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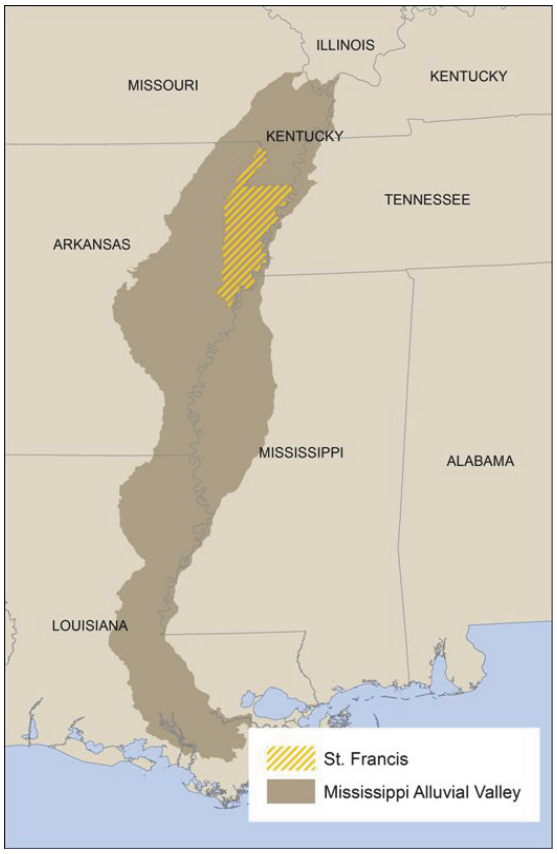
Potential Natural Vegetation of the Mississippi Alluvial Valley: St. Francis Basin, Arkansas, Field Atlas

Charles Klimas, Thomas Foti, Jody Pagan,
and Malcolm Williamson

September 2012
(Revised July 2013)



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Environmental Laboratory

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Final report

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This report replaces a previous version dated September 2012, which contained a significant error. All copies of that previous version should be discarded, and the corresponding GIS files deleted. Replacement GIS files and a pdf of this revised report are available at http://el.erdc.usace.army.mil/emrrp/analyt.html .

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Washington, DC 20314-1000

Abstract

Over the past three decades, extensive field studies of wetland plant communities have been conducted in the Mississippi Alluvial Valley. These field studies have been carried out for various purposes under the auspices of federal and state research programs or in conjunction with Corps of Engineers project planning efforts. In the process, a wetland site classification approach has evolved based on hydrology, soils, and geomorphic setting. The research data and classification system have been recently used for a new purpose: to create a set of Potential Natural Vegetation (PNV) maps covering more than 26,000 square miles within the region. The purpose of PNV maps is to serve as blueprints for restoration planning and prioritization. Due to the fact that the hydrology of the landscape has been permanently changed by major flood control projects, the PNV maps do not represent the distribution of the original, pre-settlement vegetation. Rather, they identify the natural communities that are appropriate to the modern altered site conditions. By using these maps, persons interested in restoring particular tracts of land can identify the plant communities appropriate to the conditions present. Conversely, individuals interested in restoring particular plant communities can identify parts of the landscape that can support each respective type. The PNV maps are available for use in a Geographic Information System, where a range of complex restoration scenarios (such as the development of wildlife travel corridors or refuge areas) can be explored efficiently, and alternative approaches can be compared to one another in terms of costs and ecological effectiveness. This report is one of six Field Atlases that present the same data in a downloadable, printable format at a scale of 1 in. = 1 mile.

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Preface

The Mississippi Alluvial Valley (MAV) once contained the most extensive and diverse lowland forest in North America. The complexity and productivity of the ecosystem were the result of the dynamic behavior of the large rivers that have repeatedly migrated across the landscape, eroding and depositing sediments and periodically flooding millions of acres. Since the arrival of the first European settlers in the 19th century, the rivers have been stabilized and prevented from inundating most of the former floodplain, and agriculture has largely replaced the native vegetation. The deforestation of the MAV has been recognized for more than half a century as contributing to a variety of problems such as the extinction of wildlife species and pollution of receiving waters, including the Gulf of Mexico. Various government policies and private initiatives have been implemented to reverse this damage through restoration of native plant communities.

Ecologists working to restore natural systems in the MAV have sought to understand the fundamental changes that have occurred, particularly with regard to hydrology, and evaluate the effects of these changes on ecosystem function and restorability. The state of Arkansas, with funding from the U.S. Environmental Protection Agency (EPA), initiated much of the research in this area as part of a program to develop guidebooks for hydro-geomorphic (HGM) classification and assessment of wetlands. Various Corps of Engineers offices also participated in HGM-related studies as part of impact and alternatives analyses conducted for proposed federal flood control and water development projects in the MAV. The field data and spatial information developed for some of the projects in Arkansas provided the basis for the initial Potential Natural Vegetation (PNV) maps that were intended to be used to guide restoration planning over large areas. Since then, PNV maps have been developed for all of the MAV in eastern Arkansas, northwestern Mississippi, and northeastern Louisiana, with funding from diverse sources, including Corps of Engineers District offices, EPA, the state of Arkansas, and the U.S. Fish and Wildlife Service.

PNV maps were originally intended to be used in a geographic information system (GIS), where numerous possible options for restoration design can be explored and evaluated. However, as part of their PNV efforts, the Fish

and Wildlife Service also produced the first two Field Atlases– for Louisiana and Mississippi–and made the PNV maps available as downloadable products intended to be printed and bound for field use (http://www.lmvjv.org/bookshelf.htm). This format proved popular, so a set of four additional atlases covering the Arkansas portion of the MAV has been developed, with this current atlas being one of them. All four of these documents are available for download, and the current atlas is available at: http://el.erdc.usace.army.mil/emrrp/analyt.html. The current version (June 2013) of the St. Francis Basin Atlas corrects errors that were present in the original atlas and GIS files, which should be discarded.

Charles Klimas, U.S. Army Engineer Research and Development Center (ERDC), Thomas Foti (Arkansas Natural Heritage Commission and Oakleaf Institute, Little Rock, Arkansas) and Jody Pagan (5-Oaks Wildlife Services, LLC, Stuttgart, Arkansas) developed the PNV concept and approach and have been the core mapping team across all of the basins. The original PNV maps upon which this atlas is based were developed for the Arkansas Multi-Agency Wetland Planning Team (MAWPT) with a Wetlands Program Development Grant from Region 6 of the U.S. Environmental Protection Agency. Malcolm Williamson (Center for Advanced Spatial Technologies, University of Arkansas, Fayetteville) assembled and processed the original project GIS data and subsequently updated and normalized that data and prepared the maps that are included in this atlas.

While various sponsors participated in the development of the original maps, as described above, this series of Arkansas PNV Atlases was prepared and published under the Ecosystem Management and Restoration Research Program (EMRRP), within the Environmental Laboratory, ERDC, Vicksburg, Mississippi. Glenn Rhett is EMRRP Program Manager. Dr. Al Cofrancesco is the ERDC Technical Director for the EMRRP.

COL Kevin J. Wilson is the Commander of ERDC, and Dr. Jeffery P. Holland is the Director.

Unit Conversion Factors

Multiply	By	To Obtain
acres	4,046.873	square meters
inches	0.0254	meters
miles (U.S. statute)	1,609.347	meters
square miles	2.589998 E+06	square meters

1 Introduction

Studies of wetland plant communities in the Mississippi Alluvial Valley (MAV) over the past decade have produced a site classification approach based on hydrology and geomorphic setting. The approach is consistent with the "hydrogeomorphic" or HGM wetland classification system, but it has been adapted and refined specifically to support the development of detailed maps of the Potential Natural Vegetation (PNV) of the region. PNV maps serve as a template for restoration planning and prioritization in a landscape that has been highly modified. Most of the bottomland hardwood forests and other native plant communities of the MAV were converted to agriculture during the 20th century. The remnants are largely those forest types that are adapted to the wettest sites where row cropping was infeasible. At the same time, tremendous local and federal effort has been expended on drainage, flood control, and navigation projects that have permanently altered the hydrology of the floodplain and alluvial terraces in the region. Consequently, the PNV maps are not designed to represent the distribution of the original, pre-settlement vegetation; rather, they identify the natural communities that are appropriate to the altered site conditions, hence the "potential" designation. This means that persons interested in restoring particular tracts of land can identify the plant communities appropriate to the various site conditions present. Conversely, individuals interested in restoring particular plant communities can identify parts of the landscape that could support each respective type. This information is available in GIS format, so various restoration scenarios can be explored and compared in terms of relative costs and ecological effectiveness.

This atlas covers the St. Francis Basin of northeastern Arkansas. It has been created as a field reference for professionals who plan and conduct restoration projects in that area. The maps in this atlas (Appendix A) are produced at a scale of approximately 1:63,360 (1 in. = 1 mile). As an aid to orientation in the field, each PNV map is accompanied by the corresponding aerial image on the facing page, and both pages display major roads and towns. The pages immediately preceding the maps include master indexes to the map pages, using two different basemaps to provide an overview of the mapped PNV types as well as roads and towns for orientation. Also preceding the map section is a map key that lists all of the PNV vegetation

community types present in the basin as well as the community classification code, typical site conditions, and common dominant species for each type. Appendix B follows with details on the characteristics of each community type; these details provide guidance regarding natural topographic features and plant species appropriate for restoration. The PNV approach, mapping criteria, and typical applications are described in more detail in a separate publication (Klimas et al. 2009).

2 The St. Francis Basin

The St. Francis Basin lies in northeastern Arkansas and southeastern Missouri. This atlas includes only the Arkansas portion of the basin (Figure 1). The eastern boundary is defined by the mainstem Mississippi River levee, and the western boundary is Crowley's Ridge. More than 2 million acres are included in the mapped area. The principal streams are the St. Francis, Tyronza, and Little Rivers.

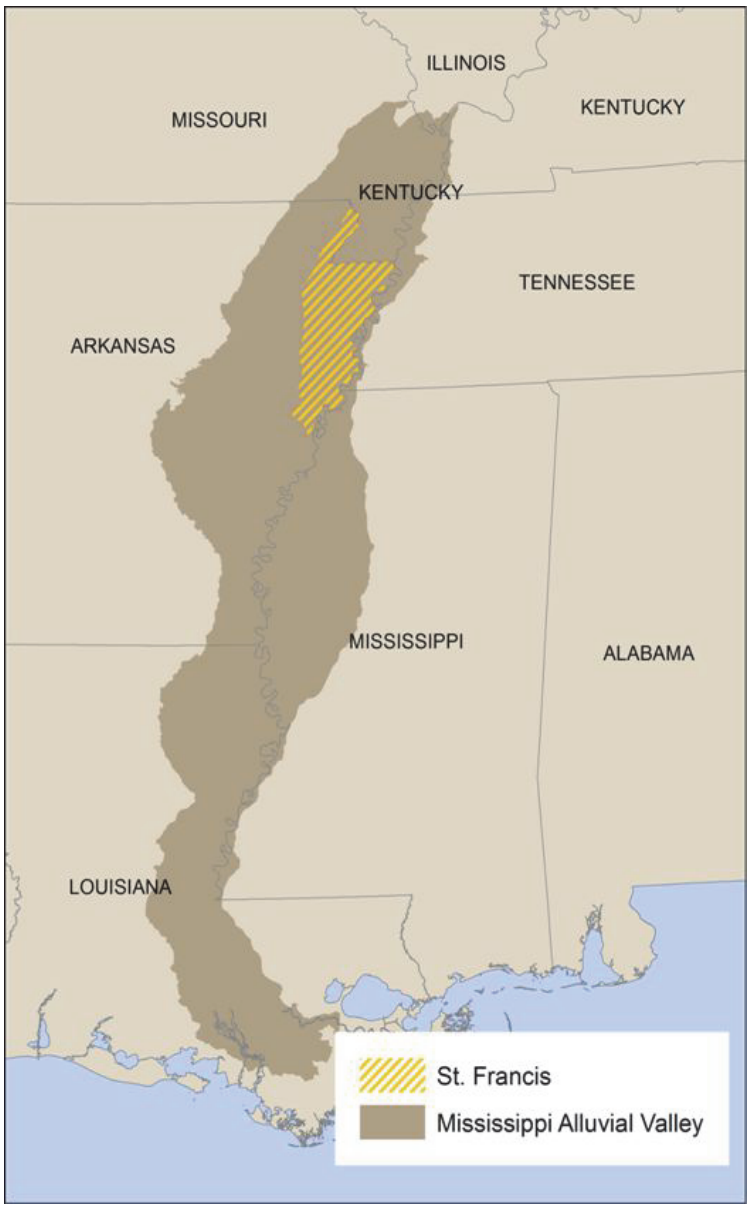

Figure 1. Location of the St. Francis Basin in Arkansas.

Within Arkansas, approximately half of the St. Francis Basin is made up of recent (Holocene) meander belt deposits of the Mississippi River and smaller streams. These include poorly-drained backswamps, better-drained point bars, and well-drained natural levees. Abandoned channel segments form crescent-shaped oxbow lakes and depressions. The remainder of the area is composed of glacial outwash that flushed into the Mississippi Valley during periods of waning Late Wisconsin continental glaciation. Sometimes called "valley train" deposits, they are composed of relatively unsorted, coarse materials deposited in a braided-stream environment, and are very different from the later fine-grained, well-sorted deposits of the modern meandering streams. In the St. Francis Basin within Arkansas, they occur as several distinct terraces. The oldest and highest levels are two narrow terraces adjacent to Crowley's Ridge; the more recent deposits are much more extensive and often lie at approximately the same elevations as the adjacent Holocene meander belts. On the lower and younger terraces, the remnant outwash channels are often distinctly visible, and may carry smaller modern streams within them. Relict sand bars and wind-blown sand are apparent on the surface of some valley train deposits. In the St. Francis Basin, there also are numerous more recent deposits known as "sand blows," consisting of buried outwash sands ejected during the New Madrid earthquakes of 1811 and 1812.

This complex landscape of old and young deposits of various origins was subject to frequent flooding prior to the early 20th century. Since then, the St. Francis Basin has been the focus of one of the most comprehensive and effective flood-control and drainage efforts in the world. The mainstem Mississippi River levee and an internal system of levees and floodways—mostly federal projects—prevent regular overbank and backwater flooding. A network of drainage ditches constructed by local interests effectively removes most of the remaining excess water—local precipitation that once ponded on the surface, supporting forested wetlands. While some of these smaller ditches might be plugged or filled as part of a wetland restoration, the large federal projects are assumed here to be permanent features on the landscape. Therefore, the PNV community type descriptions (Appendix B) specifically note that some types occur "within floodways," and there is some uncertainty concerning the long-term persistence of the species identified as dominants in those man-made environments.

3 Using the PNV Map as a Model for Restoration

The PNV mapping process was conceived as a way to provide the best available representation of restoration potential for the native plant communities of the MAV. One key aspect of these maps is that they reflect current, rather than historic, hydrologic patterns. This fundamental feature of the classification system—basing community designations on site conditions rather than species composition—also prevents misclassification of sites based on past management practices or other historic influences. The map legend (Appendix A) includes several ways of classifying the community types: by HGM subclass, for use with the corresponding HGM functional assessment guidebook (Klimas et al. 2011); by site characteristics, which can be used to help guide site preparation; and by species dominance type, which lists species that frequently dominate on similar sites throughout the MAV. Note that these dominant species are not the only ones that should be included in a restoration plan for a site, and that sometimes one or more of the listed species are not common on a site type within a specific basin. Restoration planning should be based on the detailed and basin-specific community type descriptions in Appendix B, which reflect the probable long-term dominance patterns under current conditions. On forested sites, these will sometimes include species other than those that presently dominate. Because of these characteristics, there are many possible uses for the PNV maps, including those listed below.

Replacement of critical habitat

The PNV mapping effort in Louisiana was initiated specifically to support restoration of potential habitat for the Ivory-Billed Woodpecker, which was prompted by its recent reported rediscovery in Arkansas. Foti et al. (2011) discuss how PNV mapping can be used to help guide a restoration program of that type in the modern MAV landscape. Where critical habitat for other species is dependent on the composition, structure, and distribution of plant communities, the PNV maps can be used in similar ways to target the most effective sites for habitat restoration and population management.

Site-specific restoration design

Because the PNV maps often recognize mapping units of a fraction of an acre, they can normally inform restoration design even on relatively small or diverse sites. The site characteristics and geomorphic settings described in Appendix B indicate the extent to which a particular community tends to be affiliated with the ridges or swales of point bars, the almost-imperceptible vernal pools in backswamps, and similar subtle variations in topography that may have been moderated or eliminated by agricultural practices. Users should evaluate a particular site in light of these descriptions, and restore the appropriate topography prior to planting the area. If filling a ditch or breaking a levee is part of the restoration plan, the expected change in flood frequency will indicate establishment of a plant community different from the mapped unit, and that new "target" condition can be identified by consulting Appendix B. While all of these features will help guide restoration design, users are encouraged to adjust their site preparation and planting plans as needed based on their local knowledge, experience, and observations of actual conditions in the field. In particular, it is important to recognize that the accuracy of the community boundaries on the PNV map are limited by the precision and resolution of the underlying geomorphic, soils, and hydrology mapping, and that transitions between vegetation communities are normally more gradual than the distinct polygons on such maps imply. Similarly, where the modern hydrology is affected by structures such as roads and aquaculture impoundments, community boundaries may appear as straight lines. The authors have attempted to estimate the approximate true boundary if the structure is one that can be easily removed as part of a restoration project (e.g., a low catfish pond levee), but did not modify linear boundaries where the structure is unlikely to be removed (roads and flood-control levees) or where the topography, geomorphology, and soil data did not indicate a probable community transition location. In such cases the mapped feature appears as a rectangle and users should evaluate such modified sites individually prior to developing restoration specifications.

Landscape-level restoration planning

PNV maps can be useful for identifying restoration needs and opportunities where resource objectives involve the distribution of particular habitats over large regions. For example, in a GIS environment, it is relatively simple to identify sites appropriate for the restoration of extremely rare communities (e.g., prairies); sites that would support the maximum habitat diversity

within a single large block of restored forest; or the forest communities appropriate for restoration within various sections of lengthy riparian corridors. PNV maps directly reflect flood frequency; therefore, restoration projects can be designed to assure that flood refuge areas are included in projects intended to provide habitat for terrestrial wildlife. Because the PNV maps use the HGM classification system, they reflect other wetland characteristics of potential interest. For example, the PNV map distinguishes between sites suitable for establishing Connected Depressions and Unconnected Depressions. Though these sites support the same forest communities, the latter is far more suitable for restoring amphibian populations due to the lack of predatory fish. There are numerous similar types of applications that can add flexibility and insight to the restoration planning process.

Mitigation design

The PNV maps have several obvious regulatory and planning applications. They can be used to find suitable locations for in-kind mitigation of project impacts, or to plan mitigation in a watershed context, as is currently encouraged in various federal programs. However, because the PNV maps use the HGM classification system, they can also be used in conjunction with HGM Regional Guidebooks to help calculate the appropriate amount of compensatory mitigation for particular wetland subclasses under various impact scenarios. The HGM guidebook for the Arkansas Delta Region (Klimas et al. 2011) includes assessment models and recovery trajectories that can be used to estimate the degree to which restored wetlands perform certain functions over time. This means that restoration priorities can be adjusted to offset the loss of particular functions, or to favor restoration scenarios that will most quickly meet particular functional needs.

This atlas and other files and documents related to Potential Natural Vegetation mapping in the Mississippi Alluvial Valley can be downloaded from: http://el.erdc.usace.army.mil/emrrp/analyt.html

References

Foti, T., C. Klimas, J. Pagan, and A. Keister. 2011. *Potential natural vegetation of the Mississippi Alluvial Valley: Tensas Basin, Northeastern Louisiana*. Vicksburg, MS: U.S. Fish and Wildlife Service, Lower Mississippi Valley Joint Venture.

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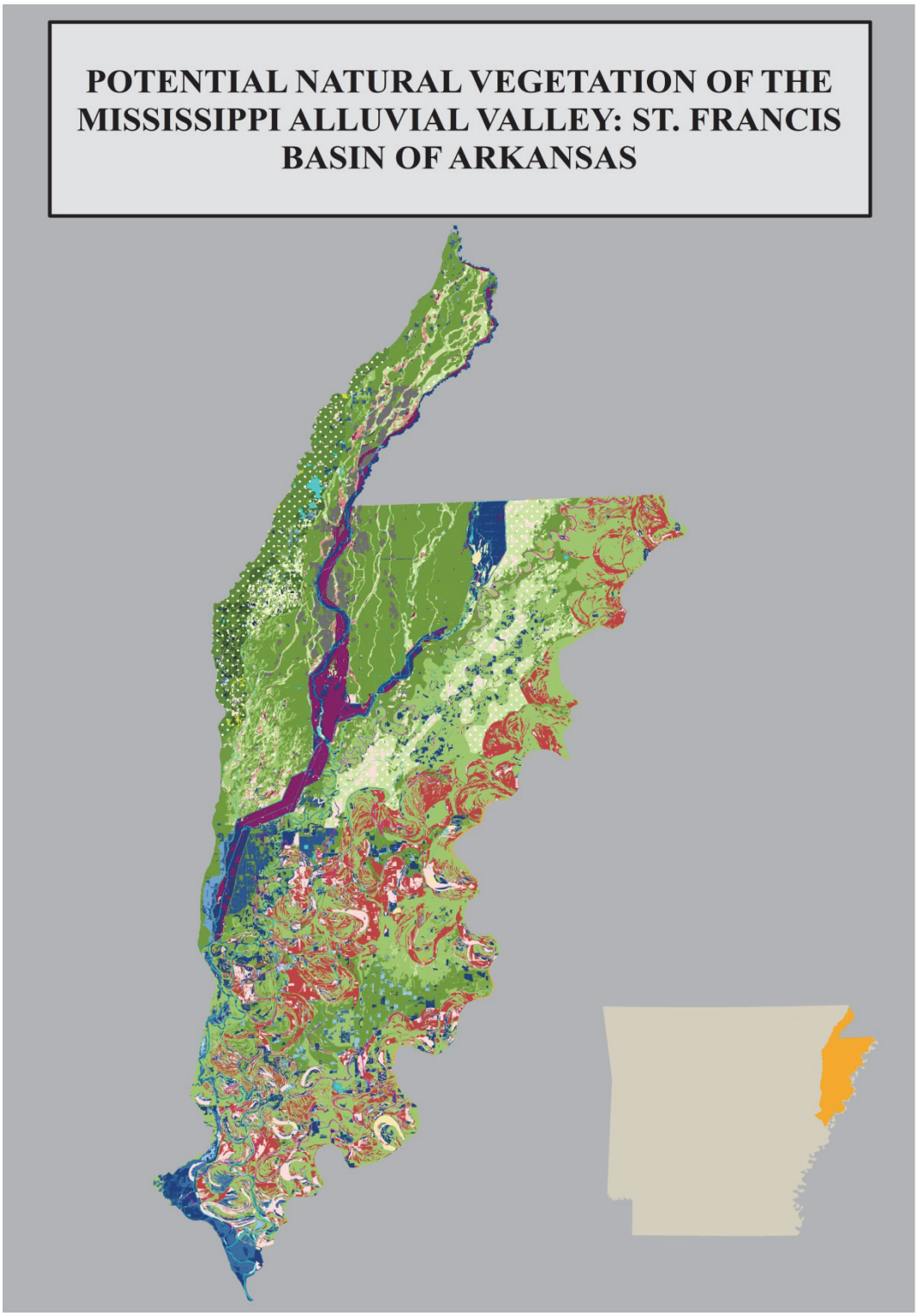
Klimas, C. V., E. O. Murray, J. Pagan, H. Langston, and T. Foti. 2011. *A regional guidebook for conducting functional assessments of forested wetlands in the Delta Region of Arkansas, Lower Mississippi River Alluvial Valley, Version 2.0*. ERDC/EL TR-11-12. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Appendix A: Field Atlas



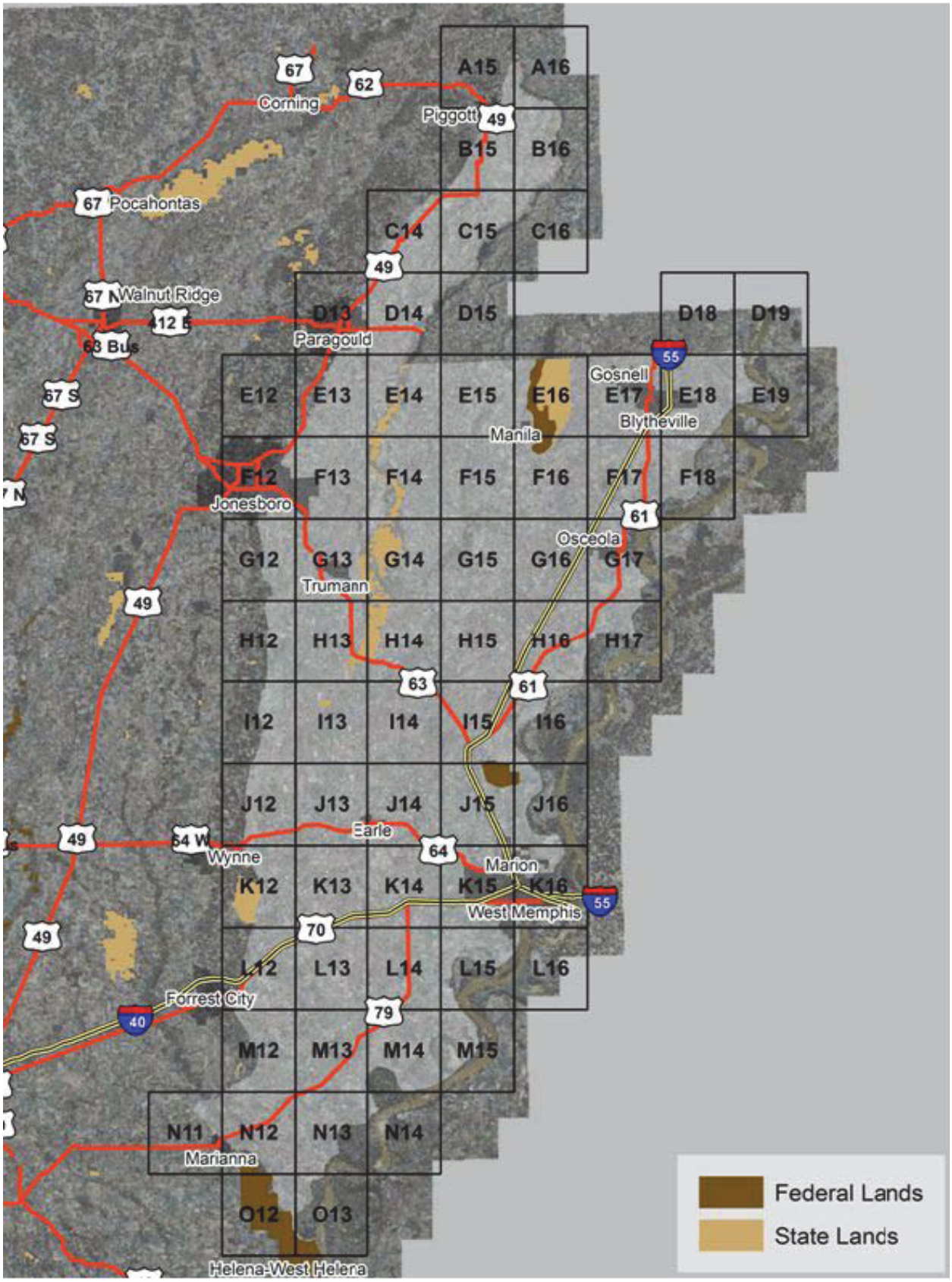


Figure A1. St. Francis Basin Map Index: Cities, Roads, and Public Lands.

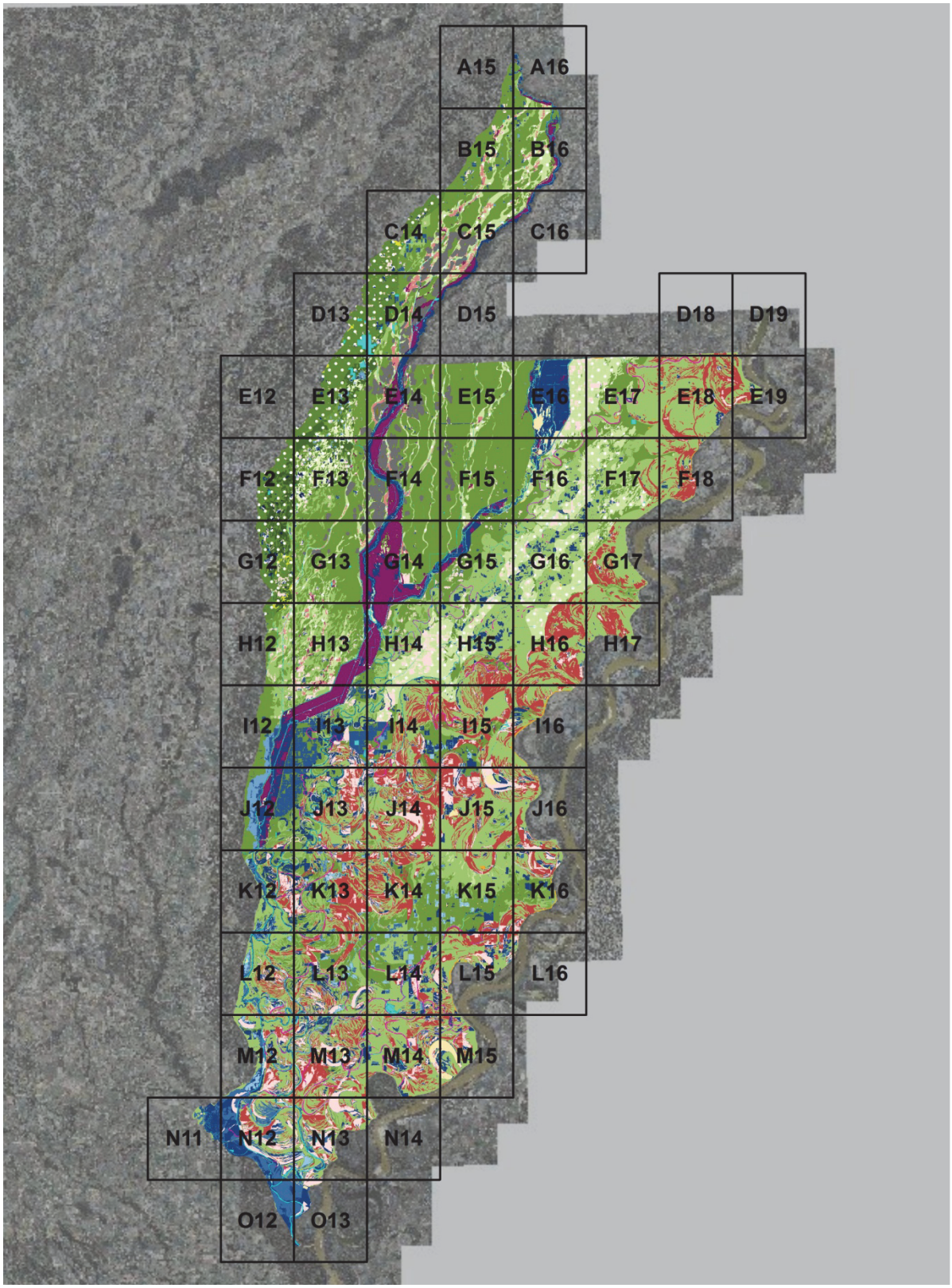
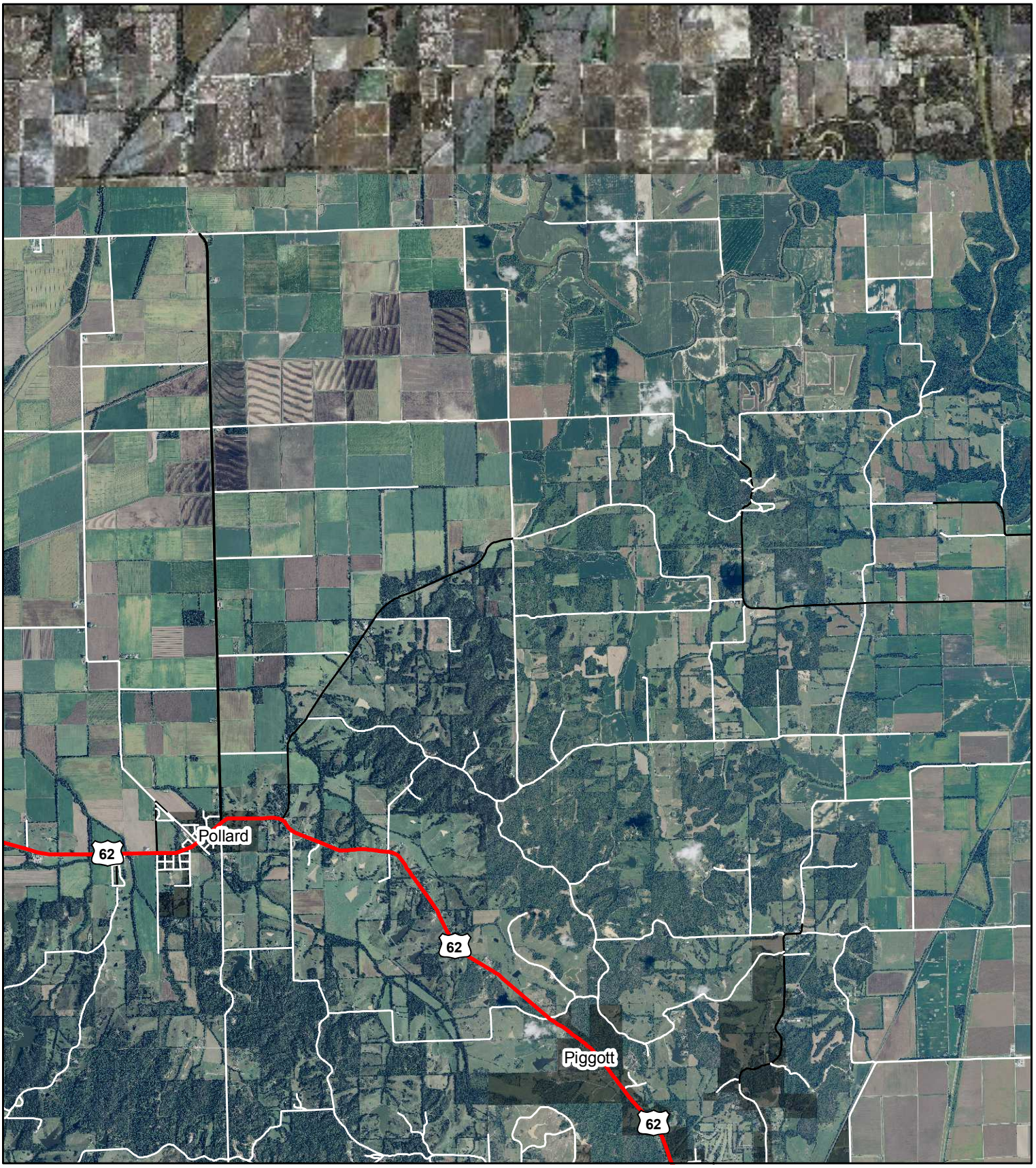


Figure A2. St. Francis Basin Map Index: Potential Natural Vegetation.

POTENTIAL NATURAL VEGETATION MAP KEY, ST. FRANCIS BASIN, ARKANSAS		
HGM Subclass	**General Site Characteristics**	**Principal Dominant Species**
RIVERINE BACKWATER	**WETLANDS MAINTAINED BY RIVERINE BACKWATER FLOODING**	
RB2	Occasionally flooded, moderately-drained lowlands	Willow Oak–Water Oak
RB3	Occasionally flooded flats	Willow Oak
RB5	Occasionally flooded Pleistocene deposits	Willow Oak–Nuttall Oak
RB6	Frequently flooded Pleistocene deposits	Baldcypress–Overcup Oak–Bitter Pecan
RB7	Frequently flooded lowlands	Overcup Oak–Bitter Pecan
RB9	Post oak flatwoods (wet saline phase)	Delta Post Oak–Willow Oak
RIVERINE OVERBANK	**WETLANDS MAINTAINED BY RIVERINE OVERBANK AND HEADWATER FLOODING**	
RO2	River swamps in underfit channels	Baldcypress–Water Tupelo
RO4	Outwash channels in Late Pleistocene deposits and floodways	Mixed Lowland Hardwoods
FLAT	**WETLANDS MAINTAINED BY PRECIPITATION**	
F2	Well-drained recent alluvium in lowlands	Cherrybark Oak–Water Oak–Sweetgum
F4	Moderately drained lowlands	Sugarberry–Green Ash–American Elm
F6	Poorly-drained lowlands	Nuttall Oak–Willow Oak
F7	Poorly-drained undulating topography on Pleistocene outwash terraces	Willow Oak–Water Oak
F12	Alkali post oak flats	Post Oak–Willow Oak–Water Oak
F13	Hardwood flats, Early Wisconsin Valley Train and Deweyville Terraces (wet phase)	Delta Post Oak–Willow Oak
F16	Willow oak flatwoods (wet phase)	Willow Oak–Green Ash
F17	Willow oak flatwoods (dry phase)	Cherrybark Oak–Delta Post Oak–Willow Oak
F18	Post oak flatwoods (wet phase)	Delta Post Oak–Willow Oak
F19	Post oak flatwoods (dry phase)	Post Oak–Southern Red Oak
DEPRESSION	**WETLANDS IN DEPRESSIONS**	
D1	Stream-connected depressions in abandoned channels	Baldcypress–Water Tupelo
D2	Stream-connected depressions on Pleistocene outwash terraces	Baldcypress–Water Tupelo
D3	Unconnected depressions in abandoned channels	Baldcypress–Water Tupelo
FRINGE	**WETLANDS FRINGING WATER BODIES**	
FR1	Stream-connected lake and pond fringe wetlands	Baldcypress–Buttonbush–Emergents
FR2	Unconnected lake and pond fringe wetlands	Baldcypress–Buttonbush–Emergents
UPLAND	**UPLANDS**	
U2	Well-drained soils of the Pleistocene terraces	Mixed Hardwood and Pine
U4	Pleistocene dunefields and barrens	Black Oak–Post Oak–Southern Red Oak
WATER	**WATER**	
W	Permanent water bodies other than lakes and ponds (fringe)	Streams and major drainage ditches

Figure A3. Map legend.



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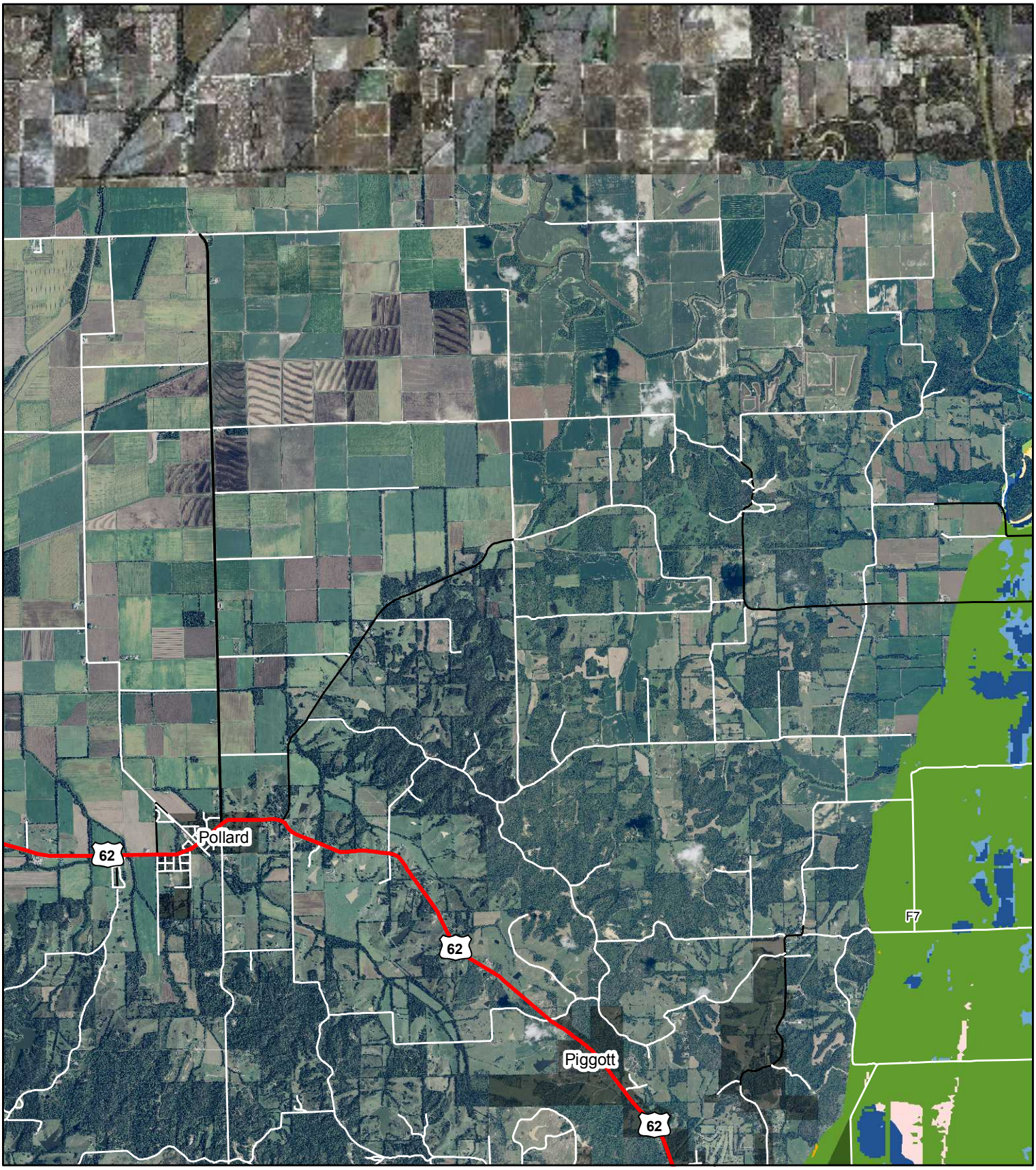

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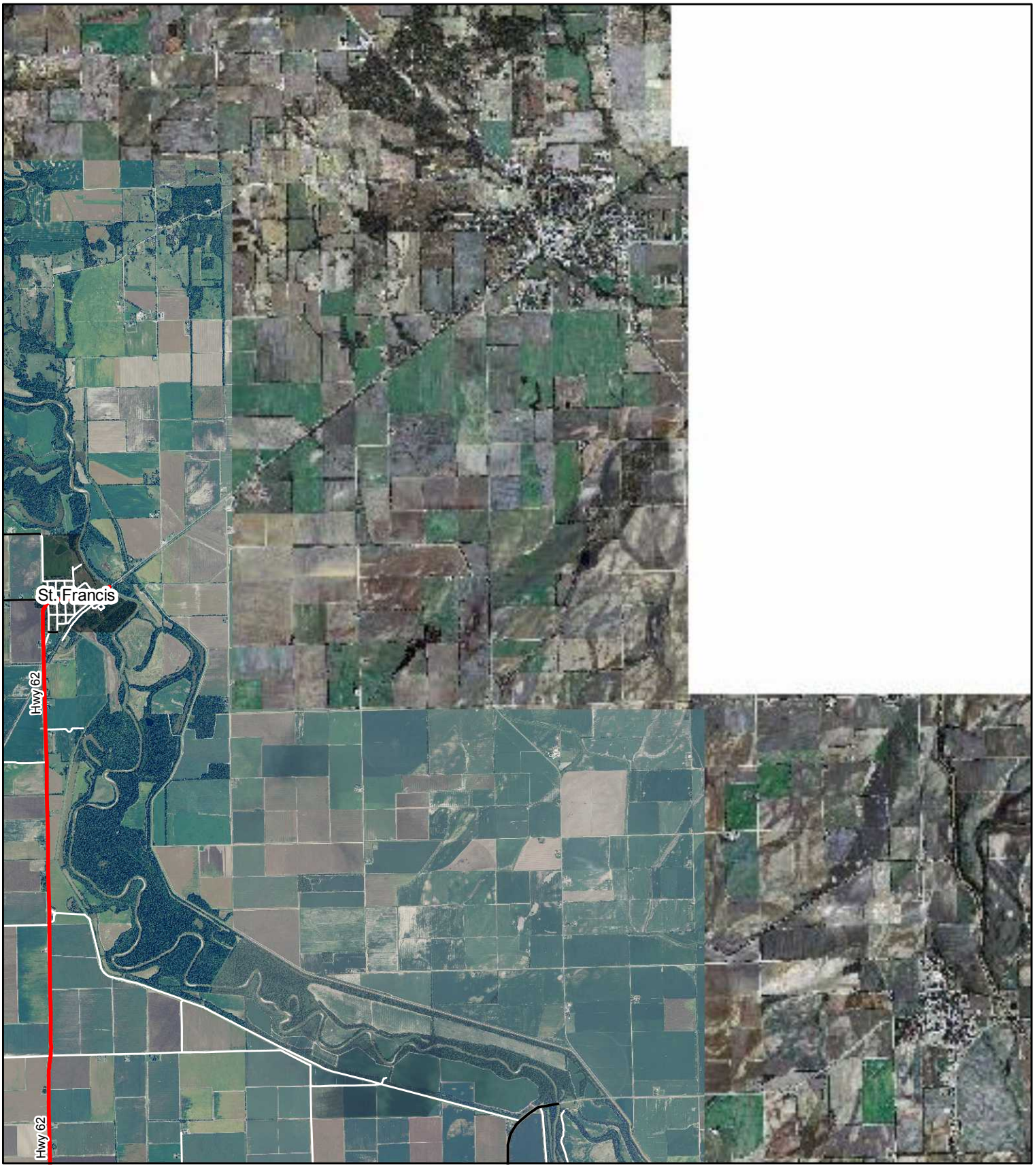

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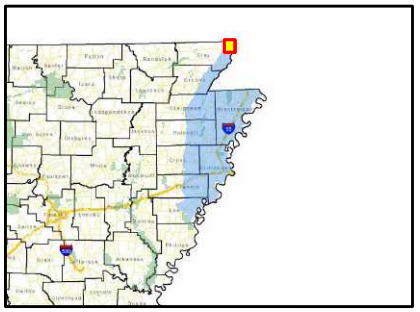

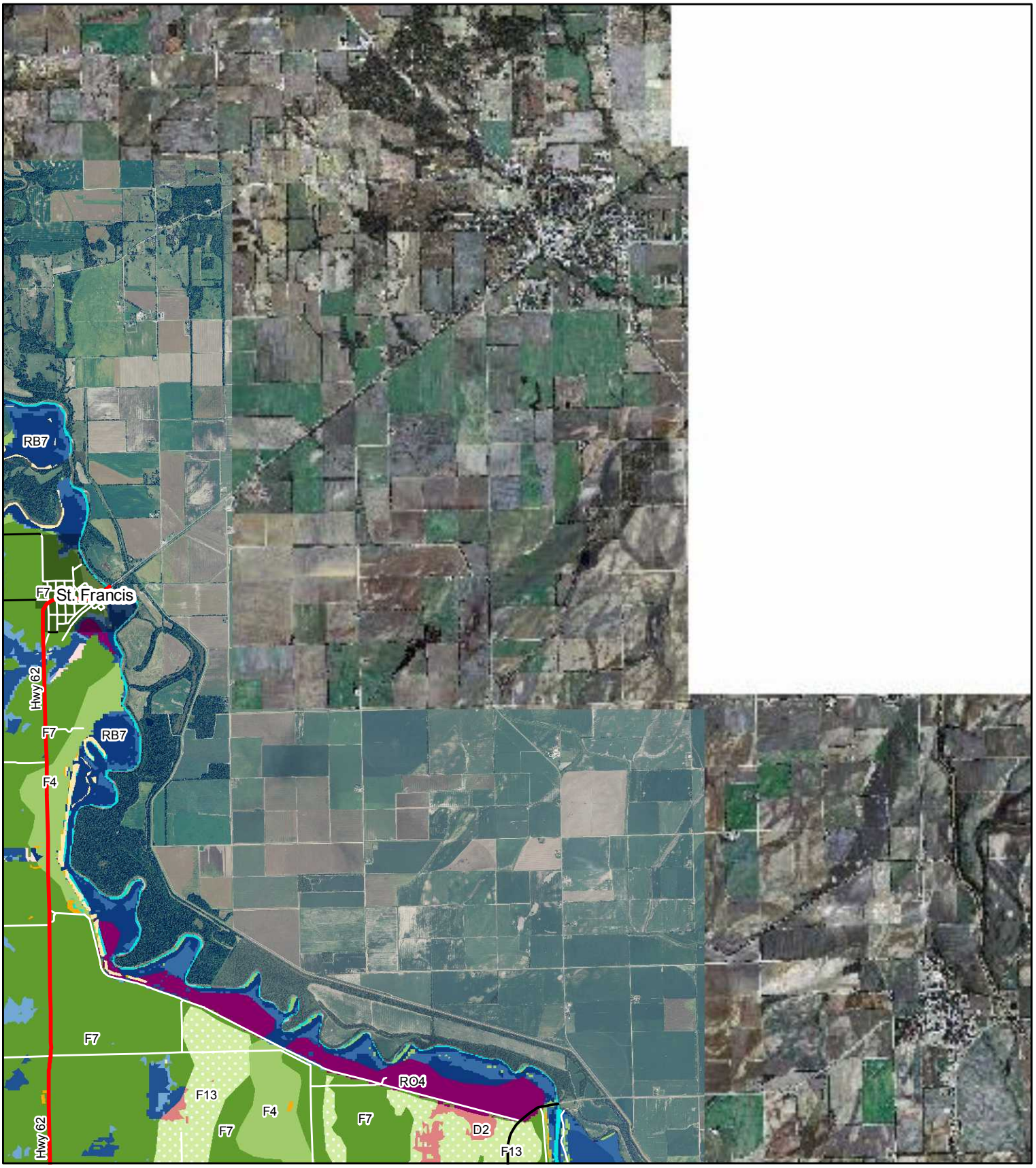

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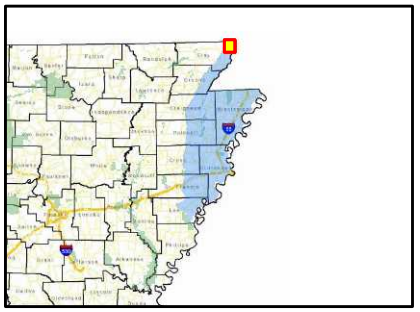

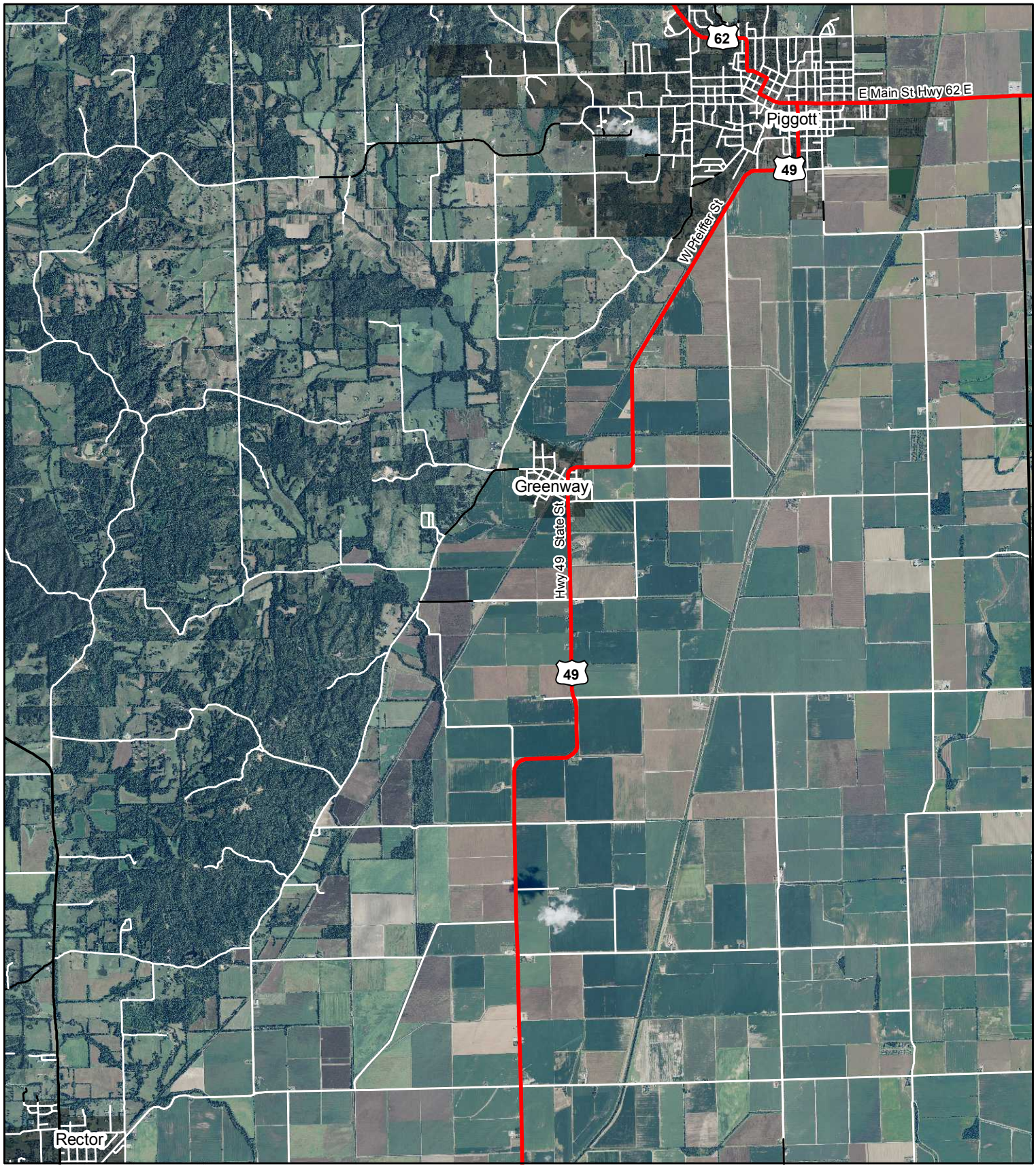

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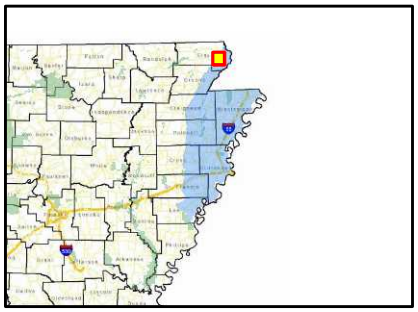

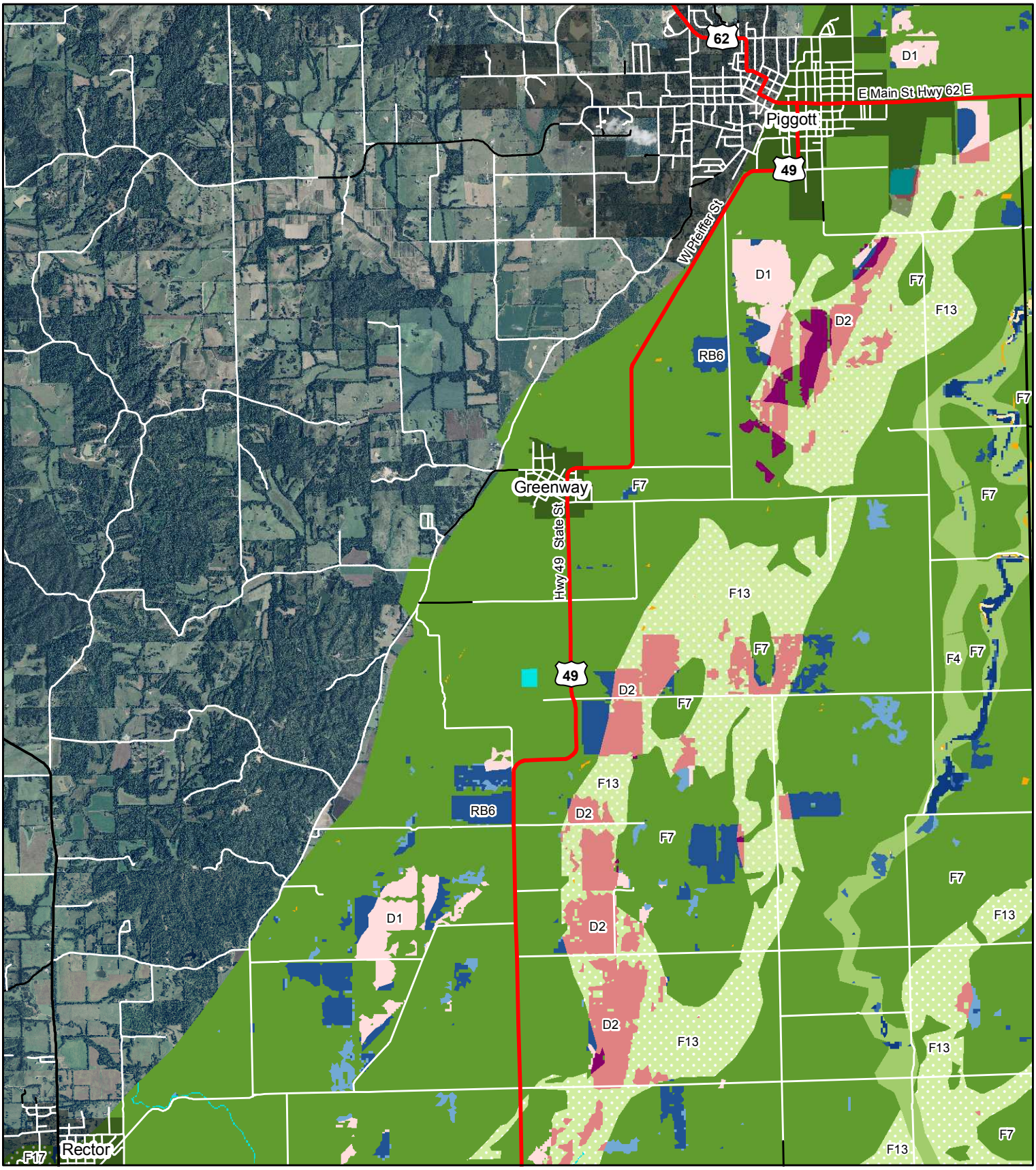

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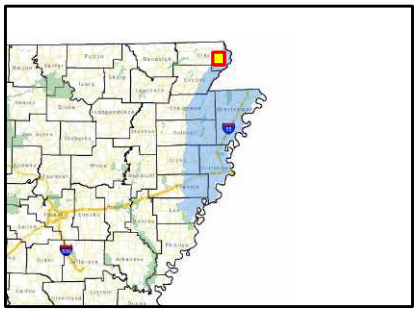

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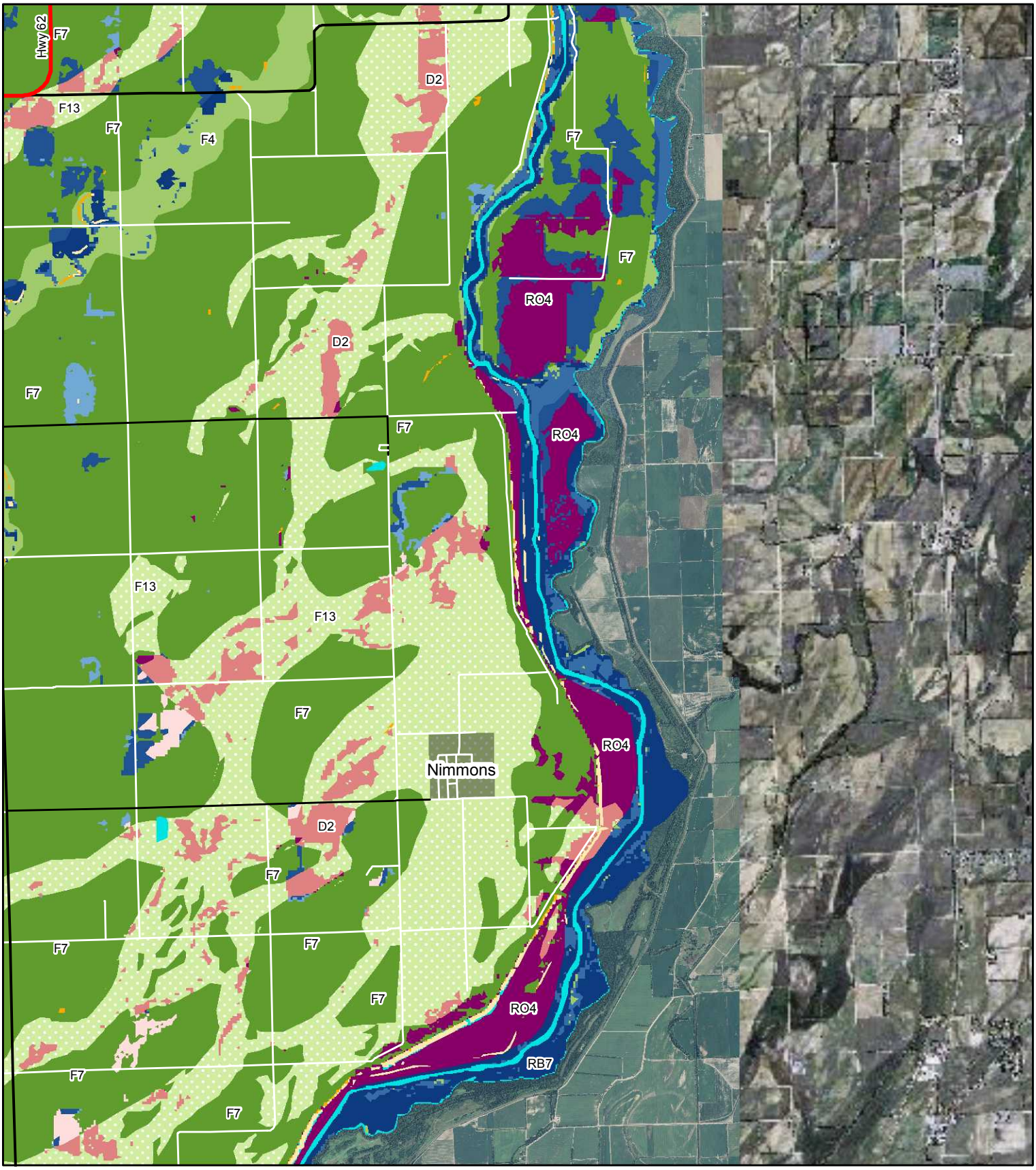

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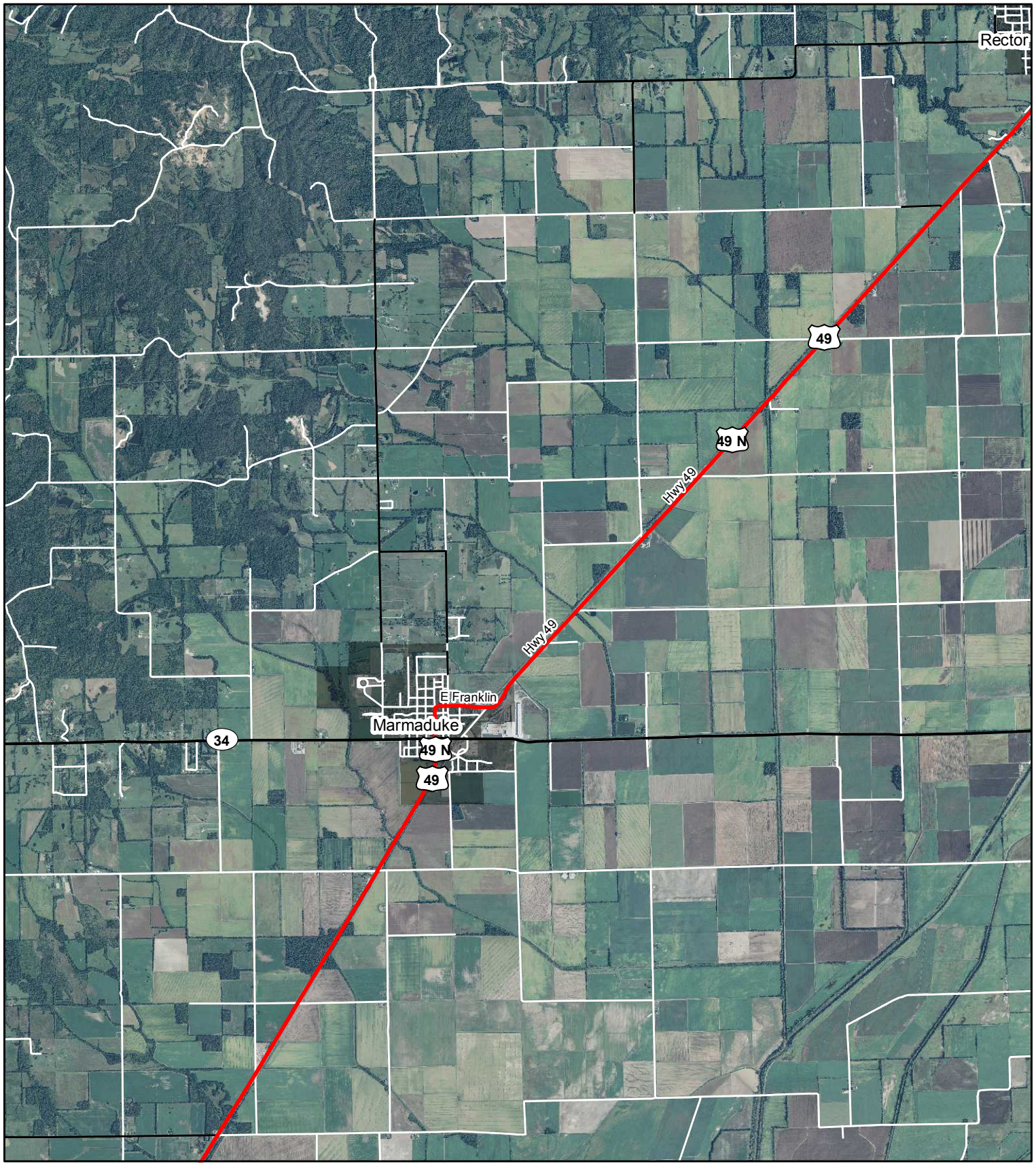

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Projection: Transverse Mercator
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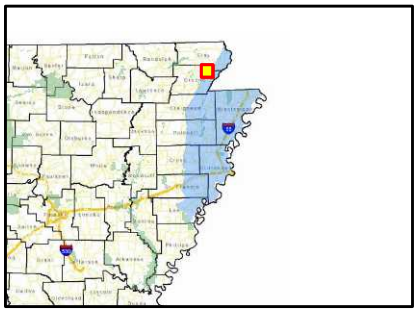
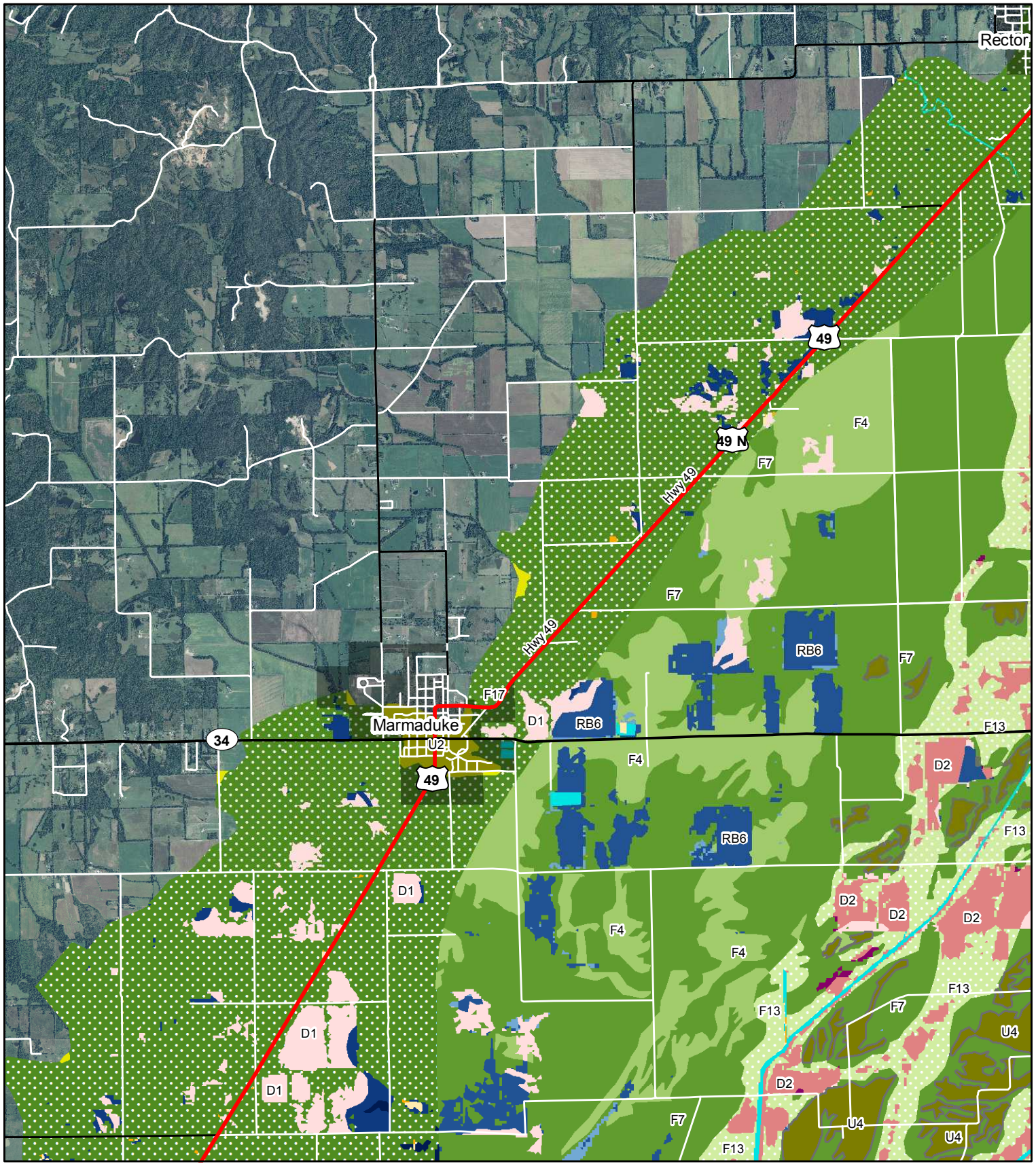
C14





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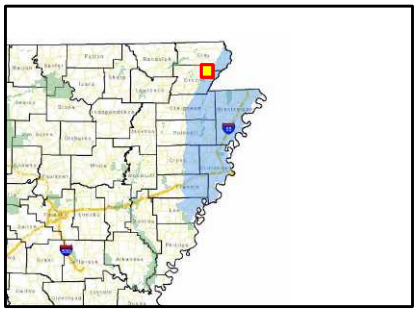

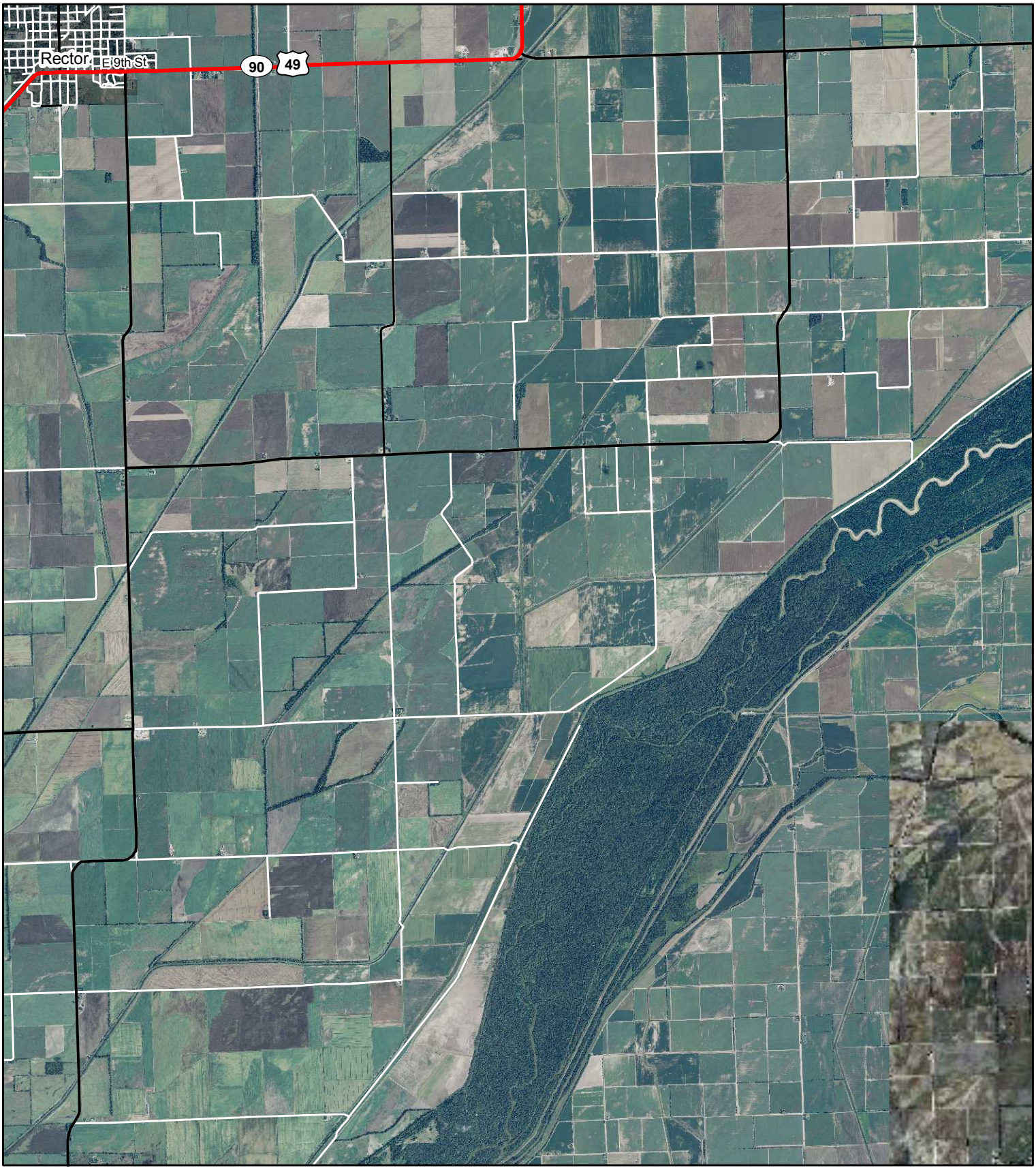

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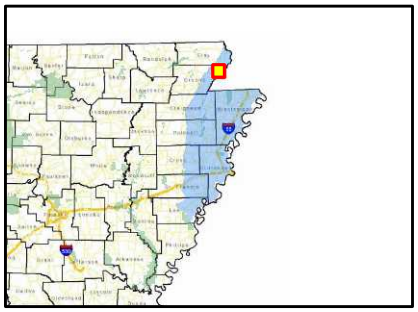

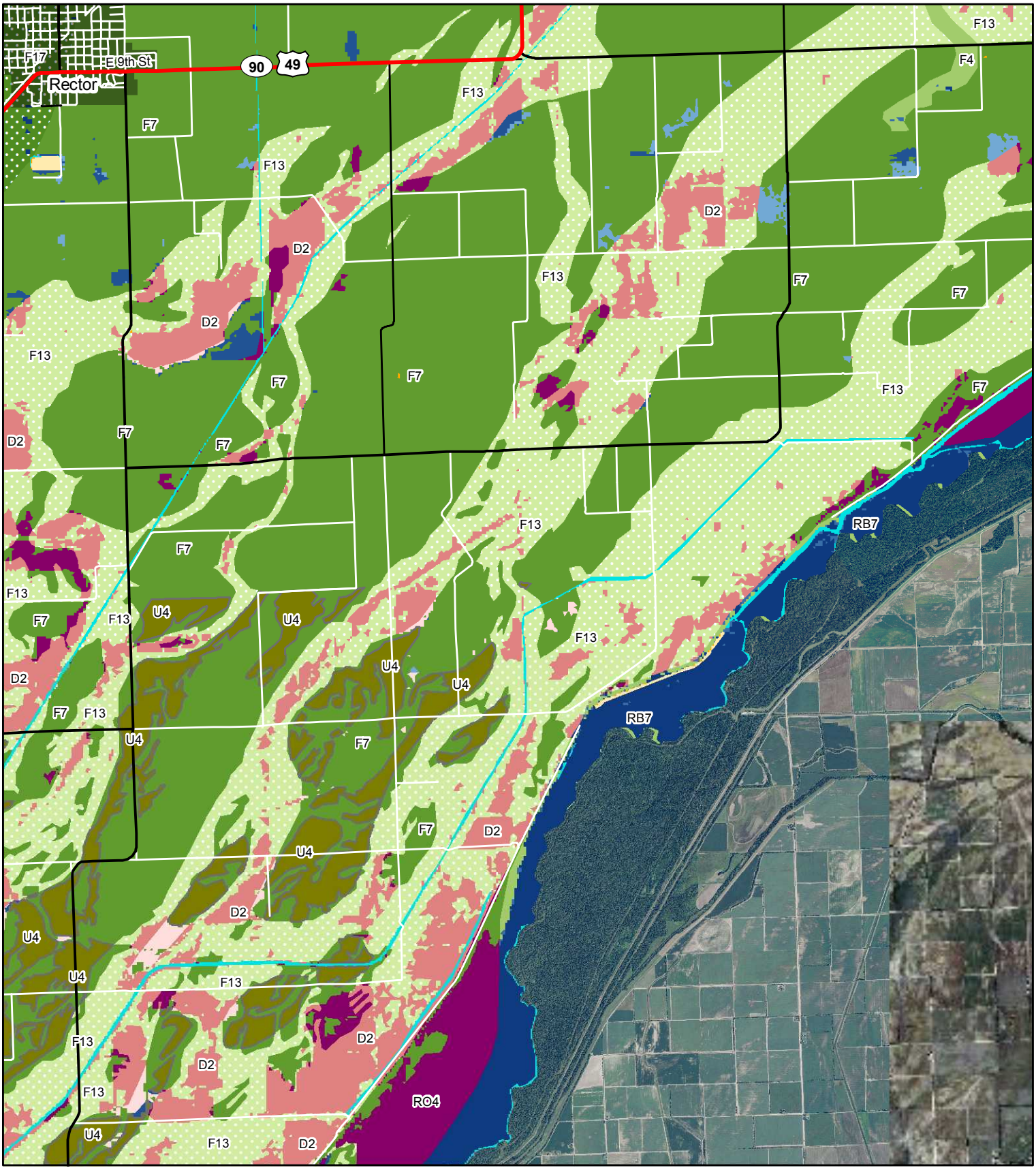

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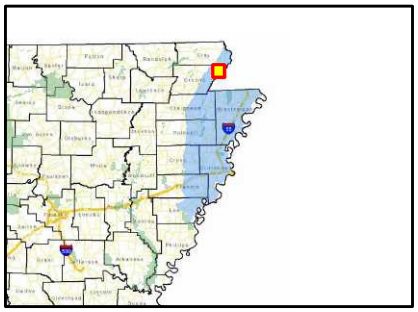

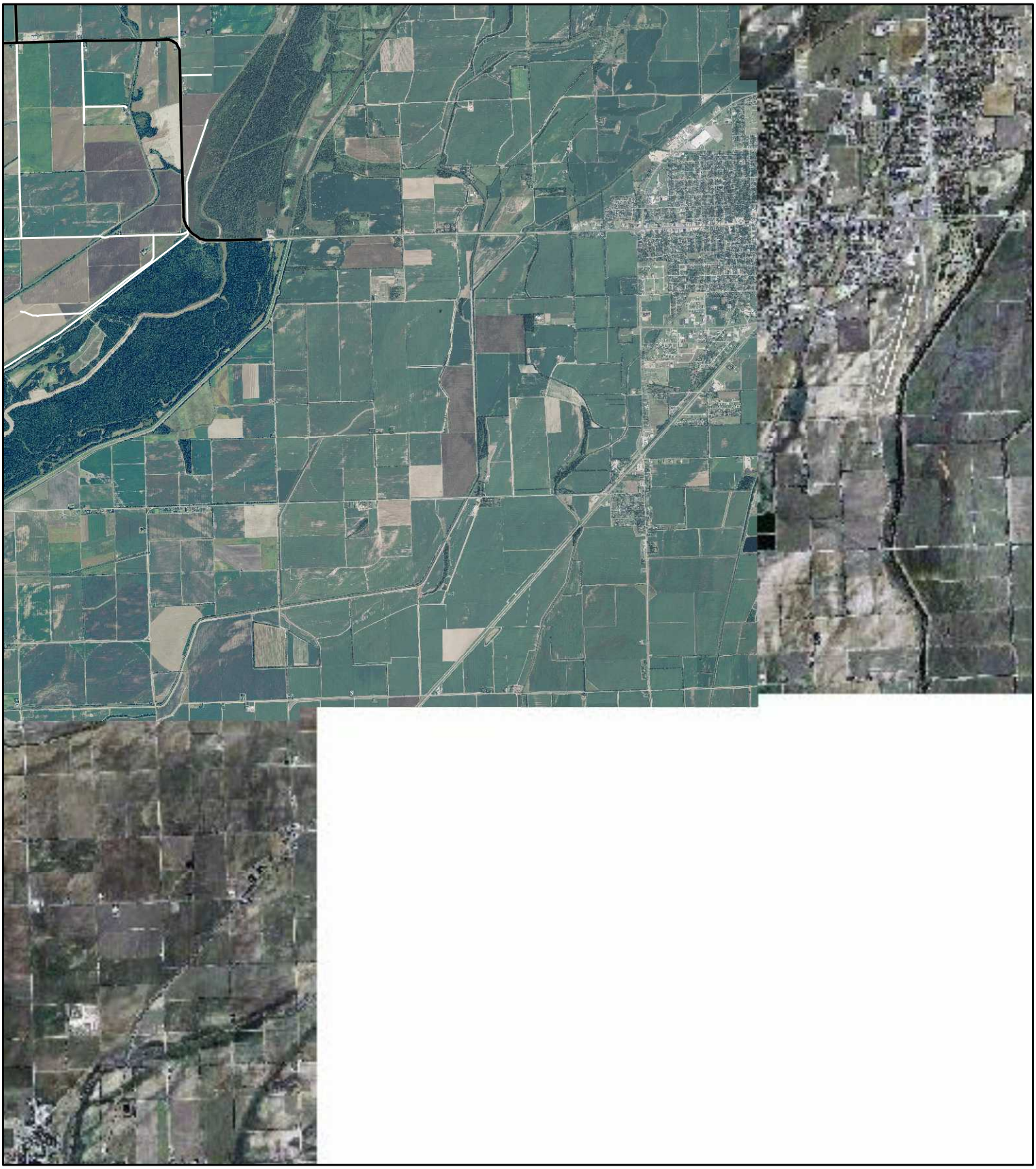

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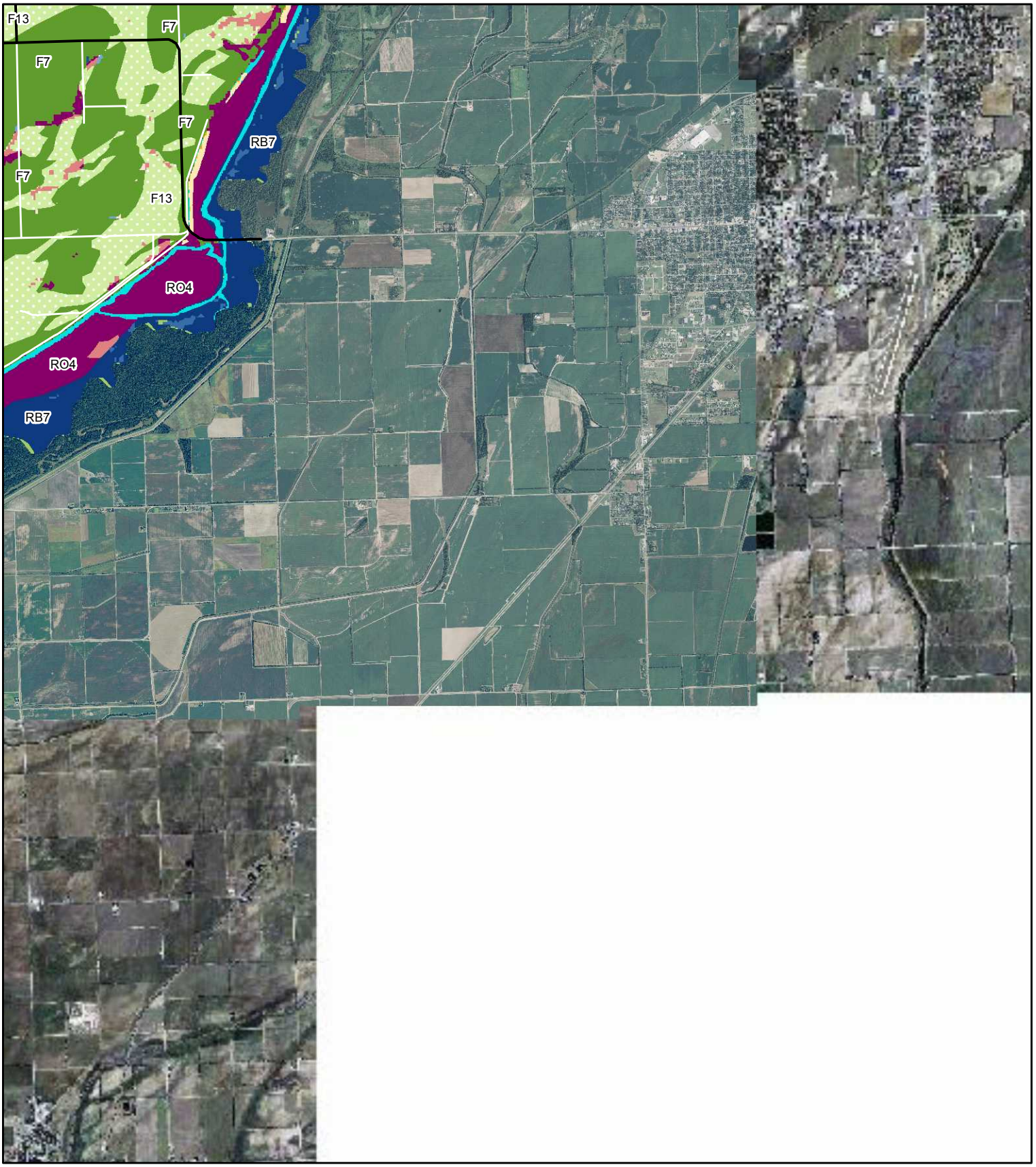

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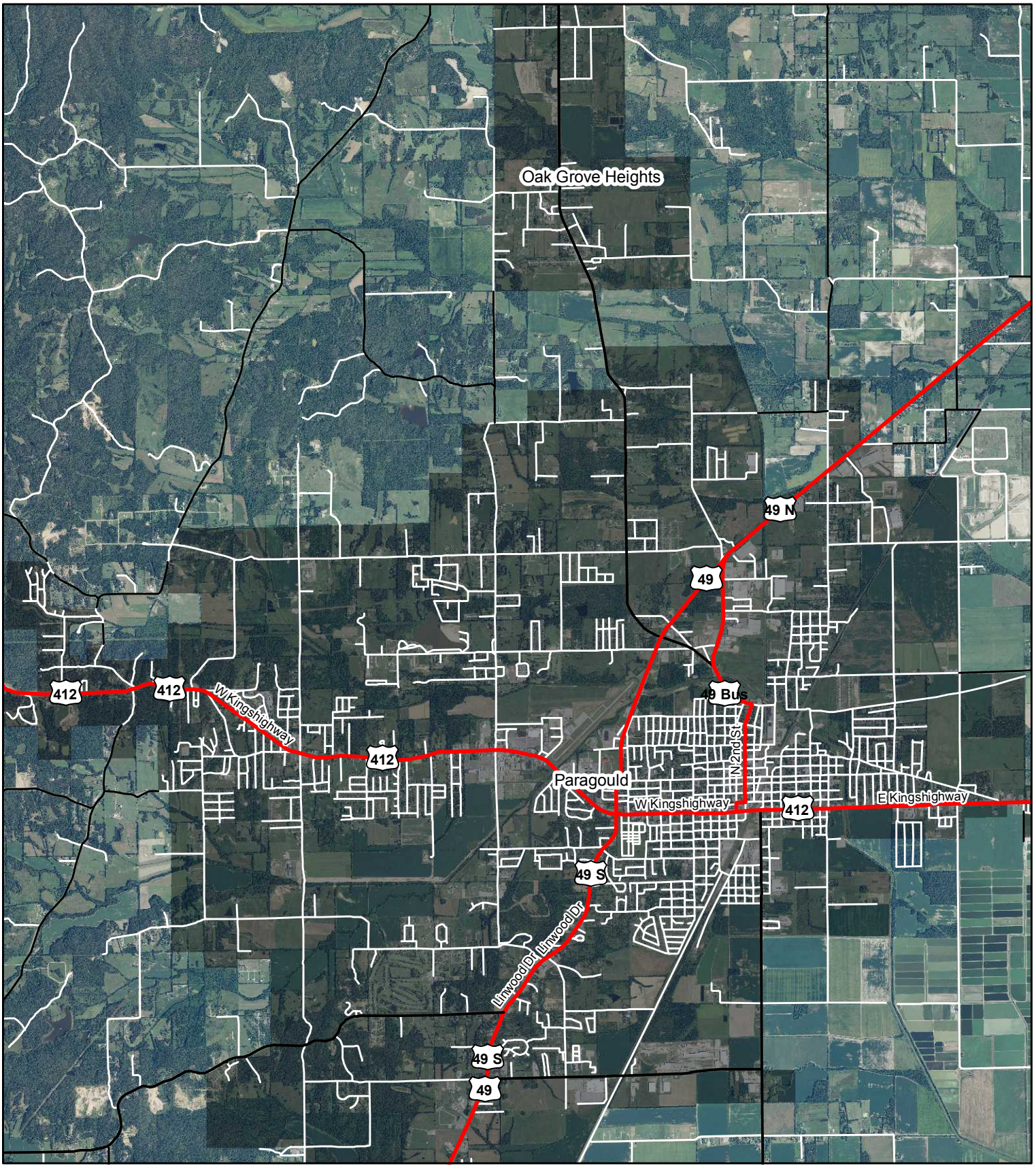

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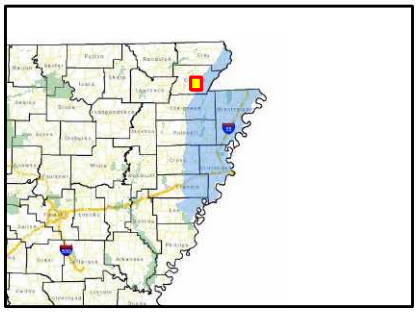

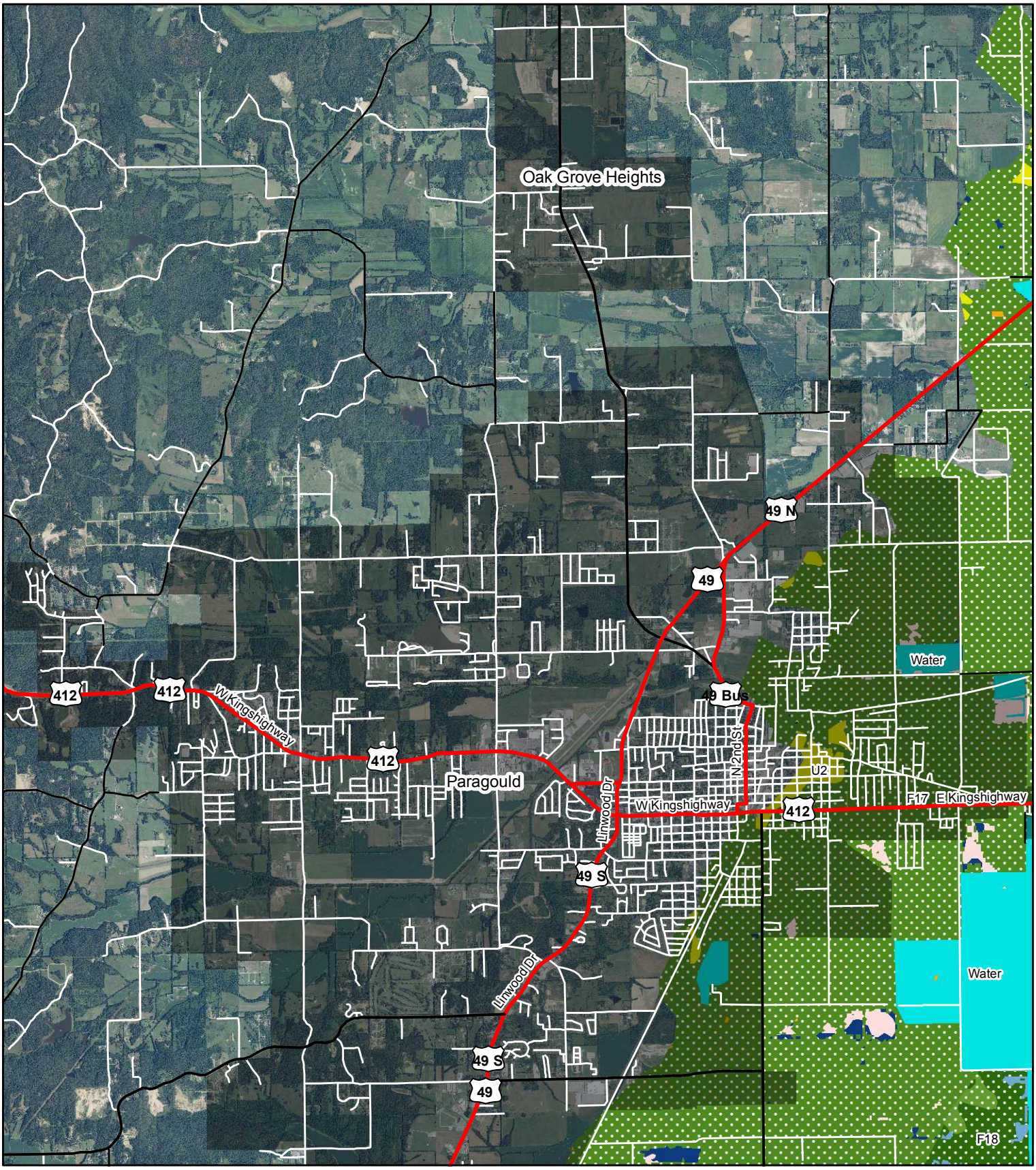

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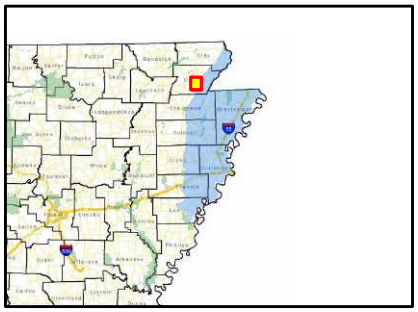

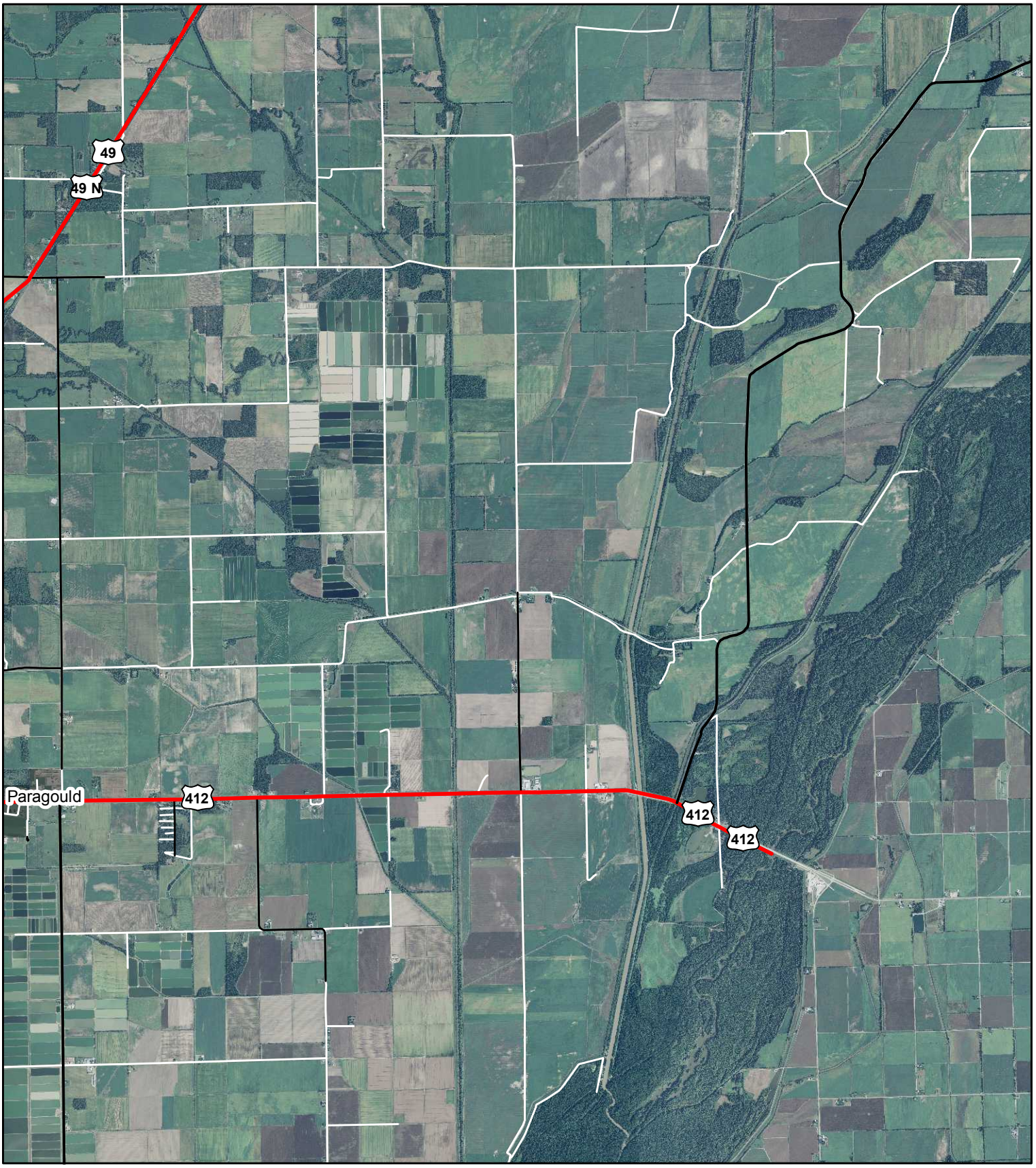

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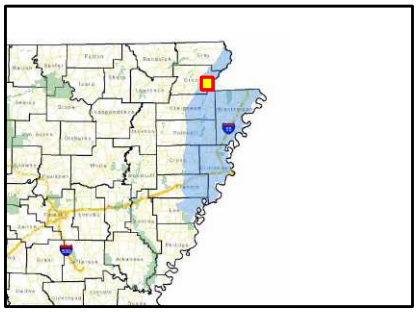

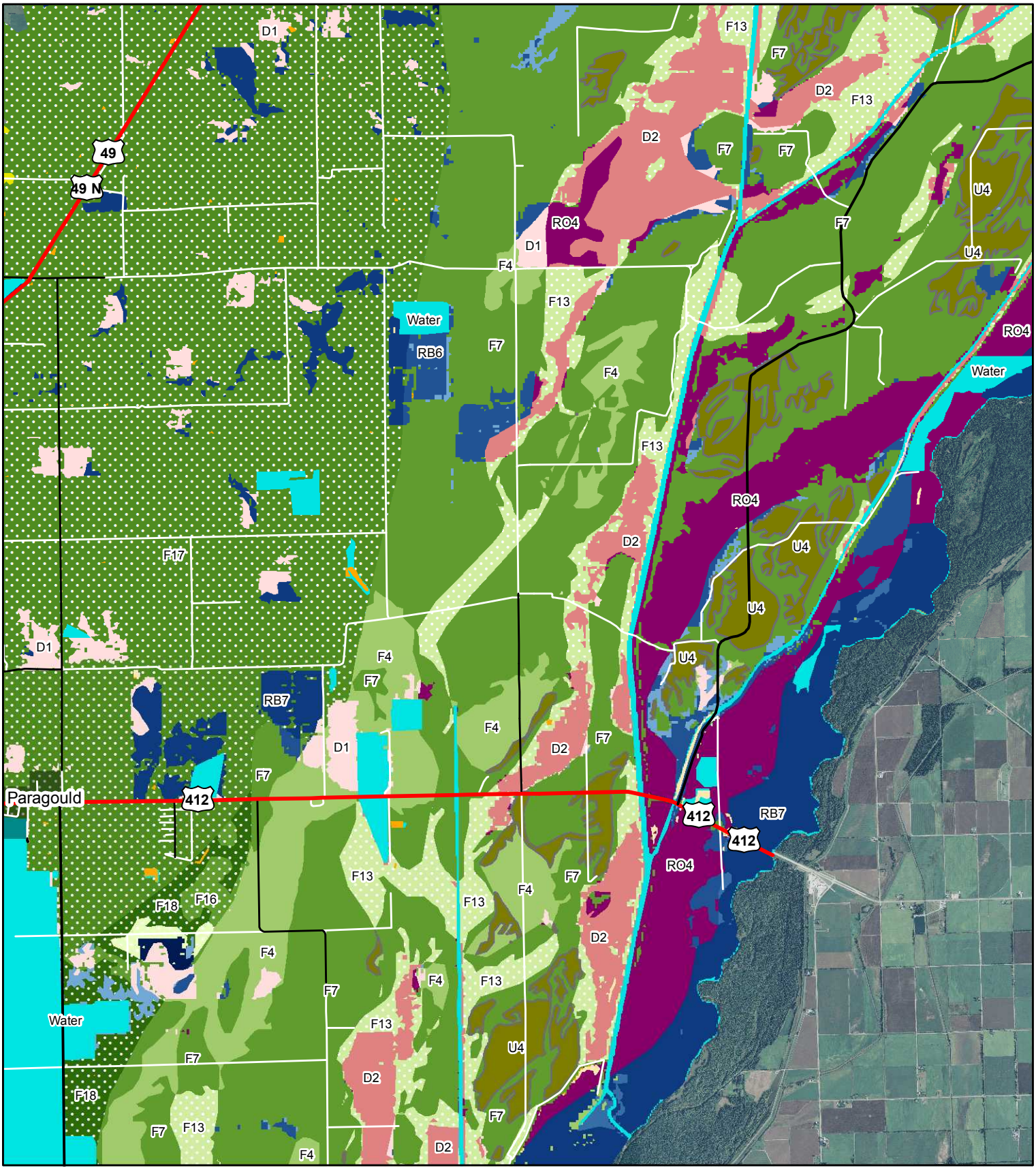

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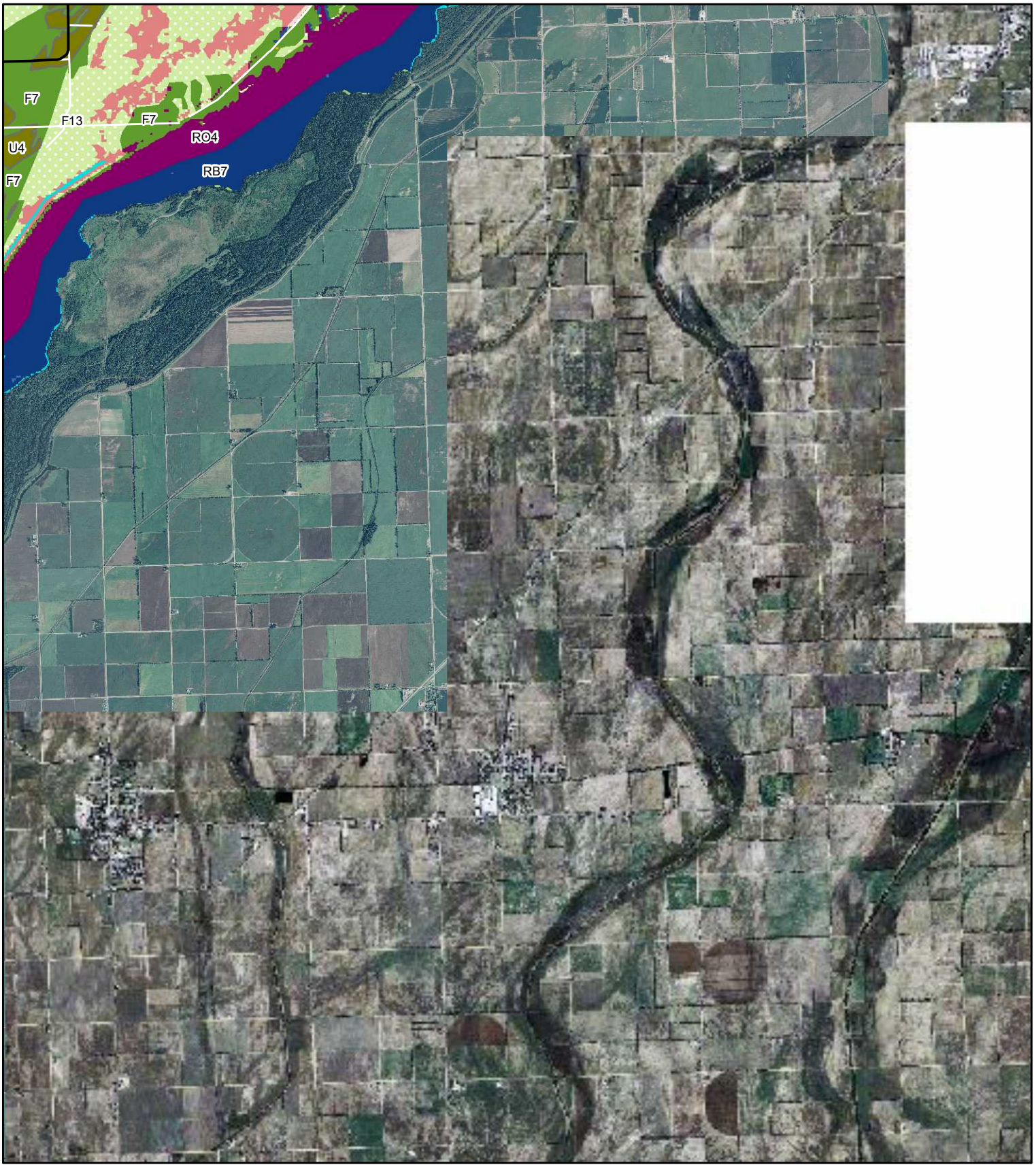

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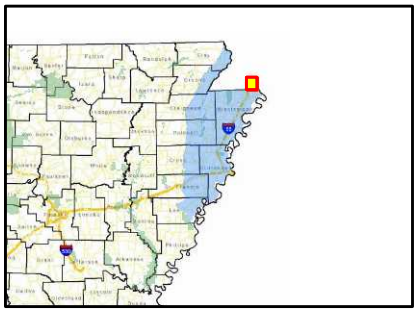
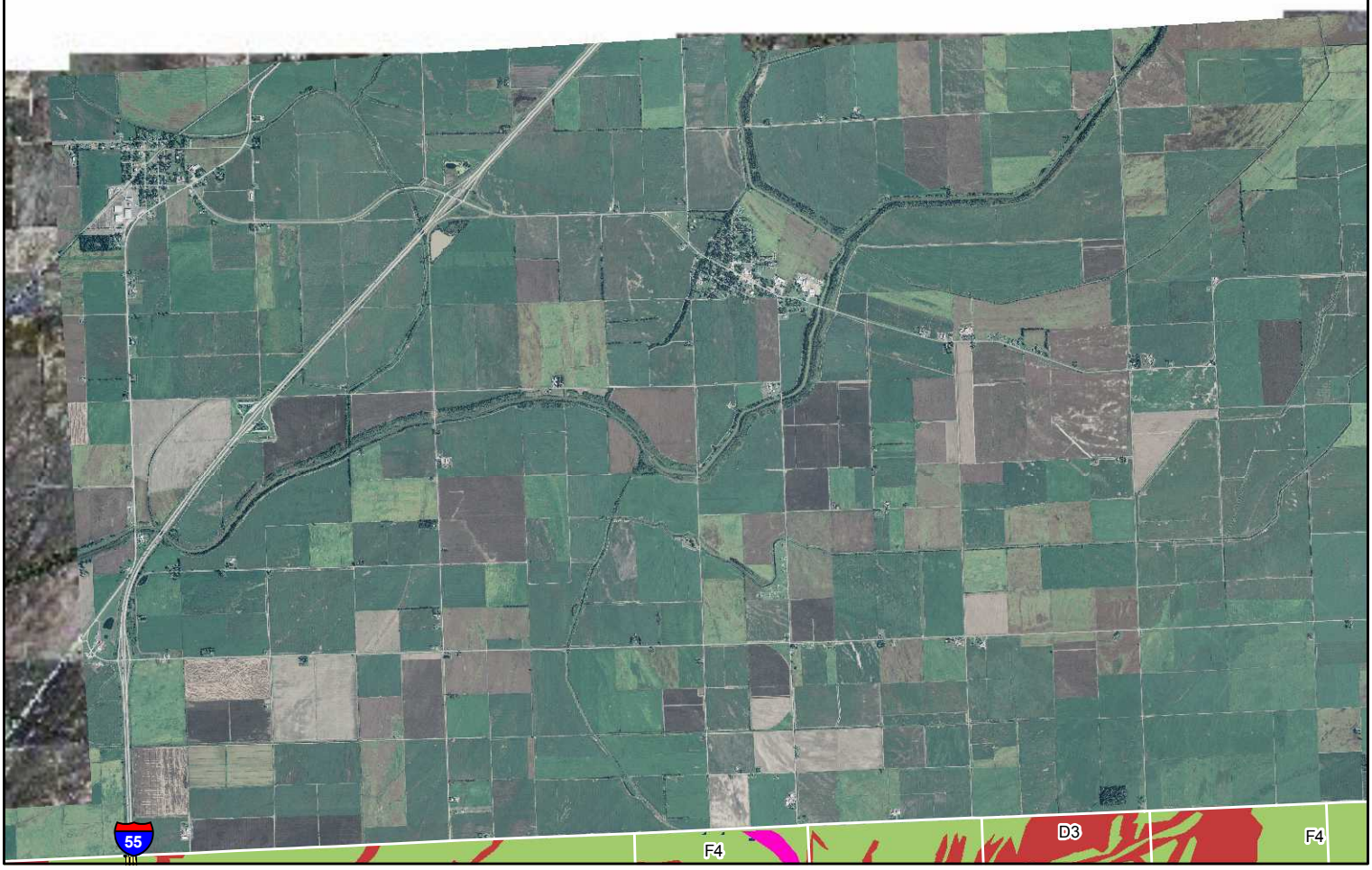
D18





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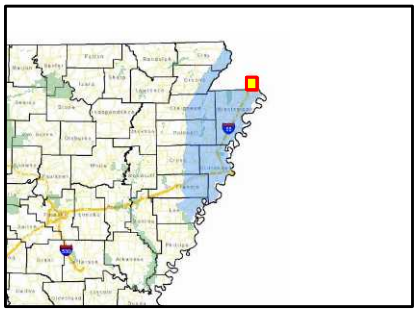

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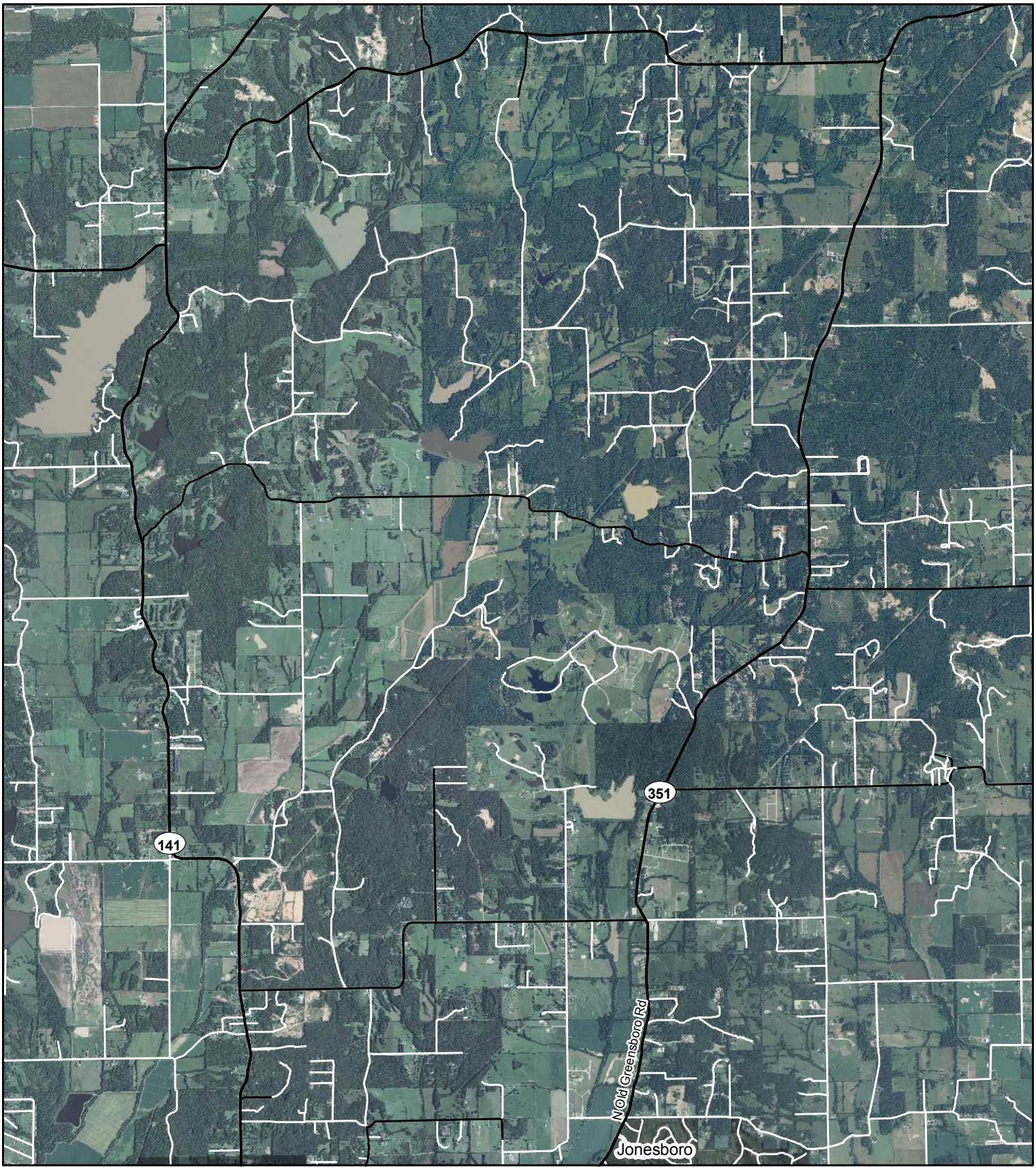

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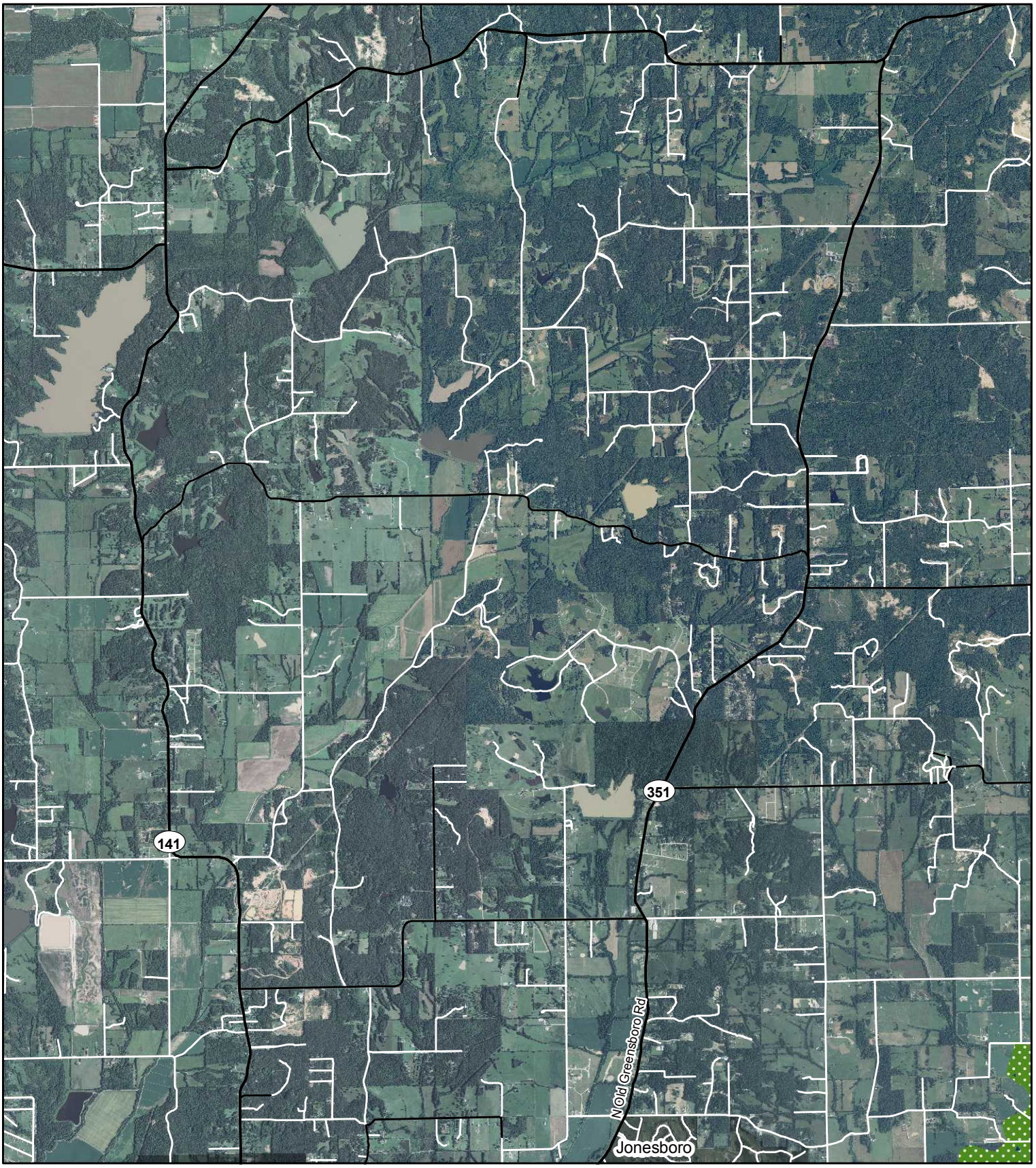

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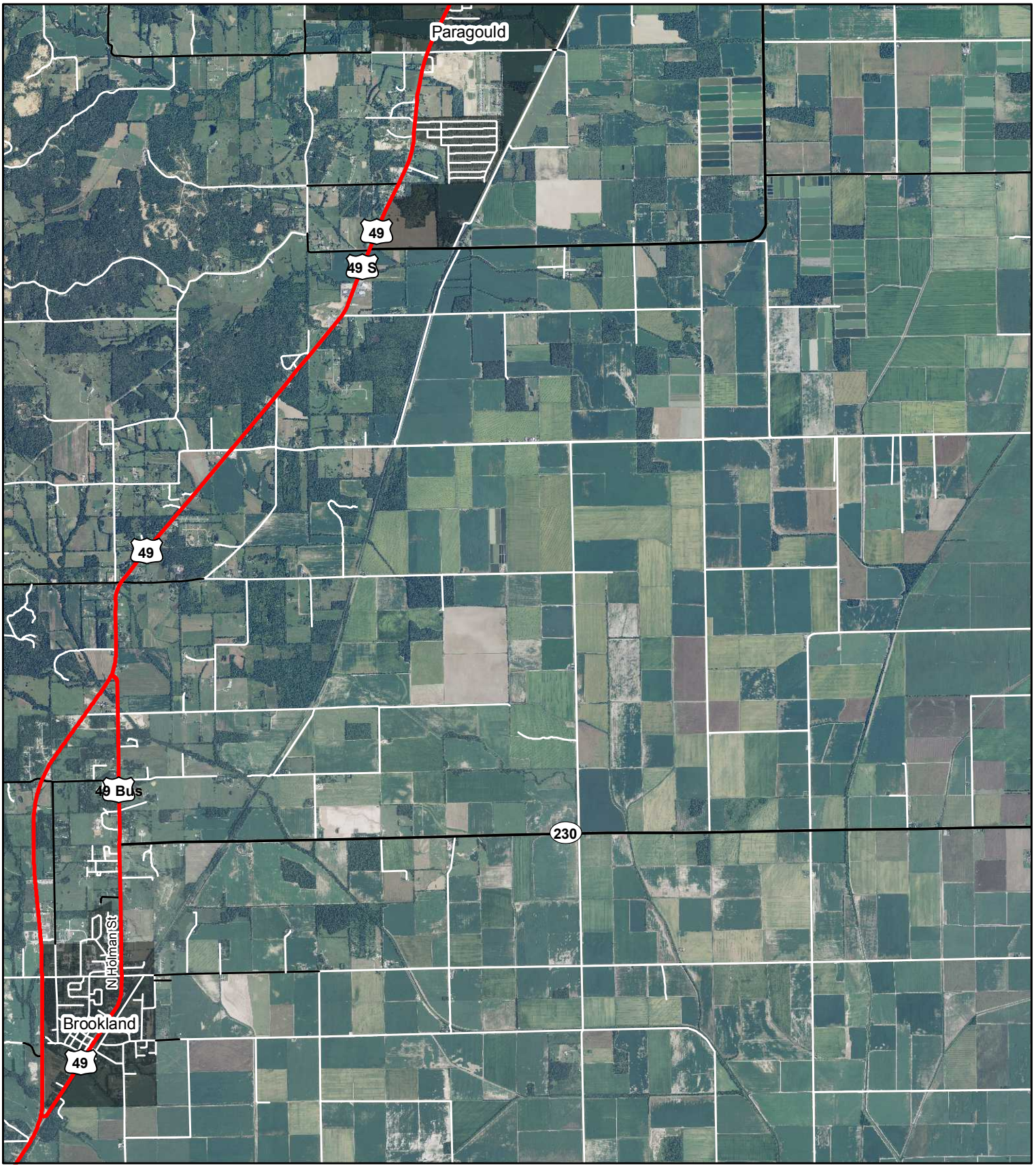

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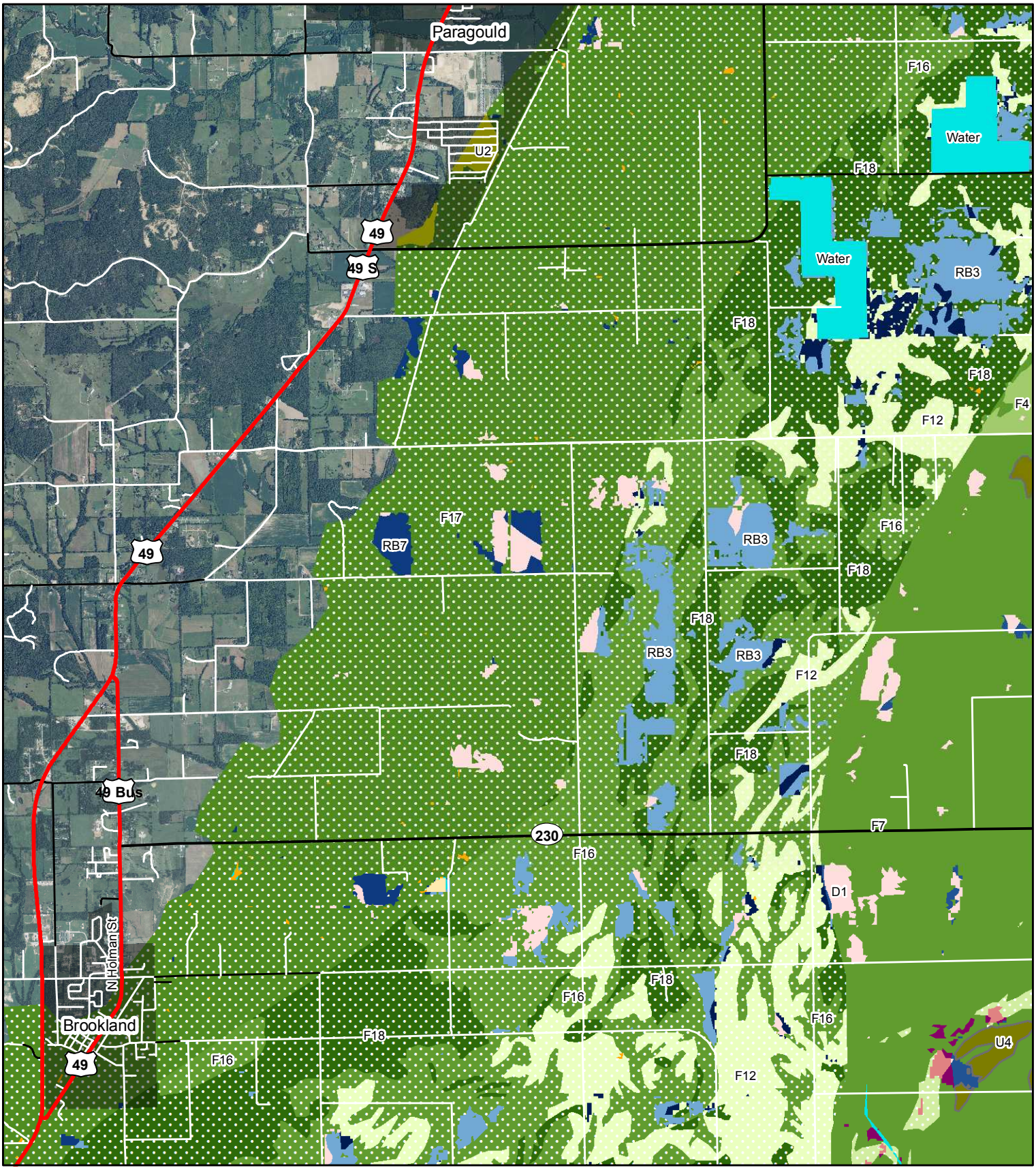

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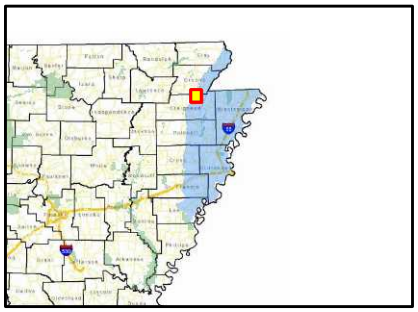

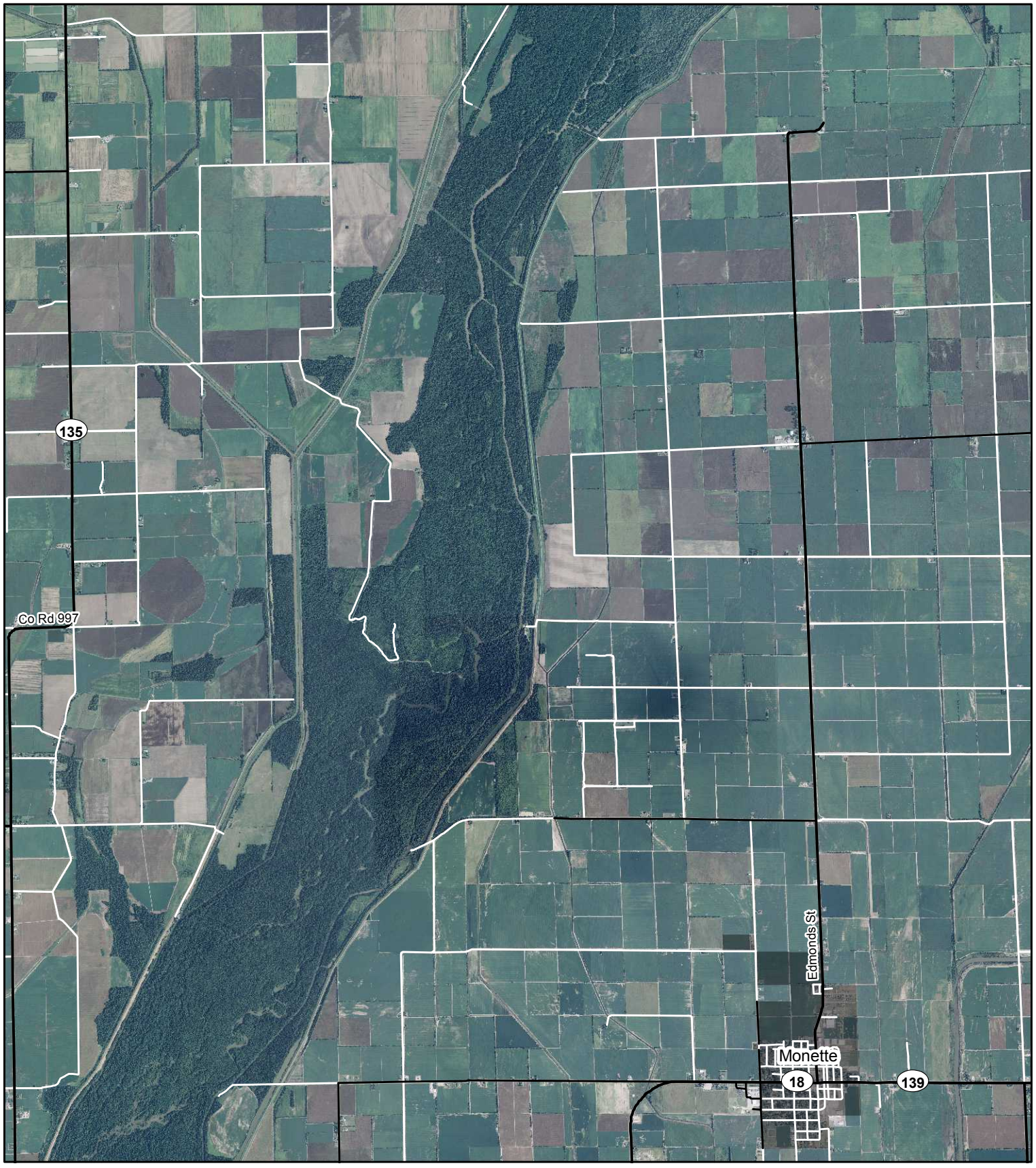

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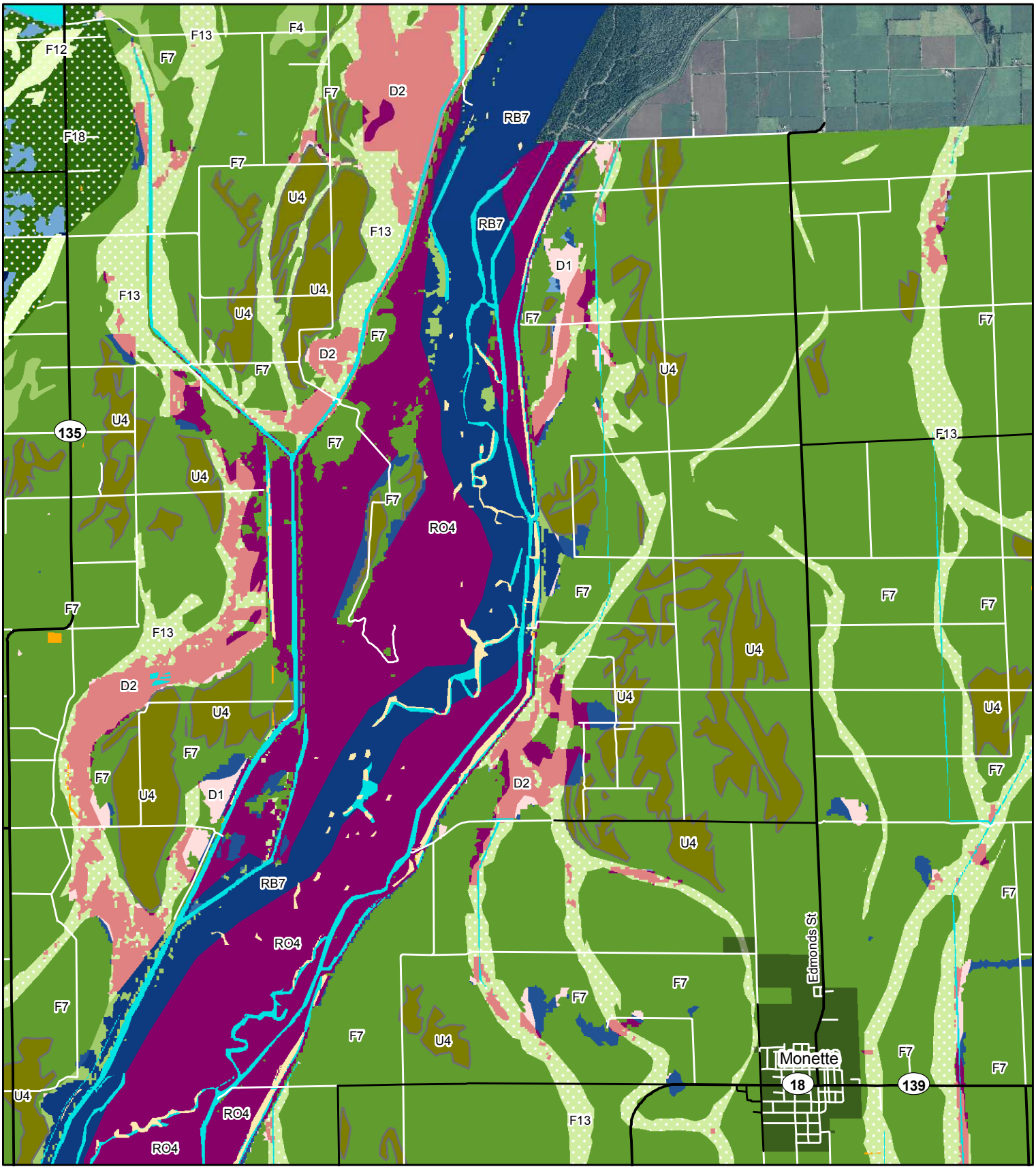

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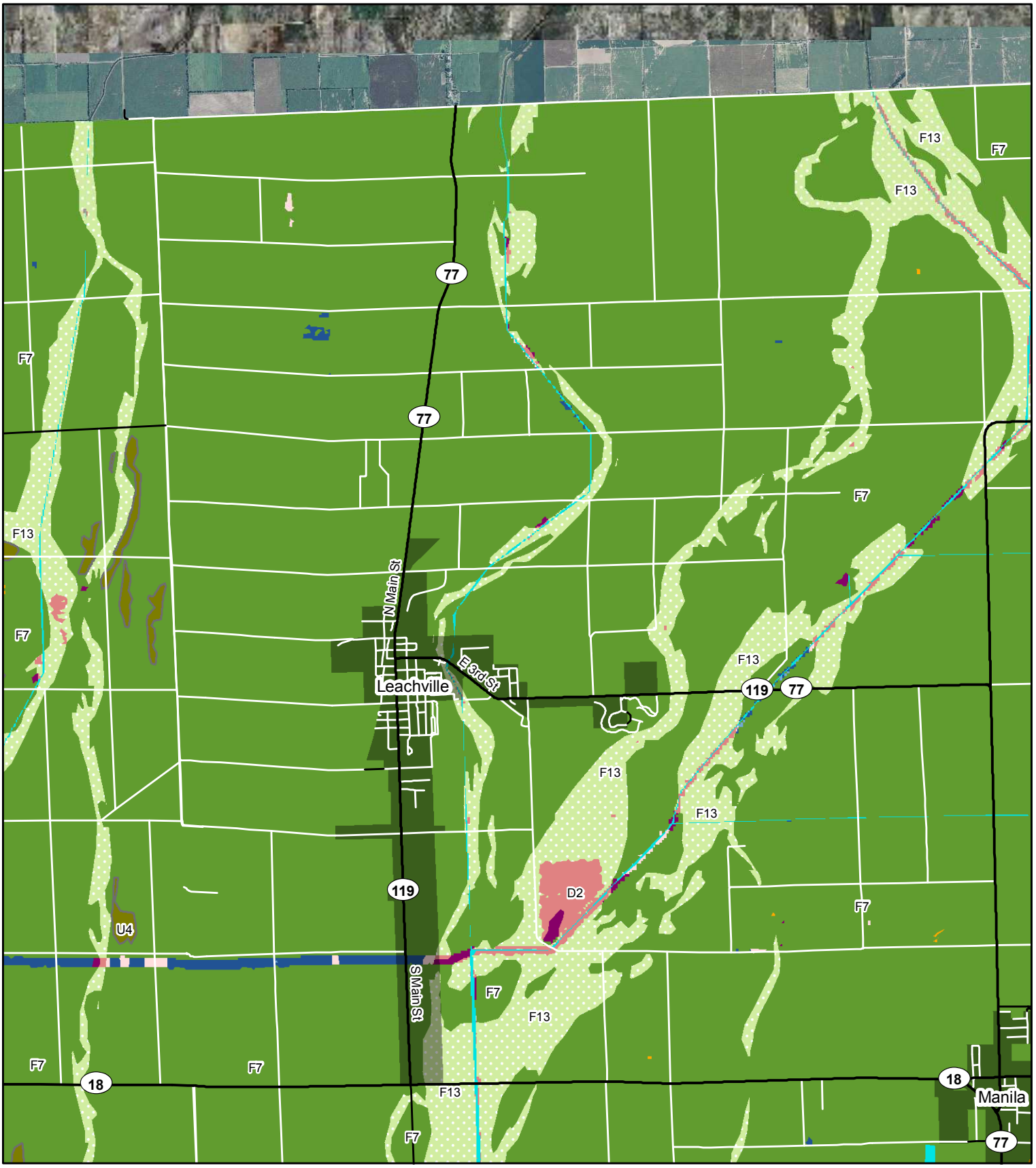

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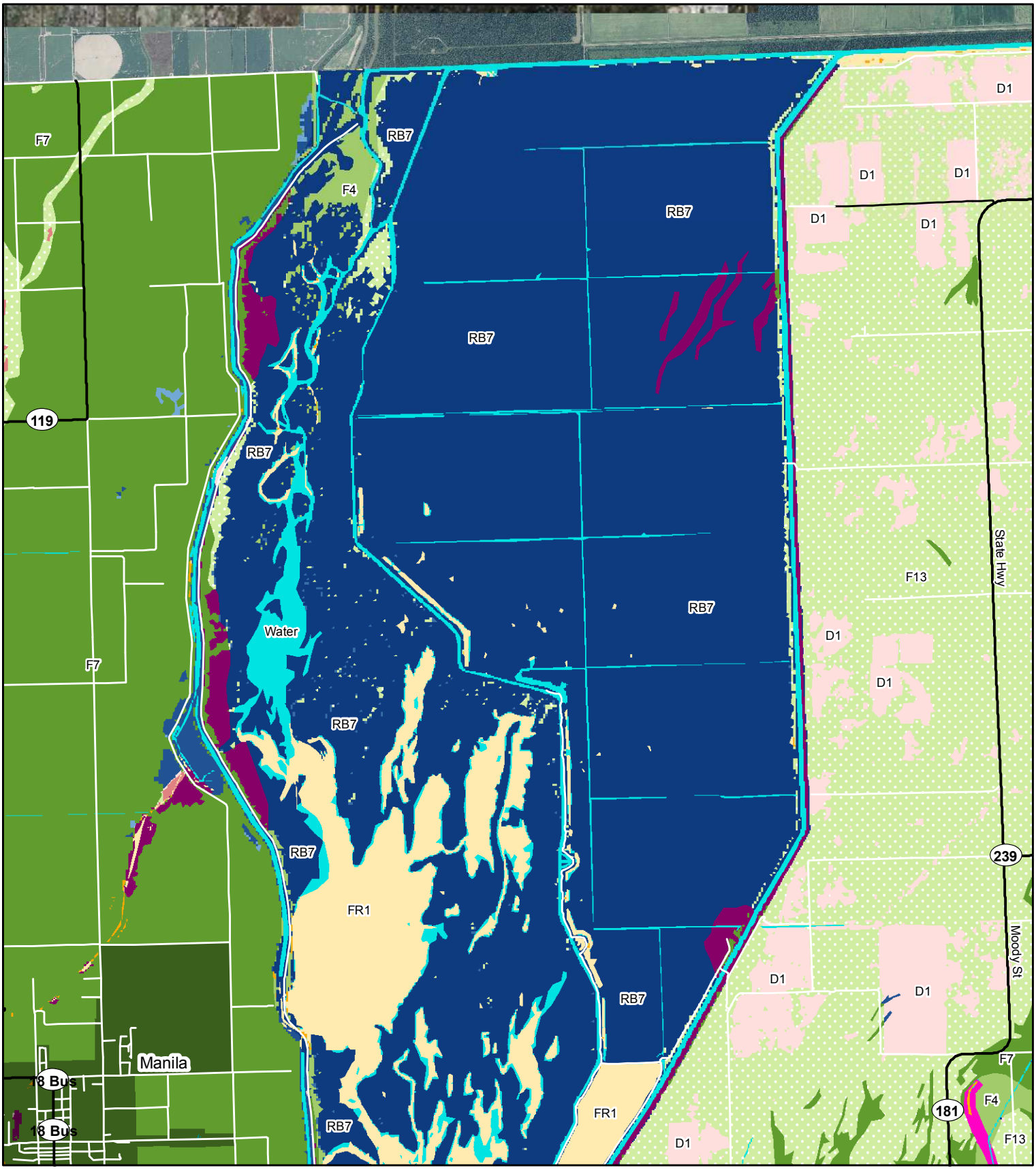

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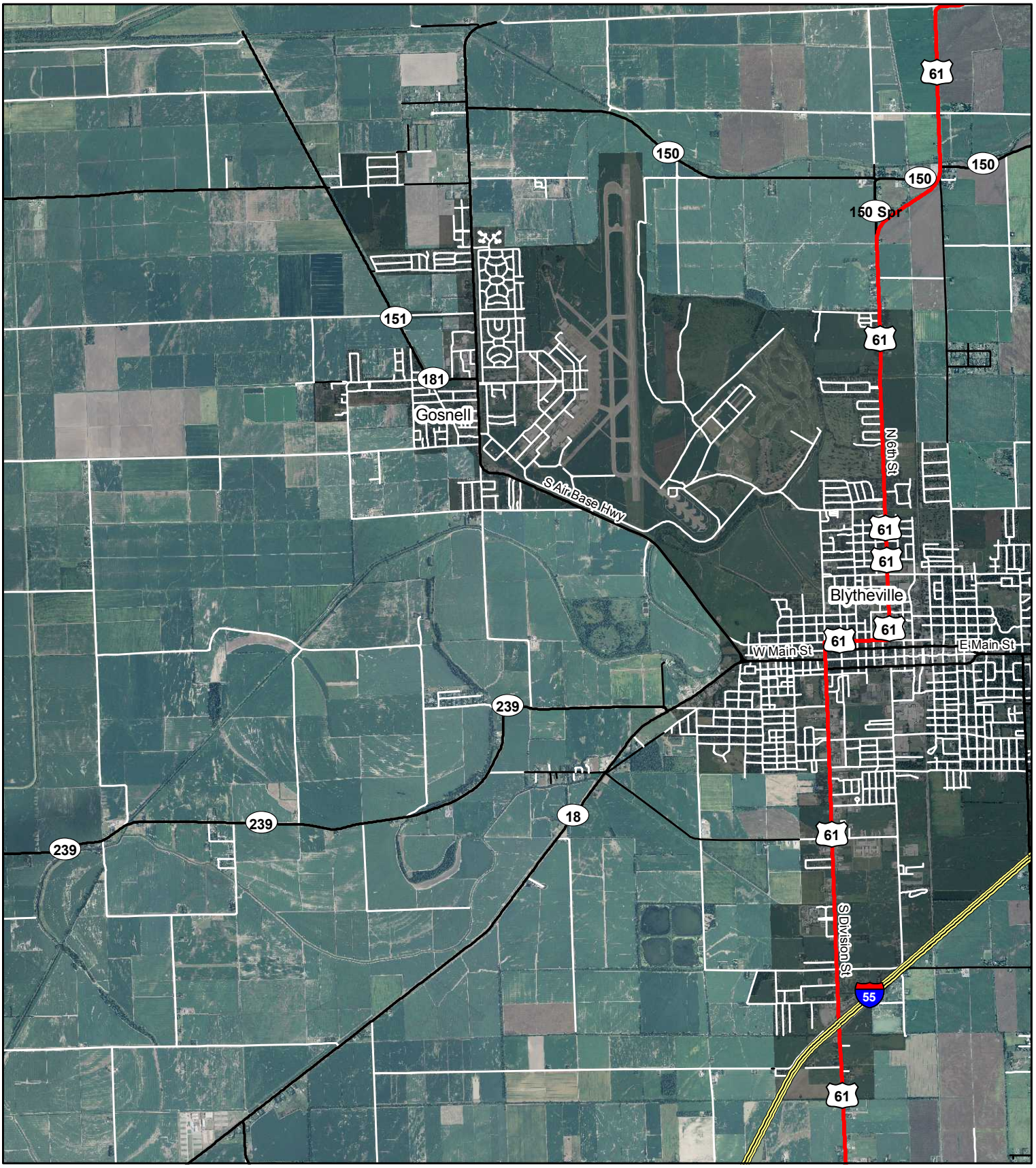

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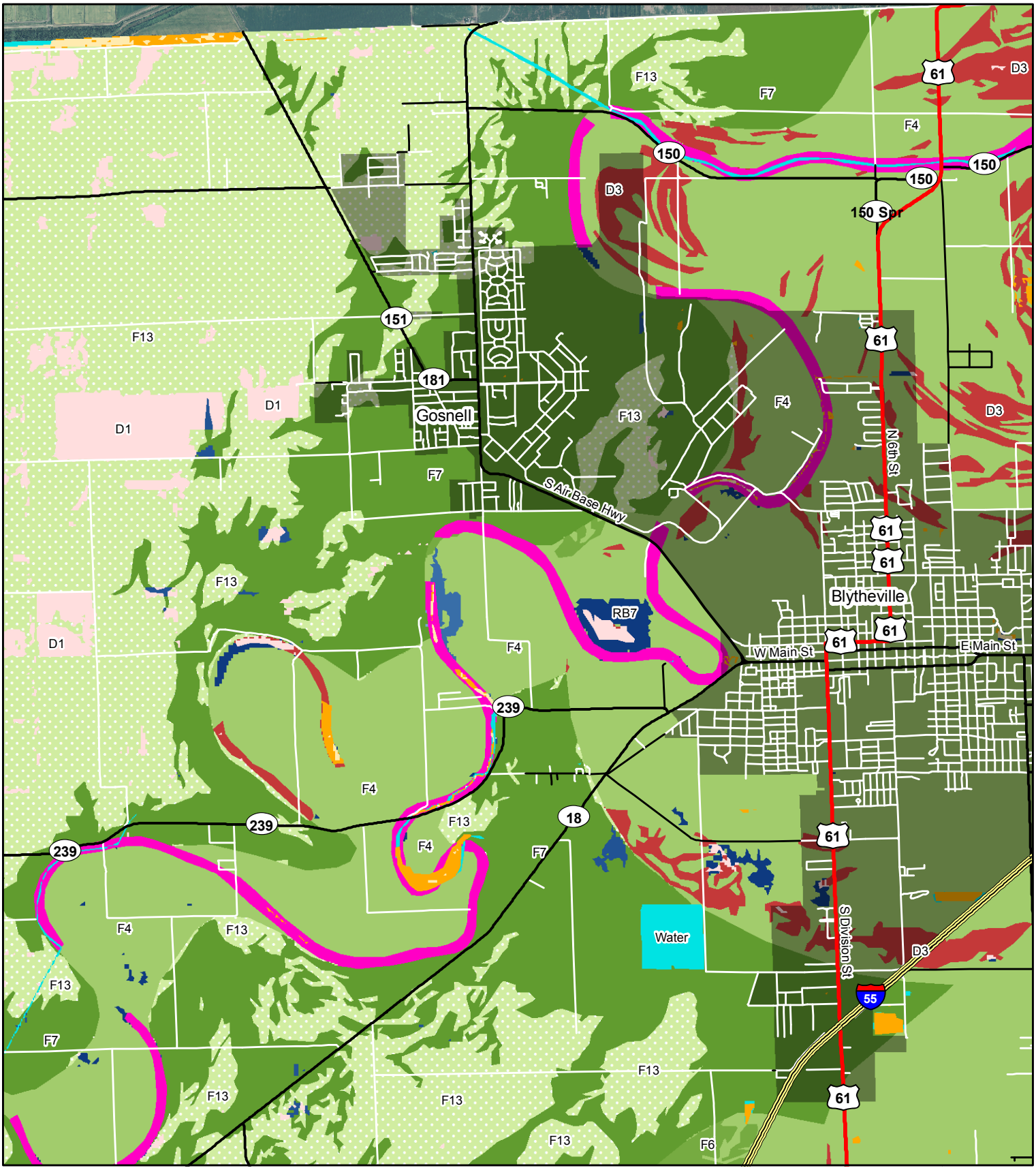

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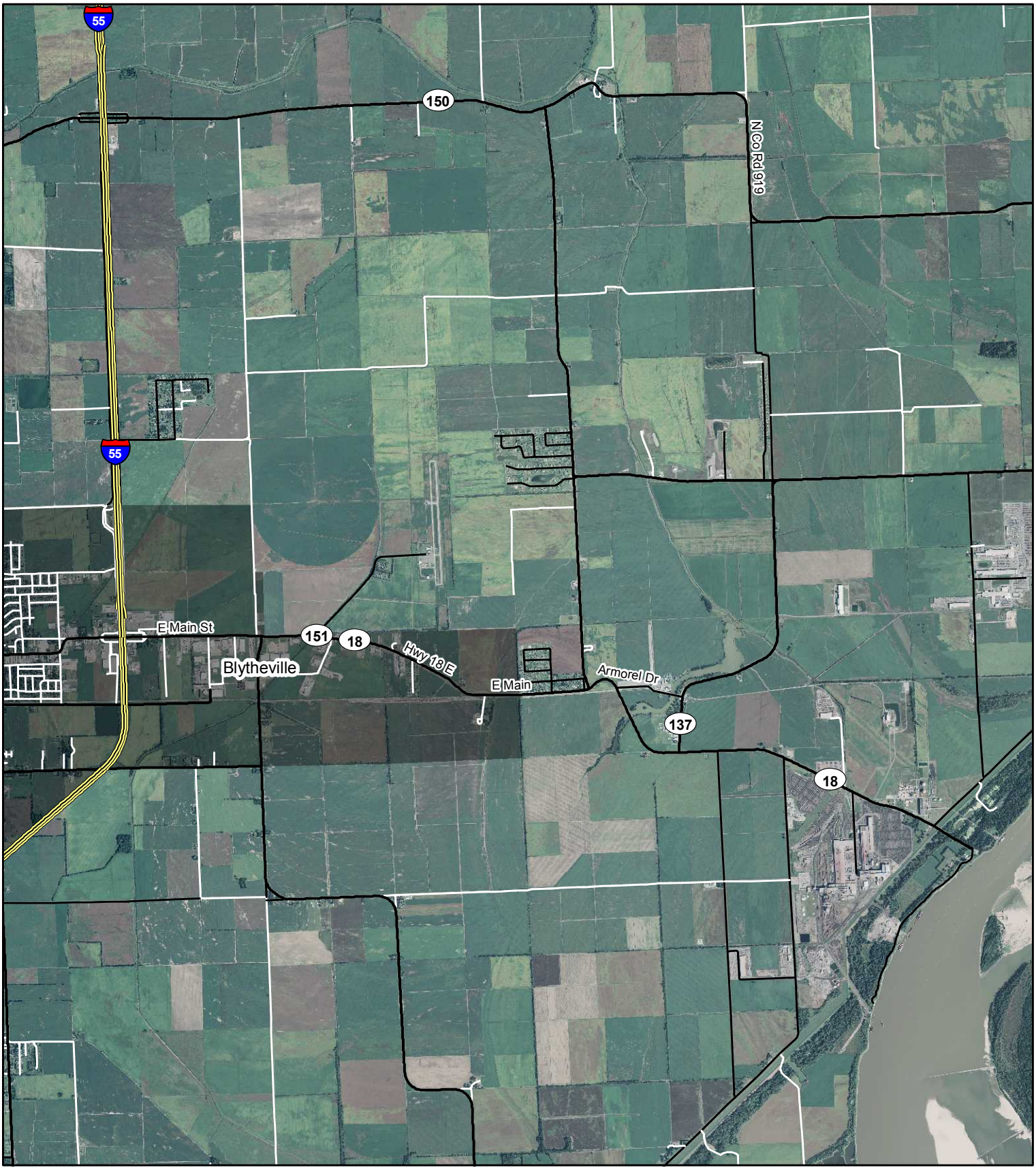

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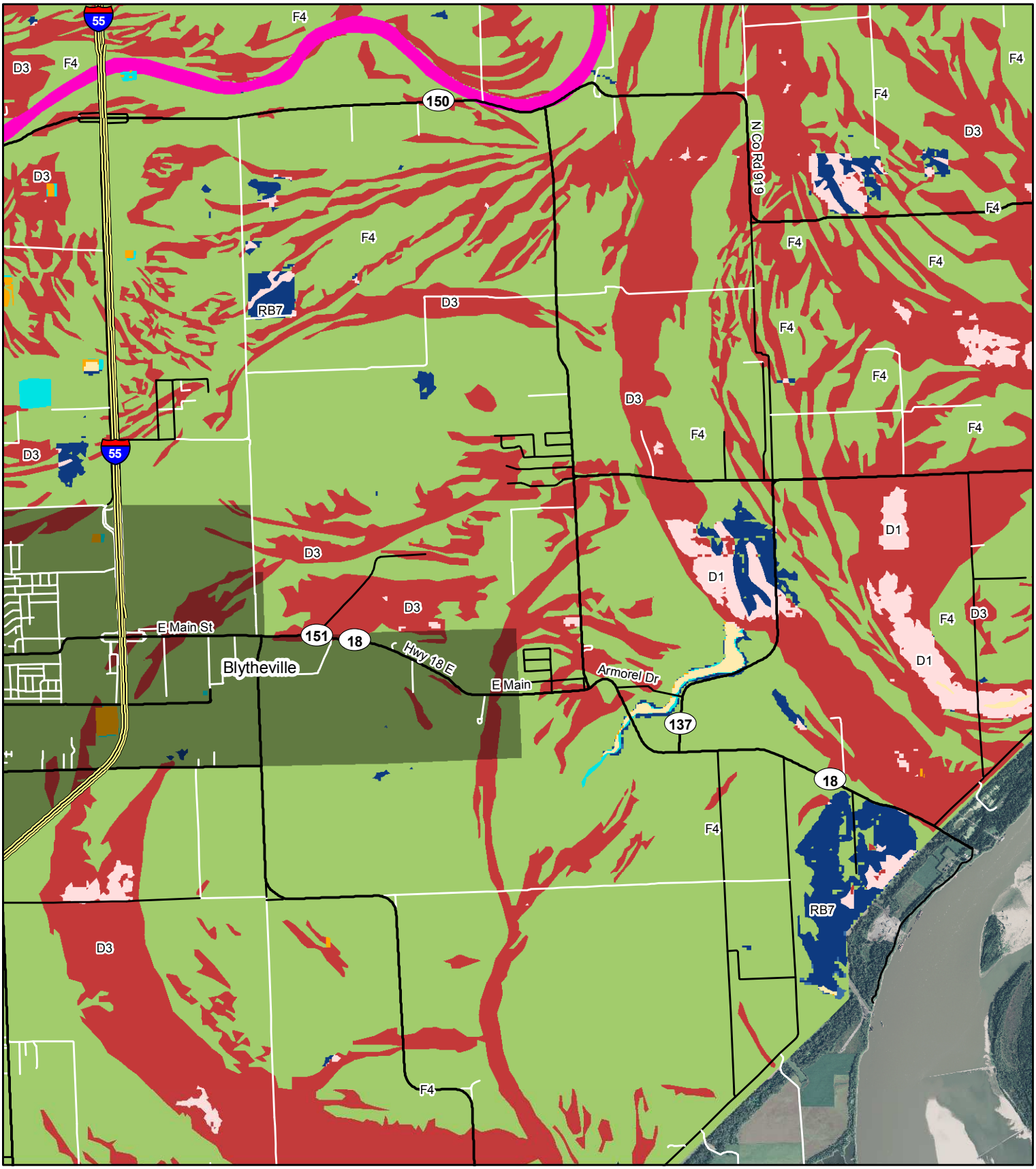

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E18

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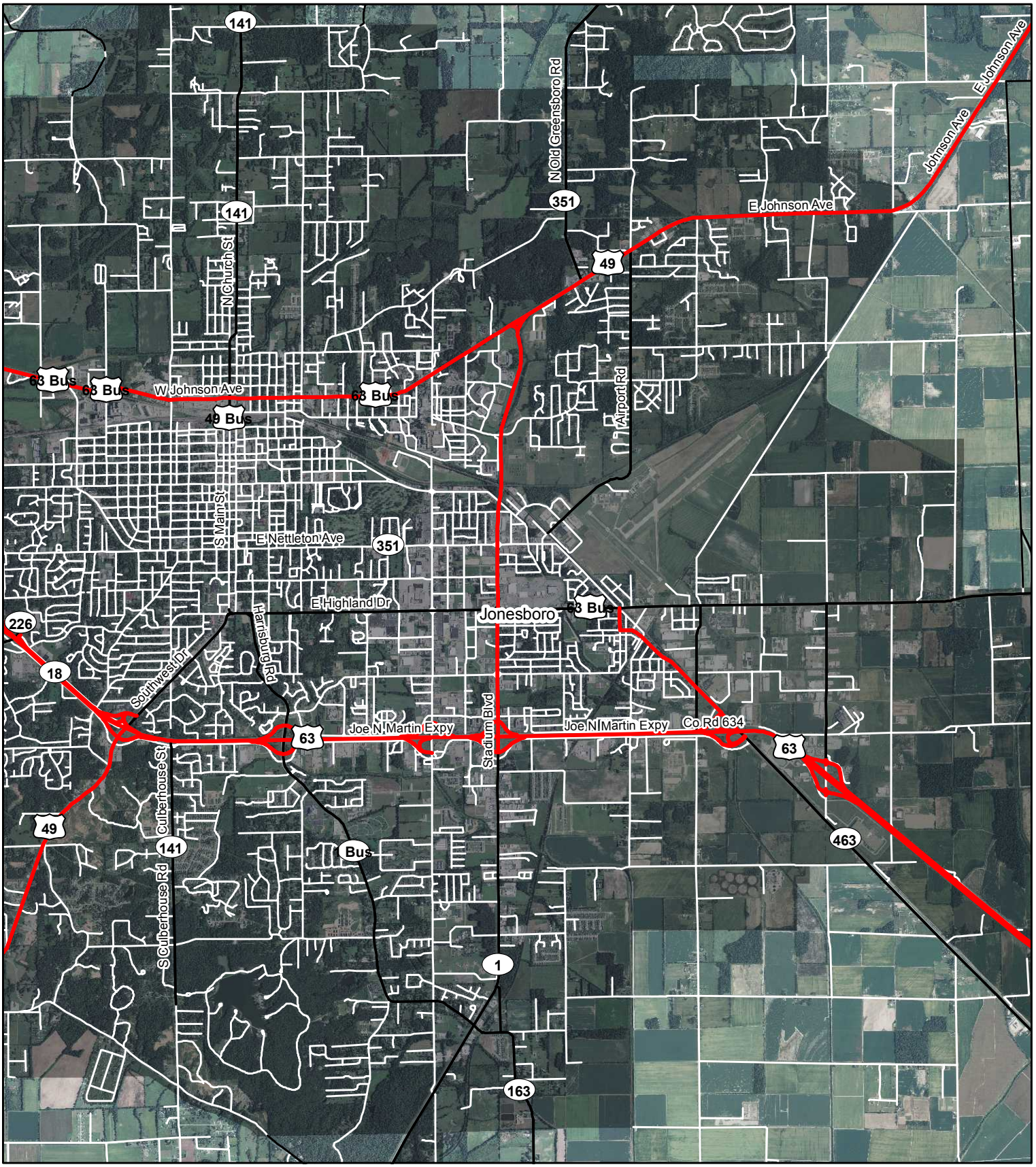

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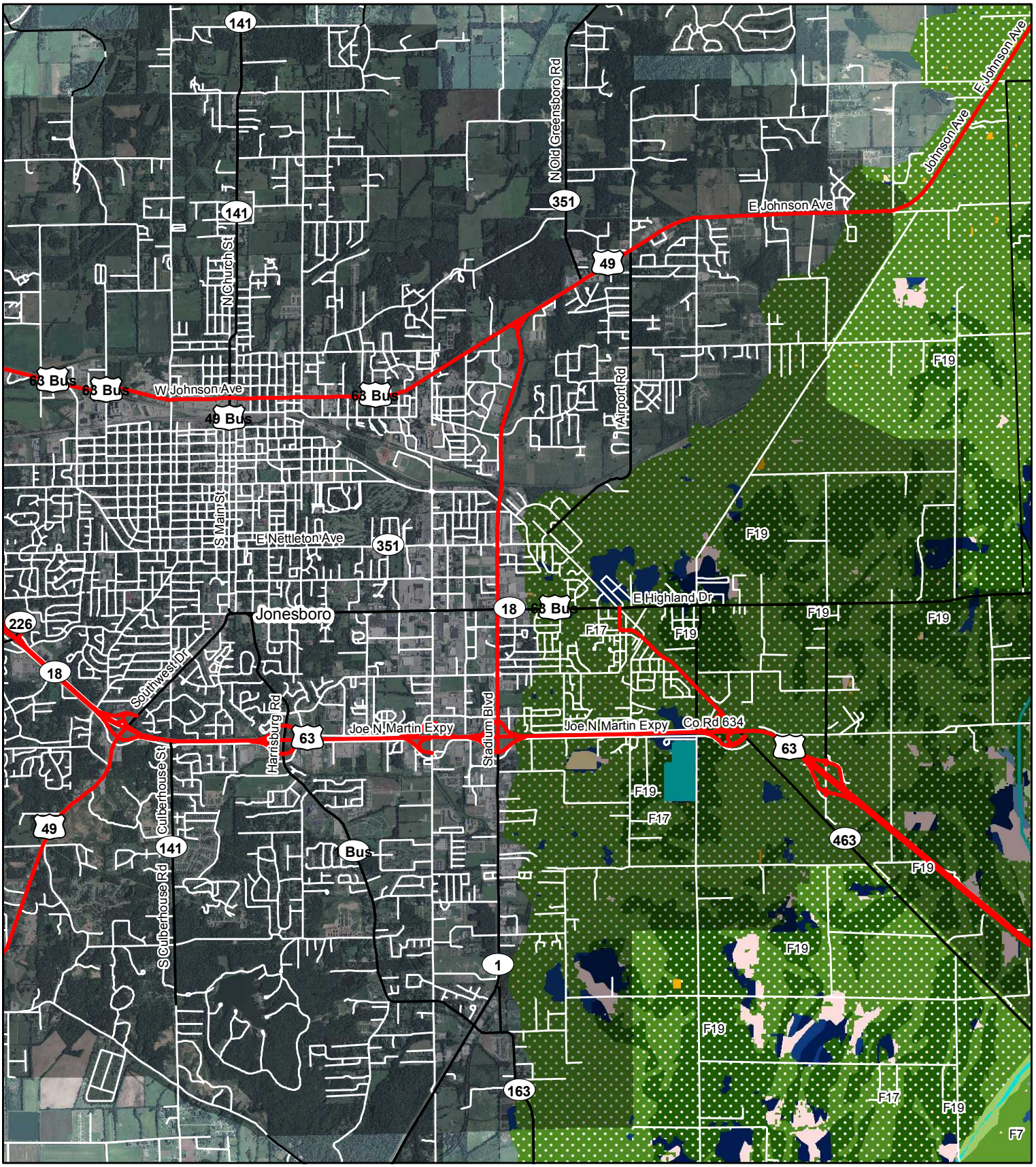

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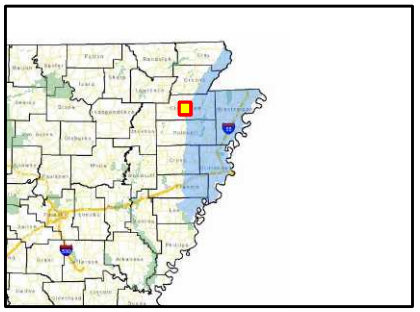

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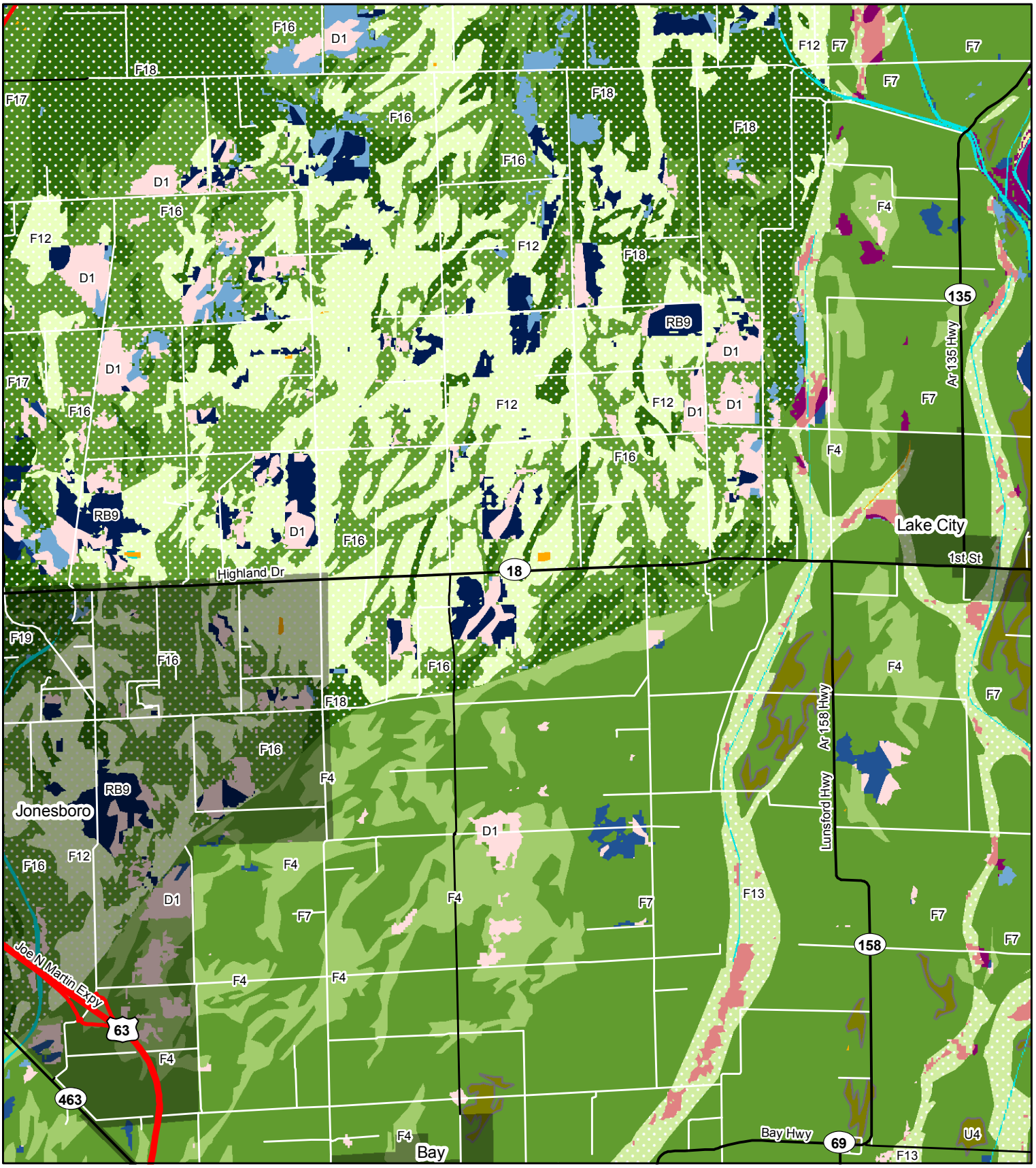

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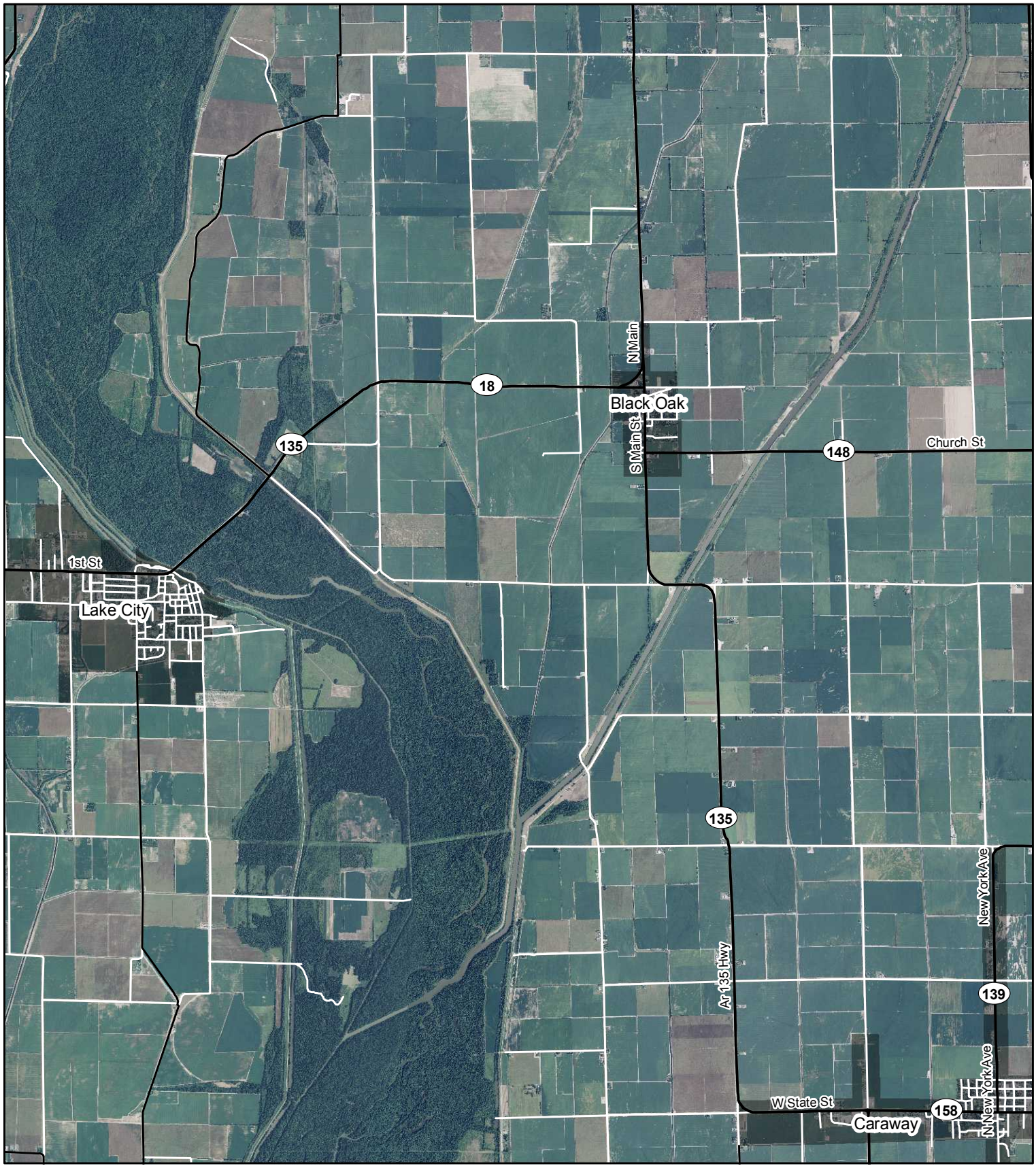

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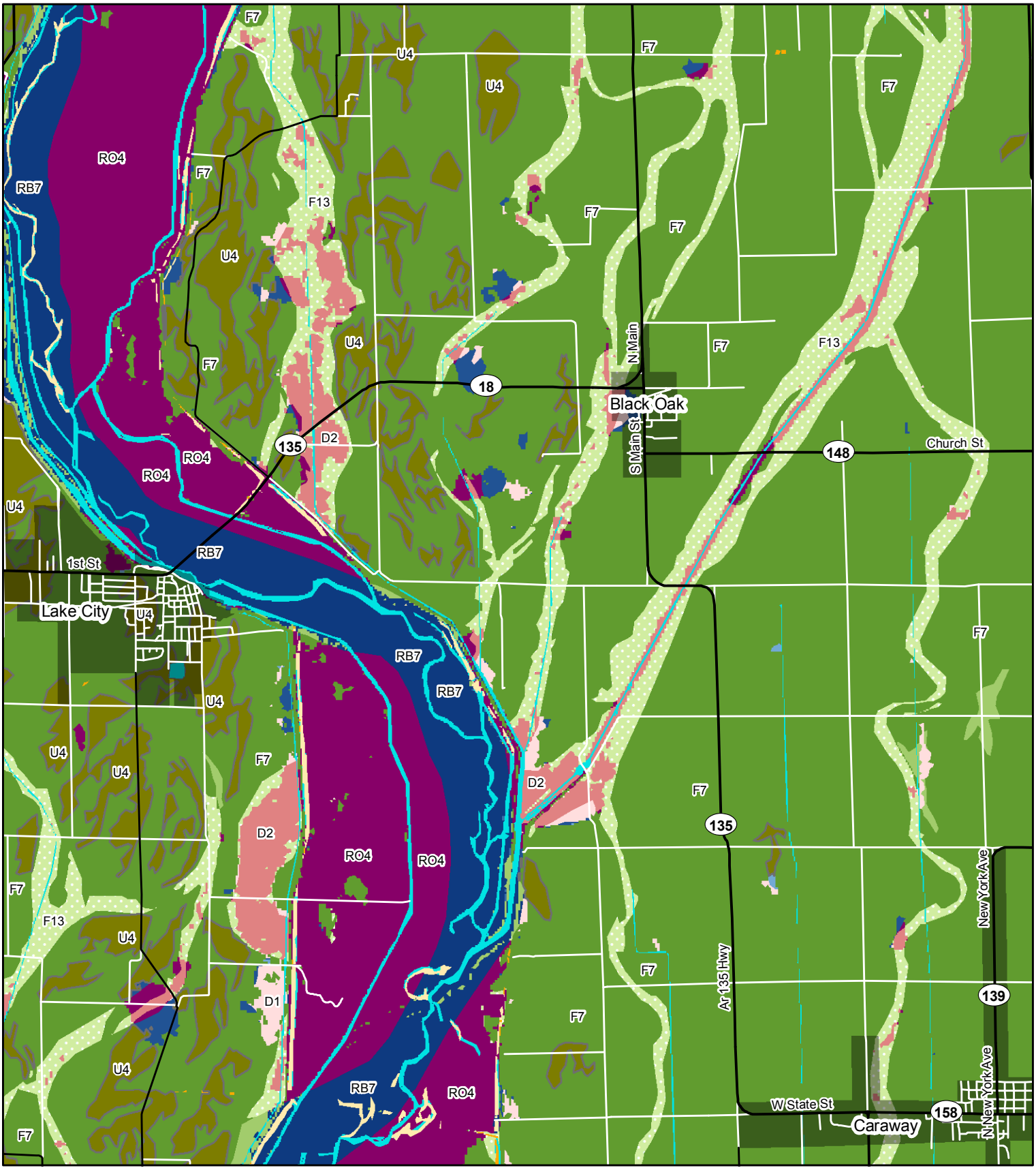

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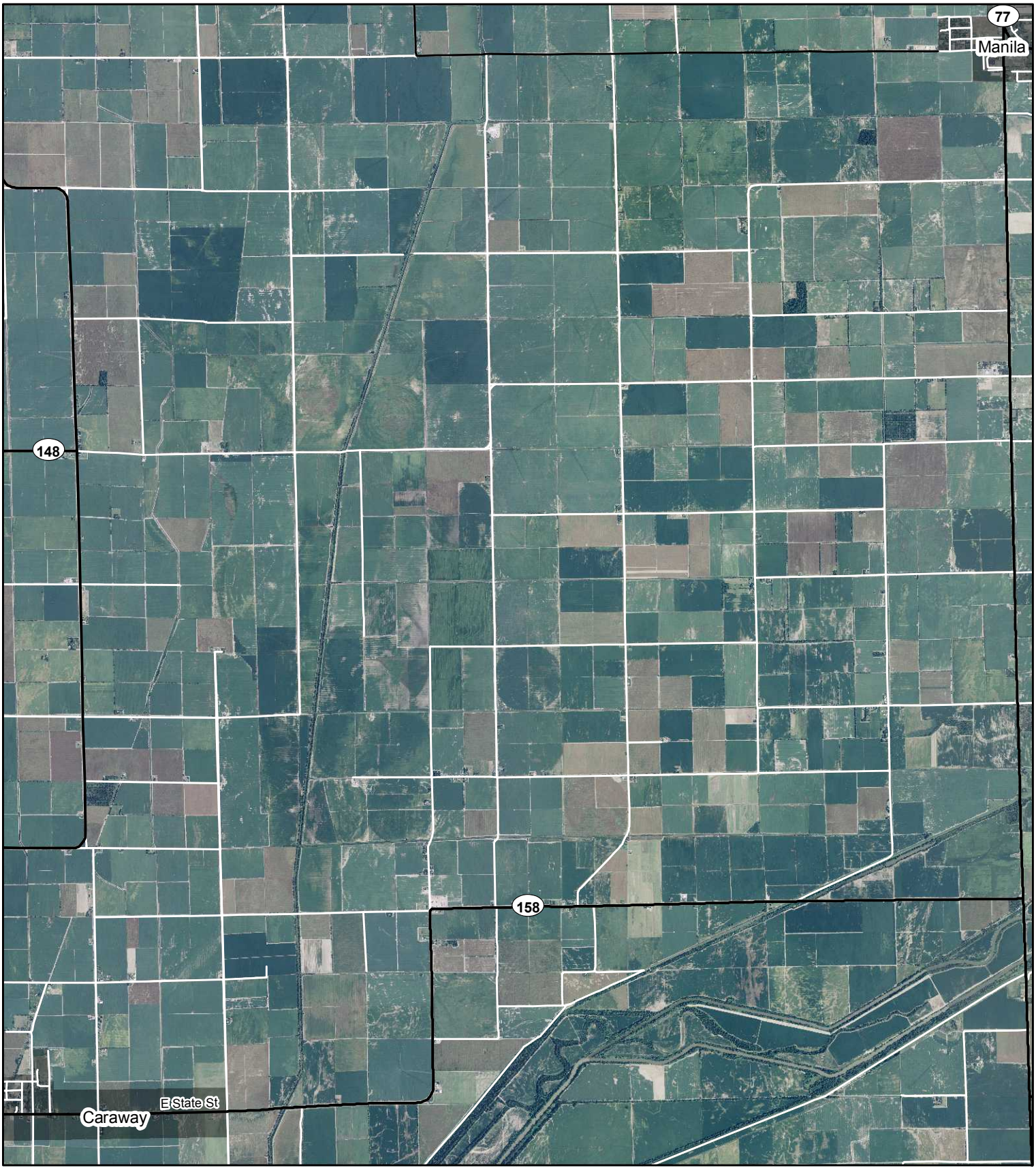

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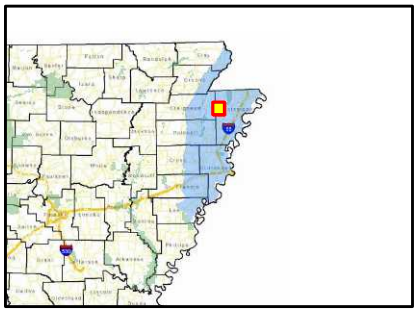

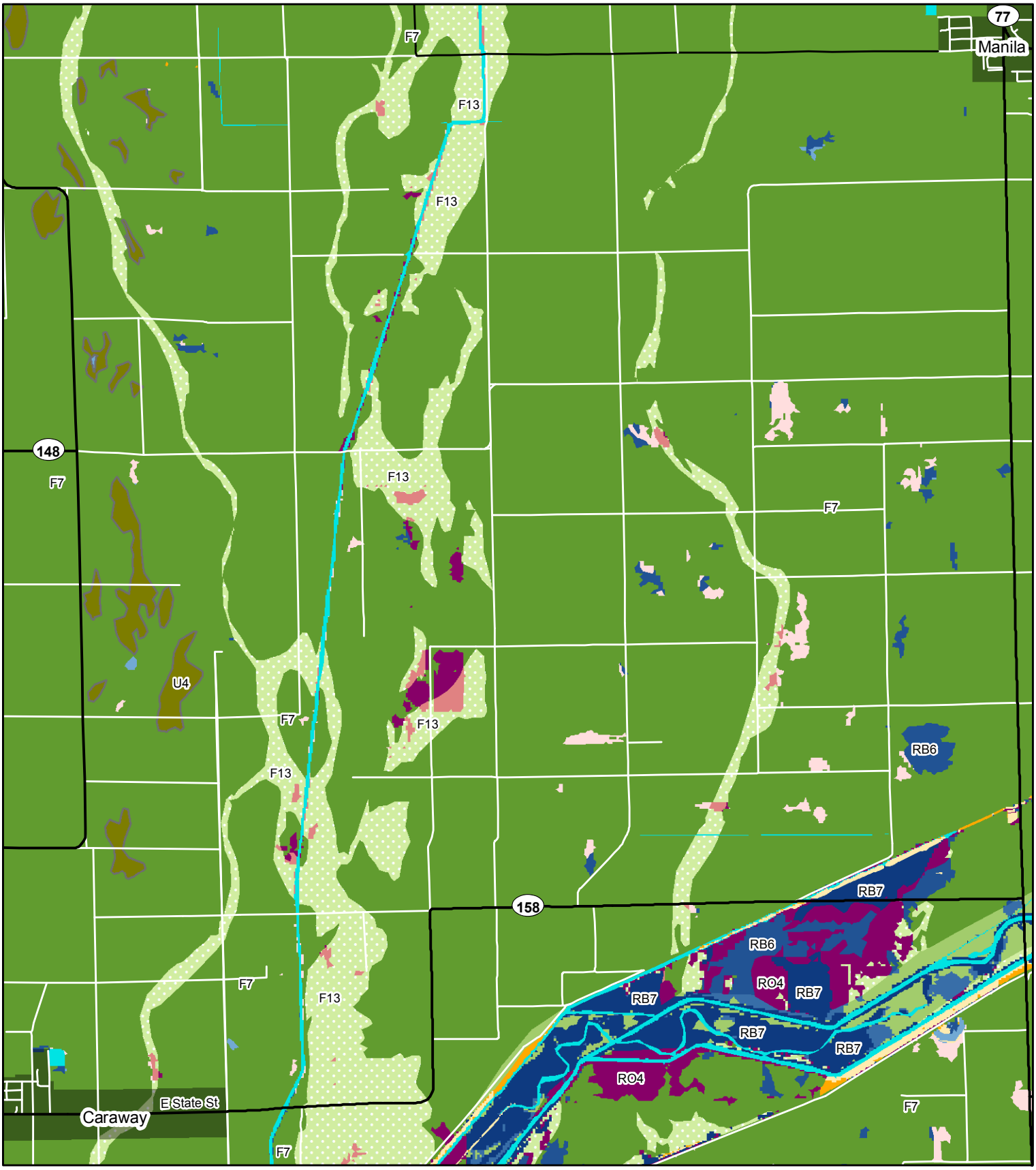

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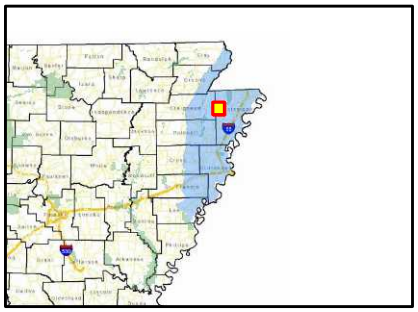

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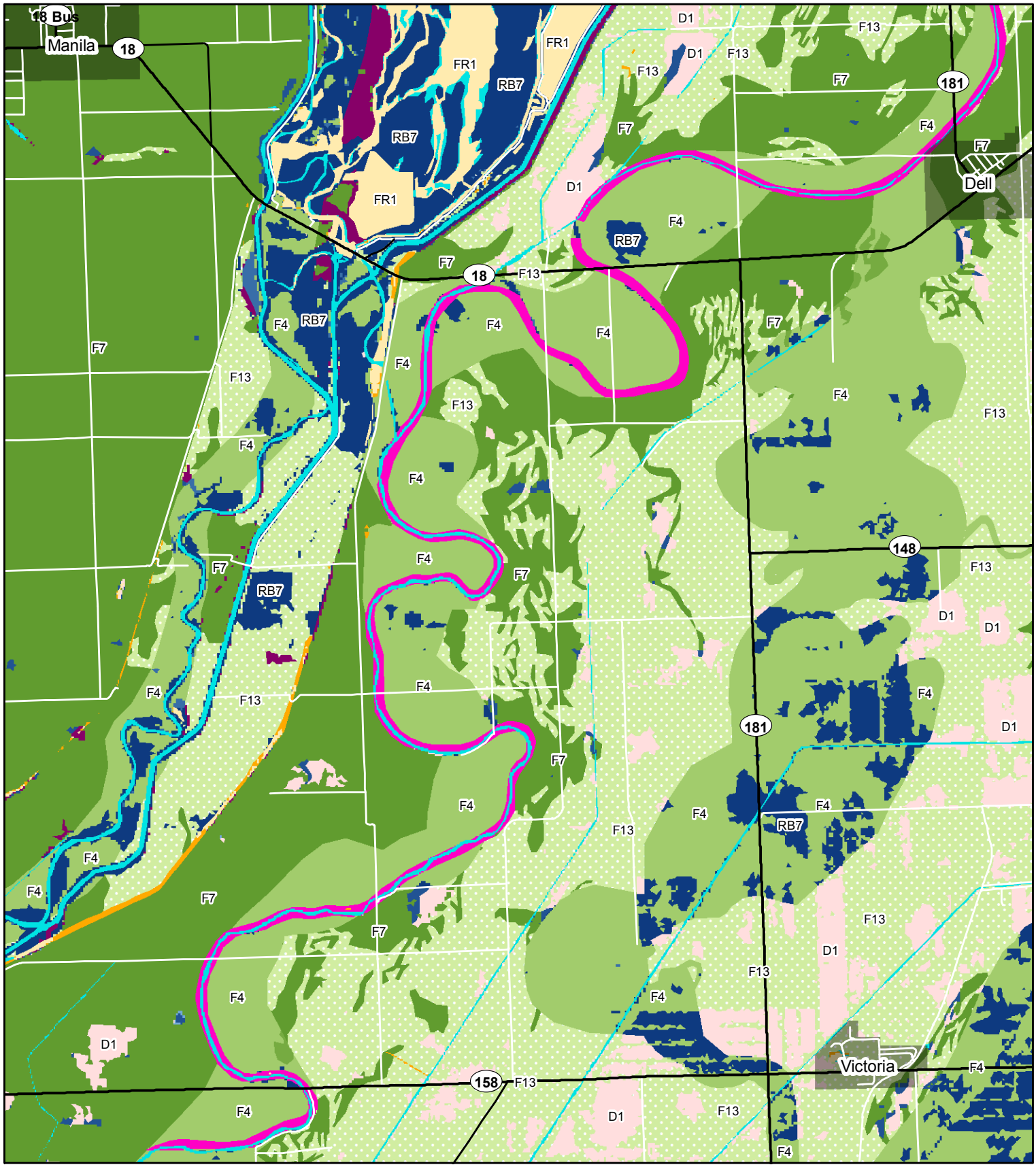

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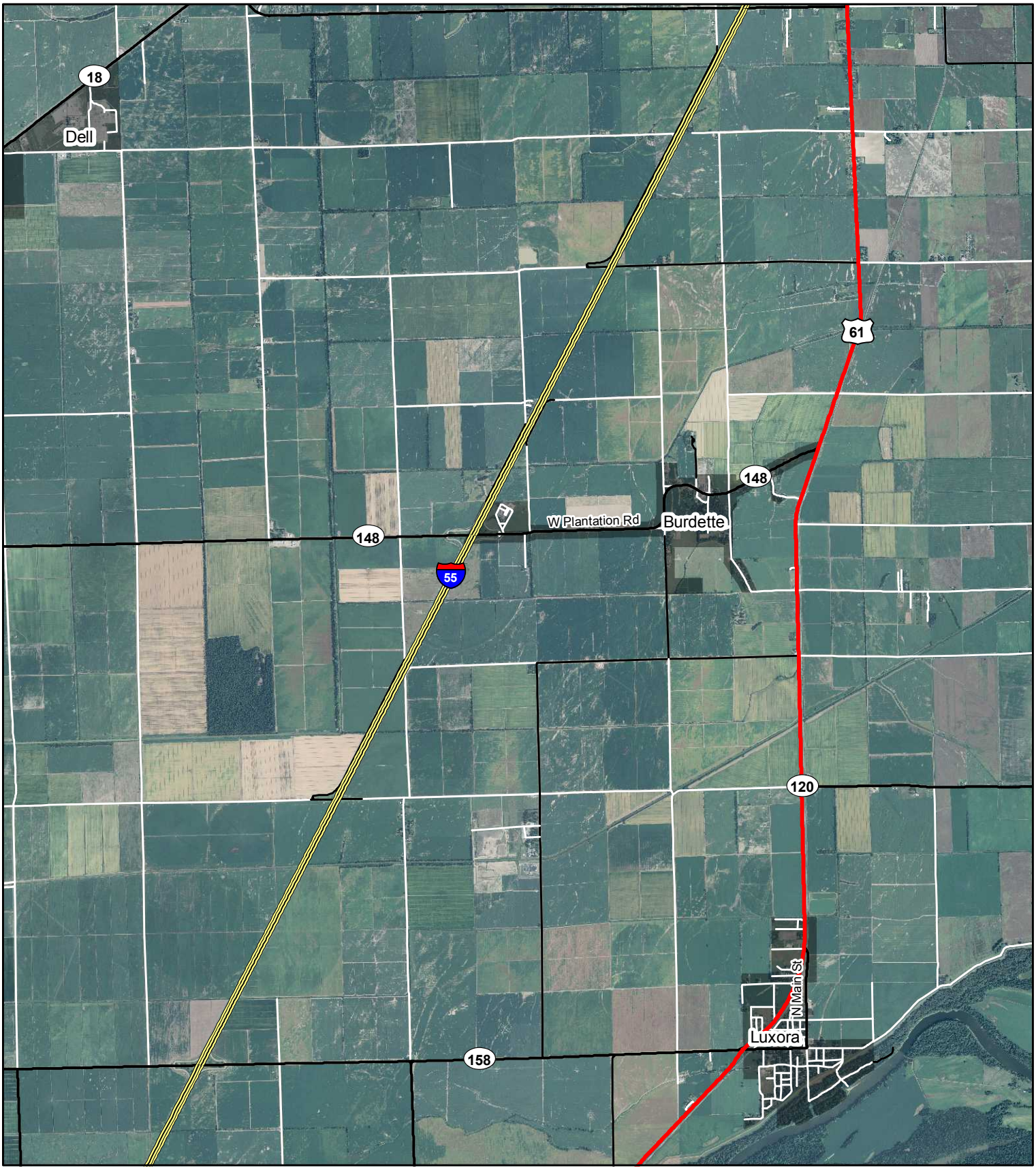

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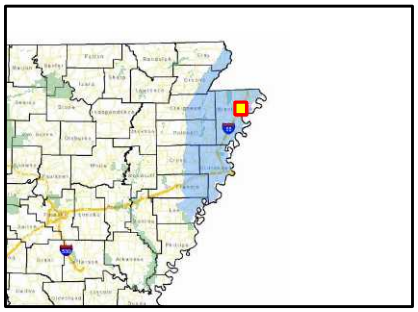

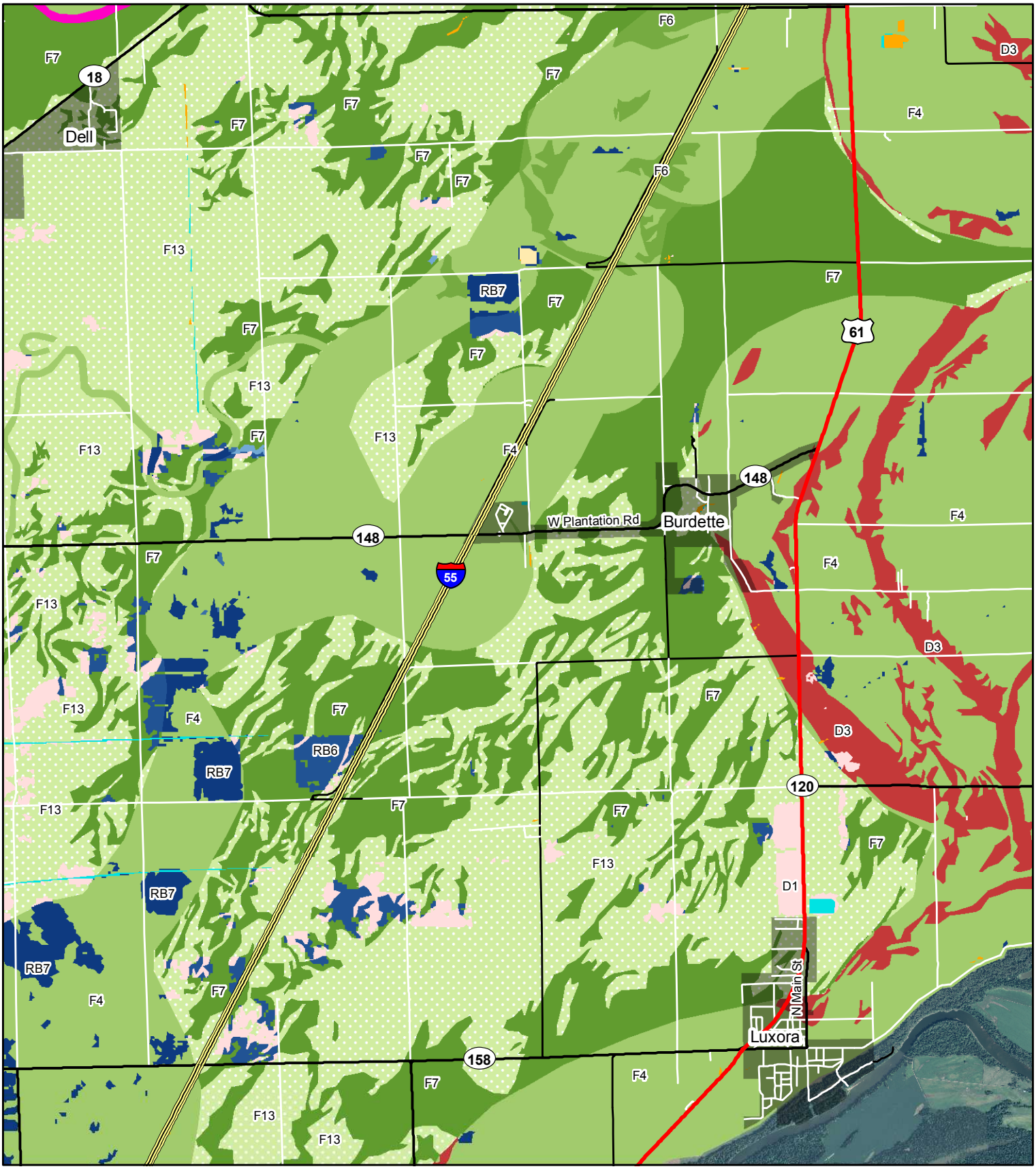

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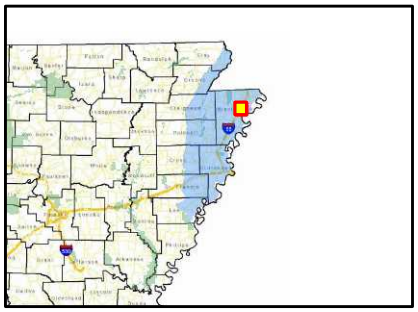

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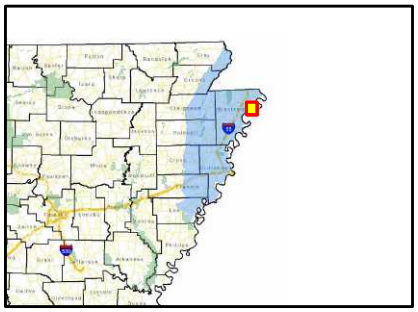

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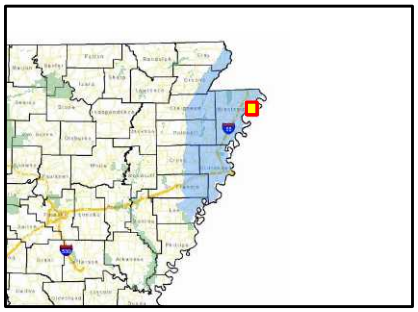

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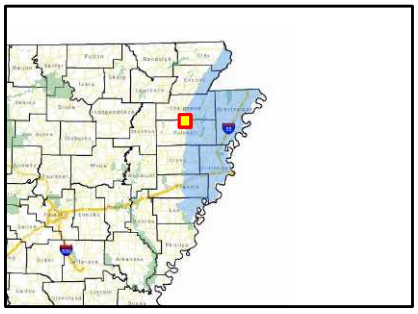

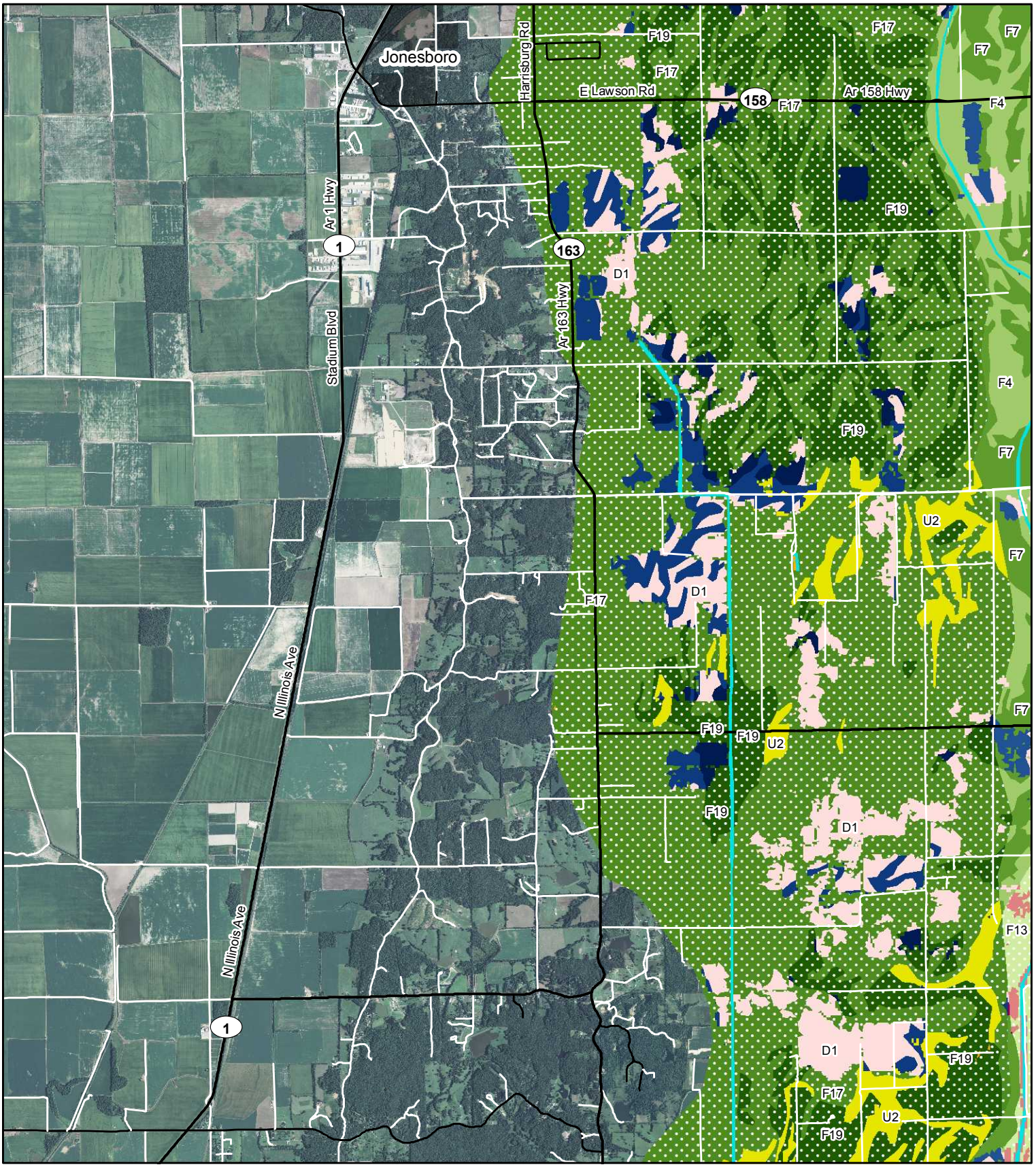

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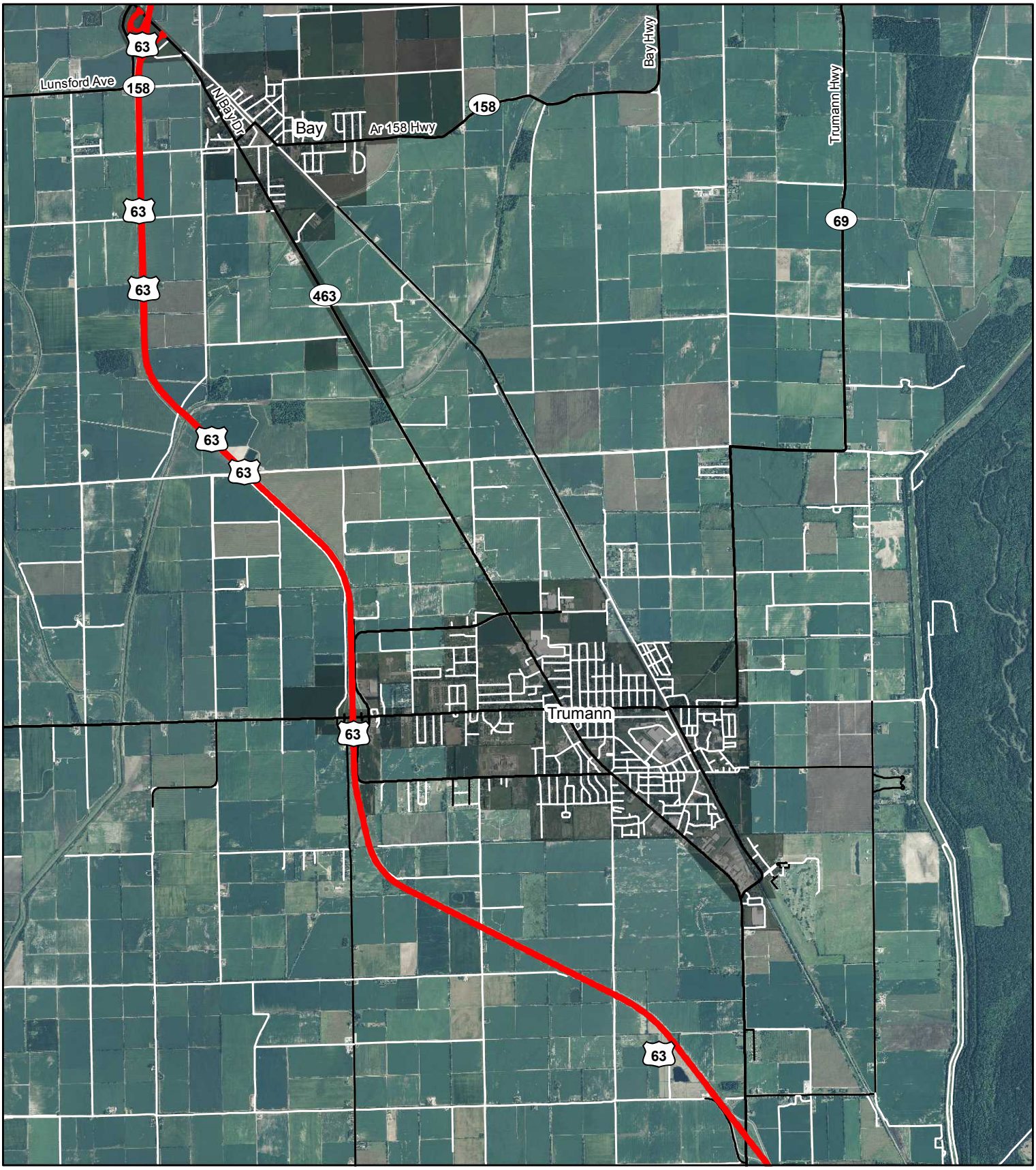

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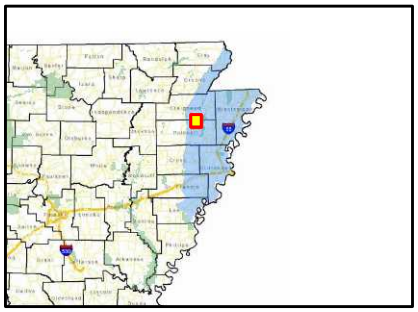

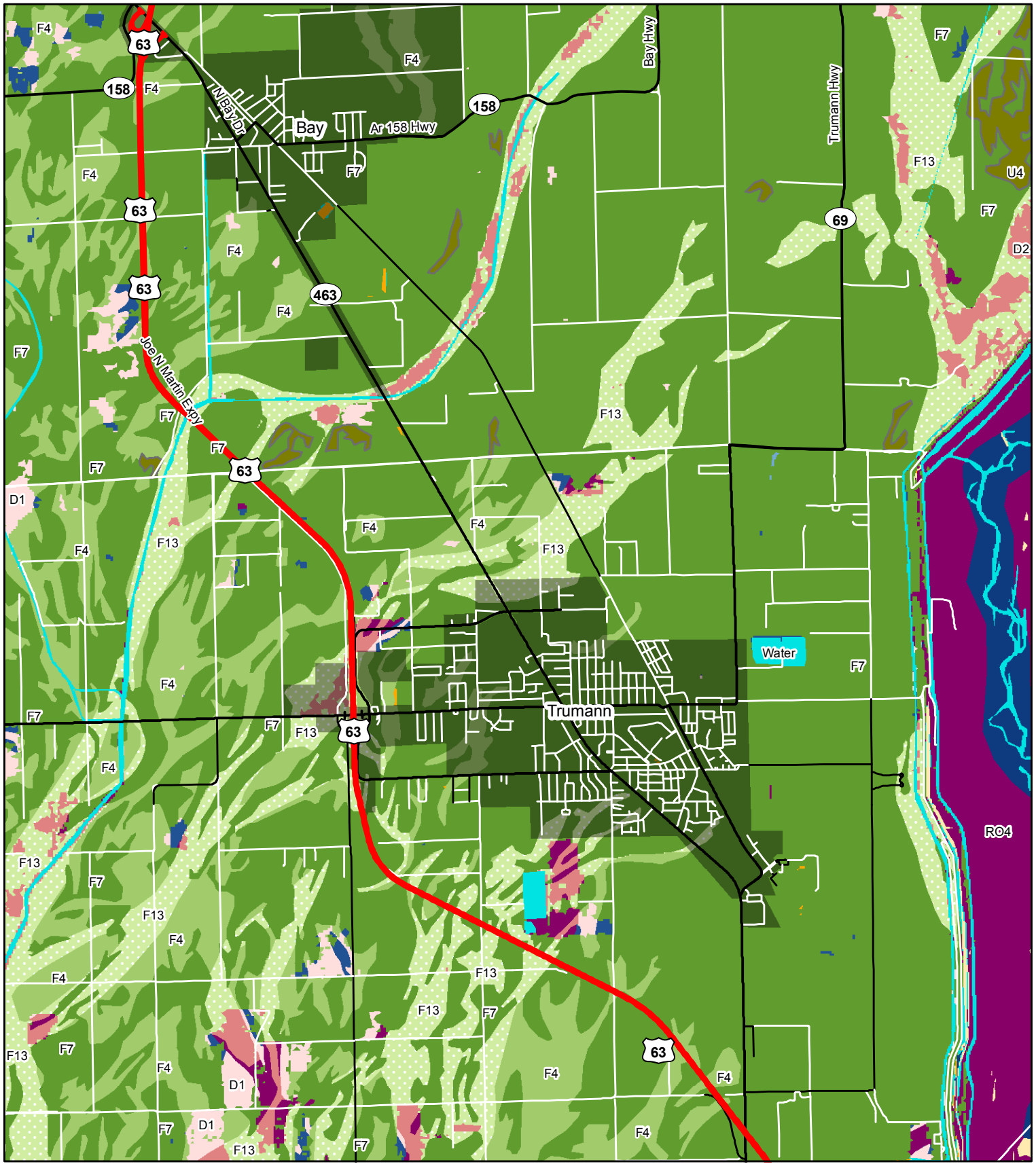

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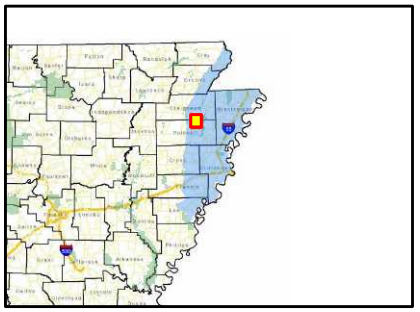

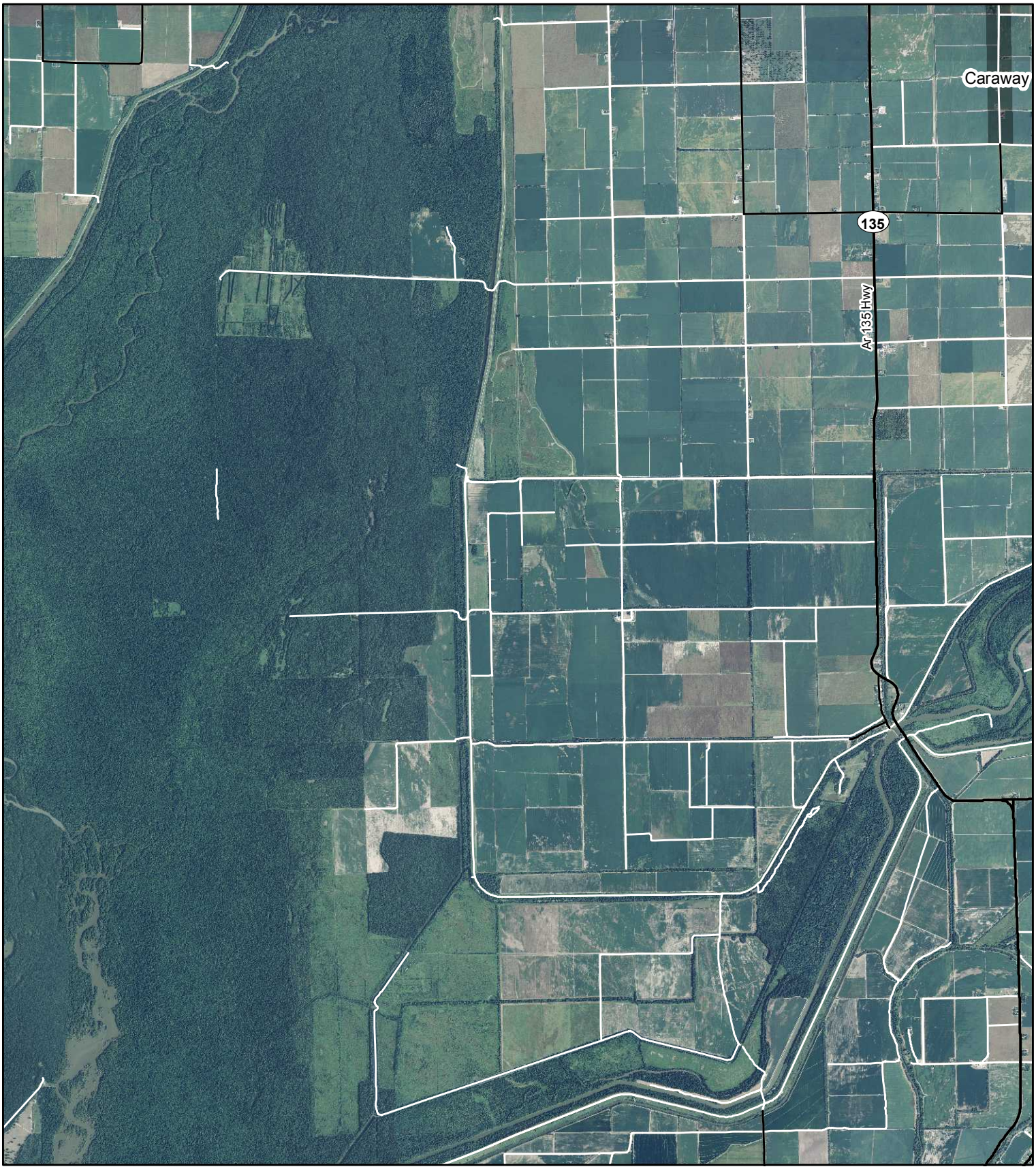

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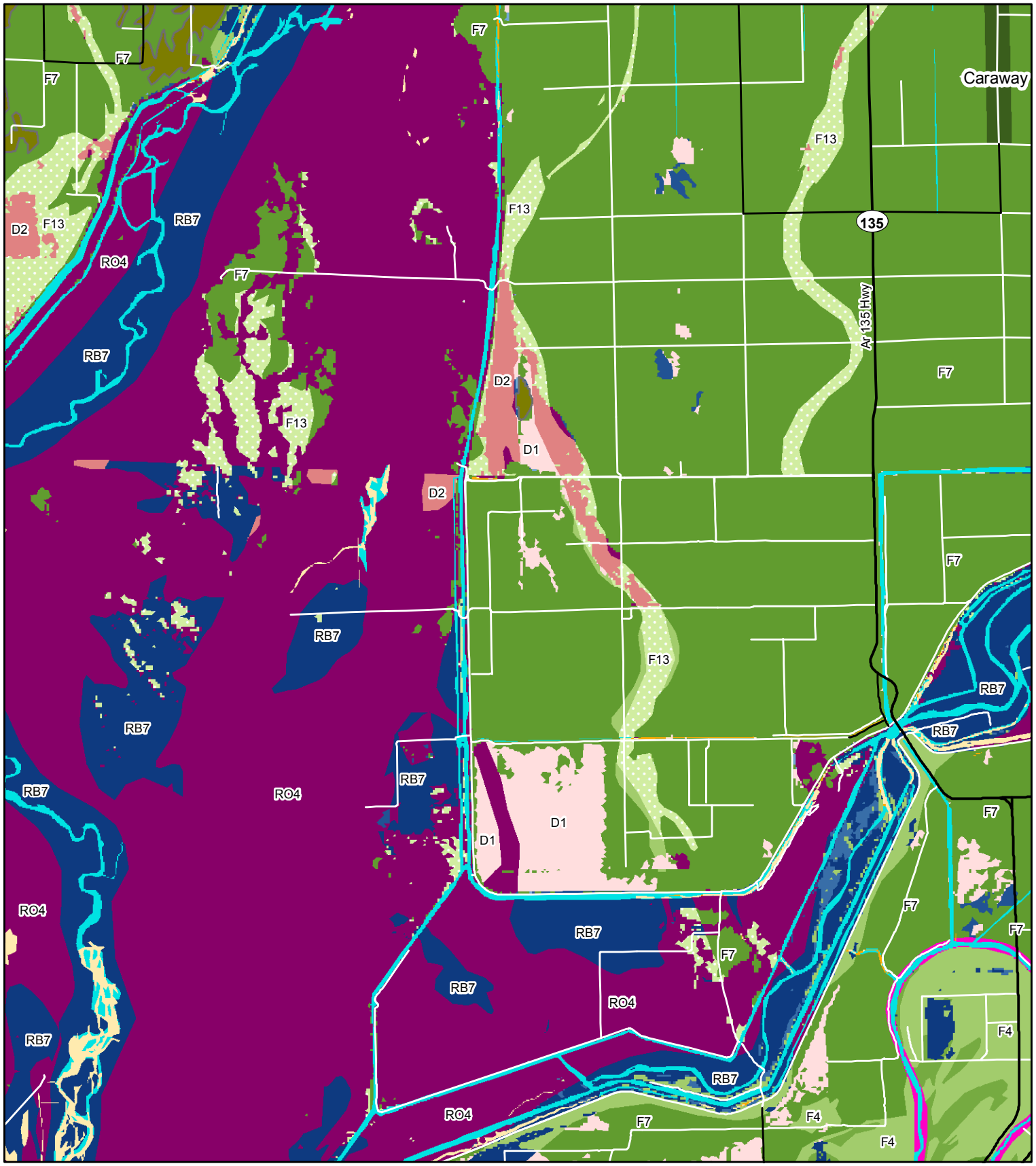

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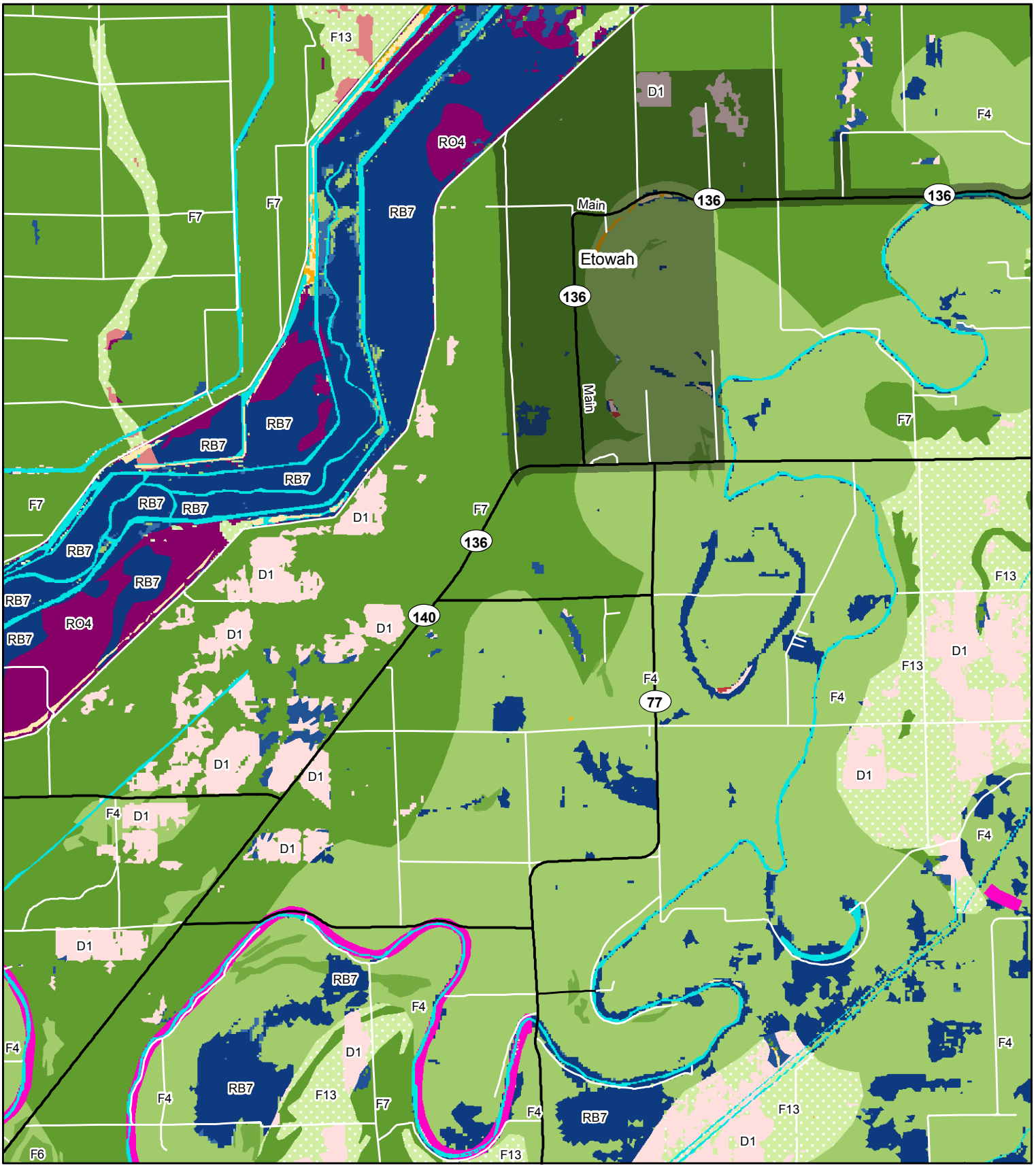

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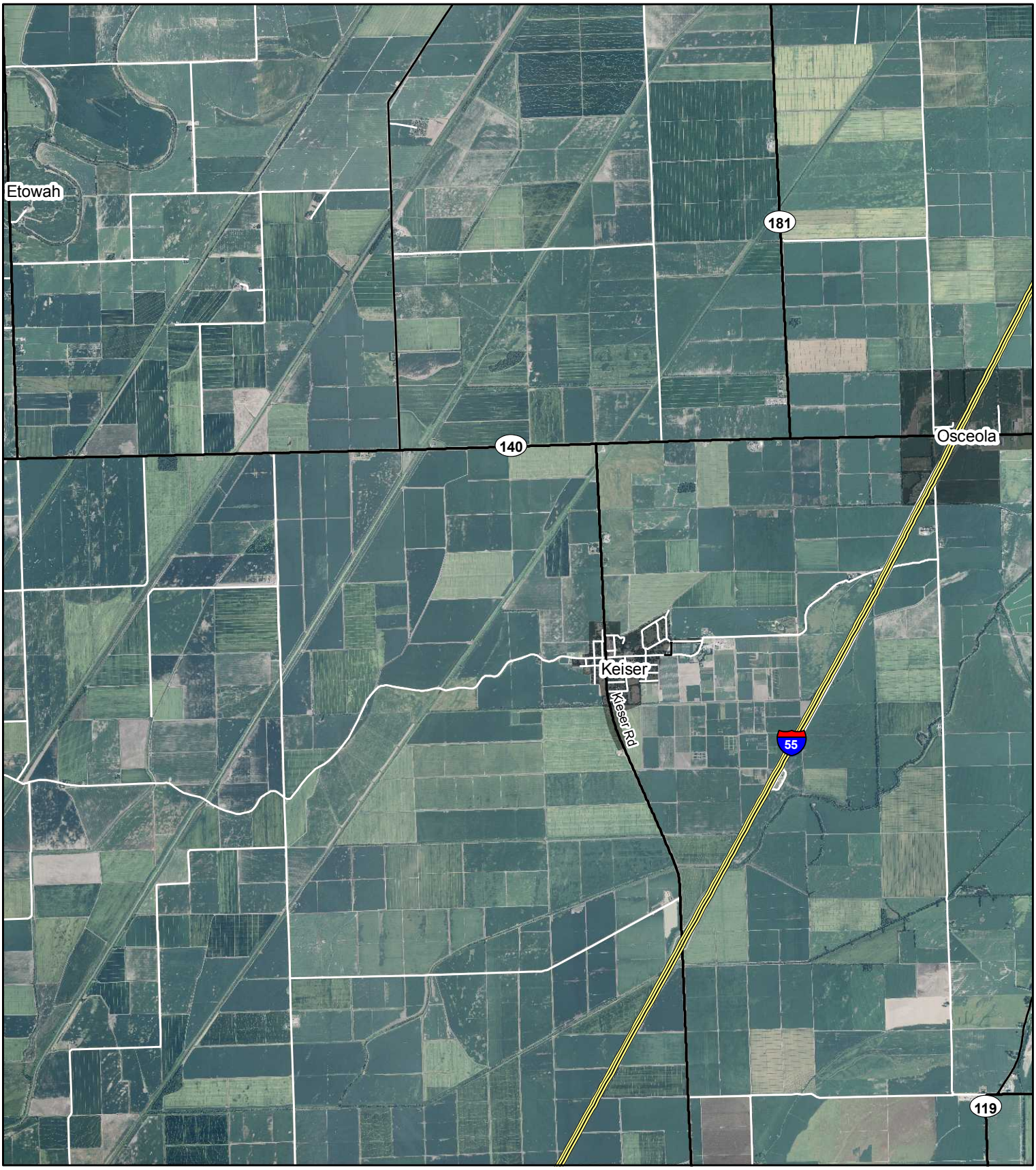

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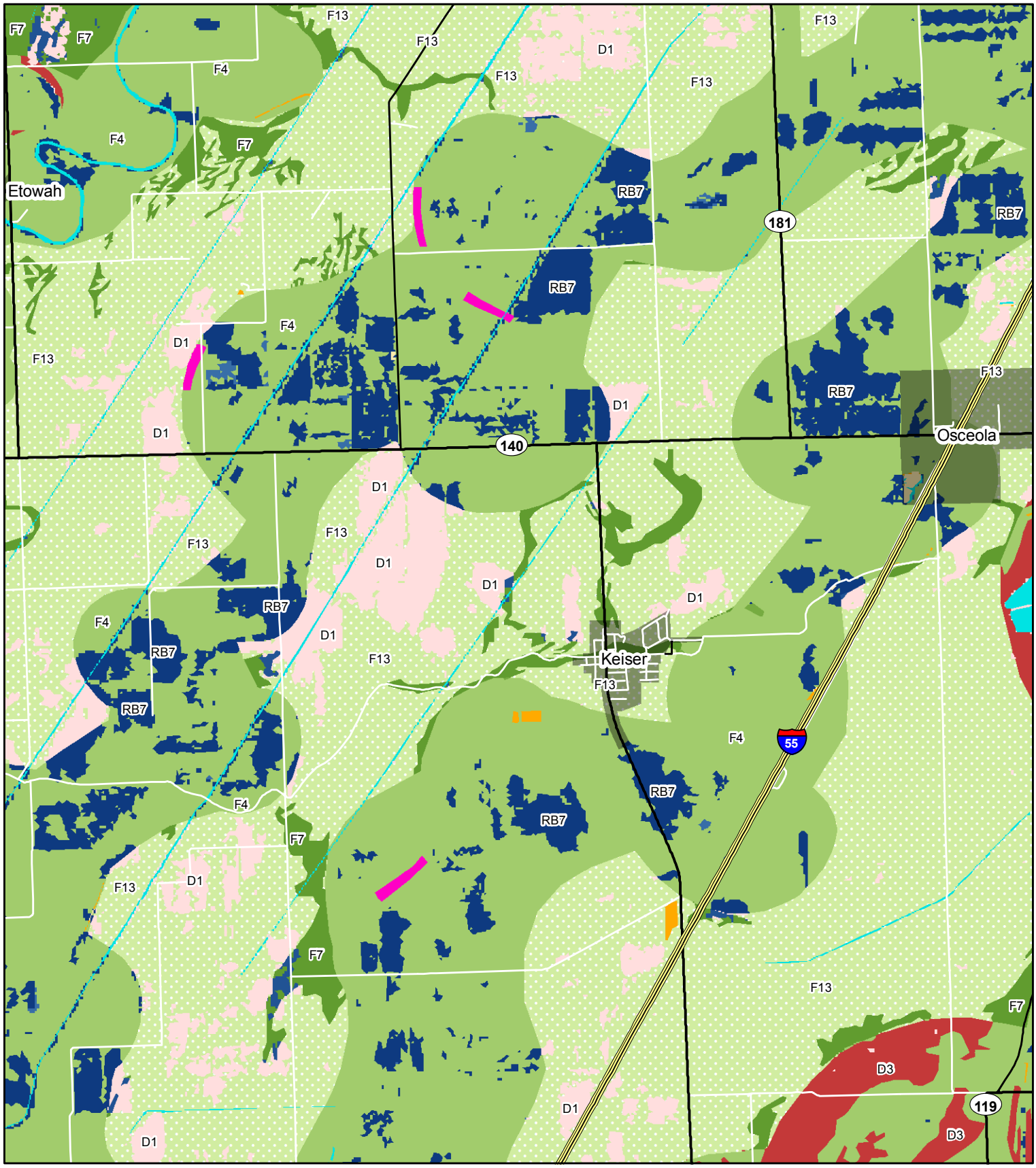

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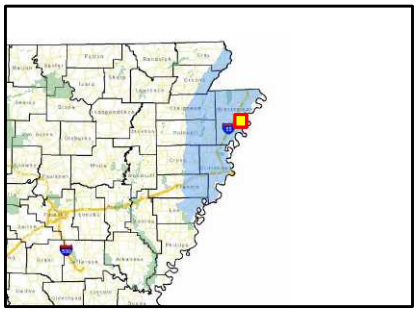

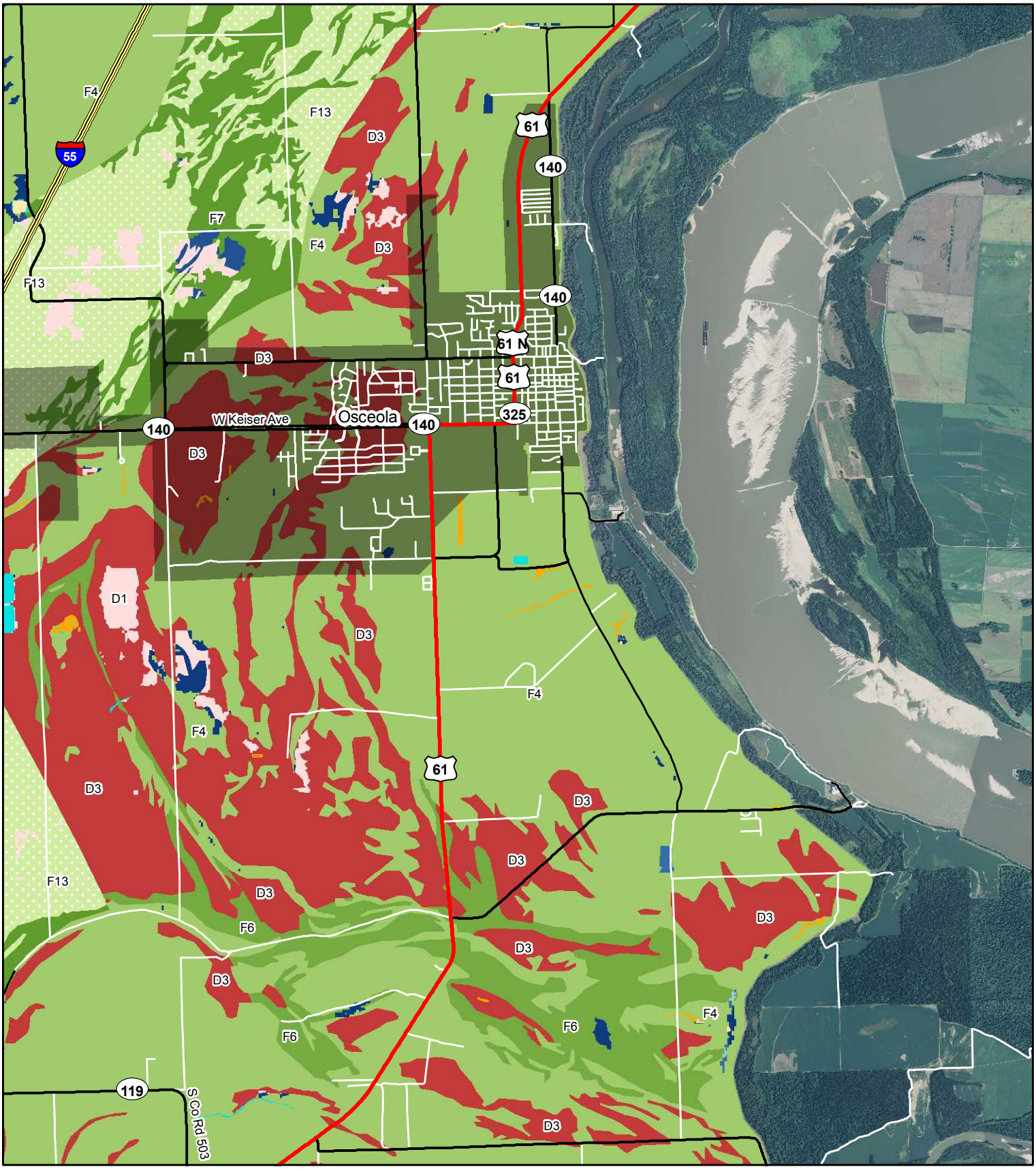

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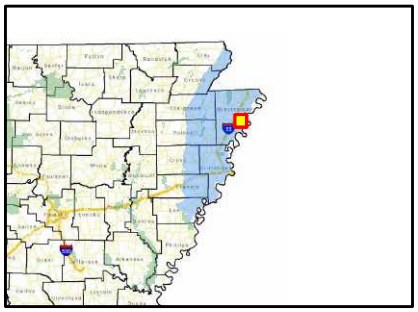

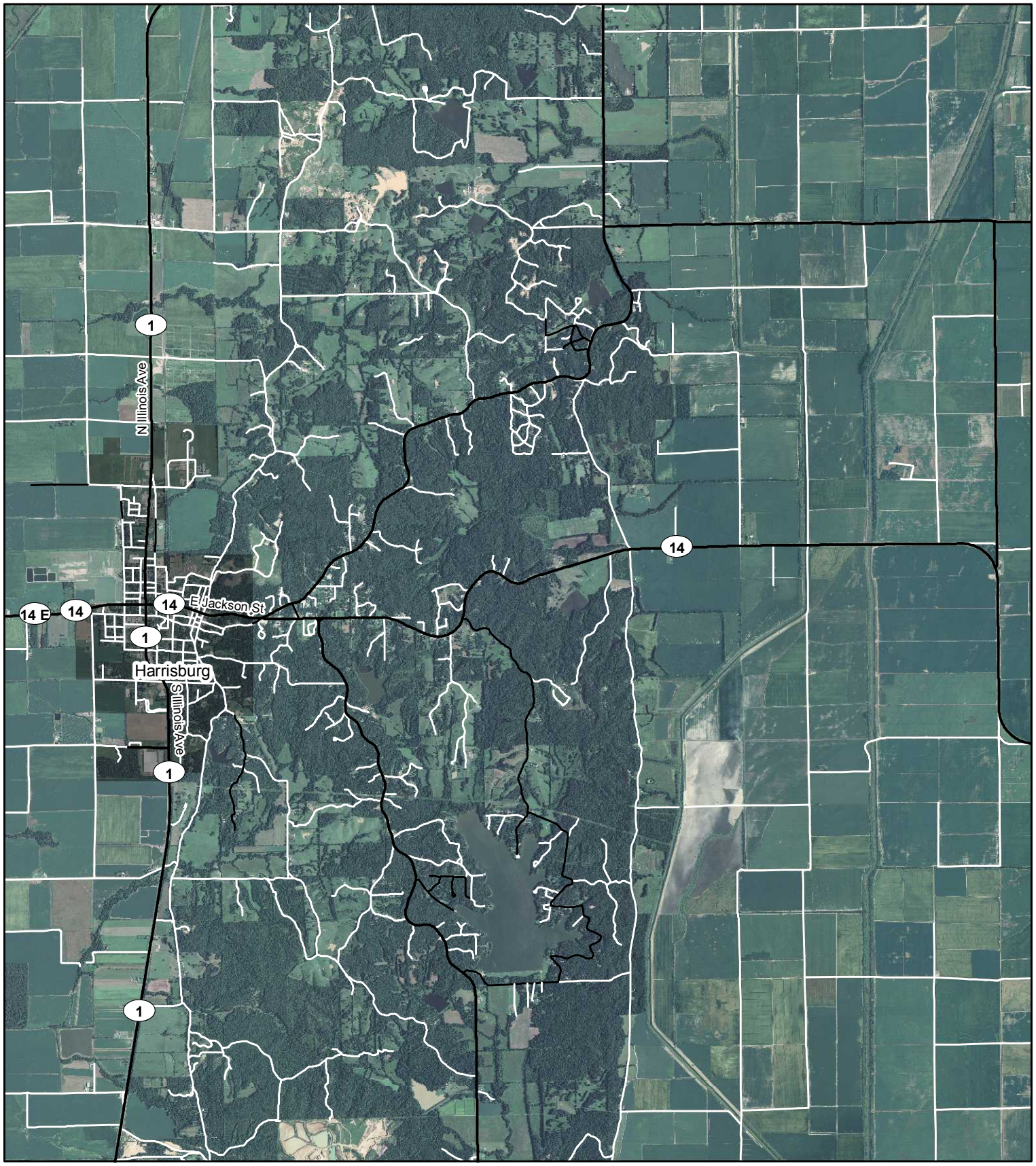

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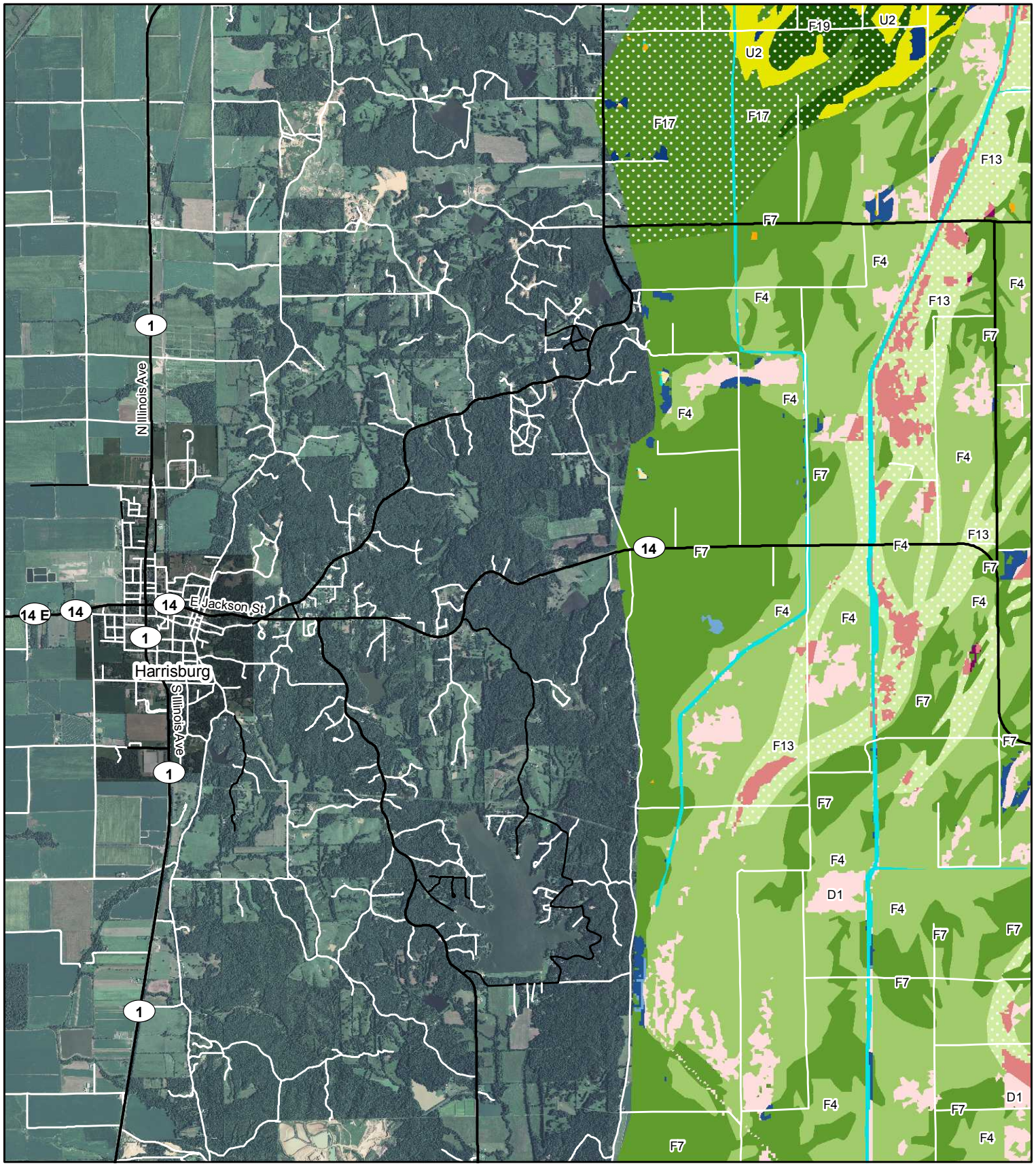

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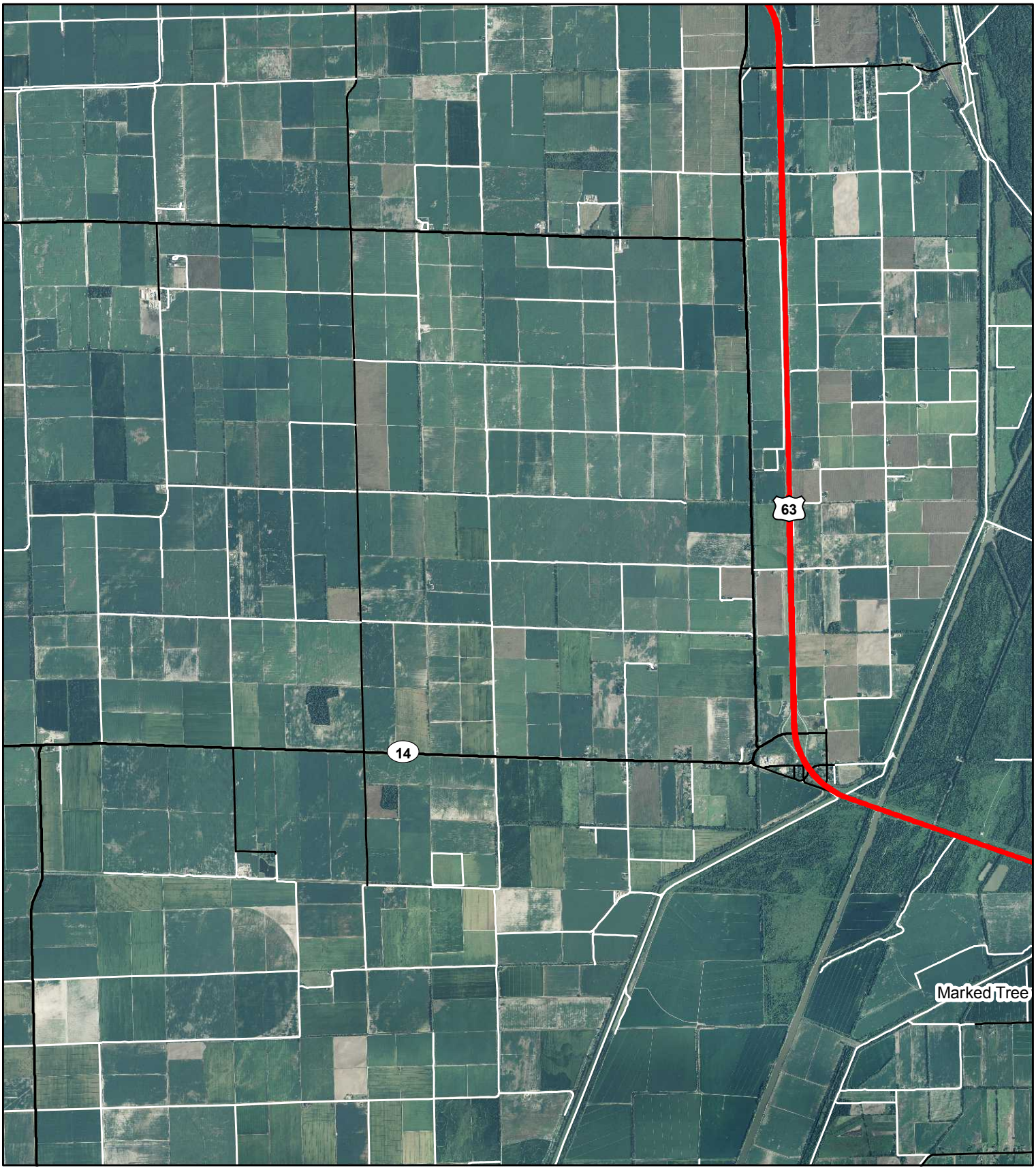

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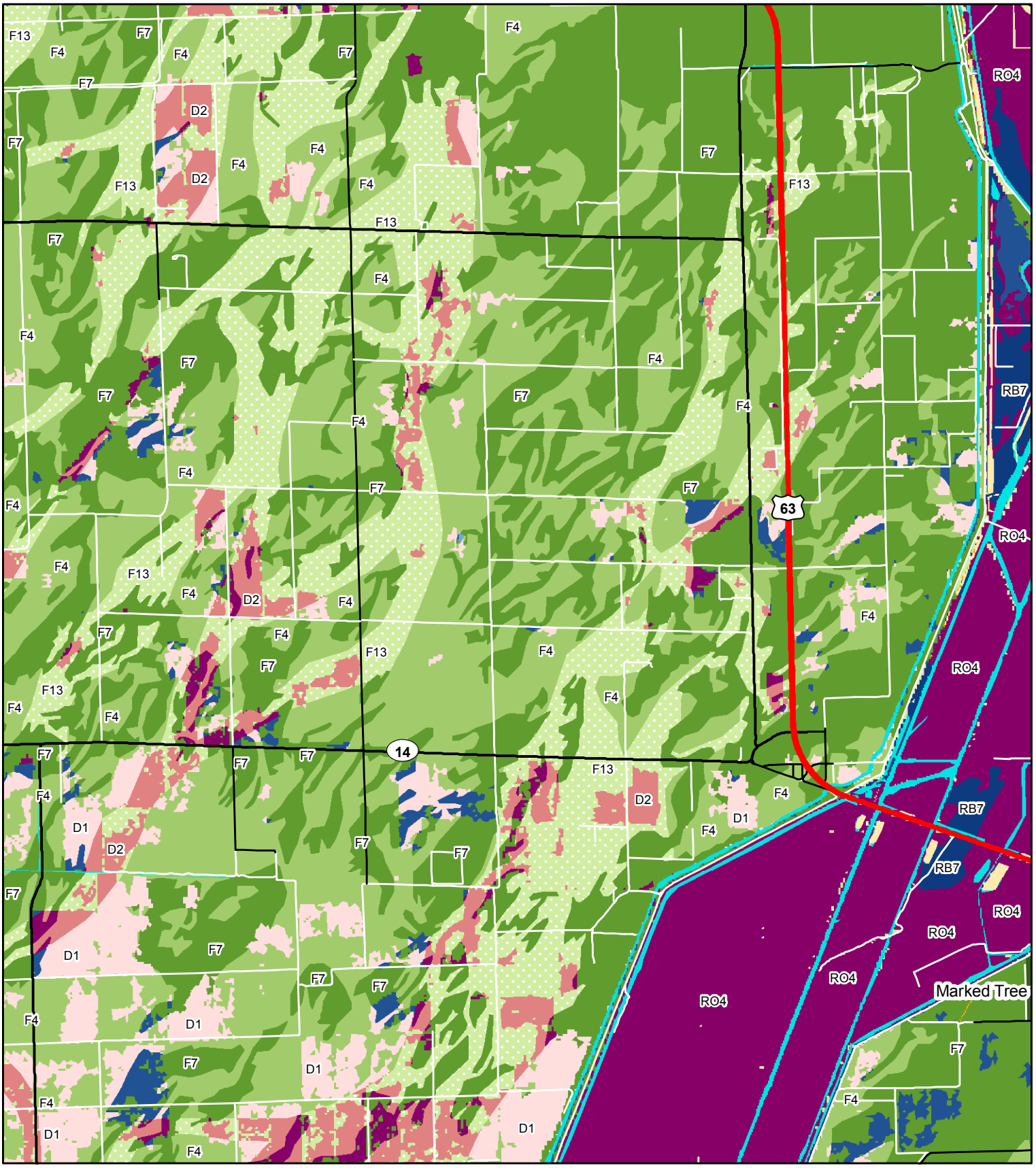

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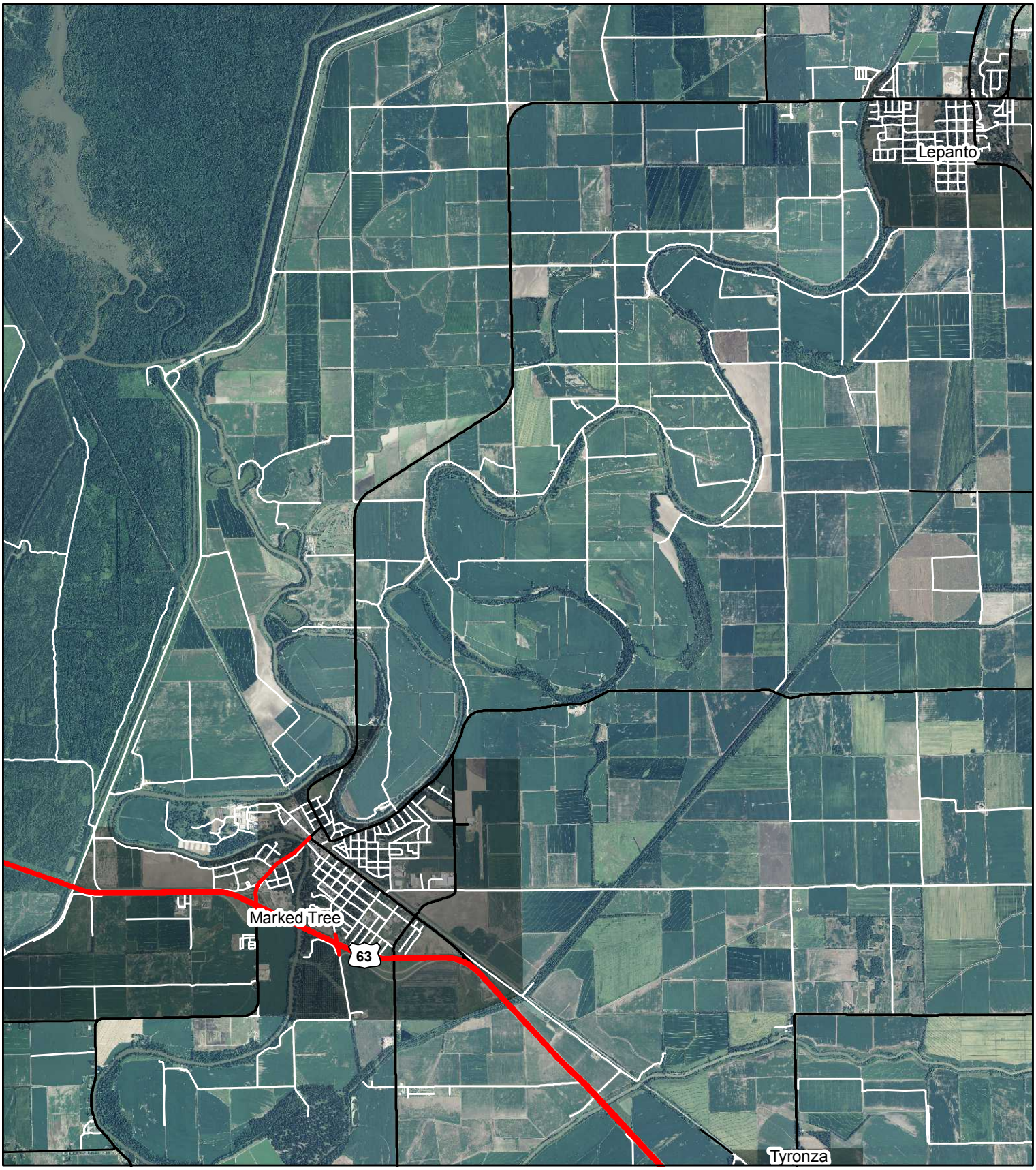

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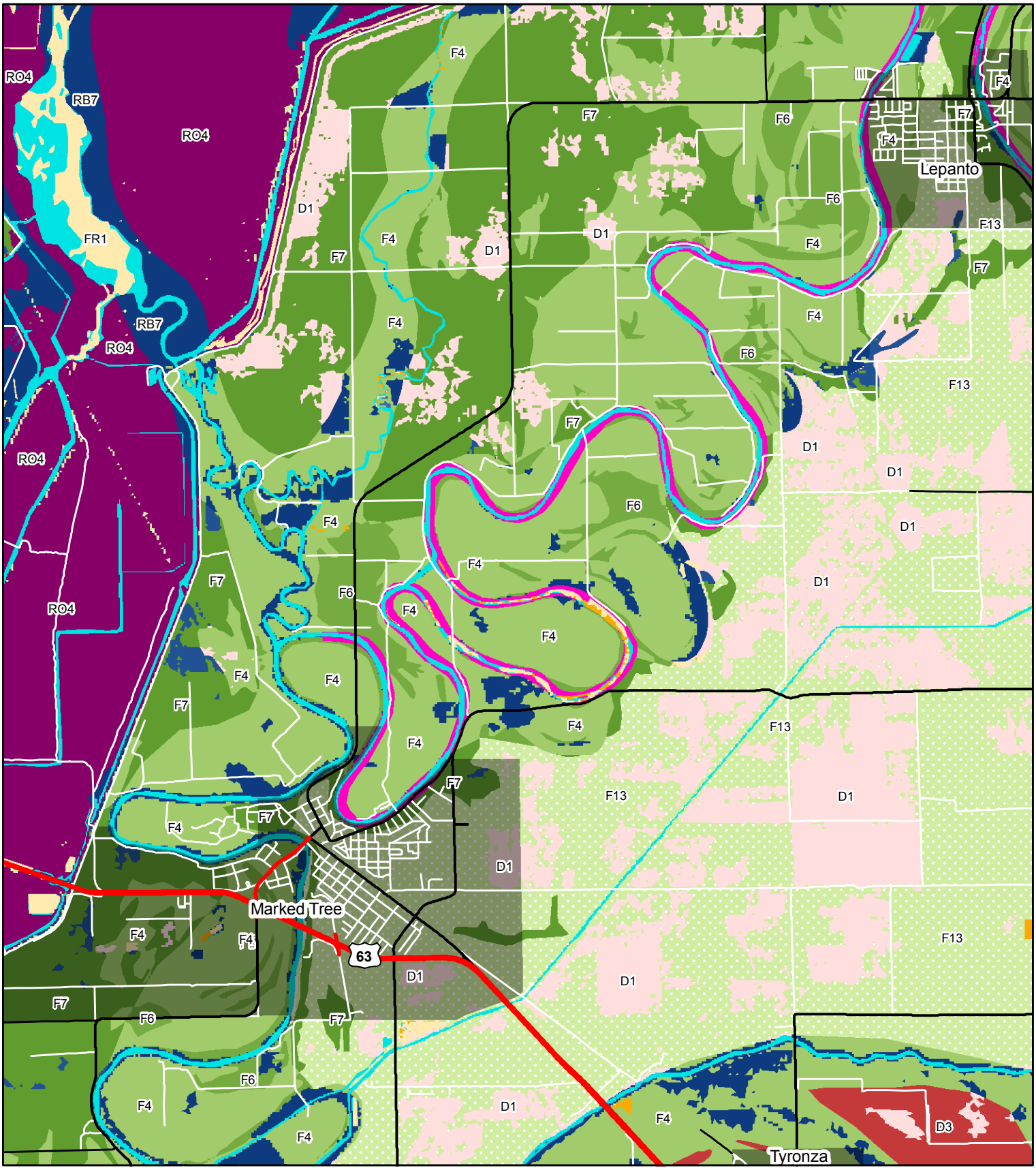

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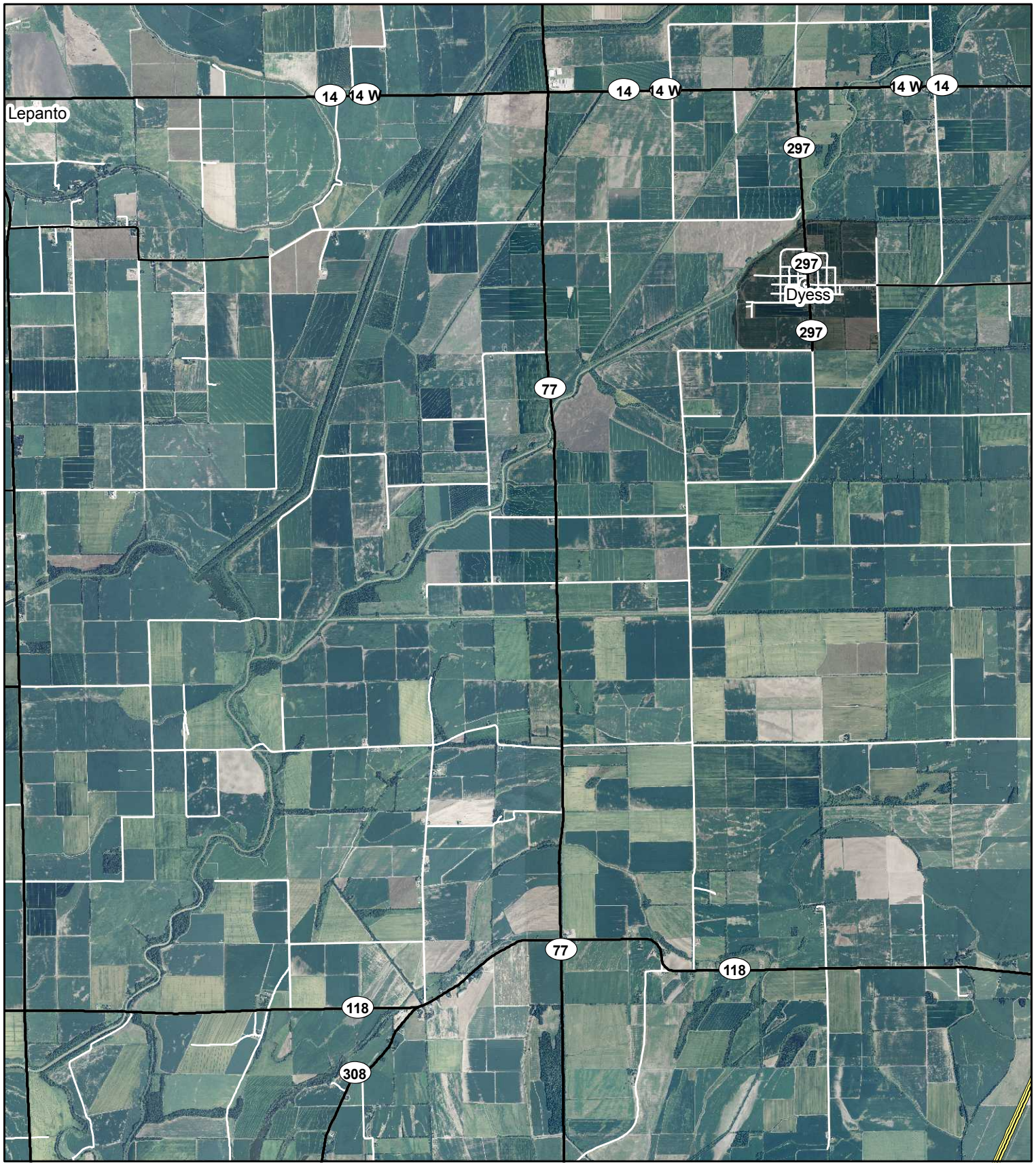

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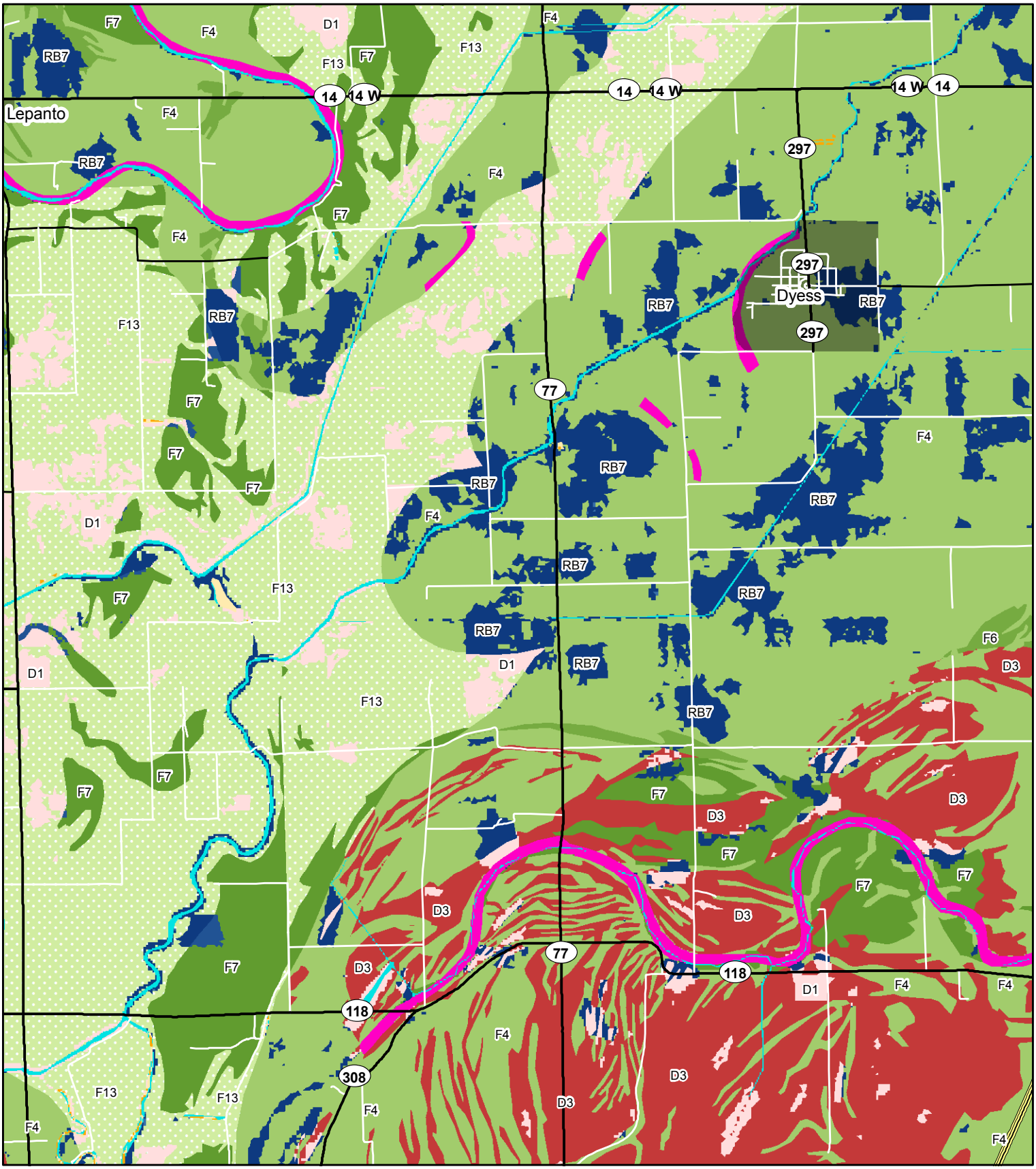

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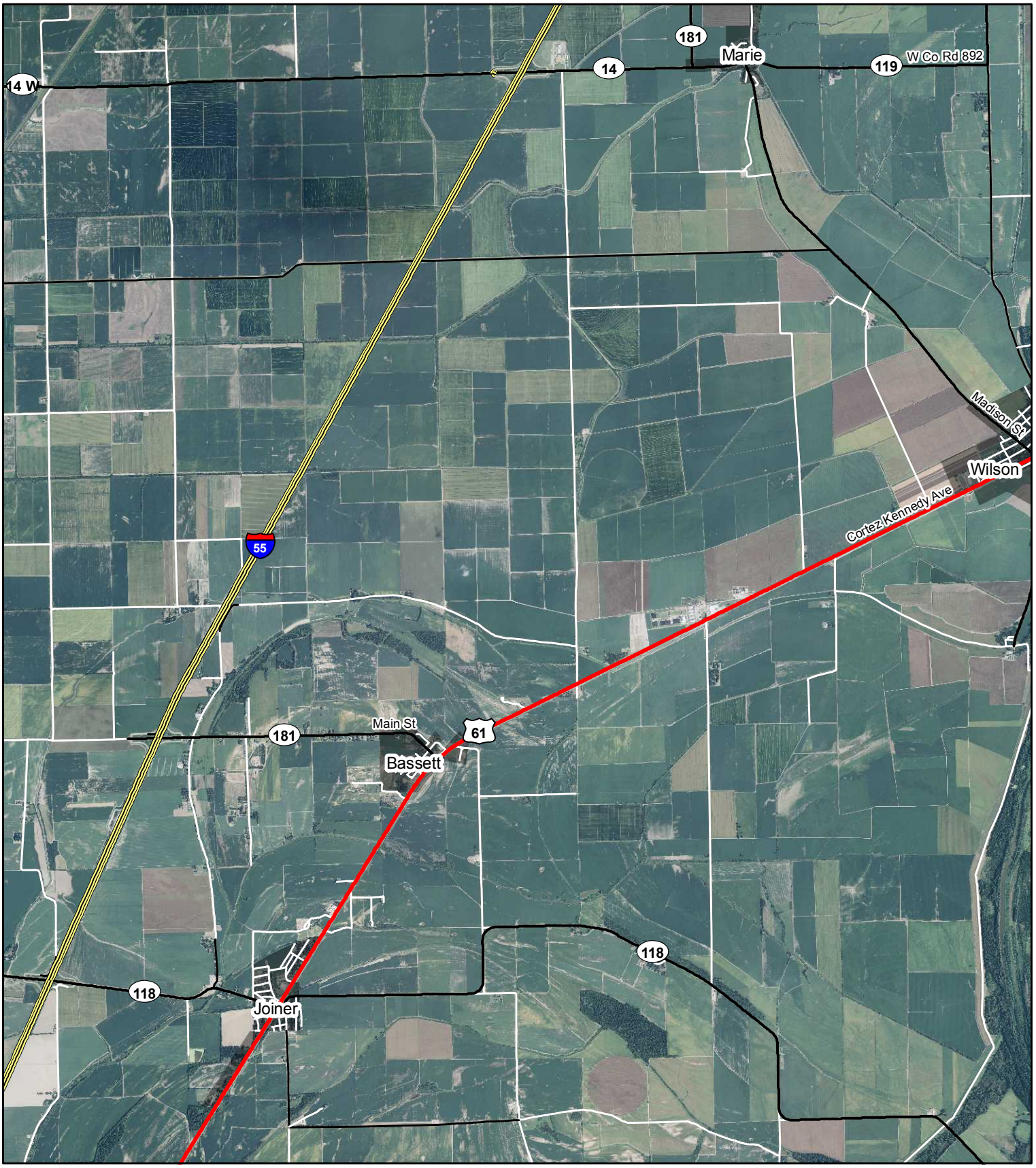

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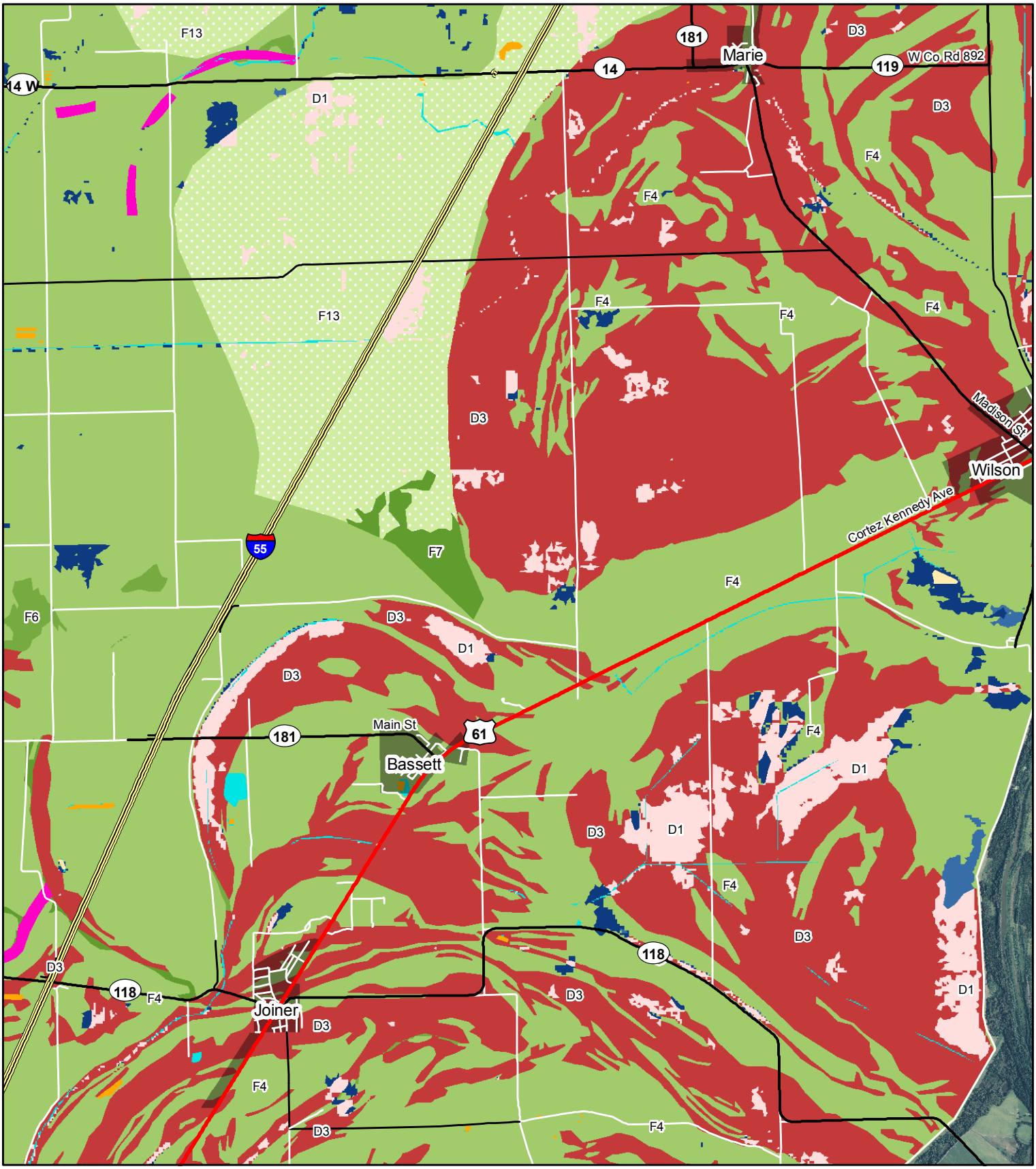

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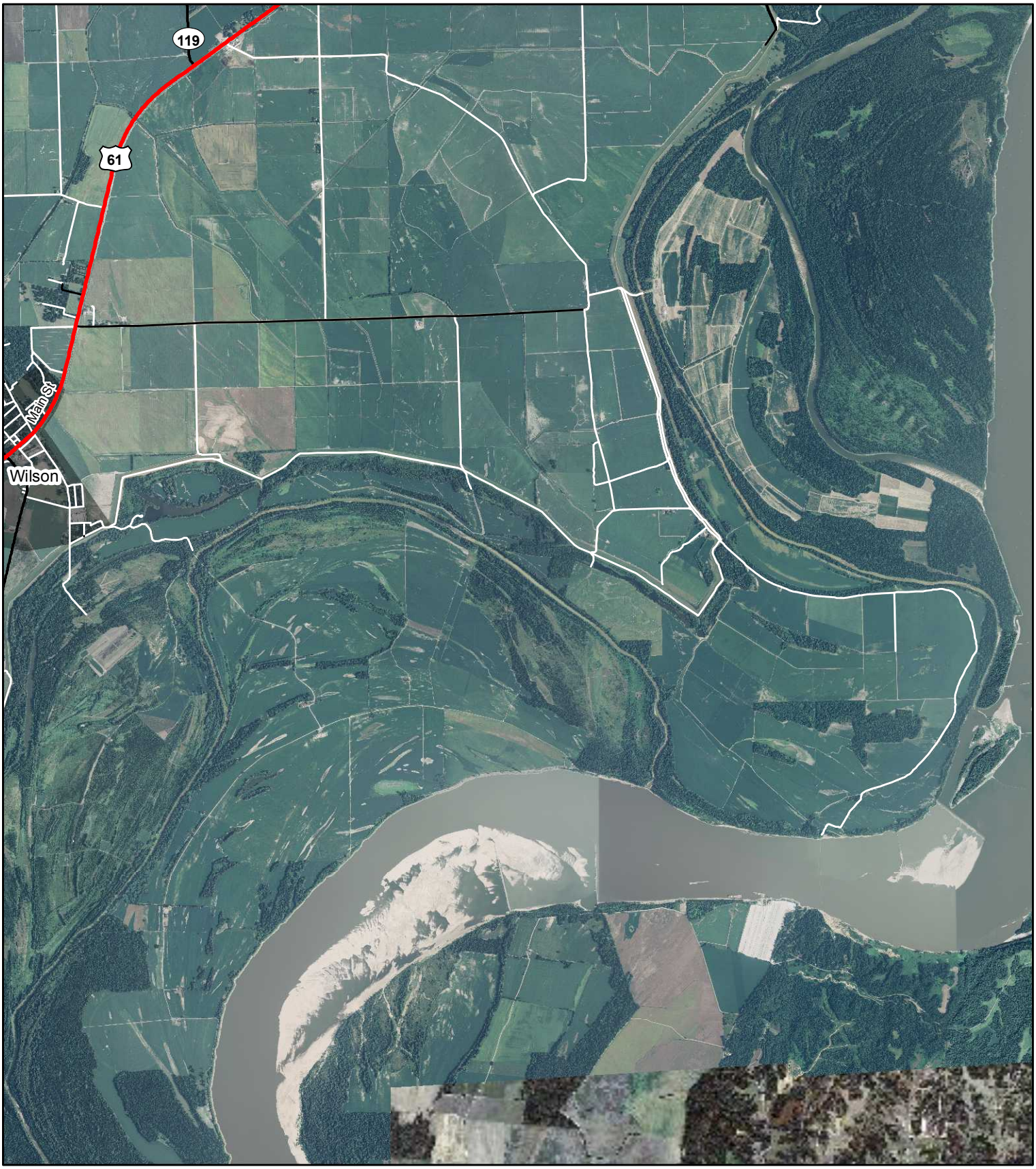

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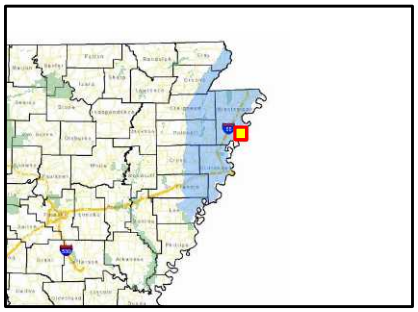

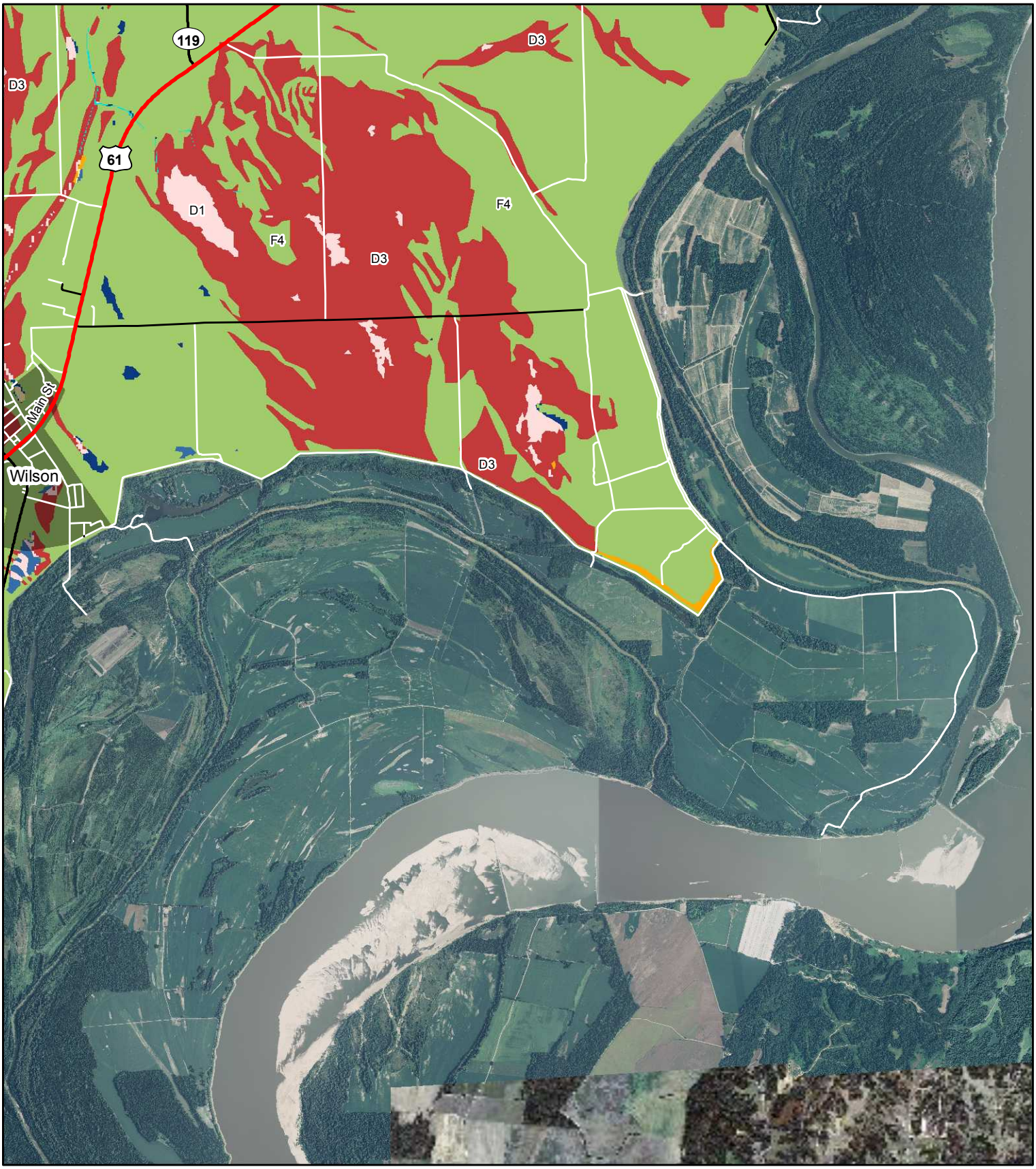

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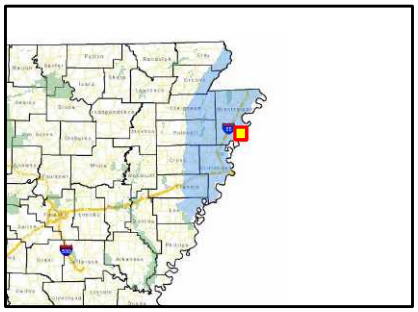

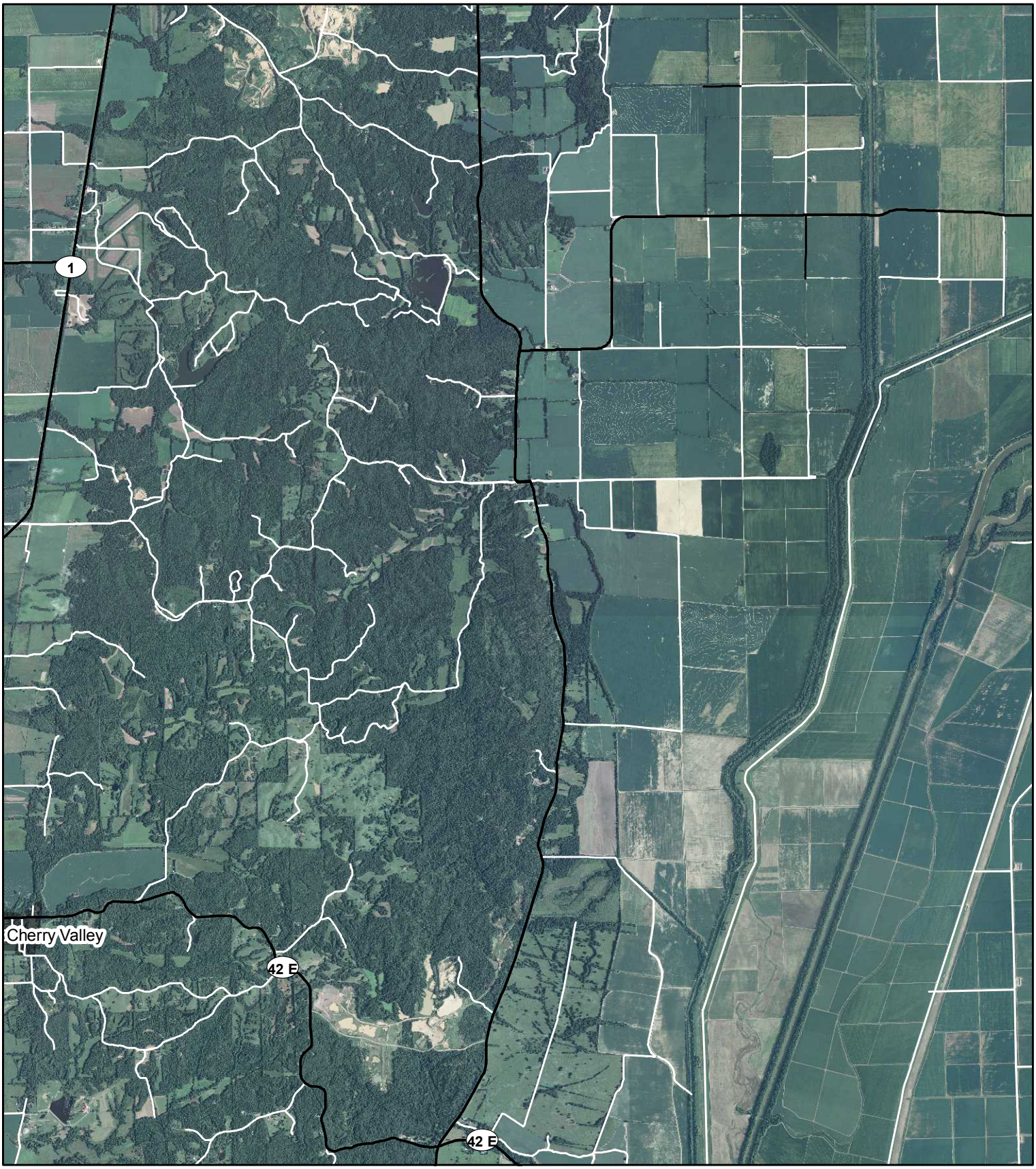

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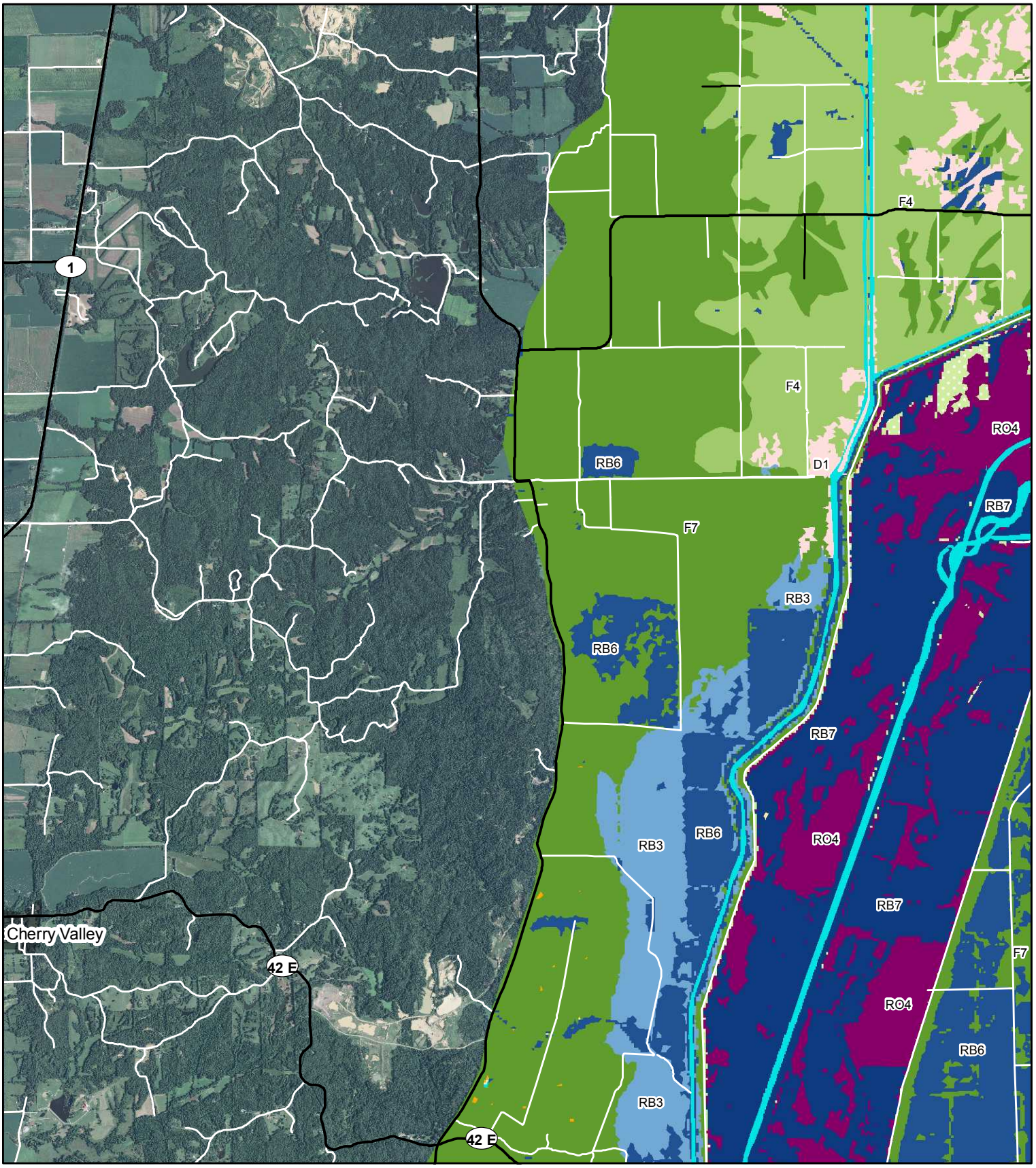

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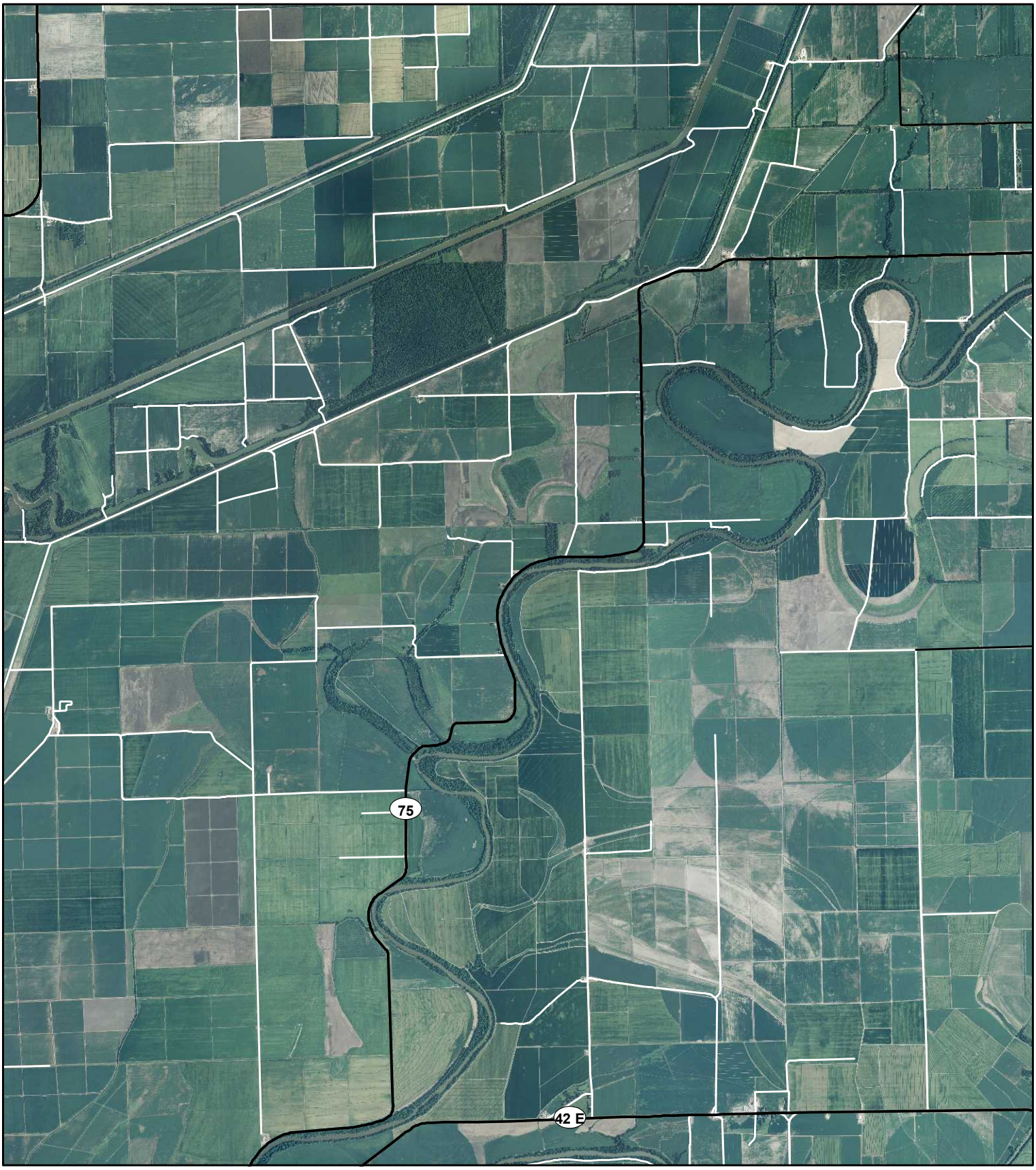

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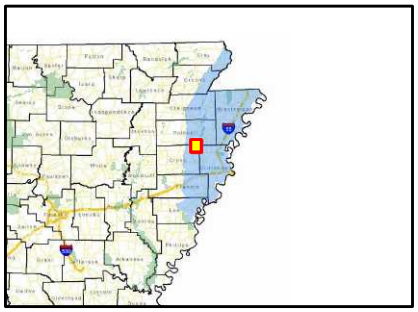

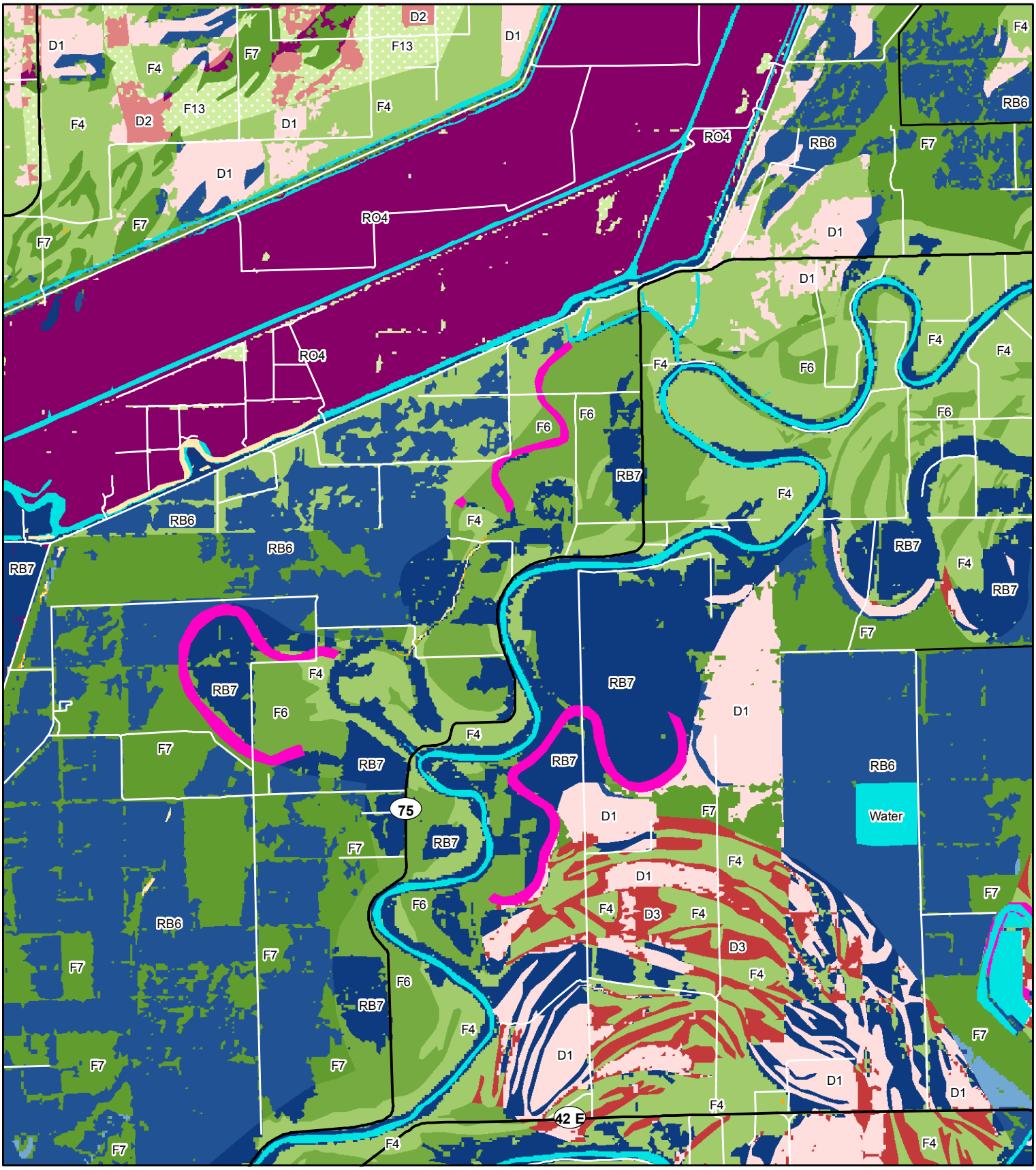

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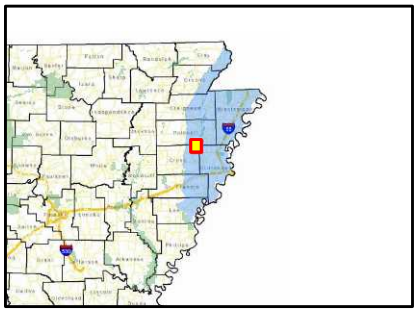

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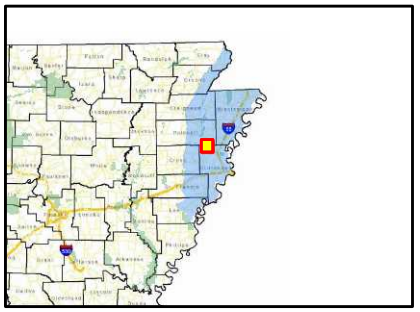

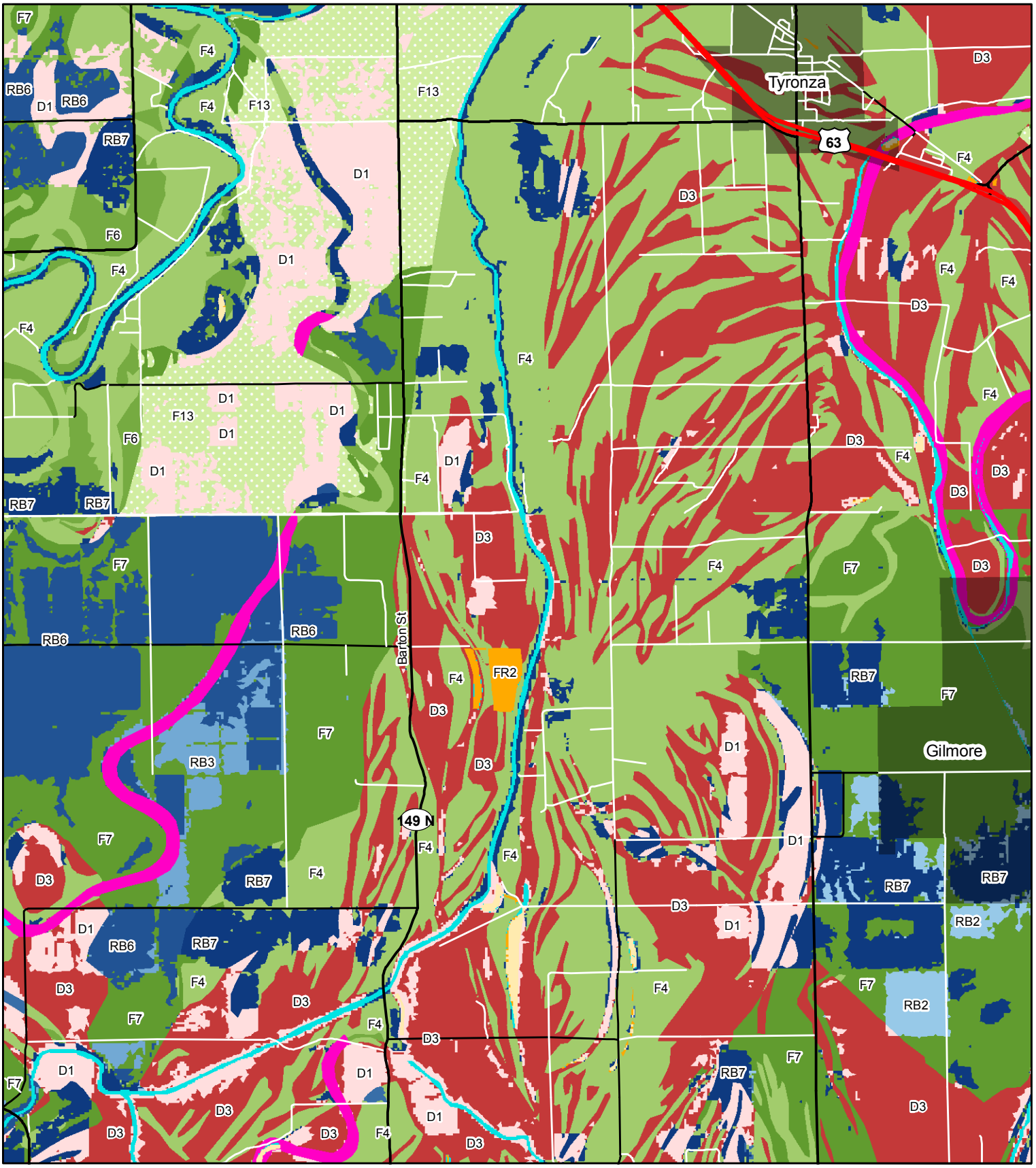

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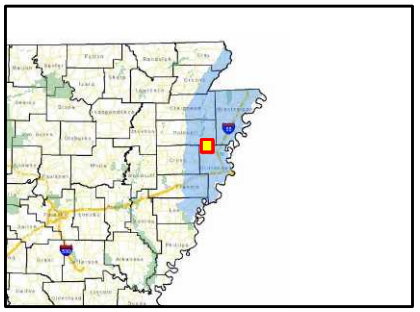

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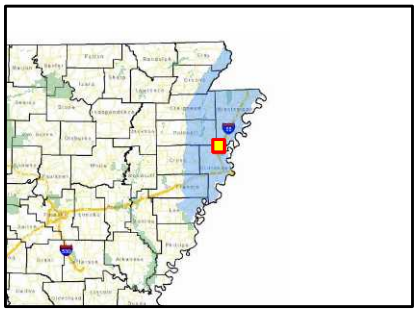

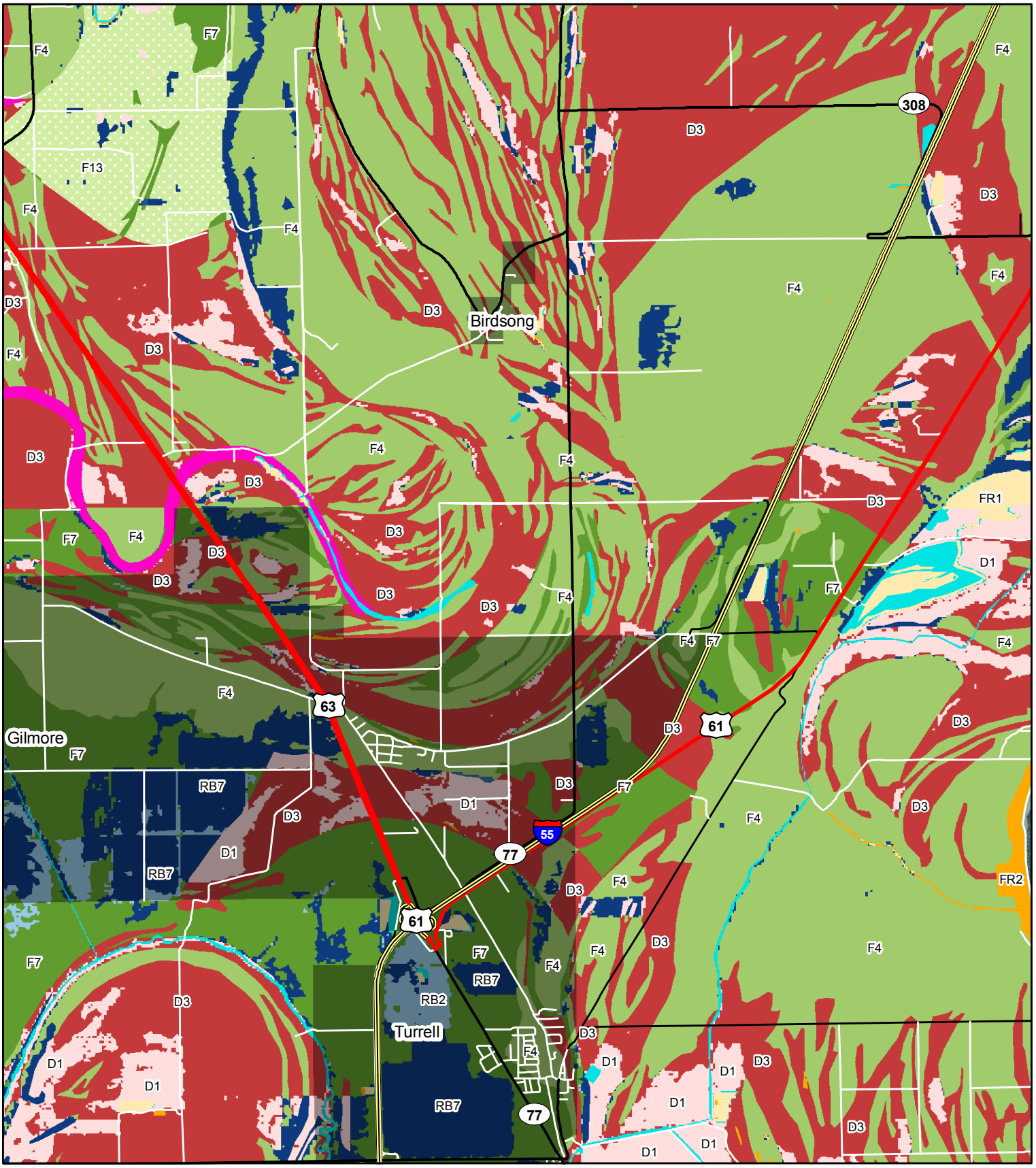

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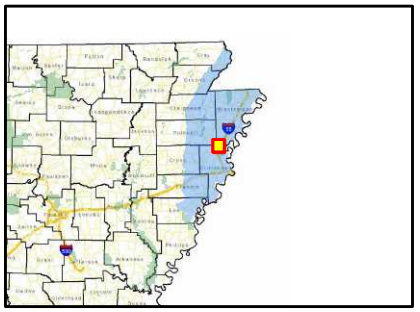

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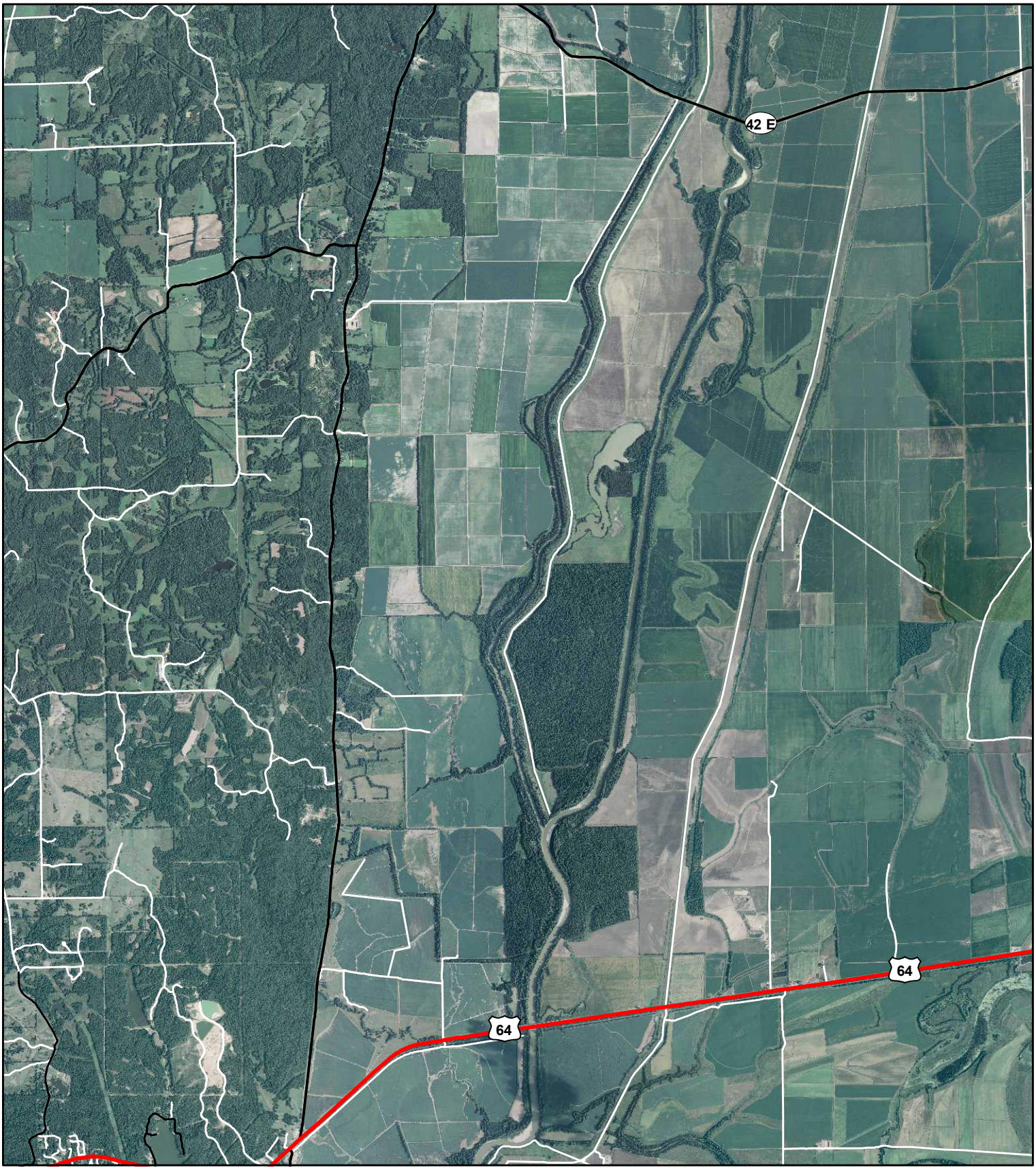

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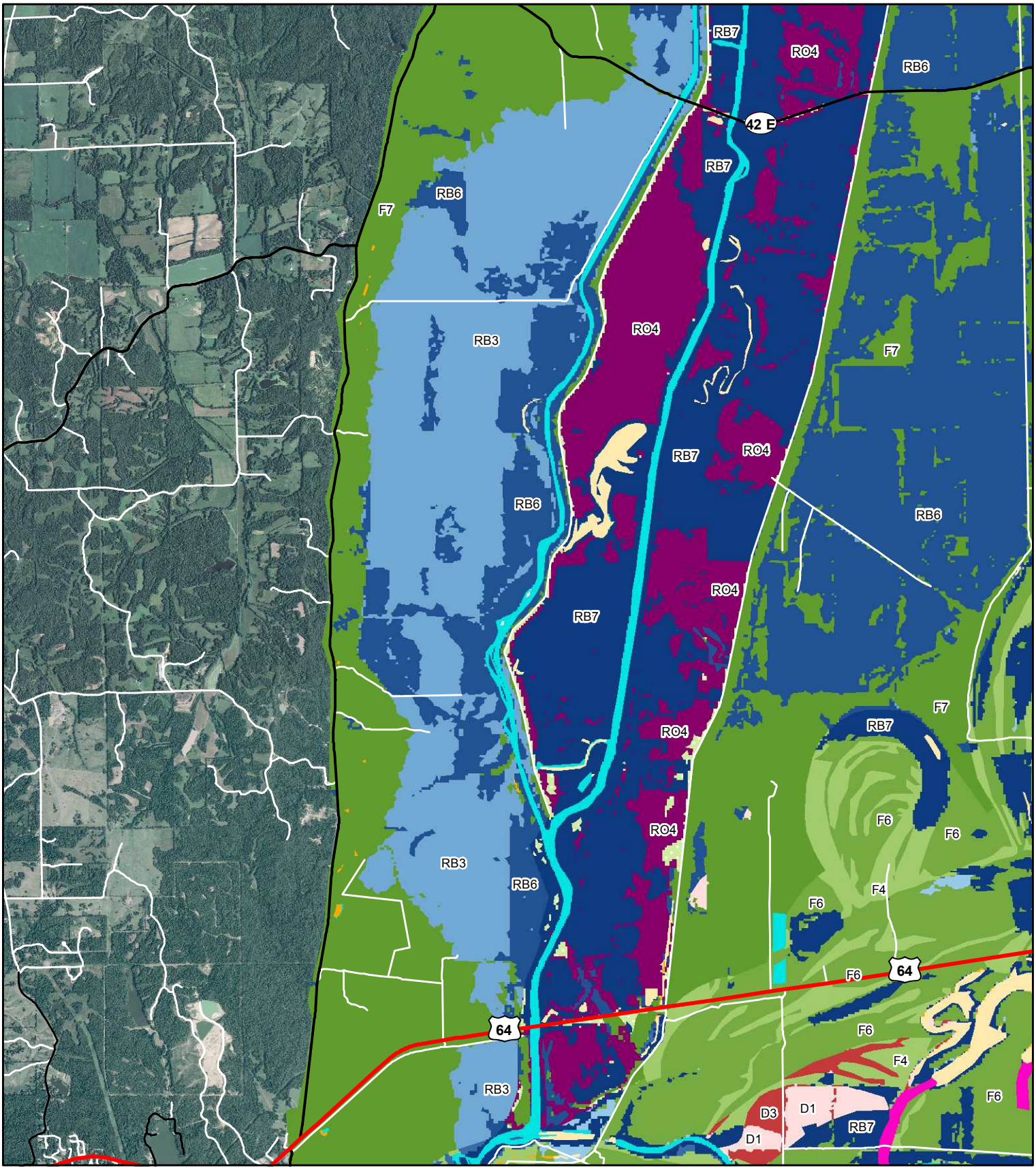

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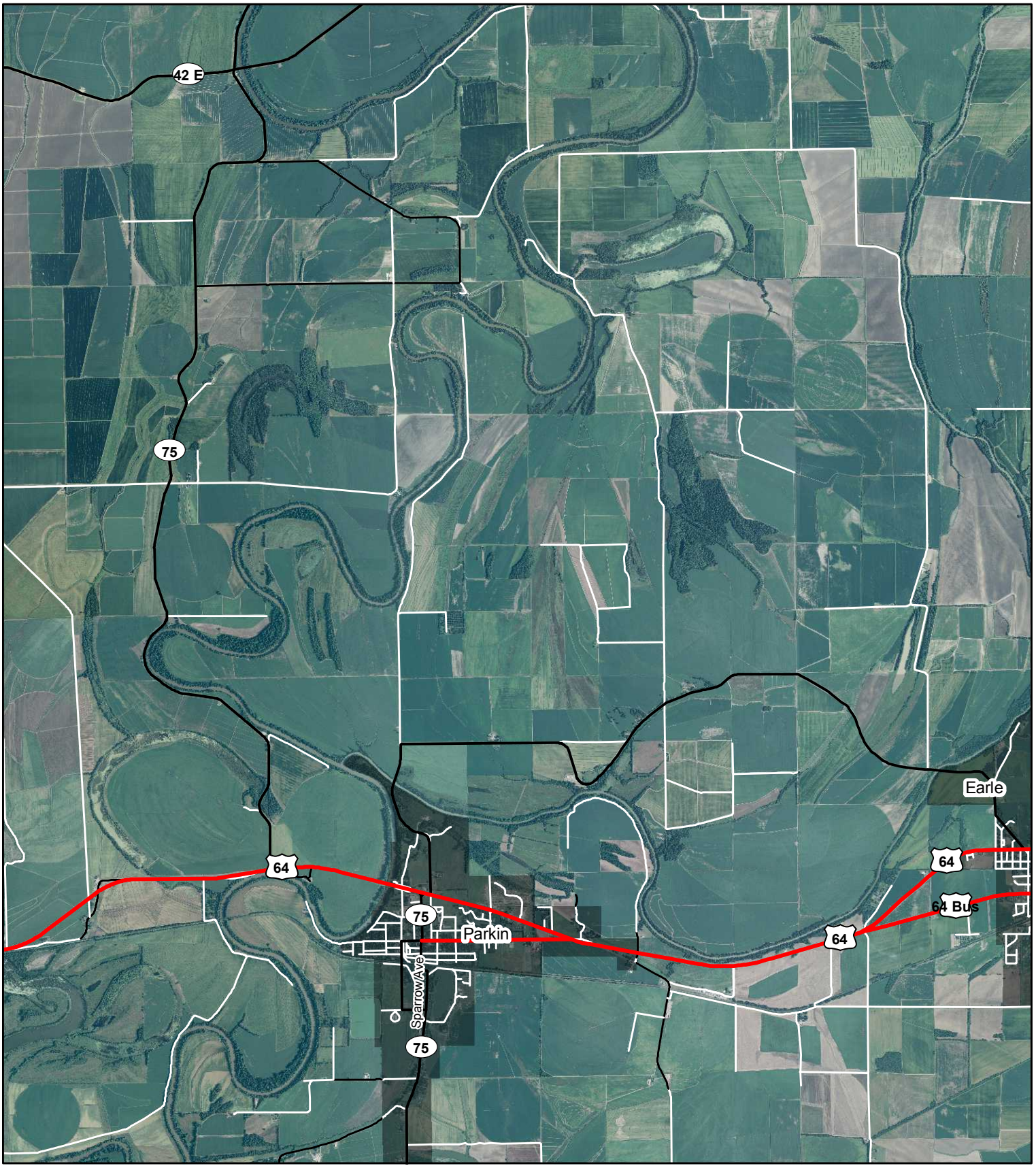

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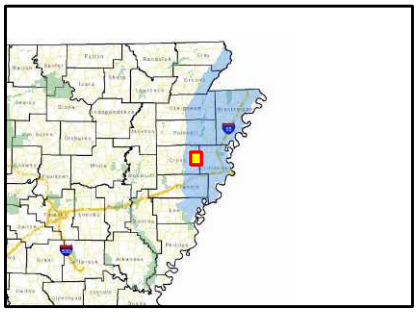

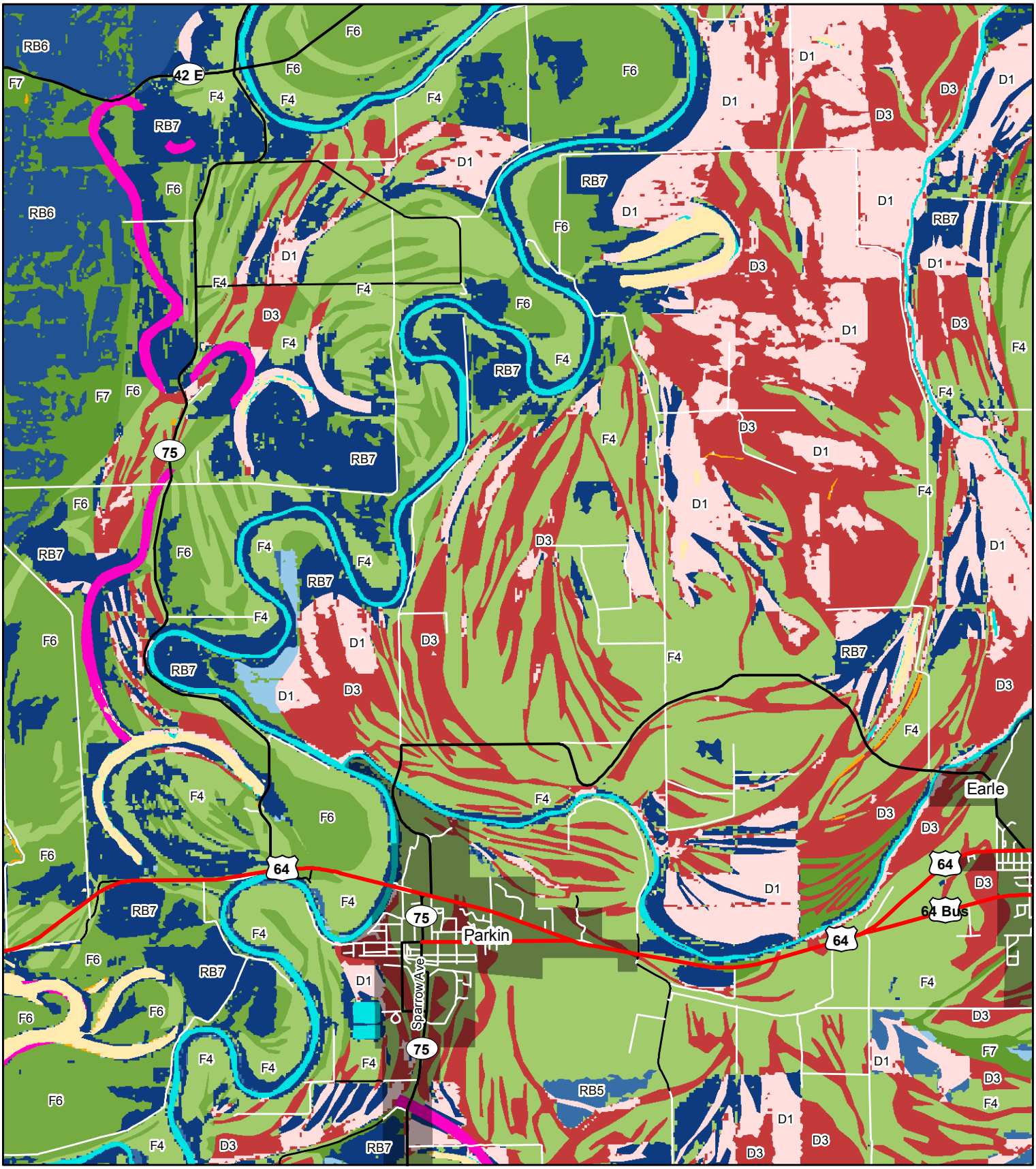

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Datum: North American 1983

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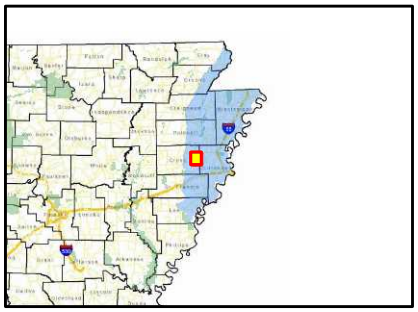

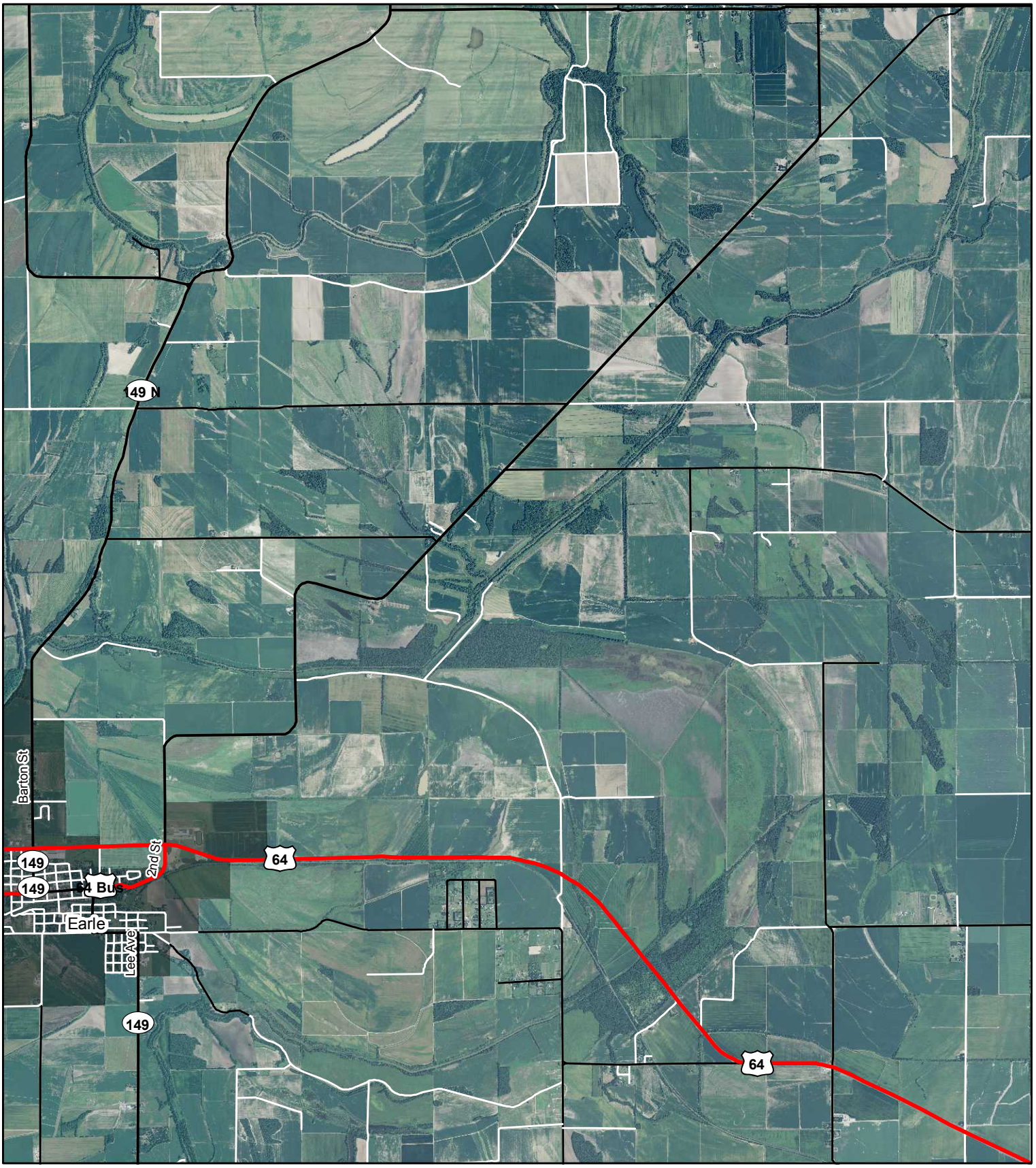

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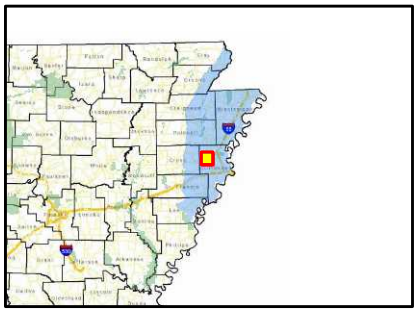

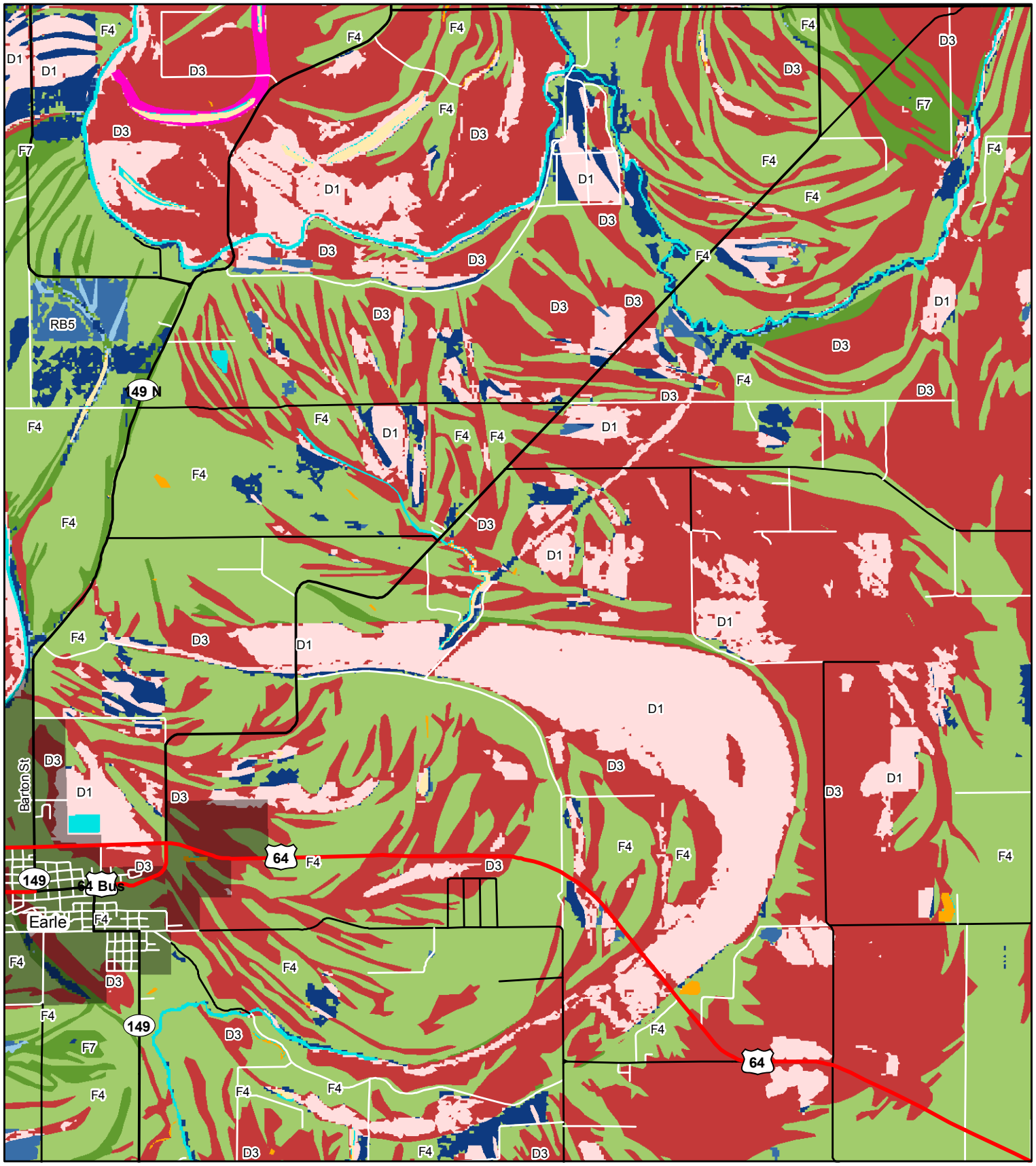

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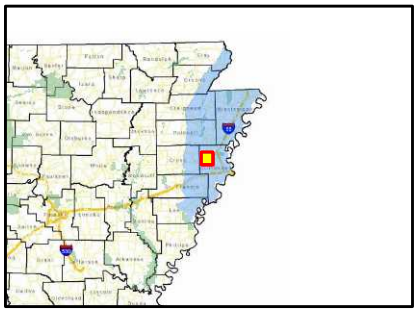

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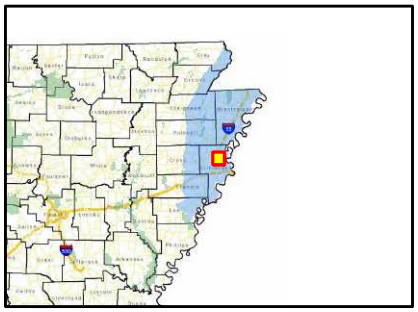

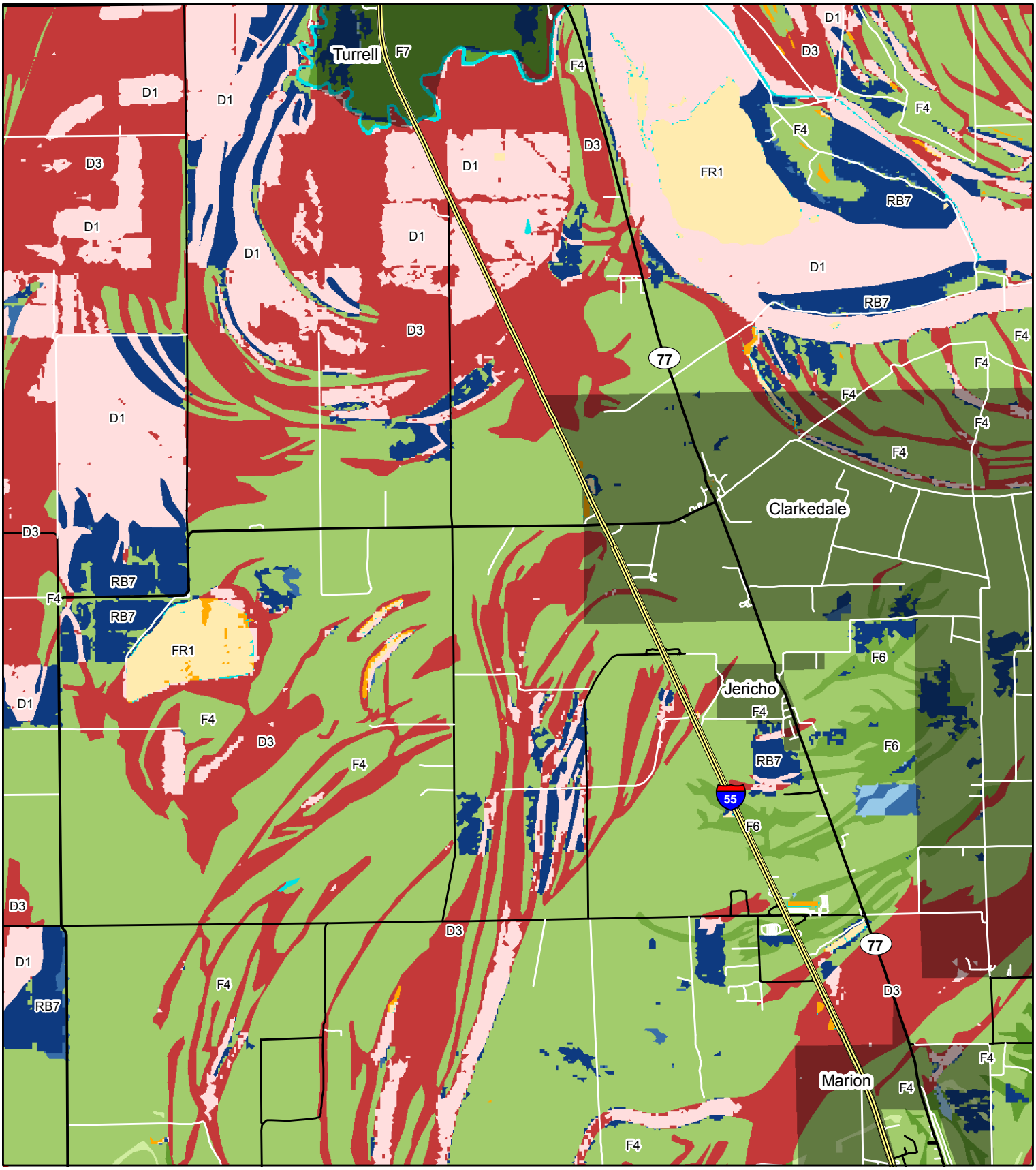

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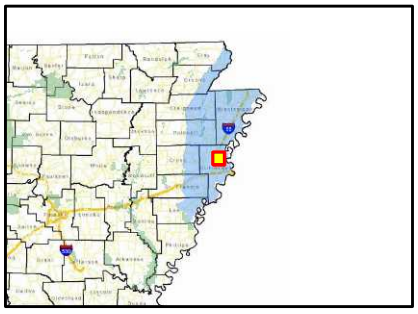

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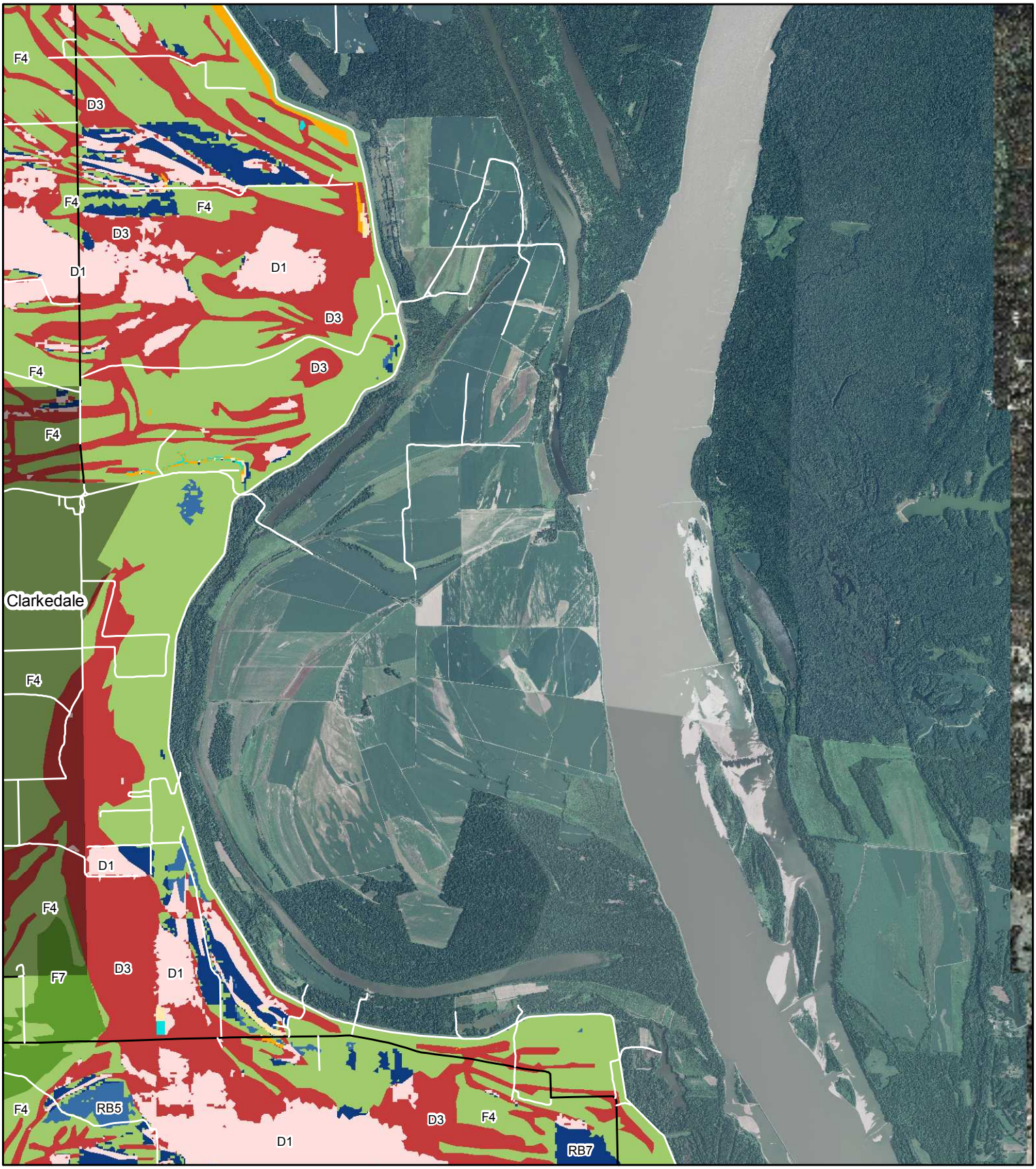

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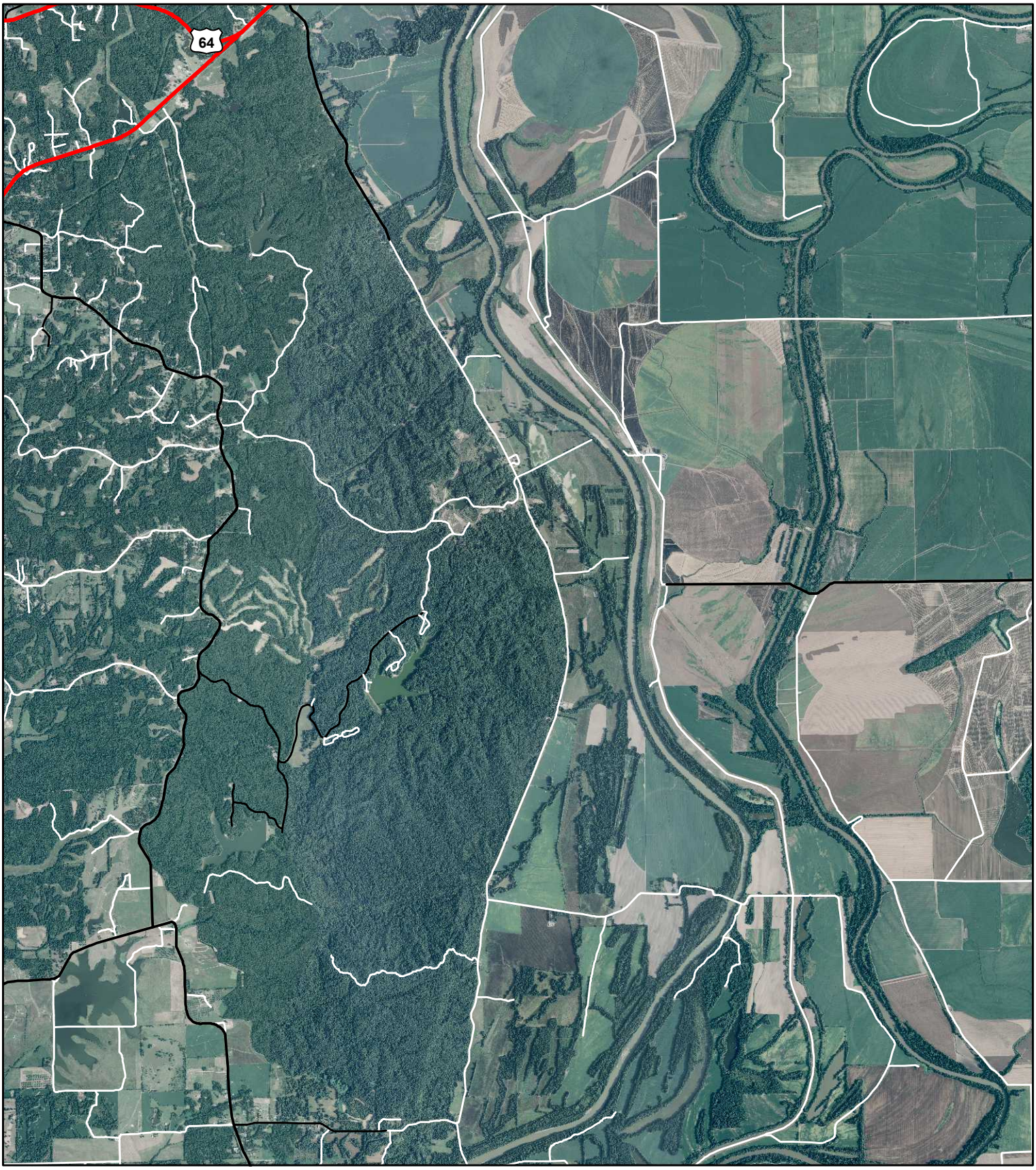

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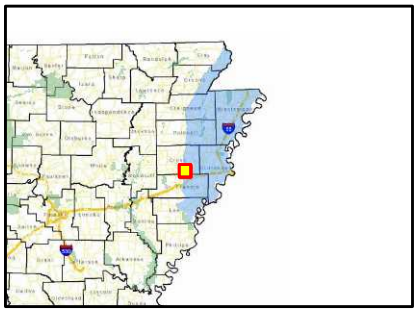

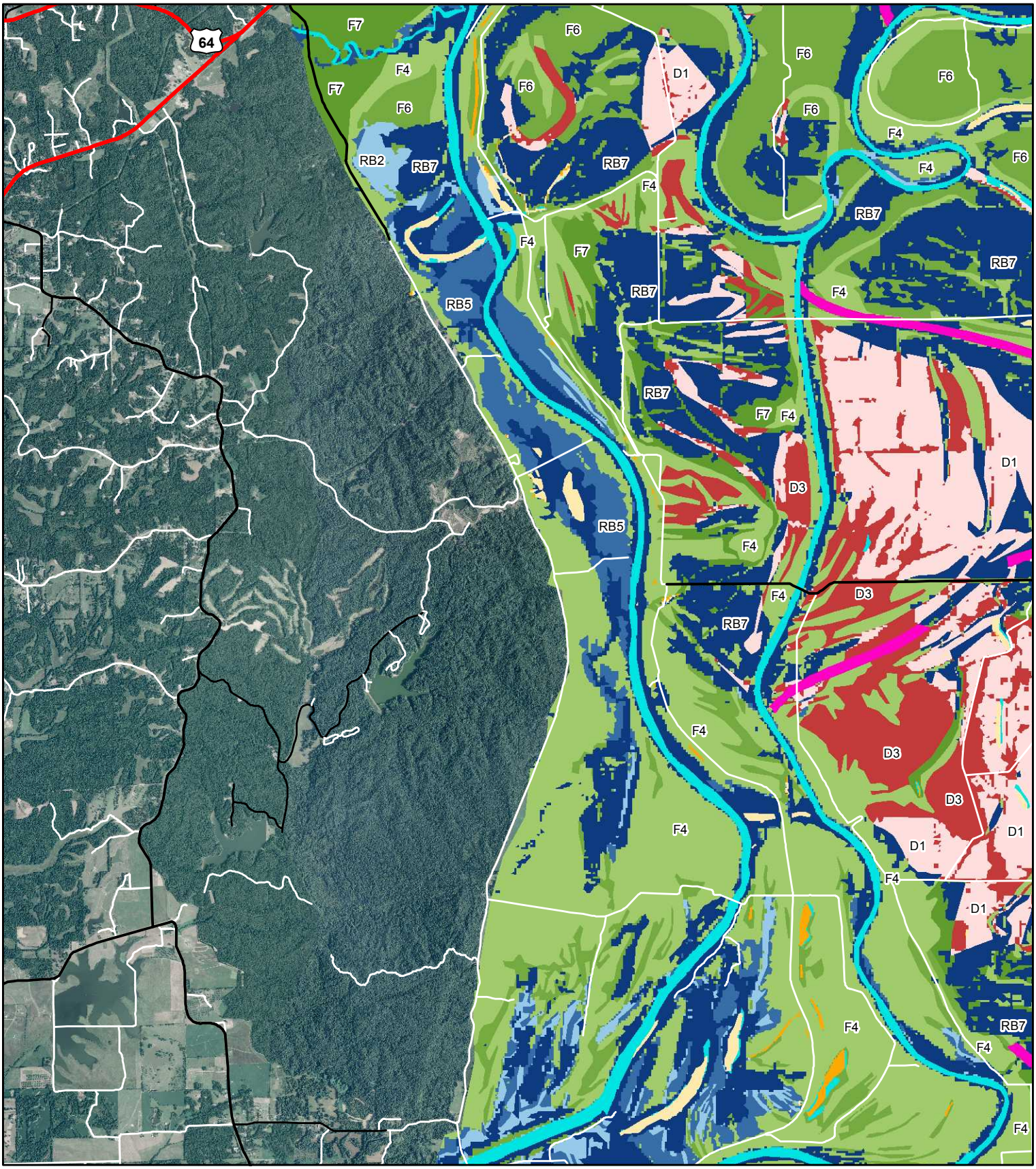

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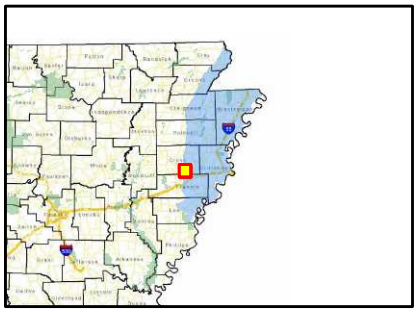

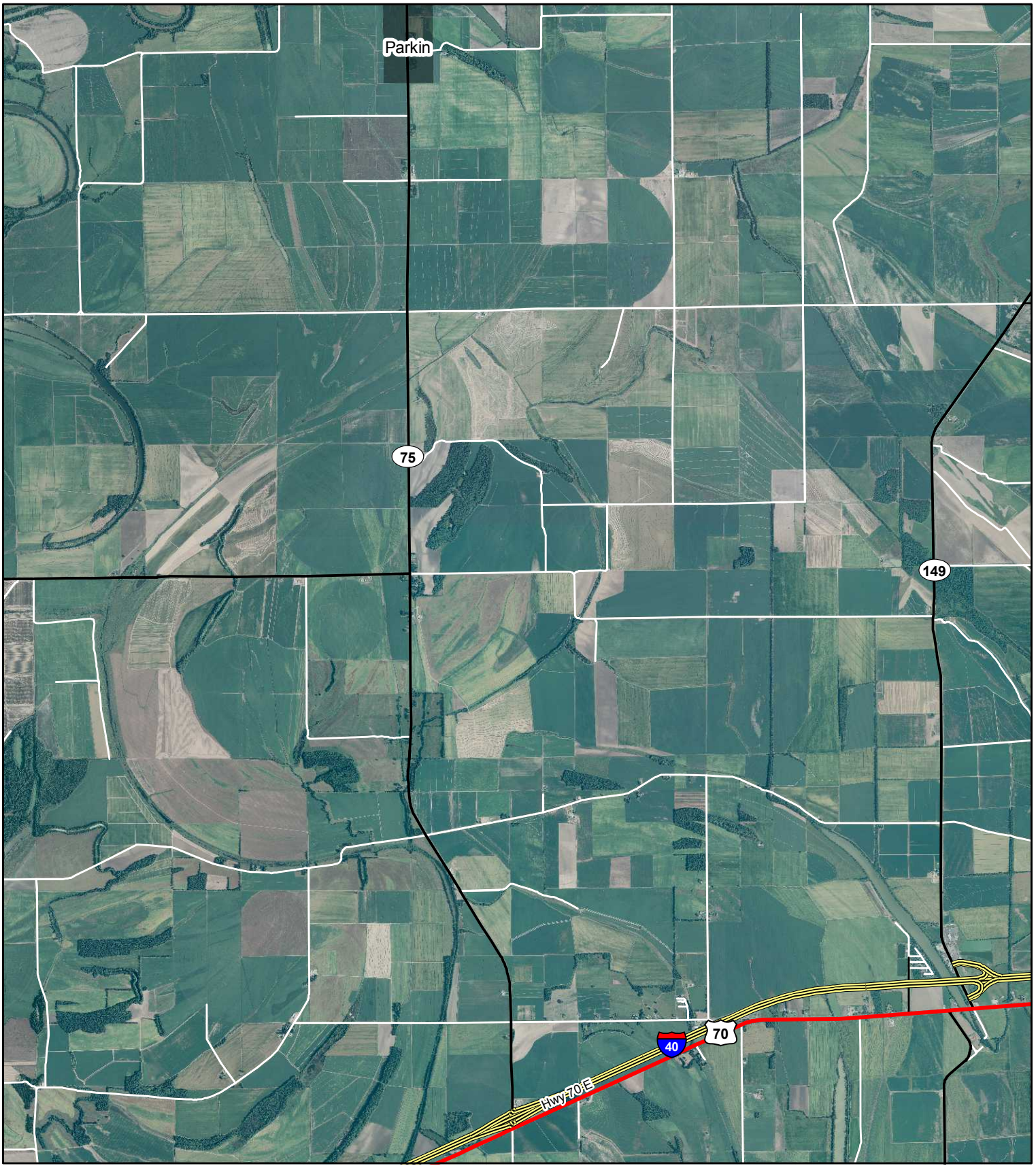

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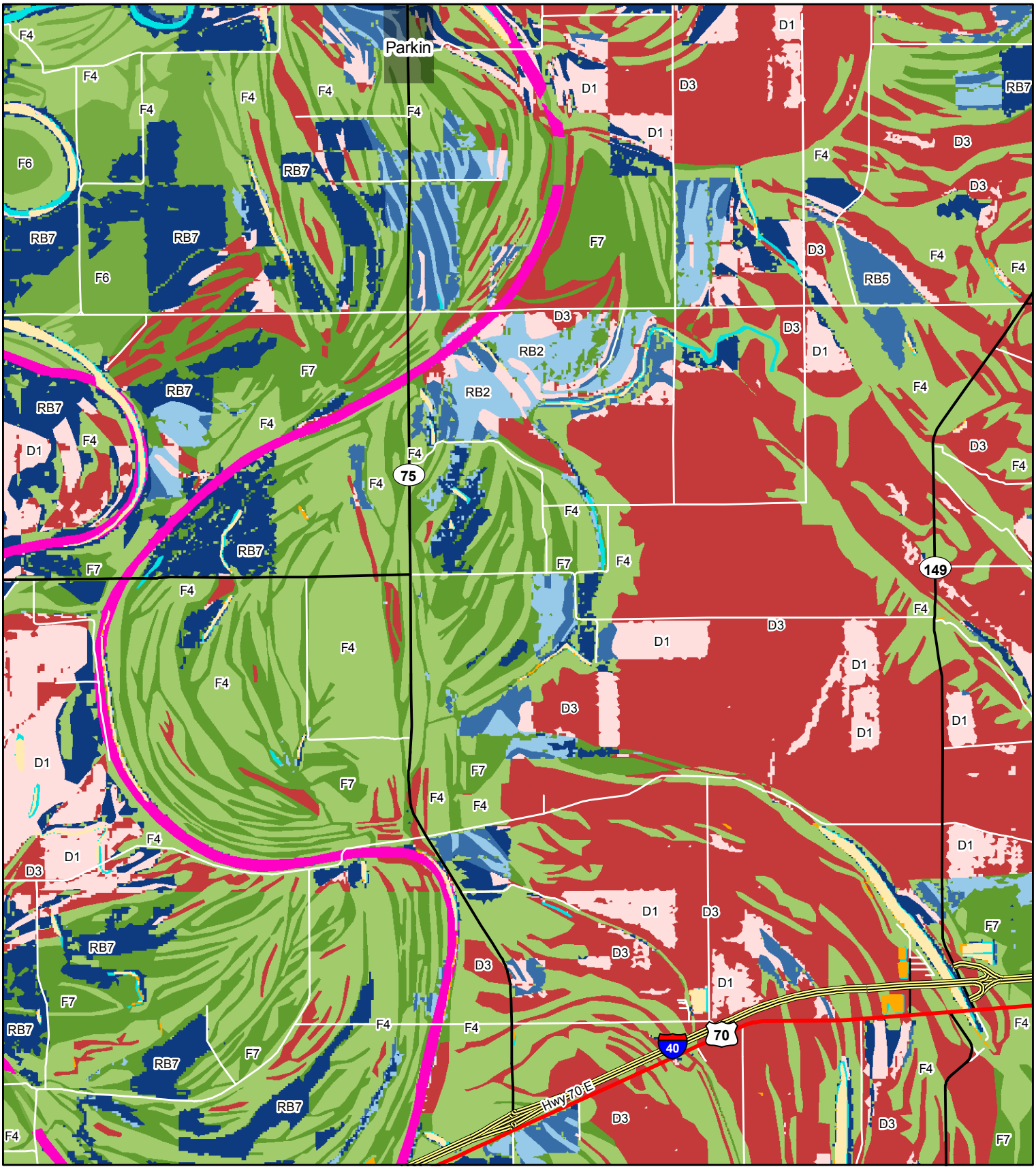

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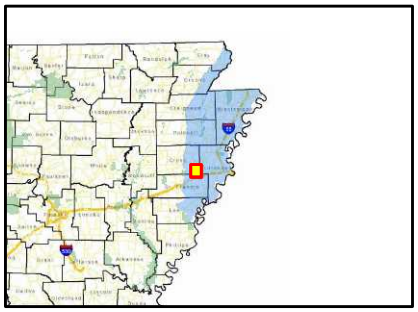

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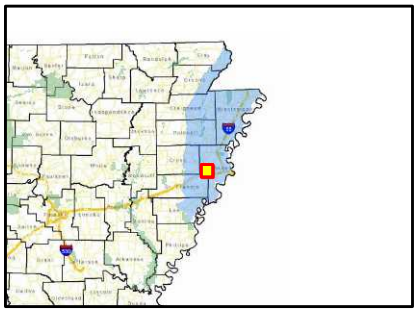

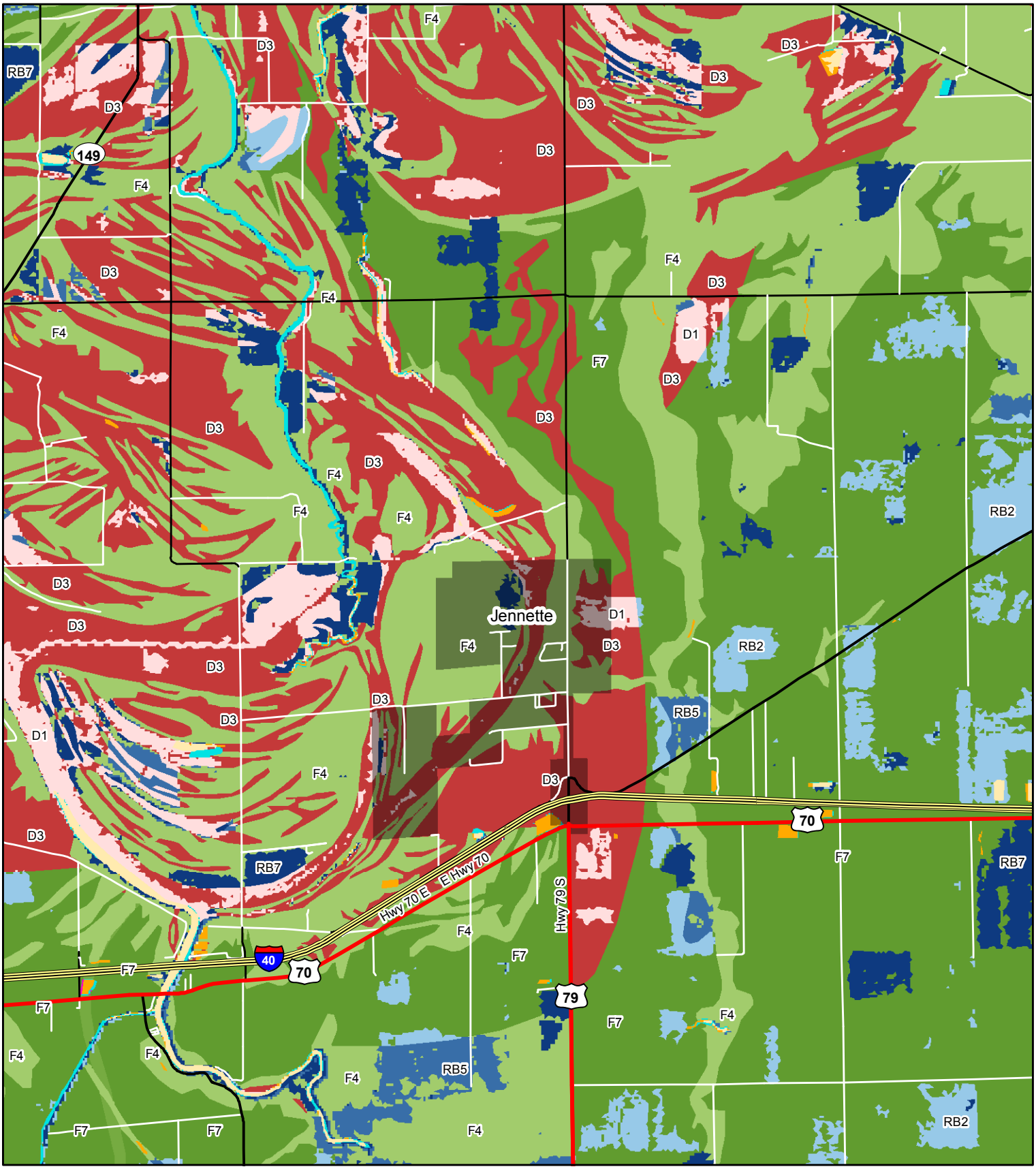

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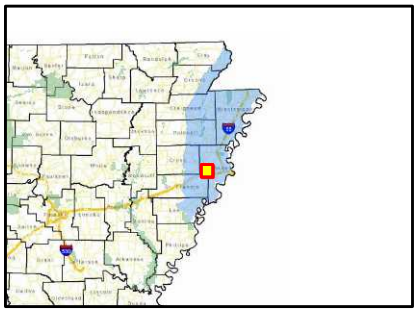

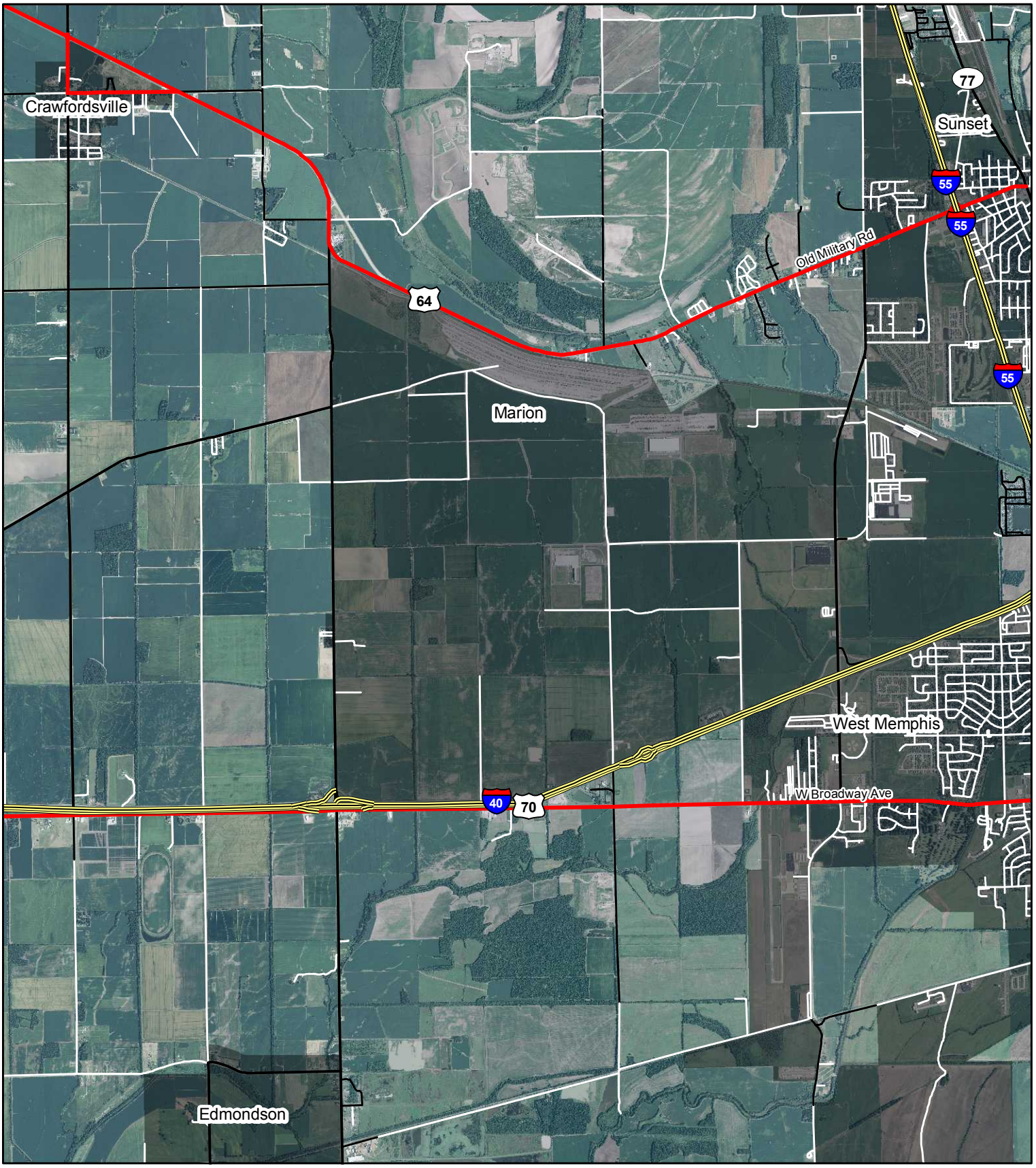

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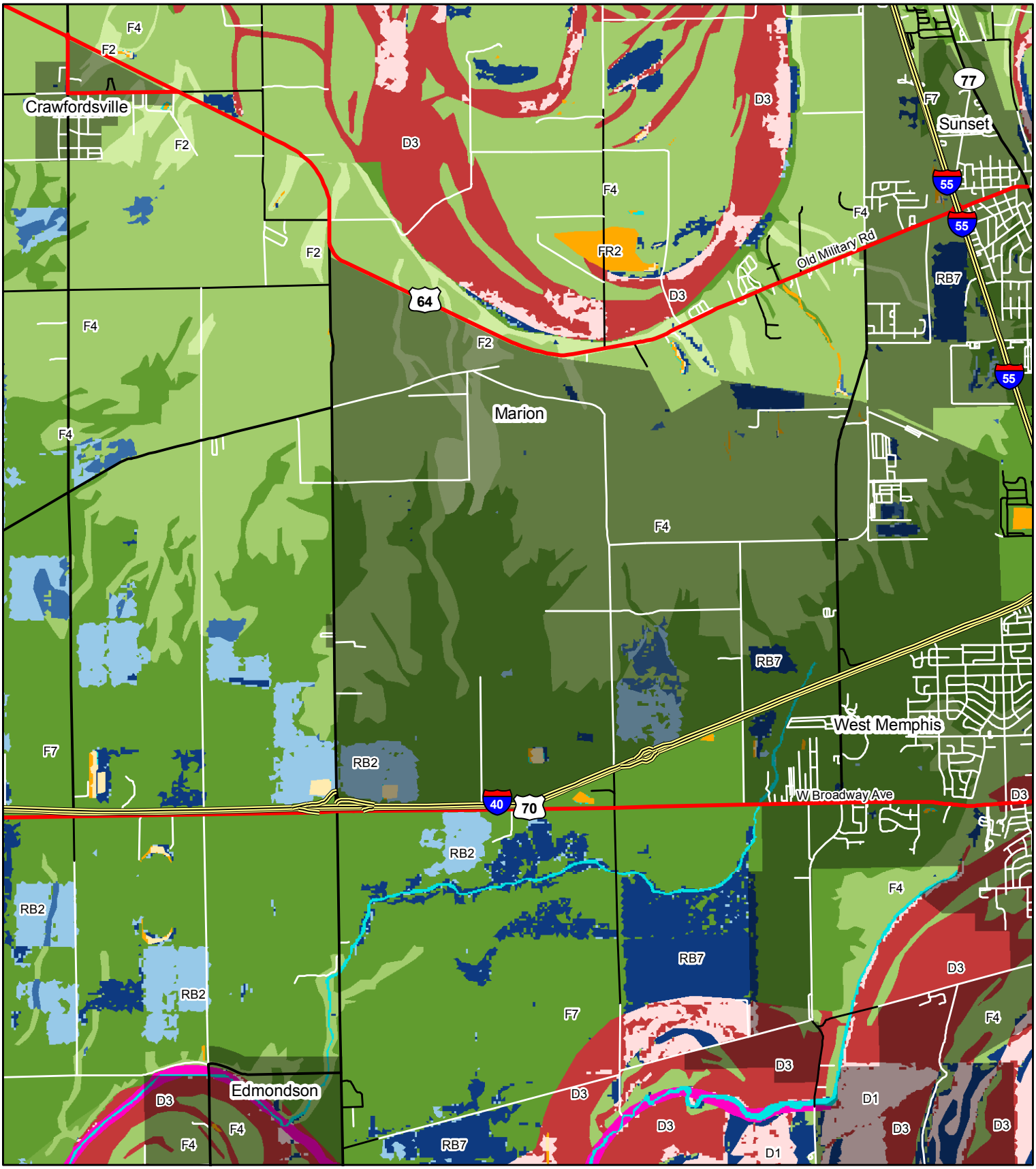

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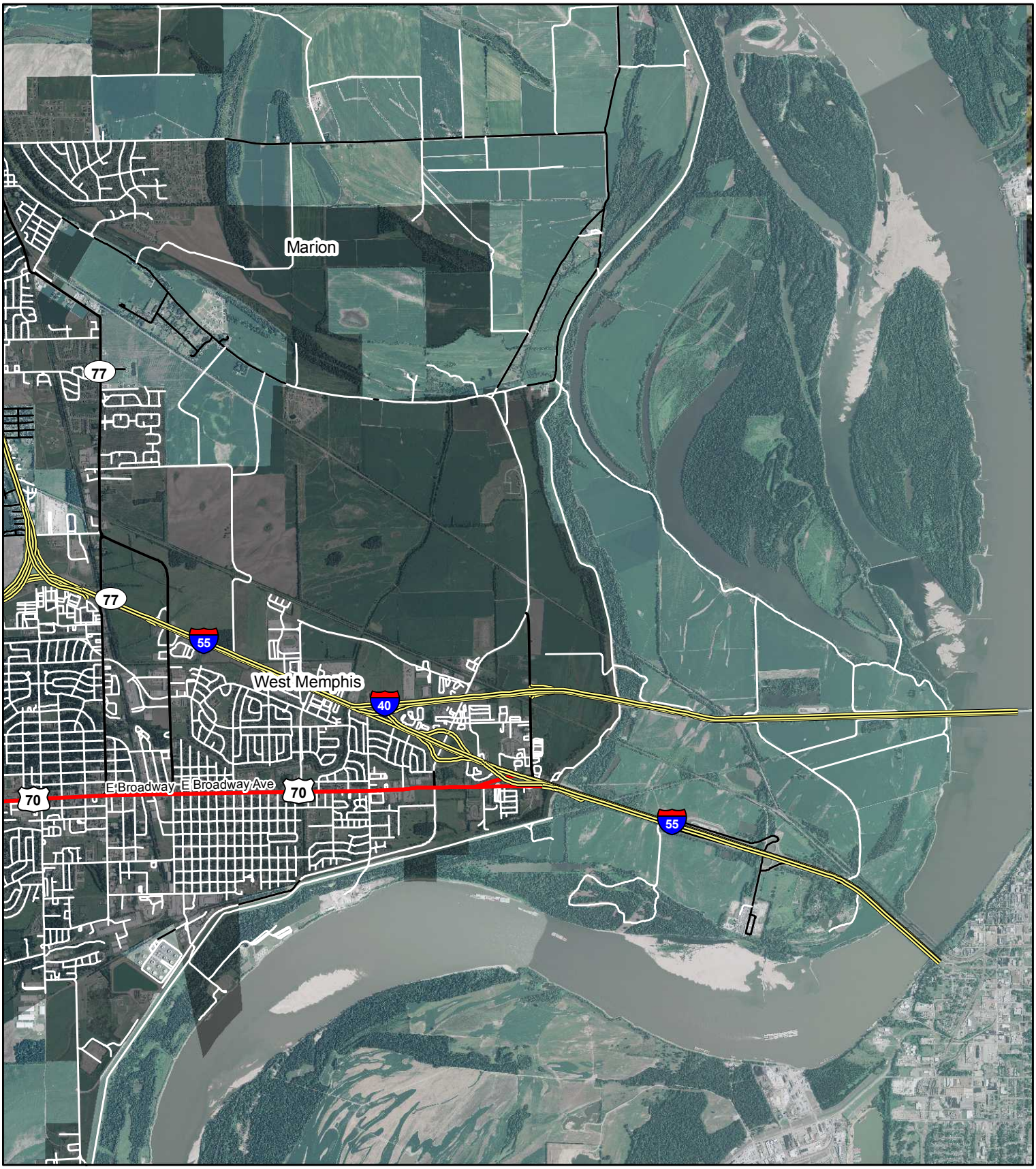

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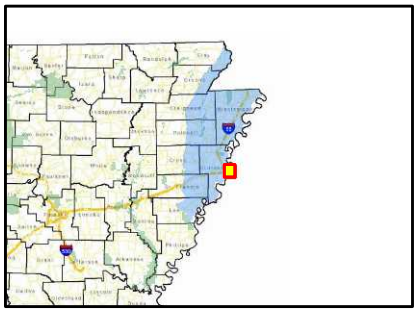

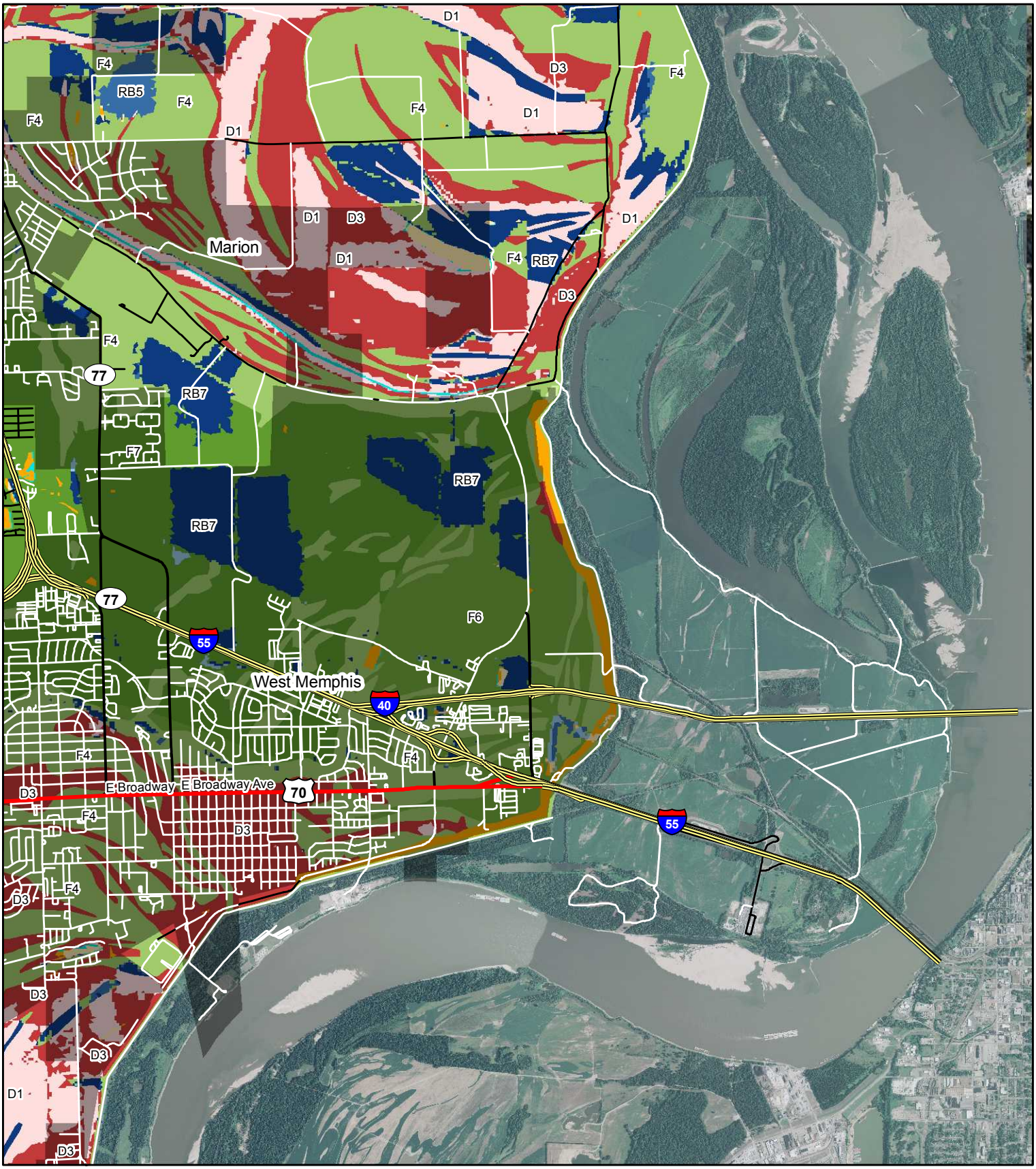

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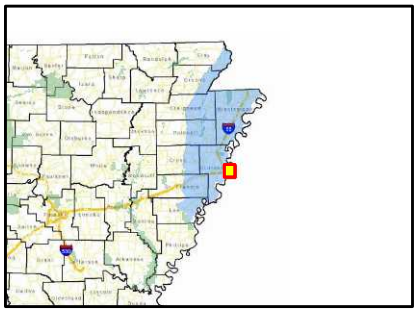

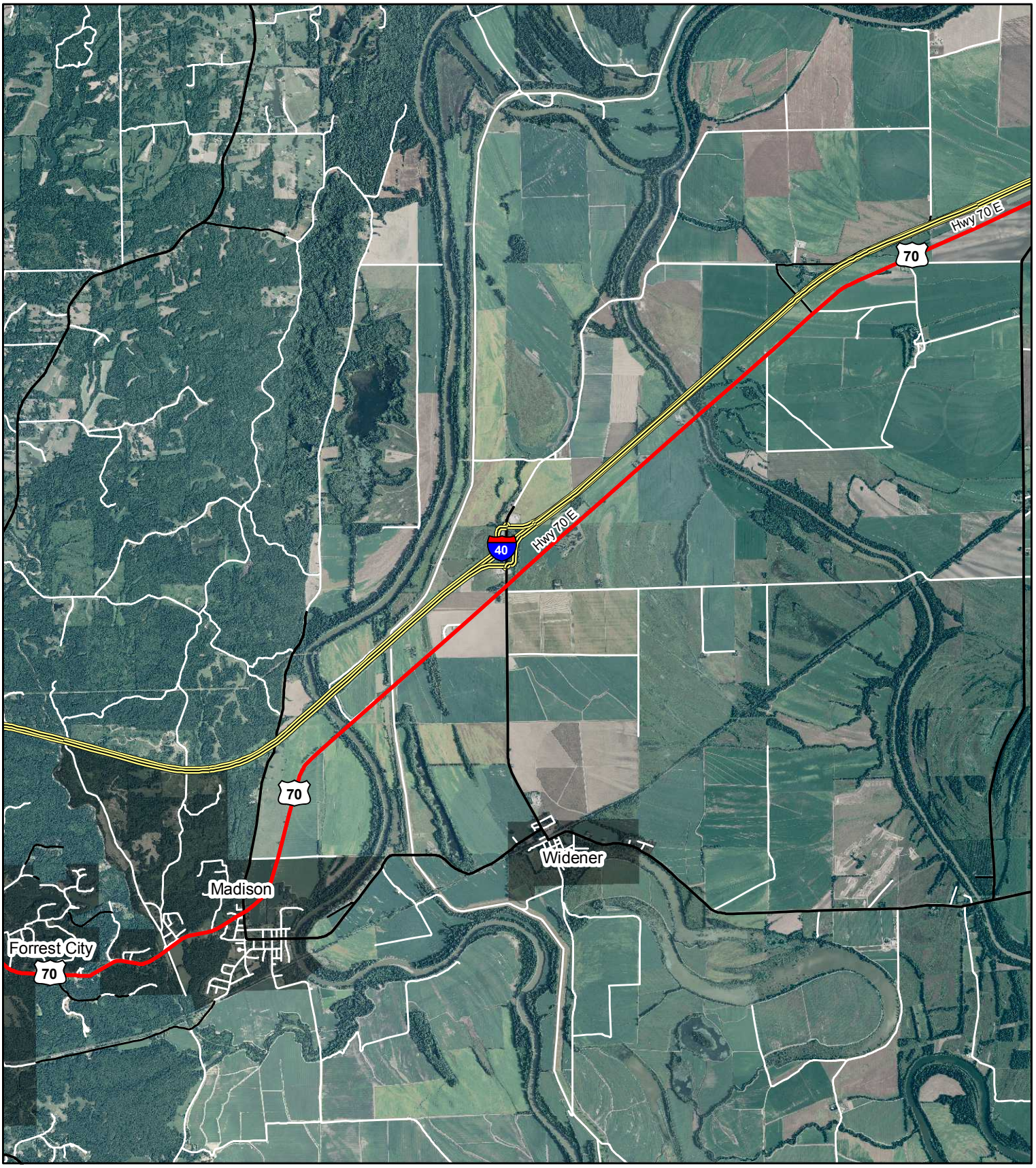

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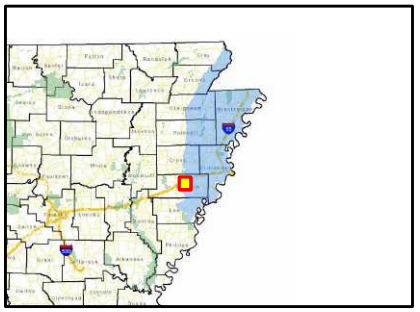

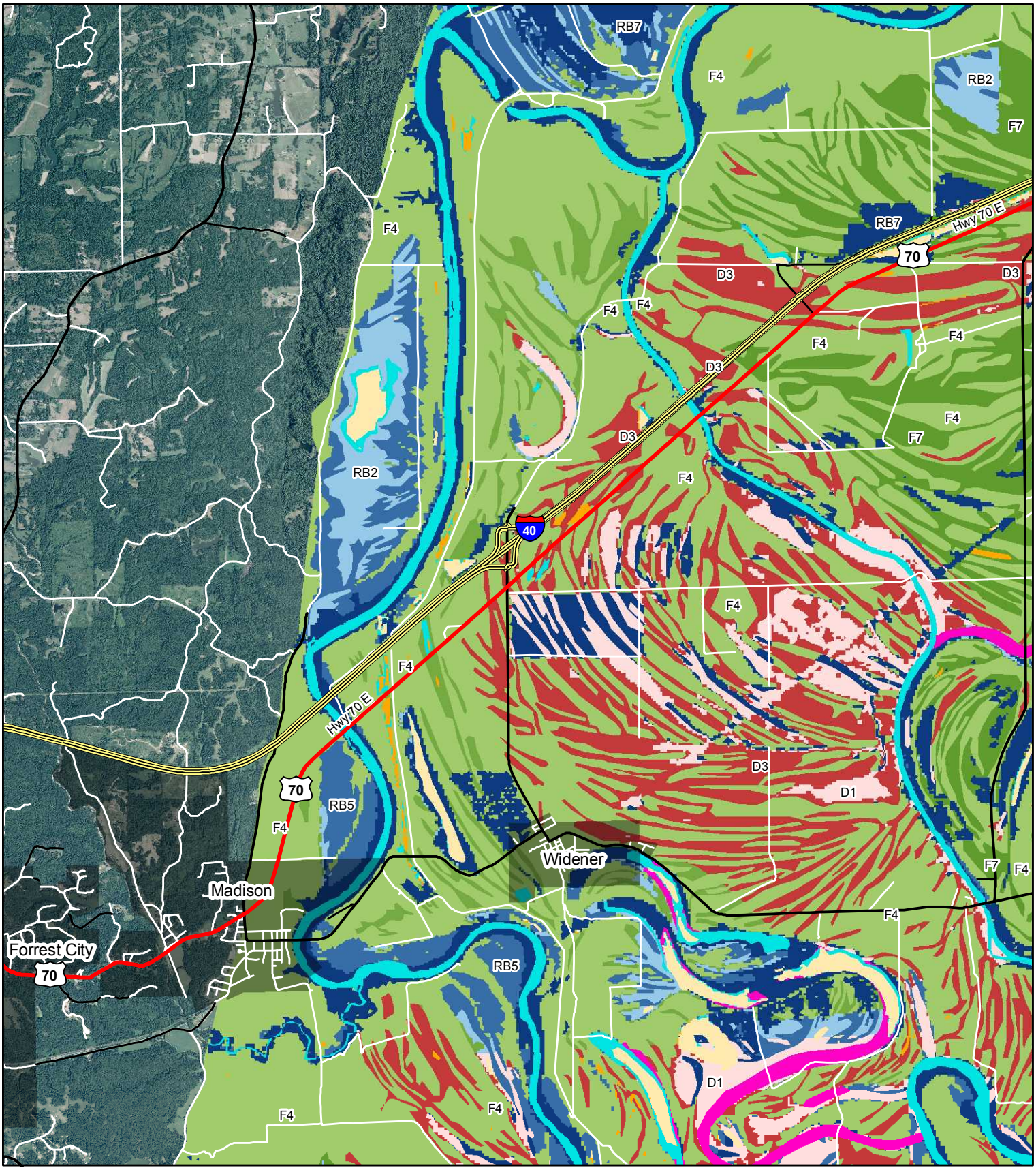

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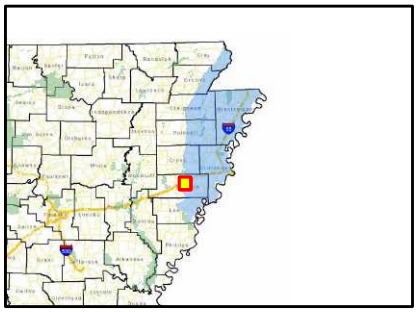

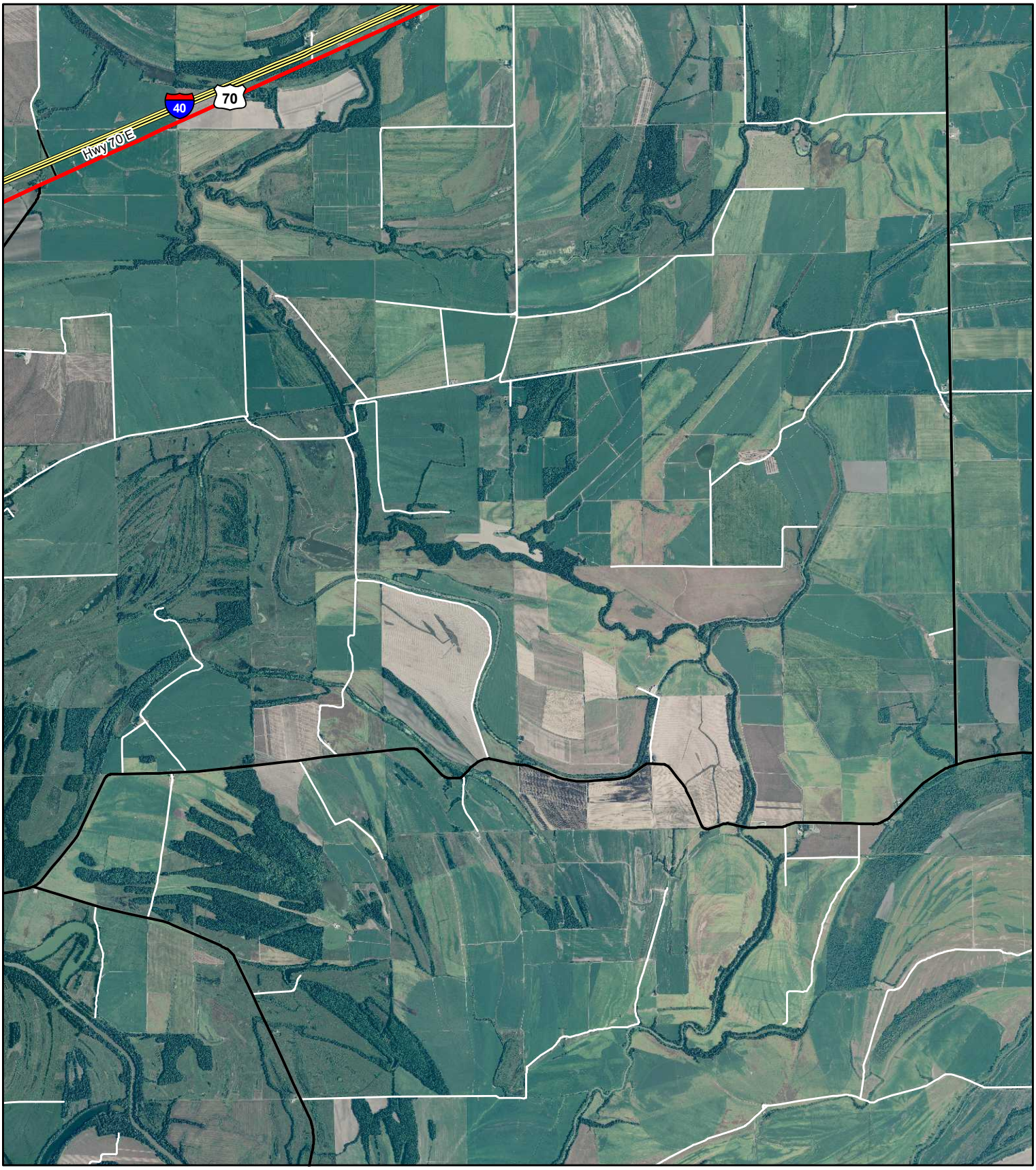

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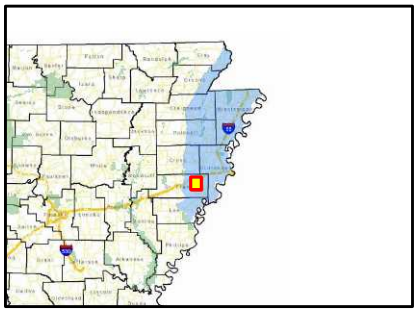

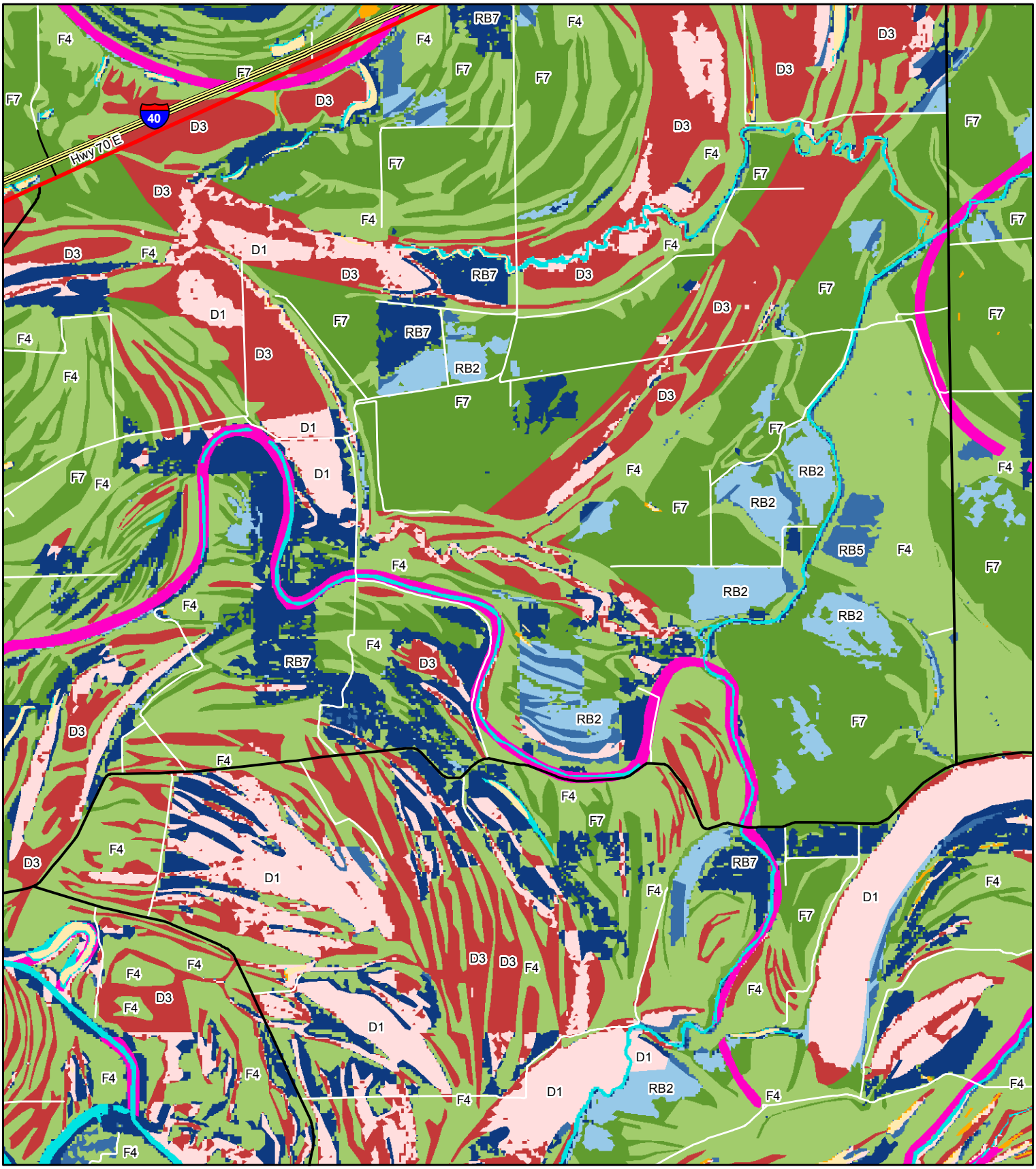

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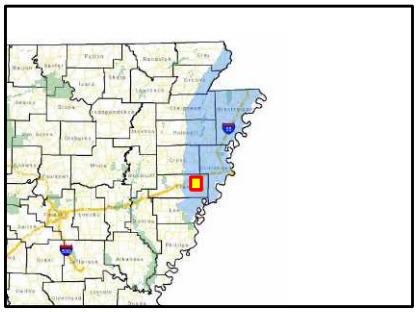

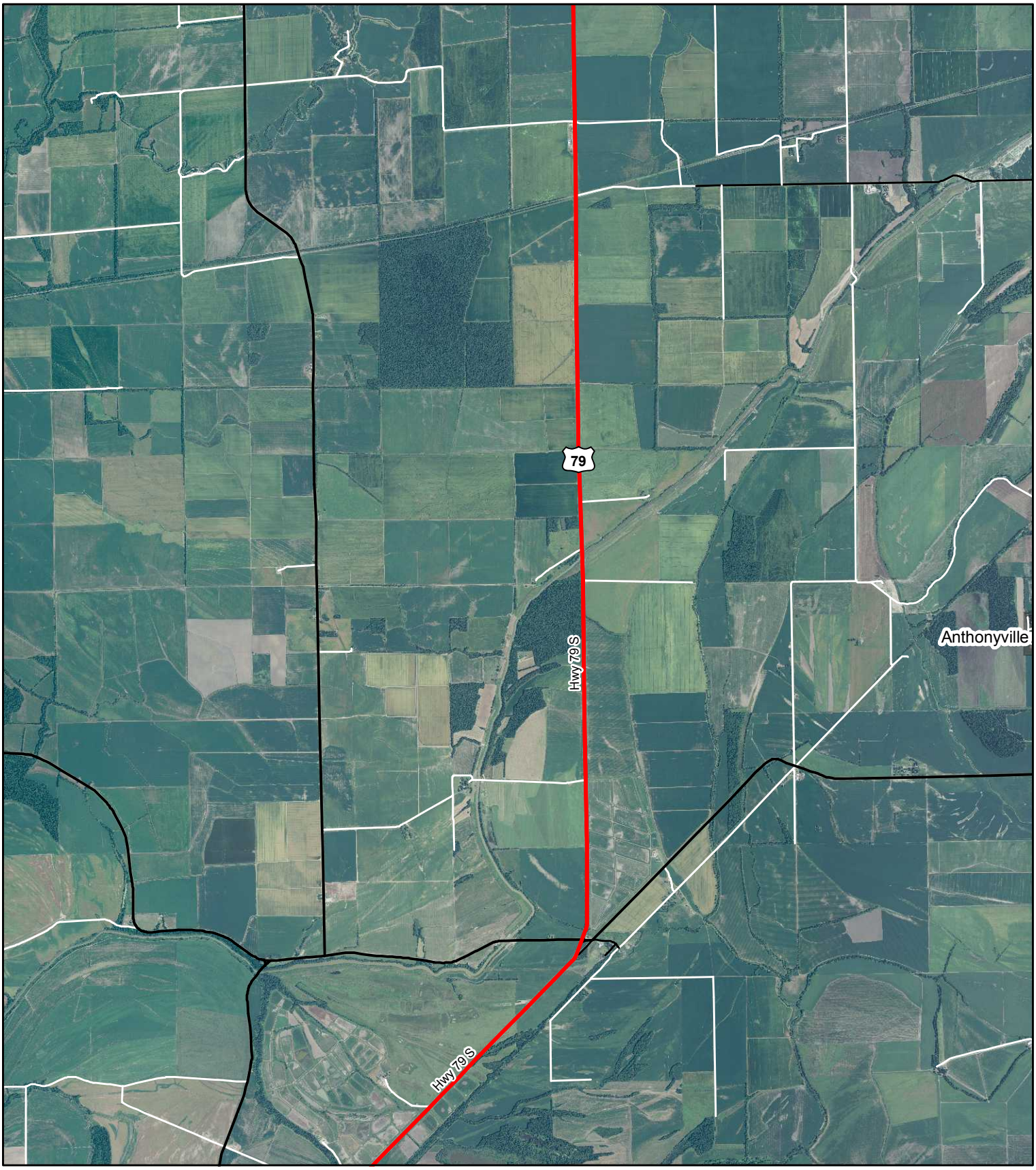

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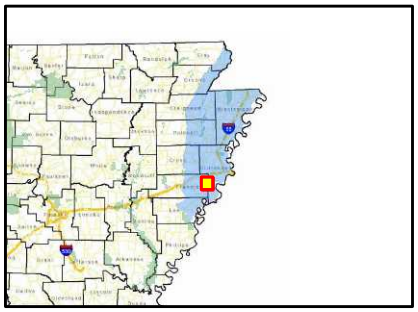

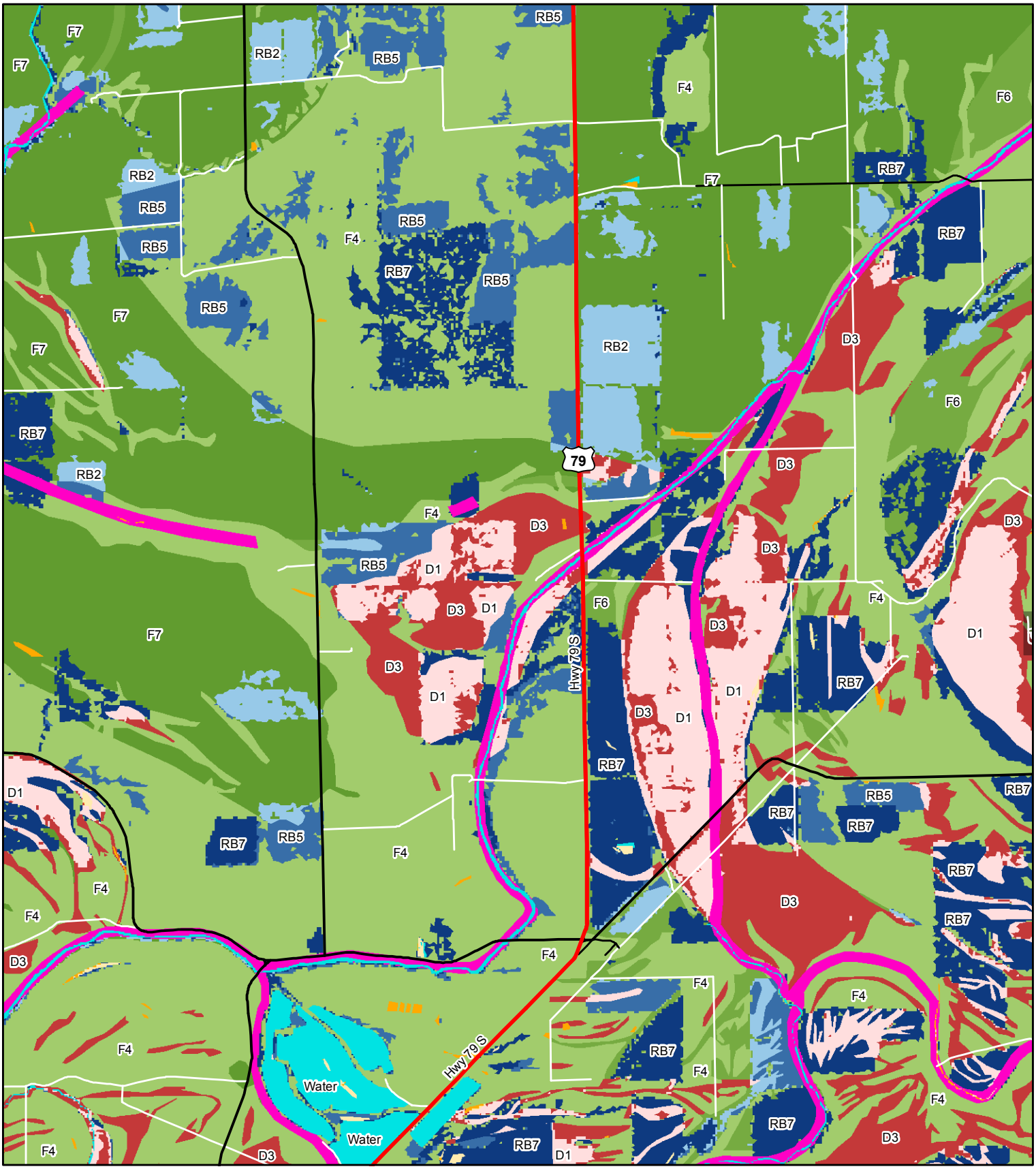

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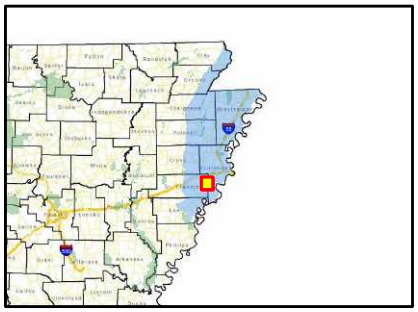

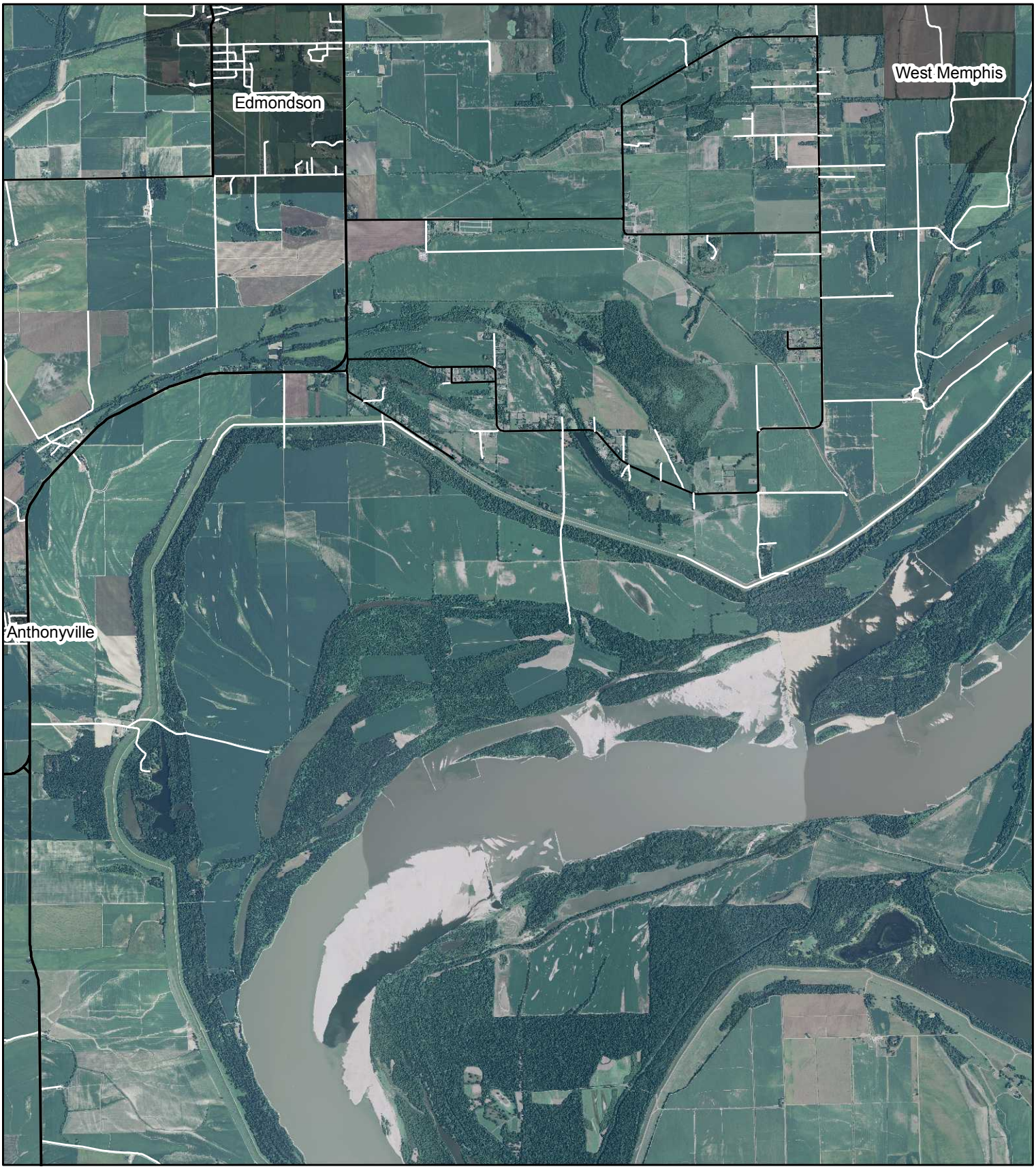

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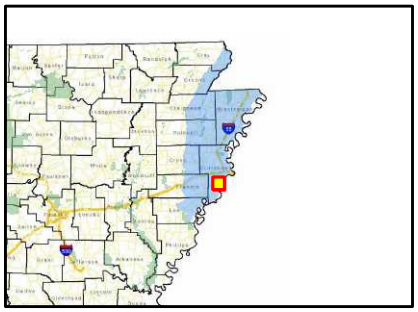

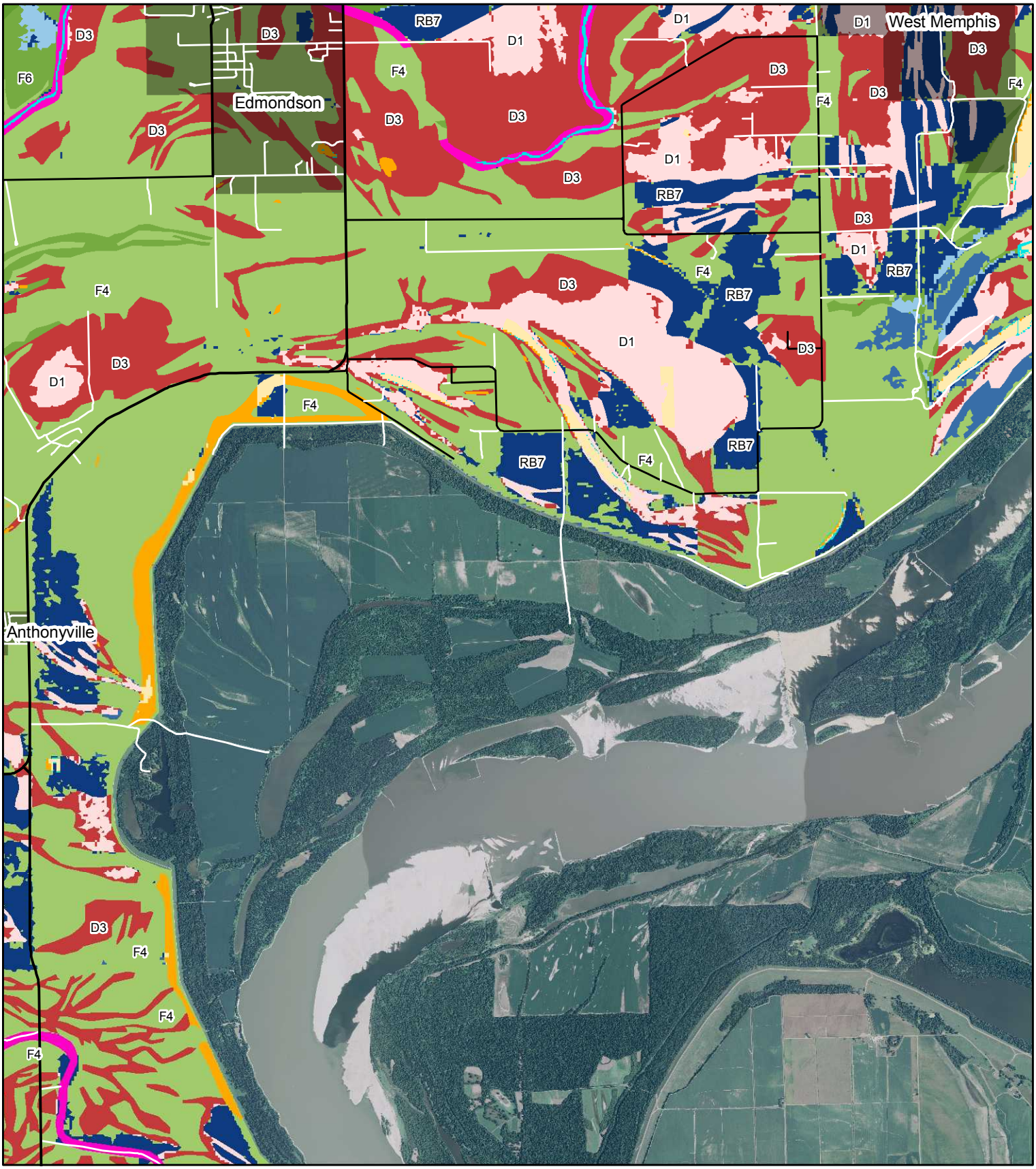

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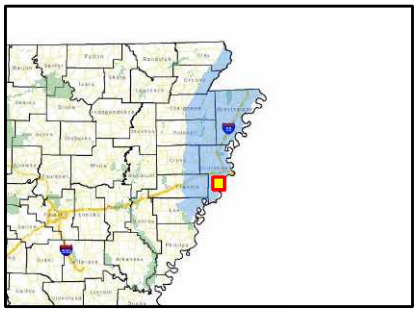

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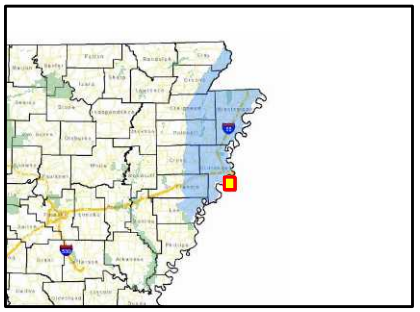

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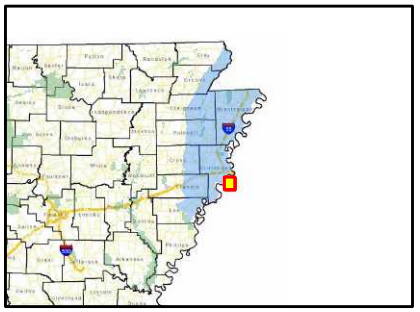

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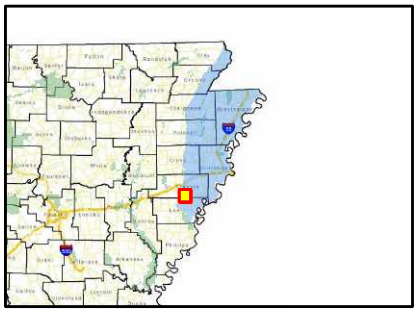

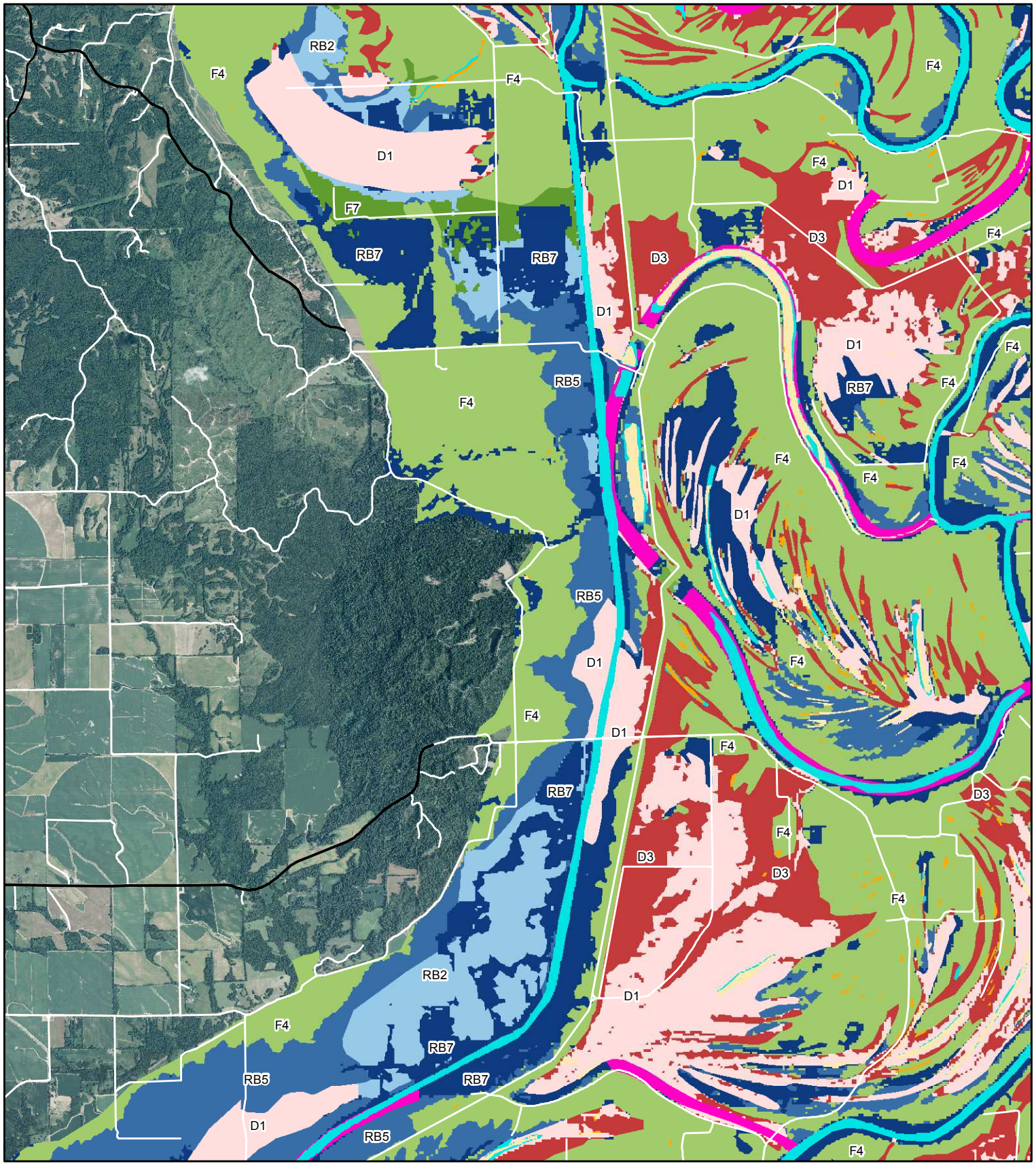

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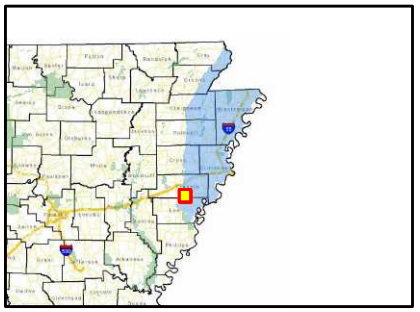

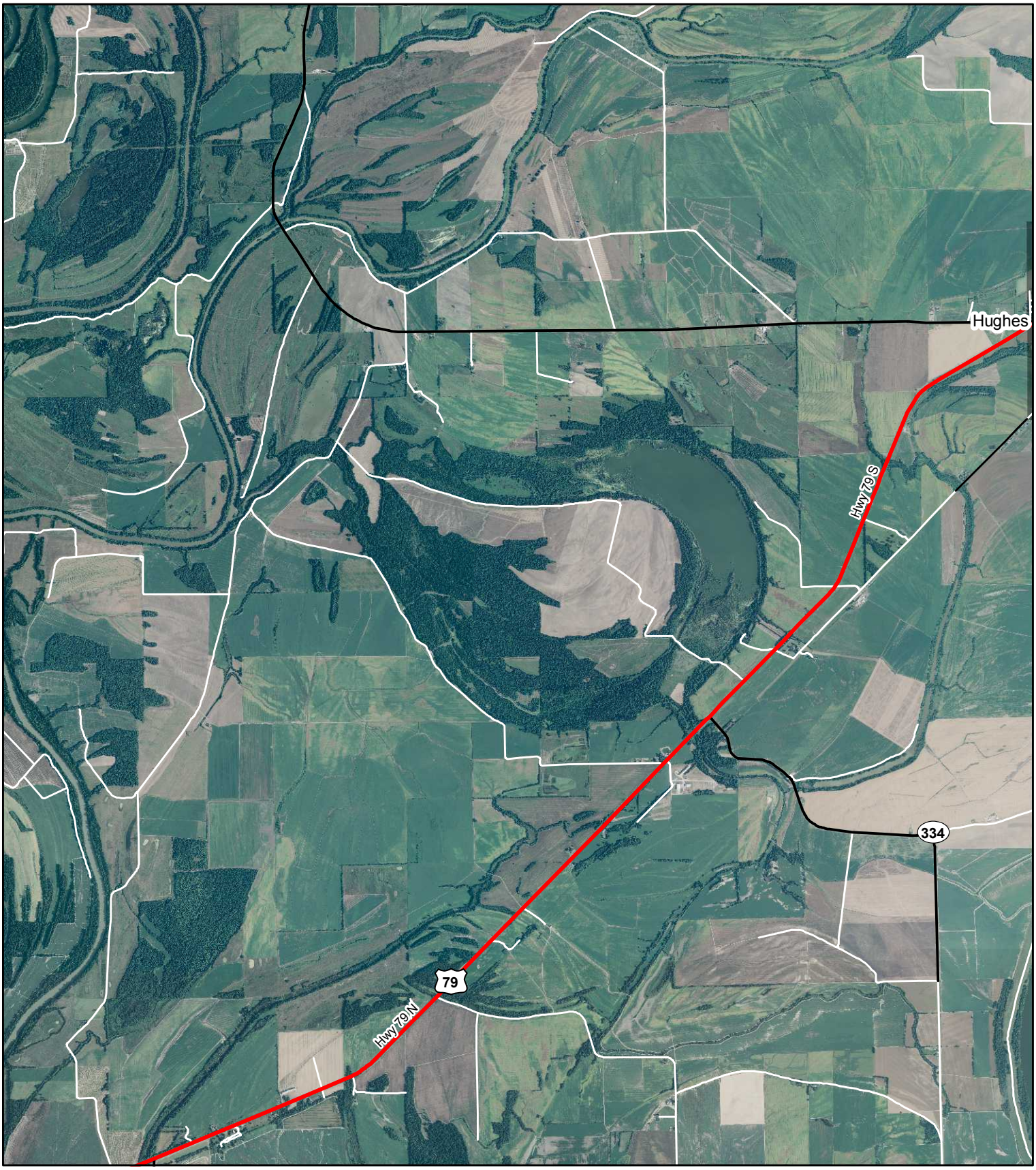

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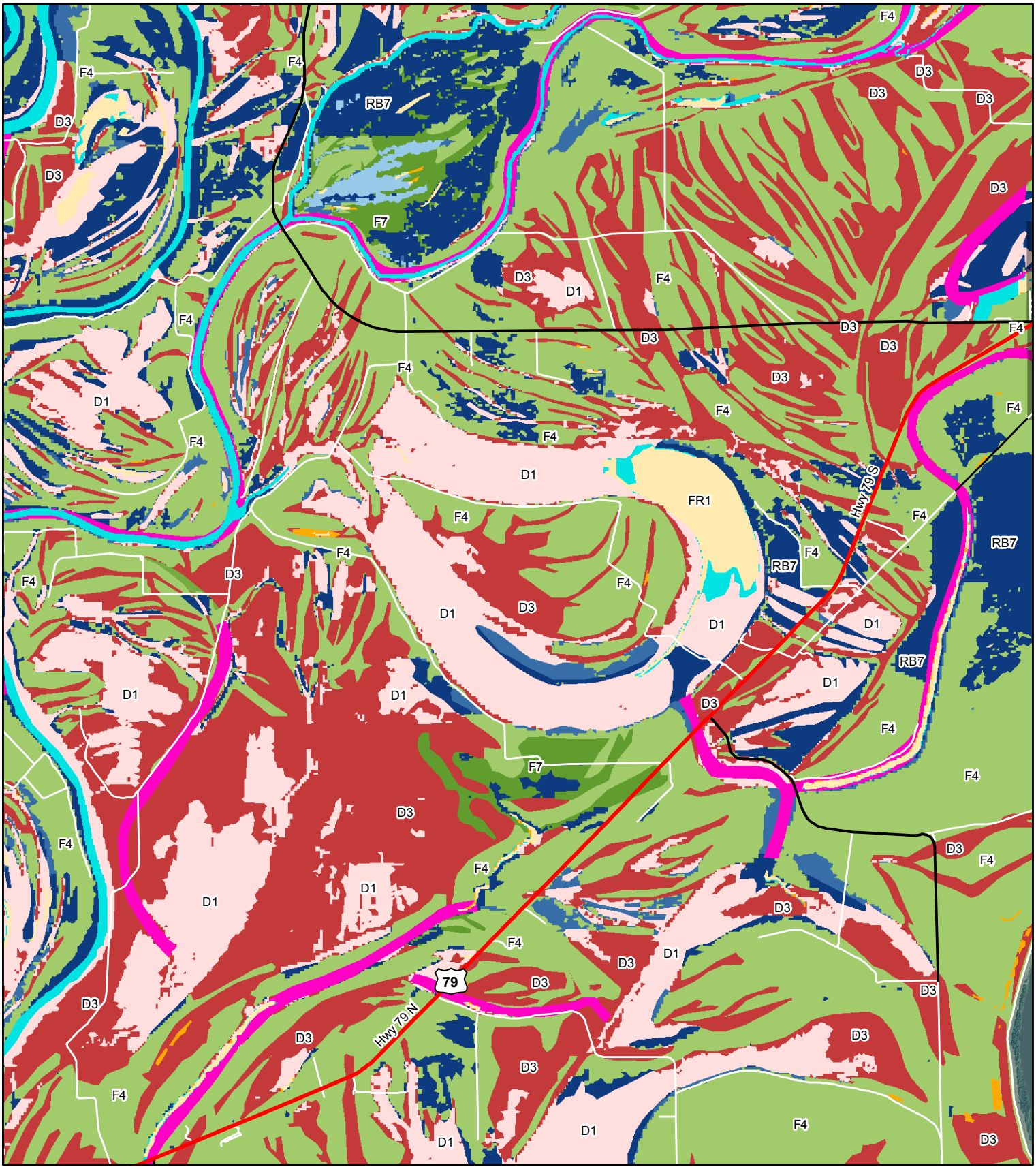

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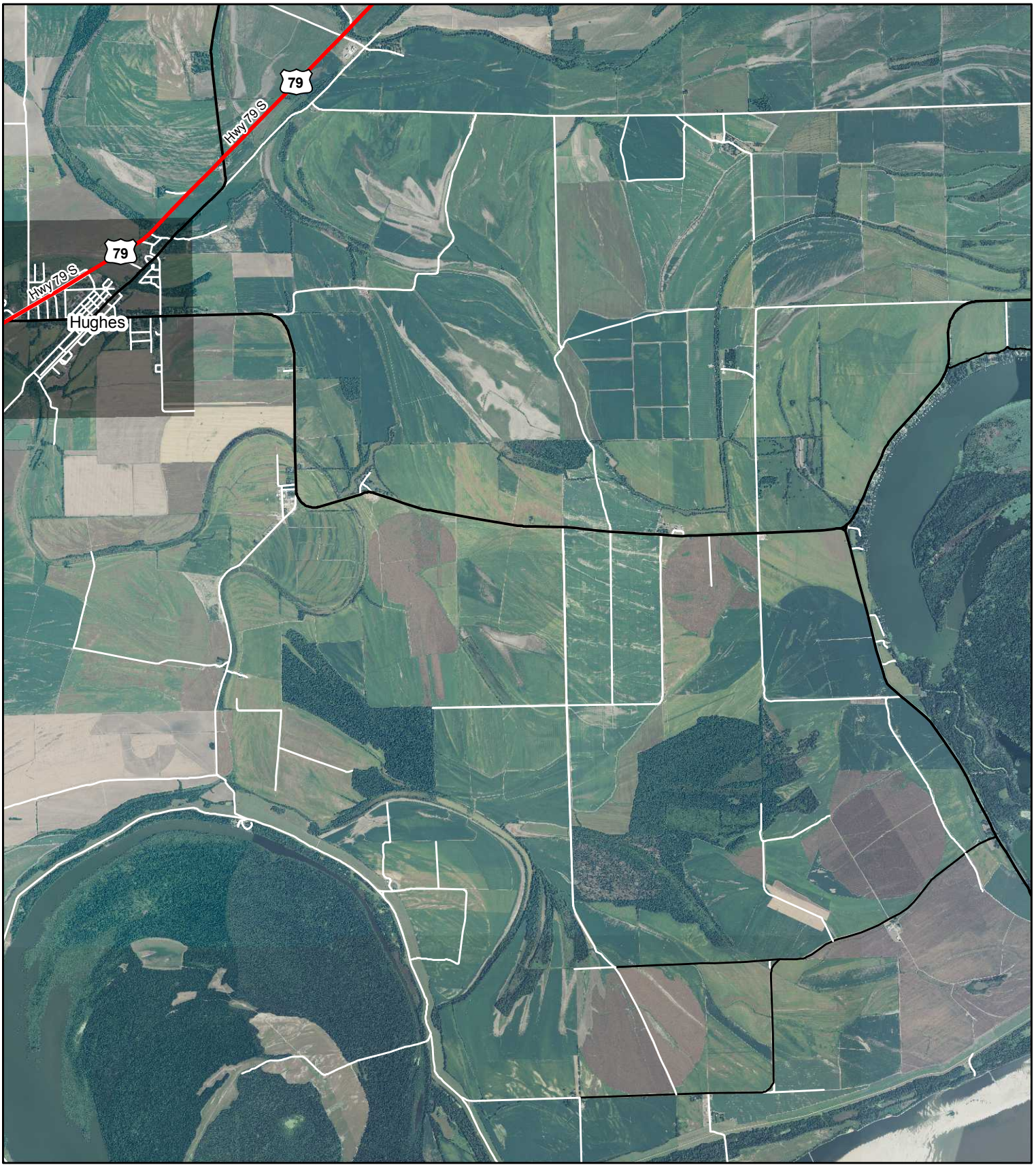

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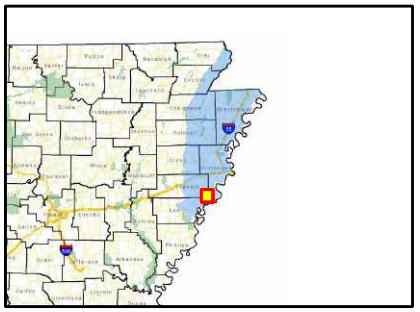

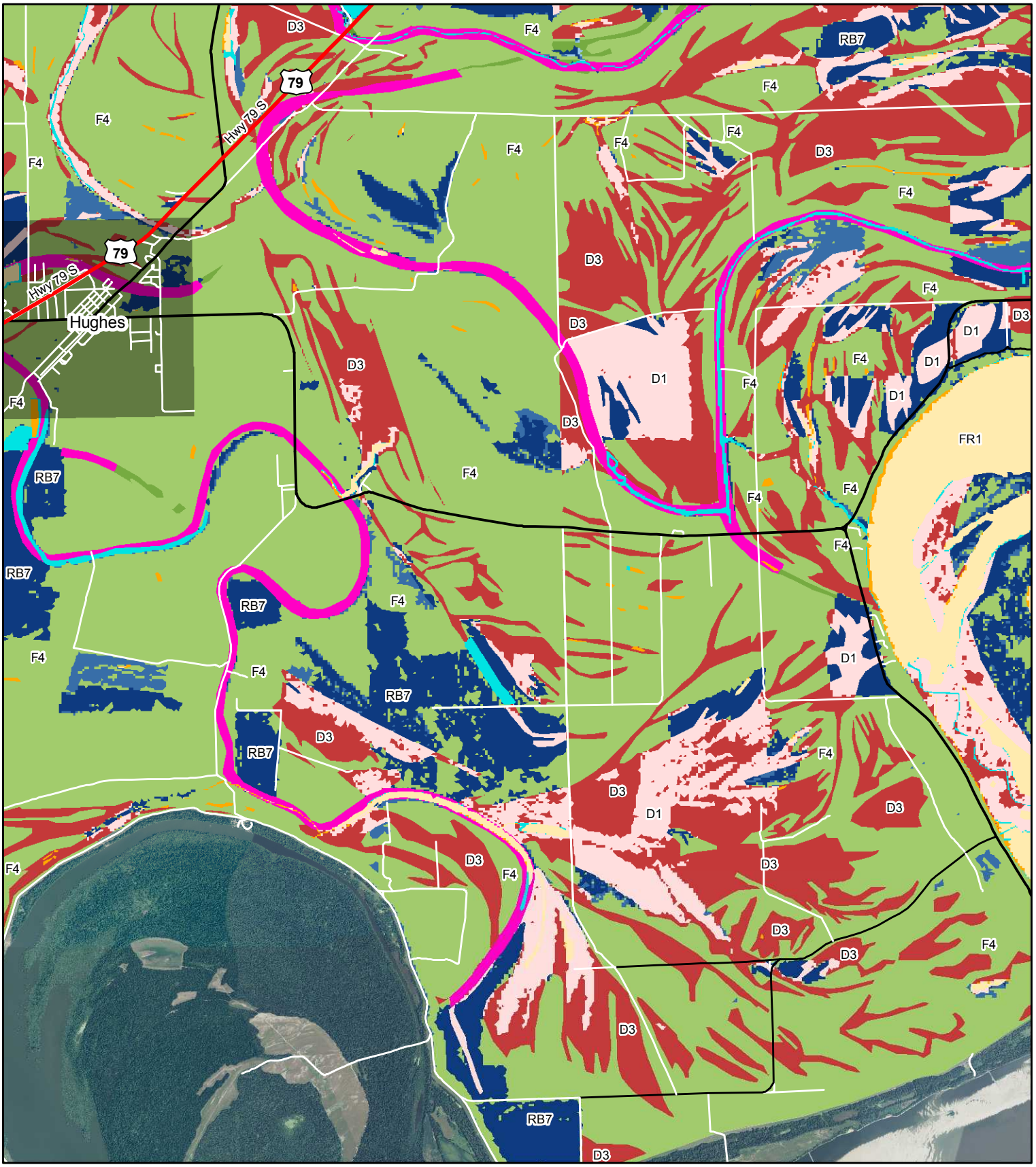

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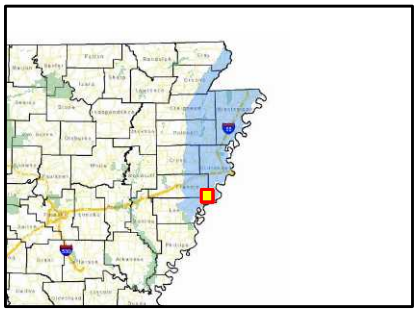

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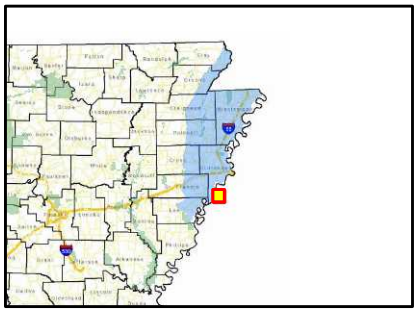

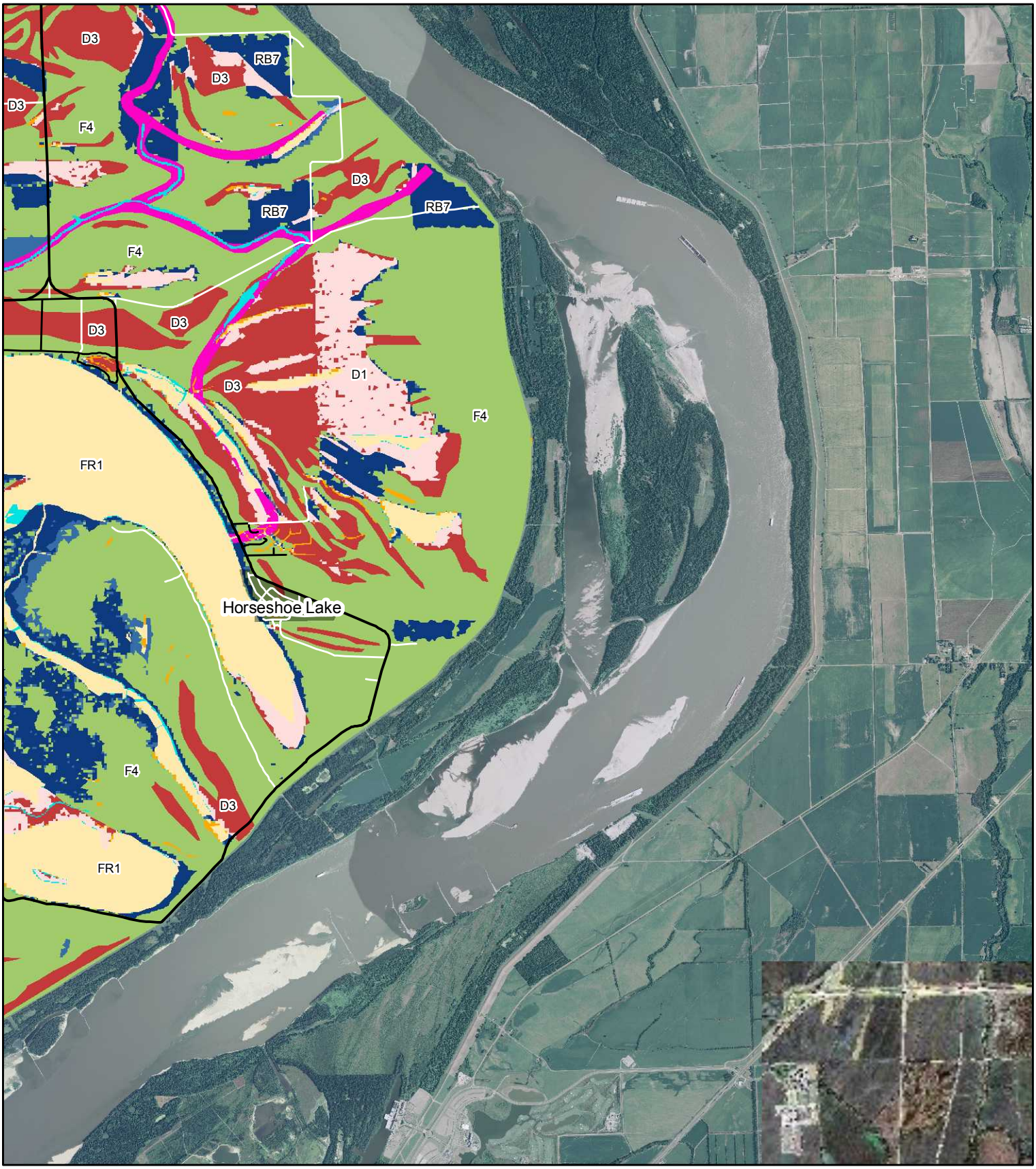

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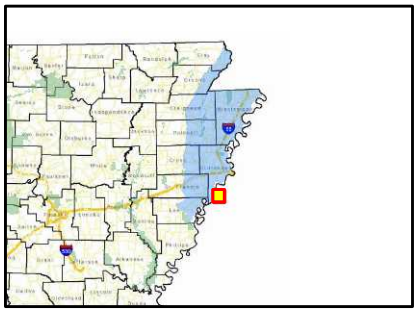

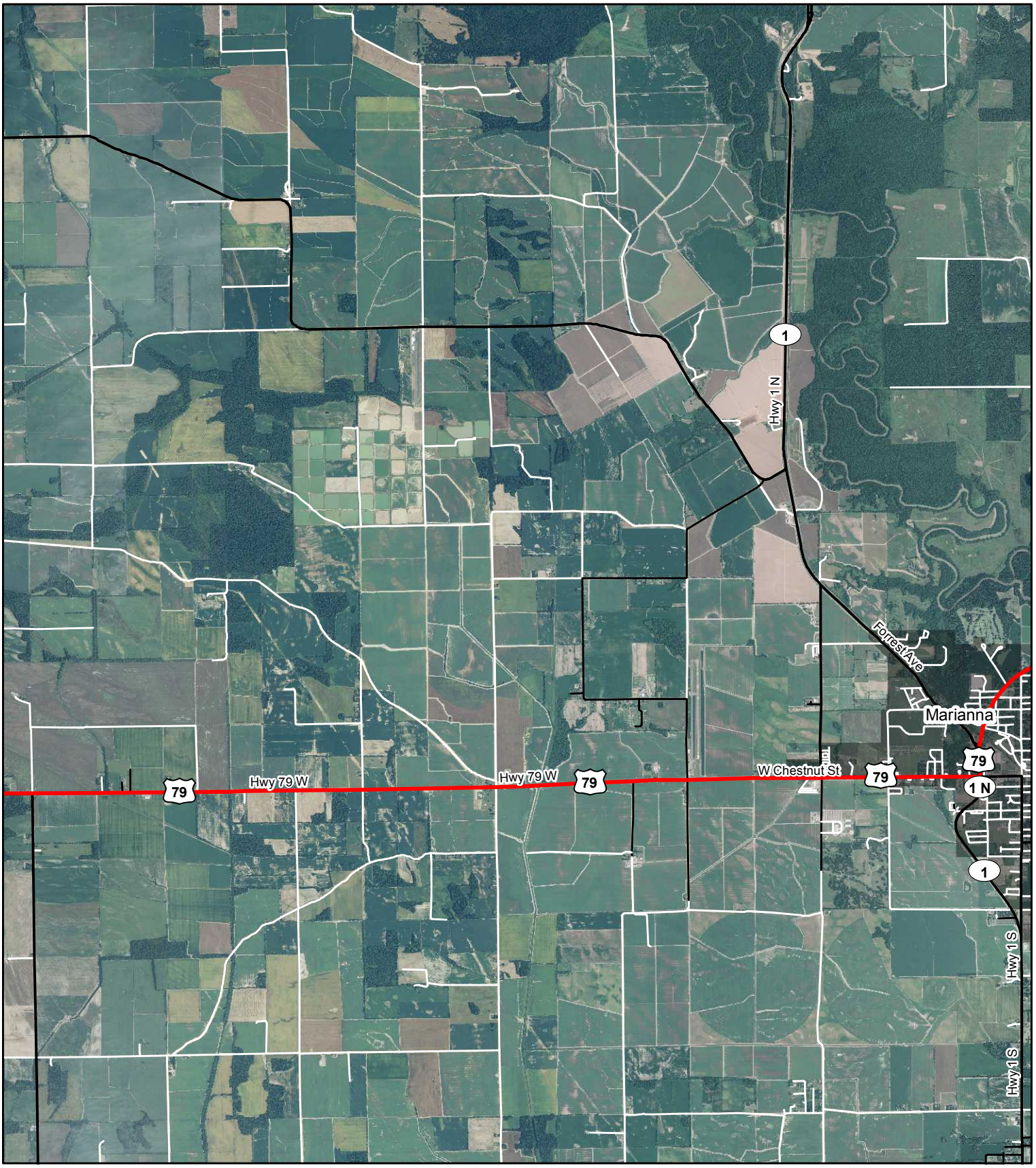

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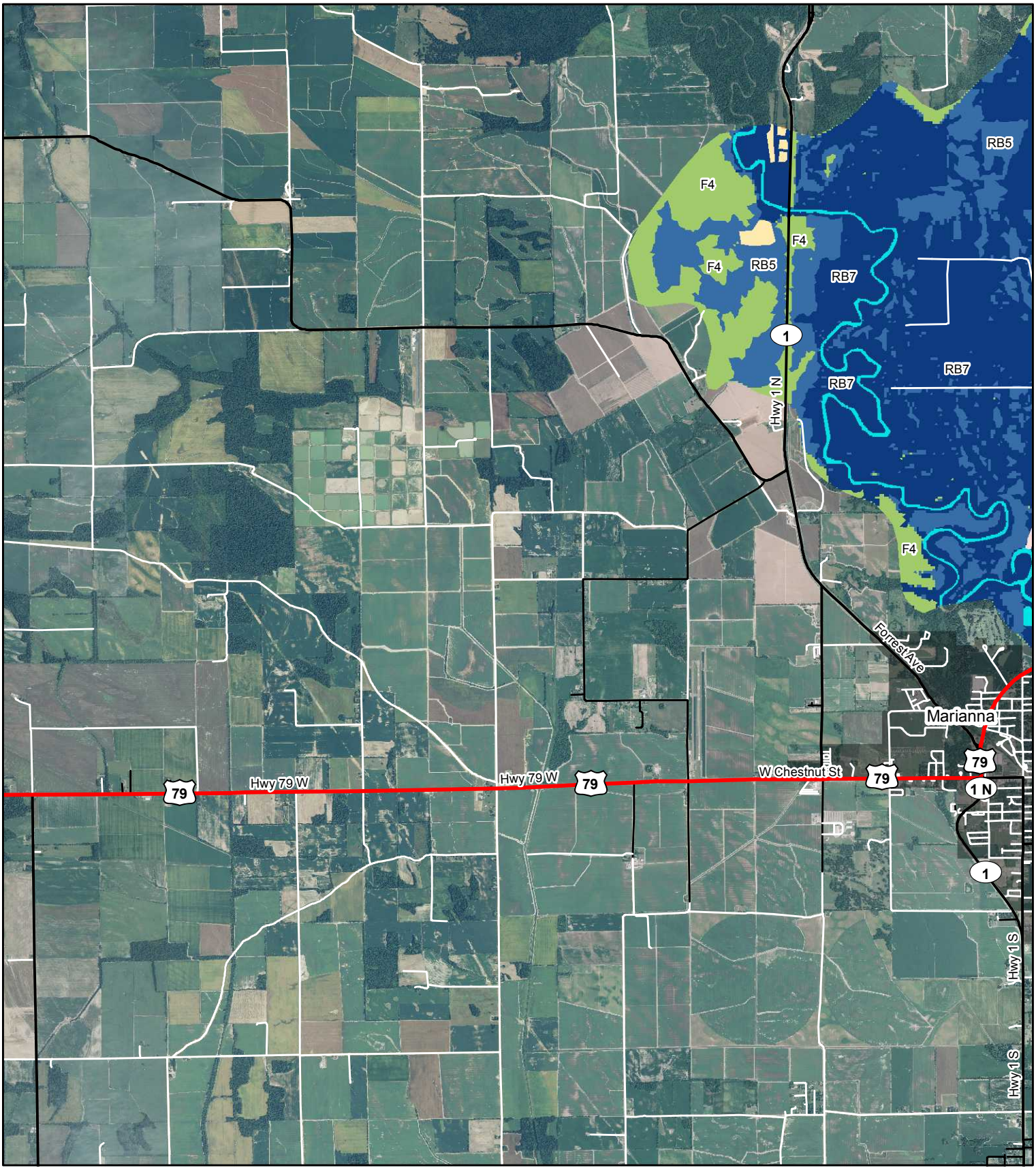

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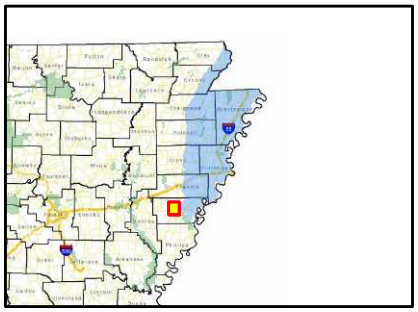

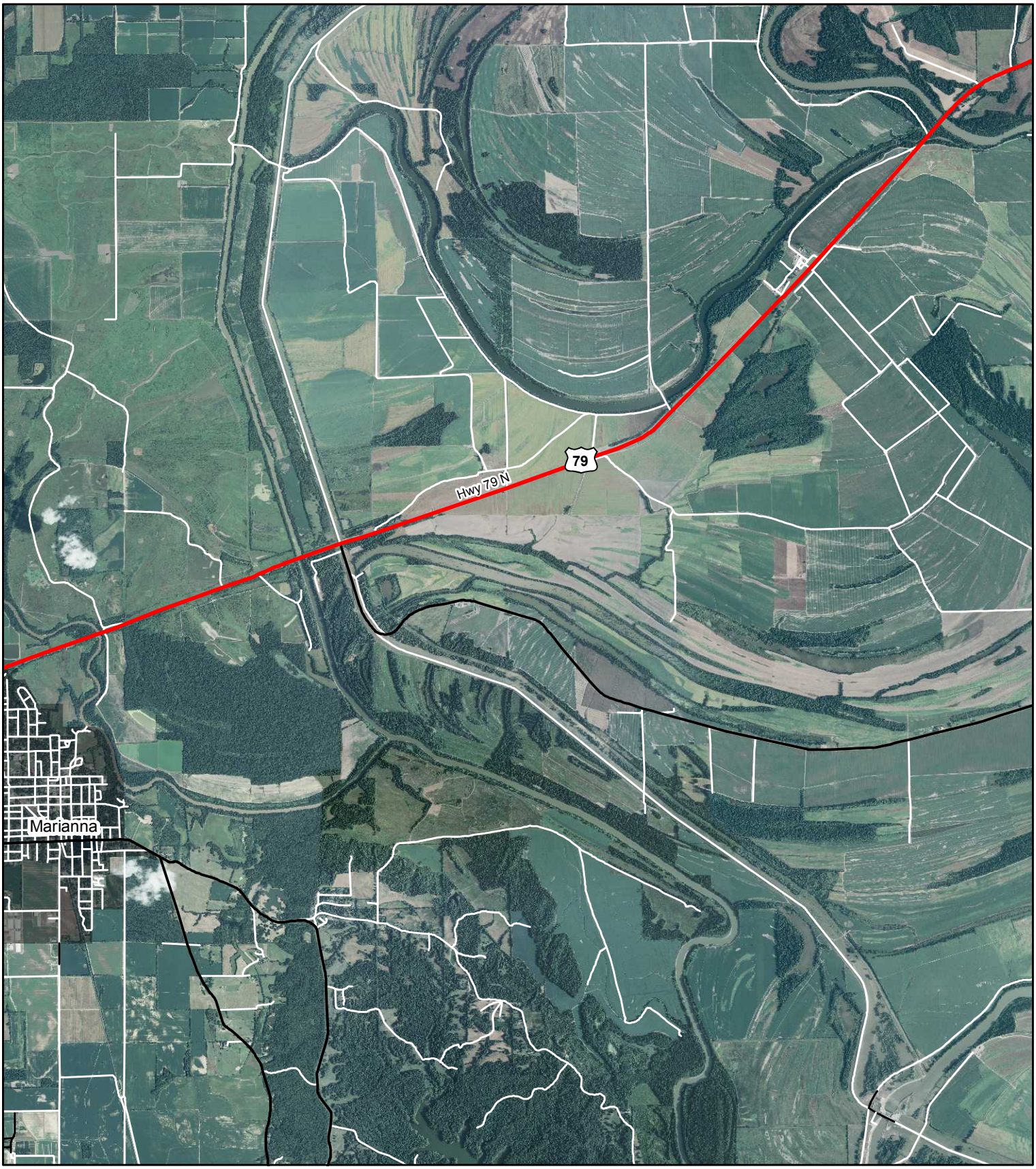

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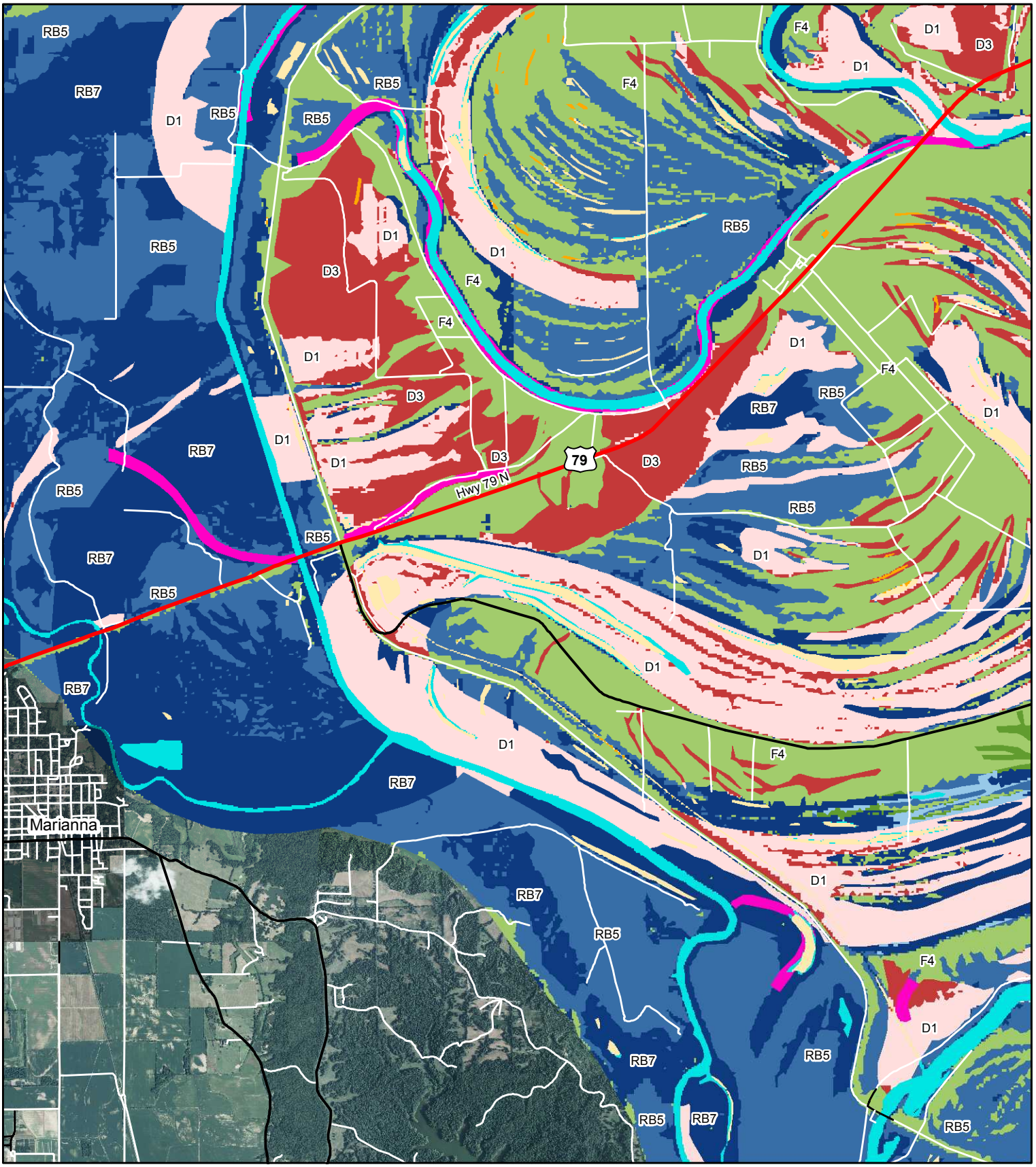

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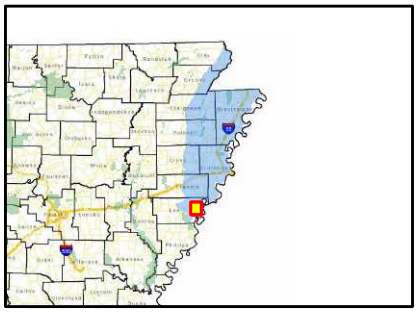

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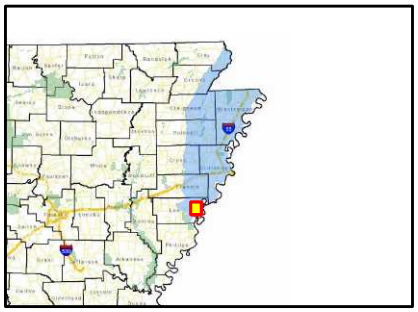

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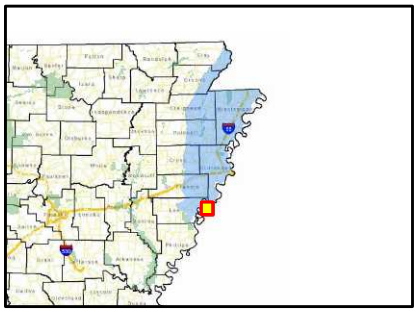

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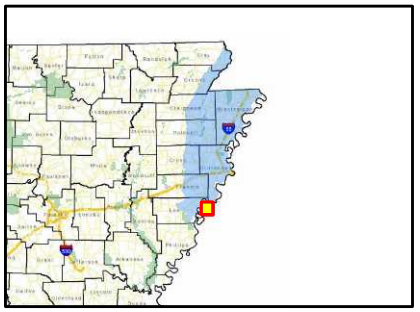

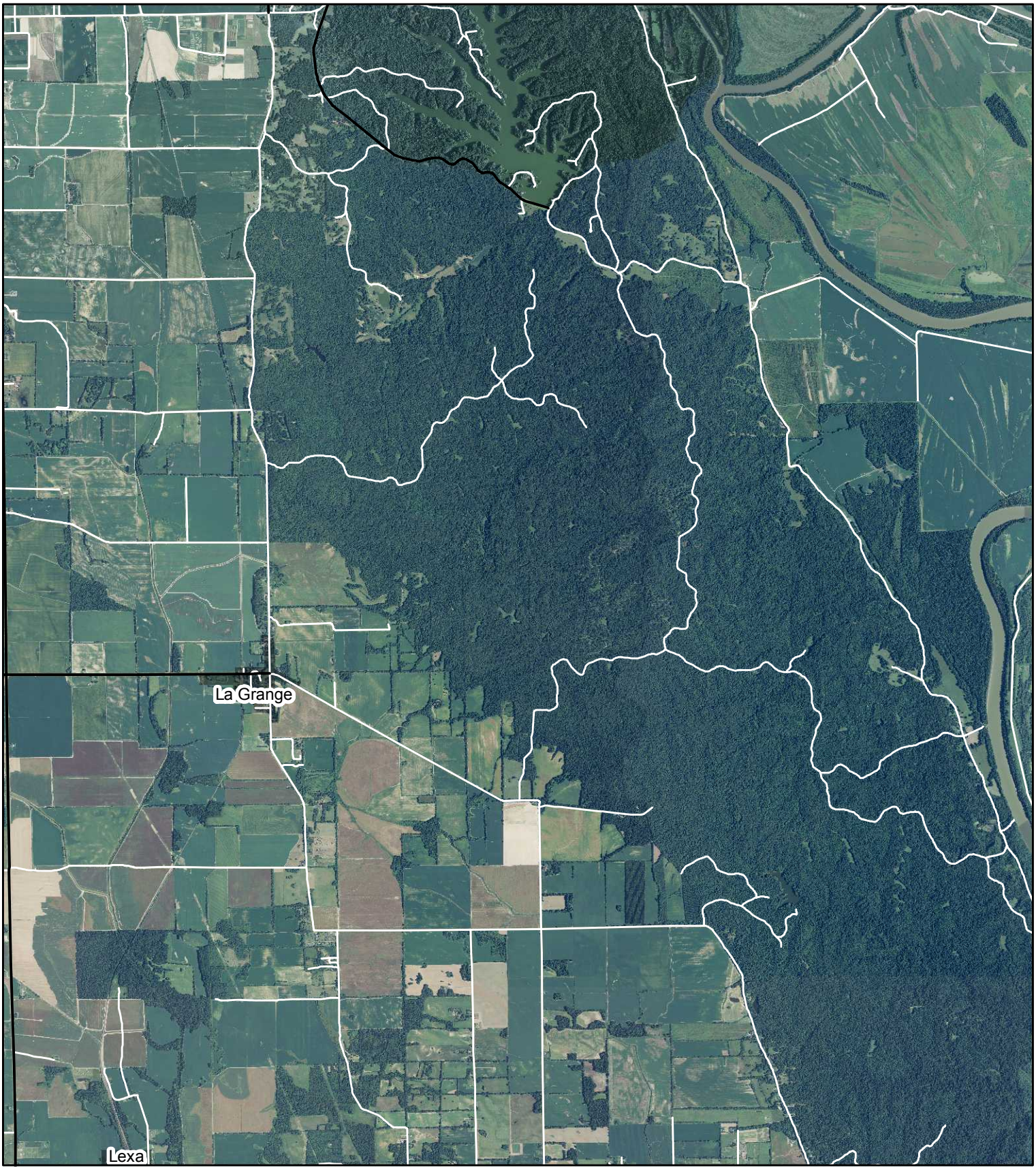

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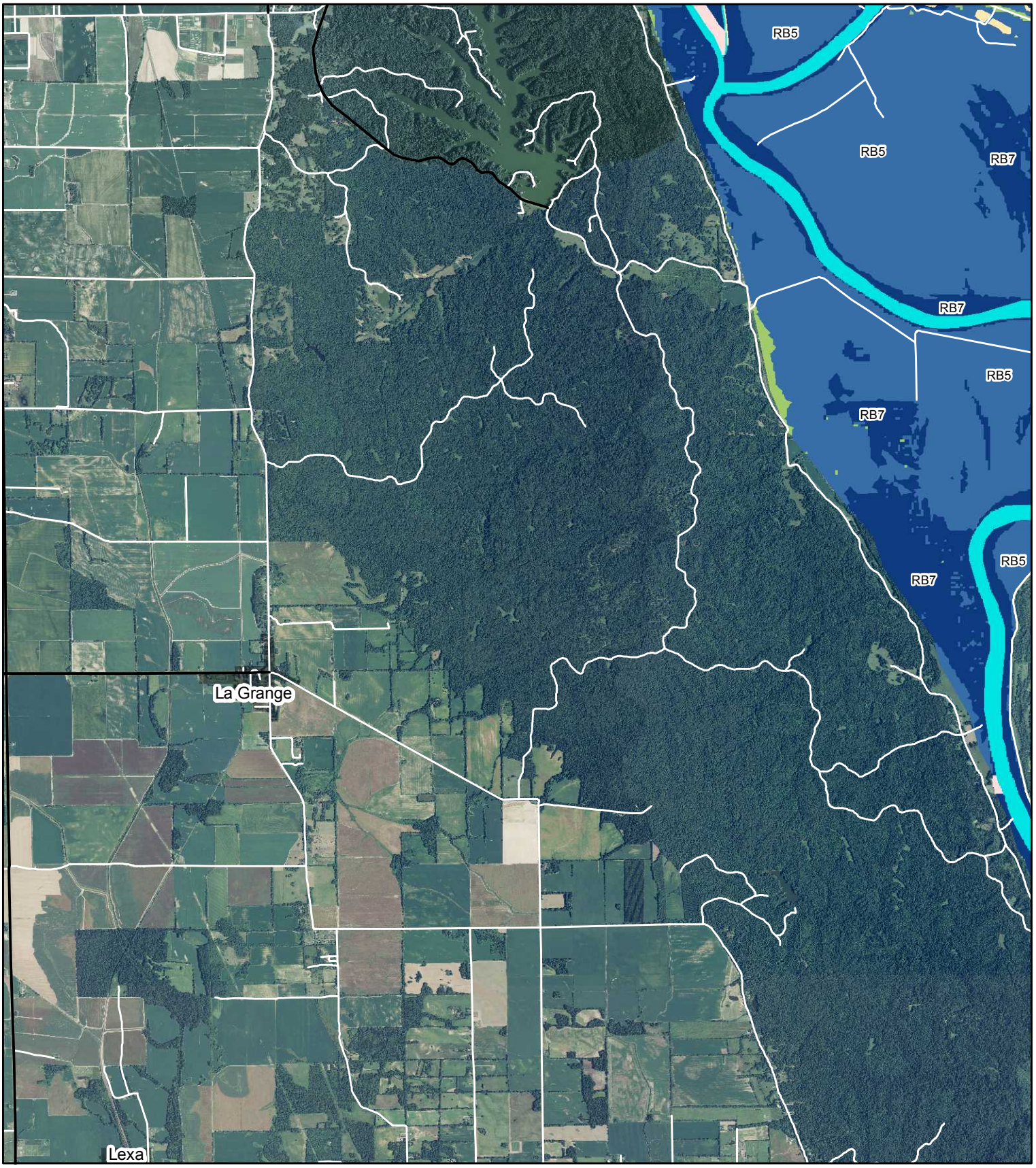

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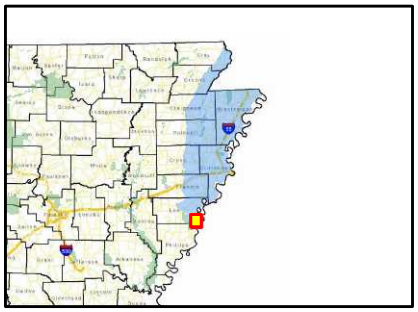

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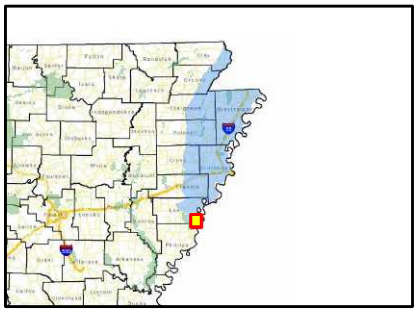

Appendix B: Potential Natural Vegetation Community Characteristics in the St. Francis Basin of Arkansas

This appendix describes the Potential Natural Vegetation of the St. Francis Basin of Arkansas. Because the purpose of the Field Atlas is to support ecosystem restoration design and planning, the focus is on the predominant long-term equilibrium community composition best adapted to persist on each site under the current hydrologic and climatic regime. This appendix is also intended to call attention to the presence and scale of topographic features, such as natural levee ridges and shallow vernal pools, which are essential elements of most of the community types. Where those features have been significantly altered, they must be restored to their approximate original extent prior to revegetation work in order to establish the community types described here and mapped in the Field Atlas.

The dominant and associated species listed are primarily trees, because most restoration projects in the region focus on reforestation, but understory species or other characteristics strongly associated with a particular community type are noted in some cases. All of the listed species do not necessarily occur together in any particular stand, but they may all be found on similar sites where mature, compositionally stable communities are present. No early successional communities are described, although seral patches exist in all of the community types, and in some settings, such as point bars within and along active channels, they may be extensive. Similarly, the community descriptions do not necessarily reflect the current vegetation found on many sites, which may have established under a previous hydrologic regime or been extensively manipulated.

The community type names reflect the Hydrogeomorphic (HGM) Classification and landscape setting. See the map legend for the corresponding dominance-type designations.

Note that, in much of the MAV, Pleistocene and Holocene deposits differ markedly in various respects, but in the St. Francis Basin the Pleistocene deposits often lie at approximately the same elevation as Holocene settings, and may be veneered with Holocene alluvium. Thus the community types identified as being on Holocene deposits often are also mapped on Pleistocene deposits, and vice versa.

HGM SUBCLASSES: RIVERINE BACKWATER		
	CHARACTERISTICS	
COMMUNITY TYPE	TYPICAL VEGETATION	DESCRIPTION
RB2 **Occasionally flooded, moderately drained lowlands**	Dominants: Willow oak Water oak Sweetgum Vernal pools: Nuttall oak Green ash Swamp privet	Relatively subdued ridge-and-swale landscapes predominantly occupied by willow oak and sweetgum. Occasional swales are dominated by Nuttall oak. Extensive areas within the floodways are in a mid-successional state characterized by pecan and American elm, and long-term restoration targets are uncertain due to unpredictable floodway operations.
RB3 **Occasionally flooded flats**	Dominants: Willow oak Nuttall oak Associated species: Cherrybark oak Green ash Cow oak Vernal pools: Overcup oak Water elm	Willow oak flatwoods on the interfluves of outwash deposits with extensive vernal pools in the remnant channels. Species diversity is relatively low.
RB5 **Occasionally flooded Pleistocene deposits**	Dominants: Willow oak Delta post oak Water oak Associates: Cherrybark oak Green ash American elm Sweetgum	Common on interfluve areas of Pleistocene outwash deposits as well as some more recent sediments, particularly those of smaller streams. Where this type occurs within the modern floodways, it is in a mid-successional state characterized by pecan and American elm, and long-term restoration targets are uncertain due to unpredictable floodway operations.
RB6 **Frequently flooded Pleistocene deposits**	Dominants: Nuttall oak Overcup oak Green ash Drummond red maple Associates: Water oak Willow oak American elm Sweetgum Relict in-channel bars (buried sand deposits):	Relict braided channels within the Late Pleistocene outwash (valley train) deposits. Relict channels tend to stay wetter and have more connection to the water table than the adjacent interfluves. In places, channel substrates include thick lenses of sand (former in-channel bars) where small stands of river-front species may occur. Where this type occurs within the floodways, composition can be highly variable due to water management history.

	Sycamore Swamp cottonwood River birch	
RB7 **Frequently flooded lowlands**	Dominants: Overcup oak Bitter pecan Associates on wetter sites: Baldcypress Water locust Associates on drier sites: Nuttall oak Green ash Sweetgum Willow oak	This community type occurs on a wide variety of geomorphic settings and soil types where forest composition is strongly controlled by extended periods of backwater flooding in most years. The characteristic community is dominated by overcup oak, bitter pecan, and a limited group of associated canopy and understory species. Vines and ground cover species are less abundant and diverse than on less flooded sites. Dominance may shift to baldcypress and water tupelo in sumps and along minor interior drainageways. A more diverse species composition may develop on the margins of this type or on somewhat higher sites within it. Within floodways, earlier successional stages dominated by box elder, cottonwood, and sycamore are common and their restoration potential is complicated by the unusual flooding patterns.
RB9 **Post Oak flatwoods (wet saline phase)**	Dominant species: Delta post oak Willow oak Associated species: Green ash Shagbark hickory	Saline soils on older, flat Pleistocene outwash terraces support a community of few species where Delta post oak is characteristically dominant.
HGM SUBCLASSES: RIVERINE OVERBANK		
COMMUNITY TYPE	**CHARACTERISTICS** **TYPICAL VEGETATION**	**DESCRIPTION**
RO2 **River swamps in underfit channels**	Channel bottom zone: Dominants: Baldcypress Buttonbush Lower bank or narrow terrace adjacent to stream: Dominants: Overcup oak Black willow Bitter pecan Box elder Sycamore Associates: Water elm Swamp privet	"River swamps" of slow-moving streams that have occupied abandoned courses of larger rivers. Typically a swamp forest of baldcypress dominates the zone occupied by the modern stream at normal flows. The adjacent narrow floodplain and terraces and the former channel sideslopes support a series of forest species reflecting flood frequency, from overcup oak adjacent to the cypress community through natural levee species such as pecan along the channel rim. A wide variety of other species may occupy the intervening zones. A standard buffer along the center lines of the abandoned courses as mapped on 1:24,000 quad sheets was used to delimit this type; therefore, the boundaries are less precise than other mapped features.

	Leadplant Side slopes of abandoned channel: Mixed hardwoods and riverfront species	
RO4 **Outwash channels in Late Pleistocene deposits and floodways**	Dominant species: Nuttall oak Red maple Green ash American elm Sugarberry Cherrybark oak Associated species: Sycamore Cottonwood River birch Swamp cottonwood Dominants on wettest sites: Bald cypress Overcup oak Bitter pecan Dominants on drier sites: Water oak Sweetgum Willow oak	A diverse and variable type associated with the most recent outwash channels with sandy soils and high water tables as well as floodways with periodic high-energy flows. The resulting communities are often of a wetter character than flood frequencies alone might suggest, and many maintain a high component of species more typical of riverfront and disturbed sites, though these species usually are not dominant. Some valley train pond depressions may be included in this type but are not separable based on soils and must be recognized in the field based on deep ponding that extends through much of the growing season.
HGM SUBCLASS: FLAT		
COMMUNITY TYPE	**CHARACTERISTICS** **TYPICAL VEGETATION**	**DESCRIPTION**
F2 **Well-drained recent alluvium in lowlands**	Dominants: Sycamore Cottonwood Pecan Cow oak Associates: Sugarberry Sweetgum Water oak Characteristic understory species: Paw-paw Cane	Diverse communities on well-drained sites on point bars and where natural levee veneers cover backswamp deposits. Vernal pools occur where poorly drained soils underlie large swales.

	Vernal pools: Nuttall oak	
F4 **Moderately drained lowlands**	Dominants: Sugarberry Green ash American elm Sweetgum Associates: Water oak Willow oak Persimmon Cherrybark oak Vernal Pools: Overcup oak Bitter pecan	Primarily on gently undulating, moderately drained point bars and veneered backswamps of various ages and origins. However, this type is widely distributed in the St. Francis Basin, including some Pleistocene sites. The characteristic community is sugarberry-elm-ash, but subtle site variations favor water oak on better drained ridges and Nuttall oak or willow oak on true topographic flats. Overcup oak usually dominates in swales.
F6 **Poorly drained lowlands**	Dominants: Willow oak Nuttall oak Sweetgum Associates: Cherrybark oak Sugarberry Shagbark hickory American elm Characteristic understory species: Green hawthorn Winged elm Vernal pools: Overcup oak Green ash	Poorly drained flats of various origins with large shallow vernal pools. Dominated by Nuttall and willow oaks. Better-drained sites within this type may shift dominance to cherrybark oak.
F7 **Poorly drained undulating topography on Pleistocene outwash terraces**	Dominant species on interfluves: Water oak Cow oak Cherrybark oak Pecan Sugarberry Dominant species in channels: Nuttall oak Sugarberry Willow oak Sweetgum American elm	Common diverse flats of the younger Late Wisconsin outwash terraces and some Holocene deposits. Higher interfluves are bisected by lower remnant outwash channels, with species dominance shifting accordingly. Shallow, linear vernal pools are present in some channels, and where sandy soils predominate, riverfront species are common associates.

	Associated species: Cottonwood Sycamore	
F12 **Alkali post oak flats**	Dominant species: Post oak Vernal pools: Willow oak	This type is restricted to high-sodium soils of the Early Wisconsin Terrace. Post oaks strongly dominate and trees are often stunted due to the soil conditions. Vernal pools are small and shallow but are important in maintaining wetland conditions and adding species and site diversity.
F13 **Hardwood flats, Early Wisconsin Valley Train and Deweyville Terraces (wet phase)**	Dominant species: Nuttall oak Willow oak Water oak Red maple Associated species: Sugarberry Green ash Sweetgum River birch Vernal pools: Overcup oak	Extensive wet flats of various Wisconsin Terraces and in floodways. Composition in these forests is similar to the vernal pools of the “dry phase” hardwood flats on the same geomorphic surfaces. Vernal pools are not common, but may be large.
F16 **Willow oak flatwoods (wet phase)**	Dominant species: Willow oak Associated species: Green ash American elm Water oak Vernal pools: Overcup oak	Wet flats of the Early Wisconsin terraces. Broad shallow vernal pools are common, and essential to restoration of wetland hydrology on these sites.
F17 **Willow oak flatwoods (dry phase)**	Dominant species: Delta post oak Cherrybark oak Associated species: White oak Shagbark hickory Sweetgum Blackgum Vernal pools: Willow oak	Willow oak flats of the highest and oldest Early Wisconsin outwash terraces, where vernal pools are relatively small, shallow, and scattered.
F18 **Post oak flatwoods (wet phase)**	Dominant species: Delta post oak Associated species: Willow oak	Post oak flats of the Early Wisconsin outwash terraces strongly dominated by Delta post oak with willow oak as an associate and dominating in the small, scattered vernal pools.

F19 **Post oak flatwoods** **(dry phase)**	Dominant species: Delta post oak Post oak Associated species: Southern red oak	Post oak flats of the highest and oldest Early Wisconsin outwash terraces, where vernal pools are relatively small, shallow, and scattered.
HGM SUBCLASSES: CONNECTED AND UNCONNECTED DEPRESSION		
COMMUNITY TYPE	**CHARACTERISTICS**	
	TYPICAL VEGETATION	**DESCRIPTION**
D1 **D3** **Stream-connected and unconnected depressions in abandoned channels**	Dominants: Baldcypress Water tupelo Overcup oak Bitter pecan Understory and associated species: Willow oak Nuttall oak Waterlocust Swamp privet Buttonbush Persimmon	Topographic depressions with very poorly drained soils in former stream channels and large swales, as well as some outwash channels. Connected depressions are connected to downstream systems by a perennial stream channel or are within the 5-year floodplain. Unconnected depressions meet neither of these criteria. Species composition is restricted to the most water-tolerant plants, which distinguishes true depressions from vernal pools. Vines and ground cover species are uncommon. Within much of the Big Lake area, this type is the natural setting but the area is currently managed similar to a riverine backwater site.
D4 **Unconnected depressions on Pleistocene outwash terraces**	Dominants: Baldcypress Water tupelo Overcup oak Understory and associated species: Swamp privet Swamp cottonwood Nuttall oak Drummond's red maple Sycamore	Depressions ("Valley Train Ponds") in remnant braided channels of the Pleistocene outwash (valley train) terraces. These features are relatively linear, and are largest and deepest on the younger (lower) terraces, where baldcypress is the most common dominant.
HGM SUBCLASSES: CONNECTED AND UNCONNECTED FRINGE		
COMMUNITY TYPE	**CHARACTERISTICS**	
	TYPICAL VEGETATION	**DESCRIPTION**
FR1 **FR2** **Stream-connected and unconnected lake and pond fringe wetlands**	Common dominants in systems with natural fluctuation patterns: Baldcypress Water tupelo Buttonbush Numerous herbaceous species Common dominants in systems with highly modified fluctuation patterns:	Wetlands within permanent lakes and ponds, including borrow pits, but not aquaculture ponds. Natural systems typically support baldcypress and tupelo forests within the fluctuation zone and in the immediate lakefront zone where water tables remain near the surface. Buttonbush thickets may dominate in shallow, near-permanent water, and zones of emergent species are usually present, with erect rooted species in shallow water, floating-leaved species in deeper water, and submerged aquatics present throughout the open-water area. Where

	Black willow Buttonbush American lotus	water levels are manipulated, these patterns are usually altered in various ways. Because water depths and fluctuation patterns are unknown, the entire water body is mapped as fringe wetland. Connected fringe wetlands are connected to downstream aquatic systems by a perennial stream channel or are within the 5-year floodplain. Unconnected fringe wetlands meet neither of these criteria.
HGM SUBCLASS: UPLAND		
COMMUNITY TYPE	**CHARACTERISTICS**	
	TYPICAL VEGETATION	**DESCRIPTION**
U2 **Upland forests of Pleistocene outwash terraces and alluvial fans**	Dominant species: Southern red oak White oak Post oak Associated species: Water oak Shagbark hickory Black oak Shumard oak	Upland forests of the Pleistocene terraces and alluvial fans. Species composition can vary widely depending on local soils and drainage conditions.
U4 **Pleistocene dunefields and barrens**	Dominant species: Blackjack oak Southern red oak Post oak Black oak Shagbark hickory Associated species: White oak Sumac Prairie grasses	Sandy barrens of the Pleistocene terraces.

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13. SUPPLEMENTARY NOTES

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This report replaces a previous version dated September 2012, which contained a significant error. All copies of that previous version should be discarded, and the corresponding GIS files deleted. Replacement GIS files and a pdf of this revised report are available at http://el.erdc.usace.army.mil/emrrp/analyt.html .

14. ABSTRACT

Over the past three decades, extensive field studies of wetland plant communities have been conducted in the Mississippi Alluvial Valley. These field studies have been carried out for various purposes under the auspices of federal and state research programs or in conjunction with Corps of Engineers project planning efforts. In the process, a wetland site classification approach has evolved based on hydrology, soils, and geomorphic setting. The research data and classification system have been recently used for a new purpose: to create a set of Potential Natural Vegetation (PNV) maps covering more than 26,000 square miles within the region. The purpose of PNV maps is to serve as blueprints for restoration planning and prioritization. Due to the fact that the hydrology of the landscape has been permanently changed by major flood control projects, the PNV maps do not represent the distribution of the original, pre-settlement vegetation. Rather, they identify the natural communities that are appropriate to the modern altered site conditions. By using these maps, persons interested in restoring particular tracts of land can identify the plant communities appropriate to the conditions present. Conversely, individuals interested in restoring particular plant communities can identify parts of the landscape that can support each respective type. The PNV maps are available for use in a Geographic Information System, where a range of complex restoration scenarios (such as the development of wildlife travel corridors or refuge areas) can be explored efficiently, and alternative approaches can be compared to one another in terms of costs and ecological effectiveness. This report is one of six Field Atlases that present the same data in a downloadable, printable format at a scale of 1 in. = 1 mile.

15. SUBJECT TERMS

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Potential Natural Vegetation (PNV) maps
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