Plant Species that Occur in Wetlands: 1996 National Summary.*" **Table 5.20-6** shows possible mitigation acreages associated with each proposed mitigation site. Please note this table has been updated since the original submission of the Section 5 BA. Mitigation acreages may differ based on changes in mitigation site design or changes in property ownership. Mitigation needs and acreages will continue to be refined as the project moves into the design phase.

Table 5.20-6. Section 5 Mitigation Site* Anticipated Acres Summary

Mitigation Site	Forest Preservation (acres)	Reforestation (acres)	Total Forest Mitigation (acres)	Emergent Wetlands (acres)	Forested Wetlands (acres)	Scrub-Shrub Wetlands (acres)	Wetland Mitigation (acres)**
Crooked Creek Maternity Colony							
Waverly Bog	81	38	**119**	0	0	0	**0**
Lambs Creek Maternity Colony							
Berean Valley	245	0	**245**	0	0	0	**0**
Nutter Ditch	250	55	**305**	0	0	0	**0**
West Fork (Bryant Creek) Maternity Colony							
Ravinia Woods	373	0	**373**	0	0	0	**0**
Union	4	2	**6**	1	1	3	**5**
Big Bend	99	0	**99**	0	0	0	**0**
Bryant Creek	17	10	**27**	0	0	0	**0**
Paragon	28	36	**64**	0	0	0	**0**
Morgan Monroe State Forest Focus Area							
Chambers Pike	3	0	**3**	0	0	0	**0**
Beanblossom Bottoms Nature Preserve Maternity Colony							
Canyon	10	0	**10**	0	0	0	**0**
Stone Belt	19	0	**19**	0	0	0	**0**
Wylie	15	2	**17**	0	0	0	**0**
Griffith	7	0	**7**	0	0	0	**0**
Long Pond	79	8	**87**	4	19	1	**24**
Modesto	117	24	**141**	2	1	0	**3**
Beanblossom Creek Focus Area							
Whisnand	54	23	**77**	1	0	0	**1**
Beanblossom Creek	36	0	**36**	0	0	0	**0**
Maple Grove Historic District Focus Area							
Kinser Pike	35	8	**43**	0	0	0	**0**
Stout Creek	16	0	**16**	0	0	0	**0**
South of Bloomington							
Victor Pike	18	29	**47**	0	0	0	**0**
Totals	*1,506*	*235*	***1,741***	*8*	*21*	*4*	***33***

** Sites and acreages listed are those which would satisfy USFWS requirements. To meet additional water resource mitigation needs, an additional 23 acres at the Beanblossom Creek site and 12 acres at the Little Indian Creek site are also being pursued.*

***Unconsolidated Bottom (PUB) and Aquatic Bed (PAB) Wetlands may be mitigated for by using out of kind mitigation.*

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INDOT will be responsible for monitoring and maintaining the mitigation areas while they are being established. The mitigation sites will be restricted from other uses to ensure that they remain in a natural condition in perpetuity. Areas set aside for mitigation plantings will be protected from development in the short term, and in the long term will provide quality roosting and foraging habitat for the Indiana bat. These areas will also help to decrease habitat fragmentation, and improve the potential for Indiana bat colonies currently using the action area to expand into other areas of suitable habitat. Successful implementation of the mitigation plans and conservation measures are expected to result in sustainable, and in some cases improved, long-term habitat conditions for Indiana bat maternity colonies, individual, and hibernating populations within the action areas. In its Section 5 Tier 2 BO summary of anticipated effects of the project, USFWS stated the following (**Appendix LL2**, *Redacted Section 5 Tier 2 Biological Opinion*, pp. 47 –48):

- *Direct habitat modification/loss will occur, but will be minimal with a loss of tree cover ranging from approximately 0% to 1% within the three maternity colony areas. Therefore, the total amount of forest loss is relatively insignificant. It is also unlikely that these maternity areas would experience a significant long-term decrease in quality of roosting or foraging habitat as a direct result of I-69, based on the amount and quality of remaining forest habitat, the location of the alignment, and the fact that it is an upgrade of an existing four-lane facility.*

- *Seasonal tree-cutting restrictions will ensure no direct impacts/take occurs from the construction of I-69 during the maternity colony season. INDOT has also extended this restriction to include all borrow areas used by construction contractors.*

- *Indirect loss of forest or wetland habitat from residential and commercial development is anticipated to be fairly small and minimal impacts are expected, particularly in the maternity colony areas.*

- *No known primary or alternate roost trees will be impacted within the three known maternity colonies. Given the capture location of the bats, the location of the I-69 alignment, and results of forest transects conducted, it is unlikely that any primary maternity roosts are within the proposed alignment that will be cleared for I-69. Thus, no take is anticipated from the loss of a primary roost tree. Loss of unidentified alternate roost trees may occur, but this is limited given the location of the proposed alignment.*

- *Because construction in Section 5 primarily involves the upgrade of an existing four-lane facility, impacts to existing stream crossings and bat travel corridors are expected to be minimal. In most cases, current stream crossings will be maintained or improved upon (longer spans, redirection of road-runoff, etc.). If any of the existing stream crossings are currently used as corridors for bats, the upgraded structures should continue to provide areas for bats to connect to existing habitat and safely cross under the interstate. Some additional structures may be developed for access roads and interchanges but we expect impacts to bat movement to be minimal from such structures.*

- *Death/kill from collision with vehicles once roadway is fully operational is anticipated on I-69 and other local roadways when traffic volume and speed increases. One bat per colony is projected to be taken every two years through 2030. Some road-kill may be offset as traffic on local roads decreases and shifts to the new interstate. Since Section 5 consists of upgrading an existing four-lane state highway, impacts of this project from vehicular collision are anticipated to be less than the other new terrain sections.*

- *The maternity colonies and individual adult males have access to ample additional habitat nearby in the unlikely case that some individual bats should become displaced from their traditional foraging/roosting areas.*

- *I-69 may induce some amount of residential/commercial development in currently forested areas and may also speed up the rate of development that otherwise would have occurred within the action area at a slower rate, particularly in the immediate vicinity of and within easy commuting distance of Section 5 interchanges (e.g. Liberty Church Interchange).*

- *Some harassment of bats roosting near construction areas may occur as a result of exposure to novel noises/vibrations/disturbance causing roost-site abandonment and atypical exposure to day-time predators while fleeing and seeking new shelter during the day-time. This will have only short term impacts, if any.*

- *Proposed forest, wetland, and stream mitigation within and near the maternity and hibernacula areas will ensure that 2,000 acres of suitable roosting and foraging habitat persists in perpetuity, in addition to the permanent protection of two Priority 1A hibernacula.*

- *Long term reproduction and viability are not expected to be impacted by the project and all maternity colonies and hibernacula are likely to persist in the area.*

An overall I-69 mitigation tracking method has been developed in consultation with permitting agencies and the United States Environmental Protection Agency (USEPA). The tracking is accomplished using a database with a GIS component. INDOT has coordinated with agencies to identify agency-specific information to be included in the database for tracking. Information on purchased, constructed, and potential mitigation sites, as well as the anticipated natural resource mitigation required and available credits of I-69 are continually being updated within the tracking system. The most recent mitigation tracking status update was sent to resource agencies in March 2013.

5.20.5 Summary

Impacts to upland forests from the alternatives vary from approximately 227.66 acres (Refined Preferred Alternative 8) to 433.16 acres (Alternative 4). Upland forest affected by the I-69 Evansville to Indianapolis project will be mitigated at a 3 to 1 ratio (with the goal of 1 to 1 replacement and 2 to 1 preservation). Therefore, the range of impacts would require mitigation of 682.98 acres to 1,299.48 acres, depending on the alternative selected. Refined Preferred

Alternative 8 would affect approximately 227.66 acres, thereby requiring mitigation of 682.98 acres of forest. The Section 5 Tier 2 BA identifies the general location of 20 possible mitigation sites for the design and construction of wetlands and upland forest. These sites are associated with four (4) maternity colonies (Crooked Creek, Lambs Creek, West Fork [Bryant Creek], and Beanblossom Nature Preserve); three (3) summer habitat focus areas (Morgan Monroe State Forest, Maple Grove Historic District, and Beanblossom Creek), and one (1) area south of Bloomington. **Appendix LL1,** *Redacted Tier 2 Biological Assessment,* **Appendix LL2**, *Redacted Tier 2 Biological Opinion,* and **Appendix BB**, *Revised Tier 1 Biological Opinion and Amendments,* provide more detail regarding the potential mitigation sites for Section 5.

Twenty-four (24) forests containing core forest habitat were identified as being affected by Section 5 Alternatives. Impacts to core forest habitat range from 41.84 acres (Refined Preferred Alternative 8) to 87.23 acres (Alternative 4). Forest within the existing SR 37 (and other state and local roads) right-of-way accounts for 28% to 56% of the total acres of forest impacts included in the alternatives. Forest within the existing SR 37 right-of-way accounts for 56% of the total acres of forest impacted for Refined Preferred Alternative 8.

Table 5.20-7 summarizes the potential direct impacts to forest areas for each alternative, and provides the approximate acres of forest mitigation associated with the impacts of each alternative.

Table 5.20-7: Summary of Forest Impacts and Potential Mitigation, by Alternatives

USDA Forest Classification	Acres of Forest in Corridor	Acres in Right-of-Way of Alternatives					
		4	5	6	7	8	Refined Preferred Alternative 8
Cherry-Ash-Yellow Poplar	112.70	38.02	43.64	18.71	22.96	22.75	21.69
Elm-Ash-Cottonwood	81.34	4.26	5.93	4.70	1.71	4.77	1.58
Maple-Beech	155.02	39.31	47.65	27.80	16.75	29.14	11.59
Oak-Hickory	1,555.16	343.93	301.75	191.90	191.75	197.37	192.31
Total Forest Acres in Corridor*	1,904.22	425.52	398.97	243.11	233.17	254.03	227.17
Percent of Forest Acres in Corridor	100.00%	22.35%	20.95%	12.77%	12.24%	13.34%	11.93%
Forest Outside Corridor**	0.00	15.44	7.06	2.39	2.82	2.23	1.89
Total Forest within the Right-of-Way***		440.96	406.03	245.50	235.99	256.26	229.06
Forest within Existing SR 37 Right-of-Way	127.04	124.99	125.32	127.60	127.60	127.58	127.51
Total Forest Outside of Existing SR 37 Right-of-Way	1,777.18	315.97	280.71	117.90	108.39	128.68	101.55
Forested Wetland Impacts within ROW**** (included in Total Forest Impacts)	37.52	7.80	10.36	6.89	3.05	6.94	1.40
Upland Forest Impacts (included in Total Forest Impacts)	1,866.70	433.16	395.67	238.61	232.94	249.32	227.66
Approximate Upland Forest Mitigation (acres) - 3 to 1 ratio		1,299.48	1,187.01	715.83	698.82	747.96	682.98
Core Forest: Acres of Reduction		87.23	76.82	45.88	44.52	44.86	41.84

Note: Some totals may not add due to rounding.

** Total acres of forest in corridor include wetland forests and the bifurcation area.*

*** In some areas, the alternatives impact forests outside the corridor boundary, due to access roads or interchanges.*

**** Includes forested wetland acreage that will be preserved within the right-of-way and also includes the bifurcation area.*

***** Forested wetland impacts will be mitigated per the Wetlands MOU and are discussed in Section 5.19, Water Resources.*

Section 5.20 Figure Index

(Figures follow this index, except as otherwise noted.)

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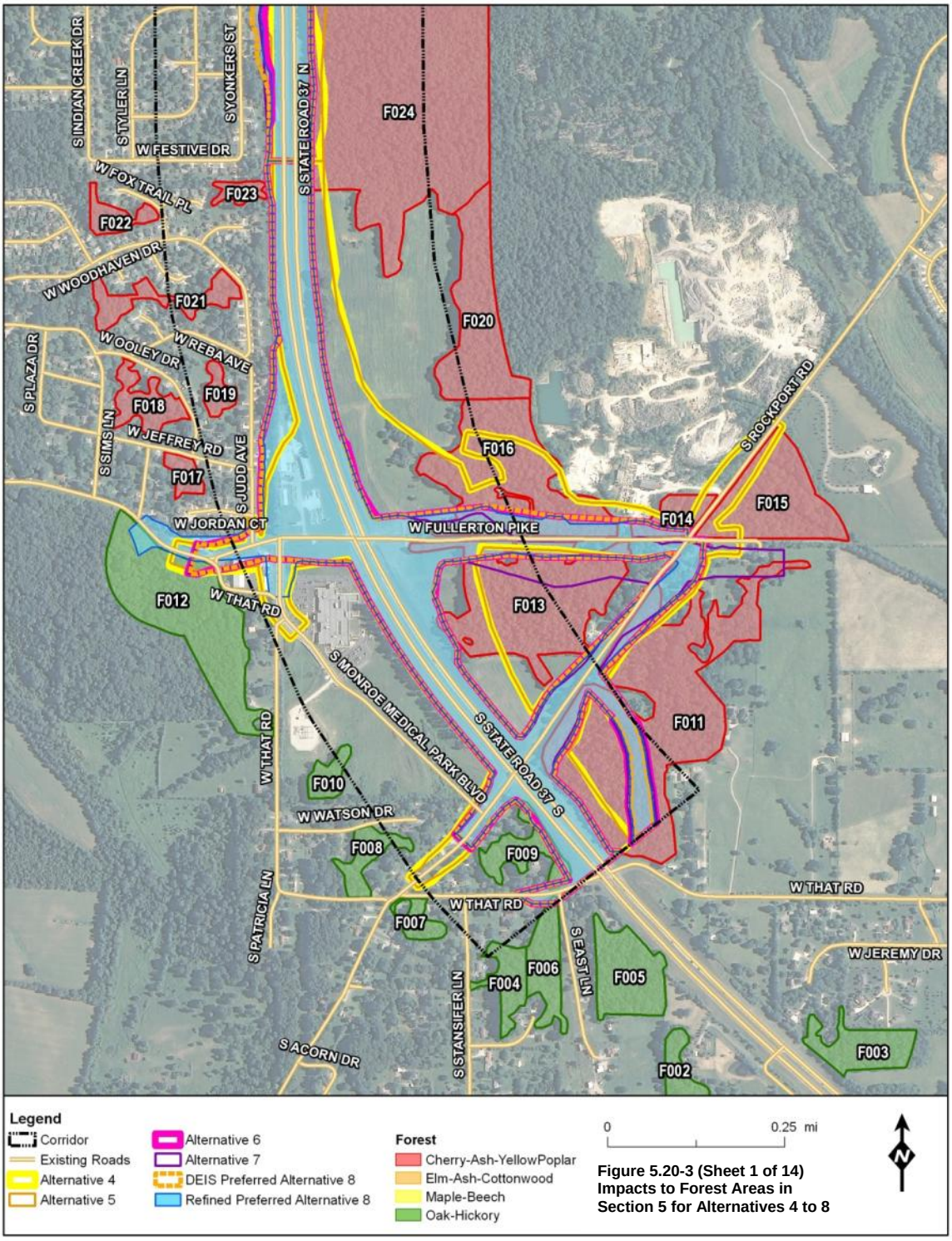

**Figure 5.20-3 (Sheet 1 of 14)
Impacts to Forest Areas in
Section 5 for Alternatives 4 to 8**

Figure 5.20-3: Impacts to Forest Areas in Section 5 for Alternatives 4 to 8 (Sheet 1 of 14)

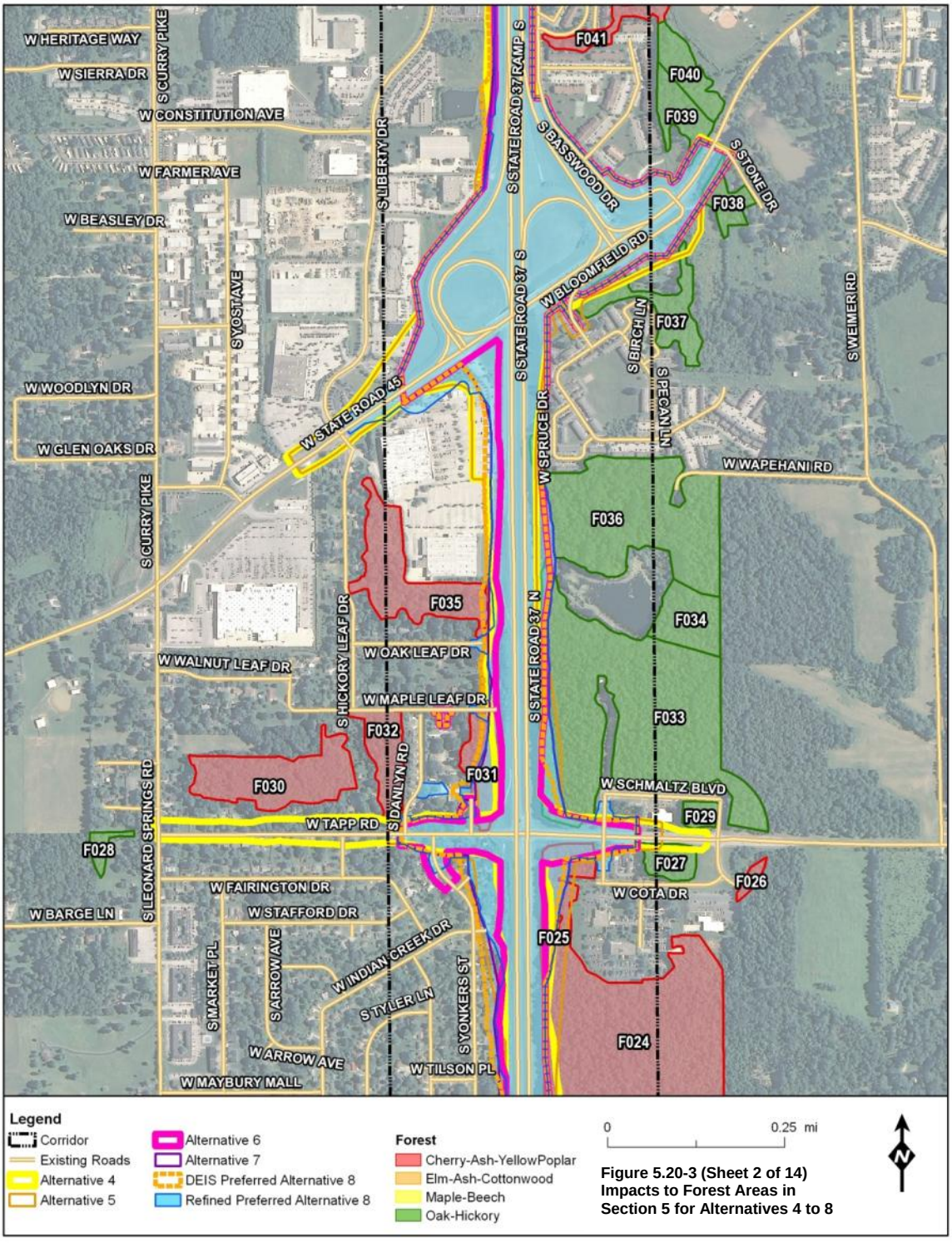

Figure 5.20-3 (Sheet 2 of 14)
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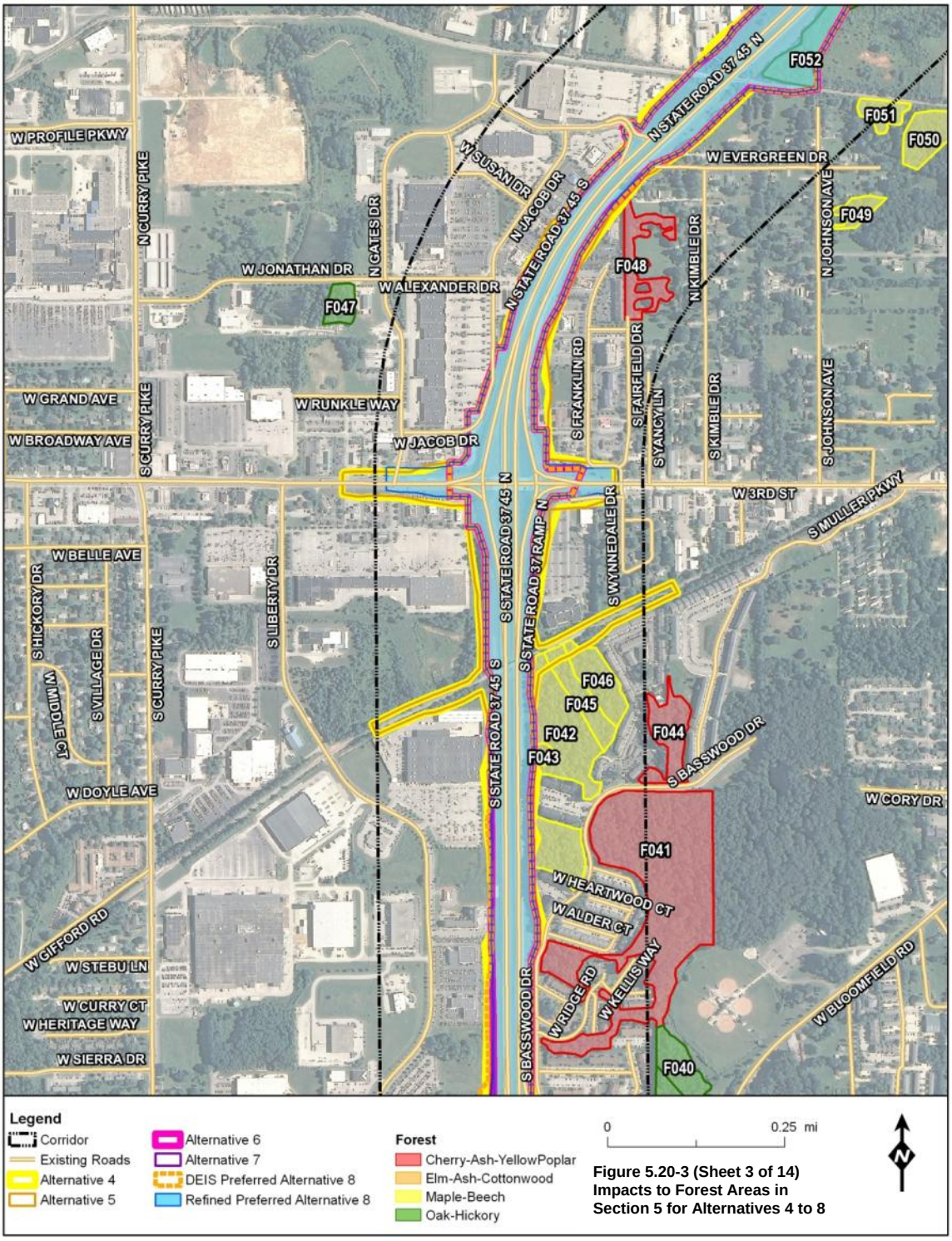

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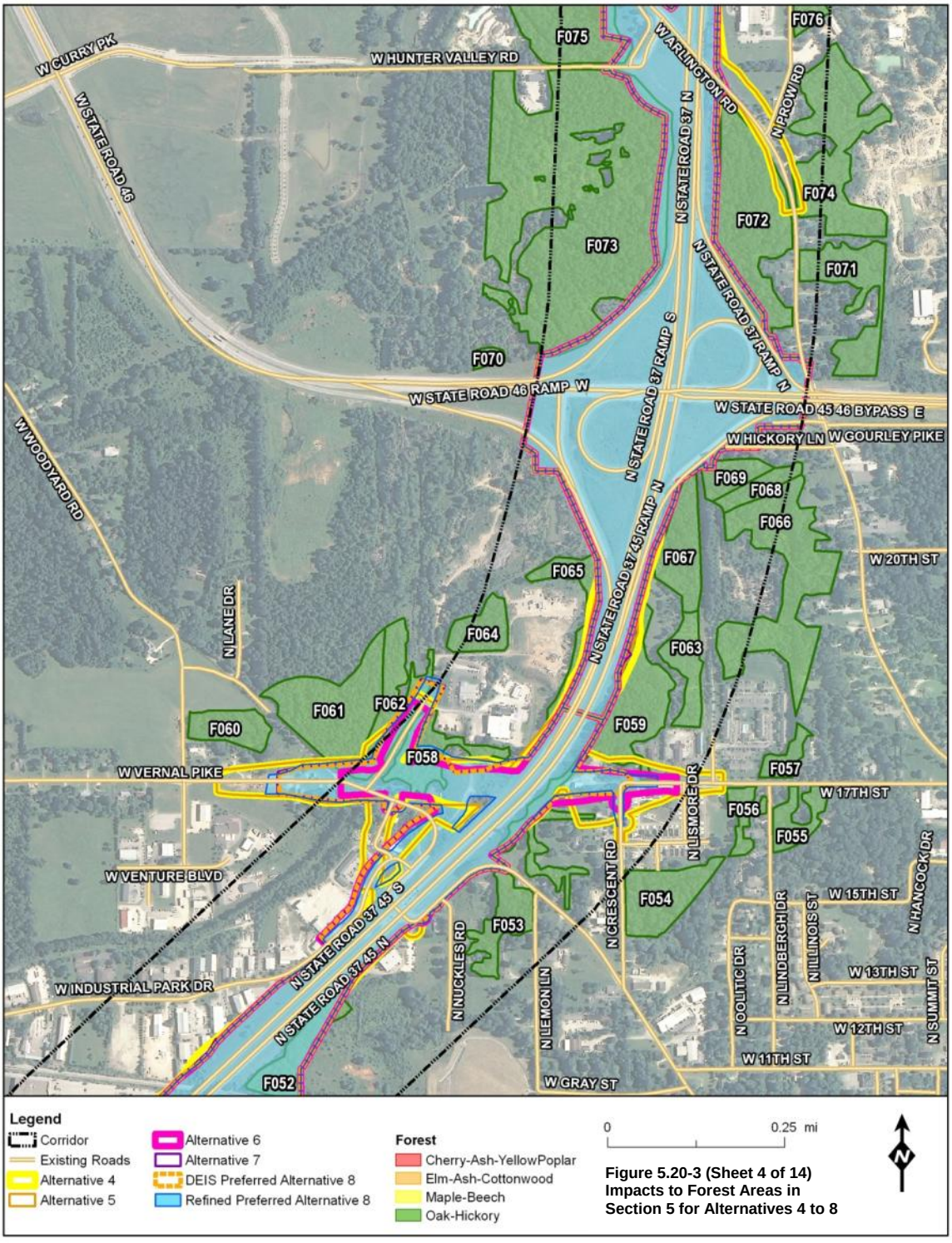

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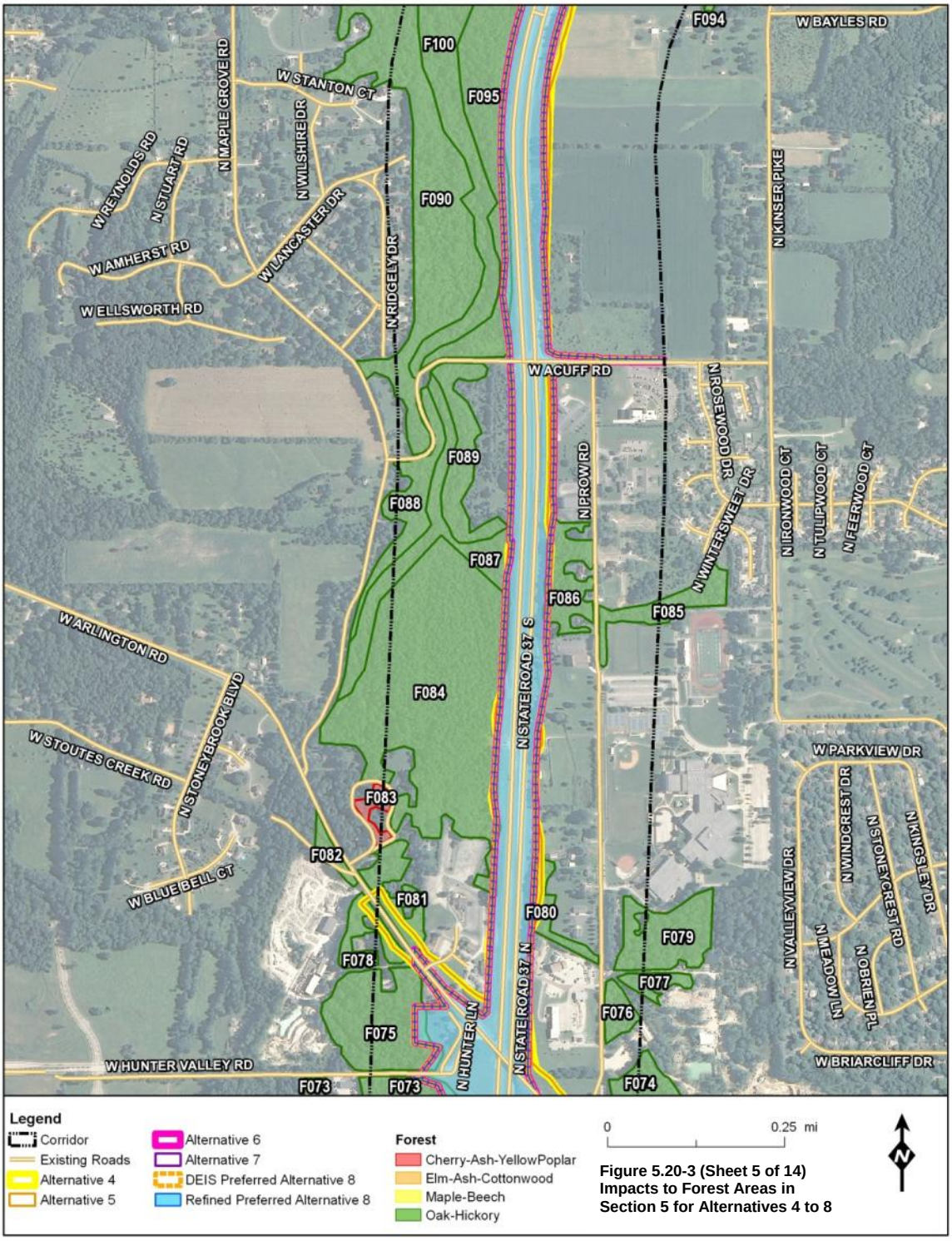

**Figure 5.20-3 (Sheet 5 of 14)
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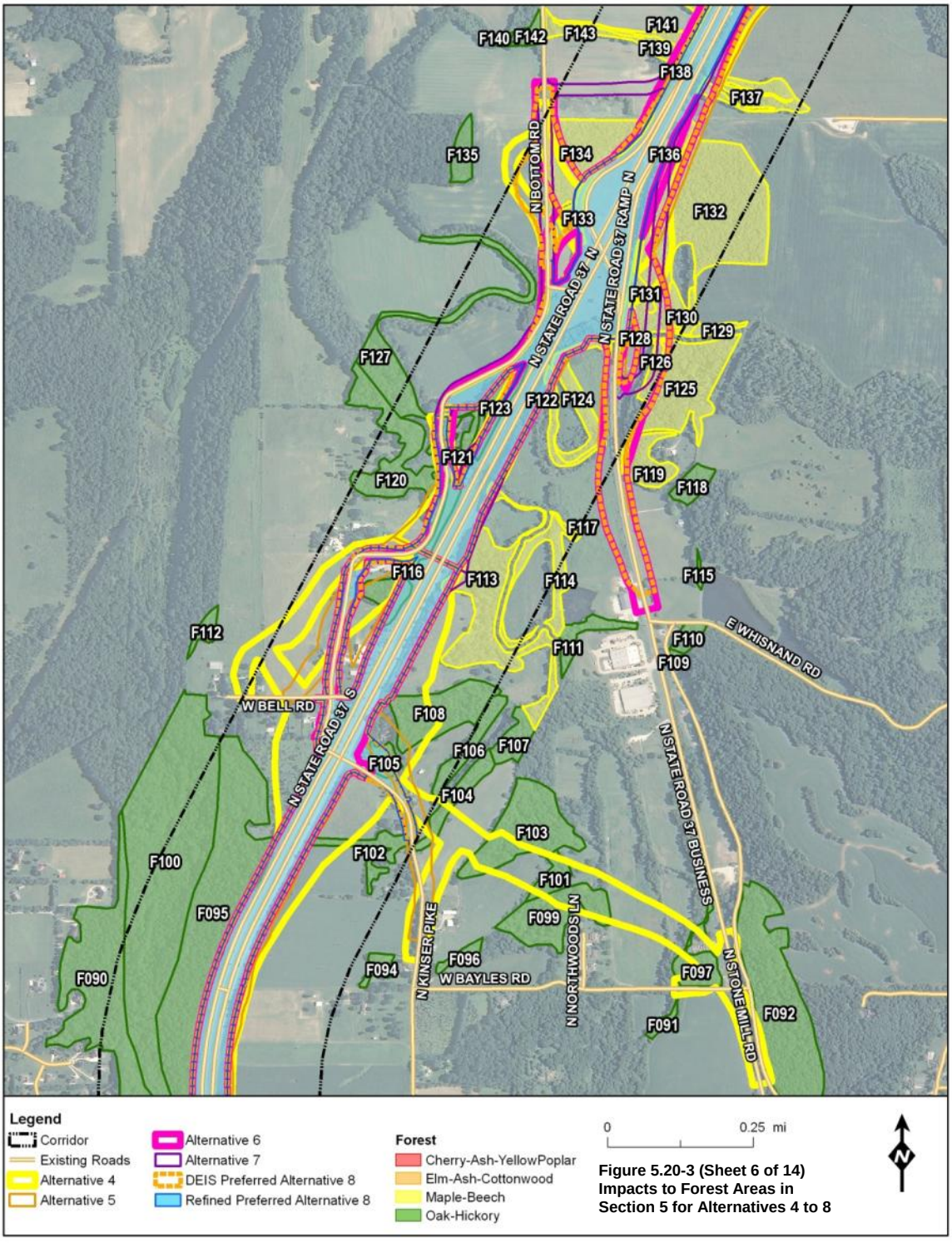

Figure 5.20-3 (Sheet 6 of 14)
Impacts to Forest Areas in Section 5 for Alternatives 4 to 8

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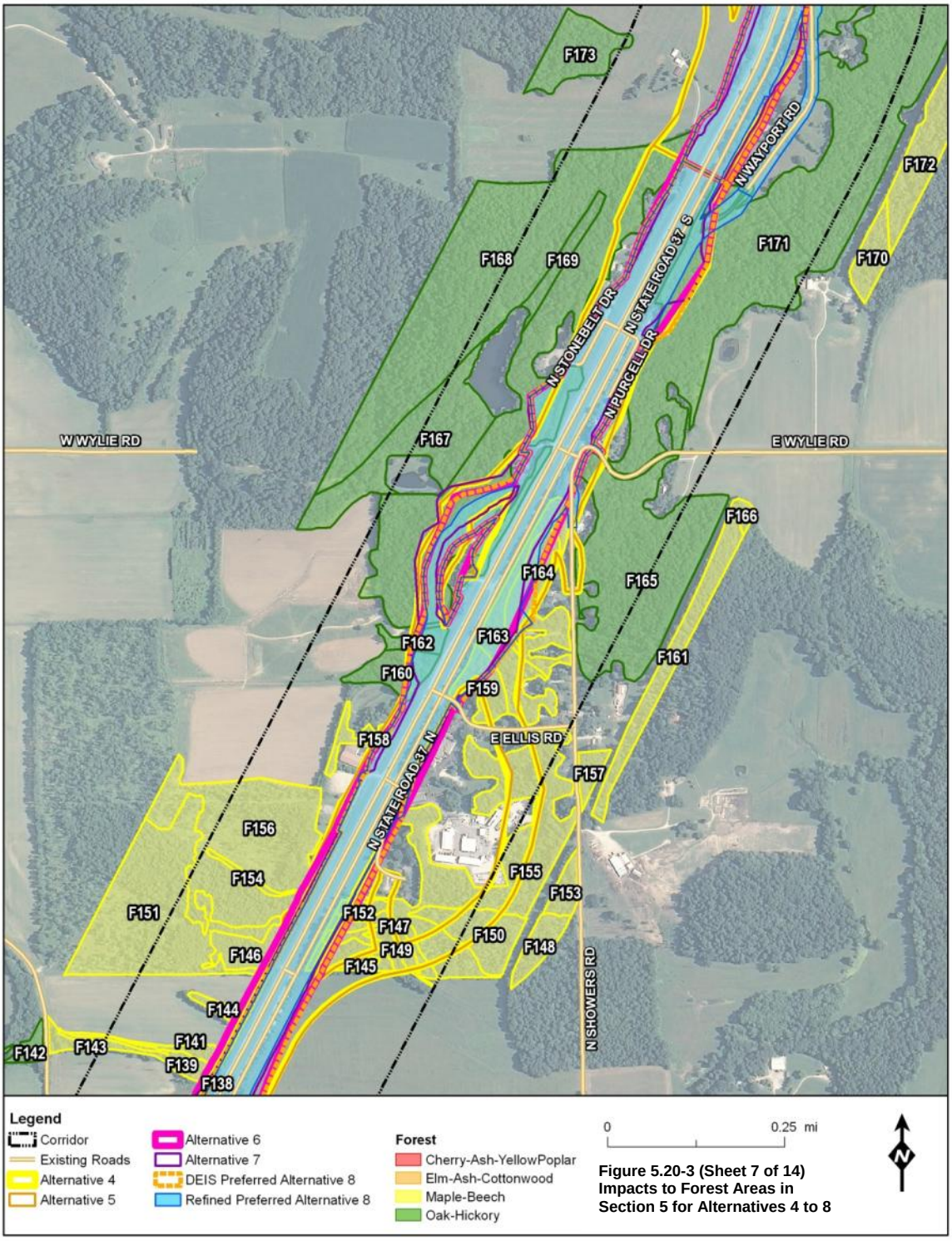

Figure 5.20-3: Impacts to Forest Areas in Section 5 for Alternatives 4 to 8 (Sheet 7 of 14)

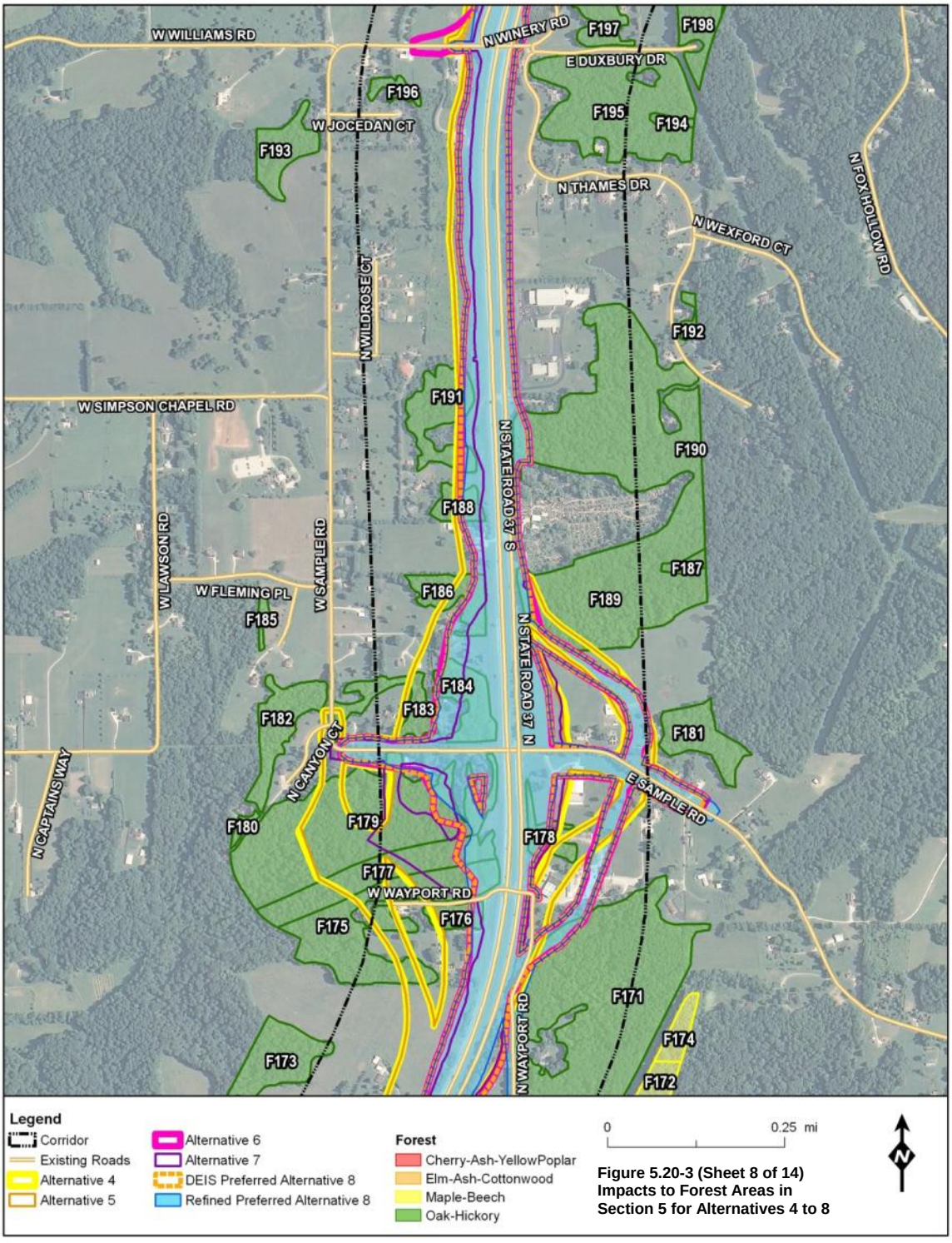

**Figure 5.20-3 (Sheet 8 of 14)
Impacts to Forest Areas in
Section 5 for Alternatives 4 to 8**

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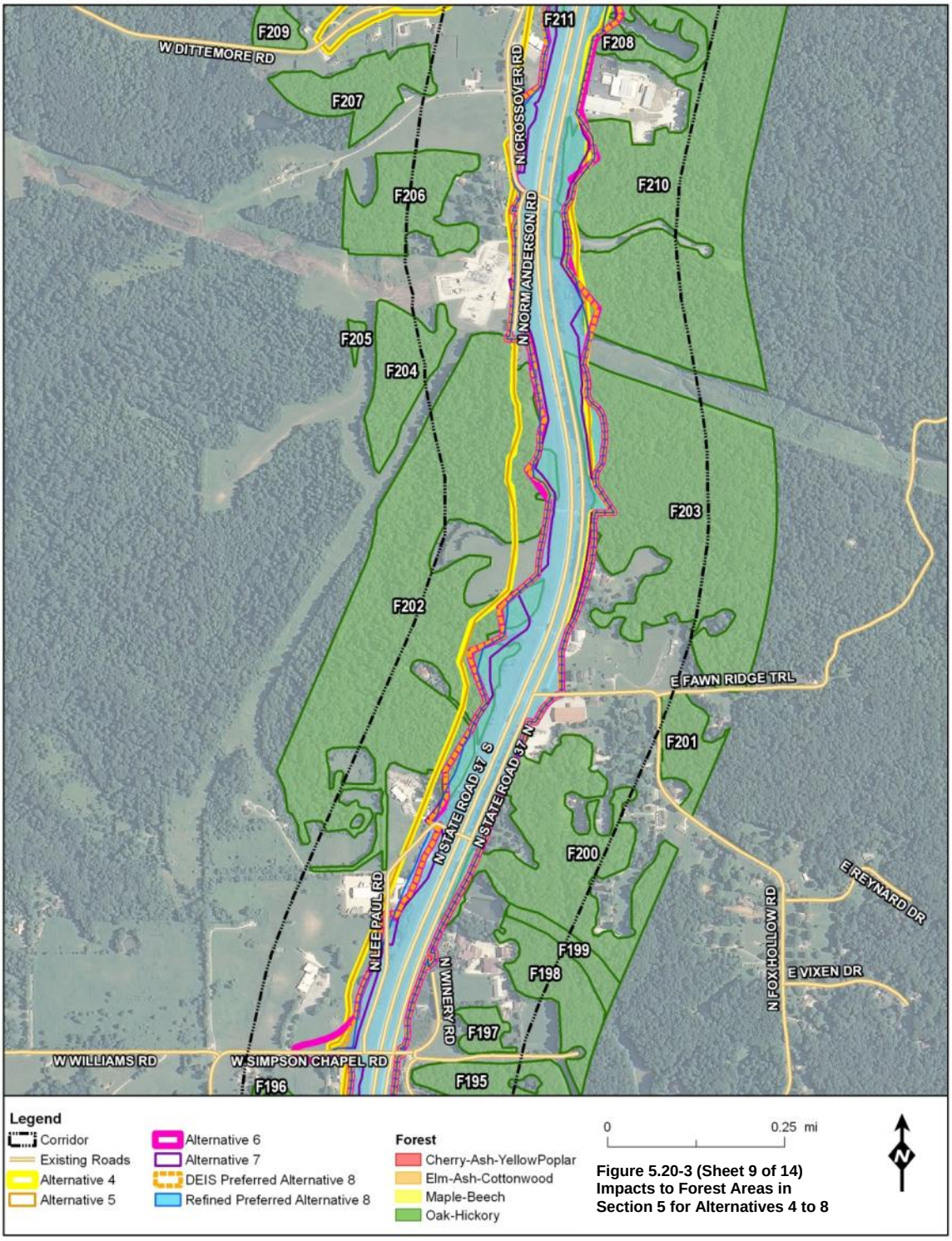

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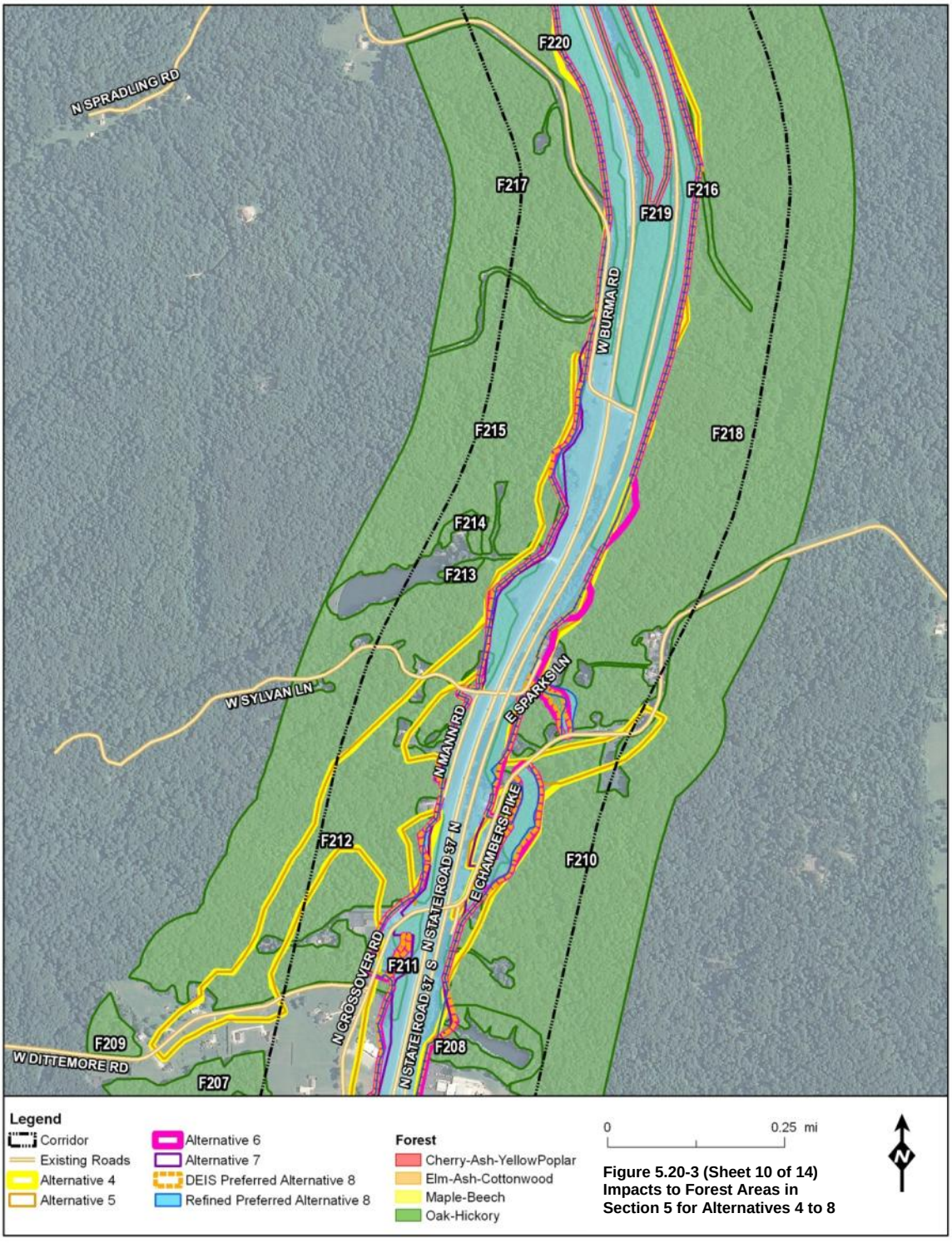

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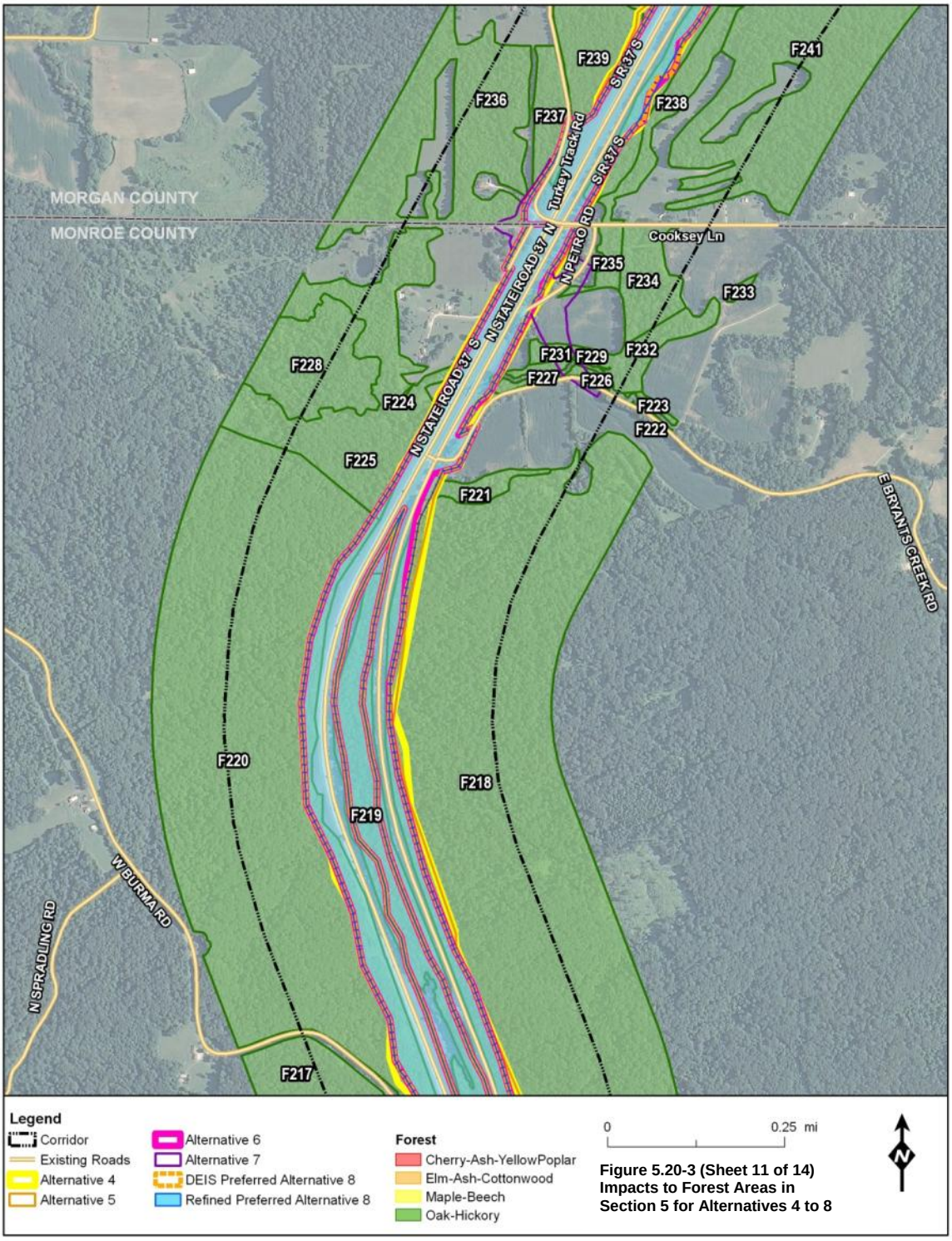

Figure 5.20-3 (Sheet 11 of 14)
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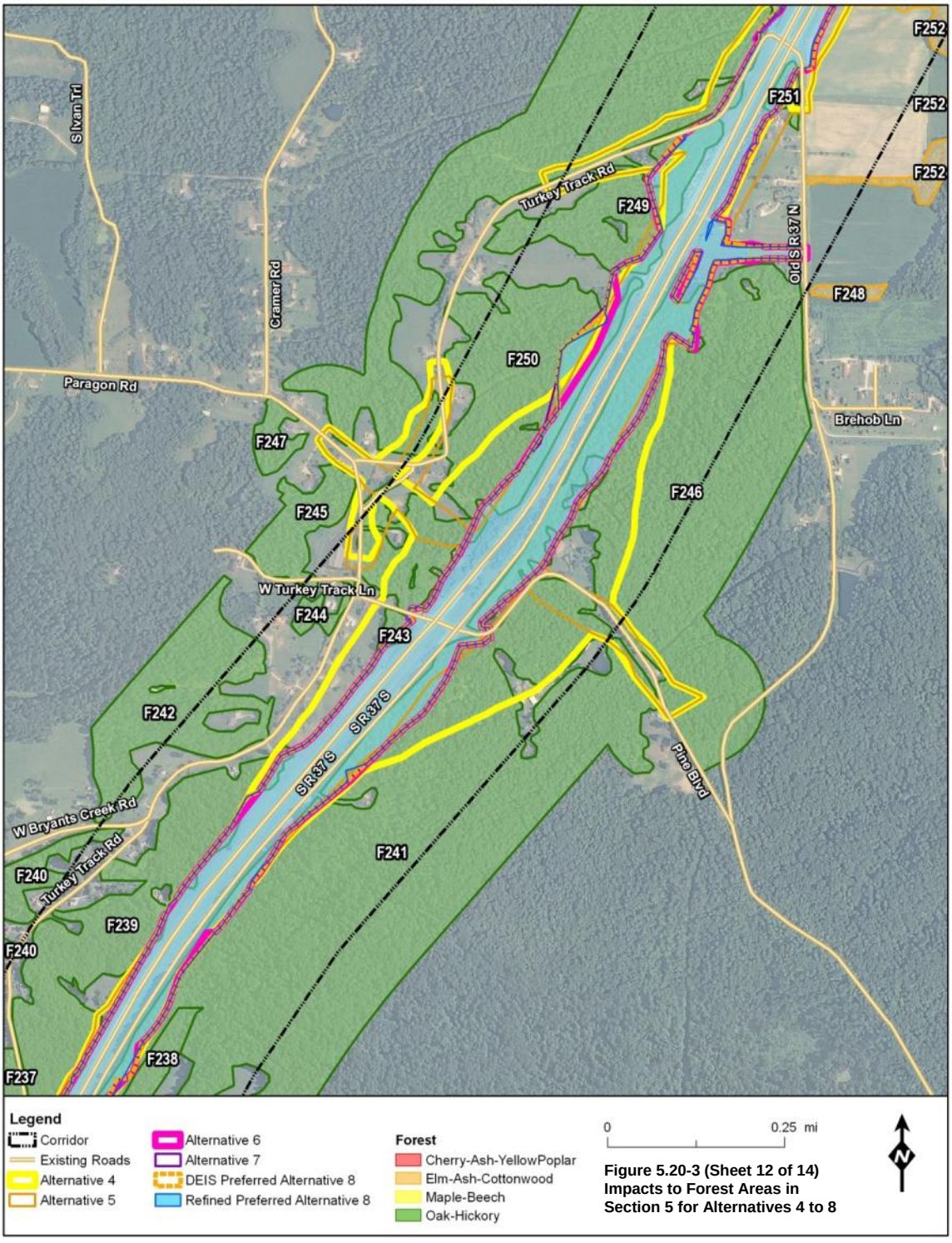

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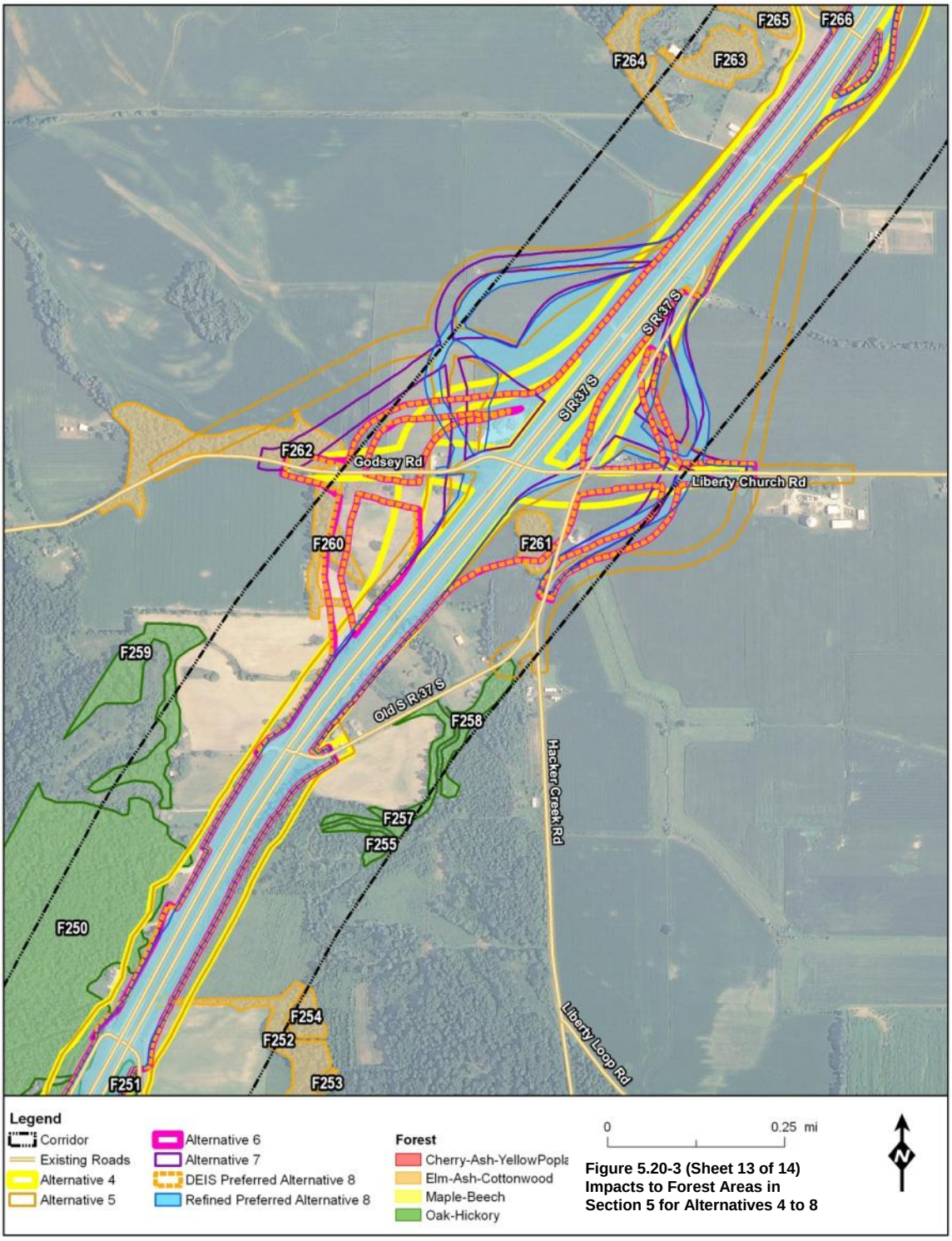

Figure 5.20-3 (Sheet 13 of 14) Impacts to Forest Areas in Section 5 for Alternatives 4 to 8

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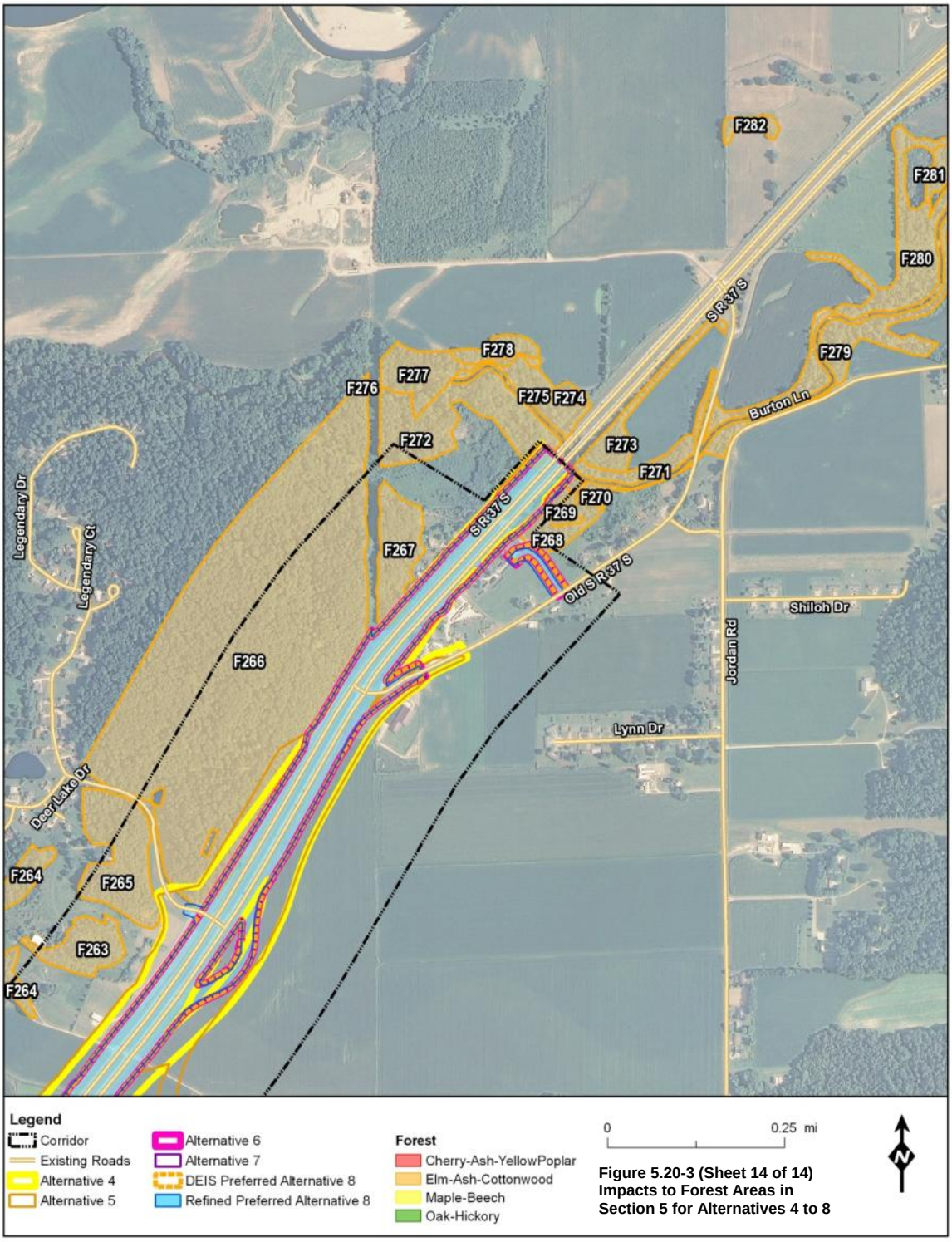

Figure 5.20-3 (Sheet 14 of 14) Impacts to Forest Areas in Section 5 for Alternatives 4 to 8

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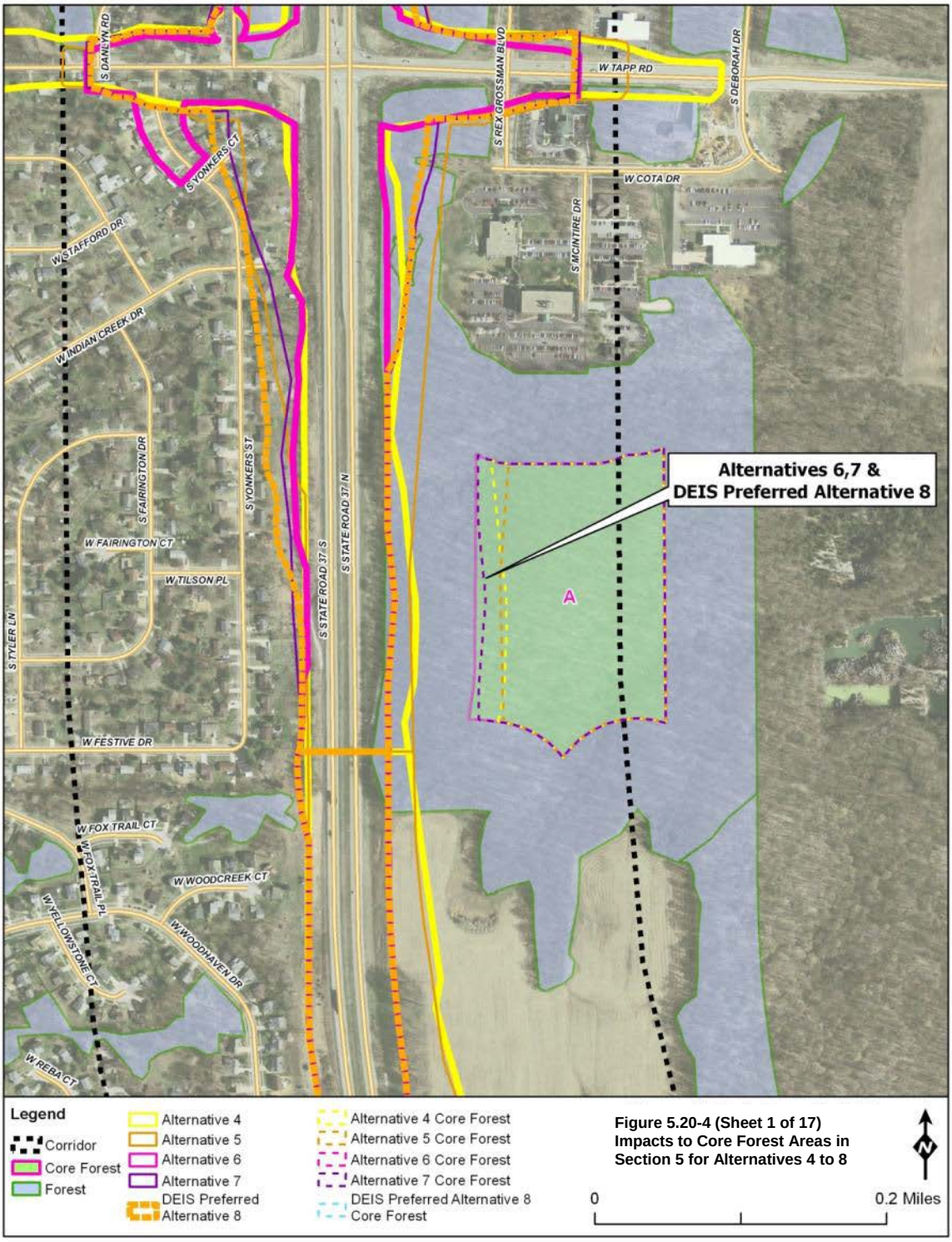
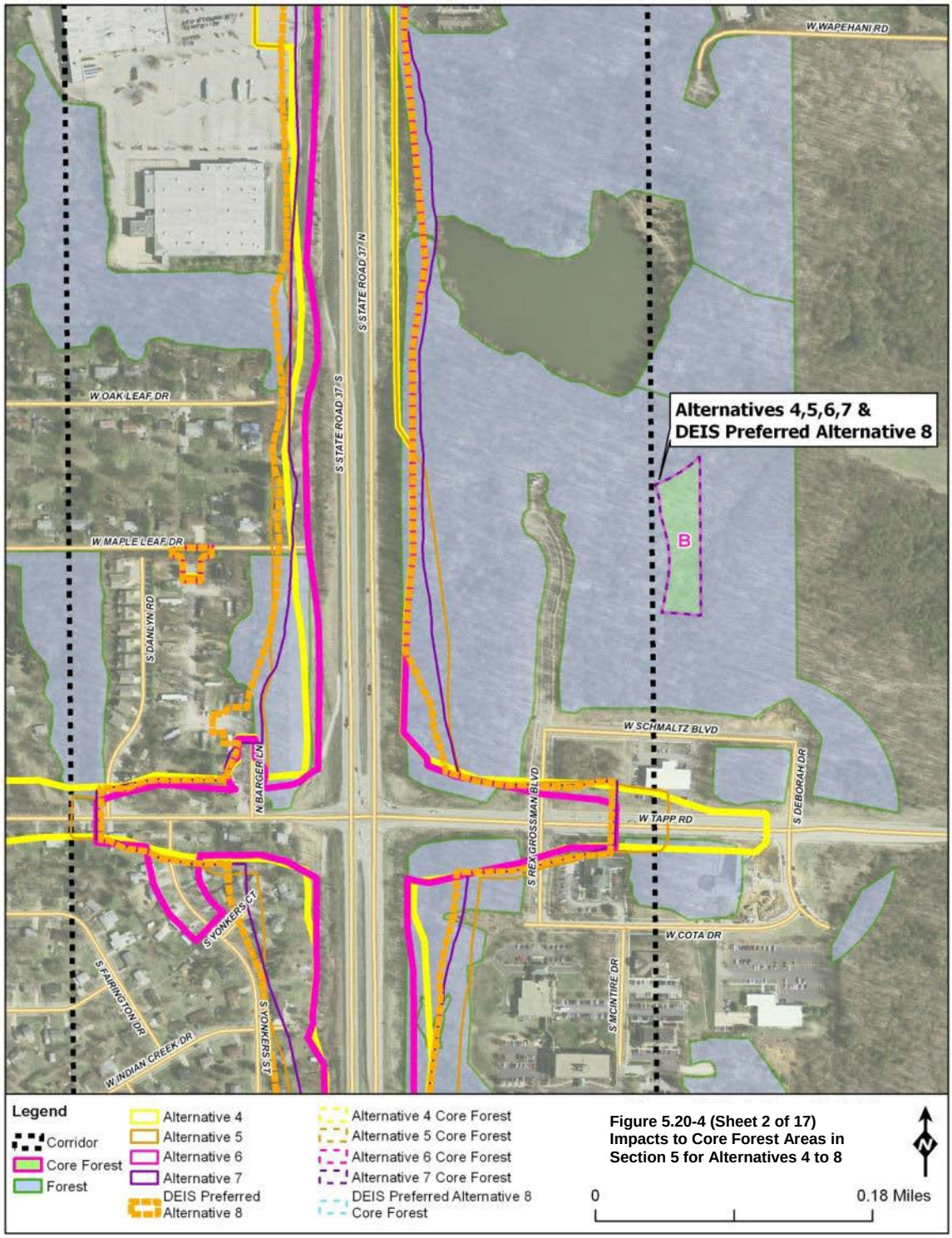


Figure 5.20-4: Impacts to Core Forest Areas in Section 5 for Alternatives 4 to 8 (Sheet 1 of 17)



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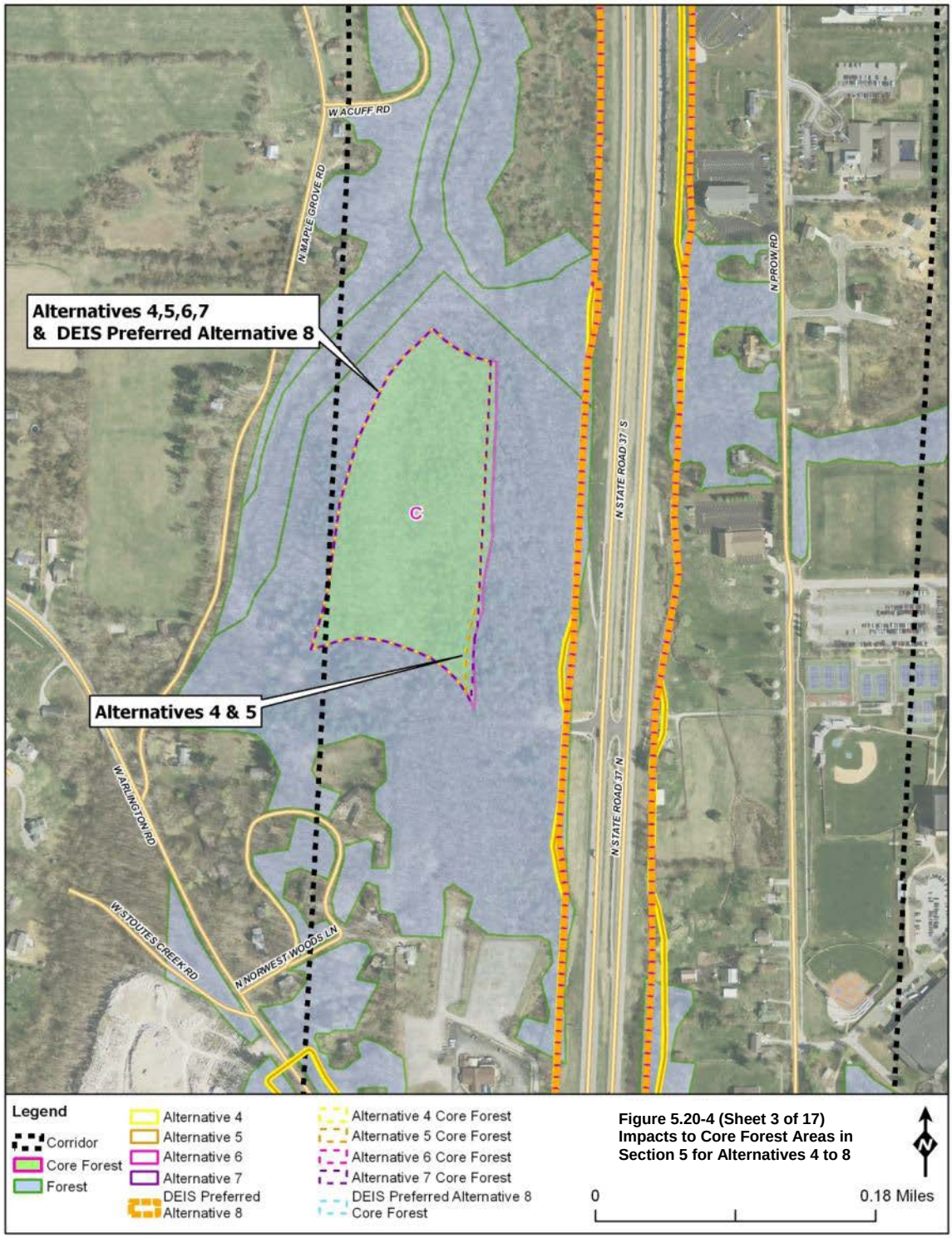

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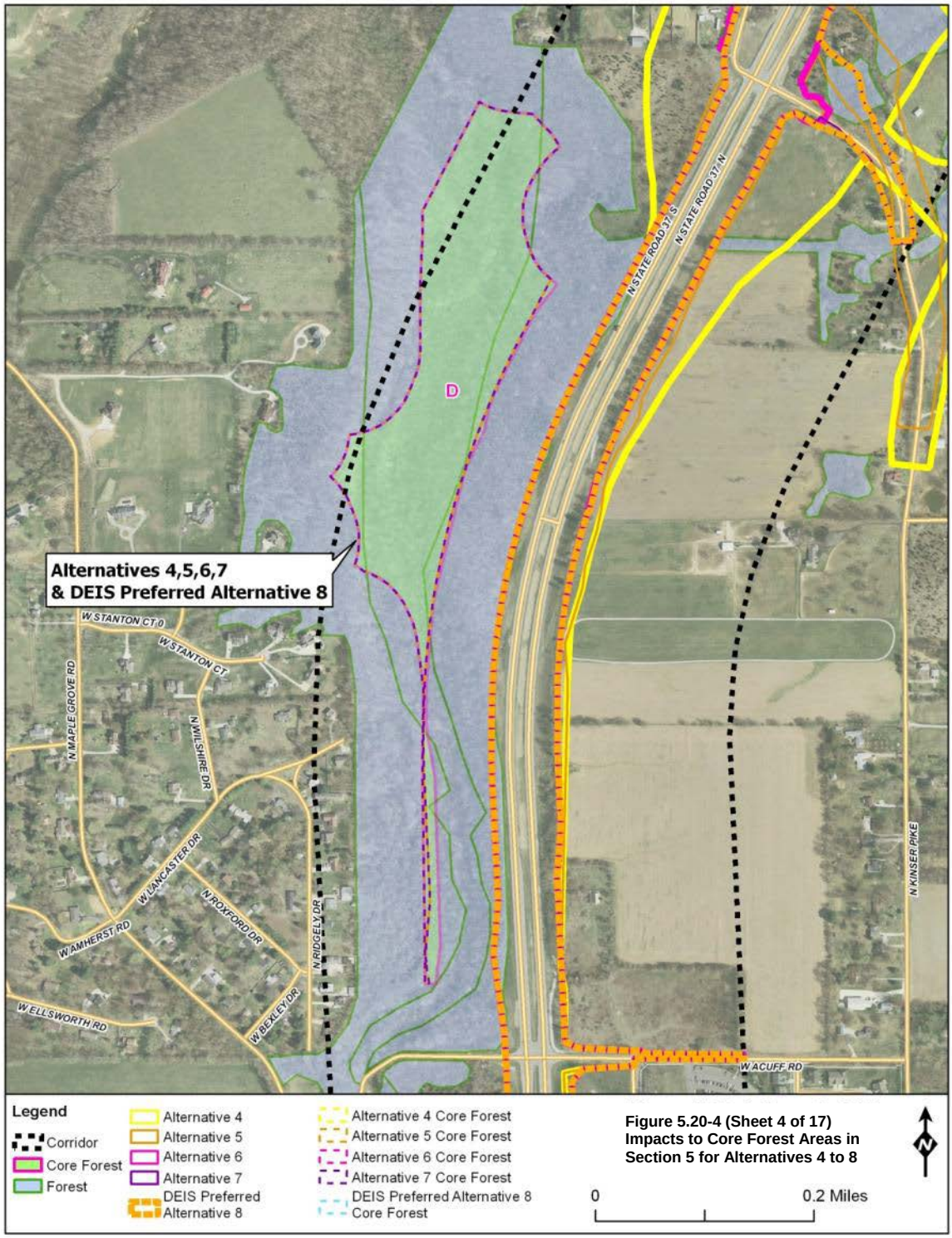

Figure 5.20-4 (Sheet 4 of 17)
Impacts to Core Forest Areas in Section 5 for Alternatives 4 to 8

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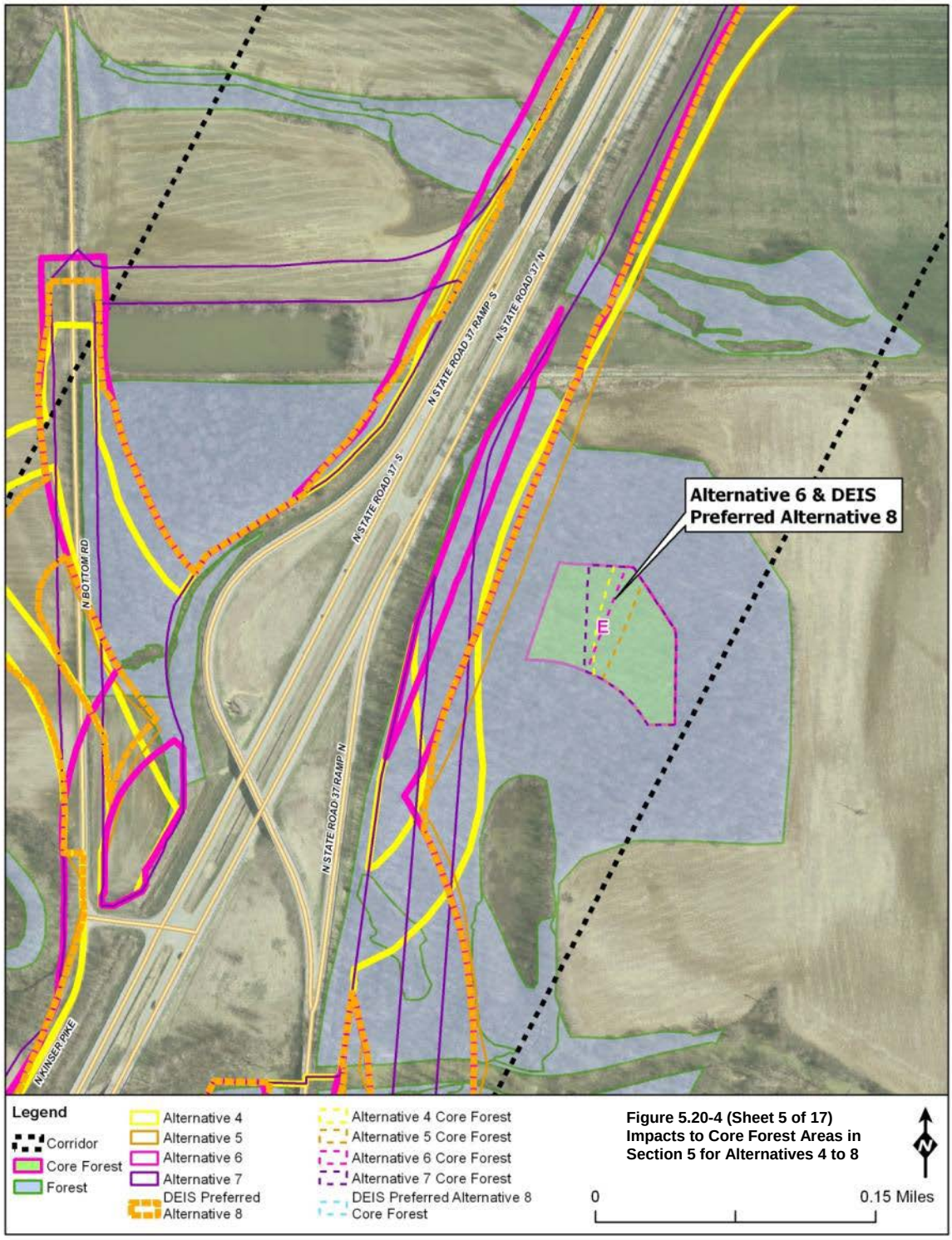

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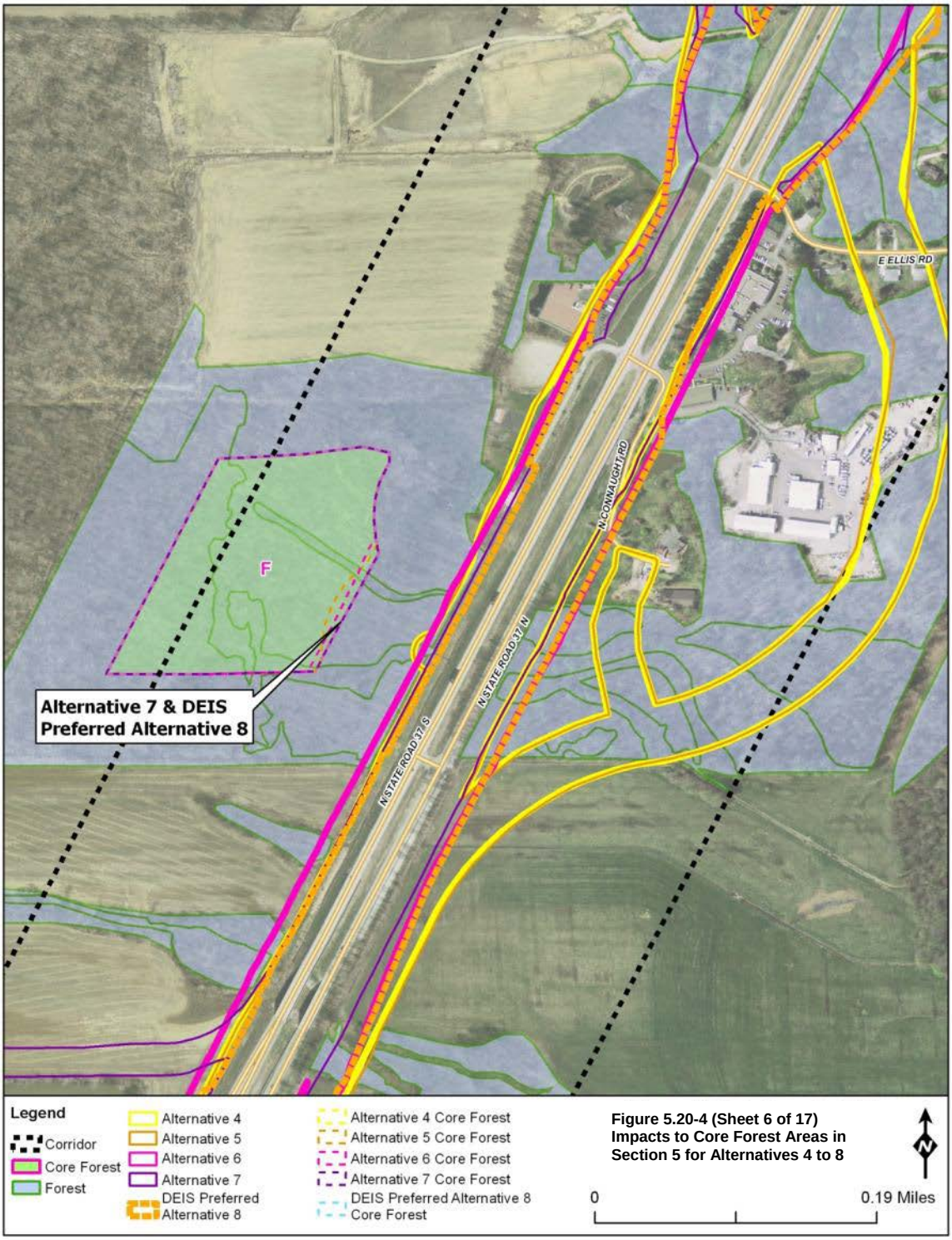

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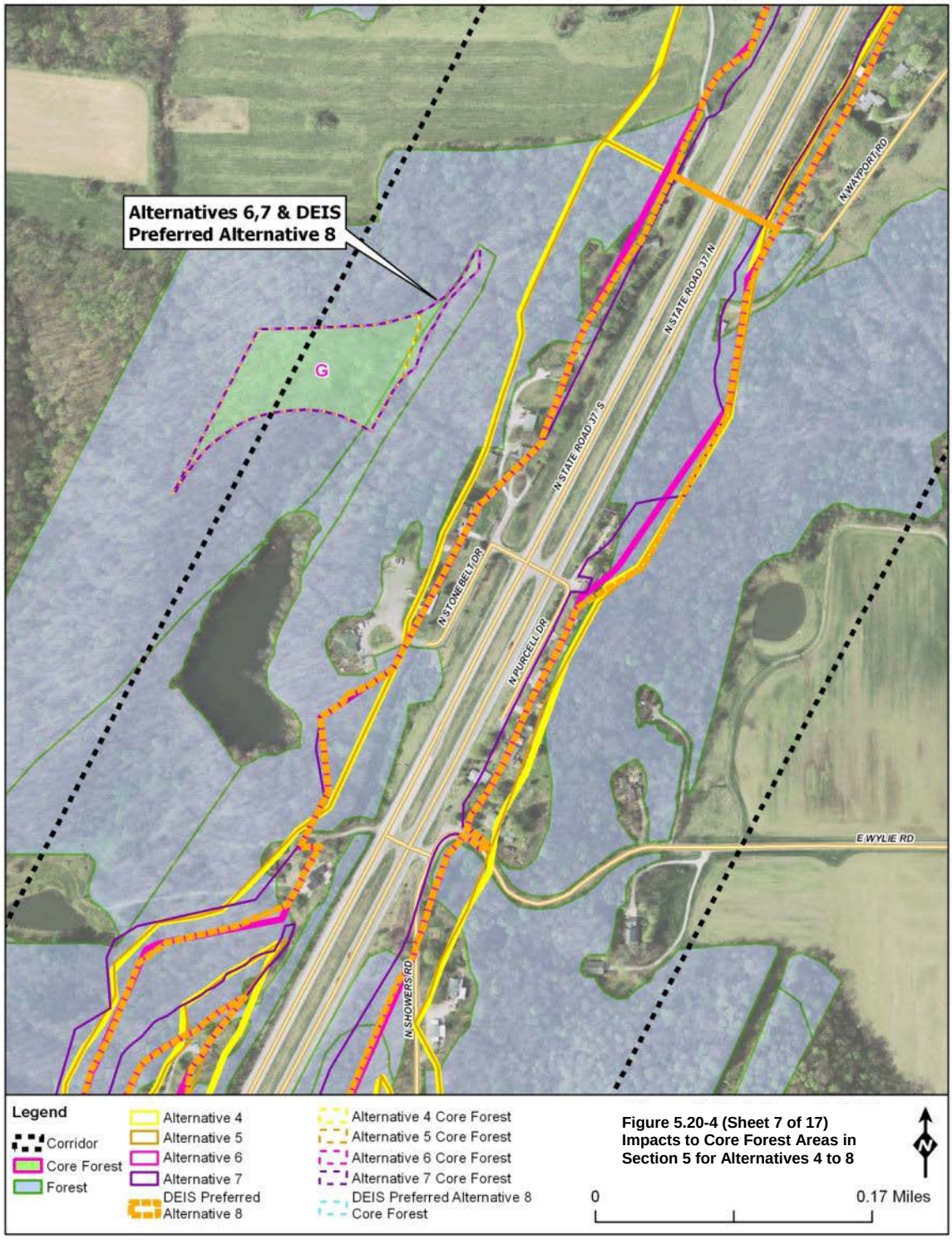

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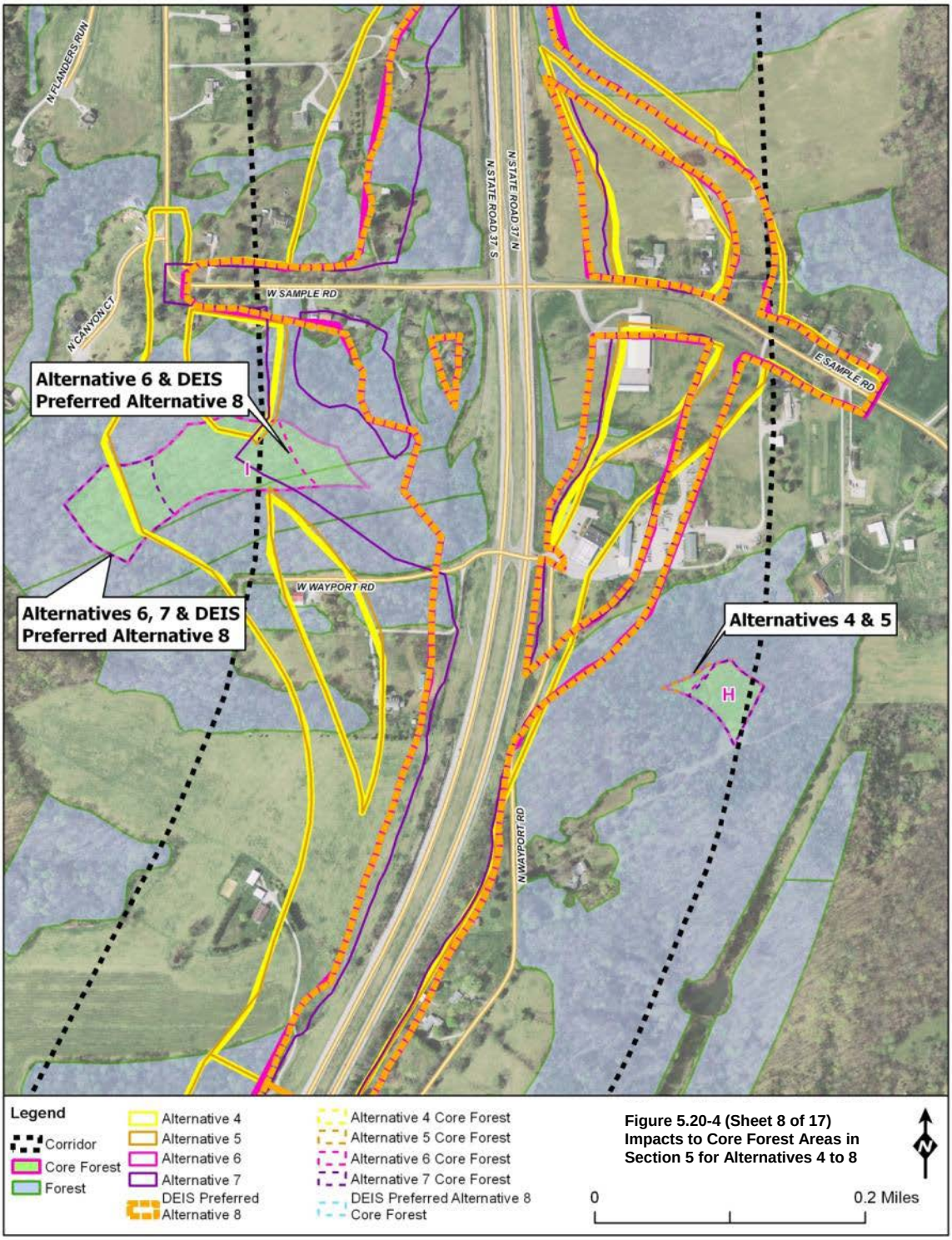

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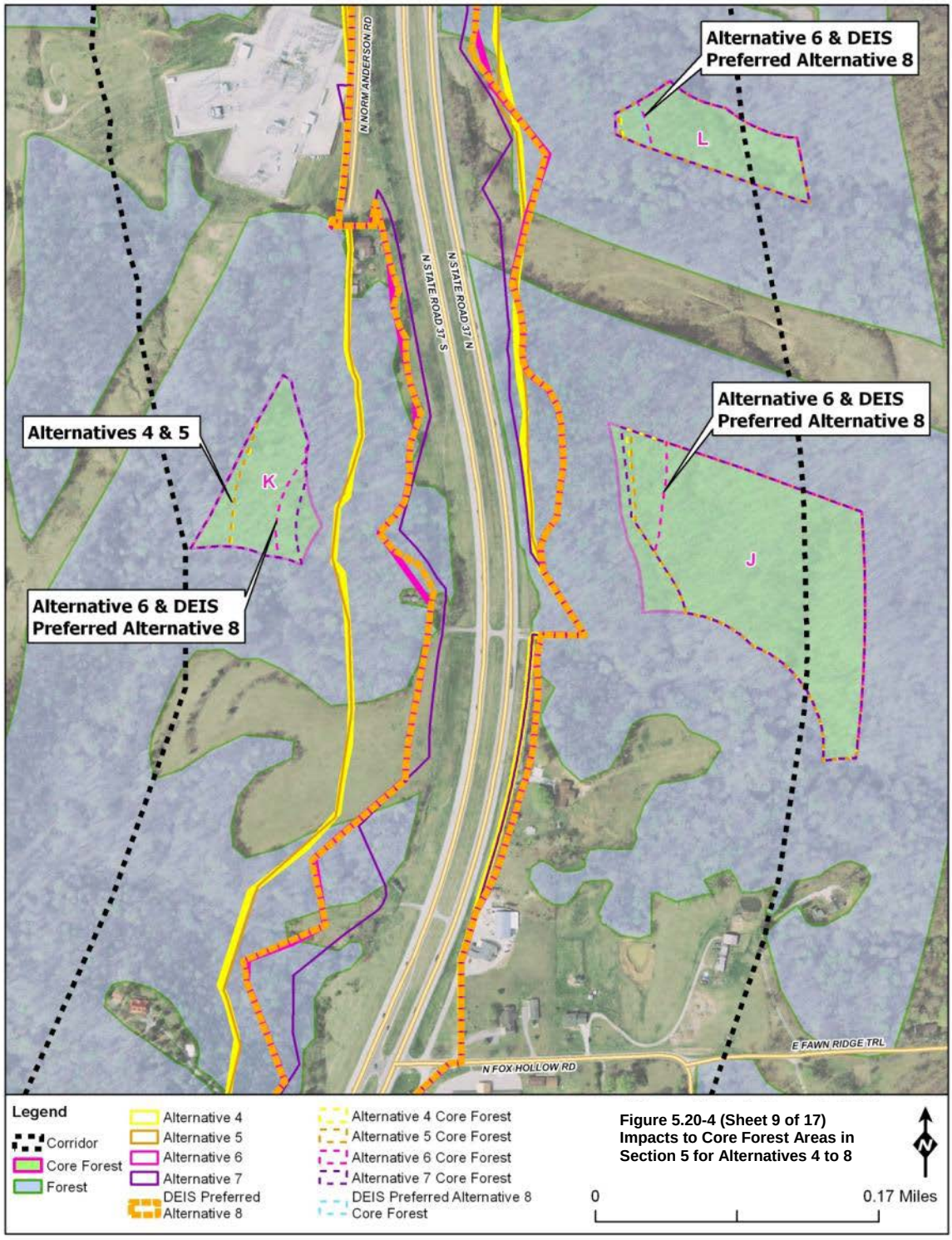

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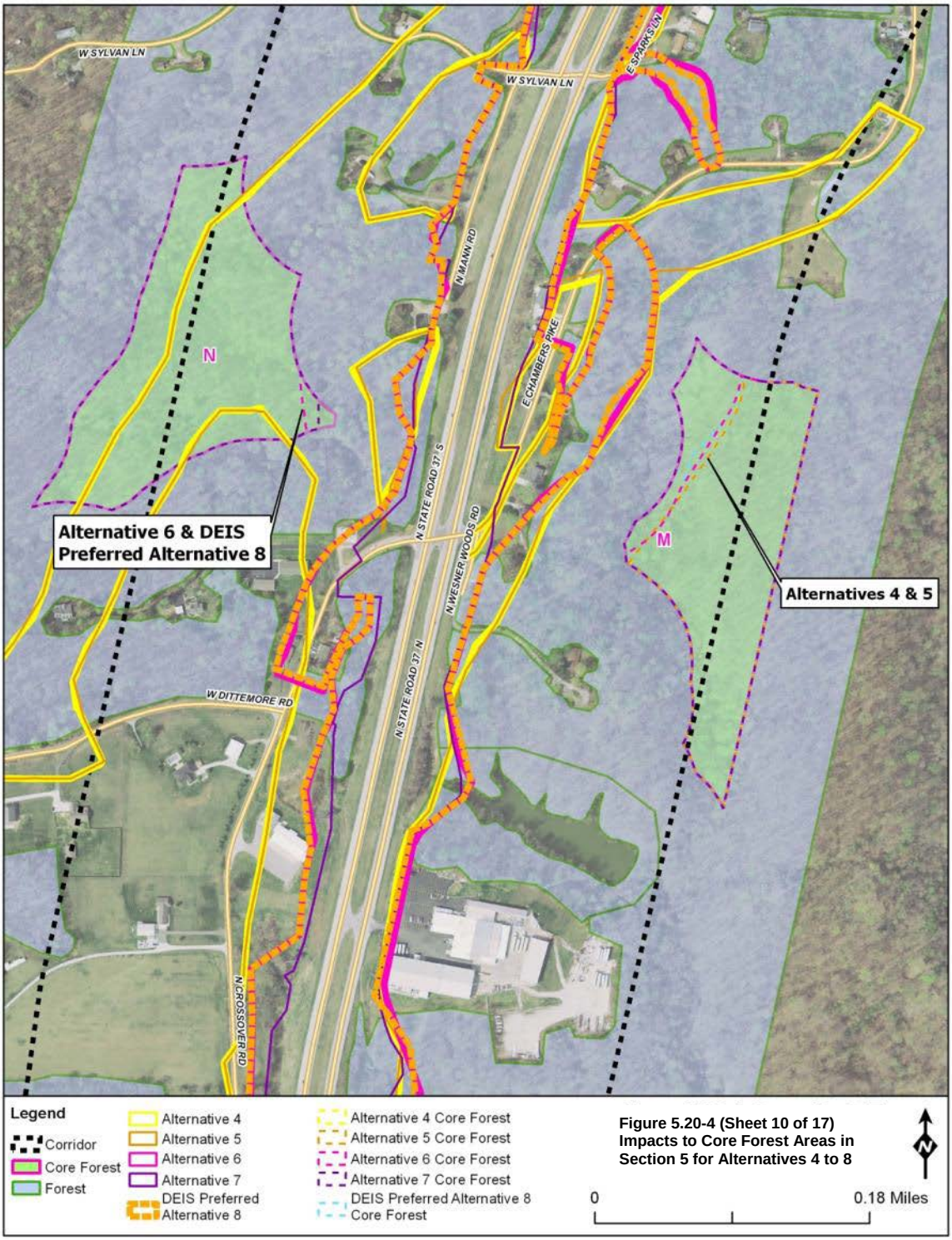

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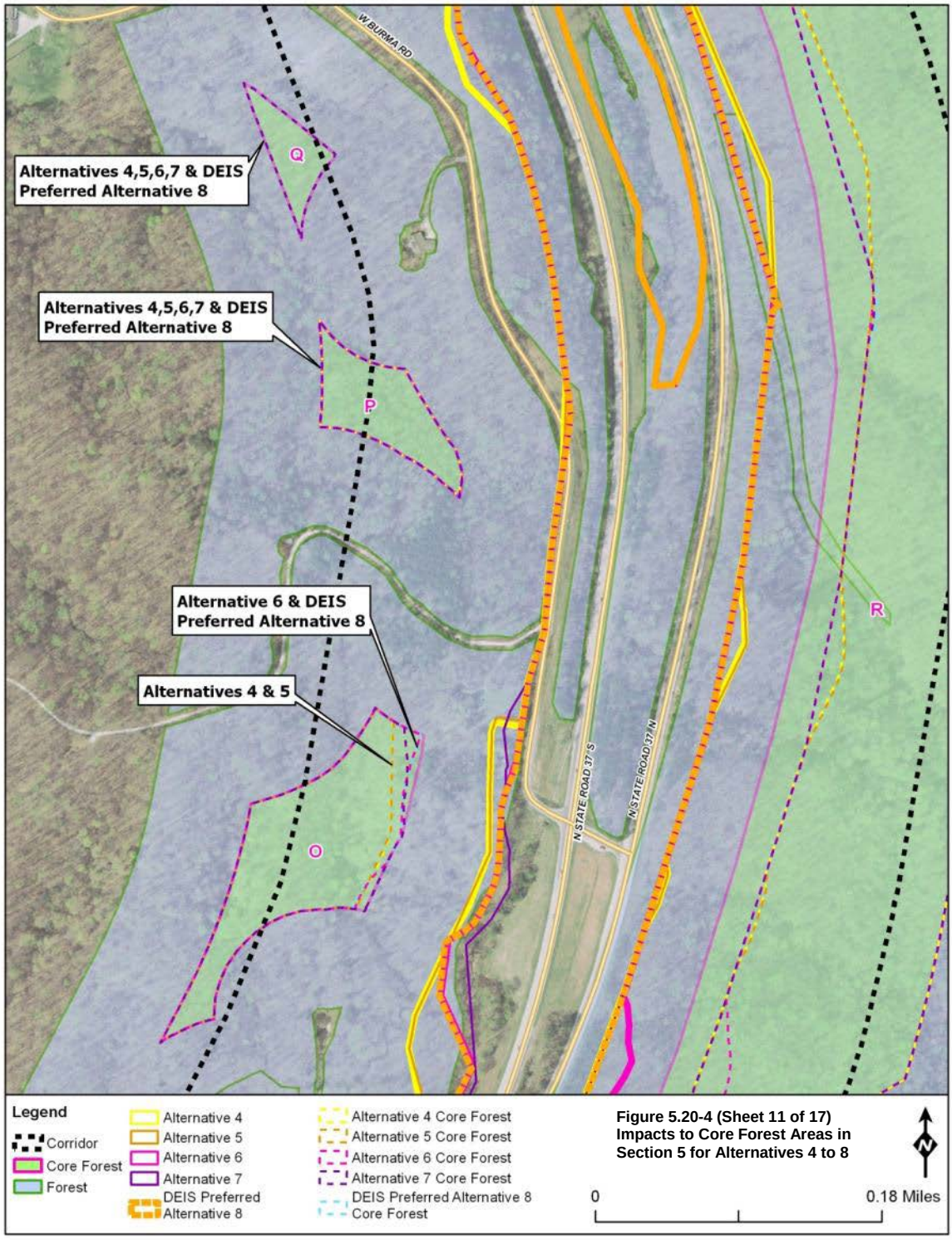

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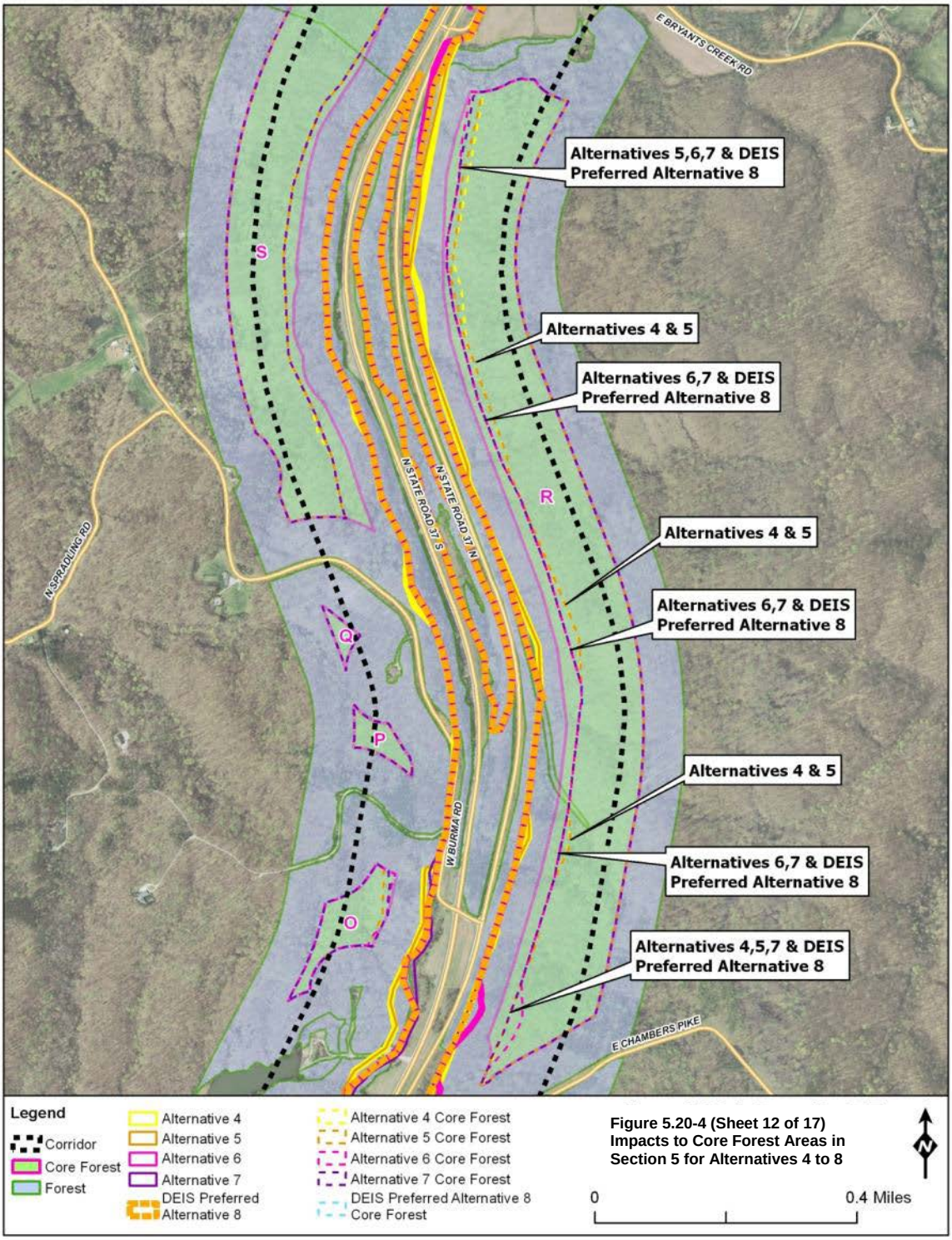

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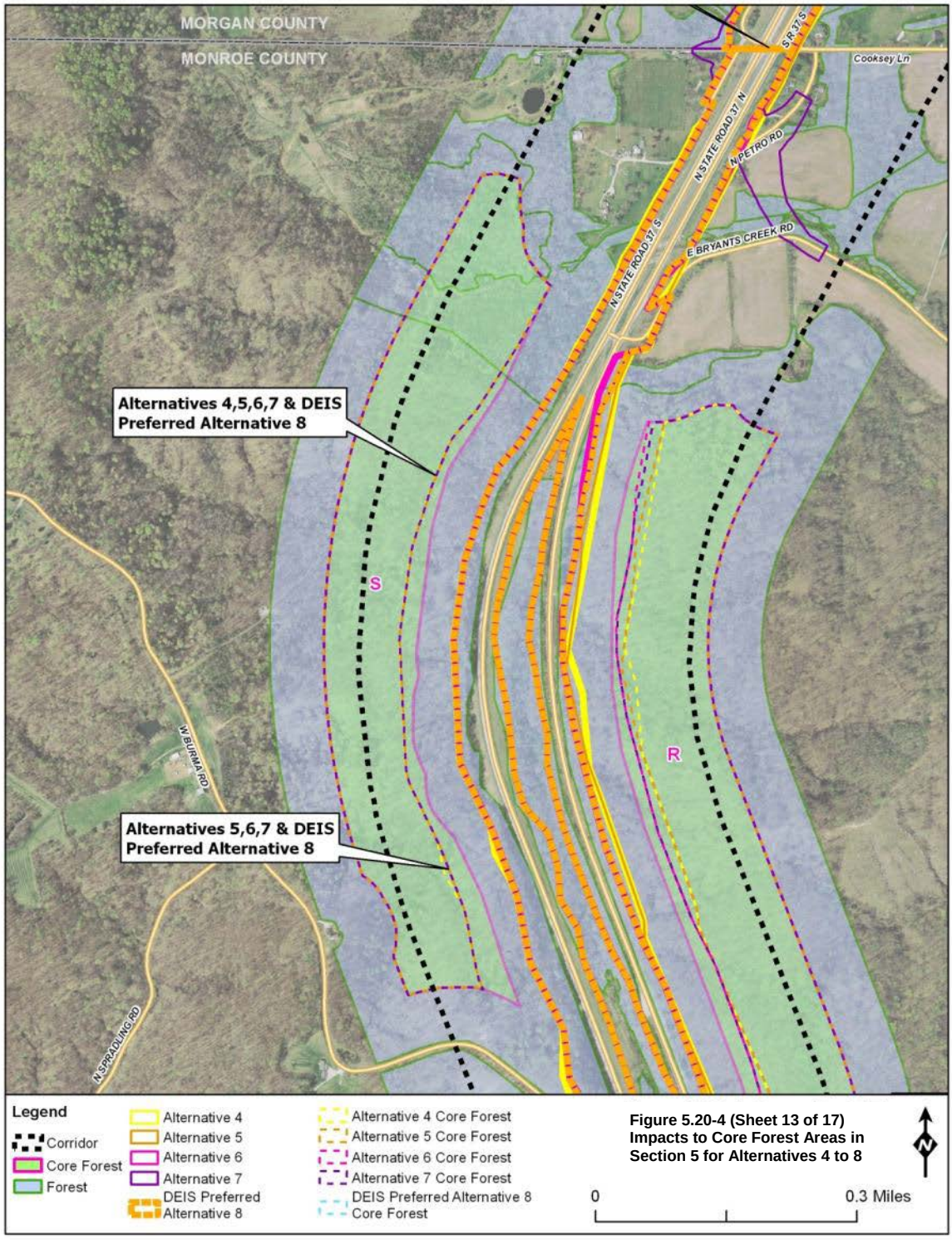

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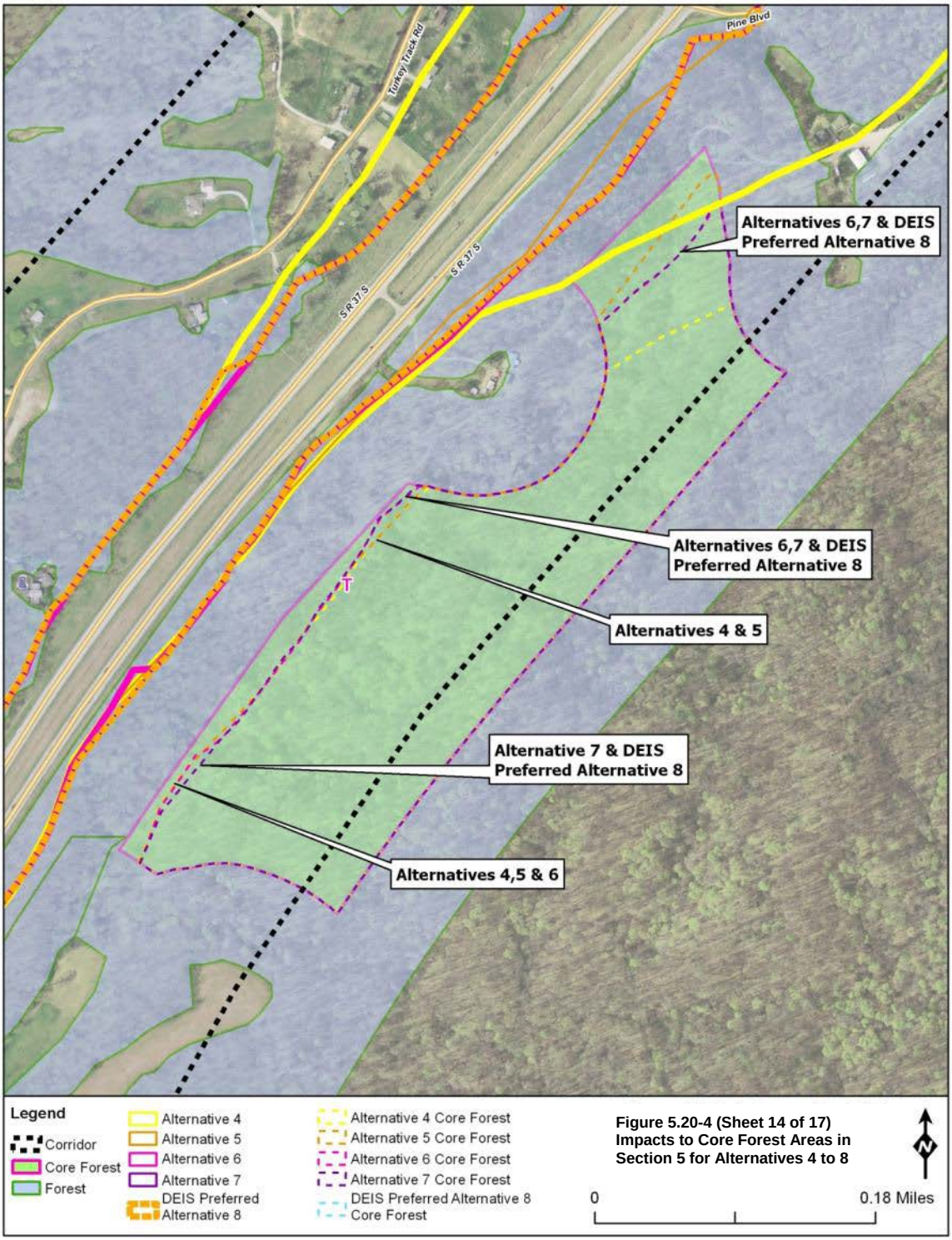

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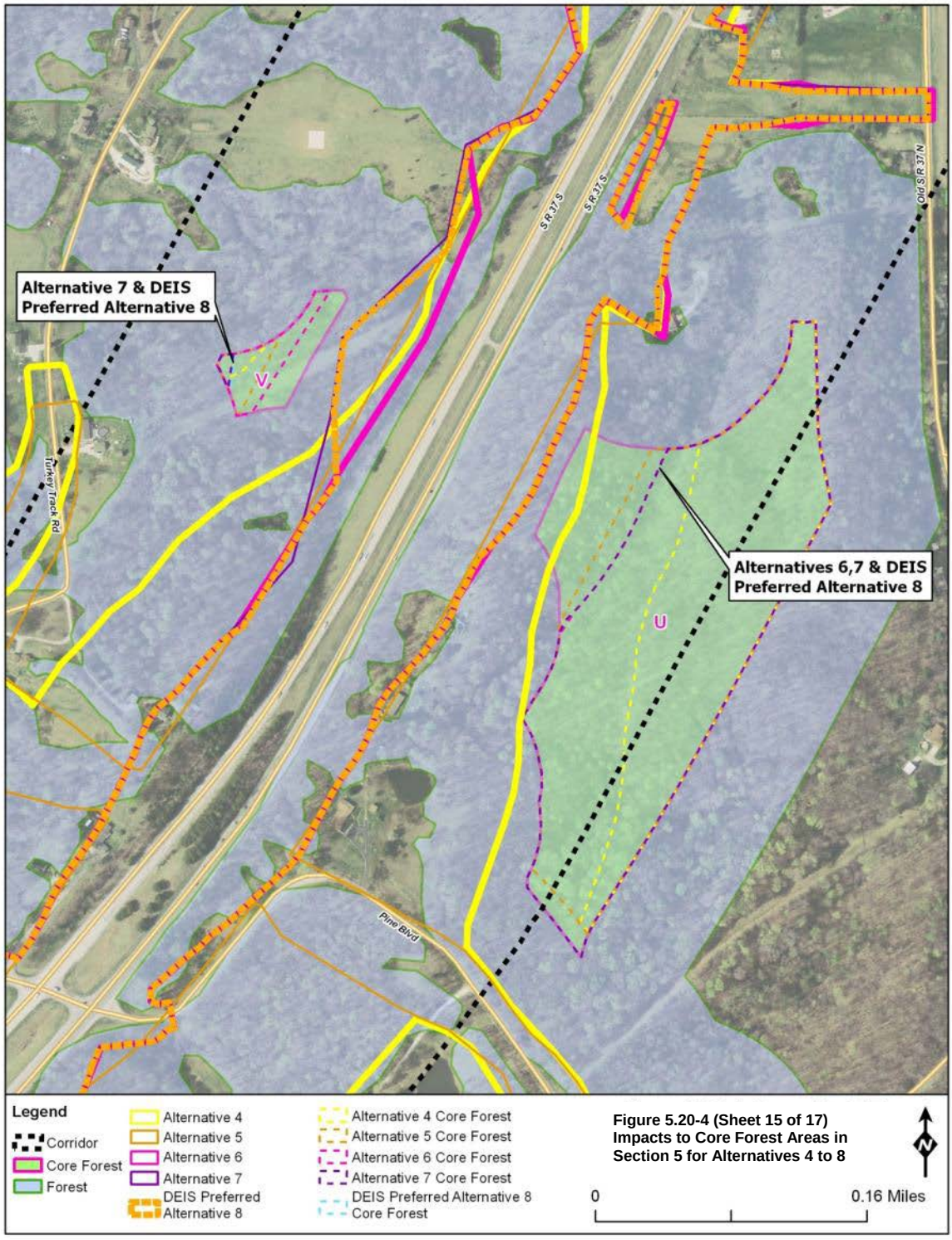

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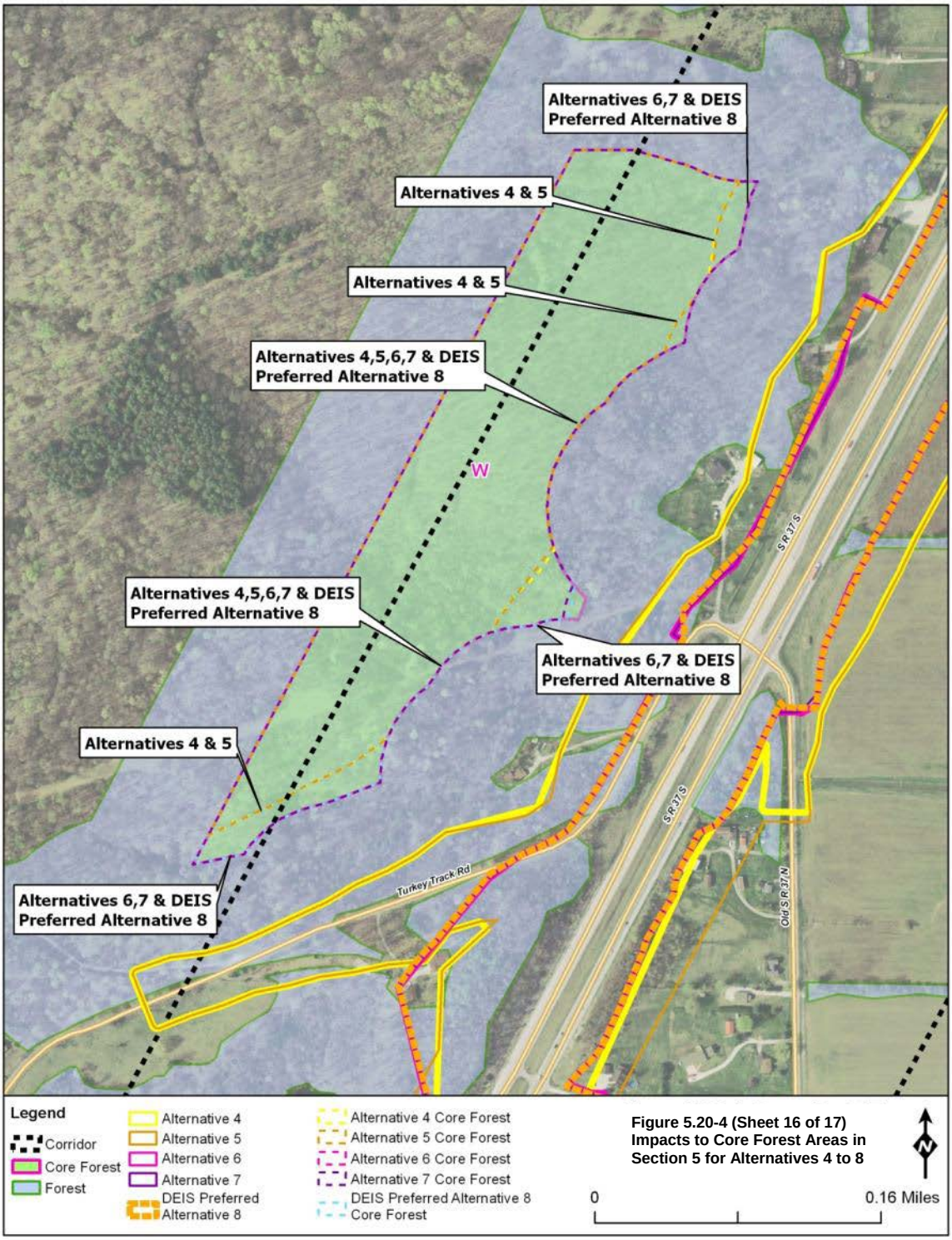

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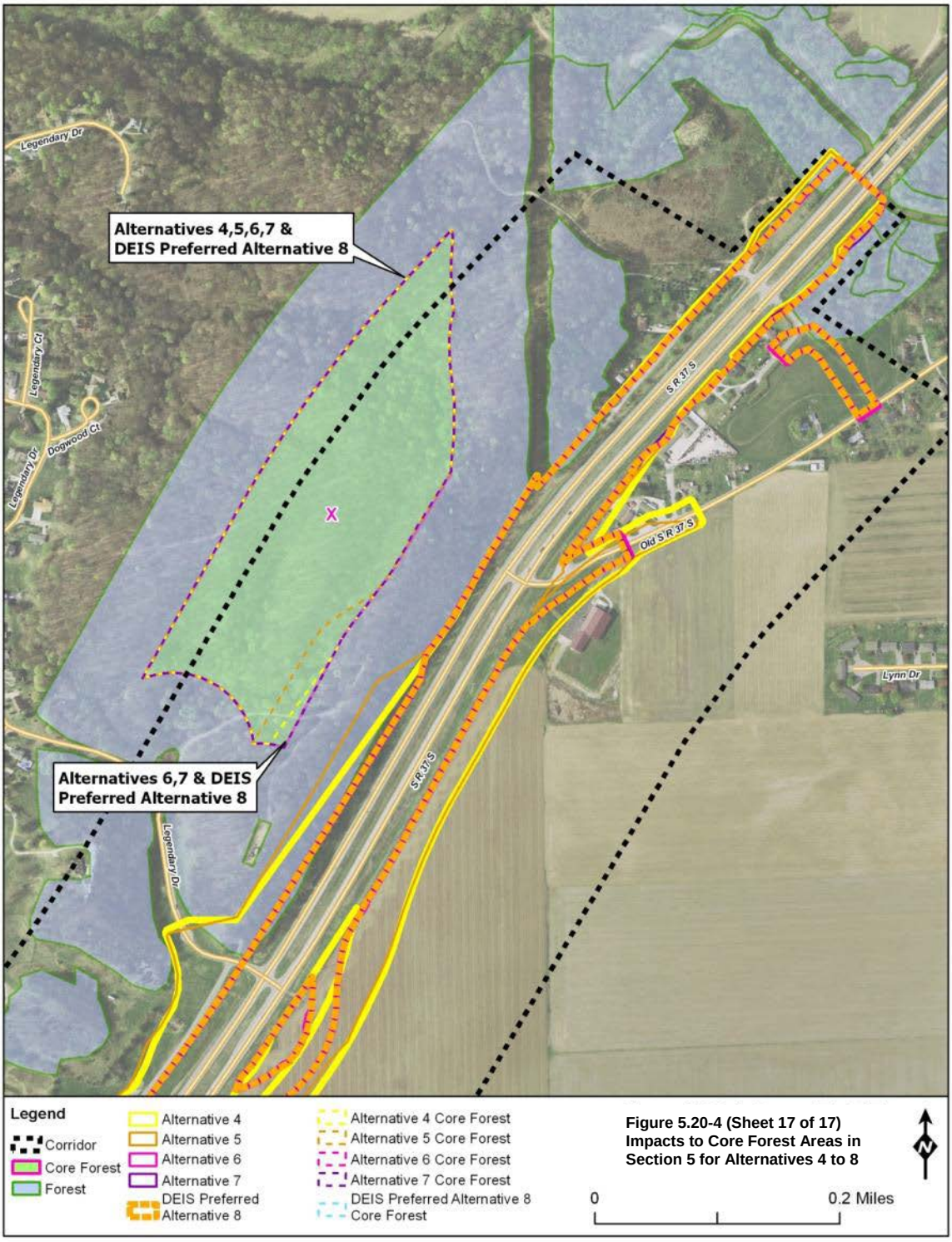

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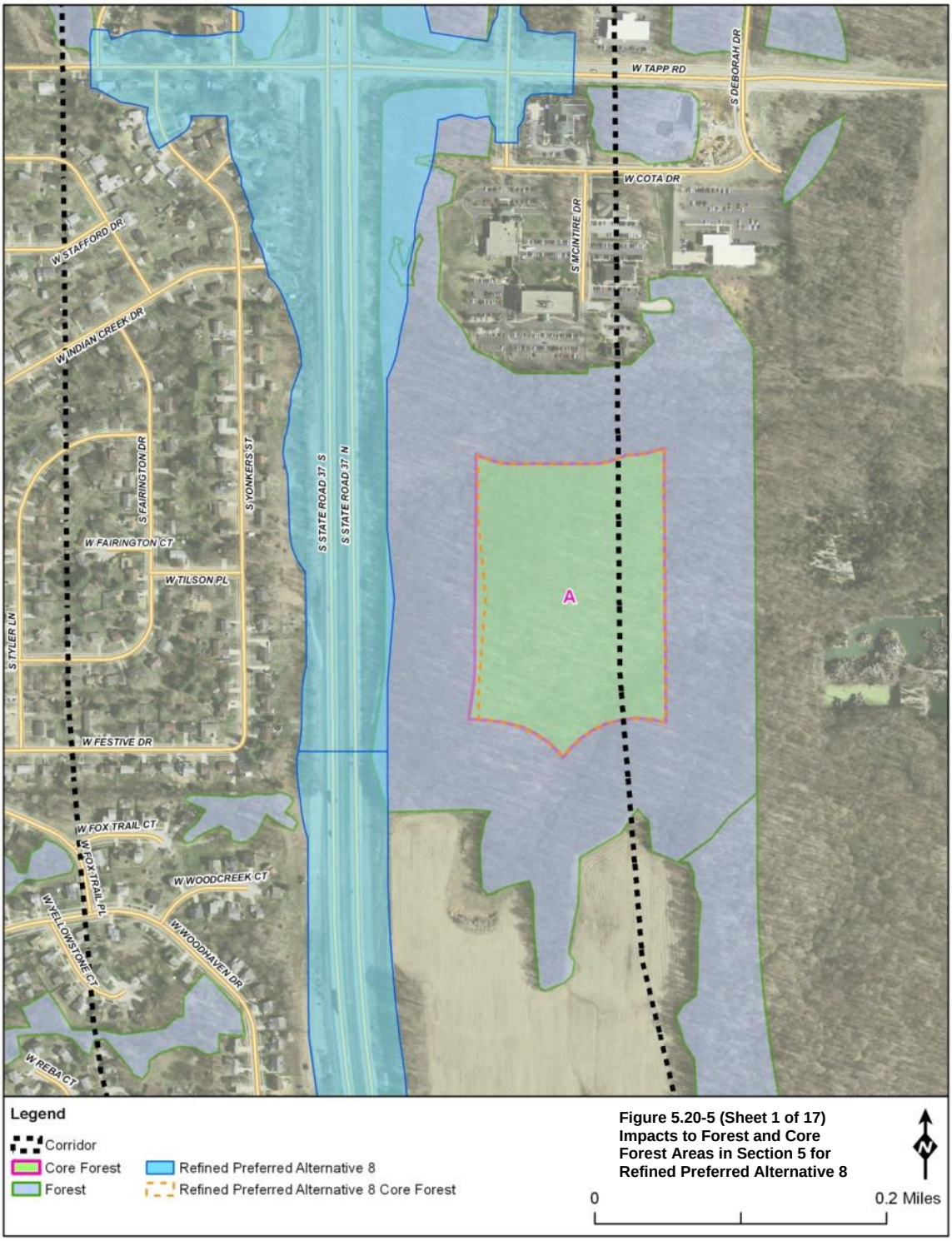
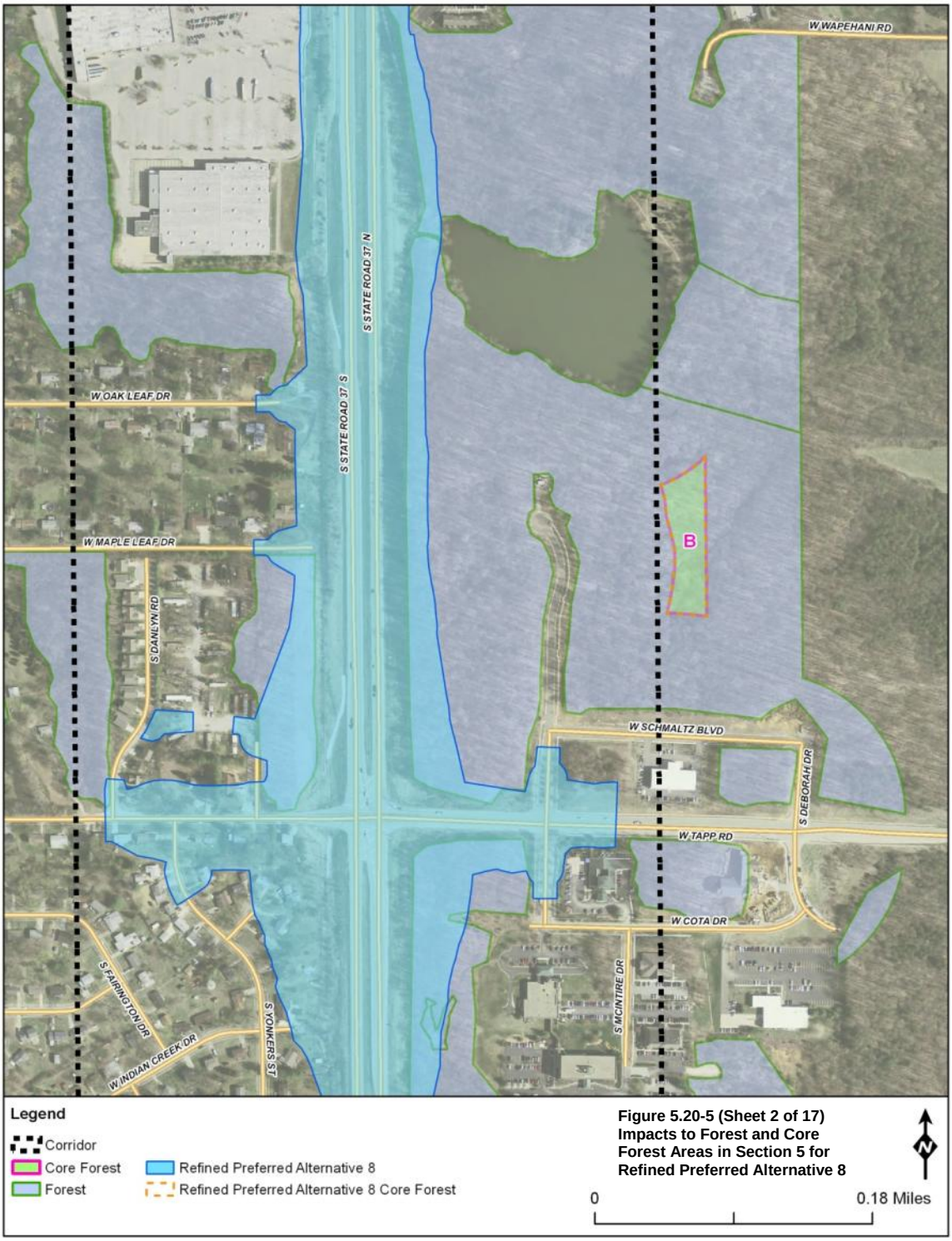


Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 1 of 17)



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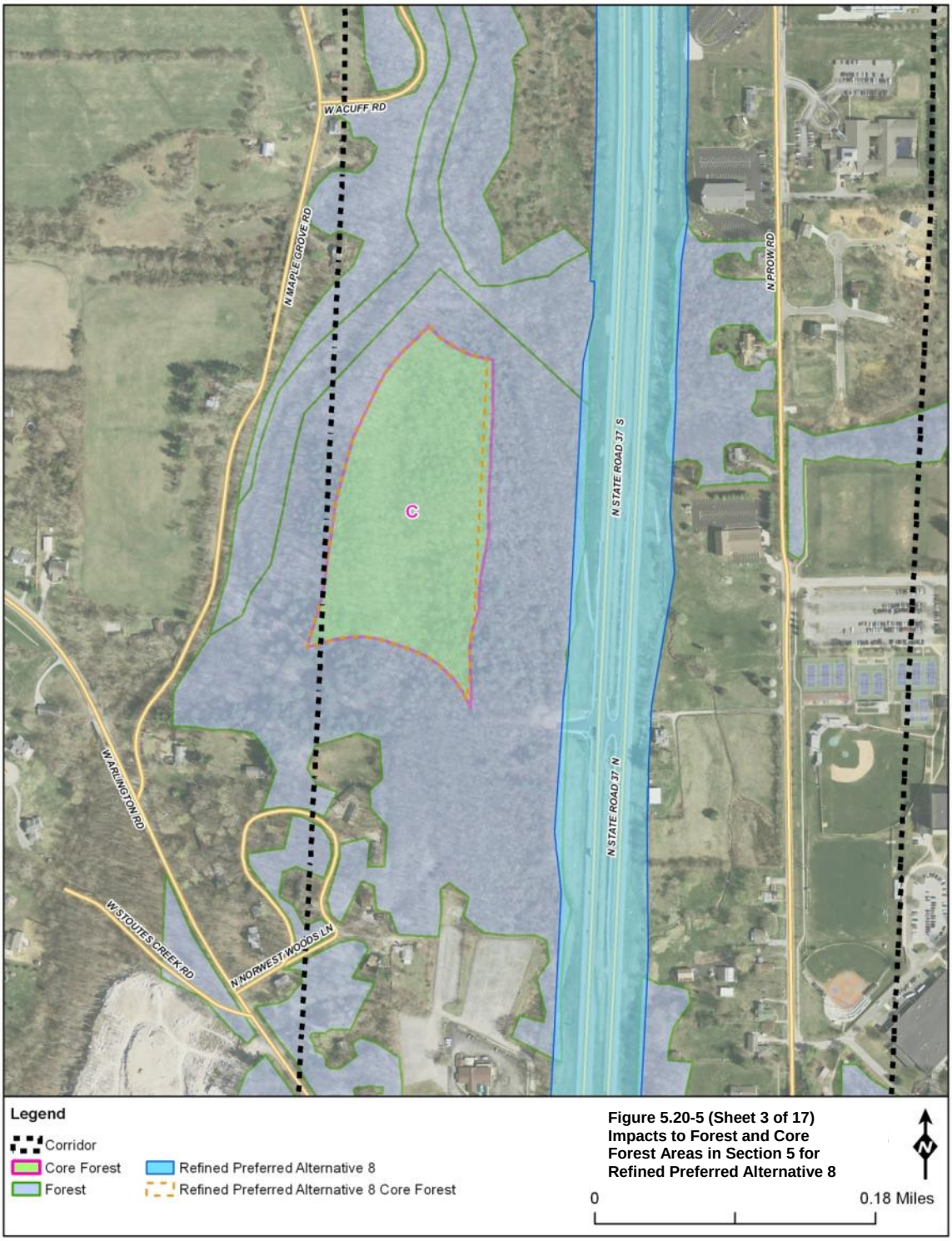

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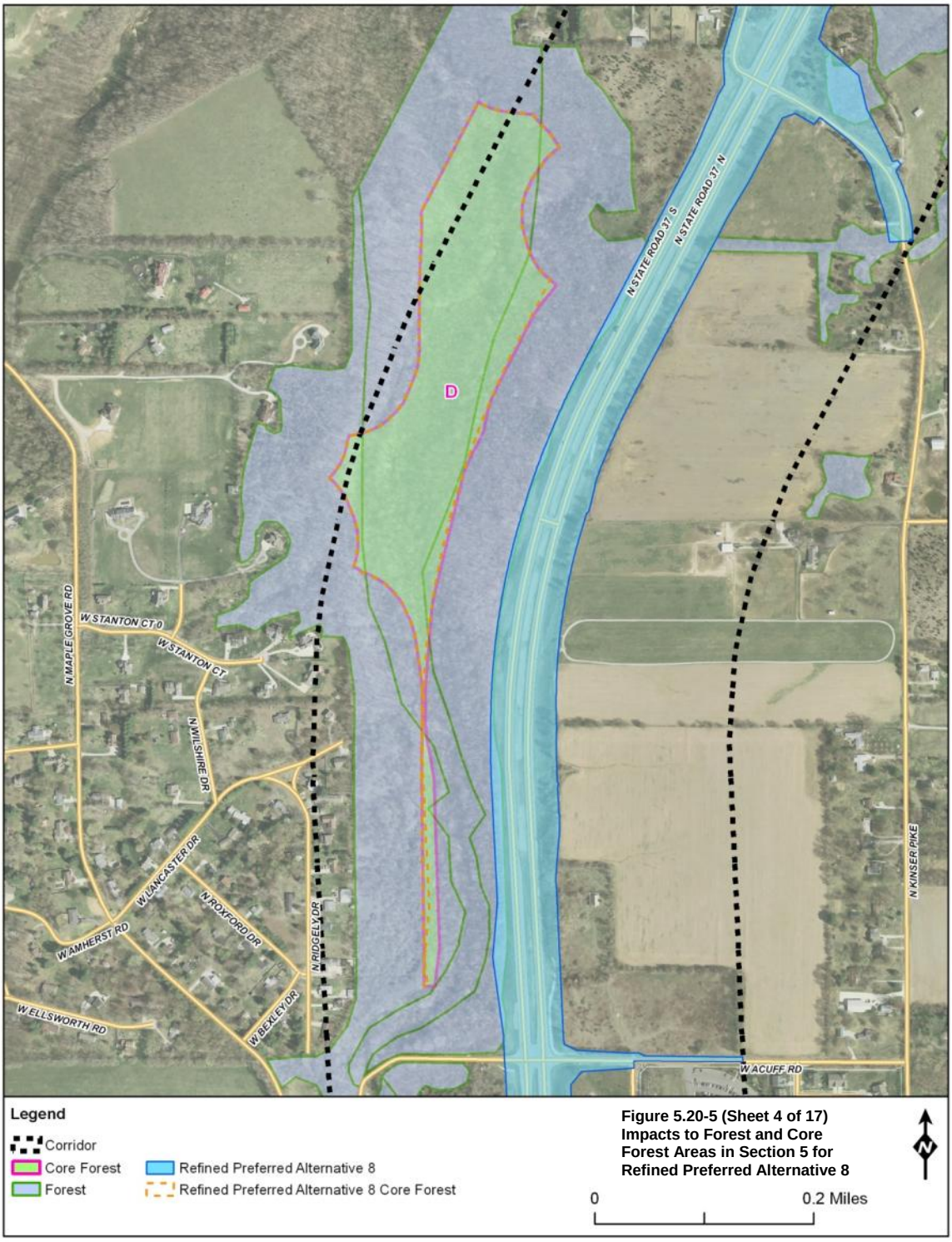

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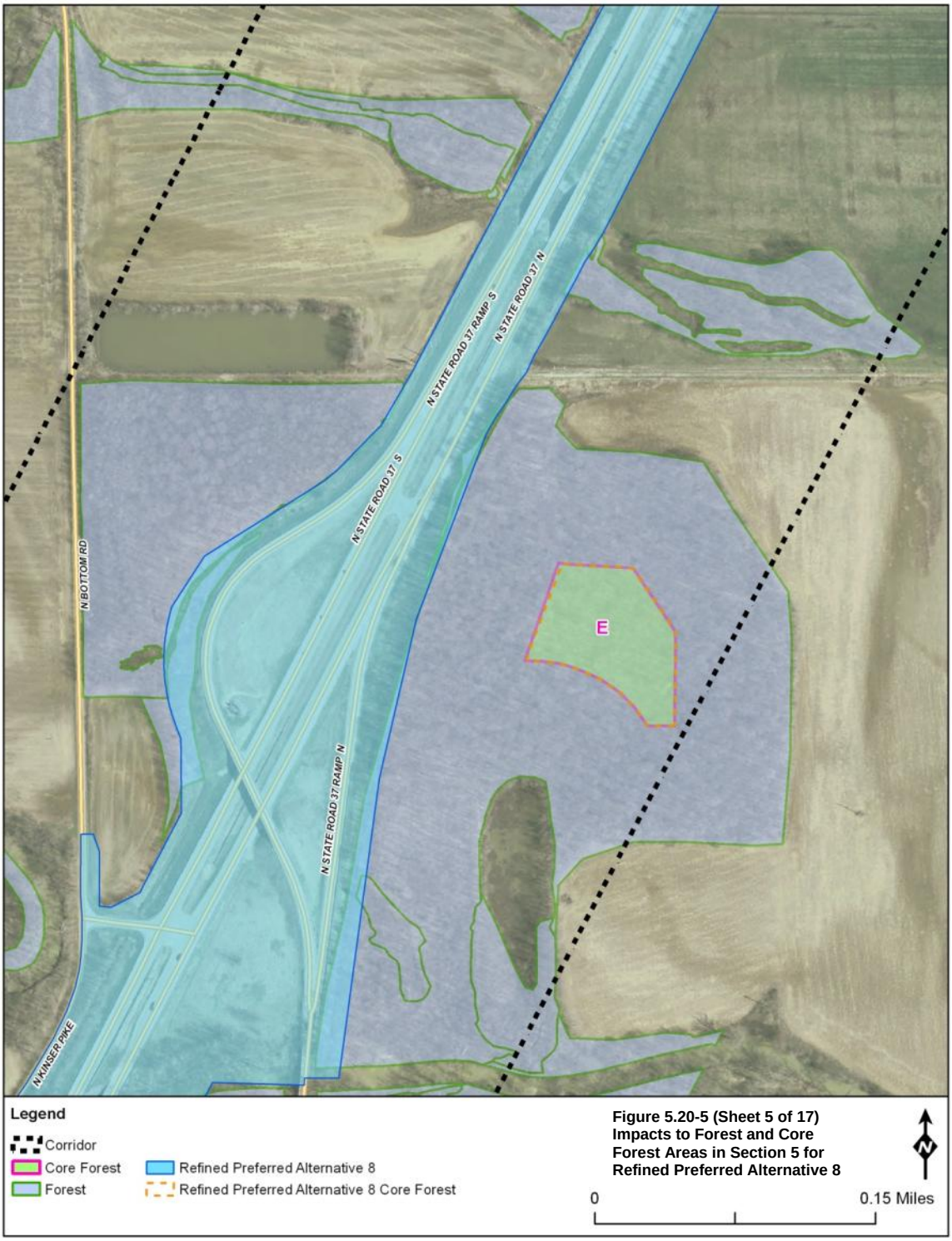

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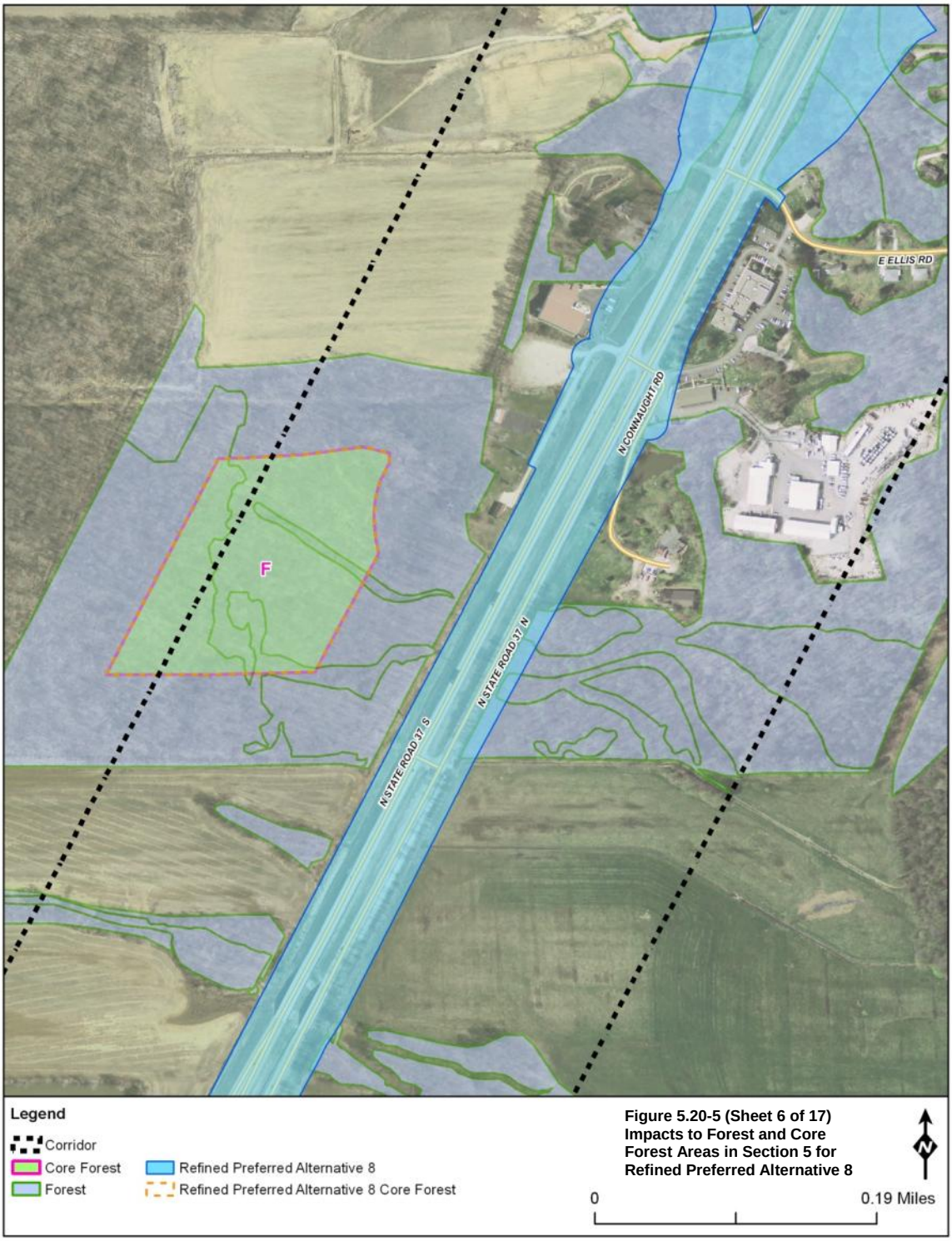

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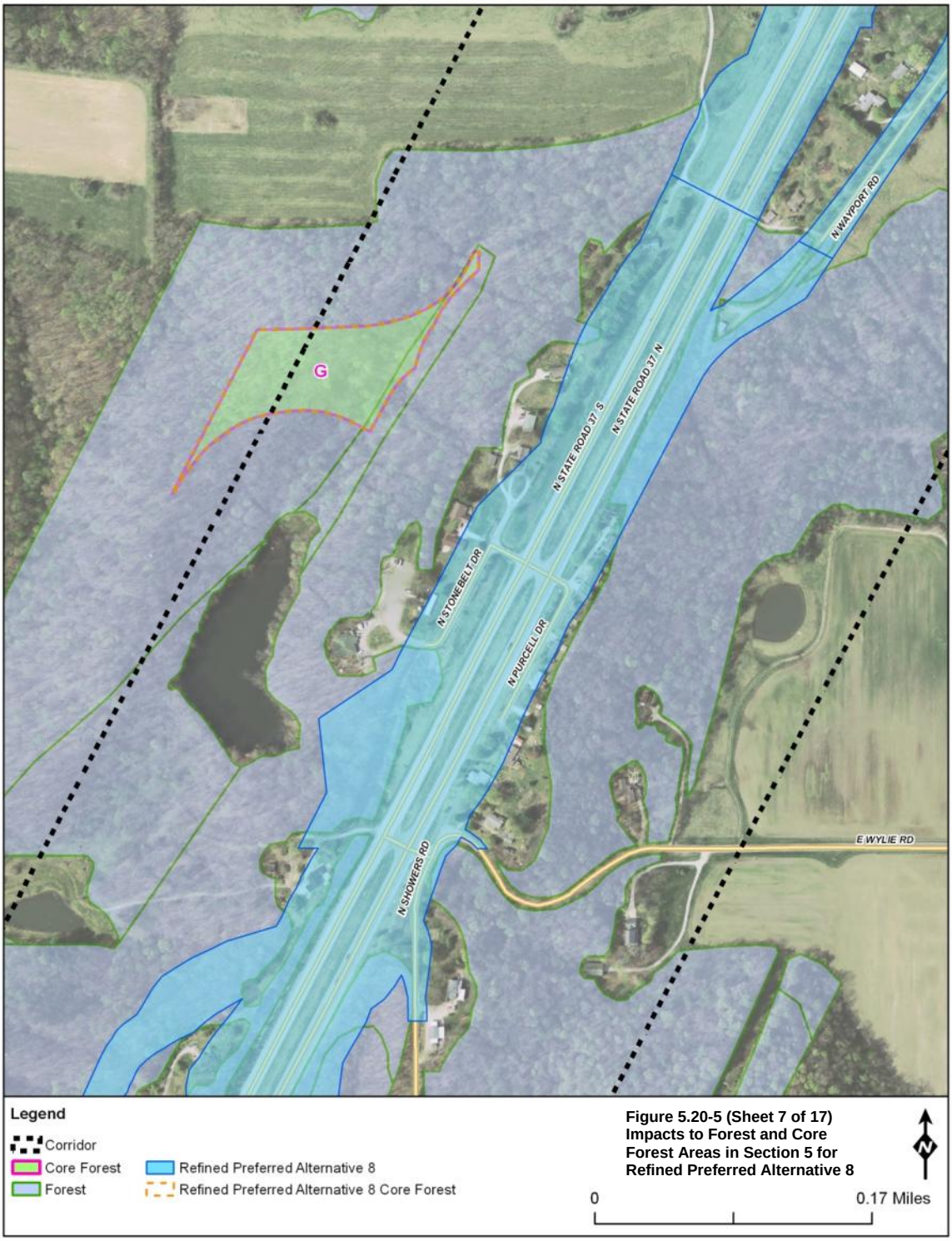

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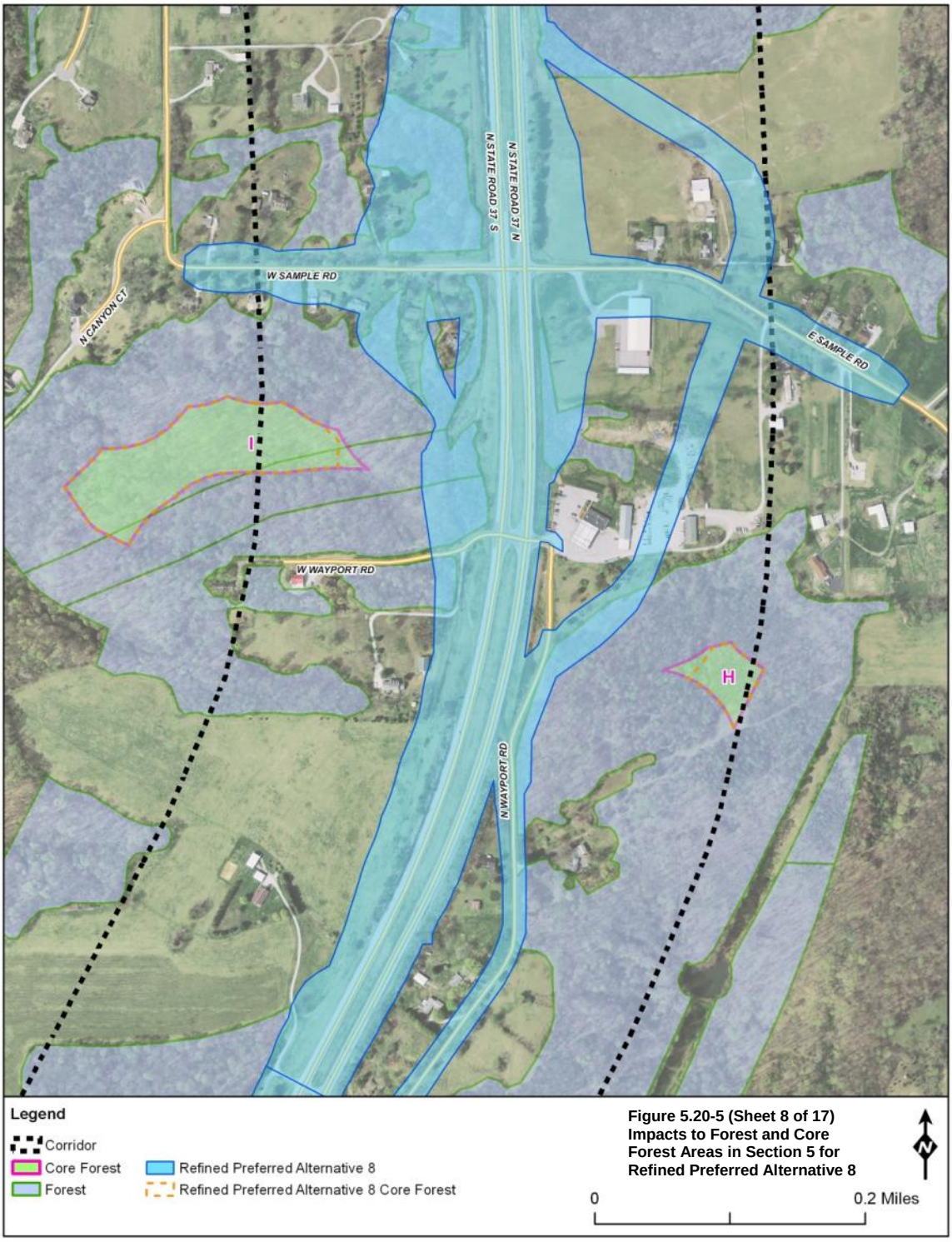

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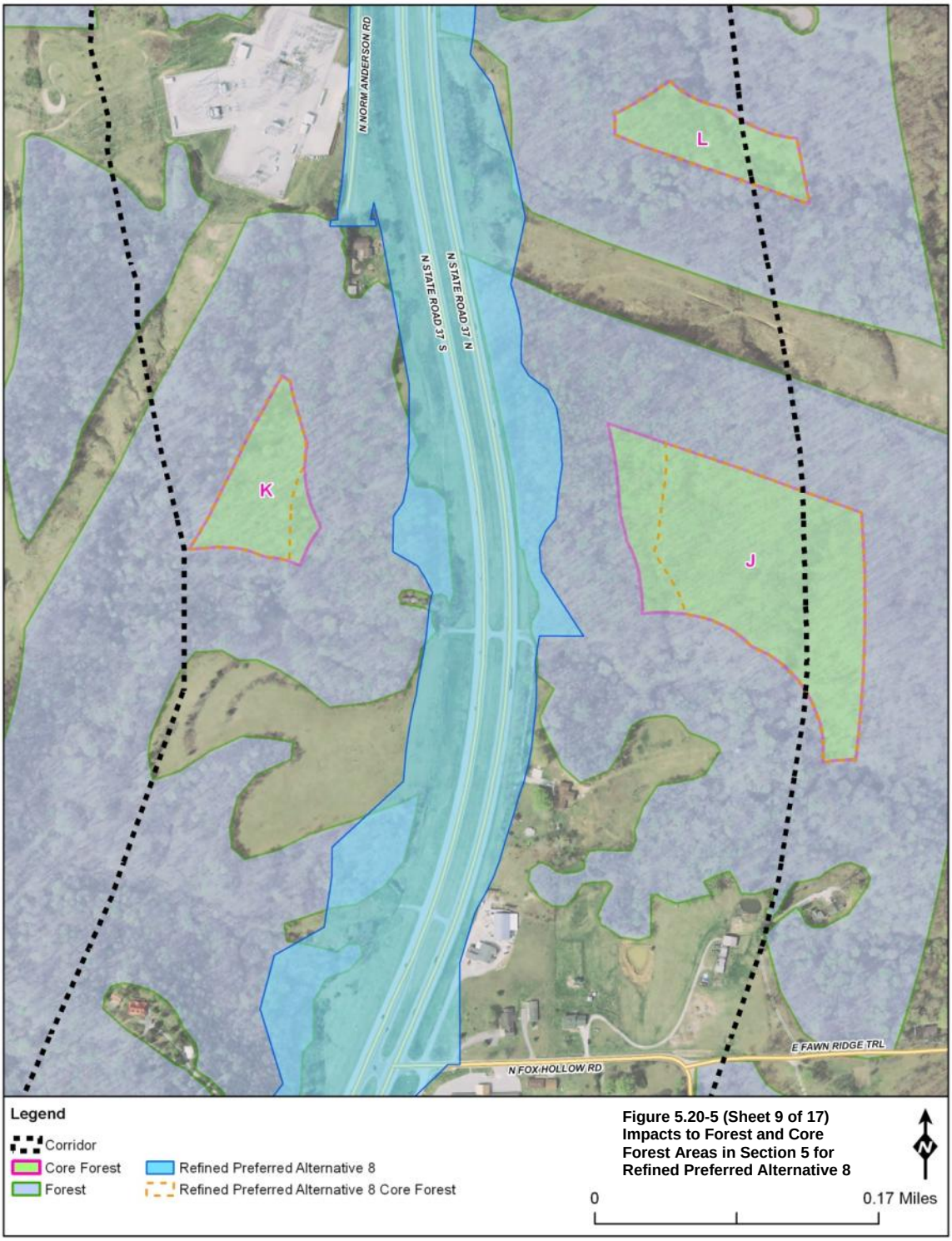

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 9 of 17)

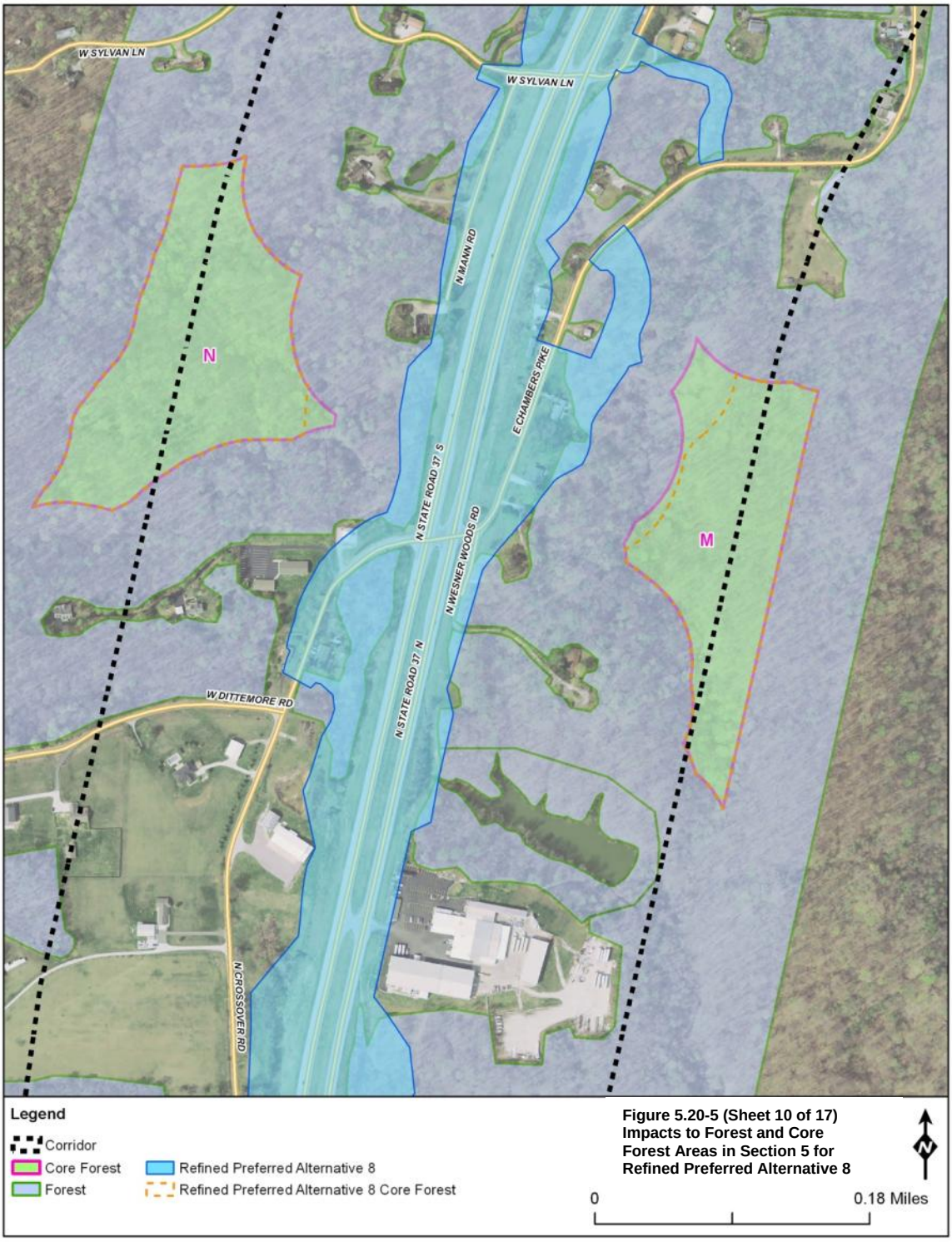

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 10 of 17)

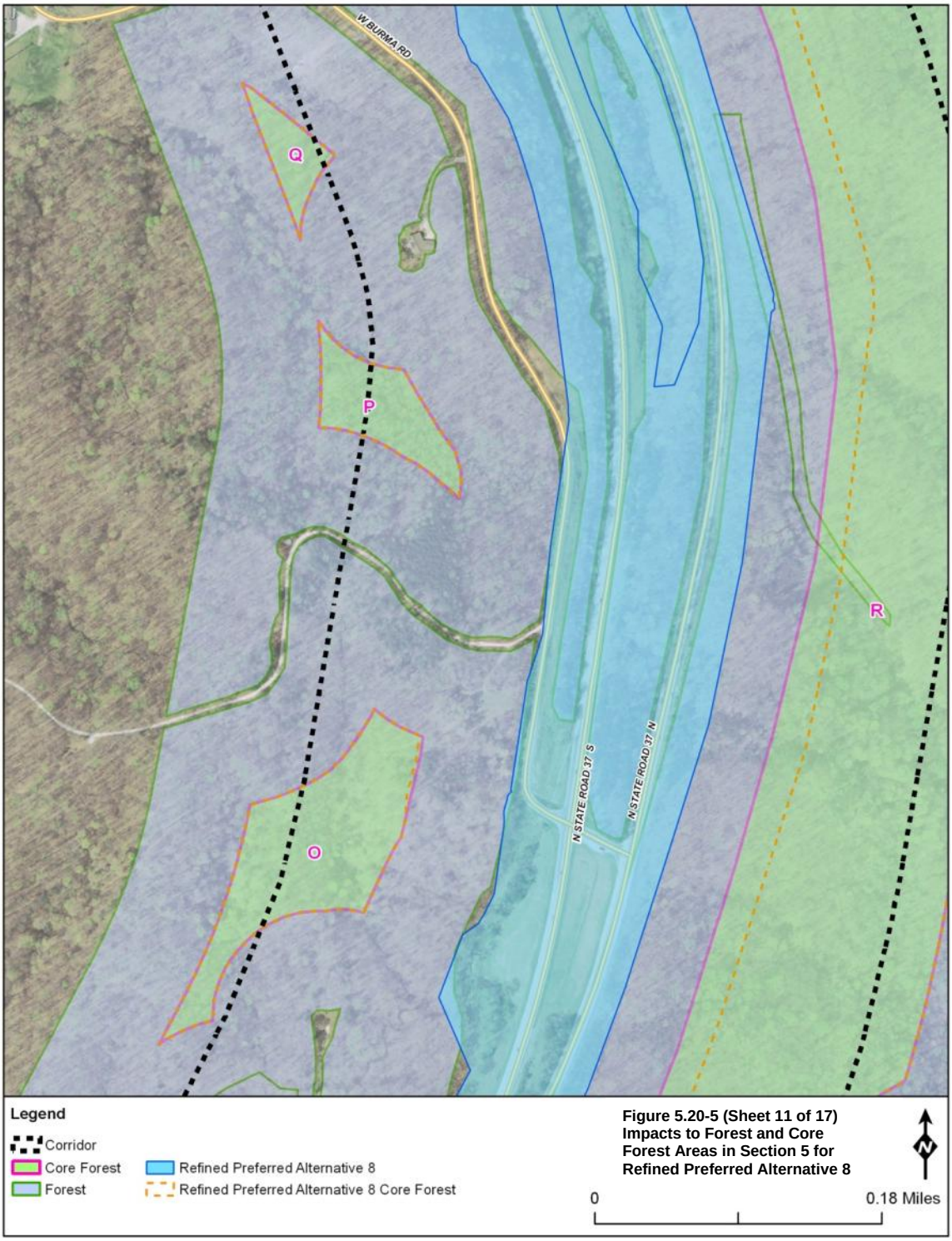

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 11 of 17)

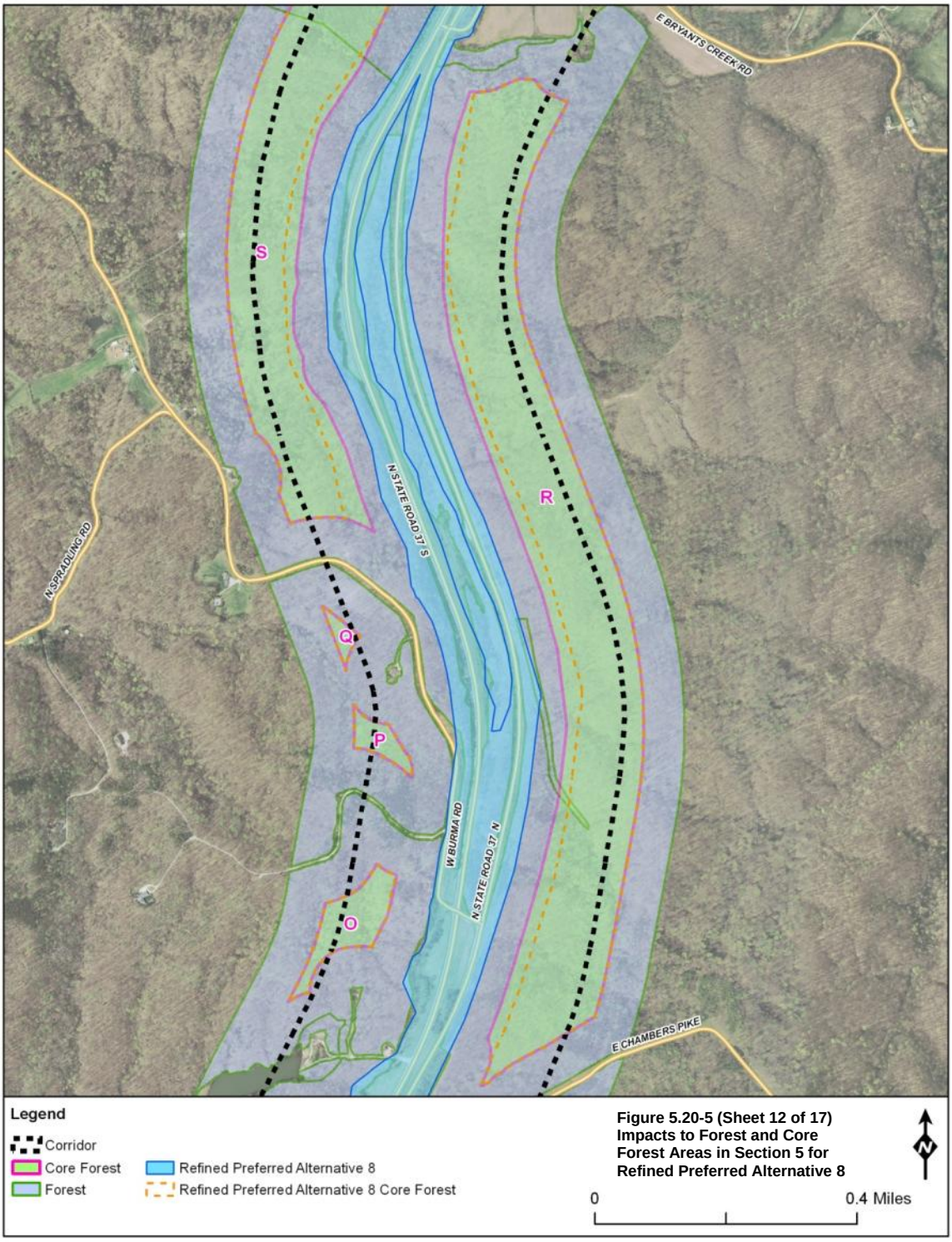

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 12 of 17)

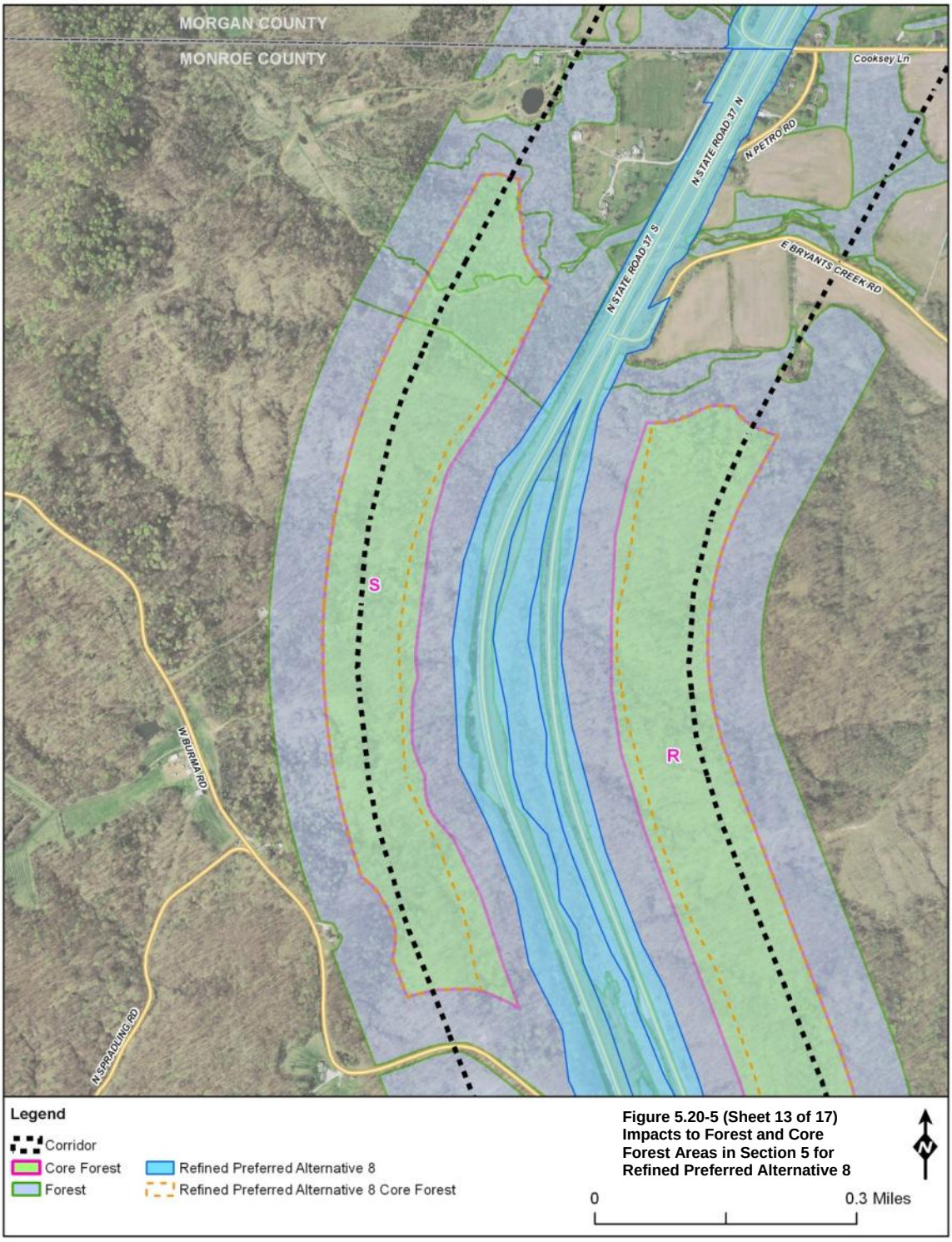

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 13 of 17)

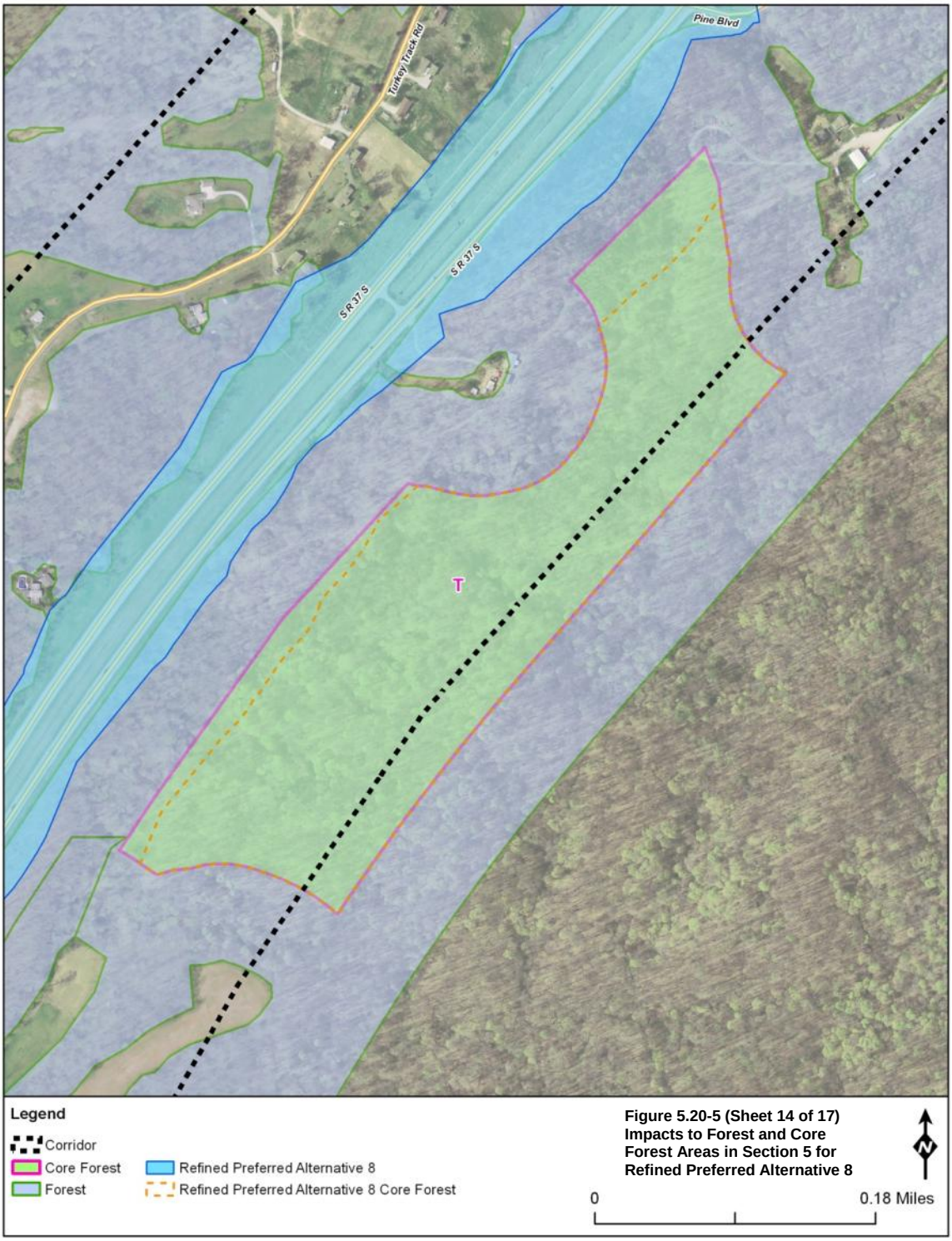

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 14 of 17)

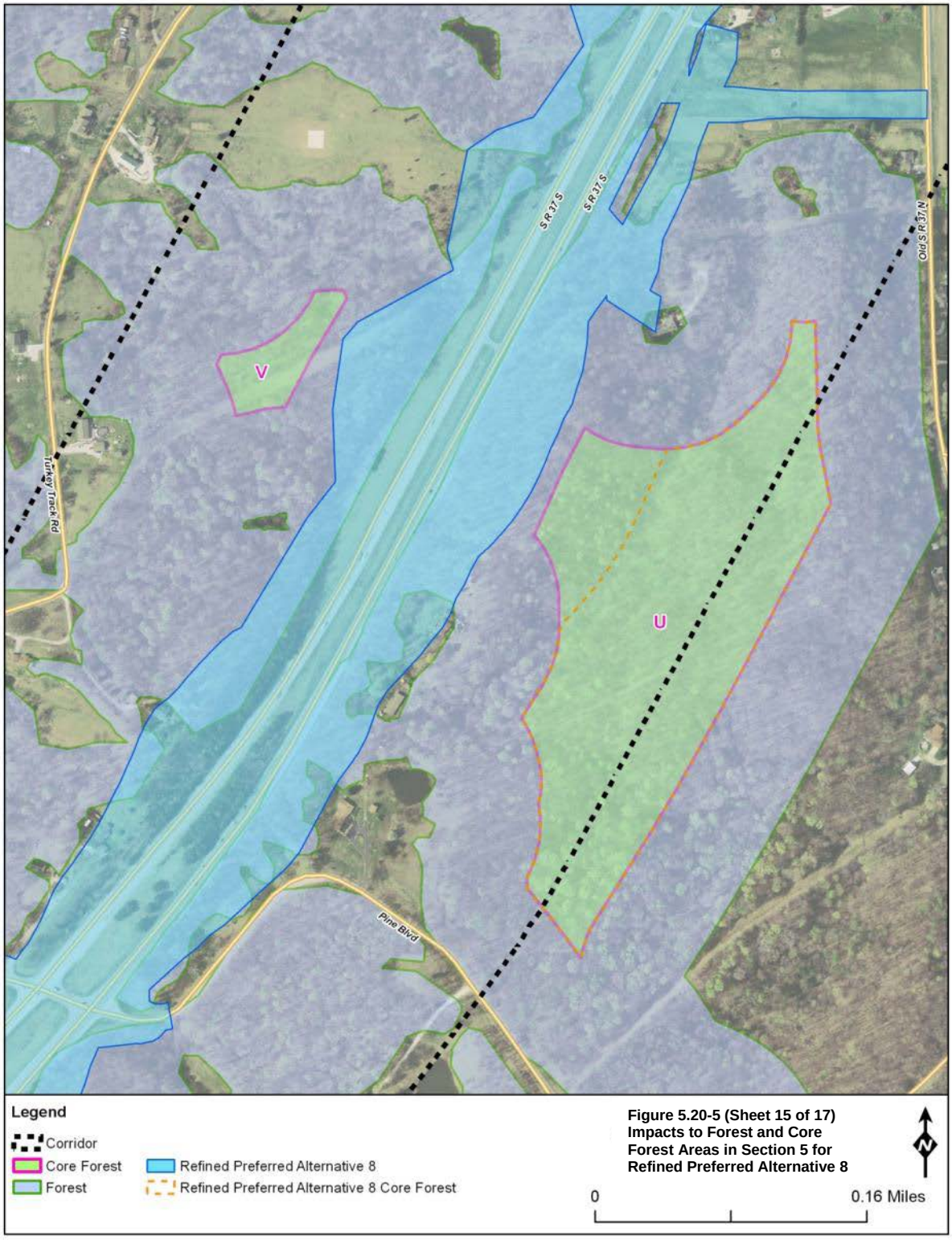

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 15 of 17)

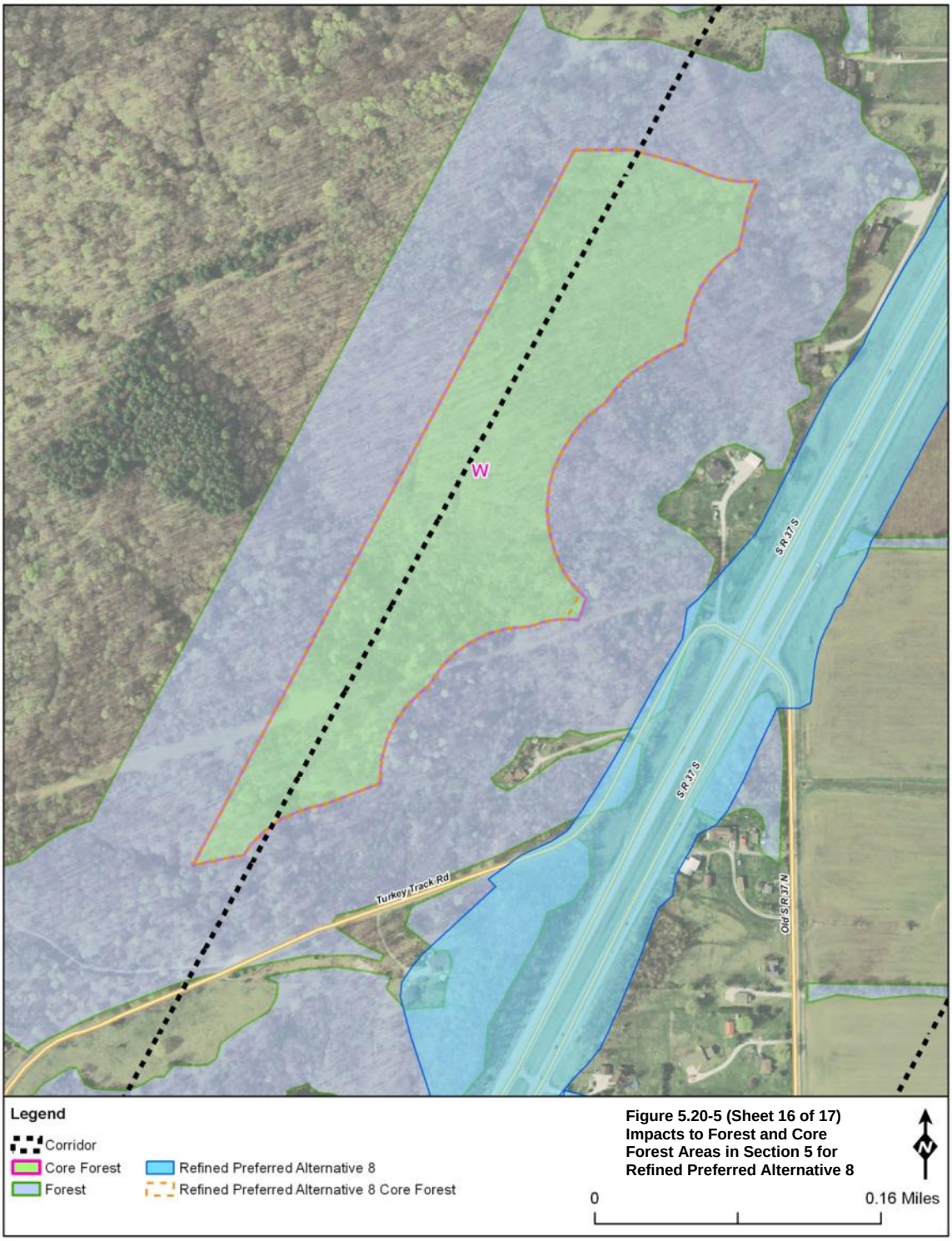

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 16 of 17)

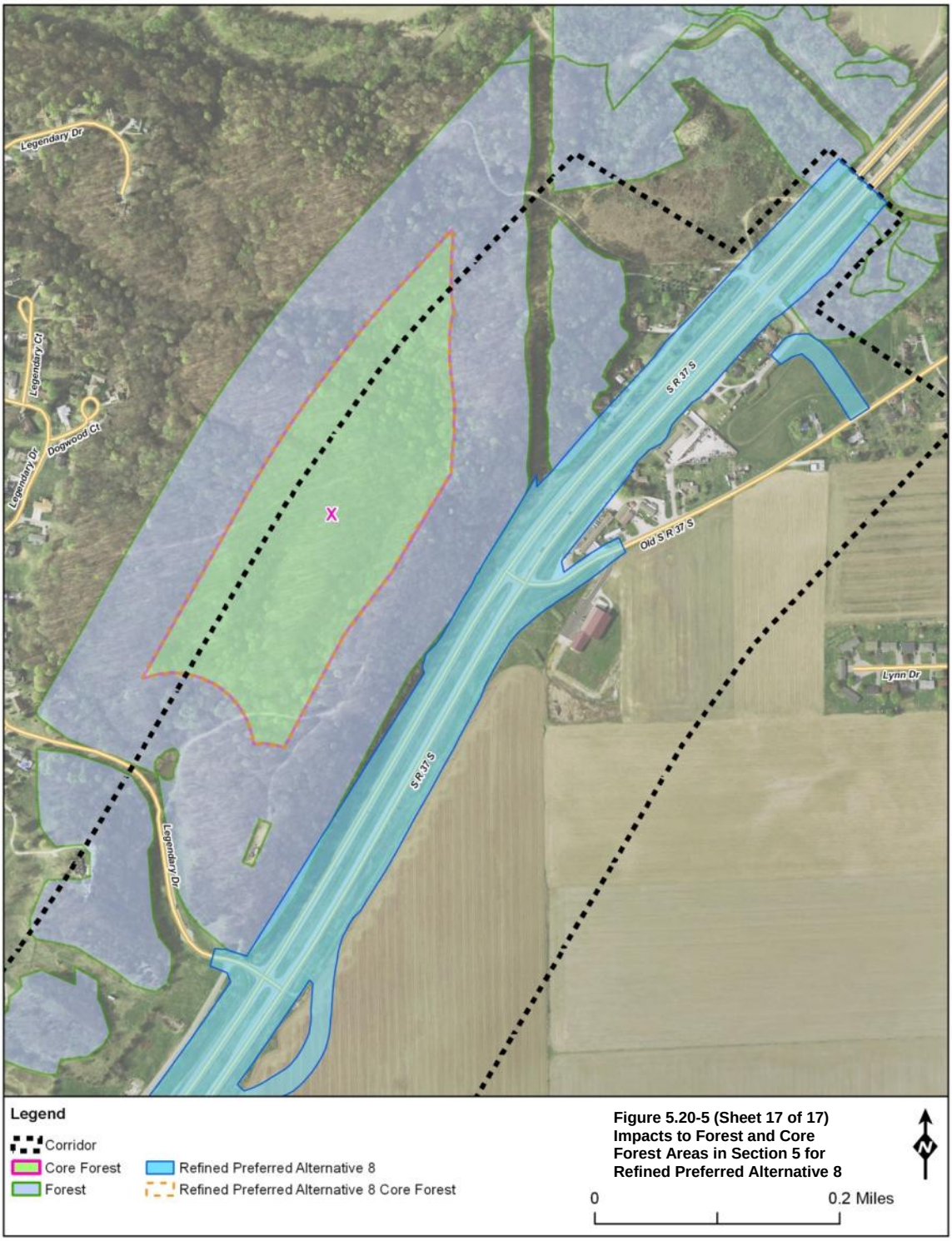

Figure 5.20-5: Impacts to Forest and Core Forest Areas in Section 5 for Refined Preferred Alternative 8 (Sheet 17 of 17)

5.21 Karst Impacts

For purposes of this section, Preferred Alternative 8 that was identified in the Draft Environmental Impact Statement (DEIS) will be referred to as "Alternative 8." The Preferred Alternative for the Final Environmental Impact Statement (FEIS) will be referred to as the "Refined Preferred Alternative 8."

Since the publishing of the DEIS, the following substantive changes have been made to this section:

- The karst features within existing SR 37 relevant karst area (acres) was updated to remove overlapping acreage that was previously analyzed in Section 4 and residential property near Lee Paul Road and clarification regarding the relevant karst was added to the footnotes in **Tables 5.21-1**, **5.21-2** and **5.21-4**.

- Added information regarding potential karst impacts from the Fullerton interchange and the Tapp Road and SR 45/2nd Street interchange to **Section 5.21.3.4**, *Karst Impacts by Alternative.*

- The Refined Preferred Alternative 8 karst impact values were calculated and included in **Table 5.21-2** and **5.21-4** and clarification regarding the relevant karst was added to the table footnotes.

- Clarified Cave B descriptions and provided the Cave B recharge area on **Figure 5.21-8** *Area of Special Concern: Cave A Recharge (with Cave B Recharge).*

- Added information on pollutant loading methodology, limitations, and results to **Section 5.21.3.8**, *Pollutant Loading Analysis.*

- Updated **Section 5.21.4**, *Mitigation,* to include mitigation commitments to prevent drainage from increasing above the existing SR 37 levels for both the Bennett's Dump and Lemon Lane Landfill Superfund sites; blasting specification for karst areas to protect karst and limestone resources; and, that the designer is to abide by Rule 5, Item B1 of the Erosion Control Plan.

5.21.1 Introduction

Karst ecosystems are important, unique, and unusual features of Southern Indiana. The term karst refers to "landscapes characterized by caves, sinkholes, underground streams, and other features formed by the slow dissolving, rather than the mechanical eroding of bedrock" (AGI, 2001). Karst features form as water dissolves and flows through bedrock via subsurface passageways. Acidic water dissolves the mineral calcite, which is found in Indiana limestones and dolomites. These rocks, particularly limestone, are associated with karst terrain.

A generalized cross section of karst terrain in Southern Indiana is presented as **Figure 5.21-1**. Karst features may be apparent (visible) within the landscape or underground and not readily apparent from the surface, as shown in **Figure 5.21-2**.

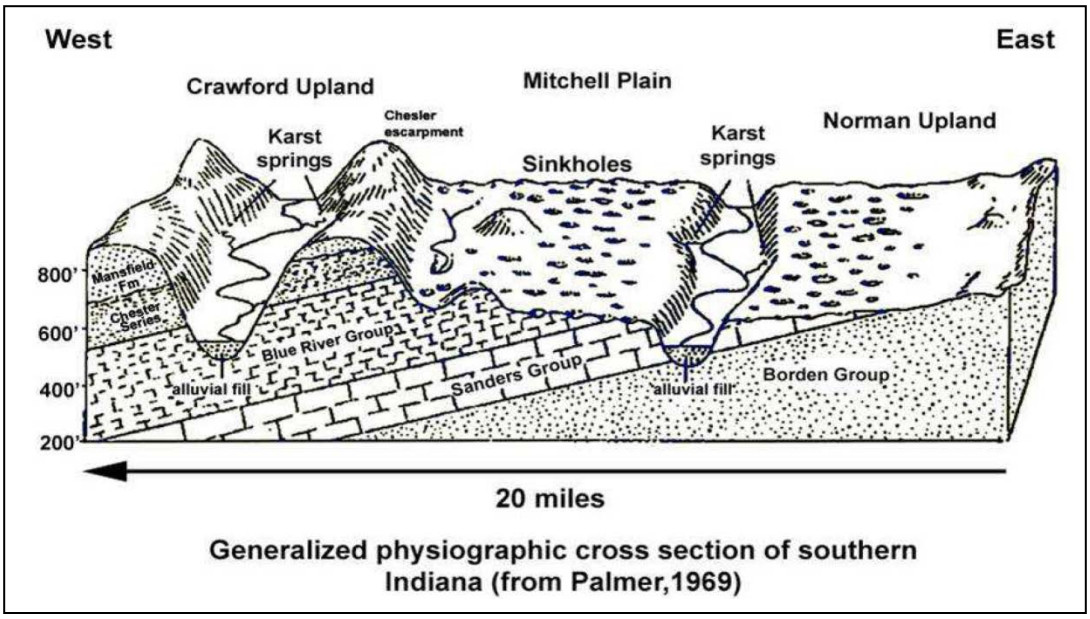

Figure 5.21-1: Generalized Physiographic Cross Section of Southern Indiana (from Palmer, 1969)

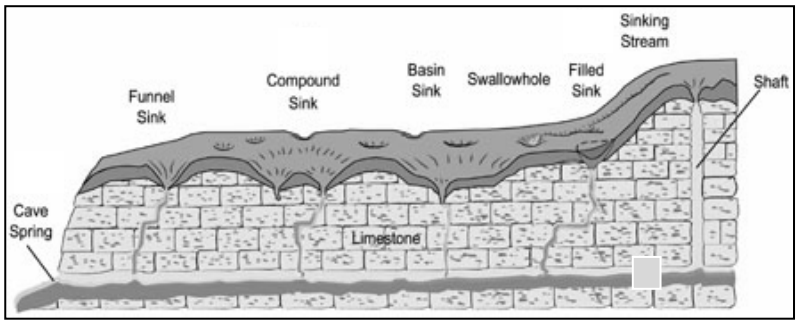

Diagram concept by R.L. Powell; drafted by R.S. Taylor ("Karst in Indiana," http://igs.indiana.edu/Bedrock/Karst.cfm)

Figure 5.21-2: Solution Features Characteristic of Karst Terrains

Water resources in karst areas are especially sensitive to impairment. Karst flowpaths (the distance and direction water travels while in the karst system) are interconnected and can cross groundwater aquifers used as private and public water supplies. While most of the Section 5 study area population utilizes surface water sources for potable water (primarily Lake Monroe Reservoir), private groundwater wells are reported throughout the Section 5 karst study area. Also, a few springs have been used by some individual landowners as a potable water supply

and/or for livestock. Very little water purification occurs naturally in karst areas because the water flows directly through cracks and fissures in rocks, rather than percolating slowly through soil as in other types of terrain. Therefore, surface and groundwater quality is an important concern in karst areas, since karst flowpaths can convey pollutants to these water sources. Karst areas are also important because they provide cave and other subterranean habitat for a number of species. For example, many species of bats, including the federally-endangered Indiana bat (*Myotis sodalis*), use caves which form in karst areas.

Karst features can be classified as recharge features or discharge features. A recharge feature channels surface water to underground karst systems. Sinkholes, swallets, and sinking streams are types of recharge features. Recharge features have an associated surface drainage area (recharge area) from which the surface water is collected and directed to the subsurface. Infiltration rates vary with feature size, filling by sedimentation and other factors. Discharge features are openings in the bedrock and/or soil that allow water to flow from the subsurface onto the land surface. Springs and gaining streams segments are types of discharge features. Caves may be recharge or discharge features depending upon their flowpath dynamics. Definitions of these features are provided in **Section 5.21.3**, *Analysis*.

Groundwater in karst terrain is contaminated easily because surface waters are channeled rapidly into the subsurface at sinkholes and other insurgence features (such as losing streams). These waters then flow underground without the benefit of filtration, long residence time, or exposure to sunlight, which may remove or neutralize some organic contaminants. Eventually the groundwater discharges at springs.

Karst terrain represents a challenge to highway construction and maintenance, as the collapse of filled sinkholes and cave passages can compromise adjacent and overlying structures. Such failures can occur without surface expression prior to collapse. Also, impermeable surfaces, including roads (such as existing SR 37), commercial development (parking lots), and residential subdivisions, can alter the natural patterns of run-off. This can result in concentrating and/or redirecting runoff into sinkholes (open or with no surface expression) leading to potential sinkhole collapse or blockage. Collapse can occur where previously stable material is undercut by new flow, like seen along stream banks. Blockage occurs when material (such as soil) enters a sinkhole faster than it can enter the underlying subsurface system. Additionally, unlined retention structures (such as median ditches) can increase the localized water pressure (head), which could result in collapse of adjacent sinkholes or the retention structure. Karst environments are also susceptible to rapid influx of potential contaminants. This requires the construction and maintenance of roadway runoff control and/or mitigation measures for water quality concerns.

Section 5 of I-69 entails upgrading an existing multi-lane, divided transportation facility to a full freeway design. Most of the right-of-way used for the Section 5 project consists of the SR 37 roadway. Accordingly, the impacts to most natural resources in Section 5 will be lessened (on a per-mile basis) in comparison to Sections 1 through 4, which are being constructed on new terrain. The resource impacts in this chapter include those inside and outside of the existing rights-of-way for SR 37 and other transportation facilities due to the potential for additional

construction work within these areas to impact karst features. However, the total karst features already impacted within the SR 37 right-of-way are shown separately for comparison purposes as these areas have been previously impacted by SR 37 (see **Tables 5.21-2** and **5.21-4**).

5.21.2 Methodology

Section 5 is located within a karst region. To define guidelines for the development of transportation projects in karst areas and to minimize the impact of construction projects, the Indiana Department of Transportation (INDOT), Indiana Department of Environmental Management (IDEM), Indiana Department of Natural Resources (IDNR), and the United States Fish and Wildlife Service (USFWS) entered into the Karst Memorandum of Understanding (Karst MOU) in 1993. It should be noted that for I-69 Tier 2 studies in Sections 4 and 5, the Federal Highway Administration (FHWA) and INDOT invited the United States Environmental Protection Agency (USEPA) to participate in the karst study and assessment. This grew out of USEPA's participation in the I-69 Tier 1 study, in particular its interest in water resource impacts in karst areas.

The Karst MOU documents that the signatory agencies have agreed to the implementation of a 17 step process for development of highway projects in karst terrain. The Karst MOU document is presented in **Appendix Y**, *Final Karst Report (Redacted)*. Portions of this document have been redacted to prevent disclosure of specific locations of karst features. Steps 1 through 4 of the Karst MOU are completed as part of the National Environmental Policy Act (NEPA) study phase of project development.

Steps 1 and 2 are karst survey efforts for the identification and documentation of karst feature locations, determination of subsurface flows and surface water drainage patterns, and calculations of estimated annual pollutant loads from the highway and drainage within the right-of-way, including prior to, during, and after construction. These steps culminated in the preparation of the Draft Karst Report.

Step 3 includes the review of the karst survey findings by the MOU signatory agencies. The Draft Karst Report was provided to the Karst MOU signatory agencies and the USEPA for review and comment on September 22, 2006, and comments received were incorporated into the updated Section 5 Draft Karst Report prior to publication of the DEIS. Agencies were provided the opportunity to review and comment on the Section 5 Draft Karst Report as part of the DEIS (October 2012). These comments were evaluated and, where applicable, have been included in the *Final Karst Report* in **Appendix Y**.

Step 4 includes the formulation of appropriate measures to offset unavoidable impacts to the identified karst features. The Karst MOU recognizes that methods proposed during the NEPA phase may be generic as they may relate to an overall project, or specific if they relate to a particular karst feature, and that some approaches may require additional investigations later in project development to determine if they are feasible or an appropriate mitigation measure for a particular feature. A list of Best Management Practices (BMPs) that will be considered for implementation in Section 5 is provided in **Section 5.21.4**, *Mitigation*.

The remaining steps of the Karst MOU are post-NEPA efforts and are summarized as follows:

- Step 5 specifies that drainage entering the project area will be treated in the same manner as highway generated runoff;

- Step 6 states the Karst MOU signatory agencies will be invited to field checks and other meetings where karst issues are discussed;

- Step 7 states that hazardous materials traps will be implemented to protect karst features against hazardous materials spills;

- Step 8 states that a monitoring and maintenance plan pertaining to affected karst features will be developed for review by signatory agencies;

- Step 9 requires development of low salt and no spray, and related signage strategies;

- Step 10 requires that signatory agencies agree in writing, prior to acceptance of final design plans, to appropriate and practicable karst mitigation measures to be implemented. This agreement will be signed by the Department Director of IDNR, the Commissioner of IDEM, the Commissioner of INDOT, and the Supervisor of the USFWS Bloomington Indiana Field Office. This mitigation agreement document will become part of the contract documents;

- Step 11 states that INDOT will assure that the terms of the above-referenced agreement will be adhered to and references that special provisions may be included as part of the contract documents. Step 11 also requires that strategies developed for dealing with karst features are discussed with construction and project administration personnel, that Rule 5 is adhered to, that an erosion control plan is available at the project administrator's office, and that an emergency response plan is made part of the project documents;

- Step 12 states that the location and nature of sinkholes and a drainage schematic will be provided to IDEM so they can provide it to local authorities and hazardous materials teams, and an emergency response plan (prepared by the contractor) will be followed;

- Step 13 states that the signatory agencies may monitor construction and maintenance;

- Step 14 allows for alteration of the above-referenced mitigation agreement document during construction, a two working day response time is needed from the resource agencies;

- Step 15 requires visual inspection of treatment/mitigation measures on a weekly basis or after every rain event and that corrective actions are taken; such inspections shall be conducted by INDOT or their representative;

- Step 16 states that if state/federal endangered/threatened species are found, construction in the area will be halted and IDNR and USFWS will be notified to determine the appropriate action to be taken; and,

- Step 17 states that the Karst MOU will be reviewed annually by the signatory agencies, or more frequently by request.

As stated above, the first step in Karst MOU implementation for transportation projects located in karst regions is the identification of karst features within the project area. A survey of karst features was conducted by Ozark Underground Laboratory of Protem, Missouri, and Philip Moss, PG, of Waterloo, Illinois, with additional data provided by Michael Baker, Jr. Inc. (Baker) of Indianapolis, Indiana, and Lewis & Associates, LLC of Borden, Indiana (see **Appendix Y**, *Final Karst Report [Redacted]*).

The Tier 2 study methodology was developed in coordination with the Karst MOU signatory agencies and the USEPA to ensure the project is consistent with the objectives of the Karst MOU. The karst survey methodology and updates on survey results were discussed with resource agencies during the following meetings (see **Appendix C**, *Agency Coordination Correspondence*, for meeting minutes). Meetings are further described in **Section 11.4**, *Agency Review and Coordination*:

- I-69 Tier 2 Interagency Water Resources Coordination Team Meeting – December 14, 2004

- I-69 Overall Agency Coordination Team Meeting: Karst Breakout Session – February 23, 2005

- I-69 Overall Agency Coordination Team Meeting – August 1, 2006

- I-69 Overall Agency Coordination Team Meeting – March 1, 2007

- I-69 USEPA Karst Review – June 26-27, 2007

The field survey identified karst features that could be visually observed from the surface of the ground. Unidentified underground karst features would be expected to be present within the project area. Following standard karst investigation practices, dye tracing was conducted in order to determine groundwater flow patterns in the area. However, identification of the exact location of the subsurface features associated with this flow cannot be accomplished without invasive ground disturbance (e.g., excavation) and potentially impacting the feature or disturbing the habitat under investigation. Accordingly, it is expected that unidentified subsurface karst features and underground flow paths would be present in the study area. The Karst MOU was developed with the understanding that it is possible that previously unknown subsurface karst features may be unearthed during construction (i.e. steps to address features discovered later in the process). The Karst MOU includes a procedure to address this potential; Step 14 states that if during construction it is found that the mitigation agreement must be altered, the MOU signatory

agencies will be contacted and an agreement reached prior to work continuing in the specific area of the project requiring alteration of the agreement.

The karst survey included the following:

- Reviews of karst information relevant to the Section 5 corridor;
- Field checks of previously recorded karst features;
- Field investigations to identify previously unrecorded karst features;
- Dye tracing of karst features; and,
- Recommendations for karst feature avoidance, impact minimization, and mitigation of unavoidable impacts.

Existing information on karst features was compiled from a number of sources. These sources included: the Indiana Geological Survey, Indiana Cave Survey, Indiana Karst Conservancy, National Speleological Society, and karst experts knowledgeable about the area. Specific karst studies, information, and mapping for the Section 5 corridor that were examined and field checked for this study included I-69 Tier 1 and Tier 2 public comments, cave maps and other karst feature data and mapping, as well as all previous I-69 related karst study data. Additional resources included Geographic Information System (GIS) data from INDOT, Monroe County, and the City of Bloomington; high resolution aerial photography; planimetric and topographic mapping in the corridor; and, USGS topographic maps and additional aerial photography.

During the study, field reconnaissance was conducted by the karst consultants within and outside of the corridor to locate and map previously unrecorded karst features. Field checks were also conducted to verify and map previously recorded karst features along the length of the Section 5 corridor. In addition, other field crews (those conducting wetland and stream assessments, archaeological reconnaissance, biological surveys, etc.) communicated the locations of observed karst features to field crews conducting karst feature identification for verification and mapping. Features were mapped outside the corridor to identify karst features which may receive surface runoff water from within the corridor, as well as to identify features to be evaluated as part of the dye tracing program to identify groundwater flow paths for features within the corridor. Drainage areas, drainage patterns, and land uses associated with karst features were determined and documented (land uses associated with the identified karst features are listed in the Karst Report). Dye tracing tests were conducted to determine the subsurface flow from recharge features to discharge features and to establish groundwater flow patterns within the study area.

The recommendations for karst feature avoidance, impact minimization, and mitigation of unavoidable impacts were developed based upon previous INDOT experience (particularly SR 37 south of Bloomington), appropriate practices in the industry, and with input from karst professionals. Recommendations included general maintenance of the existing SR 37 elevation to reduce direct impacts to karst conduits, reuse of SR 37 structures and right-of-way to reduce

new impacts, development of BMPs to address literature and field identified karst features, and specific actions in areas of concern identified during the Section 5 karst studies.

INDOT and FHWA invited the USEPA to review, comment, attend meetings, and receive the un-redacted copies Section 4 and Section 5 Draft Karst Reports during the NEPA-phase of the project along with the MOU signatory agencies in response to USEPA's concerns about water quality issues in karst terrain crossed by the I-69 project. In addition, INDOT provided funding for the USEPA to contract with a karst consultant to assist in the review of both the Section 4 and 5 karst studies and related portions of the EIS documents.

A Draft Karst Report was sent to Karst MOU signatory agencies and the USEPA[1] in July 2006. As a result of agency comments on this report, additional dye trace studies for delineation of the Cave A recharge area were subsequently conducted. An updated Draft Karst Report was submitted to the agencies as part of the DEIS in October 2012. Agency and public comments on the report were evaluated, and where applicable, incorporated into the Final Karst Report included as **Appendix Y** of this FEIS. This report gives a comprehensive description of the karst survey and dye tracing efforts, methodology, and results. Portions of the appendix have been redacted to prevent disclosure of the specific locations of karst features.

5.21.3 Analysis

The general locations of the identified karst features relative to the Section 5 corridor are depicted in **Figures 5.21-3** and **5.21-4** (figures are located at the end of the chapter unless otherwise noted).

5.21.3.1 Karst Feature Terminology

For the purposes of the Tier 2 Studies, karst features encountered within the Section 5 corridor were defined as described below.

Buried Sink – A sinkhole that did not have surface expression at the time of the field investigations but was determined via other means (such as historic aerial photographs, maps).

Cave – A naturally occurring void in earth materials that can be entered by a human for an appreciable distance.

Cave System – An assemblage of karst features that may contain multiple caves, water inlets, and springs that are all related. For management purposes, the cave system is generally the

[1] INDOT and FHWA invited the USEPA to review, comment, attend meetings, and receive responses on the un-redacted copies of the Section 4 and Section 5 Draft Karst Reports during the NEPA-phase of the project along with the Karst MOU signatory agencies in response to USEPA's concerns regarding water quality issues in karst terrain crossed by the I-69 project. In addition, INDOT provided funding for the USEPA to contract with a karst consultant to assist in the review of both the Section 4 and Section 5 karst studies and related portions of the EIS documents.

category of interest since fauna and water movement in a cave system are rarely restricted in areas where humans cannot enter.

Drainage Area – As informally used in the Karst MOU, drainage area is used in this report synonymously with recharge area (i.e., "the land surface that contributes at least some water under some flow conditions to a particular karst feature").

Karst Window – For this study, a karst window is a sinkhole that provides limited access to a submerged karst conduit.

Insurgence Feature – A surface feature that directs surface water into the karst groundwater system (i.e. sinkholes, swallet, losing and sinking streams).

Relevant Karst – The relevant karst is the portion of karst within the I-69 Section 5 corridor and associated areas outside of the corridor; that has been demonstrated to have corridor-derived water passing through it; or, is linked by logical inference based on the best available geographic, geologic, and hydrologic data, including the Tier 2 investigation. It does not include areas outside the corridor that contribute water to the corridor.

Sinking Stream – A stream that leaves the surface and enters into a subterranean groundwater system. This term can be used interchangeably with "influent stream" or "losing stream."

Spring – A discrete point for water discharging from a karst groundwater system. Springs have discernible channels that may carry perennial flow or only flow as storm response.

Sinkhole – A natural, closed depression in the surface of the earth which recharges groundwater (internal drainage). All land draining into a sinkhole is part of the sinkhole. The boundaries of sinkholes with surface expression in Section 5 were mapped based on two-foot contour data which were derived from 2010 LiDAR data along with field checking of sink points (swallets).

Swallet – The location where a stream sinks underground often associated with a stream flowing into a sinkhole or cave entrance. This term can be used interchangeably with "swallowhole."

5.21.3.2 Karst Terrain Within and Adjacent to the Section 5 Corridor

The soil depth to bedrock is relatively shallow in the Section 5 corridor, with thin soil sections (generally less than 20 feet) on the ridges, and thicker soils (from 20 feet to over 100 feet in depth) in the valleys. Older to younger bedrock is exposed, from the northeast to the southwest. Mississippian age carbonate bedrock units are the source of visible karst development in the corridor.

The Section 5 karst study area extends from Clear Creek, south of Section 5, northward along SR 37 to roughly Chambers Pike (excluding Beanblossom Valley), a total of 12.1 miles of the 21-mile Section 5 corridor (see **Figure 5.21-3**). The non-karst portion of the Section 5 corridor extends from Chambers Pike to the northern terminus with Section 5 just south of Martinsville.

While seeps have been observed north of Chambers Pike (i.e., Paragon Road/Pine Boulevard intersection) in the Martinsville Hills physiography, this area is well outside of formations associated with karst development. No karst features were observed in this portion of the Section 5 Study Area.

Relevant karst is the portion of karst along 12.1 miles of the Section 5 corridor and associated areas outside of the corridor demonstrated to have corridor derived water passing through it; or is linked by logical inference based on the best available geographic, geologic, and hydrologic data, including the Tier 2 investigation. It does not include areas outside the corridor that contribute water to the corridor. Three distinct areas (hydrogeologic units) of relevant karst geology were identified within the study area and are described below.

Bloomington Karst

Bloomington Karst begins at the southern terminus at approximately That Road (just north of the Section 5 SR 37 interchange) and continues 5.9 miles north to approximately Arlington Road (old SR 46) within the Mitchell Plateau Physiographic Region (see **Figure 5.21-3**).

The Bloomington Karst area consists of St. Louis Limestone as the dominant karst-forming limestone, with some karst development in the underlying Salem Limestone. The St. Louis Limestone (at the base of the Blue River Group) has gray-brown limestone over thinner beds of limestone, shale, and dolomite (Rupp, 1991; Gates, 1962).

Recharge to springs generally includes the grade of SR 37, and springs were being impacted from road use, maintenance, and development along SR 37. The Bloomington Karst has longer and slower groundwater flowpaths than the other karst areas, with velocities ranging from hundreds to thousands of feet per day. Water tended to go from the surface to a spring in one to two days.

Bloomington North Karst

The relevant karst begins at approximately Arlington Road and continues for 2.9 miles to Kinser Pike at the southern slope of the Beanblossom Valley within the Mitchell Plateau Physiographic Region (see **Figure 5.21-3**).

The Bloomington North Karst (and Simpson Chapel Karst) consists of the Ramp Creek and Harrodsburg Limestones with the divide between these members occurring roughly at Arlington Road. The rock immediately below the Ramp Creek Limestone is insoluble shale (Edwardsville) that provides a barrier to the downward formation of karst. Much of the Harrodsburg Limestone and all of the formations above it have been removed by erosion (Rupp, 1991).

About half of the insurgence features and some of the springs in the corridor were at higher elevations than the SR 37 grade. Sinkhole drainage recharge areas and springs flows were smaller on average than those found in the other two karst areas and reflected the thin nature of the karst that terminated at the edge of the ridge tops.

Simpson Chapel Karst

The relevant karst begins approximately at Wayport Road at the northern slope of the Beanblossom Valley and continues 3.3 miles north to just south of Chambers Pike within the Norman Upland physiography (see **Figure 5.21-3**).

The Simpson Chapel Karst is also comprised of the Ramp Creek and Harrodsburg Limestones described above for the Bloomington North Karst (Rupp, 1991).

Most sinkholes were above the elevation of SR 37; therefore, many of the nearby springs were not receiving road runoff. SR 37 was cut into the limestone through most of this area and since its construction has been redirecting runoff to other, lower elevation/deeper karst conduits (bedrock under the upper Ramp Creek Limestones) or off of the karst terrain and into typical surface drainage.

The flowpaths in the Bloomington North Karst and Simpson Chapel Karst tended to be relatively short and faster than those in the Bloomington Karst. The Section 5 karst studies demonstrated velocities over 48,000 feet per day (9.1 miles/day) and typical travel times ranging from minutes to a single day for water to run off the surface and discharge at the springs. Determination of velocities and travel times are documented in **Appendix Y**, *Final Karst Report (Redacted).*

5.21.3.3 Karst Features Within and Adjacent to the Section 5 Corridor

The Section 5 karst study area includes the 21-mile long Section 5 corridor and appropriate areas outside of the corridor to encompass karst features that may be associated with the corridor via karst groundwater flowpaths or surface run-off. This study area was determined by the professional judgment of karst geologists based on surface water flow, known or inferred groundwater connections, and knowledge of geology in the area. The Section 5 survey of karst features for the corridor and adjacent areas known and/or inferred to be linked through groundwater flowpaths or surface flow areas identified the following karst features (see **Table 5.21-1**). Once karst features were identified and mapped, this resource data was included in the alternative development and screening. As noted above, the general locations of the identified karst features relative to the Section 5 corridor are depicted in **Figure 5.21-3**.

Table 5.21-1: Karst Features Identified Within Karst Study Area*

Karst Feature Type	Quantity/ Number	Within Section 5 Corridor*	Relevant Karst** Outside of Section 5 Corridor*	Total	Karst Features within Existing SR 37
Cave Recharge Areas	No. of Features	1	1	2	1
	Area (acres)	94.5	65.8	160.3	22.5
Sinking Stream Watersheds	No. of Features	5	4	9	5
	Area (acres)	776.1	1,053.8	1,829.9	219.2
Sinkhole Drainage***	No. of Features	214	267	481	54
	Area (acres)	440.7	537.6	978.3	50.7
Buried Sinks	No. of Features	19	7	26	13
	Area (acres)	65.9	11.9	77.8	21.4
Springs	No. of Features	80	74	154	4
Totals:	No. of Features	319	353	672	77
	Karst Features Area (acres)†	1,146.6	1,493.6	2,640.2	260.7
Relevant Karst Area (acres)***		2,423.3	5,057.6	7,480.9	526.5††

Notes:

** The karst study area consists of the Section 5 corridor as well as area outside the corridor that is hydrologically linked to the corridor.*

*** The relevant karst is the portion of karst either within the I-69 Section 5 corridor or the associated areas outside of the corridor; that has been demonstrated to have corridor-derived water passing through it; areas of karst linked by logical inference based on the best available geographic, geologic, and hydrologic data, including the Tier 2 investigation. This includes areas that did not have identified surface expression as well as those areas where discrete karst features were identified and is reflective of the historically mapped underlying shallow limestone bedrock members and does not include the areas outside the corridor that contribute water to the corridor. There were 169 springs identified during the Section 5 studies with 131 springs that were either within the Corridor, linked by dye tracing, or linked by logical inference listed in **Appendix Y** Final Karst Report (Redacted).*

**** Additional smaller sinks (both observed and without surface expression during field checks) may be located within larger sinkhole drainages; these are not included in the total number of features or acreages. Karst features impacts <0.1 acres were rounded up to 0.1 acres, while the total karst feature impacts did not include this rounding.*

† The total karst features area excludes acreage from overlapping features, i.e. it is not a sum of the individual feature acreages rows listed above.

*†† The karst features within existing SR 37 relevant karst area (acres) has been updated since the DEIS to remove a portion of Section 4 ROD acreage and residential property near Lee Paul Road. Similar edits were made to **Tables 5.21-2** and **5.21-4**.*

5.21.3.4 Karst Impacts by Alternative

For the purposes of the following discussions, the term "impact" means that portions of a karst feature are located within the rights-of-way of the Section 5 alternatives. In addition, impacts to relevant karst that may not have discernible surface expression for karst feature identification

were also included in the impacts within the Section 5 right-of-way (see **Tables 5.21-2** and **5.21-4**). Relevant karst outside of the Section 5 alternatives' right-of-way was not included in the karst impacts by alternative. Potential impacts outside of the alternative right-of-way will be subject to subsequent final design and addressed as part of Best Management Practices and mitigation implementation, in coordination with the Karst MOU signatory agencies. The Refined Preferred Alternative 8 is a combination of the elements from Alternatives 4, 5, 6, 7, and 8, and was determined based upon resource impacts, integration with existing infrastructure, public and agency comments, and cost.

Existing SR 37 was constructed in the 1970's and includes right-of-way that accounts for at least 50% of the karst impacts included in the six alternatives:

- Alternatives 4 and 5 – with the inclusion of wider medians, right-of-ways, and typical sections, removal of large sections of existing SR 37 pavement, and replacement of existing structures, these alternatives have higher direct karst impacts by disrupting established drainage and infiltration patterns. This disruption results in increased erosion and flow in some areas and choked off water flow in others. The majority of karst impacts are in existing SR 37 right-of-way. New right-of-way required for Alternatives 4 and 5 accounts for 41% and 39% of the total karst impacts (in acres), respectively, and 42% and 40% of the relevant karst impacts (in acres), respectively.

- Alternatives 6, 7, 8 and Refined Preferred Alternative 8 – have a similar number of karst features and acres of impact within these features. All of the minimum impact alternatives include the reuse of existing SR 37 pavement and fewer existing structure replacements which results in lower direct karst impacts to established drainage and infiltration patterns than Alternatives 4 and 5. The majority of karst impacts are within existing SR 37 right-of-way. New right-of-way to be acquired for Alternatives 6 and 7 accounts for only 23% of the total karst impacts (in acres), 24% of Alternative 8, and 25% of the Refined Preferred Alternative 8 total karst impacts (in acres). New right-of-way to be acquired for Alternatives 6 and 7 accounts for only 23% of the relevant karst impacts (in acres) and for Alternative 8 and Refined Preferred Alternative 8 new right-of-way accounts for 26% of the relevant karst (in acres).

Specific impacts to karst features will not be determined until final design. All six of the alternatives will increase the existing SR 37 impacts to karst features with the addition of features such as a third travel lane, wider shoulders, additional right-of-way, local access roads, interchanges and overpasses. The corresponding increases in impermeable land cover and blocking of existing water entry routes, increases in stormwater runoff rates, and available mass of transportation related compounds result in increased potential impacts to karst features and habitat.

Construction related impacts may include: sediment laden runoff to sinking streams, cave recharge, or sinkholes; filling in sinkholes or reopening buried sinks; exposure, blockage, or collapse of karst conduits (in bedrock); and the blockage of spring outlet or recharge paths.

Features within the construction limits (which include features already impacted by SR 37) may be bridged, capped, or filled. There is also the potential for changes in drainage patterns for features within and outside the construction limits if the project were to sever a conduit and reduce flows. The project also will add drainage, thereby increasing flows. The impact upon each karst feature will depend on the roadway work proposed at that location. Where alternative descriptions indicate "use existing SR 37 right-of-way" or "alignment is shifted," the design may include removal of existing pavement and installation of new pavement at a different location or orientation with potential changes to established infiltration and flow patterns (increase some/choke off others). Alternatively, where descriptions indicate "use existing SR 37 pavement," the existing pavement would stay in the same general location and orientation which would reduce disruptions to established drainage patterns.

As recognized in Step 10 of the Karst MOU, information necessary to provide the case-specific karst feature impacts and treatment measures (such as depths to openings of karst features and foundation alternatives) will not be determined until post-NEPA design and construction. More detailed discussions with the Karst MOU signatory agencies will occur at that time.

The area between Chambers Pike to the northern terminus with Section 5 (just south of Martinsville) in Morgan County (**Figure 5.21-3**) has been determined not to be karst terrain based upon Indiana Geological Survey reports, historical data, and field checks. The presence of the older, Borden Group bedrock formations in the northern portion of Section 5 is not conducive to the formation of karst features. Therefore, since no karst features are known to exist in this particular part of Section 5, no impacts to karst resources are anticipated.

All of the alternatives include a six-lane urban and four-lane rural facility utilizing the existing SR 37 right-of-way and significant portions of the existing four-lane SR 37 pavement, grade, and structures overlying Monroe County karst terrain. Avoidance of karst features in the Section 5 corridor is limited and while all of the alternatives will continue to have an overall increase in impacts to karst resources in the southern portion of Section 5, many of these impacts are a modification of existing SR 37 and impacts are similar in extent between all of the six alternatives. Karst impacts are generally discussed below as total karst impacts (both existing SR 37 and new construction) for each karst area and detailed by alternative in **Table 5.21-2**.

Bloomington Karst

That Road to Arlington Road/old SR 46 (approximately 5.9 miles, see **Figure 5.21-3**). The alternatives share a common alignment of a six-lane urban type facility centered on existing SR 37, a folded loop interchange at the SR 37 and Fullerton Pike intersection, an interchange at the SR 37 and SR 48/3rd Street/Whitehall Pike intersection, and continued use of the existing SR 37 and SR 46 intersection in this hydrogeologic unit. Therefore, the alternatives will result in similar impacts to karst features, with the following exceptions:

- South of the SR 37 and Fullerton Pike intersection, Alternatives 4 and 5 shift the six-lane mainline to the east of SR 37, and Alternatives 6, 7, 8, and the Refined Preferred Alternative 8 instead utilize the existing SR 37 right-of-way and pavement. This eastern

shift in Alternatives 4 and 5 would correspondingly create increased impacts to relevant karst features such as sinkholes and could potentially alter karst recharge patterns for the new location while Alternatives 6, 7, 8, and the Refined Preferred Alternative 8's use of SR 37 components would retain more of the existing patterns.

- The Fullerton Pike interchange will have an impact on karst features such as sinkholes, could potentially alter karst recharge patterns, and the southern access ramps are within the Cave A recharge area. Alternatives 4 and 5 have increased impacts to accommodate the wider mainline design while Alternatives 6, 7, and 8 have reduced impacts with the narrower mainline. Refined Preferred Alternative 8 impacts are slightly lower with reduced right-of-way within the Cave A recharge area.

- In the Tapp Road and SR 45/2nd Street intersection areas (approximately 1.8 miles), Alternatives 4 and 6 both have an interchange at the SR 37 and SR 45/2nd Street intersection and an overpass at Tapp Road. Alternative 4 also extends an additional lane and right-of-way from Tapp Road west to Leonard Spring Road. Alternatives 5, 7, 8, and the Refined Preferred Alternative 8 have additional ramps, lanes, and right-of-way as part of a split interchange between Tapp Road and SR 45/2nd Street. The larger area of this split interchange could cause greater impacts to relevant karst features including sinkholes, increased potential for roadbed subsidence and/or reopened sinkhole(s) with the addition of the additional lanes related to the split interchange, and could potentially alter karst recharge patterns more than the less impactful features (overpasses) in Alternatives 4 and 6 and the reuse of the existing 2nd Street interchange in Alternative 6.

- Between SR 45/ 2nd Street and SR 48/3rd Street interchanges (approximately 1.2 miles), Alternatives 4 and 5 require additional right-of-way for the reconstruction of the railroad trestle which crosses over SR 37. Alternatives 6, 7, 8 and the Refined Preferred Alternative 8 utilize the existing railroad structure and SR 37 right-of-way, thereby reducing impacts to karst features.

- From Vernal Pike to the SR 46 interchange (approximately 1.8 miles), Alternatives 4, 5, and 6 include an underpass with significant rock cut on the east side of a new Vernal Pike to 17th Street crossing and intersection, which results in removal of karst material, potential disruption of karst conduits, and alteration of recharge patterns. Alternatives 4 and 5 also extend the right-of-way and lane construction further to the east and west and require additional fill material for a new intersection of Industrial Park and Packinghouse Roads thereby impacting additional acres of relevant karst. Alternatives 7, 8 and the Refined Preferred Alternative 8 have minimal rock cut as part of an overpass at this same location and reduced impacts to karst features but with comparable impacts from the increased number of lanes (i.e. impervious material).

The specific Bloomington Karst impacts discussed above are broken down by the number and/or acreage of impacts (both exiting SR 37 and new construction) by karst feature type for each of the alternatives in **Table 5.21-2**. The existing SR 37 right-of-way accounts for most of the

Bloomington Karst features included in the alternative impact breakdowns with 366.0 acres of identified karst features, one cave recharge area consisting of 22.5 acres, four sinking stream watersheds consisting of 204.4 acres, 34.0 acres draining into 28 sinkholes, 13 buried sinks totaling 21.4 acres, and one spring with flow greater than 100 gpm.

- **Alternative 4** would impact 374.6 acres of identified karst features within the Bloomington Karst area, one cave recharge area consisting of 51.5 acres, four sinking stream watersheds consisting of 288.5 acres, 98.4 acres draining into 44 sinkholes, 14 buried sinks totaling 30.5 acres, two springs with less than two-gallons per minute (gpm), one spring with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

- **Alternative 5** would impact 370.8 acres of identified karst features within the Bloomington Karst area, one cave recharge area consisting of 51.0 acres, four sinking stream watersheds consisting of 285.8 acres, 97.7 acres draining into 44 sinkholes, 15 buried sinks totaling 29.5 acres, two springs with less than two-gpm, two springs with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

- **Alternative 6** would impact 293.7 acres of identified karst features within the Bloomington Karst area, one cave recharge area consisting of 38.8 acres, four sinking stream watersheds consisting of 238.5 acres, 69.0 acres draining into 36 sinkholes, 14 buried sinks totaling 23.4 acres, two springs with less than two-gpm, one spring with 2-10 gpm, zero springs with 11-100 gpm, and one spring with greater than 100 gpm.

- **Alternative 7** would impact 300.7 acres of identified karst features within the Bloomington Karst area, one cave recharge area consisting of 39.4 acres, four sinking stream watersheds consisting of 242.7 acres, 70.3 acres draining into 39 sinkholes, 14 buried sinks totaling 24.4 acres, two springs with less than two-gpm, three springs with 2-10 gpm, zero springs with 11-100 gpm, and one spring with greater than 100 gpm.

- **Alternative 8** (DEIS Preferred Alternative) would impact 299.2 acres of identified karst features within the Bloomington Karst area, one cave recharge area consisting of 38.0 acres, four sinking stream watersheds consisting of 242.6 acres, 68.3 acres draining into 36 sinkholes, 14 buried sinks totaling 25.3 acres, two springs with less than two-gpm, two springs with 2-10 gpm, zero springs with 11-100 gpm, and one spring with greater than 100 gpm.

- **Refined Preferred Alternative 8** would impact 302.3 acres of identified karst features within the Bloomington Karst area, one cave recharge area consisting of 37.4 acres, four sinking stream watersheds consisting of 244.9 acres, 68.5 acres draining into 36 sinkholes, 14 buried sinks totaling 25.9 acres, two springs with less than two-gpm, three springs with 2-10 gpm, zero springs with 11-100 gpm, and one spring with greater than 100 gpm.

Within the Bloomington Karst, Alternative 5 has more karst impacts due to the inclusion of the 2nd Street/Tapp Road split interchange. Alternative 4 has fewer karst impacts with an overpass at Tapp Road. Alternative 7 and Refined Preferred Alternative 8 have reduced impacts with the reduction in the mainline median but with a shift to the east between Tapp Road and 2nd Street increases impacts slightly. Alternatives 6 and 8 and have fewer impacts with the reduction in the mainline median and shift to the west between Tapp Road and 2nd Street. Refined Preferred Alternative 8 includes additional right-of-way along SR 45/2nd Street and SR 48/3rd Street to accommodate bicycle, pedestrian, access, and local service road connection considerations. While there is a corresponding slight increase in karst impacts with these features that is not included in the other five Alternatives; similar karst impacts to karst features would occur if these same bicycle, pedestrian, access, and local service road connection considerations were applied to Alternatives 4, 5, 6, 7, and 8.

Bloomington North Karst

Arlington Road to Kinser Pike (approximately 2.9 miles, see **Figure 5.21-3**). The alternatives share a common alignment of a six-lane urban type facility centered on existing SR 37 in this hydrogeologic unit. Therefore, the alternatives will result in similar impacts to karst features, with the following exceptions:

- Between the SR 46 interchange and Acuff Road (approximately 1.5 miles), Alternatives 4 and 5 have additional pavement, new structure, and right-of-way as part of rebuilding the Arlington Road overpass. Alternatives 6, 7, 8, and Refined Preferred Alternative 8 utilize the existing structure SR 37 crossing but have a potential for a thin (less than a foot deep) rock cut to lower the six-lane mainline grade.

- At the SR 37 and Kinser Pike intersection, Alternative 6 has minimal impacts with the termination of access at SR 37 and Kinser Pike and upgrades to the Kinser Pike local access road to the west. Alternative 4 includes a new structure, lanes, ramps, and significant additional right-of-way with the inclusion of an interchange and impacts relevant karst with the placement of impervious pavement, potentially concentrated recharge, and disruption of karst conduit flows. Alternatives 5, 7, 8, and the Refined Preferred Alternative 8 include reduced lanes and right-of-way and no ramps with an overpass crossing the mainline and reduced impacts to relevant karst without an interchange but with comparable impacts from the increased number of lanes (i.e. impervious material).

The specific Bloomington North Karst impacts discussed above are broken down by the number and/or acreage of impacts (both existing SR 37 and new construction) by karst feature type for each of the alternatives in **Table 5.21-2**. The existing SR 37 right-of-way accounts for most of the Bloomington North Karst features included in the alternative impact breakdowns with 104.8 acres of identified karst features, zero caves, one sinking stream watershed consisting of 14.8 acres, 5.8 acres draining into 14 sinkholes, zero buried sinks, and two springs with 2-10 gpm.

- **Alternative 4** would impact 28.6 acres of identified karst features within the Bloomington North Karst area, zero caves, one sinking stream consisting of 18.8 acres, 11.5 acres draining into 31 sinkholes, zero buried sinks, two springs with less than two-gpm, three springs with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

- **Alternative 5** would impact 23.6 acres of identified karst features within the Bloomington North Karst area; zero caves, 1 sinking stream consisting of 18.6 acres, 7.0 acres draining into 21 sinkholes, zero buried sinks, one spring with less than two-gpm, six springs with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

- **Alternative 6** would impact 19.1 acres of identified karst features within the Bloomington North Karst area, zero caves, one sinking stream consisting of 14.8 acres, 6.0 acres draining into 16 sinkholes, zero buried sinks, zero springs with less than two-gpm, three springs with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

- **Alternative 7** would impact 19.1 acres of identified karst features within the Bloomington North Karst area, zero caves, one sinking stream consisting of 14.8 acres, 6.0 acres draining into 16 sinkholes, zero buried sinks, zero springs with less than two-gpm, three springs with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

- **Alternative 8** (DEIS Preferred Alternative) would impact 19.1 acres of identified karst features within the Bloomington North Karst area, zero caves, one sinking stream consisting of and 14.8 acres, 6.0 acres draining into 16 sinkholes, zero buried sinks, zero springs with less than two-gpm, three springs with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

- **Refined Preferred Alternative 8** would impact 19.0 acres of identified karst features within the Bloomington North Karst area, zero caves, one sinking stream consisting of and 14.8 acres, 5.9 acres draining into 15 sinkholes, zero buried sinks, zero springs with less than two-gpm, two springs with 2-10 gpm, and zero springs with either 11-100 gpm or greater than 100 gpm.

Within the Bloomington North Karst, Alternative 6 has the fewest relevant karst impacts with no interchange or overpass. Alternative 4 has the most karst impacts due to the inclusion of the Kinser Pike interchange. Alternative 5 has reduced karst impacts with an overpass at Kinser Pike and minimal impact to features. Alternatives 7 and 8 and Refined Preferred Alternative 8 have fewer impacts with the reduction in the mainline median. Refined Preferred Alternative 8 has a slightly smaller right-of-way and a corresponding reduction in karst impacts.

Simpson Chapel Karst

Wayport Road to Chambers Pike (approximately 3.3 miles, see **Figure 5.21-3**). The alternatives share a common alignment of a six-lane urban type facility to Sample Road then north with a four-lane rural type facility shifted slightly west from centered on existing SR 37, parallel local access roads, and a new interchange at Sample Road in this hydrogeologic unit. Therefore, the alternatives will result in similar impacts to karst features, with the following exceptions:

- From south of Wayport Road to Sample Road (approximately 0.9 miles), Alternatives 4 and 5 have additional pavement, new structure, and right-of-way with a rural type interchange layout for the Sample Road interchange which increases impacts to relevant karst features including sinkholes and potentially alters karst recharge patterns for the new additional lanes and structures. Alternative 7 has reduced right-of-way and impacts to karst with an urban type interchange layout, and Alternative 6, 8 and the Refined Preferred Alternative 8 have a similar reduced right-of-way with a folded loop interchange layout that further reduces karst feature impacts in the southwest quadrant.

- Between Sample Road and south of Chambers Pike (approximately 2.0 miles), Alternatives 4 and 5 have additional right-of-way with a an expanded center median and full setbacks for parallel local access roads, Alternatives 6, 8, and the Refined Preferred Alternative 8 have a reduced right-of-way with a rural type center median and reduced setbacks for parallel local access roads, and Alternative 7 has reduced right-of-way with an urban type median and barriers between the mainline and the eastern local access road on existing northbound SR 37. With appropriate drainage treatment, karst impacts would be similar between the alternatives.

- At the Chambers Pike intersection (approximately 0.1 miles within karst), Alternatives 4 and 5 have additional pavement and right-of-way with a rural type overpass at the SR 37 and Chambers Pike intersection which increases impacts to relevant karst features including sinkholes and potentially alters the karst recharge patterns for the new additional lanes and structures. Alternative 6, 8, and the Refined Preferred Alternative 8 have reduced pavement, right-of-way, and karst impacts with a skewed overpass layout, and Alternative 7 has the least amount of pavement and right-of-way, and karst impacts with no crossing at this location.

The specific Simpson Chapel Karst impacts discussed above are broken down by the number and/or acreage of impacts (both exiting SR 37 and new construction) by karst feature type for each of the alternatives in **Table 5.21-2**. The existing SR 37 right-of-way accounts for most of the Bloomington North Karst features included in the alternative impact breakdowns with 118.3 acres of identified karst features, zero caves, zero sinking stream watersheds, 10.9 acres draining into 12 sinkholes, zero buried sinks, and one spring with 2-10 gpm.

- **Alternative 4** would impact 36.5 acres of identified karst features within the Simpson Chapel Karst area, zero caves and zero sinking streams, 37.1 acres draining into 30 sinkholes, zero buried sinks, zero springs with less than two-gpm, six springs with 2-10 gpm, four springs with 11-100 gpm, and one spring with greater than 100 gpm.

- **Alternative 5** would impact 35.8 acres of identified karst features within the Simpson Chapel Karst area, zero caves and zero sinking streams, 36.4 acres draining into 30 sinkholes, zero buried sinks, zero springs with less than two-gpm, six springs with 2-10 gpm, four springs with 11-100 gpm, and one spring with greater than 100 gpm.

- **Alternative 6** would impact 25.7 acres of identified karst features within the Simpson Chapel Karst area, zero caves and zero sinking streams, 26.3 acres draining into 24 sinkholes, zero buried sinks, zero springs with less than two-gpm, three springs with 2-10 gpm, three springs with 11-100 gpm, and zero springs with greater than 100 gpm.

- **Alternative 7** would impact 20.5 acres of identified karst features within the Simpson Chapel Karst area, zero caves and zero sinking streams, 21.4 acres draining into 23 sinkholes, zero buried sinks, zero springs with less than two-gpm, three springs with 2-10 gpm, two springs with 11-100 gpm, and one spring with greater than 100 gpm.

- **Alternative 8** (DEIS Preferred Alternative) would impact 25.4 acres of identified karst features within the Simpson Chapel Karst area, zero caves and zero sinking streams, 26.1 acres draining into 24 sinkholes, zero buried sinks, zero springs with less than two-gpm, three springs with 2-10 gpm, three springs with 11-100 gpm, and zero springs with greater than 100 gpm.

- **Refined Preferred Alternative 8** would impact 26.0 acres of identified karst features within the Simpson Chapel Karst area, zero caves and zero sinking streams, 26.7 acres draining into 26 sinkholes, zero buried sinks, zero springs with less than two-gpm, three springs with 2-10 gpm, two springs with 11-100 gpm, and zero springs with greater than 100 gpm.

Within the Simpson Chapel Karst, Alternatives 4 and 5 have more impacts than Alternative 6 or Alternative 8. While Alternative 7 has the lowest acreages of impacts, the differences are minimal. Refined Preferred Alternative 8 includes additional right-of-way at the Chambers Pike overpass for wider turning movements and a longer span, and there is a corresponding increase in karst impacts with these features that is not include in the other five Alternatives.

Potential Karst Feature Impacts

Potential karst feature impacts associated with the alternatives and identified by hydrogeologic unit are presented in **Table 5.21-2**.

Table 5.21-2: Potential Karst Feature Impacts, by Karst Area and Alternative

Karst Feature Type	Quantity Type	Build Alternative						Karst Features within Existing SR 37 ROW
		4	5	6	7	8	Refined Preferred Alternative 8	
Bloomington Karst – That Road to Arlington Road								
Cave Recharge Area	No. of Features	1	1	1	1	1	1	1
	Area (acres)	51.5	51.0	38.8	39.4	38.0	37.4	22.5
Sinking Stream Watersheds	No. of Features	4	4	4	4	4	4	4
	Area (acres)	288.5	285.8	238.5	242.7	242.6	244.9	204.4
Sinkhole Drainage*	No. of Features**	44	44	36	39	36	36	28
	Area (acres)**	98.4	97.7	69.0	70.3	68.3	68.5	34.0
Buried Sinks	No. of Features	14	15	14	14	14	14	13
	Area (acres)	30.5	29.5	23.4	24.4	25.3	25.9	21.4
Springs †Flow rates (gallons per minute, or gpm) were estimated in the field and were not measured.	No. <2 gpm†	2	2	2	2	2	2	0
	No. 2-10 gpm†	1	2	1	3	2	3	0
	No.11-100 gpm†	0	0	0	0	0	0	0
	No. >100 gpm†	0	0	1	1	1	1	1
	Total	3	4	4	6	5	6	1
Bloomington Karst Area Subtotals	*No. of Features*	*66*	*68*	*59*	*64*	*60*	*61*	*47*
	*Area** (acres)*	*374.6*	*370.8*	*293.7*	*300.7*	*299.2*	*302.3*	*231.4*
*Bloomington Relevant Karst (within the Alternative ROW (acres))****		*505.5*	*506.6*	*394.9*	*416.0*	*417.6*	*421.4*	*320.4*††

Bloomington North Karst – Arlington Road to Kinser Pike								
Cave Recharge Area	No. of Features	0	0	0	0	0	0	0
	Area (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sinking Stream Watersheds	No. of Features	1	1	1	1	1	1	1
	Area (acres)	18.8	18.6	14.8	14.8	14.8	14.8	14.8
Sinkhole Drainage*	No. of Features**	31	21	16	16	16	15	14
	Area (acres)**	11.5	7.0	6.0	6.0	6.0	5.9	5.8
Buried Sinks	No. of Features	0	0	0	0	0	0	0
	Area (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Springs †Flow rates (gallons per minute, or gpm) were estimated in the field and were not measured.	No. <2 gpm†	2	1	0	0	0	0	0
	No.2-10 gpm†	3	6	3	3	3	2	2
	No.11-100 gpm†	0	0	0	0	0	0	0
	No. >100 gpm†	0	0	0	0	0	0	0
	Total	5	7	3	3	3	2	2
Bloomington North Karst Area Subtotals	*No. of Features*	*37*	*29*	*20*	*20*	*20*	*18*	*17*
	*Area** (acres)*	*28.6*	*23.6*	*19.1*	*19.1*	*19.1*	*19.0*	*19.0*
*Bloomington North Relevant Karst (within the Alternative ROW (acres))****		*163.5*	*128.5*	*102.8*	*106.4*	*106.4*	*105.8*	*97.0*††

Simpson Chapel Karst – Wayport Road to Chambers Pike								
Cave Recharge Area	No. of Features	0	0	0	0	0	0	0
	Area (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sinking Stream Watersheds	No. of Features	0	0	0	0	0	0	0
	Area (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sinkhole Drainage*	No. of Features**	30	30	24	23	24	26	12
	Area (acres)**	37.1	36.4	26.3	21.4	26.1	26.7	10.9
Buried Sinks	No. of Features	0	0	0	0	0	0	0
	Area (acres)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Springs †Flow rates (gallons per minute, or gpm) were estimated in the field and were not measured.	No. <2 gpm†	0	0	0	0	0	0	0
	No.2-10 gpm†	6	6	3	3	3	3	1
	No.11-100 gpm†	4	4	3	2	3	2	0
	No. >100 gpm†	1	1	0	1	0	0	0
	Total	11	11	6	6	6	5	1
Simpson Chapel Karst Area Subtotal	*No. of Features*	*41*	*41*	*30*	*29*	*30*	*31*	*13*
	*Area** (acres)*	*36.5*	*35.8*	*25.7*	*20.5*	*25.4*	*26.0*	*10.4*
*Simpson Chapel Relevant Karst (within the Alternative ROW (acres))****		*240.4*	*239.4*	*188.3*	*160.9*	*186.5*	*186.5*	*109.1*††

Total Karst Feature Impacts								
Total Karst Feature Impacts	No. of Features	144	138	109	113	110	110	77
	Area** (acres)	439.7	430.2	338.5	340.3	343.7	347.3	260.8
*Relevant Karst Area Impacts*** (acres)*		909.4	874.5	686.0	683.3	710.5	713.7	526.5††
% Total Karst Impacts outside of Existing SR 37 Right-of-Way	% of Features	47%	44%	29%	32%	30%	30%	
	% of Area	41%	39%	23%	23%	24%	25%	
*% Relevant Karst Area Impacts outside of Existing SR-37 Right-of-Way**** (% of Area)*		42%	40%	23%	23%	26%	26%	

Notes

* *Additional smaller sinks (both observed and without surface expression during field checks) may be located within larger sinkhole drainages; these are not included in the total number of features or acreages. Karst features impacts <0.1 acres were rounded up to 0.1 acres, while the total karst feature impacts did not include this rounding.*

** *The total karst features area excludes acreage from overlapping features, i.e. it is not a sum of the individual feature acreages rows listed above.*

*** *Relevant karst area is karst that has been demonstrated to have corridor-derived water passing through it; or is linked by logical inference based on the best available geographic, geologic, and hydrologic data. This includes areas that did not have identified surface expression as well as those areas where discrete karst features were identified. Relevant karst outside of Section 5 alternatives' right-of-way were not included in the Karst Impacts by Alternative since potential impacts outside of the alternatives' right-of-way will be subject to subsequent final design and addressed as part of Best Management Practices and mitigation implementation, in coordination with the Karst MOU signatory agencies. The data supporting these conclusions include karst investigations for Tier 2 studies.*

**** *% is calculated by dividing the portion of additional relevant karst area impacts that are beyond the existing SR 37 right-of-way by the total relevant karst area that is within the proposed I-69 Section 5 right-of-way for a given alternative.*

†† *The karst features within existing SR 37 relevant karst area in acres was updated since the DEIS to remove a portion of Section 4 ROD acreage and residential property near Lee Paul Road. Similar edits were made to* ***Table 5.21-1*** *and* ***5.21-4****.*

5.21.3.5 Areas of Importance

The *Final Karst Report (Redacted)* (**Appendix Y**) identified four karst areas of importance based on hydrologic, geologic, and engineering reasons. The four areas of importance are listed below, and potential impacts are discussed.

1) Lemon Lane Landfill / Illinois Central Spring Superfund Site

The Lemon Lane Landfill Superfund site is approximately 1,000 feet east of the existing SR 37 pavement and adjacent to the I-69 corridor. The Second Five-Year Review Report

for the Lemon Lane Landfill (USEPA, 2010) describes the background and actions taken for the Lemon Lane site, located in the City of Bloomington, Indiana. The site is a former 10-acre municipal landfill that accepted both municipal and industrial waste material. The Lemon Lane Landfill was operated as a sanitary landfill from the late 1930s to 1964 and included polychlorinated biphenyl (PCB) contaminated capacitors, materials, and other industrial wastes. Remedial measures at the site included: Phase II Assessment and delineation; excavation and offsite disposal of 80,087 tons of PCB contaminated material and 4,402 capacitors; consolidation of 40,000 cubic yards of landfill material to an approximately 9-acre area; and, installation of a landfill cap over this material, perimeter drainage, security fencing, and a stormwater retention pond. The cleanup of areas outside the landfill boundary to high occupancy/residential standard of two ppm PCBs (on average) to the north (toward Vernal Pike), east, and west (toward SR 37) side of the site. Coordination with IDEM site managers has occurred throughout the Section 5 study and is ongoing.

At the Superfund site, PCB impacted groundwater drains to Illinois Central Spring (ILCS) via conduits developed in the karst (limestone bedrock). The USEPA treatment plant (with the capability to treat up to 1,000 gpm via carbon adsorption) captures the water emanating from the ILCS emergence, treats it for PCBs, and then discharges the treated water to the stream. While attempts were made to treat all of the PCB impacted water discharged from the ILCS, peak flows have exceeded treatment and storage capacities, and the highest concentrations of contaminants are associated with the peak flows. Thus, any change in land use that would increase the volume or frequency of the excess flow could have significant adverse impact on the effectiveness of the site's discharge treatment. PCB impacted water discharging from ILCS that originates from the Lemon Lane Landfill is captured and treated prior to release to surface water. Recent additions at the plant have increased the treatment to a goal of 5,000 gpm. The combined treatment systems are expected to treat nearly 100% of the ILCS spring water and prevent 99.9% of the PCB mass from ILCS from entering the receiving stream.

USEPA and IDEM and site participants (primarily CBS – former Westinghouse) involved in the ongoing treatment operations have requested that the Section 5 design and planning processes take into account the overall goal of reducing the volume of water entering the ILCS recharge area. Since the ILCS treatment system operations directly affect the local surface water and sediment quality, and consequently potential human and ecological receptors, roadway pavement runoff control and redistribution away from the ICLS recharge area has been determined to be of specific concern for mitigation planning.

Alternative 4 and 5 widen away from the Lemon Lane Landfill/ILCS recharge area and Alternatives 6, 7, 8 and Refined Preferred Alternative 8 maintain use of the existing SR 37 right-of-way and add additional lanes within the existing SR 37 median.

The current alignment of SR 37 crosses the recharge area of ILCS as delineated by Fitch (1994). The Section 5 Tier 2 investigation revised the recharge area based on new data (see **Figure 5.21-4** and **Figure 5.21-5**). The revised recharge area shows that minimal amounts of SR 37 are currently in the ILCS recharge area.

The preferred alignment and design for Section 5 of I-69 would avoid contributing additional water to the ILCS recharge area, and drainage control during construction should avoid increasing runoff to the site. Ideally, less water would be directed from the pavement, frontage roads, and rights-of-way, and thus would reduce the duration and frequency of discharges in excess of treatment and storage capacity at the ILCS treatment facility.

The following three measures are recommended for reduction of roadway contribution to the ILCS recharge area:

- Maintain the eastern boundary of the SR 37 right-of-way with any required mainline expansion or new access roads to the west, away from the landfill, in Alternatives 4 and 5.
- Shift the proposed Vernal Pike grade crossing north to connect with 17th Street in all alternatives, and use of an overpass rather than rock cut for use of underpass in Alternative 7, 8, and the Refined Preferred Alternative 8.
- INDOT has made a mitigation commitment to prevent drainage from increasing above the existing SR 37 levels extending along the eastern side of SR 37 that is within the Lemon Lane Landfill/ILCS recharge area to address USEPA and IDEM concerns regarding changes in existing groundwater flow. Coordination with USEPA and IDEM has occurred throughout the Section 5 study and will continue through the design phase. Design plans for this area will be provided to USEPA and IDEM for review with a requested two week turnaround time for comment.

The area where this mitigation commitment for the ILCS recharge area is proposed to be implemented is shown on **Figure 5.21-5**.

2) Bennett's Dump Superfund Site

Bennett's Dump is located in the northwest corner of the interchange of SR 37 and SR 46 (see **Figure 5.21-4** and **Figure 5.21-6**), approximately 1,000 feet from existing SR 37 pavement and adjacent to the Section 5 corridor. I-69 Section 5 will be designed to avoid directing additional drainage greater than existing SR 46 / SR 37 conditions to the site.

The Third Five-Year Review Report for Bennett's Dump (USEPA, 2012) describes the background and actions taken for the site. During the previous SR 46 interchange construction, a series of former quarries were filled, and portions of the Stout Creek drainage system were altered. The site has exhibited elevated groundwater levels since

construction of SR 46. After soil and material excavation and off-site treatment/disposal activities were completed in 1999, five springs: Mound Spring, Middle Spring, Mid-North Spring, North Spring, and Rusty Spring on the Bennett's Dump site that discharge to Stout Creek showed PCB contamination. To address these springs, a passive drainage system to allow up gradient, abandoned quarry pits and waste stone areas to drain directly to Stout Creek, thereby bypassing residual contaminants at the dump site, was installed in 2010.

The remedy for groundwater has not been completely implemented, since low levels of PCBs continue to be detected at on-site springs. Recent data by USEPA indicated that the PCB mass discharging into Stout's Creek is being reduced by over 80% with the installation of the passive quarry drain. While the passive quarry drain has been constructed and functioning well, PCBs continue to be released from on-site springs to Stout's Creek, and further investigation into capturing and treating these releases is ongoing. The installation of a collection trench, on-site water treatment plant, and appropriate institutional controls are also under consideration as part of the completion of the groundwater remedy. A remedial option has not yet been chosen.

USEPA, IDEM, and site participants involved in ongoing remedial design and mitigation measures at the site have requested that the I-69 Section 5 design and planning processes take into account the overall goal of redirecting runoff around the site. Since mobilization of residual contaminants at the site has the potential to directly affect the local surface water and sediment quality, and consequently potential human and ecological receptors, roadway pavement runoff control and redistribution outside of the recharge area and drainage control during construction should avoid increasing runoff to the site. This has been determined to be a specific concern for mitigation planning. Coordination with IDEM site managers has occurred throughout the Section 5 study and is ongoing. IDEM has indicated that potential additions to groundwater in the SR 46 area would be of concern, as compared with drainage via surface water flow to Stout Creek.

Alternatives 4 and 5 widen to the outside of existing SR 37 lanes while Alternatives 6, 7, 8, and Refined Preferred Alternative 8 maintain use of the existing SR 37 right-of-way and add additional lanes within the existing SR 37 median. While none of the six alternatives will impact Bennett’s Dump, the current alignment of SR 37 and all of the alternative alignments are up gradient of Bennett’s Dump. A mitigation commitment to avoid additional drainage in the area for Bennett’s Dump, is shown on **Figure 5.21-6**.

The following measures are recommended for reduction of roadway contribution to the Bennett’s Dump recharge area during subsequent design phases:

- Limit paving and construction to the existing SR 37 and SR 46 mainline and intersection.
- INDOT has made a mitigation commitment to prevent drainage from increasing above the existing SR 37 levels extending along the northwest quadrant of the SR

37/SR 46 interchange area to address USEPA and IDEM concerns regarding changes in existing drainage at the Bennett's Dump area (**Figure 5.21-6**).

3) SR 45/2nd Street – SR 37 Interchange Buried Sinks

The intersection of SR 45/2nd Street and SR 37 is considered an area of special concern due to the presence of numerous sinkholes and a reported former cave that were filled as part of SR 37 construction and by various local developments. Many of these sinkholes have had roadway and development runoff culverts installed in or near them. There has been a history of sinkholes reopening in this area and causing maintenance and repair of interchange ramps and drainage structures. **Figure 5.21-4** and **Figure 5.21-7** show the area of special concern, the associated modified and filled sinkholes, and their historic catchment areas.

In the Tapp Road and SR 45/2nd Street intersections area, the split interchange (Alternatives 5, 7, 8, and the Refined Preferred Alternative 8) has a larger right-of-way for the additional ramps and access lanes. This larger area could cause greater impacts to relevant karst features including sinkholes, increased potential for roadbed subsidence and/or reopened sinkhole(s), and could potentially alter karst recharge patterns more than the less impactful features (overpasses) in Alternatives 4 and 6 and the reuse of the existing SR 45/2nd Street interchange in Alternative 6.

The Section 5 literature search provided numerous examples from across the country of roadbed failures at reopened sinkholes resulting in economic loss and sometimes loss of life (Waltham *et al.*, 2005). Care should be taken to ensure that the design of I-69 Section 5 considers sinkholes which no longer have the appearance and function of sinkholes but have the potential to destabilize the roadbed and adjacent lands.

The following two measures are recommended during design for reduction of roadway contribution to the SR 45/2nd Street – SR 37 Interchange Buried Sinks area:

- Limit paving and construction to the existing SR 37 and SR 45/2nd Street mainline and intersection.
- Care should be taken to ensure that the final design of SR 37 and SR 45/2nd Street considers sinkholes which no longer have the appearance and function of sinkholes but have the potential to destabilize the roadbed and adjacent lands.

4) Cave A Recharge

Due to Cave A's diverse troglobitic (obligate cave dwelling) fauna and state-listed endangered, rare, and watch list species, Cave A is considered an area of special concern (Lewis, 2005). The Cave A recharge area extends beyond the east/west boundaries of SR 37 and the Section 5 corridor. One of the Cave A reported passages extends under existing SR 37 (Roy and Wells, 1959). A much smaller cave system (Cave B) is hydraulically connected to, but located south of, the Section 5 corridor.

Lewis's 2005 investigation indicated that the cave's biological community appears to be in relatively good health despite historical and current runoff from SR 37 and residential land use within its recharge area. A detailed description of the survey methodologies and results of this study can be found in the unpublished *Cave Fauna of the Section 5 Corridor of I-69* (Lewis, 2005), provided as part of **Appendix Y**, *Final Karst Report (Redacted).* No federally listed species were identified during the Section 5 studies.

The I-69 Section 5 planning and design process will attempt to minimize potential additional impacts from water derived from Section 5. While there is little direct data on cave passage depth, based on a comparison of spring and corridor elevations, some Cave A conduits may be not much more than 20 feet and are no more than 100 feet in depth. While the Cave A passage that extends under SR 37 was reported as a narrow, linear feature, if bedrock removal is included in construction designs in this area, geophysical surveying to evaluate the potential for intercepting this conduit will be required.

The Monroe Hospital complex, Medical Park Boulevard, parking lots, electrical sub-station, and two retention basins were constructed on the southwest corner of the Fullerton Pike/SR 37 intersection. Additional medical or commercial development buildings and related parking lots, new access roads, onsite stormwater management, and a helipad are also planned. Most of this complex and new development is within the Cave A recharge area and is expected to alter the recharge patterns for the Cave A system (see **Figure 5.21-4** and **Figure 5.21-8**).

All of the six alternatives are within the Cave A recharge area and have similar impact areas. The proposed six-lane I-69 will have similar type of direct impacts to the Cave A and Cave B Systems as the existing four-lane SR 37 (see **Figure 5.21-8**):

- The That Road to Rockport Road local access road and the Rockport Road overpass have similar impacts to the Cave A recharge area in all six of the alternatives.
- The eastern shift off of existing SR 37 in Alternatives 4 and 5 have increased impacts to the Cave A recharge area compared to Alternatives 6, 7, 8 and Refined Preferred Alternative 8 that stay on existing SR 37 for both the mainline and the Fullerton Pike interchange.
- The Cave A recharge area impacts related to the Fullerton Pike interchange are limited to the southern part of the south side interchange ramps. This change is not considered to be of sufficient magnitude to adversely affect the Cave A fauna.
- The Cave A recharge area is to the west of the Monroe County Fullerton Pike project that begins at the Fullerton Pike and Rockport Road intersection.

Several treatment options are available for consideration as potential mitigation measures in implementation of the Karst MOU to reduce roadway impacts to the Cave A recharge area and maintain the existing base flow levels in the system:

- Engineered wetland sediment and contaminant reduction systems.
- Linear peat sand filters and/or vegetated swales along the roadway or at the terminus of lined storm water control structures.
- Runoff and storm water detention/retention systems, treatment, and infiltration galleries.
- Control of "first flush" (or initial stormwater runoff which typically will have higher contaminant concentrations) volumes with designed overflow into natural drainage systems.

5.21.3.6 Potential Impacts upon Unidentified Karst Features

The alternatives are located within karst terrain exhibiting dense concentrations of karst features distributed across the Section 5 corridor. Highway construction and operation-related impacts to identified karst features are unavoidable. It should be noted that unidentified subterranean karst features are undoubtedly present, and an unknown number of such unidentified features will be encountered and impacted during highway construction. The methodology developed for the karst survey included the identification of karst features that could be visually observed from the surface of the ground. Unidentified underground karst features are likely to be present within the project area. Following standard karst investigation practices, dye tracing was conducted in order to determine groundwater flow patterns in the area. However, identification of the exact location of the subsurface features associated with this flow cannot be accomplished without invasive ground disturbance (e.g., excavation) and potentially impacting the feature or disturbing the habitat under investigation. Accordingly, it is expected that unidentified subsurface karst features and underground flow paths would be present in the study area. The Karst MOU was developed with the understanding that it is possible that previously unknown subsurface karst features may be unearthed during construction (i.e., steps to address features discovered later in the process). Karst feature identification for areas covered by existing SR 37 pavement and clear zone included the following:

- Reviews of previously listed literature sources;
- LiDAR-based two-foot contours from Monroe County GIS;
- 1937 stereo-pair aerial photographs; and,
- Field observations.

Mitigation for impacts to unidentified karst features will be managed in the same manner as mitigation for impacts to identified features, as described below.

5.21.3.7 Potential Impacts upon Threatened and Endangered Species and Cave Biota

Both Cave A and Cave B and their associated conduits, groundwater systems, and recharge areas are hydrologically connected to the existing four-lane SR 37 right-of-way; this hydrologic connection will continue in the Section 5 portion of I-69. Additionally, historic maps of the Cave A system show cave passages that extend under existing SR 37 right-of-way. A number of cave entrances that were reported are no longer accessible, and thus, the accuracy of the historic maps cannot be confirmed. Three accessible caves have been linked to the corridor hydrologically or by logical inference:

- Cave A has been mapped under SR 37 (Roy and Wells, 1959), and six Tier 2 and two historic dye traces were detected at its spring.

- While Cave B has been linked by dye tracing to the existing SR 37 and Section 4 Corridor, the Cave B recharge area is over 800 feet south of the Section 5 corridor (see **Figure 5.21-8** *Area of Special Concern: Cave A Recharge [with Cave B Recharge]*). Cave B is more accurately termed a karst window with limited access to a water filled cave passage.

- Cave C is a tributary to Cave A, receives runoff from the Section 5 corridor, and is included in the Cave A recharge area.

Cave A and Cave B and their associated conduits, groundwater systems and recharge areas were identified for a biological survey based on their connection to SR 37, literature searches, and reconnaissance observations conducted as part of the Section 5 investigation. Ozark Underground Laboratory and its subcontractor, Lewis & Associates, conducted the survey (see **Appendix Y**, *Final Karst Report [Redacted]*). The state-listed species status has been updated since the generation of Dr. Lewis' 2005 report. The *Final Karst Report* includes the following 2012 status update:

State Listed Species	2005 Status	2012 Status
• Indian cave springtail	State Endangered	State Watch List
• Packard's groundwater amphipod	State Rare	State Watch List
• Cave crayfish	State Threatened	State Rare
• Barr's cave crayfish	not listed	State Watch List
• Bollman's cave millipede	State Rare	State Watch List

The survey report concluded the following:

- There were no federally listed species identified as part of the biological surveys.
- Five troglobitic species were identified in Cave B, two of which are state-listed Rare Species (cave crayfish *Orconectes inermis testii* and Barr's cave amphipod *Crangonyx barri*).
- A spring located down gradient of Cave B had no troglobitic species.
- Cave C had one troglobitic species (cave dung fly *Spelobia tenebrarum*) that is not designated rare or protected.
- Cave A had 11 troglobitic species, of which eight are globally rare. Two are state-listed Rare Species (Barr's cave amphipod *Crangonyx barri* and cave crayfish *Orconectes inermis testii*); four species are on the State Watch List (Barr's cave crayfish ostracod *Sagittocythere barri*, Packard's groundwater amphipod *Crangonyx packardi*, Bollman's cave millipede *Conotyla bollmani*, and Indiana cave springtail *Sinella alata*); and, two are state-listed Endangered Species (hidden spring snail *Fontigens cryptica* and Mayfield cave beetle *Pseudanophthalmus shilohensis mayfieldensis*).
- The existing four-lane SR 37 is located within the Cave A and Cave B recharge areas. All six of the Section 5 alternatives will increase the existing SR 37 impacts to karst features with the addition of a third travel lane, wider shoulders, and additional right-of-way by increasing the amount of impermeable land cover, blocking existing water entry routes, and by increasing the stormwater runoff rates and the available mass of transportation related compounds.

Since Cave A and Cave B were considered biologically significant due to the presence of state-listed species, as part of the Karst MOU compliance, special water quality protection measures may be required to protect these fauna. INDOT or its contracted representative will be responsible for development and implementation of any specific Karst MOU compliance and potential special water quality protection measures identified during the design phase. **Section 5.21.4**, *Mitigation*, details both general measures and those specific to a single karst feature, such as:

- Engineered wetland sediment and contaminant reduction systems.
- Linear peat sand filters and/or vegetated swales along the roadway or at the terminus of lined storm water control structures.
- Sinkhole sediment contaminant traps.
- Runoff and storm water detention/retention systems, treatment, and infiltration galleries.

- Control of "first flush" (or initial stormwater runoff which typically will have higher contaminant concentrations) volumes with designed overflow into natural drainage systems.

Karst springs are present within these caves. As required by Steps 4, 7, 8, and 10 of the Karst MOU, highway runoff will be treated through implementation of BMPs and measures developed for a specific feature (such as the Cave A recharge) prior to being directed toward a karst feature. Existing SR 37 was constructed through the Cave A and B recharge areas in the 1970's. The fauna identified in the 2005 biological survey (**Appendix Y**, *Final Karst Report [Redacted]*) may have become conditioned to the residential and transportation land use after more than 40 years of influence. The project should not result in such changes of a sufficient magnitude to adversely affect the identified state-listed species.

5.21.3.8 Pollutant Loading Analysis

Step 2 of the Karst MOU requires that estimates of pollutant loads from the highway and drainage area within the right-of-way be made, including prior to, during, and post construction. The calculation procedures are based upon models developed to predict pollutant loads without field measurements presented in an FHWA training course. The modeling procedure was developed based on a monitoring program conducted in 1976 and 1977 at sites in Milwaukee, Wisconsin; Harrisburg, Pennsylvania; Nashville, Tennessee; and Denver, Colorado. The model uses Total Solids as the carrier pollutant for the model because they showed the highest correlation with the other monitored quality parameters when regression analysis was performed.

Table 8.2.4 in the FHWA training course methodology in Appendix L of **Appendix Y**, *Final Karst Report (Redacted)*, shows modeled results versus actual monitored results for six highways. The predicted versus the actual monitored data are within one order of magnitude for all values. Total solids and suspended solids were relatively close but there was greater variation with the other pollutants. The methodology also acknowledges some limitations of the model due to the complex interaction of rainfall, runoff and traffic on highways. These limitations include: 1) geographic locations with low intensity, frequent rainfalls (i.e. Pacific Northwest – this is not believed to generally be a concern in Indiana); 2) procedure should be limited to non-winter periods; 3) procedure is better suited to continuous simulation using daily rainfall records covering periods of at least one month; 4) model assumes the highway area to be uniformly characterized by the three site types listed (this project was assumed to be a Type II highway with some curb or barrier, structured drainage, and grassy right-of-way); 5) predicted pounds of total solids washed off during a rainfall event are dependent upon the model prediction of the surface load at the start of the storm, if the surface load is underestimated, the pounds discharged will be low; 6) use of average runoff rate to remove surface pollutants is the quickest and easiest method; 7) long dry periods and overlapping storms present predictive problems in determining the pre-storm surface load; and, 8) construction activities are difficult to simulate unless monitoring data is available.

The FHWA calculations include the following values:

- Chemical oxygen demand (COD)
- Cadmium, chromium, copper, iron, lead, mercury, and zinc
- Total suspended solids (TSS)
- Total organic carbon (TOC)
- Volatile suspended solids (VSS)
- Total volatile solids (TVS)
- Total nitrates (TN)
- Total Kjeldhal Nitrogen (TKN)
- Total phosphorous
- Chloride

Pollutant loading estimates are included in **Appendix Y**, *Final Karst Report (Redacted)*. As required by Step 8 of the Karst MOU, a monitoring and maintenance plan will be developed for the project. IDNR, IDEM, and USFWS will be provided an opportunity to review this plan.

The pollutant loading estimates were modified into concentrations by taking the loadings and dividing by the volume of rain water (for a particular rain event) inside the right-of-way that would drain into the karst feature. Concentrations of pollutants were then compared to Indiana's Water Quality Standards for aquatic life and drinking water. These standards are from Indiana Administrative Code (327 IAC 2-1-6) and assume a hardness of 250 mg/L. The five pollutants that are exceeded the most often are lead, copper, total nitrogen, cadmium and mercury. For the *pre-construction* estimates, the roadway runoff concentrations for 37 to 53 of the karst features impacted by the Refined Preferred Alternative 8 exceeded the water quality standards for lead, copper, total nitrogen, cadmium and mercury. For the *post-construction* estimates, the roadway runoff concentrations for 39 to 57 of the karst features analyzed exceeded the water quality standards for lead, copper, total nitrogen, cadmium, and mercury. The FHWA course materials state that caution must be used when interpreting the pollutant loadings of lead predicted by the model. The reduction in lead in gasoline has resulted in an estimated 50% reduction in lead loadings since the predictive equation was developed.

The pollutant loading calculations represent estimates of pollutant loads. Several assumptions had to be made to conduct this analysis at early stages of the project design. These assumptions overestimated the pollutant loads and are acknowledged in the *Final Karst Report (Redacted)* (**Appendix Y**). For example, it is assumed that the entire length of right-of-way within the feature drainage area drains directly into an opening in the feature. In many cases, this is highly unlikely. For instance, if a karst feature is located on the backslope of a ditch along the southbound lane, there is no guarantee that highway runoff from the median or ditch along the northbound lane would drain to the karst feature. Also, where multiple karst features are located within the same right-of-way drainage area, the pollutant loading calculation for each feature assumed no run off would drain into the other features. In all likelihood, the karst features would share the runoff volumes. Finally, the roadside and median ditches are designed for conveyance and outlet into streams and creeks, not into karst features such as sinkholes or swallets. Therefore, it is reasonable to assume that runoff would not find its way to a feature, instead traveling along the ditch grades and culverts as designed and constructed. The pollutant loading calculation assumed the entire right-of-way would drain into the karst feature, and not be conveyed elsewhere.

As part of the construction and construction oversight, strict adherence to the erosion control measures is essential. Runoff and sediment control are to be performed during construction in accordance with the Erosion and Sediment Control plans developed in compliance with the October, 2007 version of the Indiana Storm Water Quality Manual (IDEM). According to the "Results of MOU-Related Karst Studies for Indiana State Road 37, Lawrence County, Indiana (1992-1995)" (EarthTech, 1997), there were elevated levels of total suspended solids (TSS) and total recoverable metals (TRM) for arsenic, copper, lead, and zinc to the subsurface associated with the during-construction activities for the SR 37 project. These levels returned to pre-construction conditions about two years after construction.

When discussing the results of the SR 37 Study ("Results of MOU-Related Karst Studies for Indiana State Road 37, Lawrence County, Indiana (1992-1995)", in relation to the I-69 project, it is acknowledged that the determination and installation of karst drainage structures for the SR 37 project was done when construction had already begun, allowing less time for planning and design. Therefore, some drainage structures, and associated detention basins, were not designed to handle the correct amount of runoff capacity. Some additional sinkhole excavation was needed to increase the size of the drainage structure and/or detention basin. This sinkhole excavation, done during the road construction, contributed to higher levels of TSS. The SR 37 Study states, when speaking of the temporary increases in pollutant loadings, "This is not likely to be a problem for future construction projects that are fully carried out within the MOU framework" (SR 37 Study, page 66). The strategy to avoid subsurface contamination of TSS and TRM will be contained in the Erosion Control Plan and fulfillment of the Rule 5 requirements. Erosion control standards and specifications have changed and improved since the SR 37 project. A mitigation commitment has been added to **Section 5.21.4,** *Mitigation* and **Section 7.3**, *Section 5 Mitigation Measures and Commitments*, requiring the designer to abide by Item B1 of the Erosion Control Plan Development which emphasizes control of pollutant sources and requires a plan to minimize the danger of pollutants entering storm water. In addition to karst feature avoidance and runoff treatment, the diversion of road runoff away from sensitive karst groundwater systems is included in the mitigation recommendations. Recommendations to treat runoff that would be directed to sensitive karst features could include: an engineered wetland sediment/containment reduction system; linear peat sand filters and or vegetated swales; sinkhole sediment and containment traps; runoff and storm water detention/retention systems, treatment and infiltration galleries; and, control of first flush volumes with designed overflow into natural drainage. These treatment options are not incorporated into the pollutant loading analysis. The methodology assumes no treatment.

Based on up-front planning associated with the Karst MOU and improved erosion control standards and specifications, it is anticipated that TSS levels, and corresponding pollutant levels, will be lower and return faster to preconstruction levels than those experienced during the SR 37 study referenced above.

5.21.3.9 Cumulative and Indirect Impacts

Within the Section 5 Indirect Impact Study Area (refer to **Section 5.24**, *Indirect and Cumulative Impacts*, for more information about induced growth), residential, commercial, and industrial development; water, sewer, and septic systems; agriculture, logging, and limestone quarrying

have been and will continue to be the principal stressors of karst resources and private groundwater wells. The use of fertilizers, insecticides, and pesticides, as well as contaminated runoff from agricultural operations and septic systems can result in karst water quality degradation. In addition, continued urban and rural development in Monroe County changes infiltration and runoff patterns, which can affect karst flowpaths and potential contaminant releases to karst resources and private groundwater wells.

The Monroe County Fullerton Pike project that begins at the Fullerton Pike and Rockport Road intersection crosses approximately 1,000 feet of the relevant karst identified for Section 5. This is a small portion and would provide limited opportunity for development beyond that already included for the Fullerton Pike interchange, additional I-69 capacity, and improvements to the Rockport Road and Fullerton Pike portion of the Section 5 project. In addition, local karst and drainage ordinances and the likelihood for utility service extensions (i.e., a reduced potential for installation of new septic fields) along the Fullerton Pike project would provide protection to karst and groundwater quality similar to those in the greater Bloomington area.

This cumulative effects analysis focuses on the direct, indirect, and other reasonably foreseeable changes to karst groundwater and private groundwater wells associated with construction of the six alternatives. Traffic Analysis Zones (TAZs) and predictions of induced growth within TAZs were made for this project. **Section 5.24**, *Indirect and Cumulative Impacts*, (**Figure 5.24-7 A-C**) depicts the location of the TAZs relative to the Section 5 corridor and relevant karst areas. The location of TAZs within which induced growth was predicted relative to karst resources within the Section 5 corridor was assessed. Since no karst features were identified in Beanblossom Valley or north of Chambers Pike, this area is not included in this assessment. Induced growth within the portion of the Section 5 corridor where karst resources were identified is predicted to occur in 10 TAZs for Alternatives 4 and 6 and in nine TAZs for Alternatives 5, 7, 8 and Refined Preferred Alternative 8.

Within the 10 TAZs applicable to Alternative 4, the total acreage of land affected by induced growth was predicted to be 34 acres (24 acres for housing and 10 acres for employment related development). Within the nine TAZs applicable to Alternatives 5, 7, 8 and Refined Preferred Alternative 8 TAZs, the total acreage of land affected by induced growth was 37 acres (27 for housing and 10 for employment related development). Within 10 TAZs applicable to Alternative 6, the total acreage was predicted to be 46 acres (36 for housing and 10 for employment related development).

While karst features are located within TAZs identified for induced growth, this would not necessarily result in an equal amount of indirect impacts to karst features. A complete analysis of potential indirect impacts to individual karst features is beyond the scope of this study. All karst features within the two-county study area have not been identified and it is not specifically known where development will occur. Additionally, karst protection land use regulations and use of municipal water and wastewater utilities would lessen the potential for indirect impacts to karst features.

These TAZs occur within the water service area of the City of Bloomington Utilities. Therefore it is likely that some percentage of the induced residential and employment related development will make use of the water utility. Private water wells and septic systems exist within these TAZs. Induced growth will cause more pressure on karst resources and private groundwater wells. It is anticipated that the potential for negative effects upon drinking water supplies would be lessened somewhat through implementation of Monroe County Health Board ordinances pertaining to septic system design approval, as well as Monroe County zoning ordinances pertaining to karst and sinkhole development standards which establish review procedures, use limitations, design standards, and performance standards applicable to site developments that encompass or affect sinkholes or other karst features. The intent of this ordinance is to protect the public health, safety, and welfare by requiring the development and use of environmentally constrained areas to proceed in a manner that promotes safe and appropriate storm water management and ground water quality. The six alternatives will result in similar impacts upon these resources. Impacts upon many karst features, including caves and areas of dense karst feature concentrations, were avoided and or minimized during alternative development and screening.

Local implementation of Chapter 829 of the Monroe County Zoning Ordinance and 20.05.042 Environmental Standards; Karst Geology of the City of Bloomington Unified Development Ordinance will lessen potential indirect and cumulative effects to karst features including limits on land disturbance within such areas, the provision of buffer areas, extraordinary erosion control measures in such areas, and water quality protection measures.

5.21.4 Mitigation

A primary objective of the Karst MOU is to minimize the effects of highway construction and operation on karst resources. The four strategies outlined in the Karst MOU to achieve this objective, in order of priority and/or effectiveness, are avoidance, alternative drainage, mitigation/treatment, and operation and maintenance.

Karst biological communities are known to be susceptible to changes in temperature and humidity within their ecosystem. In accordance with the Karst MOU, a monitoring and maintenance plan will be developed for affected karst features. This monitoring and maintenance plan would address karst impacts and treatment measures during and post construction. Also in accordance with the Karst MOU, if during construction additional karst features are discovered and it is found that the mitigation agreement must be altered, all of the agencies will be contacted and agreement reached prior to work continuing in that specific area of the project. It is also recommended that temporary caps be placed over any exposed karst feature discovered during construction to limit changes to temperature and humidity within the karst ecosystem.

Per USEPA written comments on the Section 4 DEIS, a firm commitment has been added for Section 5 that if active groundwater flow paths are discovered, measures will be taken to perpetuate the flow and protect water quality.

While avoidance is the preferred strategy for minimizing karst resource impacts associated with highway construction and operation, I-69 Section 5 would be constructed primarily on land along existing SR 37 right-of-way. Therefore, opportunities for avoidance are limited. According to Step 14 of the Karst MOU, if during construction previously unknown karst features are identified and it is found that the mitigation agreement must be altered, all of the agencies will be contacted and agreement reached prior to work continuing in that specific area of the project. Mitigation for impacts to unidentified karst features will be managed in the same manner as mitigation for impacts to identified features.

Unavoidable impacts are addressed via consideration of alternative drainage and other appropriate mitigation/treatment measures. Collection and management of highway runoff is an important consideration during the development of the roadway design as well as the development of karst impact mitigation measures. The term "alternative drainage" involves directing highway runoff to surface drainage and away from recharge features such as sinkholes, swallets, and sinking streams. Alternative drainage also includes avoiding severing karst conduits between recharge features and discharge features so as to avoid/minimize potential downstream effects upon troglobitic species that cannot be directly observed due to lack of adequate access to caves which serve as their habitat.

It should be noted that utilizing alternative drainage will not always be a viable option within the Section 5 corridor. In some areas karst features extend across the entire corridor, which could preclude diverting runoff from the highway away from all karst features. This is especially true in Monroe County.

When alternative drainage is not an option, potential highway construction, operation, and maintenance measures developed in accordance with the Karst MOU and used to perpetuate and/or treat highway drainage include, but are not limited to, the following:

- INDOT has made a mitigation commitment for a Low salt/No spray zone for Section 5 that will extend from the Section 4 interchange to approximately 200 feet north of Chambers Pike (this includes all karst areas within Section 5). Further coordination with the Karst MOU agencies will occur during the design phase of the project regarding low-salt zones.

- Implementation of hazardous waste traps will be conducted by INDOT (or their designated contractors) to protect karst features against hazardous materials spills per Step 7 of the Karst MOU.

- As stated in Step 8 of the Karst MOU, additional information on runoff treatment and protocol for long term monitoring will be developed in the design phase of the project and provided to the IDNR, IDEM, and USFWS for review. As stated in Step 10 of the Karst MOU, an agreement between INDOT, IDNR, IDEM, and USFWS that will specify the appropriate and practicable measures to offset unavoidable impacts to karst features will be signed prior to acceptance of final design plans.

- Installation of concrete caps, specially designed drainage structures, detention basins, or swales, peat filters, and spring boxes.

- Natural vegetative treatment for road runoff.

- Examination of the areas that receive runoff from the highway to detect soil piping (conduits within soil – not bedrock) or opening of buried karst features. Soil piping will be addressed by the contractor during the weekly erosion control inspections (or after a rainfall of a ½ inch or more) required as part of the Rule 5 permit during construction. Inspections following construction will be determined during the final design phase as part of the monitoring and maintenance plan under Step 11 of the Karst MOU. It will be INDOT's responsibility (or their designated agent's) responsibility to perform these inspections, depending on the structure of the contract. Quarterly inspections and inspections after all heavy rains are recommended for the first year. Annual or bi-annual inspections are recommended after the first year.

- Strict runoff/erosion control measures in accordance with Chapter 37 of the INDOT Design Manual and/or the IDEM Storm Water Quality Manual, whichever is more stringent for each situation.

- INDOT will conduct routine maintenance and inspection of treatment/containment structures. INDOT staff and other consultants have been identified to be in the field to complete contractor compliance inspections on a regular basis to help control erosion and sediment on the project.

- The Contractor will be required to develop a Storm Water Pollution Prevention Plan (SWPPP) for each individual project and the SWPPP must be reviewed by INDOT Environmental Services and IDEM Wetlands and Storm Water Section for comments.

- It is anticipated that the Blasting Operations Specifications utilized during the Section 4 construction in karst areas will be utilized for the Section 5 activities. The specification was developed to protect karst and limestone resources.

- Karst training will be developed for implementation during construction and is anticipated to include karst-specific field check meetings and a karst awareness video as a INDOT mitigation commitment.

Because this project will require a Rule 5 Permit issued by IDEM, INDOT has made a mitigation commitment (see **Section 7.3** *Mitigation Measures and Commitments*) requiring the designer to abide by Rule 5, Item B1 of the Erosion Control Plan, which states:

> "This item is included in the rule to place an emphasis on identification of pollutants that are associated with construction activity. In the past, the emphasis has been on sediment reduction; however the rule requires the plan preparer to identify other potential pollutants and their sources. Potential pollutant sources

include material and fuel storage areas, fueling locations, exposed soils, leaking vehicles and equipment, etc.

To satisfy this item, the plan needs to contain a written description of the expected pollutants that could enter storm water during the construction operation, and where those potential pollutants might be generated. In addition, the plan preparer should include discussion of measures or operational activities that will be initiated to minimize the danger of pollutants entering storm water."

Several erosion and sediment control methods could be used in steep terrain and could include surface stabilization measures, runoff control measures, sediment barriers and filters, and other measures including surface roughening and the use of retaining walls where appropriate. Surface stabilization measures could include temporary seeding, erosion control blankets, and riprap slope protection. Runoff control measures could include temporary and permanent diversions, water bars, rock check dams, and temporary slope drains. In addition, sediment barriers and filters could include silt fence, filter tubes/socks, and vegetative filter strips.

In areas where alternative drainage is not possible, mitigation and treatment for karst features receiving highway drainage will include the implementation of water quality treatment or abatement measures for highway runoff prior to its release toward karst features. Such measures include peat and sand filters, gravel filters, vegetative buffers, and lined spill or runoff containment structures. These structures could be constructed in appropriate locations along the highway to detain and/or treat highway runoff prior to discharge. Monitoring is required by the Karst MOU to assure that the drainage discharged from these structures has minimal impact on karst features.

Special planning, where appropriate and practicable, will be conducted by INDOT to ensure that highway derived runoff is dispersed through natural vegetation and/or an engineered treatment system before entering the groundwater system. Also, where appropriate and practicable, special planning should be conducted so that construction does not sever recharge features by sedimentation or impervious cover.

There are locations along existing SR 37 where runoff water is directed to karst features (i.e. sinkholes). While the specific karst features requiring a Class V injection well are not known at the stage of the Section 5 project, they are likely to be related to sinkholes if they are modified to receive Section 5 stormwater drainage as part of final design. In such a case, a Class V injection well permit may be required by USEPA Region 5 if untreated fluids discharged through a Class V well may otherwise endanger an underground source of drinking water. If there are measures in place to prevent contamination of groundwater, a Class V well could be authorized by rule rather than by a permit. Most of the Class V well permits anticipated within Section 5 would be authorized by rule because there will be measures in place to prevent contamination as part of sinkhole mitigation under the Karst MOU.

A Class V Well Inventory Form would need to be provided to USEPA Region 5 prior to construction of a Class V injection well so that USEPA could determine if a Class V injection well permit will be required for any Class V wells. For the I-69 project, if the inventory information provided indicates that any injection well would likely contaminate any underground source of drinking water, a permit would be required. Any permit would need to be applied for and obtained prior to construction of the Class V well.

Appendix Y, *Final Karst Report (Redacted)*, identifies additional BMPs that will be considered for implementation for the project and includes additional information pertaining to mitigation. Under Step 8 of the Karst MOU, a monitoring and maintenance plan will be developed for affected karst features. A listing of karst feature treatment circumstances which may require BMP implementation, BMPs that may be implemented, and a numerical cross-reference to applicable but not karst specific INDOT Standard Specifications, such as Standard Specification 205 pertaining to soil liners, is included in **Table 5.21-3**. The INDOT Standard Specifications are available on-line at: http://www.in.gov/dot/div/contracts/standards. This listing is not intended to be all-inclusive. These and other BMPs identified in the Tier 2 Section 5 FEIS/ROD, *Final Karst Feature and Groundwater Flow Investigations Report* (**Appendix Y**, ***Final Karst Report***), and the 1993 Karst MOU will be considered for implementation on a case by case basis.

Table 5.21-3: Best Management Practices (BMPs) in Karst Terrain

Best Management Practice (BMP)	Description	Numerical Reference to INDOT Standard Specification[2] (where applicable)
Ditch Lining		
Compacted clay liner	Lined ditches can be utilized to prevent erosion. The hydraulic analysis in design will determine the water flow and velocity to select the proper lining. This will not only reduce erosion but also limit the sediment transport into karst features.	205 describes the installation of pond liners, synthetic liners, and soil liners and could be adapted to this work.
Geosynthetic clay liner	This is an effective method to protect groundwater penetration along a road side ditch.	205 describes the installation of pond liners, synthetic liners and soil liners and could be adapted to this work.
Flexible membrane liners	Beneficial since these will conform to undulating topography.	205 describes the installation of pond liners, synthetic liners, and soil liners and could be adapted to this work.
Concrete, Portland cement, or asphalt	Can be used, although not as aesthetically pleasing as the other options.	607 describes paved side ditch construction for both concrete and asphalt work.

[2] INDOT has not developed standard specifications for every conceivable mitigation need which may be encountered. If specific field conditions require a mitigation measure for which INDOT presently has no Standard Specification, then a Unique Special Provision could be developed and approved by INDOT.

Table 5.21-3: Best Management Practices (BMPs) in Karst Terrain

Best Management Practice (BMP)	Description	Numerical Reference to INDOT Standard Specification[2] (where applicable)
Sinkhole - Bridging		
Culvert or bridges	The INDOT Drainage Design Manual will be used to size the openings of bridges and culverts. Unique backwater conditions created by karst features will be evaluated further in design to assure proper detention storage. If a karst feature cannot be avoided, filled, or capped, the roadway should span the feature and be anchored (reinforced) into competent bedrock. Cuts into bedrock should be minimized when possible.	714, 715, 723 describe different culverts and concrete boxes and 3-sided structures that can be installed.
Reinforcing within cave	The mortar will coat and strengthen the cave walls.	708 describes pneumatically placed mortar (shotcrete).
Ground modification	Can strengthen soils by injecting concrete or lime.	203 describes soils modification with chemical.
Geopier with cap	Typically installs quicker than traditional piers or piles; will provide strength to wide range of soils	INDOT does not directly address Geopier, but 701 gives requirements for piles and piers.
Piles with cap	Traditional method for vertical reinforcement of soils.	710 addresses pile installation.
Sinkhole - Filling		
Rock pads	Works where the velocity of the storm water needs to be decreased to prevent erosion.	205 describes rock splash pads as an erosion control measure.
Large rock fill	Effective for slope stability issues.	203 describes placing large rock fill before backfilling with structure backfill or borrow.
Compaction grouting	Useful where soil is loose or soft and does not need a large area for installation.	A standard would have to be written for this.
Cement grouting	Effective where there are significant voids and cracks in load bearing rock	206 describes the process for grout injection.
Dynamic compaction	Will increase the density of the soil, even soil below the groundwater; best for granular soils.	203 describes excavation and backfilling requirements as well as chemical soil modification.
Excavation, overlapping geotextiles, soil backfill	If a sinkhole is located within the new right-of-way, yet has a very small drainage area, then capping is more appropriate (versus installing a catch basin and standpipe).	203 describes excavation and backfilling requirements as well as chemical soil modification.
Excavation, concrete cap, soil backfill	If a sinkhole is located within the new right-of-way, yet has a very small drainage area, then capping is more appropriate (versus installing a catch basin and standpipe).	203 describes excavation and backfilling requirements as well as chemical soil modification.

Table 5.21-3: Best Management Practices (BMPs) in Karst Terrain		
Best Management Practice (BMP)	**Description**	**Numerical Reference to INDOT Standard Specification[2] (where applicable)**
Other		
Avoidance	The alternatives have been screened for the number of karst features that may be affected. As design further details the road's cross section and alignment at a particular karst feature, avoidance should continue to be considered if cost effective and within appropriate design criteria.	
Alternative drainage	Redirecting highway runoff away from karst recharge features. Will be implemented where feasible. In some areas, this is not an option due to karst features being distributed across the corridor.	
Earth berm construction	Provides a natural look to the erosion control.	205 describes diversion berms of earth or rock as an erosion control method.
Gabion berm construction	May be appropriate at very steep slopes (>10%).	Recurring provision 625-R-194 describes the requirements and placement of gabions.
Open standpipe installation	A chimney (standpipe), catch basin, and rock filter is a common BMP for sinkholes located within the right-of-way of the new road. These were used in the SR 37 project.	A standard would have to be written for this.
Concrete catch basin installation	A chimney (standpipe), catch basin, and rock filter is a common BMP for sinkholes located within the right-of-way of the new road. These were used in the SR 37 project. They can be enhanced to include a special basin to act as a hazardous material trap (HMT) that can be specially drained to avoid the adjacent watershed.	720 describes catch basins and installation.
Natural vegetative buffers	Could be constructed in appropriate locations to detain/treat runoff prior to discharge. Same season re-vegetation should occur when possible.	Section 621 describes installation of vegetative cover, as well as timeline for when they must be installed, and the method for installation.
Peat/sand/gravel filters	Could be constructed in appropriate locations to detain/treat runoff prior to discharge.	205 describes placement of erosion control and filtering devices as an erosion control measure.

Table 5.21-3: Best Management Practices (BMPs) in Karst Terrain		
Best Management Practice (BMP)	**Description**	**Numerical Reference to INDOT Standard Specification[2] (where applicable)**
Spring boxes	Use to protect spring discharge	205 describes placement of erosion control and filtering devices as an erosion control measure.
Energy dissipation devices (e.g. scour holes, riprap linings, stilling basins)	Use at culvert and storm sewer outlet locations to prevent erosion to existing channels. Will be based on INDOT's Drainage Design Manual.	Section 616 describes riprap placement and type for energy dissipation and scour protection.
Agencies (IDNR, IDEM, USFWS) attend field checks/meetings	Meet during later design in effort to negate/minimize adverse effects.	Would need special standard provision; Indiana Design Manual defines the parties required to attend field checks during design, and Section 105 defines coordination procedures and agencies the contractor much include and coordinate with.
Notify the USFWS & IDNR if a state/federal listed species is observed during construction	Work will stop within the project area and these agencies will be notified.	Would need special standard provision; Section 107 describes contractor's responsibilities to follow permits and laws, responsibility to the public.
Newly discovered cave during construction	Karst experts will be consulted to determine the significance of the cave.	Would need special standard provision; Section 107 describes contractor's responsibilities to follow permits and laws, responsibility to the public.
Geogrid or geotextile layers	Could be installed in the lower reaches of embankments, embankment foundations, or roadway subgrades.	214 describes geogrid installation requirements.
Operation/Maintenance		
Discovery of karst features previously not known	Examination of areas that receive runoff from highway to detect soil piping or opening of buried karst features.	A standard would have to be written for this.
No-mowing, low salt, or no-spray zones and associated signage	Implemented in order to increase vegetative groundcover and filter runoff prior to leaving right-of-way.	Section 621 describes "Do Not Spray" and "Do Not Mow" signage and placement.

Table 5.21-3: Best Management Practices (BMPs) in Karst Terrain

Best Management Practice (BMP)	Description	Numerical Reference to INDOT Standard Specification[2] (where applicable)
Routine maintenance and inspection of treatment/containment structures	Verify capacity, integrity, and operational efficiency of structure.	Section 205 describes the type and frequency of inspection of temporary erosion control devices; INDOT to assume responsibility of permanent devices after final acceptance of the project.
Emergency response plan	To be developed post-NEPA, as stated in Step 11 of the Karst MOU.	
Installation of signage alerting public that all spills are potentially hazardous	In order to increase public awareness in sensitive areas.	Would need a special provision; 802 describes sign placement and type for unique sign types.

Note:

INDOT has not developed standard specifications for every conceivable mitigation need which may be encountered. If specific field conditions require a mitigation measure for which INDOT presently has no Standard Specification, then a Unique Special Provision could be developed and approved by INDOT.

Feature-specific impact reduction recommendations were made for four karst Areas of Importance in Section 5:

1) Lemon Lane Landfill / Illinois Central Spring Superfund Site

The following four measures are recommended for reduction of roadway contribution to the ILCS recharge area:

- Maintain the eastern boundary of the SR 37 right-of-way with any required mainline expansion or new access roads to the west, away from landfill.
- Shifted the proposed Vernal Pike grade crossing north to connect with 17th Street in all alternatives and use of an overpass rather than rock cut for use of underpass in Alternative 7, 8, and the Refined Preferred Alternative 8.
- INDOT has made a mitigation commitment to prevent drainage from increasing above the existing SR 37 levels extending along the eastern side of SR 37 that is within the Lane Landfill/ILCS recharge area to address USEPA and IDEM concerns regarding changes in existing groundwater flow. Coordination with USEPA and IDEM has occurred throughout the Section 5 study and will continue through the design phase. Design plans for construction this area will be provided to USEPA and IDEM for review with a requested two week turnaround time for comment.

- Blasting is not anticipated and will not be allowed adjacent to the site to prevent damage to the monitoring system (see **Figure 5.21-5**).

2) Bennett's Dump Superfund Site

The following three measures are recommended for reduction of roadway contribution to the Bennett's Dump recharge area during subsequent design phases:

- Limit paving and construction to the existing SR 37 and SR 46 mainline and intersection.

- INDOT has made a mitigation commitment to prevent drainage from increasing above the existing SR 37 levels extending along the northwest quadrant of the SR 37/SR 46 interchange area to address USEPA and IDEM concerns regarding changes in existing drainage at this site. Design plans for construction in this area will be provided to USEPA and IDEM for review with a requested two week turnaround time for comment.

- Blasting is not anticipated and will not be allowed adjacent to the site to prevent damage to the monitoring system (see **Figure 5.21-6**).

3) SR 45/2nd Street – SR 37 Interchange Buried Sinks

The following two measures are recommended during design for reduction of roadway contribution to the SR 45/2nd Street – SR 37 Interchange Buried Sinks area:

- Limit paving and construction to the existing SR 37 and SR 45/2nd Street mainline and intersection.

- Care should be taken to ensure that the final design of SR 37 and SR 45/2nd Street consider sinkholes which no longer have the appearance and function of sinkholes but have the potential to destabilize the roadbed and adjacent lands.

4) Cave A Recharge

Several treatment options are available for consideration in implementation of the Karst MOU to reduce roadway impacts to the Cave A recharge area and maintain the existing base flow levels in the system:

- Engineered wetland sediment and contaminant reduction systems.

- Linear peat sand filters and/or vegetated swales along the roadway or at the terminus of lined storm water control structures.

- Sinkhole sediment and contaminant traps.

- Runoff and storm water detention/retention systems, treatment, and infiltration galleries.

- Control of "first flush" (or initial stormwater runoff which typically will have higher contaminant concentrations) volumes with designed overflow into natural drainage systems.

5.21.5 Summary

The Section 5 alternatives are located within karst terrain. The project is being developed in a manner consistent with the 17 procedural steps outlined in the 1993 Karst MOU. The majority of Steps 1 through 4 have been completed to date. Steps 5 through 17 will be completed as the project design advances, as well as during and after construction.

Highway construction in karst terrain can be challenged by physical geological conditions (construction within bedrock) and also by the need to manage highway runoff in a manner that avoids and/or minimizes groundwater quality and quantity effects. Changes in groundwater quality and quantity have the potential for adverse effects upon private and public drinking water supplies and karst (primarily cave) biota. Dye traces indicate that karst groundwater flowpaths can discharge to locations well removed from the corridor.

Of the alternatives presented in the FEIS, Alternative 4 would impact the most acreage and number of karst features with 144 features and 439.7 acres, while Alternative 5 has slightly fewer impacts with 138 features and 430.2 acres. Alternative 7 (113 features and 340.3 acres) and Alternative 6 (109 features and 338.5 acres) have similarly lower karst impacts. Alternative 8 has slightly higher karst impacts than either Alternative 6 or 7 with 110 features and 343.7 acres of impact.

Refined Preferred Alternative 8 includes additional right-of-way along SR 45/2nd Street and SR 48/3rd Street to accommodate bicycle, pedestrian, access, and local service road connection considerations. While there is a corresponding increase in karst impacts with these features that are not included in the other five alternatives; similar karst impacts to karst features would occur if these same bicycle, pedestrian, access, and local service road connection considerations were applied to Alternatives 4 through 8. The Refined Preferred Alternative 8 has slightly higher karst impacts than either Alternative 6, 7, or 8, with 110 features and 347.3 acres of impact.

Impacts to Section 5 relevant karst within the right-of-way that may not show surface expression followed a similar pattern with Alternative 4 (909.4 acres), Alternative 5 (874.5 acres), Alternative 6 (686.0 acres), Alternative 7 (683.3 acres), Alternative 8 (710.5 acres), and Refined Preferred Alternative 8 (713.7 acres).

Existing SR 37 right-of-way accounts for at least 50% of the number of karst features, acres of karst features, and acres of relevant karst impacts included in the six alternatives. The karst impacts that extend beyond existing SR 37 right-of-way may be arrived at by subtracting the last

column (Karst Features within Existing SR 37) values from any of the six alternatives shown on **Table 5.21-4.**

In accordance with the Karst MOU, unavoidable impacts upon karst features will be mitigated through implementation of alternative drainage, where feasible. If alternative drainage is not possible, impacts will be mitigated through implementation of BMPs including water quality treatment measures and appropriate operation and maintenance measures.

A summary of karst feature impacts by alternative is presented in **Table 5.21-4.**

Table 5.21-4: Potential Karst Feature Impact Summary

Karst Feature type	Quantity Type	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8	Refined Preferred Alternative 8	Karst Features within Existing SR 37 ROW
Caves Recharge Area	No. of Features	1	1	1	1	1	1	1
	Area (acres)	51.5	51.0	38.8	39.4	38.0	37.4	22.5
Sinking Streams Watershed	No. of Features	5	5	5	5	5	5	5
	Area (acres)	307.3	304.4	253.3	257.5	257.4	259.7	219.2
Sinkhole Drainage*	No. of Features**	105	95	76	78	76	77	54
	Area (acres)**	147.0	141.1	101.3	97.7	100.4	101.1	50.7
Buried Sinks	No. of Features	14	15	14	14	14	14	13
	Area (acres)	30.5	29.5	23.4	24.4	25.3	25.9	21.4
Springs †Flow rates (gallons per minute, or gpm) were estimated in the field and were not measured.	No. <2 gpm†	4	3	2	2	2	2	0
	No. 2-10 gpm†	10	14	7	9	8	8	3
	No.11-100 gpm†	4	4	3	2	3	2	0
	No. >100 gpm†	1	1	1	2	1	1	1
	Total	19	22	13	15	14	13	4
Total Karst Feature Impacts	No. of Features	144	138	109	113	110	110	77
	Area** (acres)	439.7	430.2	338.5	340.3	343.7	347.3	260.7
*Relevant Karst Area*** (acres)*		909.4	874.5	686.0	683.3	710.5	713.7	526.5††
% Total Karst Impacts outside of Existing SR 37 Right-of-Way	% of Features	47%	44%	29%	32%	30%	30%	
	% of Area***	41%	39%	23%	23%	24%	25%	
*% Relevant Karst Area Impacts outside of Existing SR-37 Right-of-Way**** (% of Area)*		42%	40%	23%	23%	26%	26%	

Notes:

* *Additional smaller sinks (both observed and without surface expression during field checks) may be located within larger sinkhole drainages; these are not included in the total number of features or acreages. Karst features impacts <0.1 acres were rounded up to 0.1 acres, while the total karst feature impacts did not include this rounding.*

** *The total karst features area excludes acreage from overlapping features, i.e. it is not a sum of the individual feature acreages rows listed above.*

*** *Relevant karst area is karst that has been demonstrated to have corridor-derived water passing through it; or is linked by logical inference based on the best available geographic, geologic, and hydrologic data. This includes areas that did not have identified surface expression as well as those areas where discrete karst features were identified. Relevant karst outside of Section 5 alternatives' right-of-way were not included in the Karst Impacts by Alternative since potential impacts outside of the alternatives' right-of-way will be subject to subsequent final design and addressed as part of Best Management Practices and mitigation implementation, in coordination with the Karst MOU signatory agencies. The data supporting these conclusions include karst investigations for Tier 2 studies.*

**** *% is calculated by dividing the portion of additional relevant karst area impacts that are beyond the existing SR 37 right-of-way by the total relevant karst area that is within the proposed I-69 Section 5 right-of-way for a given alternative.*

†† *The Karst Features within Existing SR 37 relevant karst area in acres was updated since the DEIS to remove a portion of Section 4 ROD acreage and residential property near Lee Paul Road. Similar edits were made to Tables 5.21-1 and 5.21-4.*

Section 5.21 Figure Index

(Figures follow this index, except as otherwise noted.)

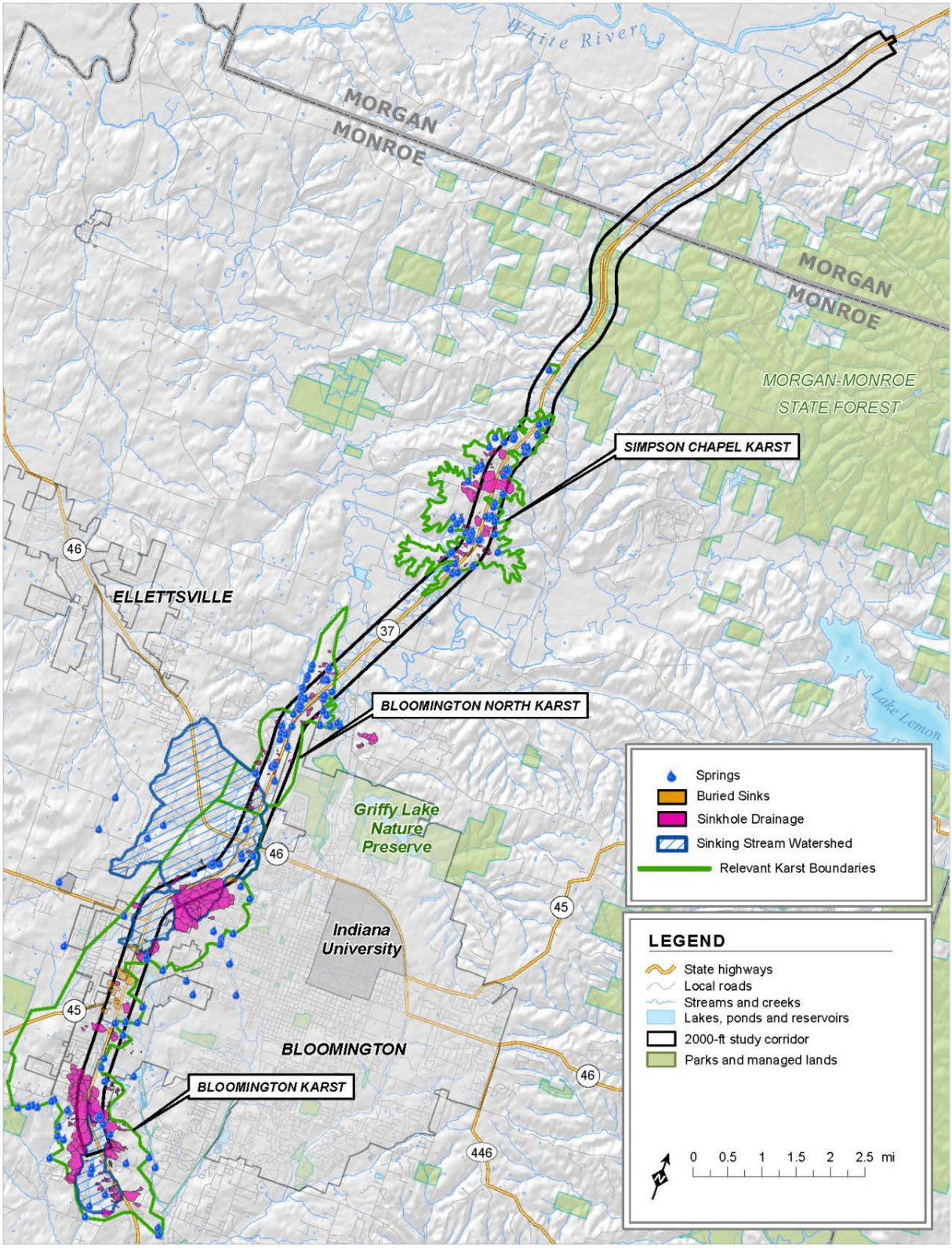

Figure 5.21-3: Location of Section 5 Karst Areas

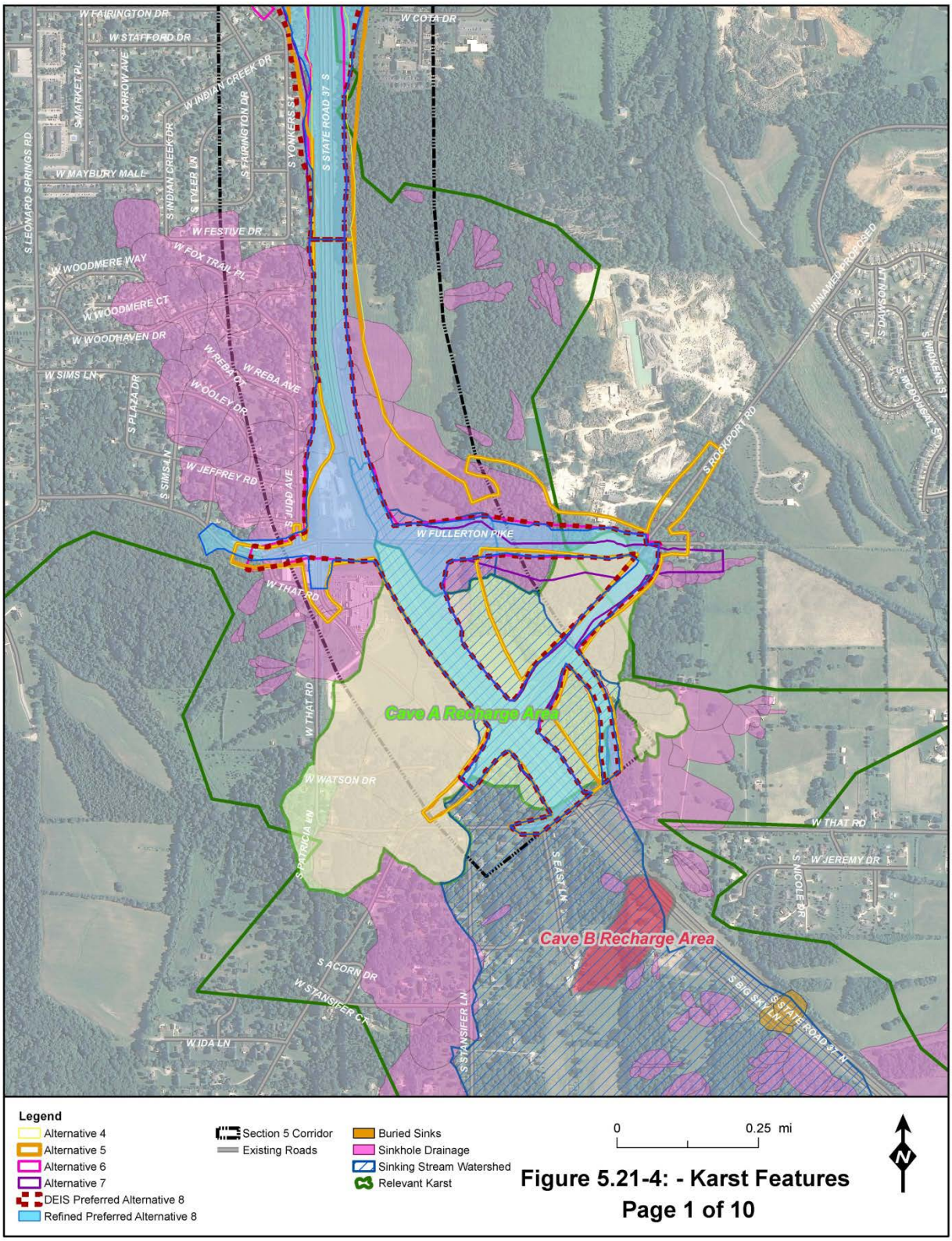

Figure 5.21-4: Karst Features (Sheet 1 of 10)

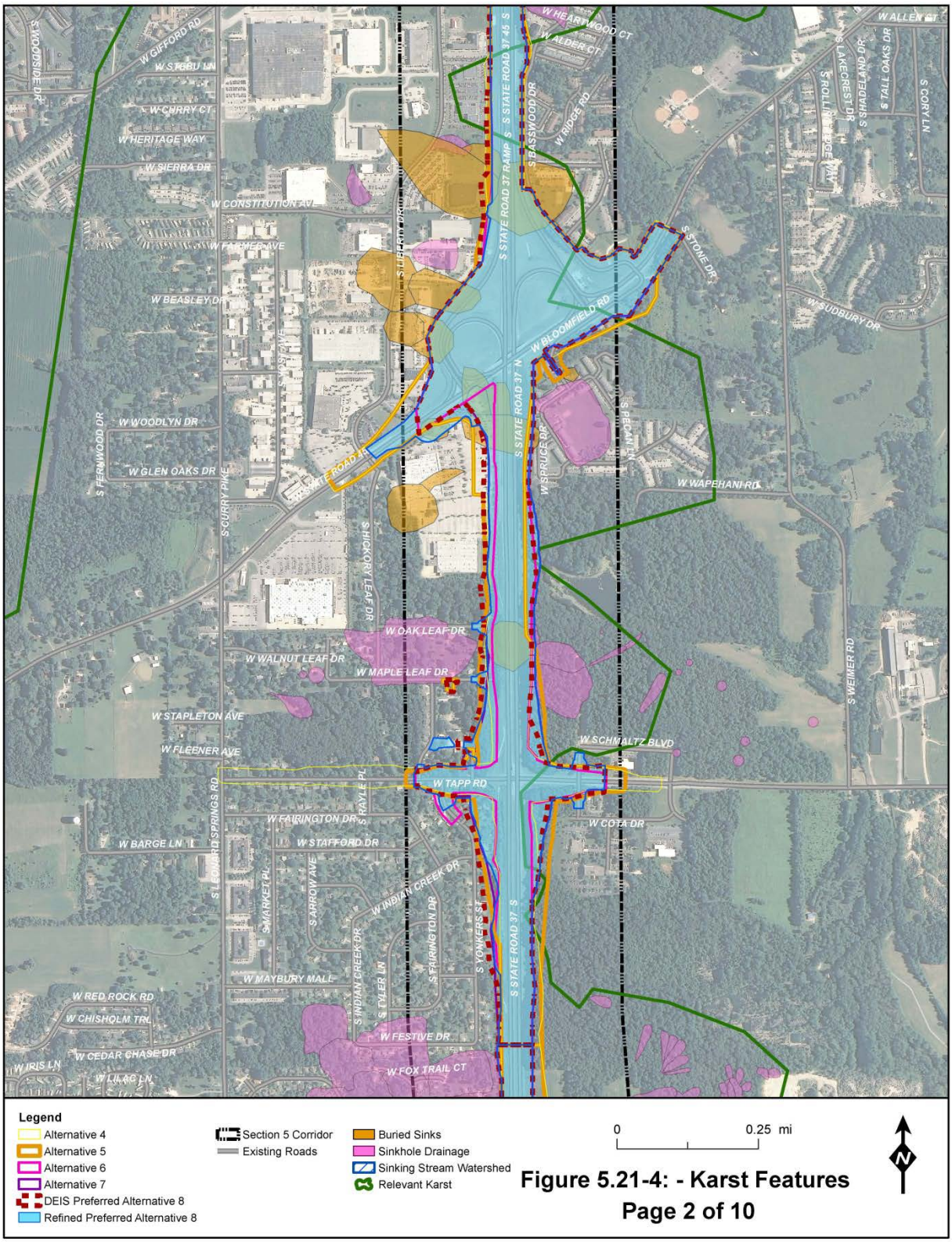

Figure 5.21-4: Karst Features (Sheet 2 of 10)

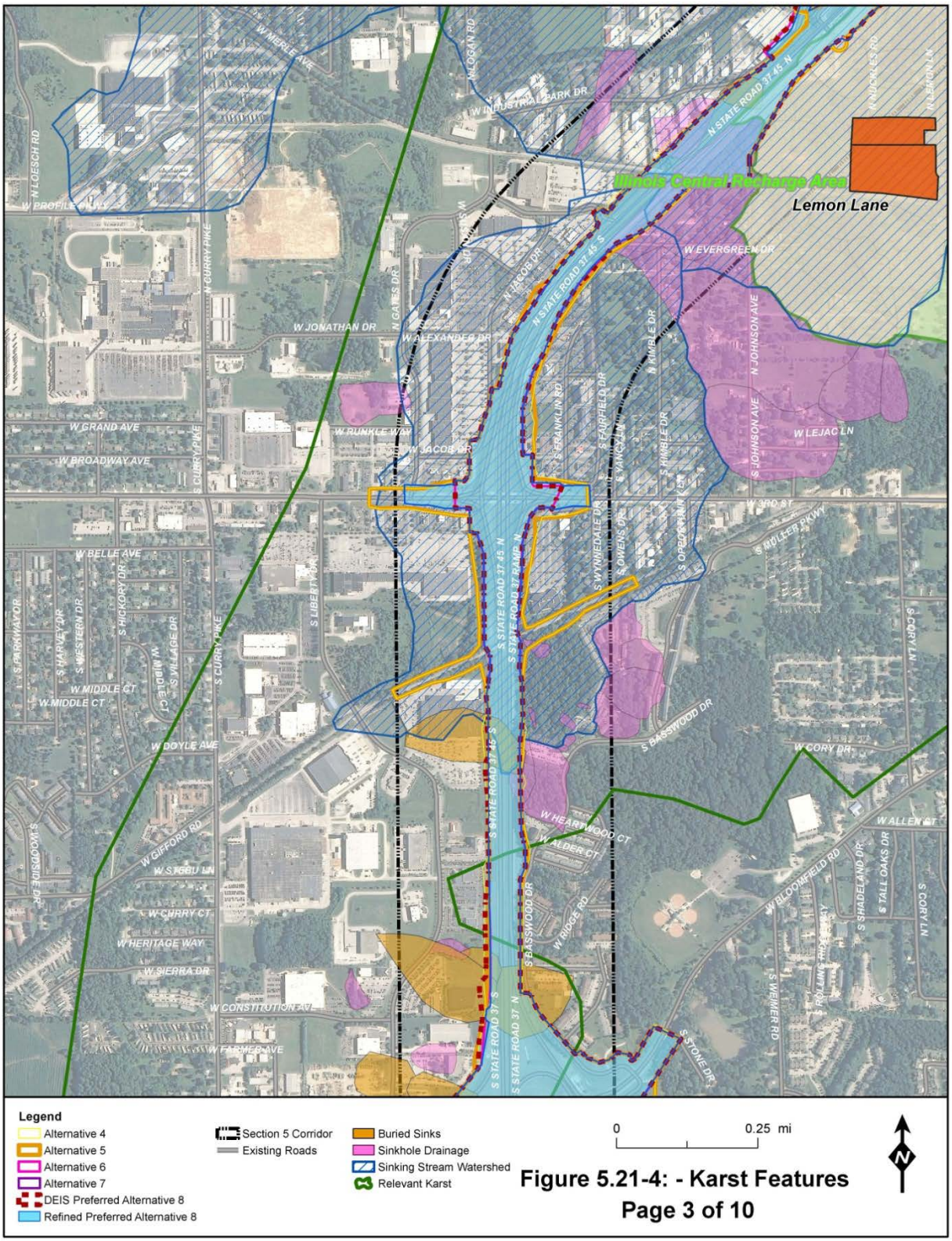

Figure 5.21-4: Karst Features (Sheet 3 of 10)

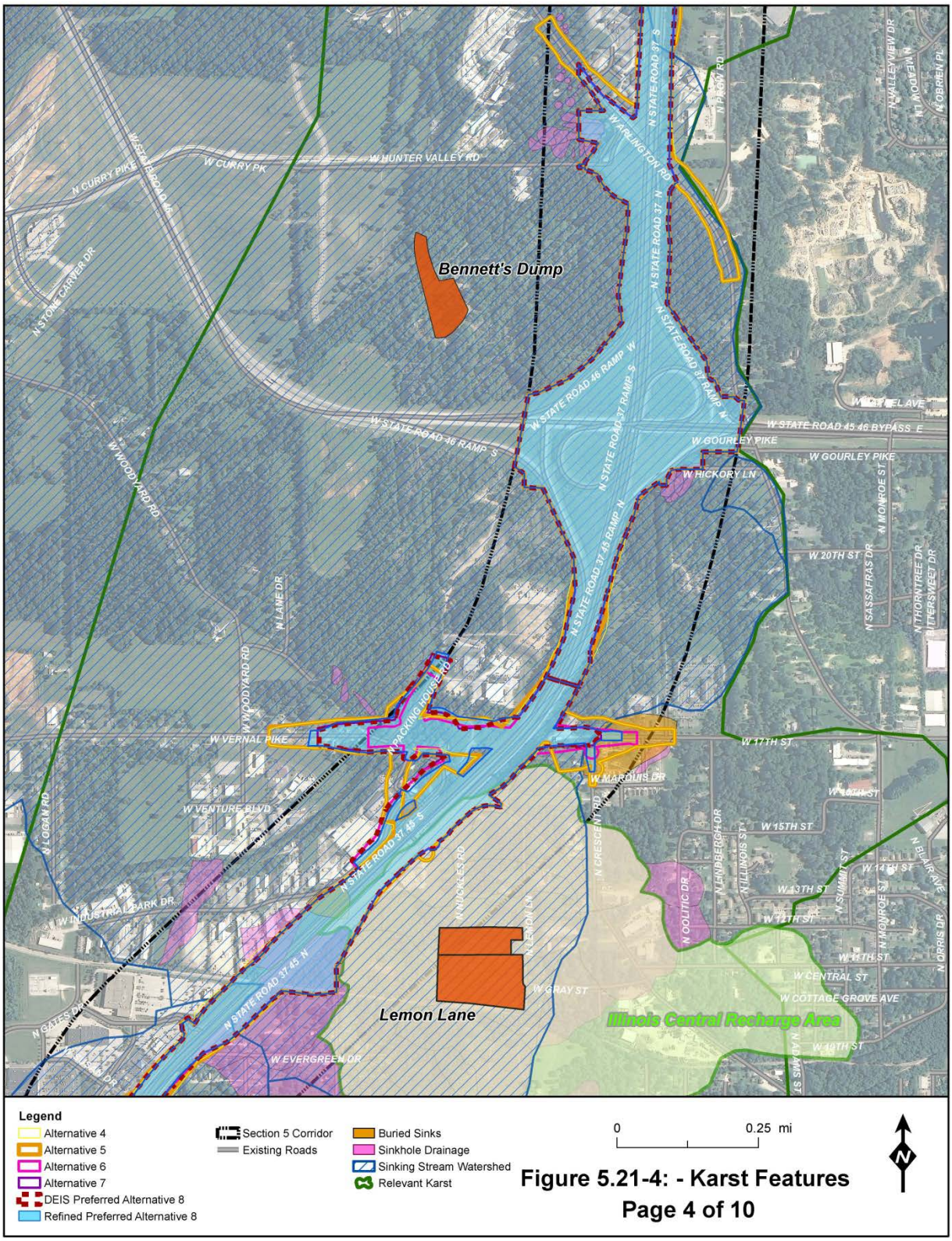

Figure 5.21-4: Karst Features (Sheet 4 of 10)

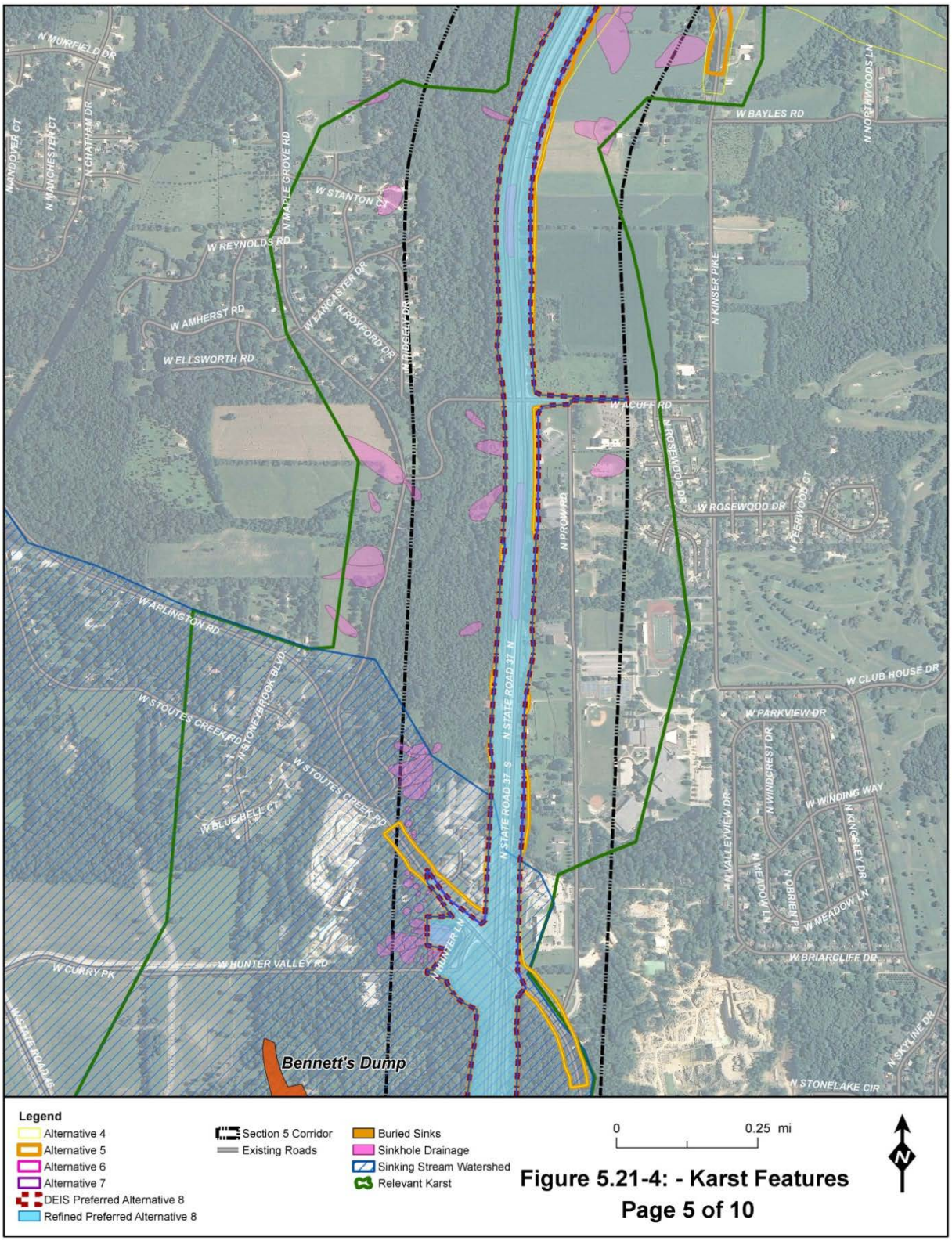

Figure 5.21-4: Karst Features (Sheet 5 of 10)

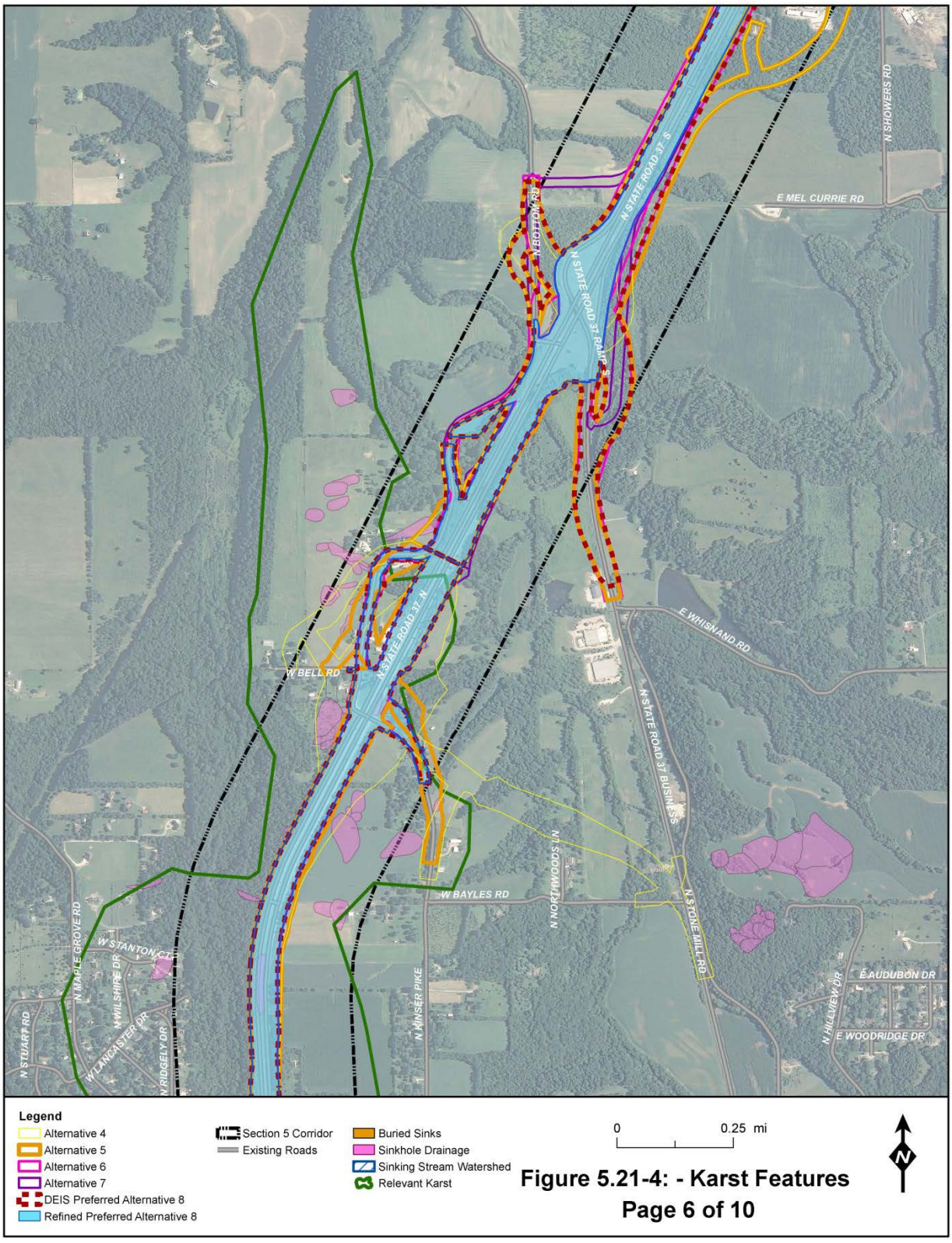

Figure 5.21-4: Karst Features (Sheet 6 of 10)

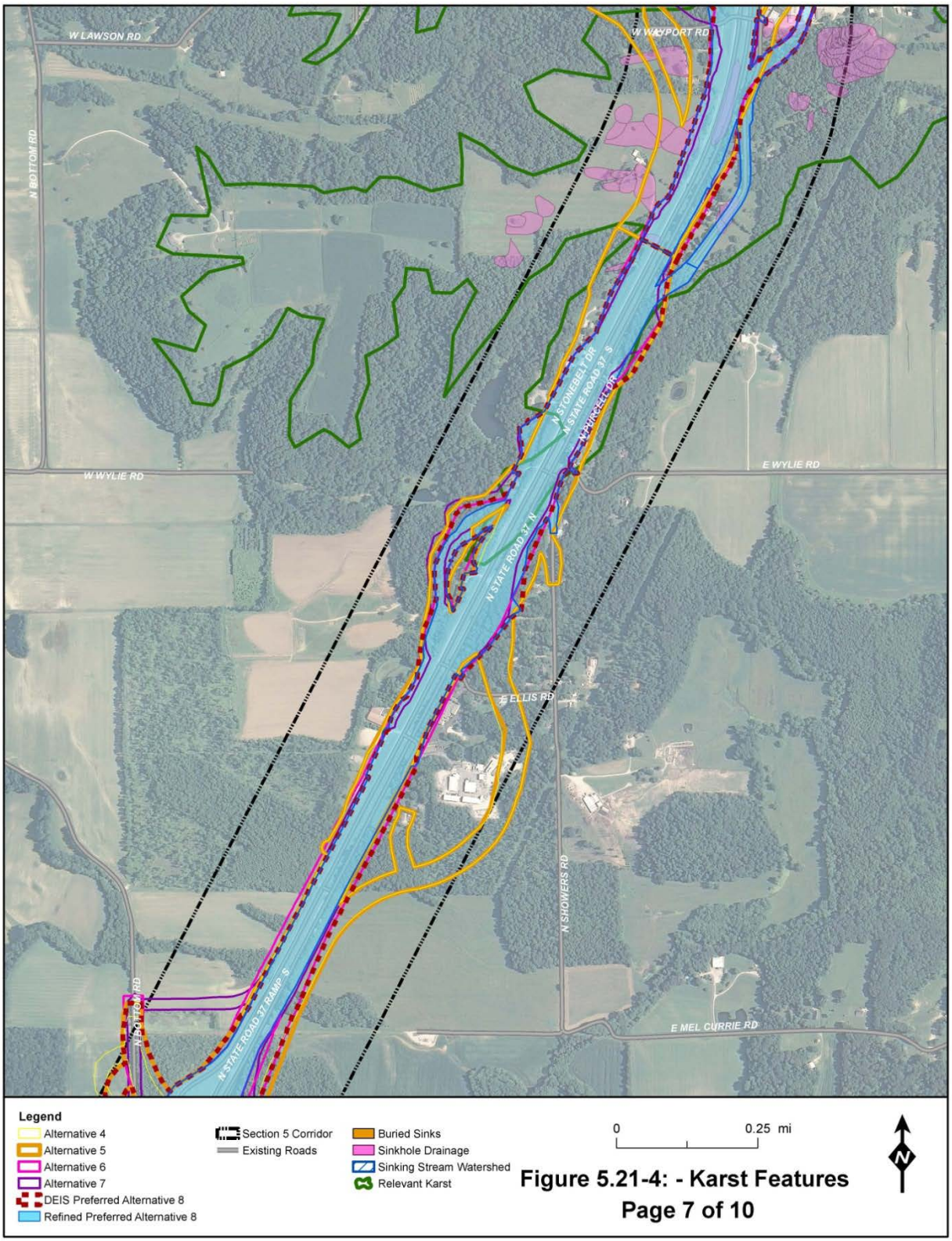

Figure 5.21-4: Karst Features (Sheet 7 of 10)

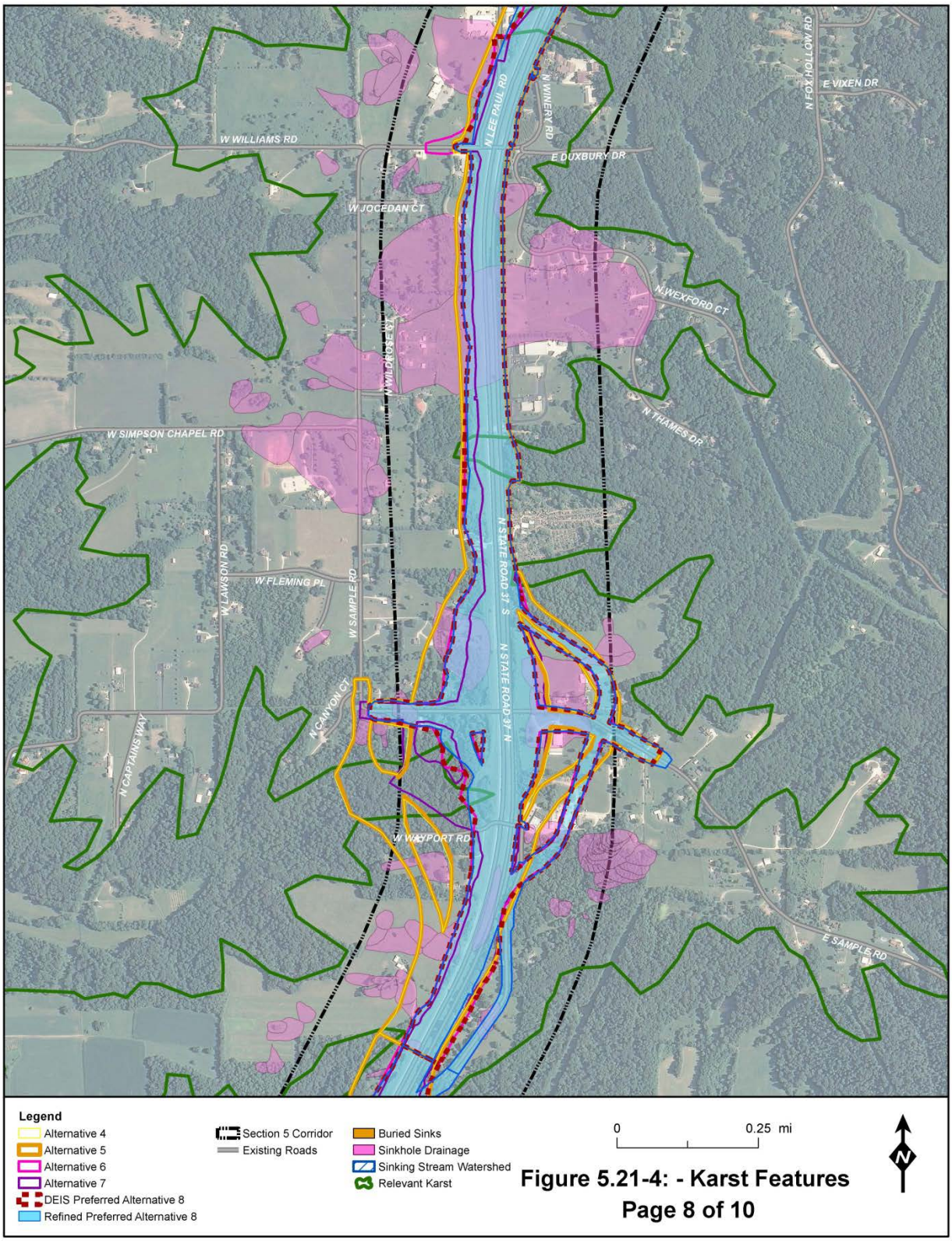

Figure 5.21-4: Karst Features (Sheet 8 of 10)

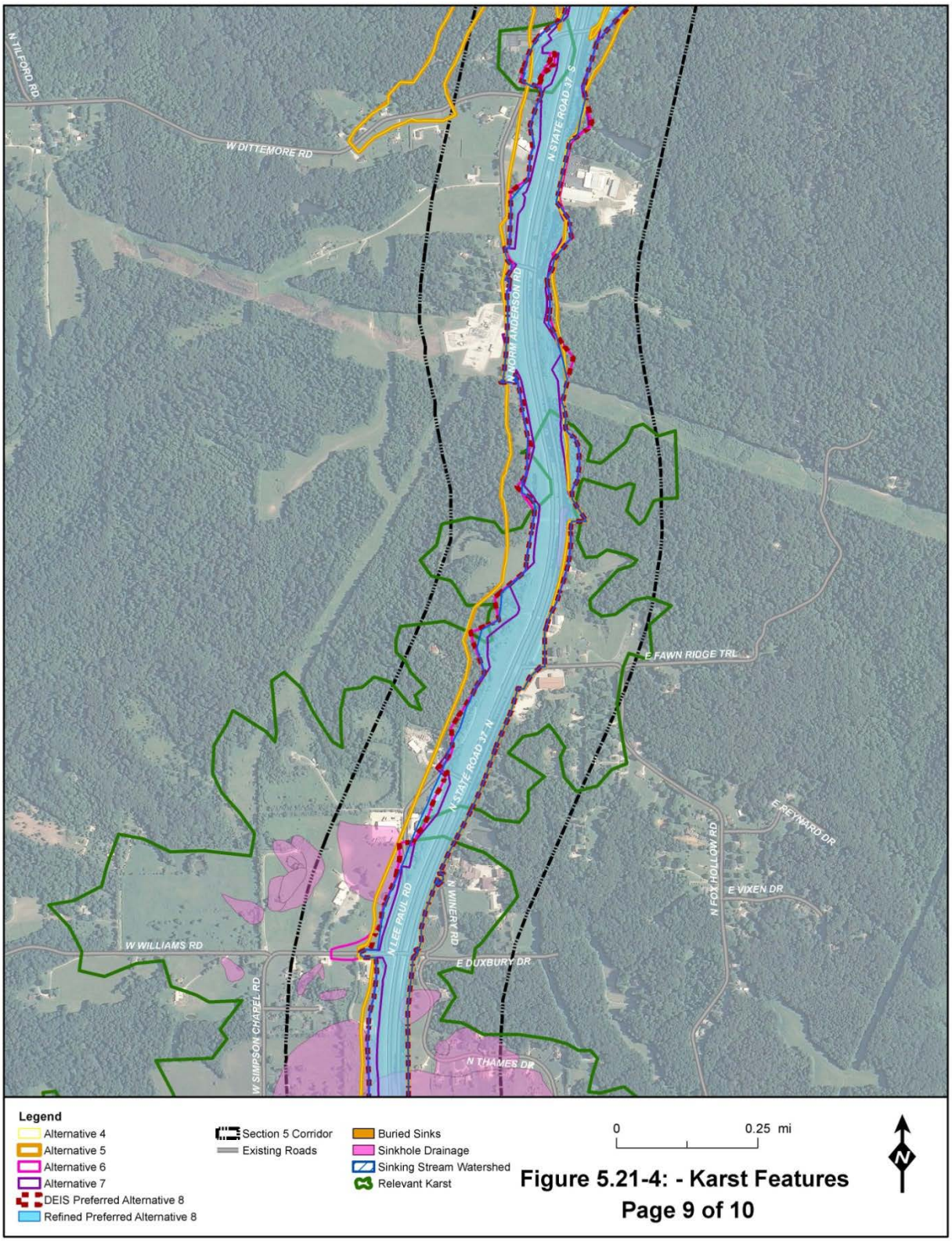

Figure 5.21-4: Karst Features (Sheet 9 of 10)

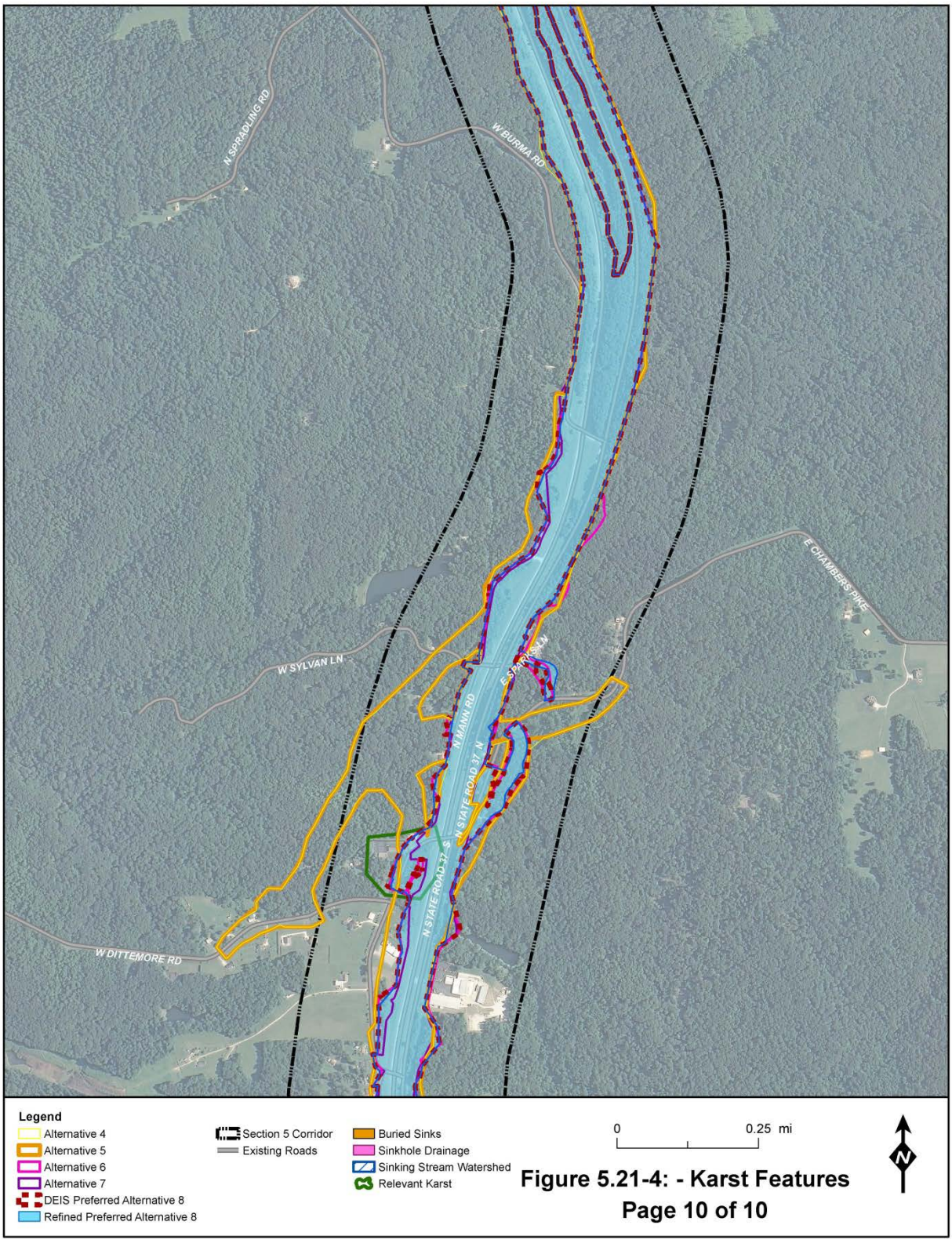

Figure 5.21-4: Karst Features (Sheet 10 of 10)

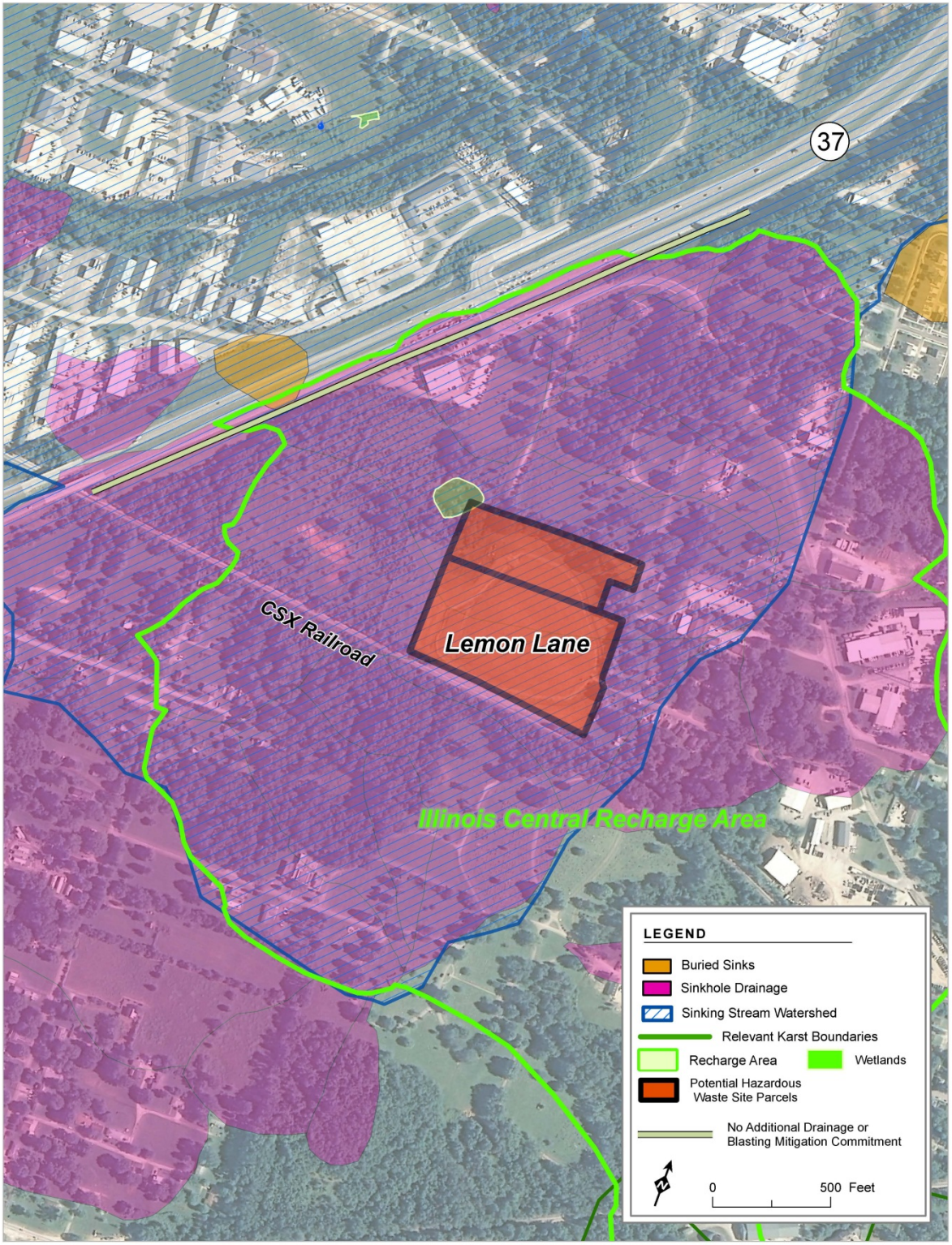

Figure 5.21-5: Area of Special Concern: Lemon Lane Landfill

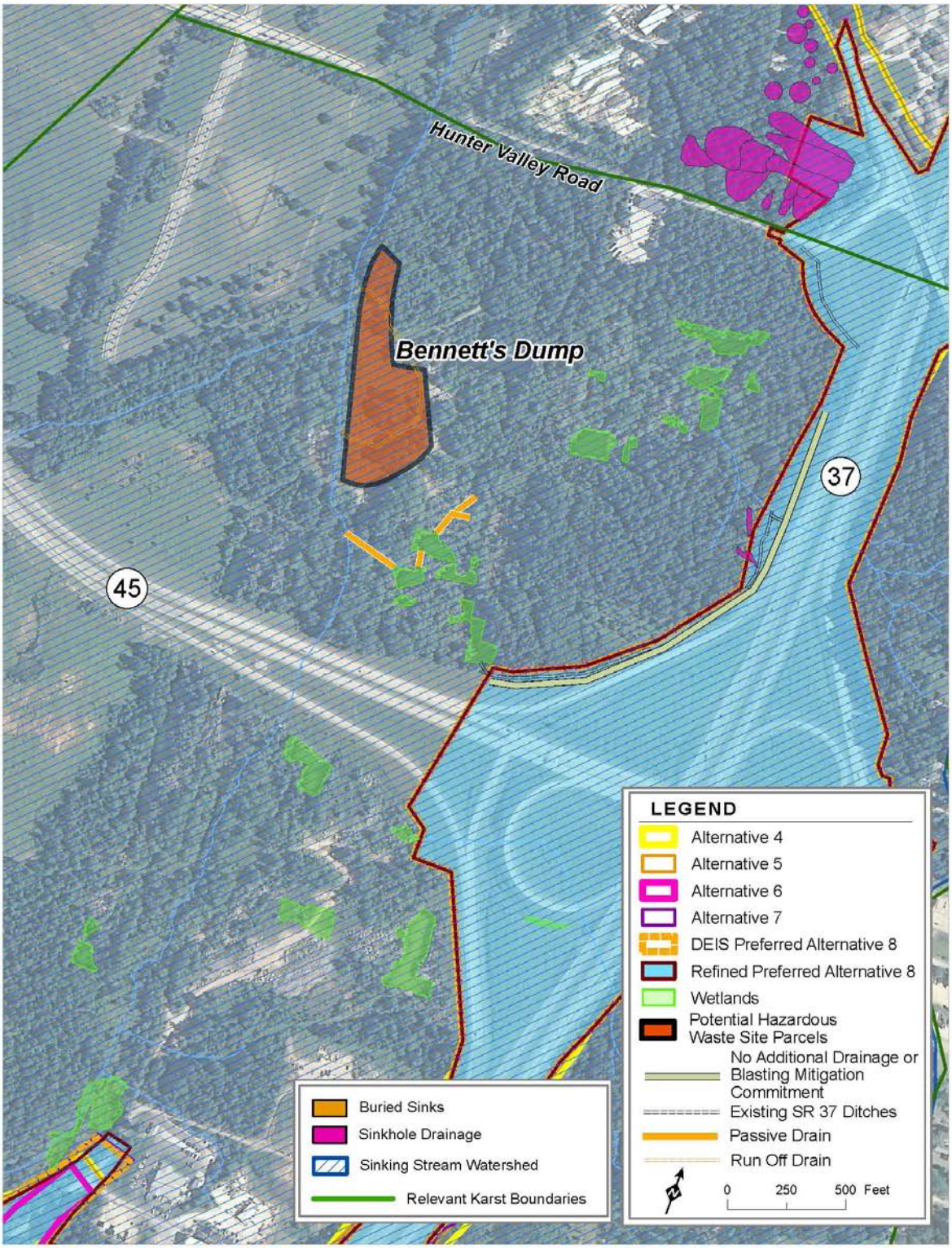

Figure 5.21-6: Area of Special Concern: Bennett's Dump

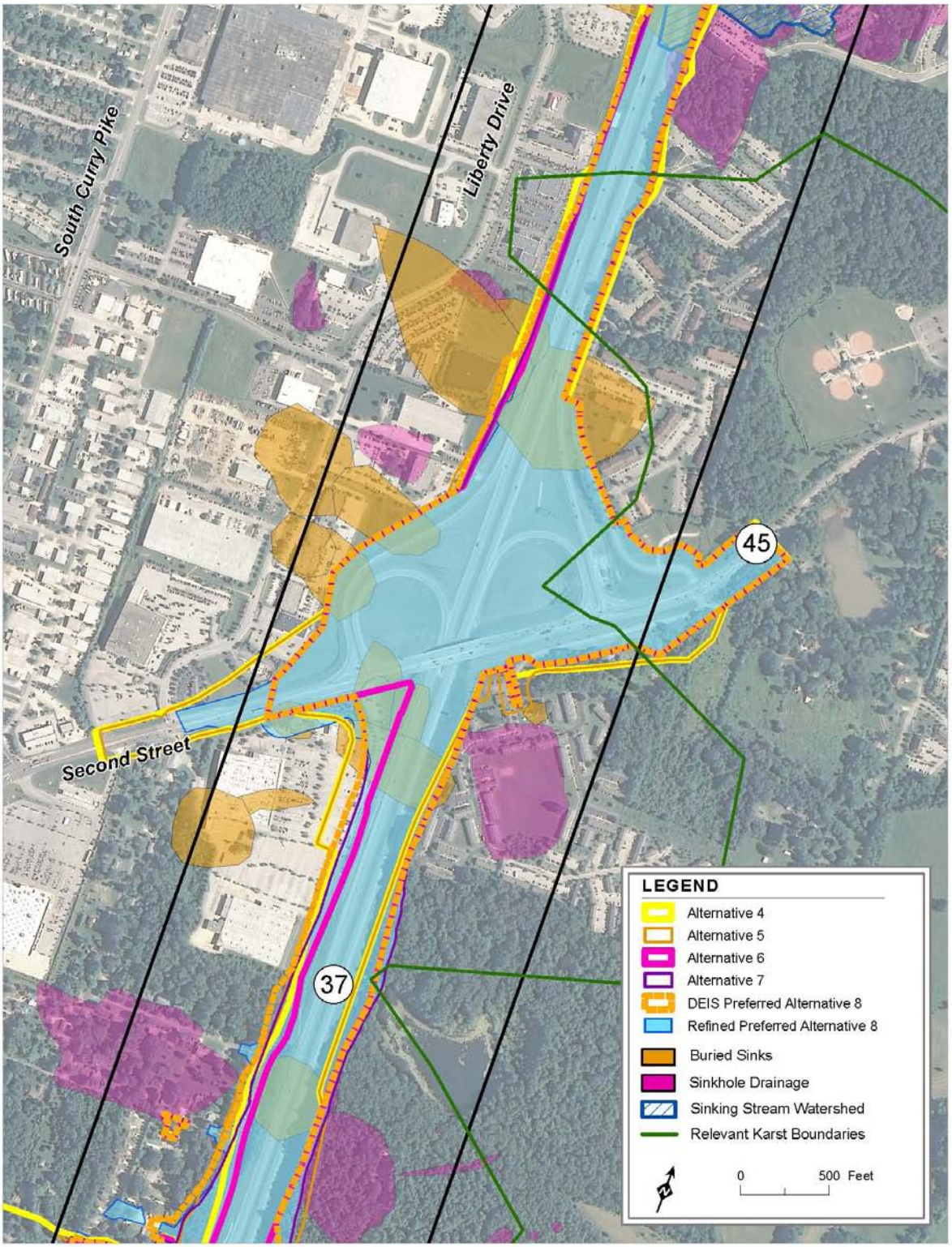

Figure 5.21-7: Area of Special Concern: SR 45/2nd Street Interchange with SR 37

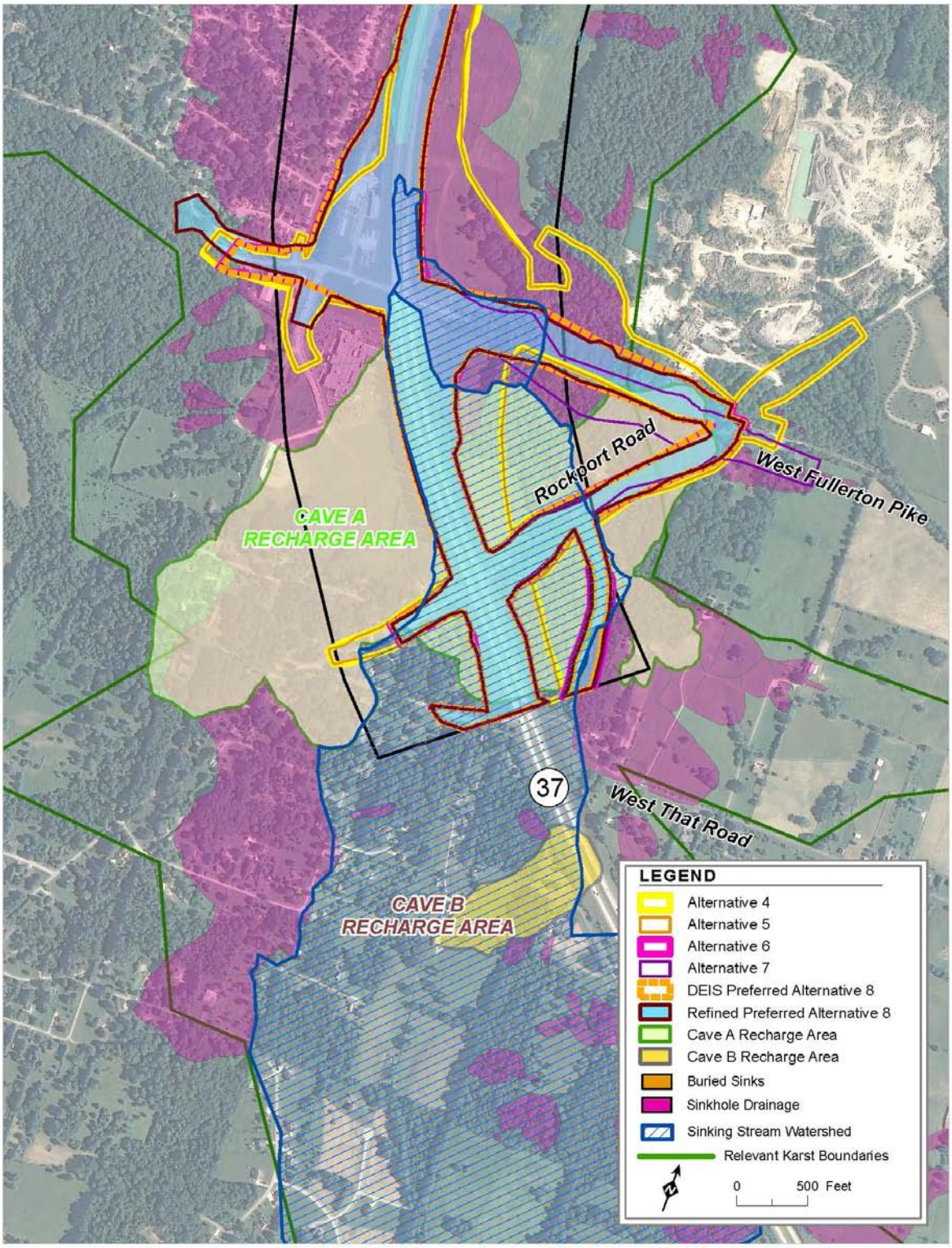

Figure 5.21-8: Area of Special Concern: Cave A Recharge (with Cave B Recharge)

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