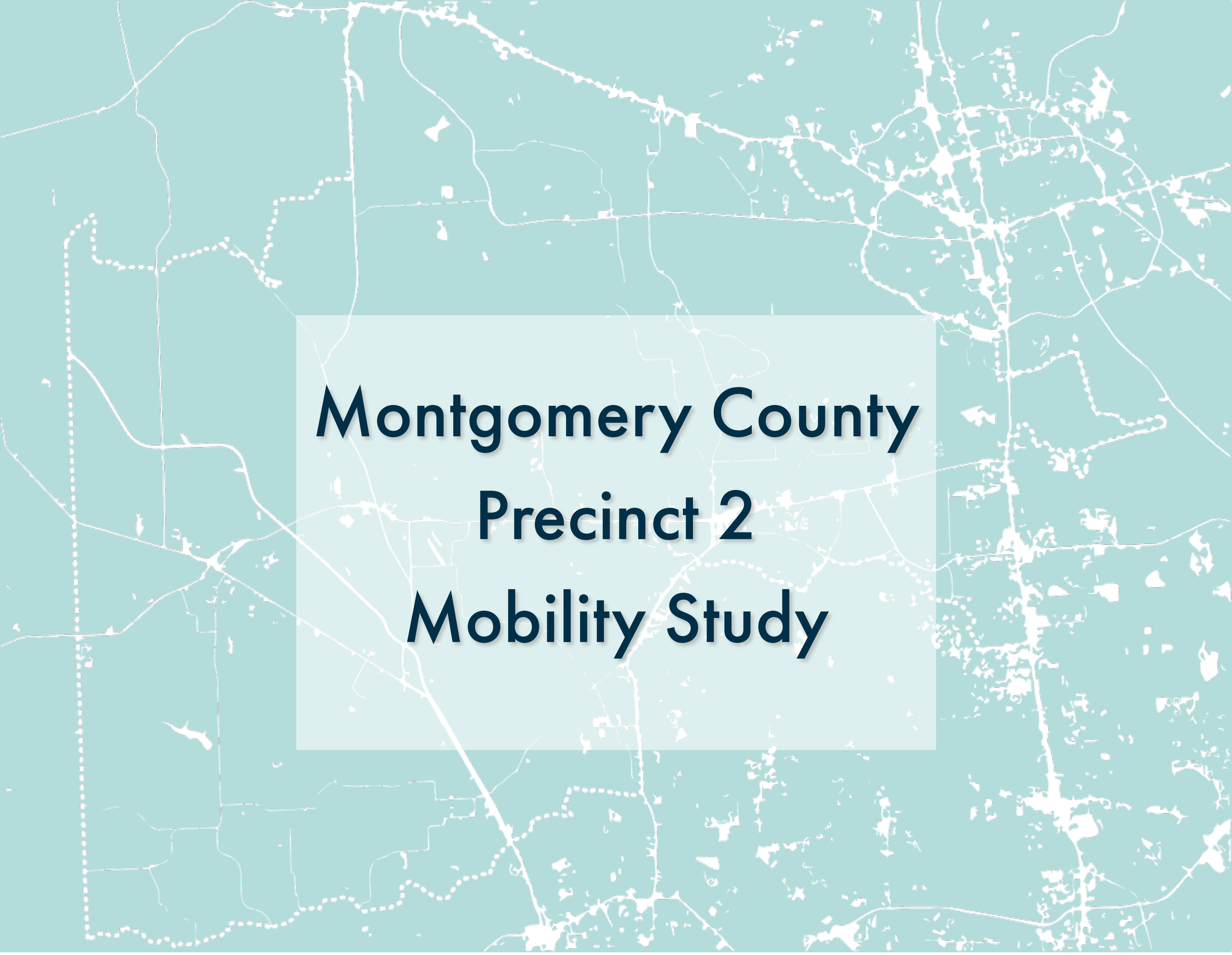
APPENDIX E
Existing Deficiencies and Challenges



Montgomery County Precinct 2 Mobility Study

Appendix E

Existing Deficiencies and Challenges

October 2021

Table of Contents

List of Tables

List of Figures

I. Introduction

As a part of the Mobility Study, a review of the existing transportation network in Montgomery County Precinct 2 was performed using assembled and collected transportation data. Traffic data, including 24-hour volume counts, turning movement counts, and travel time runs were collected in March 2021 at multiple locations throughout the precinct. In addition, existing counts from other projects were acquired. A Roadway Inventory was created by taking field observations for several corridors in Precinct 2. Additional observations have been made using Google Earth and other mapping tools. Other assembled traffic data includes Annual Average Daily Traffic (AADT) counts and crash data from TxDOT, existing signal timing plans, existing land use information, and planned developments.

Existing conditions have been modeled in Synchro using inputs such as lane configuration, turn bay storage, collected peak hour turning movement volumes, and existing signal timing and phasing. Analysis of the model shows both intersection and specific movements that are not currently operating at an acceptable level of service.

The analysis results and assembled data have been used to identify the existing deficiencies and challenges for Montgomery County Precinct 2. Existing deficiencies are described in Section II of this memo, and existing challenges are described in Section III.

II. Existing Deficiencies

Several factors were considered to identify deficiencies in Montgomery County Precinct 2. Synchro analysis helped identify intersections with excessive congestion and delay. AADT volumes have been considered to identify areas with high traffic volumes and identify key corridors that are deficient of alternative routes. Deficiencies pertaining to roadways that could enhance connectivity within Precinct 2 were identified using aerial imagery. Deficiencies exhibited by the existing transportation facilities have been listed below for the following categories: Connectivity, Capacity, Condition, Geometric Design, Intersections, and Alternative Modes.

A. Connectivity

Connectivity is the directness and density of roadway links. Greater connectivity in a region allows for improved access, reduced congestion and travel time, and an overall improvement in mobility. Throughout Montgomery County Precinct 2, there many locations where connectivity is disrupted when major roads and collectors end at T-intersections, neighborhood streets without public access, commercial parking lots, or dead ends. Additionally, there is a lack of alternate routes to connect existing corridors which are already congested during peak hours.

Figure II-1 shows a map with locations where connectivity is deficient. The map shows disconnections along key corridors in the region, including T-Intersections, dead ends, and roadways where access is restricted. Eliminating the number of T-Intersections would improve the connectivity in Precinct 2 and mitigate congestion and the lack of alternative routes.

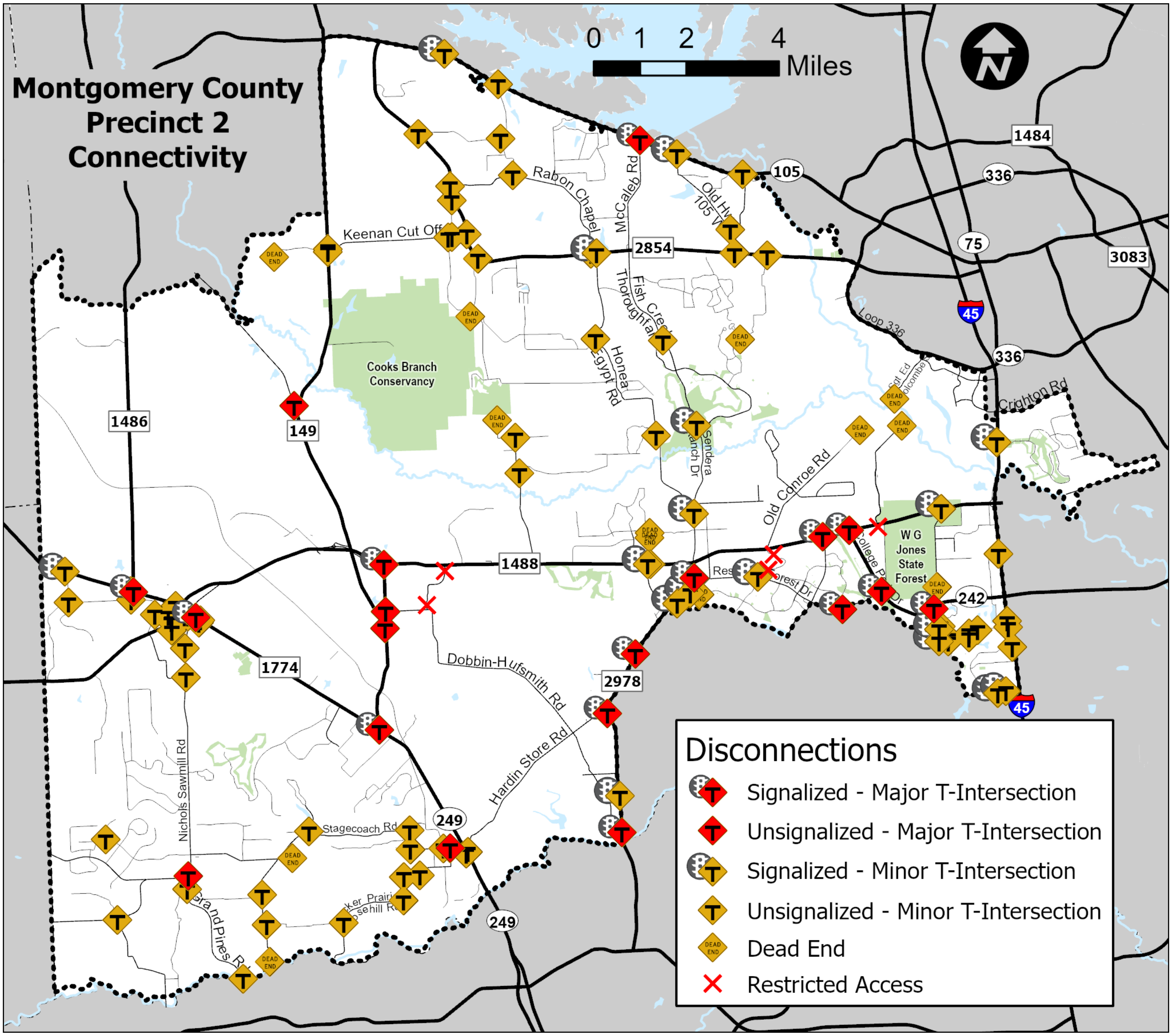


Figure II-1 Connectivity

B. Mobility and Access

The functional classification of roadways is typically determined by the ease of mobility and the accessibility to places and activities. A balance of access and mobility throughout the roadway network is essential for efficiency of movement, economic success, and quality of life. Typically, major arterial roads offer greater mobility with limited access, while collectors and local streets prioritize access with reduced mobility.

Within Precinct 2, there are a limited number of expressways and arterial roadways. The only corridors that offer fully controlled access with free flow on the main lanes are Interstate 45 (IH 45) and State Highway 249 Toll Road (SH 249). Other regional arterials include State Highway 105 (SH 105), State Highway 242 (SH 242), Farm-to-Market 1488 (FM 1488), Farm-to-Market 2978 (FM 2978), and a small portion of State Loop 336 (Loop 336).

SH 105, which is an east-west principal arterial, has no raised median. There are large segments which have dense, direct access to driveways. As the number of driveways and other access points increase along a roadway, so does the rate of crashes. There are numerous traffic signals along the corridor, but most are reasonable spaced.

SH 242 has limited access with grass medians and designated turn lanes, however there are several closely spaced signalized intersections (less than a quarter mile apart) near the IH 45 interchange. Closely spaced traffic signals decrease road capacity and travel speed, and they can cause greater delays and queueing at intersections. There are also school speed limit zones along the corridor which affect morning peak traffic.

FM 1488 is an arterial with a significant number of signalized intersections and no raised medians. Most of the corridor has two-way left turn lanes (TWLTL), but there are a few miles that have only two lanes with no TWLTL. It is one of the only corridors to cross the entirety of Precinct 2 in the east-west direction. Like SH 105, FM 1488 has several segments with a high density of driveways. The eastern portion of FM 1488 between FM 149 and IH 45 is heavily congested with high Annual Average Daily Traffic (AADT) volumes.

FM 2978 is a north-south arterial which also has dense commercial development with many driveways along much of the corridor. It is currently undergoing a widening construction project which will include a 16 ft wide center turn lane and four travel lanes. The widening project also includes 5 ft outside shoulders to accommodate bicycles. 4 ft sidewalks are planned in some locations on the east side of the corridor.

C. Corridor Capacity

Roadway capacity is determined primarily by the number of through lanes on a given corridor. Roadways that have more volume demand than available capacity cause roadway users to experience a breakdown of traffic flow. Corridors that are at or near capacity may also experience significant congestion.

Typically, the greatest traffic demand occurs during the evening hours, so for the purposes of this study, the traffic volumes collected during the PM peak period were used to calculate the volume-to-capacity (v/c) ratio. The PM peak period used is a 4 hour period from 3:00 PM to 7:00 PM. The v/c ratio is used to determine whether a corridor as above, at, near, or below capacity. Table II-1 shows what v/c values were used to determine levels of congestion.

Table II-1 Congestion Based on Volume-to-Capacity

Congestion Level	v/c Ratio
Under Capacity	≤ 0.77
Near Capacity	0.77 – 0.92
At Capacity	0.92 – 1
Over Capacity	> 1

Table II-2 below lists locations that are currently at or over capacity.

Table II-2 Congested Corridors

Corridor	From	To	v/c Ratio	Congestion
FM 149	Jackson Rd	FM 1488	0.93	At Capacity
FM 2854	Fish Creek Thoroughfare	Old Highway 105 W	1.03	Over Capacity
Hardin Store	SH 249	Dobbin-Hufsmith Rd	1.04	Over Capacity
FM 1488	FM 2978	IH 45	1.07	Over Capacity
FM 1488	FM 1774	FM 149	1.07	Over Capacity
FM 149	S. of FM 1488	N. of FM 1774	1.08	Over Capacity
Research Forest (E)	MP2 Boundary	IH 45	1.09	Over Capacity
FM 2854	Old Highway 105 W	Loop 336	1.31	Over Capacity
FM 2978	Woodlands Pkwy	Spring Creek	1.34	Over Capacity
FM 2978	FM 1488	Woodlands Pkwy	1.87	Over Capacity

Figure II-2 shows a map of regional congestion for the PM peak period.

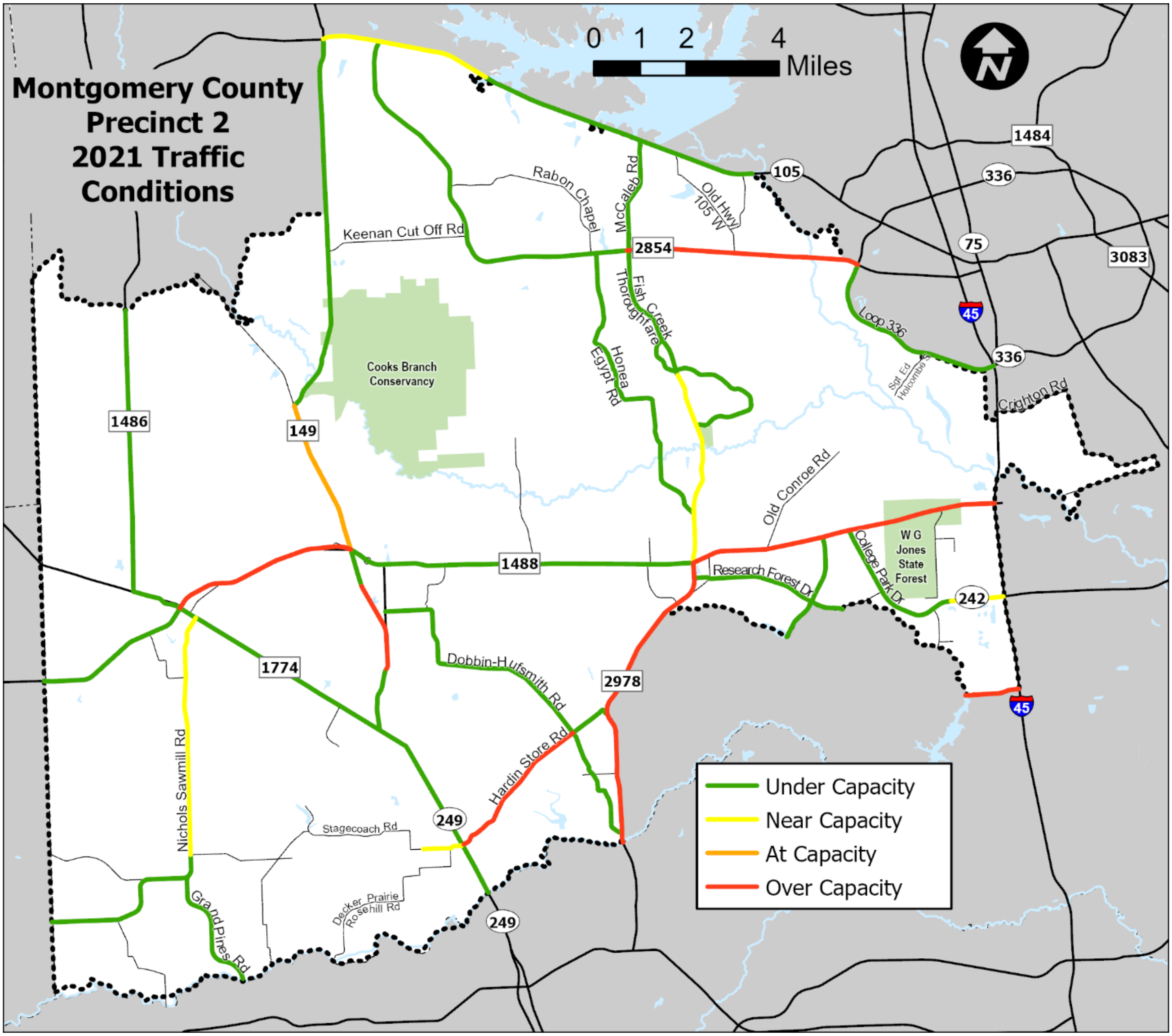


Figure II-2 2021 Congestion

D. Geometric Design and Condition

The geometric design of roadways involves alignment, vertical curvature and grade, lane width and cross slope, and the inclusion/exclusion of road features such as shoulders, curbs, ditches, etc. Roadway alignment is defined by the series of horizontal tangents and curves that make up the roads path. In addition to roadway capacity, geometric design impacts safety and efficiency of travel.

The condition of the pavement and pavement markings, as well as the placement and condition of roadway signing also impact safety and efficiency.

During the roadway inventory process, the pavement and striping condition of about 215 miles of roadway in Precinct 2 was assessed. The condition of existing road signing was also evaluated. It was found that about 37 miles of roadway have poor pavement condition. About 38 miles of road had poor pavement markings and another 12 miles had no striping at all. There were 81 signs that were either in poor or damaged condition or did not meet current standards based on the Texas Manual on Uniform Traffic Control Devices.

Within Precinct 2, there are many locations with winding curves, often with limited visibility around the curves. This is a concern when there is not enough stopping sight distance to react to other vehicles, cyclists, or road hazards. Many curves that have smaller radii require a reduction in speed. Some locations have insufficient signing and other warning devices for the approaching curve.

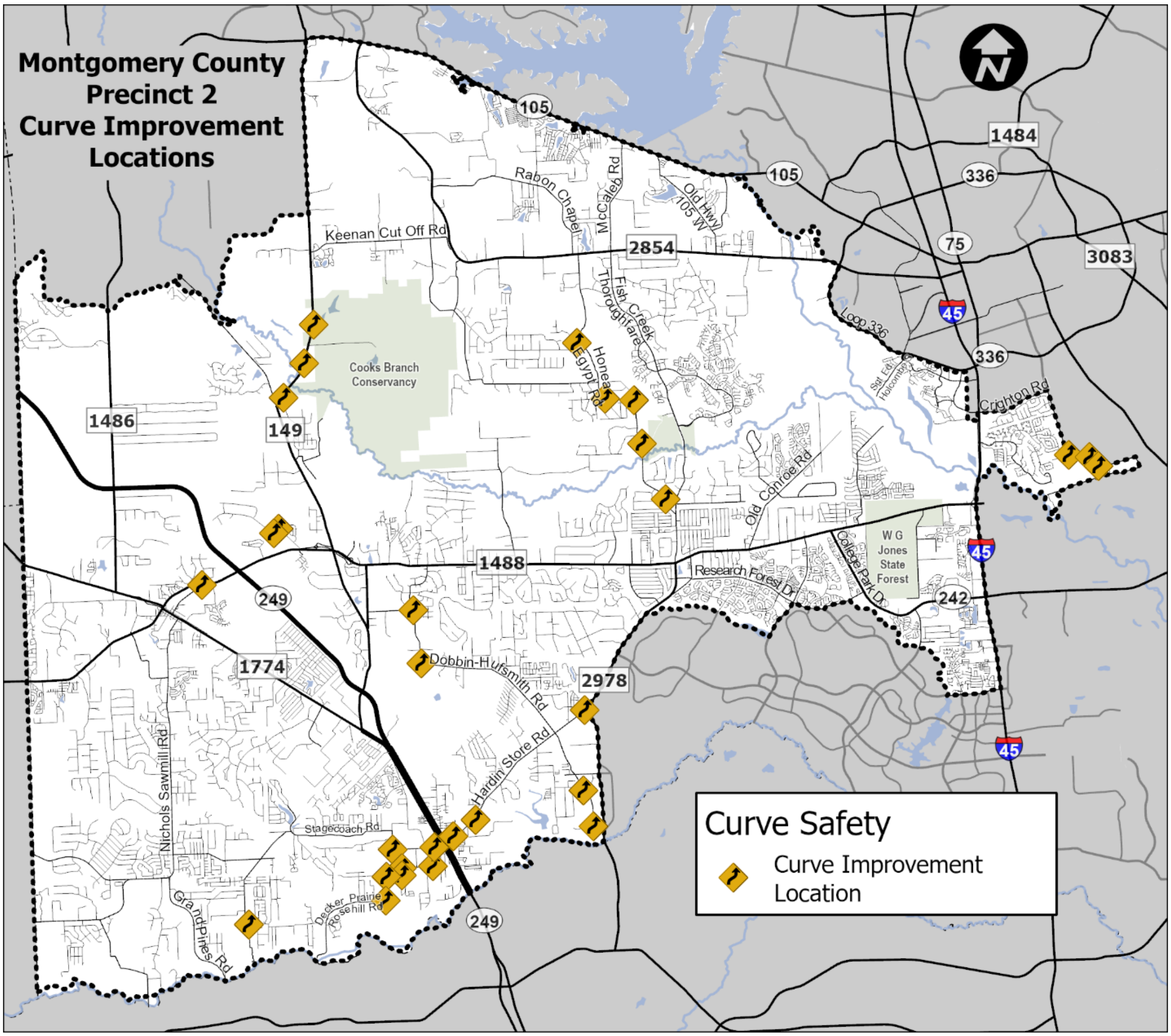


Figure II-3 Curve Improvement Locations

Below is a list of locations where curve alignment and warning devices should be improved. A map of identified locations can be found in Figure II-3.

- Dobbin-Hufsmith Rd: between Spur 149 and Robbie Lee Rd
- Dobbin-Hufsmith Rd: between Navajo Rd and McDugal
- Dobbin-Hufsmith Rd: between Rosie Ln and FM 2978
- Decker Prairie Rd: between Decker Dr and Peden Rd
- Decker Prairie Rd: between Decker Prairie Rosehill Rd and SH 249
- Decker Prairie Rosehill Rd: several locations along corridor
- FM 149: N of Lake Creek
- Hardin Store Rd: between just W of FM 2978 and FM 2978
- Hardin Store Rd: between SH 249 and Old Hardin Store Rd
- Honea Egypt Rd: several locations along corridor
- Mill Creek Rd: between just N of FM 1488 and FM 1488
- Walnut Creek: near Lonesome Pine St

E. Intersections

While roadway capacity is typically determined by the number of through lanes, individual intersections are also impacted by turning movement volumes, the number and type of turn lanes, turn lane storage length, signal phasing, and signal timing. After collecting turning movement counts and requesting current signal timing plans, key intersections throughout the precinct were modeled with Synchro traffic software.

Level of Service (LOS), which is determined by calculated intersection delay values, assigns a letter grade which describes the overall condition of how an intersection is operating. Intersections with LOS A & B are considered to be operating well with little congestion. Intersections with LOS C & D are experiencing some congestion, but most movements are able to function without excessive delay. Intersections with LOS E & F are experiencing heavy congestion, are largely over capacity, and it may take several cycles for a vehicle to cross through the intersection. Table II-3 shows the LOS based on delay values for signalized and unsignalized intersections.

Table II-3 Intersection Level of Service

LOS	Signalized Intersection Delay (Seconds)	Unsignalized Intersection Delay (Seconds)
A	≤ 10	≤ 10
B	10 – 20	10 – 15
C	20 – 35	15 – 25
D	35 – 55	25 - 35
E	55 – 80	35 - 50
F	> 80	> 50

Figure II-4 shows a Level of Service map for modeled locations in Precinct 2 during the AM Peak Hour, and Figure II-5 show LOS for the PM Peak Hour. Figure II-6 shows the highest Level of Service experienced for each intersection during the day.

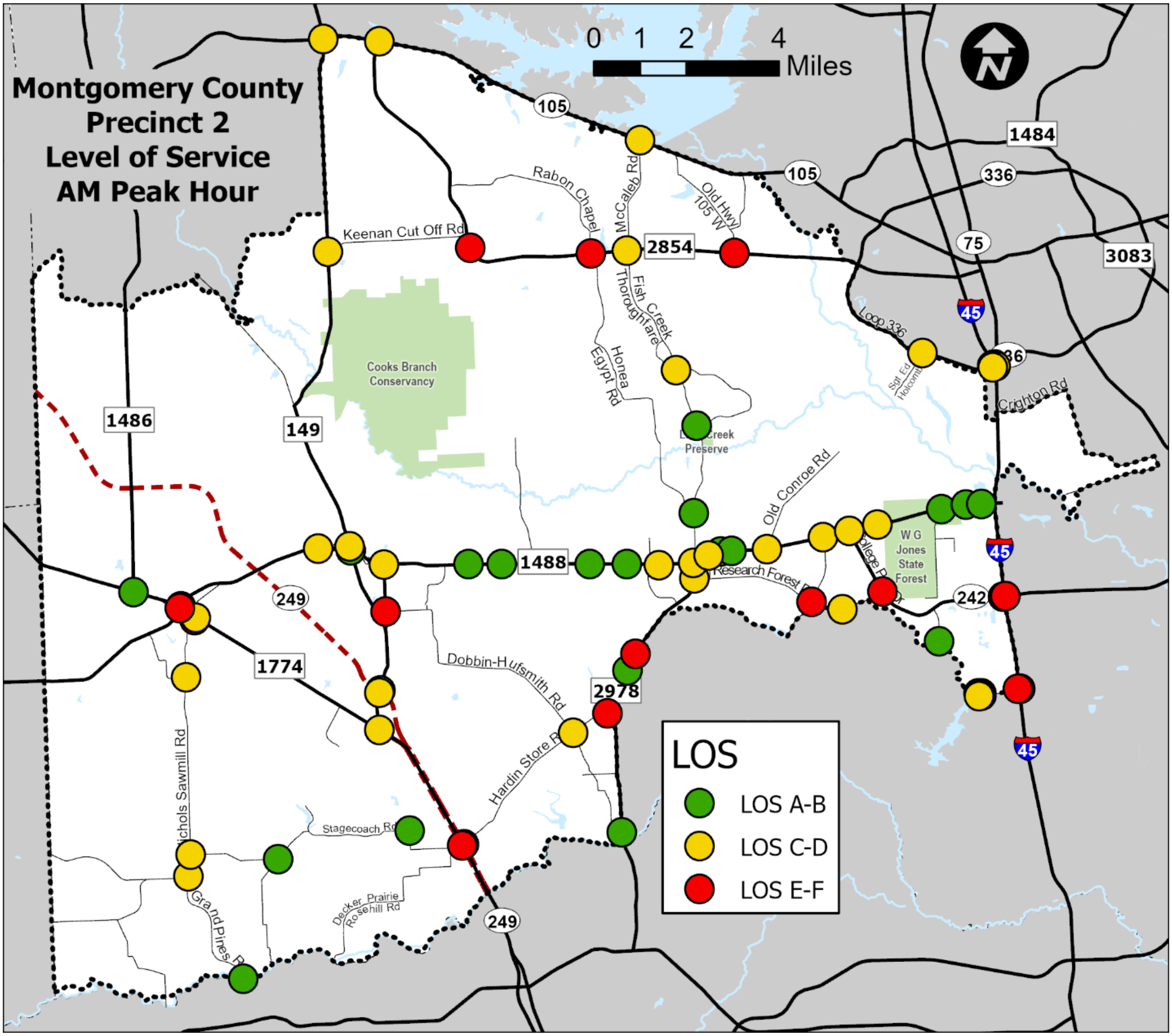


Figure II-4 AM Peak Hour Level of Service

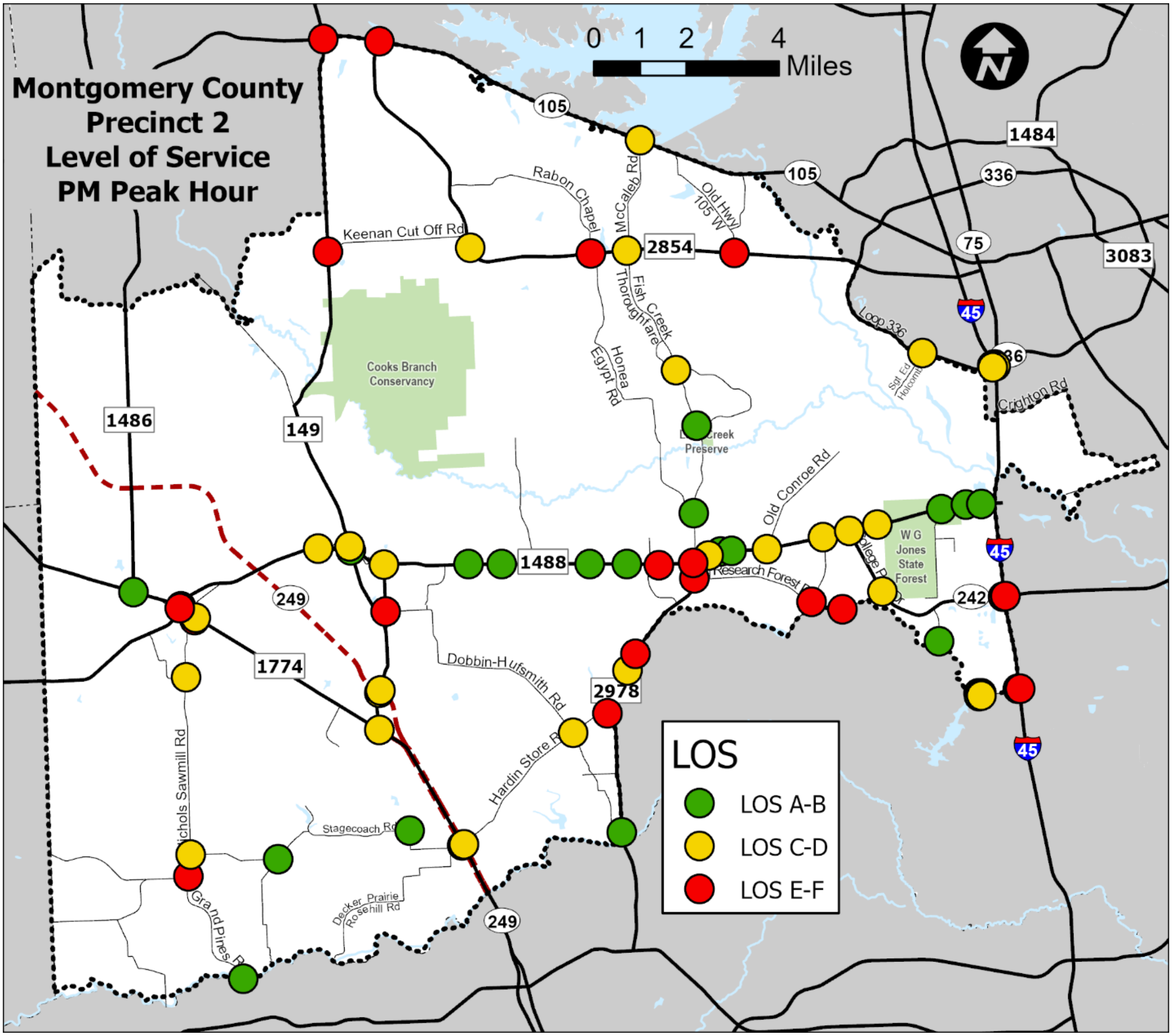


Figure II-5 PM Peak Hour Level of Service

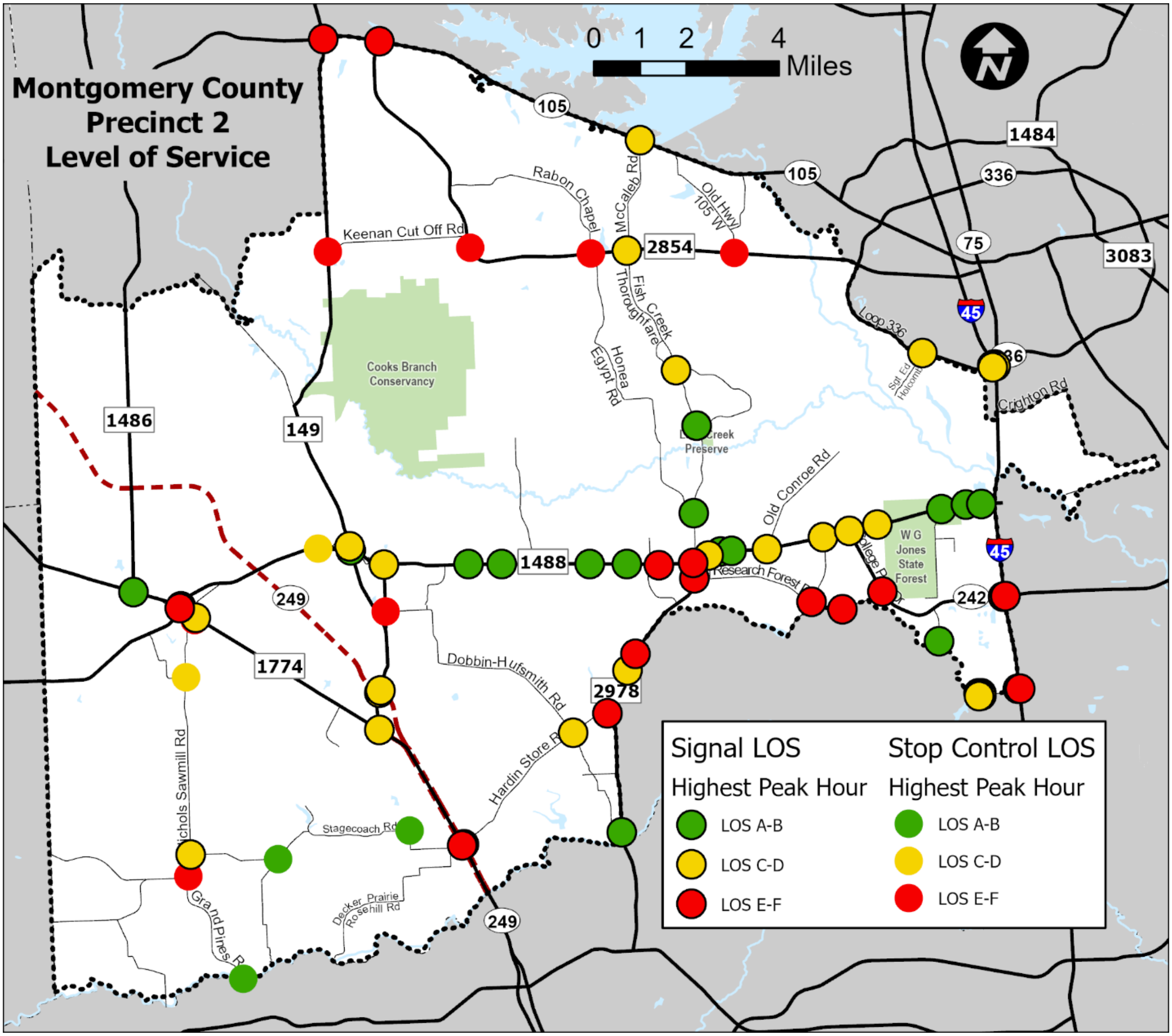


Figure II-6 Maximum Intersection Level of Service

Table II-4 shows a list of deficient intersections that are operating at LOS E or LOS F in existing conditions.

Table II-4: Intersections with Level of Service E or F

Intersection	AM - Existing		PM - Existing	
	LOS	Delay[1]	LOS	Delay[1]
FM 1488 & FM 1774	F	95.1	F	84.5
SH 249 SBFR & Decker Prairie Rd	E	70.0	D	44.8
FM 2978 & Hardin Store Rd	E	62.4	E	58.3
FM 2978 & Woodlands Pkwy	F	84.7	F	80.7
FM 2978 & Oak Creek Dr/Research Forest Dr	C	32.5	E	64.6
FM 2978/Honea Egypt Rd & FM 1488	D	46.7	E	56.1
FM 2854/Lone Star Pkwy & SH 105	D	49.1	F	81.9
FM 149 & SH 105	D	54.5	E	77.5
Kuykendahl Rd & Research Forest Dr	E	75.6	F	83.6
Research Forest Dr & Greenbridge Dr	C	32.8	E	63.5
SH 242 (College Park Dr) & Greenbridge Dr	F	101.6	C	28.9
IH 45 SBFR & SH 242	F	192.7	F	174.7
IH 45 NBFR & SH 242	F	88.6	F	217.3
IH 45 SBFR & Research Forest Dr	F	101.2	E	61.9
IH 45 NBFR & Research Forest Dr	D	47.3	E	71.1
Tamina Rd & FM 1488	C	32.4	E	68.8
Spur 149 & Dobbin Hufsmith Rd[2]	F	104.4	E	42.5
FM 149 & Keenan Cut Off Rd[2]	D	30.8	F	68.9
FM 2854 & Keenan Cut Off Rd[2]	F	57.5	C	17.3
FM 2854 & Rabon Chapel Rd[2]	F	77.1	F	51.4
FM 2854 & Old Hwy 105 W[2]	F	62.5	F	97.0
Nichols Sawmill Rd & Commerce St[2]	F	334.6	F	88.5
Grand Pines Rd & Nichols Sawmill Rd & Nichols St[2]	D	30.5	F	135.5

[1] Delay is presented in seconds per vehicle

[2] Unsignalized Intersection - HCM 6th Edition Critical Lane LOS Used

F. Alternative Modes

Alternative modes of transportation include biking, walking, and transit. While there are some shared use facilities in The Woodlands area of Precinct 2, overall, there is a lack of facilities for alternative modes of transportation. Additionally, many of the existing facilities lack connectivity.

Many of the corridors in Precinct 2 are used by cycling groups and organizations, however, there have been concerns raised about safety on some of these roadways. Some corridors are not sufficiently signed to warn drivers of the presence of bikes. Other frequently used routes lack a safe space for bicycles, such as a wide shoulder. Some locations with shoulders have jutting curbs near intersections that force cyclists into the road.

There is currently only one Park-and-Ride facility located within Precinct 2. Based on observed commute patterns, it would be beneficial to add additional locations near the City of Magnolia and the City of Montgomery. There also is no regional transit that connects major residential and employment centers in Precinct 2.

Below is a list of specific locations where alternative mode connections are deficient.

1. Lack of "Share the Road" or bicycle warning signing along roads designated as existing signed bike routes, including FM 1488, FM 2978, Dobbin Hufsmith Rd, Jackson Rd, and Keenan Cut Off Rd.
2. Sections of existing shared use paths along SH 242 are not connected.
3. Gaps and dead ends in Shenandoah trail network.
    a. About 650' gap on north side of Vision Park Blvd, east of McGoey Cir
    b. About 140' gap on west side of IH 45 SBFR, south of Vision Park Blvd
    c. About 210' gap on west side of IH 45 SBFR, between Wellman Rd and Shenandoah Dr
    d. Path on Holly Hill Dr ends about 175' south of Hickory Ridge Dr
4. Lack of connectivity between shared use trail networks in Shenandoah and The Woodlands.
    a. Shenandoah trail along north side Research Forest Dr ends at east side of Grogans Mill Rd with no connection to The Woodlands trail on west side of Grogans Mill Rd.
    b. No connection between Vision Park Blvd trail to Gosling Sports Fields or path on Marsico Pl.
5. Honea Egypt Rd, which is used regularly by cyclists, does not have shoulders, and the corridor has several sharp curves that limit visibility.
6. Jutting curbs at intersections along Research Forest Dr between Branch Crossing Dr and Alden Bridge Dr. They also occur further east on Research Forest Dr outside Precinct 2. Jutting curbs provide protection for pedestrians waiting to cross at intersections from right turning vehicles, but the current configuration forces cyclists out of the shoulder into the main vehicular travel lanes. There are currently no gaps between curb and travel lane for cyclists to remain in the shoulder through the intersection, nor are there any connections from the shoulder to shared use paths so cyclists can transition behind the curb and make use of crosswalks to travel through intersection.

III. Existing Challenges

There are several challenges to overcome in addressing the existing deficiencies in Montgomery County Precinct 2. One of the major challenges to enhancing connectivity within the precinct is due to extensive existing development. Many existing neighborhoods act as roadblocks to potential new corridors that would connect across the region. It will be a challenge to acquire new right-of-way within already developed areas both for adding capacity to existing corridors and for building new roadway corridors. The amount of connectivity for an area is often decided when neighborhoods are designed. There are hundreds of Cul-de-sacs and other dead ends within Precinct 2, and many gated communities with restricted roadway access. Cul-de-sacs and restricted access roadways significantly reduce connectivity for the surrounding area.

There are several natural barriers within Precinct 2, including the San Jacinto River, Lake Creek, numerous small creeks, flood plains, state parks, and conservancies. Natural barriers can impact connectivity, capacity, and geometric design. These pose a challenge for roadway extensions or adding new roadways would provide traffic relief for several major corridors. Rivers and flood zones require costly bridges. If not properly designed, potential roadway flooding may occur, which would block mobility and access for emergency personnel. Coordination with the Cooks Branch Conservancy and W. G. Jones State Forest will be required to provide crucial east/west and north/south connections, but these parties may be unwilling to have new roadways cross their property. While these natural barriers provide challenge to mobility, they can also provide the opportunity to create assets that benefit the region. Floodplains, which are impractical for residential and commercial development, can be turned into parks and detention facilities adjacent to new roadways. Waterways can provide attractive and safe locations to build shared use trails away from vehicular traffic.

There are several railroad corridors throughout the precinct. These provide a challenge for any new roadways, as at-grade railroad crossings are undesirable. Railroad over/under-passes are expensive to construct and typically require additional right-of-way.

Funding opportunities are limited for construction of new roadways that enhance connectivity within Montgomery County Precinct 2, particularly for those that require additional funds for bridges and overpasses.

Another challenge in addressing existing issues and preparing for future growth will be garnering support for innovative solutions from both the public and government officials. Expected growth and development in the region will test the existing infrastructure, some of which is already inadequate. Alternative modes such as transit may be needed to relieve congestion where there are physical barriers that limit connectivity and capacity. The current focus of the region is on personal vehicles, usually with a single occupant.