Biological Opinion and Conference Opinion

The U.S. Army Corps of Engineer's Authorization of Louisville Gas and Electric's Bullitt County Pipeline Project

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EXECUTIVE SUMMARY

This Endangered Species Act (ESA) Biological Opinion (BO) of the U.S. Fish and Wildlife Service (Service) addresses Louisville Gas and Electric's (LG&E) construction of an approximately 12-mile gas pipeline in Bullitt County, Kentucky. The U.S. Army Corps of Engineers (Corps) proposes to issue a Department of the Army (DA) Permit authorizing the discharge of dredge or fill material into Waters of the United States (WOTUS) associated with the construction of this pipeline (the Action) (LRL-2017-01046-jwr). The Corps determined that the Action is likely to adversely affect the Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), and Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*) and requested formal consultation with the Service. The Corps also determined that the Action is likely to adversely affect the tricolored bat (*Perimyotis subflavus*), a proposed species, and requested formal conference with the Service. The BO concludes that the Action is not likely to jeopardize the continued existence of these species. This conclusion fulfills the requirements applicable to the Action for completing consultation under §7(a)(2) of the ESA of 1973, as amended, with respect to these species.

The Corps also determined that the Action is not likely to adversely affect the gray bat (*Myotis grisescens*) or designated critical habitat for Kentucky glade cress and requested Service concurrence. The Service concurred with these determinations by letter dated April 26, 2024. Critical habitat for the Indiana bat does not occur within the Action Area and is not addressed in this consultation. No critical habitat has been designated for the northern long-eared bat.

The BO includes an Incidental Take Statement. Incidental taking of listed species that is in compliance with the terms and conditions of the incidental take statement is exempted from the ESA prohibitions against taking.

In the Conservation Recommendations section, the BO outlines voluntary actions that are relevant to the conservation of the listed species addressed in this BO and are consistent with the authorities of the Corps and LG&E.

Reinitiating consultation is required if the Corps retains discretionary involvement or control over the Action (or is authorized by law) when:

(a) the amount or extent of incidental take is exceeded;
(b) new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
(c) the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
(d) a new species is listed or critical habitat designated that the Action may affect.

CONSULTATION HISTORY

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the Service's Kentucky Field Office (KFO).

December 29, 2020	The Corps requested initiation of formal consultation for the proposed Action pursuant to section 7(a)(2) of the ESA for the Indiana bat and Kentucky glade cress. The Corps also requested concurrence with several "may affect, not likely to adversely affect" determinations for other species and designated critical habitat. A Biological Assessment (BA) dated November 13, 2020, was also provided and accompanied the requests to initiate formal consultation and concur with the Corps' "may affect, not likely to adversely affect" determinations.
January 15, 2021	The Service provided a letter acknowledging receipt of the BA and request for formal consultation. This letter also provided concurrence with the Corps' effects determinations for other species and designated critical habitat not addressed under formal consultation.
June 9, 2021	The Service provided the Final BO to the Corps.
April 18, 2022	The Service provided correspondence to the Corps recommending reinitiation of formal consultation for the proposed Action.
April 20, 2022	The Corps suspended the previous NWP No. 12 authorization for the proposed Action in consideration of the Service's recommendation and the regulations at 50 CFR §402.16 and re-initiated ESA consultation with the Service.
June 10, 2022	The Service provided a letter to the Corps outlining data and analysis needed for an updated consultation.
April 3, 2024	The Corps requested reinitiation of formal consultation for the proposed Action pursuant to section 7(a)(2) of the ESA for the Indiana bat, northern long-eared bat, and Kentucky glade cress. The Corps also requested initiation of formal conference for the tricolored bat. Additionally, the Corps requested concurrence with several "may affect, not likely to adversely affect" determinations for other species and designated critical habitat. A BA dated February 7, 2024, was also provided and accompanied the requests to initiate formal consultation and concur with the Corps' "may affect, not likely to adversely affect" determinations.
April 26, 2024	The Service provided a letter acknowledging receipt of the BA and request for formal consultation. This letter also provided concurrence with the

	Corps' effects determinations for other species and designated critical habitat not addressed under formal consultation.
July 8, 2024	The Service requested additional information from the Corps and LG&E regarding the proposed activities for the Action.
July 26, 2024	The Corps provided an update to the Service regarding jurisdictional changes for the Action, which required revisions to the BA.
July 30, 2024	LG&E provided additional information regarding the proposed activities for the Action to the Service and the Corps.
August 5, 2024	The Corps and Service agreed to a 45-day extension for completion of the BO. The Service provided a letter to LG&E informing them of the 45-day extension.
August 23, 2024	LG&E provided the BA revisions to the Service and the Corps.
September 20, 2024	The Service provided a Draft BO to the Corps and LG&E for review.
September 27, 2024	The Corps and LG&E provided the Service with comments on the Draft BO.
September 30, 2024	The Service provided the Final BO to the Corps and LG&E.

BIOLOGICAL OPINION

1. INTRODUCTION

A BO is the document that states the findings of the Service required under section 7 of the ESA of 1973, as amended, as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the Corps' proposed authorization of a DA Permit for LG&E's Bullitt County Pipeline Project. This BO considers the effects of the Action on Kentucky glade cress, the Indiana bat, and the northern long-eared bat. Designated critical habitat for the Indiana bat is not present in the action area, and no critical habitat has been designated for the northern long-eared bat. Therefore, the Action does not affect designated critical habitat for these species, and critical habitat for these species will not be addressed further in this BO. Designated critical habitat for Kentucky glade cress is present in the action area and is discussed below.

The Corps has also requested to formally conference on the tricolored bat, which is currently proposed for listing under the ESA as endangered. Therefore, this document is also a Conference Opinion (CO) for the tricolored bat and considers the effects of the Action on this species. No critical habitat for the tricolored bat has been proposed; therefore, no critical habitat for this species will be affected.

The Corps previously determined that the Action will have "no effect" on the following federally listed mussel species: clubshell (*Pleurobema clava*), fanshell (*Cyprogenia stegaria*), orangefoot pimpleback (*Plethobasus cooperianus*), pink mucket (*Lampsilis abrupta*), rabbitsfoot (*Quadrula cylindrica cylindrica*), and ring pink (*Obovaria retusa*) due to the lack of suitable habitat for these species in the Action Area. There is no statutory requirement to request concurrence with "no effect" determinations; however, the Service acknowledged these determinations and explained why the Service did not have any concerns regarding these species in a letter dated April 26, 2024. Among these mussel species, critical habitat has only been designated for the rabbitsfoot, and the nearest designated critical habitat for the rabbitsfoot is in the upper Green River in Kentucky. Therefore, critical habitat for any of these listed mussels species is not present in the Action Area, will not be affected by the Action, and is not addressed further in this BO.

In its April 26, 2024 letter, the Service also concurred with the Corps' determination that the Action is not likely to adversely affect the gray bat or designated critical habitat for the Kentucky glade cress. This concurrence fulfilled the Corps' responsibilities for the Action under section 7(a)(2) of the ESA for the gray bat and Kentucky glade cress designated critical habitat. No critical habitat has been designated for the gray bat. Therefore, the gray bat and designated critical habitat for the gray bat and Kentucky glade cress are not addressed further in this BO.

A BO evaluates the effects of a Federal action, along with those resulting from interrelated and interdependent actions and non-Federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A Service BO that concludes a proposed Federal action is not likely to jeopardize the continued existence of listed species and is not likely to result in the destruction or adverse modification of critical habitat fulfills the Federal agency's responsibilities under section 7(a)(2) of the ESA.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). "*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR §402.02).

2. PROPOSED ACTION

The Federal action is the Corps' issuance of a Nationwide Permit (NWP) verification under the terms and condition associated with NWP No. 12 - Oil or Natural Gas Pipeline Activities for impacts to aquatic features meeting the definition of WOTUS that are necessary for LG&E's construction of a 12-mile natural gas pipeline in Bullitt County, Kentucky. The Federal action will require impacts to 63 jurisdictional tributaries, including 6,253 linear feet of temporary impacts and 18 linear feet of permanent impacts to perennial, intermittent, and/or ephemeral tributaries. The Federal action will also require impacts to 0.5 acre of jurisdictional wetlands, consisting of 0.34 acre of temporary impacts to emergent wetlands and open water aquatic resources and 0.16 acre of permanent impacts to forested wetlands. The Corps has determined that its jurisdictional area for the Federal action is limited to these jurisdictional tributaries and wetlands and a 100-foot buffer around each feature; the jurisdictional area does not include the portions of the proposed pipeline outside of these 100-foot buffers. As a result, the Federal action requiring the section 7 consultation is smaller in scope than the overall pipeline project. The Corps' jurisdictional area and areas outside the Corps' jurisdictional area are shown on the figure in Appendix A.

To address situations where the Corps is considering making a permitting decision for a small component of a larger project, the Corps and the Service developed the *Process for Section 7 Consultations in Small Federal Handle Situations* (Appendix B). Under this process, when the Corps' involvement is limited to a small component of a larger project, the Corps will clearly distinguish between the areas and activities within the Corps' jurisdiction and the areas and activities outside the Corps' jurisdiction. The BA for the Federal action will also clearly distinguish between effects to listed species and designated critical habitat within and outside the Corps' jurisdiction. The Service's BO and associated incidental take statement will then evaluate all components of the larger project and consider effects that occur outside the Corps' jurisdiction. The Service will also identify in the incidental take statement any reasonable and prudent measures (RPMs) that are necessary to address impacts of activities within the Corps' jurisdiction and that the Corps must implement through its permit. The Service will likewise identify the RPMs that address impacts of the larger project outside of the Corps' jurisdiction and will specify that the RPMs must be implemented directly by the applicant if the take exemption provided by the BO is to apply.

We have determined that the *Process for Section 7 Consultations in Small Federal Handle Situations* is appropriate for the proposed pipeline project because: (1) there is a legitimate Federal nexus to the larger project via activities subject to Clean Water Act jurisdiction that cannot be avoided (i.e., but for the Federal permit, the larger action could not occur); (2) the effects considered in the BA and this BO are all appropriately within the scope and purpose of the section 7 consultation; and (3) the Corps permit applicant requests to be covered by the Corps' section 7 consultation and has actively participated in the section 7 consultation. We have also determined that the BA provided by LG&E clearly distinguishes between the areas and activities within the Corps' jurisdiction and the areas and activities outside the Corps' jurisdiction, as well as between effects to listed species and designated critical habitat within and outside the Corps' jurisdiction. Therefore, the proposed Action addressed in this BO includes the construction of the entire 12-mile natural gas pipeline.

The proposed Action begins in eastern Bullitt County on the south side of Grigsby Lane, approximately 4,575 feet east of the intersection of Grigsby Lane and United States Route 31 East [Mile Post (MP) 0.0]. The Action then extends west and south, crossing Clarks Lane (approximately MP 4.0), Cedar Grove Road (approximately MP 7.0), and Deatsville Road (approximately MP 7.7). Near the Cedar Grove Road crossing (approximately MP 7.0), the Action begins to parallel an existing electric transmission line and continues paralleling the line to the Action terminus on the east side of Interstate 65 directly across from the Bullitt County Welcome Center/Rest Area (MP 11.81).

The typical permanent right-of-way (ROW) along the proposed pipeline will be approximately 100-feet-wide from MP 0.0 to MP 6.8 and 75-feet-wide from MP 6.8 to MP 11.81. The permanent ROW will include all temporary ROW easements necessary during construction. Temporary construction storage yards, temporary workspaces, access roads, and construction entrances will also be required outside of the permanent ROW. The term "Maximum Disturbance Limits" (MDL) is used to define the area that includes the permanent ROW and all temporary and permanent work areas (e.g., construction storage yards, temporary workspaces, access roads, and construction entrances) outside the permanent ROW where activities will occur over the life of the pipeline. The following sections of the BO describe the construction, operation, and maintenance components of the proposed Action in greater detail.

2.1 Construction

The first phase of construction will involve a site visit by construction contractors retained to perform the work and land surveys to identify and mark the MDL and other project boundaries. During these activities, light-duty trucks and all-terrain vehicles (ATVs) will be driven along existing gravel roads and paths throughout the MDL. These vehicles may also access areas adjacent to the roads/paths along the edges of the MDL for parking.

The second phase of construction will include the development of access roads and construction entrances to allow construction equipment and personnel to access the MDL. Previously existing roads or paths will be used for access when possible. These existing access roads will remain in place after construction, including those roads within the known Kentucky glade cress sites within the MDL. In areas where existing roads/paths are not available, temporary access roads will be developed. Access roads will be approximately 12 to 20 feet wide, depending on the contractor's need for equipment movement along the road. Equipment will primarily travel on existing terrain; however, gravel or stone will be placed as a base for access roads where necessary and removed after construction in compliance with permit conditions. If a landowner requests for the gravel or stone base to remain after construction, the contractor and LG&E may allow the base to remain in place, if allowable under all permits and regulations for the Action. However, the gravel/stone base will not be allowed to remain on access roads located within known Kentucky glade cress sites within the MDL, with the exception of the proposed access road in Site 6-B. The road will be constructed using a gravel base and will remain in place after construction to allow continued access to the permanent valve site located at MP 7.0 (discussed further below).

Stabilized construction entrances will also be used to provide access from existing roadways to the MDL. The entrances will be constructed using native rock obtained from local quarries or excavated during pipeline installation. Some construction entrances may require a temporary culvert where there is a drainage ditch or depression along the existing paved roadway to maintain the existing drainage system. The construction entrances will also serve as a best management practice for access points by helping displace mud and dirt from construction equipment tires/tracks before entering a paved roadway. Some construction entrances will remain in place after construction if requested by the landowner and there are no permit compliance issues. All construction entrances within known Kentucky glade cress sites in the MDL will be removed after construction, with the exception of the construction entrance in Site 2-D, which will remain as a permanent entrance. Some access roads and construction entrances may be developed/constructed after tree removal if there are no trees to be removed in that portion of the MDL and access is not needed until other construction activities begin.

The third construction phase will involve site preparation to prepare for installation of the proposed pipeline, including implementation of Best Management Practices (BMPs), vegetation removal, and development of construction storage yards. BMPs will be implemented throughout the MDL to minimize soil erosion and sediment transport from construction areas and protect surface waters and wetlands located in and adjacent to the MDL. Additional BMPs will be used to address material handling, waste management, equipment use, spill prevention, and other construction-related activities. These BMPs are detailed in the stormwater pollution prevention plan (SWPPP) that has been prepared for the Action. BMPs will be inspected and maintained in accordance with applicable permits as described in the SWPPP.

Removal of trees and other vegetation will be completed using mechanical and hand clearing methods. Mechanical equipment may include feller bunchers, skidders, chippers, bucket trucks, mechanical boom-mounted saws, bulldozers, excavators, dump trucks, lowboys, and light and heavy-duty trucks. Hand clearing methods will include the use of chainsaws and other hand tools. A total of 39.46 acres of tree removal will occur as a result of the Action. Stumps will be cut flush to the ground or removed by grubbing and/or grinding if they will interfere with construction. Debris from tree removal (e.g., logs, limbs, mulch, stumps, roots) will be moved offsite; however, mulch could be lightly distributed in adjacent wooded areas within the MDL if agreeable to landowners and it would not result in impacts to waterways. No mulch will be placed in known Kentucky glade cress sites within the MDL. Mulch, limbs, and timber may also be provided to landowners upon request and could be moved to a location outside the MDL on a landowner's property. Any woody debris placed outside the MDL would only be located in areas where no Kentucky glade cress was identified during a 2018 survey by Cardno, Inc. (Cardno) (see Section 4.2.1) and outside of all designated critical habitat for this species.

Construction storage yards will be located at MP 0.0, MP 3.0, and MP 11.81 to store construction materials and supplies required during pipeline installation. The storage yard sites will be graded and covered with rock, as necessary. After construction, all rock will be removed, and the sites will be restored to preconstruction conditions, with the exception of a portion of the storage yard at MP 0.0 where a new valve station will be constructed (discussed further below) and a regulator/valve site at MP 11.81.

The fourth phase of construction is pipeline installation. The pipeline will be installed using open trench, horizontal directional drilling (HDD), and conventional boring techniques. Equipment and vehicles used within the MDL during pipeline installation will include bulldozers, side booms, excavators, rock trenchers, backhoes, dump trucks, tracked carriers, and light and heavy-duty trucks. Prior to creation of the pipeline trench, topsoil will be segregated from subsoil by bulldozer and temporarily staged on the distant side of the excavation within the MDL. Open trenches will be excavated using a track-mounted backhoe, excavator, or rock trencher/hammer to a maximum depth of approximately seven feet and an average bottom width of three to five feet. When excavating in rock, trench depth is expected to be less than seven feet. Rock will be removed using a rock trencher or hydraulic hammer. Rock trenchers utilize a chain-driven mechanism with a series of teeth designed to cut through rock. Rock hammering uses hydraulic rams mounted to tracked or wheeled equipment to break rock apart. An increased maximum depth may be required at utility crossings, road crossings, stream crossings, valve stations, and HDD pit transitions to reach sufficient depth to allow for at least three feet of cover over the installed pipe. After pipeline installation, the trench will be backfilled entirely with stockpiled subsoil and/or native soil and covered with stockpiled topsoil. If necessary, manufactured limestone sand may be added around the pipe, and the remaining portions of the trench will be filled with stockpiled/native soil and covered with stockpiled topsoil.

Pipeline construction that utilizes conventional boring techniques will require excavation of two bore pits, with one bore pit on each side of any road, utility infrastructure, stream, or other feature that needs to be crossed (i.e., intersected) by the pipeline. Mechanized equipment will be placed in one of the bore pits and will auger a hole under the relevant feature to allow the pipeline to be pushed into the other bore pit, avoiding any impact to the existing feature. HDD will also utilize two bore pits, with the associated drilling equipment placed in one bore pit to drill into the other bore pit. After the bore hole has been fully prepared, the pipeline will be pulled through the hole from one bore pit to the other bore pit. With both conventional boring and HDD methods, the cuttings will be removed, and the pits backfilled with native material.

Pipeline crossings at streams will be completed through open trench, conventional boring, or HDD methods. The contractor will be allowed to determine which of these methods is used at each stream crossing while following all applicable permit conditions and regulations and the SWPPP to minimize surface disturbances and sedimentation at the stream crossings. Open trenching will be scheduled to avoid high stream flow conditions, such as immediately following heavy periods of rain, to achieve a dry or low-flow condition. Low-flow conditions will be determined by the construction contractor using rainfall logs. Open trench stream crossings will use an open cut/dry flume method with pump-around, which includes the construction of dams upstream and downstream of the pipeline trench with a flume (i.e., pipe) between them to maintain stream flow and discharge water downstream. Water will be pumped from the stream channel between the dams to create a dry work zone. After pipeline installation, the trench will be filled, and the stream channel and banks restored to preconstruction conditions and stabilized. Efforts will be made to cross streams 10 feet in bottom width or less, including trench backfilling, in as few working days as possible. Stream crossings using conventional boring and HDD methods will be completed as previously described above.

Stream crossings for vehicles and equipment will also be required within the MDL. Crossings will be constructed using culverts placed within the stream channel or with bridges that span the stream. All crossing structures will be removed after construction, and the streams will be restored to preconstruction conditions according to applicable permits.

No regular pipeline construction activities are planned outside of daylight hours; however, some nighttime construction may be necessary during times of year when daylight is minimized. Artificial lighting used during any nighttime construction activities will be angled downward and inward toward the active construction area to limit light pollution outside this area.

The Action will also include construction of permanent valve sites at MP 0.0 and MP 7.0 and support infrastructure along the pipeline and proposed valve/regulator station at MP 11.81 where the proposed pipeline will tie into existing LG&E pipelines. A cathodic protection system will also be installed that provides a low voltage current to protect the steel pipe from corrosion. Multiple anodes will be placed in drilled holes along the pipeline, and the system will be monitored at various test stations along the pipeline. In areas where the pipeline intersects high-voltage electric transmission lines, an alternating current mitigation system will be implemented to mitigate stray current, prevent possible shock to personnel during post-construction activities, and prevent interference with the cathodic protection system. The current mitigation system will be placed in the same trench as the pipeline.

The final phase of construction will involve restoration of disturbed areas within the MDL. All disturbed ground surfaces in the MDL will be planted with a seed mix and stabilized with temporary mulch to complete restoration of the disturbed area, as described in the SWPPP. Wetlands and known Kentucky glade cress sites will be planted with a native seed mix appropriate for those areas and that is approved by the Service.

The construction phase of the Action is anticipated to take six to nine months, with an expected need to return after one winter (i.e., after freeze/thaw cycles) to restore graded areas that may have settled or where vegetation planted in restored areas did not adequately germinate. These activities would be limited to the MDL.

2.2 Operation

Operation of the pipeline after installation will be completely subsurface for distribution of natural gas in the enclosed pipeline, except at the proposed regulator station and valve sites, which are above ground. The pipeline will be operated by LG&E in accordance with applicable laws and regulations to provide safe and reliable product delivery to the service area. The pipeline is anticipated to last at least 50 years.

2.3 Maintenance

Maintenance of the pipeline will take place for the duration of its 50-year service life. The pipeline will be maintained by LG&E in a manner consistent with Federal, state, and local laws and regulations to provide a safe, continuous supply of natural gas. Maintenance activities will occur within the permanent ROW and include regularly scheduled site monitoring and ground surveys. These activities will involve the use of light-duty trucks, ATVs, and mowing equipment. Proposed maintenance activities will include:

- Painting and replacement of signs, marker posts, and decals to ensure the pipeline location is visible above ground to help prevent unintentional damages to the pipeline from construction activities, erosion, possible encroachment on the ROW, and other problems that may affect the safety and operation of the pipeline and associated facilities.
- Routine ROW mowing and erosion repairs.
- Periodic inspection of valves, water crossings, and erosion control devices.
- Maintenance activities related to installation of leak repair clamps/sleeves, emergency pipe replacement, and other equipment needed for repair activities.
- Periodic internal inspection with in-line inspection tools or “pigs”.
- Calibration and replacement and/or installation of communications equipment.
- Maintenance of the cathodic protection system and alternating current mitigation system.
- Herbicide and pesticide use for the clearing or maintenance of the permanent ROW in accordance with appropriate regulations.

While there is the possibility that the pipeline may require repairs during its service life, there is no indication that this is reasonably certain to occur. Additionally, if repairs are required, there is no indication that they are reasonably certain to result in impacts to Kentucky glade cress, the Indiana bat, the northern long-eared bat, or the tricolored bat. Therefore, repairs to the pipeline are not considered part of the Action and are not addressed in this BO.

2.4 Other Activities Caused by the Action

A BO evaluates all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see definition of “effects of the action” at 50 CFR §402.02).

In its request for consultation, the Corps described its proposed Federal Action (the issuance of a Corps permit) and the other activities caused by the Action that involve the applicant's construction, operation, and maintenance of a pipeline in areas beyond the Corps' jurisdictional area. This BO addresses the effects of the Action, including the effects of "other activities" caused by the Action.

2.5 Action Area

For purposes of consultation under ESA section 7, the action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). The Action Area for this consultation includes the MDL plus a one-kilometer (0.6-mile) buffer of the MDL (Figure 1). The one-kilometer buffer is the area in which the effects of noise and vibration are most likely to affect the Indiana bat, northern long-eared bat, and tricolored bat.

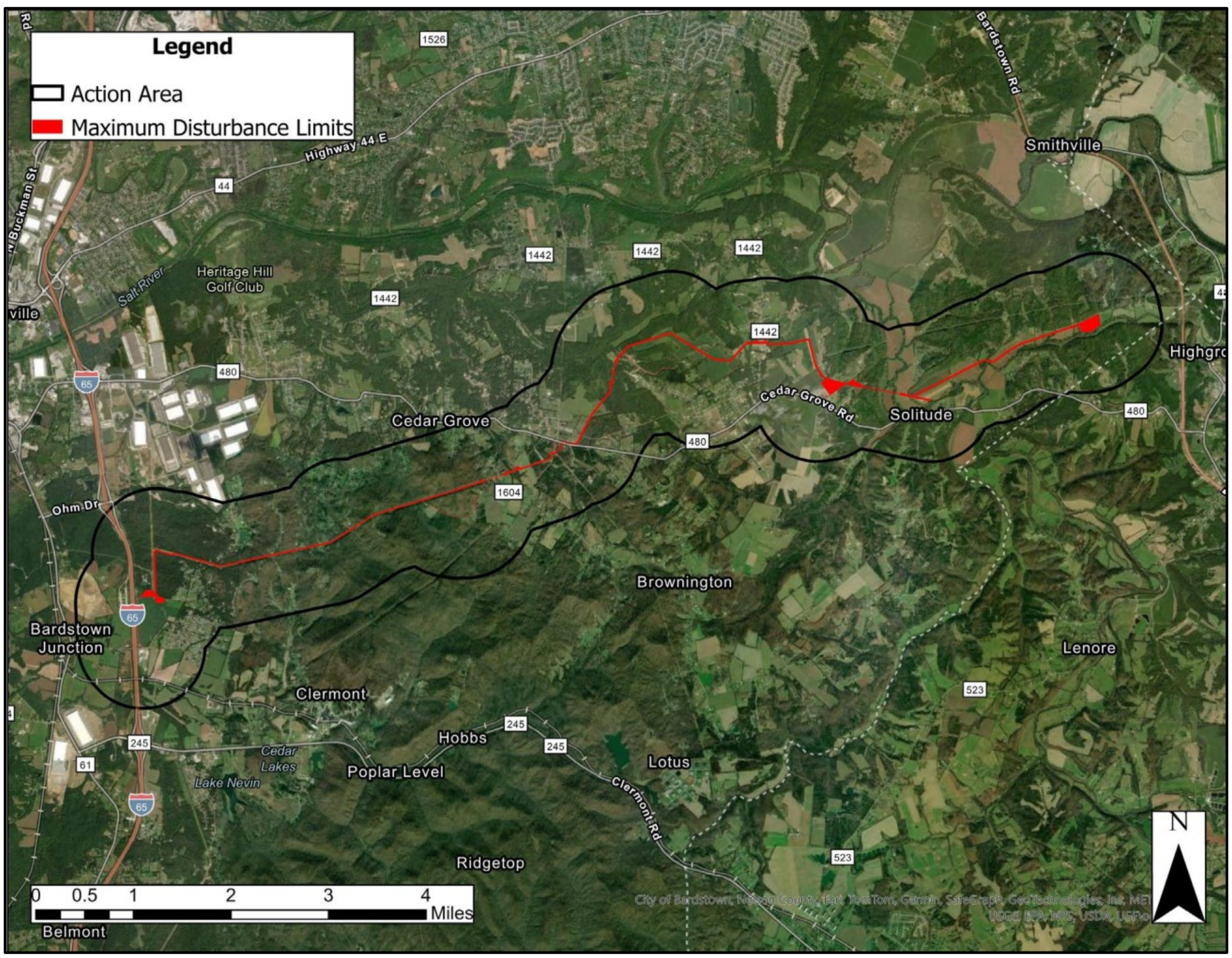

Figure 1. Map of the Action Area.

2.6 Conservation Measures

Conservation measures are proposed actions that will be undertaken by the Federal agency or the applicant as part of the Action to benefit, promote the recovery of, and/or minimize or offset effects to species affected by the Action. LG&E has committed to implement the following conservation measures as part of the Action:

Avoidance and Minimization Measures

- The pipeline alignment was altered to avoid Kentucky glade cress sites, where possible, and minimize impacts where Kentucky glade cress was identified.
- LG&E has committed to working with the Service to restore the Kentucky glade cress sites within the MDL to maximize the likelihood of these sites persisting post-construction. Examples of restoration activities will include, but are not limited to:
    - LG&E will remove and stockpile topsoil from Kentucky glade cress sites, then re-spread this material at these sites following construction to help potentially re-establish the species within impacted portions of the sites. These sites will also be restored to preconstruction contours.
    - LG&E will use a modified seed mix approved by the Service at Kentucky glade cress sites to reduce the potential for aggressive species to invade these sites and compete with Kentucky glade cress.
    - LG&E will prohibit use of fertilizer at Kentucky glade cress sites.
- LG&E has committed to adopting internal controls to ensure that herbicide will not be used at Kentucky glade cress sites.
- LG&E will use BMPs for sediment and erosion control in accordance with the Kentucky Division of Water's Water Quality Certification, Stormwater Discharge Permit, and Pollutant Discharge Elimination System General Permit (401 KAR Chapter 5) during construction activities to avoid and minimize impacts within and outside the MDL.
- The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the Indiana bat, northern long-eared bat, and tricolored bat associated with forested habitat removal.
- Tree clearing will be targeted to occur between November 15 and March 31 when forested habitats are unoccupied by Indiana bats, northern long-eared bats, and tricolored bats.
- Blasting will not be used during excavation for pipeline installation to avoid noise and vibrations from this activity.
- LG&E will utilize HDD to avoid direct impacts to the perennial streams Cox Creek and Rocky Run to avoid impacts to drinking water for listed bats and aquatic insects that may provide food for Indiana bats, northern long-eared bats, and tricolored bats.

Compensation Measures

- Unavoidable adverse effects to Kentucky glade cress will occur at 10 locations within the MDL, representing six occurrences of the species. These adverse effects will result in 4.80 acres of habitat alteration at the six occurrences. LG&E will offset these adverse effects through a voluntary contribution to fund the management and protection of habitat for this species by the Office of Kentucky Nature Preserves (OKNP) at other known populations. The OKNP's cost for general management and protection of one acre of

Kentucky glade cress habitat is $6,000.00. An additional cost of $1,500.00 is included for fire management for each occurrence. Because the OKNP estimates their management costs based on a minimum of one acre of Kentucky glade cress habitat, the five occurrences with total impacts less than one acre were rounded up to one acre. The impact acreages for the six occurrences were then combined to calculate the total impact acreage for the proposed Action, which totals 7.36 acres. Based on the OKNP's costs and the total impact acreage, LG&E proposes to make a voluntary contribution of $53,160.00, as summarized in the following table.

Element Occurrence Number	Impact Acreage	Adjusted Impact Acreage	General Management Cost/Acre	Fire Management Cost	Contribution Amount
96	0.24	1.00	$6,000	$1,500	$7,500
9	0.54	1.00	$6,000	$1,500	$7,500
58	0.74	1.00	$6,000	$1,500	$7,500
34	2.36	2.36	$6,000	$1,500	$15,660
60	0.87	1.00	$6,000	$1,500	$7,500
1	0.05	1.00	$6,000	$1,500	$7,500
Total	**4.80**	**7.36**			**$53,160**

- LG&E will offset unavoidable adverse effects to the Indiana bat and northern long-eared bat from 39.46 acres of habitat loss through a voluntary contribution to the Imperiled Bat Conservation Fund administered by the Kentucky Natural Lands Trust, consistent with the procedures described in the June 2016 *Revised Conservation Strategy for Forest-Dwelling Bats in the Commonwealth of Kentucky* (USFWS 2016). LG&E expects to contribute between $257,114.00 and $575,280.00 depending on the time of year habitat is removed.

  Within portions of two parcels located in the MDL (i.e., the Bernheim properties), LG&E will double the standard mitigation multiplier listed in the June 2016 *Revised Conservation Strategy for Forest-Dwelling Bats in the Commonwealth of Kentucky*. The higher multiplier will provide additional compensation for the loss of habitat on these properties, which were originally purchased through the Imperiled Bat Conservation Fund to compensate for other listed bat habitat losses at other locations within Kentucky.

3. SOURCES OF CUMULATIVE EFFECTS

A BO must assess the consequences to species that are reasonably certain to occur as a result of future non-Federal activities within the action area, *i.e.,* cumulative effects. "Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02).

In its request for consultation, the Corps did not describe, and the Service is not aware of, any future non-Federal activities that are reasonably certain to occur within the Action Area.

Because we anticipate no cumulative effects, cumulative effects will not be further discussed in this BO.

4. KENTUCKY GLADE CRESS

This section provides the Service's BO related to the effects of the Action on Kentucky glade cress.

4.1 Status of Kentucky Glade Cress

This section summarizes best available data about the biology and current condition of Kentucky glade cress (*Leavenworthia exigua* var. *laciniata*) throughout its range that are relevant to formulating this BO. Kentucky glade cress was listed as threatened by the Service on May 6, 2014 (USFWS 2014a). Critical habitat for the species was also designated on May 6, 2014 (USFWS 2014b). To determine if listing was warranted for Kentucky glade cress, the Service carefully assessed the best scientific and commercial information available regarding the past, present, and future threats faced by the species.

4.1.1 Description of Kentucky Glade Cress

Kentucky glade cress is an annual member of the mustard family (Brassicaceae). Plants are about five to 10 cm (1.97 to 3.94 in) in height with early leaves that are simple with a slender petiole (central stalk of the leaf) and mature leaves that are sharply lobed (appear as disconnected pieces along the main leaf vein), somewhat squared at the ends, and arranged as a rosette (circular cluster of leaves; Evans and Hannan 1990, p. 5). The flowers are small [three to six mm (0.12 to 0.24 in)], white to lilac in color with four petals, green rather than lavender sepals (the outer of two floral leaves that make up the flower), and leafless stems. Leaves typically disappear by the time the plant is in fruit (Evans and Hannan 1990, p. 6). The fruit is flat and pod-shaped.

4.1.2 Life History of Kentucky Glade Cress

The life cycle of Kentucky glade cress is almost identical to that of all members of the genus *Leavenworthia* (Baskin and Baskin 1981, p. 246; Solbrig 1972, p. 155), except for the mode of reproduction. Rather than reproducing sexually through seed production, this species has patterns of genetic diversity that suggest that it reproduces asexually, most likely through apomixis, the asexual formation of seeds from maternal ovule tissue without fertilization and recombination (Bicknell and Koltunow 2004, Edwards 2018 p. 13). However, additional research on the reproductive biology of this species is needed to understand how apomixis in this taxon is accomplished. While pollination and recombination seem to not be necessary for reproduction, bee flies (Bombyliidae) have been observed visiting flowers (Littlefield 2019, pers. comm.). Successful reproduction requires sufficient moisture for germination, growth, flowering, and seed production. Seeds may fall to the ground, be transported by animals, or be carried by water runoff from precipitation to new sites during high precipitation events.

For Kentucky glade cress, seed germination occurs in September and October (Baskin and Baskin 1981, p. 246). The young plants survive through the winter as rosettes that then flower from late February to mid-April (Baskin and Baskin 1981, p. 246; Darnell 2019a, pers. comm.; Evans and Hannan 1990, p. 11). Peak flowering between 2012 and 2019 fell between March 11 and April 20 (Darnell 2019a, pers. comm.). Seed set and plant death occur in April and May as the glade habitats dry out (Baskin and Baskin 1985, pp. 378-379; Solbrig 1972, p. 155). Seeds are typically dispersed from mid to late-May (Evans and Hannan 1990, p. 11). After the seeds ripen, the silique (pod) soon splits open. Seeds may immediately fall out or remain on the plant for several days.

At maturity, most of the seeds are dormant and will not germinate following dispersal, even if the soils are moist (Baskin and Baskin 1985, p. 379). During the summer, these seeds undergo physical changes known as after-ripening and move from dormancy to conditional dormancy and, finally, become non-dormant for fall germination (Baskin and Baskin 1985, p. 379). Baskin and Baskin (1971, p. 33; 1972, p. 1716) found that freshly harvested *Leavenworthia* spp. seeds were dormant at any temperature and that, once dormancy was broken, germination was prevented by high temperatures, regardless of moisture levels. This characteristic seems to protect *Leavenworthia* spp. from germination following short summer showers that temporarily moisten the glade habitats (Baskin and Baskin 1985, p. 381) and allows them to avoid the hot, dry summer (Baskin and Baskin 1972, p. 1720). All seeds may not germinate each fall, allowing seed reserves to accumulate (Baskin and Baskin 1981, p. 246). A study by Baskin and Baskin (1981, p. 247) found that collected Kentucky glade cress seeds germinated in a greenhouse over four autumns, although at drastically reduced numbers after the first year (4,907 in 1976, 190 in 1977, 156 in 1978, and 71 in 1979). A strong seed bank is expected to be important for the continued existence of Kentucky glade cress, especially following a year when conditions are unfavorable for reproduction (e.g., damage, natural or manmade, to plants prior to seed set).

The extent to which this plant can expand to new sites is unknown. Lloyd (1965, p. 92) noted that seeds from *Leavenworthia* lack adaptations that would allow for dispersal by wind or animals. Sheet flow likely provides local dispersion for seeds lying on the ground (Lloyd 1965, pp. 92-93; Evans and Hannan 1990, p. 11). In reviewing aerial photography and topographic mapping of known Kentucky glade cress occurrences, it appears that populations often follow suitable habitat as it extends along topographic contours or within drainage patterns. Seeds can also be dispersed by off-road vehicles and lawn mowers in disturbed habitat, and by cattle when mud that contains seeds get stuck in their hooves (Littlefield 2019, pers. comm.). Areas of bare ground are essential in the dispersal and germination of seeds. The cyclical moisture availability on the thin soils of glades and other habitats acts to limit the number of plant species that can tolerate these extremes (Evans and Hannan 1990, pp. 9-10).

4.1.3 Habitat Characteristics and Use of Kentucky Glade Cress

Kentucky glade cress is adapted to environments with shallow soils interspersed with flat-bedded, Silurian dolomite and dolomitic limestones, which is an uncommon geological formation in Kentucky (Rollins 1963, p. 5; Evans and Hannan 1990, pp. 8-9). The soil on these horizontally bedded limestone areas is often only a few inches in depth or may be completely absent in some areas (Rollins 1963, p. 5). These dolomite glades are extremely wet from late winter to early spring and quickly become dry in May and June. Currently, the natural habitat for Kentucky glade cress is dolomite glades, but the taxon is also known from eroded shallow soil areas with exposed bedrock, areas where the soil has been scraped off the underlying bedrock, and former glade and barrens sites that have been converted to pastures, lawns, or roadsides (Evans and Hannan 1990, p. 8). The species does not appear to compete well with other vegetation and is shade intolerant (Evans and Hannan 1990, p. 14). This characteristic allows for the species to exist in high numbers in disturbed sites like lawns and pastures that receive regular disturbance from mowing or grazing.

The species is not restricted to any specific soil type (Evans and Hannan 1990, p. 8). It appears to be more dependent upon lack of soil (and plant competition) and proximity of limestone rock near or at the surface. It occurs primarily in open gravelly soils around rock outcrops in an area of the Caneyville-Crider soil association (Whitaker and Waters 1986, p. 16). Within this soil association, Kentucky glade cress occurs on the following mapped soil types: Caneyville-rock outcrop complex, 6 to 40 percent slope; Caneyville silt loam, 6 to 12 percent slope, eroded; Caneyville-Beasley-rock outcrop complex, 12 to 30 percent slope; Faywood-Beasley-rock outcrop complex, 25 to 60 percent slope; and Beasley silty clay loam, 6 to 12 percent slopes, severely eroded (Whitaker and Waters 1986, pp. 26-27, 29-31, 40-41; Evans and Hannan 1990, p. 8). Where the species occurs on soils without bedrock near the surface, the soil is usually eroded to severely eroded with 25 to 100 percent of the original surface gone (Evans and Hannan 1990, p. 8).

The cyclical moisture availability on the thin soils of glades and other habitats acts to limit the number of plant species that can tolerate these extremes. Consequently, very few other plants occur on undisturbed glades (Evans and Hannan 1990, pp. 9-10). In areas where the glades have been disturbed, native and introduced weedy species (annual and perennial) have invaded glades from nearby roads, fields, and waste areas (Baskin and Baskin 1985, p. 375). Areas surrounding glade openings tend to have deeper soils that support plants with prairie/barren or forest affinities.

4.1.4 Numbers, Reproduction, and Distribution of Kentucky Glade Cress

Distribution

Kentucky glade cress is endemic to Kentucky and is known from only northeastern Bullitt County and extreme southeastern Jefferson County (Evans and Hannan 1990; Jones 2005; White 2004). Populations of Kentucky glade cress are disjunct (separated) from populations of the other two varieties of *L. exigua* that occur in Alabama, Georgia, and Tennessee (Rollins 1963). Information regarding the historical range and distribution of the species is largely lacking. The original description by Rollins (1963, p. 75) notes a single specimen collected in a cedar glade in Bullitt County and references an earlier specimen collected in 1954 by H. A. Korfhage from an open field in Bullitt County.

Over the last 20 years, the OKNP has systematically used aerial photography to identify potential glade habitat in suitable types of limestone bedrock with the intent of identifying new populations within the known range and exploring potential areas to expand the known habitat. Very little potential habitat fitting these parameters has not been surveyed. Also, this part of

Kentucky is heavily explored because it is so populated and accessible. There are still some un-surveyed areas in the region, and several new occurrences of Kentucky glade cress have been discovered in recent years (2015-2018); however, the majority of potential sites have been surveyed, and it is unlikely that a substantial number of undiscovered populations exist (Littlefield 2019, pers. comm.).

Population Size

Annual plants like Kentucky glade cress often have widely fluctuating population sizes (Bush and Lancaster 2004, n.p.), and a given year's population strongly influences the seed bank for future years. Large populations with larger seed banks will be better able to persist through environmental and demographic stochastic events (e.g., drought years that reduce seed production). Large populations will also be more likely to withstand short periods of poor habitat conditions due to human activities (e.g., mowing before seed set) because of robust seed bank. Even large populations, however, will not be able to withstand repeated human activities over several years that reduce reproduction and deplete the seed bank. Although no studies have examined the long-term viability of Kentucky glade cress seed, Baskin and Baskin (1981) found that more than 90 percent of the total germination took place in the first growing season, but germination can occur up to four autumns after the seed is produced.

Long-term quantitative monitoring data are unavailable for this taxon range-wide, but OKNP has recorded qualitative estimates of element occurrence size and quality at varying time intervals, along with consistent quantitative monitoring at a subset of sites. An element occurrence (EO) is the basic conservation unit used by OKNP in assessing species for its Natural Heritage Program. NatureServe defines an EO as "an area of land and/or water where a species or ecological community is or was present" (NatureServe 2004, p. 1). Each occurrence was evaluated with respect to size and resiliency, condition of the habitat, and degree of threat. As an annual species, plant numbers of Kentucky glade cress can naturally and greatly fluctuate from year to year based on a variety of factors, such as seed production in past years, germination rates, disturbance, and environmental conditions (e.g., temperature, rainfall; Bush and Lancaster 2005, n.p.). As such, habitat conditions often have a greater influence on the evaluation of resiliency than population numbers. Element occurrences have been ranked into the following categories: A (excellent estimated resiliency), B (good estimated resiliency), C (fair estimated resiliency), D (poor estimated resiliency), F (field surveys failed to relocate the plants at the site), O (directions for the record are not sufficient to determine an accurate location), or X (occurrence is considered extirpated). In addition to the main ranks of A, B, C, and D, EOs can be given an intermediate rank (e.g., AB, CD). In the 2020 Species Status Assessment (USFWS 2020), these intermediate ranks were collapsed to convert EO ranks into population resiliency ranks. Populations with an EO rank of A were assigned excellent resiliency, those with an EO rank of AB or B were assigned good resiliency, those with an EO rank of BC or C were assigned fair resiliency, and those with an EO rank of CD or D were assigned poor resiliency. A description of each element occurrence category is included in Table 1.

Table 1. Element occurrence resiliency ranks.

	Habitat Quality		
EO Rank	**High** > 10 acres habitat, native vegetation, appropriate disturbance regime	**Medium** > 5 acres of habitat, generally natural but may be somewhat degraded, high potential for restoration	**Low** Degraded, fragmented habitat with non- native plants, low restoration potential, important seed source for restoration
A – Excellent Resiliency	> 2,500 (plants)		
AB	1,000 – 2,500		
B – Good Resiliency	100 – 1,000	> 2,500	
BC	< 100	500 – 2,500	
C – Fair Resiliency		100 - 500	> 5,000
CD		< 100	500 - 5,000
D – Poor Resiliency			< 500
F	Failed to find: failed to find the plants at the site		
O	Obscure record: directions not sufficient to determine accurate location		
X	Extirpated		

As of 2019, there were 95 occurrences of Kentucky glade cress, 72 of which were extant as of the most recent surveys. The 23 remaining populations are either confirmed extirpated (n = 16) or have not been relocated during the most recent survey and may be extirpated (n = 7). A summary of current status ranks for all known sites is shown in Table 2. Fifty-eight occurrences have been surveyed since the last range-wide survey in 2004, and 13 new occurrences have been discovered in the last five years. Of the 72 extant occurrences, three have excellent resiliency, four have good resiliency, four have good/fair resiliency, 18 have fair resiliency, 11 have fair/poor resiliency, and 32 have poor resiliency. It is possible that some of these occurrences have become extirpated since they were last surveyed and, thus, the number of extant populations could be overestimated. All 29 occurrences ranked as having fair (C), good (B), or excellent (A) resiliency have been surveyed as recently as 2011 or later, and 26 of these occurrences have been surveyed since 2015.

Table 2. Current status ranks for Kentucky glade cress.

Rank	Resiliency	Number of Occurrences
A	Excellent	3
B	Good	4
BC	Good or Fair	4
C	Fair	18
CD	Fair or Poor	11
D	Poor	32
F	Not Located	7
X	Extirpated	16
Total		**95**

Genetics, Genetic Variation, or Trends in Genetic Variation

Genetic diversity for Kentucky glade cress is extraordinarily low. This species exhibits population genetic patterns consistent with clonality, including identical genotypes within populations, fixed heterozygosity at some loci indicating a lack of sexual recombination, an excess of heterozygotes compared to Hardy Weinberg equilibrium, and high negative inbreeding coefficients (Edwards 2018, p. 12.). Individuals within and among the 21 populations of *L. exigua* var. *laciniata* sampled were virtually genetically identical. Only a single genotype was found in each population (12-24 plants sampled per population; Edwards 2018, p. 26), and the majority of populations were identical except for five populations that showed one to two private alleles (i.e., alleles not found in any other population; Edwards 2018, p. 10). These findings were in contrast to those for *L. exigua* var. *exigua*, which exhibited higher amounts of genetic diversity both within and among populations. These population genetic findings supported the conclusion that *L. exigua* var. *laciniata* likely reproduces asexually through apomixis (Edwards 2018 p. 13). Because *L. exigua* var. *laciniata* reproduces asexually and is, therefore, reproductively isolated from the other varieties of *L. exigua*, it might warrant recognition as a unique species (Edwards 2018, p. 15).

Compared to sexually reproducing species, adaptation is slow in asexual species with no genetic recombination (Edwards 2018, p. 16). Adaptation in asexual species occurs through recent somatic mutations, most of which are not expected to be beneficial (Orr 2010, p. 1195). To protect the adaptive potential of *L. exigua* var. *laciniata*, Edwards (2018, p. 16) recommends protecting the largest number of individuals possible *in-situ*, regardless of location, to maximize the chances that beneficial mutations will occur. Populations with private alleles can be targeted specifically to preserve those low levels of variation that do exist within the species. Implications for *ex-situ* conservation are that it is not necessary to collect seed from the entire geographic range of the species to preserve representative genotypes, as a few genotypes exist range-wide (Edwards 2018, p. 16-17). *Ex-situ* seed collections of the existing genotypes could be sourced from a small number of *in-situ* populations.

4.1.5 Conservation Needs of and Threats to Kentucky Glade Cress

Threats

Habitat destruction and modification have been the primary causes of population declines and extirpations of Kentucky glade cress. Destruction and degradation of glades from residential and commercial development, construction and maintenance of roads and utility lines, and conversion to lawns has resulted in fewer occurrences of this species and reduced the quality of many of the remaining occurrences. Expansion of lawn grasses will continue to threaten Kentucky glade cress, regardless of development rates, as they encroach on glades and glade-like areas lacking the habitat management activities that would exclude them. Additional impacts of this nature are expected to continue for the foreseeable future as the human population within the species' range continues to grow. As the Louisville metropolitan area continues to expand, undeveloped portions of southern Jefferson and northeastern Bullitt counties will continue to be attractive to developers and, consequently, residential and commercial development and its ancillary activities will continue (USFWS 2020).

Agricultural activities, such as habitat conversion to pasture and changes in grazing intensity, also threaten Kentucky glade cress. Impacts from conversion of natural glade or glade-like habitat to tall fescue or other forage species are very similar to those discussed for lawns. High-intensity grazing can also have negative impacts on both plants and the glade habitat by increasing soil compaction and erosion rates or excessive trampling (USFWS 2009, p. 2). Agriculture and development have also led to fire suppression and subsequent forest encroachment throughout the species range. Suppression of fire around a glade can result in the accumulation of organic matter in and around the glade, resulting in increased soil depth and allowing trees and other plants that require deeper soils to encroach on glades. This encroachment threatens Kentucky glade cress by increasing shade and potentially changing the soil structure by adding organic materials. Another threat is recreational activities, such as off-road vehicle (ORV) use and horseback riding, which can change water flow patterns and damage fragile glade habitats. Climate change also represents a threat to plant species like Kentucky glade cress that are dependent on specialized habitat types (e.g., glades) and limited in distribution (Byers and Norris 2011, p. 5; et al. 2013, p. 197). Although some terrestrial plant populations have been able to adapt and respond to changing climatic conditions (Franks et al. 2014, entire), evolutionary changes are unlikely to be options for Kentucky glade cress based on the species' very low levels of genetic variation (Edwards 2019, pers. comm.). Additional information on threats to Kentucky glade cress can be found in the most recent species status assessment for this species (USFWS 2020).

Conservation Needs

Conservation measures that could address threats to Kentucky glade cress habitat include (but are not limited to):

- Avoiding cedar glades (or suitable glade-like habitats) when planning the location of buildings, lawns, roads (including horse or ORV trails), or utilities.
- Avoiding aboveground construction and/or excavations in locations that would interfere with natural water movement to suitable habitat sites.
- Conducting research supporting the development of management recommendations for grazing and other agricultural practices.
- Offering technical or financial assistance to landowners to design and implement management actions that protect the plant and its habitat.
- Avoiding lawn grass or tree plantings near glades.
- Protecting and restoring as many glade complexes as possible.

- Implementing habitat management, such as brush removal, soil scraping, prescribed grazing, prescribed fire, and/or eradication of lawn grasses, to maintain an intact native glade vegetation community.

4.2 Environmental Baseline for Kentucky Glade Cress

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

4.2.1 Action Area Numbers, Reproduction, and Distribution of Kentucky Glade Cress

This section focuses on those portions of Kentucky glade cress populations that occur within the MDL and are reasonably certain to be impacted by the Action. In 2018, Cardno, on behalf of LG&E, assessed habitats within and adjacent to the MDL to determine their potential for Kentucky glade cress presence and identify areas that may need to be surveyed for this species. The habitat assessment showed that land use between MP 0.0 and MP 5.0 is dominated by agricultural fields characterized by routine disc and till, herbicide use, monoculture vegetation, and thick, well-developed soils. Due to these factors, the agricultural fields were determined to be unsuitable to maintain populations of Kentucky glade cress. Several forested areas between MP 0.0 and MP 5.0 were identified as potential habitat for this species based on their low percent canopy cover, thin soils, rock outcroppings, and relatively low percentage of leaf litter. Cardno also determined that potential habitat for Kentucky glade cress is not present within the MDL from approximately MP 7.5 to MP 11.81 due to the densely forested landscape punctuated with steep slopes and narrow stream floodplains with a consistently thick duff layer.

The MDL from MP 5.0 to approximately MP 7.5 has a mixed land use of residential, light pasturing, and hay production and contains thinner soils. This section also contains known Kentucky glade cress sites, and portions of the section border designated critical habitat units for this species. Based on these factors, Cardno determined that this section of the MDL provides potential habitat for Kentucky glade cress.

LG&E submitted a report of Cardno's habitat assessment results to the Service for review under the technical assistance process. In the report, Cardno proposed not to survey for Kentucky glade cress in the agricultural fields between MP 0.0 and MP 5.0 and only survey the forested areas identified as potential habitat for this species. Cardno also proposed not to survey between MP 7.5 and MP 11.81 based on the lack of potential habitat identified in this area. A survey was proposed by Cardno in the area of potential habitat between MP 5.0 and MP 7.5. The Service reviewed the report and agreed with Cardno's assessment of potential and unsuitable habitat for

Kentucky glade cress in the MDL. The Service also agreed with the survey areas proposed by Cardno.

Cardno surveyed the identified areas of potential habitat within the MDL for Kentucky glade cress in 2018. The survey focused on the 2.5-mile section of the MDL from MP 5.0 to approximately MP 7.5 and also included two areas identified as potential habitat between MP 0.0 and MP 5.0. Several areas outside the current MDL were also surveyed to cover alternate alignments and wider portions of the MDL that were being considered at that time. Areas outside the MDL were also surveyed at identified Kentucky glade cress sites to help identify the size and extent of the population. During the survey, Cardno identified nine Kentucky glade cress sites located within the MDL. All nine sites also extend outside the MDL, and Kentucky glade cress individuals were observed both within and outside the MDL at each site. These sites are referenced as "populations" in the BA; however, to keep terminology consistent within this BO, they will be referred to as "sites".

Since the 2018 Cardno survey, a Kentucky glade cress site previously located outside of the MDL (Known Occurrence #9) was re-delineated and expanded into the MDL. The original site was located north of the MDL along Clarks Lane east of MP 4.0. During a 2020 survey by the OKNP, Kentucky glade cress individuals were discovered within and adjacent to the ROW along Clarks Lane south of the original site. Individuals had not previously been observed in these areas during surveys by the OKNP in 2011, 2012, 2016, and in March of 2018, immediately prior to the Cardno survey in April of 2018. Based on the 2020 survey results, the OKNP created a new polygon for the site that encompassed the individuals observed along Clarks Lane, which extended the site southward into the MDL. The site is referred to as Site 2-D in this BO and is located near Site 2-C that was discovered during the 2018 survey.

The portions of the 10 Kentucky glade cress sites located within the MDL total 4.80 acres. Table 3 summarizes the quality and size of each site and whether the site is part of a previously known occurrence or if it was discovered during the survey effort. Maps showing these sites relative to the MDL and the Corps' jurisdictional area are included in Appendix A of this BO.

Table 3. Kentucky Glade Cress Sites within the MDL.

Site	Quality (Rank)*	Size** (Acres)	Description
1-B	B	0.24	Discovered during survey; now part of Known Occurrence #96
2-C	C	0.10	Discovered during survey; now part of Known Occurrence #9
2-D	N/A	0.44	Extended into MDL after survey; part of Known Occurrence #9
3-C	C	0.74	Discovered during survey; now part of Known Occurrence #58
4-B	B	0.91	Part of Known Occurrence #34
5-C	C	1.18	Part of Known Occurrence #34
6-B	B	0.27	Part of Known Occurrence #34
7-D	D	0.85	Part of Known Occurrence #60
8-C	C	0.02	Discovered during survey; now part of Known Occurrence #60
8-D	D	0.05	Discovered during survey; now part of Known Occurrence #1
Total		**4.80**	

*Ranks were assigned by Cardno based on field observations.
**These values differ from those included in the previous consultation work on this project. The previous values included the acreage of the entire delineated site and were not limited to the acreage of the site within the MDL.

4.2.2 Action Area Conservation Needs of and Threats to Kentucky Glade Cress

Due to the location of the Action Area within the core of the species' range, the conservation needs and threats of Kentucky glade cress in the Action Area are the same as the conservation needs and threats for the species throughout its range that were discussed in Section 4.1.5.

4.3 Effects of the Action on Kentucky Glade Cress

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

The Service established additional requirements for making the determination of reasonably certain to occur (in effect since October 28, 2019) under 50 CFR 402 (see Federal Register : Endangered and Threatened Wildlife and Plants; Regulations for Interagency Cooperation). After determining that the "activity is reasonably certain to occur," based on clear and substantial information, and using the best scientific and commercial data available, there must be another conclusion that the consequences of that activity are reasonably certain to occur. In this context, a conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available.

Based on the description of the Action and the species' biology, we have identified four stressors (i.e., the alteration of the environment that is relevant to the species) to Kentucky glade cress that are reasonably certain to result from the Action: crushing, uprooting, displacing, and burying; habitat alteration; sedimentation; and stormwater runoff. Crushing, uprooting, displacing, and burying and habitat alteration are expected to occur during the construction and maintenance components of the proposed Action. Sedimentation and increased stormwater runoff could occur during the construction component of the Action. Operation will occur entirely underground within the enclosed pipeline and will not involve activities that could alter the above-ground characteristics within the ROW from post-construction conditions. Therefore, the operation component is not expected to result in any stressors that would impact Kentucky glade cress.

Below, we discuss the best available science relevant to each stressor. Then, we describe the Stressor-Exposure-Response pathways that identify the circumstances for an individual plant's exposure to the stressor (i.e., the overlap in time and space between the stressor and an individual plant). Finally, we identify and consider how proposed conservation measures may reduce the severity of the stressor or the probability of an individual plant's exposure for each pathway.

4.3.1 Effects of Construction on Kentucky Glade Cress

The construction component will result in impacts to Kentucky glade cress. Based on the potential for construction activities to occur any time of year and all phases of construction occurring within the 10 Kentucky glade cress sites, this component has the potential to affect Kentucky glade cress individuals, seeds, and habitat.

During the initial land survey phase, the movement of personnel and vehicles within the portions of the 10 Kentucky glade cress sites within the MDL could potentially crush, uproot, displace, and/or bury Kentucky glade cress individuals. This movement may also alter the habitat at the sites by displacing, mixing, removing, and/or adding soil layers, which could impact Kentucky glade cress individuals by crushing, uprooting, displacing, and/or burying the plants. Kentucky glade cress seeds are also likely to be displaced and/or buried, resulting in a loss or reduction of germination that would negatively impact the persistence of the species at the sites.

A temporary access road will be located within Kentucky Glade Cress Site 3-C, and a permanent access road will be located within Site 6-B. Additionally, a temporary construction entrance will be located within Site 8-D, and a permanent construction entrance will be located within Site 2-D. The temporary access road at Site 3-C follows an existing gravel/dirt road used by the landowner where Kentucky glade cress individuals were observed during the survey. Kentucky glade cress individuals were also observed within the limits of the permanent access road in Site 6-B. The construction entrances at Sites 2-D and 8-D are both located adjacent to existing paved roads, where individuals of the species are often found. The movement of vehicles, equipment, and personnel within the Kentucky glade cress sites during the development/construction of these features will likely crush, uproot, displace, and/or bury Kentucky glade cress individuals and seeds and alter habitat by displacing, mixing, removing, and/or adding soil layers, which could further affect individuals and seeds. These impacts are also likely to occur from any grading and other ground disturbance required to construct the access roads, as well as the placement and removal of stone used to construct the entrances and any gravel or stone needed for the access roads. None of the construction storage yards are located within or adjacent to the 10 Kentucky glade cress sites; therefore, no impacts to the species or its habitat are anticipated from the storage yards.

The installation of erosion and sediment controls within the Kentucky glade cress sites, such as silt fencing and other measures that require soil disturbance or placement of materials on the ground, will likely crush, uproot, displace, and/or bury Kentucky glade cress individuals and alter habitat by displacing, mixing, removing, and/or adding soil layers, which could further affect individuals and seeds. These impacts may also occur throughout construction from the movement of vehicles and personnel during inspection of the erosion and sediment controls and any required maintenance.

Mechanical equipment used during the removal of trees and other vegetation within the Kentucky glade cress sites will likely crush, uproot, displace, and/or bury Kentucky glade cress individuals and alter habitat by displacing, mixing, removing, and/or adding soil layers, which could further affect individuals and seeds. The movement of vehicles and personnel during hand clearing is also likely to result in these impacts. Although trees are not typically present where Kentucky glade cress grows, the majority of the Kentucky glade cress sites are bordered by trees, and scattered trees are present within a few of the sites. As a result, a tree that is felled within or along the edge of a Kentucky glade cress sites could crush, uproot, or displace nearby individuals. After the tree is felled, individuals could also be impacted by personnel, equipment, and woody debris during limbing, bucking, and removal of trees. Additionally, tree felling and removal in Kentucky glade cress sites could alter habitat by displacing and mixing soil layers, which could further affect individuals and seeds. Removal of tree stumps through grubbing and grinding, if required, and other woody debris (e.g., logs, limbs, mulch) could also result in these effects to Kentucky glade cress individuals and habitat if debris, displaced soil, or equipment impact a Kentucky glade cress site.

Mulch will not be placed in the known Kentucky glade cress sites, and any woody debris placed on a landowner's property outside the MDL will only be located in areas where no Kentucky glade cress was identified during the 2018 Cardno survey. Therefore, no impacts to the species or its habitat will occur from these activities.

Excavation within the Kentucky glade cress sites during open trenching will likely crush, uproot, displace, and/or bury Kentucky glade cress individuals. Individuals located within the pipeline alignment will likely be uprooted and displaced by excavation equipment, and those located adjacent to the alignment could be crushed or buried by stockpiled soil and operation of heavy equipment in those areas. Additionally, Kentucky glade cress habitat in the pipeline alignment will likely be altered through displacement, mixing, and removal of soil layers, and adjacent habitat where soil is stockpiled could be altered through mixing and adding soil layers. Although topsoil removed from the excavated areas will be replaced after pipeline installation, seeds contained in the topsoil could be damaged, destroyed, or buried too deep, potentially resulting in a loss or reduction of germination that will negatively impact the persistence of the species at the sites. Seeds are also likely to be impacted in the portions of the Kentucky glade cress sites where soil stockpiles are located due to the displacement, mixing, removal, and addition of soil layers.

Restoration of disturbed ground surfaces after pipeline installation is less likely to impact individuals and habitat at the Kentucky glade cress sites due to disturbance of these areas from the previous activities; however, the movement of personnel, vehicles, and equipment within the sites could impact individuals, seeds, and habitat within previously unaffected portions of the sites. Replanting disturbed portions of the Kentucky glade cress sites with a native seed mix will minimize potential effects to remaining individuals and habitat by reducing the likelihood that invasive and weedy plant species that could outcompete Kentucky glade cress will colonize the disturbed areas.

Personnel and vehicles that return after one winter post-construction to inspect the MDL for areas that need additional work or repairs could crush, uproot, displace, and/or bury remaining Kentucky glade cress individuals or individuals that have recolonized disturbed areas within the Kentucky glade cress sites since construction. Kentucky glade cress habitat could also be altered through displacing, mixing, removing, and/or adding soil layers, which could further affect individuals and seeds. These impacts could also occur as a result of equipment or ground disturbance that are required for any necessary repairs.

During the construction component, all activities will be restricted to the MDL; therefore, there is no potential for Kentucky glade cress individuals or habitat within the portions of the Kentucky glade cress sites outside the MDL to be directly impacted during construction. However, certain activities have the potential to indirectly impact the portions of the Kentucky glade cress sites outside the MDL. Sediment that is disturbed and exposed during construction could move from the MDL to portions of the sites outside the MDL through stormwater runoff, which could uproot, displace, or bury Kentucky glade cress individuals and alter habitat by mixing and/or adding soil layers. Seeds could also be displaced and/or buried, resulting in a loss or reduction of germination that would negatively impact the persistence of the species within the portions of the sites outside the MDL. The removal of vegetation in the MDL could also increase the volume of runoff to the portions of the Kentucky glade cress sites outside the MDL or result in the formation of ruts or gullies that could direct concentrated flows to these portions of the sites. This increased runoff could uproot or displace individuals, displace and deposit seeds into areas of unsuitable habitat, or displace, mix, remove, and/or add soil layers.

Although the Kentucky glade cress sites are located in relatively flat areas, some topographic variation is present within the sites. The portions of Sites 4-B and 7-D located outside the MDL are situated slightly upgradient of the MDL; therefore, there is no potential for sediment or stormwater runoff from the MDL to move into the portions of the sites outside the MDL. At Sites 2-D, 6-B, and 8-C, the MDL and the portions of the sites outside the MDL are located at similar elevations, making it unlikely that sediment and stormwater runoff from the MDL will travel to the portions of the sites outside the MDL. Based on these factors, potential effects to Kentucky glade cress individuals and habitat in the portions of these five sites outside the MDL from sedimentation and increased stormwater runoff are considered discountable.

At Sites 1-B, 2-C, 5-C and 8-D, all or a portion of the MDL is located slightly upgradient of a portion of the site located outside the MDL, creating the potential for sediment and stormwater runoff from the MDL to move into the portion of the site outside the MDL. Soil that is exposed during vegetation removal and excavated and stockpiled during pipeline installation could be transported from the MDL during precipitation events, leading to sedimentation in the portions of the sites outside the MDL. The movement of sediment into the Kentucky glade cress sites could uproot, displace, or bury Kentucky glade cress individuals and alter habitat by displacing, mixing, removing, and/or adding soil layers, which could further affect individuals and seeds. To minimize this potential, LG&E will use BMPs for sediment and erosion control in accordance with state permits and regulations. Silt fencing and/or other sediment control structures will be installed along the MDL boundary to capture and collect sediment contained in stormwater runoff from the MDL prior to reaching the portions of these sites outside the MDL. These sediment control structures will also help slow and dissipate runoff from the MDL, reducing the potential for higher volumes of runoff to flow into the portions of the sites outside the MDL. No concentrated flows from the MDL will be directed towards the portions of the sites outside the MDL, and any gullies or ruts that develop during construction will be remediated to restore sheet flow conditions. The proper installation, use, and maintenance of sediment and erosion controls in the MDL is anticipated to reduce the potential for sedimentation and increased runoff in the portions of the Kentucky glade cress sites outside the MDL to the extent that their effects on individuals, seeds, and habitat cannot be meaningfully measured, detected, or evaluated. As a result, potential effects to Kentucky glade cress and its habitat in the portions of these four sites outside the MDL from sedimentation and increased runoff are considered insignificant.

At Site 3-C, only the portion of the MDL that contains the proposed temporary access road is located upgradient of the portion of the site outside the MDL. As previously discussed, the proposed access road is currently used as an access road by the landowner. Sediment and erosion controls will be implemented along the access road to minimize the potential for sediment and increased runoff from the access road to reach the portion of the site downgradient of the access road. Any gravel or stone that is used as a base for the road will also help stabilize and trap sediment within the MDL. Therefore, potential effects to Kentucky glade cress individuals, seed, and habitat in the portion of Site 3-C outside the MDL from sedimentation and increased runoff are considered insignificant.

The construction entrances at Sites 2-D and 8-D will cross swales/ditches that facilitate drainage of stormwater runoff along the roads. The rock used to construct the entrances will be permeable and allow runoff to continue along the swale/ditch, and culverts will be installed if necessary to maintain the existing drainage system. These measures are expected to prevent runoff from being diverted to other portions of the sites where Kentucky glade cress individuals or habitat could be affected.

After pipeline installation is complete, the potential for sedimentation and increased runoff in the portions of the Kentucky glade cress sites outside the MDL will be minimized by backfilling the stockpiled soil into the trench/bore pits and seeding and stabilizing all disturbed areas. The temporary access roads and construction entrances located in the Kentucky glade cress sites will also be removed and seeded and stabilized as needed. The potential for any other phases of the construction component to result in sedimentation and/or increased runoff in the portions of the Kentucky glade cress sites outside the MDL during or after construction are considered unlikely.

Applicable Science

Construction of new utility lines is likely to destroy individuals and habitat through excavation and backfilling of glade areas (USFWS 2020). The use of vehicles and equipment during construction can also damage or destroy individuals and habitat. Frequent use by ORVs has been shown to result in soil compaction, increased weed invasion (both native and nonnative), wind and water erosion, altered water flow patterns, and decreased soil moisture (USFWS 2020). Erosion caused by vehicle and equipment movement can remove soils needed for plant growth and seed dispersal or deposit eroded material in glade habitat, increasing soil depth and making these areas more suitable for species that compete with Kentucky glade cress for water, nutrients, and/or sunlight (Stokowski & LaPointe 2000, p. 14-15).

In areas where glades have been disturbed, native and introduced weedy species (annual and perennial) may invade glades from nearby roads, fields, and waste areas (Baskin and Baskin 1985, p. 375). As a poor competitor, Kentucky glade cress is particularly vulnerable to habitat degradation from nonnative and woody species (USFWS 2020). Additionally, replanting of areas disturbed during construction is commonly done with nonnative species, such as tall fescue (*Schedonorus arundinaceus*) (J. Garland, pers. obs., 2012), which may outcompete Kentucky glade cress. While tall fescue is often considered desirable to landowners, it can become weedy or invasive, displacing native vegetation such as Kentucky glade cress (USDA NRCS 2001, p. 3). In places where the two species occur together, tall fescue competes with Kentucky glade cress for water and nutrients and reduces the amount of stable, suitable habitat available for plant growth and seed dispersal (Kral 1983, p. 2; Baskin and Baskin 1988, p. 836). Another threat to Kentucky glade cress is annual bluegrass (*Poa annua*), a weedy species common in lawns.

Rollins (1963, p. 17) found that invading weeds (primarily *P. annua*) killed 30 well-established *L. crassa* var. *crassa* and *L. alabamica* var. *alabamica* plants in less than two months in the portion of a test plot that was not weeded.

Changes in water runoff patterns associated with construction can alter soil and moisture conditions, making current habitat unsuitable for Kentucky glade cress. Successful reproduction requires sufficient moisture for germination, growth, flowering, and seed production. Sheet flow during precipitation events likely provides local dispersion for seeds lying on the ground (Lloyd 1965, pp. 92-93; Evans and Hannan 1990, p. 11), which may help spread seeds within sites or to new sites located downgradient. The cyclical moisture availability on the thin soils of glades and other habitats also acts to limit the number of plant species that can tolerate these extremes (USFWS 2020).

Effects Pathway #1	
Activity: Construction	
Stressor: Crushing, Uprooting, Displacing, Burying	
Exposure (time)	Kentucky glade cress will be exposed to this stressor for a relatively short period of time corresponding to the duration of the Construction component of the Action.
Exposure (space)	Kentucky glade cress will be exposed to this stressor wherever the species occurs within the MDL.
Resource affected	The stressor is expected to affect individual Kentucky glade cress plants, propagules, and seeds.
Individual response	The stressor is expected to cause a variety of potential responses on affected Kentucky glade cress plants, propagules, and seeds, including the following potentially significant effects: • Injury or mortality of individuals, propagules, and seeds. • Reduced vitality of populations or occurrences. • Reduced seed germination rates.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Alteration of the pipeline alignment to avoid Kentucky glade cress sites where possible. • Topsoil will be removed and stockpiled from Kentucky glade cress sites, then re-spread after construction to help potentially re-establish the species within impacted portions of the sites. • Use of a modified seed mix at Kentucky glade cress sites to reduce the potential for aggressive species to invade these areas and compete with the species. • Prohibit use of fertilizer at Kentucky glade cress sites. • Adopt internal controls to ensure that herbicide will not be used at Kentucky glade cress sites. • Offset unavoidable adverse effects to Kentucky glade cress through a voluntary contribution to fund the management and protection of

Effects Pathway #1	
	the species and its habitat offsite.
Interpretation	The effects of the Action on Kentucky glade cress are summarized in detail above in Section 4.3.1. In general, Kentucky glade cress individuals at the 10 known sites within the MDL are expected to be crushed, uprooted, buried, and/or displaced during construction. Seeds at the sites will be buried and/or displaced, resulting in a loss or reduction of germination. These impacts are assumed to be permanent, resulting in the loss of Kentucky glade cress individuals and seeds in the portions of the Kentucky glade cress sites within the MDL.
Effect	The effect of this stressor is Harm to affected Kentucky glade cress individuals, propagules, and seeds, which can include physical injury to individuals and/or mortality of individuals during the Construction component of the Action.

Effects Pathway #2	
Activity: Construction	
Stressor: Habitat Alteration	
Exposure (time)	Kentucky glade cress will be exposed to this stressor for a relatively short period of time corresponding to the duration of the Construction component of the Action.
Exposure (space)	Kentucky glade cress will be exposed to this stressor wherever the species occurs within the MDL.
Resource affected	The stressor is expected to affect Kentucky glade cress habitat.
Individual response	The stressor is expected to cause modification and destruction of Kentucky glade cress habitat.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Alteration of the pipeline alignment to avoid Kentucky glade cress sites where possible. • Topsoil will be removed and stockpiled from Kentucky glade cress sites, then re-spread after construction to help potentially re-establish the species within impacted portions of the sites. • Use of a modified seed mix at Kentucky glade cress sites to reduce the potential for aggressive species to invade these areas and compete with the species. • Prohibit use of fertilizer at Kentucky glade cress sites. • Adopt internal controls to ensure that herbicide will not be used at Kentucky glade cress sites. • Offset unavoidable adverse effects to Kentucky glade cress through a voluntary contribution to fund the management and protection of the species and its habitat offsite.
Interpretation	The effects of the Action on Kentucky glade cress are summarized in

Effects Pathway #2	
	detail above in section 4.3.1. In general, approximately 4.80 acres of Kentucky glade cress habitat within the 10 known sites within the MDL will be altered during construction by displacing, mixing, removing, and/or adding soil layers and removal of natural vegetation. Due to the specific substrate conditions required by the species, the habitat remaining after construction is not expected to be suitable for the species in the future and would likely result in a permanent loss of habitat at the affected sites.
Effect	The effect of this stressor is Harm to affected Kentucky glade cress individuals, propagules, and seeds resulting from physical injury and/or mortality associated with the effects of habitat removal during the Construction component of the Action.

Effects Pathway #3	
Activity: Construction	
Stressor: Sedimentation	
Exposure (time)	Kentucky glade cress will be exposed to this stressor for a relatively short period of time corresponding to the duration of the Construction component of the Action.
Exposure (space)	Kentucky glade cress will be exposed to this stressor in association with portions of the Kentucky glade cress sites outside the MDL.
Resource affected	The stressor is expected to affect individual Kentucky glade cress plants, propagules, seeds, and habitat.
Individual response	The stressor is expected to cause a variety of potential responses on affected Kentucky glade cress plants, propagules, and seeds and affected habitat, including the following potentially significant effects: • Injury or mortality of individuals, propagules, and seeds. • Reduced vitality of populations or occurrences. • Reduced seed germination rates. • Modification and/or destruction of habitat.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measure that most directly applies and minimizes effects related to this stressor is: • Use BMPs for sediment and erosion control in accordance with state permits and regulations during construction to avoid and minimize impacts within and outside the MDL.
Interpretation	The effects of the Action on Kentucky glade cress are summarized in detail above in section 4.3.1. The portions of Sites 4-B, 7-D, 2-D, 6-B, and 8-C outside the MDL are located upgradient or at a similar elevation to the MDL; therefore, there is little to no potential for sediment to travel from the MDL into the portions of these sites outside the MDL. The MDL is located upgradient of at least one portion of Sites 1-B, 2-C, 5-C and 8-D located outside the MDL, which could

Effects Pathway #3	
	allow sediment movement that could uproot, displace, or bury Kentucky glade cress individuals, propagules, or seeds and/or alter habitat by displacing, mixing, removing, and/or adding soil layers in the portions of the sites outside the MDL. However, the use of BMPs for sediment and erosion control is anticipated to reduce the potential for sedimentation outside the MDL to the extent that its effects on Kentucky glade cress individuals, seeds, and habitat at these sites is either unlikely to occur (Sites 4-B, 7-D, 2-D, 6-B, 8-C) or is unlikely to result in significant effects that can be meaningfully measured, detected, or evaluated (Sites 1-B, 2-C, 5-C, 8-D).
Effect	This stressor is expected to have an Insignificant effect on Kentucky glade cress, because no physical injury and/or mortality of individuals, propagules, or seeds is expected to result from this stressor during the Construction component of the Action.

Effects Pathway #4	
Activity: Construction	
Stressor: Stormwater Runoff	
Exposure (time)	Kentucky glade cress will be exposed to this stressor for a relatively short period of time corresponding to the duration of the Construction component of the Action.
Exposure (space)	Kentucky glade cress will be exposed to this stressor in association with portions of the Kentucky glade cress sites outside the MDL.
Resource affected	The stressor is expected to affect individual Kentucky glade cress plants, propagules, seeds, and habitat.
Individual response	The stressor is expected to cause a variety of potential responses on affected Kentucky glade cress plants, propagules, and seeds and affected habitat, including the following potentially significant effects: • Injury or mortality of individuals, propagules, or seeds. • Reduced vitality of populations or occurrences. • Reduced seed germination rates. • Modification and destruction of habitat.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measure that most directly applies and minimizes effects related to this stressor is: • Use BMPs for sediment and erosion control in accordance with state permits and regulations during construction to avoid and minimize impacts outside the MDL.
Interpretation	The effects of the Action on Kentucky glade cress are summarized in detail above in section 4.3.1. The portions of Sites 4-B, 7-D, 2-D, 6-B, and 8-C outside the MDL are located upgradient or at a similar elevation to the MDL; therefore, there is little to no potential for stormwater runoff from the MDL to flow into the portions of these sites

Effects Pathway #4	
	outside the MDL. The MDL is located upgradient of at least one portion of Sites 1-B, 2-C, 5-C and 8-D located outside the MDL, which could allow increased stormwater runoff that could uproot or displace individuals, wash seeds into areas of unsuitable habitat, or displace, mix, remove, and/or add soil layers in the portions of the sites outside the MDL. However, the use of BMPs for sediment and erosion control will also help slow and dissipate runoff from the MDL, and no concentrated flows from the MDL will be directed towards the portions of the sites outside the MDL. As a result, the potential for increased runoff is expected to be reduced to the extent that its effects on Kentucky glade cress individuals, seeds, and habitat at these sites is either unlikely to occur (Sites 4-B, 7-D, 2-D, 6-B, 8-C) or is unlikely to result in significant effects that can be meaningfully measured, detected, or evaluated (Sites 1-B, 2-C, 5-C, 8-D).
Effect	This stressor is expected to have an Insignificant effect on Kentucky glade cress, because no physical injury and/or mortality of individuals, propagules, or seeds is expected to result from this stressor during the Construction component of the Action.

4.3.2 Effects of Maintenance on Kentucky Glade Cress

The maintenance component will occur within the permanent ROW. Kentucky glade cress is not expected to remain in the ROW after construction; however, the implementation of conservation measures at the Kentucky glade cress sites, such as the stockpiling and reapplication of topsoil and using a modified seed mix, may result in habitat conditions that allow the species to become re-established through the seed bank or spreading of seeds from the remaining portions of the sites outside the MDL. Vegetative maintenance to prevent trees and other woody vegetation from growing in the ROW could also contribute to favorable conditions at the Kentucky glade cress sites. Occurrences of Kentucky glade cress are known from existing utility ROWs that are maintained in a similar manner. Although there is no data to accurately predict where and when this may occur, the potential exists for individuals to re-establish in the permanent ROW where conditions are favorable. Based on the potential for Kentucky glade cress to be present in the ROW, individuals, seeds, and habitat could be impacted by the proposed maintenance activities. Maintenance activities could occur any time of the year over the 50+-year life of the pipeline, resulting in potential impacts to all phases of the species' life cycle.

The movement of personnel and vehicles within the permanent ROW during periodic inspections and maintenance activities could crush, uproot, displace, and/or bury re-established Kentucky glade cress individuals. Kentucky glade cress habitat at the sites could also be altered through displacing, mixing, removing, and/or adding soil layers, which could further affect individuals and seeds.

Vegetative maintenance activities within the permanent ROW could also result in potential impacts to Kentucky glade cress. Mowing within the Kentucky glade cress sites and the movement of mowing equipment through the sites could crush, uproot, displace, and/or bury

Kentucky glade cress individuals, displace or bury seeds, or alter habitat by displacing, mixing, removing, and/or adding soil layers. LG&E has committed to adopting internal controls to ensure that herbicide will not be used at the Kentucky glade cress sites; therefore, herbicide use is not expected to affect any re-established individuals within the permanent ROW.

Applicable Science

Vegetation management activities within utility ROWs, such as mowing and herbicide application, can also modify and degrade habitat for Kentucky glade cress. Mowing in early spring as the species is fruiting or before seed has reached maturity could crush plants before the seeds mature or cause seeds to fall prematurely, negatively impacting reproduction and populations in subsequent years (USFWS 2020). Application of herbicide has been found to cause declines in species abundance at known sites (Littlefield 2019, pers. comm.). Vegetation management activities that occur after seed set could affect seeds lying on top of the soil (Littlefield 2019, pers. comm.).

Vegetation management in utility ROWs can also benefit Kentucky glade cress by maintaining open habitat and reducing competition from plants that would be impacted by summer mowing and herbicide applications . Large groups of Kentucky glade cress have been observed in power line ROWs, and four known occurrences occur within utility ROWs, including portions of one A-ranked, one B-ranked, and two C-ranked occurrences (USFWS 2020). Seeds may also be dispersed by mowers and vehicles (Littlefield 2019, pers. comm.).

Effects Pathway #5	
Activity: Maintenance	
Stressor: Crushing, Uprooting, Displacing, Burying	
Exposure (time)	Kentucky glade cress will be exposed to this stressor for a period of 50 or more years corresponding to the duration of the Maintenance component of the Action. Maintenance activities can occur at any time of year.
Exposure (space)	Kentucky glade cress will be exposed to this stressor in association with portions of the Action that lie within the permanent ROW of the pipeline.
Resource affected	The stressor is expected to affect individual Kentucky glade cress plants, propagules, and seeds.
Individual response	The stressor is expected to cause a variety of potential responses on affected Kentucky glade cress plants, propagules, and seeds and affected habitat, including the following potentially significant effects: • Injury or mortality of individuals, propagules, or seeds. • Reduced vitality of populations or occurrences. • Reduced seed germination rates.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measure that most directly applies and minimizes effects related to this stressor is: • Adopt internal controls to ensure that herbicide will not be used at Kentucky glade cress sites.

Effects Pathway #5	
Interpretation	The effects of the Action on Kentucky glade cress are summarized in detail above in section 4.3.2. In general, Kentucky glade cress individuals could become re-established in the permanent ROW after construction. Personnel and vehicle movement and mowing within the portions of the 10 Kentucky glade cress sites within the ROW could crush, uproot, displace, and/or bury Kentucky glade cress individuals if they become re-established or are unaffected by the initial clearing of the ROW and initial construction activities. Seeds could be buried and/or displaced, resulting in a loss or reduction of germination.
Effect	The effect of this stressor is Harm to affected Kentucky glade cress individuals, propagules, and seeds resulting from physical injury and/or mortality during with the Maintenance component of the Action.

Effects Pathway #6	
Activity: Maintenance	
Stressor: Habitat Alt ration	
Exposure (time)	Kentucky glade cress will be exposed to this stressor for a period of 50 or more years corresponding to the duration of the Maintenance component of the Action. Maintenance activities can occur at any time of year.
Exposure (space)	Kentucky glade cress will be exposed to this stressor in association with portions of the Action that lie within the permanent ROW of the pipeline.
Resource affected	The stressor is expected to affect individual Kentucky glade cress plants, propagules, seeds, and habitat.
Individual response	The stressor is expected to cause modification and destruction of Kentucky glade cress habitat.
Interpretation	The effects of the Action on Kentucky glade cress are summarized in detail above in section 4.3.2. In general, habitat conditions in the portions of the 10 Kentucky glade cress sites within the permanent ROW could be favorable for Kentucky glade cress after construction. Conservation measures, such as the stockpiling and reapplication of topsoil, using a modified seed mix, and maintenance of trees and other woody vegetation, will help maintain favorable habitat conditions at the sites and control natural succession. Personnel and vehicle movement and mowing within the sites could alter this habitat through displacing, mixing, removing, and/or adding soil layers, modifications of plant community structure, or the introduction of exotic invasive species that could compete with Kentucky glade cress.
Effect	The effect of this stressor is Harm to affected Kentucky glade cress individuals, propagules, and seeds resulting from physical injury and/or mortality associated with the effects of habitat removal or modification during the Maintenance component of the Action.

4.3.3 Summary of Effects of the Action on Kentucky Glade Cress

The Action will impact a total of 4.80 acres of Kentucky glade cress habitat at 10 known sites within the MDL representing six element occurrences. Impacts to Kentucky glade cress within the Corps' jurisdictional area will total 0.61 acre and occur at Sites 3-C, 5-C, 6-B, and 8-C. Impacts to this species outside of the Corps' jurisdictional area will total 4.19 acres and occur at Sites 1-B, 2-D, 2-C, 4-B, 7-D, and 8-D. Impacts to Kentucky glade cress will occur during the construction and maintenance components. The stressors that are expected to impact Kentucky glade cress are crushing, uprooting, displacing, and burying and habitat alteration, as summarized in Table 4.

Table 4. Summary of the Effects of the Action on the Kentucky Glade Cress.

Stressors: ***Activity***	**Adverse**	**Insignificant/ Discountable**
Crushing, Uprooting, Displacing, Burying: *Construction*	harm	
Habitat Alteration: *Construction*	harm	
Sedimentation: *Construction*		insignificant
Stormwater Runoff: *Construction*		insignificant
Crushing, Uprooting, Displacing, Burying: *Maintenance*	harm	
Habitat Alteration: *Maintenance*	harm	

4.4 Cumulative Effects on Kentucky Glade Cress

For purposes of consultation under ESA §7, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. No cumulative effects were identified by the Corps, and the Service has determined none are reasonably certain to occur.

4.5 Conclusion for Kentucky Glade Cress

In this section, we summarize and interpret the findings of the previous sections for the Kentucky glade cress (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to jeopardize the continued existence of the species. After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action, and the absence of any cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of Kentucky glade cress. We reached this determination based on the best available commercial and scientific information as described in our effects analysis in this BO and how those effects relate to the resiliency, redundancy, and representation of Kentucky glade cress, as described below.

- Only a portion of six Kentucky glade cress occurrences will be impacted by the Action, and each occurrence contains additional sites outside the MDL that will not be impacted. For example, Figure 2 shows this relationship for Kentucky glade cress element occurrence 96; most of the Kentucky glade cress site will not be impacted, and the same is true for the element occurrence. In addition, the Action will not result in the total loss of any of these six occurrences, and impacts at five of the six occurrences will affect less than 20% of the occurrence. Approximately 45% of the remaining occurrence (Element Occurrence 34) will be impacted; however, the remaining portions of the occurrence are located at additional sites beyond the MDL.

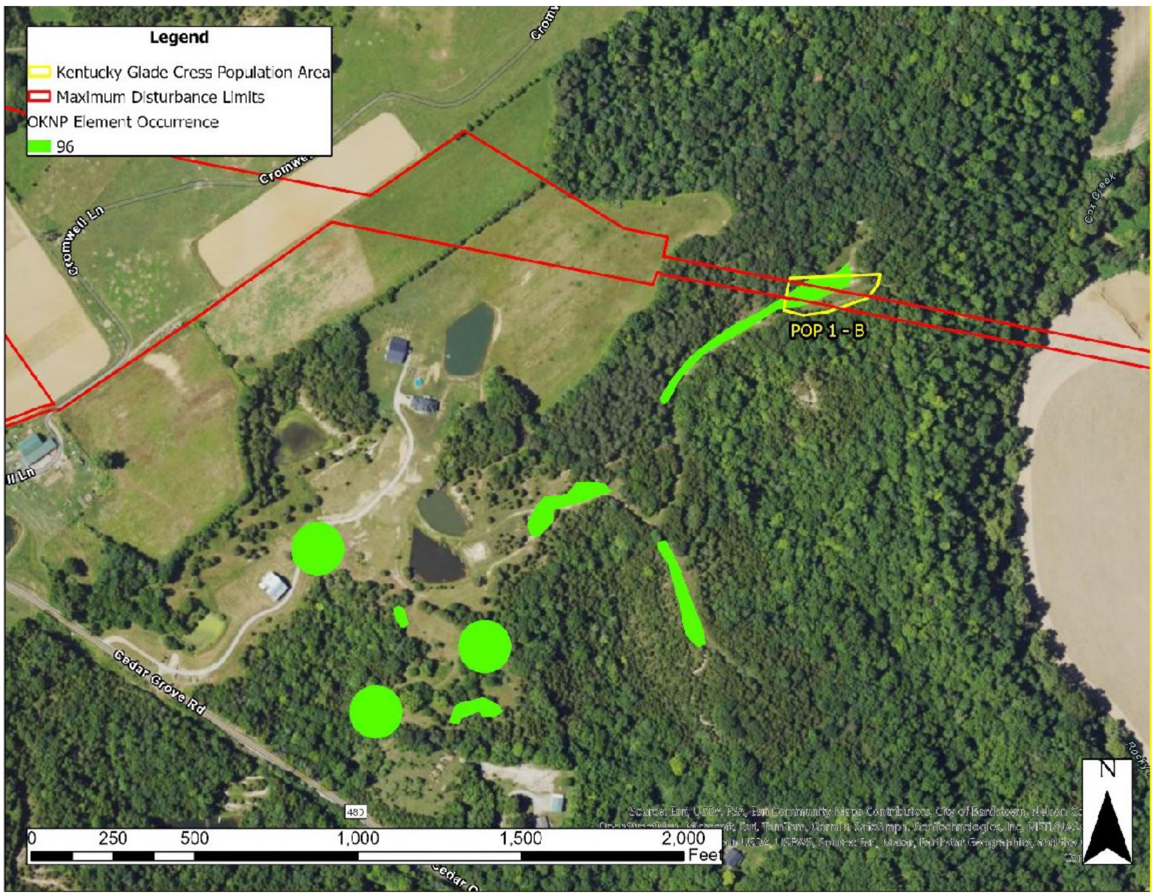

Figure 2. Example demonstrating the location of additional Kentucky glade cress sites associated with an element occurrence that occur outside of the MDL.

Additionally, the six Kentucky glade cress occurrences have a relatively wide spatial distribution, making it unlikely that a stochastic event that affects one occurrence will impact other occurrences. For these reasons, we do not expect the resiliency of Kentucky glade cress to be significantly reduced by the Action.

- Five of the Kentucky glade cress sites that will be impacted by the Action were discovered during the survey for the project and expand existing occurrences. These sites were not included as part of the 61 occurrences known at the time of listing. Additionally, the occurrences that will be impacted by the Action represent only six of more than 72 known extant occurrences for the species. Based on the small number of occurrences impacted, the fact that no reduction in the species' range will occur, and considering that none of the occurrences will be impacted in its entirety, we find that the redundancy of Kentucky glade cress will not be significantly reduced by the Action.

- The limited geographic range of Kentucky glade cress and preliminary research suggesting little genetic variation between populations establishes a naturally low representation within the species. The Action would only affect portions of six occurrences. Therefore, we do not expect the representation of the species to be significantly reduced by the Action.

Based on this analysis, we conclude that the effects of the Action will not appreciably reduce the likelihood of both the survival and recovery of Kentucky glade cress.

Designated critical habitat for the Kentucky glade cress does not occur within the MDL. On April 26, 2024, the Service concurred with the Corps' determination that the Action may affect but is not likely to result in the destruction or adverse modification of designated critical habitat for this species based on the lack of direct impacts to this habitat and implementation of conservation measures to avoid and minimize potential indirect impacts to this habitat beyond the MDL. Therefore, it is the Service's biological opinion that the Action is not likely to result in the destruction or adverse modification of designated critical habitat for Kentucky glade cress.

5. INDIANA BAT

This section provides the Service's BO related to the effects of the Action on the Indiana bat.

5.1 Status of the Indiana Bat

This section summarizes the best available data about the biology and current condition of the Indiana bat throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list the Indiana bat as endangered on March 11, 1967 (Federal Register 32[48]:4001) under the Endangered Species Preservation Act of October 15, 1966 (80 Stat. 926; 16 U.S.C. 668aa[c]). The ESA of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) subsequently extended full legal protection from unauthorized take to the species. Critical habitat was designated for the species on September 24, 1976 (41 FR 14914). Thirteen hibernacula, including 11 caves and two mines in six states, were listed as critical habitat.

5.1.1 Description of the Indiana Bat

The Indiana bat is a temperate, insectivorous, migratory bat that hibernates in caves and mines in the winter and summers in forested areas. It is a medium-sized bat, having a wingspan of nine to 11 inches and weighing only one-quarter of an ounce. It has brown to dark-brown fur, and the facial area often has a pinkish appearance. The Indiana bat closely resembles the little brown bat (*Myotis lucifugus*) and the northern long-eared bat. It is distinguished from these species by its foot structure and fur color. The Indiana Bat Draft Recovery Plan (USFWS 2007) provides a comprehensive summary of the description of the species and is incorporated by reference.

5.1.2 Life History of the Indiana Bat

The Indiana bat hibernates in caves and mines in the winter (typically October through April) and migrates to forested summer habitat. When arriving at their traditional hibernacula from August to October, Indiana bats "swarm" for several weeks prior to hibernation. Some male bats may begin to arrive at hibernacula as early as July, but females typically arrive later. The time of highest swarming activity in Indiana and Kentucky has been documented as early September (Cope and Humphrey 1977). Swarming is a critical part of the life cycle when Indiana bats converge at hibernacula, mate, and forage until sufficient fat reserves have been deposited to sustain them through the winter (USFWS 1983). Swarming behavior typically involves large numbers of bats flying in and out of cave entrances throughout the night, while most of the bats continue to roost in trees during the day (Cope and Humphrey 1977). Body weight may increase by two grams within a short time, mostly in the form of fat. Copulation occurs on cave ceilings near the cave entrance during the latter part of the swarming period (USFWS 2007). Females may mate their first autumn, whereas males may not mature until the second year (USFWS 2007). By late September, many females have entered hibernation, but males may continue swarming well into October in an attempt to breed with late arriving females.

The initiation of hibernation may vary by latitude and annual weather conditions; however, most bats are hibernating by the end of November (USFWS 2007). Hibernation facilitates survival during winter when insect prey are unavailable. Hibernating Indiana bats cluster on cave ceilings in densities of approximately 300-484 bats/ft^2 from approximately October through April. Like other cave bats, the Indiana bat naturally arouses during hibernation. Arousals are more frequent and longer at the beginning and end of the hibernation period. Limited mating occurs throughout the winter and in early April as bats emerge (USFWS 2007).

Spring emergence occurs when outside temperatures have increased and insects (prey) are more abundant (Richter et al. 1993). Most Indiana bats emerge in late March or early April; however, the timing of annual emergence may vary across the range depending on latitude and annual weather conditions. Females emerge before males. Shortly after emerging from hibernation, the females become pregnant via delayed fertilization from the sperm that has been stored in their reproductive tracts through the winter (USFWS 2007). During the "staging" period, the bats forage for a few days or weeks near their hibernaculum before migrating to their traditional summer roosting areas. Most populations leave their hibernacula to migrate to summer habitat by late April.

Most published literature indicates Indiana bats migrate north for the summer maternity season (USFWS 2007; Gardner and Cook 2002). However, recent migration studies also document lateral and southward migrations (Copperhead 2017; Roby et al. 2019). Some reproductive females have been documented to migrate up to 357 miles (Winhold and Kurta 2006) to form maternity colonies, while others form maternity colonies within only a few miles of their hibernacula (Johnson et al. 2011). Males are commonly found roosting near hibernacula but have also been documented to migrate long distances to their summer habitat (Kurta and Rice 2002). Migration is stressful for the Indiana bat, particularly in the spring when their fat reserves and food supplies are low. As a result, adult mortality may be the highest in late March and April.

Female Indiana bats, like most temperate members of the family Vespertilionidae, give birth to one young each year (Mumford and Calvert 1960; Humphrey et al. 1977; Thomson 1982). The proportion of female Indiana bats that produce young is not well documented. At a colony in Indiana, 23 of 25 female Indiana bats produced volant young during one year, and 23 of 28 females the following year (Humphrey et al. 1977). Based on cumulative mist-netting captures over multiple years, Kurta and Rice (2002) estimated that 89% of adult females in Michigan maternity colonies were in reproductive condition (e.g., pregnant, lactating, or post-lactating).

Racey (1982) notes that a particular ratio of fat to lean mass is normally necessary for puberty and the maintenance of female reproductive activity in mammals. He suggests further that the variation in the age of puberty in bats is due to nutritional factors, possibly resulting from the late birth of young and their failure to achieve threshold body weight in their first autumn. Once puberty is achieved, reproductive rates frequently reach 100% among healthy bats of the family Vespertilionidae, and young, healthy female bats can mate in their first autumn as long as their prey base is sufficient to allow them to reach a particular fat to lean mass ratio.

Studies by Belwood (2002) show asynchronous births among members of a colony. This results in great variation in size of juveniles (newborn to almost adult size young) in the same colony. Young Indiana bats are capable of flight within a month of birth. Young born in early June may fly as early as the first week of July (Clark et al. 1987), with others flying from mid- to late-July. Mortality between birth and weaning was found to be about 8% (Humphrey et al. 1977).

Indiana bats feed on aquatic and terrestrial insects. Diet varies seasonally and among different ages, sexes, and reproductive status (USFWS 1999). Numerous foraging habitat studies have found that Indiana bats forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands. Old fields and agricultural fields are also used (USFWS 2007; Sparks et al. 2005). Indiana bats frequently forage along riparian corridors and obtain water from streams, ponds, and water-filled road ruts in forest uplands.

The average life span of the Indiana bat is five to 10 years, but banded individuals have been documented living as long as 14 and 15 years (Humphrey and Cope 1977). Using winter sampling of unknown-age bats over a 23-year period, Humphrey and Cope (1977) estimated annual survival. Female survivorship in an Indiana population was 76% for ages one to six years and 66% for ages six to 10 years. Male survivorship was 70% for ages one to six years and 36% for ages six to 10 years. Following 10 years, the survival rate for females dropped to only 4% (Humphrey and Cope 1977).

5.1.3 Habitat Characteristics and Use of the Indiana Bat

<u>Winter Habitat</u>

Indiana bats roost in caves or mines with configurations that provide a suitable temperature and humidity microclimate (Brack et al. 2003; USFWS 2007). Requirements for hibernacula are discussed in the Draft Recovery Plan for the species (USFWS 2007).

Summer Habitat

Summering Indiana bats (males and females) use forested habitat for roosting, foraging, and commuting. Indiana bats are often associated with floodplain or riparian forests with large trees, scattered canopy gaps, and open understories (USFWS 2007). Research has showed adaptability in habitats used, including upland forests, forests altered by grazing, swine feedlots, row-crops, hay fields, residences, clear-cut harvests, and shelterwood cuts (Garner and Gardner 1992; USFWS 1999).

Suitability of a roost tree is determined by its condition (dead or alive), suitability of loose bark, solar exposure, spatial relationship to other trees, and its spatial relationship to water sources and foraging areas. Potentially suitable roost trees can be trees of any species with bark separating from the tree after the tree dies, senesces, or is injured. Live trees that exhibit peeling or shaggy bark, such as hickories (*Carya* spp.) and large white oaks (*Quercus alba*), may also be suitable roost trees. Many maternity colonies have been associated with oak-hickory and elm-ash-cottonwood forest types. Tree cavities, hollow portions of tree boles or limbs, and crevice and splits from broken tops occasionally have been used as roosts, usually by individual bats. Roost longevity is variable due to many factors, such as the rate at which bark sloughs off or the tree falls down. Some roosts may only be habitable for one to two years, but species with good bark retention, such as slippery elm (*Ulmus rubra*), cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), and various oaks (*Quercus* spp.) and hickories (*Carya* spp.) may provide habitat for four to eight years (USFWS 1999).

Trees in excess of 40 cm (15.7 in) in diameter-at-breast-height (dbh) are considered optimal for maternity colonies, but trees in excess of 22 cm (8.6 in) in dbh are used as alternate roosts (USFWS 2002). Females have been documented using roost trees as small as 14 cm (5.5 in) in dbh (Kurta 2005). The average size of roost trees used by males tends to be smaller than the roost trees used by maternity colonies. In one instance, a male was observed in a roost tree 6.4 cm (2.5 in) in dbh (Gumbert et al. 2002).

Maternity colonies have been documented to use eight to 25 roost trees per season (Callahan et al. 1997; Kurta et al. 2002). The extent and configuration of the roosting area is probably determined by availability of suitable roost trees. Distances between roosts can be a few meters to a few kilometers (Kurta et al. 1996; Kurta et al. 2002). Primary roosts are generally larger in diameter and located in openings or at the edge of forest stands, while alternate roosts can either be in openings or the interior of the forest stand. Maternity colony movements among multiple roosts seem to depend on climatic changes, particularly solar radiation (Humphrey et al. 1977). Cool temperatures can delay fetal development and growth of juvenile young; therefore, selection of maternity roost sites may be critical to reproductive success. Kurta et al. (1993) suggest movement between roosts may be the way that bats deal with the ephemeral nature of roost trees. It is not known how many alternate roosts must be available to assure retention of a colony within a particular area, but large, nearby forest tracts would improve the potential for an area to provide adequate roosting habitat (Callahan 1993; Callahan et al. 1997).

General observations and data collected incidentally in studies indicate that Indiana bats select forested corridors when commuting to avoid flying over open areas (Environmental Solutions and Innovations, Inc. 2006; Murray and Kurta 2004). Very little research has focused on the use of travel corridors by Indiana bats. Apparently suitable, but distant, forest patches may not be available to Indiana bats unless they are connected by a wooded corridor; however, the maximum size of an opening Indiana bats may cross is not known.

Home range size may vary between seasons, sexes, and reproductive status of the females (Lacki et al. 2007). Menzel et al. (2005) tracked seven female and four male Indiana bats from May to August in Illinois. No significant differences in home ranges between males and females were observed, and home range estimates were subsequently grouped to obtain a mean summer home range of 144.4 hectares (357 acres). Watrous et al. (2006) calculated a mean home range of 83 hectares (205 acres) for 14 female Indiana bats in Vermont. Without site-specific data, the Service generally considers the potential home range for an Indiana bat to include all suitable habitat within four km (2.5 mi) of documented roost(s) (USFWS 2011), recognizing the area of actual use may be just a portion of that area.

Indiana bats show a high degree of fidelity to roost trees, roosting areas, and foraging areas (Gardner et al. 1991; Humphrey et al. 1977; Kurta et al. 1996; Kurta et al. 2002; Kurta and Murray 2002; Gumbert et al. 2002). Bats using familiar foraging and roosting areas are thought to benefit from decreased susceptibility to predators, increased foraging efficiency, and the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert et al. 2002).

Spring and Fall Habitat
In the spring, Indiana bats usually roost, forage, and commute in habitats similar to those selected during the summer. These areas are most typically within 10 miles of a P1/P2 hibernaculum[1] and five miles of a P3/P4 hibernaculum; however, use of habitat areas that are farther from hibernacula have been documented (Kiser and Elliot 1996; MacGregor et al. 1999; Rommé et al. 2002; Hawkins et al. 2005).

5.1.4 Numbers, Reproduction, and Distribution of the Indiana Bat

Indiana bats are found over most of the eastern half of the United States. Winter surveys in 2019 found hibernating Indiana bats dispersed across 17 states. However, over 95% of the estimated range-wide population hibernated in four states – Missouri (36.3%), Indiana (34.4%), Illinois (14.6%), and Kentucky (10.4%) (USFWS 2019). Summer distribution of the Indiana bat occurs throughout a wider geographic area than its winter distribution. Most summer occurrences are from the upper Midwest including southern Iowa, northern Missouri, much of Illinois and Indiana, southern Michigan, Wisconsin, western Ohio, and Kentucky. However, many summer maternity colonies have been found in the northeastern states of Pennsylvania, Vermont, New Jersey, New York, West Virginia, and Maryland. Maternity colonies have also been found in the south, including northern Arkansas, Georgia, Alabama, Mississippi (Copperhead 2017;

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[1] Priority 1 (P1) hibernacula have a current or historical winter population of ≥10,000 Indiana bats; Priority 2 (P2) have 1,000-9.999 bats; Priority 3 (P3) have 50-999 bats; and Priority 4 (P4) have <50 bats (USFWS 2007).

Copperhead pers. comm. 2014), and southwestern North Carolina (Britzke et al. 2003; USFWS 2007). Non-reproductive summer records for the Indiana bat have also been documented in eastern Oklahoma, northern Mississippi, Alabama, and Georgia.

The data regarding Indiana bat abundance prior to Federal listing are limited, but available information, summarized in the Draft Recovery Plan (USFWS 2007), suggests that Indiana bats were once far more abundant than they were in the 1960s. When the Indiana bat was originally listed as endangered in 1967, there were approximately 883,300 bats, and most of these hibernated in a small number of hibernacula (Clawson 2002). Since the species was listed, its population numbers have apparently continued to decline through approximately 2001. Since being listed, large population declines have been observed, especially at hibernacula in Kentucky and Missouri. The range-wide population estimate dropped approximately 57% from 1965 to 2001 (USFWS 2007). The range-wide, biennial population estimates had been increasing from 2001 to 2007, indicating that the species' long-term decline had been arrested and likely reversed (USFWS 2019). However, the arrival of white-nose syndrome (or "WNS"; see discussion below) is the probable cause of the observed range-wide decline since 2007. The Service estimated the 2022 range-wide population at 596,431 bats (Figure 3) occurring in 223 hibernacula in 16 states, with the three most populous states being Missouri (228,333), Indiana (219,459), and Illinois (77,196). This represents a 10.3% decrease from the 2007 (WNS begins) range-wide population estimate of 664,637. However, there has been an 11% increase since the 2019 survey.

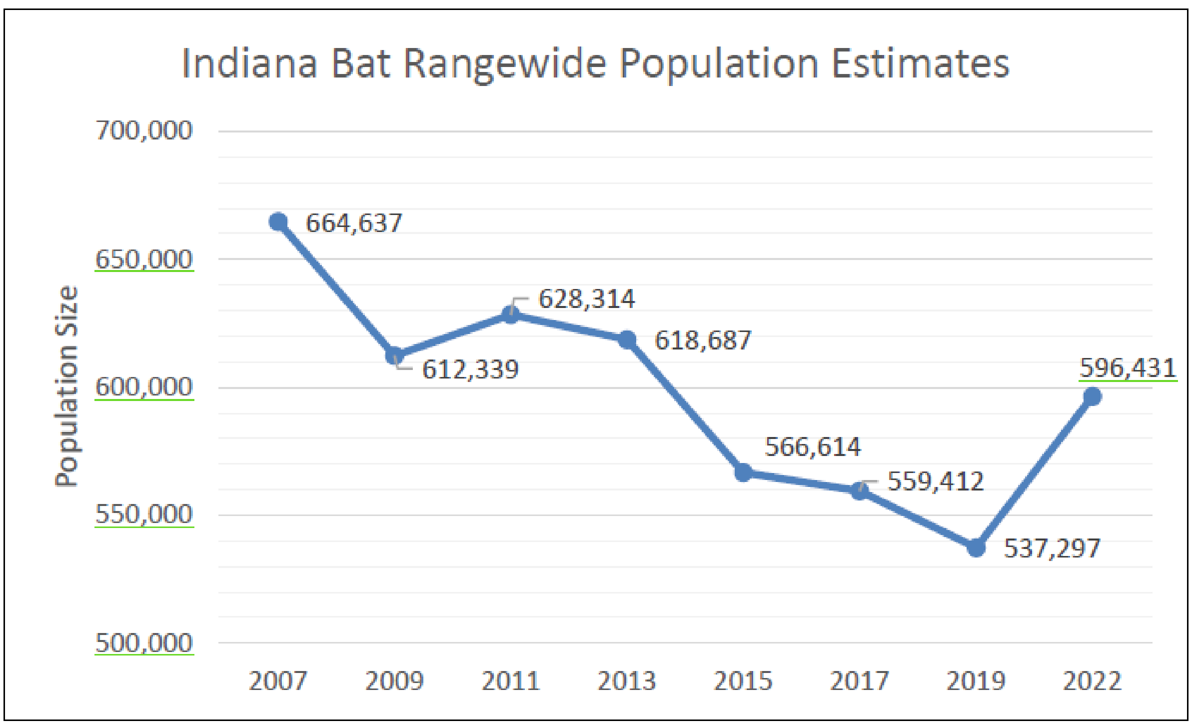

Figure 3. Indiana bat range-wide population estimates from 2007-2022.

5.1.5 Conservation Needs of and Threats to the Indiana Bat

Destruction/Degradation of Hibernacula

There are well-documented examples of modifications to Indiana bat hibernacula that affected the thermal regime of each cave and, thus, the ability of the caves to support hibernating Indiana bats, as summarized in the Draft Recovery Plan (USFWS 2007). Generally, threats to the integrity of hibernacula have decreased since the time that Indiana bats were listed as endangered under the ESA. Increasing awareness of the importance of cave microclimates to hibernating bats and regulatory authorities under the ESA have reduced, but not eliminated, this threat. In addition to purposeful modifications, there are threats from stochastic events (e.g., collapse in mines, flooding).

Loss/Degradation of Forested Habitat

Loss of forest cover and degradation of forested habitats have been cited as contributing to the decline of Indiana bats (USFWS 1983; Garner and Gardner 1992; Drobney and Clawson 1995; Whitaker and Brack 2002). Throughout the range of the Indiana bat, there is less forest now than there was prior to European settlement (Smith et al. 2003), particularly within the core of the species' range in the Midwest. Conversion to agriculture has been the largest single cause of forest loss. The conversion of floodplain and bottomland forests, recognized as high quality habitats for Indiana bats, has been a particular cause of concern (Humphrey 1978). More recently, since the 1950s, some marginal farmlands have been abandoned and allowed to revert to forest and there has been a net increase in forest within the range of the Indiana bat, particularly in the Northeast (Smith et al. 2003). Forest cover has also increased within the Midwest Recovery Unit (Smith et al. 2003). Not only has the amount of forest cover increased since the 1950s, but also the average diameter of trees has increased (Smith et al. 2003), which may equate to an increased supply of suitable roost trees for Indiana bats.

Urbanization and development is currently the greatest contributor to forested habitat loss within the range of the Indiana bat (Wear and Greis 2002; USFS 2005; USFS 2006), which results in permanent conversion to land uses generally unsuitable for Indiana bats. At a study site in central Indiana, Indiana bats avoided foraging in a high-density residential area (Sparks et al. 2005), although maternity roosts have been found in low-density residential areas (Belwood 2002). Duchamp (2006) found that greater amounts of urban land use was negatively related to bat species diversity in north-central Indiana; several bat species, including the Indiana bat, were less likely to occur in landscapes with greater amounts of urban and suburban development. Development directly destroys habitat and fragments remaining habitat.

Forest cover is not a completely reliable predictor of where Indiana bat maternity colonies will be found on the landscape (Farmer et al. 2002). Indiana bat maternity colonies occupy habitats ranging from completely forested to areas of highly fragmented forest. Nonetheless, trends in forest cover are of interest relative to Indiana bats, with increasing forest cover suggesting at least the potential for improved habitat conditions. Conversely, in areas where almost all forest land has been lost, the absence of woodlands on the landscape certainly equates to less habitat than in prehistoric and early historic periods.

Throughout the range of the Indiana bat, forest conversion is expected to increase due to commercial and urban development, energy production and transmission, and natural changes. The 2010 Resources Planning Act Assessment projects forest losses of 6.5-13.8 million hectares (16–34 million acres) (or 4–8% of 2007 forest area) across the conterminous United States, and forest loss is expected to be concentrated in the southern United States, with losses of 3.6-8.5 million hectares (9–21 million acres) (USFS 2012). Forest conversion causes loss of potential habitat, fragmentation of remaining habitat, and if occupied at the time of the conversion, direct injury or mortality to individuals.

Disturbance of Hibernating Bats
The original recovery plan for the species stated that human disturbance of hibernating Indiana bats was one of the primary threats to the species (USFWS 1983). The primary forms of human disturbance to hibernating bats result from cave commercialization (cave tours and other commercial uses of caves), recreational caving, vandalism, and research-related activities. Progress has been made in reducing the number of caves in which disturbance threatens hibernating Indiana bats, but the threat has not been eliminated. Biologists throughout the range of the Indiana bat were asked to identify the primary threat at specific hibernacula, and "human disturbance" was identified as the primary threat at 41% of Priority 1, 2, and 3 hibernacula combined.

White-nose Syndrome
WNS is an infectious wildlife disease caused by a fungus of European origin, *Pseudogymnoascus destructans* (Pd), which poses a considerable threat to hibernating bat species throughout North America, including the Indiana bat. WNS is responsible for unprecedented mortality of insectivorous bats in eastern North America (Blehert et al. 2009; Turner et al. 2011). No other threat is as severe and immediate for the Indiana bat as the disease WNS. Since the disease was first observed in New York in 2007 (later biologists found evidence from 2006 photographs), WNS has spread rapidly in bat populations from the East to the Midwest and the South.

WNS may affect behavioral changes in infected individuals. For example, at some WNS-affected sites, a shift of hibernating bats from traditional winter roosts to roosts unusually close to hibernacula entrances has been observed. Bats have also been observed flying outside of hibernacula during winter (often during the day) at some affected sites. At some sites, bat carcasses (particularly of the little brown bat) have been found outside affected hibernacula. Many infected bats do not survive the winter. The exact processes by which the fungal skin infection leads to death are not known, but depleted fat reserves (i.e., starvation) contribute to mortality (Reeder et al. 2012; Warnecke et al. 2012) and dehydration may also have a role (Willis et al. 2011; Cryan et al. 2013; Ehlman et al. 2013). It is also suspected that some of the affected bats that survive hibernation emerge in such poor condition that they die soon after emergence or during the summer. Among those bats that do survive, it appears that productivity of female survivors may be negatively affected (Francl et al. 2012; Pettit and O'Keefe 2017).

The Northeast Recovery Unit, where WNS was first observed in the winter of 2006-2007, lost over 70% of its Indiana bats between 2007 and 2015. At the time dead bats were first observed in the winter of 2006-2007, it is not known how long the (previously unidentified) fungus, Pd, had been present in affected sites. Based on subsequent observations as WNS spread, it appears that the arrival of the fungus in an area may precede large-scale fatality of bats by several years. Between 2011 and 2015 the Appalachian Recovery Unit, where WNS was confirmed in the winter of 2008-2009, declined by 84%. The Midwest Recovery Unit, where WNS was confirmed in the winter of 2010-2011, declined by 16% between 2011 and 2015. The Ozark-Central Recovery Unit, where WNS was confirmed in the winter of 2011-2012, declined by less than 1% between 2013 and 2015. As of 2016, WNS or Pd was confirmed in all the states within the species' range. Further declines in Indiana bat populations from the disease may occur in the future.

Environmental Contaminants

With the restrictions on the use of organochlorine pesticides in the 1970s, this significant threat to Indiana bats was reduced. However, cholinesterase-inhibiting insecticides, organophosphates, and carbamates have now become the most widely used insecticides (Grue et al. 1997), and the impact of these chemicals on Indiana bats is not known. Because of the unique physiology of bats in relation to reproduction, high energy demands and sophisticated thermoregulatory abilities, much more research needs to be done with these pesticides and their effects on bats. These and other contaminants likely remain a significant and poorly understood threat to Indiana bats. USFWS (2007) summarizes known and suspected contaminant threats to bats.

Climate Change

The capacity of climate change to result in changes in the range and distribution of wildlife species is recognized, but detailed assessments of how climate change may affect specific species, including Indiana bats, are limited. During winter, only a small proportion of caves provide the right conditions for hibernating Indiana bats because of the species' very specific temperature requirements. Surface temperature is directly related to cave temperature, so climate change that involves increased surface temperatures will inevitably affect the suitability of hibernacula. Impacts on the availability or timing of emergence of insect prey are also likely. Loeb and Winters (2013) modeled potential changes in Indiana bat summer maternity range within the United States; in their model, the area suitable for summer maternity colonies of Indiana bats was forecasted to decline significantly.

Wind Turbines

There is growing concern that Indiana bats (and other bat species) may be threatened by the recent surge in construction and operation of wind turbines across the species' range. Not all facilities conduct fatality monitoring and, even when monitoring is conducted, only a small proportion of dead bats are likely to be found. Based on this information, it is likely that additional Indiana bat mortality has occurred at these facilities and at other wind facilities throughout the range of the species.

5.2 Environmental Baseline for the Indiana Bat

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

5.2.1 Action Area Numbers, Reproduction, and Distribution of the Indiana Bat

The Service is using the best available data to estimate the status of the Indiana bat within the Action Area. These estimations are specific to the timeframes listed below. The timeframes represent when the Service considers the species to be present in a certain habitat type during specific periods of its life cycle in Kentucky (USFWS 2016). In the absence of data (i.e., recent survey results) for the species in the Action Area, we make certain assumptions based on the habitat in and around the Action Area, available past survey data, and our knowledge of the biology of the species.

Winter Hibernation (November 16 – March 31)
The Service does not have any records or knowledge of known hibernacula located within the Action Area, and the nearest known hibernaculum for the Indiana bat is approximately 20 miles from the Action Area (Figure 4). Indiana bat hibernacula are well documented in Kentucky, and winter surveys of these hibernacula account for the majority of Indiana bats statewide.

The BA includes the results of a winter bat habitat assessment performed by Stantec, Inc., an LG&E consultant, in April 2023. The assessment was performed to determine if caves, mine portals, sinkholes, and other underground features that could provide potential hibernacula for the Indiana bat, northern long-eared bat, and tricolored bat are present within the MDL. The assessment consisted of a desktop data review and a field assessment following the protocols listed in Appendix H: Potential Hibernaculum Survey Guidance of the Service's Range-Wide Indiana Bat and Northern Long-eared Bat Survey Guidelines (USFWS 2024). The assessment results were submitted to the Service for review on July 12, 2023, and the Service acknowledged that the assessment complied with the potential hibernaculum survey guidance.

The assessment was performed by two Stantec biologists who have held Section 10 recovery permits issued by the Service for federally listed bats, including the Indiana bat and northern long-eared bat, for over 40 combined years. The assessment consisted of a desktop data review and a field assessment. The desktop data review included reviews of various topographic, aerial, and geologic maps, information obtained from the Kentucky Speleological Survey (KSS), and previous data collected for the Action by Cardno. The field assessment consisted of a pedestrian survey of the MDL. Stantec biologists also reviewed current and historical literature related to the occurrence of Indiana bats and northern long-eared bats within three miles of the Action, which follows the protocol described in Appendix H of the Range-Wide Indiana Bat and Northern Long-eared Bat Survey Guidelines.

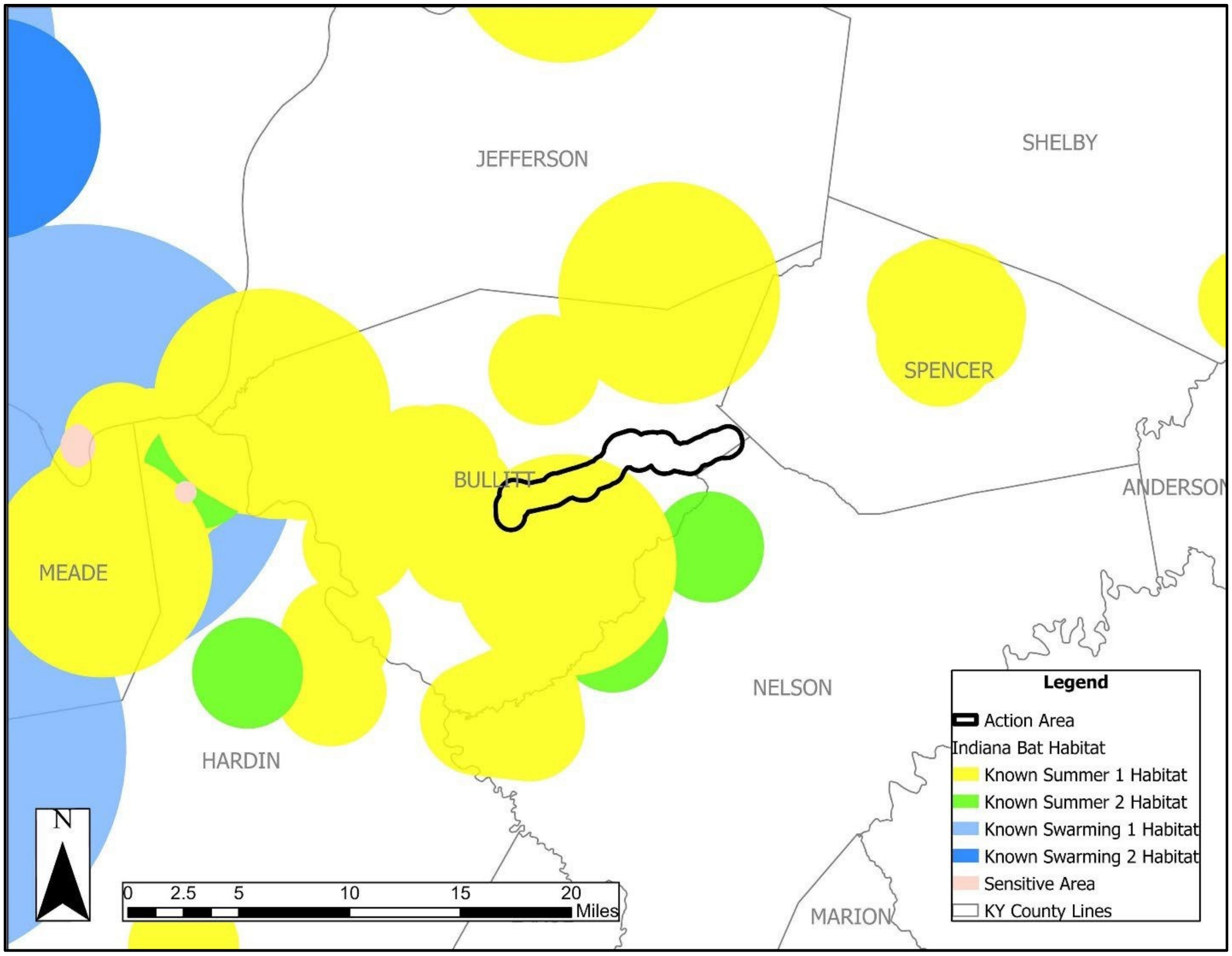

Figure 4: Proximity of the Action Area to known Indiana bat habitat.

The desktop data review included review of the Shepherdsville and Samuels USGS topographic quadrangle maps, aerial photographs of the MDL, and a karst potential map available online from the Kentucky Geological Survey (KGS). The karst potential map shows that the MDL from MP 0.0 to approximately MP 6.0 is primarily located within areas of moderate karst potential, with a few small portions located within areas of low karst potential. The karst potential between MP 6.0 and MP 7.5 varies between moderate and high potential. The remainder of the MDL from MP 7.5 to MP 11.81 is located within areas of low karst potential, with the exception of two small portions near MP 11.81.

The KSS was contacted by Stantec regarding known cave locations within five miles of the MDL. This organization of cavers is dedicated to the study of cave and karst resources throughout Kentucky, and their records may include caves and karst features outside databases maintained by Federal and state agencies. The KSS provided Stantec with the locations of three known caves, all of which are located outside the MDL. One of the caves, referred to as T10 Cave, is located approximately 700 feet south of the MDL along an existing dirt road that will be used for access by vehicles and equipment. Use of the road could occur during any time of the year, including the hibernation period. Examination of T10 Cave during the field assessment showed that the feature is more similar to a rockshelter than a cave and does not have an opening or passages. Therefore, T10 Cave was determined to be unsuitable as a potential hibernaculum. The other two caves identified by the KSS, known as Hobbes Cave and T6 Cave, are located approximately 0.9 mile and 2.3 miles, respectively, from the Action Area. Caves and other karst features located more than 0.5 mile from the Action are not required to be assessed as potential hibernacula per the range-wide survey guidance; therefore, these caves were not examined during the field assessment.

Stantec also reviewed a geologic report prepared by Cardno in 2018 that included the locations of 11 sinkholes identified within the vicinity of the proposed pipeline during their environmental reviews and assessments. During the review, Stantec determined that 10 of the 11 identified sinkholes are located outside the current MDL. The sinkhole located within the MDL was evaluated by Stantec during the 2023 field assessment based on criteria listed in the potential hibernaculum survey guidance. The guidance states that underground features can typically be deemed unsuitable as a hibernaculum if they exhibit one or more of the following characteristics:

- There is only one horizontal opening, and it is less than six inches (15.2 cm) in diameter;
- Vertical shafts are < one foot (0.3 m) in diameter;
- Passage continues < 50 feet (15.2 m) and terminates with no visible fissures that bats can access;
- Openings are prone to flooding, collapsed shut and completely sealed, or otherwise are inaccessible to bats; and
- Openings that have occurred recently (i.e., within the past 12 months) due to human activity or subsidence.

The sinkhole (referred to as Sinkhole 2) was deemed unsuitable as a potential hibernaculum due to the throat (i.e., passage) ending within 50 feet of the opening. The sinkhole was also filled with woody debris, rocks, and trash.

The 2023 field assessment also identified two additional sinkholes and six surface depressions within the MDL. The sinkholes were determined to be subsidence sinkholes, which form when subsurface water dissolves cavities in bedrock fractures that cause the overlying, unstable soil to move downward into the cavity. A throat may then form, allowing surface runoff to infiltrate the soil. Both sinkholes collect surface runoff and appeared to be newly formed, showed evidence of actively caving in, and were narrow mouthed. The throats of both sinkholes ended within 12 inches of the surface.

The six surface depressions lack an obvious throat or opening. Therefore, all of these features were determined to be unsuitable as potential hibernacula due to either their lack of openings or their passages ending within 50 feet of the opening. Several rock outcrops and a talus slope were also observed in the western portion of the MDL; however, these features were determined to be unsuitable as potential hibernacula based on one or more of the criteria listed in the potential hibernaculum survey guidance. Based on the results of the winter bat habitat assessment, Stantec concluded that no potential hibernacula for the Indiana bat are present within the MDL.

Additional review of the KGS karst maps by the Service revealed that one sinkhole identified by LiDAR (Light Detection and Ranging) is located within the MDL (KGS 2024). This area was identified and examined by Stantec biologists during the pedestrian survey of the MDL. Two surface depressions were observed (referred to as Surface Depressions 5 and 6), both of which had been filled with concrete debris and rock and were determined to be unsuitable as potential hibernacula. The Service also reviewed available coal mine maps available online from the Kentucky Energy and Environment Cabinet (KEEC 2024). No coal mining occurs within this portion of Kentucky; therefore, no active or abandoned mines are present in the Action Area.

Stantec biologists also visually assessed the portions of the Action Area immediately outside the MDL for potential karst features during the pedestrian survey. Based on the winter bat habitat assessment report, no potential hibernacula or areas that could support complex cave systems were observed outside the MDL. Several sinkholes were observed in crop fields near Sinkholes 1 and 2 that were found to have the same morphology as these two sinkholes and were determined to be unsuitable as potential hibernacula. Some additional areas outside the MDL where potential karst features could occur were surveyed after gaining landowner permission. Surveys of these areas showed that either no karst features are present or the features are similar to the sinkholes examined in the MDL and do not represent potential hibernacula. Stantec attempted to gain access to other portions of the Action Area outside the MDL where potential karst features may occur; however, permission was denied by the landowners. Because all portions of the Action Area were not accessible during the winter bat habitat assessment, the BA discussed the potential for unidentified karst features to be present in the Action Area; however, after a thorough review of the information, we believe the presence of an unidentified hibernaculum for the Indiana bat in the Action Area is unlikely, as discussed below.

The KGS karst map shows that the central and eastern portions of the Action Area have moderate to high karst potential, which is similar to the portion of the MDL between MP 0.0 and MP 7.5. The karst map also shows that the majority of potential sinkholes in the Action Area are located in the central portion, which corresponds with the portion of the MDL between MP 2.5 and MP 7.5. All sinkholes identified within and adjacent to the MDL in the 2018 Cardno report and during the 2023 winter bat habitat assessment are also located in the central portion of the MDL between MP 2.5 and MP 7.0. Based on this data, any unidentified karst features outside the MDL would likely be found in the moderate and high karst potential areas in the central portion of the Action Area that corresponds with MP 2.5 to MP 7.5. The majority of this area is actively cultivated for crops or contains residential developments, making it unlikely that a complex cave system suitable for Indiana bats would remain undocumented in these areas. Indiana bats typically prefer caves with large volumes and structural diversity that have stable internal temperatures (Tuttle and Kennedy 2002). Caves that meet the temperature requirements for Indiana bats are rare. Suitable Indiana bat hibernacula provide a wide range of vertical structure and have a configuration that provides temperatures ranging from below freezing to 13°C (55.4ºF) or above. These hibernacula tend to have multiple entrances and large rooms or vertical passages below the lowest entrance (USFWS 2007). A large, deep cave with multiple entrances located in a highly-used, developed portion of the Action Area is likely to have been documented, and the absence of a documented cave in this portion of the Action Area indicates that an undiscovered Indiana bat hibernaculum is not likely to exist.

Sinkholes that may be present in the central portion of the Action Area are expected to be similar to the subsidence sinkholes identified within and adjacent to the MDL, which were determined to be unsuitable as potential hibernacula. Additionally, sinkholes located in crop fields and other agricultural areas have an increased chance of being filled or altered by the landowner, as observed at some of the sinkholes in the MDL, which is a common practice to prevent incidents with farm equipment and livestock. Sinkholes present in the residential areas are likely to have been filled or damaged during development.

Spring Staging (April 1 – May 14)

The Service uses a 1.6-kilometer (one-mile) radius buffer around P1 and P2 hibernacula entrances and a 0.8-kilometer (0.5-mile) radius buffer around P3 and P4 hibernacula entrances to identify spring staging areas (USFWS 2016). The Action Area is not within the buffer of a known Indiana bat hibernaculum; therefore, the Action Area does not contain spring staging habitat. The Service considers it unlikely that unknown Indiana bat spring staging habitat is present within the Action Area due to the lack of known hibernacula and low probability for undiscovered potential hibernacula discussed in the previous section. As a result, the Service does not believe that Indiana bats use the Action Area during spring staging.

Summer Roosting (April 1 – October 15)

The Service uses an eight-kilometer (five-mile) radius buffer around Indiana bat reproductive (i.e., adult females and young) capture records and all acoustic detection records and a four-kilometer (2.5-mile) radius buffer around known maternity roost trees to identify known maternity summer roosting habitat. The Service also uses a four-kilometer (2.5-mile) radius buffer around Indiana bat male capture records to identify non-maternity summer roosting habitat. A portion of the Action Area between MP 6.0 and MP 11.81 occurs within Known Summer 1 (Maternity) habitat for the Indiana bat (Figure 5). This Known Summer 1 habitat is associated with a capture record and consists of an eight-kilometer (five-mile) radius buffer of the capture location. In addition, the western extent of the Action Area between MP 11.0 and MP 11.81 occurs within Known Summer 1 (Maternity) habitat associated with a known maternity colony. This Known Summer 1 habitat is associated with seven known roost trees used by the colony and consists of seven overlapping four-kilometer (2.5-mile) radius buffers of the known roost trees. Several maternity colonies and individuals have also been documented within a 10-mile radius of the Action Area.

Due to the presence of known maternity habitat within a portion of the Action Area, suitable habitat in the remaining portion of the Action Area, and the documented presence of the species in the surrounding area, the Corps and the Service are reasonably certain that Indiana bats occur throughout the Action Area. We consider two Indiana bat maternity colonies to occur in the western half of the Action Area based on the presence of Known Summer 1 habitat in this portion of the Action Area. Because the Action Area is approximately 12 miles in length, and the Known Summer 1 habitat buffers only cover half the Action Area, we assume that a third Indiana bat maternity colony with a five-mile habitat buffer is or could be present in the eastern half of the Action Area, which is graphically depicted in Figure 5. We do not believe it is likely that more than one assumed maternity colony is present in the eastern portion of the Action Area because the assumed maternity colony would overlap other known Indiana bat occurrences that are already defined and would create the type of overlapping summer distribution that is often seen in other locations with dense or continuous summer populations (e.g., Fort Knox). Without additional information, we conservatively assume that some portion of these three maternity colonies' primary and secondary roost trees occur within the 39.46 acres of forested habitat that is proposed for removal, and that the colonies also use this habitat for foraging and commuting.

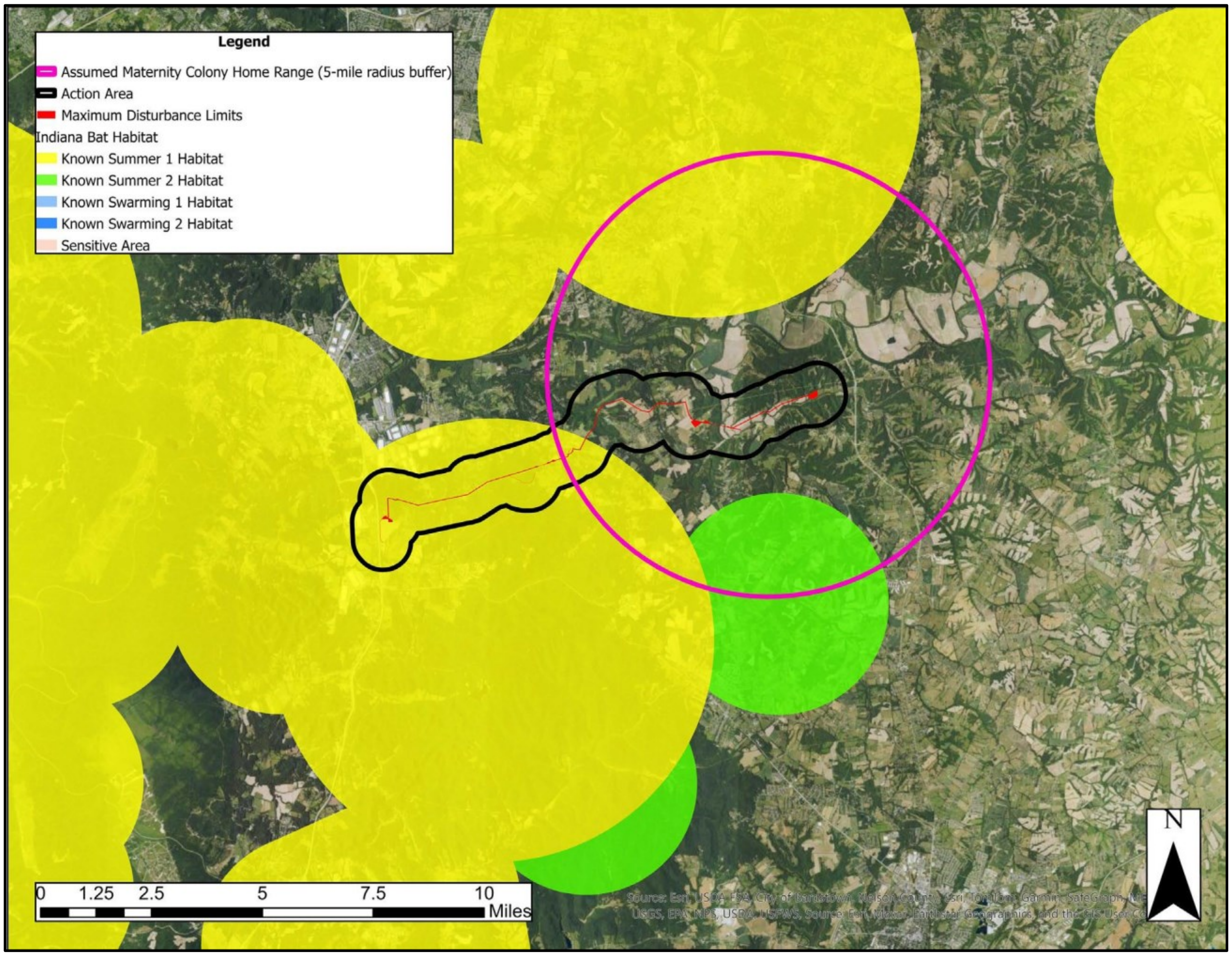

Figure 5: Assumed Indiana bat maternity colony in the Action Area.

Based on the species' biology and information on the composition of known maternity colonies, the Service estimates that each maternity colony consists of 60 adult females that will arrive in the Action Area in the spring after migrating from their hibernacula. The Service also estimates that each of these adult females will be pregnant and give birth to one juvenile each (60 total juveniles) in early June. We believe this a reasonable and conservative approach based on data from Kurta (2005) that analyzed 393 roost trees from several states and calculated the mean maximum emergence count after young began to fly as 119 individuals. Based on a sex ratio of 1:1 (female to male), the Service also estimates that 60 adult males are also associated with each maternity colony and are expected to use the Action Area for roosting, foraging, and commuting.

Therefore, the Service estimates that 180 Indiana bats per colony, or 540 Indiana bats total for the three estimated colonies, are likely to utilize the Action Area between April 1 and August 15.

Fall Swarming (August 16 – November 15)
The Service estimates the fall swarming range as a 16.1-kilometer (10-mile) radius buffer around P1 and P2 hibernacula entrances and an eight-kilometer (five-mile) radius buffer around P3 and P4 hibernacula entrances (USFWS 2016). The Action Area is not within the buffer of a known Indiana bat hibernaculum; therefore, the Action Area does not contain fall swarming habitat. The Service considers it unlikely that unknown Indiana bat fall swarming habitat is present within the Action Area due to the lack of known hibernacula and low probability for undiscovered potential hibernacula discussed in the Winter Hibernation section. As a result, the Service does not believe that Indiana bats use the Action Area for fall swarming.

5.2.2 Action Area Conservation Needs of and Threats to the Indiana Bat

Indiana bats in the Action Area are likely exposed to the same threats that the species is exposed to across the range, as discussed in Section 5.1.5. Below are the two most pertinent to this consultation.

Loss/Degradation of Forested Habitat
Forested habitat has been lost and degraded in the Action Area as a result of conversion to agricultural land and residential development. Impacts to forested habitat are expected to continue as urbanization and development from the greater Louisville metropolitan area encroach from the north.

White-nose Syndrome
WNS was first discovered in Kentucky in 2011 and has since spread across the state. Mortality at infected sites first became apparent in 2013, with an increase in observed mortality in 2014. Preliminary reports indicate that Pd and/or WNS has been detected in approximately 74% of caves surveyed in Kentucky (T. Hemberger, pers. comm. 2017); however, many of the caves without positive records have not been surveyed in recent years. Although the population and trend data following the arrival of WNS at Kentucky hibernacula is difficult to interpret, data are currently not showing the near or total loss of Indiana bat populations that has been documented in the northeastern United States.

Because Indiana bats can migrate hundreds of miles from their hibernacula and WNS has been documented from Kentucky and all of the adjacent states, we assume that all individuals that are known and assumed to occupy habitat within the Action Area have been exposed to WNS. Therefore, Indiana bats in the Action Area are expected to be experiencing stress and reduced body weights from their exposure to WNS.

5.3 Effects of the Action on the Indiana Bat

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

The Service established additional requirements for making the determination of reasonably certain to occur (in effect since October 28, 2019) under 50 CFR 402 (see Federal Register :: Endangered and Threatened Wildlife and Plants; Regulations for Interagency Cooperation). After determining that the "activity is reasonably certain to occur," based on clear and substantial information, and using the best scientific and commercial data available, there must be another conclusion that the consequences of that activity are reasonably certain to occur. In this context, a conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available.

Based on the description of the Action, other activities caused by the Action, and the species' biology, we have identified four stressors (i.e., the alteration of the environment that is relevant to the species) to the Indiana bat that are reasonably certain to result from the Action: noise and vibration, artificial lighting, aquatic resource degradation, and tree removal. All of these stressors would occur during the construction component of the proposed Action. The operation and maintenance components are not expected to impact the Indiana bat because: (a) those components would occur after the construction component, which is when all suitable habitat will be removed in the MDL, and (b) the lack of stressors that would be reasonably certain to result in impacts to individuals or habitat in portions of the Action Area outside of the MDL.

Below we discuss the best available science relevant to each stressor, then describe the Stressor-Exposure-Response pathways that identify the circumstances for an individual bat's exposure to the stressor (i.e., the overlap in time and space between the stressor and an Indiana bat). Finally, we identify and consider how proposed conservation measures may reduce the severity of the stressor or the probability of an individual bat's exposure for each pathway.

5.3.1 Effects of Noise and Vibration on the Indiana Bat

Indiana bats may be exposed to noise and vibrations during the construction component of the Action.

Applicable Science

Bats exposed to noise and vibration may flush from their roosts. Bats that flush during the daytime are at greater risk of harm due to predation (Mikula et al. 2016). Additionally, bats that flush from roosts and/or avoid travel and foraging areas in response to this stressor may be harmed due to an increase in energy expenditure. Increased energy demands could have a significant effect on bats due to their low body mass. Because females require increased energy reserves during lactation (Kurta et al. 1989), an increased demand for energy in response to noise and vibrations could be especially detrimental to lactating females and, subsequently, their pups.

Studies have found that Indiana bats can tolerate some level of noise and vibration. For example, several construction projects, prior to documentation of white-nose syndrome, have occurred on Fort Drum adjacent to multiple known Indiana bat roosts (Johnson et al. 2011). Construction around these project sites occurred for multiple years during the active season. The last known capture and roosting locations of Indiana bats near these projects were within approximately 800 and 400 meters (0.5 and 0.25 mi) of the construction activities, respectively. Indiana bats also occupy another military installation, Fort Knox, suggesting that noise from machinery and training activities may disturb colonies of roosting bats, but such disturbances would have to be severe to cause roost abandonment (Hawkins et al. 2008). Gardner et al. (1991) had evidence that Indiana bats continued to roost and forage in an area with active timber harvest. This suggested that noise and exhaust emissions from machinery could possibly disturb colonies of roosting bats, but such disturbances would have to be severe to cause roost abandonment. Callahan (1993) noted the likely cause of the bats in his study area abandoning a primary roost tree was disturbance from a bulldozer clearing brush adjacent to the tree. In another study near 1-70 and the Indianapolis Airport, a primary maternity roost was located 1,970 ft. (0.6 km) south of 1-70 (3D/International, Inc. 1996). This primary maternity roost was not abandoned despite constant noise from the interstate and airport runways. However, the roost's proximity to 1-70 may be related to a general lack of suitable roosting habitat in the vicinity, and due to the fact that the noise levels from the airport were not novel to the bats (i.e., the bats had apparently habituated to the noise) (USFWS 2002). Noise and vibration could cause an Indiana bat to flush from its roost, expending extra energy and making it more vulnerable to predation (Mikula et al. 2016). Novel noises would be expected to result in some changes to bat behaviors, but research suggests that bats can become habituated to this stressor.

Effects Pathway #1	
Activity: Construction	
Stressor: Noise and Vibration	
Exposure (time)	Indiana bats will be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Indiana bats will be exposed to this stressor wherever they occur within the Action Area.
Resource affected	The stressor is expected to affect individual Indiana bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected Indiana bats, especially if noise and vibration exceed normal, ambient levels for the Action Area where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats while roosting, such as arousing during daylight hours, shifting within the roost, and increasing vocalizations, as well as minor shifts in use of foraging and commuting habitats while active at night. However, Indiana bats are also likely to experience the following potentially significant effects if the stressor causes bats to flush from their roosts: • Extra energy expenditure that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Increased chance of predation of individuals, especially if individuals flush during daylight hours when noise and vibration are most likely to occur during the construction component of the Action.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Blasting will not be used during excavation for pipeline installation, which will avoid and minimize the amount of noise and vibrations generated by the construction component of the Action. • Tree clearing will be targeted between November 15 and March 31 when forested habitats are unoccupied by Indiana bats, which would avoid direct impacts on Indiana bats.
Interpretation	The effects of increased noise and vibrations will be greatest prior to tree removal when bats may be roosting in trees immediately adjacent to noise- and/or vibration-producing activities and are more likely to flush from their roosts or alter their behavior. Construction activities that require heavy equipment and associated vehicles, personnel, and tools will be used at this time and are likely to produce noise and vibrations in the Action Area above ambient levels. These activities include the development and construction of temporary access roads and entrances, installation of erosion and sediment controls, tree and vegetation

Effects Pathway #1	
	removal, and pipeline installation. The noise and vibration associated with these activities may affect Indiana bats by causing individuals to alter their behaviors, which may be temporary or permanent. Significant changes in noise levels or significant increases in vibration above ambient levels are more likely to result in altered behaviors, such as flushing from roosts and avoidance of habitat areas that are close to noise or vibration sources. The novelty of the noise or vibrations and the relative level of those disturbances will also likely dictate the range of responses from individuals or colonies of Indiana bats. Flushing from roosts is expected to cause Indiana bats to: (a) expend extra energy that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles; (b) be subject to an increased chance of predation of individuals, especially if individuals flush during daylight hours when noise and vibration are most likely to occur during the construction component of the Action; and (c) increase the probability that adult females may abandon roosts and/or non-volant young if the event occurs during the non-volant period. These are adverse effects that are likely to result in harm to Indiana bats, including injury or mortality of individuals. Following tree removal, individuals roosting, foraging, and/or commuting in other portions of the Action Area outside the MDL would continue to be exposed to this stressor at variable levels that would decrease with distance from the MDL. Specifically, noise and vibration levels within portions of the Action Area outside the MDL are expected to be highest at locations closer to the point of origin within the MDL and diminish with increasing distance from the point of origin, due to the diminished effects of noise and vibration with distance from the source (i.e., the noise or vibration will be absorbed and typically become less loud or noticeable). Therefore, Indiana bats in the Action Area outside of the MDL are more likely to be affected if they are closer to the noise and vibration point of origin in the MDL and if the noise or vibration is significantly different than ambient levels (i.e., loud, repetitive, novel, etc.). Conversely, Indiana bats would be less likely to be affected by noise and vibration the farther they are from the point of origin in the MDL. However, the likelihood that adverse effects will not occur cannot be discounted, because flushing from a roost may still occur and result in the same adverse effects noted in the previous paragraph. Noise and vibration disturbances from personnel and vehicles in the MDL during certain aspects of the construction component that do not involve heavy equipment (e.g., land surveying) are expected to be similar to ambient levels in the Action Area. Based on the presence of agricultural land, residential areas, roadways, utility ROWs, and other

Effects Pathway #1	
	types of human development in the Action Area, noise and vibrations generated by people, vehicles, farm equipment, and other sources are currently occurring in the Action Area. Indiana bats present within the Action Area are likely habituated to these noises and vibrations. The vehicles that will be used (e.g., light-duty trucks and UTVs) are similar to vehicles associated with the existing activities occurring in the Action Area and are expected to produce similar levels of noise and vibrations and may produce less noise and vibrations than some vehicles and equipment currently present in the Action Area (e.g., farm machinery, commercial trucks, lawnmowers, etc.). Personnel and vehicles will also be moving through the MDL during these activities and will not remain in one area for an extended period of time. Based on these factors, effects to Indiana bats from noise and vibrations associated with construction activities that do not involve heavy equipment are unlikely to occur or result in effects outside of the MDL and are considered discountable.
Effect	The effect of this stressor is Harm to affected Indiana bats, which can include physical injury to individuals and/or mortality of individuals.

5.3.2 Effects of Artificial Lighting on the Indiana Bat

Use of artificial lighting may occasionally be necessary at some locations during pipeline installation to facilitate the project schedule. Such lighting events are most likely to occur in the early morning and evening hours during times of the year when daylight is minimized (e.g., the winter months) and may not occur all night. Any artificial lighting used during construction would be angled downward and inward towards the construction area and not directed vertically or at an angle that could illuminate roosting, foraging, and commuting habitat. However, depending on the location and intensity of artificial lighting in relation to bat habitat, some indirect lighting of habitat could occur that may cause Indiana bats to alter their behaviors if such lighting occurs when the species is present.

Applicable Science

Studies document highly variable responses among species to artificial lighting. Some bat species seem to benefit from artificial lighting, taking advantage of high densities of insects attracted to light (Jung and Kalko 2010); however, other species may avoid artificial light (Furlonger et al. 1987) or not be affected (Stone et al. 2012). Lighting can cause delays in night bat activity (Stone et al. 2009; Downs et al. 2003), and effects of artificial lighting on bat activity may vary with season and moon phase (Jung and Kalko 2010).

Slow-flying bats such as *Rhinolophus*, *Myotis*, and *Plecotus* species have echolocation and wing-morphology adapted for cluttered environments (Norberg and Rayner 1987) and emerge from roosts relatively late when light levels are low, probably to avoid predation by diurnal birds of prey (Jones and Rydell 1994). In Indiana, Indiana bats avoided foraging in urban areas, and Sparks et al. (2005) suggested that it may have been in part due to high light levels. Using captive bats, Alsheimer and Kazial (2011) found that a closely related species, the little brown bat (*Myotis lucifugus*), was more active in the dark than in light.

Effects Pathway #2	
Activity: Construction	
Stressor: Artificial Lighting	
Exposure (time)	Indiana bats may be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Indiana bats may be exposed to this stressor wherever they occur within the MDL.
Resource affected	The stressor is expected to affect individual Indiana bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses on affected Indiana bats, especially if the use of artificial lighting from the Action is novel or exceeds ambient levels for the area where aspects of the construction component are occurring. These include responses that are unlikely to result in significant effects, such as minor delays in initiating normal behaviors at night (e.g., leaving roosts) and minor shifts in use of foraging and commuting habitats while active at night. The Service has no data that would suggest that these minor behavioral shifts would result in increased visibility to predators that could increase the chance of predation on individuals or require extra energy expenditures that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Interpretation	The Service has no information that would clearly indicate that use of artificial lighting during the construction component of the Action is likely to result in significant adverse effects on Indiana bats. Use of artificial lighting is expected to be minimal, centralized to a specific location, and only affect a small portion of forested habitat within the Action Area. The available science indicates that Indiana bats may delay foraging and commuting and avoid areas where artificial lighting is used. However, Indiana bats are expected to be able to avoid illuminated areas with minimal effort and continue to forage and travel in other areas of nearby habitat. Indiana bats can also utilize illuminated areas before or after lighting is used. Some studies suggest that they may be attracted to artificial lights due to increased density of insect prey items that are attracted to lights.
Effect	This stressor is expected to have an Insignificant effect on affected Indiana bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

5.3.3 Effects of Aquatic Resource Degradation on the Indiana Bat

Aquatic resource degradation may occur during the construction component. The placement of culverts in streams and drainage ditches during construction of access roads and construction entrances could disturb sediment and negatively affect water quality. Trenching at stream crossings during pipeline installation will also result in sediment disturbance in the streams, and soil that is exposed during excavation and vegetation removal could enter streams through stormwater runoff. Spills and leaks of petroleum-based products and other contaminants from vehicles and heavy equipment could also enter streams and degrade water quality. Impacts to aquatic resources that occur in the MDL could also extend to portions of the Action Area downstream if run-off occurs. Activities that reduce the quantity or alter the quality of aquatic resources could affect Indiana bats, even if conducted while individuals are not present. However, LG&E will use BMPs in accordance with state permits and regulations to minimize the potential for aquatic resource degradation. Implementation of these practices is anticipated to avoid some potential water quality impacts and minimize others.

Applicable Science
Indiana bats feed on aquatic and terrestrial insects. Numerous foraging habitat studies have found that Indiana bats often forage in closed to semi-open forested habitats and forest edges located in floodplains, riparian areas, lowlands, and uplands; old fields and agricultural fields are also used (USFWS 2007). Drinking water is essential, especially when bats actively forage. Indiana bats obtain water from streams, ponds, and water-filled road ruts in forest uplands.

Indiana bat diets vary seasonally and among different ages, sexes, and reproductive status (USFWS 1999). Four orders of insects contribute most to the diet of the species: Coleoptera, Diptera, Lepidoptera, and Trichoptera (Belwood 1979; Lee 1993; Kiser and Elliot 1996; Murray and Kurta 2002). Various reports differ considerably in which of these orders is most important. Consistent use of moths, flies, beetles, and caddisflies throughout the year at various colonies suggests that Indiana bats are selective predators to a certain degree, but incorporation of other insects into the diet also indicates that these bats can be opportunistic (Murray and Kurta 2002). Brack and LaVal (1985) and Murray and Kurta (2002) suggested that the Indiana bat may best be described as a “selective opportunist.”

Negative impacts of sedimentation on aquatic insect larvae is well-documented. In a literature review, Henley et al. (2000) summarized how stream sedimentation impacts these communities. Sediment suspended in the water column affects aquatic insect food sources by physically removing periphyton from substrate and reducing light available for primary production of phytoplankton. Sediment that settles out of the water column onto the substrate fills interstitial spaces occupied by certain aquatic insect larvae. Increases in sedimentation can change the composition of the insect community in a stream. In a three-year study measuring sedimentation and macroinvertebrate communities before, after, and during disturbance from a highway construction site, Hendrick (2008) found increased turbidity and total suspended solids downstream from the construction that correlated with a shift in macroinvertebrate communities. The change, however, was not great; the Hilsenhoff Biotic Index decreased from “excellent” before construction to “good” after construction. The use of BMPs likely minimized the effects of the construction on the macroinvertebrate communities.

Effects Pathway #3
Activity: Construction
Stressor: Aquatic Resource Degradation (sedimentation)

Effects Pathway #3	
Exposure (time)	Indiana bats may be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Foraging habitat in the Action Area consisting of streams and adjacent areas where aquatic insect prey may be located. Streams upstream of the MDL will not be exposed to this stressor.
Resource affected	The stressor is expected to affect foraging habitat, prey (aquatic insects), and individual Indiana bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected Indiana bats, especially if water quality is reduced in the Action Area where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of drinking water sources and foraging habitat while active at night. The Service has no data that would suggest that these minor behavioral shifts would require extra energy expenditures or reduce foraging efficiency that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Use BMPs for sediment and erosion control in accordance with state permits and regulations during construction to avoid and minimize impacts within and outside the MDL. • Utilize HDD to avoid direct impacts to the perennial streams Cox Creek and Rocky Run to avoid impacts to drinking water and aquatic insects that may provide food for Indiana bats.
Interpretation	The Service has no information that would clearly indicate that potential aquatic resource degradation during the construction component of the Action is likely to result in significant adverse effects on Indiana bats. The effects of sedimentation on aquatic resources are expected to be minimal due to the temporary nature of the activity and implementation of the conservation measures. Drinking water sources and aquatic insect prey are not expected to be eliminated, and the species has shown that it can use a variety of drinking water and prey sources and does not forage exclusively on aquatic insect prey.
Effect	This stressor is expected to have an Insignificant effect on affected Indiana bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

5.3.4 Effects of Tree Removal on the Indiana Bat

Tree removal during the construction component will result in the permanent loss of 39.46 acres of forested summer habitat (i.e., roosting, foraging, and commuting) for the Indiana bat. Of these 39.46 acres, 26.27 acres are located within Known Summer 1 habitat for the Indiana bat. The remaining 13.19 acres are located in unknown, or "Potential", habitat for the Indiana bat. Table 6 identifies the tree removal by bat habitat type and whether the tree removal is located within the Corps' jurisdictional area or outside the Corps' jurisdictional area.

Table 6. Amount of tree removal by Indiana bat habitat type.

Habitat Type	Tree Removal Total	Tree Removal in Corps' Jurisdictional Area	Tree Removal Outside Corps' Jurisdictional Area
Summer Habitat (Potential)	13.19 acres	2.90 acres	10.29 acres
Known Summer 1	26.27 acres	13.18 acres	13.09 acres

Habitat removal may occur during the summer occupancy (April 1 – October 15) and hibernation (November 16 – March 31) timeframes and will be scattered throughout the MDL (Appendix C). Tree removal will primarily occur along the edges of larger forest blocks and within linear forested corridors and will not result in the removal of any large blocks of habitat. The resulting open land will consist of a narrow gap through forest blocks and linear corridors ranging from 75 to 100 feet in width, and none of the remaining forested habitat is expected to be isolated as a result of the Action. The Service defines isolated as a break of more than 1,000 feet in wooded areas (USFWS 2011).

Applicable Science – Removal of Summer Habitat (Summer Occupancy Timeframe)
Belwood (2002) reported on the felling of a dead maple in a residential lawn in Ohio that resulted in the displacement of multiple Indiana bats. Thirty-four individuals were found on the ground after the tree was felled, including a dead adult female and 33 non-volant young. Five of the young died on impact or a short time later. Adult females that were not displaced remained in the tree until nighttime. The remaining young were apparently retrieved later by the adult females. The deaths of 11 adult female Indiana bats were also reported from Indiana during the felling of a shagbark hickory (John O. Whitaker, personal communication, 1986). Approximately 50 Indiana bats were also observed in Indiana flying from the loose bark of a dead American elm tree that was bulldozed. Eight of the bats were captured, including two adult females, two immature males, and four immature females, indicating that the tree was being used by a maternity colony (Cope et al. 1973). Risk of injury or death from being crushed when a tree is felled is most likely to impact non-volant pups, but adults may also be injured or killed. This risk is greater for adults during cooler weather when bats periodically enter torpor and would be unable to arouse quickly enough to respond (i.e., flush and potentially avoid being in the roost when it is felled).

In addition to the expenditure of additional energy to find new roost trees, the removal of primary or alternate maternity roosts can lead to the fragmentation or break up of a maternity colony (Sparks et al. 2003; Silvis et al. 2014a). The effect of colony fragmentation on Indiana bats is unknown; however, Indiana bats presumably congregate in large maternity colonies due to the benefits it provides the species. Barclay and Kurta (2007) stated that Indiana bats benefit from the formation of maternity colonies through: (1) information sharing about roosting and foraging habitats, (2) reduced predation risk, and (3) thermoregulatory advantages. However, this colonial behavior also comes with risks, such as increased parasite transmission and competition for resources.

Effects Pathway #4	
Activity: Construction	
Stressor: Tree Removal, Removal of Summer Habitat (summer occupancy)	
Exposure (time)	Indiana bats may be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect summer habitat (i.e., roost trees, foraging, and commuting habitat) and individual Indiana bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected Indiana bats from the loss of summer habitat in the MDL where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. However, Indiana bats are also likely to experience the following potentially significant effects from the stressor: • Bats struck by equipment or crushed by a felled tree will be injured or killed. • Colony fragmentation could decrease thermoregulation and foraging efficiency that may reduce fitness and result in reduced survival/reproductive success. • Extra energy expenditure that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Increased chance of predation of individuals, especially if individuals flush during daylight hours when roost tree removal and removal of summer habitat are most likely to occur during the construction component of the Action.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the Indiana bat from forested habitat removal. • Tree clearing will be targeted between November 15 and March 31 when forested habitats are unoccupied by Indiana bats.
Interpretation	Tree removal during the summer occupancy timeframe could result in death or injury to roosting Indiana bats that are crushed by a felled tree, especially non-volant juveniles. Those bats that survive or flush from

Effects Pathway #4	
	felled trees will be exposed to increased levels of predation and expend extra energy to find another suitable roost. This energy expenditure is in addition to what is likely necessary for foraging, pup rearing, social interactions, and other activities. The use of additional energy in response to habitat loss, especially when combined with the energy needs associated with normal life cycle processes during the summer timeframe (e.g., migration, pregnancy, lactation, etc.) or other stressors (e.g., WNS), is likely to reduce fitness and subsequently reduce survival and reproductive success. These effects would be avoided (e.g., no individual mortality would occur) or reduced to some extent if all proposed tree removal does not occur during the summer occupancy timeframe.
Effect	The effect of this stressor is Harm to affected Indiana bats, which can include physical injury to individuals and/or mortality of individuals.

Applicable Science – Removal of Summer Habitat (Hibernation Timeframe)

The potential for adverse effects to Indiana bats from tree removal during the hibernation timeframe is rooted in the well-documented knowledge that Indiana bats exhibit strong fidelity to their summer roosting areas and foraging habitat (Kurta et al. 2002; Garner and Gardner 1992; USFWS 2007). Adverse effects to Indiana bats associated with the removal of forested habitats occur through several pathways that lead to a reduction in individual fitness as a result of increased energy expenditure. This evaluation is supported by numerous bat researchers, including Kurta and Rice (2002), who commented:

> *"The U.S. Fish and Wildlife Service often allows potential roost trees to be cut after Indiana bats leave for hibernation in order to make way for developments such as new bridges, highways, and housing projects. This policy understandably is intended to allow human developments to proceed while preventing direct "take" of Indiana bats. This practice, however, should be limited, because it destroys potential roost trees without establishing whether they actually are used by Indiana bats, which may leave the bats with no shelter when they return in spring in an energetically stressed condition. Upon returning, the bats have just completed 6-7 months of hibernation and an extensive migration, and they arrive already pregnant and at a time when air temperatures are low and food (flying insects is scarce. Excessive precipitation and/or colder-than-average temperatures drastically reduce reproductive success of temperate bats (Grindal et al. 1992; Lewis 1993), and such negative effects likely would occur even during normal weather if Indiana bats do not have adequate shelter."*

Indiana bats require energetic resources to carry out the different phases of their lifecycle. Certain processes in their life cycle are particularly costly (Kunz et al. 1998). Indiana bats entering into hibernation need enough fat reserves to survive the winter (Speakman and Rowland 1999) and, for females, to trigger ovulation and gestation following emergence (Zhao et al. 2003). After migrating to their summer habitat, Indiana bats need to be prepared to cope with spring conditions by having sufficient energy resources to thermoregulate during cooler weather conditions and at a time when prey is scarce (Kurta and Rice 2002). Additionally, sufficient energy resources are necessary throughout the summer roosting period to cope with unpredictable stressors, such as unseasonably cold temperatures or high precipitation that can negatively affect reproductive success (Grindal et al. 1992) and survival.

Forested habitat loss or alteration during the hibernation timeframe (i.e., while the bats are not present) harms Indiana bats by requiring them to increase energy use to respond to the habitat loss or alteration when they return to summer habitats. This is likely to impair essential behavior patterns associated with sheltering (roosting), breeding, and/or feeding (foraging). This impairment, in turn, results in reduced survival and/or reproduction of the affected individuals. These effects are compounded because most of the returning bats are coming from hibernacula infected with WNS. Individuals surviving WNS have additional energetic demands. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012; Warnecke et al. 2012). Many may also have wing damage (Reichard and Kunz 2009; Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, maintaining a successful pregnancy, rearing pups, and healing their own bodies.

<table>
<tr><th colspan="2">Effects Pathway #5</th></tr>
<tr><td colspan="2">Activity: Construction</td></tr>
<tr><td colspan="2">Stressor: Tree Removal, Removal of Summer Habitat (hibernation)</td></tr>
<tr><td>Exposure (time)</td><td>Tree removal will occur between November 16 and March 31 during the hibernation timeframe. Indiana bats may be exposed to this stressor between April 1 and October 15 (summer occupancy timeframe) the first summer bats return after tree removal.</td></tr>
<tr><td>Exposure (space)</td><td>Forested habitat that is proposed for removal at various locations throughout the MDL.</td></tr>
<tr><td>Resource affected</td><td>The stressor is expected to affect summer habitat (i.e., roost trees, foraging, and commuting habitat) and individual Indiana bats, including adults and/or juveniles of both sexes.</td></tr>
<tr><td>Individual response</td><td>The stressor is expected to cause a variety of potential responses by affected Indiana bats from the loss of summer habitat in the MDL where the construction component previously occurred. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. However, Indiana bats are also likely to experience the following potentially significant effects from the stressor:
• Extra energy expenditure to find new suitable roosts may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles.
• Colony fragmentation could decrease thermoregulation and foraging efficiency that may reduce fitness and result in reduced survival/reproductive success.
• Colony fragmentation will increase the chance of predation for individuals.</td></tr>
</table>

Effects Pathway #5	
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measure that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the Indiana bat from forested habitat removal.
Interpretation	Adult Indiana bats are expected to experience adverse effects after they arrive at summer habitat the first year after tree removal. The extra energy to find new roosting habitat is in addition to what is already necessary for foraging, pup rearing, social interactions, or other activities. The use of additional energy in response to habitat loss, especially when combined with the energy needs associated with normal life cycle processes during the summer timeframe (e.g., migration, pregnancy, lactation, etc.) or other stressors (e.g., WNS), is likely to result in adverse effects. However, Indiana bats are expected to adapt to this stressor in subsequent years after new suitable roosts and habitat are found.
Effect	The effect of this stressor is Harm to affected Indiana bats, which can include physical injury to individuals and/or mortality of individuals.

Amount or Extent of Adverse Effects - Summer Habitats
As stated previously in Section 5.2.1, we estimate that 360 Indiana bats (180 females and 180 males) will arrive in the Action Area after hibernation to use the habitat for roosting, foraging, and commuting during the summer timeframe. We also estimate that 180 juveniles will be born in the Action Area in June. Therefore, 540 Indiana bats are reasonably certain to be adversely affected by the Action.

In addition to the applicable science discussed above for removal of habitat during the summer occupancy and hibernation timeframes, we also consider the applicable science for forest loss and fragmentation for our analysis of tree removal.

Applicable Science – Loss and Fragmentation of Forested Habitats
In addition to removal of roosting habitat, tree removal often results in the loss and fragmentation of forested habitats, resulting in the degradation of Indiana bat foraging and commuting habitat. Patterson et al. (2003) noted that the mobility of bats allows them to exploit fragments of habitat. However, they cautioned that reliance on already diffuse resources (e.g., roost trees) leaves bats highly vulnerable, and that energetics may preclude the use of overly patchy habitats.

In a fragmented landscape, Indiana bats may have to fly across less suitable or unsuitable habitat, which could pose a greater risk from predators (e.g., raptors) (Mikula et al. 2016). As a result, Indiana bats consistently follow tree-lined paths rather than cross large open areas (Gardner et al. 1991; Murray and Kurta 2004). Murray and Kurta (2004) found that Indiana bats increased their commuting distances by 55% to follow these paths rather than flying over large agricultural fields. However, if these corridors are not available, Indiana bats may be forced over open areas. For example, Kniowski and Gehrt (2014) observed Indiana bats flying across open expanses of cropland >1 km (0.6 mile) to reach remote, isolated woodlots or riparian corridors.

Indiana bat maternity colonies in Illinois, Indiana, Michigan, and Kentucky have been shown to use the same roosting and foraging areas during subsequent years (Gardner et al. 1991; Humphrey et al. 1977; Kurta and Murray 2002; Kurta et al. 1996; Kurta et al. 2002). Bats using familiar roosting and foraging areas are thought to benefit from decreased susceptibility to predators, increased foraging efficiency, and the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert et al. 2002). Conversely, bats that must use new or inferior habitats after a loss or alteration of their normal forested habitat would not have these same benefits.

Racey and Entwistle (2003) discussed the difficulties of categorizing space requirements in bats, as they are highly mobile and show relatively patchy use of habitat (and use of linear landscape features), although connectivity of habitats has some clear advantages (e.g., aid orientation, attract insects, provide shelter from wind and/or predators). Carter et al. (2002) found Indiana bat roosts in a highly fragmented landscape in their southern Illinois study, although both the number of patches and mean patch size were higher in the area surrounding roosts than around randomly selected points. Kniowski and Gehrt (2014) suggest longer or more frequent commuting flights will be required by Indiana bats in highly fragmented landscapes with smaller, more distant suitable habitat patches to obtain similar resources compared to landscapes with larger, more abundant habitat patches.

Effects Pathway #6	
Activity: Construction	
Stressor: Tree Removal, Loss and Fragmentation of Forested Habitats	
Exposure (time)	Tree removal will be a one-time occurrence but may occur any time of year. Indiana bats may be exposed to this stressor between April 1 and October 15 the first summer bats return after tree removal.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect summer habitat (i.e., foraging and commuting habitat) and individual Indiana bats, including adults and juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected Indiana bats from the loss and fragmentation of summer habitat in the MDL where the construction component has occurred. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. The Service has no data that would suggest that these minor behavioral shifts would result in an increased chance of predation on individuals or require extra energy expenditures or reduce foraging efficiency that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.

Effects Pathway #6	
Conservation Measure	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the Indiana bat from forested habitat removal.
Interpretation	Tree removal will create or expand a narrow gap in forested habitat along the edges of larger forest blocks and within linear forested corridors and will not result in the removal of any large blocks of habitat. The largest, single area of forest habitat removal is 4.871 acres of habitat. The gap will consist of open land maintained as a utility ROW and will not contain any physical barriers that would prevent bats from crossing the gap. The gap is also not expected to make access to other forested habitat more difficult, require additional energy expenditure, or limit access to habitat. Existing gaps associated with other utility ROWs are present in the Action Area, and Indiana bats currently foraging and commuting in the Action Area are presumably unaffected by these gaps. Additionally, the gap may provide forest edge habitat that Indiana bats could use for foraging and commuting habitat. Individual Indiana bats that use the Action Area in the summer or fall after habitat removal are not reasonably certain to be harmed.
Effect	This stressor is expected to have an Insignificant effect on affected Indiana bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

5.3.5 Summary of the Effects of the Action on the Indiana Bat

The Action occurs within suitable summer roosting, foraging, and commuting habitat for the Indiana bat, and a portion of the Action Area is located within Known Summer 1 habitat for this species. As a result, the Action could impact up to three maternity colonies. Impacts to the Indiana bat will occur during the construction phase of the Action. Stressors to the Indiana bat as a result of construction activities include: noise and vibration, artificial lighting, aquatic resource degradation, and tree removal (Table 7). This habitat removal could occur at any time year, including June and July when non-volant pups may be present. The habitat removal will occur in small patches within the MDL, and the 39.46 acres of habitat removal represents only 0.6% of the overall acreage of suitable Indiana bat habitat (6,736 acres) in the Action Area.

It is difficult to determine the number of individual Indiana bats that will be adversely affected during specific activities and timeframes and by the identified stressors. The Service has determined that the total number of Indiana bats adversely affected should be based on the presence of three maternity colonies, whose predicted and known home ranges would cover the Action Area. We estimate that 360 Indiana bats (180 females and 180 males) will arrive in the Action Area after hibernation to use the habitat for roosting, foraging, and commuting. In addition, we estimate that 180 juveniles will be born in the Action Area in June. Therefore, 540

Indiana bats are reasonably certain to be adversely affected by the removal of 39.46 acres of summer habitat associated with the Action.

Table 7. A summary of the effects of the Action on the Indiana bat.

Stressors: ***Activity***	**Adverse**	**Insignificant/ Discountable**
Noise and vibration: *construction*	harm	
Artificial lighting: *construction*		insignificant
Aquatic resource degradation, sedimentation: *construction*		insignificant
Tree removal, summer habitat (summer occupancy): *construction*	harm	
Tree removal, summer habitat (hibernation): *construction*	harm	
Tree removal, forest loss and fragmentation: *construction*		insignificant

5.4 Cumulative Effects on the Indiana Bat

For purposes of consultation under ESA §7, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. No cumulative effects were identified by the Corps, and the Service has determined none are reasonably certain to occur.

5.5 Conclusion for the Indiana Bat

In this section, we summarize and interpret the findings of the previous sections for the Indiana bat (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to jeopardize the continued existence of the species. We have considered the status of the species across its range, the status of the species within the Action Area, and the effects of the Action to the Indiana bat. In our effects analysis, we identified how Indiana bats would be adversely affected by the Action. We estimate that 540 Indiana bats that utilize summer habitat in the Action Area are likely to be adversely affected by the removal of forested habitat and will experience harm as a result of the Action. We believe this is an overly conservative estimate of the number of Indiana bats that may be affected by the Action, and we do not anticipate that all 540 Indiana bats will experience harm based on the following reasons:

- Injury and/or mortality of adult and juvenile Indiana bats will be reduced if some or all of the habitat removal occurs during the hibernation timeframe (November 16 – March 31) when bats will not be present in the Action Area.
- Injury and/or mortality of non-volant pups will be reduced if some or all of the habitat removal occurs outside the non-volant timeframe (May 15 – July 31).
- The minimal amount of summer habitat (39.46 acres) to be removed for the Action.
- The distribution of habitat removal over a 12-mile linear corridor.
- The small size of each area where habitat removal will occur. No single area exceeds five acres of habitat removal, and the majority of habitat removal areas are less than one acre in size.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action (including the effects of the Corps' and LG&E's Conservation Measures), and the absence of any cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Indiana bat. We reached this determination based on the best available commercial and scientific information as described in our effects analysis in this BO and how those effects relate to the resiliency, redundancy, and representation of the Indiana bat, as described below:

- Resiliency describes the ability of a species to withstand stochastic disturbance (arising from random factors). Resiliency is positively related to population size, growth rate, and fecundity and may be influenced by connectivity among populations. Generally, populations need sufficient numbers of individuals within habitats of adequate area and quality to maintain survival and reproduction in spite of disturbance. Resilient populations are better able to withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

  The recovery goals for the species include obtaining a minimum overall population estimate of 457,000 and demonstrating a positive population growth rate. The number of bats adversely affected by the Action would be 540, and we do not expect mortality of all of these Indiana bats. Additionally, 540 individuals represents only 0.09% of the 2022 range-wide estimate of Indiana bats (583,263). Therefore, the Action would adversely affect only a small proportion of the range-wide species' population. For these reasons, the Action will not reduce the resiliency of the Indiana bat.

- Redundancy describes the ability of a species to withstand catastrophic events (a rare destructive natural event or episode involving many populations). It "guards against irreplaceable loss of representation" (Redford et al. 2011, p. 42) and minimizes the effect of localized extirpation on the range-wide persistence of a species. Generally speaking, redundancy is best achieved by having multiple, resilient (connected) populations widely distributed across the species' range. Having multiple populations reduces the likelihood that all populations are affected simultaneously, while having widely distributed populations reduces the likelihood of populations possessing similar vulnerabilities to a catastrophic event. Given sufficient redundancy, single or multiple catastrophic events are unlikely to cause the extinction of a species. Therefore, as redundancy increases, species viability also increases.

  If habitat removal occurs in June or July, non-volant pups may be impacted, and mortality would be higher than at other times of the year. However, only three maternity colonies are expected to be impacted by the Action. This represents a very small proportion of the range-wide population, and thus, the redundancy of the Indiana bat will not be significantly reduced by the Action.

- Representation describes the ability of a species to adapt to changing environmental conditions over time and is characterized by the breadth of genetic and environmental diversity within and among populations. The more representation, or diversity, a species has, the more it is capable of adapting to changes (natural or human caused) in its environment. In the absence of species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the geographical range and other factors as appropriate.

The overall acreage of forested habitat within the Action Area that is suitable Indiana bat habitat (6,736 acres) represents only a fraction of the suitable habitat within the range of the species. The 39.46 acres of suitable habitat that will be removed for the Action represents only 0.6% of the total habitat in the Action Area. Additionally, no reduction in the distribution of Indiana bats is expected because the Action Area will continue to support suitable habitat, and Indiana bats are expected to continue to occupy the Action Area. For these reasons, we do not expect the representation of the Indiana bat to be reduced by the Action.

Further, the contribution to the Imperiled Bat Conservation Fund is expected to promote the survival and recovery of the species through protection and management of:

- Existing forested habitat that supports known maternity populations, particularly those that would expand existing conservation ownerships;
- Known priority hibernacula; and
- Additional conservation lands that contain potential habitat for the species, particularly those that would expand existing conservation ownerships.

Based on this analysis, we conclude that the effects of the Action will not appreciably reduce the likelihood of both the survival and recovery of the Indiana bat.

6. NORTHERN LONG-EARED BAT

This section provides the Service's BO related to the effects of the Action on the northern long-eared bat.

6.1 Status of the Northern Long-eared Bat

This section summarizes the best available data about the biology and current condition of the northern long-eared bat throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list the northern long-eared bat as endangered on November 29, 2022 (87 FR 73488). No critical habitat has been designated for this species.

6.1.1 Description of the Northern Long-eared Bat

The northern long-eared bat is a temperate, insectivorous, migratory bat that hibernates in caves and mines in the winter and summers in forested areas. Adult body weight averages five to eight grams (0.2 to 0.3 ounces), with females tending to be slightly larger than males (Caceres and Pybus 1997, p. 3). Average body length ranges from 77 to 95 mm (3.0 to 3.7 inches) (Barbour and Davis 1969, p. 76; Caceres and Barclay 2000, p. 1). The fur is medium to dark brown on the dorsal side and tawny to pale-brown on the ventral side, with dark brown (but not black) ears and wing membranes (Nagorsen and Brigham 1993, p. 87; Whitaker and Mumford 2009, p. 207). As indicated by its common name, the northern long-eared bat is distinguished from other *Myotis* species by its relatively long ears (average 17 mm (0.7 in); Whitaker and Mumford 2009, p. 207) that, when laid forward, extend beyond the nose up to five mm (0.2 in; Caceres and Barclay 2000, p. 1). The tragus (i.e., projection of skin in front of the external ear) is long (average nine mm [0.4 in]; Whitaker and Mumford 2009, p. 207), pointed, and symmetrical (Nagorsen and Brigham 1993, p. 87; Whitaker and Mumford 2009, p. 207). Within its range, the species can be confused with the little brown bat or the western long-eared myotis (*Myotis evotis*). The northern long-eared bat can be distinguished from the little brown bat by its longer ears, tapered and symmetrical tragus, slightly longer tail, and less glossy pelage (Caceres and Barclay 2000, p. 1; Kurta 2013). The northern long-eared bat can be distinguished from the western long-eared myotis by its darker pelage and paler membranes (Caceres and Barclay 2000, p. 1).

6.1.2 Life History of the Northern Long-eared Bat

The northern long-eared bat hibernates in caves and mines in the winter (typically October through April) and migrates to forested summer habitat. Northern long-eared bats are thought to predominantly overwinter in hibernacula that include caves and abandoned mines. This species has also been observed overwintering in other types of habitat that have similar conditions (e.g., temperature, humidity levels, air flow) to cave or mine hibernacula. The species may use these alternate hibernacula in areas where caves or mines are not present (Griffin 1945, p. 22). Further, Girder et al. (2016, p. 11) found northern long-eared bats to be present and active year-round on the coastal plain of North Carolina, where there is no known non-cavernicolous (cave-like) hibernacula; therefore, it is possible this population was not (traditionally) hibernating. Also, in coastal North Carolina, northern long-eared bats were observed to be active the majority of the winter. Although torpor was observed, time spent in torpor was very short, with the longest torpor bout (i.e., hibernation period) for each bat averaging 6.8 days (Jordan 2020, p. 672). Similarly, the species has been recently documented as active during the hibernation season in other southern states (e.g., Georgia, Mississippi). In those areas, it appears the species enters into temporary periods of torpor and will roost in trees and culverts while in torpor. Kentucky, however, is within the hibernating portion of the species' range.

The swarming season occurs between the summer and winter seasons (Lowe 2012, p. 50), and the purpose of swarming behavior may include: introduction of juveniles to potential hibernacula, copulation, and stopping over sites on migratory pathways between summer and winter regions (Kurta et al. 1997, p. 479; Parsons et al. 2003, p. 64; Lowe 2012, p. 51; Randall and Broders 2014, pp. 109–110). During this period, heightened activity and congregation of transient bats around caves and mines is observed, followed later by increased sexual activity and bouts of torpor prior to winter hibernation (Davis and Hitchcock 1965, pp. 304–306; Fenton 1969, p. 601; Parsons et al. 2003, pp. 63–64). The swarming period may occur between July and early October, depending on latitude within the species' range (Hall and Brenner 1968, p. 780; Fenton 1969, p. 598; Caire et al. 1979, p. 405; Kurta et al. 1997, p. 479; Lowe 2012, p. 86). Individuals may investigate several cave or mine openings during the transient portion of the swarming period, and some individuals may use these areas as temporary daytime roosts or may roost in forest habitat adjacent to these sites (Kurta et al. 1997, pp. 479, 483; Lowe 2012, p. 51). Many of the caves and mines associated with swarming are also used as hibernacula for several other species of bats (Fenton 1969, p. 599; Whitaker and Rissler 1992, p. 132; Kurta et al. 1997, p. 484; Glover and Altringham 2008, p. 1498; Randall and Broders 2014, p. 109).

Spring staging is the time period between winter hibernation and spring migration to summer habitat (Whitaker and Hamilton 1998, p. 80). During this time, bats begin to gradually emerge from hibernation, exit the hibernacula to feed, but re-enter the same or alternative hibernacula to resume daily bouts of torpor (Whitaker and Hamilton 1998, p. 80). The staging period is likely short in duration (Caire et al. 1979, p. 405; Whitaker and Hamilton 1998, p. 80). In Missouri, Caire et al. (1979, p. 405) found that northern long-eared bats moved into the staging period in mid-March through early May. Sasse et al. (2014, p. 172) found pregnant females using a mine in late April and May in Arkansas. In Michigan, Kurta et al. (1997, p. 478) determined that by early May, two-thirds of the *Myotis* species, including the northern long-eared bat, had dispersed to summer habitat. Variation in timing (onset and duration) of staging for Indiana bats was based on latitude and weather (USFWS 2007, pp. 39–40, 42); similarly, timing of staging for northern long-eared bats is likely based on these same factors.

Migratory movements between seasonal habitats (summer roosts and winter hibernacula) of 56 kilometers (35 miles) to 89 kilometers (55 miles) have been documented (Griffin 1940b, pp. 235, 236; Caire et al. 1979, p. 404; Nagorsen and Brigham 1993 p. 88). The spring migration period typically runs from mid-March to mid-May (Easterla 1968, p. 770; Caire et al. 1979, p. 404; Whitaker and Mumford 2009, p. 207); fall migration typically occurs between mid-August and mid-October.

In the summer, reproductive females form maternity colonies and give birth to young. Maternity colonies are generally small, numbering from about 30 (Whitaker and Mumford 2009, p. 212) to 60 individuals (Caceres and Barclay 2000, p. 3); however, larger colonies of up to 100 adult females have been observed (Whitaker and Mumford 2009, p. 212). Most studies have found that the number of individuals roosting together in a given roost typically decreases from pregnancy to post-lactation (Foster and Kurta 1999, p. 667; Lacki and Schwierjohann 2001, p. 485; Garroway and Broders 2007, p. 962; Perry and Thill 2007a, p. 224; Johnson et al. 2012, p. 227). Northern long-eared bats exhibit fission-fusion behavior (Garroway and Broders 2007, p. 961), where members frequently coalesce to form a group (fusion), but composition of the group is in flux, with individuals frequently departing to be solitary or to form smaller groups (fission) before returning to the main spatially discrete unit or network (Barclay and Kurta 2007, p. 44). As part of this behavior, northern long-eared bats switch tree roosts often (Sasse and Pekins 1996, p. 95), typically every two to three days (Foster and Kurta 1999, p. 665; Owen et al. 2002, p. 2; Carter and Feldhamer 2005, p. 261; Timpone et al. 2010, p. 119). Patriquin et al. (2016, p. 55) found that roost switching and use varies regionally in response to differences in ambient conditions (e.g., precipitation, temperature).

Adult females give birth to a single pup (Barbour and Davis 1969, p. 104). Birthing within the colony tends to be synchronous, with the majority of births occurring around the same time (Krochmal and Sparks 2007, p. 654). Parturition (birth) may occur as early as late May or early June (Easterla 1968, p. 770; Caire et al. 1979, p. 406; Whitaker and Mumford 2009, p. 213) and may occur as late as mid-July (Whitaker and Mumford 2009, p. 213). Juvenile volancy often occurs by 21 days after birth (Kunz 1971, p. 480; Krochmal and Sparks 2007, p. 651) and has been documented as early as 18 days after birth (Krochmal and Sparks 2007, p. 651).

Northern long-eared bats are nocturnal foragers and use hawking (i.e., catching insects in flight) and gleaning (i.e., picking insects from surfaces) behaviors in conjunction with passive acoustic cues (Nagorsen and Brigham 1993, p. 88; Ratcliffe and Dawson 2003, p. 851). The species has a diverse diet including moths, flies, leafhoppers, caddisflies, and beetles (Griffith and Gates 1985, p. 452; Nagorsen and Brigham 1993, p. 88; Brack and Whitaker 2001, p. 207), with diet composition differing geographically and seasonally (Brack and Whitaker 2001, p. 208). The most common insects found in the diets of northern long-eared bats are lepidopterans (moths) and coleopterans (beetles) (Brack and Whitaker 2001, p. 207; Lee and McCracken 2004, pp. 595–596; Feldhamer et al. 2009, p. 45; Dodd et al. 2012, p. 1122), with arachnids also being a common prey item (Feldhamer et al. 2009, p. 45).

Foraging patterns indicate a peak activity period within five hours after sunset followed by a secondary peak within eight hours after sunset (Kunz 1973, pp. 18–19). Brack and Whitaker (2001, p. 207) did not find significant differences in the overall diet of northern long-eared bats between morning (3 a.m. to dawn) and evening (dusk to midnight) feedings; however, there were some differences in the consumption of particular prey orders between morning and evening feedings. Additionally, no significant differences existed in dietary diversity values between age classes or sex groups (Brack and Whitaker 2001, p. 208).

6.1.3 Habitat Characteristics and Use of the Northern Long-eared Bat

Winter Habitat

Northern long-eared bats are thought to predominantly overwinter in hibernacula that include caves and abandoned mines. These hibernacula have relatively constant, cooler temperatures (zero to nine degrees Celsius or 32 to 48 degrees Fahrenheit) (Raesly and Gates 1987, p. 18; Caceres and Pybus 1997, p. 2; Brack 2007, p. 744), with high humidity and no strong currents (Fitch and Shump 1979, p. 2; van Zyll de Jong 1985, p. 94; Raesly and Gates 1987, p. 118; Caceres and Pybus 1997, p. 2). Bats are typically found roosting singly or in small numbers in cave or mine walls or ceilings, often in small crevices or cracks, sometimes with only the nose and ears visible, and thus are easily overlooked during surveys (Griffin 1940a, pp. 181–182; Barbour and Davis 1969, p. 77; Caire et al. 1979, p. 405; van Zyll de Jong 1985, p. 9; Caceres and Pybus 1997, p. 2; Whitaker and Mumford 2009, pp. 209–210).

This species has also been observed overwintering in other types of habitat that have similar conditions (e.g., temperature, humidity levels, air flow) to cave or mine hibernacula. The species may use these alternate hibernacula in areas where caves or mines are not present (Griffin 1945, p. 22). Individuals have been found using the following alternative hibernacula: abandoned railroad tunnels (USFWS 2015, p. 17977), the entrance of a storm sewer in central Minnesota (Goehring 1954, p. 435), a hydroelectric dam facility in Michigan (Kurta et al. 1997, p. 478), an aqueduct in Massachusetts (Massachusetts Department of Fish and Game 2012, unpublished data), and a dry well in Massachusetts (Griffin 1945, p. 22). More recently, northern long-eared bats were found in a crawl space within a dwelling in Massachusetts (Dowling and O'Dell 2018, p. 376) and a rock crevice in Nebraska (White et al. 2020, p. 114).

Summer Habitat
Northern long-eared bats typically roost singly or in maternity colonies underneath bark or, more often, in cavities or crevices of both live trees and snags (Sasse and Pekins 1996, p. 95; Foster and Kurta 1999, p. 662; Owen et al. 2002, p. 2; Carter and Feldhamer 2005, p. 262; Perry and Thill 2007a, p. 222; Timpone et al. 2010, p. 119). The species is flexible in tree species selection and, while they may select for certain tree species regionally, likely are not dependent on certain species of trees for roosts throughout their range; rather, many tree species that form suitable cavities or retain bark will be used by the bats opportunistically (Foster and Kurta 1999, p. 668; Silvis et al. 2016, p. 12; Hyzy et al. 2020, p. 62). Carter and Feldhamer (2005, p. 265) hypothesized that structural complexity of habitat or available roosting resources are more important factors than the actual tree species. Further, Silvis et al. (2012, p. 7) found forest successional patterns, stand, and tree structure to be more crucial than tree species in creating and maintaining suitable long-term roosting opportunities.

Males and non-reproductive females may also roost in cooler locations in the summer, such as caves and mines (Barbour and Davis 1969, p. 77; Amelon and Burhans 2006, p. 72). To a lesser extent, individuals have also been observed roosting in colonies in human-made structures, such as in buildings, in barns, on utility poles, behind window shutters, in bridges, and in bat houses (Mumford and Cope 1964, p. 72; Barbour and Davis 1969, p. 77; Cope and Humphrey 1972, p. 9; Burke 1999, pp. 77–78; Sparks et al. 2004, p. 94; Amelon and Burhans 2006, p. 72; Whitaker and Mumford 2009, p. 209; Timpone et al. 2010, p. 119; Bohrman and Fecske 2013, pp. 37, 74; Feldhamer et al. 2003, p. 109; Sasse et al. 2014, p. 172; USFWS 2015, p. 17984; Dowling and O'Dell 2018, p. 376). It has been hypothesized that use of human-made structures may occur in areas with fewer suitable roost trees (Henderson and Broders 2008, p. 960; Dowling and O'Dell 2018, p. 376). In north-central West Virginia, individuals were found to more readily use artificial roosts as distance from large forests [greater than 200 hectares (494 acres)] increased, suggesting that artificial roosts are less likely to be selected when there is greater availability of suitable roost trees (De La Cruz et al. 2018, p. 496).

Most foraging occurs above the understory one to three meters (three to 10 feet) above the ground but under the canopy (Nagorsen and Brigham 1993, p. 88) on forested hillsides and ridges, rather than along riparian areas (LaVal et al. 1977, p. 594; Brack and Whitaker 2001, p. 207). This coincides with data indicating that mature forests are an important habitat type for foraging (Caceres and Pybus 1997, p. 2; White et al. 2017, p. 8). Foraging also takes place over small forest clearings, water, and along roads (van Zyll de Jong 1985, p. 94). Northern long-eared bats seem to prefer intact mixed-type forests with small gaps (i.e., forest trails, small roads, or forest-covered creeks) in forest with sparse or medium vegetation for forage and travel rather than fragmented habitat or areas that have been clear cut (USFWS 2015, p. 17992).

6.1.4 Numbers, Reproduction, and Distribution of the Northern Long-eared Bat

The northern long-eared bat's range includes much of the eastern and north-central U.S. and all Canadian provinces west to the southern Yukon Territory and eastern British Columbia (Nagorsen and Brigham 1993, p. 89; Caceres and Pybus 1997, p. 1; Environment Yukon 2011, p. 10). In the U.S., the species' range reaches from Maine west to Montana, south to eastern

Kansas, eastern Oklahoma, Arkansas, and east to South Carolina (Whitaker and Hamilton 1998, p. 99; Caceres and Barclay 2000, p. 2; Simmons 2005, p. 516; Amelon and Burhans 2006, pp. 71–72). The range includes all or portions of the following 37 states and the District of Columbia: Alabama, Arkansas, Connecticut, Delaware, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Vermont, Virginia, West Virginia, Wisconsin, and Wyoming. Historically, the species has been most frequently observed in the northeastern U.S., Quebec, and Ontario, with sightings increasing during swarming and hibernation (Caceres and Barclay 2000). The species is patchily distributed throughout the majority of its range, and historically was less common in the southern and western portions of the range than in the northern portion of the range (Amelon and Burhans 2006).

More than 780 hibernacula have been identified throughout the species' range in the U.S., although many hibernacula contain only a few (one to three) individuals (Whitaker and Hamilton 1998). Northern long-eared bats are documented in hibernacula in 29 of the 37 states in the species' range, including: Alabama (2), Arkansas (71), Connecticut (8), Delaware (2), Georgia (3), Illinois (21), Indiana (25), Kentucky (119), Maine (3), Maryland (8), Massachusetts (7), Michigan (103), Minnesota (11), Missouri (more than 269), Nebraska (2), New Hampshire (11), New Jersey (7), New York (90), North Carolina (22), Oklahoma (16), Ohio (7), Pennsylvania (112), South Carolina (2), South Dakota (21), Tennessee (58), Vermont (16), Virginia (8), West Virginia (104), and Wisconsin (67). Other states within the species' range have no known hibernacula due to no suitable hibernacula present, lack of survey effort, or existence of unknown retreats.

The current range and distribution of northern long-eared bats must be described and understood within the context of the impacts of WNS. Before the onset of WNS, the best available information on the species came primarily from surveys (primarily focused on the Indiana bat or other bat species) and some targeted research projects. In these efforts, the northern long-eared bat was frequently encountered and was considered the most common myotid bat in many areas. Overall, the species was considered to be widespread and plentiful throughout its historic range (Caceres and Barclay 2000).

6.1.5 Conservation Needs of and Threats to the Northern Long-eared Bat

White-nose Syndrome

For over a decade, WNS has been the foremost stressor on the northern long-eared bat. WNS is a disease of bats that is caused by the fungal pathogen *Pseudogymnoascus destructans* (Pd) (Blehert et al. 2009, entire; Turner and Reeder 2009, entire; Lorch et al. 2011, entire; Coleman and Reichard 2014, entire; Frick et al. 2017, entire; Bernard et al. 2020, entire; Hoyt et al. 2021, entire). The effect of WNS has been extreme, such that most summer and winter colonies experienced severe declines following its arrival. Just four years after the discovery of WNS, Turner et al. (2011, pp. 18–19) estimated that the northern long-eared bat experienced a 98% decline in winter counts across 42 sites in Vermont, New York, and Pennsylvania. Similarly, Frick et al. (2015, p. 5) estimated the arrival of WNS led to a 10–fold decrease in northern long-eared bat colony size. Most recently, Cheng et al. (2021, entire) used data from 27 states and two provinces to conclude WNS caused estimated population declines of 97–100% across 79% of the species' range. Although variation exists among sites, an overwhelming majority of hibernating colonies have developed WNS and experienced serious impacts within two to three years after its arrival (Cheng et al. 2021, entire; Wiens et al. 2022, pp. 231–247). To date, there are no proven measures to reduce the severity of impacts from WNS.

Wind Related Mortality

Wind related mortality, overshadowed by the disproportionate impacts to tree bats and by the enormity of WNS, is also proving to be a consequential stressor to northern long-eared bats. There is notable spatial overlap between northern long-eared bat occurrences and wind facilities, and northern long-eared bat mortality has been documented at wind turbines. At the 2020 installed MW capacity, it was estimated that 122 northern long-eared bats are killed annually at wind facilities. Analyses using data from Wiens et al. (2022, pp. 236–247) and analyses by Whitby et al. (2022, entire) suggest that the impact of wind related mortality is discernible in the ongoing decline of the species. "Feathering" (i.e., pitching turbine blades parallel with the prevailing wind direction to slow rotation speeds) turbine blades at low wind speeds has been used to reduce bat fatalities; however, the effectiveness of curtailment at reducing fatality rates for the northern long-eared bat has not been documented.

Climate Change

The risk of exposure to changes in the climate is range-wide for the northern long-eared bat. However, the magnitude, direction, and seasonality of climate variable changes is not consistent range-wide. Although there may be some benefit to the species from a changing climate, overall, negative impacts are anticipated. Although we lack species-specific observations for the northern long-eared bat, observed impacts to the little brown bat include reduced reproduction during drought conditions (Adams 2010, pp. 2440–2442) and reduced adult survival during dry years in the Northeast (Frick et al. 2010, pp. 131–133). While sufficient moisture is important, too much precipitation during the spring can also result in negative consequences to insectivorous bats. Heavier precipitation events may lead to decreased insect availability and reduced echolocation ability (Geipel et al. 2019, p. 4), resulting in decreased foraging success. Precipitation also wets bat fur, reducing its insulating value (Webb and King 1984, p. 190; Burles et al. 2009, p. 132) and increasing a bat's metabolic rate (Voigt et al. 2011, pp. 794–795). Bats are likely to reduce their foraging bouts during heavy rain events, and reduced reproduction has been observed during cooler, wetter springs in the Northwest (Grindal et al. 1992, pp. 342–343; Burles et al. 2009, p. 136). Responses to climate change by the northern long-eared bat will vary throughout its range based on the extent of annual temperature rise in the future.

Habitat Loss

As previously discussed, northern long-eared bats require suitable roosting, foraging, and commuting habitat during the spring, summer, and fall. Loss of these habitats influences the survival and reproduction of the species. As referenced in the Service's Species Status Assessment for the northern long-eared bat (USFWS 2022), National Land Cover Database data from 2006 to 2016 shows that deciduous forest landcover decreased across all northern long-eared bat representation units (RPUs) (e.g., Southeast, Eastern Hardwoods, Subarctic, Midwest, and East Coast) by 1.4 million acres, for an average loss of 140,000 acres per year. Other cover types that provide foraging opportunities, such as emergent wetland cover types, also decreased across all RPUs by an additional 1.4 million acres. These changes in landcover may be associated with losses of suitable roosting or foraging habitat, longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colony networks, and direct injury or mortality. Impacts from forest habitat removal may range from minor (e.g., removal of a small portion of foraging habitat in unfragmented forested area with a robust population) to significant (e.g., removal of roosting habitat in highly fragmented landscape with small, disconnected population). Adverse impacts are more likely in areas with little forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat.

The complete loss of or modification of winter roosts (such that the site is no longer suitable) can result in impacts at both the individual and population levels. In addition, disturbance within hibernacula can render a site unsuitable or can pose harm to individuals using the site. Modifications to bat hibernacula can alter the ability of bats to access the site (Spanjer and Fenton 2005, p. 1110) or affect the airflow and microclimate of the subterranean habitat, affecting the ability of the cave or mine to support hibernating bats. In addition, bats present during any excavation or filling could be crushed or suffocated. Human entry or other disturbance to hibernating bats results in additional arousals from hibernation, which require an increase in total energy expenditure at a time when bats are relying on fat reserves. This is even more important for sites impacted by WNS, as more frequent arousals from torpor increases the probability of mortality in bats with limited fat stores (Boyles and Willis 2009).

6.2 Environmental Baseline for the Northern Long-eared Bat

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

6.2.1 Action Area Numbers, Reproduction, and Distribution of the Northern Long-eared Bat

The Service is using the best available data to estimate the status of the northern long-eared bat within the Action Area. These estimations are specific to the timeframes listed below. The timeframes represent when the Service considers the species to be present in a certain habitat type during specific periods of its life cycle in Kentucky (USFWS 2016). In the absence of data (i.e., recent survey results) for the species in the Action Area, we make certain assumptions based on the habitat in and around the Action Area, available past survey data, and our knowledge of the biology of the species.

<u>*Winter Hibernation (November 16 – March 31)*</u>
The Winter Hibernation section for the Indiana bat contains a detailed summary of the winter bat habitat assessment that was performed by Stantec to evaluate the Action Area for known and potential hibernacula for the listed and proposed bat species covered in this BO/CO. The Service does not have any records or knowledge of known hibernacula for the northern long-eared bat located within the Action Area, and the nearest known hibernaculum for this species is located approximately 15 miles from the Action Area (Figure 6).

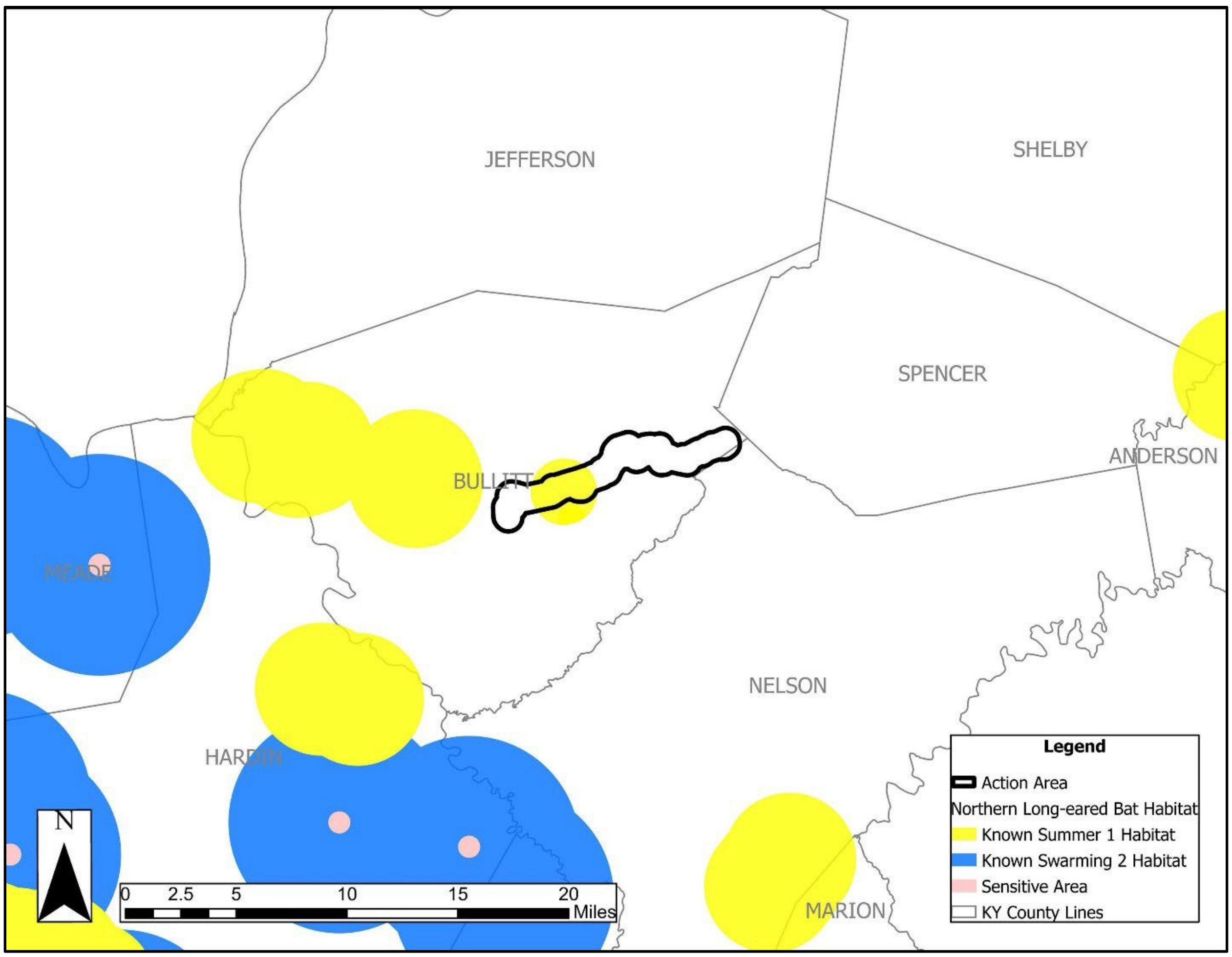

Figure 6: Proximity of the Action Area to known northern long-eared bat habitat.

Based on the findings of the winter bat habitat assessment and our review of other data related to the presence of known or potential hibernacula, the presence of a large, undocumented hibernaculum for the northern long-eared bat in the Action Area is considered unlikely based on the following factors:

- The Service does not have any records of known hibernacula located within the Action Area.

- No potential hibernacula for the northern long-eared bat are present within the MDL, based on the results of the winter bat habitat assessment.
- The winter bat habitat assessment also did not identify any potential hibernacula or areas that could support complex cave systems during visual assessments of the Action Area immediately outside the MDL or during surveys of areas outside the MDL where landowner access was allowed.
- Additional review of KGS karst maps and coal mine maps by the Service did not identify any potential hibernacula for this species in the MDL.
- A complex cave system, if present, is more likely to be found in the moderate and high karst potential areas in the central portion of the Action Area that corresponds with MP 2.5 to MP 7.5. However, this portion of the Action Area has been affected by extensive agricultural and residential development and inhabited by people for a long period of time, and no such cave systems have been identified during surveys, in published records, or by the local population. Therefore, it is not likely that an undocumented complex cave system that could serve as a northern long-eared bat hibernaculum exists.

Northern long-eared bats are thought to predominantly overwinter in large, more complex caves similar to the Indiana bat. However, the species has also been observed overwintering in smaller caves and other karst features that provide suitable conditions (Griffin 1945, p. 22; USFWS 2015, p. 17977; Massachusetts Department of Fish and Game 2012, unpublished data). Based on the findings of the winter bat habitat assessment and our review of other data related to the presence of known or potential hibernacula, the presence of a small, undocumented hibernaculum for the northern long-eared bat in the Action Area is also considered unlikely based on the following factors:

- None of the small karst features evaluated during the winter bat habitat assessment were potentially suitable hibernacula for the northern long-eared bat. This included features in both the MDL and Action Area.
- The only portion of the Action Area located within a zone of moderate to high karst potential is located between MP 2.5 and MP 7.5. The remainder of the Action Area is located within zones of low karst potential.
- While other sinkholes and other small karst features may be present or form in the Action Area, particularly within the central portion of the Action Area in areas of moderate to high karst potential, the information provided by the winter bat habitat assessment or otherwise available to us does not demonstrate that those karst features are likely to be suitable as hibernacula for the northern long-eared bat. To the contrary, the karst features are expected to be similar in size and origin (e.g., formed by minor areas of subsidence) to the features that were identified and evaluated during the winter bat habitat assessment, all of which were determined to be unsuitable as potential hibernacula.

Spring Staging (April 1 – May 14)
The Service uses a 0.8-kilometer (0.5-mile) radius buffer around northern long-eared bat hibernacula entrances to identify spring staging areas (USFWS 2016). The Action Area is not within the buffer of a known northern long-eared bat hibernaculum; therefore, the Action Area does not contain spring staging habitat. The Service also considers it unlikely that unknown spring staging habitat for this species is present within the Action Area due to the lack of known

hibernacula and low probability for undiscovered potential hibernacula discussed in the previous section. As a result, the Service does not believe that northern long-eared bats use the Action Area during spring staging.

Summer Roosting (April 1 – October 15)

The Service uses a 4.8-kilometer (three-mile) radius buffer around northern long-eared bat capture and acoustic detection records and a 2.4-kilometer (1.5-mile) radius buffer around known roost trees to identify known summer roosting habitat. A portion of the Action Area between MP 7.0 and MP 10.5 occurs within Known Summer 1 (Maternity) habitat for the northern long-eared bat. This Known Summer 1 habitat is associated with a known roost tree and consists of a 2.4-kilometer (1.5-mile) radius buffer around the roost tree. Several maternity colonies and individuals have also been documented within a 10-mile radius of the Action Area.

Due to the presence of known maternity habitat within a portion of the Action Area, suitable habitat in the remaining portion of the Action Area, and the presence of other known occurrences of the species in the surrounding area, the Corps and the Service are reasonably certain that northern long-eared bats occur throughout the Action Area. We consider a known northern long-eared bat maternity colony to occur in the Action Area between MP 7.0 and MP 10.5 based on the presence of Known Summer 1 habitat in this portion of the Action Area. Because the Action Area is approximately 12 miles in length, and the 1.5-mile buffer for Known Summer 1 habitat only covers a portion of the Action Area, we assume that a second, unknown northern long-eared bat maternity colony with a three-mile radius habitat buffer could overlap with the western extent of the Action Area between MP 10.5 and MP 11.81 (Figure 7). We also assume that a third, unknown northern long-eared bat maternity colony with a three-mile radius habitat buffer is present between MP 7.0 and MP 0.5. Additionally, we assume that a fourth, unknown northern long-eared bat maternity colony with a three-mile radius habitat buffer is present between MP 0.5 and MP 0.0. We believe this is an overly conservative estimate of summer occupancy for the northern long-eared bat due to the low post-WNS numbers of the species and because other large, post-WNS aggregations of maternity colonies have not been documented in the area. Without additional information, we conservatively assume that some portion of these four maternity colonies' primary and secondary roost trees occur within the 39.46 acres of forested habitat that is proposed for removal, and that the colonies also use this habitat for foraging and commuting.

Maternity colonies of females and young are generally small, numbering from about 30 (Whitaker and Mumford 2009, p. 212) to 60 individuals (Caceres and Barclay 2000, p. 3). Based on this information, the Service estimates that each maternity colony consists of 45 adult females that will arrive in the Action Area in the spring after migrating from their hibernacula. The Service also estimates that each of these adult females will be pregnant and give birth to one juvenile each (45 total juveniles) in early June. Based on a sex ratio of 1:1 (female to male), the Service also estimates that 45 adult males correspond with each maternity colony and are expected to use the Action Area for roosting, foraging, and commuting. Therefore, the Service estimates that 135 northern long-eared bats per colony, or 540 individuals total for the four estimated colonies, are likely to utilize the Action Area between April 1 and August 15.

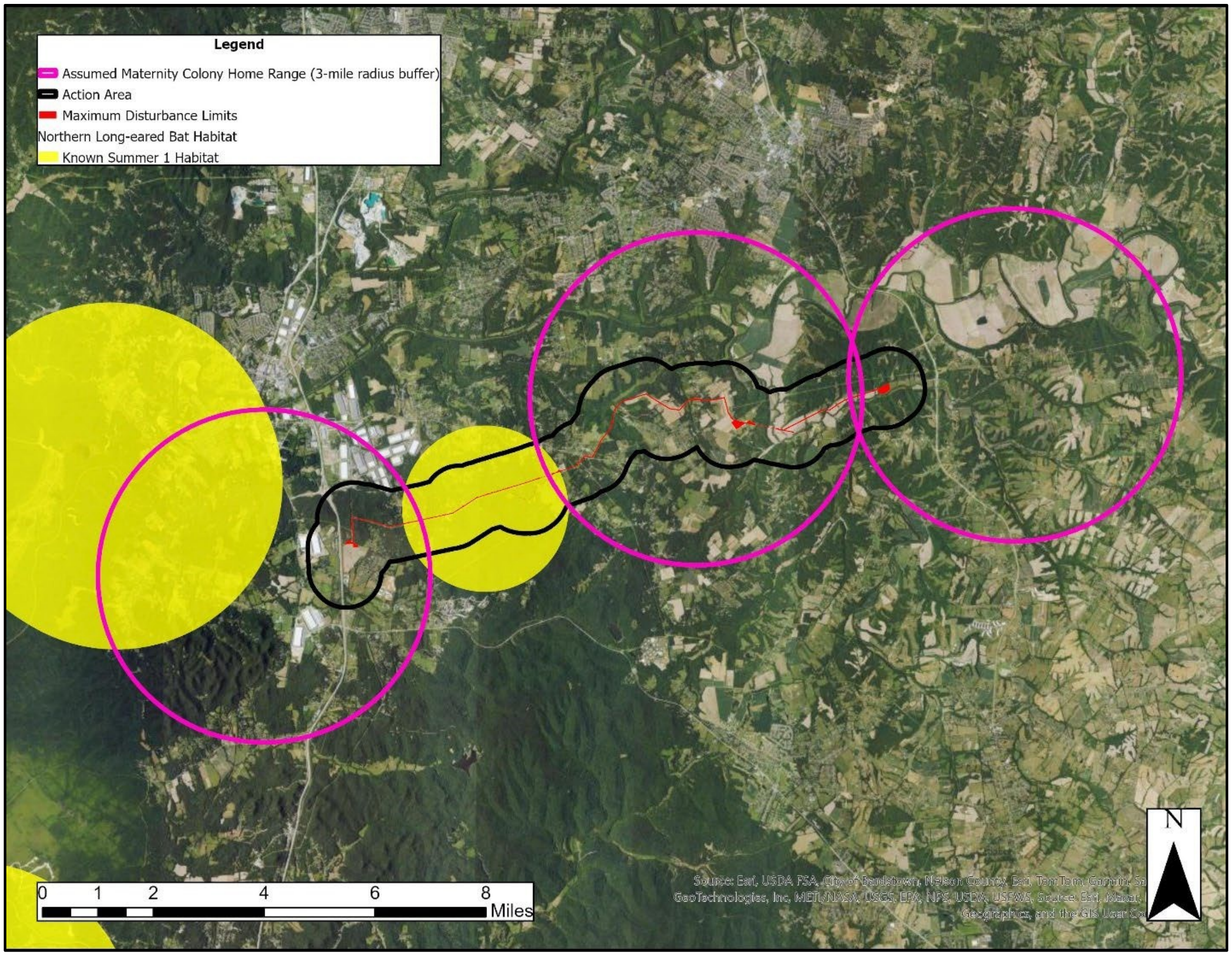

Figure 7: Assumed northern long-eared bat maternity colonies in the Action Area.

Fall Swarming (August 16 – November 15)

The Service estimates the fall swarming range for the northern long-eared bat as an eight-kilometer (five-mile) radius buffer around hibernacula entrances (USFWS 2016). The Action Area is not within the buffer of a known northern long-eared bat hibernaculum; therefore, the Action Area does not contain fall habitat. The Service considers it unlikely that unknown fall swarming habitat for this species is present within the Action Area due to the lack of known hibernacula and low probability for undiscovered potential hibernacula discussed in the Winter Hibernation section. As a result, the Service does not believe that northern long-eared bats use the Action Area for fall swarming.

6.2.2 Action Area Conservation Needs of and Threats to the Northern Long-eared Bat

Northern long-eared bats in the Action Area are likely exposed to the same threats that the species is exposed to across the range, as discussed in Section 6.1.5. Below are the two most pertinent to this consultation.

Habitat Loss
Forested habitat has been lost and degraded in the Action Area as a result of conversion to agricultural land and residential development. Impacts to forested habitat are expected to continue as urbanization and development from the greater Louisville metropolitan area encroach from the north.

White-nose Syndrome
WNS was first discovered in Kentucky in 2011 and has since spread across the state. Mortality at infected sites first became apparent in 2013, with an increase in observed mortality in 2014. Preliminary reports indicate that Pd and/or WNS has been detected in approximately 74% of caves surveyed in Kentucky (T. Hemberger, pers. comm. 2017); however, many of the caves without positive records have not been surveyed in recent years. Although the population and trend data following the arrival of WNS at Kentucky hibernacula is difficult to interpret, data are currently not showing the near or total loss of northern long-eared bat populations that has been documented in the northeastern United States.

Because northern long-eared bats can migrate hundreds of miles from their hibernacula and WNS has been documented from Kentucky and all of the adjacent states, we assume that all individuals that are known and assumed to occupy habitat within the Action Area have been exposed to WNS. Therefore, northern long-eared bats in the Action Area are expected to be experiencing stress and reduced body weights from their exposure to WNS.

6.3 Effects of the Action on the Northern Long-eared Bat

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

The Service established additional requirements for making the determination of reasonably certain to occur (in effect since October 28, 2019) under 50 CFR 402 (see Federal Register :: Endangered and Threatened Wildlife and Plants; Regulations for Interagency Cooperation). After determining that the "activity is reasonably certain to occur," based on clear and substantial information, and using the best scientific and commercial data available, there must be another conclusion that the consequences of that activity are reasonably certain to occur. In this context, a conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available.

Based on the description of the Action, other activities caused by the Action, and the species' biology, we have identified four stressors (i.e., the alteration of the environment that is relevant to the species) to the northern long-eared bat that are reasonably certain to result from the Action: noise and vibration, artificial lighting, aquatic resource degradation, and tree removal. All of these stressors would occur during the construction component of the proposed Action. The operation and maintenance components are not expected to impact the northern long-eared bat because: (a) those components would occur after the construction component, which is when all suitable habitat will be removed in the MDL, and (b) the lack of stressors that would be reasonably certain to result in impacts to individuals or habitat in portions of the Action Area outside of the MDL.

Below we discuss the best available science relevant to each stressor, then describe the Stressor-Exposure-Response pathways that identify the circumstances for an individual bat's exposure to the stressor (i.e., the overlap in time and space between the stressor and a northern long-eared bat). Finally, we identify and consider how proposed conservation measures may reduce the severity of the stressor or the probability of an individual bat's exposure for each pathway.

6.3.1 Effects of Noise and Vibration on the Northern Long-eared Bat

Northern long-eared bats may be exposed to noise and vibrations during the construction component of the Action.

<u>Applicable Science</u>
Bats exposed to noise and vibration may flush from their roosts. Bats that flush during the daytime are at greater risk of harm due to predation (Mikula et al. 2016). Additionally, bats that flush their roost and/or avoid travel and foraging areas in response to this stressor may be harmed due to an increase in energy expenditure. Increased energy demands could have a significant effect on bats due to their low body mass. Because females require increased energy reserves during lactation (Kurta et al. 1989), an increased demand for energy in response to noise and vibrations could be especially detrimental to lactating females and, subsequently, their pups.

Information is limited regarding the effects of noise and vibration on the northern long-eared bat; however, studies show that the closely-related Indiana bat can tolerate some level of noise and vibration. For example, several construction projects, prior to documentation of white-nose syndrome, have occurred on Fort Drum adjacent to multiple known Indiana bat roosts (Johnson et al. 2011). Construction around these project sites has been ongoing for multiple years during the active season. The last known capture and roosting locations of Indiana bats near these projects have been within approximately 800 and 400 meters (0.5 and 0.25 mi) of the construction activities, respectively. Indiana bats also occupy another military installation, Fort Knox, suggesting that noise from machinery and training activities may disturb colonies of roosting bats, but such disturbances would have to be severe to cause roost abandonment (Hawkins et al. 2008). Gardner et al. (1991) had evidence that Indiana bats continued to roost and forage in an area with active timber harvest. This suggested that noise and exhaust emissions from machinery could possibly disturb colonies of roosting bats, but such disturbances would have to be severe to cause roost abandonment. Callahan (1993) noted the likely cause of the bats in his study area abandoning a primary roost tree was disturbance from a bulldozer clearing brush adjacent to the tree. In another study near 1-70 and the Indianapolis Airport, a primary maternity roost was located 1,970 ft. (0.6 km) south of 1-70 (3D/International, Inc. 1996). This primary maternity roost was not abandoned despite constant noise from the interstate and airport runways. However, the roost's proximity to 1-70 may be related to a general lack of suitable roosting habitat in the vicinity, and due to the fact that the noise levels from the airport were not novel to the bats (i.e., the bats had apparently habituated to the noise)

(USFWS 2002). Noise and vibration could cause an Indiana bat to flush from its roost, expending extra energy and making it more vulnerable to predation (Mikula et al. 2016). Novel noises would be expected to result in some changes to bat behaviors, but research suggests that bats can become habituated to this stressor.

Effects Pathway #1	
Activity: Construction	
Stressor: Noise and Vibration	
Exposure (time)	Northern long-eared bats will be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Northern long-eared bats will be exposed to this stressor wherever they occur within the Action Area.
Resource affected	The stressor is expected to affect individual northern long-eared bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected northern long-eared bats, especially if noise and vibration exceed normal, ambient levels for the Action Area where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats while roosting, such as arousing during daylight hours, shifting within the roost, and increasing vocalizations, as well as minor shifts in use of foraging and commuting habitats while active at night. However, northern long-eared bats are also likely to experience the following potentially significant effects if the stressor causes bats to flush from their roosts: • Extra energy expenditure that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Increased chance of predation of individuals, especially if individuals flush during daylight hours when noise and vibration are most likely to occur during the construction component of the Action.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Blasting will not be used during excavation for pipeline installation, which will avoid and minimize the amount of noise and vibrations generated by the construction component of the Action. • Tree clearing will be targeted between November 15 and March 31 when forested habitats are unoccupied by northern long-eared bats, which would avoid direct impacts on northern long-eared bats.
Interpretation	The effects of increased noise and vibrations will be greatest prior to tree removal when bats may be roosting in trees immediately adjacent to noise- and/or vibration-producing activities and are more likely to flush from their roosts or alter their behavior. Construction activities that

Effects Pathway #1	
	require heavy equipment and associated vehicles, personnel, and tools will be used at this time and are likely to produce noise and vibrations in the Action Area above ambient levels. These activities include the development and construction of temporary access roads and entrances, installation of erosion and sediment controls, tree and vegetation removal, and pipeline installation. The noise and vibration associated with these activities may affect northern long-eared bats by causing individuals to alter their behaviors, which may be temporary or permanent. Significant changes in noise levels or significant increases in vibration above ambient levels are more likely to result in altered behaviors, such as flushing from roosts and avoidance of habitat areas that are close to noise or vibration sources. The novelty of the noise or vibrations and the relative level of those disturbances will also likely dictate the range of responses from individuals or colonies of northern long-eared bats. Flushing from roosts is expected to cause northern long-eared bats to: (a) expend extra energy that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles; (b) be subject to an increased chance of predation of individuals, especially if individuals flush during daylight hours when noise and vibration are most likely to occur during the construction component of the Action; and (c) increase the probability that adult females may abandon roosts and/or non-volant young if the event occurs during the non-volant period. These are adverse effects that are likely to result in harm to northern long-eared bats, including injury or mortality of individuals. Following tree removal, individuals roosting, foraging, and/or commuting in other portions of the Action Area outside the MDL would continue to be exposed to this stressor at variable levels that would decrease with distance from the MDL. Specifically, noise and vibration levels within portions of the Action Area outside the MDL are expected to be highest at locations closer to the point of origin within the MDL and diminish with increasing distance from the point of origin, due to the diminished effects of noise and vibration with distance from the source (i.e., the noise or vibration will be absorbed and typically become less loud or noticeable). Therefore, northern long-eared bats in the Action Area outside of the MDL are more likely to be affected if they are closer to the noise and vibration point of origin in the MDL and if the noise or vibration is significantly different than ambient levels (i.e., loud, repetitive, novel, etc.). Conversely, northern long-eared bats would be less likely to be affected by noise and vibration the farther they are from the point of origin in the MDL. However, the likelihood that adverse effects will not occur cannot be discounted, because flushing from a roost may still occur and result in the same adverse effects noted in the previous paragraph.

Effects Pathway #1	
	Noise and vibration disturbances from personnel and vehicles in the MDL during certain aspects of the construction component that do not involve heavy equipment (e.g., land surveying) are expected to be similar to ambient levels in the Action Area. Based on the presence of agricultural land, residential areas, roadways, utility ROWs, and other types of human development in the Action Area, noise and vibrations generated by people, vehicles, farm equipment, and other sources are currently occurring in the Action Area. Northern long-eared bats present within the Action Area are likely habituated to these noises and vibrations. The vehicles that will be used (e.g., light-duty trucks and UTVs) are similar to vehicles associated with the existing activities occurring in the Action Area and are expected to produce similar levels of noise and vibrations and may produce less noise and vibrations than some vehicles and equipment currently present in the Action Area (e.g., farm machinery, commercial trucks, lawnmowers, etc.). Personnel and vehicles will also be moving through the MDL during these activities and will not remain in one area for an extended period of time. Based on these factors, effects to northern long-eared bats from noise and vibrations associated with construction activities that do not involve heavy equipment are unlikely to occur or result in effects outside of the MDL and are considered discountable.
Effect	The effect of this stressor is Harm to affected northern long-eared bats, which can include physical injury to individuals and/or mortality of individuals.

6.3.2 Effects of Artificial Lighting on the Northern Long-eared Bat

Use of artificial lighting may occasionally be necessary at some locations during pipeline installation to facilitate the project schedule. Such lighting events are most likely to occur in the early morning and evening hours during times of the year when daylight is minimized (e.g., the winter months) and may not occur all night. Any artificial lighting used during construction would be angled downward and inward towards the construction area and not directed vertically or at an angle that could illuminate roosting, foraging, and commuting habitat. However, depending on the location and intensity of artificial lighting in relation to bat habitat, some indirect lighting of habitat could occur that may cause northern long-eared bats to alter their behaviors if such lighting occurs when the species is present.

<u>Applicable Science</u>
Studies document highly variable responses among species to artificial lighting. Some bat species seem to benefit from artificial lighting, taking advantage of high densities of insects attracted to light (Jung and Kalko 2010); however, other species may avoid artificial light (Furlonger et al. 1987) or not be affected (Stone et al. 2012). Lighting can cause delays in night bat activity (Stone et al. 2009; Downs et al. 2003), and effects of artificial lighting on bat activity may vary with season and moon phase (Jung and Kalko 2010).

Slow-flying bats such as *Rhinolophus*, *Myotis*, and *Plecotus* species have echolocation and wing-morphology adapted for cluttered environments (Norberg and Rayner 1987) and emerge from roosts relatively late when light levels are low, probably to avoid predation by diurnal birds of prey (Jones and Rydell 1994). In Indiana, Indiana bats avoided foraging in urban areas, and Sparks et al. (2005) suggested that it may have been in part due to high light levels. Using captive bats, Alsheimer and Kazial (2011) found that a closely related species, the little brown bat (*Myotis lucifugus*), was more active in the dark than in light.

Effects Pathway #2	
Activity: Construction	
Stressor: Artificial Lighting	
Exposure (time)	Northern long-eared bats may be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Northern long-eared bats may be exposed to this stressor wherever they occur within the MDL.
Resource affected	The stressor is expected to affect individual northern long-eared bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses on affected northern long-eared bats, especially if the use of artificial lighting from the Action is novel or exceeds ambient levels for the area where aspects of the construction component are occurring. These include responses that are unlikely to result in significant effects, such as minor delays in initiating normal behaviors at night (e.g., leaving roosts) and minor shifts in use of foraging and commuting habitats while active at night. The Service has no data that would suggest that these minor behavioral shifts would result in increased visibility to predators that could increase the chance of predation on individuals or require extra energy expenditures that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Interpretation	The Service has no information that would clearly indicate that use of artificial lighting during the construction component of the Action is likely to result in significant adverse effects on northern long-eared bats. Use of artificial lighting is expected to be minimal, centralized to a specific location, and only affect a small portion of forested habitat within the Action Area. The available science indicates that northern long-eared bats may delay foraging and commuting and avoid areas where artificial lighting is used. However, northern long-eared bats are expected to be able to avoid illuminated areas with minimal effort and continue to forage and travel in other areas of nearby habitat. Northern long-eared bats can also utilize illuminated areas before or after lighting is used. Some studies suggest that they may be attracted to artificial lights due to increased density of insect prey items that are attracted to lights.
Effect	This stressor is expected to have an Insignificant effect on affected

	northern long-eared bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

6.3.3 Effects of Aquatic Resource Degradation on the Northern long-eared Bat

Aquatic resource degradation may occur during the construction component. The placement of culverts in streams and drainage ditches during construction of access roads and construction entrances could disturb sediment and negatively affect water quality. Trenching at stream crossings during pipeline installation will also result in sediment disturbance in the streams, and soil that is exposed during excavation and vegetation removal could enter streams through stormwater runoff. Spills and leaks of petroleum-based products and other contaminants from vehicles and heavy equipment could also enter streams and degrade water quality. Impacts to aquatic resources that occur in the MDL could also extend to portions of the Action Area downstream if run-off occurs. Activities that reduce the quantity or alter the quality of aquatic resources could affect northern long-eared bats, even if conducted while individuals are not present. However, LG&E will use BMPs in accordance with state permits and regulations to minimize the potential for aquatic resource degradation. Implementation of these practices is anticipated to avoid some potential water quality impacts and minimize others.

Applicable Science
Northern long-eared bats typically forage under the canopy on forested hillsides and ridges rather than along riparian areas (LaVal et al. 1977, p. 594; Brack and Whitaker 2001, p. 207). However, forest-covered streams may also be used during foraging and travel (USFWS 2015, p. 17992). Drinking water is essential, especially when bats actively forage, and northern long-eared bats obtain water from streams, ponds, and water-filled road ruts in forest uplands. The northern long-eared bat has a diverse diet that includes aquatic insects such as caddisflies (Griffith and Gates 1985, p. 452; Nagorsen and Brigham 1993, p. 88; Brack and Whitaker 2001, p. 207).

Negative impacts of sedimentation on aquatic insect larvae is well-documented. In a literature review, Henley et al. (2000) summarized how stream sedimentation impacts these communities. Sediment suspended in the water column affects aquatic insect food sources by physically removing periphyton from substrate and reducing light available for primary production of phytoplankton. Sediment that settles out of the water column onto the substrate fills interstitial spaces occupied by certain aquatic insect larvae. Increases in sedimentation can change the composition of the insect community in a stream. In a three-year study measuring sedimentation and macroinvertebrate communities before, after, and during disturbance from a highway construction site, Hendrick (2008) found increased turbidity and total suspended solids downstream from the construction that correlated with a shift in macroinvertebrate communities. The change, however, was not great; the Hilsenhoff Biotic Index decreased from “excellent” before construction to “good” after construction. The use of BMPs likely minimized the effects of the construction on the macroinvertebrate communities.

Effects Pathway #3	
Activity: Construction	
Stressor: Aquatic Re ource Degradation (sedimentation)	
Exposure (time)	Northern long-eared bats may be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Foraging habitat in the Action Area consisting of streams and adjacent areas where aquatic insect prey may be located. Streams upstream of the MDL will not be exposed to this stressor.
Resource affected	The stressor is expected to affect foraging habitat, prey (aquatic insects), and individual northern long-eared bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected northern long-eared bats, especially if water quality is reduced in the Action Area where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of drinking water sources and foraging habitat while active at night. The Service has no data that would suggest that these minor behavioral shifts would require extra energy expenditures or reduce foraging efficiency that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Use BMPs for sediment and erosion control in accordance with state permits and regulations during construction to avoid and minimize impacts within and outside the MDL. • Utilize HDD to avoid direct impacts to the perennial streams Cox Creek and Rocky Run to avoid impacts to drinking water and aquatic insects that may provide food for northern long-eared bats.
Interpretation	The Service has no information that would clearly indicate that potential aquatic resource degradation during the construction component of the Action is likely to result in significant adverse effects on northern long-eared bats. The effects of sedimentation on aquatic resources are expected to be minimal due to the temporary nature of the activity and implementation of the conservation measures. Drinking water sources and aquatic insect prey are not expected to be eliminated, and the species has shown that it can use a variety of drinking water and prey sources and does not forage exclusively on aquatic insect prey.
Effect	This stressor is expected to have an Insignificant effect on affected northern long-eared bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

6.3.4 Effects of Tree Removal on the Northern Long-eared Bat

Tree removal during the construction component will result in the permanent loss of 39.46 acres of forested summer habitat (i.e., roosting, foraging, and commuting) for the northern long-eared bat. Of these 39.46 acres, 23.21 acres are located within Known Summer 1 habitat for the northern long-eared bat. The remaining 16.25 acres are located in unknown, or "Potential", habitat for the northern long-eared bat. Table 8 identifies the tree removal by bat habitat type and whether the tree removal is located within the Corps' jurisdictional area or outside the Corps' jurisdictional area.

Table 8. Amount of tree removal by northern long-eared bat habitat type.

Habitat Type	Tree Removal Total	Tree Removal in Corps' Jurisdictional Area	Tree Removal Outside Corps' Jurisdictional Area
Summer Habitat (Potential)	16.25 acres	4.31 acres	11.94 acres
Known Summer 1	23.21 acres	11.77 acres	11.44 acres

Habitat removal may occur during the summer occupancy (April 1 – October 15) and hibernation (November 16 – March 31) timeframes and will be scattered throughout the MDL (Appendix C). Tree removal will primarily occur along the edges of larger forest blocks and within linear forested corridors and will not result in the removal of any large blocks of habitat. The resulting open land will consist of a narrow gap through forest blocks and linear corridors ranging from 75 to 100 feet in width, and none of the remaining forested habitat is expected to be isolated as a result of the Action. The Service defines isolated as a break of more than 1,000 feet in wooded areas (USFWS 2011).

Applicable Science – Removal of Summer Habitat (Summer Occupancy Timeframe)
Risk of injury or death from being crushed when a tree is felled is most likely to impact non-volant pups, but adults may also be injured or killed. This risk is greater for adults during cooler weather when bats periodically enter torpor and would be unable to arouse quickly enough to respond (i.e., flush and potentially avoid being in the roost when it is felled). Injury and death of northern long-eared bats during tree felling has not been reported; however, as previously discussed, the deaths of Indiana bat adults and non-volant young have been documented during the felling of maternity colony roost trees in Ohio and Indiana (John O. Whitaker, personal communication, 1986; Belwood 2002).

Effects Pathway #4	
Activity: Construction	
Stressor: Tree Removal, Removal of Summer Habitat (summer occupancy)	
Exposure (time)	Northern long-eared bats may be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect summer habitat (i.e., roost trees, foraging, and commuting habitat) and individual northern long-eared bats, including adults and/or juveniles of both sexes.

Effects Pathway #4	
Individual response	The stressor is expected to cause a variety of potential responses by affected northern long-eared bats from the loss of summer habitat in the MDL where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. However, northern long-eared bats are also likely to experience the following potentially significant effects from the stressor: • Bats struck by equipment or crushed by a felled tree will be injured or killed. • Colony fragmentation could decrease thermoregulation and foraging efficiency that may reduce fitness and result in reduced survival/reproductive success. • Extra energy expenditure that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Increased chance of predation of individuals, especially if individuals flush during daylight hours when roost tree removal and removal of summer habitat are most likely to occur during the construction component of the Action.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the northern long-eared bat from forested habitat removal. • Tree clearing will be targeted between November 15 and March 31 when forested habitats are unoccupied by northern long-eared bats.
Interpretation	Tree removal during the summer occupancy timeframe could result in death or injury to roosting northern long-eared bats that are crushed by a felled tree, especially non-volant juveniles. Those bats that survive or flush from felled trees will be exposed to increased levels of predation and expend extra energy to find another suitable roost. This energy expenditure is in addition to what is likely necessary for foraging, pup rearing, social interactions, and other activities. The use of additional energy in response to habitat loss, especially when combined with the energy needs associated with normal life cycle processes during the summer timeframe (e.g., migration, pregnancy, lactation, etc.) or other stressors (e.g., WNS), is likely to reduce fitness and subsequently reduce survival and reproductive success. These effects would be avoided (e.g., no individual mortality would occur) or reduced to some extent if all proposed tree removal does not occur during the summer occupancy timeframe.

Effects Pathway #4	
Effect	The effect of this stressor is Harm to affected northern long-eared bats, which can include physical injury to individuals and/or mortality of individuals.

Applicable Science – Removal of Summer Habitat (Hibernation Timeframe)

Northern long-eared bat colonies retain their identity and exhibit high site fidelity between years (Silvis et al. 2015). A colony's use of the same general roosting area from one year to the next may occur due to the return of at least some individuals from the prior year – either juveniles (e.g., Silvis et al. 2015, p. 11) or adults. Northern long-eared bat females have been shown to roost together for multiple summers in the same location, and individual females have been captured returning to the same small area for at least five consecutive summers (Foster and Kurta 1999, p. 665, Patriquin et al. 2010, Perry 2011).

To evaluate the effects of roost removal on the northern long-eared bat, Silvis et al. (2015, p. 5) removed a primary roost and five secondary roosts, respectively, from the roosting area of two colonies in a heavily forested area of Kentucky. No roosts were removed from the roosting area of a third colony. In the year after roost removal, individuals persisted in each area and did not appear to change their colony roosting areas (Silvis et al. 2015, p. 10). Despite the 'consistent patterns of space use between years' by the colonies, few individuals were recaptured in the second year. "Colony identity" remained intact, although turnover among the individuals that comprised each colony was high (Olivera-Hyde et al. 2019, p. 724). The return of juveniles from the first year may have been key in retention of the colonies' identities despite the high colony turnover (Silvis et al. 2015, p. 10-11). Females "exhibit fidelity to a general geographic area", but they may not settle into the precisely same areas as in previous years (Olivera-Hyde et al. 2019, p. 724). Although the identity of each colony persisted, Silvis et al. (2015b, p. 12) detected signs of a "segmented roost network" in the colony from which five secondary roosts were removed. Those five roosts constituted 24% of the roosts identified during radio-tracking of colony members. This was consistent with a previous simulation in which removal of about 20% of roosts resulted in a 50% chance of colony fragmentation (Silvis et al. 2014b, p. 287).

Winter tree clearing that removes roosts and fragments colonies could harm northern long-eared bats by increasing stress, reducing opportunities to roost in thermally suitable microenvironments, and reducing benefits accrued from cooperating rearing of young. The likelihood that any winter tree clearing project is likely to take (e.g., "harm") an individual depends on: (1) the likelihood that the tree removal overlaps with an unknown northern long-eared bat colony roosting area; (2) the extent of tree (roost) removal; (3) the intensity of tree removal; (4) the availability of an alternating roosting area known to the colony; and (5) whether roosts are likely to be limiting after tree removal. The species' ability to persist in an area from which roosts have been removed may be related to the number of roosts used by the species, the degree of roost specialization, and local roost availability. Effects are further compounded for bats returning from hibernacula infected with WNS. Individuals surviving WNS have additional energetic demands. For example, WNS-affected bats have less fat reserves than non-WNS-affected bats when they emerge from hibernation (Reeder et al. 2012; Warnecke et al. 2012). Many may also have wing damage (Reichard and Kunz 2009, Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, maintaining a successful pregnancy, rearing pups, and healing their own bodies.

Effects Pathway #5	
Activity: Construction	
Stressor: Tree Removal, Removal of Summer Habitat (hibernation)	
Exposure (time)	Tree removal will occur between November 16 and March 31 during the hibernation timeframe. Northern long-eared bats may be exposed to this stressor between April 1 and October 15 (summer occupancy timeframe) the first summer bats return after tree removal.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect summer habitat (i.e., roost trees, foraging, and commuting habitat) and individual northern long-eared bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected northern long-eared bats from the loss of summer habitat in the MDL where the construction component previously occurred. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. However, northern long-eared bats are also likely to experience the following potentially significant effects from the stressor: • Extra energy expenditure to find new suitable roosts may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Colony fragmentation could decrease thermoregulation and foraging efficiency that may reduce fitness and result in reduced survival/reproductive success. • Colony fragmentation will increase the chance of predation for individuals.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measure that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the northern long-eared bat from forested habitat removal.
Interpretation	Adult northern long-eared bats are expected to experience adverse effects after they arrive at summer habitat the first year after tree removal. The extra energy to find new roosting habitat is in addition to what is already necessary for foraging, pup rearing, social interactions, or other activities. The use of additional energy in response to habitat loss, especially when combined with the energy needs associated with normal life cycle processes during the summer timeframe (e.g., migration, pregnancy, lactation, etc.) or other stressors (e.g., WNS), is

Effects Pathway #5	
	likely to result in adverse effects. However, northern long-eared bats are expected to adapt to this stressor in subsequent years after new suitable roosts and habitat are found.
Effect	The effect of this stressor is Harm to affected northern long-eared bats, which can include physical injury to individuals and/or mortality of individuals.

Amount or Extent of Adverse Effects - Summer Habitats
As stated previously in Section 6.2.1, we estimate that 360 northern long-eared bats (180 females and 180 males) will arrive in the Action Area after hibernation to use the habitat for roosting, foraging, and commuting during the summer timeframe. We also estimate that 180 juveniles will be born in the Action Area in June. Therefore, 540 northern long-eared bats are reasonably certain to be adversely affected by the Action.

Applicable Science – Loss and Fragmentation of Forested Habitats
In addition to removal of roosting habitat, tree removal often results in the loss and fragmentation of forested habitats, resulting in the degradation of northern long-eared bat foraging and commuting habitat. Patterson et al. (2003) noted that the mobility of bats allows them to exploit fragments of habitat. However, they cautioned that reliance on already diffuse resources (e.g., roost trees) leaves bats highly vulnerable, and that energetics may preclude the use of overly patchy habitats.

Northern long-eared bat maternity colonies in Illinois, Northern long-eared, Michigan, and Kentucky have been shown to use the same roosting and foraging areas during subsequent years (Gardner et al. 1991; Humphrey et al. 1977; Kurta and Murray 2002; Kurta et al. 1996; Kurta et al. 2002). Bats using familiar roosting and foraging areas are thought to benefit from decreased susceptibility to predators, increased foraging efficiency, and the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert et al. 2002). Conversely, bats that must use new or inferior habitats after a loss or alteration of their normal forested habitat would not have these same benefits. In addition, movement distances, foraging areas, and roosting areas used by female northern long-eared bats may be smaller in fragmented forest landscapes than in landscapes with larger amounts of suitable forest cover (Henderson and Broders 2008, p. 959). In these areas, the extent of available forest patches may constrain northern long-eared bat foraging areas and could even increase use of alternative roosts (e.g., buildings, Henderson and Broders 2008 p. 959-960).

Effects Pathway #6	
Activity: Construction	
Stressor: Tree Removal, Loss and Fragmentation of Forested Habitats	
Exposure (time)	Tree removal will be a one-time occurrence but may occur any time of year. Northern long-eared bats may be exposed to this stressor between April 1 and October 15 the first summer bats return after tree removal.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.

Effects Pathway #6	
Resource affected	The stressor is expected to affect summer habitat (i.e., foraging and commuting habitat) and individual northern long-eared bats, including adults and juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected northern long-eared bats from the loss and fragmentation of summer habitat in the MDL where the construction component has occurred. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. The Service has no data that would suggest that these minor behavioral shifts would result in an increased chance of predation on individuals or require extra energy expenditures or reduce foraging efficiency that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Conservation Measure	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the northern long-eared bat from forested habitat removal.
Interpretation	Tree removal will create or expand a narrow gap in forested habitat along the edges of larger forest blocks and within linear forested corridors and will not result in the removal of any large blocks of habitat. The largest, single area of forest habitat removal is 4.871 acres of habitat. The gap will consist of open land maintained as a utility ROW and will not contain any physical barriers that would prevent bats from crossing the gap. The gap is also not expected to make access to other forested habitat more difficult, require additional energy expenditure, or limit access to habitat. Existing gaps associated with other utility ROWs are present in the Action Area, and northern long-eared bats currently foraging and commuting in the Action Area are presumably unaffected by these gaps. Additionally, the gap may provide forest edge habitat that northern long-eared bats could use for foraging and commuting habitat. Individual northern long-eared bats that use the Action Area in the summer or fall after habitat removal are not reasonably certain to be harmed.
Effect	This stressor is expected to have an Insignificant effect on affected northern long-eared bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

6.3.5 Summary of the Effects of the Action on the Northern Long-eared Bat

The Action occurs within suitable summer roosting, foraging, and commuting habitat for the northern long-eared bat, and a portion of the Action Area is located within Known Summer 1 habitat for this species. We have estimated that the Action could impact up to four maternity colonies. Impacts to the northern long-eared bat will occur during the construction phase of the Action. Stressors to the northern long-eared bat as a result of construction activities include: noise and vibration, artificial lighting, aquatic resource degradation, and tree removal (Table 9). This habitat removal could occur at any time year, including June and July when non-volant pups may be present. The habitat removal will occur in small patches within the MDL, and the 39.46 acres of habitat removal represents only 0.6% of the overall acreage of suitable northern long-eared bat habitat (6,736 acres) in the Action Area.

It is difficult to determine the number of individual northern long-eared bats that will be adversely affected during specific activities and timeframes and by the identified stressors. The Service has determined that the total number of northern long-eared bats adversely affected should be based on the presence of four maternity colonies, whose predicted and known home ranges would cover the Action Area. We estimate that 360 northern long-eared bats (180 females and 180 males) will arrive in the Action Area after hibernation to use the habitat for roosting, foraging, and commuting. In addition, we estimate that 180 juveniles will be born in the Action Area in June. Therefore, 540 northern long-eared bats are reasonably certain to be adversely affected by the removal of 39.46 acres of summer habitat associated with the Action.

Table 9. A summary of the effects of the Action on the northern long-eared bat.

Stressors: ***Activity***	**Adverse**	**Insignificant/ Discountable**
Noise and vibration: *construction*	harm	
Artificial lighting: *construction*		insignificant
Aquatic resource degradation, sedimentation: *construction*		insignificant
Tree removal, summer habitat (summer occupancy): *construction*	harm	
Tree removal, summer habitat (hibernation): *construction*	harm	
Tree removal, forest loss and fragmentation: *construction*		insignificant

6.4 Cumulative Effects on the Northern Long-eared Bat

For purposes of consultation under ESA §7, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. No cumulative effects were identified by the Corps, and the Service has determined none are reasonably certain to occur.

6.5 Conclusion for the Northern Long-eared Bat

In this section, we summarize and interpret the findings of the previous sections for the northern long-eared bat (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to jeopardize the continued existence of the species. We have considered the status of the species across its range, the status of the species within the Action Area, and the effects of the Action to the northern long-eared bat. In our effects analysis, we identified how northern long-eared bats would be adversely affected by the Action. We estimate that 540 northern long-eared bats that utilize summer habitat in the Action Area are likely to be adversely affected by the removal of forested habitat and will experience harm as a result of the Action. We believe this is an overly conservative estimate of the number of northern long-eared bats that may be affected by the Action, and we do not anticipate that all 540 northern long-eared bats will experience harm based on the following reasons:

- Injury and/or mortality of adult and juvenile northern long-eared bats will be reduced if some or all of the habitat removal occurs during the hibernation timeframe (November 16 – March 31) when bats will not be present in the Action Area.
- Injury and/or mortality of non-volant pups will be reduced if some or all of the habitat removal occurs outside the non-volant timeframe (May 15 – July 31).
- The minimal amount of summer habitat (39.46 acres) to be removed for the Action.
- The distribution of habitat removal over a 12-mile linear corridor.
- The small size of each area where habitat removal will occur. No single area exceeds five acres of habitat removal, and the majority of habitat removal areas are less than one acre in size.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action (including the effects of the Corps' and LG&E's Conservation Measures), and the absence of any cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the northern long-eared bat. We reached this determination based on the best available commercial and scientific information as described in our effects analysis in this BO and how those effects relate to the resiliency, redundancy, and representation of the northern long-eared bat, as described below:

- Resiliency describes the ability of a species to withstand stochastic disturbance (arising from random factors). Resiliency is positively related to population size, growth rate, and fecundity and may be influenced by connectivity among populations. Generally, populations need sufficient numbers of individuals within habitats of adequate area and quality to maintain survival and reproduction in spite of disturbance. Resilient populations are better able to withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

  The range of the northern long-eared bat includes 37 states and the District of Columbia in the eastern and north-central United States and portions of eight Canadian provinces. The number of bats adversely affected by the Action would be 540, and we do not expect mortality of all of these individuals. The Action would also only affect an extremely small portion of the species range; therefore, the Action would adversely affect only a small proportion of the range-wide species' population. In addition, the habitat losses associated with the Action are not expected to cause significant or meaningful reductions in habitat connectivity or habitat quality that would lead to negative population-level effects. For these reasons, the Action will not reduce the resiliency of the northern long-eared bat.

- Redundancy describes the ability of a species to withstand catastrophic events (a rare destructive natural event or episode involving many populations). It "guards against irreplaceable loss of representation" (Redford et al. 2011, p. 42) and minimizes the effect of localized extirpation on the range-wide persistence of a species. Generally speaking, redundancy is best achieved by having multiple, resilient (connected) populations widely distributed across the species' range. Having multiple populations reduces the likelihood that all populations are affected simultaneously, while having widely distributed populations reduces the likelihood of populations possessing similar vulnerabilities to a catastrophic event. Given sufficient redundancy, single or multiple catastrophic events are unlikely to cause the extinction of a species. Therefore, as redundancy increases, species viability also increases.

  If habitat removal occurs in June or July, non-volant pups may be impacted, and mortality would be higher than at other times of the year. However, only four maternity colonies are expected to be impacted by the Action. This represents a very small proportion of the range-wide population, and the species will remain widely distributed; thus, the redundancy of the northern long-eared bat will not be significantly reduced by the Action.

- Representation describes the ability of a species to adapt to changing environmental conditions over time and is characterized by the breadth of genetic and environmental diversity within and among populations. The more representation, or diversity, a species has, the more it is capable of adapting to changes (natural or human caused) in its environment. In the absence of species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the geographical range and other factors as appropriate.

  The overall acreage of forested habitat within the Action Area that is suitable northern long-eared bat habitat (6,736 acres) represents only a fraction of the suitable habitat within the range of the species. The 39.46 acres of suitable habitat that will be removed for the Action represents only 0.6% of the total habitat in the Action Area. Additionally, no reduction in the distribution of northern long-eared bats is expected because the Action Area will continue to support suitable habitat, and the species is expected to continue to occupy the Action Area after completion of the Action with no discernable effect on the genetic or habitat diversity of the species. For these reasons, we do not expect the representation of the northern long-eared bat to be reduced by the Action.

Further, the contribution to the Imperiled Bat Conservation Fund is expected to promote the survival and recovery of the species through protection and management of:

- Existing forested habitat that supports known maternity populations, particularly those that would expand existing conservation ownerships;
- Known priority hibernacula; and
- Additional conservation lands that contain potential habitat for the species, particularly those that would expand existing conservation ownerships.

Based on this analysis, we conclude that the effects of the Action will not appreciably reduce the likelihood of both the survival and recovery of the northern long-eared bat.

7. TRICOLORED BAT

This section provides the Service's CO related to the effects of the Action on the tricolored bat.

7.1 Status of the Tricolored Bat

This section summarizes the best available data about the biology and current condition of the tricolored bat throughout its range that are relevant to formulating an opinion about the Action. The Service received a petition to list the tricolored bat as threatened on June 16, 2016. On December 20, 2017, the Service found that the petition presented substantial scientific or commercial information indicating that listing the species may be warranted and initiated a review (i.e., a 12-month listing finding) to determine if listing the species was warranted (82 C.F.R. 60362; December 20, 2017). On September 14, 2022, the Service posted a completed Species Status Assessment Report for the tricolored bat (USFWS 2021) and published a proposed rule to list the species as endangered.

7.1.1 Description of the Tricolored Bat

The tricolored bat is a temperate, insectivorous, often-migratory bat that hibernates in caves and mines in the winter and summers in forested areas. This species is one of the smallest bats in eastern North America and is distinguished by its unique tricolored fur that appears dark at the base, lighter in the middle, and dark at the tip (Barbour and Davis 1969, p. 115). Tricolored bats often appear yellowish (varying from pale yellow to nearly orange), but may also appear silvery-gray, chocolate brown, or black (Barbour and Davis 1969, p. 115). Males and females are colored alike, but females are consistently heavier than males (LaVal and LaVal 1980, p. 44). Newly volant young are much darker and grayer than adults (Allen 1921, p. 55). Other distinguishing characteristics include 34 teeth (compared with 38 teeth in eastern North American *Myotis* spp.), a calcar (i.e., spur of cartilage arising from the inner side of the ankle) with no keel, and fur on only the anterior third of the uropatagium (i.e., the membrane that stretches between the legs) (Barbour and Davis 1969, p. 115; Hamilton and Whitaker 1979, p. 85).

7.1.2 Life History of the Tricolored Bat

Prior to hibernation, males and females converge at cave and mine entrances between mid-August and mid-October to swarm and mate. Tricolored bats are one of the first cave-hibernating species to enter hibernation in the fall and one of the last to leave in the spring (LaVal and LaVal 1980, p. 29; Merritt 1987, p. 102). Tricolored bats hibernate in more caves and mines than any other cave-hibernating bat species in eastern North America (Sealander and Young 1955, pp. 23–24; Barbour and Davis 1969, p. 117; Brack et al. 2003, p. 65). Raesly and Gates (1987, p. 19) found tricolored bats hibernating in 80% of the 50 locations surveyed in Pennsylvania versus little brown bats, Indiana bats, northern long-eared bats, and big brown bats (*Eptesicus fuscus*), which were found in 56%, 16%, 16%, and 34% of potential hibernacula, respectively. Almost every cave in Indiana that has been surveyed for bats has contained at least one tricolored bat (Mumford and Whitaker 1982, pp. 167–168), and small numbers of the species have likely occupied most of Missouri's 6,400 caves (Perry 2021, pers. comm.). Prior to the arrival of WNS, hibernating tricolored bat colonies varied between one and 5,300 individuals. However, nearly 40% of hibernacula had between just one and 10 individuals.

In the southern U.S., hibernation length is shorter compared to northern portions of the range, and some individuals exhibit shorter periods of torpors and remain active and feed during the winter (Layne 1992, pp. 43–44; Grider et al. 2016, p. 8; Limon et al. 2018, p. 219; Newman 2020, pp. 13–17; Stevens et al. 2020, p. 528). The number of hibernating tricolored bats does not peak at caves and mines until December or later, suggesting some bats stay on the landscape or in alternate hibernacula and only move into caves and mines when it gets colder (Barbour and Davis 1969, p. 119; Vincent and Whitaker 2007, p. 61). In some cases, individuals may remain on the landscape and hibernate in rock shelters (e.g., fissures in sandstone and sedimentary rock) (Johnson 2021, pers. comm.).

In the spring, tricolored bats disperse from winter hibernacula to summer roosting habitat. Fraser et al. (2012, p. 5) concluded that at least some individuals engage in latitudinal migration that is more typically associated with hoary bats (*Lasiurus cinereus*), eastern red bats (*Lasiurus borealis*), and silver-haired bats (*Lasionycteris noctivagans*), and this behavior is more common for males than females. The maximum migration distance on record is for a female tricolored bat that migrated a straight-line distance of 243 km (151 miles) from her winter hibernaculum in southern Tennessee to a summer roost in Georgia (Samoray et al. 2019, p. 17). Other migration records between winter hibernacula and summer habitat include less than 80 km (50 miles) (Barbour and Davis 1969, p. 117), 44 km (27 miles) (Samoray et al. 2019, p. 18), and 137 km (85 miles) (Griffin 1940a, p. 237). Hibernaculum to hibernaculum movement up to 209 km (130 miles) has also been documented between two consecutive winters (Lutsch 2019, p. 38).

Female tricolored bats exhibit high site fidelity, returning year after year to the same summer roosting locations (Allen 1921, p. 54; Veilleux and Veilleux 2004a, p. 197). Adult females store sperm in their uterus during the winter, and fertilization occurs soon after spring emergence from hibernation (Guthrie 1933, p. 209). Females typically give birth to two young (rarely one or three) between May and July (Allen 1921, p. 55; Barbour and Davis 1969, p. 117; Cope and Humphrey 1972, p. 9). Young grow rapidly and begin to fly at three weeks of age and achieve adult-like flight and foraging ability at four weeks (Lane 1946, p. 59; Whitaker 1998, pp. 653–655).

Females form maternity colonies and switch roost trees regularly (e.g., between 1.2 days and 7 days at roost trees in Indiana) (Veilleux and Veilleux 2004a, p. 197; Quinn and Broders 2007, p. 19; Poissant et al. 2010, p. 374). Males roost singly (Perry and Thill 2007b, p. 977; Poissant et al. 2010, p. 374). Maternity colonies are typically small compared to other communal bat species. In Indiana, maternity colonies typically consist of one to eight (mean = 4.4) females and pups (Veilleux and Veilleux 2004b, p. 62). Perry and Thill (2007, p. 977) observed an average of 6.9 adult females and pups per colony in Arkansas (range of three to 13). In Nova Scotia, maternity colonies include up to 18 females (Poissant et al. 2010, p. 374). Whitaker (1998, p. 652) found colonies in buildings averaged 15 adult females (range of seven to 29 adult females).

Hoying and Kunz (1998, p. 19) reported the largest colony on record in a Massachusetts barn, which included 19 adult females and 37 young. Females often abandon maternity roosts soon after weaning, but young remain longer (Whitaker 1998, p. 653). Tricolored bats are considered juveniles (i.e., subadults) when entering their first hibernation, and most probably do not mate their first fall (Fujita and Kunz 1984, p. 3).

Tricolored bats are opportunistic feeders and consume small insects, including caddisflies (Trichoptera), flying moths (Lepidoptera), small beetles (Coleoptera), small wasps and flying ants (Hymenoptera), true bugs (Homoptera), and flies (Diptera) (Whitaker 1972, p. 879; LaVal and LaVal 1980, p. 24; Griffith and Gates 1985, p. 453; Hanttula and Valdez 2021, p. 132). The species emerges early in the evening and typically forages at treetop level or above (Davis and Mumford 1962, p. 397; Barbour and Davis 1969, p. 116) but may forage closer to the ground later in the evening (Mumford and Whitaker 1982, p. 170). Tricolored bats exhibit slow, erratic, fluttery flight while foraging (Fujita and Kunz 1984, p. 4) and commonly forage with eastern red bats and silver-haired bats (Davis and Mumford 1962, p. 397; Mumford and Whitaker 1982, p. 169). Individuals forage most commonly over waterways and forest edges (Barbour and Davis 1969, p. 116; Mumford and Whitaker 1982, pp. 170–171; Hein et al. 2009, p. 1204). Maximal distance traveled from roost areas to foraging grounds was 4.3 kilometers (2.7 miles) for reproductive (pregnant or lactating) adult females in Indiana (Veilleux et al. 2003, p. 1074) and 24.4 km (15.2 miles) for males in Tennessee (Thames 2020, p. 61).

7.1.3 Habitat Characteristics and Use of the Tricolored Bat

Winter Habitat

In the northern portion of the range, tricolored bats hibernate in caves and mines during the winter. Tricolored bats may use small caves and mines that are unsuitable to other cave-hibernating bat species (Barbour and Davis 1969, p. 117; Mumford and Whitaker 1982, p. 168; Hamilton and Whitaker 1979, p. 87). In the southern U.S. where caves are sparse, tricolored bats often hibernate in road-associated culverts (Sandel et al. 2001, p. 174; Katzenmeyer 2016, p. 32; Limon et al. 2018, entire; Bernard et al. 2019, p. 5; Lutsch 2019, p. 23; Meierhofer et al. 2019, p. 1276), as well as tree cavities (Newman 2020, p. 14) and abandoned water wells (Sasse et al. 2011, p. 126). The species exhibits high site fidelity, with many individuals returning year after year to the same hibernaculum (Davis 1966, p. 385; Jones and Pagels 1968, p. 137; Jones and Suttkus 1973, p. 964; Sandel et al. 2001, p. 175).

Tricolored bats are often found hibernating at warmer locations within caves and mines compared to other cave-hibernating bat species (Barbour and Davis 1969, p. 119; Raesly and Gates 1987, p. 17). At caves and mines in Pennsylvania, Maryland, and West Virginia, the species was observed hibernating at a mean temperature of 51.6 degrees Fahrenheit (10.9 degrees Celsius) (Raesly and Gates 1987, p. 18). Tricolored bats are also found in areas of caves and mines with high humidity (e.g., 99%; Mohr 1976, p. 97) and were not observed in caves where relative humidity was below 80% (Ploskey and Sealander 1979, p. 72).

Hibernating individuals do not typically form large clusters and most commonly roost singly. Tricolored bats will also roost in pairs or small clusters of both sexes away from other bats (Hall 1962, p. 29; Barbour and Davis 1969, p. 117; Mumford and Whitaker 1982, p. 169; Raesly and

Gates 1987, p. 19; Briggler and Prather 2003, p. 408; Vincent and Whitaker 2007, p. 62). Tricolored bats roost on cave walls and ceilings and are rarely found in cave crevices (Mumford and Whitaker 1982, p. 169). Individuals will shift from one roost to another during the winter but arouse less frequently than other cave-hibernating bat species (Barbour and Davis 1969, p. 119; Mumford and Whitaker 1982, p. 169). Consequently, water beads will sometimes collect on their fur, making them appear almost white (Hamilton 1943, p. 86; Barbour and Davis 1969, p. 119). In road associated-culverts in the southern U.S., tricolored bats exhibit shorter periods of torpor and move within and between culverts throughout the winter (Anderson et al. undated).

<u>*Summer Habitat*</u>
Tricolored bats are a forest-dwelling species that can be found in a variety of predominantly deciduous forest vegetation communities throughout their summer range. At the landscape scale, they are more abundant in highly forested landscapes with adequate connectivity and less abundant in open areas, such as predominantly urban and agricultural landscapes (Duchamp and Swihart 2009; Farrow and Broders 2011).

During the spring, summer, and fall, tricolored bats primarily roost among live and dead leaf clusters of live or recently dead deciduous hardwood trees (Veilleux et al. 2003, p. 1071; Perry and Thill 2007b, pp. 976–977; Thames 2020, p. 32). In the southern and far northern portions of the range, individuals will also roost in Spanish moss (*Tillandsia usneoides*) and *Usnea trichodea* lichen, respectively (Davis and Mumford 1962, p. 395; Poissant 2009, p. 36; Poissant et al. 2010, p. 374). Tricolored bats have also been observed roosting among pine needles (Perry and Thill 2007b, p. 977), in eastern red cedars (*Juniperus virginiana*) (Thames 2020, p. 32), within artificial roosts (e.g., barns, beneath porch roofs, bridges, concrete bunkers) (Jones and Pagels 1968, entire; Barbour and Davis 1969, p. 116; Jones and Suttkus 1973, entire; Hamilton and Whitaker 1979, p. 87; Mumford and Whitaker 1982, p. 169; Whitaker 1998, p. 652; Feldhamer et al. 2003, p. 109; Ferrara and Leberg 2005, p. 731; Smith 2020, pers. comm.), and, rarely, within caves (Humphrey et al. 1976, p. 367; Briggler and Prather 2003 p. 408; Damm and Geluso 2008, p. 384).

7.1.4 Numbers, Reproduction, and Distribution of the Tricolored Bat

The tricolored bat is known from 39 states, including Alabama, Arkansas, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, Wisconsin, West Virginia, and Wyoming, as well as Washington D.C. The species current distribution in New Mexico, Colorado, Wyoming, South Dakota, Texas, and the Great Basin is the result of westward range expansion in recent decades (Geluso et al. 2005, p. 406; Kurta et al. 2007, p. 405; Slider and Kurta 2011, p. 380; Adams et al. 2018, entire; Hanttula and Valdez 2021, p. 132;). This expansion is largely attributed to increases in trees along rivers and increases in suitable winter roosting sites, such as abandoned mines and other human-made structures (Benedict et al. 2000, p. 77; Geluso et al. 2005, p. 406; Slider and Kurta 2011, p. 380). The species is also known from four Canadian provinces (Ontario, Quebec, New Brunswick, Nova Scotia) and the countries of Guatemala, Honduras, Belize, Nicaragua, and Mexico.

Prior to the onset of WNS, tricolored bats were highly abundant and widespread throughout their range. The Service estimates that there were over 140,000 bats observed during hibernacula surveys of 1,951 wintering sites prior to WNS. Tricolored bat occurrence varied spatially and temporally; however, overall abundance on the landscape was stable (Cheng et al. 2021; Wiens et al. 2022). Available evidence from both winter and summer data indicates that tricolored bat abundance has and will continue to decline substantially over the next 10 years under current conditions. Range-wide winter abundance has declined by 52%, and the number of extant winter colonies has declined by 29% since 2000. There has also been a noticeable shift towards smaller winter colony sizes. The magnitude of winter declines, although widespread, varies spatially. The largest decline has been in the northeastern U.S. (89%) where WNS was first discovered, followed by northern states and Canadian providences (57% decline). The southern portion of the range has seen only a 24% decline.

Summer occurrence and abundance data also show a declining trend for tricolored bats. Stratton and Irvine (2022) found that range-wide occupancy declined by 28% from 2010-2019. Similarly, Whitby et al. (2022) analyzed range-wide mobile acoustic data and found a 53% decline from data collected between 2009-2019. Finally, Deeley and Ford (2022) observed a significant decline in mean capture rates from 1999 to 2019 across the species' range.

7.1.5 Conservation Needs of and Threats to the Tricolored Bat

White-nose Syndrome

For over a decade, WNS has been the foremost stressor on the tricolored bat. WNS is a disease of bats that is caused by the fungal pathogen Pd (Blehert et al. 2009, entire; Turner and Reeder 2009, entire; Lorch et al. 2011, entire; Coleman and Reichard 2014, entire; Frick et al. 2017, entire; Bernard et al. 2020, entire; Hoyt et al. 2021, entire). The effect of WNS has been extreme, such that most summer and winter colonies experienced severe declines following its arrival. Just four years after the discovery of WNS, Turner et al. (2011, pp. 18–19) estimated that the species experienced a 75% decline in winter counts across 42 sites in Vermont, New York, and Pennsylvania. Similarly, Frick et al. (2015, p. 5) estimated the arrival of WNS led to a 10–fold decrease in tricolored bat colony size. Most recently, Cheng et al. (2021, p. 7) used data from 27 states and two provinces to conclude WNS caused estimated population declines of 90–100% across 59% of the species' range. Although variation exists among sites, an overwhelming majority of hibernating colonies have developed WNS and experienced serious impacts within two to three years after its arrival (Cheng et al. 2021, p. 8; Wiens et al. 2022, pp. 231–247).

Pd has also been detected in culverts where tricolored bat colonies hibernate in the southern U.S.; however, WNS-induced mortality has not been documented in these hibernacula (Cross 2019). Regardless, most bat colonies exposed to Pd have developed and are expected to continue to develop WNS and experience impacts from the disease (Cheng et al. 2021, Appendix S3; Wiens et al. 2022, pp. 231–247). To date, there are no proven measures to reduce the severity of impacts from WNS.

Wind Related Mortality
Wind related mortality, although overshadowed by the disproportionate impacts of WNS on tree bats, is also proving to be a consequential stressor to tricolored bats. There is notable spatial overlap between tricolored bat occurrences and wind facilities, and tricolored bat mortality has been documented at wind turbines. Based on October 2020 installed wind energy capacity (Hoen et al. 2018, entire; USFWS unpublished data), the Service estimates that 3,227 tricolored bats are killed annually at wind facilities (Udell et al. 2022, pp. 265–266). Analyses using data from Wiens et al. (2022, pp 236–247) and analyses by Whitby et al. (2022, entire) suggest that the impact of wind related mortality is discernible in the ongoing decline of the species. "Feathering" (i.e., pitching turbine blades parallel with the prevailing wind direction to slow rotation speeds) turbine blades at low wind speeds has been used to reduce bat fatalities; however, the effectiveness of curtailment at reducing fatality rates for the tricolored bat has not been documented.

Climate Change
The risk of exposure to changes in the climate is range-wide for the tricolored bat. However, the magnitude, direction, and seasonality of climate variable changes is not consistent range-wide. Although there may be some benefit to the species from a changing climate, negative impacts are anticipated overall. Although we lack species-specific observations for the tricolored bat, observed impacts to the little brown bat include reduced reproduction during drought conditions (Adams 2010, pp. 2440–2442) and reduced adult survival during dry years in the Northeast (Frick et al. 2010, pp. 131–133). While sufficient moisture is important, too much precipitation during the spring can also result in negative consequences to insectivorous bats. Heavier precipitation events may lead to decreased insect availability and reduced echolocation ability (Geipel et al. 2019, p. 4), resulting in decreased foraging success. Precipitation also wets bat fur, reducing its insulating value (Webb and King 1984, p. 190; Burles et al. 2009, p. 132) and increasing a bat's metabolic rate (Voigt et al. 2011, pp. 794–795). Bats are likely to reduce their foraging excursions during heavy rain events, and reduced reproduction has been observed during cooler, wetter springs in the Northwest (Grindal et al. 1992, pp. 342–343; Burles et al. 2009, p. 136). Responses to climate change by the tricolored bat will vary throughout its range based on the extent of annual temperature rise in the future.

Habitat Loss
As previously discussed, tricolored bats require suitable roosting, foraging, and commuting habitat during the spring, summer, and fall. Loss of these habitats influences the survival and reproduction of the species. As referenced in the Service's Species Status Assessment for the tricolored bat (USFWS 2021), National Land Cover Database data from 2006 to 2016 shows that deciduous forest landcover decreased across all tricolored bat representation units (RPUs) (e.g., Eastern, Northern, and Southern) by 1.9 million acres, for an average loss of 190,000 acres per year. Other cover types that provide foraging opportunities, such as emergent wetland cover types, also decreased across all RPUs by 1.7 million acres. These changes in landcover may be associated with losses of suitable roosting or foraging habitat, longer flights between suitable roosting and foraging habitats due to habitat fragmentation, fragmentation of maternity colonies, and direct injury or mortality. Impacts from forest habitat removal may range from minor (e.g., removal of a small portion of foraging habitat in unfragmented forested area with a robust population) to significant (e.g., removal of roosting habitat in highly fragmented landscape with

small, disconnected population). Adverse impacts are more likely in areas with little forest or highly fragmented forests (e.g., western U.S. and central Midwestern states), as there is a higher probability of removing roosts or causing loss of connectivity between roosting and foraging habitat.

The complete loss of or modification of winter roosts (such that the site is no longer suitable) can result in impacts at both the individual and population levels. In addition, disturbance within a hibernaculum can render a site unsuitable or can pose harm to individuals using the site. Modifications to bat hibernacula can alter the ability of bats to access the site (Spanjer and Fenton 2005, p. 1110) or affect the airflow and microclimate of the subterranean habitat, affecting the ability of the cave or mine to support hibernating bats. In addition, bats present during any excavation or filling could be crushed or suffocated. Human entry or other disturbance to hibernating bats results in additional arousals from hibernation, which require an increase in total energy expenditure at a time when bats are relying on fat reserves. This is even more important for sites impacted by WNS, as more frequent arousals from torpor increases the probability of mortality in bats with limited fat stores (Boyles and Willis 2009).

7.2 Environmental Baseline for the Tricolored Bat

In accordance with 50 CFR 402.02, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the Action Area, without the consequences to the listed species or designated critical habitat caused by the Action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

7.2.1 Action Area Numbers, Reproduction, and Distribution of the Tricolored Bat

The Service is using the best available data to estimate the status of the tricolored bat within the Action Area. These estimations are specific to the timeframes listed below. The timeframes represent when the Service considers the species to be present in a certain habitat type during specific periods of its life cycle in Kentucky (USFWS 2016). In the absence of data (i.e., recent survey results) for the species in the Action Area, we make certain assumptions based on the habitat in and around the Action Area, available past survey data, and our knowledge of the biology of the species.

Winter Hibernation (November 16 – March 31)
The Winter Hibernation section for the Indiana bat contains a detailed summary of the winter bat habitat assessment that was performed by Stantec to evaluate the Action Area for known and potential hibernacula for the listed bat species covered in this BO/CO. One tricolored bat hibernaculum (Spalding Cave) is known to exist near the Action Area, and the presence of tricolored bats was documented in Spalding Cave by Service biologists in 2016 (USFWS,

unpublished data, 2016). Spalding Cave is not located within the Action Area, but the tricolored bat swarming buffer for this hibernaculum overlaps a portion of the Action Area and MDL (Figure 8). Additional details on the Spring Staging and Fall Swarming habitat related to Spalding Cave are found in the sections related to those topics below.

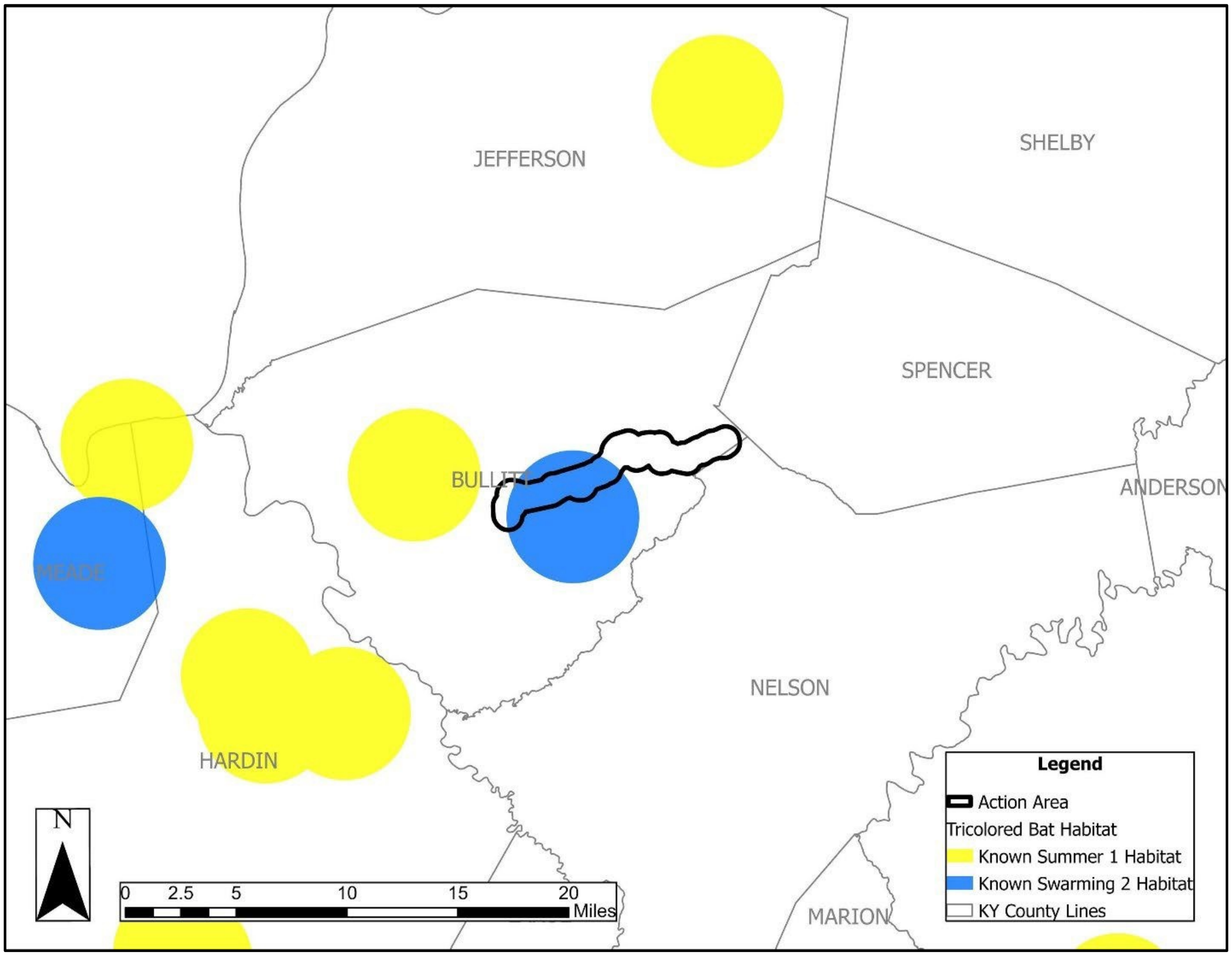

Figure 8: Proximity of the Action Area to known tricolored bat habitat.

Based on the findings of the winter bat habitat assessment and our review of other data related to the presence of known or potential hibernacula, the presence of a large, undocumented hibernaculum for the tricolored bat in the Action Area is considered unlikely based on the following factors:

- The Service does not have any records of known hibernacula located within the Action Area. The nearest known hibernaculum (Spalding Cave) for the tricolored bat is located approximately 0.75 mile from the Action Area.
- No potential hibernacula for the tricolored bat are present within the MDL, based on the results of the winter bat habitat assessment.
- The winter bat habitat assessment also did not identify any potential hibernacula or areas that could support complex cave systems during visual assessments of the Action Area

immediately outside the MDL or during surveys of areas outside the MDL where landowner access was allowed.

- Additional review of KGS karst maps and coal mine maps by the Service did not identify any potential hibernacula for this species in the MDL.
- A complex cave system, if present, is more likely to be found in the moderate and high karst potential areas in the central portion of the Action Area that corresponds with MP 2.5 to MP 7.5. However, this portion of the Action Area has been affected by extensive agricultural and residential development and inhabited by people for a long period of time, and no such cave systems have been identified during surveys, in published records, or by the local population. Therefore, it unlikely that an undocumented complex cave system that could serve as a tricolored bat hibernaculum exists.

Although tricolored bats have been observed in greater numbers in hibernacula with stable temperatures representative of large, more complex caves (Briggler and Prather 2003, p. 411), the species may also use small caves and mines that are unsuitable to other cave-hibernating bat species (Barbour and Davis 1969, p. 117; Mumford and Whitaker 1982, p. 168; Hamilton and Whitaker 1979, p. 87). Based on the findings of the winter bat habitat assessment and our review of other data related to the presence of known or potential hibernacula, the presence of a small, undocumented hibernaculum for the tricolored bat in the Action Area is also considered unlikely based on the following factors:

- None of the small karst features evaluated during the winter bat habitat assessment were potentially suitable hibernacula for the tricolored bat. This included features in both MDL and Action Area.
- The only portion of the Action Area located within a zone of moderate to high karst potential is located between MP 0.0 and MP 7.5. The remainder of the Action Area is located within zones of low karst potential.
- While other sinkholes and other small karst features may be present or form in the Action Area, particularly within the central portion of the Action Area in areas of moderate to high karst potential, the information provided by the winter bat habitat assessment or otherwise available to us does not demonstrate that those karst features are likely to be suitable as hibernacula for the tricolored bat. To the contrary, the karst features are expected to be similar in size and origin (e.g., formed by minor areas of subsidence) to the features that were identified and evaluated during the winter bat habitat assessment, all of which were determined to be unsuitable as potential hibernacula.

Spring Staging (April 1 – May 14)
The Service uses a 0.8-kilometer (0.5-mile) radius buffer around tricolored bat hibernacula entrances to identify spring staging areas (USFWS 2016). The Action Area is not within the spring staging habitat buffer of the known tricolored bat hibernaculum at Spalding Cave, because the hibernaculum is 0.75 miles from the boundary of the Action Area; therefore, the Action Area does not contain spring staging habitat. The Service also considers it unlikely that unknown spring staging habitat for this species is present within the Action Area due to the lack of known hibernacula and low probability for undiscovered potential hibernacula discussed in the previous section. As a result, the Service does not believe that tricolored bats use the Action Area during spring staging.

Summer Roosting (April 1 – October 15)

The Service uses a 4.8-kilometer (three-mile) radius buffer around tricolored bat capture and acoustic detection records and a 2.4-kilometer (1.5-mile) radius buffer around known roost trees to identify known summer roosting habitat (USFWS 2016). The Action Area is not within the buffer of a known summer capture/detection or roosting record; therefore, the Action Area does not contain known summer roosting habitat for this species. The nearest known tricolored bat summer occurrence is a maternity colony record located approximately 3.75 miles from the Action Area boundary.

Due to the presence of suitable habitat for this species in the Action Area and presence of the species in the surrounding area, the Corps and the Service are reasonably certain that tricolored bats may occur throughout the Action Area. Because the Action Area is approximately 12 miles in length, we assume that two tricolored bat maternity colonies, each with a three-mile buffer radius (i.e., six-mile diameter), are present in the Action Area (Figure 9). These two buffers cover the entirety of the Action Area, with the exception of a small area near the Action Area boundary north of MP 6.5. This area contains approximately 28 acres, including 21 acres of agricultural land and seven acres of forested habitat that is likely suitable summer habitat for the tricolored bat. The forested habitat is located within a large forest block that is located within the home ranges of both assumed maternity colonies. Because this forested habitat is connected to other forested habitat in the colonies' home ranges and the remainder of the area is unforested, we believe this area would likely be part of the home range of one of these colonies and is unlikely to be part of a potential home range for a third maternity colony. We believe this is an overly conservative estimate of summer occupancy for the tricolored bat due to the low post-WNS numbers of the species and because other large, post-WNS aggregations of maternity colonies have not been documented in the area. Without additional information, we conservatively assume that some portion of the primary and secondary roost trees associated with these maternity colonies may occur within the 39.46 acres of forested habitat that is proposed for removal, and that the tricolored bats associated with these maternity colonies may use this habitat for foraging and commuting.

Tricolored bat maternity colonies are small and typically contain fewer individuals than other colonial-roosting bat species. Observations of colony size have ranged from a single adult female to up to 29 adult females (Veilleux and Veilleux 2004b, p. 62; Perry and Thill 2007b, p. 977; Poissant et al. 2010, p. 374; Whitaker 1998, p. 652; Hoying and Kunz 1998, p. 19), with the largest documented colonies found in buildings or other artificial structures (e.g., barn). Natural tree roosts typically contain small colonies (Perry and Thill 2007b, p. 62; Veilleux and Veilleux 2004b, p. 977) that range from an estimated one to seven females. Based on this information, the Service estimates that each maternity colony may consist of four adult females that will arrive in the Action Area in the spring after migrating from their hibernacula. The Service also estimates that each of these adult females will be pregnant and give birth to two juveniles each (eight total juveniles per maternity colony) in early June. Based on a sex ratio of 1:1 (female to male), the Service also estimates that four adult males correspond with each maternity colony and are expected to use the Action Area for roosting, foraging, and commuting. Therefore, the Service estimates that 16 tricolored bats per colony, or 32 individuals total for the two estimated colonies, are likely to utilize the Action Area between April 1 and August 15.

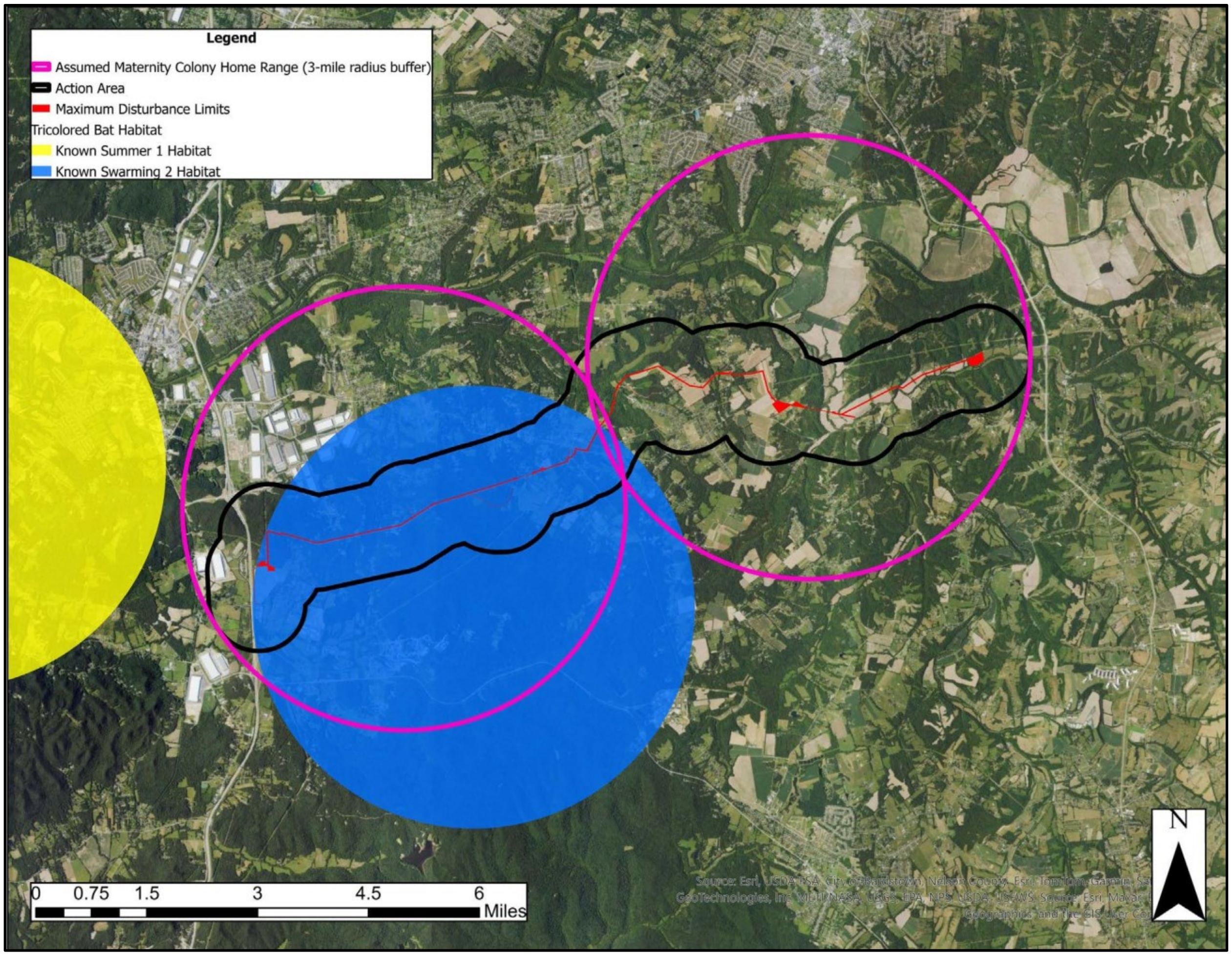

Figure 9: Assumed tricolored bat maternity colonies in the Action Area.

Fall Swarming (August 16 – November 15)

The Service estimates the fall swarming range for the tricolored bat as a 4.8-kilometer (three-mile) radius buffer around hibernacula entrances (USFWS 2016). A portion of the Action Area between MP 6.0 and MP 11.81 occurs within Known Swarming 2 habitat for the tricolored bat. Therefore, the Service assumes that tricolored bats are likely to utilize the that portion of the Action Area during fall swarming between August 16 and November 15. In 2016, the tricolored bat hibernaculum contained six tricolored bats (USFWS, unpublished survey data, 2016).

7.2.2 Action Area Conservation Needs of and Threats to the Tricolored Bat

Tricolored bats in the Action Area are likely exposed to the same threats that the species is exposed to across the range, as discussed in Section 7.1.5. Below are the two most pertinent to this consultation.

Habitat Loss

Forested habitat has been lost and degraded in the Action Area as a result of conversion to agricultural land and residential development. Impacts to forested habitat are expected to continue as urbanization and development from the greater Louisville metropolitan area encroach from the north.

White-nose Syndrome
WNS was first discovered in Kentucky in 2011 and has since spread across the state. Mortality at infected sites first became apparent in 2013, with an increase in observed mortality in 2014. Preliminary reports indicate that Pd and/or WNS has been detected in approximately 74% of caves surveyed in Kentucky (T. Hemberger, pers. comm. 2017); however, many of the caves without positive records have not been surveyed in recent years. Although the population and trend data following the arrival of WNS at Kentucky hibernacula is difficult to interpret, data are currently not showing the near or total loss of tricolored bat populations that has been documented in the northeastern United States.

Because tricolored bats can migrate hundreds of miles from their hibernacula and WNS has been documented from Kentucky and all of the adjacent states, we assume that all individuals that are known and assumed to occupy habitat within the Action Area have been exposed to WNS. Therefore, tricolored bats in the Action Area are expected to be experiencing stress and reduced body weights from their exposure to WNS.

7.3 Effects of the Action on the Tricolored Bat

In accordance with 50 CFR 402.02, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

The Service established additional requirements for making the determination of reasonably certain to occur (in effect since October 28, 2019) under 50 CFR 402 (see Federal Register :: Endangered and Threatened Wildlife and Plants; Regulations for Interagency Cooperation). After determining that the "activity is reasonably certain to occur," based on clear and substantial information, and using the best scientific and commercial data available, there must be another conclusion that the consequences of that activity are reasonably certain to occur. In this context, a conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available.

Based on the description of the Action, other activities caused by the Action, and the species' biology, we have identified four stressors (i.e., the alteration of the environment that is relevant to the species) to the tricolored bat that are reasonably certain to result from the Action: noise and vibration, artificial lighting, aquatic resource degradation, and tree removal. All of these stressors would occur during the construction component of the proposed Action. The operation and maintenance components are not expected to impact the tricolored bat because: (a) those components would occur after the construction component, which is when all suitable habitat will be removed in the MDL, and (b) the lack of stressors that would be reasonably certain to result in impacts to individuals or habitat in portions of the Action Area outside of the MDL.

Below we discuss the best available science relevant to each stressor, then describe the Stressor-Exposure-Response pathways that identify the circumstances for an individual bat's exposure to the stressor (i.e., the overlap in time and space between the stressor and a tricolored bat). Finally, we identify and consider how proposed conservation measures may reduce the severity of the stressor or the probability of an individual bat's exposure for each pathway.

7.3.1 Effects of Noise and Vibration on the Tricolored Bat

Tricolored bats may be exposed to noise and vibrations during the construction component of the Action.

Applicable Science

Bats exposed to noise and vibration may flush from their roosts. Bats that flush during the daytime are at greater risk of harm due to predation (Mikula et al. 2016). Additionally, bats that flush their roost(s) and/or avoid travel and foraging areas in response to this stressor may be harmed due to an increase in energy expenditure. Increased energy demands could have a significant effect on bats due to their low body mass. Because females require increased energy reserves during lactation (Kurta et al. 1989), an increased demand for energy in response to noise and vibrations could be especially detrimental to lactating females and, subsequently, their pups.

Information is lacking regarding the effects of noise on roosting tricolored bats; however, some data exists relating to the effects of noise on foraging behavior of other bats in the genus *Pipistrellus* (the tricolored bat was formerly known as *Pipistrellus subflavus*). Finch et al. 2020 found that the feeding behavior of *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus* was negatively affected by traffic noise. Another study showed that noise associated with an airport significantly affected the number of bat passes and feeding buzzes of Japanese pipistrelle bats (*Pipistrellus abramus*) near the runway (Wang et al. 2022). Additionally, as previously discussed for the Indiana bat, another tree-roosting bat that exhibits fidelity to roost trees and roosting areas, individuals can tolerate some level of noise and vibration, but novel noises may result in some changes to bat behaviors, such as flushing from roosts.

Effects Pathway #1	
Activity: Construction	
Stressor: Noise and Vibration	
Exposure (time)	Tricolored bats will be exposed to this stressor between April 1 and November 15, which corresponds with the occupancy timeframe of summer and fall swarming habitat.
Exposure (space)	Tricolored bats will be exposed to this stressor wherever they occur within the Action Area.
Resource affected	The stressor is expected to affect individual tricolored bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected tricolored bats, especially if noise and vibration exceed normal, ambient levels for the Action Area where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats while roosting, such as arousing during daylight hours, shifting within the roost, and increasing vocalizations, as well as minor shifts in use of foraging and commuting habitats while active at night. However, tricolored bats are also likely to experience the following potentially significant effects if the stressor causes bats to flush from their roosts: • Extra energy expenditure that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Increased chance of predation of individuals, especially if individuals flush during daylight hours when noise and vibration are most likely to occur during the construction component of the Action.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Blasting will not be used during excavation for pipeline installation, which will avoid and minimize the amount of noise and vibrations generated by the construction component of the Action. • Tree clearing will be targeted between November 15 and March 31 when forested habitats are unoccupied by tricolored bats, which would avoid direct impacts on tricolored bats.
Interpretation	The effects of increased noise and vibrations will be greatest prior to tree removal when bats may be roosting in trees immediately adjacent to noise- and/or vibration-producing activities and are more likely to flush from their roosts or alter their behavior. Construction activities that require heavy equipment and associated vehicles, personnel, and tools will be used at this time and are likely to produce noise and vibrations in the Action Area above ambient levels. These activities include the development and construction of temporary access roads and entrances, installation of erosion and sediment controls, tree and vegetation

Effects Pathway #1	
	removal, and pipeline installation. The noise and vibration associated with these activities may affect tricolored bats by causing individuals to alter their behaviors, which may be temporary or permanent. Significant changes in noise levels or significant increases in vibration above ambient levels are more likely to result in altered behaviors, such as flushing from roosts and avoidance of habitat areas that are close to noise or vibration sources. The novelty of the noise or vibrations and the relative level of those disturbances will also likely dictate the range of responses from individuals or colonies of tricolored bats. Flushing from roosts is expected to cause tricolored bats to: (a) expend extra energy that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles; (b) be subject to an increased chance of predation of individuals, especially if individuals flush during daylight hours when noise and vibration are most likely to occur during the construction component of the Action; and (c) increase the probability that adult females may abandon roosts and/or non-volant young if the event occurs during the non-volant period. These are adverse effects that are likely to result in harm to tricolored bats, including injury or mortality of individuals. Following tree removal, individuals roosting, foraging, and/or commuting in other portions of the Action Area outside the MDL would continue to be exposed to this stressor at variable levels that would decrease with distance from the MDL. Specifically, noise and vibration levels within portions of the Action Area outside the MDL are expected to be highest at locations closer to the point of origin within the MDL and diminish with increasing distance from the point of origin, due to the diminished effects of noise and vibration with distance from the source (i.e., the noise or vibration will be absorbed and typically become less loud or noticeable). Therefore, tricolored bats in the Action Area outside of the MDL are more likely to be affected if they are closer to the noise and vibration point of origin in the MDL and if the noise or vibration is significantly different than ambient levels (i.e., loud, repetitive, novel, etc.). Conversely, tricolored bats would be less likely to be affected by noise and vibration the farther they are from the point of origin in the MDL. However, the likelihood that adverse effects will not occur cannot be discounted, because flushing from a roost may still occur and result in the same adverse effects noted in the previous paragraph. Noise and vibration disturbances from personnel and vehicles in the MDL during certain aspects of the construction component that do not involve heavy equipment (e.g., land surveying) are expected to be similar to ambient levels in the Action Area. Based on the presence of

Effects Pathway #1	
	agricultural land, residential areas, roadways, utility ROWs, and other types of human development in the Action Area, noise and vibrations generated by people, vehicles, farm equipment, and other sources are currently occurring in the Action Area. Tricolored bats present within the Action Area are likely habituated to these noises and vibrations. The vehicles that will be used (e.g., light-duty trucks and UTVs) are similar to vehicles associated with the existing activities occurring in the Action Area and are expected to produce similar levels of noise and vibrations and may produce less noise and vibrations than some vehicles and equipment currently present in the Action Area (e.g., farm machinery, commercial trucks, lawnmowers, etc.). Personnel and vehicles will also be moving through the MDL during these activities and will not remain in one area for an extended period of time. Based on these factors, effects to tricolored bats from noise and vibrations associated with construction activities that do not involve heavy equipment are unlikely to occur or result in effects outside of the MDL and are considered discountable.
Effect	The effect of this stressor is Harm to affected tricolored bats, which can include physical injury to individuals and/or mortality of individuals.

7.3.2 Effects of Artificial Lighting on the Tricolored Bat

Use of artificial lighting may occasionally be necessary at some locations during pipeline installation to facilitate the project schedule. Such lighting events are most likely to occur in the early morning and evening hours during times of the year when daylight is minimized (e.g., the winter months) and may not occur all night. Any artificial lighting used during construction would be angled downward and inward towards the construction area and not directed vertically or at an angle that could illuminate roosting, foraging, and commuting habitat. However, depending on the location and intensity of artificial lighting in relation to bat habitat, some indirect lighting of habitat could occur that may cause tricolored bats to alter their behaviors if such lighting occurs when the species is present.

Applicable Science
Studies document highly variable responses among species to artificial lighting. Some bat species seem to benefit from artificial lighting, taking advantage of high densities of insects attracted to light (Jung and Kalko 2010); however, other species may avoid artificial light (Furlonger et al. 1987) or not be affected (Stone et al. 2012). Bats of the genus *Pipistrellus* have been observed foraging at streetlights and other artificial light sources (Blake et al. 1994; Rydell and Racey 1996), suggesting that tricolored bats may also be attracted to artificial lighting. However, the introduction of artificial lighting in areas where there is no existing lighting could cause delays in night bat activity (Stone et al. 2009; Downs et al. 2003).

Effects Pathway #2
Activity: Construction
Stressor: Artificial Lighting

Exposure (time)	Tricolored bats may be exposed to this stressor between April 1 and November 15, which corresponds with the occupancy timeframe of summer and fall swarming habitat.
Exposure (space)	Tricolored bats may be exposed to this stressor wherever they occur within the MDL.
Resource affected	The stressor is expected to affect individual tricolored bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses on affected tricolored bats, especially if the use of artificial lighting from the Action is novel or exceeds ambient levels for the area where aspects of the construction component are occurring. These include responses that are unlikely to result in significant effects, such as minor delays in initiating normal behaviors at night (e.g., leaving roosts) and minor shifts in use of foraging and commuting habitats while active at night. The Service has no data that would suggest that these minor behavioral shifts would result in increased visibility to predators that could increase the chance of predation on individuals or require extra energy expenditures that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Interpretation	The Service has no information that would clearly indicate that use of artificial lighting during the construction component of the Action is likely to result in significant adverse effects on tricolored bats. Use of artificial lighting is expected to be minimal, centralized to a specific location, and only affect a small portion of forested habitat within the Action Area. The available science indicates that tricolored bats may delay foraging and commuting and avoid areas where artificial lighting is used. However, tricolored bats are expected to be able to avoid illuminated areas with minimal effort and continue to forage and travel in other areas of nearby habitat. Tricolored bats can also utilize illuminated areas before or after lighting is used. Some studies suggest that they may be attracted to artificial lights due to increased density of insect prey items that are attracted to lights.
Effect	This stressor is expected to have an Insignificant effect on affected tricolored bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

7.3.3 Effects of Aquatic Resource Degradation on the Tricolored Bat

Aquatic resource degradation may occur during the construction component. The placement of culverts in streams and drainage ditches during construction of access roads and construction entrances could disturb sediment and negatively affect water quality. Trenching at stream crossings during pipeline installation will also result in sediment disturbance in the streams, and soil that is exposed during excavation and vegetation removal could enter streams through stormwater runoff. Spills and leaks of petroleum-based products and other contaminants from vehicles and heavy equipment could also enter streams and degrade water quality. Impacts to aquatic resources that occur in the MDL could also extend to portions of the Action Area downstream if run-off occurs. Activities that reduce the quantity or alter the quality of aquatic resources could affect tricolored bats, even if conducted while individuals are not present. However, LG&E will use BMPs in accordance with state permits and regulations to minimize the potential for aquatic resource degradation. Implementation of these practices is anticipated to avoid some potential water quality impacts and minimize others.

Applicable Science

Tricolored bats forage most commonly over waterways and forest edges (Mumford and Whitaker 1982, pp. 170–171; Hein et al. 2009, p. 1204) and are considered generalists, feeding on a variety of insects, including aquatic species such as caddisflies and stoneflies. Drinking water is essential, especially when bats actively forage, and tricolored bats obtain water from streams, ponds, and water-filled road ruts in forest uplands.

The negative impact of sedimentation on aquatic insect larvae and other aquatic macroinvertebrates is well-documented. In a literature review, Henley et al. (2000) summarized how stream sedimentation impacts these communities. Sediment suspended in the water column affects aquatic insect food sources by physically removing periphyton from substrate and reducing light available for primary production of phytoplankton, which are both sources of food for aquatic taxa and larvae. Sediment that settles out of the water column onto the substrate fills interstitial spaces occupied by certain taxa and larvae. Increases in sedimentation can change the composition of the insect and macroinvertebrate communities in a stream. In a three-year study measuring sedimentation and macroinvertebrate communities before, after, and during disturbance from a highway construction site, Hendrick (2008) found increased turbidity and total suspended solids downstream of the construction site that correlated with a shift in macroinvertebrate communities. The change, however, was not great; the Hilsenhoff Biotic Index decreased from "excellent" before construction to "good" after construction. The use of BMPs likely minimized the effects of the construction on the macroinvertebrate communities.

Effects Pathway #3	
Activity: Construction	
Stressor: Aquatic Resource Degradation (sedimentation)	
Exposure (time)	Tricolored bats may be exposed to this stressor between April 1 and November 15, which corresponds with the occupancy timeframe of summer and fall swarming habitat.
Exposure (space)	Foraging habitat in the Action Area consisting of streams and adjacent areas where aquatic insect prey may be located. Streams upstream of the MDL will not be exposed to this stressor.
Resource affected	The stressor is expected to affect foraging habitat, prey (aquatic insects), and individual tricolored bats, including adults and/or juveniles of both sexes.

Effects Pathway #3	
Individual response	The stressor is expected to cause a variety of potential responses by affected tricolored bats, especially if water quality is reduced in the Action Area where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of drinking water sources and foraging habitat while active at night. The Service has no data that would suggest that these minor behavioral shifts would require extra energy expenditures or reduce foraging efficiency that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • Use BMPs for sediment and erosion control in accordance with state permits and regulations during construction to avoid and minimize impacts within and outside the MDL. • Utilize HDD to avoid direct impacts to the perennial streams Cox Creek and Rocky Run to avoid impacts to drinking water and aquatic insects that may provide food for tricolored bats.
Interpretation	The Service has no information that would clearly indicate that potential aquatic resource degradation during the construction component of the Action is likely to result in significant adverse effects on tricolored bats. The effects of sedimentation on aquatic resources are expected to be minimal due to the temporary nature of the activity and implementation of the conservation measures. Drinking water sources and aquatic insect prey are not expected to be eliminated, and the species has shown that it can use a variety of drinking water and prey sources and does not forage exclusively on aquatic insect prey.
Effect	This stressor is expected to have an Insignificant effect on affected tricolored bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

7.3.4 Effects of Tree Removal on the Tricolored Bat

Tree removal during the construction component will result in the permanent loss of 39.46 acres of forested summer habitat (i.e., roosting, foraging, and commuting) for the tricolored bat. In addition, 26.38 acres of these 39.46 acres of habitat loss are within Known Swarming 2 habitat for the tricolored bat. Table 10 identifies the tree removal by bat habitat type and whether the tree removal is located within the Corps' jurisdictional area or outside the Corps' jurisdictional area.

Table 10. Amount of tree removal by tricolored bat habitat type.

Habitat Type	Tree Removal Total	Tree Removal in Corps' Jurisdictional Area	Tree Removal Outside Corps' Jurisdictional Area
Summer Habitat	39.46 acres	16.08 acres	23.38 acres
Known Swarming 2	26.38 acres	13.18 acres	13.20 acres

Habitat removal may occur during the summer occupancy (April 1 – October 15), fall swarming (August 16 – November 15), and hibernation (November 16 – March 31) timeframes (i.e., at any time of year) and will be scattered throughout the MDL (Appendix C). Tree removal will primarily occur along the edges of larger forest blocks and within linear forested corridors and will not result in the removal of any large blocks of habitat. The resulting open land will consist of a narrow gap through forest blocks and linear corridors ranging from 75 to 100 feet in width, and none of the remaining forested habitat is expected to be isolated as a result of the Action. The Service defines isolated as a break of more than 1,000 feet in wooded areas (USFWS 2011).

Applicable Science – Removal of Summer Habitat (Summer Occupancy Timeframe)
Risk of injury or death from being crushed when a tree is felled is most likely to impact non-volant young. Female tricolored bats have been observed carrying young from roosts during disturbance (Lane 1946); however, females may flush without young if the disturbance is abrupt and in close proximity to the roost. During high ambient temperatures, females appear to switch roost trees less often, use fewer roosts, and remain at roosts for longer periods (Veilleux et al. 2003), which may make them less likely to flush from a roost tree prior to felling. As previously discussed, the deaths of Indiana bat adults and non-volant young have been documented during the felling of maternity colony roost trees in Ohio and Indiana (John O. Whitaker, personal communication, 1986; Belwood 2002).

Effects Pathway #4	
Activity: Construction	
Stressor: Tree Removal, Removal of Summer Habitat (summer occupancy)	
Exposure (time)	Tricolored bats may be exposed to this stressor between April 1 and October 15, which corresponds with the occupancy timeframe of summer habitat.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect summer habitat (i.e., roost trees, foraging, and commuting habitat) and individual tricolored bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected tricolored bats from the loss of summer habitat in the MDL where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. However, tricolored bats are also likely to experience the following potentially significant effects from the stressor: • Bats struck by equipment or crushed by a felled tree will be injured or killed.

Effects Pathway #4	
	• Colony fragmentation could decrease thermoregulation and foraging efficiency that may reduce fitness and result in reduced survival/reproductive success. • Extra energy expenditure that may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Increased chance of predation of individuals, especially if individuals flush during daylight hours when roost tree removal and removal of summer habitat are most likely to occur during the construction component of the Action.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the tricolored bat from forested habitat removal. • Tree clearing will be targeted between November 15 and March 31 when forested habitats are unoccupied by tricolored bats.
Interpretation	Tree removal during the summer occupancy timeframe could result in death or injury to roosting tricolored bats that are crushed by a felled tree, especially non-volant juveniles. Those bats that survive or flush from felled trees will be exposed to increased levels of predation and expend extra energy to find another suitable roost. This energy expenditure is in addition to what is likely necessary for foraging, pup rearing, social interactions, and other activities. The use of additional energy in response to habitat loss, especially when combined with the energy needs associated with normal life cycle processes during the summer timeframe (e.g., migration, pregnancy, lactation, etc.) or other stressors (e.g., WNS), is likely to reduce fitness and subsequently reduce survival and reproductive success. These effects would be avoided (e.g., no individual mortality would occur) or reduced to some extent if all proposed tree removal does not occur during the summer occupancy timeframe.
Effect	The effect of this stressor is Harm to affected tricolored bats, which can include physical injury to individuals and/or mortality of individuals.

Applicable Science – Removal of Summer Habitat (Hibernation Timeframe)

Female tricolored bats exhibit high roost fidelity both within summers and between summers, returning year after year to the same roosting locations (Allen 1921, p. 54; Veilleux and Veilleux 2004a, p. 197). Evidence of fidelity to natal roost sites has been reported, with recaptured females documented returning to their place of birth in subsequent years (Hoying 1983; Perry 2011). Research has also shown that the roosting areas used by tricolored bats are relatively small (Vonhoff and Barclay 1996; Mager and Nelson 2001), suggesting that tree removal within these roosting areas could adversely affect returning individuals. A study in Indiana found that the average distance between roosts ranged from 19 to 139 meters (Veilleux et al. 2003). In Kentucky, the average distance between roosts was reported to be 86 meters (Schaefer 2017). Additionally, maternity colonies switch roost trees on average every 3.9 days (Whitaker 1998, Veilleux and Veilleux 2004a, p. 197; Quinn and Broders 2007, p. 19; Poissant et al. 2010, p. 374) and require an abundance of suitable roost trees within their roosting area.

Winter tree clearing that removes roosts and fragments colonies could harm tricolored bats by increasing stress, reducing opportunities to roost in thermally suitable microenvironments, and reducing benefits accrued from cooperating rearing of young. The likelihood that any winter tree clearing project is likely to take (e.g., "harm") an individual depends on: (1) the likelihood that the tree removal overlaps with an unknown tricolored bat colony roosting area; (2) the extent of tree (roost) removal; (3) the intensity of tree removal; (4) the availability of an alternative roosting area known to the colony; and (5) whether roosts are likely to be limiting after tree removal. Effects are further compounded for bats returning from hibernacula infected with WNS. Individuals surviving WNS have additional energetic demands. For example, WNS-affected bats have reduced fat reserves when they emerge from hibernation (Reeder et al. 2012; Warnecke et al. 2012). Many may also have wing damage (Reichard and Kunz 2009; Meteyer et al. 2009) that makes migration and foraging more challenging. Females that survive the migration to their summer habitat must partition energy resources between foraging, keeping warm, maintaining a successful pregnancy, rearing pups, and healing their own bodies.

Effects Pathway #5	
Activity: Construction	
Stressor: Tree Removal, Removal of Summer Habitat (hibernation)	
Exposure (time)	Tree removal will occur between November 16 and March 31 during the hibernation timeframe. Tricolored bats may be exposed to this stressor between April 1 and October 15 (summer occupancy timeframe) the first summer bats return after tree removal.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect summer habitat (i.e., roost trees, foraging, and commuting habitat) and individual tricolored bats, including adults and/or juveniles of both sexes.
Individual response	The stressor is expected to cause a variety of potential responses by affected tricolored bats from the loss of summer habitat in the MDL where the construction component previously occurred. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. However, tricolored bats are also likely to experience the following potentially significant effects from the stressor: • Extra energy expenditure to find new suitable roosts may reduce the fitness of individuals and result in reduced survival and/or reproductive success, especially for females and juveniles. • Colony fragmentation could decrease thermoregulation and foraging efficiency that may reduce fitness and result in reduced survival/reproductive success.

Effects Pathway #5	
	• Colony fragmentation will increase the chance of predation for individuals.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measure that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the tricolored bat from forested habitat removal.
Interpretation	Adult tricolored bats are expected to experience adverse effects after they arrive at summer habitat the first year after tree removal. The extra energy to find new roosting habitat is in addition to what is already necessary for foraging, pup rearing, social interactions, or other activities. The use of additional energy in response to habitat loss, especially when combined with the energy needs associated with normal life cycle processes during the summer timeframe (e.g., migration, pregnancy, lactation, etc.) or other stressors (e.g., WNS), is likely to result in adverse effects. However, tricolored bats are expected to adapt to this stressor in subsequent years after new suitable roosts and habitat are found.
Effect	The effect of this stressor is Harm to affected tricolored bats, which can include physical injury to individuals and/or mortality of individuals.

Applicable Science – Removal of Swarming Habitat (Fall Swarming Timeframe)

The risk of injury or death from being crushed when a tree is felled during the fall swarming timeframe is similar to the risk of tree felling during the summer occupancy timeframe, with the exception of impacts to non-volant young. Bats may enter torpor when roosting in trees during cooler weather associated with the fall and may be unable to arouse quickly enough to respond to the felling of their roost tree. As previously discussed, the deaths of Indiana bat adults have been documented during the felling of maternity colony roost trees in Ohio and Indiana (John O. Whitaker, personal communication, 1986; Belwood 2002).

Effects Pathway #6	
Activity: Construction	
Stressor: Tree Removal, Removal of Swarming Habitat (fall swarming)	
Exposure (time)	Tricolored bats may be exposed to this stressor between August 16 and November 15, which corresponds with the occupancy timeframe of fall swarming habitat.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect swarming habitat (i.e., roost trees, foraging, and commuting habitat) and individual tricolored bats, including adults of both sexes.

Effects Pathway #6	
Individual response	The stressor is expected to cause a variety of potential responses by affected tricolored bats from the loss of swarming habitat in the MDL where the construction component is occurring. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. However, tricolored bats are also likely to experience the following potentially significant effects from the stressor: • Bats struck by equipment or crushed by a felled tree will be injured or killed. • Increased effort to find new suitable roosting habitat may require extra energy expenditure that can reduce fitness and result in reduced survival/reproductive success.
Conservation Measures	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the tricolored bat from forested habitat removal. • Tree clearing will be targeted between November 15 and March 31 when forested habitats are unoccupied by tricolored bats.
Interpretation	Tree removal during the fall swarming timeframe could result in death or injury to roosting tricolored bats that are crushed by a felled tree. Those bats that survive or flush from felled trees will be exposed to increased levels of predation and expend extra energy to find another suitable roost. This energy expenditure is in addition to what is likely necessary for foraging, social interactions, and other activities. The use of additional energy in response to habitat loss, especially when combined with the energy needs associated with normal life cycle processes during the swarming timeframe (e.g., migration, accumulation of fat reserves, mating, etc.) or other stressors (e.g., WNS), is likely to reduce fitness and subsequently reduce survival and reproductive success. These effects would be avoided (e.g., no individual mortality would occur) or reduced to some extent if all proposed tree removal does not occur during the swarming timeframe.
Effect	The effect of this stressor is Harm to affected tricolored bats, which can include physical injury to individuals and/or mortality of individuals.

<u>Amount or Extent of Adverse Effects - Summer and Fall Swarming Habitats</u>

As stated previously in Section 7.2.1, we estimate that 16 tricolored bats (eight females and eight males) will arrive in the Action Area after hibernation to use the habitat for roosting, foraging, and commuting during the summer period. We also estimate that 16 juveniles will be born in the Action Area in June. Therefore, 32 tricolored bats are reasonably certain to be adversely affected by the 39.46 acres of tree removal associated with the summer habitat in the Action Area.

In addition, we estimate that the 26.38 acres of swarming habitat will affect six tricolored bats based on the most recent survey of Spalding Cave. These six bats are in addition to the 32 bats that may be present in summer habitat because the species can migrate long distances to hibernacula and we have no data showing that the tricolored bats that may be present in the Action Area in summer are the same tricolored bats that use the hibernaculum. Collectively, the Action will adversely affect 32 tricolored bats from summer habitat removal and six tricolored bats from swarming habitat removal, for a total of 38 tricolored bats.

In addition to the applicable science discussed above for removal of habitat during the summer occupancy, hibernation, and fall swarming timeframes, we also consider the applicable science for forest loss and fragmentation for our analysis of tree removal.

Applicable Science – Loss and Fragmentation of Forested Habitats
In addition to removal of roosting habitat, tree removal often results in the loss and fragmentation of forested habitats, potentially resulting in the degradation of tricolored bat foraging and commuting habitat. Patterson et al. (2003) noted that the mobility of bats allows them to exploit fragments of habitat. However, they cautioned that reliance on already diffuse resources (e.g., roost trees) leaves bats highly vulnerable, and that energetics may preclude the use of overly patchy habitats.

Tricolored bat maternity colonies have been shown to use the same roosting areas during subsequent years (Allen 1921, p. 54; Veilleux and Veilleux 2004a, p. 197). Bats using familiar roosting and foraging areas are thought to benefit from decreased susceptibility to predators, increased foraging efficiency, and the ability to switch roosts in case of emergencies or alterations surrounding the original roost (Gumbert et al. 2002). Conversely, bats that must use new or inferior habitats after a loss or alteration of their normal forested habitat would not have these same benefits.

Effects Pathway #7	
Activity: Construction	
Stressor: Tree Removal, Loss and Fragmentation of Forested Habitats	
Exposure (time)	Tree removal will be a one-time occurrence but may occur any time of year. Tricolored bats may be exposed to this stressor between April 1 and October 15 (summer occupancy timeframe) and/or August 16 to November 15 (fall swarming timeframe) the first season bats return after tree removal.
Exposure (space)	Forested habitat that is proposed for removal at various locations throughout the MDL.
Resource affected	The stressor is expected to affect summer and fall swarming habitat (i.e., foraging and commuting habitat) and individual tricolored bats, including adults and juveniles of both sexes.

Effects Pathway #7	
Individual response	The stressor is expected to cause a variety of potential responses by affected tricolored bats from the loss and fragmentation of summer and swarming habitat in the MDL where the construction component has occurred. These include responses that are unlikely to result in significant effects to bats, such as minor shifts in use of foraging and commuting habitats while active at night. The Service has no data that would suggest that these minor behavioral shifts would result in an increased chance of predation on individuals or require extra energy expenditures or reduce foraging efficiency that would reduce fitness and/or result in reduced survival and/or reproductive success of individuals.
Conservation Measure	Numerous conservation measures have been proposed by LG&E to avoid potential adverse effects on federally listed and proposed species. The conservation measures that would most directly apply and minimize effects related to this stressor are: • The proposed pipeline alignment was kept as close to existing utility corridors as possible to minimize impacts to the tricolored bat from forested habitat removal.
Interpretation	Tree removal will create or expand a narrow gap in forested habitat along the edges of larger forest blocks and within linear forested corridors and will not result in the removal of any large blocks of habitat. The largest, single area of forest habitat removal is 4.871 acres of habitat. The gap will consist of open land maintained as a utility ROW and will not contain any physical barriers that would prevent bats from crossing the gap. The gap is also not expected to make access to other forested habitat more difficult, require additional energy expenditure, or limit access to habitat. Existing gaps associated with other utility ROWs are present in the Action Area, and tricolored bats currently foraging and commuting in the Action Area are presumably unaffected by these gaps. Additionally, the gap may provide forest edge habitat that tricolored bats could use for foraging and commuting habitat. Individual tricolored bats that use the Action Area in the summer or fall after habitat removal are not reasonably certain to be harmed.
Effect	This stressor is expected to have an Insignificant effect on affected tricolored bats. No physical injury to individuals and/or mortality of individuals is expected to result from this stressor.

7.3.5 Summary of the Effects of the Action on the Tricolored Bat

The Action occurs within suitable summer and swarming habitat for the tricolored bat and could impact up to two maternity colonies. Impacts to tricolored bat habitat will occur during the construction phase of the Action. Stressors to the tricolored bat as a result of construction activities include: noise and vibration, artificial lighting, aquatic resource degradation, and tree removal (Table 11). This habitat removal could occur at any time year, including June and July when non-volant pups may be present. The habitat removal will occur in small patches within the MDL, and the 39.46 acres of habitat removal represents only 0.6% of the overall acreage of suitable tricolored bat habitat (6,736 acres) in the Action Area.

It is difficult to determine the number of individual tricolored bats that will be adversely affected during specific activities and timeframes and by the identified stressors. The Service has determined that the total number of tricolored bats adversely affected should be based on the presence of two maternity colonies, whose predicted home ranges would cover the Action Area. We estimate that 16 tricolored bats (eight females and eight males) will arrive in the Action Area after hibernation to use the habitat for roosting, foraging, and commuting. In addition, we estimate that 16 juveniles will be born in the Action Area in June. Therefore, 32 tricolored bats are reasonably certain to be adversely affected by the removal of 39.46 acres of summer habitat associated with the Action.

In addition, 26.38 acres of the 39.46 acres to be removed are swarming habitat for the tricolored bat. This swarming habitat is associated with Spalding Cave, which has been documented to contain six tricolored bats. Because the species can migrate long distances to hibernacula and because we have no data showing that the tricolored bats that may be present in summer habitat in the Action Area are the same tricolored bats that use the hibernaculum, we estimate that another six tricolored bats are reasonably certain to be adversely affected by the removal of 26.38 acres of swarming habitat in the Action Area.

Table 11. A summary of the effects of the Action on the tricolored bat.

Stressors: ***Activity***	**Adverse**	**Insignificant/ Discountable**
Noise and vibration: *construction*	harm	
Artificial lighting: *construction*		insignificant
Aquatic resource degradation, sedimentation: *construction*		insignificant
Tree removal, summer habitat (summer occupancy): *construction*	harm	
Tree removal, summer habitat (hibernation): *construction*	harm	
Tree removal, swarming habitat (fall swarming): *construction*	harm	
Tree removal, forest loss and fragmentation: *construction*		insignificant

7.4 Cumulative Effects on the Tricolored Bat

For purposes of consultation under ESA §7, cumulative effects are the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. No cumulative effects were identified by the Corps, and the Service has determined none are reasonably certain to occur.

7.5 Conclusion for the Tricolored Bat

In this section, we summarize and interpret the findings of the previous sections for the tricolored bat (status, baseline, effects, and cumulative effects) relative to the purpose of a CO under the ESA, which is to determine whether a Federal action is likely to jeopardize the continued existence of the species. We have considered the status of the species across its range, the status of the species within the Action Area, and the effects of the Action to the tricolored bat. In our effects analysis, we identified how tricolored bats would be adversely affected by the Action. We estimate that 32 tricolored bats that utilize summer habitat and six tricolored bats that utilize swarming habitat in the Action Area are likely to be adversely affected by the removal of forest habitat and will experience harm as a result of the Action. We believe this is an overly conservative estimate of the number of tricolored bats that may be affected by the Action, and we do not anticipate that all 38 tricolored bats will experience harm based on the following reasons:

- Injury and/or mortality of adult and juvenile tricolored bats will be reduced if some or all of the habitat removal occurs during the hibernation timeframe (November 16 – March 31) when bats will not be present in the Action Area.
- Injury and/or mortality of non-volant pups will be reduced if some or all of the habitat removal occurs outside the non-volant timeframe (May 15 – July 31).
- The avoidance of injury and mortality to adult and juvenile bats if some or all of the habitat removal occurs outside the fall swarming timeframe (August 16 – November 15).
- The minimal amount of summer habitat (39.46 acres) to be removed for the Action.
- The distribution of habitat removal over a 12-mile linear corridor.
- The small size of each area where habitat removal will occur. No single area exceeds five acres of habitat removal, and the majority of habitat removal areas are less than one acre in size.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action (including the effects of the Corps' and LG&E's Conservation Measures), and the absence of any cumulative effects, it is the Service's conference opinion that the Action is not likely to jeopardize the continued existence of the tricolored bat. We reached this determination based on the best available commercial and scientific information as described in our effects analysis in this CO and how those effects relate to the resiliency, redundancy, and representation of the tricolored bat, as described below:

- Resiliency describes the ability of a species to withstand stochastic disturbance (arising from random factors). Resiliency is positively related to population size, growth rate, and fecundity and may be influenced by connectivity among populations. Generally, populations need sufficient numbers of individuals within habitats of adequate area and quality to maintain survival and reproduction in spite of disturbance. Resilient populations are better able to withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), variations in rainfall (environmental stochasticity), or the effects of anthropogenic activities.

The range of the tricolored bat includes 39 states and the District of Columbia, portions of four Canadian provinces, and portions of Guatemala, Honduras, Belize, Nicaragua, and Mexico. The number of bats adversely affected by the Action would only be 38, and we do not expect mortality of all these individuals. The Action would also only affect an extremely small portion of the species range; therefore, the Action would adversely affect only a small proportion of the range-wide species' population. For these reasons, the Action will not reduce the resiliency of the tricolored bat.

- Redundancy describes the ability of a species to withstand catastrophic events (a rare destructive natural event or episode involving many populations). It "guards against irreplaceable loss of representation" (Redford et al. 2011, p. 42) and minimizes the effect of localized extirpation on the range-wide persistence of a species. Generally speaking, redundancy is best achieved by having multiple, resilient (connected) populations widely distributed across the species' range. Having multiple populations reduces the likelihood that all populations are affected simultaneously, while having widely distributed populations reduces the likelihood of populations possessing similar vulnerabilities to a catastrophic event. Given sufficient redundancy, single or multiple catastrophic events are unlikely to cause the extinction of a species. Therefore, as redundancy increases, species viability also increases.

  If habitat removal occurs in June or July, non-volant pups may be impacted, and mortality would be higher than at other times of the year. However, only two maternity colonies are expected to be impacted by the Action. This represents a very small proportion of the range-wide population, and thus, the redundancy of the tricolored bat will not be significantly reduced by the Action.

- Representation describes the ability of a species to adapt to changing environmental conditions over time and is characterized by the breadth of genetic and environmental diversity within and among populations. The more representation, or diversity, a species has, the more it is capable of adapting to changes (natural or human caused) in its environment. In the absence of species-specific genetic and ecological diversity information, we evaluate representation based on the extent and variability of habitat characteristics across the geographical range and other factors as appropriate.

  The overall acreage of forested habitat within the Action Area that is suitable tricolored bat habitat (6,736 acres) represents only a fraction of the suitable habitat within the range of the species. The 39.46 acres of suitable habitat that will be removed for the Action represents only 0.6% of the total habitat in the Action Area. Additionally, no reduction in the distribution of tricolored bats is expected because the Action Area will continue to support suitable habitat, and the species is expected to continue to occupy the Action Area after completion of the Action. For these reasons, we do not expect the representation of the tricolored bat to be reduced by the Action.

Based on this analysis, we conclude that the effects of the Action will not appreciably reduce the likelihood of both the survival and recovery of the tricolored bat.

8. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3(19)). In regulations, the Service further defines:

- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" (50 CFR §17.3) and
- "incidental take" as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant" (50 CFR §402.02).

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to a Federal agency action that would not violate ESA §7(a)(2) is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

This BO evaluated effects of the Action on the threatened Kentucky glade cress. ESA §7(b)(4) and §7(o)(2), which provide the authority for issuing an ITS, do not apply to listed plant species. However, ESA §9(a)(2) prohibits certain acts with respect to endangered plant species, including to:

(a) remove and reduce to possession from areas under Federal jurisdiction;
(b) maliciously damage or destroy on areas under Federal jurisdiction; and
(c) remove, cut, dig up, or damage or destroy on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law.

Regulations issued under ESA §4(d) extend the prohibition under (a) above to threatened plant species (50 CFR §17.71). The damage or destruction of endangered and threatened plants that is incidental to (i.e., not the purpose of) an otherwise lawful activity is not prohibited. Therefore, this ITS does not address Kentucky glade cress.

Due to the use of the *Process for Section 7 Consultations in Small Federal Handle Situations*, this ITS identifies the amount of take and reasonable and prudent measures (RPMs) within the Corps' jurisdictional area that the Corps must implement through its permits and those of the larger project outside of the Corps' jurisdictional area that must be implemented by LG&E. For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, the Corps and LG&E must undertake the non-discretionary measures described in their respective sections of this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. The Corps and LG&E have a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the Corps or LG&E fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of incidental take, the Corps and LG&E must report the progress of the Action and its impact on the species to the Service as specified in their respective sections of this ITS.

8.1 Amount or Extent of Take

This section specifies the amount or extent of take of the Indiana bat, northern long-eared bat, and tricolored bat that the Action is reasonably certain to cause.

8.1.1 Indiana Bat

Based on our evaluation, the proposed Action is reasonably certain to cause the incidental take of 540 individual Indiana bats. This taking is expected in the form of harm. The mechanisms of this taking and the basis for our estimation of its extent are described in Section 5.3 (Effects of the Action) of this BO.

Of the 39.46 acres of forested habitat to be impacted, 16.08 acres (40.8%) occur within the Corps' jurisdictional area. Assuming an even or proportional distribution of the species, as related to the Corps' jurisdictional area and areas outside the Corps' jurisdictional area, across the Action Area and because species occurrence data are not available, we believe that the incidental taking of 40.8% of the 540 Indiana bats impacted by the Action will occur within the Corps' jurisdictional area. The remainder of the incidental take will occur within the larger project outside the Corps' jurisdictional area. Incidental take for the Indiana bat is summarized in Table 12.

Table 12. Amount of incidental take of the Indiana bat caused by the Action.

Species	# of Individuals	Form of Take
Indiana bat	220 (Corps)	Harm (Tree Removal, Summer Habitat)
	320 (LG&E)	Harm (Tree Removal, Summer Habitat)

<u>Surrogate Measures for Monitoring</u>
The Service anticipates the incidental taking of Indiana bats associated with this project will be difficult to detect for the following reasons:

- The individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to find, capture, or observe;
- The Indiana bat forms maternity colonies under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- Finding dead or injured specimens during or following project implementation is unlikely; and
- Most incidental take is in the form of non-lethal harm and not directly observable.

When it is not practical to monitor take in terms of individuals of the listed species, the regulations at 50 CFR §402.14(i)(1)(i) indicate that an ITS may express the amount or extent of take using a surrogate (e.g., a similarly affected species, habitat, or ecological conditions), provided that the Service also:

- describes the causal link between the surrogate and take of the listed species; and
- sets a clear standard for determining when the level of anticipated take has been exceeded.

Due to the difficulty of detecting take of Indiana bats caused by the proposed Action, the Service has decided to monitor the extent of taking using the acreage of suitable habitat removed by the Action. This surrogate measure is appropriate because the majority of the anticipated taking will result from habitat removal/alteration and activities associated with that alteration, and because it sets a clear standard for determining when the extent of taking is exceeded. The level of take anticipated in this BO that is within the Corps' jurisdictional area and outside the Corps' jurisdictional area (i.e., attributable to LG&E) is included in Table 13. Instructions for monitoring and reporting take are provided in Section 8.4.

Table 13. Amount of suitable habitat removal by Indiana bat habitat type.

Habitat Type	Tree Removal Total	Tree Removal in Corps' Jurisdictional Area	Tree Removal Outside Corps' Jurisdictional Area
Summer Habitat (Potential)	13.19 acres	2.90 acres	10.29 acres
Known Summer 1	26.27 acres	13.18 acres	13.09 acres

8.1.2 Northern Long-eared Bat

Based on our evaluation, the proposed Action is reasonably certain to cause the incidental take of 540 individual northern long-eared bats. This taking is expected in the form of harm. The mechanisms of this taking and the basis for our estimation of its extent are described in Section 6.3 (Effects of the Action) of this BO.

Of the 39.46 acres of forested habitat to be impacted, 16.08 acres (40.8%) occur within the Corps' jurisdictional area. Assuming an even or proportional distribution of the species, as related to the Corps' jurisdictional area and areas outside the Corps' jurisdictional area, across the Action Area and because species occurrence data are not available, we believe that the incidental taking of 40.8% of the 540 northern long-eared bats impacted by the Action will occur within the Corps' jurisdictional area. The remainder of the incidental take will occur within the larger project outside the Corps' jurisdictional area. Incidental take for the northern long-eared bat is summarized in Table 14.

Table 14. Amount of incidental take of the northern-long eared bat caused by the Action.

Species	# of Individuals	Form of Take
Northern long-eared bat	220 (Corps)	Harm (Tree Removal, Summer Habitat)
	320 (LG&E)	Harm (Tree Removal, Summer Habitat)

Surrogate Measures for Monitoring
The Service anticipates the incidental taking of northern long-eared bats associated with this project will be difficult to detect for the following reasons:

- The individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to find, capture, or observe;
- The northern long-eared bat forms small maternity colonies under loose bark or in the cavities of trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- Finding dead or injured specimens during or following project implementation is unlikely; and
- Most incidental take is in the form of non-lethal harm and not directly observable.

When it is not practical to monitor take in terms of individuals of the listed species, the regulations at 50 CFR §402.14(i)(1)(i) indicate that an ITS may express the amount or extent of take using a surrogate (e.g., a similarly affected species, habitat, or ecological conditions), provided that the Service also:

- describes the causal link between the surrogate and take of the listed species; and
- sets a clear standard for determining when the level of anticipated take has been exceeded.

Due to the difficulty of detecting take of northern long-eared bats caused by the proposed Action, the Service has decided to monitor the extent of taking using the acreage of suitable habitat removed by the Action. This surrogate measure is appropriate because the majority of the anticipated taking will result from habitat removal/alteration and activities associated with that alteration, and because it sets a clear standard for determining when the extent of taking is exceeded. The level of take anticipated in this BO that is within the Corps' jurisdictional area and outside the Corps' jurisdictional area (i.e., attributable to LG&E) is included in Table 15. Instructions for monitoring and reporting take are provided in Section 8.4.

Table 15. Amount of suitable habitat removal by northern long-eared bat habitat type.

Habitat Type	Tree Removal Total	Tree Removal in Corps' Jurisdictional Area	Tree Removal Outside Corps' Jurisdictional Area
Summer Habitat (Potential)	16.25 acres	4.31 acres	11.94 acres
Known Summer 1	23.21 acres	11.77 acres	11.44 acres

8.1.3 Tricolored Bat

Based on our evaluation, the proposed Action is reasonably certain to cause the incidental take of 38 individual tricolored bats. This taking is expected in the form of harm. The mechanisms of this taking and the basis for our estimation of its extent are described in Section 7.3 (Effects of the Action) of this CO.

Of the 39.46 acres of forested habitat to be impacted, 16.08 acres (40.8%) occur within the Corps' jurisdictional area. Assuming an even or proportional distribution of the species, as related to the Corps' jurisdictional area and areas outside the Corps' jurisdictional area, across the Action Area and because species occurrence data are not available, we believe that the incidental taking of 40.8% of the 32 tricolored bats impacted by the Action will occur within the Corps' jurisdictional area. The remainder of the incidental take will occur within the larger project outside the Corps' jurisdictional area.

Of the 26.38 acres of forested habitat within Known Swarming 2 habitat to be impacted, 13.18 acres occur within the Corps' jurisdictional area. Assuming an even or proportional distribution of the species, as related to the Corps' jurisdictional area and areas outside the Corps' jurisdictional area, across the swarming habitat in the Action Area, we believe that the incidental taking of 50% of the six tricolored bats associated with swarming habitat impacted by the Action will occur within the Corps' jurisdictional area. The remainder of the incidental take will occur within the larger project outside the Corps' jurisdictional area. Incidental take for the northern long-eared bat is summarized in Table 16.

Table 16. Amount of incidental take of the tricolored bat caused by the Action.

Species	# of Individuals	Form of Take
Tricolored bat	13 (Corps)	Harm (Tree Removal, Summer Habitat)
	19 (LG&E)	Harm (Tree Removal, Summer Habitat)
	3 (Corps)	Harm (Tree Removal, Swarming Habitat)
	3 (LG&E)	Harm (Tree Removal, Swarming Habitat)

Surrogate Measures for Monitoring

The Service anticipates the incidental taking of tricolored bats associated with this project will be difficult to detect for the following reasons:

- The individuals are small, mostly nocturnal, and when not hibernating, occupy forested habitats where they are difficult to find, capture, or observe;
- The tricolored bat forms small maternity colonies in leaf clusters of live or dead trees, and males and non-reproductive females may roost individually, which makes finding roost trees difficult;
- Finding dead or injured specimens during or following project implementation is unlikely; and
- Most incidental take is in the form of non-lethal harm and not directly observable.

When it is not practical to monitor take in terms of individuals of the listed species, the regulations at 50 CFR §402.14(i)(1)(i) indicate that an ITS may express the amount or extent of take using a surrogate (e.g., a similarly affected species, habitat, or ecological conditions), provided that the Service also:

- describes the causal link between the surrogate and take of the listed species; and
- sets a clear standard for determining when the level of anticipated take has been exceeded.

Due to the difficulty of detecting take of tricolored bats caused by the proposed Action, the Service has decided to monitor the extent of taking using the acreage of suitable habitat removed by the Action. This surrogate measure is appropriate because the anticipated taking will result from habitat removal/alteration and activities associated with that alteration, and because it sets a clear standard for determining when the extent of taking is exceeded. The level of take anticipated in this CO that is within the Corps' jurisdictional area is 16.08 acres of suitable roosting, foraging, and commuting habitat. The remaining level of take anticipated in this BO is 23.38 acres of suitable roosting, foraging, and commuting habitat, which is attributable to LG&E. Since the take associated with the removal of swarming habitat overlaps with the acreage of tree removal associated with summer habitat, no additional monitoring is necessary for the take associated with swarming habitat. Instructions for monitoring and reporting take are provided in Section 8.4.

8.2 Reasonable and Prudent Measures

The Service believes the reasonable and prudent measures (RPMs) we describe in this section for the Indiana bat, northern long-eared bat, and tricolored bat are necessary and appropriate to minimize the impact (i.e., the amount or extent) of incidental take caused by the Action.

RPM #1. KARST FEATURES: Any karst feature or void that is discovered or forms during construction within the MDL will be inspected to determine if the feature could be a potential hibernaculum for the Indiana bat, northern long-eared bat, or tricolored bat.

For the tricolored bat, the prohibitions against taking the species found in section 9 of the Act do not apply until the species is listed. However, the Service advises the Corps to consider implementing RPM #1 for the tricolored bat. If the CO for this species is adopted as a BO following a listing or designation, these measures, along with their implementing terms and conditions, will be nondiscretionary.

8.3 Terms and Conditions

In order for the exemption from the take prohibitions of §9(a)(1) and of regulations issued under §4(d) of the ESA to apply to the Action, the Corps and LG&E must comply with the terms and conditions (T&Cs) of this statement, provided below, which carry out the RPMs described in the previous section. These T&Cs are mandatory. Below we identify the T&C responsibilities of the Corps and LG&E.

8.3.1 U.S. Army Corps of Engineers

As necessary and appropriate to fulfill this responsibility, the Corps must require any permittee, contractor, or grantee to implement the T&Cs that apply to Action activities under its jurisdiction through enforceable terms that the Corps includes in the permit, contract, or grant document.

T&C #1 (RPM #1). KARST FEATURES: A visual inspection of any karst feature that is discovered or forms during construction within the MDL shall occur immediately after discovery and prior to the continuation of any activities that could potentially impact the karst feature. If the feature is determined to be located entirely underground and has a visible termination point(s), the feature would not meet the criteria for a potential hibernaculum, and no further assessment of the feature is required. If the feature does not have a visible termination point(s) and/or contains an opening or connection to the ground surface, the Service and the Corps shall be notified. The Service or a qualified biologist shall then assess the feature to determine if it meets the criteria for a potential hibernaculum according to the Service's *Range-Wide Indiana Bat and Northern Long-eared Bat Survey Guidelines*.

8.3.2 Louisville Gas & Electric

As necessary and appropriate to fulfill this responsibility, LG&E must implement, or ensure that any agent or contractor implement, the T&Cs that apply to Action activities that are not under the Corps' jurisdiction.

T&C #1 (RPM #1). KARST FEATURES: A visual inspection of any karst feature that is discovered or forms during construction within the MDL shall occur immediately after discovery and prior to the continuation of any activities that could potentially impact the karst feature. If the feature is determined to be located entirely underground and has a visible termination point(s), the feature would not meet the criteria for a potential hibernaculum, and no further assessment of the feature is required. If the feature does not have a visible termination point(s) and/or contains an opening or connection to the ground surface, the Service and the Corps shall be notified. The Service or a qualified biologist shall then assess the feature to determine if it meets the criteria for a potential hibernaculum according to the Service's *Range-Wide Indiana Bat and Northern Long-eared Bat Survey Guidelines*.

8.4 Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the Corps and LG&E must report the progress of the Action and its impact on the species to the Service as specified in the ITS (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting (M&R), including procedures for handling and disposing of any individuals of a species actually killed or injured. These M&R requirements are mandatory. Below we identify the M&R responsibilities of the Corps and LG&E.

8.4.1 U.S. Army Corps of Engineers

As necessary and appropriate to fulfill their M&R responsibility, the Corps must require any permittee, contractor, or grantee to accomplish the M&R through enforceable terms that the Corps includes in the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the Corps and the Service if the amount or extent of incidental take specified in this ITS is exceeded during implementation of the Action.

M&R #1. HABITAT REMOVAL: Beginning with the start of construction, the Corps will submit a ledger to the Service reporting on the amount of forested habitat removal that occurred in the portions of the MDL within the Corps' jurisdictional area during the timeframe for each habitat type [e.g., November 16 – March 31 (hibernation), April 1 – October 15 (summer occupancy), October 16 – November 15 (fall swarming)]. Due to the overlap between the end of the summer occupancy period and the beginning of the fall swarming period, forested habitat removal between August 16 and October 15 will be included in the summer occupancy ledger. Ledgers are due 30 days after the end of the habitat type timeframe (e.g., April 30, November 15, December 15). These ledgers must clearly state: (1) the acreage of habitat removed, (2) the dates of removal, (3) the mitigation multiplier applied per the 2016 Conservation Strategy, and (4) the appropriate contribution amount for the Imperiled Bat Conservation Fund. If the Corps delegates this responsibility to LG&E, a single project ledger for the Action may be submitted by LG&E that clearly identifies the Corps' and LG&E's portions of the habitat removed. Reporting may cease once all forested habitat removal has been completed.

M&R #2. IBCF CONTRIBUTION: The Corps will provide a receipt for the IBCF contribution for each ledger referenced in M&R #1 within 30 days of submission of the ledger to the Service. If the Corps delegates this responsibility to LG&E, a single receipt for the quarter may be submitted by LG&E.

8.4.2 Louisville Gas & Electric

As necessary and appropriate to fulfill their M&R responsibility, LG&E must require any permittee, contractor, or grantee to accomplish the M&R through enforceable terms LG&E includes in the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify LG&E, the Corps, and the Service if the amount or extent of incidental take specified in this ITS is exceeded during implementation of the Action.

M&R #1. HABITAT REMOVAL: Beginning with the start of construction, LG&E will submit a ledger to the Service reporting on the amount of forested habitat removal that occurred in the portions of the MDL outside the Corps' jurisdictional area during the timeframe for each bat habitat type [e.g., November 16 – March 31 (hibernation), April 1 – October 15 (summer occupancy), October 16 – November 15 (fall swarming)]. Due to the overlap between the end of the summer occupancy period and the beginning of the fall swarming period, forested habitat removal between August 16 and October 15 will be included in the summer occupancy ledger. Ledgers are due 30 days after the end of the habitat type timeframe (e.g., April 30, November 15, December 15). These ledgers must clearly state: (1) the acreage of habitat removed, (2) the dates of removal, (3) the mitigation multiplier applied per the 2016 Conservation Strategy, and (4) the appropriate contribution amount for the Imperiled Bat Conservation Fund.

M&R #2. IBCF CONTRIBUTION: LG&E will provide a receipt for the IBCF contribution for each ledger referenced in M&R #1 within 30 days of submission of the ledger to the Service.

M&R #3.EXCEEDANCE: If the amount or extent of incidental take specified in this ITS is exceeded during Action implementation, LG&E must immediately notify the Corps and the Service.

Upon locating a dead, injured, or sick individual, initial notification shall be made to the Service. Care shall be taken in handling sick or injured individuals and in the preservation of specimens in the best possible condition for later analysis of cause of death or injury.

9. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the Corps and/or LG&E.

- Avoid tree removal during the active season, particularly June and July, where feasible, to minimize impacts to Indiana bat, northern long-eared bat, and tricolored bat maternity colonies.
- Clean construction equipment and vehicles prior to entering Kentucky glade cress areas to minimize potential spread of invasive plant species.

10. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the Corps retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the Corps is required to immediately request a reinitiation of formal consultation. This consultation was assigned FWS Project Code 2023-0052626. Please refer to this number in any correspondence concerning this consultation.

Formal conference for the Action considered in this BO is also concluded. The Corps may ask the Service to confirm the CO for the tricolored bat as a BO issued through formal consultation if the species is listed. The request must be in writing. If the Service reviews the proposed Action and finds that there have been no significant changes in the Action as planned or in the information used during the conference, the Service will confirm the CO for the tricolored bat as the BO for this species, and no further section 7 consultation will be necessary. After listing of the tricolored bat and any subsequent adoption of this CO, the Federal agency shall request reinitiation of consultation if any of the above reinitiation conditions are met.

The ITS provided in this CO does not become effective until the species is listed and the CO is adopted as the BO issued through formal consultation. At that time, the project will be reviewed to determine whether any take of the tricolored bat has occurred. Modifications of the opinion and ITS may be appropriate to reflect that take. No take of the tricolored bat may occur between the listing of the species and the adoption of the CO through formal consultation or the completion of a subsequent formal consultation.

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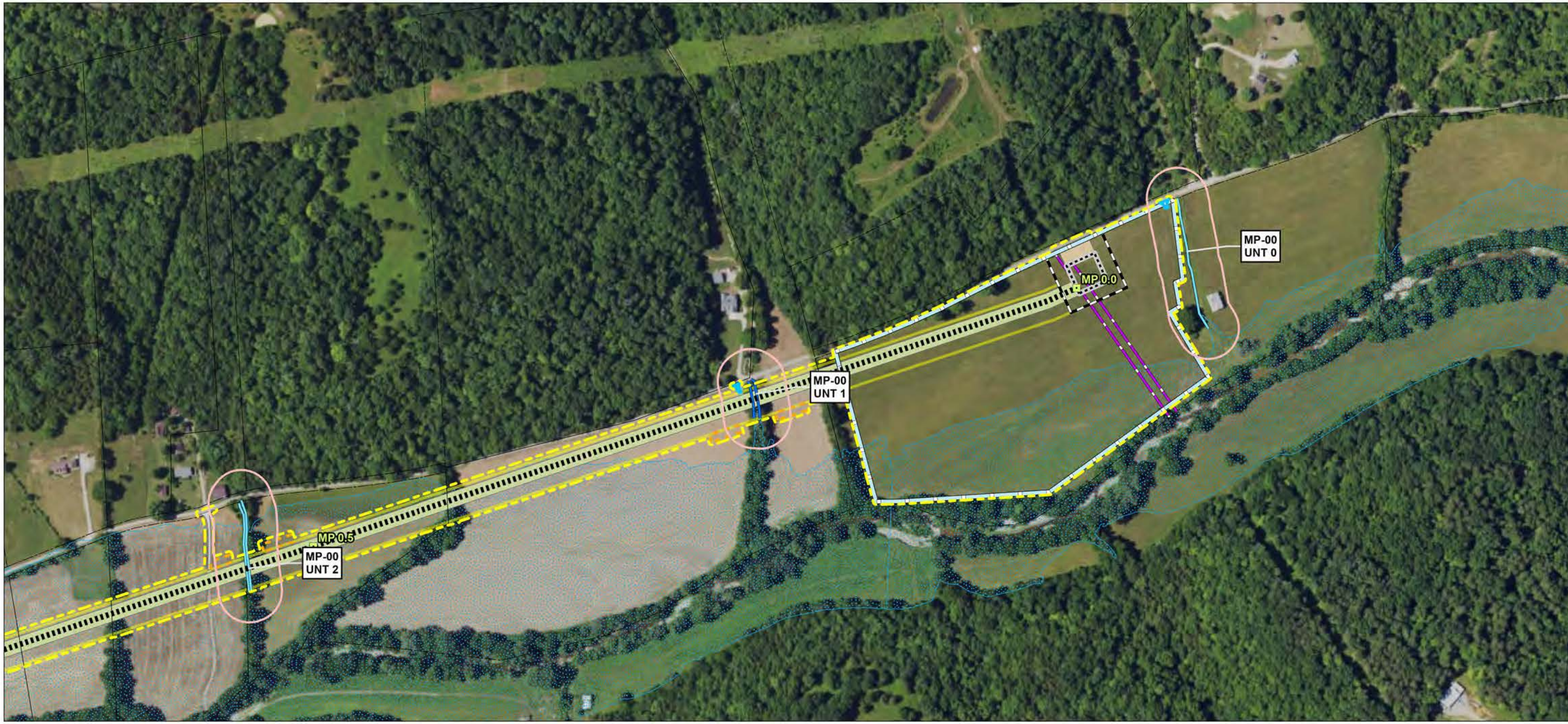
APPENDIX A



Notes
1. Coordinate System: NAD 1983 StatePlane Kentucky FIPS 1600 Feet
2. Data Sources: Stantec, LG&E, USFWS
3. Background: ESRI World Imagery
4. Ephemeral streams are assumed to be non-jurisdictional

Legend
- Maximum Disturbance Limits
- USACE Jurisdictional Area
- Kentucky Glade Cress Observed
- Mile Posts
- Previously Identified Sinkhole
- Cox Creek Drill Points
- Proposed Pipeline
- Existing LGE Easement
- Property Lines
- Ephemeral Stream
- Intermittent Stream
- Perennial Stream
- Open Water
- Existing Wetland
- Kentucky Glade Cress Population Area
- Areas Kentucky Glade Cress Surveyed Was Not Observed
- Federally Designated Critical Habitat - Kentucky Glade Cress
- Temporary Work Space - Off ROW
- Temporary Work Space - On ROW
- 100 Yr Floodway
- Construction Storage Yard
- Proposed Fence
- Proposed Regulator Station
- Construction Entrance
- Permanent Access Road
- Temporay Access Road
- Permanent Right-of-Way

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Stantec

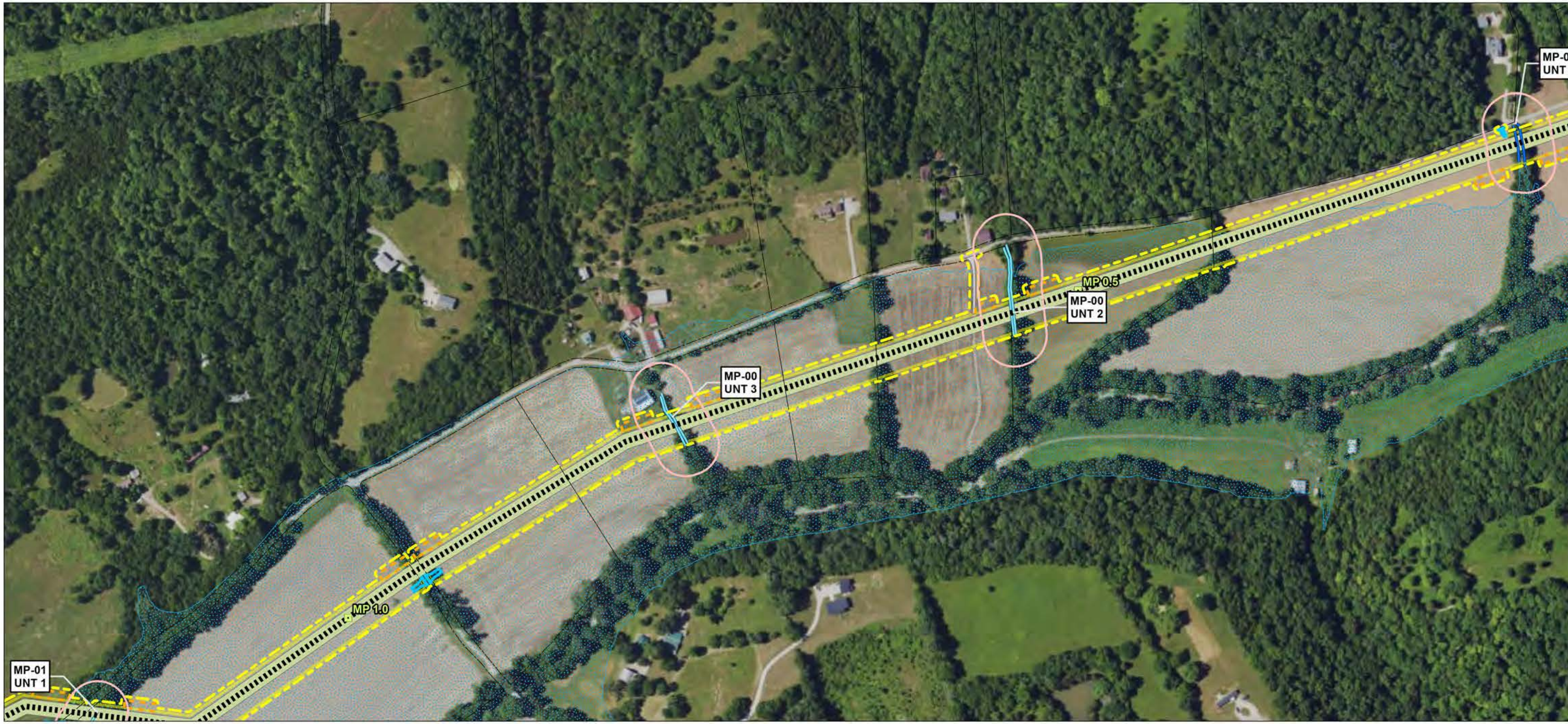
Project Location
Bullitt County, Kentucky

Prepared by TCN on 2023-01-26
TR by RJB on 2023-02-02
IR by JJA on 2023-02-17

Client/Project
Louisville Gas & Electric
Bullitt County Gas Transmission Pipeline Project
Biological Assessment

Figure No.
3a

Title
Kentucky Glade Cress Survey



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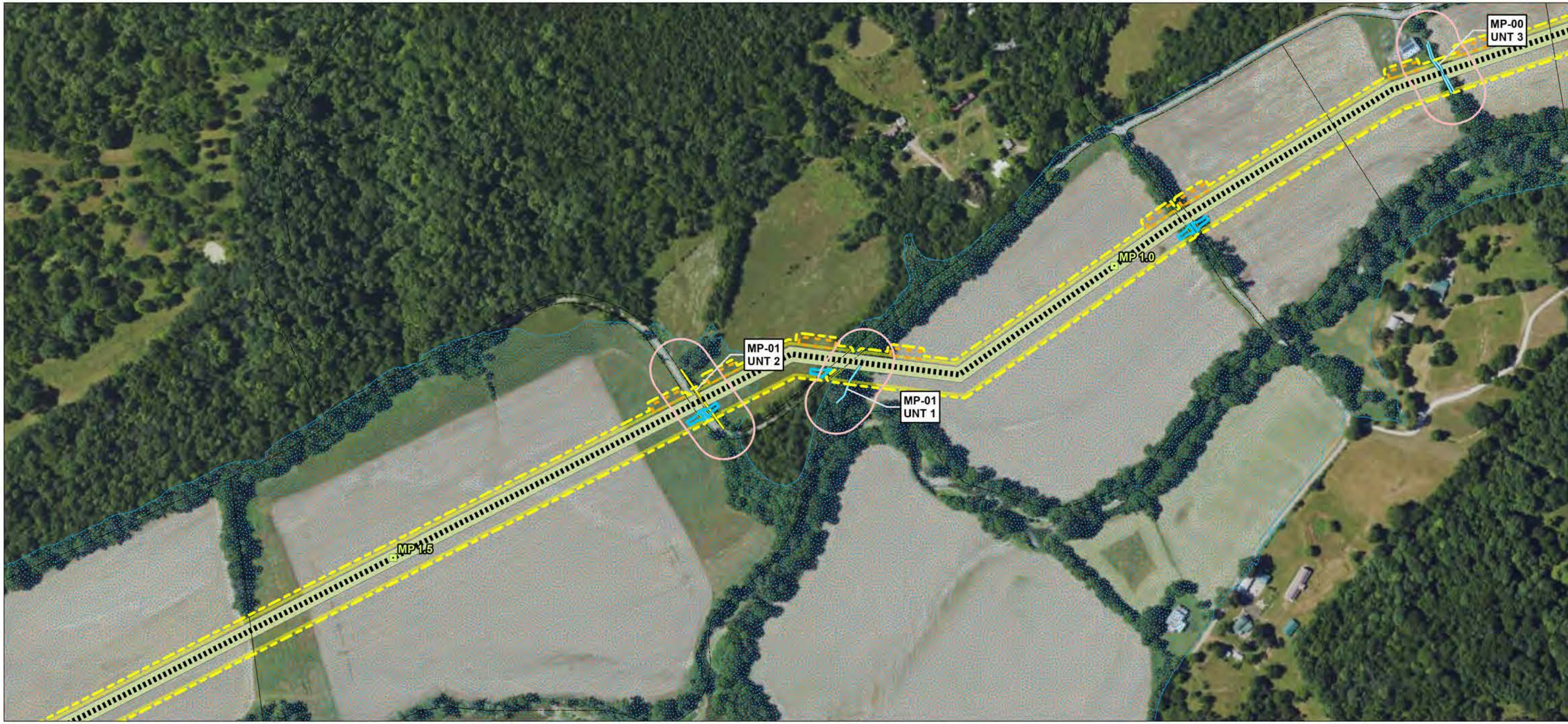

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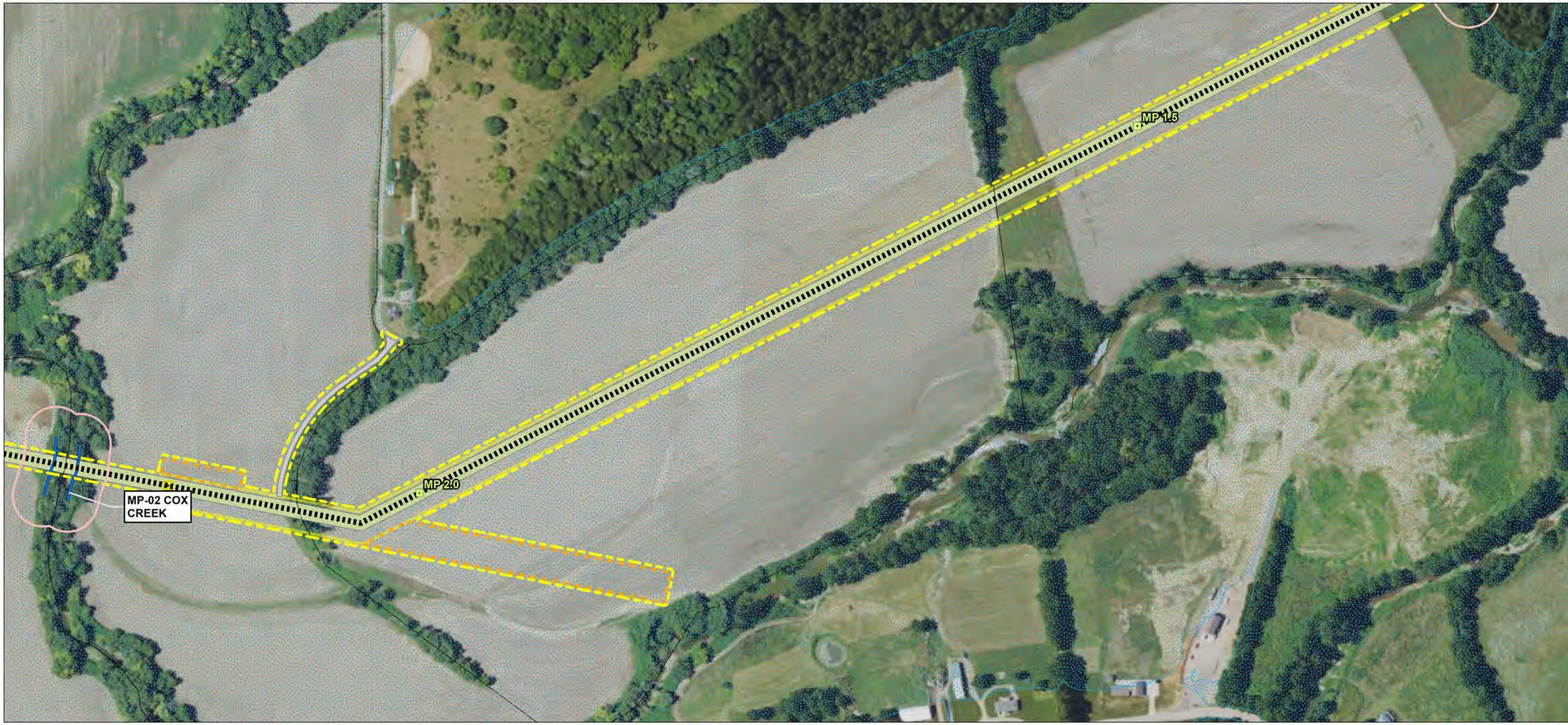

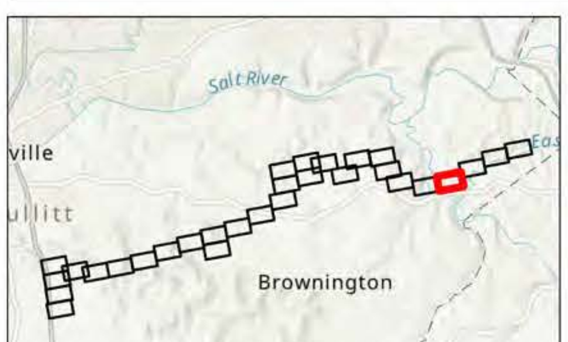

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Stantec

Project Location
Bullitt County, Kentucky

Prepared by TCN on 2023-01-26
TR by RJB on 2023-02-02
IR by JJA on 2023-02-17

Client/Project
Louisville Gas & Electric
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Biological Assessment

Figure No.
3a

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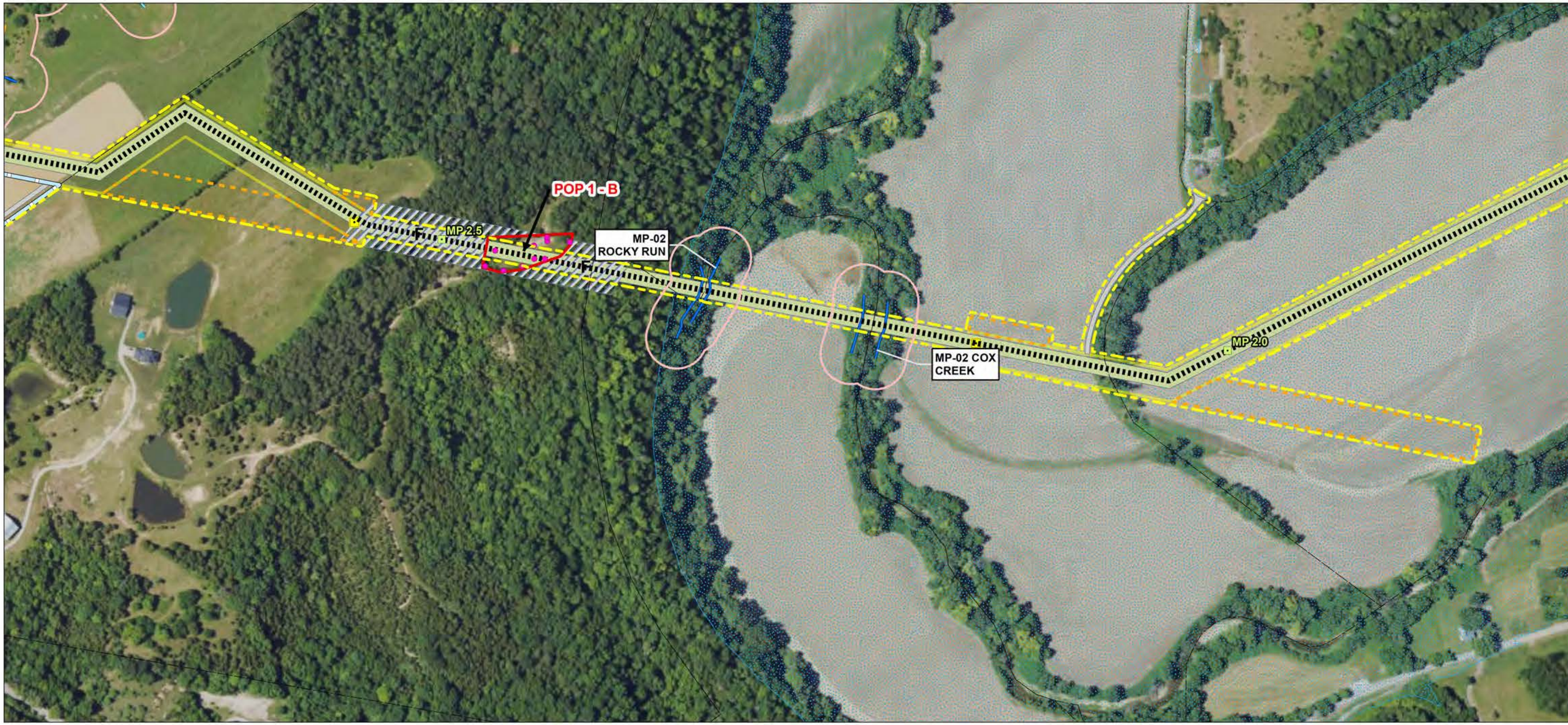
Kentucky Glade Cress Survey



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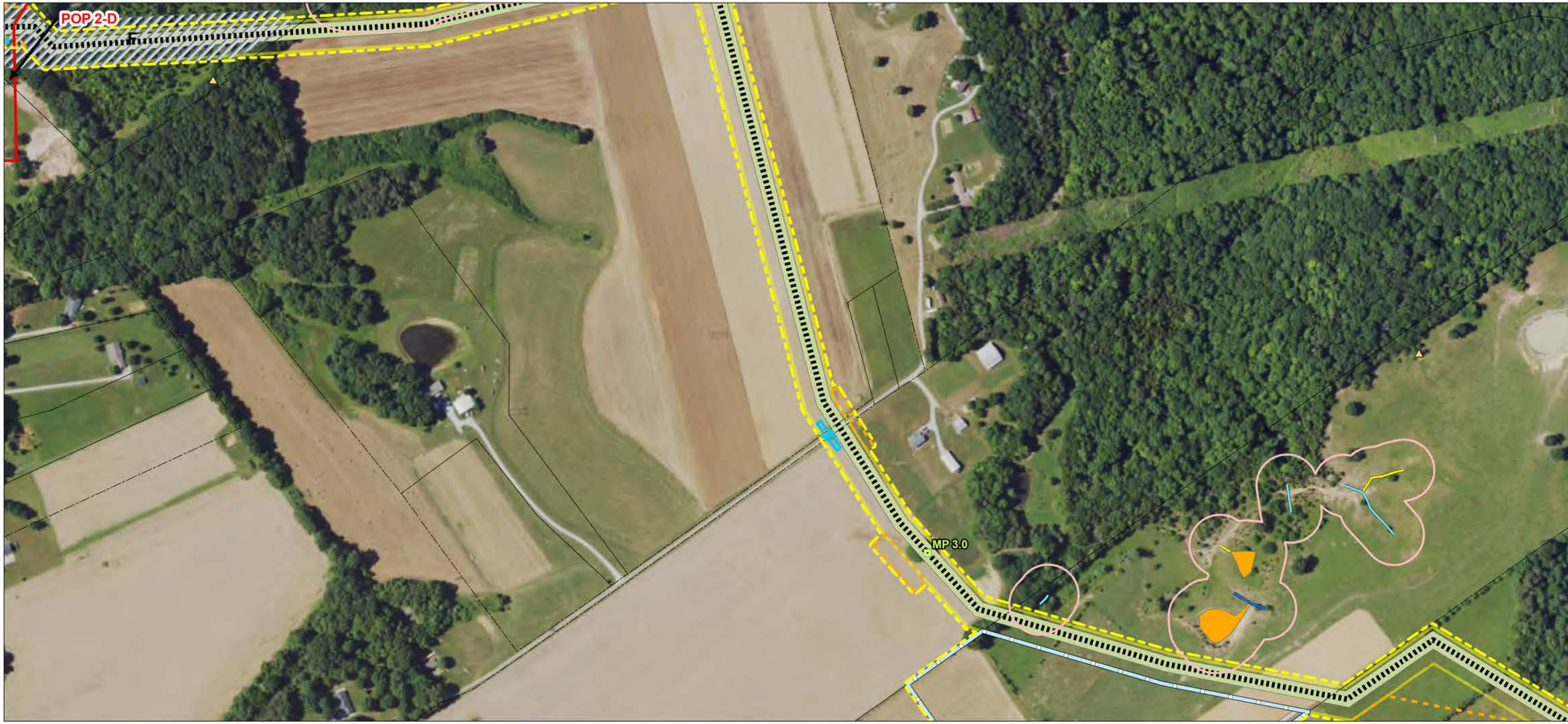

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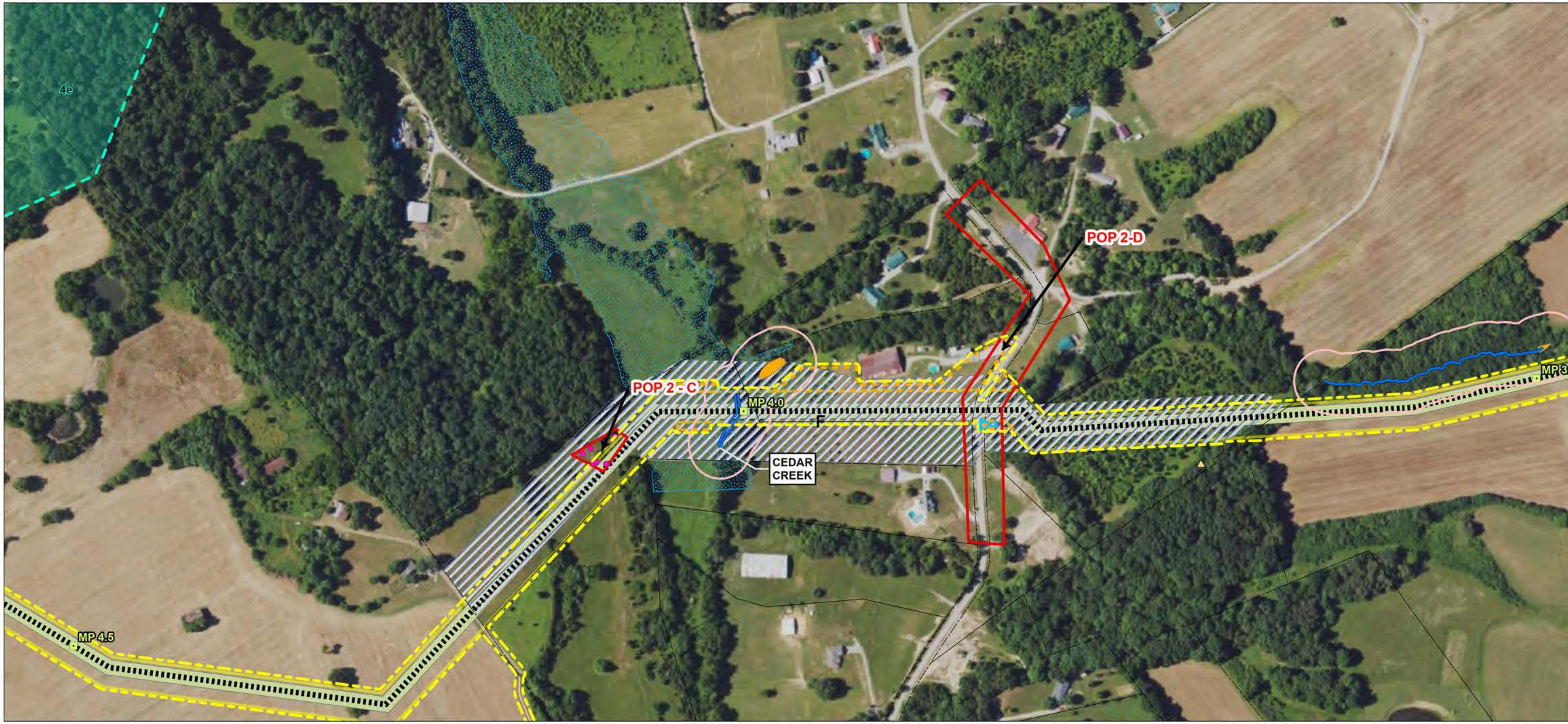

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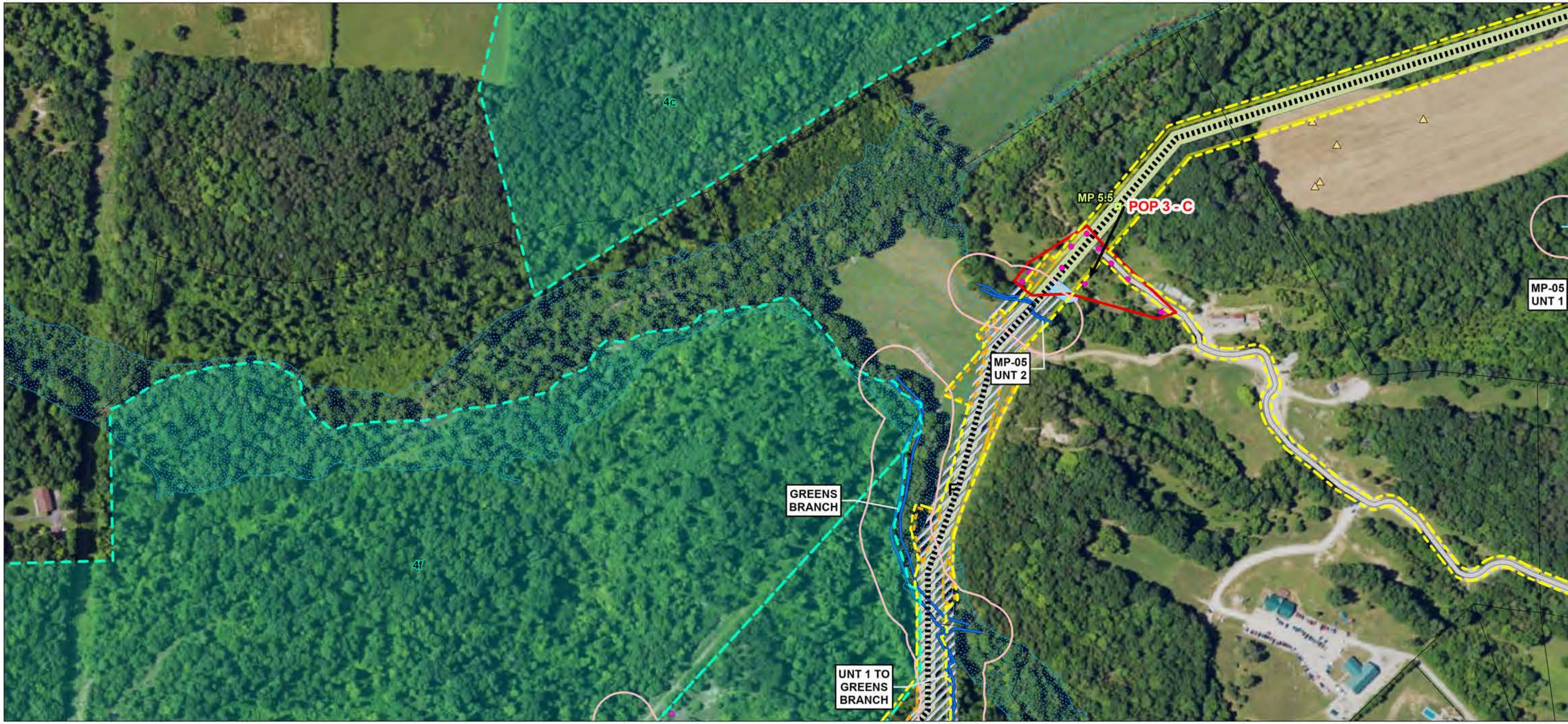

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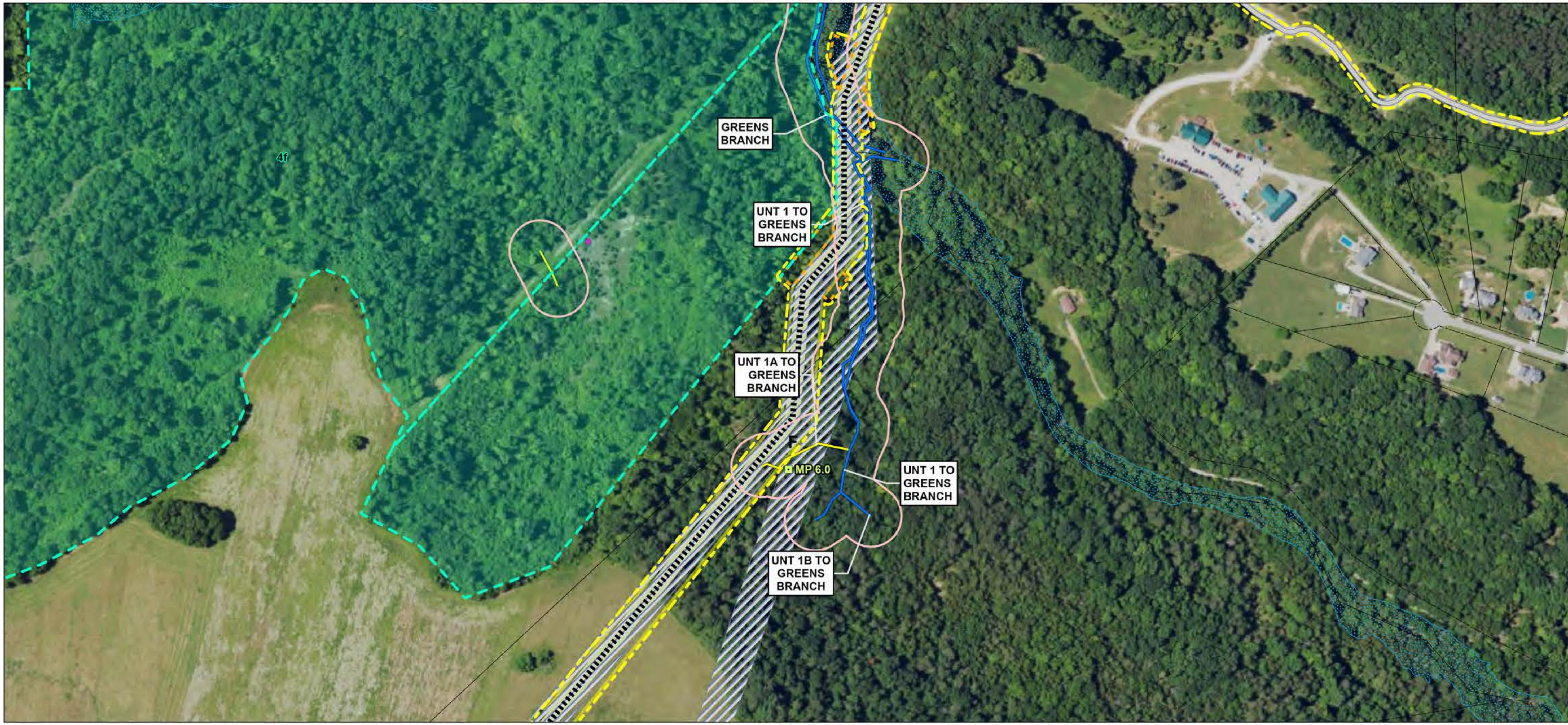

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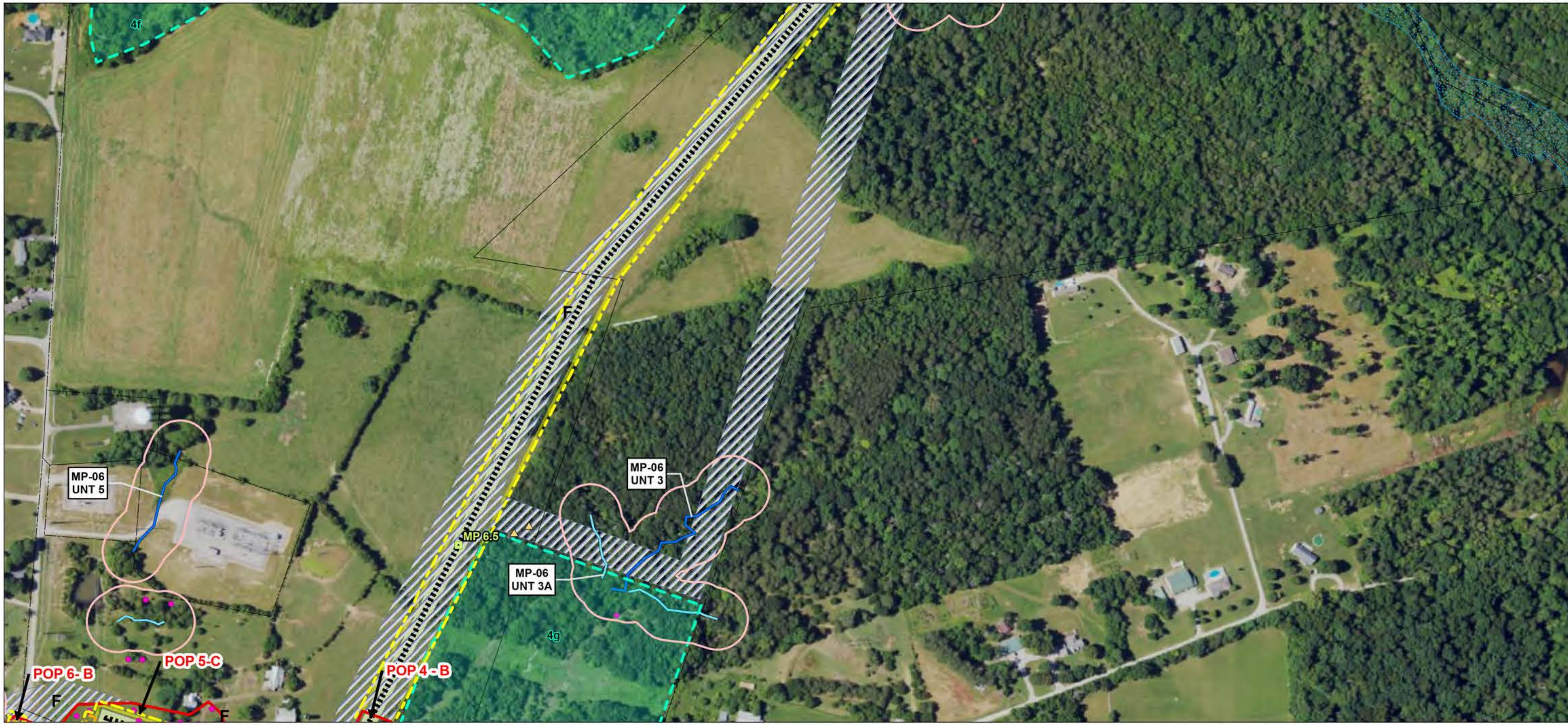

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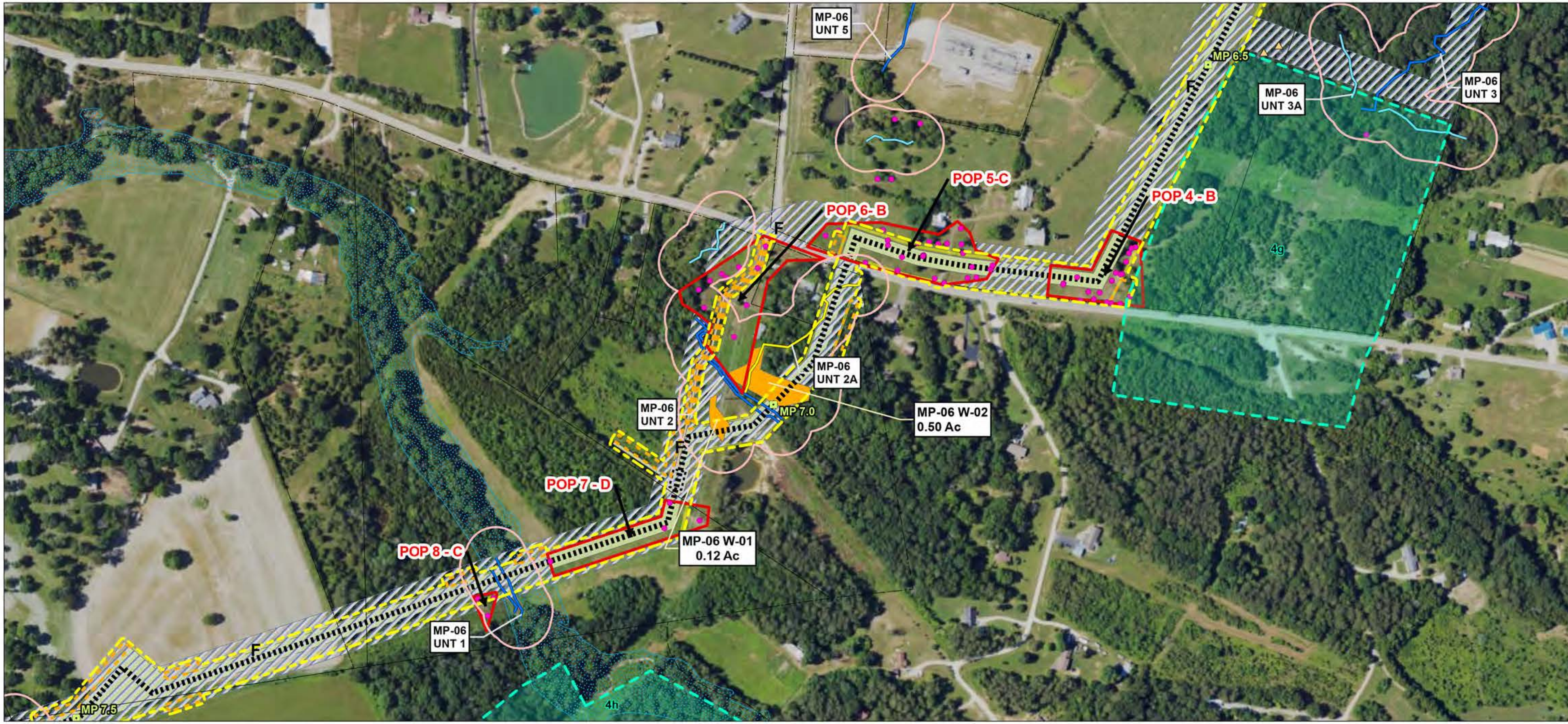

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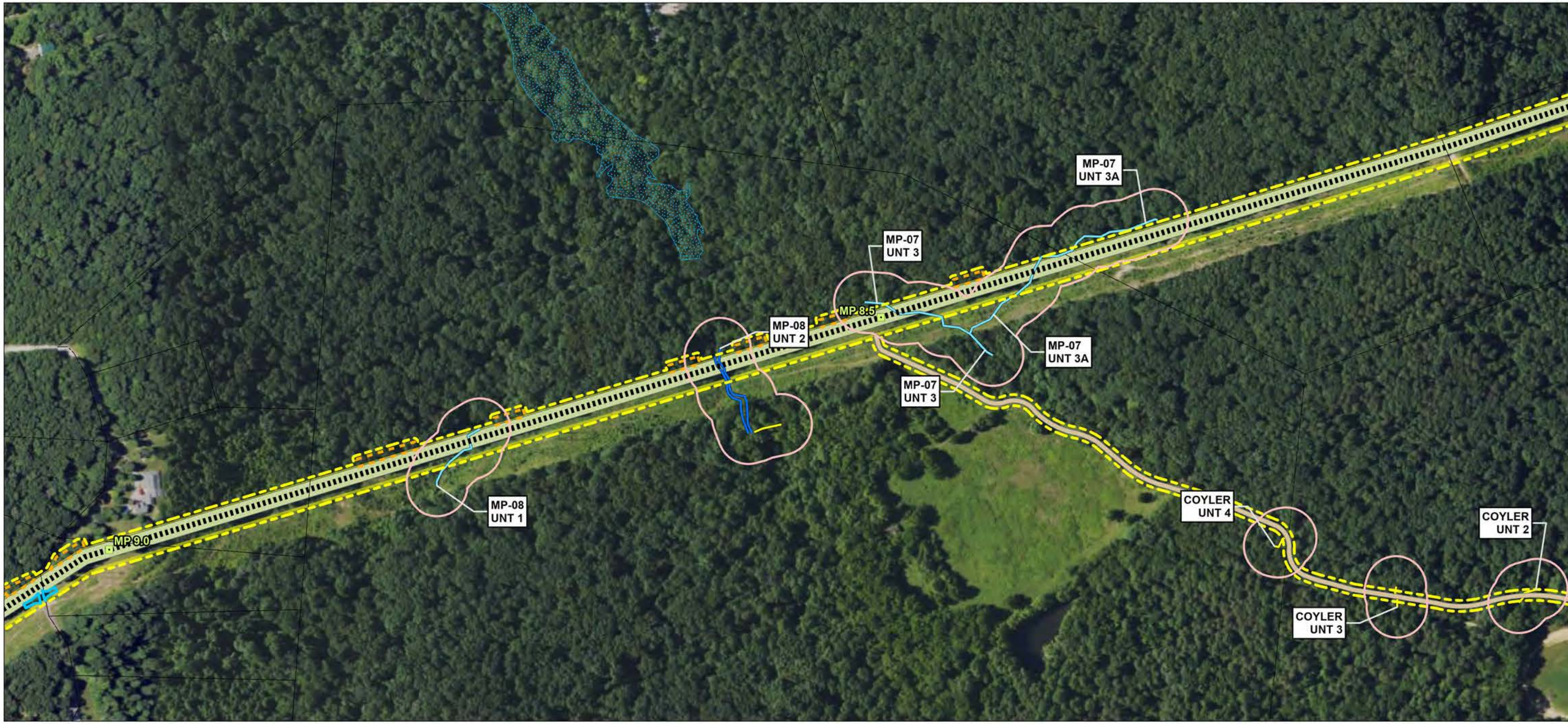

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- 100 Yr Floodway
- Construction Storage Yard
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Stantec

Project Location
Bullitt County, Kentucky

Prepared by TCN on 2023-01-26
TR by RJB on 2023-02-02
IR by JJA on 2023-02-17

Client/Project
Louisville Gas & Electric
Bullitt County Gas Transmission Pipeline Project
Biological Assessment

Figure No.
3a

Title
Kentucky Glade Cress Survey

Legend

- Maximum Disturbance Limits
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- Mile Posts
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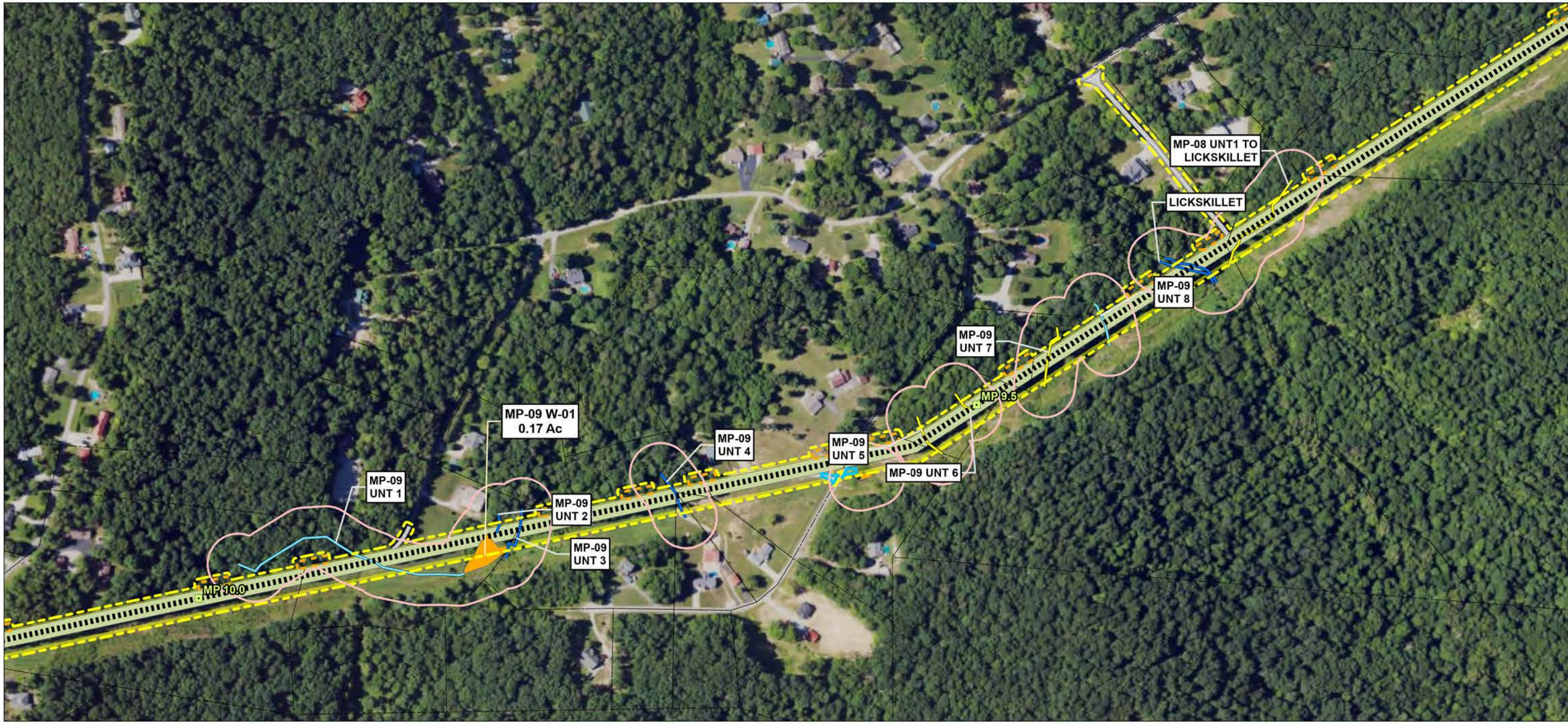

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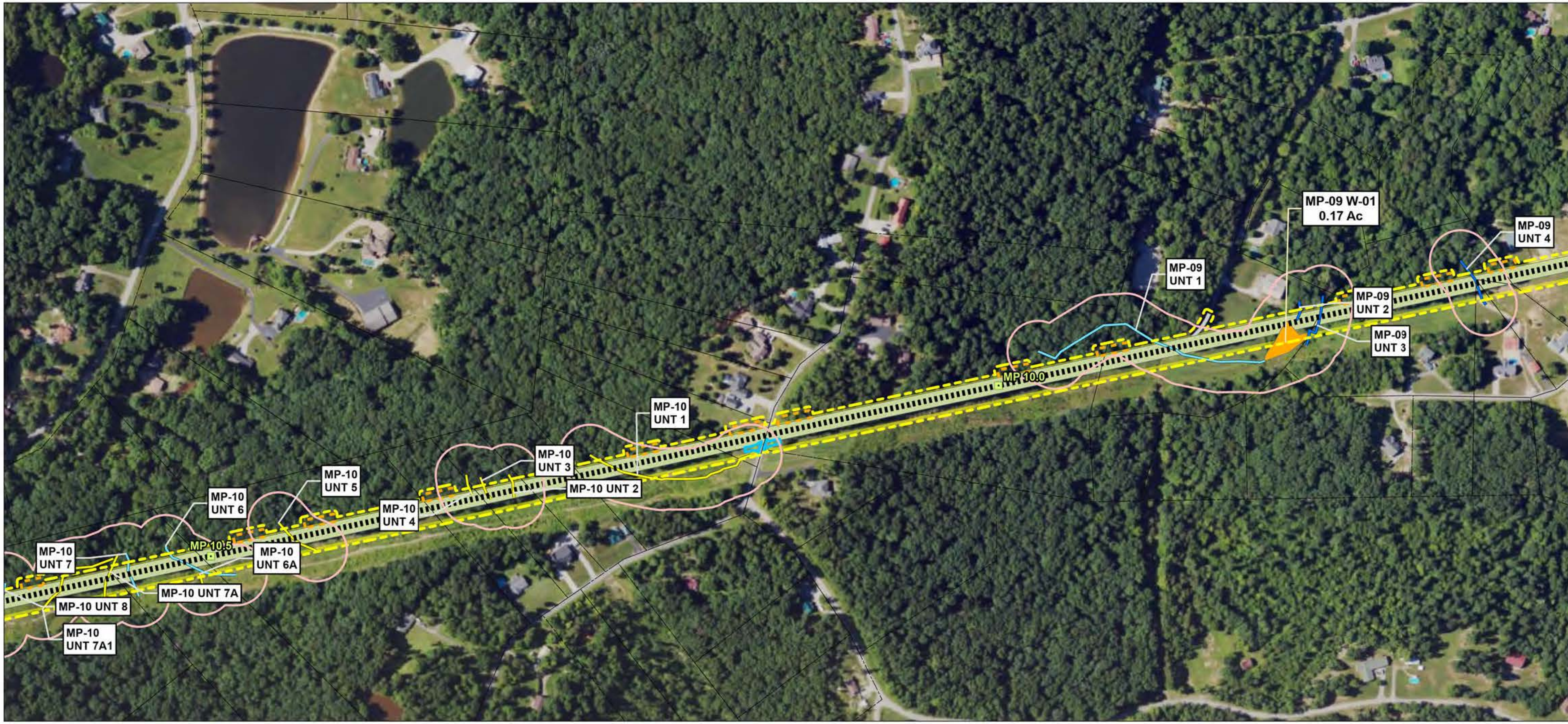

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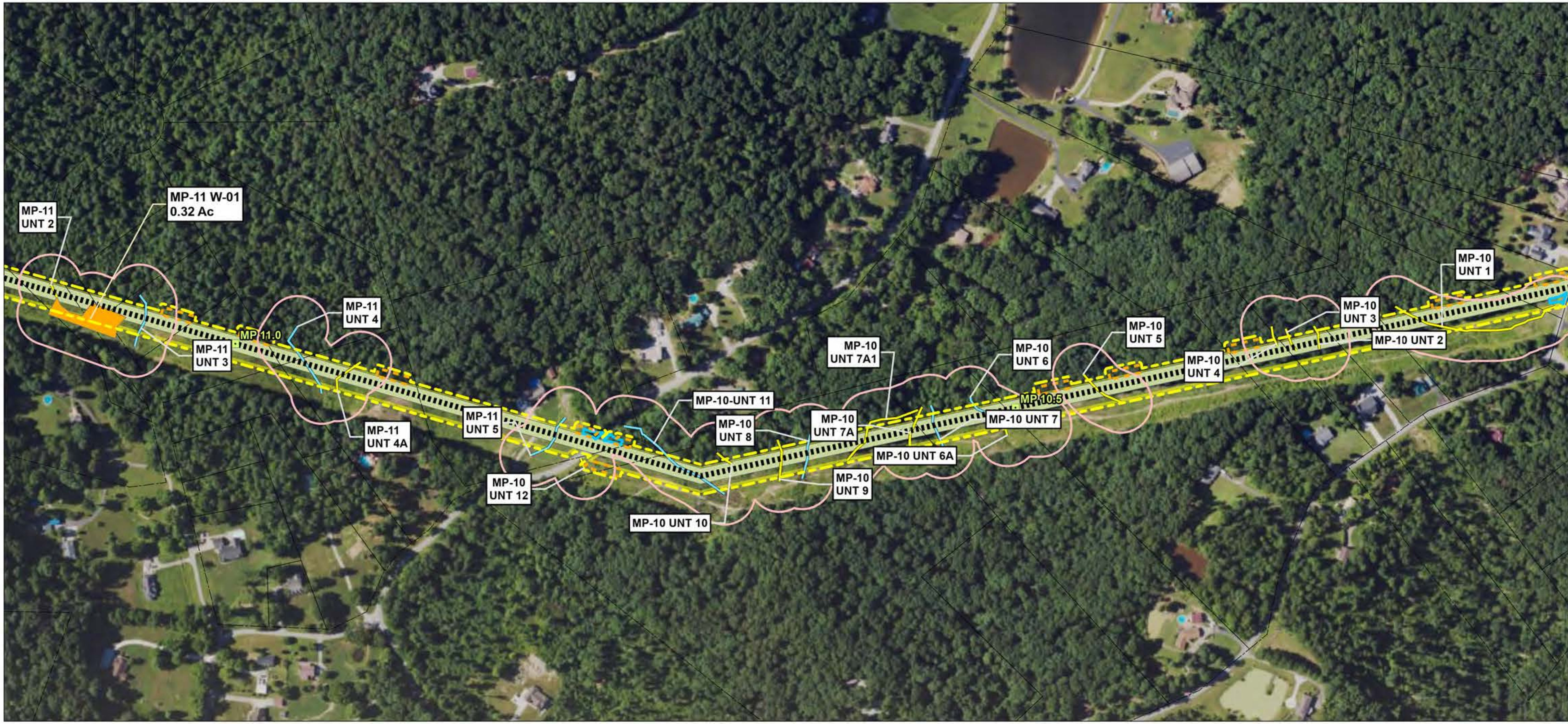

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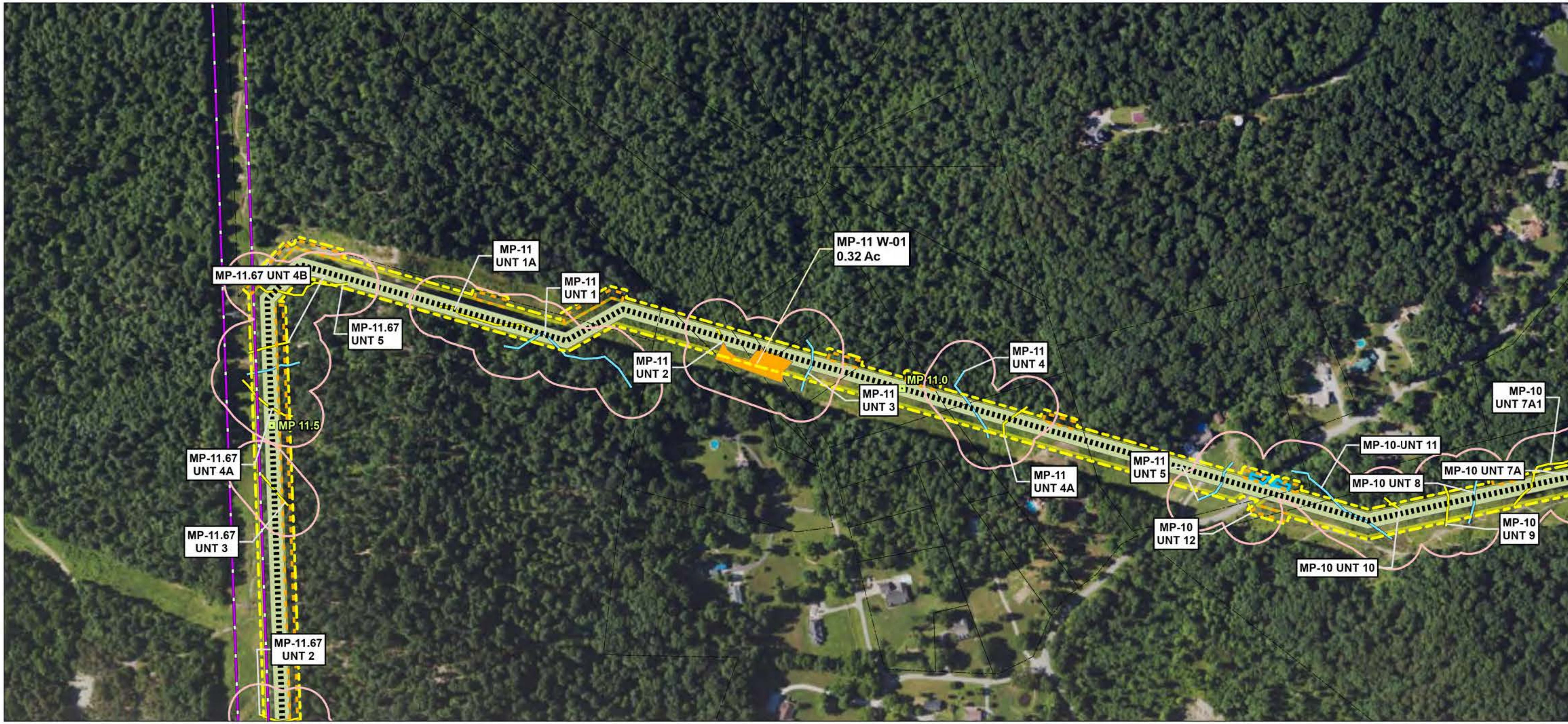

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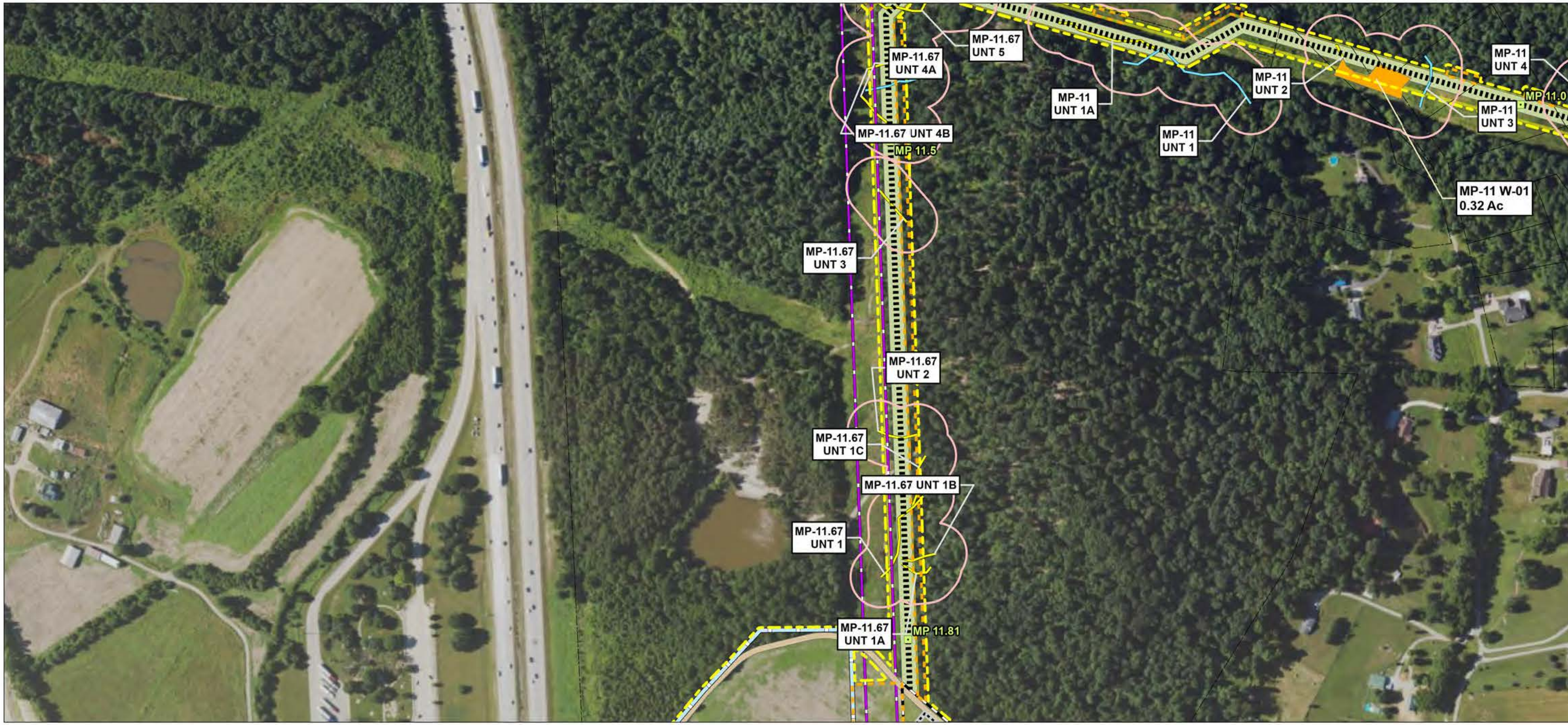

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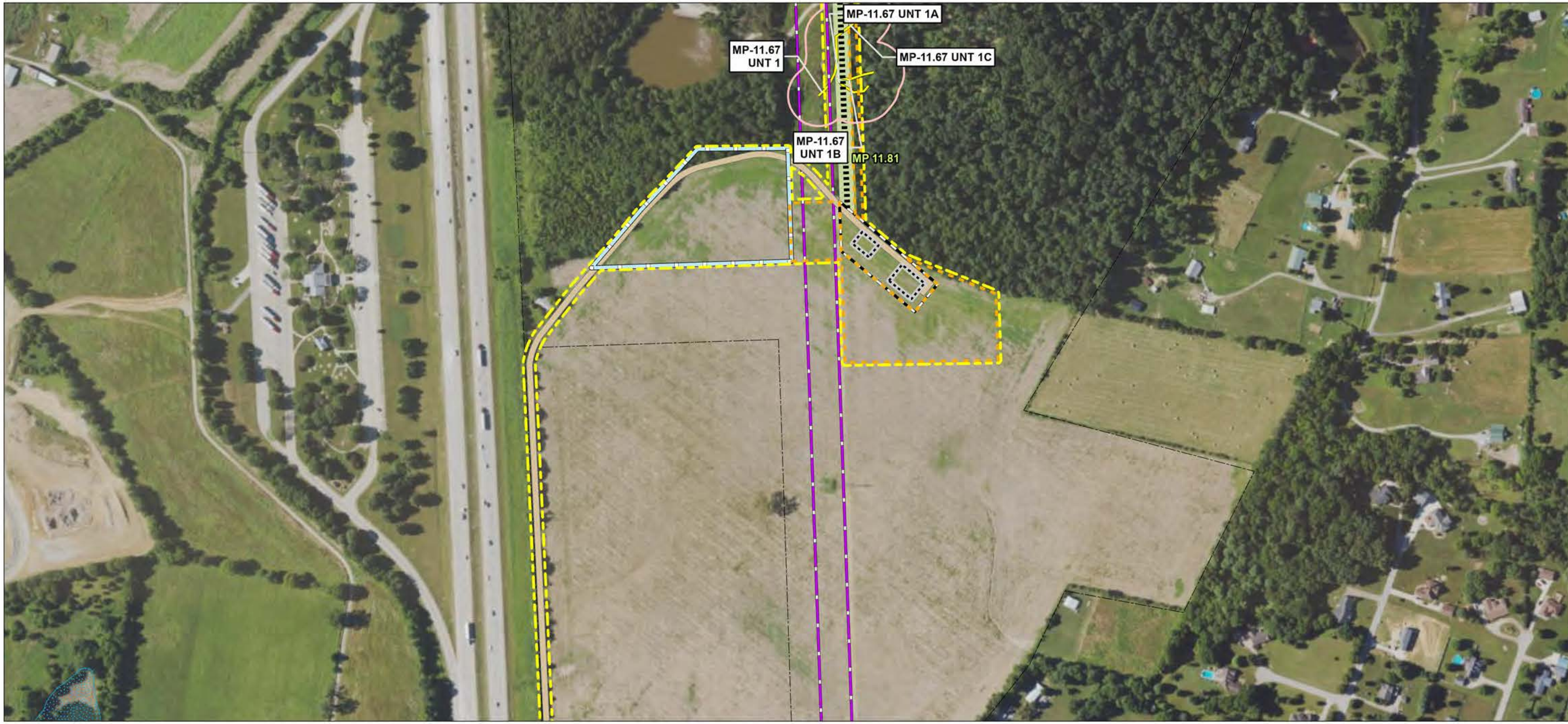

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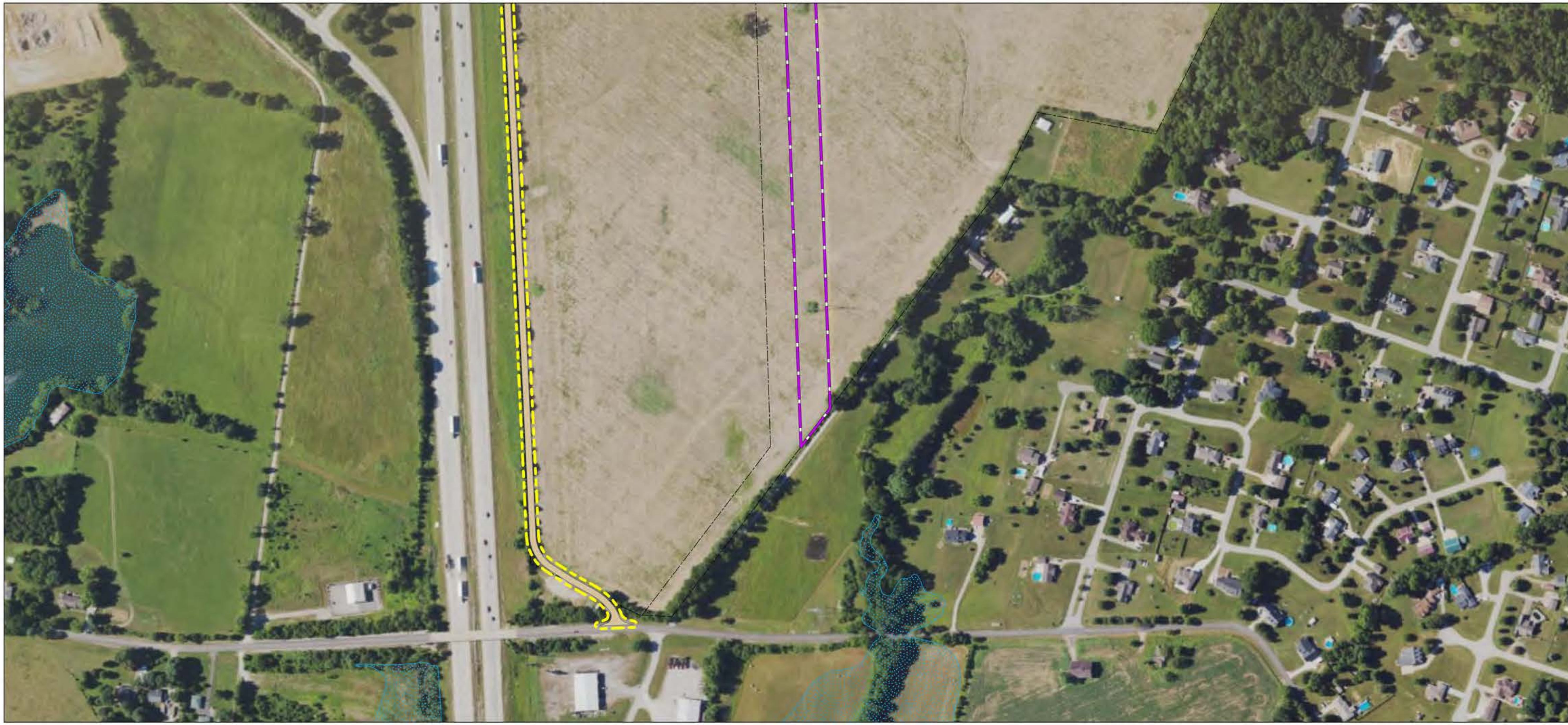

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Biological Assessment

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APPENDIX B

Process for Section 7 Consultation in Small Federal Handle Situations

The agreement in principle outlined below applies to situations where both of the following conditions apply: (1) where there is a legitimate Federal nexus to the larger project via activities subject to Clean Water Act or Rivers and Harbors Act of 1899 jurisdiction that cannot be avoided (i.e., but for the federal permit, the larger action could not occur); and (2) where the effects considered within the biological assessment and biological opinion are all appropriately within the scope of a section 7 consultation (i.e., the direct and indirect effects of the federal action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, and including consideration of cumulative effects).

- The Corps will provide the Service with a Biological Assessment (BA) for a proposed action that evaluates the larger project as a whole and is inclusive of all anticipated effects of the larger project (including those resulting from interrelated or interdependent activities) to listed species and critical habitat, along with consideration of cumulative effects. However, in situations where the Corps' involvement is limited to a small component of the larger project, in the BA the Corps will clearly distinguish between the areas and activities within the Corps' jurisdiction and the areas and activities outside the Corps' jurisdiction. The BA will also clearly distinguish between effects to listed species and designated critical habitat within and outside the Corps' jurisdiction.

- If the BA outlines avoidance and minimization measures that may lead to a "not likely to adversely affect" determination for the entire project, the Corps will work with the Service to finalize the informal consultation. The Corps may ask the Service to work directly with the permit applicant to develop avoidance and minimization measures, but the Corps will provide the final letter requesting concurrence regarding the determination of "may affect, not likely to adversely affect" for the project.

- For formal consultations, the Service will issue a biological opinion that evaluates all components of the larger project, including the effects of the larger project on listed species and critical habitat. Take that is anticipated to result from the larger project that is not likely to jeopardize the continued existence of a species, or that results from implementing a reasonable and prudent alternative in order to avoid the likelihood of jeopardy, will be addressed through an incidental take statement included with the biological opinion. As noted in section 7(o)(2), "any taking that is in compliance with the terms and conditions specified in ... [an incidental take statement] shall not be considered to be a prohibited taking of the species concerned." The Service will identify in the incidental take statement what reasonable and prudent measures (RPMs) address impacts of activities within the Corps' jurisdiction and thus which the Corps must implement through its permit. The Service will likewise identify those RPMs that address impacts of the larger project outside of the Corps' jurisdiction and will specify that they must be implemented directly by the applicant if the take exemption is to apply.

- The Corps will oversee compliance with RPMs, including monitoring and reporting the impacts of incidental take, that apply to the activities within its jurisdiction. For RPMs that apply to activities outside of the Corps' jurisdiction, the Service will monitor the impacts of the incidental take through reports submitted by the applicant on the progress of the action and its impact on the listed species, as specified in the incidental take statement. The Corps is required to request reinitiation of section 7 consultation when triggered by one of the reinitiation factors listed at 50 C.F.R. § 402.16 and "where discretionary Federal involvement or control over the action has been retained or is authorized by law." Reinitiation is triggered by, among other factors, exceedance of the extent of taking specified in the incidental take statement regardless of where such taking occurs.

- If the Corps never had or no longer retains discretionary Federal involvement or control over incidental take anticipated in the biological opinion, but the applicant is carrying out the action in full compliance with the associated incidental take statement, the Service will exercise its enforcement discretion and not seek section 11(e) enforcement against the applicant in these situations for the take that was anticipated in the incidental take statement. However, we recognize that the applicant in those situations will face some exposure to a citizen suit brought under section 11(g).

- The process outlined above will also apply to species and critical habitat addressed through conference opinions, as appropriate.

APPENDIX C

Legend

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- Intermittent Stream
- Perennial Stream
- NHD Waterway
- Proposed Pipeline
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- Proposed Tree Clearing Area Overall
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Client/Project
Louisville Gas & Electric
Bullitt County Gas Pipeline Project Biological Assessment

Figure No.
6a

Title
Proposed Tree Clearing

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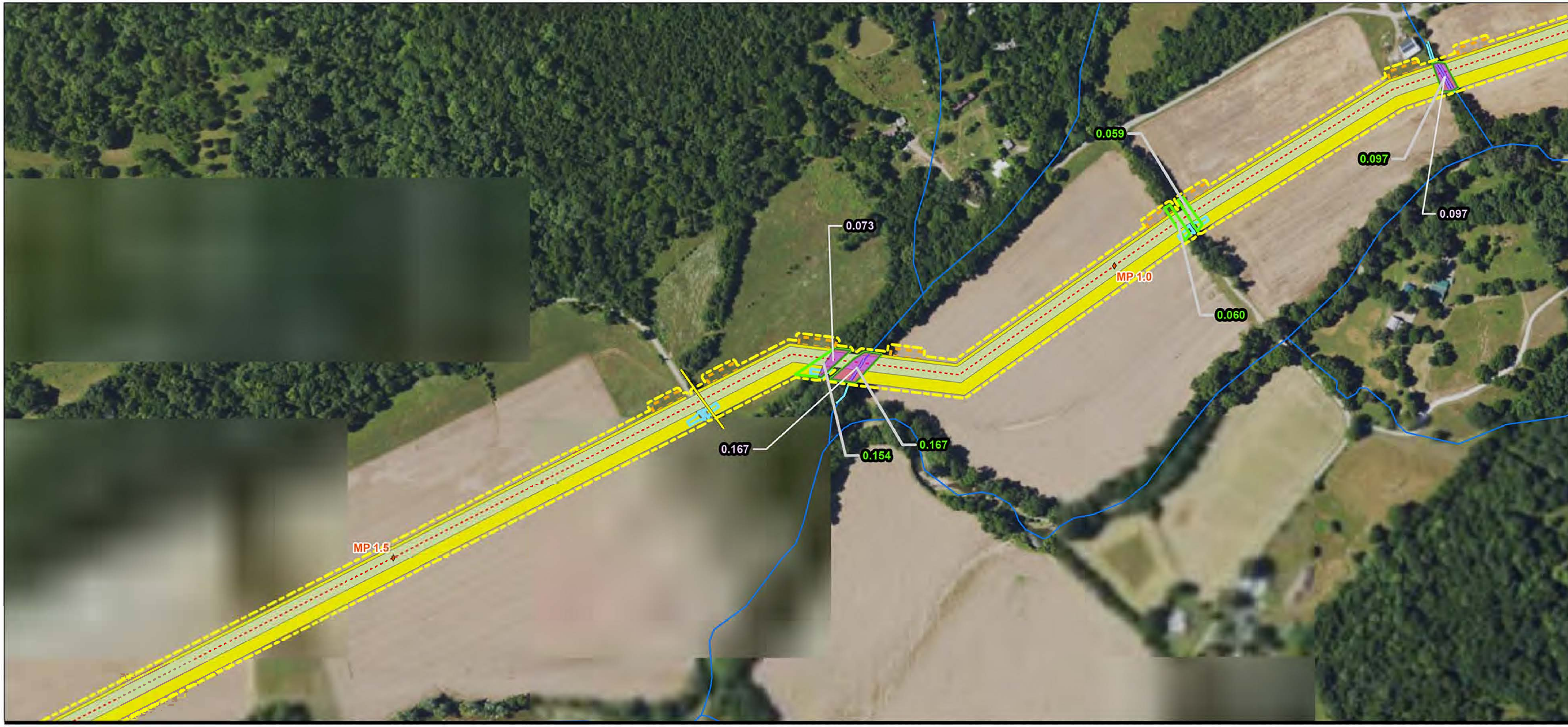

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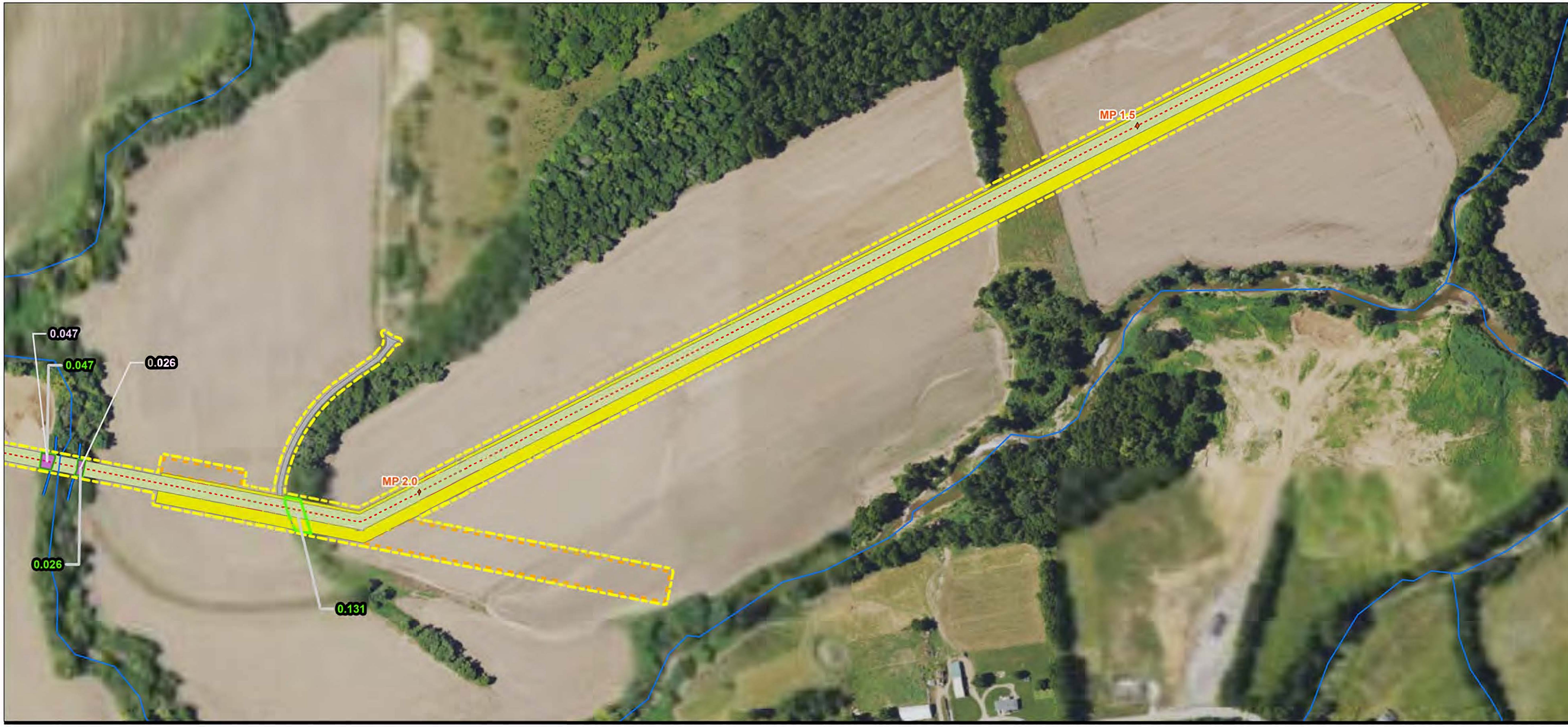

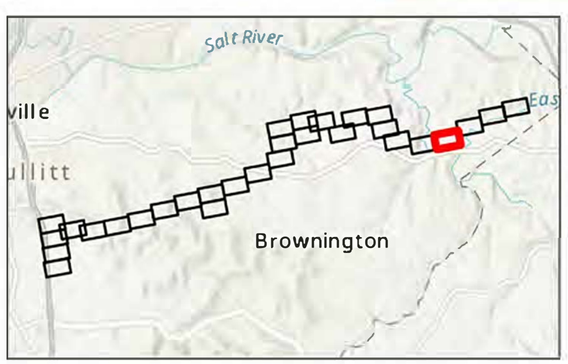

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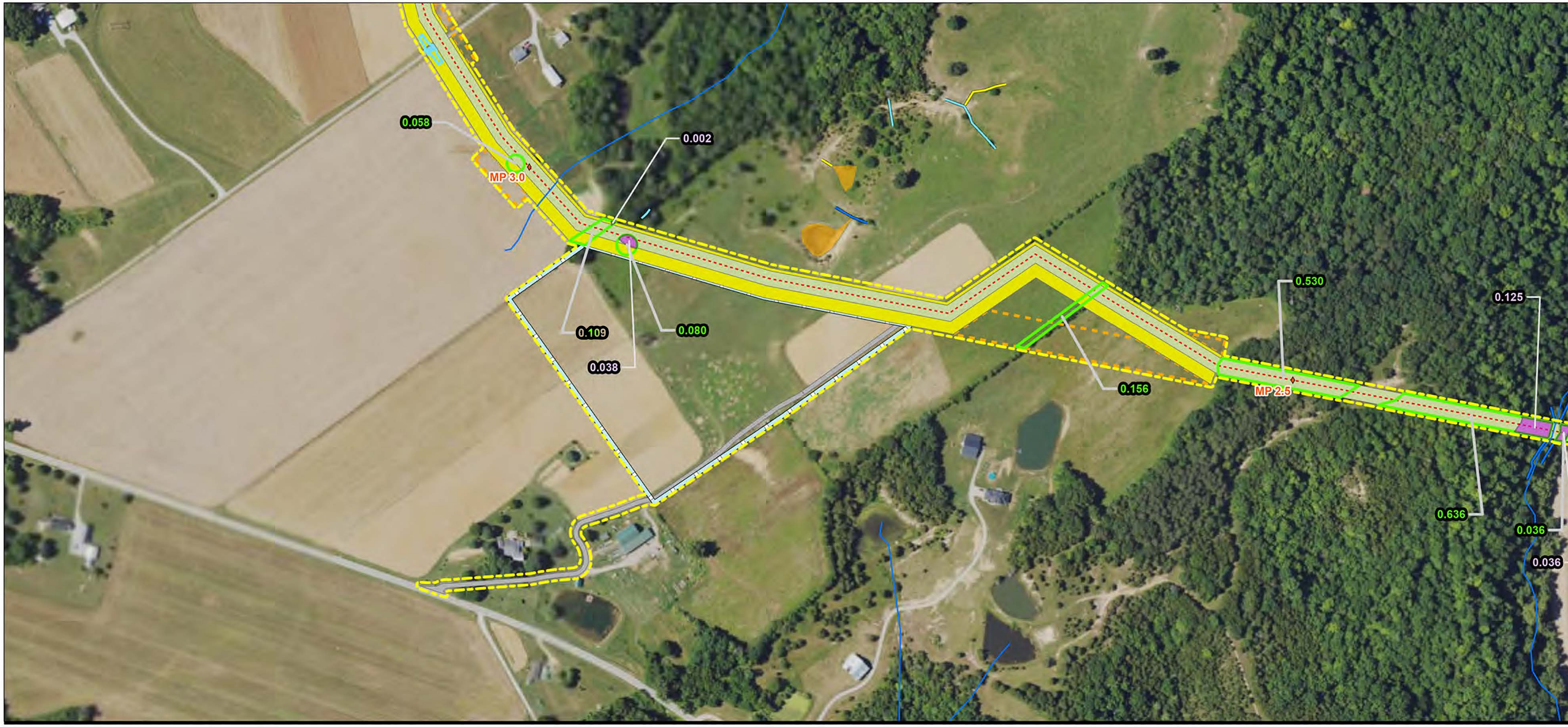

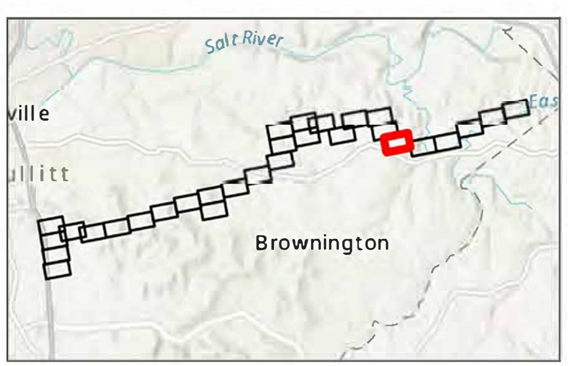

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Project Location
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Prepared by TCN on 2023-01-26
TR by RJB on 2023-02-02
IR by JJA on 2023-02-17

Client/Project
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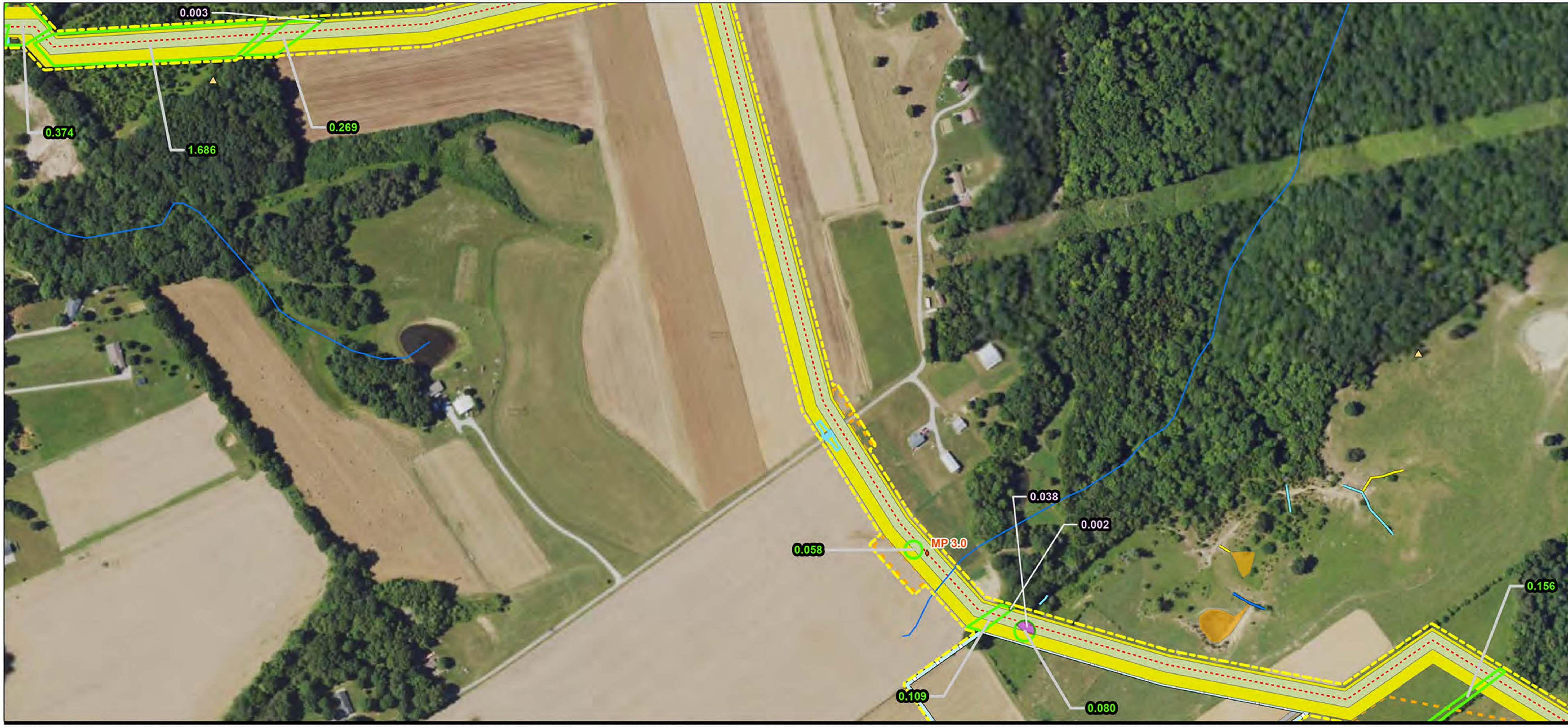

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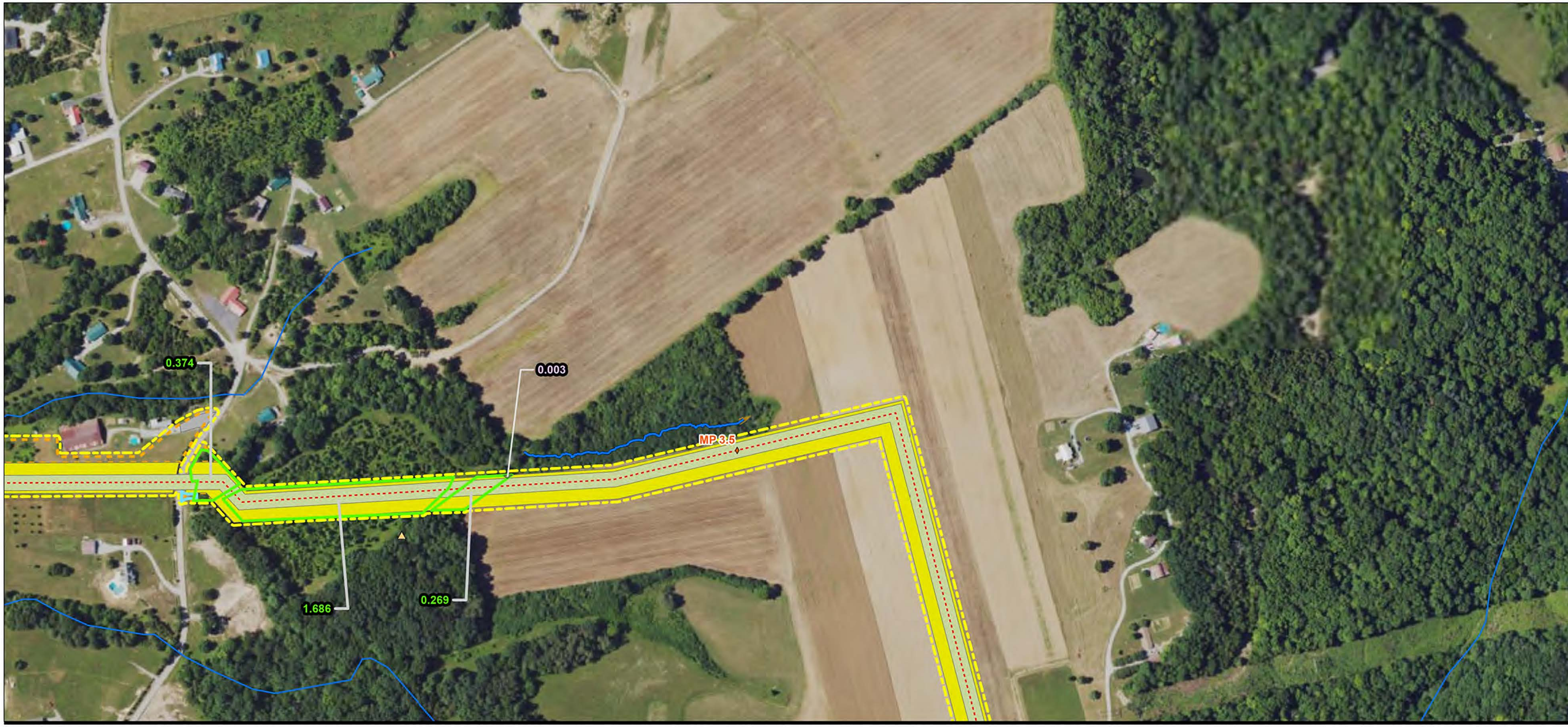

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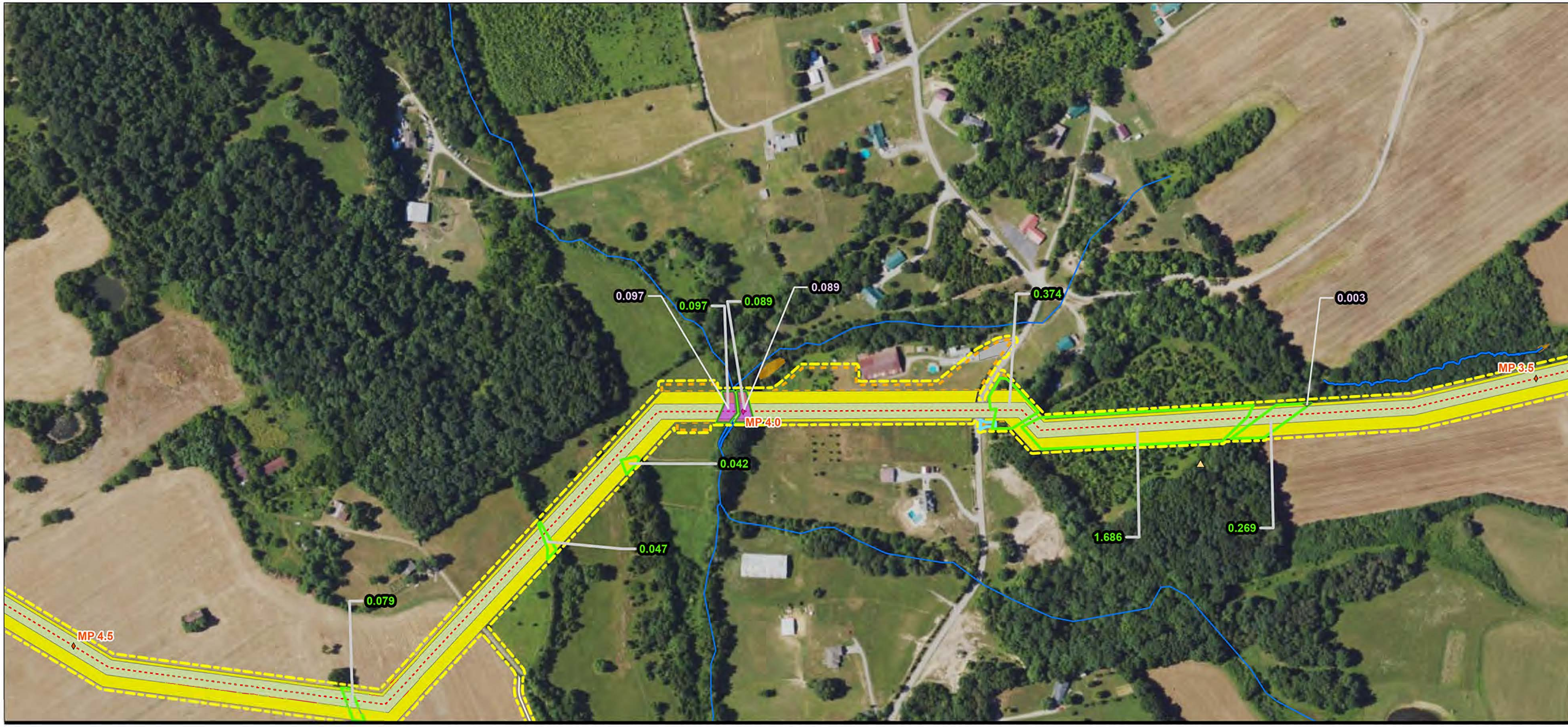

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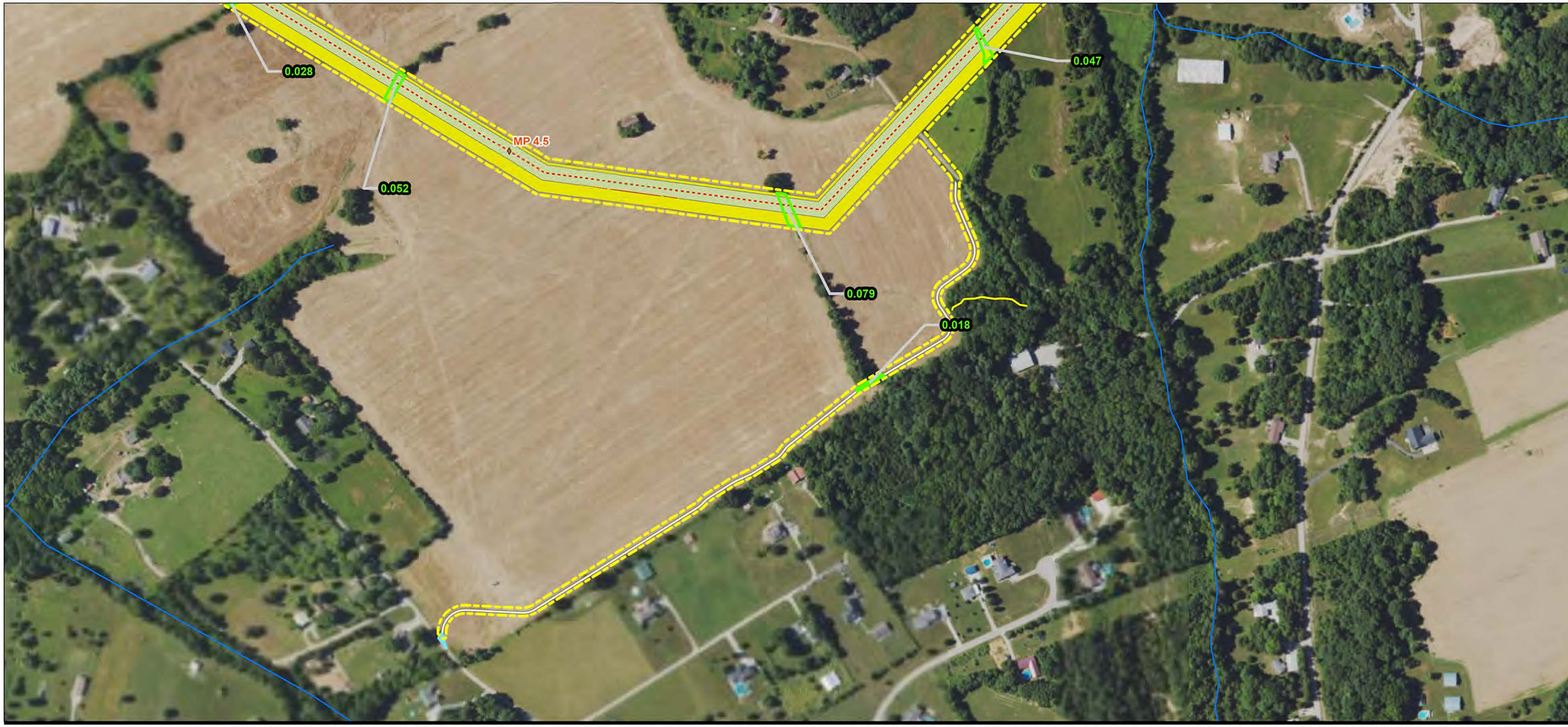

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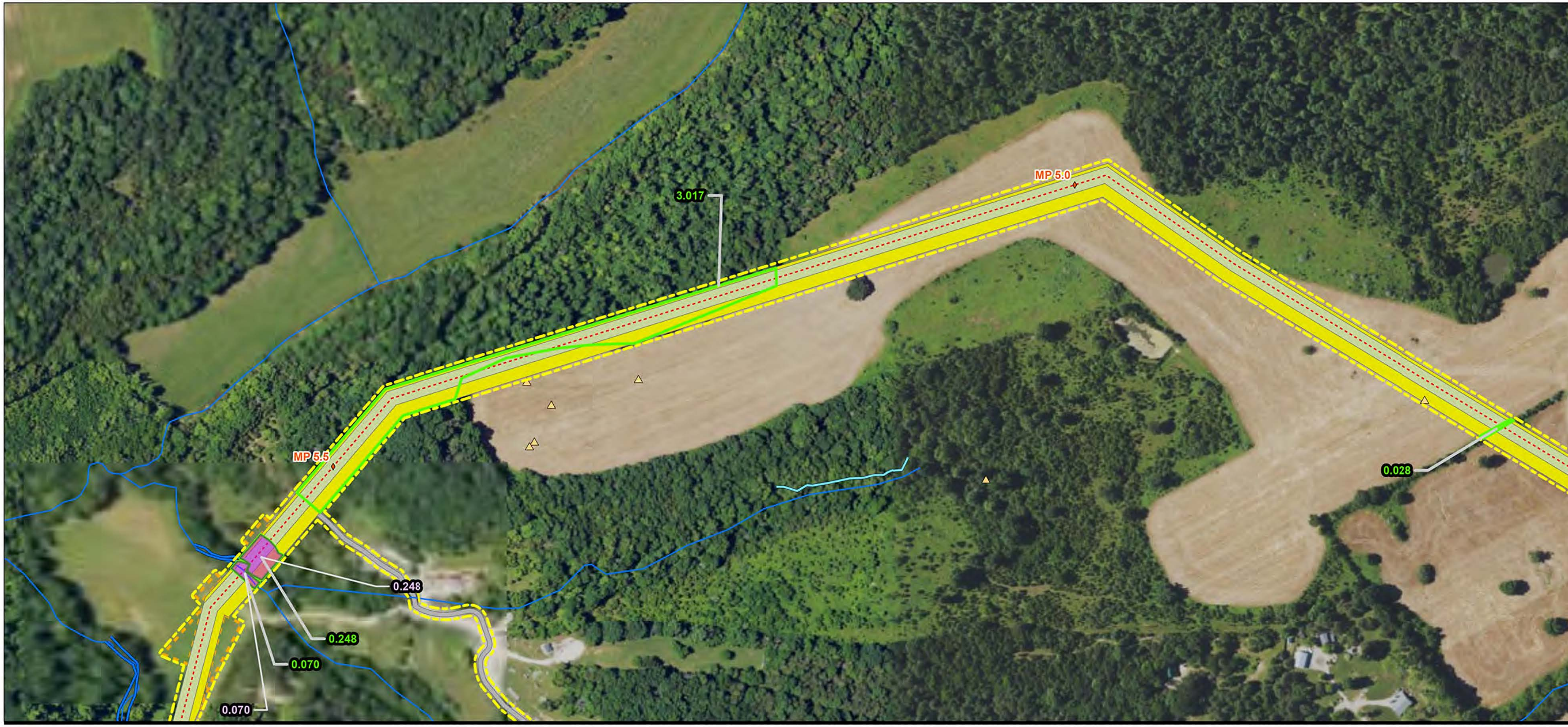

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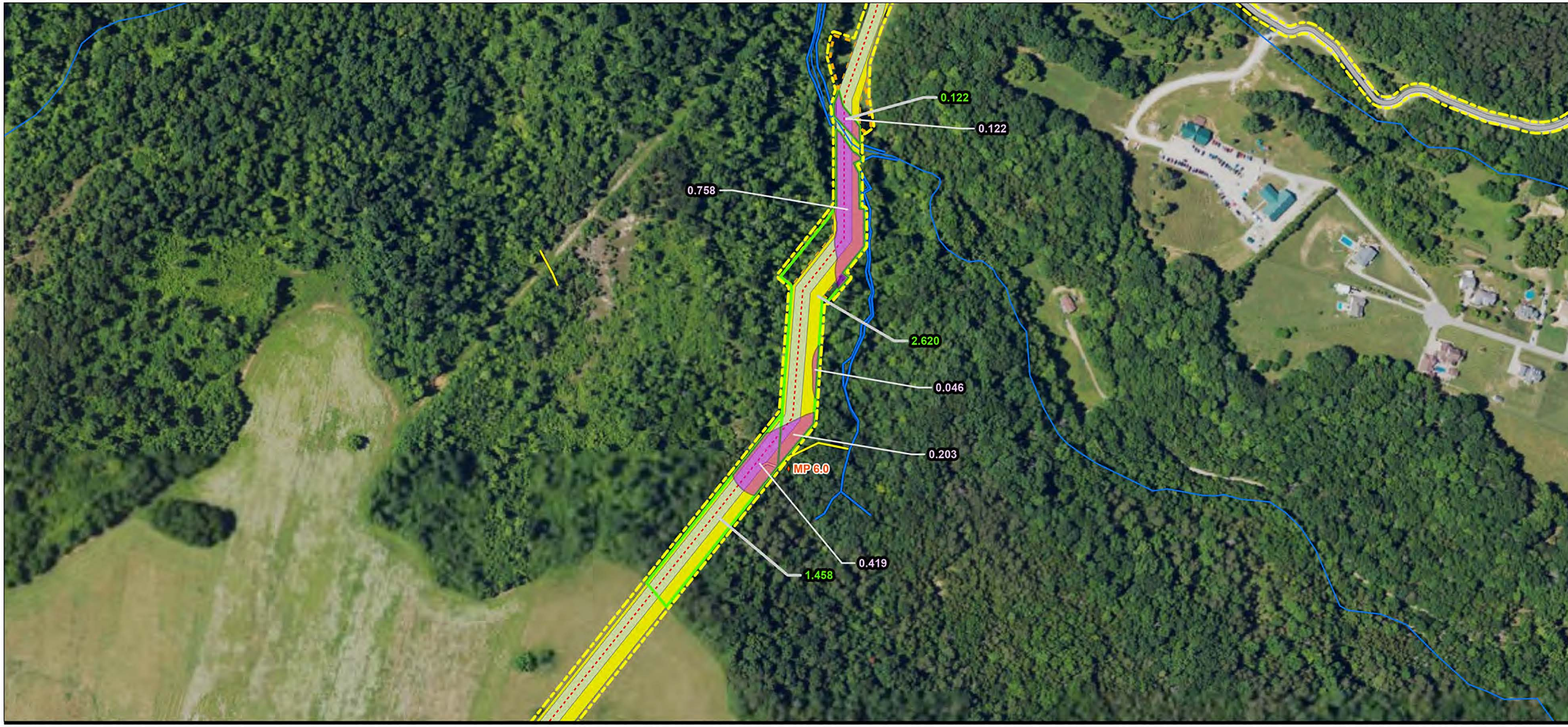

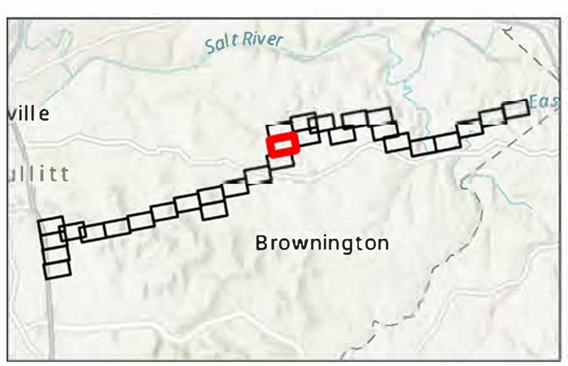

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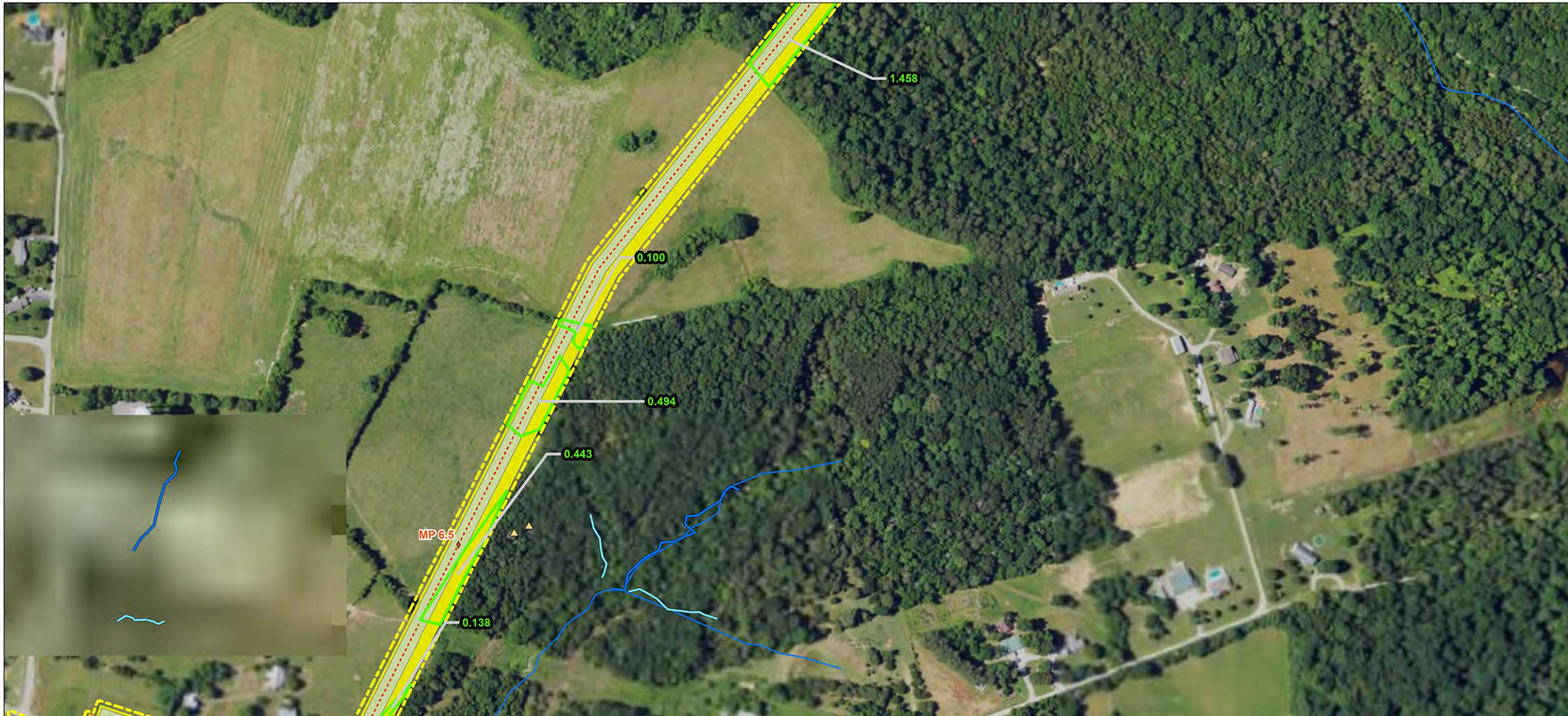

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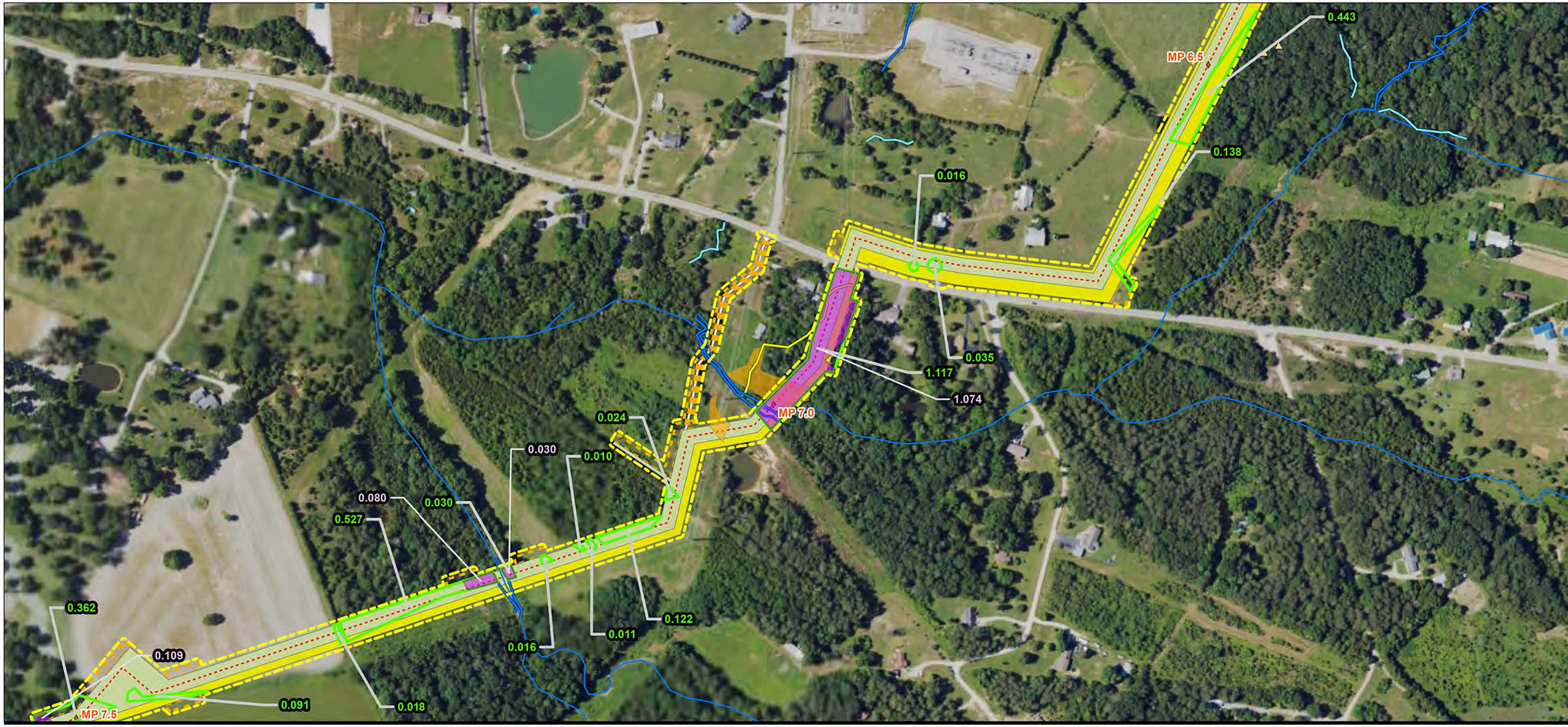

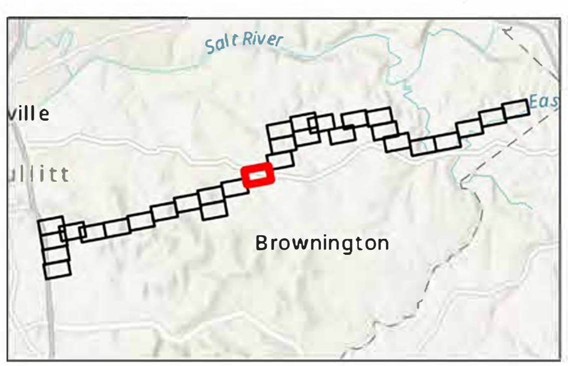

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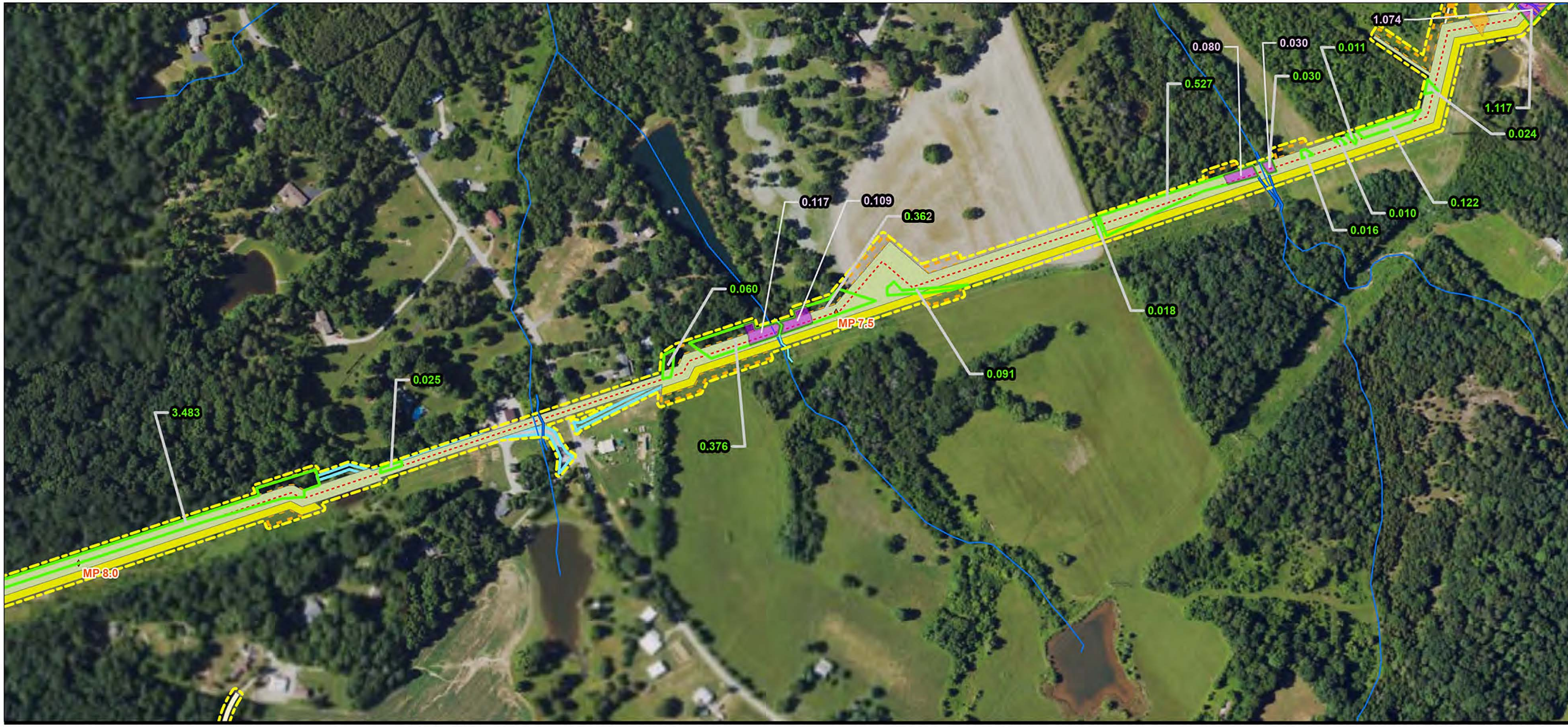

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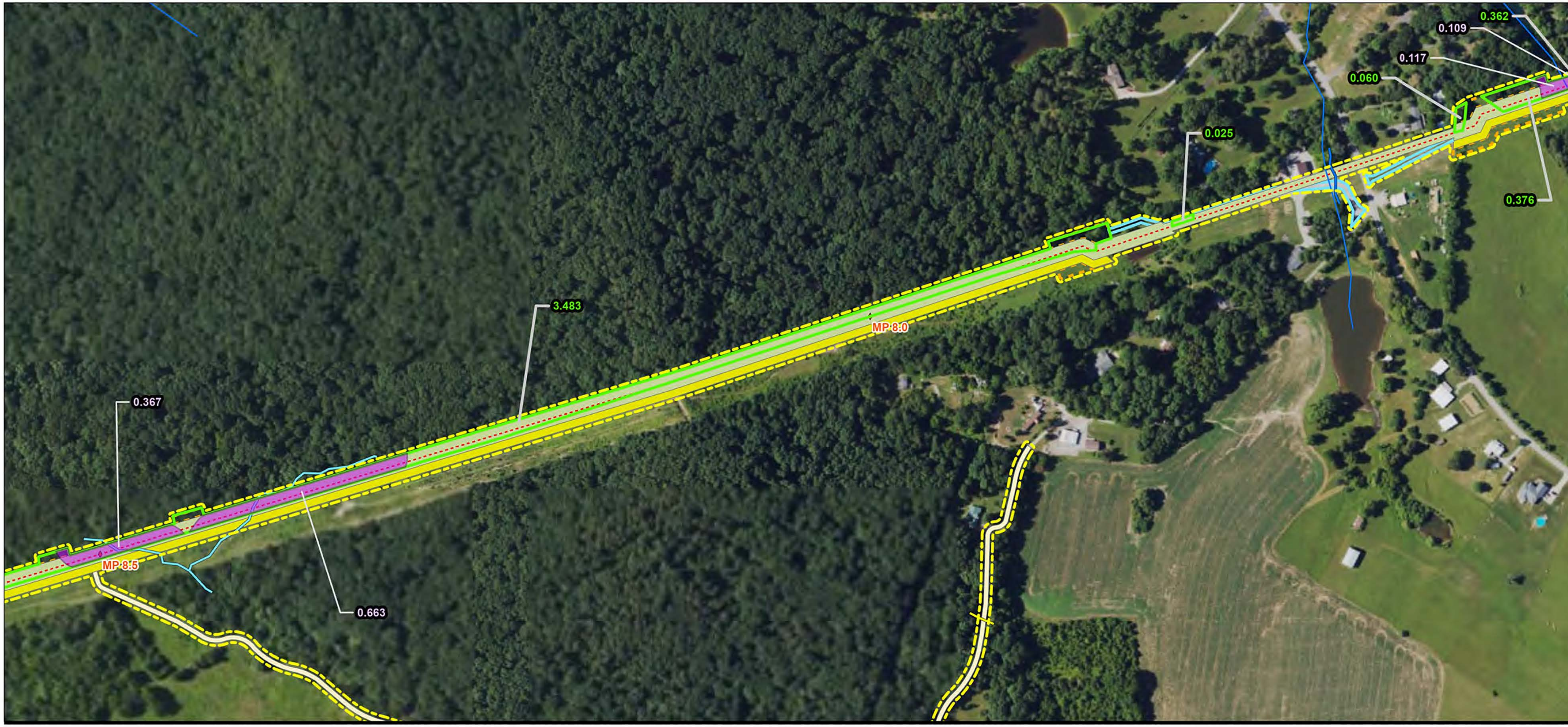

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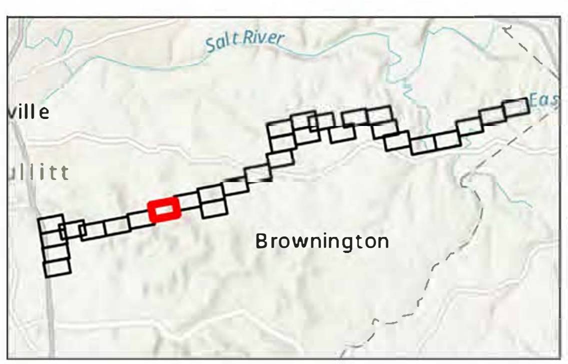

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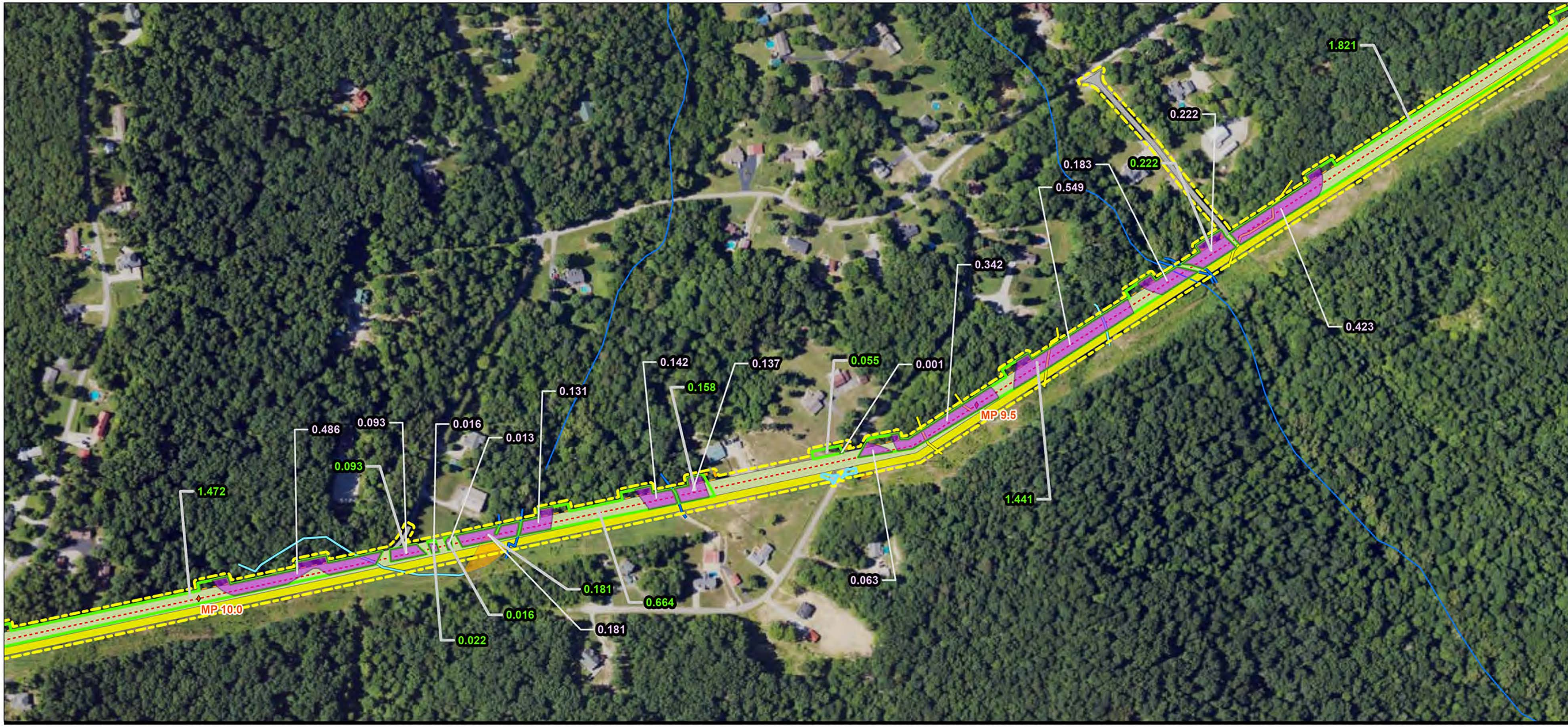

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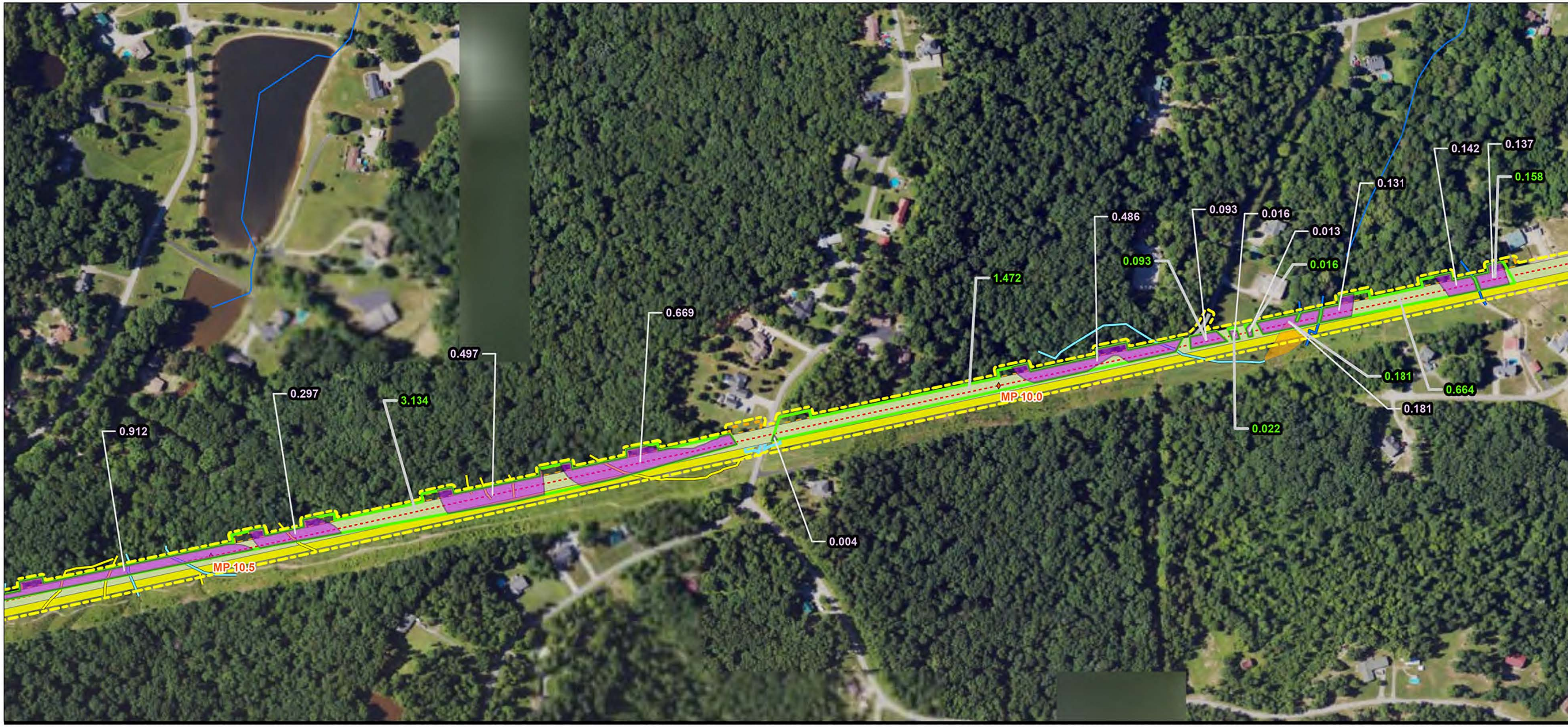
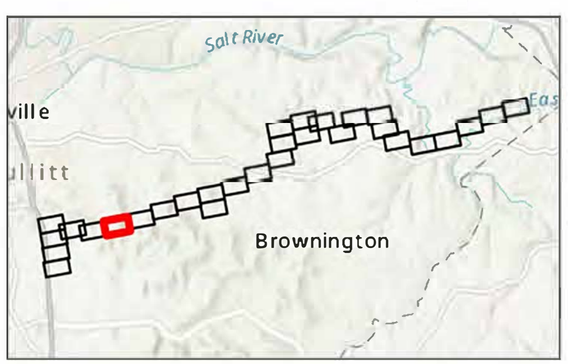
TR by RJB on 2023-02-02
IR by JJA on 2023-02-17

Client/Project
Louisville Gas & Electric
Bullitt County Gas Pipeline Project Biological Assessment

Figure No.
6a

Title
Proposed Tree Clearing





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3. Background: NAIP
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Legend
- Maximum Disturbance Limits
- KY Speliological Society Identified Cave
- Mile Posts
- Previously Identified Sinkhole
- Ephemeral Stream
- Intermittent Stream
- Perennial Stream
- NHD Waterway
- Proposed Pipeline
- Tree Clearing within 100ft WOTUS
- Proposed Tree Clearing Area Overall
- Existing Wetland
- Permanent Right-of-Way
- Construction Entrance
- Temporary Work Space - On ROW
- Temporary Work Space - Off ROW
- Construction Storage Yard
- Proposed Regulator Station
- Temporary Access Road
- Permanent Access Road

0 200 400 600 Feet
(At original document size of 11x17)
1:4,000

N

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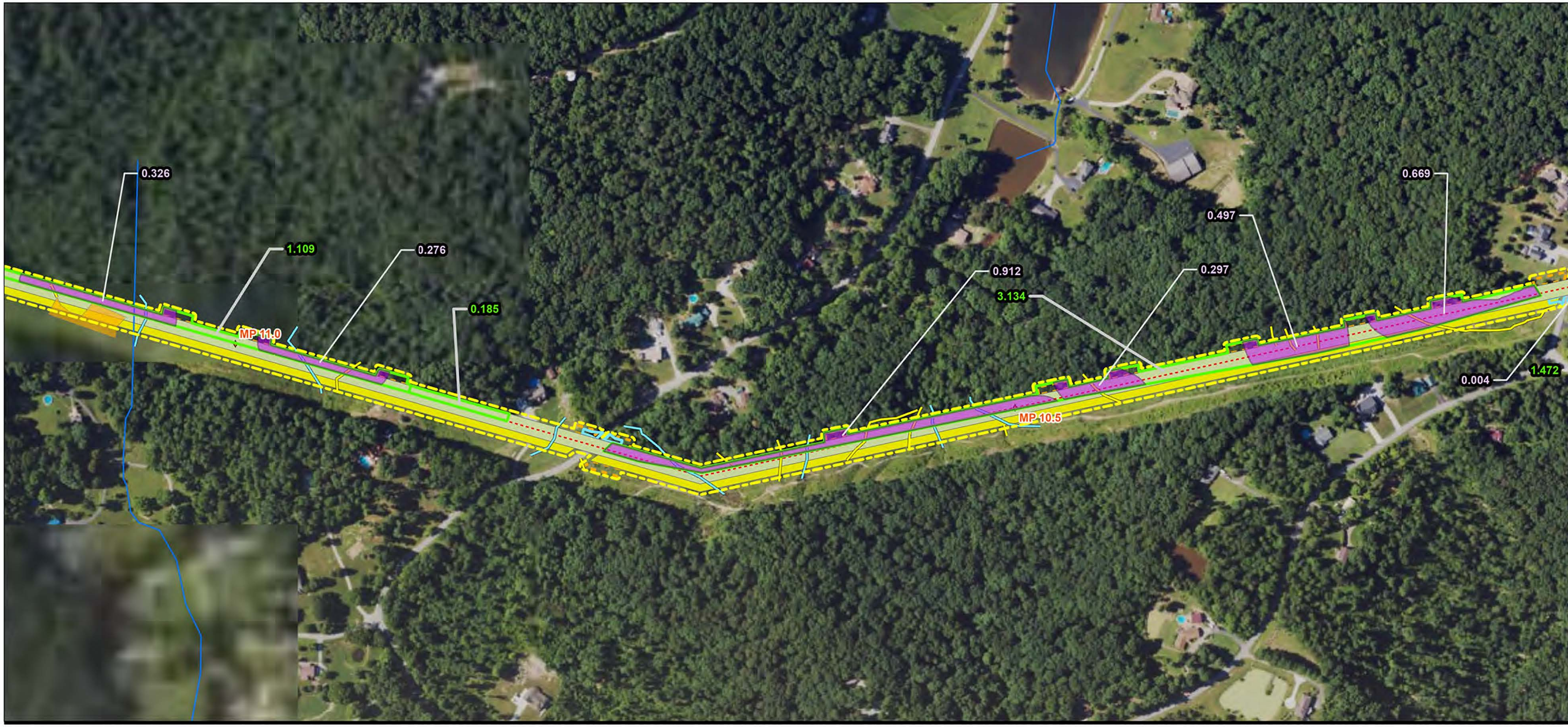

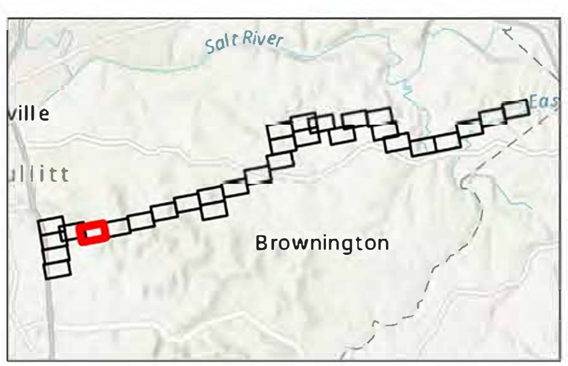

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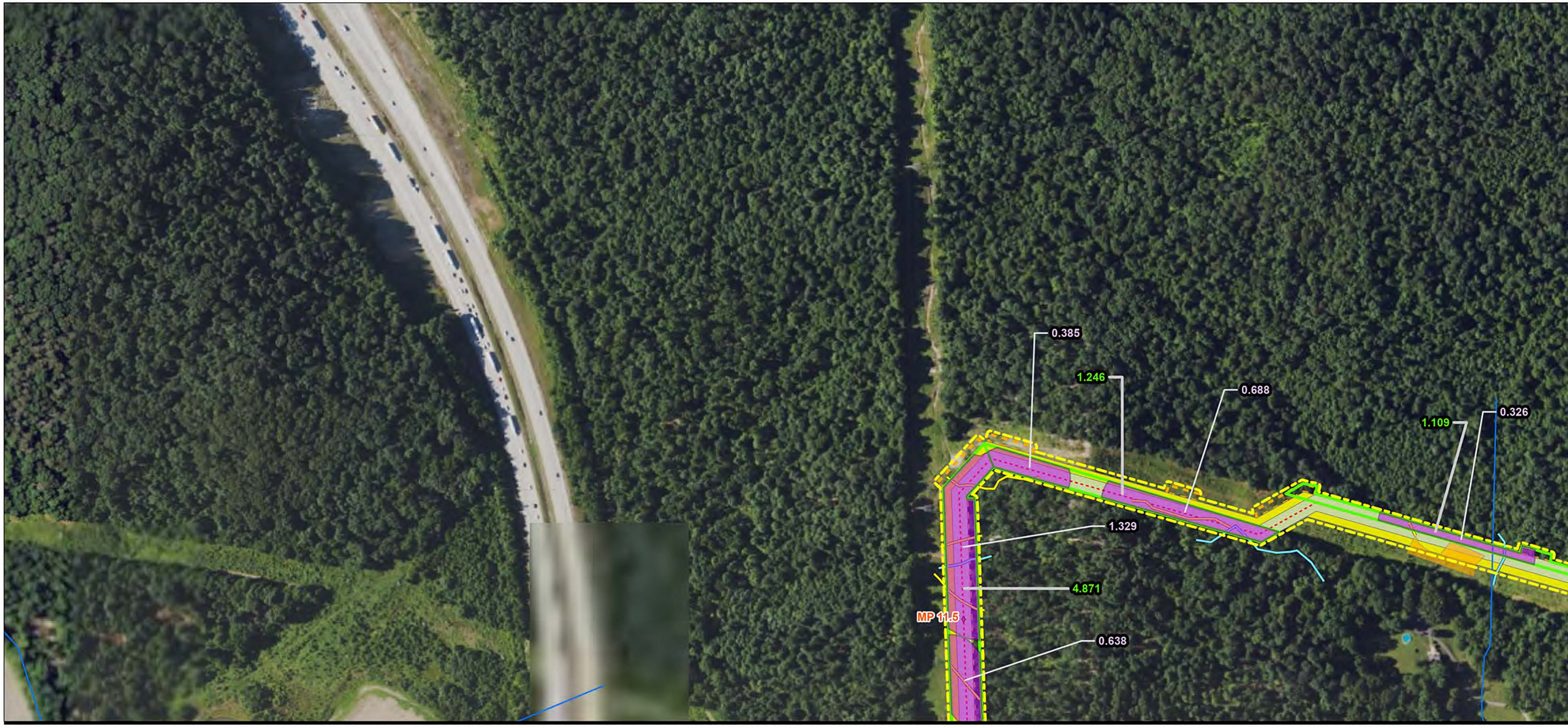

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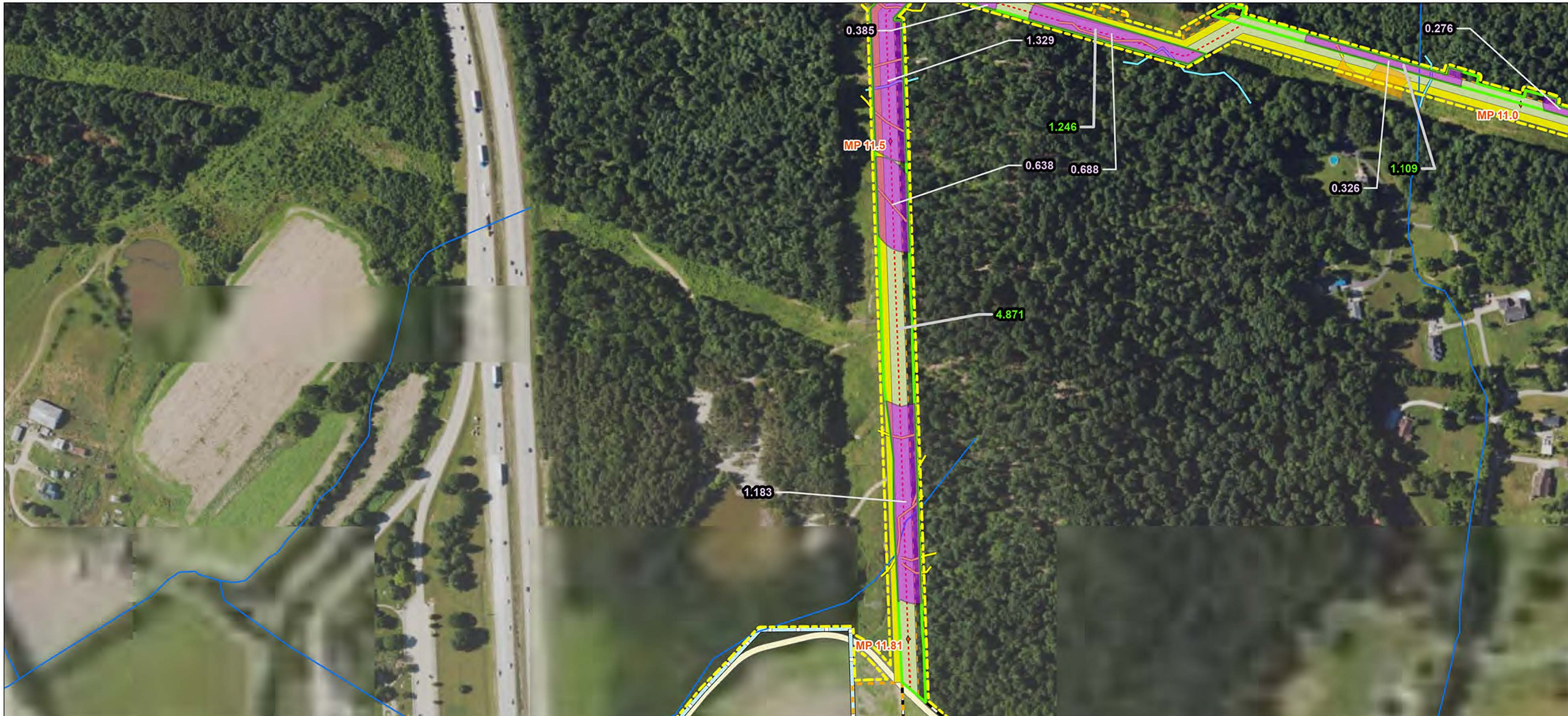

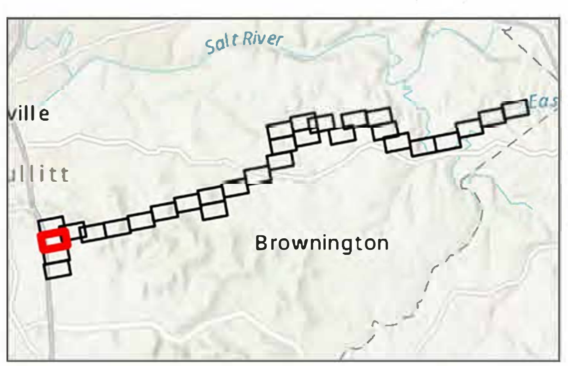

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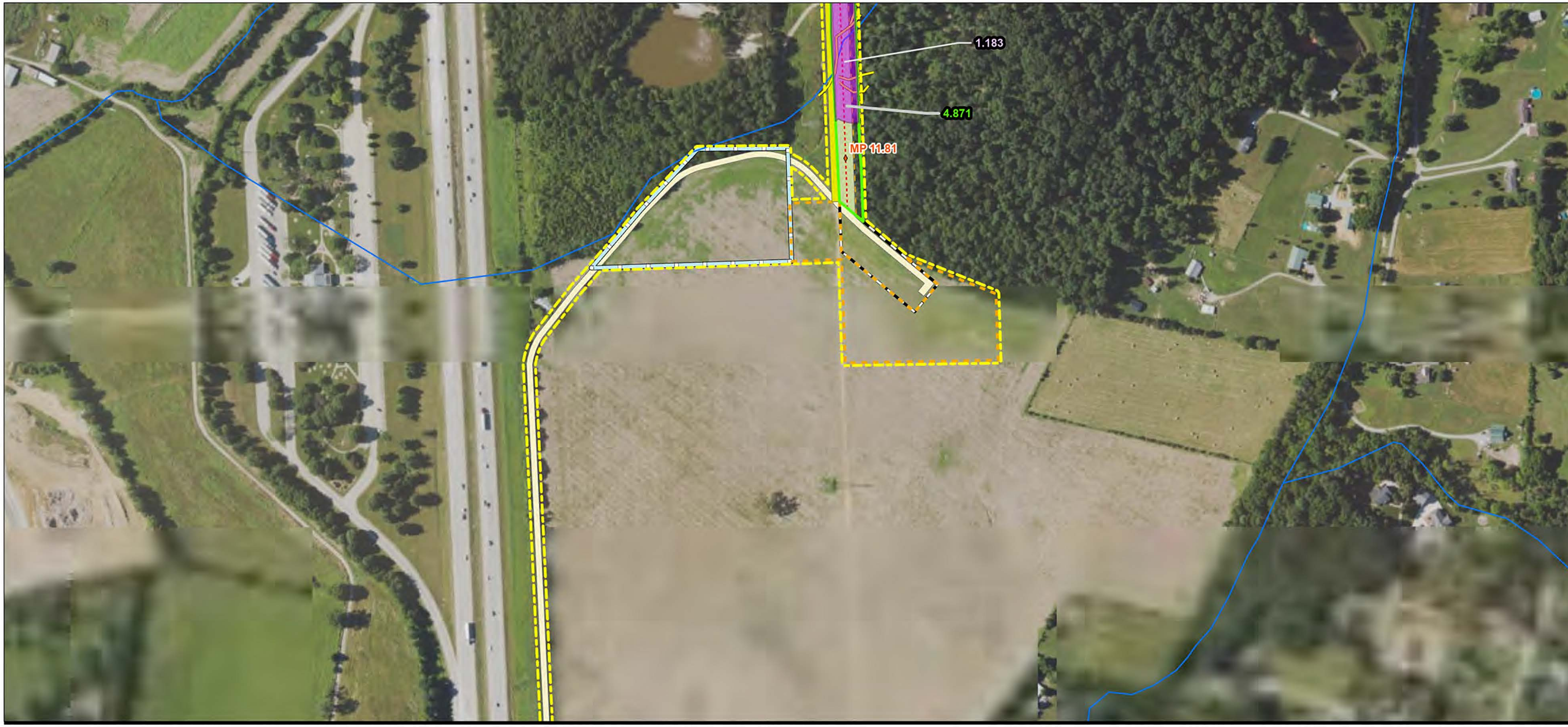

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