

TRAFFIC ANALYSIS (APPENDIX C)

For
KINGWOOD AREA MOBILITY STUDY

Prepared for:
Lake Houston Redevelopment Authority (TIRZ # 10)
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May 2015

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LAKE HOUSTON REDEVELOPMENT AUTHORITY



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May 4, 2015

TABLE OF CONTENTS

1.0	Executive Summary	1
2.0	Project Background and Project Description	2
3.0	Measures of Effectiveness	3
4.0	BASE CONDITIONS	4
4.1	Geometrics and Traffic Control	4
5.0	Existing Traffic Data	6
5.1	Volumes	6
5.2	Signal Timing and Phasing	8
5.3	Travel Time Data	8
5.4	Speed Data	8
5.5	Crash Data Review	9
5.6	Traffic Analysis	11
5.7	Results	11
6.0	Known Developments	13
6.1	Future Planned/Scheduled/Funded Improvements	13
7.0	Public Input	15
8.0	Future Traffic Projections	16
8.1	Volumes	16
8.2	Traffic Analysis	16
8.3	Results	16
9.0	Alternative Analysis	18
9.1	Traffic Volumes and Diversions	18
9.2	Traffic Analysis	18
9.3	Results	20
10.0	CONCLUSIONS	21

LIST OF TABLES

Table 4-1	Study Area Intersections	4
Table 5-1	Speed Data	9
Table 5-2	Crash Rate Calculation	10
Table 5-3	2014 Study Area Intersections LOS and Delay	12
Table 8-1	2020 Study Area Intersections LOS and Delay (No-Build)	17

LIST OF FIGURES

Figure 2-1	Study Area Map	2
Figure 5-1	Existing Turning Movement Count Data	7
Figure 5-2	Crash Data Map.....	11
Figure 6-1	Planned Developments and Infrastructure Improvements.....	14

LIST OF EXHIBITS

- Priority 1: Alternative A: Intersection Improvements
- Priority 2: Alternative C: Kingwood Drive Widening to Six Lanes from US 59 to Woodland Hills Drive
- Priority 3: Alternative D: Northpark Drive Widening to Six Lanes from US 59 to Woodland Hills Drive
- Priority 4: Alternative J: Woodland Hills Extension to Hamblen and Widening of Hamblen Road
- Priority 5: Alternative L: Kingwood Drive Grade Separation at Loop 494/Rail Road Crossing
- Priority 6: Alternative M: Northpark Drive Grade Separation at Loop 494/Rail Road Crossing

LIST OF APPENDICES

APPENDIX C-1	Traffic Data
APPENDIX C-2	Existing Traffic Analysis Worksheets (Synchro)
APPENDIX C-3	Future Traffic Analysis Worksheets (Synchro)
APPENDIX C-4	Alternative Analysis Worksheets (Synchro)
APPENDIX C-5	Alternatives (Exhibits)

1.0 EXECUTIVE SUMMARY

The Kingwood Area Mobility Study presents an ambitious yet realistic vision of providing mobility options for Kingwood Area residents. This report focuses on capital improvement plan (CIP), in recognition that significant changes to the physical infrastructure on various corridors with minimal impact to the trees. It is also a plan that these projects, while identified as recommended improvements, will require future design and engineering studies to finalize the details. Some of the improvement options can be implemented almost immediately, by working on pending financial details for the other projects at the time of this report.

The prioritized projects are planned with the aim to work together to achieve multiple goals, individually as well as collectively. These roadway projects are also intended to facilitate improved traffic flow by reducing congestion, and improving safety, thereby improving the quality of life for Kingwood area residents. The list projects in the order of priority are:

Priority # 1 Intersection Improvements

Priority #2 Widening of Kingwood Drive to 6-Lanes from US 59 to Woodland Hills Drive

Priority #3 Widening of Northpark Drive to 6-Lanes from US 59 to Woodland Hills Drive

Priority #4 Extension of Woodland Hills Drive to Hamblen Road and Widening of Hamblen Road

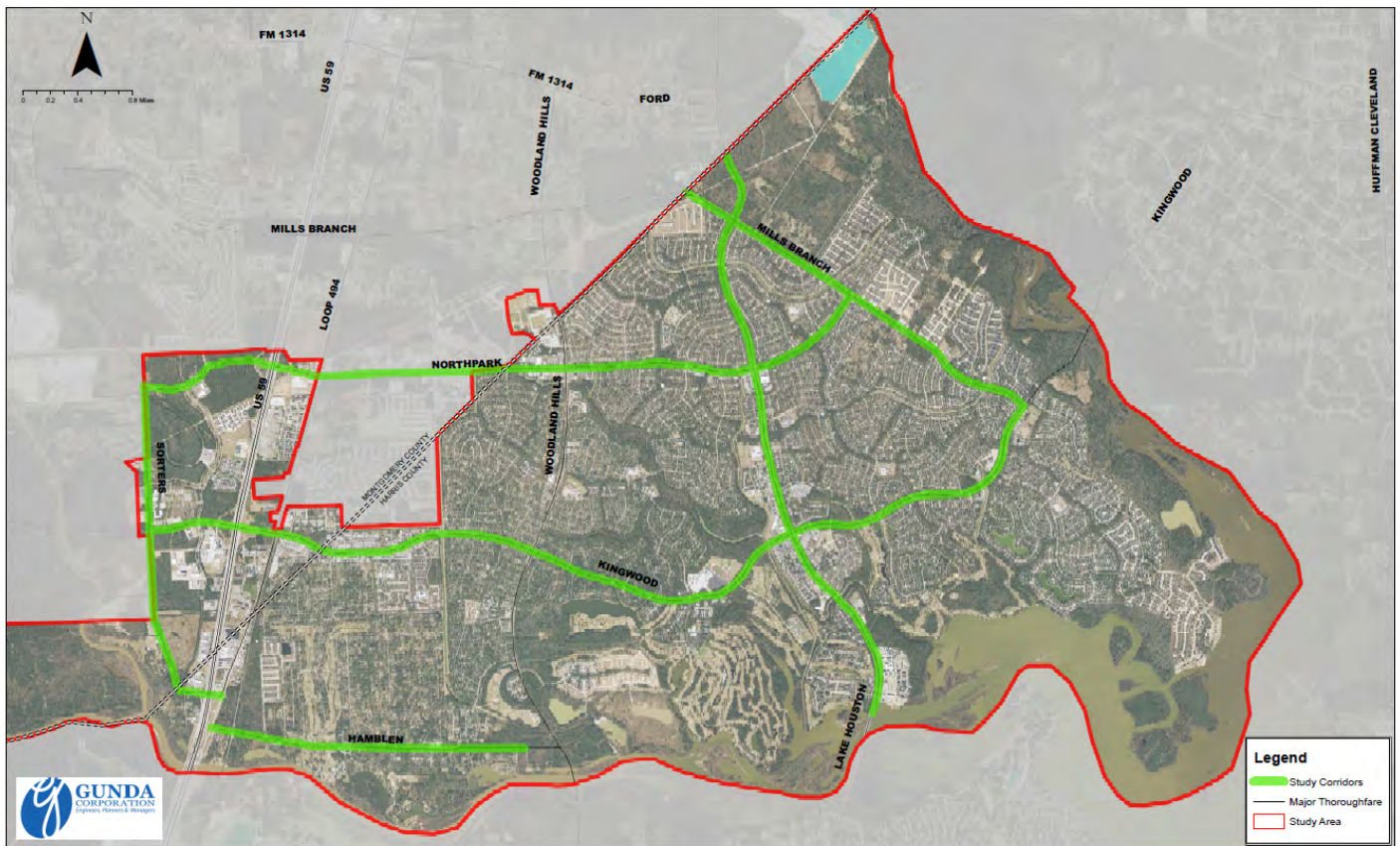
Priority #5 Grade Separation on Kingwood Drive at Loop 494/Rail Road Crossing

Priority #6 Grade Separation on Northpark Drive at Loop 494/Rail Road Crossing

2.0 PROJECT BACKGROUND AND PROJECT DESCRIPTION

In February 2014, the Lake Houston Redevelopment Authority authorized Gunda Corporation to conduct a Mobility Study in the Lake Houston area. The purpose of the study is to develop a strategy to address the transportation needs based on existing deficiencies and future growth. The study was undertaken to improve the overall quality of life for Kingwood Area citizens. Please see Figure 2-1 for Study Area Map.

Figure 2-1 Study Area Map



3.0 MEASURES OF EFFECTIVENESS

Goals were developed for the study based on the experience of the study team members and the steering committee members. Feedback from the project steering committee was captured during the first steering committee meeting to understand what outcomes key stakeholders wanted to achieve through the course of the study. The previous Kingwood Area Mobility Study completed in 2004 was reviewed to capture some of the past concerns and important details. Goals identified the need for the study to:

- Obtain community input
- Improve mobility – short and long term
- Maintain same or better quality of life
- Identify funding sources
 - Educate public regarding funding sources
- Plan for future
- Improve Safety
- Look for possible transit solutions for aging population
- Provide pedestrian facilities as part of street improvements
- Consider public transportation
- Consider trolley system – not typical METRO bus
- Look for quick fixes

The following measures of effectiveness were developed by the Steering Committee at the first Steering Committee Meeting on March 18, 2014 in order to measure the above goals.

- Less Congestion
- Decrease Delay/Travel Time
- Pedestrian Safety/Bicycle Safety
- Vehicular Safety
- Cost Effectiveness
- Schedule
- Regulatory Impacts
- Environmental Impacts Including Tree Impacts

4.0 BASE CONDITIONS

4.1 Geometrics and Traffic Control

The project area field review was conducted to gather information such as roadway geometry, intersection traffic control, and general traffic conditions in the study area. The lane configurations at each of the study intersections were verified in field for further use in the analysis. The following information was collected for further use in the analysis.

- Lane configurations
- Type of traffic control
- Signal timing
- Posted speed limit
- Existing travel time information

Traffic data was collected at the following intersections for alternative analysis.

Table 4-1 Study Area Intersections

Northpark Drive at Sorters Road*
Northpark Drive at US 59 SBFR
Northpark Drive at US 59 NBFR
Northpark Drive at Loop 494
Northpark Drive WB at Russell Palmer Road
Northpark Drive EB at Russell Palmer Road
Northpark Drive WB at Hidden Pines/Woodridge Pkwy
Northpark Drive EB at Hidden Pines/Woodridge Pkwy
Northpark Drive at Woodland Hills Drive
Northpark Drive at Brookdale Drive
Northpark Drive at Lake Houston Parkway
Northpark Drive WB at Rock Springs Drive
Northpark Drive EB at Rock Springs Drive
Northpark Drive & Mills Branch Road
Lake Houston Parkway NB @ Rustic Woods Drive
Lake Houston Parkway SB @ Rustic Woods Drive
Lake Houston Parkway NB @ Kings Crossing Drive
Lake Houston Parkway SB @ Kings Crossing Drive
Kingwood Drive at Sorters Road*
Kingwood Drive at US 59 SBFR
Kingwood Drive at US 59 NBFR
Kingwood Drive at Loop 494
Kingwood Drive at Royal Forest Drive

Kingwood Drive WB at Chestnut Ridge Drive
Kingwood Drive EB at Chestnut Ridge Drive
Kingwood Drive WB at Green Oak Drive
Kingwood Drive EB at Green Oak Drive
Kingwood Drive at Woodland Grove Drive
Kingwood Drive at Trailwood Village Drive
Kingwood Drive at Woodland Hills Drive
Kingwood Drive WB at Lake Kingwood Trail
Kingwood Drive EB at Lake Kingwood Trail
Kingwood Drive WB at Kingwood High School
Kingwood Drive EB at Kingwood High School
Kingwood Drive at Lake Houston Parkway
Kingwood Drive at Forest Garden Drive
Kingwood Drive WB at Timber Shade Drive
Kingwood Drive EB at Timber Shade Drive
Kingwood Drive WB at Willow Terrace Drive
Kingwood Drive EB at Willow Terrace Drive
Kingwood Drive WB at High Valley Drive
Kingwood Drive EB at High Valley Drive
Kingwood Drive & Mills Branch Road
US 59 SBFR at Sorters Road
Loop 494 at Sorters Road
Hamblen Road at US 59 NBFR*
Hamblen Road at W. Hamblen/US 59 NBFR*
Hamblen Road at Laurel Springs Lane*
Hamblen Road at Forest Cove Drive*
Hamblen Road at Redbud Lane*

*Unsignalized Intersection

5.0 EXISTING TRAFFIC DATA

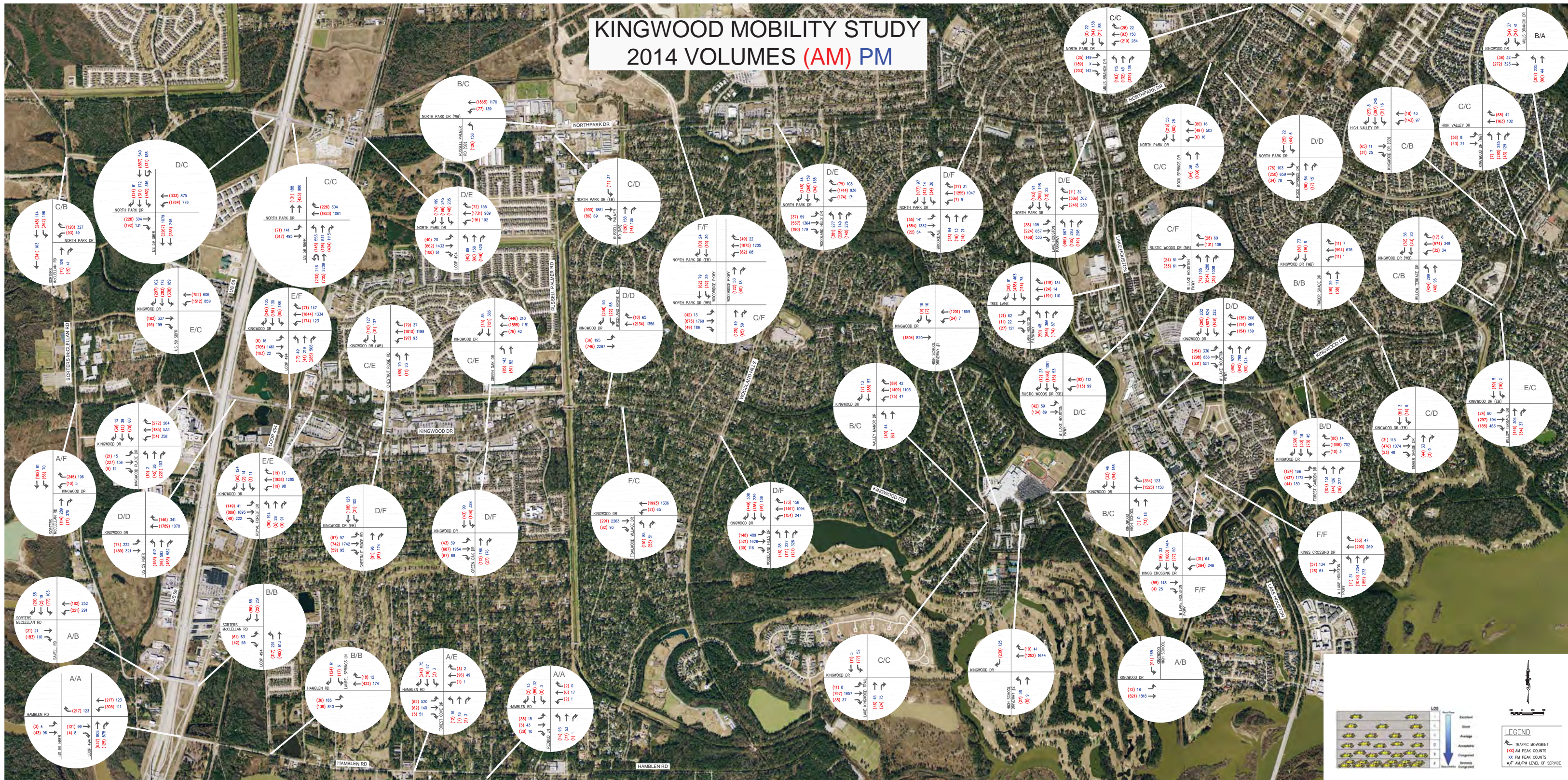
5.1 Volumes

A traffic counting program was undertaken by the study team to obtain the existing weekday AM and PM peak hour traffic data at all study intersections. Existing AM peak period (7.00 AM to 9.00 AM) and PM peak period (4.30 PM to 6.30 PM) turning movement counts for the existing study intersections were collected. The existing traffic data is included in Appendix C.1 in electronic format. Traffic volumes for all study intersections were compared to determine the study area peak hours within the peak periods. The overall peak hours determined from these counts are as follows:

- AM Peak Hour: 7:15 AM to 8:15 AM
- PM Peak Hour: 4:45 PM to 5:45 PM

The existing AM and PM peak hour intersection traffic data are summarized in Figure 5-1 for reference. Raw turning movement counts are included in Appendix C-1 in electronic format.

FIGURE 5-1 EXISTING TURNING MOVEMENT COUNT DATA



5.2 Signal Timing and Phasing

In addition, the existing traffic signal timing for the signalized intersections were obtained by contacting City of Houston Traffic Operations Division. The existing signal timing data is included in Appendix C.1 in electronic format.

5.3 Travel Time Data

The existing travel time data for Kingwood Drive and Northpark Drive for both AM and PM peak hour was obtained by COH PWE staff. The travel times on Kingwood Drive collected by COH PWE staff are as follows. Field collected travel times are included in Appendix C.1.

Kingwood Drive Westbound (AM Peak):

West Lake Houston Parkway to US 59: 10 Minutes, 40 Seconds

Kingwood Drive Eastbound (PM Peak):

US 59 to West Lake Houston Parkway: 11 Minutes, 55 Seconds

5.4 Speed Data

The speed data was collected at two locations in the study area. The first is on Kingwood Boulevard near Kingwood High School and the second is on West Lake Houston Parkway near Creekwood Middle School. A speed study was conducted along the study segments utilizing the guidelines provided by the ITE manual for conducting Transportation Engineering Studies. The speed data was collected on September 10, 2014. The speed data is summarized in the Table 5-1 below. Detailed speed data reports are presented in Appendix C.1.

Table 5-1 Speed Data

Kingwood High School (Westbound)					
Peak Period	Total	<25 mph	26-35 mph	36 to 45 mph	>45 mph
6:30 AM to 7:45 AM	1,739	446	433	583	277
2:30 PM to 3:15 PM	1,503	242	406	572	283
School Zone Flasher Timings	6:40 AM to 7:40 AM and 2:30 PM to 3:15 PM				
Posted Speed	40 mph; School Zone Speed = 25 mph				
85th Percentile Speed	49.2 mph (DAILY BASIS)				

Kingwood High School (Eastbound)					
Peak Period	Total	<25 mph	26-35 mph	36 to 45 mph	>45 mph
6:30 AM to 7:45 AM	973	348	532	91	2
2:30 PM to 3:15 PM	893	379	466	47	1
School Zone Flasher Timings	6:40 AM to 7:40 AM and 2:30 PM to 3:15 PM				
Posted Speed	45 mph; School Zone Speed = 25 mph				
85th Percentile Speed	35 mph (DAILY BASIS)				

Creekwood Middle School (Southbound)					
Peak Period	Total	<20 mph	20-30 mph	30 to 45 mph	>45 mph
7:45 AM to 9:00 AM	1,157	205	726	211	15
3:30 PM to 4:30 PM	1,233	197	522	493	21
School Zone Flasher Timings	7:50 AM to 8:50 AM and 3:40 PM to 4:25 PM				
Posted Speed	45 mph; School Zone Speed = 20 mph				
85th Percentile Speed	44.1 mph (DAILY BASIS)				

Creekwood Middle School (Northbound)					
Peak Period	Total	<20 mph	20-30 mph	30 to 45 mph	>45 mph
7:45 AM to 9:00 AM	1,353	373	541	439	0
3:30 PM to 4:30 PM	1,277	519	353	394	11
School Zone Flasher Timings	7:50 AM to 8:50 AM and 3:40 PM to 4:25 PM				
Posted Speed	45 mph; School Zone Speed = 20 mph				
85th Percentile Speed	40.3 mph (DAILY BASIS)				

5.5 Crash Data Review

Understanding roadway safety performance is critical in developing effective solutions that provide safety, mobility, and in maintaining quality of life. One of the key components in understanding safety performance is recognizing any pre-existing safety issues and concerns. To identify this the study team obtained crash data from 2010 to 2013 from the Houston Galveston Area Council (H-GAC) for the Kingwood Study area roadways. These data came from TxDOT’s Crash Records Information System (CRIS). These crashes represent traffic accidents with a fatality, an injury or property damage with one or more vehicles having to be towed.

The crashes were selected using a set of streets located within the study area. The study area comprises a dense street network out of which six (6) major streets were chosen to query from, primarily based on what was surmised as containing a significant amount of traffic, based on existing traffic patterns. Using the historical crash data a crash rate was calculated for each roadway segment in the study area and was compared to a statewide average. Table 5-2 below shows crash rate by segment within the study area. This table also indicated the statewide average for the two types of roadways beings studied (four-lane and two-lane roadways). The statewide average for a two-lane facility is 193.07 crashers per 100 MVMT and for a four lane facility is 125.01 crashes per 100 MVMT.

From the review of available crash data, three (3) fatalities were found to occur within the study in the year 2013. The Crash Rate (R) is expressed as crashes per 100 Million Vehicle Miles Traveled (MVMT) by the equation described below:

$$R = \frac{C \times 100,000,000}{V \times 365 \times N \times L}$$

Where,

- R = Roadway crash rate for the road segment expressed as crashes per 100 million vehicle-miles of travel
- C = Total number of roadway crashes in the study period
- V = Traffic volumes Average Annual Daily Traffic (AADT)
- N = Number of years of data
- L = Length of the roadway segment in miles

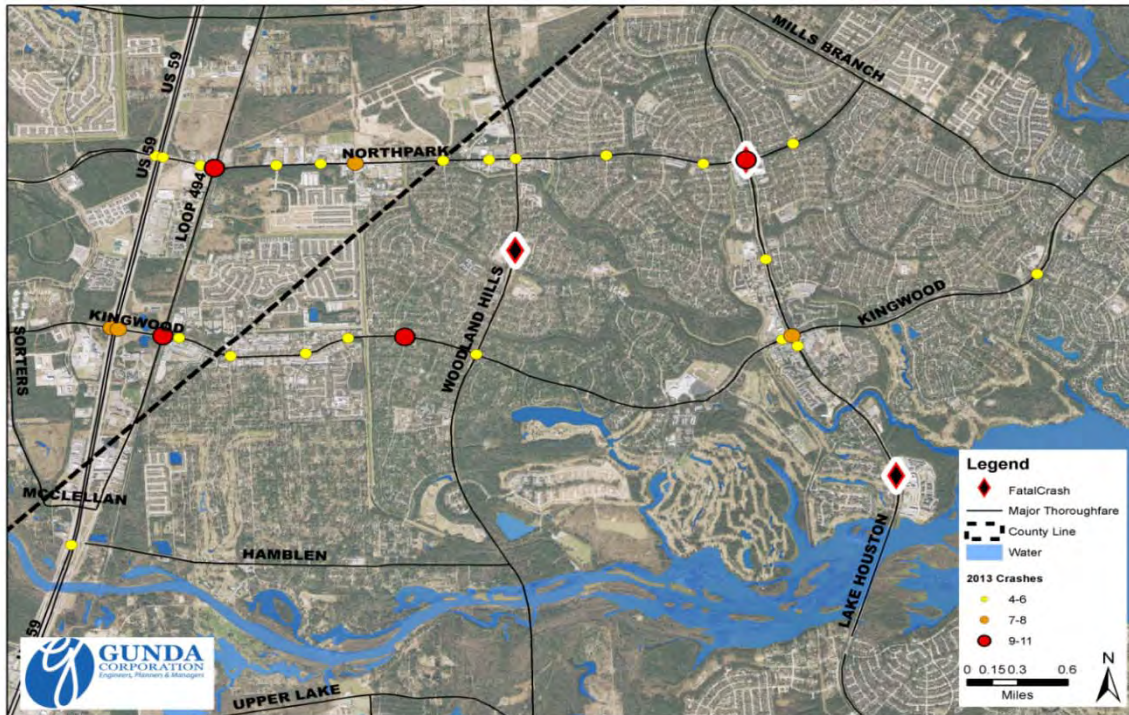
Table 5-2 Crash Rate Calculation

Roadway	Number of Crashes	Crash Rate per 100 MVMT	Statewide Average
	C	R	
Kingwood Drive	200	249.73	125.01(4-Lanes)
Northpark Drive	212	454.49	125.01 (4-Lanes)
West Lake Houston Parkway	82	578.63	125.01 (4-Lanes)
Woodland Hills Drive	49	690.01	125.01 (4-Lanes)
Mills Branch Road	50	662.78	193.07 (2-Lanes)
Hamblen Road	14	187.12	193.07 (2-Lanes)

From the review of this historical crash data, the following roadways within study area were found to be experiencing more crashes than the statewide average during 2013.

- Kingwood Drive
- Northpark Drive
- West Lake Houston Parkway
- Woodland Hills Drive
- Mills Branch Road

Hamblen Road is the only roadway that is experiencing lower crash rate than the statewide average for a similar type of roadway. Figure 5-2 below shows the crash intensity map for the year 2013.

Figure 5-2 Crash Data Map

5.6 Traffic Analysis

Intersection Level of Service analyses were performed in accordance with the procedures set forth and recommended by the 2010 Highway Capacity Manual (HCM) Level of Service methodologies for evaluation of signalized and unsignalized intersections. The traffic analysis software SYNCHRO was used to evaluate the operations of the study intersections. *Level of Service (LOS)* is a quantitative stratification of a performance measure or measures that represent quality of service. A change of LOS indicates that roadway performance has transitioned from one given range of traveler-perceivable conditions to another range. LOS "A" is considered best, free-flow conditions and LOS "F" is considered failing conditions. LOS "D" is considered acceptable during the peak traffic periods by the City of Houston. Study models for AM and PM peak hours were created using existing (2014) traffic volumes collected in February 2014, existing roadway geometries verified in the field, and signal timing obtained from the City of Houston.

5.7 Results

The results for the existing conditions analysis which include the Average Delay (in seconds per vehicle) and LOS for each study intersection are presented in this section. Existing Traffic Analysis Worksheets (Synchro) are included in Appendix C.2 in electronic format. Table 5-3 below shows that summary of Delay and LOS for study area intersections.

Table 5-3 2014 Study Area Intersections LOS and Delay

Intersection	2014 AM		2014 PM	
	LOS	Delay	LOS	Delay
Northpark Drive at Sorters Road*	B	11	A	8.7
Northpark Drive at US 59 SBFR	D	47.8	C	27.1
Northpark Drive at US 59 NBFR	C	22.3	C	34.6
Northpark Drive at Loop 494	D	43.3	E	71.9
Northpark Drive WB at Russell Palmer Road	B	18.7	C	30.5
Northpark Drive EB at Russell Palmer Road	C	33.1	D	44.4
Northpark Drive WB at Hidden Pines/Woodridge Pkwy	F	263.0	F	85.8
Northpark Drive EB at Hidden Pines/Woodridge Pkwy	C	22.5	F	252.9
Northpark Drive at Woodland Hills Drive	D	45.3	D	35.6
Northpark Drive at Brookdale Drive	B	17.8	D	40.8
Northpark Drive at Lake Houston Parkway	D	41.5	E	70.9
Northpark Drive WB at Rock Springs Drive	C	31.2	C	30.6
Northpark Drive EB at Rock Springs Drive	D	42.8	D	37.6
Lake Houston Parkway NB @ Rustic Woods Drive	D	37.4	D	50.1
Lake Houston Parkway SB @ Rustic Woods Drive	C	22.1	C	26.8
Lake Houston Parkway NB @ Kings Crossing Drive	F	167.5	F	217.1
Lake Houston Parkway SB @ Kings Crossing Drive	F	90.4	F	245.9
Kingwood Drive at Sorters Road*	A	9.5	F	86.1
Kingwood Drive at US 59 SBFR	E	57.1	C	35.0
Kingwood Drive at US 59 NBFR	D	48.3	D	48.1
Kingwood Drive at Loop 494	E	56.9	F	93.1
Kingwood Drive at Royal Forest Drive	E	66.4	F	80.5
Kingwood Drive WB at Chestnut Ridge Drive	C	27.4	E	60.0
Kingwood Drive EB at Chestnut Ridge Drive	D	43.6	F	327.7
Kingwood Drive WB at Green Oak Drive	C	30.7	E	56.5
Kingwood Drive EB at Green Oak Drive	D	40.6	F	111.8
Kingwood Drive at Woodland Grove Drive	D	43.6	D	43.8
Kingwood Drive at Trailwood Village Drive	F	84.0	C	23.0
Kingwood Drive at Woodland Hills Drive	D	47.0	F	96.0
Kingwood Drive WB at Lake Kingwood Trail	B	19.3	C	20.6
Kingwood Drive EB at Lake Kingwood Trail	C	22.7	C	31.7
Kingwood Drive WB at Kingwood High School	B	18.5	C	27.0
Kingwood Drive EB at Kingwood High School	B	18.8	B	14.9
Kingwood Drive at Lake Houston Parkway	D	46.2	D	54.7
Kingwood Drive at Forest Garden Drive	B	13.8	D	45.4
Kingwood Drive WB at Timber Shade Drive	B	10.3	B	19.6
Kingwood Drive EB at Timber Shade Drive	C	26.8	D	36.1
Kingwood Drive WB at Willow Terrace Drive	C	24.7	B	15.7
Kingwood Drive EB at Willow Terrace Drive	E	58.9	C	28.3
Kingwood Drive WB at High Valley Drive	C	23.4	B	19.7
Kingwood Drive EB at High Valley Drive			C	21.2
US 59 SBFR at Sorters Road	A	6.6	B	14.7
Loop 494 at Sorters Road	B	10.2	B	10.8
Hamblen Road at US 59 NBFR*	A	3.6	none	none
Hamblen Road at W. Hamblen/US 59 NBFR*	A	3.9	A	2.5
Hamblen Road at Laurel Springs Lane*	A	3.1	A	3.7
Hamblen Road at Forest Cove Drive*	A	8.8	E	58.9
Hamblen Road at Redbud Lane*	A	7.8	A	8.2

Shaded area represents one-way pair; * represents Unsignalized Intersection.

Based on the results of the traffic analysis for study area intersections, there are 15 intersections operating below LOS standard per COH standards.

6.0 KNOWN DEVELOPMENTS

The following is the list of developments which are currently under construction are scheduled to be constructed in the near future:

- **Watercrest Kingwood** – This development is 236 unit senior living villas/Apartments anticipated to be complete and operational in the summer of 2015.
- **Kings Creek Mixed Use Development** – This a mixed use development anticipated to start construction in the summer of 2015. This includes some high end restaurants, retail, and luxury residential units.
- **Kingwood Parc Mixed Use Development** – This mixed-use development is anticipated to start construction in 2015.
- **New Caney Middle School** – This a new middle school for 1,100 students which is currently in operation.
- **Royal Brook Residential Development** – This includes a 774 unit single family residential development anticipated to be opened by 2016.
- **Main Street Kingwood Mixed-Use Development** – This is mixed use retail development anticipated to be complete and operational in the year 2016.
- **Woodridge Forest** – This residential development has four sections completed as of February 2015 and three additional sections currently under development.

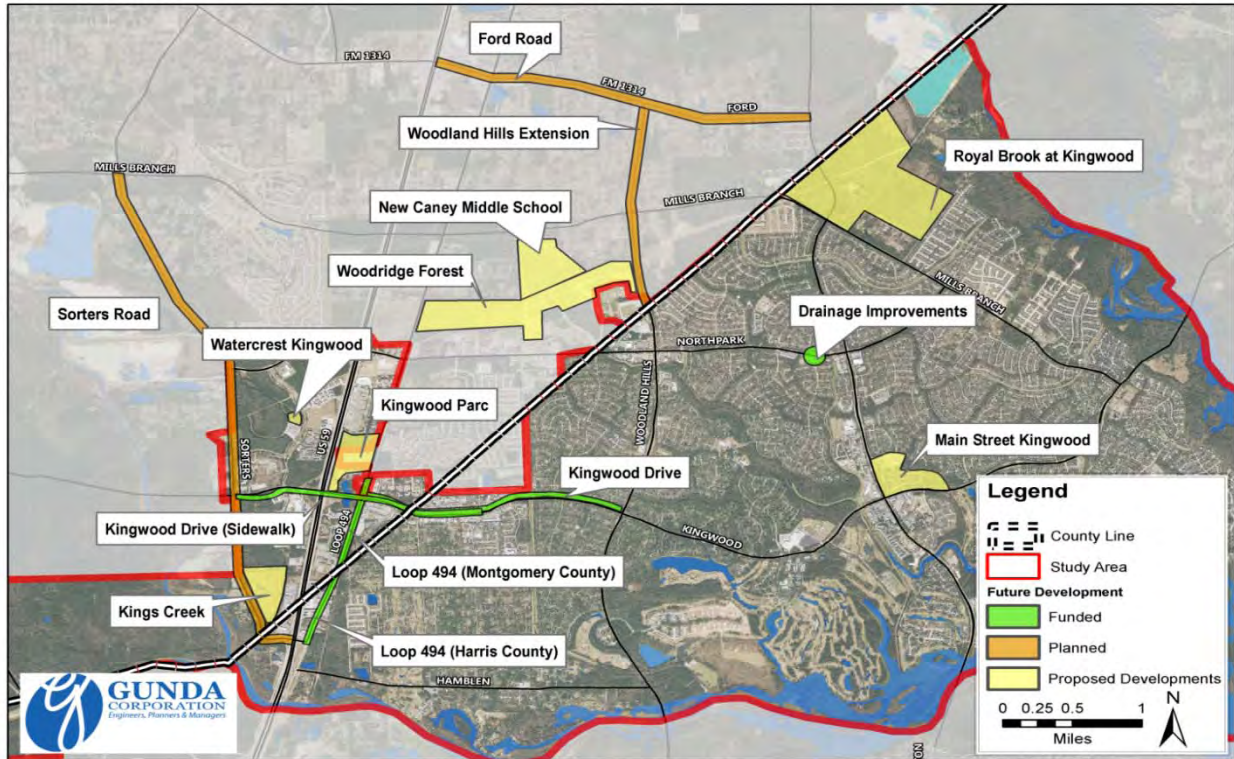
6.1 Future Planned/Scheduled/Funded Improvements

The following is the list of infrastructure improvement projects which are planned and funded:

- **Four Lane Widening of Kingwood Drive from Loop 494 to Woodland Hills Drive** – This improvement is funded by the City of Houston for FY 07/2016
- **Four Lane Widening of Loop 494 from North of Kingwood Drive to Harris County Line** - This improvement is funded by the TXDOT for FY 09/2016
- **Four Lane Widening of Loop 494 from North of Sorters to Montgomery County Line** - This improvement is funded by the TXDOT for FY 09/2016
- **Woodland Hills Drive Extension from Northpark Drive to Ford Road** - This improvement is planned by Montgomery County for FY 09/2019
- **Four Lane Widening of Sorters Road from FM 1314 to Northpark Drive** - This improvement is planned by Montgomery County for FY 09/2019,
- **Reconstruction of Ford Road from US 59 to West Lake Houston Parkway** - This improvement is planned by Montgomery County for FY 01/2022

The locations of the known developments and planned improvements are graphically illustrated in the following figure 6-1:

Figure 6-1 Planned Developments and Infrastructure Improvements



7.0 PUBLIC INPUT

The number-one goal of the Steering Committee was to obtain community input, which was achieved through several opportunities. The Public were invited to participate in Stakeholder Meetings on May 13, 2014 and on October 14, 2014. In these meetings, citizens were given the opportunity to view all collected data, ask questions, write comments or questions on cards, and fill out a survey. Residents were also informed that they could complete a survey or comment card and fax, mail, or scan to e-mail these to Gunda Corporation.

In addition to the public meetings, residents of the Kingwood area were also able to e-mail any comments, questions, or suggestions to the staff at Gunda Corporation through a project-dedicated e-mail address. Upon receipt of the e-mails, Gunda staff logged the comment and any associated contact information. The survey that was made available to citizens at the first Stakeholder Meeting was also hosted online through Survey Monkey for several months so that any residents unable to attend the meeting could complete the survey. Later in the Study, when alternatives were developed, the public was given the opportunity to rank them and submit to Gunda Corporation.

In order to keep the public informed throughout the process, a website was developed to host past presentations, project maps, and contact information. Several media outlets, such as The Observer, The Tribune, The Houston Chronicle, and Kingwood Service Association, made efforts throughout the Study in order to gain input from the public.

There were a total of 1,075 surveys submitted as of June 30, 2014, when the website closed the survey. There were a total of 196 comments from residents submitted via comment card, e-mail or mail. There were 169 ranking cards submitted by the deadline of November 11, 2014.

8.0 FUTURE TRAFFIC PROJECTIONS

8.1 Volumes

The future traffic volumes were obtained by projecting existing (2014) traffic volumes collected in February 2014 to year 2020. Future Year 2020 traffic volumes for the study facilities were developed taking into consideration the cumulative traffic expected to be generated by the proposed commercial and residential developments in the close proximity of the project location. Presently, the specific land use details of those developments are available. The traffic volumes for the Year 2020 are developed by projecting Year 2014 traffic volumes at an annual growth rate of 2%.

8.2 Traffic Analysis

Intersection Level of Service analyses were performed in accordance with the procedures set forth and recommended by the 2010 Highway Capacity Manual (HCM) Level of Service methodologies for evaluation of signalized and unsignalized intersections. The traffic analysis software SYNCHRO was used to evaluate the operations of the study intersections. *Level of Service (LOS)* is a quantitative stratification of a performance measure or measures that represent quality of service. A change of LOS indicates that roadway performance has transitioned from one given range of traveler-perceivable conditions to another range. LOS "A" is considered best, free-flow conditions and LOS "F" is considered failing conditions. LOS "D" is considered acceptable during the peak traffic periods by the City of Houston. Study models for AM and PM peak hours for future conditions were developed using the projected 2020 traffic volumes. Existing roadway geometries verified in the field were used and signal timing was optimized for future conditions.

8.3 Results

The results which include the Average Delay (in seconds per vehicle) and LOS for each study intersection are presented in this section. Year 2020 Traffic Analysis Worksheets (Synchro) are included in Appendix C.3 in electronic format. The delay and LOS for study area intersections for the year 2020 no-build conditions are summarized in Table 8-1.

Table 8-1 2020 Study Area Intersections LOS and Delay (No-Build)

Intersection	2020 AM		2020 PM	
	LOS	Delay	LOS	Delay
Northpark Drive at Sorters Road*	B	17.6	B	10.7
Northpark Drive at US 59 SBFR	E	69.6	C	31.3
Northpark Drive at US 59 NBFR	C	24.4	D	42.3
Northpark Drive at Loop 494	E	66.5	F	102.3
Northpark Drive WB at Russell Palmer Road	C	22.2	C	32
Northpark Drive EB at Russell Palmer Road	C	34.4	E	73.5
Northpark Drive WB at Hidden Pines/Woodridge Pkwy	F	359	F	144
Northpark Drive EB at Hidden Pines/Woodridge Pkwy	D	36.4	F	347.5
Northpark Drive at Woodland Hills Drive	E	57.7	D	45.2
Northpark Drive at Brookdale Drive	B	19.9	E	64.2
Northpark Drive at Lake Houston Parkway	D	45.4	F	98.4
Northpark Drive WB at Rock Springs Drive	C	31.9	C	31.7
Northpark Drive EB at Rock Springs Drive	D	43.6	D	39.6
Lake Houston Parkway NB @ Rustic Woods Drive	D	39.5	E	69.2
Lake Houston Parkway SB @ Rustic Woods Drive	C	23.9	C	30.7
Lake Houston Parkway NB @ Kings Crossing Drive	F	233.1	F	288.6
Lake Houston Parkway SB @ Kings Crossing Drive	F	142.2	F	324.6
Kingwood Drive at Sorters Road*	B	10.2	F	144.5
Kingwood Drive at US 59 SBFR	E	60.4	E	55.5
Kingwood Drive at US 59 NBFR	E	73.9	E	64.8
Kingwood Drive at Loop 494	E	58.6	F	101.8
Kingwood Drive at Royal Forest Drive	E	67	F	98.2
Kingwood Drive WB at Chestnut Ridge Drive	D	50.4	E	69.6
Kingwood Drive EB at Chestnut Ridge Drive	D	46.7	F	397.9
Kingwood Drive WB at Green Oak Drive	D	38.7	E	66
Kingwood Drive EB at Green Oak Drive	D	44.6	F	149.8
Kingwood Drive at Woodland Grove Drive	D	45.7	E	58.7
Kingwood Drive at Trailwood Village Drive	F	119.4	D	41.3
Kingwood Drive at Woodland Hills Drive	E	66	F	121.5
Kingwood Drive WB at Lake Kingwood Trail	C	22	C	23.6
Kingwood Drive EB at Lake Kingwood Trail	C	24.3	D	44.8
Kingwood Drive WB at Kingwood High School	C	21.5	C	29.9
Kingwood Drive EB at Kingwood High School	C	20.4	C	20.1
Kingwood Drive at Lake Houston Parkway	D	52.8	E	64.5
Kingwood Drive at Forest Garden Drive	B	17.8	D	51.5
Kingwood Drive WB at Timber Shade Drive	B	10.7	C	20.3
Kingwood Drive EB at Timber Shade Drive	C	27.3	D	39.2
Kingwood Drive WB at Willow Terrace Drive	C	25.2	B	16.7
Kingwood Drive EB at Willow Terrace Drive	E	61	C	30.5
Kingwood Drive WB at High Valley Drive	C	24.7	B	19.9
Kingwood Drive EB at High Valley Drive			C	23.7
US 59 SBFR at Sorters Road	A	8.1	C	22.6
Loop 494 at Sorters Road	B	10.5	B	11.5
Hamblen Road at US 59 NBFR*	A	4.1	none	none
Hamblen Road at W. Hamblen/US 59 NBFR*	A	4	A	2.5
Hamblen Road at Laurel Springs Lane*	A	3.4	A	4.4
Hamblen Road at Forest Cove Drive*	A	9.3	F	104.5
Hamblen Road at Redbud Lane*	A	7.9	A	8.4

Shaded area represents one-way pair; * represents Unsignalized Intersection.

Based on the results of the traffic analysis for study rea intersections, there are 22 intersections operating below LOS standard per COH standards.

9.0 ALTERNATIVE ANALYSIS

Based upon the existing traffic data, analysis, current development activity, proposed infrastructure improvements, and public input, a total of 16 alternatives were analyzed to present results to the Steering Committee and the public.

9.1 Traffic Volumes and Diversions

When analyzing these 16 alternatives necessary traffic volume diversions were accounted for the analysis purposes. As a result, traffic volumes on some of the study area roadways were decreased/increased appropriately.

9.2 Traffic Analysis

The alternative analysis focuses on identifying both the short-term and long-term goals, developing alternatives, obtaining public input on various alternatives and providing recommendations to address congestion issues in the study area. The alternative roadway geometries were used along with optimized signal timing in order to develop the LOS and Delay for the alternatives. Additionally, the analyses of alternatives included the future conditions, taking into consideration the proposed developments as well as the roadway improvements.

The alternative analysis was conducted for sixteen (16) different scenarios which are described below. The LOS and delay data for each of these alternatives along with a conceptual layout is attached in the Appendix C-5 for reference.

No-Build Scenario

This scenario is a model of the existing roadway geometry with traffic volumes projected to future the year 2020.

1. Alternative A: Intersection Improvements

This alternative includes all improvements required at study area intersections that will improve the intersection to an acceptable LOS and delay. A total of thirteen intersection were altered in this alternative.

2. Alternative B: Left-Turn Prohibition on Kingwood Drive from US 59 to West Lake Houston Parkway

Left-turn prohibition is the ban on left turns that interfere with the peak direction traffic. In the case of Kingwood, the AM peak period peak direction of travel is westbound, therefore all vehicles traveling eastbound would not be able to turn left across from Kingwood Drive to go northbound on a cross street. The opposite would be true for PM peak hour. A total of nine intersections along Kingwood Drive would have this treatment.

3. Alternative C: Six Lanes on Kingwood Drive from US 59 to Woodland Hills Drive

Alternative C is the widening of Kingwood Drive from a four-lane to a six-lane roadway from US 59 to Woodland Hills Drive.

4. Alternative D: Six Lanes on Northpark Drive from US 59 to Woodland Hills Drive

Alternative D is the widening of Northpark Drive from a four-lane to a six-lane roadway from US 59 to Woodland Hills Drive.

5. Alternative E: Kingwood Drive Direct Connector to US 59 Southbound

Alternative E is the construction of a Direct Connector from Kingwood Drive to US 59 Southbound. The Direct Connector would begin just east of Russell Palmer Road and would connect to US 59 southbound lanes.

6. Alternative F: Northpark Drive Direct Connector to US 59 Southbound

Alternative F is the construction of a Direct Connector from Northpark Drive to US 59 Southbound. The Direct Connector would begin just east of Loop 494 and would connect to US 59 southbound lanes.

7. Alternative G: Six Lanes on Kingwood Drive + Kingwood Drive Direct Connector

Alternative G is a combination of Alternative C and Alternative E.

8. Alternative H: Six Lanes on Northpark Drive + Northpark Drive Direct Connector

Alternative H is a combination of Alternative D and Alternative F.

9. Alternative I: Six Lanes on Kingwood Drive + Kingwood Drive Direct Connector + Six Lanes on Northpark Drive + Northpark Drive Direct Connector

Alternative I is a combination of Alternative C, Alternative D, Alternative E, and Alternative F.

10. Alternative J: Woodland Hills Drive Four-Lane Extension to Hamblen Road and Widening of Hamblen Road to Loop 494 at Sorters McClellan Road

Alternative J is the widening of Woodland Hills Drive from Kingwood Drive south to Hamblen Road. With this improvement a new intersection of Hamblen Road & Woodland Hills Drive will be created and, Woodland Hills Drive will become a continuous roadway that connects to Hamblen Road. The existing Hamblen Road would continue as a four-lane roadway to connect to Sorters-McClellan Road.

11. Alternative K: Six Lanes on Kingwood Drive + Six Lanes on Northpark Drive

Alternative K is a combination of Alternative C and Alternative D.

12. Alternative L: Grade Separation at Kingwood Drive & Loop 494/Railroad

Alternative L is the construction of an overpass along Kingwood Drive that would bypass Loop 494 and the railroad. The overpass would begin east of Royal Forest Drive and end east of US 59 northbound frontage road. This alternative also includes intersection improvements at the US 59 & Kingwood Drive.

13. Alternative M: Grade Separation at Northpark Drive & Loop 494/Railroad

Alternative M is the construction of an overpass along Northpark Drive that would bypass Loop 494 and the railroad. The overpass would begin west of Kings Mill Park Drive and end east of US 59 northbound frontage road. This alternative also includes intersection improvements at the US 59 & Northpark Drive.

14. Alternative N: Six Lanes on Kingwood Drive + Grade Separation at Northpark Drive & Loop 494/Railroad

Alternative N is a combination of Alternative C and Alternative L.

15. Alternative O: Six Lanes on Northpark Drive + Grade Separation at Northpark Drive & Loop 494/Railroad

Alternative O is a combination of Alternative D and Alternative M.

9.3 Results

The results of the alternative analysis are documented in this section. As identified in the first Steering Committee Meeting on March 18, 2014, reducing the delay, improving the safety, cost effectiveness and minimal environmental impact are the primary measures of effectiveness of the alternatives analyzed. Other measures include the schedule for implementation and regulatory impacts. The following tables present the before and after delay, tree impacts, safety, cost, pros and cons of each of the sixteen (16) alternatives analyzed. Existing, Future, and Alternative Traffic Analysis Worksheets (Synchro) are included in Appendix C.2, C.3, and C.4 in electronic format.

10.0 CONCLUSIONS

After evaluation of the results of alternative analysis for Kingwood Area Roadways, a wide range of improvement options were developed and prioritized based on measures of effectiveness. The following is the list of roadway improvement projects which are intended to facilitate improved traffic flow by reducing congestion, and improving safety, thereby improving the quality of life for Kingwood area residents:

Priority # 1 Intersection Improvements

Priority #2 Widening of Kingwood Drive to 6-Lanes from US 59 to Woodland Hills Drive

Priority #3 Widening of Northpark Drive to 6-Lanes from US 59 to Woodland Hills Drive

Priority #4 Extension of Woodland Hills Drive to Hamblen Road and Widening of Hamblen Road

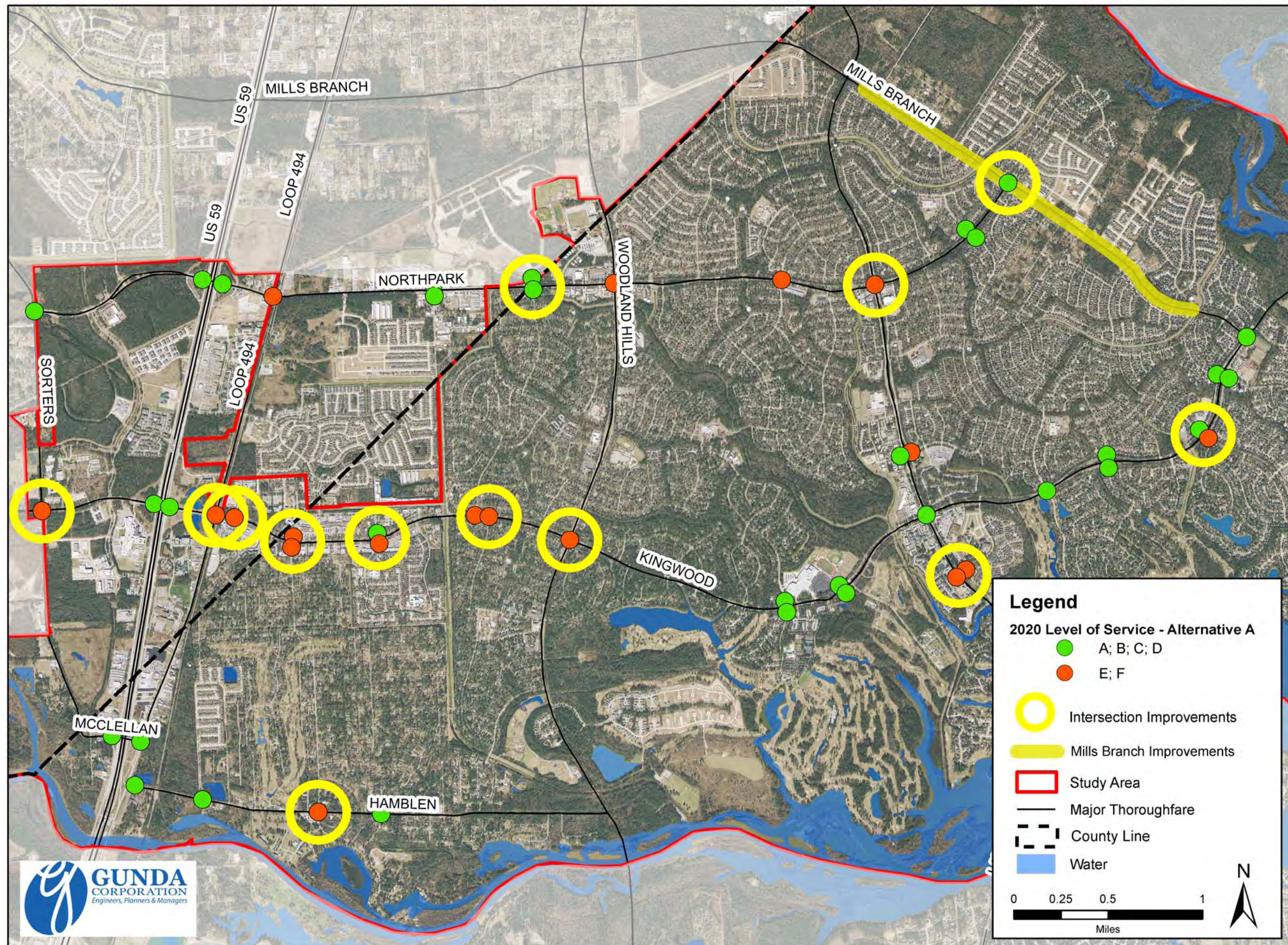
Priority #5 Grade Separation on Kingwood Drive at Loop 494/Rail Road Crossing

Priority #6 Grade Separation on Northpark Drive at Loop 494/Rail Road Crossing

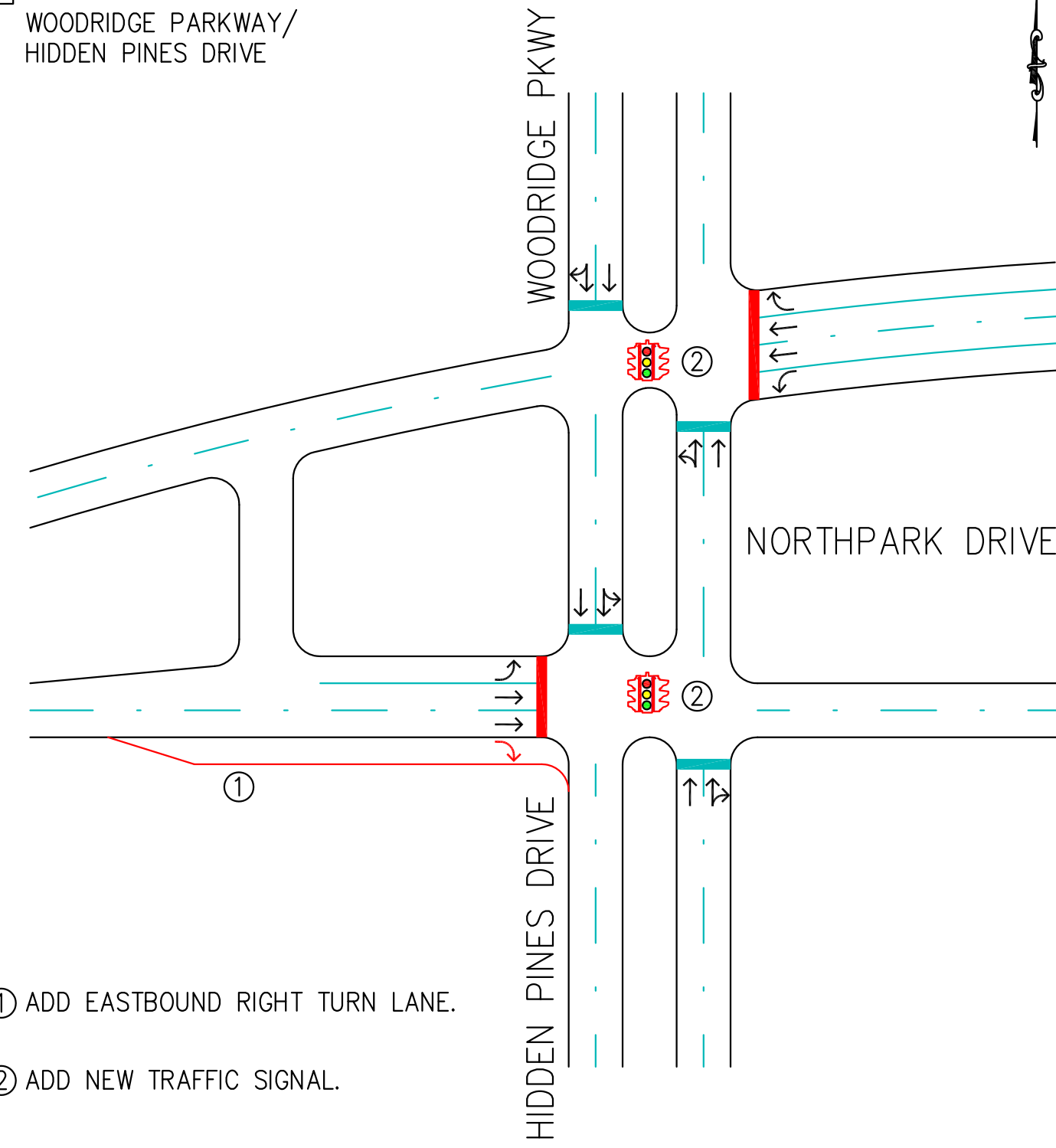
Prioritized exhibits (Priority 1 to Priority 6) are presented in the following pages. .

Lake Houston/Kingwood Area Mobility Study

Priority 1: Alternative A: Intersection Improvements

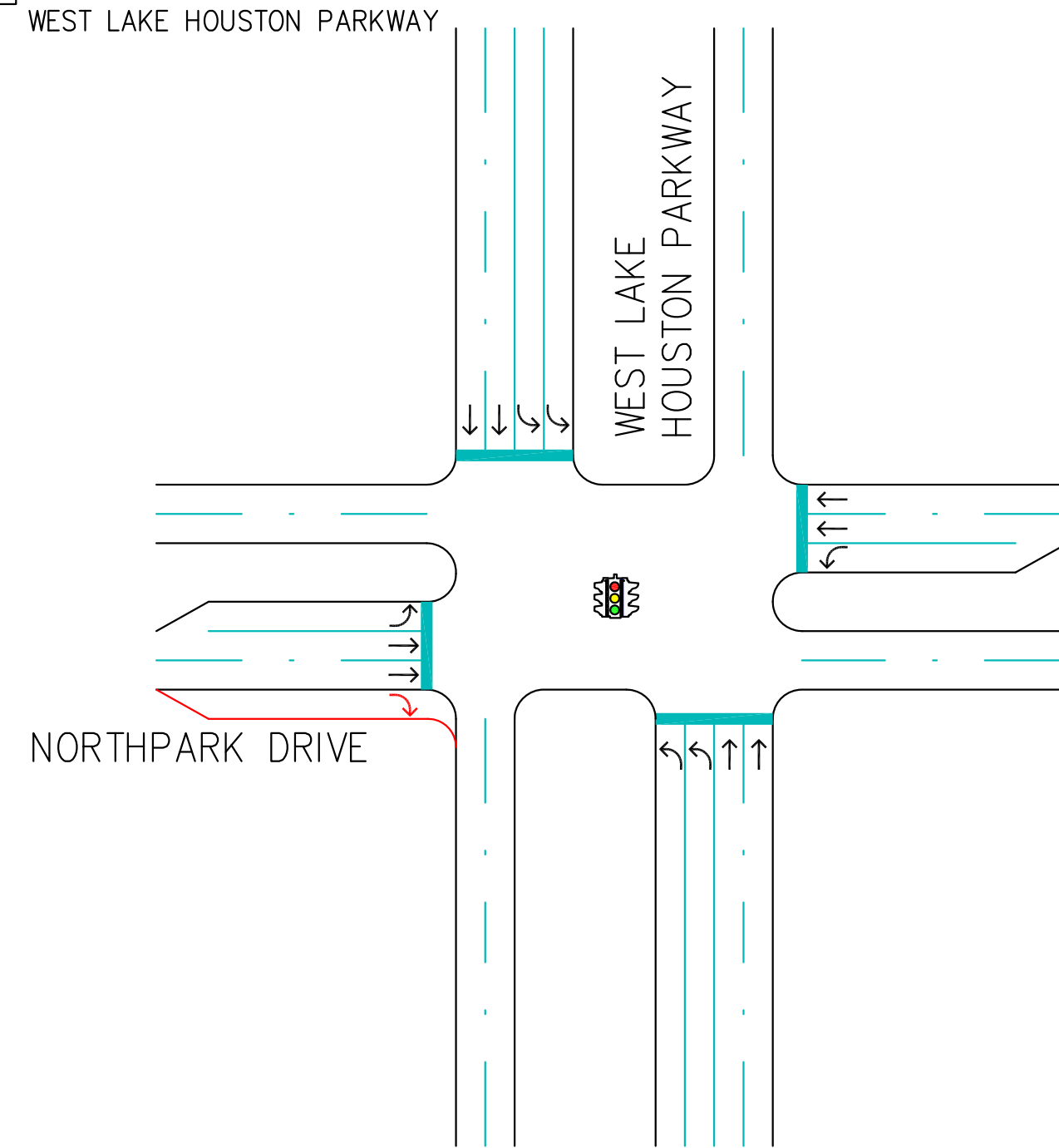


1 NORTH PARK DRIVE & WOODRIDGE PARKWAY/ HIDDEN PINES DRIVE



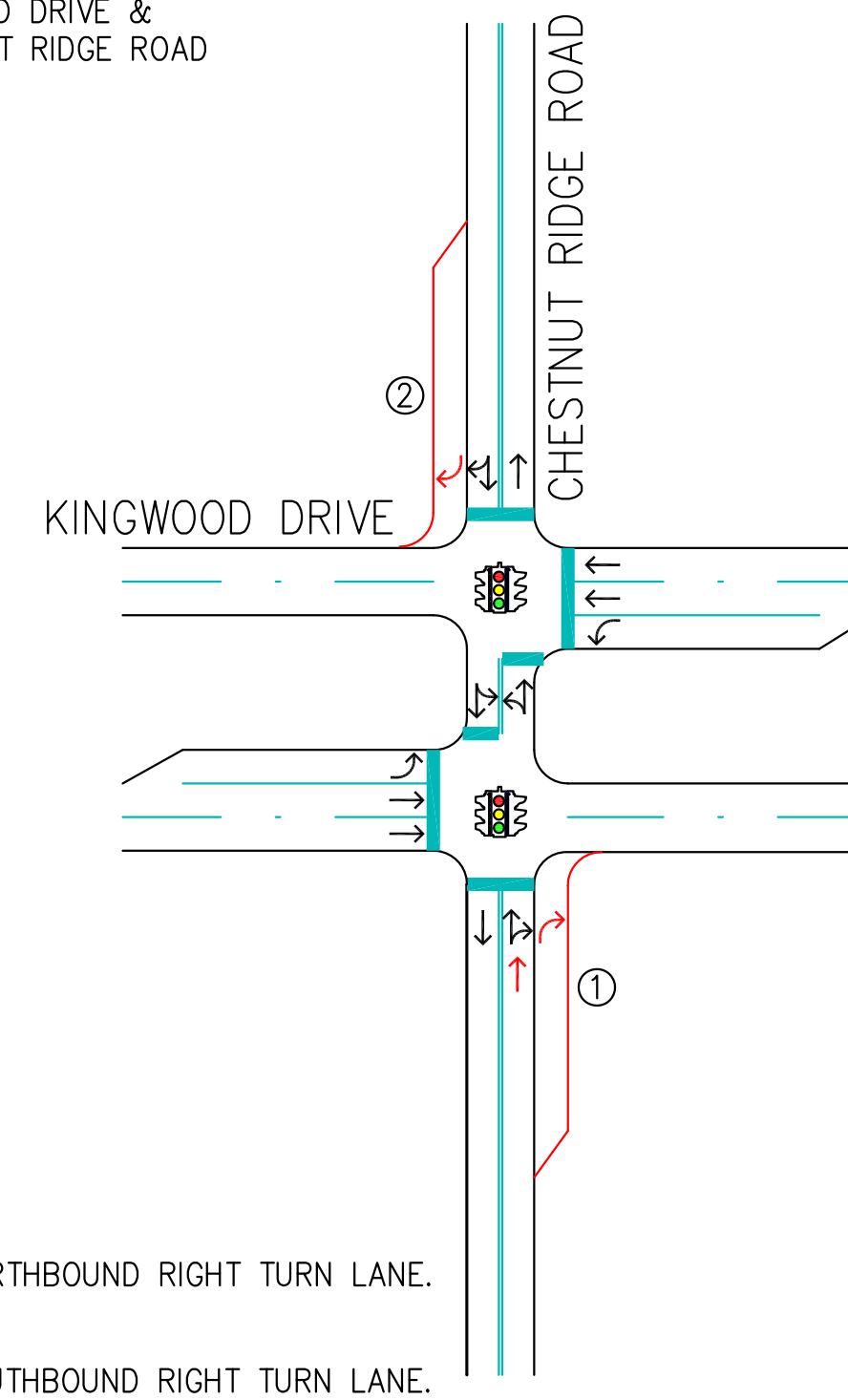
- ① ADD EASTBOUND RIGHT TURN LANE.
- ② ADD NEW TRAFFIC SIGNAL.

2 NORTH PARK DRIVE & WEST LAKE HOUSTON PARKWAY



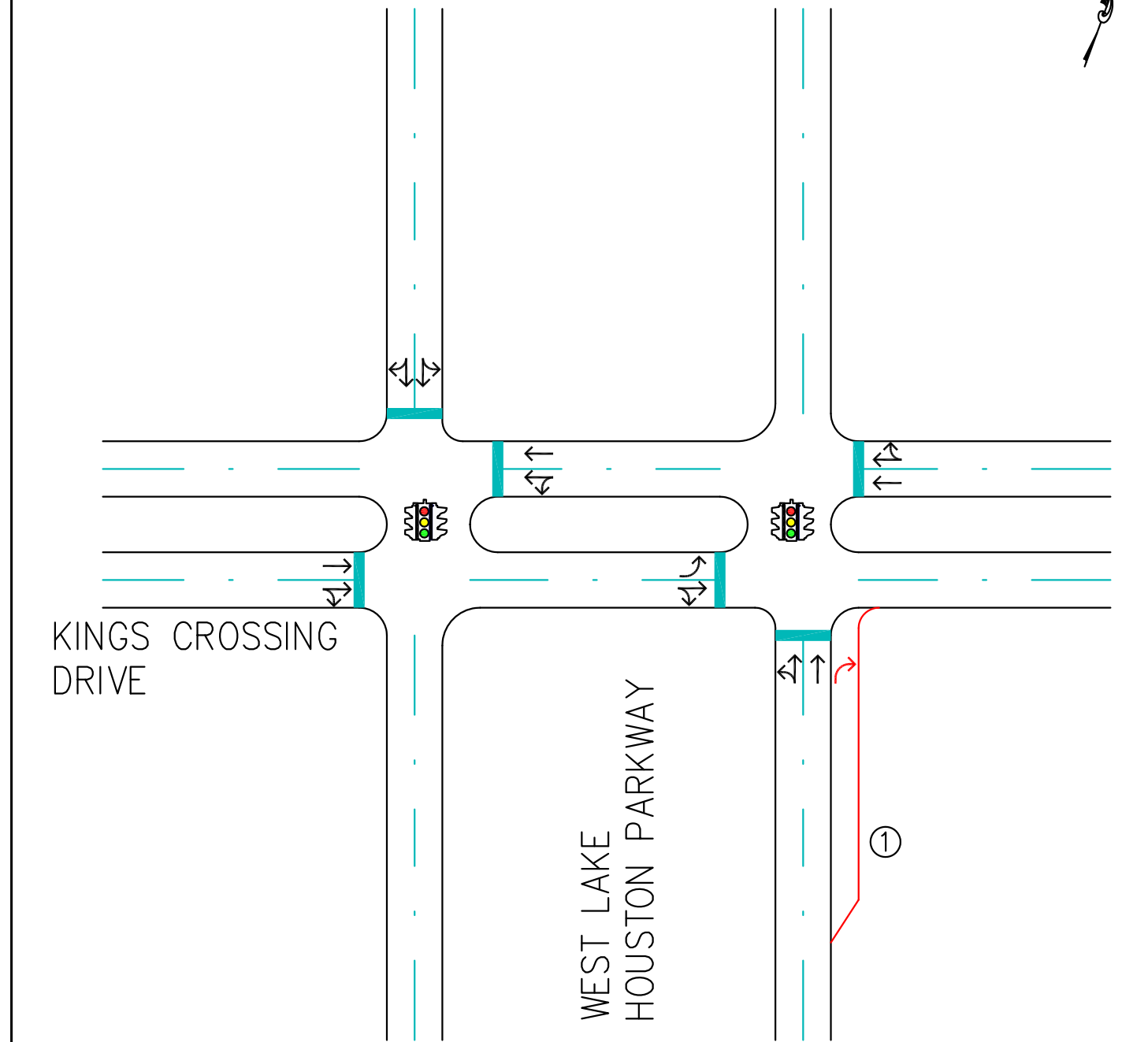
- ① ADD EASTBOUND RIGHT TURN LANE.

3 KINGWOOD DRIVE & CHESTNUT RIDGE ROAD



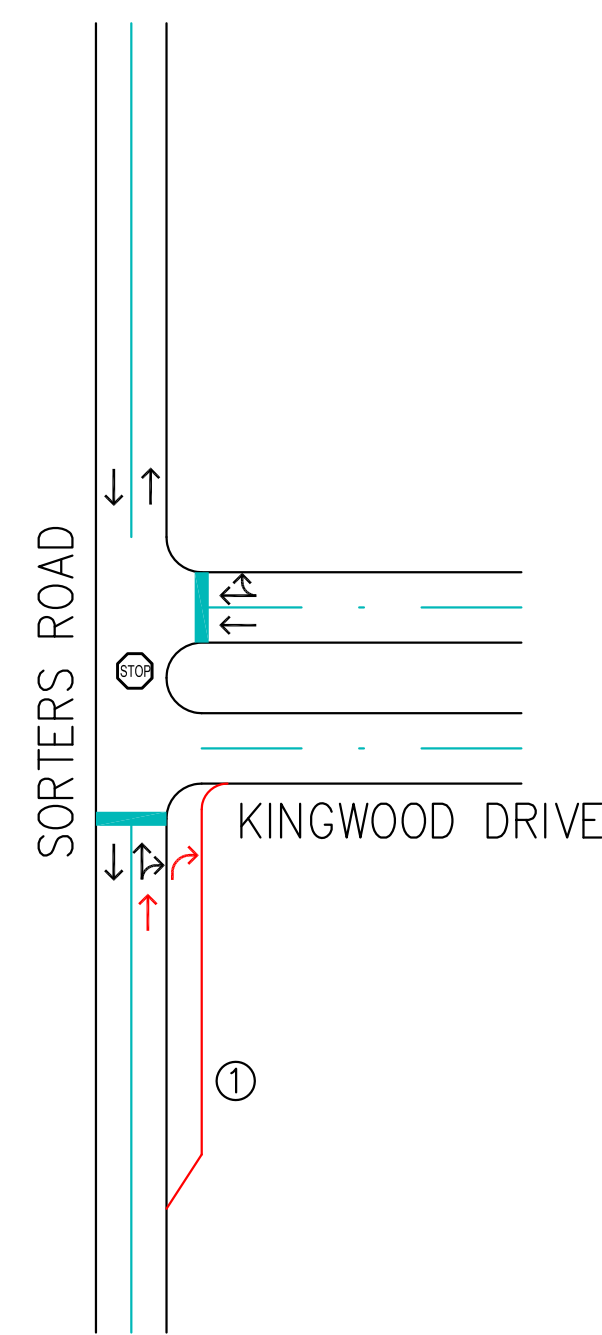
- ① ADD NORTHBOUND RIGHT TURN LANE.
- ② ADD SOUTHBOUND RIGHT TURN LANE.

4 WEST LAKE HOUSTON PARKWAY & KINGS CROSSING DRIVE



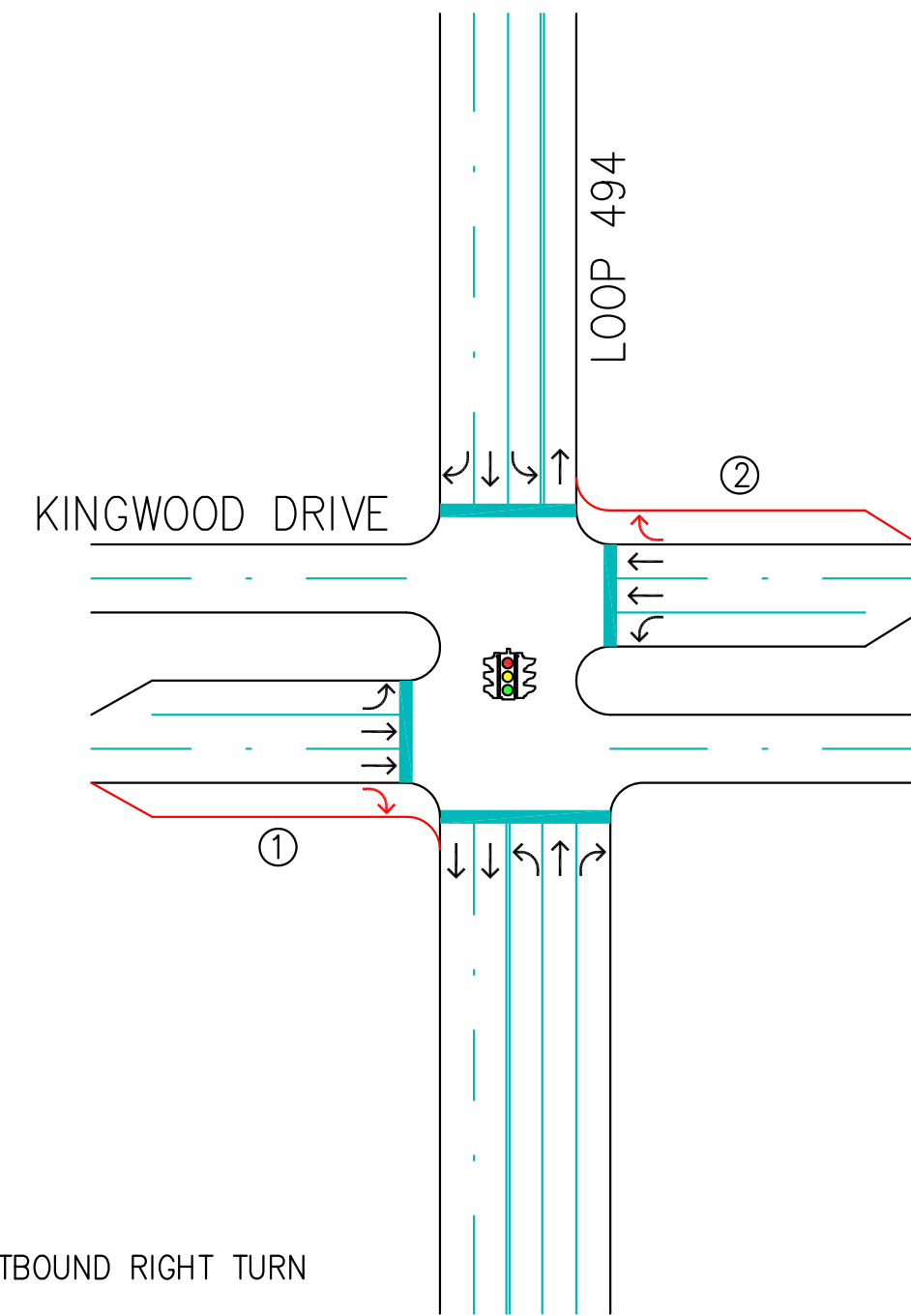
- ① ADD NORTHBOUND RIGHT TURN LANE.

5 KINGWOOD DRIVE & SORTERS ROAD



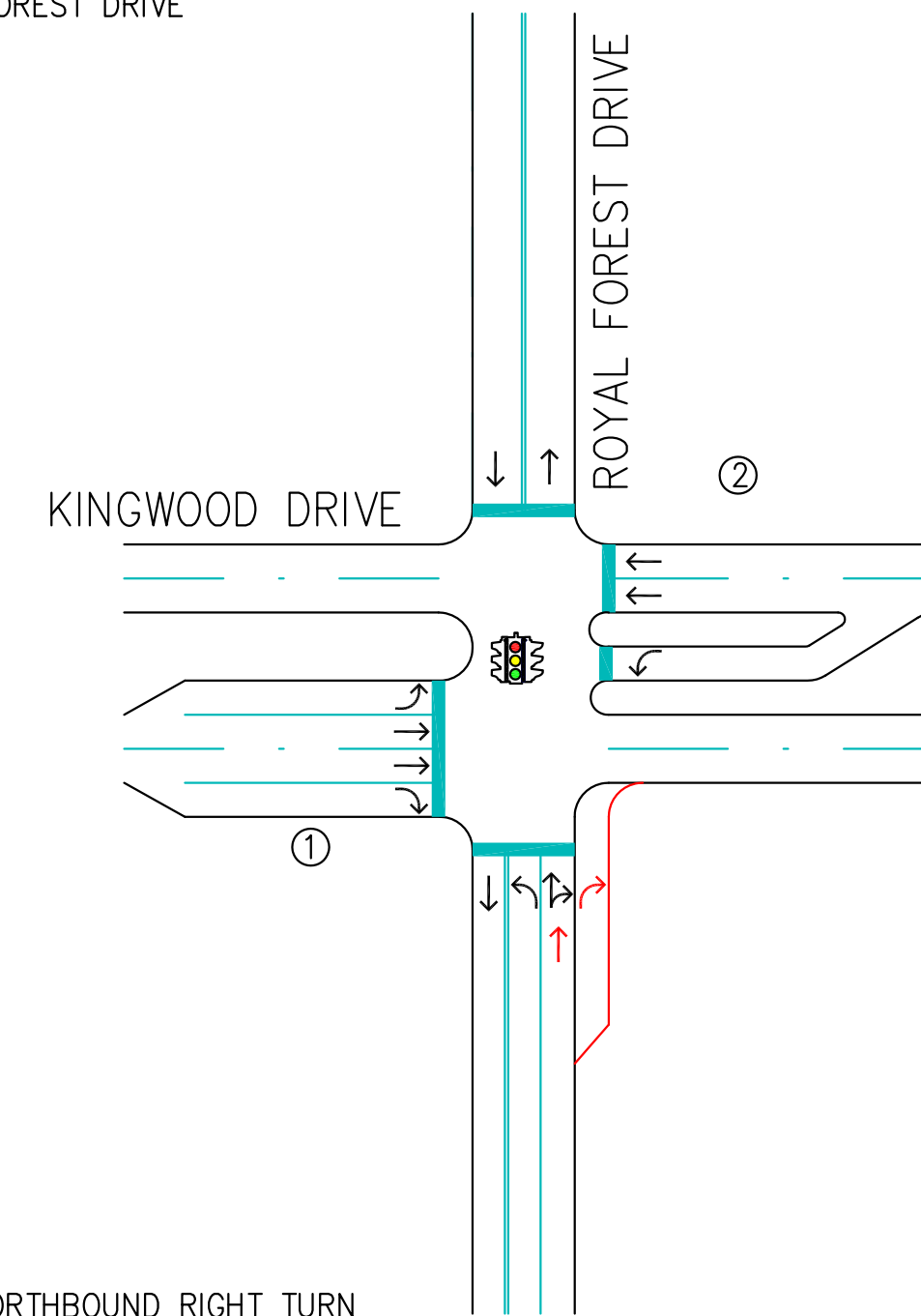
- ① ADD NORTHBOUND RIGHT TURN LANE TO KINGWOOD DRIVE.

6 KINGWOOD DRIVE & LOOP 494



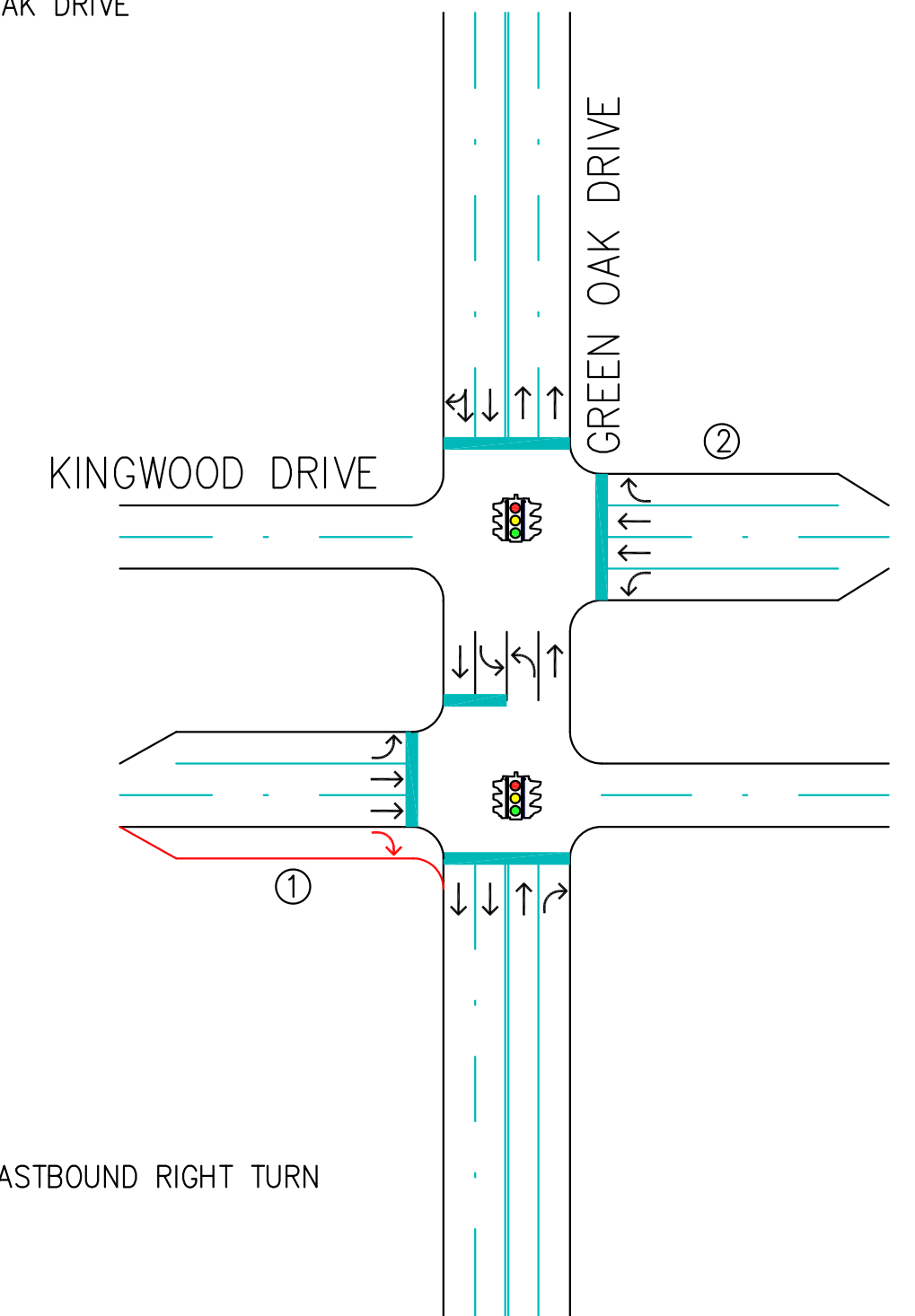
- ① ADD EASTBOUND RIGHT TURN LANE.
- ② ADD WESTBOUND RIGHT TURN LANE.

7 KINGWOOD DRIVE & ROYAL FOREST DRIVE



- ① ADD NORTHBOUND RIGHT TURN LANE.

8 KINGWOOD DRIVE & GREEN OAK DRIVE



- ① ADD EASTBOUND RIGHT TURN LANE.

- LEGEND:
- EXISTING
 - PROPOSED IMPROVEMENT
 - EXISTING STRIPING
 - EXISTING CURB
 - PROPOSED CURB

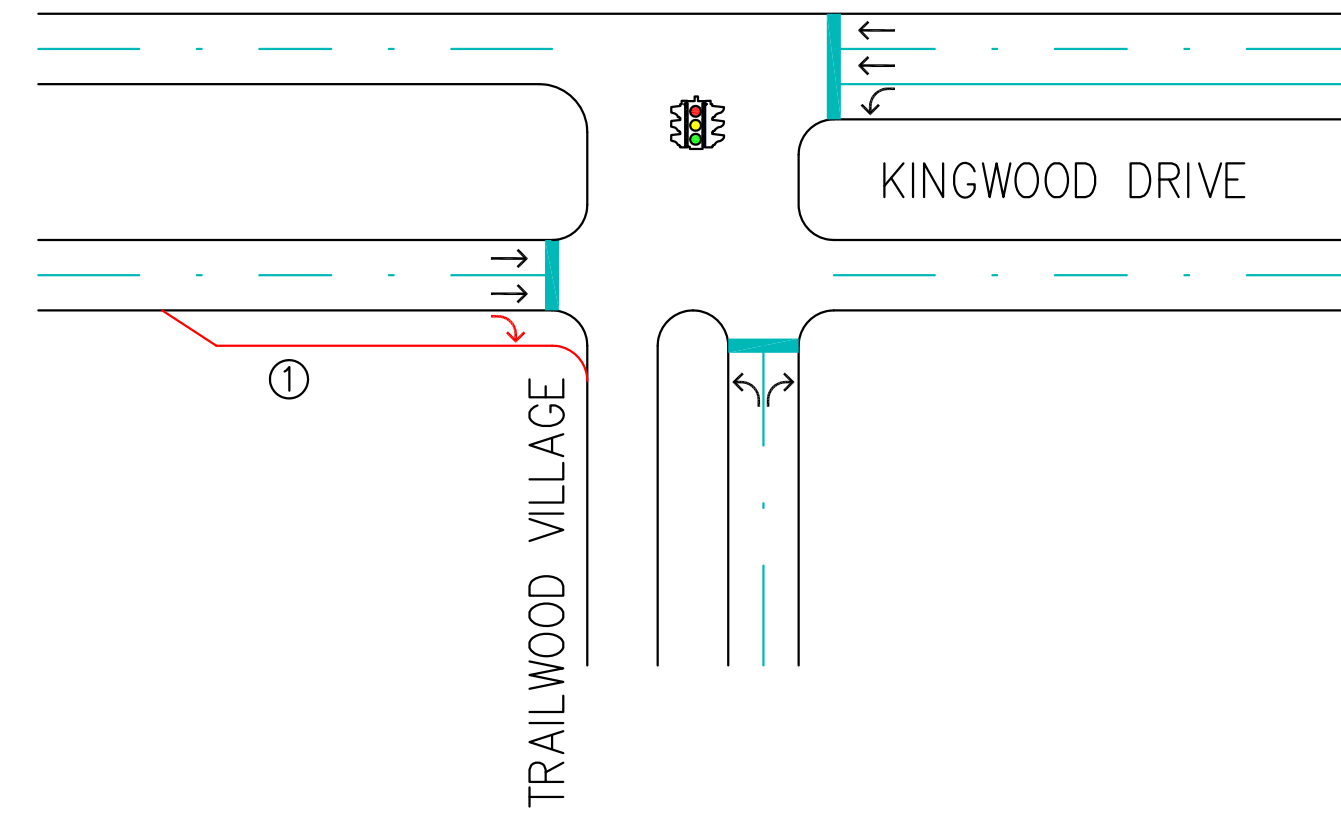


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LAKE HOUSTON KINGWOOD MOBILITY PLAN

SHEET TITLE:
INTERSECTION IMPROVEMENTS EXISTING (2014)

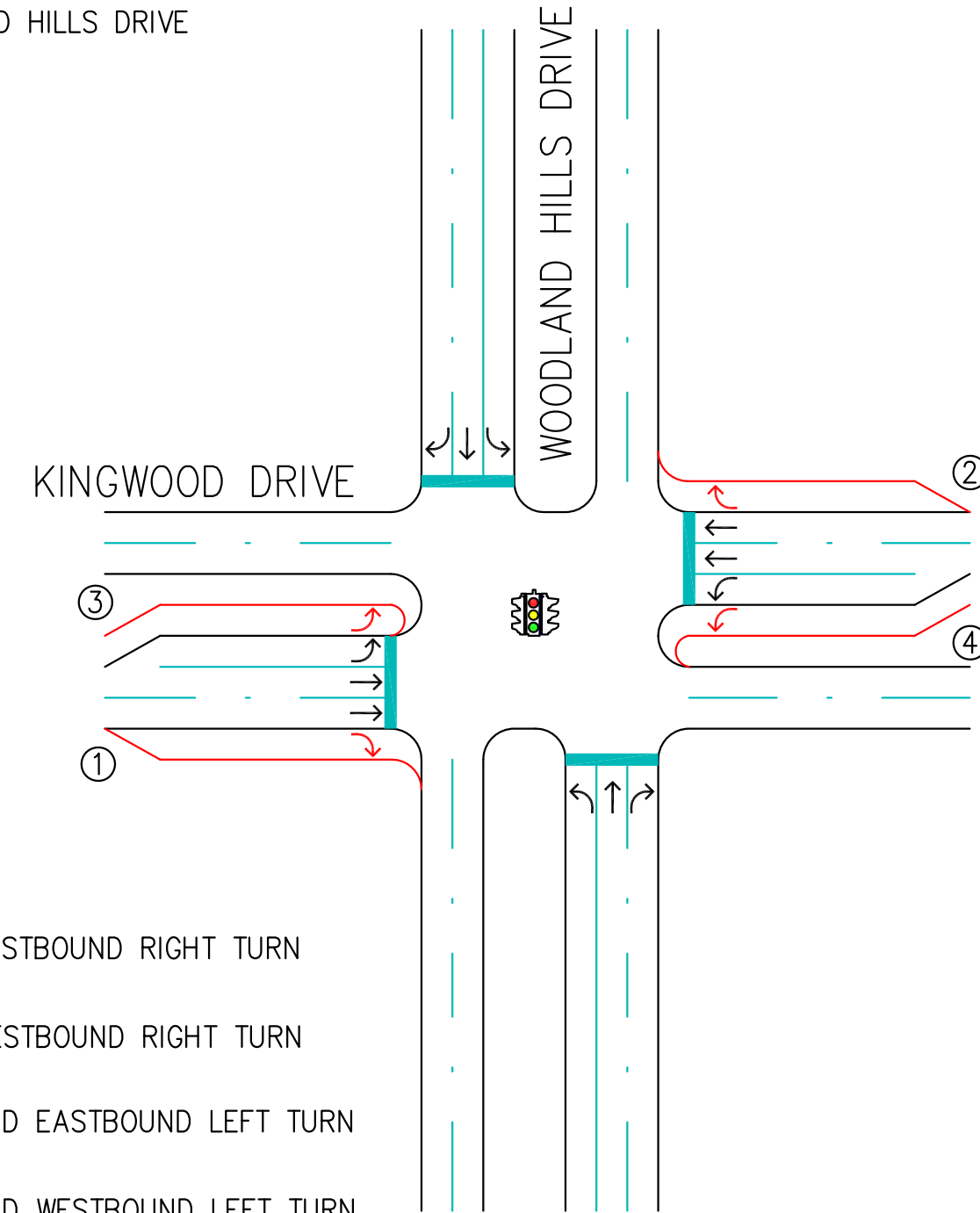
GUNDA PROJ. NO.:	SHEET NO.
14004-01	EXHIBIT E7
DATE:	SHEET 1 OF 2
SEPT., 2014	

9 KINGWOOD DRIVE & TRAILWOOD VILLAGE



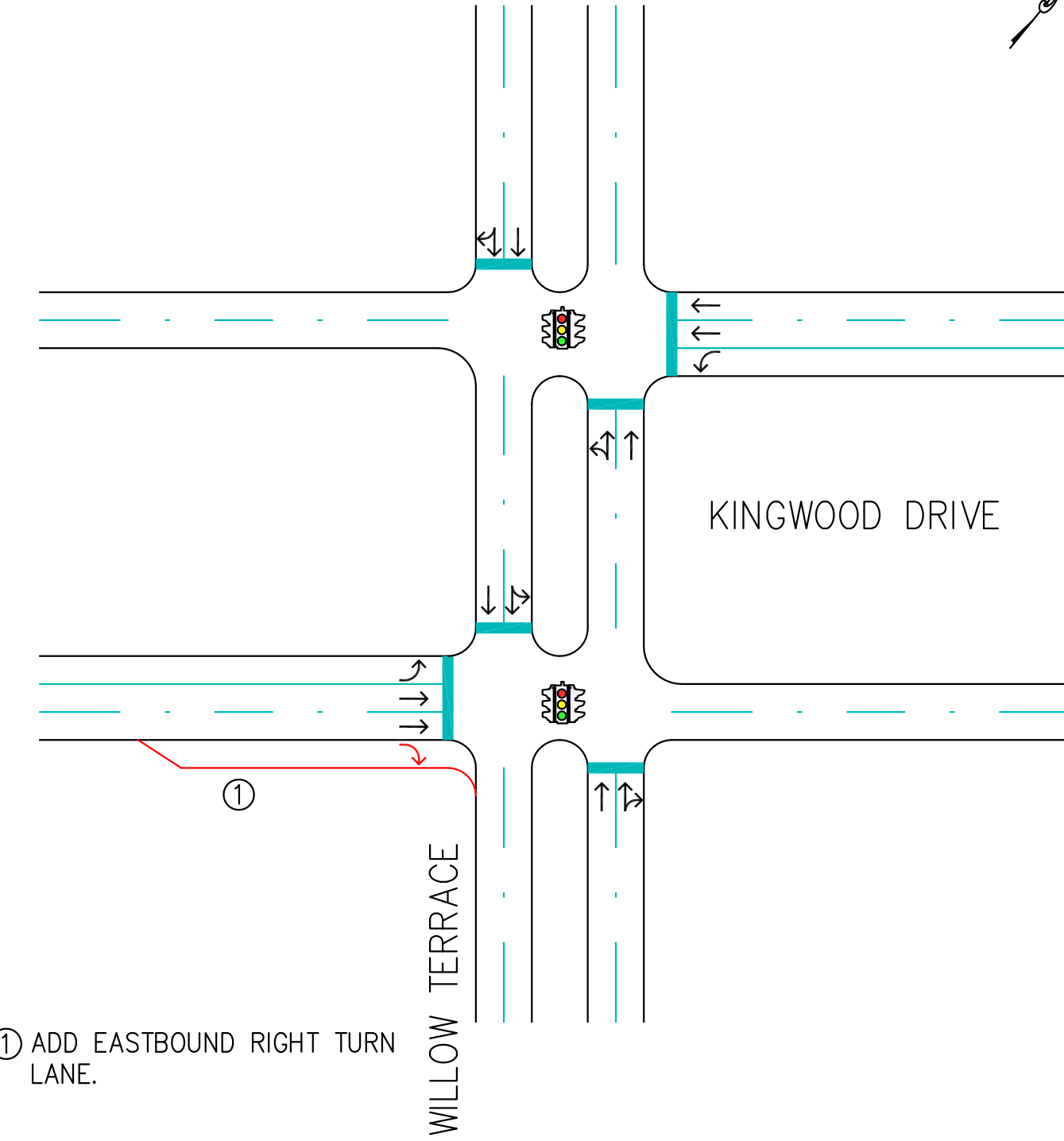
1 ADD EASTBOUND RIGHT TURN LANE.

10 KINGWOOD DRIVE & WOODLAND HILLS DRIVE



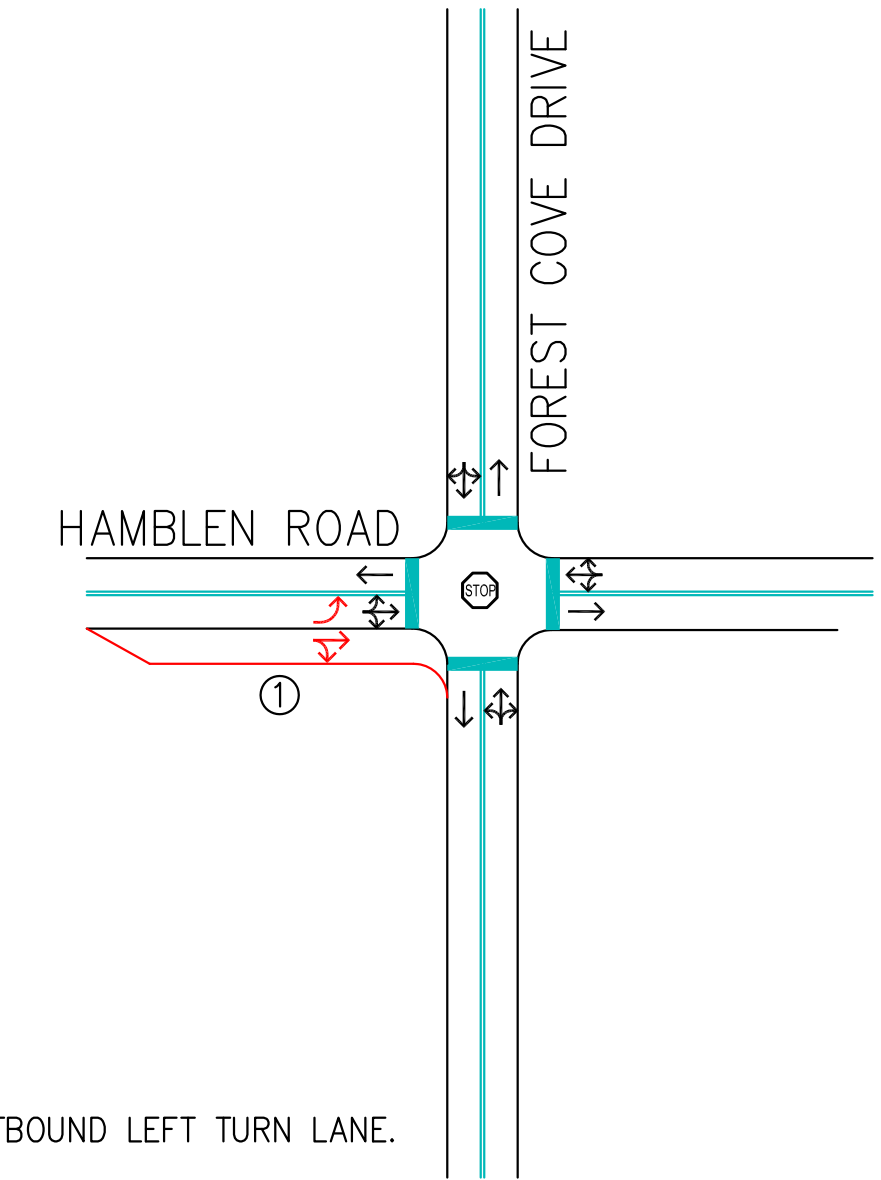
1 ADD EASTBOUND RIGHT TURN LANE.
 2 ADD WESTBOUND RIGHT TURN LANE.
 3 ADD 2ND EASTBOUND LEFT TURN LANE.
 4 ADD 2ND WESTBOUND LEFT TURN LANE.

11 KINGWOOD DRIVE & WILLOW TERRACE



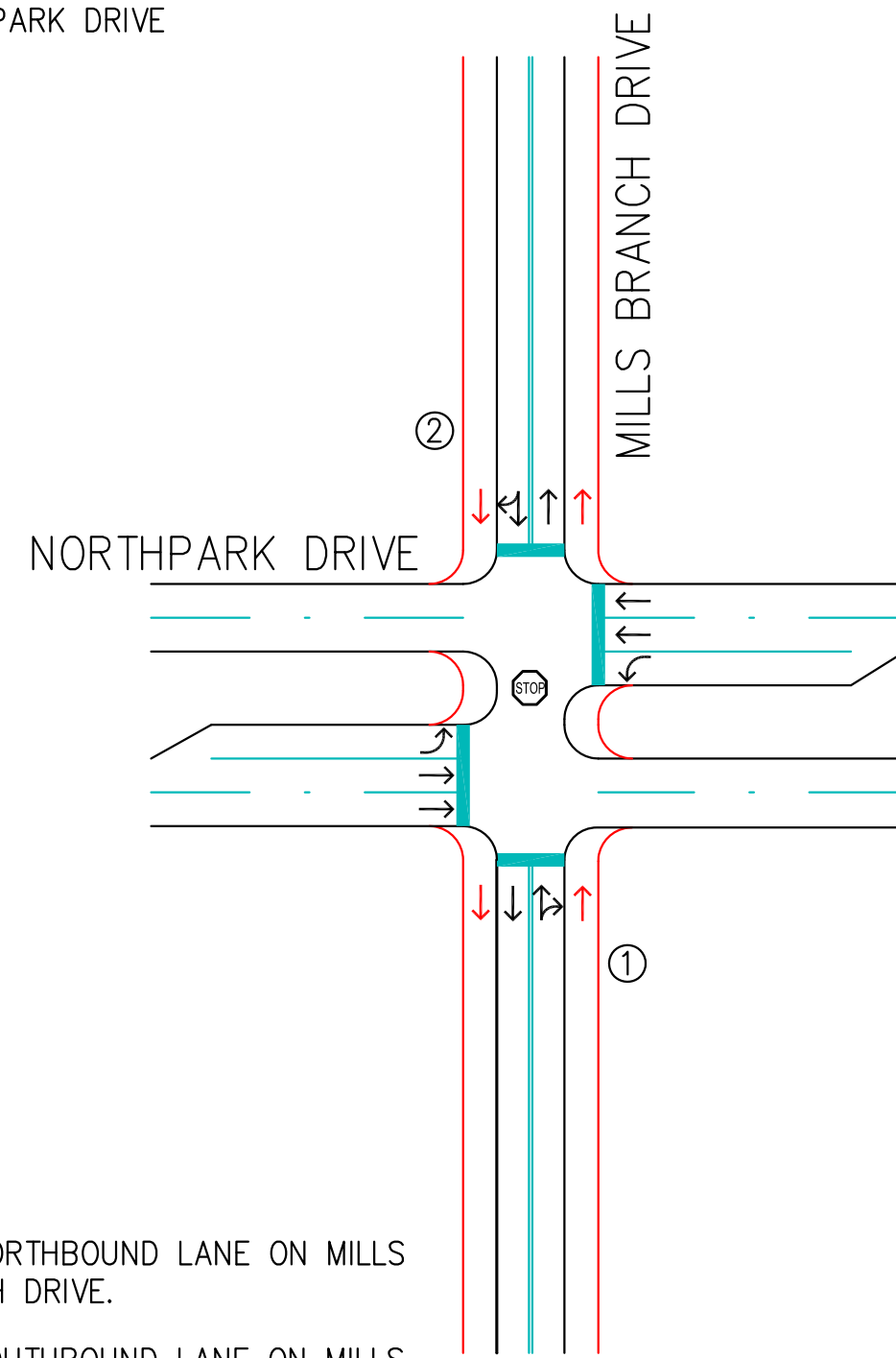
1 ADD EASTBOUND RIGHT TURN LANE.

12 HAMBLEN ROAD & FOREST COVE DRIVE



1 ADD EASTBOUND LEFT TURN LANE.

13 MILLS BRANCH DRIVE & NORTHPARK DRIVE



1 ADD NORTHBOUND LANE ON MILLS BRANCH DRIVE.
 2 ADD SOUTHBOUND LANE ON MILLS BRANCH DRIVE.

- LEGEND:
- EXISTING
 - PROPOSED IMPROVEMENT
 - EXISTING STRIPING
 - EXISTING CURB
 - PROPOSED CURB



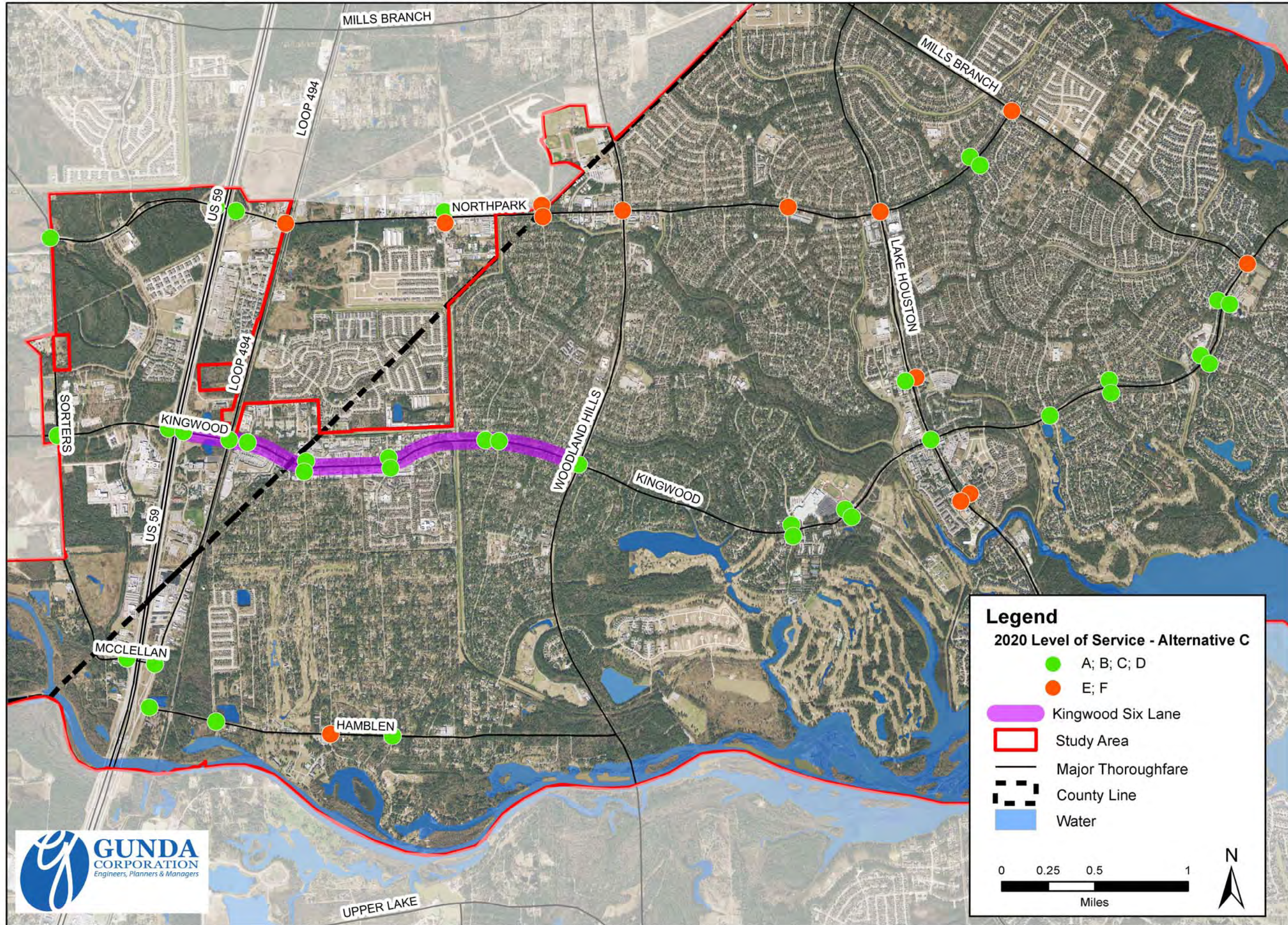
PROJECT NAME:
LAKE HOUSTON KINGWOOD
MOBILITY PLAN

SHEET TITLE:
INTERSECTION IMPROVEMENTS
EXISTING (2014)

GUNDA PROJ. NO.:	SHEET NO.
14004-01	EXHIBIT E7
DATE:	SHEET 2 OF 2
SEPT., 2014	

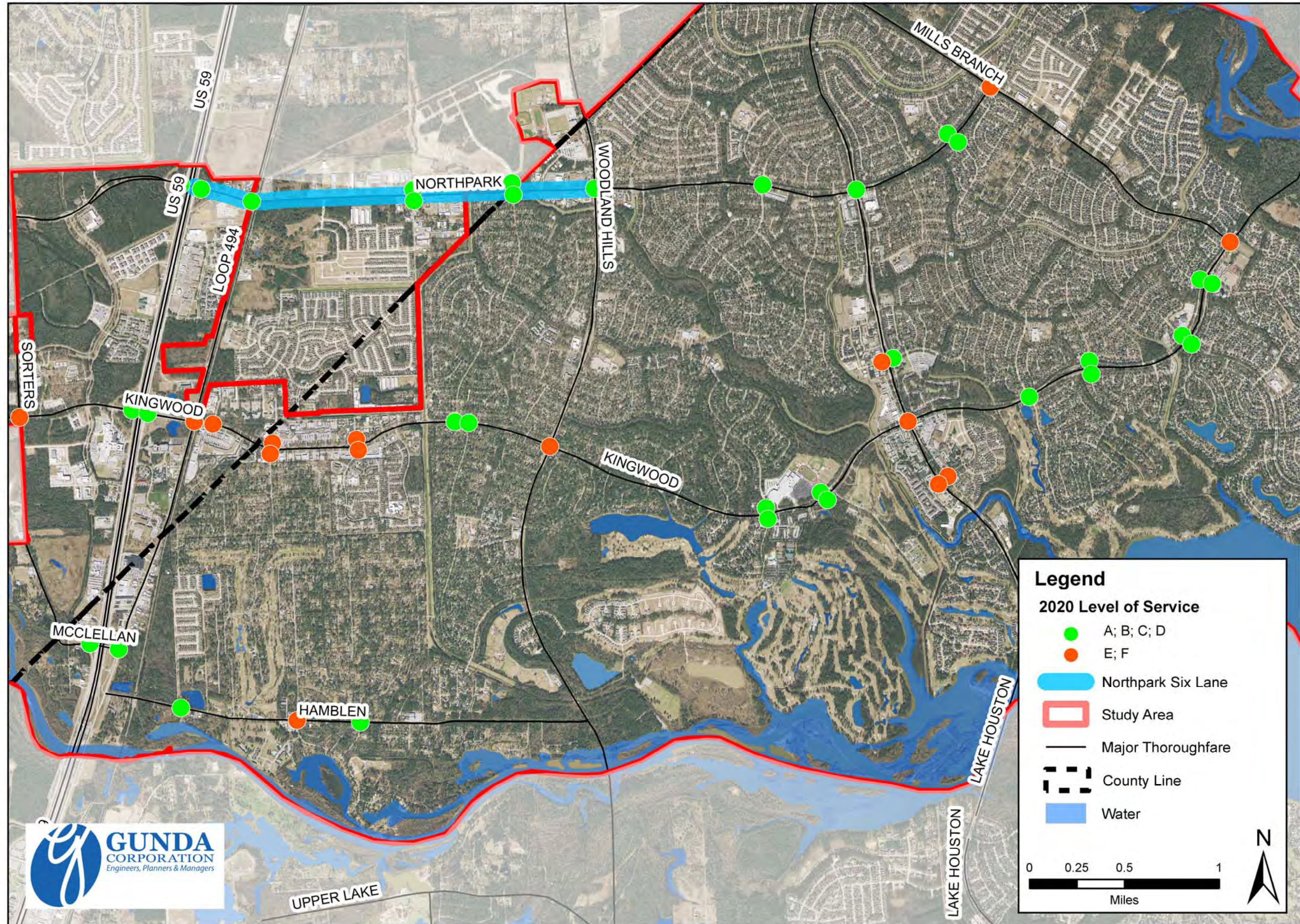
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Priority 2: Alternative C: Kingwood Six Lanes (US 59 to Woodland Hills)



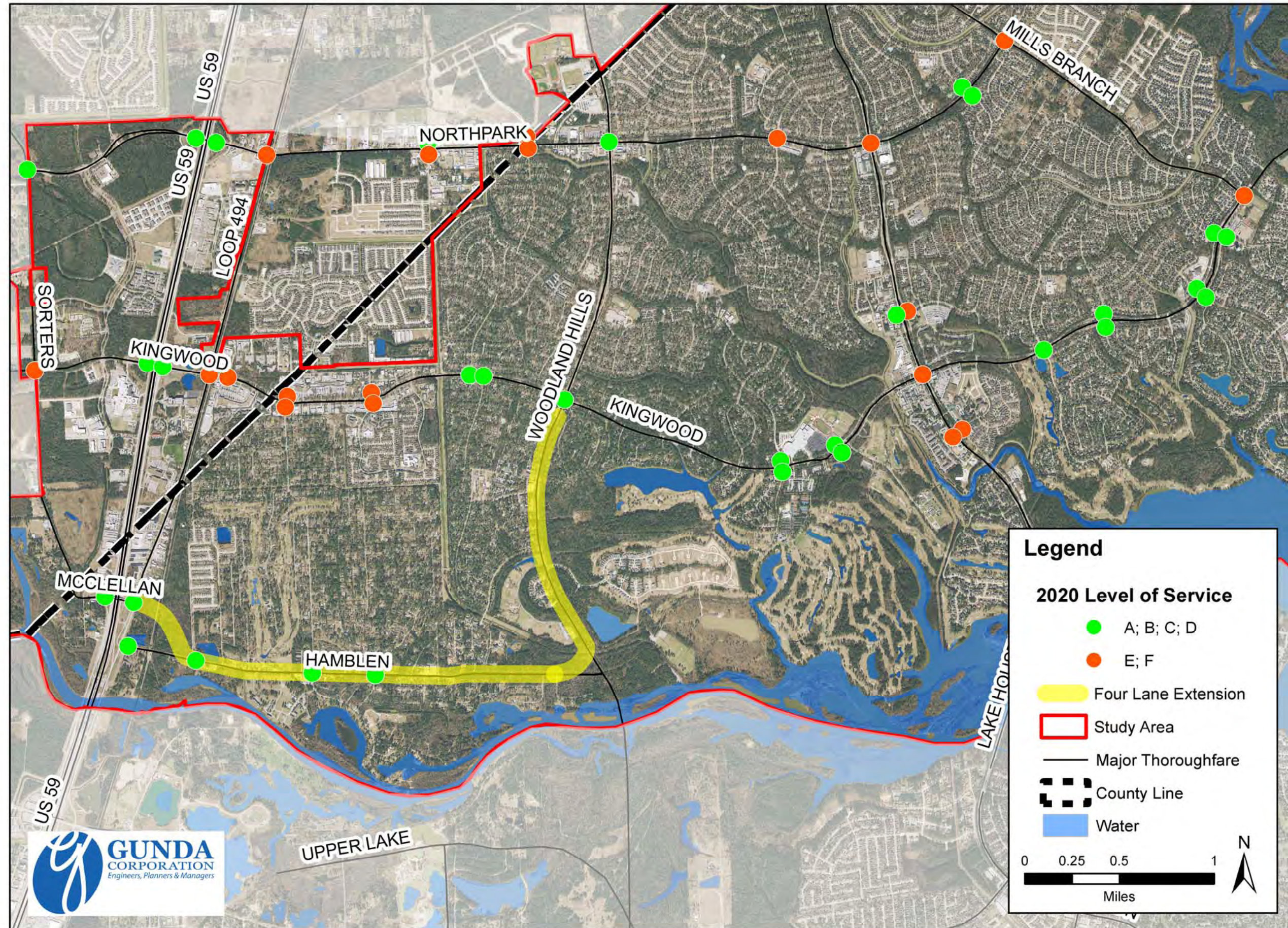
Lake Houston/Kingwood Area Mobility Study

Priority 3: Alternative D: Northpark Six Lanes (US 59 to Woodland Hills)



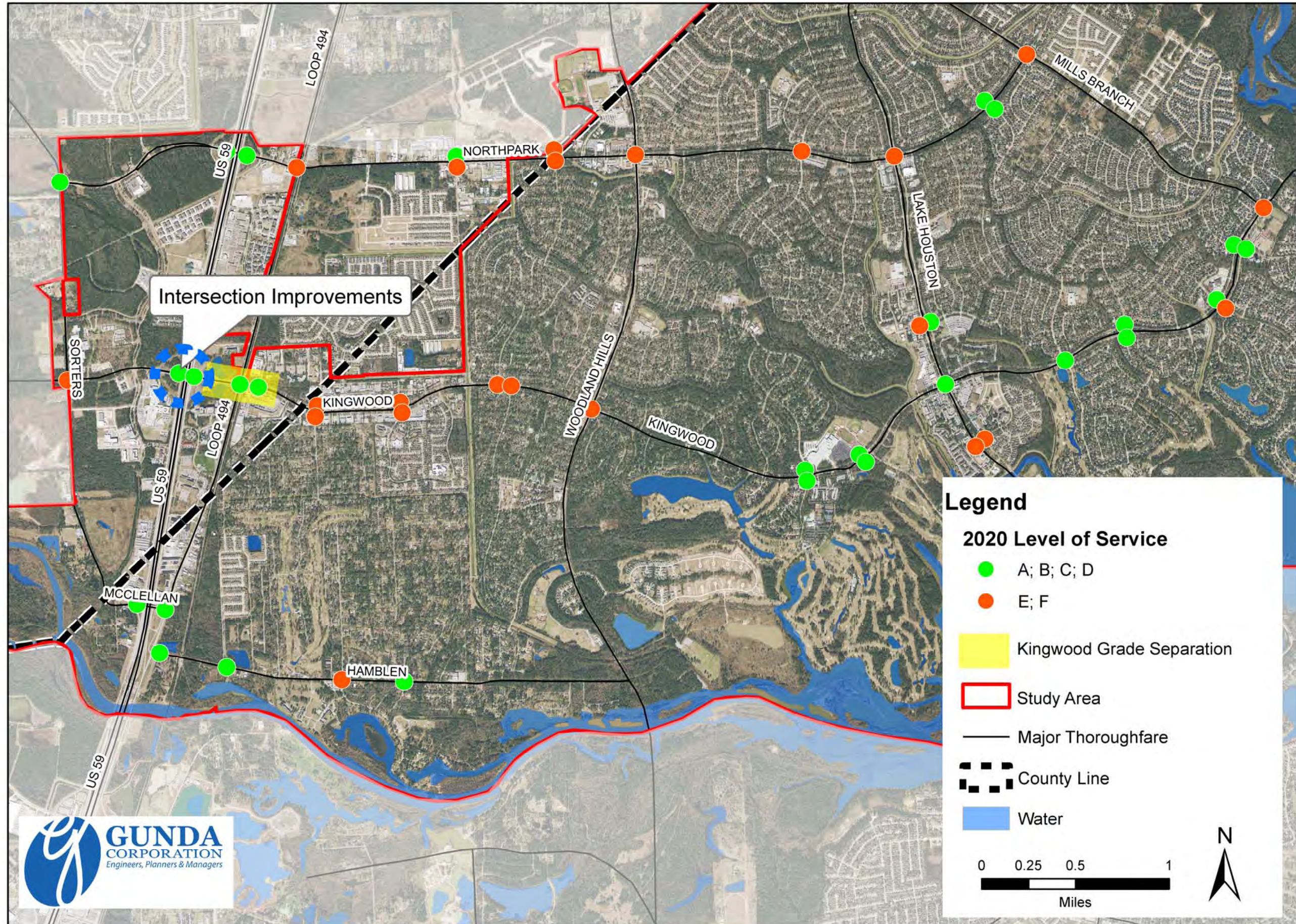
Lake Houston/Kingwood Area Mobility Study

Priority 4: Alternative J: Woodland Hills Drive and Hamblen Road Four Lane Extension



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Priority 5: Alternative L: Kingwood Drive Grade Separation



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Priority 6: Alternative M: Northpark Drive Grade Separation

