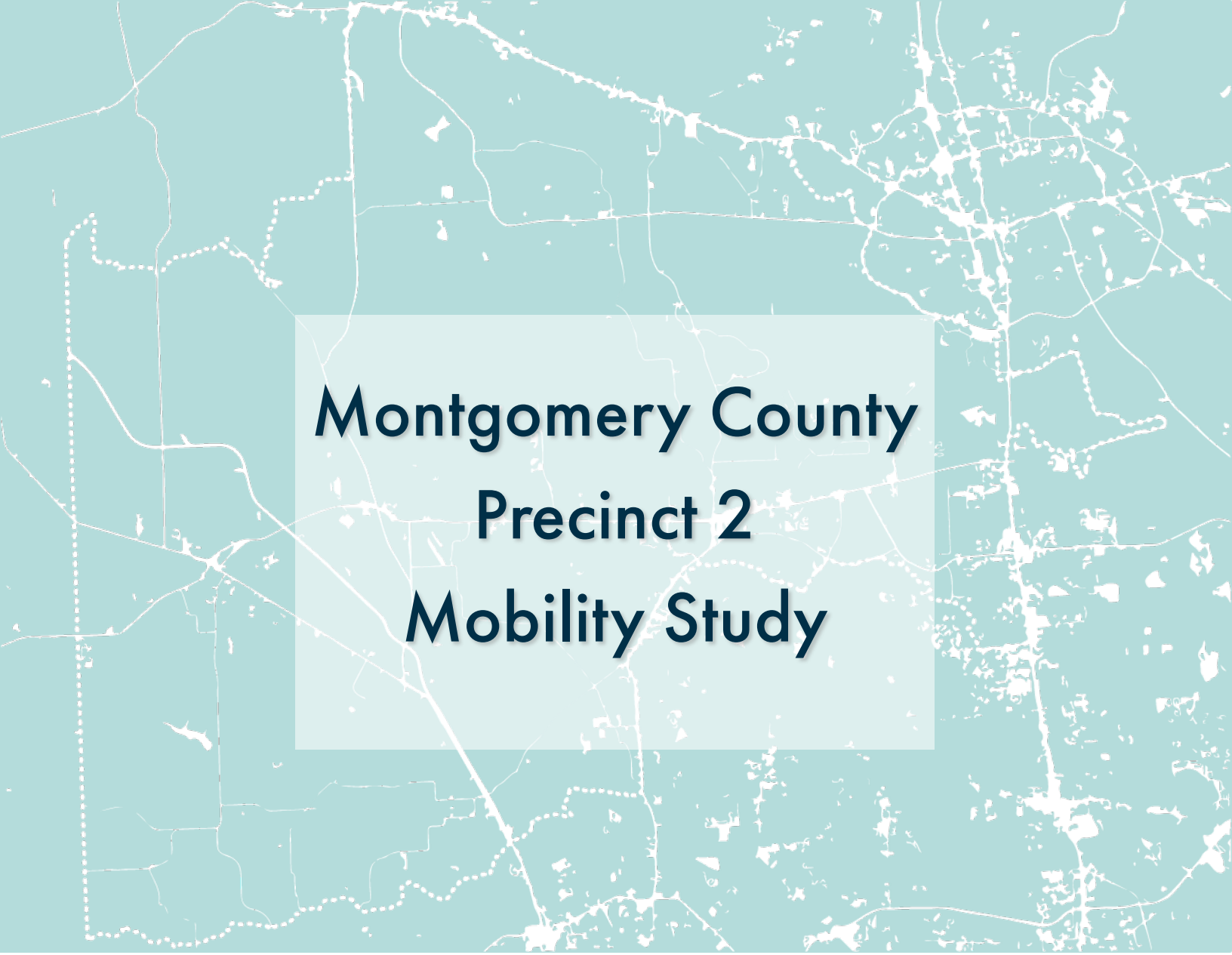

Montgomery County Precinct 2 Mobility Study

Final Report

December 2022

HDR

GUNDA CORPORATION

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Acknowledgements

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I. Introduction

Houston-Galveston Area Council (H-GAC) established a partnership with Montgomery County Precinct 2, led by Commissioner Charlie Riley, to conduct a regional mobility study. Montgomery County Precinct 2 Mobility Study represents a concentrated effort to address existing and future mobility needs in Southwest Montgomery County. The Precinct includes the City of Magnolia and portions of the Cities of Conroe, Montgomery, Shenandoah, and The Woodlands Township. Due to the completion of SH 249 toll road, this area is experiencing explosive growth in residential and commercial developments resulting in escalating congestion and mobility challenges. This sub-regional mobility plan aims to address these challenges and provide a framework for future investments. Figure I-1 shows a map of the area covered by this study.

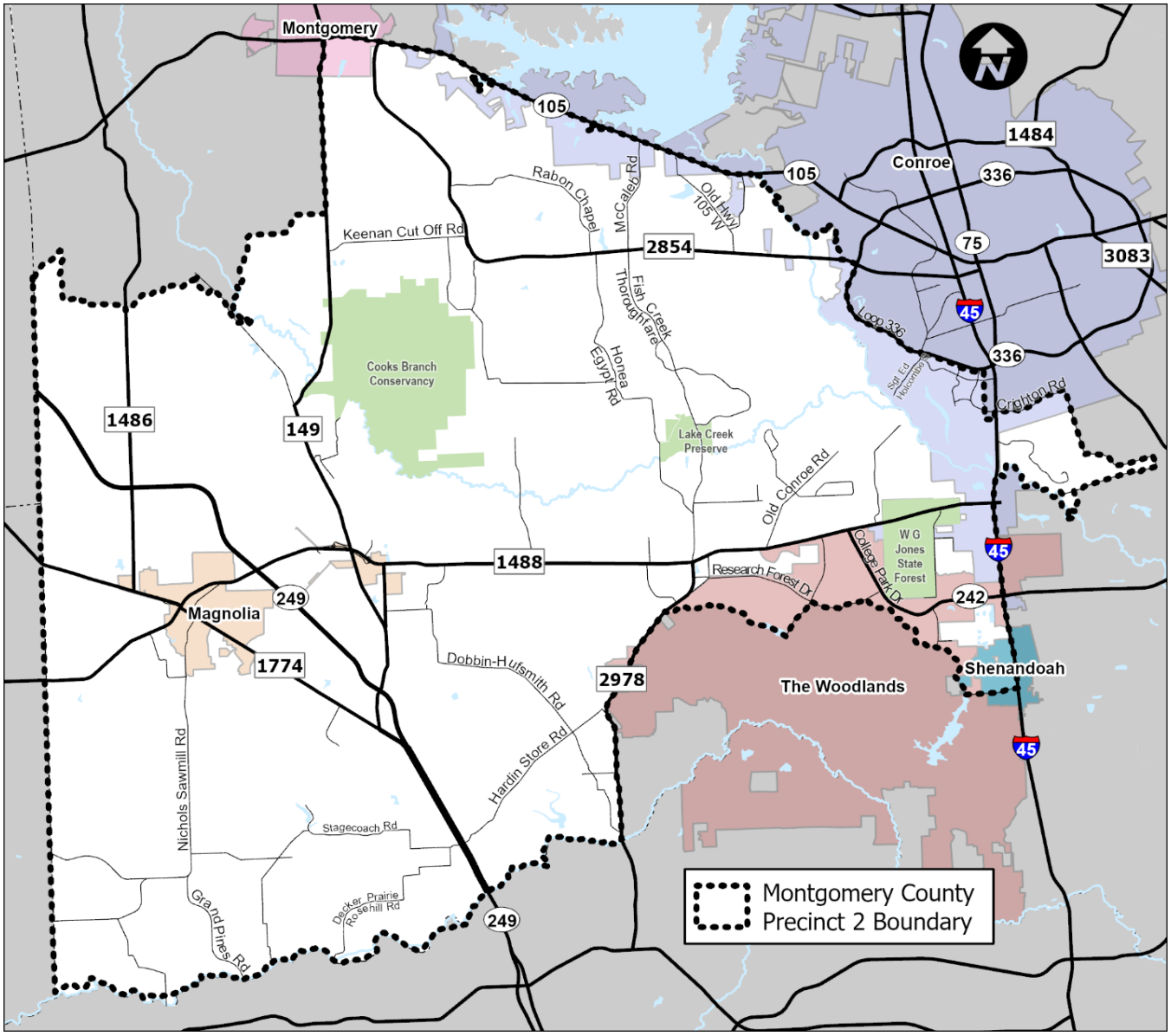

Figure I-1: Study Area Map

The Montgomery County Precinct 2 Mobility Study is a 2-year comprehensive transportation study that has identified existing and future transportation needs by integrating land use and growth scenarios. A roadway inventory of arterial and collector streets was performed to identify maintenance, safety, and capacity concerns within the precinct. Additional mobility needs and issues have been identified using input from the steering committee, focus groups, public, and data analysis. The study team has collected a variety of existing conditions data for the region, including existing roadway conditions, crash data, planned developments, and traffic data. The study has resulted in a list of projects that, if implemented, will improve the safety and mobility of the region into the future. The findings of this study will guide short-term and long-term transportation investment decisions of local governments within the study area region.

II. Vision and Goals

A project vision and goals were developed for Montgomery County Precinct 2 Mobility Study to guide the trajectory of the project. These are listed below.

A. Vision

Develop a **safe**, **well-connected**, and **efficient** multi-modal transportation system, achieved through **coordinated public and private investments**, that promotes **orderly growth** and provides **adequate mobility** for people, goods and services.

B. Goals

- Improve Safety
- Achieve and Maintain a State of Good Repair
- Move People and Goods Efficiently
- Strengthen Regional Economic Competitiveness
- Conserve/Protect Natural and Cultural Resources

III. Data Collection & Roadway Inventory

A. Data Collection

Types of data collected as a part of the mobility study include Average Annual Daily Traffic, crash records, collected traffic counts (24-hour volume and 12-hour turning movement counts), travel time runs, existing land use, proposed developments, signal timing plans, projected population, household, and job growth rates, planned roadway improvements, GIS data, regional plans, previous studies, and existing traffic count data from other studies.

A full summary of raw data assembled, including traffic volume and travel time reports, can be found in APPENDIX B.

B. Roadway Inventory

A roadway inventory was conducted to evaluate the physical conditions of the existing roadways. The inventory was developed to help identify and prioritize roadway segments in need of maintenance to continue operability. **214 miles** of arterial and major collector roadways in Montgomery County Precinct 2 were evaluated. The inventory collected information on the state of pavement condition, signage, pavement marking, and drainage. Also identified were the number of lanes, the median or roadway center type, pavement type, approximate roadway and shoulder width, sidewalks, bike lanes, the posted speed limit, and curb and gutter. The complete Roadway Inventory can be found in APPENDIX C. A map of roadways included in the Roadway Inventory can be seen in Figure III-1.

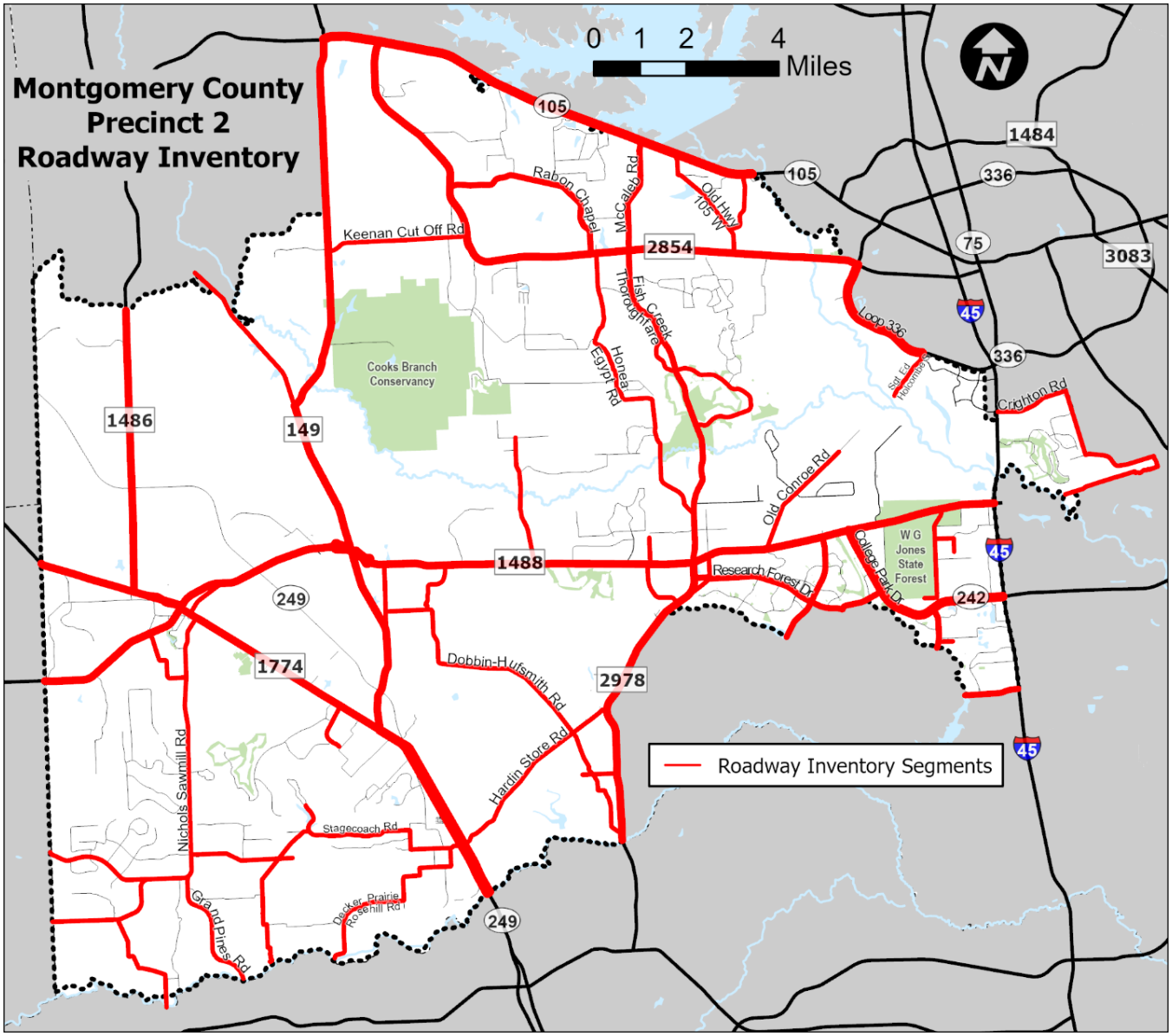

Figure III-1: Inventoried Roadways in Montgomery County Precinct 2

IV. Issues and Needs

Hundreds of specific issues and needs were identified by the steering committee members, stakeholders, and the public. Those issues and needs were grouped into major issues, shown in Table IV-1

Table IV-1: Major Identified Issues

Major Issues	Steering Committee	Focus Groups	Public Input
Traffic Congestion	X	X	X
Dangerous Road Curves	X	X	X
North/South Connectivity	X	X	X
East/West Connectivity	X		X
Transit Needs	X	X	
Intersection Congestion	X	X	X
Need Bike Routes	X	X	X
Corridor Signal Timings	X	X	X
Railroad Crossings	X	X	X
Flooding near IH-45/SH242	X		X
Extend Old Conroe Road	X	X	X
FM 2978 Construction	X	X	X
School Traffic	X		X
Safety - Crashes	X	X	X
New Developments	X		X
Hospital Access		X	
Need Turn Lanes			X
Access Management			X
Need Road Widening			X
Need Street Lighting			X
Signing and Pavement Marking			X

Using input and data collected for the mobility study, the study team has identified the following as overall issues and needs affecting Montgomery County Precinct 2 mobility:

- Issue: Lack of Road Connectivity
  - Limited east-west and north-south corridors
  - Lack of alternative routes
  - Cities, large commercial areas, and medical/educational institutions are disconnected
  - Many roads end in T-intersections, dead ends, or have restricted access (see Figure IV-1)
- Issue: Limited Sidewalks/Bike Trails
  - Paths are limited to certain regions of Precinct 2
  - Existing sidewalks, bike trails, and shared use paths are disjointed (see Figure IV-2)
  - Existing on street bike routes not well signed to alert drivers or lack sufficient shoulders
- Issue: Limited Transit Options
  - One existing Park & Ride in Precinct 2
  - No fixed route transit services located within Precinct 2

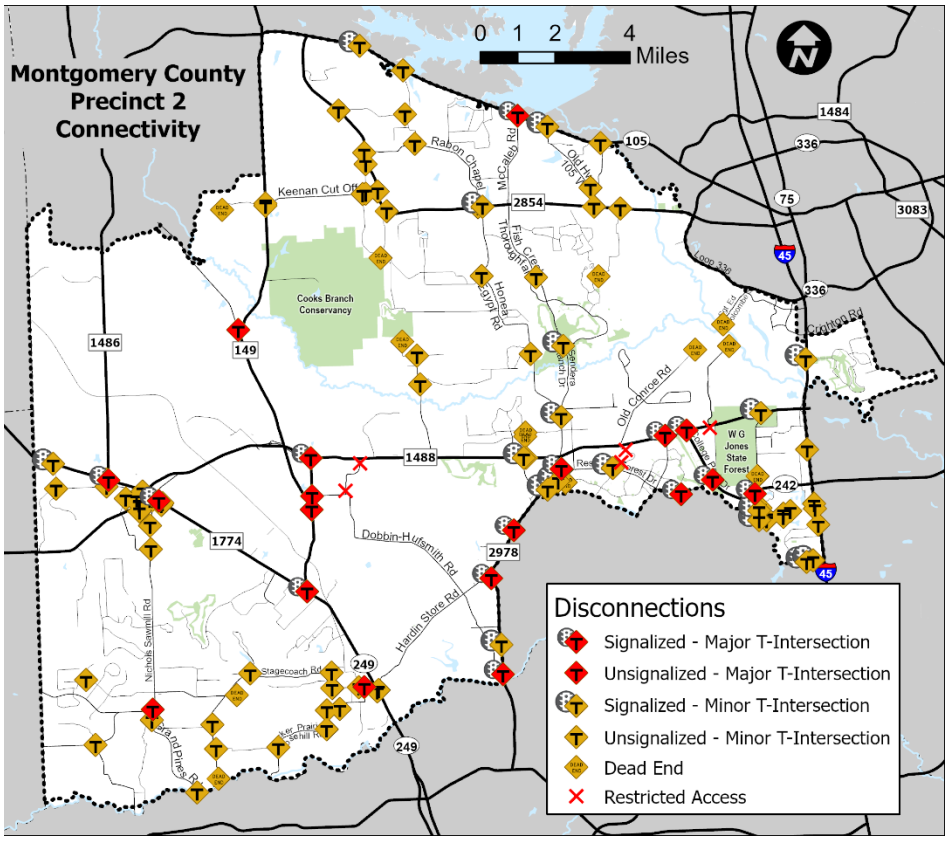

Figure IV-1: Precinct 2 Disconnections

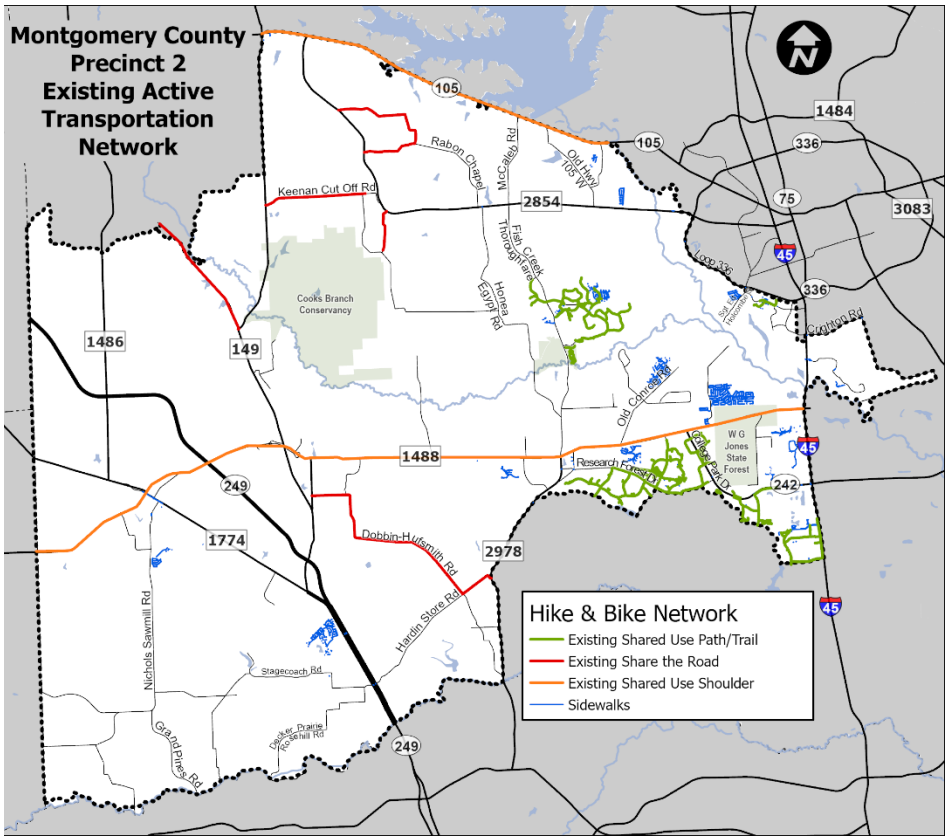

Figure IV-2: Existing Active Transportation Network

- Issue: Natural and Man-made Barriers (see Figure IV-3)
  - Major waterways and flood plains
  - Railroads
  - Existing development
  - Protected lands and conservancies

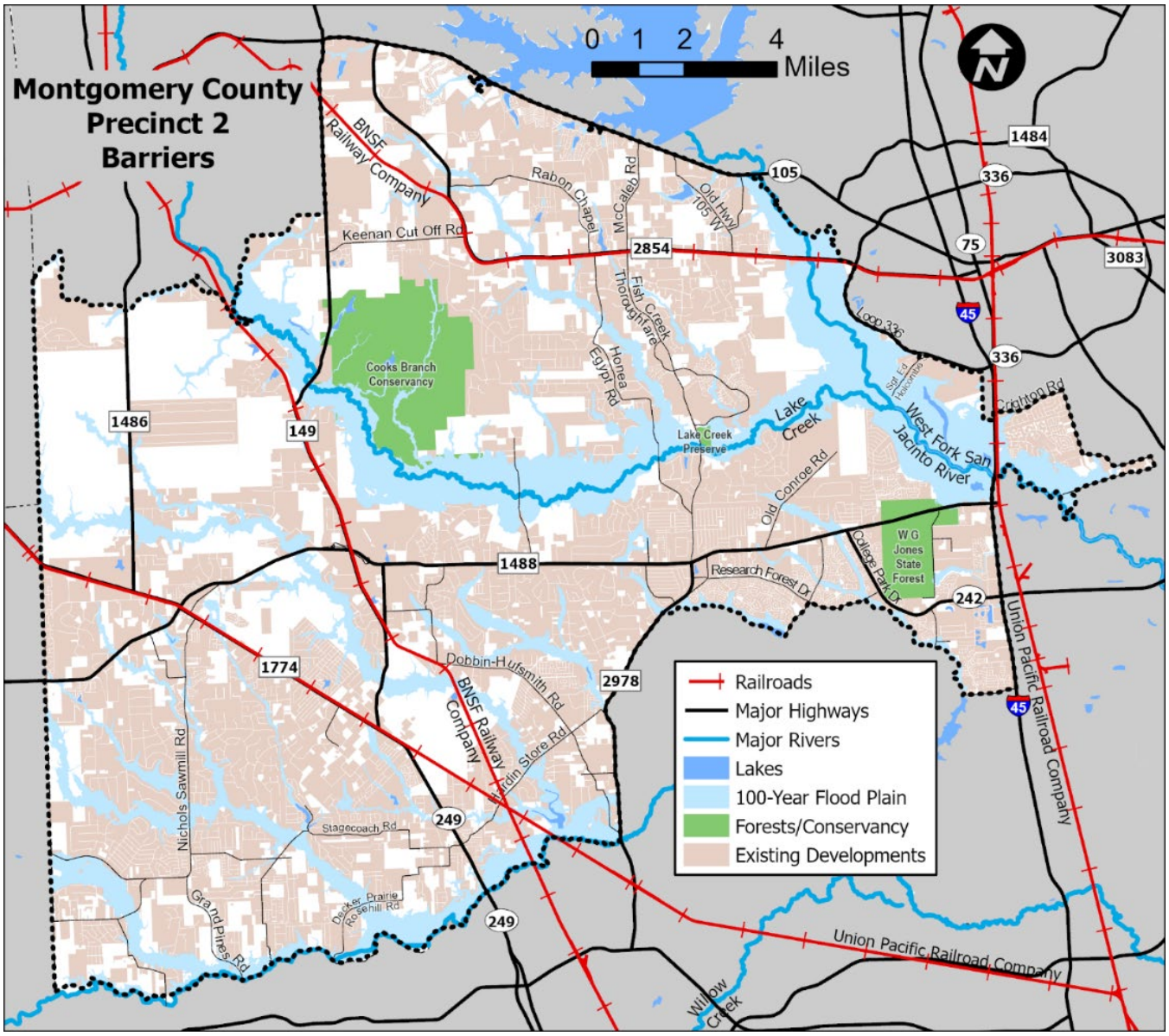

Figure IV-3: Barriers

- Issue: New Development
  - Insufficient roadway network to support new development and associated traffic

- Issue: Safety
  - "S" curves on roadways
  - High driver speeds
  - At-grade railroad crossings
  - Limited street lighting
  - High number of crashes – 12,459 from 2016 to 2020 (see Figure IV-4)
  - Driveway related crashes – lack of access management

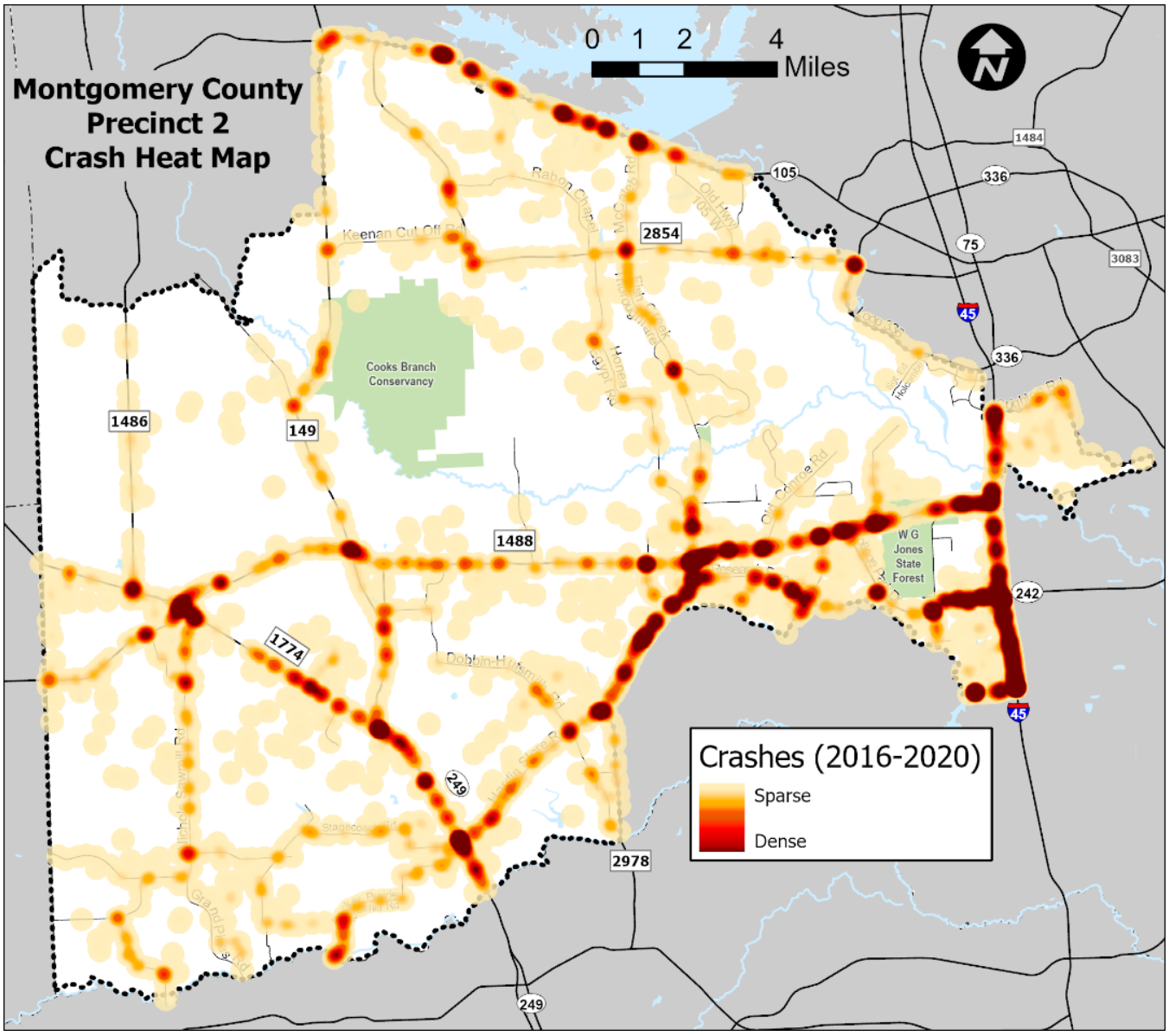

Figure IV-4: 2016-2020 Crash Heat Map

- Issue: Congestion
  - Intersection delays – many intersections currently have Level of Service E or F during peak hours (see Figure IV-5)
  - Corridor congestion – many corridors currently over capacity (see Figure IV-6)

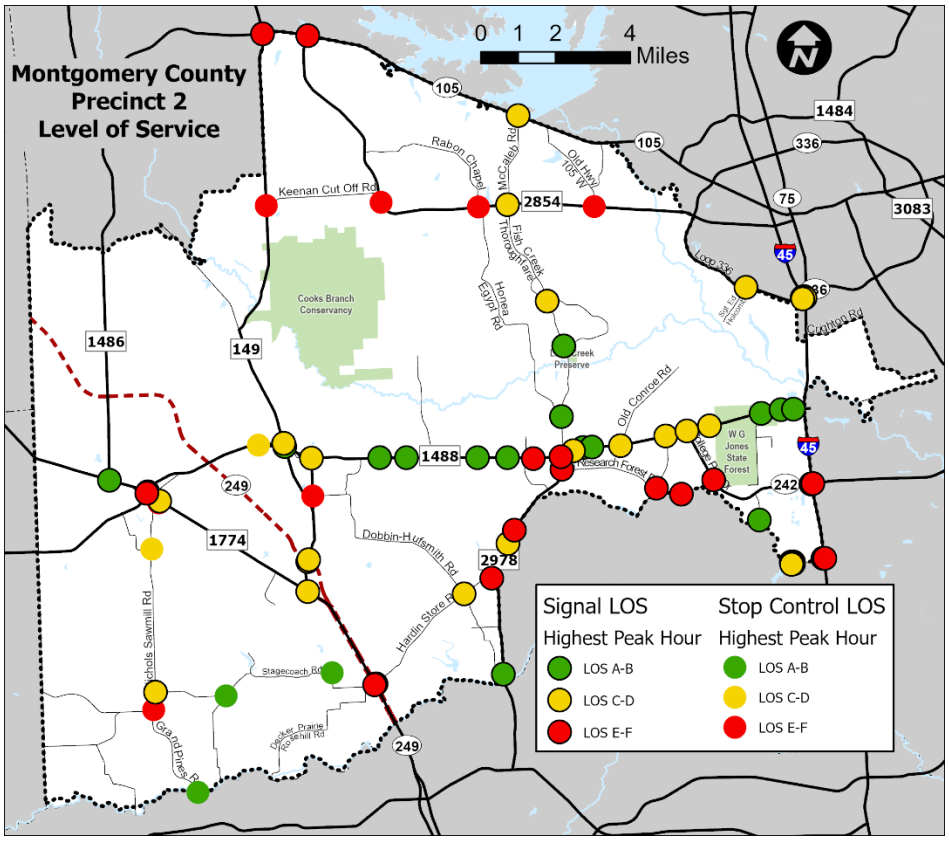

Figure IV-5: Existing Highest Peak Hour Level of Service

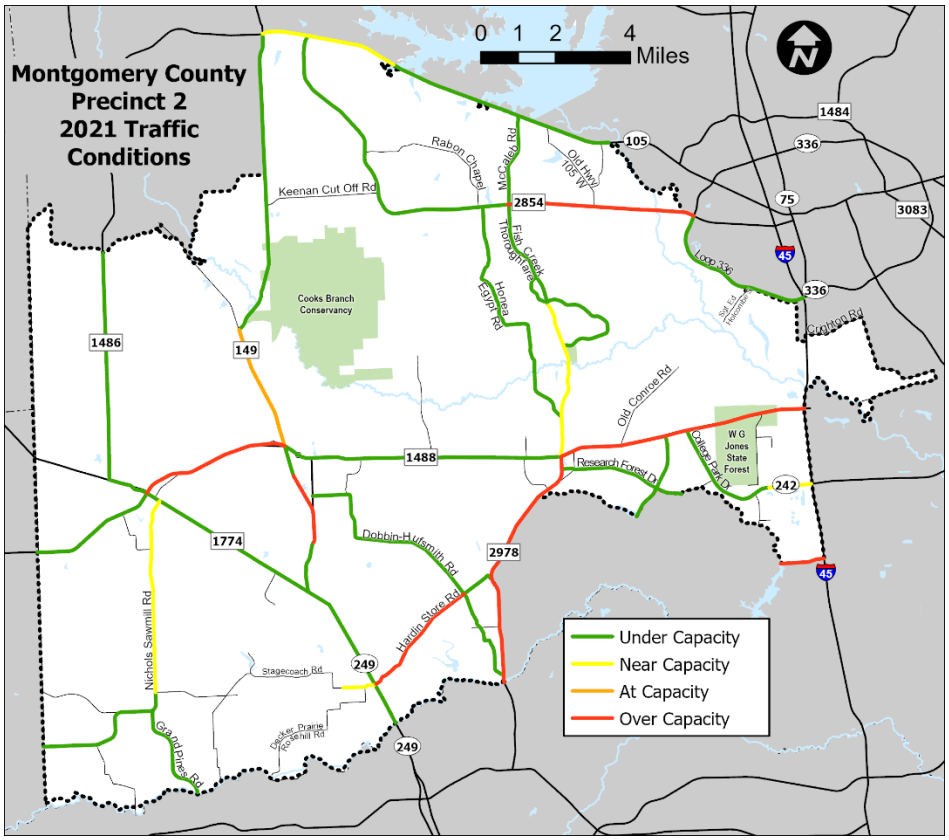

Figure IV-6: 2021 Corridor Congestion

- Need: Intersection Improvements
    - Signal timing updates
    - Added turn lane capacity
    - Turning radius adjustments for large vehicles
    - Railroad grade separation
- Need: Corridor Connectivity
    - Added capacity – road widening and turn lanes
    - Better connectivity – connect existing roads that end in T-intersections or dead ends and add alternative routes
- Need: Safety Improvements and Maintenance
    - Added street lighting for nighttime visibility
    - Reduced curvature of road curves
    - Improved or added warning signs and pavement markings for curves, wildlife, bicycles, and highway intersections
    - Railroad grade separations
    - Access management – raised medians and driveway consolidation
    - Repair or resurfacing of roadways in poor condition
    - Refreshed roadway markings or corrected striping to follow standards
- Need: Active Transportation and Transit Improvements
    - Improved regional connectivity for alternative transportation modes
    - Protected paths for bicycles and pedestrians separate from roadway
    - Local transit options between major regional destinations

There are several challenges to overcome in addressing the existing deficiencies and issues in Montgomery County Precinct 2. A major challenge is enhancing connectivity around existing developments, such as neighborhoods and commercial centers, and natural barriers, including the San Jacinto River, Lake Creek, numerous small creeks, flood plains, state parks, and conservancies. These barriers act as roadblocks to potential new corridors or require costly additions such as bridges and route bypasses. Other challenges include explosive regional growth that will test the existing regional infrastructure, identifying timely funding opportunities to meet regional needs, and garnering public and governmental support for unconventional and innovative solutions.

A full summary of issues and needs can be found in APPENDIX D. A memo outlining existing deficiencies and challenges can be found in APPENDIX E.

V. Public Engagement

The Montgomery County Precinct 2 Mobility Study has sought to engage with members of the public that live and work within the study area, as well as key interest groups such as school districts, fire departments, hospital groups, and other area local responders. Feedback from the public helped to identify major mobility and safety concerns, determine and prioritize the wants and needs of people who travel through the region, and to solidify the final list of recommendations. During the course of the mobility study, there have been 2 public meetings, 8 steering committee meetings, 3 rounds of focus group meetings, and a working group meeting focused on the Research Forest Dr at Grogan's Mill Rd intersection. Meeting summaries can be found in APPENDIX F.

A. Working Group Meeting

The Research Forest Dr at Grogan's Mill Rd Working Group meeting identified several issues at the intersection and discussed local preferences for the future of the intersection. There were several safety concerns identified during the meeting, including visibility issues (overgrown vegetation and poor nighttime lighting), speeding, red light running, wrong way drivers, drivers going straight in turn only lane, driver inattention, and missing signage and pavement markings.

It was determined that if future geometric changes were to eventually be implemented at the intersection, an at-grade solution would be preferable to the meeting attendees and to the City of Shenandoah.

As a result of the meeting, several additional improvements were added to the project recommendations. Figure V-1 shows a map of the intersections with some of the recommended improvements. Recommended improvements include adding missing and additional signing and pavement markings, improved intersection street lighting, additional and extended turn bays, clearing vegetation and lowering berm, and signal improvements. Signing and marking improvements include adding required "Do Not Enter" and "Wrong Way" signs, adding a pedestrian and bicycle warning sign, adding additional lane configuration signs, and updating turn lane pavement markings. Signal improvements include adding louvers on some signal heads to prevent visibility from upstream intersection, updated signal timing, and adding reflectorized back plates to signal heads.

Some of the recommendations have already been implemented by Montgomery County. All missing "Do Not Enter" signs have been added, and illuminated "Wrong Way" signs have been added for improved safety and visibility. Additionally, reflective tape has been added to all of the intersection signal head back plates. This will improve both day and nighttime visibility. Louvers have been added to green ball signals on internal movements to prevent vehicles at the upstream signal from seeing the traffic light until they get closer to the intersection. Additional signal heads have also been added for some approaches. Left and through arrows have been added to some locations for further clarity.

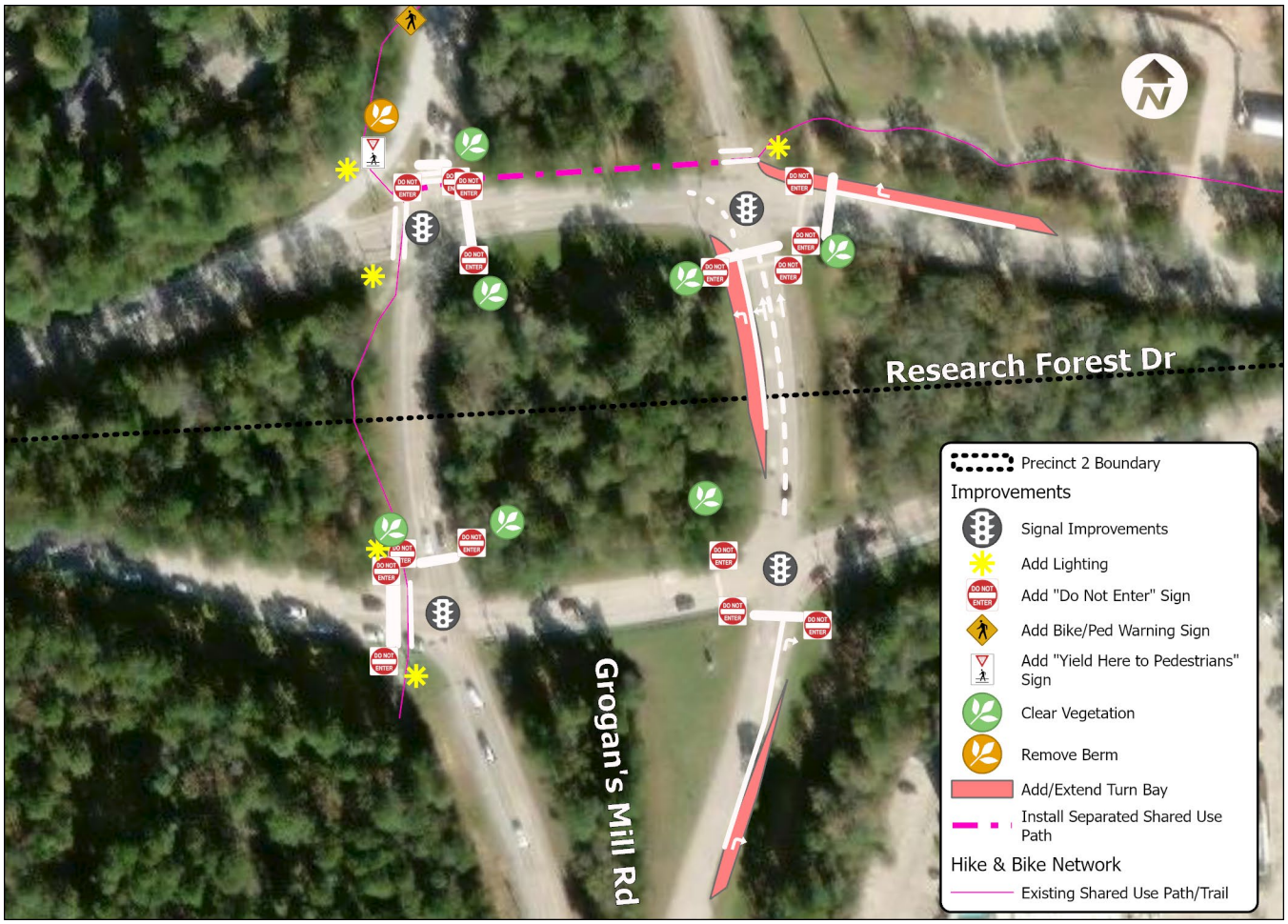

Figure V-1: Research Forest at Grogan's Mill Recommended Improvements

B. Public Input

1. First Public Meeting and Public Comment Maps

The first public meeting for the study was held virtually in April 2021 and had 75 attendees. Following the first Montgomery County Precinct 2 Mobility Study Public Meeting, people were asked to identify locations on an interactive map where they had mobility concerns. Figure V-2 shows a map of locations identified by members of the public using the interactive tool. Categories include Congestion and Delay, Safety, Access and Connectivity, Bike/Pedestrian/Transit, and Other. There were 103 comments received from 40 respondents. Table V-1 shows the number of comments received for each category. The largest number of comments were on Congestion and Delay.

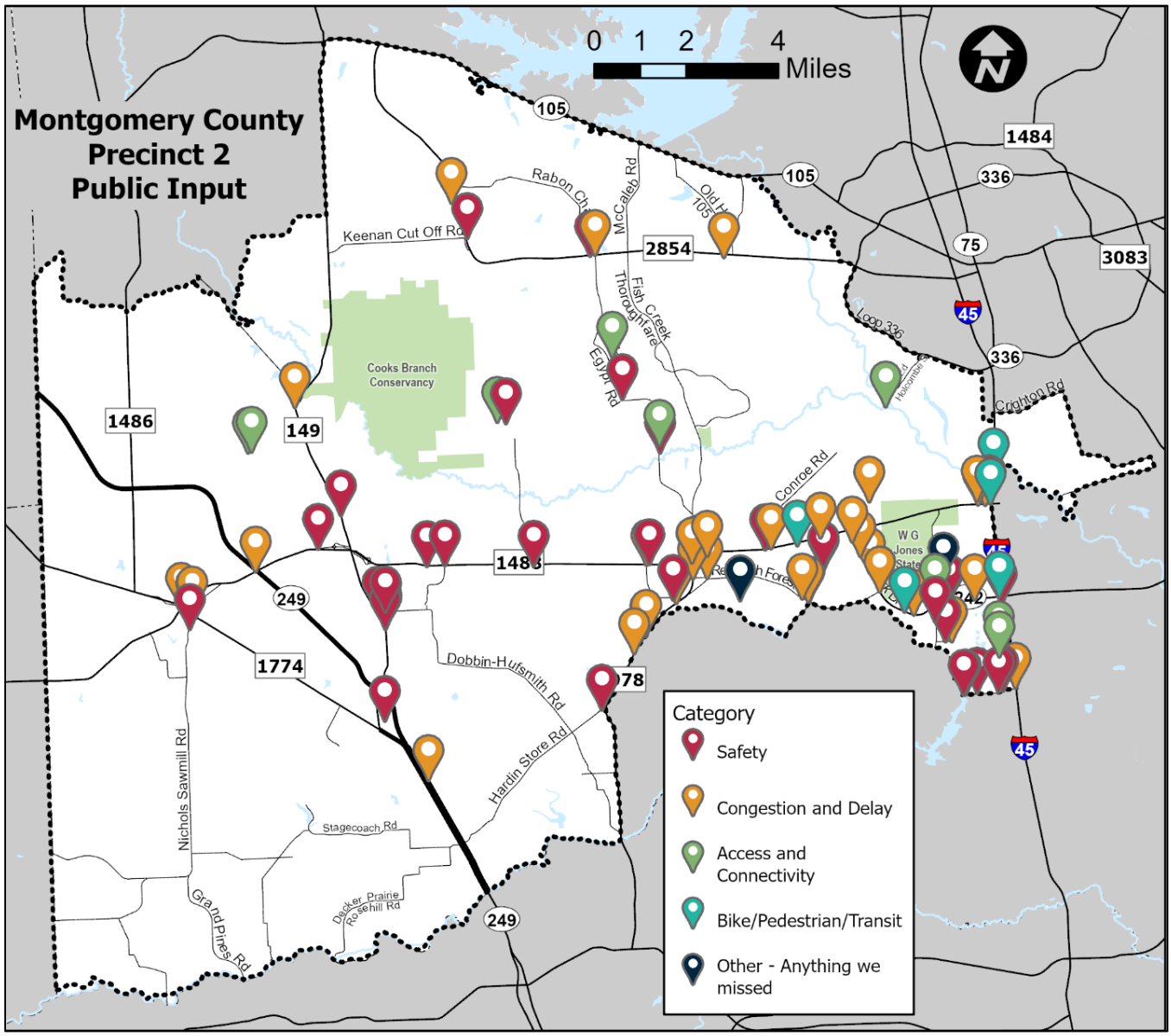

Figure V-2: Public Input Map

Table V-1: Public Input Categories

Category	Number of Comments
Congestion and Delay	52
Safety	35
Access and Connectivity	19
Bike/Pedestrian/Transit	5
Other	2

2. Public Survey

In addition to the interactive comment map, there was also a public survey put out on the HGAC project website after the first public meeting. There were 81 responses to the survey. One of the questions asked respondents to rank a series of mobility issues within Precinct 2. Figure V-3 shows the issues ranked from most preferred to least preferred, and Table V-2 shows in more detail what rank was designated for each issue by all respondents.

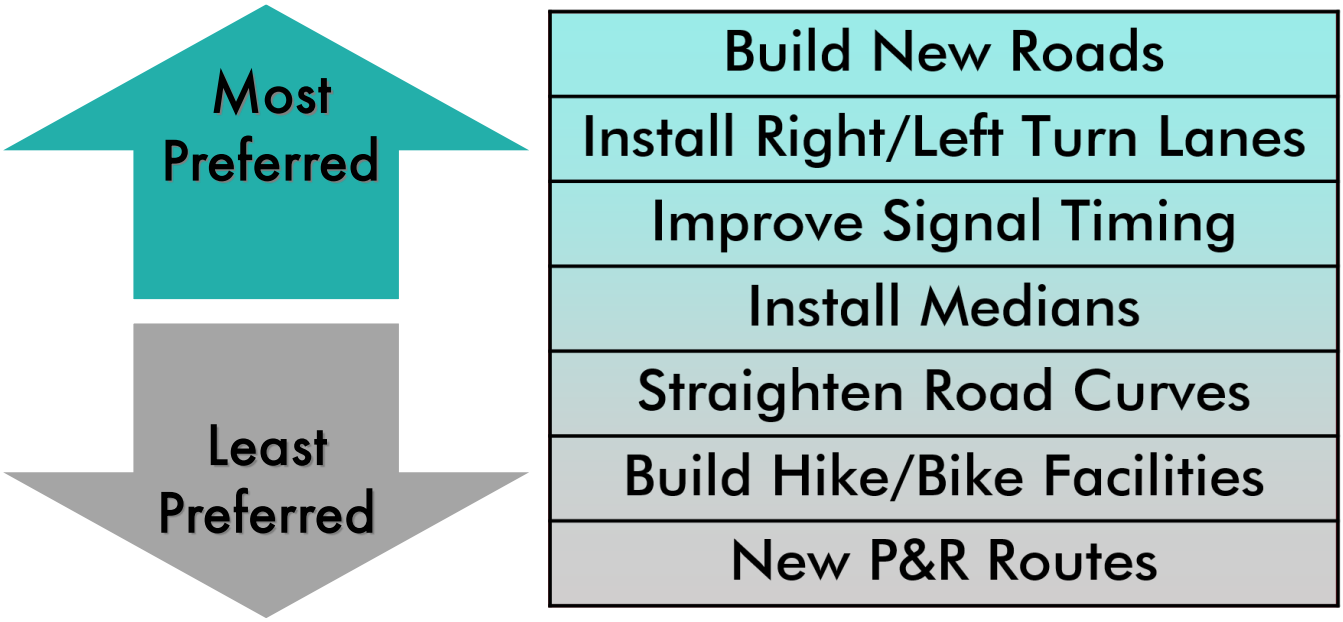

Figure V-3: Ranked Mobility Issues

Table V-2: Ranked Mobility Issues

Mobility Issue	Ranking						
	1 (Most Preferred)	2	3	4	5	6	7 (Least Preferred)
Build New Roads	28	12	13	7	5	6	10
Improve Signal Timing	18	17	18	9	10	3	6
Install Right/Left Turn Lanes	14	24	13	17	7	4	2
Install Medians	13	9	15	19	18	6	1
New P&R Routes	4	7	4	2	11	19	34
Straighten Road Curves	2	6	13	17	15	23	5
Build Hike/Bike Facilities	2	6	5	10	15	20	23

Some of the key issues identified by the public include:

- Congestion and delay on FM 1488 at FM 2978
- Issue with signal coordination along SH 242/College Park Dr
- Issue with I-45 and FM 1488 interchange traffic operations
- Congestion and safety issue on FM 149 at Spur 149
- Cut-through traffic on Tamina Rd
- Illumination, drainage, and signal coordination issue on Research Forest Dr
- Bike safety along Honea Egypt Rd
- Speeding on FM 1488 east of FM 149

3. Second Public Meeting

The second Public Meeting was held in person in August 2022 and was well attended with over 80 participants. An interactive map of the draft recommendations was shared with the public, and a survey was provided online to receive feedback on the recommendations. During the public meeting, 10 comment cards were received, and 24 online recommendations surveys were completed.

Many of the comments were related to removing specific recommendations, while others showed support for recommended projects.

After reviewing the public comments, a number of draft recommendations were modified or removed, and additional recommendations were added to the final list.

Added recommendations include updating crosswalk push button location to meet ADA requirements at the intersection of FM 1488 at Carriage Hills Blvd, signal timing improvements for the intersection of SH 249 at Woodtrace Blvd, and adding safety lighting at the intersection of Grand Pines Rd at Mueschke Rd. Removed recommendations based on public input include removal of the Magnolia Ridge extension, Tree Farm Rd extension, Little Thorn Ln extension, and S Alden Bridge Dr extension. Also removed was the recommended widening of Grogan's Mill Rd north of Research Forest Dr. Figure V-5 shows changes that were made to the project recommendations after Public Meeting #2.

Figure V-4: Public Meeting #2

A summary of public comments received, as well as survey results can be found in APPENDIX F.

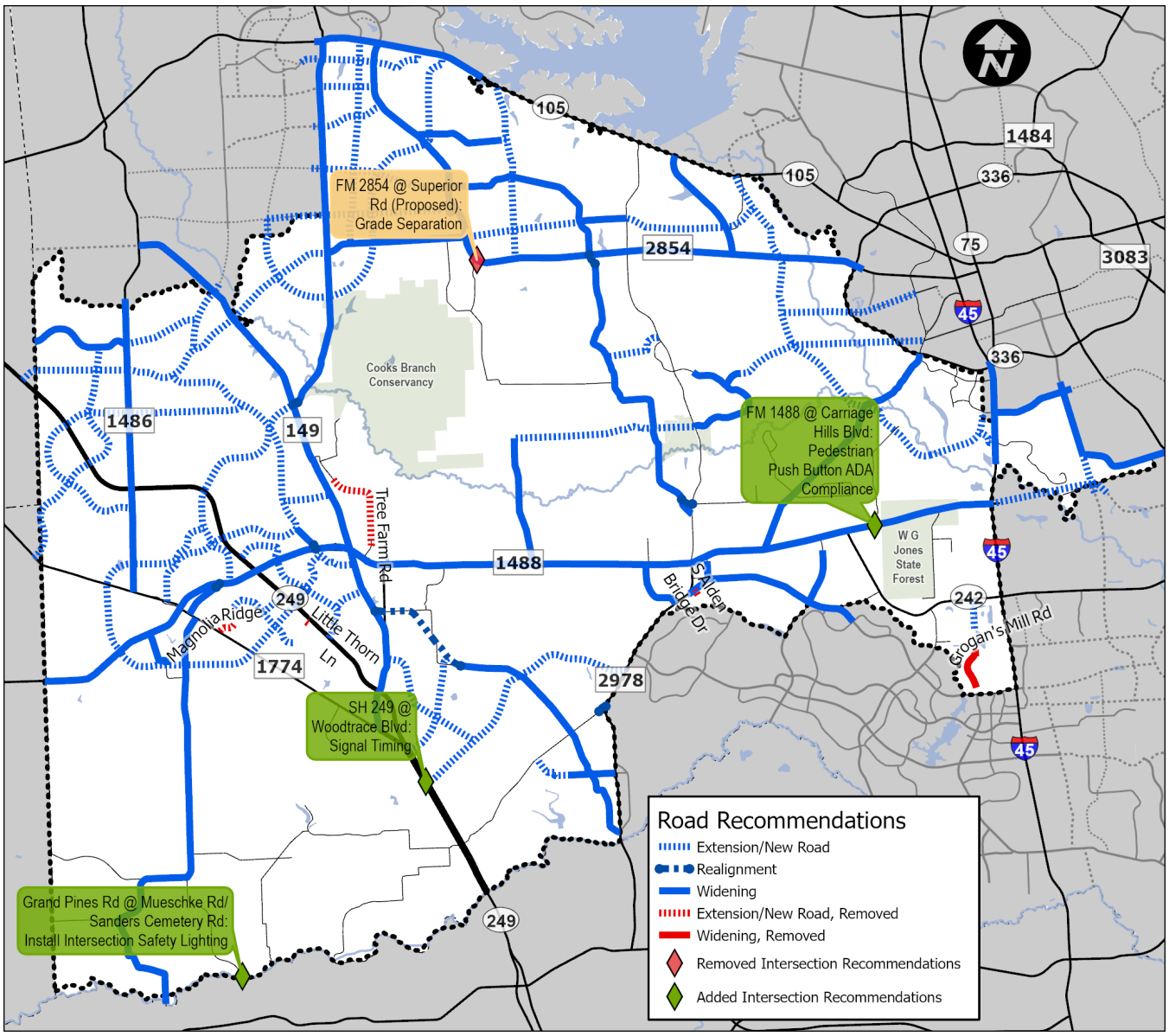

Figure V-5: Recommendation Updates after Public Meeting #2

VI. Analysis

A review of the existing transportation network in Montgomery County Precinct 2 was performed by analyzing major roadway corridors and critical intersections. Analysis was performed using the traffic operations analysis tool Synchro (Version 11). The primary focus was to analyze the performance of the major intersections within the precinct, to identify bottlenecks in the network, and to assess potential transportation solutions. Peak hour conditions were modeled with existing conditions (No Build) and with multiple alternative Build solutions. Analysis of various scenarios was performed with existing 2021 traffic volumes which were collected as a part of the project, as well as projected future volumes for 2030 and 2045. Analysis scenarios are listed below. Figure VI-1 shows the locations that were modeled as a part of the study.

Analysis scenarios:

- No Build – this network included existing and funded roadway/intersection projects only using population projections for 2021, 2030 and 2045 to determine the roadway needs
- Build – these networks included existing and funded roadway/intersection improvements in addition to new proposed roads using population projections for 2021, 2030 and 2045 to determine if the proposed improvements mitigated congestion and improved connectivity.
    - Build Alternative 1 – Short-Term – Signal Timing Updates
    - Build Alternative 2 – Short-Term – Added Turn Lanes/Lane Configuration Updates + Signal Timing Updates
    - Build Alternative 3 – Short-Term – New Roads, Widening, Realignment + Added Turn Lanes, Signal Timing Updates
    - Build Alternative 4 – Short-Term – Changing Traffic Control Type (Signals, Roundabouts, All-Way Stops) + New Roads, Widening, Realignment, Added Turn Lanes, Signal Timing Updates
    - Build Alternative 5 – Long-Term – Signal Timing Updates, Added Turn Lanes & Long-Term New Roads, Widening, Realignment

The performance of each study intersection for each scenario was measured in terms of control delay (seconds/vehicle) which is then represented in terms Level of Service for the intersection.

A full analysis summary can be found in APPENDIX G.

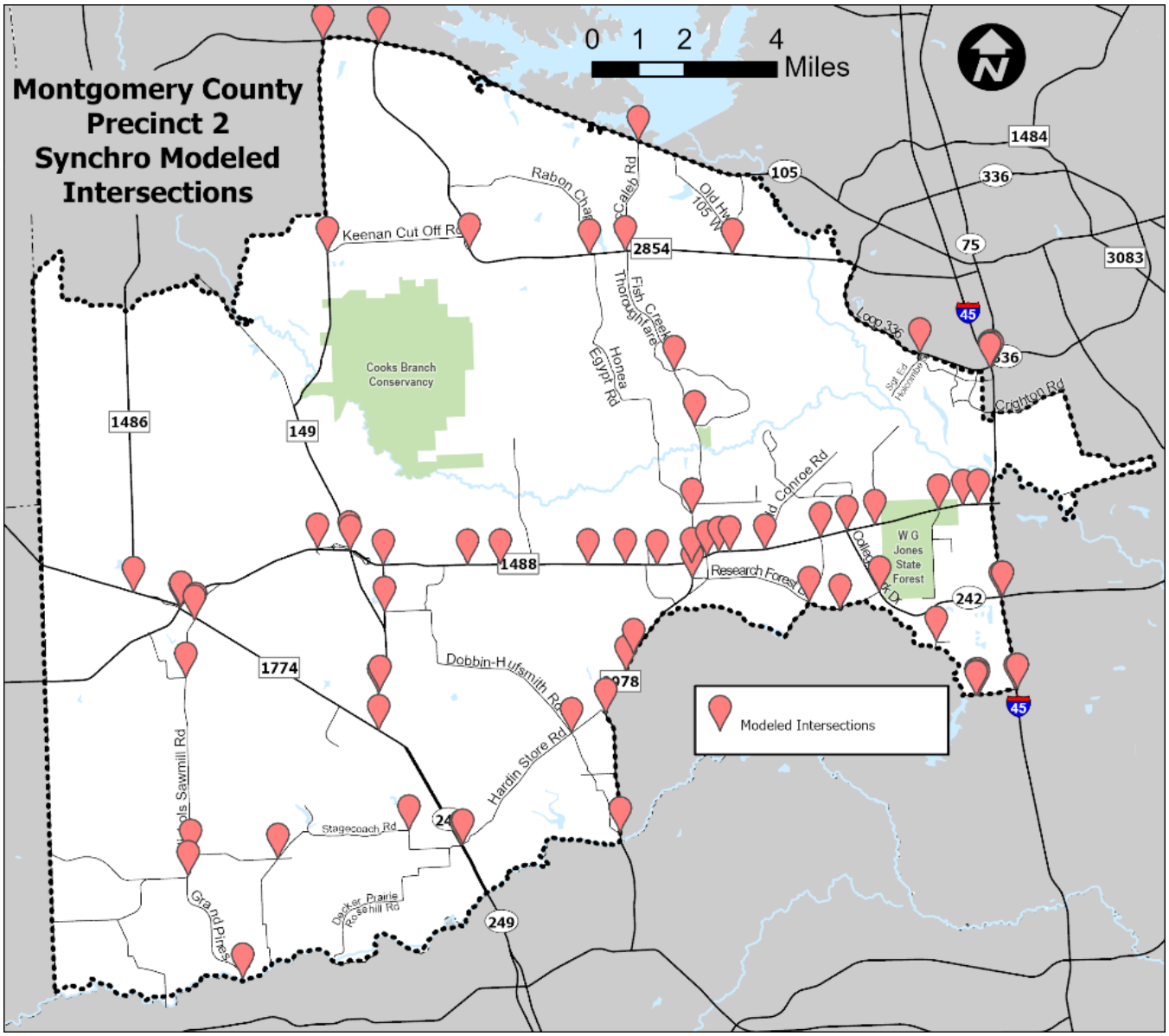

Figure VI-1: Intersections Modeled with Synchro

VII. Recommendations

A major component of this study has been to identify and assess mobility recommendations for Montgomery County Precinct 2. Recommendations were found through analysis of existing and projected data, identified issues, identified needs, and suggestions from the public and steering committees. Initial recommendations were presented to Montgomery County Precinct 2 Commissioner's office, the steering committee, focus groups, and the public. Feedback from these groups was used to modify, add to, and remove from the list of recommendations. A complete discussion on the universe of alternatives and how recommendations were developed can be found in APPENDIX H.

Specific recommendations for roadway, intersection, and alternative transportation mode improvements have been made. Each of these recommendations have been given Short-Term (0-10 years) or Long-Term (11+ years) time frames. Safety and Maintenance recommendations, a result of the Roadway Inventory, are considered a subset of the Short-Term recommendations from 0-1 year.

The most common types of roadway recommendations include building new roads or extensions, widening existing roadways, roadway resurfacing, restriping of pavement markings, roadway realignments for improved curvature or intersection geometry, and corridor signal timing.

The most common intersection improvements include adding turn lanes, signal timing updates, changing traffic control (installing signal, roundabout, or all way stop), grade separations, and signing and pavement marking upgrades.

Alternative modes of transportation include pedestrians, bicycles, transit, and carpooling/car-sharing. Throughout Precinct 2, a network of connected shared use paths has been recommended. Some of these paths are adjacent to existing or proposed roadways, while others follow natural waterways or utility easements. The proposed network ties into existing pedestrian and bicycle infrastructure and closes gaps between existing paths. Improved signage for existing bike corridors where cyclists use the shoulders or share vehicle lanes has also been recommended.

A. Mobility Toolbox

The Mobility Toolbox is a list of potential solutions that can be applied to solve mobility and safety issues throughout the region. The list is broken out by category, duration, and solution type. The solution type is either traditional or innovative. Traditional solutions are tools that have a long history of implementation, while innovative solutions are modern concepts that provide new ways of solving transportation and mobility problems. Categories include access management, alternative modes, intersection, roadway, signal, and signing and pavement marking. Multiple tools can be applied at an individual location to get the best outcome, and traditional and innovative solutions can be blended to meet the needs and preferences of the region. An example of tools from the Mobility Toolbox can be found in Figure VII-1. The complete Mobility Toolbox list is found in APPENDIX A.

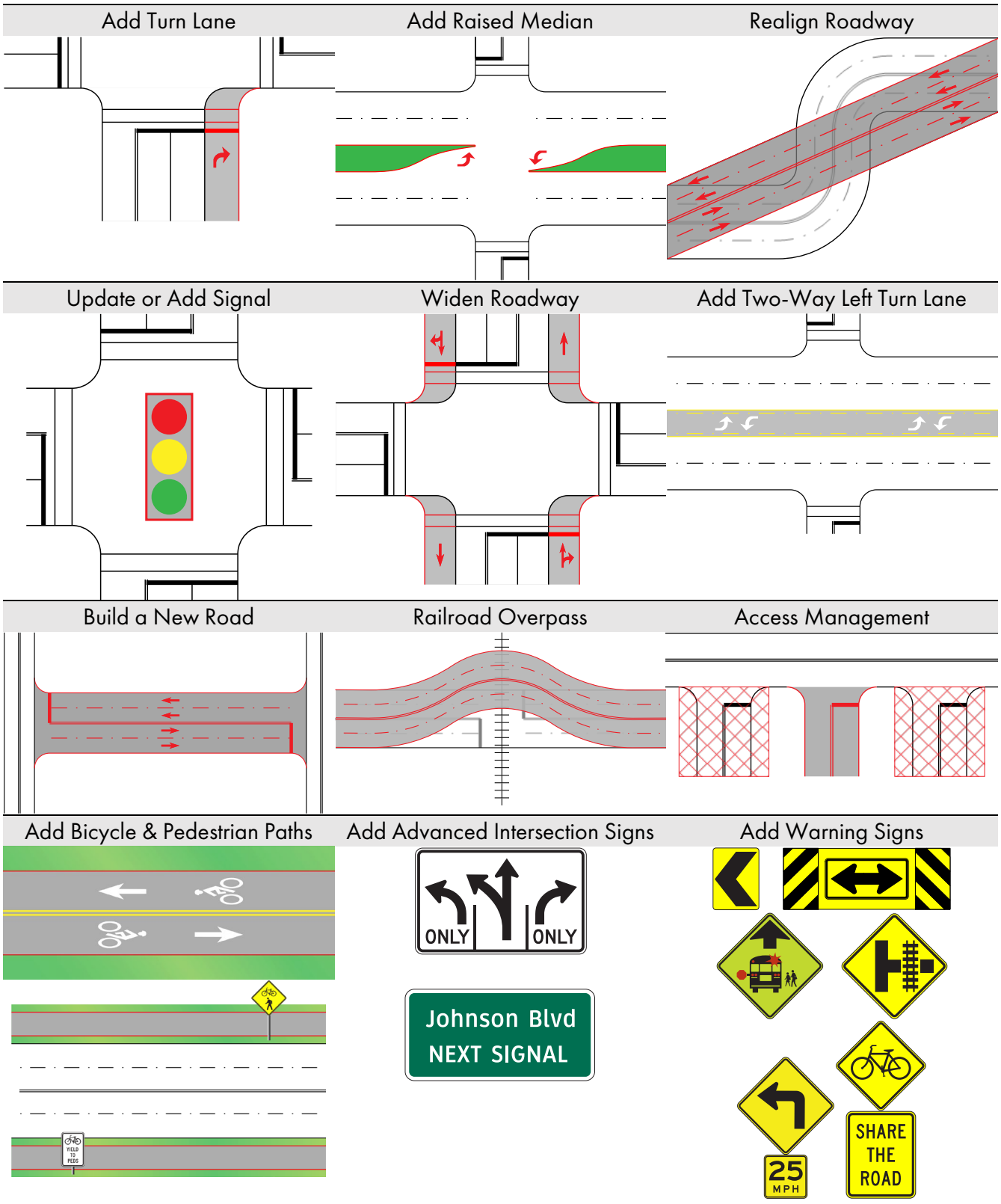

Figure VII-1: Mobility Toolbox Examples

B. Roadway Recommendations

The existing roadway network in Montgomery County Precinct 2 will not be adequate for the future growth expected in the region. Both Short-Term and Long-Term solutions have been considered, and several roadway recommendations have been made related to increasing capacity, improving connectivity and mobility, and reducing delay experienced by roadway users. Some of these suggested improvements include roadway extensions, new roadways, roadway widening and corridor signal timing. Other short-term recommendations are related to improving roadway safety or maintaining the existing network.

1. Safety & Maintenance

Safety and maintenance recommendations include replacing or adding warning signs, installing raised medians, installing street lighting, resurfacing roads, installing rumble strips, and restriping roads. Maintenance recommendations are a result of the findings of the Roadway Inventory. An overview map showing the safety and maintenance recommendations for Precinct 2 is found in Figure VII-2. Safety & Maintenance recommendations cover **255 miles** of road in Precinct 2.

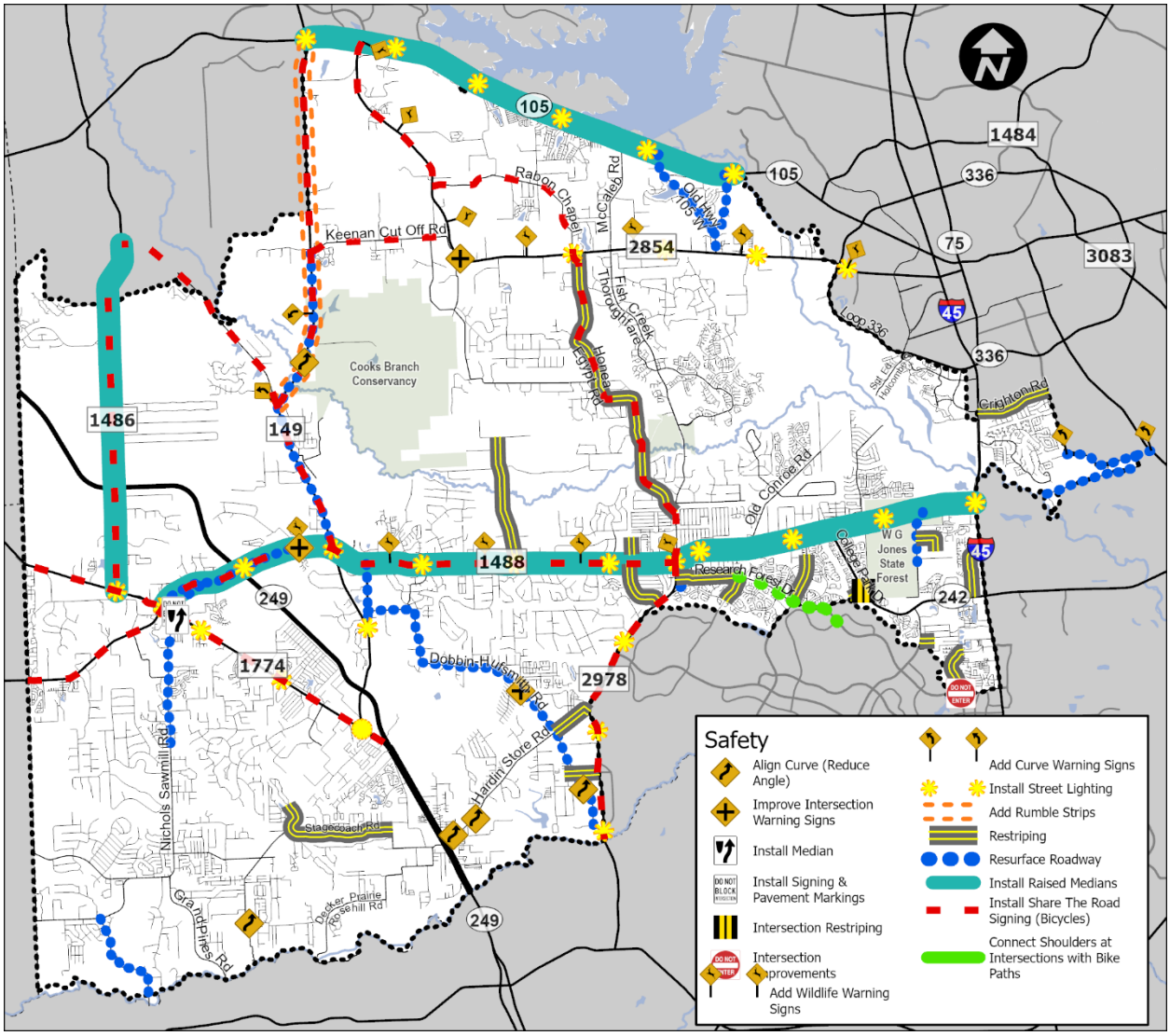

Figure VII-2: Safety and Maintenance Recommendations

2. Extensions/New Roads, Widenings, and Realignments

Figure VII-3 shows a map of Short-Term roadway recommendations, including roadway extensions, new roadways, roadway widening, and corridor signal timing. **Short-Term** widening and new/extended roadway recommendations include a total of **91.6 miles**. There are proposed **56.5 miles of widening**, **34.5 miles of extended/new roadways**, and **0.5 miles of roadway realignment**.

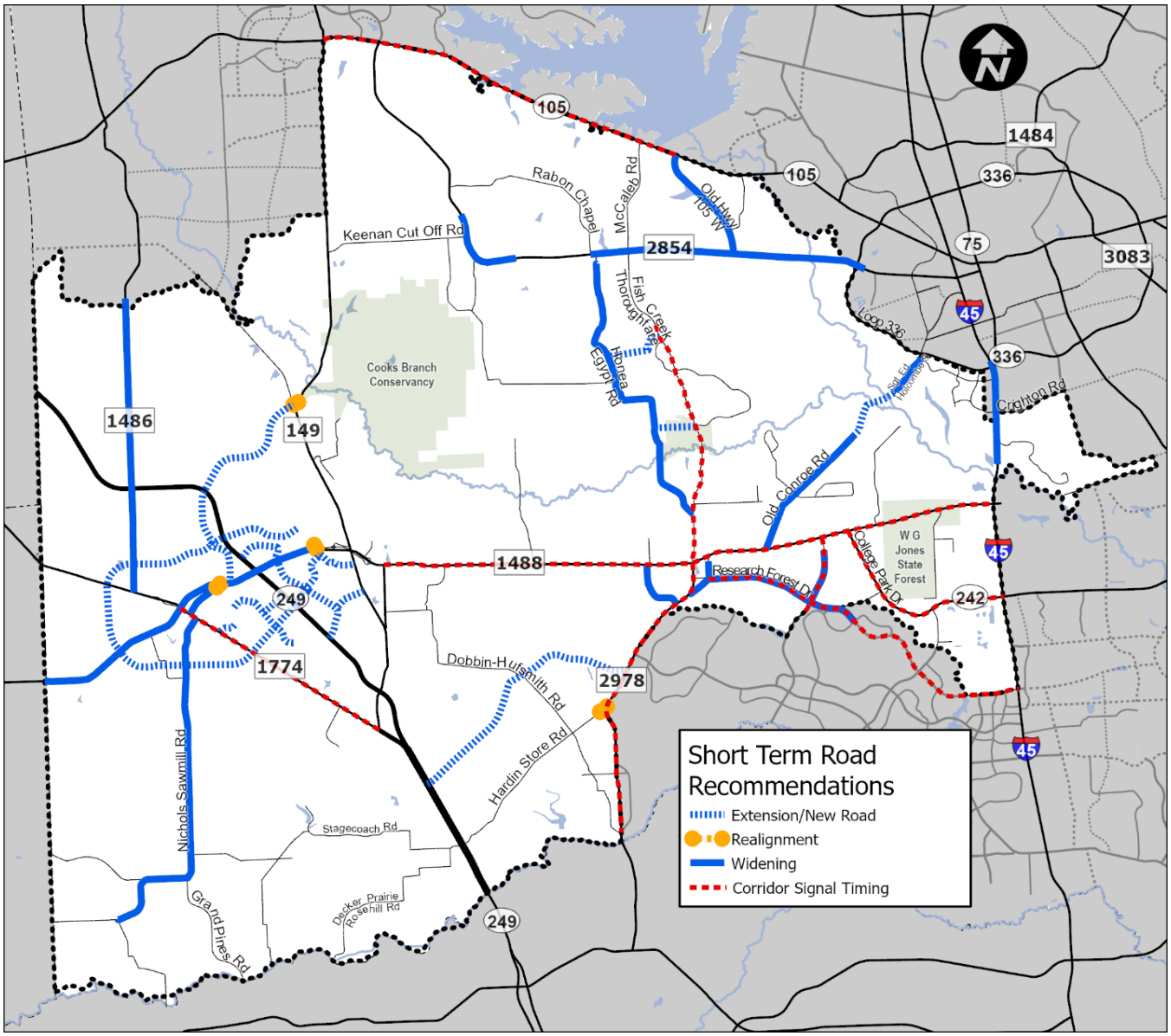

Figure VII-3: Short Term Roadway Recommendations

There are**192.1 miles** of **Long-Term** roadway recommendations. **94.9 miles are for extensions** and new roads, **94.1 miles are of widening**, and there are **3.1 miles of roadway realignment**. A map of these recommendations is found in Figure VII-4.

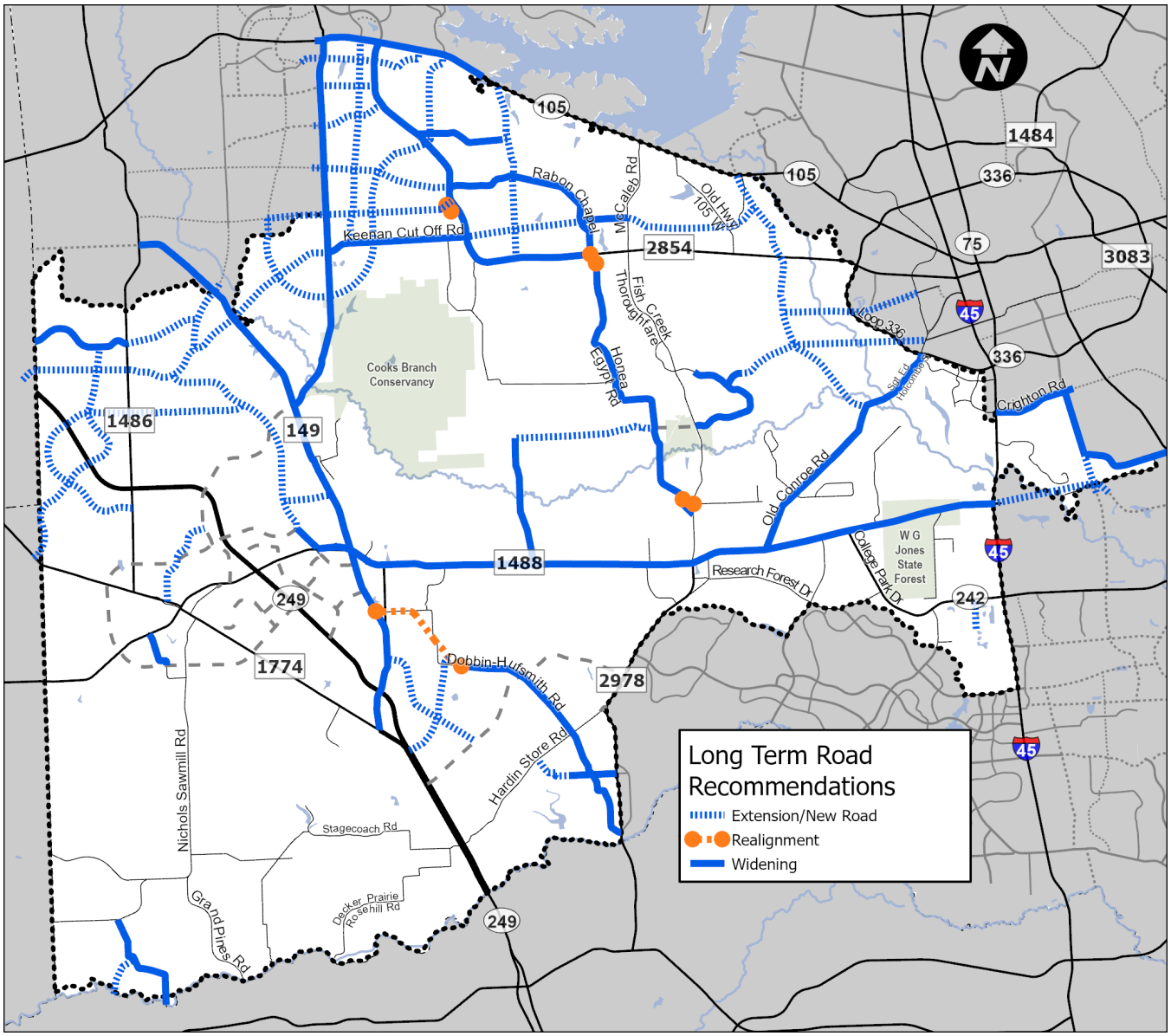

Figure VII-4: Long Term Roadway Recommendations

The combined roadway network of both Short-Term and Long-Term roadway recommendations can be seen in Figure VII-5. The combined total length of new, widened, and realigned roadway recommendations for Precinct 2 is **283.7 miles**.

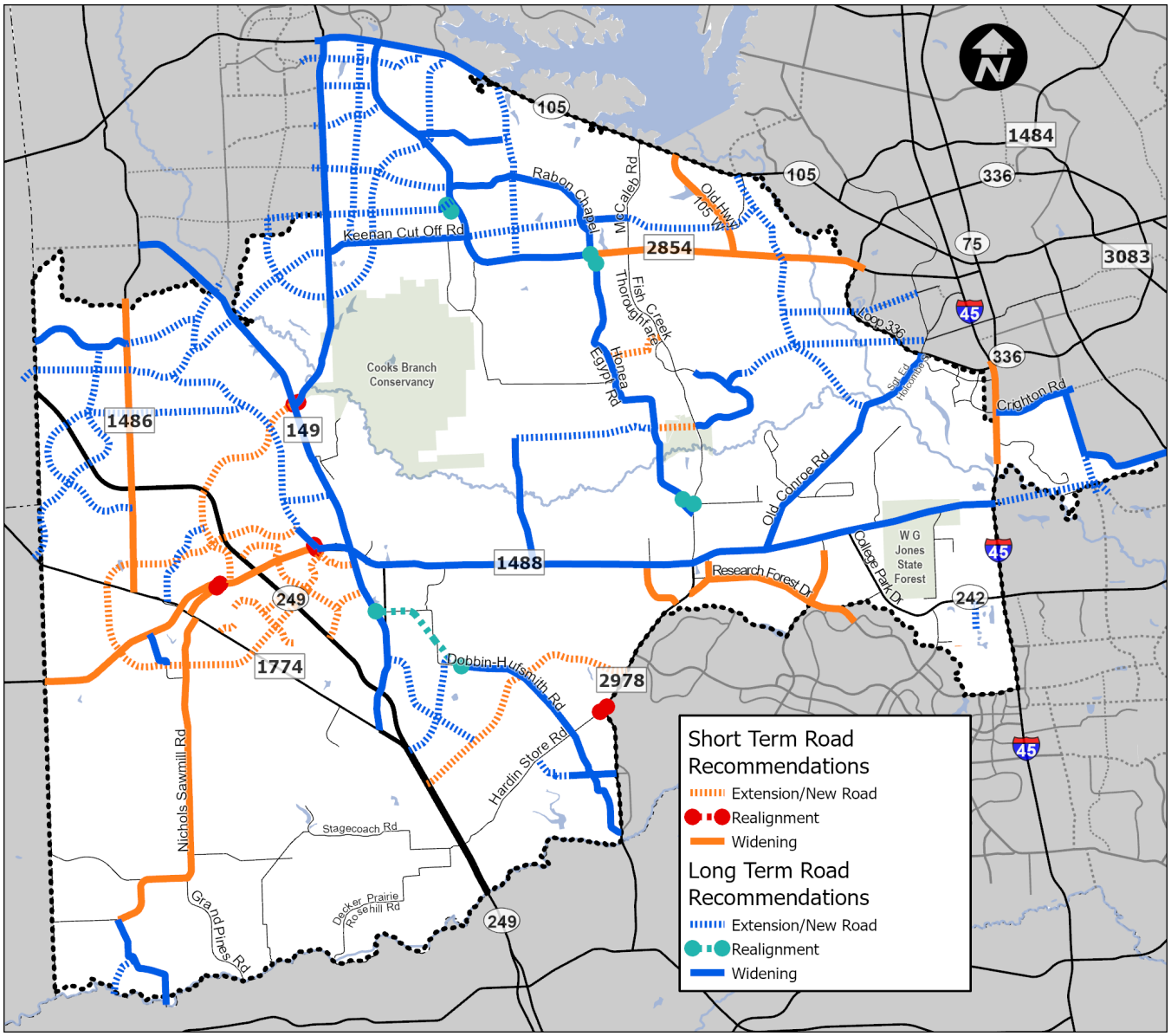

Figure VII-5: Combined Roadway Recommendations

C. Intersection Recommendations

Intersection recommendations for Montgomery County Precinct 2 include adding turn lanes, changing traffic control type (signals, all-way stops, or roundabouts), signal timing improvements, upgrading signing and pavement markings, construction of grade separations, and many others.

There are **137 total intersection recommendations** for Precinct 2. **108 are Short-Term** and **29 are Long-Term**. Figure VII-6 shows an overview map of Short-Term intersection recommendations, and Figure VII-7 show Long-Term recommendations. A combined map can be found in Figure VII-8.

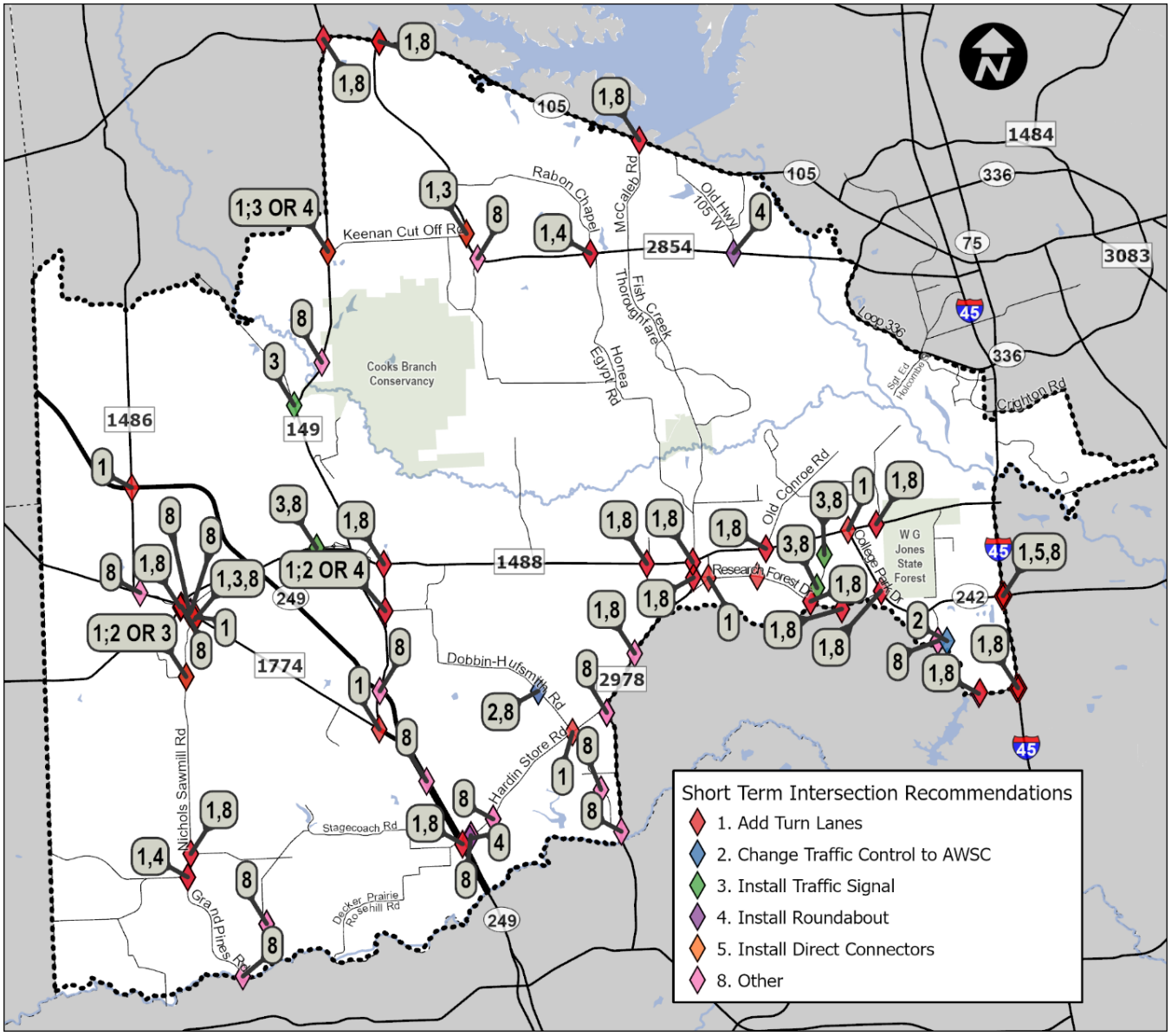

Figure VII-6: Short Term Intersection Recommendations

Many of the intersection recommendations such as adding turn lanes and updating signal timing are aimed at reducing delay for vehicles and improving capacity at intersections. The goal of other recommendations such as adding intersection warning signs or improving curve signing and pavement marking is to improve safety and reduce the frequency and severity of crashes.

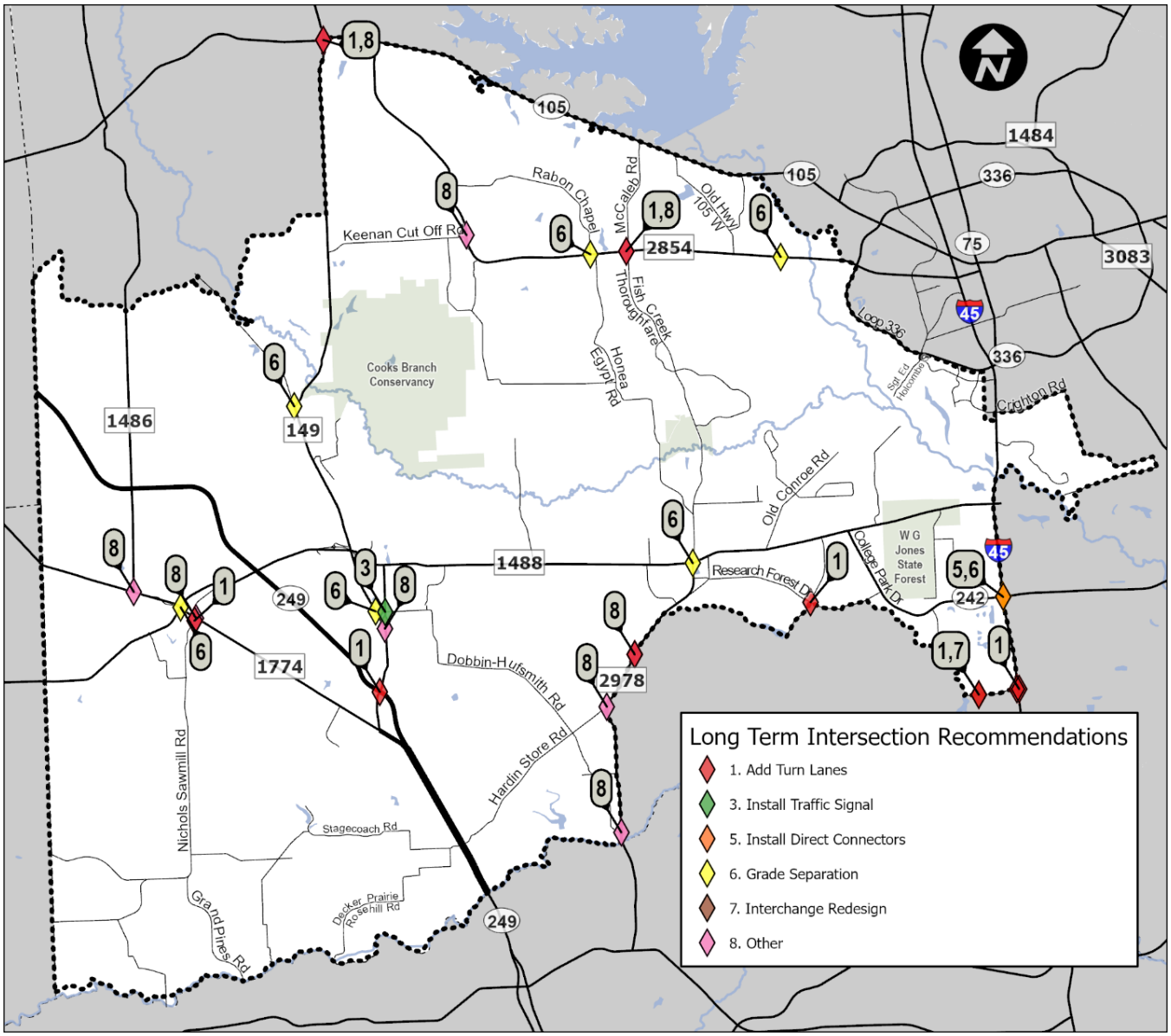

Figure VII-7: Long-Term Intersection Recommendations

In addition to individual intersection recommendations, there are also several precinct-wide intersection recommendations. These include the following:

- Installation of GPS Emergency Preemption Equipment at all signalized intersections
  - Requested by regional emergency responders to improve response times
- Installation of Retroreflective Backplates for all signal heads
  - Improves visibility of traffic signals, especially at night
- Installation of Flashing Yellow Arrow Left Turn Signals
  - Upgrade existing signals that have a permissive left turn phase – flashing yellow arrow proven safer than green ball signal
  - Evaluate currently protected only (green arrow) left turn signals to see if flashing yellow arrow is appropriate

- Installation of "All Way" Sign Plaques
    - Required by the Texas Manual and Uniform Traffic Control at all All-Way Stop controlled intersections, but many existing All-Way Stop locations are missing these sign plaques
- Installation of Speed Limit Signs
    - Add additional speed limit signs throughout Precinct 2, especially on major corridors and after major intersections
- Development of a 311 app for Precinct 2
    - This app would allow residents to submit comments and issues, in lieu of residents calling the precinct office
    - Inform residents of construction projects, major traffic incidents, emergency information, etc.

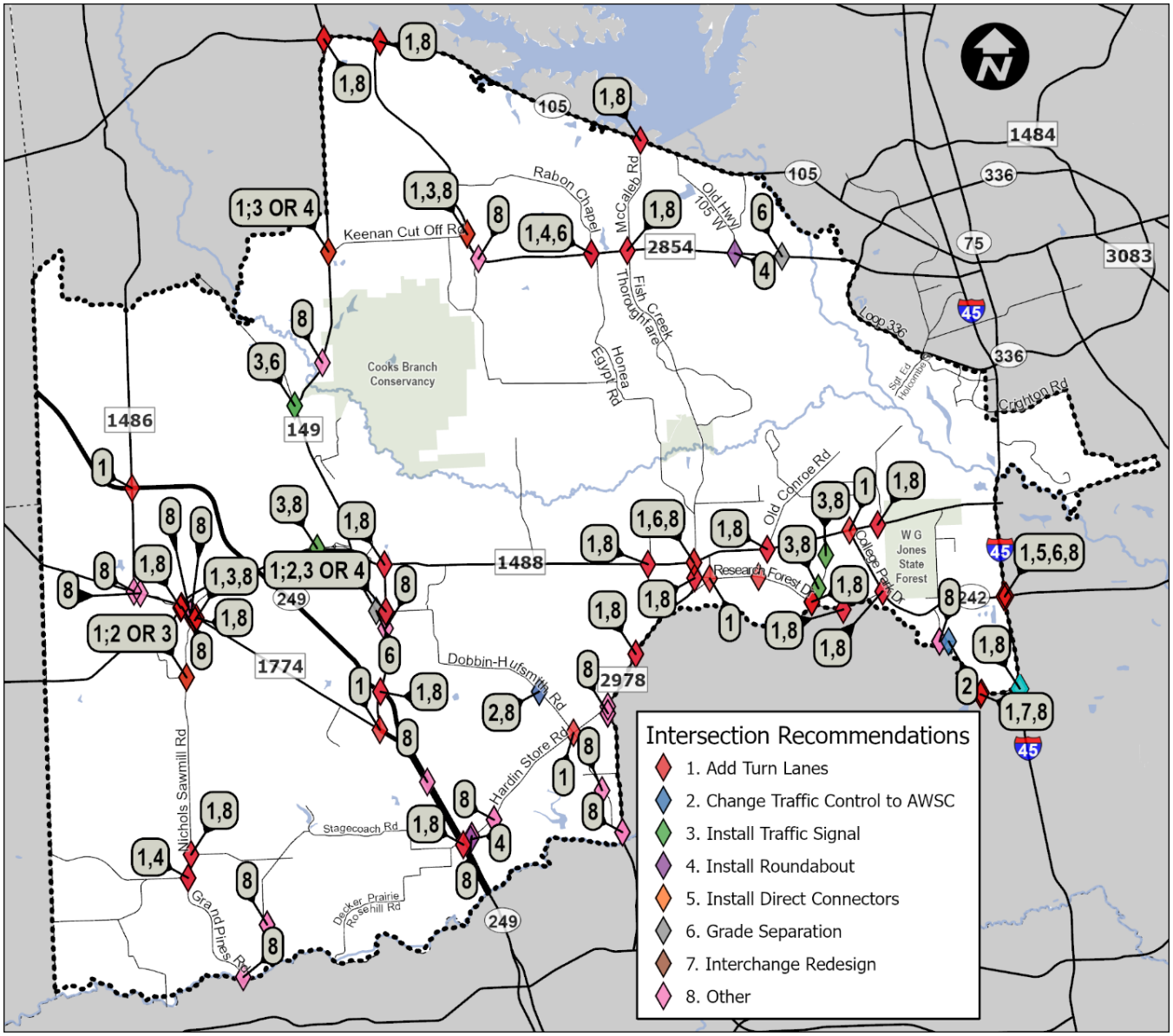

Figure VII-8: Combined Intersection Recommendations

D. Active Transportation

Active Transportation, previously referred to as "Hike and Bike," recommendations include installing separated shared use paths, widening existing sidewalks for shared use with bicycles, providing safe interchange crossings for cyclists, and one shared use bridge. There are **173.5 miles of proposed shared use paths** in Precinct 2 and **1.6 miles of proposed sidewalk widening**. Figure VII-9 shows an overview of these locations.

There are also several locations identified in the Safety and Maintenance recommendations for the addition of "Share the Road" signing along existing bike route corridors.

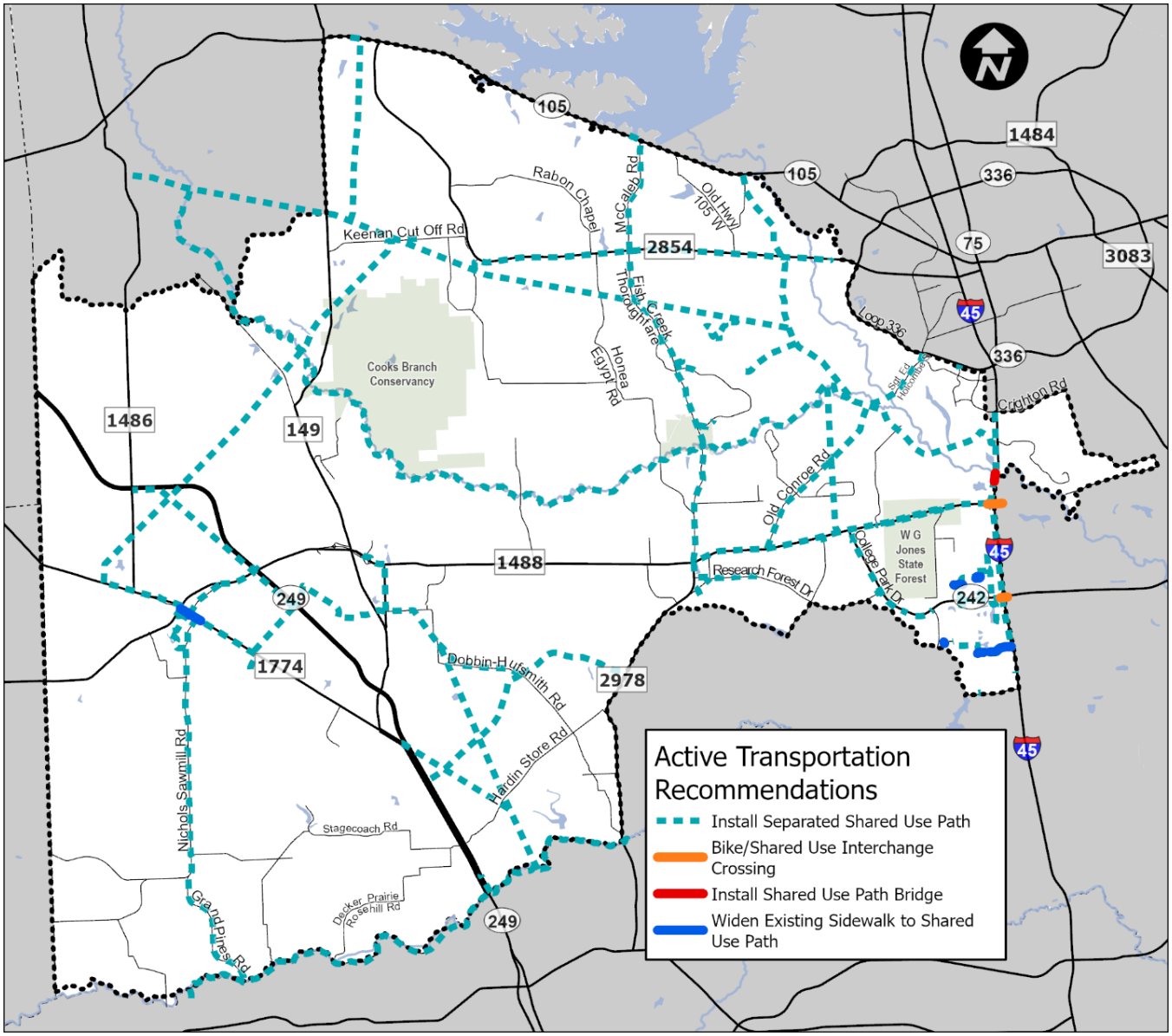

Figure VII-9: Active Transportation Recommendations

Increasing coverage and connectivity of shared use paths provides opportunities for trips to be made without cars. This can reduce the number of road users, thereby reducing vehicle delay and emissions. An improved active transportation network also provides more opportunities for recreational activities on high comfort, safe paths that are separated from vehicular traffic.

E. Transit

Figure VII-10 shows a map of the proposed transit recommendations, which include Park-and-Ride facilities and a Regional Express Route.

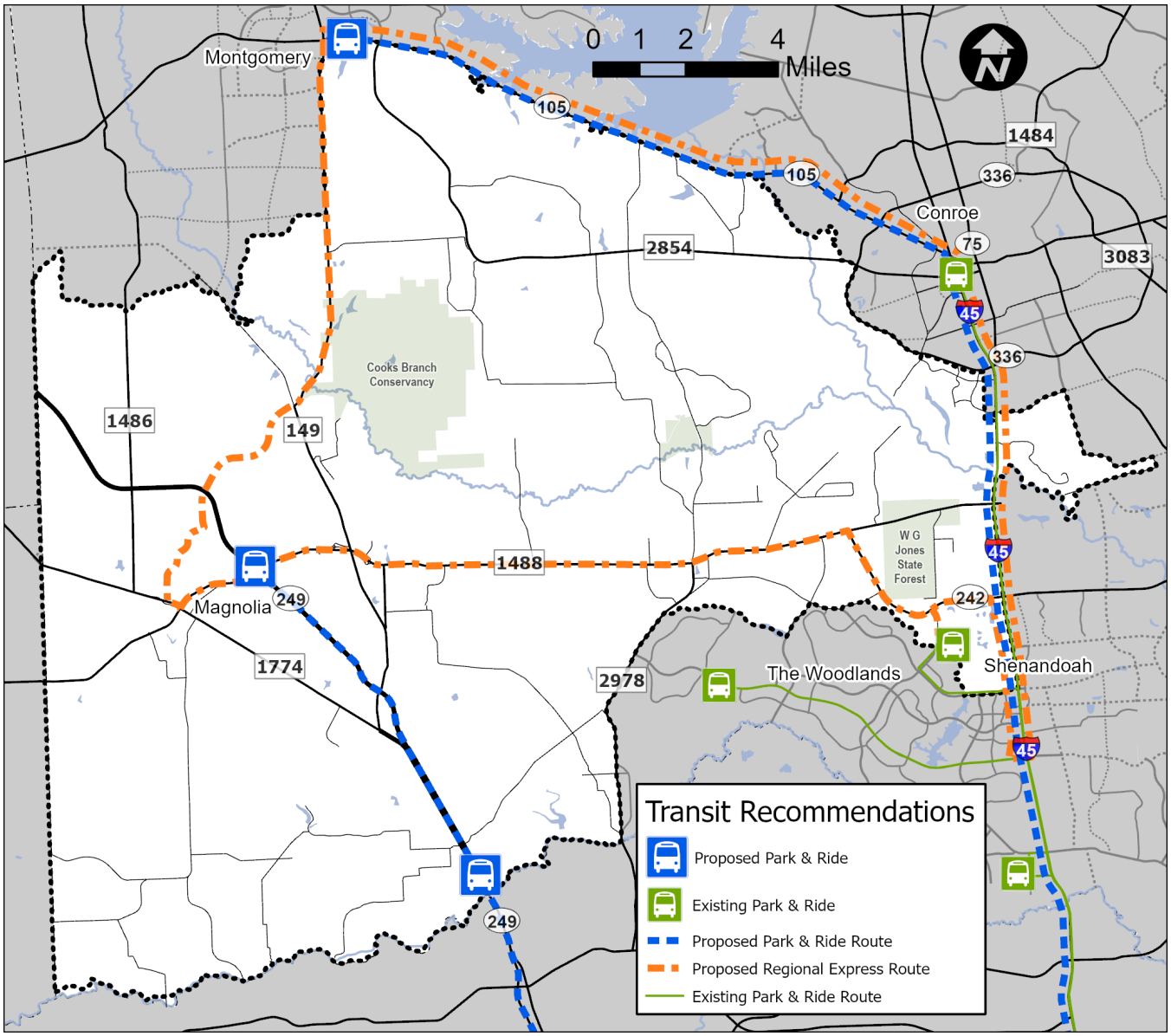

Figure VII-10: Transit Recommendations

There are 3 proposed Park-and-Ride facilities. Both existing and recommended Park-and-Ride facilities near Precinct 2 are shown on the map. Proposed locations focused on areas not conveniently served by existing facilities and are located near Montgomery, Magnolia, and just north of Tomball.

The proposed route shown for the Regional Express Route uses the major existing corridors of Interstate 45, FM 1488, FM 149, and SH 105, as well as some recommended new roadways to connect the largest cities in Montgomery County Precinct 2. The route could be used in both clockwise and counterclockwise directions, and the path can be modified to provide access to other destinations in the region as the demand arises. The route connects Montgomery, Magnolia, The Woodlands, Shenandoah, and Conroe.

Providing opportunities to use transit can reduce the total number of vehicles on the network while increasing the capacity of people that can travel on a given corridor. The more trips that are taken by bus means reduced travel delay on the road and reduced vehicle emissions. While Park and Rides still involve passenger car trips for part of the journey, they reduce the total distance and time spent in an individual vehicle.

F. Removed Recommendations

Some preliminary recommendations were removed from the final list. Some were removed or modified because all or part of the recommendation has already been implemented. Some were removed because a new barrier was formed in a previously unobstructed area, typically in the form of a planned commercial or residential development. Other recommendations were removed or modified based on input we received from the Precinct 2 Commissioner's office, the steering committee, or public comments. Figure VII-11 shows a map of removed roadway and intersection recommendations. Lists of all removed or modified recommendations are included in APPENDIX A under their relevant categories.

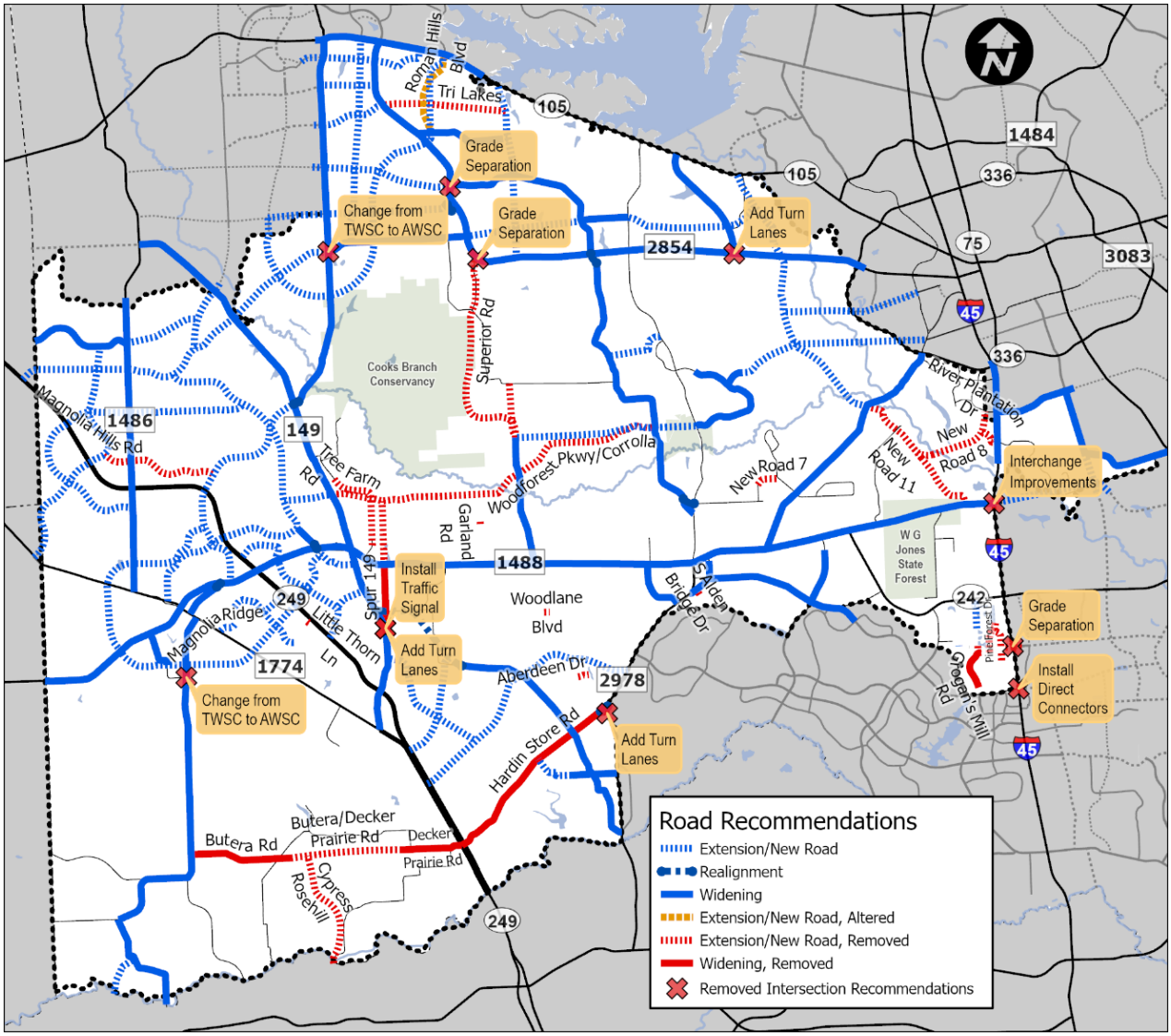

Figure VII-11: Removed Recommendations

Detailed maps and lists of all recommendations can be found in APPENDIX A.

VIII. Implementation & Funding

An important part of implementation of the recommended projects is understanding the cost of potential improvements and identifying funding sources that can be used to make projects a reality.

It is also critical to understand the benefits and impacts of the proposed improvements and the partners and entities that will be directly or indirectly associated with the improvements. Partnerships are a key part of project implementation from multiple perspectives, including funding, construction, scheduling, and additional cost-effective enhancements. Partnerships also provide opportunities to leverage multiple funding options and coordinated implementation strategies.

A. Implementation

A cost has been estimated for each recommended project. Cost estimates relied on average pricing for similar roadway and intersection projects or from average low bid prices for required items, with TxDOT as the primary source of data. When available, existing similar projects within Montgomery County or the TxDOT Houston District were used for estimation. If all recommended projects were implemented, including both Short-Term and Long-Term, the total estimated cost comes to $3.5 Billion. Table VIII-1 shows the breakdown in Roadway and Intersection recommendations by Safety, Short-Term, and Long-Term recommendations. Table VIII-2 shows the costs for Active Transportation and Transit recommendations.

The detailed list of individual recommendations in APPENDIX A also includes the unit cost and total estimated cost for each recommended project.

Table VIII-1: Roadway and Intersection Estimated Costs

Category	Roadway	Intersection	Estimated Cost
Safety	$ 49.7 MM	$ 12.5 MM	$ 62.2 MM
Short	$ 917.2 MM	$ 40.0 MM	$ 957.2 MM
Long	$ 2042.6 MM	$ 167.5 MM	$ 2.2 Billion
Road Total	**$ 3009.5 MM**	**$ 220.0 MM**	**$ 3.2 Billion**

Table VIII-2: Active Transportation and Transit Estimated Costs

Category	Estimated Cost
Active Transportation (Bike/Pedestrian)	$ 289.5 MM
Transit	$ 26.0 MM
Total	**$ 315.5 MM**

1. Project Summary Sheets

Project summary sheets have been created for all roadway and intersection recommendations. Roadway recommendations have been broken up into corridor segments. The corridor summary sheets list Short- and

Long-Term recommendations for a particular segment along with segment characteristics and the cost to implement each recommendation. Segment characteristics include segment length, posted speed limit, number of existing & proposed lanes, existing and proposed roadway characteristics, and existing & proposed pedestrian/bicycle infrastructure. Existing and proposed cross sections have also been provided to help visualize the recommendations.

Intersection summary sheets list Short- and Long-Term recommendations for an individual intersection with the associated cost for each item. Existing and proposed layouts are shown to help visualize what the intersection could look like if all recommendations are implemented.

Corridor and intersection summary sheets can be found in APPENDIX A.

B. Benefits

If implemented, project recommendations would provide many benefits to Montgomery County Precinct 2. Roadway, intersection, active transportation, and transit recommendations would:

- Improve regional connectivity and mobility by developing an expanded network of roads and new mobility options
    - The recommended network would provide better connections between communities in the region, making access to home, work, shopping, and recreation faster and safer.
    - Active transportation recommendations, including a widespread network of connected shared use paths, provides opportunity for recreation, commuting and running errands without using a car.
    - Added Park-and-Ride facilities would allow shorter distances and travel times for commuters in individual vehicles and would reduce the overall demand on the road network. The recommended Regional Express Route would provide a mobility option that doesn't require a personal vehicle and would connect between key interest areas in the region.
- Improve safety and reduce crashes
    - Improved intersection alignments, gentler road curves, added warning signs, updated pavement markings, resurfaced roads, added rumble strips, roadway lighting, raised medians, grade separations over railroads, installing roundabouts, and many other recommended improvements serve to reduce both the number and severity of crashes. Combining multiple improvements on a corridor or at an intersection will further increase safety.
    - Safety of bicycle and pedestrians is improved by adding or widening shoulders on proposed and existing roadways, adding warning signs, creating paths separated from vehicular traffic, and improving intersection crossings.
    - GPS Emergency Preemption Equipment at traffic signals would improve response times for emergency vehicles, as would a more robustly connected network of roads. Improved roadway access and reduced response times for fire trucks and ambulances could save lives and property throughout the region.

- Distribute traffic by providing alternate travel routes
    - New roads and extensions allow existing traffic to spread throughout the region and provide added capacity for new traffic created by growing development.
    - When there is a crash, construction, road maintenance, or another bottleneck on one road, travelers can still get to their destination without significant delay using nearby alternative routes.
- Reduce congestion and delay
    - Added roadway capacity to existing roads and the addition of new roads allows more vehicles to use the connected road network, reduces congestion, and improves travel times. Grade separations, direct connectors, and changes to traffic control such as installing a traffic signal or roundabout provides better flow and reduced delay. Added turn lanes and signal timing improvements would also significantly reduce delay at intersections.
    - Increasing coverage and connectivity of shared use paths provides opportunities for trips to be made without cars. Adding transit routes means more passenger capacity is available on a given corridor with fewer vehicles. If more people choose active transportation or transit options, this reduces the total number of vehicles on the road network, thereby reducing congestion and delay.
- Improved air quality
    - Reducing vehicle emissions improves air quality. When drivers are able to take a shorter route to their destination, and when they spend less time in congested traffic, vehicle emissions are reduced. This is possible with added roadway capacity, better coordinated signal timing, and more roadways that provide shorter travel distances. Additionally, emissions can be eliminated or significantly reduced for a trip when a driver is able to choose an alternate mode of transportation such as biking, walking, or transit. Active transportation is more appealing with a well-connected network of safe, high comfort paths.

C. Funding

In order to implement the recommended projects from this study, funding must be found to cover design and construction costs. Federal and state funds can be made available to local jurisdictions through H-GAC's Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP), which are administered through the H-GAC Transportation Policy Council (TPC). Other funding sources such as Capital Improvement Bonding, impact fees, and the creation of special districts and zones can be utilized by local governments and taxing authorities to implement transportation projects.

A Development Funding Toolbox has been created to list potential funding sources, how the programs function, applicable jurisdictions, and project types, and some of the pros and cons of each source. Figure VIII-1 shows a condensed version of the funding toolbox with the list of potential funding sources and their program functions. While each of the funding strategies are listed individually, there may be opportunities to leverage multiple funding sources and coordinate implementation strategies with various jurisdictions and agencies. The full version of the funding toolbox, as well as additional implementation and funding information, can be found in APPENDIX I.

DEVELOPMENT FUNDING TOOLBOX	PROGRAM FUNCTION
Regional Transportation Plan (RTP) and Transportation Improvement Program (TIP) Funding	Transportation Improvements designed to enhance mobility, relieve congestion, support the safe and efficient movement of people, goods, and services, promote economic growth and development, improve regional air quality, maintain state of good repair, and protect natural environment and resources.
Capital Improvement Bonding (CIP) Capacity	Provides funding to finance major capital improvements through the issuance of bonds.
Local Government Corporation (LGC)	An entity that provides an alter ego of the city & county that allows a separate board to be created to administer the approval of public improvements. Typically used in Gulf Coast Region to complement TIRZ/TIF operations.
Community Development Block Grant (CDBG)	Funds can be used for public improvements for Low Mod Income Areas; should be part of the City or County CDBG Program
Tax Increment Reinvestment Zone (TIRZ)	Tax Increment Reimbursement Zones (TIRZ or TIF) allows a portion of city or county tax revenue increment to be applied to an area or project improvement
Public Improvement Districts (PID)	PIDs allow a city or county to charge a special assessment against properties within the designated area, or district, to pay for improvements. Created by petition.
Municipal Management Districts (MMD)	Public Improvements include intersection, mobility improvements as well as water, sewer, drainage, landscape architecture, and monuments. Again, an area approach that imposes overlapping tax or assessment depending on the type of creation.
Housing Initiatives	This initiative allows cities or counties to incentivize area development of Housing which can include a requirement for on-site and off-site transportation improvements.
County Assistance Districts	A special district, managed by the commissioners' court or and appointed board of directors, that may impose a sales and use tax or accept grants or loans.
Impact Fees	A charge or assessment imposed by a political subdivision against new development in order to generate revenue for funding or recouping the costs of capital improvements or facility expansions necessitated by and attributable to the new development.
Municipal Utility District (MUD)	Public Improvement Finance which can include transportation if RUD, Road Utility District Powers are also created
Federal Grant Programs	Various Federal Grant Programs award transportation funding to applicants based on a given set of criteria.

Figure VIII-1: Funding Toolbox