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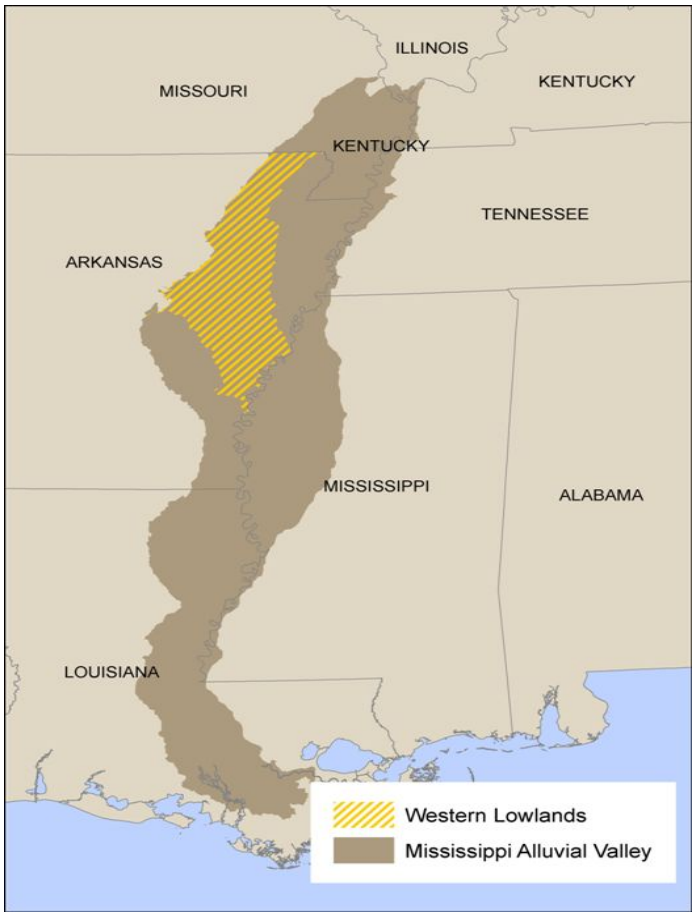
Potential Natural Vegetation of the Mississippi Alluvial Valley: Western Lowlands, Arkansas, Field Atlas

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

September 2012



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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 development of wildlife travel corridors or refuge areas) can be explored efficiently and alternative approaches can be compared to one another in terms of relative 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 inch = 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 Environmental Protection Agency (EPA), initiated much of the research in this area as part of a program to develop guidebooks for hydrogeomorphic (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, the current atlas being one of them (http://el.erdc.usace.army.mil/emrrp/analyt.html).

Charles Klimas, U.S. Army Engineer Research and Development Center (ERDC), Thomas Foti (Arkansas Natural Heritage Commission and Oakleaf Institute, Little Rock AR) and Jody Pagan (5-Oaks Wildlife Services, LLC, Stuttgart AR) 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. Elizabeth Murray (ERDC) was the MAWPT coordinator with the Arkansas Game and Fish Commission at the time and a member of the field mapping team. Malcolm Williamson (Center for Advanced Spatial Technologies, University of Arkansas, Fayetteville) assembled and processed the original project GIS data; updated and normalized the 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.

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. The purpose of PNV maps is to 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 Western Lowlands region of 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 inch = 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 included in front of 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 Western Lowlands

The Western Lowlands correspond to that portion of the White River basin that lies within the MAV. The region is bounded on the west and north by the Ozark escarpment, on the west and south by the Grand Prairie, and on the east by Crowley's Ridge. Part of this area is located in southeast Missouri; however, this atlas covers only the Arkansas portion of the Western Lowlands (Figure 1), which includes more than 4.5 million acres.

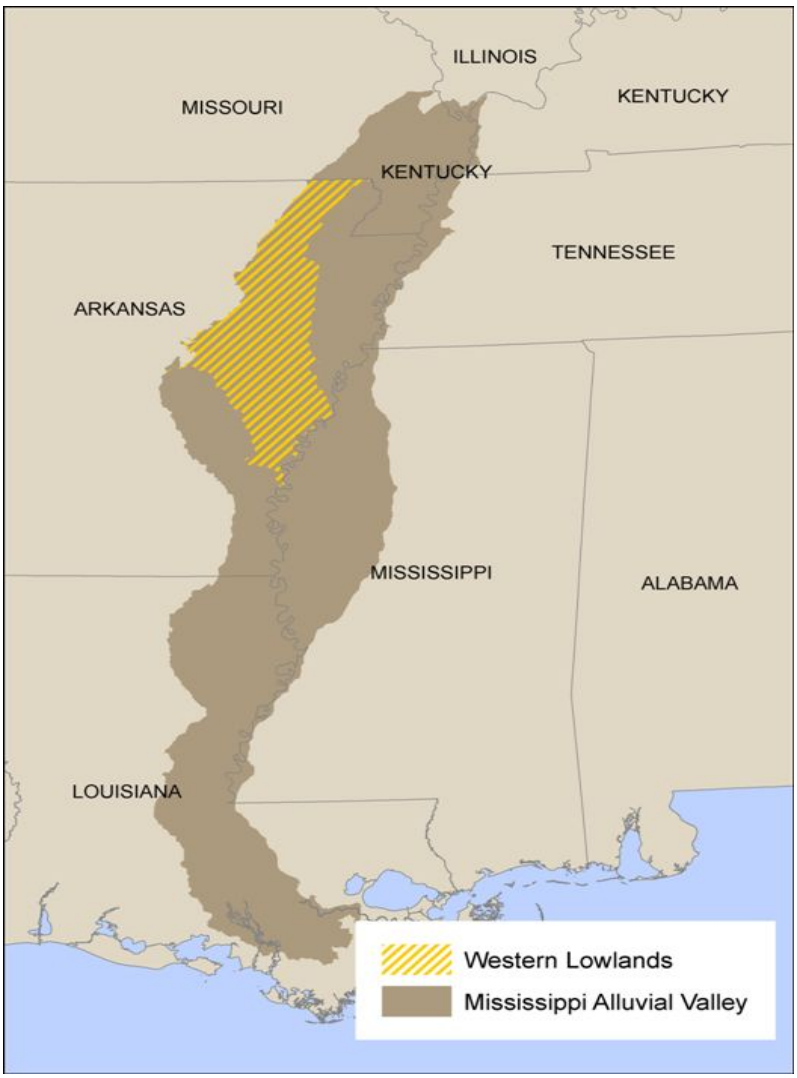


Figure 1. Location of the Western Lowlands in Arkansas.

Various streams enter the basin from the western uplands in Arkansas, including the Black, Current, Spring, White, and Little Red Rivers. The Cache River and Bayou De View originate within the lowlands on the

eastern side of the basin. All of these streams drain to the White River, which discharges to the Arkansas River.

All of the major streams in the basin are flanked by relatively narrow floodplains with recent (Holocene) landforms that are typical of meandering river systems, including poorly drained backswamps, better-drained point bars, and well-drained natural levees. Abandoned channel segments form crescent-shaped oxbow lakes and depressions. However, most of the Western Lowlands region is made up of much older features that are higher in the landscape. These are a series of terraces made up of glacial outwash that flushed into the Mississippi Valley during periods of waning Late Wisconsin continental glaciation. Sometimes called “valley train” terraces, 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. They form several distinct terrace surfaces in the Western Lowlands, with the oldest and highest being 30 feet or more above the modern floodplain. On the lower and younger terraces, the remnant outwash channels are often distinctly visible, and may carry smaller modern streams within them. Some of the valley train surfaces are covered with extensive dunefields made up of wind-blown sands deflated from younger outwash channels and deposited on adjacent older surfaces.

This complex landscape of old and young deposits of various origins historically was subject to frequent flooding in the low-lying areas, and the higher terraces were prone to long-term ponding of precipitation in many places. Flooding has been reduced in the past century by federal projects that included levee construction, channel straightening and deepening, and upstream reservoir construction. Local interests have effectively drained many of the areas that were subject to ponding during wet periods. However, the lower White River remains subject to backwater inundation from the Mississippi River during major floods.

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. These descriptions reflect the probable long-term dominance patterns under current conditions. Forested sites sometimes will include species other than those that presently dominate. As a consequence of these characteristics, there are many possible uses for the PNV maps, including the following:

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) present a discussion of 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; or 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 different plant community than 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 a lengthy riparian corridor. 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

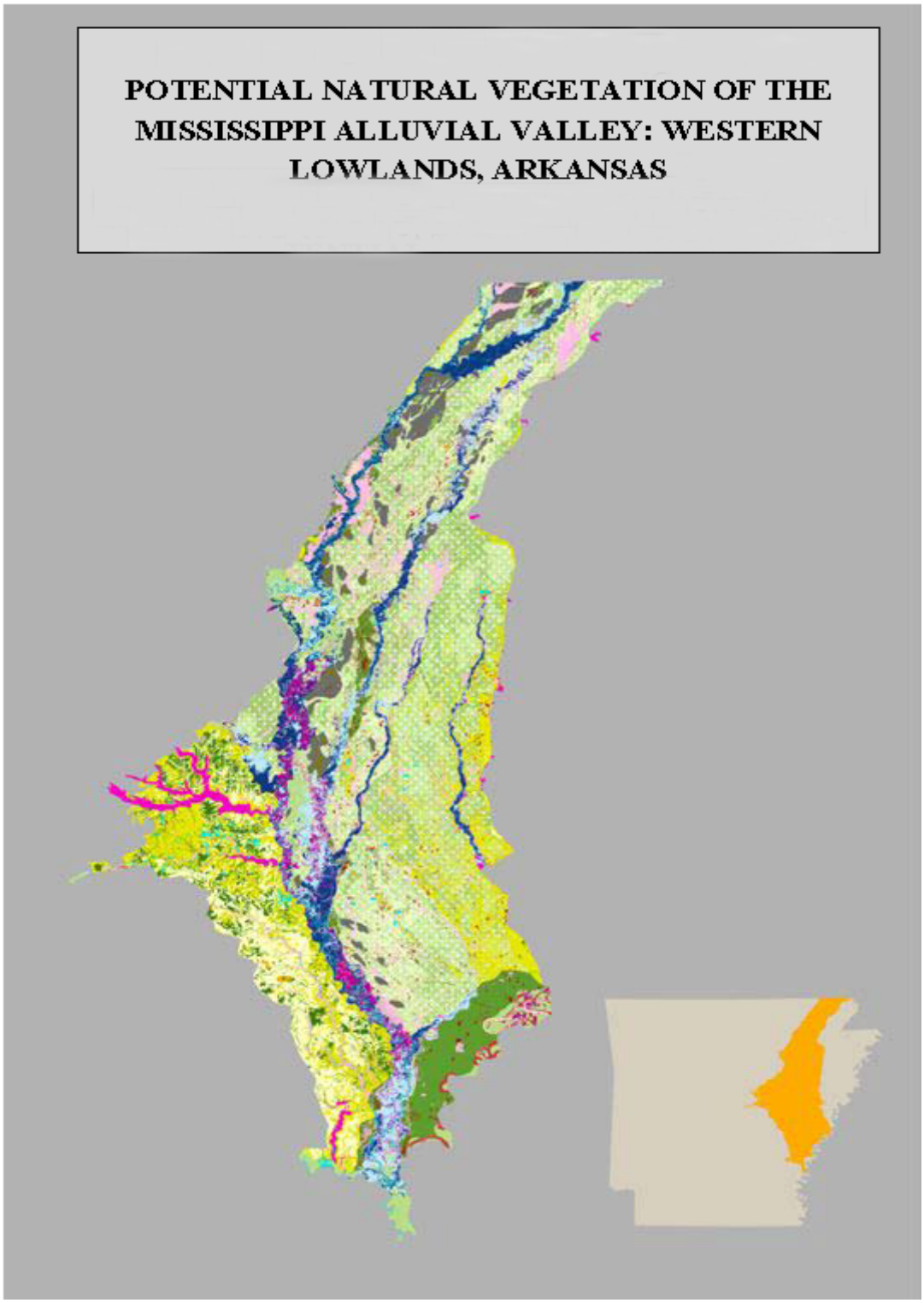
References

Foti, T., C. Klimas, J. Pagan, 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.

Klimas, C. V., E. O. Murray, T. Foti, J. Pagan, M. Williamson, and H. Langston. 2009. An ecosystem restoration model for the Mississippi Alluvial Valley based on geomorphology, soils, and hydrology. *Wetlands* 29: 430–450.

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*. EMRRP Technical Report 11-12. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Appendix A: Field Atlas



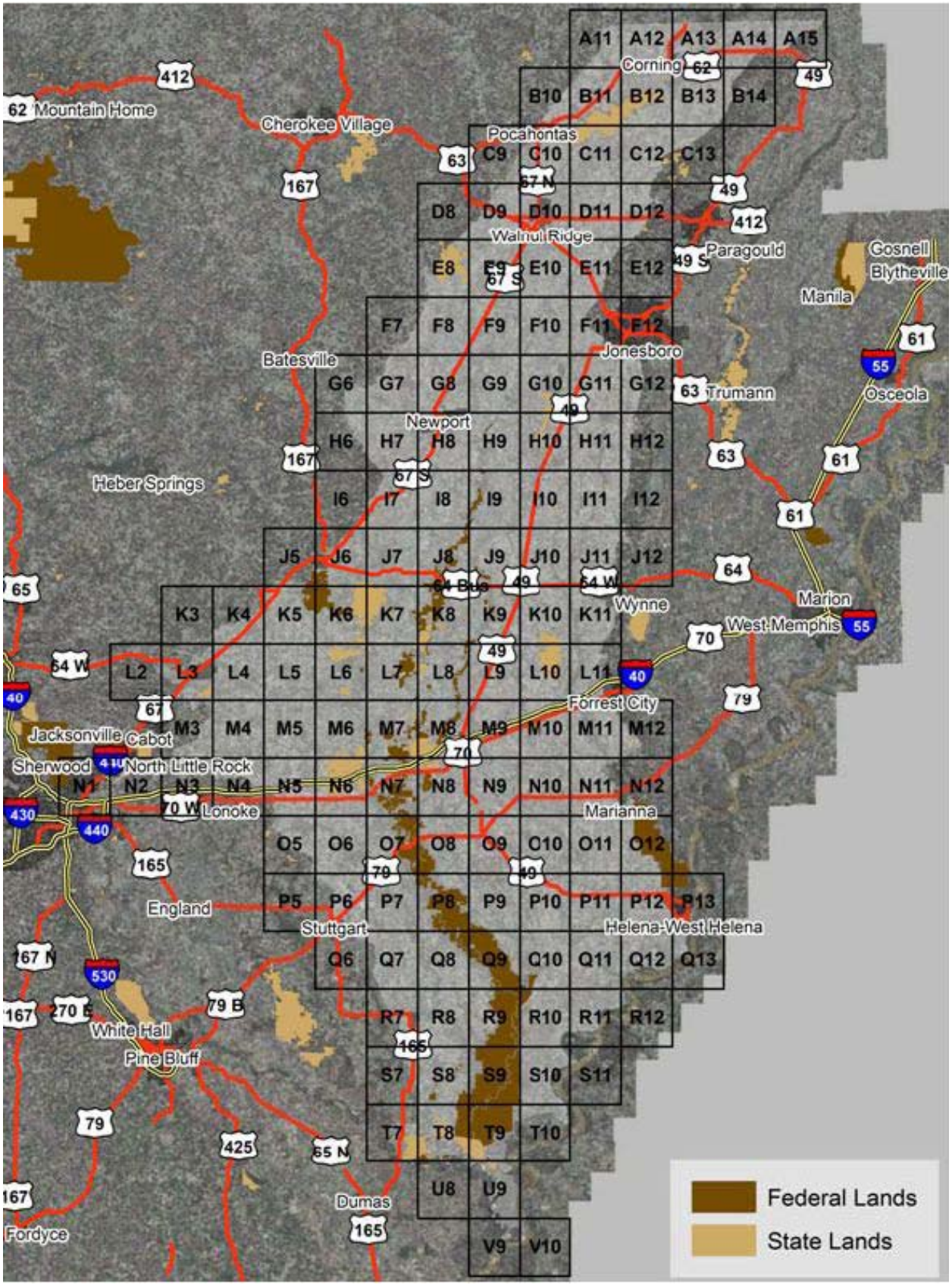


Figure A1. Western Lowlands Map Index: Cities, Roads, and Public Lands.

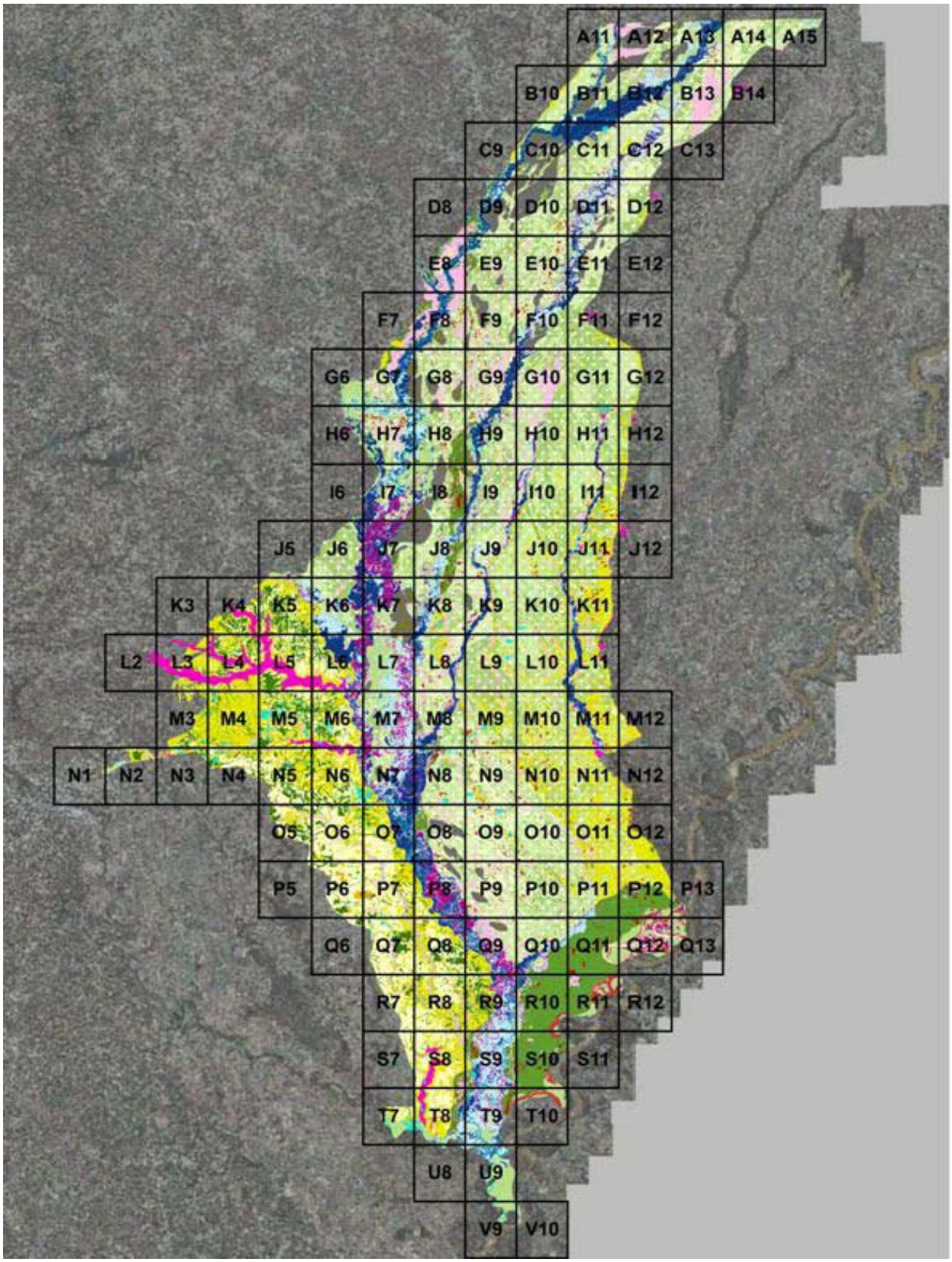
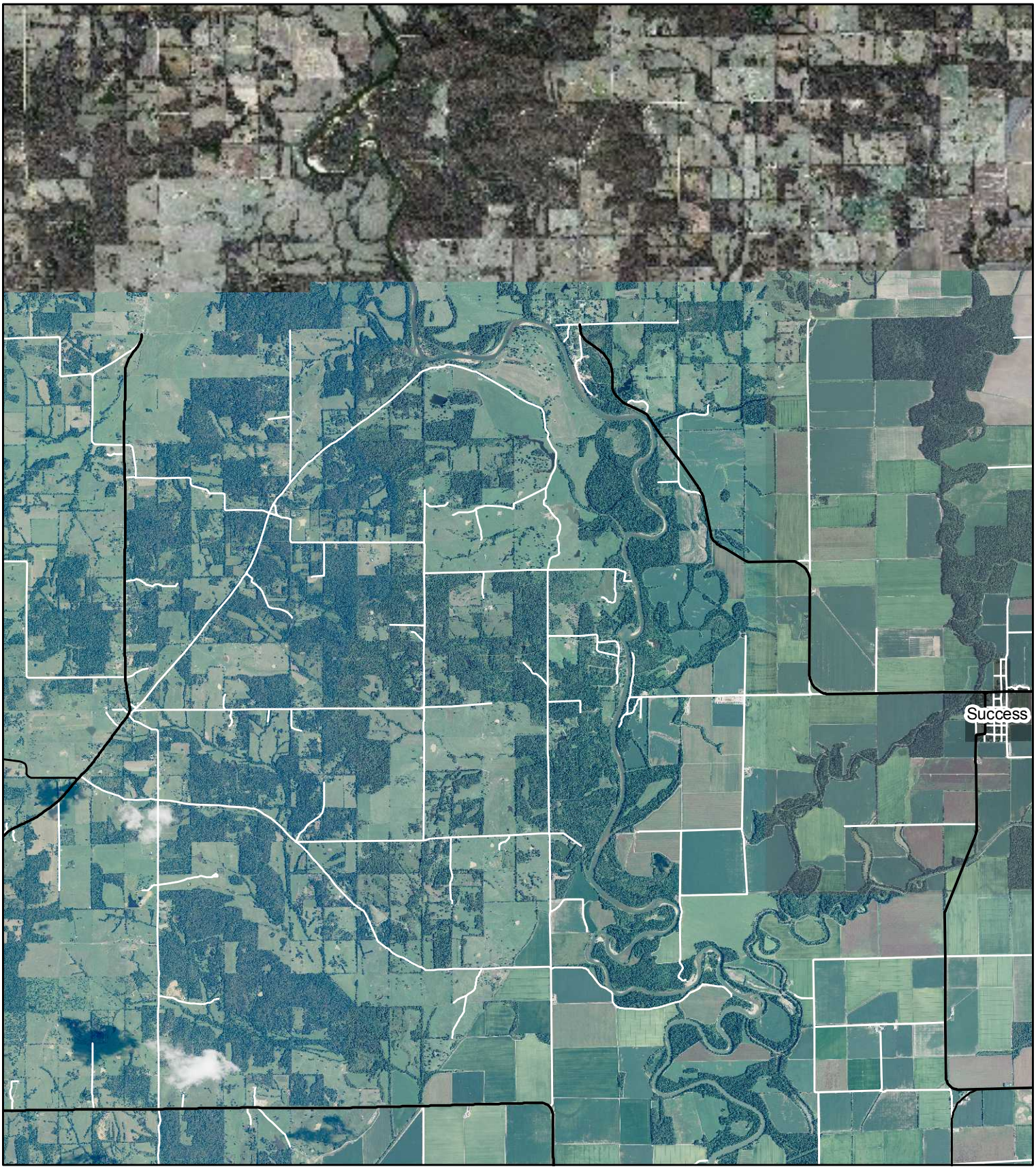


Figure A2. Western Lowlands Map Index: Potential Natural Vegetation.

POTENTIAL NATURAL VEGETATION MAP KEY, WESTERN LOWLANDS, ARKANSAS		
HGM Subclass	**General Site Characteristics**	**Principal Dominant Species**
RIVERINE BACKWATER	**WETLANDS MAINTAINED BY RIVERINE BACKWATER FLOODING**	
RB1	Occasionally flooded, well-drained lowlands	Nuttall Oak–Sweet Pecan
RB7	Frequently flooded lowlands	Overcup Oak–Bitter Pecan
RIVERINE OVERBANK	**WETLANDS MAINTAINED BY RIVERINE OVERBANK AND HEADWATER FLOODING**	
RO1	Floodplains and terraces of small stream valleys	Mixed Lowland Hardwoods
RO2	River swamps in underfit channels	Baldcypress–Water Tupelo
RO3	Riverfront natural levee and point bar	Cow Oak–Pecan–Cherrybark Oak–Cottonwood
FLAT	**WETLANDS MAINTAINED BY PRECIPITATION**	
F2	Well-drained recent alluvium in lowlands	Cherrybark Oak–Water Oak–Sweetgum
F3	Well-drained older alluvium in lowlands	Cow Oak–Cherrybark Oak–Water Oak
F7	Poorly-drained undulating topography on Pleistocene outwash terraces	Willow Oak–Water Oak
F8	Poorly-drained level topography on Pleistocene outwash terraces	Wet Prairie
F9	Flatwoods on poorly-drained sites of the Prairie Terrace	Delta Post Oak–Cherrybark 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
F14	Hardwood flats, Early Wisconsin Valley Train (dry phase)	Post Oak–Southern Red Oak–Shagbark Hickory
F15	Hardwood flats, Late Wisconsin dune fields	Post Oak–Willow Oak
DEPRESSIONS	**WETLANDS IN DEPRESSIONS**	
D1	Stream-connected depressions in abandoned channels	Baldcypress–Water Tupelo
D3	Unconnected depressions in abandoned channels	Baldcypress–Water Tupelo
D4	Unconnected depressions on Pleistocene outwash terraces	Baldcypress–Water Tupelo
D5	Stream-connected depressions on the Cache River terrace	Baldcypress–Water Tupelo–Swamp Cottonwood
D6	Unconnected depressions on the Cache River terrace	Baldcypress–Water Tupelo–Swamp Cottonwood
D7	Unconnected Sand Pond depressions	Baldcypress–Water Tupelo–Swamp Cottonwood
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**	
U1	Shallow, droughty soils of the Pleistocene terraces	Prairie–Post Oak
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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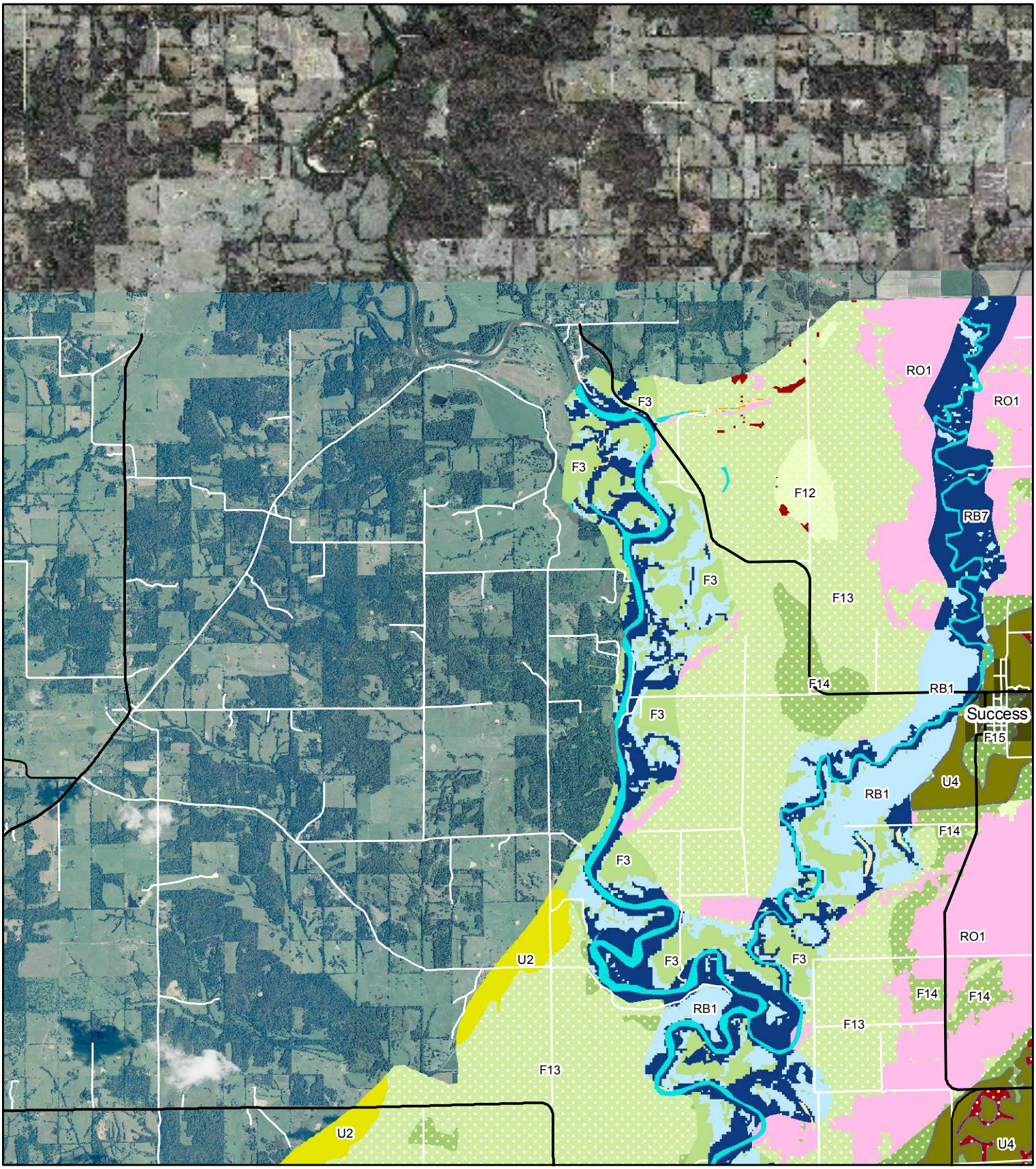

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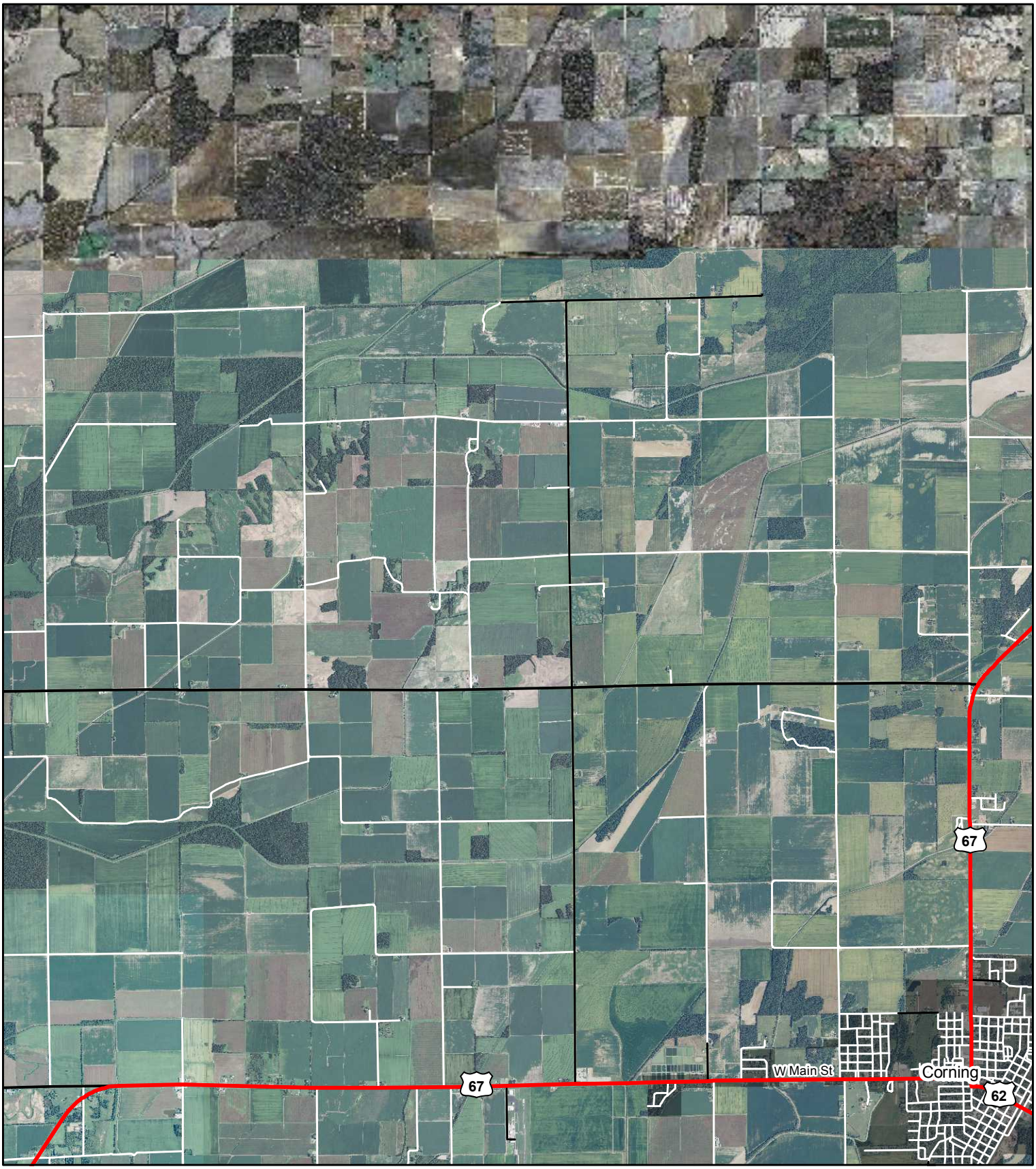

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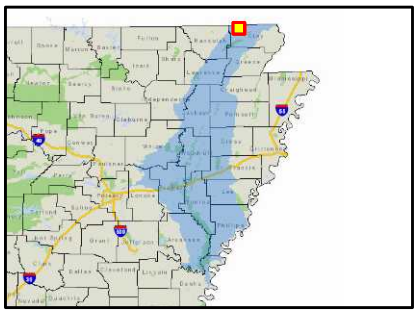

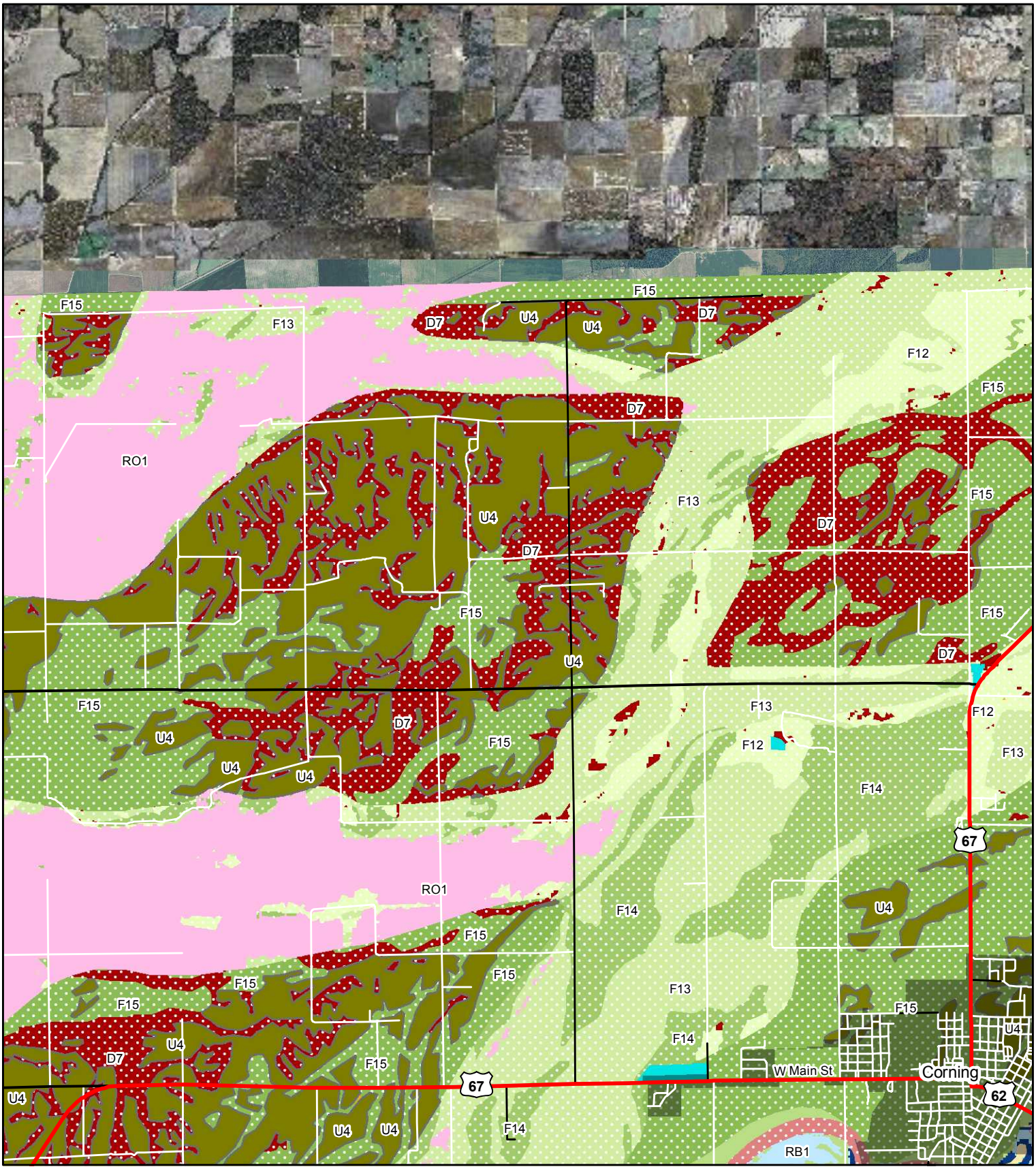

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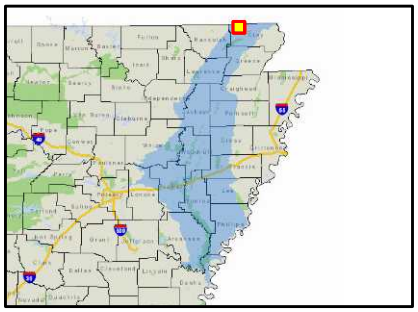

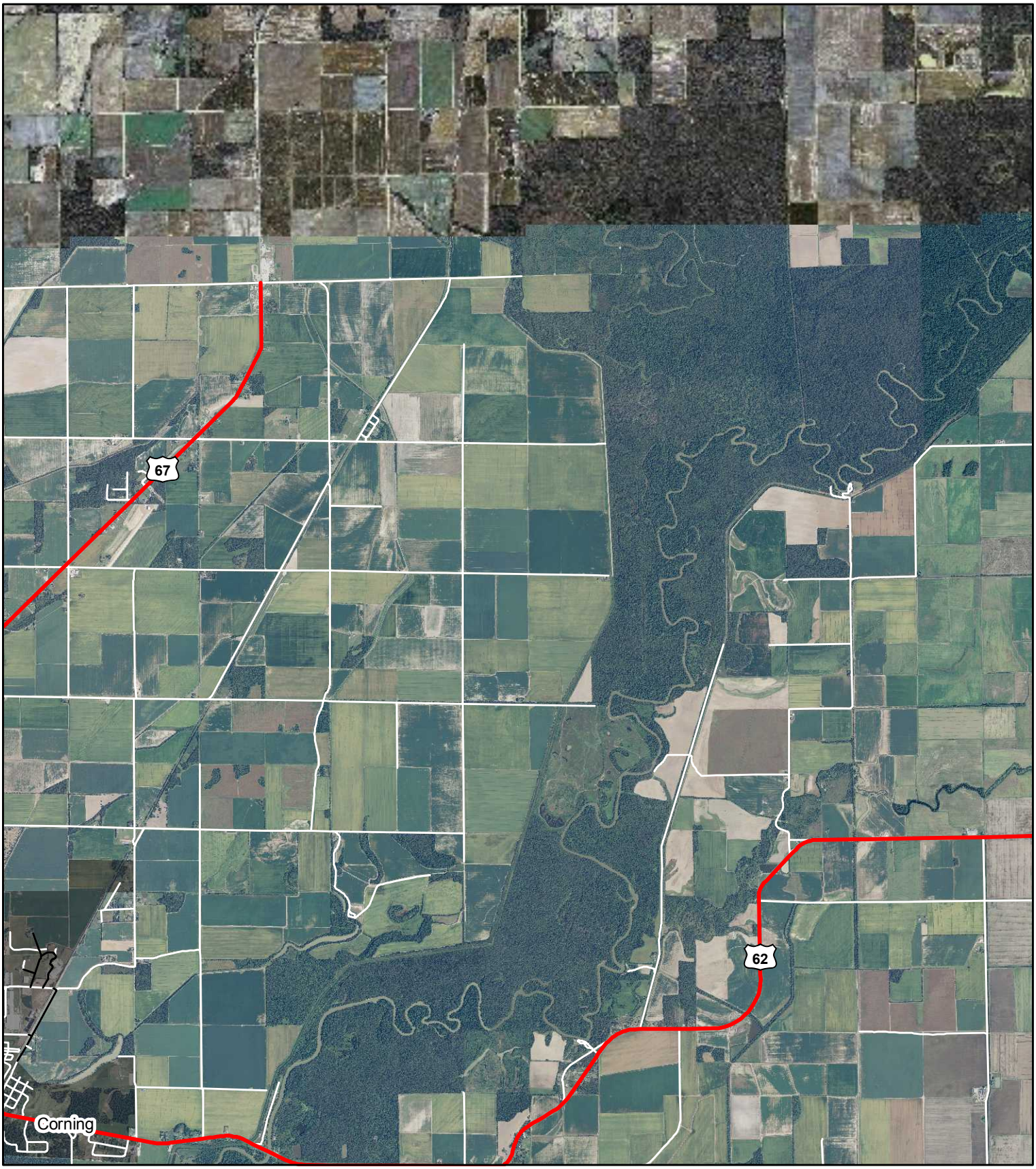

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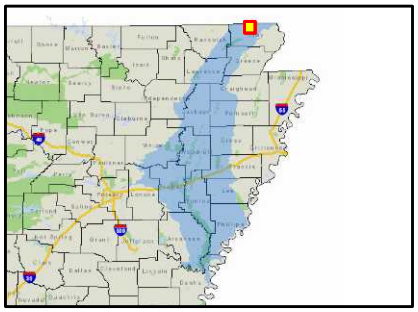

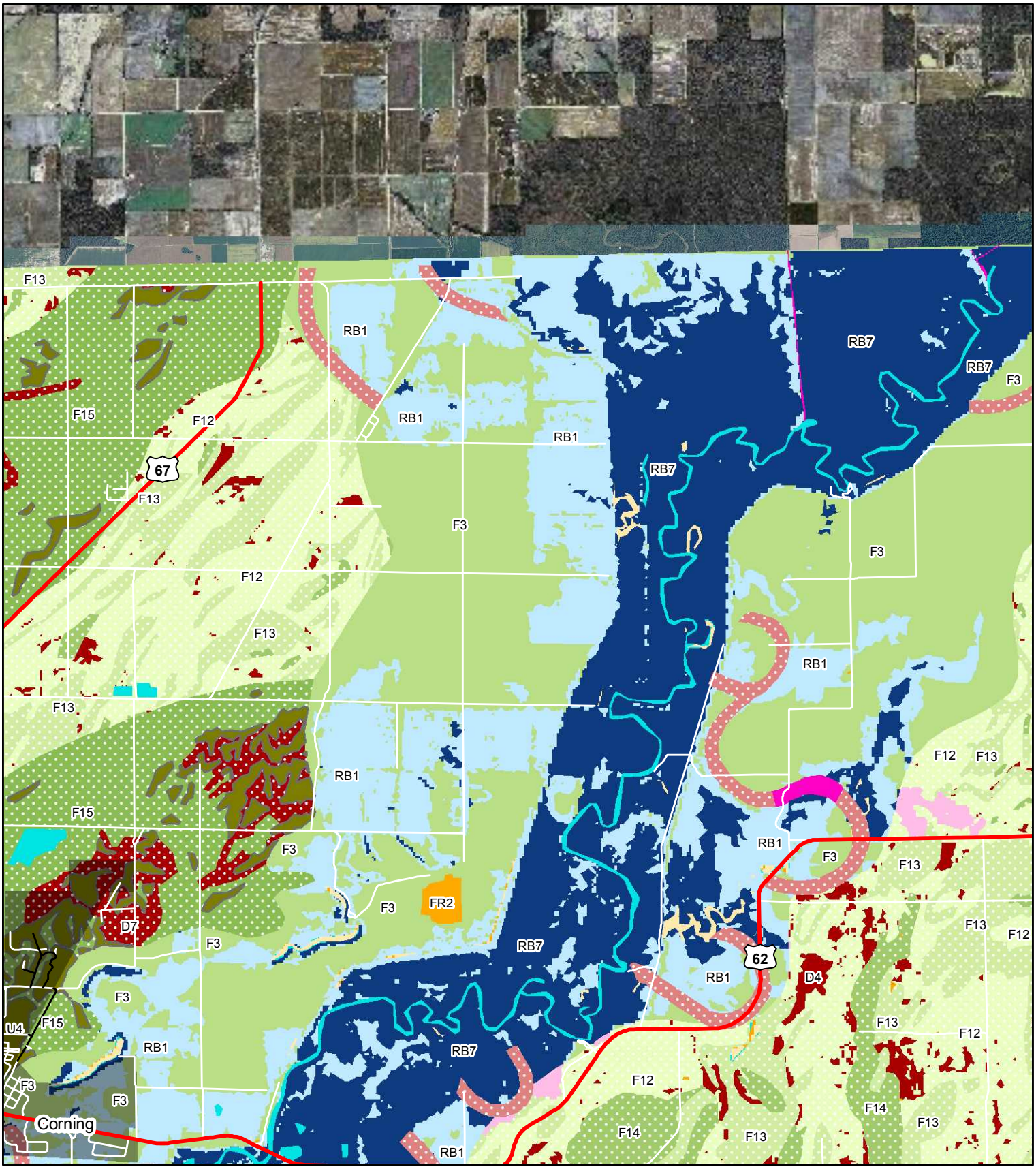

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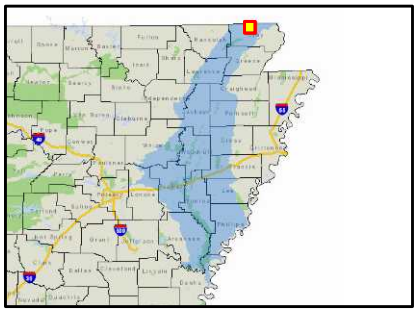

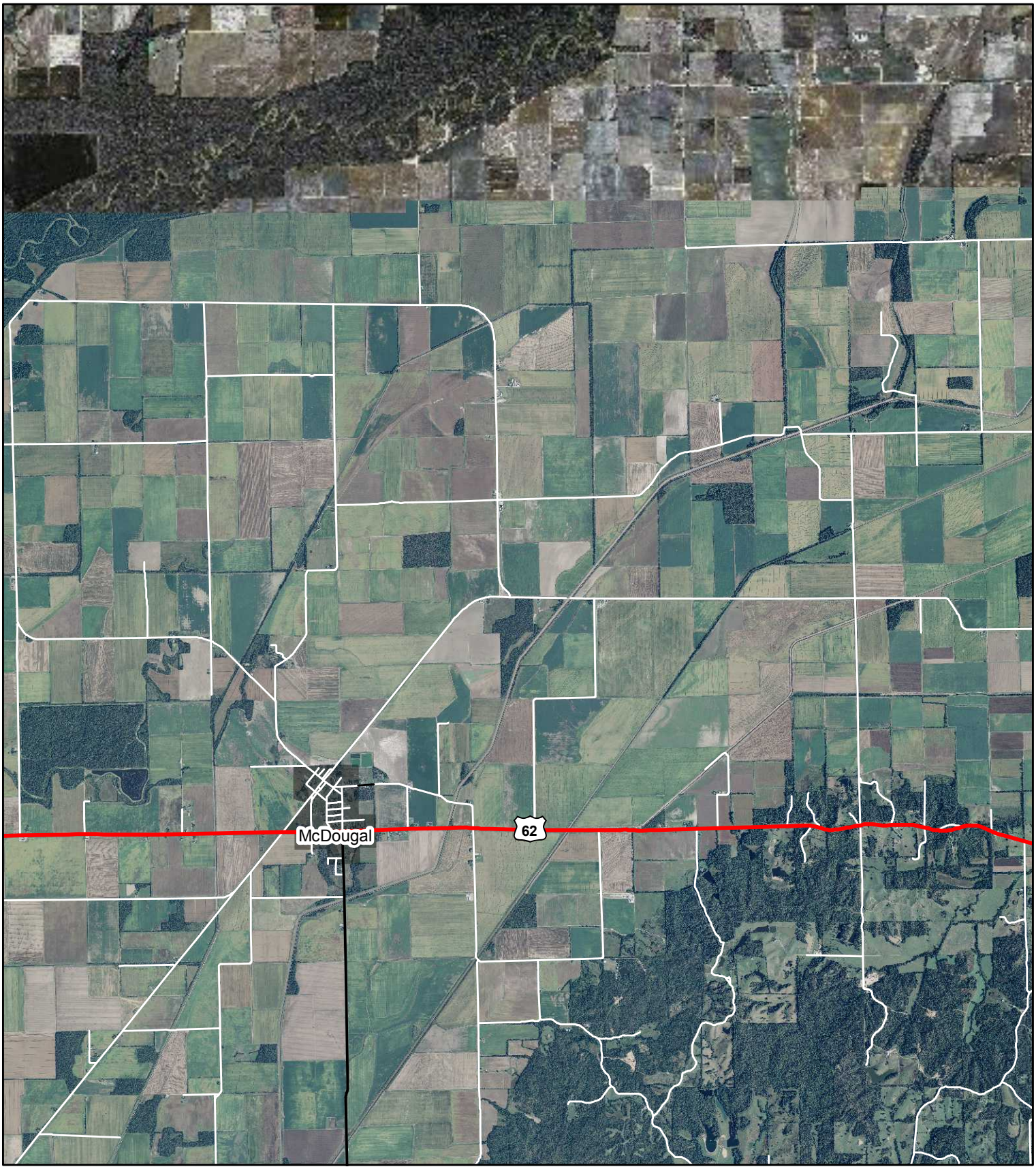

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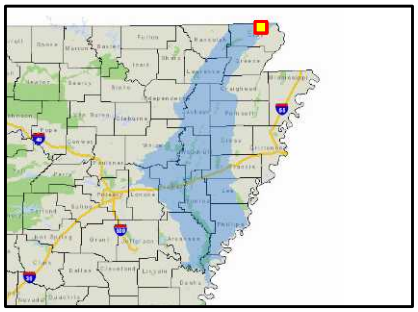

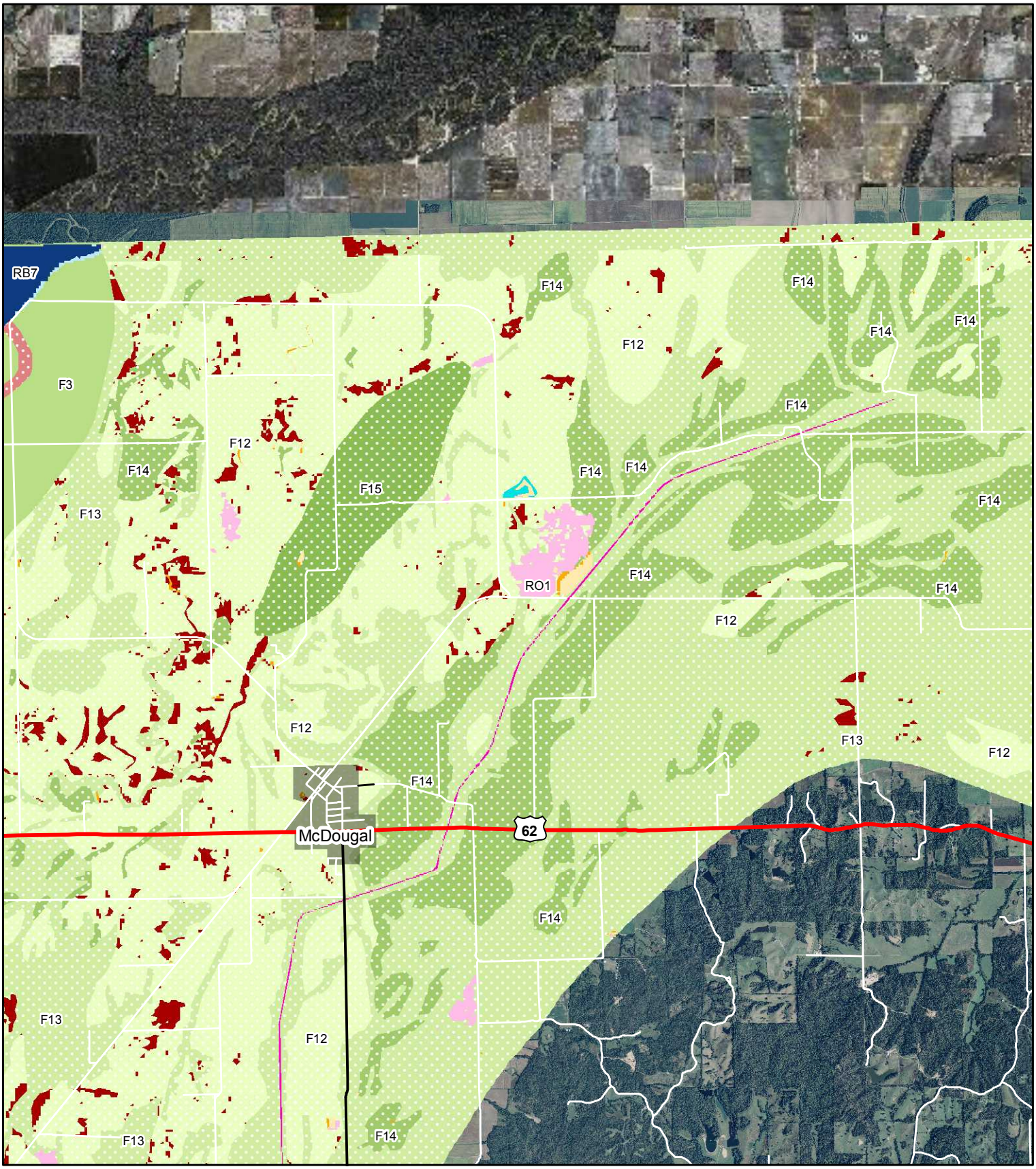

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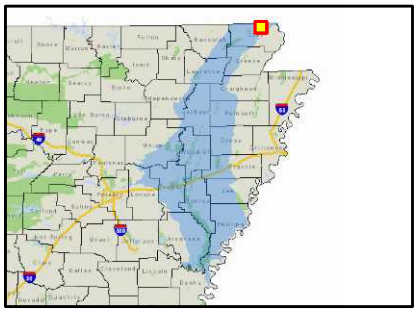
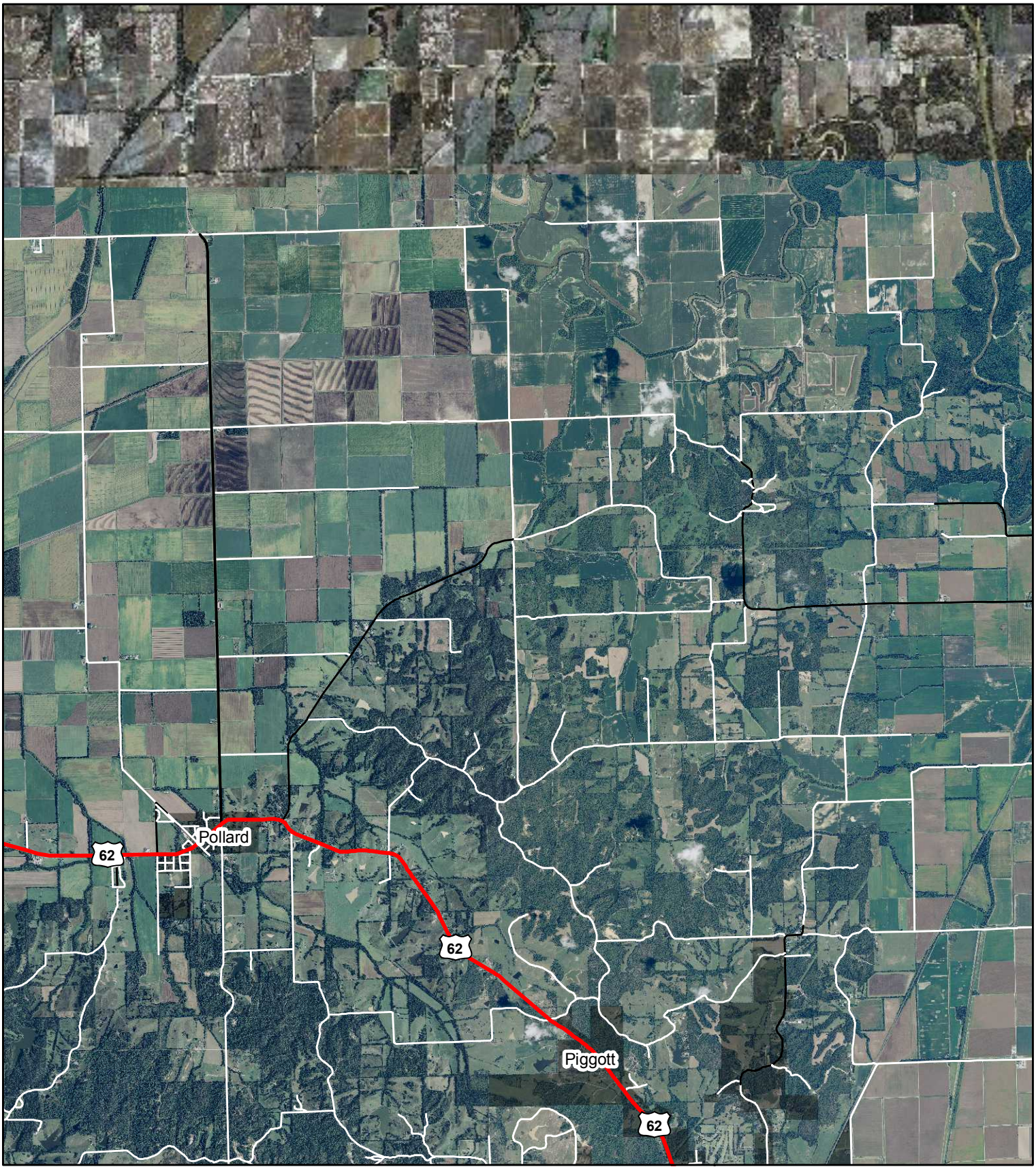




0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

A15

F14
F13
F14
F3
RB1
F14
F14
F14
F12
F14
F14
F13
F14
F14
F14
Pollard
62
RO2
RO2
62
Piggott
62

0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

A15

Hwy 115

115

Hwy 115

115

Hwy 67 N

62

67

Pocahontas

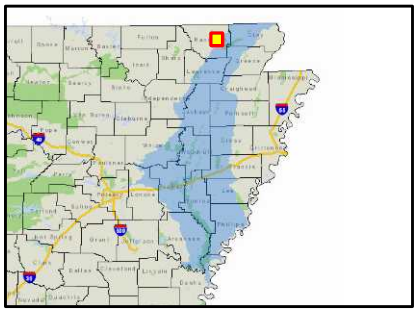
115

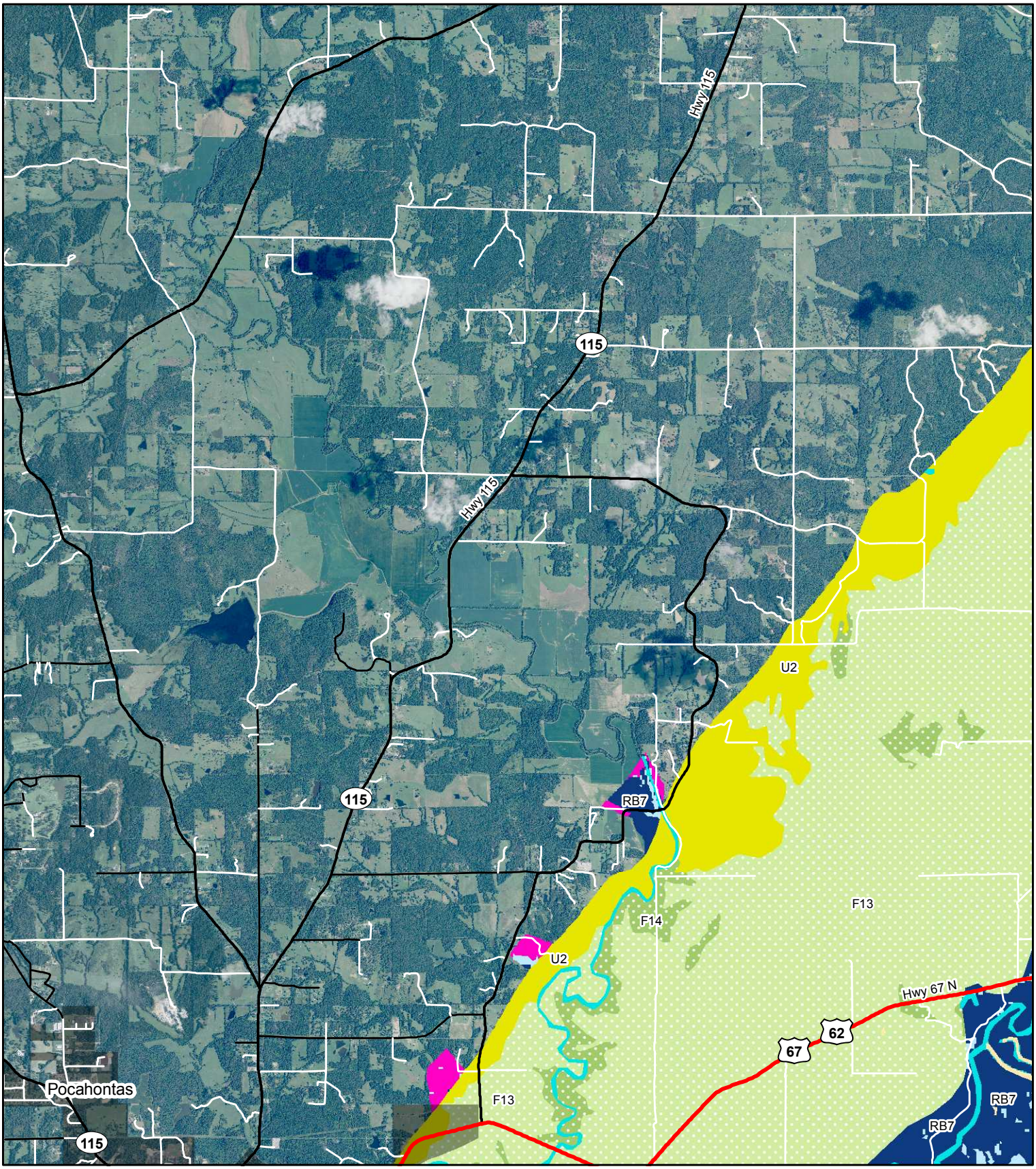
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B10





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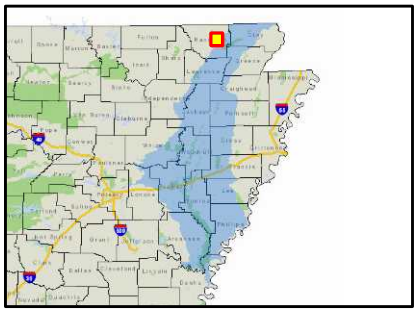
Projection: Transverse Mercator
Datum: North American 1983

B10



0 0.5 1 2 3 4 Miles

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Coordinate System: NAD 1983 UTM Zone 15N
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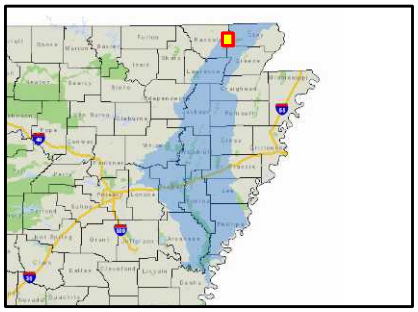
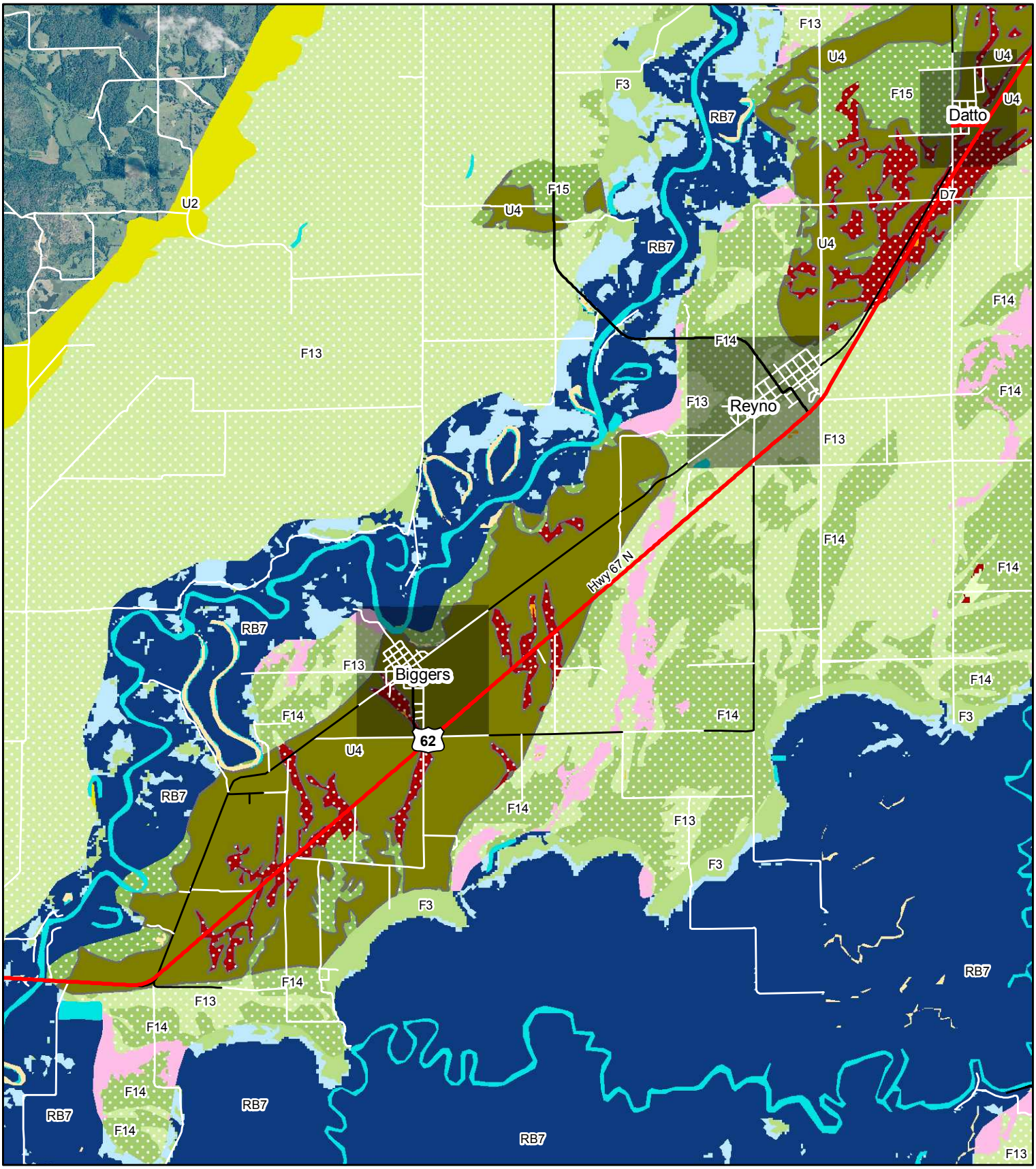
Datum: North American 1983

B11





0 0.5 1 2 3 4 Miles

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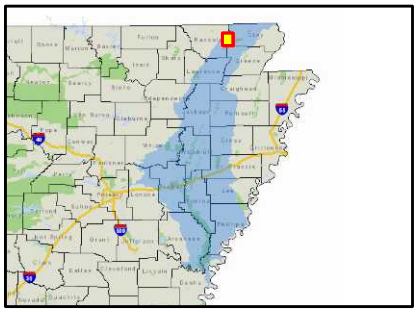
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B11

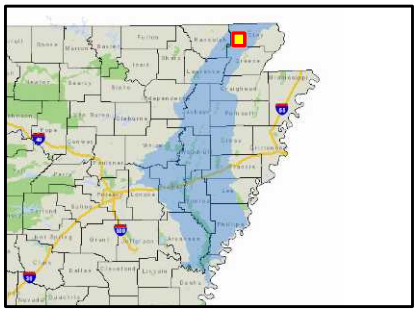


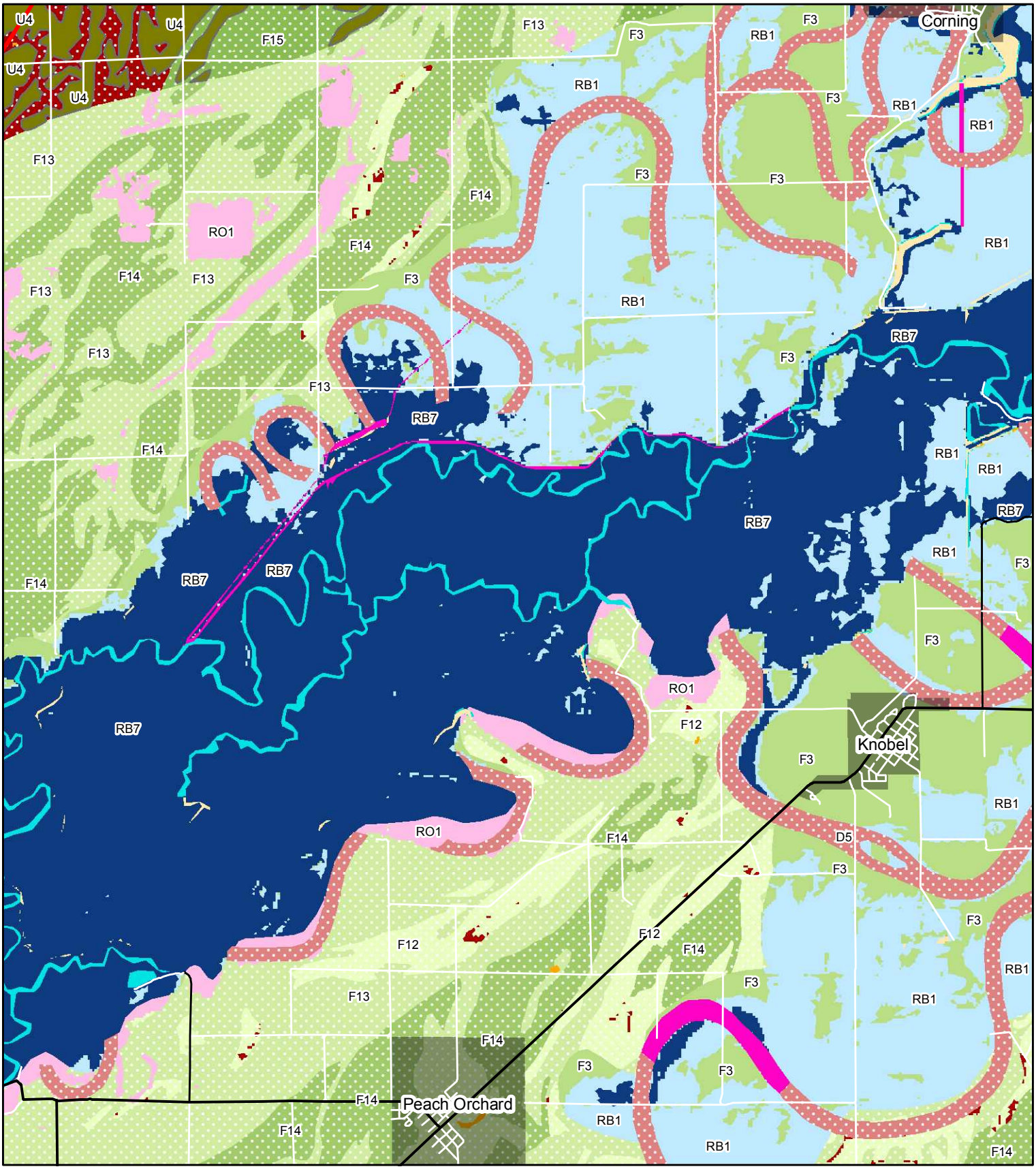
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B12



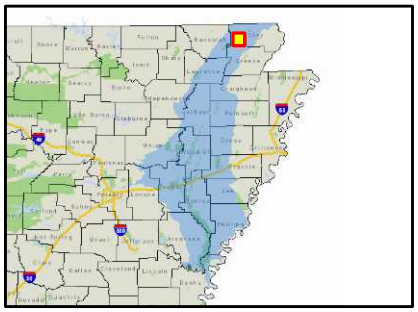


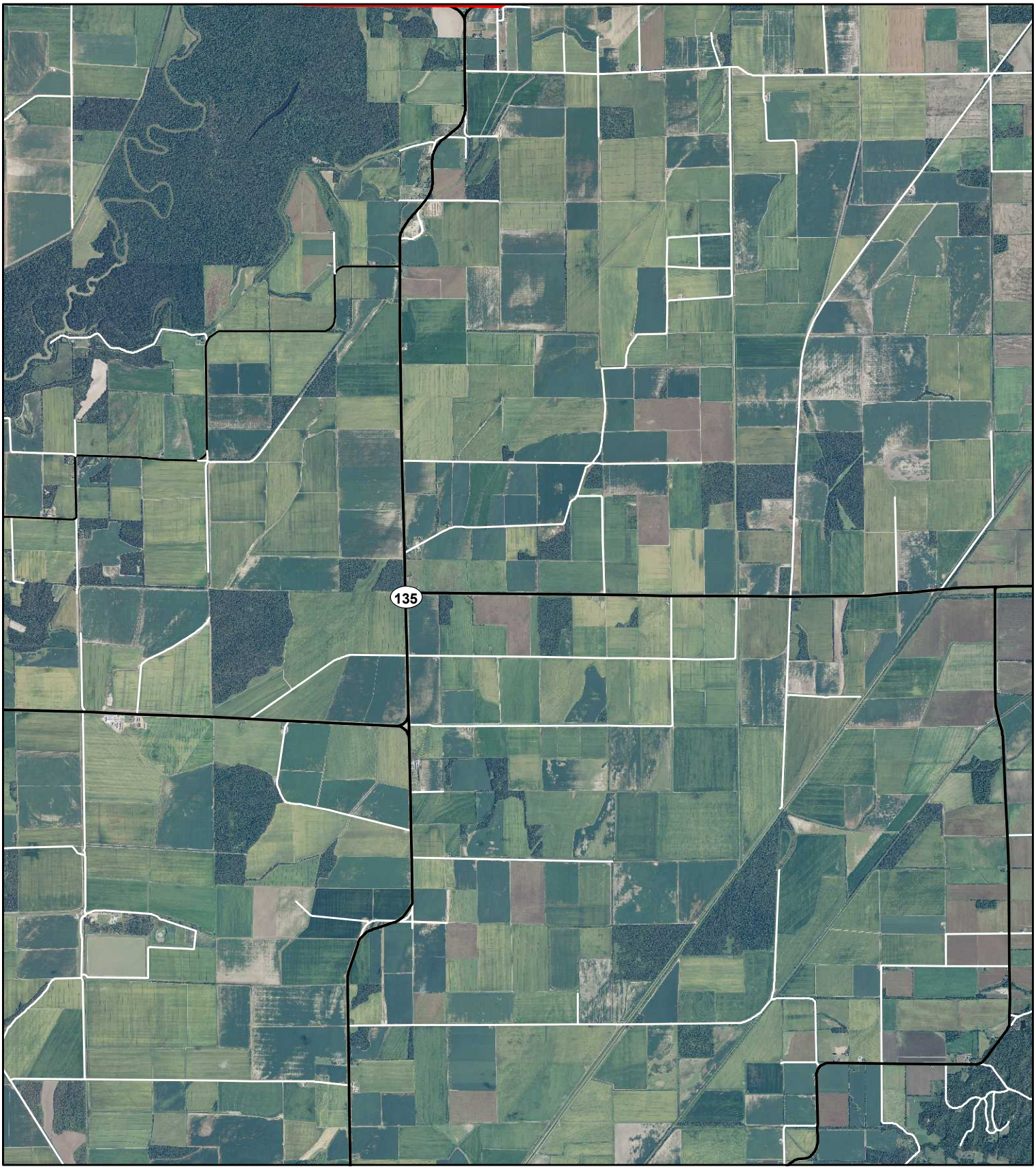
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B12



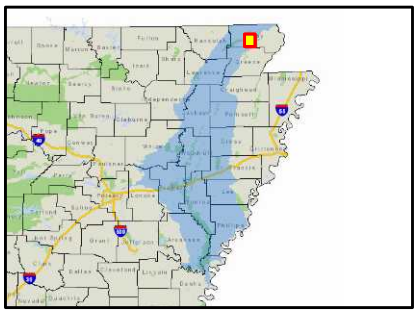


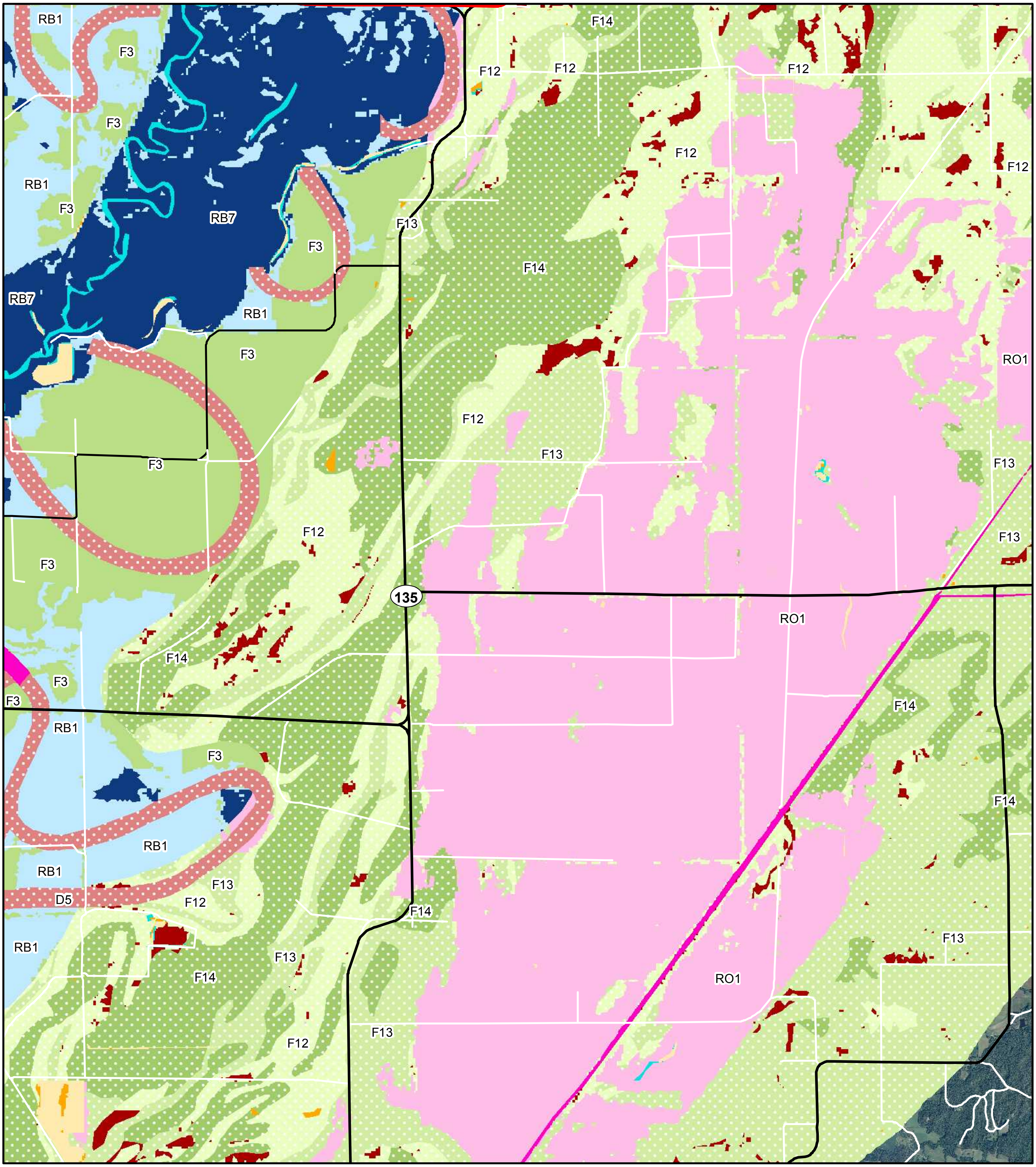
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B13



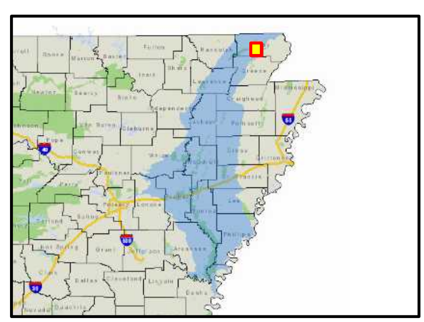


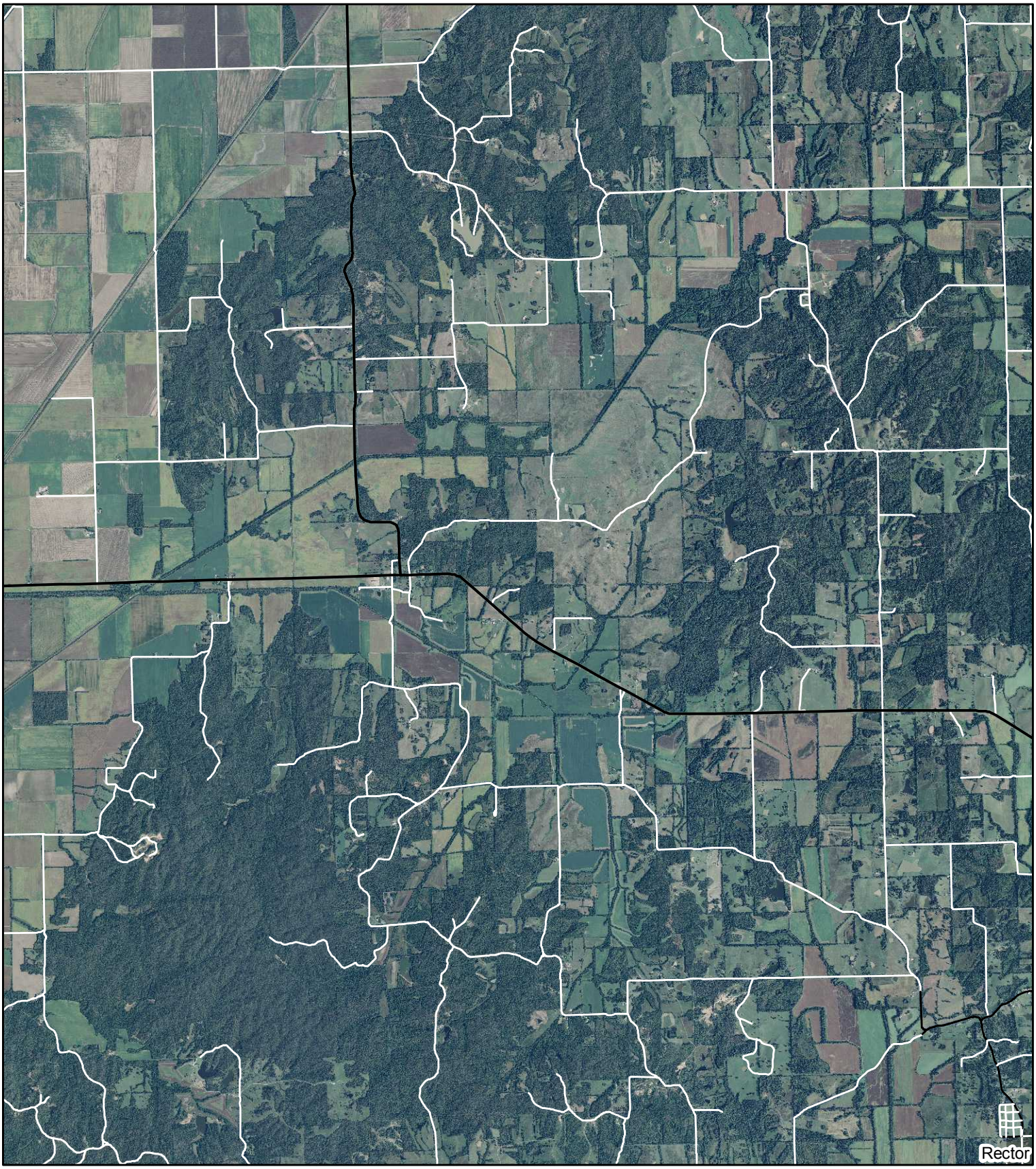
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B13



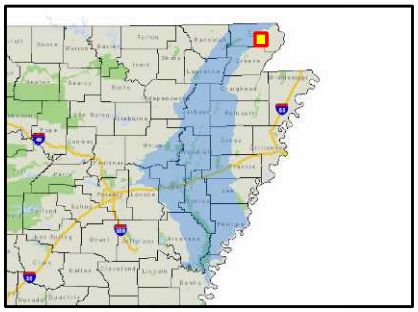


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B14



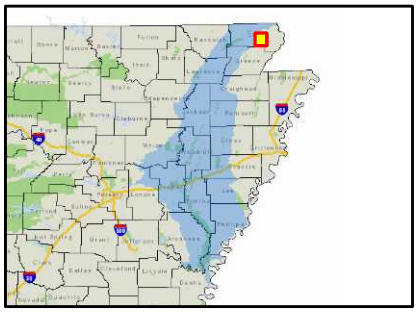
F12
F12
F13
F13
F12
RO1
RO2
F13
F13
Rector

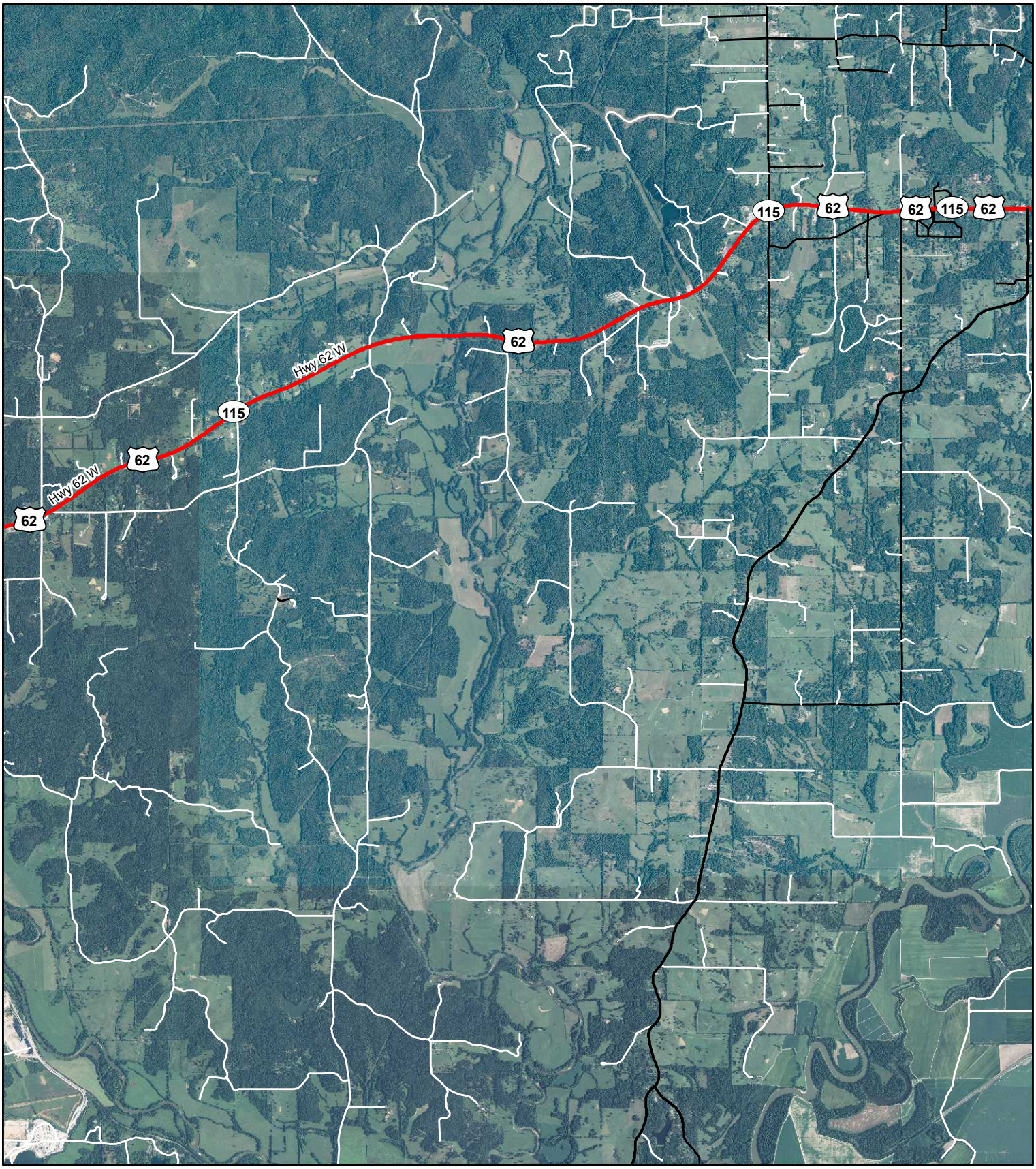
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

B14



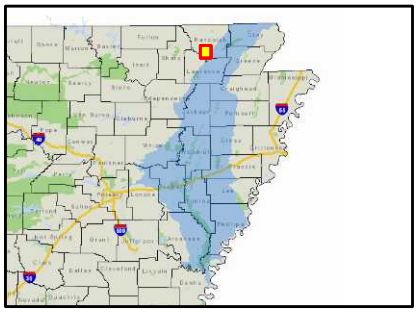


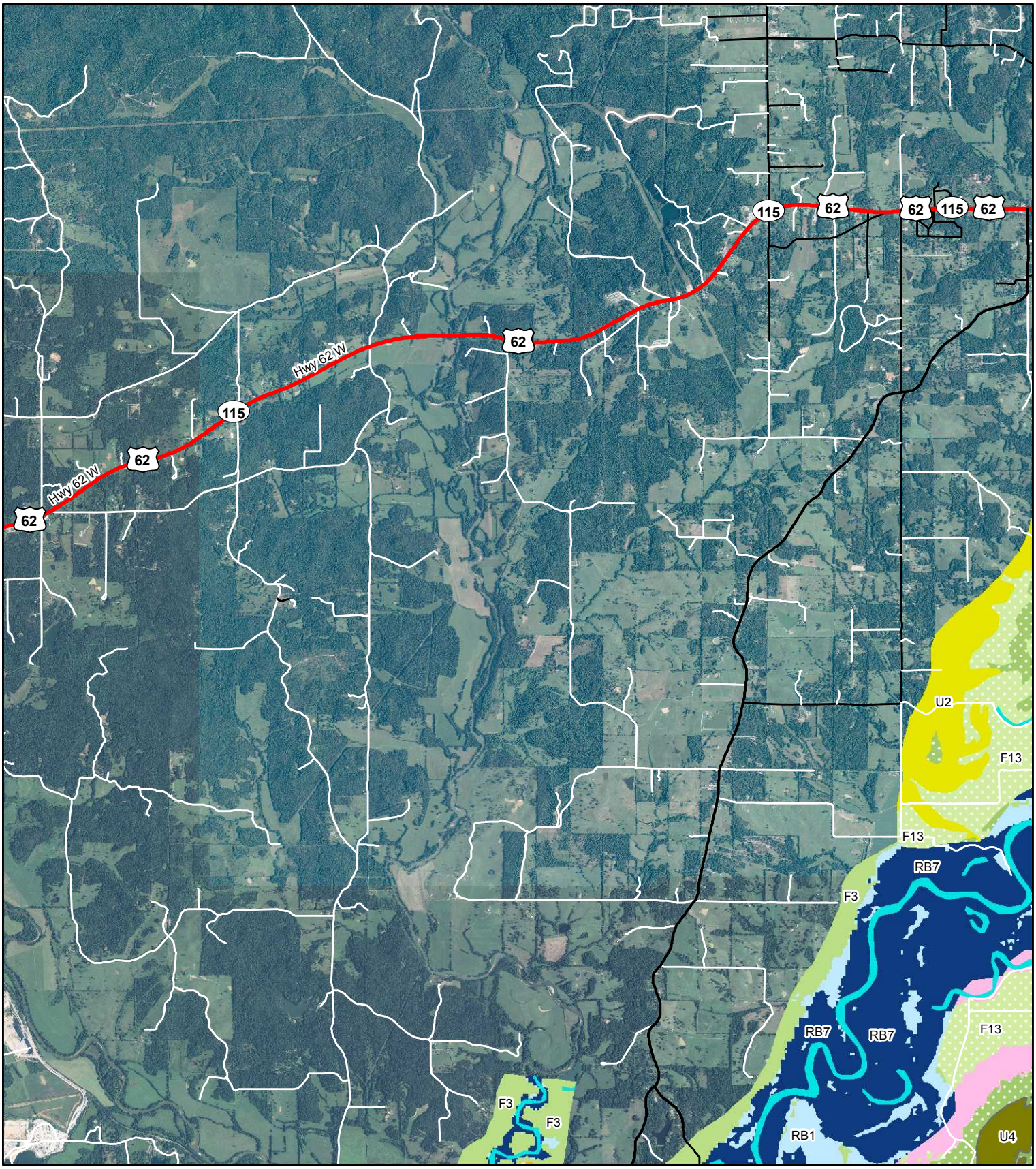
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

C9



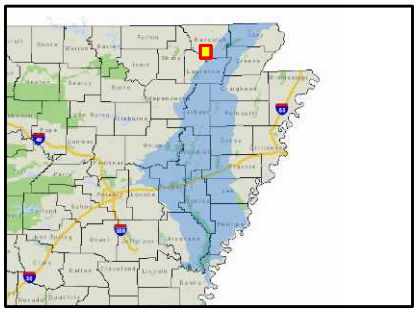


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

C9



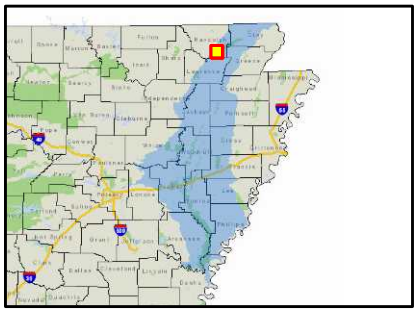
115
115
Hwy 67 N
62
W. Church St
Pocahontas
62
62
62
62
Hwy 67 S
67
90
67
Hwy 67 S
90
Hwy 67 S
Hwy 90 E
67

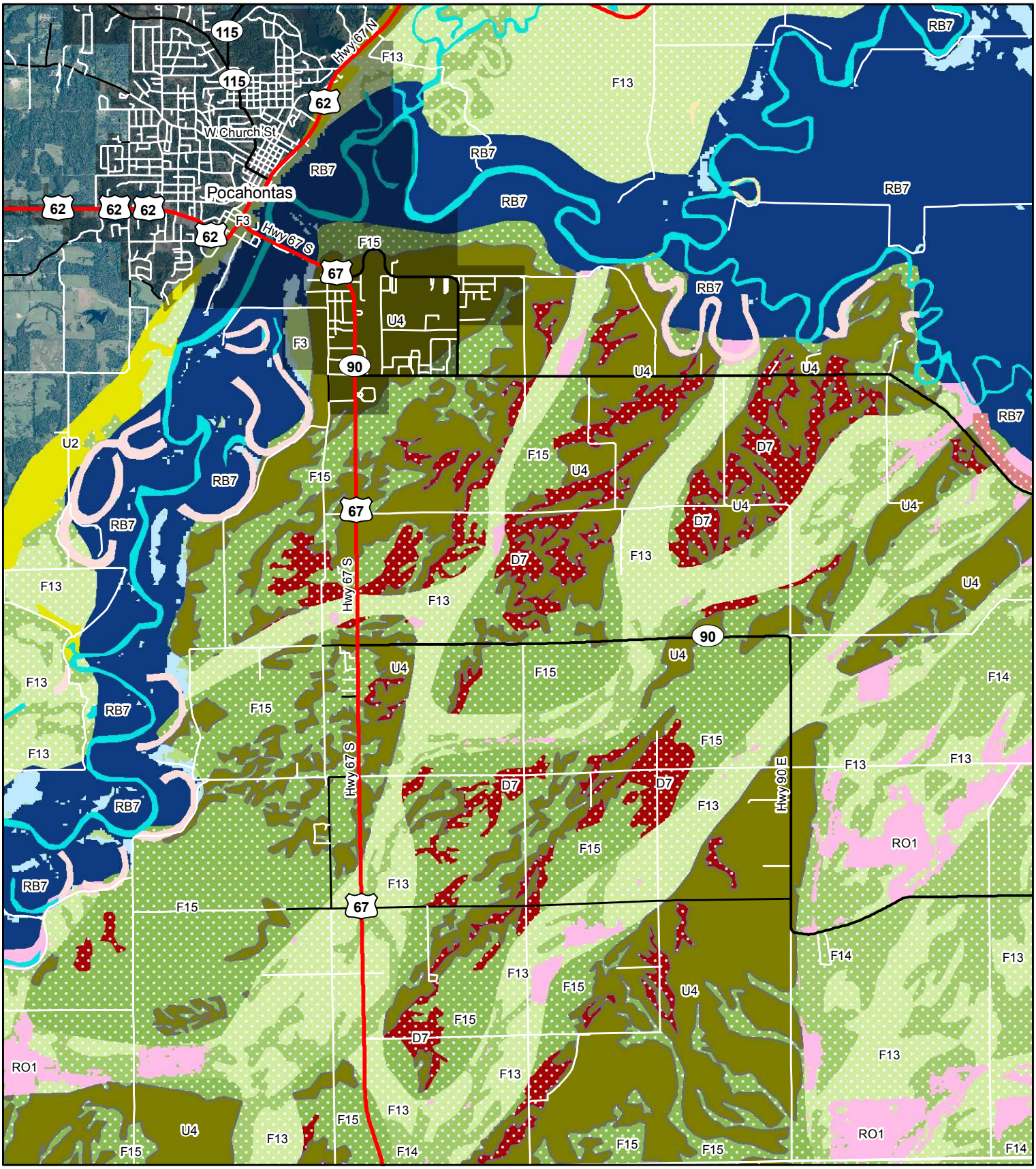
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

C10





0 0.5 1 2 3 4 Miles

N

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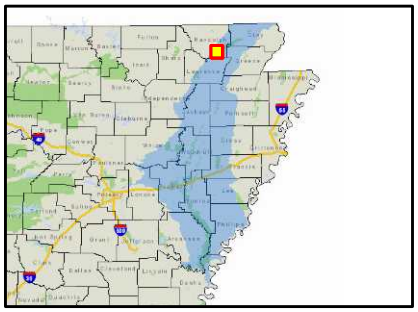
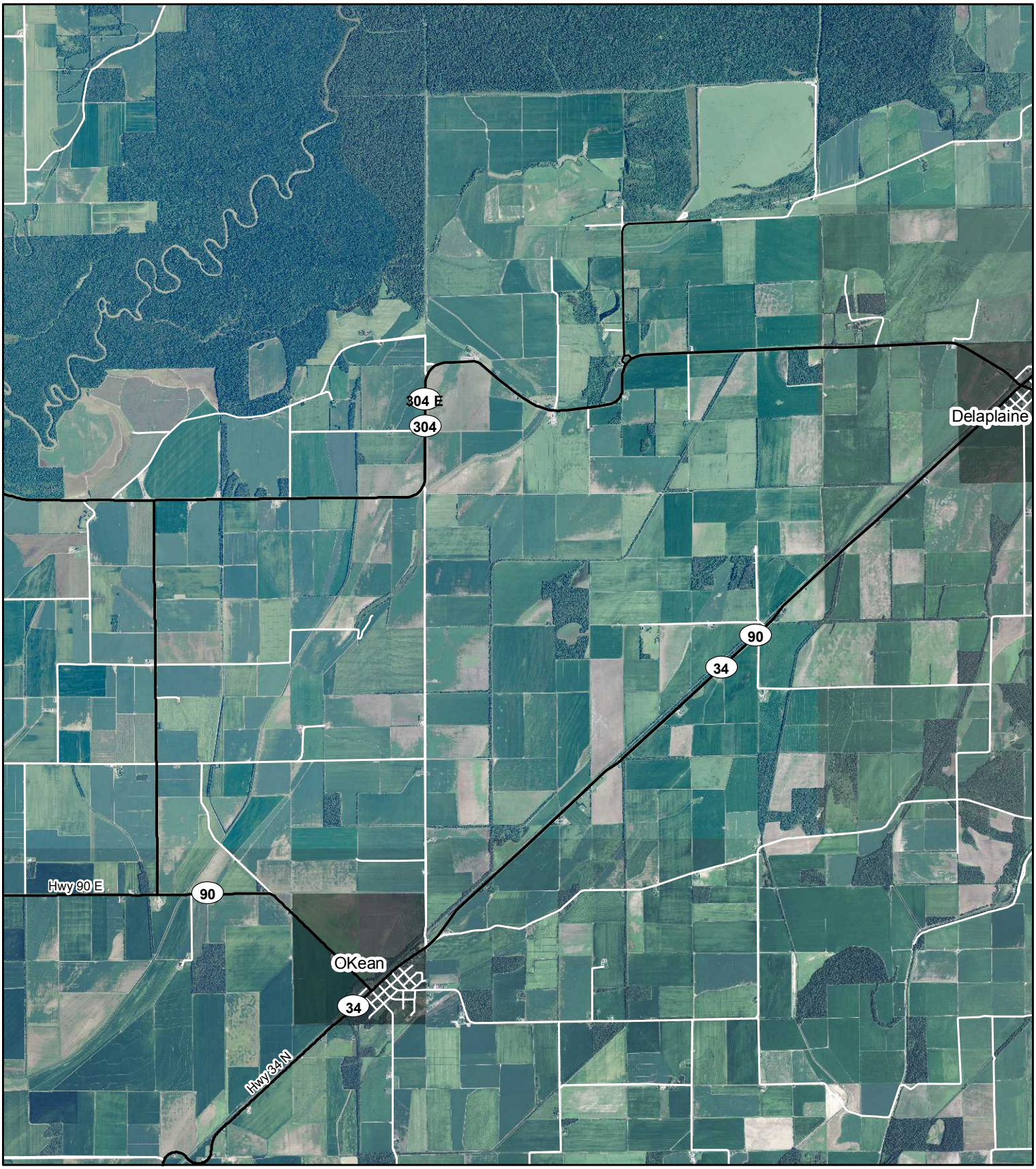
Datum: North American 1983

C10





0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
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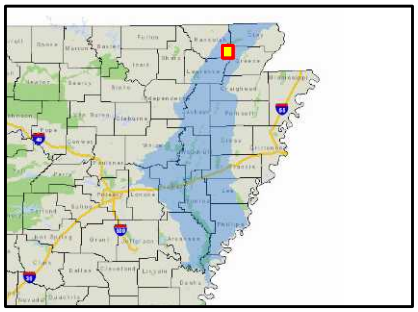
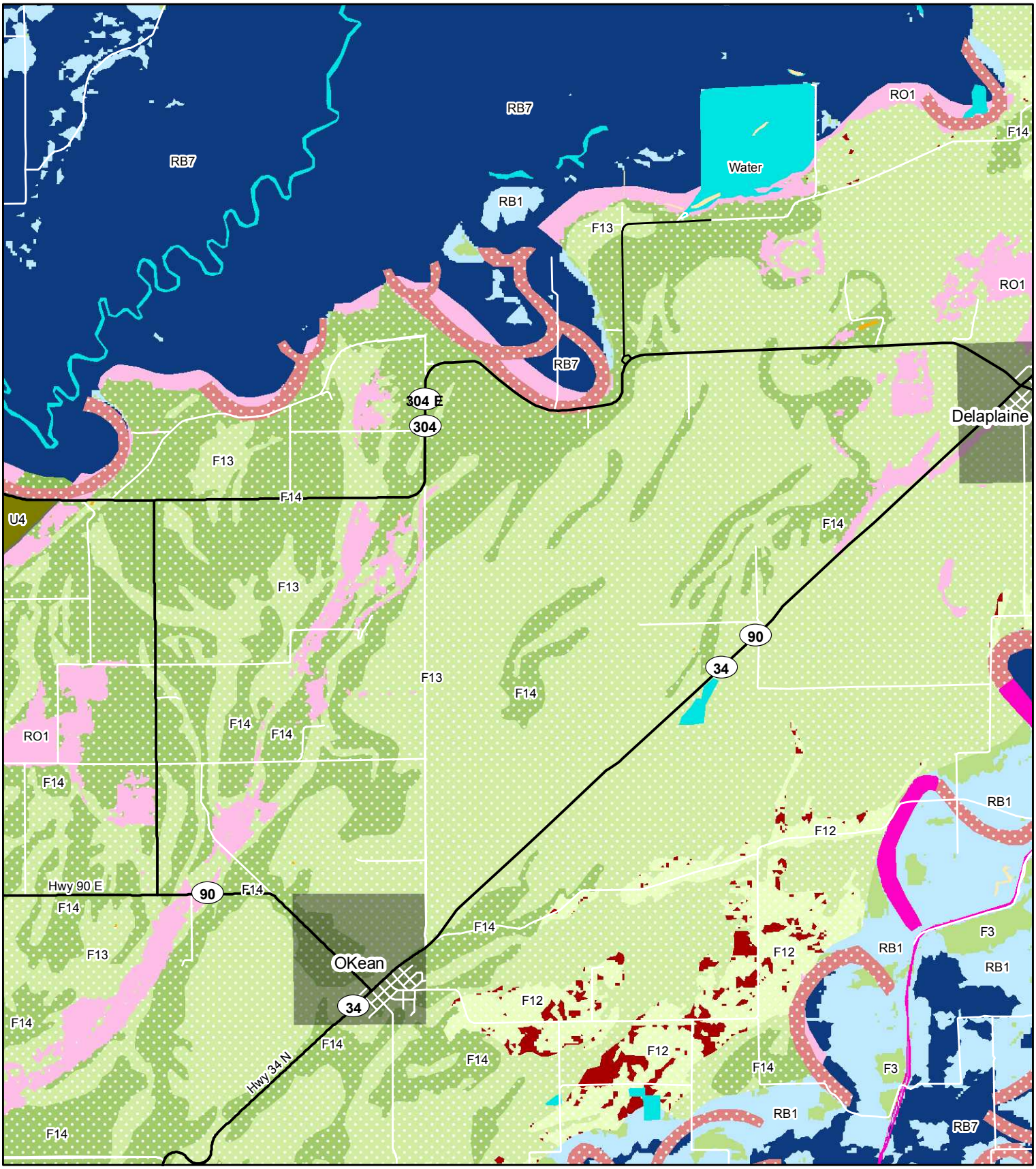
Datum: North American 1983

C11





0 0.5 1 2 3 4 Miles

N

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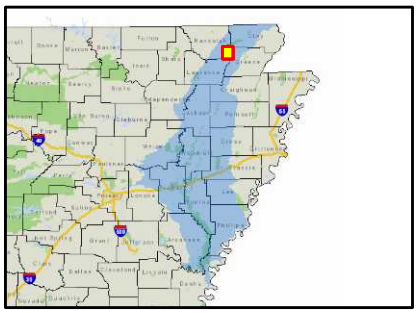
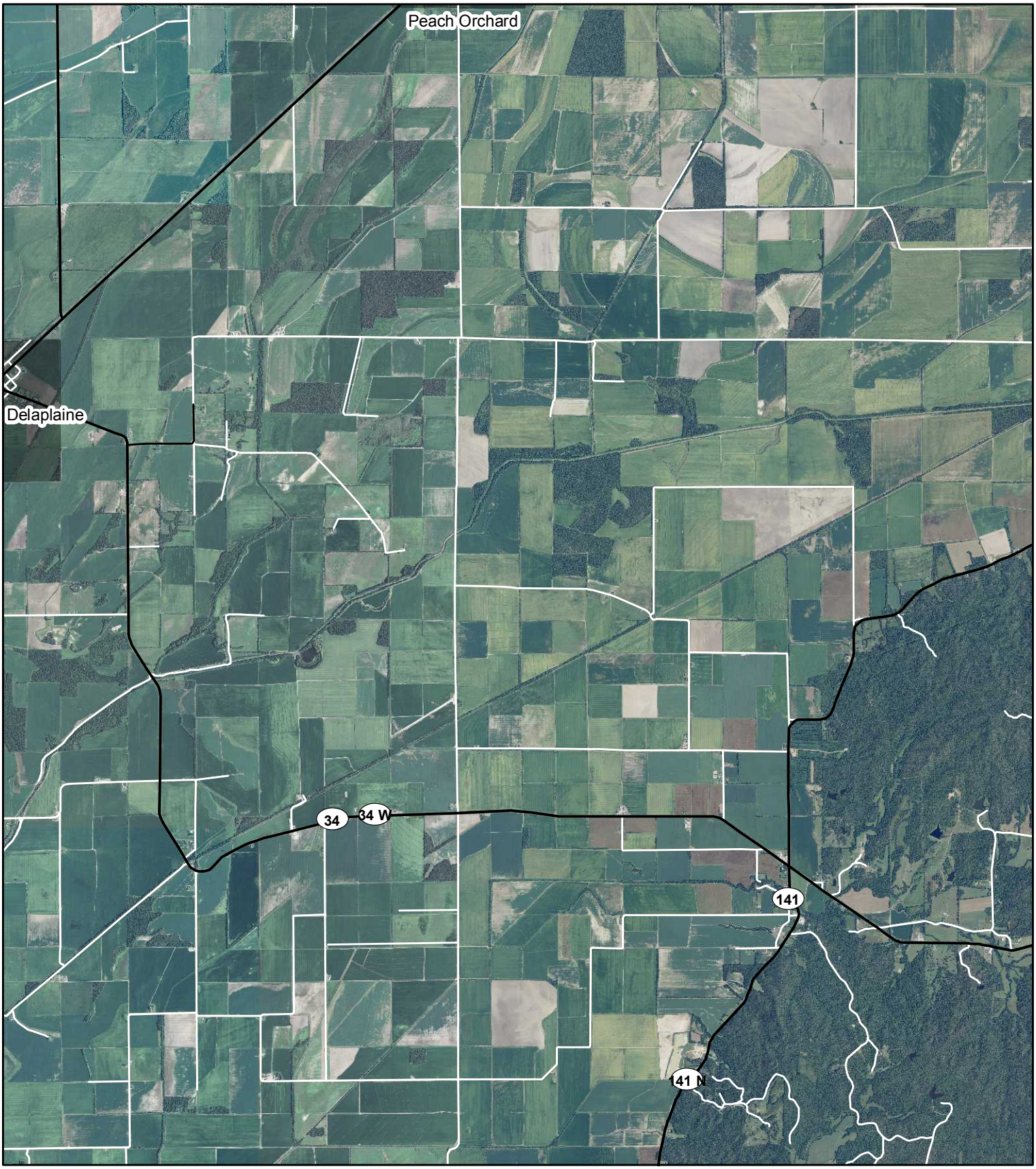
Projection: Transverse Mercator
Datum: North American 1983

C11



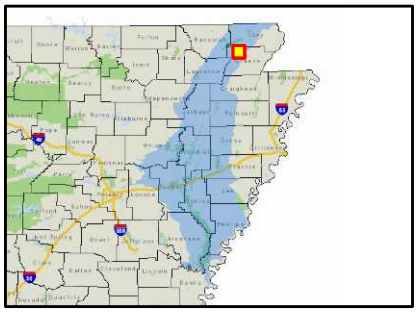


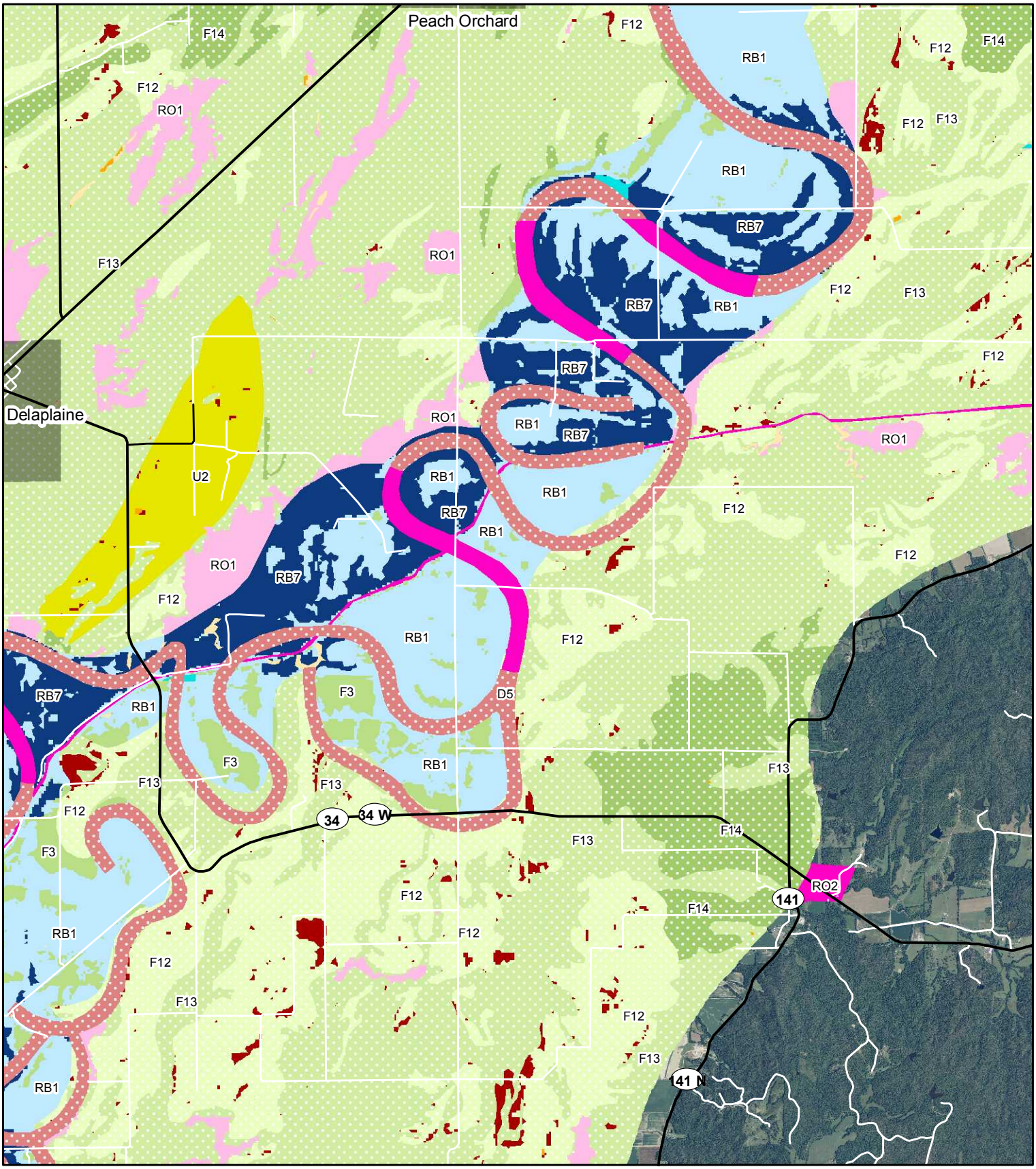
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

C12



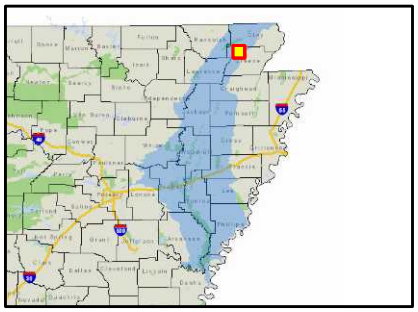


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

C12



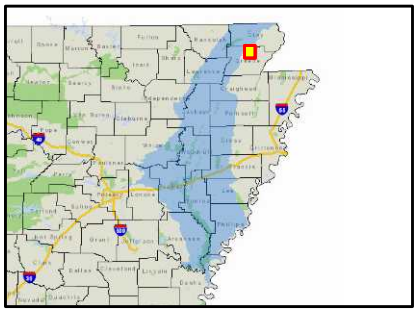
135
141
Lafe
34 E
34 E
34
135
Hwy 135 N
34
34 W
Oak Grove Heights

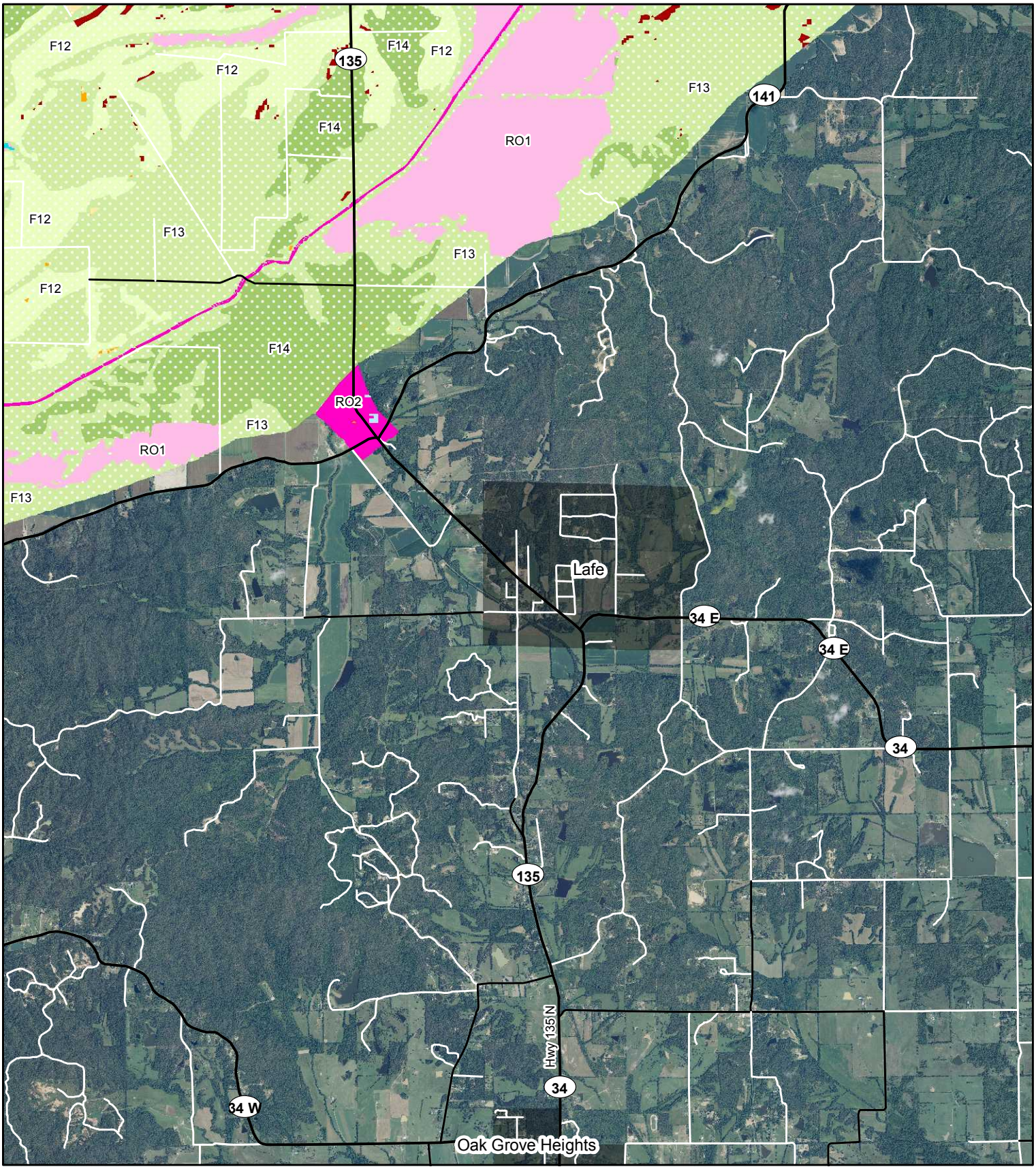
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

C13





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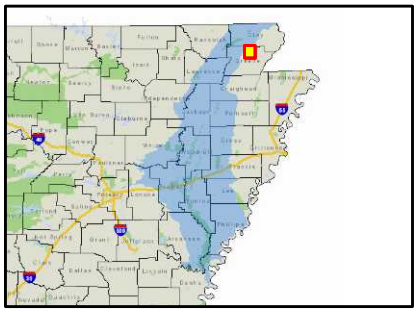
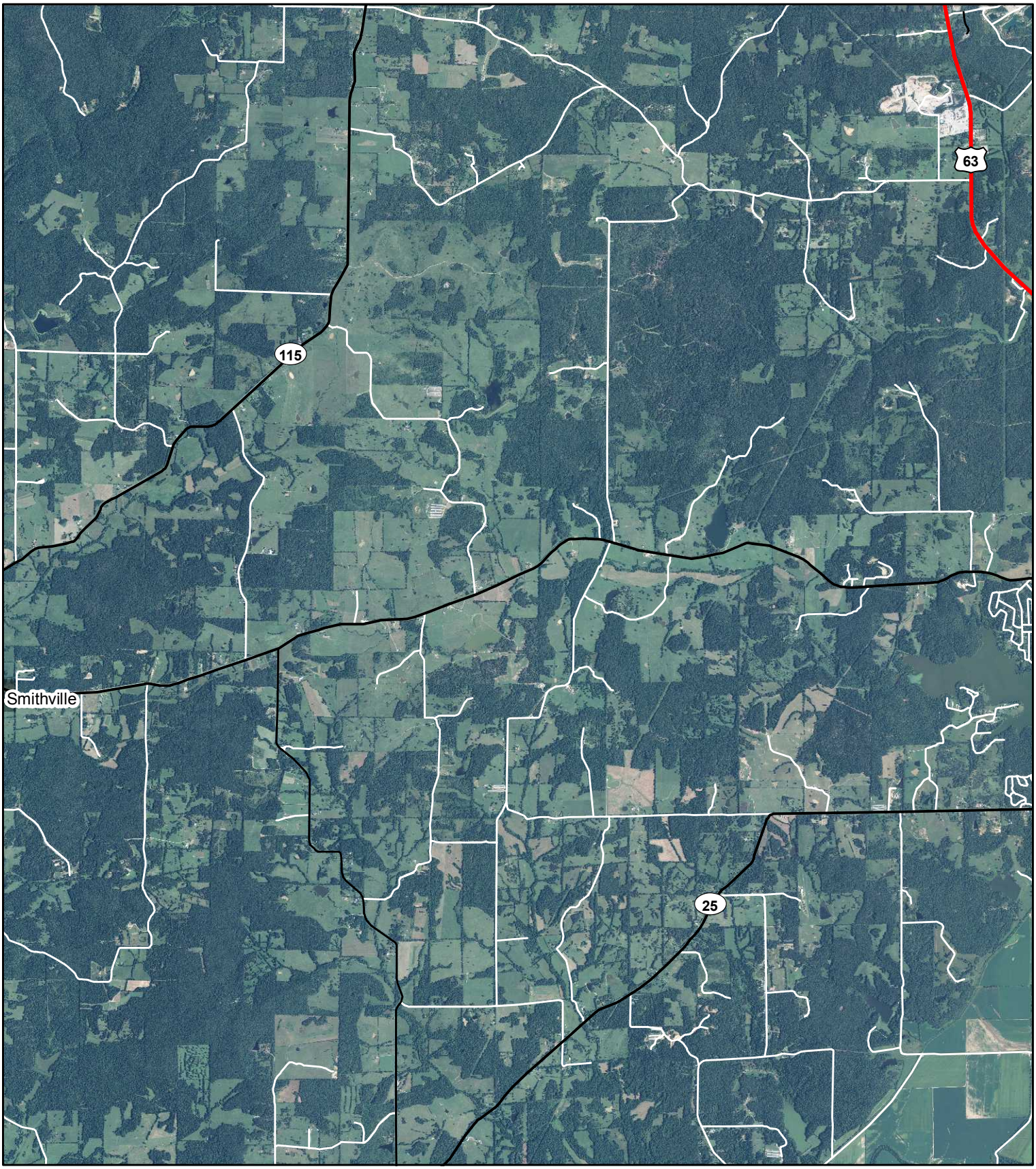
Datum: North American 1983

C13



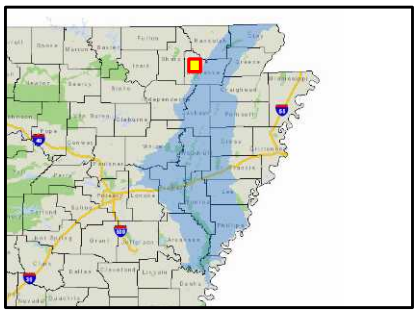


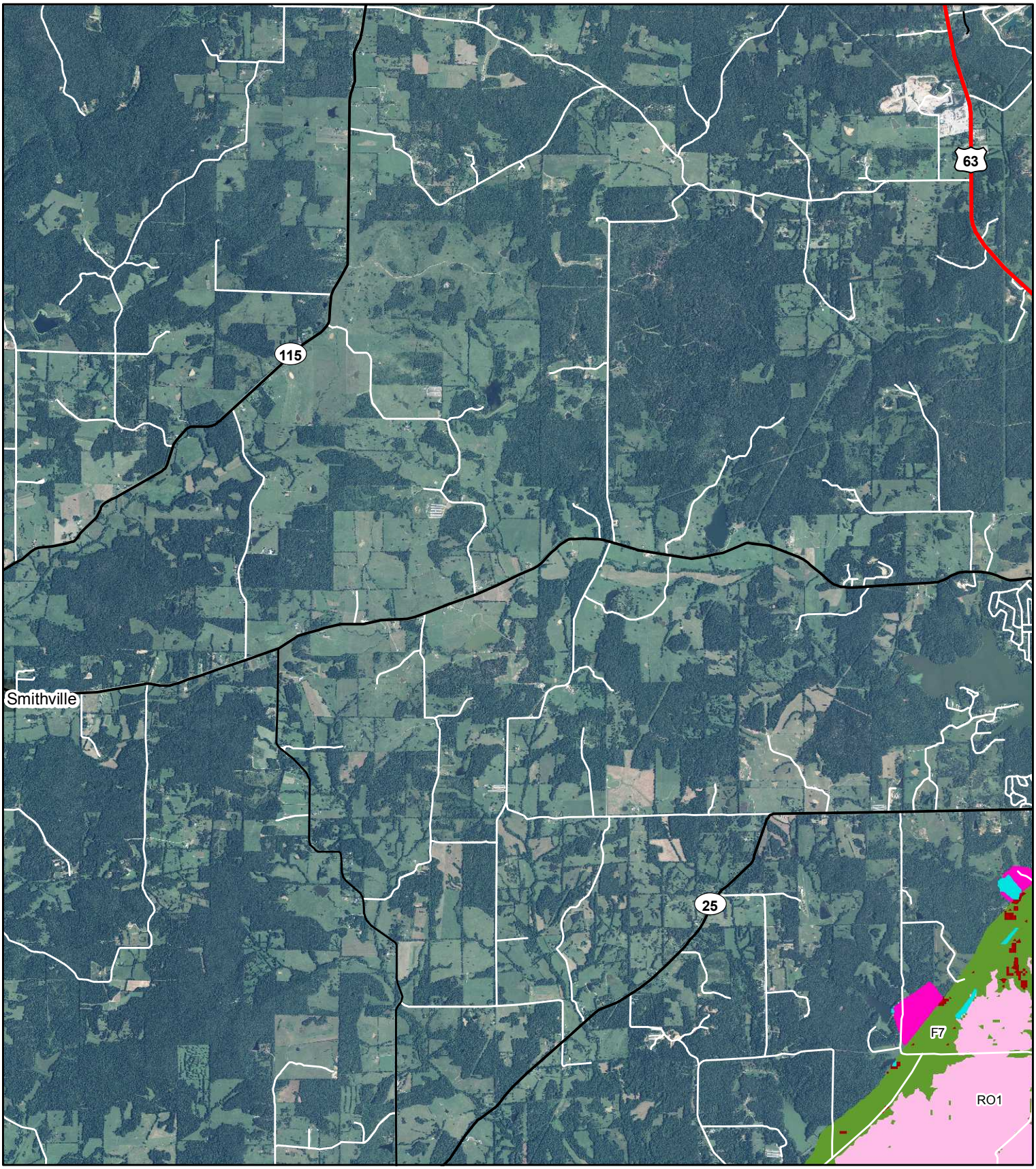
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D8





0 0.5 1 2 3 4 Miles

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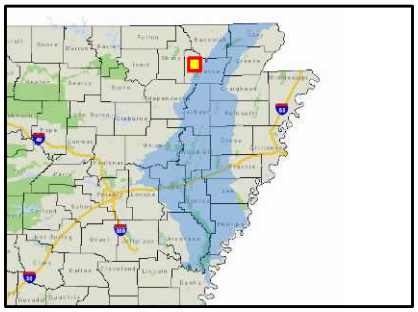
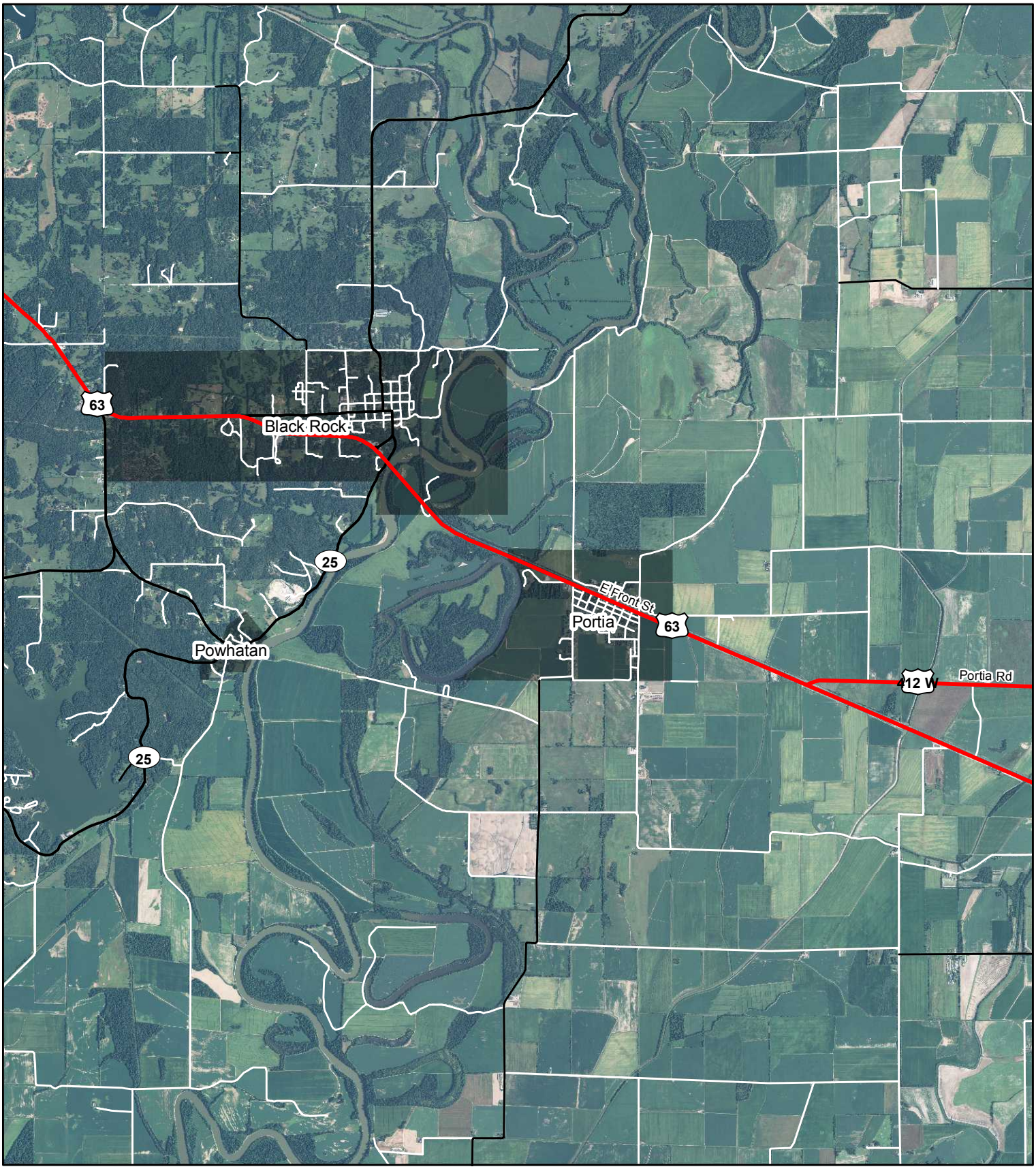
Projection: Transverse Mercator
Datum: North American 1983

D8



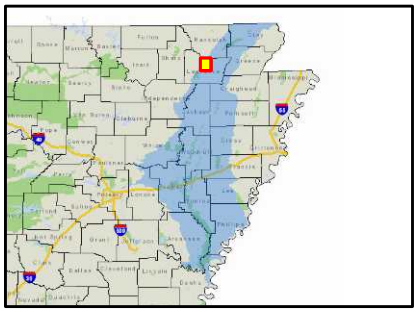


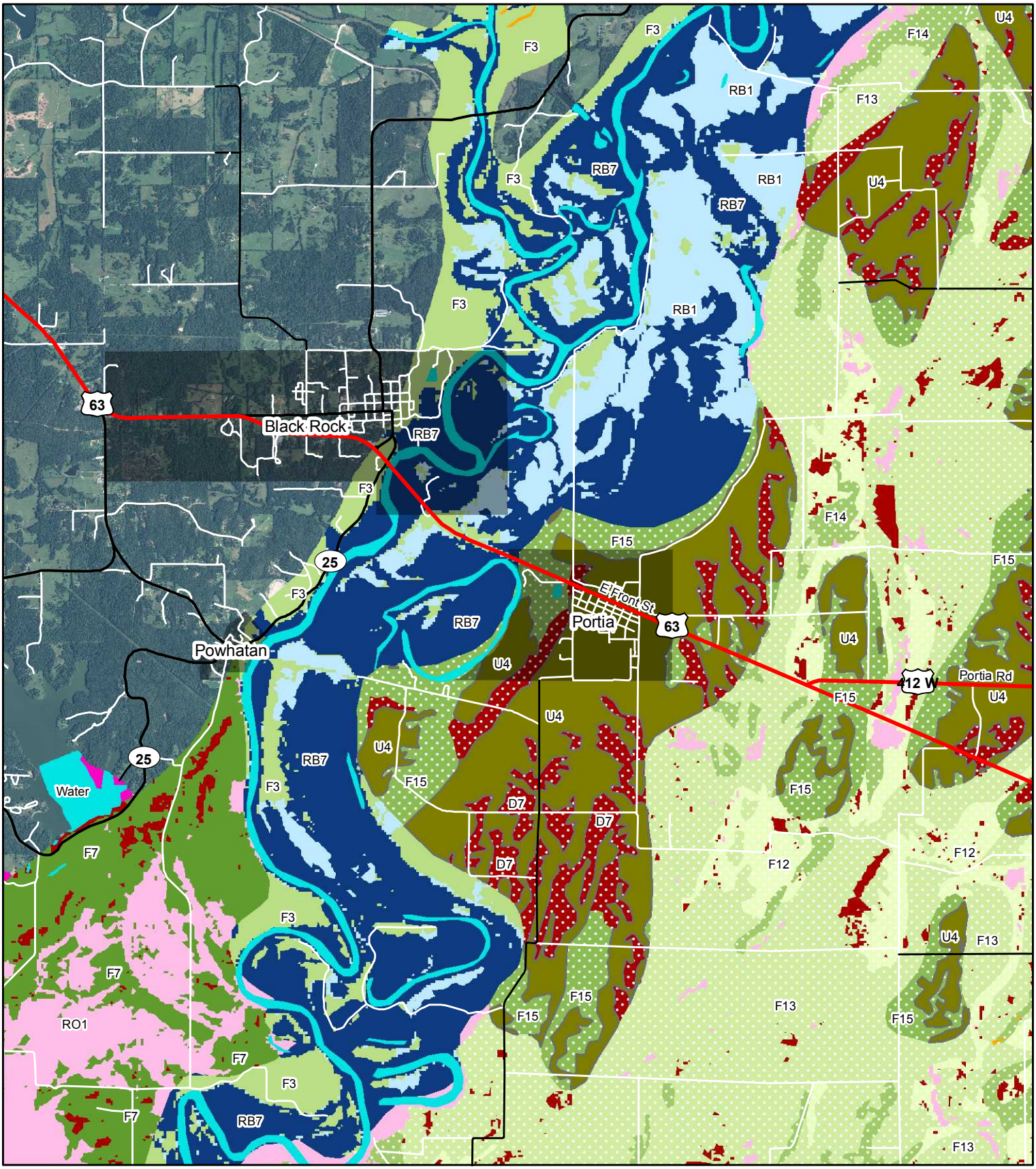
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D9



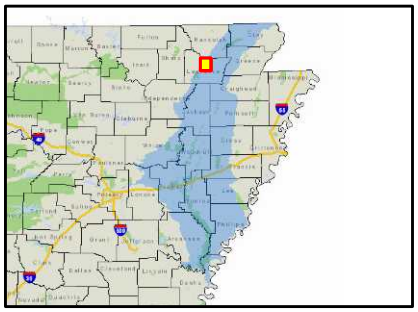


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D9



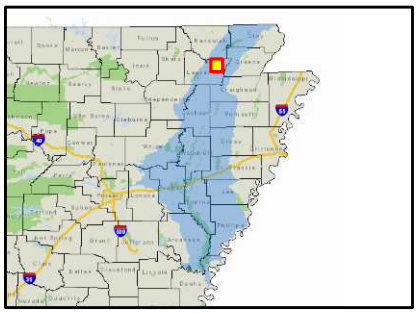
College City
67 N
67
Holloway Rd
Walnut Ridge
Portia Rd
412 W
W Main St
NW 4th St
412
SW Front St
E Main St
63
Hwy 63 B N
63
67 S
Hartigan Rd
91
Hwy 63 B S
Hoxie
63 Bus
63 Byp
63 Byp
67 S
67

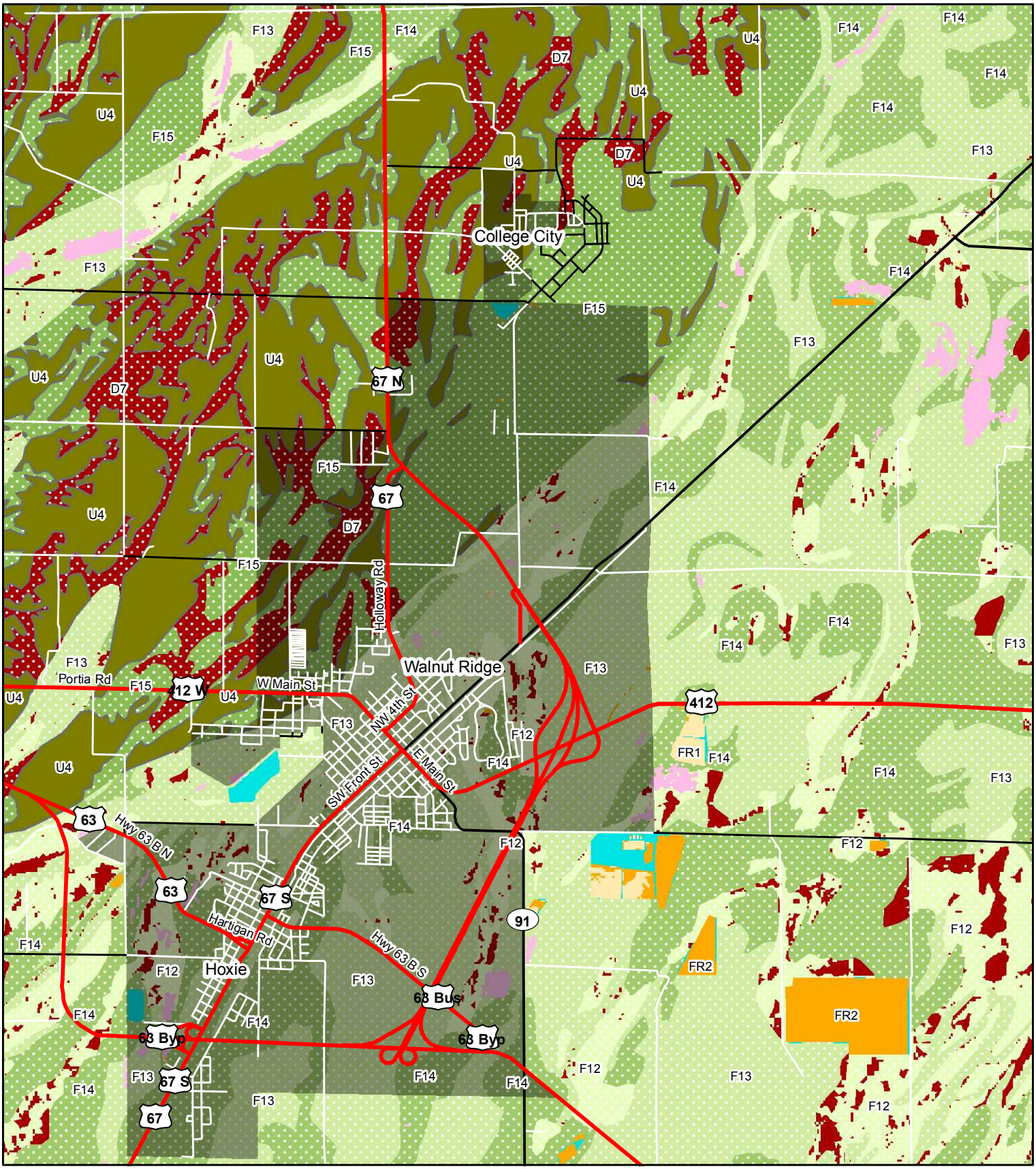
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D10



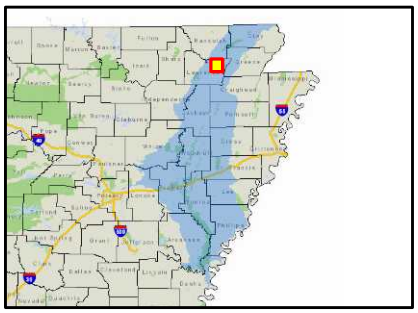


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D10

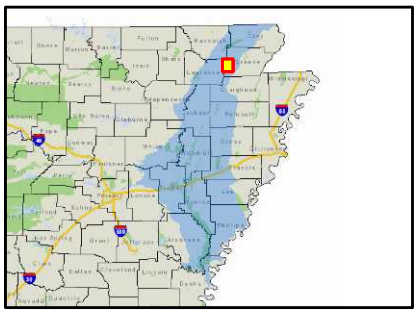


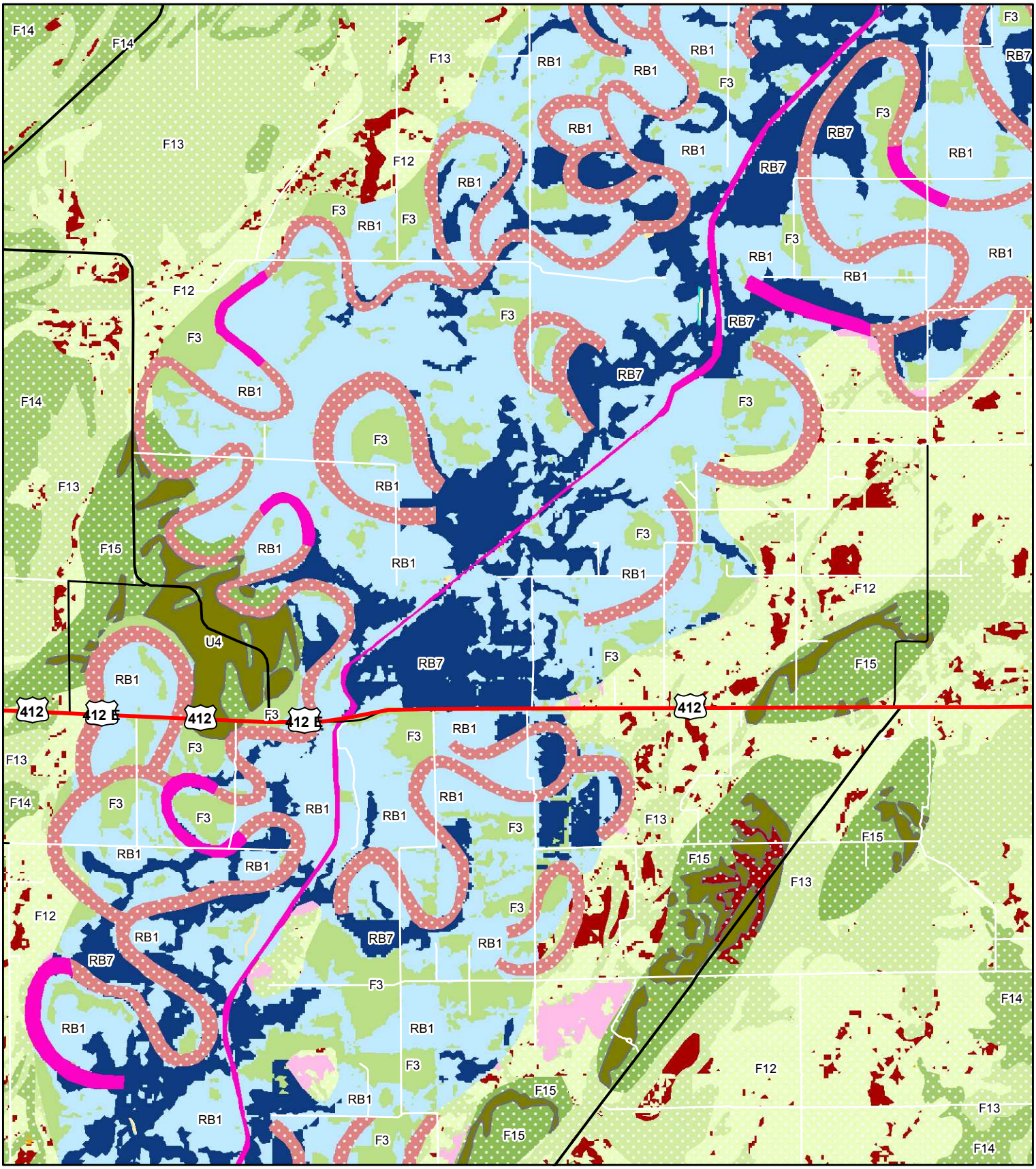
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D11





0 0.5 1 2 3 4 Miles

N

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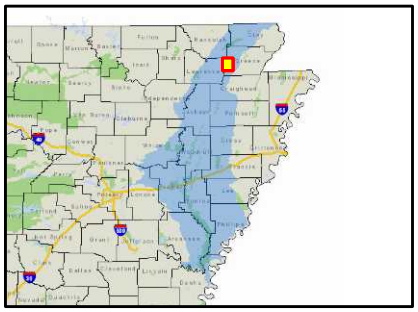
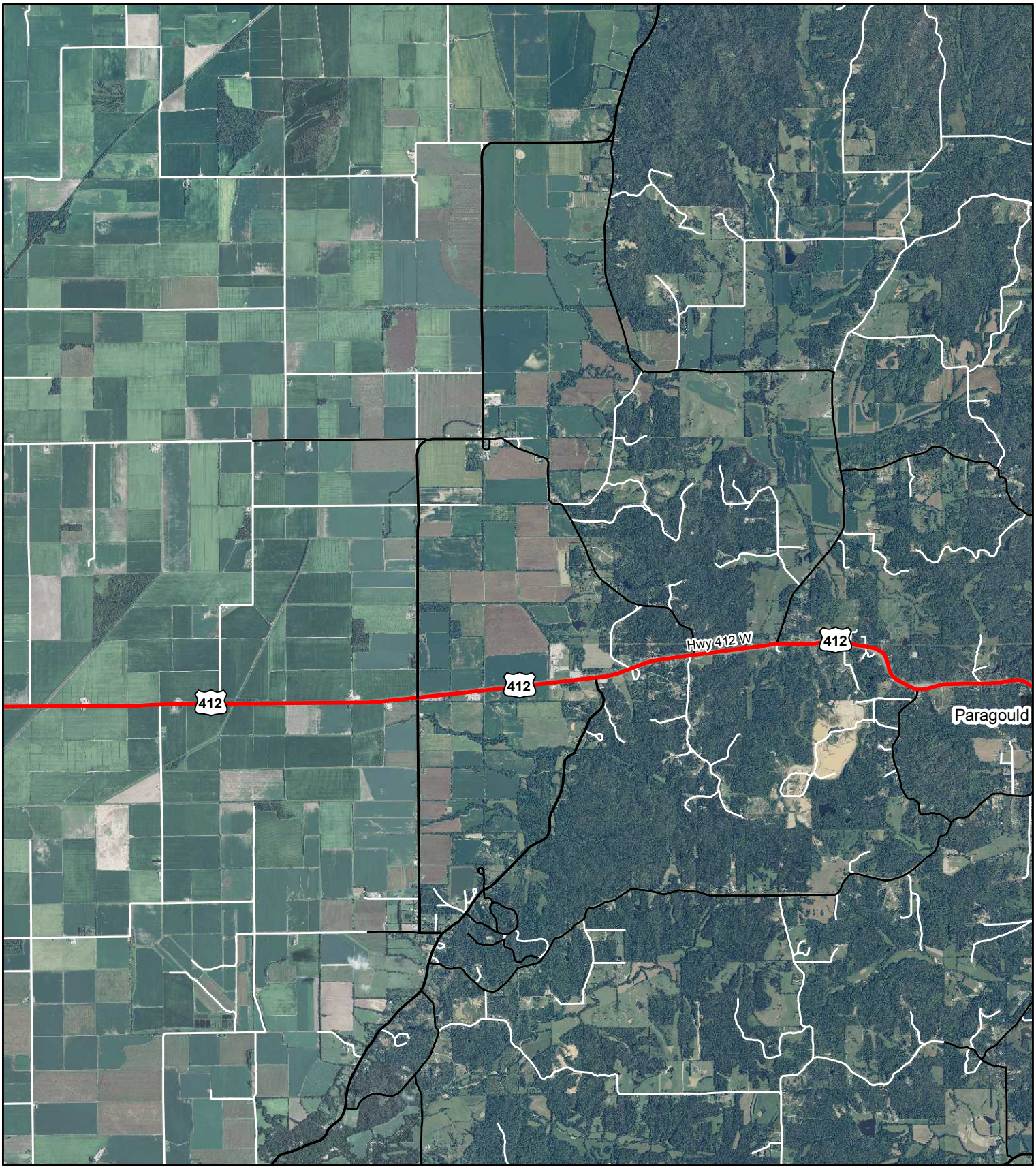
Projection: Transverse Mercator
Datum: North American 1983

D11



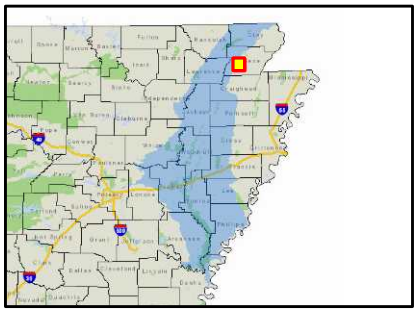


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D12



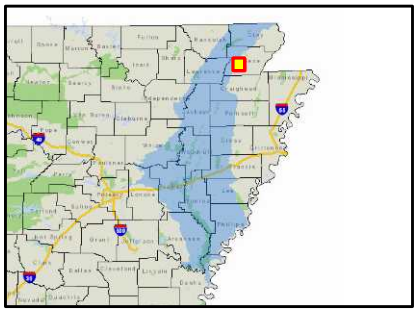
RB1
F3
RB1
F13
F12
F13
F12
RO2
F13
F14
F12
F12
F13
F12
Hwy 412 W
412
412
412
Paragould
F13
F14
U2
F12
F14
F13
F14
RO2

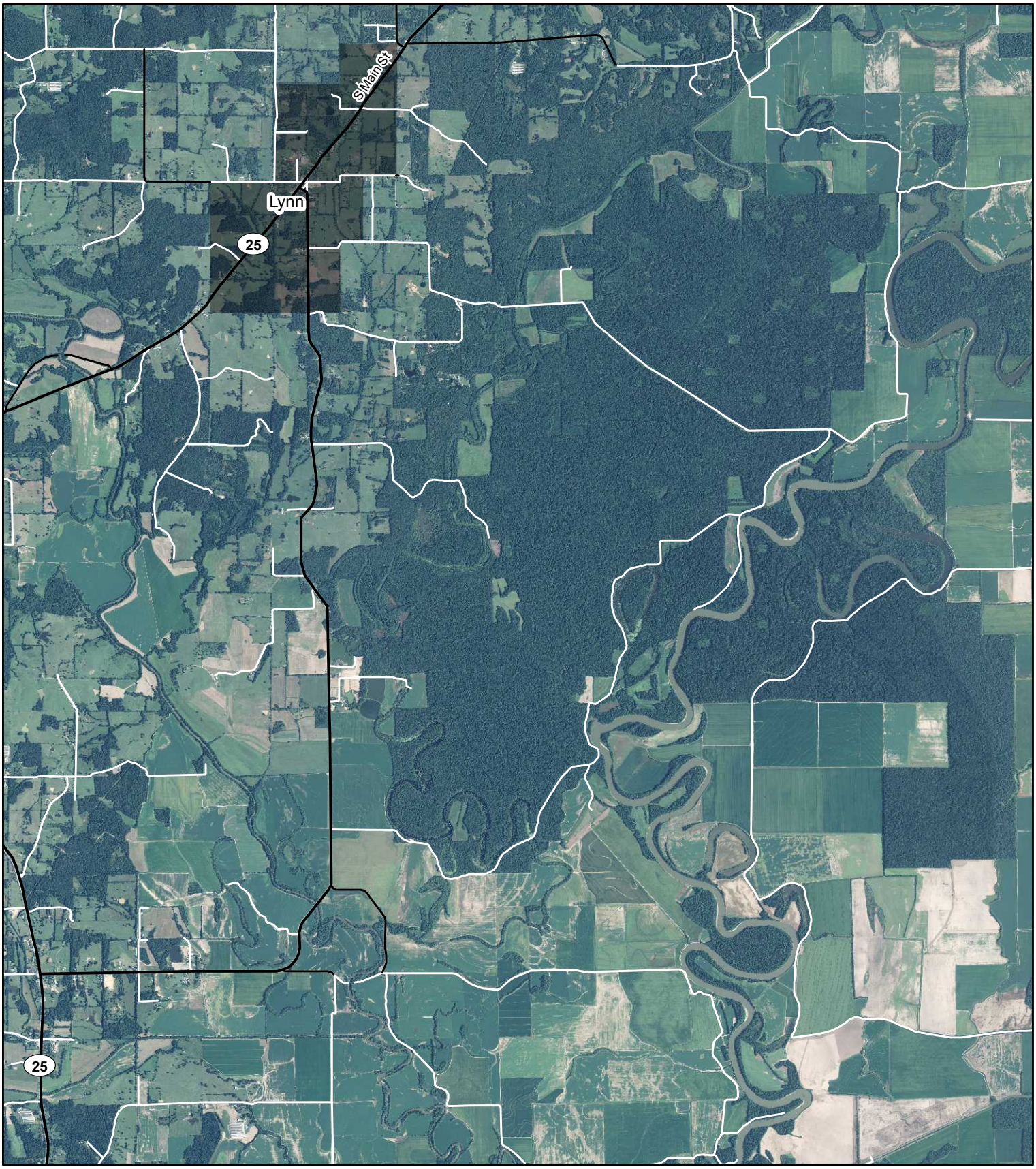
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

D12



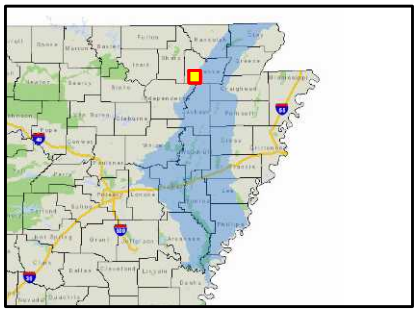


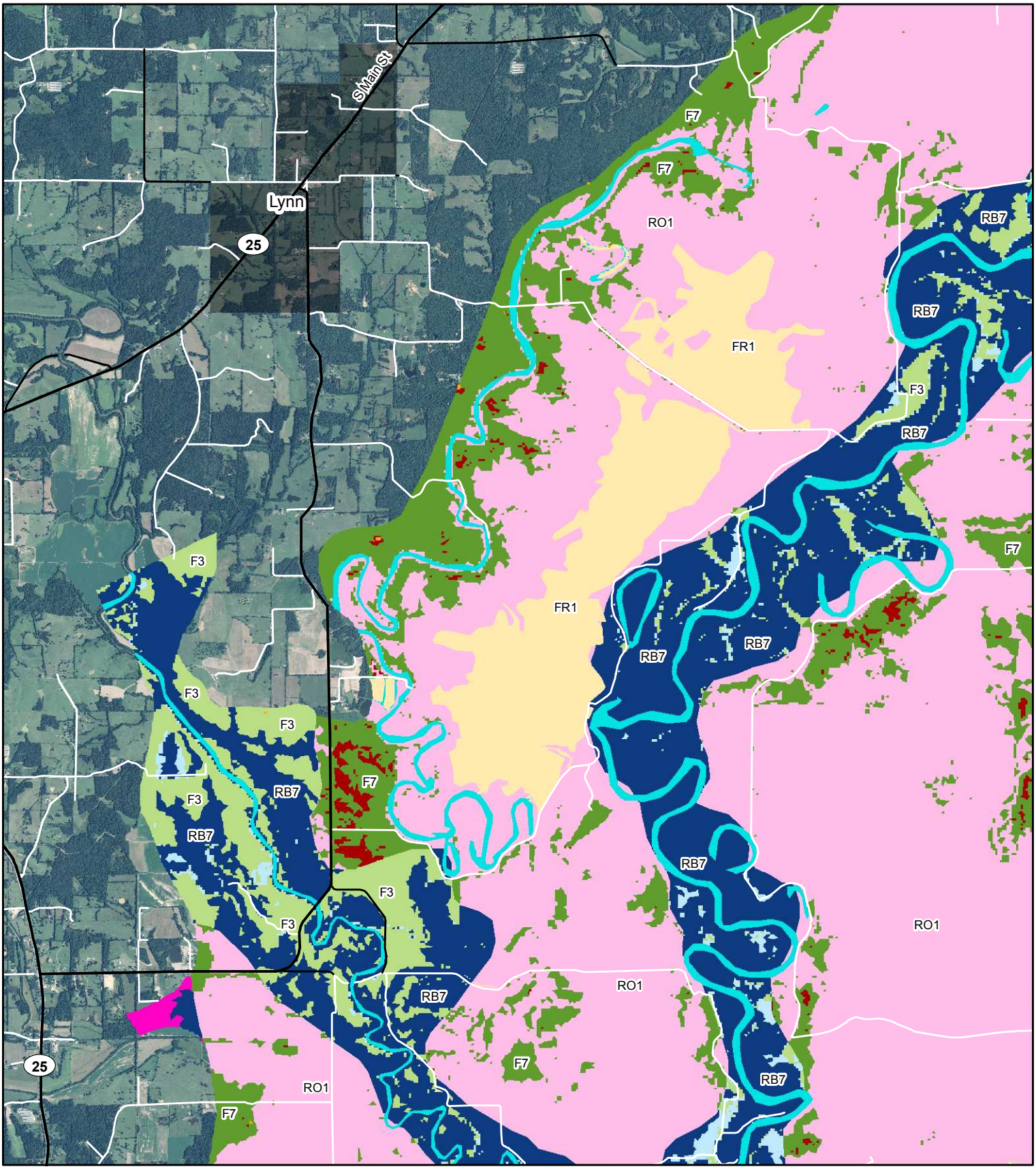
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

E8





0 0.5 1 2 3 4 Miles

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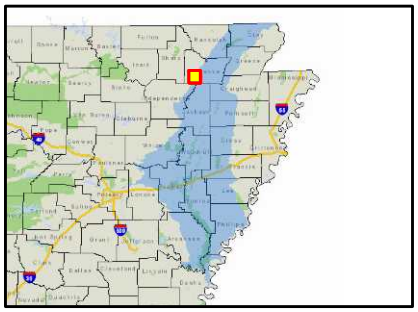
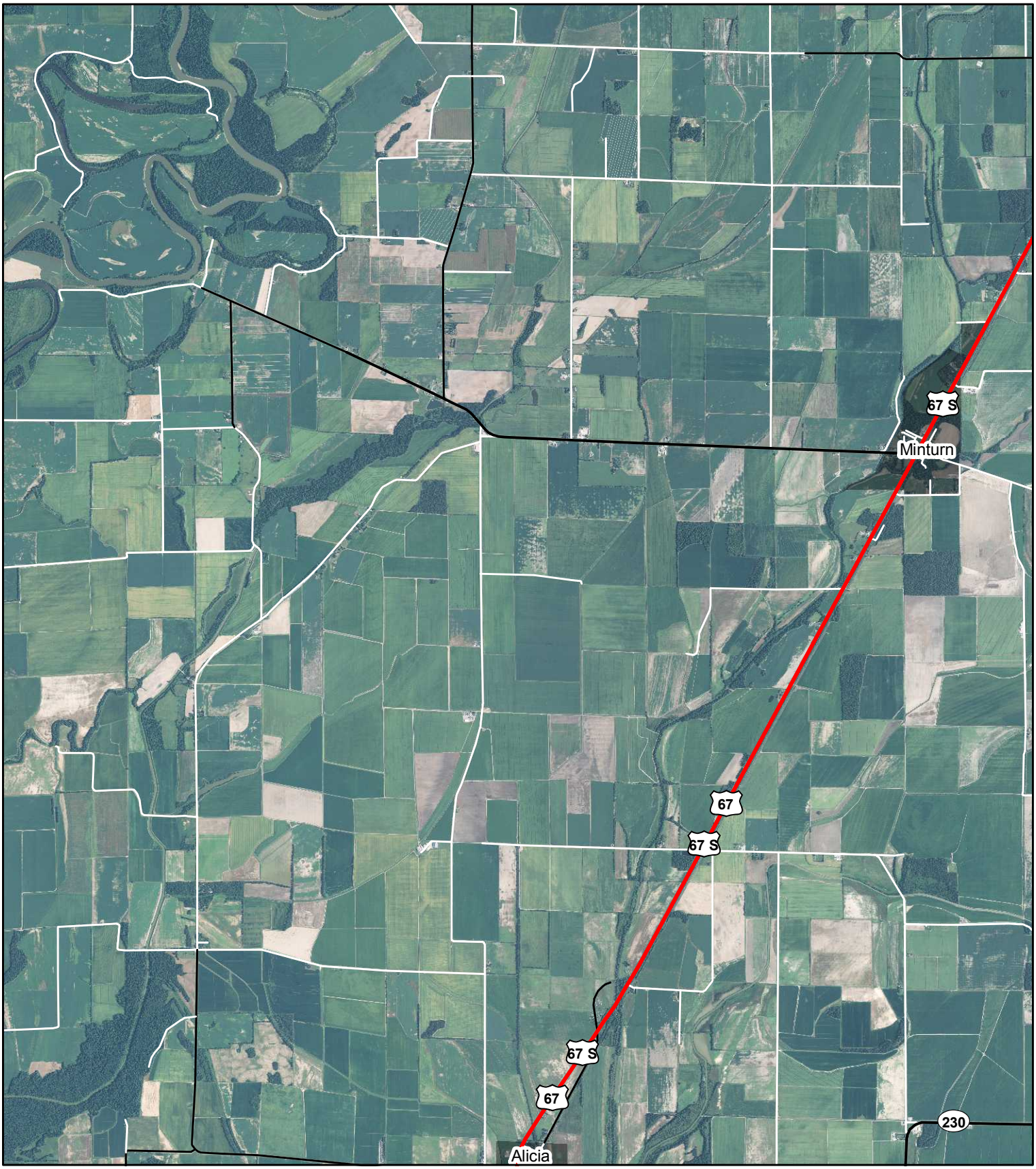
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

E8





0 0.5 1 2 3 4 Miles

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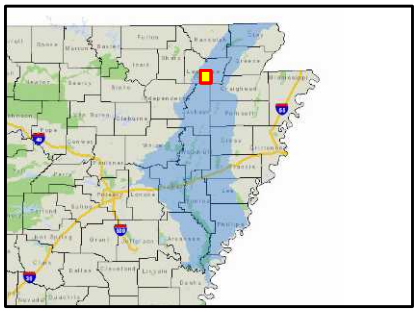
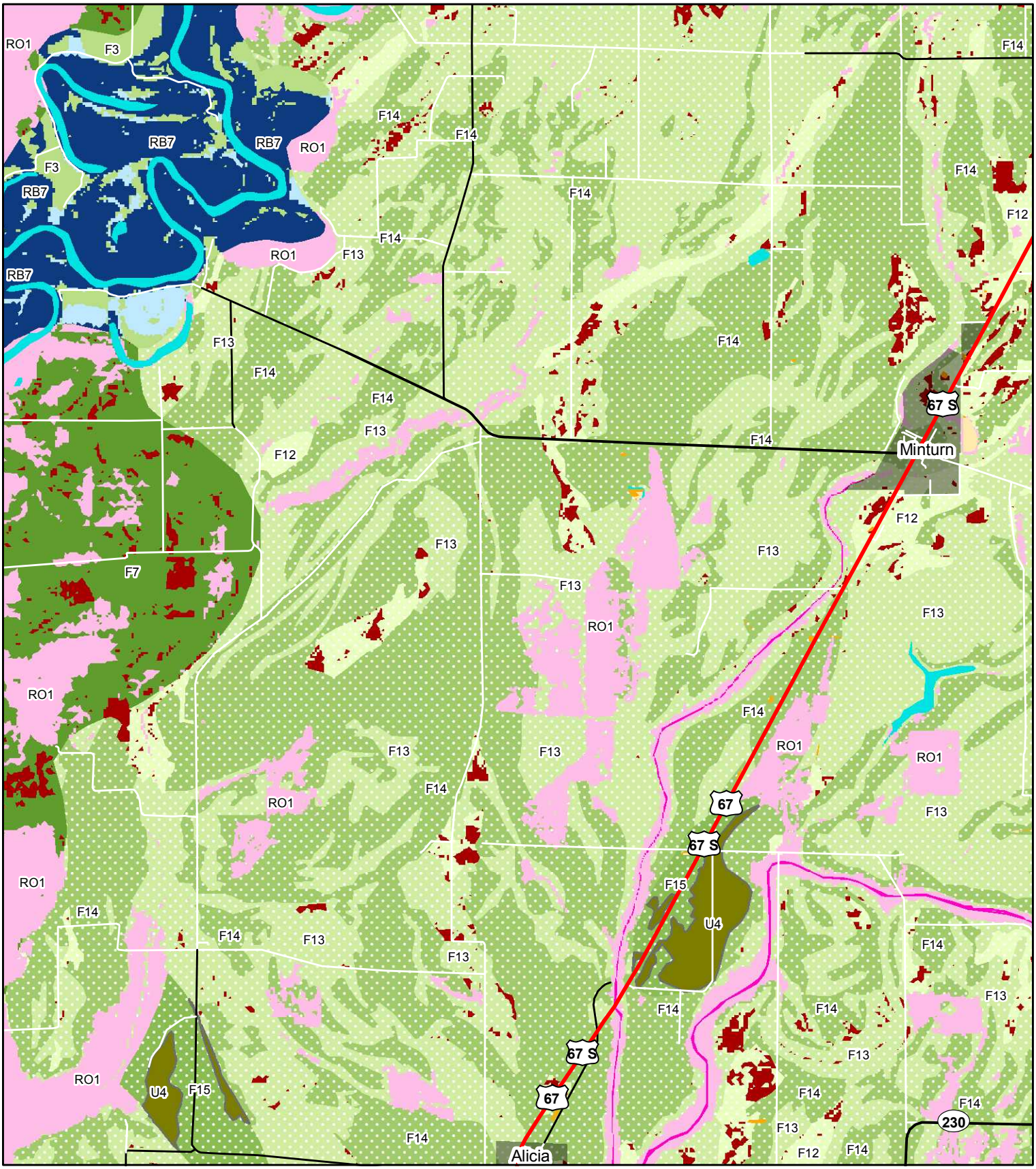
Projection: Transverse Mercator
Datum: North American 1983

E9





0 0.5 1 2 3 4 Miles

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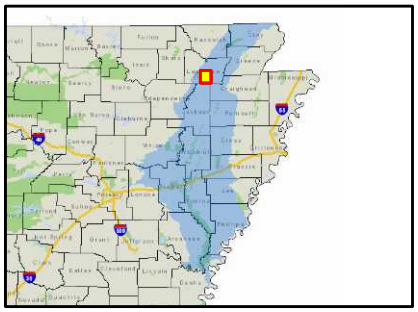
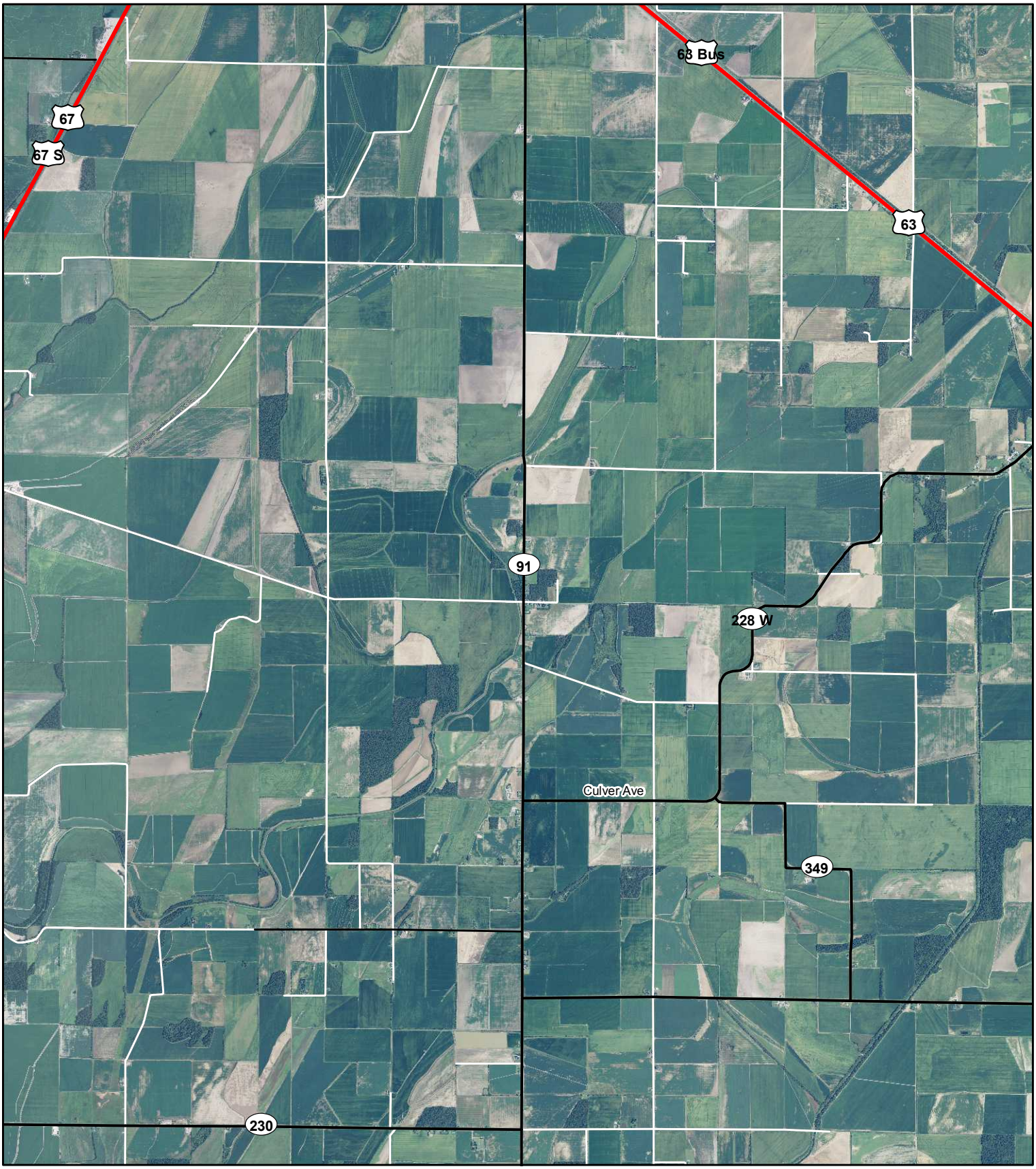
E9





0 0.5 1 2 3 4 Miles

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Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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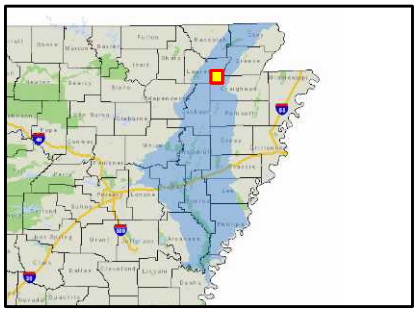

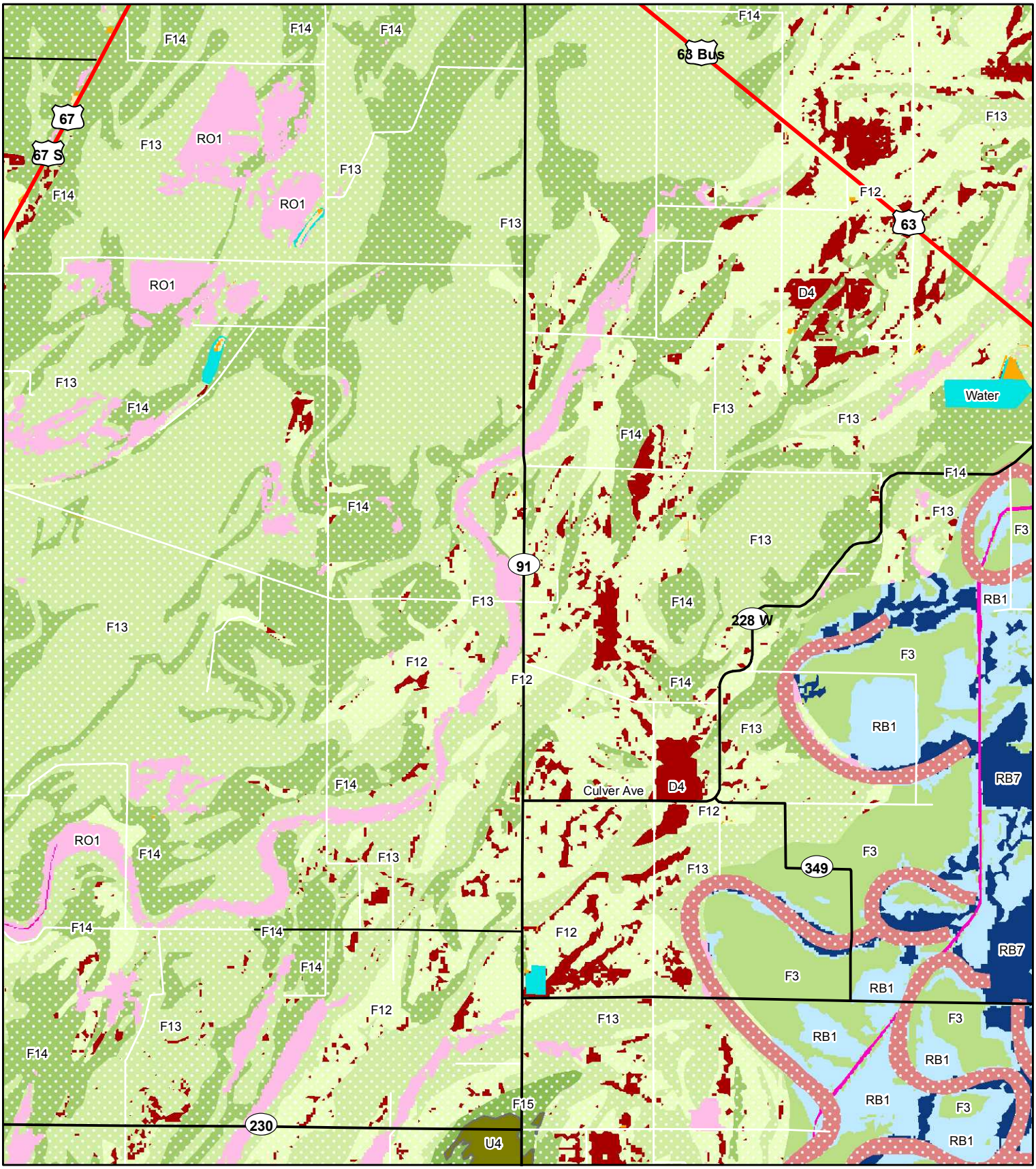

0 0.5 1 2 3 4 Miles

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Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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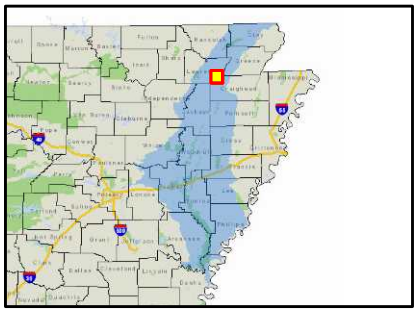


228 W

Sedgwick

63

230

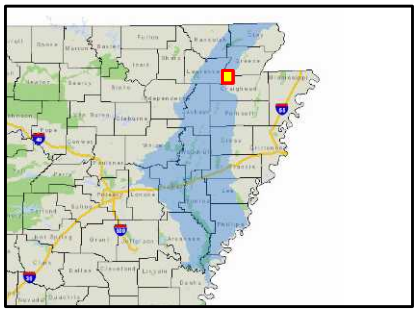
Bono

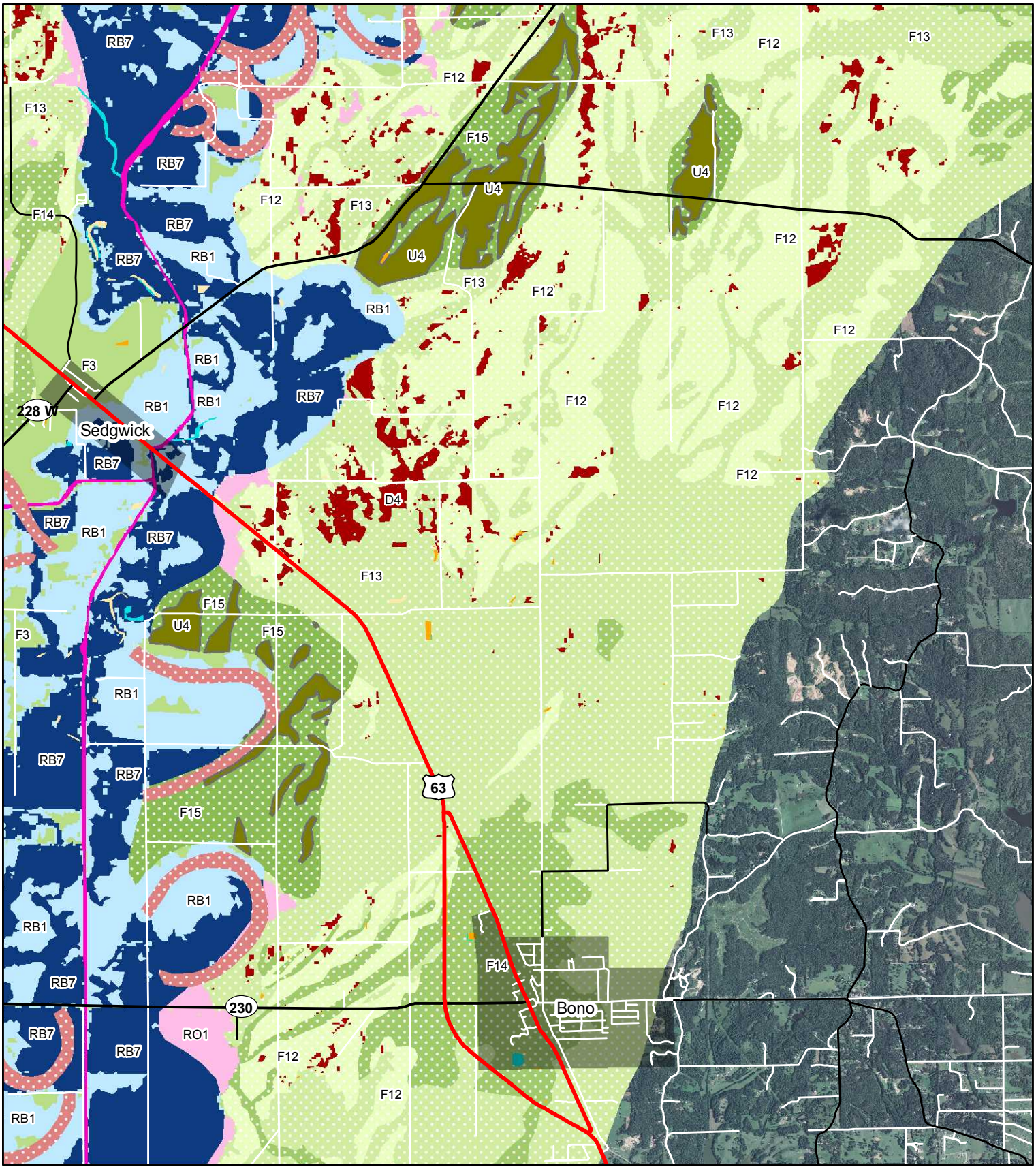
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

E11





0 0.5 1 2 3 4 Miles

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Coordinate System: NAD 1983 UTM Zone 15N
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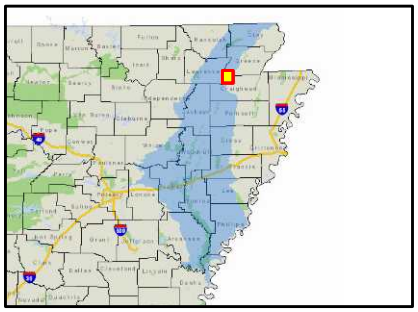
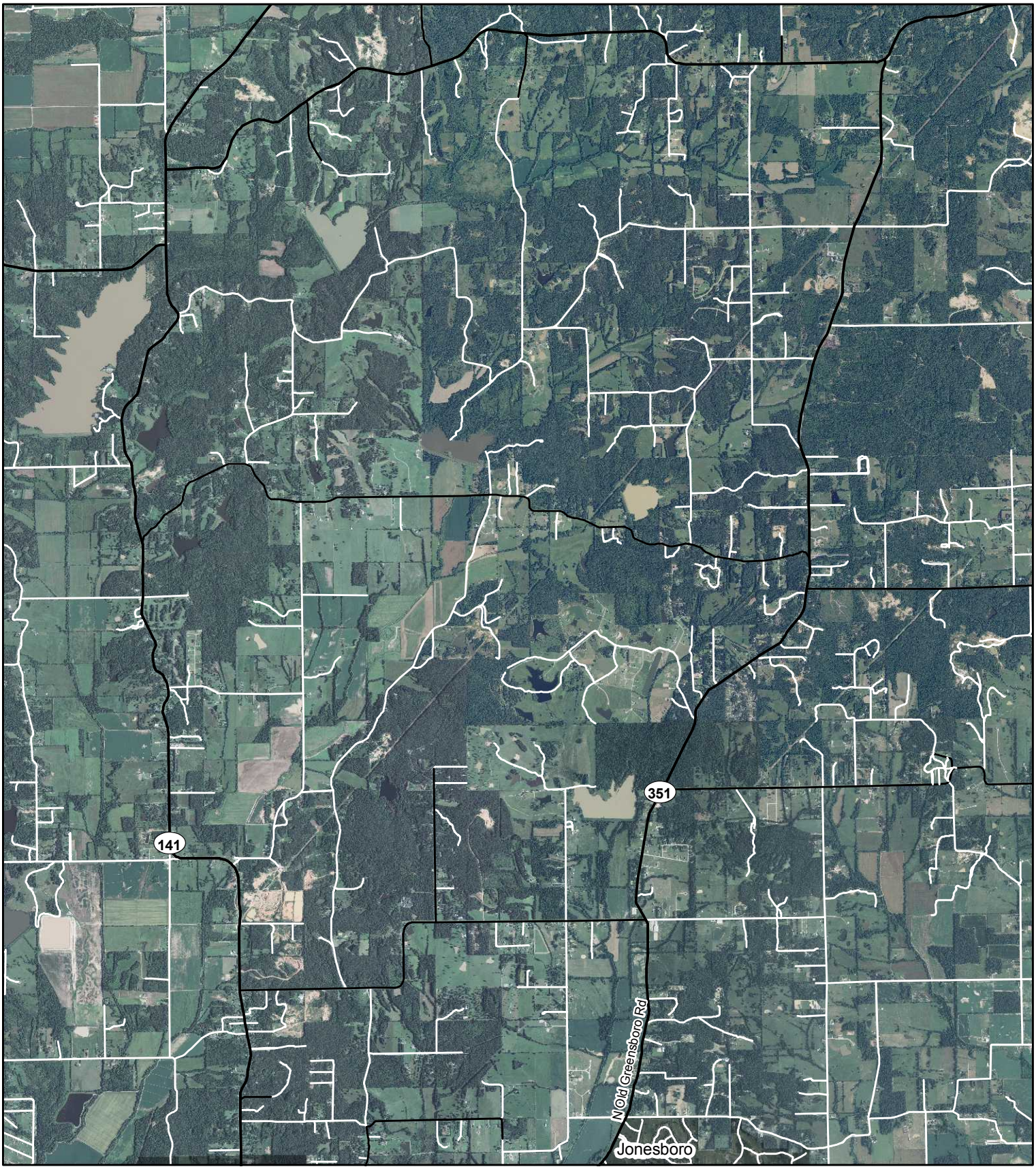
Datum: North American 1983

E11





0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

E12

F14
F13
F13
141
351
N Old Greensboro Rd
Jonesboro

0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

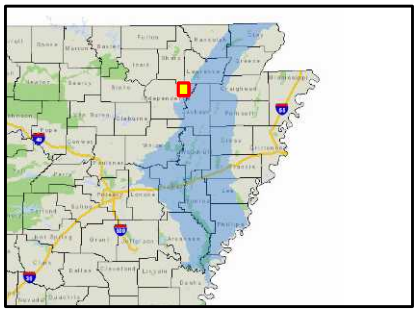
E12

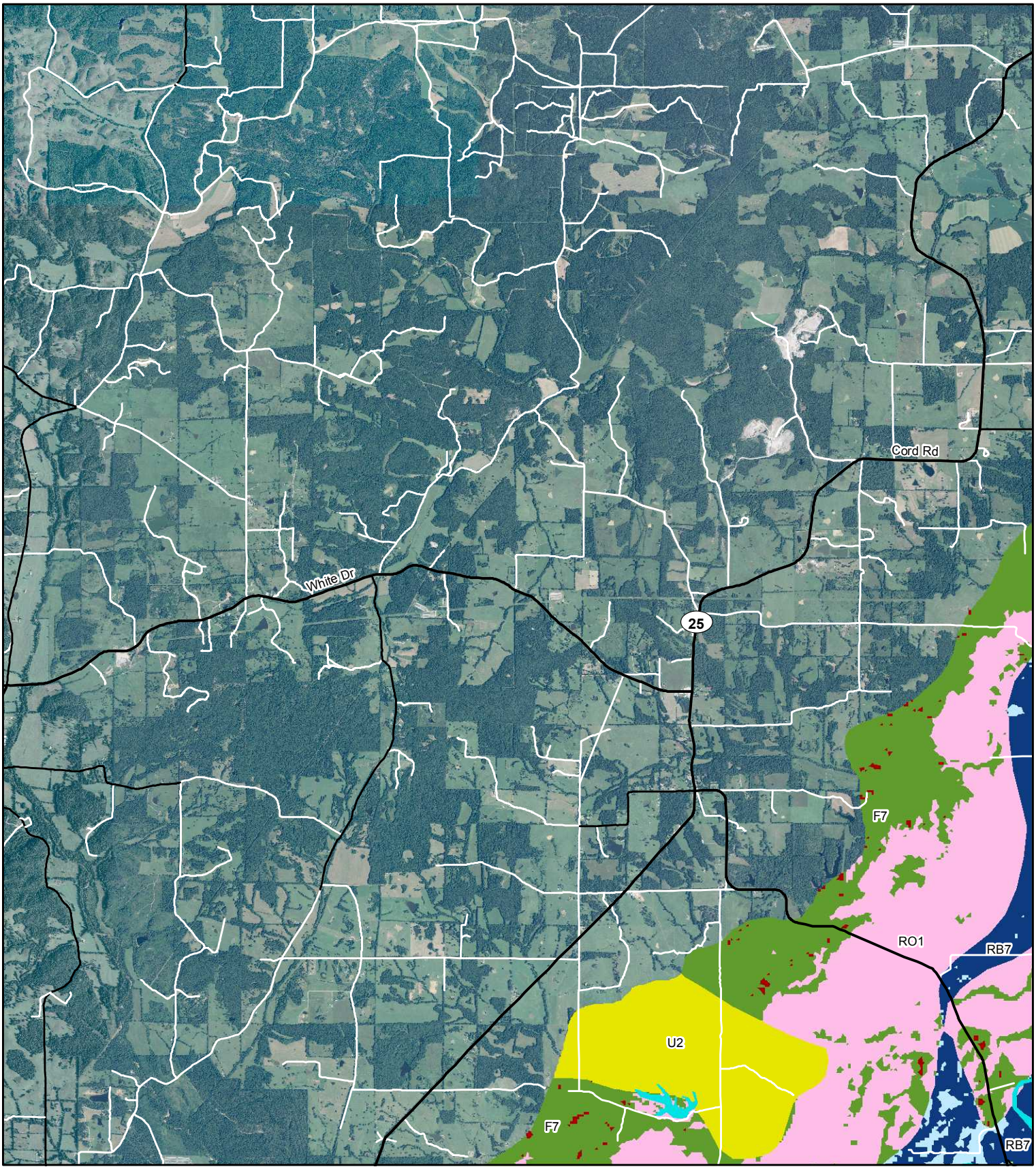
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

F7





0 0.5 1 2 3 4 Miles

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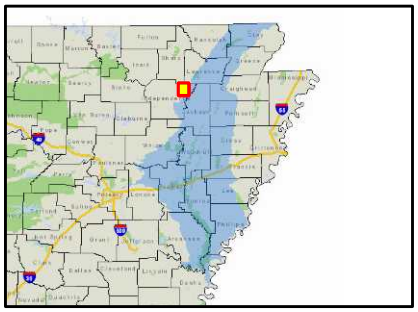
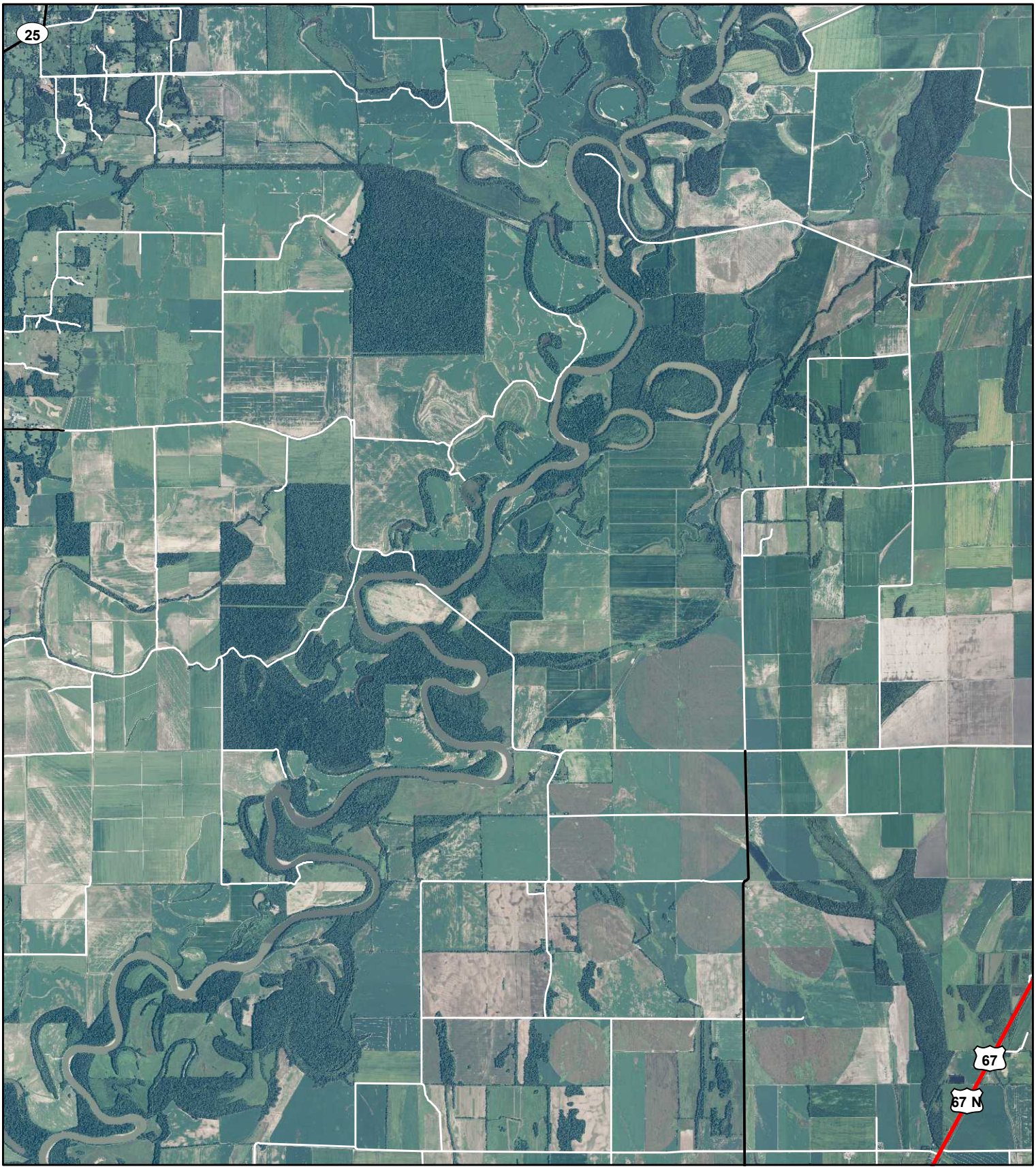
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

F7





0 0.5 1 2 3 4 Miles

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Projection: Transverse Mercator
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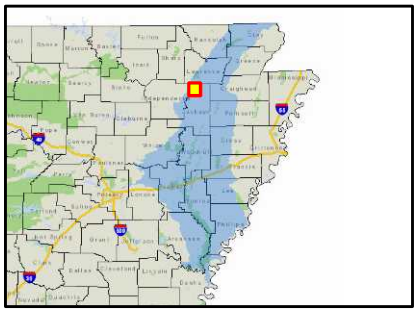
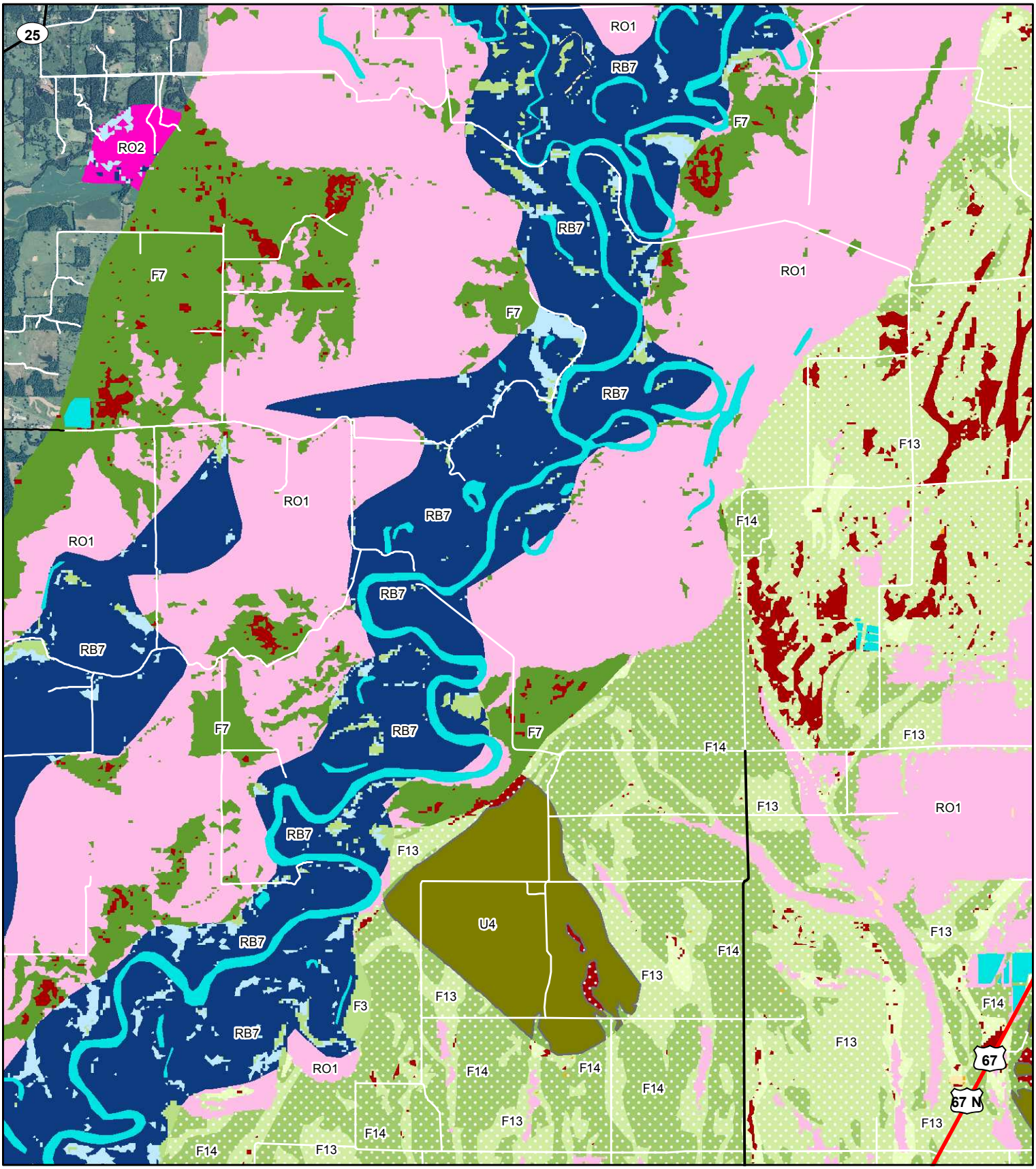
F8





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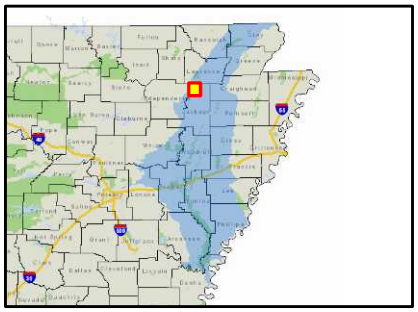

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Datum: North American 1983

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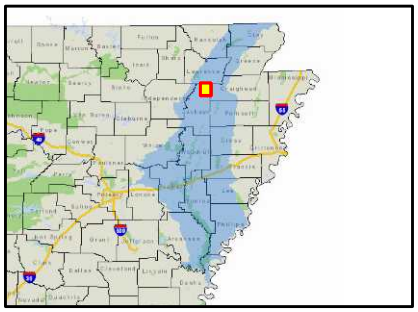

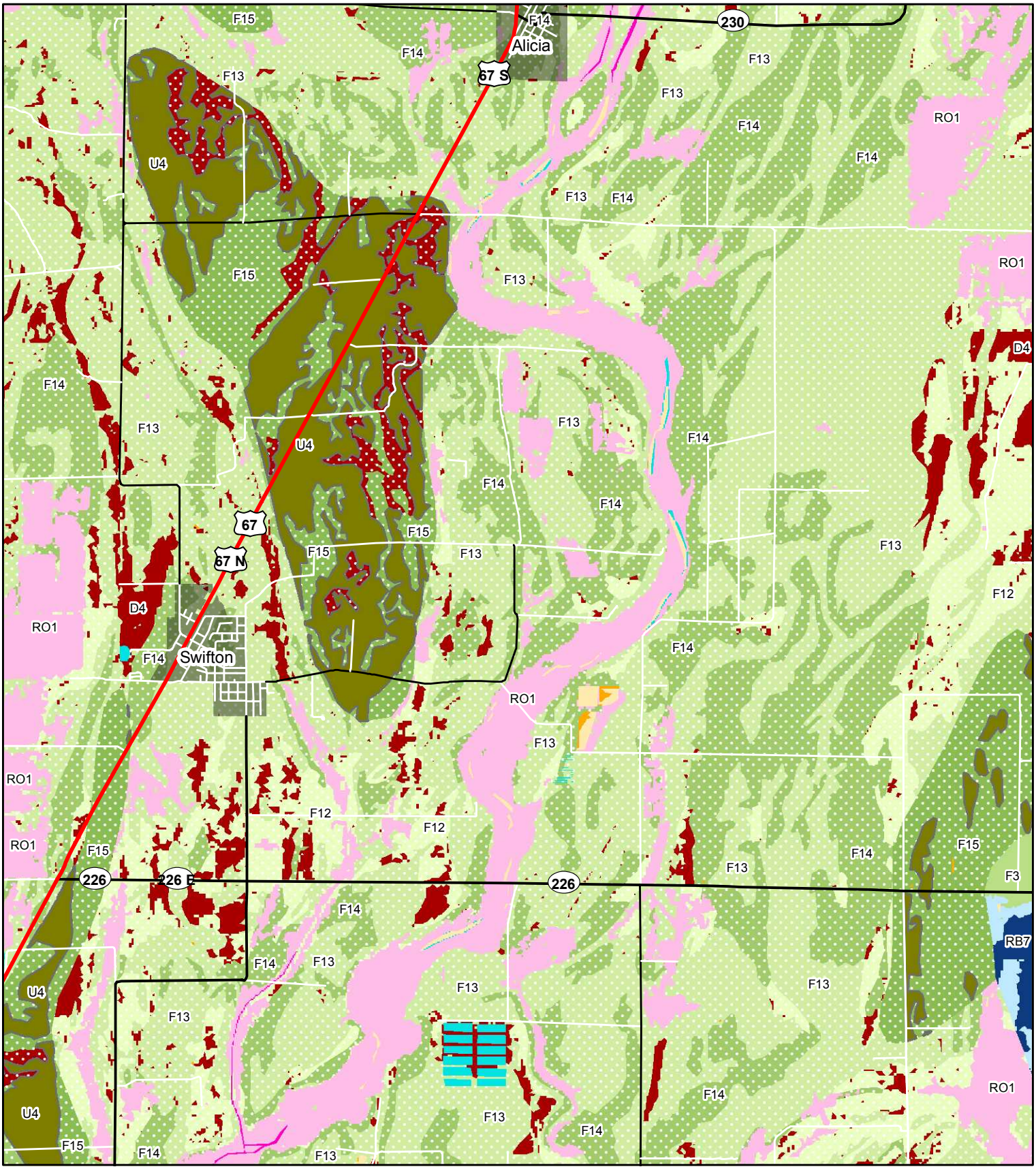

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Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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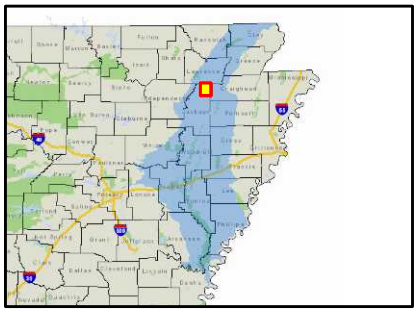

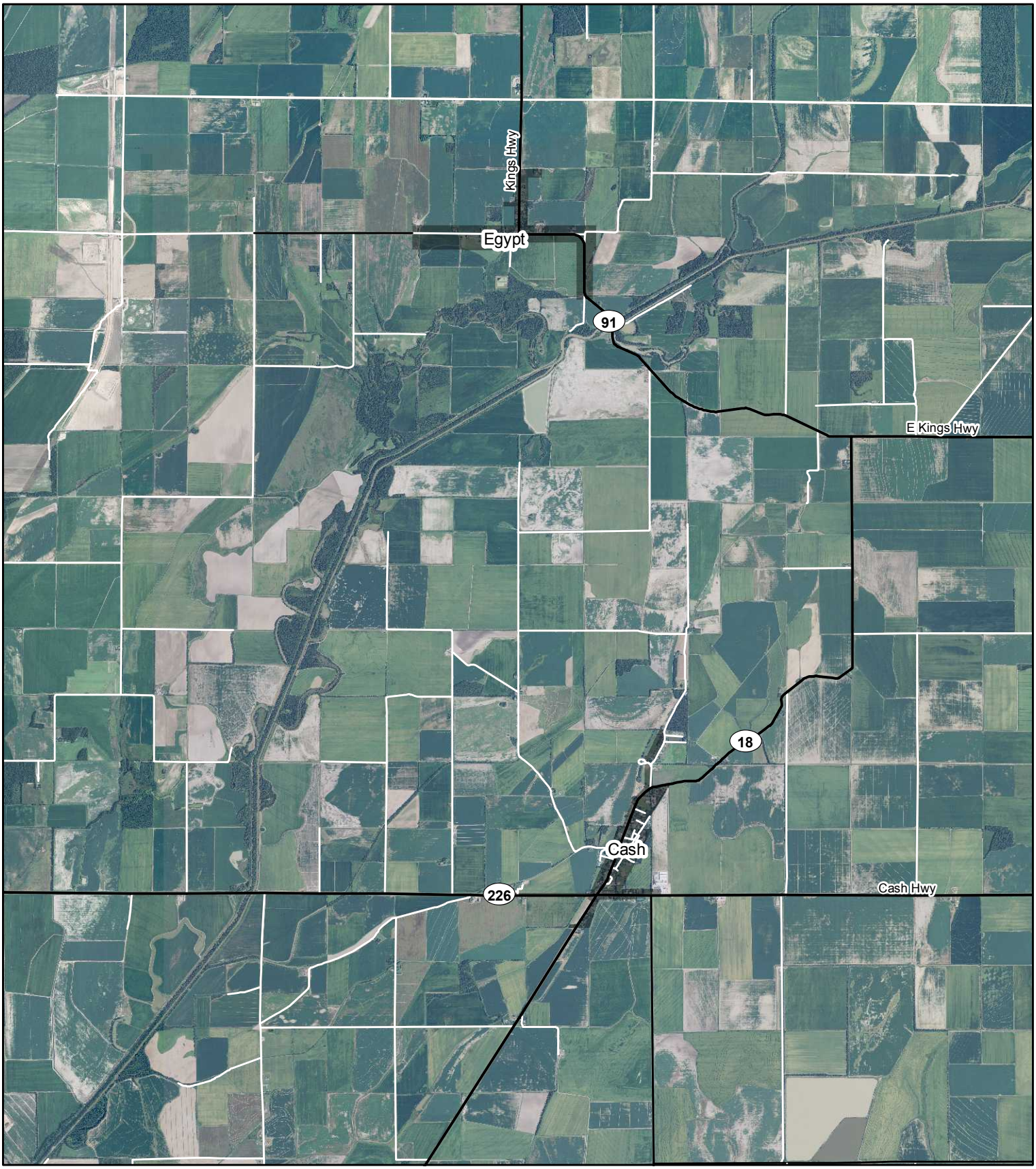

0 0.5 1 2 3 4 Miles

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Coordinate System: NAD 1983 UTM Zone 15N
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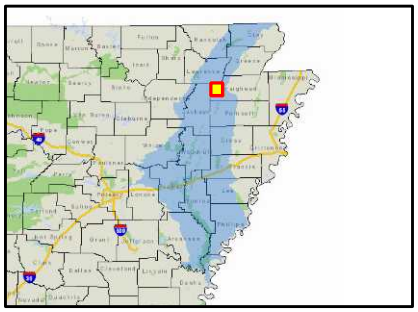
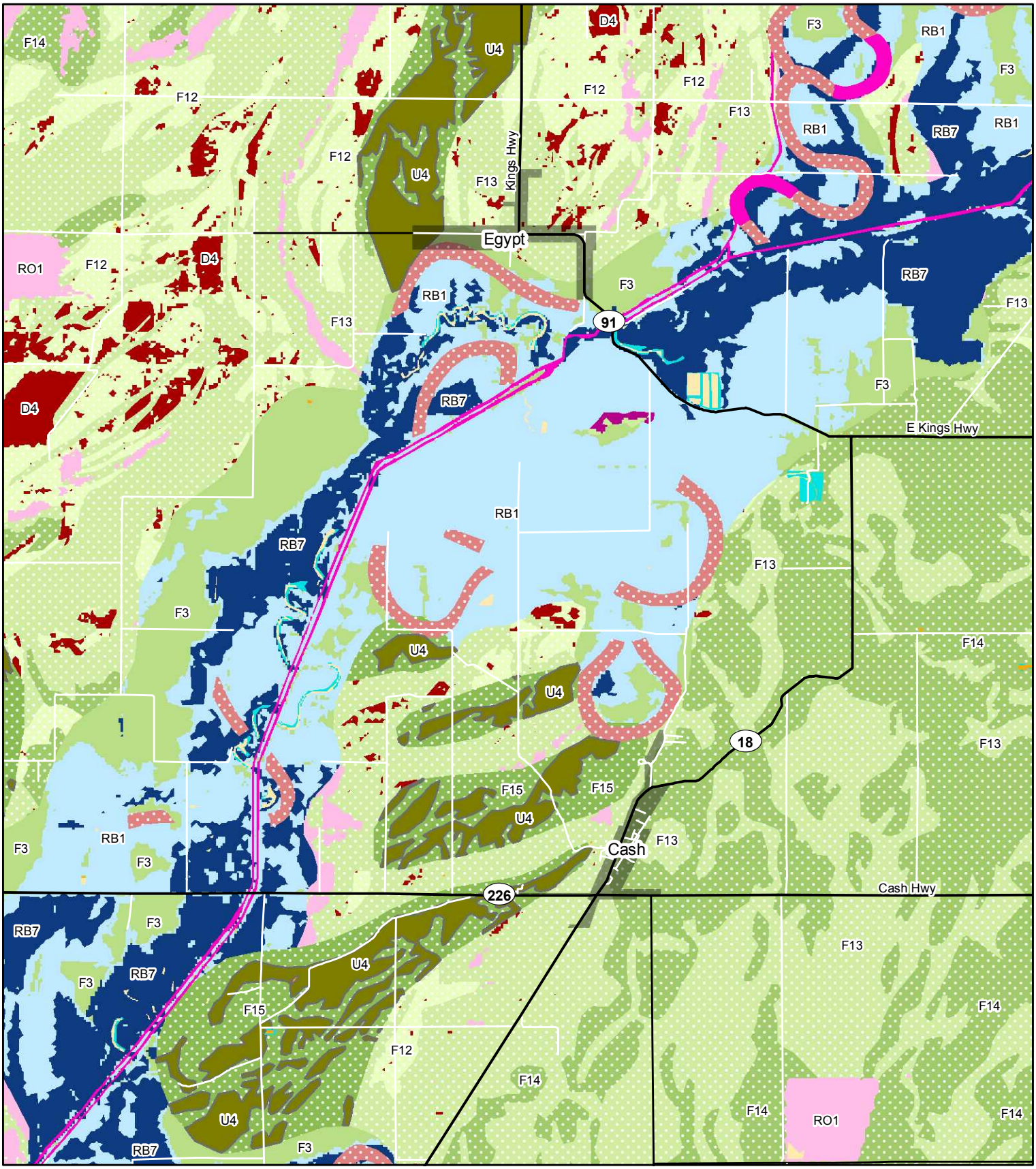
F10





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Projection: Transverse Mercator
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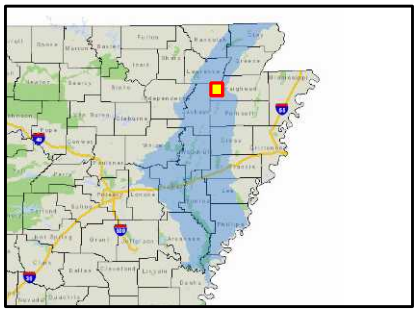
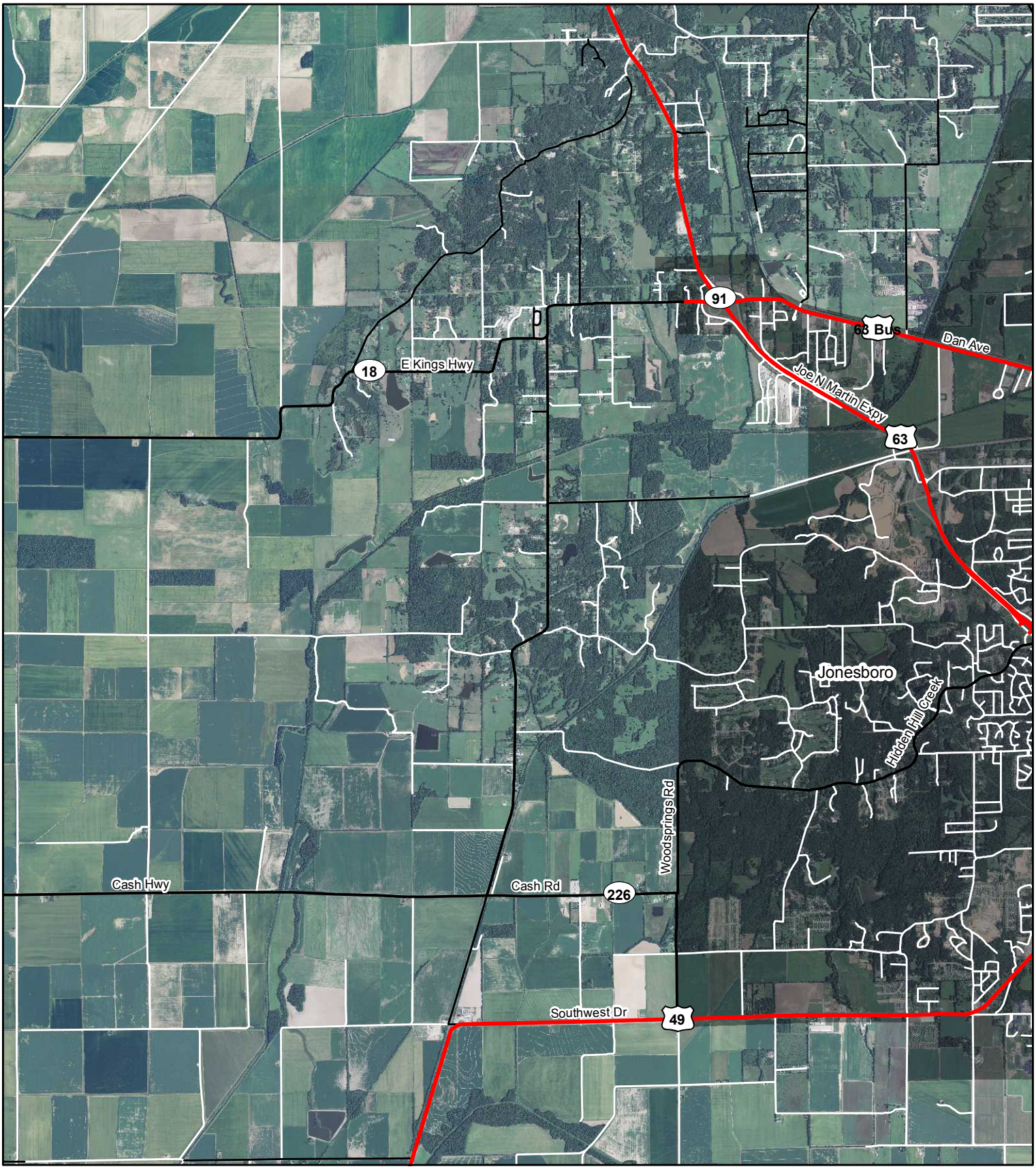


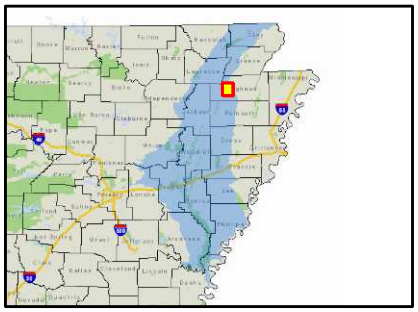


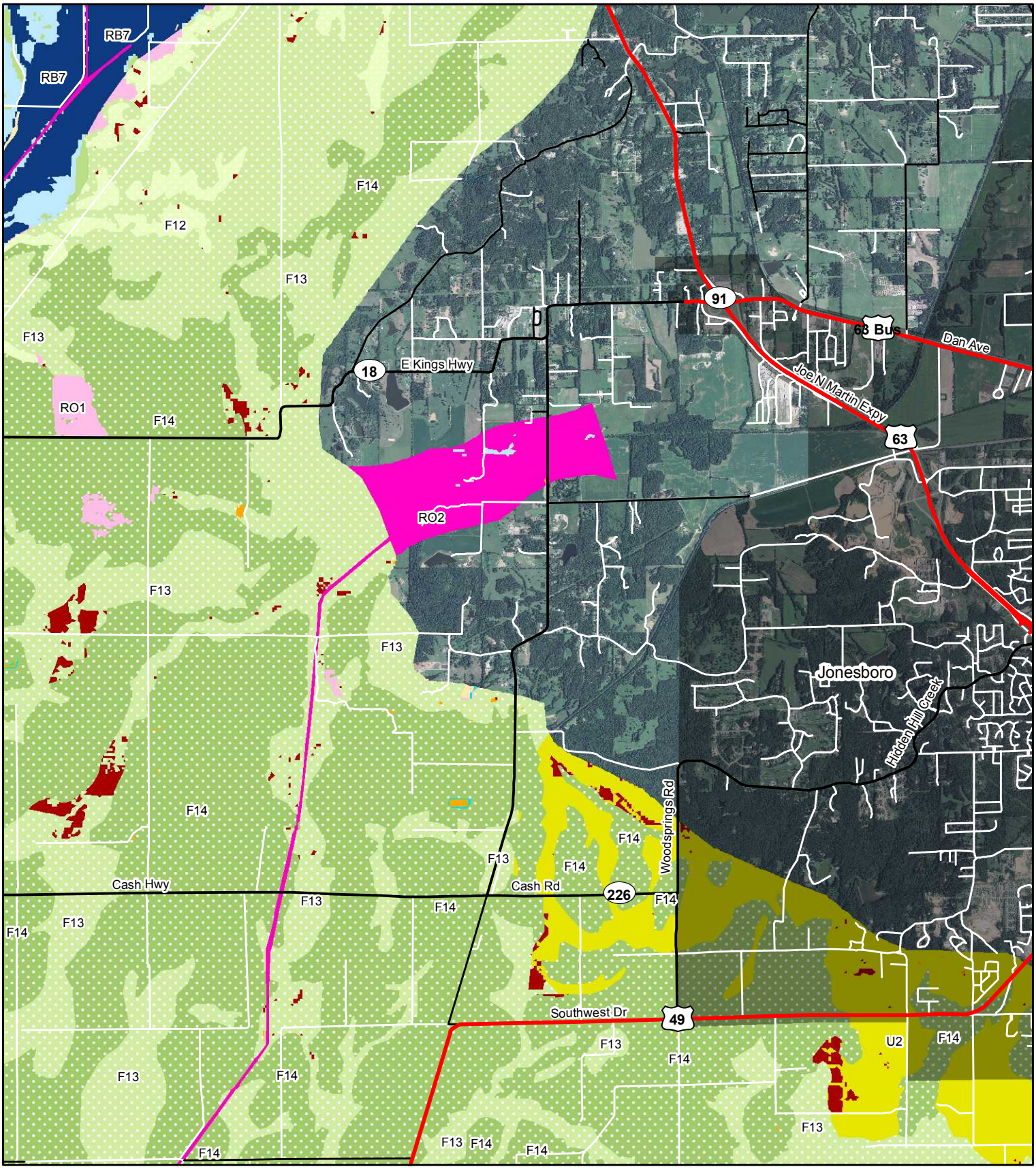
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

F11





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Projection: Transverse Mercator
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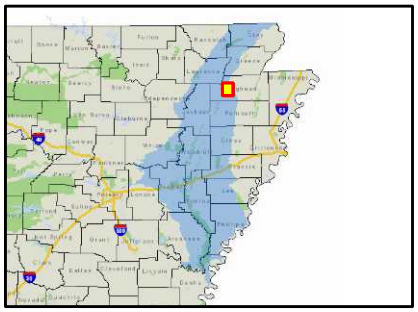


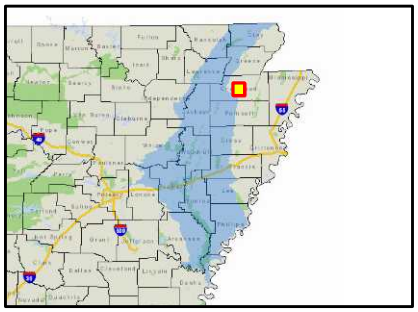
141
141
N Church St
N Old Greensboro Rd
351
49
E Johnson Ave
Johnson Ave
E Johnson Ave
63 Bus
68 Bus
W Johnson Ave
68 Bus
49 Bus
Airport Rd
S Main St
E Nettleton Ave
351
E Highland Dr
Jonesboro
63 Bus
226
18
Southwest Dr
Harrisburg Rd
Joe N Martin Expy
Stadium Blvd
Joe N Martin Expy
Co Rd 634
63
63
Culberhouse St
49
141
Bus
463
S Culberhouse Rd
1
163

0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

F12



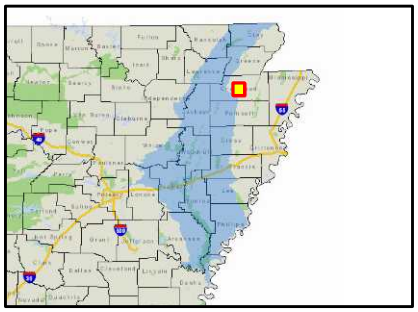
141
141
N Church St
N Old Greensboro Rd
351
49
E Johnson Ave
Johnson Ave
E Johnson Ave
63 Bus
63 Bus
W Johnson Ave
63 Bus
49 Bus
Airport Rd
S Main St
E Nettleton Ave
351
E Highland Dr
Jonesboro
63 Bus
226
18
Southwest Dr
Harrisburg Rd
Joe N Martin Expy
Stadium Blvd
Joe N Martin Expy
Co Rd 634
63
63
49
Culberhouse St
141
Bus
463
S Culberhouse Rd
1
163
F14
U2

0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

F12



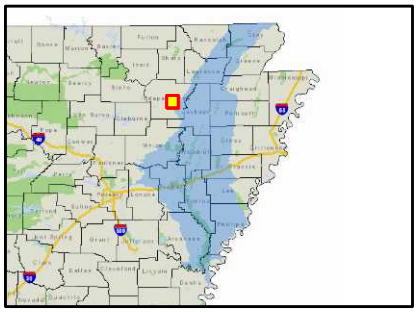
Moorefield
69
Harrison St
Annex
W Broadway
Sulphur Rock
Batesville
Main St
69
Newark
Harrison St
6th St W
Magness
N Locust St
14
122
14
14
Newport Rd

0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G6



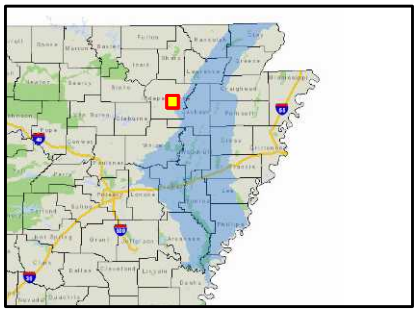
Moorefield
69
Harrison St
Annex
W Broadway
Sulphur Rock
Main St
Batesville
69
Newark
Harrison St
6th St W
Magness
N Locust St
14
122
F3
F3
14
RB1
F3
14
Newport Rd
F3
F3
F3

0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G6



Newark

69

Point Ferry Rd

Harrison St

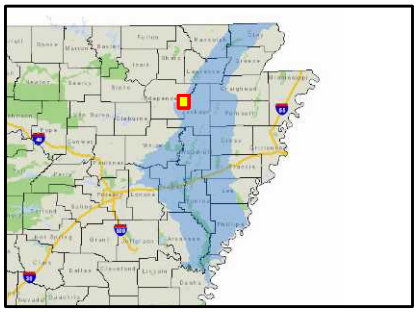
Jackson-Port

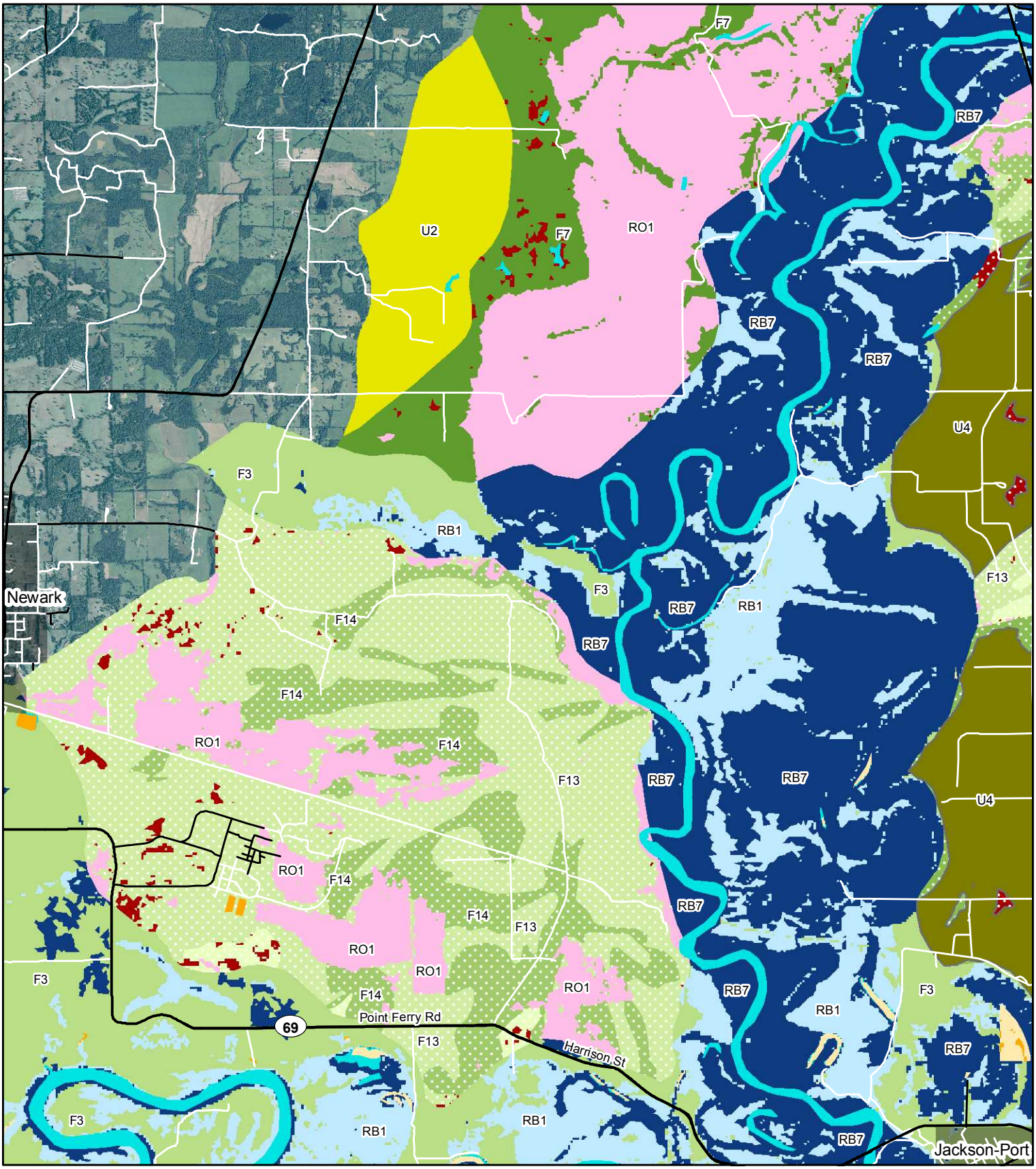
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G7



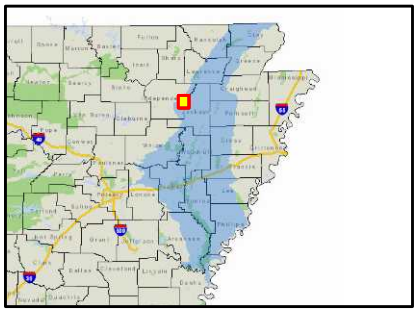


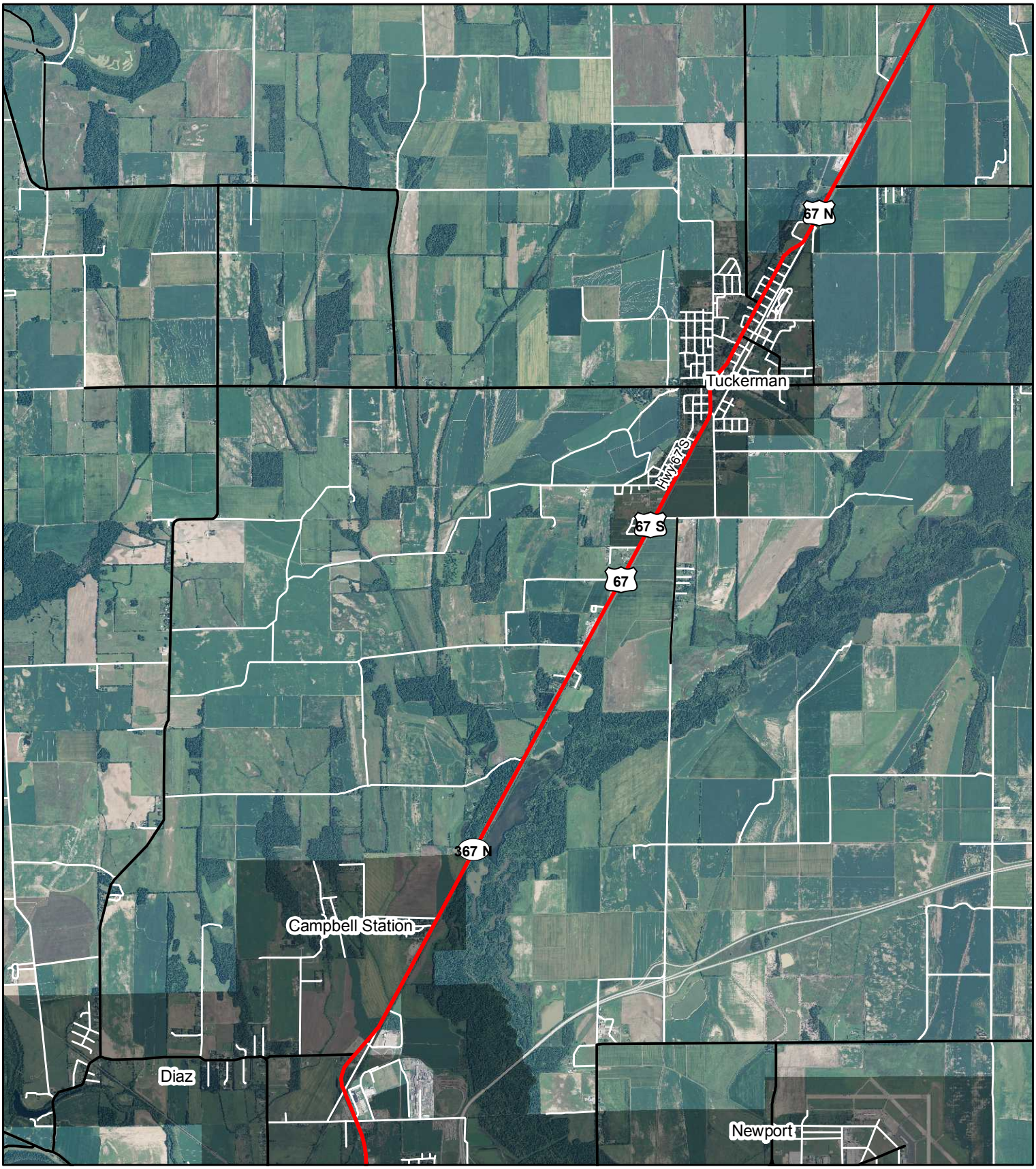
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G7



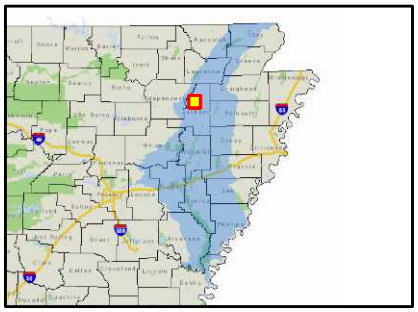


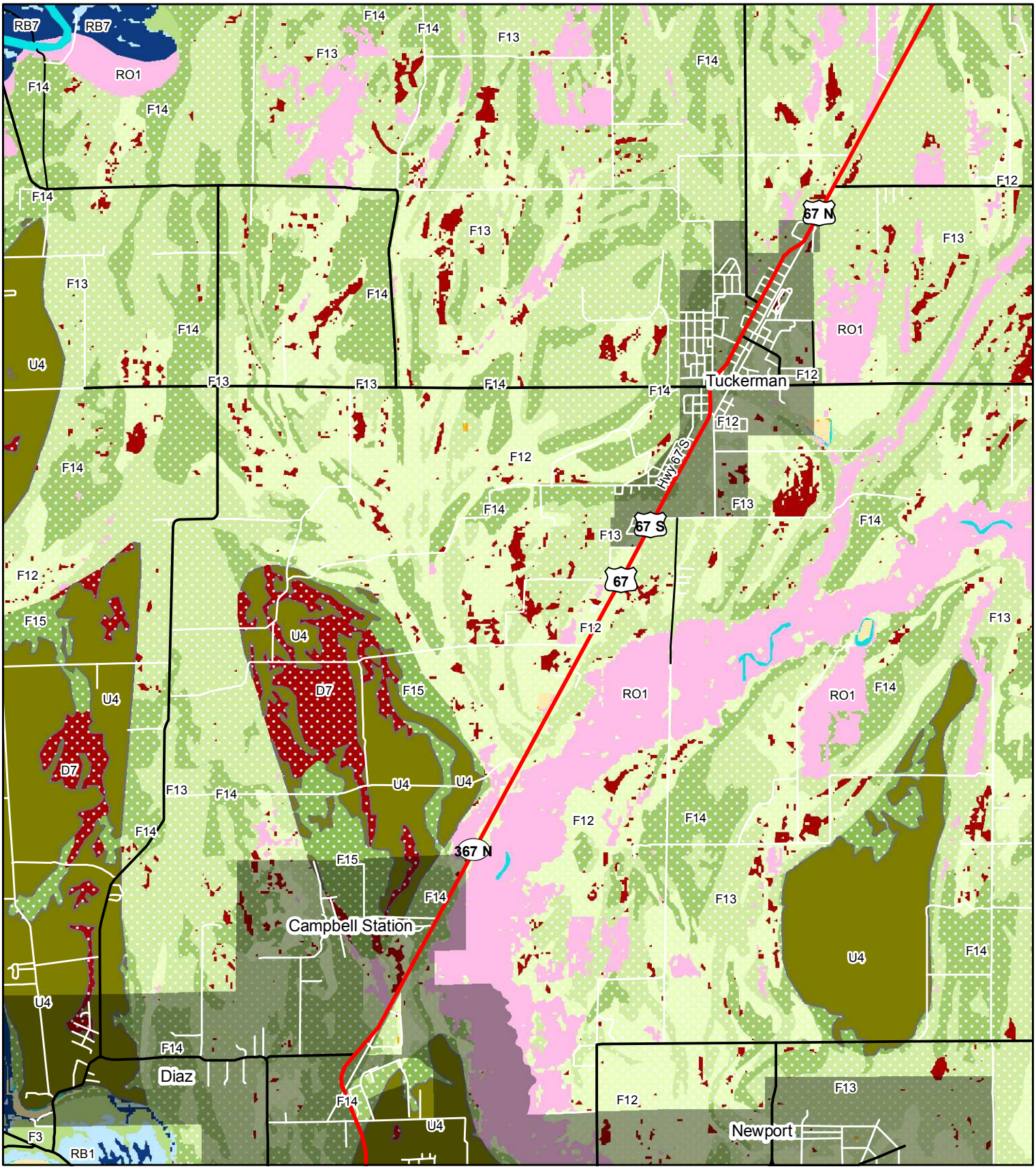
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G8



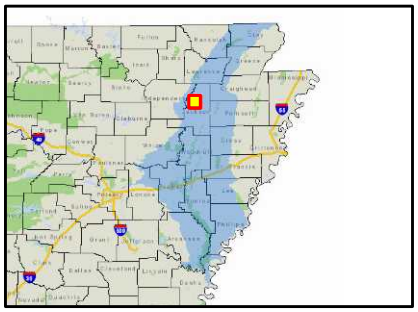


0 0.5 1 2 3 4 Miles

N

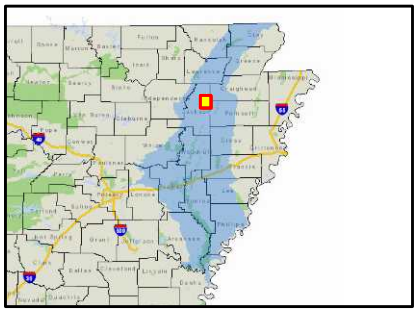
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G8



0 0.5 1 2 3 4 Miles

G9



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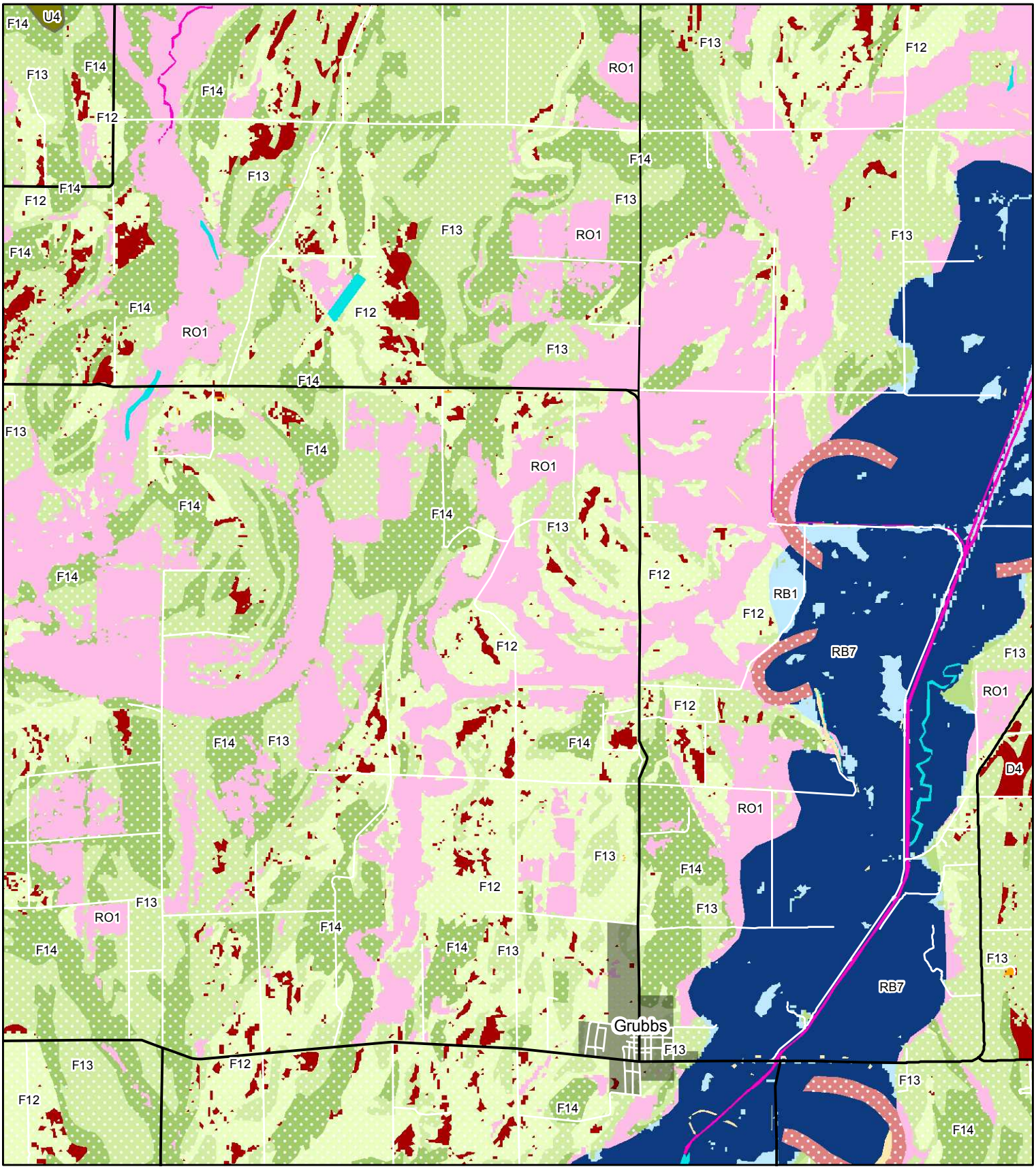
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

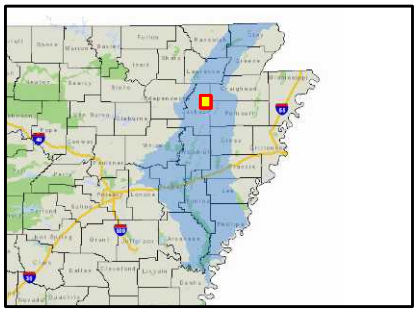


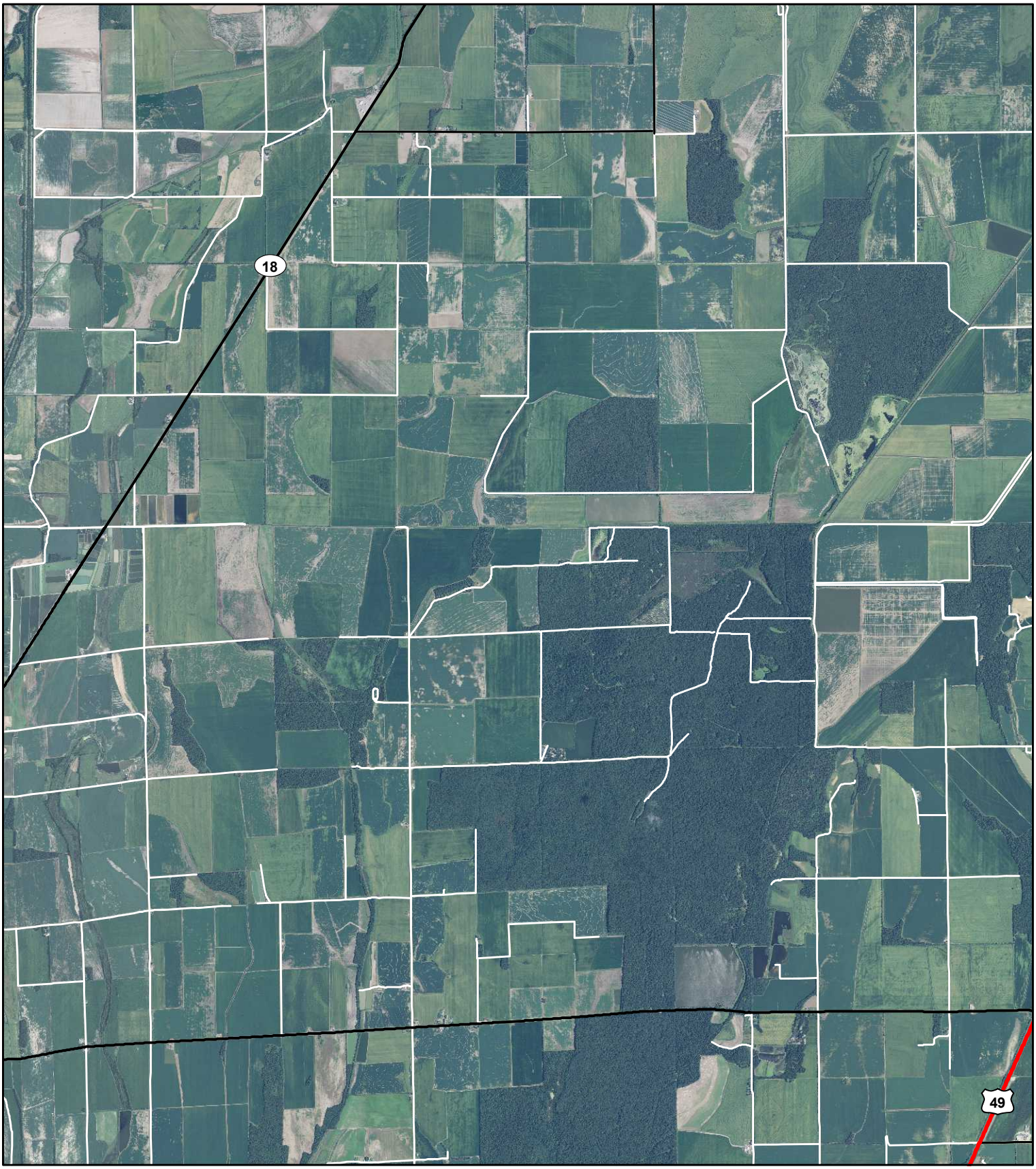
0 0.5 1 2 3 4 Miles

G9

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983



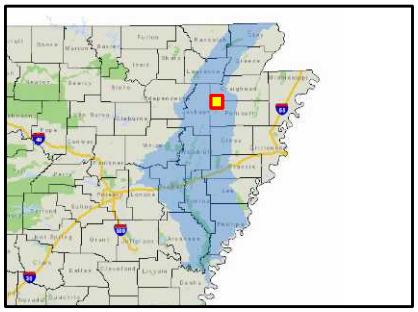


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G10



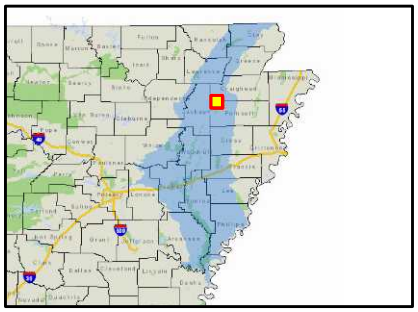
RB1
RB1
RB7
18
F14
F14
F14
F14
F14
F14
F13
F14
RO1
F14
F14
F13
F13
Water
RO1
F13
RO1
RO1
U2
F13
F14
F13
F14
F14
F14
FR1
F13
F14
RO1
49
F14
F14
RO1

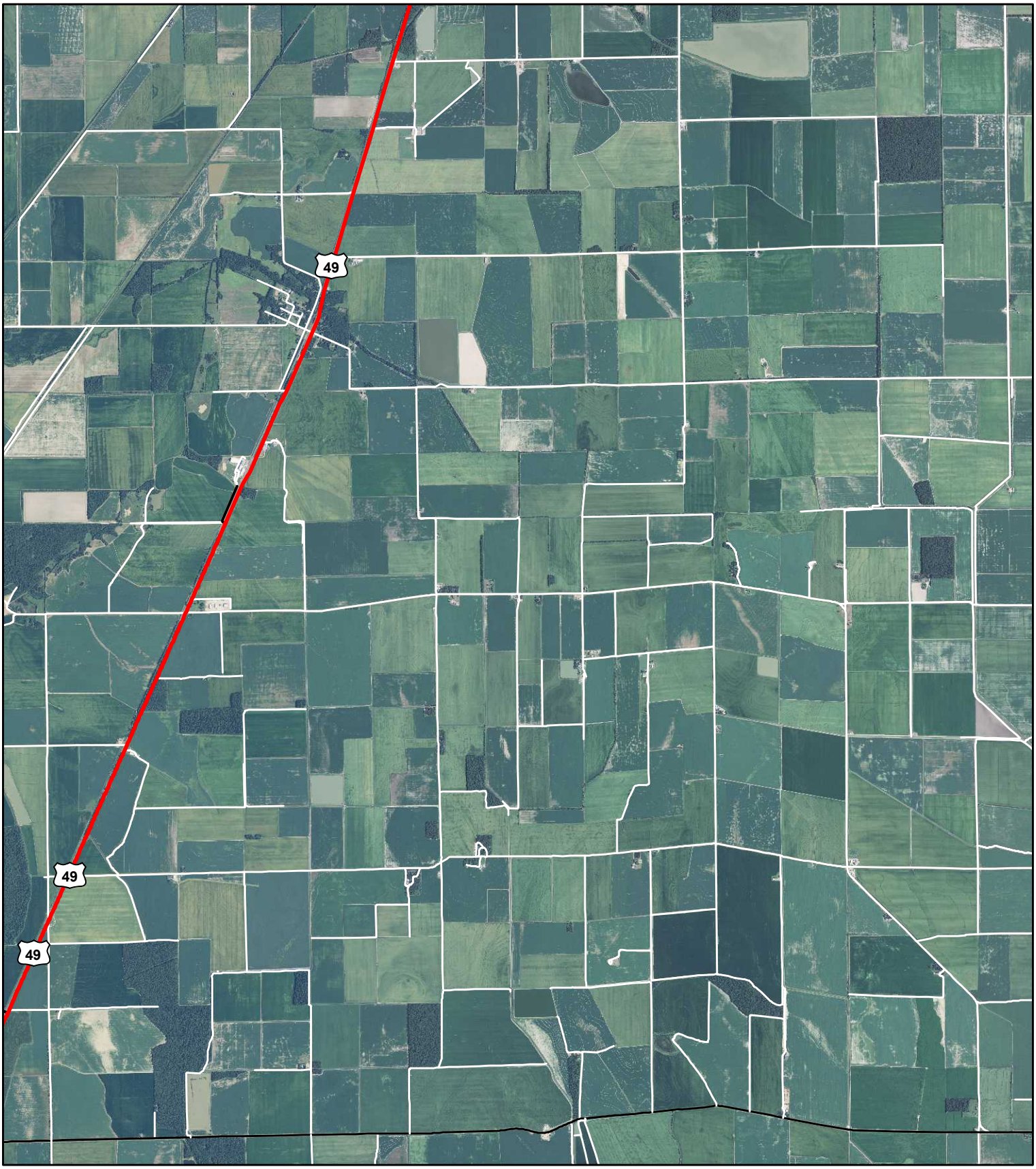
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G10



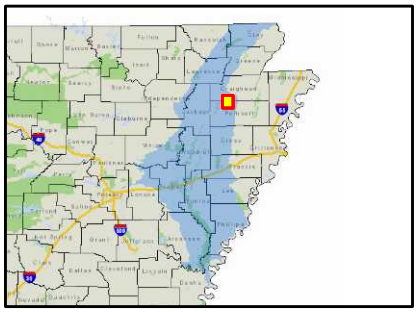


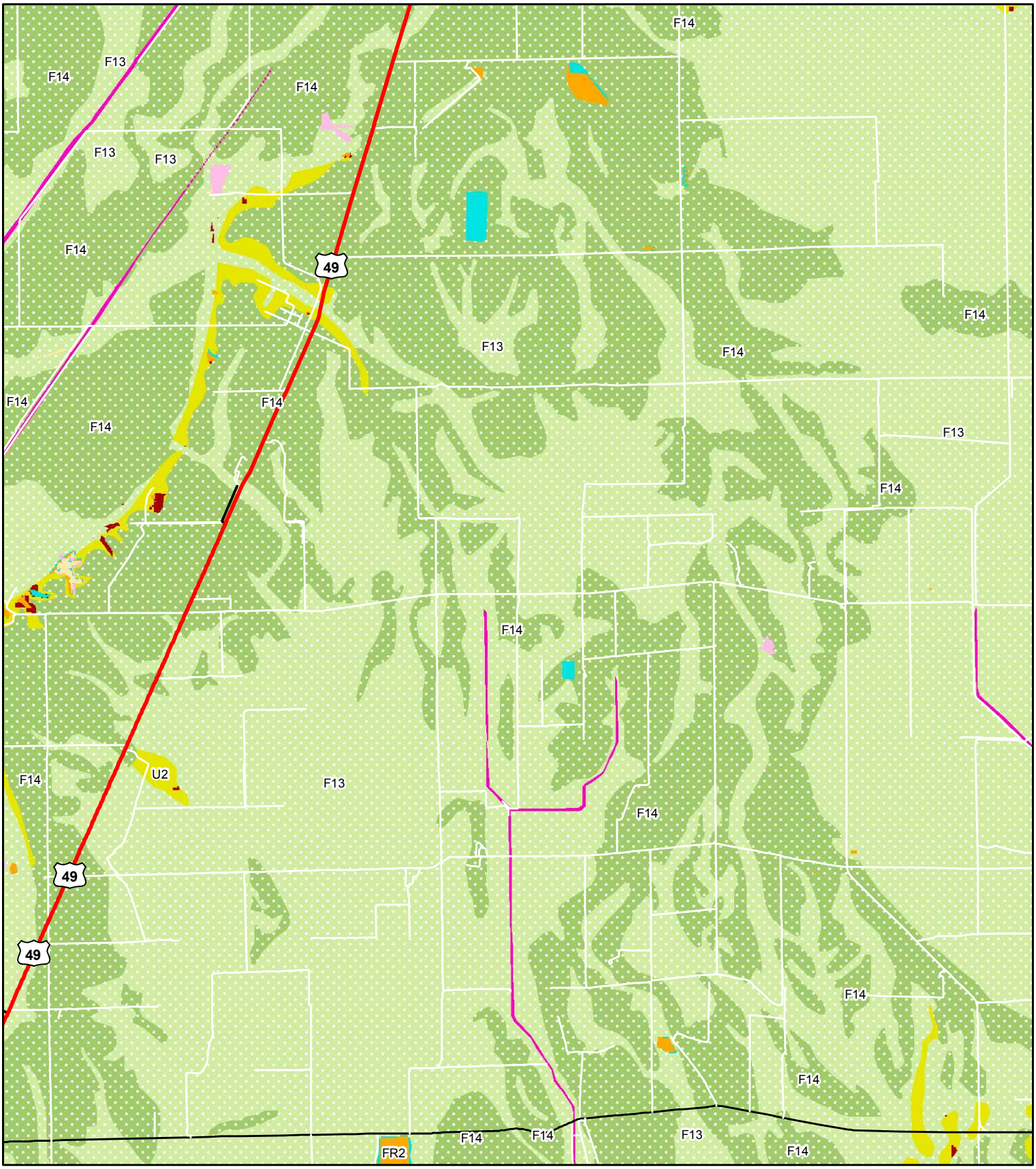
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G11



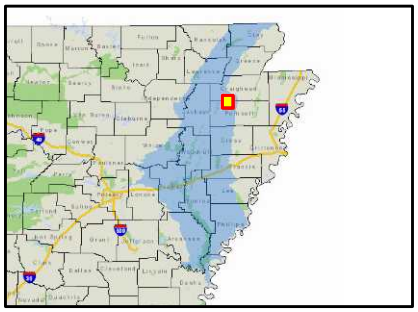


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G11



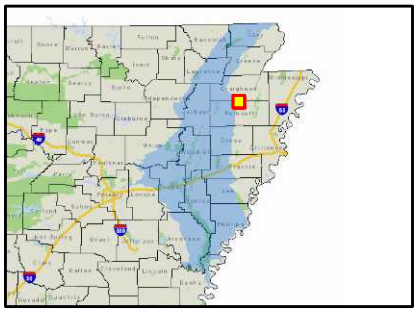
Jonesboro
Harrisburg Rd
E Lawson Rd
158
Ar 158 Hwy
Ar 1 Hwy
1
163
Ar 163 Hwy
Stadium Blvd
N Illinois Ave
N Illinois Ave
1

0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G12



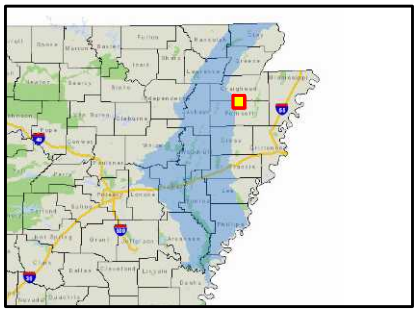
Jonesboro
Harrisburg Rd
E Lawson Rd
158
Ar 158 Hwy
Ar 1 Hwy
1
163
Ar 163 Hwy
U2
Stadium Blvd
F13
N Illinois Ave
N Illinois Ave
F13
F14
1
F13
U2
F14

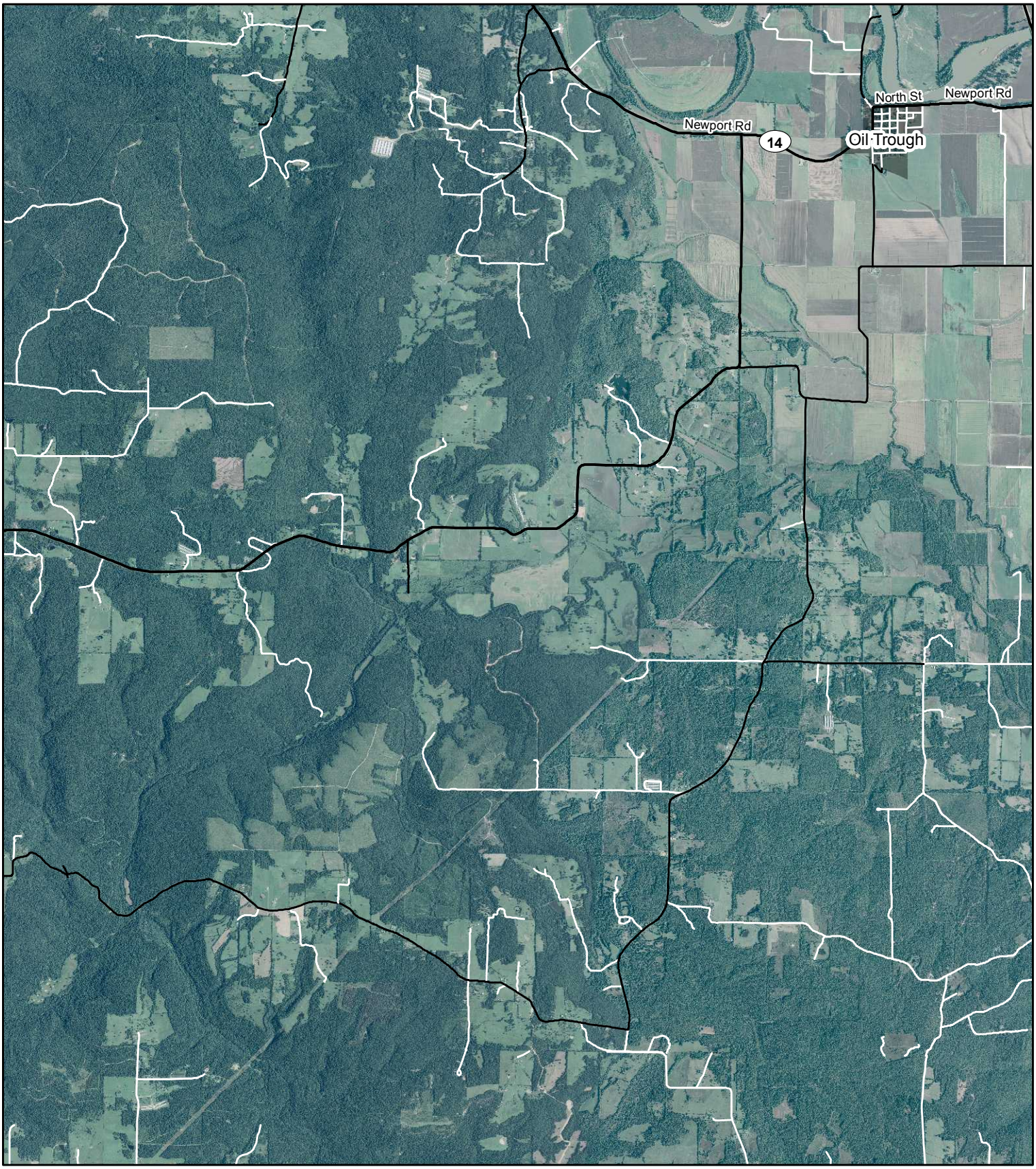
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

G12



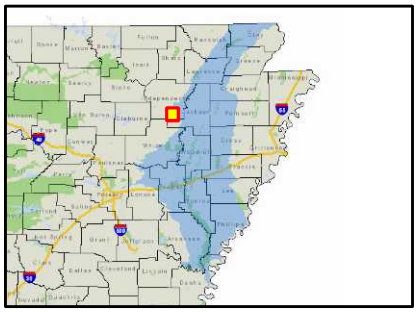


0 0.5 1 2 3 4 Miles

H6

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983



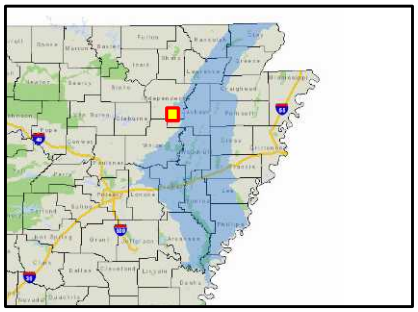
F3
F3
F3
North St
Newport Rd
Newport Rd
14
Oil Trough
F13
RB7
F3
RB7
RB7
RO2

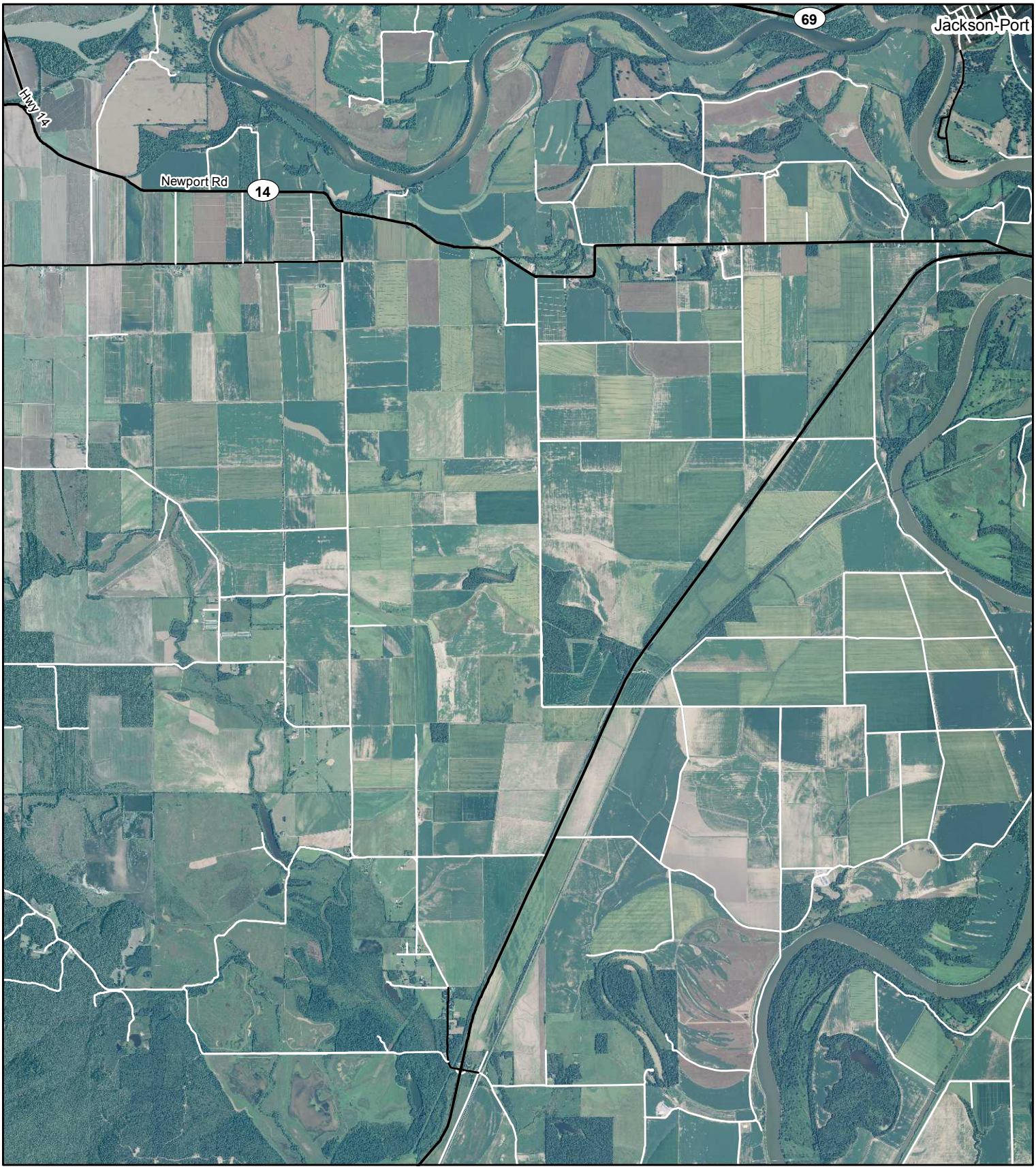
0 0.5 1 2 3 4 Miles

H6

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983



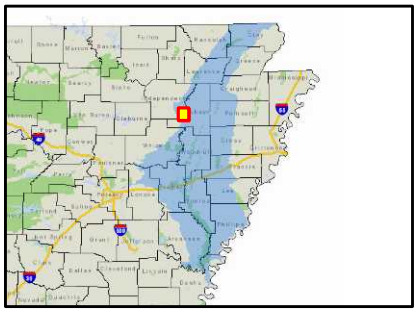


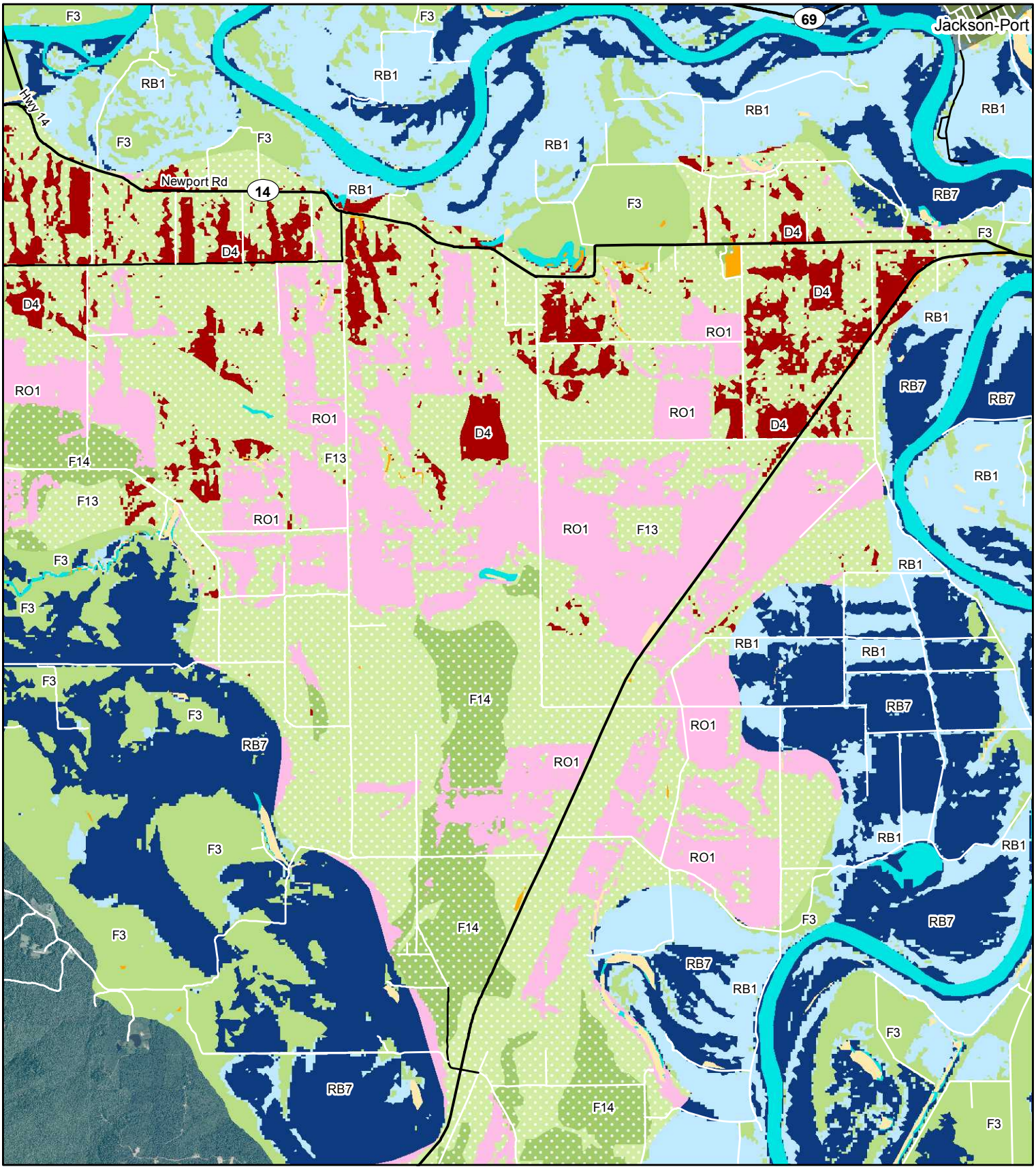
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

H7





0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
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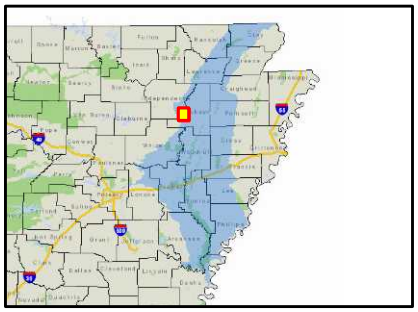
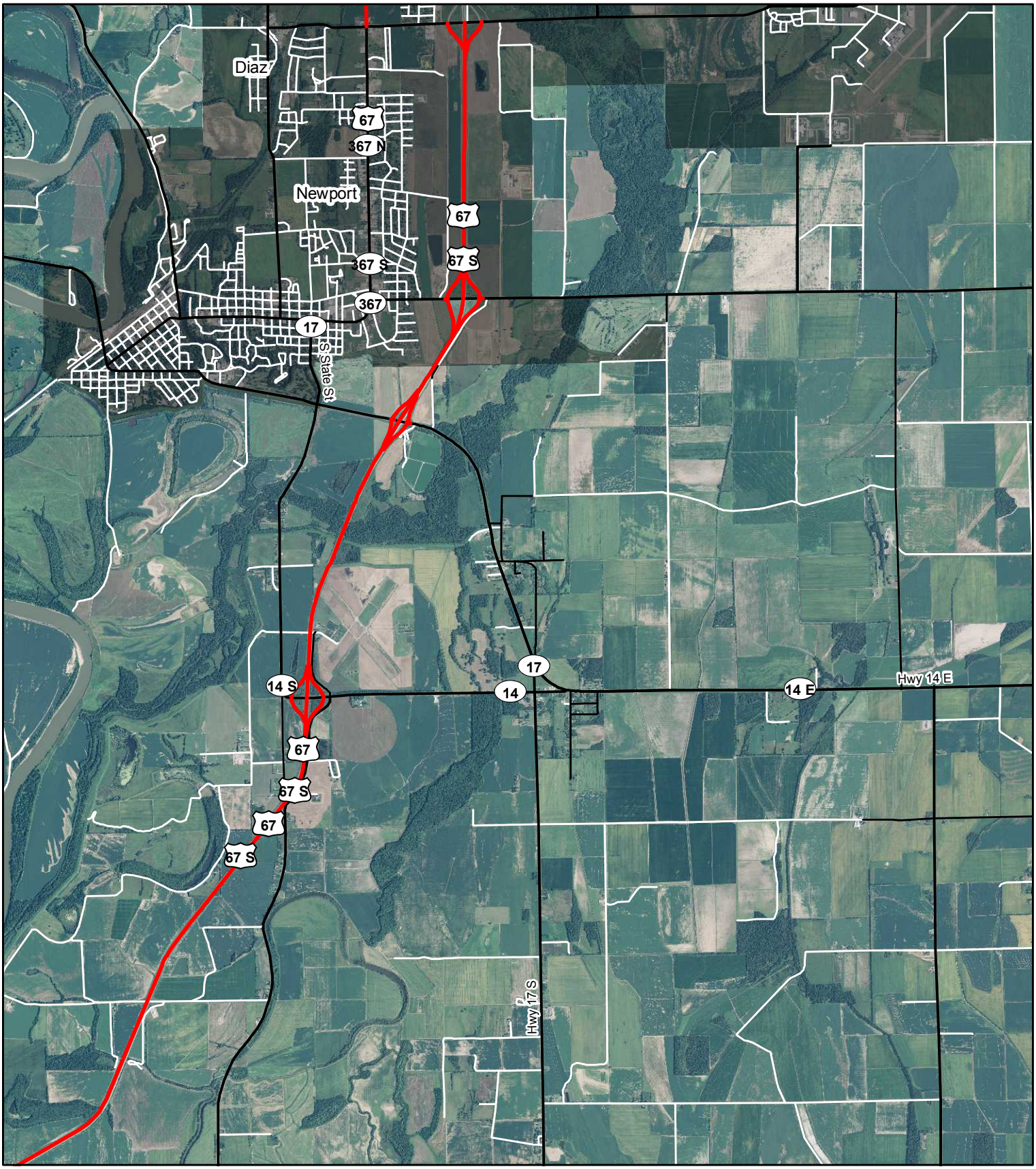
H7



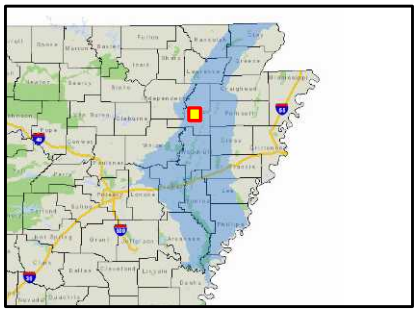


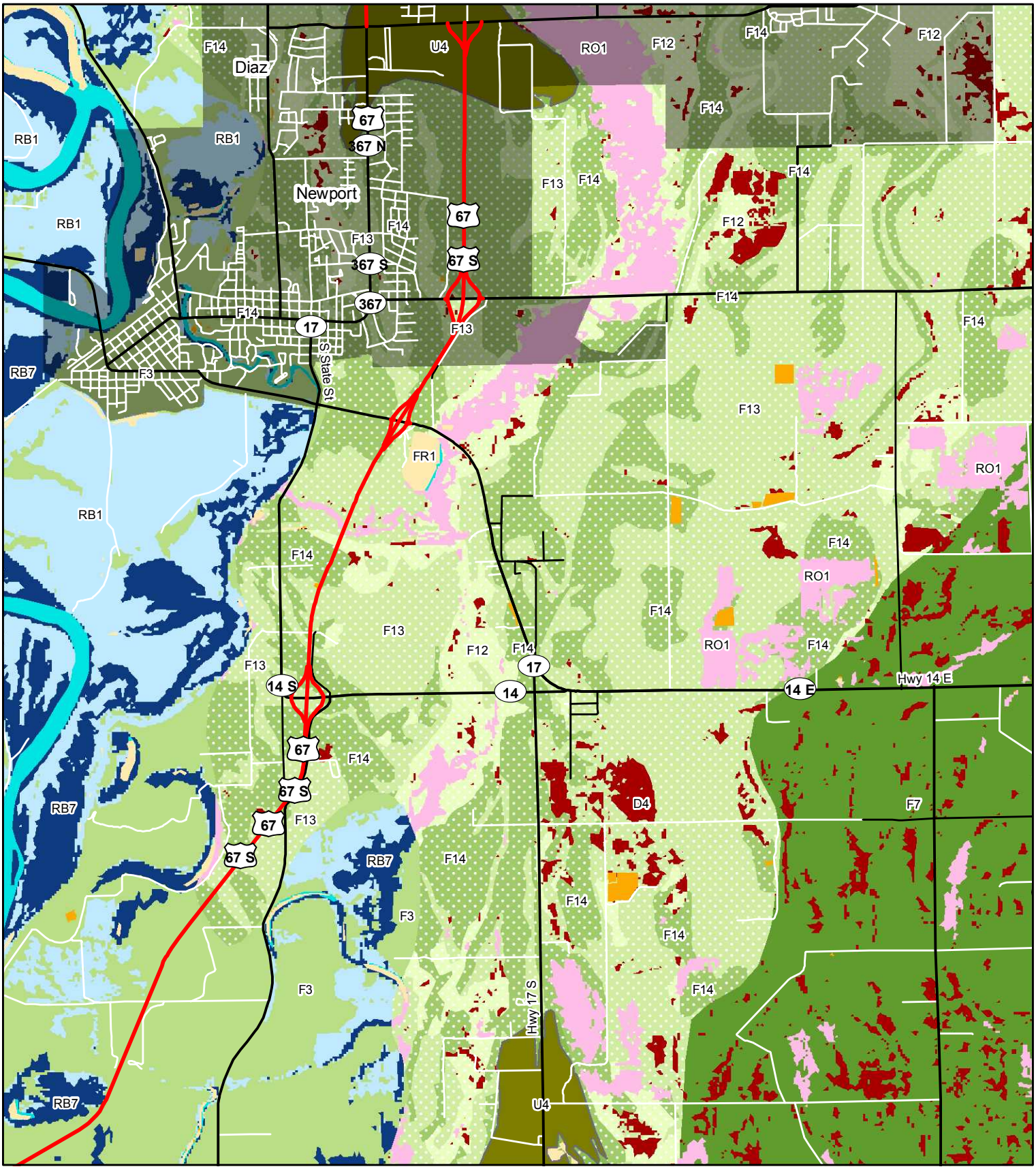
0 0.5 1 2 3 4 Miles

H8

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983





0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
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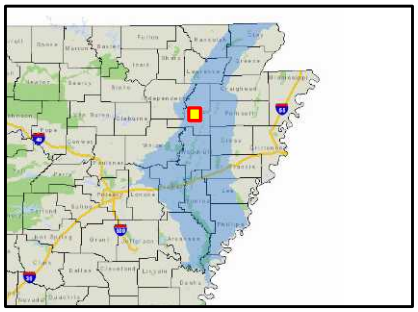
Datum: North American 1983

H8



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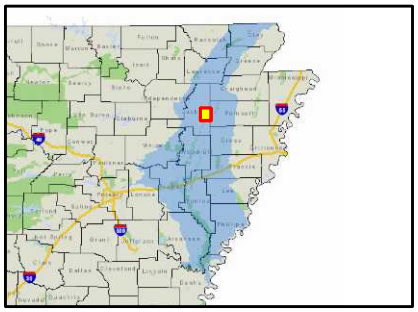
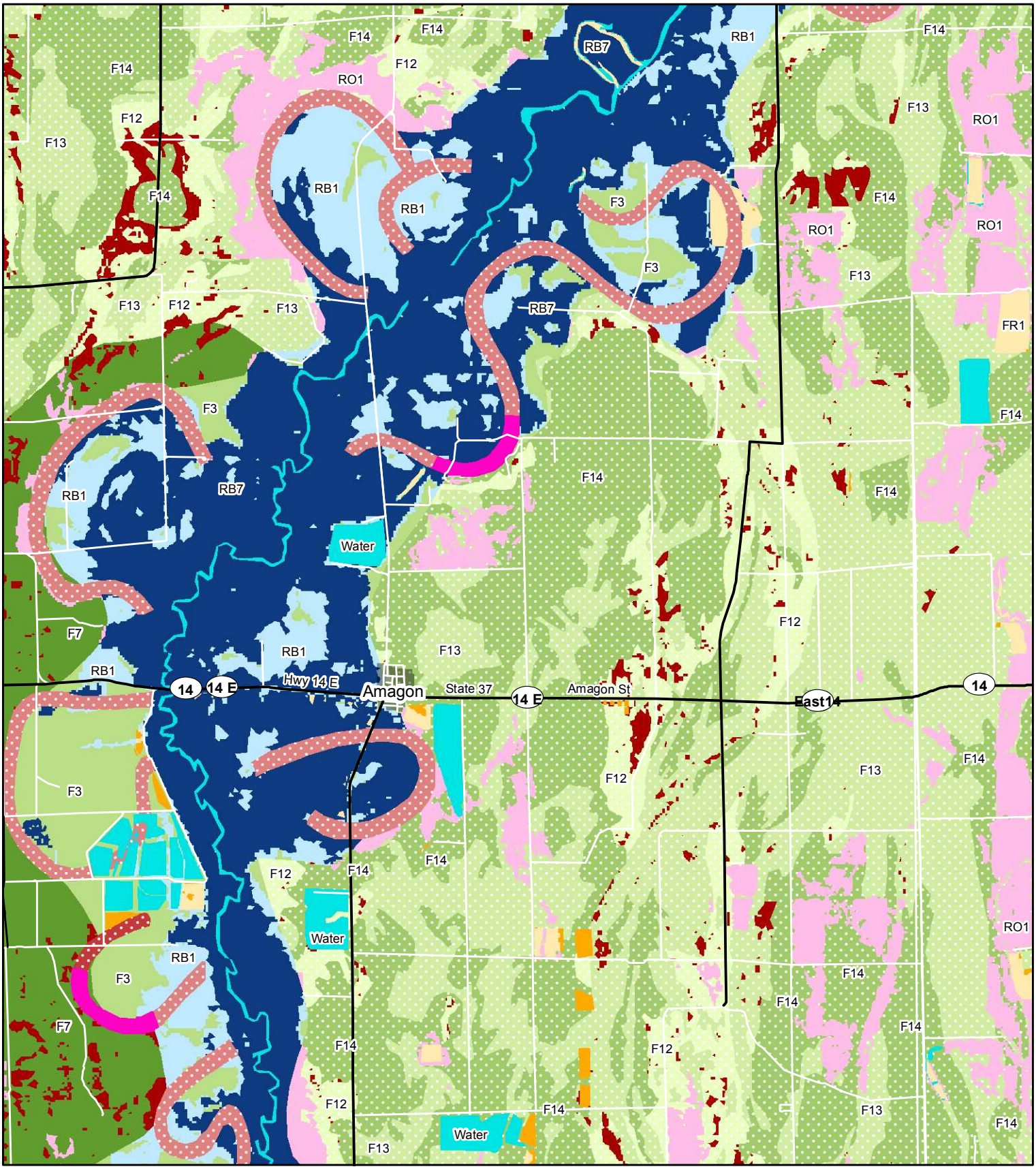
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

H9





0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
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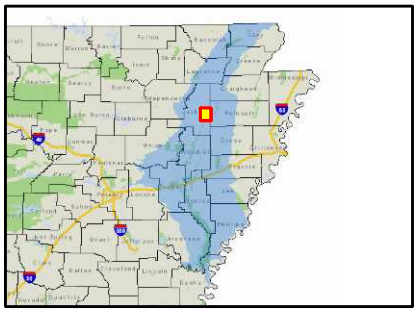
H9



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N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
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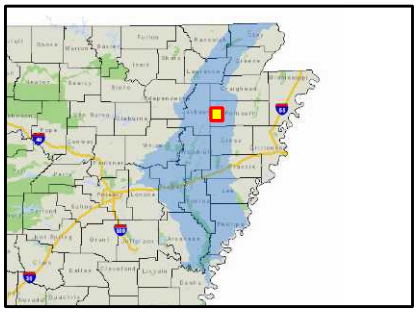
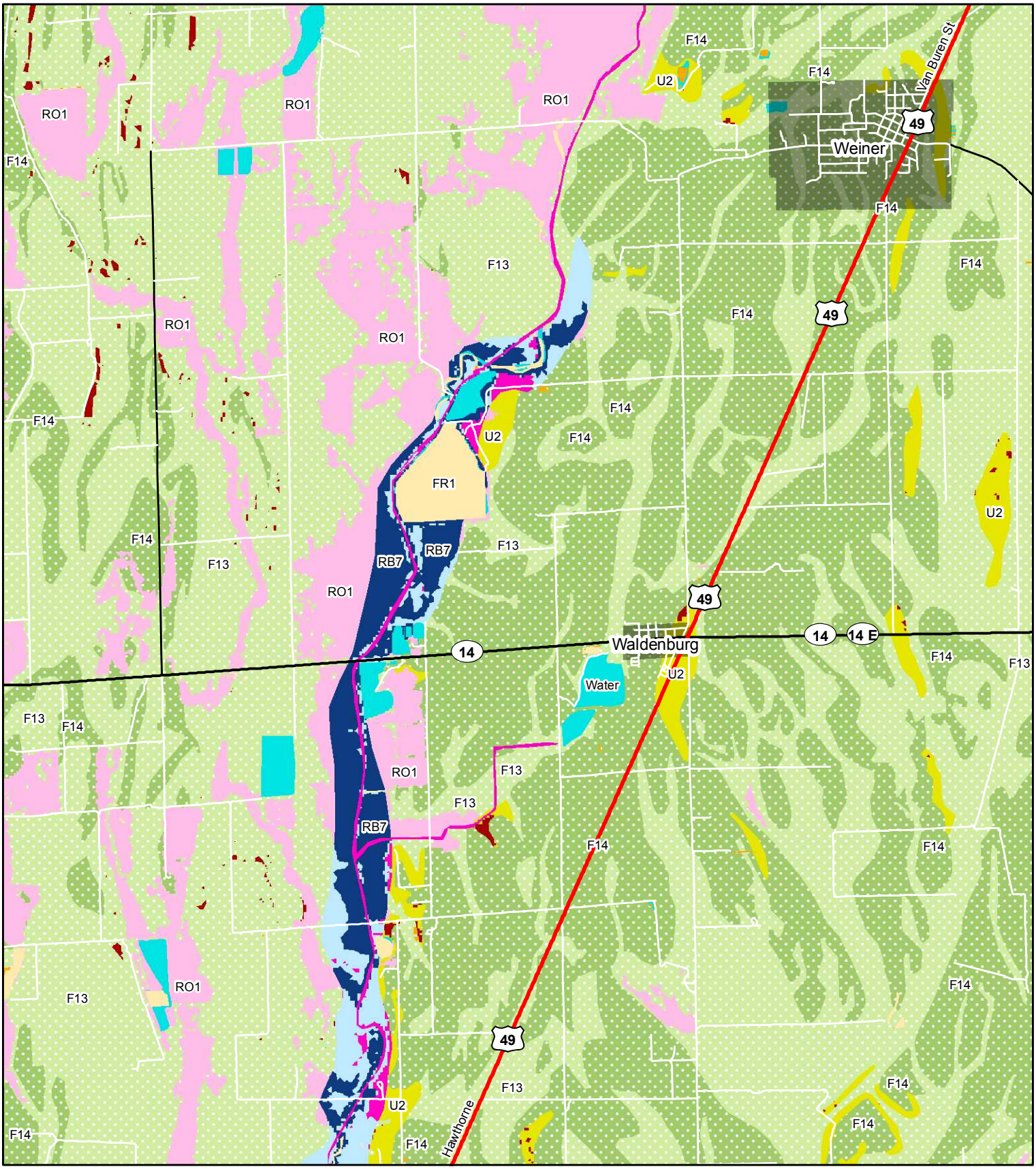
H10





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Projection: Transverse Mercator
Datum: North American 1983

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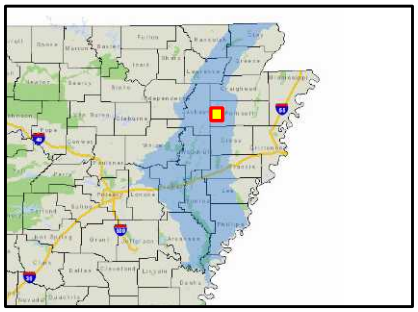

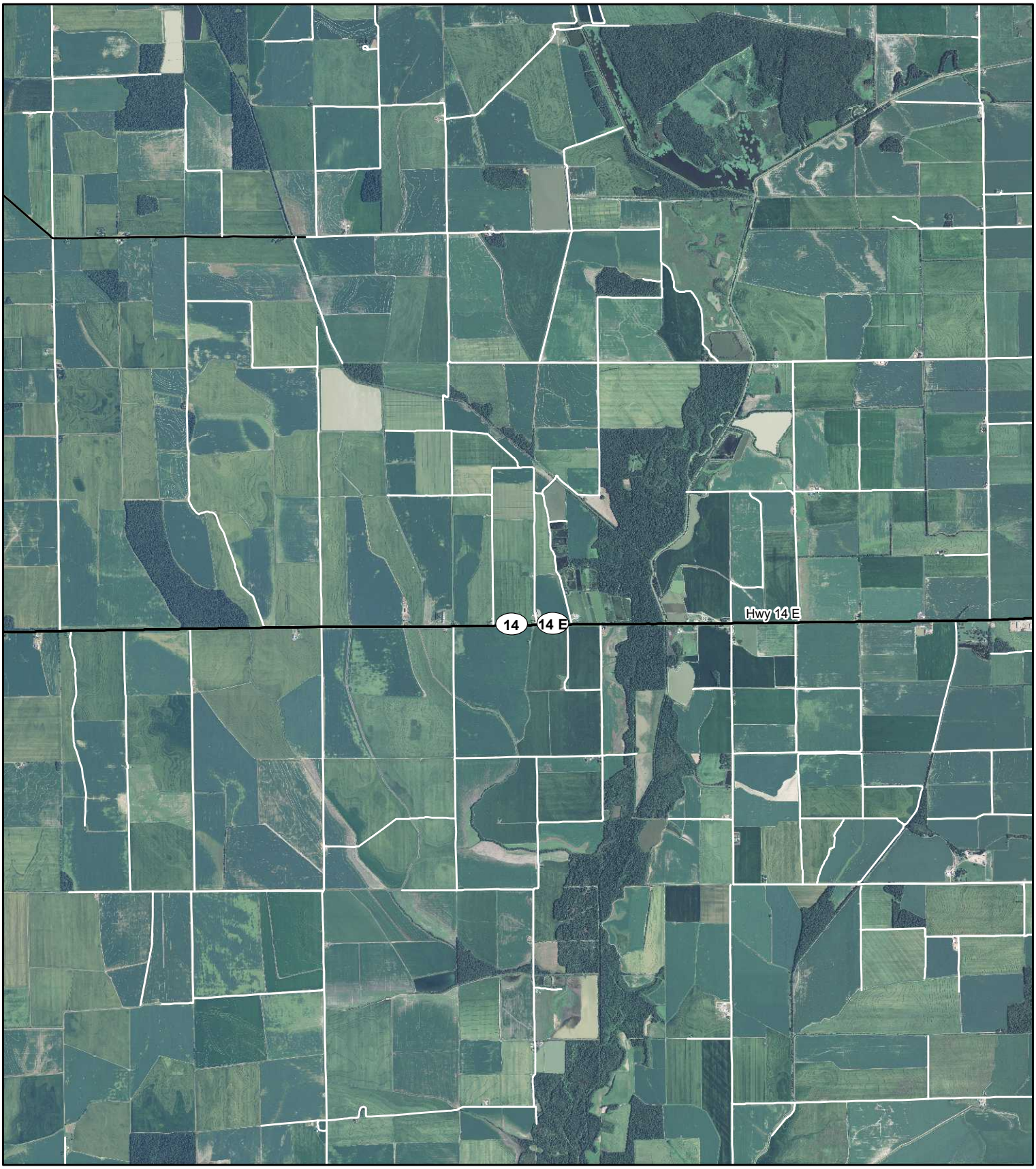

0 0.5 1 2 3 4 Miles

H11

N

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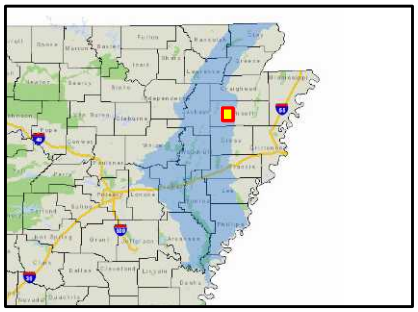
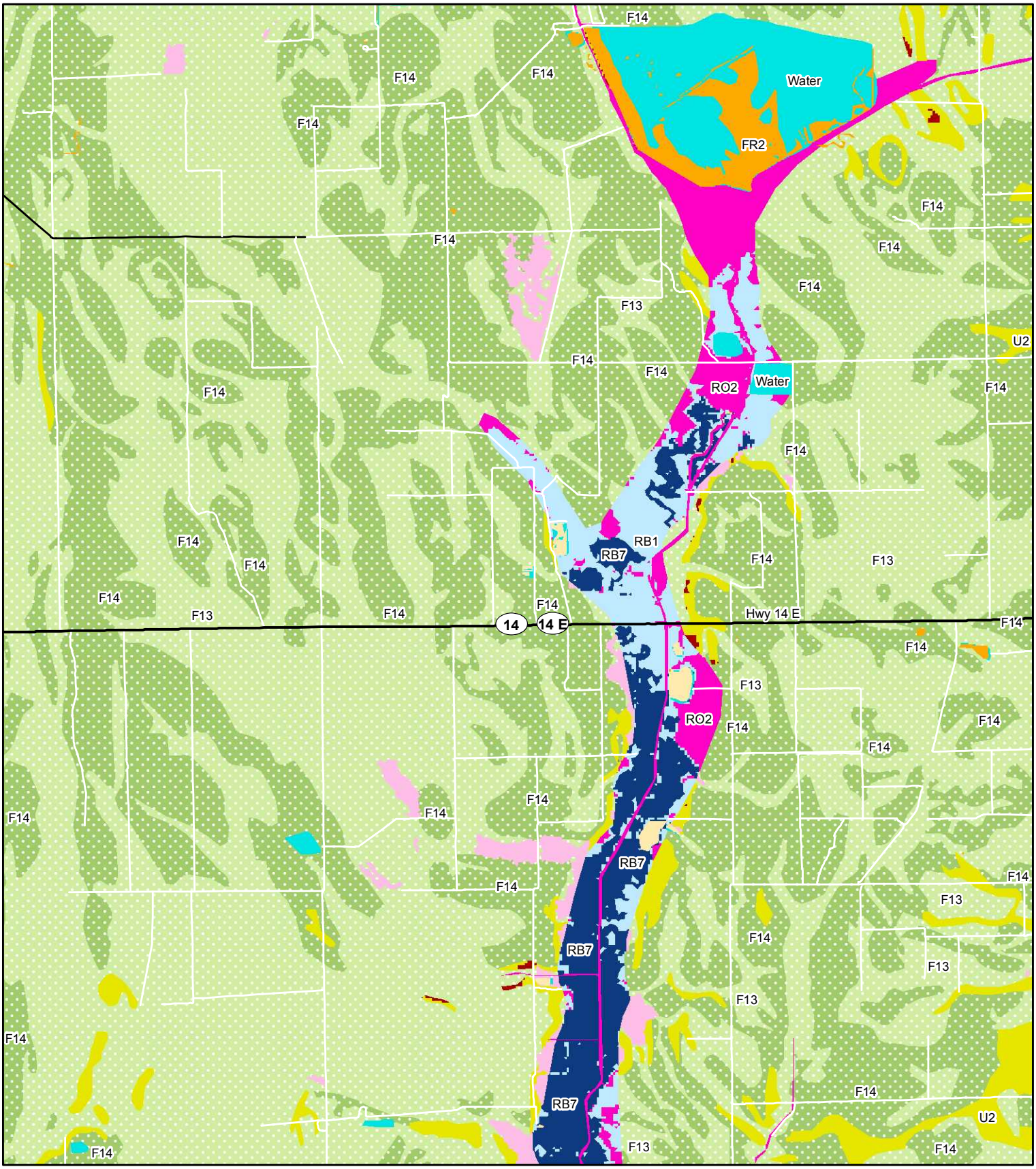
Projection: Transverse Mercator
Datum: North American 1983



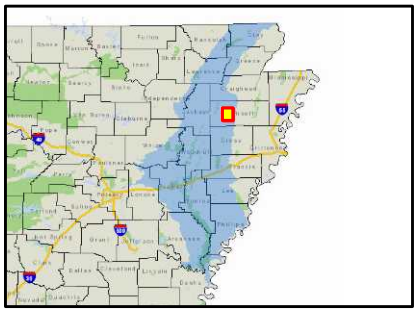


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

H11



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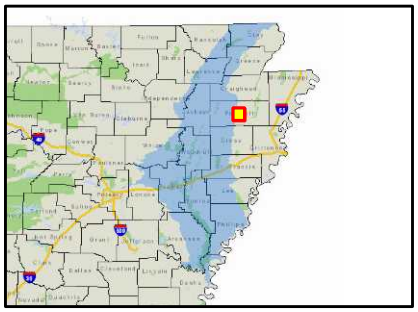
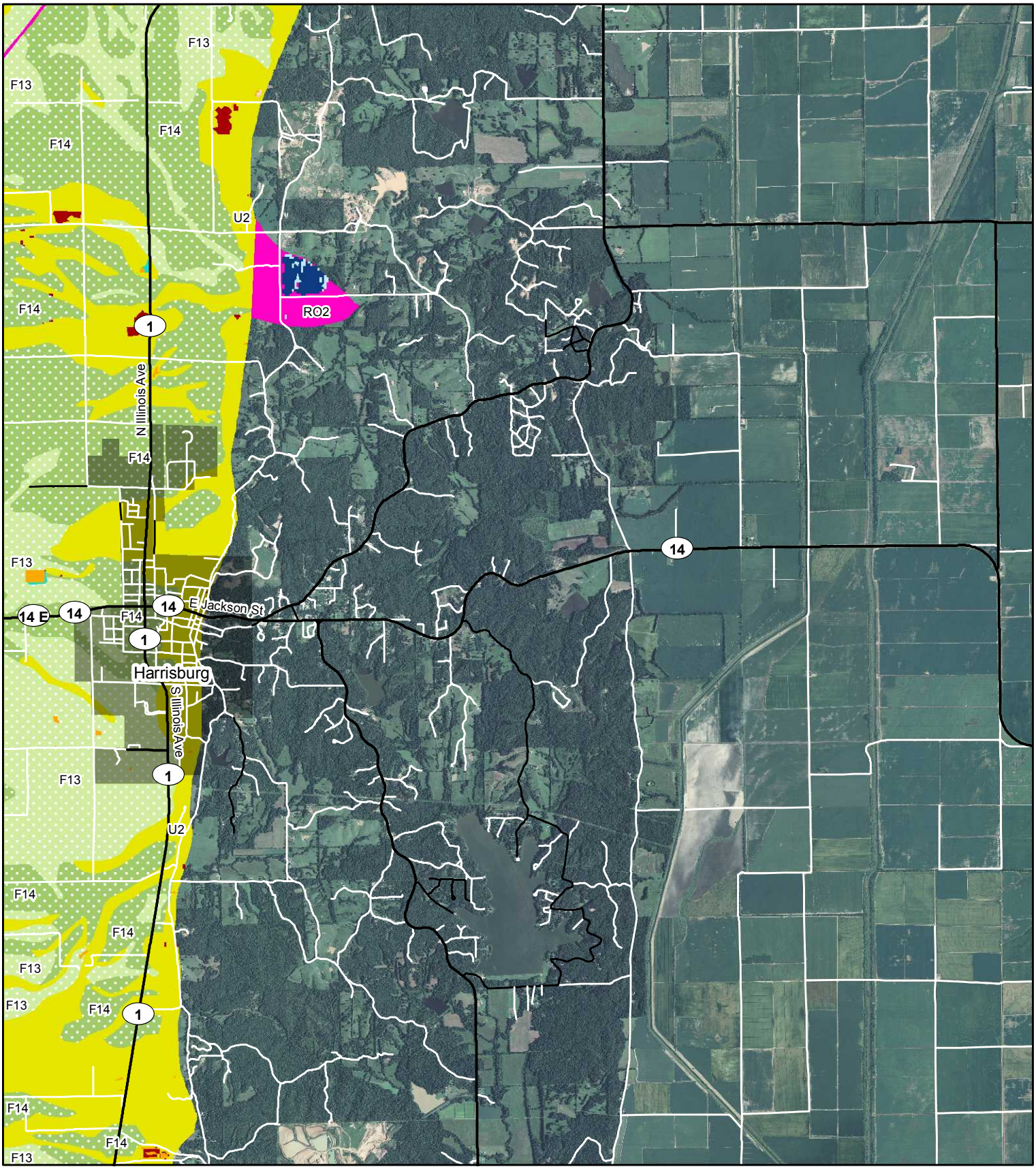
N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

H12





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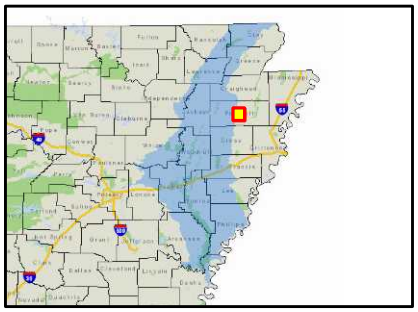
Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

H12



Hwy 87

167

167

Bradford

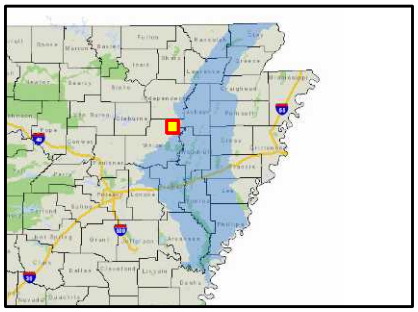
67

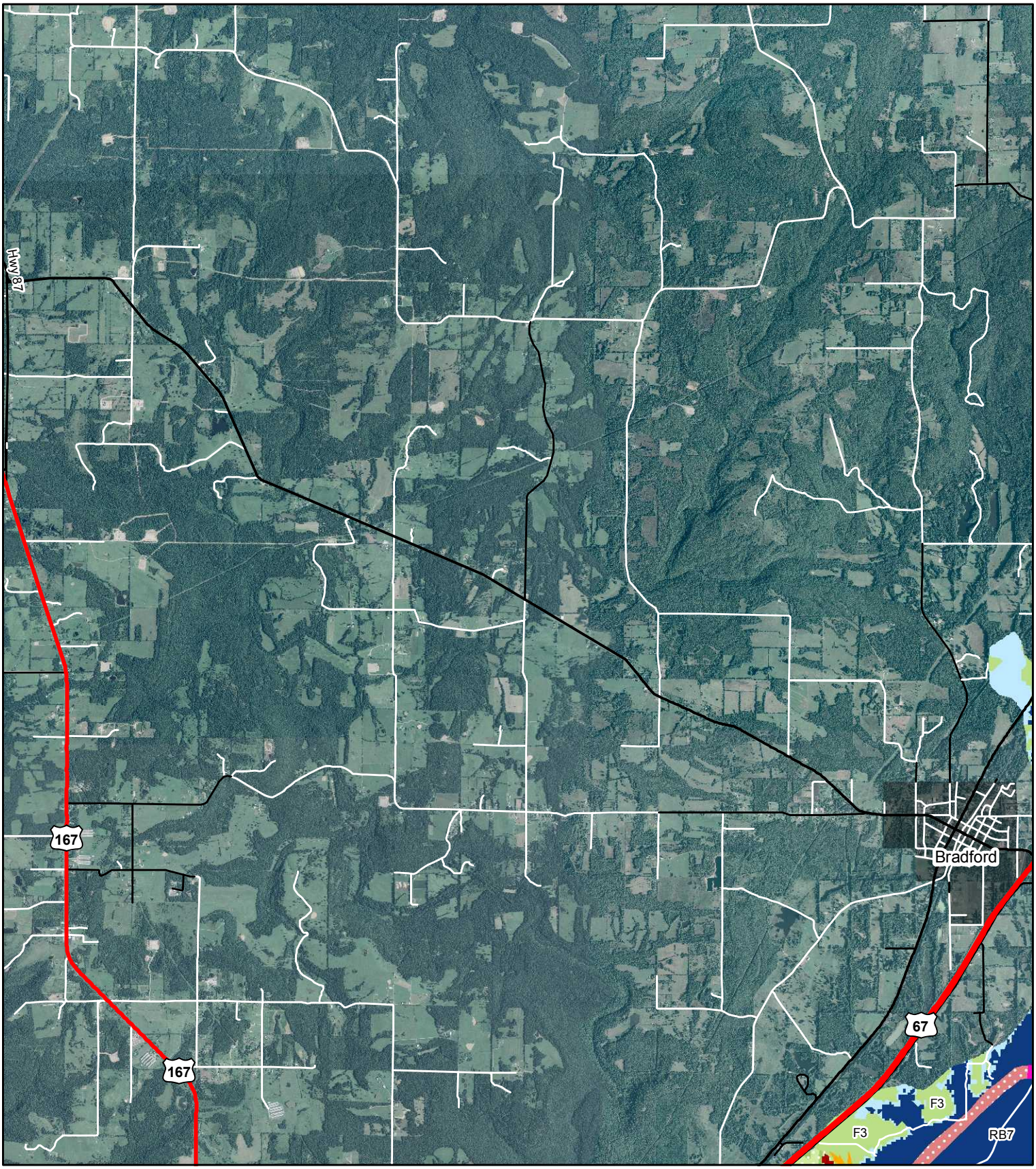
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

I6





0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
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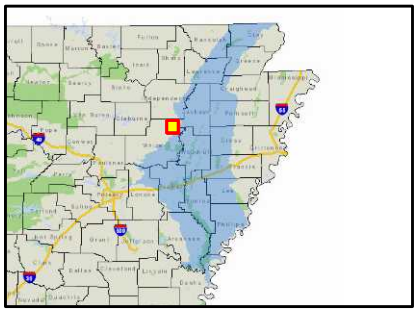
I6

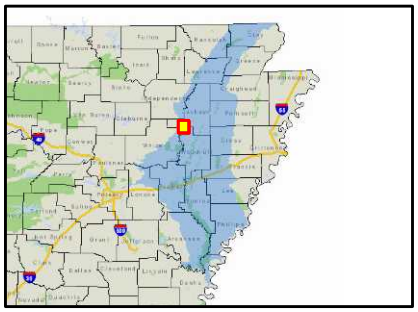


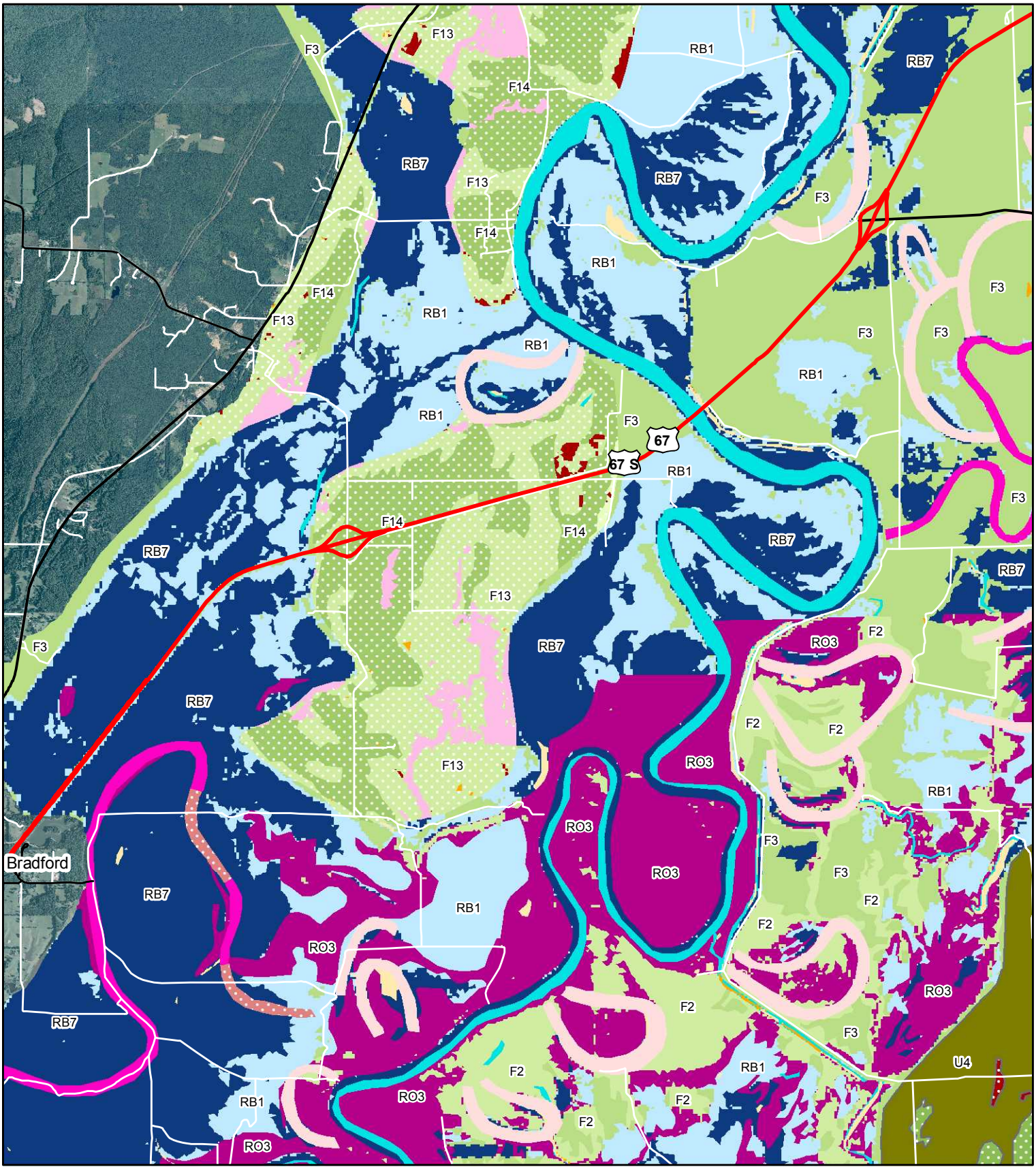
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

17



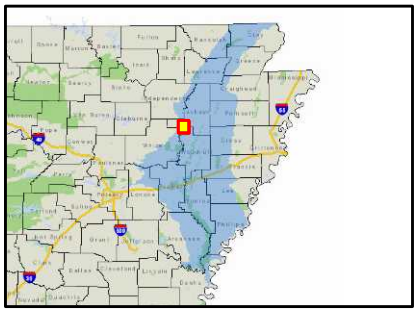


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

17



Hwy 17 S

Weldon

17

Hwy 17 S

17 S

E Front

Tupelo

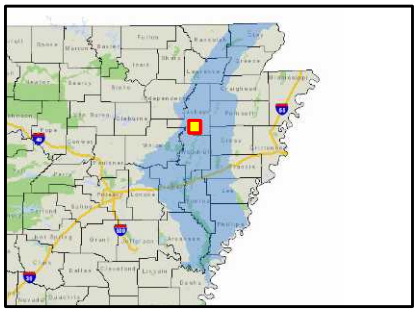
33

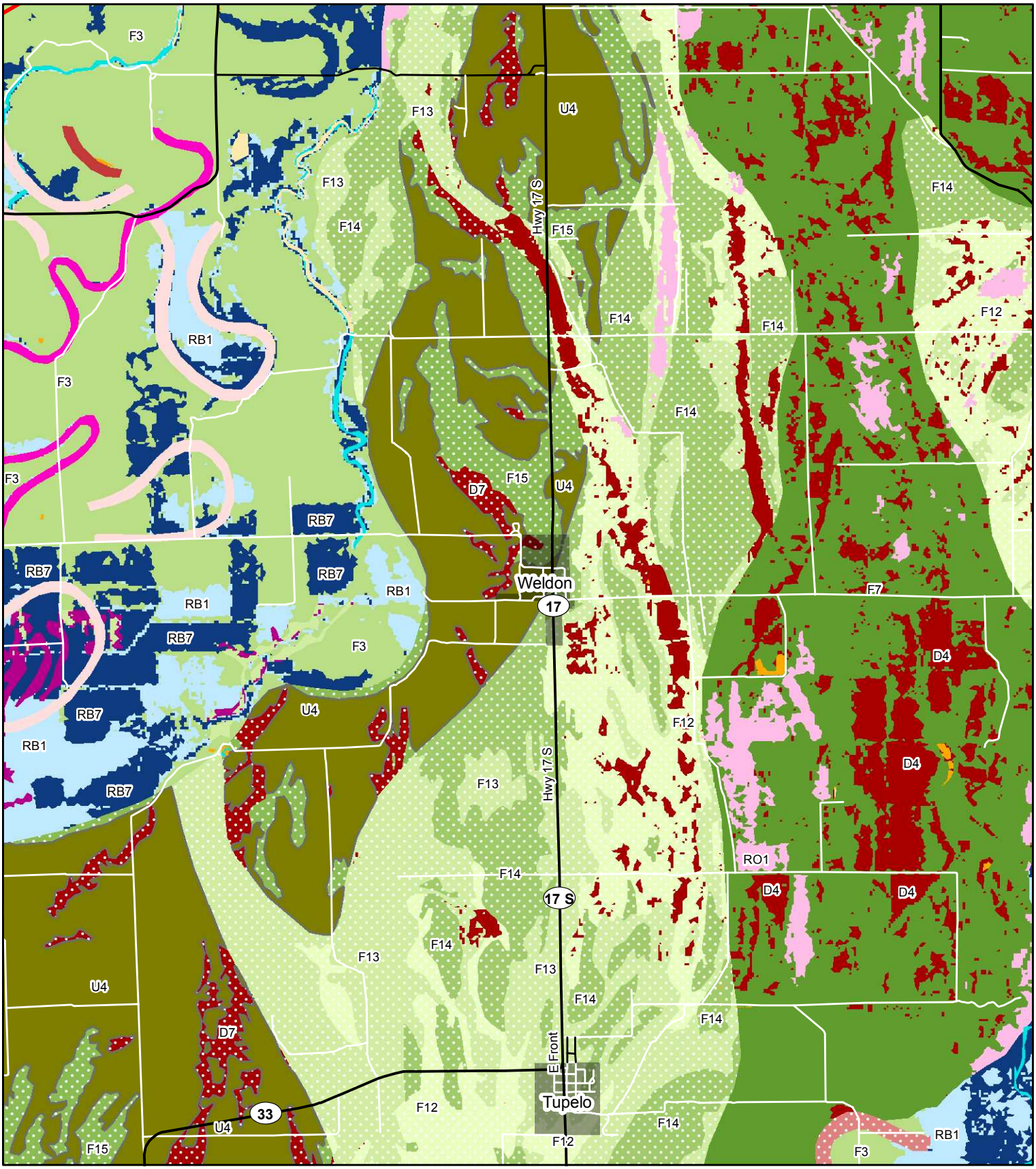
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

18



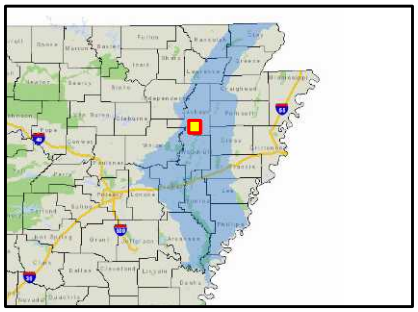


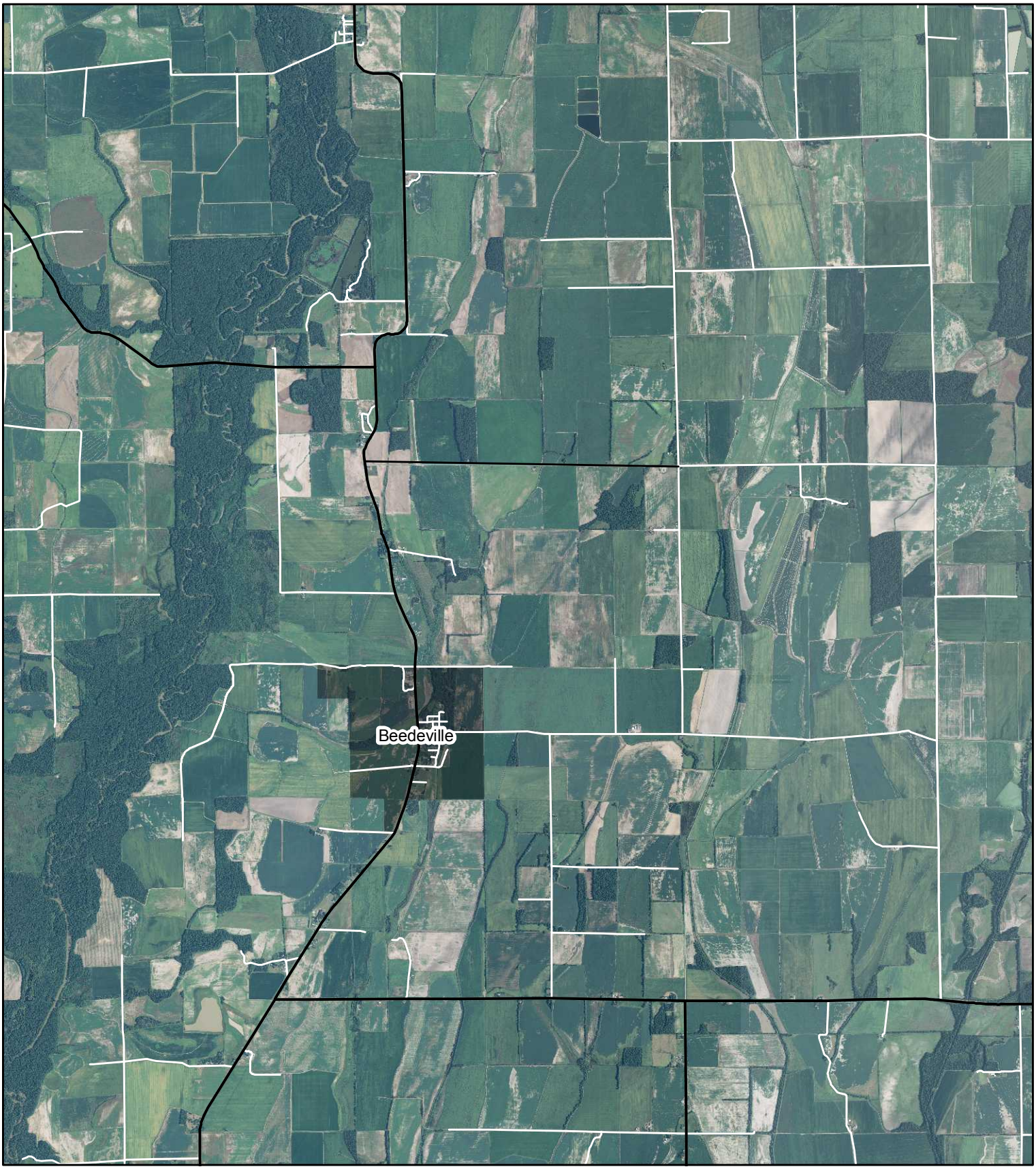
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

I8



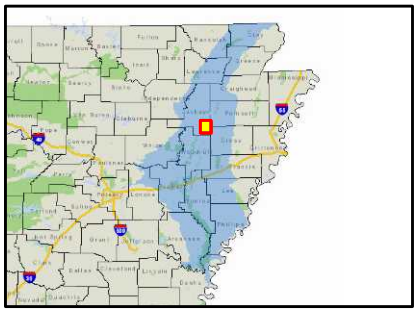


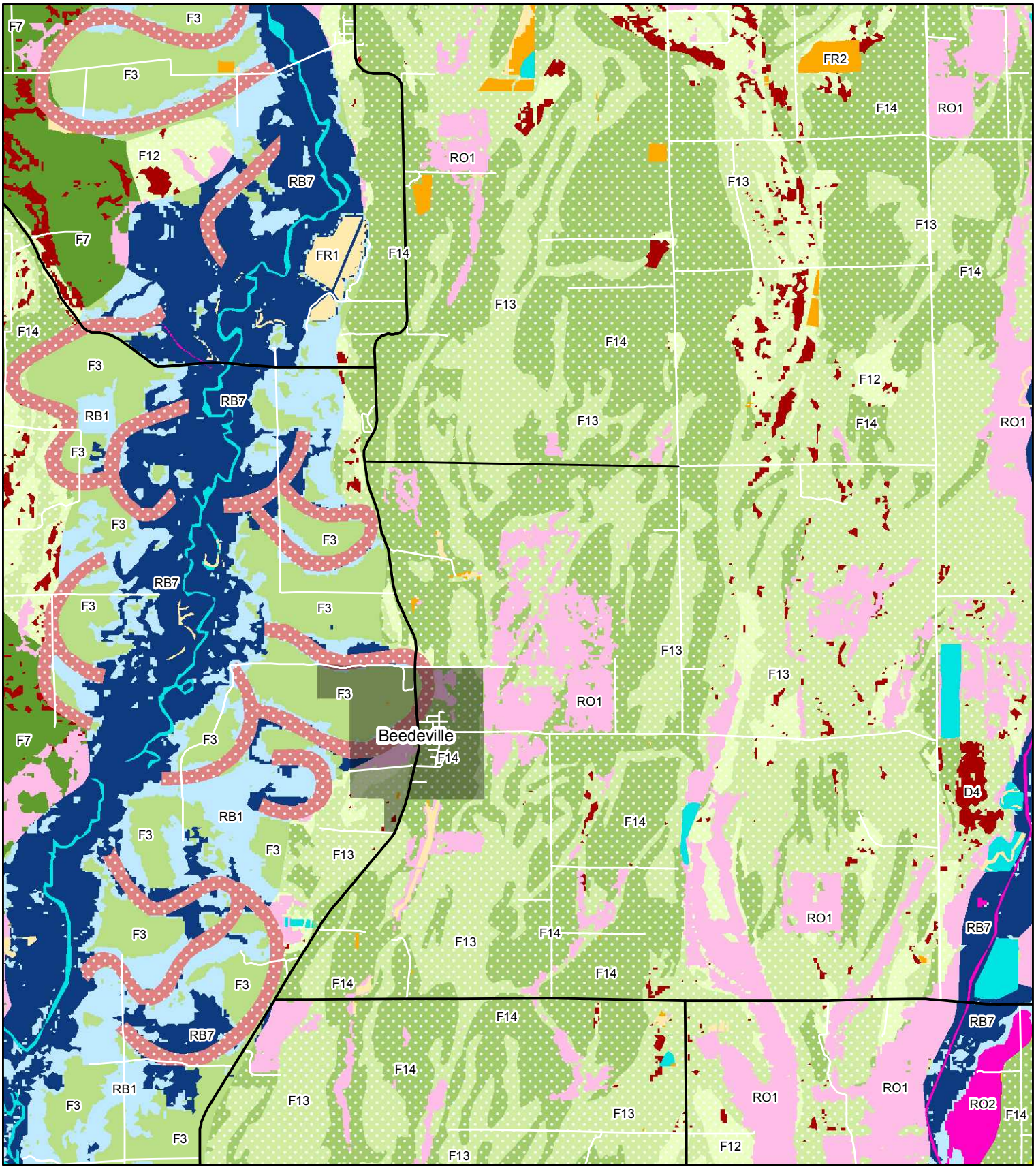
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

I9



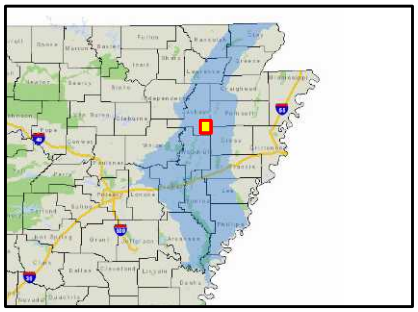


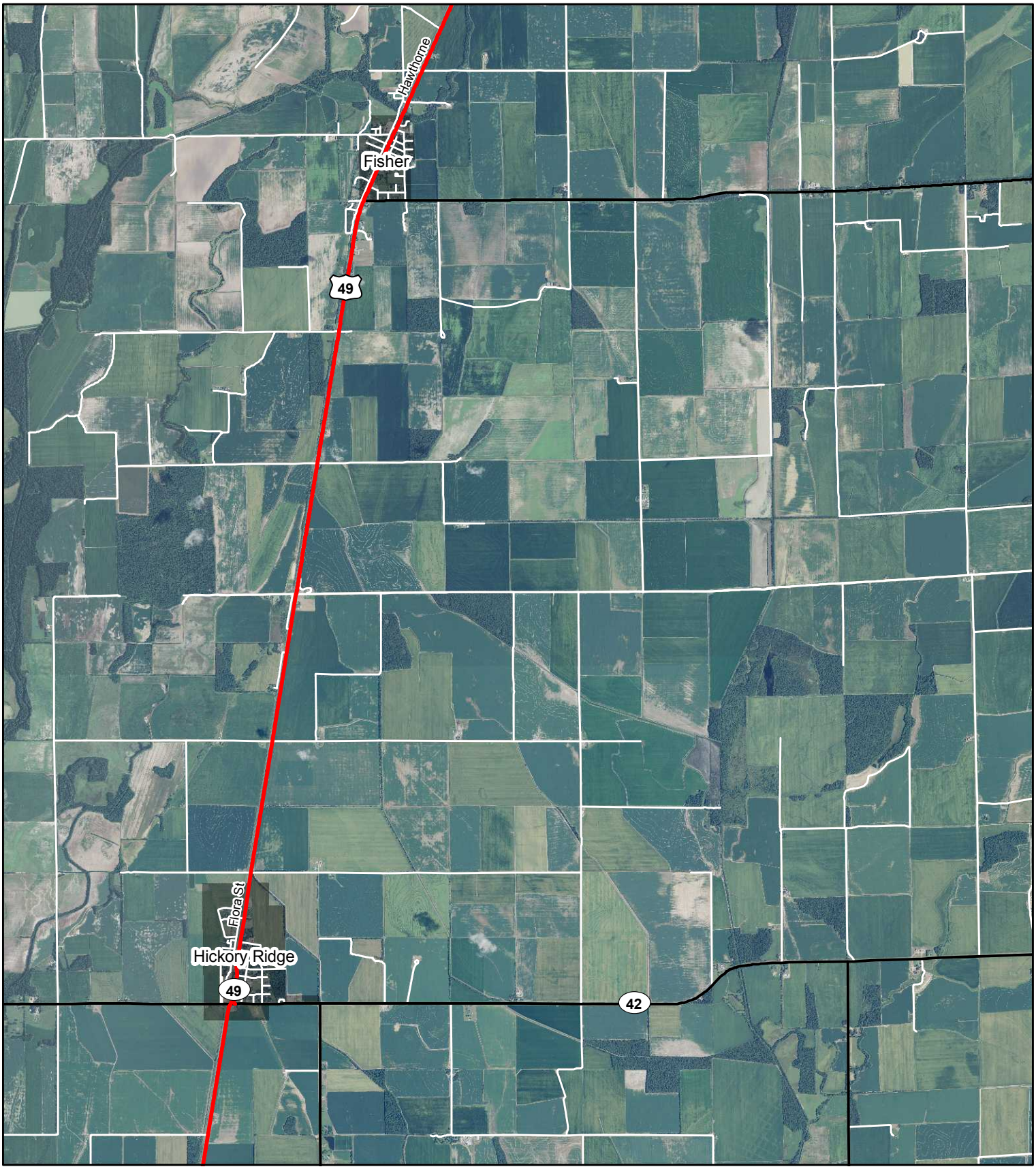
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

I9





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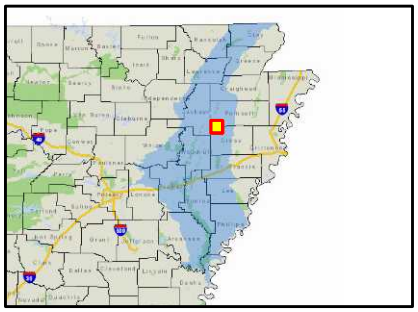

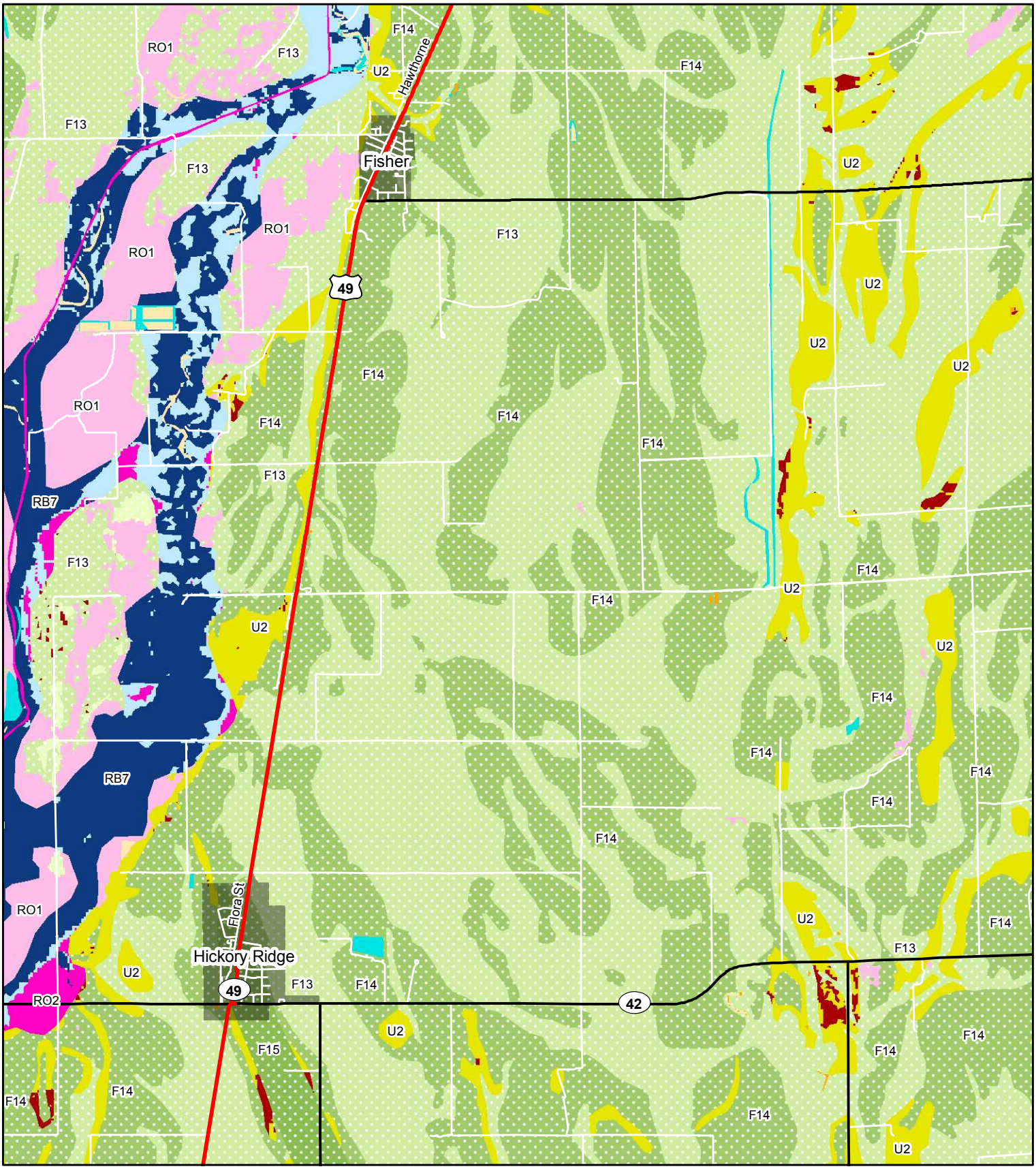

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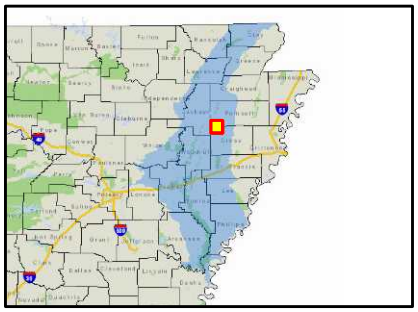

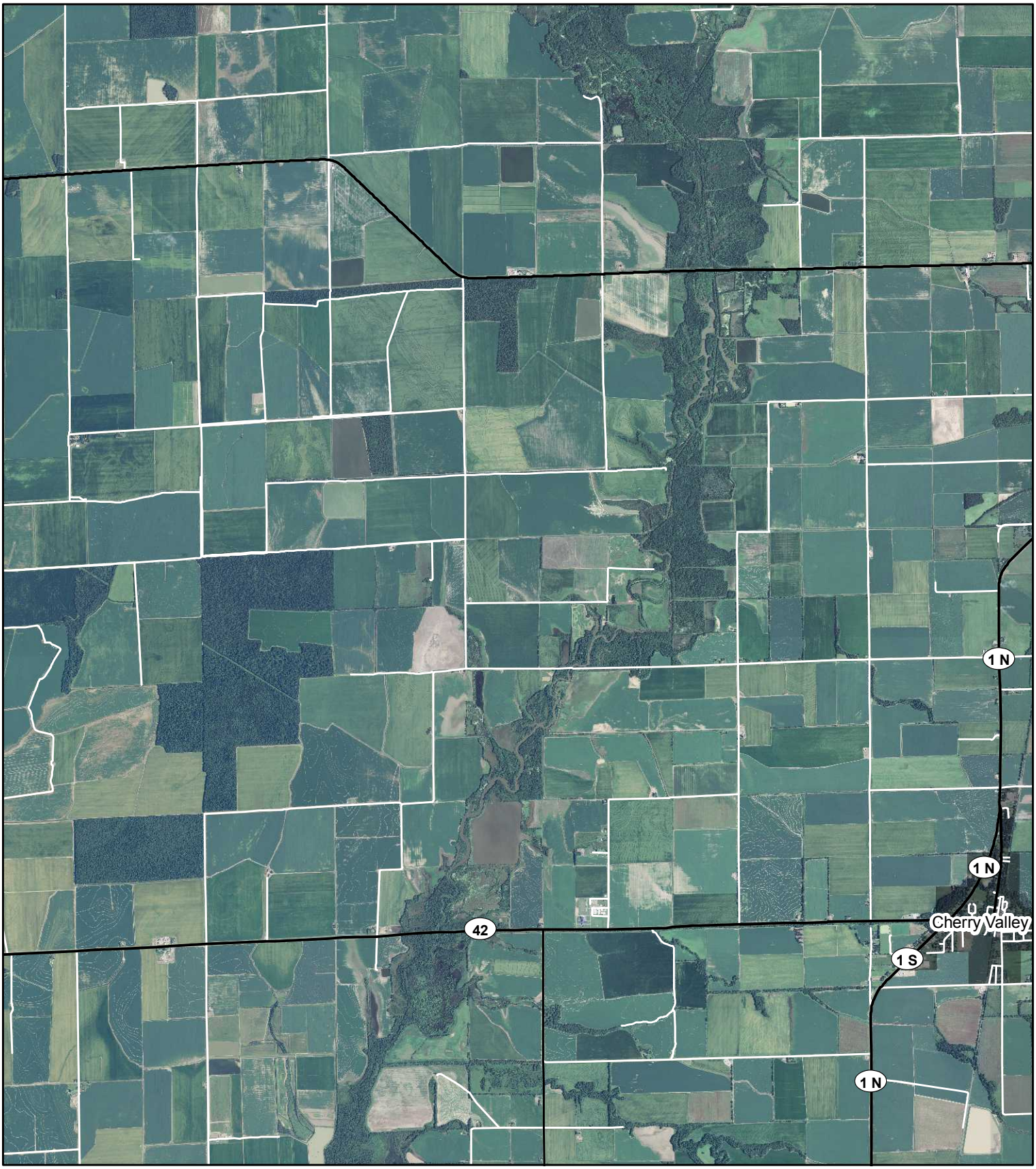

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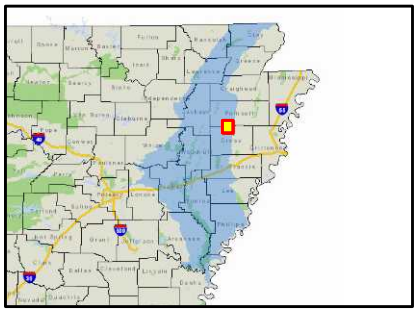
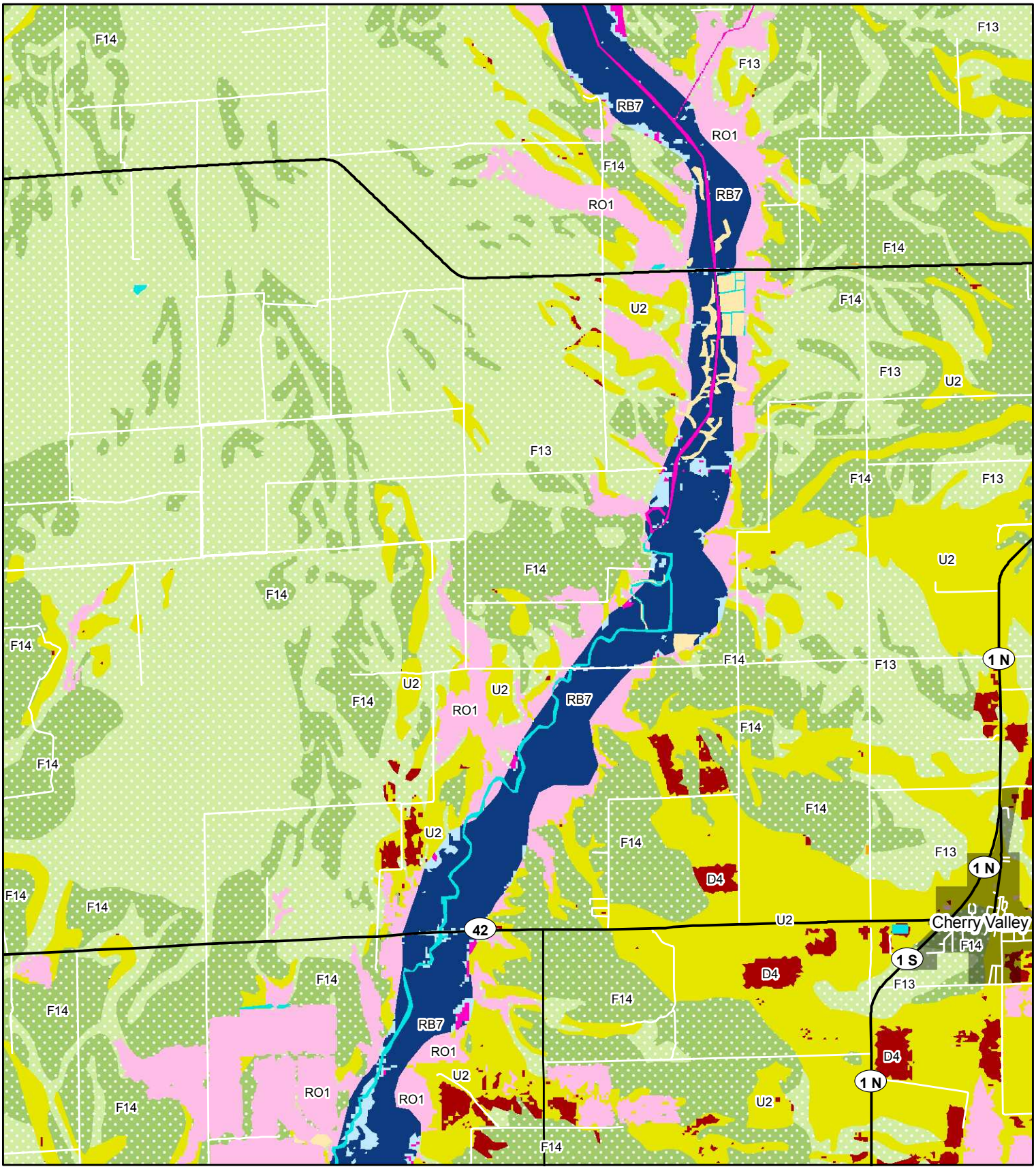
I11





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N

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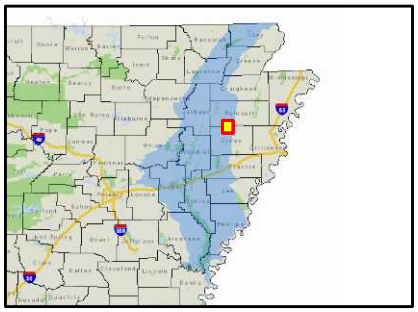
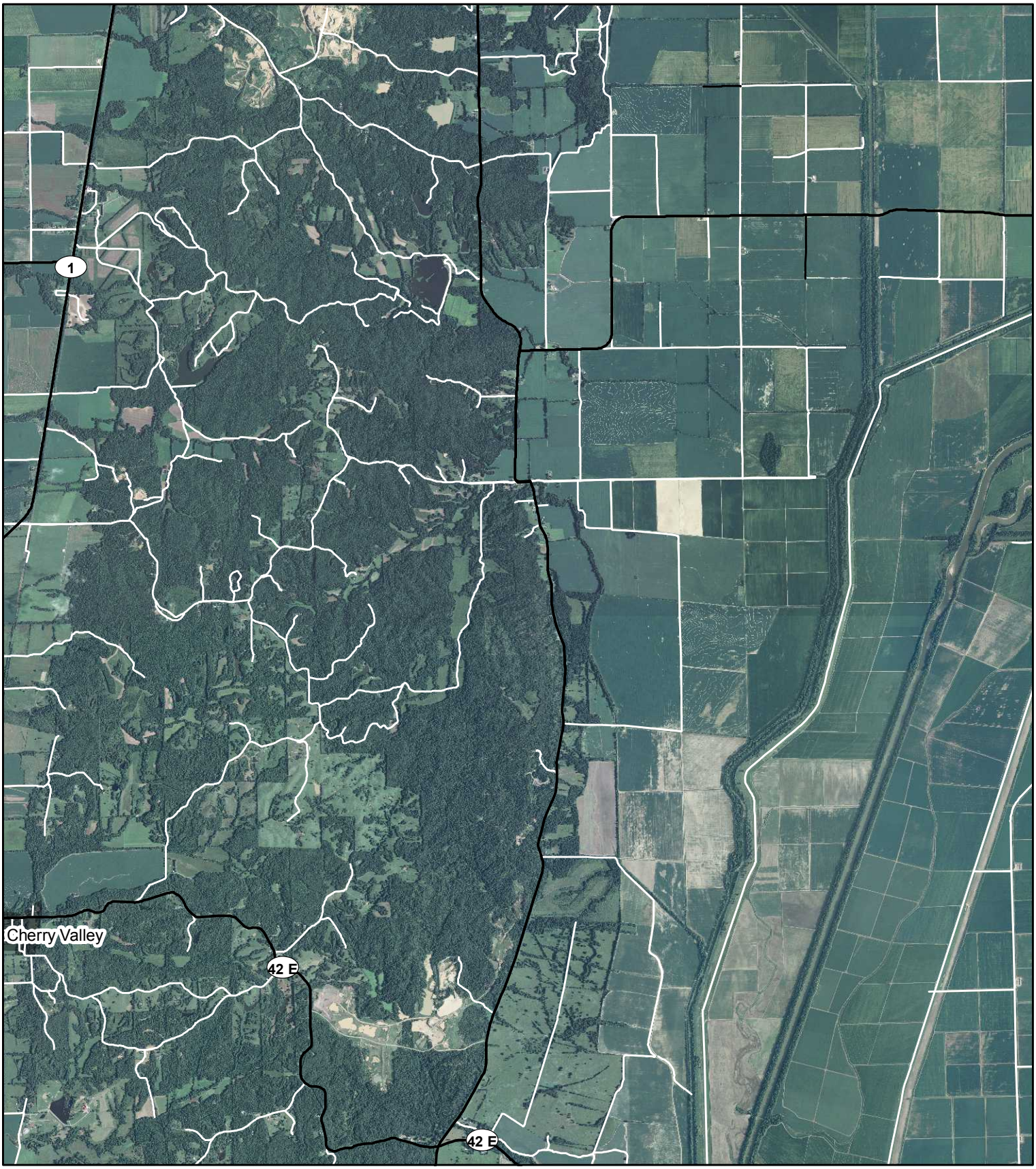
Projection: Transverse Mercator
Datum: North American 1983

I11





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Projection: Transverse Mercator
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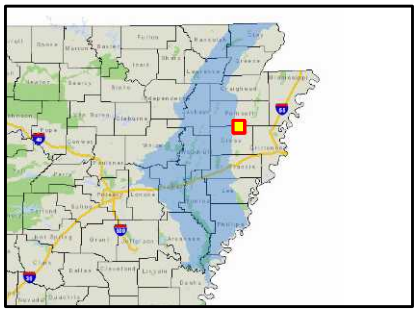


F14

U2

F14

F14

1

F14

U2

D4

U2

Cherry Valley

42 E

RO2

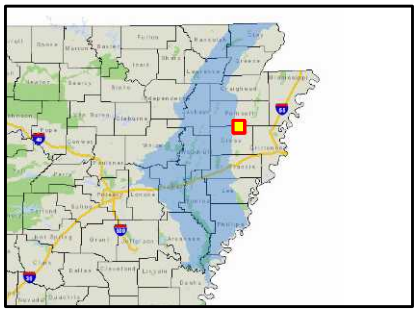
42 E

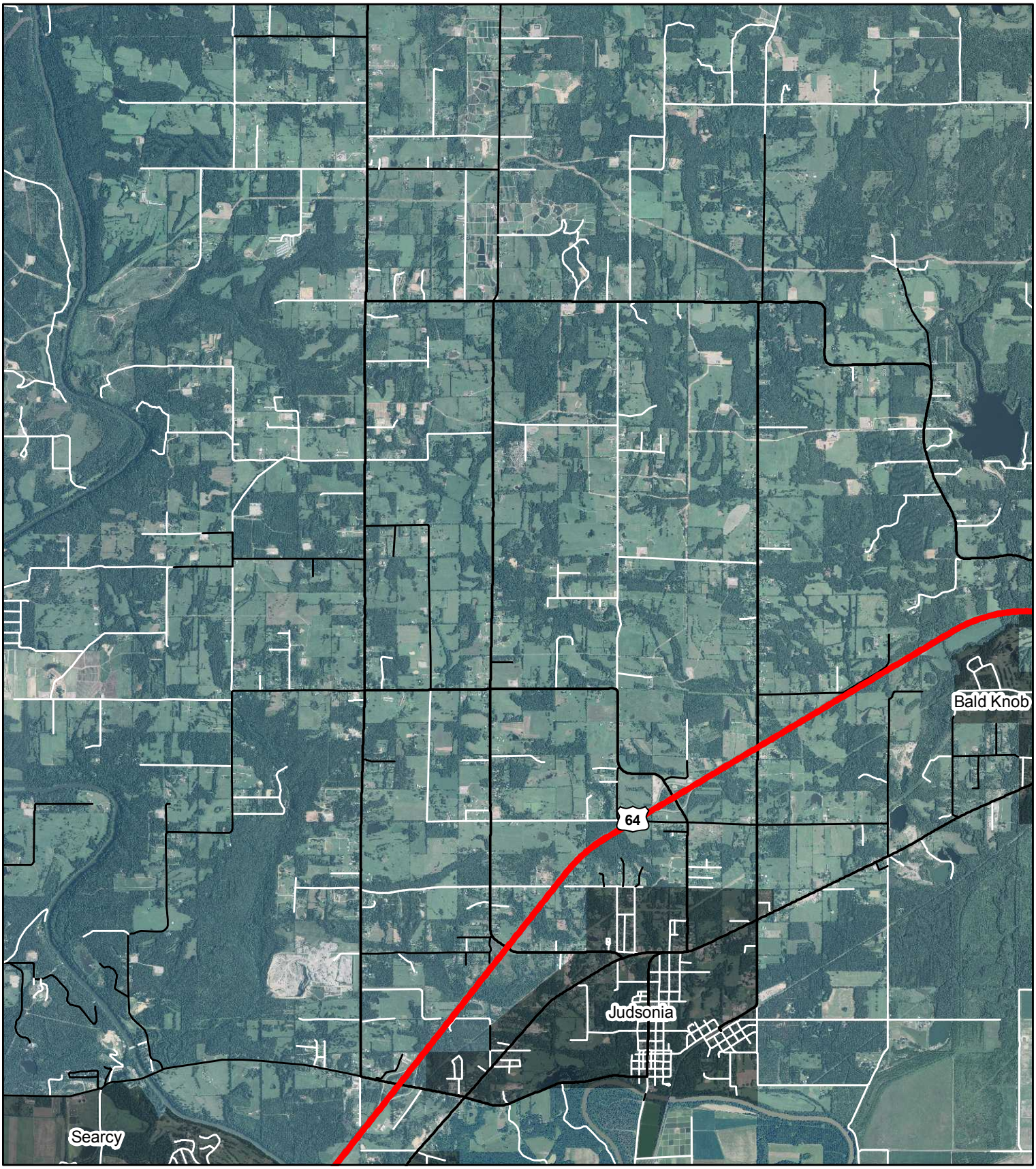
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

I12



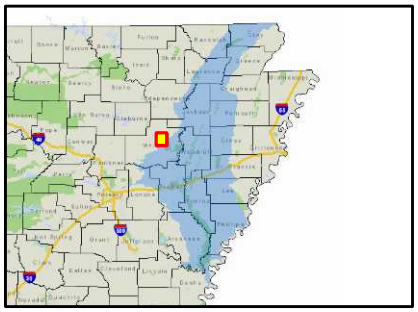


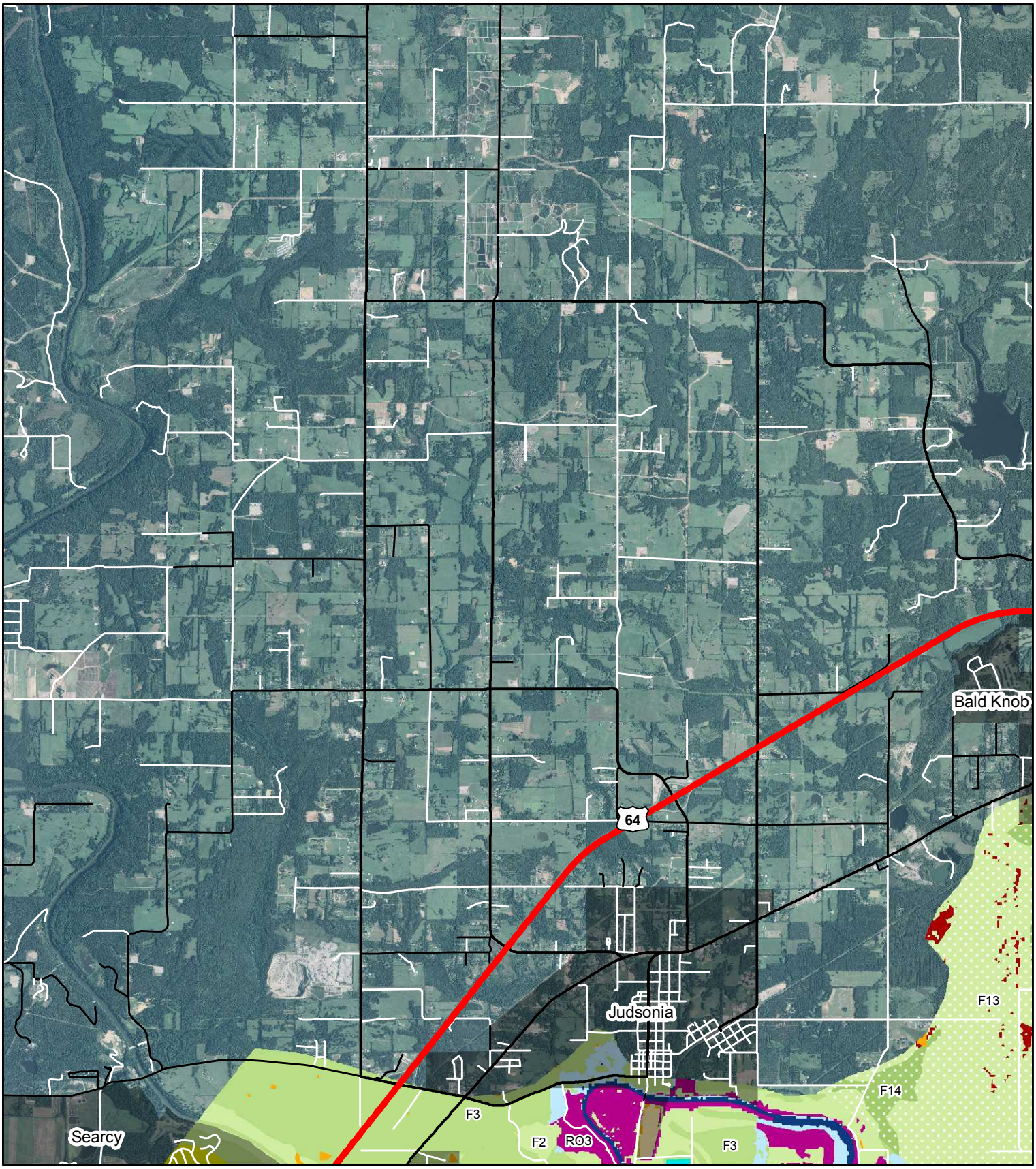
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

J5





0 0.5 1 2 3 4 Miles

N

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Projection: Transverse Mercator
Datum: North American 1983

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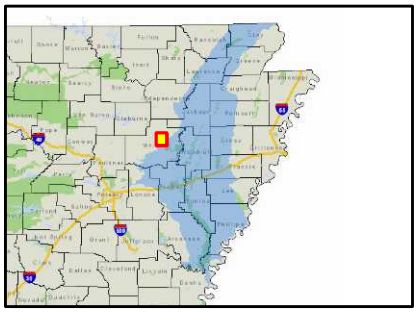


Russell

167

67

167

167

167

67

64 E

Bald Knob

64

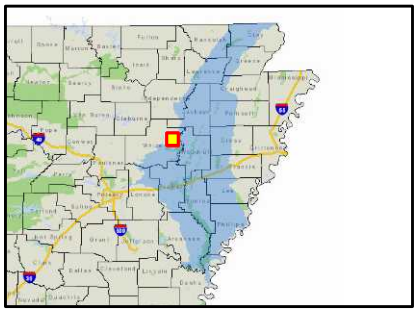
64 E

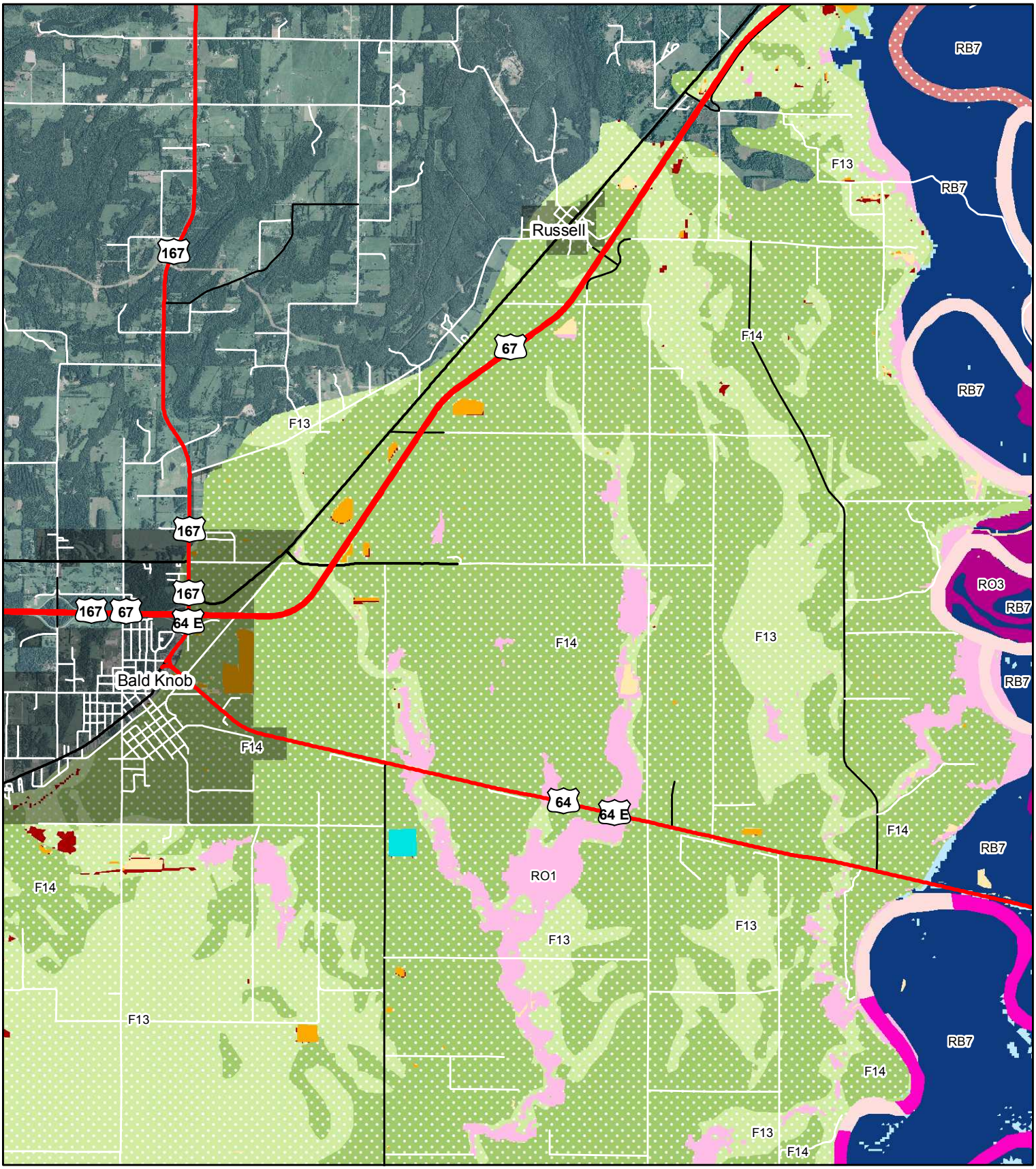
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

J6





0 0.5 1 2 3 4 Miles

N

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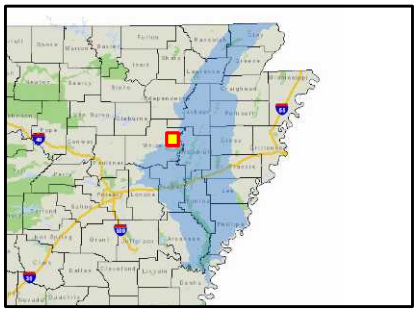
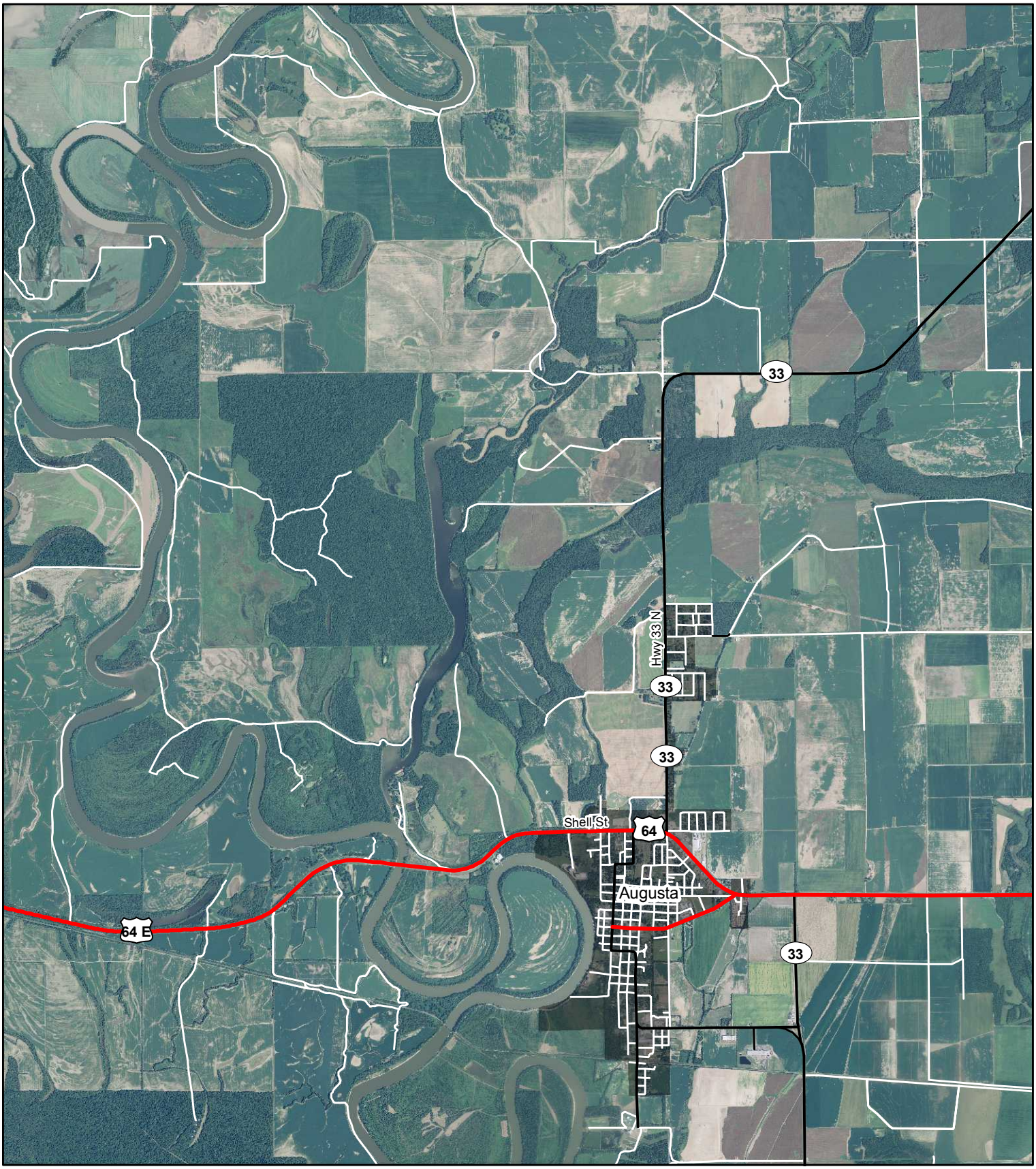
J6





0 0.5 1 2 3 4 Miles

N

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Projection: Transverse Mercator
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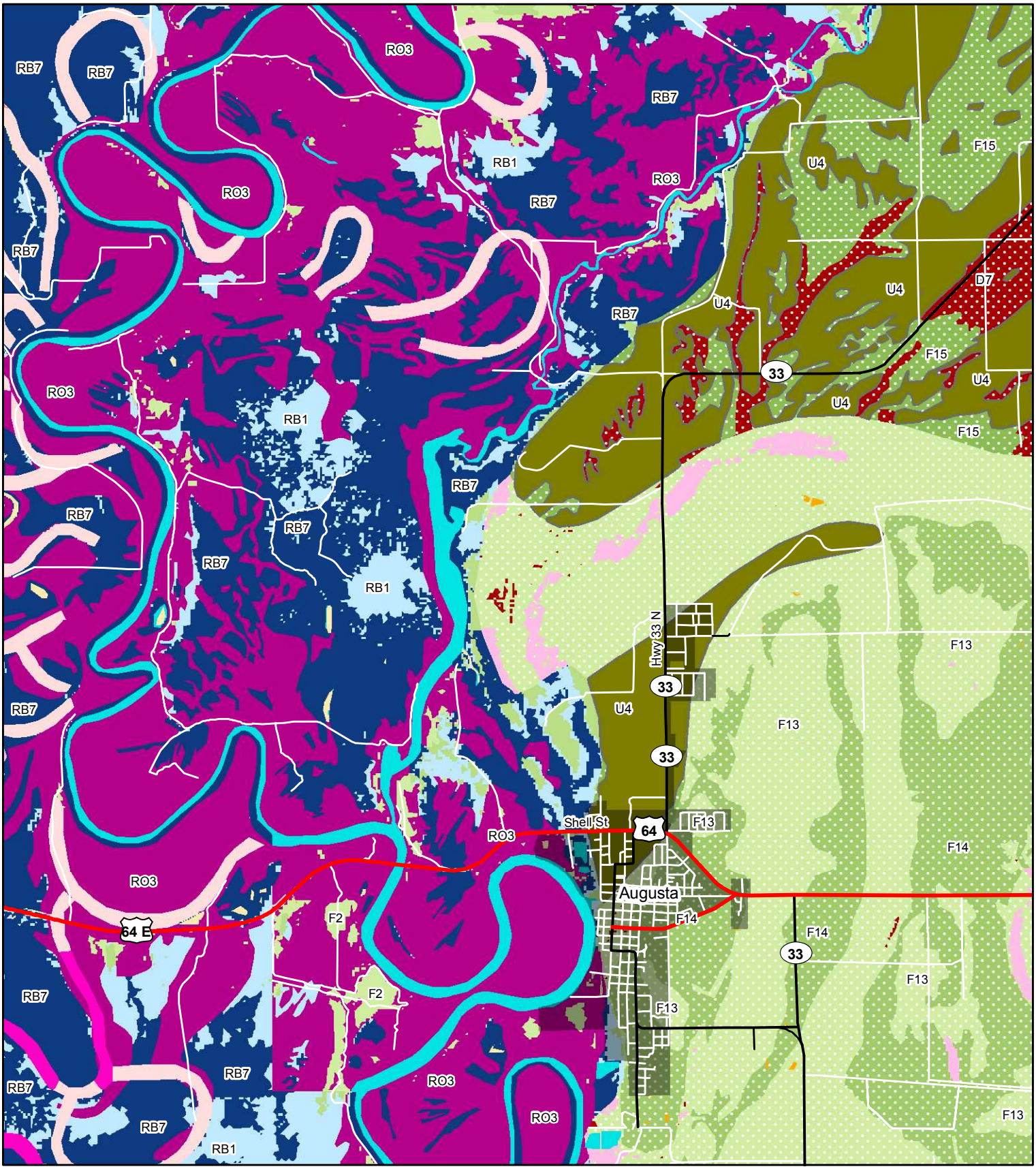
J7



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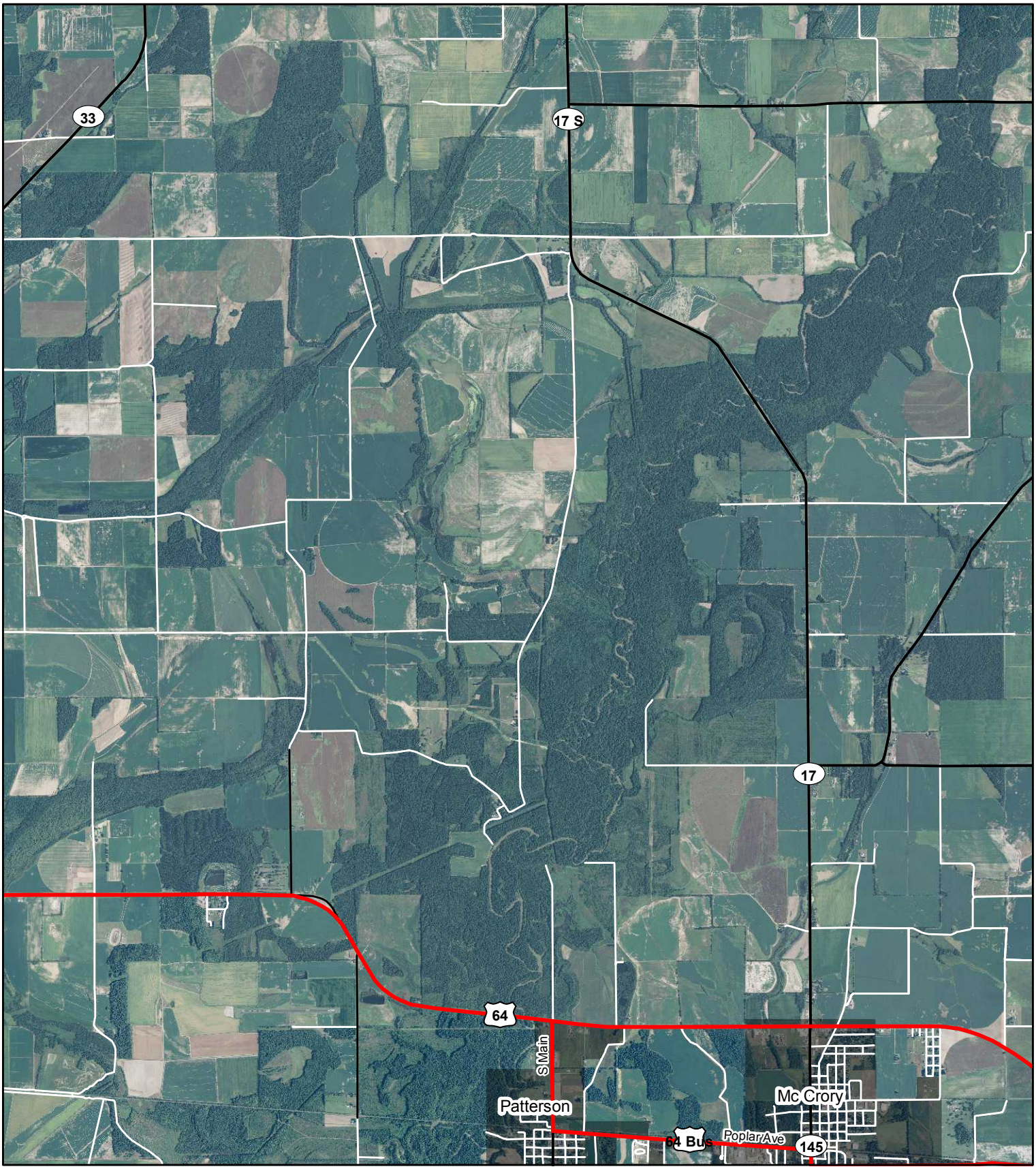
J7



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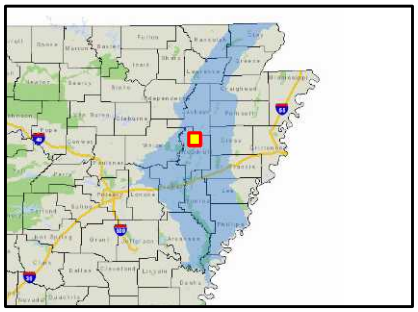

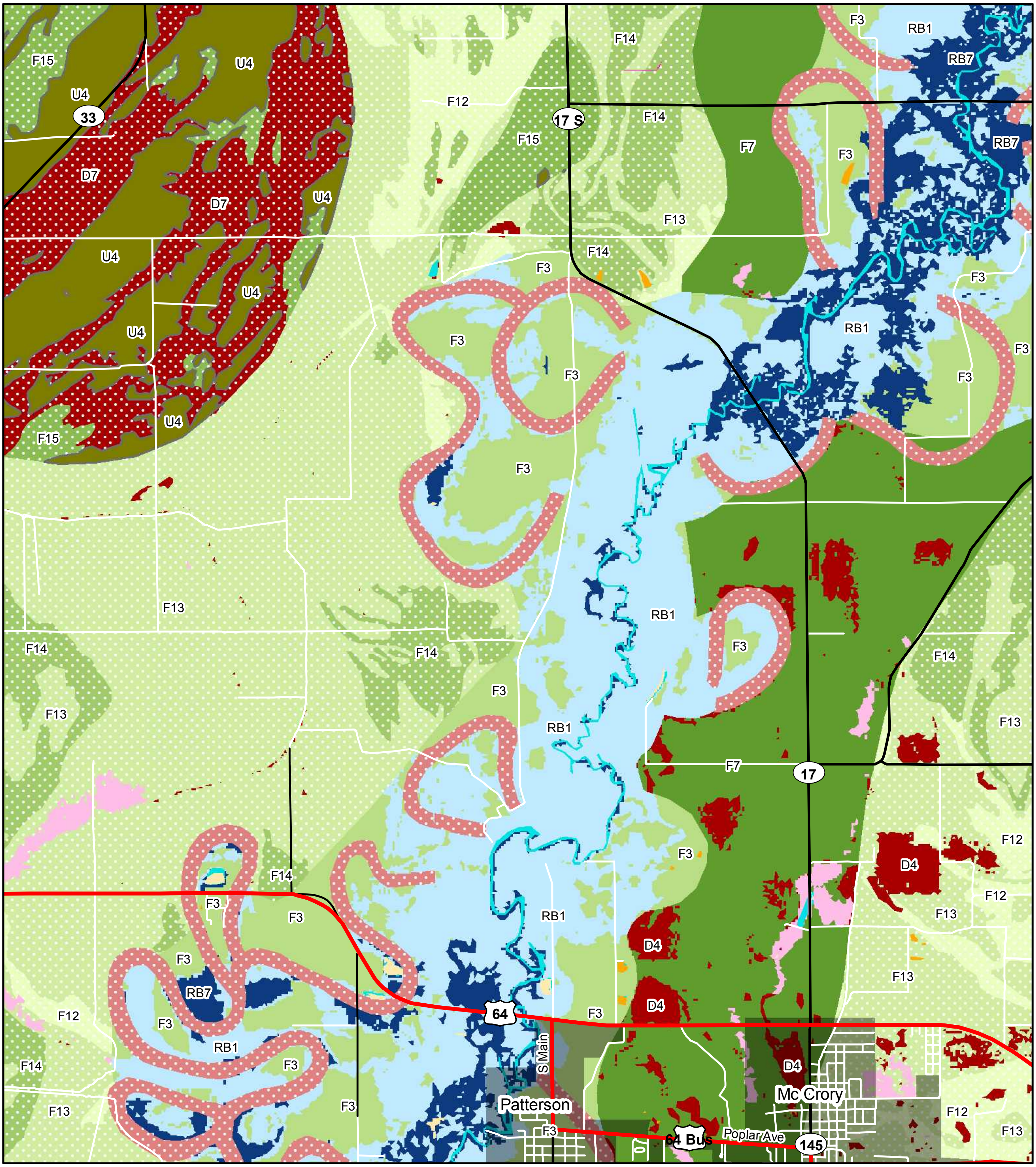

0 0.5 1 2 3 4 Miles

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N

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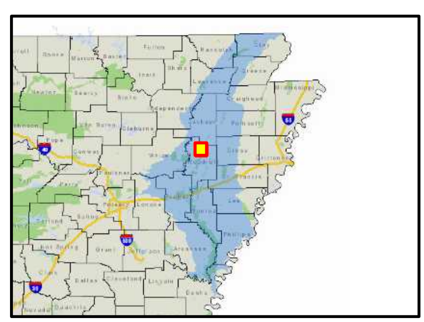

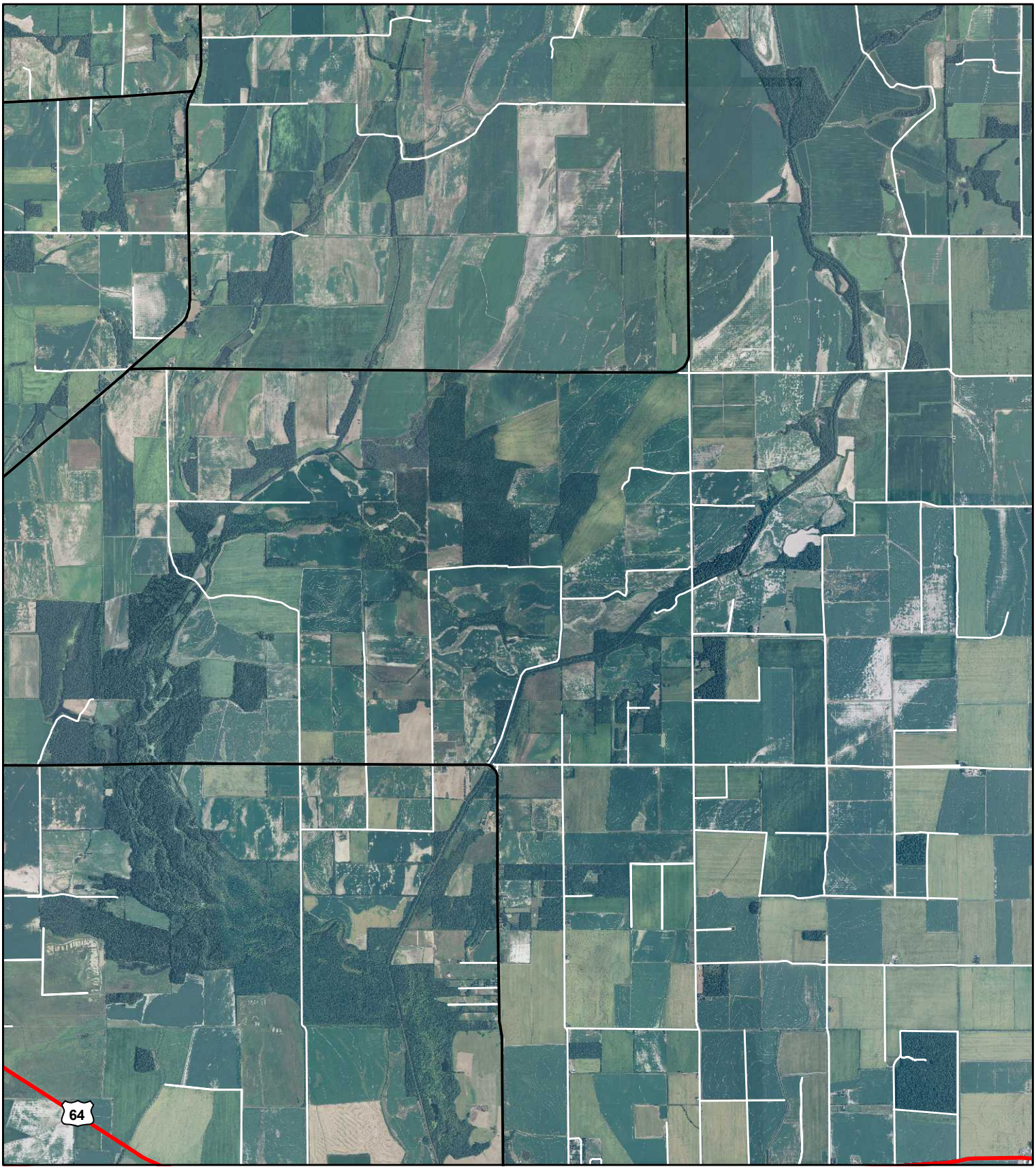

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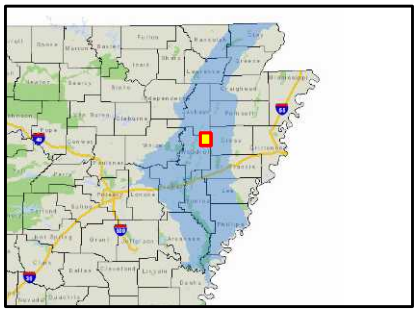

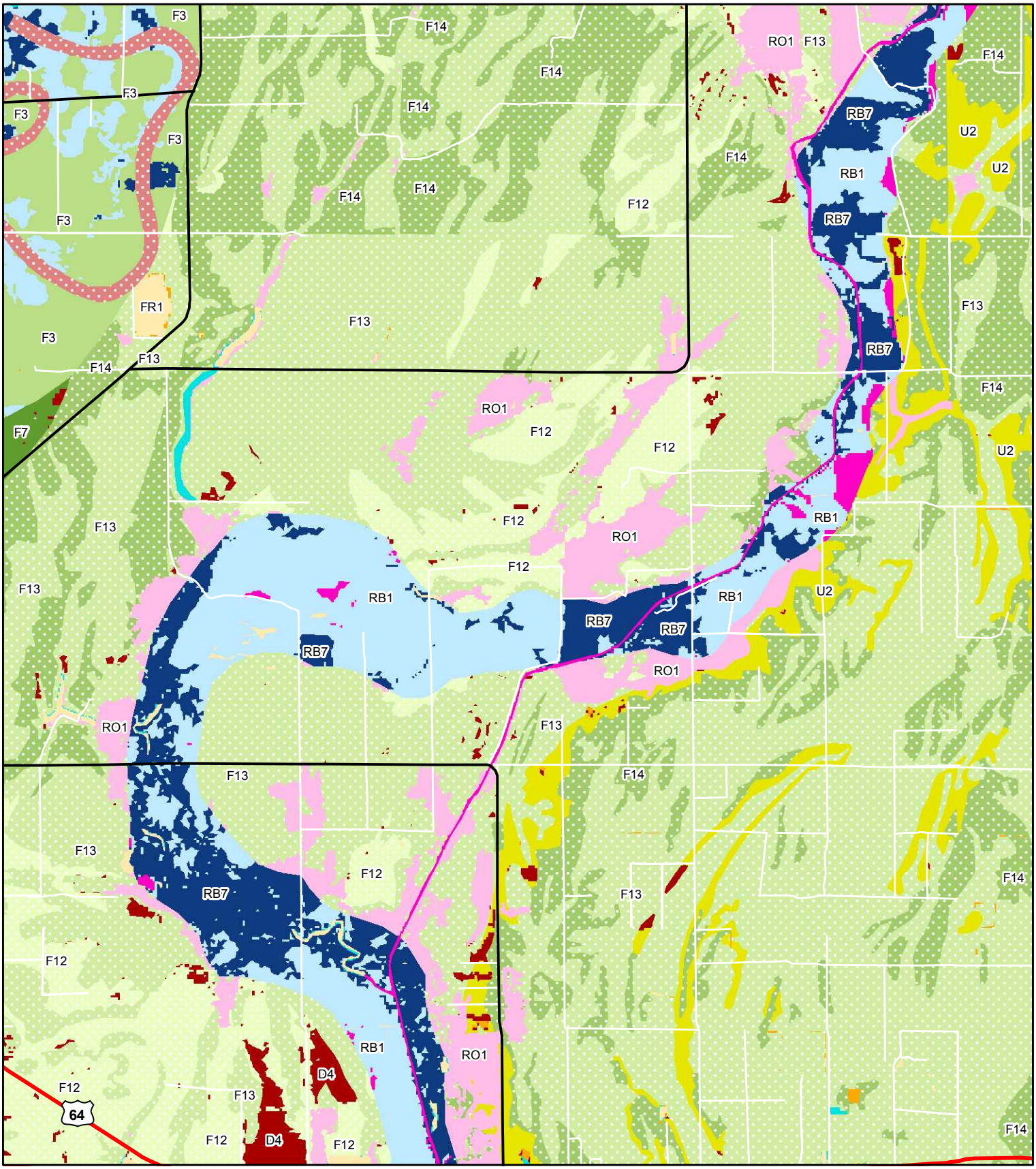

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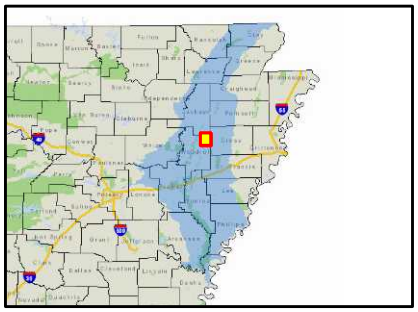

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J10

N

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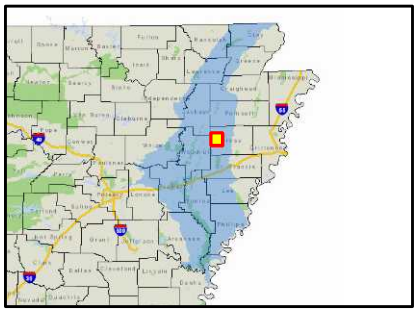

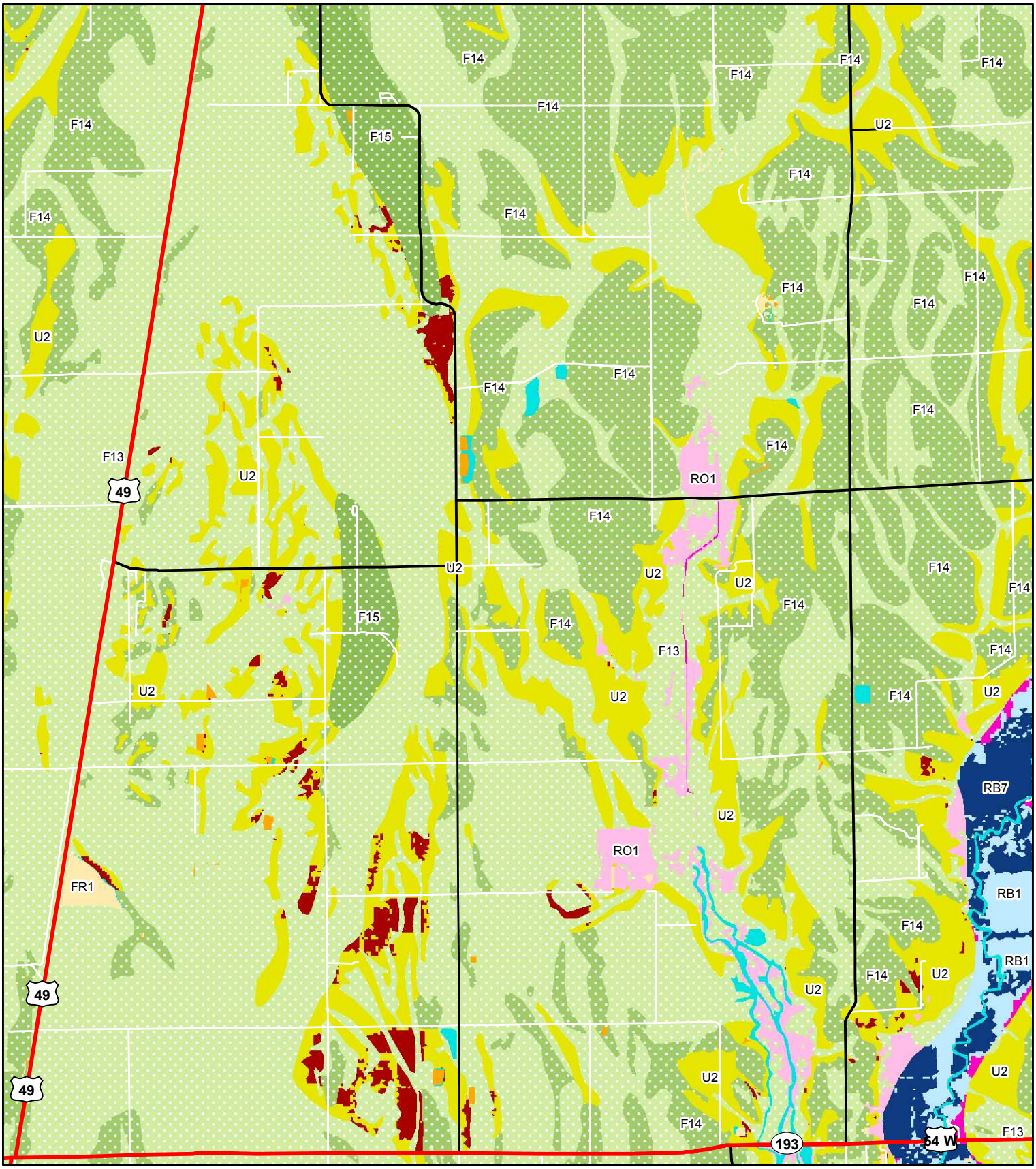

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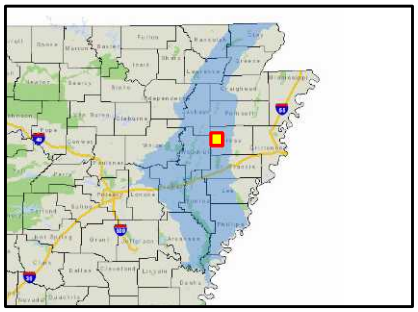

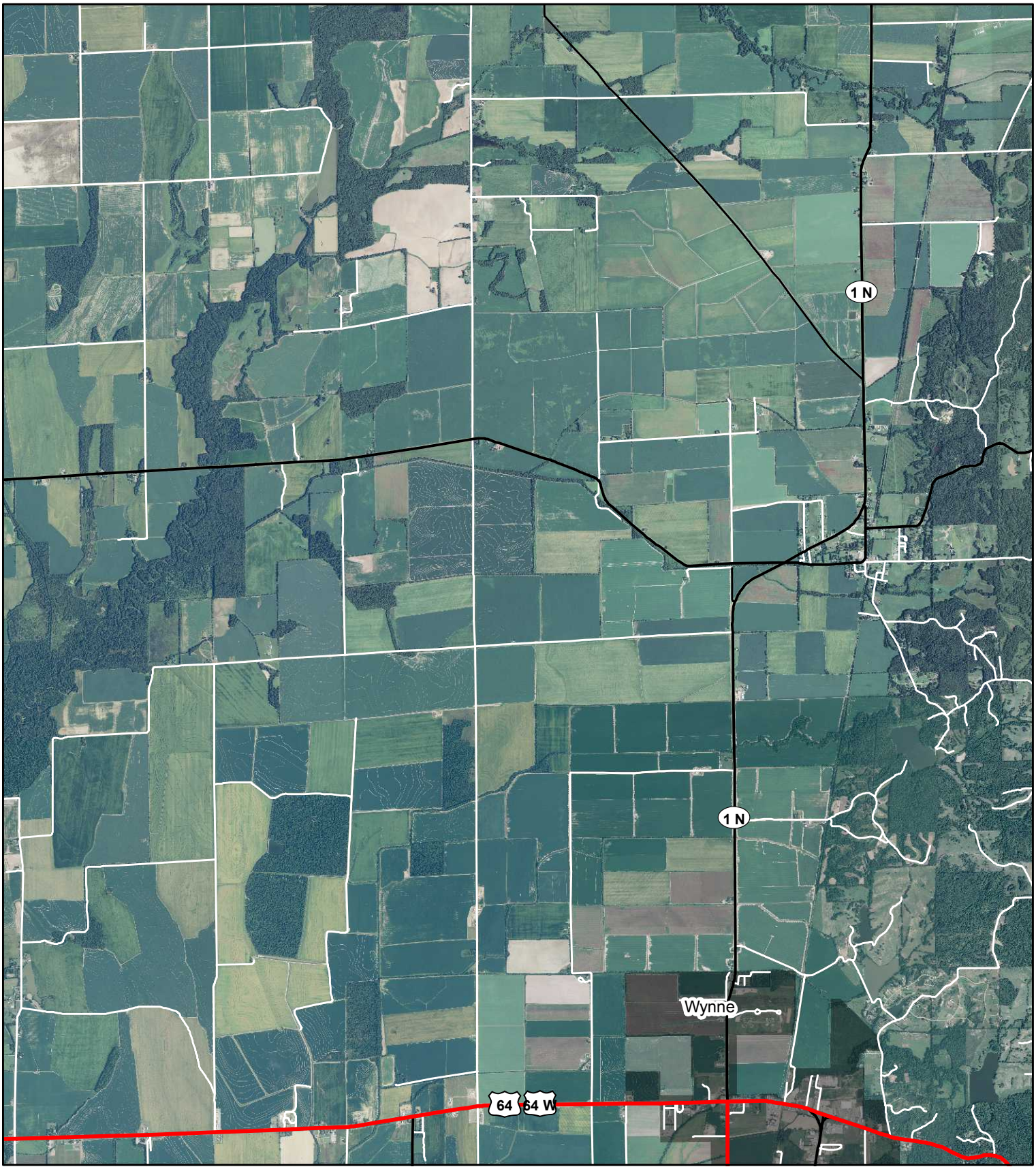

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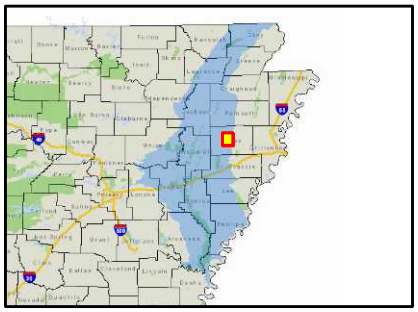

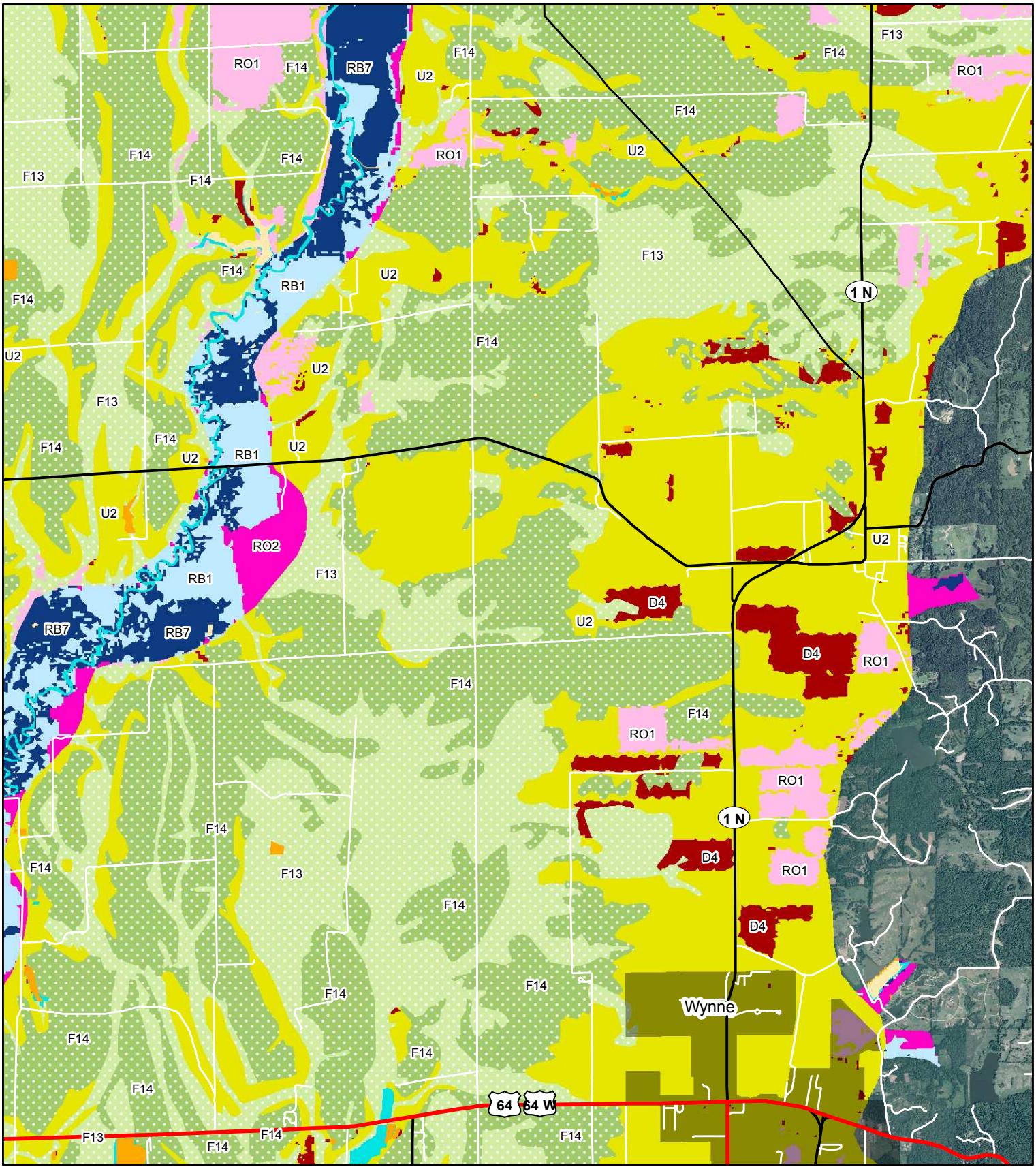

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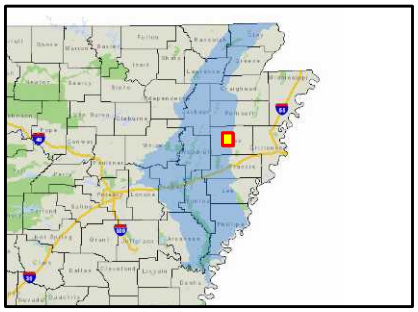

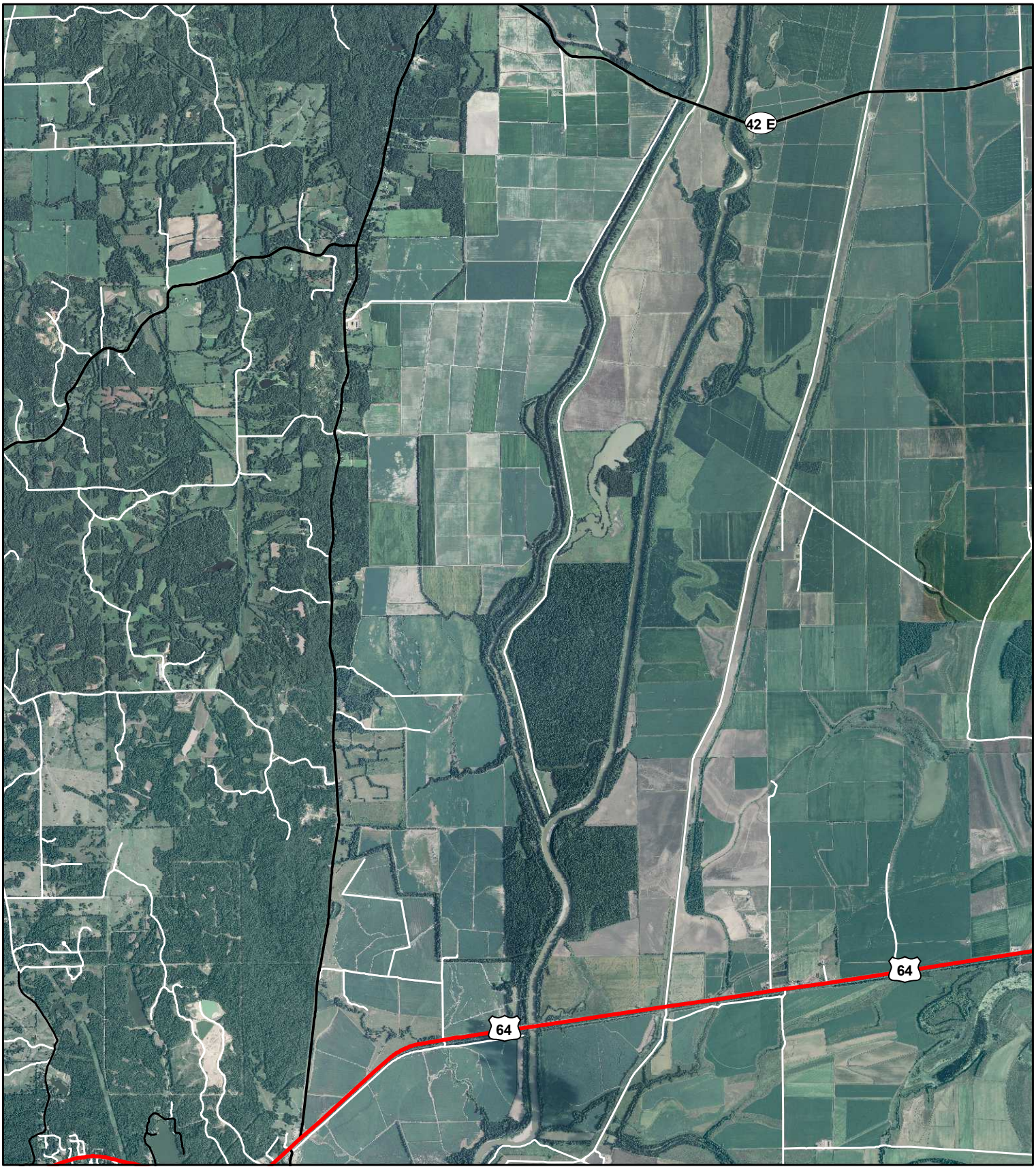

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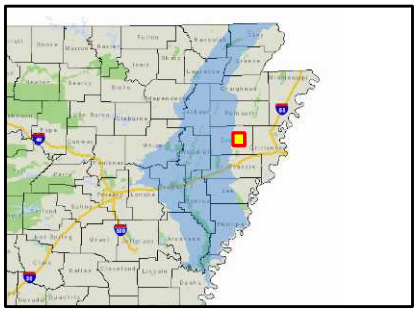

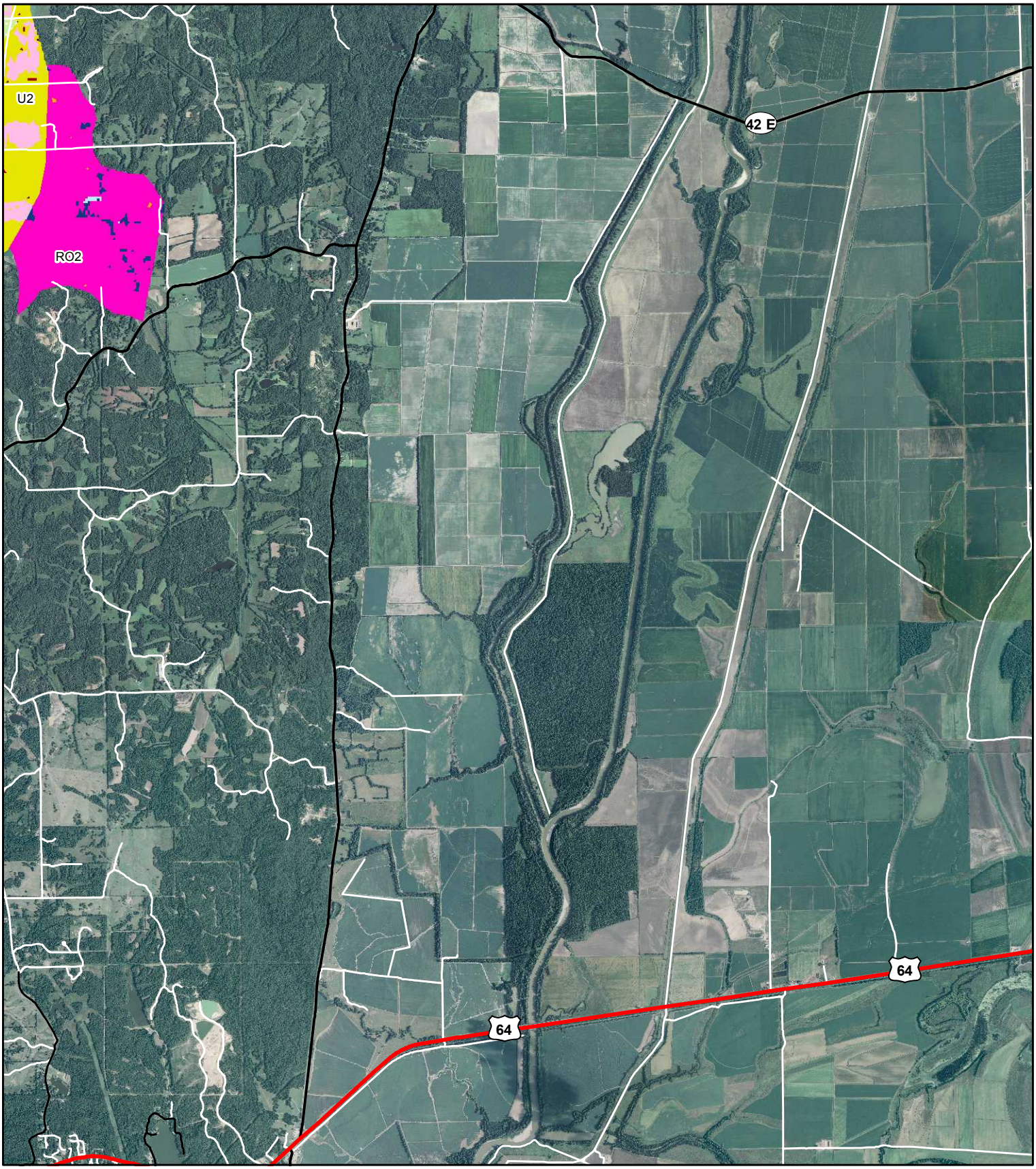

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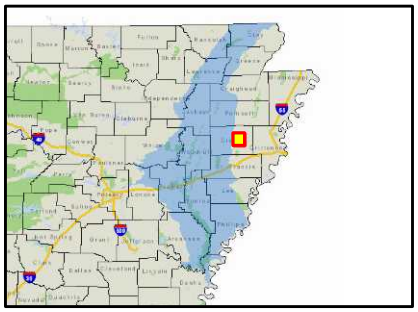
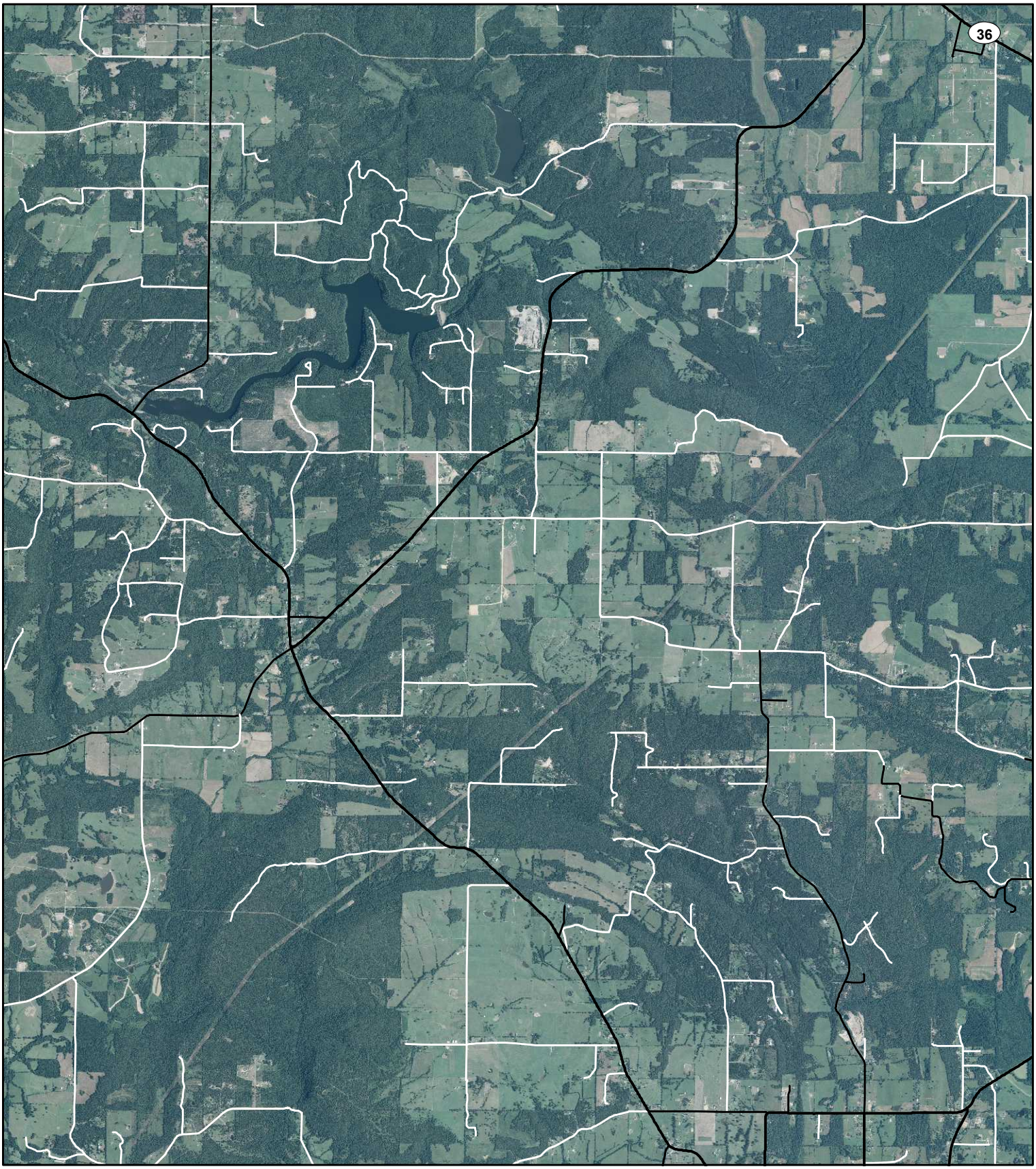
J12





0 0.5 1 2 3 4 Miles

K3

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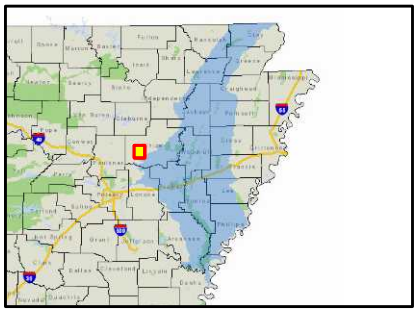
Projection: Transverse Mercator
Datum: North American 1983



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K3

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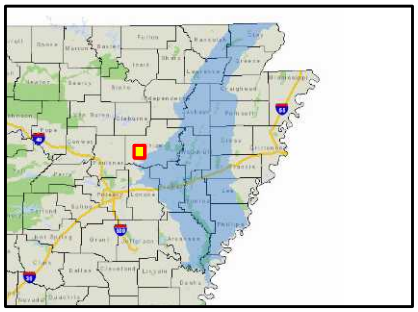


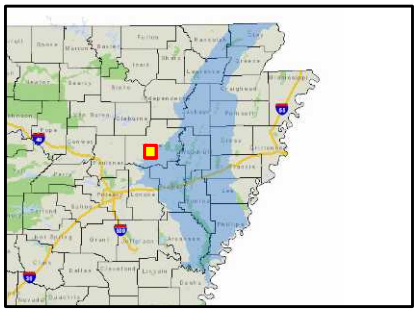
36
36 W
W Pleasure Ave
16
E Pleasure Ave
W Beebe Capps Expy
Searcy
67 Bus
367
S Main St
Hwy 367 S
64
67
Garner

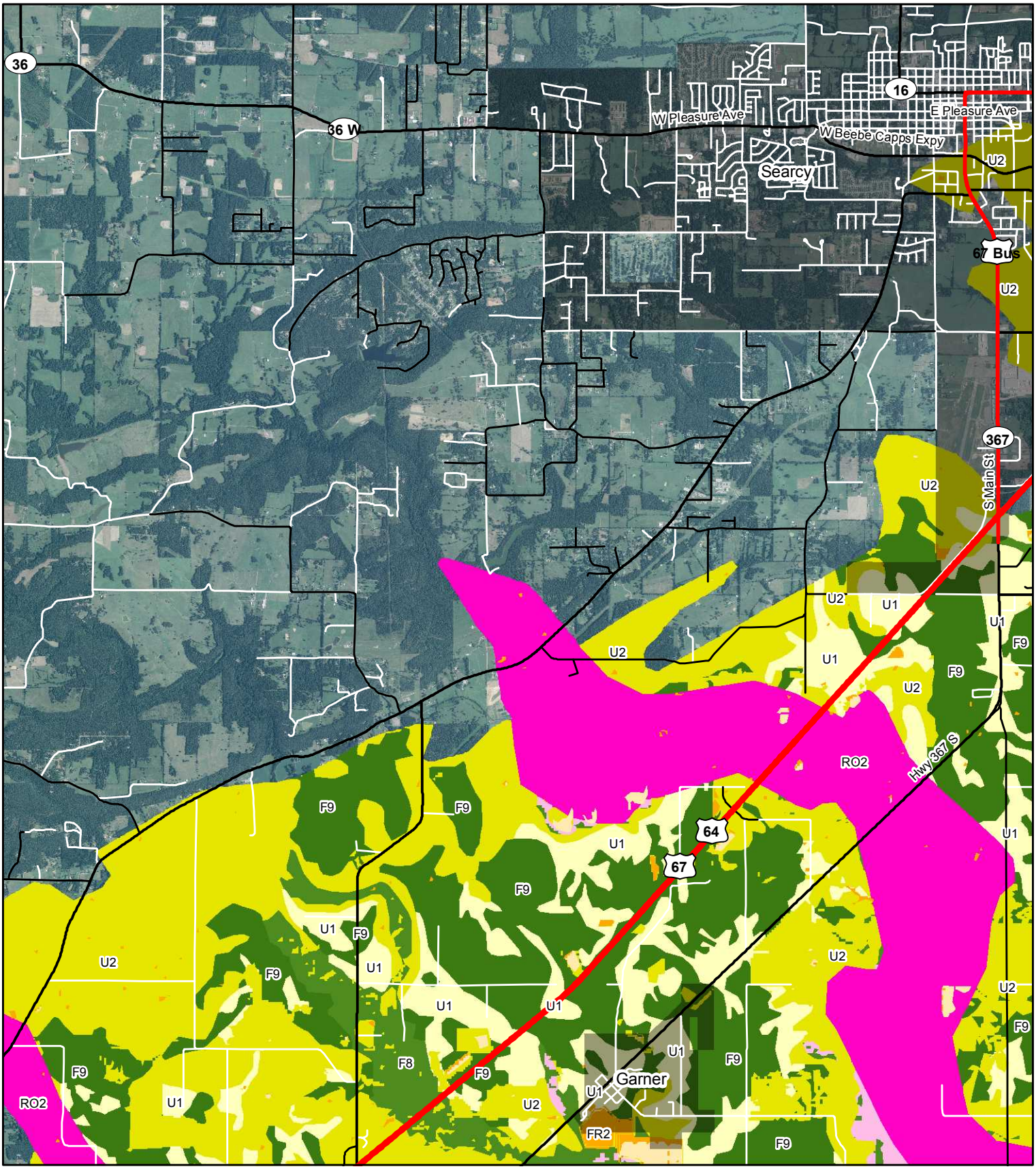
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

K4





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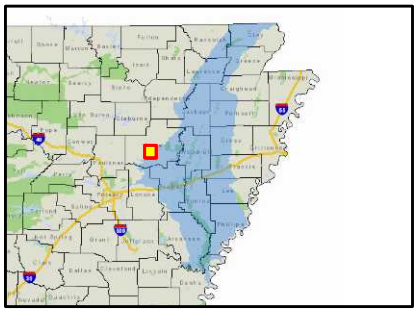

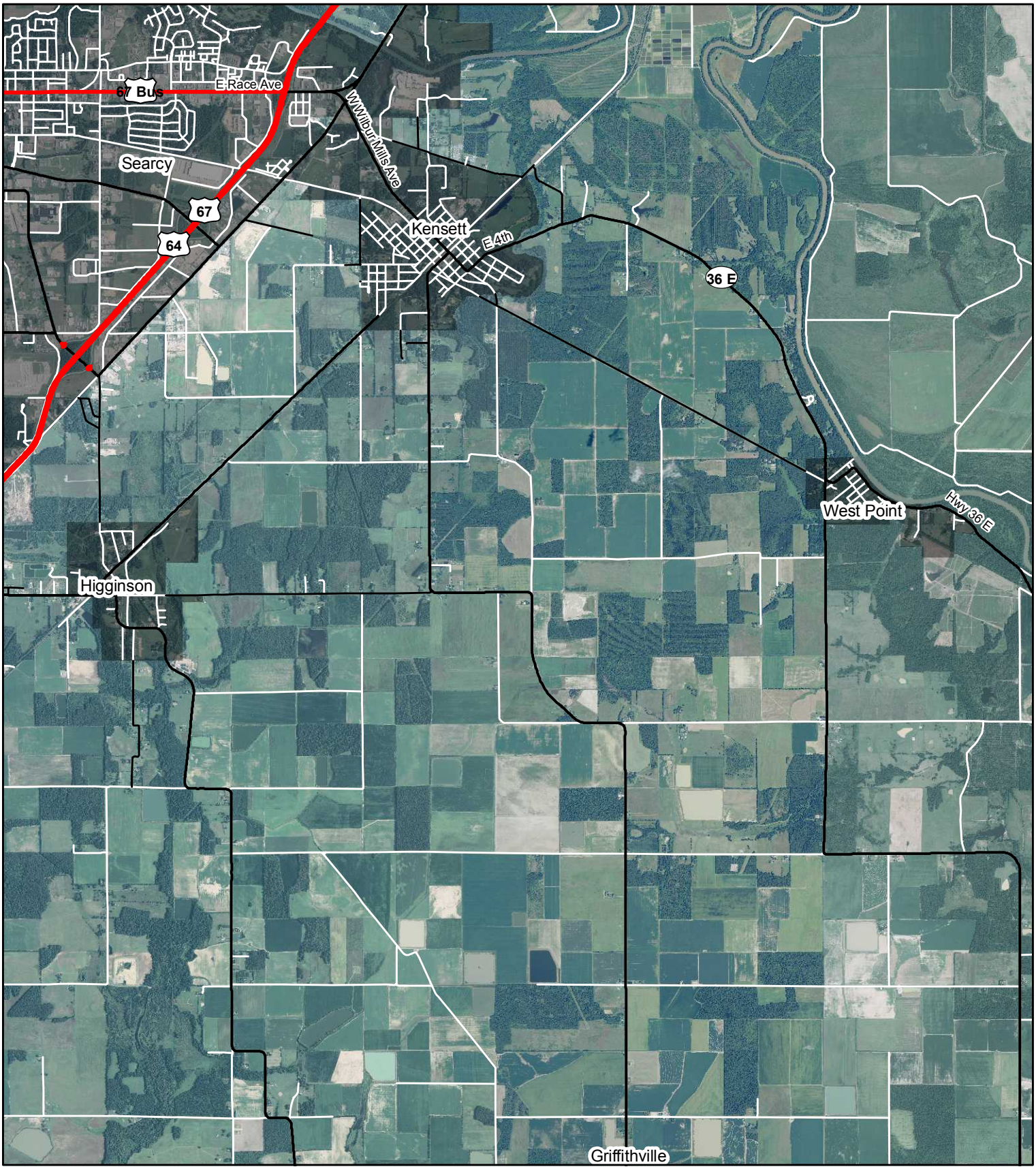

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Projection: Transverse Mercator
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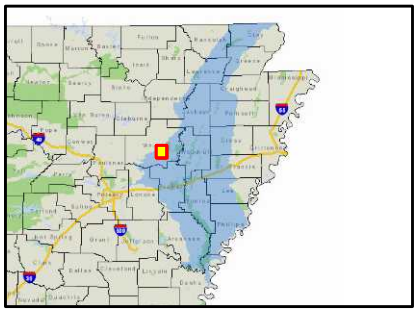
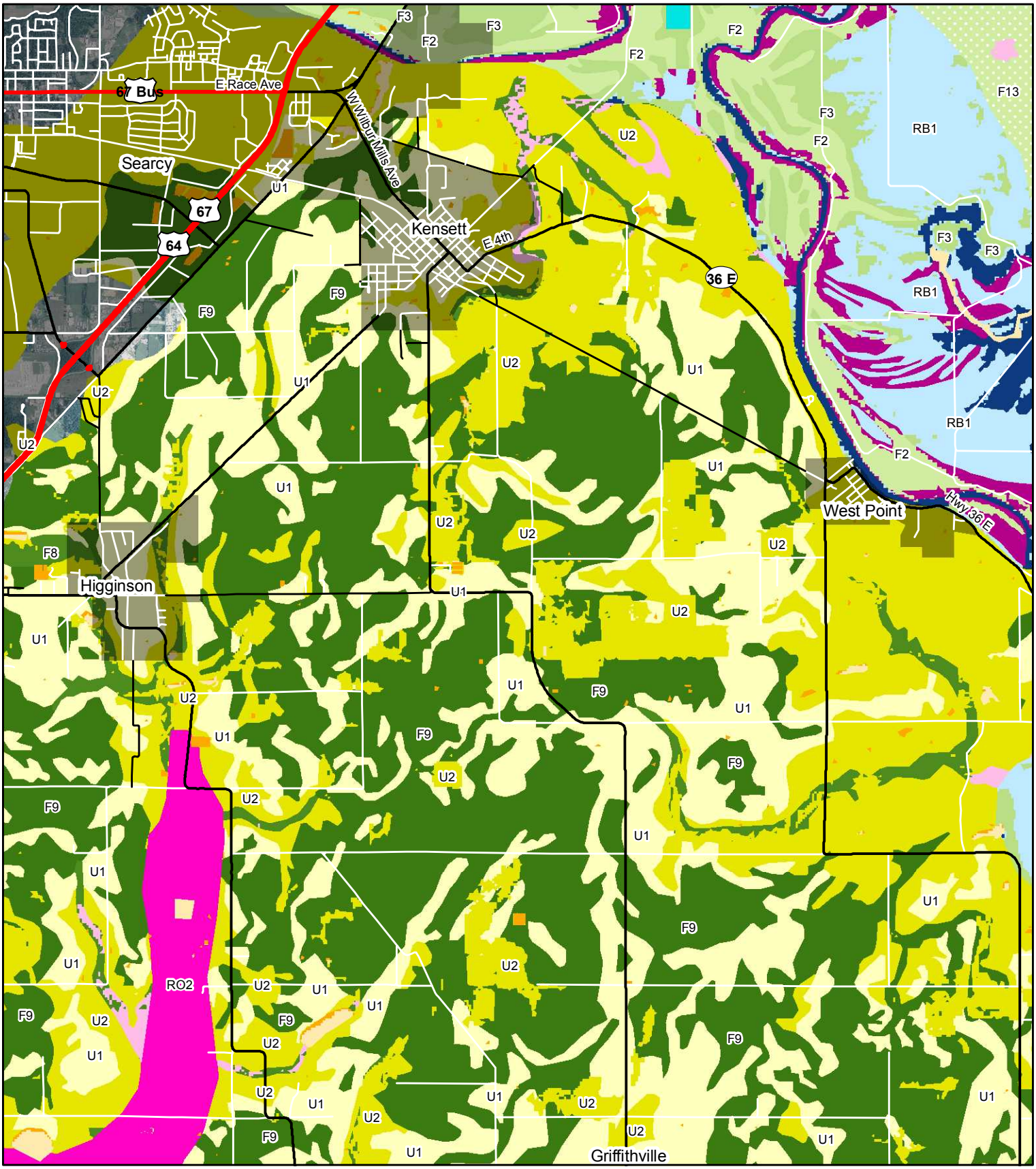


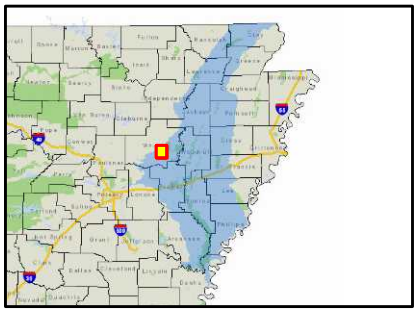


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

K5



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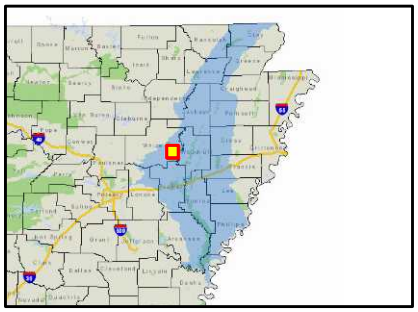
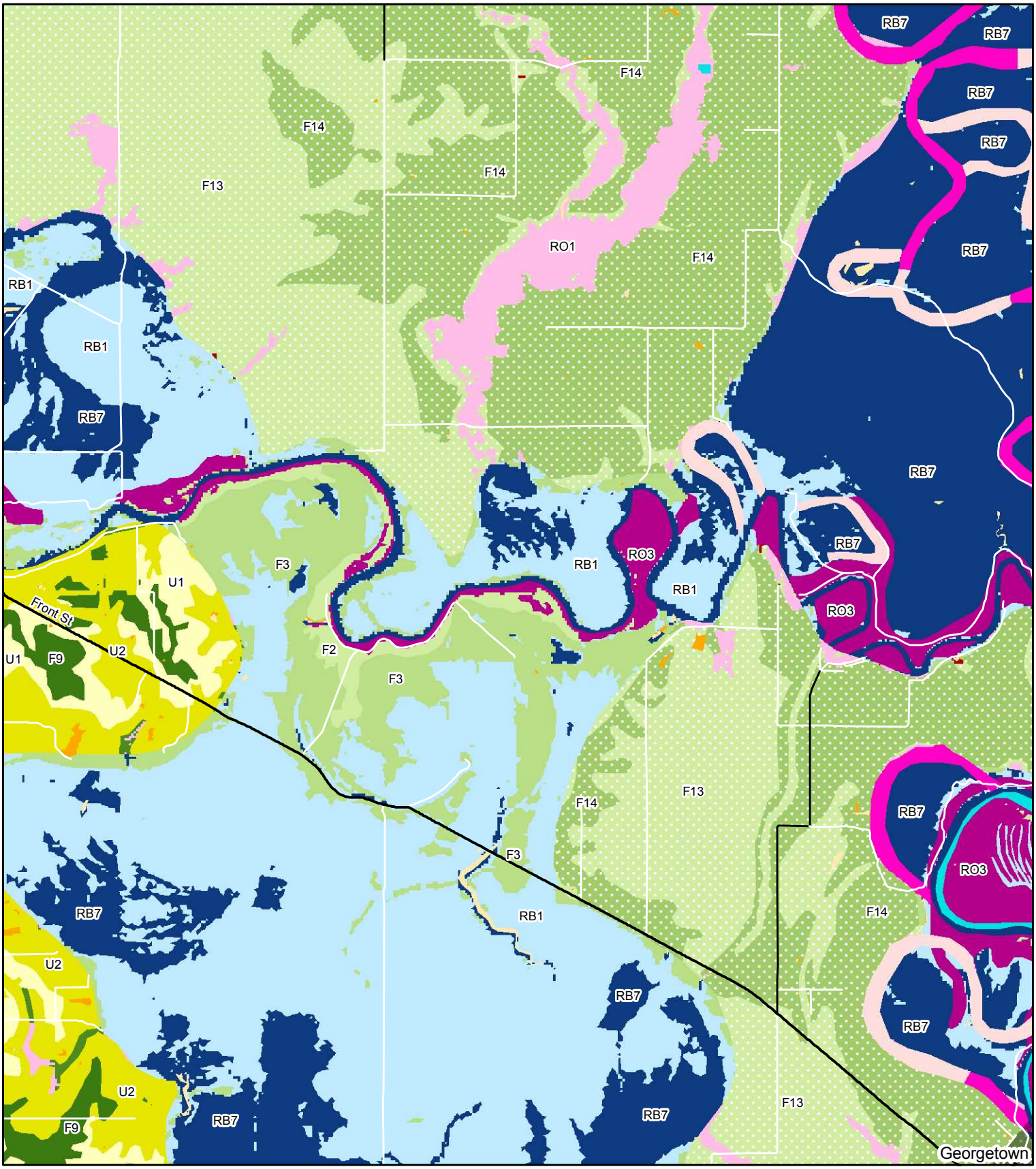
N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

K6





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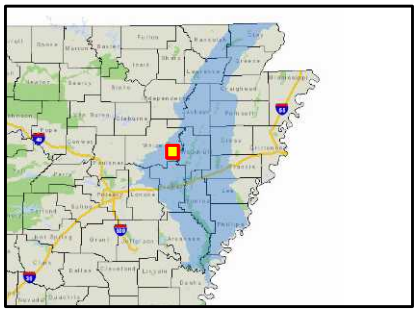

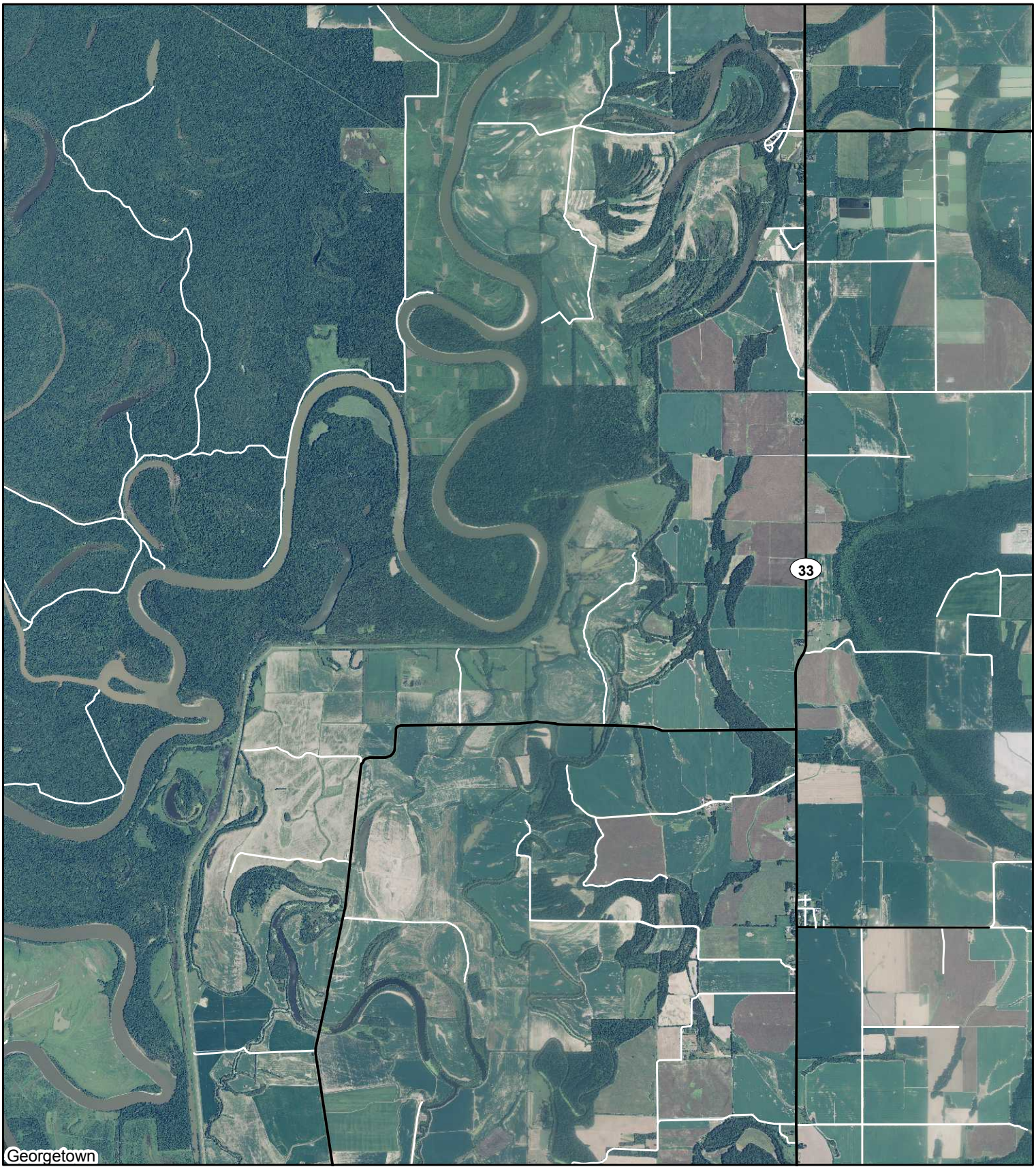

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K7

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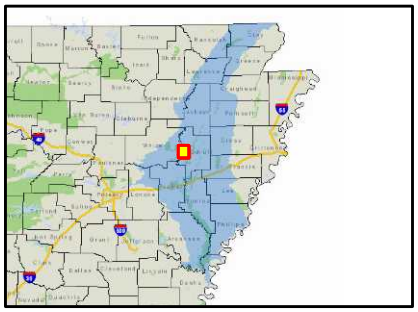

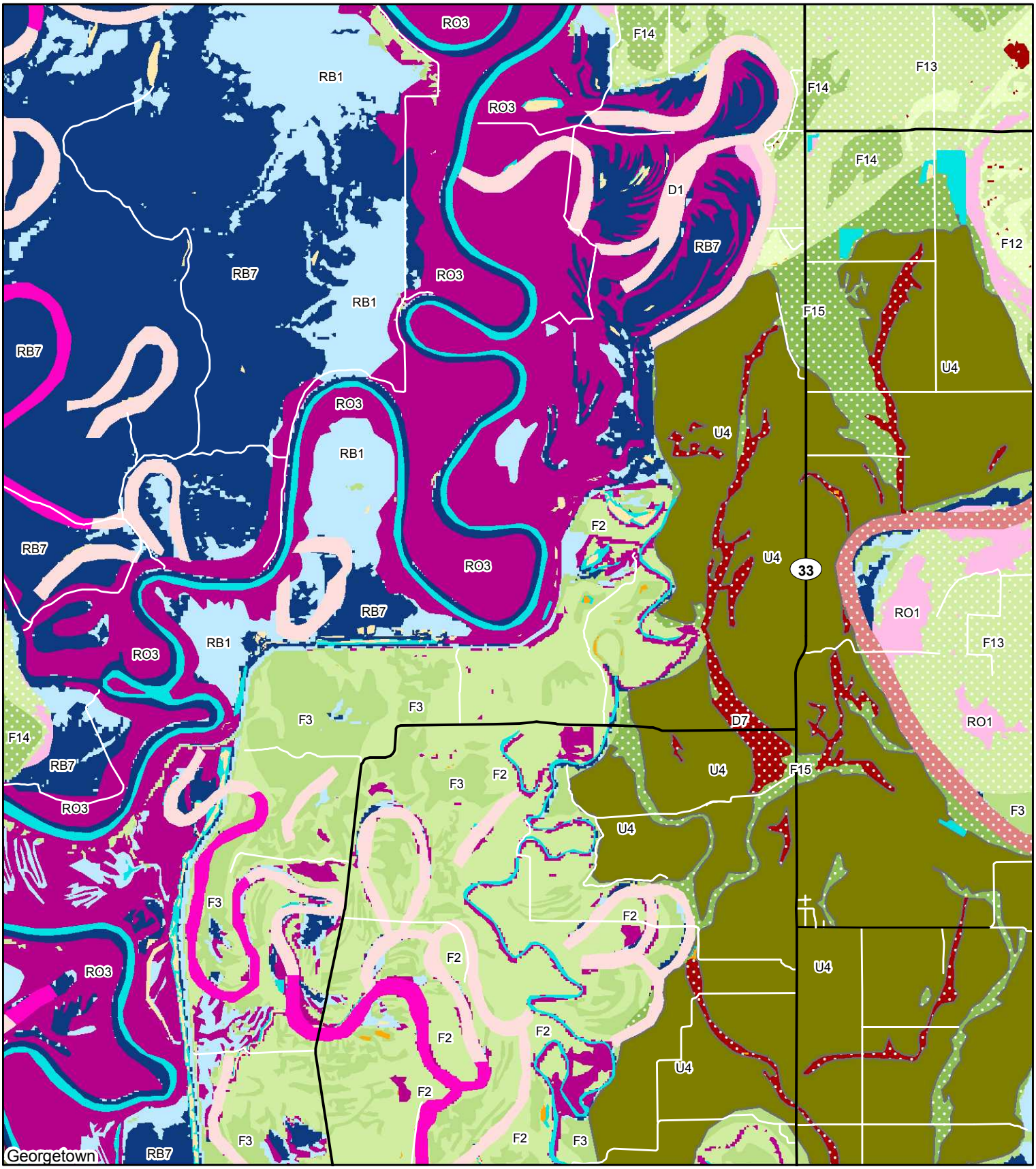

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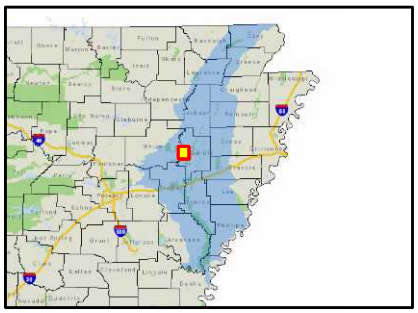

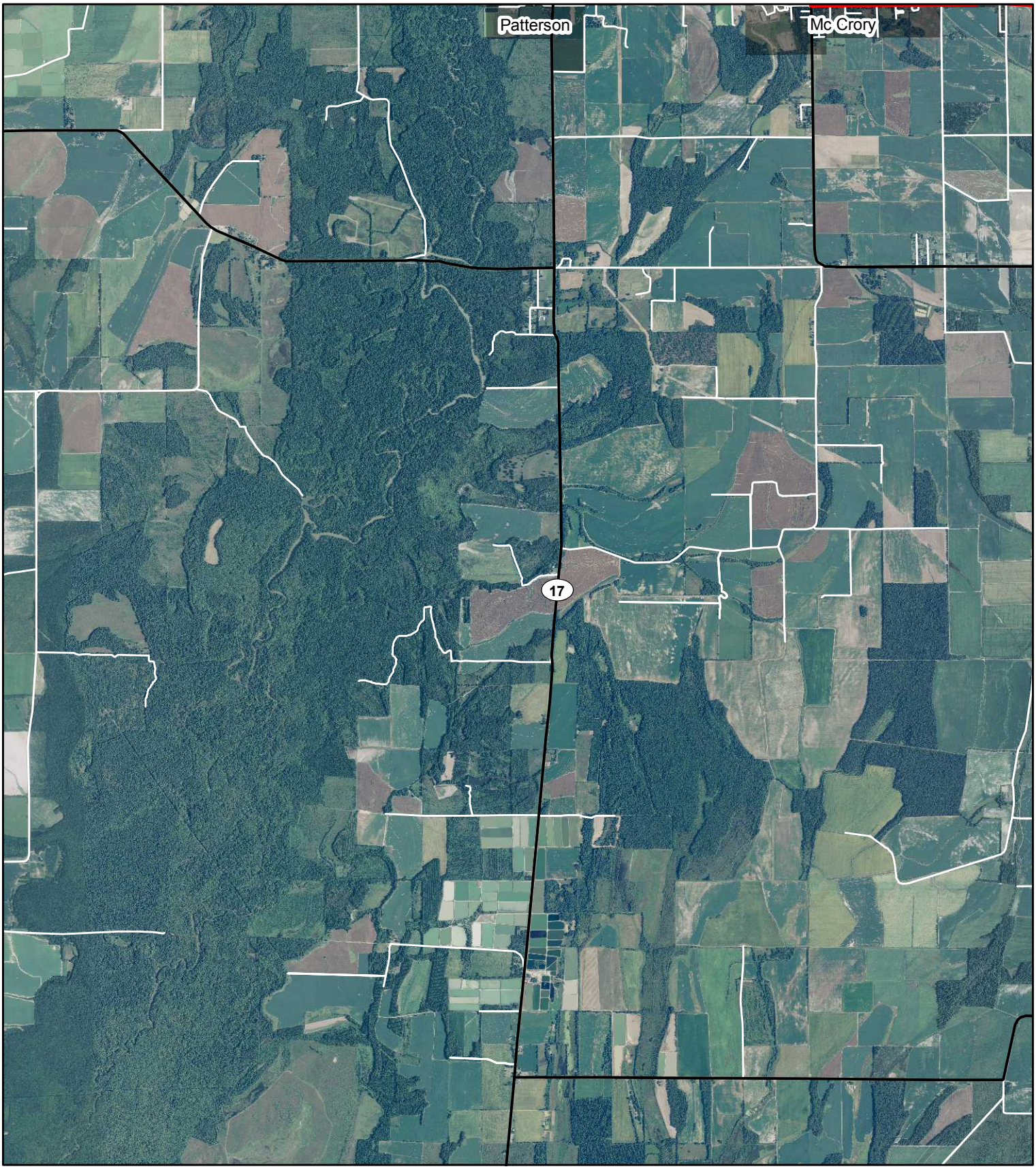

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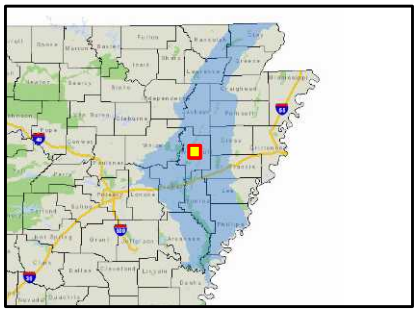
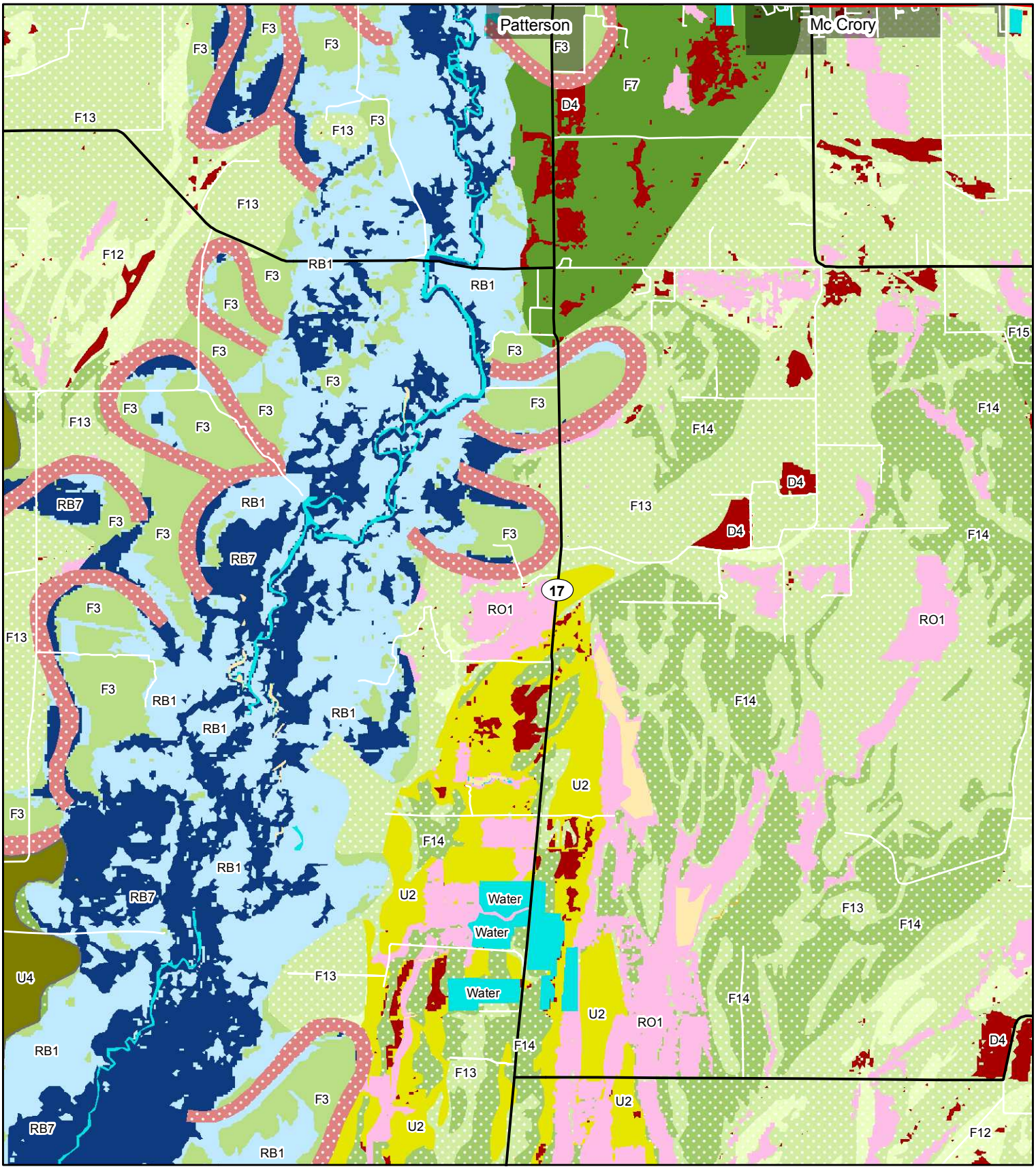
K8





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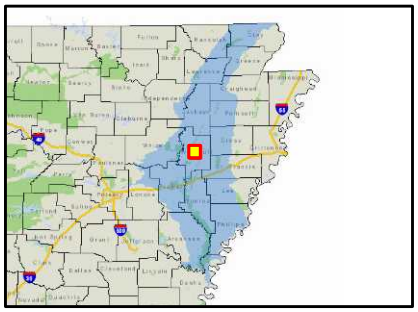

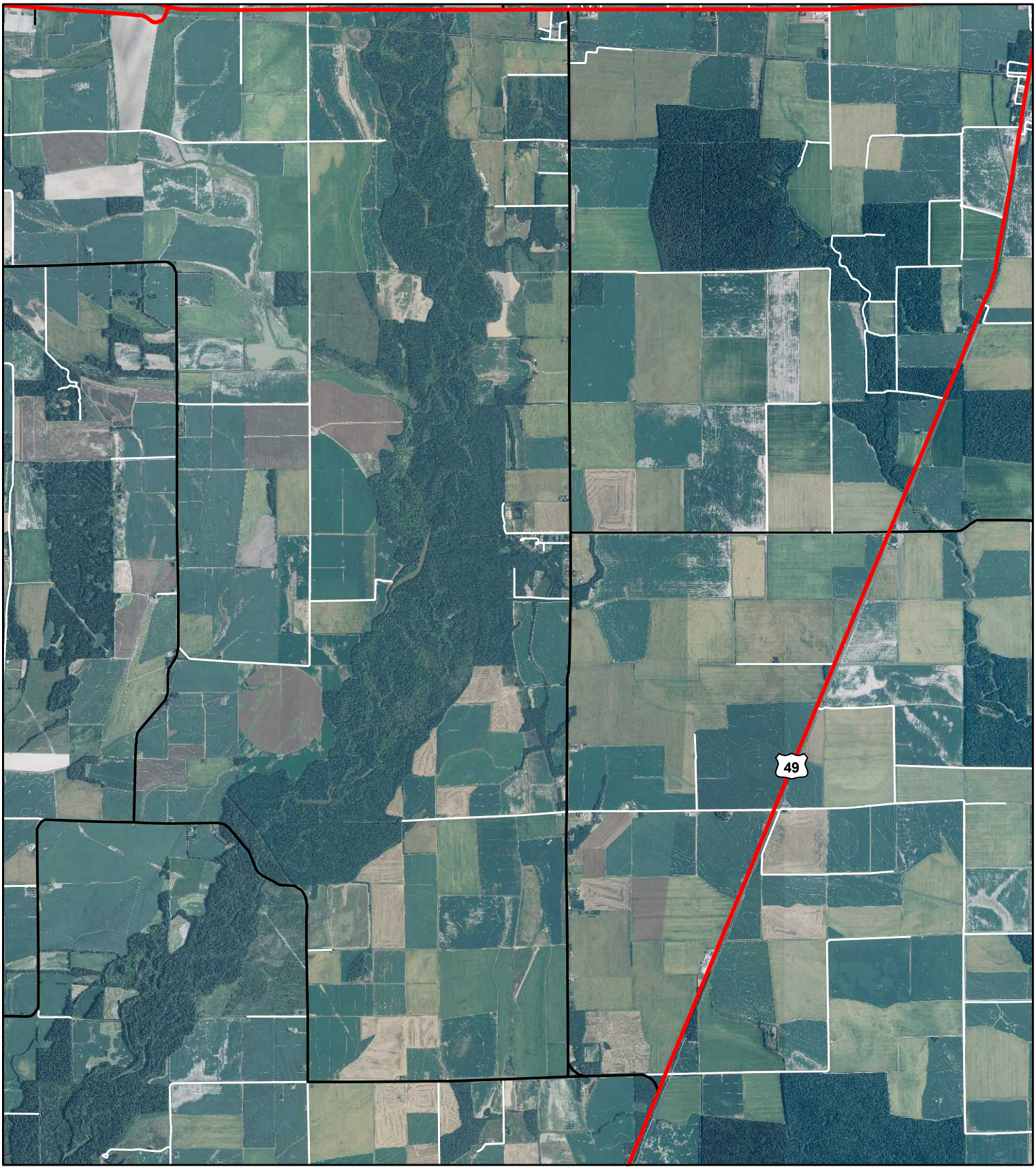

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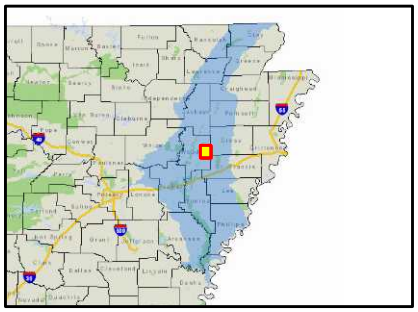

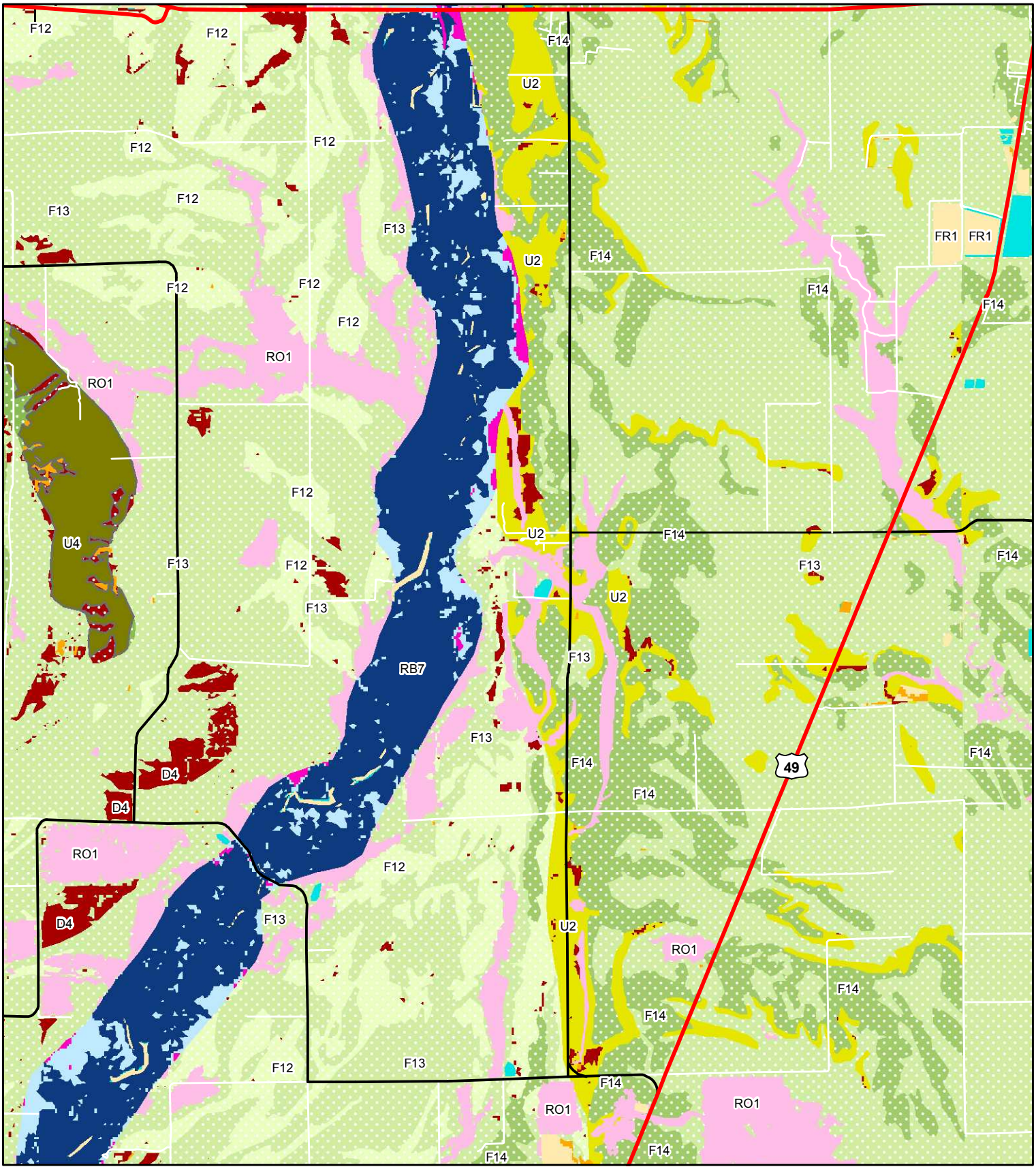

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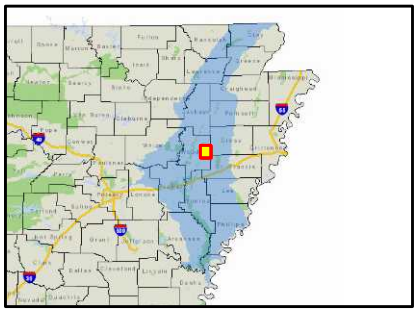

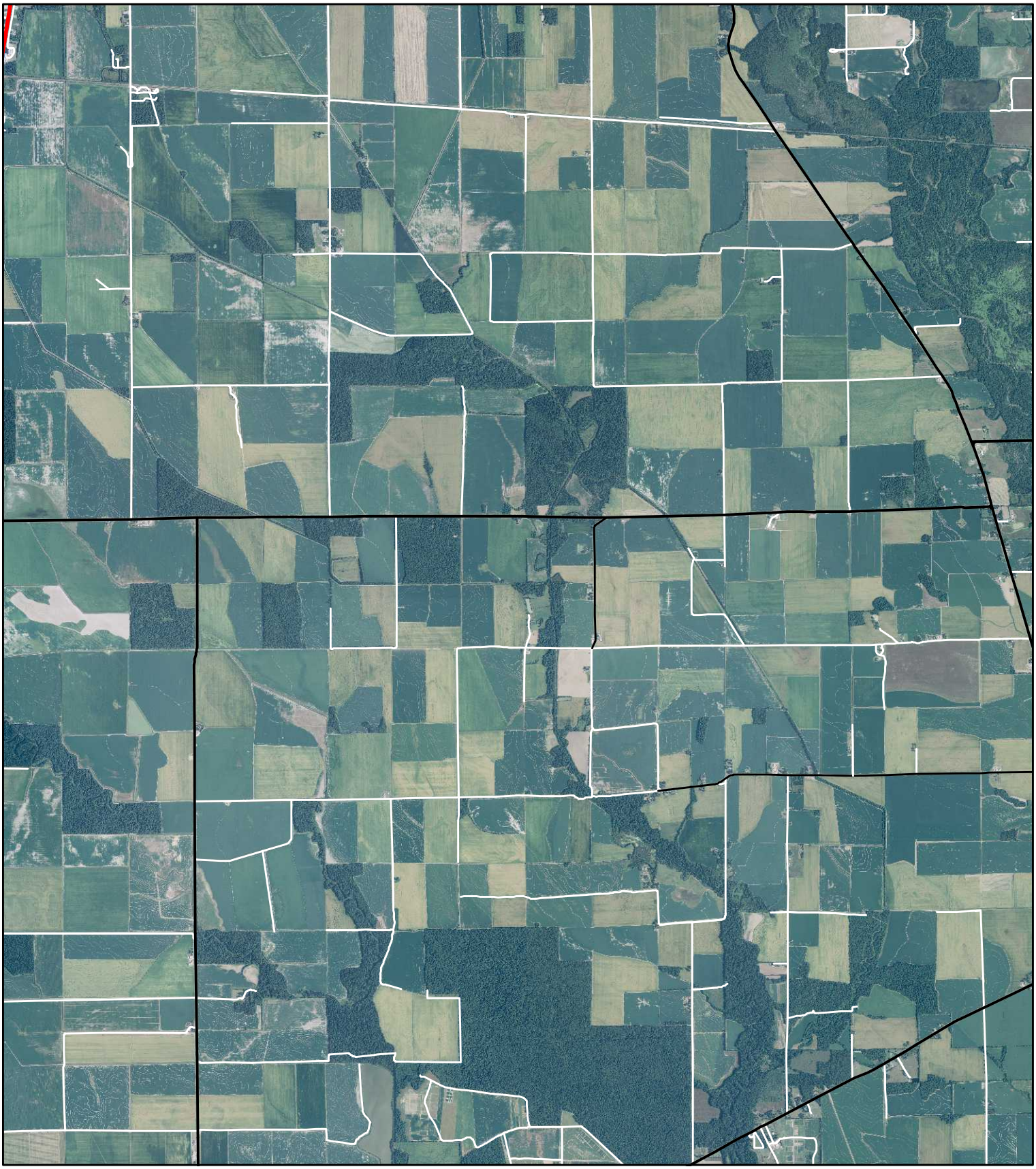

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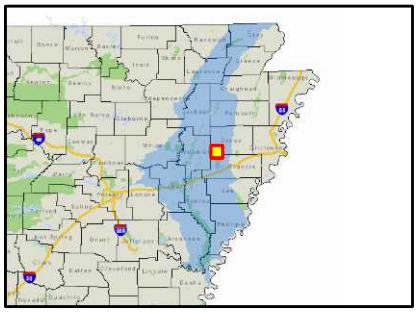

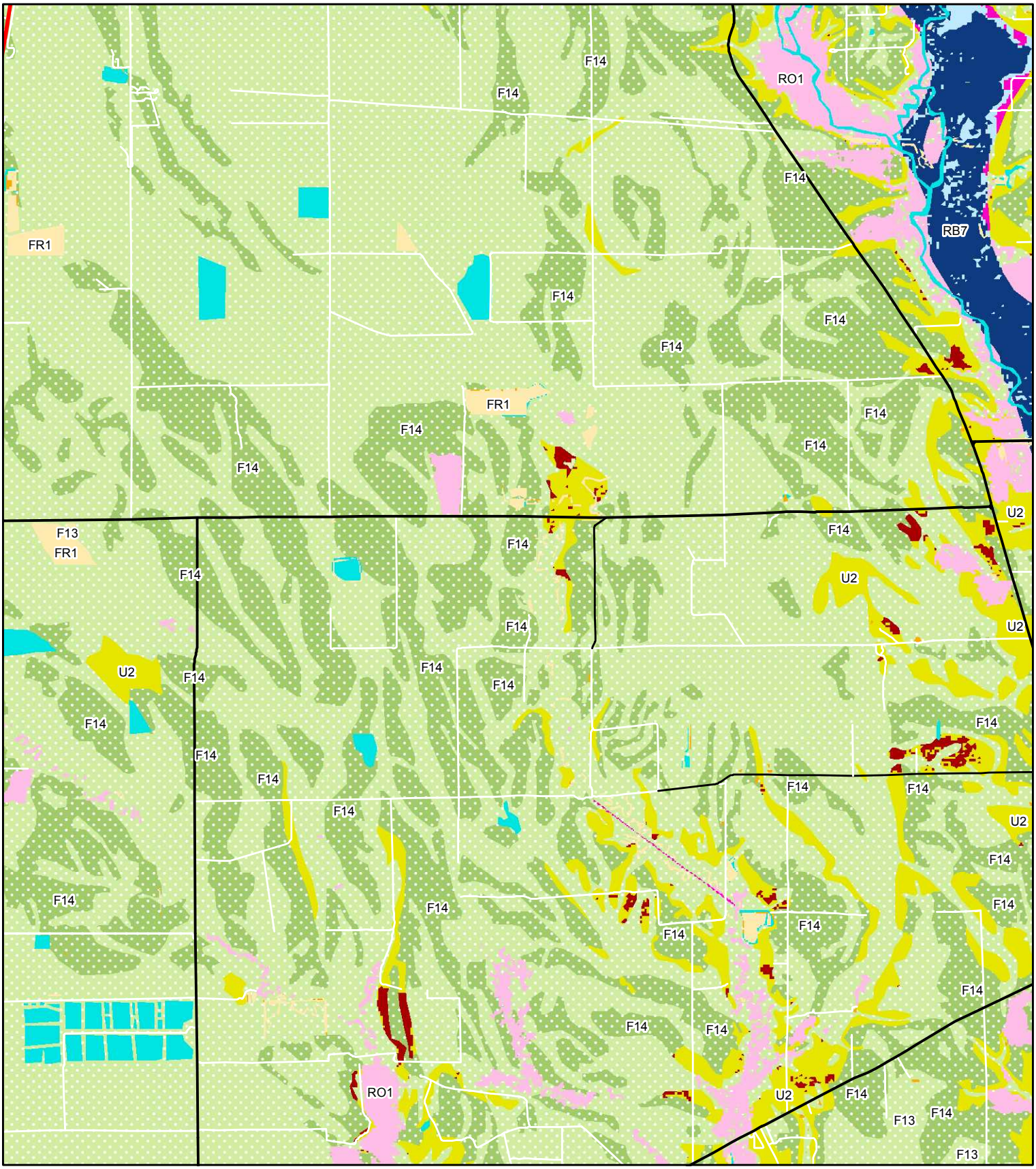

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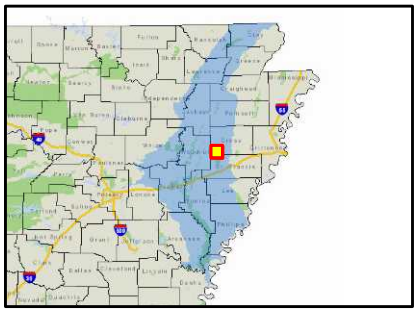

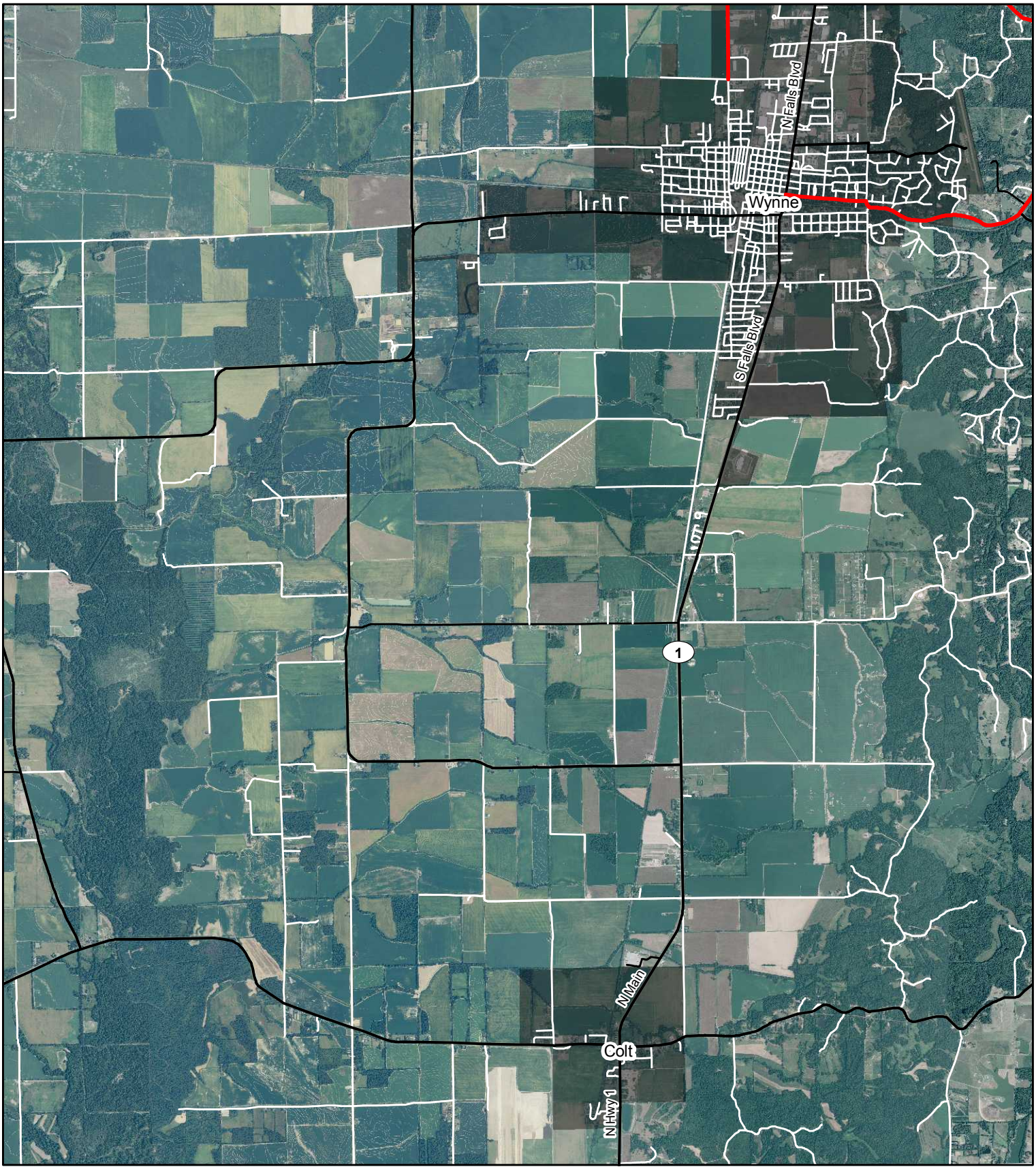

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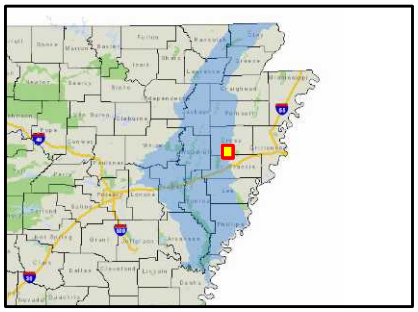
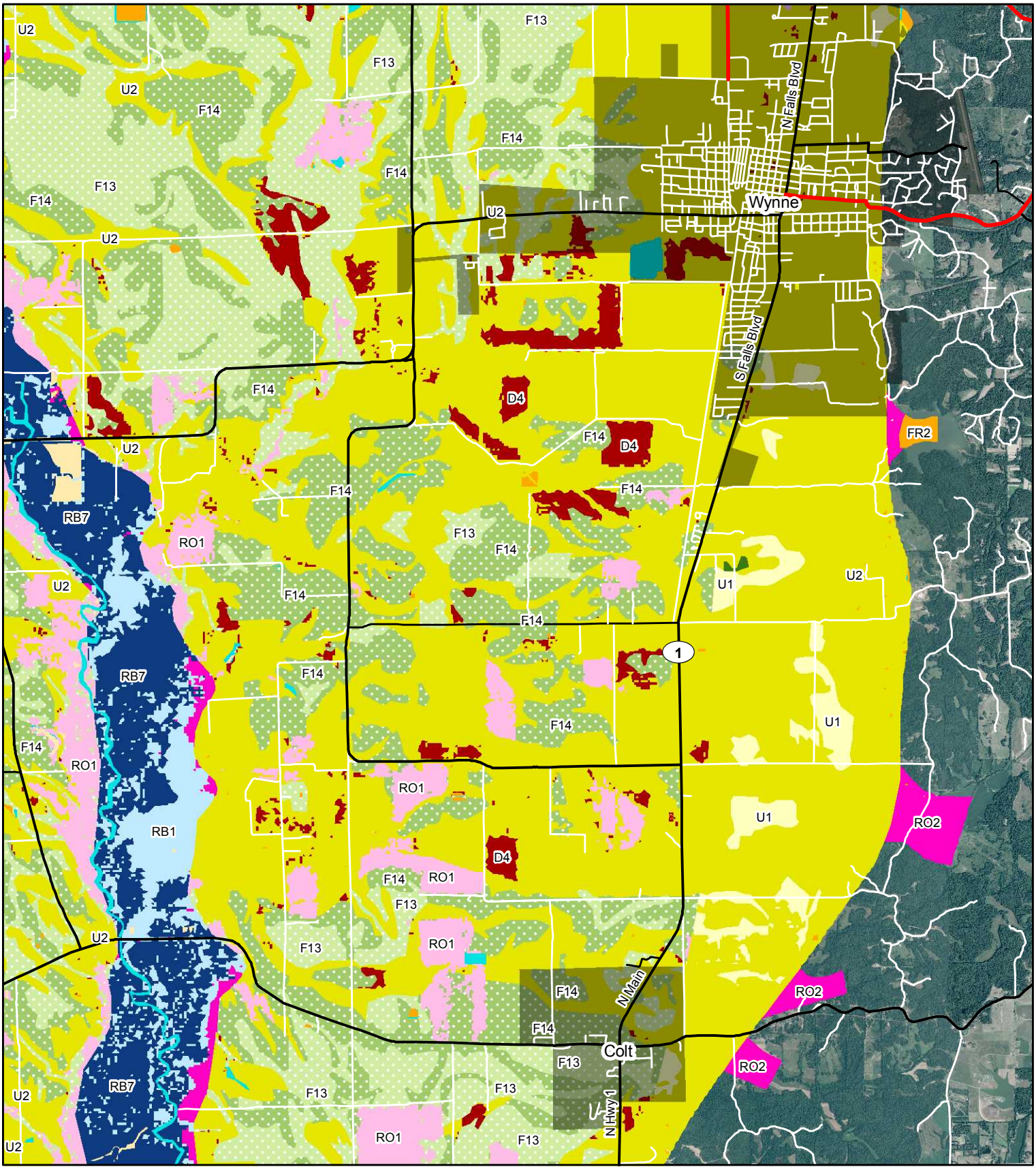
K11





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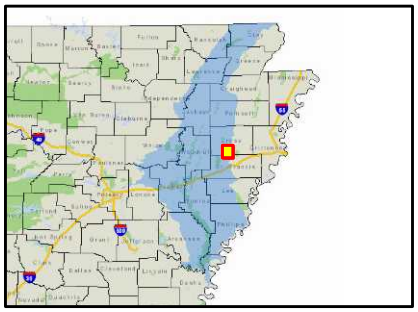
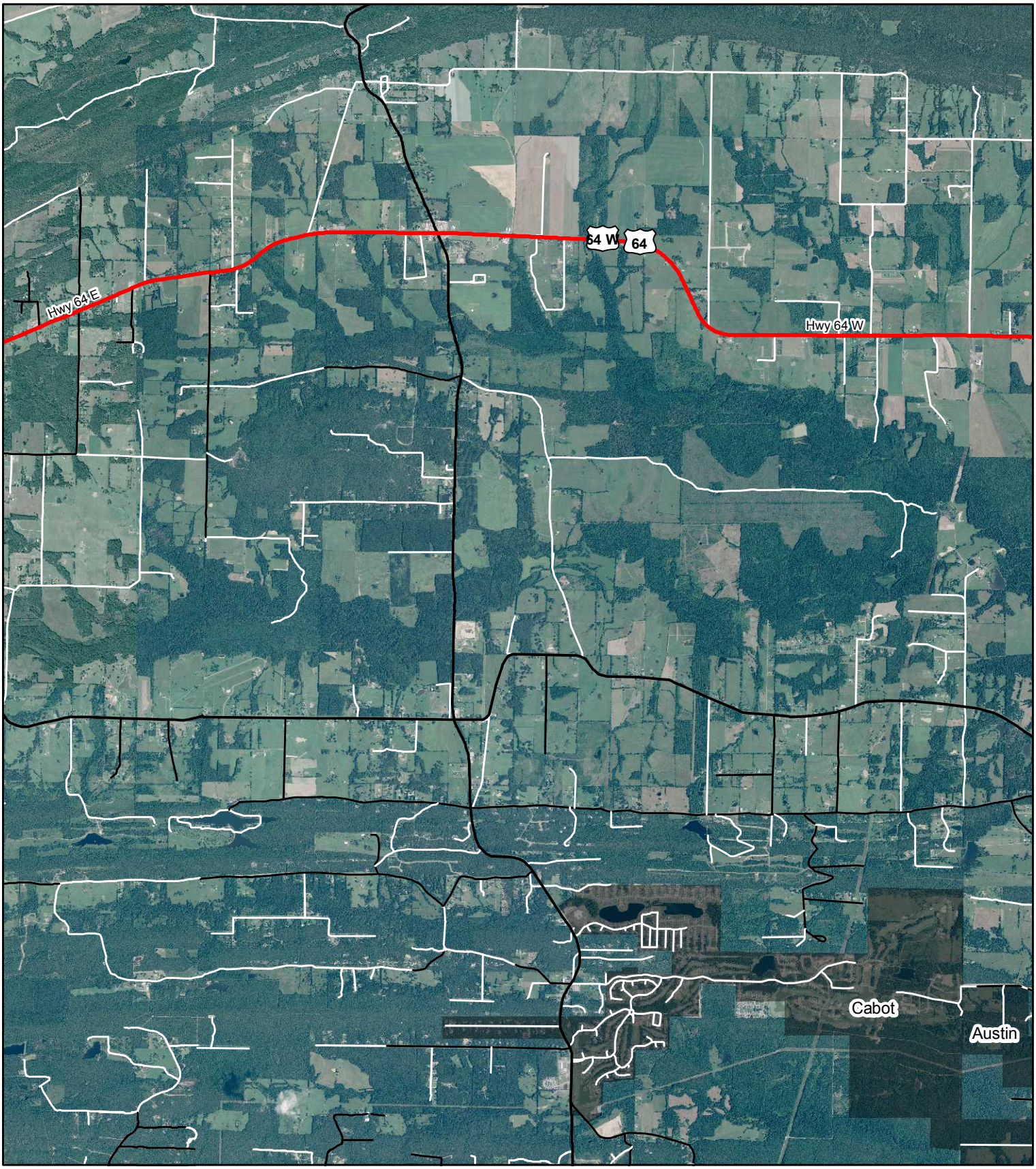
K11





0 0.5 1 2 3 4 Miles

L2

N

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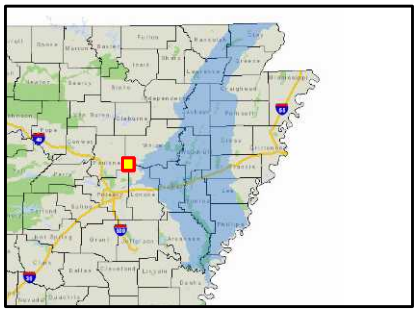
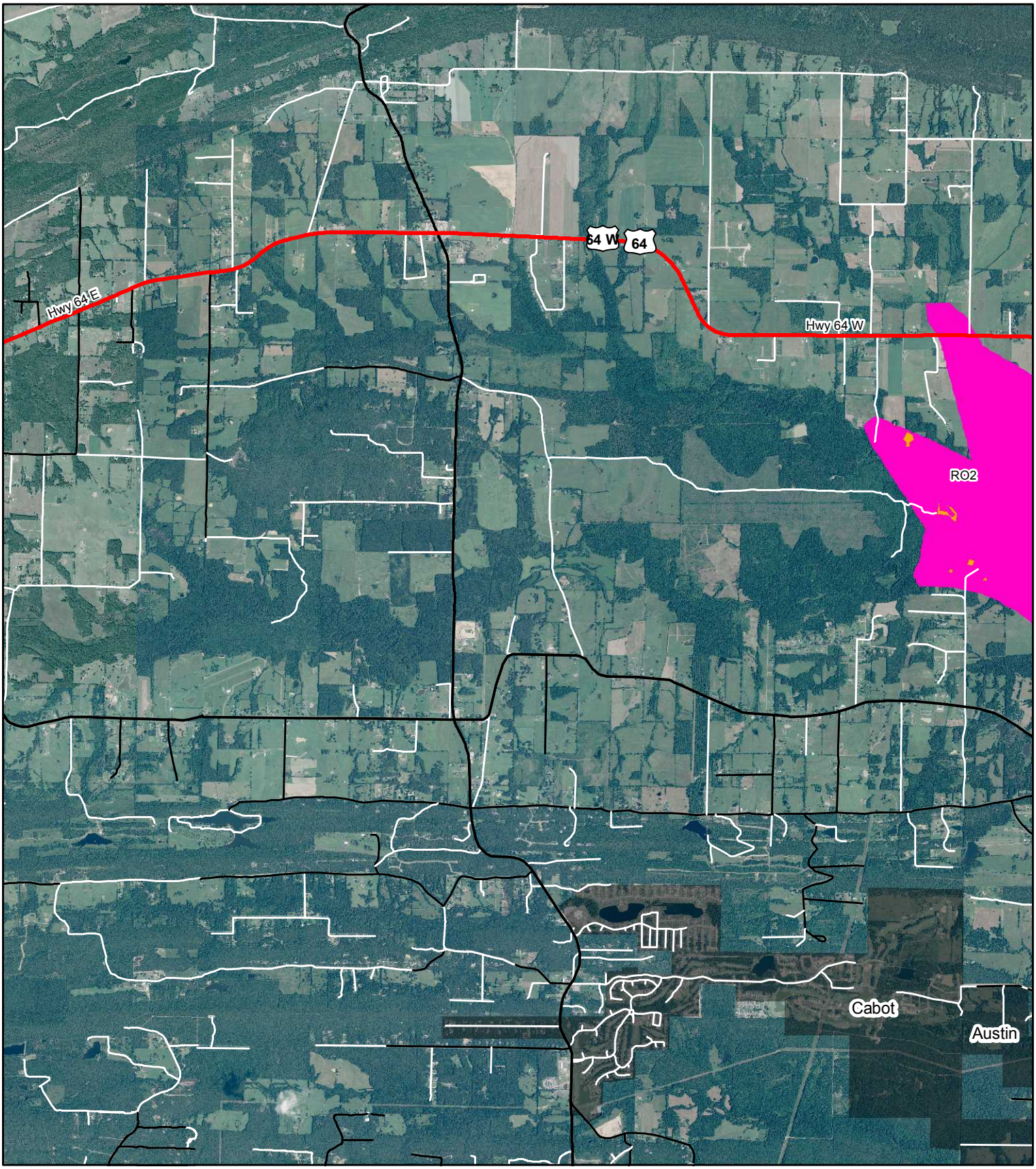
Projection: Transverse Mercator
Datum: North American 1983





0 0.5 1 2 3 4 Miles

N

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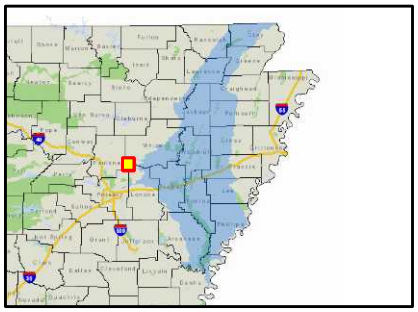
L2



Hwy 64 W

64 W

64

167

Beebe

67

67

67

Ward

Austin

Cabot

Hwy 31 N

31

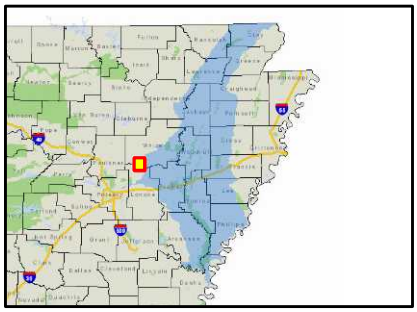
31 N

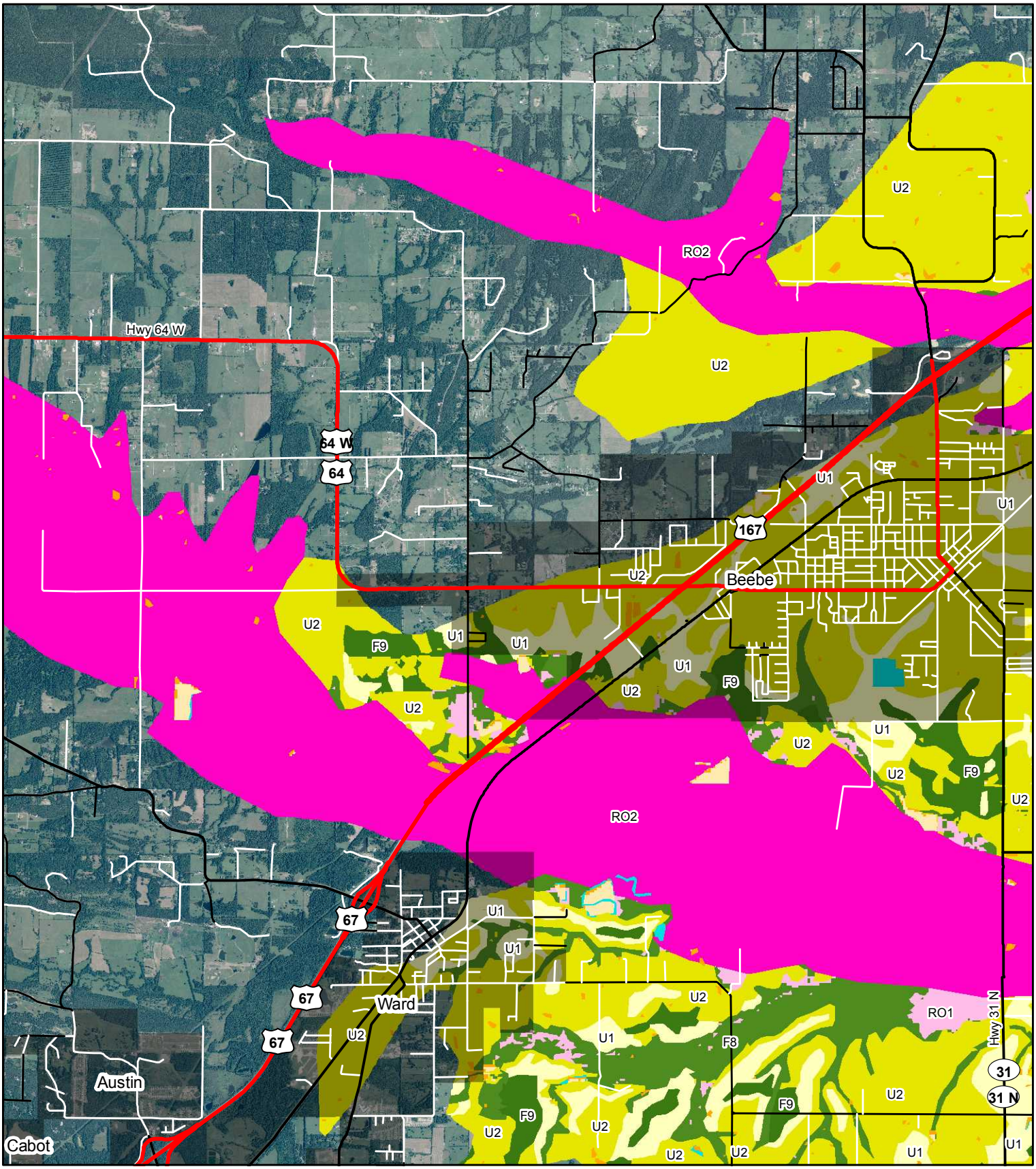
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

L3





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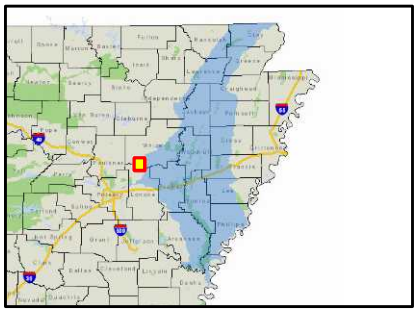
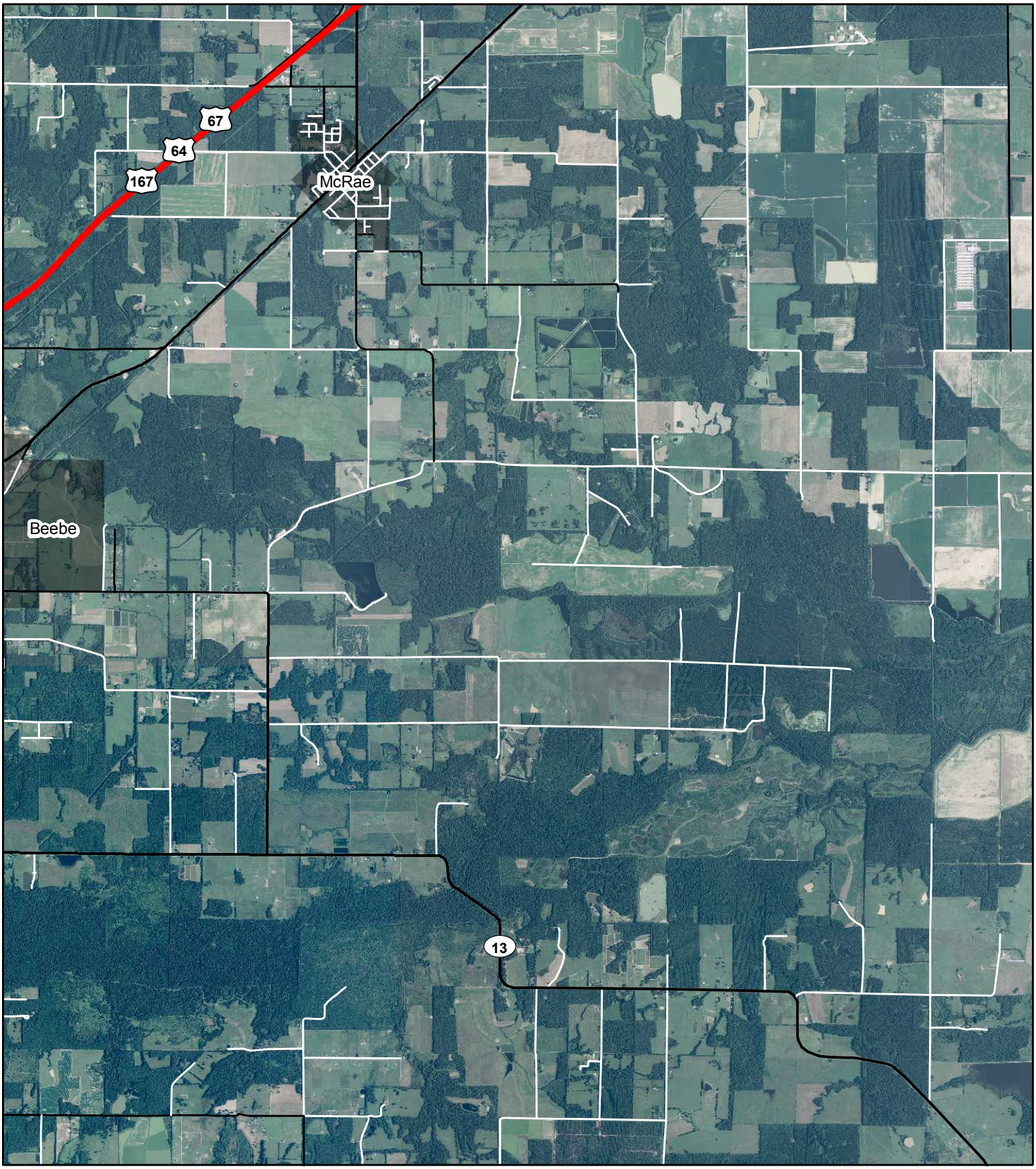
L3





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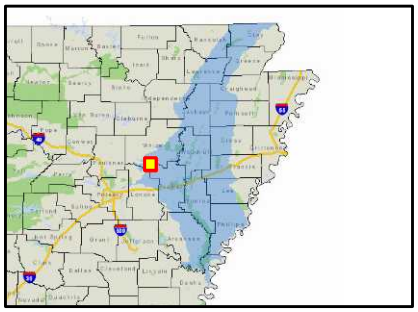
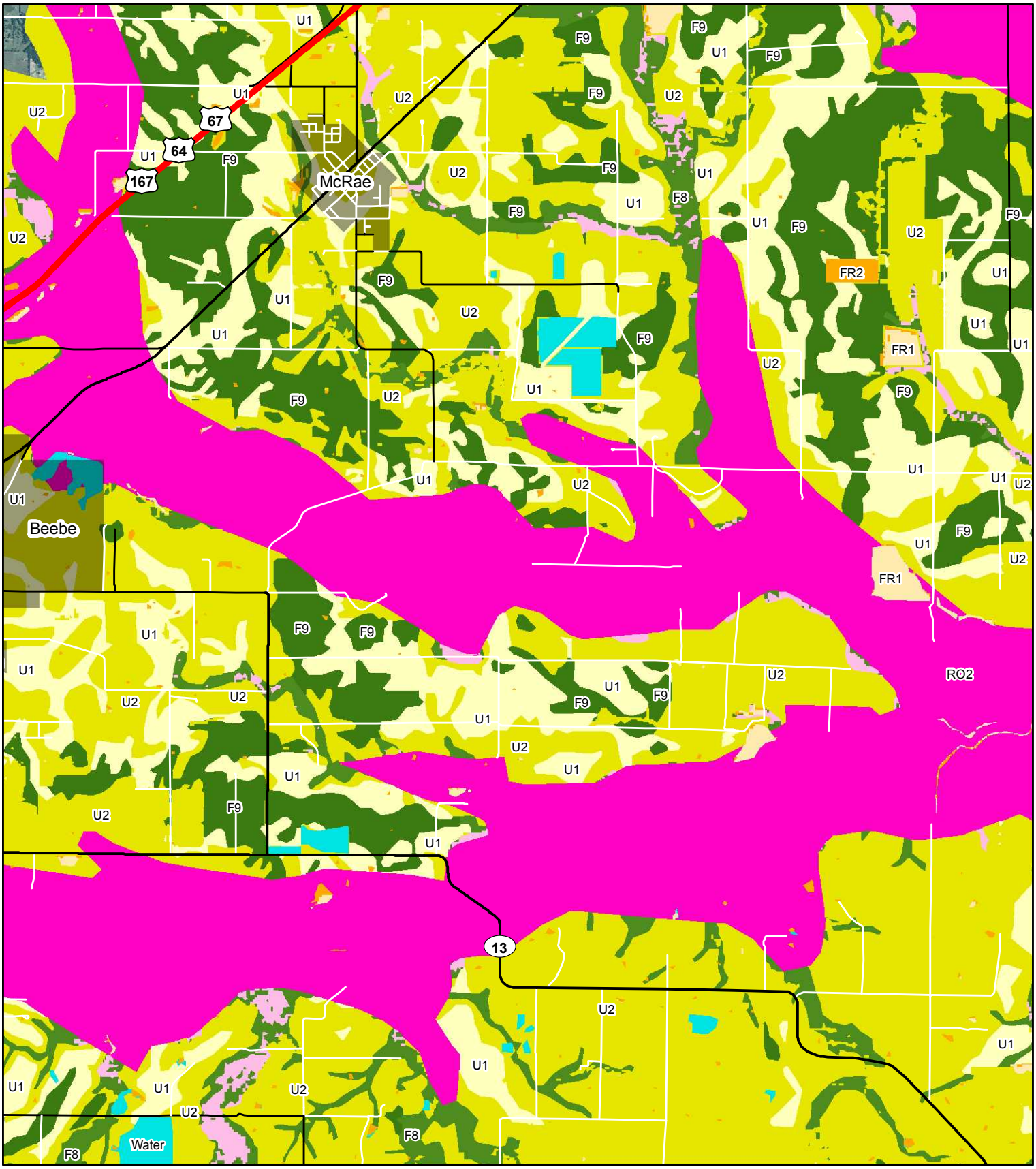
L4





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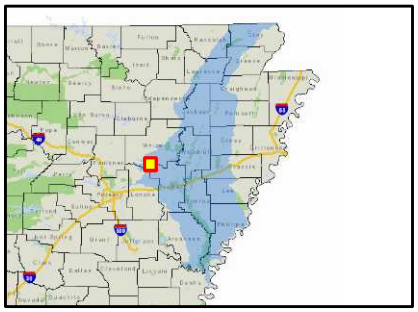

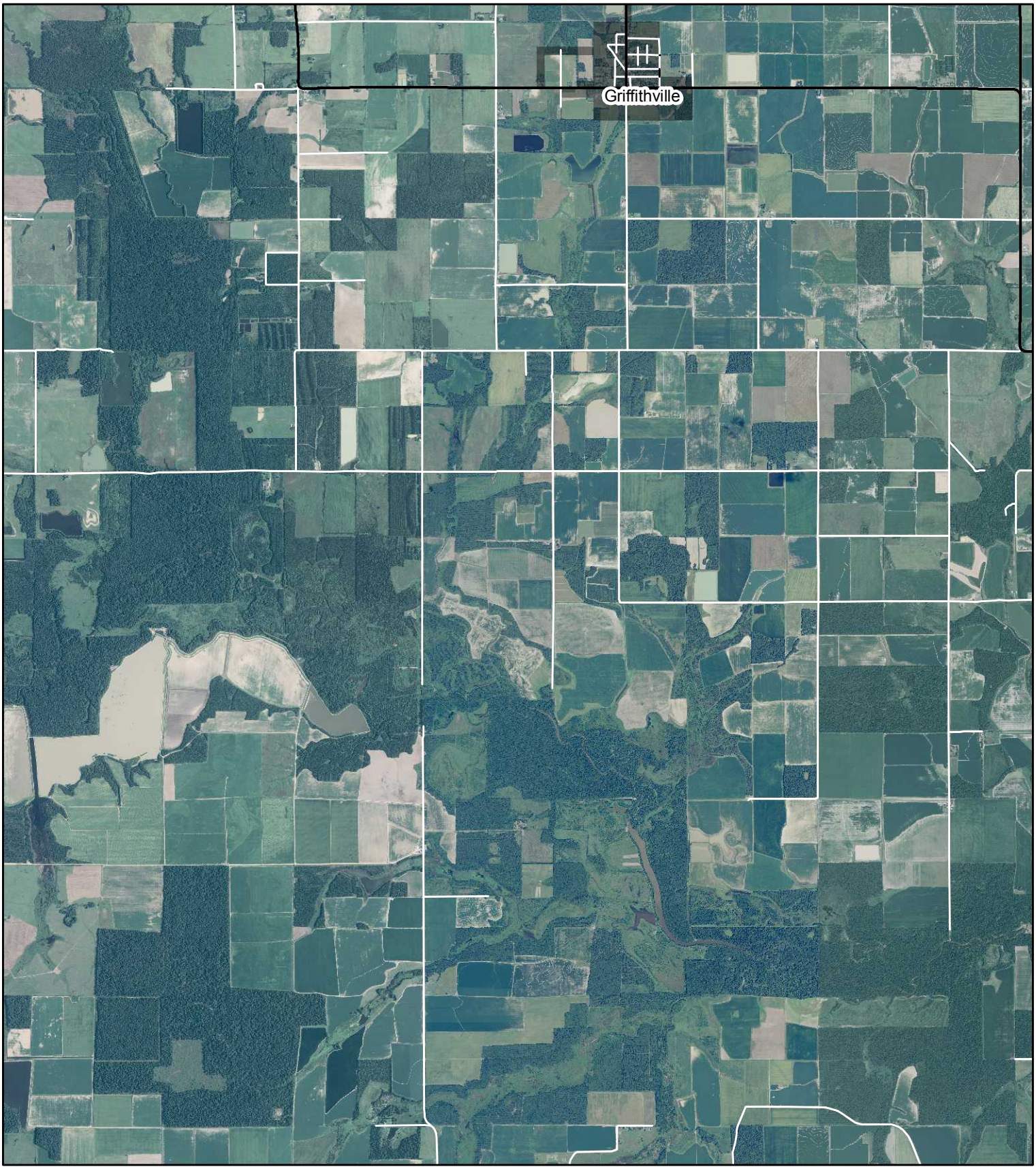

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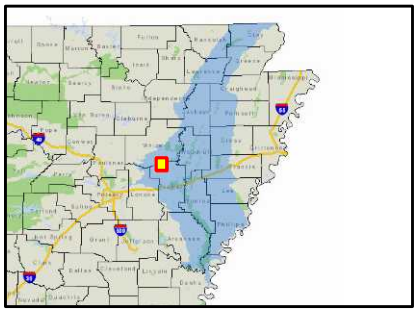

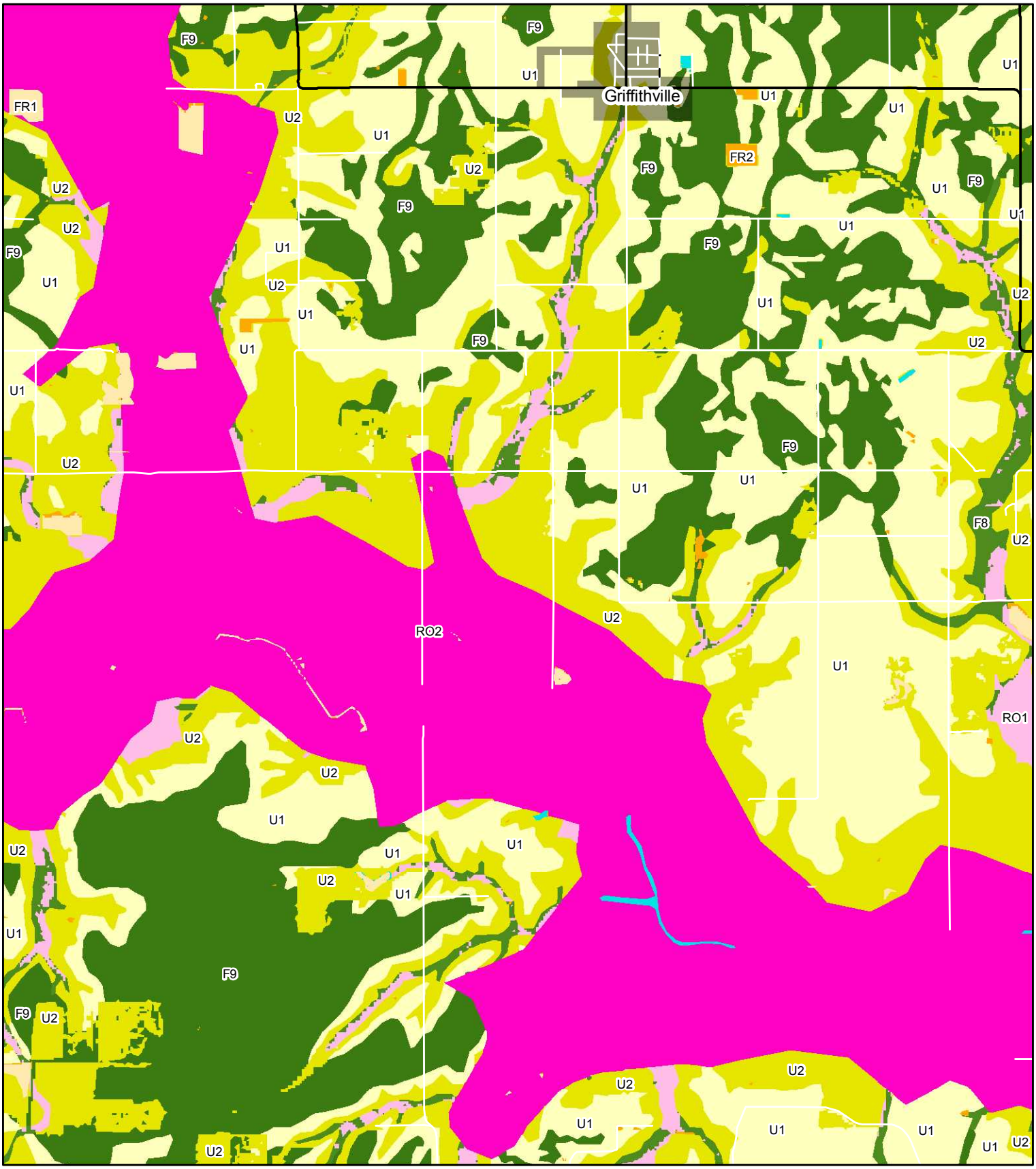

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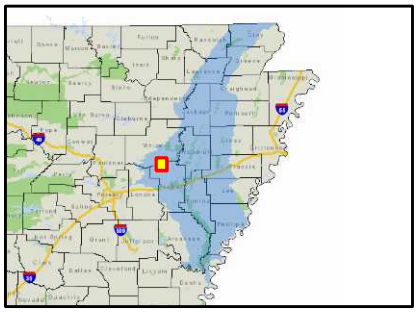

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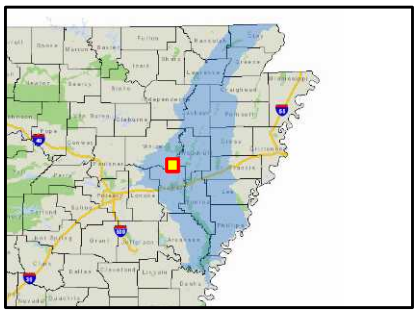
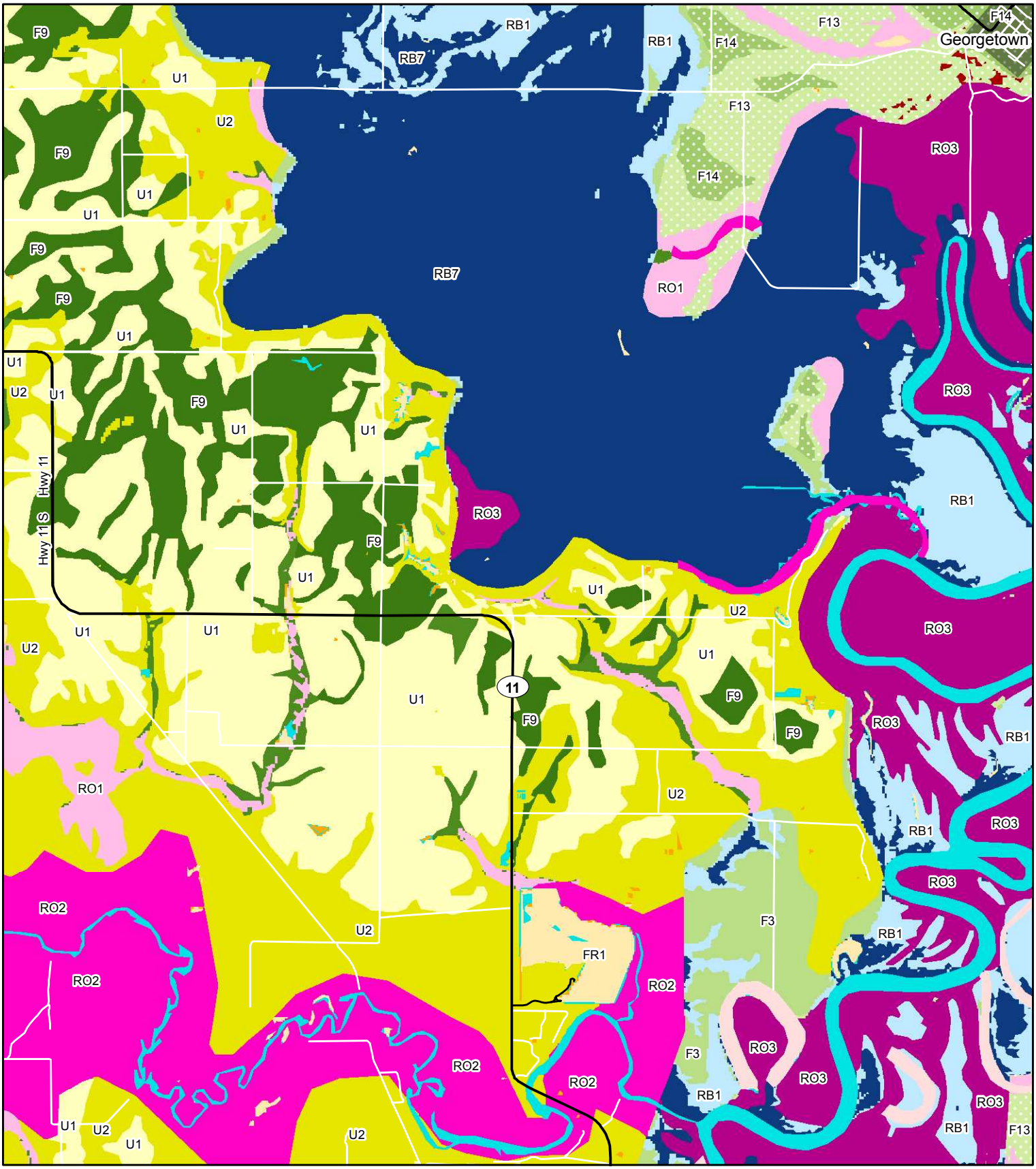
L6





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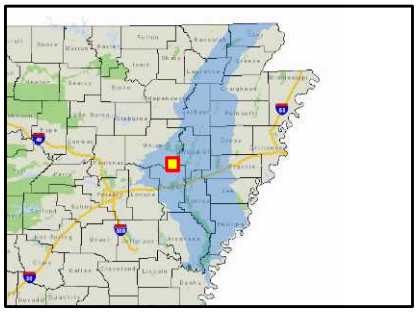

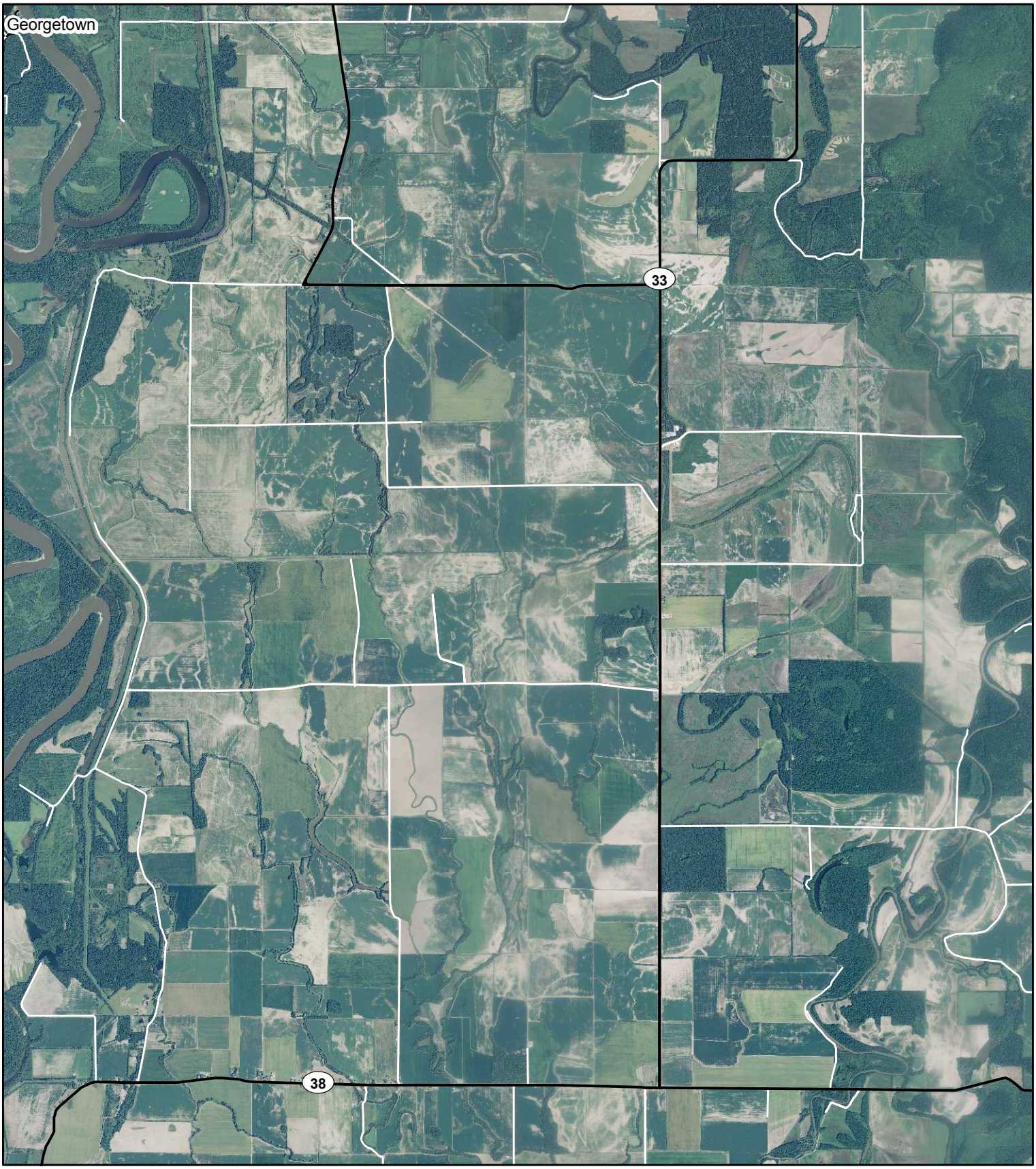

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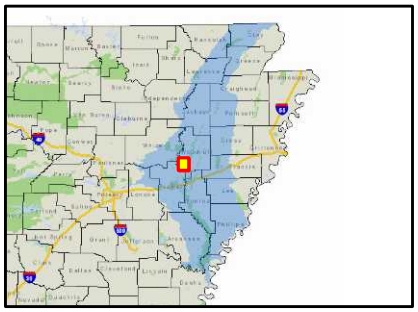

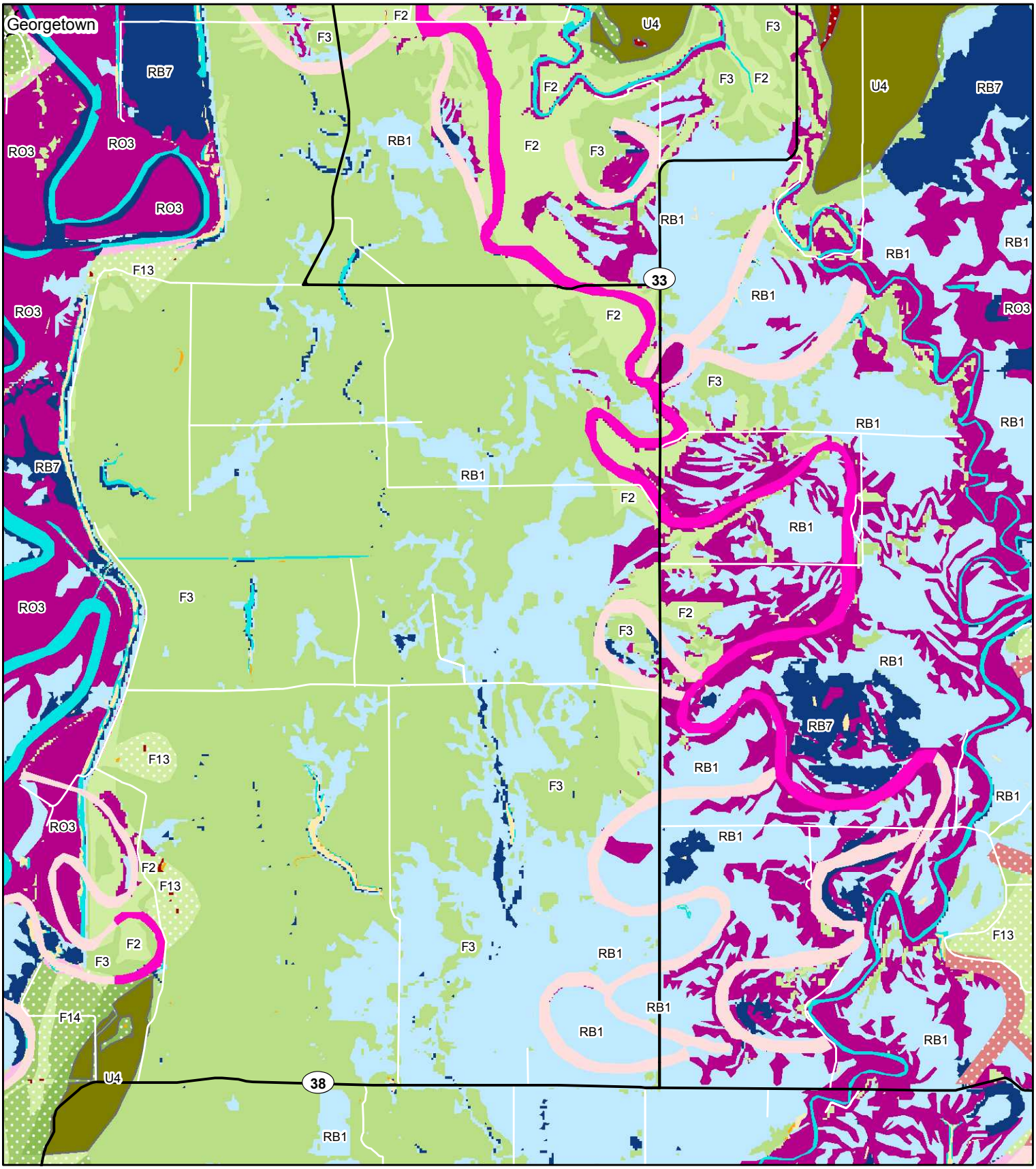

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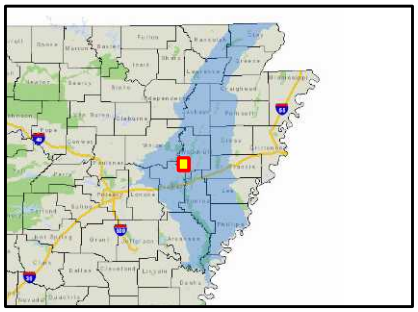

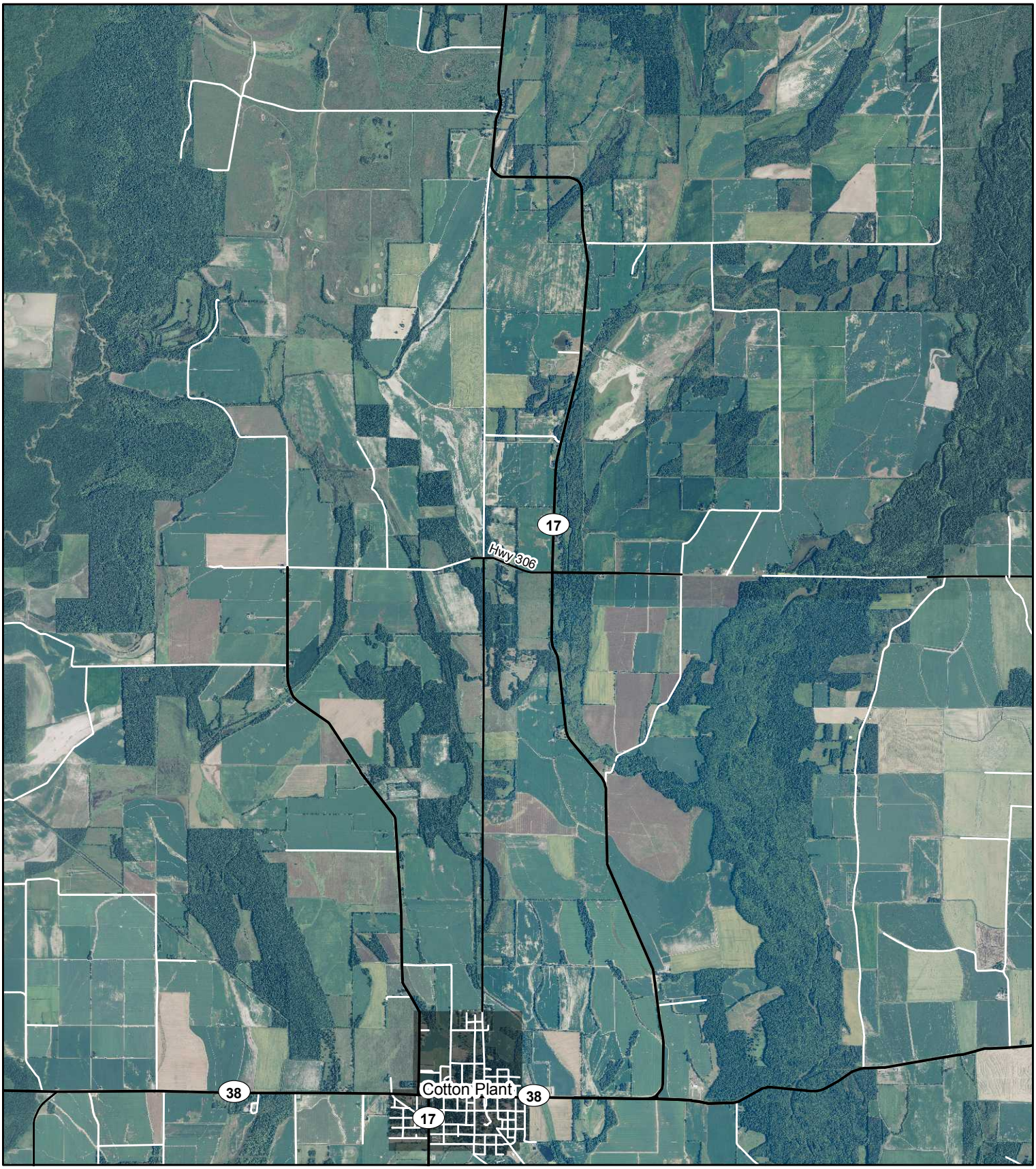

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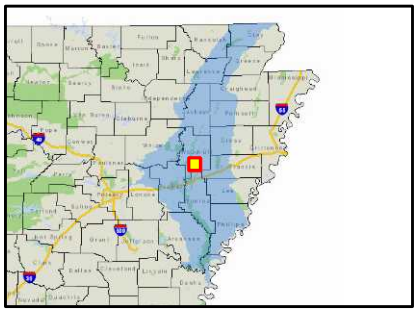

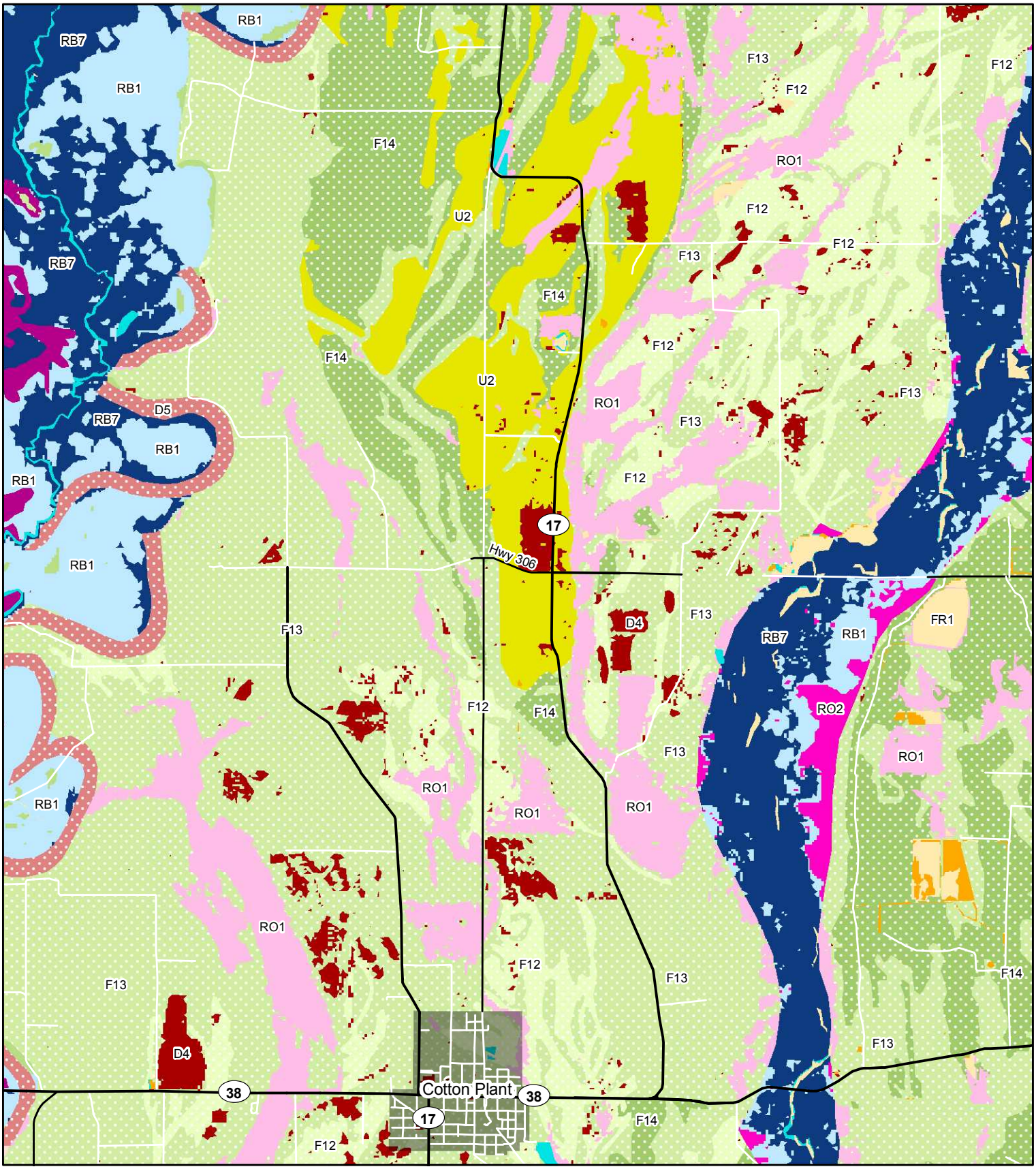

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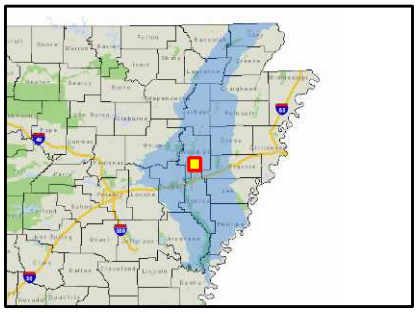

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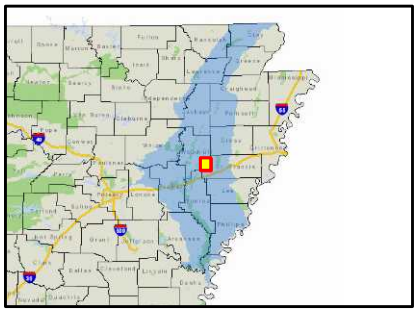

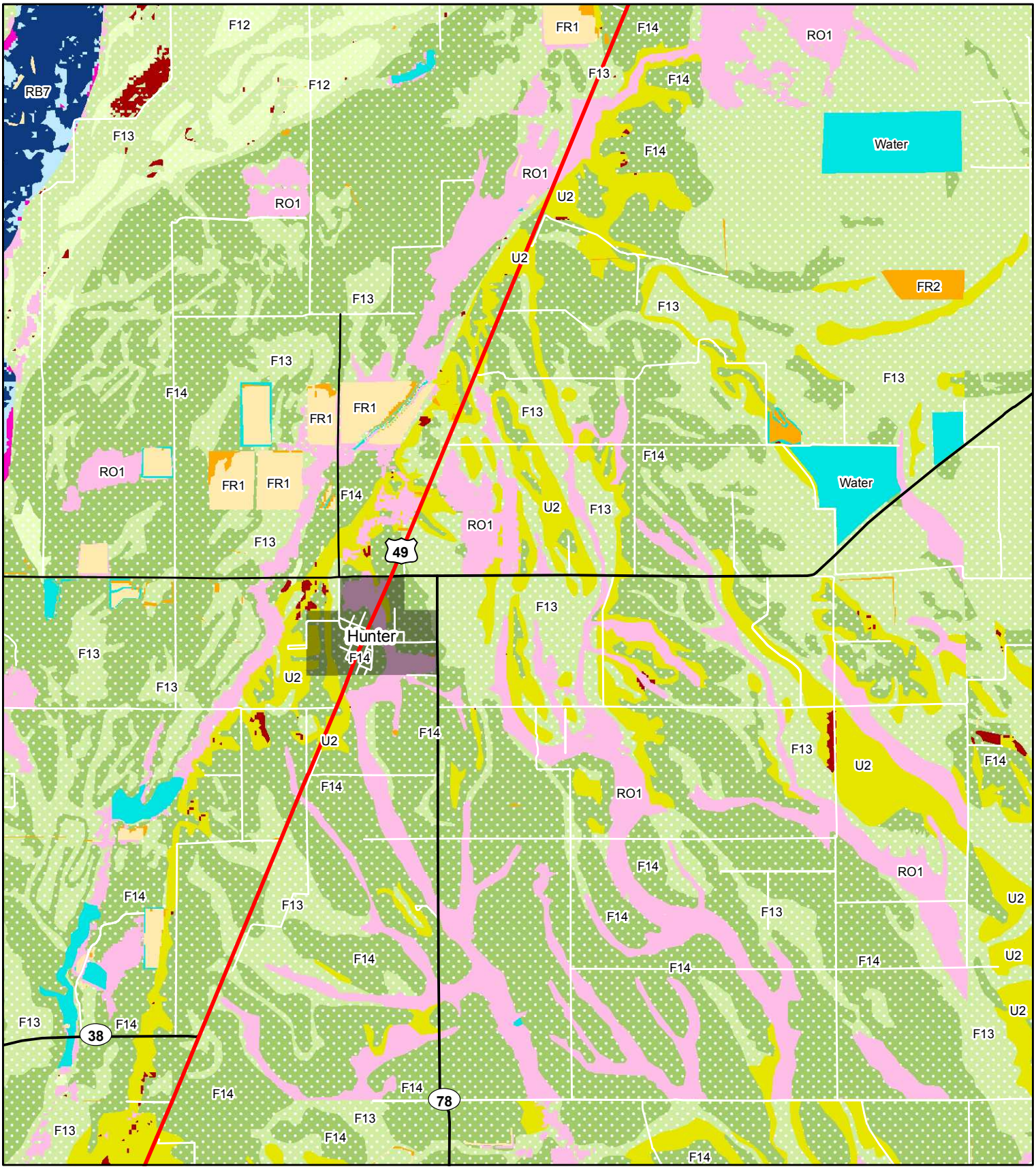

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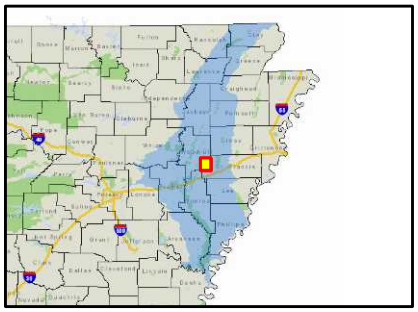
L9



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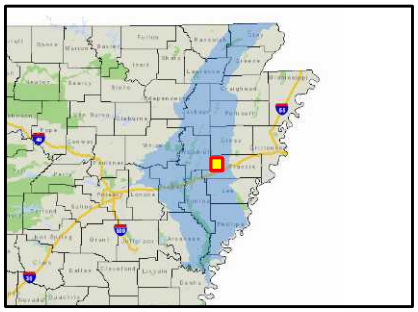
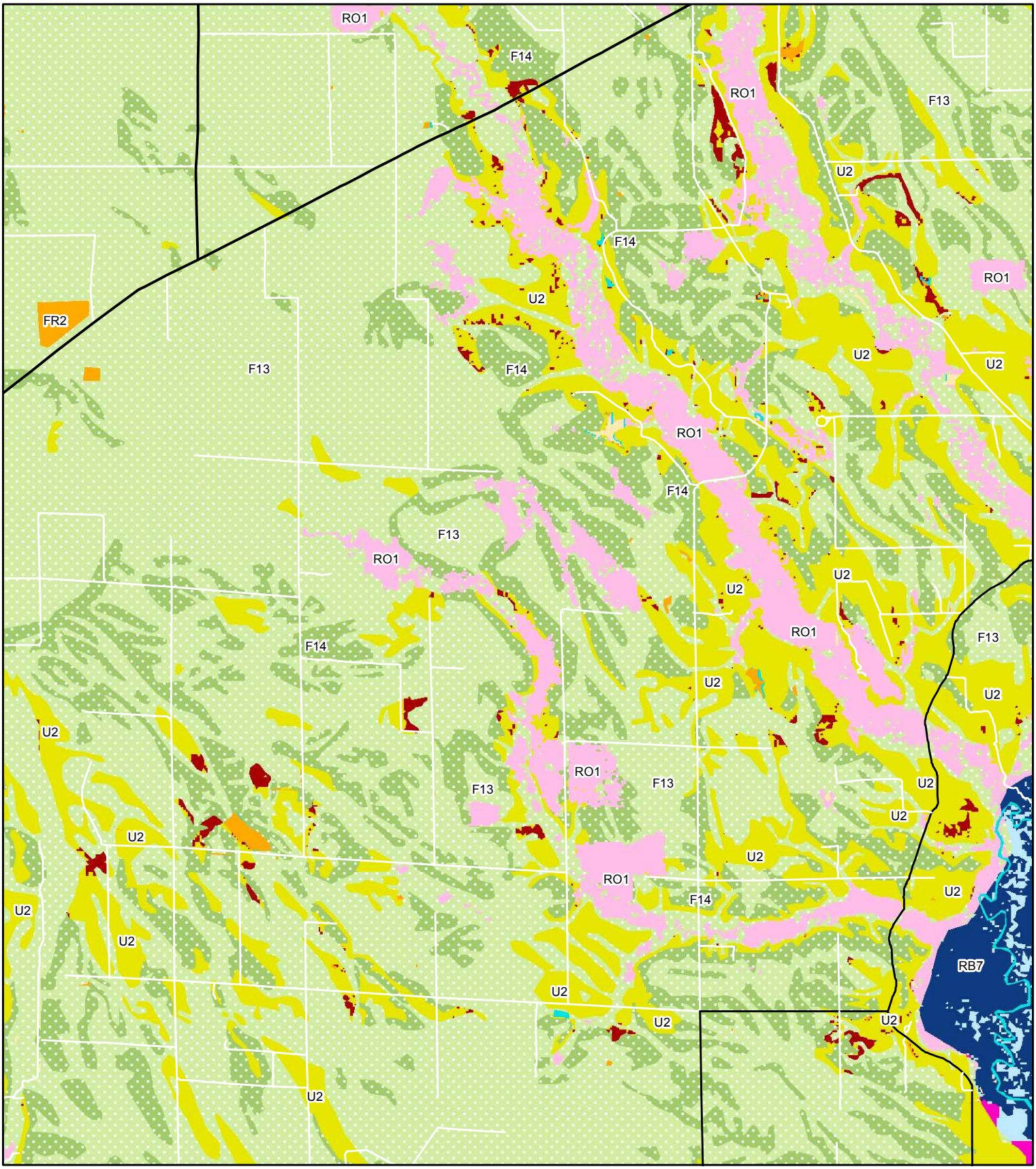
N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

L10





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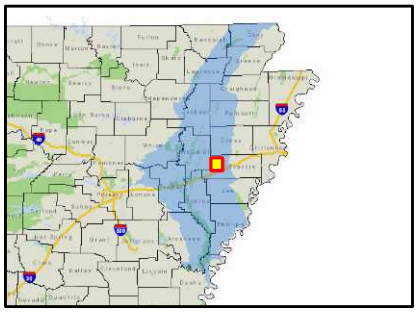
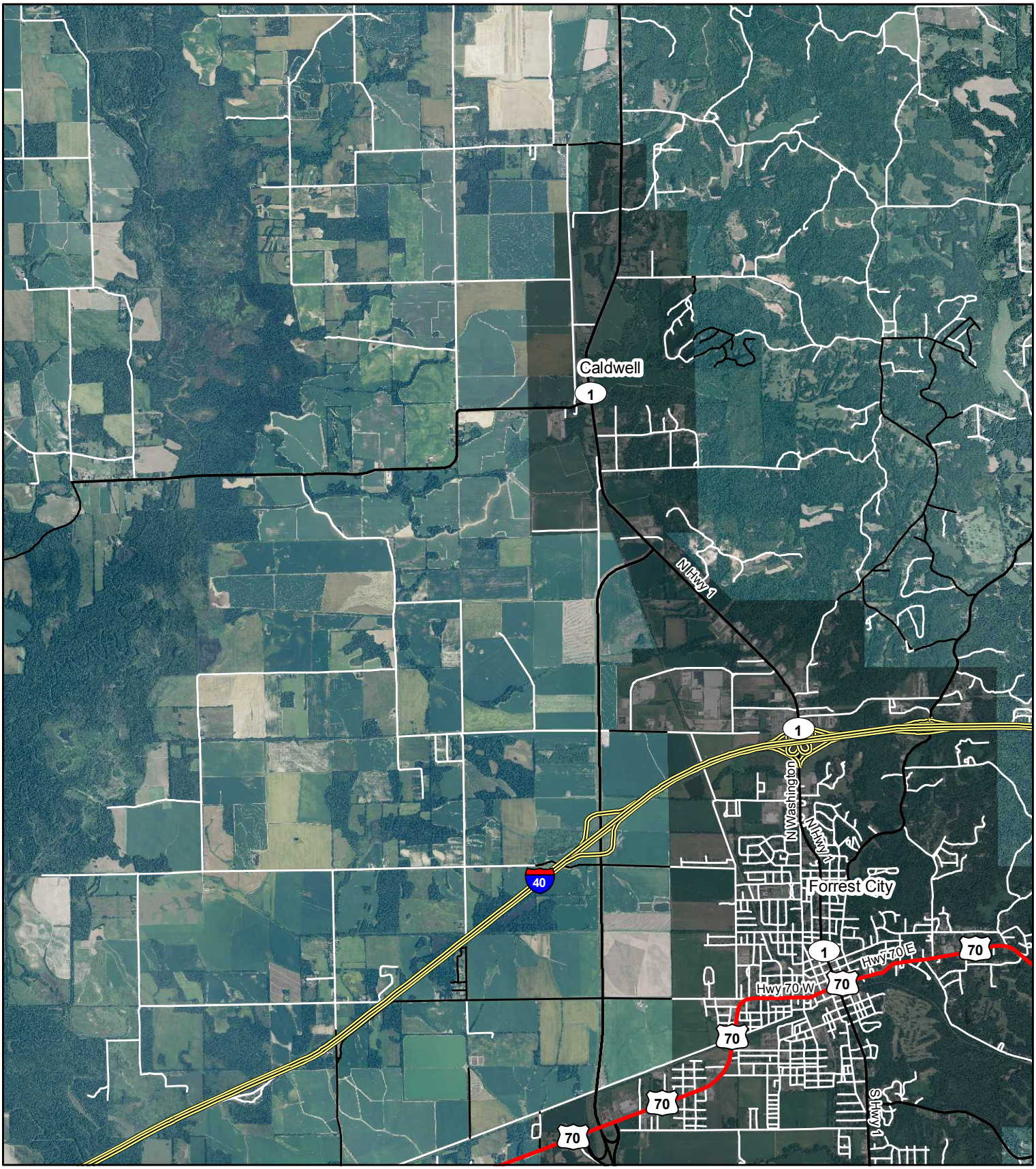
Projection: Transverse Mercator
Datum: North American 1983

L10





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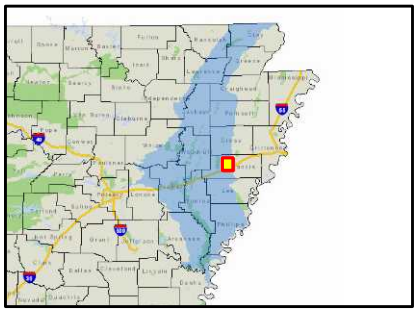

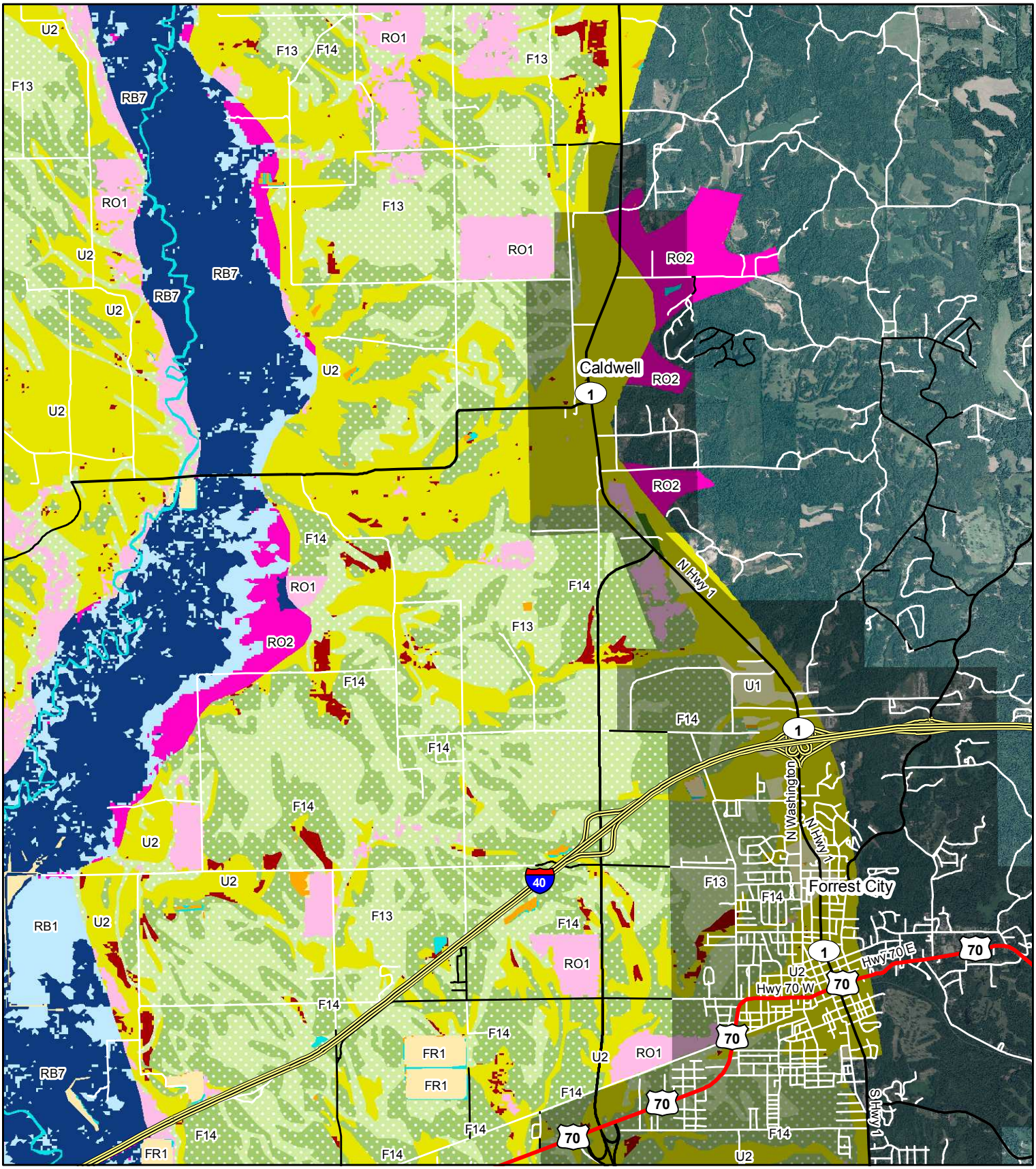

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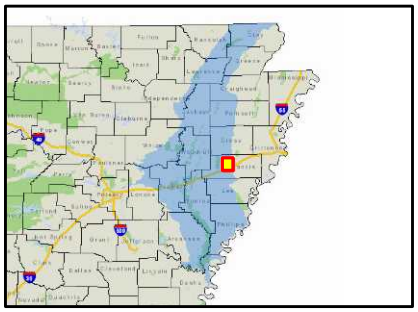
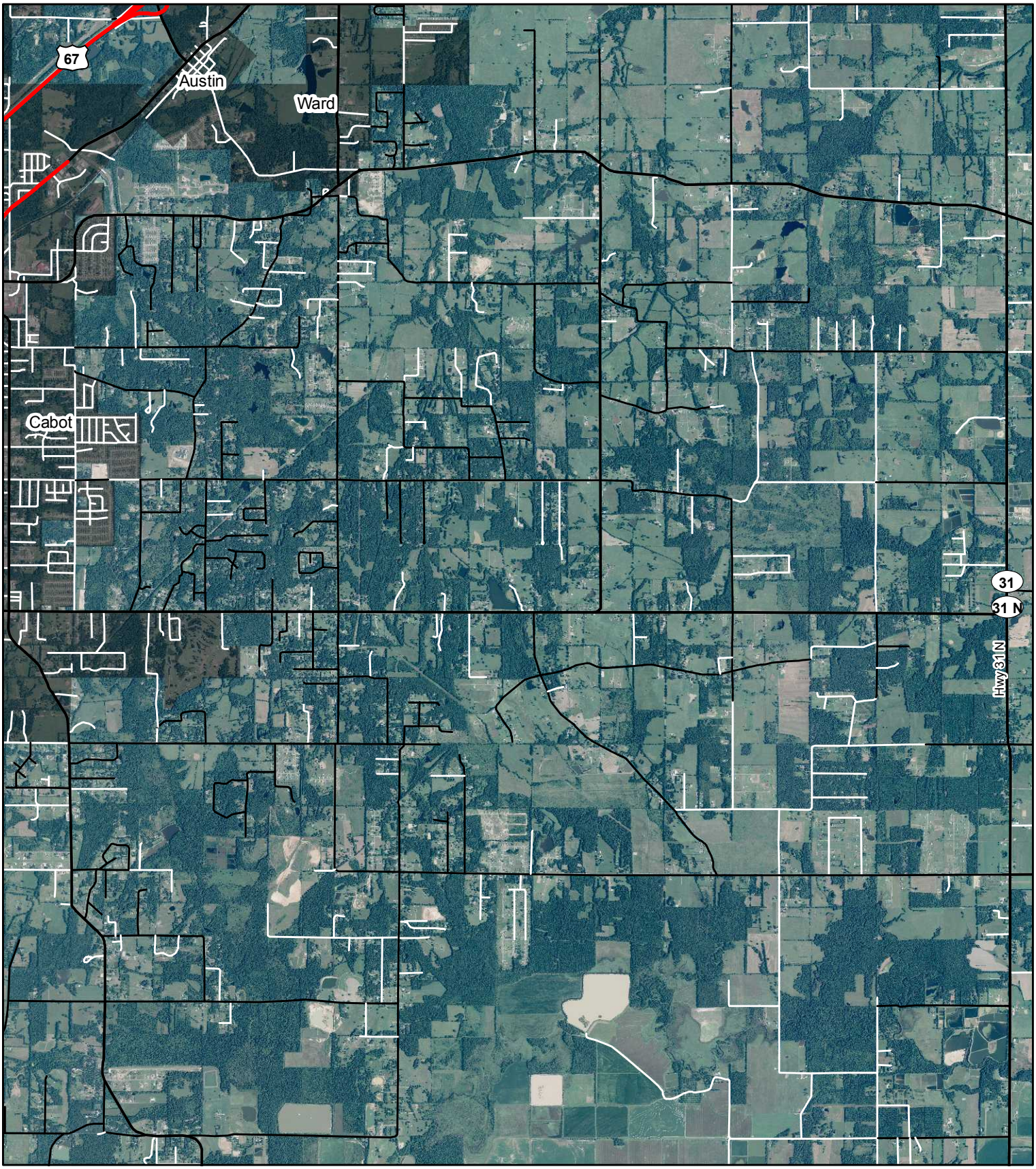
L11





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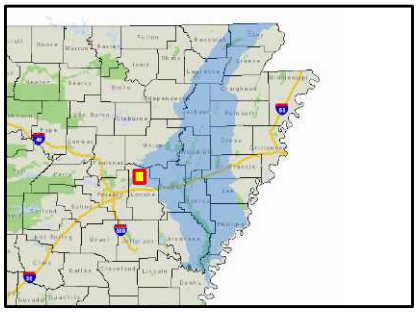
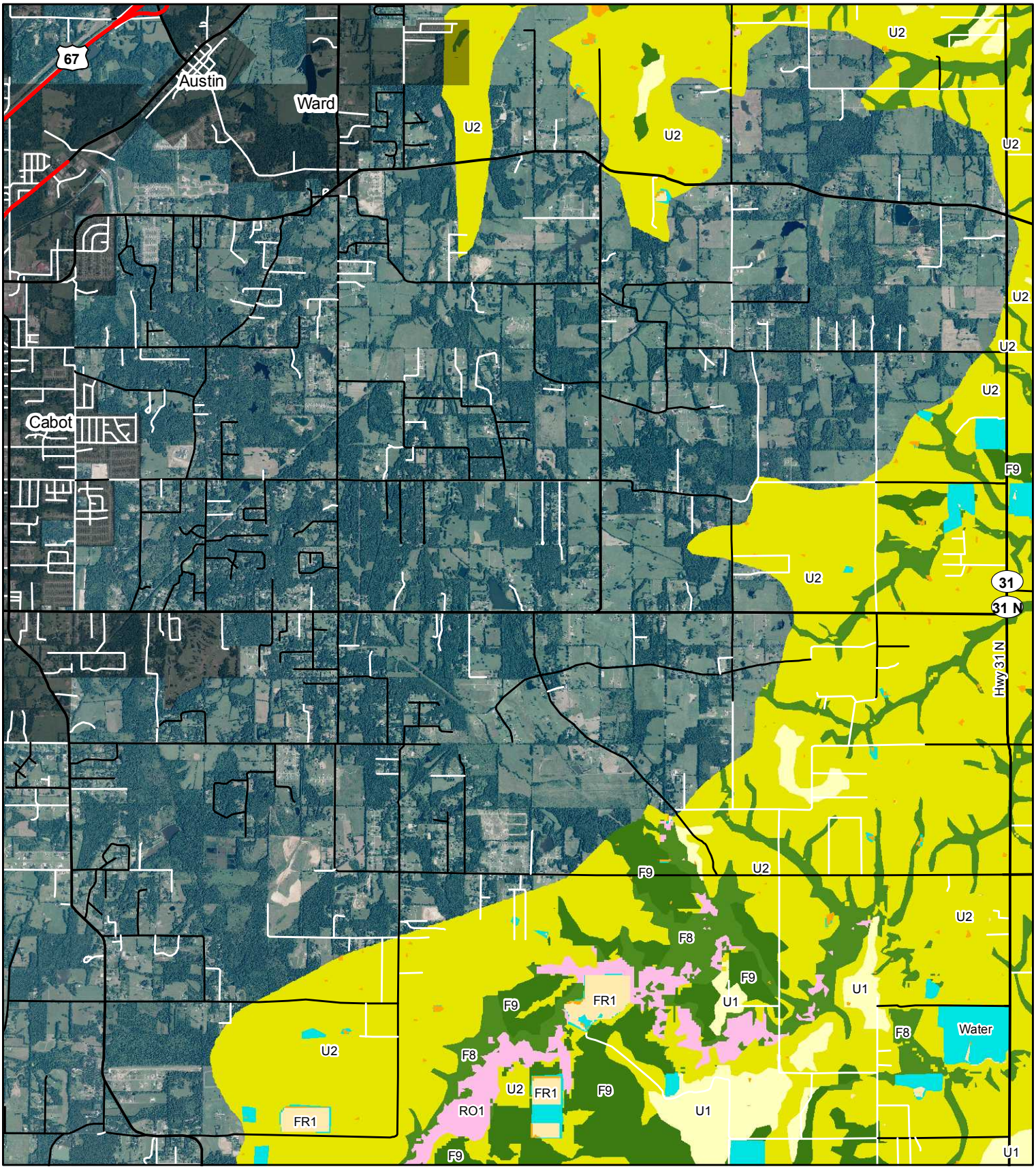
Projection: Transverse Mercator
Datum: North American 1983

M3





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N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
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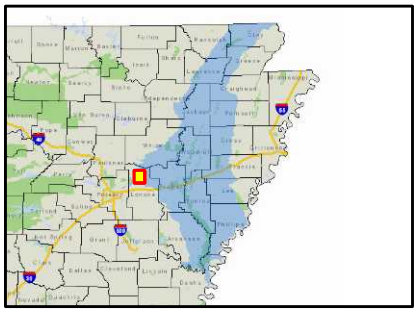
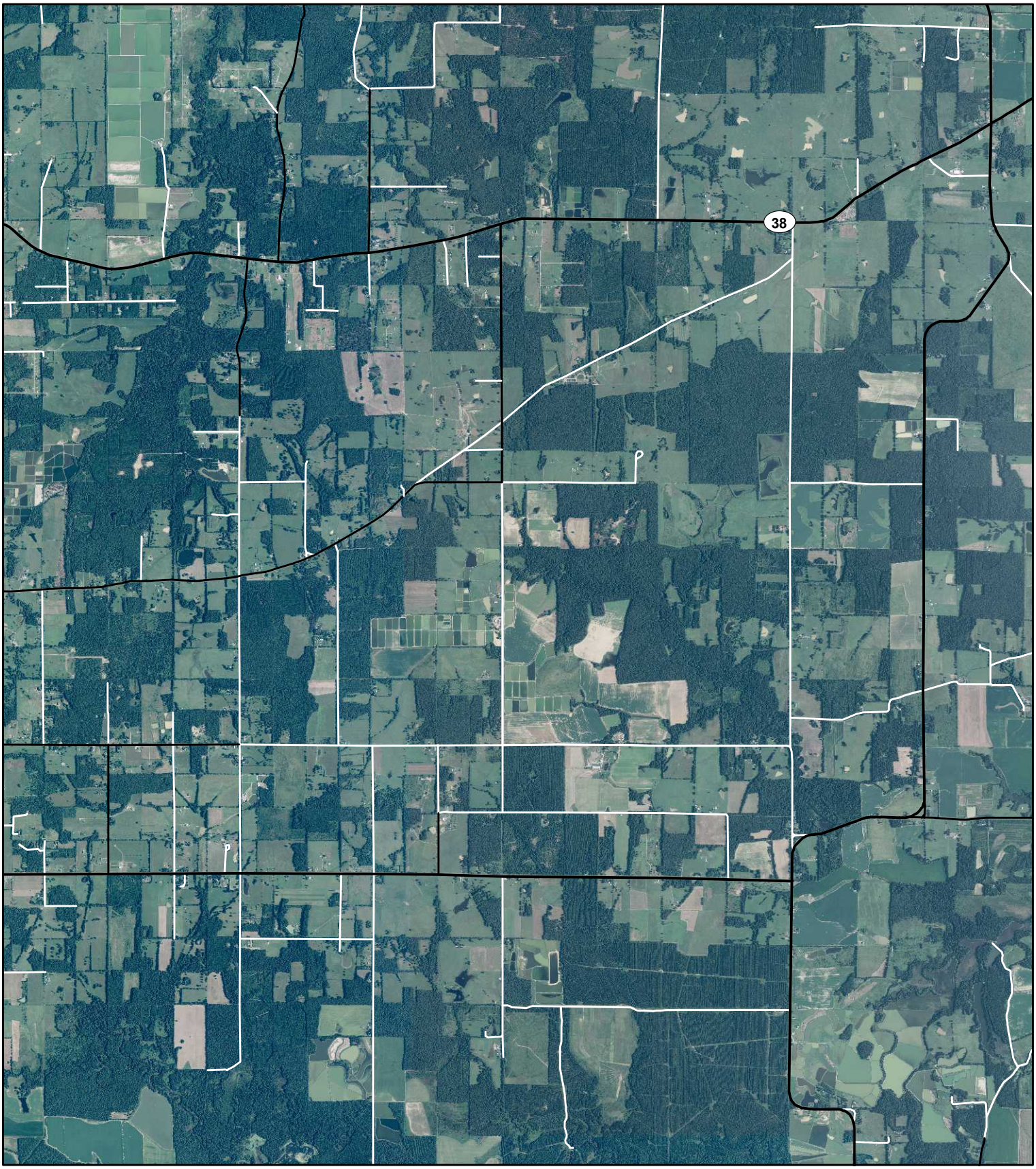
M3





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N

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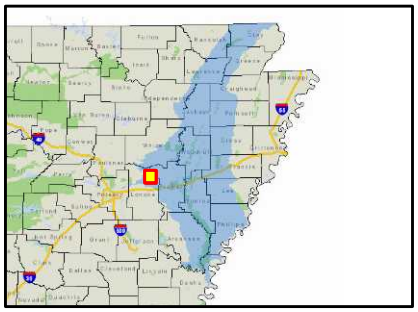
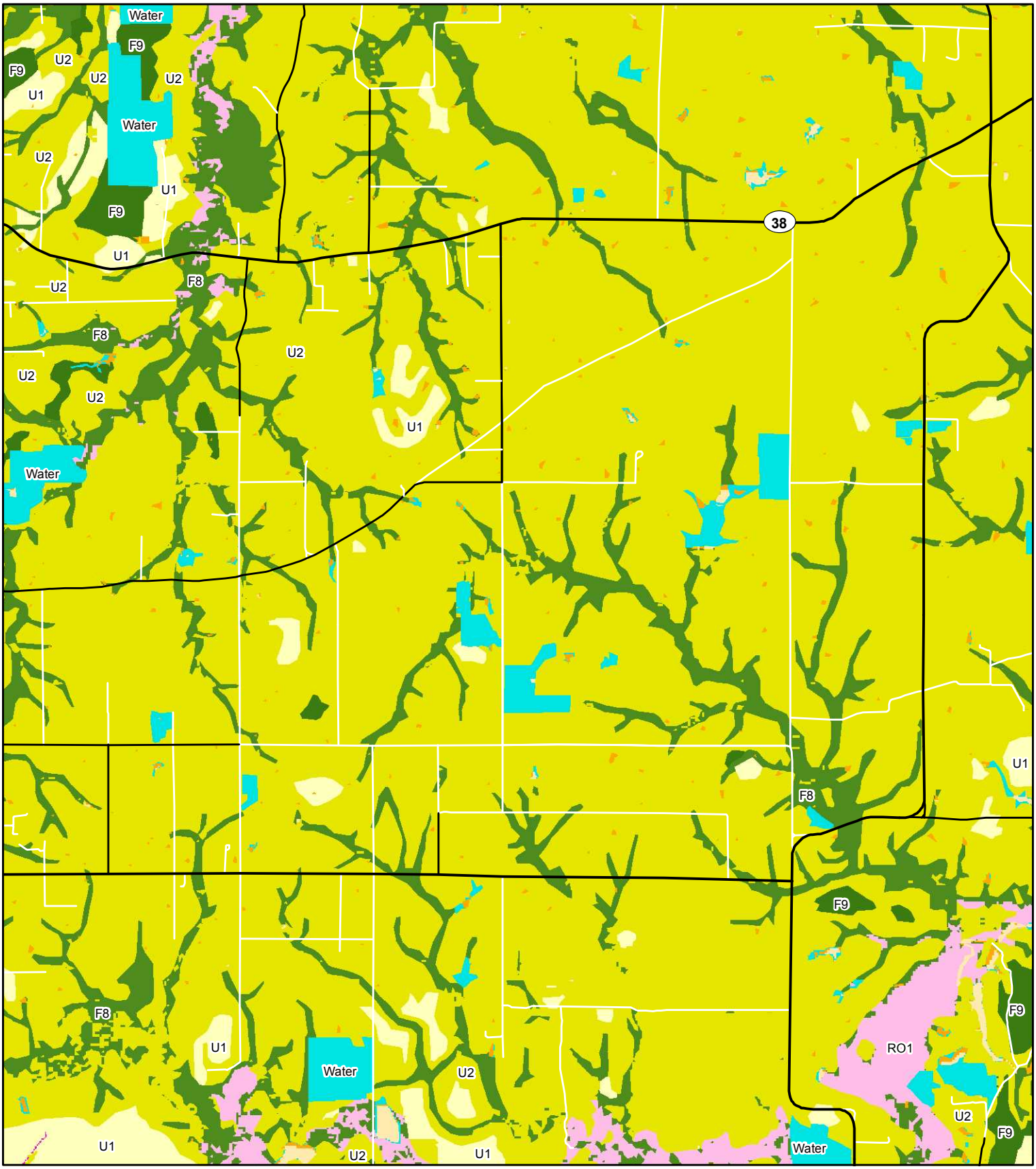
M4





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N

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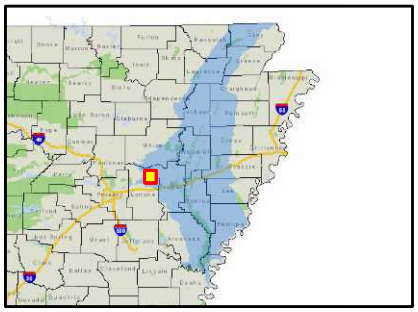
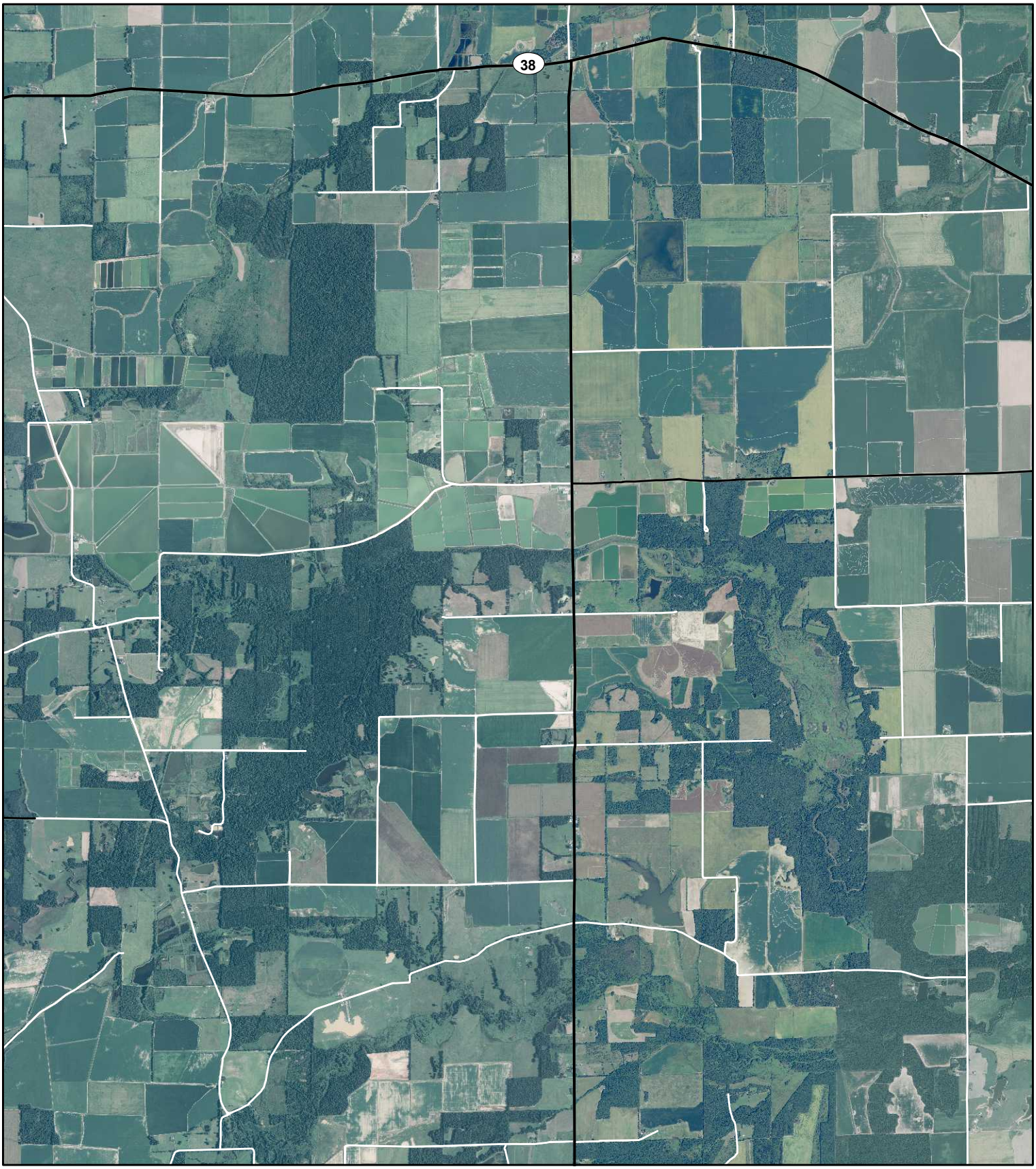
Projection: Transverse Mercator
Datum: North American 1983

M4





0 0.5 1 2 3 4 Miles

N

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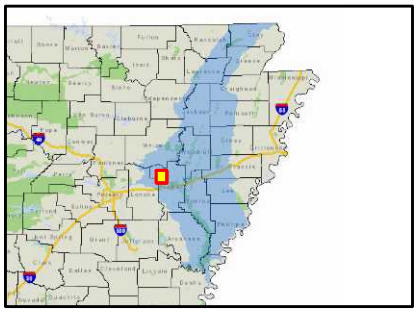
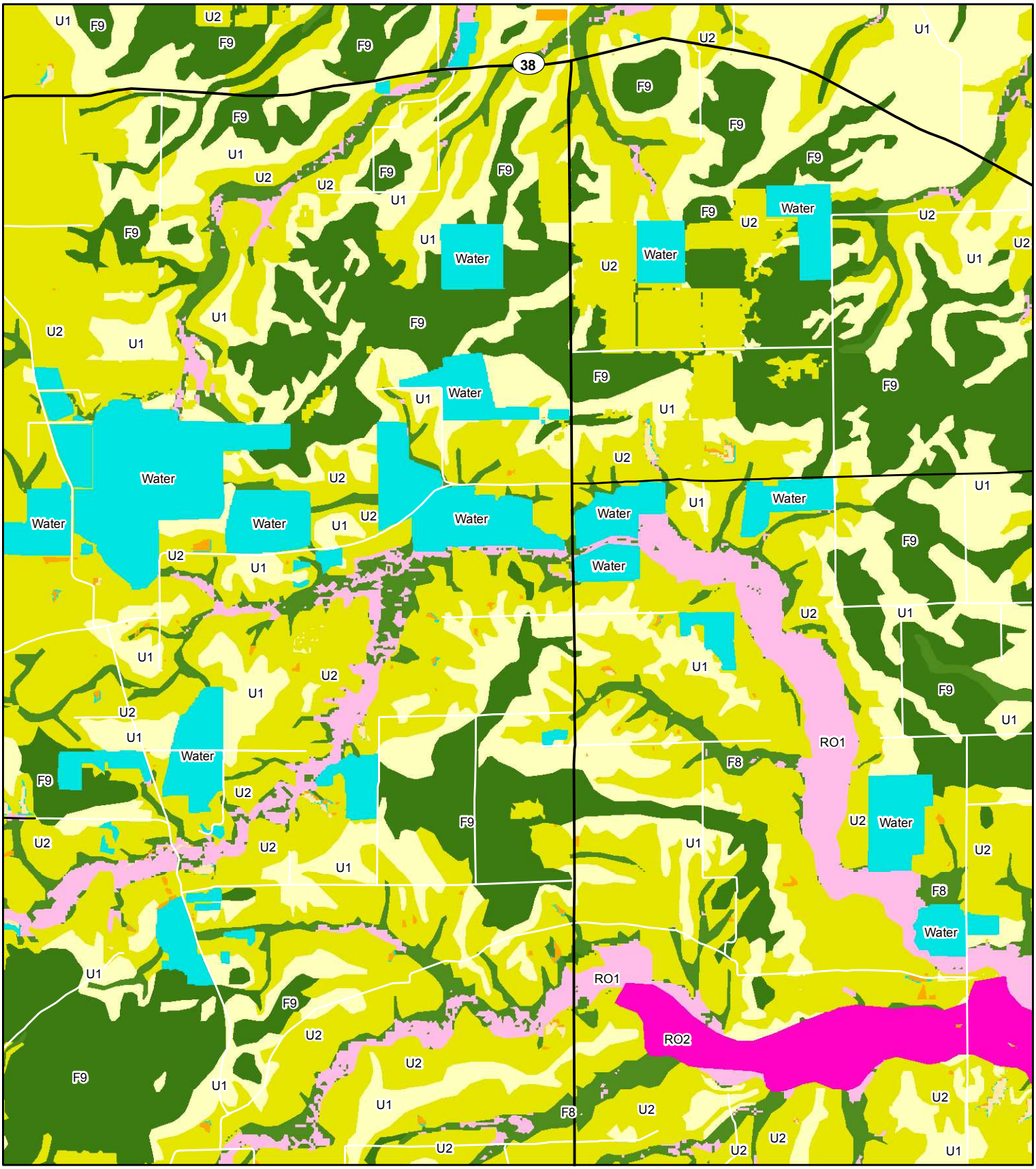
Projection: Transverse Mercator
Datum: North American 1983

M5





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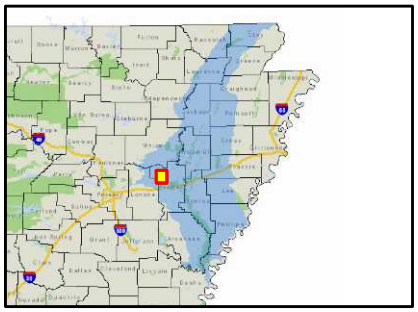
N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

M5



0 0.5 1 2 3 4 Miles

N

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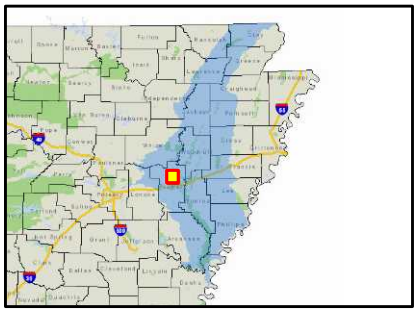
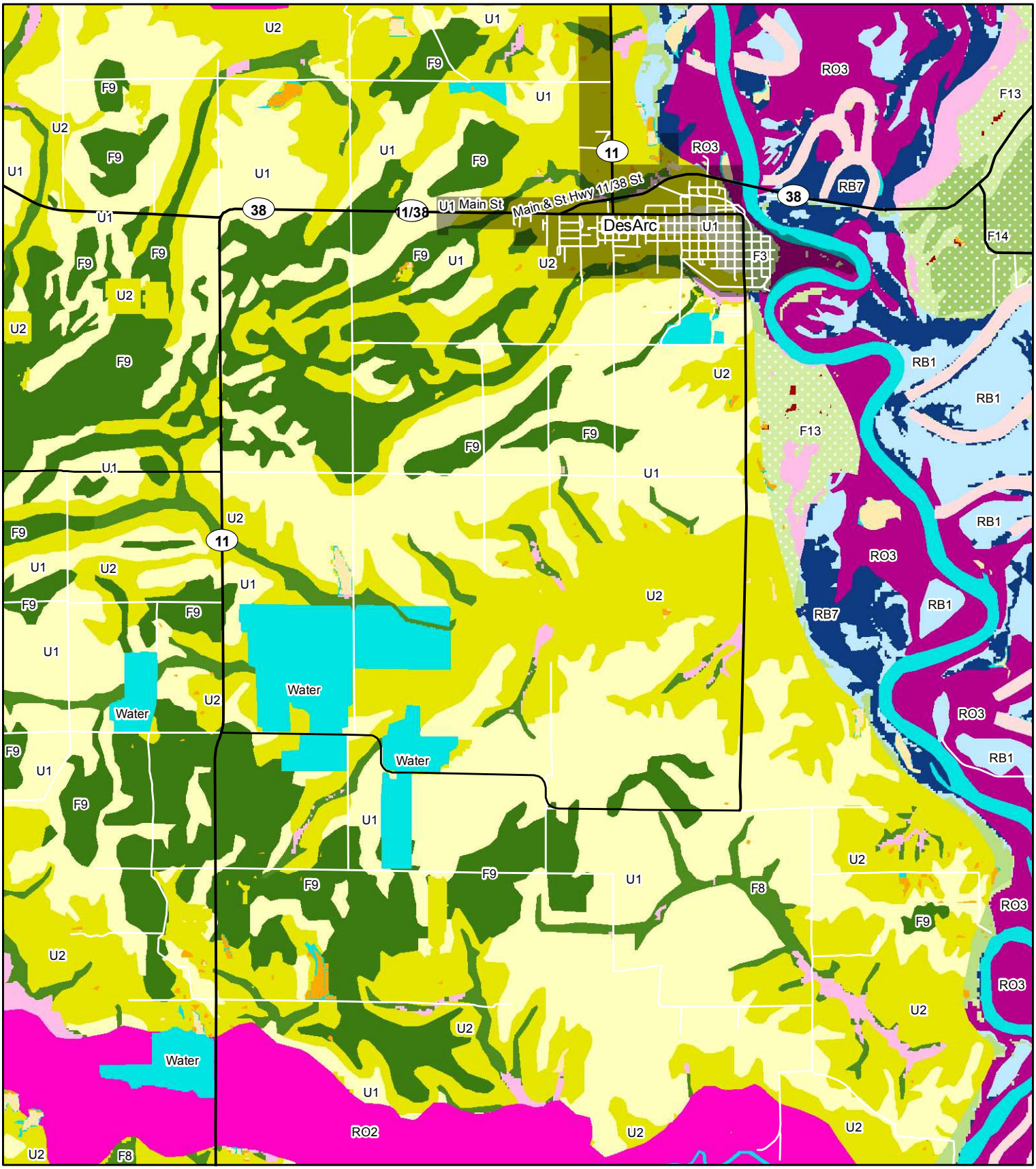
Projection: Transverse Mercator
Datum: North American 1983

M6





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N

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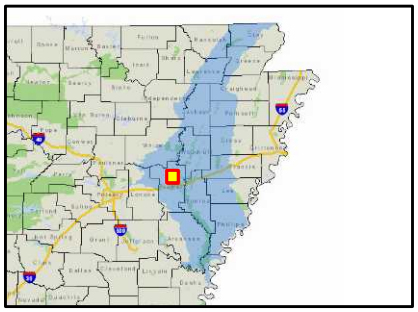
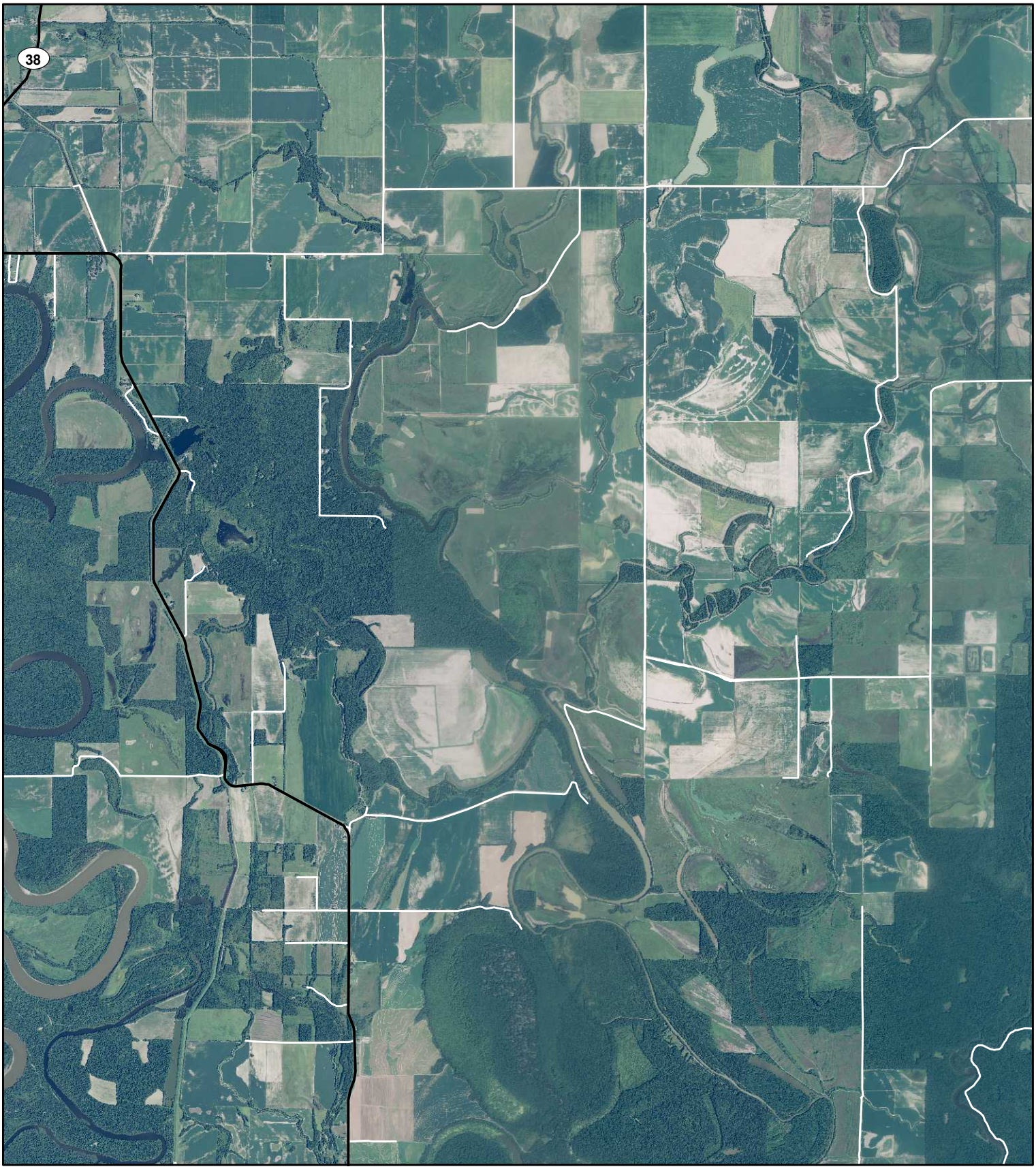
Projection: Transverse Mercator
Datum: North American 1983

M6





0 0.5 1 2 3 4 Miles

N

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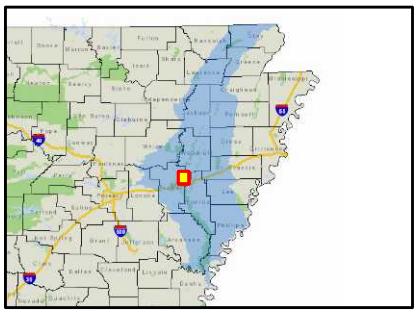
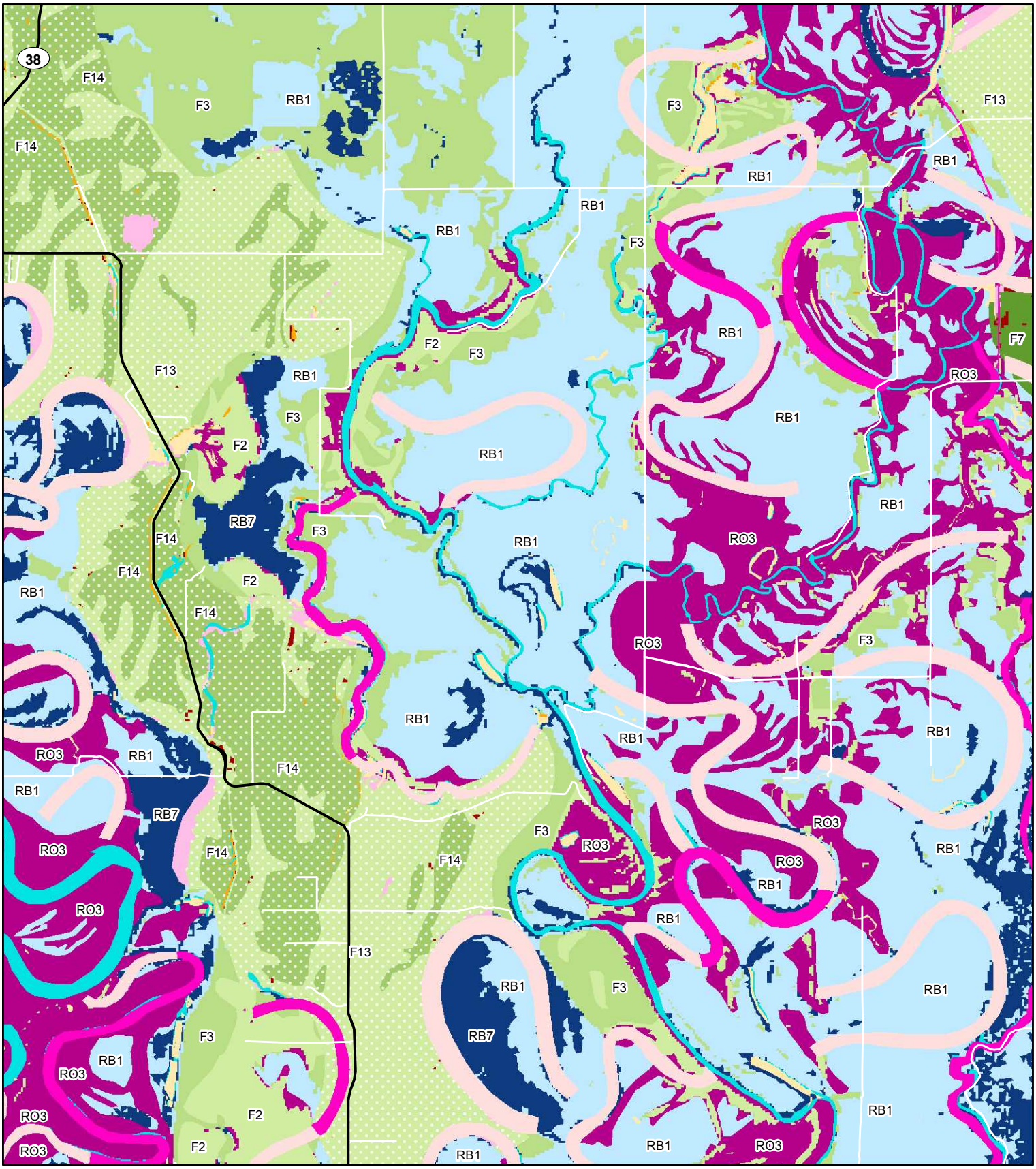
M7





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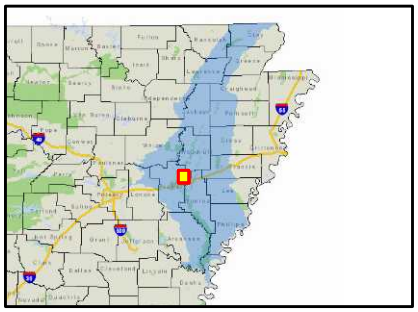
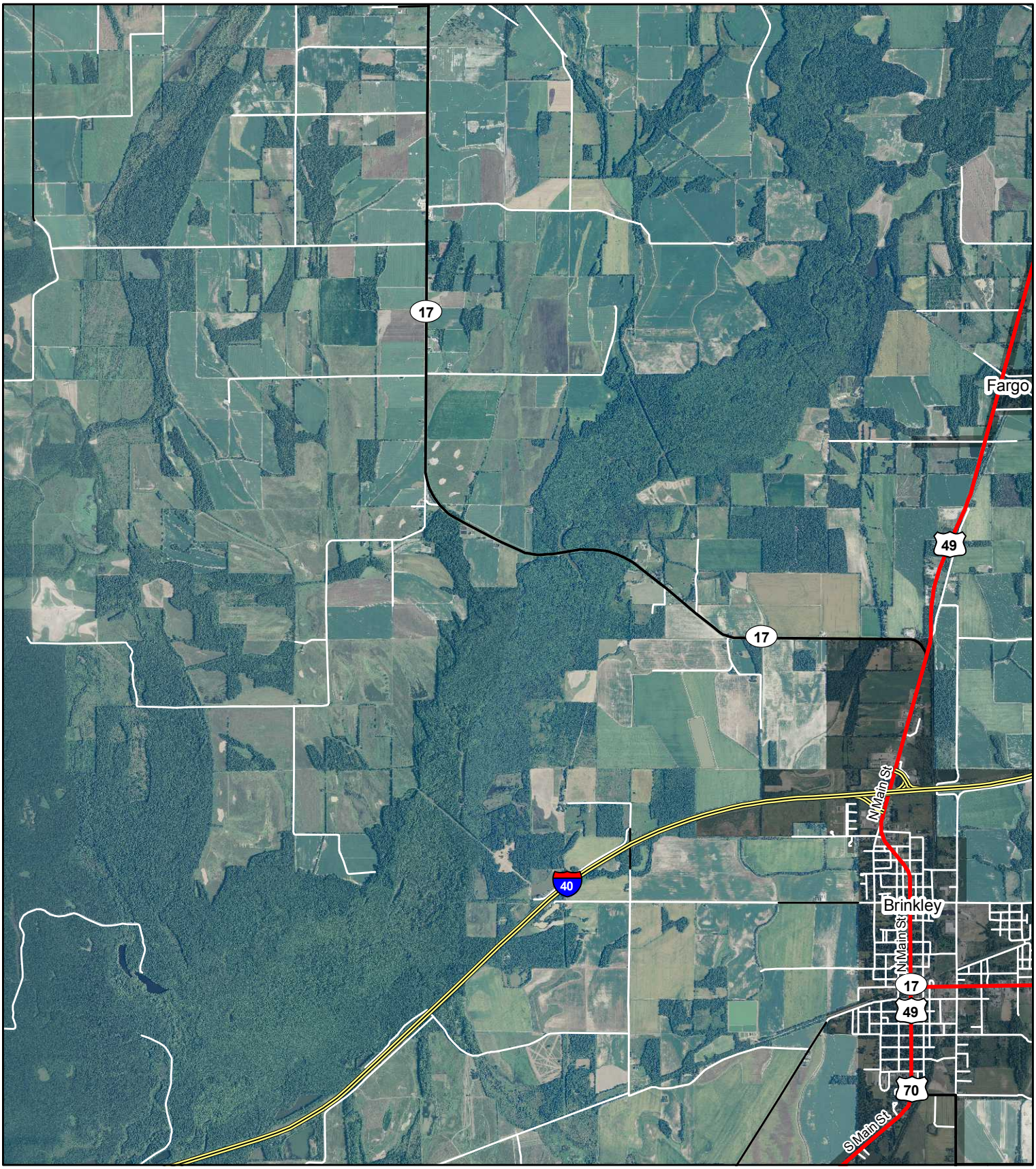
M7





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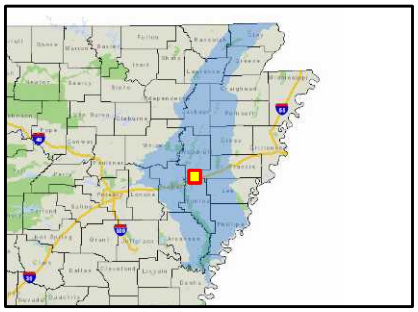
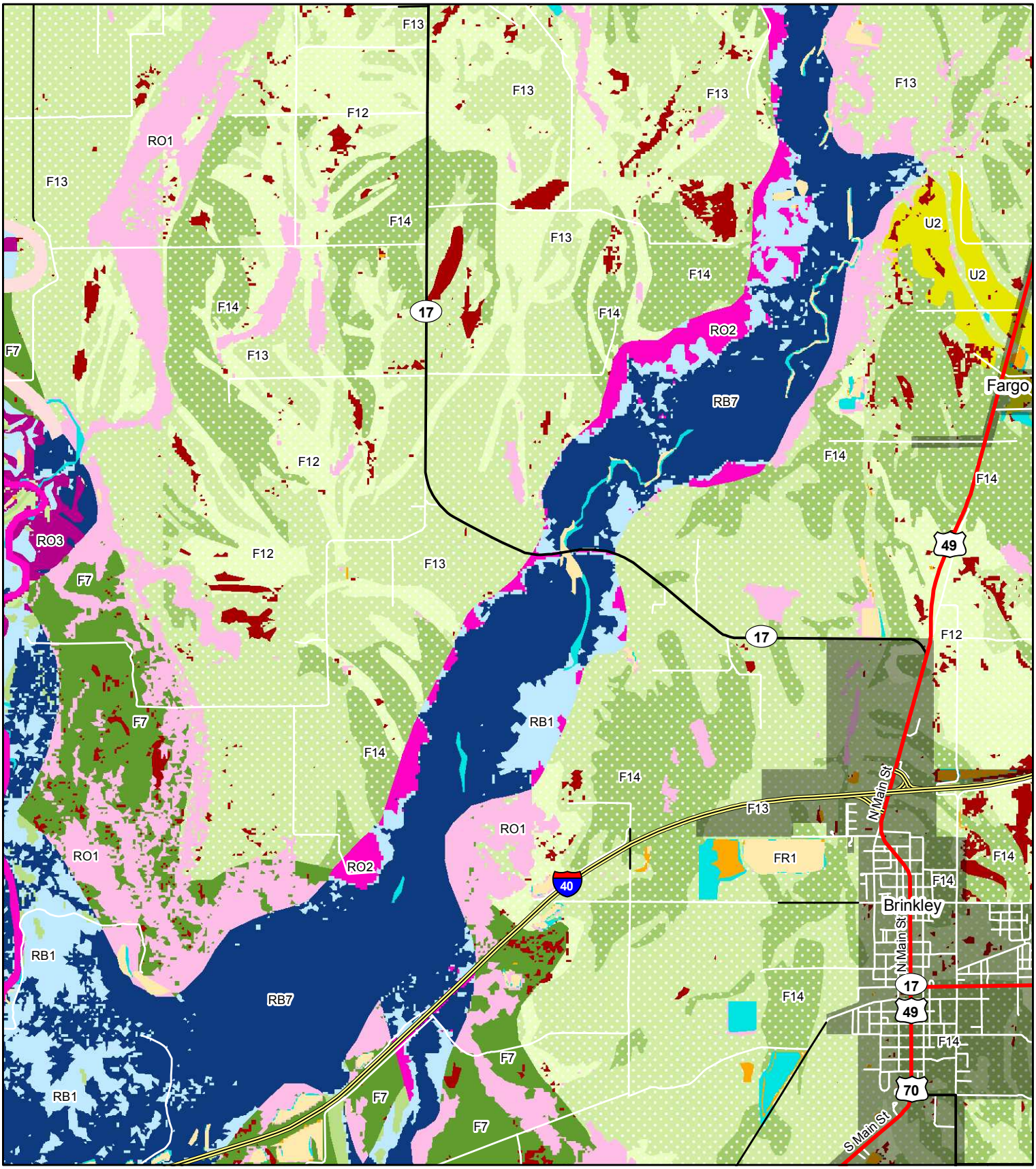
M8





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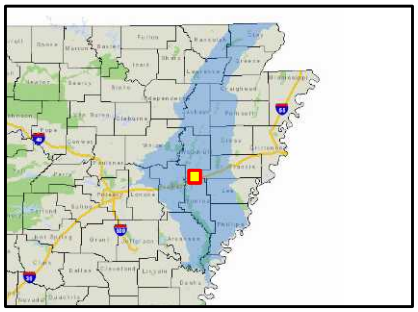
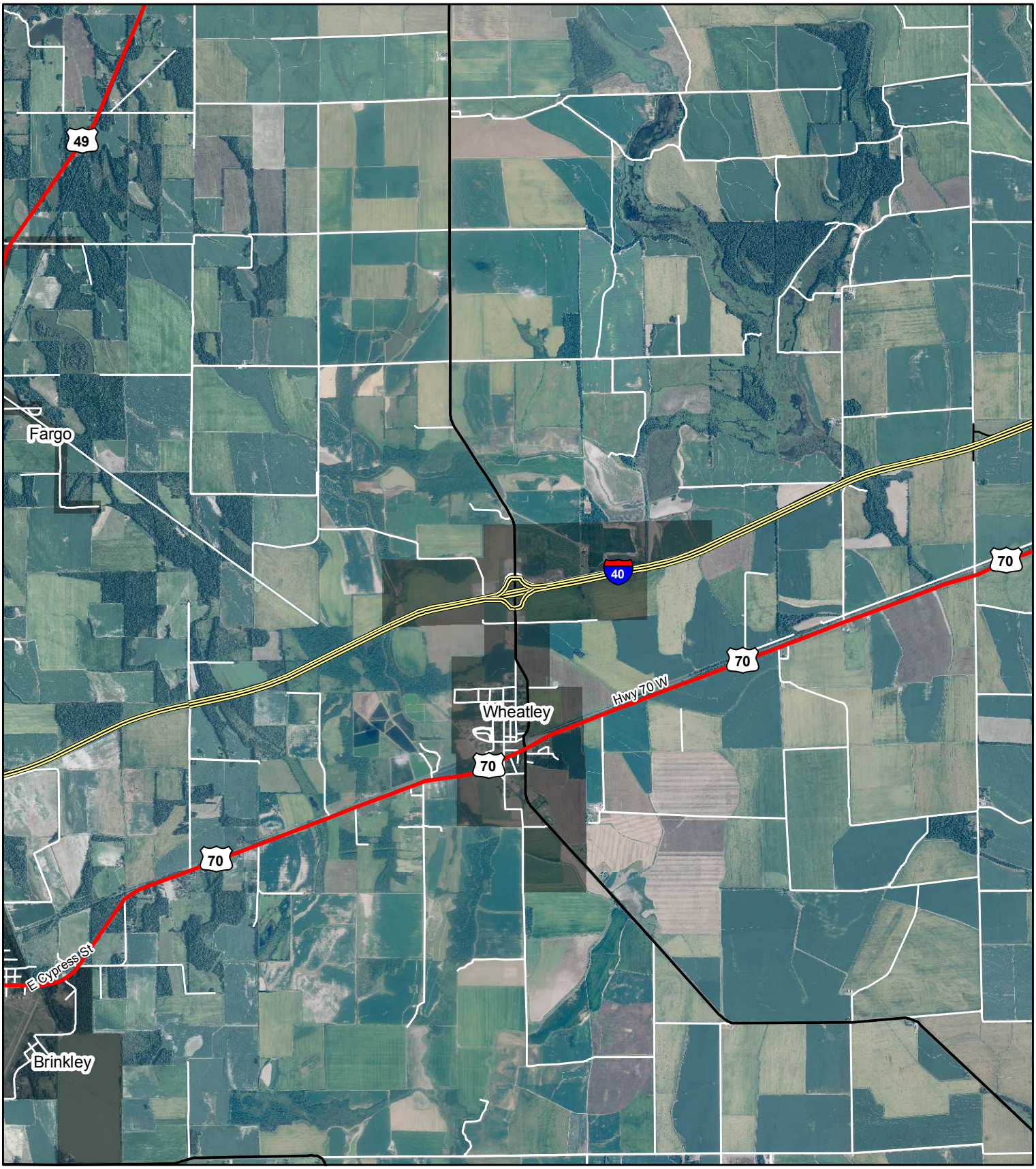
M8





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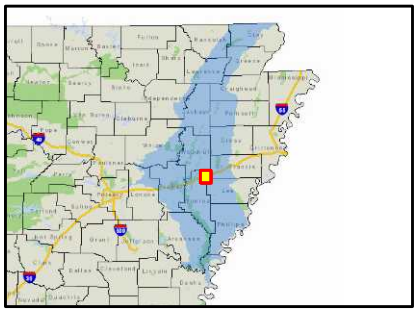
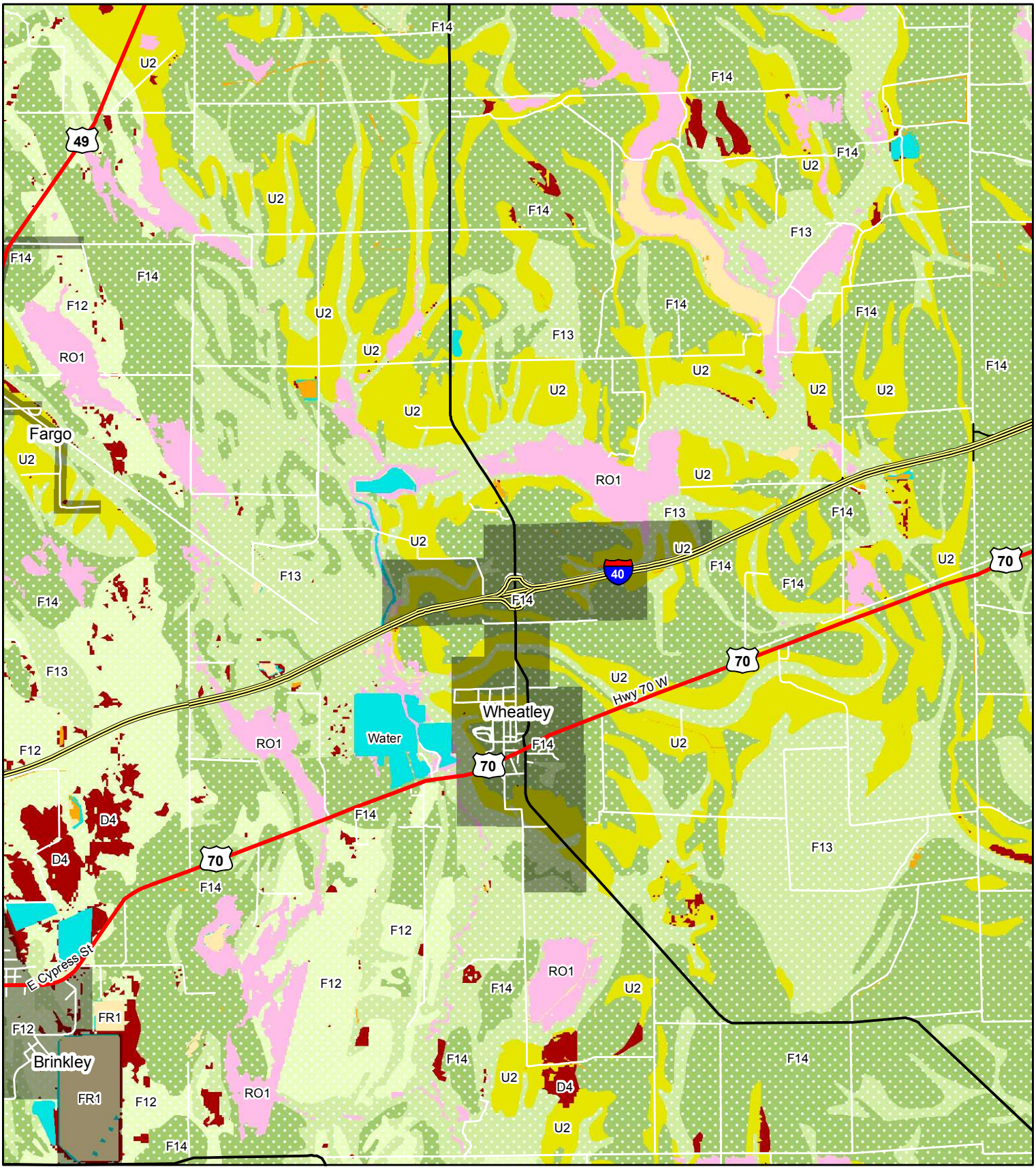
M9





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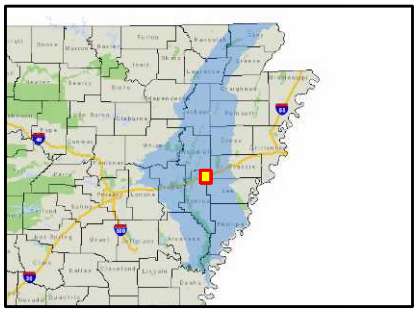

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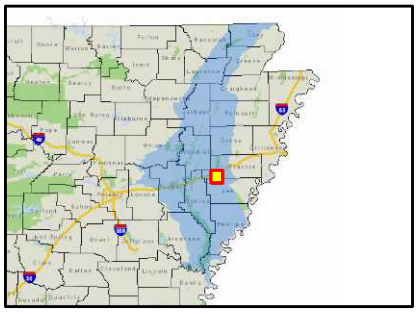

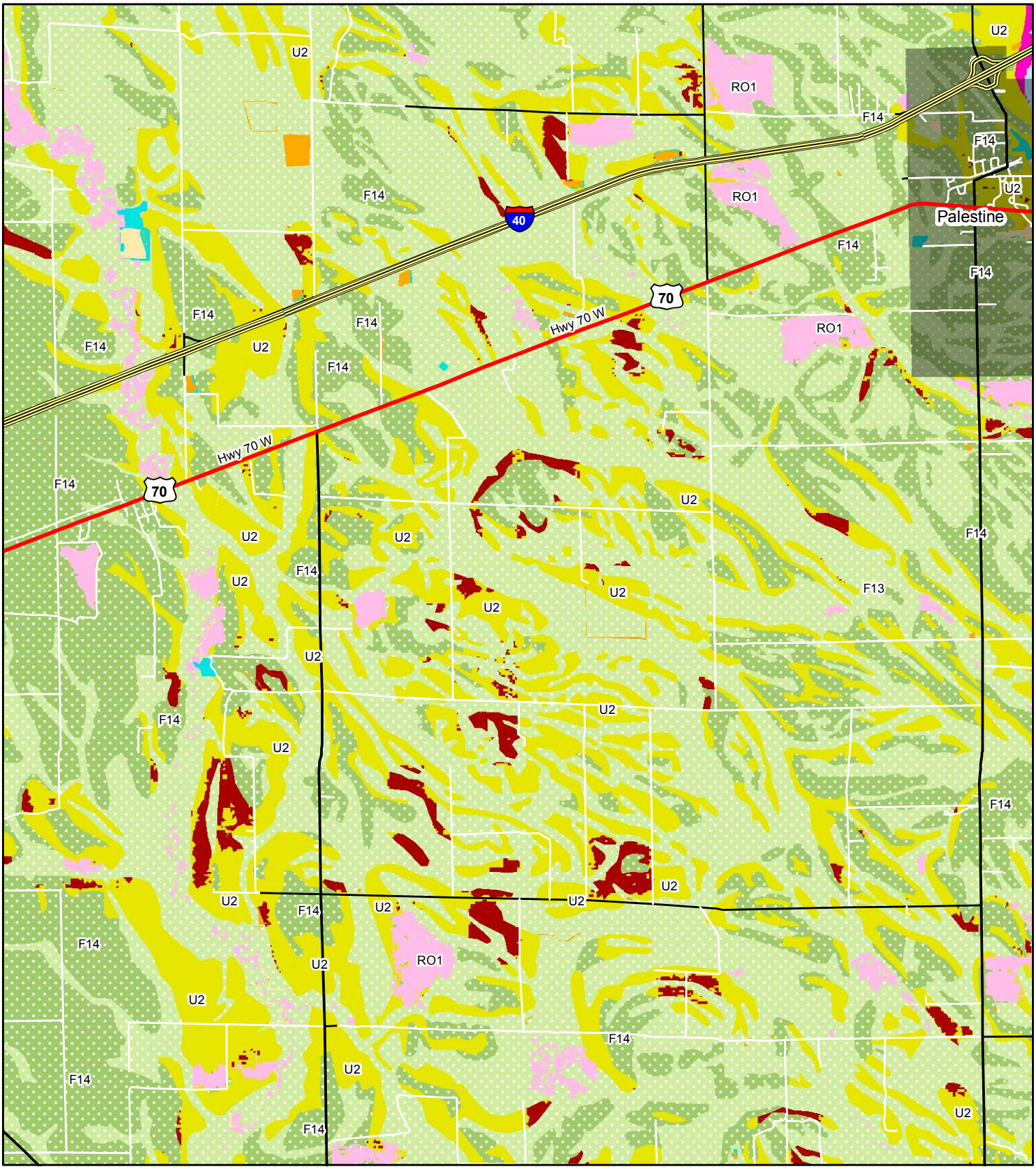

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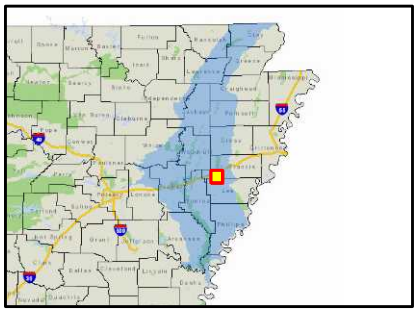
M10



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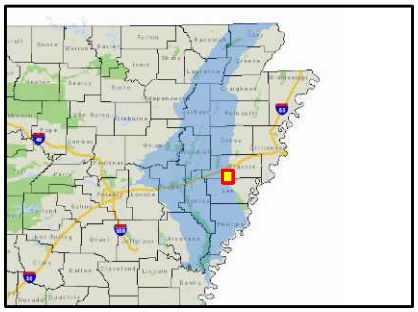
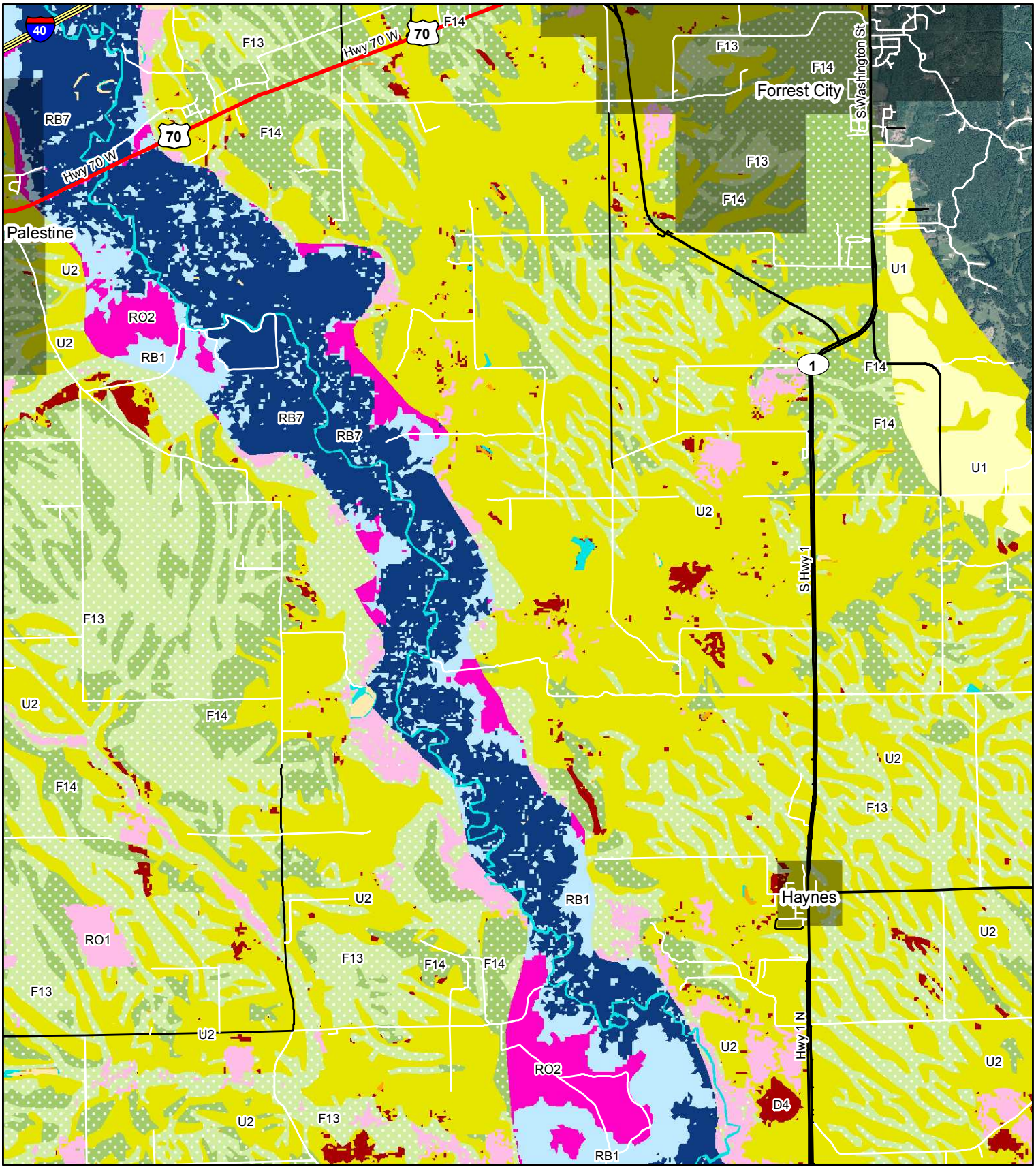
M11





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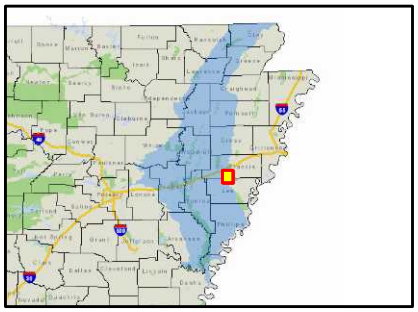
M11



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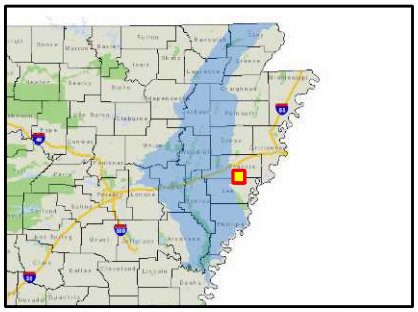
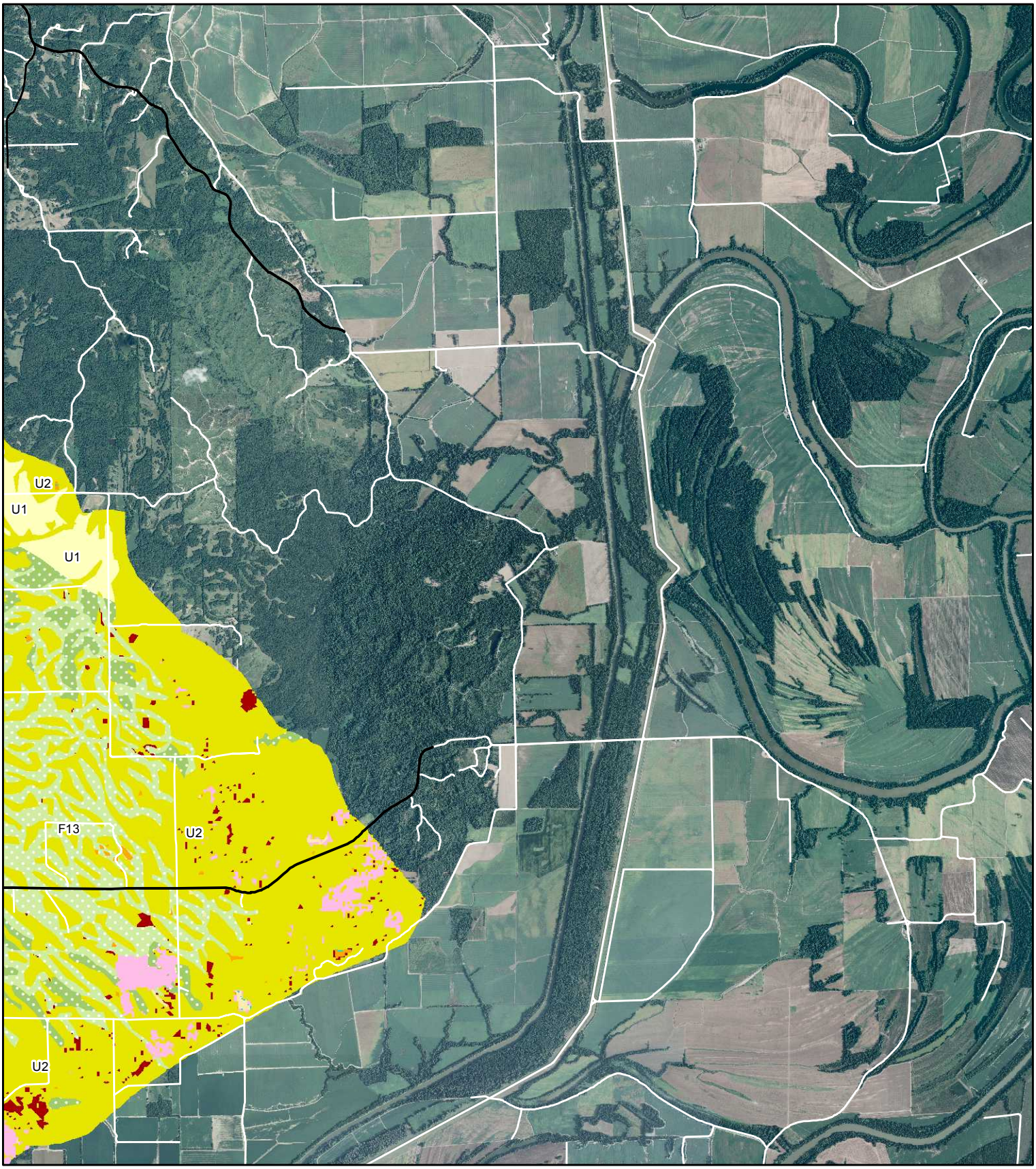
M12





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Projection: Transverse Mercator
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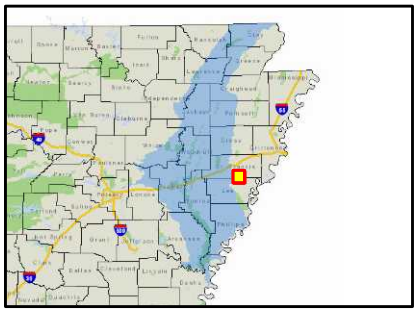
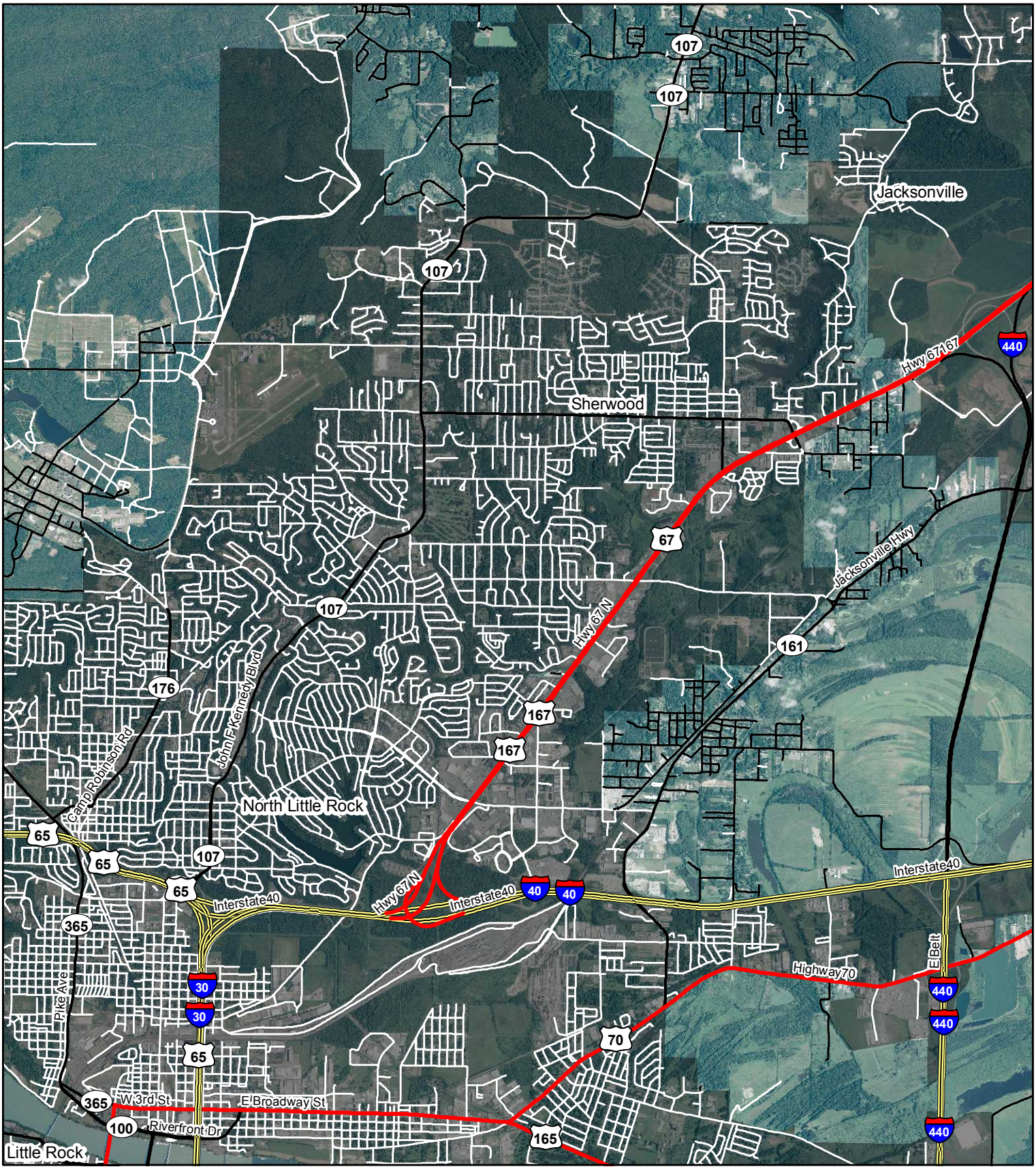
M12



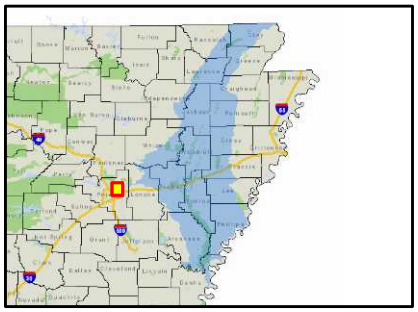


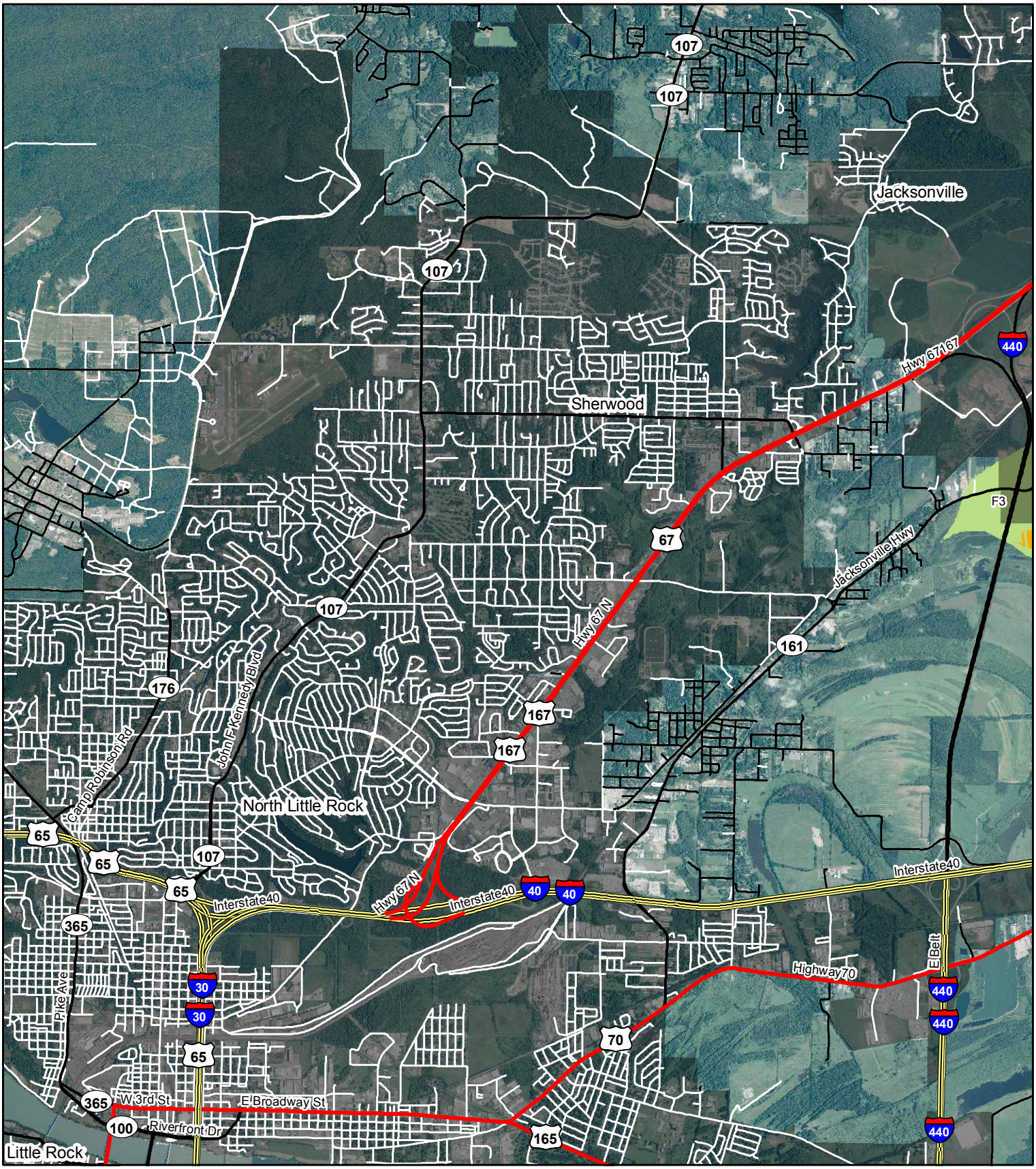
0 0.5 1 2 3 4 Miles

N1

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983





0 0.5 1 2 3 4 Miles

N

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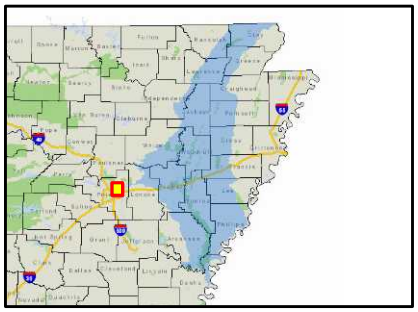
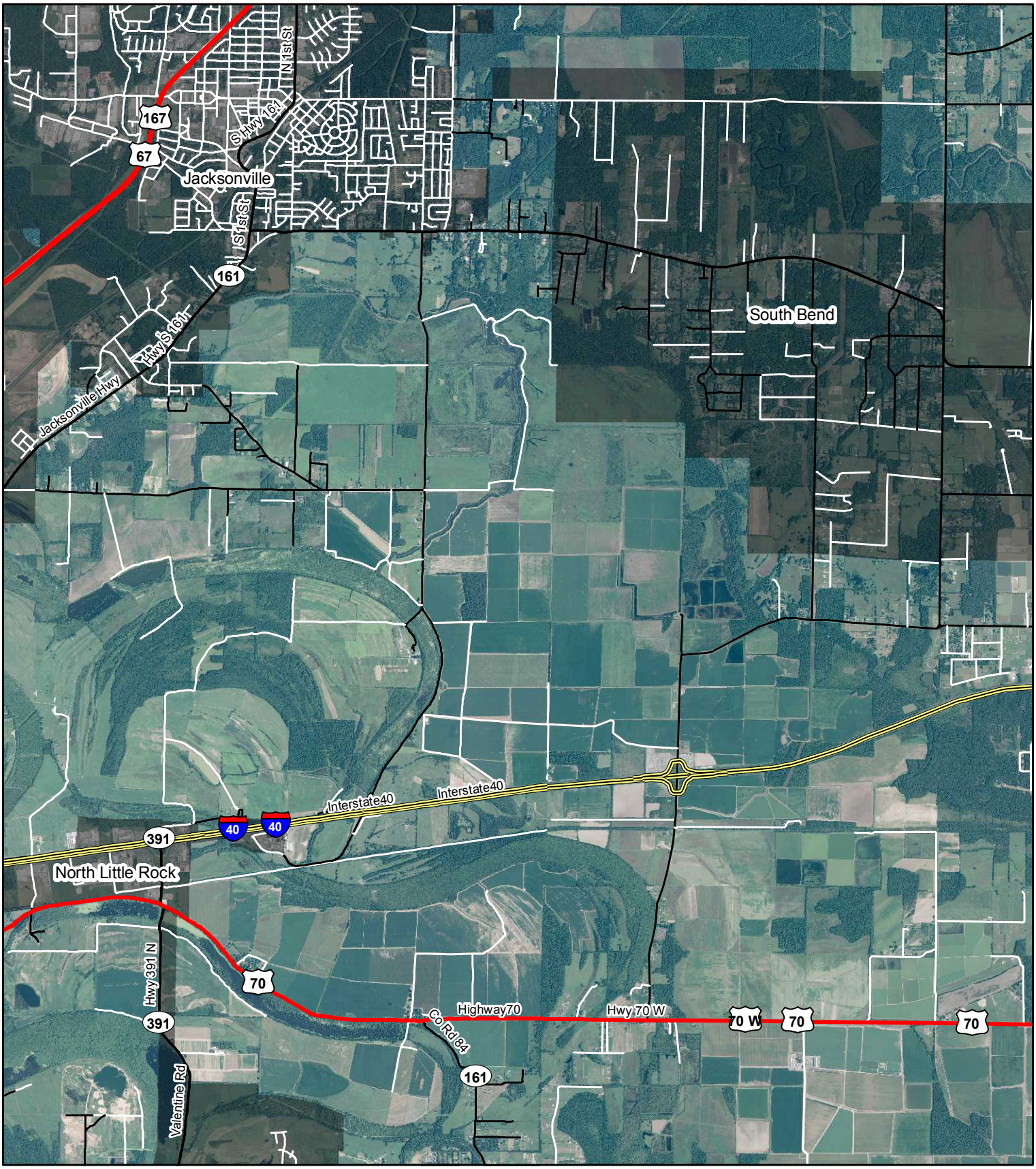
Projection: Transverse Mercator
Datum: North American 1983

N1





0 0.5 1 2 3 4 Miles

N

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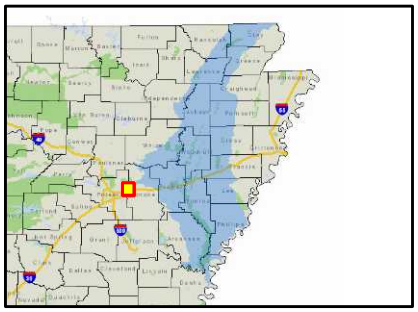
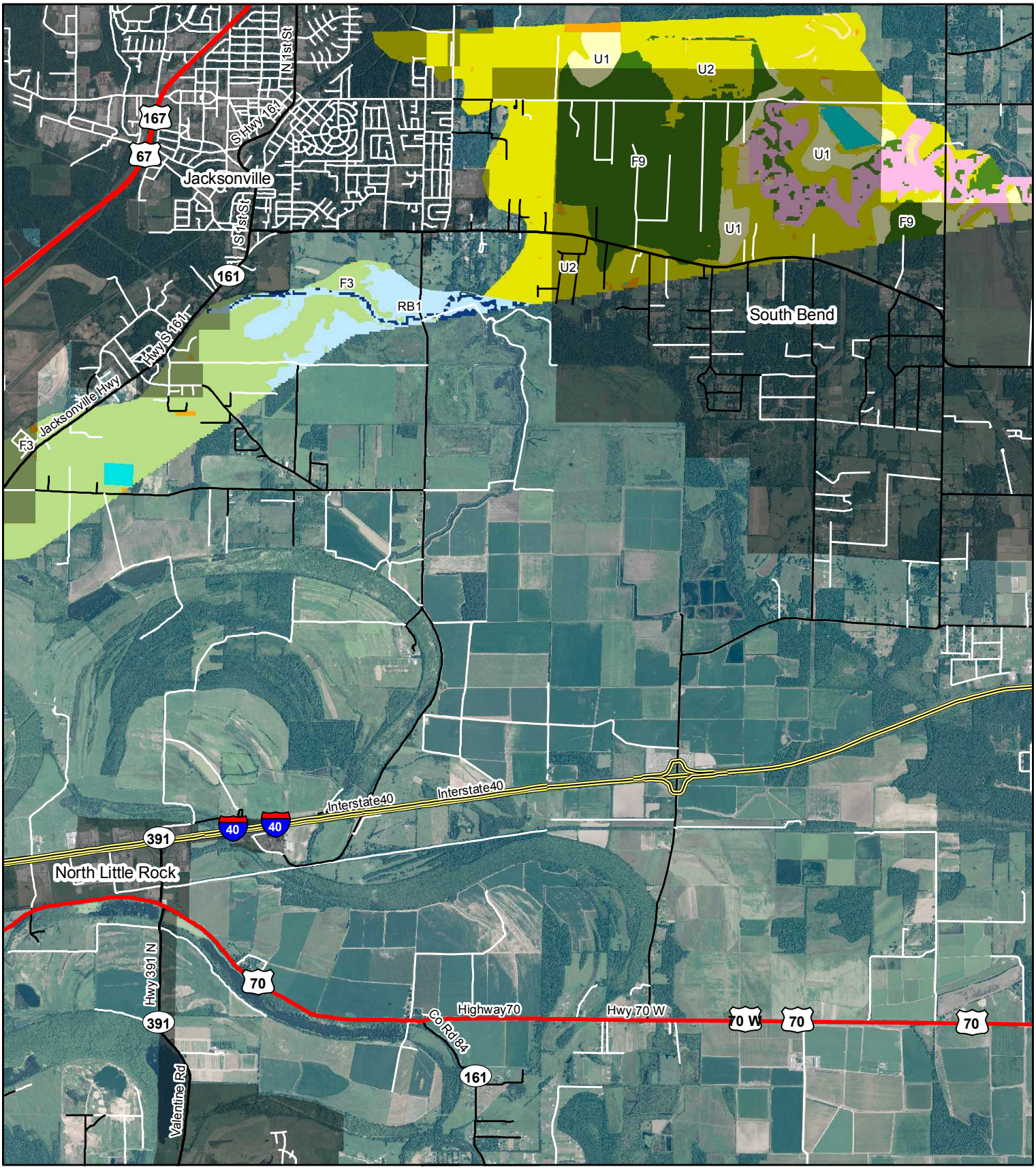
Projection: Transverse Mercator
Datum: North American 1983

N2





0 0.5 1 2 3 4 Miles

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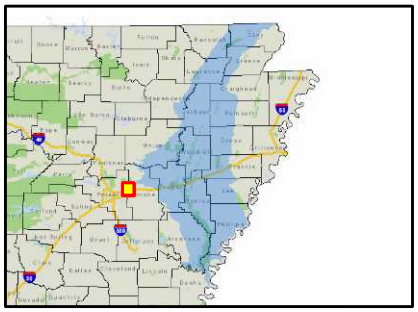
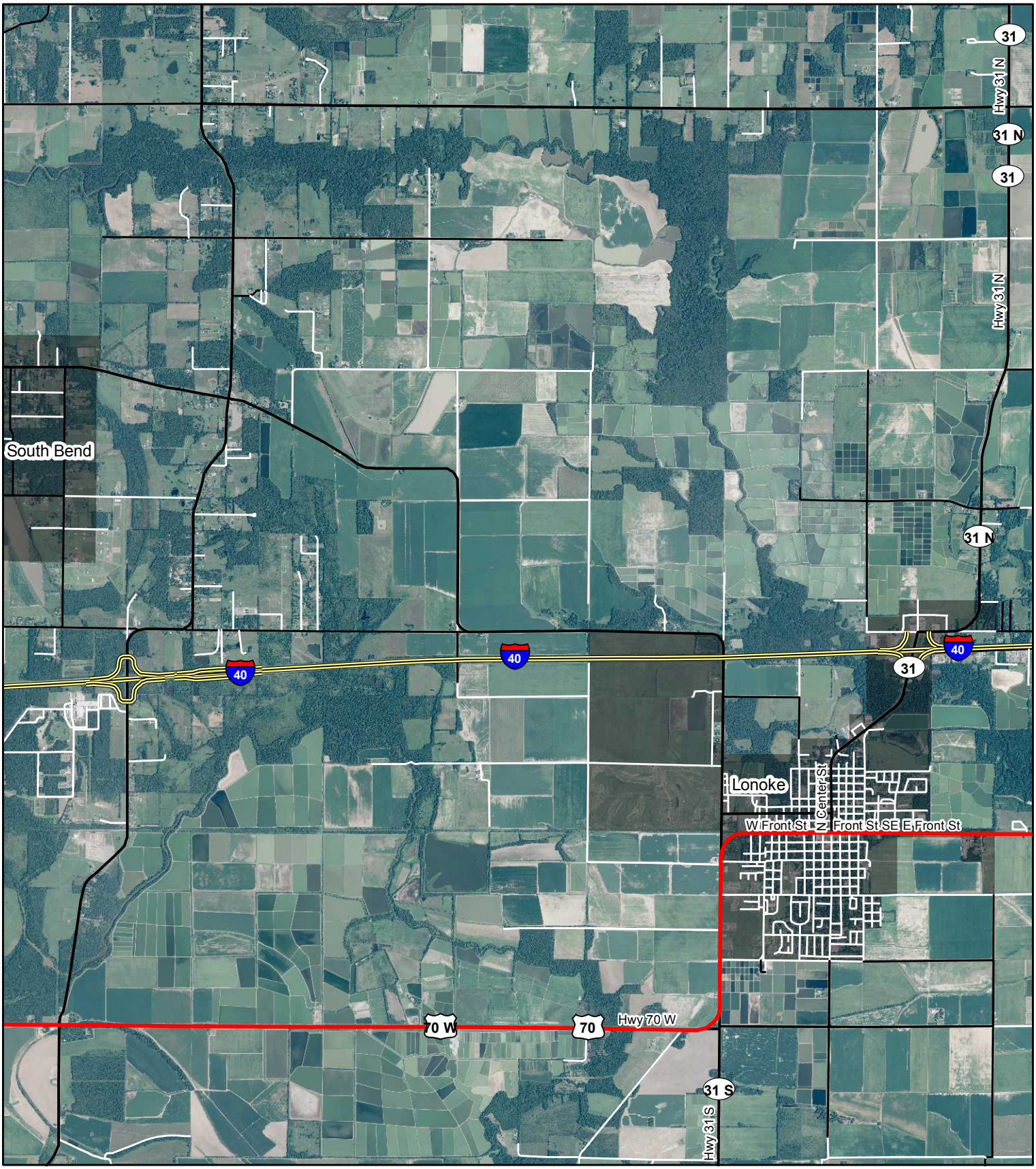
Projection: Transverse Mercator
Datum: North American 1983

N2



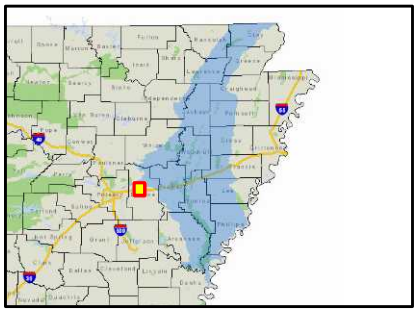


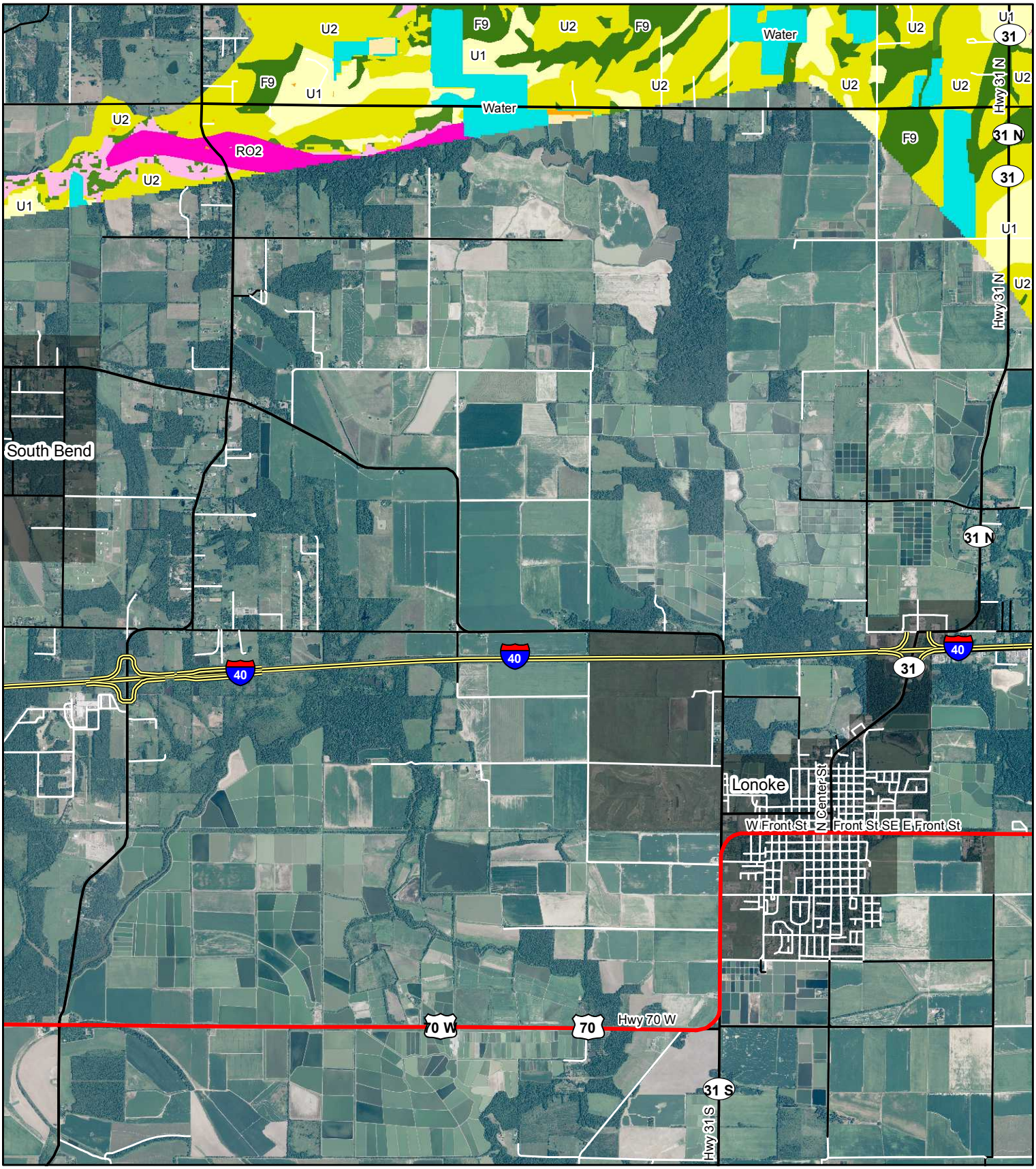
0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

N3





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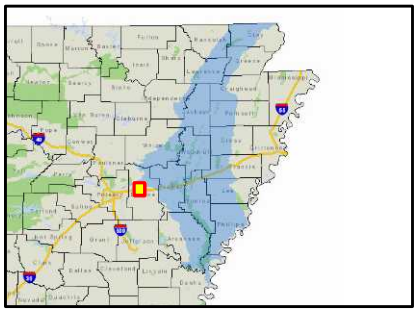
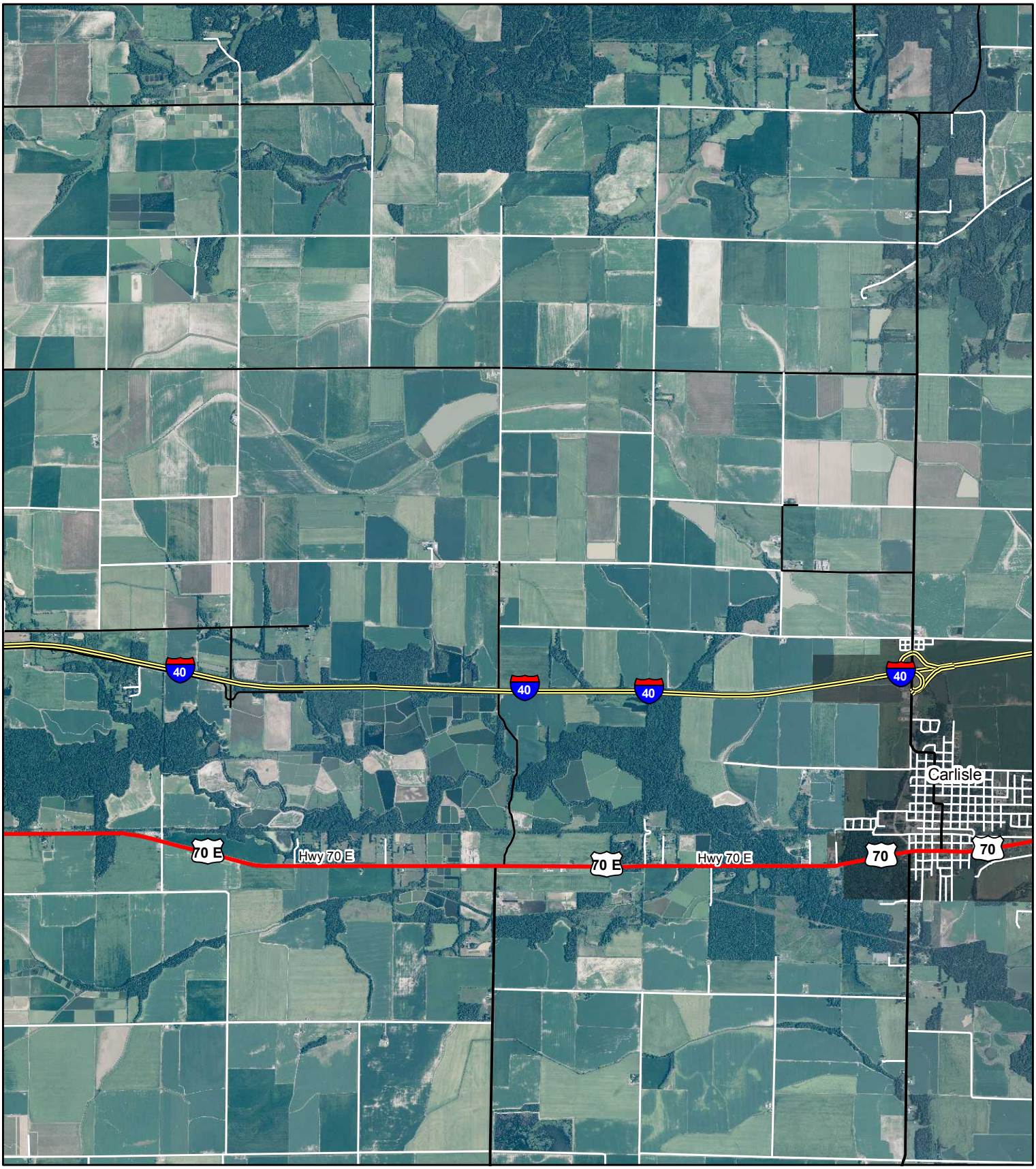
Datum: North American 1983

N3





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Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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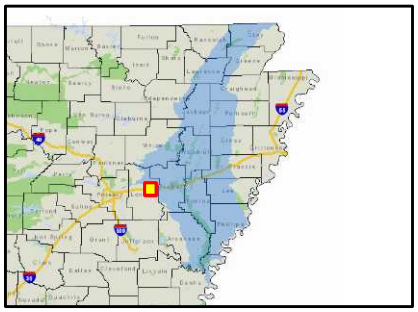

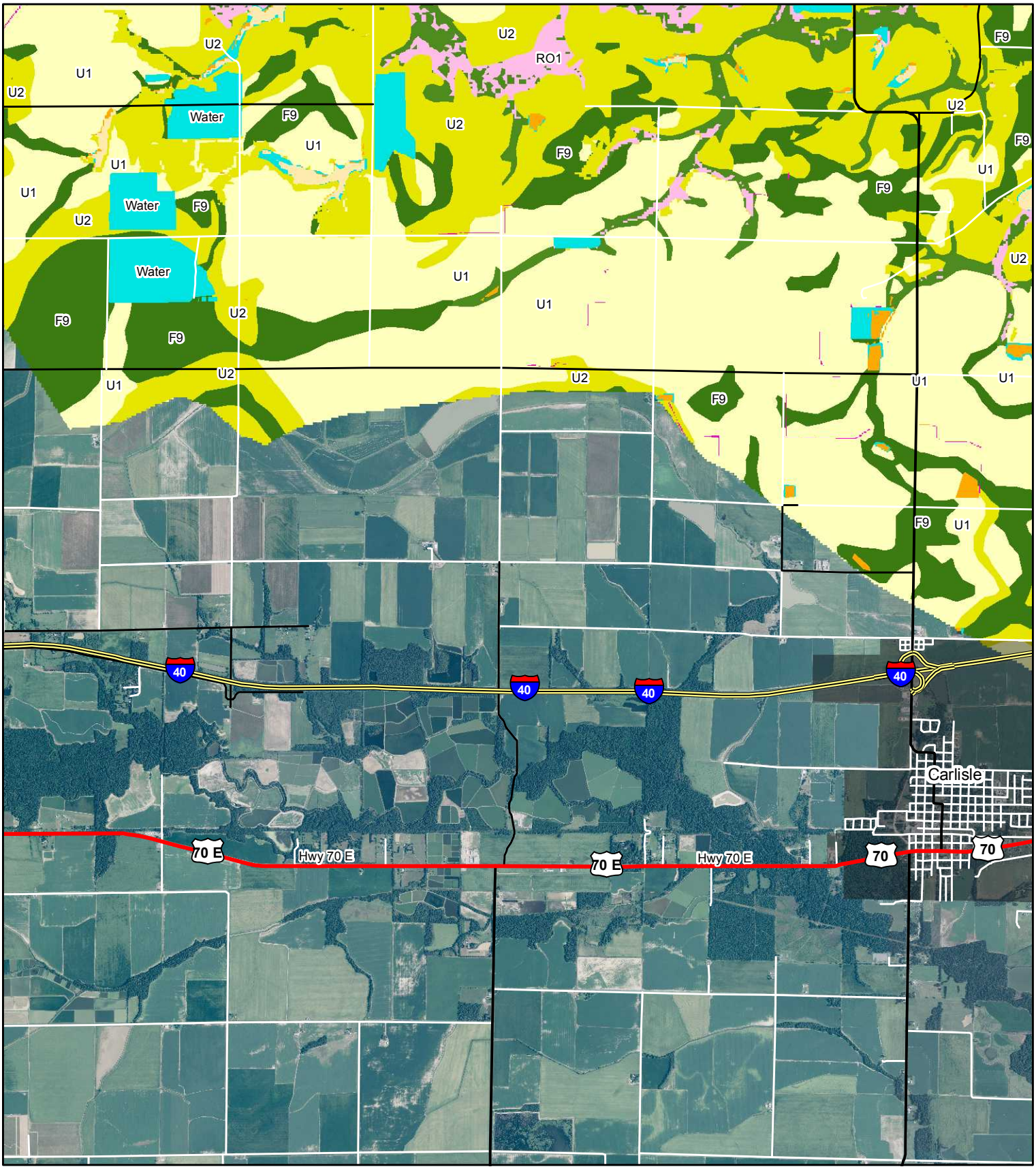

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Projection: Transverse Mercator
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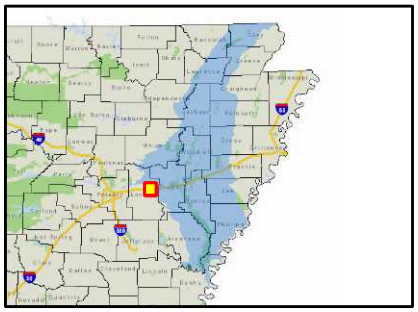

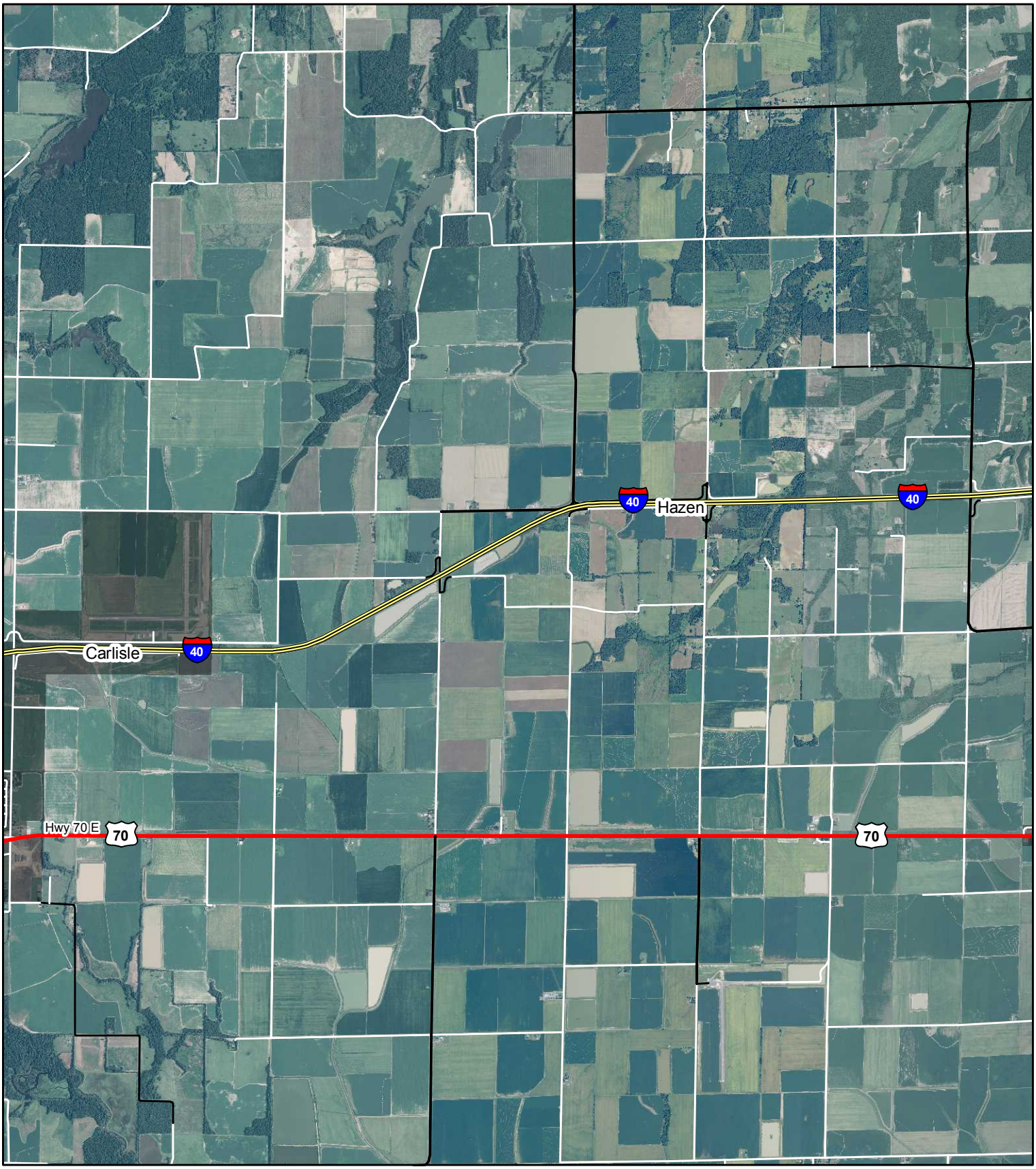

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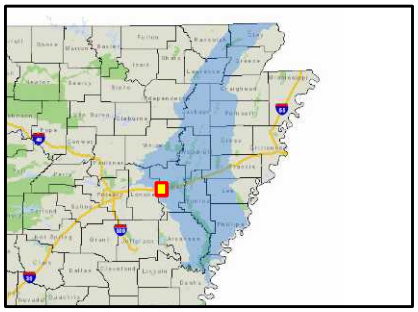

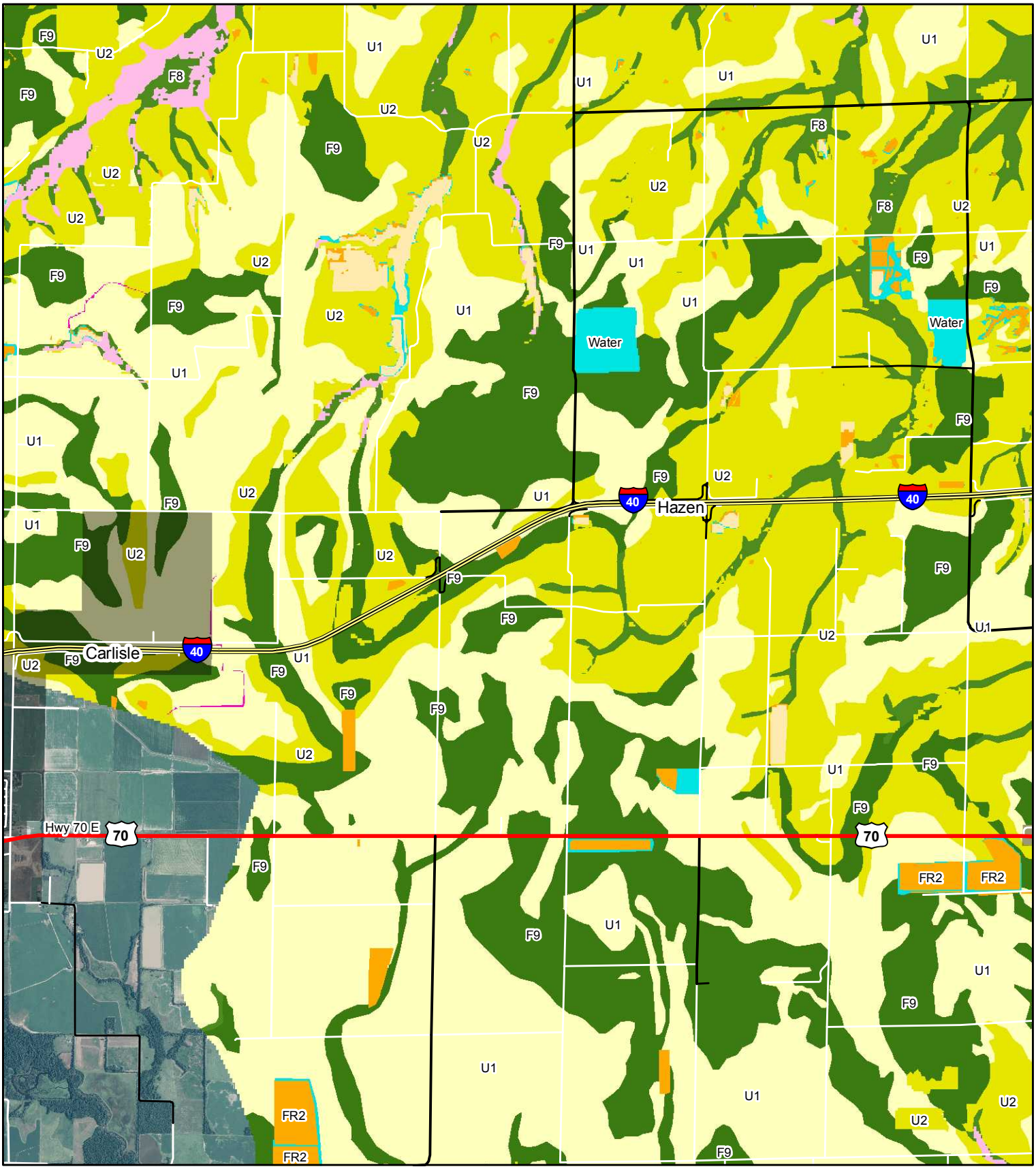

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Datum: North American 1983

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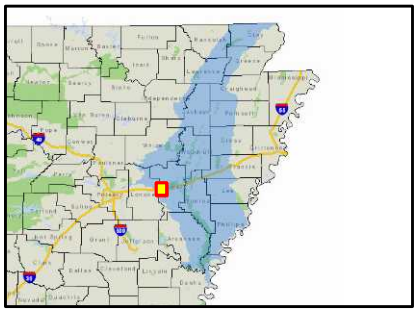

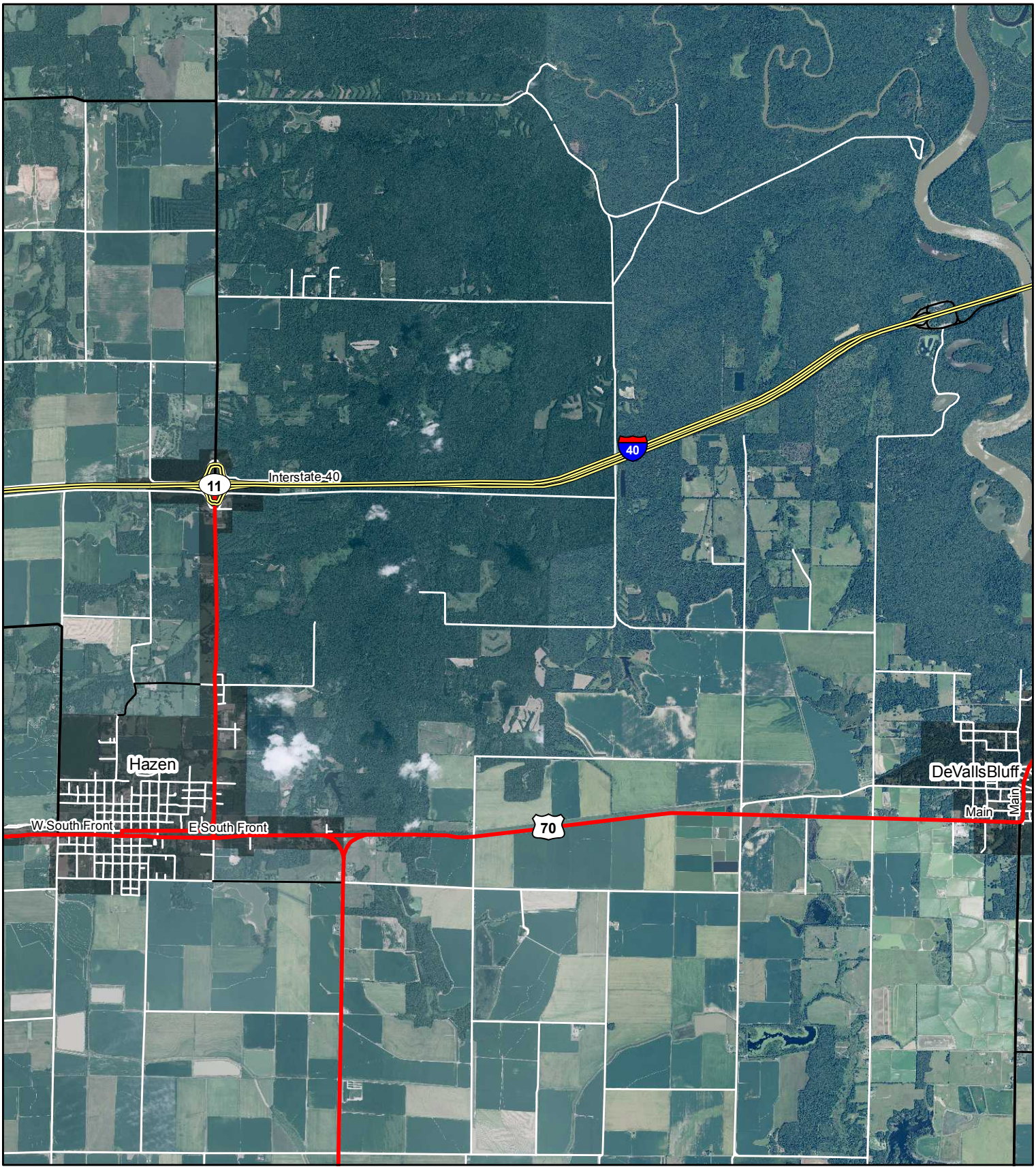

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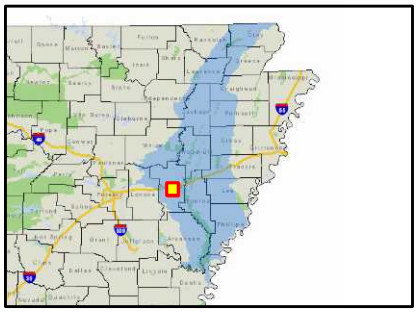
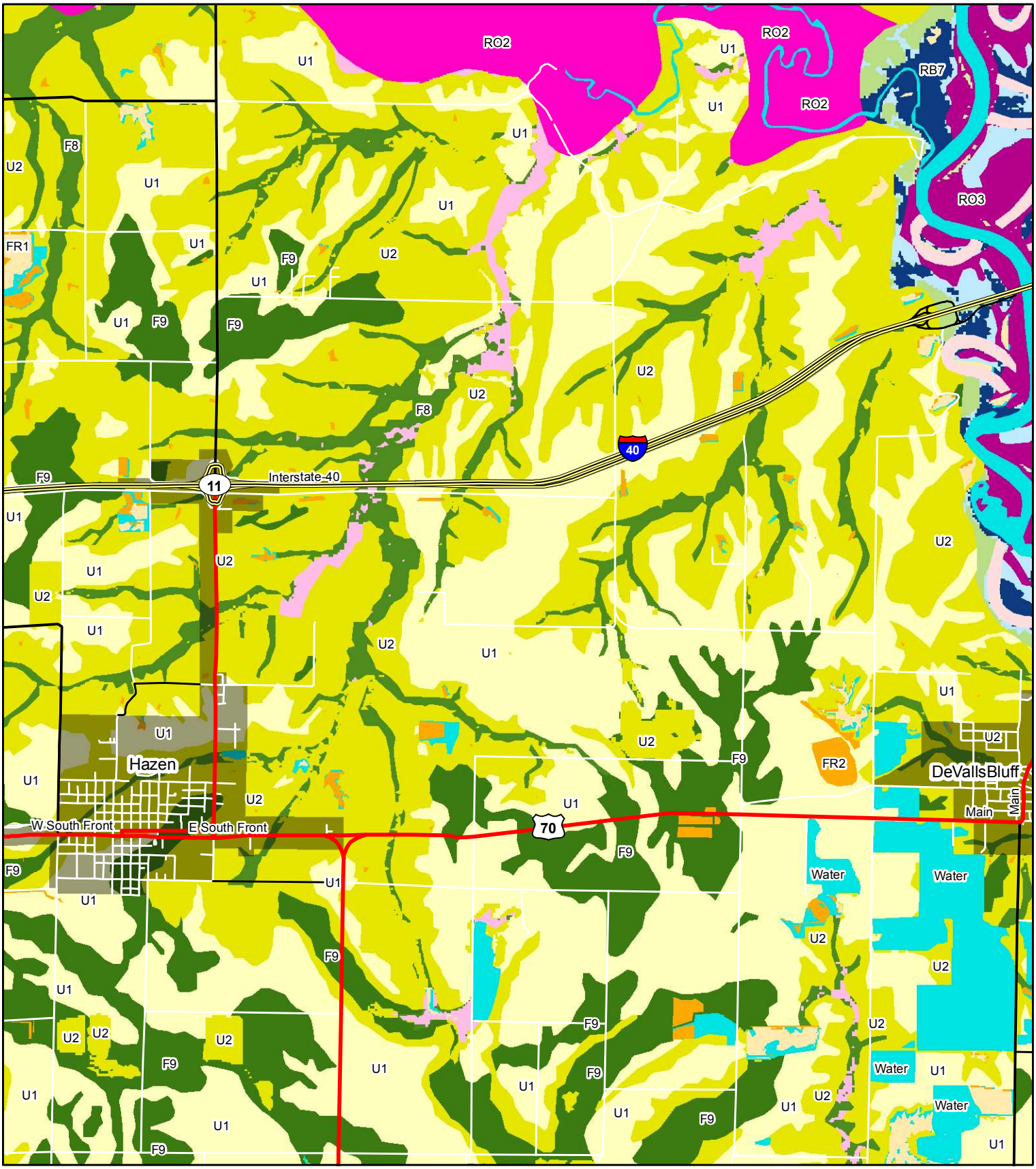
N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

N6





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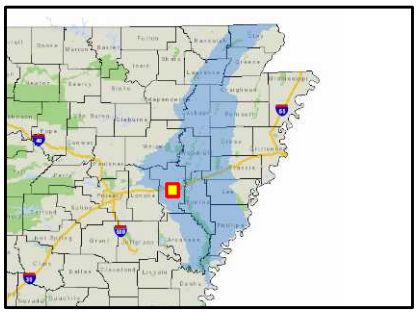

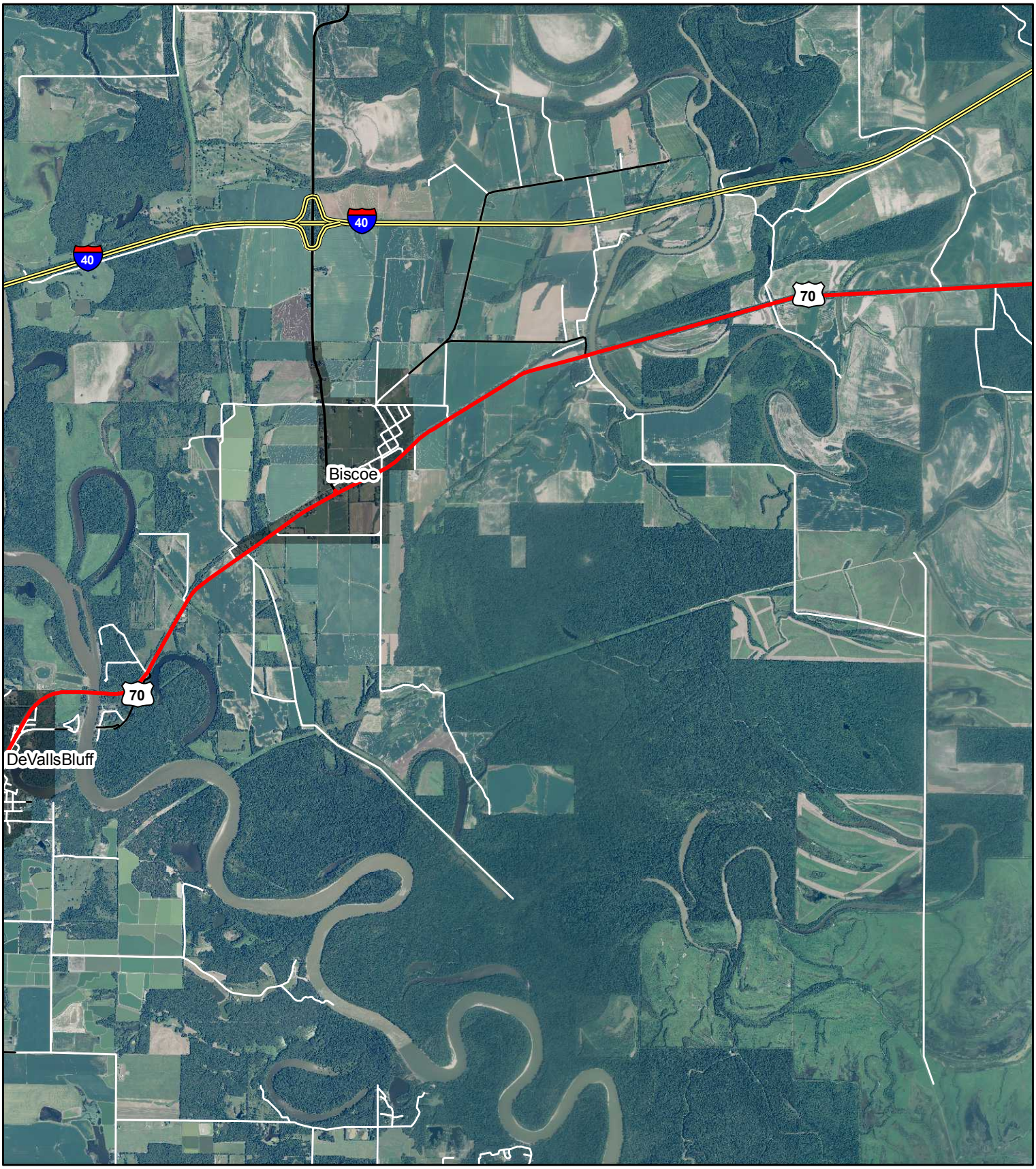

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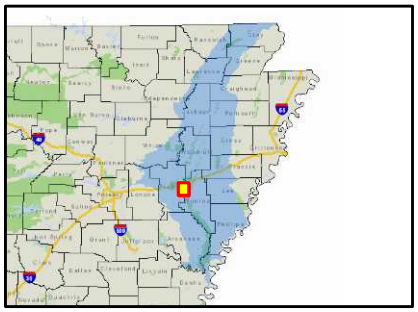
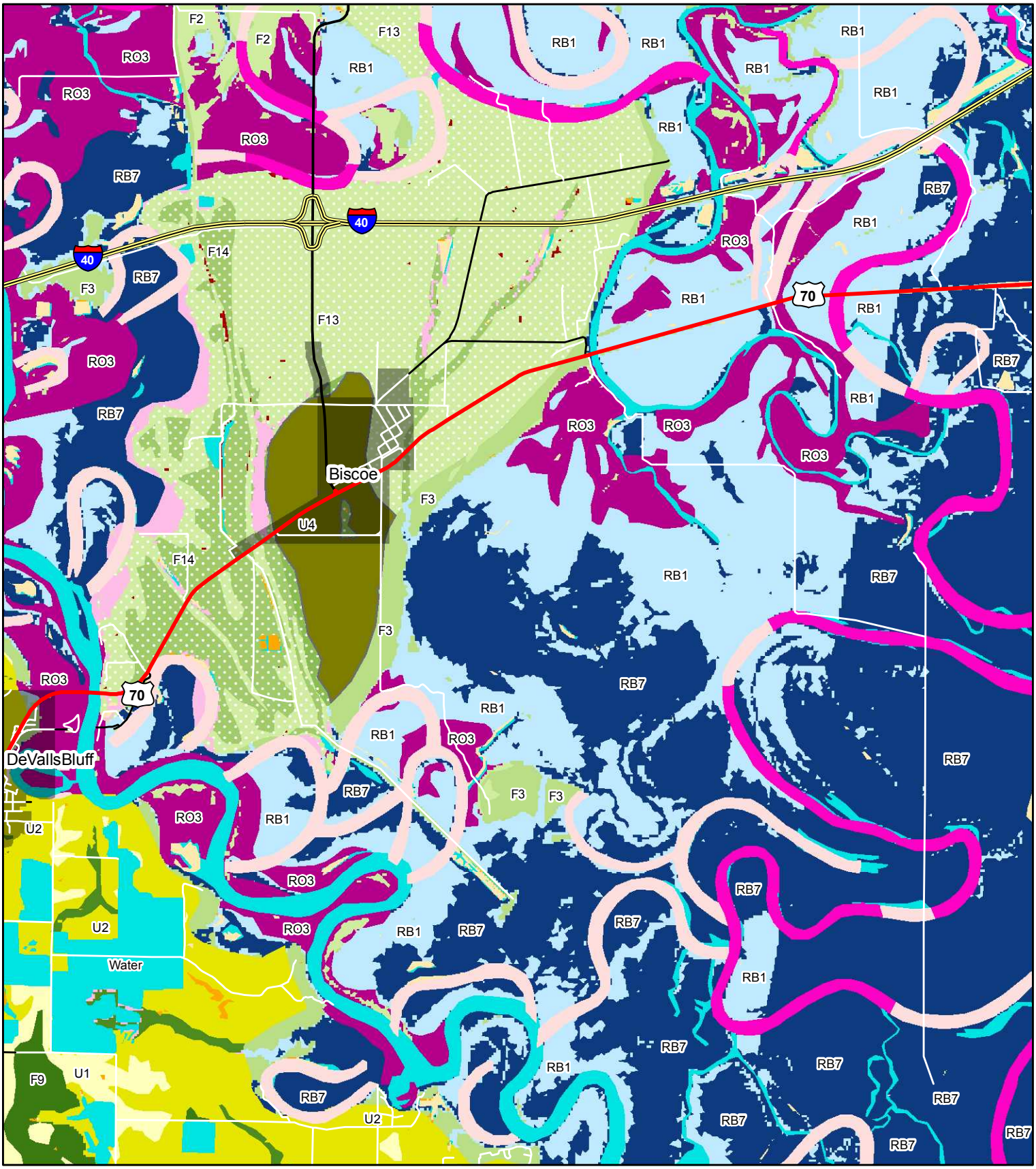
Projection: Transverse Mercator
Datum: North American 1983

N7





0 0.5 1 2 3 4 Miles

N7

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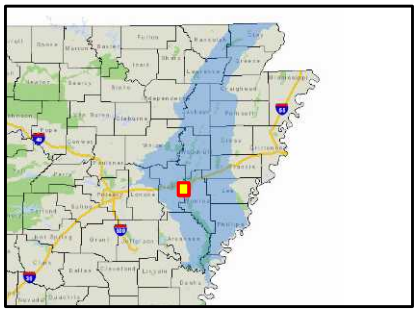

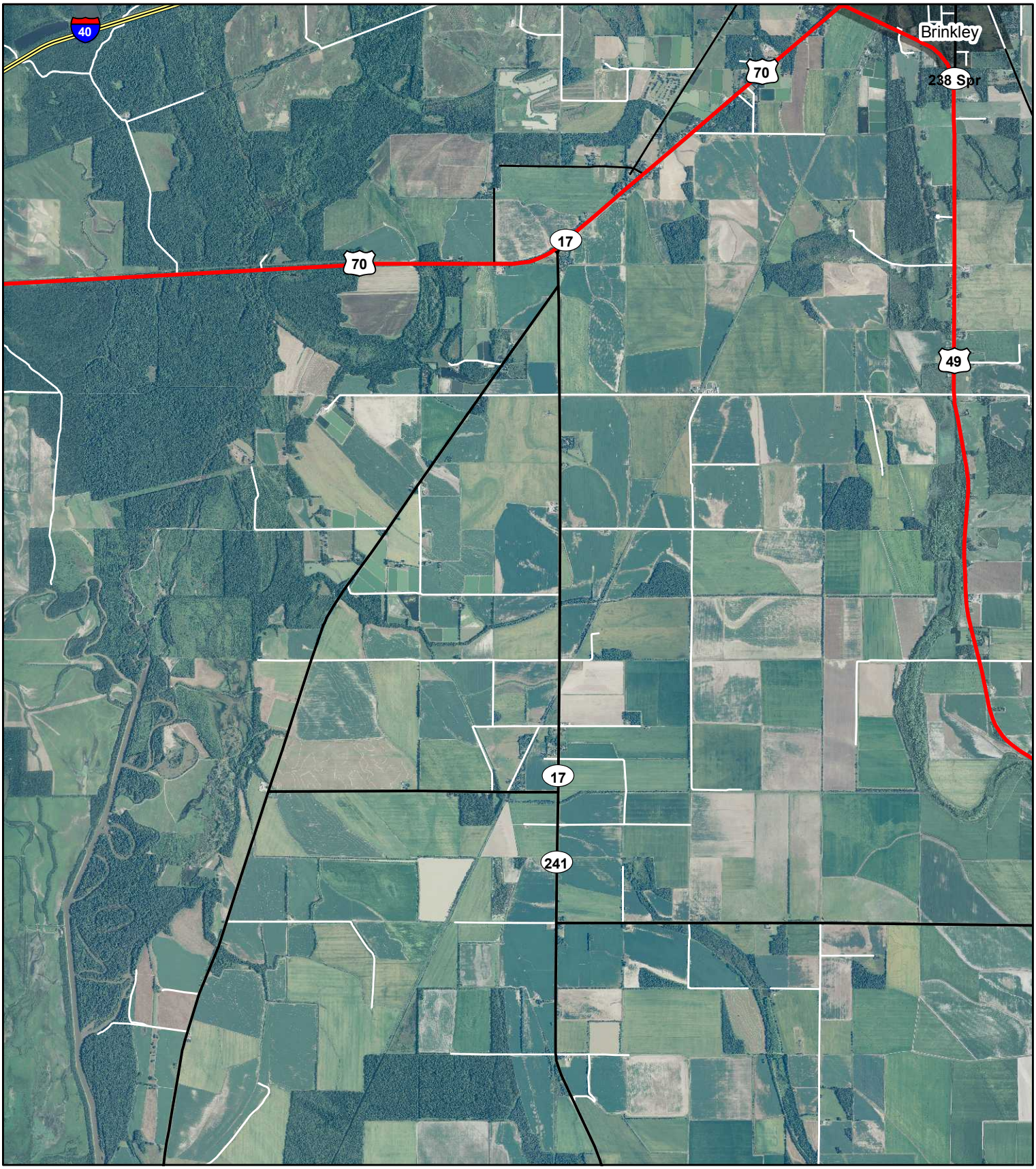

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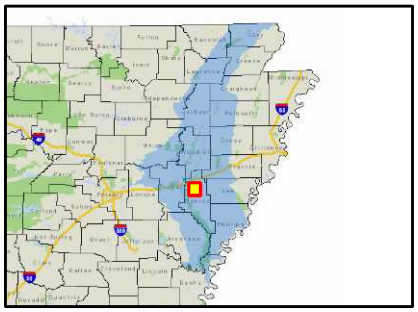
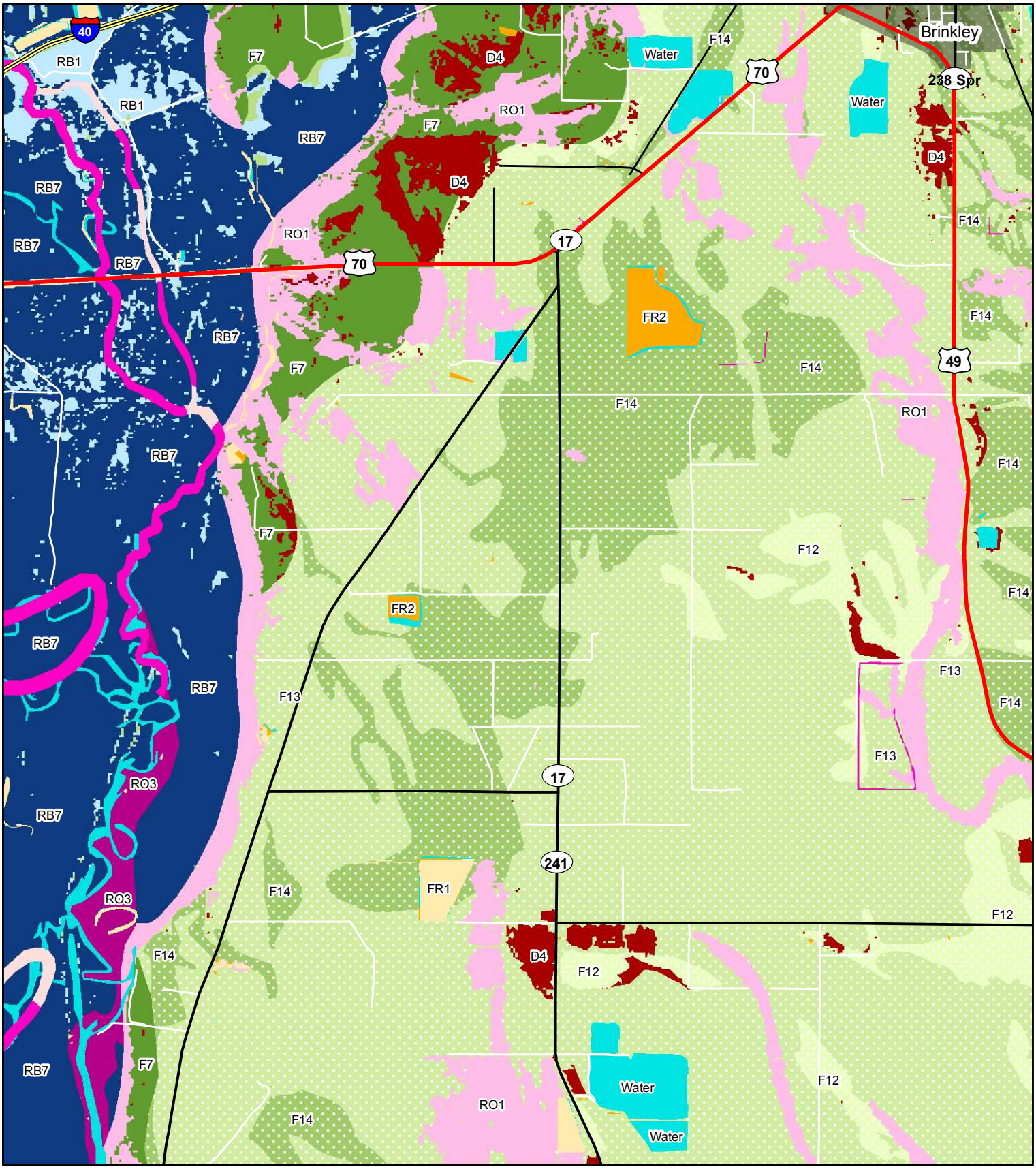
N8





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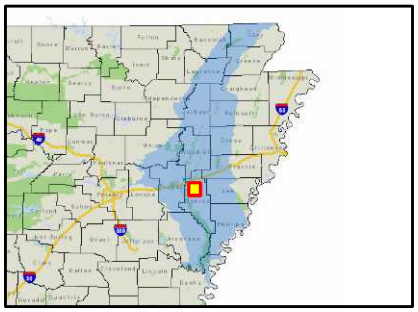

0 0.5 1 2 3 4 Miles

N

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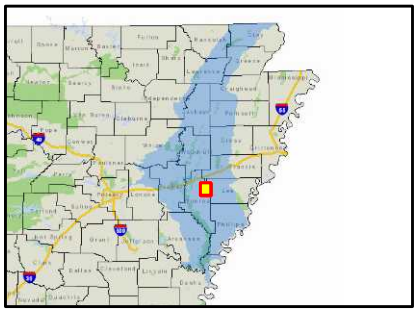
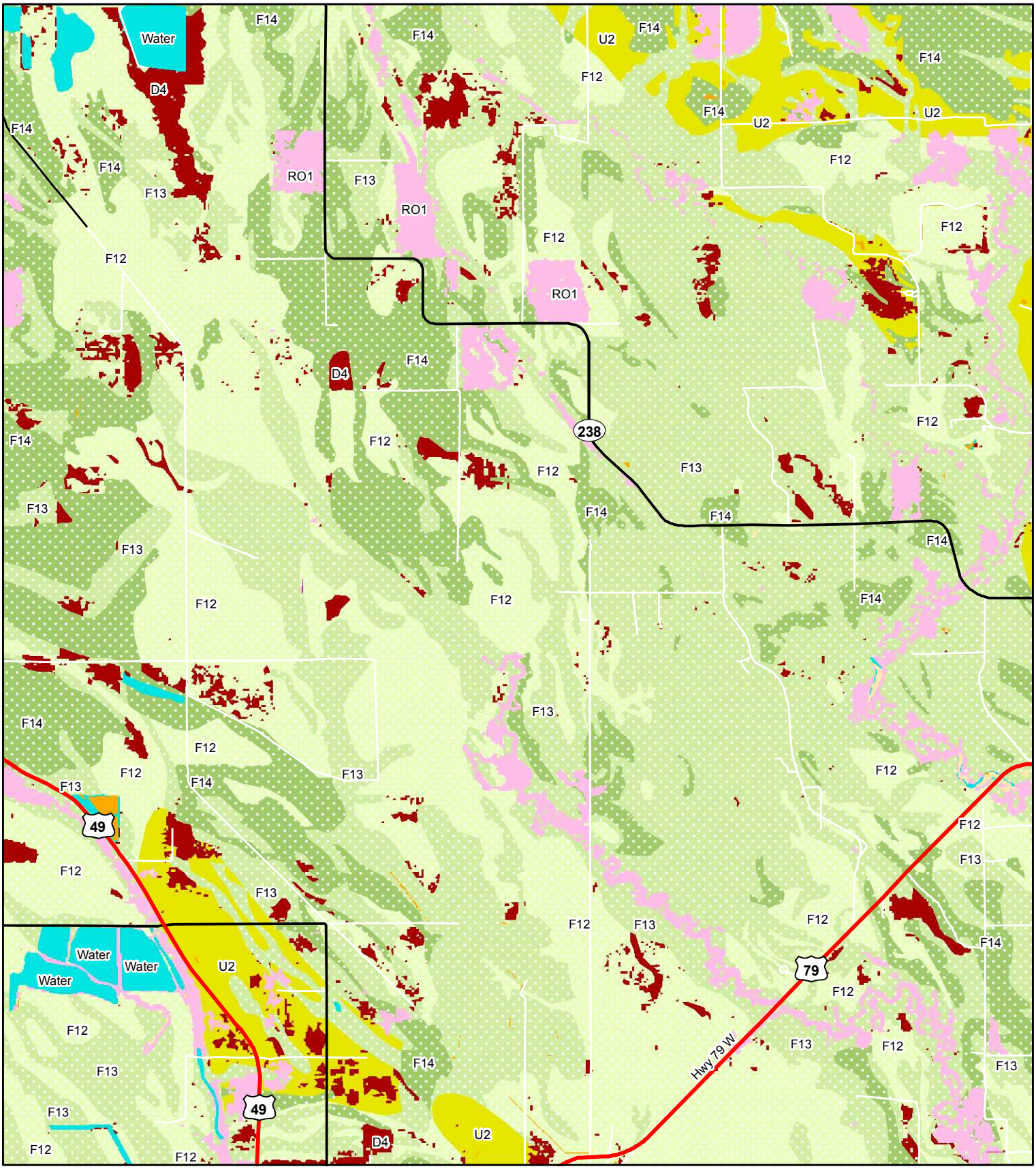
N9





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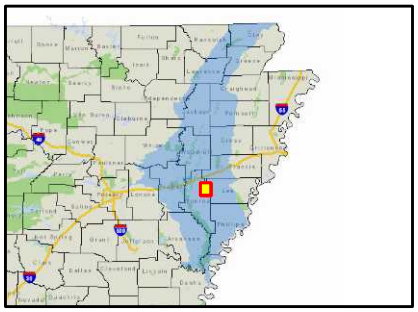
N9



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N

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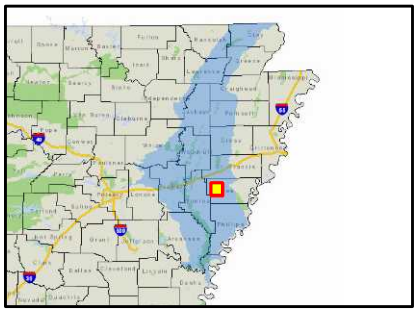
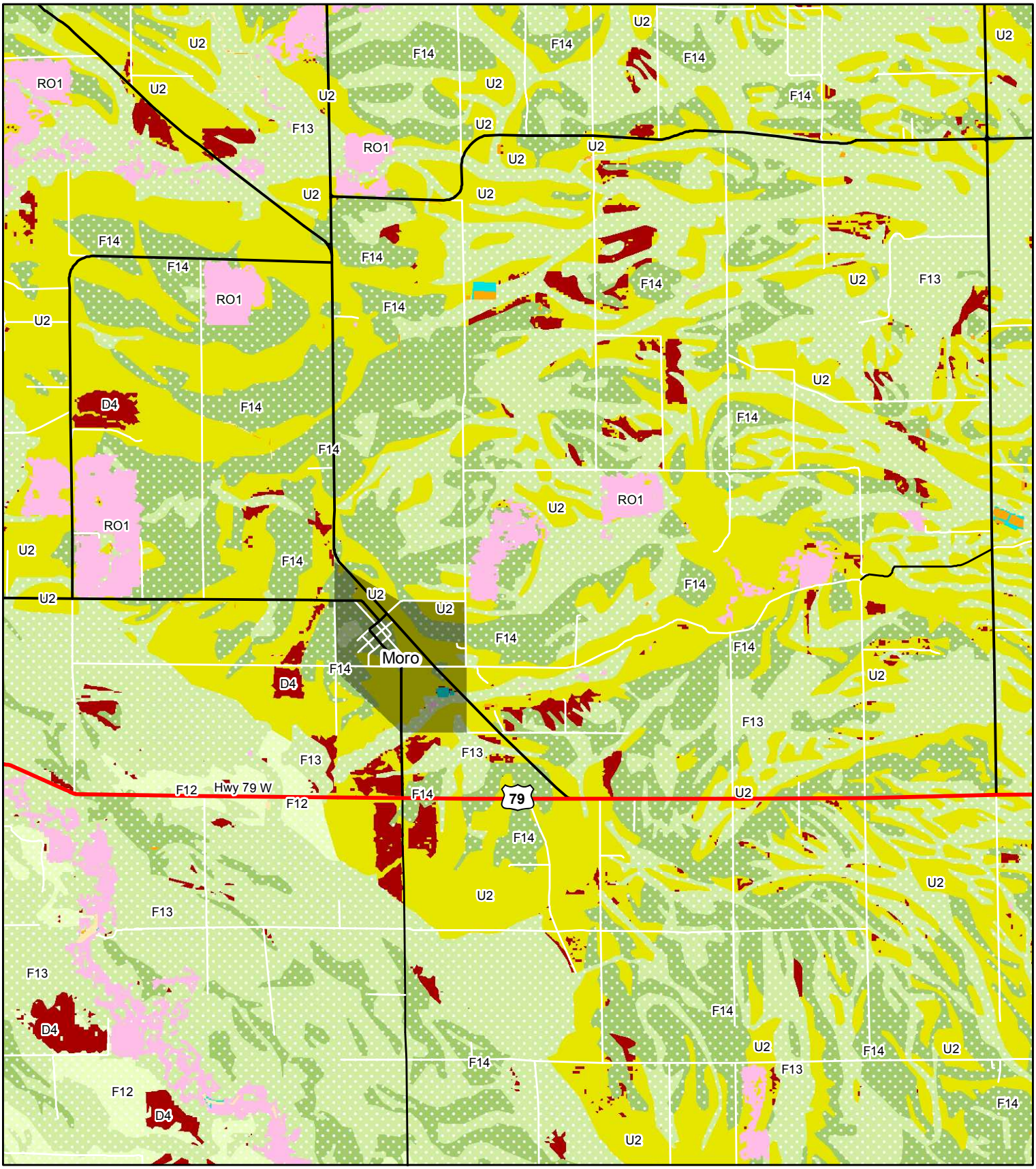
N10





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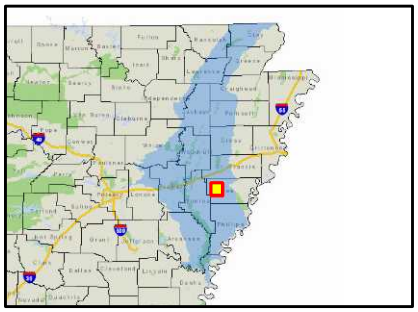

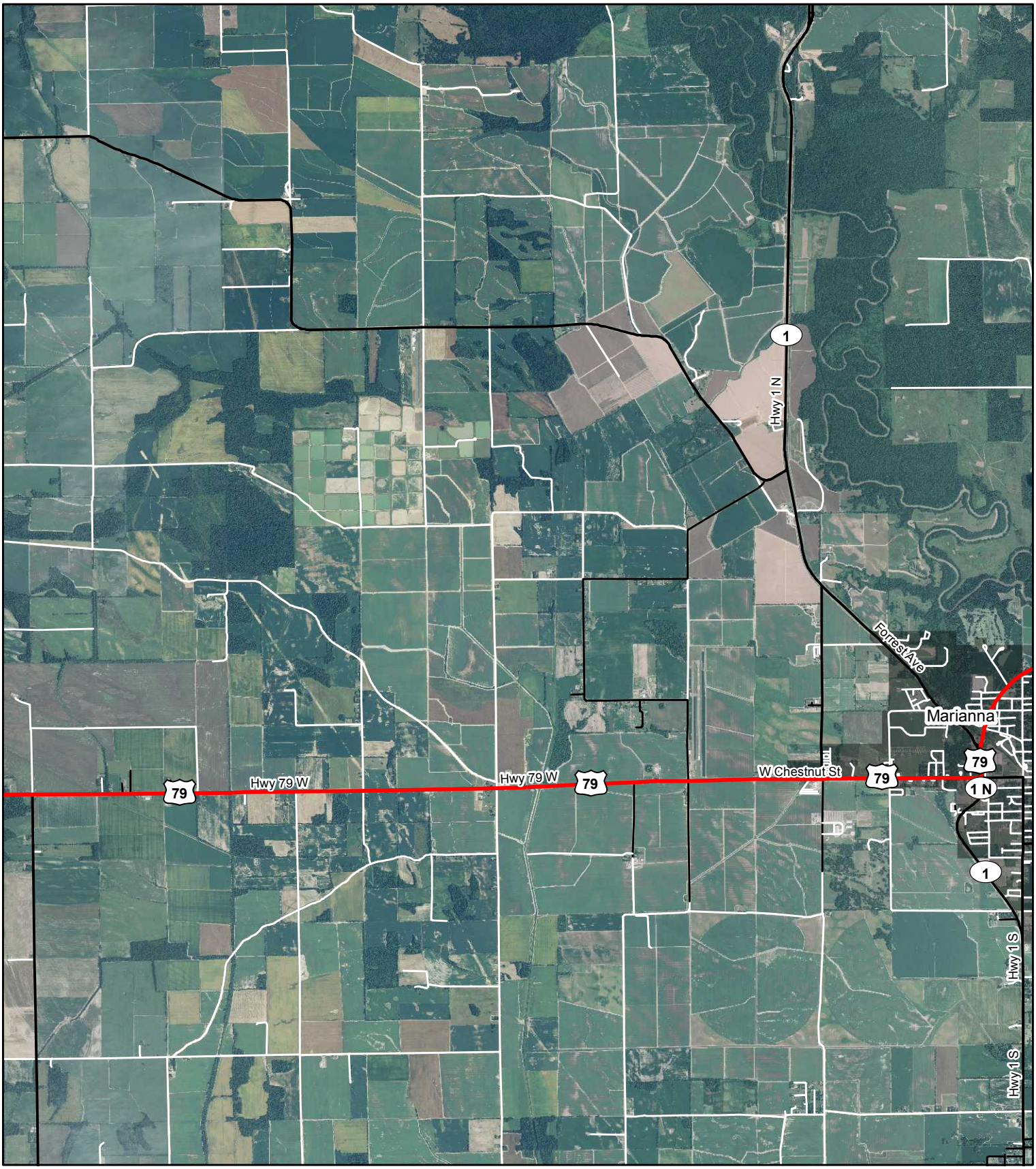

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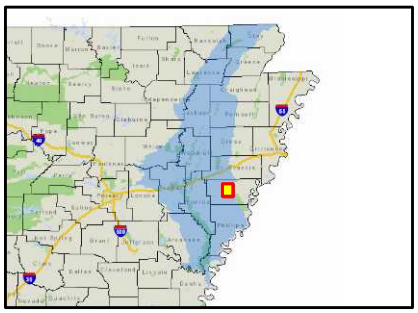
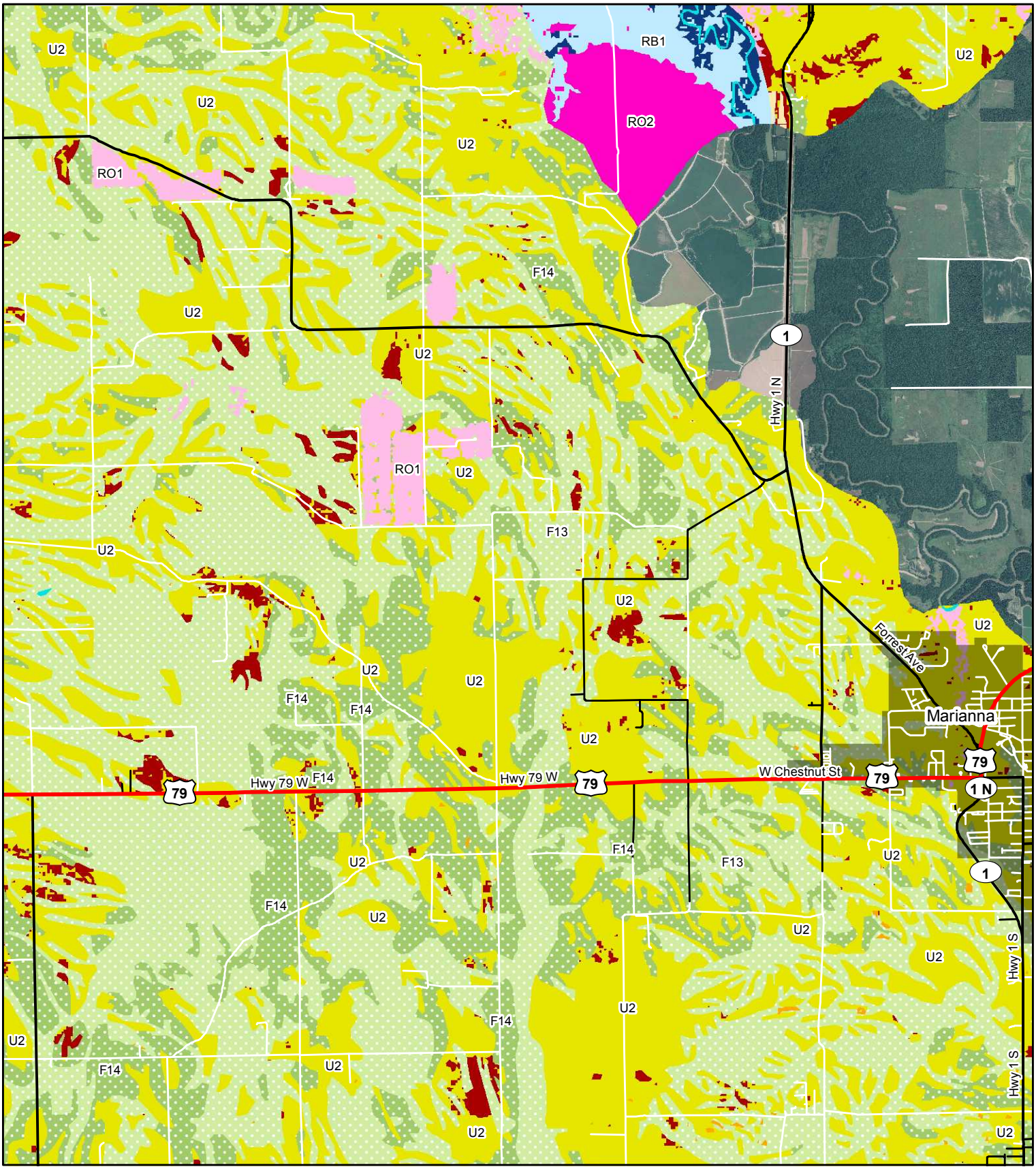
N11





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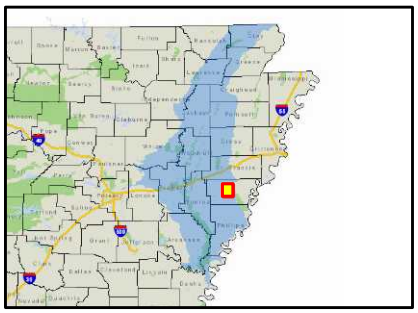

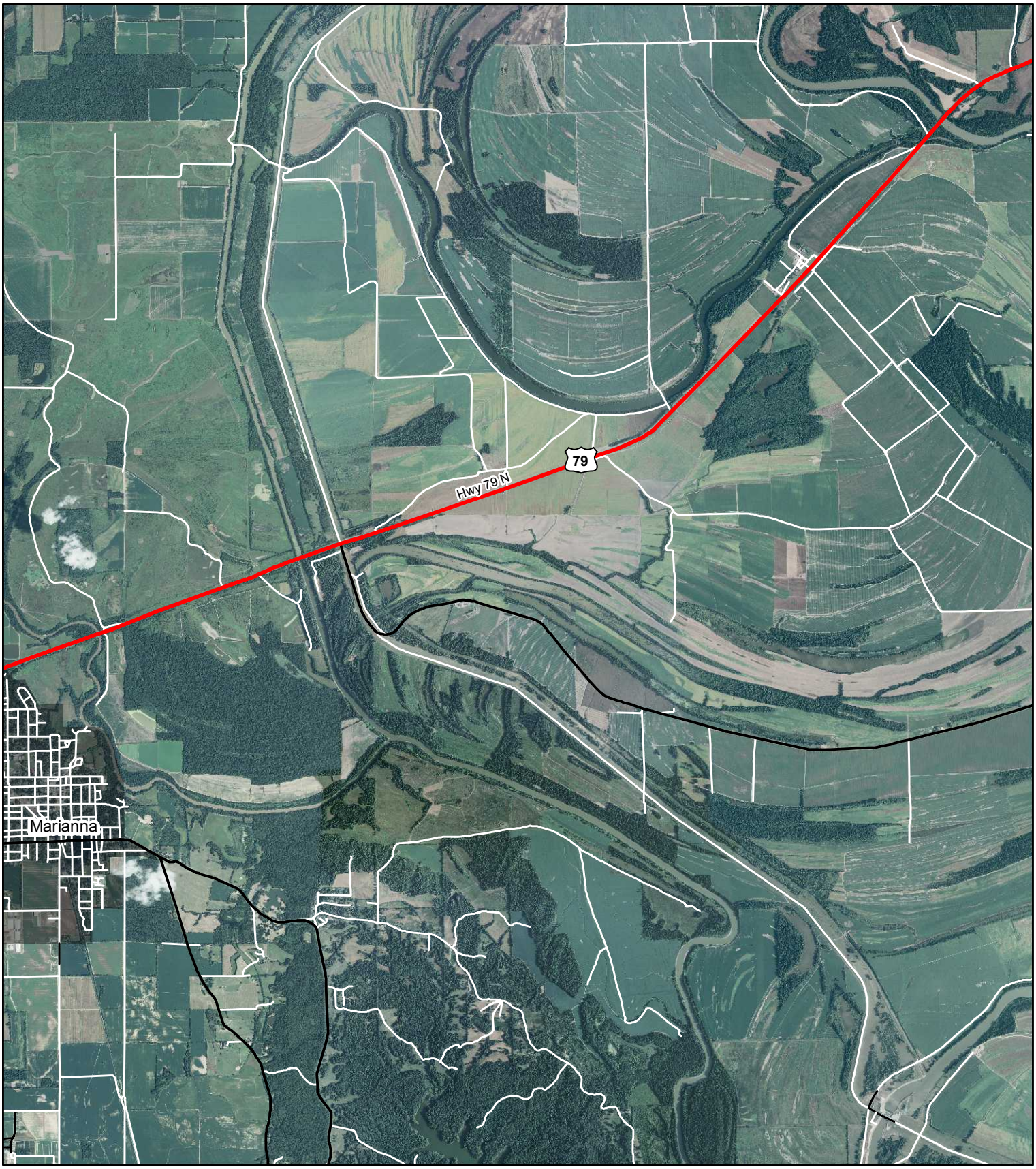

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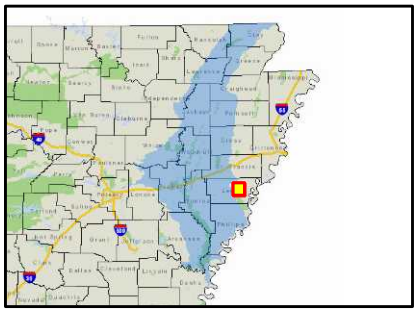

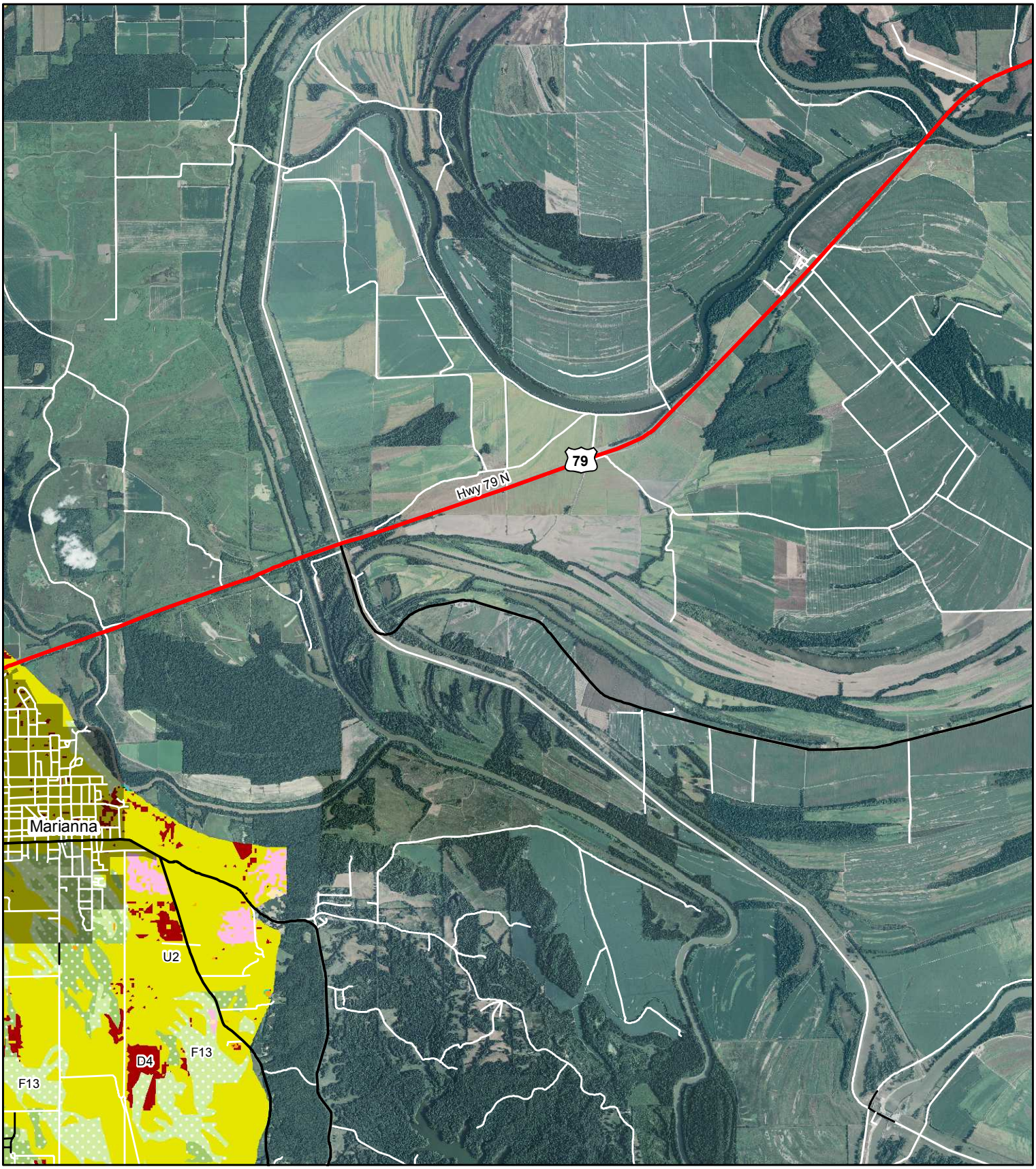

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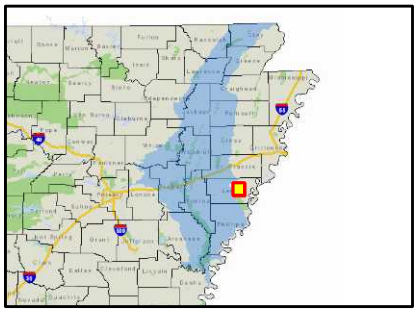

0 0.5 1 2 3 4 Miles

O5

N

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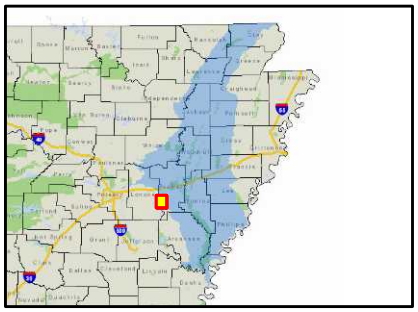

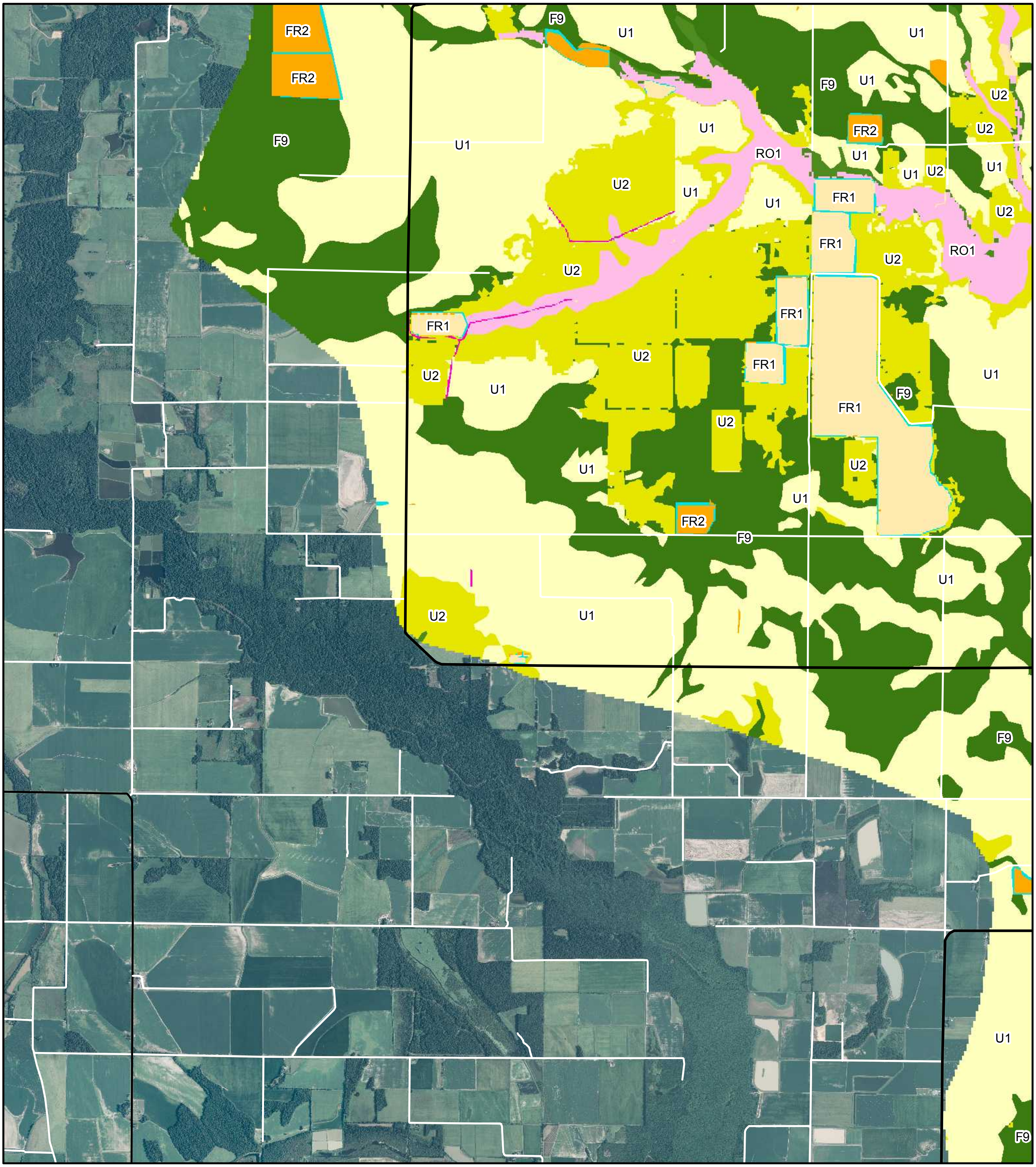

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O5

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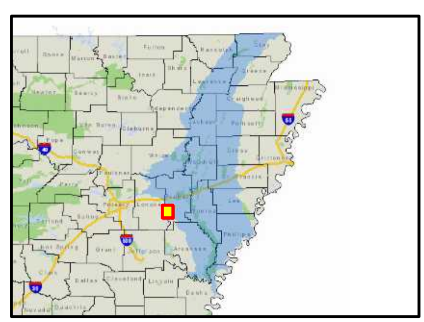

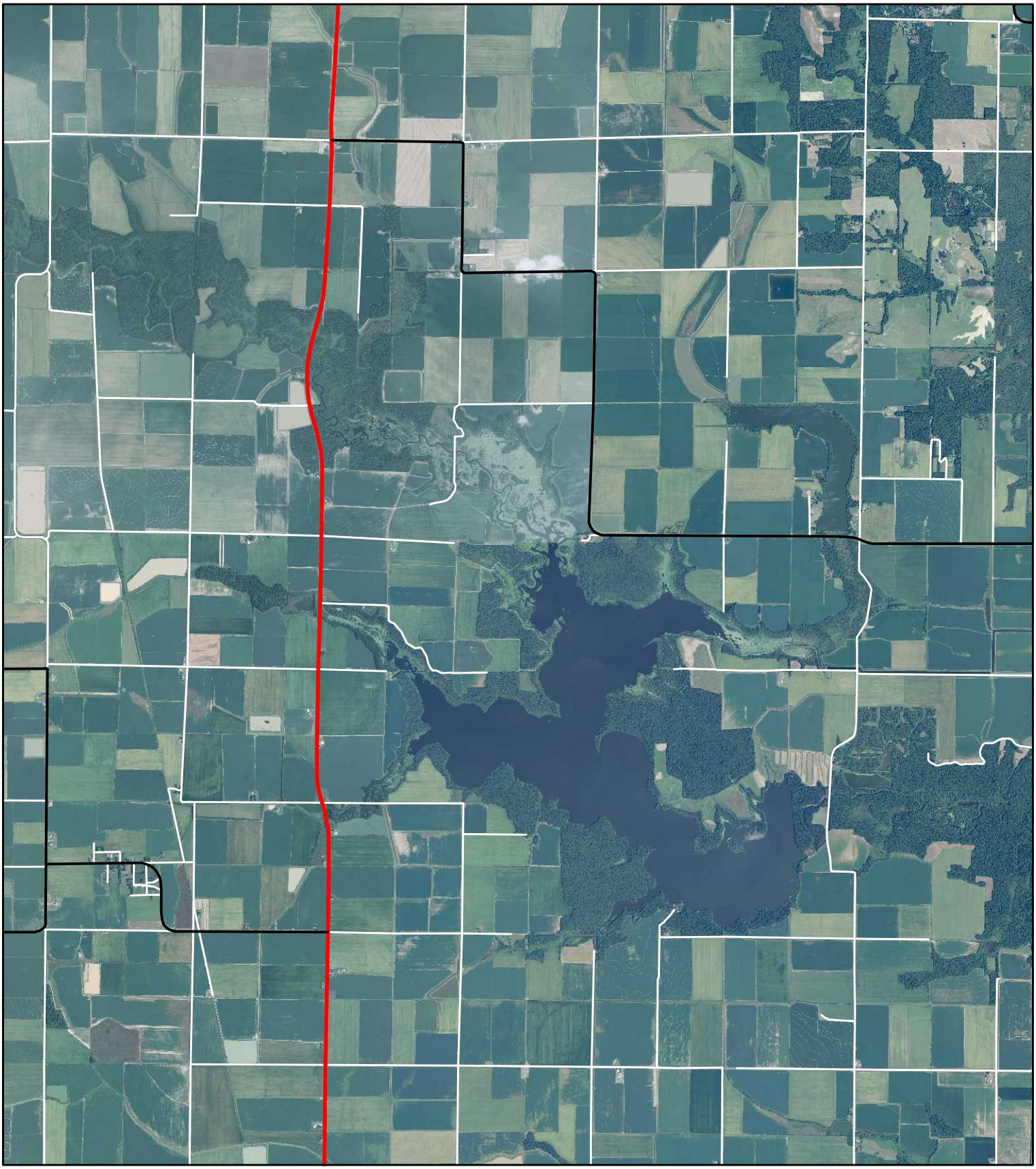

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N

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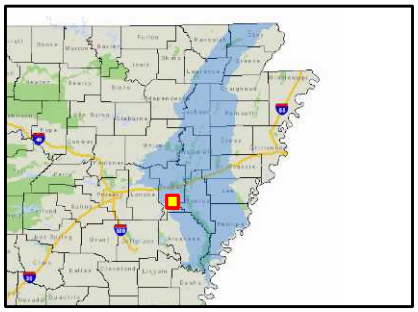
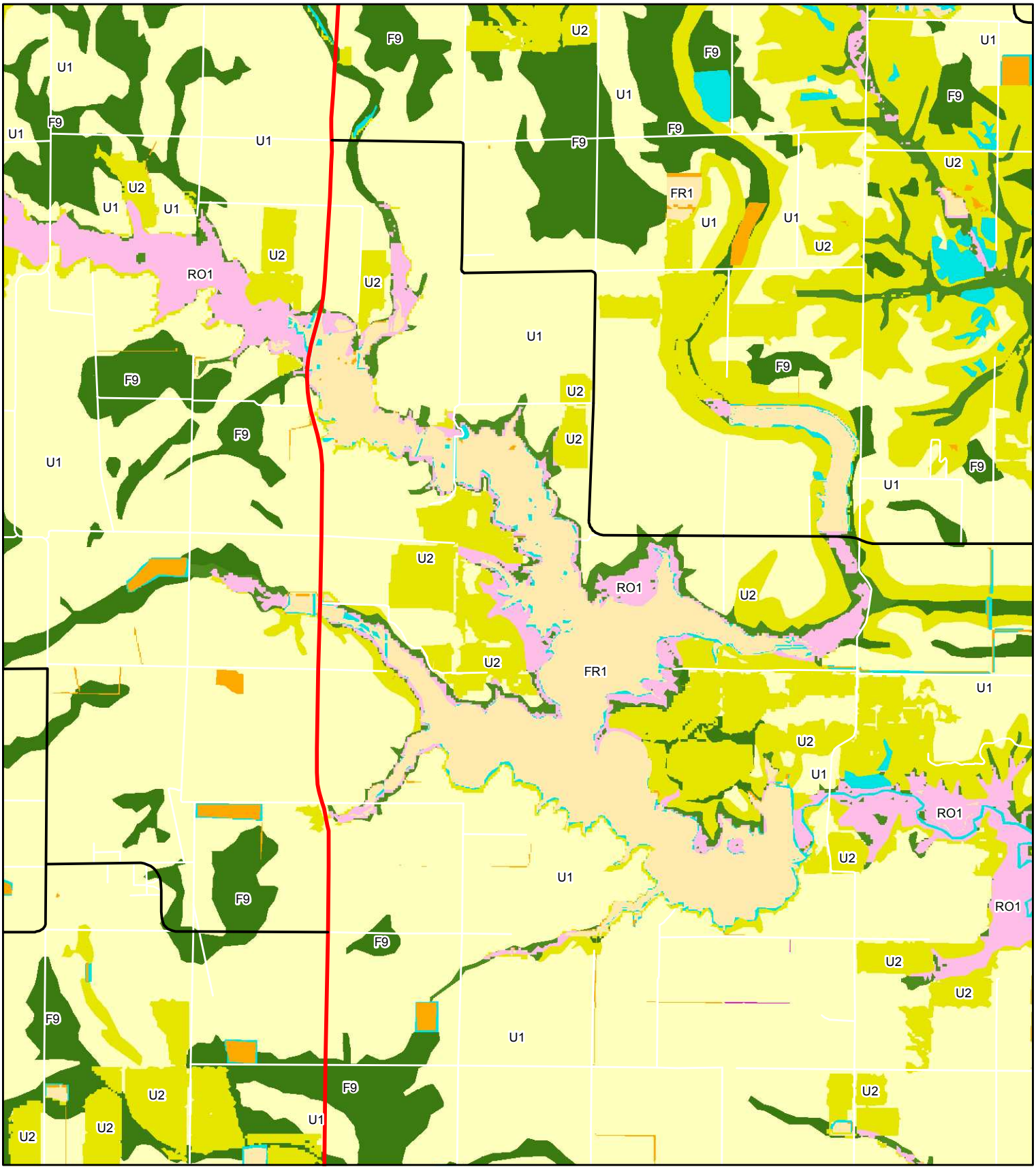
O6





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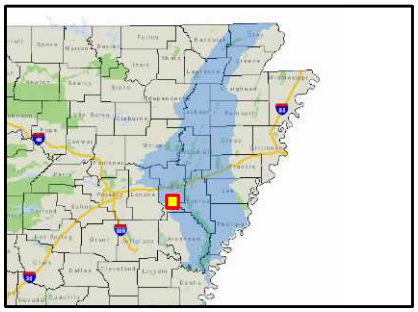

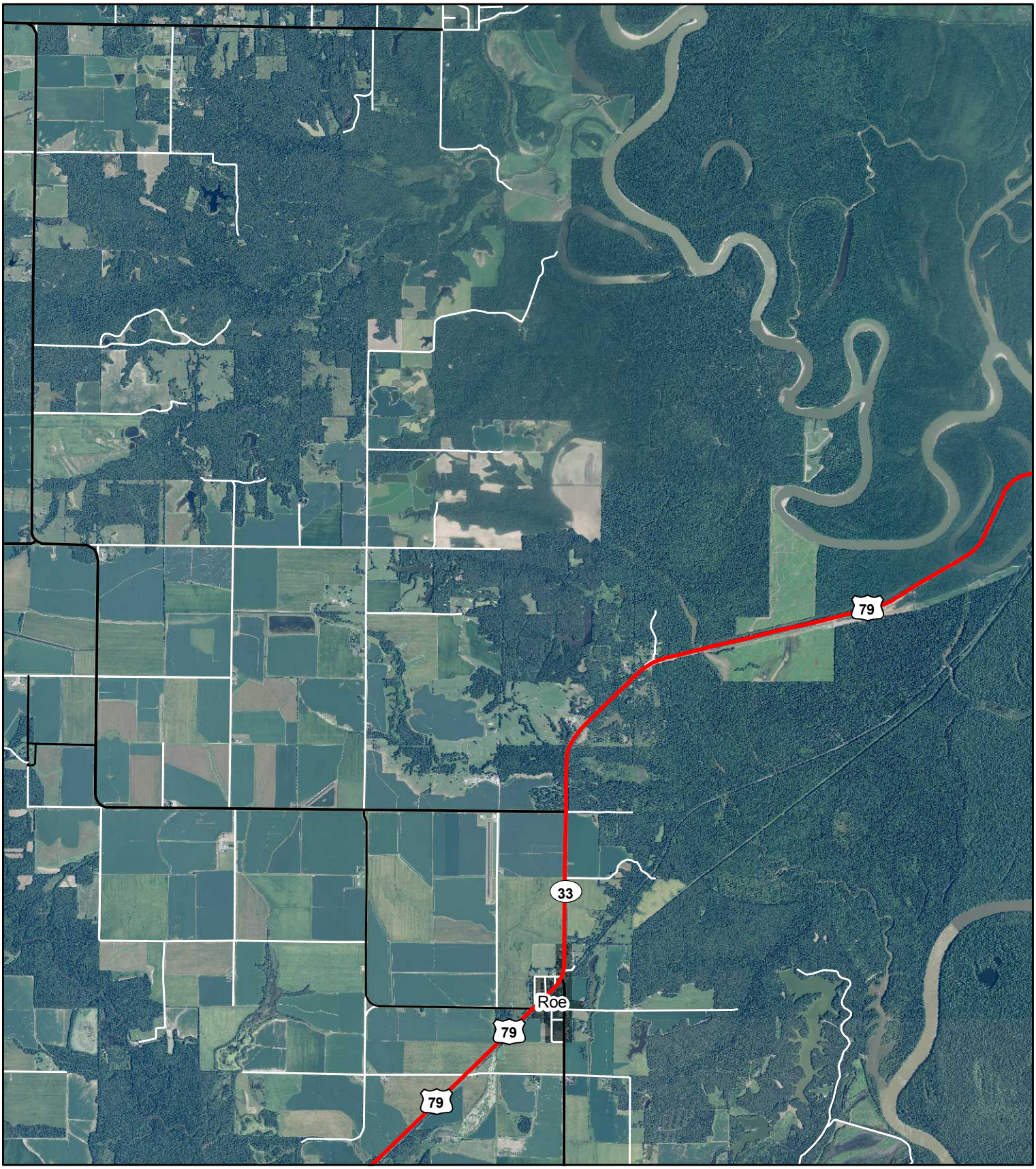

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O7

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Projection: Transverse Mercator
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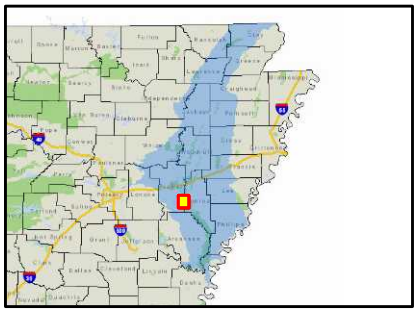

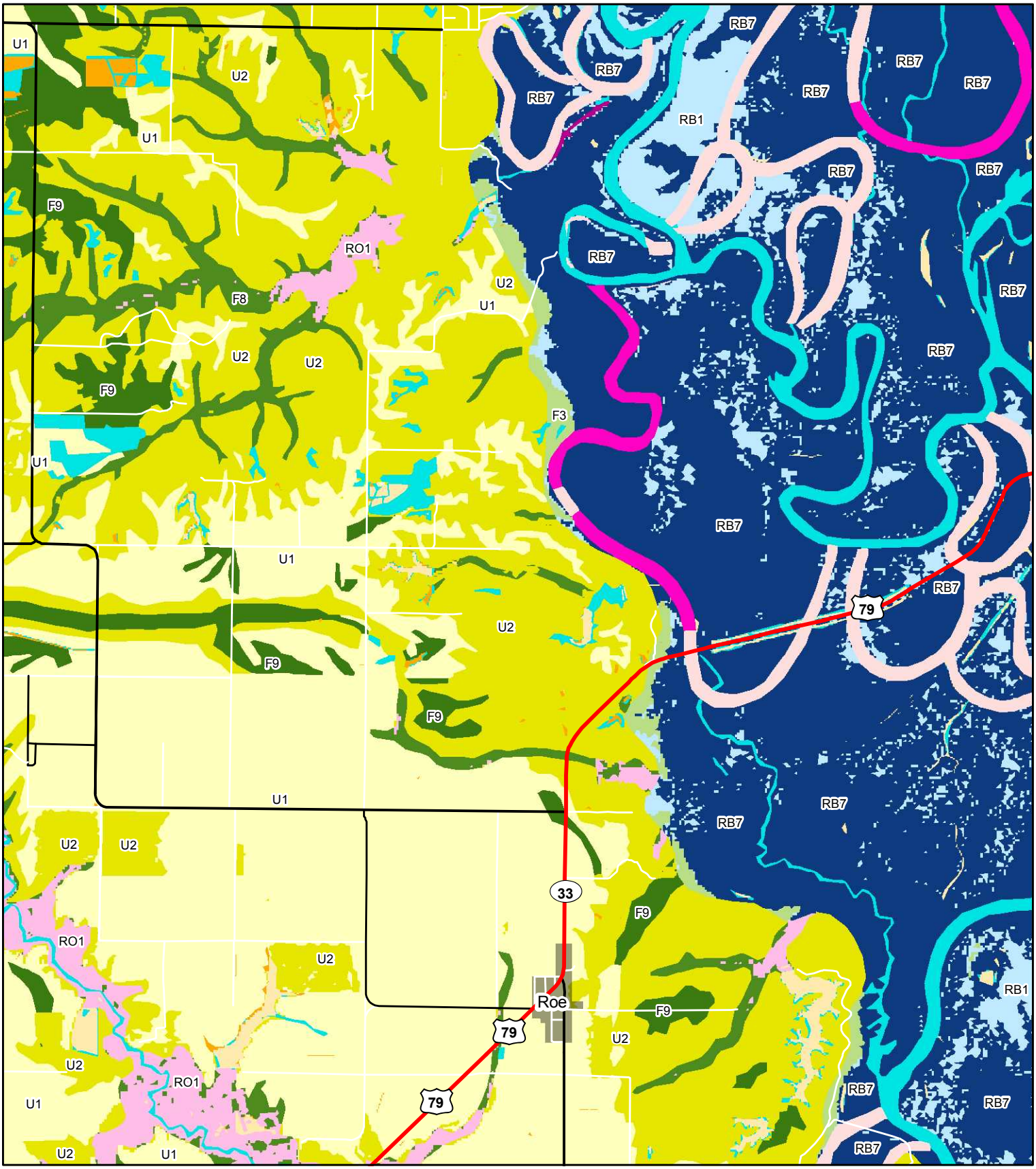

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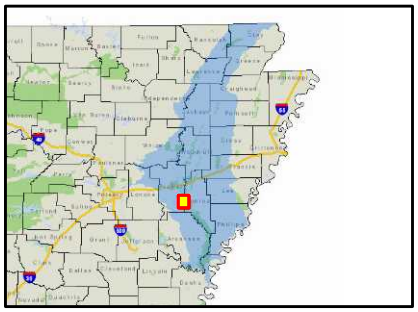

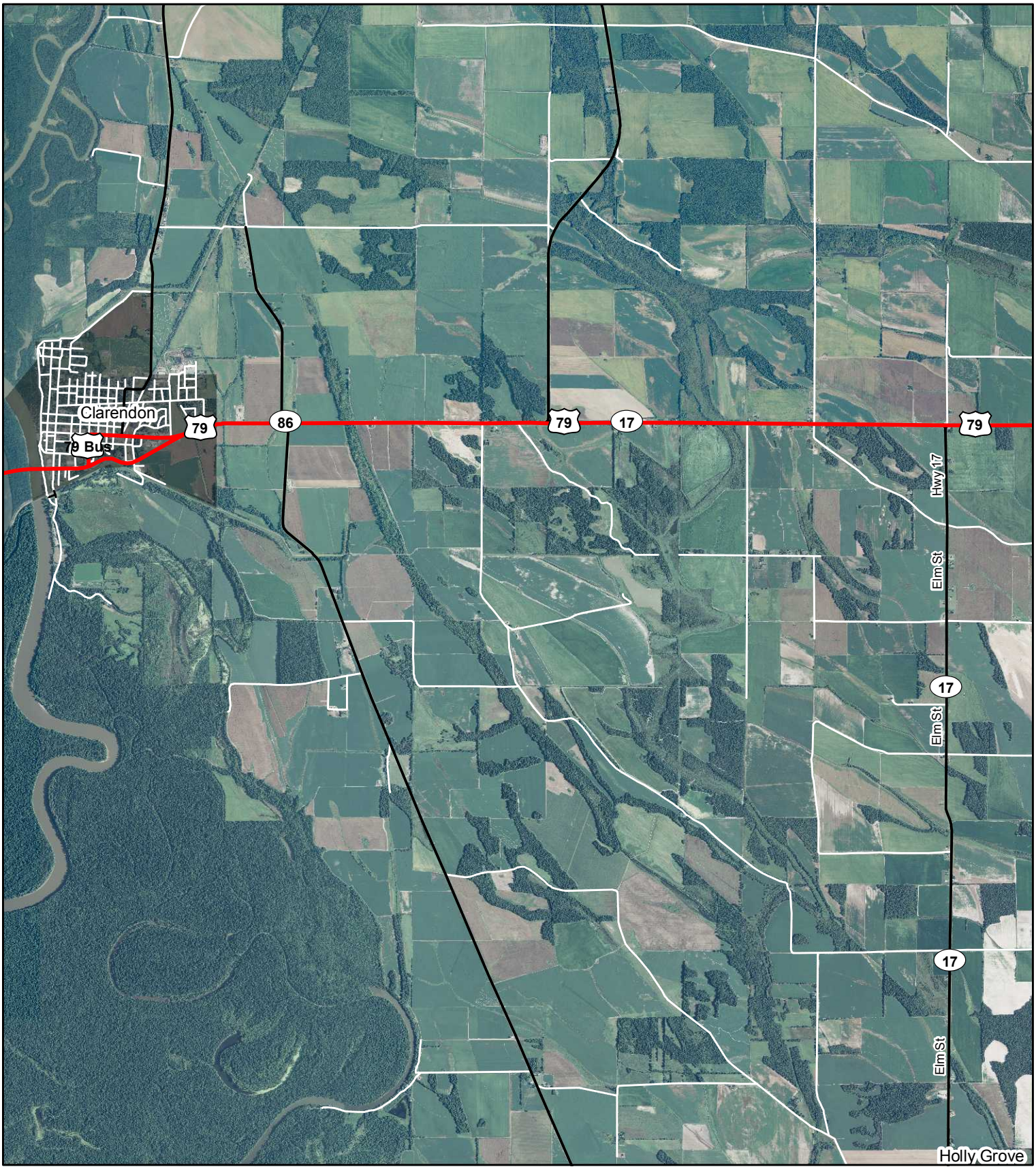

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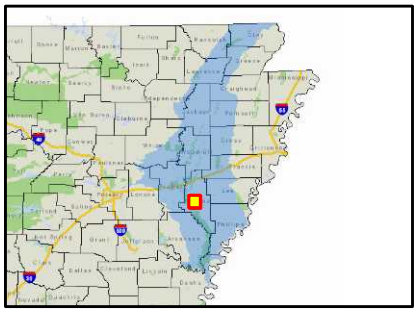
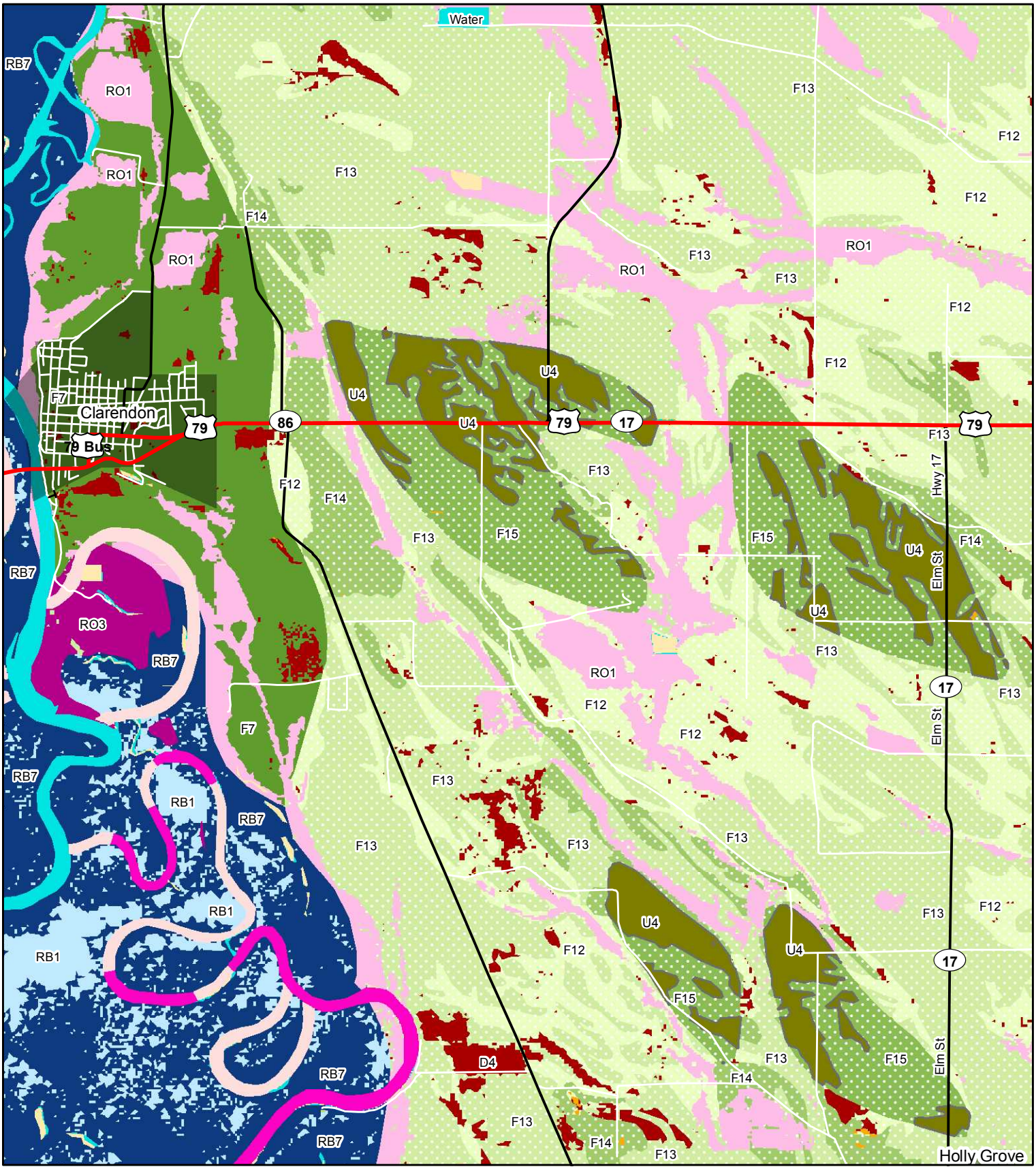
O8





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Projection: Transverse Mercator
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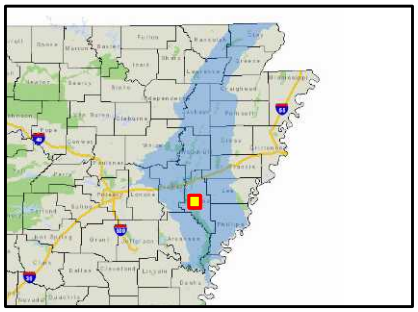

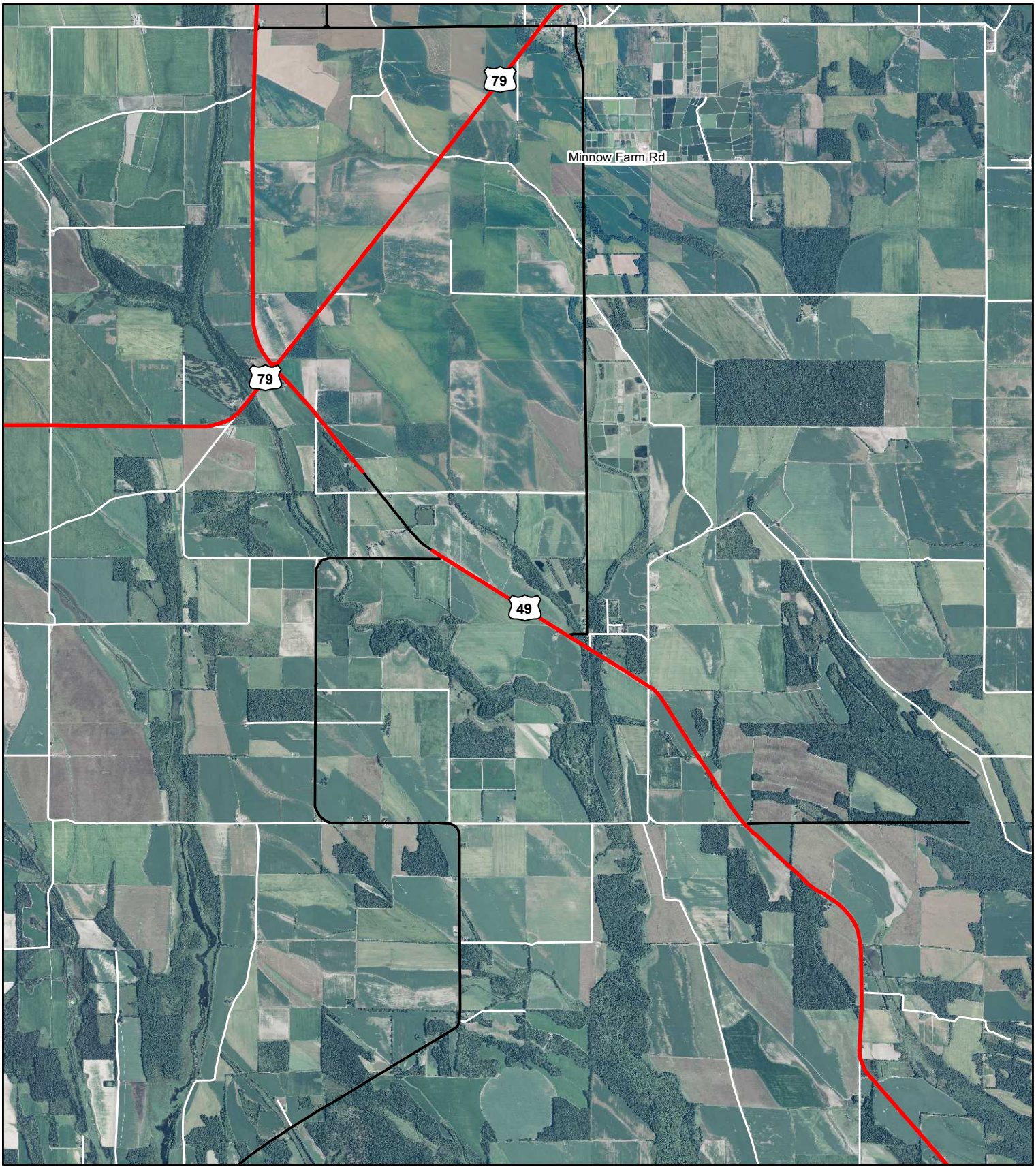

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N

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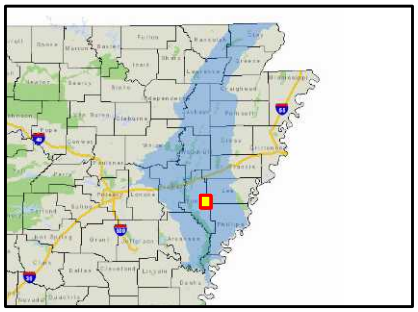
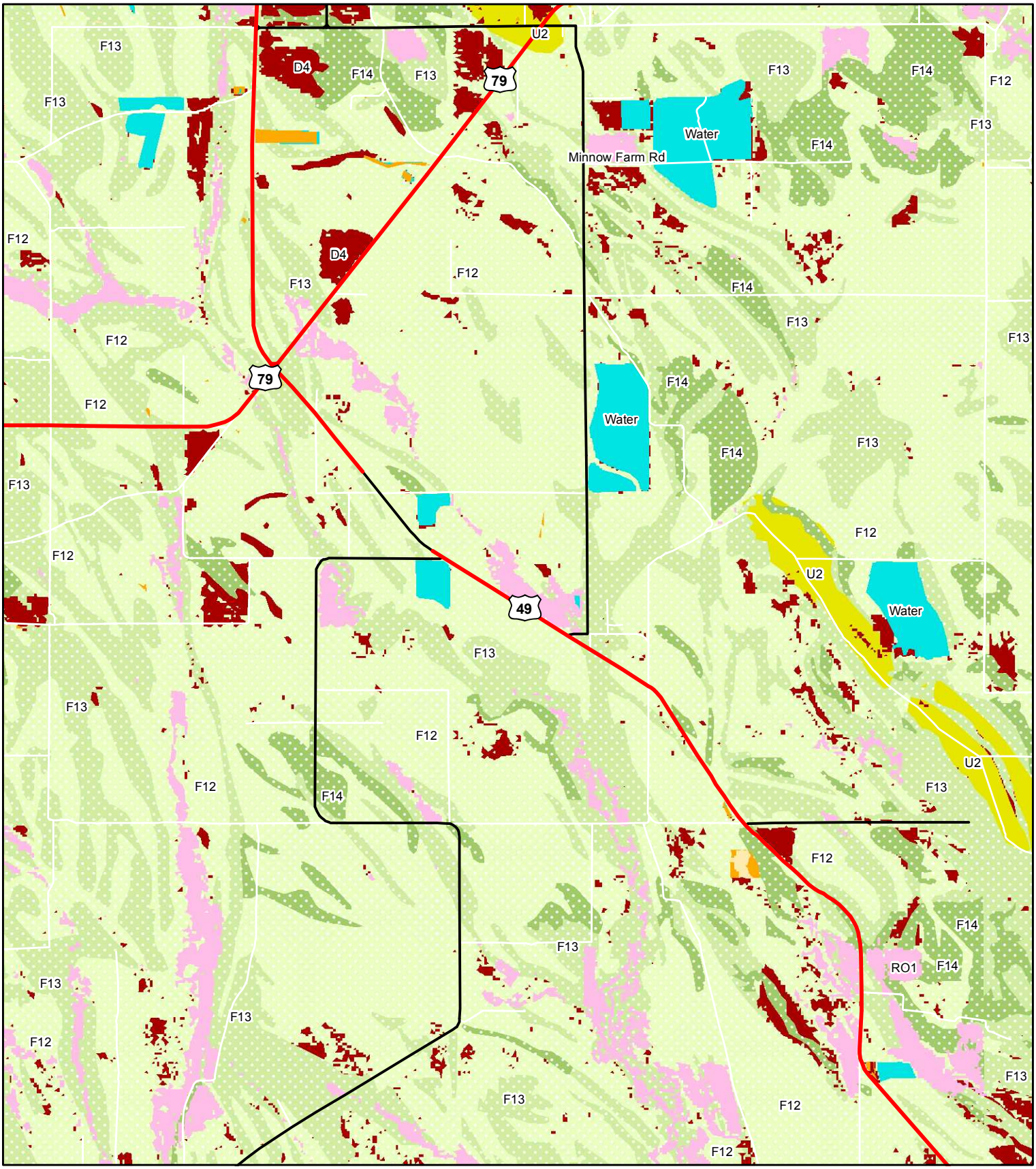
Projection: Transverse Mercator
Datum: North American 1983

O9



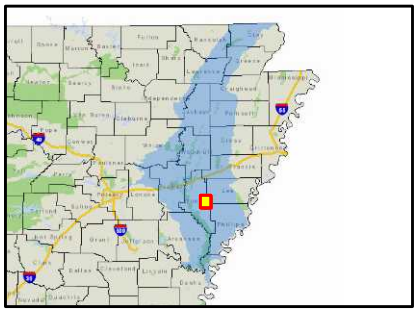


0 0.5 1 2 3 4 Miles

N

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

O9



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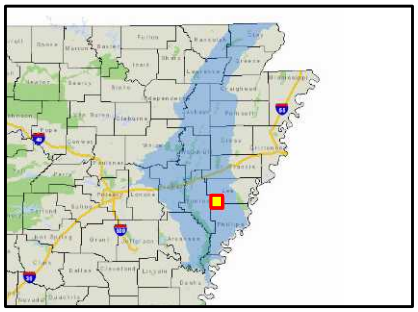

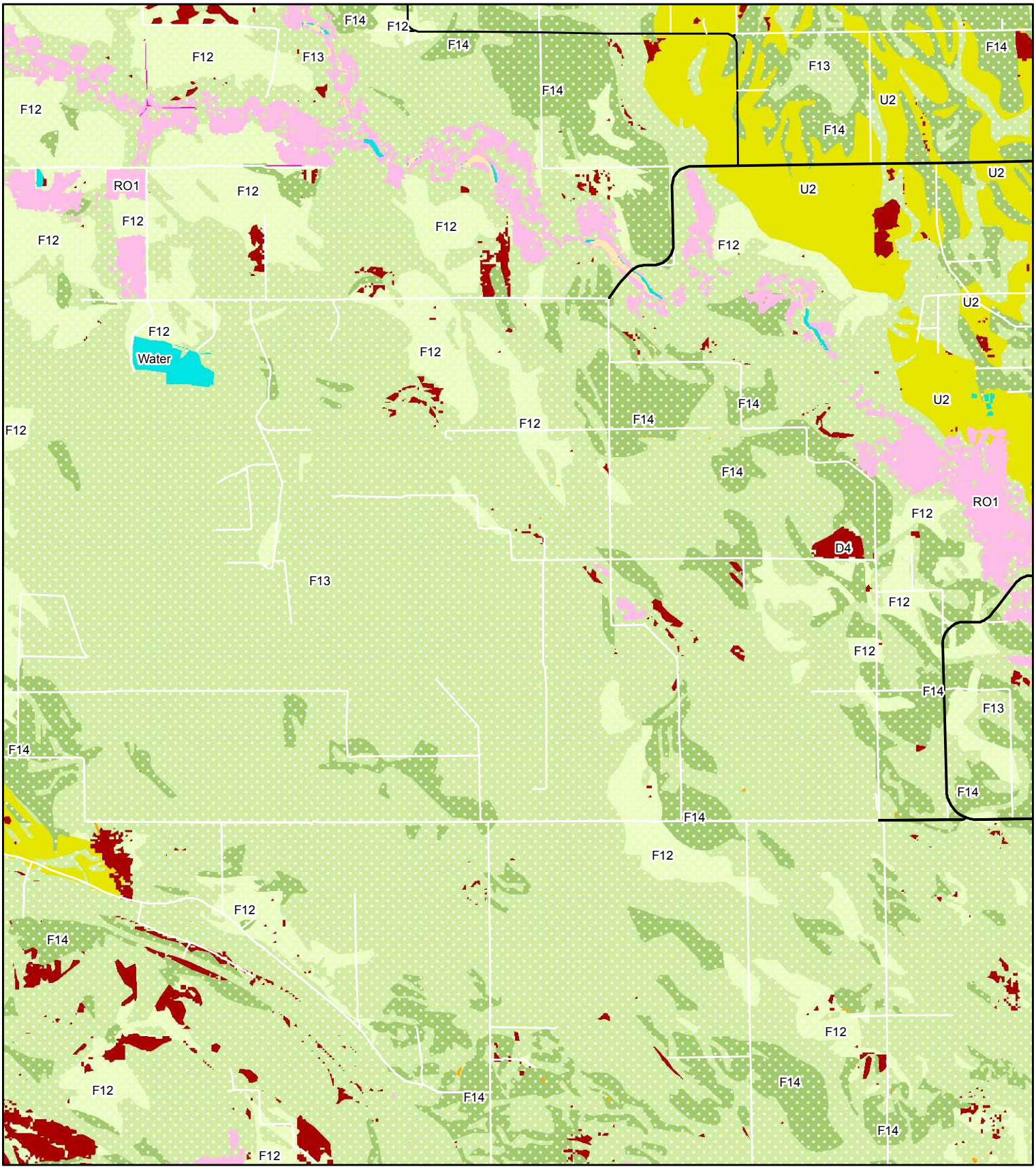

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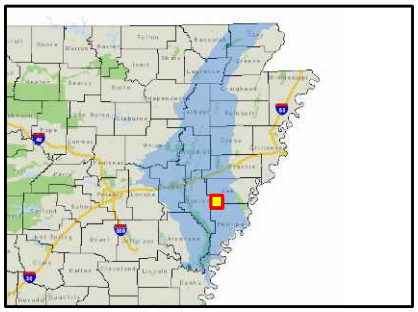
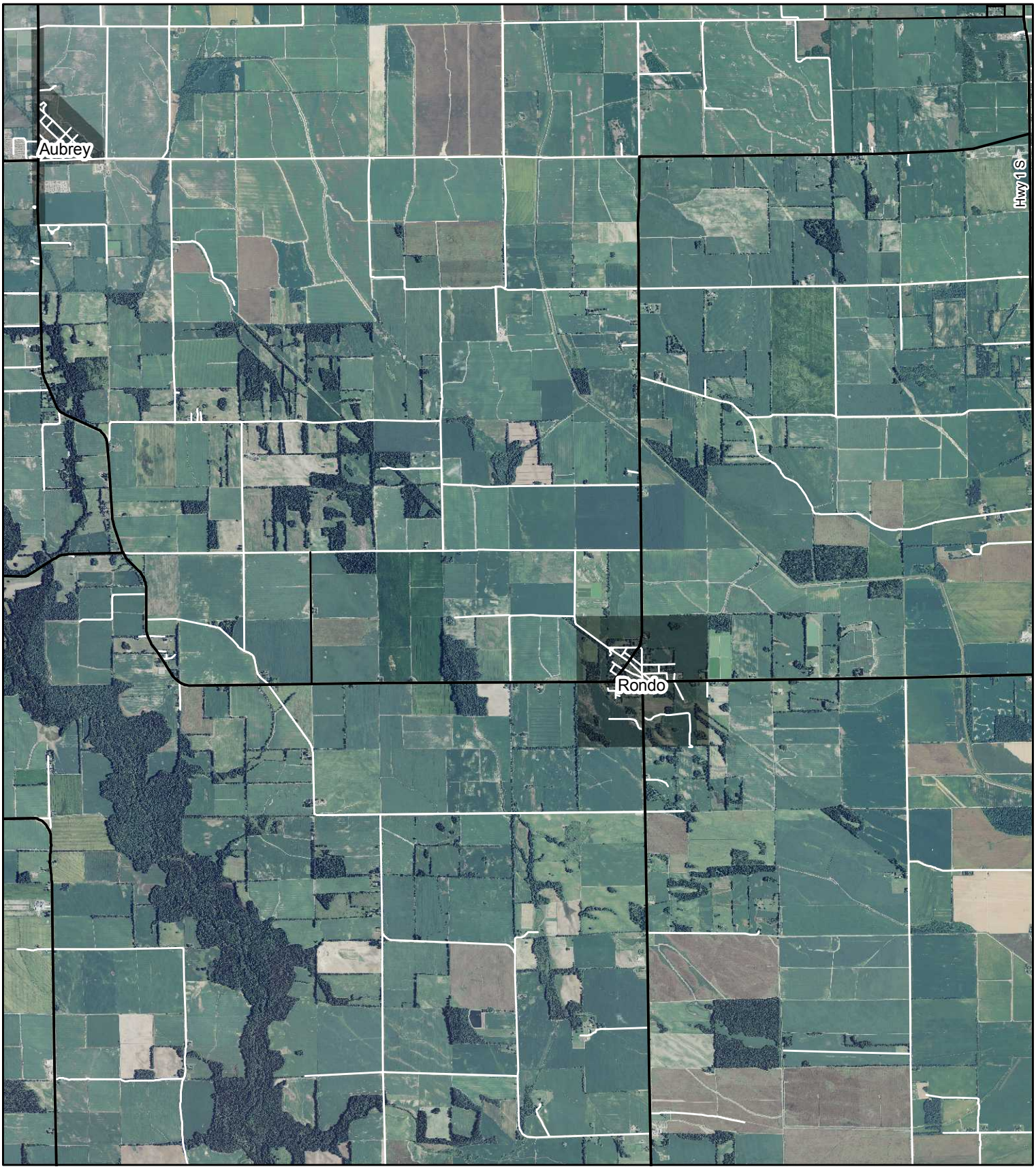
O10





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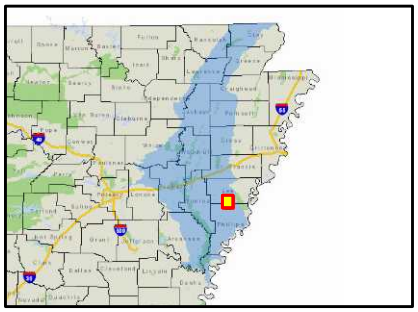

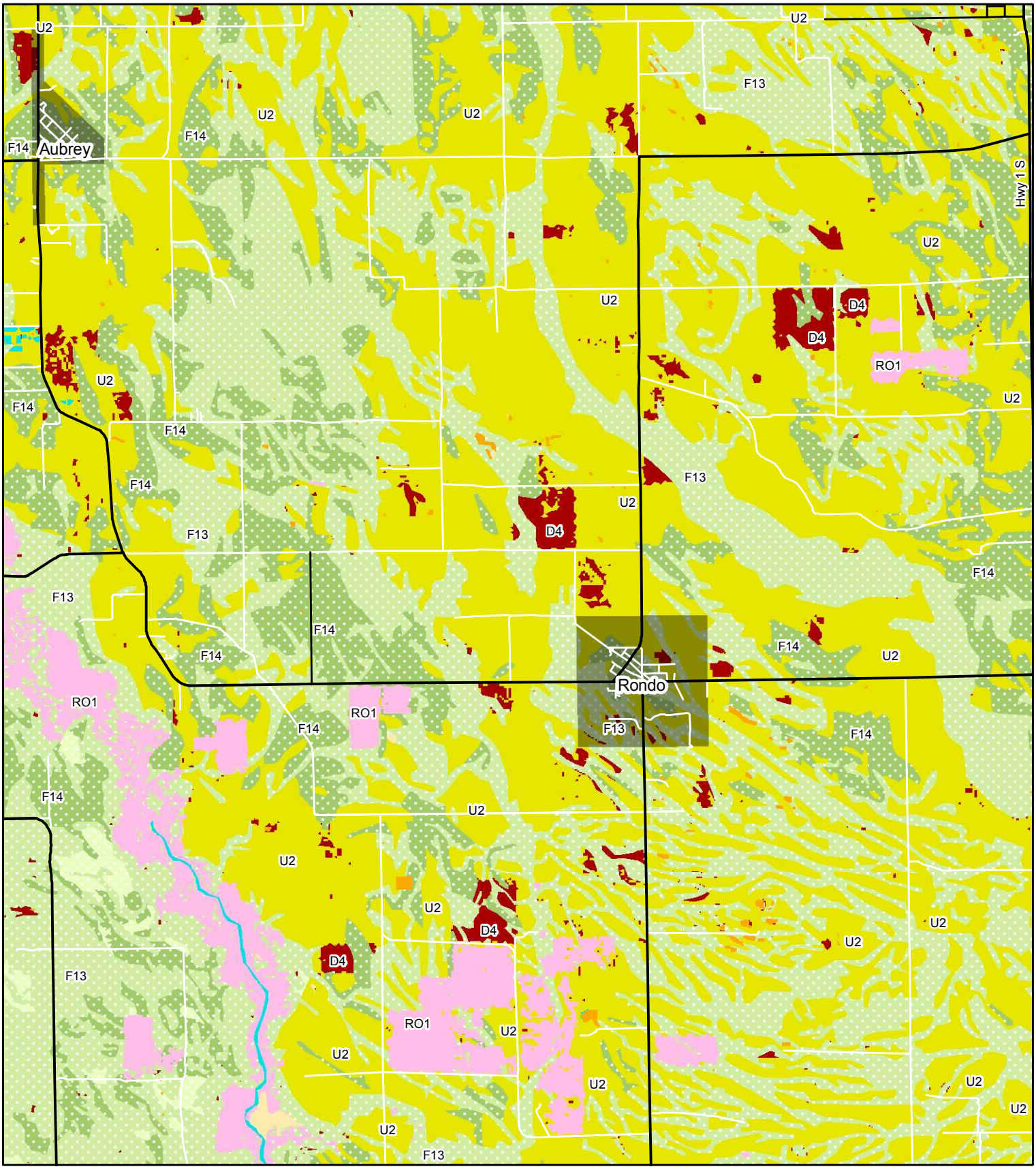

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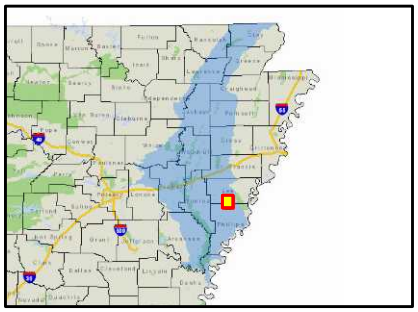

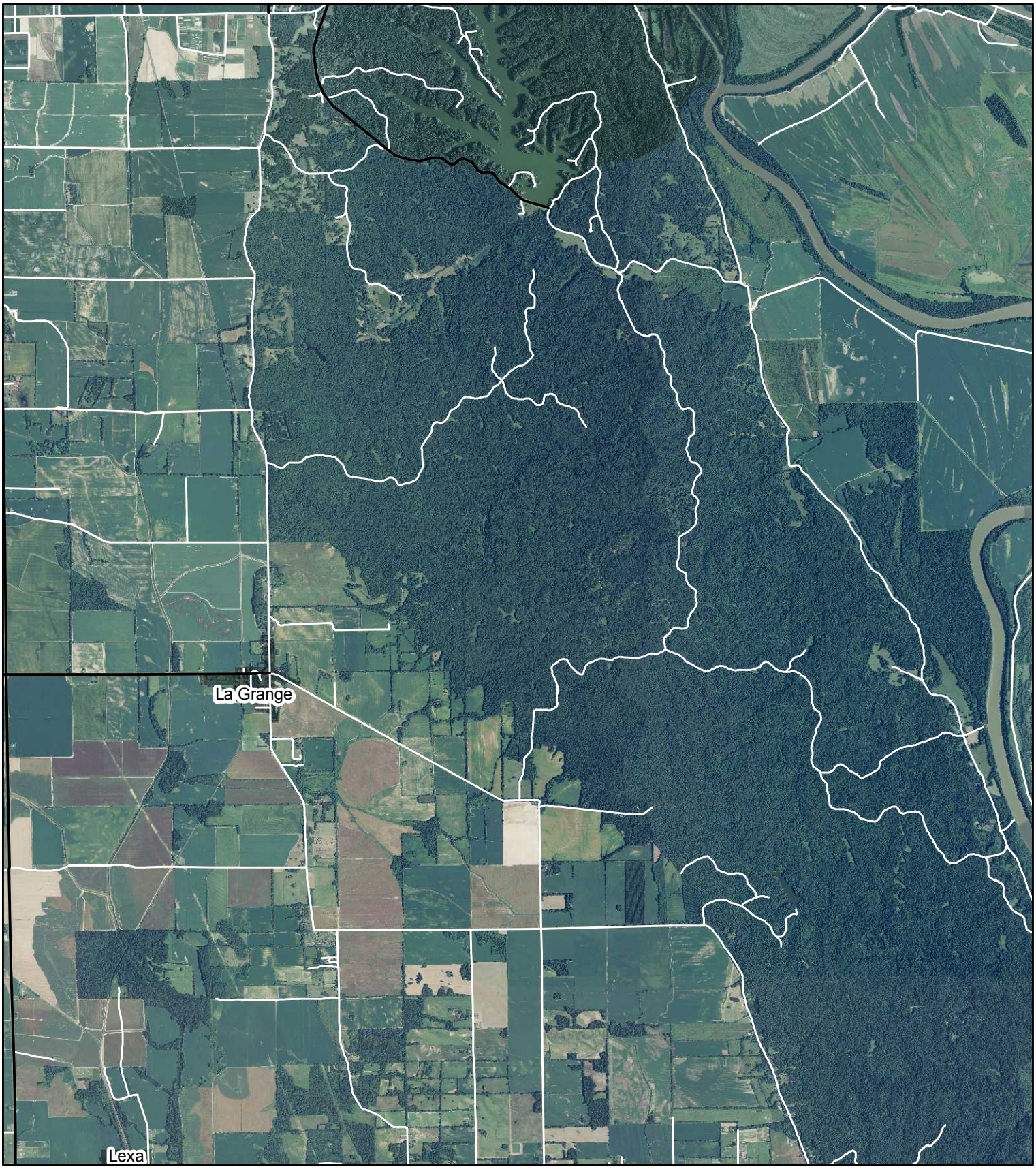

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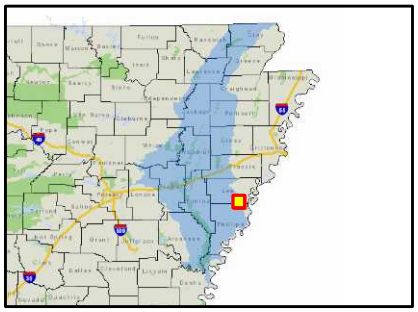

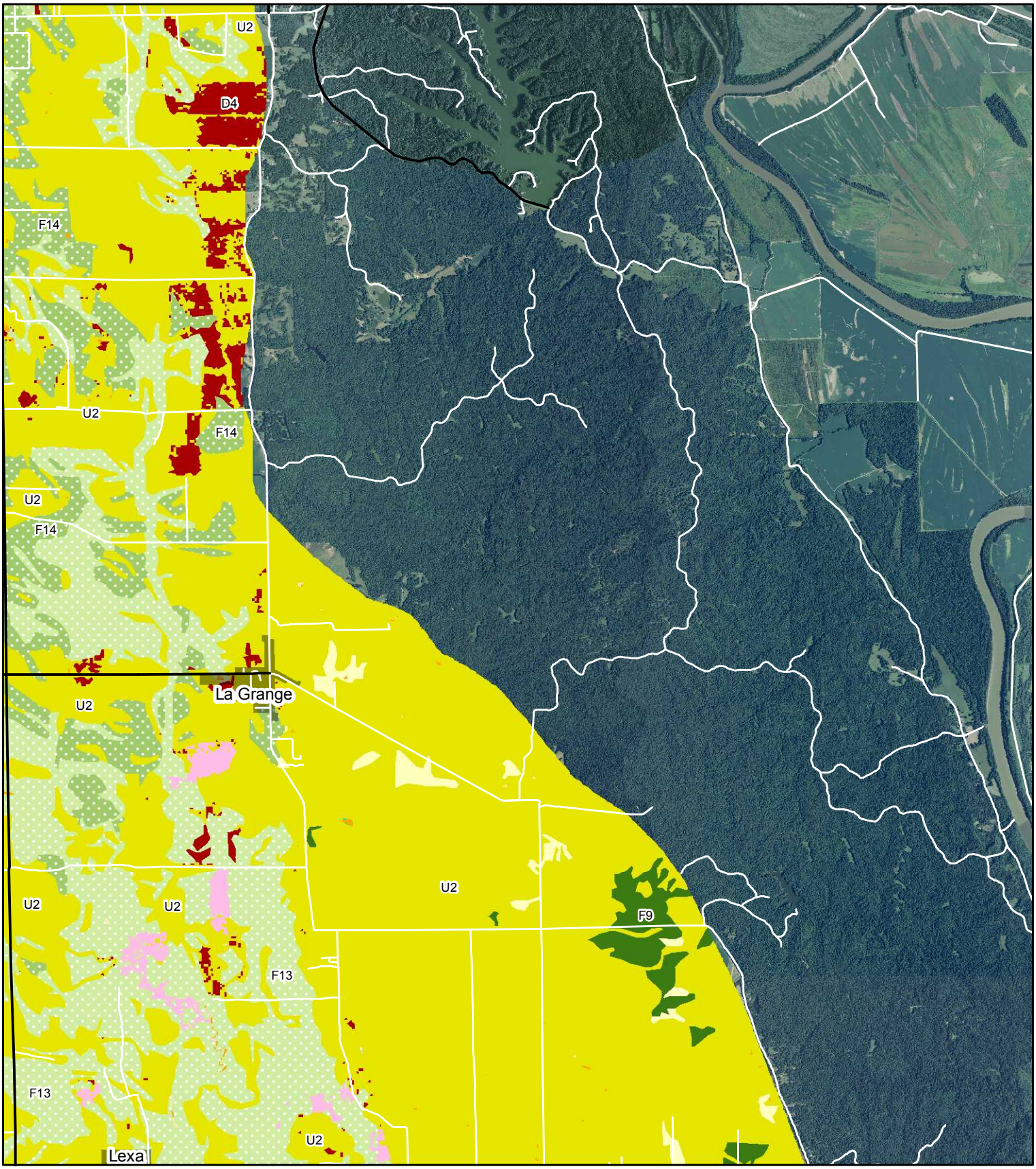

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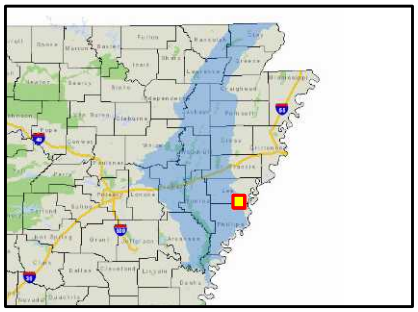

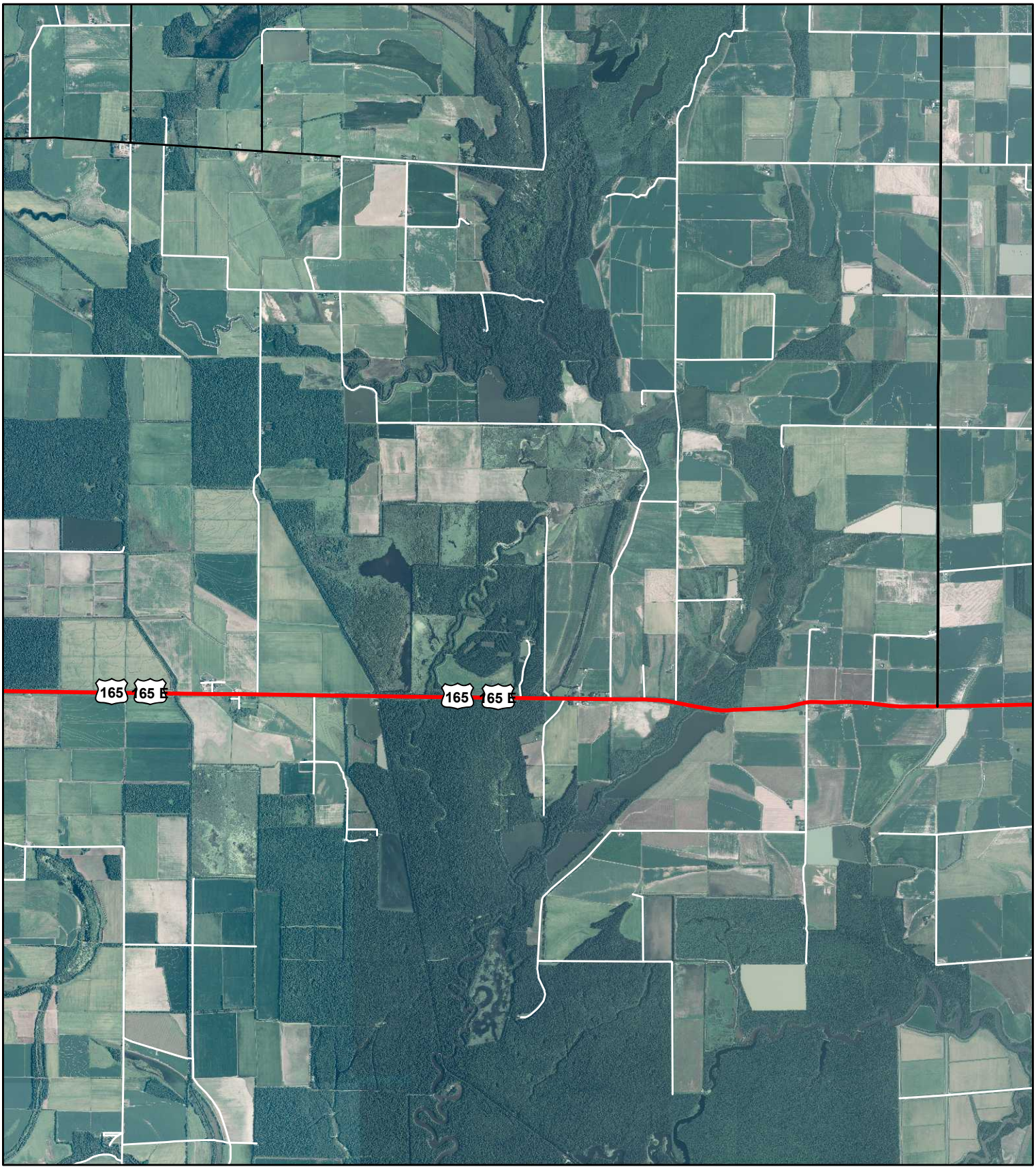

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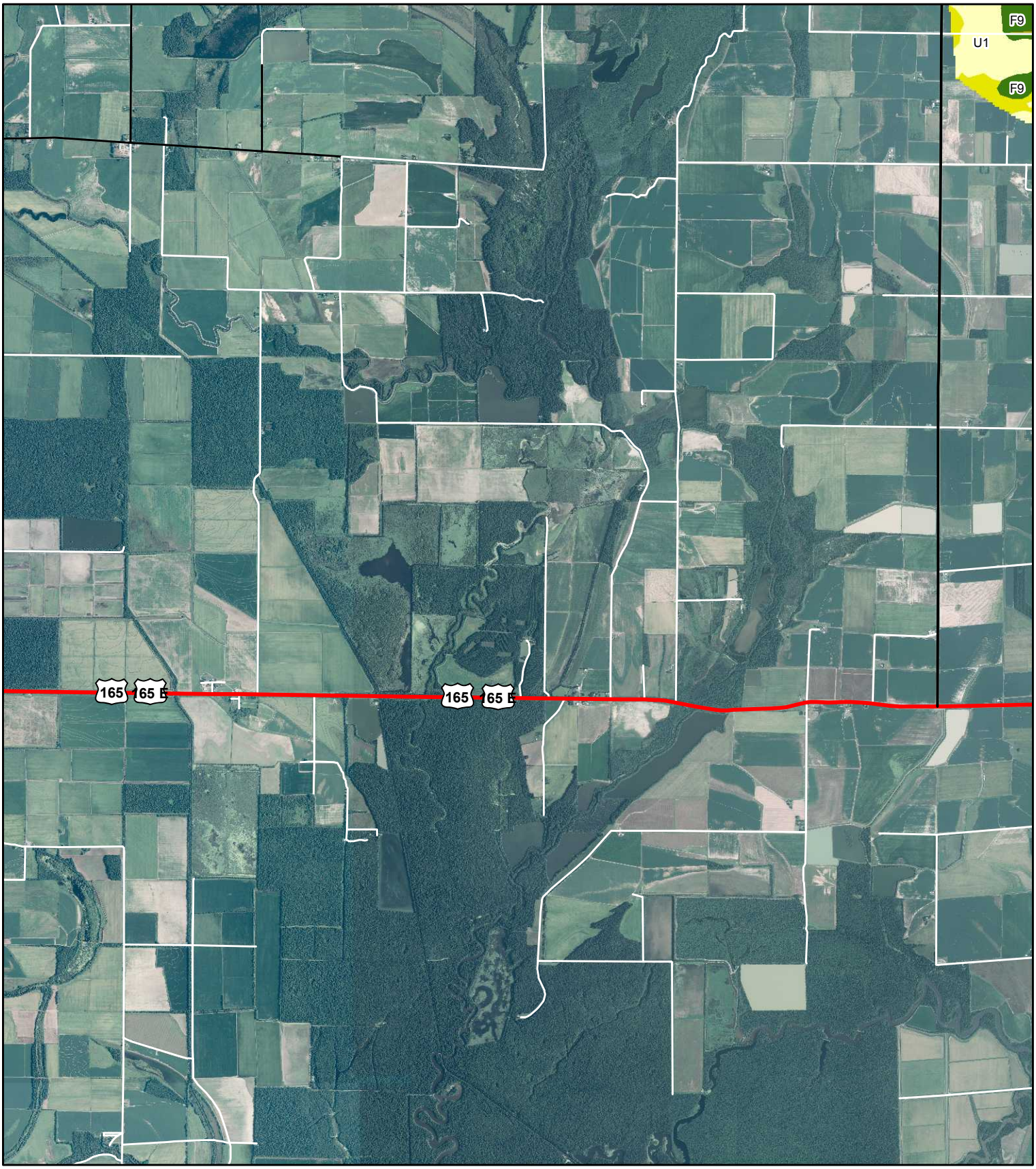

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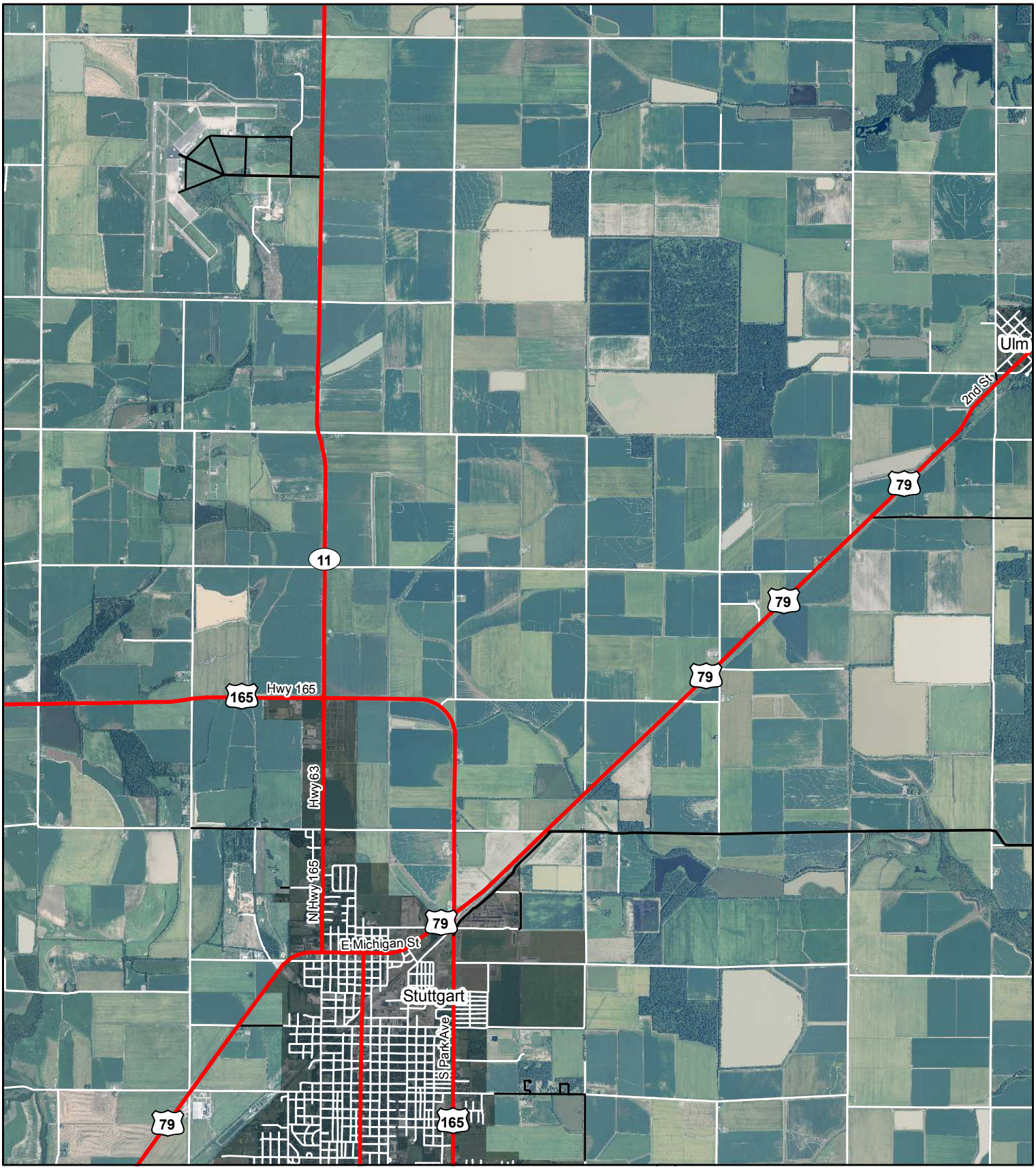
P5



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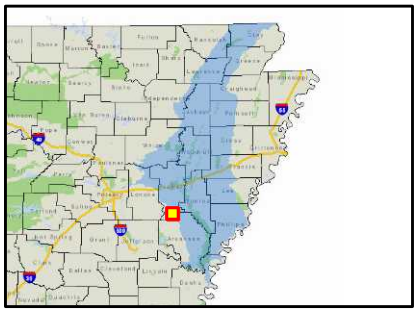
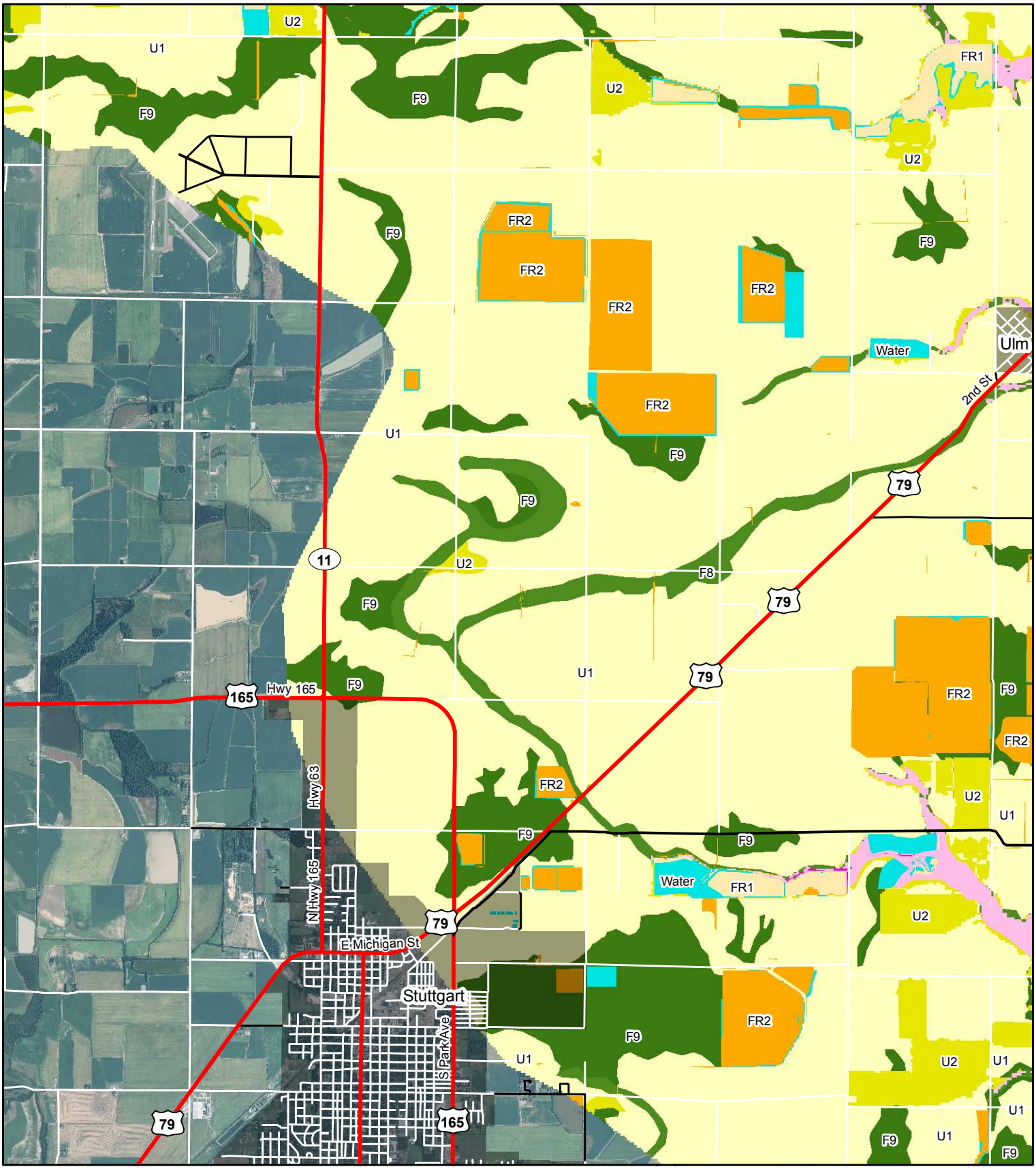
Projection: Transverse Mercator
Datum: North American 1983

P6





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Projection: Transverse Mercator
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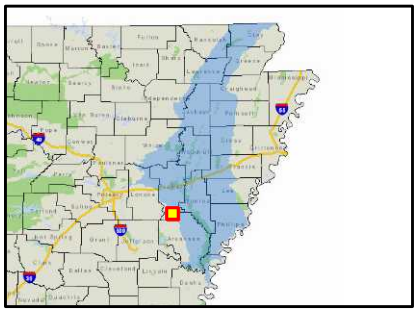
P6



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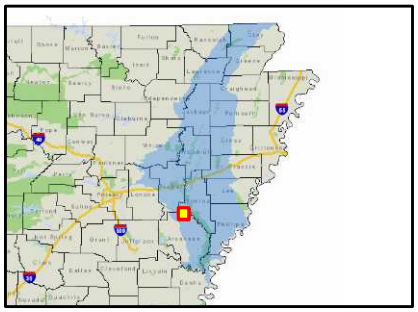
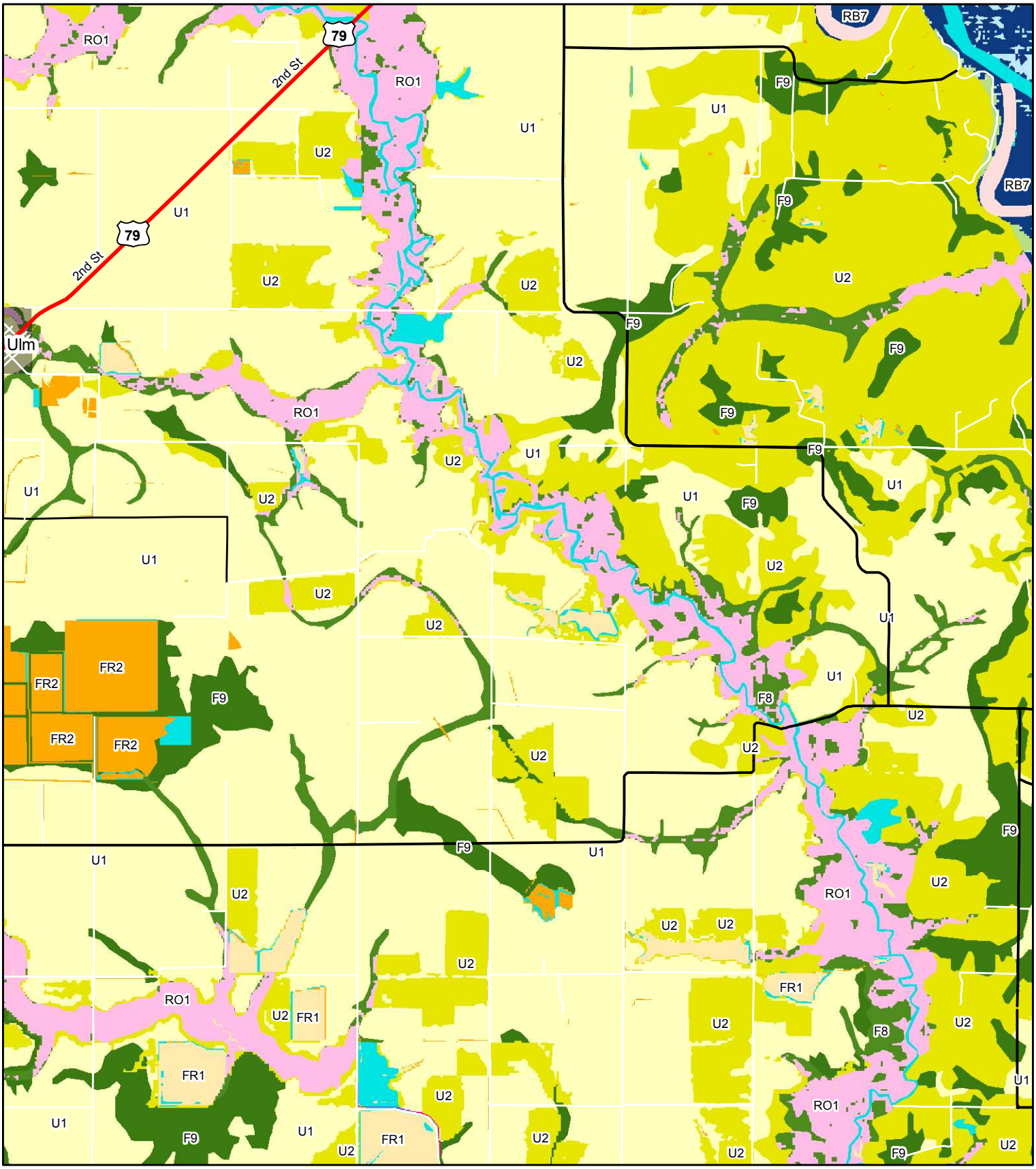
P7





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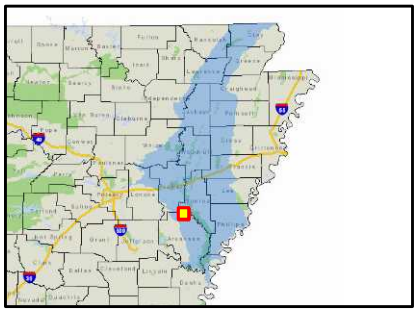

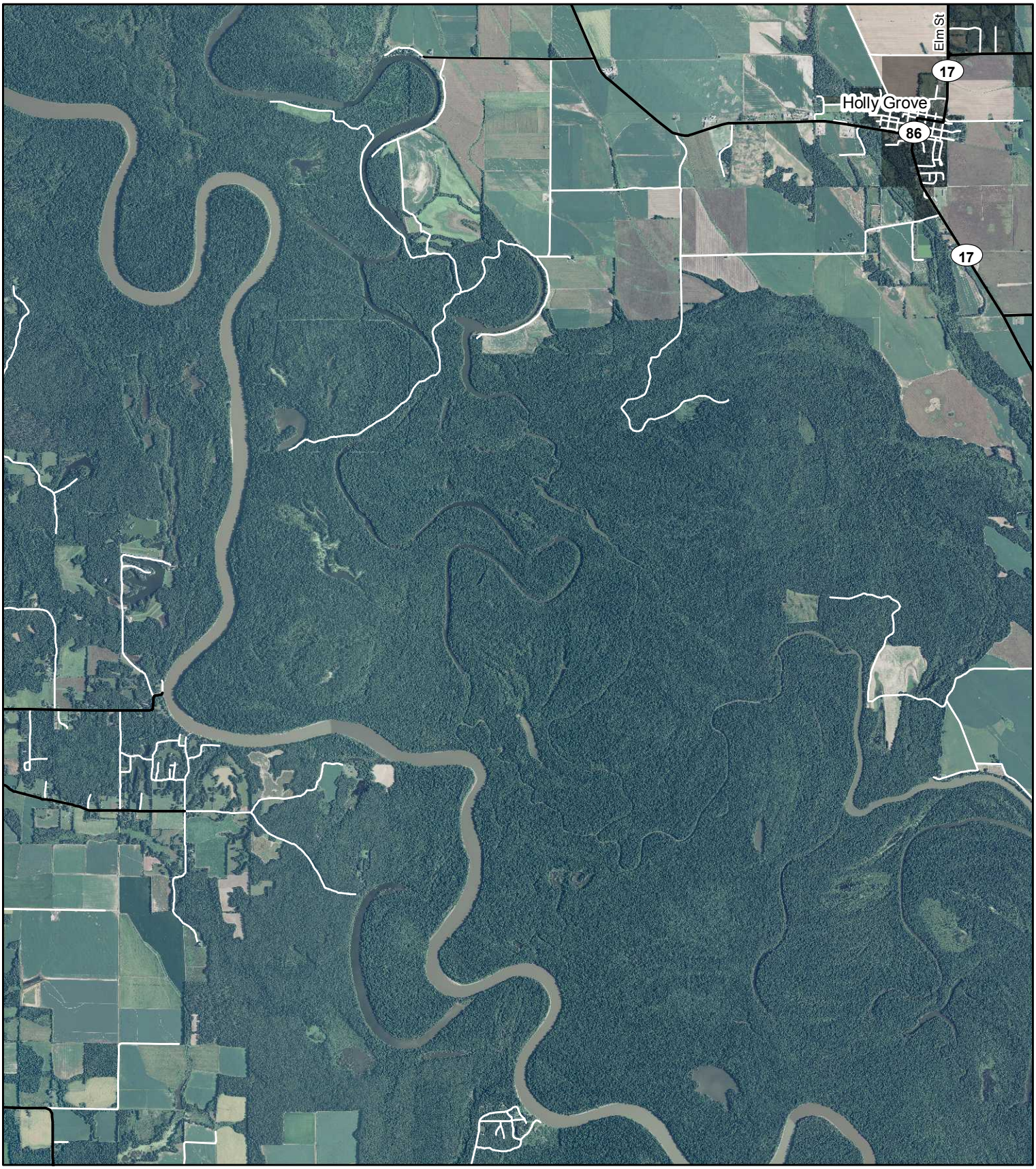

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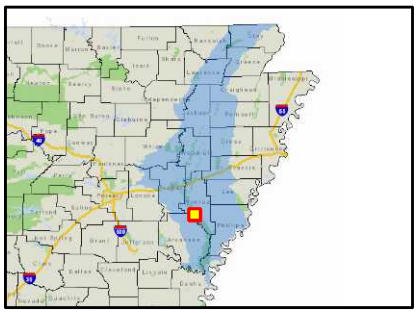
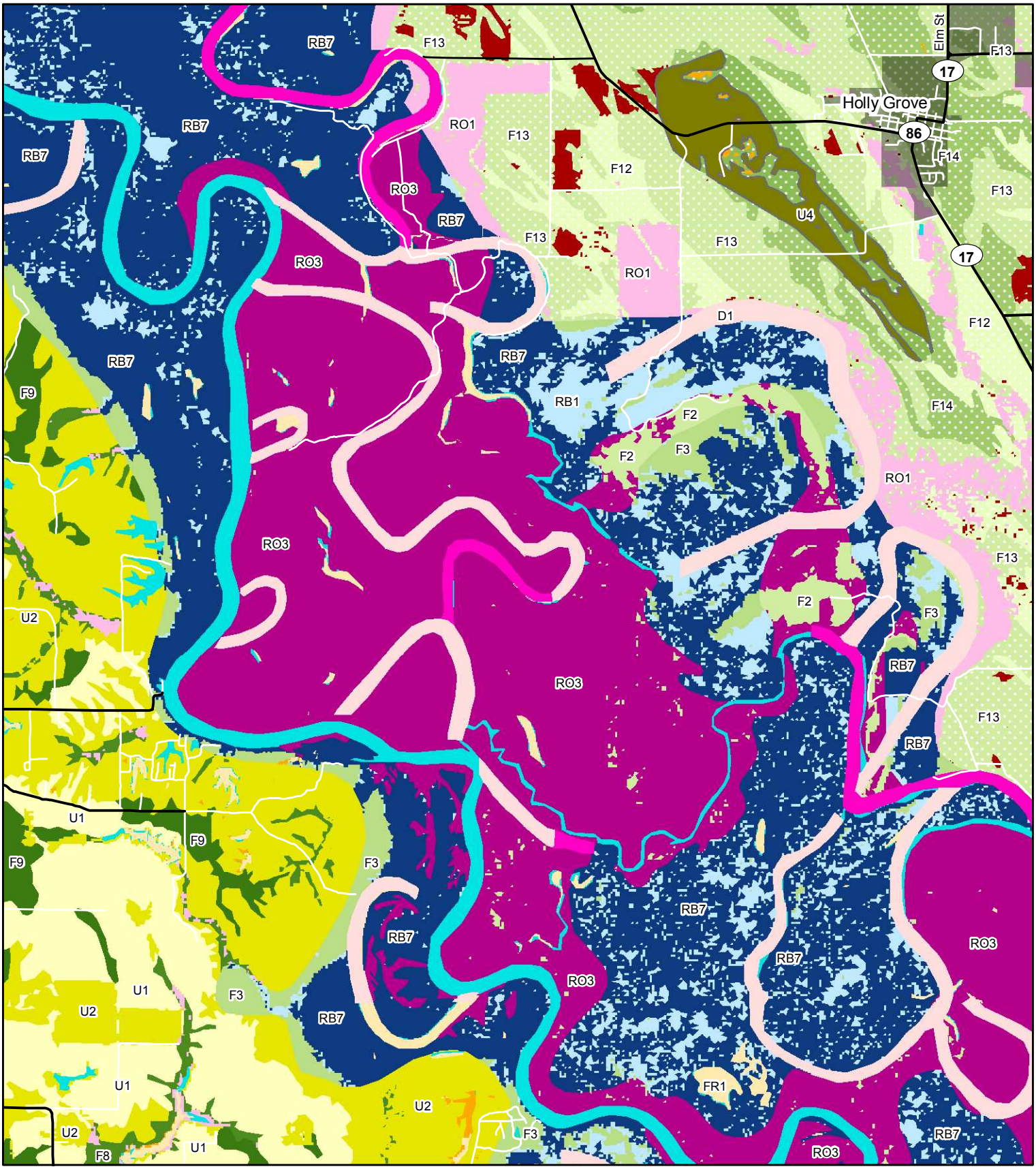
P8





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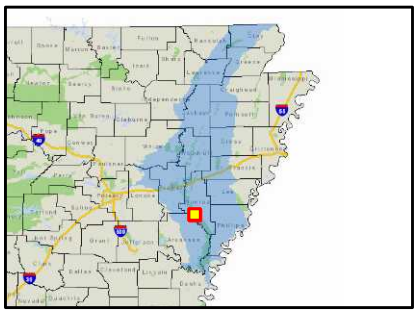

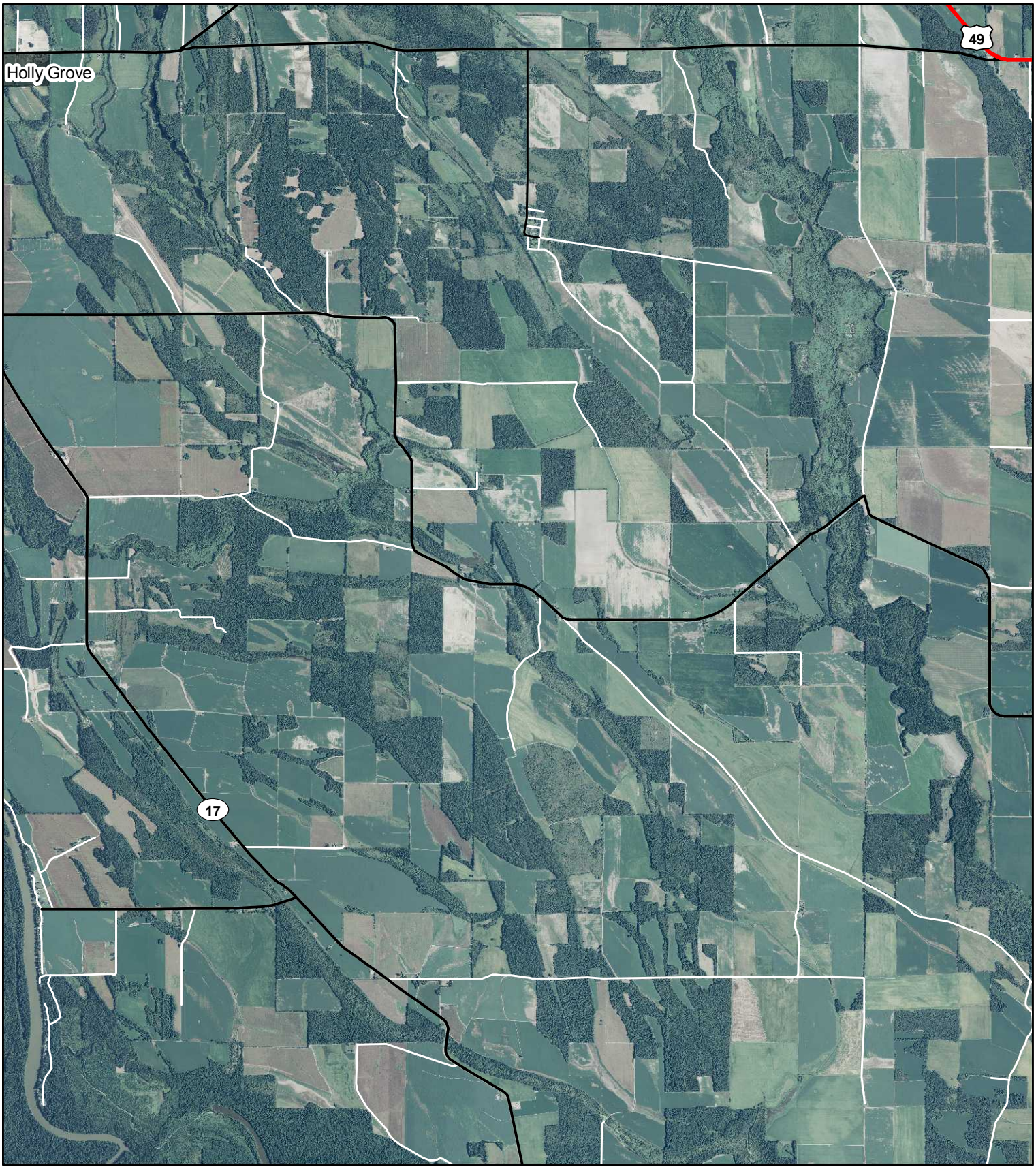

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P9

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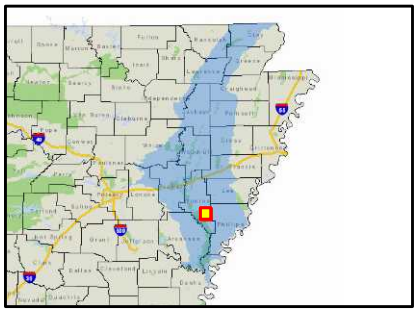

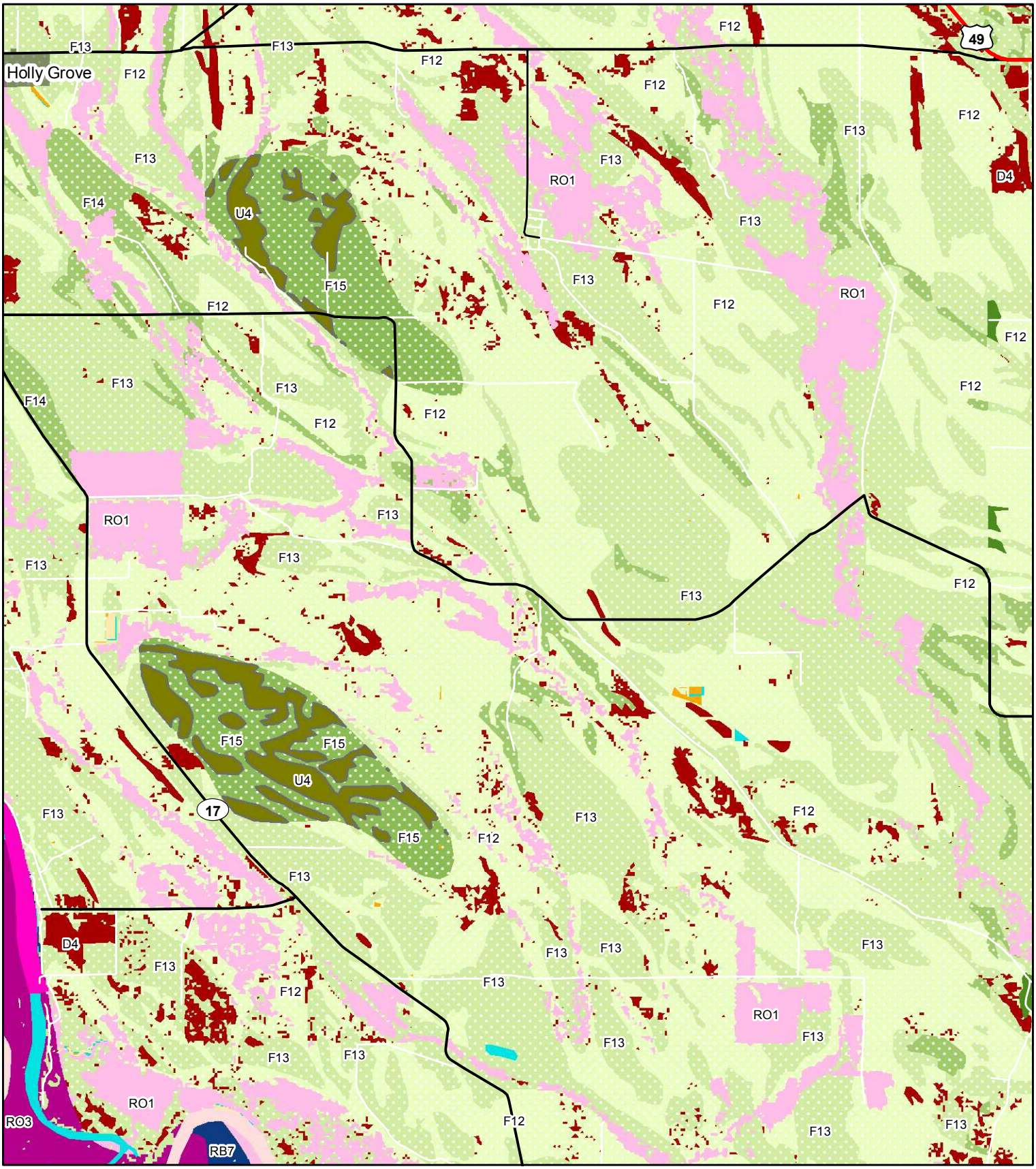

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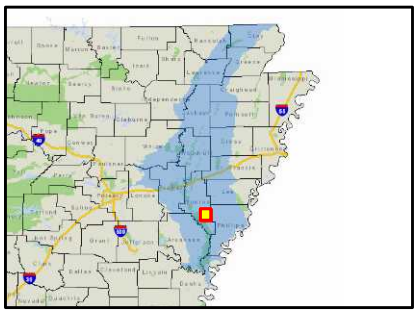

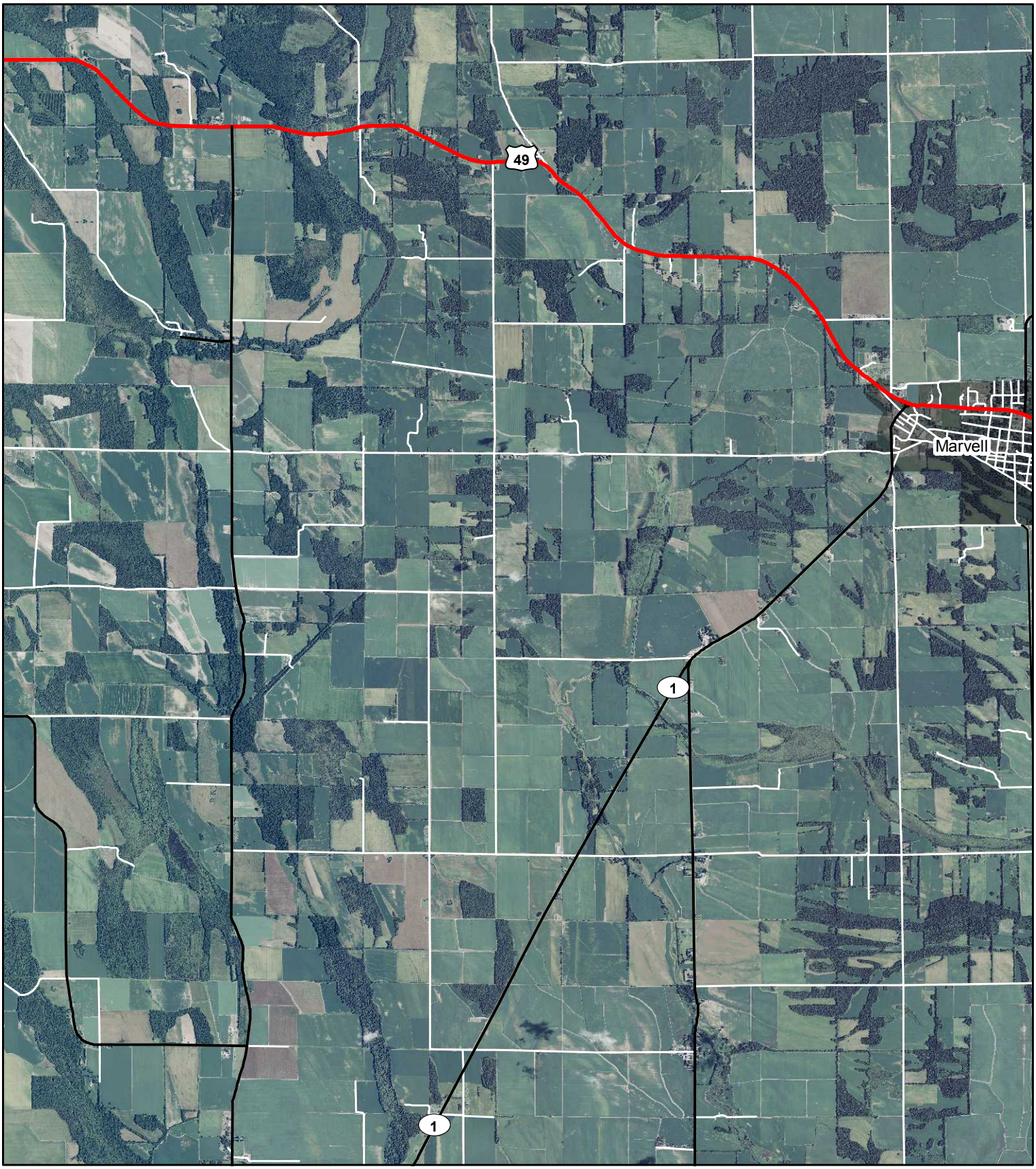

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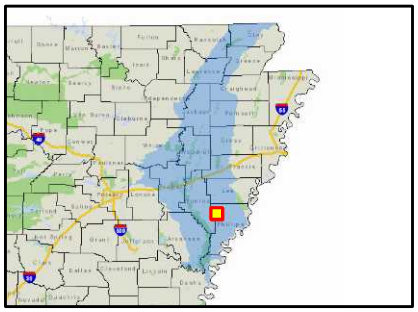

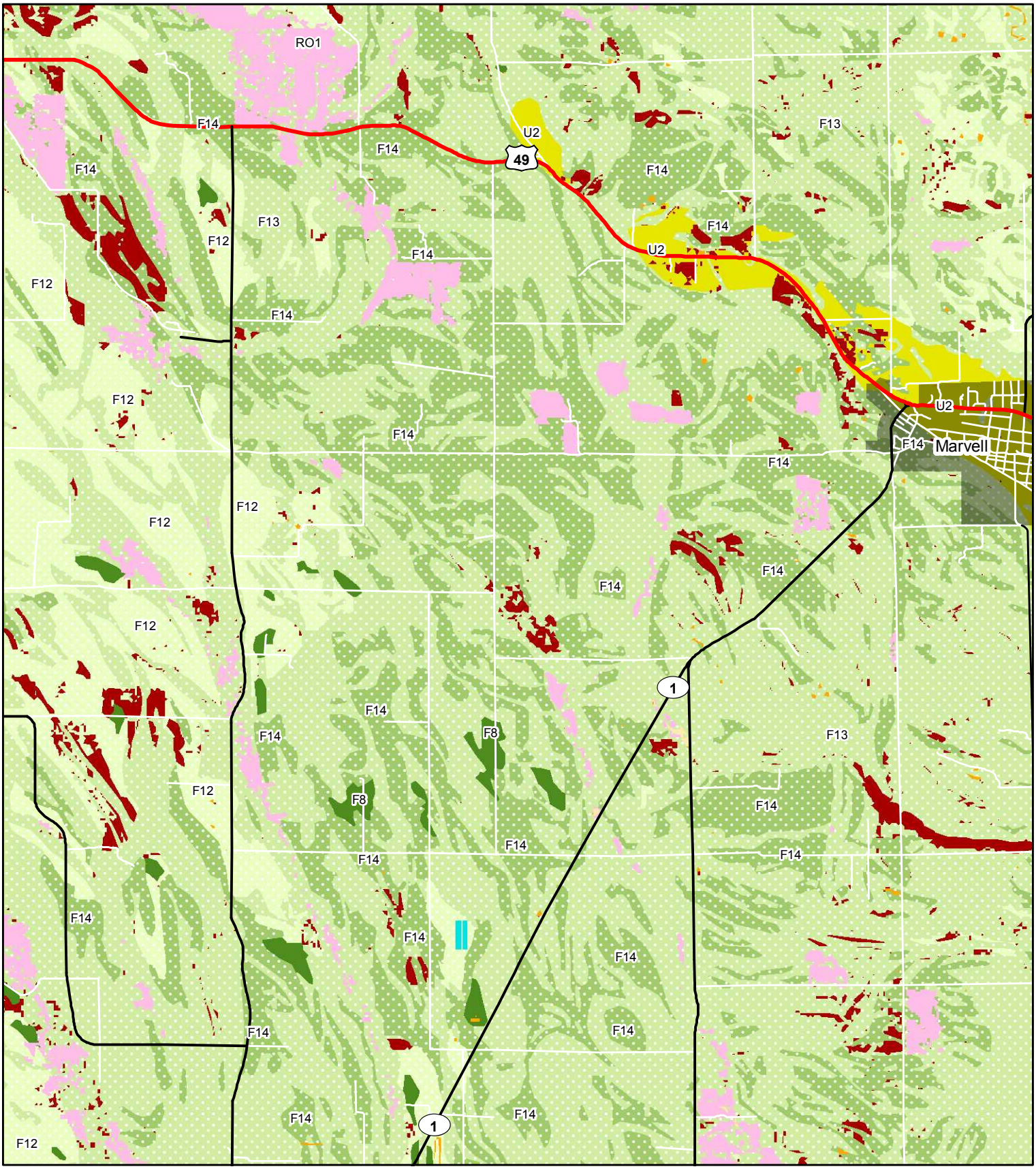

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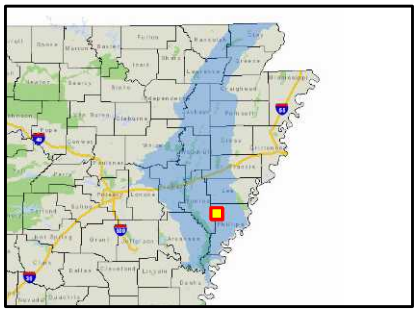

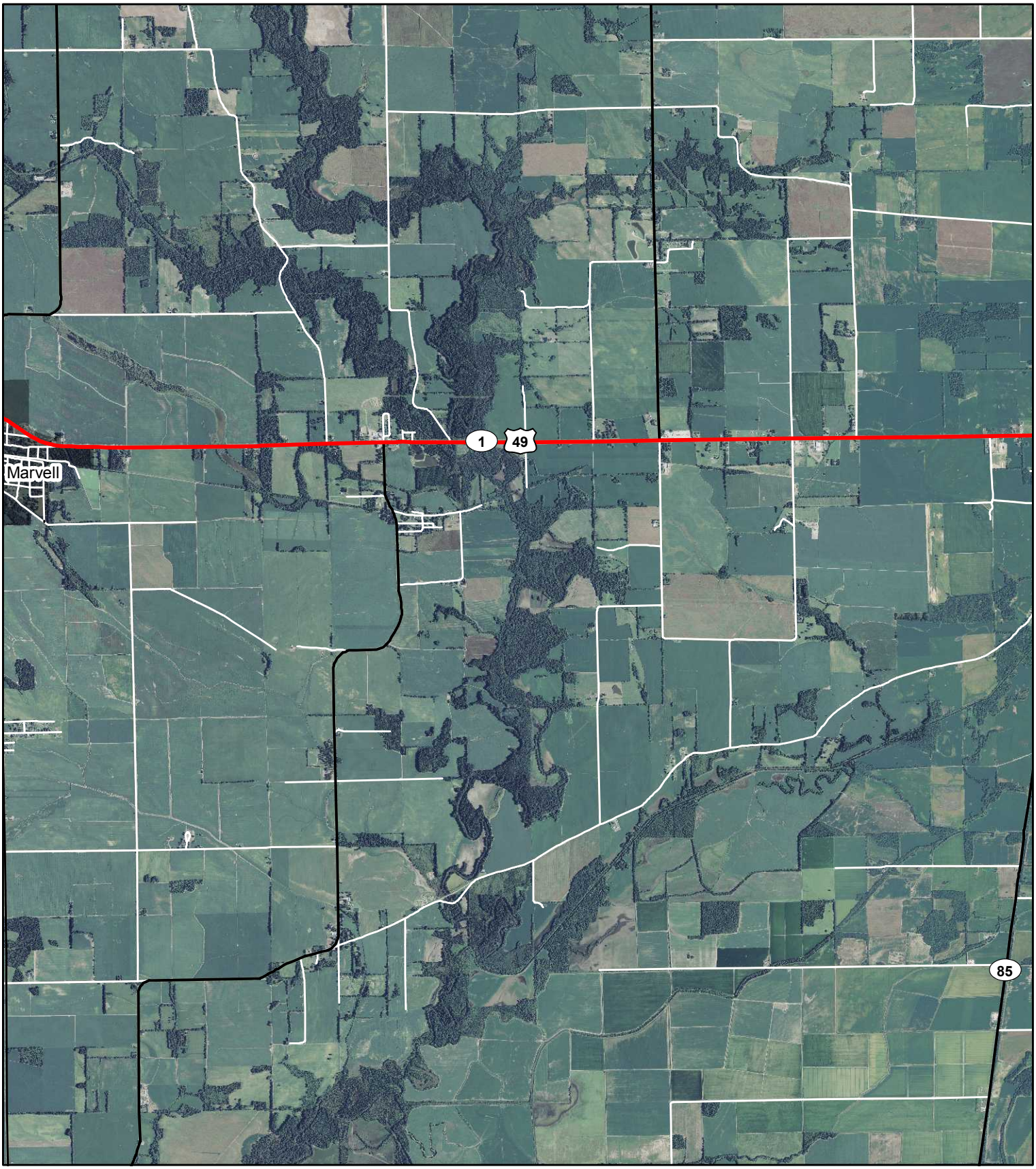

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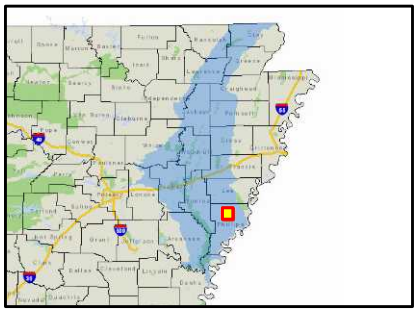

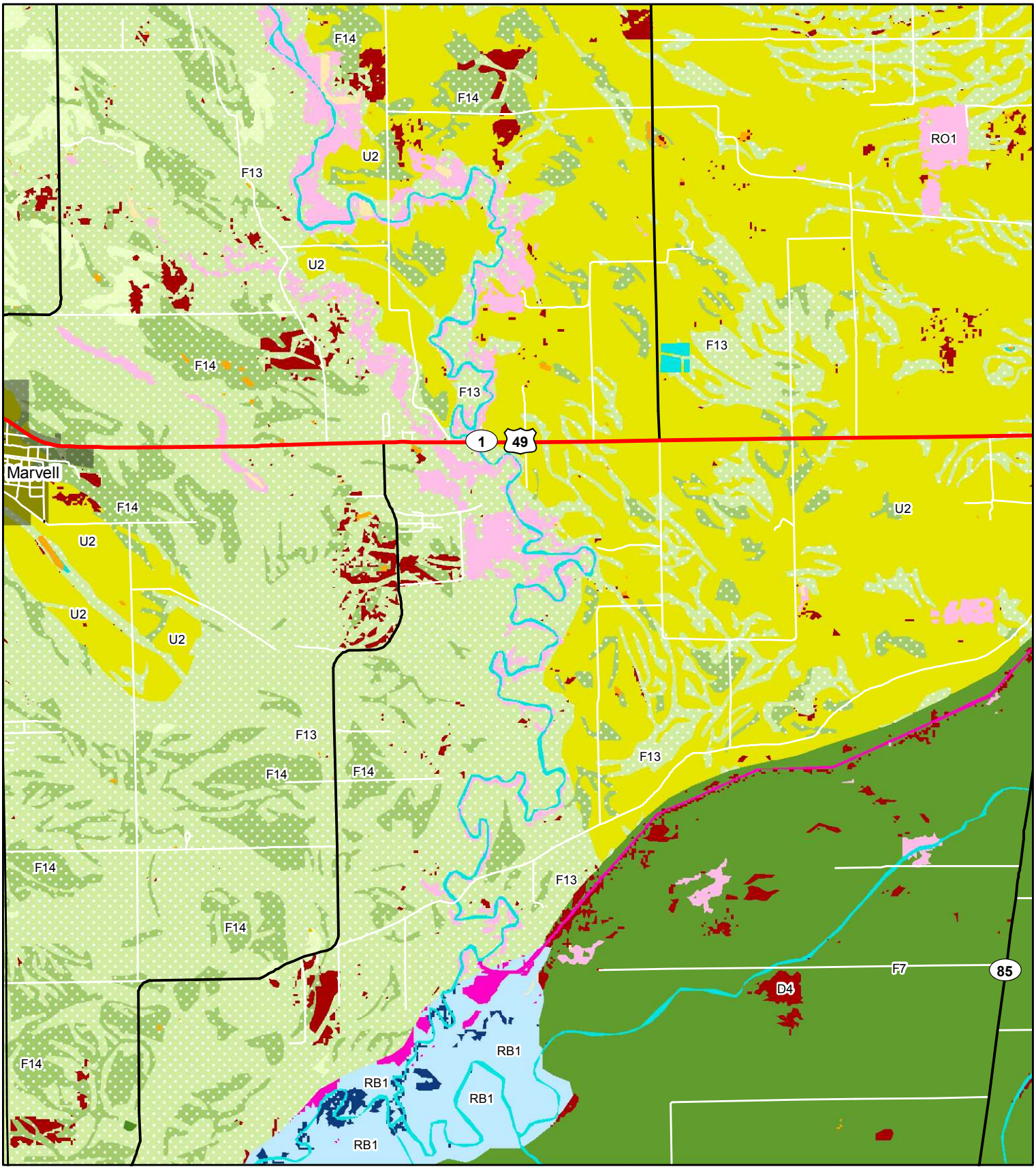

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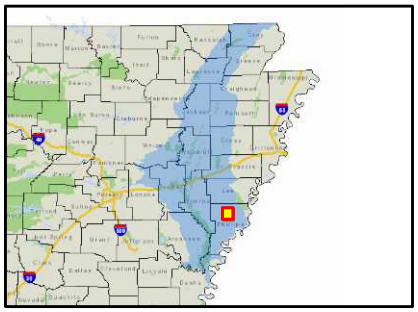

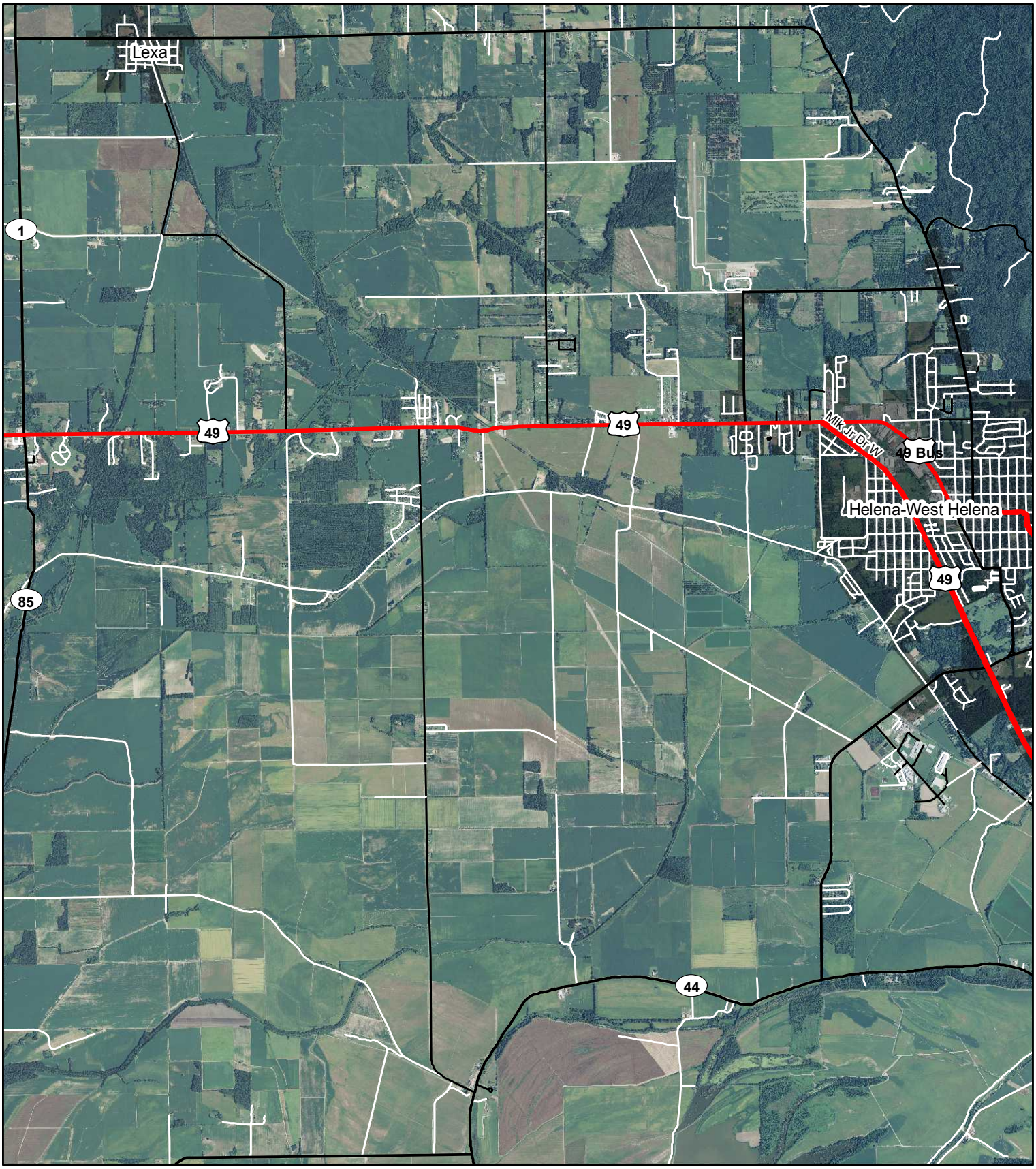

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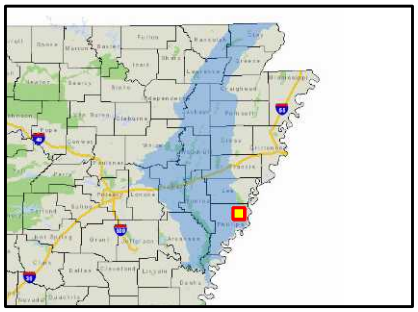

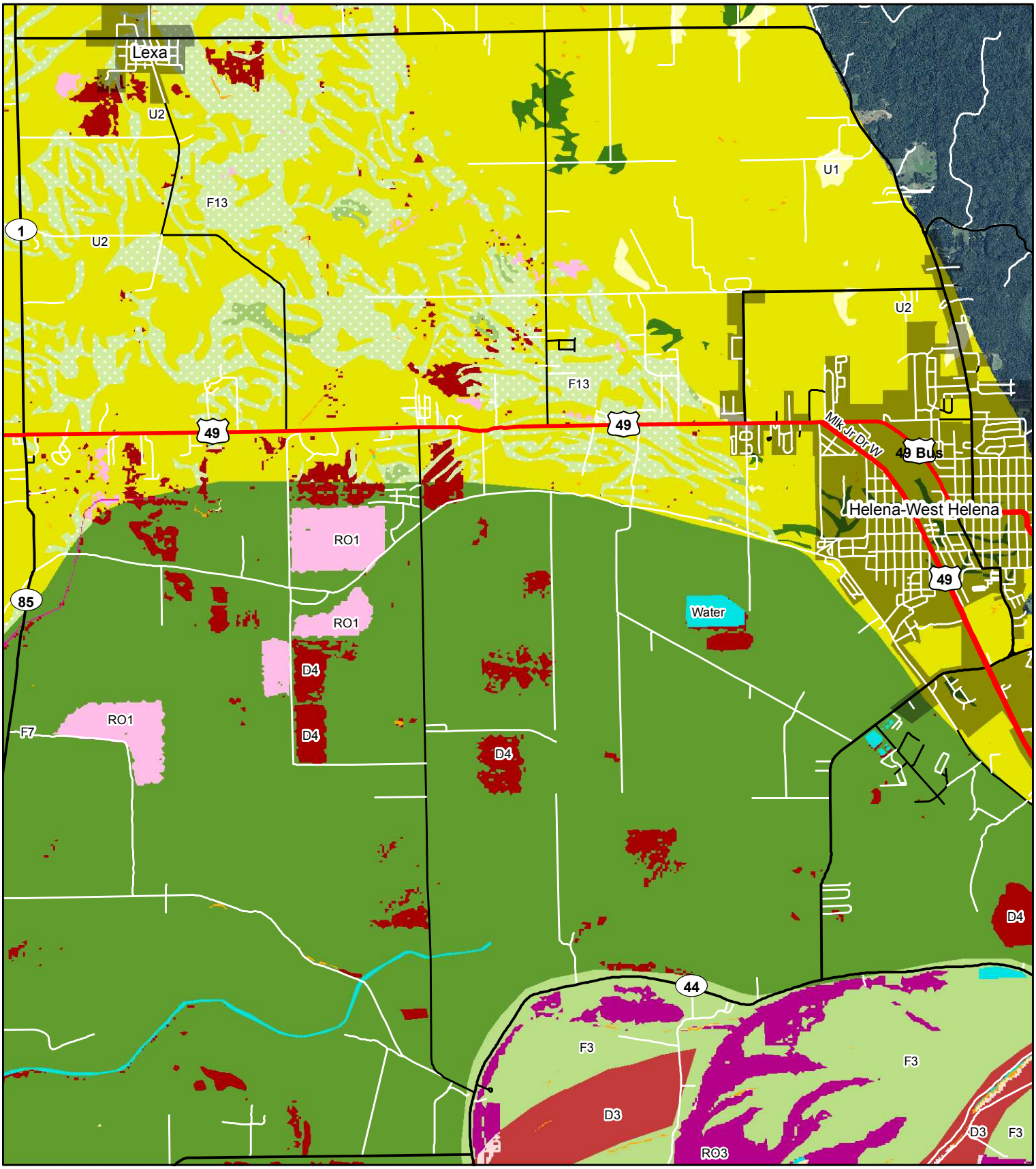

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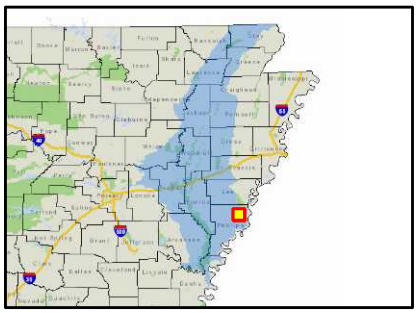

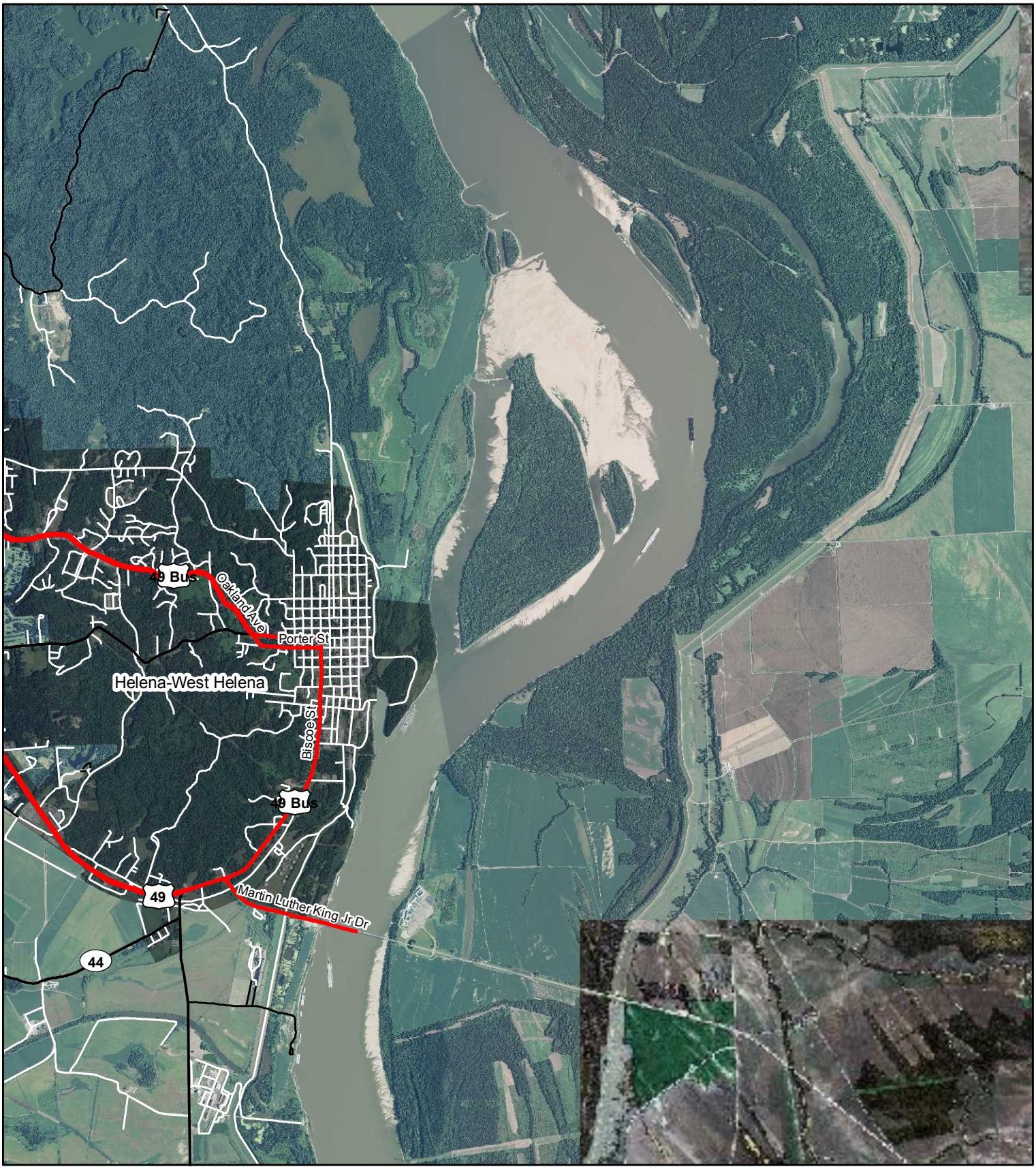

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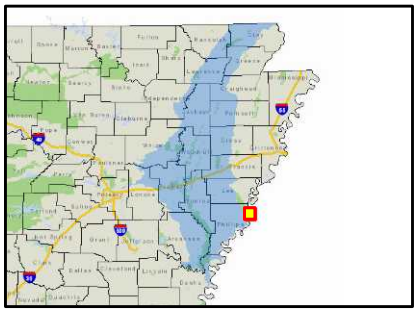

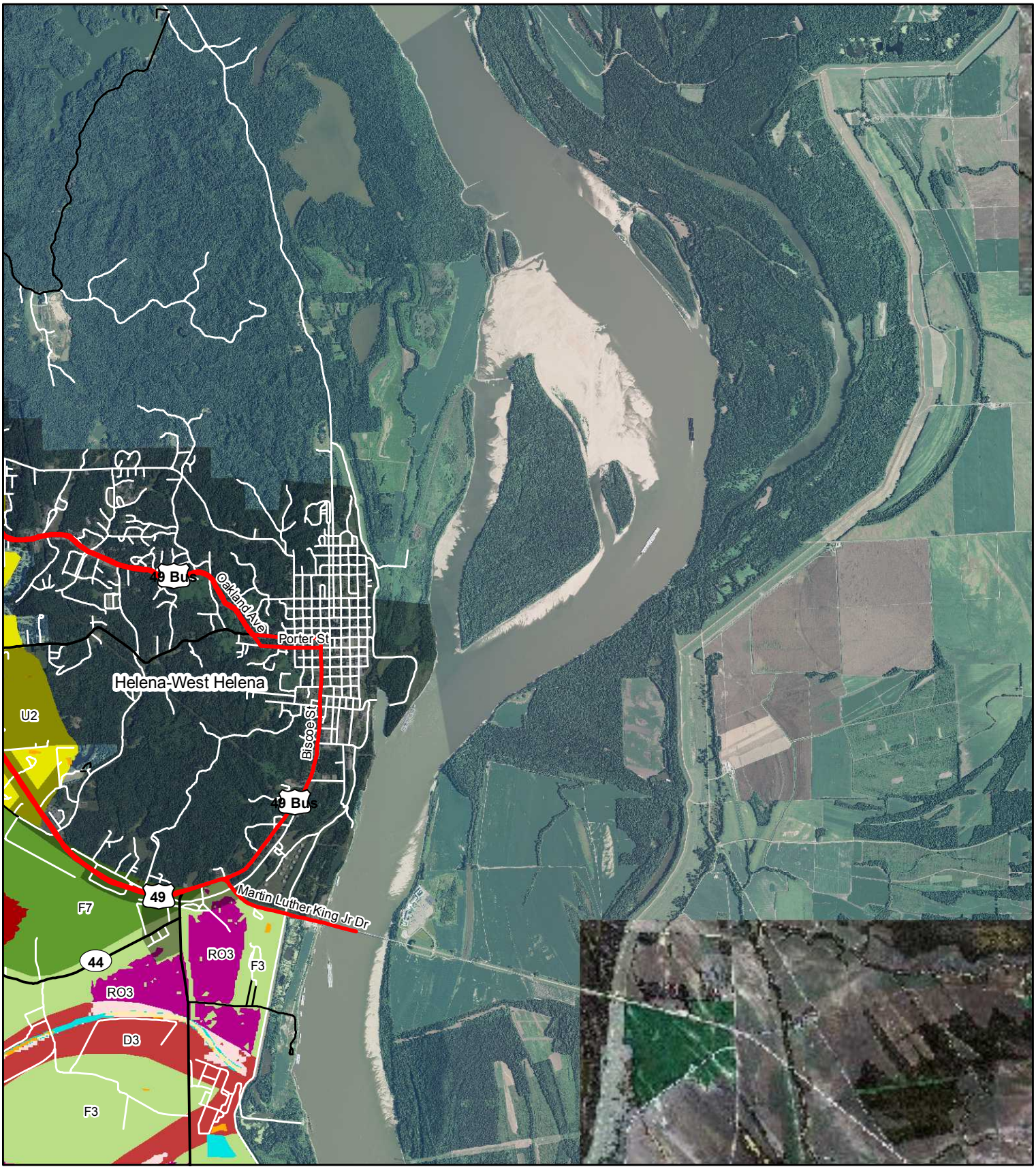

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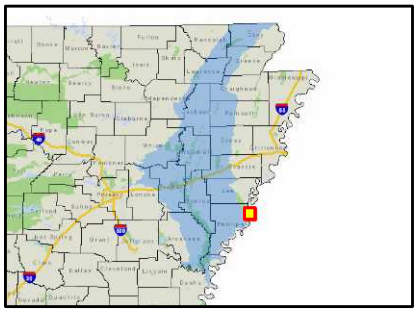

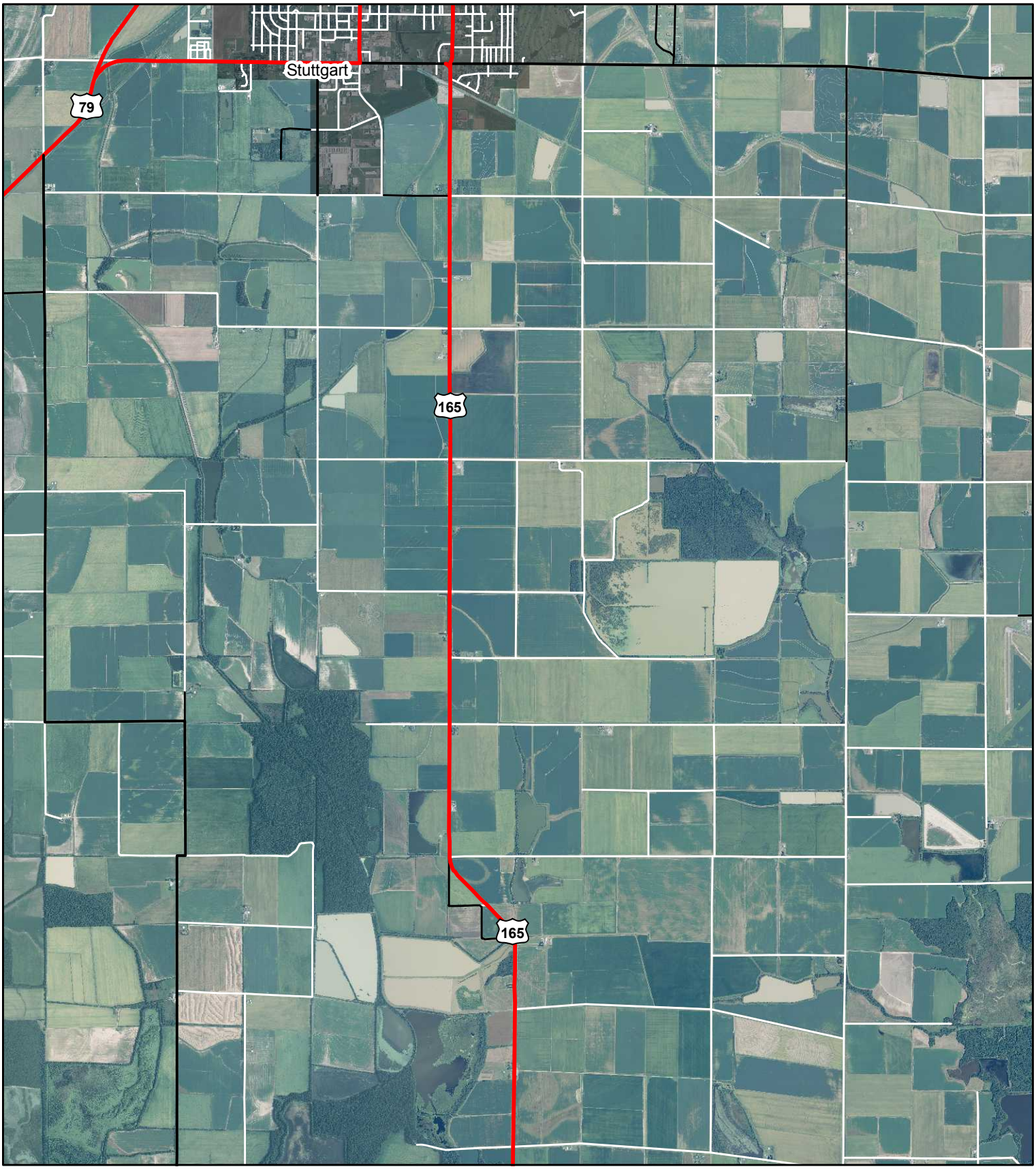

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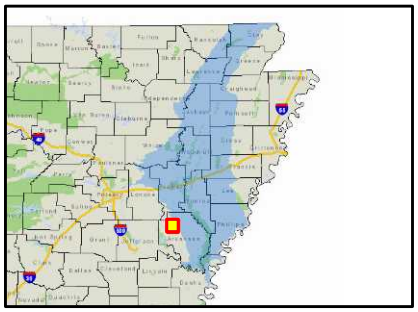
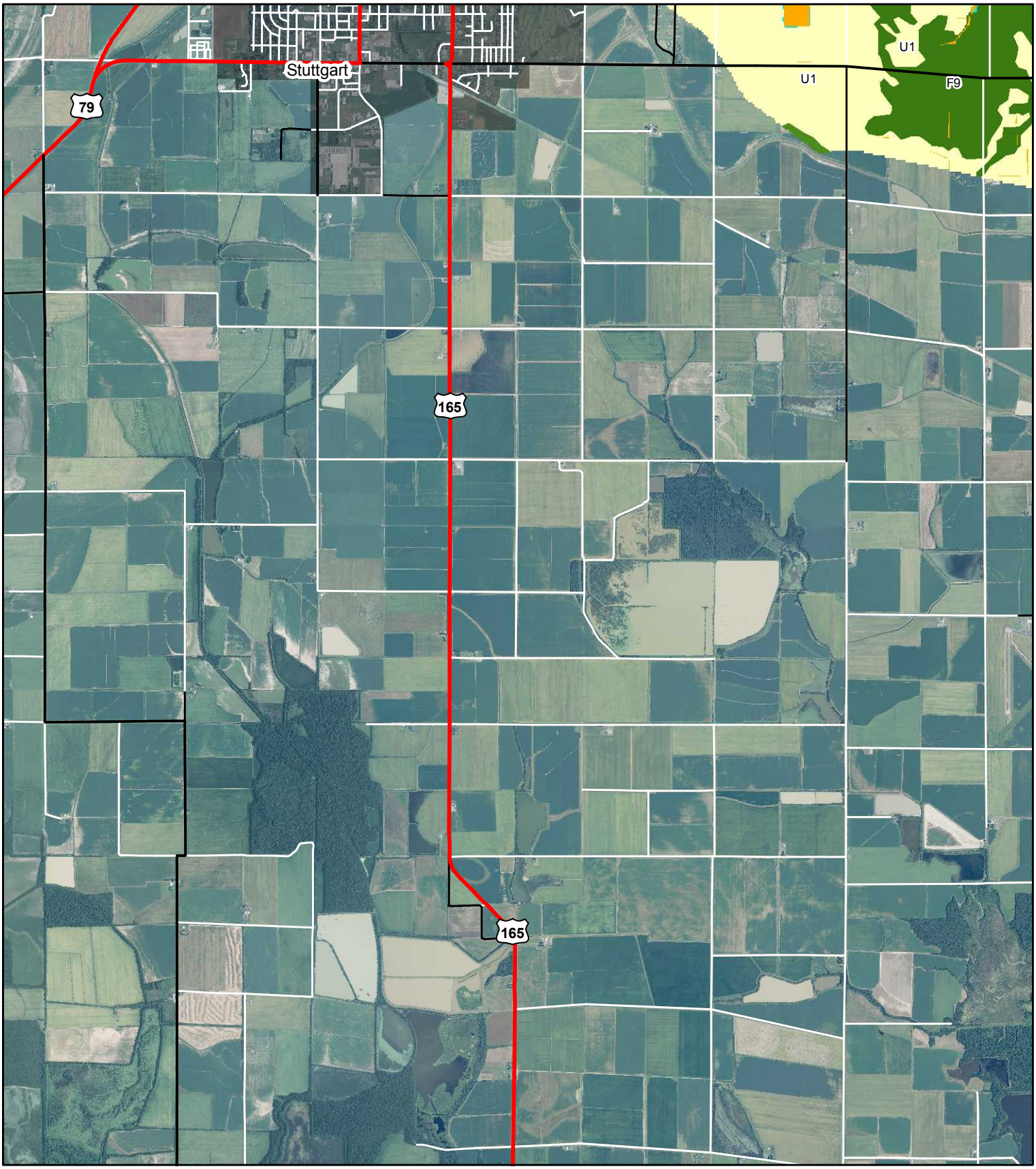
Datum: North American 1983

Q6





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Projection: Transverse Mercator
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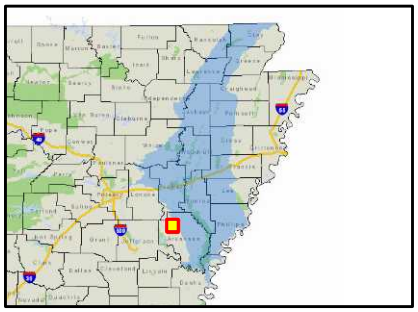
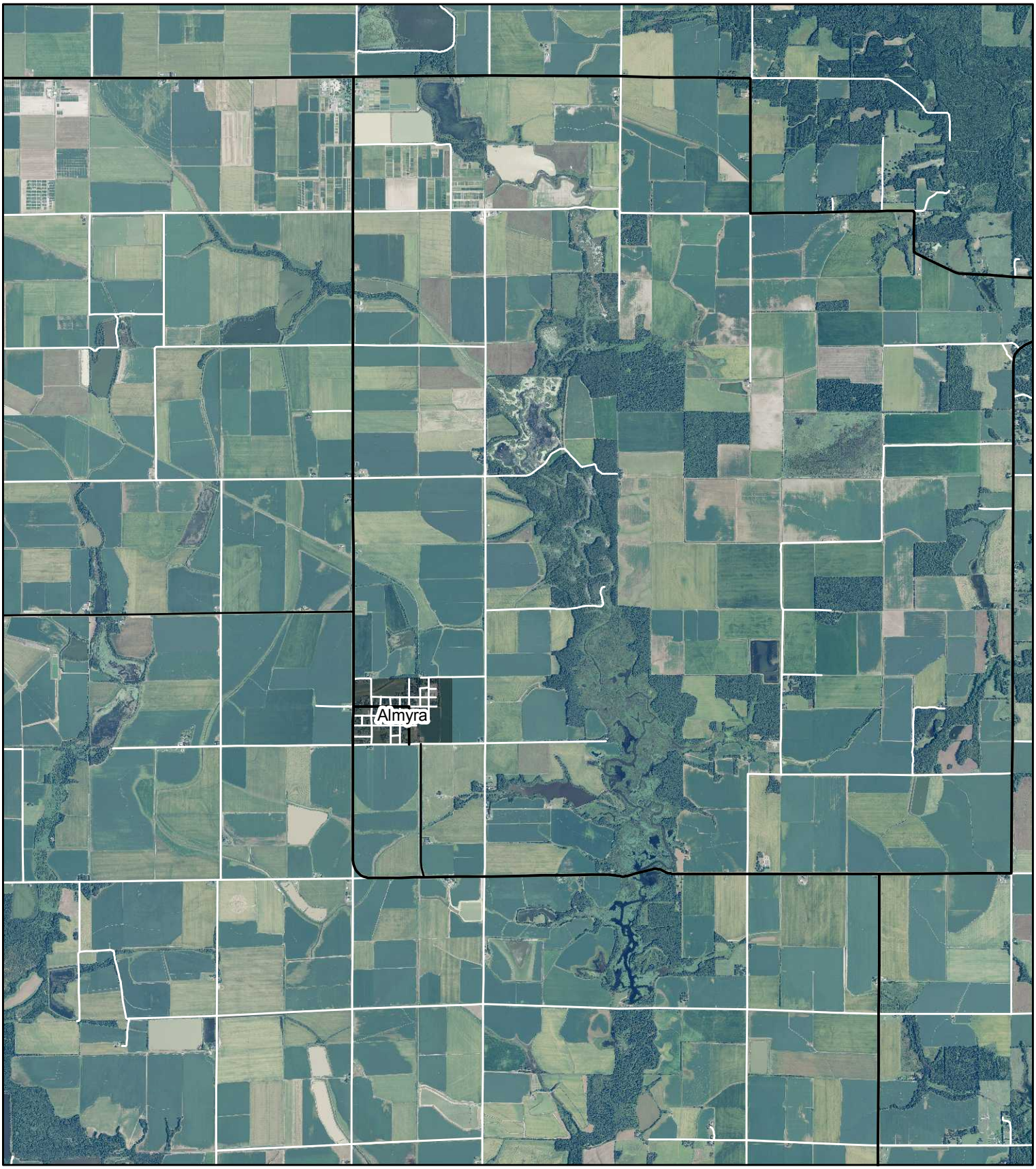
Q6





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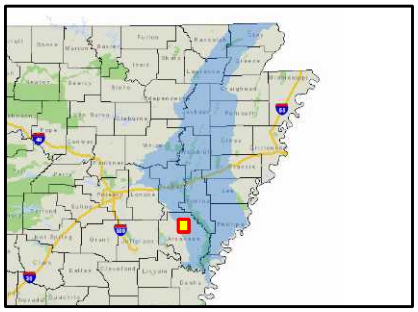

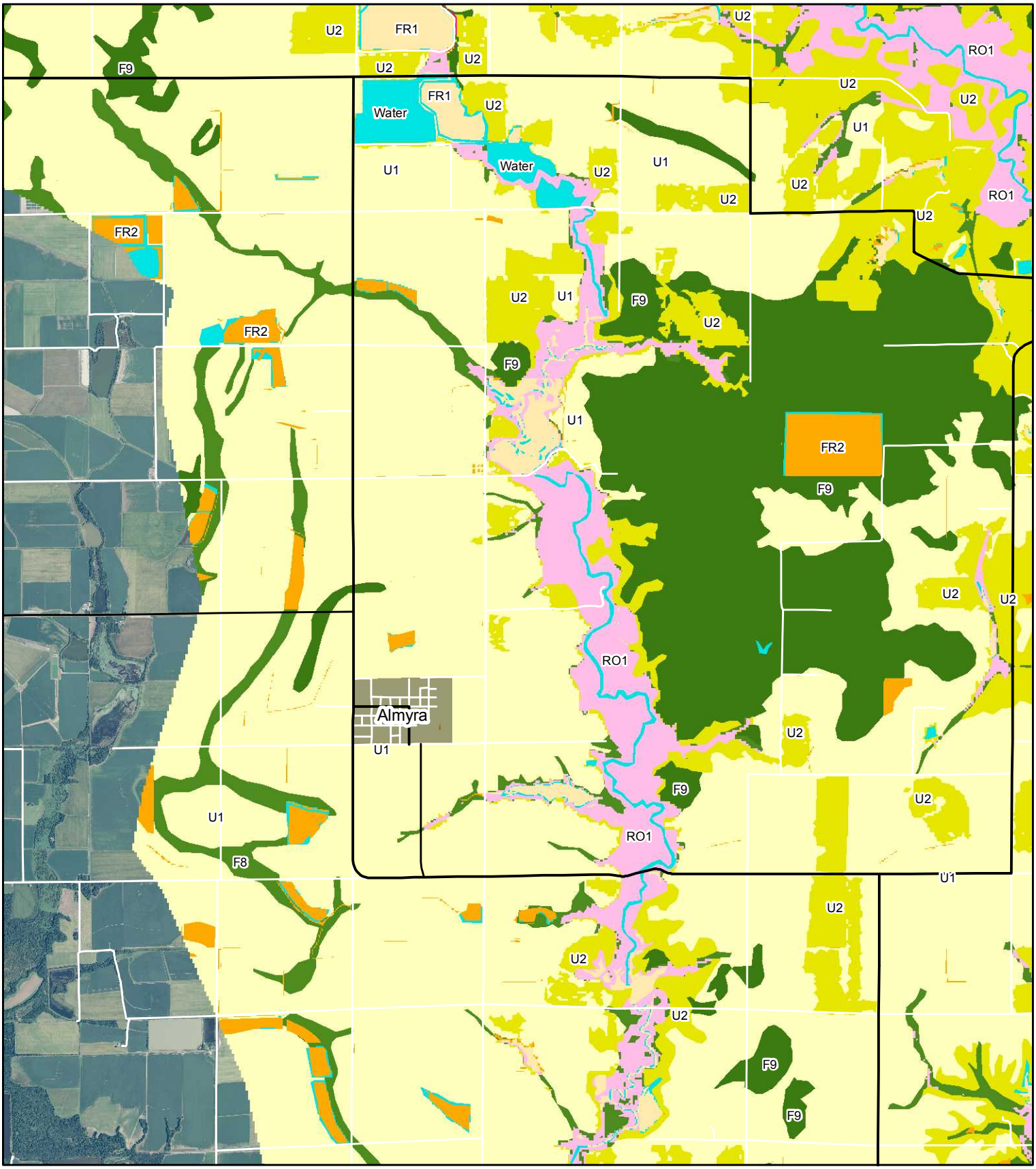

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Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

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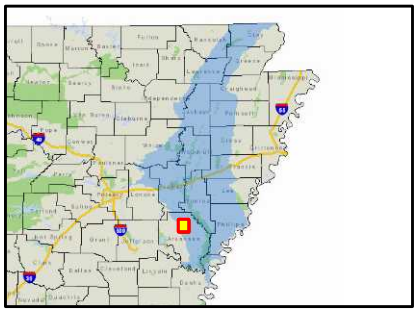

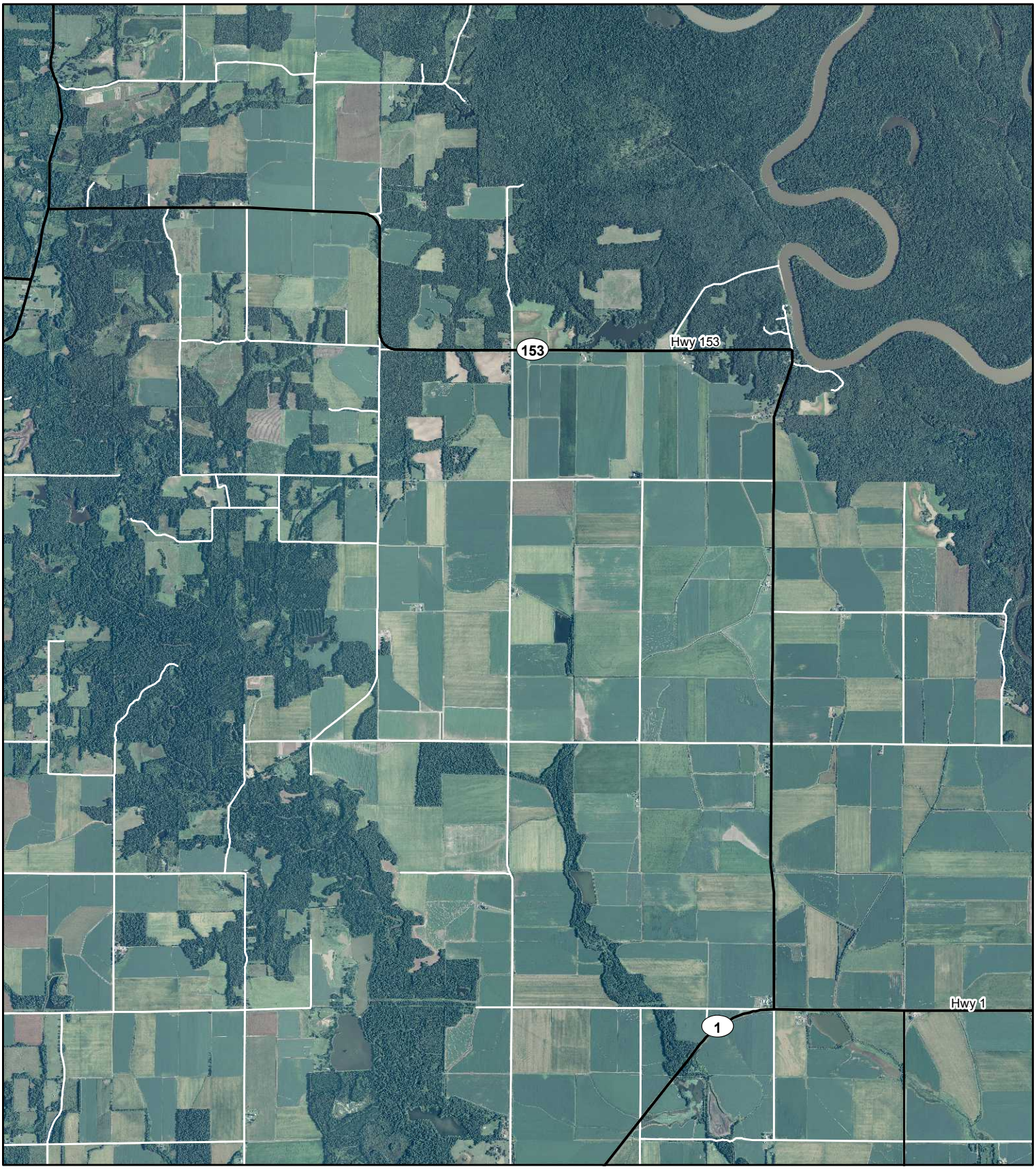

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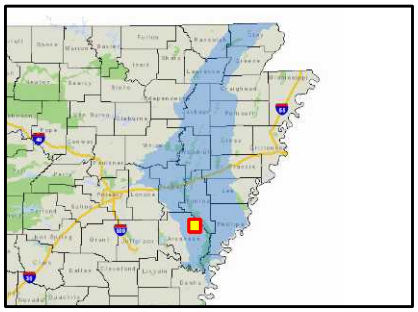

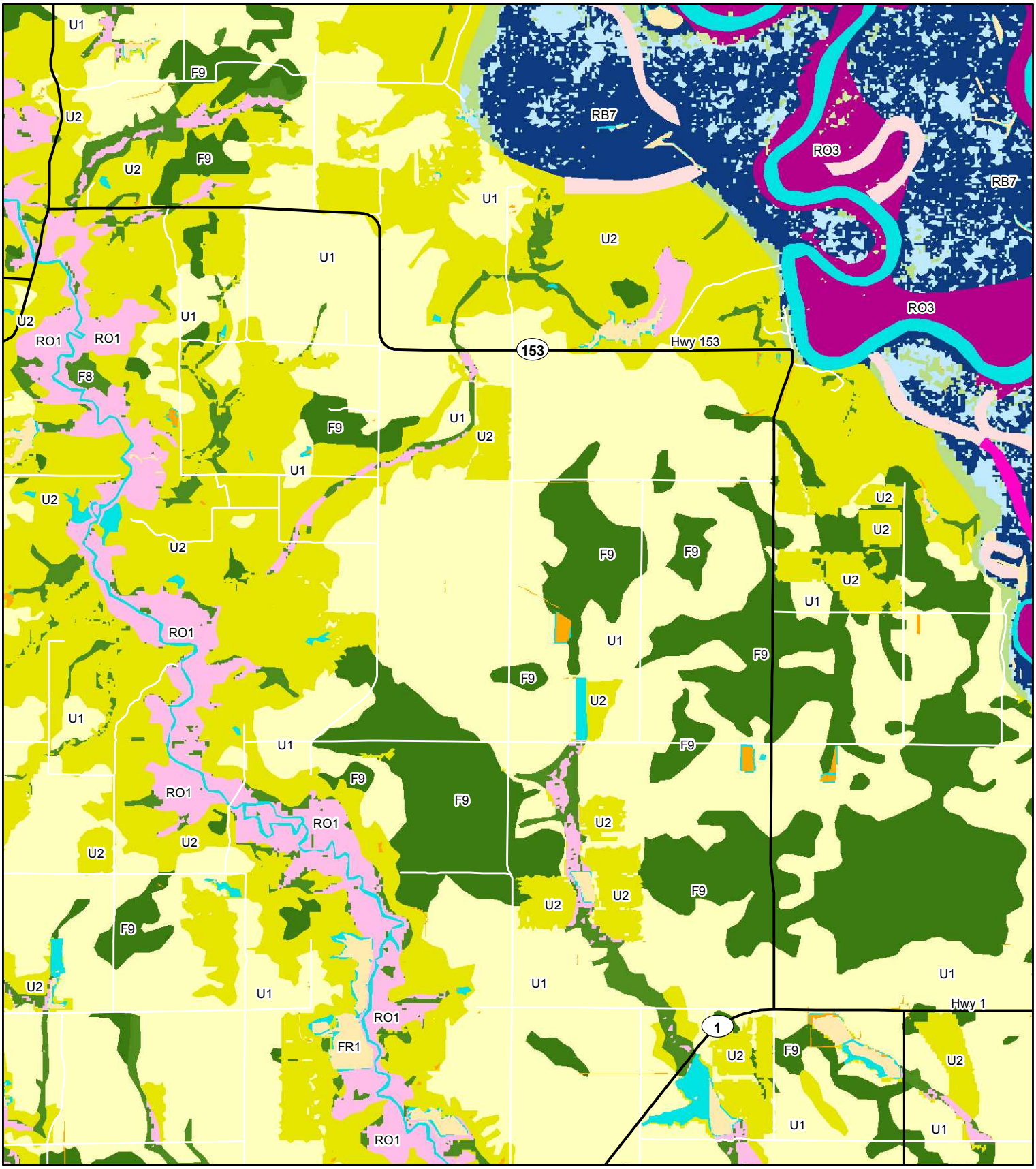

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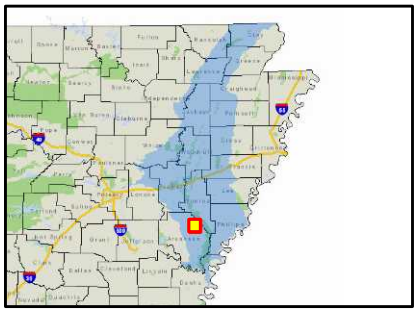

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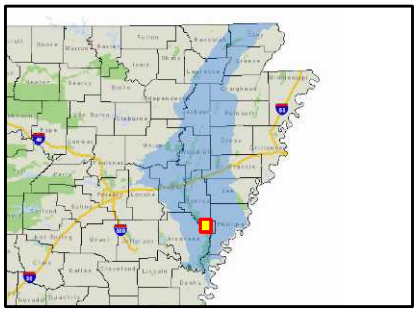

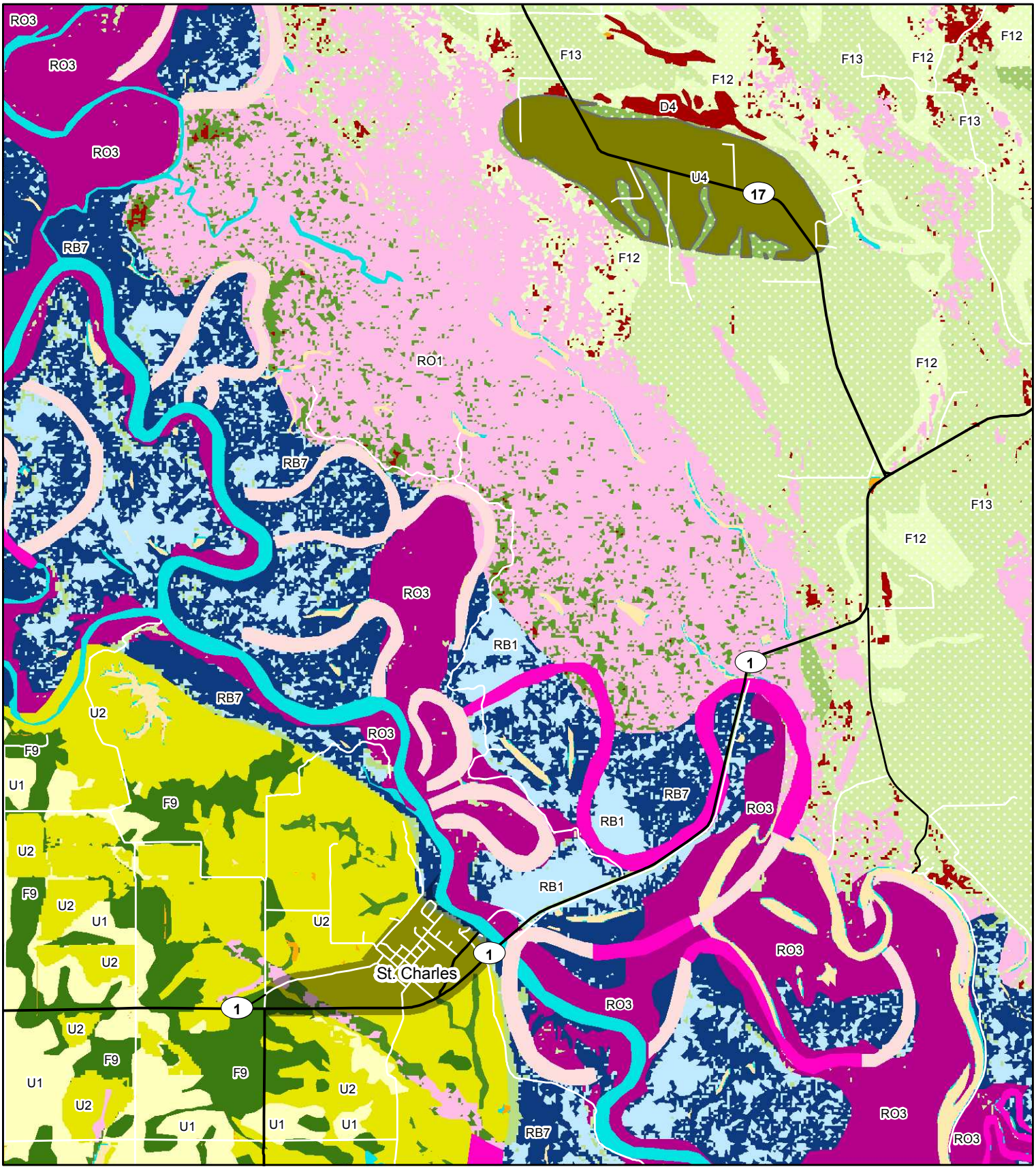

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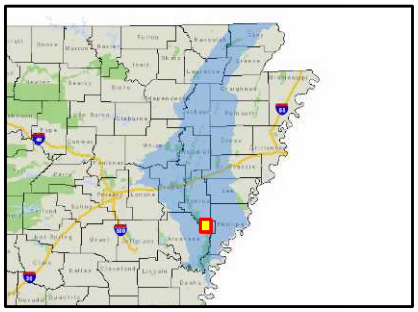

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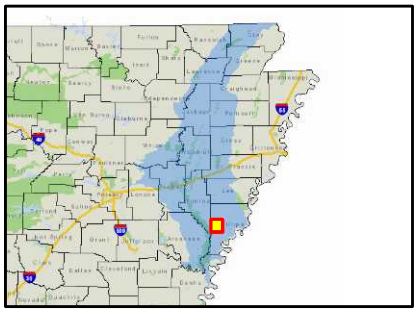

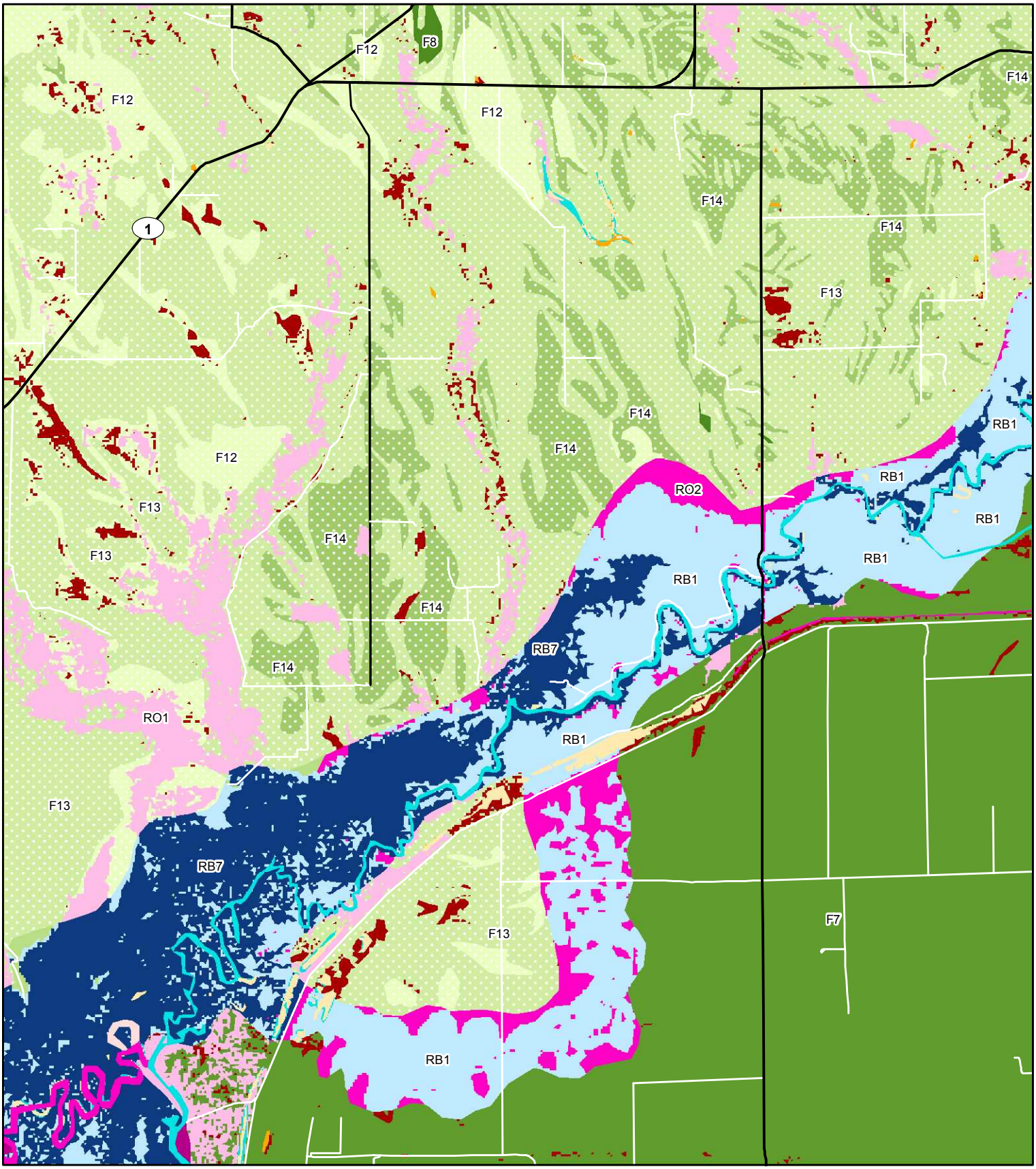

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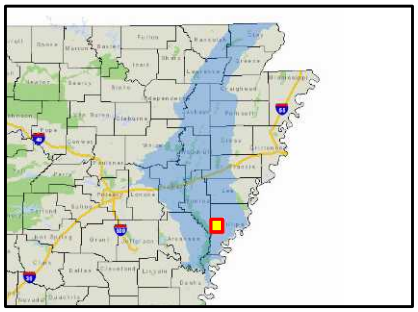

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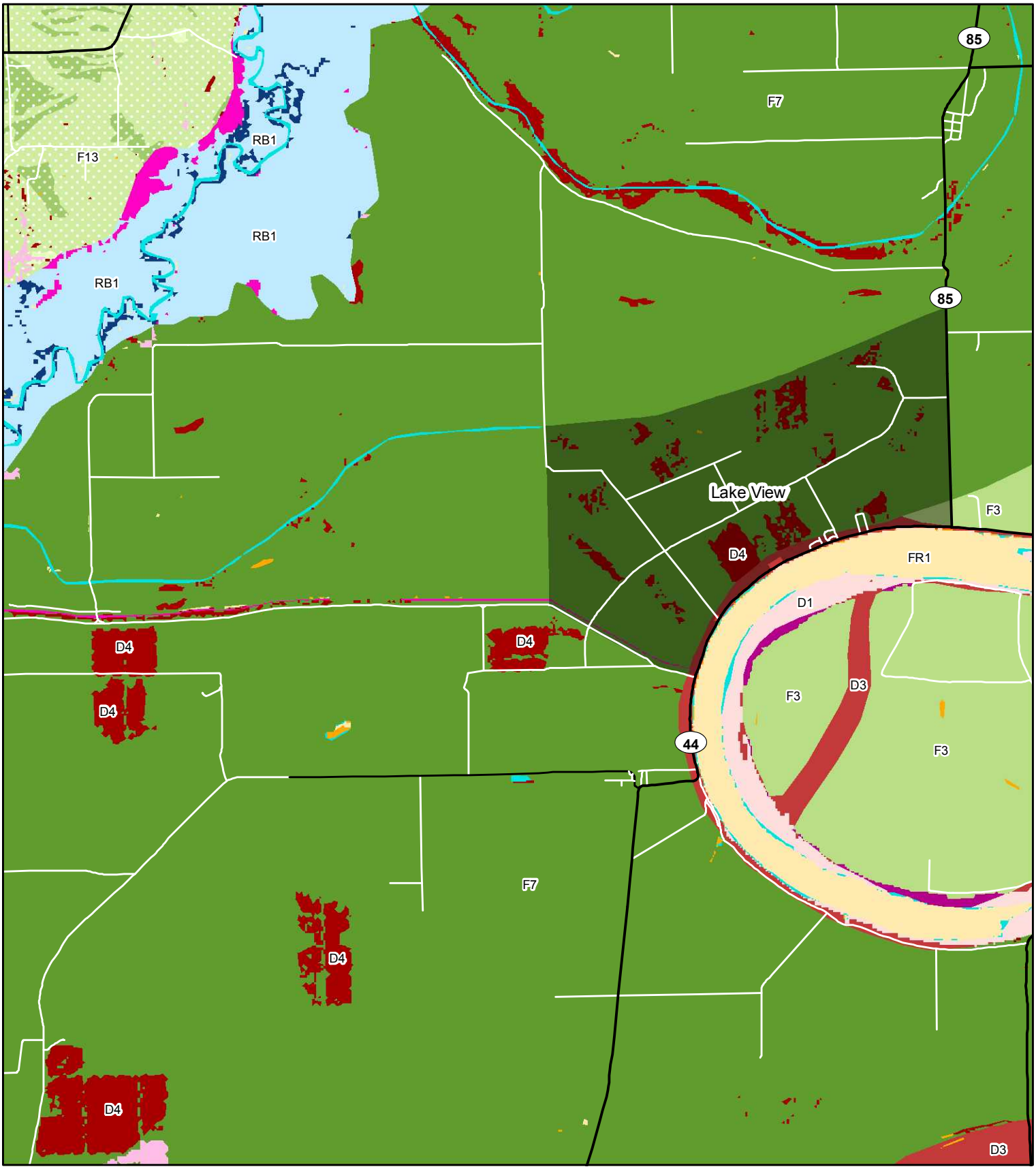

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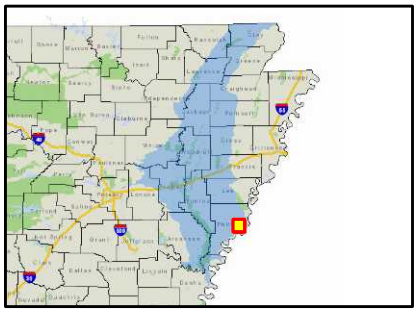

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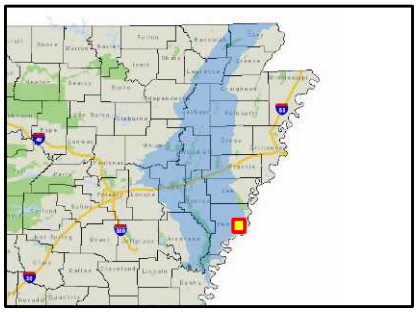

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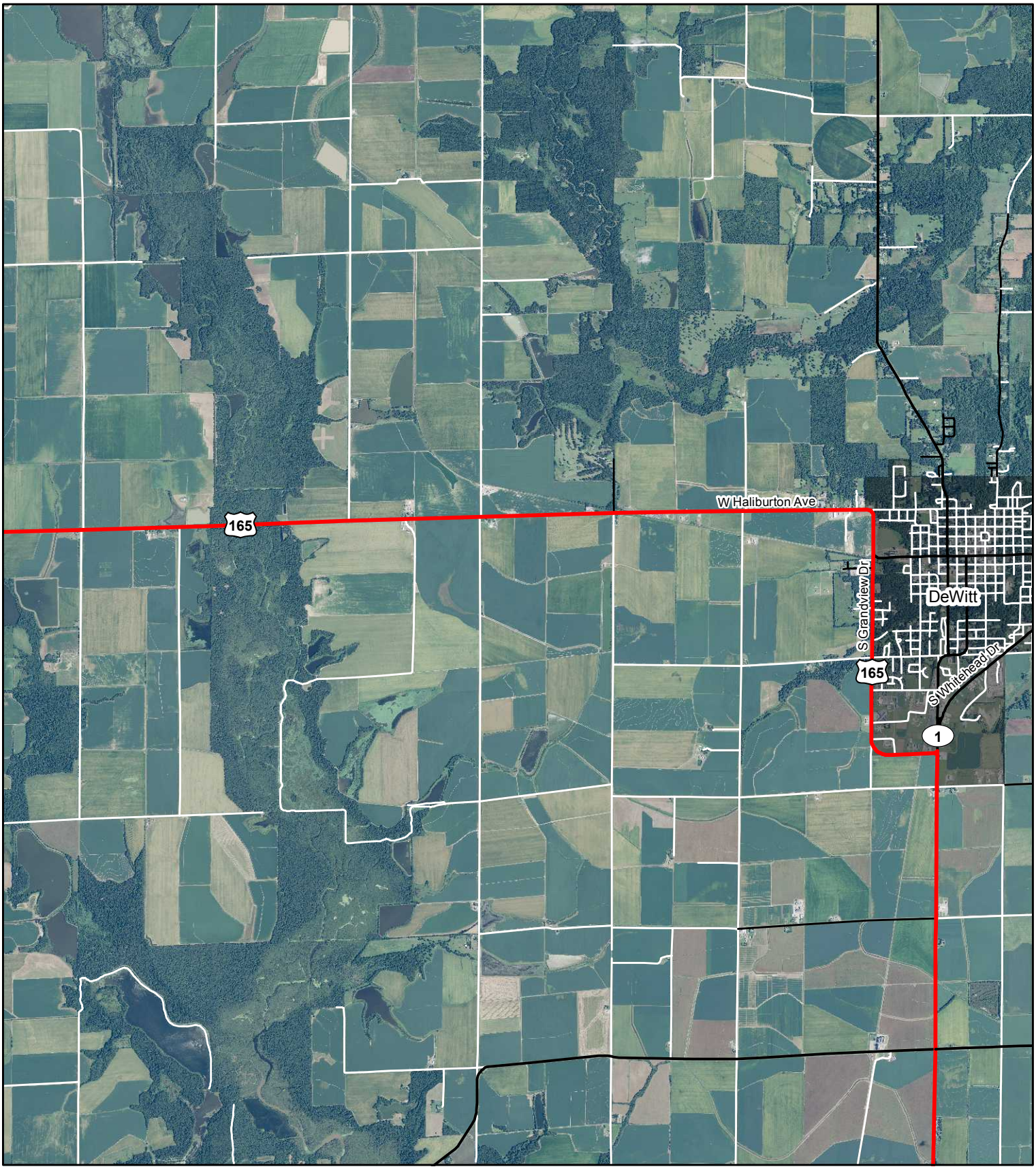
Q13



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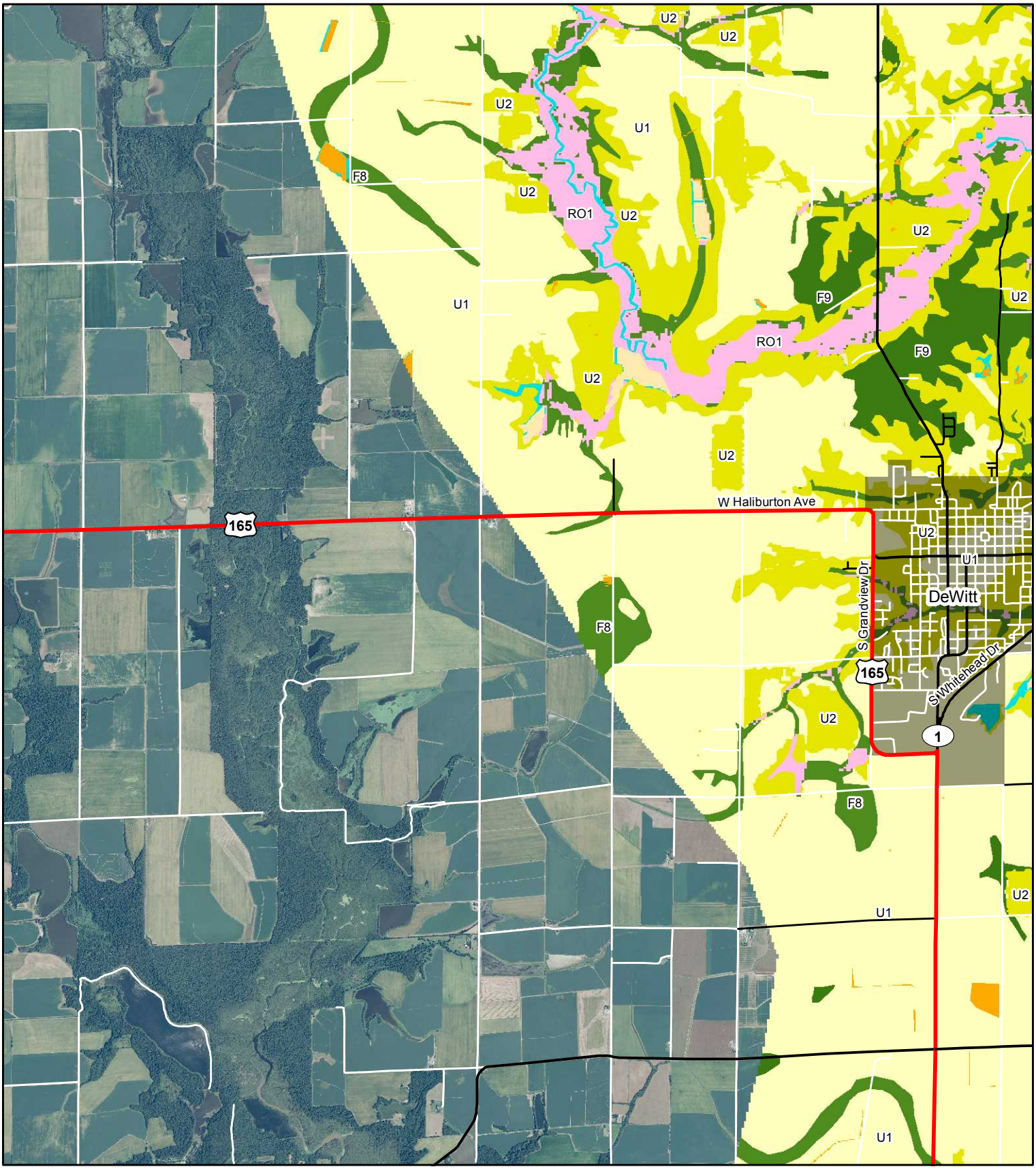
R7



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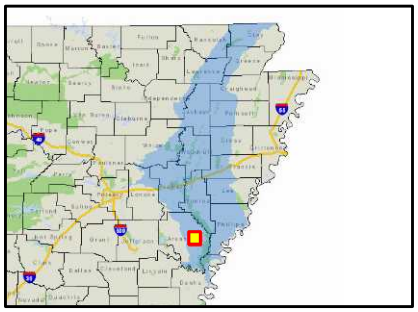
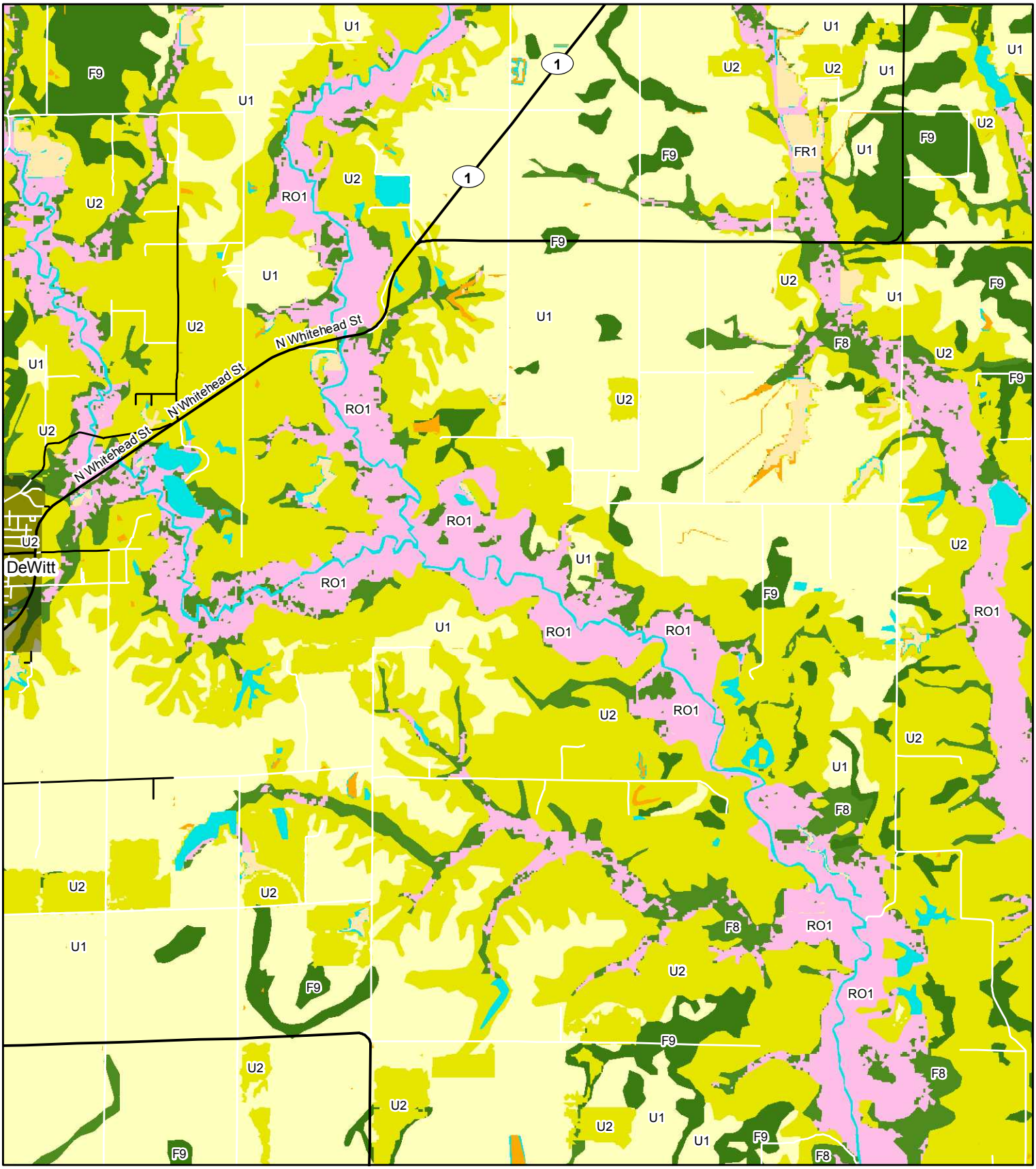
R8





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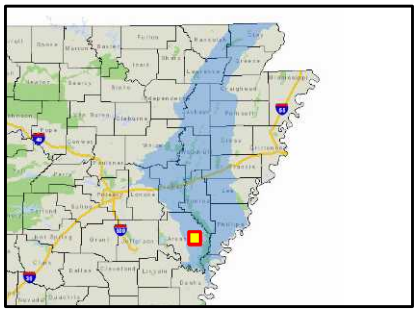

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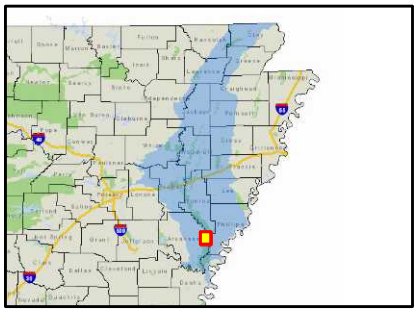

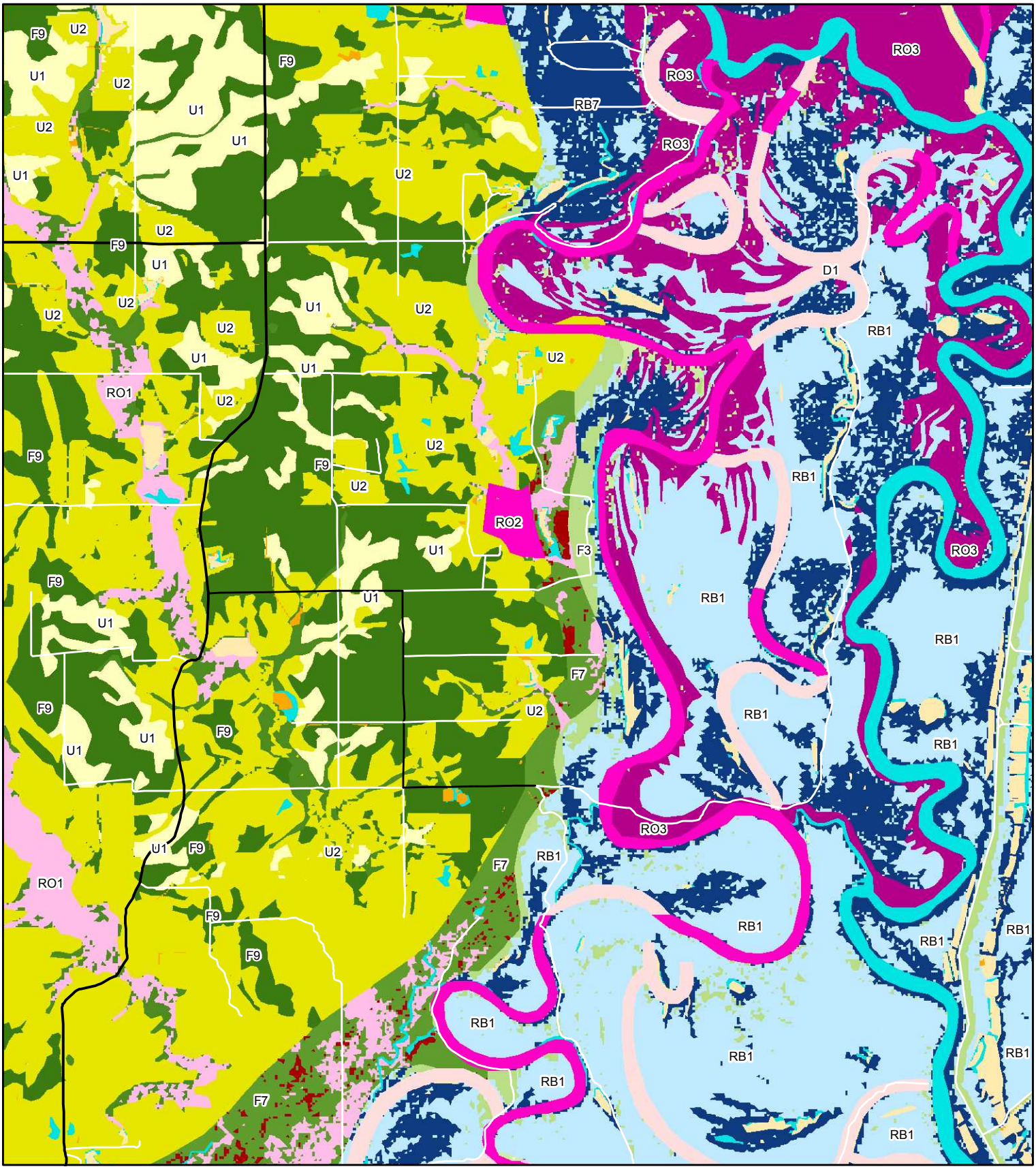

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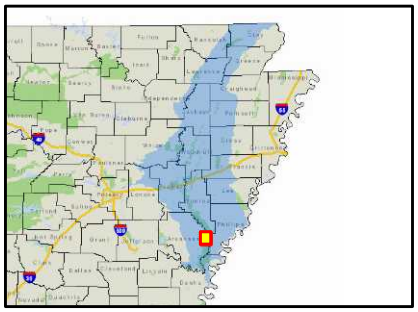

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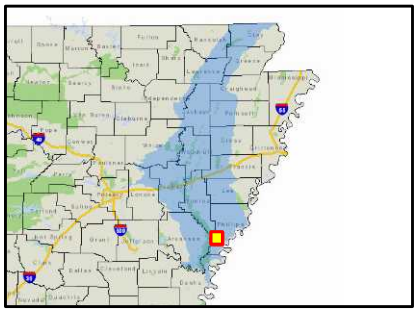

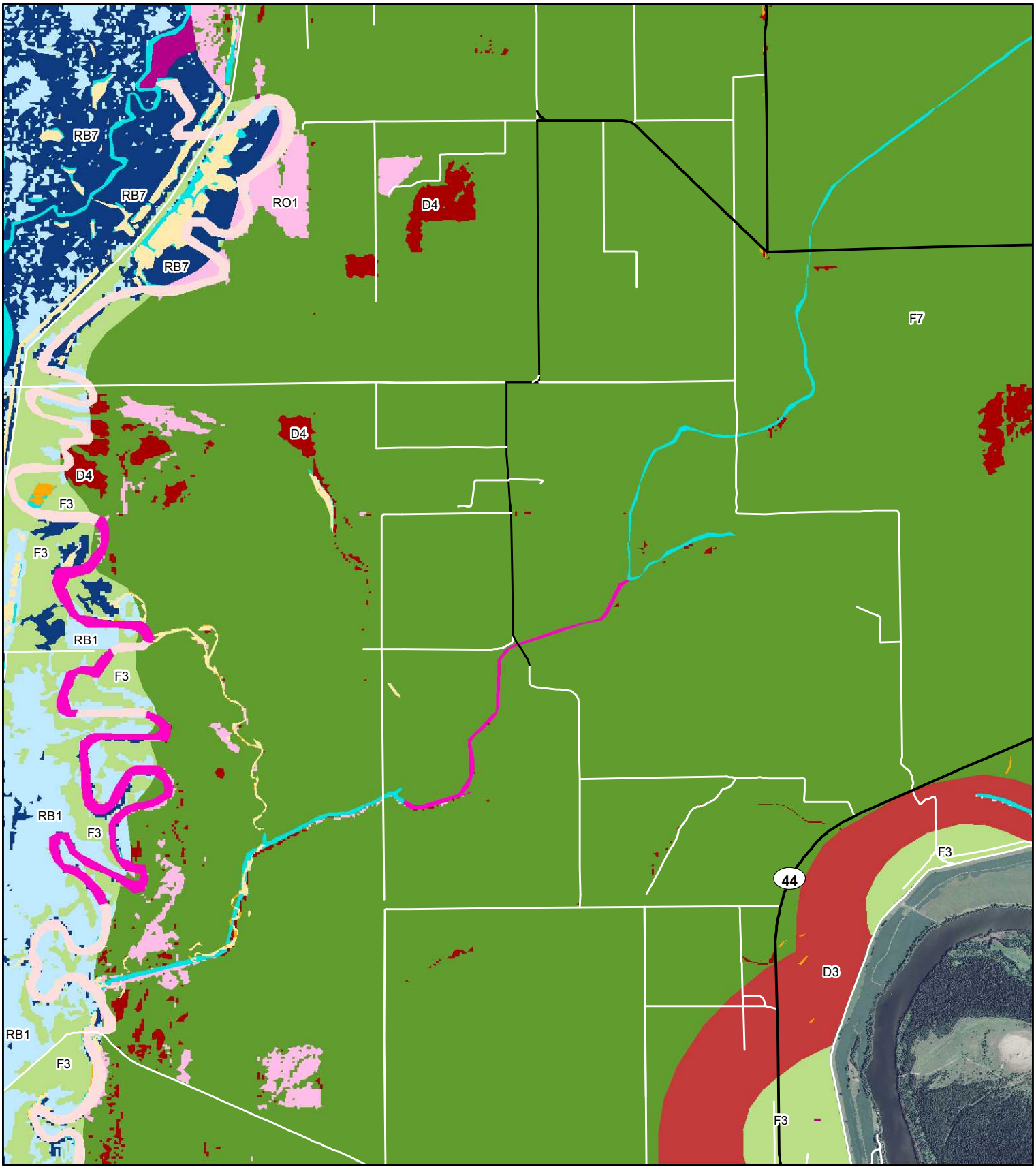

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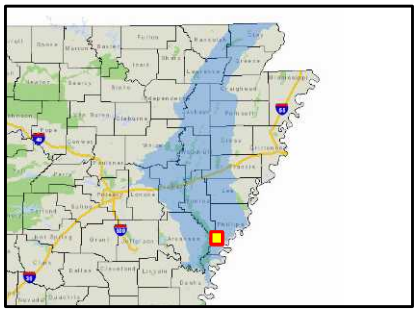

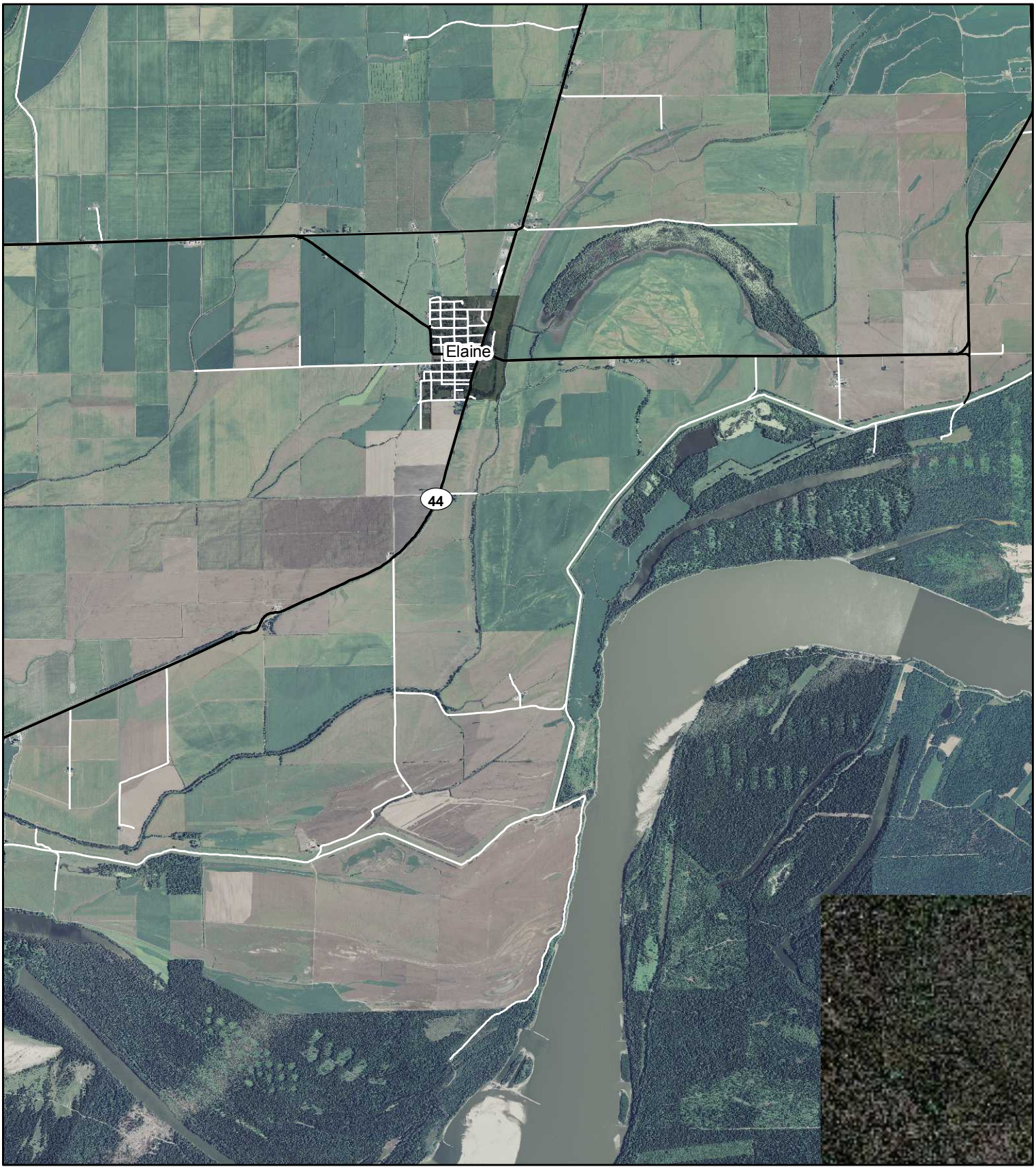

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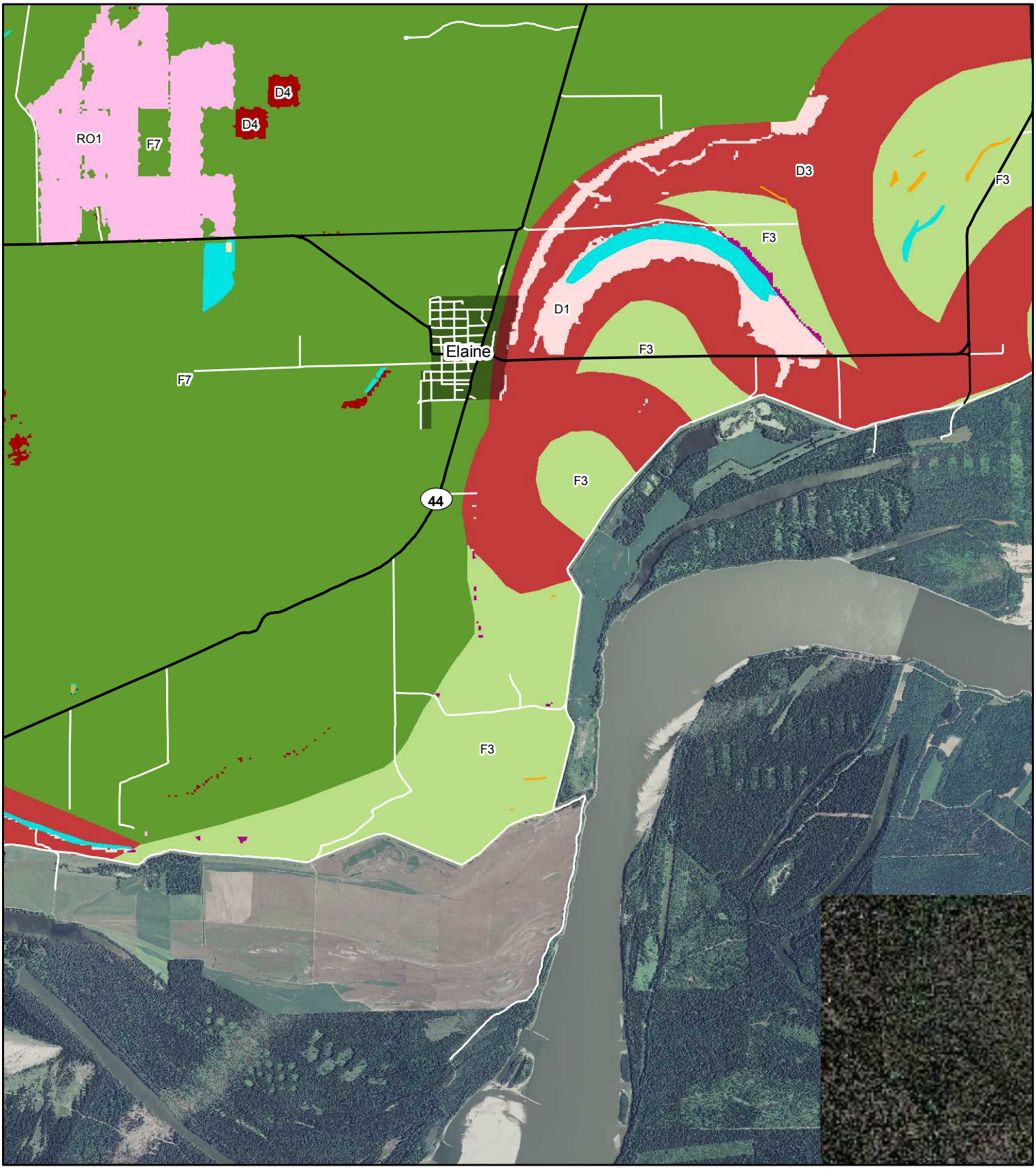
R11



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R11

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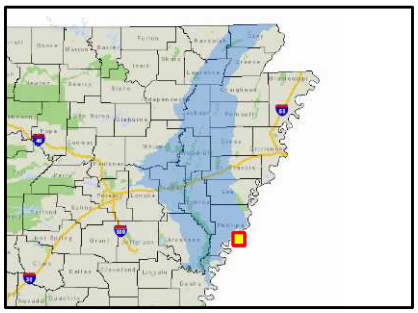
R12



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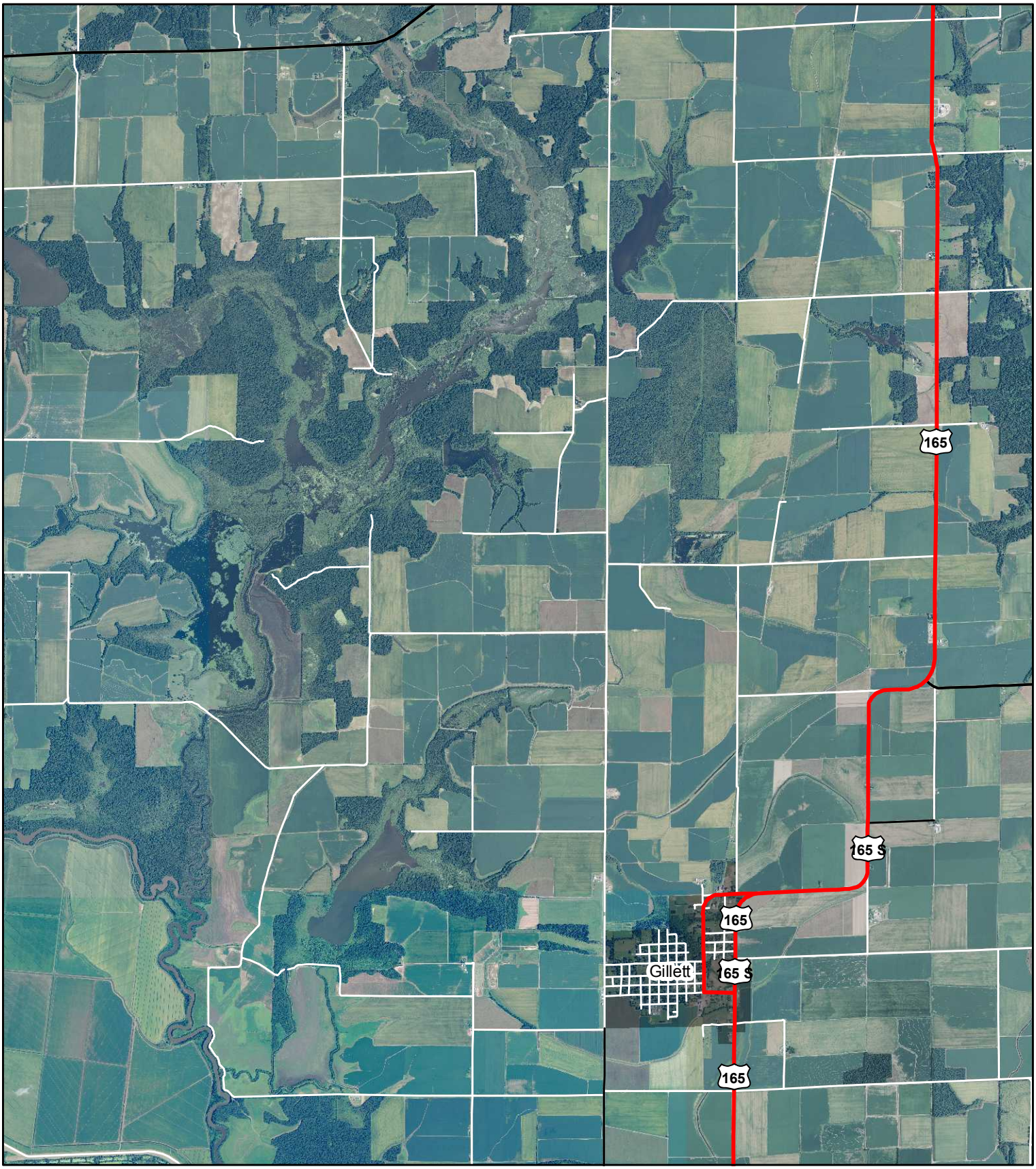

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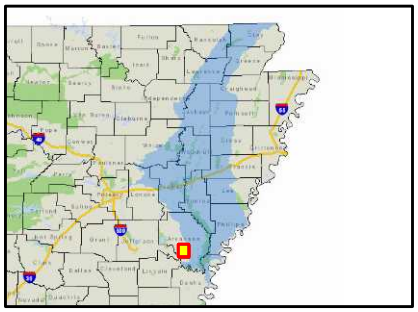

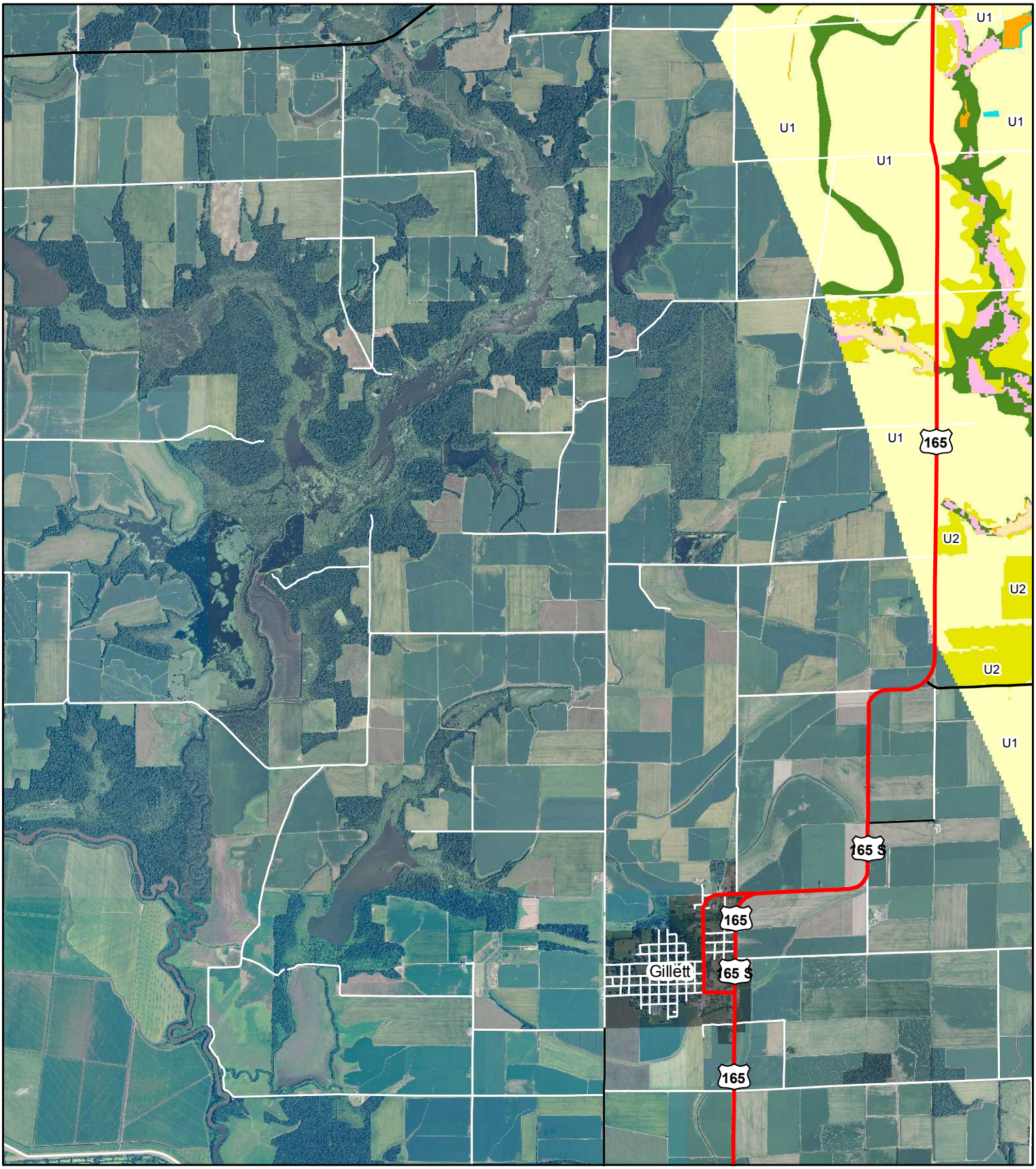

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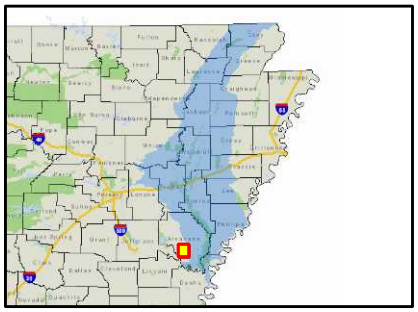

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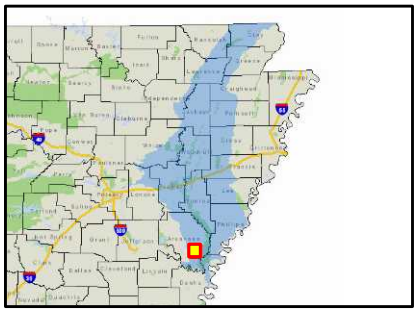

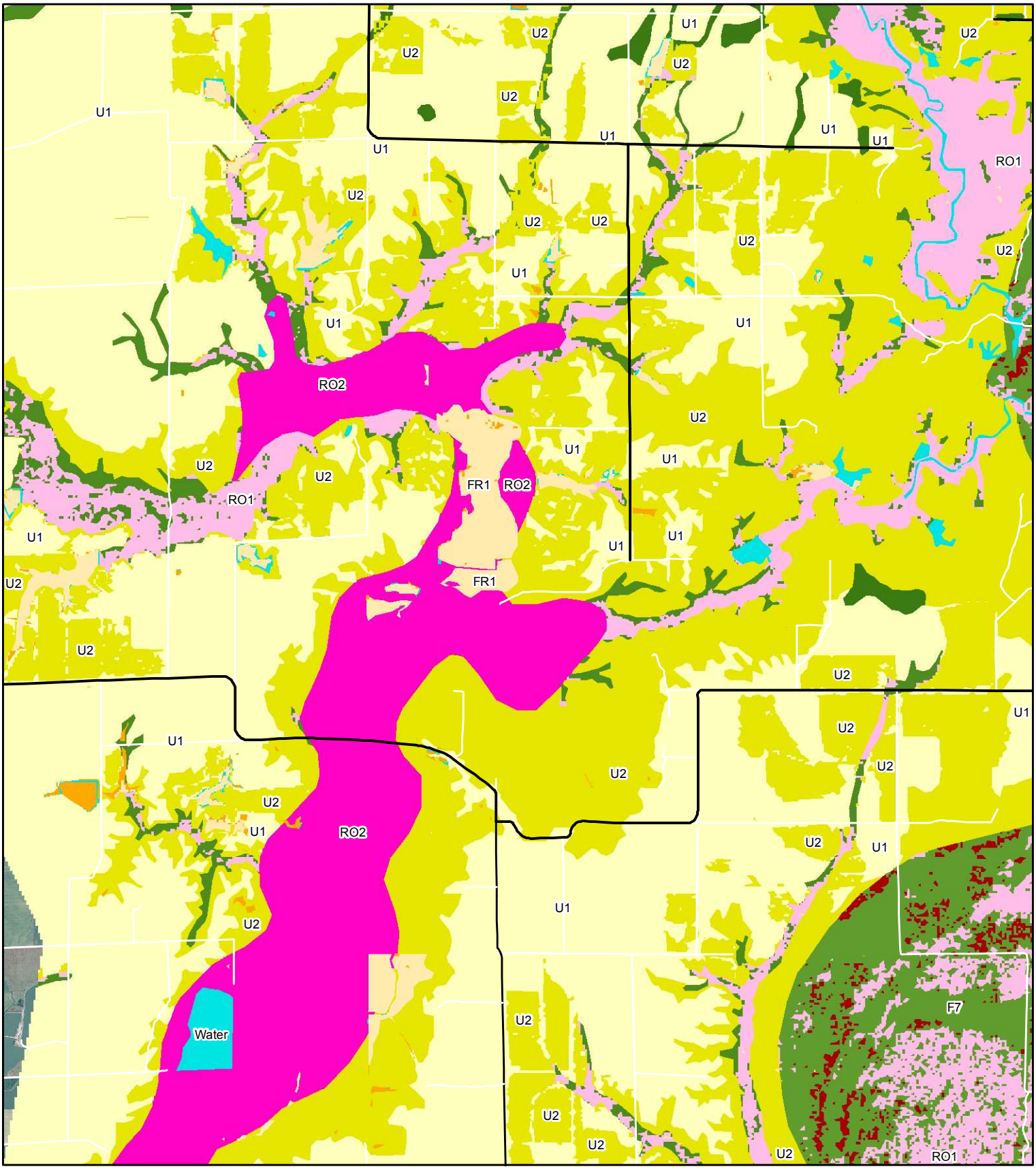

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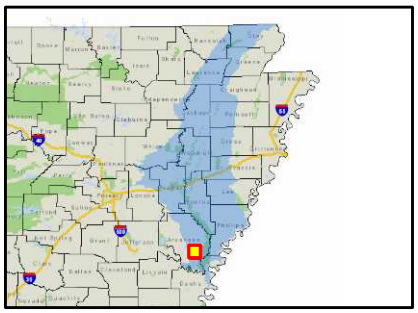

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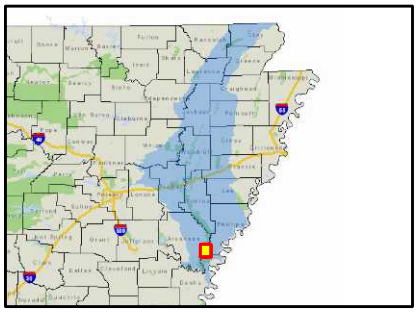

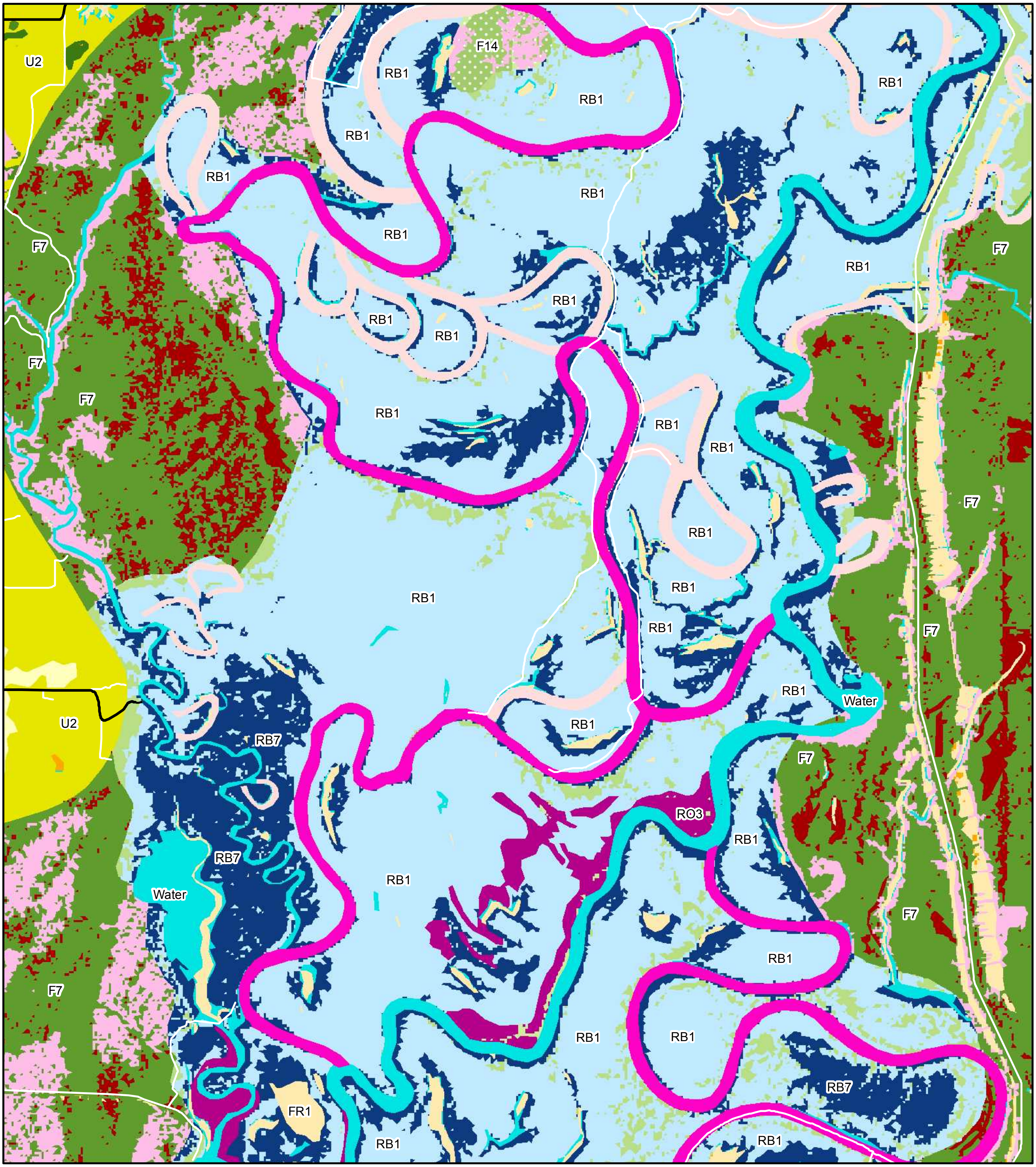

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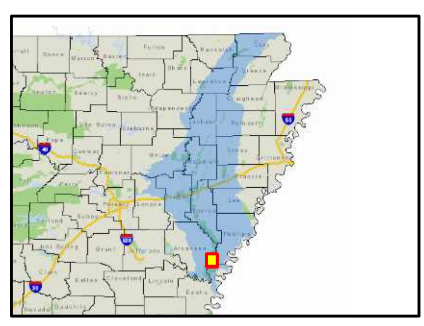

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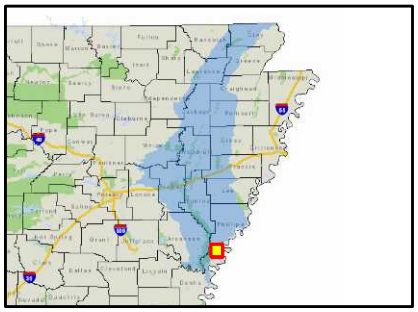

F3
F3
D3
RO1
D4
D4
44
RO1
F7
D4
85
D3
F3

0 0.5 1 2 3 4 Miles

N

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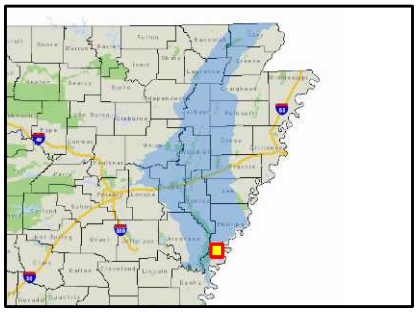
S10



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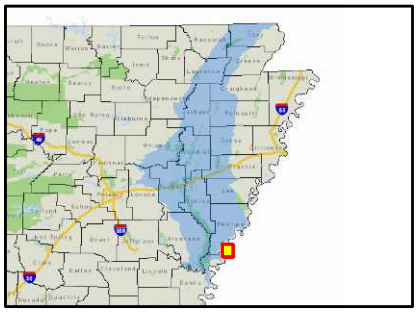

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S11

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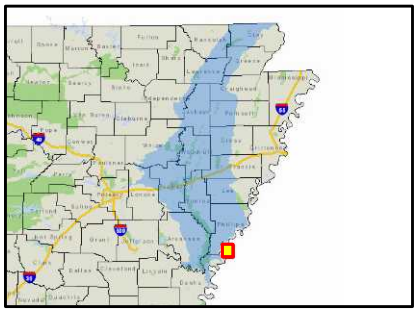

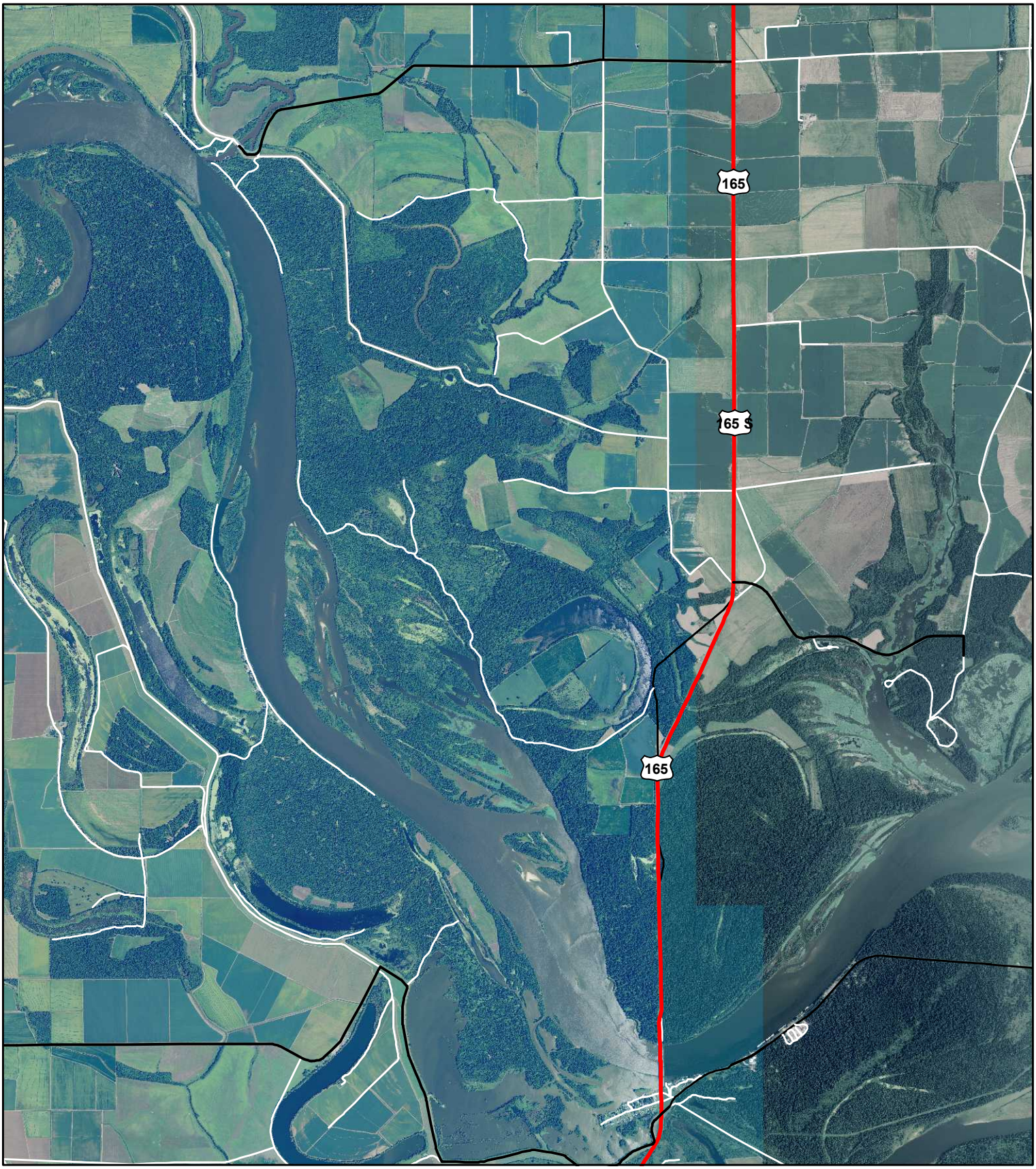

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T7

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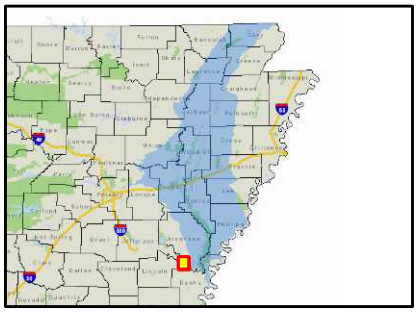

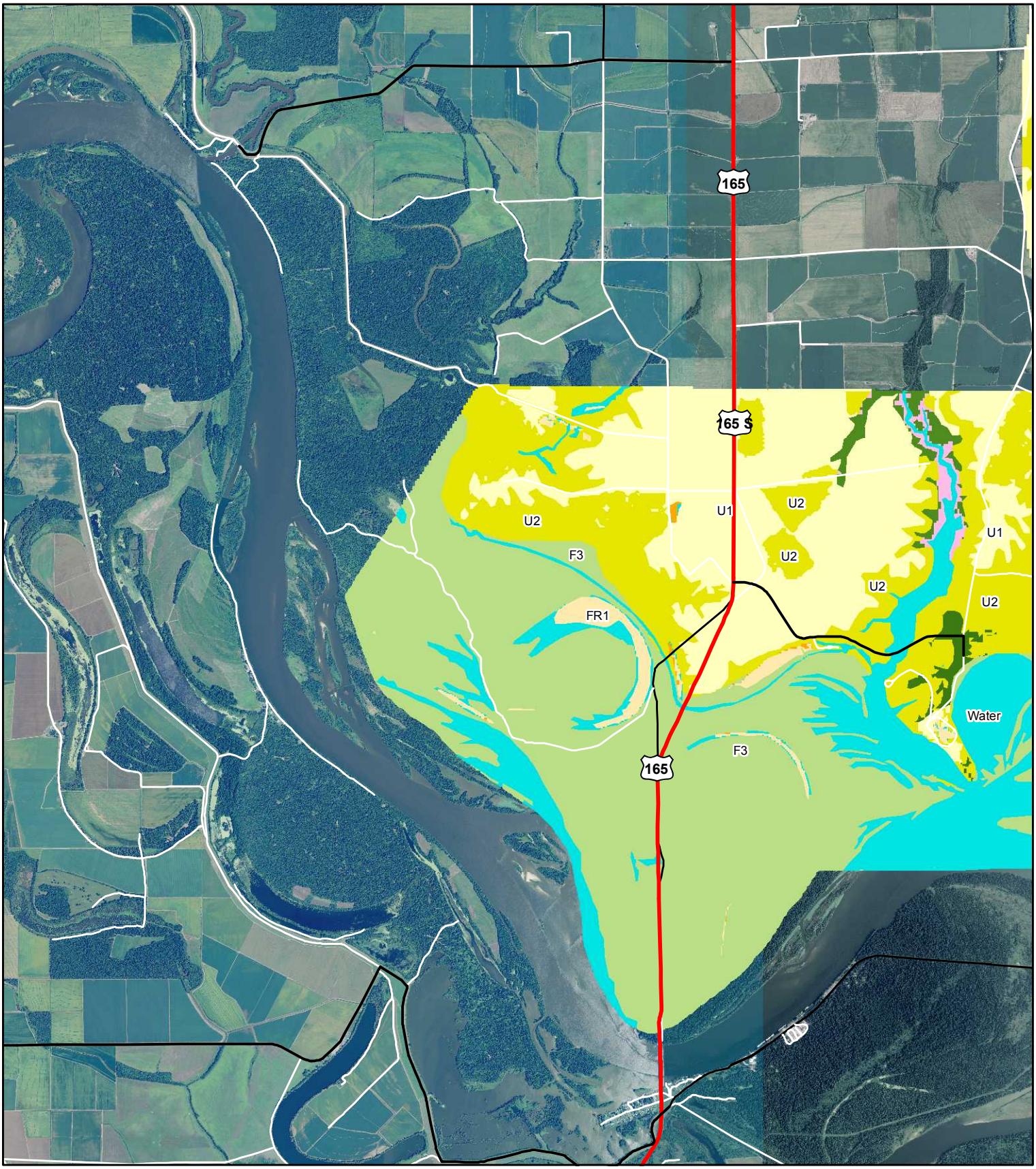

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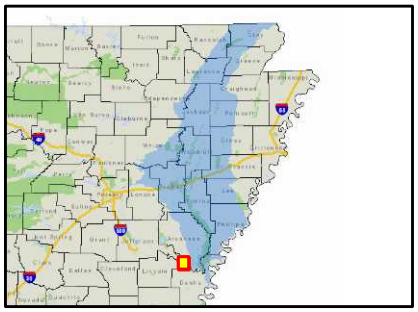

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T8

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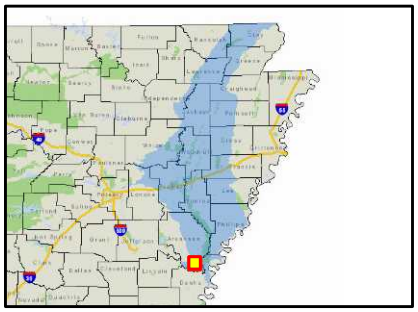

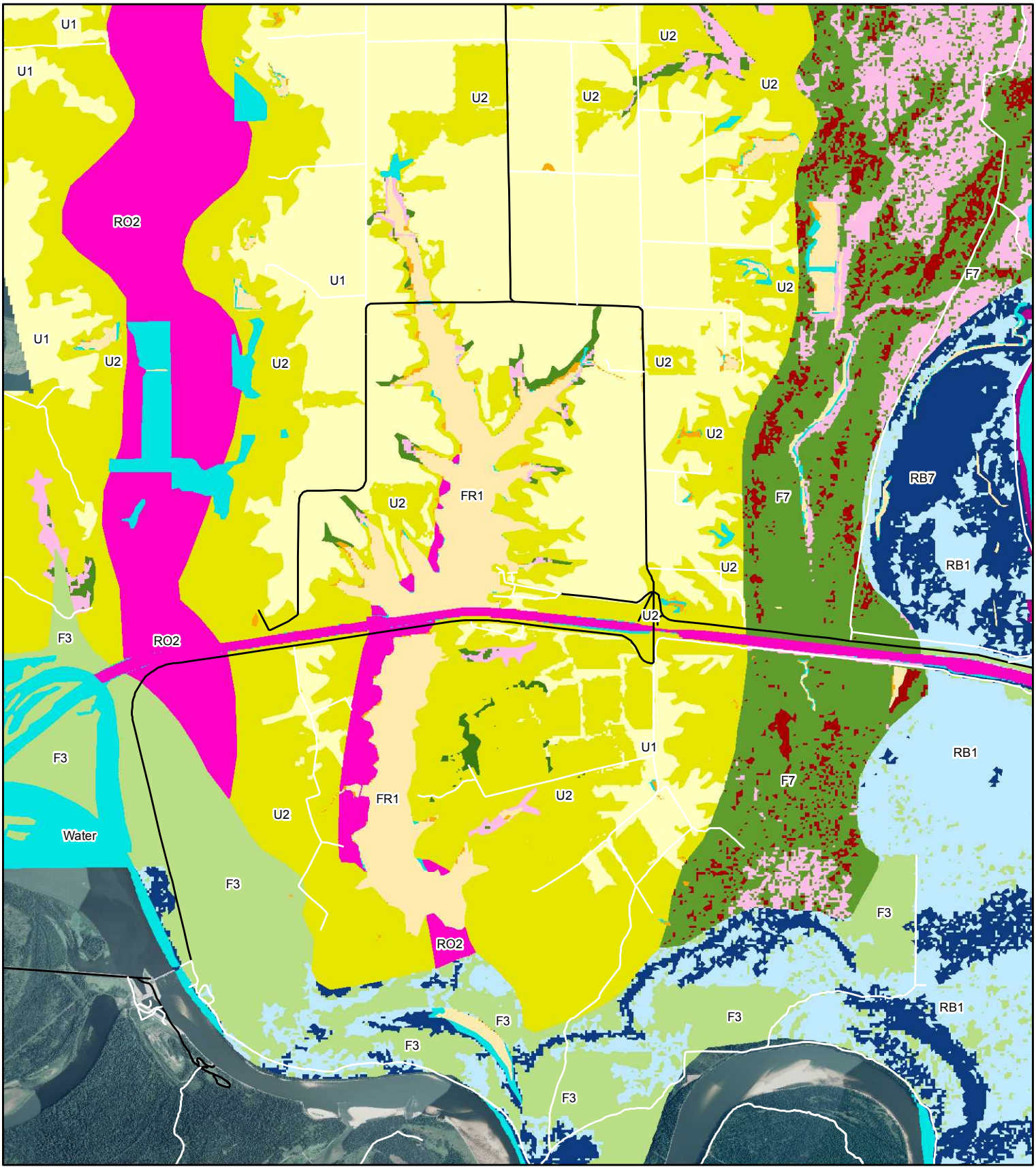

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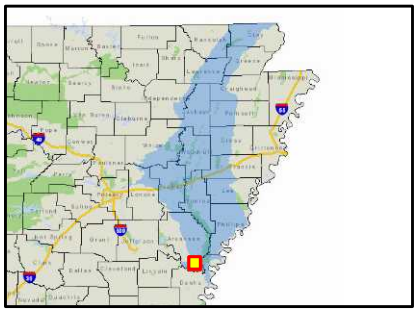

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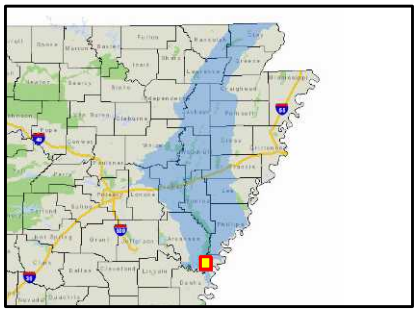

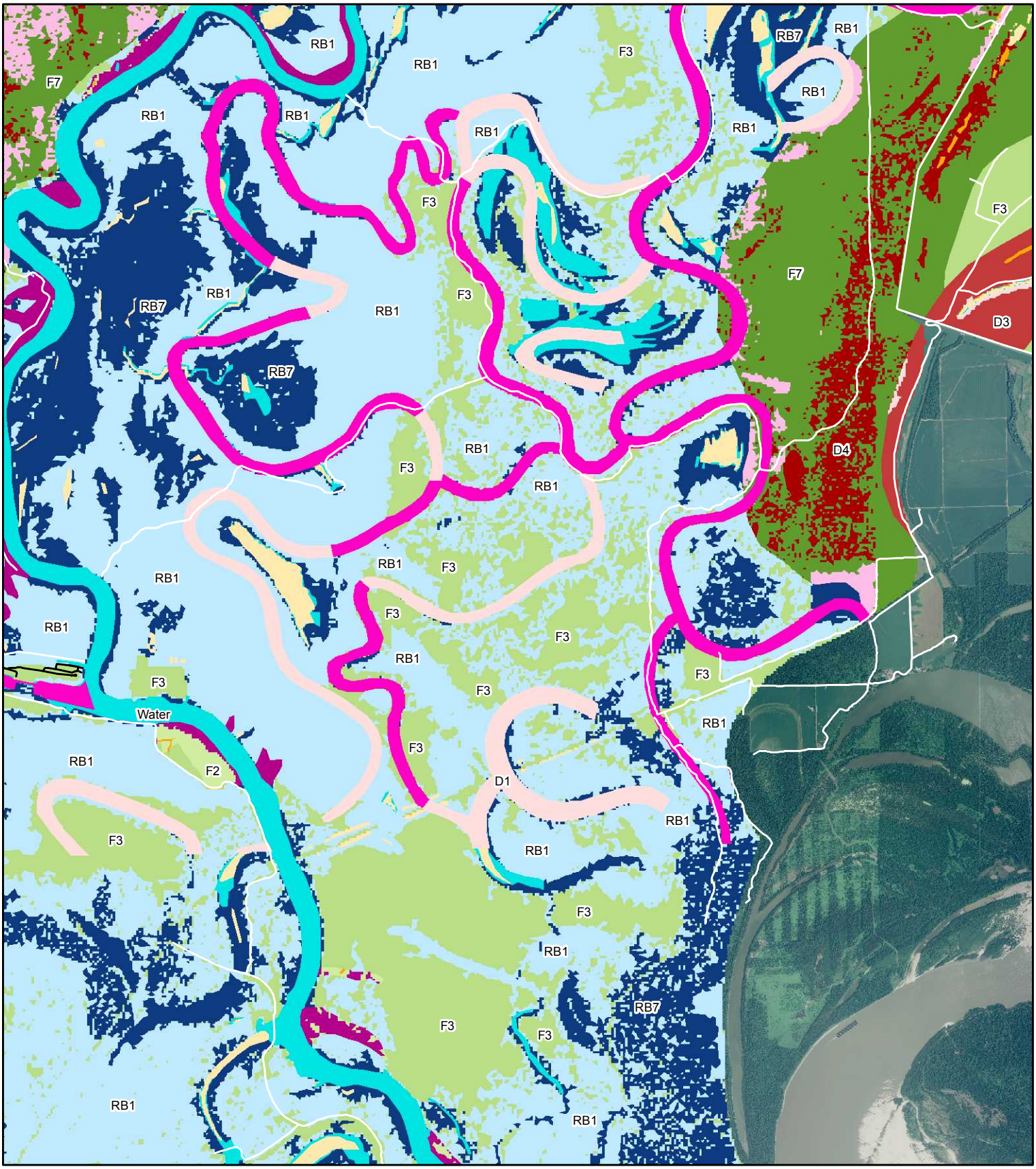

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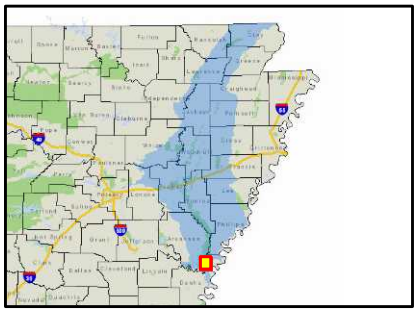

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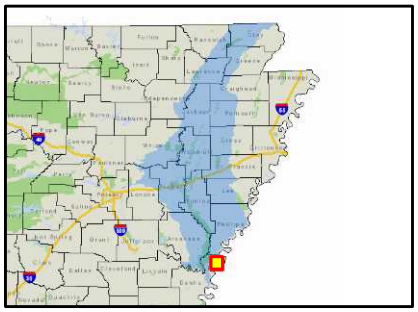

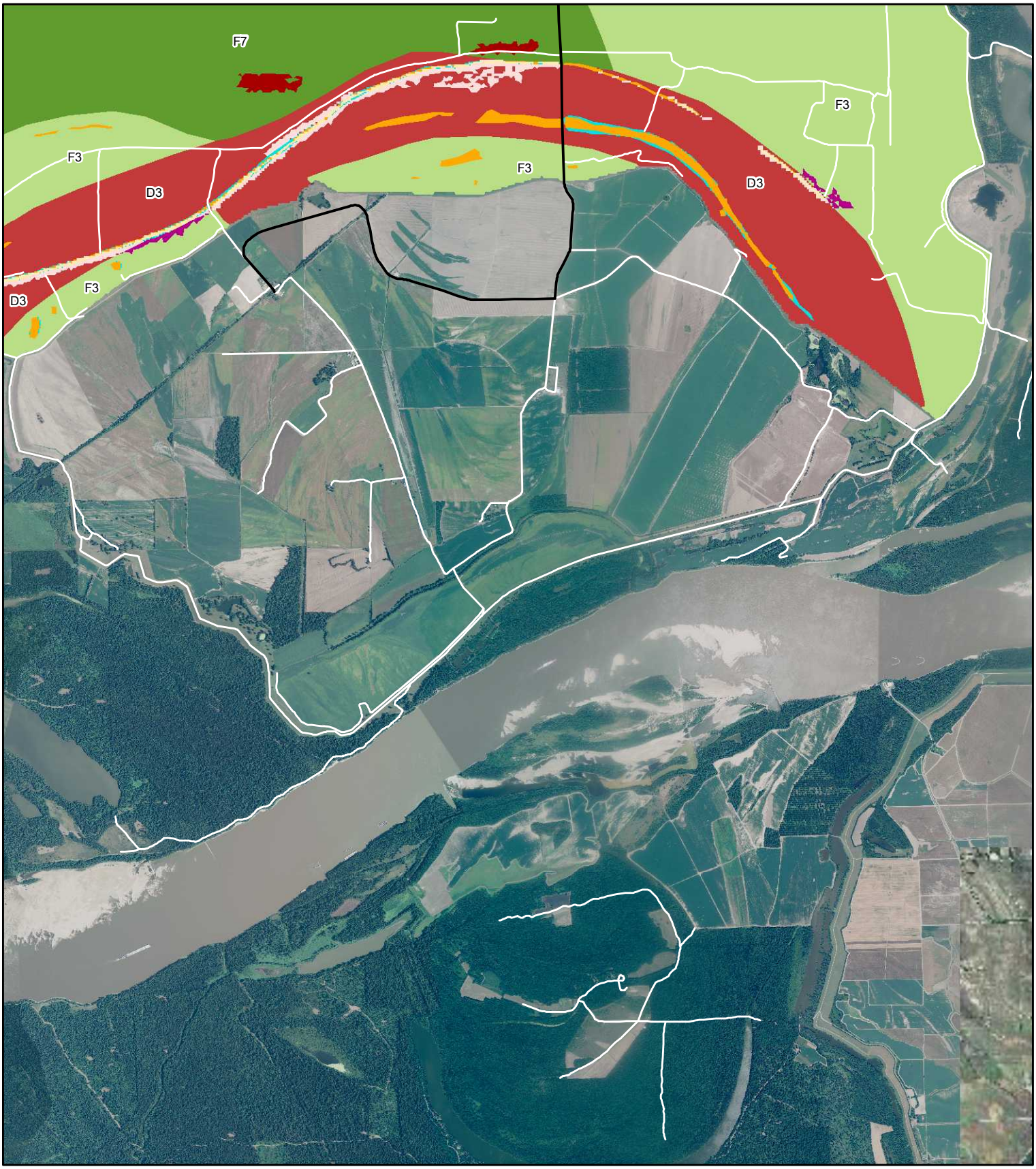

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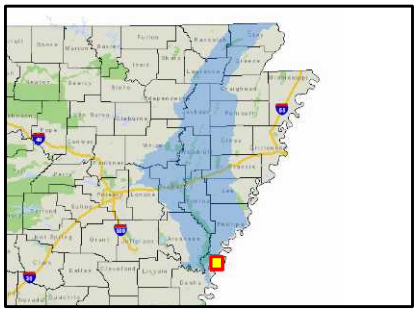

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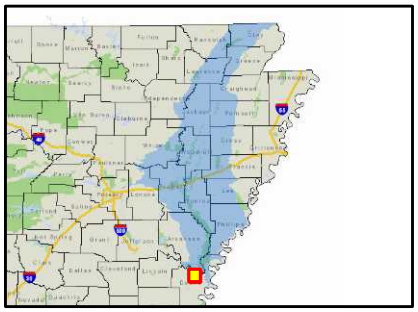

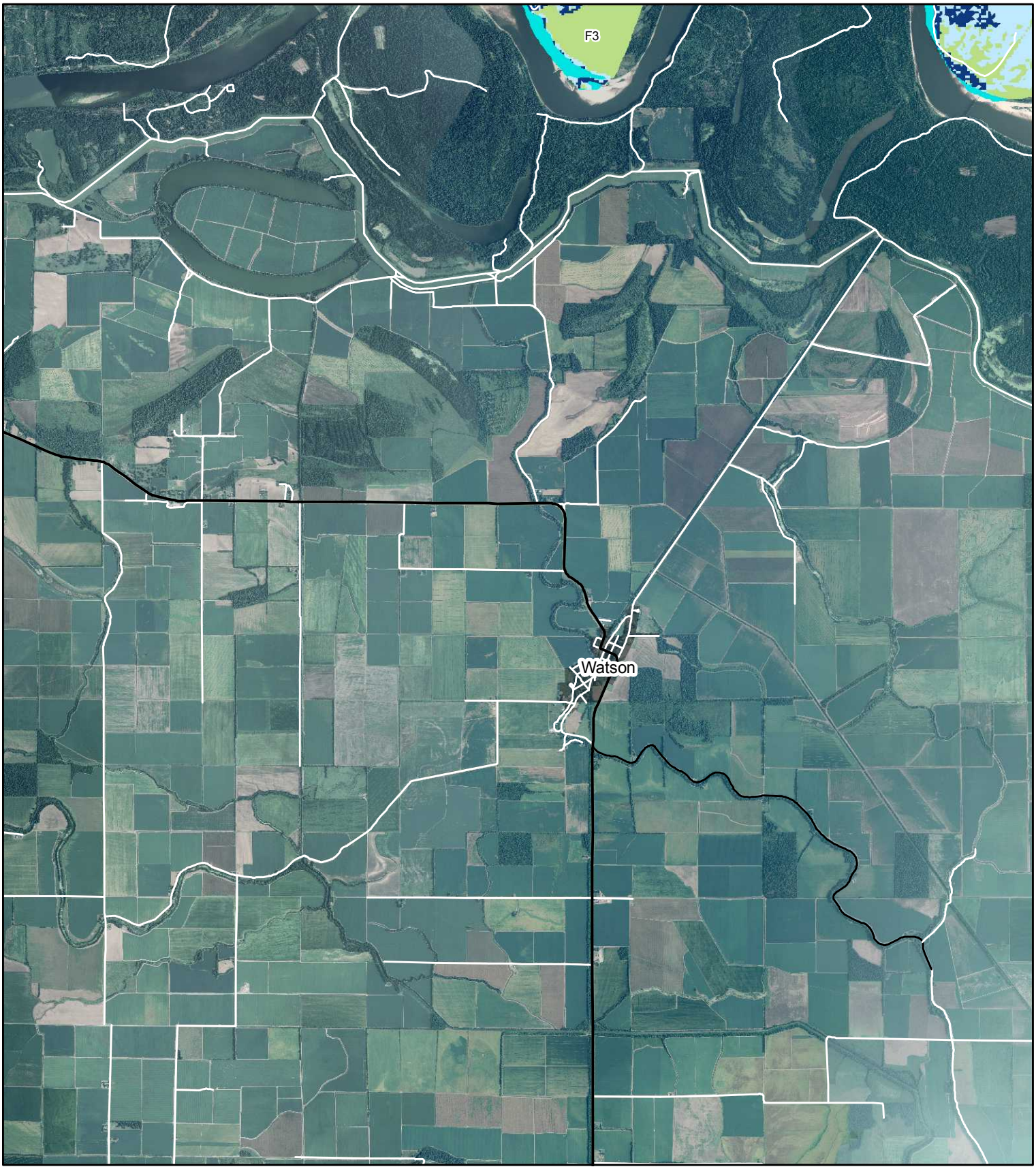

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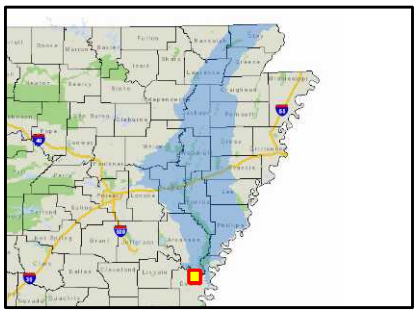

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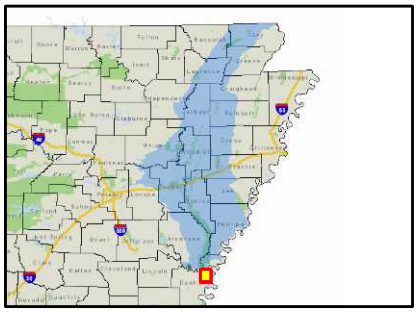

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Water
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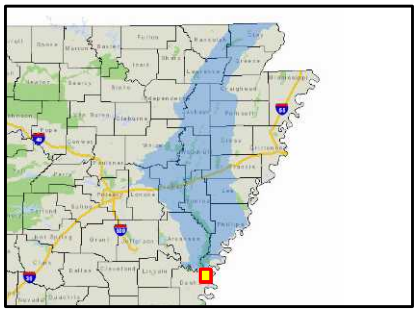

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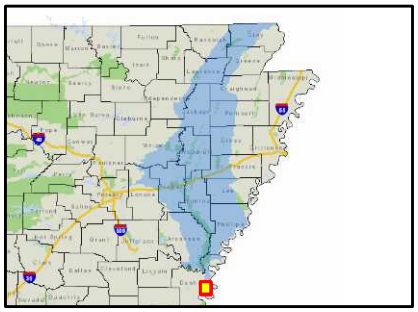

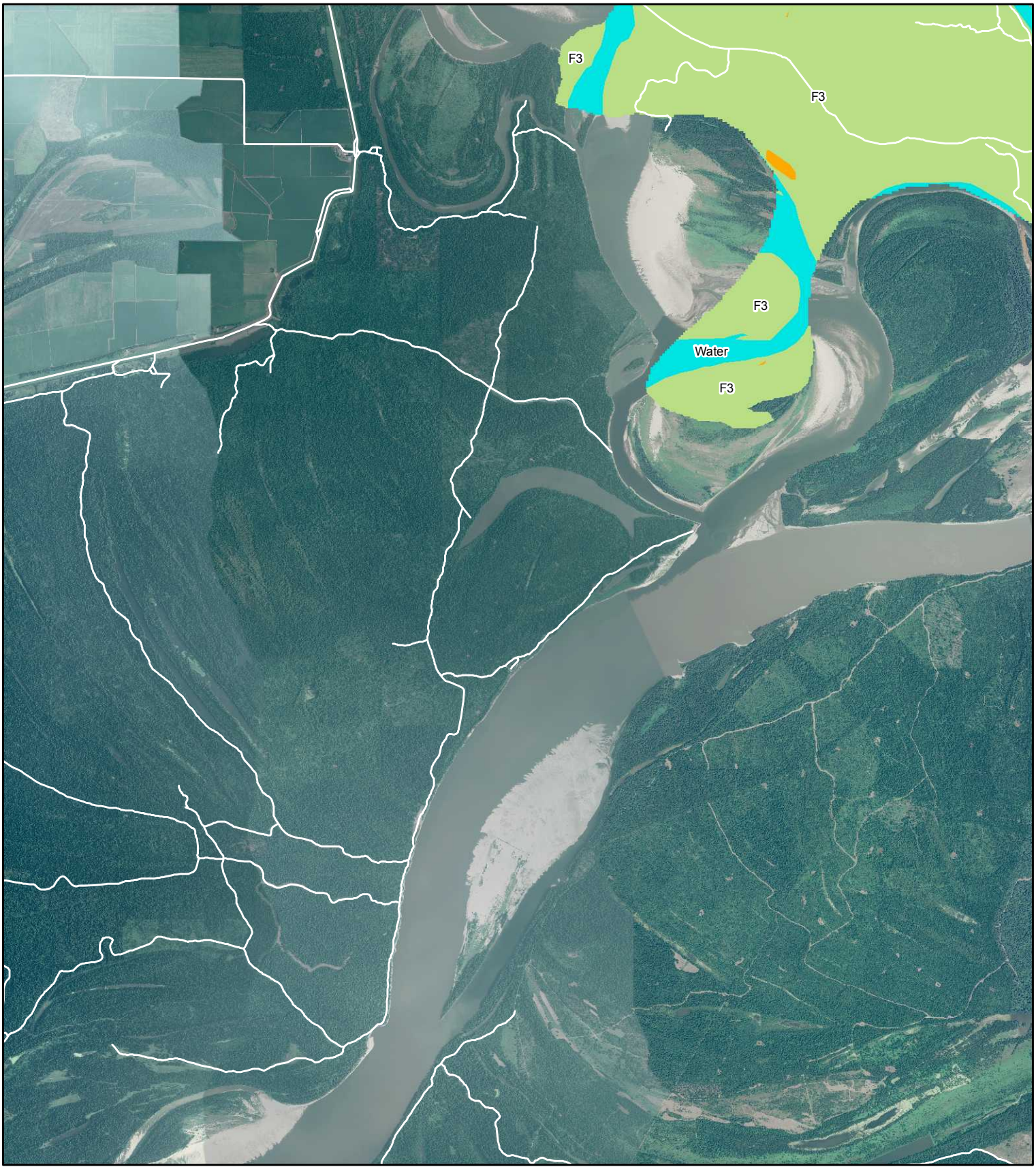

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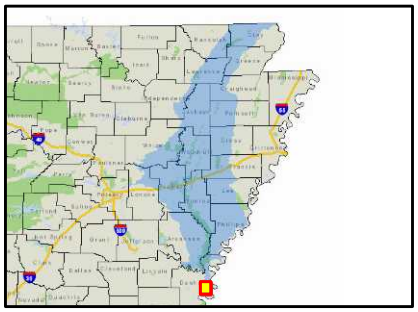

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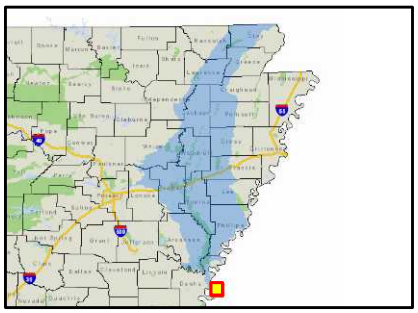

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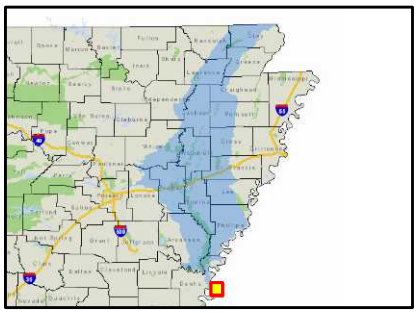

Appendix B: Potential Natural Vegetation Community Characteristics in the Western Lowlands of Arkansas

This Appendix describes the potential natural vegetation of the Western Lowlands of Arkansas. Since 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, that 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, since 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. The listed species do not necessarily all occur together in any particular stand, but 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.

HGM SUBCLASSES: RIVERINE BACKWATER		
COMMUNITY TYPE	CHARACTERISTICS	
	TYPICAL VEGETATION	DESCRIPTION
RB1 Occasionally flooded, well drained lowlands	Dominants: Willow oak Nuttall oak Sweetgum Pin Oak Associates: Cherrybark oak Sugarberry American elm Vernal pools: Overcup oak Bitter pecan	Diverse forest of point bar complexes as well as backswamps where natural levee deposits are present. Some Pleistocene settings are included where they lie at the same elevation as more recent deposits. Sweetgum is the characteristic species, but others typically dominate. Pin oak is a dominant only in the Black River watershed. Overcup oak and bitter pecan dominate in vernal pools that form within the largest point bar swales and sump areas within backswamps. Vernal pools are generally small and infrequent elsewhere, the smaller swales having been filled with veneer deposits.
RB7 Frequently flooded lowlands	Dominants: Overcup oak Bitter pecan Understory: Swamp privet Palmetto Associates on wetter sites: Baldcypress Water tupelo Associates on drier sites: Nuttall oak Green ash Willow oak American elm Persimmon Pin 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. Pin oak is a component in the Black River watershed.
HGM SUBCLASSES: RIVERINE OVERBANK		
COMMUNITY TYPE	CHARACTERISTICS	
	TYPICAL VEGETATION	DESCRIPTION
RO1 Floodplains and terraces of small stream valleys	Dominants: Water oak Willow Oak Cherrybark oak Associates: American elm Green ash Persimmon	This subtype occupies narrow valleys in the margins of Crowley's Ridge and the Grand Prairie as well as drainages within the Pleistocene outwash terraces. Sideslope areas above the floodplain are mapped as components of the upland forest types.

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 Leadplant Side slopes of abandoned channel: Mixed hardwoods and riverfront species	"River swamps" of slow-moving streams that have occupied abandoned courses of larger rivers such as the Cache and White 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 cow oak 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, and therefore the boundaries are less precise than other mapped features. Major ditches are included in this category because this is the most appropriate restoration target in the event some portion of one of those drainage systems is abandoned.
RO-3 Riverfront natural levee and point bar	Dominant species on active riverfront sites: Cottonwood Sycamore Black willow Dominants on older soils: Pecan Water oak Sugarberry American elm Persimmon Associated species: Box elder Sweetgum Vernal Pools: Overcup oak Bitter pecan Water elm	Diverse communities of natural levees and upper banks of abandoned stream courses and active channels, as well as small tributary floodplains. Vegetation composition and structure on these sites is related to proximity to the channel and associated high flows, light availability, and sedimentation. Most of these sites are on substantial natural levee deposits, but active point bars occupied by pioneer riverfront species are included. Where large swales occur between levee deposits, narrow vernal pools support overcup oak, bitter pecan, and similar species.

HGM SUBCLASS: FLAT		
	CHARACTERISTICS	
COMMUNITY TYPE	TYPICAL VEGETATION	DESCRIPTION
F2 Well-drained recent alluvium in lowlands	Dominants: Cherrybark oak Cow oak Sweetgum Associates: Sugarberry Shagbark hickory Water oak Vernal Pools: Nuttall oak	Diverse communities on well-drained sites not subject to regular flooding. Commonly on natural levee and point bar deposits, including those along abandoned channel segments such as oxbow lakes. Vernal pools are common in swales.
F3 Well-drained older alluvium in lowlands	Dominant species: Cow oak Water oak Delta post oak Associates: Mockernut hickory Sweetgum Sugarberry Vernal pools: Green ash Nuttall oak Willow oak	Relatively flat topographic settings of older backswamps and point bars, often where man-made levees have cut off former floodplains. Vernal pools are common but not large.
F7 Poorly drained undulating topography on Pleistocene outwash terraces	Dominant species: Water oak Sugarberry Associates: Post oak Sweetgum Vernal pools: Nuttall oak Willow oak	Primarily on the younger Late Wisconsin outwash terraces, where sufficient topographic variety is present to maintain vernal pools of moderate size. Pools tend to be relatively long and narrow, rather than the short arcuate swales found in point bar environments. Post oak and willow oak are common only where the Overcup soil series occurs.
F8 Poorly drained level topography of the Prairie Terrace	Dominant prairie species: Prairie cordgrass Eastern gammagrass Dominant slash species: Sugarberry Green ash	The wet prairie communities are limited to fairly small areas where soil conditions, subtle relict depressional features, and the size of the local drainage source area promoted wet inclusions within the larger dry prairies. Slash communities occurred in similar settings at the head of drainage systems. The distributions of both of these

	Greeen hawthorn Stiff dogwood Deciduous holly American elm	community types were strongly affected by fire, and their boundaries with adjacent systems were dynamic. Restoration of prairie and slash requires periodic fire as a component of the restoration and management plan.
F9 Flatwoods on poorly drained sites of the Prairie Terrace	Dominant species: Post oak Cherrybark oak Associates: American elm Southern red oak Delta post oak Vernal pools: Green ash Nuttall oak Willow oak	"Flatwoods" of the Prairie Terrace where precipitation ponds shallowly but soils will not support prairie. These forests are characterized by a high degree of interspersion among micro-habitats, including upland species on pimple mounds, mixed hardwood flats between mounds, and large, shallow vernal pools dominated by willow oak and ringed by mosses. Similar sites with very shallow fragipans are likely to support wet prairie or savanna.
F12 Alkali post oak flats	Dominant species: Post oak Vernal pools: Willow oak Water 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: Water oak Delta post oak Willow oak Vernal pools: Nuttall oak Overcup oak	Extensive wet flats of the Early Wisconsin Terraces and on some alluvial fan surfaces on the western edge of the basin. Composition in these forests is similar to the vernal pools of the "dry phase" hardwood flats on the same geomorphic surfaces. Pine flatwoods occur in this type near the southern end of the basin. Vernal pools are not common but may be extensive.
F14 Hardwood flats, Early Wisconsin Valley Train (dry phase)	Dominant species: Post oak Southern red oak Shagbark hickory Vernal pools: Willow oak Water oak	Relatively level or gently undulating sites on the Early Wisconsin terraces and on alluvial fans on the western side of the basin. Similar to upland hardwood sites but the flat terrain and vernal pools maintain wetland characteristics.
F15 Hardwood flats, Late Wisconsin dune fields	Dominant species: Post oak Associates: Willow oak	Flats of limited size among the uplands and sandponds within the extensive dunefields of the Pleistocene terraces.

HGM SUBCLASSES: CONNECTED AND UNCONNECTED DEPRESSION		
	CHARACTERISTICS	
COMMUNITY TYPE	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: Water elm Waterlocust Swamp privet Buttonbush	Topographic depressions with very poorly drained soils in former stream channels and large swales. 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.
D4 Unconnected depressions on Pleistocene outwash terraces	Dominants: Baldcypress Water tupelo Willow oak Water oak Understory and associated species: Water elm Waterlocust Swamp privet Swamp cottonwood	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. Willow and water oaks are more common in the shallow features of the older, higher terraces.
D5, D6 Stream-connected and unconnected depressions on the Cache River terrace	Dominants: Baldcypress Water tupelo Associated species: Overcup oak Green ash Pumpkin ash Swamp cottonwood	Depressions on the Cache River Terrace occur in abandoned channels and courses which are much larger and deeper than those left by the same river in Holocene times. Connected depressions have streams flowing through them from the adjacent Pleistocene terraces, while unconnected depressions do not, but otherwise the two types are similar.
D7 Unconnected Sand Pond depressions	Dominants: Overcup oak Nuttall oak Willow oak Swamp red maple Pin oak (north) Baldcypress Associated species: Swamp cottonwood Pumpkin ash Corkwood Pondberry	This type is unique to closed depressions within the Pleistocene dunefields of this basin and adjacent parts of Missouri. Uncommon plant species associated with this type include the rare corkwood, and the federally endangered pondberry.

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: Black willow Buttonbush American lotus	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 water levels are manipulated, these patterns are usually altered in various ways. Since 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
U1 Prairie and savanna of the Prairie Terrace	Dominants: Big bluestem Little bluestem Indian grass Switchgrass Associates: Various prairie forbs	Non-wetland prairie of the Prairie Terrace. Original distribution is estimated from historic maps and soils. Boundaries vary over time depending on fire history. Areas that were likely to have been predominantly savanna are included in the U3 map units.
U2 Upland forests of Pleistocene outwash terraces and alluvial fans	Dominant species: Southern red oak Post oak Water oak Shagbark hickory Associated species: Black gum White oak Shortleaf pine	Upland forests of the Pleistocene terraces and alluvial fans. Species composition can vary widely depending on local soils and drainage conditions. In some locations, fire and soil conditions favored open woodlands that were transitional to the savanna and prairie communities. Although the boundary among these types was dynamic.
U4 Pleistocene dunefields and barrens	Dominant species: Southern red oak Post oak Black oak Shagbark hickory	Dry slopes and ridges of the Pleistocene dunefields.

	Associated species (lower slopes): Cow oak White oak Associated species (xeric sites): Blackjack oak Prickly pear Prairie grasses	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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1. REPORT DATE *(DD-MM-YYYY)*
September 2012

2. REPORT TYPE
Final report

3. DATES COVERED *(From - To)*

4. TITLE AND SUBTITLE
Potential Natural Vegetation of the Mississippi Alluvial Valley: Western Lowlands, Arkansas, Field Atlas

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Charles Klimas, Thomas Foti, Jody Pagan, Elizabeth Murray, and Malcolm Williamson

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Environmental Laboratory
U.S. Army Engineer Research and Development Center
3909 Halls Ferry Road, Vicksburg, MS 39180;
Arkansas Natural Heritage Commission
323 Center Street, Little Rock, AR 72201;
5-Oaks Wildlife Services, L.L.C.
620 East 22nd St. Suite 206, Stuttgart, AR 72160;
Center for Advanced Spatial Technologies
1 University of Arkansas, Fayetteville AR 72701

8. PERFORMING ORGANIZATION REPORT NUMBER
ERDC/EL TR-12-27

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers
Washington, DC 20314-1000

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

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 relative 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 inch = 1mile.

15. SUBJECT TERMS
Western Lowlands, AR
Mississippi Alluvial Valley
Plant communities
Potential Natural Vegetation (PNV) maps
Restoration planning
Wetland site classification

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER *(include area code)***
Unclassified	Unclassified	Unclassified		318	

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