DESIGN CONCEPT REPORT

Memorial Drive Drainage & Mobility Improvements - Tallowood Road to Tealwood N Drive

WBS No. N-T17000-0020-7

TIRZ 17 REDEVELOPMENT AUTHORITY

August 2022

Gauge ENGINEERING

Table of Contents

List of Exhibits

Exhibit Number	Description	Exhibit Number	Description
Exhibit 1A	Recent Development	Exhibit 2.3D	Bike Plan Map
Exhibit 2.1A	Land Use Map	Exhibit 2.3E	Existing Signalized Intersections
Exhibit 2.1B	Plats and Permits	Exhibit 2.4A	Structures Map
Exhibit 2.1C	Back of Curb Features	Exhibit 2.4B	FEMA Firm Panel No. 48201C0645L
Exhibit 2.1D	Right of Way	Exhibit 2.4C	Existing Storm Sewer Layout
Exhibit 2.2A	Utility Schematic Layout	Exhibit 2.4D	Existing Ponding Depths (2-Year)
Exhibit 2.3A	METRO Map	Exhibit 2.4E	Existing Ponding Depths (100-Year)
Exhibit 2.3B	Pavement Conditions Map	Exhibit 3.3A	Proposed Roadway Schematic
Exhibit 2.3C	311 Service Calls	Exhibit 4.1A	Proposed Utility Schematic

List of Appendices

Appendix	Description
Appendix A	2022 TEI Traffic Engineering Study – Memorial Drive Segments Between Tallowood Road and Tealwood N Drive
Appendix B	Drainage Analysis
Appendix C	Cost Estimate

ES Executive Summary

ES.1 Background & Area Characteristics

Memorial Drive Drainage and Mobility Improvements project from Tallowood Road to N Tealwood Drive (City of Bunker Hill Village limits) is identified in the City of Houston (City) approved Memorial City Redevelopment Authority/Tax Increment Reinvestment Zone 17's (TIRZ 17) adopted Capital Improvement Plan. This project includes roadway, drainage, utility, and traffic signal improvements.

The project limits include Memorial Drive from Tallowood Road to City of Houston/City of Bunker Hill Village limits, approximately 2,300 feet. The project is in west Houston, Texas just east of Sam Houston Tollway at the southeast limit of the TIRZ 17 boundary. See **Figure ES1** Project Location Map for more information.

Several years ago, TIRZ 17 pursued federal money and secured approximately $13.7 million in Surface Transportation – Mobility funding for the reconstruction of the first phase of improvements along Memorial Drive from Beltway 8 to Tallowood Road. This segment of Memorial Drive is currently under construction and is over 85% completed.

Both, the City of Bunker Hill Village and TIRZ 17 are interested in building on TIRZ 17's current Memorial Drive project and further extending the roadway and drainage improvements. To achieve this, the City of Bunker Hill Village and TIRZ 17 plan to jointly pursue additional funding in the upcoming Houston-Galveston Area Council (H-GAC) Call for Projects for a complementary project via a new grant application for the reconstruction of Memorial Drive as described below.

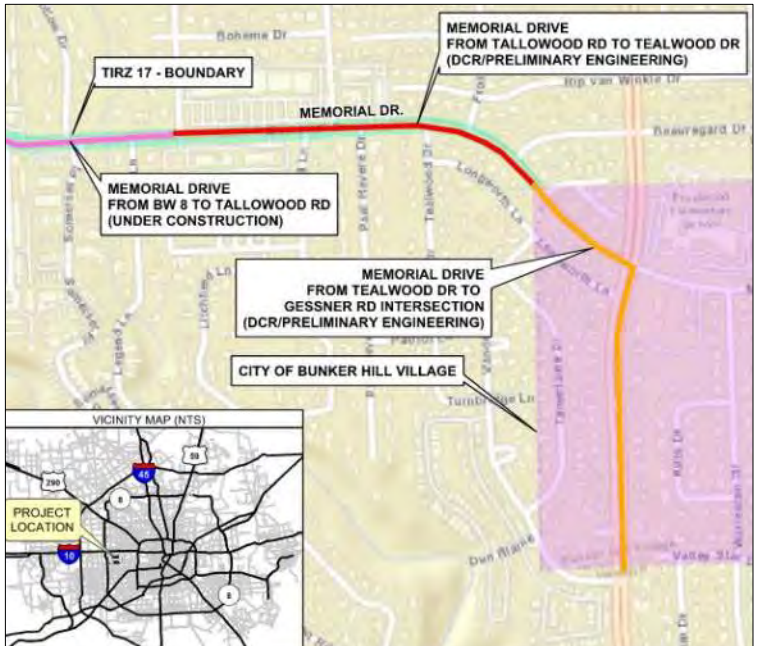


Figure ES1: Project Location & Vicinity Map

- For TIRZ 17, the reconstruction limits of Memorial Drive are within the City of Houston and TIRZ 17 boundaries, from Tallowood Road to just west of Tealwood North Drive, approximately 2,320 linear feet. The project will integrate with the ongoing construction work on the west and will include full roadway and drainage reconstruction, in addition to shared use paths to accommodate pedestrian and bicycle facilities, utility upgrades, signalization, and landscaping.
- For the City of Bunker Hill, the reconstruction limits of Memorial Drive are within the City of Bunker Hill boundaries, from just west of Tealwood North Drive to just east of Warrenton Drive, approximately 1,370 linear feet including the intersection of Gessner Road. The project will integrate with the proposed TIRZ 17 segment and will include full roadway and drainage reconstruction, in addition to sidewalks to accommodate pedestrian and bicycle facilities, utility upgrades, signalization, and landscaping.

Since TIRZ 17 is pursing federal funding for this project and if awarded then TxDOT will let the project, therefore; Texas Department of Transportation Roadway Design Manual (RDM) was taken into consideration in conjunction with City of Houston Infrastructure Design Manual (IDM).

ES.2 Need & Purpose

This report details the mobility and drainage improvements of Memorial Drive from Tallowood Road to City of Houston/City of Bunker Hill Village limits. The project involves full drainage and mobility reconstruction as well as upgrades and relocations of impacted public utilities. All associated impacts would be determined. The objectives of the Memorial Drive mobility and drainage improvement project are as follows:

- **Improve Mobility & Safety**
  - Complete reconstruction of the roadway including conversion from an elevated roadside ditch asphalt road to a curb and gutter concrete road. Lane configuration will be four 11-ft lanes with a raised median that varies from 3-ft to 18-ft throughout the project. The raised medians will replace the two-way-left-turn-lane by creating safe left turn median openings to enter a residential street or commercial parking lot.

- **Improve Drainage**
  - Improve the drainage by replacing the open ditches and existing storm sewer with upgraded storm sewers.
  - Size storm sewers that function independently as a stand-alone project and in concert with future regional improvements.
  - Meet minimum City of Houston drainage criteria.

- **Improve Pedestrian Safety**
  - Open drainage ditches and sidewalks that are too close to the road pavement makes it difficult and unsafe for pedestrians to walk. Promote a pedestrian-friendly environment with continuous 8-foot-wide shared use paths with City compliant curb ramps. Protect pedestrians on the shared use path by adding curb and gutter at the edge of the travel lane and creating a buffer for a clear zone where possible.

The Design Concept Report (DCR) is Phase I of the overall project process and will identify the impacts associated with the implementation of the DCR recommendations. The following scope describes the procedures that will be followed to provide Preliminary Engineering services and produce the Design Concept Report.

ES.3 Existing Conditions

A thorough existing conditions assessment was conducted to better understand the characteristics of Memorial Drive. Aerial information, field investigations, record drawings, and information from GIMS available on the City of Houston's website were used to evaluate the existing conditions.

ES.3A Existing Roadway

The existing typical section and lane configuration comprises of an undivided four-lane asphalt roadway with roadside ditches. The segment between Tallowood Road and Frostwood Drive has a 100-foot right-of -way (ROW) which then transitions to 95 feet at Frostwood through the intersection and then from 95 feet to 80 feet ROW between Frostwood Drive and Beauregard Drive. The 100-foot row segment has 2 lanes in each direction plus a two-way-left-turn-lane (TWLTL) for a total of a five-lane cross-section. The pavement width is 56-feet wide with 11-foot travel lanes and 12-foot TWLTL. The segment east of Frostwood Drive narrows to 80-foot ROW and transitions to a four-lane undivided roadway. See **Figures ES.3A to ES.3C** for existing typical sections. See **Figures ES.3D to ES.3G** for photographs of the existing roadway.

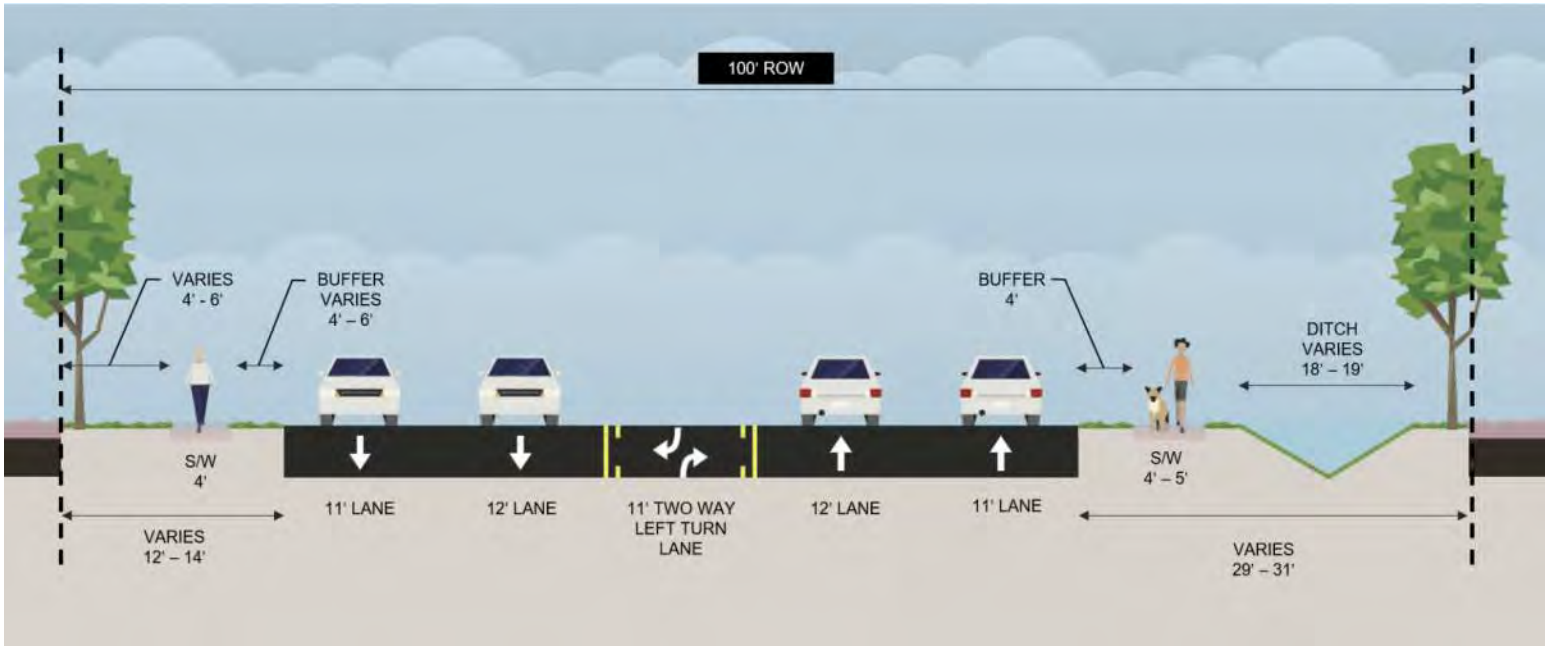


Figure ES.3A Existing Typical Section: Memorial Drive – Tallowood Rd to Paul Revere Dr
N.T.S.

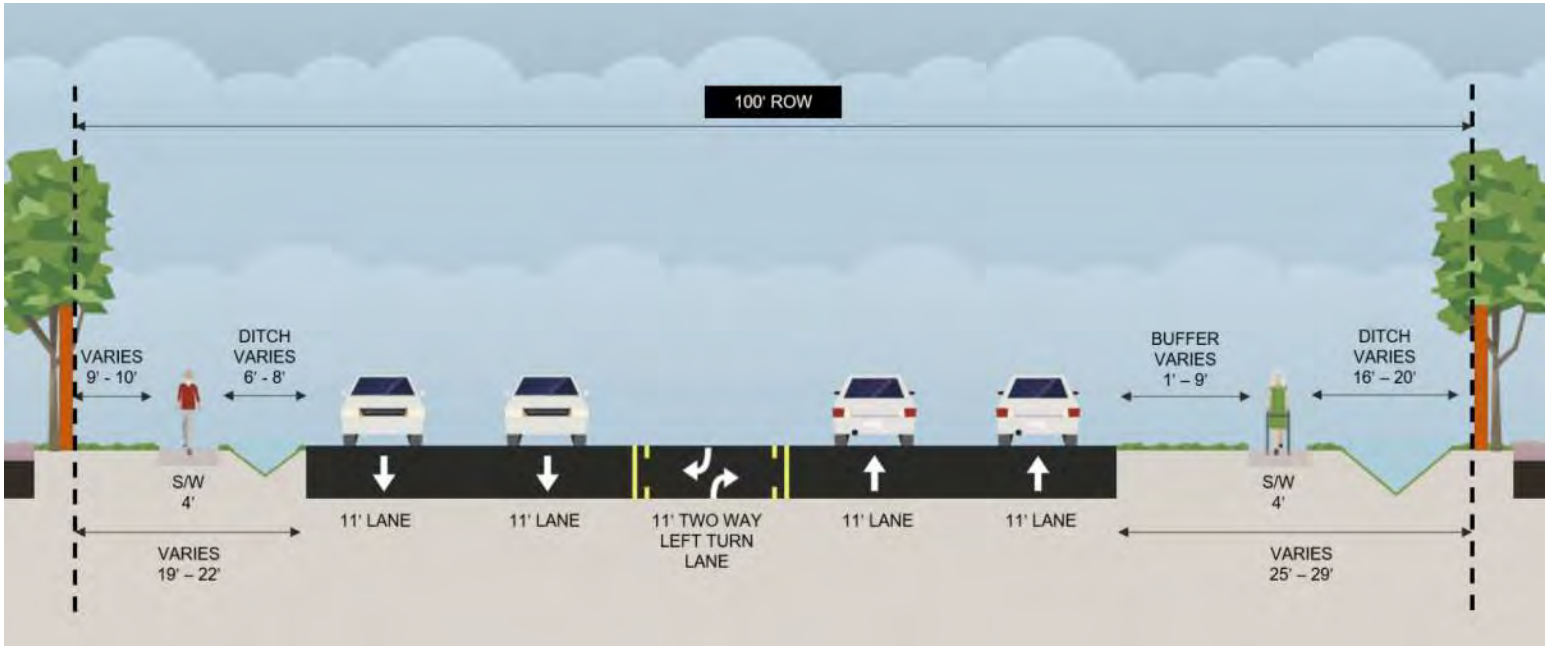


Figure ES.3B Existing Typical Section: Memorial Drive - Paul Revere Dr to Frostwood Dr
N.T.S.

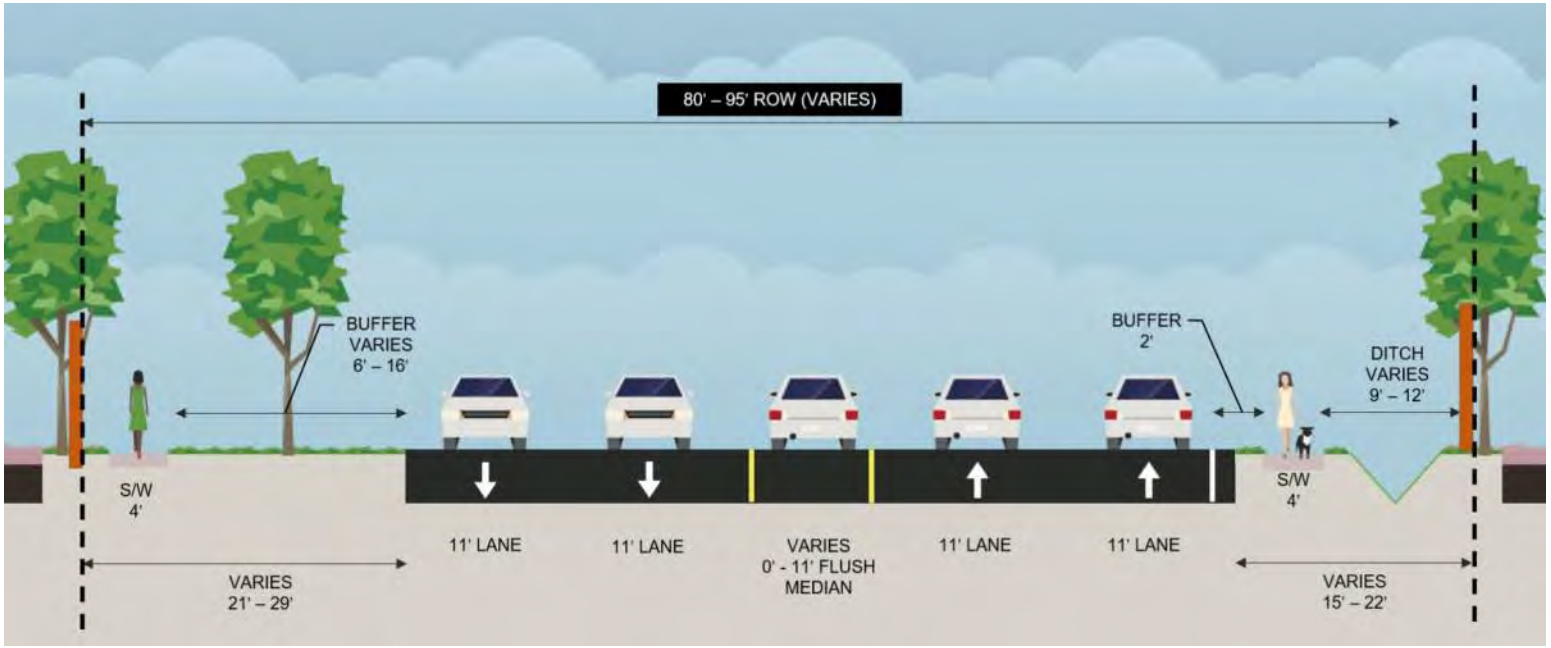


Figure ES.3C Existing Typical Section: Memorial Drive - Frostwood Dr to Tealwood N Dr
N.T.S.

Figure ES.3D Memorial Drive at Paul Revere Drive (looking west)

Figure ES.3E Memorial Drive at Paul Revere Drive (looking east)

Figure ES.3F - Memorial Drive at Tealwood N Drive (looking west)

Figure ES.3G - Memorial Drive at Tealwood N Drive (looking east)

ES.3B Existing Pavement Conditions

The City of Houston's Pavement Condition Rating (PCR), from HPW GeoLink Public Map, classifies pavement condition by block with a numeric score. The pavement conditions along Memorial Dr from Tallowood Rd to Tealwood N Dr vary from very poor to good conditions with PCI values ranging from 33-90. There are numerous sections with pavement deficiencies such as asphaltic patches. See **Exhibit 2.3C** for existing pavement condition ratings along Memorial Drive.

ES.3C Existing Sidewalk, Ramps, Pedestrian, and Bicyclist Facilities

Most of the corridor has narrow sidewalks and non-ADA compliant wheelchair ramps. The sidewalk width along the segment varies from four feet to five feet. They are narrow, broken and worn at several locations on the east end of the segment. See **Figures ES.3H and ES.3I.**

Figure ES.3H Existing Sidewalk Along the West Side of Memorial Drive

Figure ES.3I Existing Sidewalk Along the East Side of Memorial Drive

Wheelchair ramps are present at the Memorial Drive – Benignus Road intersection and Memorial Green Shopping Center. See **Figures ES.3J and ES.3K.**

Figure ES.3J Existing Ramp at Benignus Road

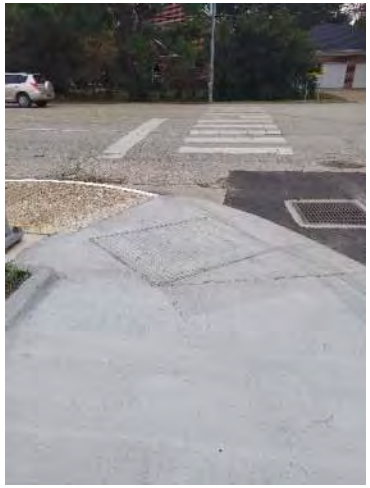


Figure ES.3K Existing Ramp at Benignus Road

Existing pedestrian crossings:

- A pedestrian crossing is marked on the intersection of Memorial Drive and Benignus Road.

Existing Bicyclist Facilities

There are no existing bicycle facilities present along Memorial Drive or on the crossing streets within project area.

ES.3D Existing Access Management

An access management assessment of the corridor intersections has determined that one or more non-compliant access management measures are present as described in the City of Houston Infrastructure Design Manual (COH IDM). Driveways near Benignus Road and Litchfield Lane do not meet driveway spacing requirements.

The southbound driveway from the shopping plaza on the north side is too close to the intersection of Litchfield Lane and Memorial Drive. To provide a safer intersection, the southbound driveway will be shifted east to align with Litchfield Lane.

The driveway to Memorial Green on the south side and west of Litchfield Lane will be shifted to align with the median opening. A new driveway would also be placed from Memorial Green on Litchfield Lane to allow motorists a safer exit from the development so that they can go to the traffic signal and turn west onto Memorial Drive.

ES.3E Existing Transit

Two METRO routes are currently present along segment. The METRO 161 Wilcrest Express and the 162 Memorial Express routes overlap in the area. The 161 connects downtown Houston to the Energy Corridor. Westchase, Addicks, and Meadows place with a run every 30 minutes. The 162 route connects downtown Houston and the Addicks Park and Ride and runs hourly. Transit stops are place at Tallowood Road, Benignus Road, Tealwood Drive, and Beauregard Drive within the project corridor.

ES.3F Speed Limits, Traffic, and Traffic Signals

The existing speed limit is of 35 mph along project corridor. 2022 field data gathered by CJ Hensch & Associates for the Traffic Engineers, Inc. (TEI) Memorial Drive Traffic Engineering Study conducted as part of this effort shows an average daily traffic (ADT) of 14,059. Historical ADT Houston Public Works (HPW) GIMS data from 2019 shows the ADT for project segment of Memorial Drive is of 17,510. According to TEI, the difference in volumes which could be attributed to the construction on Memorial Drive between Beltway 8 and Tallowood Road as well as impacts form the COVID-19 pandemic. TEI used an adjustment factor of 19.7% to the field collected traffic counts to convert the traffic volume back to the 2019 levels to better reflect the conditions before the construction on Memorial Drive and COVID-19 pandemic. As such, ADT is better reflected by HPW GeoLink Public data from 2019 which is reflected in **Table 2.3.**

The existing two-way stop-controlled T-intersection will be converted into a signalized intersection and will operate in coordination with the intersection at Benignus Road with a single controller to align signal timings. This will provide optimal traffic operations and safety at the intersections.

ES.3G Existing Lighting

There are streetlights present for part of the corridor. Lighting is placed on existing power distribution utility poles. There are no streetlights east of the Benignus Road intersection, which does not meet current Houston Public Works lighting standard.

ES.3H Existing Public and Private Utilities

The existing water lines, sanitary, and storm sewers are old and do not provide adequate service for the project area. There are sanitary lines ranging in diameter from small service connections around existing neighborhoods to a 48-inch sanitary line that goes from Tallowood Road to Benignus Road. Existing water lines range from small diameter fire lines and service connections to distribution lines measuring 8 inches to 20 inches in diameter. Storm sewer systems run east-west and discharge excess runoff to existing two 10-foot by 10-foot RCBs and a 72-inch RCP. Utility tables in Section 2.2 list the utility sizes, location, and age. There are also utility tables in Section 4 that show which ones will be replaced. Some of the utilities have reached the end of their life expectancy or need to be replaced due to conflicts or lack of clearance from storm sewers. Analysis of the existing infrastructure was conducted to determine if any other miscellaneous improvements would be necessary to meet the standards specified in the City of Houston Infrastructure Design Manual (COH IDM). There must be an increase in the number of Fire Hydrants along the alignment to the required spacing by COH IDM.

- Water Lines:

  The existing water lines within the project limits have been in service since 1963,1967, and 1995 based on City of Houston GIMS. There is a 20-inch cast iron water line from Benignus Road to Tealwood Drive and an 8-inch cast iron water line from Tealwood Drive to Frostwood Drive. It is recommended to remove and replace these water lines due to age and the material of the water lines.

  - 8-inch polyvinyl chloride pipe (PVC): Runs east to west, along the southern ROW of Memorial Drive from Frostwood Drive to Tealwood N Drive. Also, there are some that run along Tallowood Road, Frostwood Drive, Beauregard Drive, Paul Revere Drive, and Tealwood North Drive.
  - 8-inch cast iron (CI): Runs east to west, along the southern ROW of Memorial Drive from Tealwood Drive to Frostwood Drive.
  - 8-inch ductile iron (DI): A short segment is on Tealwood North Drive near Memorial Drive.
  - 16-inch ductile iron (DI): Runs east to west, along the southern ROW of Memorial Drive from Tallowood Road to east of Litchfield Lane.
  - 20-inch cast iron (CI): Runs east to west, along the southern ROW of Memorial Drive from Benignus Road to Tealwood Drive. Also, there is one that runs along Benignus Road.

- Sanitary Sewers:
  The existing sanitary sewer lines within the project limits appears to have been rehabilitated in 1987, 1998, and 2010 based on City of Houston GIMS. The City does not have any plans to replace or upsize any of the lines. It is recommended that CCTV be performed for all sanitary sewers at the onset of the detailed design phase to evaluate the current condition of the rehabilitated pipes.

  - 48-inch polyvinyl chloride pipe (PVC): Located along northern ROW of Memorial Drive from Tallowood Road to Benignus Road.
  - 12-inch polyvinyl chloride pipe (PVC): A lateral service lead between Tallowood Road and Benignus Road.
  - 21-inch Cured in Place Pipe: Located along northern ROW of Memorial Drive near Benignus Road.
  - 15-inch Cured in Place Pipe: Located along northern ROW of Memorial Drive near Paul Revere Drive. Also, there is one that runs along the northern ROW of Memorial Drive near Frostwood Drive to Tealwood North Drive.
  - 15-inch polyvinyl chloride pipe (PVC): Located along northern ROW of Memorial Drive near Tealwood Drive.
  - 8-inch Cured in Place Pipe: Located laterally at Tealwood Drive.
  - 15-inch ductile iron (DI): Located along northern ROW of Memorial Drive from Tealwood Drive to Frostwood Drive.
  - 8-inch polyethylene pipe (PE): Located laterally between Paul Revere Drive and Tealwood Drive.
  - 8-inch concrete pipe: located laterally between Beauregard Drive and Frostwood Drive.

- Storm Sewers:
  - 36-inch reinforced concrete pipe (RCP): Located along the northern ROW of Memorial Drive from Tallowood Road to Benignus Road (from 2021 plans, not on GIMS).
  - 18-inch reinforced concrete pipe (RCP): Located along the northern ROW of Memorial Drive from Benignus Road to halfway in between Paul Revere Drive and Tealwood Drive.
  - Within drainage easement between Paul Revere Drive and Tealwood Drive: One of the major outfalls is down this easement. An 18-inch RCP and 60-inch RCP cross Memorial Drive from north to south where they combine into a 72-inch Monolithic Reinforced Concrete Pipe.
  - 24-inch reinforced concrete pipe (RCP): Located along northern ROW of Memorial Drive between Paul Revere Drive and Tealwood Drive at the drainage easement.
  - 60-inch reinforced concrete pipe (RCP): Located laterally between Paul Revere Drive and Tealwood Drive.
  - 72-inch reinforced concrete pipe (RCP): Located along the northern ROW of Memorial Drive between Paul Revere Drive and Frostwood Drive.
  - Open Ditches: The existing roadway has roadside ditches with driveway culverts along the south side of Memorial Drive.

- Private Utilities:

  Private utility companies provide services including electrical, gas, internet, and telephone along Memorial Drive. These utilities may require adjustment due to conflicts with the proposed utility improvements. Coordination with these companies would be conducted to obtain utility drawings of the existing facilities along this project. Utility coordination would occur during the design phase of this project.

  - On the west side of Memorial Drive within the right-of-way CenterPoint Energy has an underground gas line. Also, on both sides of Memorial Drive there are overhead distribution and transmission electrical lines. Streetlights are on both side of Memorial Drive and are mounted on existing electrical wooden poles. The distance between these lights would be evaluated to ensure they meet the city streetlight standards.

  - Southwestern Bell Company (SBC or AT&T) has underground fiber optic cables on the west side of Memorial Drive. The rest of Memorial Drive has overhead communication facilities.

ES.4 Alternatives Evaluated

A multimodal transportation analysis that evaluates all modes of transportation and accommodates all user's safety was conducted. The following alternatives were evaluated:

- Alternative 0: No Build
- Alternative 1: Divided 4 lane typical section along with shared use path and utility improvements.

ES.5 Preferred Alternative

Alternative 1 was selected as the preferred option as the four lane typical sections will provide sufficient roadway capacity based on the traffic analysis. Alternative 1 includes reconstruction of Memorial Drive from Tallowood Road to Tealwood North Drive with improvements to roadway, drainage, traffic, and utilities. The estimated cost of the improvements is $21M.

Alternative 1 improvement consists of:

- Reconstruction of existing roadway with four eleven-foot concrete curb and gutter travel lanes, with raised center medians.
- Continuous 8-foot-wide shared use paths on both sides of the corridor with a 4.5' buffer from curb to shared use path.
- Replace the existing traffic signal at Benignus Road with two fully coordinated traffic signals operating on a single controller at the intersections of Litchfield Lane and Benignus Road.
- Installation of large reinforced concrete boxes storm sewer network meeting current City's standards except for minimum velocity, which cannot be achieved without causing an increase in outflow.
- Installation of far-side bus stops with larger platforms at optimal spacing and locations close to major trip generators while avoiding signal interference.
- High visibility crosswalks at intersections for pedestrian crossings.
- Tree planting along Memorial Drive within the proposed center medians and clear zones.
- Utility improvements throughout the corridor, replacing water and sanitary lines that exceeded their useful life cycles.

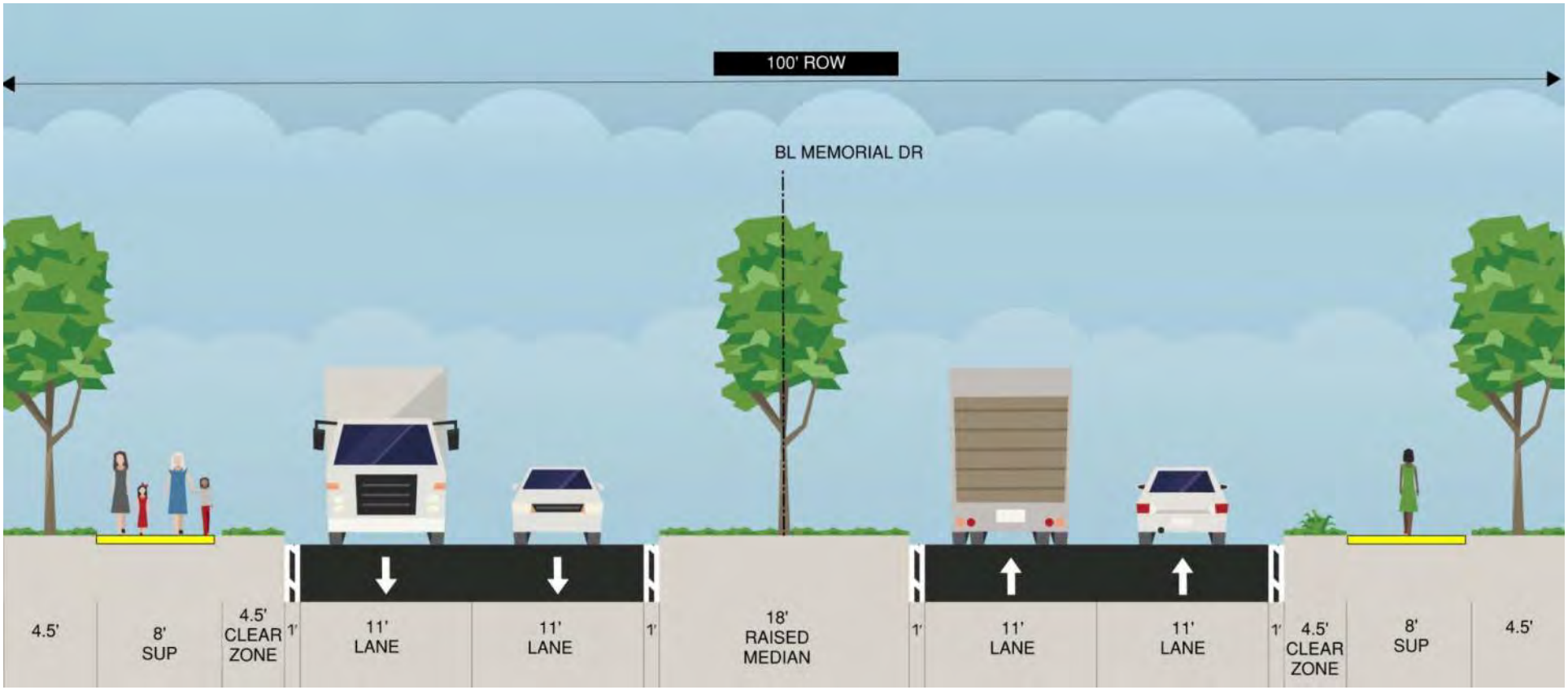


Figure ES.5: Alternative 1 Typical Section 100-ft ROW

1 Introduction

Neighborhood: Frostwood, Tealwood, Tealwood North, Bunker Hill Woods, Ethans Glen, Woodland Hollow

Annexed/Developed: 1960,1970, 1977, 2018

Residential: Primarily single-family residential with some Townhomes.

Commercial: Retail and commercial properties along Memorial Drive near Tallowood Road and Benignus Road. Commercial includes strip center developments and smaller single-building commercial spaces.

Industrial: None

Recent Development Activity **(Exhibit 1A)**:

- Memorial Dr Reconstruction and Access Management (CSJ: 0912-72-391)-Under Construction

Watershed: Buffalo Bayou

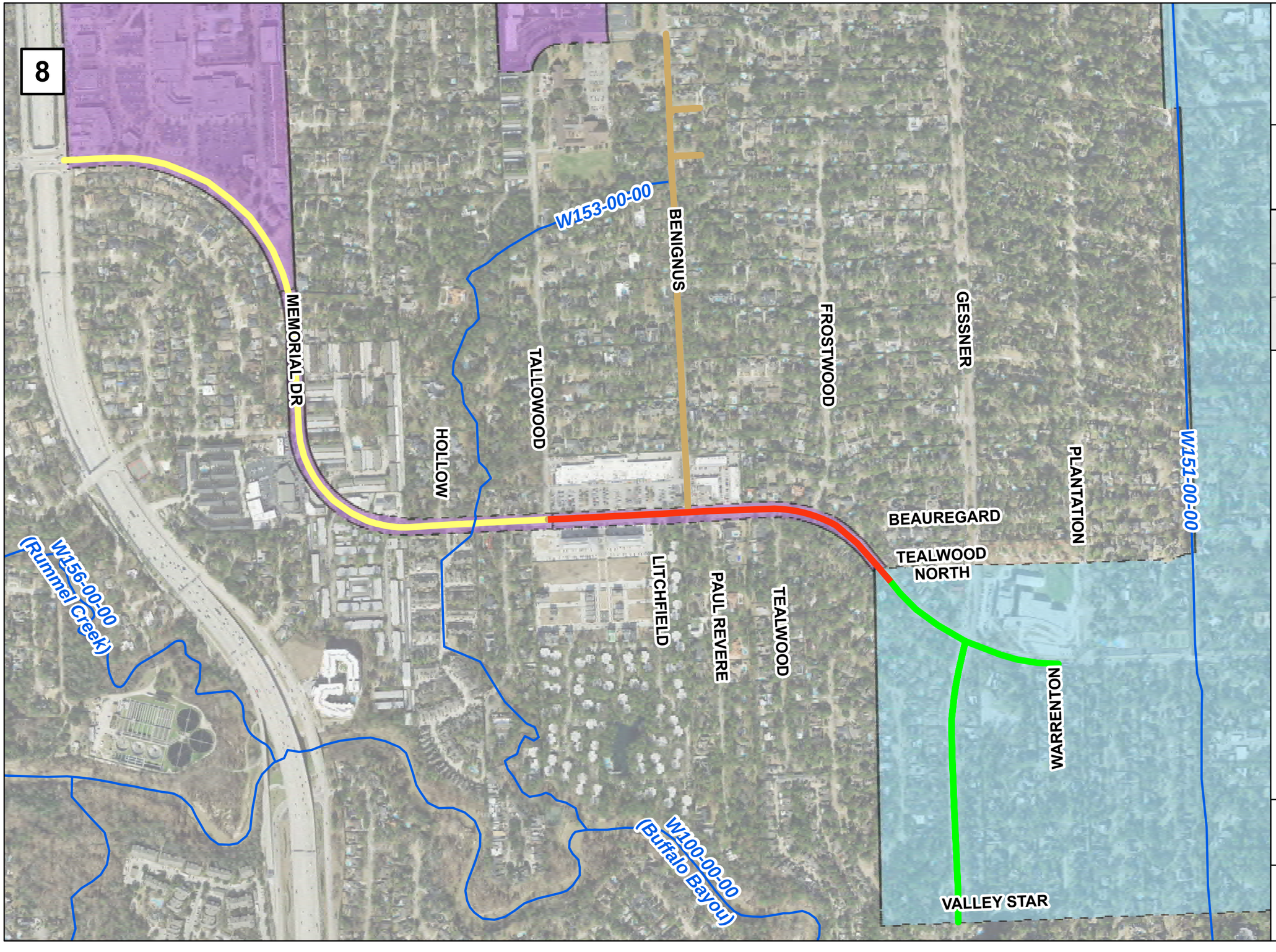
Water Facilities: City of Houston

Major Transportation Facilities: Memorial Dr, Beltway 8, IH-10, Gessner Rd

Population Demographics: Heavily developed urban area

Figure 1A: Memorial Drive Mobility and Drainage Improvements
Project Limits: Tallowood Road to Tealwood North Drive

Recent Development Exhibit



TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 1A
RECENT DEVELOPMENTS

Legend

- Project Limits
- Channels

Recent Improvements

- Benignus Road Roadside Ditch Rehabilitation
- Memorial Drive Reconstruction & Access Management

Upcoming Improvements

- Memorial Drive & Gessner Road Improvements

Boundary

- City of Bunker Hill Village
- TIRZ 17 Boundary

N

0 300 600

1 inch = 600 feet

Gauge ENGINEERING

2 Existing Conditions

2.1 Land Use & Environmental

Memorial Drive is a mix of residential and commercial.

Item	Data	Source	Format	Exhibit/ Page Number
Residential Land Use	411 residential structures including 339 single family homes, and 72 townhome structures of 4 units each.	HGAC Land Use; HPW GIS; HCAD data, Aerial Imagery	Map	Exhibit 2.1A
Commercial Land Use	10 Commercial Structures; including PNC BANK, Memorial Green, Wick Lane shopping plaza, Lantern Lane Shopping Center, Shell gas station among other commercial structures.	HGAC Land Use HPW GIS, HCAD data, Aerial Imagery	Map	Exhibit 2.1A
Vacant Property	Number of lots – 1 (0.6 acres)	HGAC Land Use; HPW GIS, HCAD data, Aerial Imagery	Map	Exhibit 2.1A
Plats/Permits	(2014 – 2020) 1 GP Plats, 1 C2 Plats, 4 C3F Plats, 1 C3P Plats, 3 C3N Plats	Houston Public Works	Map	Exhibit 2.1B
Parks	None	HGAC Land Use HPW; HPW GIS, HCAD data	N/A	N/A
Cultural/Historical Resources	None	National Historic Register	N/A	N/A
Geotechnical/ESAs	Will be assessed in design phase.	Will be assessed in design phase.	N/A	N/A
Trees	Trees are present. Will be assessed by an Urban Forester in the design phase. Approximately 69 trees will be impacted by the project.	Aerial photography; physical observation	Map	Exhibit 2.1C

Back of curb amenities	Existing Lighting mounted on existing wood poles. Signs. Landscaping trees and shrubs. Sidewalks. Open roadside ditch.	Aerial photography; physical observation	Map	Exhibit 2.1C
Right-of-Way	Memorial Dr. -Tallowood Rd. to Frostwood Dr 100 ft -Frostwood Dr to Tealwood North Dr 80 ft - 95 ft (varies)	HPW GIS	Map	Exhibit 2.1D
Other	N/A	N/A	N/A	N/A

2.2 Utilities

Item	Data/Format	Source	Format	Exhibit
Water	Along the S ROW of Memorial Dr from Tallowood Rd to Benignus Drive: 16-inch Ductile Iron (DI) Rd in service 7/5/1995; Fire Lines east of Tallowood: 6-in and 4-in, unknown material and age. Along the S ROW of Memorial Dr from Benignus Rd to Tealwood Rd: 20-in Cast Iron (CI) in service 3/23/1967; Perpendicular to Memorial Drive near Benignus Rd: 20-in cast iron in service 3/23/1967. Along the S ROW of Memorial Dr from Tealwood Rd to Frostwood Dr: 8-in Cast Iron (CI) in service 2/28/1967 and 7/18/1963; Perpendicular of Memorial Dr east of Frostwood Dr: 8-in polyvinyl chloride pipe (PVC) in service 08/17/1995; Along the S ROW of Memorial Dr from Frostwood Dr to Bauregard Dr: 8-in polyvinyl chloride pipe (PVC) in service 08/17/1995; Perpendicular to Memorial Dr east of Beauregard Dr: 8-in PVC service 8/17/1995. Along S ROW of Memorial Dr east of Beauregard Dr: 8-in PVC service 8/17/1995.	HPW GIS	Map	Exhibit 2.2A

	Along the S ROW of Memorial Dr Beauregard Dr to Tealwood N Dr: 8-in polyvinyl chloride pipe (PVC) in service 8/18/2019			
Wastewater	Along the N ROW of Memorial Dr from Tallowood Rd to Benignus Rd: 48-in PVC in service 1997; Along the N ROW of Memorial Dr between Benignus Rd and Paul Revere Dr: 21-in Cured in Place Pipe, 12/31/1989. Lateral between Tallowood Rd & Benignus Rd on Memorial Dr ROW: 12-in PVC, N/A Along the N ROW of Memorial Dr from Paul Revere Dr to halfway between Paul Revere Dr and Tealwood Dr: 15-in; Cured in Place, N/A Along the N ROW of Memorial Dr from halfway between Paul Revere Dr and Tealwood Dr to Tealwood Dr: 15-in Polyethylene rehab 1987 8-in Polyethylene Lateral between Paul Revere Dr & Tealwood Dr on Memorial Dr from Paul Revere Dr to Tealwood Dr rehab 2019; Lateral on Tealwood Dr of Memorial Dr ROW: 8-in Cured in Place rehab 1998; Along the N ROW of Memorial Dr from Tealwood Dr to Frostwood: 15-in DI in service 2002 Along the N ROW of Memorial Dr east of Frostwood: 15 Polyethylene in service 2/28/1987	HPW GIS	Map	Exhibit 2.2A

	Along the N ROW of Memorial Dr halfway between Frostwood Dr to Beauregard Dr: 15-in cured in place in service 12/31/1989. Along the N ROW of Memorial Dr passes over Beauregard Dr: 15-in cured in place serviced in 12/31/1989. Along the N ROW of Memorial Dr west of Tealwood North Drive: 15-in cured in place serviced in 12/31/1989.			
Storm	Along the N ROW from Memorial Dr Tallowood Rd Benignus Rd: 36-in RCP Along the N ROW of Memorial Dr from Benignus Rd to Paul Revere Dr: 18-in RCP Along the N ROW of Memorial Dr from Benignus Rd to Paul Revere Dr: 24-in RCP in service 2002, Lateral between Memorial Dr Benignus Rd Paul Revere Dr Paul Revere Dr & Tealwood Dr: 18-in RCP Lateral between Paul Revere Dr & Tealwood Dr on Memorial Dr ROW: 60-in CP Along the N ROW Memorial Dr Tealwood Dr Frostwood Dr: 72-in RCP in service 2002	HPW GIS	Map	Exhibit 2.2A
Electric	CenterPoint Energy- On both sides of Memorial Drive there are overhead distribution electrical lines	Physical observation	Map	N/A
Gas	On the west side of Memorial Drive within the right-of-way CenterPoint Energy has an underground gas line	Physical observation of gas markers	Map	N/A

Telecommunications	*Cell towers* Mobilitie has a DAS cell tower, Southwestern Bell Company (SBC or AT&T) has underground fiber optic cables on the west side of Memorial Drive. The rest of Memorial Drive has overhead communication facilities.	Physical Observation, Street view	Map	N/A
Pipelines	There are no hazardous liquid, gas, nitrogen, or refined product transmission pipelines in the project area.	NPMS	N/A	N/A
Transmission corridors	There are no transmission corridors in the project area.	Physical Observation, Street view	N/A	N/A
Other	None	N/A	N/A	N/A

2.3 Transportation

Memorial Dr is designated as a Major Thoroughfare

Item	**Data/Format**	**Source**	**Format**	**Exhibit/ Page Number**
TxDOT Facilities	No TxDOT Facilities.	HPW GIS	N/A	N/A
METRO	161-Wilcrest Express 162-Memorial Express	METRO System Map, Memorial Drive Traffic Engineering Study by TEI	Map	Exhibit 2.3B
HCTRA	W Sam Houston Tollway is near project area but not along project corridor	HCTRA System Map	N/A	N/A
Railroads	None	HPW GIS	N/A	N/A
County Facilities	No county transportation facilities cross the corridor.	HPW GIS	N/A	N/A

Airport Facilities	None	HPW GIS	N/A	N/A
Port Facilities	*None*	HPW GIS	N/A	N/A
PCI	Memorial Drive- 4 Lanes,100-ft ROW from Tallowood Road to Frostwood Drive and 80 ft – 95 ft ROW from Frostwood drive to Tealwood N Drive, Pavement Condition Rating varies from 23 to 79.	HPW GIS	Map	Exhibit 2.3B
311	Mix of Water Service, recycling participation, dead animal collection, recycling cart repair, nuisance on property, and sewer wastewater service requests for the vicinity of the project.	3-1-1 Service Map	Map	Exhibit 2.3C
ADT	Memorial Drive 2019 - 17,510 (HPW GIMS) 2022 – 14,059 (CJ Hensch & Associates)	Houston GIMS, Houston GeoLink HUB Data, Memorial Drive Traffic Engineering Study by TEI	Report	N/A
Bike Plan	No existing bike facility. The Houston Bike Plan Map classifies Memorial Drive as a future off-street bike route as part of the Long-Term Houston Bikeway Vision.	Field Investigation COH Bike Plan	Map	Exhibit 2.3D
Pedestrian infrastructure	Sidewalks on Memorial Drive are 4-ft to 5-ft on both sides.	Site visit, Memorial Drive Traffic Engineering Study by TEI	N/A	N/A
As-builts	List of HPW as-built drawings -WD8094, WD4742, WD2647, WD7778, WD2405, WD1446, WD04278 -P30645, P32345, P31112, P11340, P36727, P53026, P49456, P11976, P11340, P11387, P11872, P14400, P36986, P16966, P15388, P15802	HPW GeoLink Public Map Database	N/A	N/A
Bridge/Bridge Condition	No bridges are present along project corridor	Field Investigation	N/A	N/A

Signalized Intersections/ Parking	There is a traffic signal located at the intersection of Memorial Drive and Benignus Road.4 Lanes, No protected left turn, 3 way- crosswalk. No on-street parking available.	Aerial imagery, Memorial Drive Traffic Engineering Study by TEI	N/A	Exhibit 2.3E
Crash Data/History	This segment of Memorial Drive is not part of the Vision Zero High Injury Network. Crash Data was collected between the years 2016 to 2020 resulting in 21 crashes (including 16 intersection crashes). One crash involved a bicyclist, and none involved pedestrians.	Vision Zero High Injury Network Map TEI Traffic Report	Report	N/A

2.4 Drainage

Item	Data/Format	Source	Format	Exhibit/ Page Number
Losses	*Multiple Loss: 3 Residential Structures* *Only Hurricane Harvey: 6 Structures*	FEMA Repetitive Loss Structures HCFCD Historically Flooded Structures	ArcGIS	Exhibit 2.4.A
Structures in Flood Plain	*2 commercial structures in 500-year floodplain*	FEMA Firm Panel / GIS	PDF	Exhibit 2.4.A Exhibit 2.4.B
Larger storm system/Outfall area	*Outfall A to existing 2-10'x10' RCBs* *Outfall B to existing 72" RCP*	Record Drawings	PDF	Exhibit 2.4.C
Related Improvements /Improvements in Watershed	*Memorial Drive Reconstruction and Access Management Project (Beltway 8 to Tallowood Drive) WBS # N-T17000-031B*	Record Drawings	PDF	N/A
H&H Model – Infoworks ICM	*Existing 2D model*	Infoworks ICM / GIS	ArcGIS	Exhibit 2.4.C
Watershed	*Buffalo Bayou*	N/A	N/A	N/A

Ponding	*2 yr existing ponding depths:* *Tallowood Rd. intersection - 0.46 feet* *Benignus Rd. intersection - 0.77 feet* *Frostwood Dr. intersection - 0.25 feet* *Beauregard Dr. intersection - 0.10 feet* *Tealwood N Dr. intersection - 0.49 feet* *100 yr existing ponding depths:* *Tallowood Rd. intersection - 1.69 feet* *Benignus Rd. intersection - 0.98 feet* *Frostwood Dr. intersection - 1.16 feet* *Beauregard Dr. intersection - 0.96 feet* *Tealwood N Dr. intersection - 0.97 feet*	Infoworks ICM / GIS	ArcGIS	Exhibit 2.4.D Exhibit 2.4.E
Survey	*LiDAR & Record Drawings*	N/A	N/A	N/A
HCFCD	*None*	N/A	N/A	N/A
COH	*Roadside Ditches: Less than 2-year LOS from Tallowood Rd. to Paul Revere Dr, 10-year LOS east of Paul Revere Dr* *Storm Sewer: 2-Year LOS from Tallowood Rd to Frostwood Dr, less than 2-year LOS at Tealwood N Dr*	Infoworks ICM / GIS	ArcGIS	N/A
Water/River Authority	*None*	N/A	N/A	N/A
MUDs	*None*	N/A	N/A	N/A
Existing Drainage Agreements	*None*	N/A	N/A	N/A

2.5 ROW

Item	Data/Format	Source	Format	Exhibit/Page Number
Property Ownership	City of Houston owns property in between back of residential properties along Paul Revere Drive and Tealwood Drive. There are storm sewers that outfall to Buffalo Bayou	HCAD		
Public Easements	N/A			
Public ROW	City of Houston			Exhibit 2.1D
Private Easements	N/A			
Utility Easements	N/A			

2.6 Previous Studies and Plans

Item	**Data/Format**	**Source**	**Format**	**Exhibit/ Page Number**
HCFCD	Feasibility Study of W151-00-00 and W153-00-00	HCFCD Projects Overview	Map	N/A
COH	-Briar Court: Water Line Replacement S-000035-0228 -Tallowood: @ Memorial Drive N-00610A-00C2 -Tallowood - Safe Sidewalk Program N-00610A-00C2 -Tallowood: Memorial to Old Oaks M-000126-0071 -Frostwood West: Drainage Improvements M-001001-0001 -Briar Cove: Water Line Replacement S-000035-0212 -Rustling Oaks & Fonn Villas Subdivision Storm Sewer Improv. M-000249-0002	HPW GIS	Map	N/A

	-Memorial: Legend to Somerset N-00610A-0118			
METRO	METRO Universal Accessibility	METRONext.org, TEI Traffic Report	Map, Report	N/A
Counties	None	N/A	N/A	N/A
TxDOT	None	N/A	N/A	N/A
HGAC	None	N/A	N/A	N/A
TIRZ/MD/BID	TIRZ 17 Regional Drainage Study 2012 Memorial Drainage and Mobility Study from Beltway 8 to West Bough	TIRZ 17	Report	N/A
Associated projects	-TIRZ 17 Memorial Drive Mobility and Drainage Improvements WBS No. N-T17000-031B-7 -COH HPW Transportation and Drainage Operations S.W.A.T. Benignus Road Roadside Ditch Rehabilitation Design WBS No. M-420126-0099-3	TIRZ 17	Report	N/A
COH Programs (i.e. Complete Communities, Walkable Centers)	*None*	N/A	N/A	N/A

List of Exhibits

Exhibit Number	Description
Exhibit 2.1A	Land Use Map
Exhibit 2.1B	Plats and Permits
Exhibit 2.1C	Back of Curb Features
Exhibit 2.1D	Right of Way
Exhibit 2.2A	Utility Schematic Layout
Exhibit 2.3A	Memorial Dr Base Map
Exhibit 2.3B	METRO Map
Exhibit 2.3C	Pavement Conditions Map
Exhibit 2.3D	311 Service Calls
Exhibit 2.3E	Bike Plan Map
Exhibit 2.3F	Existing Signalized Intersections
Exhibit 2.4A	Structures Map
Exhibit 2.4B	FEMA Firm Panel No. 48201C0645L
Exhibit 2.4C	Existing Storm Sewer Layout
Exhibit 2.4D	Existing Ponding Depths (2-Year)
Exhibit 2.4E	Existing Ponding Depths (100-Year)

Land Use and Environmental Exhibits

TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.1A
LAND USE

Legend

- Project Limits
- Channels

Land Use

- Commercial
- Residential
- Townhome
- Vacant

Boundary

- City of Bunker Hill Village
- TIRZ 17 Boundary

Land Use	Acre	Percentage
Residential	99.9	72.5%
Commercial	12.8	9.3%
Townhome	24.5	17.8%
Vacant	0.6	0.5%

N

0 250 500

1 inch = 500 feet

Gauge ENGINEERING

W153-00-00

OLD OAKS

HUNTINGWICK

MOSSYCUP

MOSSYCUP

BOHEME

BOHEME

TALLOWOOD

BENIGNUS

FROSTWOOD

GESSNER RD

HOLLOW

RIP VAN WINKLE

BEAUREGARD

PLANTATION

W151-00-00

MEMORIAL DR

TEALWOOD NORTH

LEGEND

LITCHFIELD

PAUL REVERE

TEALWOOD

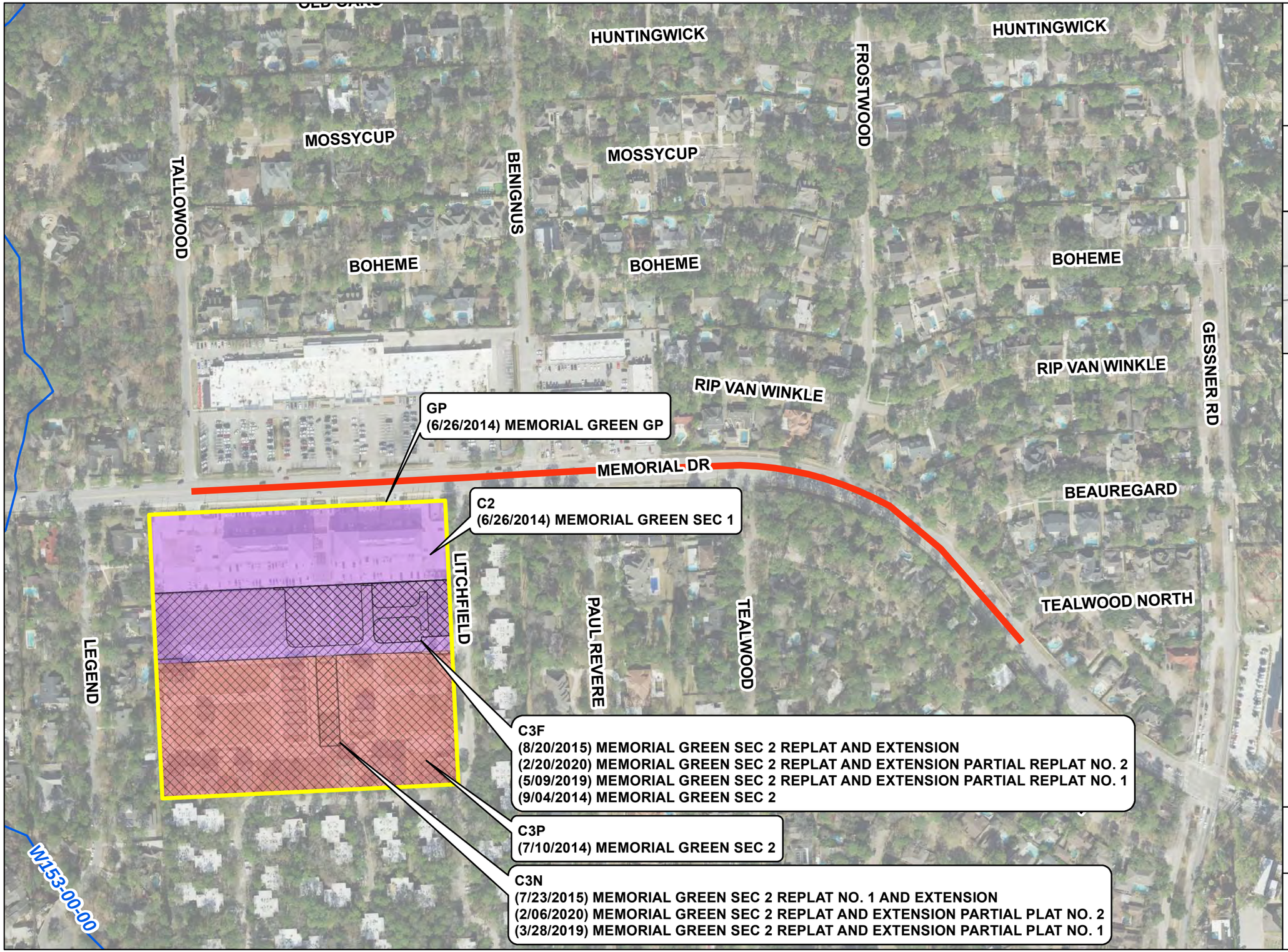
LONGWORTH

VANDERPOOL

TAMERLAINE

8

W100-00-00 (Buffalo Bayou)



TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.1B
Plats & Permits

Legend

- Project Limits
- Channels

Plats (2014 - 2022)

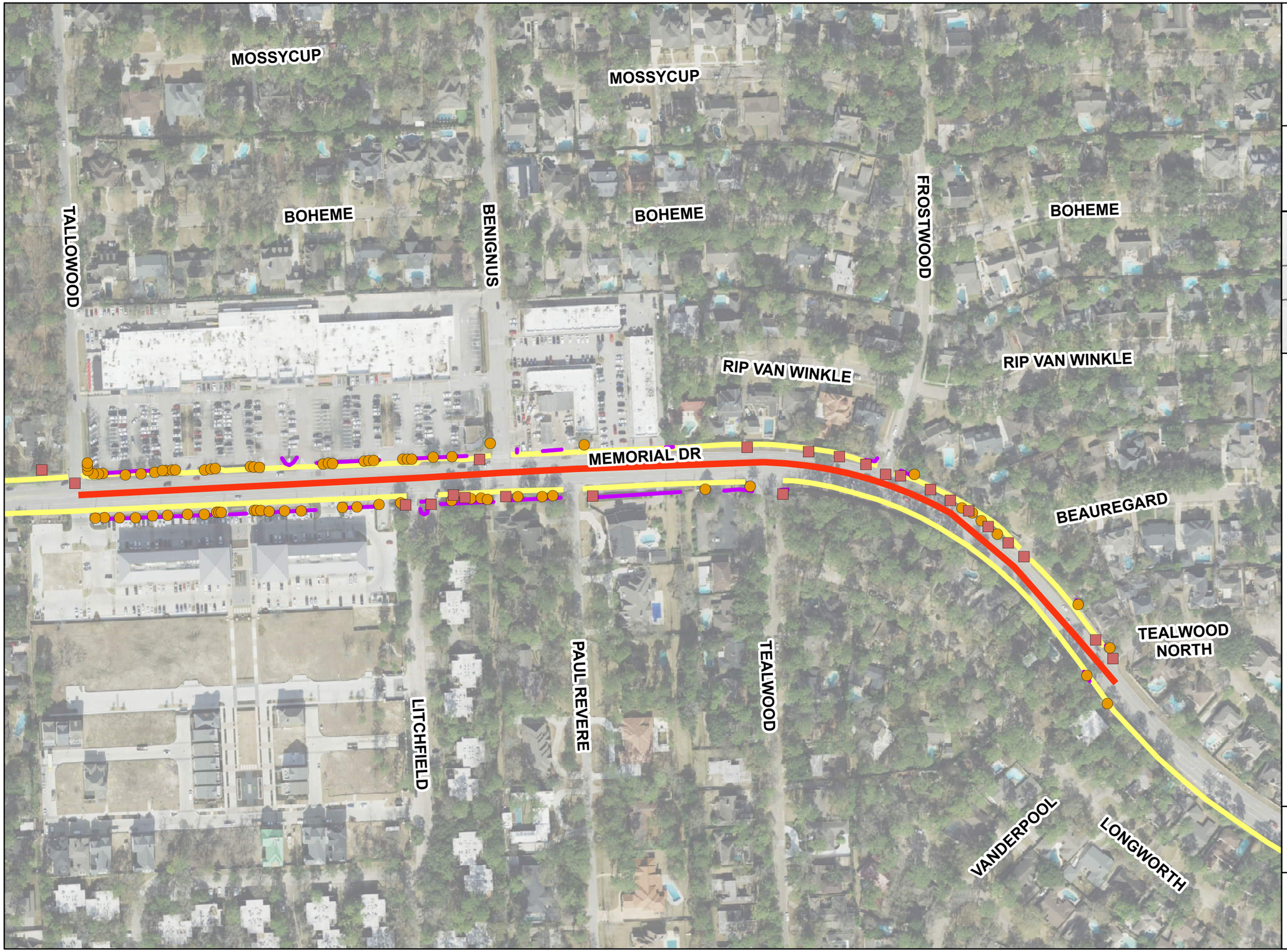
- GP
- C3F
- C3N
- C2
- C3P

N

0 125 250

1 inch = 250 feet

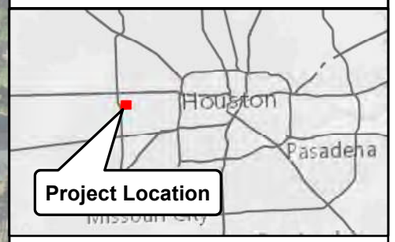
Gauge ENGINEERING



TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.1C
BACK OF CURB FEATURES



Legend

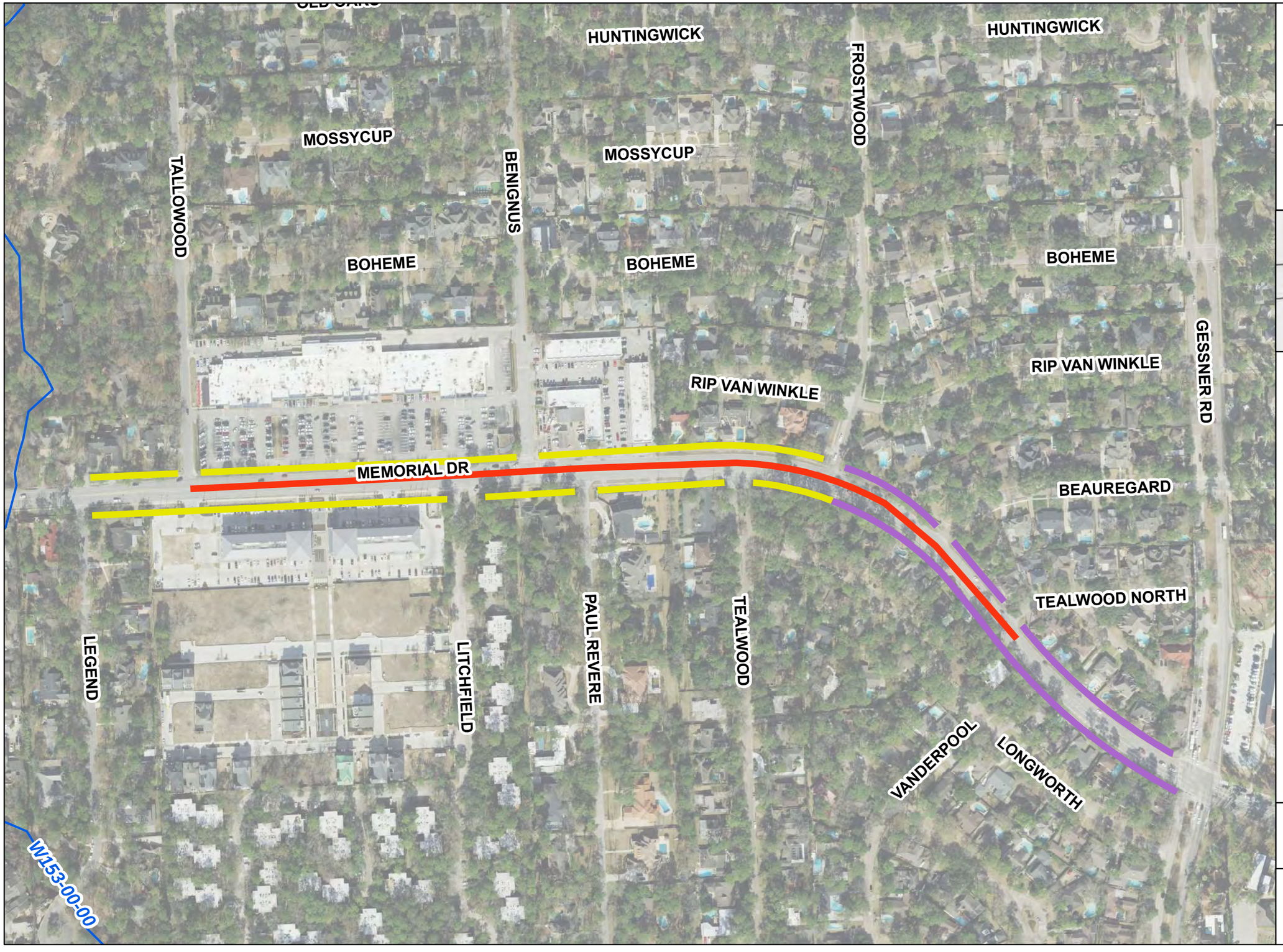
- Project Limit
- Traffic Signs
- Existing Tree
- Existing Shrub
- Existing Sidewalk

N

0 100 200

1 inch = 200 feet

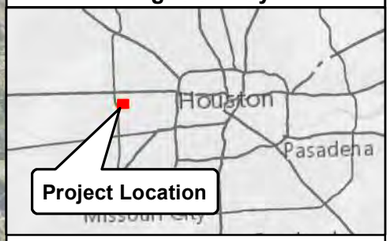
Gauge ENGINEERING



TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.1D
Right-of-Way



Legend

- Project Limits
- Channels

Approximate Right-of-Way

- 100' ROW
- 80' - 95' (Varies) ROW

N

0 125 250

1 inch = 250 feet

Gauge ENGINEERING

Utilities Exhibits

EXISTING
UTILITY SCHEMATIC LAYOUT
MEMORIAL DRIVE IMPROVEMENTS
FROM TALLOWOOD RD.
TO FROSTWOOD DR.

TIRZ 17
REDEVELOPMENT
AUTHORITY

0' 10' 20'
SCALE IN FEET

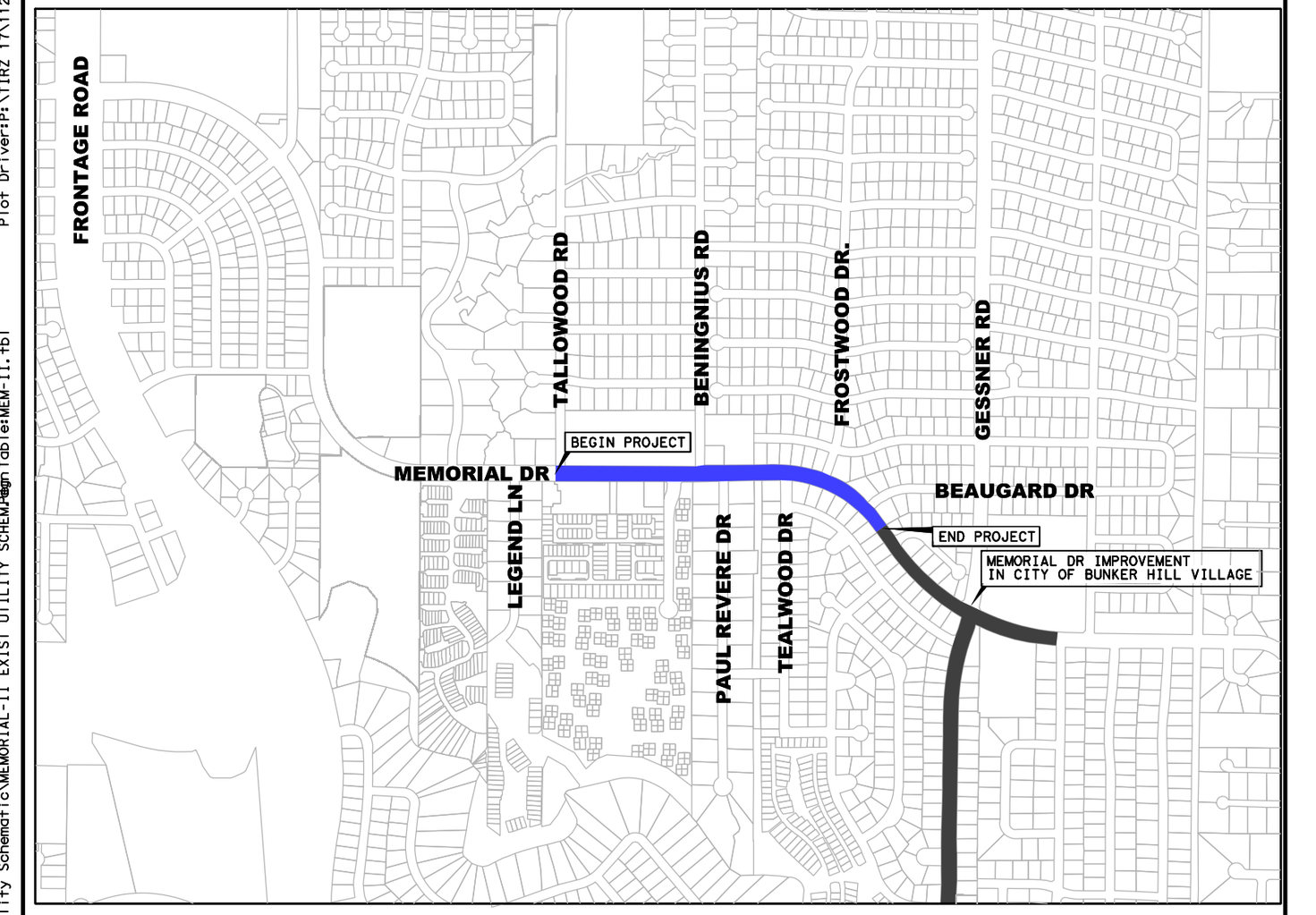
AUGUST 2022

NOT A BIDDING DOCUMENT

Engineer:	DAVID G. GREANEY
P.E. Serial No:	125563
Date:	8/9/2022
Firm Name:	GAUGE ENGINEERING
FIRM No.	F-20017

PRELIMINARY
SUBJECT TO CHANGE

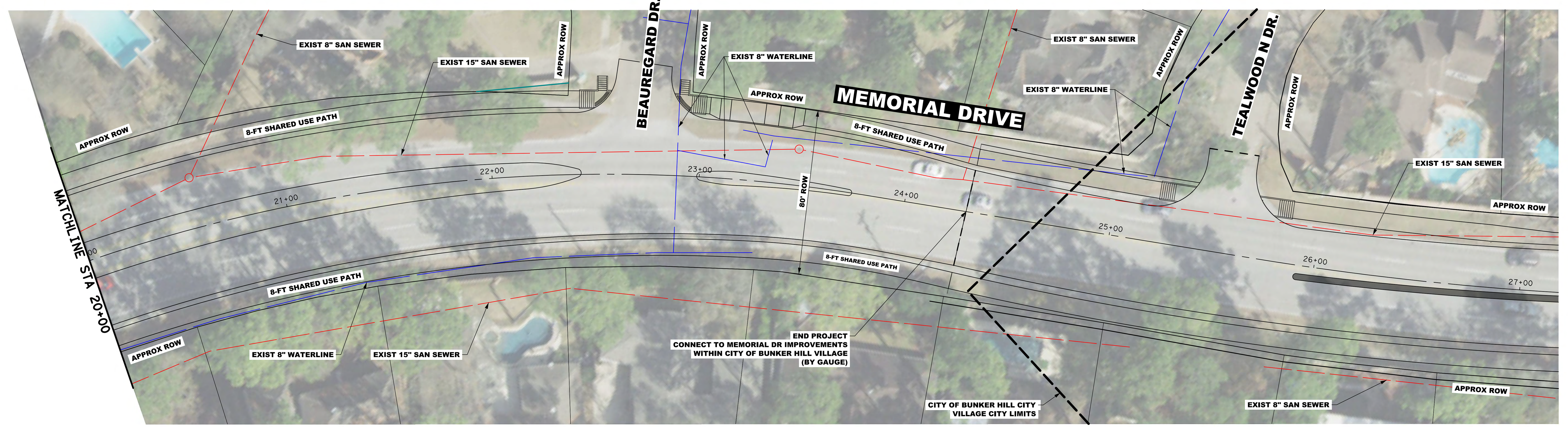
NOT INTENDED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.



LOCATION MAP

LEGEND

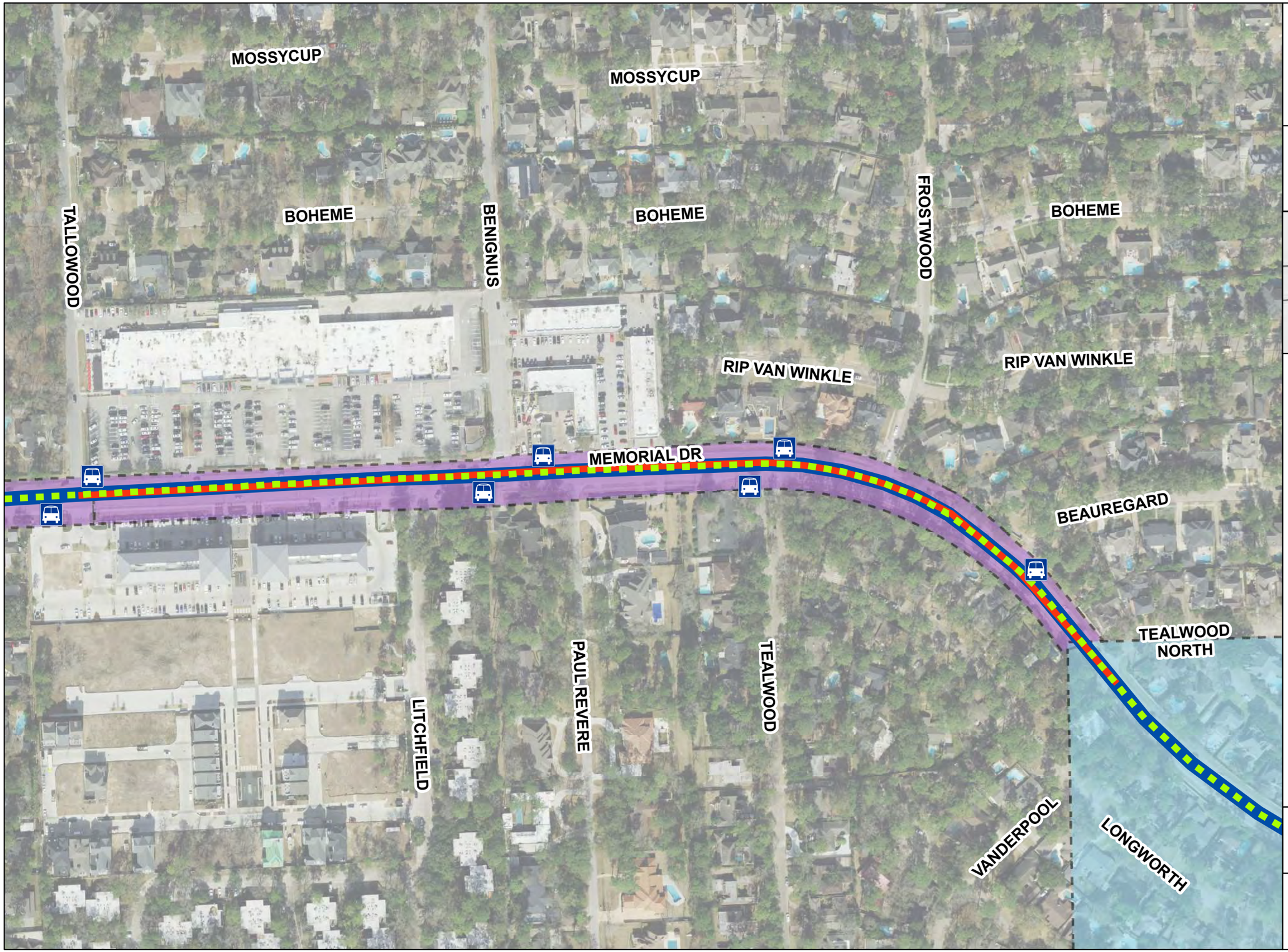
- PROPOSED ALIGNMENT
- PROPOSED CURB
- EXISTING RIGHT-OF-WAY
- EXISTING DRAINAGE
- EXISTING SANITARY
- EXISTING WATER



Gauge ENGINEERING

FIRM # 20017
17500 KATY FREEWAY, SUITE 400
HOUSTON, TX 77079

Transportation Exhibits



TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.3A
METRO MAP

Legend

- Project Limit

METRO

- METRO Bus Stop
- Route No. 161
- Route No. 162

Boundary

- City of Bunker Hill Village
- TIRZ 17 Boundary

N

0 100 200

1 inch = 200 feet

Gauge ENGINEERING

TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.3B
PAVEMENT CONDITIONS

Legend

- Channels

Pavement Condition Rating

- 0 - 67 (Poor)
- 68 - 74
- 75 - 81 (Fair)
- 82 - 90
- 91 - 100 (Good)

Boundary

- City of Bunker Hill Village
- TIRZ 17 Boundary

N

0 125 250

1 inch = 250 feet

Gauge ENGINEERING

TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.3C
311 Service Calls

Legend

- Project Limits
- Channels

311 Service Calls

- Neighborhood Condition
- Wastewater Maintenance
- Water Service Maintenance

Boundary

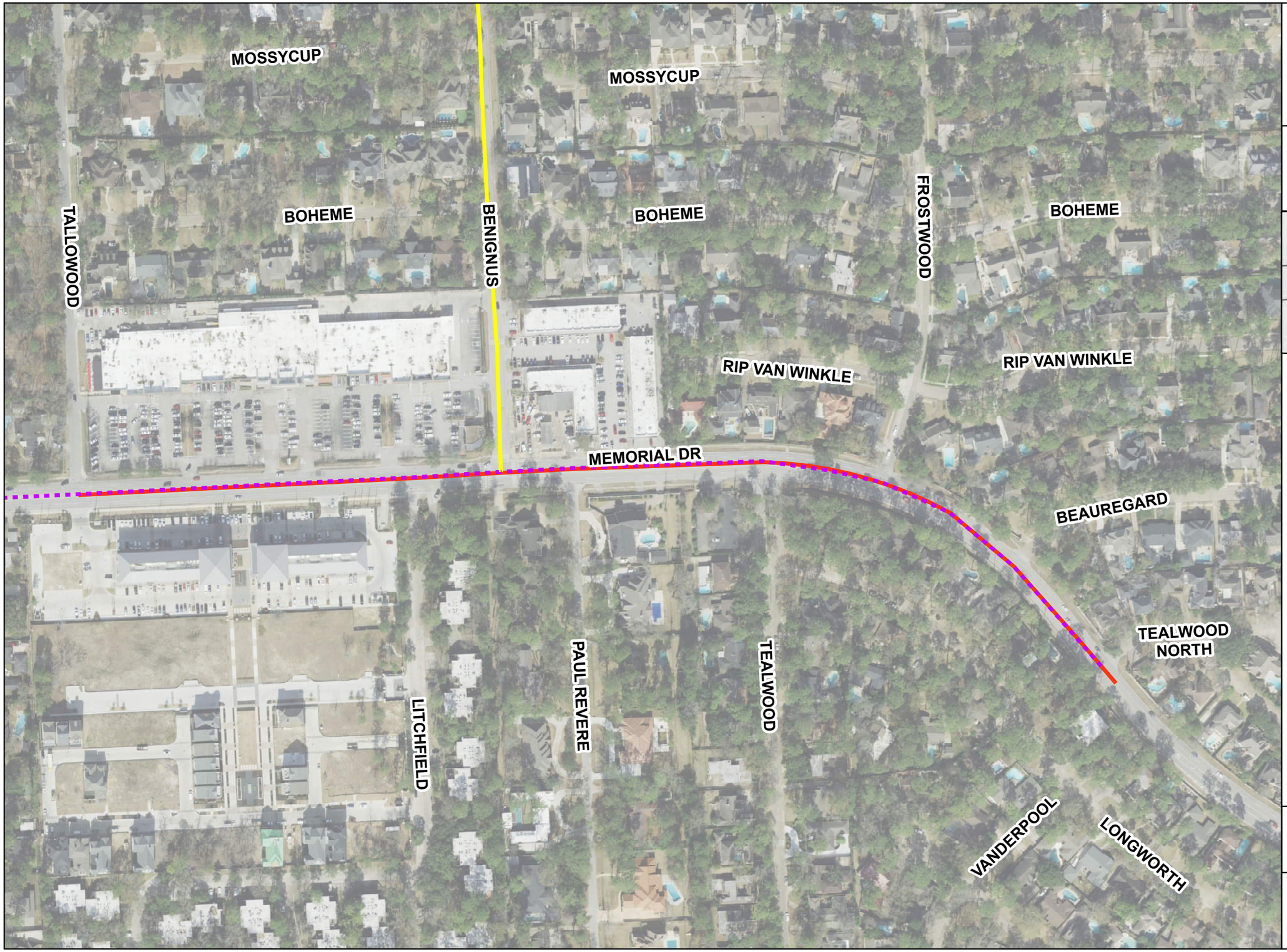
- City of Bunker Hill Village
- TIRZ 17 Boundary

N

0 125 250

1 inch = 250 feet

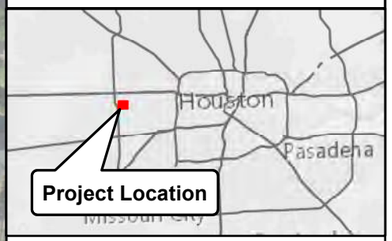
Gauge ENGINEERING



TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS

EXHIBIT 2.3D
BIKE PLAN MAP



Legend

- Project Limit

Bikeway Paths

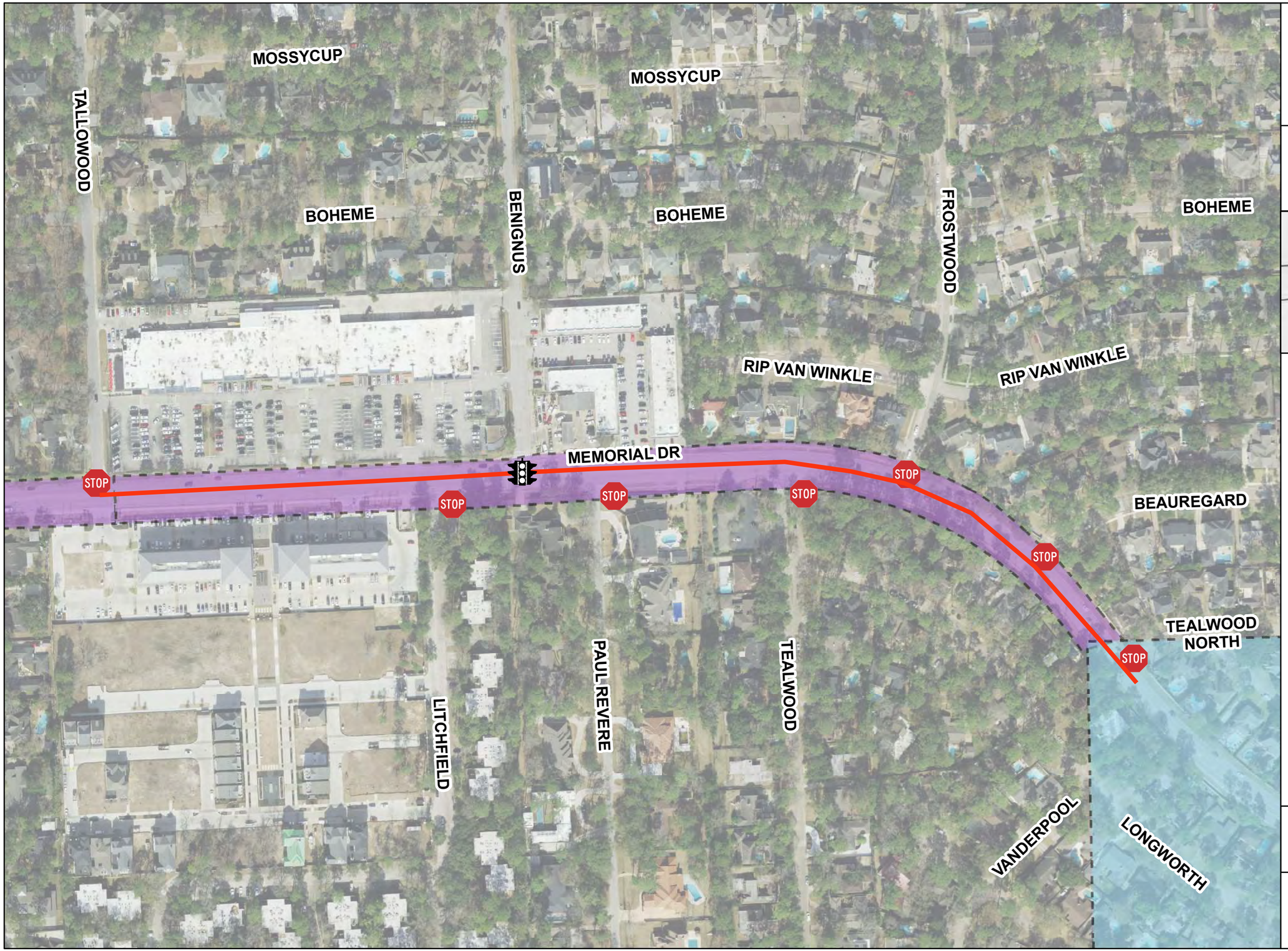
- Proposed Off-Street
- Proposed Shared On-Street

N

0 100 200

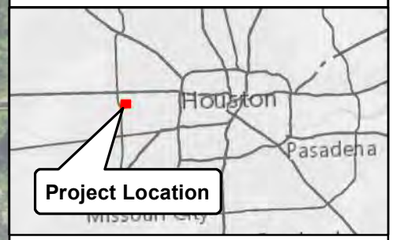
1 inch = 200 feet

Gauge ENGINEERING



TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DRAINAGE & MOBILITY IMPROVEMENTS
EXHIBIT 2.3E
EXISTING SIGNALIZED INTERSECTIONS



Legend

- Project Limit
- Traffic Signal
- STOP Stop Sign

Boundary

- City of Bunker Hill Village
- TIRZ 17 Boundary

N

0 100 200

1 inch = 200 feet

Gauge ENGINEERING

Drainage Exhibits

TIRZ 17
REDEVELOPMENT
AUTHORITY

MEMORIAL DRIVE
DESIGN CONCEPT REPORT

Exhibit 2.4.A
Structures Map

TALLOWOOD RD
BENIGNUS RD
MOSSYCUP DR
FROSTWOOD DR
HOLLOW DR
BOHEME DR
RIP VAN WINKLE
MEMORIAL DR
BEAUREGARD DR
LEGEND LN
WILLOWS GROVE LN
LITCHFIELD LN
PAUL REVERE DR
TEALWOOD
LONGWORTH LN
VANDERPOOL LN
TAMERLAINE DR
MEMORIAL PARKVIEW DR
W153-00-00

1
2
3
4
5
6
7

Legend

- Channels
- Roads
- Project Limits
- HCAD Parcels
- Project Adjacent Structure In Floodplain
- Building Footprints

Historically Flooded Structures

- Harvey
- Tax Day 2016
- FEMA Repetitive Loss

FEMA Flood Hazard Layer

- Floodway
- Zone AE (100-Year)
- Zone X (500-Year)

0 125 250 500

1 inch = 250 feet

Gauge ENGINEERING

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevation** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevation (BFEs) shown on this map apply only landward of 0.0° North American Vertical Datum (**NAVD**). Users of this FIRM should be aware that coastal flood elevations may also be provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this community. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures in this jurisdiction.

The **projection** used in the preparation of this map is Universal Tranverse Mercator (UTM) zone 15. The **horizontal datum** is NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or **UTM** zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the **FIRM.**

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242,** or visit their website at www.ngs.noaa.gov.

Base map information shown on this FIRM was provided in digital format by the Harris Galveston Area Council and was revised and enhanced by Harris County.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

An accompanying Flood Insurance Study report, Letters of Map Revision or Letters of Map Amendment revising portions of this panel, and digital versions of this PANEL may be available. Contact the **FEMA Map Service Center** at the following phone numbers and Internet address for infomation on all related products available from FEMA;

Phone: 800-358-9616
FAX: 800-358-9620
www.fema.gov/msc

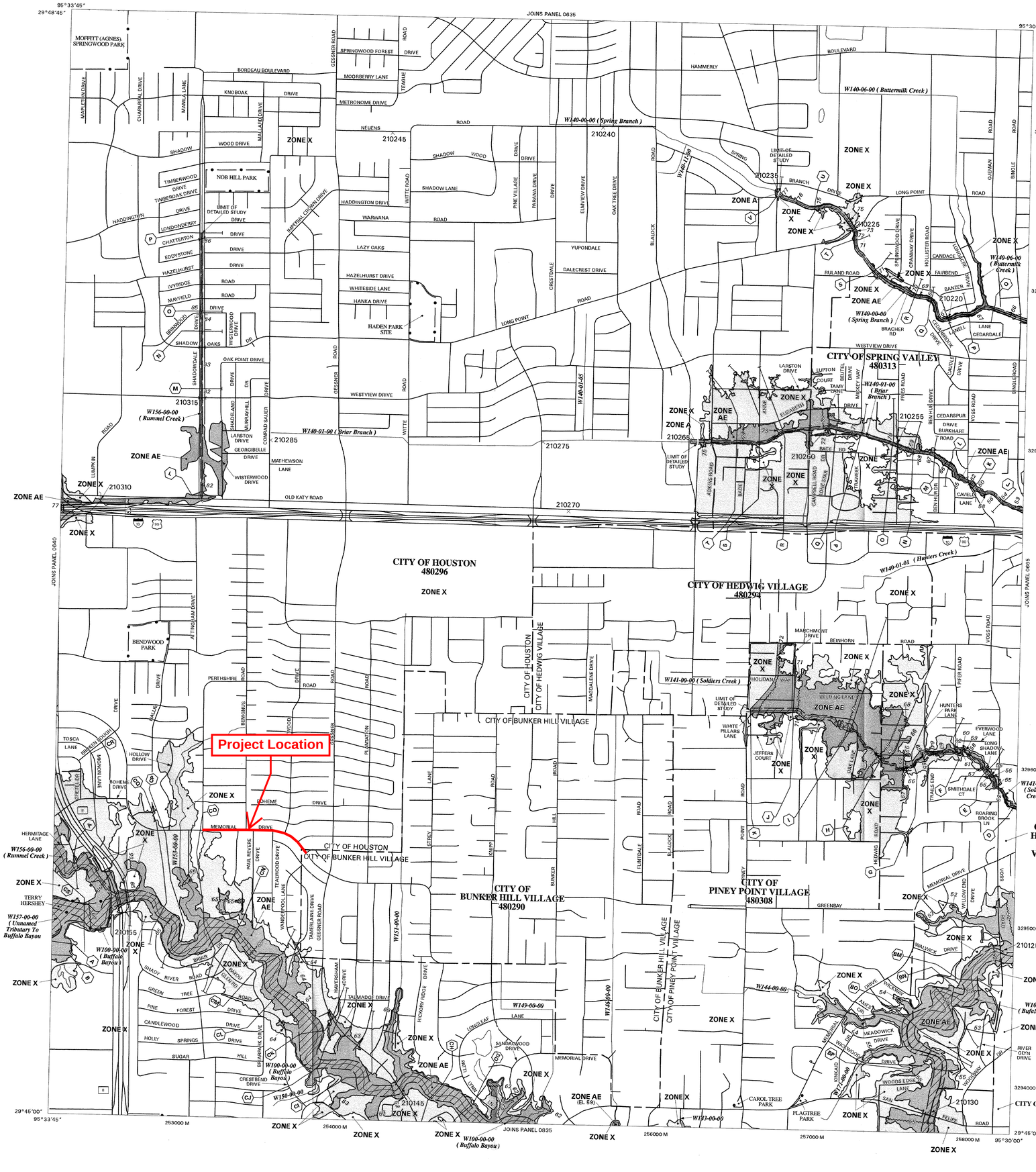
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at www.fema.gov.

This map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report may reflect stream channel distances that differ from what is shown on this map.

Vertical Datum Adjustment due to subsidence is the 2001 adjustment.

Benchmarks shown on this map were provided by either Harris County or the National Geodetic Survey. To obtain elevation, description, and location information for benchmarks provided by Harris County, please contact the Permits Office of the Public Infrastructure Departement at (713) 956-3000 or visit their website at http://www.eng.hctx.net/permits. For information regarding the benchmarks provided by the National Geodetic Survey, please see note above.

Some bridges and other structures shown on the detailed studied streams are not labeled. See corresponding flood profile for appropriate name.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD EVENT

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water surface elevation of the 1% annual chance flood.

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood event.

ZONE A99 Area to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no base flood elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross Section Line
- 23 — 23 — Transect Line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4276000M — 1000-meter Universal Transverse Mercator grid values, zone 15
- 600000 FT — 5000-foot grid ticks
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel).
- M1.5 — River Mile

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
SEPTEMBER 28, 1990

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

SEPTEMBER 30, 1992
NOVEMBER 6, 1996
APRIL 20, 2000
JUNE 18, 2007: to change base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to change zone designations, to reflect updated topographic information, and to change floodway.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at (800) 638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0645L

FIRM
FLOOD INSURANCE RATE MAP

HARRIS COUNTY, TEXAS
AND INCORPORATED AREAS

PANEL 645 OF 1150

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HOUSTON, CITY OF	480296	0645	L
SPRING VALLEY, CITY OF	480313	0645	L
HEDWIG VILLAGE, CITY OF	480294	0645	L

EXHIBIT 2.4.B

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
48201C0645L

MAP REVISED:
JUNE 18, 2007

Federal Emergency Management Agency

TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DESIGN CONCEPT REPORT

Exhibit 2.4.C
Existing Storm Sewer Layout

MOSSYCUP DR
BOHEME DR
HOLLOWDR
TALLOWOOD RD
BENIGNUS RD
FROSTWOOD DR
RIP VAN WINKLE
BEAUREGARD DR
MEMORIAL DR
LEGEND LN
LITCHFIELD LN
WILLOWS GROVE LN
MEMORIAL PARKVIEW DR
PAUL REVERE DR
TEALWOOD
LONGWORTH LN
VANDERPOOL LN
TEALWOOD N DR
W153-00-00

2-10'x10' RCBs
36"
36"
18"
72"
24"
60"
42"
36"
18"
72"
18"
Outfall A
Outfall B

Legend

- Project Limits
- Channels
- Roads

Node

- Type A Inlet
- Type D-1 Inlet
- Type D Inlet
- Type E Inlet
- Manhole

Conduit

- Conduit
- Driveway Culvert
- Conduits Outside of Project Limits
- Roadside Ditch

0 125 250 500

1 inch = 250 feet

Gauge ENGINEERING

TIRZ 17 REDEVELOPMENT AUTHORITY

MEMORIAL DRIVE DESIGN CONCEPT REPORT

Exhibit 2.4.D
2-Year Existing Inundation

MOSSYCUP DR
TALLOWOOD RD
BOHEME DR
HOLLOWDR
FROSTWOOD DR
RIP VAN WINKLE
MEMORIAL DR
TEALWOOD
PAUL REVERE DR
WILLOWS GROVE LN
LEGEND LN
LITCHFIELD LN
LONGWORTH LN
VANDERPOOL LN
W153-00-00

Legend

- Nodes
- Conduit
- Channels
- HCAD Parcels
- Building Footprints

2-Year Existing Inundation (ft)

- < 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 5.00
- > 5.00

0 125 250 500

1 inch = 250 feet

Gauge ENGINEERING

TIRZ 17
REDEVELOPMENT
AUTHORITY

MEMORIAL DRIVE
DESIGN CONCEPT REPORT

Exhibit 2.4.E
100-Year Existing Inundation

MOSSYCUP DR
TALLOWOOD RD
BOHEME DR
HOLLOWDR
FROSTWOOD DR
RIP VAN WINKLE
TEALWOOD
PAUL REVERE DR
WILLOWS GROVE LN
LEGEND LN
LITCHFIELD LN
W153-00-00
LONGWORTH LN
VANDERPOOL LN
MEMORIAL DR

Legend

- Nodes
- Conduit
- Channels
- HCAD Parcels
- Building Footprints

100-Yr Existing Inundation (ft)

- < 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 5.00
- > 5.00

0 125 250 500

1 inch = 250 feet

Gauge ENGINEERING

3 Alternatives Analysis

3.1 Alternatives

Gauge considered two alternatives for the reconstruction of Memorial Drive as summarized below:

No-Build Alternative:

The no build alternative consists of zero alterations to the existing infrastructure throughout the project limits, maintaining the current roadway configuration, pavement condition, pedestrian facilities, drainage network, and other underground utilities such as sanitary sewers and water lines.

The existing roadway along the project corridor consists of four lanes with no medians or dedicated left turn lanes. This current roadway configuration is ineffective in accommodating the projected future roadway capacity needs due to the growing volume of traffic received from neighboring commercial and residential land use, as outlined in **Appendix A**. The lane configuration facilitates an unsafe driver experience by having motorists making left turns utilizing the center two-way-left-turn-lane. Some of the most common types of collisions within the project limits are “opposite direction, one-straight one left turn,” and “right angle, one straight one left turn.” Combined the two collisions contribute to 40% of all collisions reported in the Crash Analysis, see **Appendix A**. The major contributor to accidents in this area is at intersections. Half of intersection crashes occur at the intersection of Memorial Drive and Benignus Road, see **Appendix A.**

Memorial Drive corridor consists of aging and deteriorated asphalt pavement. In 2020, the pavement condition was recorded. Long segments of the road received a Pavement Condition Index score of less than 67 categorized as Poor Condition, See **Exhibit 2.3B.** PCI values can be lowered for Memorial Drive due to various distress types in asphalt pavement such as depressions, swelling, potholes, and weathering. These distresses can lead to dangerous turn movements around potholes leading to an overall low ride quality. The no build alternative has no plans to improve the condition of the roads.

Memorial Drive currently does not accommodate a safe pedestrian-friendly environment with its narrow sidewalks, non-ADA compliant ramps and minimal opportunities for safe crossing. Foot traffic along Memorial Drive is generated from pedestrians traveling to and from adjacent commercial and residential properties. The existing narrow sidewalks do not allow for pedestrians to walk shoulder to shoulder, making it uncomfortable and discourages use of the sidewalks. Furthermore, there is no curb along the side of the road. The only protection from oncoming traffic and pedestrians is a four-foot grass buffer, decreasing the overall walkability of Memorial Drive. The current non-ADA compliant wheelchair ramps lack the proper truncated domes which are vital for the visually impaired.

The existing drainage for the project corridor consists of open roadside ditches and a storm sewer network ranging in size from 18-inches to 72-inches. There is significant ponding and overtopping of the roadway in the 100-year event near the Tallowood Road intersection. There is significant ponding in intersections ranging from 0.96-feet to 1.69-feet. See **Appendix B** for additional information. The flooding in the area would not be reduced if the project was not built.

Many of the existing sanitary sewers and water lines have exceeded their 30-year useful life and are in need of replacement to maintain the longevity of the project corridor. The no build alternate has no plans to replace these utilities.

Estimated Property Impacts:	None	**Estimated Total Cost:**	$0
Estimated ROW Cost:	$0	**Estimated Construction Time:**	None
Estimated Mitigation Required:	None		

Alternative 1:

Alternative 1 is a full reconstruction of Memorial Drive corridor with a priority on improving mobility, drainage, pedestrian facilities, and underground aging utility replacement. The proposed cross sections promote a safe and comfortable experience for all modes of travel along the Memorial Drive corridor. This option redesigns the current roadway corridor with consideration for future growth and needs for the region. These improvements consist of reconfiguring the current roadway cross section, wider continuous shared use paths, signalized intersection at Litchfield Lane, optimized transit infrastructure, aging utility replacements, and upgrades to drainage facilities. It also allows for additional tree planting opportunities within the median and safety buffer.

The proposed cross section is a boulevard section comprised of a concrete pavement with four eleven-foot-wide lanes with one-foot offsets to the curb (TxDOT requirements for TIP funded projects), a raised median that ranges from three to eighteen feet, eight-foot-wide shared use paths, and a four-foot safety buffer. The proposed roadway provides sufficient capacity for the roadway to accommodate traffic growth through 2045. Access management is also improved by providing a median with left turn lanes at openings for safer access to driveways.

The southbound driveway from the shopping plaza on the north side is too close to the intersection of Litchfield Lane and Memorial Drive. To provide a safer intersection, the southbound driveway will be shifted east to align with Litchfield Lane. The existing two-way stop-controlled T-intersection will be converted into a signalized intersection and will operate in coordination with the intersection at Benignus Road with a single controller to align signal timings. This will provide optimal traffic operations and safety at the intersections.

The driveway to Memorial Green on the south side and west of Litchfield Lane will be shifted to align with the median opening. A new driveway would also be placed from Memorial Green on Litchfield Lane to allow motorists a safer exit from the development so that they can go to the traffic signal and turn west onto Memorial Drive.

Currently there are two bus routes along the Memorial Drive project limits, the 161 and 162. Public transit recommendations include far-side bus stops to avoid signal interference, optimized bus stop spacings and locations to major trip generators, and building platforms large enough to provide semi-level boarding and enhanced amenities (See **Appendix A** for additional information). There is one new bus stop, one bus stop to be removed and relocated to the far-side of Benignus Road, four bus stops to be improved in-place, and two bus stops to be removed at Tealwood Drive. Bus stop designs are in accordance with the Universal Accessibility project and will provide far-side bus stops with larger platforms for bus stop amenities.

Improvements also extend to the pedestrian realm, with an emphasis on improving walkability and safer travel for non-motorized modal transportation throughout the corridor. A widened eight-foot shared use path is proposed and will provide a safe, comfortable, pedestrian-friendly environment for both bicyclists and pedestrians. This shared use path is improving both walkability and connectivity by linking the TxDOT shared use path project from Terry Hershey Park to the southeast corner of Beltway 8 northbound frontage road and Memorial Drive.

The proposed storm sewer trunkline consists of two ten-foot by ten-foot reinforced box culverts (RCB) with two outfalls, one to the existing two ten-foot by ten-foot RCBs at Tallowood Road and one to the existing 72-inch reinforced concrete pipe (RCP) between Paul Revere Drive and Tealwood Drive, heading south. This storm sewer system functions both as a stand-alone system for this project and in concert with future regional improvements. It results in a reduction in the floodplain for the 2-, 10-, and 100-year events. See **Appendix B** for additional information.

The Alternative is posed to replace sanitary sewers and water lines that exceeded their useful life cycles. Additional water lines are also to be replaced if in conflict with the current drainage structures. Offsets to the forty-eight-inch sanitary sewer is also being considered to shift it away from the curb to make room for inlets and other appurtenances.

Estimated Property Impacts:	None	**Estimated Total Cost:**	$21M
Estimated ROW Cost:	$0	**Estimated Construction Time:**	15 months
Estimated Mitigation Required:	Significant upgrades are required to meet current City criteria		

3.2 Comparison of Alternatives

Benefits and risks for the individual alternatives:

No-Build Alternative: *No build Alternative*		
Criteria	**Benefits**	**Risks**
Mobility	No construction disruption	The poor pavement condition would not be improved, and it would continue to deteriorate. The undivided roadway would remain, which is not as safe for motorists as it is with a raised median.
Pedestrians	No construction disruption	The sidewalks east of Tealwood Drive are discontinuous, which does not promote a pedestrian-friendly environment.
Bicycles	No construction disruption	The roadway would remain without bicycle facilities.
Transit	No construction disruption	Bus stops would remain merely signs without a bus pad and landing.
Drainage	No construction disruption	Existing drainage network does not meet the City's current criteria and will become susceptible to flooding.
Water/wastewater	No construction disruption	Some of the existing utilities have exceeded their useful service life.
Cost	Would not cost anything.	N/A

Alternative 1: *four lanes with median and 8 ft shared use path*		
Criteria	**Benefits**	**Risks**
Mobility	Safety would be greatly enhanced with the new divided roadway.	None
Pedestrians	- Promotes safe, comfortable, low-stress environment for pedestrians. - Would have continuous shared use paths for the entire project.	None
Bicycles	Shared use path will provide bicyclists enough room to ride comfortably and will satisfy the Houston Bike Plan Map proposed Off-Street Bikeway.	None

Transit	As part of the Universal Accessibility project, METRO is enhancing bus stops with stops on the far side.	None
Drainage	Installation of a storm sewer system that is based on ATLAS 14 with the objective to reduce flooding to neighboring areas.	Increasing impervious cover will increase detention required.
Water/wastewater	Utilities that have exceeded their useful service life will be replaced.	None
Cost		Construction costs are more expensive.

3.3 Preferred Alternative

The **No Build Alternative** does not provide any improvement within the project limits. The area would continue to have poor pavement conditions and narrow, interrupted sidewalks. The projected increase in traffic would not be well-accommodated without a median. Flooding would not be reduced.

Alternative 1 is the preferred option. It consists of two lanes in each direction with a left-turn lane at signalized intersections and median openings. This proposed typical section creates a safe environment for motorists, pedestrians, and bicyclists. Intersection safety is enhanced with the addition of a traffic signal at Litchfield and the shopping plaza southbound driveway re-alignment with the signal, which will operate in coordination with the intersection at Benignus Road with a single controller to align signal timings Pedestrian crossings at intersections are enhanced with high-visibility crosswalks. See **Exhibit 3.3A** for the proposed roadway schematic. **Figures 3.3A to 3.3C** show the typical sections for Memorial Drive between Tallowood Road and Tealwood North Drive as proposed in Alternative 1. The proposed typical section configuration consists of:

- A divided two-way, four lane concrete curb and gutter roadway with 11-foot lanes and a 1-foot offset to the curb (TxDOT requirements for TIP projects).
- Continuous eight-foot-wide shared use paths of both sides with curb ramps and high visibility crosswalks at all intersections to create a safe, comfortable, low-stress environment for pedestrians.
- Three to eighteen-foot-wide medians for enhanced safety and tree planting.
- Four-foot-wide safety buffer/clear zone for added safety on the shared use path and planting of trees.

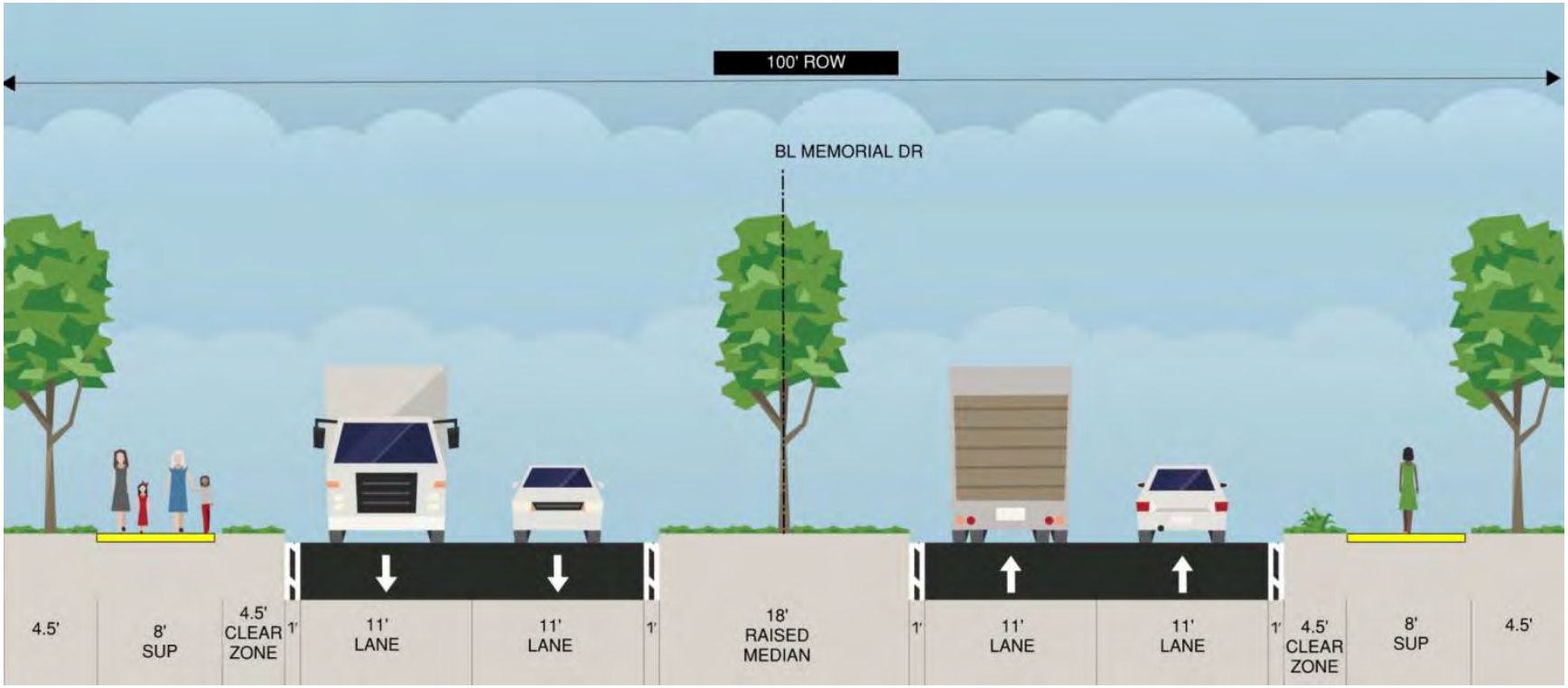


Figure 3.3A: Proposed Typical Section – Memorial Drive (Tallowood Road to Frostwood Drive)

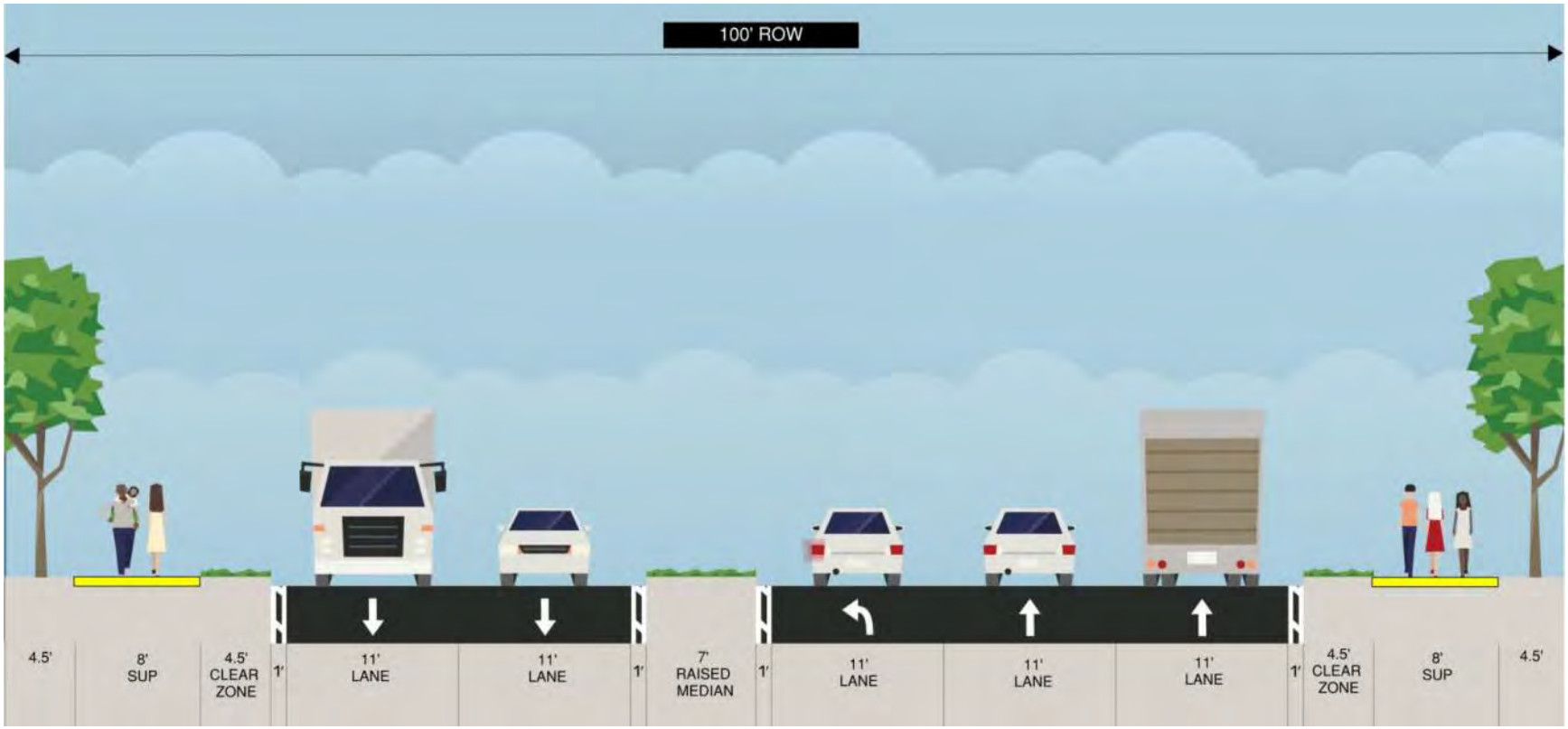


Figure 3.3B: Proposed Typical Section with Left Turn – Memorial Drive (Tallowood Road to Frostwood Drive)

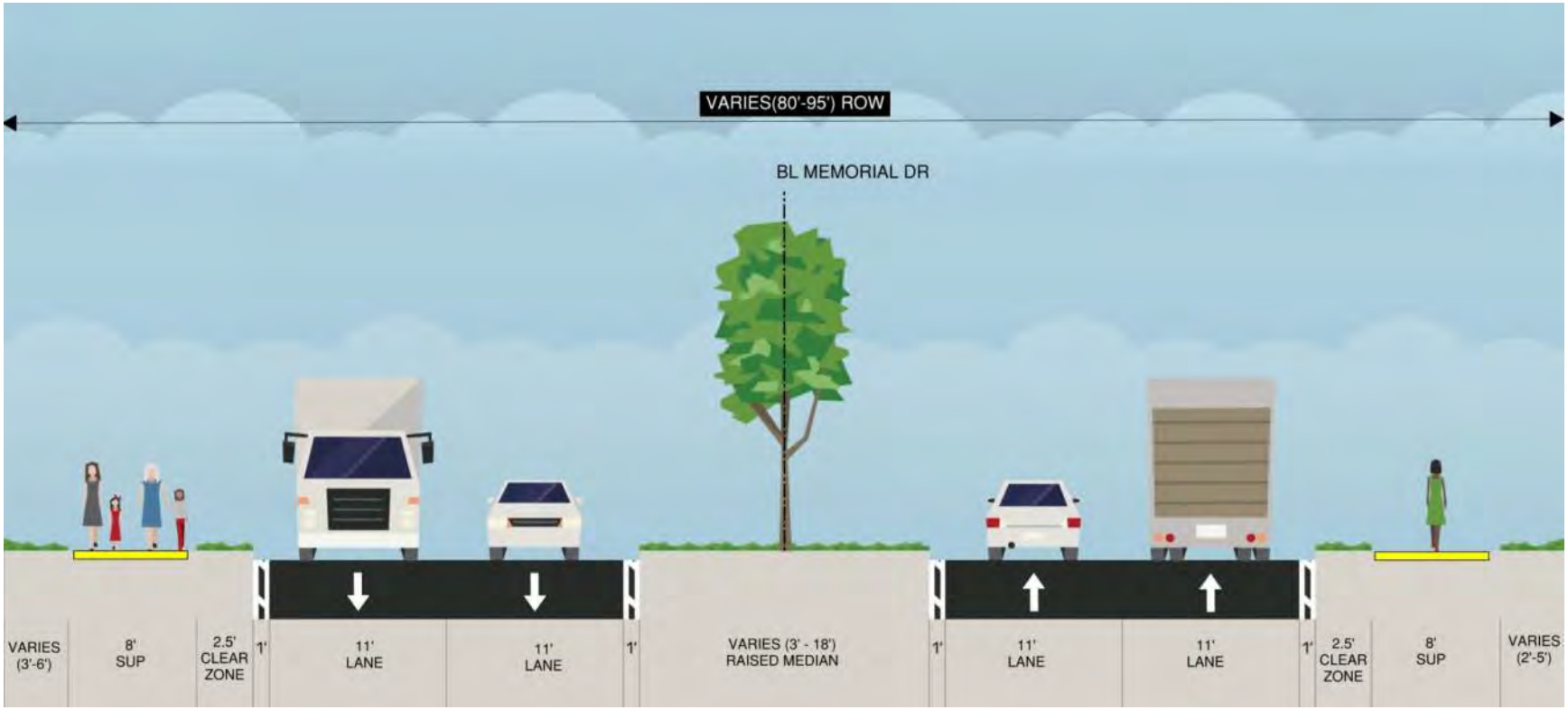


Figure 3.3C: Proposed Typical Section – Memorial Drive (Frostwood Drive to North Tealwood Drive)

Alternative 1 has other advantages also that include:

- Converting the existing open ditch asphalt roadway to a four-lane two-way concrete curb and gutter roadway with 8-ft wide shared use paths.
- Mobility improvements for all motorists and pedestrians.
- Maximized safety for all modes of transportation.
- meeting current City's standards except for minimum velocity, which cannot be achieved without causing an increase in outflow.
- Improves drainage conditions by reducing flooding and ponding along the project limits. The storm sewer system will meet current City's standards except for minimum velocity, which cannot be achieved without causing an increase in outflow.
- Right-of-way acquisition may be necessary at the northwest corner of the intersection of Beauregard Drive. Once survey is received, the final determination will be made.

List of Exhibits

Exhibit Number	Description
Exhibit 3.3A	Proposed Roadway Schematic

Proposed Roadway Schematic

PROPOSED SCHEMATIC LAYOUT
MEMORIAL DRIVE IMPROVEMENTS
FROM TALLOWOOD RD.
TO TEALWOOD NORTH DR.

TIRZ 17 REDEVELOPMENT AUTHORITY

SCALE IN FEET 0' 10' 20'

AUGUST 2022

NOT A BIDDING DOCUMENT

Engineer: DAVID G. GREANEY

P.E. Serial No.: 125563

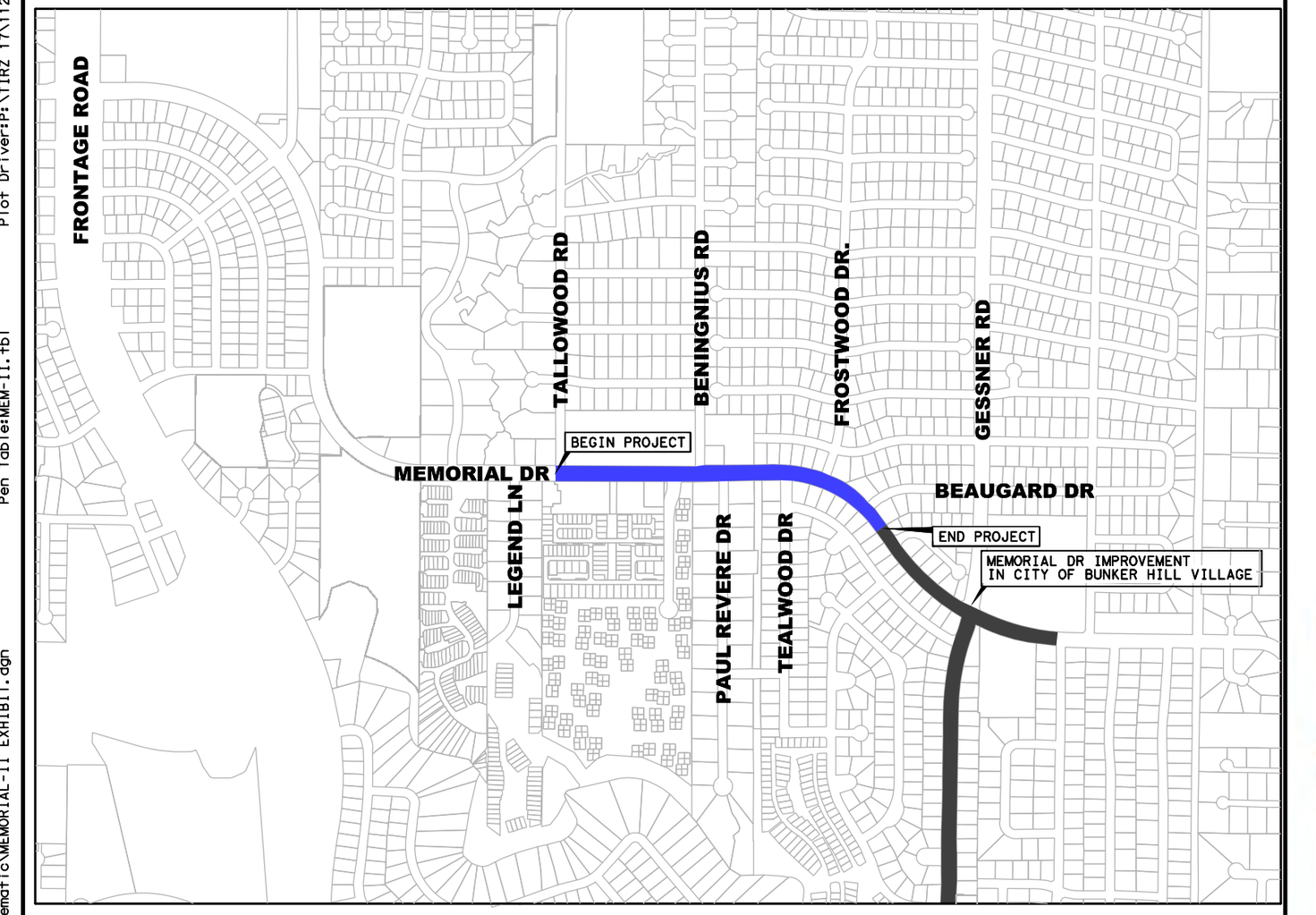
Date: 8/9/2022

Firm Name: GAUGE ENGINEERING

FIRM No. F-20017

PRELIMINARY
SUBJECT TO CHANGE

NOT INTENDED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.



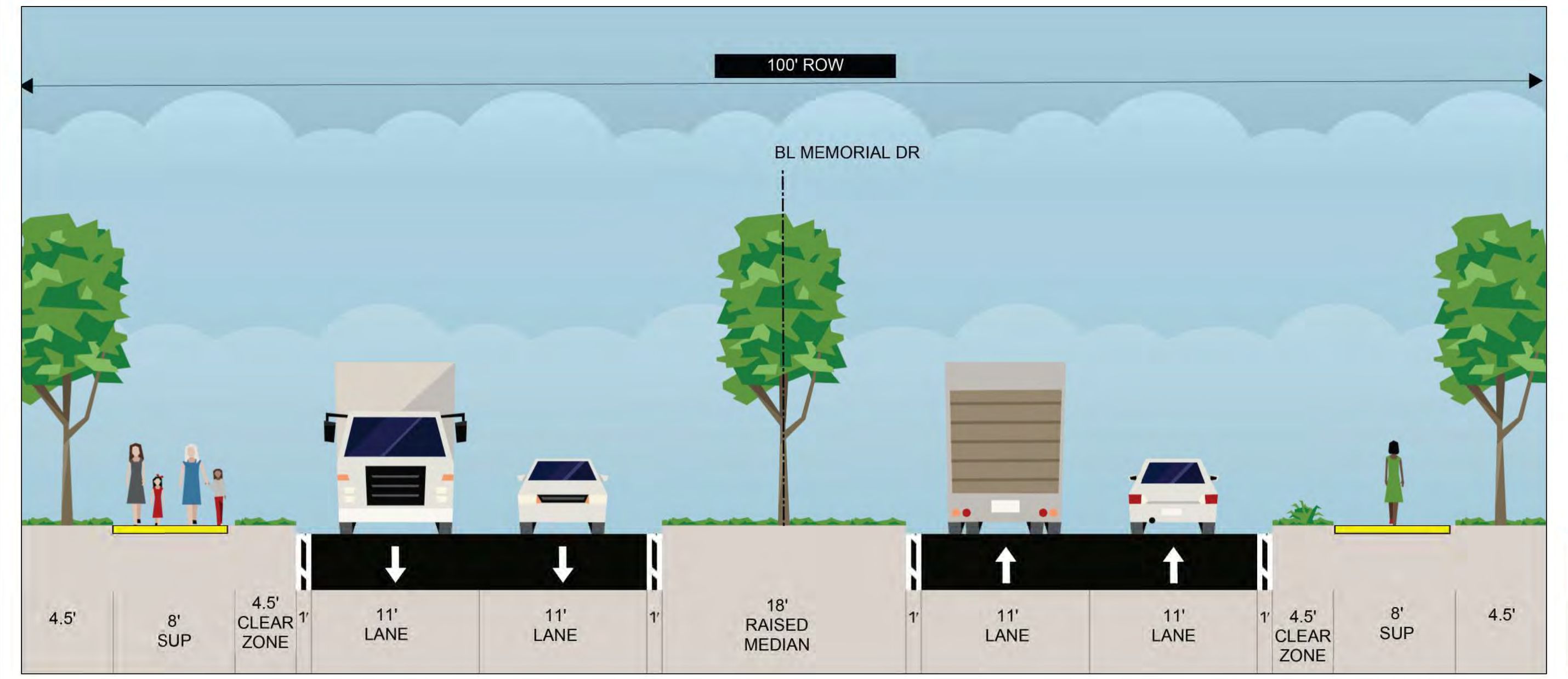
LOCATION MAP

LEGEND

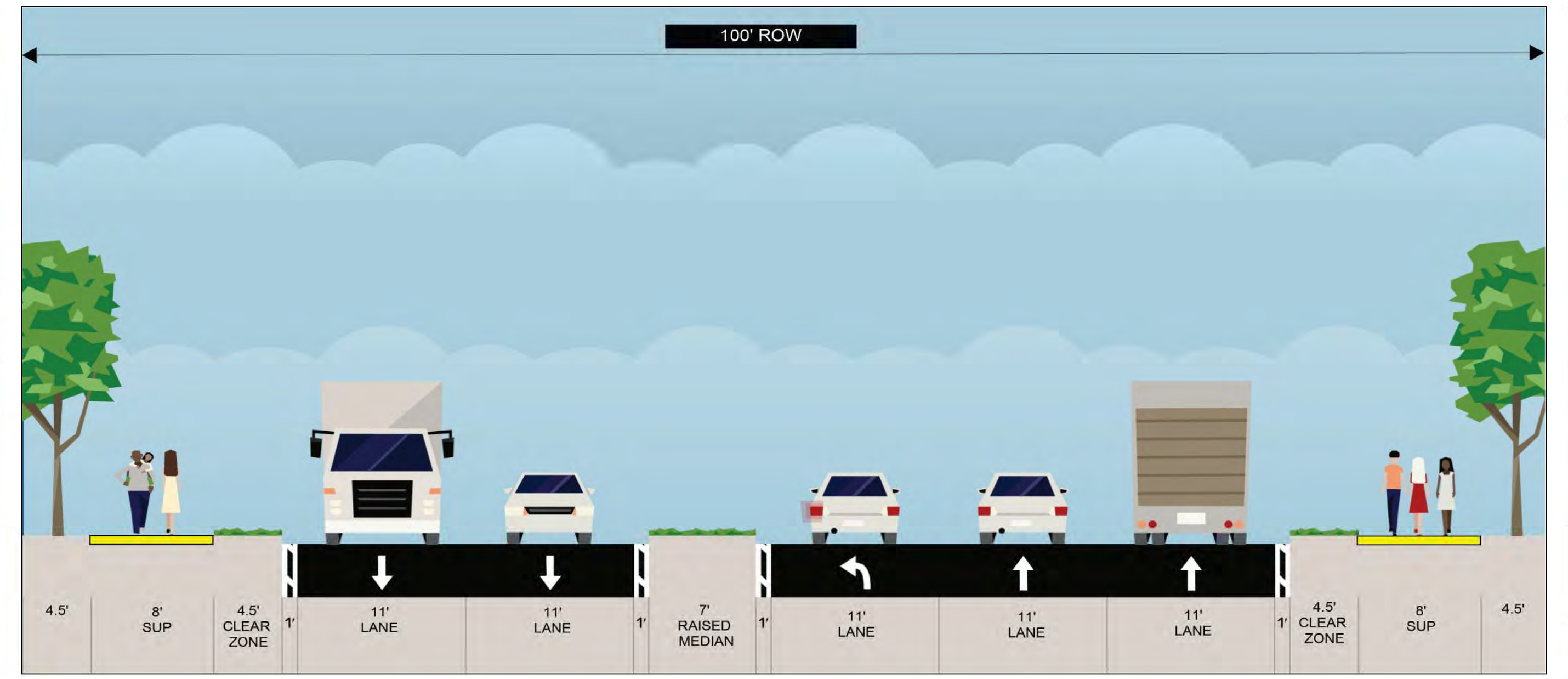
- PROPOSED ALIGNMENT
- PROPOSED CURB
- APPROX RIGHT-OF-WAY
- PROPOSED TRAFFIC ARROW
- EXISTING TRAFFIC ARROW
- PROPOSED SHARED USE PATH
- PROPOSED CONCRETE DRIVEWAY
- PROPOSED CONCRETE PAVEMENT
- PROPOSED SODDING
- PROPOSED SIDEWALK AT STREET LEVEL
- PROPOSED DRAINAGE

Gauge ENGINEERING

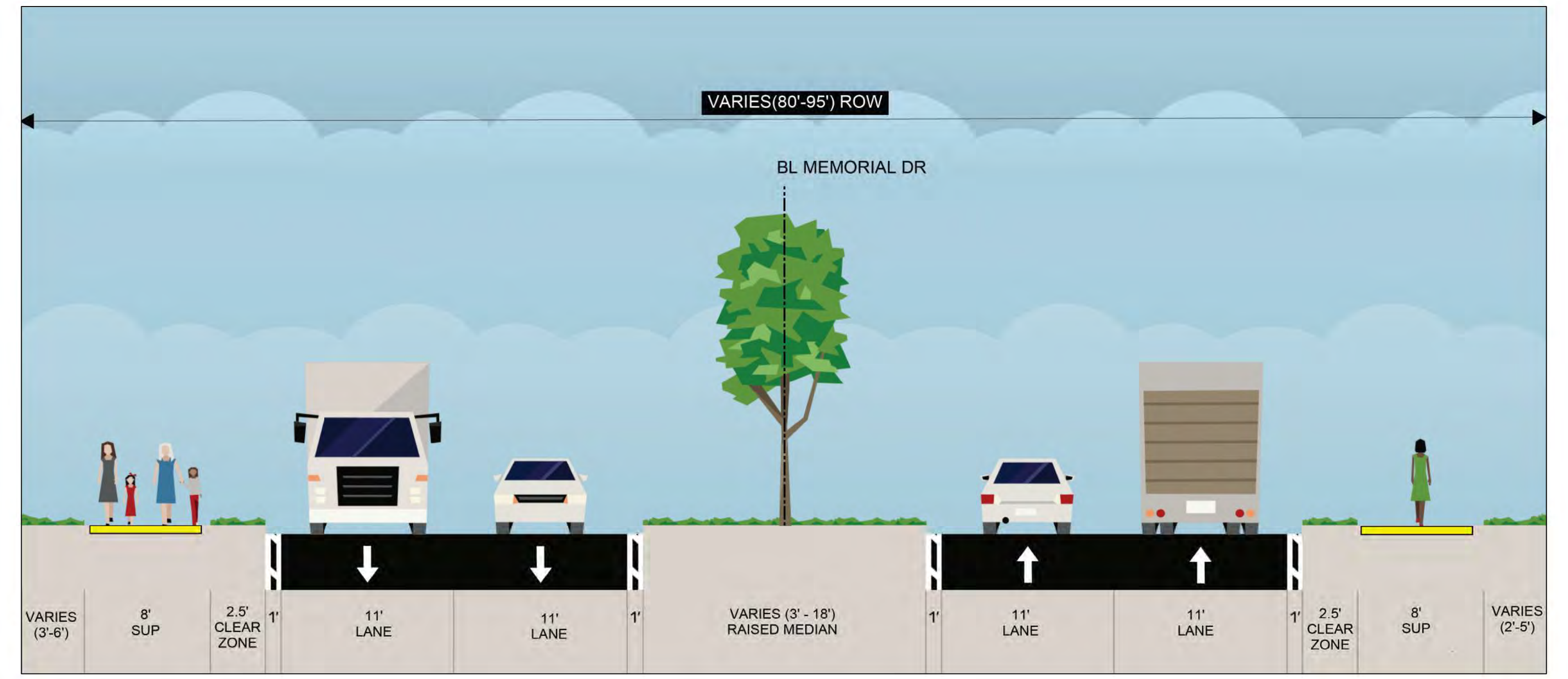
FIRM # 20017
17500 KATY FREEWAY, SUITE 400
HOUSTON, TX 77079



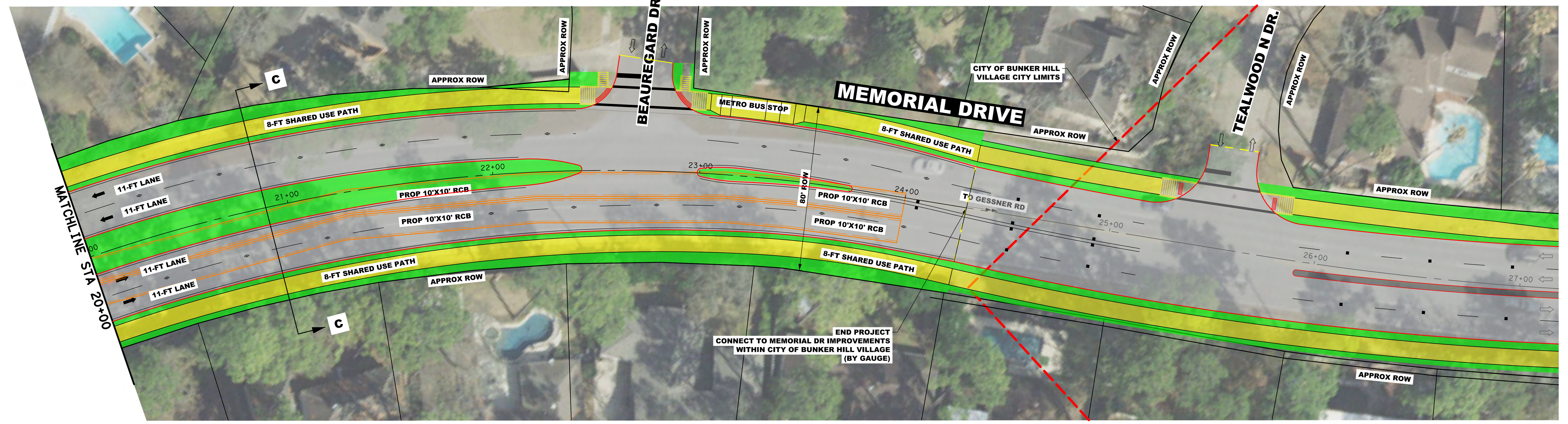
PROPOSED TYPICAL SECTION A-A
N.T.S

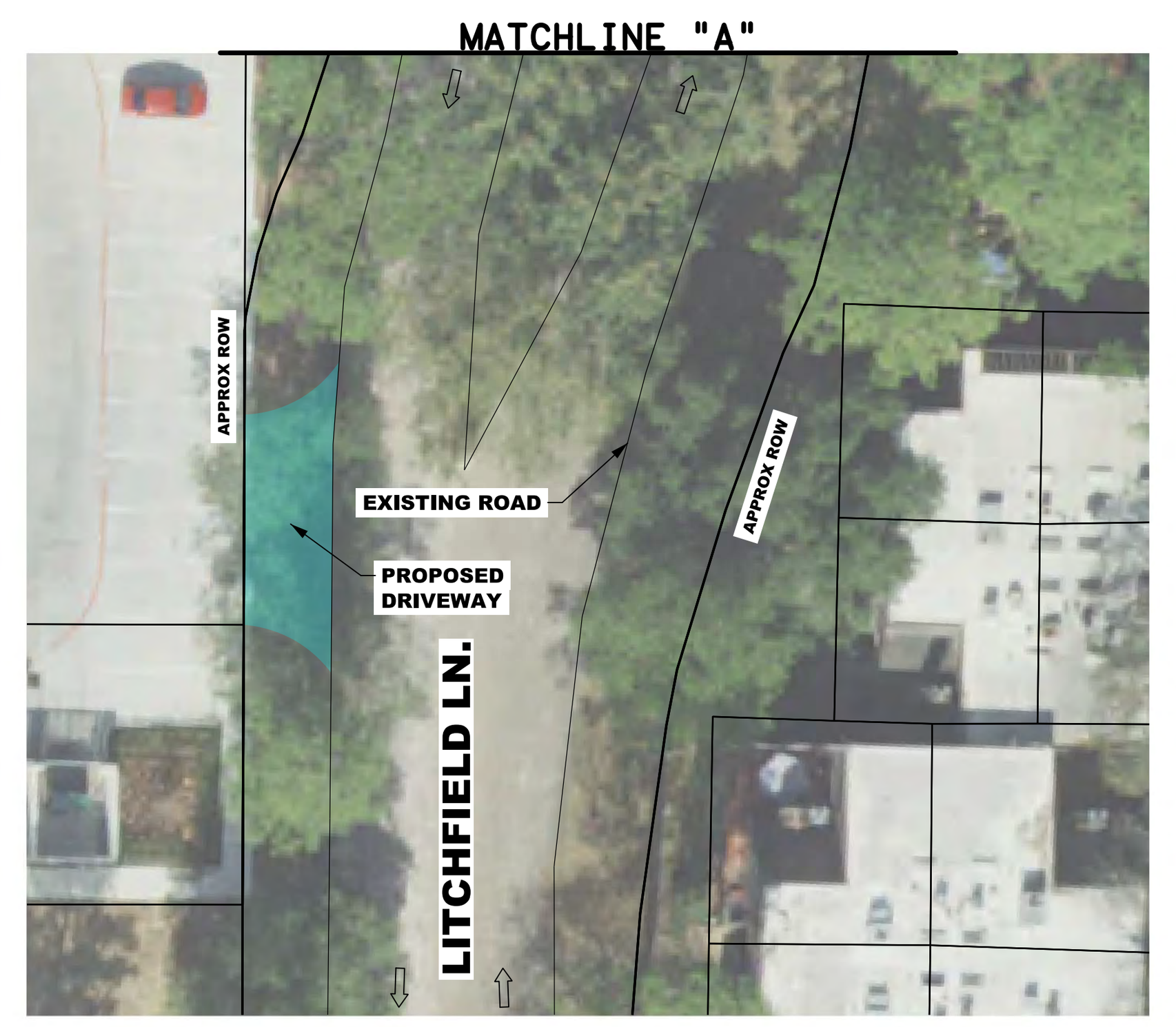


PROPOSED TYPICAL SECTION B-B
N.T.S



PROPOSED TYPICAL SECTION C-C
N.T.S





4 Preferred Alternative

4.1 Main Design Features

Transportation

- The standards applicable to the Memorial Drive Mobility and Drainage Improvements are contained within the City of Houston Infrastructure Design Manual (COH IDM), July 2021 and Texas Department of Transportation Roadway Design Manual (TxDOT RDM), July 2020.

Feature	Existing	Standard*	Proposed	Justification/ Methodology	Variance Required
Typical Section					
- Number of Lanes	4	4	4	Capacity Analysis modeling	No
- Lane Width(s)	10-ft to 12-ft	10-ft to 11-ft	11’ + 1’ offset	Houston IDM requires 11-ft lanes. TxDOT requires 12’ lanes. The compromise is 11’ lanes with 1’ offset on TIP funded projects.	No

Feature	Existing	Standard*	Proposed	Justification/ Methodology	Variance Required
- Median Width & Type	No existing medians	15-ft to 17-ft, 4'-6' at turn lane	3-ft to 18-ft raised median	COH IDM 2021, Table 10.6 TxDOT RDM 2020 Chapter 3 Section 2	No
- Auxiliary Lanes	12-ft Center Left Turn Lane	COH IDM, 2021 TxDOT RDM, 2022	Dedicated left-turn lanes to be present at all median openings		Yes. Not all median openings have room for a left-turn lane.
Access Control	No existing access control	COH IDM, 2021 TxDOT RDM, 2022	Median with openings at all cross-streets. Close and realign median openings at locations where needed. Replace all existing driveways in the same location and bring any substandard driveways up to standard. Any driveways that are clearly no longer in use should be removed.	Median closures and driveway consolidation are assessed on a case-by-case basis. A variety of factors assessed including: safety, intersection operations, and opportunities for cross-access.	Approval by TDO for median spacings do not meet the IDM requirements

			Driveway consolidation where needed.		
Feature	**Existing**	**Standard***	**Proposed**	**Justification/ Methodology**	**Variance Required**
Outside Shoulder or Border Area Width	N/A	N/A	N/A	Not Present	
Outside Shoulder Slope	N/A	N/A	N/A	Not Present	
Inside Shoulder Width	N/A	N/A	N/A	Not Present	
Sidewalks	4-ft to 5-ft	6-ft	8-ft	COH IDM 2021, Table 17.3	Only for safety buffer where sidewalk is less than 4-ft from curb
Bike Lanes	None		Incorporated into shared use path		No
Bus Stop	Design and amenities vary by stop	COH IDM, 2021	Bus stop improvements based on METRO Universal Accessibility Project	COH IDM 2021, Figure 10.14	No
Posted Speed	35 MPH	N/A	35 MPH		No
Design Speed					
Min Horizontal Curve Radius					
Maximum Superelevation Rate					
Maximum Grade					
Pavement Type	Asphalt	COH IDM, 2021 TxDOT RDM, 2020	Concrete		
Additional Items as warranted					

*Identify design standard utilized (City of Houston Infrastructure Design Manual, etc)

Major Intersections and Structures		
Intersection/Structure	**Existing**	**Proposed**
Type and Location		
Tallowood Road	Minor Roadway Stop Control	Same as existing
Litchfield Drive	No existing traffic signal control	Install traffic signal
Benignus Drive	Traffic signal control	Improve traffic signal with new ADA compliant wheelchair ramps. Litchfield and Benignus will be connected with one signal controller
Tealwood Drive	Minor Roadway Stop Control	Same as existing
Frostwood Drive	Minor Roadway Stop Control	Same as existing
Beauregard Drive	Minor Roadway Stop Control	Same as existing

Drainage

Drainage Facility					
Feature	Existing	Standard*	Proposed	Justification/ Methodology	Variance Required?
Storm drain LOS (sewer or open ditch)	ATLAS 14 Less than 2-Year	ATLAS 14 2-Year and 100-Year	ATLAS 14 100-Year	COH IDM, 2D Modeling	No
- Minimum flow velocity, pipe	3.57 fps	3 fps	0.11 fps	COH IDM, 2D Modeling	Yes

- Maximum flow velocity, pipe	7.66 fps	12 fps	2.20 fps	COH IDM, 2D Modeling	No
- Maximum flow velocity, outfall	1.14 fps	8 fps	0.99 fps	COH IDM, 2D Modeling	No
- Minimum flow velocity, open ditch	0.04 fps	<1 fps	N/A	COH IDM, 2D Modeling	N/A
- Maximum flow velocity, open ditch	5.45 fps	3 fps	N/A	COH IDM, 2D Modeling	N/A
- Ditch depth	3.3 feet	4 feet max	N/A	COH IDM, 2D Modeling	N/A
- Storm sewer diameter	18-inch to 72-inch	24-inch min	2- 10-foot by 10-foot RCBs	COH IDM, 2D Modeling	No
- Inlet lead diameter	18-inch min	24-inch min	24-inch min	COH IDM, 2D Modeling	No
- Storm sewer inlet type	D, D-1, A	BB min	C-1, A	COH IDM, 2D Modeling	No
2-year ponding elevation, maximum	0.77 feet	0.0 feet	0.55 feet	HPW IDM, 2D Modeling	No
100-year ponding elevation, maximum	1.69 feet	1.5 feet	1.69 feet	COH IDM, 2D Modeling	No, due to backwater from W153-00-00
Mitigation/Detention Volume	1.05 ac-ft	1.78 ac-ft	10.74 ac-ft	COH IDM, 2D Modeling	No
Additional Items as warranted	*Required to add 0.73 ac-ft of additional volume to mitigate increased impervious area. The project is adding an additional 9.7 ac-ft, compared to what is in place today.*				

Water

Water Facilities					
Feature	Existing	Standard*	Proposed	Justification/ Methodology	Variance Required?
Memorial Dr					
Tallowood Rd to Benignus Rd	16-inch	8-inch min	16-inch	From 1995. Keep if possible.	No
Benignus Rd to Tealwood Rd	20-inch	8-inch min	20-inch	Older than useful service life.	No
Tealwood Rd to Frostwood Dr	8-inch	8-inch min	8-inch	Older than useful service life.	No
Frostwood Dr to Bauregard Dr	8-inch	8-inch min	8-inch	At end of useful service life.	No
Baurgard Dr to Tealwood N Dr	8-inch	8-inch min	N/A	From 2019. Keep if possible.	No

Wastewater

Wastewater Facilities					
Feature	Existing	Standard*	Proposed	Justification/ Methodology	Variance Required?
Memorial Dr					
Tallowood Rd to Benignus Rd	48-inch	8-inch min	48-inch	Replace due to conflict with curb inlets.	No
Lateral between Tallowood Rd and Benignus Rd	12-inch	8-inch min	12-inch	Replace due to conflict with RCB	No

Benignus Rd to Paul Revere Drive	21-Inch	8-inch min	21-Inch	From 1989, To remain	
Paul Revere Dr to Tealwood Dr	15-inch	8-inch min	15-inch	1987 & 1989. Assumed older than useful service life.	No
Paul Revere Dr to Tealwood Dr	8-inch	8-inch min	N/A	From 2019. Keep if possible	No
Lateral on Tealwood Dr	8-inch	8-inch min	8-inch	Replace due to conflict with box.	No
Tealwood Dr to Frostwood Dr	15-inch	8-inch min	N/A	From 2002. Keep if possible	No
Frostwood Dr to Tealwood N Dr	15-inch	8-inch min	15-inch	Replace due to conflict with storm sewer	No

4.2 Real Estate/ROW Assessment and Parcel Survey

The intersection of Memorial Drive with Benignus Road does not meet the minimum corner clip.

ROW acquisition may be needed at the northwest corner of the intersection of Memorial Drive with Beauregard Drive. The current schematic is based on parcels, which may not be accurate. Once survey is received, the final determination for ROW acquisition will be made.

4.3 Permits, Commitments, Coordination, and Agreements

Entity	Item	Description
HPW	Permit, Commitment, Coordination, Agreement	• Permits for construction • Coordination and approval of design
TIRZ 17		• Coordination and approval of design • Public engagement process

City of Bunker Hill Village	Coordination	• Coordination with connecting Memorial Drive Project within Bunker Hill Village
TxDOT	Permit, Coordination	• Coordination and approval design if federal funding is acquired. • Will be involved in the public engagement process
METRO	Coordination	• Coordination to accommodate Routes 161 and 162 • Proposed METRO Bus Shelters/Stops
Private Utilities	Coordination	• Coordination will be required throughout design phase

4.4 Timeline and Phasing

Memorial Drive Phase II has a construction period of 15 months. The project would be divided into four phases to always maintain traffic in at least one direction during construction, reduce impacts to adjacent properties, and minimize construction time.

Phase 1 The proposed work would be along the northern side of Memorial Drive. It would involve constructing water line and sanitary sewer improvements. There would also be an enclosed ditch with temporary 24-inch storm sewer. Temporary asphalt will be installed on the existing ditch and where pavement needs to be restored. There will be one 10-foot lane in each direction with a continuous two-way-left-turn-lane to maintain access to private properties and avoid left turning vehicle queues impacting the thru movements.

Phase 2 The proposed work would be along the southern side of Memorial Drive. It would involve constructing water line, storm sewer, and roadway improvements. This would include shifting traffic onto the northern side of Memorial Drive. There will be one 10-foot lane in each direction and a continuous two-way-left-turn-lane on the northern/eastern side of Memorial. This would allow the construction of the proposed eastbound lanes in addition to the installation of the storm sewer boxes.

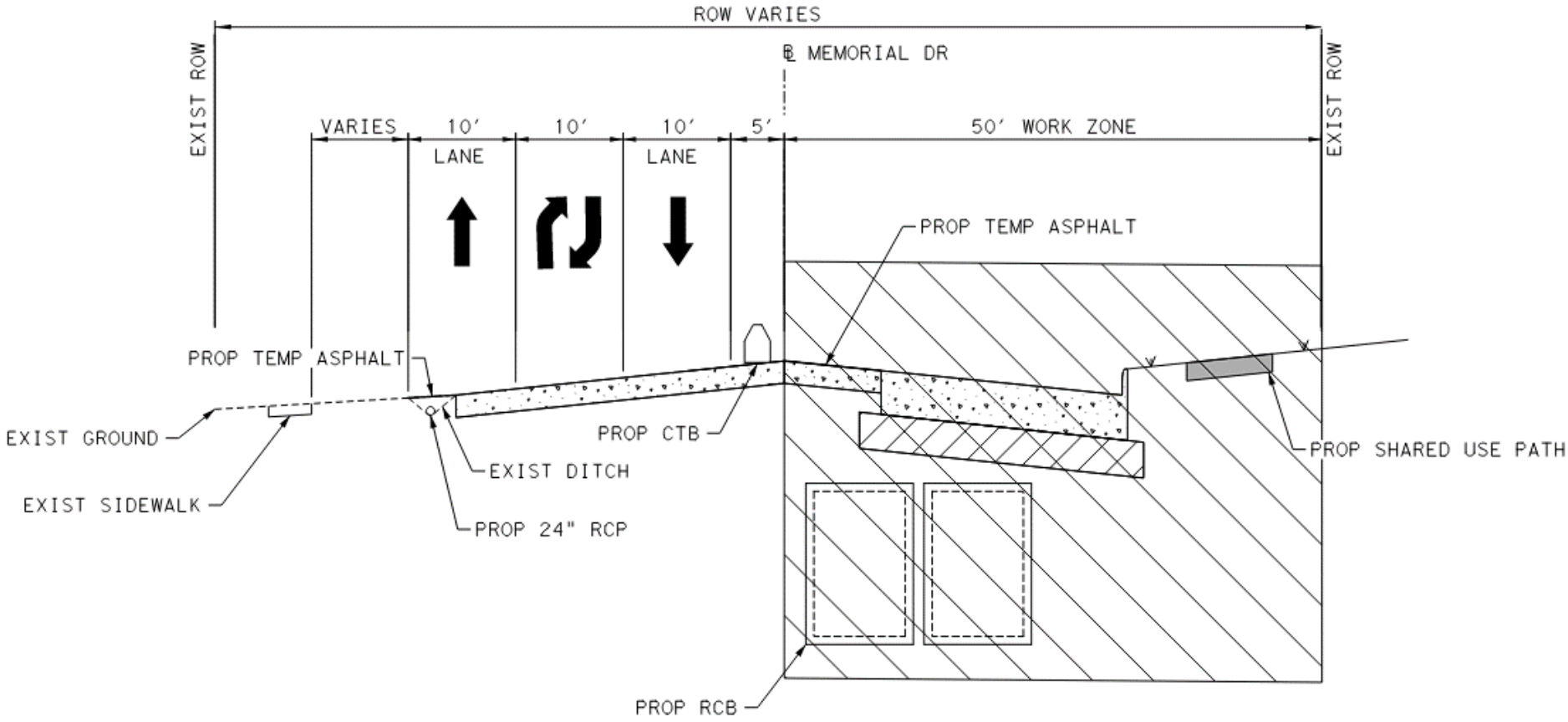


Figure 4.4A: Phase 2 Typical Section

HOUSTON PUBLIC WORKS

Phase 3- The proposed work would be along the northern side of Memorial Drive. It would involve constructing the storm sewer and roadway improvements. This would include shifting traffic to the newly constructed southern side of Memorial Drive with one lane in each direction and a continuous two-way-left-turn-lane.

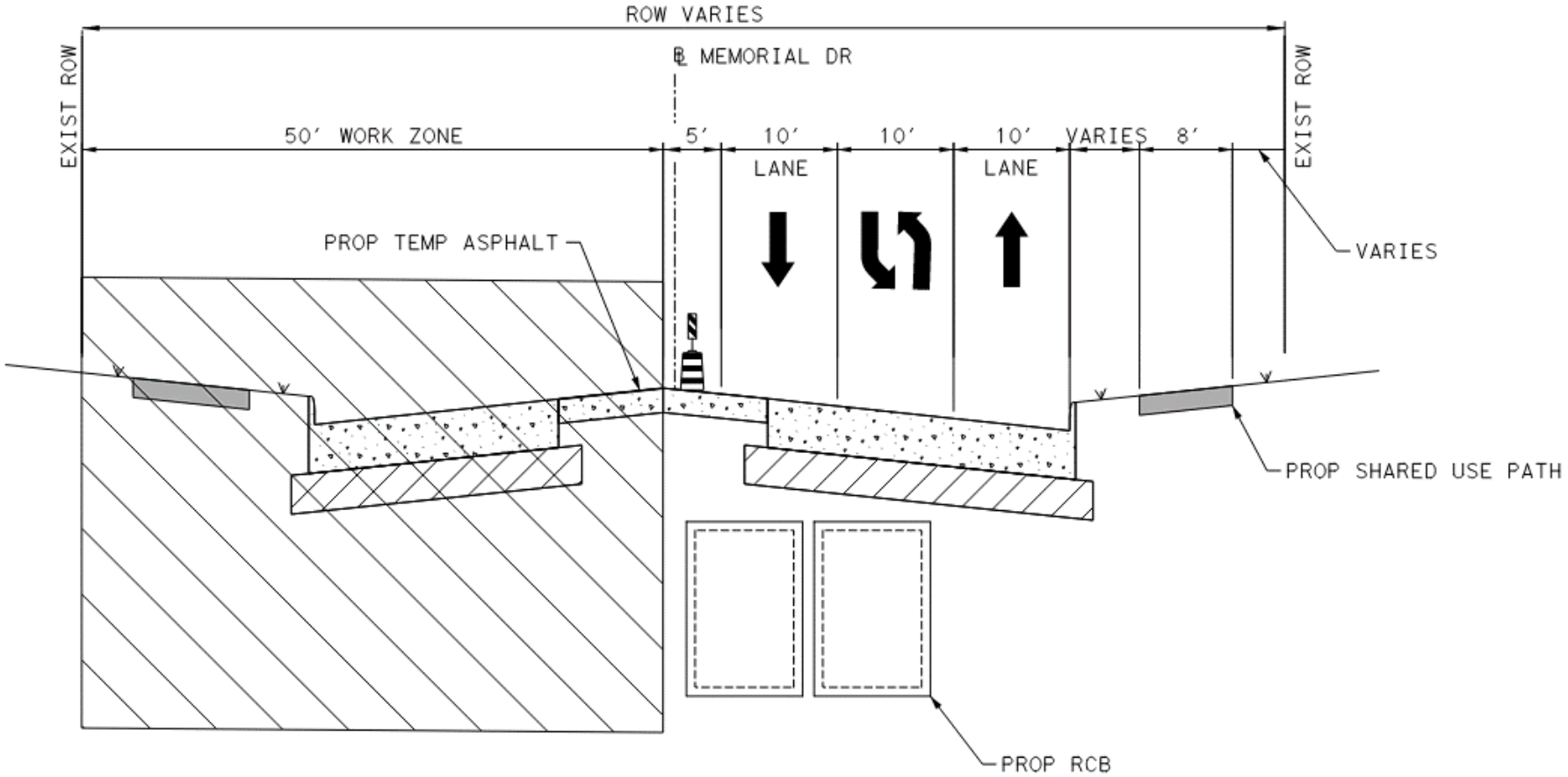


Figure 4.4B: Phase 3 Typical Section

HOUSTON PUBLIC WORKS

Phase 4- The proposed work would be to install medians, traffic signals at Litchfield Lane and Benignus Road, and landscaping.

During detailed design, METRO will be contacted to coordinate traffic control phases with their bus routes and bus stops.

4.5 Cost Estimate

The estimated cost of the improvements is $21M. A detailed estimate of probable construction costs is provided in **Appendix C**.

4.6 Funding

Soft cost will be funded by TIRZ 17.

Construction cost will be funded by TIP grants (80%) and 20% local match will be funded by TIRZ 17.

List of Exhibits

Exhibit Number	Description
Exhibit 4.1A	Proposed Utility Schematic

Proposed Utility Schematic

PROPOSED
UTILITY SCHEMATIC LAYOUT
MEMORIAL DRIVE IMPROVEMENTS
FROM TALLOWOOD RD.
TO FROSTWOOD DR.

TIRZ 17
REDEVELOPMENT
AUTHORITY

0' 10' 20'
SCALE IN FEET

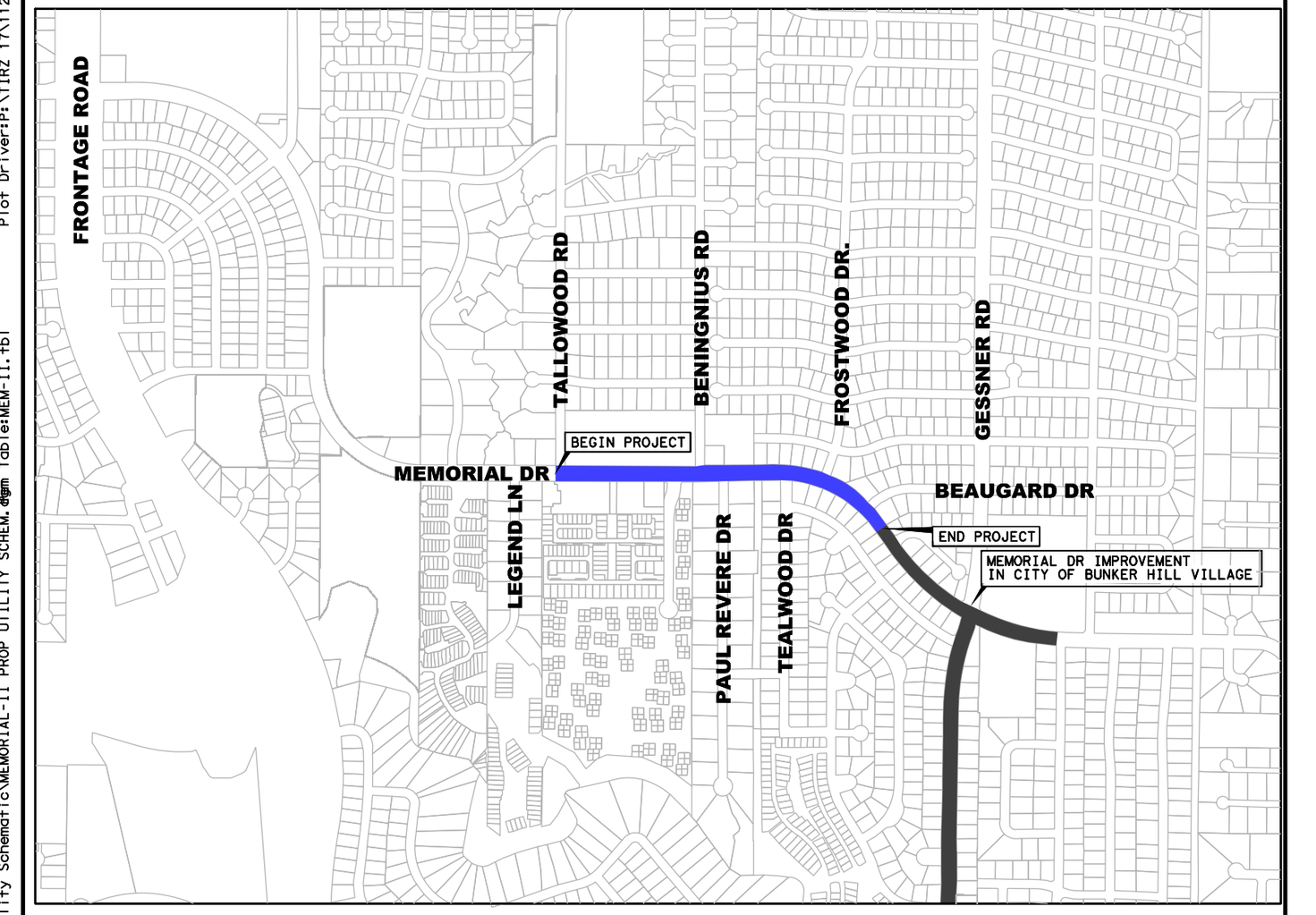
AUGUST 2022

NOT A BIDDING DOCUMENT

Engineer: DAVID G. GREANEY
P.E. Serial No.: 125563
Date: 8/9/2022
Firm Name: GAUGE ENGINEERING
FIRM No. F-20017

PRELIMINARY
SUBJECT TO CHANGE

NOT INTENDED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.



LOCATION MAP

LEGEND

- PROPOSED ALIGNMENT
- PROPOSED CURB
- EXISTING RIGHT-OF-WAY
- EXISTING DRAINAGE
- PROPOSED DRAINAGE
- EXISTING SANITARY
- PROPOSED SANITARY
- EXISTING WATER
- PROPOSED WATER

Gauge ENGINEERING

FIRM # 20017
17500 KATY FREEWAY, SUITE 400
HOUSTON, TX 77079

Memorial Drive and Gessner Road Improvements
Technical Memorandum

Prepared for:

City of Bunker Hill Village

INTERIM REVIEW ONLY
THIS DOCUMENT IS RELEASED FOR
THE PURPOSE OF INTERIM REVIEW
UNDER THE AUTHORITY OF
NAME: Haidar A Baidani, PE
SEAL NO: 141782
FIRM: Gauge Engineering, LLC
FIRM NO: F-20017
DATE: June 16, 2022

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THIS DOCUMENT IS RELEASED FOR
THE PURPOSE OF INTERIM REVIEW
UNDER THE AUTHORITY OF
NAME: Michael R. McClung, PE
SEAL NO: 105080
FIRM: RPS Infrastructure, Inc.
FIRM NO: F-929
DATE: June 16, 2022

Prepared By:

Gauge Engineering, LLC (F-20017)

11750 Katy Freeway, Suite 400 • Houston, TX 77079

June 2022

TABLE OF CONTENTS

APPENDICES

1. Project Authorization

Gauge Engineering, LLC. (Gauge) has been retained by the City of Bunker Hill Village (City) to provide professional engineering services to provide preliminary engineering services in the form of a Technical Memorandum for Memorial Drive and Gessner Road. The project limits include Memorial Drive from Tealwood North Drive to Warrenton Drive and Gessner Road at the intersection of Memorial Drive south to the limits of City of Bunker Hill Village.

This project meets City of Bunker Hill delivery method and will be implemented in three phases:

- Preliminary Engineering Phase – Technical Memorandum
- Design & Bid Phase
- Construction Phase

2. Project Introduction and Background

The existing pavement for both corridors, Memorial Drive and Gessner Road have deteriorated and are in poor condition. Several years ago, TIRZ 17/Memorial City Redevelopment Authority (City of Houston entity) pursued federal money and was awarded approximately $13.7 million in Surface Transportation – Mobility funding for the reconstruction of Memorial Drive from Beltway 8 to Tallowood Road. This segment of Memorial Drive is currently under construction and is over 80% completed.

Both, the City and TIRZ 17 are interested in building on TIRZ 17's current Memorial Drive project and further extending the roadway and drainage improvements. To achieve this, the City and TIRZ 17 plan to jointly pursue additional funding in the upcoming Houston-Galveston Area Council (H-GAC) Call for Projects for a complementary project via a new grant application for the reconstruction of Memorial Drive as described below.

- For TIRZ 17, the reconstruction limits of Memorial Drive are within the City of Houston and TIRZ 17 boundaries, from Tallowood Road to just west of Tealwood North Drive, approximately 2,320 linear feet. The project will integrate with the ongoing construction work on the west and will include full roadway and drainage reconstruction, in addition to wide sidewalks to accommodate pedestrian and bicycle facilities, utility upgrades, signalization, and landscaping.
- For the City, the reconstruction limits of Memorial Drive are within the City's boundaries, from just west of Tealwood North Drive to just east of Warrenton Drive, approximately 1,370 linear feet including the intersection of Gessner Road. The project will integrate with the proposed TIRZ 17 segment and will include full roadway and drainage reconstruction, in addition to wide sidewalks to accommodate pedestrian and bicycle facilities, utility upgrades, signalization, and landscaping. Other improvements within the Bunker Hill limits include:
    - The reconstruction of the northbound lanes of Gessner between Memorial Drive and the southern City limits (to include additional storm water conveyance), approximately 1,830 linear feet.
    - The construction of sidewalks along both sides of Gessner between Memorial Drive and the southern City limits to improve safe school access to Frostwood Elementary School and promote a pedestrian friendly environment.

3. Project Location

The project limits for Memorial Drive are from City of Bunker Hill Village western limits to the Warrenton Drive, and on Gessner Road from City of Bunker Hill Village southwestern limits to Memorial Dr/Gessner Rd intersection. The project is in west portion of the city, just east of Sam Houston Tollway. See *Figure 1* Project Location & Vicinity Map for more information.

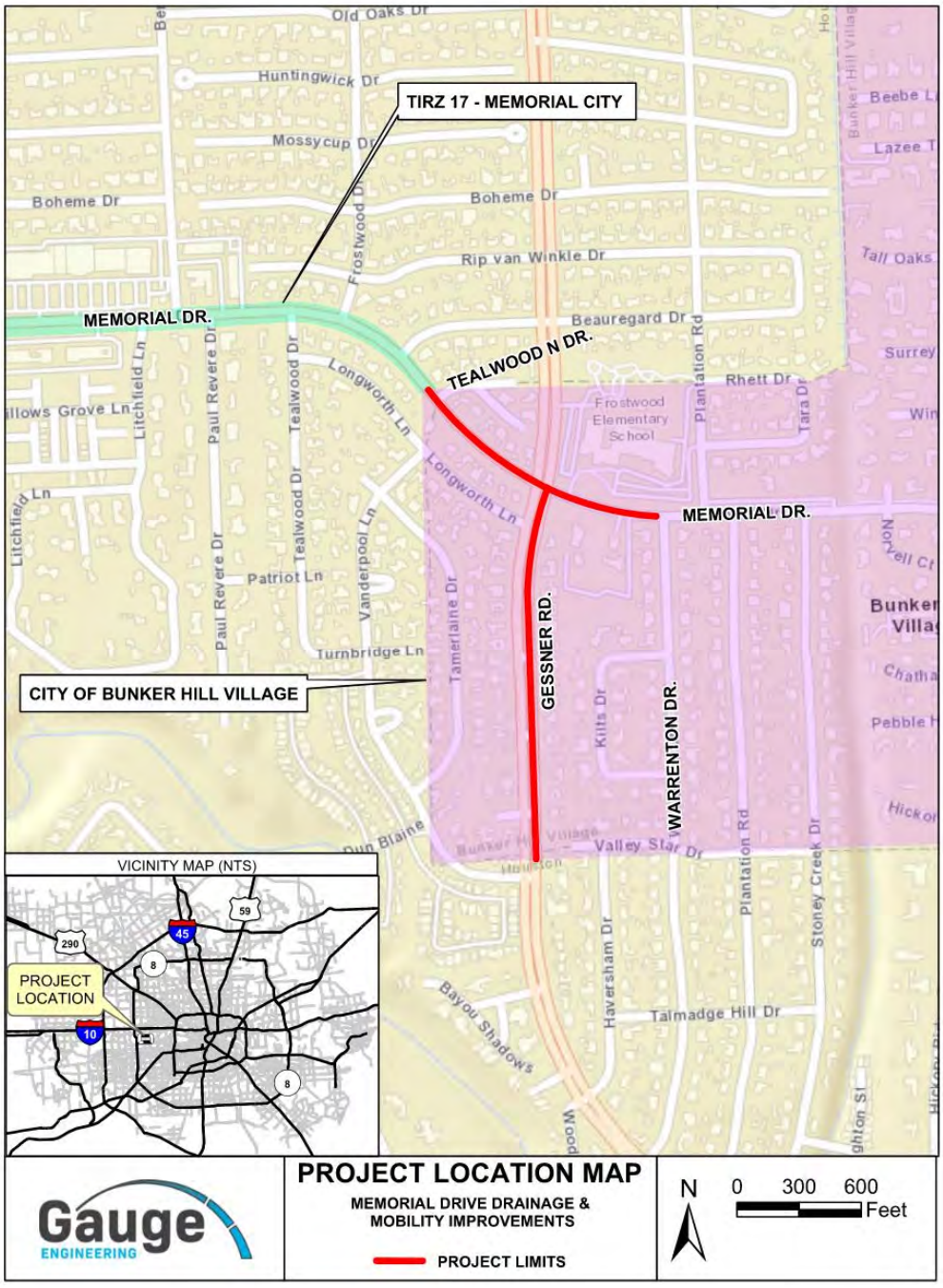


Figure 1: Project Location & Vicinity Map

4. Objectives

The objective of this project is to build on the current ongoing construction work between Beltway 8 Frontage Road and Tallowood Road to create a cohesive corridor for automobiles, transit, pedestrians, and cyclists. Combining both the City and TIRZ 17 segments into a single project and application will provide the best opportunity to compete for discretionary funding opportunities. Specific objectives of the project include:

4.1 Improve Mobility & Safety

- Fully reconstruct Memorial Drive to convert it from an asphalt roadway with roadside ditches and grate inlets to a curb and gutter roadway with sidewalks.
- Reconstruct the northbound lanes of Gessner Road

4.2 Improve Drainage

- Improve the drainage by replacing the existing storm sewer with new upgraded storm sewer system.

4.3 Improve Pedestrian Safety

- Promote a pedestrian-friendly environment by incorporating continuous, uninterrupted continuous wide sidewalks with ADA compliant curb ramps.

5. Scope of Work

The project scope includes the following tasks: address the engineering components associated with roadway reconstruction, perform an initial existing conditions assessment, evaluate, and develop recommended solutions for improving the roadway, drainage, and utilities along the project limits.

A summary of the major tasks performed for the study are listed below:

- Site Visits and Data Collection
- Review Record Drawings
- Conceptual Construction Sequencing, Detours, and Impacts.
- Private/Public Utilities Assessment
- Develop Existing and Proposed Roadway Sections
- Develop Proposed Preliminary Roadway Schematic
- Prepare Opinion of Probable Construction Cost (OPCC)

Upon completion of this Study and approval of the recommended project by the City of Bunker Hill Village and securing federal money to build the project, the design phase may commence. The design phase of the project will provide the engineering services required to provide the necessary construction documents for the approved improvements of Memorial Drive and Gessner Road based on recommendations in this study.

Since there is an opportunity to receive federal funding, the design criteria will be in accordance with the Texas Department of Transportation Roadway Design Manual (RDM) primarily. However, some of the criteria absent in the RDM are taken from the City of Houston Infrastructure Design Manual (IDM).

6. Existing Conditions

A thorough existing conditions assessment was conducted to better understand the characteristics of Memorial Drive and segments of Gessner Road. Aerial information, field investigations, record drawings, information from GIMS available on the City of Houston's and City of Bunker Hill websites and correspondences with private utility companies were used to evaluate the existing conditions.

6.1 Roadway

Memorial Drive is an undivided 4-lane asphalt open ditch roadway with 11-ft to 12-ft travel lanes with a 10-ft to 11-ft auxiliary right turn lane of approx. 250 ft of length. Memorial Drive has storm inlets on both sides with no curb and gutter. There is an existing 4-ft wide sidewalk along the eastbound side of Memorial Drive within the project limits. Memorial Drive is classified as major thoroughfare according to 2021 major thoroughfare and freeway plan (MTFP) and classified as minor arterial according to 2021 TxDOT functional classification.

Gessner Road is a divided 4-lane jointed reinforced concrete pavement JRCP with 12-ft travel lanes, 12-ft left turn bay and a raised 20-ft to 32-ft median. Gessner Road is classified as major thoroughfare according to 2021 major thoroughfare and freeway plan (MTFP) and classified as principal arterial according to 2021 TxDOT functional classification.

The existing right-of-way is 80-ft to 100-ft wide for Memorial Drive and 100-ft for Gessner Road. See *Figures 2, 3 and 4* for existing typical sections.

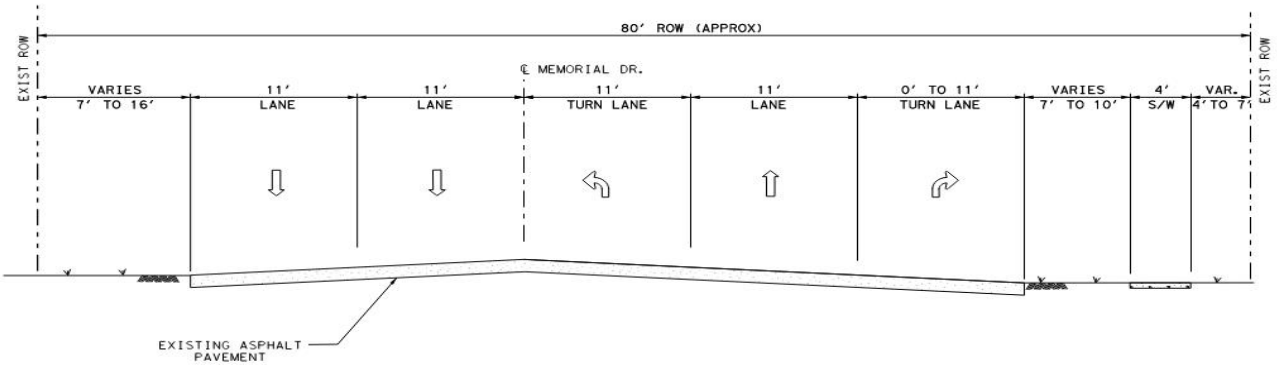


Figure 2: Existing Typical Section of Memorial Drive (West)

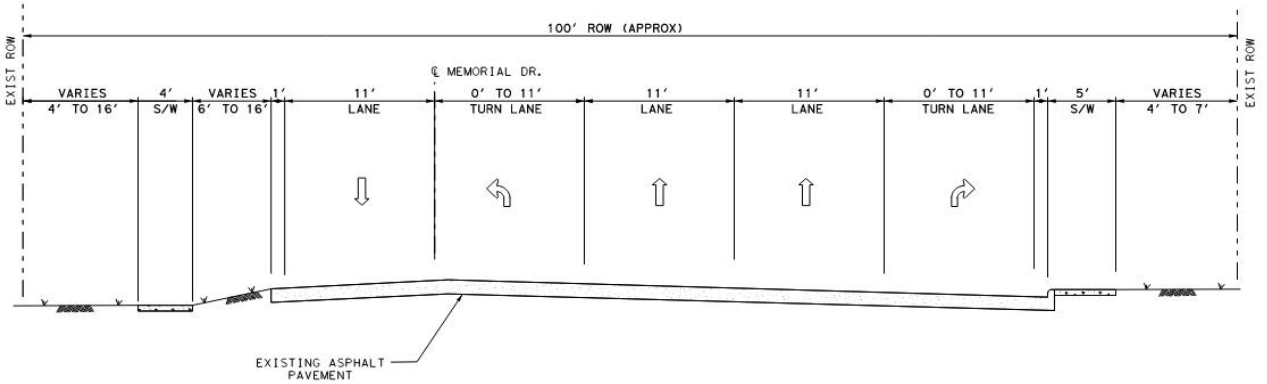


Figure 3: Existing Typical Section of Memorial Drive (East)

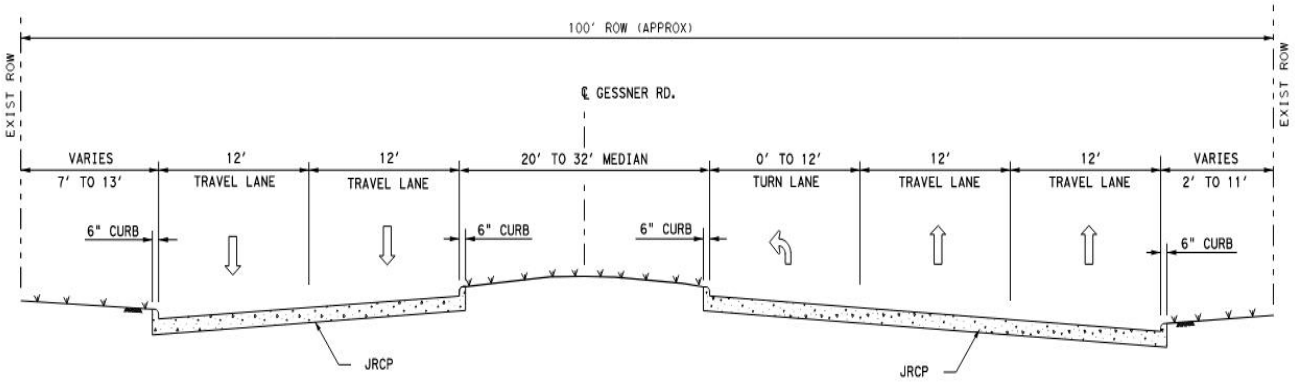


Figure 4: Existing Typical Section of Gessner Road

Figure 5: Memorial Drive West (Eastbound)

Figure 6: Memorial Drive West (Westbound)

Figure 7: Memorial Drive East (Eastbound)

Figure 8: Memorial Drive East (Westbound)

Figure 9: Gessner Road (Southbound)

Figure 10: Gessner Road (Northbound)

Figure 11: Intersection (Looking from Southwest Corner)

Figure 12: Intersection (Looking from Southeast Corner)

6.2 Sidewalk and Ramps

There is a continuous existing 4-ft wide sidewalk along the eastbound side of Memorial Drive west leg within the project limits. Also, continuous 4-ft to 5-ft sidewalks extend along both sides of Memorial Drive east leg. Short stretches of 4-ft sidewalks exist on both ends of the southbound side of Gessner Road and from the bus stop on the northbound side to Memorial Drive. They are in fair to good condition but narrow, inadequate, and not City compliant. Non-ADA compliant Wheelchair ramps are present at all intersection corners. See *Figures 13 to 16*.

6.3 Land Use

Adjacent land use is single family residential. In addition, the adjacent land use at the northwest side of Memorial Dr/Gessner Rd intersection is public (Frostwood Elementary School).


Figure 13. Existing Sidewalk Along the Eastbound of West Memorial Drive


Figure 14. Existing Sidewalk Along the Southbound Side of Gessner Road


Figure 15. Existing Sidewalk Along the Eastbound of East Memorial Drive


Figure 16. Existing Sidewalk Along the Southbound Side of Gessner Road

6.4 Existing Transit

Four METRO routes are currently present along segments. The METRO 161 Wilcrest Express and the 162 Memorial Express routes overlap in the area. The 161 connects downtown Houston to West Bellfort Park and Ride with a run every 30 minutes. The 162 route connects downtown Houston and the Addicks Park and Ride and runs hourly.

46 Gessner route connects Hempstead Hwy at NW Houston and Airport Blvd at SW Houston with a run every 15 minutes. 70 Memorial route connects HCC Spring Branch Campus and Northwest Transit Center at IH-10/W Loop N Fwy and runs hourly. 6 METRO stops are present at and nearby Memorial/Gessner intersection. *See Figure 17.*

6.5 Existing Traffic Characteristics

Existing speed limits are 35 mph. There is a span wire traffic signal within the project limits. The traffic signal is located at the intersection of Memorial Drive and Gessner Road.

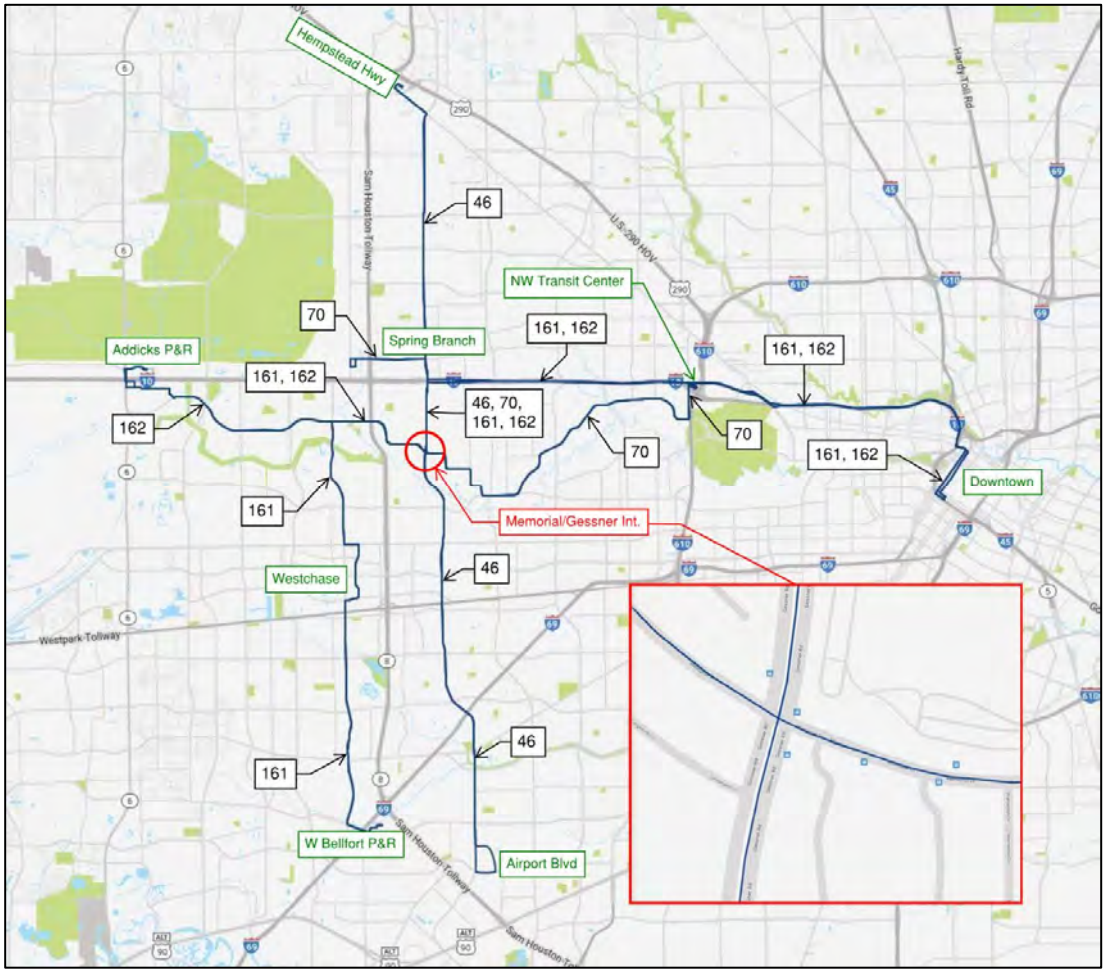


Figure 17. Existing METRO routes through Memorial/Gessner intersection

6.6 Drainage

This project resides within the Buffalo Bayou watershed and is drained by storm grate and curb inlets. RPS Infrastructure conducted a drainage analysis to size the trunklines and the proposed conditions.

Table 1 summarizes all the storm sewer lines within the project limits:

Table 1. Storm Sewer Lines

Road	From	To	Size	Material	Location	Plan #	In Service, Rehab Date
Gessner Rd	City's southwest limits	Memorial Dr	72-in X 84-in	Concrete	Along the southbound of Gessner Rd	P36986	2004

6.7 Existing Public & Private Utilities:

Based on GIMS and record drawings, the existing public and private utilities within the project limits are listed below:

Memorial Drive:

- Water Line (6-inch non-rehabilitated polyvinyl chloride pipe "PVC"): runs along the southern ROW of Memorial Drive; between Tealwood North and just west of Warrenton Drive.
- Sanitary sewer gravity line (8-inch rehabilitated polyethylene pipe "PEP"): runs approximately 100 feet from Tealwood North on the southern ROW of Memorial Drive.
- Sanitary sewer gravity line (8-inch cured in place pipe "CIPP"): runs along the southern ROW of Memorial Drive; from rehabilitated polyethylene pipe "PEP" to east of Gessner Road.

Gessner Road:

- Water Line (6-inch non-rehabilitated polyvinyl chloride pipe "PVC"): runs along the eastern ROW of Gessner Road; between southwestern limits of Bunker Hill Village and southern side of Memorial at Memorial/Gessner intersection
- Sanitary sewer gravity line (8-inch cured in place pipe "CIPP"): runs along the back of residences just east of Gessner Road; between southwestern limits of Bunker Hill Village and southern side of Memorial at Memorial/Gessner intersection.

Table 2 summarizes the water lines within the project limits:

Table 2. Water Lines

Road	From	To	Size	Material	Location	Plan #	Planned Date/In Service
Memorial Dr	Tealwood North	East of Gessner Rd	6-in	PVC	Along S ROW of Memorial Dr	N/A	N/A
Memorial Dr	City's southwest limits	Memorial Dr	6-in	PVC	Along E ROW of Gessner Rd	N/A	N/A

Table 3 summarizes all the sanitary sewer lines within the project limits:

Table 3. Sanitary Sewer Lines

Road	From	To	Size	Material	Location	Plan #	In Service, Rehab Date
Memorial	Tealwood North	Approx. 100' from Tealwood North	8-in	PVC	Along the S ROW of Memorial Dr	N/A	N/A
Memorial	Approx. 100' from Tealwood North	E of Gessner Rd	8-in	Cured in Place	Along the S ROW of Memorial Dr	N/A	N/A
Gessner	City's southwest limits	Memorial Dr	8-in	Cured in Place	Along back of residences outside E ROW	N/A	N/A

Private Utilities:

- Private utility companies provide services including electrical, gas, internet, and telephone along Memorial Drive. These utilities may require adjustment due to conflicts with the proposed utility improvements. Coordination with these companies would be conducted to obtain utility drawings of the existing facilities along this project. Utility coordination would occur during the design phase of this project.

    - On both sides of Memorial Drive and Gessner Road near the right-of-way line, CenterPoint Energy has underground gas lines.
    - On eastbound side of Memorial Drive, there are five poles for overhead distribution and transmission electrical lines.
    - Streetlights are only on eastbound side of Memorial Drive and are mounted on existing electrical wooden poles. Light poles were observed on both sides of Gessner Road, 3 light poles on southbound and 4 light poles on northbound side.
    - Southwestern Bell Company (SBC or AT&T) has underground fiber optic cables on the westbound side of Memorial Drive.
    - At each corner of Memorial/Gessner intersection, there is one traffic signal pole with cables and traffic light mounted for each traffic movement. On the southwest corner, three existing buried boxes for the purpose of traffic signaling were observed as well as one on-ground cabinet for the same purpose. Additionally, one separate pole with no-right-turn symbol light was observed at the westbound side of Memorial Drive.

7. Assessment and Recommendations

7.1 Design Criteria

The following publications were referenced for determining key design criteria in developing improvement alternatives for Memorial Drive & Gessner Road:

- American Association of State Highway and Transportation Officials (AASHTO): AASHTO Guide for Design of Pavement Structures.
- American Association of State Highway and Transportation Officials (AASHTO): A Policy on Geometric Design of Highways and Streets, 2018 (Green Book).
- Texas Department of Transportation Roadway Design Manual, May 2022
- Texas Manual on Uniform Traffic Control Devices, 2011.
- City of Bunker Hill Village Drainage Criteria Manual 2016

7.2 Recommended Roadway Improvements

The project includes reconstructing Memorial Drive (Approx. 1,370 LF) and Gessner Northbound lanes (Approx. 1,830 LF). Based on the information obtained, analysis, and assessment of the existing conditions, the recommended project involves full reconstruction of roadway, sidewalks, storm sewer, and utility relocations. Refer to **Appendix B** for proposed roadway schematic.

Full roadway reconstruction is comprised of the following improvements:

West Memorial Drive:

- Convert from asphalt roadway with grate inlets to a 4-lane two-way concrete curb and gutter roadway separated by 3-ft wide stamped median, with an auxiliary right turn lane. Construct 6-ft to 8-ft wide sidewalks along both sides of the roadway.

East Memorial Drive:

- Convert from asphalt roadway with grate inlets to a concrete curb and gutter separated by 3-ft to 14-ft median, with auxiliary left and right turn lanes. Construct 6-ft to 8-ft wide sidewalks along both sides of the roadway. Note that existing travel lane configuration to remain with no changes.

Gessner Road:

- Reconstruct northbound lanes of Gessner Road. Construct 6-ft wide sidewalks along southbound side. No change on lane configuration.

The proposed typical sections and lane configuration vary along the corridor limits as follows:

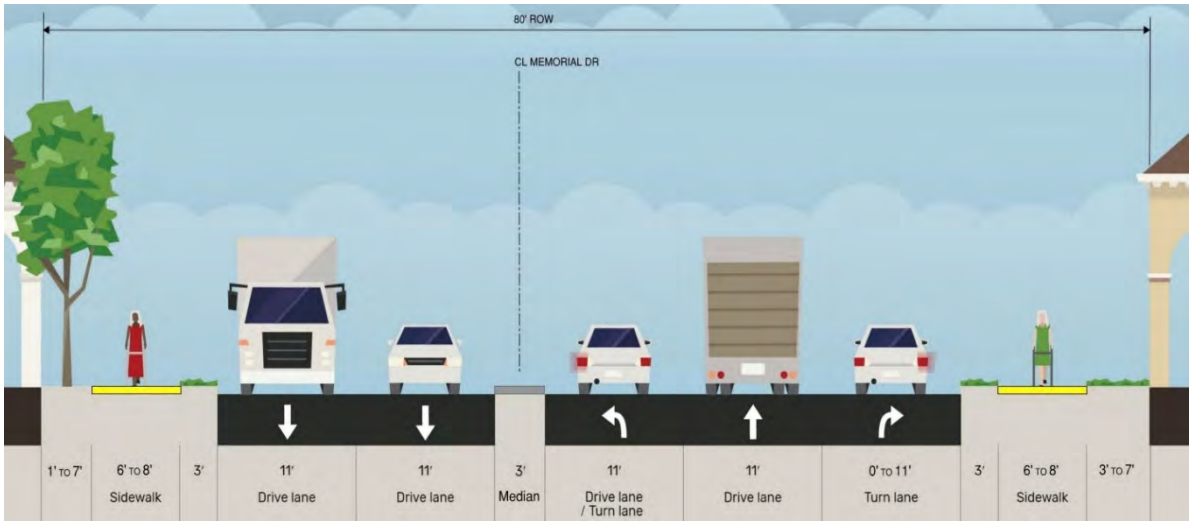


Figure 18: Proposed Typical Section – West Memorial Drive (Tealwood North to Gessner Rd)

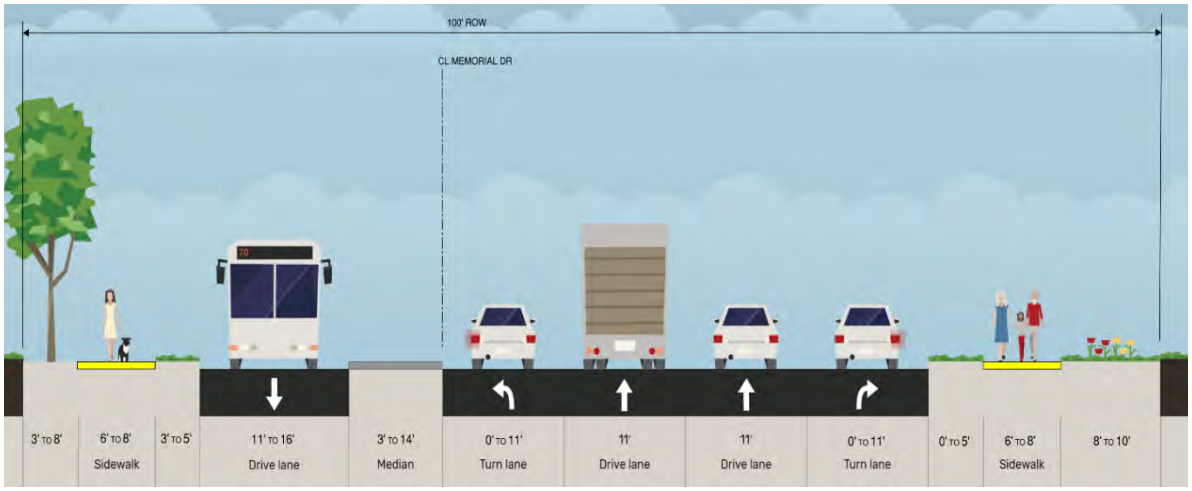


Figure 19: Proposed Typical Section – East Memorial Drive (Gessner Rd to Warrenton Dr)

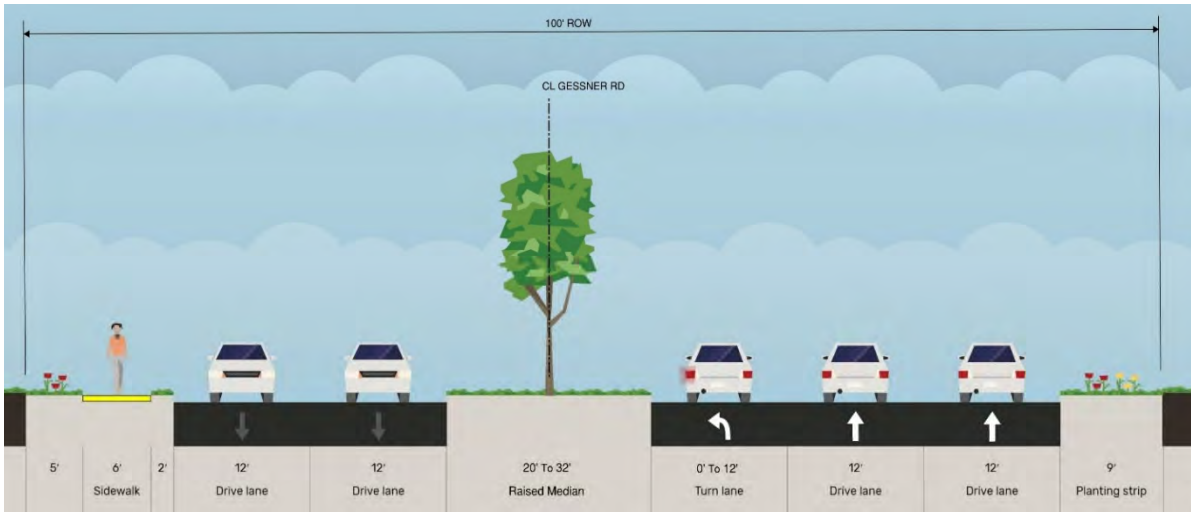


Figure 20: Proposed Typical Section – Gessner Road (City's southwest limits to Memorial Dr)

7.3 Recommended Drainage Improvements

According to the City of Bunker Hill Village Drainage Criteria Manual (DCM), the storm sewer system shall be designed to convey the 10-yr storm event. Drainage areas were created (**Appendix C**), and the rational method was utilized for the calculation of peak flows. The time of concentration and rainfall intensities were based on Chapter 9 of City of Houston Infrastructure Design Manual. Rational method runoff coefficients were based on the City of Bunker Hill Village DCM.
The 10-yr peak flow was compared with the existing storm sewer capacity and storm sewer upsizing was recommended where the 10-yr peak flow exceeds the existing storm sewer capacity (Table 4).

Table 4. Memorial System Drainage Calculations

Storm Sewer Project	10-yr Peak Flow (cfs)	Existing Size	Existing Storm Sewer Capacity (cfs)	Proposed Size	Proposed Storm Sewer Capacity (cfs)	Length (ft)
West Memorial (DA-01)	8	24”	16	24”	16	850
East Memorial (DA-02)	45	24”	16	36”	47	550

No drainage calculations were needed for the Gessner system. The existing storm sewers have enough capacity to convey the 10-yr peak flow from the proposed Gessner Rd system. No storm sewer replacement is proposed on Gessner except the leads to connect the new inlets to the existing box culverts. The existing Gessner system storm sewer sizes are shown in Table 5 and **Appendix C**.

Table 5. Existing Gessner System Storm Sewers

Storm Sewer Project	Size	Length (ft)
Gessner	7’x6’	1500’
Gessner	8’x6’	200’

7.4 Bike Plan Map

The Houston Bike Plan Map classifies Memorial Drive as a future off-street bike route up to City of Bunker Hill western limits as part of the Long-Term Houston Bikeway Vision. On the other side, City of Bunker Hill has an existing off-street bikeway that is located off this project area limits at Plantation Road on the westbound side of East Memorial Drive. With the challenging limited right-of-way, the recommended typical section for Memorial Drive incorporates 6 to 8-ft sidewalks in an attempt to accommodate bicyclists traversing the TIRZ 17 Memorial Drive 8-ft sidewalk.

7.5 Driveways and Pedestrian Facilities

All driveways along the project alignment will be removed and replaced with City standard concrete driveways. At some locations, the existing driveways may be replaced beyond the ROW limits to provide a smooth transition and mitigate drainage impacts resulting from the change in grade. The final removal limits of the driveways will be determined during detailed design.

Pedestrian facilities will be added to meet ADA requirements along the entire project limits. The sidewalks will be 6-ft to 8-ft wide on both sides of Memorial Drive from Tealwood North Drive to Warrenton Drive and 6-ft wide on Gessner Road from City's southwestern limits to Memorial Drive along both sides of the road. The goal is to achieve consistent 8' sidewalks throughout Memorial Drive corridor as a continuation of the work proposed on TIRZ 17 COH limits. However, at certain locations, sidewalk width must be reduced to 6-ft.

7.6 Traffic Signals

The existing traffic signal will be replaced and upgraded from span wire to black finish mast arm with mounted lights.

7.7 Right-of-Way Acquisition

15'x15' corner clips at southeast and southwest corners may be required to accommodate the proposed roadway geometric requirements at the intersection of Memorial Drive and Gessner Road. Right-of-Way acquirement or easement may be necessary to accommodate proposed sidewalk along the northbound side of Gessner Road. A probable encroachment at the eastbound ROW of Memorial Drive. If so, a list of properties encroaching into the City ROW will be prepared during detailed design when the survey is available to identify exact limits.

7.8 Conceptual Construction Sequencing, Detours, and Impacts to Area

During construction, the project will be built in 3 phases to maintain two-way traffic at all times on Memorial Drive and Gessner Road. The corridors will be reduced to two lanes of two-way traffic to allow for the work zone to be on the other side of the road. See below breakdown and Figure 21 for construction sequencing.

Phase 1 Work Zone:

- Two consecutive construction steps would construct storm sewer, roadway, and miscellaneous improvements on Memorial Drive.

Phase 2 Work Zone:

- Two consecutive construction steps would construct storm sewer, roadway, and miscellaneous improvements on Gessner Road.

Phase 3 Work Zone:

- Four consecutive construction steps would construct storm sewer, roadway, and miscellaneous improvements on Memorial/Gessner intersection.

The following tools and techniques would be used during construction to reduce impacts to traffic flow:

- High early strength concrete pavement
- Temporary asphalt pavement
- Temporary signs

- Low-profile concrete barrier
- Temporary detours for through traffic
- Night work (if needed)
- Short term closures.

Figure 21: Construction Sequencing

7.9 Landscaping and Existing Trees

Based on field visits, there are few mature trees along the project. Depending on the extent of their root systems, the trees may be impacted by construction. A more detailed report, landscaping plans, and tree protection plans will be included in the detailed design.

The extent of Landscaping amenities will be evaluated with City of Bunker Hill during detailed design.

7.10 Street Lighting

Besides existing street light poles, entire project corridor will require an additional 26 standard cobra style CenterPoint light fixtures. New installations will be spaced 200-ft apart with ±10% spacing variance due to tree, driveways, etc. on pair positions along project corridor.

7.11 Geotechnical Study

No geotechnical Study was prepared as part of this memorandum. A geotechnical investigation report will be prepared during the design phase.

7.12 Environmental Site Assessment

No Environmental Site Assessment Study was prepared as part of this memorandum. An Environmental Site Assessment will be prepared during the design phase.

8. TRAFFIC ANALYSIS AND RECOMMENDATIONS

In 2017, a traffic analysis was conducted by Kimley-Horn to evaluate the roadway improvements that was previously studied by RPS. For this study, the roadway schematic recommendations will be consistent with the traffic analysis results from the previously conducted study by Kimley-Horn. The traffic study may potentially need to be updated during the detail design phase.

9. PUBLIC AND PRIVATE UTILITIES ASSESSMENT AND RECOMMENDATIONS

9.1 Regulatory Agencies

The design of the proposed water lines will comply with the Texas Commission on Environmental Quality criteria. In all cases where the water lines parallel or cross sanitary sewer lines, appropriate separation will be maintained, or required protection will be provided.

9.2 Recommended Public and Private Utility Improvements

Information on existing water and sanitary sewer lines within the project limits were obtained from City of Bunker Hill Village's city maps, record drawings and the City of Houston Geographic Information & Management System (GIMS). See **Appendix D** for existing public utilities along the project Limits.

Coordination with private utility companies will take place during the design in an effort to have the private utility companies upgrade the utility poles/facilities in conjunction with the full roadway reconstruction. The following sections summarizes the recommendations:

Water Line Improvements:

- It is recommended to remove these 6-inch non-rehabilitated water lines due to age and the material of the water lines and replace with new 8-inch PVC pipes.

Sanitary Sewer Improvements:

- The existing sanitary sewer line on Gessner Road appears to be outside the project limits based on City of Houston GIMS and it may not be necessary to be replaced.
- The existing sanitary sewer line on Memorial was cured in place. It is recommended to remove 8-inch non-rehabilitated cured in place pipes (CIPP); from Tealwood North Drive to Gessner Road and one lateral pipe and replace with new 8-inch PVC pipes.

- CCTV may be conducted for all sanitary sewers at the onset of the detailed design phase to evaluate the current condition of the pipes.

Private Utility Improvements:

- Exact locations of private utilities will be determined during the design phase when a full topographic survey is conducted.

10. PUBLIC ENGAGEMENT AND AGENCY COORDINATION

A public meeting will be conducted in coordination with the City and TIRZ 17 to solicit input from the local stakeholders and the residents on the typical sections and the proposed improvements. Their comments will be collected and addressed as part of the public engagement process.
Contact with different entities will be required throughout the final design phase of the project. Coordination meetings will be scheduled with the City of Bunker Hill and the Texas Department of Transportation as needed to coordinate design. Drawings at different milestones will be submitted to the City of Bunker Hill and Texas Department of Transportation for review and approval. Early coordination with private utility entities will also be conducted in design.

11. OPINION OF PROBABLE CONSTRUCTION COST (OPCC)

The estimated construction cost of the recommended improvements is as follows on table 6:

General	$ 592,000
Demolition	$ 186,547
Traffic Control	$ 200,000
Roadway	$ 1,662,230
Signing & Pavement Markings	$ 17,500
Drainage	$ 381,550
SWPPP	$ 15,000
Water Line	$ 360,400
Traffic Signal	$ 300,000
Illumination	$ 54,730
Landscaping	$ 35,195
Subtotal	$ 3,919,153
30% Contingency	$ 1,175,746
Approximate Grand Total	**$ 5,094,899**

Table 6: Construction Cost Estimate

The detailed preliminary estimated construction cost can be found in **Appendix A**.

12. CONCLUSION

Based on the results from the preliminary roadway geometric evaluation and condition assessment, traffic analysis, drainage analysis, and utility assessments and to satisfy the three main project objectives: Improve Safety and Mobility, Improve Drainage, and Quality of Life, the following improvements are recommended:

12.1 Improve Mobility & Safety

- Complete reconstruction of Memorial Drive including conversion from an asphalt road with grate inlets drainage to a curb and gutter concrete road.
- Reconstruct northbound side of Gessner Road.
- Reconstruct roadway to meet Texas Department of Transportation current roadway geometric requirements.

12.2 Improve Pedestrian Safety

- On Memorial Drive, open drainage with grate inlets and sidewalks makes it difficult and unsafe for pedestrians to walk.
- Promote a pedestrian-friendly environment with continuous 6-foot-wide sidewalks on Gessner Road and 6-ft to 8-ft wide sidewalks on Memorial Drive with ADA compliant curb ramps.
- Protect pedestrians on the sidewalk by adding curb and gutter at the edge of the travel lane and creating a buffer for a clear zone and/or guard fencing.

The total preliminary estimated construction cost for project, including a 30% contingency, is approximately **$5.1 M**. These costs do not include any landscaping, right-of-way acquisition or private utility relocation costs. The detailed preliminary estimated construction costs can be found in **Appendix A.**

Appendix B

PROPOSED SCHEMATIC LAYOUT MEMORIAL DRIVE (FROM TEALWOOD NORTH DR. TO WARRENTON DR.) GESSNER ROAD (FROM CITY OF BUNKER HIL/CITY OF HOUSTON LIMITS TO MEMORIAL DRIVE)

City of Bunker Hill Village
Est. 1954

0' 25' 50'
SCALE IN FEET

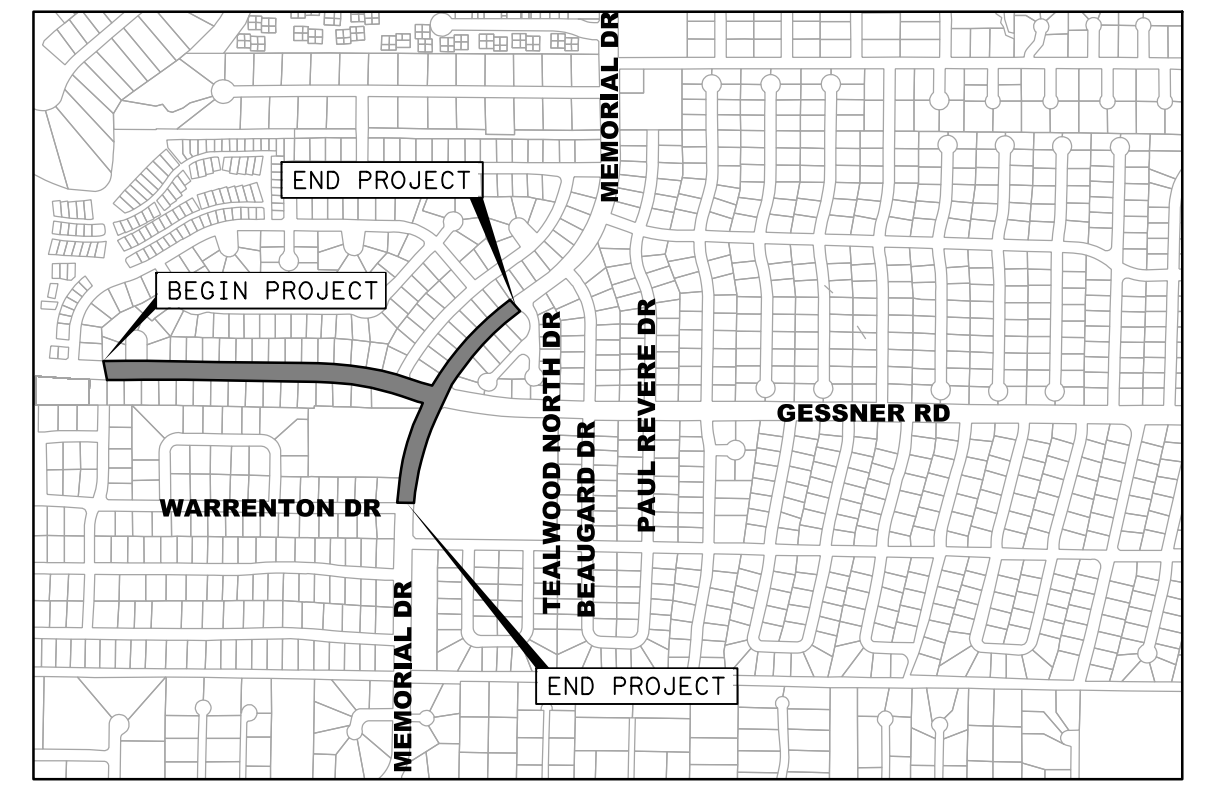
APRIL 2022

NOT A BIDDING DOCUMENT

Engineer:	HAIDAR A. BAIDANI
P.E. Serial No.:	141782
Date:	4/15/2022
Firm Name:	GAUGE ENGINEERING
FIRM No.	F-20017

PRELIMINARY
SUBJECT TO CHANGE

NOT INTENDED FOR CONSTRUCTION, BIDDING, OR PERMIT PURPOSES.



VICINITY MAP

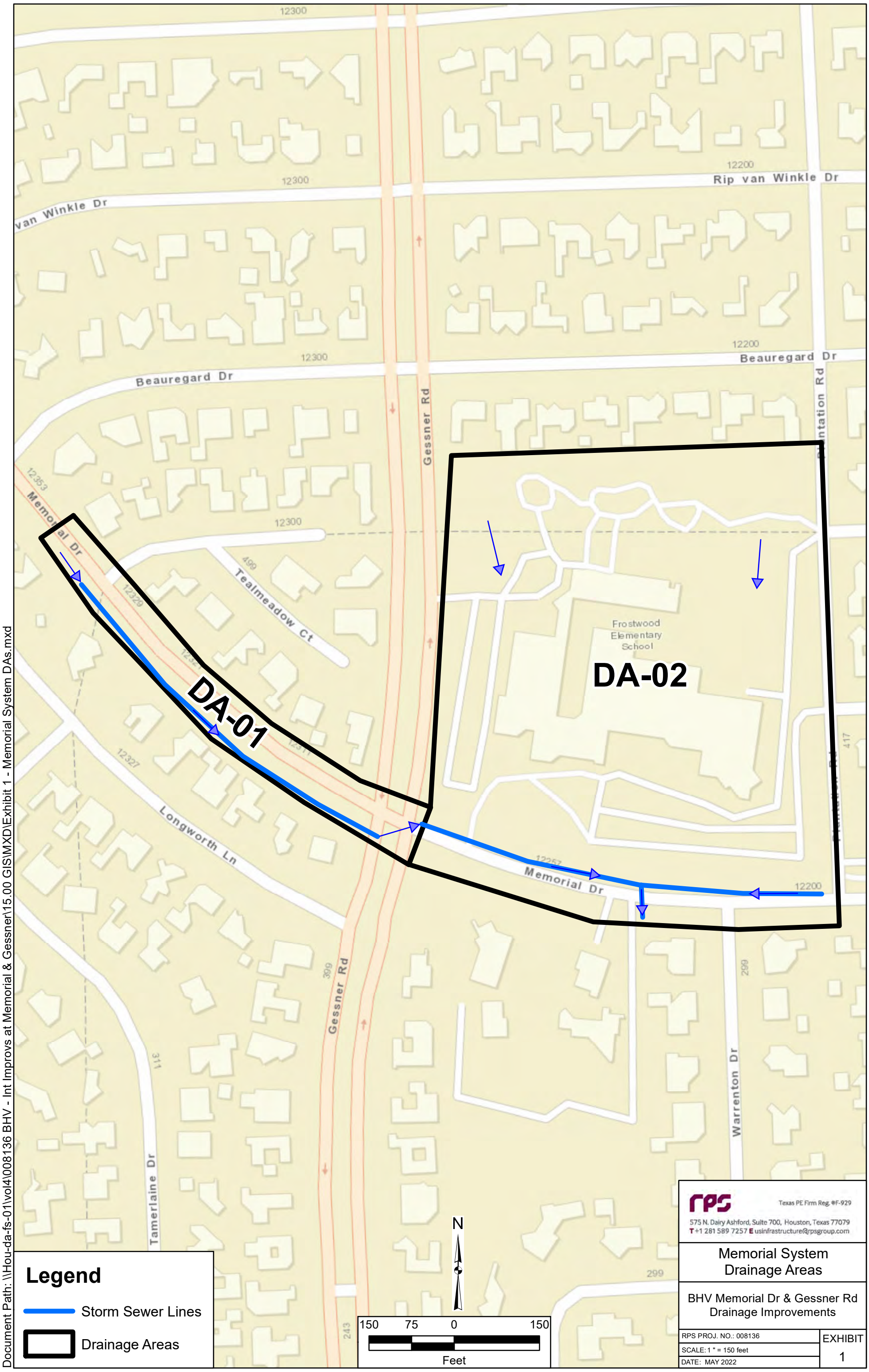
LEGEND

— — —	EXISTING CURB	🟩	PROPOSED SODDING
———	EXISTING RIGHT-OF-WAY	🟨	PROPOSED SIDEWALK
— —	EXISTING SIDEWALK	⬜	PROPOSED CONCRETE PAVEMENT
———	PROPOSED CURB	🟦	PROPOSED CONCRETE DRIVEWAY
— — —	SAWCUT LINE	⬅	PROPOSED TRAFFIC ARROW
— —	PROPOSED WATER	⇦	EXISTING TRAFFIC ARROW

Gauge ENGINEERING

FIRM # 20017
11750 KATY FREEWAY, SUITE 400
HOUSTON, TX 77079

Appendix C



Document Path: \\Hou-da-fs-01\vol4\008136 BHV - Int Improvs at Memorial & Gessner\15.00 GIS\MXD\Exhibit 1 - Memorial System DAs.mxd

rps
Texas PE Firm Reg. #F-929
575 N. Dairy Ashford, Suite 700, Houston, Texas 77079
T +1 281 589 7257 E usinfrastructure@rpsgroup.com

Memorial System Drainage Areas

BHV Memorial Dr & Gessner Rd Drainage Improvements

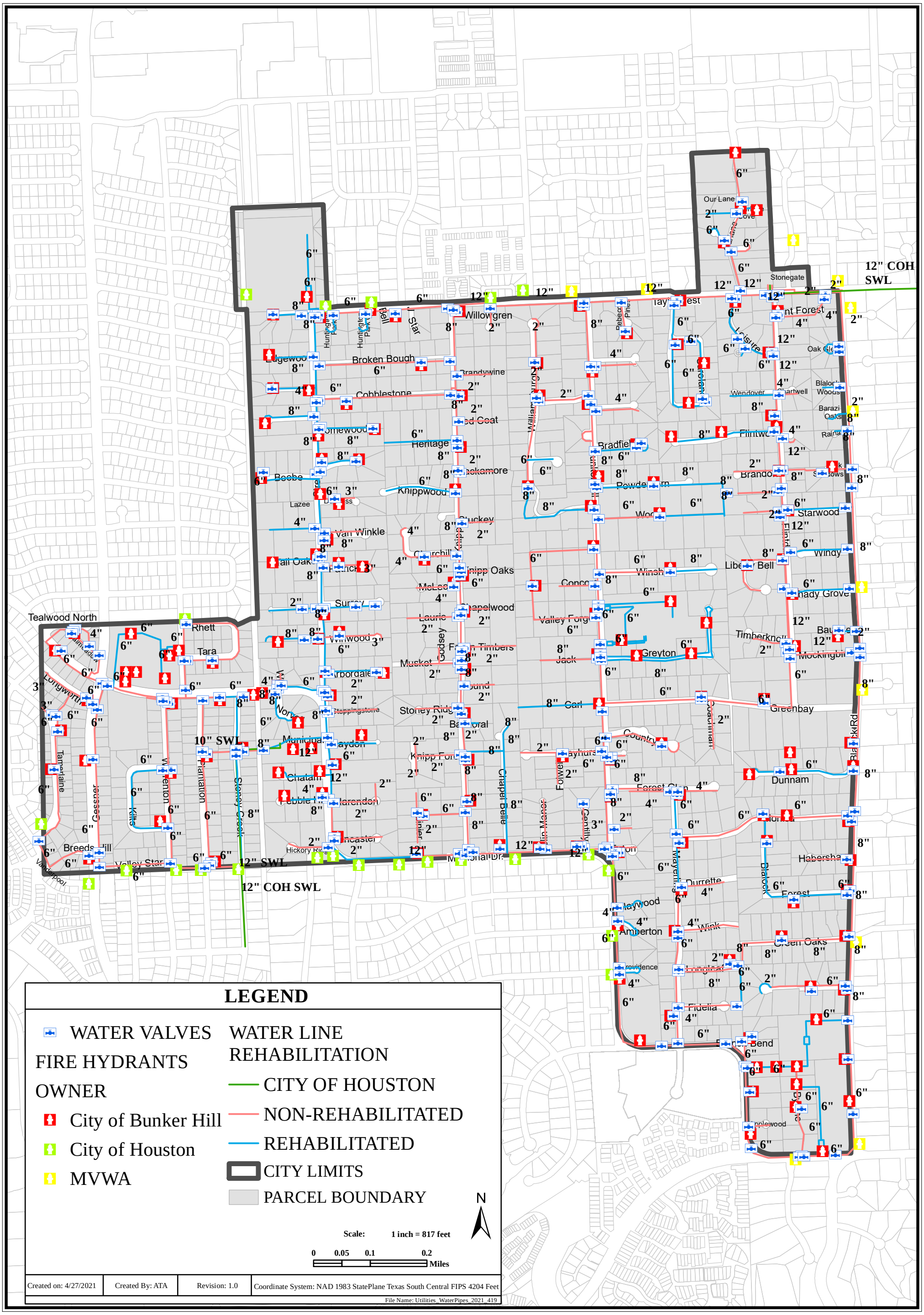
RPS PROJ. NO.: 008136	EXHIBIT 1
SCALE: 1 " = 150 feet	
DATE: MAY 2022	

Appendix D

City of Bunker Hill, TX

11977 Memorial Drive, Houston, TX 77024 Phone: (713) 467-9762 www.bunkerhilltx.gov

WATER LINES REHAB & SIZE



LEGEND

- WATER VALVES
- FIRE HYDRANTS
- OWNER
  - City of Bunker Hill
  - City of Houston
  - MVWA
- WATER LINE REHABILITATION
  - CITY OF HOUSTON
  - NON-REHABILITATED
  - REHABILITATED
  - CITY LIMITS
  - PARCEL BOUNDARY

N

Scale: 1 inch = 817 feet

0 0.05 0.1 0.2 Miles

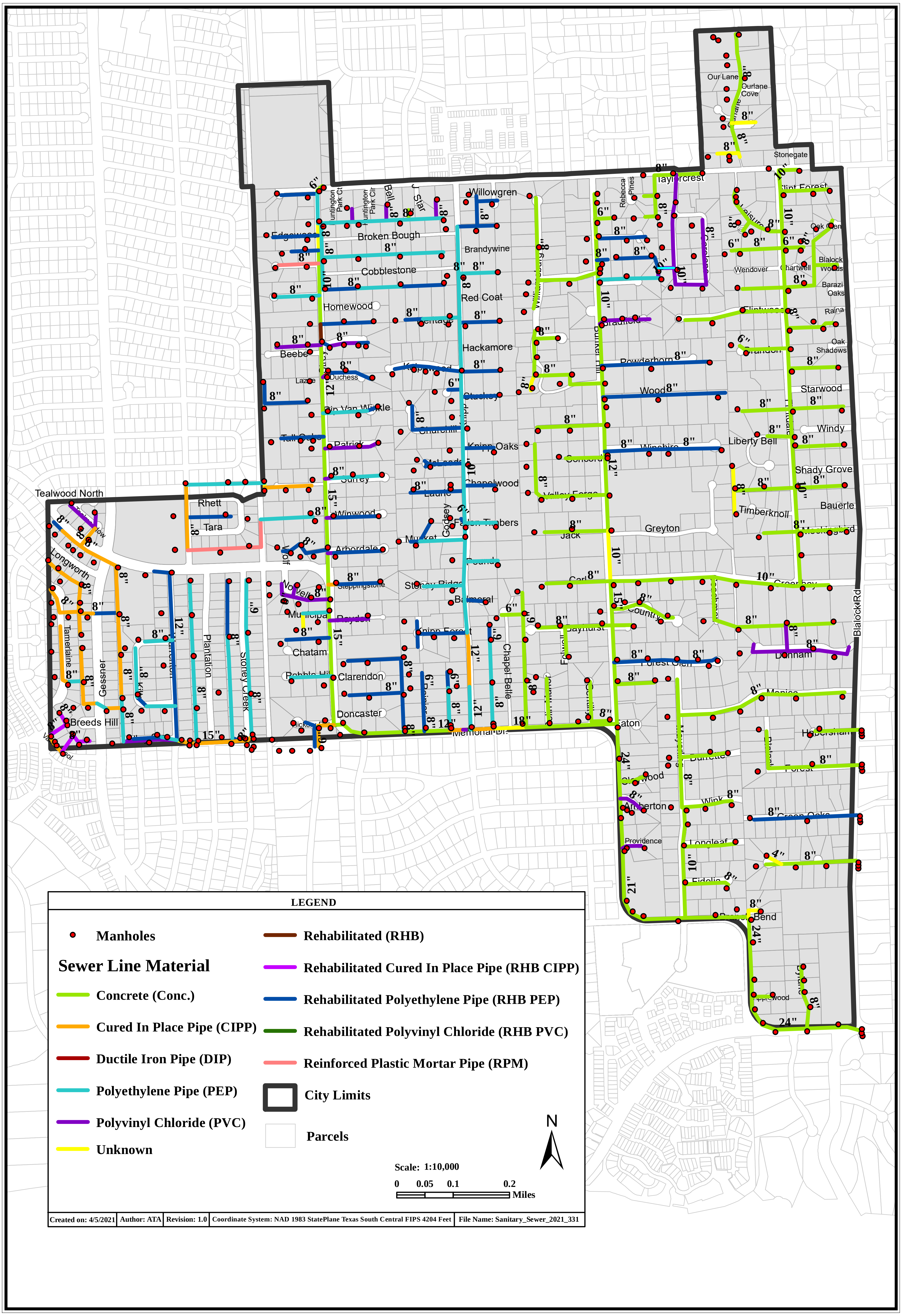
Created on: 4/27/2021	Created By: ATA	Revision: 1.0	Coordinate System: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

File Name: Utilities_WaterPipes_2021_419

City of Bunker Hill, TX

11977 Memorial Drive, Houston, TX 77024 Phone: (713) 467-9762 www.bunkerhilltx.gov

SANITARY SEWER LINES



The Houston Report

'Town Square' Project Aims to Reinvent Memorial City Complex

Published May 24, 2022 by A.J. Mistretta

Memorial Town Square rendering

The traditional American mall is changing from coast to coast, with some shopping centers facing the wrecking ball while others are being reinvented to meet the evolving needs of 21st century urban and suburban communities. Here in Houston, developers are redeveloping some malls as mixed-use commercial districts.

At Memorial City near Gessner and Katy Freeway, real estate development firm MetroNational recently revealed plans to reimagine the massive 300-acre site that includes Memorial City Mall. The company will start with construction of Memorial Town Square, a 27-acre, 190,000-square-foot mixed-use project that will include local and national boutiques, innovative restaurants and health and wellness services.

Memorial Town Square aims to set the tone for a new master plan at Memorial City that will eventually include a much denser urban experience with residential units, a new office tower, coworking spaces and more. Completion of Memorial Town Square is expected in 2025.

Developers say Memorial Town Square will strive to improve the way people in the area come together, with lush landscaping, walkable streetscapes and an iconic town square vibe. Centered around expansive green space, the project will offer a variety of gathering spots crafted for lively and low-key get togethers. Visitors will experience art, entertainment, and events within a relaxed yet vibrant communal hub.

"MetroNational has been working towards this day for more than 25 years," said Jason Johnson, President of MetroNational. "Memorial Town Square was designed for the community with the hope that they would one day consider it a part of their daily lives - hence the name."

Memorial City isn't the only mall getting rethought. Baybrook Mall has served the residents of the Clear Lake/Friendswood area for decades, but in 2016 the mall got a major upgrade with an outdoor lifestyle center adjacent to the existing structure. A wide assortment of restaurant concepts and boutique stores centered around an open lawn for events and performances has reinvigorated the center that's now drawing a new crop of new shoppers and diners. In total, the Baybrook expansion added more than 500,000 square feet to the development.

Back in 2017, Houston's iconic Galleria shopping debuted $300 million in renovations that added a luxury "jewel box" complete with a number of high-end restaurants and retail concepts. The expansion aimed to elevate the already popular Houston shopping complex.

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HOUSTON

Midway plans $88M office development in Houston's CityCentre

Will include 210K of office building and 270K of parking garage

Midway CEO Bradley Freels and rendering of CityCentre Six (Midway)

By TRD Staff

NOV 30, 2023, 6:07 PM

Midway wants to add to an already massive mixed-use development in West Houston.

The Houston-based firm, whose CEO is Bradley Freels, is plotting a nearly $88 million office tower at 903 Town and Country Boulevard in the CityCentre, a 37-acre megadevelopment with retail, restaurants, office space, residences and entertainment, the Houston Business Journal **reported**.

The project, dubbed CityCentre Six, is scheduled to break ground in March and be completed in October 2025. While Midway's exact plans are unclear, the project is set to include a 310,000-square-foot office tower and a 371,000-square-foot parking garage, according to a filing with the Texas Department of Licensing and Regulation.

A leasing brochure on Midway's website outlines features such as 27,500-square-foot floor plates, two rooftop terraces, 11,000 square feet of retail space and a 25,000-square-foot urban plaza. Michael Anderson of Cushman & Wakefield is the leasing agent, and Houston-based Kirksey Architecture is designing the development.

Midway has also started construction on CityCentre Seven, a six-story office building and hotel that's replacing the former Four Points by Sheraton Houston West. Once completed, CityCentre Seven will feature 120,000 square feet of office space and more than 27,000 square feet of retail and restaurant space, along with various wellness amenities such as a spa, the outlet said.

CityCentre was 97 percent leased as of last year and has attracted major tenants like Amazon, Jacobs Engineering, Infosys and Pin Oak Group.

Midway's expertise with large-scale, mixed-use projects has helped establish its reputation as one of Houston's real estate heavyweights. One notable project on the way is **East River**, a 150-acre, $2.5 billion development along Buffalo Bayou that's slated for offices, retail, apartments and recreation space.

Midway is also working to **redevelop** oil giant ConocoPhillips' former headquarters in West Houston into a 70-acre mixed-use district.

—Quinn Donoghue

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HOUSTON

Port Houston moving to Midway's East River

HOUSTON